Application Name: Bird Track Springs Fish Habitat Restoration Project

Application Number: 216-8205-15455

By: Grande Ronde Model WS Foundation

Offering Type: Upper Grande Ronde Initiative

Application Type: Restoration

OWEB Region: Eastern Oregon
County: Union
Coordinates: 45.302262,-118.305257

Applicant:
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Budget Summary:
OWEB Amount Requested: $507,016
Total Project Amount: $3,880,162

Administrative Information

Location Information

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

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

What agency(ies) are involved?

U.S. Forest Service
Oregon Department of Transportation

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

Please select one of the following Landowner Contact Certification statements:

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

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

Please include a complete list of participating private landowners

David Lowe
Jordan Creek Ranch
55503 Hwy. 244
La Grande, OR 97850

Dan Heath
Bear Creek Ranch
55959 Hwy. 244
La Grande, OR 97850

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

Permits

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

● Yes
○ No

For Details Go to Permit Page

Racial and Ethnic Impact Statement

Racial and Ethnic Impact Statement

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

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

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

☐*Women*
☐*Persons with Disabilities*
☐*African-Americans*
☐*Hispanics*
☐*Asians or Pacific Islanders*
✓*American Indians*
☐*Alaskan Natives*

Please provide the rationale for the existence of policies or programs having a disproportionate or unique impact on minority persons.

In January of 2007, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) Department of Natural Resources (DNR) adopted the following mission:

To protect, restore, and enhance the First Foods - water, salmon, deer, cous, and huckleberry - for the perpetual cultural, economic, and sovereign benefit of the CTUIR. We will accomplish this utilizing traditional ecological and cultural knowledge and science to inform: 1) population and habitat management goals and actions; and 2) natural resource policies and regulatory mechanisms.

The First Foods are considered by the CTUIR DNR to constitute the minimum ecological products necessary to sustain CTUIR culture. The CTUIR DNR has a mission to protect First Foods and a long-term goal of restoring related foods in the order to provide a diverse table setting of native foods for the Tribal community. The mission was developed in response to long-standing and continuing community expressions of First Foods traditions, and community member requests that all First Foods be protected and restored for their respectful use now and in the future.

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

Please provide evidence of consultation with representative(s) of affected minority persons.

The Confederated Tribes of the Umatilla Indian Reservation is the sponsor of the Bird Track Springs Fish Habitat Restoration Project.

Insurance Information

☐ *Working with hazardous materials (not including materials used in the normal operation of equipment such as hydraulic fluid)*
☐ *Earth moving work around the footprint of a well*
☐ *Aerial application of chemicals*
☐ *Transporting individuals on the water*
☐ *Removal or alteration of structures that hold back water on land or instream including dams, levees, dikes, tidegates and other water control devices (this does not include temporary diversion dams used solely to divert water for irrigation)*

Additional Information

☐ *This project affects Sage Grouse.*

Problem Statement

Abstract

Provide an abstract statement for the project in 250 words or less. Include the following information: 1.) Identify the project location, including the stream and larger rivers to which it drains (if appropriate), county and nearest town; 2) briefly state the watershed issue, problem, limiting factor(s) to be addressed; 3) Identify and briefly describe the restoration component(s) to be implemented; 4) Identify project partners.

The Bird Track Springs Fish Habitat Enhancement Project is located along a 2 mile reach of the Upper Grande Ronde River between river miles 144-146, 10 miles SW of LaGrande, Oregon in Union County on USFS and private land.

The Grande Ronde River provides critical habitat for Snake River ESA-listed Chinook salmon, steelhead, and Bull trout. Anthropogenic alteration of the watershed has affected channel morphology, instream diversity/complexity, riparian/wetland communities, and habitat quality, quantity, and fish habitat suitability and productivity.

The CTUIR, in cooperation with project partners (BOR, GRMW, and BPA), propose implementation of floodplain and riverine restoration using CTUIR's River Vision to restore fluvial processes and ecological functions that support cold water fishery resources.

Fish habitat suitability has been affected by degradation of the river and associated floodplain. Existing conditions include a high energy, plane bed riffle-run channel type that lacks channel plan form diversity, channel over widening and bed armoring, coarsening of streambed gravel, altered groundwater and hyporheic function, extensive loss of large pool and side channel habitat, and degradation of riparian and wetland plant communities.

Natural habitat recovery is suppressed by conditions that limit development of diverse hydrologic and geomorphic processes due to armored streambed, lack of mature riparian vegetation and structure, and anchor/raft ice that continues to negatively influence habitat.

The restoration plan includes promoting an island braided channel and floodplain system through channel, floodplain, and large pool construction, development of riparian and wetland habitat, and promoting groundwater and hyporheic functions that moderate and improve water quality. A fundamental premise is that self-sustaining, high quality, and diverse habitat provides habitat suitability for all life stages of target fishery resources.

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

Fish habitat suitability has been significantly affected and suppressed by physical alterations of the river and its associated floodplain that have contributed to severely degraded habitat conditions. Problems include homogenous, high energy, plane bed riffle-run channel types with a lack of channel plan form diversity and sinuosity, simplified hydraulic geometry, channel over widening and bed armoring, alteration of sediment sorting and coarsening of streambed gravel, altered groundwater and hyporheic function, extensive loss of large pool and side channel habitat, and degradation of riparian and wetland plant communities.

Natural habitat recovery is limited by current environmental conditions that suppress development of diverse hydrologic and geomorphic processes, including an armored streambed, lack of mature riparian vegetation and associated complexity, and anchor and raft ice that continues to influence bedform, streambank lines, and establishment of mature riparian cover.

Core habitat suitability limiting factors affecting juvenile summer and winter rearing and adult holding and migration include: water quality (temperature), channel and bed form and complexity (limited low velocity and large pool habitat), riparian conditions, and sediment.

In the Project reach, the upper Grande Ronde River would have had an unconfined, forced alluvial channel with alternating pool-riffle and run bedforms. Beechie et al. (2006) empirically determined based on regional data that intermediate sized unconfined channels, similar to the upper Grande Ronde River, that transport their sediment primarily as bedload and retain wood long enough to establish erosion-resistant points were transitional, and generally favored island-braided patterns in forested mountain systems. Beechie et al. (2006) data also shows that island-braided channels are continually adjusting to intermittent perturbations which sustains a high degree of successional states, resiliency, and habitat diversity. In general, island-braided riverine systems provide abundant peripheral and transitional habitats, and complex channel structure and bedforms resulting in the highest degree of biological diversity that supports both aquatic and terrestrial species during varying life stages.

Channel degradation has occurred in response to floodplain constriction from constructed levees and railroads, as well historical log transport operations by splash damming through the project reach. The quantity and force of logs moving along the channel are known regionally to have coarsened stream beds and severely truncated pool-riffle sequences.
Railroad grades, road grades, and levees through the floodplain create artificial channel constrictions and disconnected floodplains that have resulted in a single-thread, enlarged, and incised channel. Constriction increases flow depths, flow velocities, and shear stresses during high water events. The outcome is a wider, more uniform plane-bed channel.

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

Icing has been a significant process during winter low flows, and has likely been exacerbated by the wider, shallower channel geometry. Surface ice accumulation can also be significant during winter months to the point of creating large ice dams. The formation of ice dams and their subsequent failure reinforces bed armoring and the wide-plane bed conditions that have been in place since splash damming at the turn of the century.

Eroding banks within the project reach actively supply sediment to the Grande Ronde River. Major and minor sources of sediment along actively eroding banks were mapped in the field. Minor sources are classified as any eroding banks mapped along floodplain geomorphic units, whereas major sediment sources were classified as eroding banks along alluvial fans, river terraces, and valley walls. A limiting factor identified for the Bird Track Springs Project reach also includes channel armoring.

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

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

Fish habitat has been adversely affected by historic land uses, including livestock overgrazing, road construction, logging, channelization, and utility right of ways. Riparian conditions throughout the project are poor with lack of floodplain connectivity and altered hydrology which, coupled with historic livestock grazing, is limiting recovery of riparian and wetland vegetation and associated beaver colonization. Current channel conditions are out of balance with the sediment supply and disconnected from the historic floodplain, resulting in channels with high stream energy, little to no spawning gravel, limited velocity refugia, and lack of pool habitat.

Prior to Euro-American settlement and associated disturbances, the upper Grande Ronde River developed under an intermittent disturbance regime where flows, sediment inputs, and large wood dynamically interacted to create successional states. Riparian vegetation likely included woody species such as cottonwood (Populus), willow (Salix), river birch (Betula nigra) and alder (Alnus) of varying ages (seral stages). The upland areas adjacent to the active flooplain likely supported mature Ponderosa pine (Pinus ponderosa) and Douglas fir (Pseudotsuga menziesii) trees readily delivered to the channel through lateral channel migration and avulsion.

Beavers were common and played a vital role in the local delivery of wood to the channel and maintaining and diversifying the off-channel habitats and riparian conditions. Necessary wood sizes and quantities would have accumulated during high-water events to form transient logjams (i.e., bar apex jams and flow deflection jams). These logjams could have persisted long enough to create erosion-resistant hard points capable of forcing flow divergence that result in split-flow channels and floodplain-type side channels.

The role of beaver in riverine ecosystems has been well documented along with the benefits they provide for fish and wildlife species. Much of the Grande Ronde River and tributaries have been subject to extensive anthropogenic alterations which have contributed to degraded instream and riparian conditions and decreased habitat suitability for beaver. The current beaver population in the basin is thought to be extremely low, though no formal population census has been completed. Currently, beaver colonies within the system are geographically limited with isolated colonies found in suitable locations, and sporadic small populations that appear to be transient groups which typically dwell in bank lodges. Loss of floodplain and wetland habitat from historic conditions and associated loss of hydrophytic shrubs and trees (a primary food source) results in local beaver selecting poor locations for dam construction.

Proposed Solution

Goals and Objectives

Provide a goal statement for this restoration application.

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

Benefits to salmonids will be achieved through restoration and rehabilitation of the whole floodplain ecosystem. Targeting of present and specific limiting factors such as temperature will achieve immediate benefits to salmon. Long term benefits will be realized through a focus on restoring fluvial habitat-forming processes, floodplain and groundwater hyporheic connectivity, riparian and wetland plant communities, and instream complexity and diversity commensurate with the reach's natural potential.

List the objectives of this restoration application.

Objective 1 - Address Limiting Factor: Riparian Condition/Large Wood Recruitment

Facilitate development of a diversity of native plant communities and seral stages that contribute to floodplain process and function. In conjunction with natural channel and floodplain objectives, a combination of riparian/wetland habitat protection, planting and seeding, and natural recruitment will result in increased tree, shrub, and herbaceous plant communities that are resilient and self-sustaining, contributing to shade, structure, terrestrial food web, streambank stability, and future large wood recruitment.

Objective 2 -Address Limiting Factor: Peripheral and Transitional Habitats-Side Channel, Wetland, and Floodplain Conditions

Increase activation of historic floodprone areas by restoring and promoting connection of the main channel to a network of side channel and floodplain swales, decreasing channel width-to-depth and adjusting the vertical position of mainstem Grande Ronde, where appropriate, to increase annual floodplain inundation. A functioning floodplain ecosystem contains hydraulic and vegetation diversity, including an assemblage of forests, shrub-scrub areas, and emergent wetlands. This diversity is a foundation for a healthy aquatic food-web and improved temperatures through hyporheic exchange. Beaver recolonization is a key path toward this reinvigorated floodplain system.

Objective 3 - Address Limiting Factor: Channel Structure and Form - Bed and Channel Form/Instream Structural Complexity

Enhance in-stream structural diversity and complexity by reconnecting historic floodplain and side channel network, promoting natural channel function and form, increasing instream and floodplain structural diversity through large wood complex additions that promote roughness, scour, sorting and storage of sediment, and development of a diverse assemblage of riffle, run, pool, glide, side channel, and alcove habitats.

Objective 4 - Address Limiting Factor: Water Quality-Temperature

Increase diversity and function of hydrodynamics that decrease summer maximum water temperatures, increase winter water temperatures, and moderate and buffer diurnal water temperature fluctuations during both summer and winter rearing periods. Apply restoration techniques that maximize the interaction and function of small and large scale hyporheic and groundwater exchange, reduce channel width-to-depth ratios and decrease solar input to decrease temperature loading within the reach.

Biological Objectives

1. Improve summer and winter rearing for juvenile salmonids

a. Increase cover and channel complexity by adding large wood structures
b. Increase foraging opportunities by restoring a more natural riffle pool sequence to support a diverse macroinvertebrate community by adding constructed riffles, pools, and side channels.
c. Increase foraging opportunities by improving the interaction between riparian vegetation and the water surface through planting of woody plant species, sedges and grasses and protection of existing riparian vegetation.
d. Create high quality pools by excavating the channel and adding large wood for maintenance of the pool and added complexity. The expectation will be that these pools will be maintained or improved over time by large wood structures that will alter the channel width-to-depth ratio.
e. Create additional rearing areas by improving existing side channel networks and developing new side channels. Identify and enhance areas of thermal refugia. Spring water and hyporheic flows can provide both cool water refuge in the summer and warmer water refuge in the winter. These areas will be enhanced with large wood additions and plantings to provide cover. Additional thermal refugia will be created through channel realignment, floodplain connectivity, and the addition of beaver pond wetlands that will support future beaver populations and create diverse, highly productive juvenile salmonid rearing habitat.

2. Improve habitat for emigrating juvenile salmonids

a. Increase the number of complex pools by changing the high energy, wide-plane channel bedform to a multi-threaded channel with high variability and lower energy.
b. Activate side channels, alcoves and other off channel habitat to provide high water refuge for juvenile fish.
c. Large wood will be added to the margins of the channel to provide cover and low velocity areas for juvenile fish.

3. Improve habitat for immigrating adults

a. Decrease width to depth ratio to provide better low flow passage for adults by installing large wood to encourage scour and associated deposition to narrow channel. Install large apex jams to encourage midchannel gravel bar formation and natural willow and cottonwood regeneration to decrease channel width and increase channel depth. and create hyporheic connections that provide temperature relief.
b. Excavate deep pools and install wood structures for additional complexity in pools. These pools should be well connected to groundwater and provide thermal refugia for adult holding and resting.

4. Restore habitat conditions suitable for spawning

a. Large wood structures will be installed to collect and sort gravel, decrease stream energy, and change the channel from a plane-bedform to a multi-threaded, pool-riffle bedform.
b. Decrease late summer temperatures through increasing floodplain connectivity to encourage more groundwater interaction.
c. Decrease late summer temperatures through additional riparian vegetation that will reduce thermal loading.

Project History

Continuation - Are you requesting funds to continue work on a project previously funded by OWEB where that work did not result in a completed project?

○ Yes
● No

Resubmit - Have you submitted, but were not awarded an OWEB application for this project before?

○ Yes
● No

Phased - Is proposed work in this application a phase of a comprehensive watershed restoration plan or project?

○ Yes
● No

Plans and Salmon

Is the proposed restoration activity(ies) identified in a local assessment or other plan?

● Yes
○ No

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

Bureau of Reclamation (Reclamation). 2014. Upper Grande Ronde River Tributary Assessment, Grande Ronde River Basin, Tributary Habitat Program, Oregon: Department of Interior, Bureau of Reclamation, Pacific Northwest Region, Boise, Idaho, 74 p.

ODFW, CTUIR, NPT, Washington Department of Fisheries, and Washington Department of Wildlife. 1990. Grande Ronde River Subbasin Salmon and Steelhead Production Plan. Columbia Basin System Planning. Northwest Power Planning Council. Columbia Basin Fish and Wildlife Authority.

Federal Columbia River Power System (FCRPS Biological Opinion (BiOp) (U.S. Bureau of Reclamation, Bonneville Power Association, US Army Corps of Engineers, 2004).

Northeast Oregon Snake River Recovery Plan (National Marine Fisheries Service, 2010); see p. 261 Re: increased sediment quantity; p. 258, riparian condition; p. 262, LWD recruitment and temperature; p. 260. side channel & wetland conditions, floodplain connection, anthropological barriers, in-stream structural complexity; p. 263. decreased water quantity.

NMFS [National Marine Fisheries Service]. 2014. Endangered Species Act Section 7(a) (2) Supplemental Biological Opinion. Consultation on Remand for Operation of the Federal Columbia River Power System. National Oceanic and Atmospheric Administration. NWR-2013-9562. Re: basin appropriate passage and limiting factors.

NMFS [National Marine Fisheries Service]. 2013. Draft Proposed ESA Recovery Plan for Snake River Spring/Summer Chinook salmon and Snake River Steelhead. National Marine Fisheries Service, Northwest Region. National Oceanic and Atmospheric Administration. Predecisional document, Accessed March 28, 2014. Re: limiting factors by species.

Will this project benefit salmon or steelhead?

● Yes

○ No

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

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

Summer and winter rearing habitat will increase in the main channel and side channels through (1) addition of large wood to provide cover and create pools, (2) creation of natural pool-riffle sequences and enhanced riparian vegetation to increase foraging opportunities for juvenile salmonids, (3) creation of additional side channel habitat by using historic side channel relic features within the reach that are currently disconnected, (4) creation of multiple locations of increased hyporheic exchange through increases in floodplain connectivity and the water table, construction of bar features, and alcove features providing thermal refugia with cooler temperatures in summer and warmer in the winter. As a whole, the design will increase the occurrence of low velocity refugia, increase the availability of open water habitat during the winter, and moderate winter temperatures to reduce anchor ice formation.

Juvenile emigration habitat will increase by adding the number and area of pools, creating additional side channels, alcoves, and off-channel habitat, and creating slow-water edge and cover habitat through the addition of large wood structures. Habitat for immigrating and holding adults will improve by decreasing summer temperatures and enhancing the availability of thermal refugia, creating new pool habitat, enhancing main channel passage during low-flow conditions by restoring natural width to depth ratios, and increasing complexity through the addition of large wood. Spawning habitat will increase by decreasing temperatures and creating thermal refugia for adults (reducing pre-spawn mortality). Conditions for spawning, incubation, and emergence will improve by natural gravel sorting through large wood placement.

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

● Yes
○ No

Regional Assessments or Recovery Plans
Middle Columbia River Steelhead Distinct Population Segment ESA Recovery Plan
The Oregon Plan for Salmon and Watersheds
Oregon Conservation Strategy
Oregon's Native Fish Conservation Policy
Northwest Power and Conservation Council Grande Ronde Subbasin Plan

Habitat Types

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

✓ *Instream Habitat: below the ordinary high water mark (includes in-channel habitat restoration, bank stabilization, flow, fish screening, and fish passage) -- Details will follow.*
✓ *Riparian Habitat: above the ordinary high-water mark of the stream and within the stream's floodplain. -- Details will follow.*
☐ *Upland Habitat: above the floodplain and improves native habitat and watershed function.*
✓ *Wetland Habitat: land or areas covered, often intermittently, with shallow water or have soil saturated with moisture. -- Details will follow.*
☐ *Estuarine Habitat: tidally influenced areas.*

Instream Habitat

Select all applicable Instream categories.

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

✓ **Instream habitat restoration**

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

✓ *Placement of materials in channel*

Does the proposed project follow:

✓ *ODFW Guidelines*
✓ *NOAA Guidelines*
✓ *Other*

Specify
BPA HIP III Guidelines

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

✓ *Large wood*

Number of structures.
716

Average number of logs per structure.
2

Average length of logs per structure (feet)
35

Average diameter of logs per structure (feet)
1.5

Provide additional information on the log structures, as relevant.
Large wood structures will be constructed using the US Bureau of Reclamation's Pacific Northwest Region Resource & Technical Services Large Woody Material Risk Based Design Guidelines, 2014

Quantities:
Large Trees - 500

Medium Tree - 400
Small Trees -1550

✓ *Boulders*

Number of structures.

60

Average number of boulders per structure.

5

Average size of boulders per structure (feet)

3

Average measurement of boulders per structure (feet)

2.5

Provide additional information on the boulder structures, as relevant.

Approximately 1000 (24"+ diameter) boulders will be used. Boulders will be added to riffles to break up velocities and provide resting locations for fish. There will be 60 riffles constructed or enhanced with boulders in the project reach.

☐ *Combination log/boulder*
✓ *Other materials: Materials that stabilize the streambed*

Specify structure type(s):

- ✓ *Beaver dam alternative*
- ☐ *Constructed riffle*
- ☐ *Weirs installed*

Number of structures

13

Provide additional information on the structures, as relevant.

13 Beaver Dam Analogs (BDAs) will be installed within constructed side channels and swales.

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

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

The existing channel through the project area is lacking in channel bedform diversity. It is almost entirely a plane-bed riffle or shallow run with limited depth and very few small pocket pools of limited depth and no channel spanning pools. The channel is armored with coarse sediment with limited small sediment stored and sorted into bars. A combination of multiple historic human actions and the physical setting have created these conditions. Previous attempts at adding channel complexity and bed diversity within the project reach have included full channel spanning rock weirs, rock jetties, large wood buried into banks, and large wood buried into bar features. Today, it appears that none of these features have significantly altered the channel diversity within this reach. It is hypothesized that the single-threaded channel planform, limited bank strength, lack of woody vegetation, and ice have all been important factors that have negatively influenced the lack of channel bedform diversity within the project reach.

One of the main objectives of this project is to reestablish an island-braided planform. Evidence suggests that a multi-threaded channel was common historically within this reach. Historically, dominant channels would likely come and go through channel swapping forced by natural processes of large wood, ice-jams, and beaver activity. The existing planform resides between a straight channel and a meandering channel. It is an objective for this design to move the planform towards a stable multi-thread pattern with relatively narrow, deep channel(s) between vegetated islands.

To address the lack of channel diversity, large wood will be placed throughout the project reach to mimic natural historic conditions. Large wood features will be designed to force pools, initially protect banks, and to maintain the multi-channel planform. Additionally, for channel diversity to be sustainable within the project reach, riparian vegetation must be robust to reinforce channel banks and include multiple age classes, which will require significant attention in both funding and design for this project to be successful.

Currently, the Grande Ronde River is disconnected from its historic floodplain. Restoring processes requires a frequently connected floodplain. Some process benefits include: reduced instream energy, improved sediment sorting, improved riparian vegetation to include necessary mechanisms for re-generation, increased water storage, decreased flood peaks, and access to refuge and rearing for fish during high flows. Hydraulic modeling has shown that for a large portion of the project area (upstream of the Bear Creek Ranch meadow channel network), the existing channel begins to interact with its historic floodplain between the 5-year and ten-year flood events. For the design, it is proposed that the channel interacts with the floodplain much more regularly, during each spring runoff or at and above the 1.25-year (bankfull) flood event.

Side channels or off-channels are important features of a healthy river network for fish to utilize for off-channel refuge and rearing. Side channels are typically formed by either new channels that are being created through a channel forcing mechanism such as bend avulsion, or from remnant historic channels that have been cut-off or partially cut-off from newly dominant channels. Historic floodplain features have been largely disconnected as a result of historic human activities in a large portion of the project area. Many of these features are still mostly intact, which indicates a high potential for re-connection, resulting in a “ready-made” side channel network within the project area that the proposed design will interact with on a frequent basis. Several placed fill features (constructed levees and abandoned railroad grades) will also be breached or removed to obtain side channel and floodplain connection objectives where removal of these features do not negatively affect infrastructure or neighboring properties from increased flooding.

Acres off-channel or floodplain habitat connected

114

Number of pools created/added

31

☐ *Spawning gravel placement*
☐ *Beaver reintroduction*
✓ *Non-native plant control*

Specify species

Leafy Spurge (Euphorbia esula)
Diffuse Knapweed (Centaurea diffusa)
Canadian Thistle (Cirsium arvense)

Bull Thistle (Cirsium vulgare)
Garlic Mustard (Alliaria petiolata)
White Top (Lepidium draba)

Treatment(s) to be applied

- ✓ *Mechanical (cutting, mowing, girdling, etc.)*
- ✓ *Chemical (pesticides, fungicides, etc.)*
- ☐ *Biological (predators, herbivores, pathogens, etc.)*

Acres to be treated
160

- ☐ *Nutrient enrichment*
- ☐ *Animal species removal*

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

Total miles of stream to be treated with all instream habitat restoration treatments
2

☐ **Stockpiling logs**

Riparian Habitat

Select all applicable Riparian categories.

☐ **Road activities**

✓Fencing and other materials for habitat protection

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

✓*Fencing*

What other livestock and/or land management practices are you using in conjunction with fencing?

US Forest Service property currently has no grazing allotments within the project area. The Jordan Creek Ranch property currently uses a corral system within the project area and active floodplain. Negotiations are underway to relocate the corrals to a more suitable, upland site across Hwy. 244 and place the floodplain in a (15-year minimum) conservation easement. All livestock grazing within the project area post-construction will be prohibited.

Are you proposing to fence one or both sides of the streambank?

○ One side

● Both sides

Stream miles treated

2

☐*Exclusion other than fencing*

Miles of fencing and other materials for habitat protection

4

Riparian acres protected by fencing and/or other exclusion

160

✓Vegetation establishment or management

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

✓*Planting*

For Details Go to Plant Page

✓*Non-native plant control*

Specify species

Leafy Spurge (Euphorbia esula)
Diffuse Knapweed (Centaurea diffusa)
Canadian Thistle (Cirsium arvense)
Bull Thistle (Cirsium vulgare)
Garlic Mustard (Alliaria petiolata)
White Top (Lepidium draba)

Treatment(s) to be applied

✓*Mechanical (cutting, mowing, girdling, etc.)*

✓*Chemical (pesticides, fungicides, etc.)*

☐*Biological (predators, herbivores, pathogens, etc.)*

Acres to be treated
160

☐*Prescribed burnings, stand thinning, stand conversions, silviculture*

✓Livestock management

Select all the actions you propose to implement to address the problem.
✓*Riparian pasture management*
☐*Cross fencing installed*
☐*Water gap development*

☐Debris and Structure Removal

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

✓Sediment
✓Sediment
✓High Temperature
✓High Temperature
✓High Temperature
✓High Temperature
✓High Temperature
✓Dissolved Oxygen

Total riparian acres to be treated:
160

Total riparian streambank miles to be treated
2

Are you proposing to treat one or both sides of streambank?
○ One side
● Both sides

Left side of bank
1

Right side of bank
1

Stream miles
2

Wetland Habitat

Are you working in artificial or historic wetland habitat? (select one or both)

✓*Artificial wetland*
✓*Historic wetland*

Select all applicable Wetland categories.

☐**Road activities**

✓**Channel modification including creation**

Type of modification to channel

Pools will be created within the active channel by excavation, and large wood will be installed for maintenance of the pool and added complexity. The expectation will be that these pools will be maintained or improved over time by large wood structures that will create scour. Large wood will be added to the margins of the channel to provide cover and slow water areas for juvenile fish, and additional side channels, alcoves and other off channel habitat will be created to provide high water refuge for juvenile fish.

Width-to-depth ratios will decrease to provide better low flow passage for adults by installing large wood to encourage scour and associated deposition to narrow channel. Large apex jams will be installed to encourage midchannel gravel bar formation and natural willow and cottonwood regeneration to decrease channel width and increase channel depth. This process will take time and continue to improve over several years.

Juvenile rearing habitat will be improved by creating and enhancing side channel networks. Areas of thermal refugia will be identified and enhanced by adding large wood and plantings to provide cover. Additional thermal refugia will be created through channel realignment, floodplain connectivity, and the creation and enhancement of beaver pond complexes.

Length of channel created or modified

2.7

Miles of wetland habitat treated

4.8

Acres of wetland habitat connected

46.6

✓Vegetation establishment or management

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

✓*Planting*

For Details Go to Plant Page

✓*Non-native plant control*

Specify plants

Whitetop (Lepidium draba)
Leafy Spurge (Euphorbia esula)
Canada Thistle (Cirsium arvense)
Diffuse Knapweed (Centaurea diffusa)
Garlic Mustard (Alliaria petiolata)

Treatment(s) to be applied

✓*Mechanical (cutting, mowing, girdling, etc.)*
✓*Chemical (pesticides, fungicides, etc.)*
☐*Biological (predators, herbivores, pathogens, etc.)*

Acres to be treated

160

☐Fencing and other materials for habitat protection
☐Structure removal/modification/installation
☐Nonstructural removal and placement protection

Total wetland acres to be treated:

46

Wrap-Up

Outcomes

Explain how the proposed restoration activities address the watershed problem described in the Problem Statement and Goals and Objectives.

Benefits to salmonids will be achieved through restoration and rehabilitation of the whole floodplain system. Targeting of present and specific limiting factors such as temperature will achieve immediate benefits to salmon. Long term benefits will be realized through a focus on restoring fluvial and habitat-forming processes, floodplain, groundwater, and hyporheic connectivity, riparian and wetland plant communities, and instream complexity and diversity commensurate with the reach’s natural potential. These habitat-forming processes are driven by the natural episodic disturbance regime that historically occurred prior to direct and in-direct human modifications. Intermittent disturbances, such as floods, sediment delivery, wood accumulations, beaver activity, and associated channel dynamics foster and maintain a spatial mosaic and diverse range of aquatic and terrestrial habitats within a healthy riverine corridor.

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

1) Erosion control.
a) If there is a potential for eroded sediment to enter the stream, sediment barriers will be installed and maintained for the duration of project implementation.
b) Temporary erosion control measures may include fiber wattles, silt fences, jute matting, wood fiber mulch and soil binder, or geotextiles and geosynthetic fabric.
c) Soil stabilization utilizing wood fiber mulch and tackifier (hydro-applied) may be used to reduce erosion of bare soil if the materials are noxious weed free and nontoxic to aquatic and terrestrial animals, soil microorganisms, and vegetation.
d) Sediment will be removed from erosion controls once it has reached 1/3 of the exposed height of the control.
e) Once the site is stabilized after construction, temporary erosion control measures must be removed.

2) Emergency erosion controls.
a) A supply of sediment control materials; and
b) An oil-absorbing floating boom whenever surface water is present.
c) Turbidity will be monitored a minimum of 100 ft downstream of all ground disturbing activities.
d) Disturbed areas within the riparian buffer or areas likely to experience run-off will be seeded with a native grass mix and mulched with weed free straw following the end of disturbance activties. Jute/coconut fibre matting or seeded coir fibre logs may also be used as a post disturbance erosion control measure.

3) Contaminants.The project sponsor will complete a site assessment with the following elements to identify the type, quantity, and extent of any potential contamination for any action that involves excavation of more than 20 cubic yards of material:
a) A review of available records, such as former site use, building plans, and records of any prior contamination events;
b) A site visit to inspect the areas used for various industrial processes and the condition of the property;
c) Interviews with knowledgeable people, such as site owners, operators, and occupants, neighbors, or local government officials; and
d) A summary, stored with the project file that includes an assessment of the likelihood that contaminants are present at the site, based on items 3(a) through 3(c).

4) Site layout and flagging. Prior to construction, the action area will be clearly flagged to identify the following:
a) Sensitive resource areas, such as areas below ordinary high water, spawning areas, springs, and wetlands;
b) Equipment entry and exit points;

c) Road and stream crossing alignments;
d) Staging, storage, and stockpile areas; and
e) No-spray areas and buffers.

5) Temporary access roads and paths.
a) Existing access roads and paths will be preferentially used whenever reasonable, and the number and length of temporary access roads and paths through riparian areas and floodplains will be minimized to lessen soil disturbance and compaction, and impacts to vegetation.
b) No new roads will be built as part of this project.
c) At project completion all roads and paths will be re-seeded with a native grass mix.

6) Temporary stream crossings.
a) Existing stream crossings will be preferentially used whenever reasonable, and the number of temporary stream crossings will be minimized.
b) Temporary bridges and culverts will be installed to allow for equipment and vehicle crossing over perennial streams during construction. Treated wood shall not be used on temporary bridge crossings or in locations in contact with or over water.
c) Vehicles and machinery will cross streams at right angles to the main channel wherever possible.
d) The location of the temporary crossing will avoid areas that may increase the risk of channel re-routing or avulsion.
e) Potential spawning habitat (i.e., pool tailouts) and pools will be avoided to the maximum extent possible.
f) No stream crossings will occur at active spawning sites, when holding adult listed fish are present, or when eggs or alevins are in the gravel. .
g) After project completion, temporary stream crossings will be obliterated and the stream channel and banks restored.

7) Staging, storage, and stockpile areas.
a) Staging areas (used for construction equipment storage, vehicle storage, fueling, servicing, and hazardous material storage) will be 150-feet or more from any natural water body or wetland, or on an adjacent, established road area in a location and manner that will preclude erosion into or contamination of the stream or floodplain.
b) Natural materials used for implementation of aquatic restoration, such as large wood, gravel, and boulders, may be staged within the 100-year floodplain.
c) Any large wood, topsoil, and native channel material displaced by construction will be stockpiled for use during site restoration at a specifically identified and flagged area.

d) Any material not used in restoration, and not native to the floodplain, will be removed to a location outside of the 100-year floodplain for disposal.

8) Equipment. Mechanized equipment and vehicles will be selected, operated, and maintained in a manner that minimizes adverse effects on the environment. Gas-powered equipment with tanks larger than 5 gallons will be refueled in a vehicle staging area placed 150-feet or more from a natural waterbody or wetland, or in an isolated hard zone, such as a paved parking lot or adjacent, established road. All vehicles and other mechanized equipment will be:
a)Stored, fueled, and maintained in a vehicle staging area placed 150-feet or more from any natural water body or wetland or on an adjacent, established road area;
b) Inspected daily for fluid leaks before leaving the vehicle staging area for operation within 150-feet of any natural water body or wetland; and
c) Thoroughly cleaned before operation below ordinary high water, and as often as necessary during operation, to remain grease free.
d) Synthetic hydraulics - hydraulic oil in the track-mounted excavators that are utilized during project construction must meet or exceed stringent acute aquatic toxicity (L-50), which is inherently biodegradable. Example: Chevron Clarity or equivalent.

e) Spill Kits (including rag pads and booms) will be required on site at all times.
f) Equipment will be free of leaks and in good operating condition.

9) Dust abatement. The project sponsor will determine the appropriate dust control measures (if necessary) by considering soil type, equipment usage, prevailing wind direction, and the effects caused by other erosion and sediment control measures.

10) Spill prevention, control, and countermeasures.
a) A description of hazardous materials that will be used, including inventory, storage, and handling procedures will be available on-site.
b) Written procedures for notifying environmental response agencies will be posted at the work site.
c) Spill containment kits (including instructions for cleanup and disposal) adequate for the types and quantity of hazardous materials used at the site will be available at the work site.
d) Workers will be trained in spill containment procedures and will be informed of the location of spill containment kits.
e) Any waste liquids generated at the staging areas will be temporarily stored under an impervious cover, such as a tarpaulin, until they can be properly transported and disposed of.

11) Invasive species control. The following measures will be followed to avoid introduction of invasive plants and noxious weeds into project areas:
a) Prior to entering the site, all vehicles and equipment will be power washed, allowed to fully dry, and inspected to make sure no plants, soil, or other organic material adheres to the surface.
b) Watercraft, waders, boots, and any other gear to be used in or near water will be inspected for aquatic invasive species.

Does this proposed project include outreach activities?
● Yes
○ No

Describe these activities, as well as any related products, and explain how the proposed activities relate to the project's objectives.

Project partners (US Forest Service and CTUIR) will share information with the public, potential funders, local elected officials, and others to build their knowledge base, gain overall participation, and encourage the sharing of innovative ideas. Post-project tours will be conducted with members of the public, funding agencies, stakeholders, and school groups to inform interested parties of the benefits to the overall health of the watershed. Public outreach on Forest Service property will include educational signs and a trail network that will describe the project and associated habitat benefits.

Design

Were design alternatives considered?

● Yes
○ No

If yes, describe the design alternatives that were considered and why the preferred alternative was selected.

Two conceptual designs were developed for the BTS project during preliminary planning, refined via field visits in the summer and fall of 2015, and updated in December 2015. Both concept alternatives were developed to address the same project goals, key objectives, and applying the same biological design flow considerations.

The Instream Treatment alternative would install Large Wood Structures in the mainstem channel to restart geomorphic processes to form bars and increase overbank flooding and side channel activation. Additionally, this alternative would remove all or portions of some of the artificial barriers and constrictions on the floodplain (abandoned railroad grade/berms and other fill material from discontinued land uses).

The Channel Reconstruction alternative would excavate new main channel segments, and construct and/or partially excavate portions of remnant channels on the floodplain to create functional side channels to increase overbank flooding, and the length and frequency of activated side channels.
Additionally, this alternative would remove all or portions of some of the artificial barriers and constrictions on the floodplain (abandoned railroad grade/berms and other fill material from discontinued land uses).

The Channel Reconstruction alternative was chosen as the preferred design alternative because of the most assured immediate and long term habitat uplift potential. The floodprone area, active floodplain area, channel margin inundation, active winter channel area, winter juvenile Chinook Weighted Usable Area (WUA), summer juvenile Chinook WUA, pool numbers and area, side channel/wetland habitat, and channel and hyporheic complexity will dramatically increase and will provide the greatest benefit to salmonids.

Select the appropriate level of design for your project.

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

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

Hydraulic modeling, grading plan, large wood structure design, and bioengineering/planting plans are currently in progress (~50-60% complete) and are expected to be mostly complete (85%) by September, 2017. Environmental compliance (section 106, U.S. Forest Service Environmental Assessment, HIP III, DSL/Army Corps permitting) are expected to be complete by fall, 2017. Construction documents, contract solicitation, and contract award are expected to be complete by June, 2018.

Project Management

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

Role	Name	Affiliation	Qualifications	Email	Phone
Project Sponsor	Allen Childs	Confederated Tribes of the Umatilla Indian Reservation	Project management, design, implementation, and inspection experience	allenchilds@ctuir.org	(541) 429-7940
Project Sponsor	Jake Kimbro	Confederated Tribes of the Umatilla Indian Reservation	Project management, design, implementation, and inspection experience	jakekimbro@ctuir.org	(541) 429-7941
Project Manager	Brian Drake, P.E.	U.S. Bureau of Reclamation	Project management, design, implementation, and inspection experience	bdrake@usbr.gov	(208) 378-5031
Technical Team Lead – Hydraulic Engineer	Mike Knutson, P.E.	U.S. Bureau of Reclamation	Project management, design, implementation, and inspection experience	mknutson@usbr.gov	(208) 378-5031
Consultant Project Manager	Jenna Scholz	Cardno	Project management, design, implementation, and inspection experience	jenna.scholz@cardno.com	(206) 239-7383
Fish & Wildlife Program Engineer (RRT)	Sean Welch, P.E.	Bonneville Power Administration	Project management, design, implementation, and inspection experience	spwelch@bpa.gov	(503) 230-7691
Project Partner	Bill Gamble	U.S. Forest Service	Natural resource management experience	bgamble@fs.fed.us	(541) 962-8582

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

Element	Start Date	End Date
Sec. 106 permitting	3/2015	10/2017
NEPA Environmental Assessment	3/2016	10/2017
HIP III Permit	3/2016	4/2018
Large wood harvest	3/2018	6/2018
Construction Contract Solicitation	5/2018	5/2018
Mobilization, access roads, staging	6/2018	7/2018
Channel construction and railroad grade excavation	6/2018	10/2018
Construct LWD in existing channel	6/2018	10/2018
Fill/enhance existing channel segments	7/2018	7/2018
Clean-up and demobilize	8/2018	8/2018
Planting	9/2018	12/2018

Element	Q1 2015	Q2 2015	Q3 2015	Q4 2015	Q1 2016	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018
Sec. 106 permitting	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨					
NEPA Environmental Assessment				🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨					
HIP III Permit				🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨	🟨			
Large wood harvest												🟨	🟨	🟨		
Construction Contract Solicitation													🟨			
Mobilization, access roads, staging													🟨	🟨		
Channel construction and railroad grade excavation													🟨	🟨	🟨	
Construct LWD in existing channel													🟨	🟨	🟨	
Fill/enhance existing channel segments														🟨		
Clean-up and demobilize														🟨		
Planting														🟨	🟨	🟨

Optional Monitoring

OPTIONAL: Restoration Project Monitoring

✓*Salmonid Monitoring*
✓*Non-salmonid biological monitoring*
✓*Water (quantity) flow monitoring*
✓*Water quality monitoring*
✓*Onsite*
✓*Downstream*
✓*Upstream*
☐*Upslope*
✓*Effectiveness monitoring will be conducted for this project*

Budget

Item	Unit Type	Unit Number	Unit Cost	OWEB Funds	External Cash	External In-Kind	Total Costs
Salaries, Wages and Benefits							
			$0	$0	$0	$0	$0
Category Sub-total				$0	$0	$0	$0
Contracted Services							
General Alluvial Fill Placement	Cubic yards	56400	$4.00	$0	$225,600	$0	$225,600
Soil Placement	Cubic yards	24200	$5.00	$0	$121,000	$0	$121,000
Rough Cut Channel Excavation	Cubic yards	80600	$6.00	$483,600	$0	$0	$483,600
Boulder Excavation	Each	600	$25.00	$0	$15,000	$0	$15,000
Riffle Over-excavation	Cubic yards	10200	$6.00	$0	$61,200	$0	$61,200
Point Bar Over Excavation	Cubic yards	8000	$6.00	$0	$48,000	$0	$48,000
Riffle Material Screening	Cubic yards	9400	$8.50	$0	$79,900	$0	$79,900
Riffle Construction	Cubic yards	9400	$12.50	$0	$117,500	$0	$117,500
Point Bar Construction in New Channels	Cubic yards	8000	$7.00	$0	$56,000	$0	$56,000
Point Bar and Glide Grading in Other Channels	Days	10	$2,200.00	$0	$22,000	$0	$22,000
Fine Grading of Channel/Floodplain Features	Days	6	$2,800.00	$0	$16,800	$0	$16,800
Boulder Placement	Each	1200	$25.00	$0	$30,000	$0	$30,000
Purchase of Small Rip-Rap	Cubic yards	900	$35.00	$0	$0	$31,500	$31,500
Purchase of Large Rip-Rap	Cubic yards	100	$100.00	$0	$10,000	$0	$10,000
Tree Transport by Helicopter	Days	2	$40,000.00	$0	$80,000	$0	$80,000
Brush Bank Treatment Difficult Site	Feet	2200	$20.00	$0	$44,000	$0	$44,000
Brush Bank Treatment Simple Site	Feet	10000	$12.00	$0	$120,000	$0	$120,000
Salvage/Store - Existing Riparian Vegetation	Feet	70000	$1.00	$0	$70,000	$0	$70,000
Salvage/Store - Sod	Cubic yards	3225	$8.00	$0	$25,800	$0	$25,800
Environmental Controls	Each	1	$40,000.00	$0	$40,000	$0	$40,000
Temporary Haul Roads	Each	1	$20,000.00	$0	$20,000	$0	$20,000
Temporary Access Road Stabilization	Cubic yards	1000	$5.00	$0	$5,000	$0	$5,000
Temporary Bridge Crossing	Each	2	$20,000.00	$0	$40,000	$0	$40,000
Cofferdams and Temporary Diversion Dams	Feet	500	$40.00	$0	$20,000	$0	$20,000
Dewatering	Each	1	$75,000.00	$0	$75,000	$0	$75,000
Site Clearing	Acres	12	$3,000.00	$0	$36,000	$0	$36,000
Straw Mulch Purchase/Placement	Acres	26	$1,500.00	$0	$39,000	$0	$39,000
Access Road Decommissioning	Each	1	$10,000.00	$0	$10,000	$0	$10,000
Staging Area Decommissioning	Each	1	$10,000.00	$0	$10,000	$0	$10,000
Site General Cleanup	Each	1	$10,000.00	$0	$10,000	$0	$10,000
Move Electric Power Pole	Each	1	$20,000.00	$0	$20,000	$0	$20,000
Relocate/Construct Corral	Each	1	$75,000.00	$0	$75,000	$0	$75,000
Corral Water Developments	Each	2	$6,000.00	$0	$12,000	$0	$12,000
Ditch Clean along Hwy 244 to Moss Creek	Feet	600	$20.00	$0	$12,000	$0	$12,000
Upstream Hwy Rock Toe Bank Treatment	Feet	600	$25.00	$0	$15,000	$0	$15,000

GPS Survey Support to Contractor	Each	1	$15,000.00	$0	$15,000	$0	$15,000
Traffic Control - Hwy 244	Each	1	$10,000.00	$0	$10,000	$0	$10,000
Riffle 1' placement with Alluvial Fill	Cubic yards	800	$7.00	$0	$5,600	$0	$5,600
Mobilization	Each	1	$100,000.00	$0	$100,000	$0	$100,000
Labor-Large Wood Structures (Dry)	Each	15	$15,000.00	$0	$225,000	$0	$225,000
Labor-Medium Structures (Dry)	Each	20	$4,300.00	$0	$86,000	$0	$86,000
Labor-Small Structures (Dry)	Each	332	$570.00	$0	$189,240	$0	$189,240
Labor-Beaver Dam Analog	Each	10	$1,710.00	$0	$17,100	$0	$17,100
Labor-Floodplain	Hours	229	$114.00	$0	$26,106	$0	$26,106
Labor-Large Wood Structures (Wet)	Each	6	$20,000.00	$0	$120,000	$0	$120,000
Labor-Medium Structures (Wet)	Each	16	$6,450.00	$0	$103,200	$0	$103,200
Category Sub-total				**$483,600**	$2,479,046	$31,500	$2,994,146
Travel							
			$0	$0	$0	$0	$0
Category Sub-total				**$0**	$0	$0	$0
Materials and Supplies							
Large Tree Purchase	Each	550	$650.00	$0	$357,500	$0	$357,500
Medium Tree Purchase	Each	500	$250.00	$0	$125,000	$0	$125,000
Small Tree Purchase	Each	2450	$100.00	$0	$245,000	$0	$245,000
1 gallon containerized tree-USFS	Each	14000	$5.00	$0	$70,000	$0	$70,000
Seed mix	Pounds	896	$15.04	$13,476	$0	$0	$13,476
Tracked Excavator - 300 series	Hours	60	$200.00	$0	$12,000	$0	$12,000
Tracked Excavator - 200 series	Hours	160	$160.00	$0	$25,600	$0	$25,600
Off-Road Dump Truck	Hours	60	$200.00	$0	$12,000	$0	$12,000
Dozer (D5-D6)	Hours	60	$165.00	$0	$9,900	$0	$9,900
30' End Dump	Hours	40	$140.00	$0	$5,600	$0	$5,600
Category Sub-total				**$13,476**	$862,600	$0	$876,076
Equipment and Software							
			$0	$0	$0	$0	$0
Category Sub-total				**$0**	$0	$0	$0
Other							
			$0	$0	$0	$0	$0
Category Sub-total				**$0**	$0	$0	$0
Modified Total Direct Cost Amounts				**$497,076**	$3,341,646	$31,500	$3,870,222
Indirect Costs							
Federally Accepted 'de minimus' Indirect Cost Rate		1.9996%			**Indirect Cost Total: $9,940**		
Total				**$507,016**	$3,341,646	$31,500	$3,880,162

If the budget includes unusually high costs and/or rates, provide justification for those costs and/or rates.

If the budget identifies a contingency amount for specific line item(s) within the Contracted Services and Materials and Supplies budget categories, explain the specific reasons a contingency is needed for each line item.

Contingencies are line-item specific and cannot be used for other costs.

Funding and Match

Fund Sources and Amounts

Organization Type	Name	Source Note	Contribution Type	Amount	Description	Status
Federal	Bonneville Power Administration		Cash	$3,341,646	BPA/Grande Ronde Funding Proposal will be submitted September, 2017.	Pending
Federal	Bonneville Power Administration		In-Kind - Materials	$31,500	In-Kind Materials Small Rip Rap	Pending
Fund Source Cash Total	**$3,341,646**	**Fund Source In-Kind Total**	**$31,500**			

Match

Contribution Source-Type: Description	Amount
Bonneville Power Administration-Cash: BPA/Grande Ronde Funding Proposal will be submitted September, 2017.	$3,341,646
Bonneville Power Administration-In-Kind - Materials: In-Kind Materials Small Rip Rap	$31,500
Match Total	**$3,373,146**

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

○ Yes
● No

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

○ Yes
● No

Does the non-OWEB funding include NOAA/PCSRF funds?

○ Yes
● No

Uploads

Map: Brid Track Springs Overview Map.pdf - Bird Track Springs Fish Habitat Enhancement Project Overview Map

Reports: BTS_30BDR_Draft.pdf - Bird Track Springs Basis of Design Report

Planting Details: BTS Planting Map.pdf - Bird Track Springs Draft Planting Map

Photos: Bird Track Springs photos for OWEB proposal.pdf - Project Photos

Project Design: Bird Track Springs_30pct Plan Set-2016-11-04_reduced3.pdf - Bird Track Springs 30% Design Planset

Plant Page

Planting Questions

Relationship to other conservation programs

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

Planting Activities

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

Ponderosa Pine Forest/ Woodland, Open Grand Fir Forest, Dry Graminoid Meadow, Open Black Cottonwood Forest, Wet-Moist Graminoid Meadow Complexes, Moist Graminoid Meadow Complexes, Alder Floodplain Shrubland, Open Tall Willow, Black Cottonwood/ Willow Floodplain, Willow Gravel Bar Shrublands, and native sedge communities currently exist within the project area, but have been suppressed or modified from historical conditions.

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

Tree and shrub species to be planted within the project area include: Mountain alder, Serviceberry, Water birch, Red osier dogwood, Black hawthorn, Cascara, Mock orange, Ninebark, Black cottonwood, Chokecherry, Golden currant, Woods and Nutka rose, Booth willow, Coyote willow, Blue elderberry, Snowberry, and Ponderosa pine. Upland areas, access roads, and disturbed areas will be planted with locally-adapted grass species which include Idaho fescue, Bluebunch wheatgrass, Basin wildrye, and Tufted hairgrass. Swale complexes and side channels will be planted with sedges which include Nebraska sedge and Beaked sedge. Trees and shrubs will be planted using hand augers, a mini-excavator (trenching), and a 9” diameter hydraulic auger attached to a skid steer. Grass seeding will be conducted by hand seeding or by an ATV mounted spreader, and will be harrowed post-seeding.

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

Vegetation Community	Acres	Density
Ponderosa Pine Forest/ Woodland	28.5	125
Open Grand Fir Forest	10	125
Dry Graminoid Meadow	19	125
Alder Floodplain Shrubland	3	125
Open Tall Willow	1	500
Black Cottonwood/ Willow Floodplain	8.5	125

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

Vegetation Community	Plants: Common Name	Plants: Scientific Name	Form	Type	Year	Month

Open Tall Willow, Black Cottonwood/Willow Forest, Graminoid Meadows, Alder Floodplain Shrubland	Black Cottonwood	Populus trichocarpa	Tree	Rooted	2018	November
Open Tall Willow, Black Cottonwood/Willow Forest, Graminoid Meadows, Alder Floodplain Shrubland	Red Osier Dogwood	Cornus sericea	Tree	Rooted	2018	November
Open Tall Willow, Black Cottonwood/Willow Forest, Graminoid Meadows, Alder Floodplain Shrubland	Speckled Alder	Alnus incana	Tree	Rooted	2018	November
Open Tall Willow, Black Cottonwood/Willow Forest, Graminoid Meadows, Alder Floodplain Shrubland	Black Hawthorne	Crataegus douglasii	Tree	Rooted	2018	November
Open Tall Willow, Black Cottonwood/Willow Forest, Graminoid Meadows, Alder Floodplain Shrubland	Ponderosa Pine	Pinus ponderosa	Tree	Rooted	2018	November
Ponderosa Pine Forest, Open Grand Fir Forest, Dry Graminoid Meadow, Open Black Cottonwood Forest	Bluebunch Wheatgrass	Pseudoroegneria spicata	Grass	Seeds	2018	November
Ponderosa Pine Forest, Open Grand Fir Forest, Dry Graminoid Meadow, Open Black Cottonwood Forest	Idaho Fescue	Festuca idahoensis	Grass	Seeds	2018	November
Ponderosa Pine Forest, Open Grand Fir Forest, Dry Graminoid Meadow, Open Black Cottonwood Forest	Blue Wildrye	Elymus glaucus	Grass	Seeds	2018	November
Ponderosa Pine Forest, Open Grand Fir Forest, Dry Graminoid Meadow, Open Black Cottonwood Forest	Black Cottonwood	Populus trichocarpa	Tree	Rooted	2018	November
Ponderosa Pine Forest, Open Grand Fir Forest, Dry Graminoid Meadow, Open Black Cottonwood Forest	Ponderosa Pine	Pinus ponderosa	Tree	Rooted	2018	November
Alder Floodplain Shrubland, Open Tall Willow, Willow Gravel Bar Scrubland	Speckled Alder	Alnus incana	Tree	Rooted	2018	November

Alder Floodplain Shrubland, Open Tall Willow, Willow Gravel Bar Scrubland	Willow spp.	Salix	Tree	Cutting	2018	November
Alder Floodplain Shrubland, Open Tall Willow, Willow Gravel Bar Scrubland	Nebraska Sedge	Carex nebrascensis	Forb	Plugs	2018	November

Plant Stewardship

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

● Yes
○ No

Are you requesting OWEB funds for plant stewardship activities?

○ Yes
● No

Explain how you plan to carry out activities to help the plantings survive and grow over time.

The majority of the plantings will be high quality rooted stock from local nurseries. Plants will be installed in fall 2018 after dormancy to alleviate stressing. Containerized plants will be installed using hand-held or track-mounted augers to ensure proper planting depths. Willow cuttings will be installed using hand-held augers along stream banks or by trenching using a mini-excavator on gravel bars and point bars, and cuttings will be conditioned in water for 10+ days prior to planting. To prevent damage from herbivores (primarily deer and elk), Plantskydd will be applied to susceptible plants every 3 months until plants grow above browse heights, and elk fence enclosures will be built around concentrated planting units.

Before project implementation, strategic line intercept transect locations will be established in order to document existing vegetation. Following project implementation, the same transects will be used in order to monitor plant communities every other year for ten years. This will allow identification of any change in the overall plant community structure within the project area and enable us to monitor the existing and future populations of noxious weeds.

Measures of Planting Success

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

Vegetation Community	Parameter	Percentages
Open Tall Willow, Black Cottonwood/Willow Forest, Graminoid Meadows, Alder Floodplain Shrubland	Percent Survival	80
Ponderosa Pine Forest, Open Grand Fir Forest, Dry Graminoid Meadow, Open Black Cottonwood Forest	Percent Survival	80
Alder Floodplain Shrubland, Open Tall Willow, Willow Gravel Bar Scrubland	Percent Survival	80

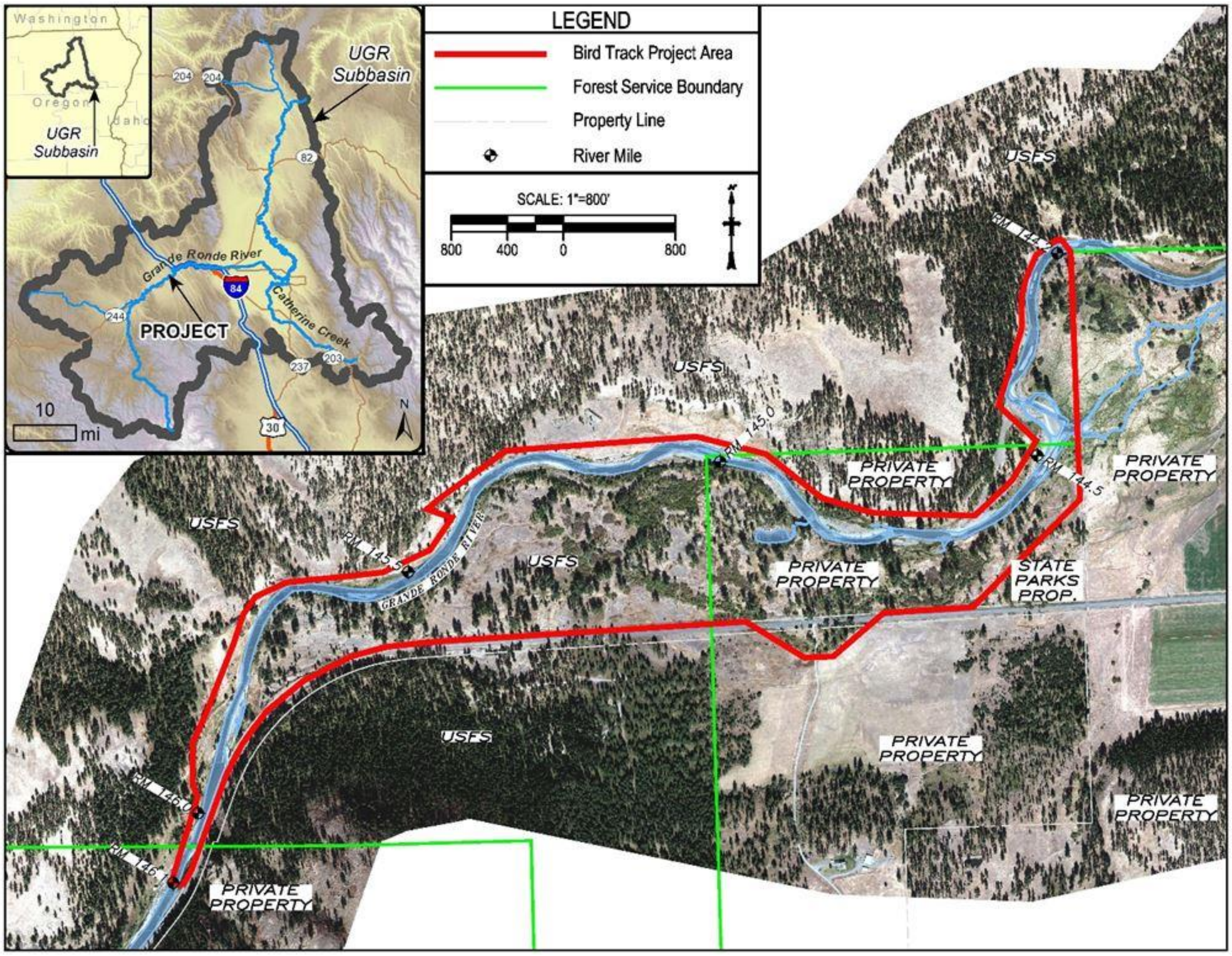
If, in the course of the 3-5 years following planting, the success rate falls below your standard, what is your plan?

Planting areas falling below the 80% survival threshold will be replanted. If planting areas are determined to be falling below the threshold due to deer and elk herbivory, ungulate enclosures will be constructed around damaged units. Plantskydd application timing will also be increased to prevent further damage. If units fall below the threshold due to a lack of moisture, the units will be replanted and watered throughout the growing season.

Permit Page

Project Activity Requiring a Permit or License	**Name of Permit or License**	**Entity Issuing Permit or License**	**Status**
Fill/Removal	DSL/Army Corps Joint Permit Application (JPA)	Oregon Department of State Lands/ U.S. Army Corps	In Progress
River, Stream, Floodplain, and Wetland restoration	HIP III	NOAA/USFWS	In Progress
Restoration activities on Forest Service land	NEPA Environmental Assessment	U.S. Forest Service	In Progress
Ground disturbing activities	Section 106 SHPO Concurrence	Oregon State Historical Preservation Office (SHPO)	In Progress

Brid Track Springs Overview Map



Basis of Design Report: Preliminary (30%)

Bird Track Springs Habitat Improvement Project

December 1, 2016, Draft

Shaping the Future

Document Information

Prepared for	U.S. Bureau of Reclamation
Project Name	Basis of Design Report: Preliminary (30%) Bird Track Springs Habitat Improvement Project
Project Number	E113000603
Project Manager	Michel Ybarrondo, PE
Date	December 1, 2016, Draft

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Acronyms

BiOp	Biological Opinion
BPA	Bonneville Power Administration
CHaMP	Columbia Habitat Monitoring Program
COTR	Contracting Officers Technical Representative
dbh	Diameter at Breast Height
DPS	Distinct Population Segment
EC	Environmental Compliance
EFH	essential fish habitat
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
FCRPS	Federal Columbia River Power System
FWIP EIS	BPA's Fish and Wildlife Implementation Plan Final Environmental Impact Statement
HIP III	BPA's Habitat Improvement Program
HUC	hydrologic unit code
IDEQ	Idaho Department of Environmental Quality
mi^2	square miles
MPG	Major Population Group
NOAA Fisheries Service	NOAA's National Marine Fisheries Service
Reclamation	U.S. Bureau of Reclamation
Rehabilitation Plan	??? Fluvial Habitat Rehabilitation Plan
RM	river mile
RPA	Reasonable and Prudent Alternative
RRT	Restoration Review Team
USFWS	U.S. Fish and Wildlife Service

1 Introduction

The Bureau of Reclamation (Reclamation) and Bonneville Power Administration contribute to the implementation of salmonid habitat improvement projects in the Grande Ronde subbasin to help meet commitments contained in the 2008 Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) (NOAA Fisheries 2008) and the 2010 and 2014 Supplemental Biological Opinions (NOAA Fisheries 2010 and 2014). This BiOp includes a Reasonable and Prudent Alternative (RPA), or a suite of actions, to protect salmon and steelhead listed under the Endangered Species Act (ESA) across their life cycle. Habitat improvement projects in various Columbia River tributaries are one aspect of this RPA. Reclamation's contributions to habitat improvement are all meant to be within the framework of the FCRPS RPA or related commitments and follows the requirements of the NOAA and USFWS BiOp as outlined under BPAs Habitat Improvement Program (HIP III).

The Bird Track Springs (BTS) project is Phase I of the larger Bird Track Reach Project which includes BTS, Longley Meadows and Bear Creek Ranch. The "basis of design" described in this document provides scientific information on geomorphology and physical processes that are used to help identify, prioritize, and implement sustainable fish habitat improvement projects and to help focus those projects on addressing key limiting factors to protect and improve survival of salmon and steelhead listed under the ESA. Much of the background on existing conditions presented herein is applicable across the all Phases of the Bird Track Reach Project. However, the design and associated analysis is specific to BTS.

This iteration of the Project's Basis of Design Report (BDR) reflects the planning process and 30% design development. As the design progresses, additional technical information supporting design guidance and decisions will be incorporated in updated versions of the BDR and its appendices (i.e., at the 80 percent and final design milestones).

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2 Project Background and Purpose

The Background and Purpose have not been updated from the 15% report, it is retained here for context.

2.1 Vision and Goals

The long-term rehabilitation vision (CTUIR's River Vision) for the Bird Track Springs (BTS) reach of the Grande Ronde River shown in Figure 2-1 is to improve physical and ecological processes by rehabilitating and restoring the project area to achieve immediate and long-term benefits to chinook, steelhead, and bull trout at all life stages.

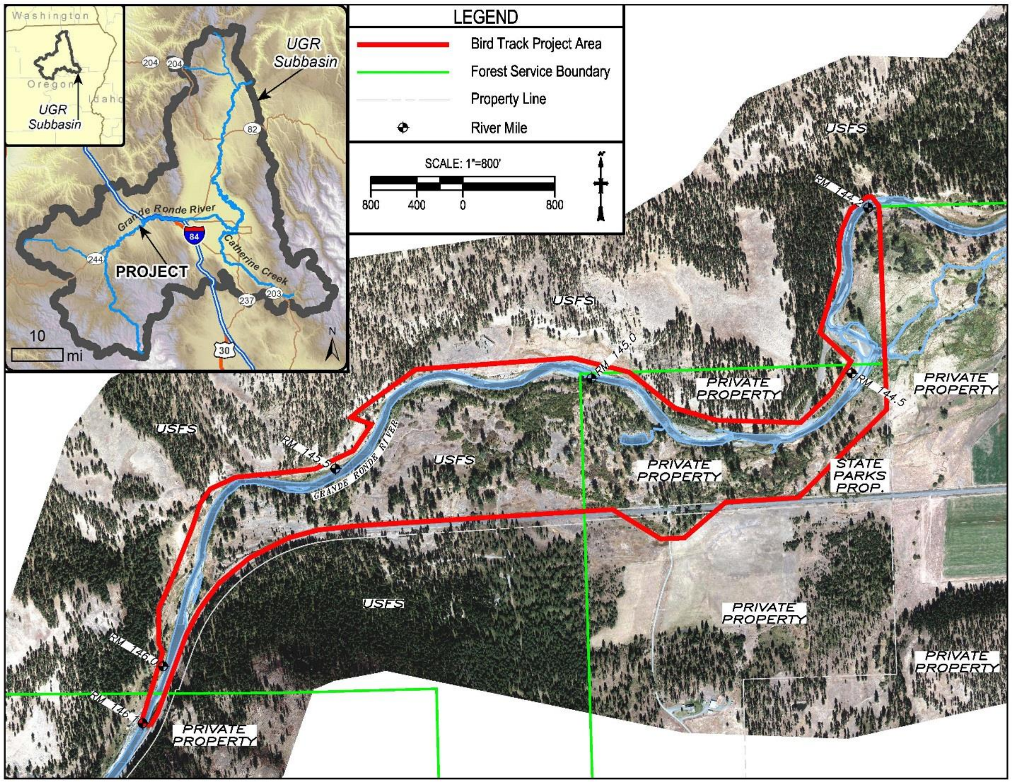


Figure 2-1 Bird Track Spring Fish Habitat Enhancement Project

Benefits to salmonids will be achieved through restoration and rehabilitation of the whole floodplain system. Targeting of present and specific limiting factors such as temperature will achieve immediate benefits to salmon. Long term benefits will be realized through a focus on restoring fluvial and habitat-forming processes, floodplain, groundwater, and hyporheic connectivity, riparian and wetland plant communities, and instream complexity and diversity commensurate with the reach's natural potential. These habitat-forming processes are driven by the natural episodic disturbance regime that historically occurred prior to direct and in-direct human modifications. Intermittent disturbances, such as floods, sediment delivery, wood accumulations, beaver activity, and associated channel dynamics foster and maintain a spatial mosaic and diverse range of aquatic and terrestrial habitats within a healthy riverine corridor.

An inclusive approach to project implementation which accounts for the interests and needs of stakeholders and the broader community is essential for project success. Similarly, achieving the necessary biologic and ecologic outcomes must, at the same time, incorporate approaches and measures to minimize adverse impacts to public infrastructure, local land use, and natural and culturally significant resources.

The life-stage related goals expressed for the Grande Ronde in the Model Watershed/Atlas Process (Table 2-1) are applied to the Project as the core biological objectives. The specific priorities for the Bird Track Springs site, based on the Project Team discussions at the March 2016 Goals and Objectives meeting, are organized as follows: winter rearing; juvenile support and over the long-term, adult habitat benefits. These groupings are consistent with the Atlas Process ranking.

Table 2-1 Project Goals Relative to Key Life Stages

Life Stage Description	Atlas Scoring Rank*	Goal Statement**
Winter Rearing	1	Increase summer and winter rearing habitat in the main channel and side channels through (1) addition of LWD to provide cover and create pools, (2) creation of natural pool-riffle sequences and enhanced riparian vegetation to increase foraging opportunities, (3) creation of additional side channel habitat mimicking existing side channels in the project reach, (4) creation of enhanced area of thermal refugia providing cool temperatures in the summer and warm temperatures in the winter. As a whole, the design should increase the occurrence of low velocity refugia, increase the availability of open water habitat during the winter, and moderate winter temperatures to reduce anchor ice formation.
Summer Rearing	2	
Juvenile Emigration	6	Improve habitat for emigrating juveniles by increasing the number and area of pools, creating additional side channels, alcoves, and off-channel habitat, and creating slow-water edge and cover habitat through addition of LWD.
Spawning / Incubation / Emergence	5	Restore spawning in the project reach first and foremost by decreasing temperatures and creating thermal refugia for adults (reducing pre-spawn mortality). Improve conditions for spawning, incubation, and emergence by improving natural gravel sorting through LWD placement.
Adult Immigration	3	Improve habitat for immigrating and holding adults by decreasing summer temperatures and enhancing the availability of thermal refugia, increasing the abundance and complexity of pool habitat, enhancing main channel passage during low-flow conditions by restoring natural width to depth ratios, and increasing complexity through addition of LWD.
Adult Holding	4	

*Ranking based on Atlas Scoring.

The BTS goals identified in relation to ecological concerns (Table 2-2) form the basis for objectives linking physical processes to channel and riparian geomorphic conditions that affect habitat attributes.

Table 2-2 Project Goals Relative to Key Ecological Concerns

Limiting Factor ID	Description	Rank of Importance*	Goal Statement **
4.1	Riparian Condition: Riparian Condition	4	Facilitate development of a diversity of native plant communities and seral stages that contribute to floodplain process and function. In conjunction with natural channel and floodplain objectives, a combination of riparian/wetland habitat protection, planting and seeding, and natural recruitment result in increased tree, shrub, and herbaceous plant communities that are resilient and self-sustaining, contributing to shade, structure, terrestrial food web, streambank stability, and future large wood recruitment.
4.2	Riparian Condition: LWD Recruitment	4	
5.1	Peripheral and Transitional Habitats: Side Channel and Wetland Conditions	3	Increase activation of historic floodprone area by restoring and promoting connection of main channel to network of side channel and floodplain swales, decreasing width to depth and adjusting vertical position of mainstem Grande Ronde, where appropriate, to increase annual floodplain inundation. A functioning floodplain system contains hydraulic and vegetative diversity, including an assemblage of forests, shrub-scrub areas, and emergent wetlands. This diversity is a foundation for a healthy aquatic food-web and improved temperatures through hyporheic exchange. Beaver recolonization is a key path toward this reinvigorated floodplain system.
5.2	Peripheral and Transitional Habitats: Floodplain Condition	3	
6.1	Channel Structure and Form: Bed and Channel Form	5	Enhance in-stream structural diversity and complexity by reconnecting historic floodplain and side channel network, promoting natural channel function and form, and increasing instream and floodplain structural diversity through large wood complex additions that promote roughness, scour, sorting and storage of sediment, and development of a diverse assemblage of riffle, run, pool, glide, side channel, and alcove habitat.
6.2	Channel Structure and Form: Instream Structural Complexity	2	
7.2	Sediment Condition: Increased Sediment Quantity	6	Encourage sediment sorting, transport, and storage consistent with stable channel morphology to provide a diverse and complex distribution of particle sizes commensurate with hydrologic and morphologic processes that provide spawning and rearing habitat diversity and productive and resilient aquatic invertebrate communities that support food web processes. Enhance sorting and flushing of high loads of fine sediment generated in the upper Grande Ronde watershed.
8.1	Water Quality: Temperature	1	Increase diversity and function of hydrodynamics that decreases summer maximum water temperatures, increases winter water temperatures, and moderates and buffers diurnal water temperature changes during both summer and winter rearing periods. Apply restoration techniques that maximize the interaction and function of small and large scale hyporheic and groundwater exchange, reduce channel width to depth ratios and decrease solar input to increase the productivity of cold water fishery resources.

*Ranking based on Atlas Scoring.

2.2 Specific Objectives

A set of specific objectives were developed to address all the desired physical conditions and habitat attributes and the biologic goals for the Project. At the 15 percent level of design, these specific objectives were established emphasize the potential project benefits (Table 2-3). During later steps in design development additional performance guidance and/or impact avoidance targets would be incorporated as specific objectives.

Table 2-3 Project Objectives

Objective Title	**Description**
Physical Habitat Conditions and Attributes	
Enhance Large Pool Habitat	Increase the number and quality of ‘large’ pools in the main and/or side channels.
Mitigate Ice Jam Processes	Decrease the potential for ice formation and reduce the likelihood of damage from ice jams that do form.
Expand Peripheral Habitats	Create and enhance channel margin slow water areas in the main and/or side channels.
Increase Hyporheic Connectivity	Add lateral and vertical complexity to the channel planform and bed morphology to increase Hyporheic exchange
Improve Riparian & Wetland Condition	Re-invigorate self-sustaining native plant communities with diverse compositions and structures along channel margins and across the floodplain, including patches associated with beaver colony activity.
Moderate Water Temperature	Provide the physical, geomorphic, and ecologic conditions that buffer diurnal and seasonal water temperature fluctuations within the project area and target accessing cold water spring sources.
Evolve Channel Plan Form	Foster channel plan form evolution towards a stable multi-thread pattern with relatively narrow, deep channel(s) between vegetated islands.
Diversify Channel Bed	Create self-sustaining in-channel hydraulics that support varied bed forms including deep pools, and a range of particle sizes with a smaller median particle size.
Strengthen Bed Sediment Sorting	Support diverse geomorphic processes, features, and patterns of sediment movement, sorting and deposition within the active channel(s), including flushing of fine sediment.
Biologic Function Uplift*	
Juvenile Winter Rearing WUA	Increase the quantity of suitable habitat for juvenile Chinook winter rearing, based on the depth and velocity HSI curves per Favrot and Jonasson, 2014
Juvenile Emigration WUA	Increase the quantity of suitable habitat for juvenile Chinook emigration.
Juvenile Summer Rearing WUA	Increase the quantity of suitable habitat for juvenile Chinook summer rearing, based on the depth and velocity HSI curves per Maret et al., 2006
Adult Fish Use Potential	Increase the quantity of suitable habitat for adult salmonid use

* At this level of screening analysis, weighted useable area (WUA) of habitat is calculated only for juvenile Chinook.

3 Background – Existing Conditions

Chapter 3 has been updated since the 15% BDR to incorporate some new information and subsections based on new field data and analyses, as well as with some minor edits or clarifications without track changes. Areas containing new information have been labeled (NEW) for easy identification.

3.1 Landscape Setting

The Bird Track Springs Fish Habitat Enhancement Project (Project reach) is located in the Upper Grande Ronde Subbasin, on the Grande Ronde River, between about RM 146.1 and RM 144.7 (Figure 3-1). The Project reach sits at an elevation of approximately 3,100 feet and with contributing watershed area of 475 mi^2, which is predominantly snowmelt-driven. Most of the basin is forested (over 73 percent) and has very little development (less than 0.1 percent estimated impervious area) (USGS 2014). The Project reach includes Wallowa-Whitman National Forest and private lands along State Highway 244 within the Grande Ronde recovery plan assessment units UGC3A and UGS16. The Upper Grande Ronde River Tributary Assessment (Appendix A; Reclamation 2014) identifies the Project reach as an unconfined geomorphic reach with a high potential to improve the overall physical and ecological processes that support salmonids in the basin.

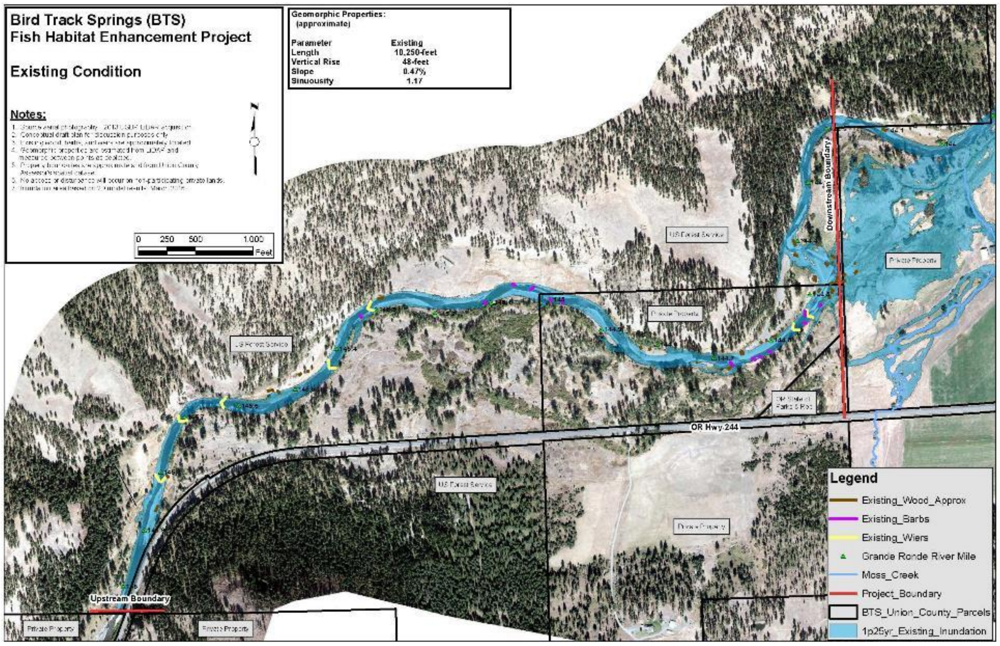


Figure 3-1 **Project Reach**

3.2 Fluvial Geomorphology (Updated)

This section includes new information based on recent field observations and desktop analyses since the 15% BDR. In addition to the information below, detailed geomorphic mapping and existing channel morphology/habitat information is provided in Appendix H.

The existing Project reach has an unconfined, free-formed alluvial channel with a straighter planform, a planar bed and lower degree of channel-floodplain connectivity compared to historical conditions (Figure 3-2). It is one of the few large, unconfined valley sections within the Upper Grande Ronde basin and as such, it is a reach of high biological potential for the basin as a whole.

The Upper Grande Ronde Subbasin covers about 1,400 mi^2 (459 mi^2 at the project reach) in northeastern Oregon, between the Blue Mountains to the west and the Wallowa Mountains to the east. The area is drained by the Grande Ronde River, which flows northeast through this region and is tributary to the Snake River. Topography of the subbasin is strongly controlled by the geologic structures, principally those related to block faulting and associated variations in surficial bedrock. The terrain ranges from the nearly flat floors of the Grande Ronde Valley, whose elevations are 2,600 to about 2,750 feet, to the mountainous uplands, whose average elevations are about 5,000 feet and which have local prominences exceeding 6,500 feet. (USGS 1964)

3.2.1 Historical Conditions

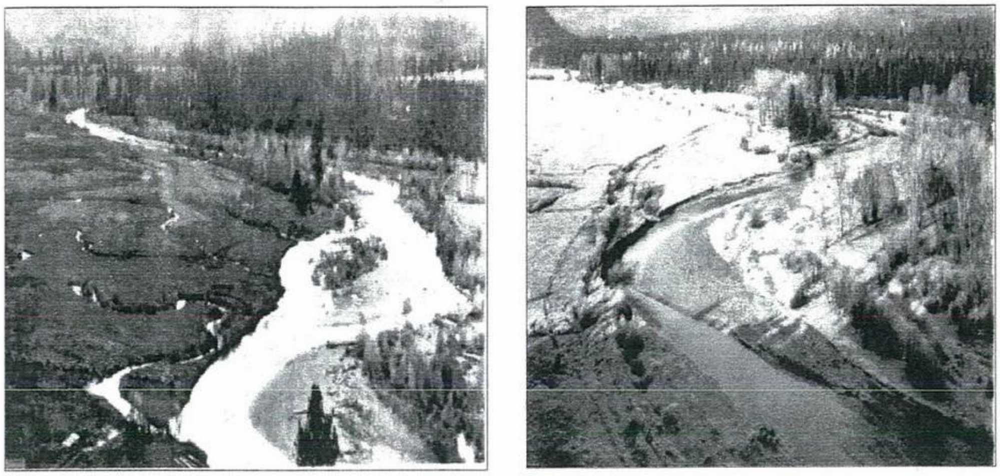
Prior to Euro-American settlement and associated disturbances, the upper Grande Ronde River developed under an intermittent disturbance regime where flows, sediment inputs, and large wood dynamically interacted to create successional states. Riparian vegetation likely included woody species such as cottonwood (*Populus*), willow (*Salix*), river birch (*Betula nigra*) and alder (*Alnus*) of varying ages (seral stages). The upland areas adjacent to the active flooplain likely supported mature Ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*) trees readily delivered to the channel through lateral channel migration and avulsion.

Beavers were common and played a vital role in the local delivery of wood to the channel and maintaining and diversifying the off-channel habitats and riparian conditions. Necessary wood sizes and quantities would have accumulated during high-water events to form transient logjams (i.e., bar apex jams and flow deflection jams). These logjams could have persisted long enough to create erosion-resistant hard points capable of forcing flow divergence that result in split-flow channels and floodplain-type side channels.

In the Project reach, the upper Grande Ronde River would have had an unconfined, forced alluvial channel with alternating pool-riffle and run bedforms. Beechie et al. (2006) empirically determined based on regional data that intermediate sized unconfined channels, similar to the upper Grande Ronde River, that transport their sediment primarily as bedload and retain wood long enough to establish erosion-resistant points were transitional, and generally favored island-braided patterns in forested mountain systems. Beechie et al. (2006) data also shows that island-braided channels are continually adjusting to intermittent perturbations which sustains a high degree of successional states, resiliency, and habitat diversity. In general, island-braided riverine systems provide abundant peripheral and transitional habitats, and complex channel structure and bedforms resulting in the highest degree of biological diversity that supports both aquatic and terrestrial species during varying life stages.

Channel degradation has occurred in response to floodplain constriction from constructed levees and railroads, as well historical log transport operations by splash damming through the project reach. Railroad grades, road grades, and levees through the floodplain create artificial channel constrictions and disconnected floodplains that have resulted in an enlarged and incised channel. Constriction increases flow depths, flow velocities, and shear stresses during high water events. The outcome is a wider, more uniform plane-bed channel. Historical splash dam and log transport originating from upstream of the project reach also resulted in a degraded channel. The quantity and force of logs moving along the channel are known regionally to have coarsened stream beds and severely truncated pool-riffle sequences.

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



Source: Gildemeister 1998.

**Figure 3-2	Paired images looking upstream at the confluences between the upper Grande Ronde and Jordan and Bear Creeks. Left image was taken in 1919 and the right image was taken in 1982**

### 3.2.2	Geomorphic Characterization and Mapping NEW

Geomorphic and in-channel habitat features have been mapped along the project reach using a combination of desktop analyses and field observations. The existing characteristics and driving forces including: valley width, landform surfaces, channel planform, channel profile, and land ownership/uses all informed sub-division into six geomorphic reaches.

Table 1 below summarizes results of in-channel habitat unit mapping, Figure XX shows an overview of geomorphic mapping and the geomorphic reaches, and Figure XX shows a longitudinal profile of the project reach and geomorphic reaches. These data sets support the following description of geomorphic reaches in terms of their geomorphic features, physical processes, and opportunities for restoration.

Table 1 **Key Channel and Streambank Characteristics by Geomorphic Sub-Reach.**

Sub-Reach	Length	Slope	Average Riffle Spacing		Ratio of Riffle Length to Slow Water Unit (run, glide, or pool) Length	# Slow Water Units with > 1 foot residual depth	% Bar Area	% Eroding Banks
ID	ft	ft/ft	ft	xBFW*	-	#	% of active channel	% of total bank length
1	1631	0.0036	631	6.51	0.71	0	28%	12%
2	2086	0.0046	460	4.75	1.14	0	17%	35%
3	2477	0.0046	495	5.11	0.72	2	33%	44%
4	1034	0.0045	517	5.33	0.83	0	36%	28%
5	2104	0.0037	444	4.58	0.36	1	38%	14%
6	1663	0.0045	554	5.71	0.36	1	27%	38%
Total	**10995**	**0.004**	**509**	**5.25**	**0.64**	**4**	**0.31**	**0.29**

* Multiples of bankfull width

Minimum and maximum values for each metric are shown in green and red, respectively.

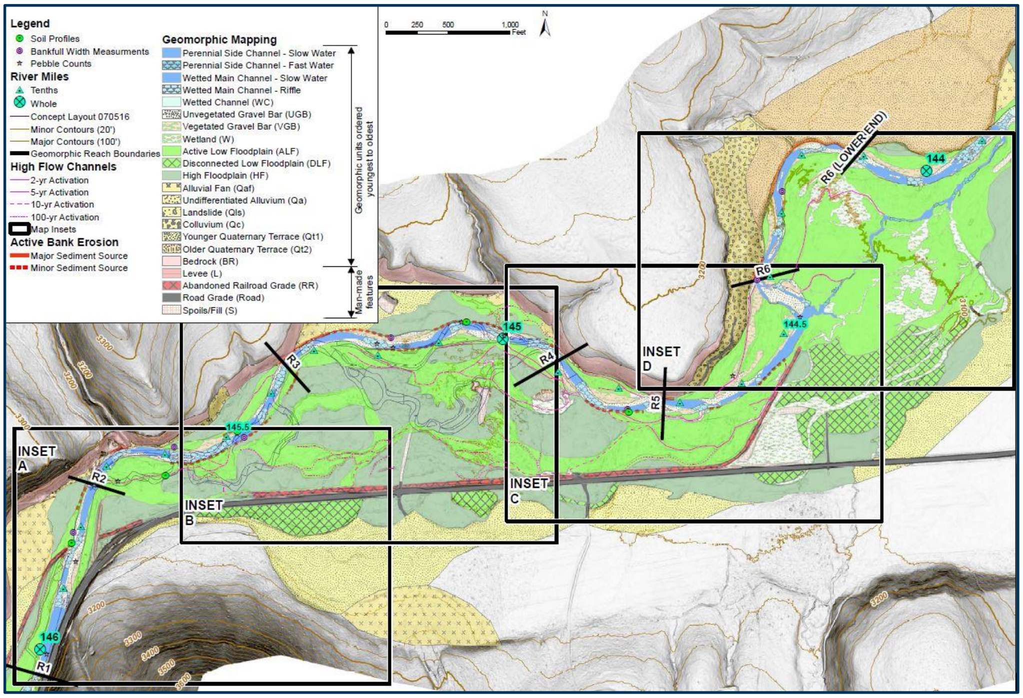


Figure 1 **Geomorphology overview map and sub-reach map index (see Appendix H for the detailed map sheets and expanded legend).**

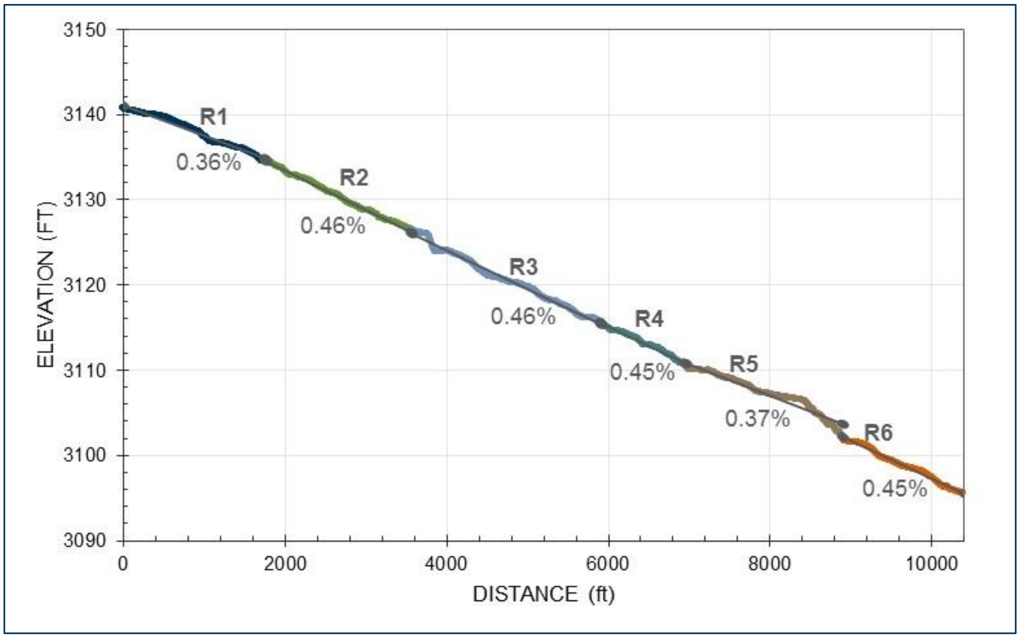


Figure 2 **Existing channel bed longitudinal profile, with average bed slope by sub-reach**

Key physical, geomorphic, and habitat conditions and process for each geomorphic reach are summarized below, along with observed restoration opportunities or constraints.

3.2.2.1 Geomorphic Reach 1

The GRR is moderately confined with a straight channel planform. Ice scour is a major process, while lateral channel migration and bank erosion are negligible. Key lateral constrains include a Highway 244 a levee on the right bank, and the historic railroad grade on the left bank. Historic log abutments from the historic railroad bridge are exposed in the channel bed along the left bank. Channel complexity is low as indicated by the lack of pools and general lack of woody debris.

Opportunities

> Slough present on LB. Reconnection possible by excavation of abandoned railroad grade. Low migration rates mean the reconnected slough should persist for a long period.

> Ice influence is strong within this reach. Potential for harnessing of ice dams to divert flows overbank.

> Remove levee on right bank to reconnect floodplain

Constraints

> Ice scour appears to limit cottonwood and other vegetation recruitment

3.2.2.2 Geomorphic Reach 2

The GRR is decreasingly confined relative to Reach 1, but intersects the bedrock valley wall on the left bank where a historic quarry is present. Downstream of the quarry and bedrock is an apparent abundance of in angular cobbles and boulders, which wanes by the downstream end of the reach. Historical channel migration rates have been low to moderate, while ice scour is active. An existing high flow channel (activated by 5-year flood) is present on the right bank, while additional high flow channels currently activated only during 10- and 100-year floods extend downstream along the right valley. Channel complexity is low as indicated by the lack of pools and general lack of woody debris.

Opportunities

> Active, low floodplain adjoins much of the channel.

> The existing high flow channel can be augmented. Ice accumulation appears to increase the frequency of inundation.

> Increase activation frequency of high flow channels running along the right valley downstream

> Enhance surfaces for cottonwood recruitment on the right bank.

Constraints

> Ice scour may limit cottonwood and other vegetation recruitment

3.2.2.3 Geomorphic Reach 3

The GRR is unconfined with a slightly sinuous planform and moderate bed profile variation/instability. Historical channel migration rates have been relatively high, which has helped to create surfaces for cottonwood recruitment. Recent cottonwood recruitment occurred within the upper reach within the last 10 years. Ice scour processes, if active, are not apparent from vegetation indicators. An alluvial fan and river terrace remnant on the left bank are major sediment sources. Existing high flow channels on the right activate at 2- and 5-year intervals. An alcove on the right bank has a strong groundwater/hyporheic temperature signature in the summer, and was observed ice-free in winter 2016 during a period when the river channel was largely frozen otherwise. Channel complexity, as indicated by area and prevalence of wetted off-channel features, is improved relative to reaches 1 and 2.

Opportunities

> Active, low floodplain adjoins much of the channel.

> Bank erosion and channel migration in this reach could be allowed and/or enhanced to increase habitat formation and cottonwood recruitment

> Significant floodplain area to the south available for channel reconstruction

> Protect and/or enhance groundwater/hyporheic features

3.2.2.4 Geomorphic Reach 4

The GRR is unconfined with a slightly sinuous planform. Historical channel migration has occurred at moderate rates. Low, active floodplain extends for the reach entirety on the LB, whereas high floodplain is present on much of the right bank. On the left bank, existing off channel features include a high flow channel (2-year activation) and wetland. This wetland exhibits a subtle temperature signature of hyporheic upwelling. On the right bank, an excavated pond/wetland is located in the upper reach, and a high flow channel (2-year activation) departs from the main channel in the lower reach.

Opportunities

> Bank erosion and channel migration in this reach could be allowed and/or enhanced, to increase habitat formation, cottonwood recruitment, or sediment recruitment from the nearby valley wall.

> Enhance or protect existing off-channel features.

- > Relocate and/or redirect channel against valley wall to induce scour pool development (as observed in Reach 6 discussed below)

3.2.2.5 Geomorphic Reach 5

The GRR is unconfined and dynamic in this reach, with shifting bars and a meandering to braided planform and moderate bed profile instability. Historical channel migration rates have been high, and have generally involved bend growth, and channel switching between the existing main channel and high-flow channel on the left. The main channel longitudinal profile exhibits a significant decrease in slope in the upper ~2/3 of the reach, at which point the channel steepens and turns abruptly to the northwest. A perennial side channel diverges from the main channel at this sharp bend, and is a priority for preservation. While this side channel is connected to the main channel at the surface, temperature mapping indicates that groundwater is the primary source. The main channel is braided with multiple channels and shifting bars below the bend. The historic (abandoned) railroad grade is present in the right floodplain.

The high flow channel on the left is activated in the 2-year flood and has adjacent ponds wetted during low-flow conditions. Temperature signatures in these ponds indicate either groundwater or hyporheic connection (see figure x1 in 3.3.6). In addition, indications of hyporheic upwelling are present along the downstream end of the high flow channel at its convergence with the main channel.

Opportunities

- > Maintain reach dynamism and increase complexity through wood additions.
- > Existing hyporheic upwelling. Design features could improve access and/or focus the upwelling zones to maximize their habitat benefit.
- > Existing, groundwater-fed side channel

3.2.2.6 Geomorphic Reach 6

The GRR is unconfined, but runs along the northern valley wall for much of its length. The valley wall is composed of the bedrock-cored hillslope in the upper portion of the reach, and an older river terrace in the lower reach. This river terrace (Qt2) appears to be older than the Mount Mazama eruption, and is largely composed of fluvial sand and gravels, overlain by hillslope-derived silts and sands. At the base of this terrace (underlying fluvial deposits) are indurated silts and sands resembling weakly cemented bedrock. This exposed sedimentary unit is likely the base of the hillslope bedrock (over which the terrace has been deposited), or a subtle strath (bedrock-cored) river terrace. Deep pools are present in the main channel where it impinges upon the terrace at sharp bends. This terrace, while erosion resistant, appears to have retreated historically with fluvial erosion, suggesting this reach provides sediment to the Longley Meadows project reach downstream. Away from valley walls, the channel runs entirely through active, low floodplain area.

Opportunities

- > Valley wall and river terrace (Qt2) as possible sediment source and erosion resistant feature to induce pool scour. The channel could be narrowed using wood structures to further induce scour and pool formation.
- > Low floodplain areas present possible areas for cottonwood recruitment.

3.2.3 Channel Forming Flow NEW

Channel forming flow, or bankfull discharge, is a fundamental parameter for channel design. To estimate the flood recurrence interval at bankfull discharge, bankfull width was measured at various points along the BTS reach (see geomorphic mapping in Appendix B for locations). Measured bankfull widths from these geomorphic field indicators were then compared modeled flood widths at the same locations. As shown in Table 4, bankfull widths best match flow widths of the 1.05-year flood. A regional analysis of bankfull discharges by Castro and Jackson (2001) supports a similar recurrence interval, as demonstrated by their local estimates from the Blue Mountains and eastern Oregon (Table 5). Their local data have a median bankfull recurrence interval of 1.2, with multiple gauges having bankfull discharges at recurrence intervals of less than 1.1, suggesting a similar value for the site is reasonable.

Table 4 Table showing measured bankfull widths relative to modeled flow widths at the same locations.

Cross Section ID	Measured Bankfull Width (ft)	Modeled Flow Width at:		
		~1.05-yr* flood	**1.25-yr Flood**	**1.5-yr Flood**
BF-1	92	101	114	114
BF-2	86	87	88	88
BF-3	100	113	113	119
BF-4	101	105	105	108
BF-5	104	91	100	108
BF-6	91	97	117	154
BF-7	115	133	148	149
BF-8	91	87	87	88
Mean	98	102	109	116
Median	96	99	109	111
Mean (excluding BF-7)	*95*	*97*	*103*	*111*
Median (excluding BF-7)	*92*	*97*	*105*	*108*

Note:

The anomalously large bankfull measurements at BF-7 were collected in the depositional area near Bear Creek Ranch, and are thus excluded from a second set of statistical calculations for comparison. See geomorphic maps for measurement locations.

*Measured using modeled inundation at the "winter high" design flow of 900 cfs, which approximates the 1.05-yr flow of 957 cfs.

Table 5. Measured bankfull recurrence intervals in the Blue Mountains and eastern Oregon by Castro and Jackson (2001) for comparison to the project reach.

Stream Name	Gauge ID	Drainage Area (mi^2)	Return Interval (yr)
Grande Ronde	13333000	3275	1.39
Umatilla	14021000	637	1.09
Umatilla	14026000	1280	1.26
John Day	14038530	386	1.12
John Day	14046500	5090	1.84
John Day	14048000	7580	1.13
Asotin	13334700	170	2.63
Tucannon	13344500	431	1.45
Touchet	14017000	361	1.15

Stream Name	Gauge ID	Drainage Area (mi^2)	Return Interval (yr)
Walla Walla	14018500	1657	1.03
Mean	-	2087	1.41
Median	-	959	1.21
Bird Track Springs	-	459	≤1.25

3.2.4 Ice Scour Influence NEW

Icing has been a significant process during winter low flows, and has likely been exacerbated by the wider, shallower channel geometry. Anchor ice along the bed of the channel dislodge and disturb the gravel beds thereby exposing and/or crushing redds where eggs incubate over the winter. Surface ice accumulation can also be significant during winter months to the point of creating large ice dams. The formation of ice dams and their subsequent failure can scour the stream bed and damage banks and riparian vegetation.

The extent of ice scour is a major design consideration in the upper project reach. Scarred trees adjacent to the channel indicate the elevations and approximate downstream extent of ice scour in the upper BTS reach. Scoured trees are present in the upper 3000 feet, which should be considered a conservative estimate on longitudinal ice scour extent given the sparsity of mature vegetation further downstream. These trees also record an upper limit of scour consistently above the 100-year water surface elevation, as shown in Figure 3.

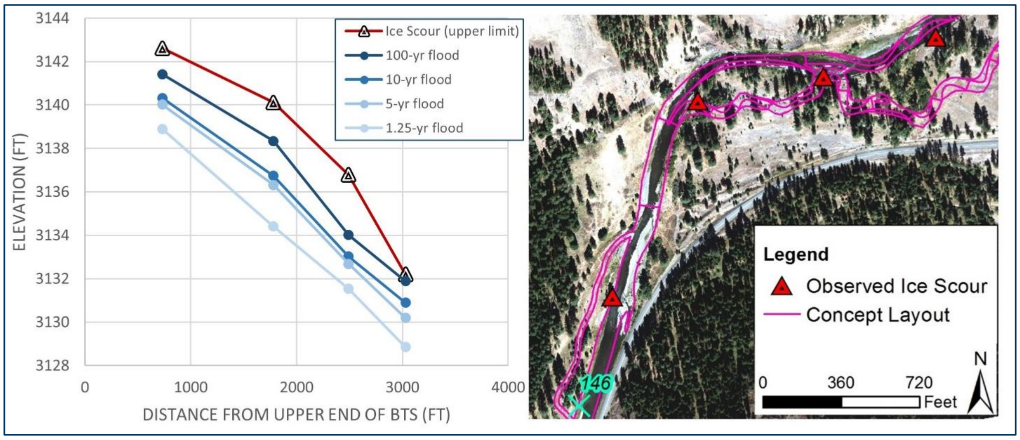


Figure 3. **Observed ice scour on channel adjacent trees. The graph to the left shows ice scour elevations relative to the modeled flood elevations (existing conditions). The map to right shows observed locations of ice scour.**

3.2.5 Sediment Supply and Transport NEW

3.2.5.1 Local Sediment Supply

Eroding banks within the project reach actively supply sediment to the Grande Ronde River. Major and minor sources of sediment along actively eroding banks were mapped in the field. Minor sources are classified as any eroding banks mapped along floodplain geomorphic units, whereas major sediment sources were classified as eroding banks along alluvial fans, river terraces, and valley walls. As shown in Table XX, active bank erosion is most predominant in the middle (geomorphic reaches 2, 3, and 4) and at the lower end of the project (geomorphic reach 6). The percent eroding banks corresponds roughly with observed channel migration rates in each reach, with exception of reach 6 where erosion is along relatively a resistant terrace side slope. In general, the channel character does not appear to change in direct response to local sediment inputs except in one location observed in geomorphic reach 2. The upper limit of reach 2 is marked by the channel intersecting a bedrock valley wall and historic quarry (major sediment source). Extending downstream for approximately 1,000 feet is a zone of increased abundance of angular cobble and boulder sized grains.

Table 2. Table showing the length of mapped bank erosion along the project reach, subdivided by geomorphic reach.

Geomorphic Reach	Reach Length (ft)	Eroding Bank Length by Source Type (ft)		% Eroding Banks
		Minor	Major	
1	1631	402	0	12%
2	2086	1279	201	35%
3	2477	1744	420	44%
4	1034	514	56	28%
5	2104	495	86	14%
6	1663	164	1085	38%

3.2.5.2 Sediment Size

Grain size distributions were collected using pebble count sampling techniques across various in-channel habitat units and floodplain features present onsite (Wolman, 1954). To date, a total of 11 pebble counts have been collected within the BTS project reach. Pebble counts were performed on riffles, glides/runs, exposed gravel bars, high flow channels, and eroding banks. Table XX below summarizes the grain size distributions of each sample, and then composite distributions for each habitat unit type. Composite grain size distributions for each unit type are shown in graphical form in Figure XX. As expected, riffles had the coarsest grain sizes (D50 = 67.3 mm), with runs/glides (D50 = 48.1 mm) and exposed bars (D50 = 50.4) having similar median grain sizes. Sediment size within high flow channels and exposed banks were finer, with D50 values of 28.0 and 18.8 mm, respectively.

Within the main channel, habitat unit mapping provides relative proportions of each habitat unit (riffles, glides/runs, and gravel bars), in turn allowing calculation of a reach-average grain size distribution, weighted by habitat unit. Riffles, glides/runs, and exposed gravel bars comprised 27%, 42%, and 31% of the active channel area. These proportional areas yield a reach-average, in-channel D50 of 54.0 mm.

From eroding banks, one full (>100 grains) pebble count was performed, as well as two abbreviated pebble counts at soil profiles 1 and 4 (SP-1 and SP-4). These samples inform size estimates of excavated volumes during construction. Grain sampling in vertical banks was guided by specified intervals along stretched measuring tapes. Given the difficulty in capturing the true proportion of fines (<2 mm) in exposed gravel layers using the pebble count technique, a point count of fines versus gravel was performed on gridded photos in the office following field work. This point count revealed an estimate of 26% fines at location PC-10. The raw grain size distribution collected representing grain sizes greater than 2 mm had a D50 of 18.8 mm. Adjusting this distribution for the proportional volume of fines results in a D50 of 11.4 mm.

Table 3. Pebble count data within existing main channel, high flow channel, and streambanks

Unit Type	Sample ID	# grains	Grain Size (mm) by Percentile						
			D5	D16	D25	D50	D75	D84	D95
Riffle (27% of active channel)	PC-11	101	21.2	35.3	41.9	62.5	87.4	112.0	158.8
	PC-16	122	18.1	32.5	45.3	72.1	113.0	137.3	213.7
	PC-17	102	22.7	32.9	39.5	67.9	103.0	124.5	169.6
	Composite	**325**	**20.3**	**33.7**	**41.9**	**67.3**	**102.9**	**125.4**	**176.1**
Run/Glide (42% of active channel)	PC-2	99	8.9	13.2	16.5	25.2	36.3	43.4	64.3
	PC-5	100	48.7	60.4	69.7	96.4	123.1	143.4	190.9
	PC-12	103	11.1	18.0	24.2	41.0	71.1	85.6	119.5
	Composite	**302**	**11.2**	**18.6**	**24.9**	**48.1**	**87.6**	**107.1**	**151.5**
Bar (31% of active channel)	PC-1	100	17.4	33.4	40.5	62.9	88.8	107.3	145.5
	PC-3	100	16.0	23.8	30.3	42.3	59.0	68.0	84.7
	Composite	**200**	**16.4**	**27.1**	**34.3**	**50.4**	**74.1**	**85.7**	**123.1**
Reach-Average Main Channel	**Weighted by habitat unit area**	**-**	**15.3**	**25.3**	**32.4**	**54.0**	**87.5**	**105.4**	**149.3**
Eroding Bank	PC-10	109	4.1	6.2	8.1	16.7	33.6	44.4	72.5
	SP-1	20	6.7	11.4	16.0	24.7	37.9	44.2	64.0
	SP-4	20	3.2	4.3	8.9	22.6	64.0	78.5	107.3
	Composite	**149**	**3.9**	**6.4**	**8.8**	**18.8**	**36.6**	**49.0**	**78.4**
	Composite (with fines added)*	**-**	**<2**	**<2**	**<2**	**11.4**	**29.0**	**40.7**	**72.4**
High Flow Channel	PC-13	113	9.5	15.5	24.1	31.8	44.3	54.1	86.1
	PC-19	112	3.5	8.3	12.0	22.6	39.7	49.3	77.6
	Composite	**225**	**4.4**	**11.6**	**16.4**	**28.0**	**42.4**	**52.1**	**81.4**

* Gridded photo point count revealed 26% fines (<2 mm) in exposed bank gravel layers. The eroding bank pebble counts were corrected to include this proportion gravel.

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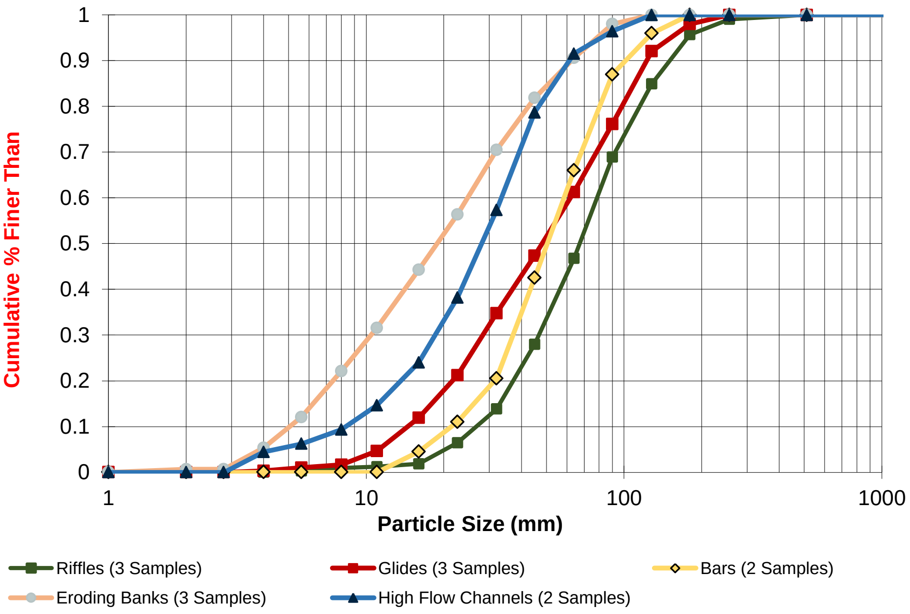


Figure 14. Composite grain size distributions by habitat type in the BTS project reach.

3.2.5.3 *Bed Armoring*

A limiting factor identified for BTS project reach includes channel armoring (or coarsening) as a result of historical log runs. Ratios of median grain sizes on the bed surface to those in subsurface gravels ($D50_{surface}/D50_{subsurface}$) is the typical metric for the degree of armoring. In the absence of invasive sampling to obtain subsurface sediment sizes, the degree of bed armoring can be alternatively evaluated by comparing the bed surface to floodplain alluvium exposed in eroding banks. In meandering streams, it is the subsurface sediment (below the armoring layer) that should be preserved in the floodplain alluvium (Wolman and Leopold, 1970). Therefore, in the absence of subsurface grain size measurements, the typical armoring ratio ($D50_{surface}/D50_{subsurface}$) can be replaced with $D50_{bedsurface}/D50_{floodplain\_gravel.}$ Depending on the chosen in-channel grain size, this alternative armoring ratio ranges from 2.7 to 4.7 for the BTS reach. For context, the calculated range for BTS falls within the lower-middle range of observed armoring ratios in snowmelt-fed streams, as reported by Hassan et al. (2006). The BTS range also brackets the average armoring ratio of 3.4 reported by Hassan et al. Based on these comparisons, bed armoring in the existing channel is in line with natural streams, and therefore may represent less of a degraded condition than had originally been surmised.

3.2.5.4 *Sediment Size Characterization of Floodplain Alluvium and Cut Volumes*

Recycling of excavated material for other project features depends on the encountered grain size distributions. The expected size gradations of proposed cut volumes were evaluated using a combination of soil profile observations, grain size sampling in eroding banks, and test pit data from a cultural survey performed onsite.

As documented through soil profile descriptions and cultural test pits, the typical near-surface alluvial stratigraphy includes a surface layer of fine sediment (<2 mm and smaller) interpreted as overbank flood deposits, underlain by a layer of river-lain sandy gravel. The thickness of overbank deposits varies from zero to over 3 feet and average 1.25 feet thick across the site. These overbank deposits are characterized texturally as silty sand to sandy silt. The underlying sandy gravel layer is projected to have grain sizes similar to those measured in eroding banks.

A topographic surface of the boundary between overbank and gravel deposits was developed, and then compared to proposed excavations. Table XX below provides estimates of cut volumes above and below that surface.

Table 14. Table showing cut volumes relative to the transition from silty sand overbank deposits and sandy gravels below, as mapped using cultural test-pit data.

	Cut Volume (cy)
Silty Sand - "Overbank" sediments	3820
Sandy Gravel layer	55030

3.2.5.5 Sediment Transport

The Project reach has a 0.4 percent channel gradient and has a bed comprised of cobble and gravel with sand, small sections of bounder sized colluvium occur where the river is located near the valley wall. Energy and flow volume are currently dissipated on the floodplain during large floods. Maximum instream competency maintained within the stream is in the cobble size range. The sediment is generally reworked within the reach rather than being transported for any significant distance (Reclamation 2014).

Much of the channel thalweg downstream of river mile 145.7 is under marginal bed load transport or marginal motion of particles during the 2-yr discharge. Pebble Counts show that the channel in the Project Area is coarse (small cobbles), and particles smaller than this size classification (gravels, sands, silt/clay) generally move through the system or accumulate on the few bars present within the Project reach.

Sediment transport was also modeled in this 30% effort. A discussion of the results can be found in Section 6.2.7.

3.3 Surface Hydrology

The hydrology analysis done during prior design phases has not changed. In addition to the information below, please refer to the hydrologic study provided in Appendix C for more information.

3.3.1 General Setting

The project reach sits at approximately 3,100 feet elevation and drains an approximately 475 mi^2 watershed extending to a maximum elevation of 7,923 feet. The mean annual precipitation is 26.2 in, most of which falls as snow during winter months. As a result, the annual hydrograph is dominated by snowmelt-derived high flows from April to May. Peak flows also occasionally occur from winter rain storms. The low flow season typically extends from August through December. Most of the basin is forested (over 73 percent) and has very little development (less than 0.1 percent estimated impervious area) (USGS 2014). Watershed characteristics of key points (Figure 3-3) along the main-stem GRR are shown in Table 3-1.

Six tributary streams enter the project reach from adjacent valley walls. Figure 3-3 shows the project reach and the watersheds of Moss, Bear, and Jordan Creeks entering from the south (river right), and Spring Creek and two unnamed tributaries entering from the north (river left). All six tributary streams have no stream gaging records. Table 3-2 summarizes general attributes of the tributary basins. Despite their small drainage areas, the two unnamed tributaries (Unnamed Tributary 1 and 2) were included in the analysis to provide a full picture of possible flow inputs along the project reach.

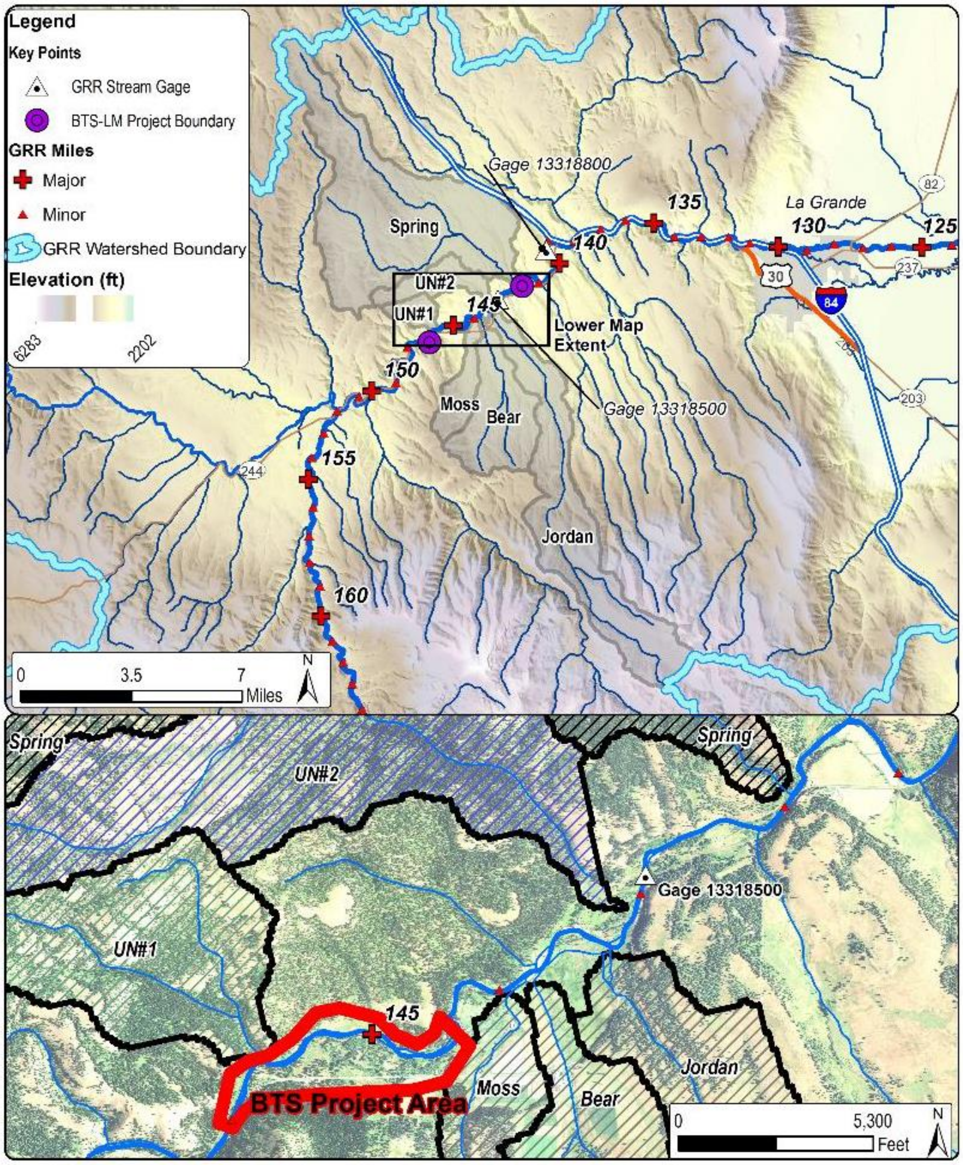


**Figure 3-3	Map of Key Locations and Tributary Watersheds**

Table 3-1 Watershed Characteristics of Key GRR Mainstem Sites and Tributaries Contributing to the Project Reach

Watershed Outlet Description	River Mile	Drainage Area (mi^2)	Outlet Elevation	Maximum Elevation	Mean Annual Precipitation (in)
Mainstem Points					
Upper Project Reach Boundary	146.1	459.0	3139	7923	26.4
Historic Stream Gage Location (13318500)	142.9	495.7	3060	7923	26.2
Lower Project Reach Boundary	141.9	525	3050	7923	26.3
Tributary Outlets					
Unnamed Tributary 1 (enters left)	145.6	1.3	3144	4247	22.9
Moss Creek (enters right)	144.0	2.7	3090	4705	21.0
Bear Creek (enters right)	143.8	7.9	3090	4729	22.0
Jordan Creek (enters right)	143.3	17.7	3078	6057	26.0
Unnamed Tributary 2 (enters left)	143.1	2.8	3074	4352	23.0
Spring Creek (enters left)	141.95	26.6	3050	4650	27.3

Table 3-2 Stream Gauges in the Grande Ronde River Basin Used in this Hydrologic Analysis

Station Number	Name	Agency	River Mile	Drainage Area (mi^2)	Start Year	End Year
13319000	Grande Ronde R at La Grande, OR	USGS	132	686	1903	1989
13318960	Grande Ronde R Near Perry, OR	OWRD	135.9	677	1997	Current
13318920	Five Points Cr at Hilgard, OR	OWRD	137.7	71.9	1992	Current
13318800	Grande Ronde R at Hilgard, OR	USGS	139.3	544	1966	1981
13318500	Grande Ronde R Near Hilgard, OR*	USGS	142.9	495.7	1937	1956

* Historic gauge 13318500 is located within the project reach.

3.3.2 General Approach

The goals of this study were to estimate stream flows in the mainstem GRR and tributary streams (see locations noted in Table 3-1) along the project reach. Flows were estimated both in terms of peak flows and flow exceedance statistics. In terms of recurrence intervals, 1.05, 1.1, 1.25, 1.5, 2, 2.33, 5, 10, 25, 50, 100, 200, and 500-year peak flows were estimated. Flow duration estimates included 5%, 10%, 25%, 50%, and 95% annual flow exceedance values, and inform project design flows. With exception of a historic stream gage in the lower project reach, all other flow estimates are at ungauged sites and thus required various flow estimation techniques as described below.

The two primary flow estimation approaches used to estimate flows at ungauged sites included the drainage area-ratio method and regional regression equations. The drainage area-ratio method (Cooper, 2006) ties flow estimates at ungauged sites to gaging records up- or downstream, and thus was the preferred method of flow estimation. Since the drainage area method is only applicable at sites on the same stream and with drainage areas between 0.5 and 1.5 times that of the gaged site (Cooper, 2006), it could only be employed at mainstem locations where downstream GRR stream gages (13319000 and 13318960) were within the specified range. Given that tributary basin outflow points were outside the applicable range of the drainage area method, regional regression equations for peak discharges (Cooper, 2006) and annual flow duration (Risley et al., 2008) were needed to estimate flow. To corroborate regression equation estimates, Cardno used data from an active stream gauge on Five Points Creek (ID 13318920, see Table 3-2), a gage with a small drainage basin entering the GRR 4.2 miles below the lower project boundary.

3.3.3 Mainstem Peak Flows

To evaluate the peak flow hydrograph in the mainstem, annual peak flow records from multiple gauges were compiled, adjusted to the upstream site boundary, and then input into PeakFQ. The resulting hydrograph is presented graphically in Figure 3-4 and in Table 3-3.

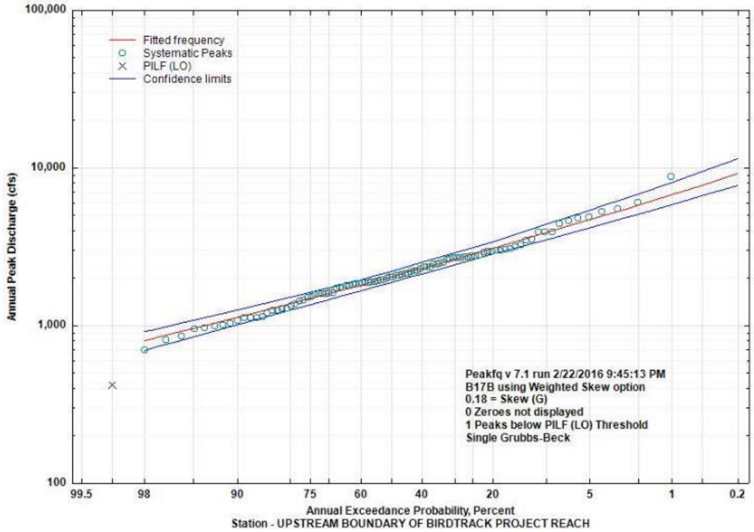


Figure 3-4 **PeakFQ output showing the discharges of various annual exceedance probabilities for the upstream project boundary (RM 146.1).**

Table 3-3 **PeakFQ Results for the Upstream Site Boundary**

Annual Probability	Return Interval	Bull 17b	95% Confidence Intervals	
			Low	High
0.95	1.05	957	838	1069
0.9	1.1	1122	998	1240

Annual Probability	Return Interval	Bull 17b	95% Confidence Intervals	
			Low	High
0.8	1.25	1368	1238	1495
0.6667	1.5	1654	1515	1795
0.5	2	2029	1872	2199
0.4292	2.33	2212	2042	2401
0.2	5	3072	2813	3393
0.1	10	3847	3477	4333
0.04	25	4922	4367	5685
0.02	50	5791	5069	6812
0.01	100	6719	5805	8042
0.005	200	7713	6580	9386
0.002	500	9141	7675	11360

3.3.4 Design Flows

In addition to an evaluation of the flow hydrograph in the project reach, a key outcome was a determination of design flows relating to key periods of salmonid use in the project reach. Winter and summer rearing were identified as the target life stages (Figure 3-5). The proposed design flows are listed in Table 3-4, and the subsequent text provides the supporting rationale.

Table 3-4 Design Flows for the Upstream Project Boundary (RM 146.1)

Design Flow Description	Flow (cfs)	Exceedance Statistic
Low Flow (Winter and Summer)	18	95% exceedance for critical winter rearing period (October-March). 50% exceedance flow for August
Winter median flow	82	50% exceedance for critical winter rearing period (Oct.-Mar.).
Median March flow	400	Approximately the 50% exceedance flow for March.
Winter high flow	900	5% exceedance for critical winter rearing period (Oct.-Mar.)

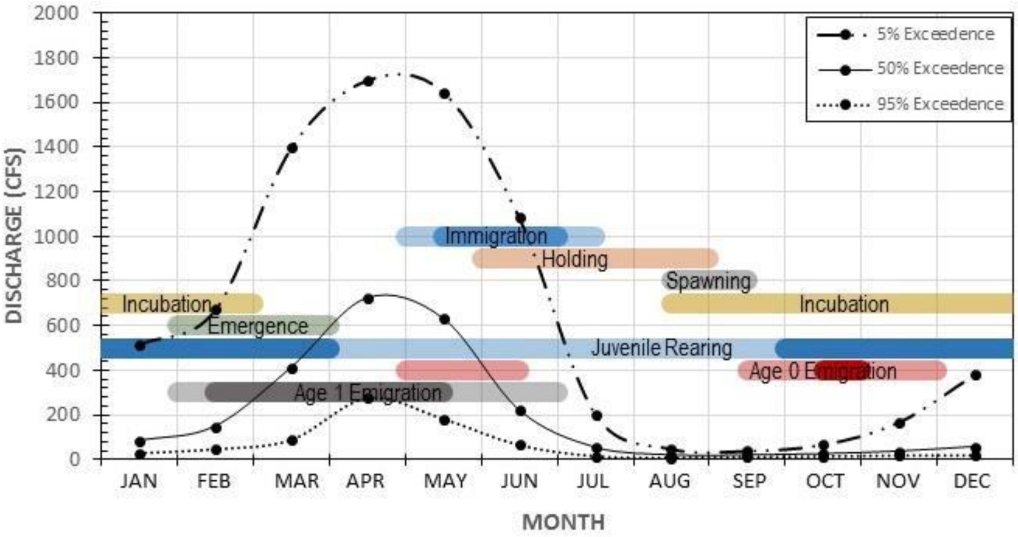
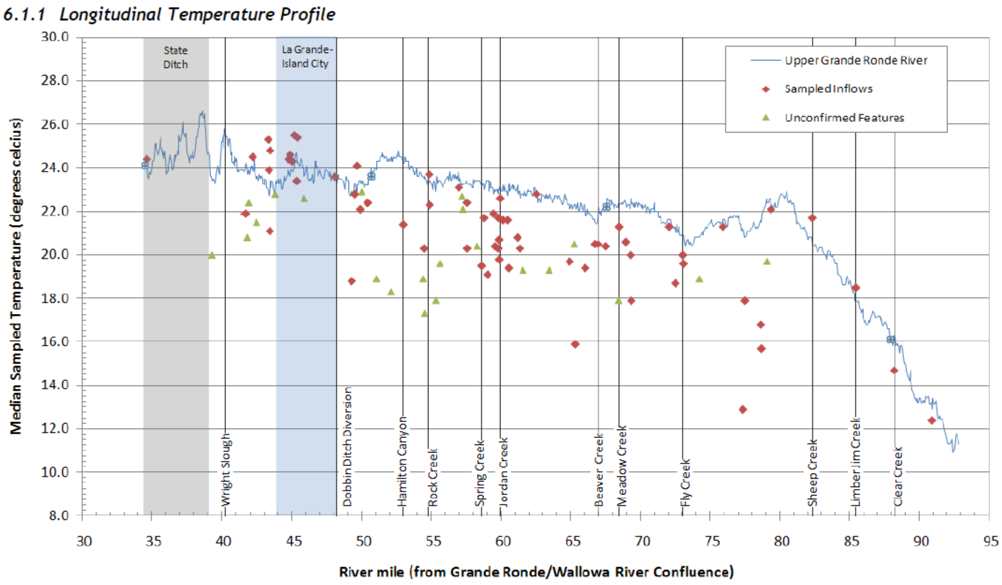


Figure 3-5 **Annual hydrograph at the upstream end of the project reach (RM 146.1). Fish periodicity data generated in the Atlas Process are shown. Darker portions of fish periodicity bands show the critical period and lighter bands show secondary periods of a given life stage.**

3.3.5 Water Quality and Temperature

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

As part of a larger project in the Upper Grande Ronde Subbasin, Watershed Sciences, Inc. (WSI 2010) collected thermal infrared (TIR) in August 2010 from Fly Creek downstream to Hamilton Canyon, which brackets the Project reach. These data, described in more detail in Appendix D, illustrate the location and thermal influence of point sources, tributaries and surface springs at that time. Observations by WSI indicate bulk water temperature gradually increase along the Grande Ronde River from Fly Creek confluence to Hamilton Canyon from 69°F to 77°F. The Project reach contains a concentration of cooler water influences (Figure 3-6). Table 3-5 contains the locations (downstream to upstream) of surface water influences on the mainstem. Note the concentrated cluster of cooler water inputs to the mainstem as compared to the rest of the Upper Grande Ronde River. These cool water influences are what would be expected based on the structural geology of the Project reach.



Source: CRITFC/Watershed Sciences 2010

Figure 3-6 **Upper Grande Ronde River longitudinal Temperature Profile and Location of Project Reach (WSI 2010).**

Table 3-5 **Thermal Relationship of Tributaries and Other Surface Inflows along Upper Grande Ronde River in August 2010**

	River Mile	Tributary Temp (°C)	Mainstem Temp (°C)	Thermal Difference
Spring Creek (L)	58.60	19.5	23.2	-3.7
Unnamed (R)	58.76	21.7	23.3	-1.6
Hyporheic flow (R)	59.02	19.1	23.4	-4.3
Hyporheic flow (R)	59.45	21.9	23.1	-1.2
Unnamed (L)	59.57	20.4	23.0	-2.6
Seep (L)	59.78	20.3	22.8	-2.5
Seep (L)	59.81	21.7	23.0	-1.3
Seep (R)	59.84	20.7	23.0	-2.3
Seep (L)	59.85	19.8	23.1	-3.3
Jordan Creek (R)	59.92	22.6	23.0	-0.4
Seep (R)	60.11	21.6	23.2	-1.6
Side channel (R)	60.48	21.6	22.7	-1.1
Unnamed (R)	60.56	19.4	23.2	-3.8
Hyporheic flow (L)	61.17	20.8	23.2	-2.4
Spring (R)	61.35	20.3	22.8	-2.5
Side channel (L)	62.54	22.8	22.8	0.0

With left (L) or right (R) indicating bank designation (looking downstream)

Spring Creek was chosen as a reference point- it is located just downstream of the project reach so that river miles listed by Watershed Sciences, Inc. can be scaled to the Grande Ronde River's river miles used in other reports.

3.3.6 Surface Water Temperature Monitoring NEW

Surface water temperature studies can inform understanding of hyporheic exchange and its influence on spatial variation of surface temperature in a localized river reach. Thus, to inform Project design efforts, surface water field data collection was performed during the summer of 2016.

Goals for the data collection and analysis were to demonstrate the extreme amplitude of the daily (diurnal) temperature fluctuations that occur in the main channel surface water under existing conditions, along with the buffered signals that occur in areas influenced by hyporheic exchange (e.g. alcoves and side channels). As well, it was desired to locate potential zones of cold water refuge that may influence the Project design. Efforts at this stage would inform future, longer term surface water temperature studies which may help combine HSI mapping efforts with spatial temperature variation for optimized habitat design.

The surface water temperature data collection effort was twofold. Step one involved searching for sites with characteristics indicative of hyporheic return flow (e.g. crystal clear water, certain types of algae, and/or clean substrate). Such sites are often but no limited to alcoves or side channels. Surface water temperatures were then measured using handheld smartphone FLIR devices, and main channel areas were compared with potential hyporheic return flow areas (figure x1). The FLIR method was also used separately from the hyporheic character identification approach in the event areas lacked the physical characteristics identified.

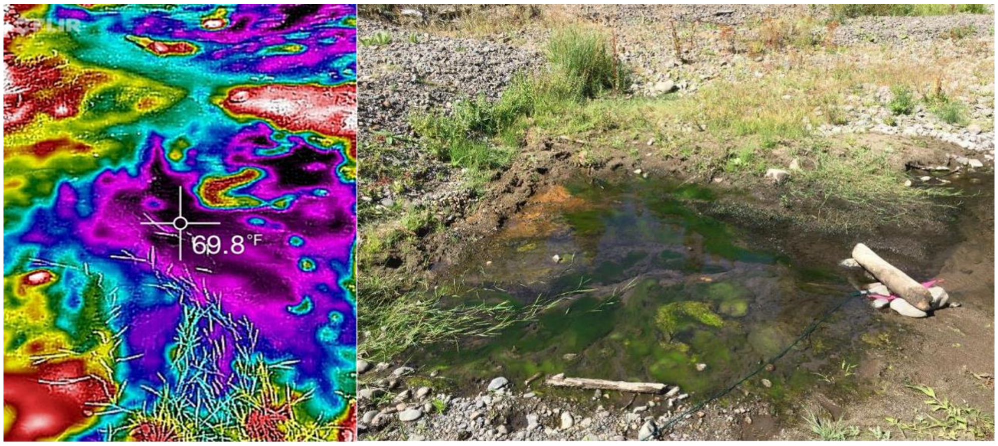


Figure x1 Measuring surface water temperature using handheld FLIR at a characteristic hyporheic return flow alcove location.

Locations with surface water temperatures differing by approximately 2 or more degrees Fahrenheit from the main channel were selected for the second step – placing surface water temperature data loggers. Time-series temperature data logging would allow comparison of the diurnal fluctuation of temperature between the main channel and alcoves or side channels. Figure x2 shows locations and names associated with the temperature data collected. Paired sensors were also placed in the main channel to allow comparison of diurnal signals.

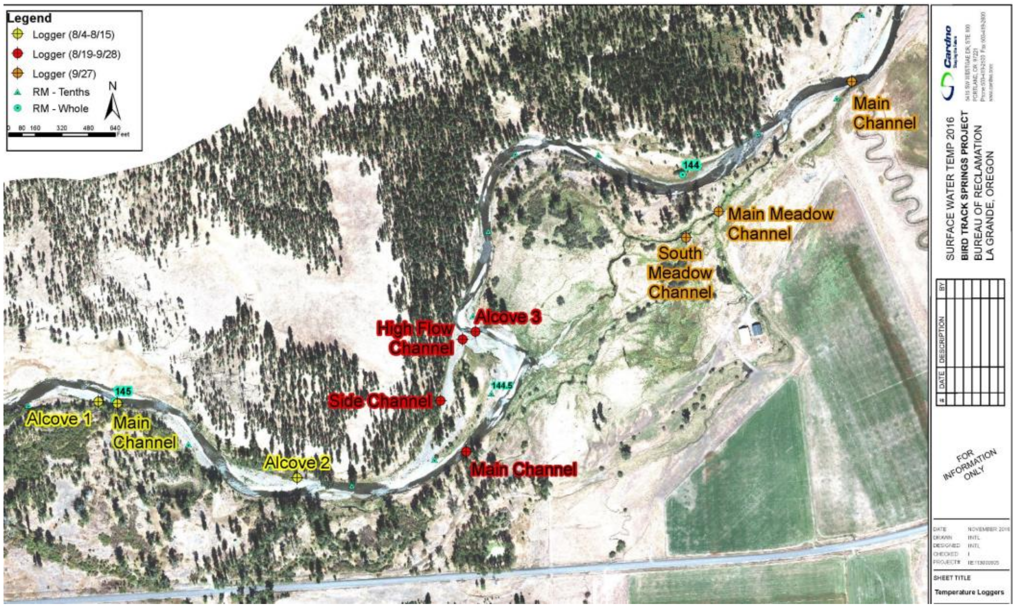


Figure x2 Map of 2016 surface water temperature data collection.

Two temperature logger deployment periods occurred during August and September, 2106. Plots of the collected data are shown in figures x3 and x4. Several interpretations can be made by visual examination of the diurnal signals. It is evident that some alcoves not only buffer high temperature variations that occur in the main channel but also have a reduced mean temperature during the period of data collection. With a bit more abstract view, one can see that the multi-day trend occurring in the main channel is not evident in some locations. This disconnect in longer term trend may be indicative of long residence times in the subsurface during hyporheic exchange or perhaps other influences on temperature such as groundwater inputs. Locations like the high flow channel that have virtually no diurnal signal may indicate areas with strong groundwater input (i.e. disconnected from hyporheic exchange) or having such long hyporheic residence times to buffer the diurnal fluctuations nearly entirely. Zones with high buffering (i.e. weak and/or lagged diurnal signals) indicate locations where design elements might focus on areas of temperature refuge.

A limiting factor in utilizing the presented temperature data for design is the length of record. A continuous record of multiple months if not seasons or years will provide greater understanding of the distribution of hyporheic exchange within the Project. As such, future surface water temperature monitoring plans have been proposed. These efforts, combined with the proposed groundwater monitoring plan presented later in this document will provide opportunities to understand hyporheic exchange and its influence on spatial variation in temperature within the Project. Proposed surface water temperature monitoring locations will be paired with and depend upon groundwater monitoring well locations. A more detailed surface water monitoring plan will follow installation of the groundwater monitoring wells. The combined monitoring results can then be overlain with HSI and life stages to utilize zones of buffered temperature to the maximum extent.

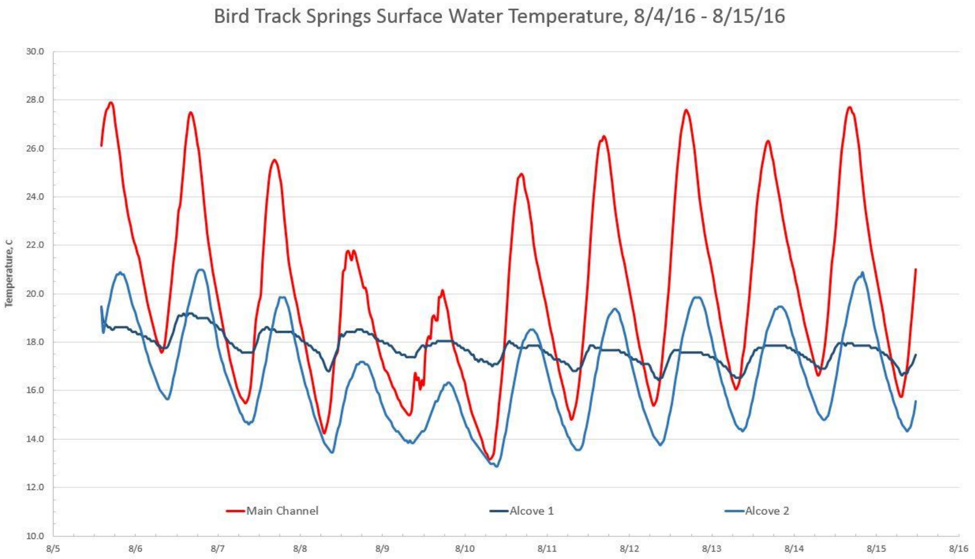


Figure x3 **Plot of surface water temperature data collection, August 2016.**

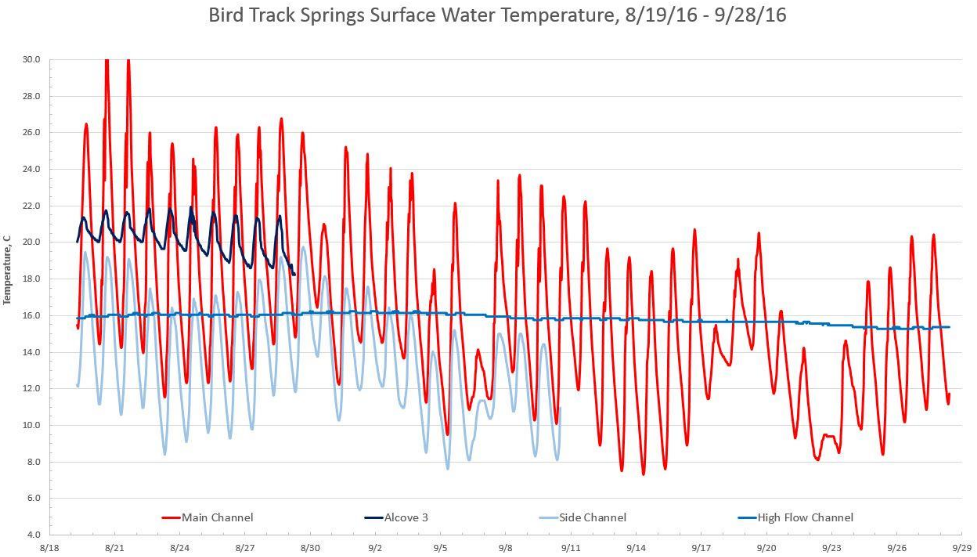


Figure x4 **Plot of surface water temperature data collection, August through September 2016.**

3.4 Groundwater Hydrology NEW

The following section briefly summarizes the groundwater evaluation portion of Appendix J, the Groundwater Evaluation & Monitoring Plan. A summary of the groundwater monitoring plan is summarized in Section 6.1.5.

Comment [VM2]: Comment on the use of non invasive methods to expand our understanding of the alluvial basin and groundwater system in the interim during 30% (while permission for monitoring wells is pending cultural clearances).

3.4.1 Geologic Structure/Groundwater Basins

The Upper Grande Ronde River Subbasin is located within the Blue Mountains physiographic province (Blue Mountains). The Project reach is located in the western uplands subregion of the Blue Mountains province, which includes all of the area drained by the Grande Ronde River upstream from Grande Ronde Valley. Topography of the Blue Mountains province is strongly controlled by geologic structure. The valley segment in which the Project reach is located from about Starkey (RM 152.3) to Hilgard (RM 138.9) along the upper Grande Ronde River. Geomorphic reaches along the main river valley alternate between bedrock/colluvial segments and alluvial segments. In bedrock/colluvial channel segments are laterally confined and higher gradient, whereas the alluvial channel segments are moderately-confined with lower gradient. The Project reach is atypical, as it displays an unconfined, low gradient, free-formed alluvial channel.

3.4.2 Hydrogeology

The *Upper Grande Ronde River Watershed Storage Feasibility Study* (Anderson Perry et al. 2013) includes information on the regional hydrogeology of the project area. The regional groundwater aquifer includes more or less disconnected shallow aquifers in alluvial sediments and a deep bedrock aquifers in Columbia River Basalt Group (CRBG). The younger alluvial sediments are those in the broader floodplain sections (e.g., the BTS reach) and near tributary confluences (e.g., Bear Creek, Jordan Creek). The bedrock aquifer in the CRBG is in excess of 2,000 feet thick, with more than 20 to 30 potential water-bearing zones. Moderate to high potential well yields have been reported in shallow units, and flowing artesian conditions are noted along both the main stem of the Grande Ronde and lower segments of tributaries.

3.4.3 Local Groundwater Basin

3.4.3.1 Aquifer Extent, Shape, and Thickness

Well logs from production wells in the vicinity of the Bear Creek subbasin show between 40 feet to over 100 feet of weakly cemented interbedded sandstone, siltstone, and gravel overlying basalt flows. The alluvial aquifer is in a veneer of fluvial deposits overlying much older sedimentary and volcanic rock within a shallow, fault-bounded structural basin.

A recent seismic refraction survey completed in August 2016 characterizes the alluvial stratigraphy and depth to bedrock along the Bird Track Springs and Longley Meadows project reaches (excluding Bear Creek Ranch). The survey was comprised of a series of cross-valley profiles spaced approximately 1000 feet apart (Figure 3.4-1). The survey mapped transitions from unconsolidated to consolidated sediment, and from consolidated sediment to bedrock. The geophysical report (Appendix K) details the methods and raw results along profiles; the general results are summarized below. Typical errors for the bedrock depth determinations are ±15% (Sage Geophysical, personal communication).

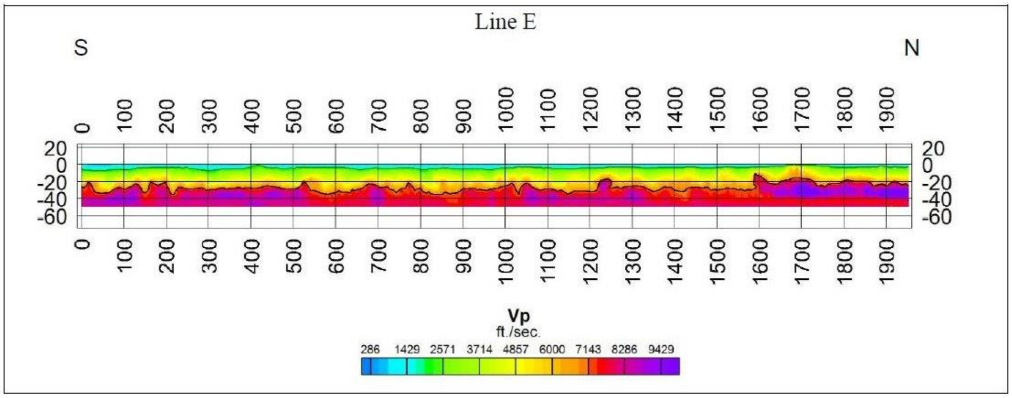


Figure 3.4-1. Geophysical profile along Line E located as shown in Figure 3.4-3

The geophysical survey results are summarized in a depth to bedrock map (Figure 3.4-2). and longitudinal valley profile (Figure 3.4-3). Unconsolidated sediment depths average approximately 3.5 feet across the site, whereas average depth to bedrock is 23 feet. The nature of the transition from unconsolidated to consolidated sediment is somewhat uncertain. The transition may correspond with a simple increase in the density of alluvium, but may also correspond with groundwater tables at the time of the geophysical survey (see geophysical report of typical velocities for dry versus saturated sand).

Depth to bedrock depths likely have greater implications for the project than thickness of unconsolidated alluvium, and is important for construction planning, as well as characterization of the alluvial aquifer geometry for the groundwater evaluation. Overall, the results suggest construction excavations are only likely to encounter bedrock along valley margins. Along the valley centerline, bedrock depth is expectedly least (averaging 17 feet in profiles A-C) in the more confined upper reaches of the BTS site. Downstream of profile C, depth to bedrock increases to 30 feet, with localized depressions in the bedrock exceeding 40 feet depth. Down-valley of profile D, depth to bedrock along the valley center consistently ranges from 23 to 28 feet. These depths compare reasonably well with depths to bedrock in groundwater supply wells on Bear Creek Ranch (12', 25', and 20' in OWRD well logs 52061, 52062, and 52063, respectively) (Table 2-1).

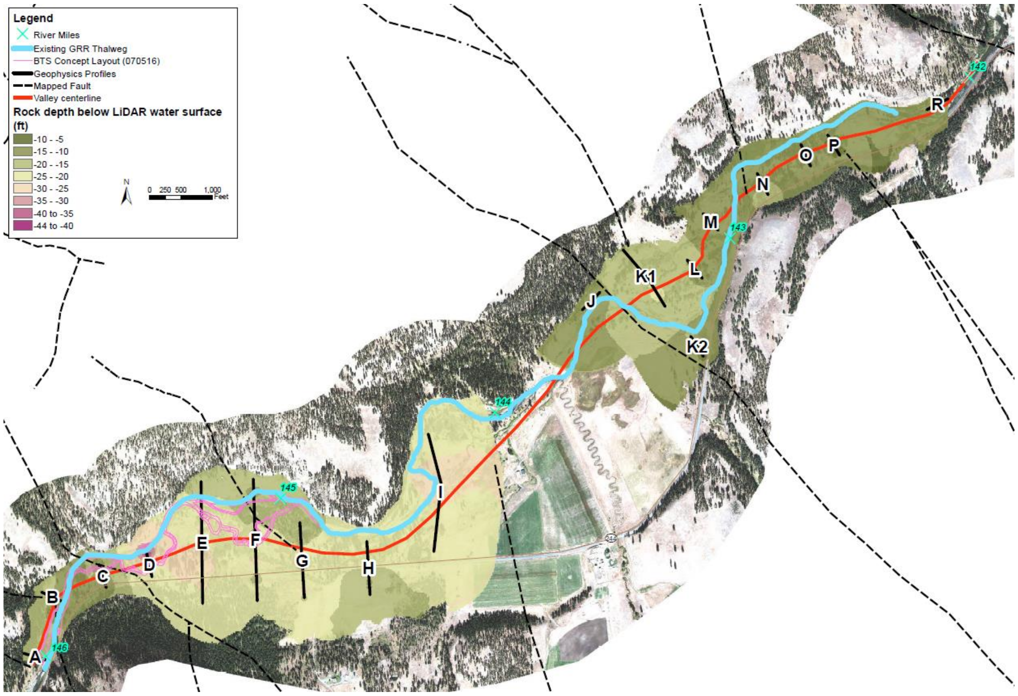


Figure 3.4-2. Map of geophysical profiles and interpolated depth to bedrock using an inverse distance weighting algorithm. To create a consistent along-valley datum, depth to bedrock is mapped relative to the LiDAR water surface elevation, in a similar manner to Height Above Water Surface (HAWS) maps of floodplain topography

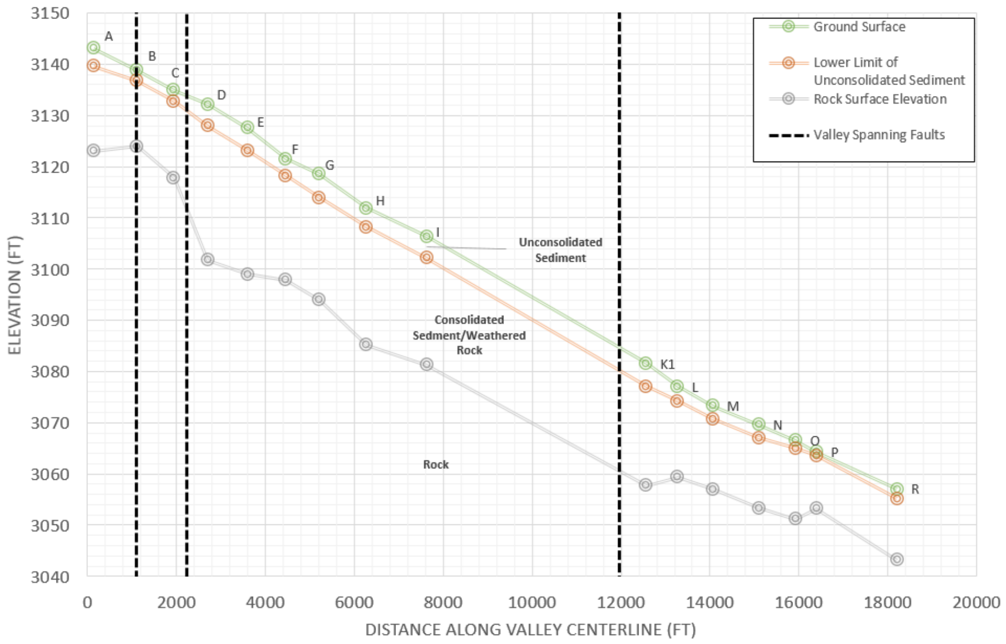


Figure 3.4-3 Valley-center profile view of geophysical results. Lettering labels seismic profile IDs. The profile shows the unconsolidated -consolidated sediment contact, and the consolidated sediment-bedrock contact. The data shown are averages of depths within 100 feet of the valley centerline. Note that profiles J and K2 are not shown due to their valley margin locations. Project reaches are shown along the X axis.

3.4.3.2 Alluvial Aquifer production

There are very few production wells in the alluvial aquifer, since the underlying deep aquifer is a more reliable, productive source for agricultural or domestic uses, but the well data available indicate low yields and low specific capacities (Anderson Perry et al. 2013). Data from a series of 17 observation wells placed along the Bear Creek restoration site by ODFW indicate water levels between 2 and 8 feet below the ground surface that vary seasonally. Surface water in Bear creek follows a similar trend, with seasonal dry-down, usually in late July or August, indicating a strong connection between groundwater in the alluvial aquifer and surface water in Bear Creek. There is no reason to believe that the alluvial aquifer and the Grande Ronde River in the restoration sites would not exhibit a similar coupling of groundwater and surface water elevation.

3.4.3.3 Temperature & Chemistry

At present there is no information on alluvial groundwater temperature and chemistry at the BTS site. The groundwater monitoring plan presented in Appendix J describes our strategy for a comprehensive campaign of hyporheic temperature data collection the framework for collecting chemistry data that should provide more comprehensive information of groundwater temperature and chemistry at the BTS site.

3.5 Wetlands NEW

A site specific wetland survey was conducted in June of 2016 to identify wetlands within the active project area. The survey identified three primary types of wetland resources, including Type 1) unvegetated riverine Other Waters (the GRR), Type 2) vegetated Other Waters (riparian corridor of the GRR) and Type 3) floodplain wetlands (floodplain/depressional wetlands). Table xx describes the wetlands mapped within the active project area and their corresponding Cowardin Classification.   Functions of these wetlands include protection and armoring of the banks of the GRR, mechanical filtration, chemical filtration, energy dissipation during high flow events, as well as a high capacity to support resident wildlife including fish, fish spawning, and fish rearing habitat. The Wetlands report is in prep and will be included with the 80% Basis of Design Report.

Table x **Field-mapped wetlands within the active project area.**

Type	Description	Acres	Description	Cowardin Classification
1	Unvegetated Riverine Other Waters	13.0	Located within the active channel of the GRR, below the field observed Ordinary High Water Mark (OHWM). All unvegetated areas within the OHWM were inundated by surface water. Classified as RIVERINE wetlands under the 2008 USDA hydrogeomorphic (HGM) wetland classification system (USDA 2008).	Unvegetated portions of the GRR would be classified as R3UB1H; Riverine (R) Upper Perennial (3) Unconsolidated Bottom (UB) Cobble-Gravel (1) Permanently Flooded (H). This area is located within the wetted portion of the river channel. Low, unvegetated mid-channel bars would also be classified at R3UB1 with a modifier of C, E, F, G H, or J (Seasonally Flooded, Seasonally Flooded/Saturated, Semi-permanently Flooded, Intermittently Exposed, Permanently Flooded or Intermittently Flooded).
2	Vegetated Other Waters	21.4	Herbaceous and shrub scrub wetland vegetation communities commonly colonized the low banks and water bars within the OHWM of the GRR. These areas were evaluated as potentially jurisdictional wetlands owing to the presence of established hydric vegetation and indicators of h All sites were located within the OHWM of the GRR, and showed primary indicators of hydrology such as surface water, high water table and/or saturation. Drift deposits and inundation visible on aerial imagery was also recorded. For the purposes of this delineation, Vegetated Other Waters were considered potentially jurisdictional wetlands based on a prevalence of semi-permanent wetland vegetation, frequent inundation and indicators of hydric soil. However, because these areas are within the OHWM, they are subject to fluvial processes such as frequent scour and deposition, and therefore could be considered transient communities. Classified as RIVERINE wetlands	Vegetated areas including the river margin and mid-channel or point bars were classified as Palustrine Emergent (PEM) or Palustrine Scrub-Shrub (PSS) based on predominance of shrub and/or herbaceous vegetation at each location. Modifiers for Water Regime would likely be Temporarily Flooded (A), Saturated (B) or Seasonally Flooded (C) based on the site specific water regime.

			under the 2008 USDA hydrogeomorphic (HGM) wetland classification system (USDA 2008).	
3	Floodplain Wetlands	12.2	Typically located on floodplain areas directly adjacent to the river corridor, and/or separated by an upland low terrace feature. Several wetland features were characterized by a linear, channel-like depression possibly derived from a relic (or current) flood channel. Not all wetland areas had a visible connection to the river, indicating that hydrology at these locations is driven by groundwater, rather than maintained by seasonal flood flows. In some cases, surface flow from the main river channel was observed, indicating that seasonal high flows are likely to migrate onto some floodplain areas occupied by wetlands. A linear, channel-like wet depression (the lowest point of each wetland area) holding surface water was observed frequently in most wetland areas. In all cases, wetland areas displayed indicators of vegetation, soils and hydrology. , These wetlands would be classified as DEPRESSIONAL wetlands under the HGM system (USDA 2008).	These adjacent or “flood-plain” wetlands are categorized as Palustrine Emergent (PEM), Palustrine Scrub-Shrub (PSS) or Palustrine Forested (PFO). If tree and shrub cover was greater than 30 percent, the wetland was classified as PSS, and otherwise PEM was assigned to reflect dominance by herbaceous (emergent) vegetation. Based on the prevalence of hydrophytic vegetation, and presence (or lack) of surface water present at each site (during the dry season), it is likely that these wetlands are best described as Temporarily Flooded (A), Saturated (B), Seasonally Flooded (C), Seasonally Flooded/Saturated (E) or F (Semi-permanently Flooded) (Cowardin et al. 1979).

3.6 Soils NEW

Soil descriptions and units are from the USDA Soil Survey report of Union County Area, Oregon (1985). Additional soil data is available for the US Forest Service system lands portion of the project, but was not used since that data was not available for the private land portion of the project and the USDA soil survey covers the entire project area.

The upland soils are generally derived from the underlying basalt bedrock or tuff deposits and recent deposits of volcanic ash. They tend to have steeper slopes and be moderately deep, moderately to well drained, and are used for wildlife habitat and timber production. The majority of the soils in the active project area in the Grande Ronde River valley bottom are deep to moderately deep, well drained soils that form in alluvial deposits. Their location in an active floodplain has subjected them to fluvial forces over time that tends to disrupt the soil-forming processes that creates the deeper soil horizons that typically form through erosion, sorting, and deposition.

The soil unit that comprises the majority of the active project area is Veazie-Voats complex (Unit 66, Figure 1). The complex is found on bottom lands and low stream terraces and has slopes of less than 3 percent. It consists of approximately 45 percent Veazie loam, 35 percent Voats fine sandy loam and 20 percent other soils. Both formed from basalt, andesite, or granite and are well drained. Permeability is moderate, runoff is slow, and the hazard of water erosion is slight. Both soil types are subject to flooding.

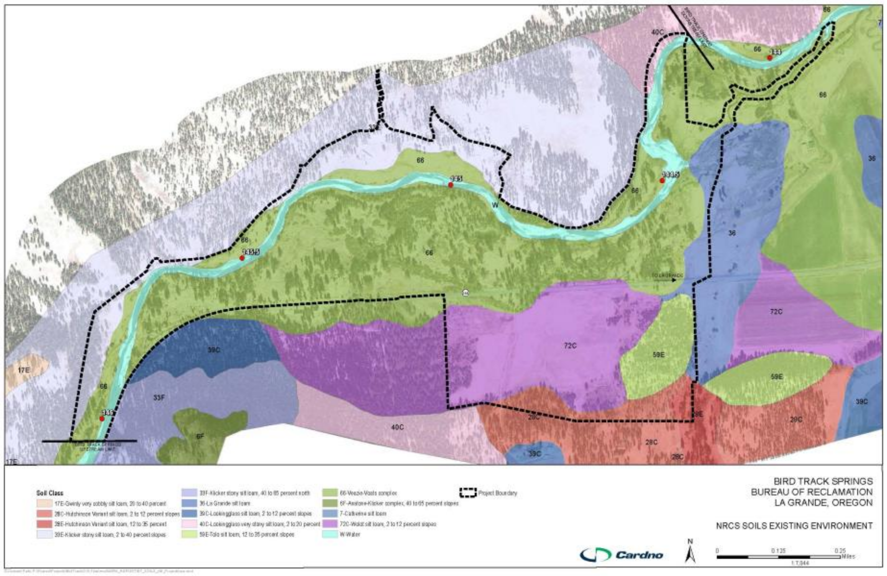


Figure 1. Active project area showing soil types.

Table 1 lists the soil types, acreages and features of the soils within the active project areas (Soils covering less than 1 percent of the active project area were not included in the table). None of the soils are hydric. The hydrologic soil group rating is based on the soil's runoff potential. Group A generally has the smallest runoff potential, and group D has the greatest.

Table 1. Soil types and characteristics for soils within the active project area.

Code	Name / Surface Texture	Slope (percent)	Drainage Class	Hydro-logic Soil Group	Erosion Potential	Acres	Percent
28C	Hutchinson Variant silt loam	2-12	Well	D	Slight to moderate	9.1	3
33E	Klicker stoney silt loam	2-40	Well	C	Slight to high	25.9	9
36	La Grande silt loam	0-2	Moderately well	C	Slight	8.8	3
59E	Tolo silt loam	12-35	Well	C	Moderate to high	13	4
66	Veazie-Voats complex - loam	0-3	Well	B	Low	154	53
72C	Wolot silt loam	2-12	Well	C	Slight to moderate	53.6	18
W	Water					24.5	8

3.7 Fish Biology

Within the Grande Ronde Subbasin, riparian and instream habitat degradation has negatively affected Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*O. mykiss*), bull trout (*Salvelinus confluentus*) and other sensitive aquatic species. Excess sediment, water temperature extremes, low stream flows and habitat quality and quantity are the most limiting for the salmonid populations. These habitat limitations are the result of several anthropogenic disturbances that include, but are not limited to: surface water diversions for agriculture, residential development, livestock grazing, hydraulic mining, logging and use of splash-dams, and road construction (NPCC 2004). Although some of these impacts occurred historically but are not longer ongoing, others are continuing, at least in portions of the subbasin.

Fish species of concern in the Upper Grande Ronde include:

- Snake River spring/summer-run Chinook salmon: ESA listed as Threatened April 22, 1992; reaffirmed June 28, 2005 and April 14, 2014. Critical habitat was designated December 28, 1993 and revised October 25, 1999.
- Snake River Basin steelhead: ESA listed as Threatened August 18, 1997, reaffirmed January 5, 2006 and updated on April 14, 2014, Critical Habitat was designated September 2, 2005.
- Columbia River bull trout: ESA listed as Threatened, June 10, 1998, Critical Habitat was designated September 30, 2010.
- Redband trout (*O. mykiss gibbsi*) are present in the Upper Grande Ronde Subbasin and are listed as a sensitive species by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS).
- Pacific lamprey (*Lampetra tridentate*) were historically present, current remnant populations may persist but distribution and abundance is unknown. They are listed as a sensitive species by the USFWS and NMFS.

3.7.1 Fish Usage by Life Stages

Focal species for the Bird Track Springs Fish Habitat Enhancement Project are Chinook salmon and steelhead, however, bull trout and other aquatic species are also expected to benefit from the proposed habitat actions. Additional information for each of the ESA listed species and their current use of the Project reach is provided below.

3.7.1.1 Upper Grande Ronde Spring Chinook Salmon

In general, adult spring Chinook salmon return to their natal streams to spawn from ages 3 to 6, after they've spent 1 to 4 years in the ocean. The Grande Ronde adults begin their upstream migration in early spring and enter the Columbia Basin in April and May (ODFW et al. 1990). They then proceeded upstream to their natal tributaries where they hold from June through August and spawn from August through September. Their eggs are deposited as redds in the gravel beds where they incubate over the winter and emerge as fry between March and May. The Upper Grande Ronde spring Chinook salmon juveniles typically rear in the Grande Ronde Subbasin for one year before migrating to the ocean as smolts from March through May. However, some juveniles will begin their downstream migration from June through October, and will continue to rear in freshwater until they smolt the following spring.

Chinook life stage utilization within the Project reach, as determined during the UGR Atlas Process, is provided in Table 3-6.

Table 3-6 Chinook Life Stage Utilization

Life Stage	Timing	Utilization^1	Notes
Adult Immigration	May through mid-July	High	No passage barriers but

			high temperatures affecting immigration, especially late arrivals.
Adult Holding	June through August	High	Adult holding questionable due to high temperature. Significant pre-spawn mortality in this reach. Unclear on where they hold. Literature states they dropback to spawn - hold upstream.
Spawning / Incubation / Emergence	Mid-August through March	High	
Juvenile Emigration	Age 0: May through mid-June/mid-September through November Age 1:Feburary through June	Low	
Summer Rearing	June through September	High	
Winter Rearing	October through May	High	

[1]High – Critical life stage use in need of immediate action for salmonid population performance
Medium – Life stage use that is import to the long term salmonid population performance
Low – Life stage use that is minimally affected by existing conditions

3.7.1.2 Upper Grande Ronde Steelhead

Steelhead are capable of spawning more than once before death, but rarely spawn more than twice before dying (Nickelson et al. 1992). Adult steelhead enter tributaries weeks to months before they spawn, preferring clear, cool streams with suitable gravel sizes and flow velocities. Grande Ronde adults begin their upstream migration in early spring and pass Bonneville Dam in July and John Day Dam in August. The adults swim upstream to their natal tributaries where they begin holding from June through October. Most adult steelhead enter the Lower Grande Ronde River September through March with spawning occurring from March through mid-June (SPCC 2014). Their eggs are deposited in the gravel beds where they incubate for about 1.5 to 4 months depending on water temperatures before they emerge. The juveniles rear in freshwater from one to four years. During the summer, rearing young-of-the-year juveniles tend to be denser in glides and riffles, whereas the older juveniles tend to be denser in the faster parts of pools. In the winter rearing juveniles tend to disperse across a range of fast and slow water habitats. A smaller percentage of older juveniles migrate downstream to rear in larger tributaries and rivers (Nickelson et al., 1992). The most productive steelhead habitats are characterized by instream large and small wood accumulations that create diverse and complex hydraulic conditions.

Steelhead life stage utilization within the Project reach, as determined during the UGR Atlas Process, is provided in Table 3-7.

Table 3-7 Steelhead Life Stage Utilization

Life Stage	Timing	Utilization[2]	Notes
Adult Immigration	Mid-February through May	Low	
Adult Holding	Mid-February through May	Low	Adults typically do not hold in the Upper Grande Ronde River. They tend to

			quickly migrate, spawn then leave.
Spawning / Incubation / Emergence	N/A[1]	Low	
Juvenile Emigration	February through June/mid-September through mid-November	Low	
Summer Rearing	June through September	High	
Winter Rearing	October through May	High	

[1] timeframe not identified in the Atlas Fish Periodicity worksheet

[2]High – Critical life stage use in need of immediate action for salmonid population performance

Medium – Life stage use that is import to the long term salmonid population performance

Low – Life stage use that is minimally affected by existing conditions

3.7.1.3 Grande Ronde Bull Trout

Grande Ronde bull trout exhibit two distinct life history forms. Fluvial bull trout mature in their natal stream and then migrate to larger streams or rivers where they can grow quite large, whereas resident bull trout spend their lives in their natal streams or small tributaries at higher elevations and remain smaller in size.

Fluvial bull trout can move in and out of the Grande Ronde Subbasin from the lower Snake River, and are also able to move throughout the Grande Ronde Subbasin during fall, winter, and spring. However, warm water temperatures and low flows in the mainstem Grande Ronde during the summer months can limit their movements thus reducing population connectivity.

Bull trout sexually mature after about four years and can live up to ten years. Adults can withstand water temperatures of up to 64°F, but prefer much cooler water temperatures. Adults spawn every year or every other year, and they require cold water streams with suitable gravel sizes that are silt-free. Spawning usually takes place in the tributaries and headwater areas from late July to September, spawning success is strongly influenced by water temperatures and siltation that can significantly decrease egg survival. Bull trout eggs do best with water temperatures around 36°F, and their survival rates dramatically decrease with increasing water temperatures. For example, water temperatures up to 46°F can reduce egg survival by at least 75 percent. Following emergence, the juveniles typically rear in the cooler waters found in the tributaries and headwater areas.

Bull trout life stage utilization within the Project reach, as determined during the UGR Atlas Process, is provided in Table 3-8.

Table 3-8 Bull Trout Life Stage Utilization

Life Stage	Timing	Utilization[1]	Notes
Adult Immigration	Mid-March through June/mid-September through mid-December	Medium	No passage barriers but high temperatures affecting immigration.
Adult Holding	October through mid-June	Low	
Spawning / Incubation / Emergence	N/A	N/A	
Juvenile Emigration	October though	Low	
Summer Rearing	NA	N/A	No current summer rearing due to high temps
Winter Rearing	October through mid-June	Medium	

[1] High – Critical life stage use in need of immediate action for salmonid population performance
Medium – Life stage use that is import to the long term salmonid population performance
Low – Life stage use that is minimally affected by existing conditions
N/A Life state does not utilize the area

3.7.2 Fish Flows (Passage, Usages)

Low and high fish passage discharges were computed based upon NMFS (2011) for the fish passage season based on the fish periodicity chart (Figure 3-8). Guidance for fish passage structures requires exceedance probabilities for low flow to be the 95% condition and for high flow to be the 5% exceedance condition.

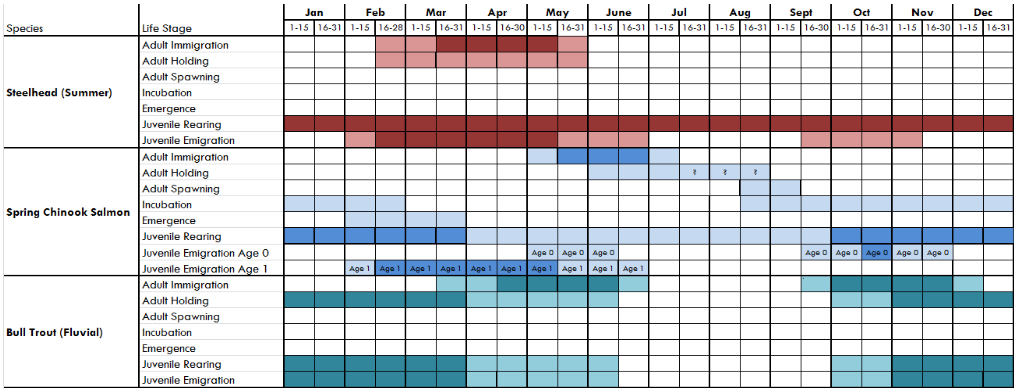


Figure 3-8 Fish Periodicity in the Project Area (Source: Atlas 2016)

3.8 Topography and Property Boundaries NEW

3.8.1 Topography

3.8.1.1 Land Surface

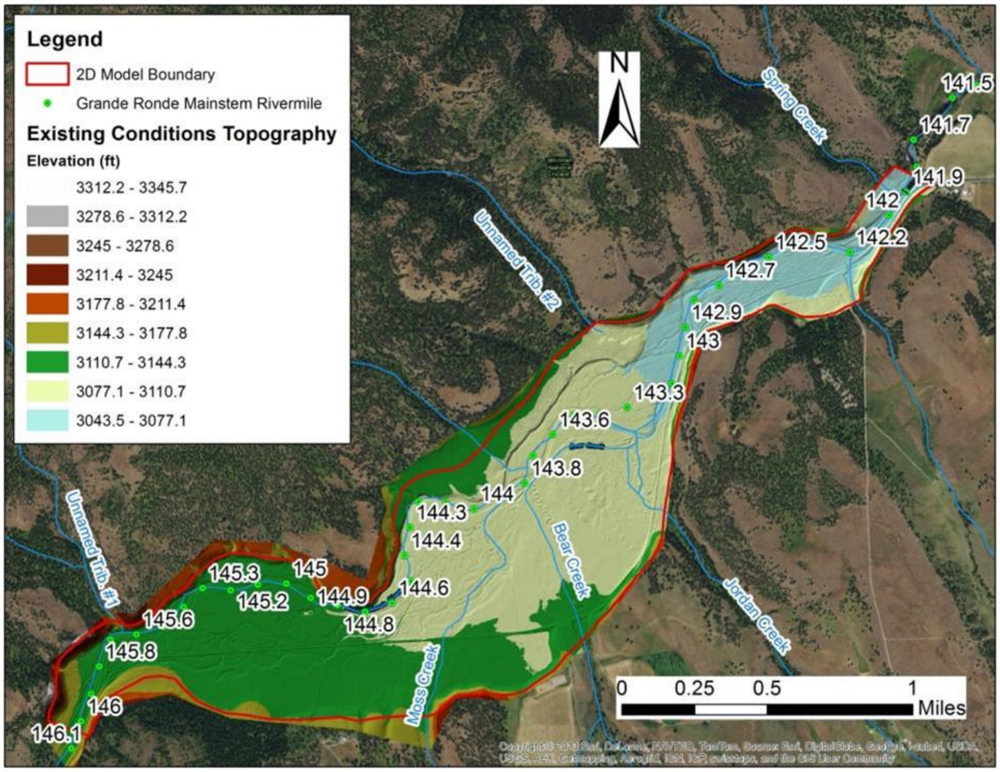
The physical foundation for the hydraulic models is the topographic dataset, particularly the river bed and river bank topography as shown in Figure 3-11. The Project Area topography is based on a combination of LiDAR and land survey points. The LiDAR surface was merged with the land survey points to build a final digital elevation model (DEM) reflecting the present topographic and bathymetric conditions. This final DEM was used to develop the cross sections used in the one-dimensional HEC-RAS model and the surface mesh used for the two-dimensional model.

The existing conditions topography (in TIN format) included Light Detection and Ranging (LiDAR) data collected in April 2013 within the floodplain area (Woolpert and WSI, 2013), and on-the-ground Global Positioning System (GPS) channel survey data collected by Anderson Perry and Associates (AP) from August 2014 through April 2015. Additional GPS survey has been collected by RTS staff in 2015 and 2016. Survey is an ongoing activity and the current status is summarized Table XX.

Table XXX Summary of On-the-Ground GPS Survey Data

Survey Date	Survey Data Source	Comments
April 15, 2015	Anderson Perry & Associates, Inc.	Set primary control, topographic survey, and channel bathymetry throughout project. Post processed data and made primary surface
October 1, 2015	Reclamation-River Systems Group	High water mark survey for hydraulic model calibration
November 4, 2015	Reclamation-Design Group	Topographic survey in Spring Creek Area (Longley Meadows)
February 16, 2016	Reclamation-River Systems Group	Water Surface Elevation survey during flow measurement activities for hydraulic model calibration.
April 28, 2016	Reclamation-River Systems Group	Water Surface Elevation survey during flow measurement activities for hydraulic model calibration.
June 9, 2016	Reclamation-River Systems Group and Design Group	Surveyed trees, topo on Jordan Creek Ranch Corral area, interpretive trails on USFS, and stakeout of proposed channel alignments. Field verification and adjustment of channel alignments.
September 26, 2016	Reclamation-River Systems Group and Design Group	Surveyed bathymetry in key areas of main channel where proposed alignment leaves/enters existing main channel. Surveyed Bear Creek Ranch Side channel bathymetry and floodplain to update topography changes. Surveyed long profile of bed elevation of Bear Creek Ranch Side Channel.
November 1, 2016	CTUIR	Surveyed additional bathymetry in main channel near Bear Creek Ranch Side Channel Entrance.

The horizontal datum for topography is based on the State Plane Oregon Coordinate System – North Zone NAD83 (2011) Epoch 2010, expressed in international feet, with reference to the NGS CORS control network. The vertical datum is represented in North American Vertical Datum (NAVD) 88 as determined by reference to NGS CORS station OPUS positions using GEOID 12a geoid model to determine orthometric (ground) elevations.



Source: TSC report May 5 2016 (Appendix E)

Figure 3-11 Existing Topography

3.8.2 Property Boundaries

Project Boundaries at this time are represented using the Union County Oregon Assessor's Tax Lot Parcels from their GIS server. The following properties were identified in the project area: Wallowa-Whitman National Forest, Oregon Department of Transportation, Oregon Department of Parks and Recreation, La Grande Rifle Club, Lowe Family Ranch LLC, and Bear Creek Ranch Quarter Horses. The survey control monuments in the Project reach are shown on the construction drawings as established by Anderson Perry & Associates.

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4 Existing Conditions and Alternatives Modeling

Chapter 4 of the 15% BDR described the 2D and 1D hydraulic modeling efforts completed in support of concept design and alternatives evaluation. To focus the review of this document on efforts completed between the 15 and 30% milestones, the discussion of the preliminary modeling efforts have been removed. If necessary, the data for the 2D and 1D modeling efforts are reported in Appendix F and E, respectively.

5 Conceptual Design and Alternatives Screening

The Conceptual Design and Alternatives Screening has not been updated from the 15% report, it is retained here for context.

5.1 Conceptual Design

Two conceptual (~15%) designs were developed for the BTS project during preliminary planning, refined via field visits in the summer and fall of 2015, and updated in December 2015. Both concept alternatives were developed to address the same project goals, key objectives, and applying the same biological design flow considerations (Table 5-1). The following descriptions reflect the version of these concepts at the time of the Kickoff Meeting February 2016 that were analyzed in the screening process described in the following section.

Table 5-1 Bird Track Springs Fish Habitat Design Flows

Design Flow Description	Flow (cfs)	Exceedance Statistics
Low Flow (Winter and Summer)	18	95% exceedance for critical winter rearing period (October-March). 50% exceedance flow for August
Winter Median Flow	82	50% exceedance for critical winter rearing period (Oct.-Mar.).
Median March Flow	400	Approximately the 50% exceedance flow for March.
Winter High Flow	900	5% exceedance for critical winter rearing period (Oct.-Mar.)

Source: Refer to Hydrology Appendix (Appendix C).

5.1.1 In-stream Treatment Alternative

The Instream Treatment alternative would install Large Wood Structures in the mainstem channel to restart geomorphic processes to form bars and increase overbank flooding and side channel activation (Figure 5-1). Additionally, this alternative would remove all or portions of some of the artificial barriers and constrictions on the floodplain (abandoned railroad grade/berms and other fill material from discontinued land uses).

5.1.2 Channel Reconstruction Alternative

The Channel Reconstruction alternative would excavate new main channel segments, and construct and/or partially excavate portions of remnant channels on the floodplain to create functional side channels to increase overbanking, and the length and frequency of activated side channels (Figure 5-2).

Additionally, this alternative would remove all or portions of some of the artificial barriers and constrictions on the floodplain (abandoned railroad grade/berms and other fill material from discontinued land uses).

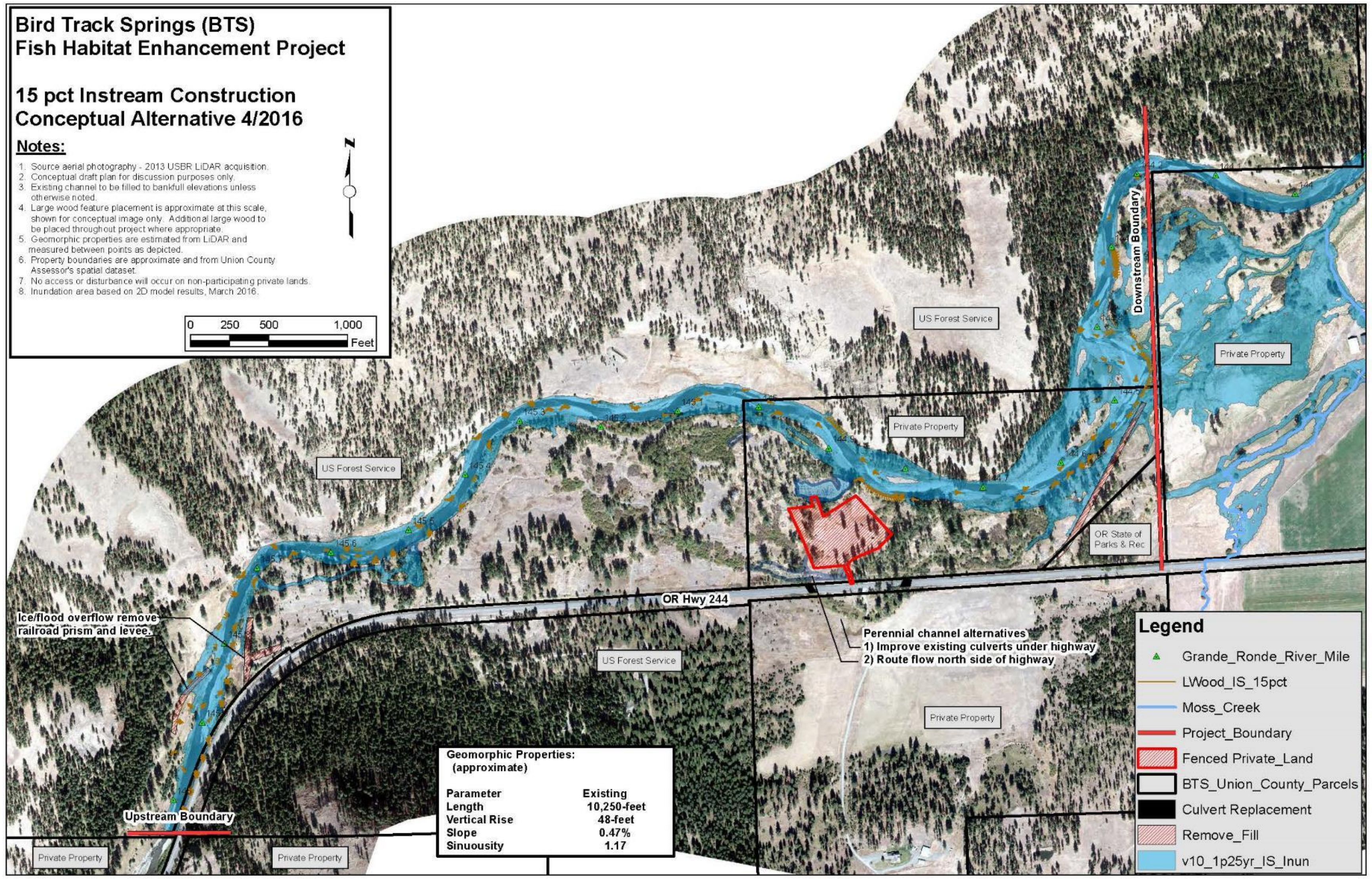


Figure 5-1 **Instream Treatment Concept Alternative**

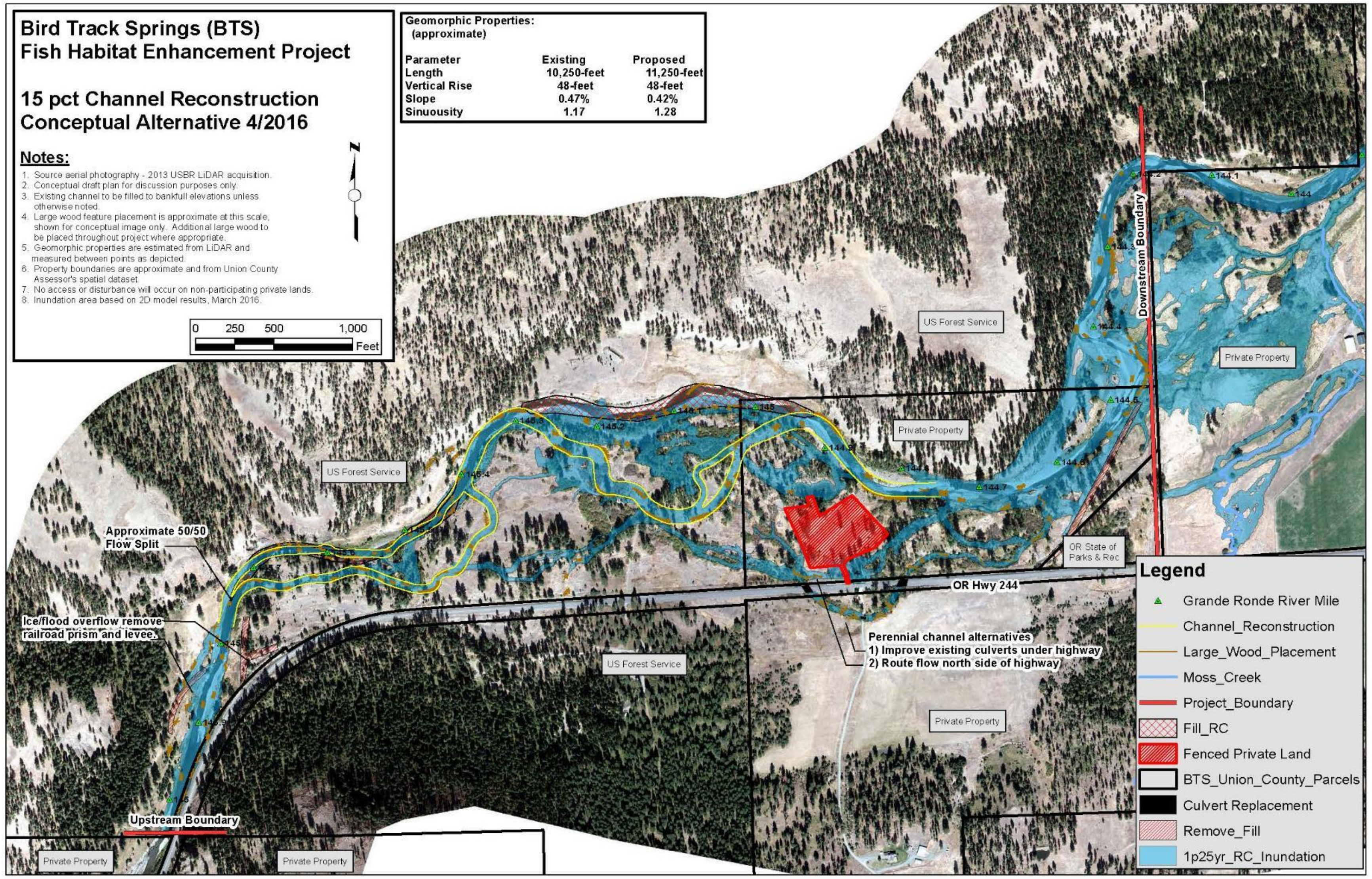


Figure 5-2 Channel Reconstruction Concept Alternative

5.2 Alternatives Screening

The alternatives screening process and results described below are the steps used to support selection of a preferred conceptual (~15 percent) design to move forward into the 30 percent level of detail. The criteria, metrics and methods applied during this initial screening are expected to be modified for application later in design development. Additional screening criteria, metrics and/or the level of detail for particular metrics would be employed. Particular design targets, risks or environmental impacts to minimize, and/or cost indicators could be incorporated in the matrix at future points for design decisions.

5.2.1 Screening Criteria and Matrix

For equitable comparison of the Conceptual Designs, it is assumed that each of the action alternatives are technically feasible and that their range of risks and order-of-magnitude costs would not constitute fatal flaws.

The emphasis for screening criteria useful this level of detail are to ensure the criteria:

> Include important driving processes

> Link to all key Goals and Objectives

> Distinguish between Alternatives

> Allow additional detail for future levels of BTS design

> Can be adapted for use in Project Area 2 (Longley Meadows)

In particular, it is crucial that parameters representing the driving processes of interest for design are part of the screening:

> Change the geomorphic planform from single-thread to ‘island-braided’

> Wet the alluvial valley fill at greater frequency and for longer durations

> Increase the connectivity and availability of active side channels

> Develop thermal refuge locations

> Increase the complexity and dynamics of the channel system

> Manage ice processes and effects

Each of the selected criterion are linked to at least one of the project objectives. Some criteria have an influence on various objectives, and some objectives are assessed by a combination of multiple criteria. These relationships and the relative importance of each criterion as an indicator for alternatives’ performance on individual objectives is expressed by weighting (Table 5-2).

Table 5-2 Relationship of Screening Criteria to Objectives

Criteria	Key Goals and Objectives													
	Physical Condition and Habitat Attributes										Biologic Functions (Chinook)			
	Enhance	Mitigate	Expand	Increase	Improve	Moderate	Evolve	Diversify	Vary	Strengthen	Weighted Usable Area Uplift			
	Large Pool Habitat	Ice jam Processes	Peripheral Habitats	Hyporheic Connectivity	Riparian & Wetland Condition	Water Temperature	Channel Plan Form	Channel Bed Form	Bed Sediment Caliber	Bed Sediment Sorting	Juvenile Winter Rearing	Juvenile Emigration	Juvenile Summer Rearing	Adult Fish Use
Flood Prone Area					20									
Active Floodplain		20	20	25	20	10								
Channel Margin Inundation		30	20	25	30	20	20	30		20		20		
Active Winter Channel	40		30						20		10	10		
Winter Juvenile Chinook WUA											70	70		20
Summer Juvenile Chinook WUA													70	20
Channel and Hyporheic Complexity	20	30	30	50	30	50	40			30			20	40
Critical Streambed d50 Particle Size	20						20	20	80					
Critical Streambed d50 Particle Diversity	20	20				20	20	50		50	20		10	20
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Cells are shaded if the criteria is considered to contribute 30 percent of more of the effects on an objective.

The metrics chosen to represent each criterion (Table 5-3) emphasize parameters that can be reliably quantified using the available empirical inventory data, conceptual design features, and 1D and 2D numerical modeling outputs. These are metrics that can be applied to the existing condition and both action alternatives with relatively consistent, sensible assumptions. The metrics include parameters concerning in-channel hydraulics, out-of-bank inundation, and aquatic habitat quality and quantity.

Table 5-3 Screening Criteria and Metrics

15% Level Screening Criteria	Definition of Metric	Units
Flood Prone Area	Area inundated under the 10-year peak flow	acres
Active Floodplain	Area inundated under the 2-year peak flow	acres
Channel Margin Inundation	Incremental Wetted Area (1.25 yr > March median flow)	acres
Active Winter Channel	Length (one bank) of Wetted Channel(s) under March median	mi
Winter Juvenile Chinook WUA	HSI of the 2D model output for the Low Flow using Favrot and Jonassan 2014 curves for depth and velocity	acres
Summer Juvenile Chinook WUA	HSI of the 2D model output for the Low Flow using Maret 2006 curves for depth and velocity	acres
Channel and Hyporheic Complexity	Channel Complexity Index = sinuosity for the active winter channel * (1+ intersection nodes at march median flow)	n
Critical Streambed d50 Particle Size	Average of critical d50 within the March median channel and flow	mm
Critical Streambed d50 Particle Diversity	Coefficient of Variation of critical d50 within the March median flow channel and flow	n

5.2.2 Screening Methods and Results

Results of the screening analysis for the action alternatives are summarized in Table 5-4. The methods used to quantify metrics, as well as the approach to estimate upper and lower boundaries of possible values are discussed below, organized by criterion. Quantification for nearly all of the screening criteria metrics is based on the 1D and 2D hydraulic modeling, using direct or processed output. Results for the existing and proposed conditions, if not presented below for ease of comparison, are cross-referenced back to Chapter 3, above.

In addition to the existing conditions (which represents the immediate "No Action Alternative"), the channel hydraulics for the two conceptual designs was modeled by Cardno with 1D modeling (HEC-RAS) and by Reclamation with 2D hydraulic modeling (SRH2D). Consistent geographic boundaries for the BTS project reach were applied to measurements of areas and lengths for quantitative metrics comparing the existing conditions and action alternatives. All areas and lengths mentioned below were determined in Civil 3D and/or ArcGIS by analyzing the shapefiles generated as output from the hydraulic models.

Table 5-4 Screening Results Summary

Criteria	Units	Range of Conditions		Alternative		
		Lower Bound	Upper Bound	Existing/ No-Action	In-Channel	Re-Construction
Flood Prone Area	acres	0	134	69	128	115
Active Floodplain	acres	10	90	35	73	74
Channel Margin Inundation	acres	0	40	6	22	35
Active Winter Channel	mi	1.4	4.6	1.9	2.2	2.6
Winter Juvenile Chinook WUA	acres	0.2	2.1	0.3	0.4	1.1
Summer Juvenile Chinook WUA	acres	2.2	10.3	3.9	4.0	6.2
Channel and Hyporheic Complexity	n	1.0	26	1.1	1.1	6.2
Critical Streambed d50 Particle Size	mm	32.0	155	90.2	88.4	71.2
Critical Streambed d50 Particle Diversity	n	0	1.0	0.19	0.21	0.37

5.2.2.1 Flood Prone Area

The flood prone area criterion is represented as the area subject to inundation under the 10-year peak flow. This metric provides an indicator of the hydraulic and geomorphic processes associated with moderate magnitude, but relatively frequent flood events important to support riparian community structure, diversity, and patchiness. Larger and potentially deeper inundation for these events represent increased potential for side channel dynamics, floodplain scour and deposition. This criterion is the only one available to evaluate conditions relative to the “improve riparian & wetland condition” objective (Table 2-3).

Modeling of the hydraulic conditions under the two action alternatives used topography in TIN format and with the same datum and extent as for the existing conditions. The instream alternative topography added 108 large wood features along the banks and middle of the existing channel (Figure 5-3). The channel reconstruction alternative topography added split channels and realigned channel within the middle of the project area, but did not include large wood features within the realigned portions (Figure 5-4).

The upper bound for the flood prone area criterion was established by assuming that the existing 100-year floodplain (134.4 acres) would be the maximum area likely to be inundated during a 10-year event, even under improved floodplain connectivity. The lower bound for the flood prone area criterion was assumed to be an adverse outcome from continued channel degradation where flood conveyance capacity within the main channel would increase and the 10-year floodplain would decrease.

Both action alternatives have much larger flood prone areas than the existing conditions (Table 5-4), but there is little difference in area or distribution between the two action alternatives (Figure 5-5).

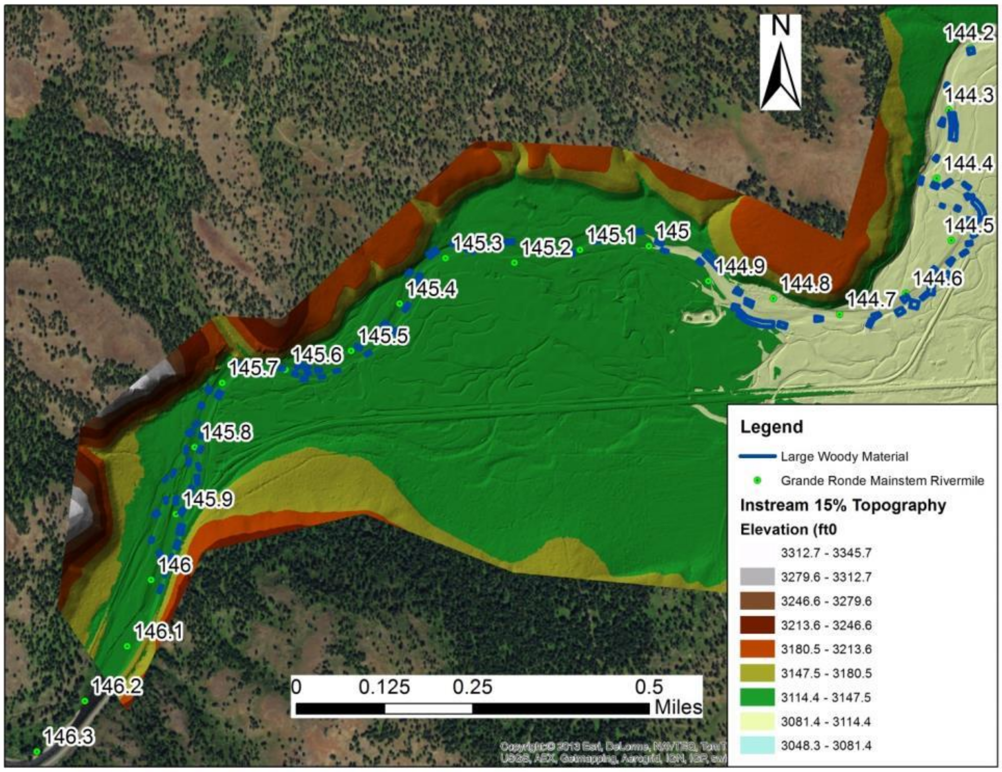


Figure 5-3 Model Topography for the Instream Alternative

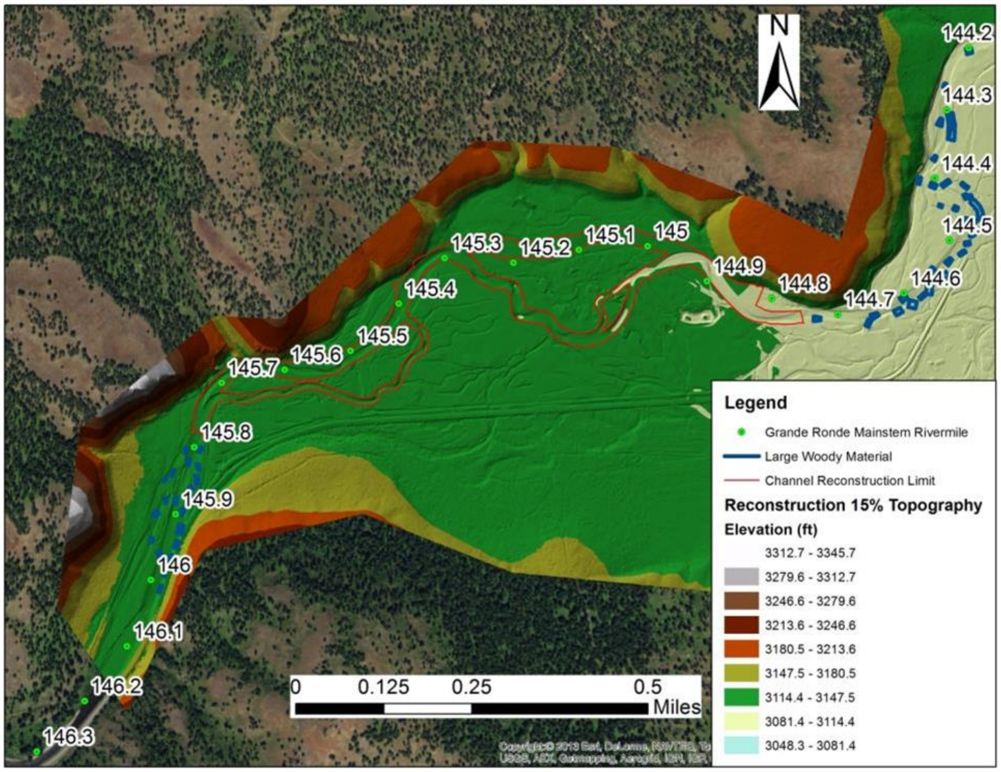


Figure 5-4 Model Topography for the Reconstruction Alternative

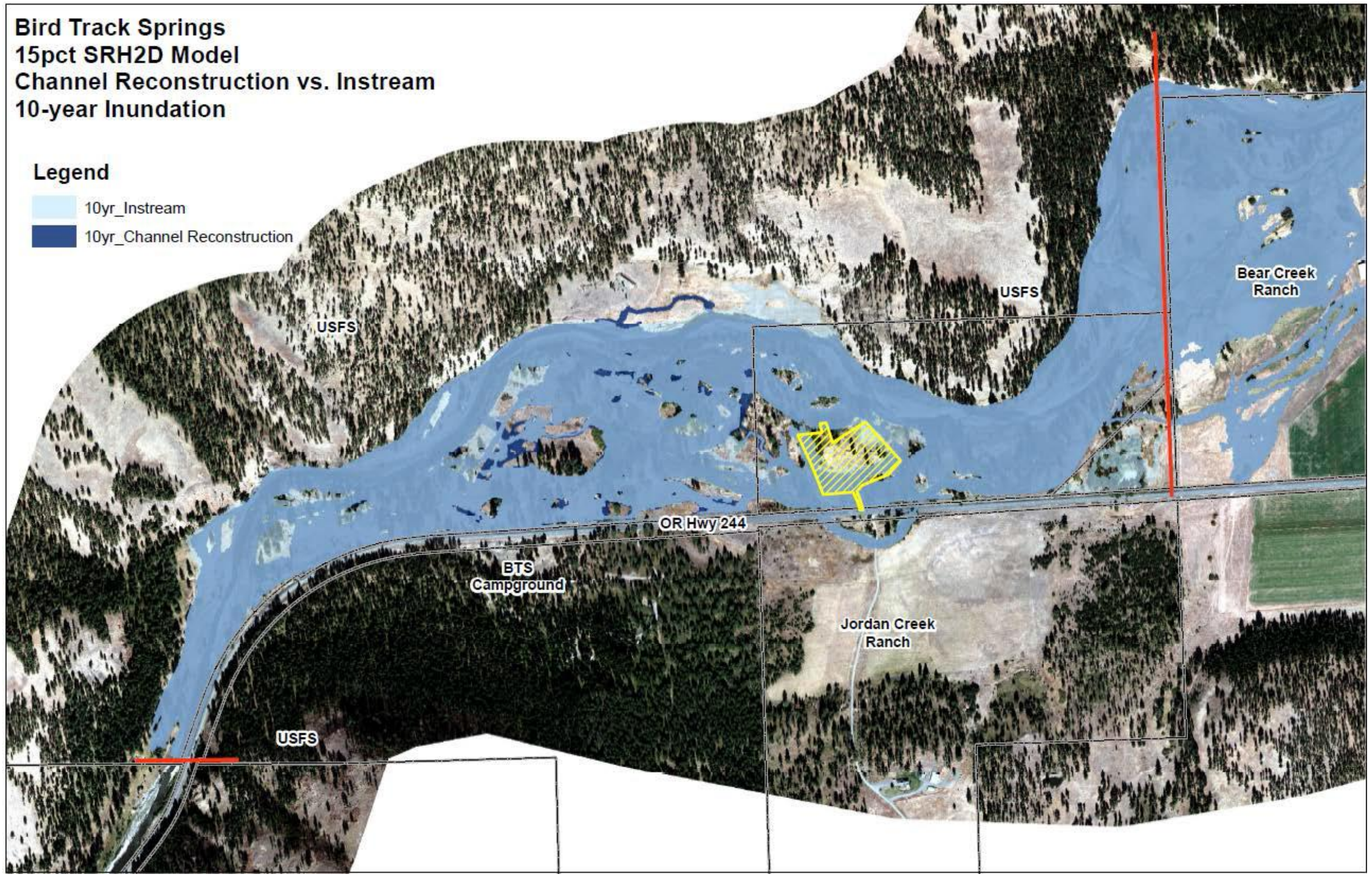


Figure 5-5 Flood Prone Area (10-year Event Inundation) under the Action Alternatives

5.2.2.2 Active Floodplain

The active floodplain criterion is represented as the area subject to inundation under the 2-year peak flow. This metric provides an indicator of the connectivity of the channel with its floodplain as well as the extent of inundation that would result from small magnitude, but frequent flood events, which are important to groundwater recharge, sustaining riparian vegetation, net deposition of fine sediment, and dissipation of ice jams. This criterion is used to evaluate conditions relative to several of the physical objectives (Table 5-4).

The upper bound for the active floodplain criterion was established by assuming that improved floodplain connectivity and overbanking frequency could only increase proportionally to the peak event discharges' relationships, which would be about 66 percent of the 100-year event (90 acres). The lower bound for the active floodplain criterion was assumed to be an adverse outcome from continued channel degradation where flood conveyance capacity within the main channel would increase and the 2-year floodplain would be reduced to just under half, to 10 acres.

The active floodplain areas for both action alternatives are more than twice as large as for the existing condition (Table 5-4).

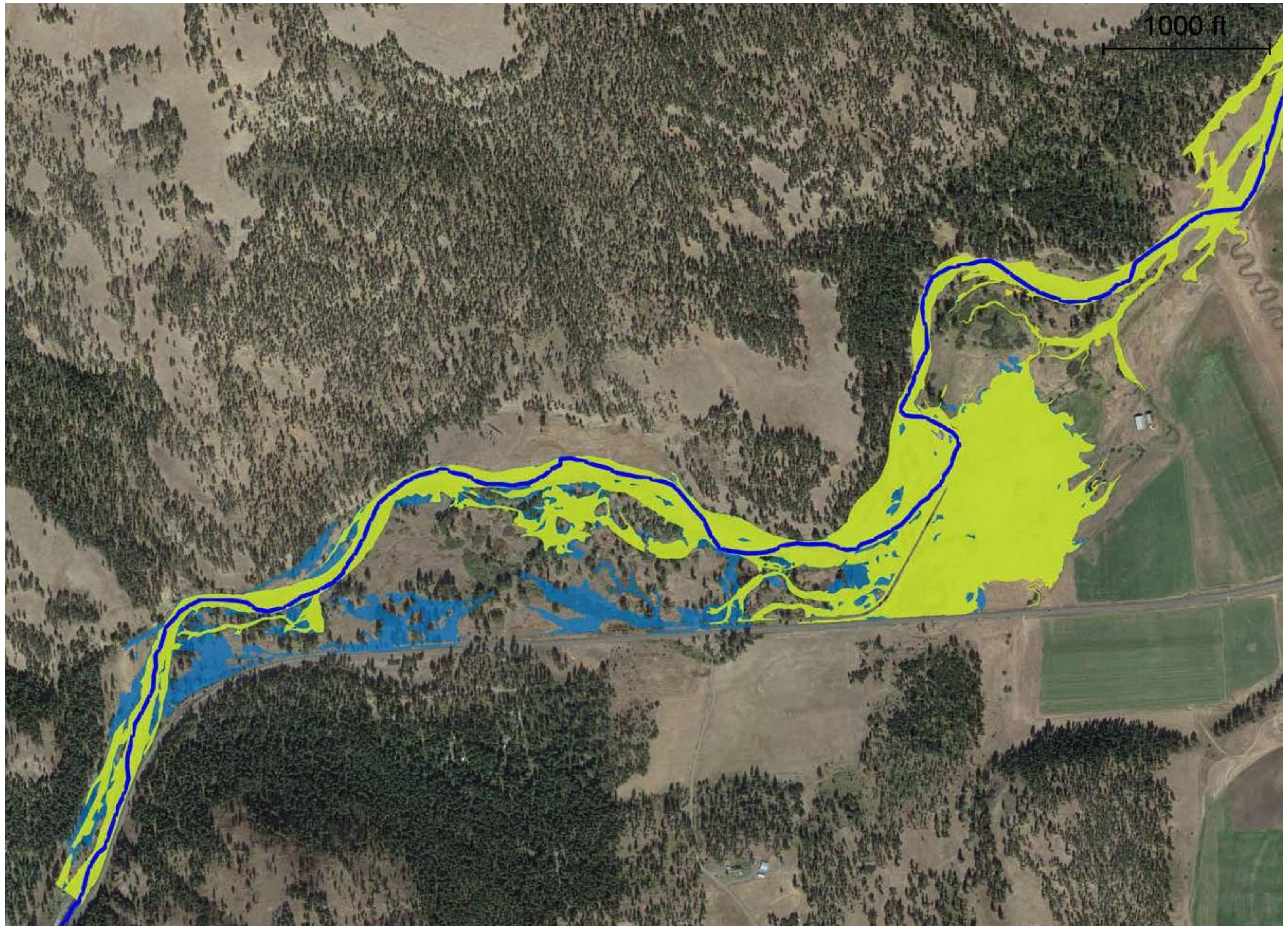


Figure 5-6 **Active Floodplain Area (2-year Event) for the In-Channel Alternative**

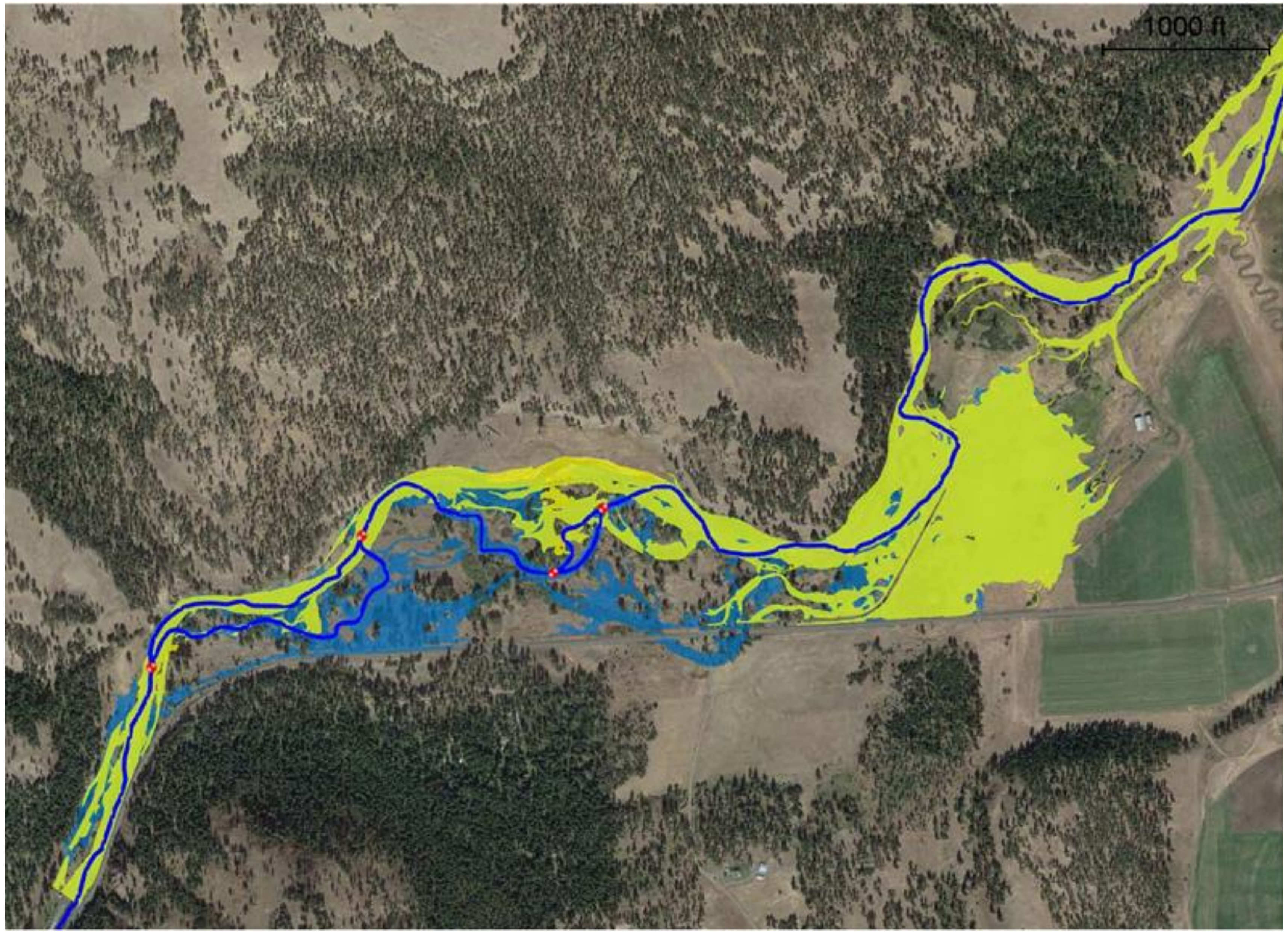


Figure 5-7 Active Floodplain Area (2-year Event) for the Channel Reconstruction Alternative

5.2.2.3 Channel Margin Inundation

The channel margin inundation criterion is represented as the area subject to inundation under the 1.25-year peak flow, outside the boundary of the active winter channel (march median flow). This metric provides an indicator of the connection of the channel with its floodplain and the quantity/extent of inundation that would result from small magnitude, but frequent flood events, important to low velocity habitat, riparian vegetation establishment, and diverse in channel hydraulics. This criterion is used to evaluate conditions relative to numerous physical objectives, and for the 'juvenile emigration' objective as a supplement to the preliminary WUA calculations (Table 5-4).

The upper bound for the channel margin inundation criterion was established by assuming that improved floodplain connectivity and channel length could only increase the marginal area to about 66 percent of the existing 10-year event (40 acres). The lower bound for the channel margin inundation criterion was assumed to be an adverse outcome from continued channel degradation where the main channel entrenchment would continue and the channel margins would continue to simplify no incremental increase in area between the active winter channel and the 1.25-year event.

The channel margin inundation area is extremely limited under the existing condition; the instream treatment alternative, would make a considerable improvement, and the reconstruction alternative would have an even larger effect (Table 5-4).

5.2.2.4 Active Winter Channel

The active winter channel criterion is represented by the length of wetted channel (equivalent to one bank) under the march median flow. This metric provides an indicator of the quantity of potential aquatic habitat for winter rearing, including pools, margins, and varied in-channel hydraulics. This criterion is used to evaluate conditions relative to a few physical objectives, and as a contributor to biological objectives in addition to preliminary WUA calculations (Table 5-4).

The upper bound for the active winter channel criterion was established by first developing a theoretical maximum multi-thread channel alignment (Figure 5-8). This same theoretical alignment was employed in modeling and estimates for the upper bounds on several other (physical and biological) criteria as discussed below.

The lower bound for the active winter channel criterion was established by first developing a theoretical degraded channel with a straight, single thread alignment (Figure 5-9). This same theoretical alignment was employed in modeling and estimates for the lower bounds on several other (physical and biological) criteria as discussed in subsections below.

The active winter channel length under the existing condition is only slightly modified by the instream treatment alternative, while a larger increase occurs under the reconstruction alternative (Table 5-4).

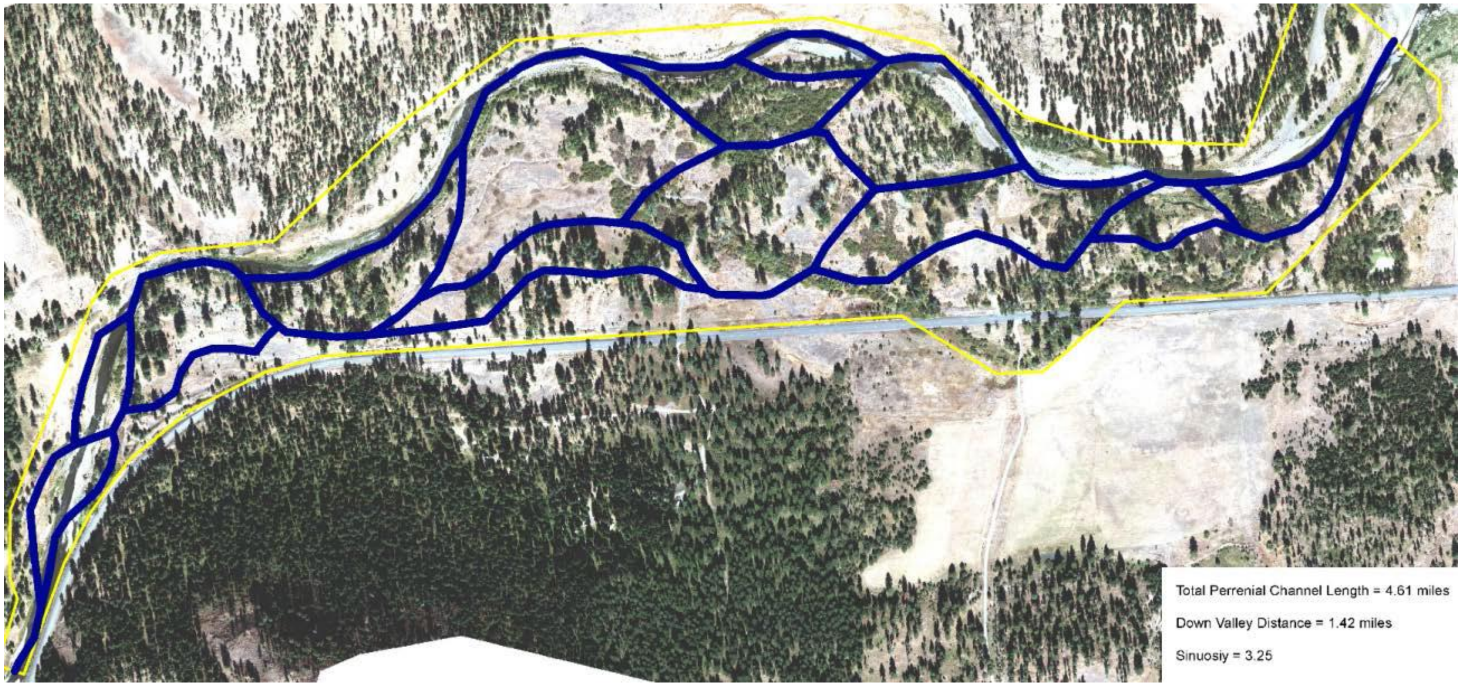


Figure 5-8 Theoretical Maximum Multi-Thread Channel Network

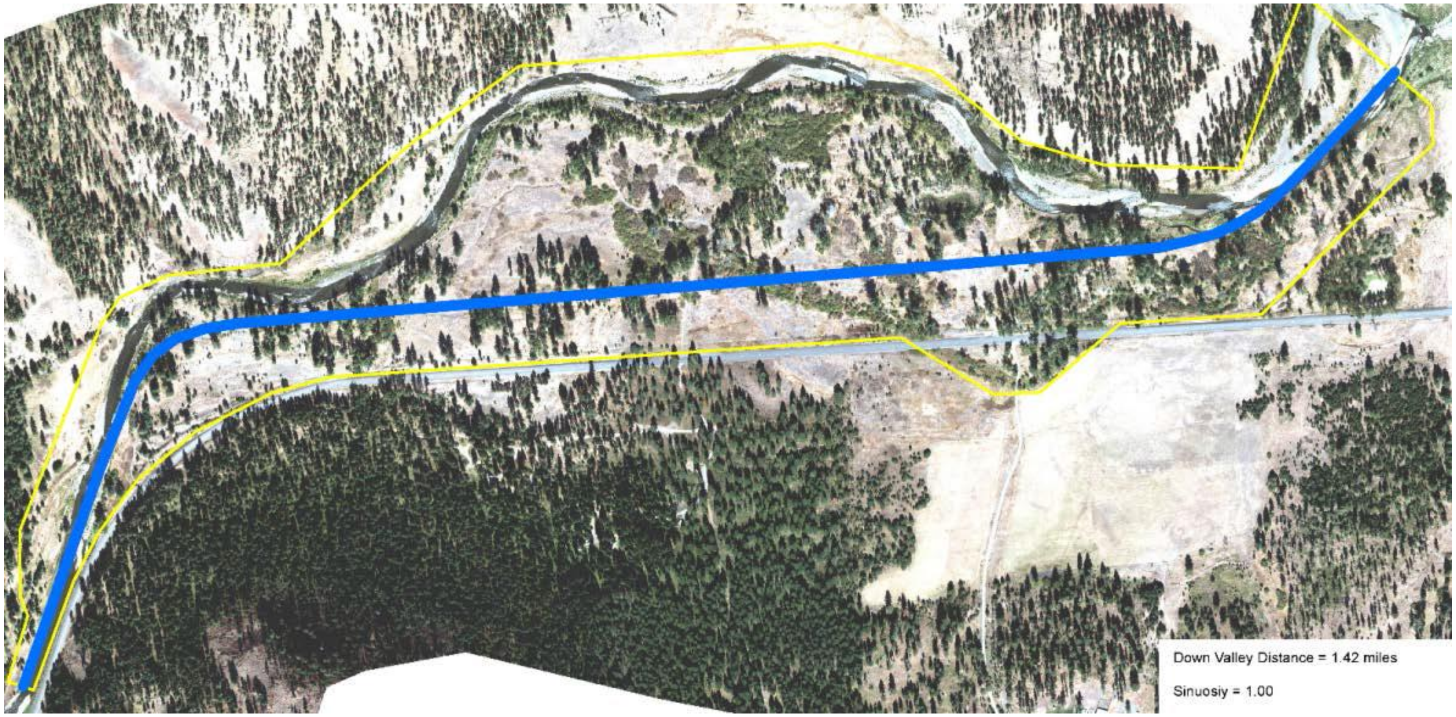


Figure 5-9 Theoretical Minimal Length, Single Thread Channel

5.2.2.5 Winter Juvenile Chinook WUA

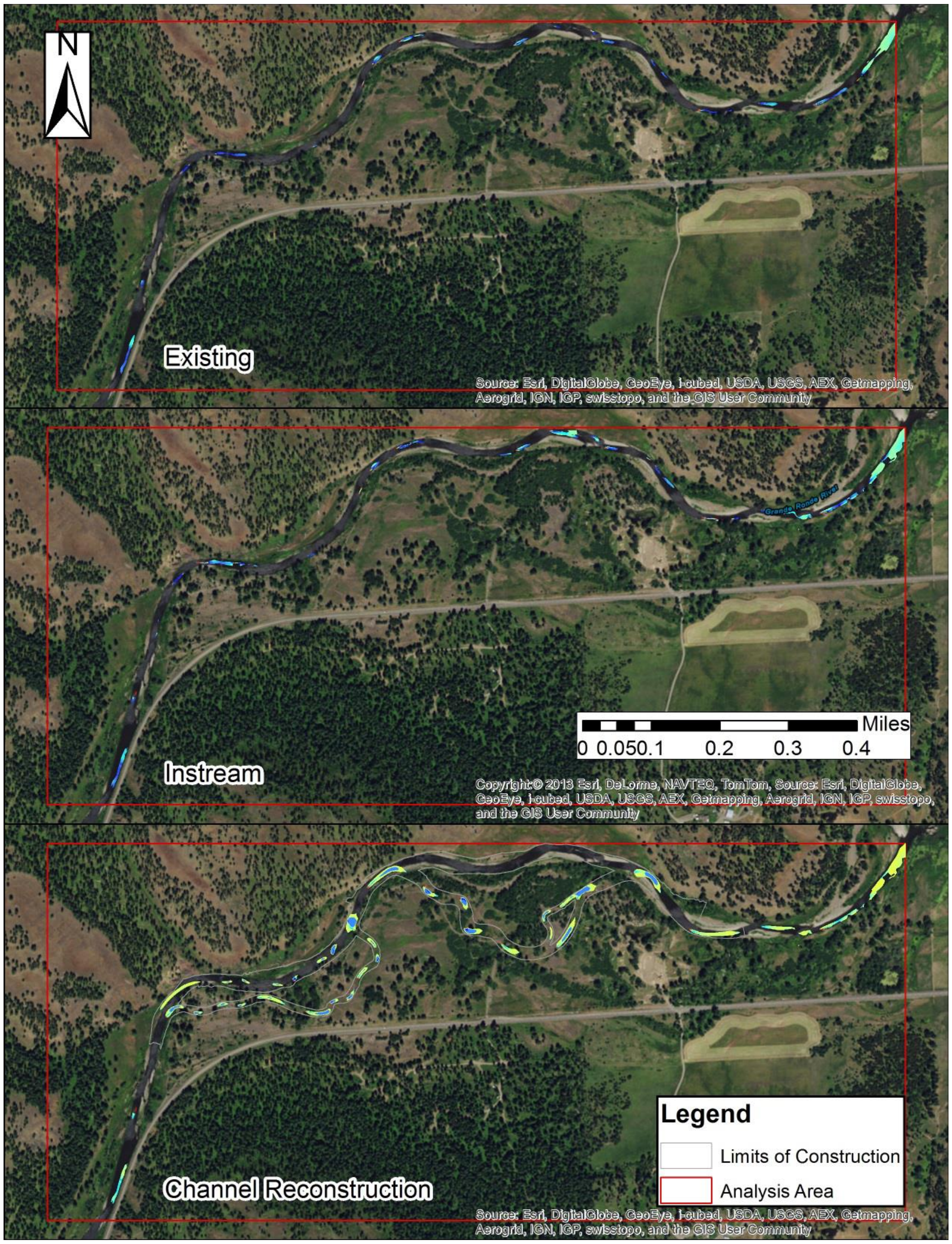
The winter juvenile Chinook salmon Weighted Usable Habitat Area (WUA) criterion is represented by applying the Habitat Suitability Index (HSI) methodology to the 2D model output for depth and velocity under the winter low flow (18 cfs). This metric provides an indicator of the quantity of suitable aquatic habitat for winter rearing of juvenile Chinook and is used to evaluate specific biological objectives (Table 2-2).

Spatial distributions of flow depth and depth-average velocity converted to ArcGIS Rasters in a grid size of 2ft by 2ft were imported into the North Arrow Research Habitat Model (http://habitat.northarrowresearch.com/technical_reference/hsi_methodology/), where HSI analyses were performed. Habitat suitability for the winter season was assessed using the Habitat Suitability Curves (HSCs) developed from microhabitat data in middle Catherine Creek and recommended by Favrot and Horn (2016). The recommended HSCs were added to the Habitat Model and computed using the weighted mean.

The upper bound for the winter juvenile Chinook WUA was established using the theoretical maximum multi-thread channel alignment (Figure 5-8).

The lower bound for the winter juvenile Chinook WUA was established using the theoretical degraded channel with a straight, single thread alignment (Figure 5-9).

The winter juvenile Chinook salmon WUA is marginally increased over the existing conditions for the instream alternatives, but a substantial gain results from the reconstruction alternative (Figure 5-10).



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Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 5-10 Winter Season Low Flow Juvenile Chinook WUA

Comment [MK3]: Need updated figures with all colors in legend – email sent to team

Comment [MK4]: MY – if you didn't get these just delete the comment and leave as is

5.2.2.6 Summer Juvenile Chinook WUA

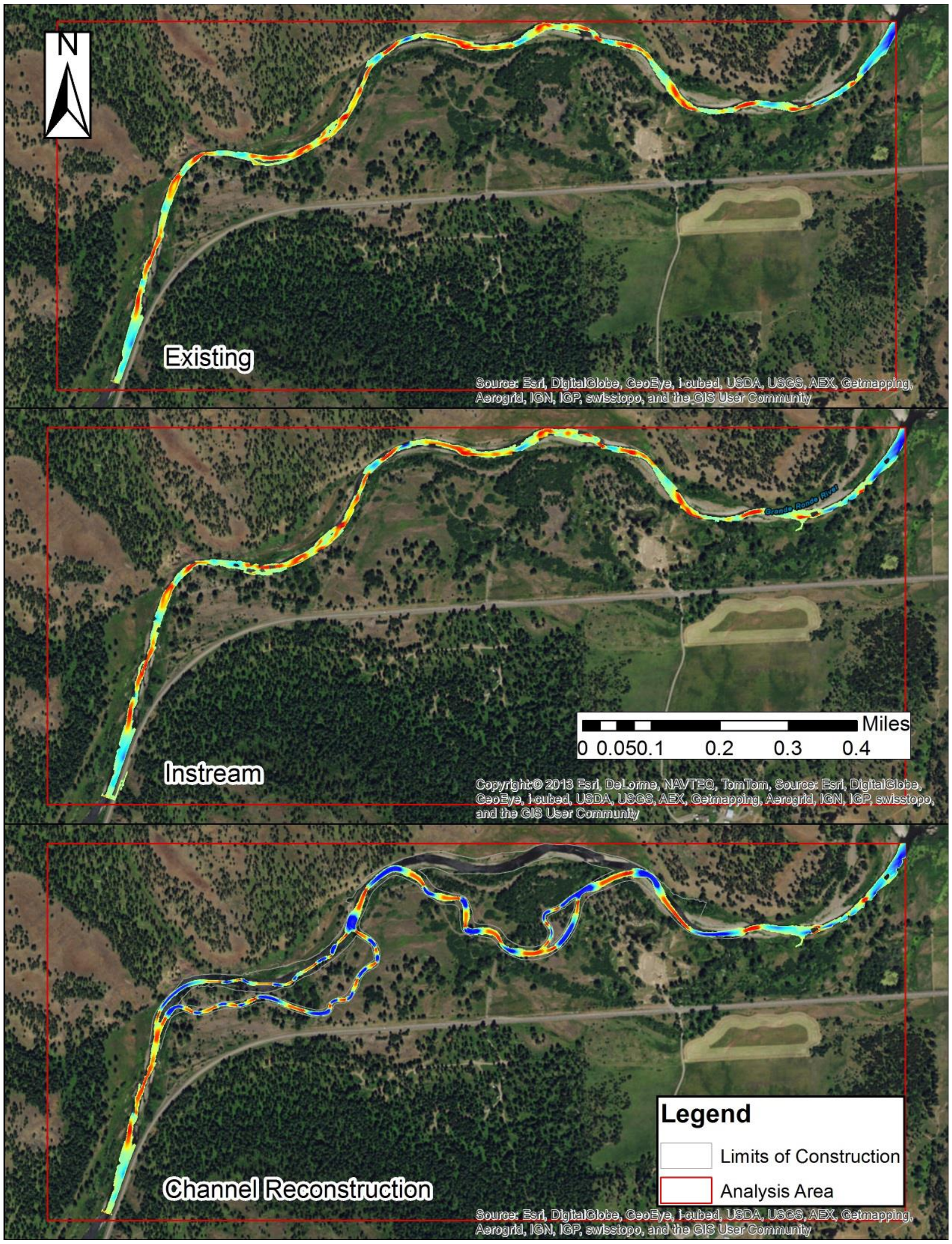
The summer juvenile Chinook salmon Weighted Usable Habitat Area (WUA) criterion is represented by applying the Habitat Suitability Index (HSI) methodology to the 2D model output for depth and velocity under the summer median flow (18 cfs). This metric provides an indicator of the quantity of suitable aquatic habitat for summer rearing of juvenile Chinook and is used to evaluate specific biological objectives (Table 2-2).

Spatial distributions of flow depth and depth-average velocity converted to ArcGIS Rasters in a grid size of 2ft by 2ft were imported into the North Arrow Research Habitat Model (http://habitat.northarrowresearch.com/technical_reference/hsi_methodology/), where HSI analyses were performed. Habitat suitability for the summer season was assessed using the Habitat Suitability Curves (HSCs) from Maret et al., (2006) within the Habitat Model and computed as the arithmetic mean.

The upper bound for the summer juvenile Chinook WUA was established using the theoretical maximum multi-thread channel alignment (Figure 5-8).

The lower bound for the summer juvenile Chinook WUA was established using the theoretical degraded channel with a straight, single thread alignment (Figure 5-9).

The summer juvenile Chinook salmon WUA is marginally increased over the existing conditions for the instream alternatives, but a substantial gain results from the reconstruction alternative (Figure 5-11). However, given that summer season water temperatures at the site can be lethal to salmonids, the preliminary WUA habitat suitability results based on velocity and depth alone are primarily useful for comparative purposes.



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Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 5-11 Summer Season Low Flow Juvenile WUA

Comment [MK5]: Need updated figures with all colors in legend – email sent to team

5.2.2.7 Channel and Hyporheic Complexity

The channel and Hyporheic complexity criterion is represented by an index adapting the method of Brown (2002), whose River Complexity Index (RCI) is calculated as RCI = S(1+J) and S= channel sinuosity and J = the number of channel junctions. For this application, the active winter channel is used rather than focus on the bankfull channel, but the index is a valid indictor of channel planform pattern, dynamic processes, winter and diversity of in-channel conditions. This metric also provides one of the few indicators of lateral influences on Hyporheic exchange. This criterion is particularly important to evaluate conditions relative to numerous physical objectives, and as an sign of potential benefits for adult fish use (Table 2-2).

The upper bound for the channel and Hyporheic complexity criterion was established using the theoretical maximum multi-thread channel alignment (Figure 5-8).

The lower bound for the channel and Hyporheic complexity criterion was established using the theoretical degraded channel with a straight, single thread alignment (Figure 5-9).

The channel and Hyporheic complexity is quite low under existing conditions, and would not be expected to increase from construction of the instream treatment alternative. A substantial increase in channel length, and thus sinuosity, as well as intersections, would produce a much larger index for the channel reconstruction alternative (Table 2-3).

5.2.2.8 Critical Streambed Median Particle Size

The critical streambed median particle size criterion is represented by the average value of the calculated median particle size (d50) within the March median channel and flow. This metric provides an indicator of the magnitude and range of in-channel hydraulics under typical flow events, important as a control on the bed material particle sizes. This criterion is the most important indicator for evaluating the bed sediment size objective, and is related to sustainability of desired bed form diversity (Table 5-4).

The critical grain size at incipient motion was calculated at each element center in the 2D model mesh, with a critical dimensionless shear stress of 0.04.

Dimensionless shear stress values from steady-state discharge model results were split into 3 different criteria for the marginal bed transport analysis. The criteria set forth in Andrews (1994) are as follows:

> $\tau_i^* < 0.02$; little to no transport of particle size d_i,

> $0.02 < \tau_i^* < 0.06$; marginal bed load transport of particle size d_i,

> $\tau_i^* > 0.06$; significant motion of particle size d_i, vigorous bed load transport.

The upper bound for the critical streambed median particle size criterion was established using the theoretical maximum multi-thread channel alignment (Figure 5-8).

The lower bound for the critical streambed median particle size criterion was established by constructing a simple 1D hydraulic model of the theoretical degraded channel with a straight, single thread alignment (Figure 5-9). This simplified ‘flume’ representation of the degraded channel was used to generate average shear stress, exported to excel for statistical analyses, and used to calculate critical dimensionless Shields number data. Since the modeling technique for the lower bound using the flume differed from the 2D modeling of existing and the other action alternatives, similar 1D methods were applied to those as well so the ‘flume’ results could be adjusted for comparison.

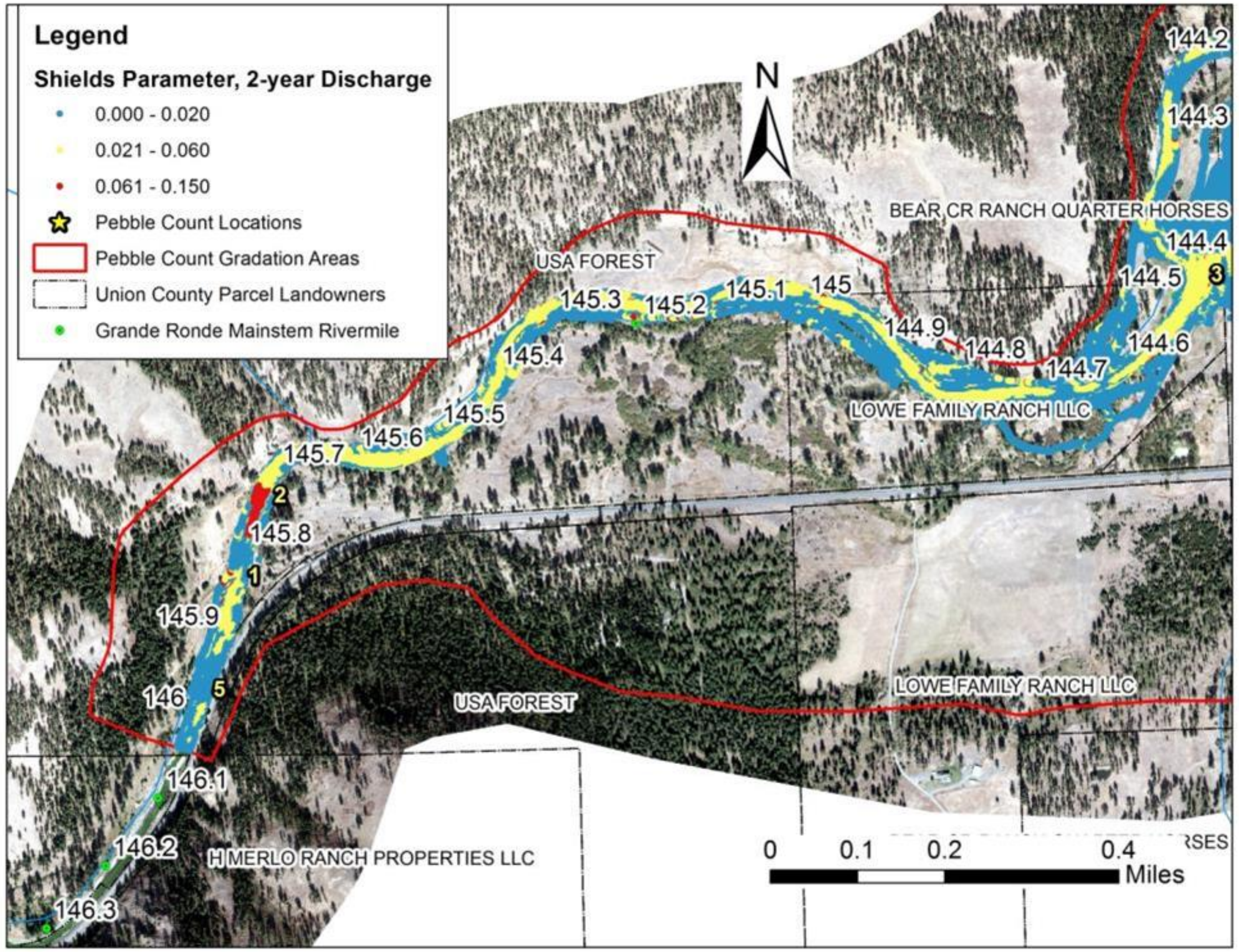
The critical streambed median particle size is quite coarse under existing conditions and both action alternatives result in a positive (smaller) trend, although only the reconstruction alternative produces a very noticeable change in the particle dimension.

5.2.2.9 *Critical Streambed Median Particle Diversity*

The critical streambed median particle size diversity criterion is represented by the coefficient of variation (CV) of the calculated median particle size (d50) within the March median channel and flow. This metric provides an indicator of the variation of in-channel hydraulics under typical flow events, important as a control on the range bed material particle sizes and spatial patterns, including sorting. This criterion is the most important indicator for evaluating the bed sediment sorting and sustainable bed form diversity objectives. As a measure of physical habitat diversity and sustainability, this criterion is also considered for the biological objectives as a supplement the preliminary WUA calculations (Table 5-4).

The upper bound for the critical streambed median particle diversity criterion is the mathematical maximum of the CV (1) and the lower bound is zero, which would represent a theoretically uniform median particle size.

While neither action alternative is expected (given the present modeling representations) to produce a large change in diversity of streambed particle distributions, the instream treatment alternative would remain similar to the existing condition, but the reconstruction alternative would be expected to produce a very noticeable increase in diversity.


Legend
Shields Parameter, 2-year Discharge
0.000 - 0.020
0.021 - 0.060
0.061 - 0.150
Pebble Count Locations
Pebble Count Gradation Areas
Union County Parcel Landowners
Grande Ronde Mainstem Rivermile
N
144.2
144.3
BEAR CR RANCH QUARTER HORSES
144.4
144.5
3
USA FOREST
145.3
145.2
145.1
145
144.9
144.8
144.7
144.6
145.4
145.5
LOWE FAMILY RANCH LLC
145.6
145.7
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USA FOREST
LOWE FAMILY RANCH LLC
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Figure 5-12

5.2.3 Normalizing and Scaling Screening Data

To facilitate comparisons, given the variety of units and range of absolute values for the metrics, the data for each criterion is normalized for scoring and ranking. The normalizing scale for each criterion assigns a numeric value to the raw metric (Table 5-4) within percentiles between the estimated upper and lower bounds (Table 5-4). To assist with interpreting the scaled results for comparing alternatives, four general groups of scores on a zero to 10 scale are associated with qualitative performance explanations (Table 5-5).

The intent of the Project is to improve conditions, so potential beneficial changes are emphasized in the numeric scores. However, it is possible that natural processes of continued channel degradation and/or responses to construction disturbance could result in worsening relative to the existing condition since the channel condition is unstable. Therefore, the lower bounds and lowest numeric scores allow for potential adverse change from existing conditions.

Table 5-5 Normalizing Scale and Scoring Applied to All Screening Criteria

Numeric Score	Explanation*
10	Large magnitude and relatively certain beneficial effect relative to the bounding conditions.
5	Likely measureable, but uncertain beneficial effect relative to the bounding conditions.
3	Difficult to detect or uncertain beneficial effect relative to the bounding conditions.
0	Could result in an adverse effect (of any magnitude or certainty) relative to the bounding conditions.

* The lower bounding condition is considered 'worst' and the upper bounding condition is considered 'best' for all criterion aside from the median particle size, since the desired condition for that criterion is a reduction in median particle size.

Using the normalizing and scaling methods described above, the raw output for each metric and each alternative was modified (Table 5-6). These data provide a ready illustration of the poor condition of the Existing/No-Action Alternative for all of the screening criteria, with the exception of median streambed particle size. This summary by criteria also indicates that either of the Action Alternatives could be expected to create measureable benefits in terms of the floodplain and flood prone areas. However, it is relatively clear that a measureable or large improvement in most criteria, and particularly the in channel conditions, is only possible with the Re-Construction Alternative.

Table 5-6 Normalized Screening Analysis Results

	Alternative		
Criteria	**Existing/No-Action***	**In-Channel**	**Re-Construction**
Flood Prone Area	4.7	9.5	8.4
Active Floodplain	3.2	7.9	8.1
Channel Margin Inundation	1.4	5.4	8.8
Active Winter Channel	1.5	2.4	3.7
Winter Juvenile Chinook WUA	0.6	1.4	4.6

	Alternative		
Criteria	**Existing/No-Action***	**In-Channel**	**Re-Construction**
Summer Juvenile Chinook WUA	2.2	2.3	5.0
Channel and Hyporheic Complexity	0.0	0.0	2.1
Critical Streambed d50 Particle Size	5.3	5.4	6.8
Critical Streambed d50 Particle Diversity	1.9	2.1	3.7

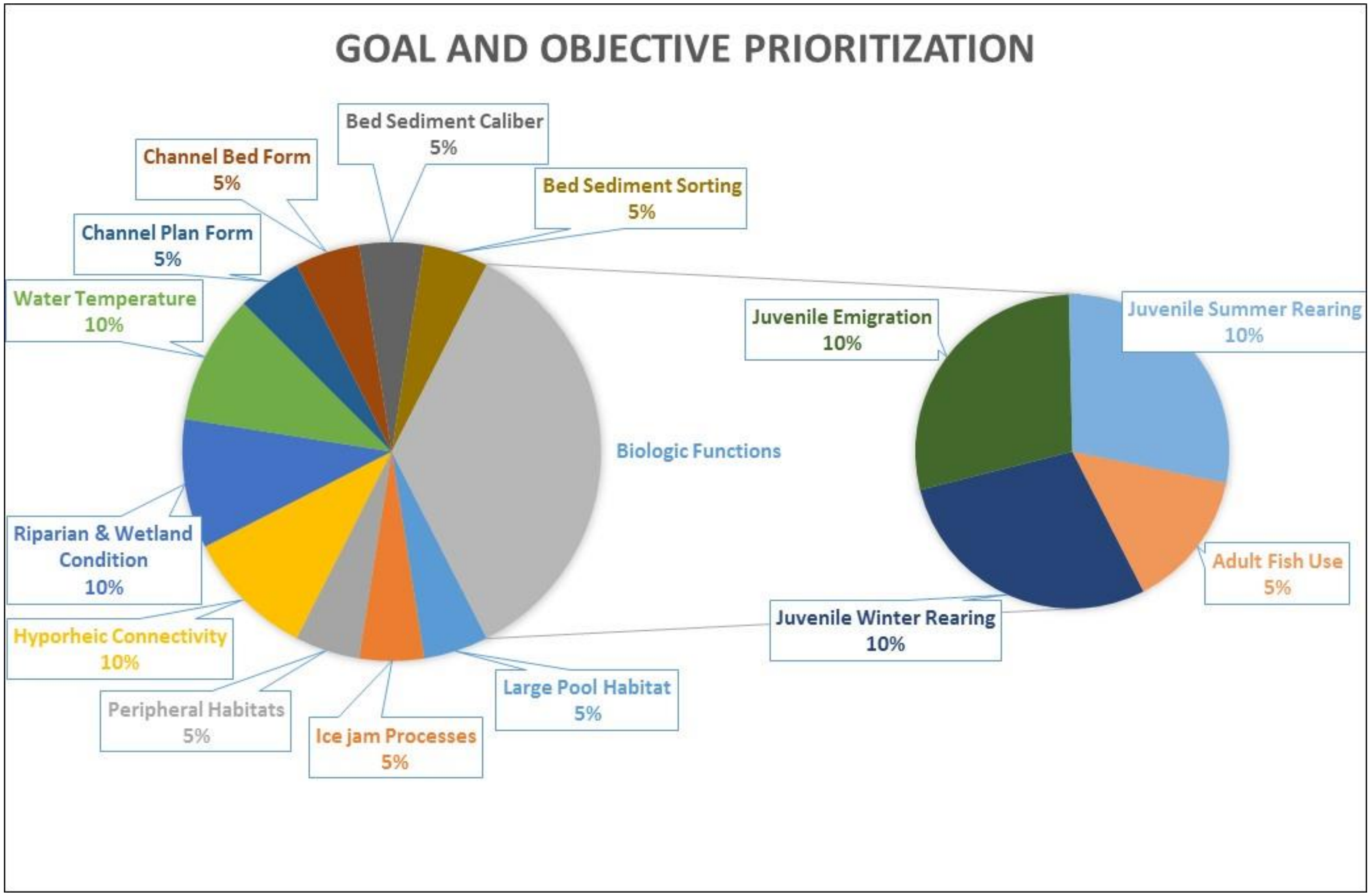


Figure 5-13 Relative Importance of the Fourteen Objectives, with Overall and Specific Priorities for the Biologic Function Objectives

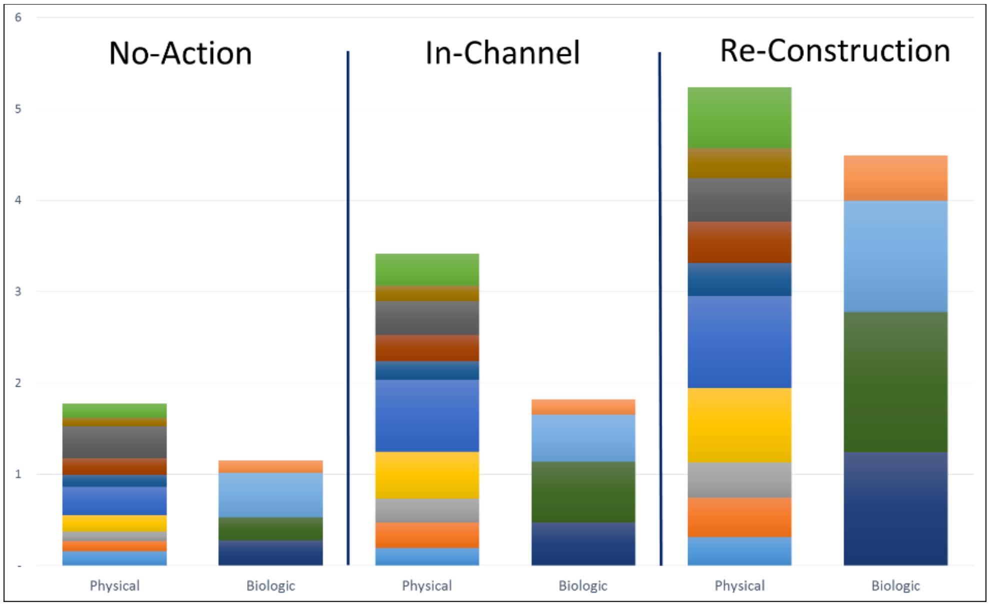
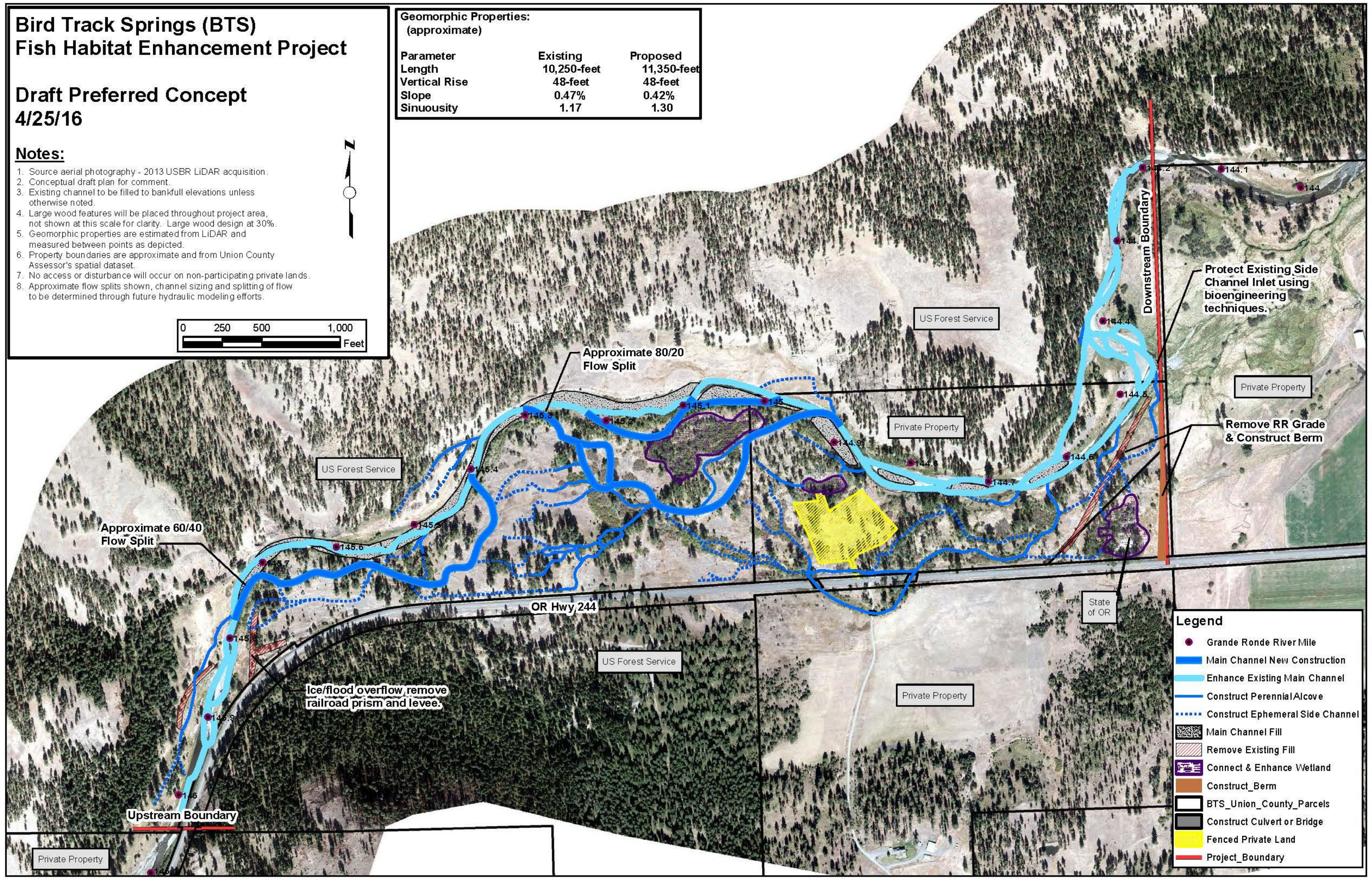


Figure 5-14 **Normalized Screening Criteria Results, Grouped for the Physical and Biological Objectives for Each Alternative**

5.3 15% Preferred Concept

The draft preferred concept shown in Figures 5-15 and 5-16 is an expansion of the channel reconstruction conceptual alternative. Through the alternative ranking process, the design team recognized the relative importance of the River Complexity Index (RCI) (Brown, 2002) metric in meeting many of the physical goals and objectives of the project. The RCI is a measure of both channel sinuosity and number of channel intersections. To increase the RCI metric requires increasing the sinuosity of the river, adding more channel intersections, or both. The physical vision for the project area is a multi-threaded river that changes flow paths and therefore energy partitioning through dynamic forcing agents over time (i.e. ice, large wood, and beaver). To achieve this vision, the design team intends to evaluate the addition of more channel paths (anabranching, secondary, and ephemeral) to the current channel reconstruction alternative.

The foundation of the preferred concept lies within the primary channel represented in the channel reconstruction alternative. Additional channel features to be evaluated include, but are not limited to, an anabranching channel and secondary channel paths along the existing mainstem channel in areas that have been filled with alluvium. Additional side channels (ephemeral and perennial) and perennial alcove opportunities will also be evaluated. The present additional side channels and alcove opportunities have been selected from existing topographic features that represent historic channel features (i.e. scars, oxbows, etc.). The intent will be to maximize off-channel and peripheral juvenile rearing opportunities through maximizing connected side channels and alcoves with low velocity zones that will maximize the RCI within the physical geomorphic limits of the project reach. Further analysis will be required to balance goals and objectives with social, fiscal, and physical constraints.



Bird Track Springs (BTS)
Fish Habitat Enhancement Project

Draft Preferred Concept
4/25/16

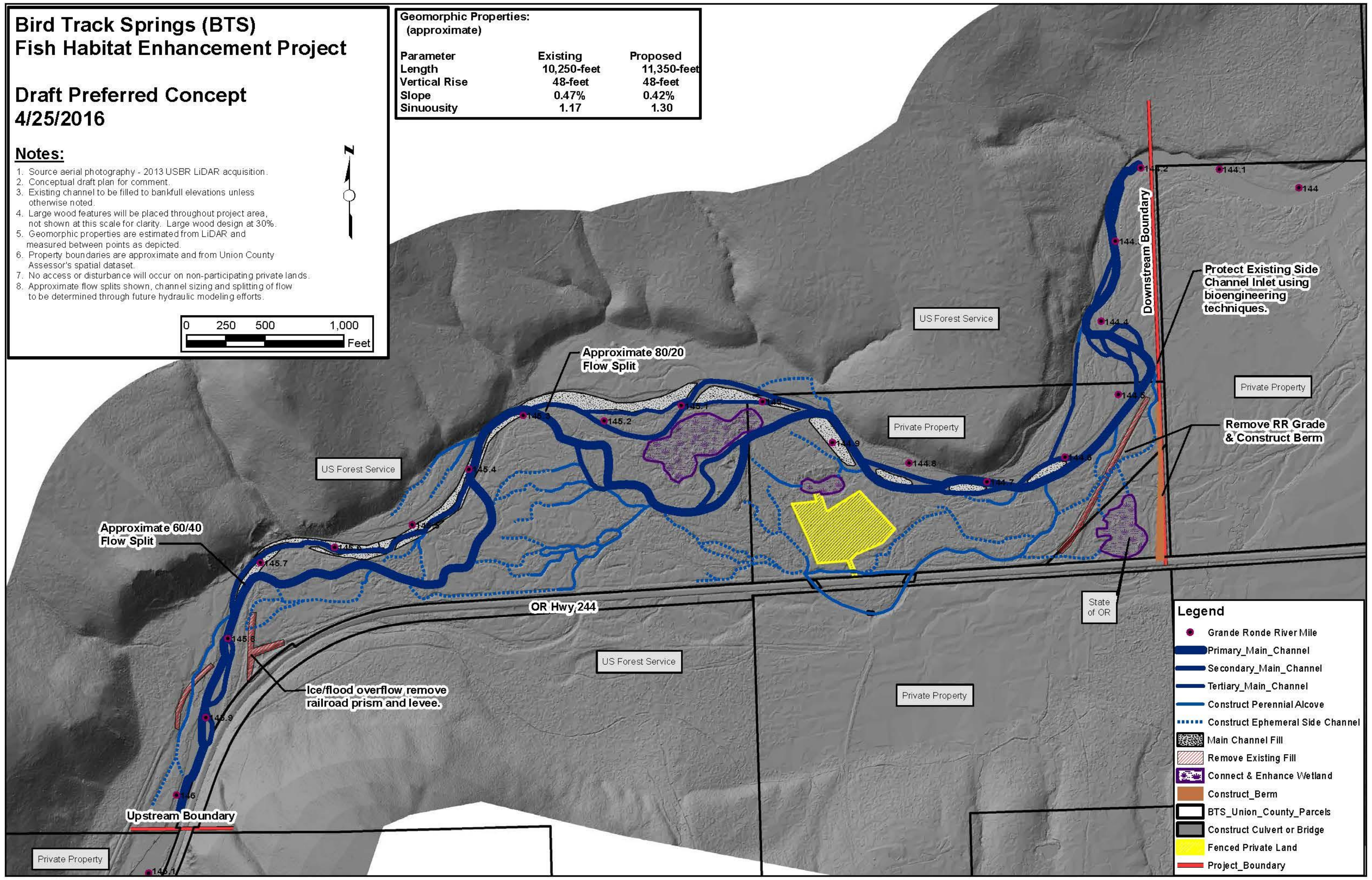
Notes:

1. Source aerial photography - 2013 USBR LiDAR acquisition.
2. Conceptual draft plan for comment.
3. Existing channel to be filled to bankfull elevations unless otherwise noted.
4. Large wood features will be placed throughout project area, not shown at this scale for clarity. Large wood design at 30%.
5. Geomorphic properties are estimated from LiDAR and measured between points as depicted.
6. Property boundaries are approximate and from Union County Assessor's spatial dataset.
7. No access or disturbance will occur on non-participating private lands.
8. Approximate flow splits shown, channel sizing and splitting of flow to be determined through future hydraulic modeling efforts.

Geomorphic Properties:
(approximate)

Parameter	Existing	Proposed
Length	10,250-feet	11,350-feet
Vertical Rise	48-feet	48-feet
Slope	0.47%	0.42%
Sinuousity	1.17	1.30

Figure 5-15


Bird Track Springs (BTS)
Fish Habitat Enhancement Project
Draft Preferred Concept
4/25/2016
Notes:
1. Source aerial photography - 2013 USBR LiDAR acquisition.
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3. Existing channel to be filled to bankfull elevations unless otherwise noted.
4. Large wood features will be placed throughout project area, not shown at this scale for clarity. Large wood design at 30%.
5. Geomorphic properties are estimated from LiDAR and measured between points as depicted.
6. Property boundaries are approximate and from Union County Assessor's spatial dataset.
7. No access or disturbance will occur on non-participating private lands.
8. Approximate flow splits shown, channel sizing and splitting of flow to be determined through future hydraulic modeling efforts.
N
0
250
500
1,000
Feet
Geomorphic Properties:
(approximate)
Parameter | Existing | Proposed
Length | 10,250-feet | 11,350-feet
Vertical Rise | 48-feet | 48-feet
Slope | 0.47% | 0.42%
Sinuousity | 1.17 | 1.30
Approximate 80/20 Flow Split
Approximate 60/40 Flow Split
Ice/flood overflow remove railroad prism and levee.
Upstream Boundary
Downstream Boundary
Protect Existing Side Channel Inlet using bioengineering techniques.
Remove RR Grade & Construct Berm
OR Hwy 244
US Forest Service
US Forest Service
US Forest Service
Private Property
Private Property
Private Property
Private Property
State of OR
144.1
144
144.4
144.8
145.2
145.4
145.7
145.9
146
Legend
● Grande Ronde River Mile
Primary_Main_Channel
Secondary_Main_Channel
Tertiary_Main_Channel
Construct Perennial Alcove
Construct Ephemeral Side Channel
Main Channel Fill
Remove Existing Fill
Connect & Enhance Wetland
Construct_Berm
BTS_Union_County_Parcels
Construct Culvert or Bridge
Fenced Private Land
Project_Boundary

Figure 5-16

6 Recommended Alternative Design NEW

Chapter 6 presents the focus of design guidelines, describes specific design elements and documents methods used in developing the 15% preferred concept to a 30% level of design.

6.1 Design Guidelines/Proposed Conditions

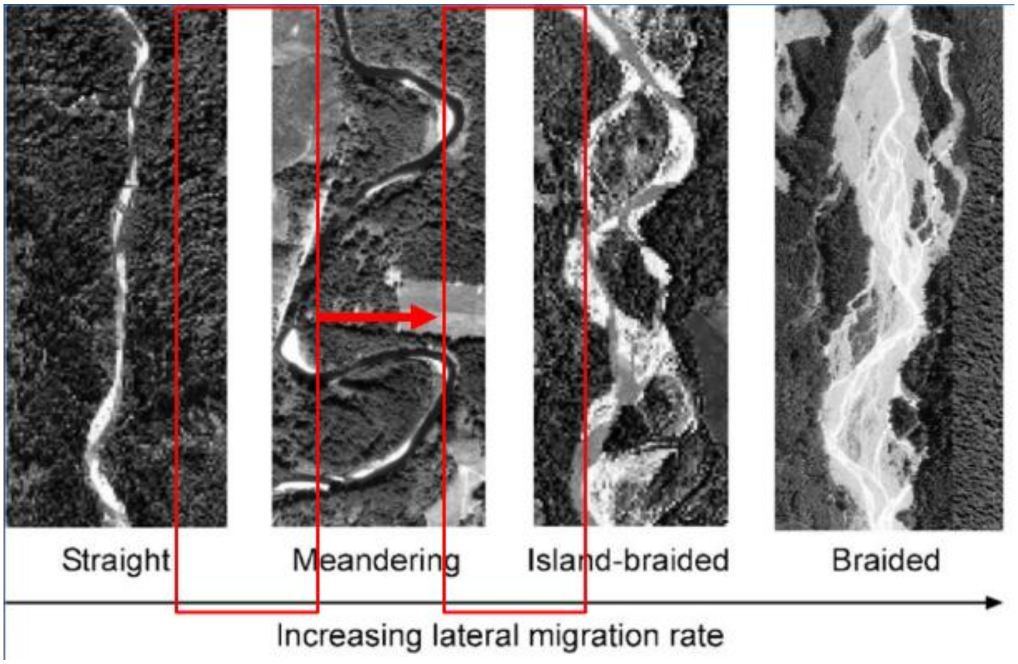
The physical project objectives developed to meet habitat, sustainability, and social goals of the project described above in Section 2 include numerous specific targets that will work together to create the overall vision of restoring natural processes within this reach of the Grande Ronde River (see Table 2-3). The objectives were grouped into six 'key driving design forces' guiding the efforts moving the preferred concept to a 30% level of design (Table 6-1).

Table 6-1: Key Driving Design Forces

Driving Design Force	Definition
1. Change Channel Planform	Change from Straight to Island-Braided
2. Wet the Sponge	Increase river-floodplain interaction – increased floodplain occurrence and duration
3. Increase Side Channels	Increase number and connectivity to side channels for fish to access
4. Develop Cool Water Refuges	Develop increased hyporheic conditions and connectivity to groundwater and hyporheic water table throughout project.
5. Increase Instream Complexity and Dynamic Behavior	Develop increased instream planform and bed diversity through planform and large wood treatments.
6. Manage Ice	Reduce anchor ice formation and improve flood conditions for rafted ice.

6.1.1 Change Channel Planform

One of the main objectives of this project is to re-establish an island-braided planform. Evidence suggests that a multi-threaded channel was common historically within this reach. Historically, dominant channels would likely come and go through channel swapping forced by natural processes of large wood, ice-jams, and beaver activity. The existing planform resides between a straight channel and a meandering channel. It is an objective for this design to move the planform towards a stable multi-thread pattern with relatively narrow, deep channel(s) between vegetated islands similar to those depicted by Beechie et al. (2006) (Figure 6-1).



Source: Modified from Beechie et. al. 2006

Figure 6-1 Desired Shift in Channel Planform

6.1.2 Wet The Sponge

Currently, the Grande Ronde River is disconnected from its historic floodplain for all but the largest flood events. Restoring processes requires a frequently connected floodplain. Some process benefits include: reduced instream energy, improved sediment sorting, improved riparian vegetation to include necessary mechanisms for re-generation, increased water storage, decreased flood peaks, and access to refuge for fish during high flows. Hydraulic modeling has shown that for a large portion of the project area (upstream of the Bear Creek Ranch meadow channel network), the existing channel begins to interact with its historic floodplain between the 5-year and ten-year flood events. For the design, it is proposed that the channel interacts with the floodplain much more regularly, at and above the 1.25-year (bankfull) flood event.

6.1.3 Increase Side Channels

Side channels or off-channels are important features of a healthy river network for fish to utilize for off-channel refuge and rearing. Side channels are typically formed by either new channels that are being created through a channel forcing mechanism such as bend avulsion, or from remnant historic channels that have been cut-off or partially cut-off from newly dominant channels. The Bird Track Springs Project topography indicates multiple examples of both remnant historic channels and newly forming channels that show great potential in reconnecting to a complex side channel network (Figure 6-2).

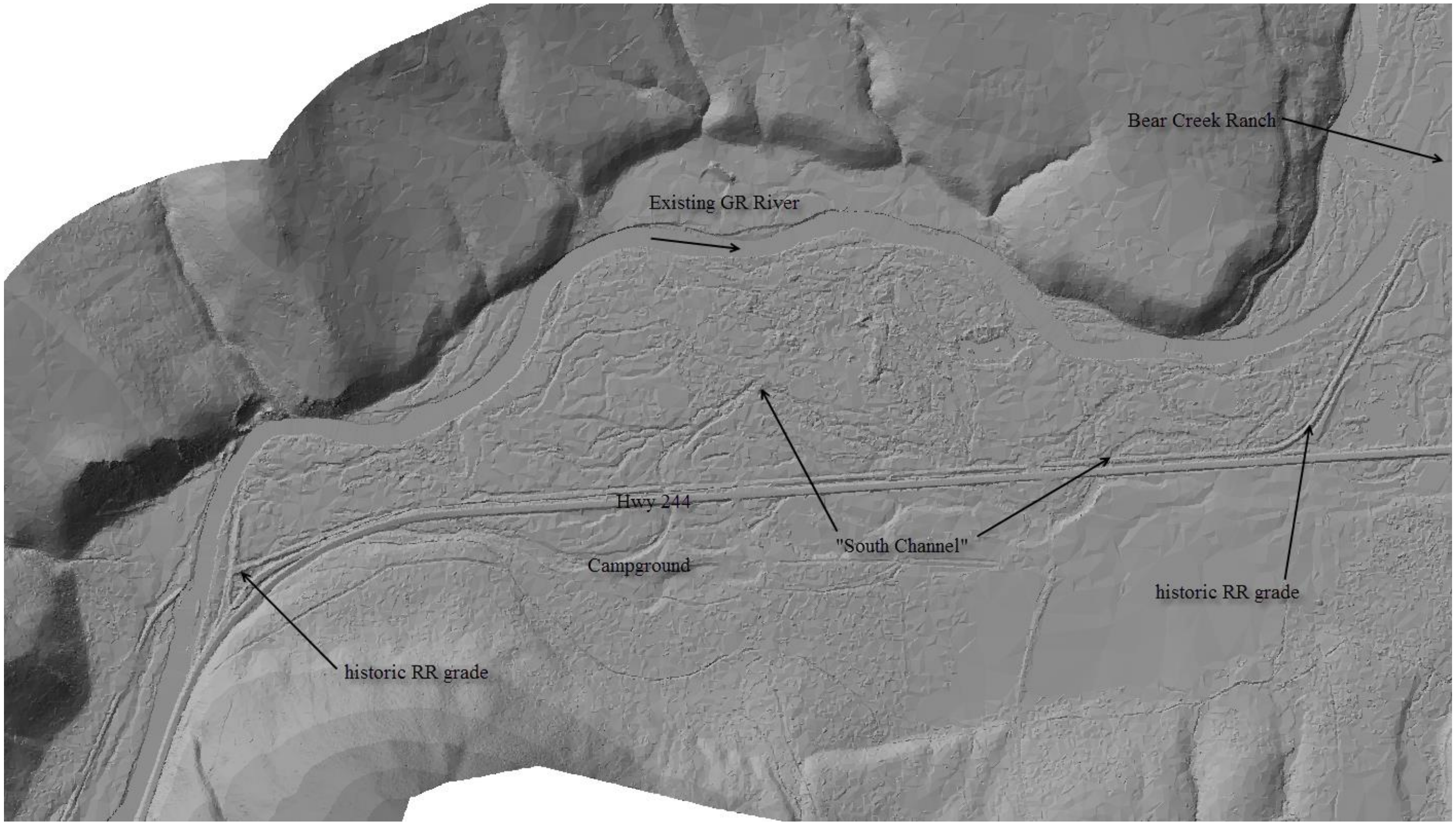


Figure 6-2: Bare-Earth LiDAR Image of the BTS project area

As one can see from the figure above, the Grande Ronde River has occupied its entire floodplain as remnant channel scars are prolific. In more recent times, the Grande Ronde River has remained in its current alignment as identified by channel mapping from aerial photography dating back to 1939 (see Appendix B). The current channel alignment is located to the north side of the floodplain through much of the project area. A prominent feature of the southern floodplain is the "South Channel". This approximately 3000-foot channel is still relatively intact to include vegetation lining its banks. The southern floodplain is disconnected at most discharges, therefore, the river does not currently interact with historic channel scars often or at all. Historic floodplain features have been largely disconnected as a result of historic human activities in a large portion of the project area. Many of these features are still mostly intact, which indicates a high potential for re-connection, resulting in a "ready-made" side channel network within the project area.

In addition to remnant channel scars, the figure shows human fill disturbances to include the existing Highway 244 prism, the historic Mount Emily Railroad Grade, fill excavated and placed at Jordan Creek Ranch corrals, and additional disturbance (fill piles) located in the middle of the project from what appears to be a historic gravel sorting operation. Highway 244 is located along the southern edge of the floodplain with limited impacts as it cuts off several historic channel meander scars. The historic railroad grade cuts off floodplain processes in several locations to include the upstream left and right banks and the entire downstream floodplain as shown by the diagonal raised berm. Several placed fill features will be breached or removed to obtain side channel and floodplain connection objectives where removal of these features do not negatively affect infrastructure or neighboring properties from increased flooding.

6.1.4 Develop Cool Water Refuge

An important consideration for successfully meeting this project's objectives is to create opportunities for cool water refuge from high summer water temperatures. The Grande Ronde River through the project reach experiences high water temperatures in the low flow summer period that is critical for juvenile salmonids to have sustainable rearing conditions. It is recognized that this project will not be able to significantly reduce overall summer water temperatures in the Grande Ronde River, however, the project team is optimistic that there is a high potential to develop and improve hyporheic connections within the project through changes to channel planform, channel grade, sediment sorting, sediment distribution, and sediment storage throughout the project reach. The most important aspects of these physical changes will be to increase the river complexity and add lateral and vertical complexity to the channel planform and bed. Existing conditions are further evaluated and discussed in Section 3.

6.1.5 Implement Groundwater Monitoring Plan

To better inform the design and identify potential cool water refuge opportunities, a detailed monitoring plan, including a rationale and theoretical basis, is presented in Appendix J. Here we briefly summarize the overall objectives and goals of the groundwater monitoring plan.

The objective of the monitoring plan is to fill in gaps in knowledge of groundwater and hyporheic interactions with surface water, help guide design, and monitor potential changes in groundwater hydrology that contribute to groundwater and surface water support of aquatic and riparian habitats. The more specific goal is to better understand hydrologic and temperature dynamics of groundwater-surface water exchange, the extent of the hyporheic zone, and related implications for channel realignment, LWD placement, and riparian revegetation in the BTS restoration site. To these ends, our monitoring approach is multi-pronged and focuses on both short-term rapidly acquired information as well as long-term monitoring.

Short-term approaches may include any or all of the following activities: 1) continued collection of surface water temperature logger data at the upstream and downstream site-bounding gaging stations, 2) deployment of a number of surface water temperature loggers at locations throughout the project area that provide a year-round secure anchor site (e.g., bedrock outcrops or large boulders that do not move during winter floods) 3) 1-3 additional stream gages at the similar locations, 4) during late spring and summer low flow opportunistic mapping of obvious groundwater upwelling sites along the stream, 5) deployment paired temperature loggers at the same seeps and in the open channel flow, 6) detailed investigation of hyporheic upwelling/downwelling at key locations such a sites of future logjam installation, and 7) surface water hydrologic investigations aimed at determining gaining and losing reaches in the project area.

The long-term monitoring method that we propose is to install a well network throughout the BTS site to track movement of water and energy (e.g., temperature) before and after the sequenced restoration actions at the site. Therefore, a hypothesis-driven hyporheic zone monitoring plan with a well network was developed to characterize current GW-SW process in the Project reach, metrics to be quantified include groundwater levels and temperatures. The groundwater temperature data will be used as a tracer to track patterns and rates of water movement through the hyporheic zone as well as evaluate potential effects of the BTS on hyporheic hydrology and thermal energy processes. From a restoration design perspective, the findings from the monitoring study will identify design options that should provide aquatic habitat benefits derived from GW–SW processes. From an effectiveness monitoring perspective, the results from the monitoring study will provide the basis to determine whether hyporheic hydrology and related temperature dynamics are altered in response to channel restoration.

6.1.6 Increase Instream Complexity and Dynamic Behavior

The existing channel through the project area is lacking in channel bedform diversity. It is almost entirely a plane-bed riffle or shallow run with limited depth and very few small pocket pools of limited depth and no channel spanning pools. The channel is armored with coarse sediment with limited small sediment stored and sorted into bars. A combination of multiple historic human actions and the physical setting have created these conditions as discussed in Section 3.2 and Appendix H. Previous attempts at adding channel complexity and bed diversity within the project reach have included full channel spanning rock weirs, rock jetties, large wood buried into banks, and large wood buried into bar features. Today, it appears that none of these features have significantly altered the channel diversity within this reach. It is hypothesized that channel planform, limited bank strength, lack of woody vegetation, and ice have all been important factors that have negatively influenced the lack of channel bedform diversity within the project reach. To address the lack of channel diversity will require a large scale project that addresses causative factors for the current channel form. As discussed in other sections, this will include reducing channel energy through multi-channel networks and improved floodplain connectivity to reduce stream power and remove ice from the channel during large flood events. Additionally, wood played a role in forming and maintaining a complex and dynamic channel historically. Large wood and rock will be placed throughout the project reach to mimic natural historic conditions. Large wood and rock features will be designed to force pools, initially protect banks, and to maintain the multi-channel planform. Additionally, for channel diversity to be sustainable within the project reach, riparian vegetation must be robust and include multiple age classes, which will require significant attention in both funding and design for this project to be successful.

6.1.7 Change Channel Planform

The Upper Grande River is an icemaker in the winter months. Ice is problematic throughout the river and is evidenced in several locations throughout the project reach. It is hypothesized that ice has always been a force within the Upper Grande Ronde River, but has become a much larger and self-sustaining force due to historic human influences. Ice is formed during extended periods of cold weather, where temperatures remain below freezing for several days. This can occur several times over a typical winter in this region. When air temperatures rise, ice that has formed through anchor or frazil processes blocks the river from flow, which can cause flooding problems. As temperatures and floodwaters continue to rise, ice rafts in large quantities down the river corridor often times jamming on bar features or exiting through the channelized system entirely.

The simplification of the river channel to include shallowing and over-widening from historic human activities (see Appendix X) has created a condition in which ice is formed throughout the river and the project reach. At break-up, ice has nowhere to go but down the channel. Anchor ice formation adheres to the channel bed and is able to pluck sediment, biota, and vegetation upon break-up. Additionally, ice rafts down the channel during higher flows and scrapes the channel clean, which has likely led to stagnant recovery. Fine sediments, gravels, biota and vegetation are regularly removed from the channel. It is hypothesized that ice processes have greatly influenced the channel that is seen today, a wide, shallow, and largely dead watercourse. In order to obtain the many objectives that this project has described, ice will need to be addressed. Within the project reach, forced bedform diversity and multi-threaded channels along with connection to the floodplain are the primary methods in which this design parameter will be addressed.

In addition to the negative channel effects that the current ice situation is believed to have, ice is also problematic for the Oregon Department of Transportation (ODOT) along Highway 244. Ice is formed above the project reach and forms dams as it rafts down the river at the upstream end of the project reach causing flooding of the highway (Figure 6-3).

One of the objectives of this project is to not make the flooding situation worse for adjacent landowners and stakeholders to include ODOT. Given the current ice problem at the upstream end of the project reach along Highway 244, a significant design parameter for this project will include identifying elements of the design that can achieve environmental objectives and make the ice situation better for the highway and flood conditions.

Figure 6-3 Ice choking Grande Ronde River along Highway 244 within upstream project reach – looking downstream. (Photo courtesy of P. Kennington, ODOT.)

6.2 Proposed Conditions

The focus of the proposed conditions for design during the 15% stage was on improving connection to the floodplain and feasibly activating existing (remnant) side and overflow channels at various portions of the annual hydrograph and/or specific events. The preferred 15% concept was able to greatly increase floodplain interaction and activation relative to existing conditions. During the 30% design development, the focus has been on increasing river complexity and refining channel planform, dimension, and heterogeneity. Field evaluations and direct survey of unique existing features on the landscape, concurrent integration of interpretations from the geomorphic assessment, and iterative modeling have all supported the 30% design channel design depicted in the 30% design package.

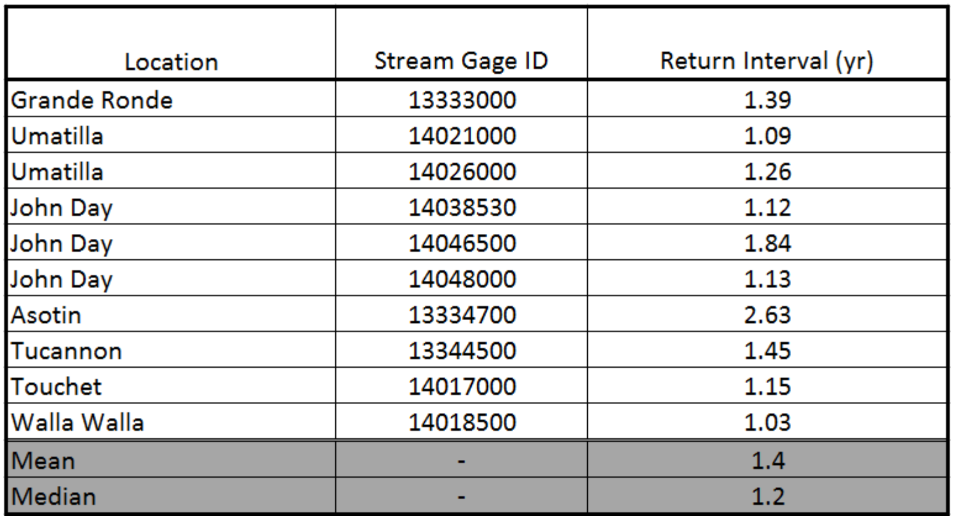
6.2.1 Channel Dimensions

6.2.1.1 Bankfull Discharge

Initial steps for design of the channel included defining the cross-sectional area to convey average discharges in the Grande Ronde River and to connect with the floodplain more often and at “normal” rates. The inflection point for a channel or network of channels to convey a discharge to the point where water flows onto the floodplain is often referred to as the “channel forming discharge” or “bankfull discharge”. This discharge is variable and dependent upon multiple factors to include the prime physical and environmental drivers of geology and hydrology for a specific river reach. Bankfull discharge represents “the discharge at which channel maintenance is most effective” that “results in the average channel morphologic characteristics” (Dunne and Leopold, 1978).

A Pacific Northwest regional study to estimate the recurrence interval of bankfull discharge published in 2001 by Castro and Jackson resulted in a regional bankfull discharge estimate for the Eastern Oregon Ecoregion with an average of 1.4-year recurrence and a median of 1.3-year recurrence. For the Bird Track Springs project, 10-nearby sites were selected from the Castro and Jackson study (2001) and tabulated to estimate a project-scale regional bankfull discharge recurrence period. The resulting average project regional recurrence interval for bankfull discharge was 1.4-year recurrence and a median of 1.2-year recurrence (Table 6-X).

Table 6-X Bankfull discharge estimates for ten nearby sites in the vicinity of the Upper Grande Ronde River at Bird Track Springs (Castro and Jackson, 2001)



Location	Stream Gage ID	Return Interval (yr)
Grande Ronde	13333000	1.39
Umatilla	14021000	1.09
Umatilla	14026000	1.26
John Day	14038530	1.12
John Day	14046500	1.84
John Day	14048000	1.13
Asotin	13334700	2.63
Tucannon	13344500	1.45
Touchet	14017000	1.15
Walla Walla	14018500	1.03
Mean	-	1.4
Median	-	1.2

Connectivity to the floodplain is a primary objective of this project. A risk to not meeting project goals and objectives lies in over-estimating the channel capacity. Additionally, limited infrastructure risk in terms of worsening flood conditions exists by having the channel connect to its floodplain. For this specific project, a worsened flood risk exists in keeping flood waters in the channel as a result of ice jamming without adequate floodplain relief.   For these reasons, the design team initially selected a design bankfull discharge closer to that of the project-regional mean of 1.25-year recurrence period.

The 1.25-year recurrence interval discharge was developed based upon historic gaging records at several USGS gages that operated between 1903 and 2015 on the Grande Ronde River. This effort (see Appendix C) established a long term record of approximately 100-years (splicing various records together) and adjusting the long term record to the project site. The 1.25-year discharge has been established (see Appendix C) as 1368 cubic feet per second (cfs) at the upstream limits of the project.

6.2.1.2 Bankfull Width

Channel design for this project relies on riffle features to control channel grade and conveyance. Bankfull widths at riffles were measured at several locations (Figure 6-X) in the field using geomorphic indicators as discussed in Section 3.2. Additionally, wetted widths at these same locations were measured from the existing conditions SRH2D hydraulic model output.

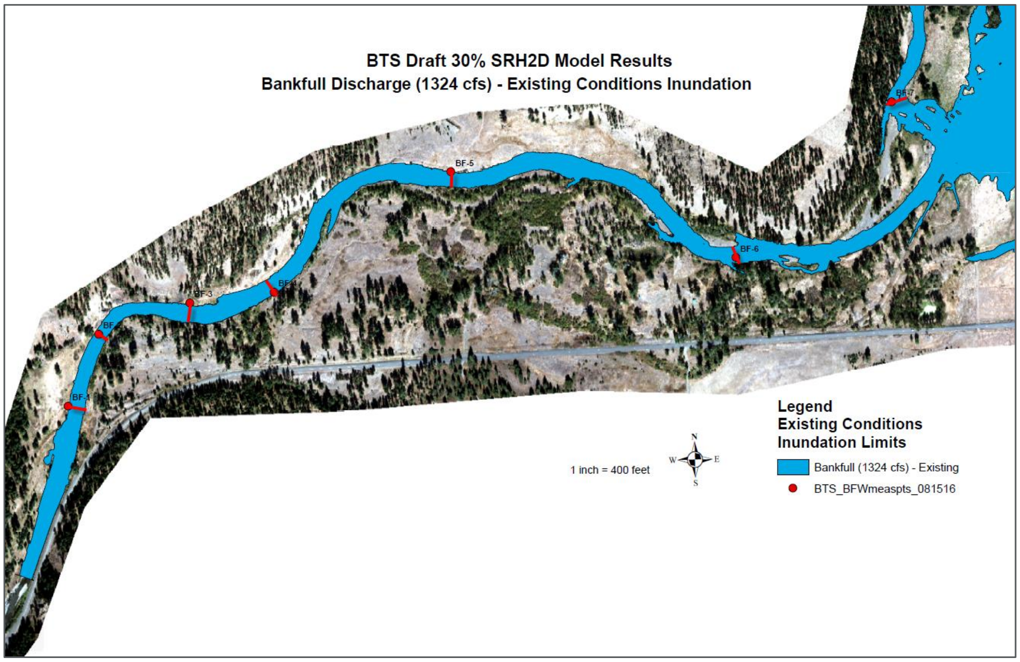
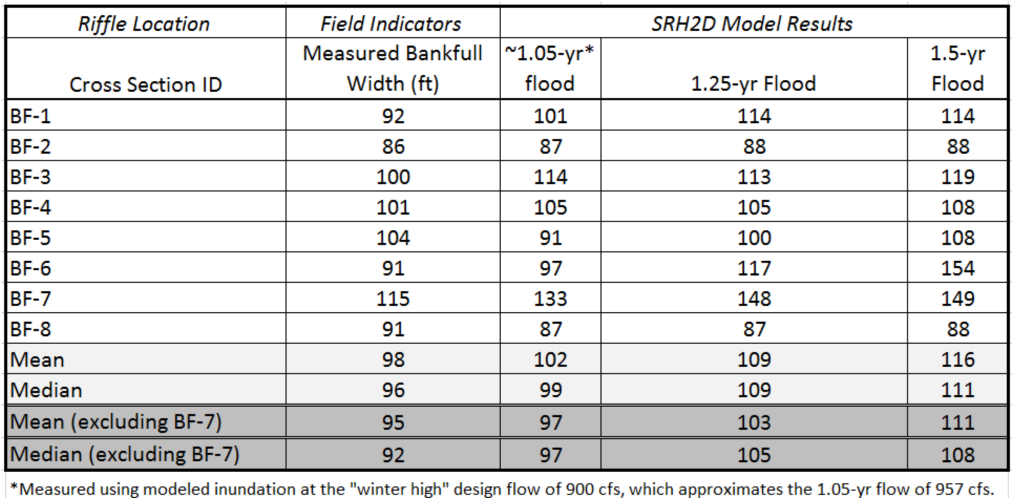


Figure 6-X. **Riffle locations where bankfull channel widths were estimated in the field and later verified from SRH2D model output for the existing conditions channel.**

Table 6-X. **Existing bankfull width estimates from field and model results**



Riffle Location	*Field Indicators*	*SRH2D Model Results*		
Cross Section ID	Measured Bankfull Width (ft)	~1.05-yr* flood	1.25-yr Flood	1.5-yr Flood
BF-1	92	101	114	114
BF-2	86	87	88	88
BF-3	100	114	113	119
BF-4	101	105	105	108
BF-5	104	91	100	108
BF-6	91	97	117	154
BF-7	115	133	148	149
BF-8	91	87	87	88
Mean	98	102	109	116
Median	96	99	109	111
Mean (excluding BF-7)	95	97	103	111
Median (excluding BF-7)	92	97	105	108

*Measured using modeled inundation at the "winter high" design flow of 900 cfs, which approximates the 1.05-yr flow of 957 cfs.

The existing channel widths are not highly variable through the project reach. Field measurements were located at well-defined riffle features with distinct field indicators. Geomorphic Bankfull widths ranged between approximately 86 and 115-feet (Table 6-X). Comparison of the field measurements at geomorphic indicators with modeled wetted-widths at the same locations (Table 6-X) suggest that the field indicators relate closest to the 1.05-year recurrence interval model run. The field measurements and modeled wet widths are consistent for the locations, but the pattern suggests that the 1.25-year discharge over-estimates the geomorphic Bankfull. The field measurements do not encompass the entire wetted-width at each section under the 1.25-year flow.

Comment [VM6]: I have no sweat over this difference at this point in design, but feel we will continue to evaluate and avoid 'over capacity' as we proceed…channel is not in a true geomorphically stable situation, but it is important to note that the field indicators are associated with a slightly lower flow…nearly the annual event

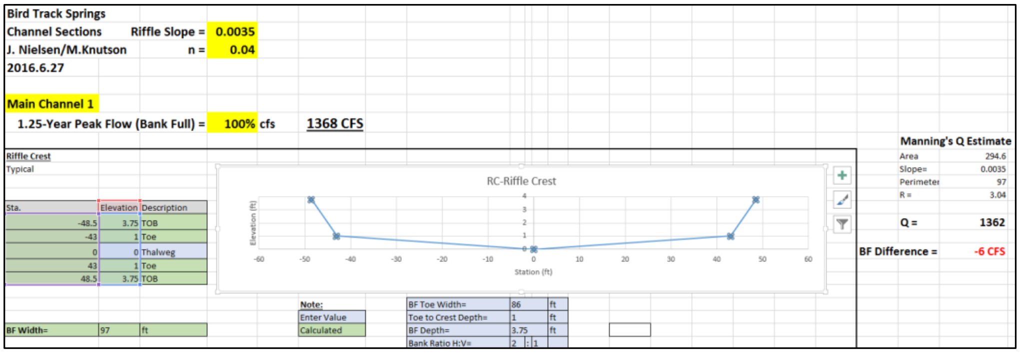
As described above, the design uses the 1.25-year discharge as the foundation for initial channel dimensioning at riffle sections. As an starting point, the mainstem channel is assigned a width of approximately 95 to 100-feet depending upon its local channel slope. At split flows, initial estimates of bankfull channel widths are proportioned based upon desired split flow outcome. These initial estimates provide a framework to begin development of channel sections that will ultimately be refined and designed from the 2-dimensional hydraulic model output and further analysis.

6.2.2 <u>Typical Channel Cross Sections</u>

Channel cross sections were developed for three typical sections riffles, runs, and pools for the design of the proposed horizontal and vertical alignments used in generating the proposed 3D-surface model. A Manning's equation approach was utilized to develop a general shape of each main channel section and side channel for the proposed condition based on the desired proportion of flow in that specific section. The dependent variables in this approach are channel slope, the Manning's roughness factor, and cross sectional area. Slope was calculated for each main channel location and side channel in existing and re-meandering reaches and will be further discussed below. A Manning's N value of 0.04 was assumed based on previous hydraulic analysis and calibration in the project area. Using the Manning's equation a flow rate was calculated and then compared with the desired proportion of 1.25 year discharge for each section. The cross sectional area was then optimized to convey the required portion of the flow.

6.2.2.1 Riffles

Riffle sections and the energy slope between riffles control hydraulics and inundation using this design approach. With an approximate bank-full top width established at 95-100 feet for a 100% of bank-full flow channel (see above), the channel depth and side slope was initially adjusted to optimize the cross sectional area in order to convey the required flow. It was determined that a depth of approximately 3.75feet resulted in a favorable geometry typical of riffles. This depth was then compared with existing topography throughout the project to determine if there was improved floodplain inundation at the 1.25-year discharge and if there was enough elevation to maintain a minimum channel slope of approximately 0.30% to maintain the pool-riffle channel planform and allow for sediment transport through the reach. By assuming this depth, the toe width was further optimized to balance conveyance. A model in Excel was developed to perform the analysis. An example of a 100% of bank-full channel (Figure 6-Y) demonstrates that a riffle section has a top width of 97 feet which is within the targeted bank-full depth of 95-100 feet. For split flow areas and side channels, a similar depth was utilized and the resulting top width of the riffles was proportionally reduced based on the approximate percentage of the flow partitioning assumed for the location.



Bird Track Springs
Channel Sections **Riffle Slope =** **0.0035**
J. Nielsen/M.Knutson **n =** **0.04**
2016.6.27

Main Channel 1
1.25-Year Peak Flow (Bank Full) = **100%** **cfs** **1368 CFS**

Riffle Crest
Typical

Sta.	Elevation	Description
-48.5	3.75	TOB
-43	1	Toe
0	0	Thalweg
43	1	Toe
48.5	3.75	TOB

BF Width= 97 ft

Note:
Enter Value
Calculated

BF Toe Width=	86	ft
Toe to Crest Depth=	1	ft
BF Depth=	3.75	ft
Bank Ratio H:V=	2 : 1	

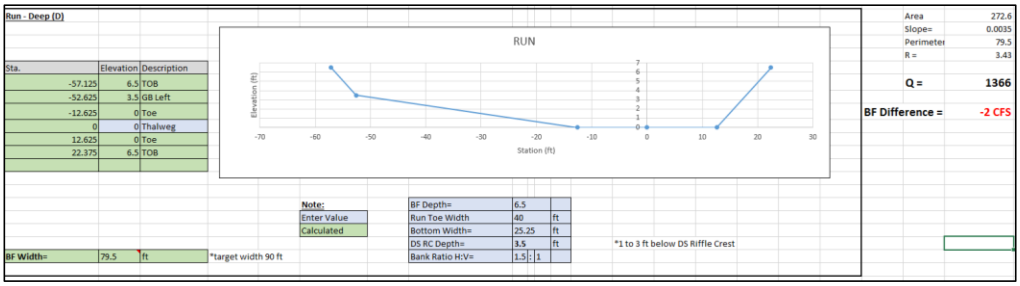
Manning's Q Estimate

Area	294.6
Slope=	0.0035
Perimeter	97
R =	3.04
Q =	**1362**
BF Difference =	**-6 CFS**

Figure 6-Y Typical Riffle Section

6.2.2.2 *Runs*

Run sections are commonly more narrow and deep than riffle sections. The shape of a run can vary considerably depending upon where the section is cut within the run and the thalweg location. Sinuosity and the distance between upstream and downstream riffle crests control the overall width and depth. Runs were characterized as moderate or deep resulting in a bed elevation that was at minimum 1 foot (moderate) and a maximum of 3 feet (deep) below the downstream riffle crest. This results in a bankfull depth between 4.75 and 6.75 feet (typical riffles where designed to be 3.75 feet). Run geometry was adjusted for each channel and side channel location and optimized similarly to the riffle sections using the Excel model. A typical section for a 100% bankfull flow location in a deep run (Figure 6-X), with geometry is optimized to within 2 cfs of 1,368 cfs, results in a bankfull depth of 6.5 feet and a top width of 79.5 feet.



Run - Deep (D)

Sta.	Elevation	Description
-57.125	6.5	TOB
-52.625	3.5	GB Left
-12.625	0	Toe
0	0	Thalweg
12.625	0	Toe
22.375	6.5	TOB

BF Width= 79.5 ft *target width 90 ft

Note:
Enter Value
Calculated

BF Depth=	6.5	
Run Toe Width	40	ft
Bottom Width=	25.25	ft
DS RC Depth=	3.5	ft
Bank Ratio H:V=	1.5 : 1	

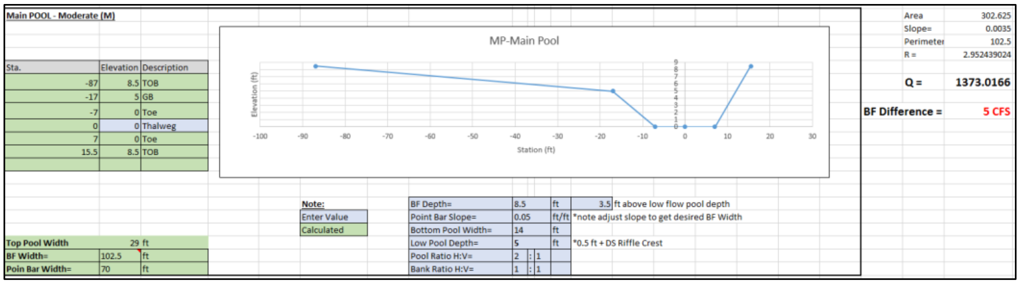
*1 to 3 ft below DS Riffle Crest

Area	272.6
Slope=	0.0035
Perimeter	79.5
R =	3.43
Q =	**1366**
BF Difference =	**-2 CFS**

Figure 6-X Typical Run Section

6.2.2.3 *Pools*

Pool sections similar to runs vary considerably depending upon where the section is cut, the sinuosity and distance between the upstream and downstream riffle crests. The sinuosity affects the hydraulic forcing and resulting depth of scour, point bar width and shape, and the bottom width and shape. Our approach was to characterize pools as shallow, moderate, or deep resulting in a bed elevation that was 4 feet (shallow), 5 feet (moderate), or 6 feet (deep) below the downstream riffle crest during low flow conditions. The type was determined by the sinuosity and expected stream power at each location. The expected depths were correlated with a few existing pools within and near the project area where most are shallow and only the most forced locations result in deep pools. The bank-full depth was typically 3.75 feet (typical riffle bank-full depth) higher than the low flow depth for each. Pool geometry was adjusted for each channel and side channel pool location and optimized similarly to the riffle sections using the Excel model. A typical section for a 100% bank-full flow location in a moderate pool (Figure 6-Z) with optimized geometry has a bankfull depth of 8.5 ft. and a top width of 102.5 ft.



Main POOL - Moderate (M)

Sta.	Elevation	Description
-87	8.5	TOB
-17	5	GB
-7	0	Toe
0	0	Thalweg
7	0	Toe
15.5	8.5	TOB

Top Pool Width	29	ft
BF Width=	102.5	ft
Poin Bar Width=	70	ft

Note:
Enter Value
Calculated

BF Depth=	8.5	ft	3.5	ft above low flow pool depth
Point Bar Slope=	0.05	ft/ft		*note adjust slope to get desired BF Width
Bottom Pool Width=	14	ft		
Low Pool Depth=	5	ft		*0.5 ft + DS Riffle Crest
Pool Ratio H:V=	2 : 1			
Bank Ratio H:V=	1 : 1			

Area	302.625
Slope=	0.0035
Perimeter	102.5
R =	2.952439024
Q =	1373.0166
BF Difference =	5 CFS

Figure 6-Z **Typical Moderate Pool Section**

6.2.3 Horizontal Channel Alignment

The 15-percent preferred alternative was the basis for further developing the horizontal alignments for the main and side channels in the project area. The goal moving towards 30-percent was to establish the horizontal alignments to a degree in which the channel and side channel thalweg locations would not change dramatically moving towards final design. Major changes beyond 30-percent design horizontally result in a considerable effort of analysis that require revising hydraulic models, risk analysis, plan sets, and the required permitting for implementation.

In an effort to minimize the potential for major changes beyond 30% design, the project team staked out the preferred alignments in the field and then made adjustments based on avoidance of existing vegetation, opportunities to activate existing topographic features such as channel networks and low floodplains, and opportunities for additional flow partitioning to access potential existing habitat/shading. Using Real Time Kinematic (RTK) survey, the team established channel boundaries, approximate centerline (thalweg) of channels, and features to avoid or enhance. These data were brought into AutoCad Civil 3D and designers utilized the typical channel cross sections discussed above to establish channel boundaries and create the initial the planform. Further adjustment to planform was made based on flow partitioning and side channel activation goals. The preferred alignments evolved considerably in several areas. Many existing mature trees were avoided and the River Complexity Index (RCI) increased substantially with the increased sinuosity and number of channel junctions.

Additionally, opportunities to enhance the preferred alternative occurred halfway through 30-percent design when private landowners enabled further restoration activities on their property. In particular, the Jordan Creek Ranch Corral area came on board as the owners are likely to enter into an agreement to move the corral upland onto the south side of Highway 244 away from the river corridor. This has allowed for further enhancement of the corral area including improving connection of the existing South Channel and improving the excavated pond into a simulated beaver complex. Other opportunities are likely to occur at the entrance to the Bear Creek Ranch Meadow Channel potentially including bioengineering approaches to reduce the risk of channel evulsion, and establishment of riparian vegetation. In addition cover wood is likely to be placed within the meadow channel. Many of these changes on private property are only partially represented in the 30-percent design and further analysis and detail will occur in these areas moving towards 80-percent.

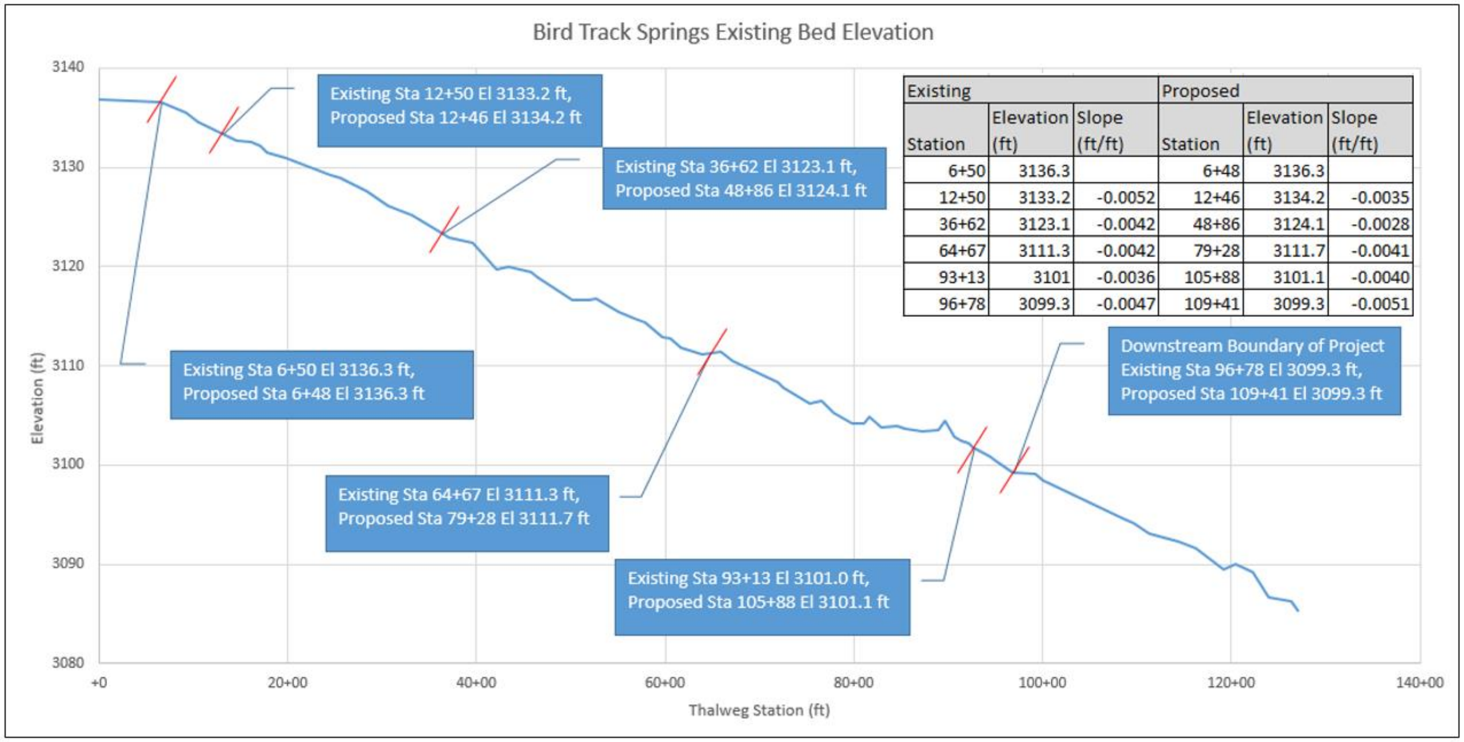
Comment [VM7]: Do we need to state this here or just at the end of the doc about next steps or something?

We also SHOULD note that our geomorphic analysis will be providing input during the 80% design phase about the stability and sustainability of the island-braided channel system; looking at what natural slope, sediment size, discharge would support, and whether bank strengths and LWM and ice jam effects overall will help sustain permanent multiple threads and/or the desired level of channel dynamics.

6.2.4 Vertical Channel Alignment

In addition to bankfull widths at control sections (riffles), channel conveyance is also dependent upon the channel hydraulic slope between riffle crests (bankfull channel slope). Bankfull channel slopes were developed to meet physical conditions along the project alignment. This was an iterative process in which channel feature breakpoints (riffle, pool, run) were assumed based upon horizontal alignments. Bankfull channel slopes were calculated and assigned to unique sections and then alignments and features were adjusted to meet specific vertical requirements.

Under the existing conditions, the Grande Ronde River slope ranges between 0.36% on the upper end of the project to 0.46% through the middle of the project and back to 0.37% upstream of Bear Creek Ranch. The proposed mainstem channel has an increased length of approximately 1,260-feet, and therefore has an overall decreased slope through the project. Design considerations channel slope included ensuring that the proposed channel tie ins to the existing channel at downstream riffle control at station 109+41 and upstream at the existing upstream riffle control at station 6+48 are stable. The proposed channel bed is located at the same elevation as existing at these two points. It is slightly raised in elevation through the middle reach at station 44+86, then reduced up to the upstream tie-in at station 6+48. In the reach near the entrance to the Bear Creek Ranch Meadow Channel, the proposed channel slope is higher than existing to encourage sediment transport. The difference in channel elevation and slope is compared at key locations along the existing main channel where the proposed channel ties into the existing channel in Figure 6-X.



Existing Sta 12+50 El 3133.2 ft, Proposed Sta 12+46 El 3134.2 ft

Existing Sta 36+62 El 3123.1 ft, Proposed Sta 48+86 El 3124.1 ft

Existing Sta 6+50 El 3136.3 ft, Proposed Sta 6+48 El 3136.3 ft

Downstream Boundary of Project Existing Sta 96+78 El 3099.3 ft, Proposed Sta 109+41 El 3099.3 ft

Existing Sta 64+67 El 3111.3 ft, Proposed Sta 79+28 El 3111.7 ft

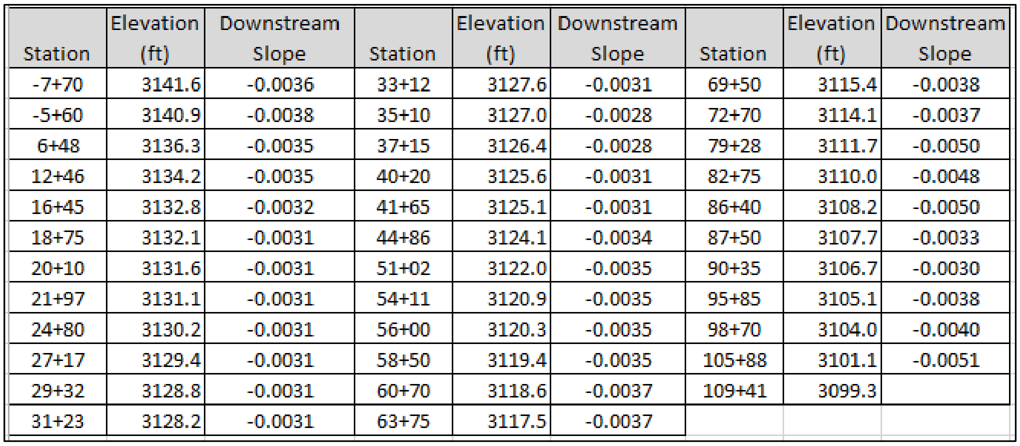
Existing Sta 93+13 El 3101.0 ft, Proposed Sta 105+88 El 3101.1 ft

Existing			Proposed		
Station	Elevation (ft)	Slope (ft/ft)	Station	Elevation (ft)	Slope (ft/ft)
6+50	3136.3		6+48	3136.3	
12+50	3133.2	-0.0052	12+46	3134.2	-0.0035
36+62	3123.1	-0.0042	48+86	3124.1	-0.0028
64+67	3111.3	-0.0042	79+28	3111.7	-0.0041
93+13	3101	-0.0036	105+88	3101.1	-0.0040
96+78	3099.3	-0.0047	109+41	3099.3	-0.0051

Figure 6-X Existing channel bed profile with existing versus proposed elevations at key locations

For the proposed conditions, bankfull channel slopes range between a minimum of 0.28% and a maximum of 0.51%, providing a wider range of channel energy (Table 6-x).

Table 6-x Representative proposed Bankfull channel bed slopes



Station	Elevation (ft)	Downstream Slope	Station	Elevation (ft)	Downstream Slope	Station	Elevation (ft)	Downstream Slope
-7+70	3141.6	-0.0036	33+12	3127.6	-0.0031	69+50	3115.4	-0.0038
-5+60	3140.9	-0.0038	35+10	3127.0	-0.0028	72+70	3114.1	-0.0037
6+48	3136.3	-0.0035	37+15	3126.4	-0.0028	79+28	3111.7	-0.0050
12+46	3134.2	-0.0035	40+20	3125.6	-0.0031	82+75	3110.0	-0.0048
16+45	3132.8	-0.0032	41+65	3125.1	-0.0031	86+40	3108.2	-0.0050
18+75	3132.1	-0.0031	44+86	3124.1	-0.0034	87+50	3107.7	-0.0033
20+10	3131.6	-0.0031	51+02	3122.0	-0.0035	90+35	3106.7	-0.0030
21+97	3131.1	-0.0031	54+11	3120.9	-0.0035	95+85	3105.1	-0.0038
24+80	3130.2	-0.0031	56+00	3120.3	-0.0035	98+70	3104.0	-0.0040
27+17	3129.4	-0.0031	58+50	3119.4	-0.0035	105+88	3101.1	-0.0051
29+32	3128.8	-0.0031	60+70	3118.6	-0.0037	109+41	3099.3	
31+23	3128.2	-0.0031	63+75	3117.5	-0.0037			

Channel features (vertically) between riffle crests were design based upon proposed channel planform including degree of sinuosity, existing features such as trees, and the proposed typical channel sections. Riffles were designed to have slopes ranging between -0.0045 and -0.005 and not exceeding -0.0055. The depth of Runs and Pools was previously discussed in the Channel Cross Sections above. In general, depths were based on observed runs and pools within the project area and were classified as shallow, moderate, and deep depending upon the planform sinuosity, degree of constriction/forcing with anticipated wood structures, and available stream power to work on the channel bed to maintain scour pools. Low flow depths were designed for each based on the depth below downstream riffle crests. Grade breaks from riffles to pools/runs (riffle slopes) and glides from pools/runs to riffles varied considerably depending on sinuosity however riffle slopes and glide slopes were generally targeted at -0.005 and 0.01 feet/feet respectively. With these design criteria, the vertical profile of the main channel and side channels were developed. Figure X below shows the vertical alignment for the proposed main channel.

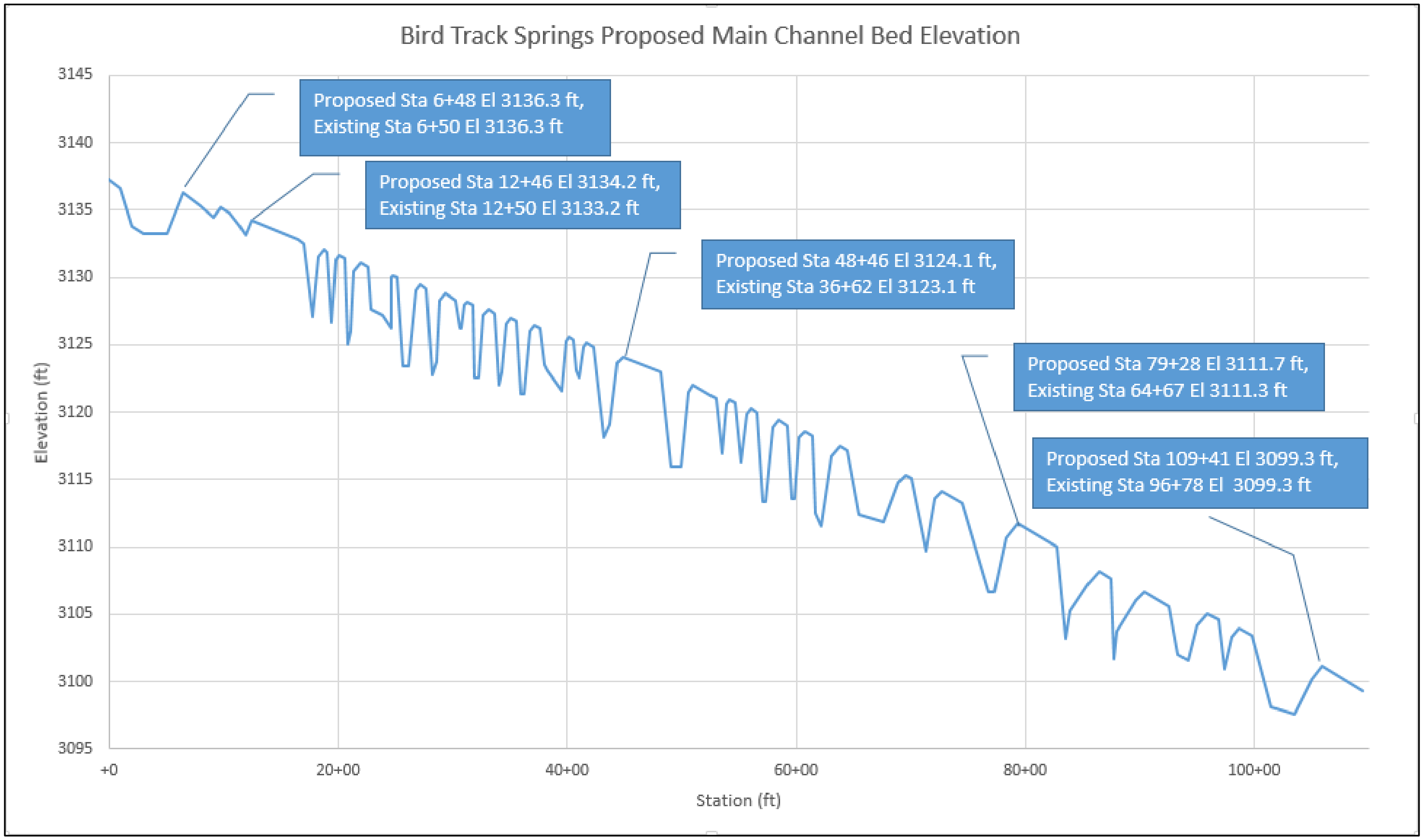


Figure 6-X Proposed channel bed profile with existing versus proposed elevations at key locations

6.2.5 Model Development and Analysis

6.2.5.1 Digital Elevation Modeling (DEM)

Proposed conditions topographic DEM development was performed using AutoCAD Civil 3D 2015. Proposed conditions grading utilized the existing conditions DEM (see Existing Conditions Topography – Section 3.8) as a base. Proposed conditions channel features were developed into a separate DEM (surface) through placement of breakline features at bank tops and toes, channel thalweg, and to represent gravel bar features. The initial DEM for each channel was developed using a horizontal alignment, a vertical alignment, and cross-sections at major channel feature breaks (riffles, runs, and pools). This initial step provided rough channel outlines for each channel. Breaklines were then manually adjusted to fix irregularities and "smooth-out" channels into a more natural form. Surface features (breaklines and triangles) were also adjusted manually at channel junctions. Fill features were developed utilizing additional breaklines and grading tools in AutoCAD Civil 3D. The proposed condition DEM was then overlaid or "pasted" into the existing conditions DEM to form a composite DEM of the proposed condition. Once edited for irregularities, the three-dimensional surface model was ready for use in creating the two-dimensional hydraulic model for analysis.

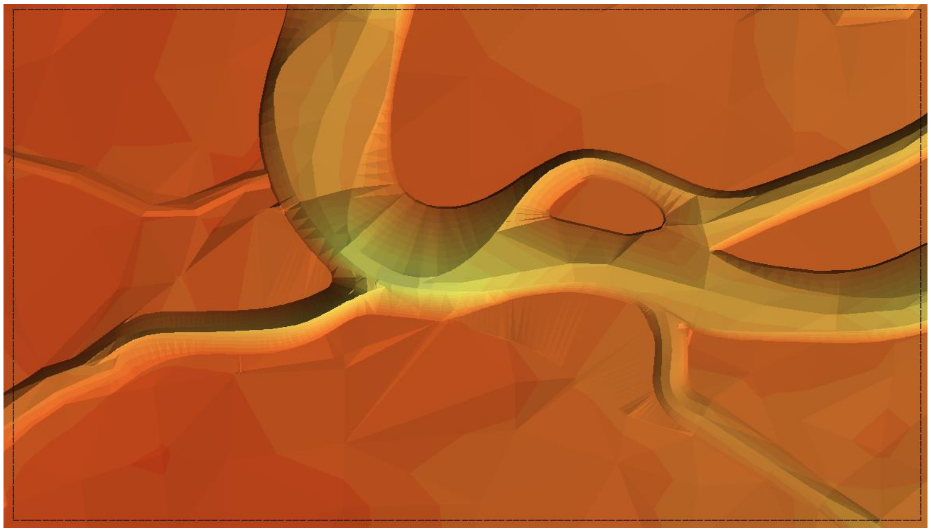


Figure X **Snapshot of the three-dimensional digital elevation model (DEM) created for the project between main channel stations 60+00 and 65+00.**

6.2.5.2 Hydraulic Modeling

Development

The fixed-bed version of the two-dimensional numerical hydraulic model, SRH-2D (Lai, 2008), was utilized to assess the hydraulics and sedimentation effects between the existing and proposed design conditions in the Bird Track Springs project area. The evaluation includes a cursory analysis of model results of flow depth, velocity, shear stress, and potential channel bed mobility (flow competence) results in the project area. In addition, juvenile Chinook rearing habitat suitability was assessed under existing and proposed conditions using Habitat Suitability Index (HSI) methodologies.

The two-dimensional model was developed in Aquaveo SMS Version 11.1 (http://www.aquaveo.com/). The unstructured mesh had a node spacing of up to 1.8 feet within side channel and floodplain channels, decreasing in density to 40 feet on the edge of the model domain boundary. Element size (node density) in the main channel through the project area is generally 5 feet in transverse direction and 10 feet in longitudinal direction. The high mesh element density through the side and floodplain channels was intended to represent the features with as much detail as possible without compromising computational run times. The existing conditions model mesh, which includes areas downstream of the Bird Track Springs project area (Bear Creek and Longley Meadows) has a total of 305,413 nodes and 350,540 elements. The proposed conditions model mesh, which simulates only the Bird Track Springs project area has 218,709 elements. The following figure represents the two-dimensional model mesh for the Bird Track Springs proposed project conditions at 30% design between Main Channel Station 60+00 and 65+00:

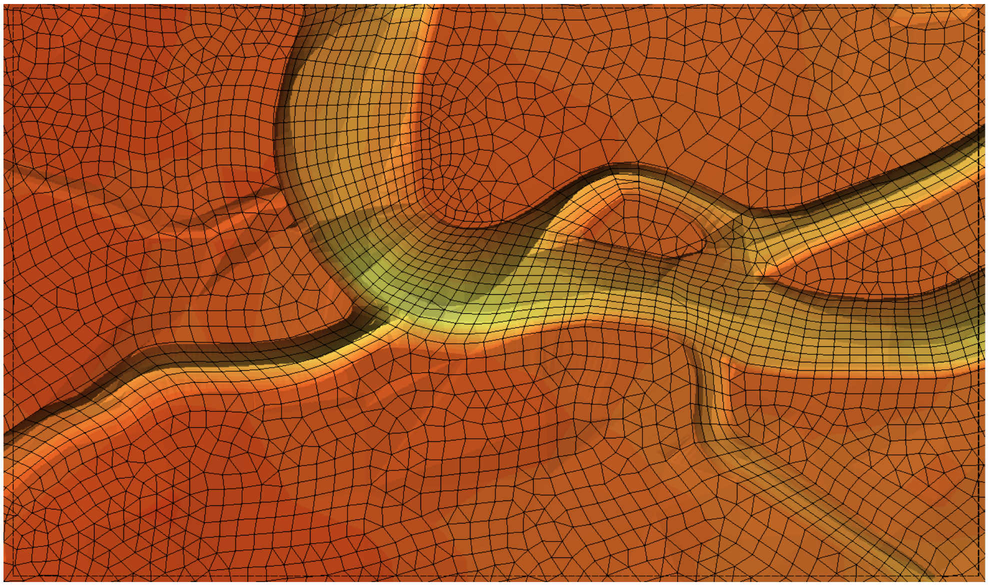
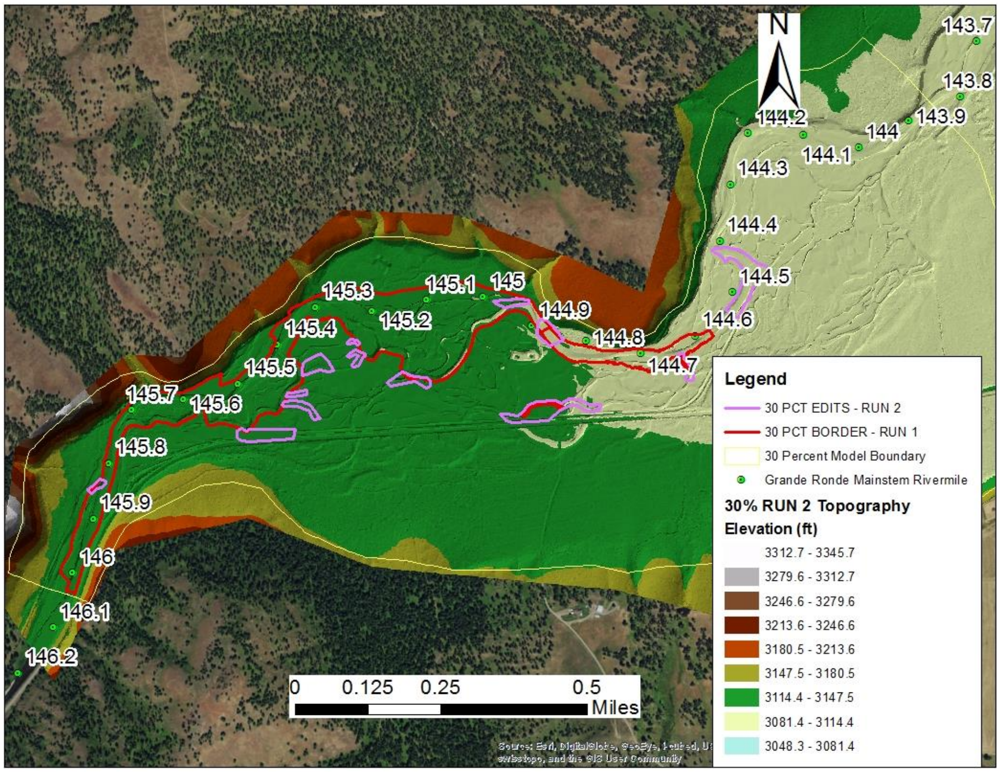


Figure X **Thirty-Percent Design Proposed Conditions Model Mesh Layout and Density – Example Location at Main Channel between approximate stations 60+00 to 65+00.**

Multiple steady-state discharges were simulated in the SRH-2D model. Table X presents the discharges simulated for both existing and proposed conditions for the Mainstem Grande Ronde River, estimated from the most recent hydrology study (Appendix F). Two iterations of proposed conditions topography were created for the 30 Percent design (Figure X), which was built off the 15-percent Channel Reconstruction Design Alternative (Figure X).

Table X **Mainstem Grande Ronde River (GRR) Flood Frequency Peak Discharges Provided by Cardno.**

Design Flow Description	Flow (cfs)	Exceedance Statistic
Low Flow (Winter and Summer)	18	95% exceedance for critical winter rearing period (October-March). 50% exceedance flow for August.
Winter Median Flow	82	50% exceedance for critical winter rearing period (Oct.-Mar.).
Median March Flow	400	Approximately the 50% exceedance flow for March.
Winter High Flow	900	5% exceedance for critical winter rearing period (Oct.-Mar.).
1.25-year	1,368	
1.5-year	1,654	
2-year	2,029	
5-year	3,072	
10-year	3,847	
25-year	4,922	
100-year	6,719	



Source: Esri, DigitalGlobe, GeoEye, i-cubed, U
swisstopo, and the GIS User Community

Figure X **30 Percent Design Channel Reconstruction Alternative Conditions Topography–Bird Track Springs Project Area**

Further detail of the hydraulic and habitat suitability modeling methodologies not discussed in the body of this BDR report can be referenced in Appendix E – Grande Ronde River Numerical Hydraulic Modeling Study – Bird Track Springs Project Area, 15% and 30% Designs.

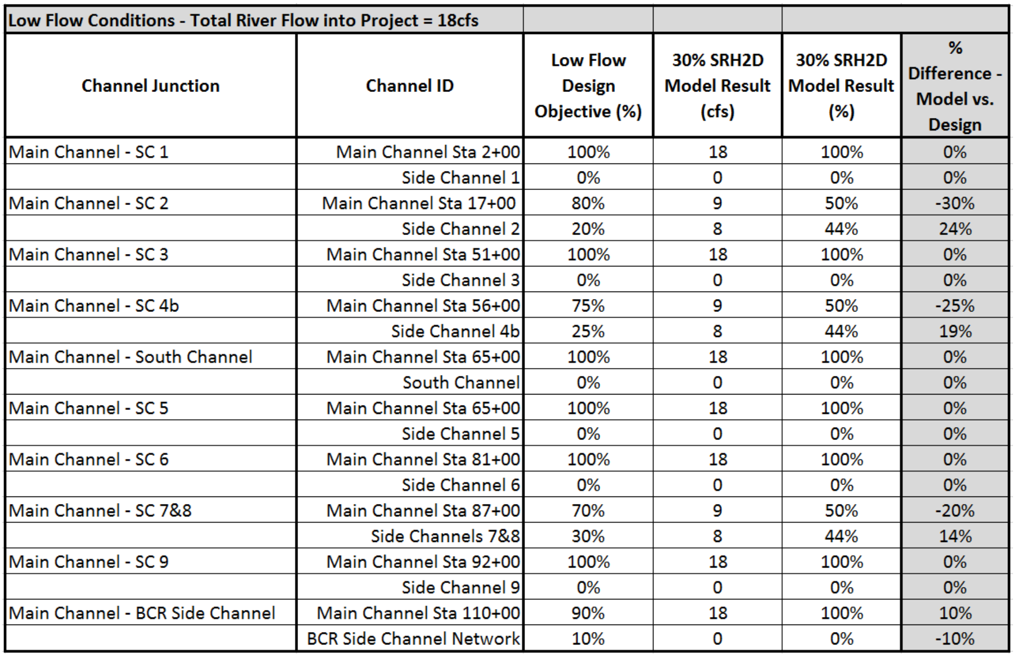
Analysis

Channel design for this project relies heavily on analysis of the proposed conditions 2-dimensional model. Channel design for this project is iterative, where a DEM is developed, modeled, analyzed, refined, and modeled again. Channel features that do not perform as planned are adjusted in an attempt to balance channel design objectives. The two-dimensional model is then run for the refined conditions and re-analyzed.   This process continues until objectives of the design are reasonably met. Once objectives are met, new features (such as wood, alcoves, side channels) are then added and the model is refined with the added features. Further model-analysis-refinement iterations are performed until the project design meets all objectives and is considered final. For proposed conditions of the Bird Track Springs Project, three milestones are anticipated to document this iterative process: 30% design, 80% design, and Final Design.

At the 30% design level, the emphasis of the channel design process was on establishing channel horizontal planform, main channel splitting of flows, and establishing connectivity to the floodplain. Large wood features were not modeled at this level of design. Channel bed features were not refined for erosion or deposition, but were reviewed to ensure reasonable and flagged for further refinement. Habitat suitability modeling was performed in the same fashion as that provided for alternative selection (see Appendix O.) Habitat suitability results were reviewed and tabulated, but no refinements were made to the 30% design. Future design efforts will focus on these additional details. For the 30% design milestone, two model runs were performed, an initial run of the preferred alternative and a second model run where edits were made to improve specific objectives of channel-floodplain connectivity and channel sizing. The following sections describe channel split flow objectives and resulting split flows, followed be a discussion of connectivity to ephemeral channels and the floodplain at the 30% design stage of this project.

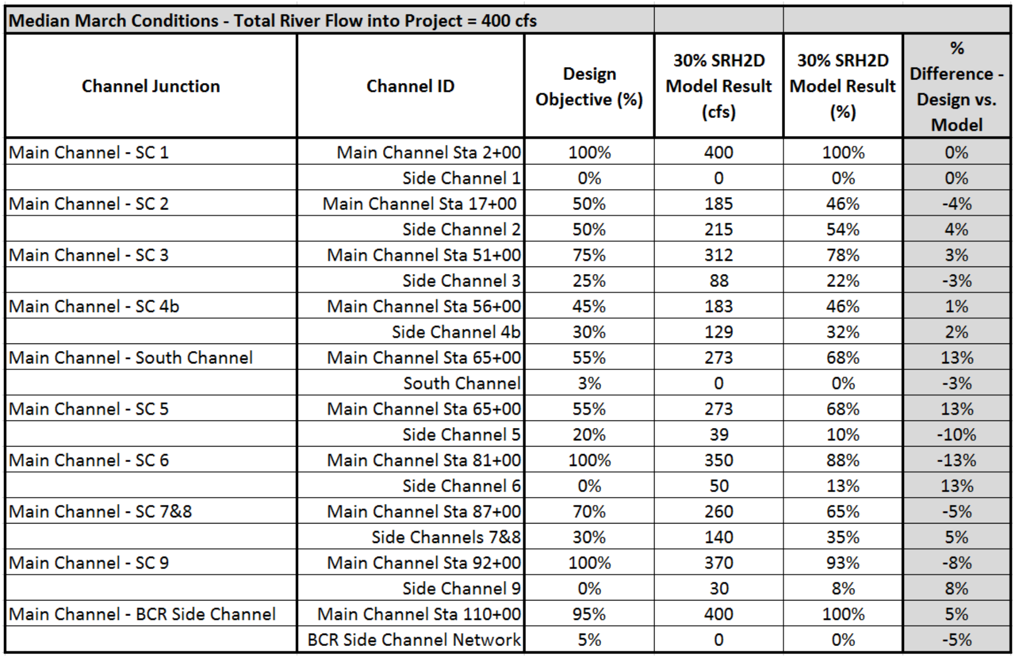
6.2.5.3 Flow Splits and Junction Design

At the 30% design phase, the Bird Track Springs Project has ten major channel flow splits along with multiple minor channel flow splits. This section details channel flow split objectives and results at the 30% design level. For 30-percent design, split flows at junctions were initially developed using geometric sizing and invert elevations of each channel's initial riffle control section. Initial channels were sized for a specific design percentage of the bankfull discharge. Riffle inverts were assigned an estimated elevation to initiate the flow split. The 30% model run (second run) was a refinement of initial channel invert riffle elevations. Future model iterations will continue refinement of channel junctions until all sediment and split flow objectives are reasonably achieved. The following tables display results of split flows at each of the ten major channel junctions for low flows through bankfull discharge conditions, followed by a discussion of each major channel junction in more detail.



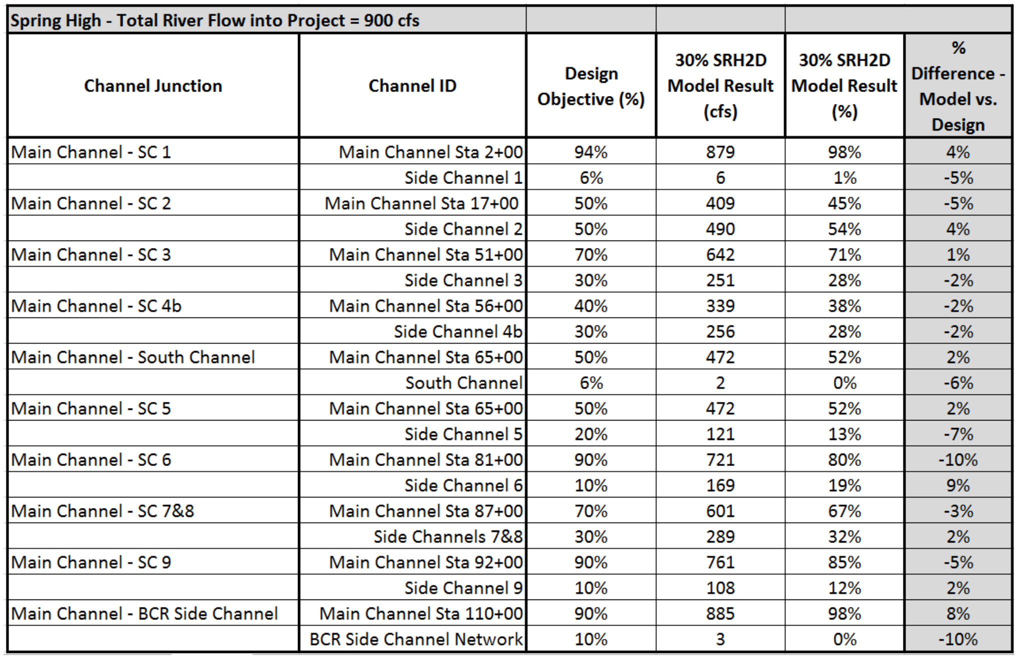
Low Flow Conditions - Total River Flow into Project = 18cfs					
Channel Junction	Channel ID	Low Flow Design Objective (%)	30% SRH2D Model Result (cfs)	30% SRH2D Model Result (%)	% Difference - Model vs. Design
Main Channel - SC 1	Main Channel Sta 2+00	100%	18	100%	0%
	Side Channel 1	0%	0	0%	0%
Main Channel - SC 2	Main Channel Sta 17+00	80%	9	50%	-30%
	Side Channel 2	20%	8	44%	24%
Main Channel - SC 3	Main Channel Sta 51+00	100%	18	100%	0%
	Side Channel 3	0%	0	0%	0%
Main Channel - SC 4b	Main Channel Sta 56+00	75%	9	50%	-25%
	Side Channel 4b	25%	8	44%	19%
Main Channel - South Channel	Main Channel Sta 65+00	100%	18	100%	0%
	South Channel	0%	0	0%	0%
Main Channel - SC 5	Main Channel Sta 65+00	100%	18	100%	0%
	Side Channel 5	0%	0	0%	0%
Main Channel - SC 6	Main Channel Sta 81+00	100%	18	100%	0%
	Side Channel 6	0%	0	0%	0%
Main Channel - SC 7&8	Main Channel Sta 87+00	70%	9	50%	-20%
	Side Channels 7&8	30%	8	44%	14%
Main Channel - SC 9	Main Channel Sta 92+00	100%	18	100%	0%
	Side Channel 9	0%	0	0%	0%
Main Channel - BCR Side Channel	Main Channel Sta 110+00	90%	18	100%	10%
	BCR Side Channel Network	10%	0	0%	-10%

Figure X **Low Flow (18 cfs) - Flow Splits at Major Channel Junctions – 30% Proposed Model versus Design Objective.**



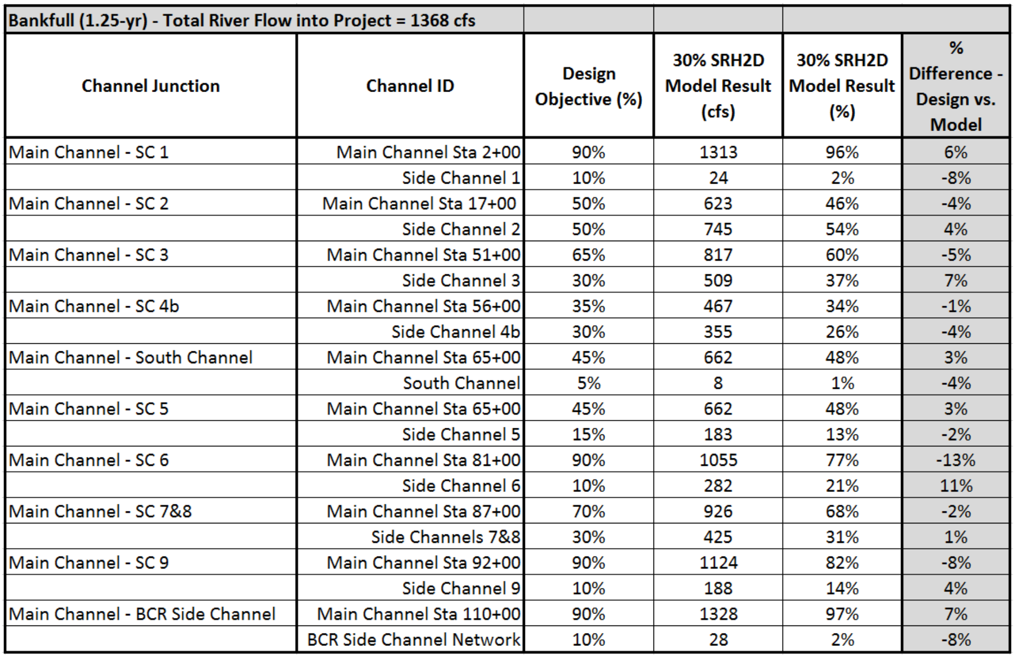
Median March Conditions - Total River Flow into Project = 400 cfs					
Channel Junction	**Channel ID**	**Design Objective (%)**	**30% SRH2D Model Result (cfs)**	**30% SRH2D Model Result (%)**	**% Difference - Design vs. Model**
Main Channel - SC 1	Main Channel Sta 2+00	100%	400	100%	0%
	Side Channel 1	0%	0	0%	0%
Main Channel - SC 2	Main Channel Sta 17+00	50%	185	46%	-4%
	Side Channel 2	50%	215	54%	4%
Main Channel - SC 3	Main Channel Sta 51+00	75%	312	78%	3%
	Side Channel 3	25%	88	22%	-3%
Main Channel - SC 4b	Main Channel Sta 56+00	45%	183	46%	1%
	Side Channel 4b	30%	129	32%	2%
Main Channel - South Channel	Main Channel Sta 65+00	55%	273	68%	13%
	South Channel	3%	0	0%	-3%
Main Channel - SC 5	Main Channel Sta 65+00	55%	273	68%	13%
	Side Channel 5	20%	39	10%	-10%
Main Channel - SC 6	Main Channel Sta 81+00	100%	350	88%	-13%
	Side Channel 6	0%	50	13%	13%
Main Channel - SC 7&8	Main Channel Sta 87+00	70%	260	65%	-5%
	Side Channels 7&8	30%	140	35%	5%
Main Channel - SC 9	Main Channel Sta 92+00	100%	370	93%	-8%
	Side Channel 9	0%	30	8%	8%
Main Channel - BCR Side Channel	Main Channel Sta 110+00	95%	400	100%	5%
	BCR Side Channel Network	5%	0	0%	-5%

Figure X **Median March Discharge (400 cfs) - Flow Splits at Major Channel Junctions – 30% Proposed Model versus Design Objective.**



Spring High - Total River Flow into Project = 900 cfs					
Channel Junction	Channel ID	Design Objective (%)	30% SRH2D Model Result (cfs)	30% SRH2D Model Result (%)	% Difference - Model vs. Design
Main Channel - SC 1	Main Channel Sta 2+00	94%	879	98%	4%
	Side Channel 1	6%	6	1%	-5%
Main Channel - SC 2	Main Channel Sta 17+00	50%	409	45%	-5%
	Side Channel 2	50%	490	54%	4%
Main Channel - SC 3	Main Channel Sta 51+00	70%	642	71%	1%
	Side Channel 3	30%	251	28%	-2%
Main Channel - SC 4b	Main Channel Sta 56+00	40%	339	38%	-2%
	Side Channel 4b	30%	256	28%	-2%
Main Channel - South Channel	Main Channel Sta 65+00	50%	472	52%	2%
	South Channel	6%	2	0%	-6%
Main Channel - SC 5	Main Channel Sta 65+00	50%	472	52%	2%
	Side Channel 5	20%	121	13%	-7%
Main Channel - SC 6	Main Channel Sta 81+00	90%	721	80%	-10%
	Side Channel 6	10%	169	19%	9%
Main Channel - SC 7&8	Main Channel Sta 87+00	70%	601	67%	-3%
	Side Channels 7&8	30%	289	32%	2%
Main Channel - SC 9	Main Channel Sta 92+00	90%	761	85%	-5%
	Side Channel 9	10%	108	12%	2%
Main Channel - BCR Side Channel	Main Channel Sta 110+00	90%	885	98%	8%
	BCR Side Channel Network	10%	3	0%	-10%

Figure X **Winter high Discharge (900 cfs) - Flow Splits at Major Channel Junctions – 30% Proposed Model versus Design Objective.**



Bankfull (1.25-yr) - Total River Flow into Project = 1368 cfs					
Channel Junction	Channel ID	Design Objective (%)	30% SRH2D Model Result (cfs)	30% SRH2D Model Result (%)	% Difference - Design vs. Model
Main Channel - SC 1	Main Channel Sta 2+00	90%	1313	96%	6%
	Side Channel 1	10%	24	2%	-8%
Main Channel - SC 2	Main Channel Sta 17+00	50%	623	46%	-4%
	Side Channel 2	50%	745	54%	4%
Main Channel - SC 3	Main Channel Sta 51+00	65%	817	60%	-5%
	Side Channel 3	30%	509	37%	7%
Main Channel - SC 4b	Main Channel Sta 56+00	35%	467	34%	-1%
	Side Channel 4b	30%	355	26%	-4%
Main Channel - South Channel	Main Channel Sta 65+00	45%	662	48%	3%
	South Channel	5%	8	1%	-4%
Main Channel - SC 5	Main Channel Sta 65+00	45%	662	48%	3%
	Side Channel 5	15%	183	13%	-2%
Main Channel - SC 6	Main Channel Sta 81+00	90%	1055	77%	-13%
	Side Channel 6	10%	282	21%	11%
Main Channel - SC 7&8	Main Channel Sta 87+00	70%	926	68%	-2%
	Side Channels 7&8	30%	425	31%	1%
Main Channel - SC 9	Main Channel Sta 92+00	90%	1124	82%	-8%
	Side Channel 9	10%	188	14%	4%
Main Channel - BCR Side Channel	Main Channel Sta 110+00	90%	1328	97%	7%
	BCR Side Channel Network	10%	28	2%	-8%

Figure X **Bankfull Discharge (1368 cfs) - Flow Splits at Major Channel Junctions – 30% Proposed Model versus Design Objective.**

Main Channel Junction with Side Channel 1 (SC1)

As one can see from figure X, an eddy forms at the Main Channel junction with SC1 during high flows, which indicates potential deposition. Designed as a high-overflow channel, low flows do not enter the side channel, but high flows into side channel 1 are lower than designed at 30%. The 30% design model did not incorporate wood or ice. It is anticipated that this channel will receive more flow during icing events as ice collects in the main channel and water spills into this channel. Future design will include adjustments of the apex wood structure to break up the eddy formed at this side channel entrance during high flows along with anticipated future alterations to the Main Channel in this area to increase velocities and route larger sediment through this reach.

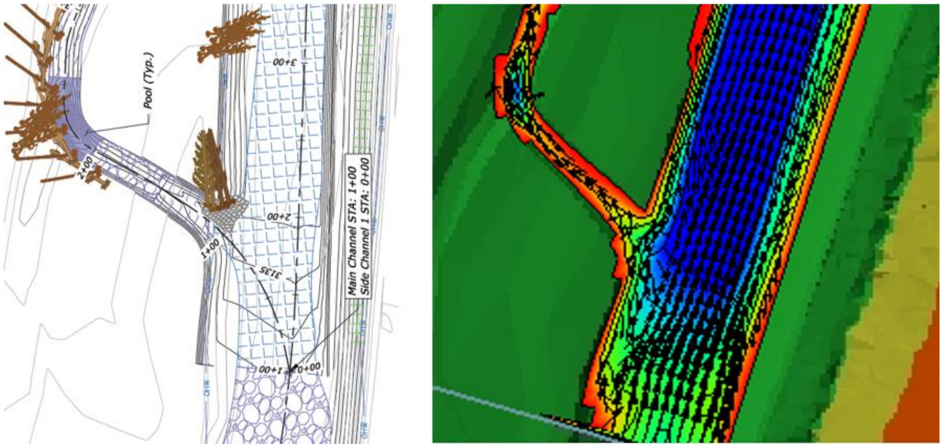


Figure X **Side Channel 1 and Main Channel Junction – plan view alongside 30% - Bankfull (1368 cfs) SRH-2D hydraulic model vectors with color coded depth.**

Main Channel Junction with Side Channel 2 (SC2)

As one can see from figure X, the Main Channel and SC2 essentially split discharges into two fairly equal channels, as designed for this channel junction. However, a design objective for extreme low flows was to keep the majority of flow in the Main Channel with a lesser amount in SC2. Future design efforts will work towards better meeting this objective along with potentially adding a high flow swale feature on the right bank upstream to relieve water pressure during severe icing events.

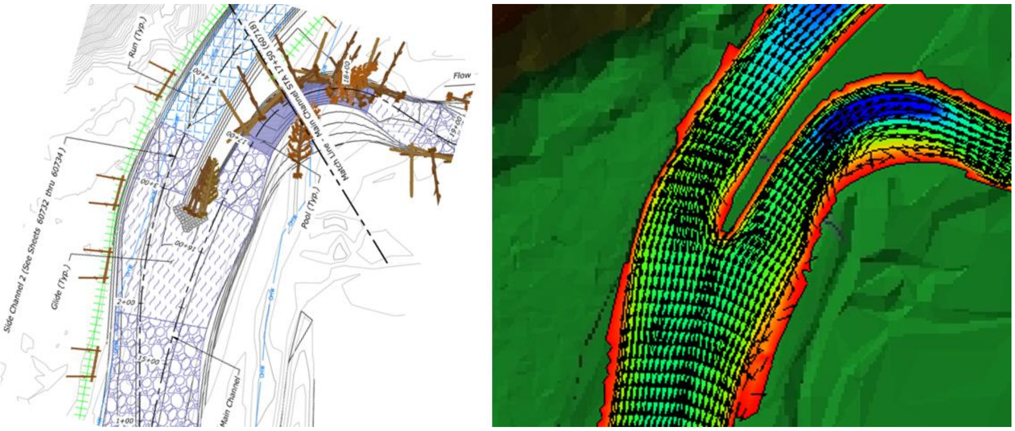


Figure X **Side Channel 2 and Main Channel Junction – plan view alongside 30% - Bankfull (1368 cfs) SRH-2D hydraulic model vectors with color coded depth.**

Main Channel Junction with Side Channel 3 (SC3)

Side channel 3 was designed to flow at and above approximately 100 cfs with no connection at lower discharges. For flows at and above the March median event (400 cfs), this channel has been designed to contain approximately 20-30% of the total river discharge. These basic design objectives have been met. However, as can be seen in the figure, several floodplain overflow paths are activated with discharges as low as 900 cfs that generate additional flow to SC3. Further investigation into these sources will be made with potential grading changes to the floodplain as necessary.

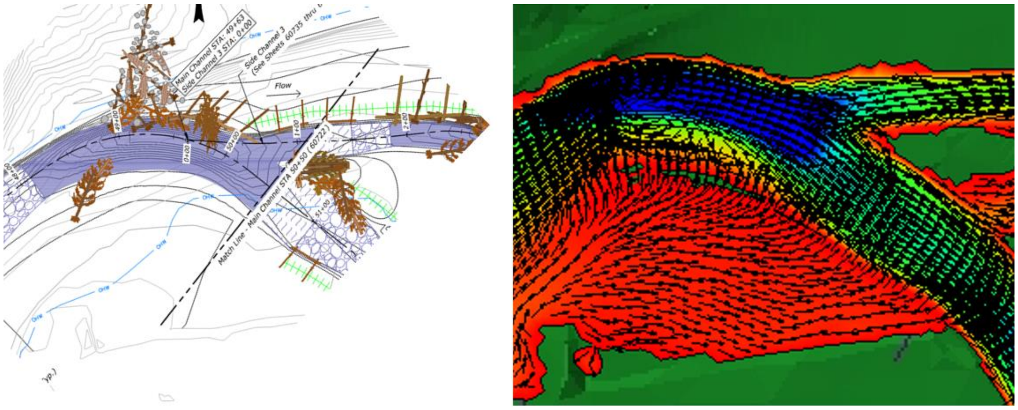


Figure X **Side Channel 3 and Main Channel Junction – plan view alongside 30% - Bankfull (1368 cfs) SRH-2D hydraulic model vectors with color coded depth.**

Main Channel Junction with Side Channel 4 (SC4a and SC4b)

Side channel 4a and 4b were designed to split flows around islands of existing trees and vegetation with channel-spanning large wood features impeding the channel through channel 4b and reconnection through a central bar feature. These dynamic side channels were initially designed to contain approximately 25-30% of the total discharge for all discharges. For 30% design, with the exception of low flow, this has been achieved. In addition to refinement of low flow channel splitting, details of large wood spanning features are yet to be incorporated into the design, with anticipated additional geometric design and model iteration.

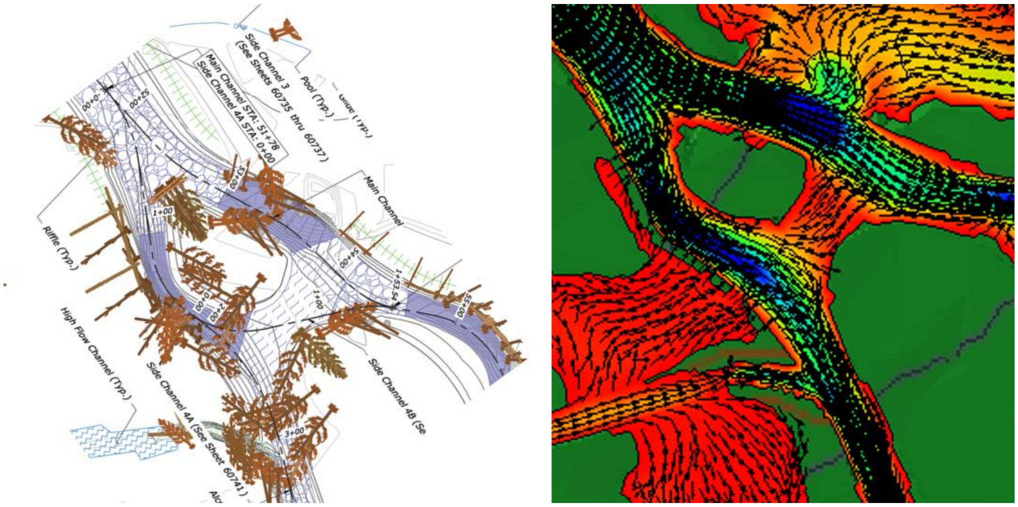


Figure X **Side Channel 4a, Side Channel 4b and Main Channel Junctions – plan view alongside 30% - Bankfull (1368 cfs) SRH-2D hydraulic model vectors with color coded depth.**

Main Channel Junction with Side Channel 5 (SC5) and the "South Channel"

Side channel 5 was designed to flow at and above approximately 100 cfs with no connection below and for discharges exceeding 400 cfs, this channel has been designed to contain between 15% and 20% of the total river discharge. For higher flows, these design objectives have been met. However, additional flow into SC5 is desired at discharges around 100 cfs. This appears to best be accomplished through geometric and large wood design alterations between the upstream "island" feature and the SC5 entrance as currently it appears that a bar feature will be more prominent than desired.

The South Channel has been designed to activate at discharges of approximately 200 cfs and above. Above approximately 200 cfs, the South Channel is designed to contain approximately 3% and 6% of the total river discharge. These objectives have not been met. Additional design will include alterations to the side channel entrance, modifications of the channel at the Jordan Creek Ranch Corrals, and modification to its outlet. Once these changes have been made, the South Channel will be optimized to contain the desired flow split proportion at various discharges through the iterative hydraulic modeling design process.

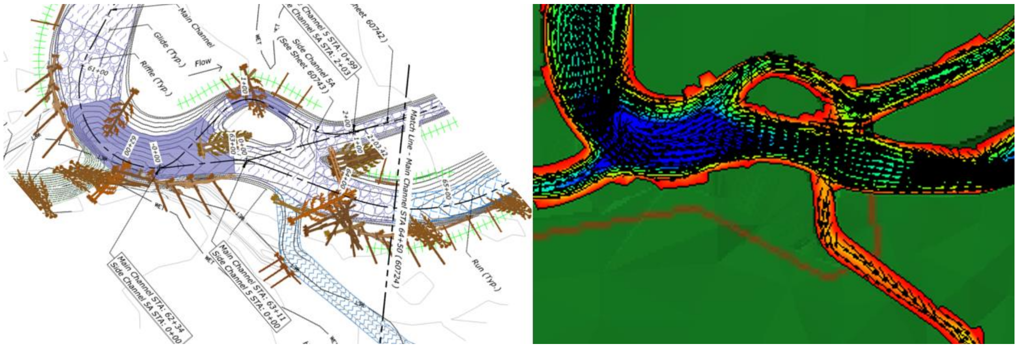


Figure X **Side Channel 5, the South Channel, and the Main Channel Junction – plan view alongside 30% - Bankfull (1368 cfs) SRH-2D hydraulic model vectors with color coded depth.**

Main Channel Junction with Side Channel 6 (SC6)

Side channel 6 was designed as a high overflow channel, designed to activate above approximately 400-to 500 cfs. Above this, the objective for this channel is to convey upwards of approximately 10% of the total river discharge. At 30% design, the channel is activated below 400 cfs and conveys more flow than desired for higher flows. Future design modifications will include alterations to the invert elevation of this channel to reduce flows into side channel 6.

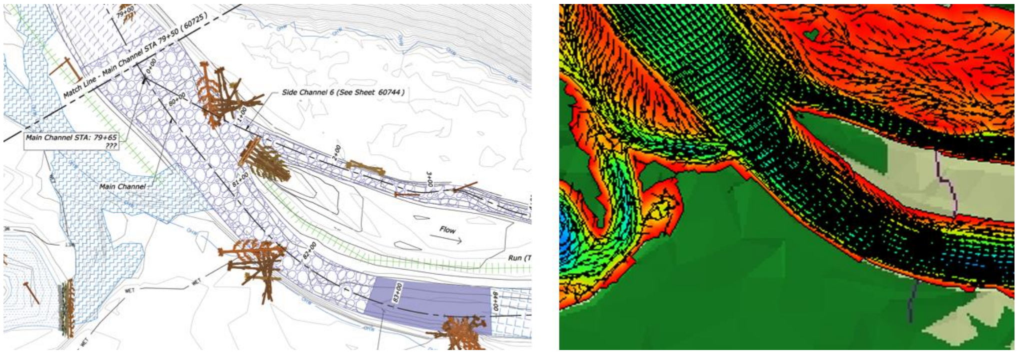


Figure X **Side Channel 6 and Main Channel Junction – plan view alongside 30% - Bankfull (1368 cfs) SRH-2D hydraulic model vectors with color coded depth.**

Main Channel Junction with Side Channel 7 and 8 (SC7 and SC8)

Side channels 7 and 8 were designed to split flows in the main channel. The combination of the two side channels were to contain approximately 30% of the total river discharge for all flows. This has nearly been achieved, however, these side channels are currently passing too much of the flow during lower flow conditions. This will be modified through geometric changes to these side channels to include riffle invert adjustment and large wood development. Additional future design work will include alterations to both side channel 7 and 8. It is anticipated that Side channel 7 will be a thread of the main channel with relatively high velocities and energy. Side channel 8 will function as a refuge side channel with lower velocities and channel spanning features to develop perennial pools.

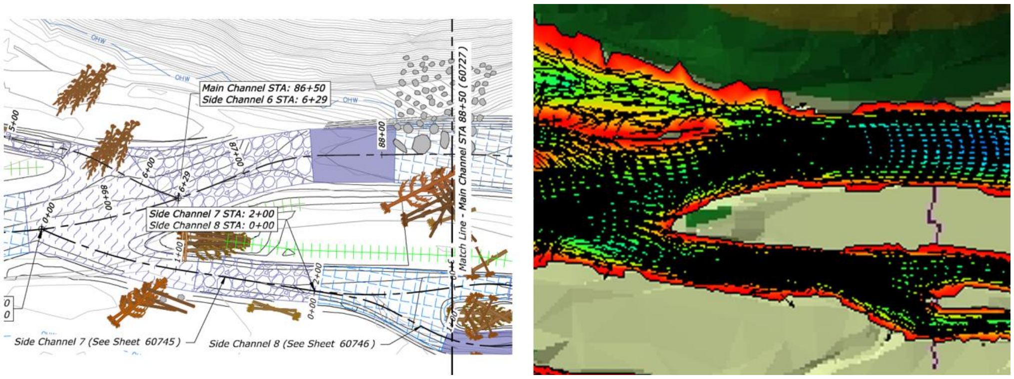


Figure X. Side Channels 7 and 8 and Main Channel Junction – plan view alongside 30% - Bankfull (1368 cfs) SRH-2D hydraulic model vectors with color coded depth.

Main Channel Junction with Side Channel 9 (SC9)

Side channel 9 was designed as a high overflow channel, designed to activate above approximately 600 cfs. Above this, the objective for this channel is to convey upwards of approximately 10% of the total river discharge. At 30% design, the channel is activated below 400 cfs and conveys more flow than desired for higher flows. Future design modifications will include alterations to the invert elevation of this channel to reduce flows into side channel 9.

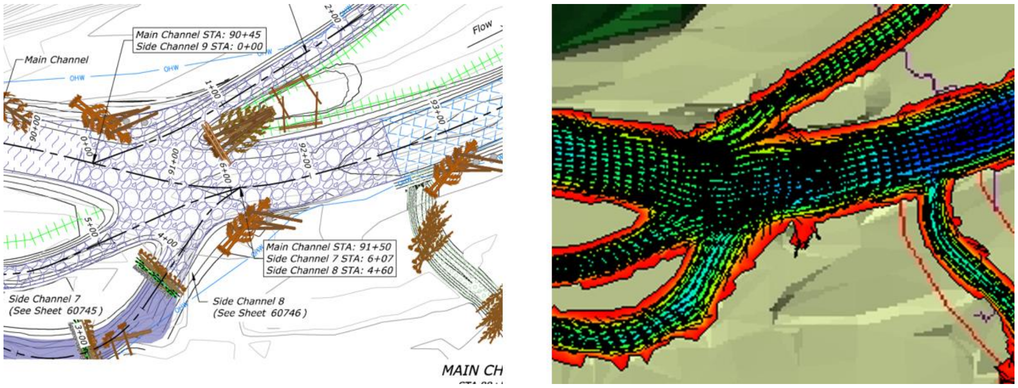


Figure X Side Channel 9 and Main Channel Junction – plan view alongside 30% - Bankfull (1368 cfs) SRH-2D hydraulic model vectors with color coded depth.

Main Channel Junction with Bear Creek Ranch Side Channels

The current overall objective for this dynamic area is to maintain connectivity into the Bear Creek Ranch side channel network, but reduce the potential for Main Channel avulsion through the existing side channel network. To achieve this objective, the design utilizes Main Channel construction, bioengineering, and gravel bar fill placement to direct more discharge into the Main Channel and reduce low flow surface connectivity to the Bear Creek Ranch side channel network. It is anticipated that continued low flow connection will occur through hyporheic exchange and groundwater sources as gravel bar fill will be designed to have specific properties. Initial flow split percentages were approximately 5-20% of the total river discharge for discharges between low flow and bankfull. Surface connection objectives include having an active surface connection at and above approximately 700- to 900 cfs. Surface activation results were close to the objective, but split flow objectives were not achieved at this initial stage of design. Future design work will attempt to achieve these split flow objectives along with balancing all other objectives to include sediment transport through geometric channel adjustment and model iteration at this location.

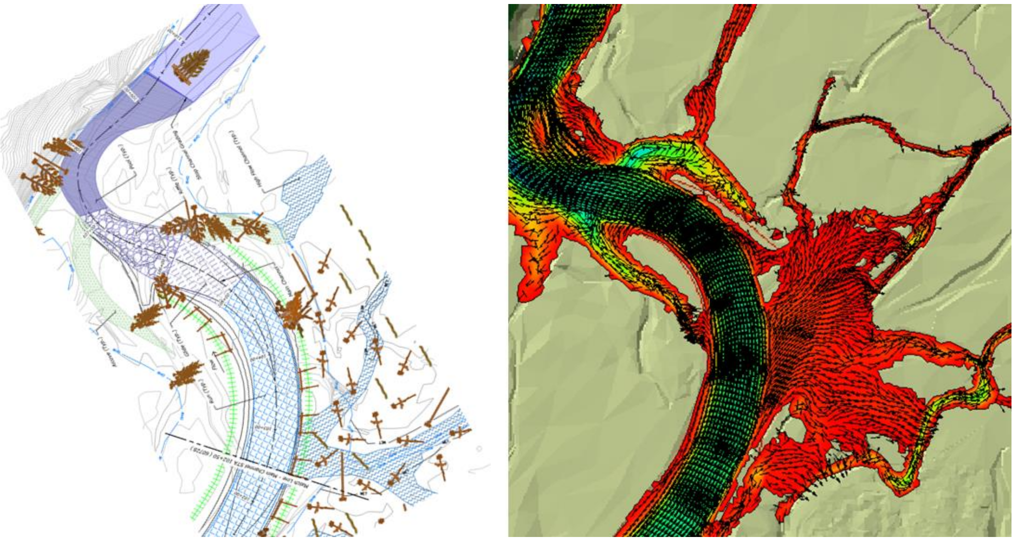


Figure X. Junction of Main Channel with Bear Creek Ranch side channels – plan view alongside 30% - Bankfull (1368 cfs) SRH-2D hydraulic model vectors with color coded depth.

6.2.6 Floodplain Connectivity

As mentioned, one of the major objectives of this project is to re-connect the Upper Grande River to its floodplain throughout the Bird Track Springs Project area. Currently, the river is disconnected from its floodplain within the project reach except for very high (and infrequent) flows. An objective of this project is to establish floodplain connectivity through historic channel scars and ephemeral channels at the annual high flow (1.05-year event) and to increase floodplain connectivity as discharges increase without increasing flood damage to nearby infrastructure or neighboring properties. Another major objective of this project is to re-connect ephemeral channels as side channels and to provide perennial off-channel habitat features as alcoves or connected ponds. This section describes the draft 30% proposed condition results for inundation and ephemeral side channel connectivity for discharges ranging between low flow and the 100-year flood event.

6.2.6.1 Low Flow Inundation –

Low flow conditions (modeled as 18 cfs) occur for long periods during the late summer through early fall, and can also occur through long periods of the winter season. Low flow conditions are critical as they define critical periods of desired rearing fish use and they occur the most frequent and for the longest duration of all flows. The Grande Ronde River experiences severe low flows relative to its watershed size and annual high flow. The existing channel is typically oversized for extreme low flows that tend to be wide and shallow. Several physical objectives coincide with improved conditions for fish during the critical low flow period to include:

- reduce surface area through project under low flow
- provide access to perennial alcoves in low flow
- maximize areas with depth (pool and run features) during low flow
- maximize heterogeneity of channel bed (form and substrate) during low flow

For low flow conditions, the 30% design achieves most of these stated objectives as seen in the following two figures:

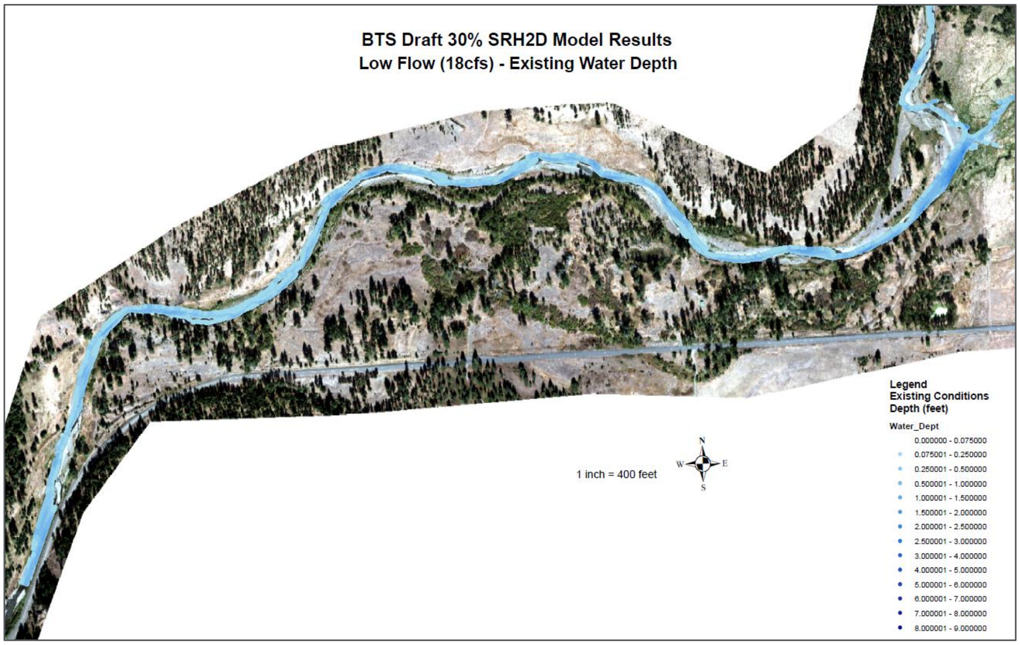


Figure X **Low flow (18cfs) inundation as water depth for the existing conditions through the project area.**

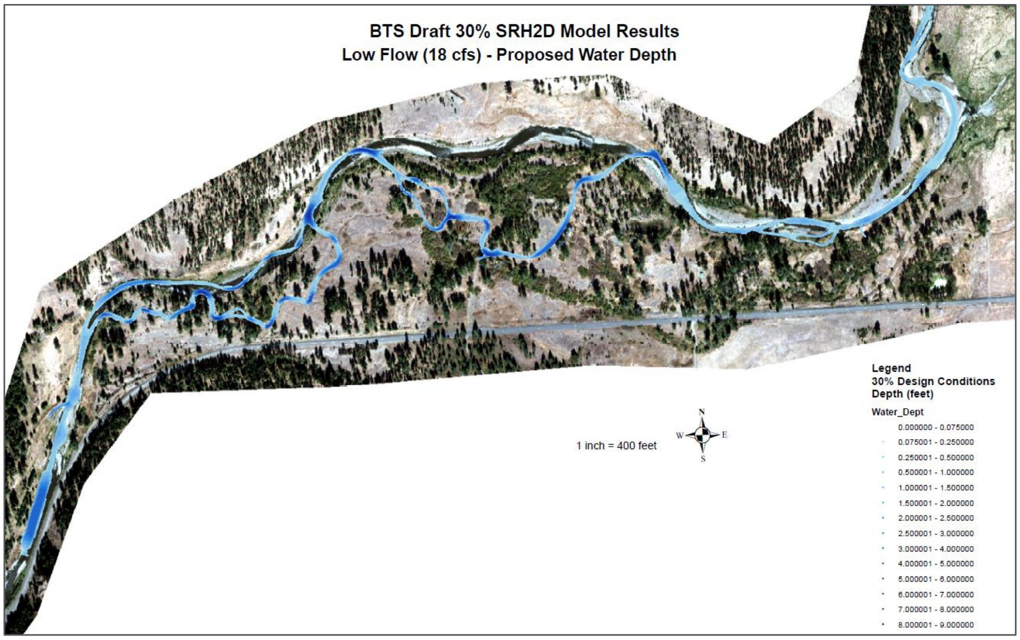


Figure X. Low flow (18cfs) inundation as water depth for the proposed conditions (30% design) through the project area.

As one can see from the existing conditions figure above, the existing channel has no pools greater than 2.5-feet in depth during low flow conditions and very few pools with depths ranging between 1.5- and 2.5-feet deep. Low flow channel widths are consistently wide and shallow with a range between approximately 45- and 85-feet.

For the proposed low flow conditions, approximately 31-areas representing pool, run, and alcove features with low flow depths between 3-feet and 7-feet have been developed at 30% design. All of these deep areas are located in the upper three-quarters of the project (above main channel station 79+00). The lower one-quarter of the project (below main channel station 79+00) shows limited depth improvements at low flow for the 30% design. Low flow channel widths for the proposed conditions are much more variable than existing, ranging between approximately 10-feet at pool and run features to upwards of 80-feet at riffle crests within the lower end of the project.   The intent for design of this lower reach is to maintain the existing conditions planform with instream work to narrow and focus energy using large wood and fill. The upper three-quarters of the project has generally met the objectives of design. Future design work will concentrate on the lower end of the project. Future design work will include additional instream grading and large wood placement to develop perennial pool, run, and alcove features to improve low flow water depths within this area.

6.2.6.2 Annual Winter High (≈1.05-year discharge) Inundation

As stated previously, beyond channel forming objectives, additional objectives for the annual Winter high discharge (≈1.05-year) are to engage with existing floodplain features that include remnant channel scars and ponds such that juvenile fish will have places to hold outside of the main river current and to remain to rear. The Main Channel horizontal alignment was designed to intersect with several remnant channel scars and swales and to then intersect with these features again downstream such that fish utilizing such features would have both access on the upstream side during high flows and would then have perennial access to the channel downstream. The following figure depicts results of inundation and connectivity for the Winter High discharge:

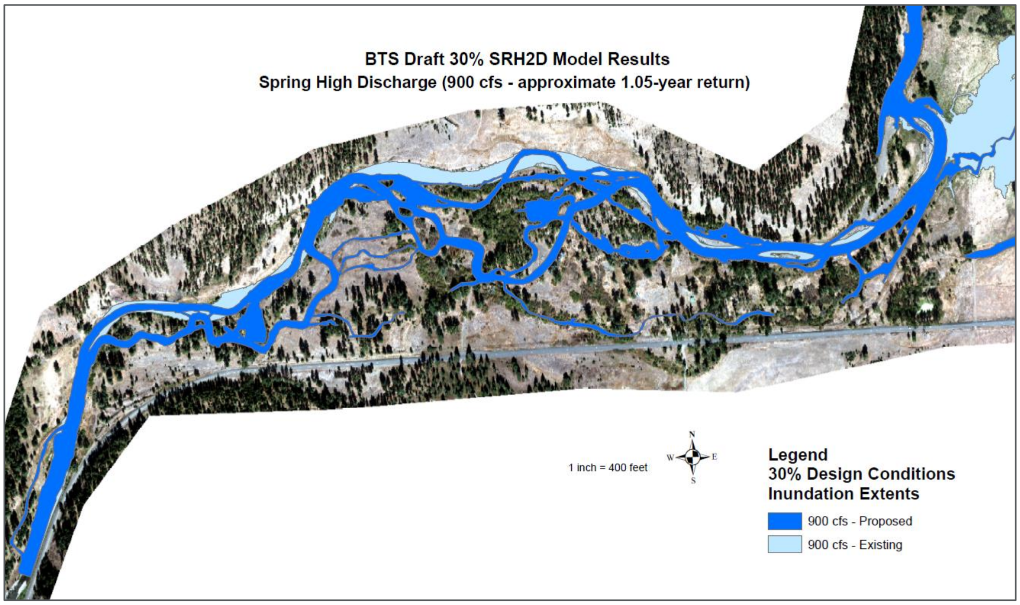


Figure X **Annual Winter High (900 cfs – 1.05-year) inundation for the proposed conditions (30% design).**

As one can see from the figure above, the designed channel network is fully engaged at this discharge with all designed side channels wetted. In addition to designed channels, multiple existing floodplain features are engaged to include several existing ephemeral channels leading to designed alcoves and three existing pond features where beaver either exist or are expected to establish themselves once the project is in place. Also, as a surrogate of potential hyporheic connectivity, the river complexity index (RCI) has skyrocketed from approximately 6 to 60 due to the large number of proposed channel junctions engaged at this discharge compared to the very few number of channel junctions in the existing condition.

6.2.6.3 Flood Inundation

As mentioned, an objective of this project is to increase floodplain connectivity as discharges increase without increasing flood damage to nearby infrastructure or neighboring properties. The preliminary 30% design results indicate that this has been achieved for the project with only one minor increased flooding of Highway 244 to re-evaluate. As discharges increase from the annual winter high flow, wetted floodplain area and connectivity continues to expand as shown in the following table:

Table X. Area in acres of inundation for floods for the 30% proposed conditions.

Flood Event	Inundation Area (acres)**	% Increase in wetted area***
1.05-year*	45 ac	0%

1.25-year	66 ac	46%
2-year	110 ac	67%
10-year	176 ac	60%
100-year	223 ac	27%

Notes:

*≈1.05-yr discharge (900 cfs), area computed from model domain-does not include entire Bear Creek Ranch, ***% increase from previous tabulated flood event

For 30% design, channels were initially sized to convey bankfull conditions with new channel banks “carved out” of the existing topography. Addition of berms along low points in the new channel banks to contain the bankfull discharge was not performed. Future design of the proposed channel network will evaluate where and when the river connects to existing floodplain features at low points along banks to identify locations where the channel has opportunities to engage with the floodplain or where some fill may be needed. As one can see in the following figure of bankfull inundation, the channel engages with the floodplain to a greater extent than at the 1.05-year event and reveals locations where additional floodplain opportunities will be explored along with areas in need of attention in the form of additional fill to narrow and focus stream energy. The iterative channel design process will continue until objectives of have been fully met.

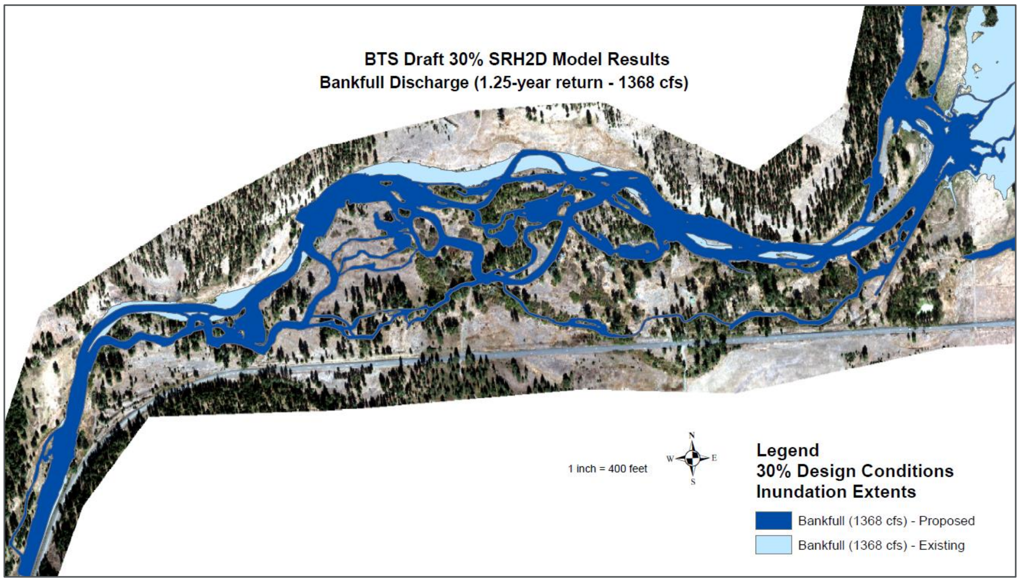


Figure X **Bankfull (1.25-year recurrence – 1368 cfs) inundation extents for proposed conditions (30% design).**

The 2-year flood inundation results depict a large improvement to floodplain connectivity as the 100-year floodplain area is nearly 50% flooded during this event as opposed to almost no floodplain inundation at the 2-year event for the existing conditions. Similarly, the 10-year flood shows large improvements and expands the 2-year floodplain by approximately 60%. The differences in area between these two floods and between smaller (i.e. 1.25-year) and larger (i.e. 100-year) floods indicate that the active floodplain will be wide ranging in terms of inundation timing and duration, which will likely lead to a mosaic of riparian vegetation types as desired.

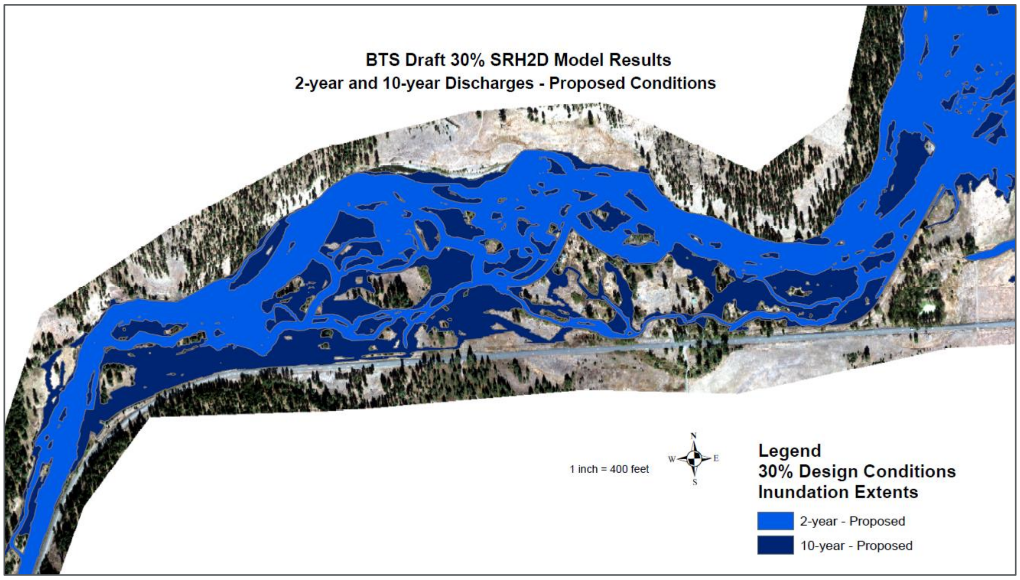


Figure X **2-year and 10-year flood inundation extents for the proposed conditions (30% design).**

As one can see from the following two figures, inundation limits for the 100-year flood do not change substantially from the existing conditions. There are a few instances on the north side of the floodplain where inundation has been slightly reduced and one area just east of the Bird Track Springs Campground where the 100-year flood now overtops Highway 244. This minor increase in flooding across Highway 244 will be addressed through fill placement in the next design iteration. From these results, it is assumed that no additional flooding will occur from the 100-year flood event on Oregon Highway 244. Minor differences in flooding are also evident within the neighboring downstream property (Bear Creek Ranch) for the 100-year flood event. The majority of these minor differences indicate a slight reduction in flood inundation extent, likely due to the improved mainstem channel conveyance for the draft proposed conditions.

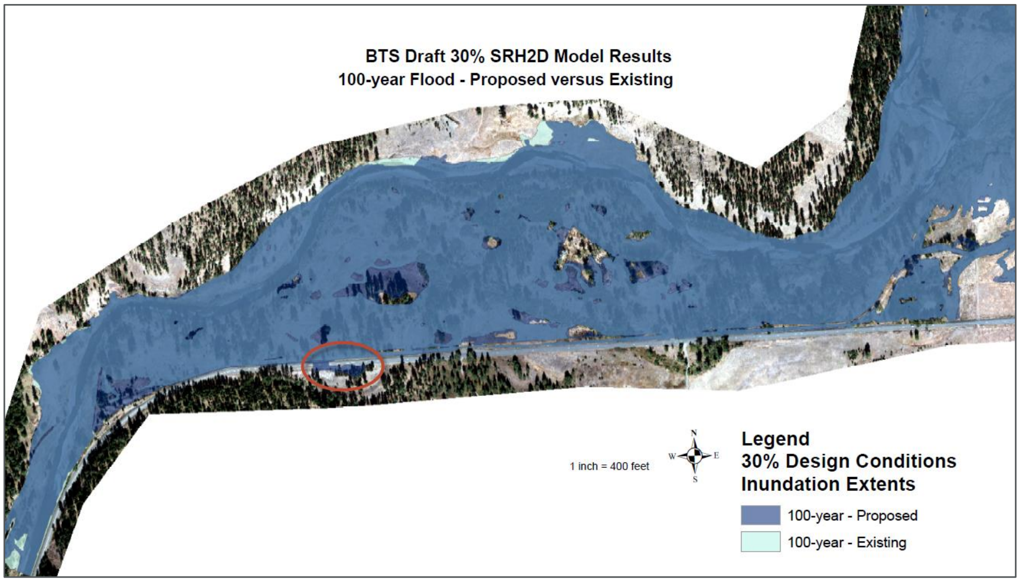


Figure X 100-year flood inundation extents for the proposed (30% design) and existing conditions through the project area. (Note – area of flooding over Highway 244 highlighted by red oval.)

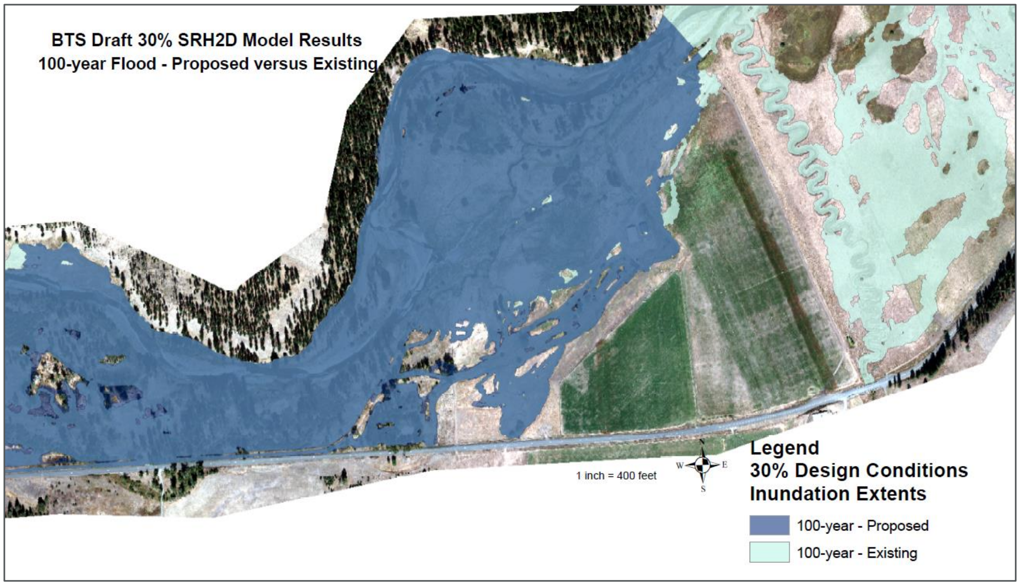


Figure X 100-year flood inundation extents for the proposed (30% design) and existing conditions at the downstream end of the project and through neighboring private property (Bear Creek Ranch).

6.2.7 Sediment Transport

Pebble count particle size data has been collected along the channel in the Bird Track Springs project area by Reclamation staff in fall 2015 and by Cardno Staff in fall 2016. Figure X presents the particle size distributions of the collected data. Under existing conditions, the channel bed riffle median particle sizes (d_{50}) range from very coarse gravel to small cobbles (64 to 100 mm), while the median particle size of depositional (bar) features are noticeably finer in size (very coarse gravel) and range from 45 to 64mm. Channel bank and high flow areas are even finer in median particle size, ranging from 16 to 32 mm.

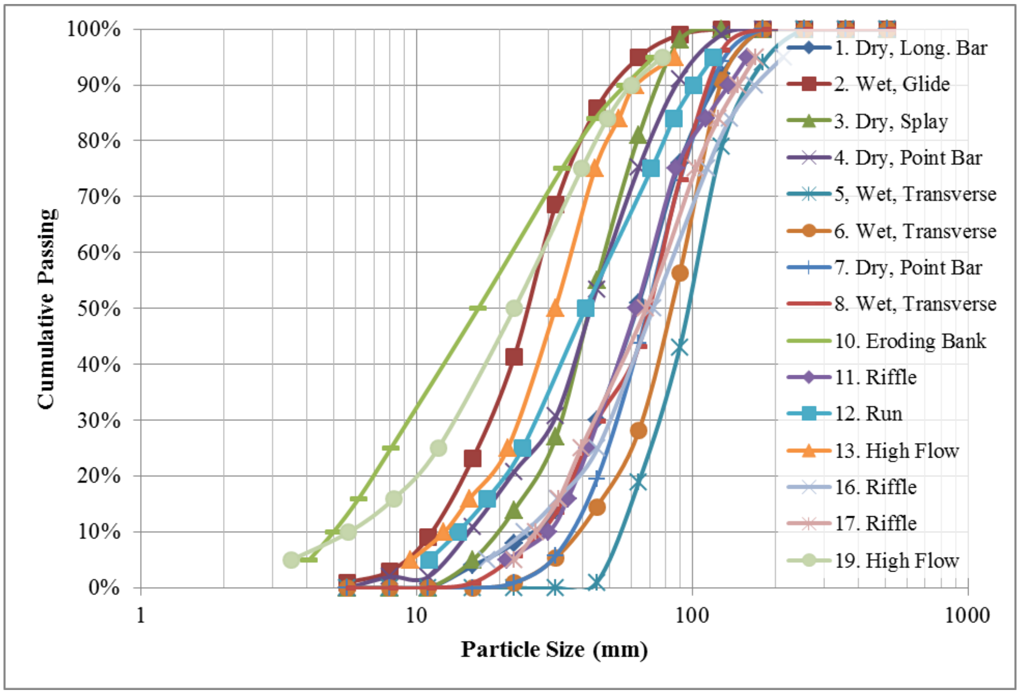
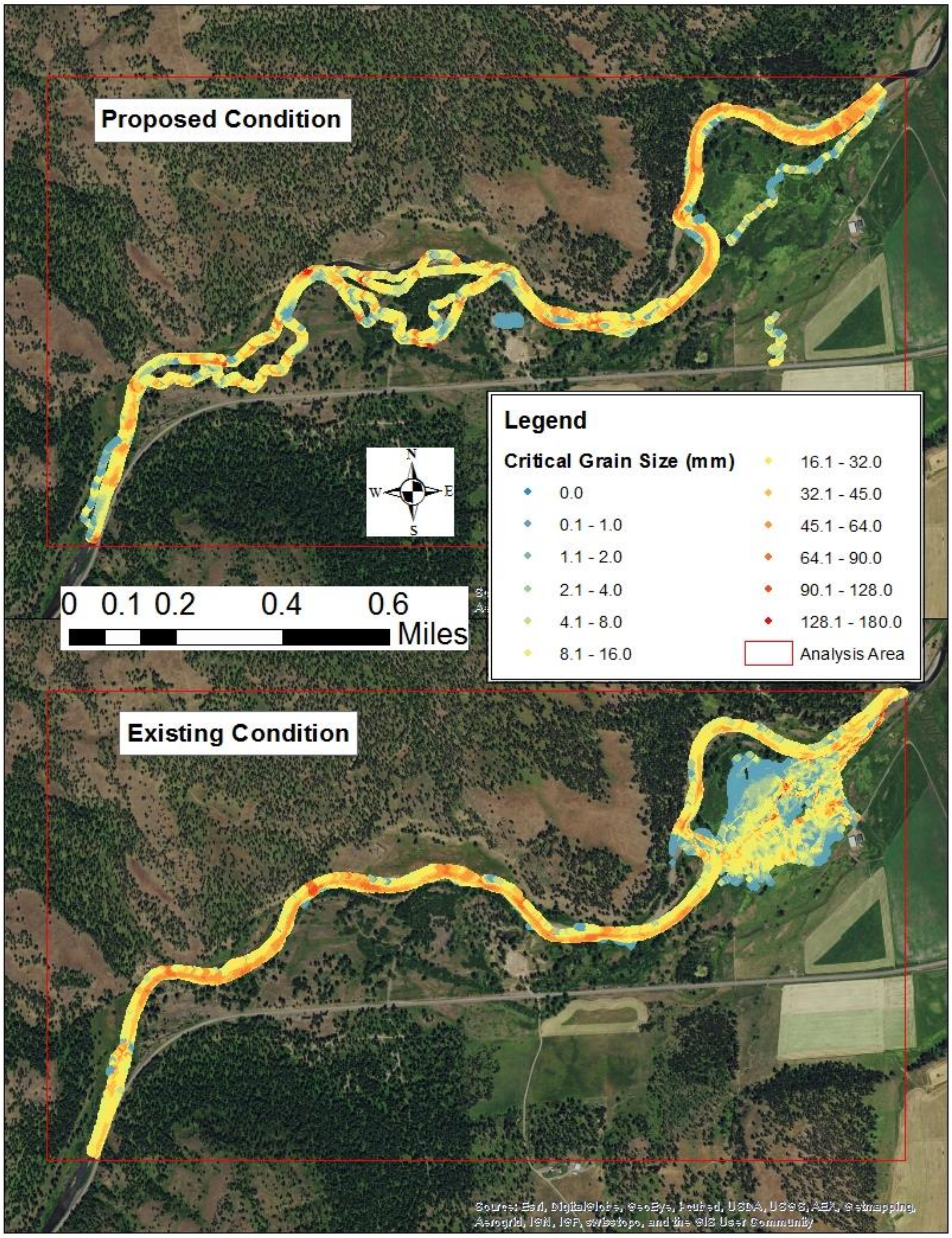


Figure X **Sediment Particle Size Distributions of Reclamation RTS (1-8) and Cardno (10-19) Pebble Count Samples**

To provide the ability to assess the potential of future geomorphic change (erosion/deposition) and the stability of the existing and proposed features in the project area, the critical grain size at incipient motion (i.e. flow competence) was calculated at each element center in the SRH-2D model mesh for a given discharge. This analysis can be helpful in lieu of not having information of upstream sediment supply to be able to perform a full-blown sediment transport analysis with a mobile-bed sediment transport model. Further description of the methodology can be referenced in the Hydraulic Modeling Appendix Report (Appendix X).

During the 30% design phase, increased attention was given to conditions during the 1.25-year discharge (1368 cfs), as this discharge was set as the general threshold of bankfull conditions and when flows begin to access the floodplain in the project area (Figure X). Only the 1.25-year discharge was assessed for channel change and stability in this design phase, nonetheless, flow competence at multiple discharges can be analyzed to assess the robustness of the proposed design features under varying flow conditions.



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure X **Critical Grain Size at Incipient Motion for the 1.25-year event between Existing and 30% Design Proposed Conditions.**

In Figure X, under the existing condition and during the 1.25-year discharge, model results show that much of the particles finer than 64 mm would be in motion. Particles smaller than 64 mm (gravels, sands, silt/clay) generally move through the system or deposit on the few bars present within the Project Area.

In Figure X, under the proposed condition and during the 1.25-year discharge, model results show that much of the particles finer than 64 mm would be in motion where riffle crests are to be located in the design. A larger spatial variance (both laterally and longitudinally) in critical particle size is observed, indicating increased storage of smaller particles and particle heterogeneity in the proposed conditions. Furthermore, there are pockets where even cobbles (64 to 180 mm) would be in motion, indicating scour and adjustment relative to the size of particle sizes present in the existing conditions. Increasing the storage of smaller particles (allowing the formation of bars and pools) improves the processes diversifying the channel bed, creating pool habitat for rearing, in addition, expanding peripheral habitat in the channel margins and/or side channels.

It is important to note that there will be some adjustment to the surface upon experiencing high flows and with the general reduction with channel slope, the increase in flow splits, and little knowledge on upstream sediment supply and gradation. It is also important to remember that flows both higher and lower will impart change to the system other than the design discharge (e.g. some pools may get drowned or form out at higher flows, while some may form or be maintained at lower flows).

6.2.8 Habitat Suitability Indices Applied

Rearing habitat suitability was assessed for juvenile Chinook Salmon using the Habitat Suitability Index (HSI) methodology under existing and proposed conditions in the Bird Track Springs project area. For the 30% design phase, both the summer and winter seasons were assessed in the Bird Track Springs and Bear Creek Project Areas under all modeled flows (Low Flow to 100-year discharge). Point-based 2D Hydraulic modeling results of flow depth and depth-average velocity was converted to ArcGIS Rasters in a grid size of 2-ft by 2-ft for comparison between proposed and existing conditions

Spatial distributions of flow depth and depth-average velocity were then imported into the North Arrow Research Habitat Model (http://habitat.northarrowresearch.com/technical_reference/hsi_methodology/), where HSI analyses were performed. Habitat suitability for the summer season was assessed using the Habitat Suitability Curves (HSCs) from Maret et al., (2006) within the Habitat Model. Habitat suitability for the winter season was assessed using the Habitat Suitability Curves (HSCs) developed from microhabitat data in middle Catherine Creek and recommended by Favrot and Horn (2016). The recommended HSCs were added to the Habitat Model via user input. Further description of the methodology can be referenced in Appendix P.

To quantitatively assess the increase in habitat suitability from existing to proposed conditions in the Bird Track Springs Project Area, the Bear Creek project area is excluded. The Bear Creek project area is excluded because of the dynamic change in surface connection actively occurring at this location, and the model limitation of simulating surface flow only in SRH-2D. Tabular results are presented for the winter and summer seasons in Table X and Table X, respectively. Within the Bird Track Springs project area, there is a significant increase in habitat suitability for both seasons and for all flows.

A visual comparison of winter juvenile Chinook rearing Habitat Suitability for all modeled flow discharges between existing and proposed conditions is presented in Appendix X in the Hydraulic Modeling Appendix report. A significant gain in habitat suitability is observed from the existing to the proposed conditions.

Table X **Winter Season WUA by Scenario in only the Bird Track Springs Project Area, all Modeled Discharges**

Scenario	Season	Flow	WUA (acre)	Change
Existing	Winter	Low	0.2	432%
Proposed	Winter	Low	1.0	
Existing	Winter	WinMed	0.4	338%
Proposed	Winter	WinMed	1.6	
Existing	Winter	WinMar	0.8	129%
Proposed	Winter	WinMar	1.8	
Existing	Winter	WinHi	1.1	126%
Proposed	Winter	WinHi	2.5	
Existing	Winter	1.25-yr	1.2	148%
Proposed	Winter	1.25-yr	3.0	
Existing	Winter	1.5-yr	1.2	203%
Proposed	Winter	1.5-yr	3.6	
Existing	Winter	2-yr	1.3	227%
Proposed	Winter	2-yr	4.2	
Existing	Winter	10-yr	3.2	99%
Proposed	Winter	10-yr	6.4	
Existing	Winter	25-yr	5.2	50%
Proposed	Winter	25-yr	7.8	
Existing	Winter	100-yr	7.6	31%
Proposed	Winter	100-yr	9.9	

Table X **Summer Season WUA by Scenario in only the Bird Track Springs Project Area, all Modeled Discharges**

Scenario	Season	Flow	WUA (acre)	Change
Existing	Summer	Low	3.4	73%
Proposed	Summer	Low	5.9	
Existing	Summer	WinMed	4.9	34%
Proposed	Summer	WinMed	6.5	
Existing	Summer	WinMar	5.2	50%
Proposed	Summer	WinMar	7.9	
Existing	Summer	WinHi	7.6	86%
Proposed	Summer	WinHi	14.0	
Existing	Summer	1.25-yr	8.9	100%
Proposed	Summer	1.25-yr	17.7	
Existing	Summer	1.5-yr	12.4	78%
Proposed	Summer	1.5-yr	22.0	
Existing	Summer	2-yr	14.5	75%
Proposed	Summer	2-yr	25.4	
Existing	Summer	10-yr	28.7	44%
Proposed	Summer	10-yr	41.3	
Existing	Summer	25-yr	42.9	9%
Proposed	Summer	25-yr	46.9	
Existing	Summer	100-yr	49.5	1%
Proposed	Summer	100-yr	50.1	

6.2.9 Large Woody Material (LWM)

In general, it is expected that the channel will change horizontally over time. However, in the near term (approximately 15-20 years,) LWM structures have been designed in specific locations throughout the mainstem river corridor to hold channels in place while additional riparian vegetation establishes. LWM has been located based upon split flow locations, direct bank attack, and from bank shear stresses identified in the 2D hydraulic model. Over the longer term, it is expected that natural channel migration rates will prevail throughout much of the proposed project with the exception of those locations identified as critical to break-up ice flows, establish split flows and protect existing infrastructure, such as the highway.

As mentioned, LWM has been designed throughout the project for two specific reasons, to provide initial bank stability (horizontal stability) and for initial habitat cover benefits. Beyond specific locations of bank attack, LWM was added to re-supply this reach of the Upper Grande Ronde River to loading levels that mimic natural recruitment prior to anthropogenic disturbance of the area. It is recognized that LWM features will deteriorate over time and initial LWM loading is intended to provide stability and habitat benefits while surrounding riparian vegetation re-establishes and eventually replaces the LWM added to the project. LWM has been designed through Reclamations' Risk Based Design Process (Reclamation 2014). Several typical LWM features were designed to be utilized throughout the project, while a few unique locations required unique LWM design features, such breaking up ice-flows or highway protection. Design of LWM was also based on the design and post-construction experience of the design team on other similar projects throughout the West. drawing of LWM is included as part of the 30% design package.

Several design criteria for this project apply to all of the LWM structures, to include:

> All visible ends of logs will be cut or broken off to create a natural appearance.

> Racking logs will have irregular and natural appearance and not be stacked.

> Several different sizes and lengths of trees will be supplied locally from the Lowe Family Ranch - an adjacent property owner. The trees will be harvested with rootwads and branches intact to the best extents possible. The log sizes are:
  - Key – greater than 18-inch DBH
  - Medium - 12- to 18-inch DBH
  - Racking - 6- to 12-inch DBH
  - Pinning - 12-inch DHH
  - Tree tops and branches - 1- to 6-inch average diameter

> Native coarse alluvium and selected boulders will be used for ballast.

> Bolted connections will not be used if possible. For stability and risk reduction, sufficient soil and/or boulder ballast will be utilized. At this design stage, no need for bolted connections has been identified.

The on-site construction Contracting Officer is allowed to make field modifications to fit the structure optimally at each site with prior verification from the Engineer of Record.

Comment [MK8]: MY to review

7 Risk Assessment NEW

7.1 Risks and Monitoring

7.2 Literature Review

The Cardno team conducted a literature review to assess if any recreation assessments had previously been completed for the Grande Ronde River. The most recent recreation research for the study area identified through the literature review was the 2014 publication State Scenic Waterway Report: Grande Ronde River. The Report's purpose was to evaluate segments of the Grande Ronde River and determine if designation as an Oregon State Scenic Waterway, under the Scenic Waterway Act. It found that boating opportunities through the project reach were flow-dependent, and generally limited to March throughout late May. It was noted that occasional inner-tubers were seen between Red Bridge and Hilgard.

The report highlighted the Bird Track Springs Interpretive Site, as one main trail, with 5 smaller spur trails, popular with birders, photographers, and general wildlife enthusiasts. The Forest Service describes the use of this location as "light" with users being locals from the surrounding area.

7.3 Site Visit

7.3.1 Recreation Usage Counts

Recreation usage counts began at 7:00 am and were conducted every 3 hours by Cardno staff. Shoreline counts occurred along the south shoreline of the Upper Grande Ronde River at Bird Track Springs (Latitude 45.3012564, Longitude −118.31626099) and concluding at the Bear Creek Ranch (Latitude 45.304394, Longitude −118.294252). A basecamp was also established at the entrance to the Bird Track Interpretive Site (Latitude 45.300546 Longitude -118.307164), as this was the origination point for all foot traffic to the site.

Low river recreation use was observed at 7:00 am, while river use peaked at 1:00 pm (Table 1). As illustrated below, it is common for children to participate in recreational activities within the study area.

Table 6-1 Summary of Recreation Usage Counts

Type of Use	7:00 am		10:00 am		1:00 pm		4:00 pm	
	Adult	Child	Adult	Child	Adult	Child	Adult	Child
Beach/Swimming	0	0	0	0	15	7	2	5
Fishing	0	0	0	0	0	0	3	3
Hiking	0	0	6	6	2	0	0	0
Birdwatching	0	0	0	0	1	0	0	0
Total	0	0	6	6	18	7	5	8

7.3.2 Interviews

Between August 4, 2016 and August 6, 2016, Cardno conducted five interviews with recreationists and an additional interview with an Oregon Parks and Recreation Department Park Ranger. Interviews were conducted to obtain information on the frequency and duration of visits to the study area, to obtain local knowledge of any groups using the river, to assess user skill level, and to gauge the typical seasons in which recreational activities were occurring. Interviews were not designed to provide statistically representative data; rather, they were intended to obtain qualitative information to help understand the key characteristics of river recreation.

7.3.2.1 Oregon Parks and Recreation Department Interview

Cardno conducted an interview with Maggie, Oregon Parks and Recreation Department Park Ranger, on August 6, 2016 at Hilgard Junction State Park. Key information obtained from this interview included:

- 5 groups of River floaters spotted in June 2016. All groups using inflatable kayaks.
- Very little fishing between Red Bridge State Wayside and Hilgard Junction State Park.
- Hilgard Junction State Park is mostly one-night campers.
- Frequently sends groups to Bird Track Springs who are looking for trails.
- Most groups go to Hilgard Junction State Park to swim as that is the deepest swimming hole between Red Bridge State Wayside and Hilgard Junction State Park.

7.3.2.2 Recreationist Interviews

Cardno conducted five interviews with recreationists between August 4, 2016 and August 6, 2016. Key findings from these interviews include:

- Typical recreational activities when visiting the river include walking, fishing, birdwatching, and swimming
- Respondents cited the typical size of their party as ranging from one person to five people when visiting the river.
- Respondents cited access originating at the entrance to the Bird Track Interpretive Site.
- Most of the respondents (four) were staying at the Bird Track Springs Campground.
- All of the respondents utilize the site during the summer months, with occasional uses outside of peak times.
- Most of the respondents (four) were from Eastern Oregon, near the La Grande area.

7.4 Public Safety Risks

Reclamation's *Public Safety Risk Matrix (2014)* is used to evaluate the Project's risk to public safety from LWM in the Project's Reach. The matrix used to generate a "low" or "high" risk to public safety for the Project is shown in Figure 6-5.

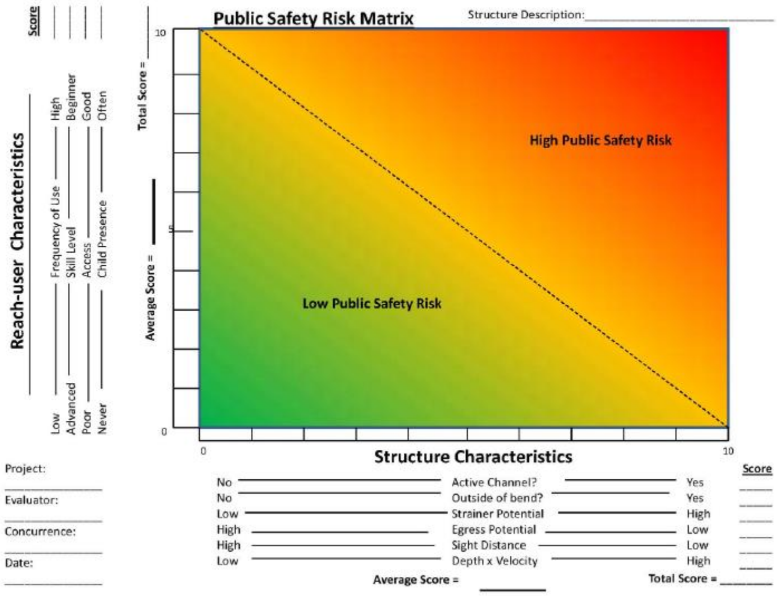


Figure 6-5 Public Safety Risk Matrix

The X-axis value of the matrix for each structure or group of structures is the average score of the six structure characteristics shown in Figure 2. These scores varied between 4.2 and 7.3 with 10 being highest risk. A low reach-user characteristics score of 3.8 was assigned to the project reach on the Y-axis. The low reach-user characteristics score offset the high structure characteristics scores on the matrix, resulting in all structures receiving a “Low” public safety risk rating. The public safety ratings for each structure type are summarized in Table 1 and a comprehensive description of the assessment scores and rationale is provided in the spreadsheets in Appendix M.

A number of the Project’s critical LWM structures and certain groups of LWM structures were identified for assessment. Structures types include:

- Apex Jam
- Apex Jam (Narrow)
- Meander Jam
- Meander - Upstream Component
- Meander - Downstream Component
- Longitudinal Channel Margin
- Angled Channel Margin
- Deflector Jam (Small)
- Deflector Jam (Large)
- Sweeper Jams
- Floodplain Roughness Elements
- Side Channel Habitat - Single Log
- Side Channel Habitat - Double Log
- Side Channel Habitat - Triple Log

- Ice Jam
- Highway Protection Jam
- Beaver Dam
- Simulated Debris Flow

Each critical LWM structure and groups of structures identified for risk assessment were evaluated based on the six Structure Characteristics (X-axis) factors. The detailed individual assessments with numerical ratings and rationale are included in Appendix M. First, at each structure or group of structures, the potential or anticipation of channel migration was assessed. Those structures located in the alluvial fan or poorly armored were given high ratings. Those structures bound by natural hard points or with well-armored beds, which would inhibit channel migration, and where there is no evidence of recent channel migration, received low to moderate ratings.

Next, each structure was given a rating as to whether it is located on the outside of a channel bend or not. Meander Jams, located along the outside bank of channel bends, were given high ratings for this reason; sweeper jams located on the inside of bends and channel margin jams located along straight riffle sections were given low ratings.

Each structure was given a rating based on its potential to pin or entrap a person against it. Structures such as Apex Jams and Deflector Jams are porous and lie perpendicular to or across the channel and flow. Structures such as these received high ratings. Structures that are hydraulically smooth or situated parallel to the flow, such as upstream meander jam component and longitudinal channel margin jams, received low to moderate ratings.

Next, the ability for a swimmer or floater to easily avoid a structure was evaluated. Those located in deep pools, incised channel locations, or where stream currents direct flow directly towards structures, such as meander jams along the outside of bends, the rating is high because these are locations where it would be difficult to get around the structure. In situations where small LWM structures are located in wide uniform channels, such as channel margin jams or floodplain roughness elements, a swimmer or floater would be able to navigate around the structure and thus these LWM structures were given a low risk rating for Egress Potential.

Each structure is also rated for the ability of recreationalists to see a structure and have time to move away as they approach from upstream. Those structures located around a bend, or hidden by natural features, such as Meander Jams or the Highway Protection Jam, received high risk ratings for sight distance. Those structures located along long straight segments of channel, such as Apex Jams and Channel Margin Jams, received low risk ratings for sight distance. .

The final Structure Characteristic risk factor rates channel approach velocity and depth to evaluate the safety of standing and moving away or around a structure.

The entire Project Reach was assessed as a whole for the Reach-User Characteristics. This reach of the Upper Grande Ronde has a low use factor. Recreational use in this location would most likely be either hiking or swimming, and will be low because of the lack of water in the river during peak usage. Swimmers were noted to typically come from the adjacent Bird Track Springs Campground, which is only operated seasonally from Memorial Day (end of May) to September 30th. Due to the campground's proximity and presence of interpretive trails on the site, recreational access and presence of children is available and encouraged, however; peak usage is during periods of low, slow moving water.

A study of the recreational usage at the site indicated that the majority of the limited floaters and boaters, were likely professionals doing biological studies on the river, indicating a higher skill level and knowledge of the river. The skill level of the persons anticipated in the Project Area is high, so the risk associated with skill level is low. Boating is flow-dependent and therefore limited to a relatively short season, generally from sometime in March through late May. There are no developed boating facilities at either location. Occasionally people have been seen on inner-tubes between Red Bridge and Hilgard.

Consensus was reached on the risks associated with recreational use and skill level based on the extensive knowledge of the Project Reach, the extent of its use and the general characteristics of those that use it, within members of the Design Team.

Table 6-1 Reach User Characteristics

Factor	Rating
Frequency of Use	2
Skill Level	3
Access	5
Child Presence	3
Average Score	**3.3**

Table X.X summarizes the Structure Characteristics and Reach-User Characteristics Scores for each LWM structure or group of LWM structures. Using these values and the Public Safety Risk Matrix in Figure 1, a Public Safety Risk Rating was determined for each LWM structure or group of structures. Each LWM structure or group of structures proposed in the Bird Track Springs Area Rehabilitation received a Public Safety Risk Rating of “Low”. The detailed Public Safety Risk assessment is included in Appendix M.

Table 6-1 Summary of Public Safety Risk

LWM ID	Structure Characteristics Score (X-axis)	Reach-User Characteristics Score (Y-axis)	Public Safety Risk Rating
Apex Jam	4.8	3.3	Low
Apex Jam (Narrow)	4.8	3.3	Low
Meander Jam	6.8	3.3	High
Meander - Upstream Component	6.3	3.3	Low
Meander - Downstream Component	7.3	3.3	High
Longitudinal Channel Margin	2.8	3.3	Low
Angled Channel Margin	3.0	3.3	Low
Deflector Jam (Small)	5.0	3.3	Low
Deflector Jam (Large)	5.2	3.3	Low
Sweeper Jams	4.3	3.3	Low
Floodplain Roughness Elements	3.5	3.3	Low
Side Channel Habitat - Single Log	4.7	3.3	Low
Side Channel Habitat - Double Log	4.8	3.3	Low
Side Channel Habitat - Triple Log	4.8	3.3	Low
Ice Jams	3.3	3.3	Low
Highway Protection Jam	7.2	3.3	High
Beaver Dam	3.2	3.3	Low
Simulated Debris Flow	4.3	3.3	Low

7.5 Property Damage Risks

The Project reach is located in the UGR River subbasin, in northeast Oregon, approximately 11 miles southwest (upstream) of the city of La Grande, OR. Most of the basin is forested (over 73 percent) and has very little development (less than 0.1 percent estimated impervious area) (USGS 2014). The project reach is surrounded by a mix of Forest Service and privately owned ranch lands; and is bound to the south (river right) by the Ukiah-Hilgard Highway (Oregon State Route 244).

The presence of infrastructure (highway) and private properties within the reach and downstream necessitate an analysis of potential property damage risks. Reclamation's Property Damage Risk Matrix (2014) was used to evaluate the Project's risk to potential property damage from LWM in the project's reach. The matrix below is used to generate a "low", "moderate" or "high" risk to potential property damage for the project is shown in Figure 6-6.

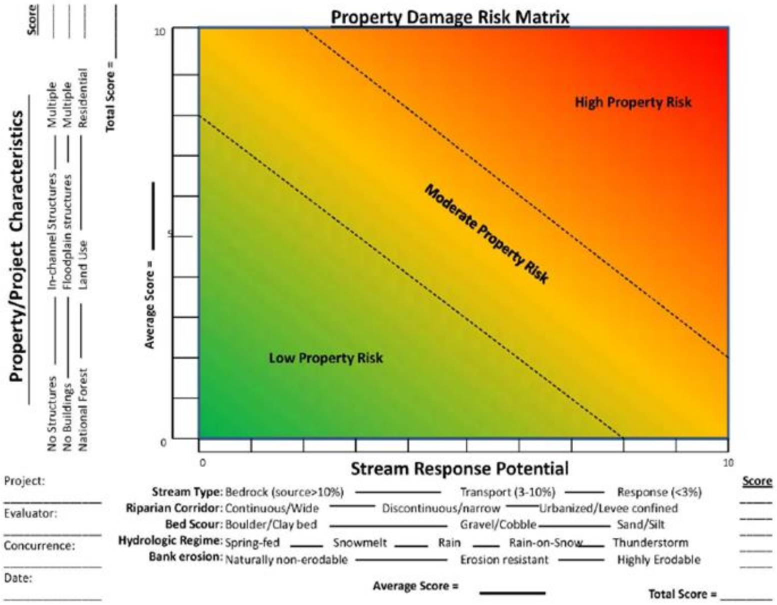


Figure 6-6 Property Damage Risk Matrix

7.5.1 Stream Response Potential

The X-axis value of the matrix is the average of the five stream response factors assessed for the Property Damage Risk Matrix shown in Figure 6-6. An overview of matrix scoring, by factor, follows and the Project's potential stream response numerical scores are provided in Table 6-2.

- **Stream Type** - Moderate to High rating - Proposed condition is an alluvial channel with pool-riffle bedforms and moderate slope.
- **Riparian Corridor** - Moderate rating- Proposed condition would reestablish connectivity to an increased floodplain to allow the reach to absorb changes.
- **Bed Scour Potential** - Moderate rating - Bed material has a good amount of fine to medium gravel which should be relatively mobile.
- **Bank Erosion Potential** – Bank material composition includes sand and loosely deposited alluvium. Evidence of recent bank erosion indicated future potential.
- **Hydrologic Regime** - Moderate to High rating- the Upper Grande Ronde is a snowmelt driven river and is susceptible to rain-on-snow events.

Table 6-3 Stream Response Potential Summary

Factor	Rating
Stream Type	7
Riparian Corridor	2
Bed Scour Potential	5
Bank Erosion Potential	7
Dominant Hydrologic Regime	8
Average Score	**5.8**

7.5.2 Property/Project Characteristics

7.5.2.1 In-Channel Structures – Bridge Assessment

There are no in-stream structures or infrastructure within the project reach or immediately downstream of the project reach. The nearest downstream bridge, at the interchange of the Hilgard Highway and I84, is approximately six miles downstream.

The proposed design eliminates the straight alignments of the existing Upper Grande Ronde by modifying the alignment and providing split flows. The result is a lengthened river channel with increased sinuosity, floodplain connectivity and floodplain roughness which will translate to slower flows and increased wood recruitment potential. Mobile wood originating from upstream will be more likely to recruit by becoming racked on one of the designed structures or settling out on the floodplain rather than passing through and continuing on to the downstream bridge.

The proposed design does increase the amount of wood in the river system. Design measures are being taken with the proposed LWM structures to prevent dislodgement and mobilization of the wood members. Stability calculations are performed on each structure to prevent mobility during design flow events, which the recurrence of is determined by the Public Safety Risk and Property Damage Risk matrices. LWM Structure calculations are included in Appendix M.

The photo below shows the downstream bridge at an approximate 10-year flow. As part of the project design, hydraulic modeling was performed on the Project Area to analyze inundation limits as well as water surface elevations upstream, through the project reach, and downstream. Comparing the existing conditions water surface elevations to the proposed conditions water surface elevations downstream of the project limits shows the project does not increase water surface elevations downstream.

This along with the low likelihood of any proposed wood from the project traveling 6 miles downstream, results in the Project's proposed LWM posing a "Low" risk for In-Channel Structures.

7.5.2.2 *Floodplain Structures*

The Project Area is located within a basin that is predominantly forest lands with limited development, however; there is some development within the floodplain of the project reach. The Project reach is bound to the south by the Ukiah-Hilgard Highway (Oregon State Route 244); and the highway is within the active floodplain. The highway is a two-lane paved road maintained by Oregon Department of Transportation (ODOT). Between the highway and the river, directly north of the Bird Track Springs campground is a series of trails that run through the floodplain. The trailhead is located at the highway turn-out directly across from the campground entrance.

Within the Lowe Family and Bear Creek Ranches, there are a handful of barn-type structures, as well as a corral on the Lowe Family Ranch. As this coral is intended to be relocated out of the floodplain as part of this project, the Project’s proposed LWM pose a “Low” risk for Floodplain Structures.

7.5.2.3 *Land Use*

Most of the basin is forested (over 73 percent) and has very little development (less than 0.1 percent estimated impervious area) (USGS 2014). The project reach is surrounded by a mix of Forest Service and privately owned ranch lands; and is bound to the south (river right) by the Ukiah-Hilgard Highway (Oregon State Route 244). As the project is predominantly within National Forest lands and poses little or no risk to the adjacent rural farm land, the Project’s LWM pose a “Low” risk for Land Use.

7.5.2.4 *Property/Project Characteristics Ratings*

Factor	Rating
In-Channel Structures	0
Floodplain Structures	4

Land Use	3
Average Score	**2.3**

Table X.X summarizes the Project's Property/Project Characteristics Ratings. Using these Average Score of these ratings along with the Average Score of the Stream Response Potential in Table X.X and the Property Damage Risk Matrix in Figure 2, a Property Damage Risk Rating was determined for the Project. The Bird Track Springs Project received a Property Damage Risk Rating of "Moderate". The detailed Property Damage Risk assessment is included in Appendix M.

7.5.3 Overall Risk

The Bird Track Springs Project received a "Low" Public Safety Risk Rating and a "Moderate" Property Damage Risk Rating. As specified in Table 1 "LWM Risk Rating Design requirements for Reclamation Projects" in BOR's *Large Woody Material – Risk Based Design Guidelines*, these risk ratings are used to determine the Stability Design Flow Criteria, River Use Survey Needs, Geomorphic Assessment Needs, Design Team Needs and hydraulic Model Requirements. Using the Low:Moderate ratings determined above, the LWM structures for this project shall be designed for 25-year flow event. Even though it is stated that a one-dimensional hydraulic model is required for a project of this risk, two-dimensional modeling is being performed. Using the Low:Moderate rating determined above, the design team has met or exceeded the requirements for each category.

8 Cost Estimation NEW

Preliminary cost estimate will be prepared for the 80% BDR

8.1 Quantities

8.1.1 Large Woody Material

The installation of Large Woody Material (LWM) is proposed as a key element of the design. The design proposes nine different LWM structure types located as shown on the Concept Plan. Each structure type calls for a specific number of logs meeting certain size criteria. The total number of each type of LWM structure was summed, and subsequently the total number of each size of wood piece determined. Tables 6-4 and 6-5 summarize the LWM structure and individual wood piece quantities.

Table 6-4 LWM Structure Quantities

Structure Type	Structure Quantity
Apex Jam	7
Apex Jam (Narrow)	8
Meander Jam	22
Meander - Upstream Component	16
Meander - Downstream Component	20
Longitudinal Channel Margin	74
Angled Channel Margin	17
Deflector Jam (Small)	21
Deflector Jam (Large)	6
Sweeper Jams	110
Floodplain Roughness Elements	65
Side Channel Habitat - Single Log	69
Side Channel Habitat - Double Log	30
Side Channel Habitat - Triple Log	16
Cover Logs	225
Ice Jam	3
Highway Protection Jam	1
Beaver Dam	4
Simulated Debris Flow	2

Table 6-5 Wood Quantities

Size Class	Key Member (18"+)	Medium Log (12"–18")	Racking Logs (6"-12")	Pinning Logs (12")	Tree Tops & Branches (1"-6")	Large Boulders (>24")
Quantity	930	450	3220	780	5610	540

8.2 Cost Assumptions

8.3 Engineer's Cost Estimate

9 Monitoring, Maintenance and Adaptive Management

To be included at 80%

Comment [MK9]: MY YOU NEED TO RSEPONT TO A FEW OF THESE YET

Comment [MY10]: I filled out one, the rest will get filled out during our meeting tomorrow.

10 15% BDR Comment Matrix

The following table lists the comments received during the 15% design review process and the responses.

Comment Number	Commenter	Page/Drawing	Section/Line	Comment	Response
1	NMFS - Lind	3-12/BDR	3.5 Fish Biology/ Line 10	Listing history is incomplete, suggest the following: Snake River spring/summer Chinook salmon were originally listed as Threatened 4/22/1992 (57 FR 14658); reaffirmed 6/28/2005 (70 FR 37160) and 4/14/2014 (79 FR 20802). Critical habitat was designated 12/28/1993 (58 FR 68543), revised 10/25/1999 (64 FR 57399).	(11/28/15 MSK) Text updated
2	NMFS - Lind	3-12/BDR	3.5 Fish Biology/ Line 12	Listing history is incomplete, suggest the following: Snake River basin steelhead were originally listed as Threatened 8/18/1997 (62 FR 43937); reaffirmed 1/5/2006 (71 FR 834) and 4/14/2014 (79 FR 20802). Critical habitat was designated 9/2/2005 (70 FR 52630).	(11/28/15 MSK) Text updated
3	NMFS - Lind	3-13/BDR	3.5.1.1/ Line 3	Potential edits: They then proceeded upstream to their natal tributaries where they hold from June through August and spawn from August through September.	(11/28/15 MSK) Text updated
4	NMFS - Lind	3-14/BDR	3.5.1.2./ Line 1	Omitted text: Grande Ronde adults begin their upstream migration in early spring and pass Bonneville Dam in July and John Day Dam during August through [insert appropriate end month].	(11/28/15 MSK) Text updated
5	NMFS - Lind	3-17/BDR	3.6.1/Line 33; 3.6.2/ Line 1	Probably a minor point, but section 3.6.1. states reach has a 0.4% gradient, and on the same page in the next section document states gradient is 0.5%. Probably should be consistently described.	(11/28/15 NL) Text updated to 0.4%

Comment Number	Commenter	Page/Drawing	Section/Line	Comment	Response
6	NMFS - Lind	4-4/BDR	4.1.2/ Lines 5-18	Paragraph under Figure 4-3 is repeated immediately thereafter. Delete duplicate paragraph.	(11/28/15 MSK) 1D Modeling is associated with 15% design and has been moved to Appedix F for the the 30% report
7	NMFS - Lind	4-5/BDR	4.2/Line 6	Hyperlink takes reader to an inactive page on the BOR website.	(7/1/16 MSK) fix hyperlink - Cardno
8	NMFS - Lind	5-19/BDR	Fig. 5-10	Consider addition of color codes in the figure's legend.	(11/28/16) MY to follow-up with Justin re: figure
9	NMFS - Lind	5-20/BDR	Fig. 5-11	Consider addition of color codes in the figure's legend.	(11/28/16) MY to follow-up with Justin re: figure
10	NMFS - Lind	6-3/BDR	Fig. 6-2	Can't see the orange lines on the figure; also should identify the yellow x's in your legend	(10/28/16 BEA) this figure has been compeltely updated and revised - Cardno.
11	NMFS - Lind	6-4/BDR	Fig. 6-3.	Can't see the orange lines on the figure; also should identify the yellow x's in your legend	(10/28/16 BEA) this figure has been compeltely updated and revised - Cardno.
12	NMFS - Lind	6-5/BDR	Fig. 6-4	Can't see the orange lines on the figure; also should identify the yellow x's in your legend	(10/28/16 BEA) this figure has been compeltely updated and revised - Cardno.
13	NMFS - Lind	15% Map Package		No Comment.	(7/1/16 MSK) no edit required
14	NMFS - Lind	15% Inundation Map		No Comment	(7/1/16 MSK) no edit required
15	BPA-RRT			Temperature – This reach of the Upper Grande Ronde has high water temperatures during many months of the year that significantly limit the spawning and rearing of listed fish species (Chinook, steelhead, bull trout). It is not clear in the BDR how the proposed alternative will address the stated objectives of temperature limiting factor. Especially during summer low flow periods during which the vast majority of water in the alluvial aquifer is of riverine origin.	(10/31/16 BEA) The comment address a site-specific impact of a basin-wide temperature impact While the restoration will potenntially have some site specific effects, it can't be expected to mitigate for a basin wide water quality impact. However, the GW Evaluation and Monitoring Plan details more background as well as monitoring plan details to address these questions. In particulay a study is detailed to ascertain how shallow GW upwelling (e.g. hyporheic flow) will be impacted by the

Comment Number	Commenter	Page/Drawing	Section/Line	Comment	Response
					restoration. - Cardno.
16	BPA-RRT	3-13 BDR		Fish Utilization – This reach of the Upper Grande Ronde currently serves as a migration corridor for Chinook, steelhead, and bull trout. Holding, spawning, and rearing appear to represent 5% or less of the fish populations' use of this reach. However the BDR states that Chinook Life Stage utilization for spawning, rearing, holding is high. What information supports this?	(11/28/16 MSK) Anecdotal info from ODFW indicates a lot of YOY are going through trap that are not being enumerate so as you move toward late spring/early summer pick-up a chunk of population that were not previously enumerated as fingerlings.
17	BPA-RRT			Additional analysis and interpretation relative to temperature impacts should be provided to better ascertain existing condition water quality and the anticipated benefits from proposed restoration actions in addressing this key limiting factor. Additional synthesis of temperature impacts from tributary contributions, subsurface geologic structure, hydraulic conductivities of valley sediments, existing wetland resources and the cumulative effects of these inputs are requested . These comments and suggestions arise from the following statement from page 3-12 Background – Existing Conditions of the BDR "Throughout the year, it does not appear that deep groundwater inputs add appreciably to discharge at this site (This key question will be answered during the upcoming groundwater/hyporheic study). Therefore all water in the alluvial aquifer is either from seepage from the river itself, vertical percolation of precipitation, or hillslope inputs. Especially during summer low flow, the vast majority of water in the alluvial aquifer is of riverine origin."	(10/31/16 BEA) the GW Evaluation and Monitoring Plan details more background as well as monitoring plan details to address these questions . Pump test on the proposed monitoring wells as wells as techniques using water temperature differences between the stream and aquifer can possibly provide more insight into floodplain transmissivity, residence time, and turnover rates. - Cardno.

Comment Number	Commenter	Page/Drawing	Section/Line	Comment	Response
				Perhaps there are pump test records from nearby wells that could retrieved and evaluated?	
18	BPA-RRT			CTUIR worked cooperatively with the GRMW to establish a biological objectives document for the project to clearly outline the fisheries habitat goals and objectives. Please describe how the project goals and objectives from this document have been integrated into the preferred alternative, and alternative selection process.	(7/1/16 MSK) updated BDR to show this connection
19	BPA-RRT			Please describe how the ODFW fish tracking study has informed the preferred alternative and how preliminary study results are be utilized to optimize the project design.	(11/28/16 MSK) Allen discussed at 30% RRT meeting. See response to cmt #16. The purpose of this project is to create good winter AND summer habitat for these fish – improving fish survival before they exist the basin as smolts. Allen to talk with Scott re: what the research is showing and where additional work might be required.
20	BPA-RRT			Please describe how ice impacts will be accommodated in the preferred alternative include the engineering analysis in future submittals. Specifically, please address the following questions in future submittals: a. What is the general ice regime on the river system and what type of ice conditions can be expected in the project area? b. Will the proposed in-stream structure(s) affect the ice regime? c. Specifically, will the structure(s) retain or pass ice, and under what conditions? d. If the project affects the local ice regime, will this be a problem in terms of ice jams, ice jam floods, or ice-related bed and bank erosion? e. How well will the structures survive the ice environment?	(7/1/16 MSK) 30% design package will include quantitative information and additional science to address ice impacts. See BDR Section(s) 3.2, 5.2, and 6.

Comment Number	Commenter	Page/Drawing	Section/Line	Comment	Response
				If ice problems are anticipated, can the project be designed to avoid or mitigate them?	
21	ODOT - Paul Kennington			If rock is taken from the roadside at MP 44.4, ODOT wants to ensure there will not be a rockfall issue post construction.	Status?
22	ODOT - Paul Kennington			Would like to see riprap placed adjacent to the roadway embankment along the north side of OR244 to prevent flood waters from scouring the roadway.	Did they provide this?
23	ODOT - Paul Kennington			Concerned that if the two culverts under OR244 are used to reactivate the channel on the south side of the highway, that water could cause issues for the highway - especially if one of the culverts becomes blocked. If the project directs additional water into this channel causing ODOT's culverts to become inadequate, the project needs to have a hydrologic report done and fund work to increase culverts to handle additional flows and fish passage.	(11/28/16 MWY) South channel activation is no longer in the design.
24	ODOT - Paul Kennington			Concerned that large woody debris may be washed downstream, and cause entanglement/scour issues on the highway and/or bridges.	(11/28/16 MSK) See Section 6.3 Risk Assessment.
25	ODOT - Paul Kennington			Concerned that the project could alleviate ice encroachment on OR244	(7/1/16 MSK) assume ODOT would like to see ice encroachment fixed. See BDR Section 6.1.6
26	ODOT - Paul Kennington			Concerned about the effects this project will have on the OR244 bridge just upstream from the stream bank restoration.	Status?

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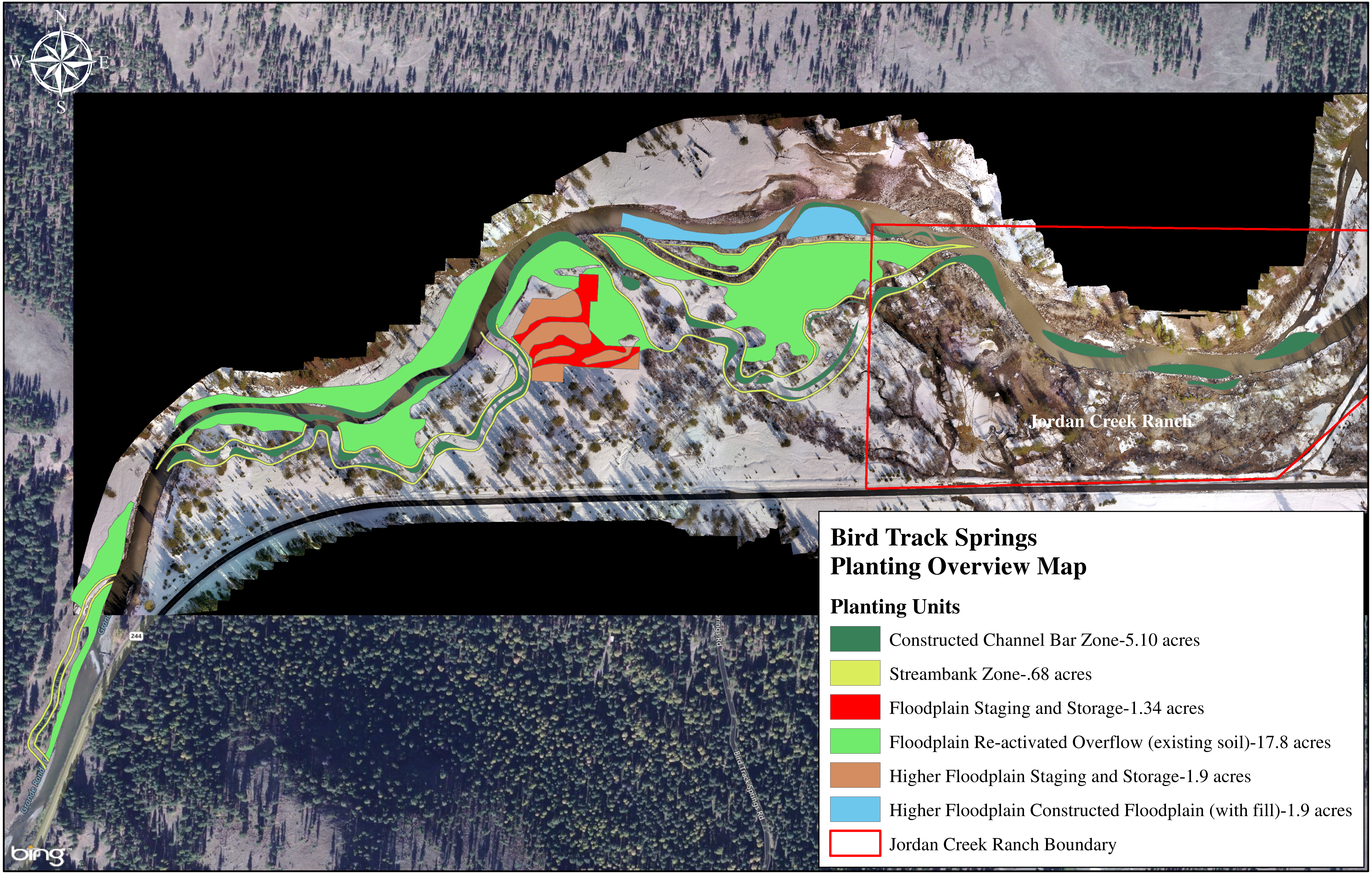

Bird Track Springs
Planting Overview Map

Planting Units

- 🟩 Constructed Channel Bar Zone-5.10 acres
- 🟨 Streambank Zone-.68 acres
- 🟥 Floodplain Staging and Storage-1.34 acres
- 🟩 Floodplain Re-activated Overflow (existing soil)-17.8 acres
- 🟫 Higher Floodplain Staging and Storage-1.9 acres
- 🟦 Higher Floodplain Constructed Floodplain (with fill)-1.9 acres
- ☐ Jordan Creek Ranch Boundary

Downstream reach of project area with side channel on Heath property

Middle of project area with remnant beaver pond on Jordan Cr. Ranch

Upper area of BTS

Ice flow event in February 2017 on lower reach of project area, Jordan Creek Ranch

Ice flow event in February 2017 on lower reach of project area, Jordan Creek Ranch

Time-lapse photo of ice movement from BTS camera #7

Drone image of lower project reach in February 2017

Drone image of middle of project area taken in February 2017

BIRDTRACK SPRINGS FISH HABITAT ENHANCEMENT PROJECT

UPPER GRANDE RONDE RIVER - GRANDE RONDE SUBBASIN

30% DRAFT DESIGN DRAWINGS

GRANDE RONDE RIVER-BEAVER CREEK SUBWATERSHED - HYDROLOGICAL UNIT CODE (HUC) 17060 10403

RECLAMATION
Managing Water in the West

Cardno
Shaping the Future

LOCATION MAP

PREPARED FOR:
CONFEDERATED TRIBES OF THE
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PARTNERS:
BONNEVILLE POWER ADMINISTRATION
GRANDE RONDE MODEL WATERSHED
WALLOWA-WHITMAN NATIONAL FOREST

VICINITY MAP

5ITE SUMMARY
T3S, R36E, SEC. 15 & SEC. 16
UNION COUNTY, OREGON
UPSTREAM: 44°21'22"N 114°43'42"W
DOWNSTREAM: 45°22'55"N 114°43'34"W
RIVER MILES 7.4-6.8

PROJECT SITE

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ALWAYS THINK SAFETY

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA/SNAKE RIVER SALMON RECOVERY PROGRAM

GRANDE RONDE RIVER SUBBASIN
BIRD TRACK SPRINGS FISH HABITAT
ENHANCEMENT PROJECT

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M. Knutson
DESIGNED
M.BERGSTROM
DRAWN
X
CHECKED
X
TECH. APPR.
X
APPROVED
ADMIN APPROVAL - TITLE

CSRO (BOISE, IDAHO) 2016-11-04

COVER SHEET

TITLE, SHEET INDEX, & LOCATION MAP

1678-100-60689

SHEET 1 of 1

DATE AND TIME PLOTTED
11/4/2016 11:06 AM
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NICK DAVIS

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HIP 3 GENERAL AQUATIC CONSERVATION MEASURES APPLICABLE TO ALL ACTIONS

THE ACTIVITIES COVERED UNDER THE HIPIII ARE INTENDED TO PROTECT AND RESTORE FISH AND WILDLIFE HABITAT WITH LONG-TERM BENEFITS TO ESA-LISTED SPECIES. TO MINIMIZE THESE SHORT-TERM ADVERSE EFFECTS AND MAKE THEM PREDICTABLE FOR THE PURPOSES OF PROGRAMMATIC ANALYSIS, BPA WILL INCLUDE IN ALL PROJECTS IMPLEMENTED UNDER THIS HIP III PROPOSED ACTION THE FOLLOWING GENERAL CONSERVATION MEASURES (DEVELOPED IN COORDINATION WITH USFWS AND NMFS).

PROJECT DESIGN AND SITE PREPARATION.

1) STATE AND FEDERAL PERMITS. ALL APPLICABLE REGULATORY PERMITS AND OFFICIAL PROJECT AUTHORIZATIONS WILL BE OBTAINED BEFORE PROJECT IMPLEMENTATION. THESE PERMITS AND AUTHORIZATIONS INCLUDE, BUT ARE NOT LIMITED TO, NATIONAL ENVIRONMENTAL POLICY ACT, NATIONAL HISTORIC PRESERVATION ACT, AND THE APPROPRIATE STATE AGENCY REMOVAL AND FILL PERMIT, USACE CLEAN WATER ACT (CWA) 404 PERMITS, AND CWA SECTION 401 WATER QUALITY CERTIFICATIONS.

2) TIMING OF IN-WATER WORK. APPROPRIATE STATE (OREGON DEPARTMENT OF FISH AND WILDLIFE (ODFW), WASHINGTON DEPARTMENT OF FISH AND WILDLIFE (WDFW), IDAHO DEPARTMENT OF FISH AND GAME (IDFG), AND MONTANA FISH WILDLIFE AND PARKS (MFWP)) GUIDELINES FOR TIMING OF IN-WATER WORK WINDOWS (IWW) WILL BE FOLLOWED.

A) BULL TROUT - WHILE UTILIZING THE APPROPRIATE STATE DESIGNATED IN-WATER WORK PERIOD WILL LESSEN THE RISK TO BULL TROUT, THIS ALONE MAY NOT BE SUFFICIENT TO ADEQUATELY PROTECT LOCAL BULL TROUT POPULATIONS. THIS IS ESPECIALLY TRUE IF WORK IS OCCURRING IN SPAWNING AND REARING AREAS BECAUSE EGGS, ALEVIN, AND FRY ARE IN THE SUBSTRATE OR CLOSELY ASSOCIATED HABITATS NEARLY YEAR ROUND. SOME AREAS MAY NOT HAVE DESIGNATED IN-WATER WORK WINDOWS FOR BULL TROUT OR IF THEY DO, THEY MAY CONFLICT WITH WORK WINDOWS FOR SALMON AND STEELHEAD. IF THIS IS THE CASE, OR IF PROPOSED WORK IS TO OCCUR WITHIN BULL TROUT SPAWNING AND REARING HABITATS, PROJECT PROPONENTS WILL CONTACT THE APPROPRIATE USFWS FIELD OFFICE TO INSURE THAT ALL REASONABLE IMPLEMENTATION MEASURES ARE CONSIDERED AND AN APPROPRIATE IN-WATER WORK WINDOW IS BEING USED TO MINIMIZE PROJECT EFFECTS.

B) LAMPREY - THE PROJECT SPONSOR AND/OR THEIR CONTRACTORS WILL AVOID WORKING IN STREAM OR RIVER CHANNELS THAT CONTAIN PACIFIC LAMPREY FROM MARCH 1 TO JULY 1 IN LOW TO MID ELEVATION REACHES (<5,000 FEET). IN HIGH ELEVATION REACHES (>5,000 FEET), THE PROJECT SPONSOR WILL AVOID WORKING IN STREAM OR RIVER CHANNELS FROM MARCH 1 TO AUGUST 1. IF EITHER TIMEFRAME IS INCOMPATIBLE WITH OTHER OBJECTIVES, THE AREA WILL BE SURVEYED FOR NESTS AND LAMPREY PRESENCE, AND AVOIDED IF POSSIBLE. IF LAMPREYS ARE KNOWN TO EXIST, THE PROJECT SPONSOR WILL UTILIZE DEWATERING AND SALVAGE PROCEDURES OUTLINED IN US FISH AND WILDLIFE SERVICE BEST MANAGEMENT PRACTICES TO MINIMIZE ADVERSE EFFECTS TO PACIFIC LAMPREY (2010).

C) EXCEPTIONS TO ODFW, WDFW, MFWP, OR IDFG IN-WATER WORK WINDOWS WILL BE REQUESTED THROUGH THE VARIANCE PROCESS (PAGE 2).

3) CONTAMINANTS. THE PROJECT SPONSOR WILL COMPLETE A SITE ASSESSMENT WITH THE FOLLOWING ELEMENTS TO IDENTIFY THE TYPE, QUANTITY, AND EXTENT OF ANY POTENTIAL CONTAMINATION FOR ANY ACTION THAT INVOLVES EXCAVATION OF MORE THAN 20 CUBIC YARDS OF MATERIAL:

A) A REVIEW OF AVAILABLE RECORDS, SUCH AS FORMER SITE USE, BUILDING PLANS, AND RECORDS OF ANY PRIOR CONTAMINATION EVENTS;

B) A SITE VISIT TO INSPECT THE AREAS USED FOR VARIOUS INDUSTRIAL PROCESSES AND THE CONDITION OF THE PROPERTY;

C) INTERVIEWS WITH KNOWLEDGEABLE PEOPLE, SUCH AS SITE OWNERS, OPERATORS, AND OCCUPANTS, NEIGHBORS, OR LOCAL GOVERNMENT OFFICIALS; AND

D) A SUMMARY, STORED WITH THE PROJECT FILE THAT INCLUDES AN ASSESSMENT OF THE LIKELIHOOD THAT CONTAMINANTS ARE PRESENT AT THE SITE, BASED ON ITEMS 4(A) THROUGH 4(C).

4) SITE LAYOUT AND FLAGGING. PRIOR TO CONSTRUCTION. THE ACTION AREA WILL BE CLEARLY FLAGGED TO IDENTIFY THE FOLLOWING:

A) SENSITIVE RESOURCE AREAS, SUCH AS AREAS BELOW ORDINARY HIGH WATER, SPAWNING AREAS, SPRINGS, AND WETLANDS;

B) EQUIPMENT ENTRY AND EXIT POINTS;

C) ROAD AND STREAM CROSSING ALIGNMENTS;

D) STAGING, STORAGE, AND STOCKPILE AREAS; AND

E) NO-SPRAY AREAS AND BUFFERS.

5) TEMPORARY ACCESS ROADS AND PATHS.

A) EXISTING ACCESS ROADS AND PATHS WILL BE PREFERENTIALLY USED WHENEVER REASONABLE, AND THE NUMBER AND LENGTH OF TEMPORARY ACCESS ROADS AND PATHS THROUGH RIPARIAN AREAS AND FLOODPLAINS WILL BE MINIMIZED TO LESSEN SOIL DISTURBANCE AND COMPACTION, AND IMPACTS TO VEGETATION.

B) TEMPORARY ACCESS ROADS AND PATHS WILL NOT BE BUILT ON SLOPES WHERE GRADE, SOIL, OR OTHER FEATURES SUGGEST A LIKELIHOOD OF EXCESSIVE EROSION OR FAILURE. IF SLOPES ARE STEEPER THAN 30%, THEN THE ROAD WILL BE DESIGNED BY A CIVIL ENGINEER WITH EXPERIENCE IN STEEP ROAD DESIGN.

C) THE REMOVAL OF RIPARIAN VEGETATION DURING CONSTRUCTION OF TEMPORARY ACCESS ROADS WILL BE MINIMIZED. WHEN TEMPORARY VEGETATION REMOVAL IS REQUIRED, VEGETATION WILL BE CUT AT GROUND LEVEL (NOT GRUBBED).

D) AT PROJECT COMPLETION, ALL TEMPORARY ACCESS ROADS AND PATHS WILL BE OBLITERATED, AND THE SOIL WILL BE STABILIZED AND REVEGETATED. ROAD AND PATH OBLITERATION REFERS TO THE MOST COMPREHENSIVE DEGREE OF DECOMMISSIONING AND INVOLVES DECOMPACTING THE SURFACE AND DITCH, PULLING THE FILL MATERIAL ONTO THE RUNNING SURFACE, AND RESHAPING TO MATCH THE ORIGINAL CONTOUR.
E) TEMPORARY ROADS AND PATHS IN WET AREAS OR AREAS PRONE TO FLOODING WILL BE OBLITERATED BY THE END OF THE IN-WATER WORK WINDOW.

6) TEMPORARY STREAM CROSSINGS.

A) EXISTING STREAM CROSSINGS WILL BE PREFERENTIALLY USED WHENEVER REASONABLE, AND THE NUMBER OF TEMPORARY STREAM CROSSINGS WILL BE MINIMIZED.

B) TEMPORARY BRIDGES AND CULVERTS WILL BE INSTALLED TO ALLOW FOR EQUIPMENT AND VEHICLE CROSSING OVER PERENNIAL STREAMS DURING CONSTRUCTION. TREATED WOOD SHALL NOT BE USED ON TEMPORARY BRIDGE CROSSINGS OR IN LOCATIONS IN CONTACT WITH OR OVER WATER.

C) EQUIPMENT AND VEHICLES WILL CROSS THE STREAM IN THE WET ONLY WHERE:

  I. THE STREAMBED IS BEDROCK; OR

  II. MATS OR OFF-SITE LOGS ARE PLACED IN THE STREAM AND USED AS A CROSSING.

D) VEHICLES AND MACHINERY WILL CROSS STREAMS AT RIGHT ANGLES TO THE MAIN CHANNEL WHEREVER POSSIBLE.

E) THE LOCATION OF THE TEMPORARY CROSSING WILL AVOID AREAS THAT MAY INCREASE THE RISK OF CHANNEL RE-ROUTING OR AVULSION.

F) POTENTIAL SPAWNING HABITAT (I.E., POOL TAILOUTS) AND POOLS WILL BE AVOIDED TO THE MAXIMUM EXTENT POSSIBLE.

G) NO STREAM CROSSINGS WILL OCCUR AT ACTIVE SPAWNING SITES, WHEN HOLDING ADULT LISTED FISH ARE PRESENT, OR WHEN EGGS OR ALEVINS ARE IN THE GRAVEL. THE APPROPRIATE STATE FISH AND WILDLIFE AGENCY WILL BE CONTACTED FOR SPECIFIC TIMING INFORMATION.

H) AFTER PROJECT COMPLETION, TEMPORARY STREAM CROSSINGS WILL BE OBLITERATED AND THE STREAM CHANNEL AND BANKS RESTORED.

7) STAGING, STORAGE, AND STOCKPILE AREAS.

A) STAGING AREAS (USED FOR CONSTRUCTION EQUIPMENT STORAGE, VEHICLE STORAGE, FUELING, SERVICING, AND HAZARDOUS MATERIAL STORAGE) WILL BE 150 FEET OR MORE FROM ANY NATURAL WATER BODY OR WETLAND, OR ON AN ADJACENT, ESTABLISHED ROAD AREA IN A LOCATION AND MANNER THAT WILL PRECLUDE EROSION INTO OR CONTAMINATION OF THE STREAM OR FLOODPLAIN.

B) NATURAL MATERIALS USED FOR IMPLEMENTATION OF AQUATIC RESTORATION, SUCH AS LARGE WOOD, GRAVEL, AND BOULDERS, MAY BE STAGED WITHIN THE 100-YEAR FLOODPLAIN.

C) ANY LARGE WOOD, TOPSOIL, AND NATIVE CHANNEL MATERIAL DISPLACED BY CONSTRUCTION WILL BE STOCKPILED FOR USE DURING SITE RESTORATION AT A SPECIFICALLY IDENTIFIED AND FLAGGED AREA.

D) ANY MATERIAL NOT USED IN RESTORATION, AND NOT NATIVE TO THE FLOODPLAIN, WILL BE REMOVED TO A LOCATION OUTSIDE OF THE 100-YEAR FLOODPLAIN FOR DISPOSAL.

8) EQUIPMENT. MECHANIZED EQUIPMENT AND VEHICLES WILL BE SELECTED, OPERATED, AND MAINTAINED IN A MANNER THAT MINIMIZES ADVERSE EFFECTS ON THE ENVIRONMENT (E.G., MINIMALLY-SIZED, LOW PRESSURE TIRES; MINIMAL HARD-TURN PATHS FOR TRACKED VEHICLES; TEMPORARY MATS OR PLATES WITHIN WET AREAS OR ON SENSITIVE SOILS). ALL VEHICLES AND OTHER MECHANIZED EQUIPMENT WILL BE:

A) STORED, FUELED, AND MAINTAINED IN A VEHICLE STAGING AREA PLACED 150 FEET OR MORE FROM ANY NATURAL WATER BODY OR WETLAND OR ON AN ADJACENT, ESTABLISHED ROAD AREA;

B) REFUELED IN A VEHICLE STAGING AREA PLACED 150 FEET OR MORE FROM A NATURAL WATERBODY OR WETLAND, OR IN AN ISOLATED HARD ZONE, SUCH AS A PAVED PARKING LOT OR ADJACENT, ESTABLISHED ROAD (THIS MEASURE APPLIES ONLY TO GAS-POWERED EQUIPMENT WITH TANKS LARGER THAN 5 GALLONS);

C) BIODEGRADABLE LUBRICANTS AND FLUIDS SHALL BE USED ON EQUIPMENT OPERATING IN AND ADJACENT TO THE STREAM CHANNEL AND LIVE WATER.

D) INSPECTED DAILY FOR FLUID LEAKS BEFORE LEAVING THE VEHICLE STAGING AREA FOR OPERATION WITHIN 150 FEET OF ANY NATURAL WATER BODY OR WETLAND; AND

E) THOROUGHLY CLEANED BEFORE OPERATION BELOW ORDINARY HIGH WATER, AND AS OFTEN AS NECESSARY DURING OPERATION, TO REMAIN GREASE FREE.

9) EROSION CONTROL. EROSION CONTROL MEASURES WILL BE PREPARED AND CARRIED OUT, COMMENSURATE IN SCOPE WITH THE ACTION, THAT MAY INCLUDE THE FOLLOWING:

A) TEMPORARY EROSION CONTROLS.

  I. TEMPORARY EROSION CONTROLS WILL BE IN PLACE BEFORE ANY SIGNIFICANT ALTERATION OF THE ACTION SITE AND APPROPRIATELY INSTALLED DOWNSLOPE OF PROJECT ACTIVITY WITHIN THE RIPARIAN BUFFER AREA UNTIL SITE REHABILITATION IS COMPLETE.

  II. IF THERE IS A POTENTIAL FOR ERODED SEDIMENT TO ENTER THE STREAM, SEDIMENT BARRIERS WILL BE INSTALLED AND MAINTAINED FOR THE DURATION OF PROJECT IMPLEMENTATION.

  III. TEMPORARY EROSION CONTROL MEASURES MAY INCLUDE FIBER WATTLES, SILT FENCES, JUTE MATTING, WOOD FIBER MULCH AND SOIL BINDER, OR GEOTEXTILES AND GEOSYNTHETIC FABRIC.

  IV. SOIL STABILIZATION UTILIZING WOOD FIBER MULCH AND TACKIFIER (HYDRO-APPLIED) MAY BE USED TO REDUCE EROSION OF BARE SOIL IF THE MATERIALS ARE NOXIOUS WEED FREE AND NONTOXIC TO AQUATIC AND TERRESTRIAL ANIMALS, SOIL MICROORGANISMS, AND VEGETATION.
  V. SEDIMENT WILL BE REMOVED FROM EROSION CONTROLS ONCE IT HAS REACHED 1/3 OF THE EXPOSED HEIGHT OF THE CONTROL.
  VI. ONCE THE SITE IS STABILIZED AFTER CONSTRUCTION, TEMPORARY EROSION CONTROL MEASURES WILL BE REMOVED.

B) EMERGENCY EROSION CONTROLS. THE FOLLOWING MATERIALS FOR EMERGENCY EROSION CONTROL WILL BE AVAILABLE AT THE WORK SITE:

  I. A SUPPLY OF SEDIMENT CONTROL MATERIALS; AND

  II. AN OIL-ABSORBING FLOATING BOOM WHENEVER SURFACE WATER IS PRESENT.

10) DUST ABATEMENT. THE PROJECT SPONSOR WILL DETERMINE THE APPROPRIATE DUST CONTROL MEASURES BY CONSIDERING SOIL TYPE, EQUIPMENT USAGE, PREVAILING WIND DIRECTION, AND THE EFFECTS CAUSED BY OTHER EROSION AND SEDIMENT CONTROL MEASURES. IN ADDITION, THE FOLLOWING CRITERIA WILL BE FOLLOWED:

A) WORK WILL BE SEQUENCED AND SCHEDULED TO REDUCE EXPOSED BARE SOIL SUBJECT TO WIND EROSION.

B) DUST-ABATEMENT ADDITIVES AND STABILIZATION CHEMICALS (TYPICALLY MAGNESIUM CHLORIDE, CALCIUM CHLORIDE SALTS, OR LIGNINSULFONATE) WILL NOT BE APPLIED WITHIN 25 FEET OF WATER OR A STREAM CHANNEL AND WILL BE APPLIED SO AS TO MINIMIZE THE LIKELIHOOD THAT THEY WILL ENTER STREAMS. APPLICATIONS OF LIGNINSULFONATE WILL BE LIMITED TO A MAXIMUM RATE OF 0.5 GALLONS PER SQUARE YARD OF ROAD SURFACE, ASSUMING A 50:50 (LIGNINSULFONATE TO WATER) SOLUTION.

C) APPLICATION OF DUST ABATEMENT CHEMICALS WILL BE AVOIDED DURING OR JUST BEFORE WET WEATHER, AND AT STREAM CROSSINGS OR OTHER AREAS THAT COULD RESULT IN UNFILTERED DELIVERY OF THE DUST ABATEMENT MATERIALS TO A WATERBODY (TYPICALLY THESE WOULD BE AREAS WITHIN 25 FEET OF A WATERBODY OR STREAM CHANNEL; DISTANCES MAY BE GREATER WHERE VEGETATION IS SPARSE OR SLOPES ARE STEEP).

D) SPILL CONTAINMENT EQUIPMENT WILL BE AVAILABLE DURING APPLICATION OF DUST ABATEMENT CHEMICALS.

E) PETROLEUM-BASED PRODUCTS WILL NOT BE USED FOR DUST ABATEMENT.

11) SPILL PREVENTION, CONTROL, AND COUNTER MEASURES. THE USE OF MECHANIZED MACHINERY INCREASES THE RISK FOR ACCIDENTAL SPILLS OF FUEL, LUBRICANTS, HYDRAULIC FLUID, OR OTHER CONTAMINANTS INTO THE RIPARIAN ZONE OR DIRECTLY INTO THE WATER. ADDITIONALLY, UNCURED CONCRETE AND FORM MATERIALS ADJACENT TO THE ACTIVE STREAM CHANNEL MAY RESULT IN ACCIDENTAL DISCHARGE INTO THE WATER. THESE CONTAMINANTS CAN DEGRADE HABITAT, AND INJURE OR KILL AQUATIC FOOD ORGANISMS AND ESA-LISTED SPECIES. THE PROJECT SPONSOR WILL ADHERE TO THE FOLLOWING MEASURES:

A) A DESCRIPTION OF HAZARDOUS MATERIALS THAT WILL BE USED, INCLUDING INVENTORY, STORAGE, AND HANDLING PROCEDURES WILL BE AVAILABLE ON-SITE.

B) WRITTEN PROCEDURES FOR NOTIFYING ENVIRONMENTAL RESPONSE AGENCIES WILL BE POSTED AT THE WORK SITE.

C) SPILL CONTAINMENT KITS (INCLUDING INSTRUCTIONS FOR CLEANUP AND DISPOSAL) ADEQUATE FOR THE TYPES AND QUANTITY OF HAZARDOUS MATERIALS USED AT THE SITE WILL BE AVAILABLE AT THE WORK SITE.

D) WORKERS WILL BE TRAINED IN SPILL CONTAINMENT PROCEDURES AND WILL BE INFORMED OF THE LOCATION OF SPILL CONTAINMENT KITS.

E) ANY WASTE LIQUIDS GENERATED AT THE STAGING AREAS WILL BE TEMPORARILY STORED UNDER AN IMPERVIOUS COVER, SUCH AS A TARPAULIN, UNTIL THEY CAN BE PROPERLY TRANSPORTED TO AND DISPOSED OF AT A FACILITY THAT IS APPROVED FOR RECEIPT OF HAZARDOUS MATERIALS.

12) INVASIVE SPECIES CONTROL. THE FOLLOWING MEASURES WILL BE FOLLOWED TO AVOID INTRODUCTION OF INVASIVE PLANTS AND NOXIOUS WEEDS INTO PROJECT AREAS:

A) PRIOR TO ENTERING THE SITE, ALL VEHICLES AND EQUIPMENT WILL BE POWER WASHED, ALLOWED TO FULLY DRY, AND INSPECTED TO MAKE SURE NO PLANTS, SOIL, OR OTHER ORGANIC MATERIAL ADHERES TO THE SURFACE.

B) WATERCRAFT, WADERS, BOOTS, AND ANY OTHER GEAR TO BE USED IN OR NEAR WATER WILL BE INSPECTED FOR AQUATIC INVASIVE SPECIES.

C) WADING BOOTS WITH FELT SOLES ARE NOT TO BE USED DUE TO THEIR PROPENSITY FOR AIDING IN THE TRANSFER OF INVASIVE SPECIES.

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GRANDE RONDE RIVER SUBBASIN

BIRD TRACK SPRINGS FISH HABITAT
ENHANCEMENT PROJECT

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M. Knutson
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M.BERGSTROM
DRAWN
X
CHECKED
X
TECH. APPR.
X
APPROVED
ADMIN APPROVAL - TITLE

CSRO (BOISE, IDAHO) 2016-11-04

NOTES

HIP III GERNERAL
CONSERVATION MEASURES

1678-100-60690

SHEET 1 of 2

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WORK AREA ISOLATION & FISH SALVAGE.

ANY WORK AREA WITHIN THE WETTED CHANNEL WILL BE ISOLATED FROM THE ACTIVE STREAM WHENEVER ESA-LISTED FISH ARE REASONABLY CERTAIN TO BE PRESENT, OR IF THE WORK AREA IS LESS THAN 300-FEET UPSTREAM FROM KNOWN SPAWNING HABITATS. WHEN WORK AREA ISOLATION IS REQUIRED, DESIGN PLANS WILL INCLUDE ALL ISOLATION ELEMENTS, FISH RELEASE AREAS, AND, WHEN A PUMP IS USED TO DEWATER THE ISOLATION AREA AND FISH ARE PRESENT, A FISH SCREEN THAT MEETS NMFS'S FISH SCREEN CRITERIA (NMFS 2011, OR MOST CURRENT). WORK AREA ISOLATION AND FISH CAPTURE ACTIVITIES WILL OCCUR DURING PERIODS OF THE COOLEST AIR AND WATER TEMPERATURES POSSIBLE, NORMALLY EARLY IN THE MORNING VERSUS LATE IN THE DAY, AND DURING CONDITIONS APPROPRIATE TO MINIMIZE STRESS AND DEATH OF SPECIES PRESENT.

- NATIONAL MARINE FISHERIES SERVICE. 2011. ANADROMOUS SALMONID PASSAGE FACILITY DESIGN. NORTHWEST REGION. AVAILABLE ONLINE AT:
HTTP://WWW.NWR.NOAA.GOV/SALMON-HYDROPOWER/FERC/UPLOAD/FISH-PASSAGE-DESIGN.PDF
- U.S. FISH AND WILDLIFE SERVICE. 2010. BEST MANAGEMENT PRACTICES TO MINIMIZE ADVERSE EFFECTS TO PACIFIC LAMPREY.
HTTP://WWW.FWS.GOV/PACIFIC/FISHERIES/SPHABCON/LAMPREY/PDF/BEST%20MANAGEMENT%20PRACTICES%20FOR%20PACIFIC%20LAMPREY%20APRIL%202010%20VERSION.PDF

FOR SALVAGE OPERATIONS IN KNOWN BULL TROUT SPAWNING AND REARING HABITAT, ELECTROFISHING SHALL ONLY OCCUR FROM MAY 1 TO JULY 31. NO ELECTROFISHING WILL OCCUR IN ANY BULL TROUT OCCUPIED HABITAT AFTER AUGUST 15. BULL TROUT ARE VERY TEMPERATURE SENSITIVE AND GENERALLY SHOULD NOT BE ELECTROSHOCKED OR OTHERWISE HANDLED WHEN TEMPERATURES EXCEED 15 DEGREES CELSIUS. SALVAGE ACTIVITIES SHOULD TAKE PLACE DURING PERIODS OF THE COOLEST AIR AND WATER TEMPERATURES POSSIBLE, NORMALLY EARLY IN THE MORNING VERSUS LATE IN THE DAY, AND DURING CONDITIONS APPROPRIATE TO MINIMIZE STRESS TO FISH SPECIES PRESENT.

SALVAGE OPERATIONS WILL FOLLOW THE ORDERING, METHODOLOGIES, AND CONSERVATION MEASURES SPECIFIED BELOW IN STEPS 1 THROUGH 6. STEPS 1 AND 2 WILL BE IMPLEMENTED FOR ALL PROJECTS WHERE WORK AREA ISOLATION IS NECESSARY ACCORDING TO CONDITIONS ABOVE. ELECTROFISHING (STEP 3) CAN BE IMPLEMENTED TO ENSURE ALL FISH HAVE BEEN REMOVED FOLLOWING STEPS 1 AND 2, OR WHEN OTHER MEANS OF FISH CAPTURE MAY NOT BE FEASIBLE OR EFFECTIVE. DEWATERING AND REWATERING (STEPS 4 AND 5) WILL BE IMPLEMENTED UNLESS WETTED IN-STREAM WORK IS DEEMED TO BE MINIMALLY HARMFUL TO FISH, AND IS BENEFICIAL TO OTHER AQUATIC SPECIES. DEWATERING WILL NOT BE CONDUCTED IN AREAS KNOWN TO BE OCCUPIED BY LAMPREY, UNLESS LAMPREYS ARE SALVAGED USING GUIDANCE SET FORTH IN US FISH AND WILDLIFE SERVICE (2010)3.

<u>1) ISOLATE</u>.

A) BLOCK NETS WILL BE INSTALLED AT UPSTREAM AND DOWNSTREAM LOCATIONS AND MAINTAINED IN A SECURED POSITION TO EXCLUDE FISH FROM ENTERING THE PROJECT AREA.

B) BLOCK NETS WILL BE SECURED TO THE STREAM CHANNEL BED AND BANKS UNTIL FISH CAPTURE AND TRANSPORT ACTIVITIES ARE COMPLETE. BLOCK NETS MAY BE LEFT IN PLACE FOR THE DURATION OF THE PROJECT TO EXCLUDE FISH.

C) IF BLOCK NETS REMAIN IN PLACE MORE THAN ONE DAY, THE NETS WILL BE MONITORED AT LEAST DAILY TO ENSURE THEY ARE SECURED TO THE BANKS AND FREE OF ORGANIC ACCUMULATION. IF THE PROJECT IS WITHIN BULL TROUT SPAWNING AND REARING HABITAT, THE BLOCK NETS MUST BE CHECKED EVERY FOUR HOURS FOR FISH IMPINGEMENT ON THE NET. LESS FREQUENT INTERVALS MUST BE APPROVED THROUGH A VARIANCE REQUEST.

D) NETS WILL BE MONITORED HOURLY ANYTIME THERE IS INSTREAM DISTURBANCE.

<u>2) SALVAGE</u>. AS DESCRIBED BELOW, FISH TRAPPED WITHIN THE ISOLATED WORK AREA WILL BE CAPTURED TO MINIMIZE THE RISK OF INJURY, THEN RELEASED AT A SAFE SITE:

A) REMOVE AS MANY FISH AS POSSIBLE PRIOR TO DEWATERING.

B) DURING DEWATERING, ANY REMAINING FISH WILL BE COLLECTED BY HAND OR DIP NETS.

C) SEINES WITH A MESH SIZE TO ENSURE CAPTURE OF THE RESIDING ESA-LISTED FISH WILL BE USED.

D) MINNOW TRAPS WILL BE LEFT IN PLACE OVERNIGHT AND USED IN CONJUNCTION WITH SEINING.

E) IF BUCKETS ARE USED TO TRANSPORT FISH:

  I. THE TIME FISH ARE IN A TRANSPORT BUCKET WILL BE LIMITED, AND WILL BE RELEASED AS QUICKLY AS POSSIBLE;

  II. THE NUMBER OF FISH WITHIN A BUCKET WILL BE LIMITED BASED ON SIZE, AND FISH WILL BE OF RELATIVELY COMPARABLE SIZE TO MINIMIZE PREDATION;

  III. AERATORS FOR BUCKETS WILL BE USED OR THE BUCKET WATER WILL BE FREQUENTLY CHANGED WITH COLD CLEAR WATER AT 15 MINUTE OR MORE FREQUENT INTERVALS.

  IV. BUCKETS WILL BE KEPT IN SHADED AREAS OR WILL BE COVERED BY A CANOPY IN EXPOSED AREAS.

  V. DEAD FISH WILL NOT BE STORED IN TRANSPORT BUCKETS, BUT WILL BE LEFT ON THE STREAM BANK TO AVOID MORTALITY COUNTING ERRORS.

F) AS RAPIDLY AS POSSIBLE (ESPECIALLY FOR TEMPERATURE-SENSITIVE BULL TROUT), FISH WILL BE RELEASED IN AN AREA THAT PROVIDES ADEQUATE COVER AND FLOW REFUGE. UPSTREAM RELEASE IS GENERALLY PREFERRED, BUT FISH RELEASED DOWNSTREAM WILL BE SUFFICIENTLY OUTSIDE OF THE INFLUENCE OF CONSTRUCTION.

G) SALVAGE WILL BE SUPERVISED BY A QUALIFIED FISHERIES BIOLOGIST EXPERIENCED WITH WORK AREA ISOLATION AND COMPETENT TO ENSURE THE SAFE HANDLING OF ALL FISH.

<u>3) ELECTROFISHING.</u> ELECTROFISHING WILL BE USED ONLY AFTER OTHER SALVAGE METHODS HAVE BEEN EMPLOYED OR WHEN OTHER MEANS OF FISH CAPTURE ARE DETERMINED TO NOT BE FEASIBLE OR EFFECTIVE. IF ELECTROFISHING WILL BE USED TO CAPTURE FISH FOR SALVAGE, THE SALVAGE OPERATION WILL BE LED BY AN EXPERIENCED FISHERIES BIOLOGIST AND THE FOLLOWING GUIDELINES WILL BE FOLLOWED:

A) THE NMFS'S ELECTROFISHING GUIDELINES (NMFS 2000).

B) ONLY DIRECT CURRENT (DC) OR PULSED DIRECT CURRENT (PDC) WILL BE USED AND CONDUCTIVITY MUST BE TESTED.

  I. IF CONDUCTIVITY IS LESS THAN 100 MS, VOLTAGE RANGES FROM 900 TO 1100 WILL BE USED.

  II. FOR CONDUCTIVITY RANGES BETWEEN 100 TO 300 MS, VOLTAGE RANGES WILL BE 500 TO 800.

  III. FOR CONDUCTIVITY GREATER THAN 300 MS, VOLTAGE WILL BE LESS THAN 400.

C) ELECTROFISHING WILL BEGIN WITH A MINIMUM PULSE WIDTH AND RECOMMENDED VOLTAGE AND THEN GRADUALLY INCREASE TO THE POINT WHERE FISH ARE IMMOBILIZED.

D) THE ANODE WILL NOT INTENTIONALLY CONTACT FISH.

E) ELECTROFISHING SHALL NOT BE CONDUCTED WHEN THE WATER CONDITIONS ARE TURBID AND VISIBILITY IS POOR. THIS CONDITION MAY BE EXPERIENCED WHEN THE SAMPLER CANNOT SEE THE STREAM BOTTOM IN ONE FOOT OF WATER.

F) IF MORTALITY OR OBVIOUS INJURY (DEFINED AS DARK BANDS ON THE BODY, SPINAL DEFORMATIONS, DE-SCALING OF 25% OR MORE OF BODY, AND TORPIDITY OR INABILITY TO MAINTAIN UPRIGHT ATTITUDE AFTER SUFFICIENT RECOVERY TIME) OCCURS DURING ELECTROFISHING, OPERATIONS WILL BE IMMEDIATELY DISCONTINUED, MACHINE SETTINGS, WATER TEMPERATURE AND CONDUCTIVITY CHECKED, AND PROCEDURES ADJUSTED OR ELECTROFISHING POSTPONED TO REDUCE MORTALITY.

<u>4) DEWATER.</u> DEWATERING, WHEN NECESSARY, WILL BE CONDUCTED OVER A SUFFICIENT PERIOD OF TIME TO ALLOW SPECIES TO NATURALLY MIGRATE OUT OF THE WORK AREA AND WILL BE LIMITED TO THE SHORTEST LINEAR EXTENT PRACTICABLE.

A) DIVERSION AROUND THE CONSTRUCTION SITE MAY BE ACCOMPLISHED WITH A COFFER DAM AND A BY-PASS CULVERT OR PIPE, OR A LINED, NON-ERODIBLE DIVERSION DITCH. WHERE GRAVITY FEED IS NOT POSSIBLE, A PUMP MAY BE USED, BUT MUST BE OPERATED IN SUCH A WAY AS TO AVOID REPETITIVE DEWATERING AND REWATERING OF THE SITE. IMPOUNDMENT BEHIND THE COFFERDAM MUST OCCUR SLOWLY THROUGH THE TRANSITION, WHILE CONSTANT FLOW IS DELIVERED TO THE DOWNSTREAM REACHES.

B) ALL PUMPS WILL HAVE FISH SCREENS TO AVOID JUVENILE FISH IMPINGEMENT OR ENTRAINMENT, AND WILL BE OPERATED IN ACCORDANCE WITH NMFS'S CURRENT FISH SCREEN CRITERIA (NMFS 20114, OR MOST RECENT VERSION). IF THE PUMPING RATE EXCEEDS 3 CUBIC FEET SECOND (CFS), A NMFS HYDRO FISH PASSAGE REVIEW WILL BE NECESSARY.

C) DISSIPATION OF FLOW ENERGY AT THE BYPASS OUTFLOW WILL BE PROVIDED TO PREVENT DAMAGE TO RIPARIAN VEGETATION OR STREAM CHANNEL.

D) SAFE REENTRY OF FISH INTO THE STREAM CHANNEL WILL BE PROVIDED, PREFERABLY INTO POOL HABITAT WITH COVER, IF THE DIVERSION ALLOWS FOR DOWNSTREAM FISH PASSAGE.

E) SEEPAGE WATER WILL BE PUMPED TO A TEMPORARY STORAGE AND TREATMENT SITE OR INTO UPLAND AREAS TO ALLOW WATER TO PERCOLATE THROUGH SOIL OR TO FILTER THROUGH VEGETATION PRIOR TO REENTERING THE STREAM CHANNEL.

4 NATIONAL MARINE FISHERIES SERVICE. 2011. ANADROMOUS SALMONID PASSAGE FACILITY DESIGN. NORTHWEST REGION. AVAILABLE ONLINE AT:
HTTP://WWW.NWR.NOAA.GOV/SALMON-HYDROPOWER/FERC/UPLOAD/FISH-PASSAGE-DESIGN.PDF

<u>5) SALVAGE NOTICE.</u> MONITORING AND RECORDING OF FISH PRESENCE, HANDLING, AND MORTALITY MUST OCCUR DURING THE DURATION OF THE ISOLATION, SALVAGE, ELECTROFISHING, DEWATERING, AND REWATERING OPERATIONS. ONCE OPERATIONS ARE COMPLETED, A SALVAGE REPORT WILL DOCUMENT PROCEDURES USED, ANY FISH INJURIES OR DEATHS (INCLUDING NUMBERS OF FISH AFFECTED), AND CAUSES OF ANY DEATHS.

CONSTRUCTION AND POST-CONSTRUCTION CONSERVATION MEASURES.

<u>1) FISH PASSAGE.</u> FISH PASSAGE WILL BE PROVIDED FOR ANY ADULT OR JUVENILE FISH LIKELY TO BE PRESENT IN THE ACTION AREA DURING CONSTRUCTION, UNLESS PASSAGE DID NOT EXIST BEFORE CONSTRUCTION OR THE STREAM IS NATURALLY IMPASSABLE AT THE TIME OF CONSTRUCTION. IF THE PROVISION OF TEMPORARY FISH PASSAGE DURING CONSTRUCTION WILL INCREASE NEGATIVE EFFECTS ON AQUATIC SPECIES OF INTEREST OR THEIR HABITAT, A VARIANCE CAN BE REQUESTED FROM THE NMFS BRANCH CHIEF AND THE FWS FIELD OFFICE SUPERVISOR. PERTINENT INFORMATION, SUCH AS THE SPECIES AFFECTED, LENGTH OF STREAM REACH AFFECTED, PROPOSED TIME FOR THE PASSAGE BARRIER, AND ALTERNATIVESCONSIDERED, WILL BE INCLUDED IN THE VARIANCE REQUEST.

<u>2) CONSTRUCTION AND DISCHARGE WATER.</u>

A) SURFACE WATER MAY BE DIVERTED TO MEET CONSTRUCTION NEEDS, BUT ONLY IF DEVELOPED SOURCES ARE UNAVAILABLE OR INADEQUATE.

B) DIVERSIONS WILL NOT EXCEED 10% OF THE AVAILABLE FLOW.

C) ALL CONSTRUCTION DISCHARGE WATER WILL BE COLLECTED AND TREATED USING THE BEST AVAILABLE TECHNOLOGY APPLICABLE TO SITE CONDITIONS.

D) TREATMENTS TO REMOVE DEBRIS, NUTRIENTS, SEDIMENT, PETROLEUM HYDROCARBONS, METALS AND OTHER POLLUTANTS LIKELY TO BE PRESENT WILL BE PROVIDED.

ACRONYMS AND ABBREVIATIONS

N.	*North*
S.	*South*
E.	*East*
W.	*West*
BPA	*Bonneville Power Administration*
C.O.	*Contracting Officer*
CP	*Control Point*
CSRO	*Columbia-Snake Salmon Recovery Office*
CWA	*Clean Water Act*
DBH	*Diameter at Breast Height*
DC	*Direct Current*
DEQ	*Department of Environmental Quality*
El	*Elevation*
EPA	*Environmental Protection Agency*
ESA	*Endangered Species Act*
FCRPS	*Federal Columbia River Power System*
F.G.	*Finished Grade*
Hwy	*Highway*
I	*Interstate*
ID	*Idaho*
IDFG	*Idaho Department of Fish and Wildlife*
IDWR	*Idaho Department of Water Resources*
NAD	*North American Datum*
NAVD	*North American Vertical Datum*
NEPA	*National Environmental Policy Act*
NMFS	*National Marine Fisheries Service*

NPDES	*National Pollutant Discharge Elimination System*
NRS	*National Response System*
ODFW	*Oregon Department of Fish and Wildlife*
O.G.	*Original Grade*
OHW	*Ordinary High Water*
OR	*Oregon*
OSHA	*Occupational Safety and Health Administration*
PDC	*Pulsed Direct Current*
PH	*Phone*
R	*Range*
Rd.	*Road*
RM	*River Mile*
Sec.	*Section*
sf	*Square Foot*
SHPO	*State Historic Preservation Officer*
STA	*Station*
SWPPP	*Storm Water Pollution Prevention Plan*
T	*Township*
U.S.	*United States*
USACE	*United States Army Corps of Engineers*
USFWS	*United States Fish and Wildlife Service*
WA	*Washington*
WDFW	*Washington Department of Fish and Wildlife*
WSE	*Water Surface Elevation*
yr	*Year*

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11/4/2016 10:33 AM
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ADMIN APPROVAL - TITLE

CSRO (BOISE, IDAHO) *2016-11-04*

NOTES

HIP III GENERAL CONSERVATION MEASURES

1678-100-60691

SHEET 2 of 2

RECLAMATION
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SURVEY CONTROL POINTS

Point #	Northing	Easting	Elevation	Description
201	605967.39	8769570.76	3099.50	MON_ALCAP
530	603864.41	8772236.12	3117.45	APA-RPC
531	607385.55	8773931.08	3081.95	APA-RPC
532	605748.63	8773702.35	3104.51	APA_RPC
533	603513.47	8769676.15	3108.78	APA_RPC
534	603391.89	8767600.70	3116.99	APA-RPC
535	603336.42	8766254.37	3125.79	APA_RPC
536	602596.28	8763709.79	3143.20	APA_RPC
537	600553.10	8762230.18	3151.85	APA_RPC
538	609646.60	8775495.36	3067.04	APA_RPC
560	601417.26	8763192.04	3145.56	APA_RPC
561	603173.56	8764579.37	3134.96	APA_RPC
562	603676.15	8764534.08	3133.36	APA_H+MAG
563	603792.94	8764786.80	3131.90	APA_H+MAG
564	604088.12	8765060.50	3129.25	APA_H+MAG
565	603979.38	8767754.93	3116.49	APA_H+MAG
566	603896.74	8768108.01	3113.03	APA_H+MAG
567	607740.65	8772533.72	3083.87	APA_NLSPK
568	607868.34	8772881.47	3083.55	APA_MAGTREE

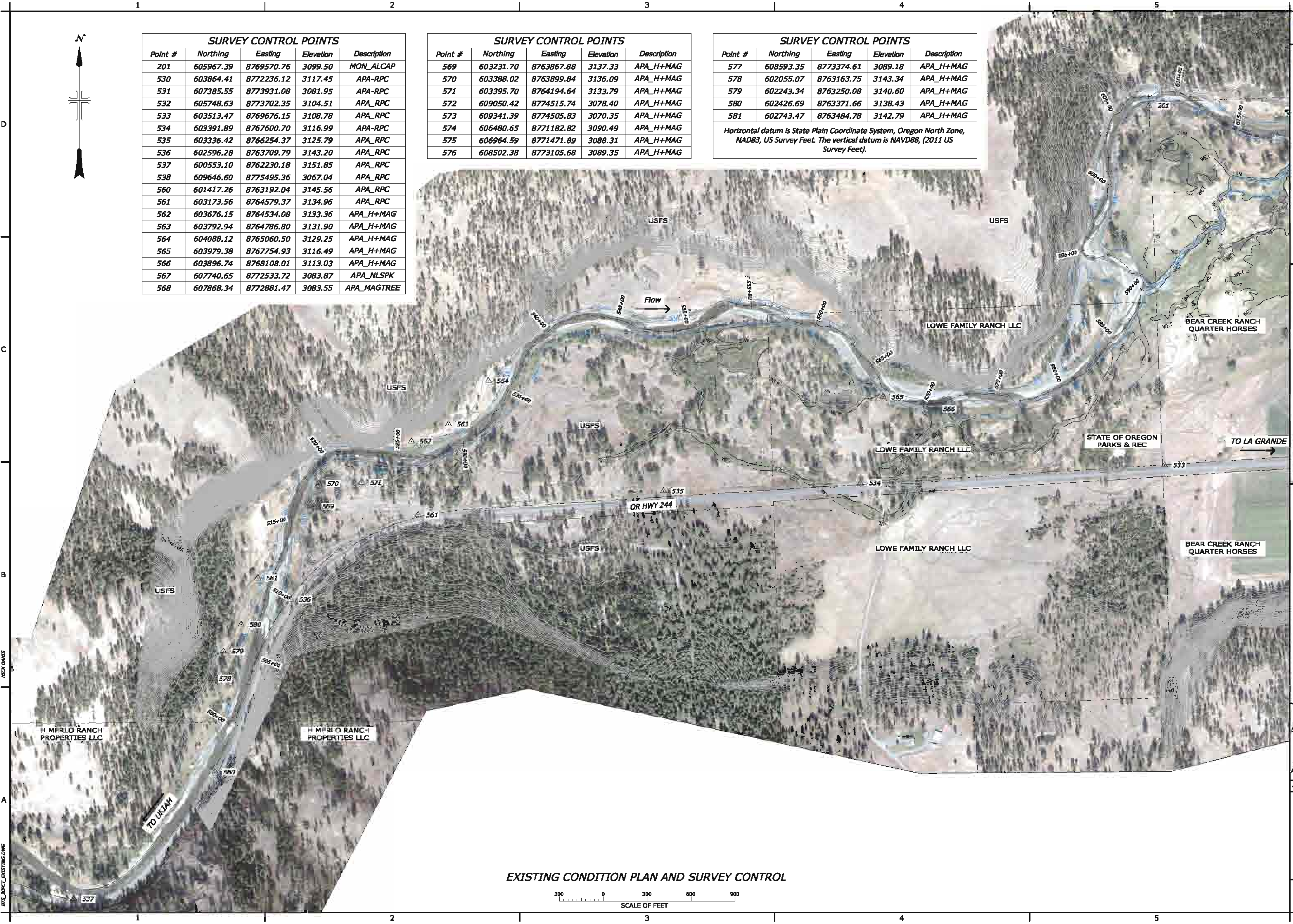
SURVEY CONTROL POINTS

Point #	Northing	Easting	Elevation	Description
569	603231.70	8763867.88	3137.33	APA_H+MAG
570	603388.02	8763899.84	3136.09	APA_H+MAG
571	603395.70	8764194.64	3133.79	APA_H+MAG
572	609050.42	8774515.74	3078.40	APA_H+MAG
573	609341.39	8774505.83	3070.35	APA_H+MAG
574	606480.65	8771182.82	3090.49	APA_H+MAG
575	606964.59	8771471.89	3088.31	APA_H+MAG
576	608502.38	8773105.68	3089.35	APA_H+MAG

SURVEY CONTROL POINTS

Point #	Northing	Easting	Elevation	Description
577	608593.35	8773374.61	3089.18	APA_H+MAG
578	602055.07	8763163.75	3143.34	APA_H+MAG
579	602243.34	8763250.08	3140.60	APA_H+MAG
580	602426.69	8763371.66	3138.43	APA_H+MAG
581	602743.47	8763484.78	3142.79	APA_H+MAG

Horizontal datum is State Plain Coordinate System, Oregon North Zone, NAD83, US Survey Feet. The vertical datum is NAVD88, (2011 US Survey Feet).



EXISTING CONDITION PLAN AND SURVEY CONTROL

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COLUMBIA/SNAKE RIVER SALMON RECOVERY PROGRAM

GRANDE RONDE RIVER SUBBASIN
BIRD TRACK SPRINGS FISH HABITAT
ENHANCEMENT PROJECT

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CSRO (BOISE, IDAHO) 2016-11-04

EXISTING CONDITION
PLAN AND SURVEY
CONTROL

1678-100-60692

SHEET 1 of 1

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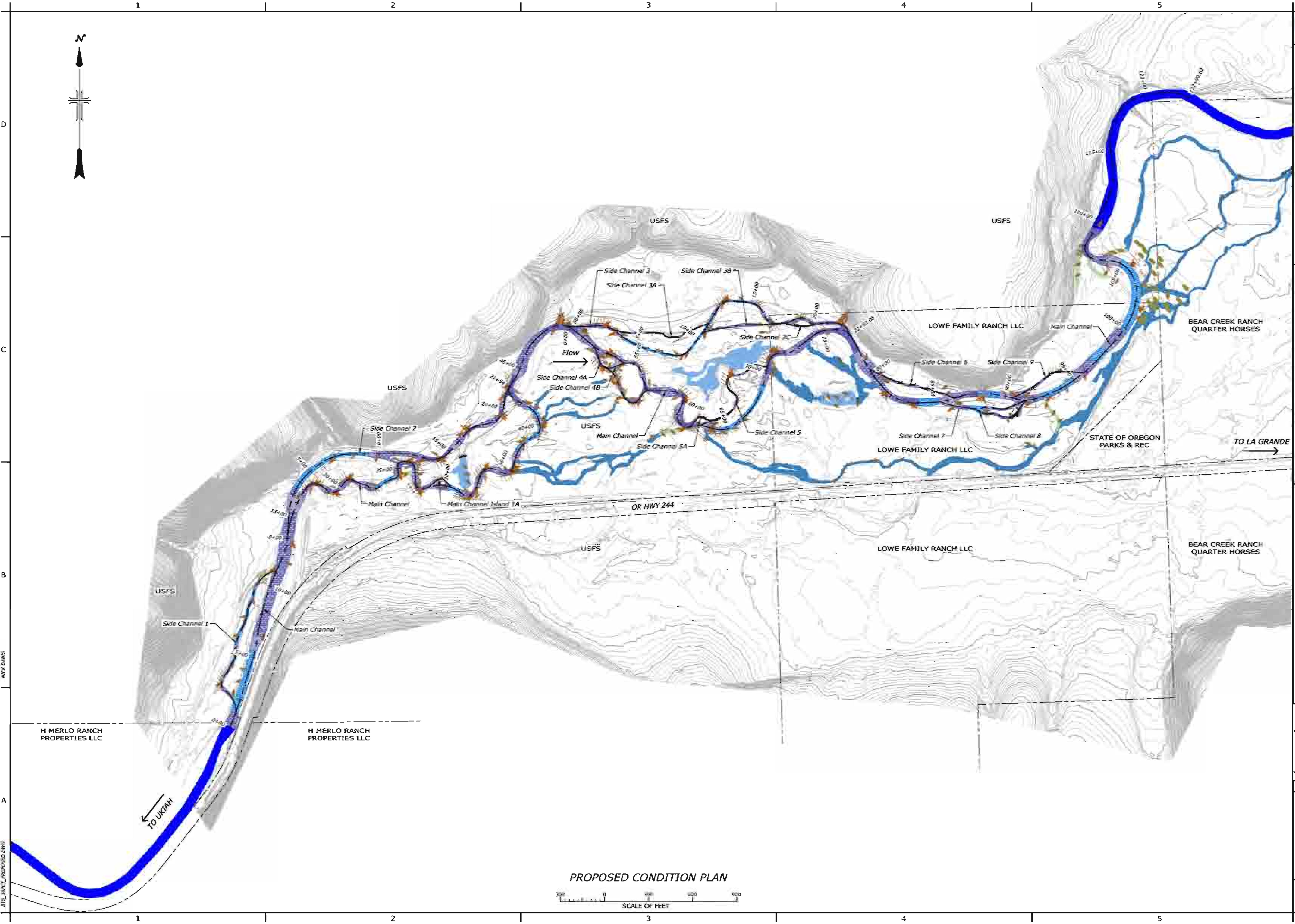

PROPOSED CONDITION PLAN

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PROPOSED CONDITION
PLAN

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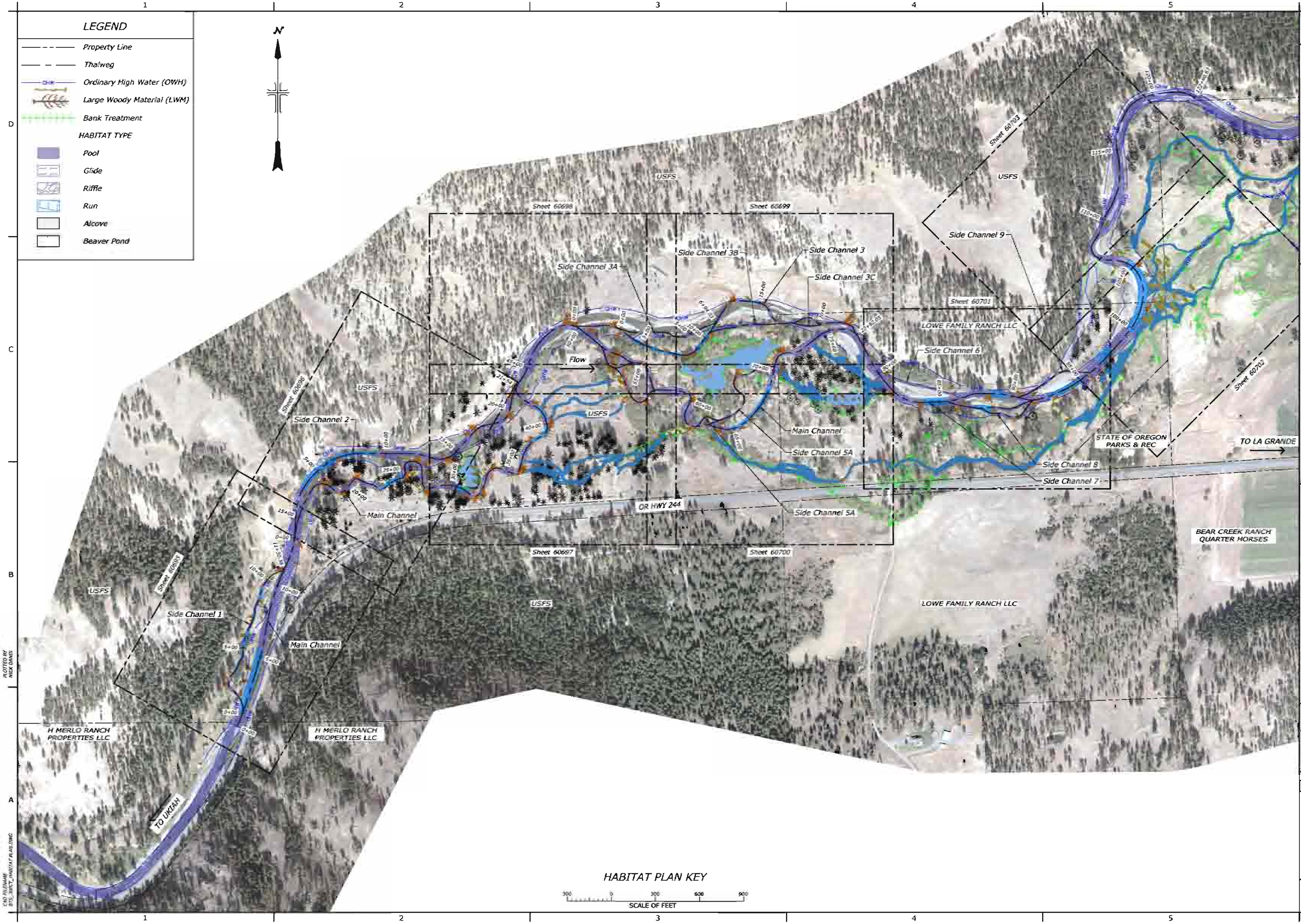

HABITAT PLAN KEY

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HABITAT PLAN KEY

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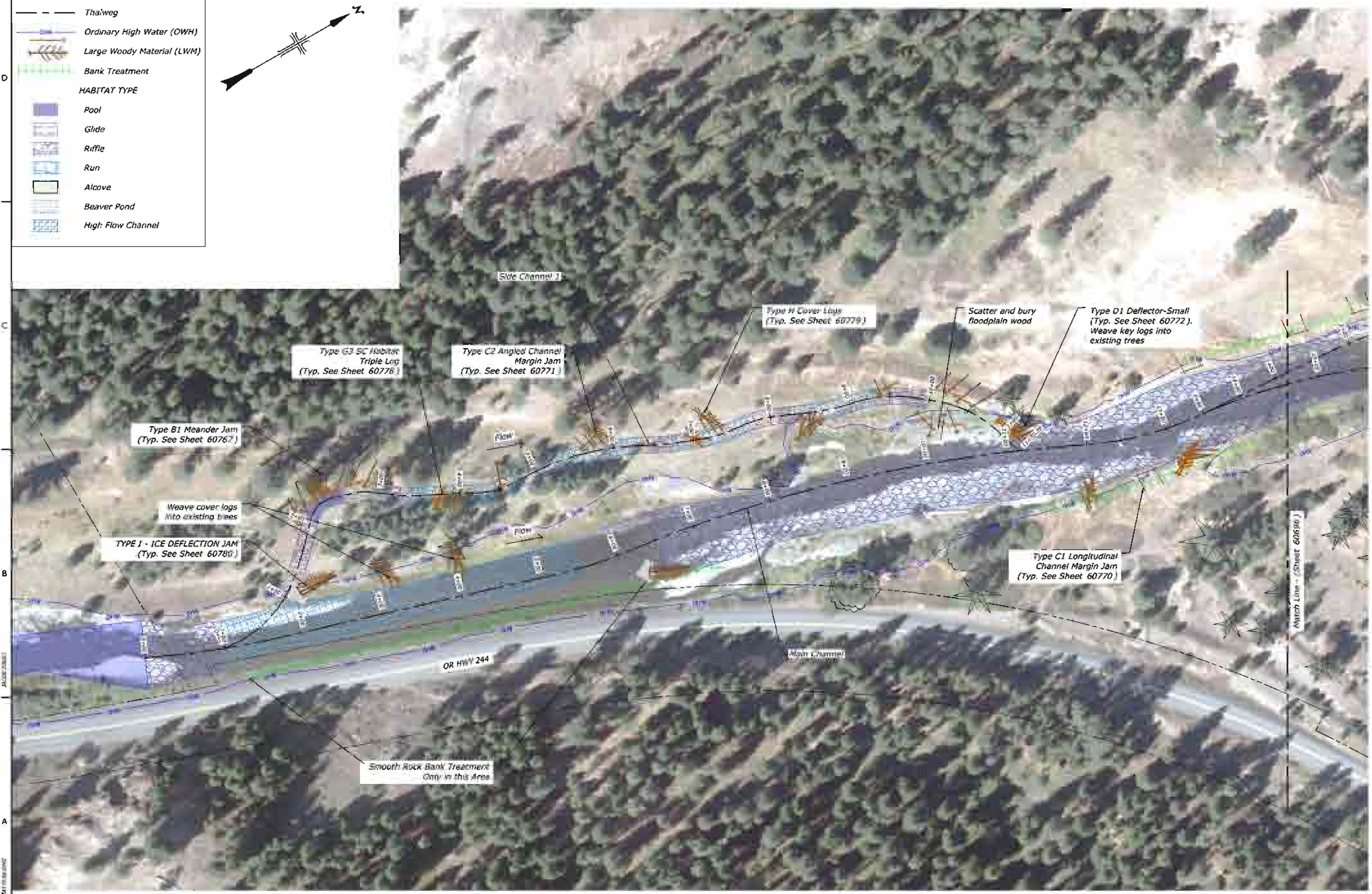
LEGEND

- Property Line
- Thalweg
- Ordinary High Water (OWH)
- Large Woody Material (LWM)
- Bank Treatment

HABITAT TYPE

- Pool
- Glide
- Riffle
- Run
- Alcove
- Beaver Pond
- High Flow Channel



HABITAT PLAN 1

60 0 60 120 180
SCALE OF FEET

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HABITAT PLAN 1

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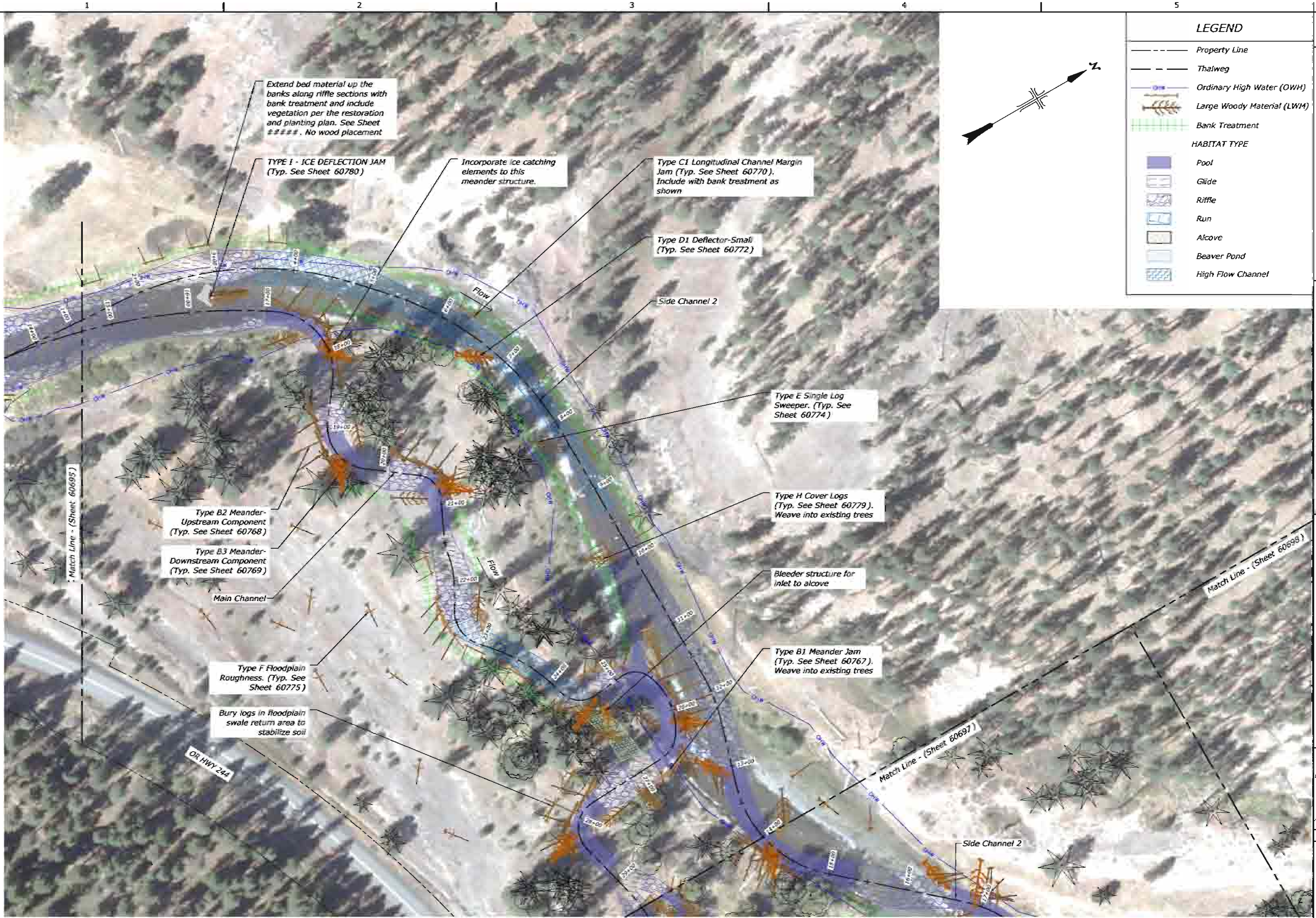

HABITAT PLAN 2

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HABITAT PLAN 2

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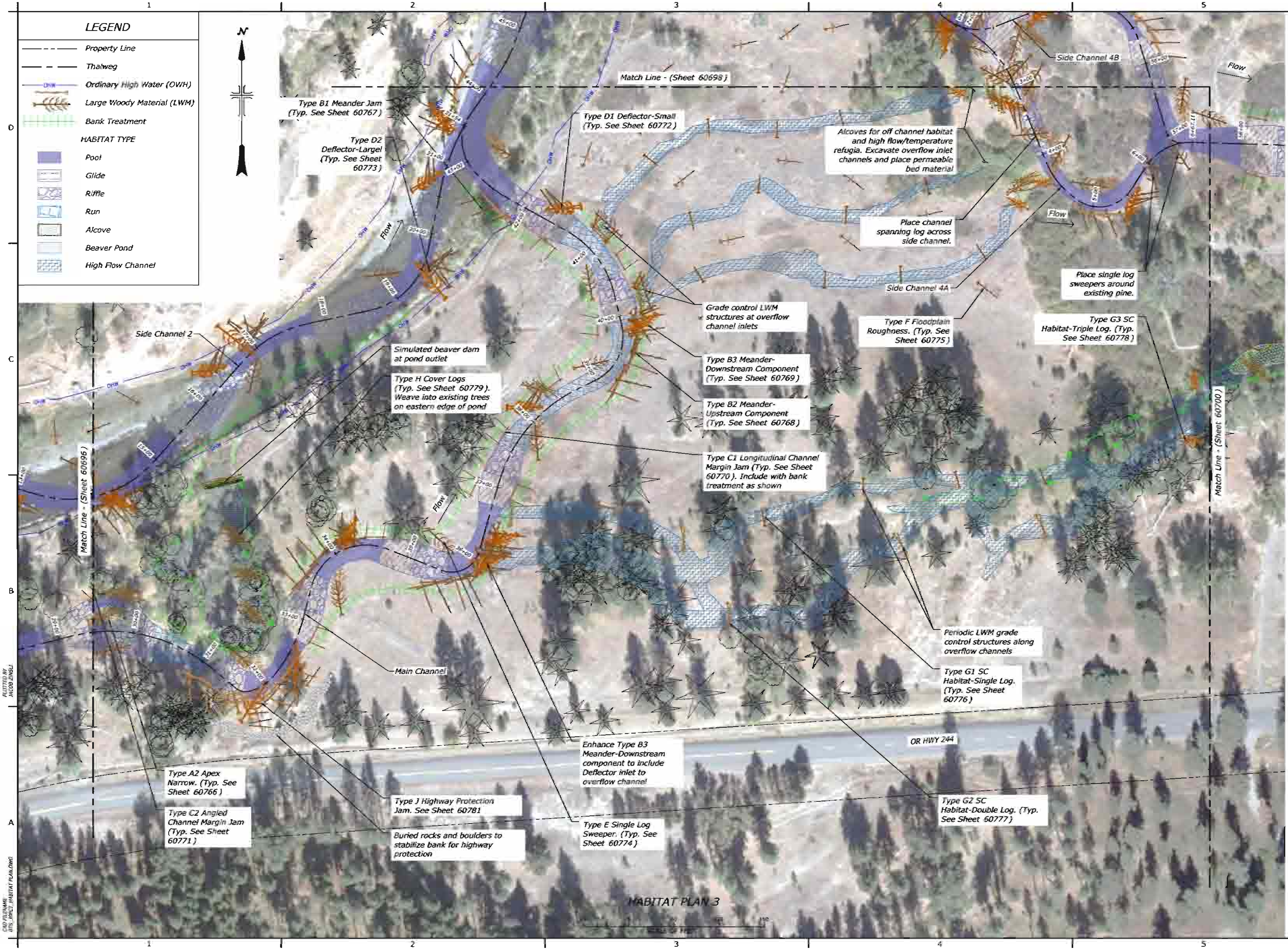

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HABITAT PLAN 3

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CAD FILENAME
BTS_60697_HABITAT PLAN.DWG

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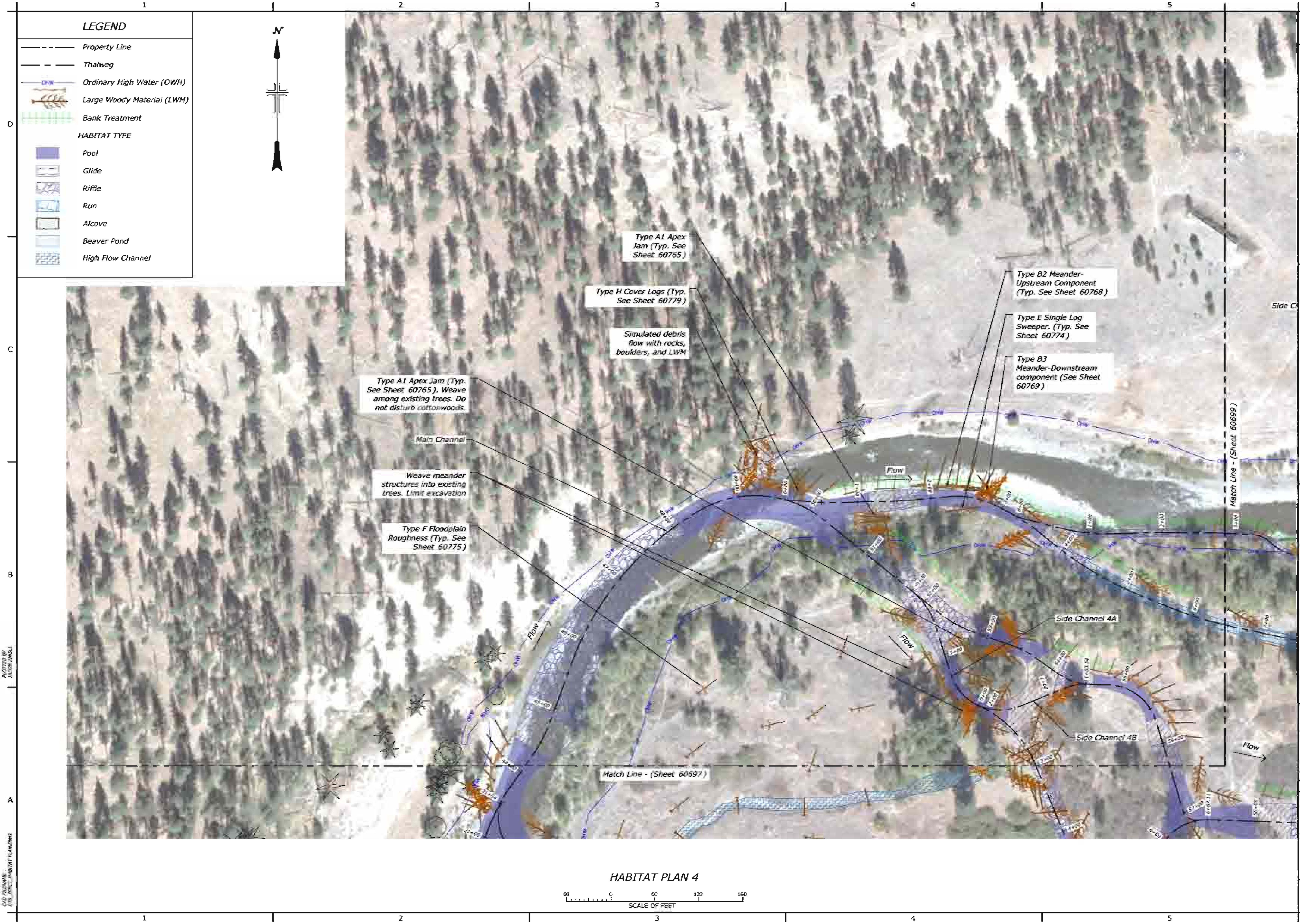
LEGEND

— · — · —	Property Line
— — —	Thalweg
—OHW—	Ordinary High Water (OWH)
	Large Woody Material (LWM)
	Bank Treatment

HABITAT TYPE

▨	Pool
▨	Glide
▨	Riffle
▨	Run
☐	Alcove
▨	Beaver Pond
▨	High Flow Channel



HABITAT PLAN 4

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HABITAT PLAN 4

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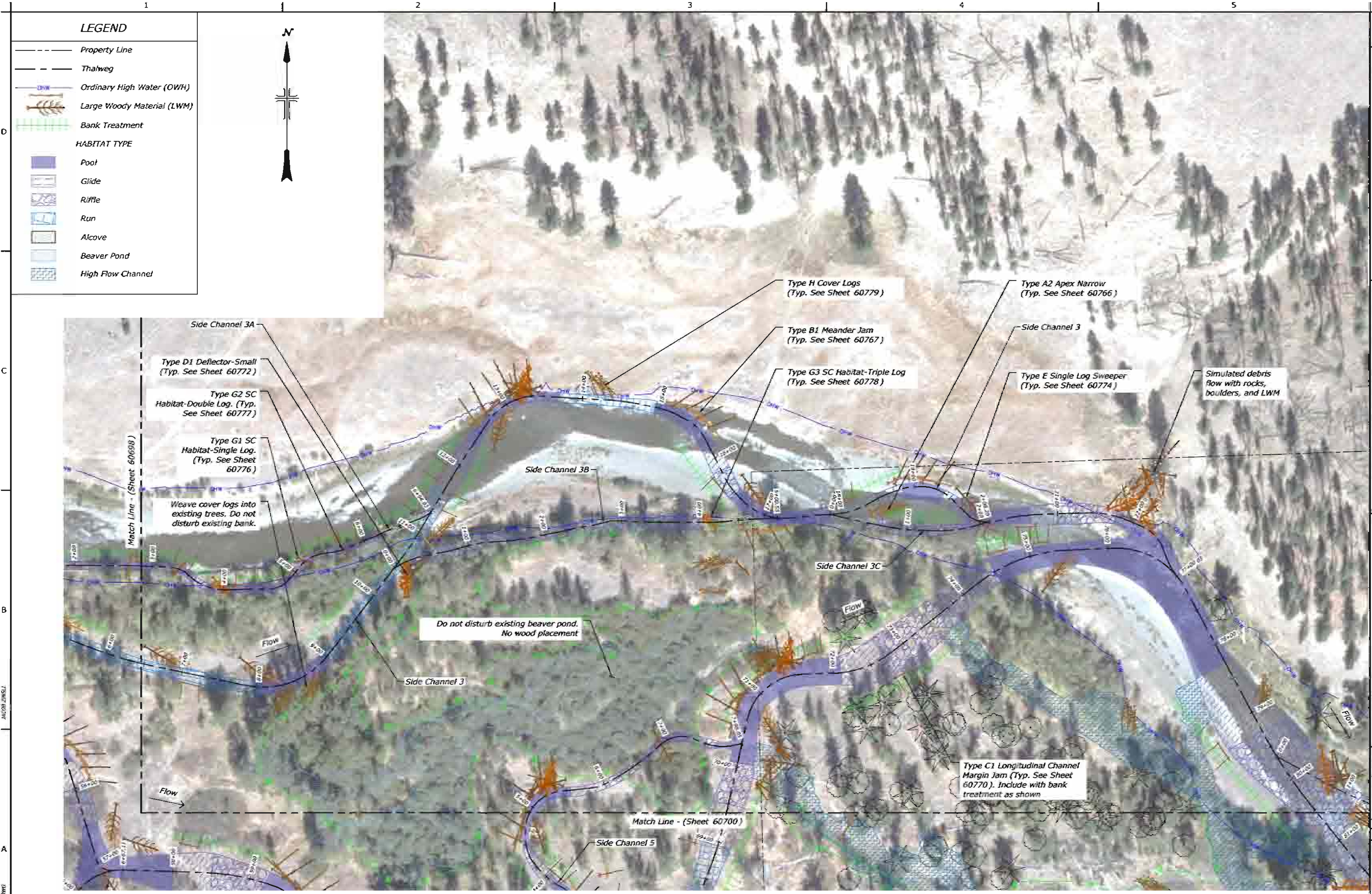

HABITAT PLAN 5

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HABITAT PLAN 5

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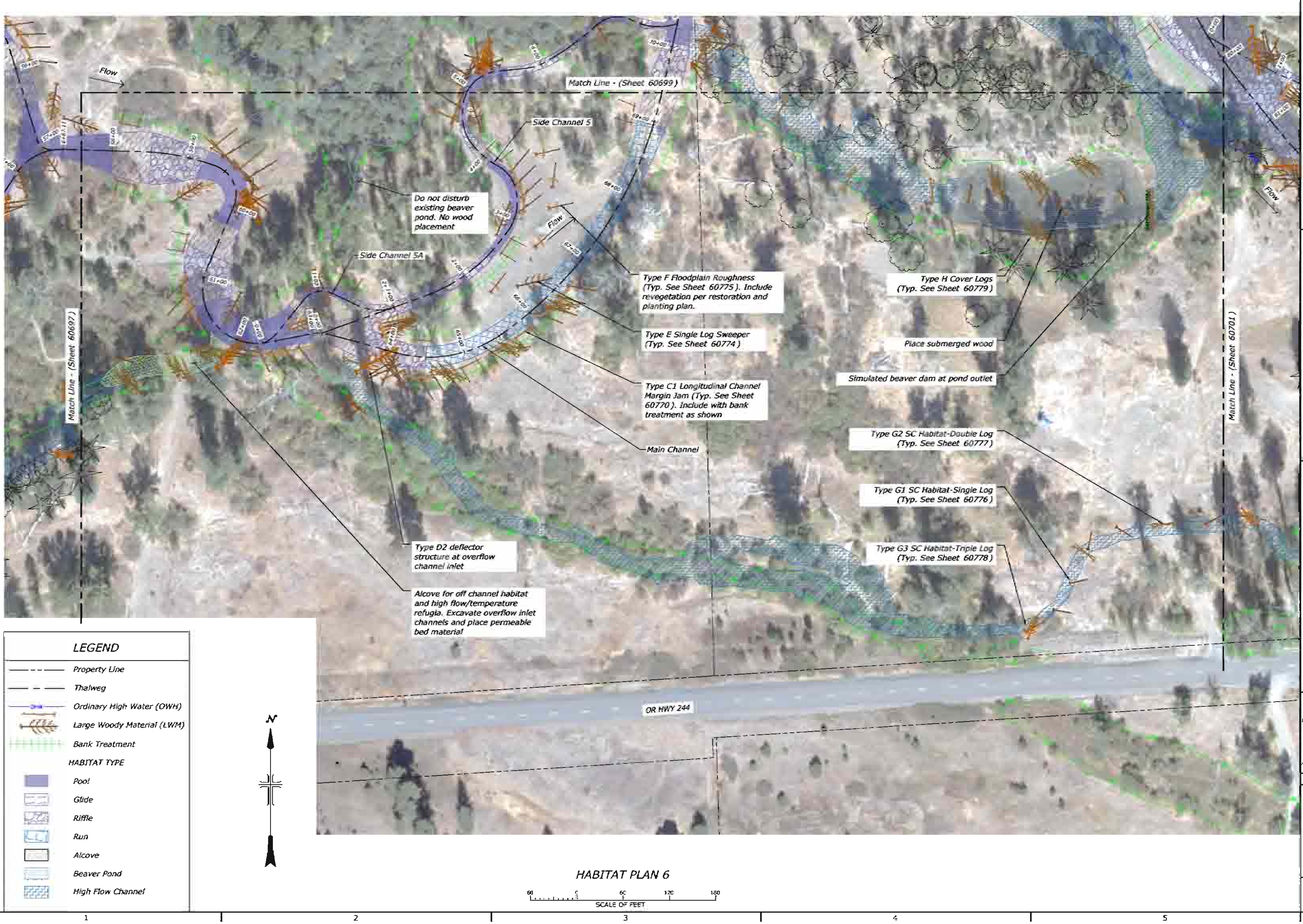

HABITAT PLAN 6

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HABITAT PLAN 6

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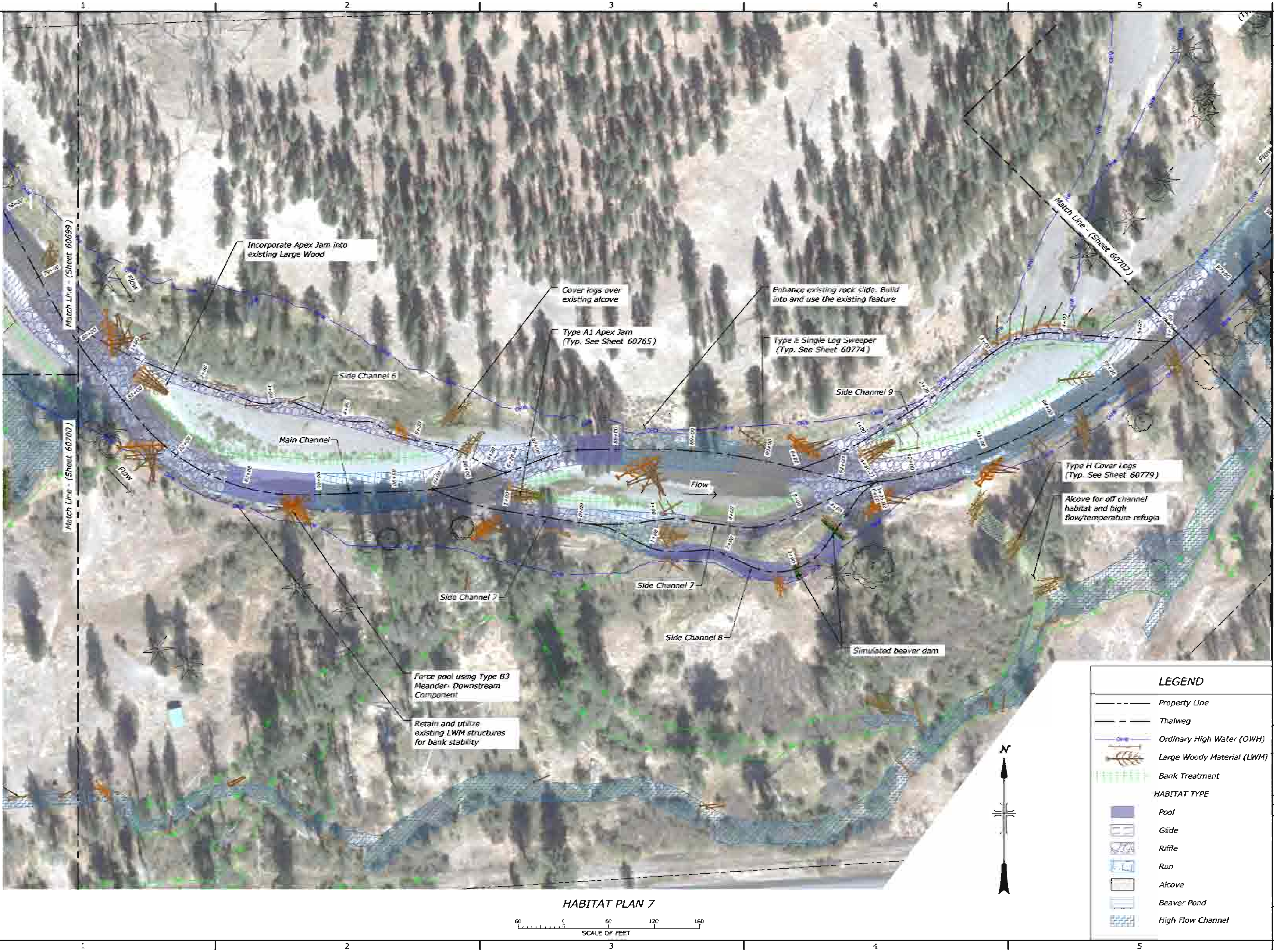

HABITAT PLAN 7

LEGEND

— - —	Property Line
— —	Thalweg
—OHW—	Ordinary High Water (OWH)
⟿	Large Woody Material (LWM)
┼┼┼	Bank Treatment
	HABITAT TYPE
▇	Pool
▭	Glide
▨	Riffle
▭	Run
▭	Alcove
▭	Beaver Pond
▩	High Flow Channel

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HABITAT PLAN 7

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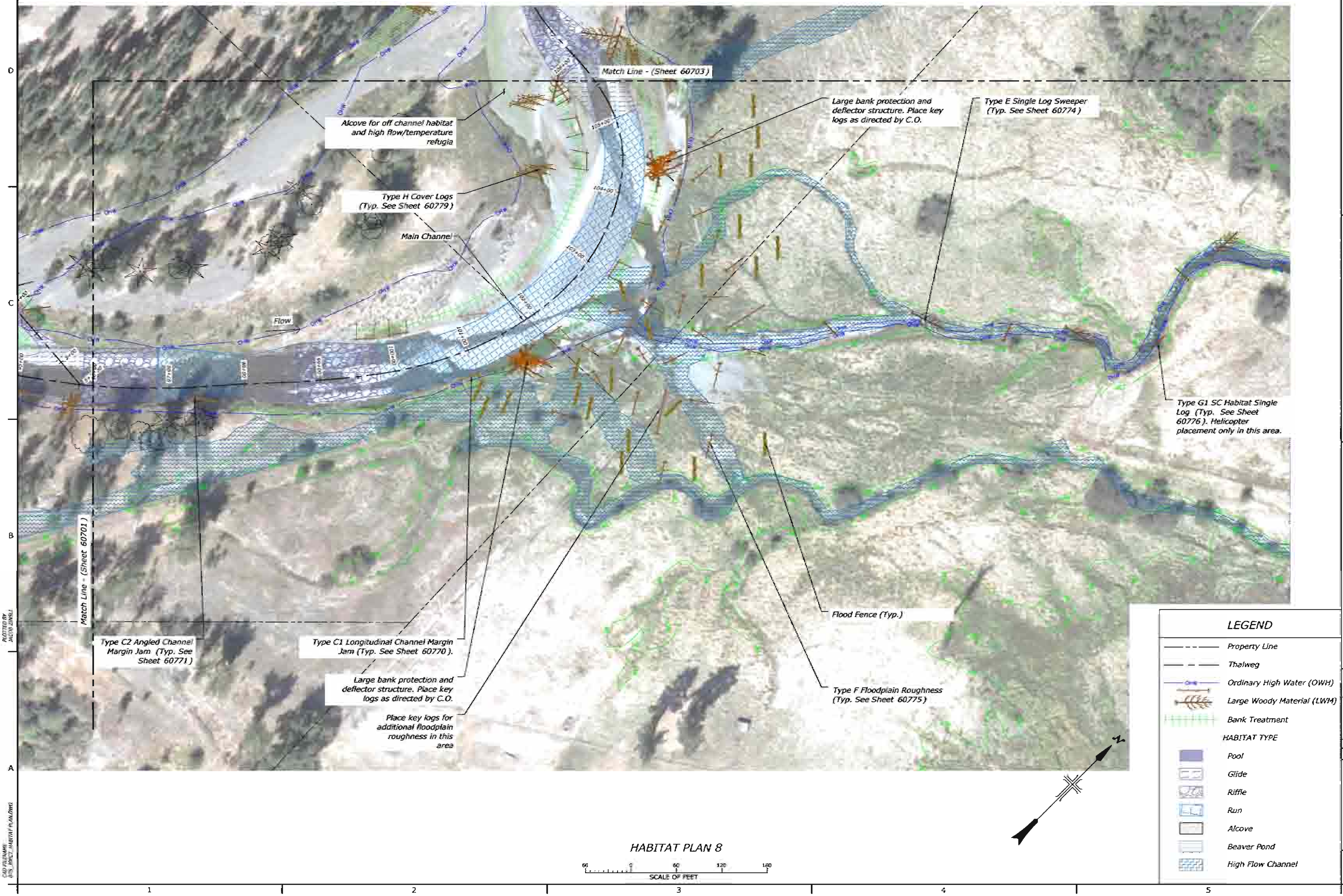

HABITAT PLAN 8

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HABITAT PLAN 8

1678-100-60702

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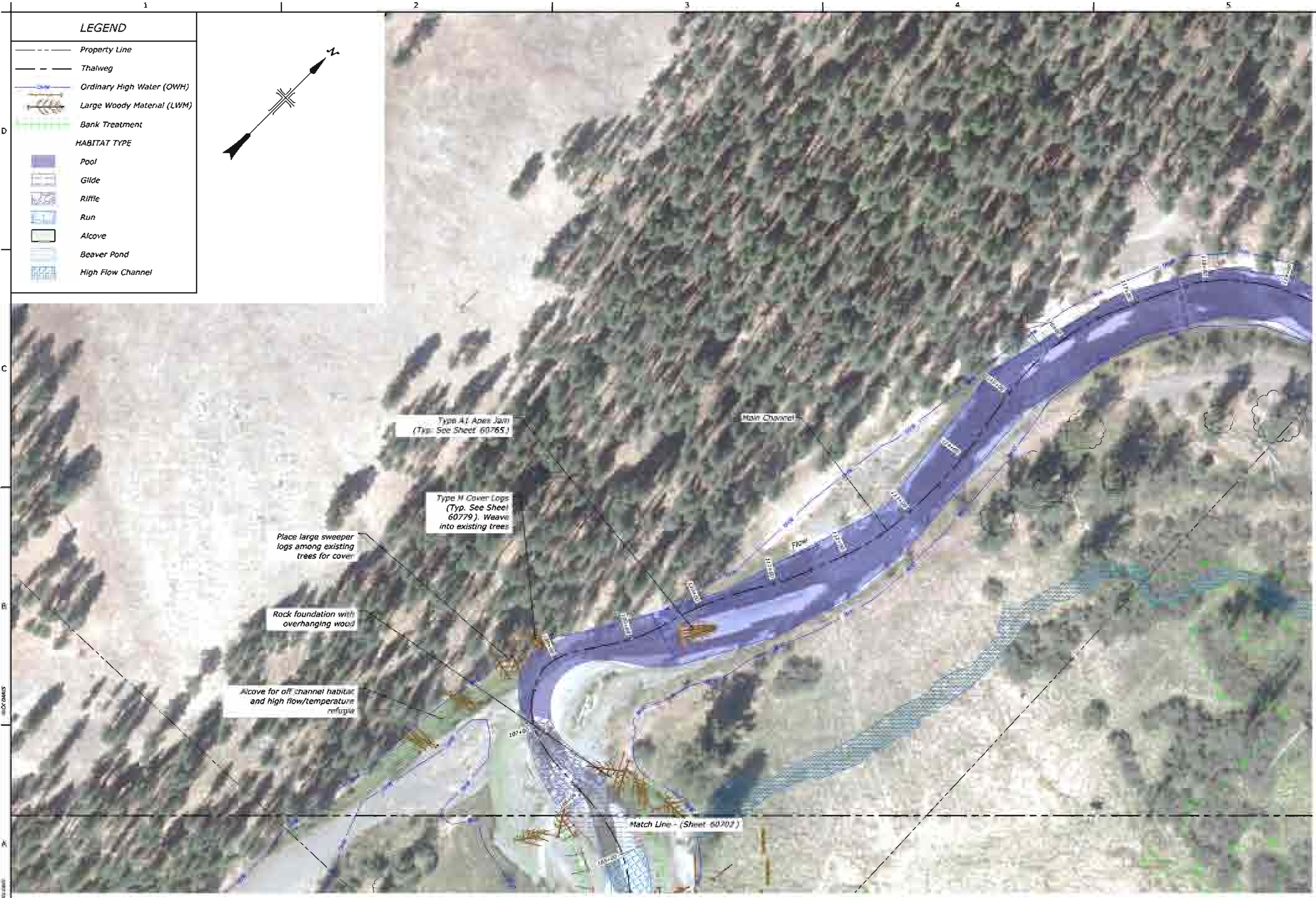

HABITAT PLAN 9

60 0 60 120 180
SCALE OF FEET

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HABITAT PLAN 9

1678-100-60703

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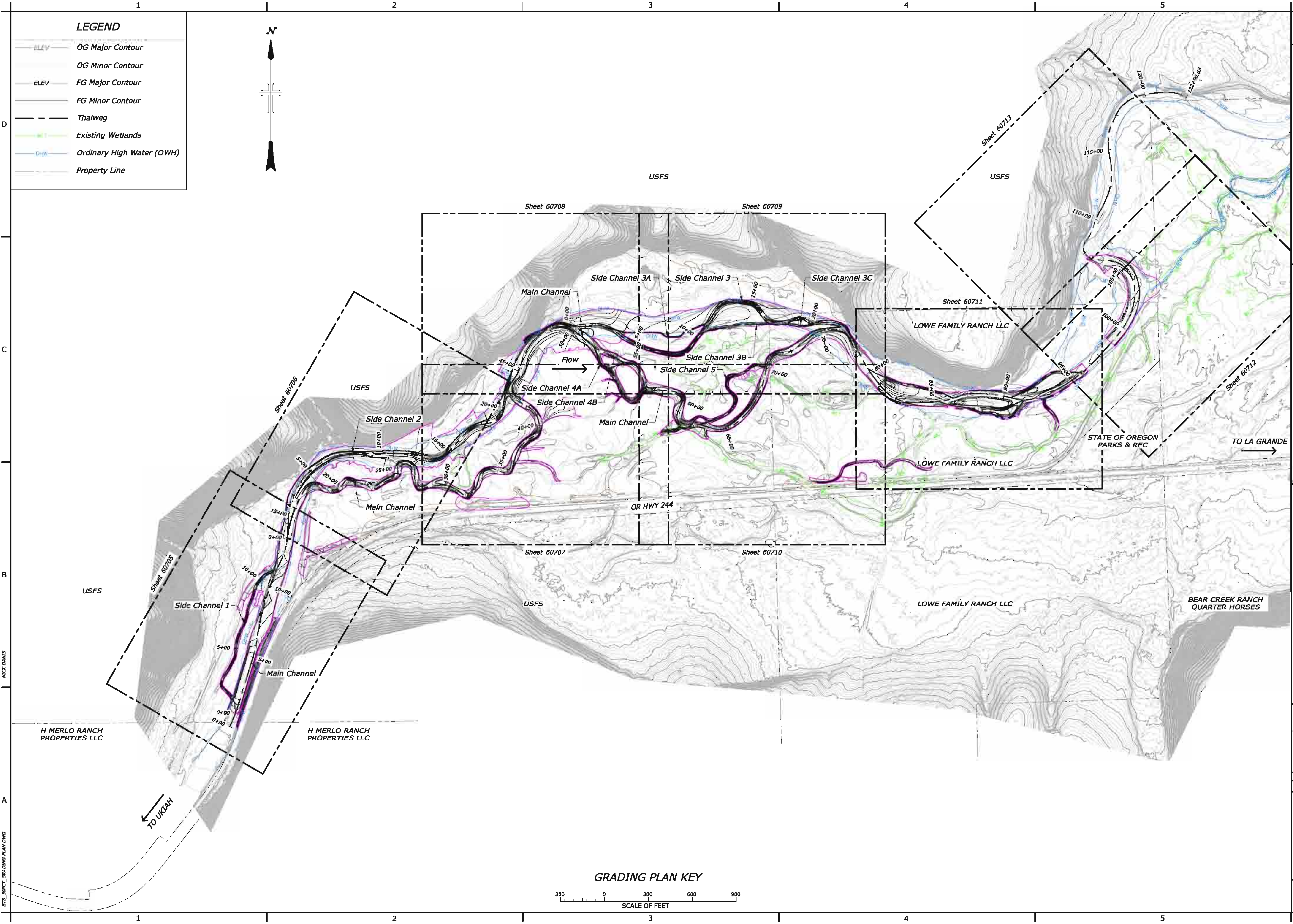

GRADING PLAN KEY

300 0 300 600 900
SCALE OF FEET

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GRADING PLAN KEY

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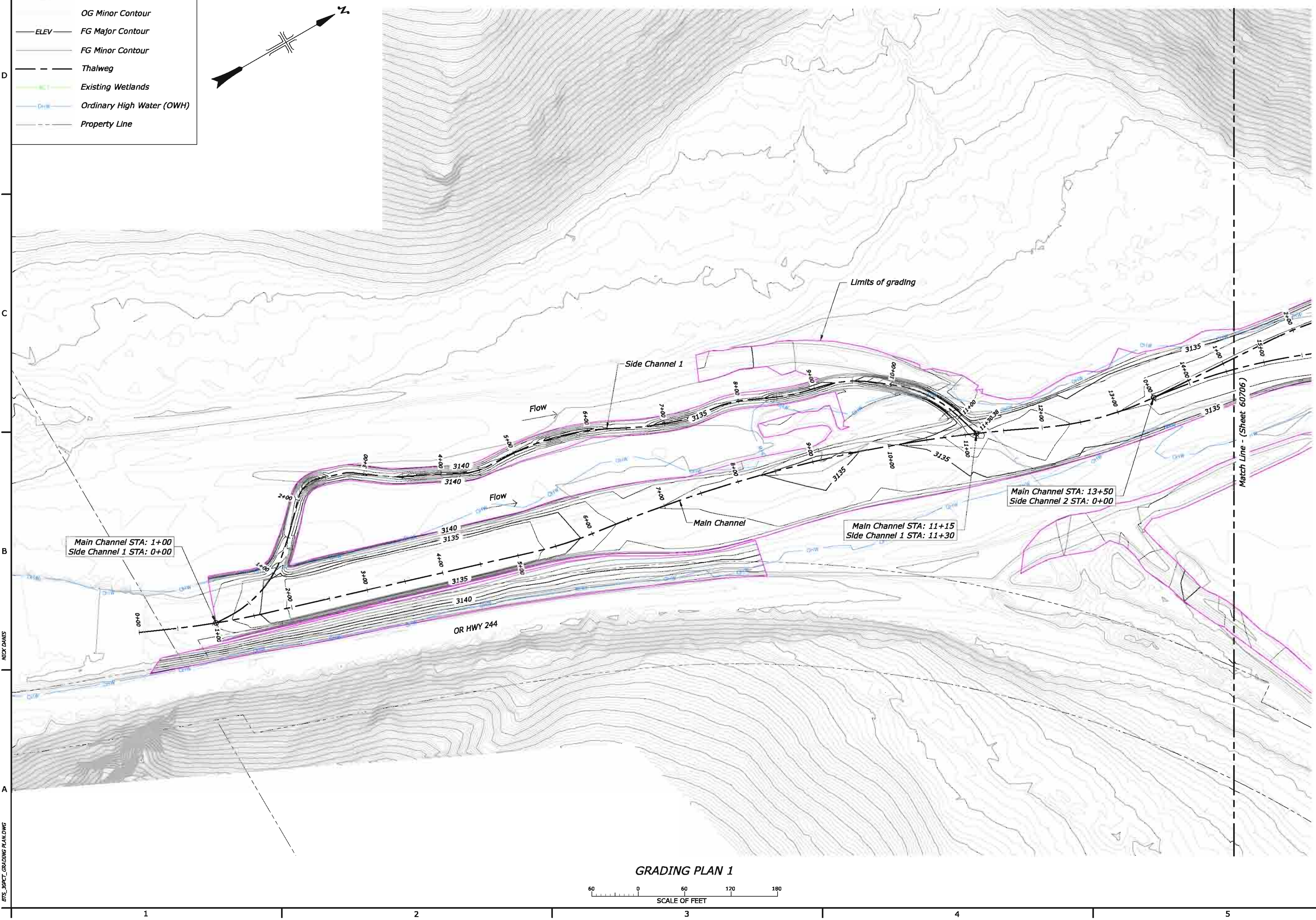
LEGEND

- ELEV OG Major Contour
- OG Minor Contour
- ELEV FG Major Contour
- FG Minor Contour
- Thalweg
- WET Existing Wetlands
- OHW Ordinary High Water (OWH)
- Property Line



GRADING PLAN 1

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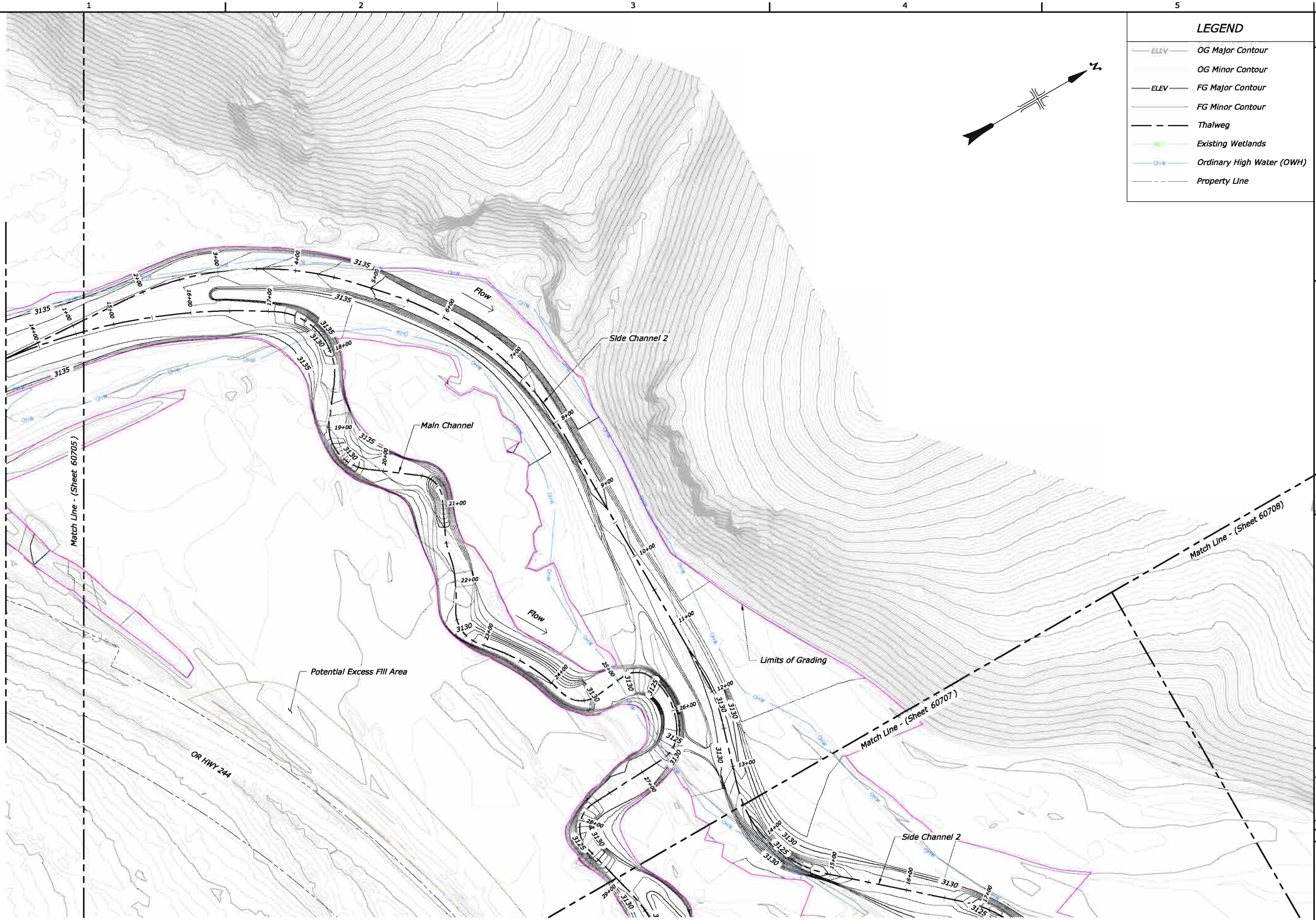

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
	Thalweg
WET	Existing Wetlands
OHW	Ordinary High Water (OWH)
	Property Line

GRADING PLAN 2

60 0 60 120 180
SCALE OF FEET

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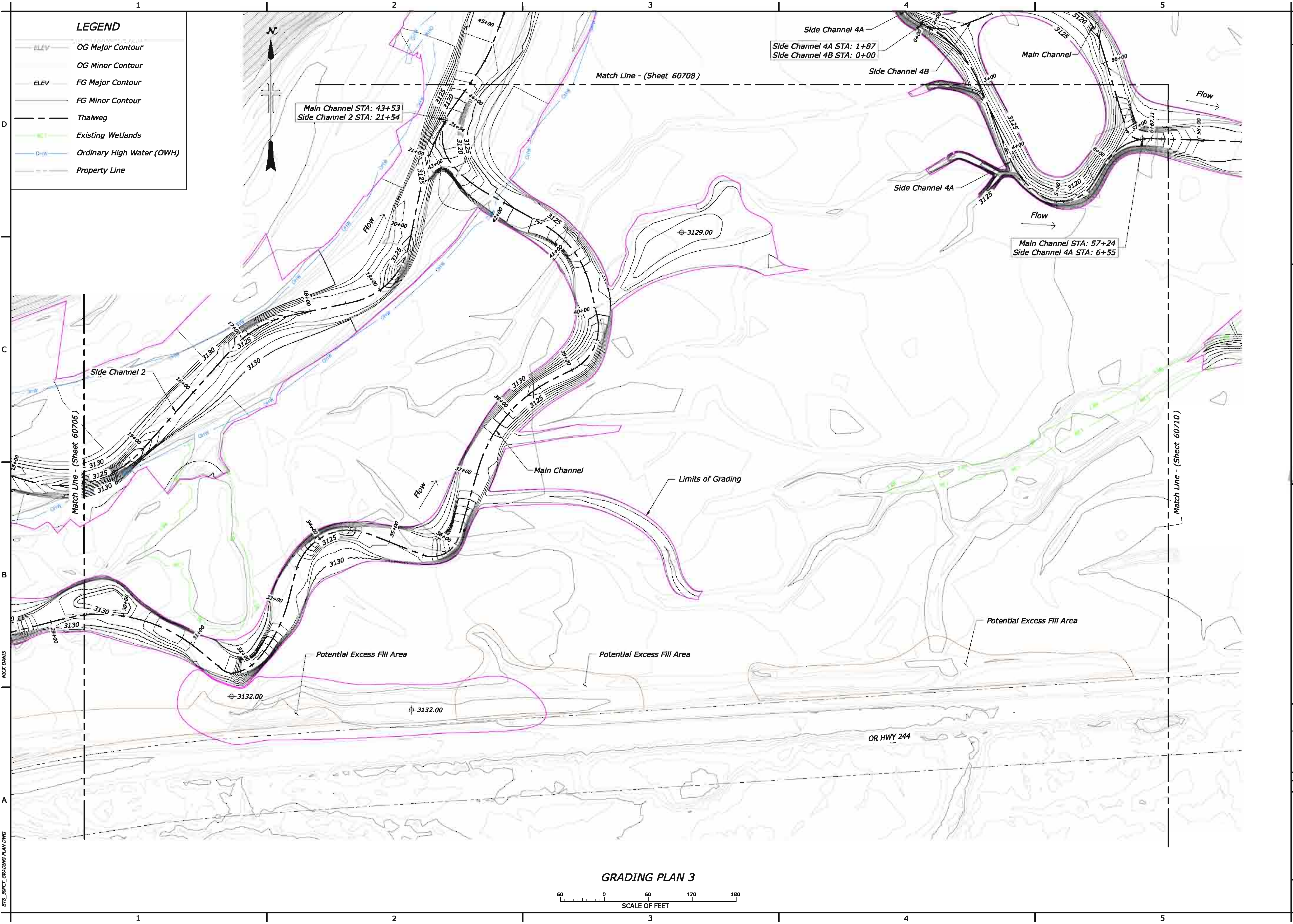

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GRADING PLAN 3

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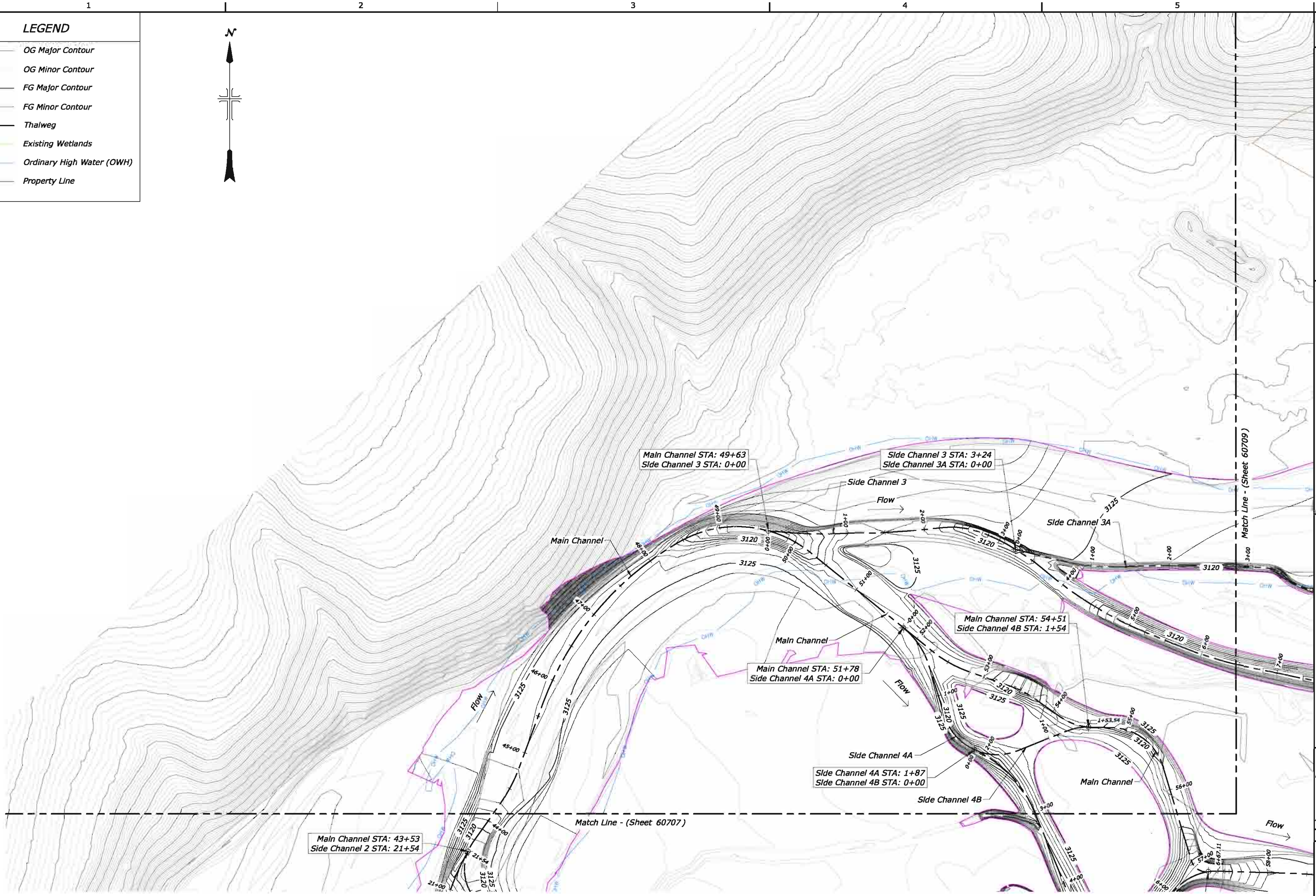
LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
— — —	Thalweg
WET	Existing Wetlands
OHW	Ordinary High Water (OWH)
— - —	Property Line



GRADING PLAN 4

60 0 60 120 180
SCALE OF FEET

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GRADING PLAN 4

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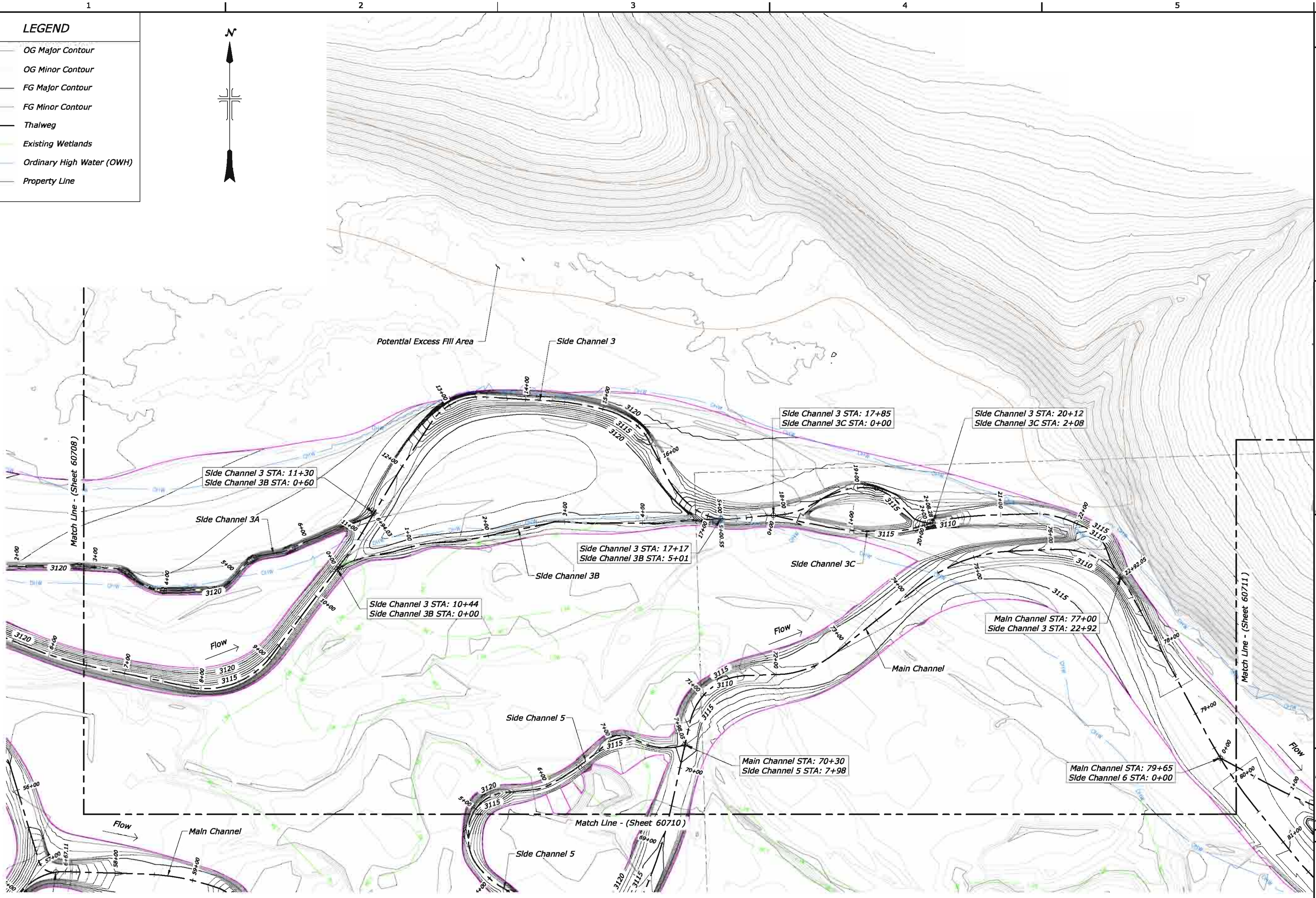
LEGEND

- ELEV — OG Major Contour
- OG Minor Contour
- ELEV — FG Major Contour
- FG Minor Contour
- Thalweg
- WET — Existing Wetlands
- OHW — Ordinary High Water (OWH)
- Property Line



GRADING PLAN 5

60 0 60 120 180
SCALE OF FEET

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GRADING PLAN 5

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LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
— —	Thalweg
	Existing Wetlands
OHW	Ordinary High Water (OWH)
— - —	Property Line

N

GRADING PLAN 6

60 0 60 120 180
SCALE OF FEET

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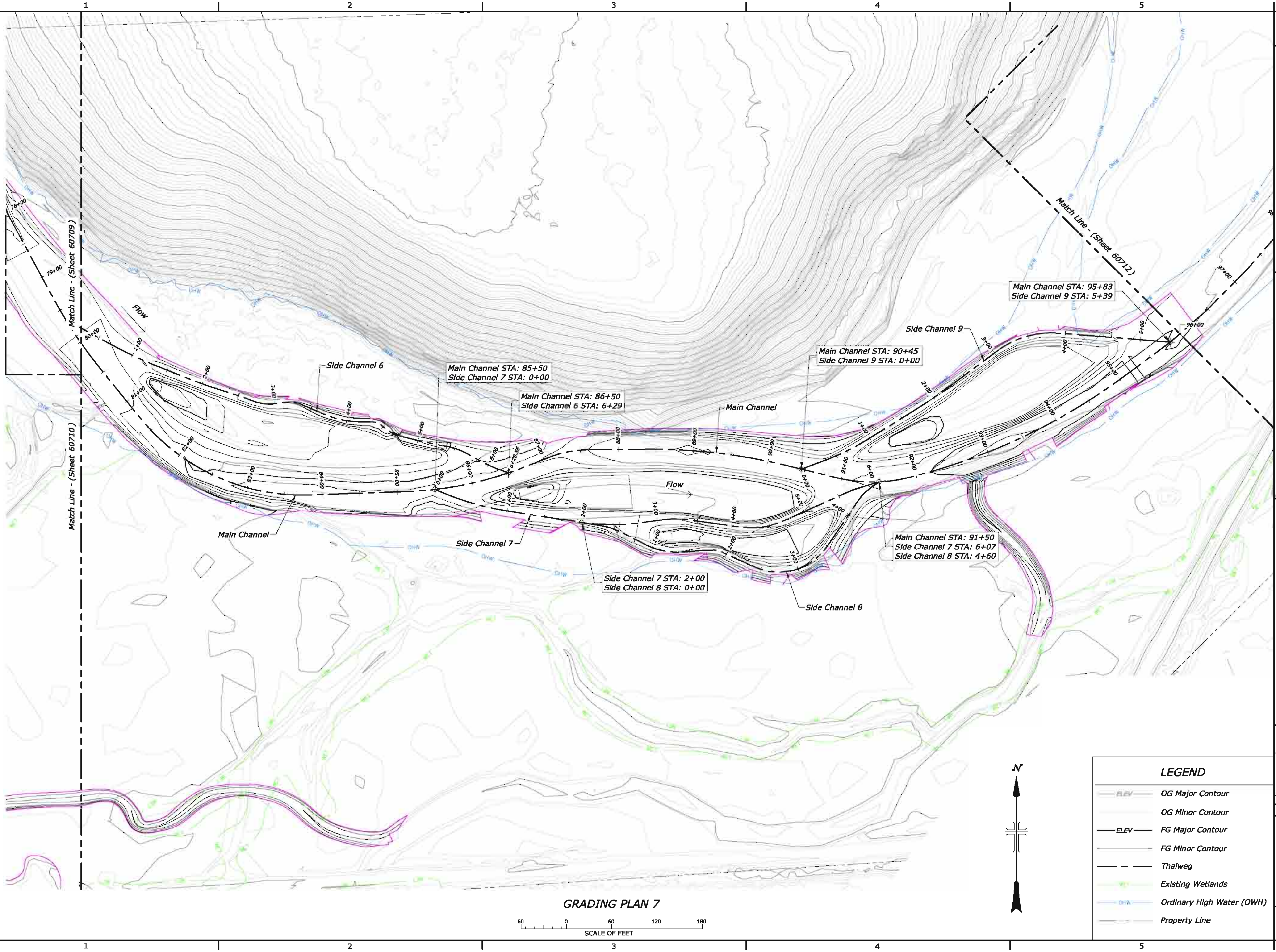

GRADING PLAN 7

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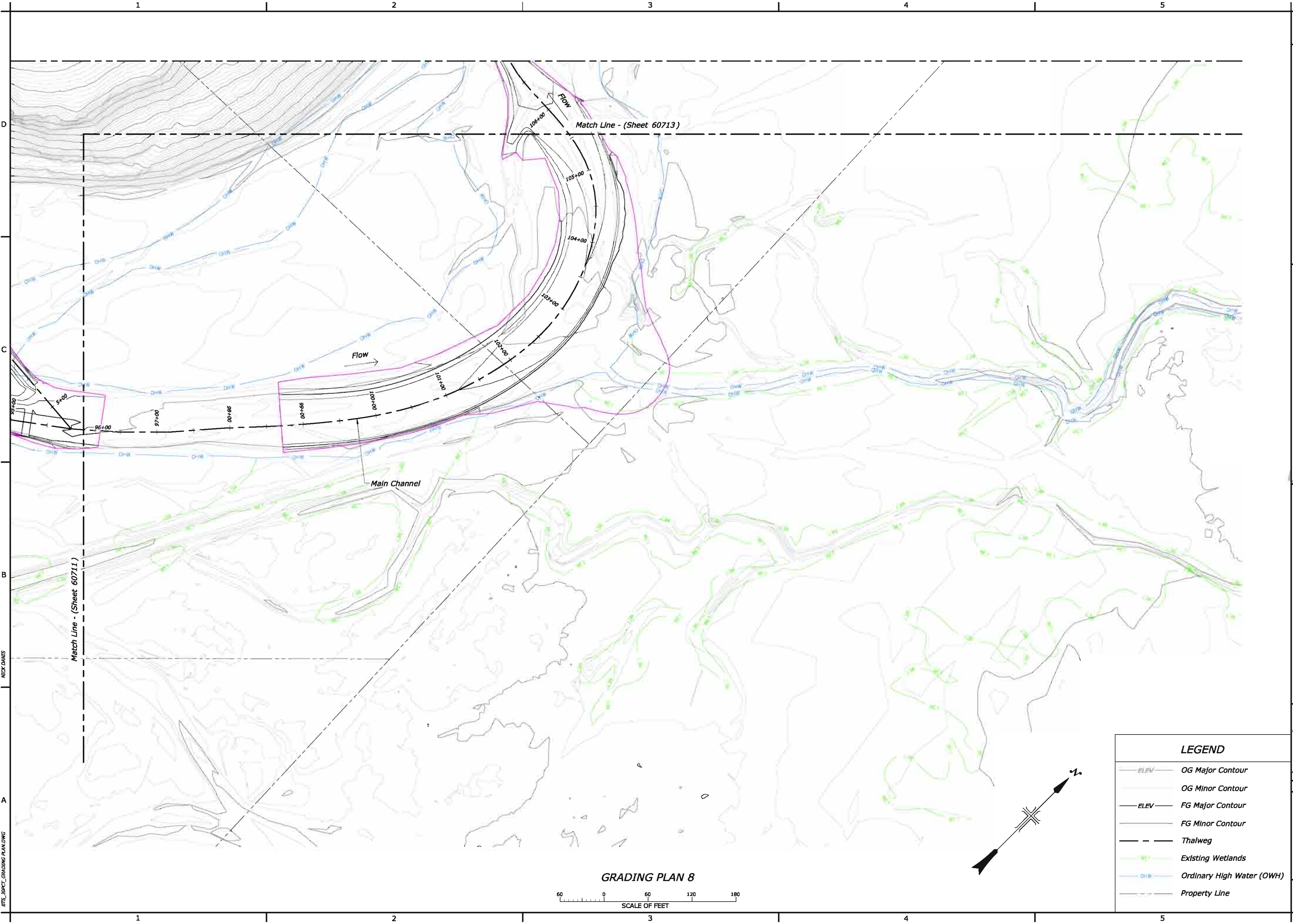

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ENHANCEMENT PROJECT

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GRADING PLAN 8

1678-100-60712

SHEET 9 of 10

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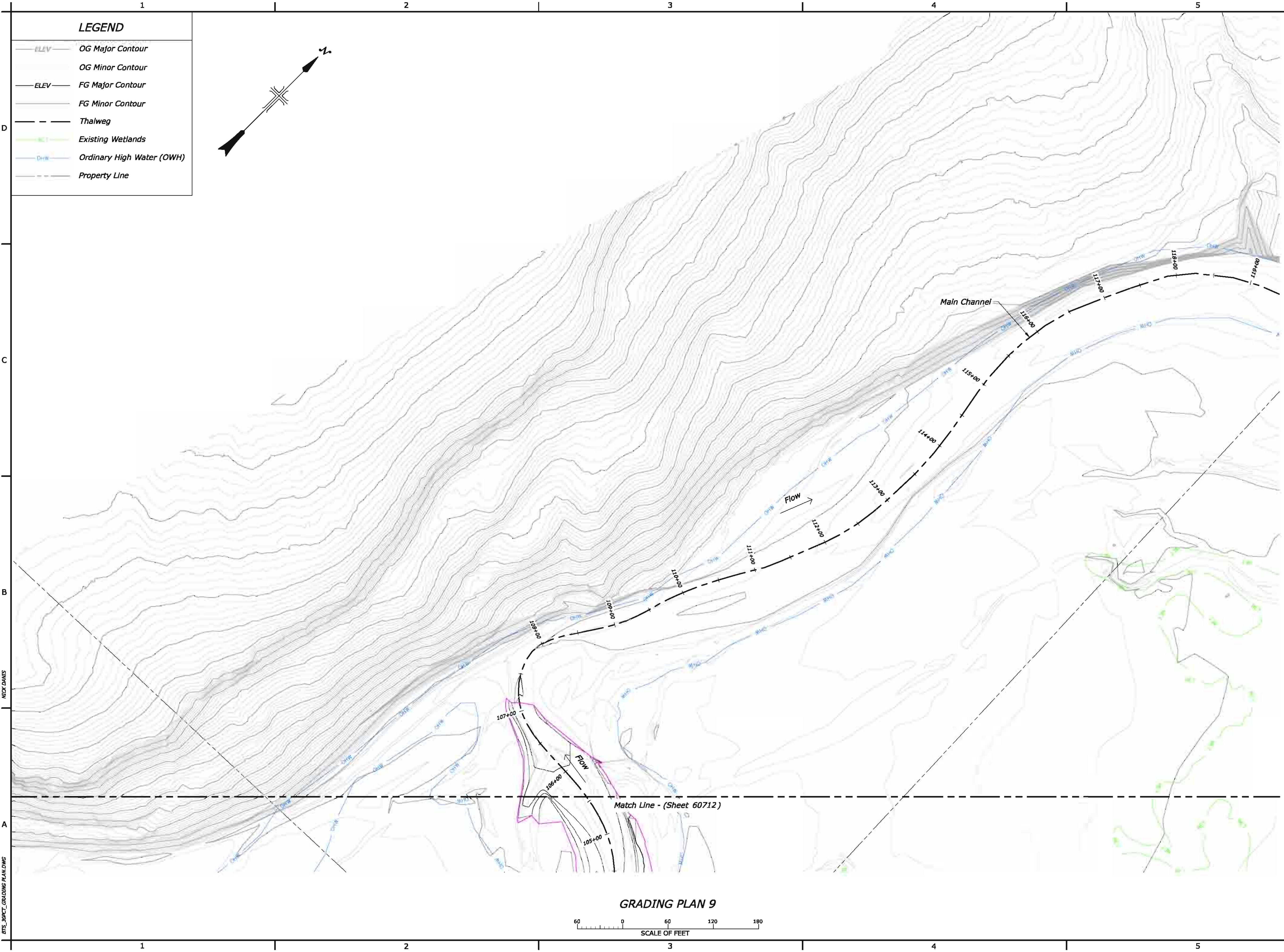
CAD FILENAME
BTS_30PCT_GRADING PLAN.DWG

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
— —	Thalweg
WET	Existing Wetlands
OHW	Ordinary High Water (OWH)
— - —	Property Line



GRADING PLAN 9

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GRADING PLAN 9

1678-100-60713

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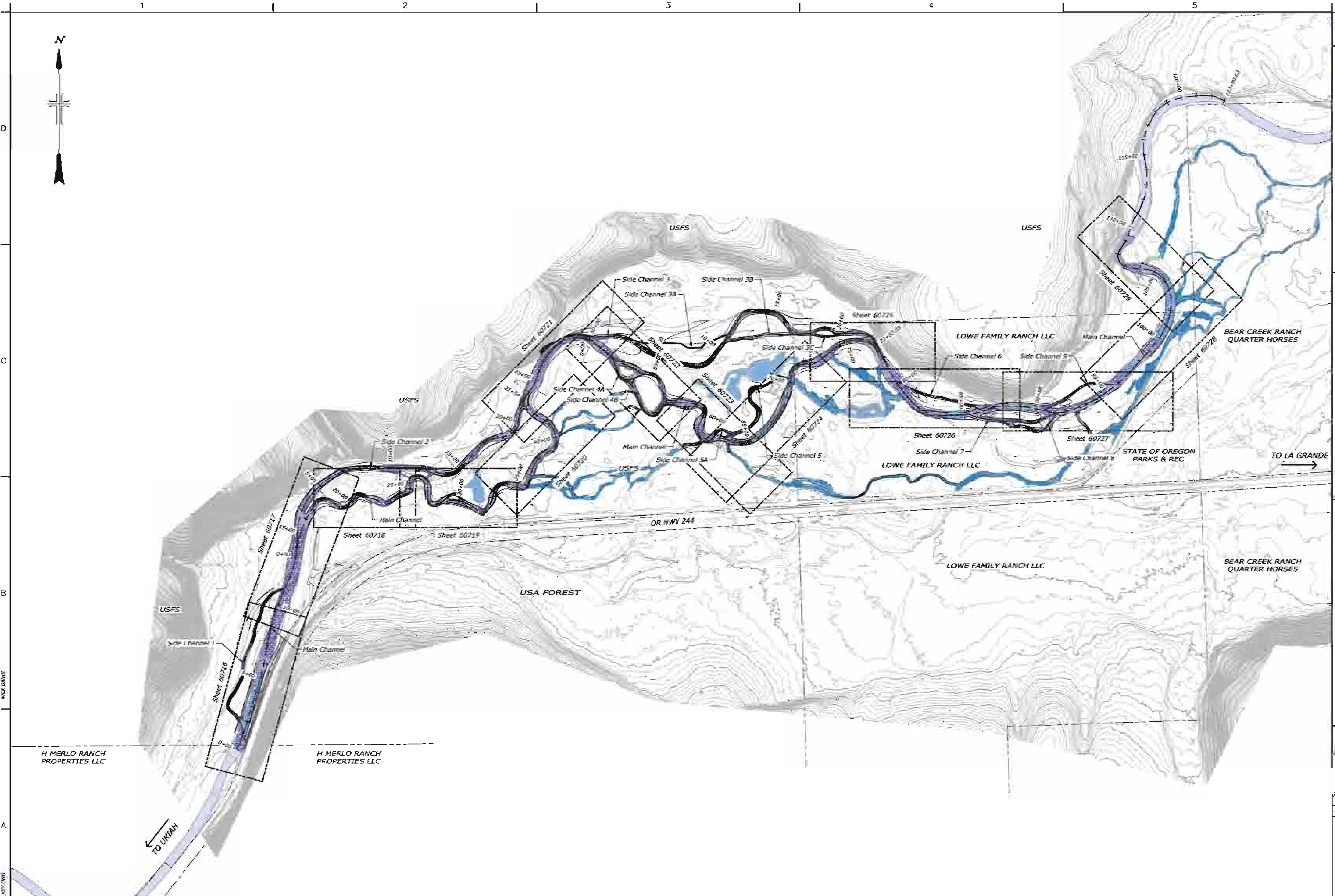

MAIN CHANNEL PLAN AND PROFILE

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MAIN CHANNEL PLAN AND PROFILE

KEY MAP

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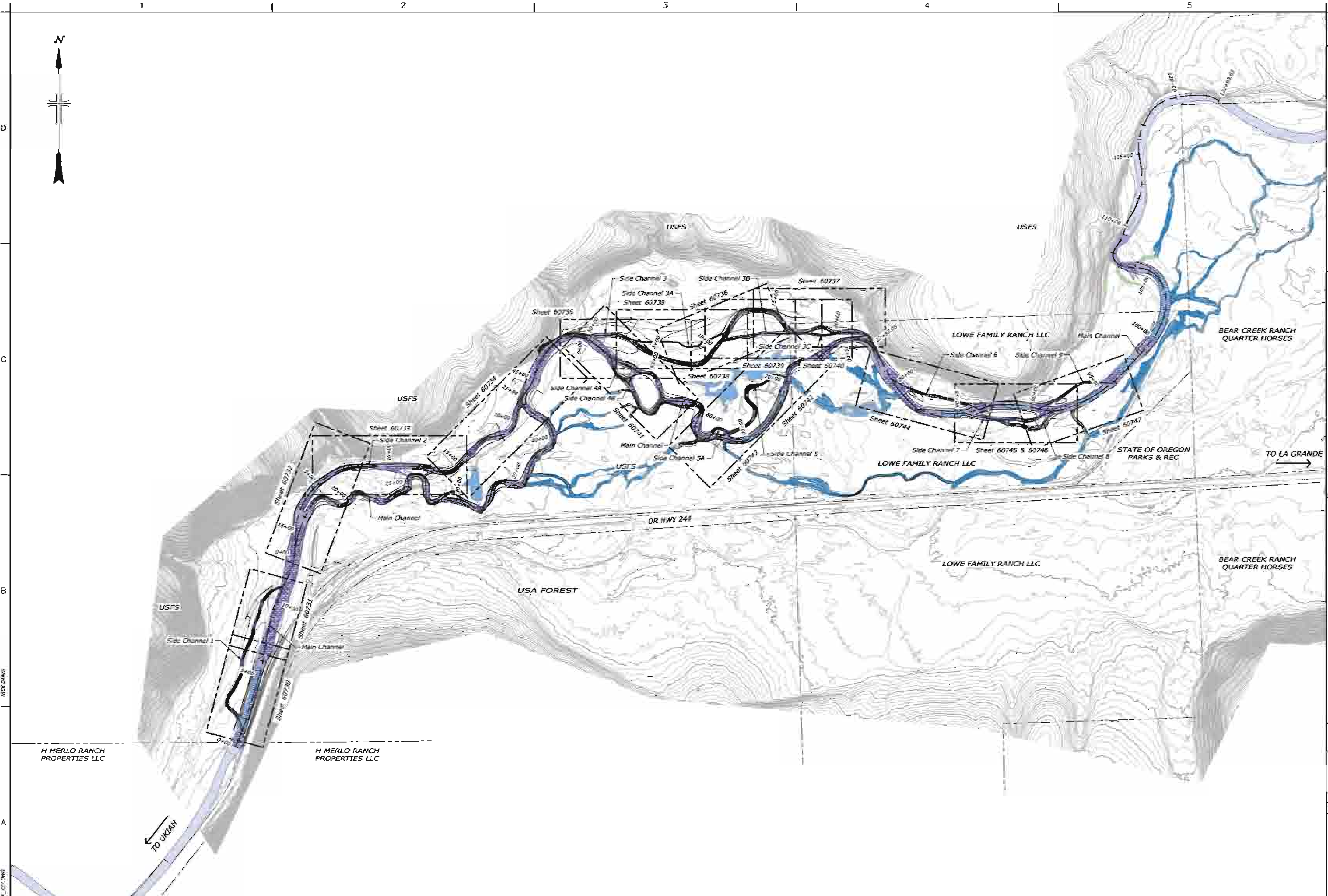

SIDE CHANNEL PLAN AND PROFILE

300 0 300 600 900
SCALE OF FEET

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SIDE CHANNEL PLAN AND PROFILE

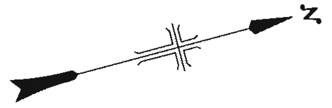
KEY MAP

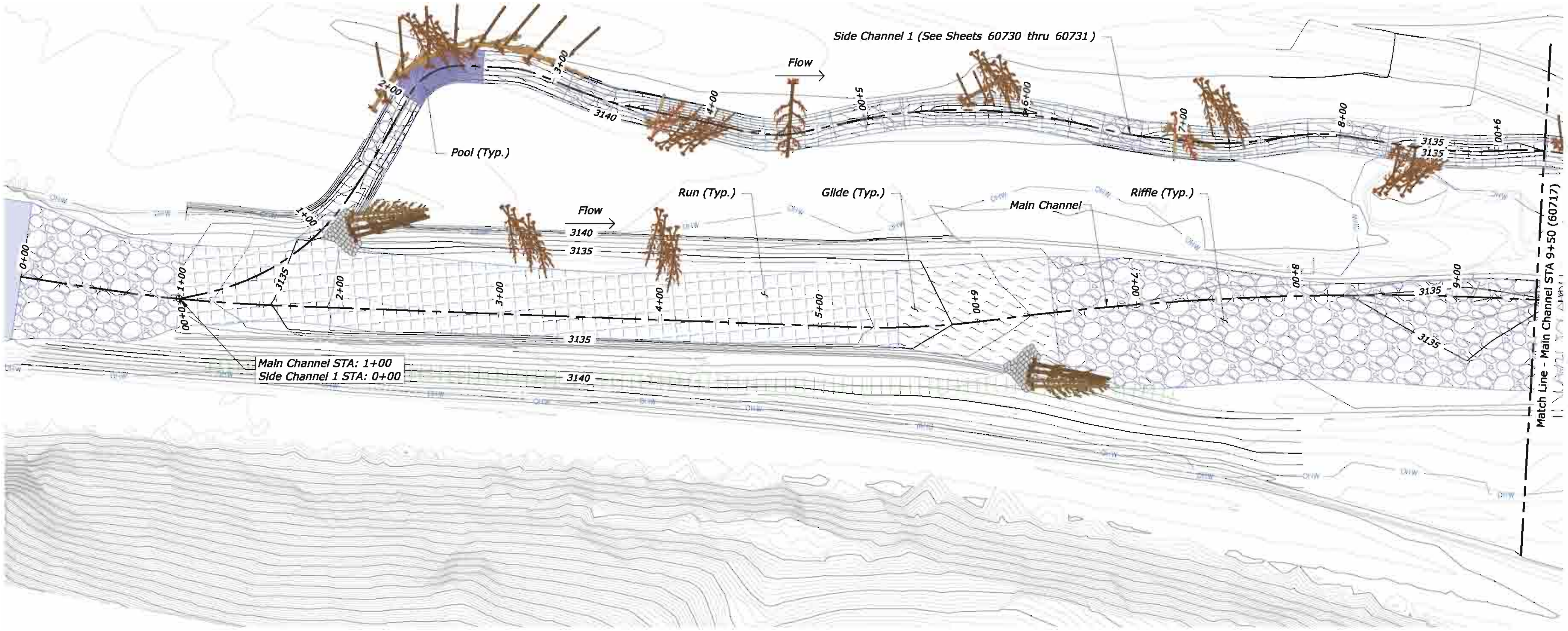
1678-100-60715

SHEET 2 of 34

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
	Thalweg
	Existing Wetlands
OHW	Ordinary High Water (OHW)
	Property Line
	Finish Grade Profile
	Existing Grade Profile
	Bankfull Water Surface Profile

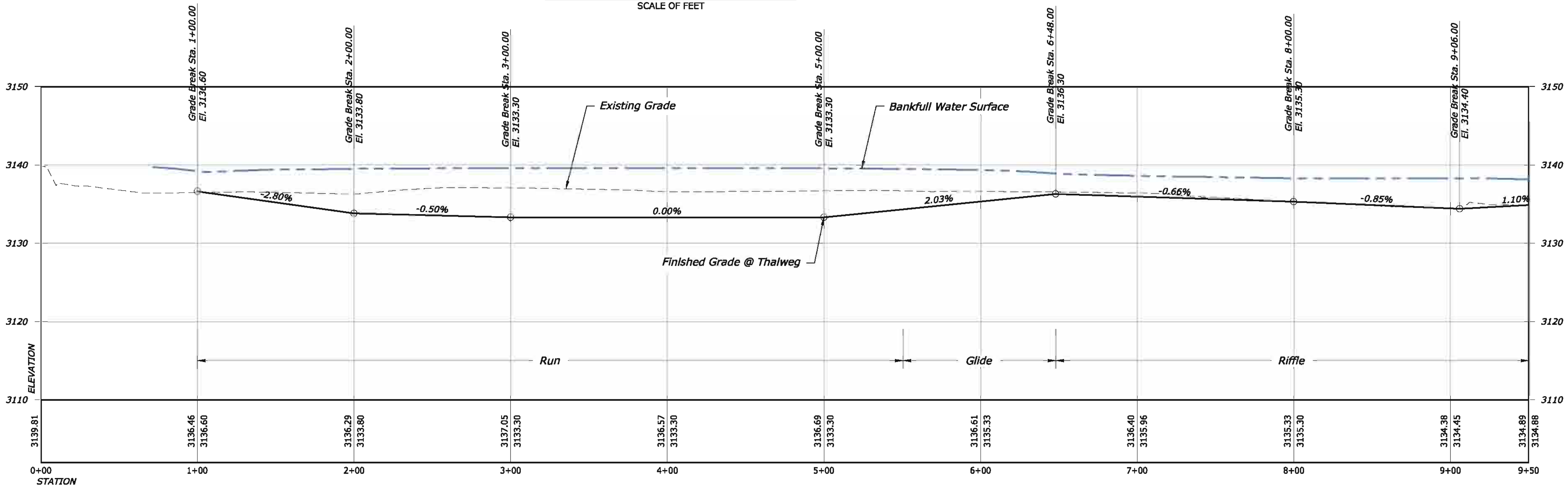




MAIN CHANNEL - PLAN

STA 0+00 TO STA 9+50

40 0 40 80 120
SCALE OF FEET



MAIN CHANNEL - THALWEG PROFILE

STA 0+00 TO STA 9+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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MAIN CHANNEL PLAN
AND PROFILE

STA 0+00 TO
STA 9+50

1678-100-60716

SHEET 3 of 34

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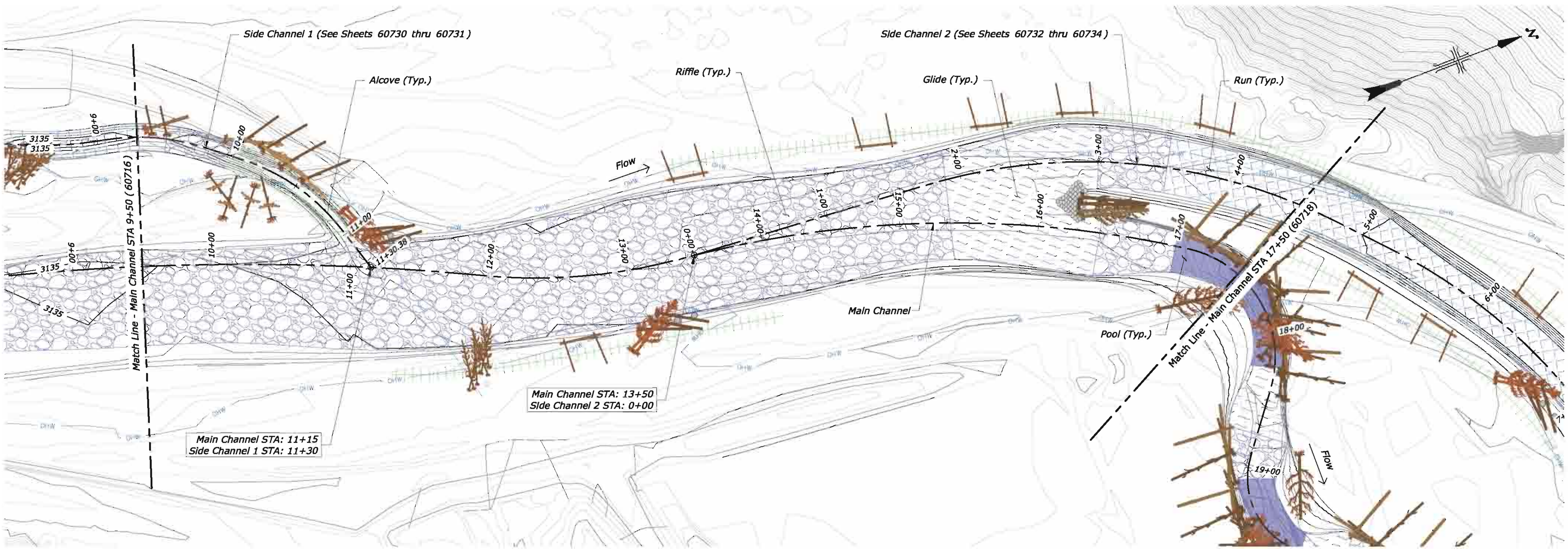
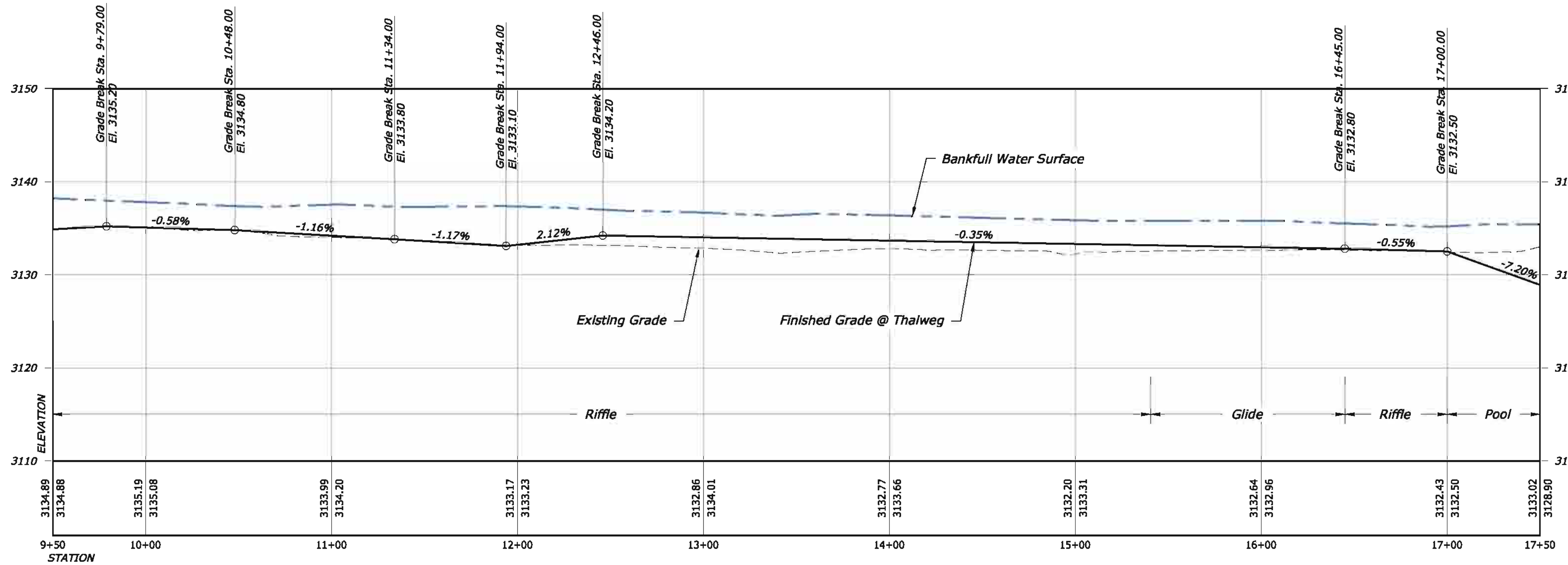


MAIN CHANNEL - PLAN

STA 9+50 TO STA 17+50

40 0 40 80 120
SCALE OF FEET



MAIN CHANNEL - THALWEG PROFILE

STA 9+50 TO STA 17+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

LEGEND

- ELEV — OG Major Contour
- OG Minor Contour
- ELEV — FG Major Contour
- FG Minor Contour
- Thalweg
- Existing Wetlands
- OHW — Ordinary High Water (OHW)
- Property Line
- Finish Grade Profile
- Existing Grade Profile
- Bankfull Water Surface Profile

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MAIN CHANNEL PLAN
AND PROFILE

STA 9+50 TO
STA 17+50

1678-100-60717

SHEET 4 of 34

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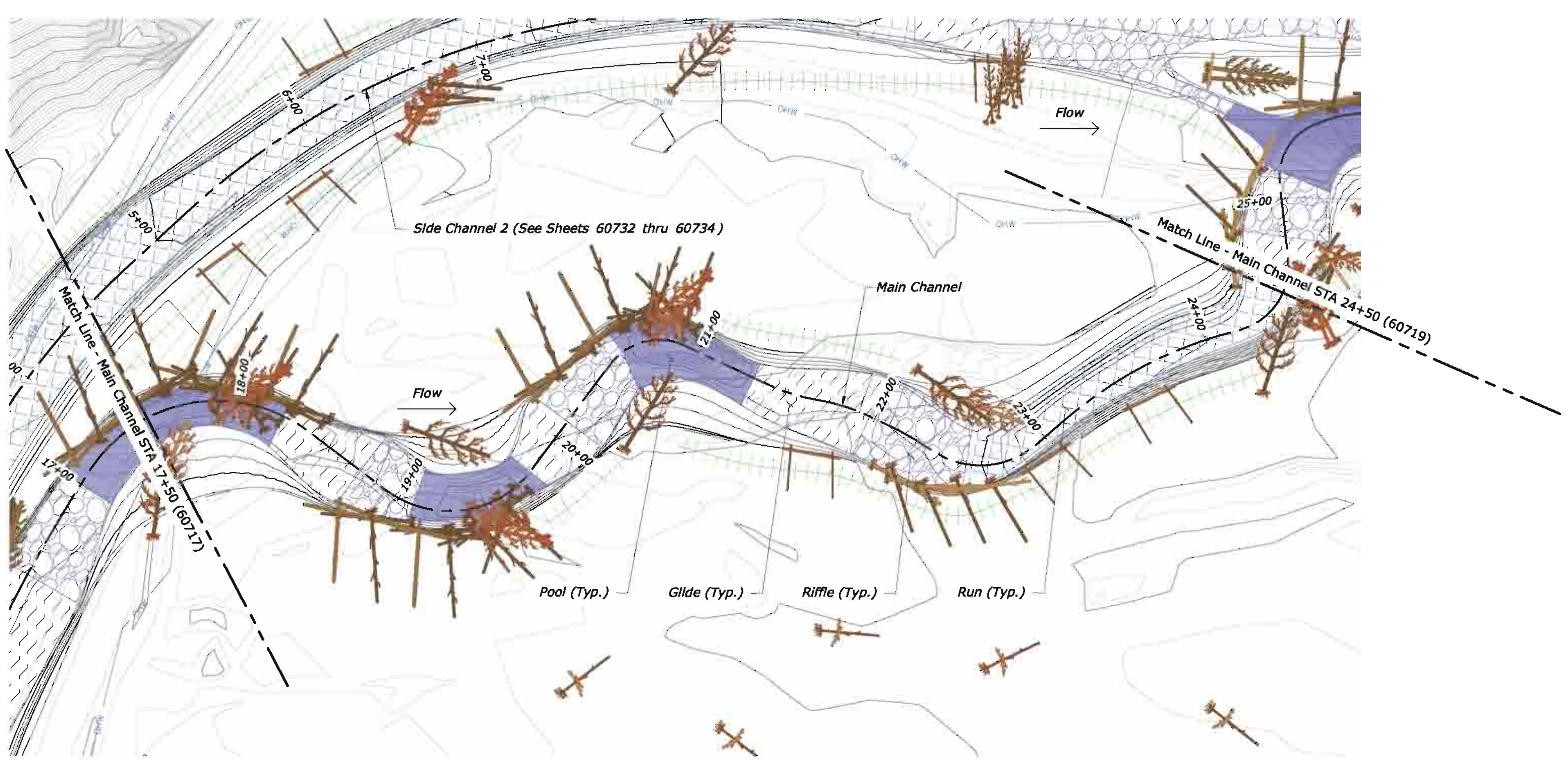
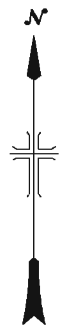




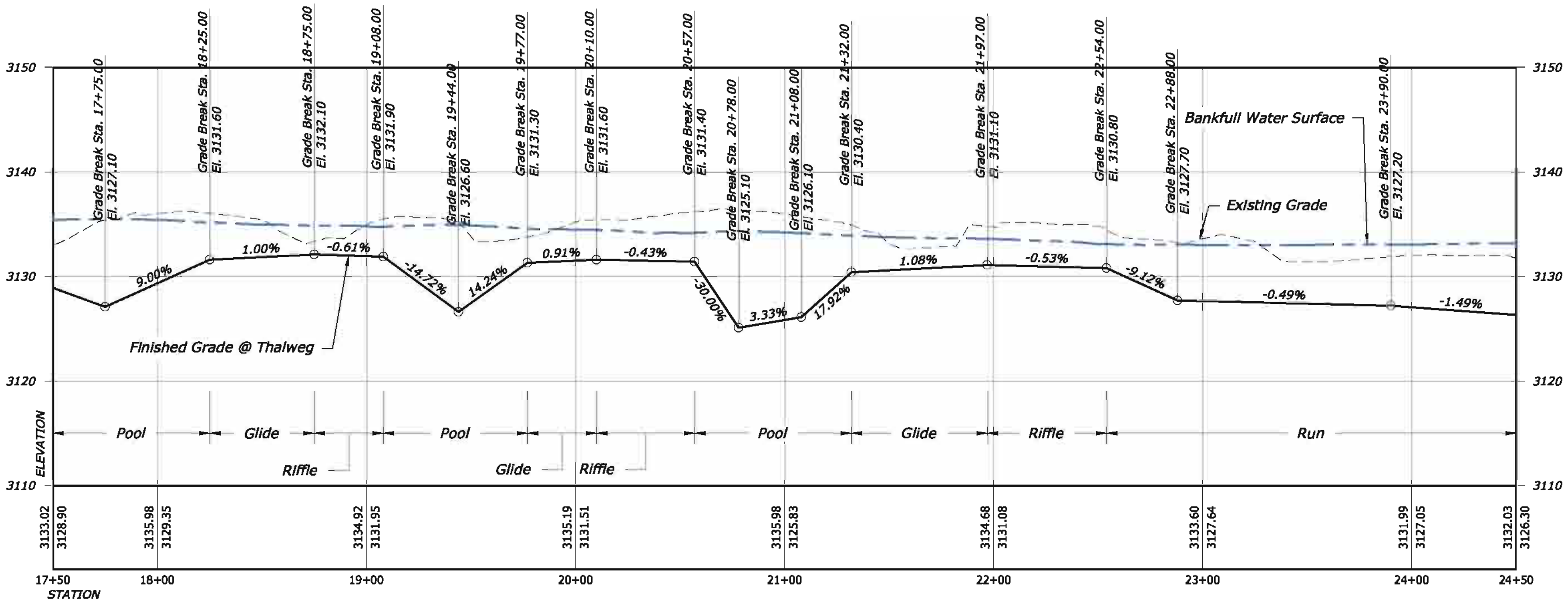
LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
— —	Thalweg
W	Existing Wetlands
OHW	Ordinary High Water (OHW)
	Property Line
	Finish Grade Profile
	Existing Grade Profile
	Bankfull Water Surface Profile

MAIN CHANNEL - PLAN

STA 17+50 TO STA 24+50

40 0 40 80 120
SCALE OF FEET



MAIN CHANNEL - THALWEG PROFILE

STA 17+50 TO STA 24+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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MAIN CHANNEL PLAN
AND PROFILE

STA 17+50 TO
STA 24+50

1678-100-60718

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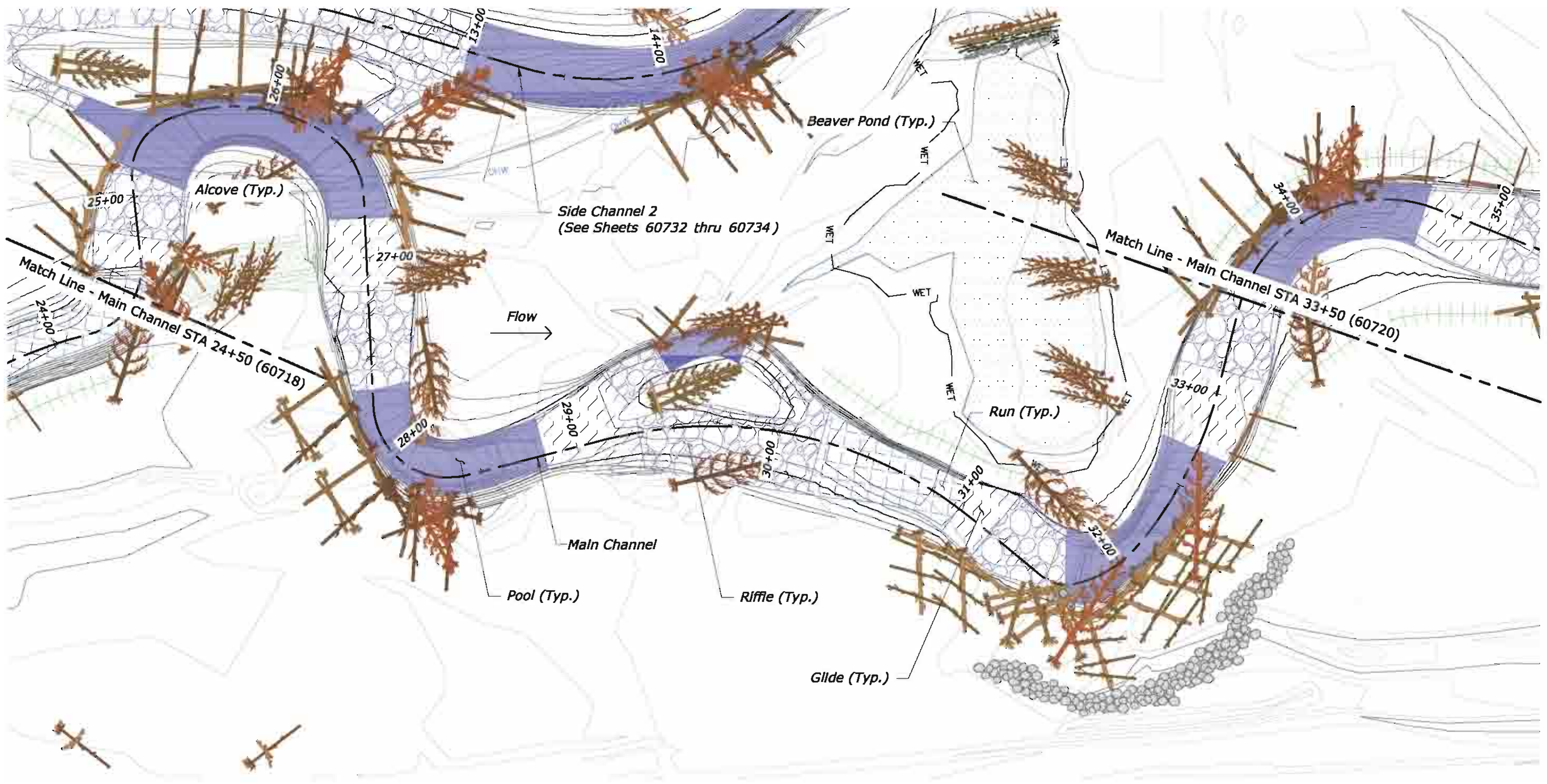


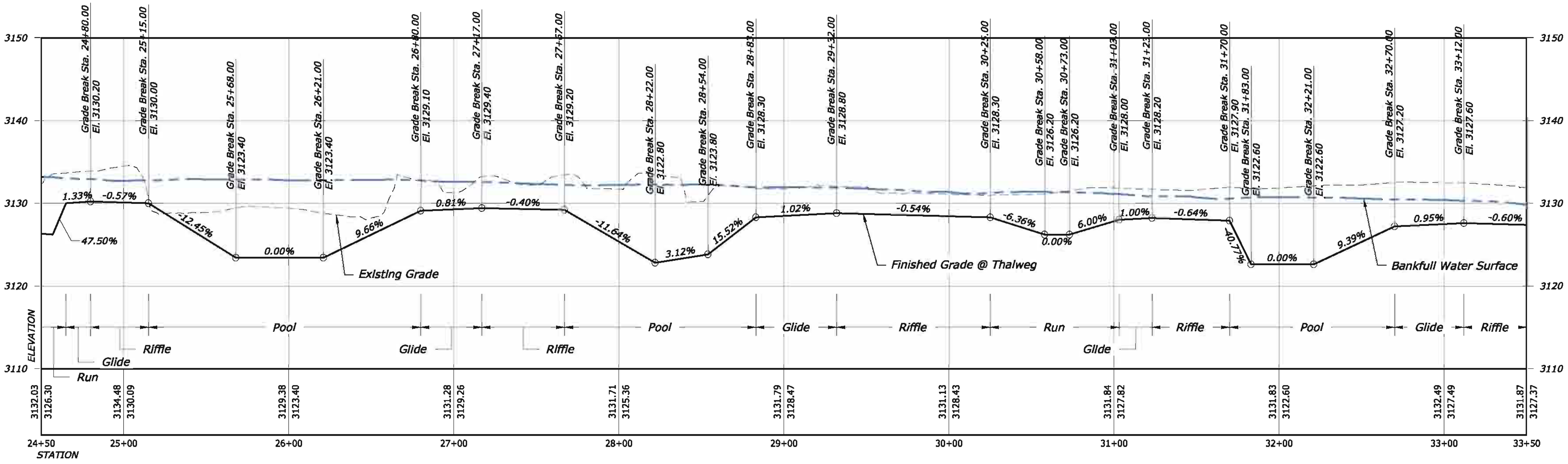
MAIN CHANNEL - PLAN

STA 24+50 TO STA 33+50

40 0 40 80 120
SCALE OF FEET

LEGEND

- ELEV OG Major Contour
- OG Minor Contour
- ELEV FG Major Contour
- FG Minor Contour
- Thalweg
- Existing Wetlands
- Ordinary High Water (OHW)
- Property Line
- Finish Grade Profile
- Existing Grade Profile
- Bankfull Water Surface Profile



MAIN CHANNEL - THALWEG PROFILE

STA 24+50 TO STA 33+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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MAIN CHANNEL PLAN
AND PROFILE

STA 24+50 TO
STA 33+50

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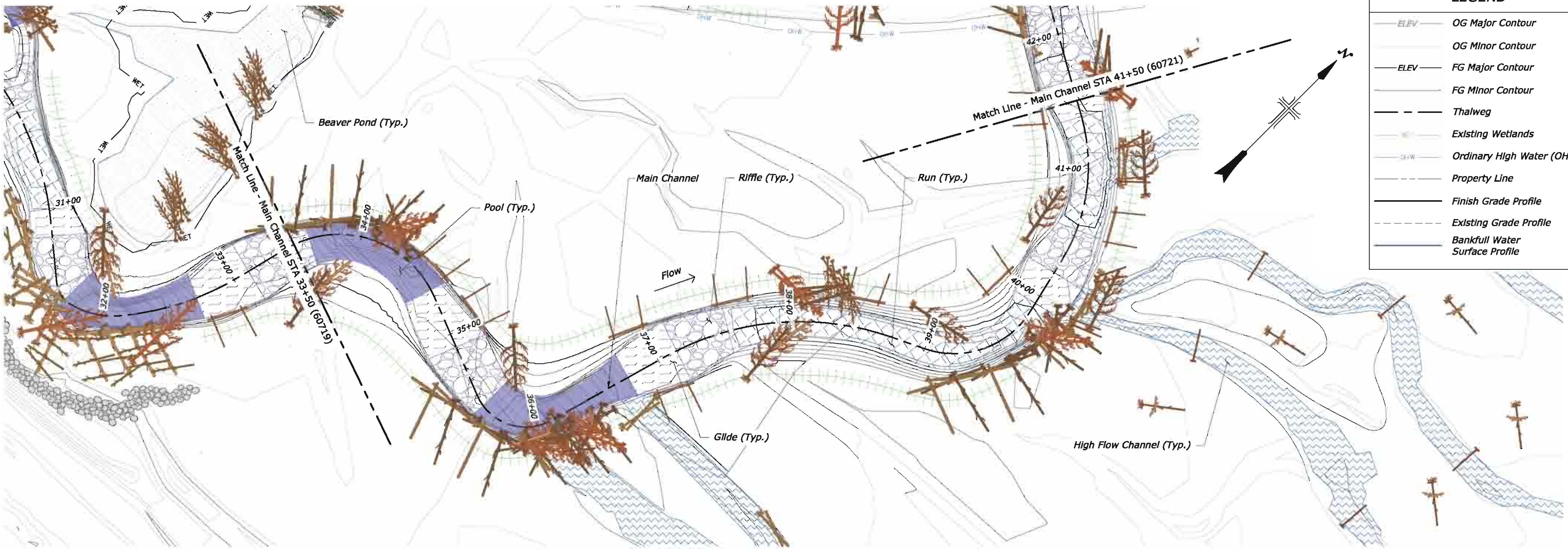

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
	Thalweg
	Existing Wetlands
OHW	Ordinary High Water (OHW)
	Property Line
	Finish Grade Profile
	Existing Grade Profile
	Bankfull Water Surface Profile

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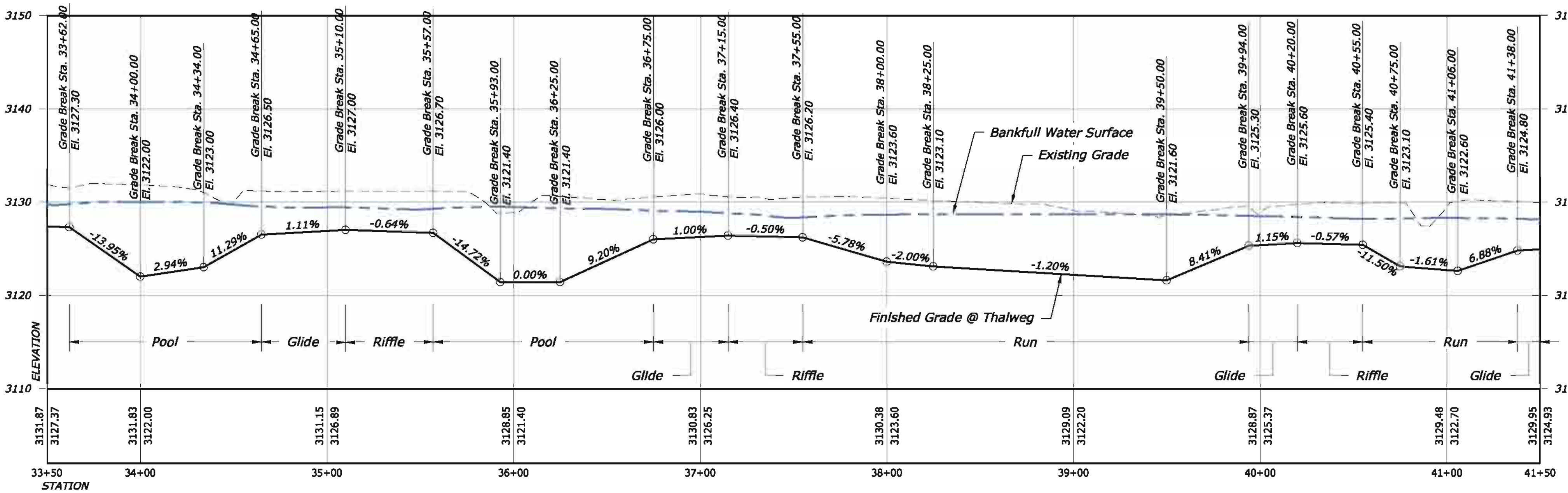
MAIN CHANNEL - PLAN

STA 34+50 TO STA 41+50

40 0 40 80 120
SCALE OF FEET



MAIN CHANNEL - THALWEG PROFILE

STA 33+50 TO STA 41+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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MAIN CHANNEL PLAN
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STA 33+50 TO
STA 41+50

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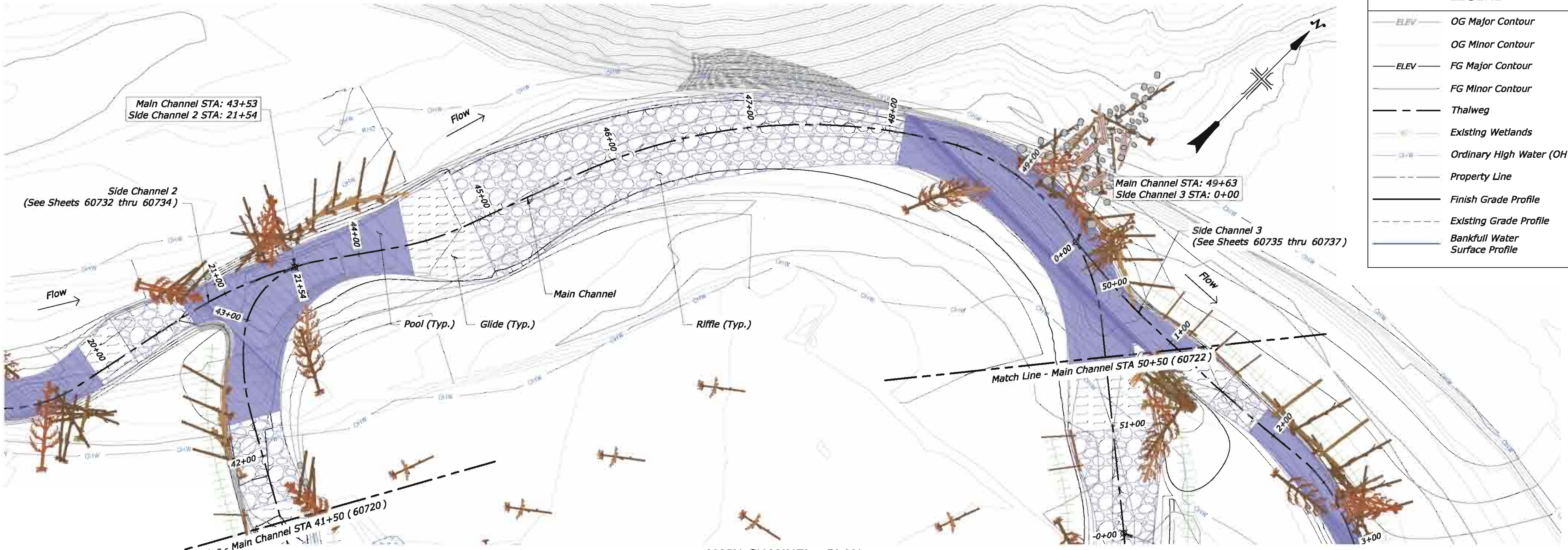


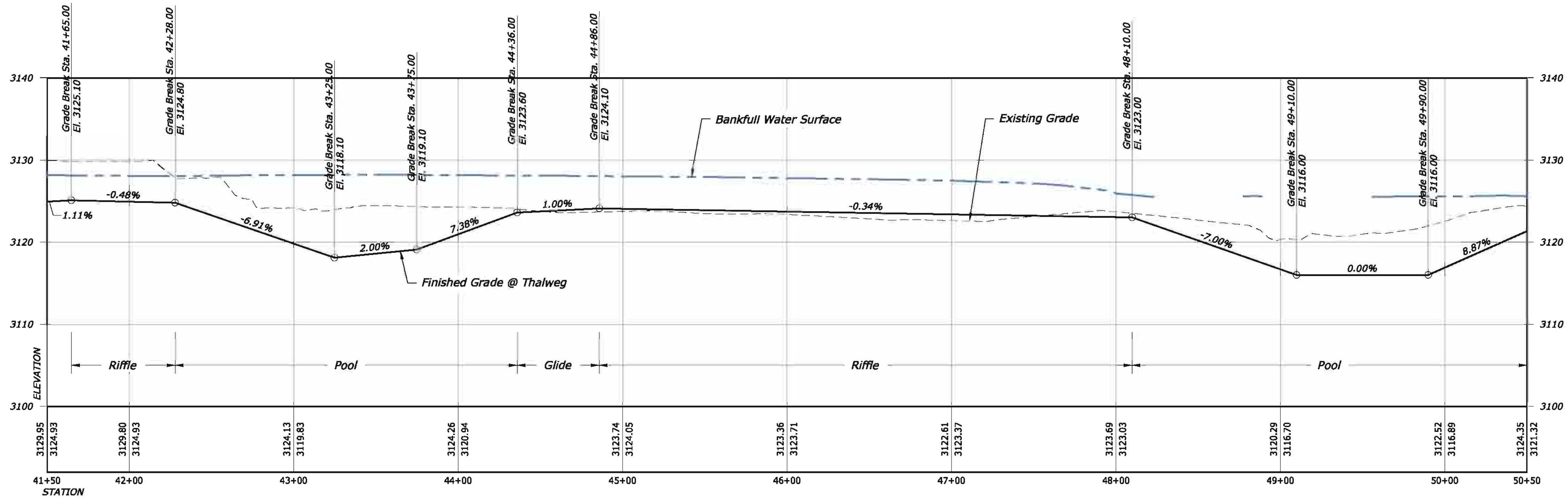
LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
	Thalweg
	Existing Wetlands
OHW	Ordinary High Water (OHW)
	Property Line
	Finish Grade Profile
	Existing Grade Profile
	Bankfull Water Surface Profile

MAIN CHANNEL - PLAN

STA 41+50 TO STA 50+50

40 0 40 80 120
SCALE OF FEET



MAIN CHANNEL - THALWEG PROFILE

STA 41+50 TO STA 50+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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MAIN CHANNEL PLAN
AND PROFILE

STA 41+50 TO
STA 50+50

1678-100-60721

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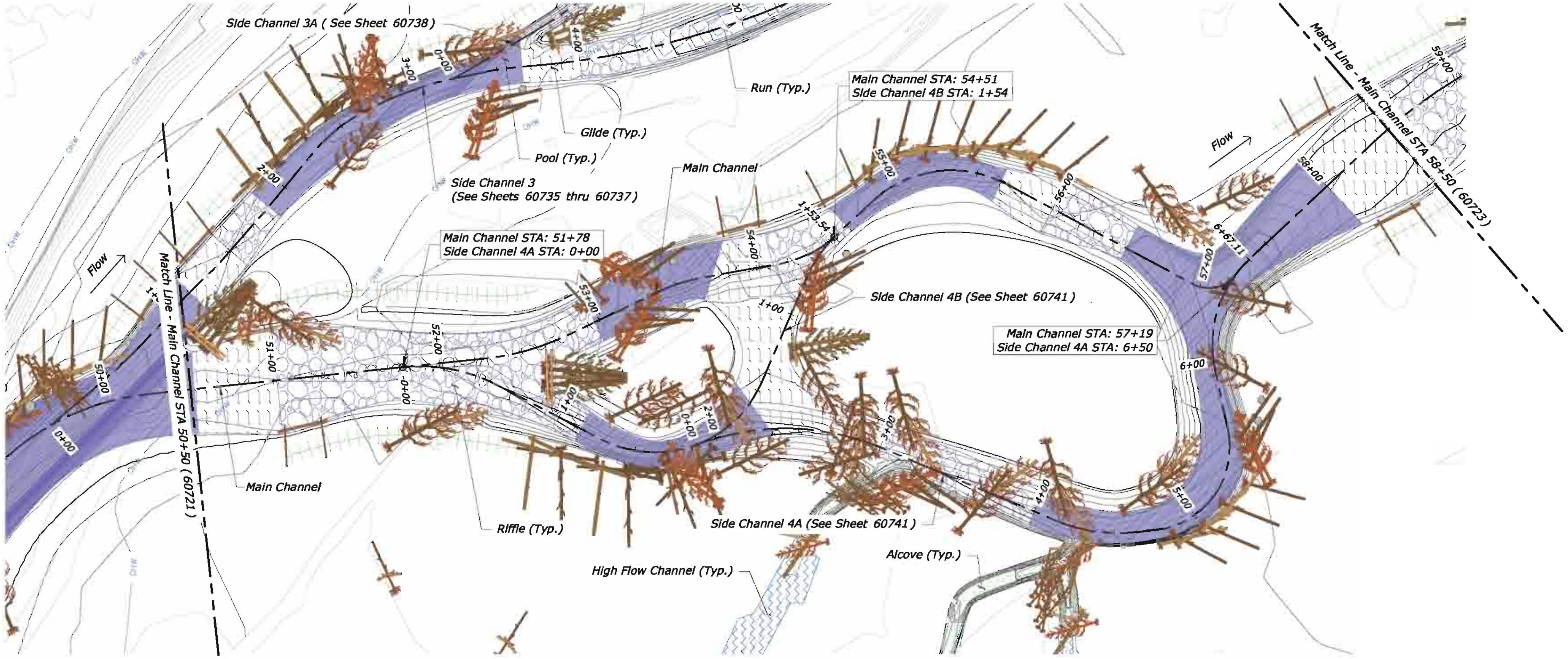


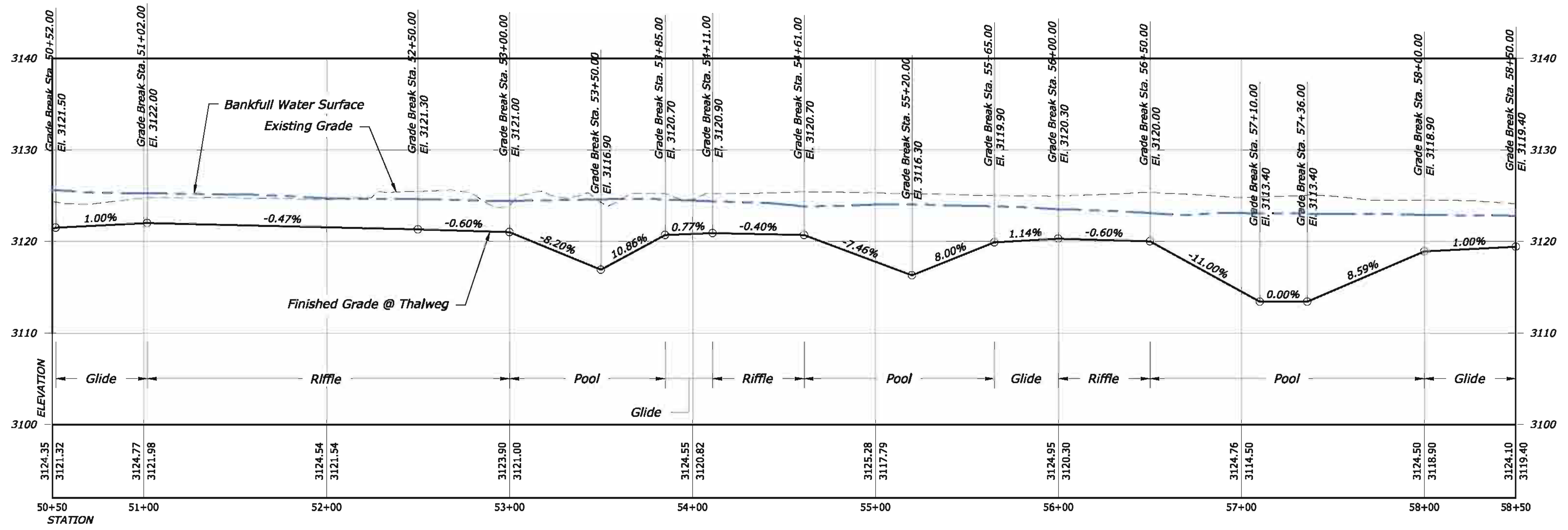
MAIN CHANNEL - PLAN

STA 50+50 TO STA 58+50

40 0 40 80 120
SCALE OF FEET

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
	Thalweg
	Existing Wetlands
	Ordinary High Water (OHW)
	Property Line
	Finish Grade Profile
	Existing Grade Profile
	Bankfull Water Surface Profile



MAIN CHANNEL - THALWEG PROFILE

STA 50+50 TO STA 58+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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MAIN CHANNEL PLAN
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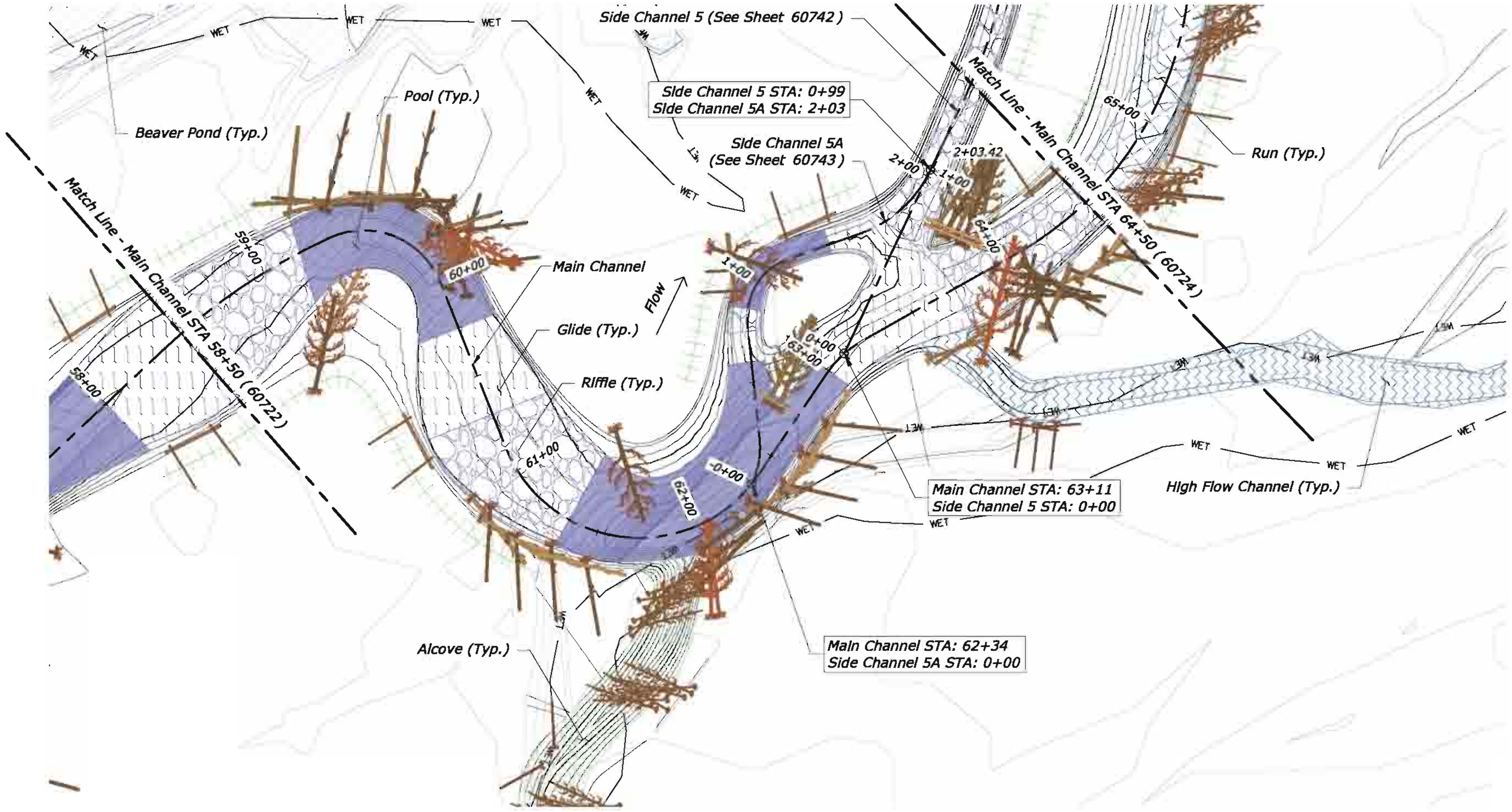
STA 50+50 TO
STA 58+50

1678-100-60722

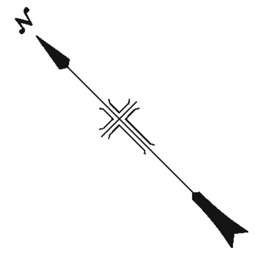
SHEET 9 of 34



MAIN CHANNEL - PLAN

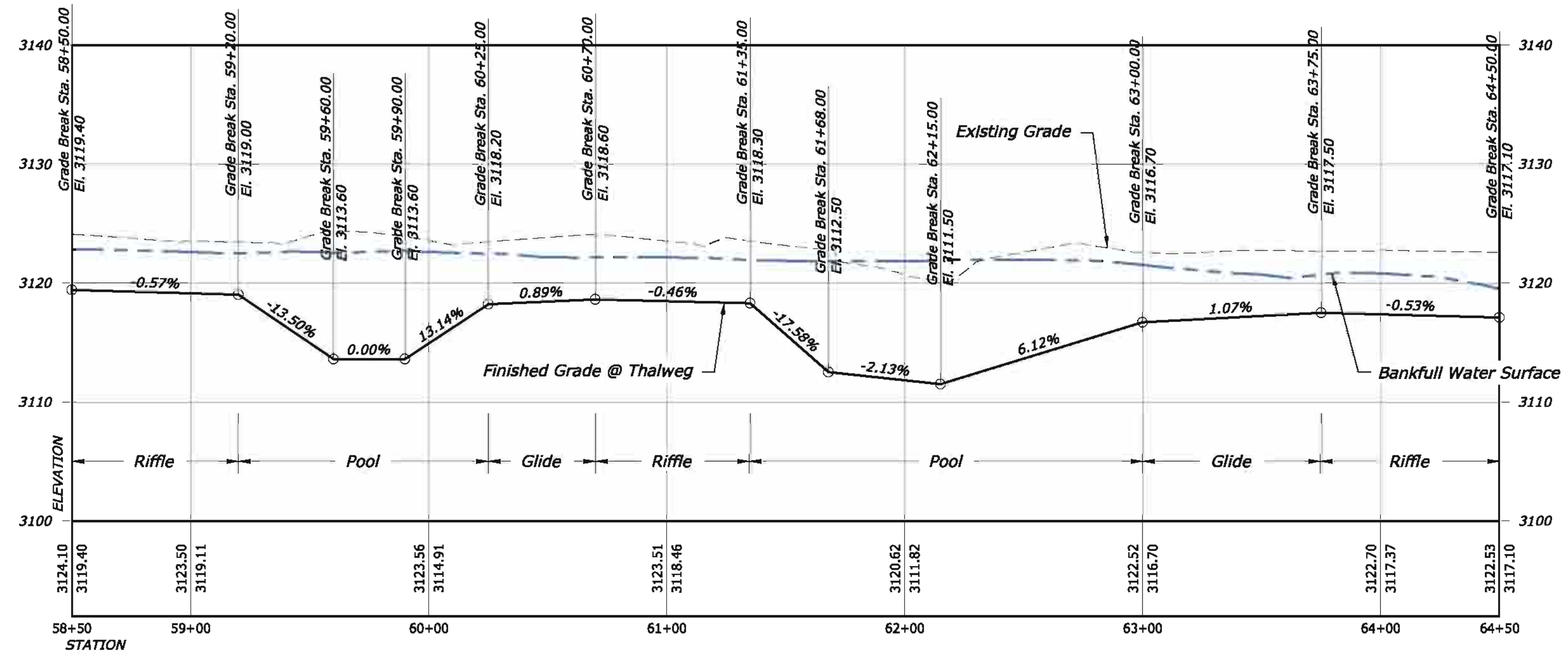
STA 58+50 TO STA 64+50

40 0 40 80 120
SCALE OF FEET



LEGEND

- ELEV OG Major Contour
- OG Minor Contour
- ELEV FG Major Contour
- FG Minor Contour
- Thalweg
- Existing Wetlands
- OHW Ordinary High Water (OHW)
- Property Line
- Finish Grade Profile
- Existing Grade Profile
- Bankfull Water Surface Profile



MAIN CHANNEL - THALWEG PROFILE

STA 58+50 TO STA 64+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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STA 58+50 TO
STA 64+50

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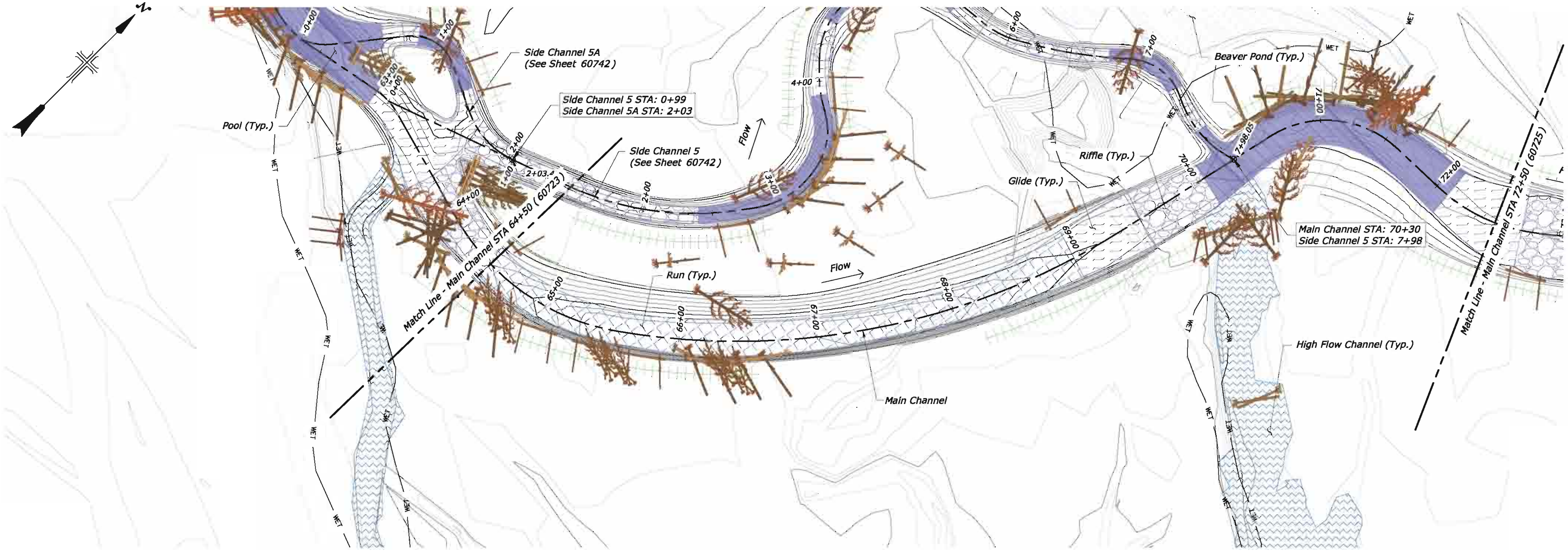
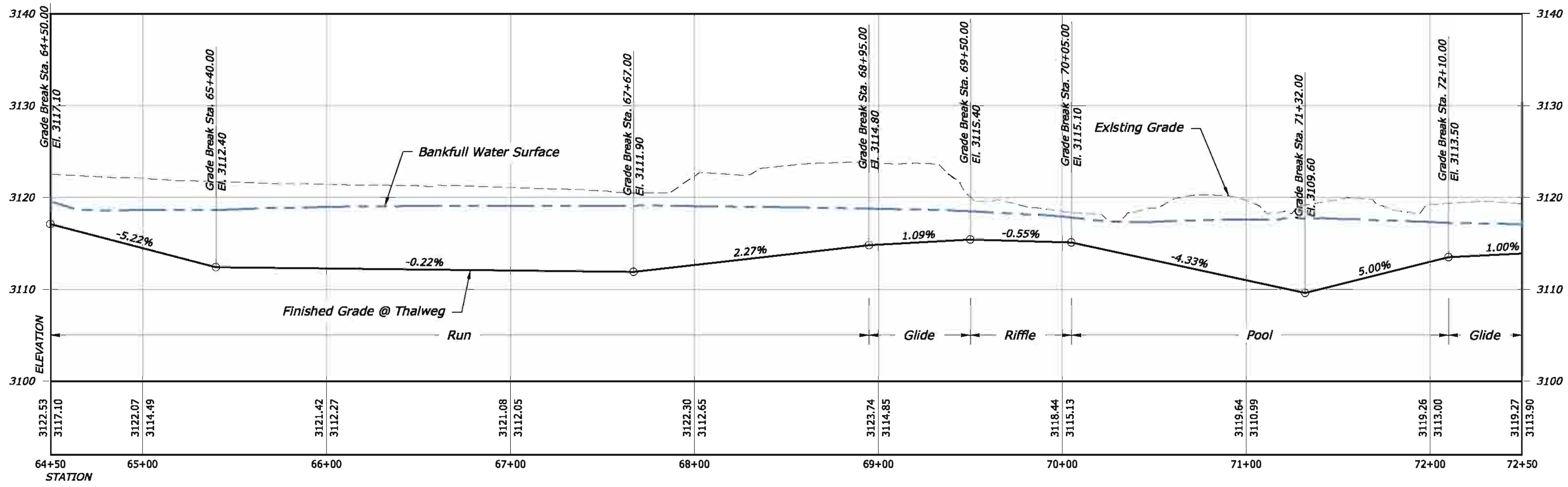


MAIN CHANNEL - PLAN

STA 64+50 TO STA 72+50

40 0 40 80 120
SCALE OF FEET



MAIN CHANNEL - THALWEG PROFILE

STA 64+50 TO STA 72+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

LEGEND

ELEV OG Major Contour
OG Minor Contour
ELEV FG Major Contour
FG Minor Contour
Thalweg
WET Existing Wetlands
OHW Ordinary High Water (OHW)
Property Line
Finish Grade Profile
Existing Grade Profile
Bankfull Water Surface Profile

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MAIN CHANNEL PLAN
AND PROFILE

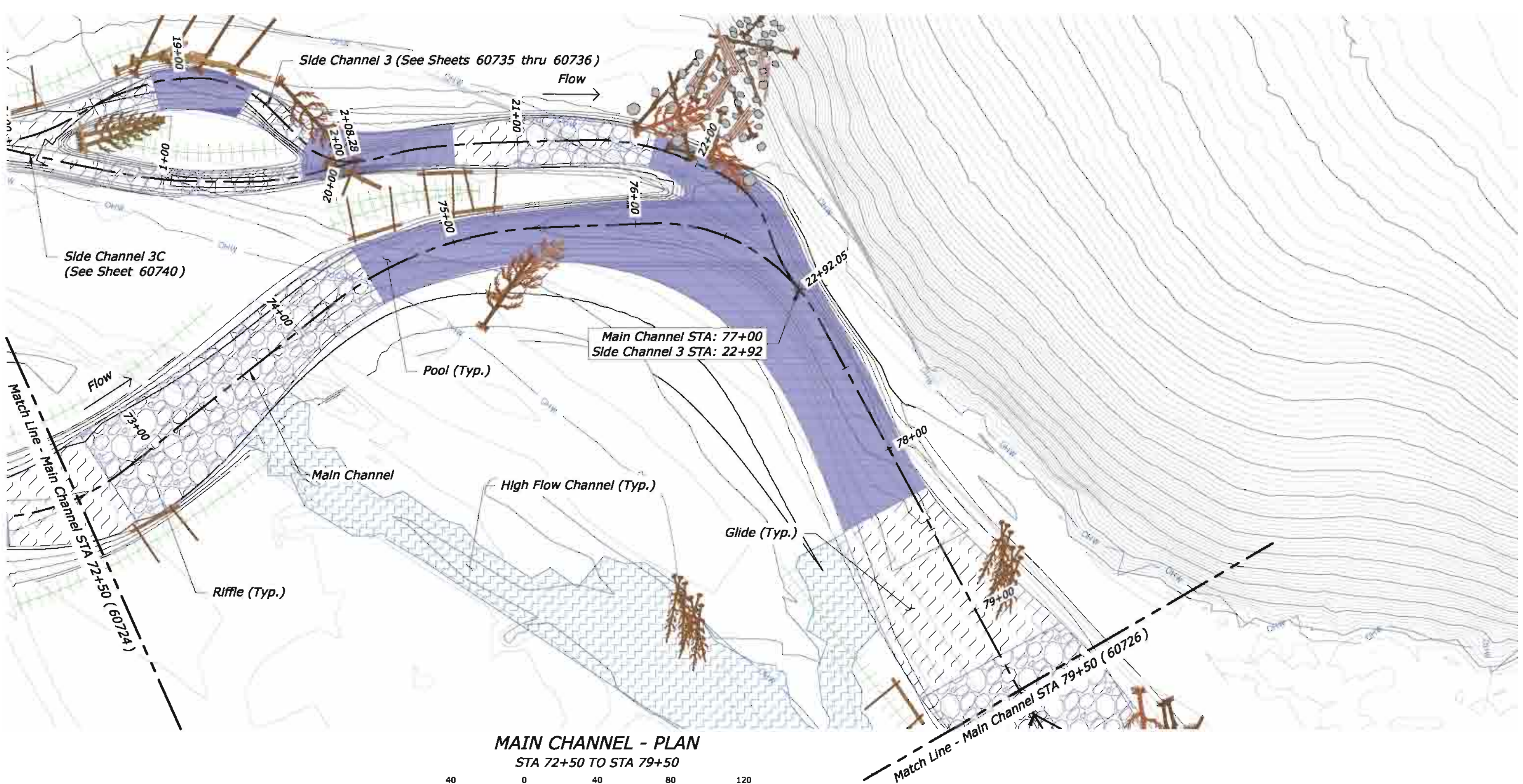
STA 64+50 TO
STA 72+50

1678-100-60724

SHEET 11 of 34

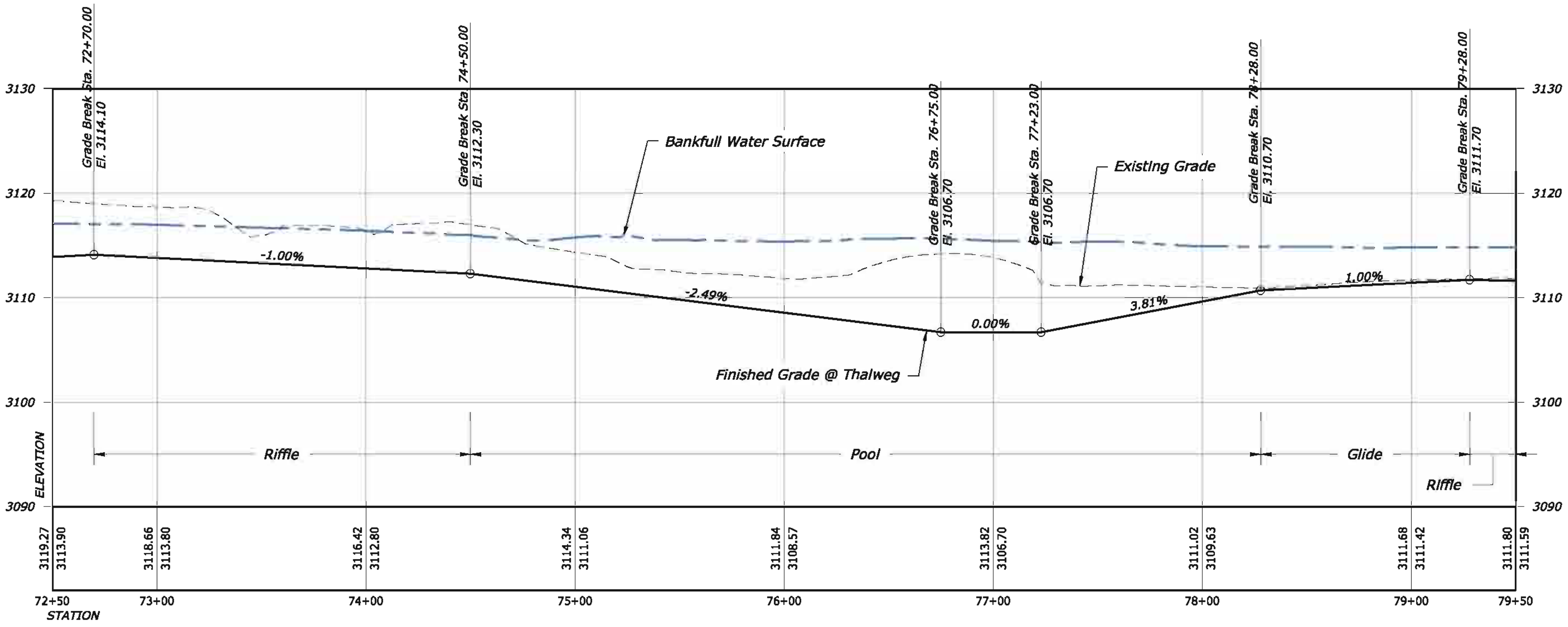
LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
— —	Thalweg
WL	Existing Wetlands
OHW	Ordinary High Water (OWH)
— - —	Property Line



MAIN CHANNEL - PLAN

STA 72+50 TO STA 79+50



MAIN CHANNEL - THALWEG PROFILE

STA 72+50 TO STA 79+50

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GRANDE RONDE RIVER SUBBASIN
BIRD TRACK SPRINGS FISH HABITAT
ENHANCEMENT PROJECT

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MAIN CHANNEL PLAN
AND PROFILE

STA 72+50 TO
STA 79+50

1678-100-60725

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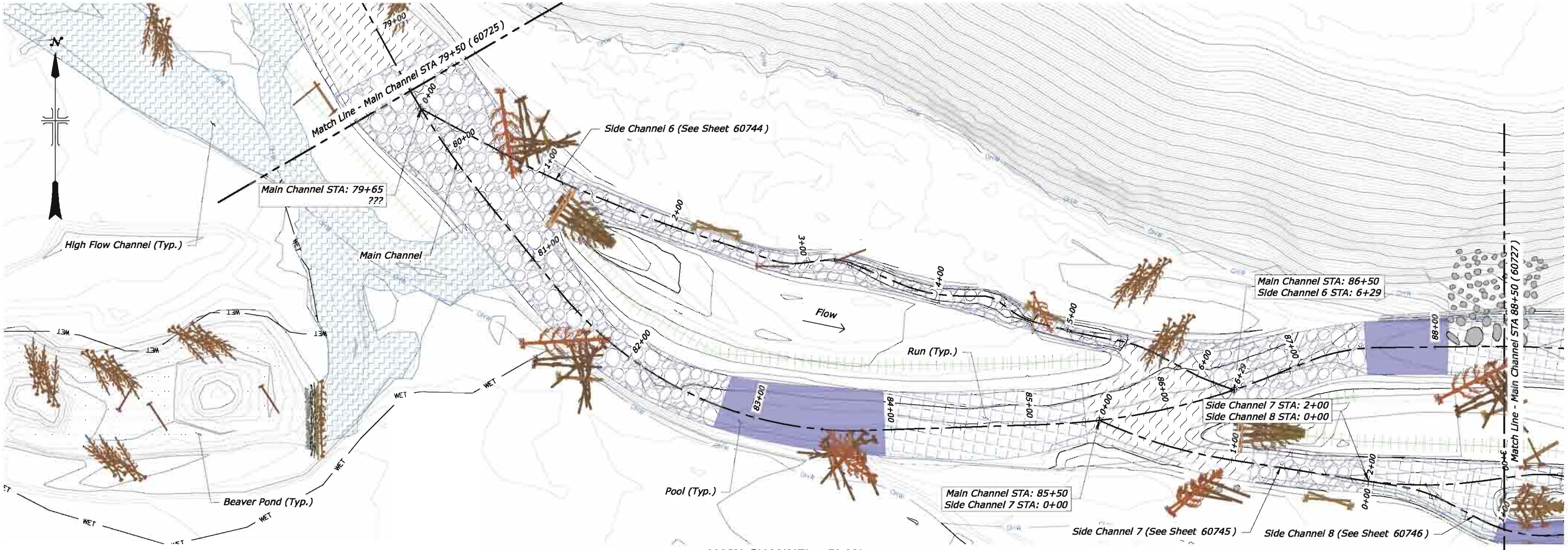
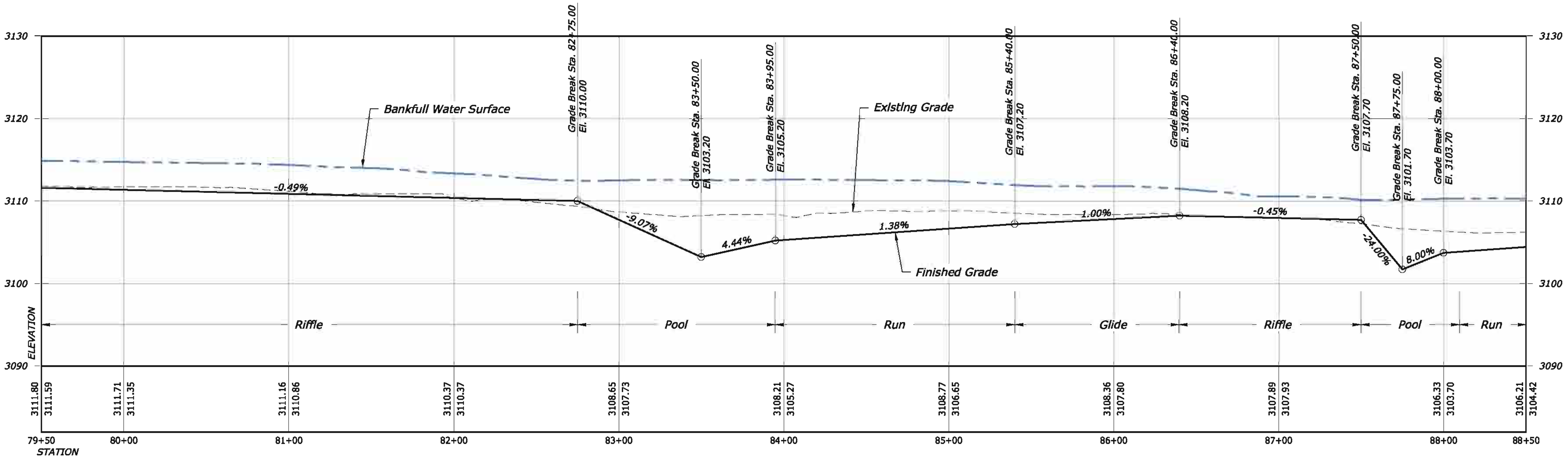


MAIN CHANNEL - PLAN

STA 79+50 TO STA 88+50

40 0 40 80 120
SCALE OF FEET



MAIN CHANNEL - THALWEG PROFILE

STA 79+50 TO STA 88+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
	Thalweg
WET	Existing Wetlands
OHW	Ordinary High Water (OHW)
	Property Line
	Finish Grade Profile
	Existing Grade Profile
	Bankfull Water Surface Profile

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MAIN CHANNEL PLAN
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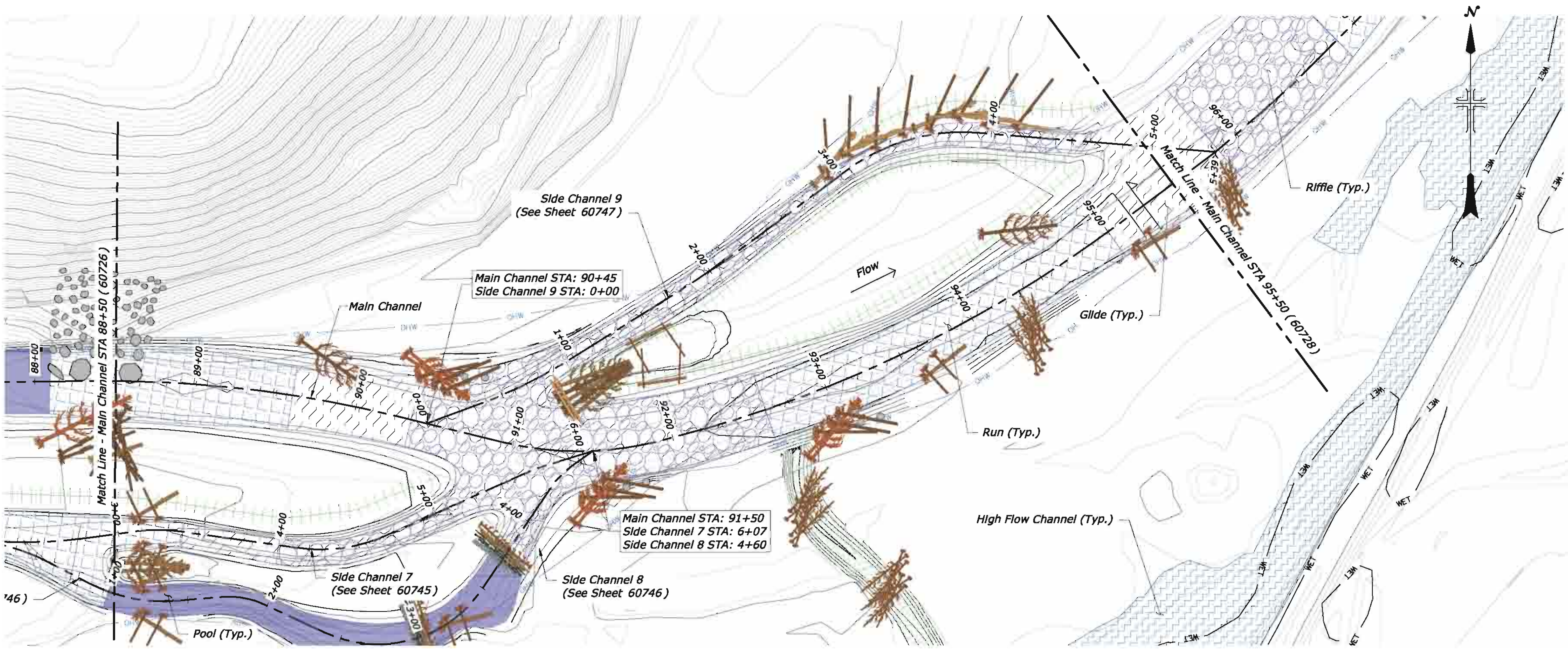
STA 79+50 TO
STA 88+50

1678-100-60726

SHEET 13 of 34

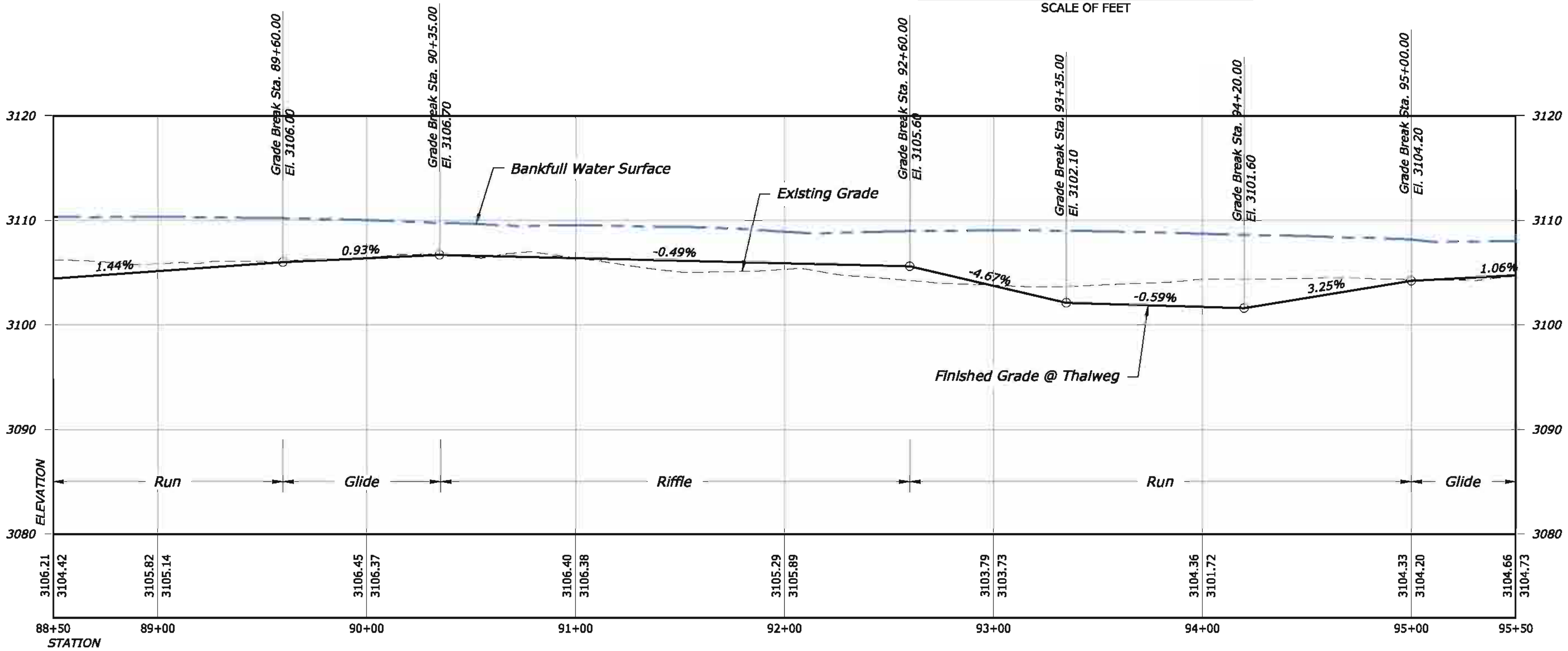


MAIN CHANNEL - PLAN
STA 88+50 TO STA 95+50

40 0 40 80 120
SCALE OF FEET

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
	Thalweg
	Existing Wetlands
OHW	Ordinary High Water (OHW)
	Property Line
	Finish Grade Profile
	Existing Grade Profile
	Bankfull Water Surface Profile



MAIN CHANNEL - THALWEG PROFILE
STA 88+50 TO STA 95+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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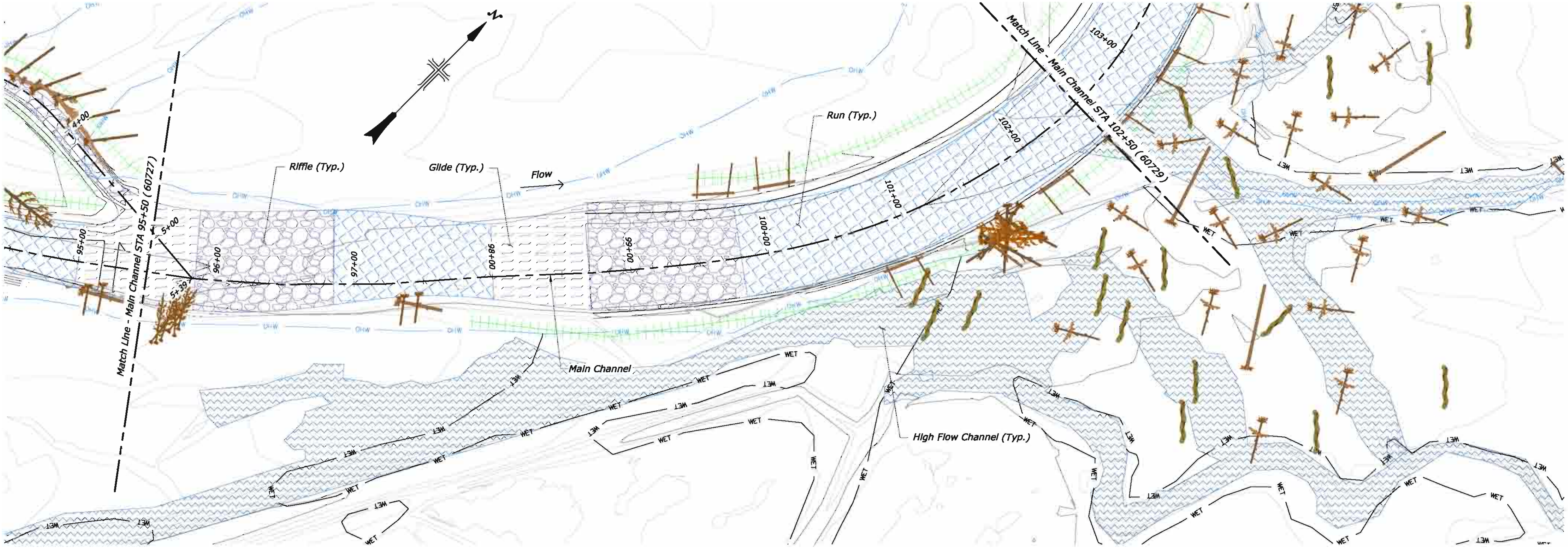
MAIN CHANNEL PLAN
AND PROFILE

STA 88+50 TO
STA 95+50

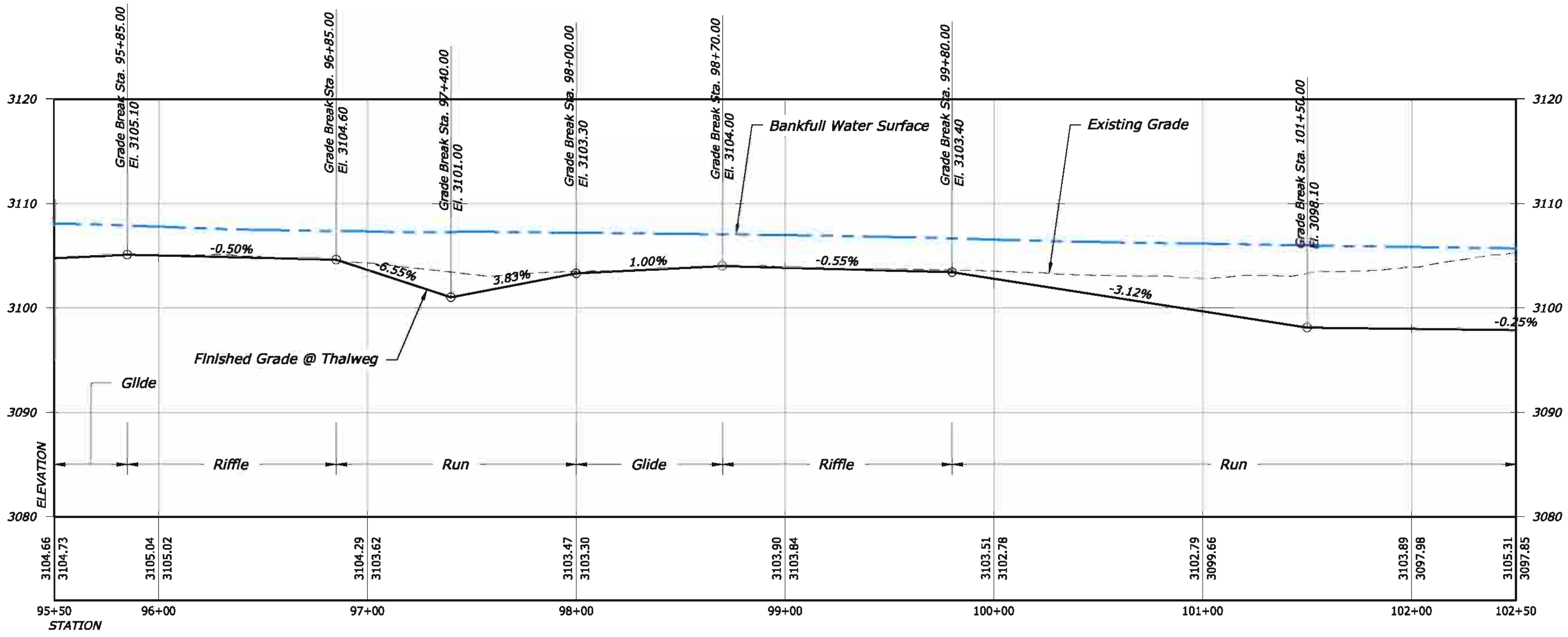
1678-100-60727



MAIN CHANNEL - PLAN

STA 95+50 TO STA 102+50

40 0 40 80 120
SCALE OF FEET



MAIN CHANNEL - THALWEG PROFILE

STA 95+50 TO STA 102+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

LEGEND

- ELEV OG Major Contour
- OG Minor Contour
- ELEV FG Major Contour
- FG Minor Contour
- Thalweg
- Existing Wetlands
- OHW Ordinary High Water (OHW)
- Property Line
- Finish Grade Profile
- Existing Grade Profile
- Bankfull Water Surface Profile

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MAIN CHANNEL PLAN
AND PROFILE

STA 95+50 TO
STA 102+50

1678-100-60728

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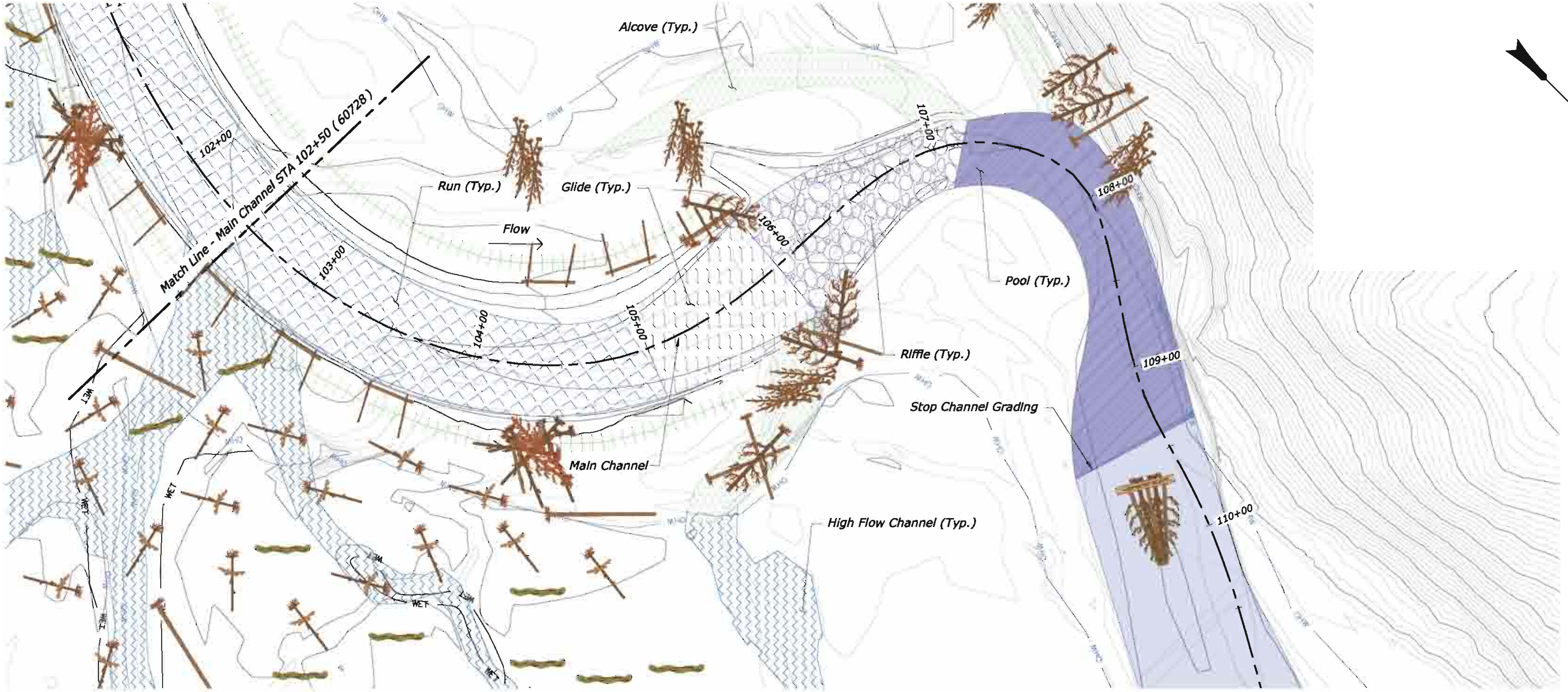
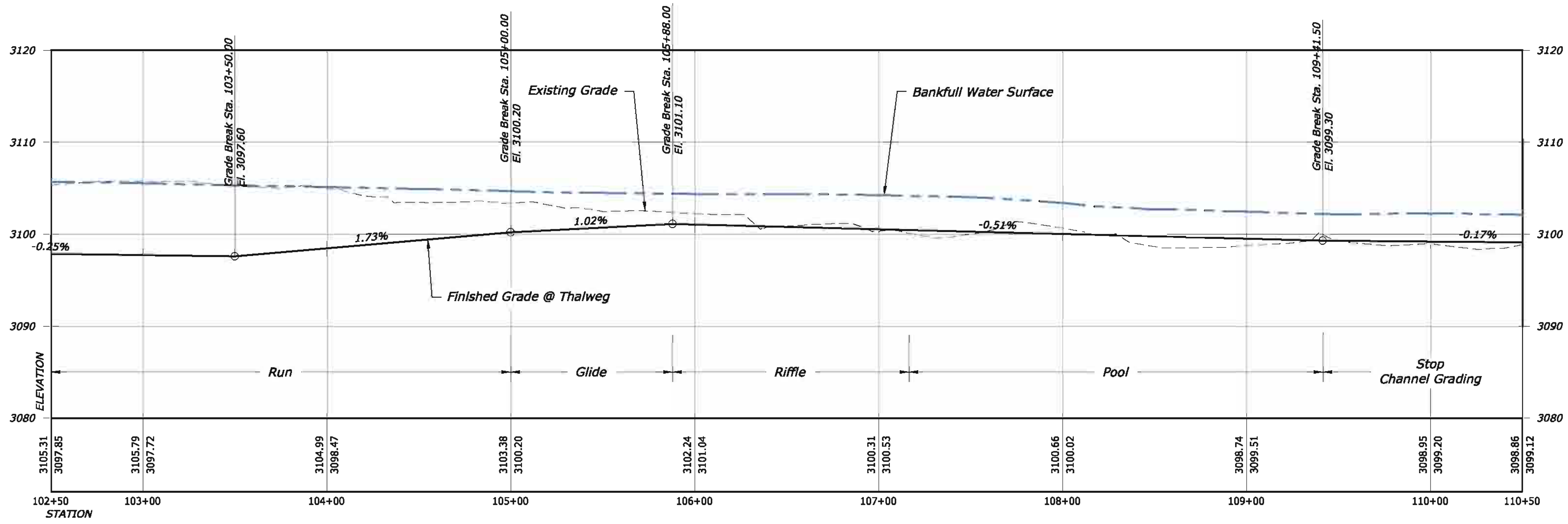


MAIN CHANNEL - PLAN

STA 88+50 TO STA 94+00

40 0 40 80 120
SCALE OF FEET



MAIN CHANNEL - THALWEG PROFILE

STA 102+50 TO STA 110+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

LEGEND

- ELEV OG Major Contour
- OG Minor Contour
- ELEV FG Major Contour
- FG Minor Contour
- Thalweg
- Existing Wetlands
- OHW Ordinary High Water (OHW)
- Property Line
- Finish Grade Profile
- Existing Grade Profile
- Bankfull Water Surface Profile

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MAIN CHANNEL PLAN
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STA 102+50 TO
STA 110+50

1678-100-60729

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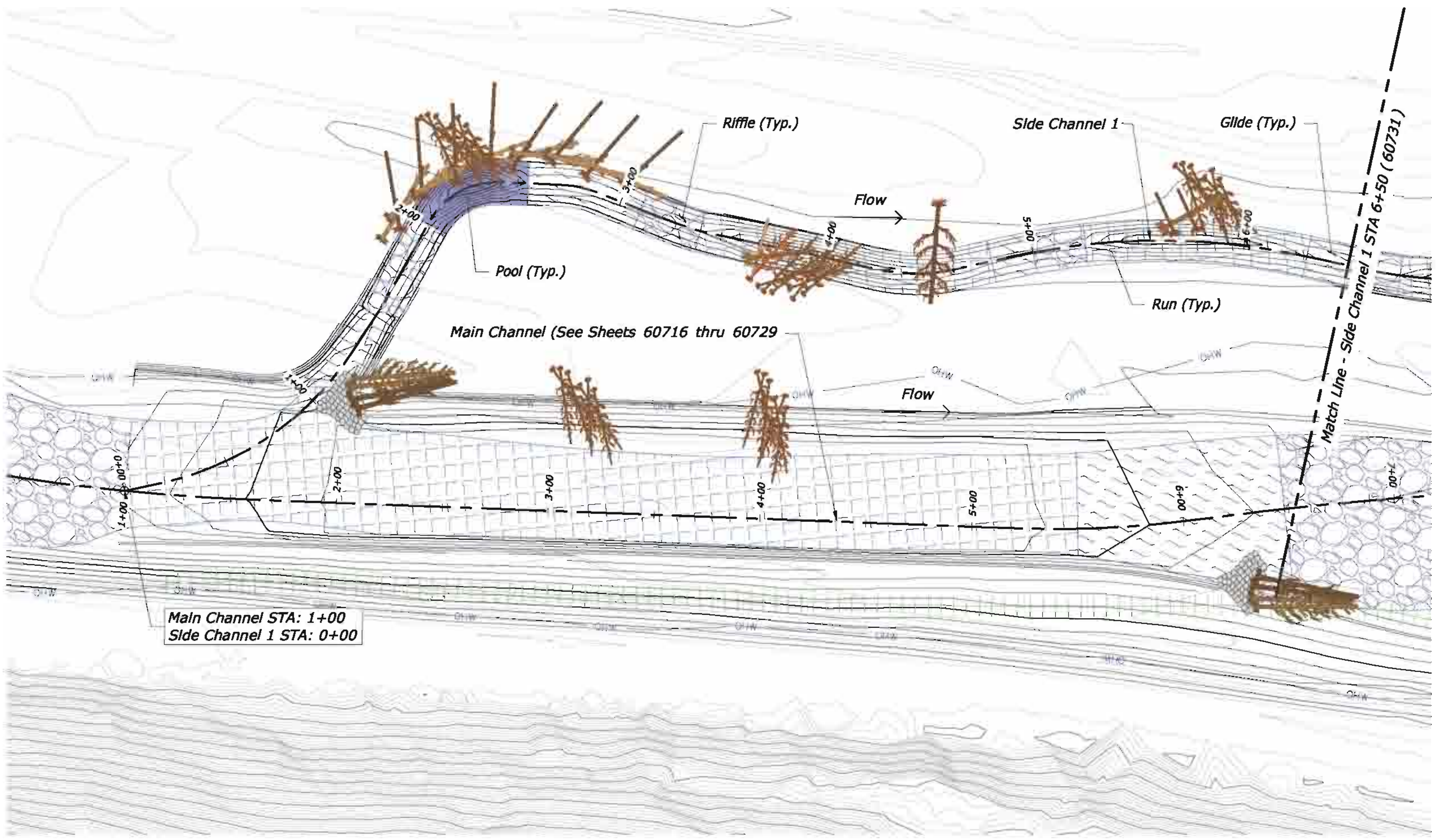


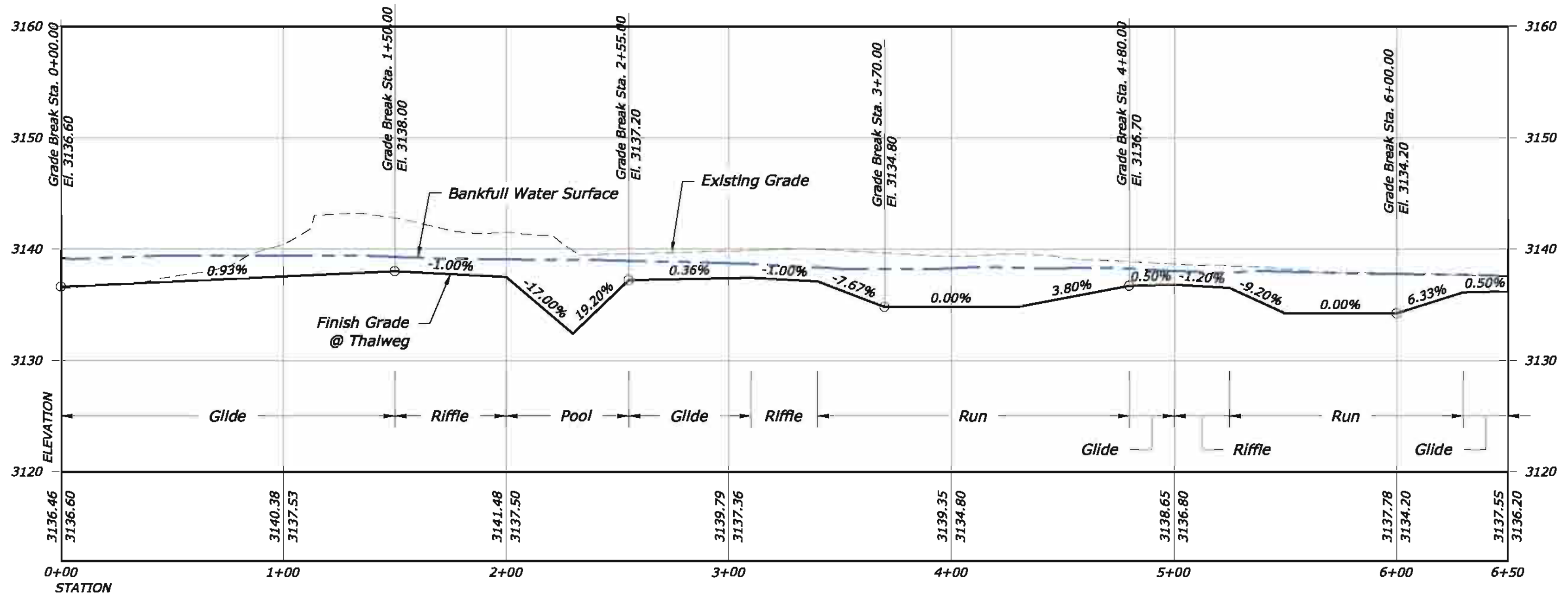
SIDE CHANNEL 1 - PLAN

STA 0+00 TO STA 6+50

40 0 40 80 120
SCALE OF FEET

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
	Thalweg
	Existing Wetlands
OHW	Ordinary High Water (OHW)
	Property Line
	Finish Grade Profile
	Existing Grade Profile
	Bankfull Water Surface Profile



SIDE CHANNEL 1 - THALWEG PROFILE

STA 0+00 TO STA 6+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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CAD FILENAME
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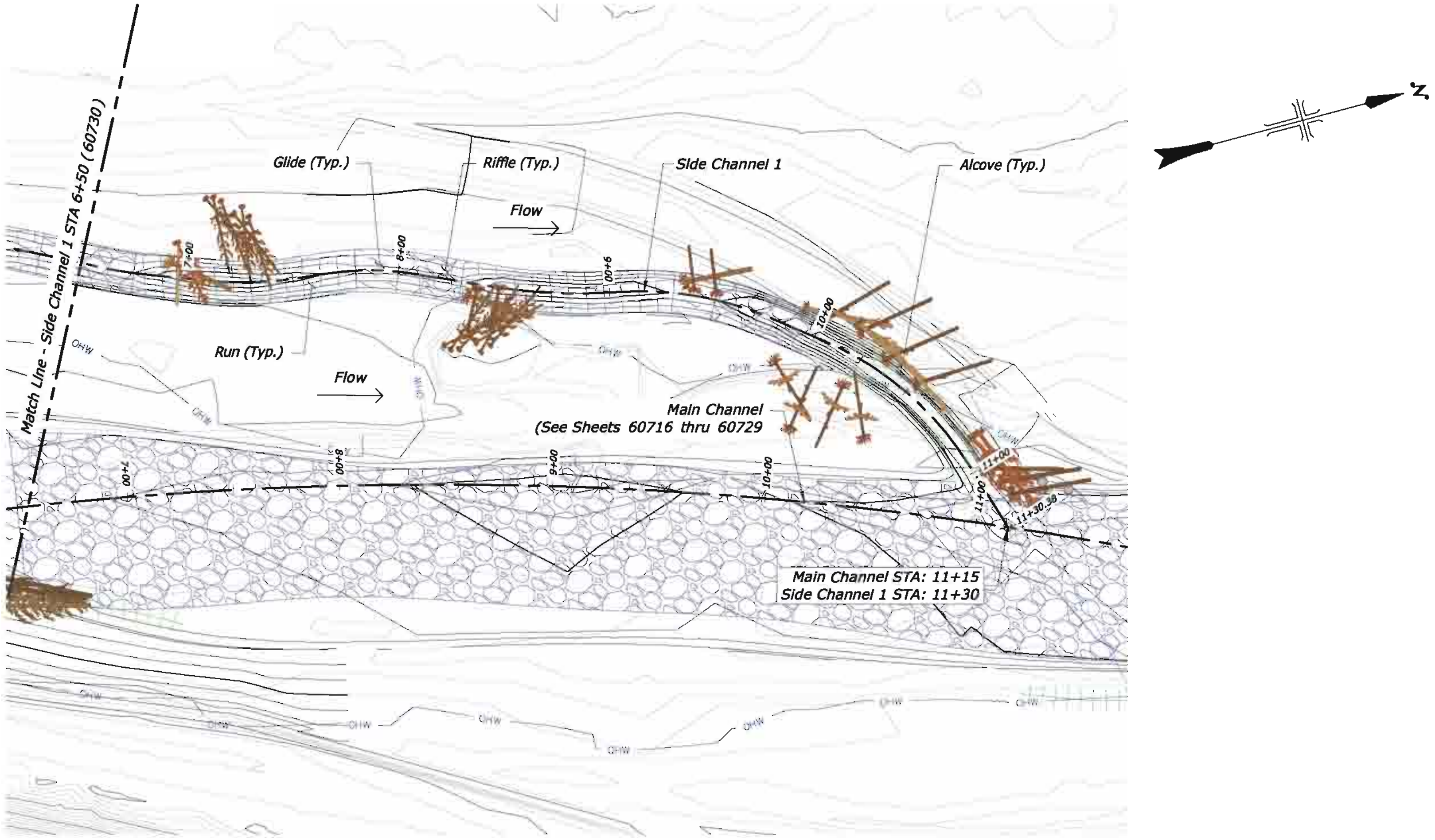
SIDE CHANNEL 1 PLAN
AND PROFILE

STA 0+00 TO STA 6+50

1678-100-60730

SHEET 17 of 34



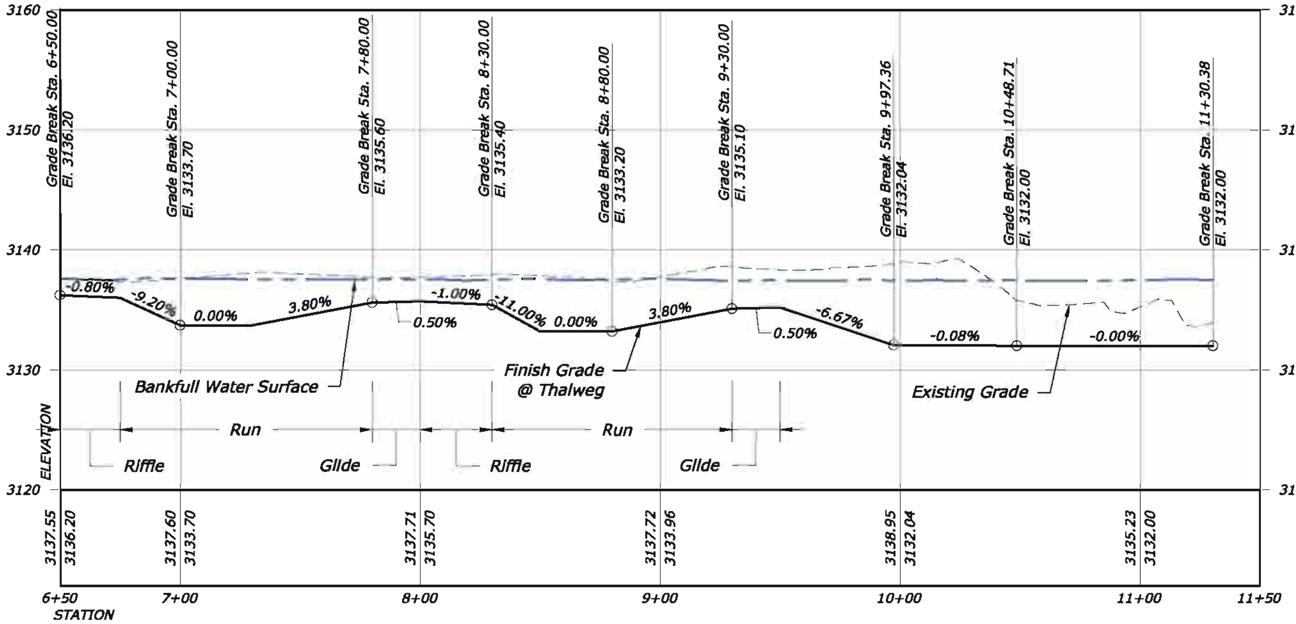
SIDE CHANNEL 1 - PLAN

STA 6+50 TO STA 11+50

40 0 40 80 120
SCALE OF FEET

LEGEND

- OG Major Contour
- OG Minor Contour
- FG Major Contour
- FG Minor Contour
- Thalweg
- Existing Wetlands
- Ordinary High Water (OHW)
- Property Line
- Finish Grade Profile
- Existing Grade Profile
- Bankfull Water Surface Profile



SIDE CHANNEL 1 - THALWEG PROFILE

STA 6+50 TO STA 11+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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SIDE CHANNEL 1 PLAN
AND PROFILE

STA 6+50 TO STA 11+50

1678-100-60731

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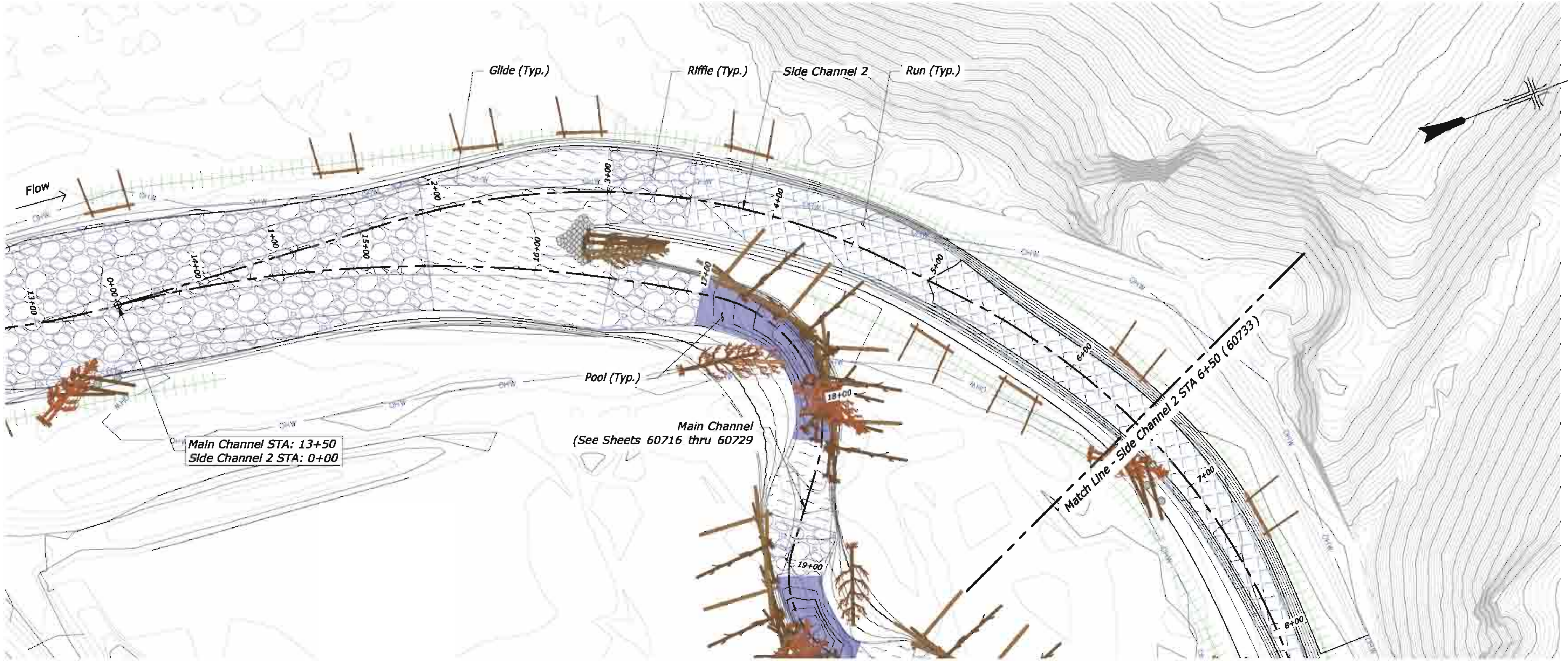


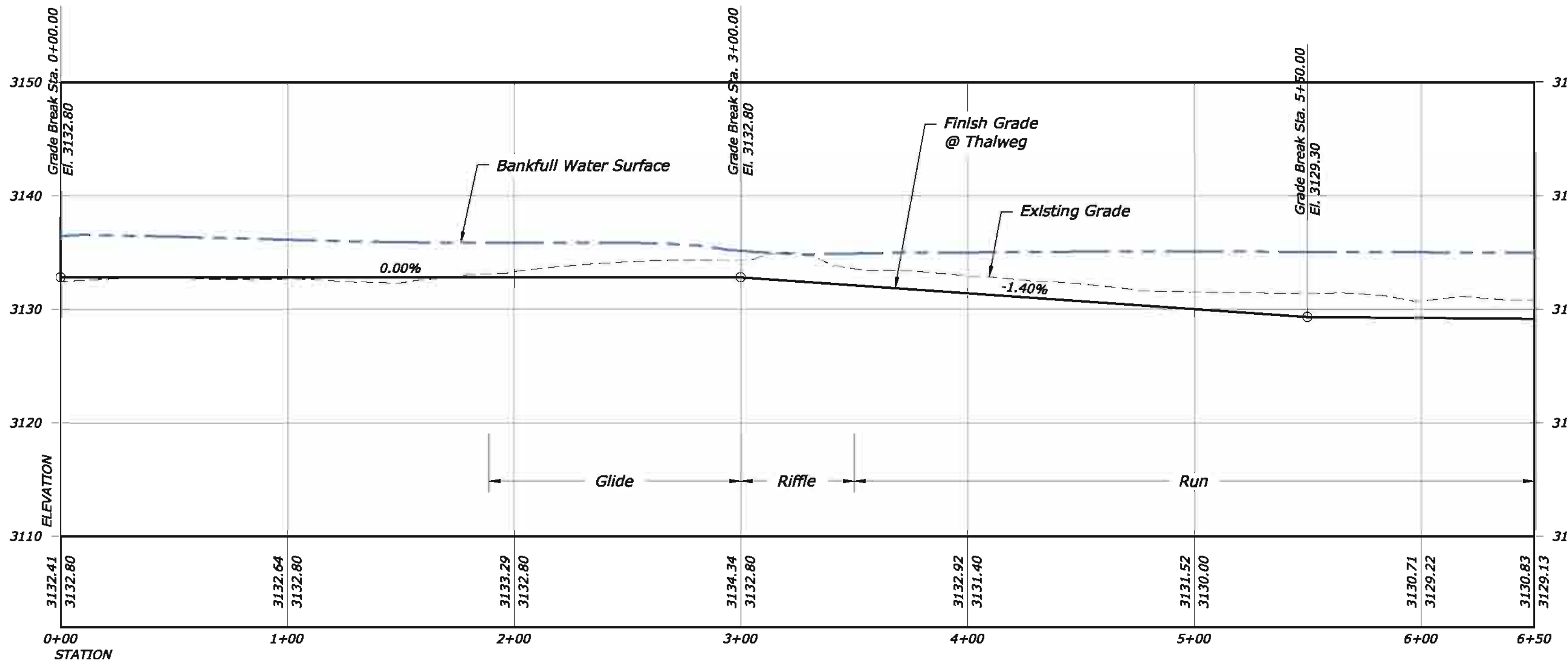
SIDE CHANNEL 2 - PLAN

STA 0+00 TO STA 6+50

40 0 40 80 120
SCALE OF FEET

LEGEND

───	OG Major Contour
───	OG Minor Contour
──ELEV──	FG Major Contour
───	FG Minor Contour
─ ─ ─	Thalweg
─ ─	Existing Wetlands
─OHW─	Ordinary High Water (OHW)
─ ─ ─	Property Line
───	Finish Grade Profile
- - -	Existing Grade Profile
───	Bankfull Water Surface Profile



SIDE CHANNEL 2 - THALWEG PROFILE

STA 0+00 TO STA 6+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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SIDE CHANNEL 2 PLAN
AND PROFILE

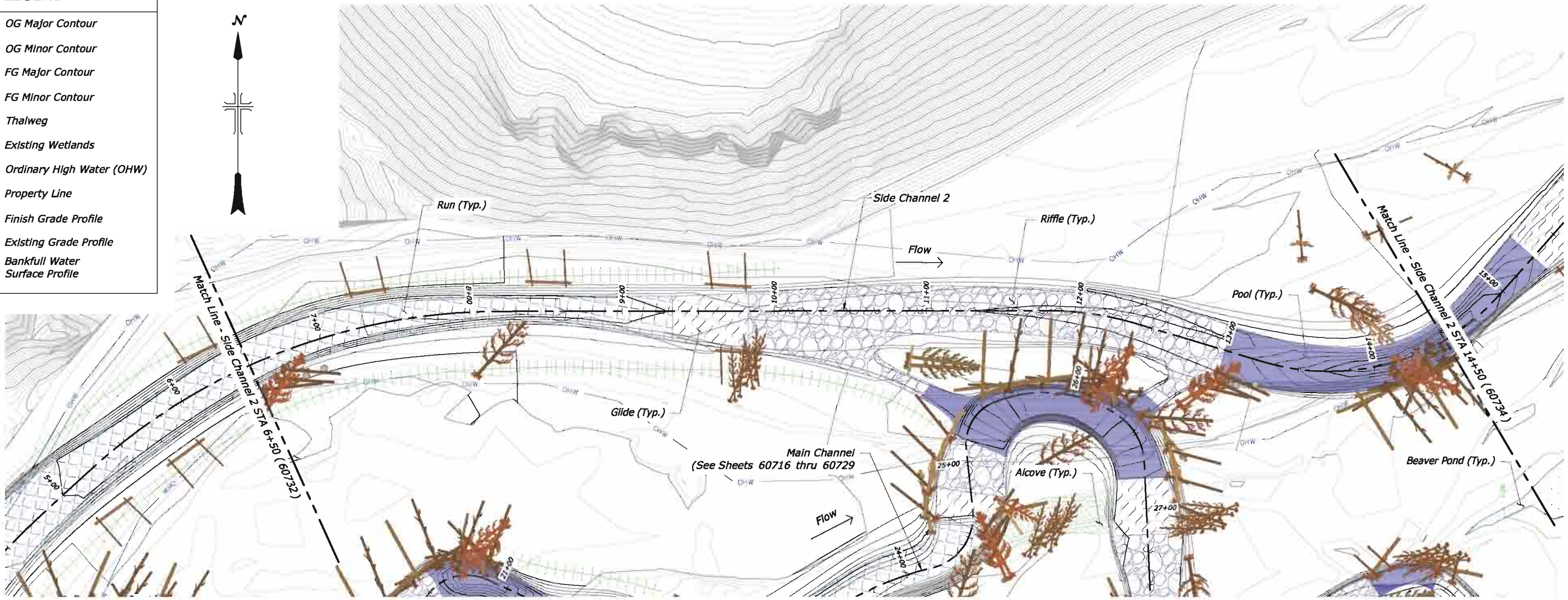
STA 0+00 TO STA 6+50

1678-100-60732

SHEET 19 of 34

LEGEND

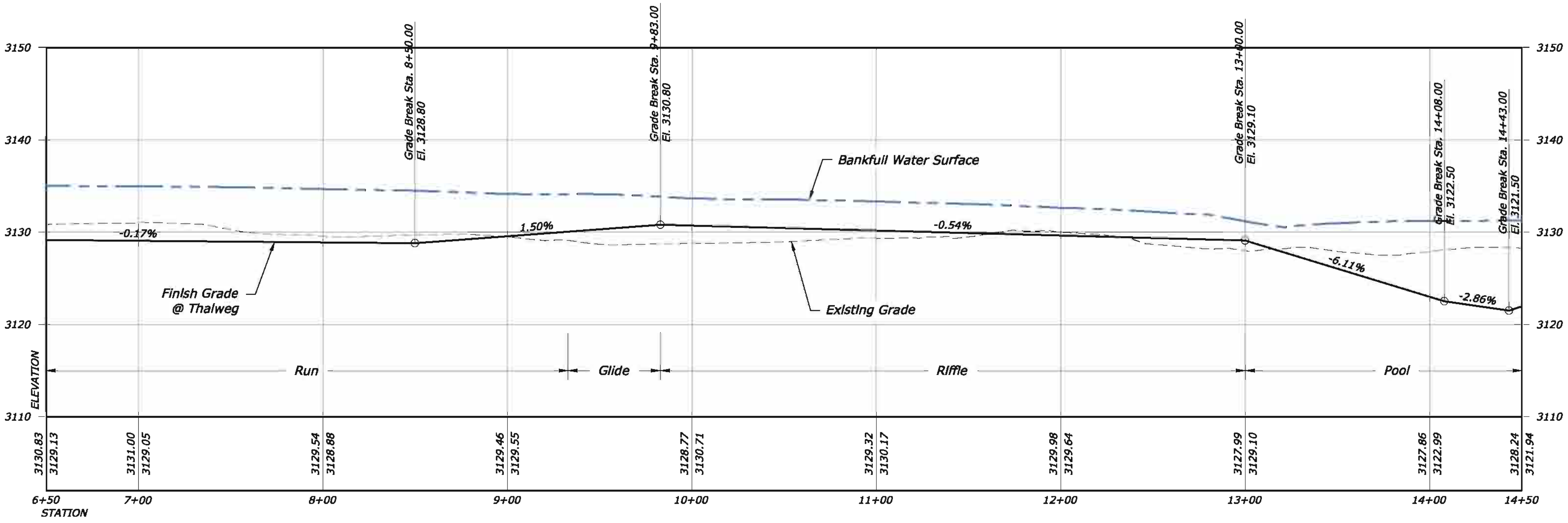
- ELEV OG Major Contour
- OG Minor Contour
- ELEV FG Major Contour
- FG Minor Contour
- Thalweg
- WET Existing Wetlands
- OHW Ordinary High Water (OHW)
- Property Line
- Finish Grade Profile
- Existing Grade Profile
- Bankfull Water Surface Profile



SIDE CHANNEL 2 - PLAN

STA 6+50 TO STA 14+50

40 0 40 80 120
SCALE OF FEET



SIDE CHANNEL 2 - THALWEG PROFILE

STA 6+50 TO STA 14+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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SIDE CHANNEL 2 PLAN
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STA 6+50 TO STA 14+50

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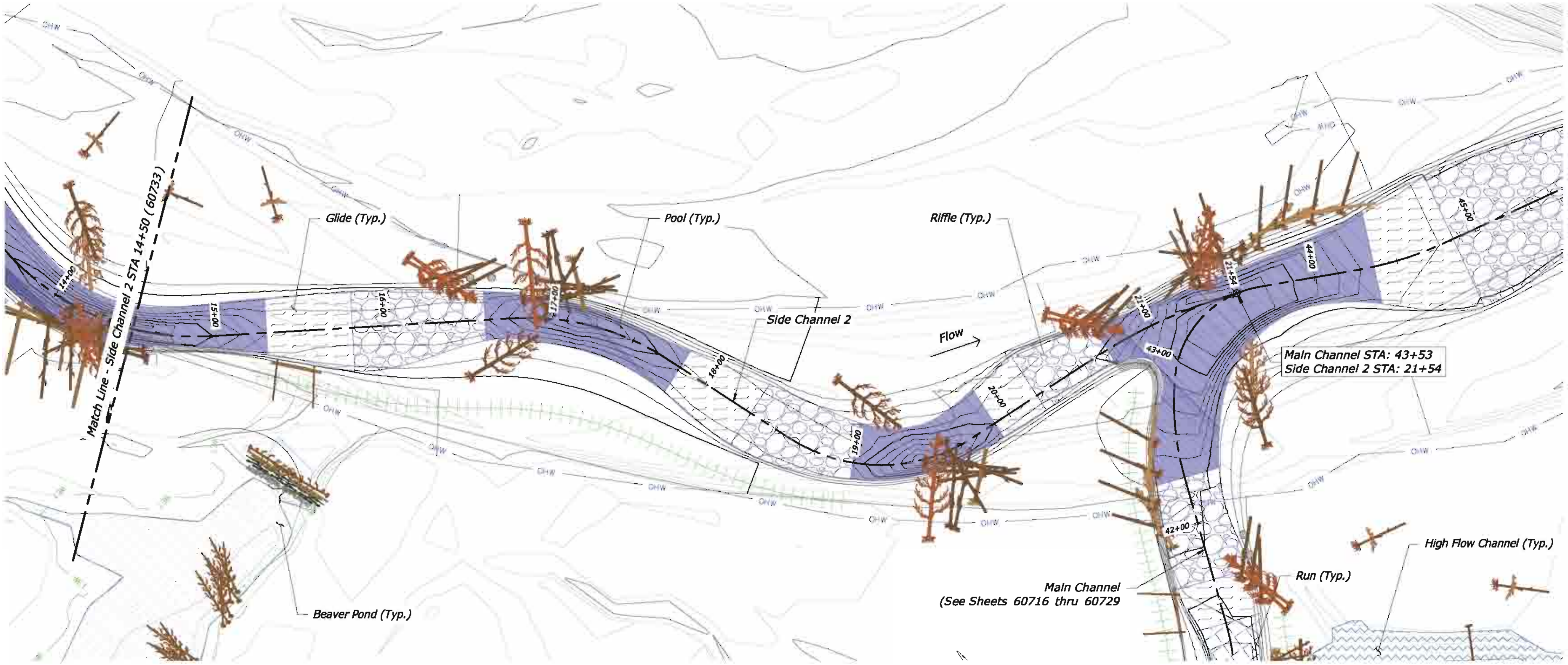
SHEET 20 of 34



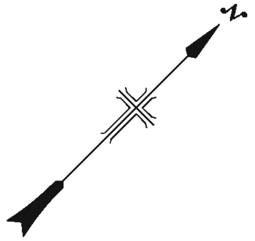
SIDE CHANNEL 2 - PLAN

STA 14+50 TO STA 22+00

40 0 40 80 120
SCALE OF FEET

LEGEND

- ELEV — OG Major Contour
- OG Minor Contour
- ELEV — FG Major Contour
- FG Minor Contour
- Thalweg
- Existing Wetlands
- OHW — Ordinary High Water (OHW)
- Property Line
- Finish Grade Profile
- Existing Grade Profile
- Bankfull Water Surface Profile



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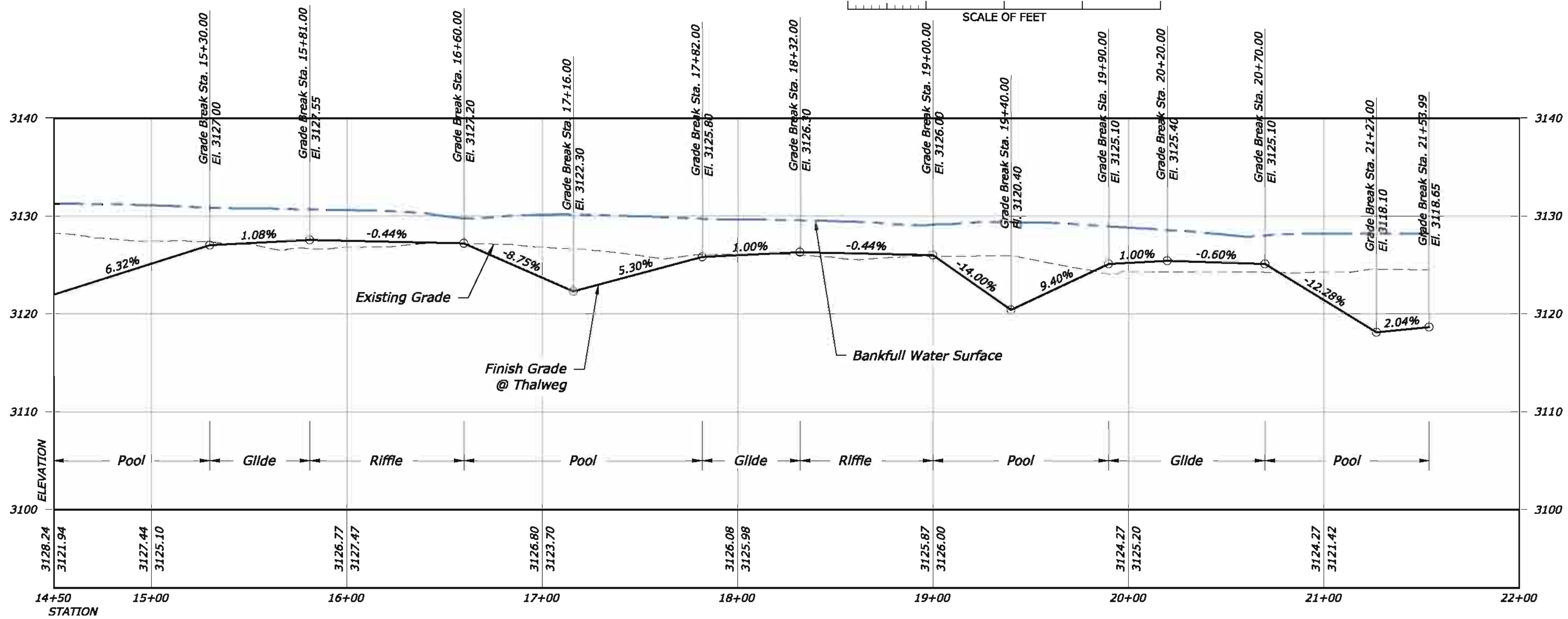

SIDE CHANNEL 2 - THALWEG PROFILE

STA 14+50 TO STA 22+00

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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SIDE CHANNEL 2 PLAN
AND PROFILE

STA 14+50 TO
STA 22+00

1678-100-60734

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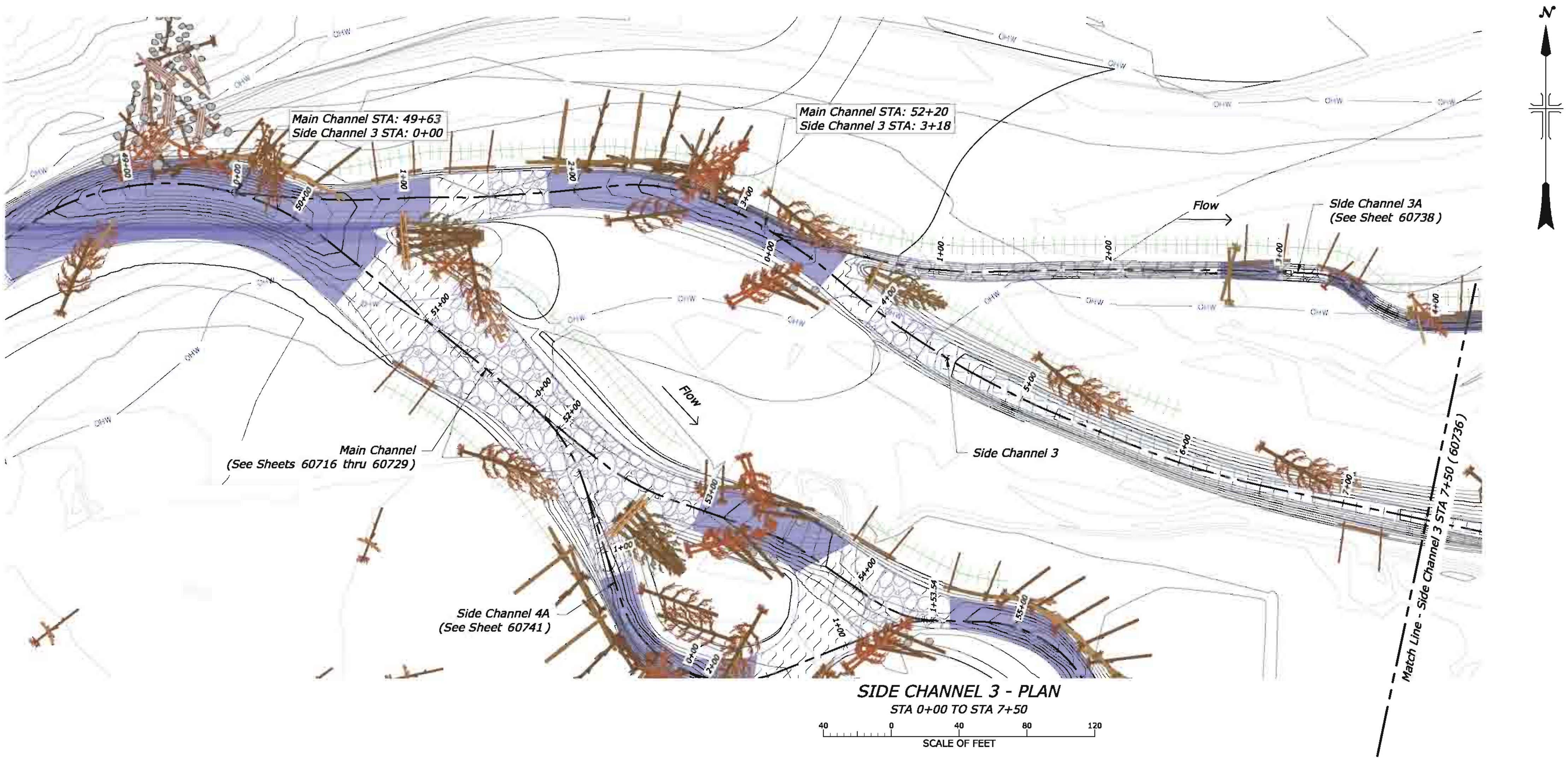
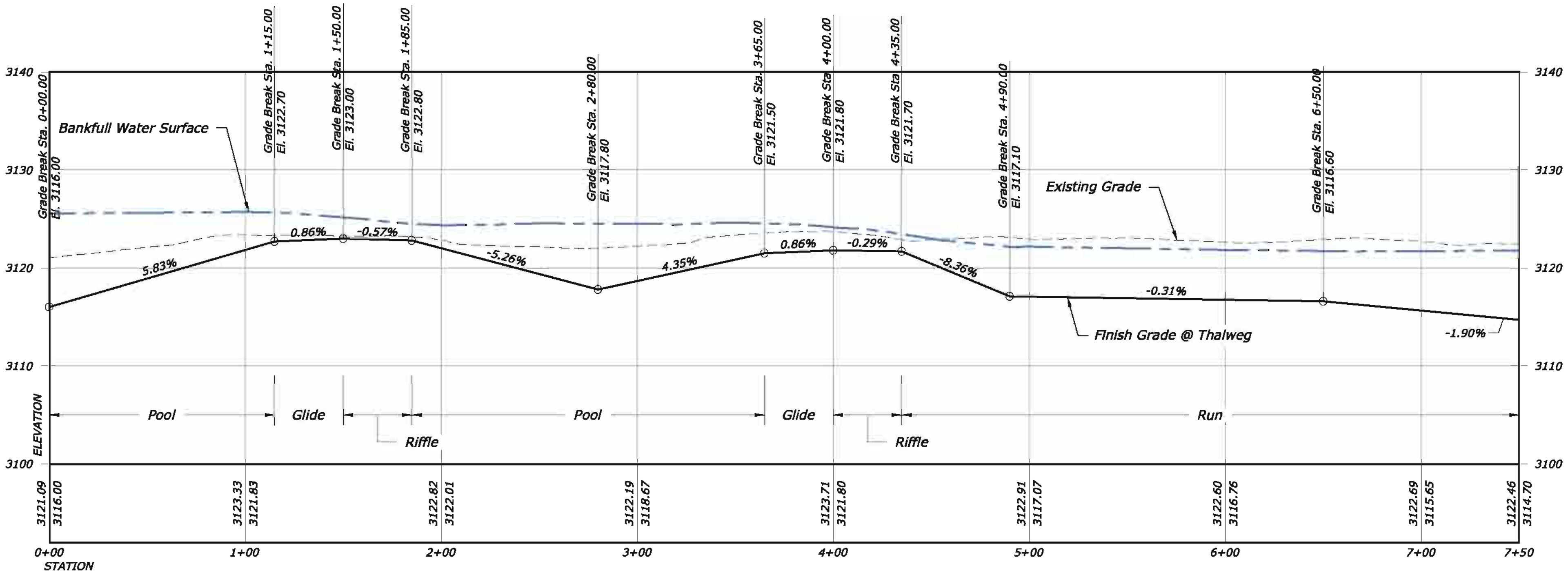


SIDE CHANNEL 3 - PLAN

STA 0+00 TO STA 7+50

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
— — —	Thalweg
	Existing Wetlands
OHW	Ordinary High Water (OHW)
— - —	Property Line
——	Finish Grade Profile
- - -	Existing Grade Profile
——	Bankfull Water Surface Profile



SIDE CHANNEL 3 - THALWEG PROFILE

STA 0+00 TO STA 7+50

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STA 0+00 TO STA 7+50

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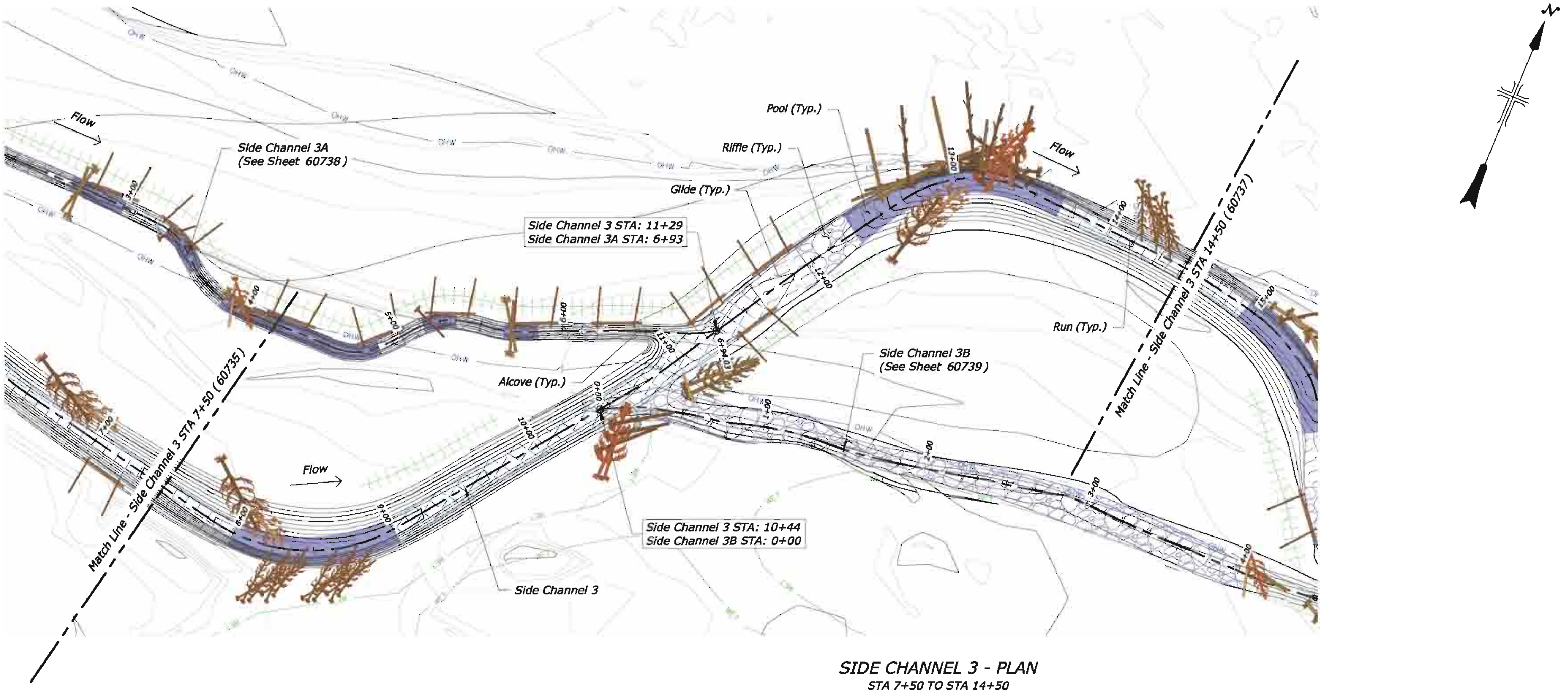


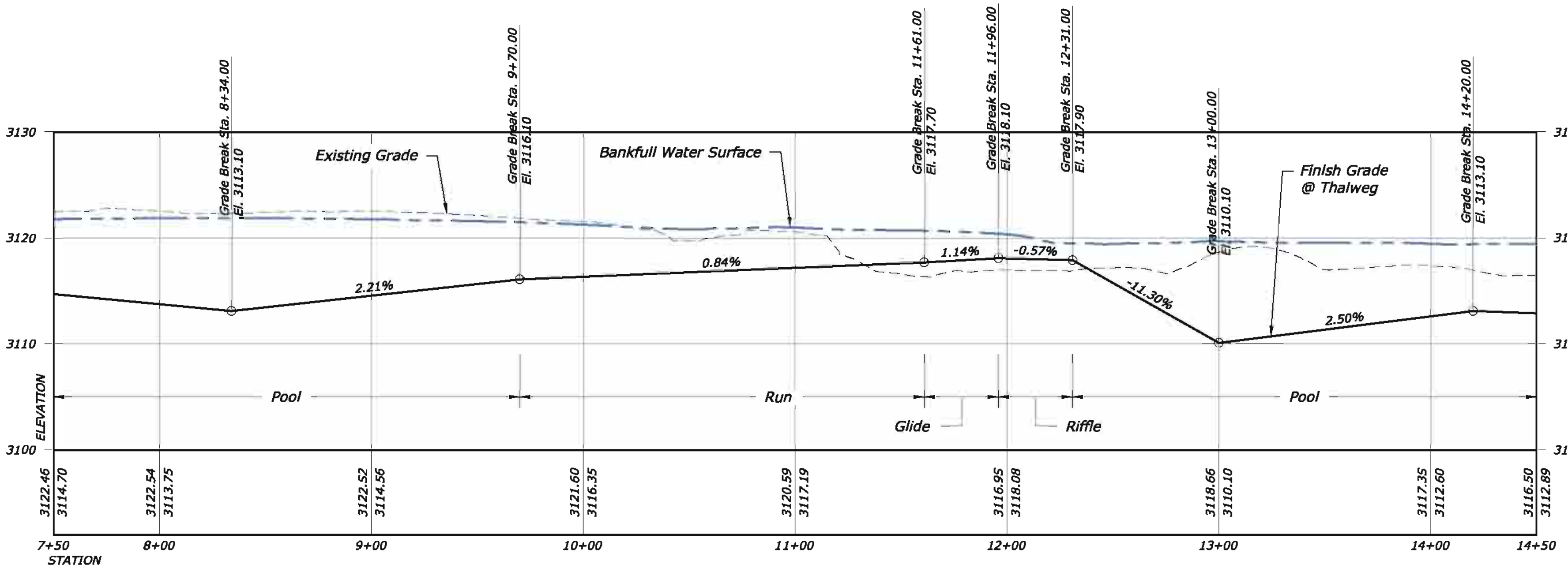
SIDE CHANNEL 3 - PLAN

STA 7+50 TO STA 14+50

40 0 40 80 120
SCALE OF FEET

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
	Thalweg
	Existing Wetlands
OHW	Ordinary High Water (OHW)
	Property Line
	Finish Grade Profile
	Existing Grade Profile
	Bankfull Water Surface Profile



SIDE CHANNEL 3 - THALWEG PROFILE

STA 7+50 TO STA 14+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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SIDE CHANNEL 3 PLAN
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STA 7+50 TO STA 14+50

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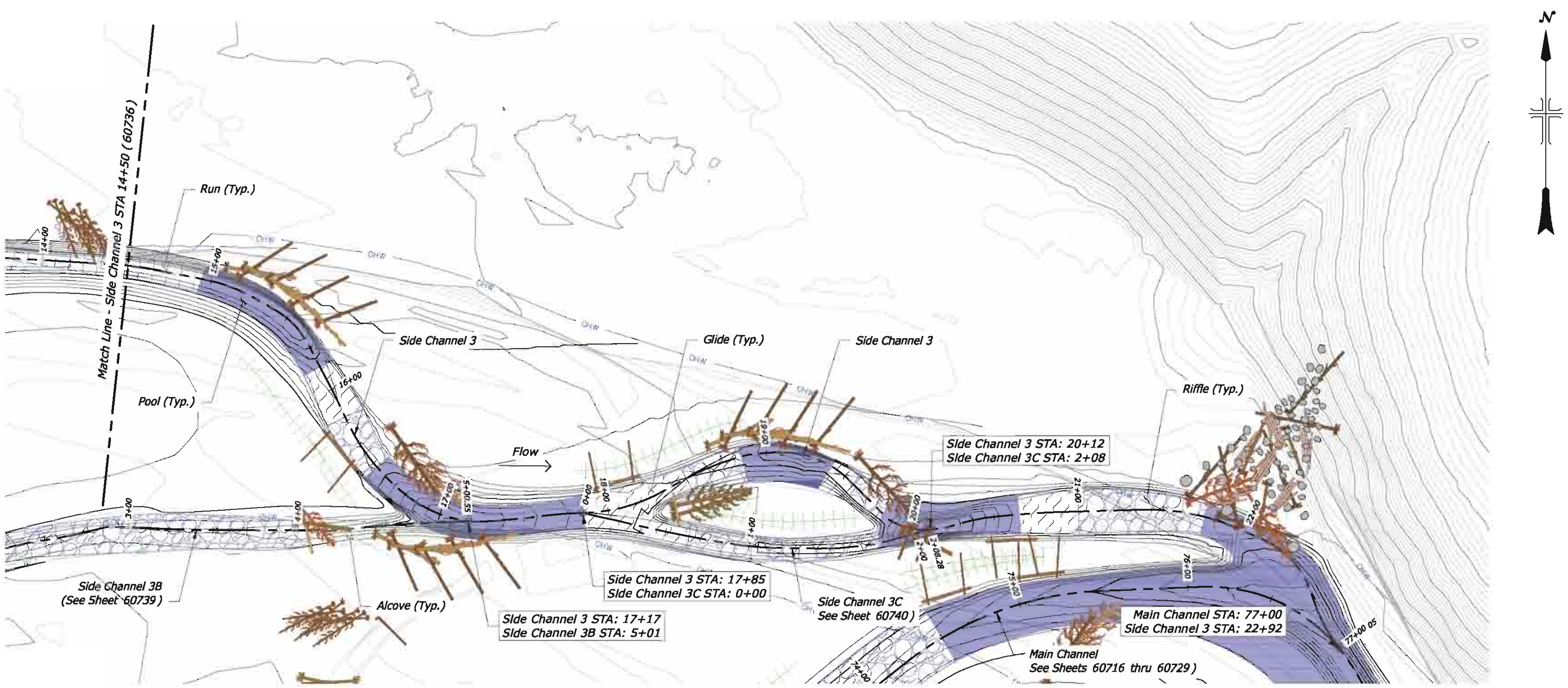
SHEET 23 of 34

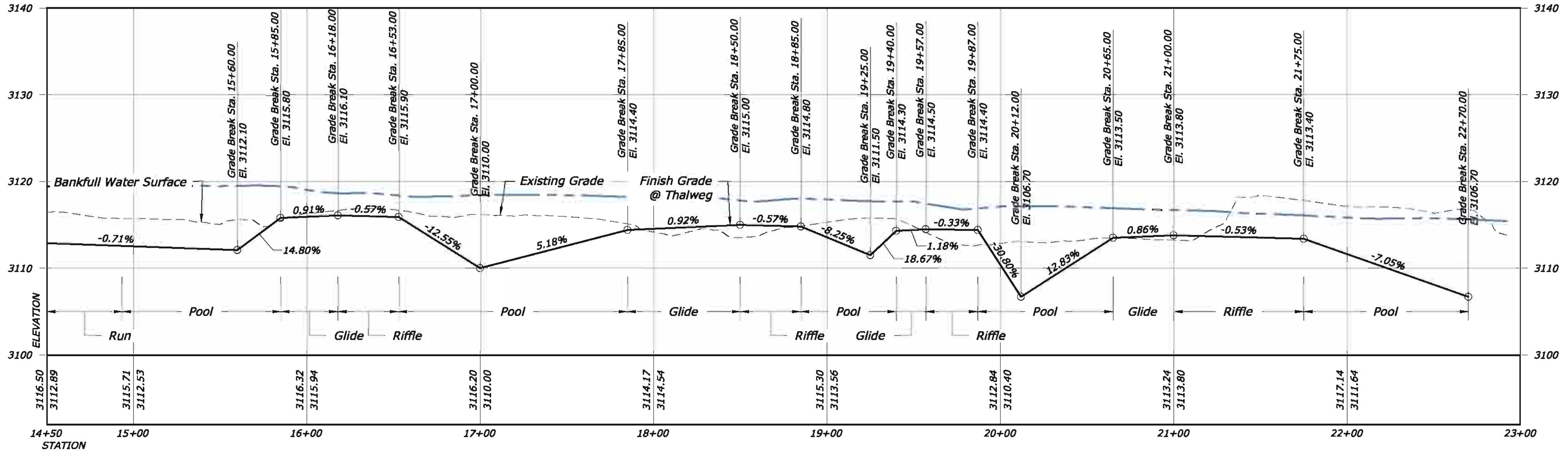


SIDE CHANNEL 3 - PLAN

STA 14+50 TO STA 23+00

LEGEND

- OG Major Contour
- OG Minor Contour
- FG Major Contour
- FG Minor Contour
- Thalweg
- Existing Wetlands
- Ordinary High Water (OHW)
- Property Line
- Finish Grade Profile
- Existing Grade Profile
- Bankfull Water Surface Profile



SIDE CHANNEL 3 - THALWEG PROFILE

STA 14+50 TO STA 23+00

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ENHANCEMENT PROJECT

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SIDE CHANNEL 3 PLAN
AND PROFILE

STA 14+50 TO
STA 23+00

1678-100-60737

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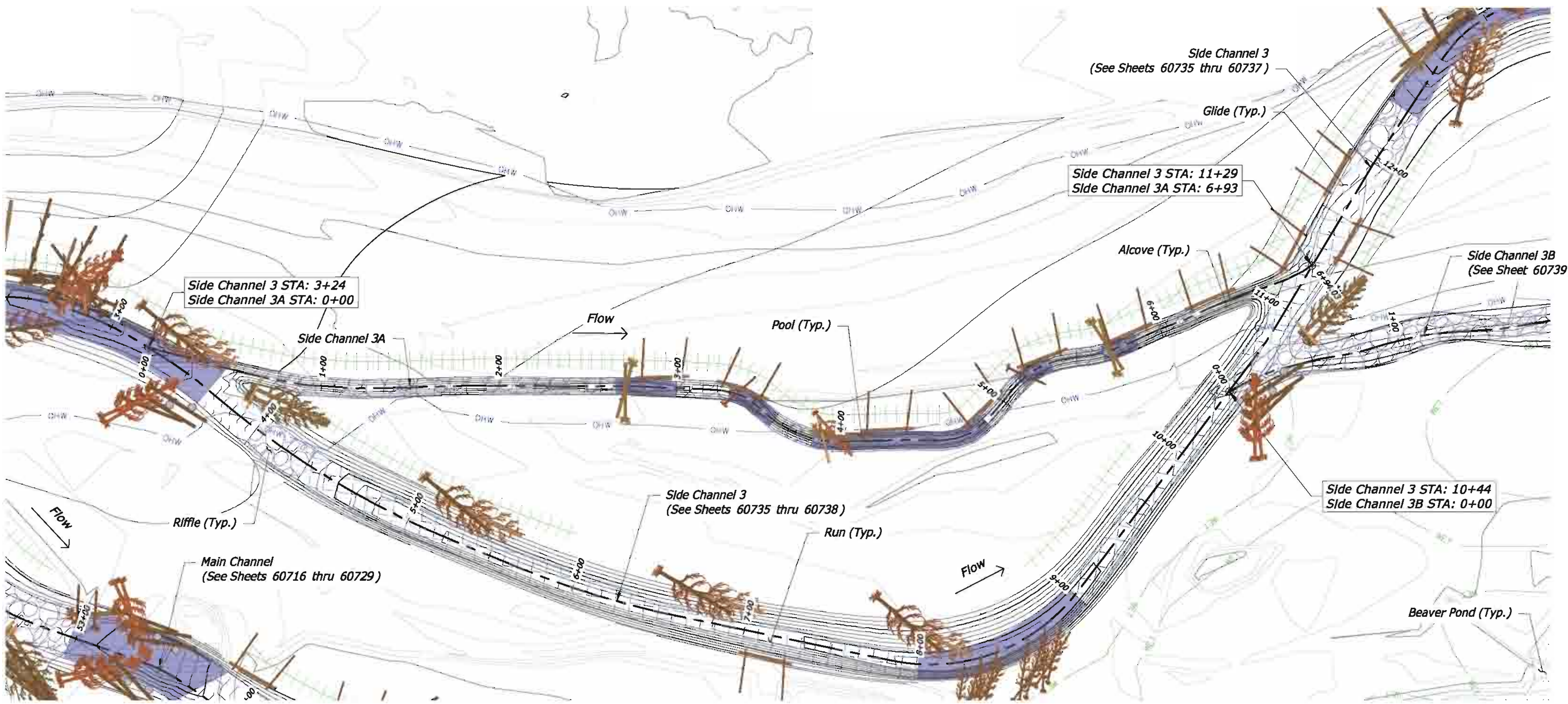


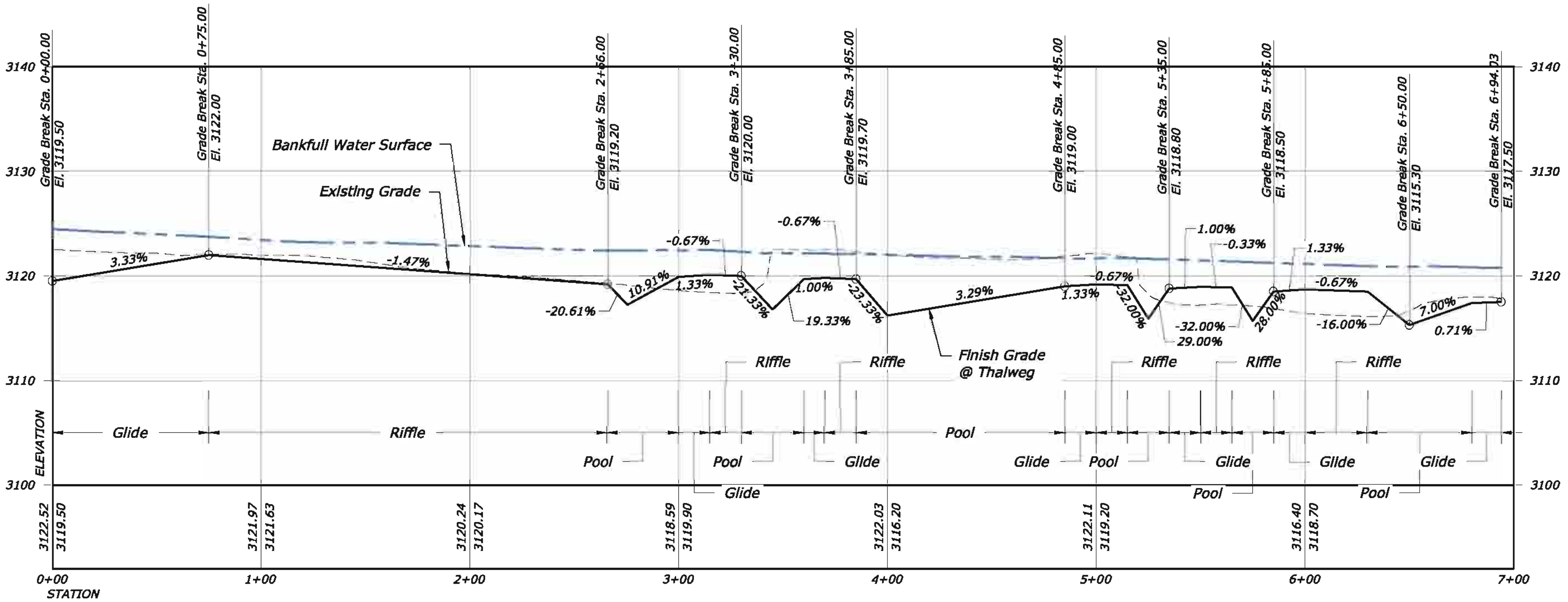
SIDE CHANNEL 3A - PLAN

STA 0+00 TO STA 7+00

40 0 40 80 120
SCALE OF FEET

LEGEND

- OG Major Contour
- OG Minor Contour
- FG Major Contour
- FG Minor Contour
- Thalweg
- Existing Wetlands
- Ordinary High Water (OHW)
- Property Line
- Finish Grade Profile
- Existing Grade Profile
- Bankfull Water Surface Profile



SIDE CHANNEL 3A - THALWEG PROFILE

STA 0+00 TO STA 7+00

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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SIDE CHANNEL 3A PLAN
AND PROFILE

STA 0+00 TO STA 7+00

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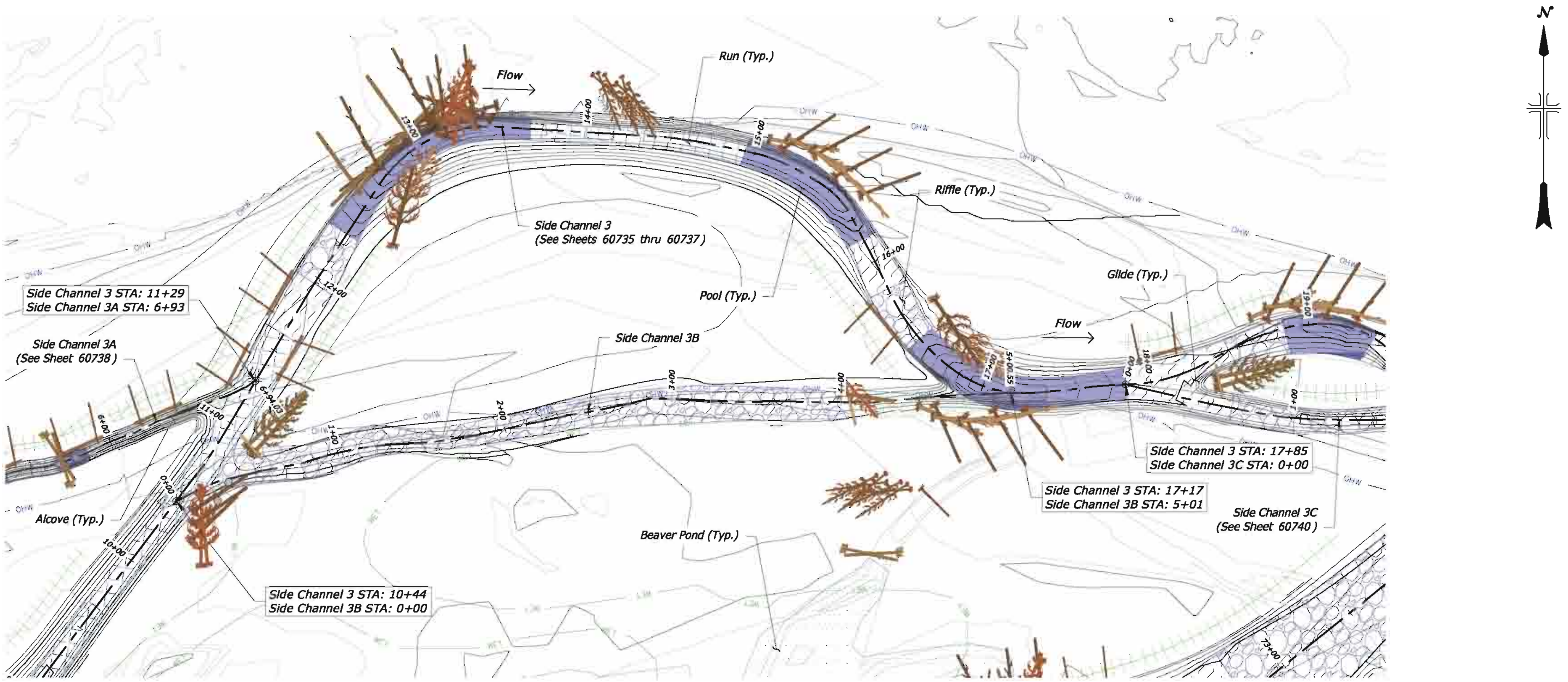
SHEET 25 of 34



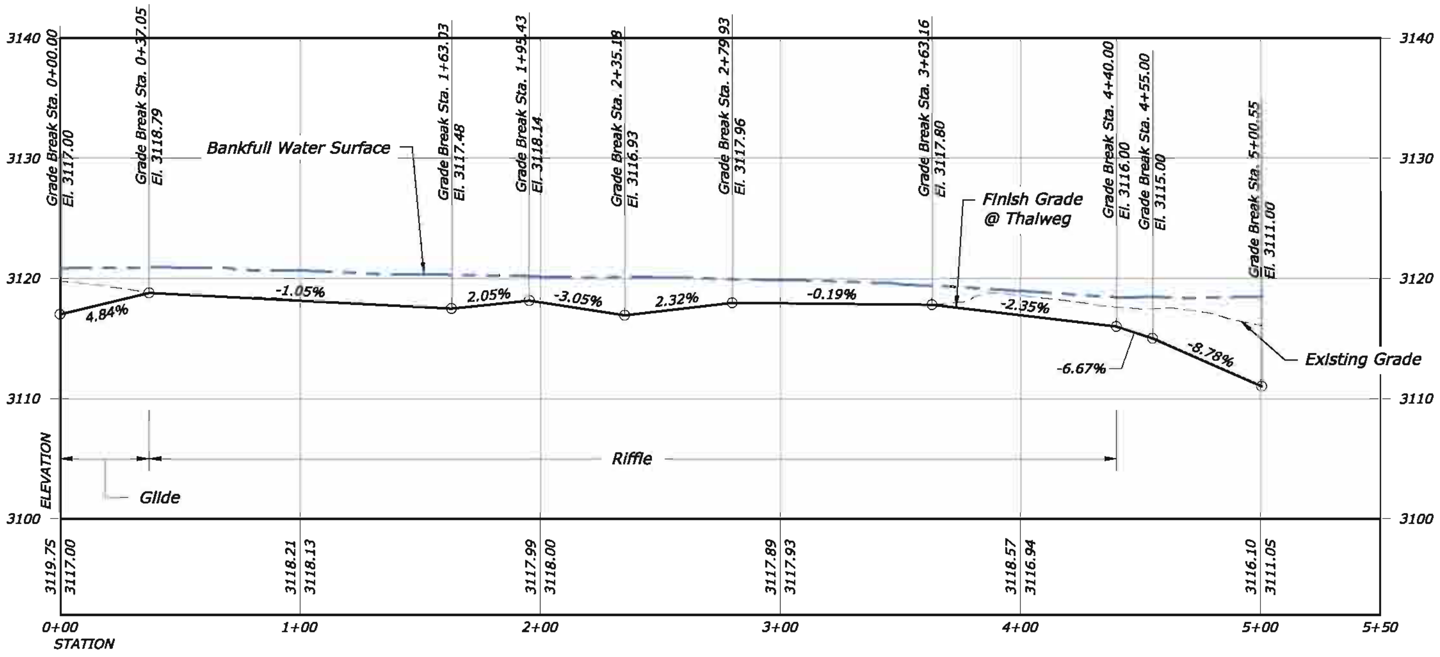
SIDE CHANNEL 3B - PLAN

STA 0+00 TO STA 5+50

40 0 40 80 120
SCALE OF FEET

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
	Thalweg
	Existing Wetlands
OHW	Ordinary High Water (OHW)
	Property Line
	Finish Grade Profile
	Existing Grade Profile
	Bankfull Water Surface Profile



SIDE CHANNEL 3B - THALWEG PROFILE

STA 0+00 TO STA 5+50

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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SIDE CHANNEL 3B PLAN
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STA 0+00 TO STA 5+50

1678-100-60739

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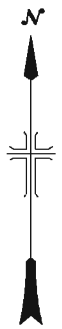
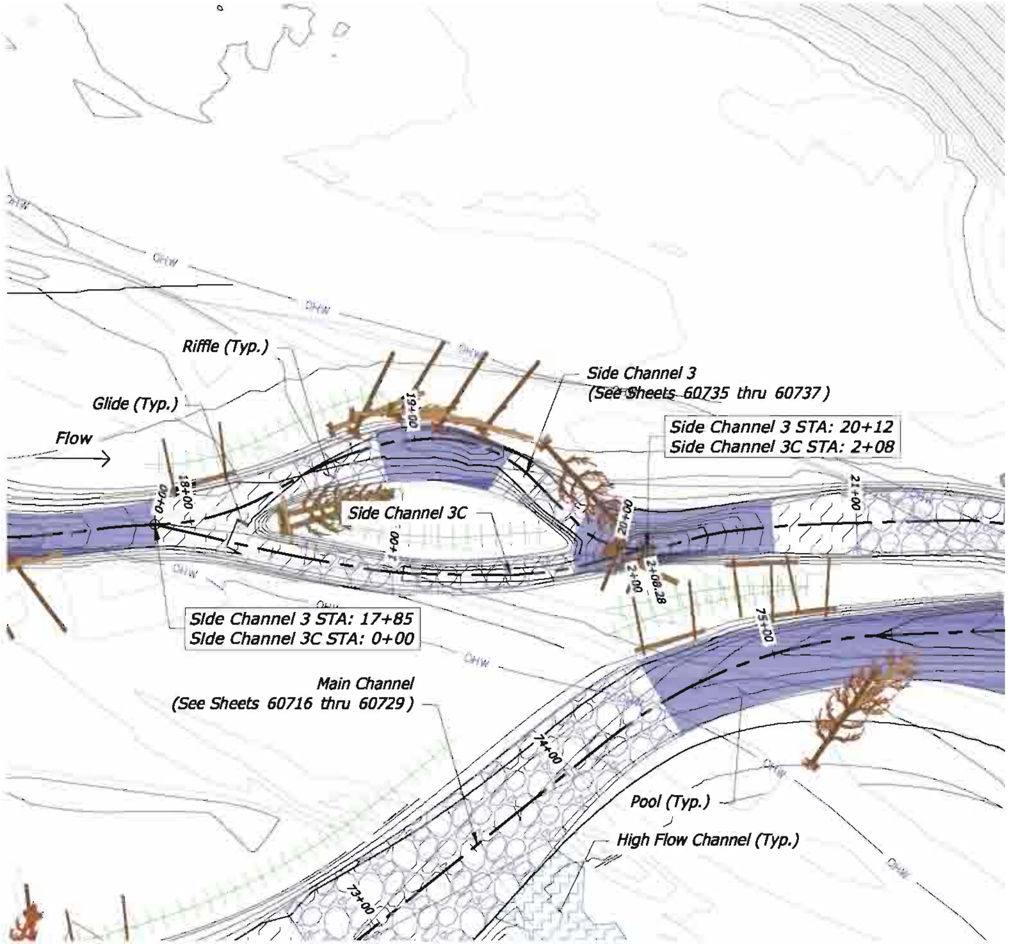


LEGEND

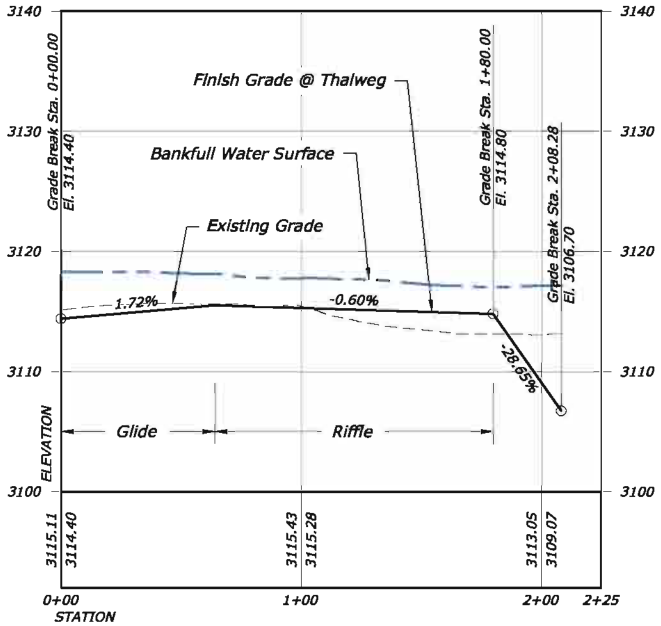
- OG Major Contour
- OG Minor Contour
- FG Major Contour
- FG Minor Contour
- Thalweg
- Existing Wetlands
- Ordinary High Water (OHW)
- Property Line
- Finish Grade Profile
- Existing Grade Profile
- Bankfull Water Surface Profile



SIDE CHANNEL 3C - PLAN

STA 0+00 TO STA 2+25

40 0 40 80 120
SCALE OF FEET



SIDE CHANNEL 3C - THALWEG PROFILE

STA 0+00 TO STA 2+25

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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SIDE CHANNEL 3C PLAN
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STA 0+00 TO STA 2+25

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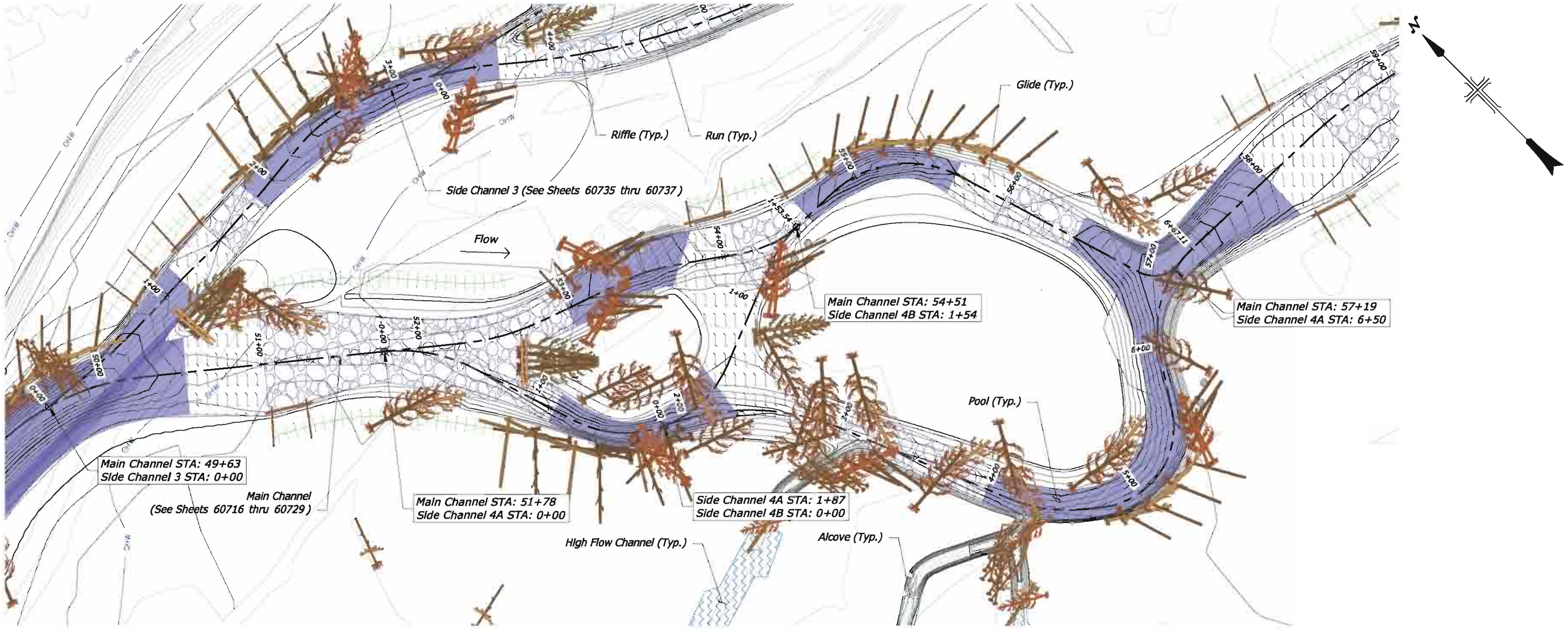


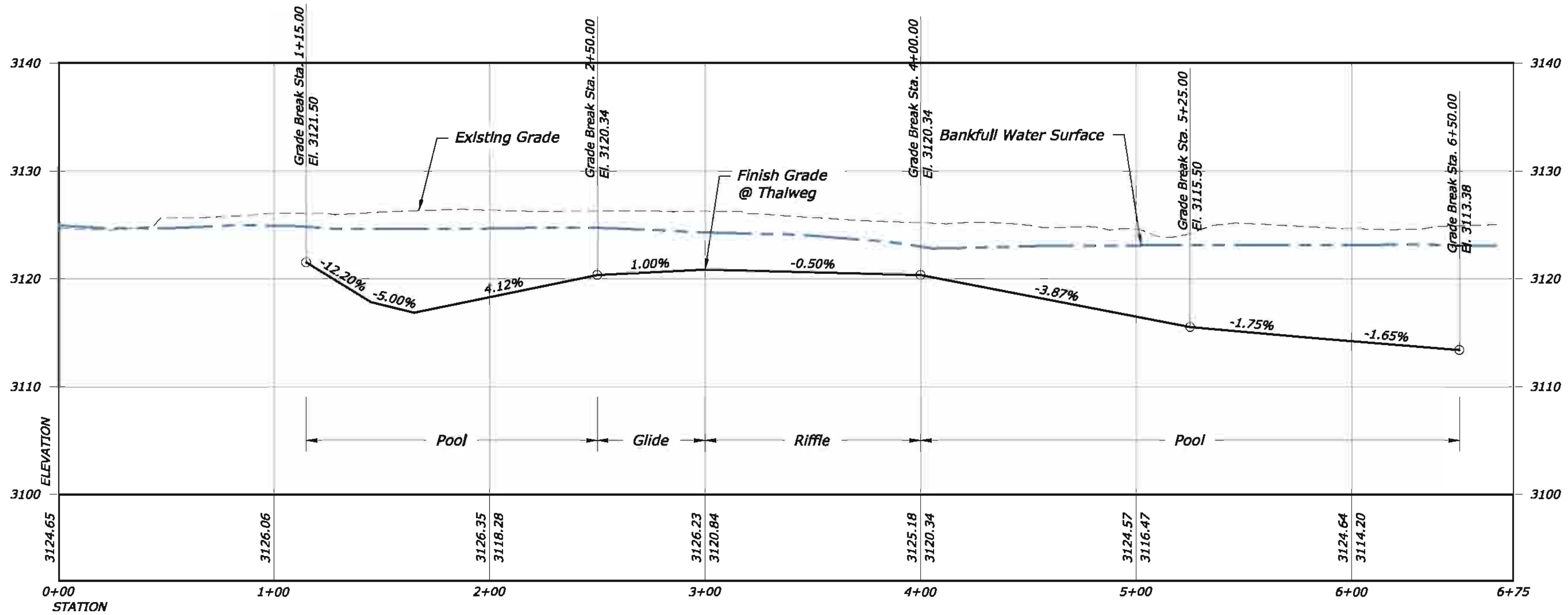
SIDE CHANNEL 4A - PLAN

STA 0+00 TO STA 6+75

40 0 40 80 120
SCALE OF FEET

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
	Thalweg
	Existing Wetlands
OHW	Ordinary High Water (OHW)
	Property Line
	Finish Grade Profile
	Existing Grade Profile
	Bankfull Water Surface Profile



SIDE CHANNEL 4A - THALWEG PROFILE

STA 0+00 TO STA 6+75

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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SIDE CHANNEL 4A PLAN
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STA 0+00 TO STA 6+75

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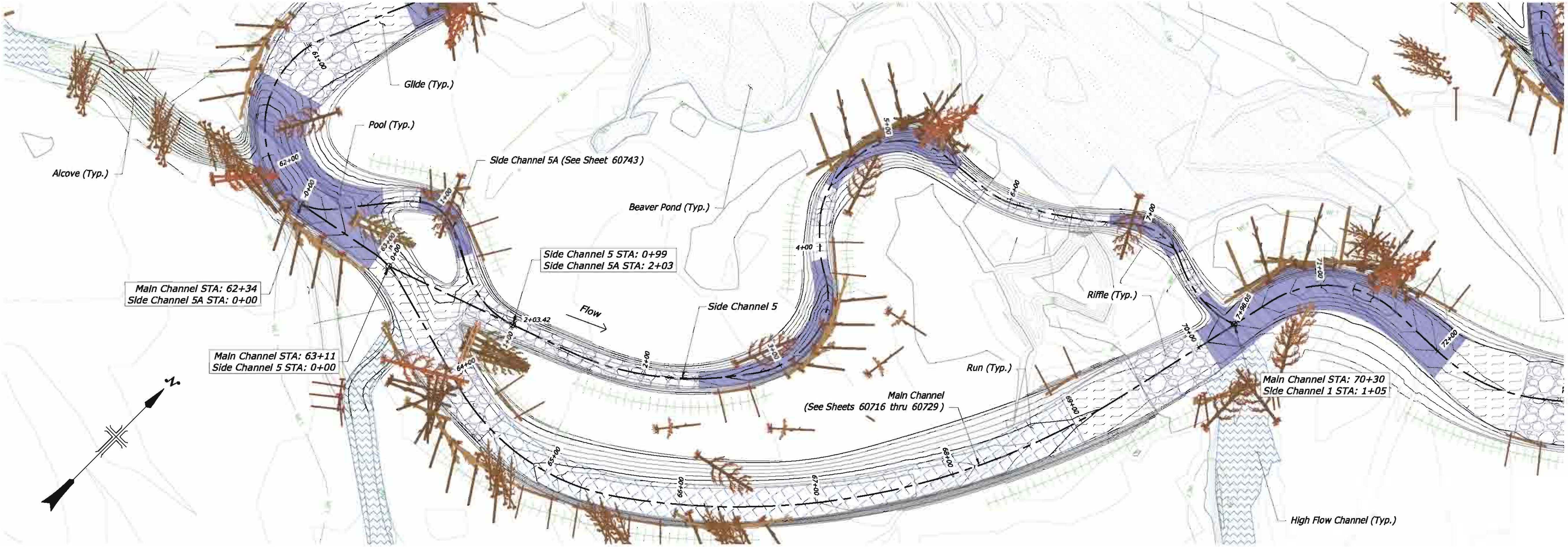
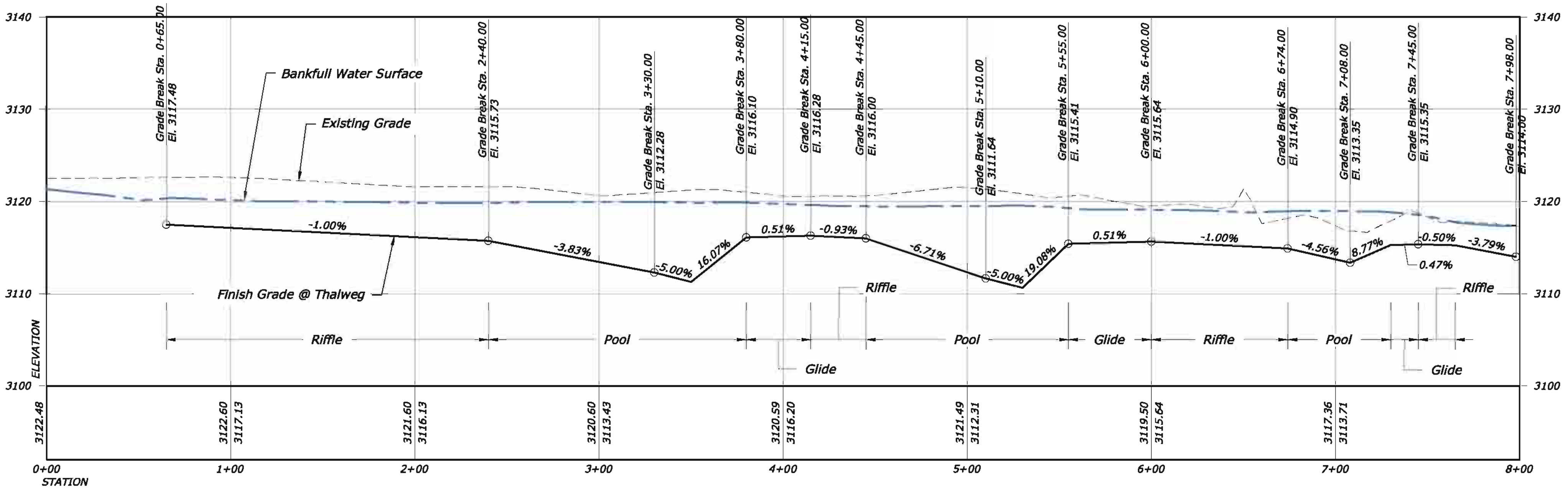


SIDE CHANNEL 5 - PLAN

STA 0+00 TO STA 8+00

40 0 40 80 120
SCALE OF FEET



SIDE CHANNEL 5 - THALWEG PROFILE

STA 0+00 TO STA 8+00

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

LEGEND

—— ELEV ——	OG Major Contour
——	OG Minor Contour
—— ELEV ——	FG Major Contour
——	FG Minor Contour
— — —	Thalweg
—— W ——	Existing Wetlands
—— OHW ——	Ordinary High Water (OHW)
—— – – ——	Property Line
——	Finish Grade Profile
– – – –	Existing Grade Profile
——	Bankfull Water Surface Profile

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SIDE CHANNEL 5 PLAN
AND PROFILE

STA 0+00 TO STA 8+00

1678-100-60742

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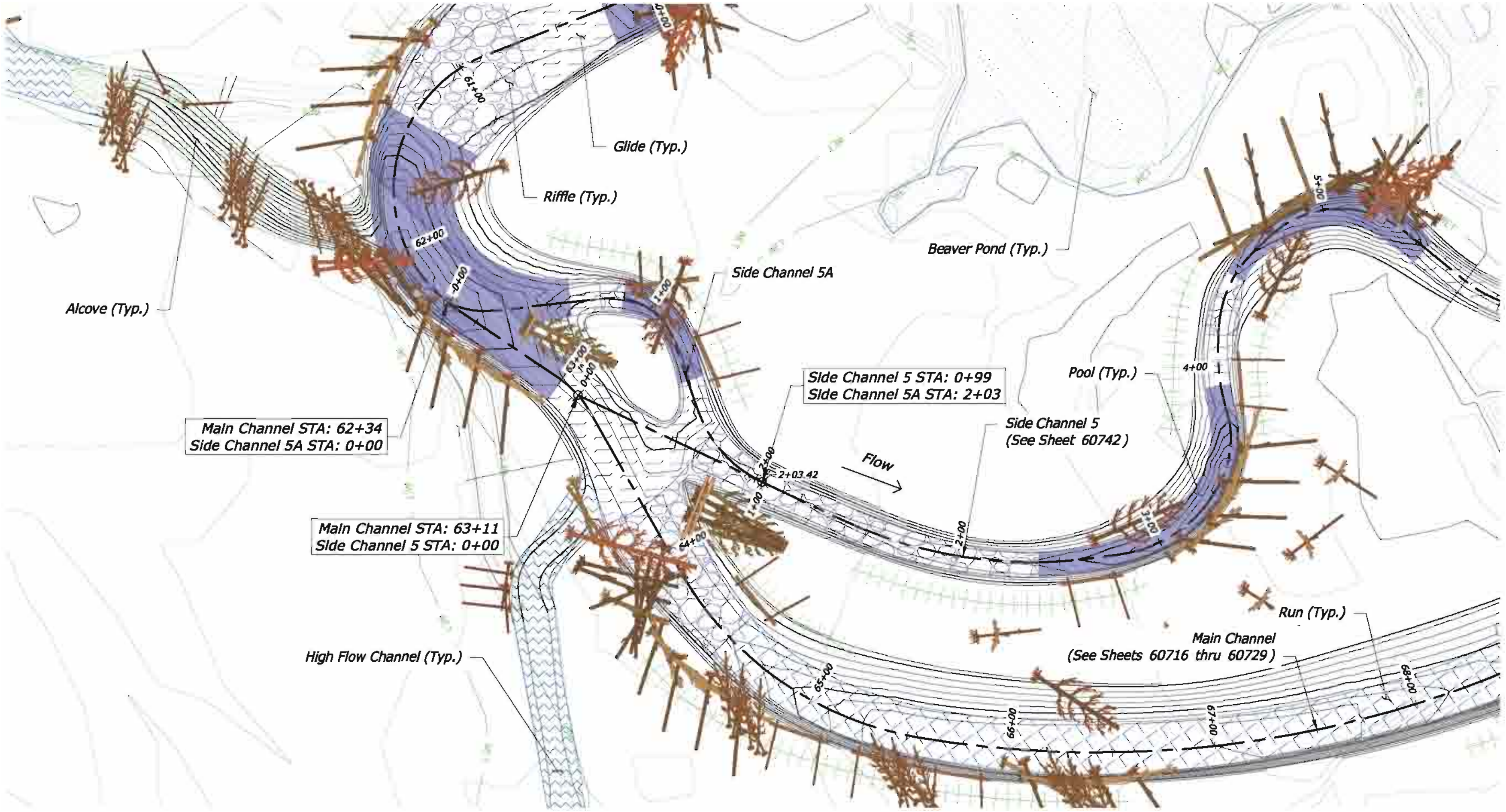


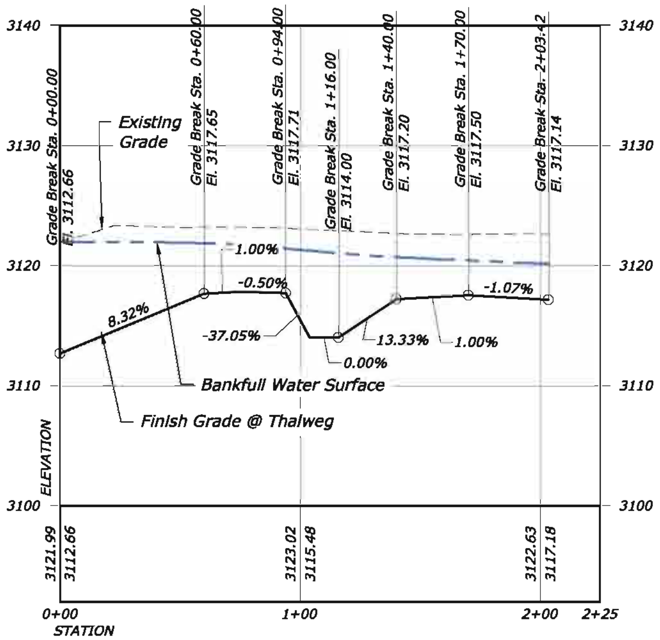
SIDE CHANNEL 5A - PLAN

STA 0+00 TO 2+25

40 0 40 80 120
SCALE OF FEET

LEGEND

ELEV OG Major Contour
OG Minor Contour
ELEV FG Major Contour
FG Minor Contour
Thalweg
Existing Wetlands
OHW Ordinary High Water (OHW)
Property Line
Finish Grade Profile
Existing Grade Profile
Bankfull Water Surface Profile



SIDE CHANNEL 5A - THALWEG PROFILE

STA 0+00 TO 2+25

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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SIDE CHANNEL 5A PLAN
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STA 0+00 TO 2+25

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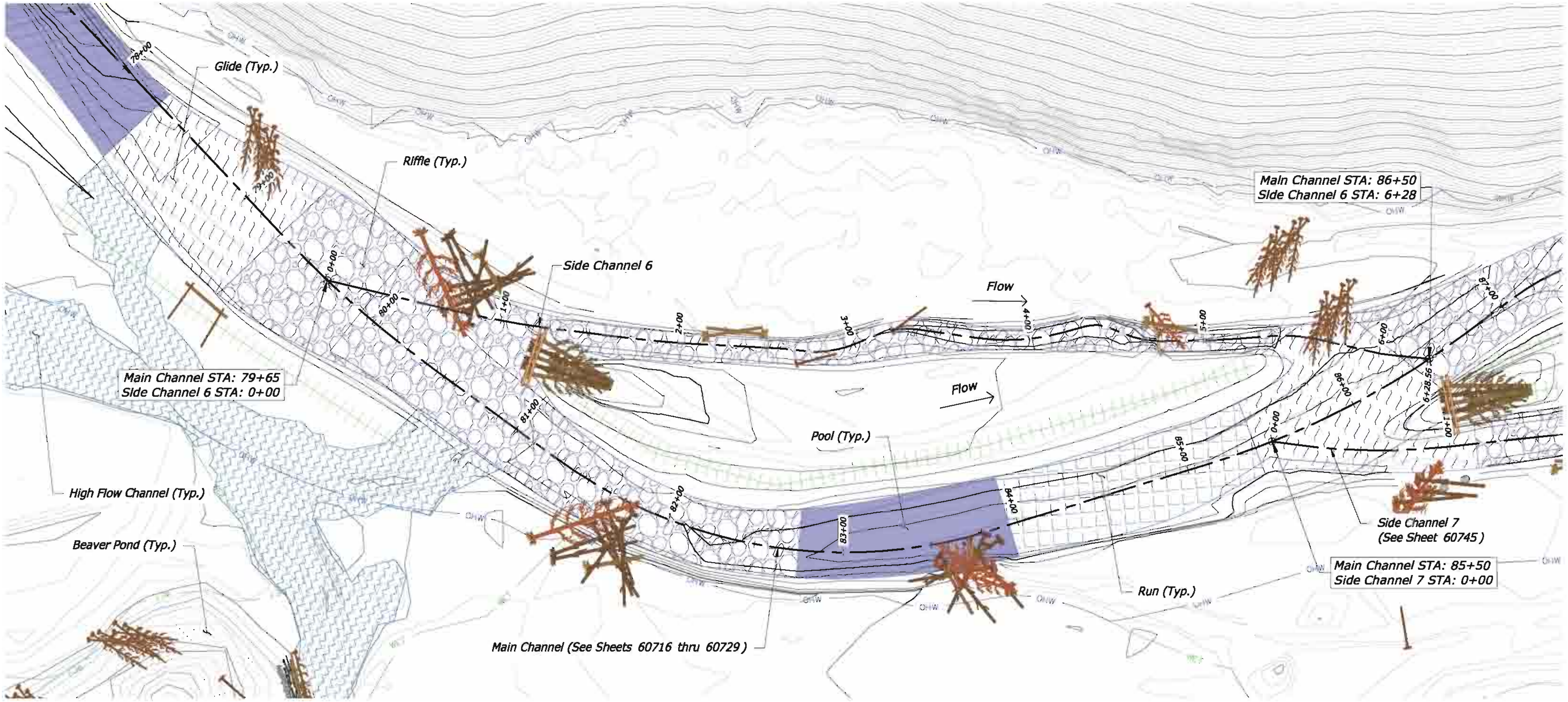


SIDE CHANNEL 6 - PLAN

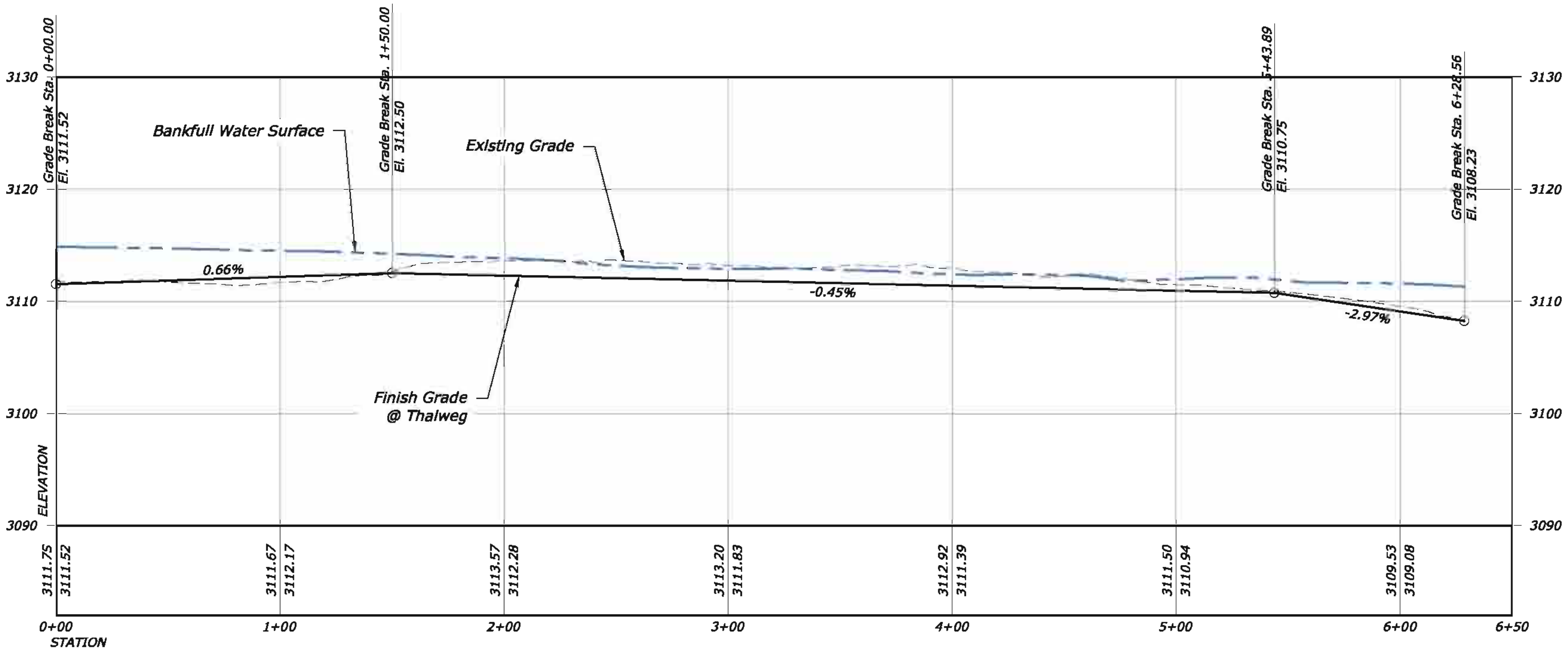
STA 0+00 TO STA 6+50

40 0 40 80 120

SCALE OF FEET

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
	Thalweg
	Existing Wetlands
OHW	Ordinary High Water (OHW)
	Property Line
	Finish Grade Profile
	Existing Grade Profile
	Bankfull Water Surface Profile



SIDE CHANNEL 6 - THALWEG PROFILE

STA 0+00 TO STA 6+50

HORIZONTAL SCALE

40 0 40 80 120

SCALE OF FEET

VERTICAL SCALE

8 0 8 16 24

SCALE OF FEET

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STA 0+00 TO STA 6+50

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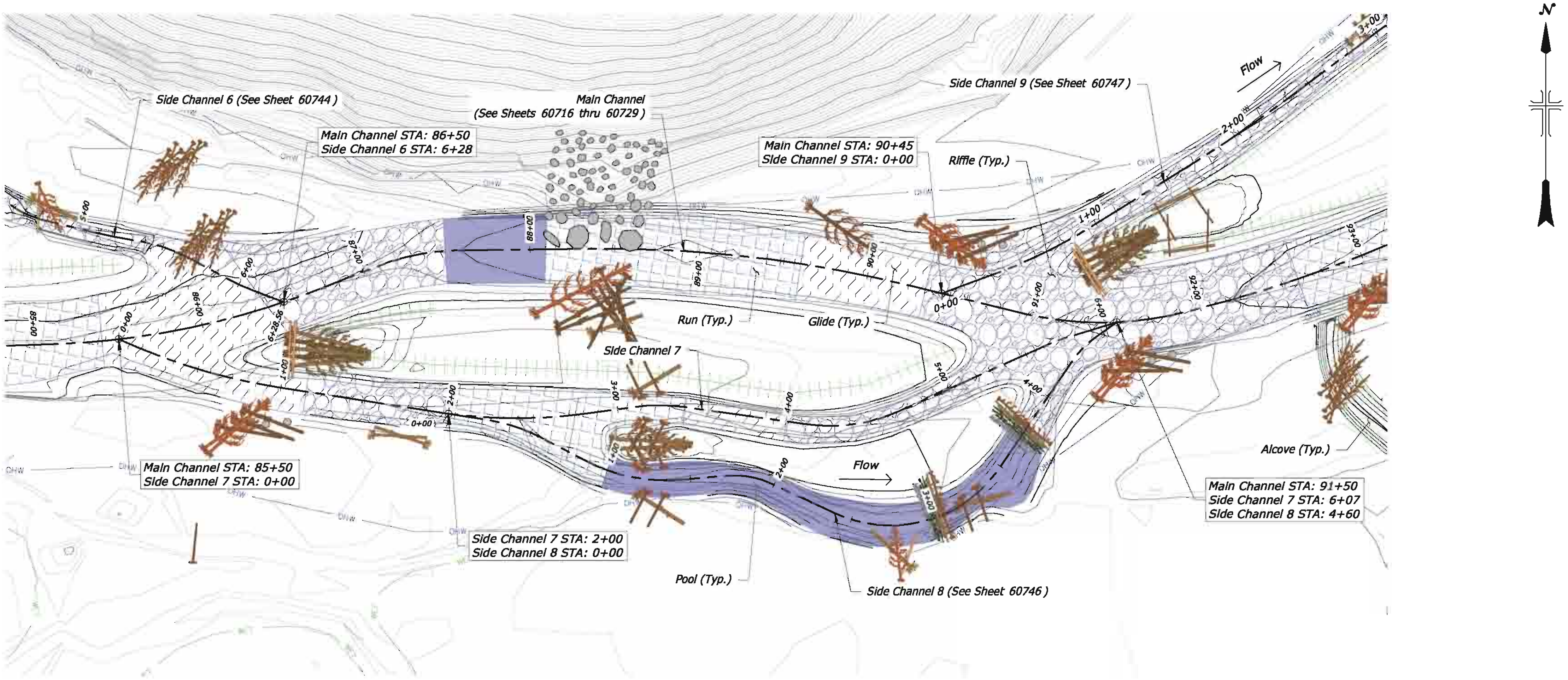


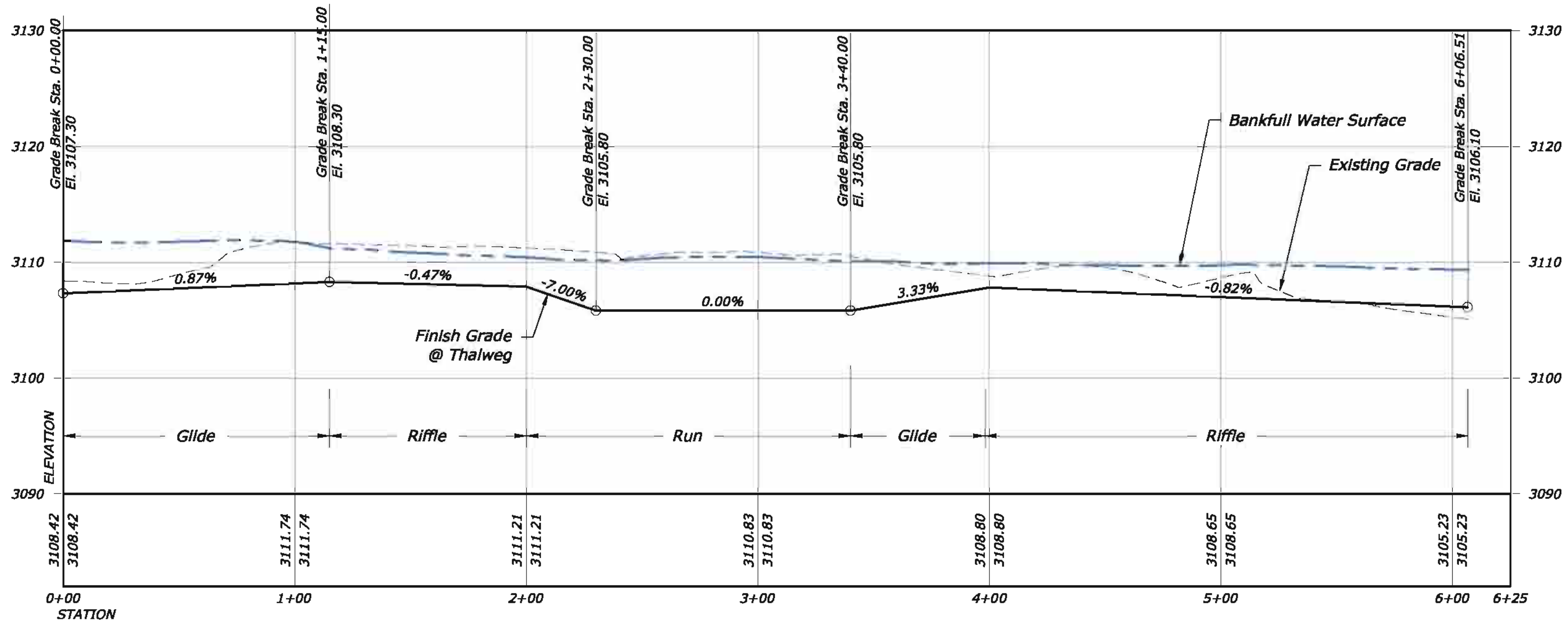
SIDE CHANNEL 7 - PLAN

STA 0+00 TO STA 6+60

40 0 40 80 120
SCALE OF FEET

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
	Thalweg
	Existing Wetlands
OHW	Ordinary High Water (OHW)
	Property Line
	Finish Grade Profile
	Existing Grade Profile
	Bankfull Water Surface Profile



SIDE CHANNEL 7 - THALWEG PROFILE

STA 0+00 TO STA 6+60

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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SIDE CHANNEL 7 PLAN
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STA 0+00 TO STA 6+60

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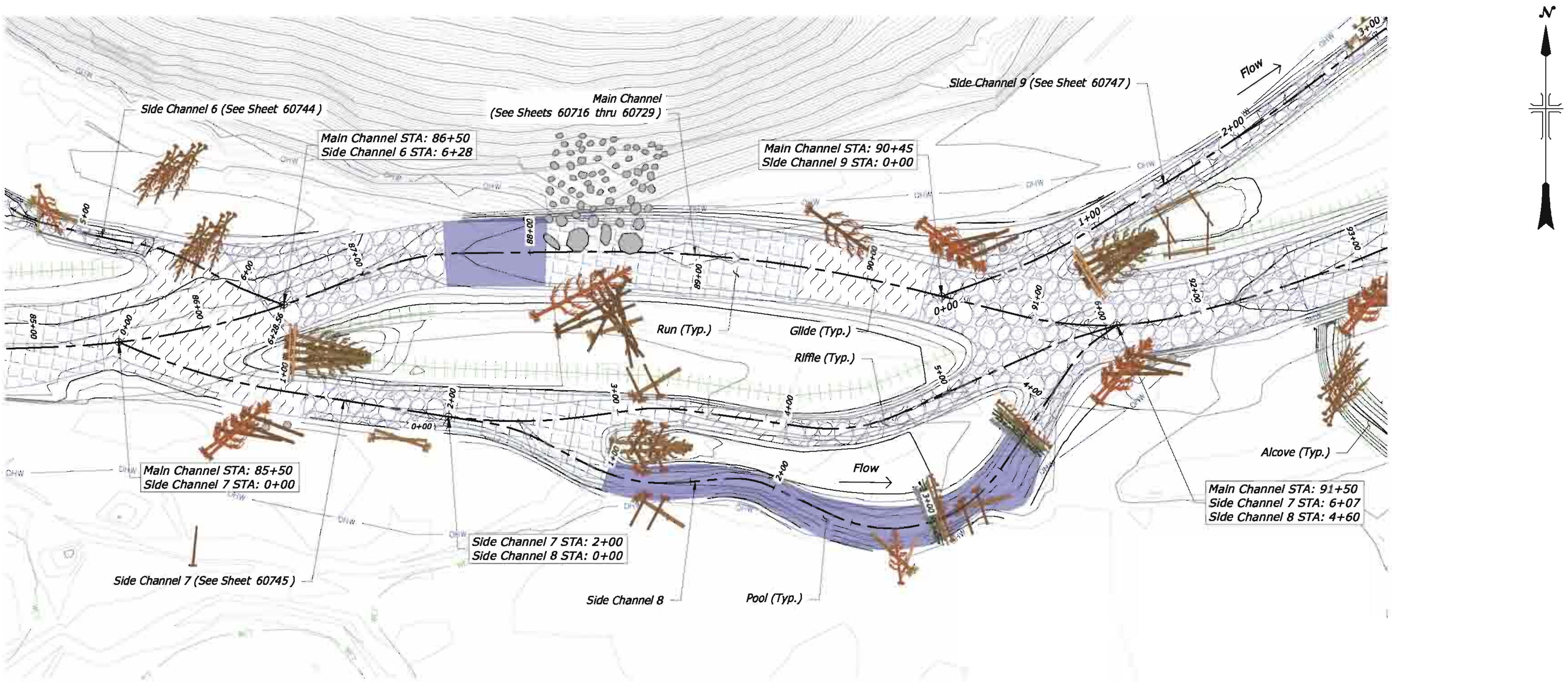

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
	Thalweg
	Existing Wetlands
OHW	Ordinary High Water (OHW)
	Property Line
	Finish Grade Profile
	Existing Grade Profile
	Bankfull Water Surface Profile

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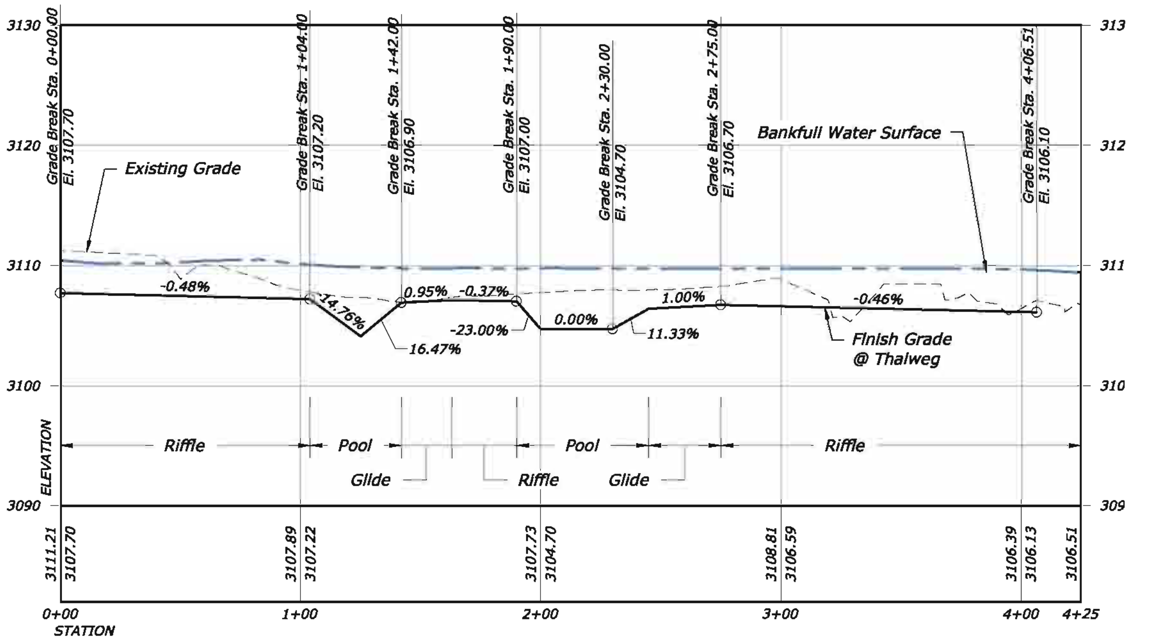
SIDE CHANNEL 8 - PLAN

STA 0+00 TO STA 4+25

40 0 40 80 120
SCALE OF FEET



SIDE CHANNEL 8 - THALWEG PROFILE

STA 0+00 TO STA 4+25

HORIZONTAL SCALE
40 0 40 80 120
SCALE OF FEET

VERTICAL SCALE
8 0 8 16 24
SCALE OF FEET

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SIDE CHANNEL 8 PLAN
AND PROFILE

STA 0+00 TO STA 4+25

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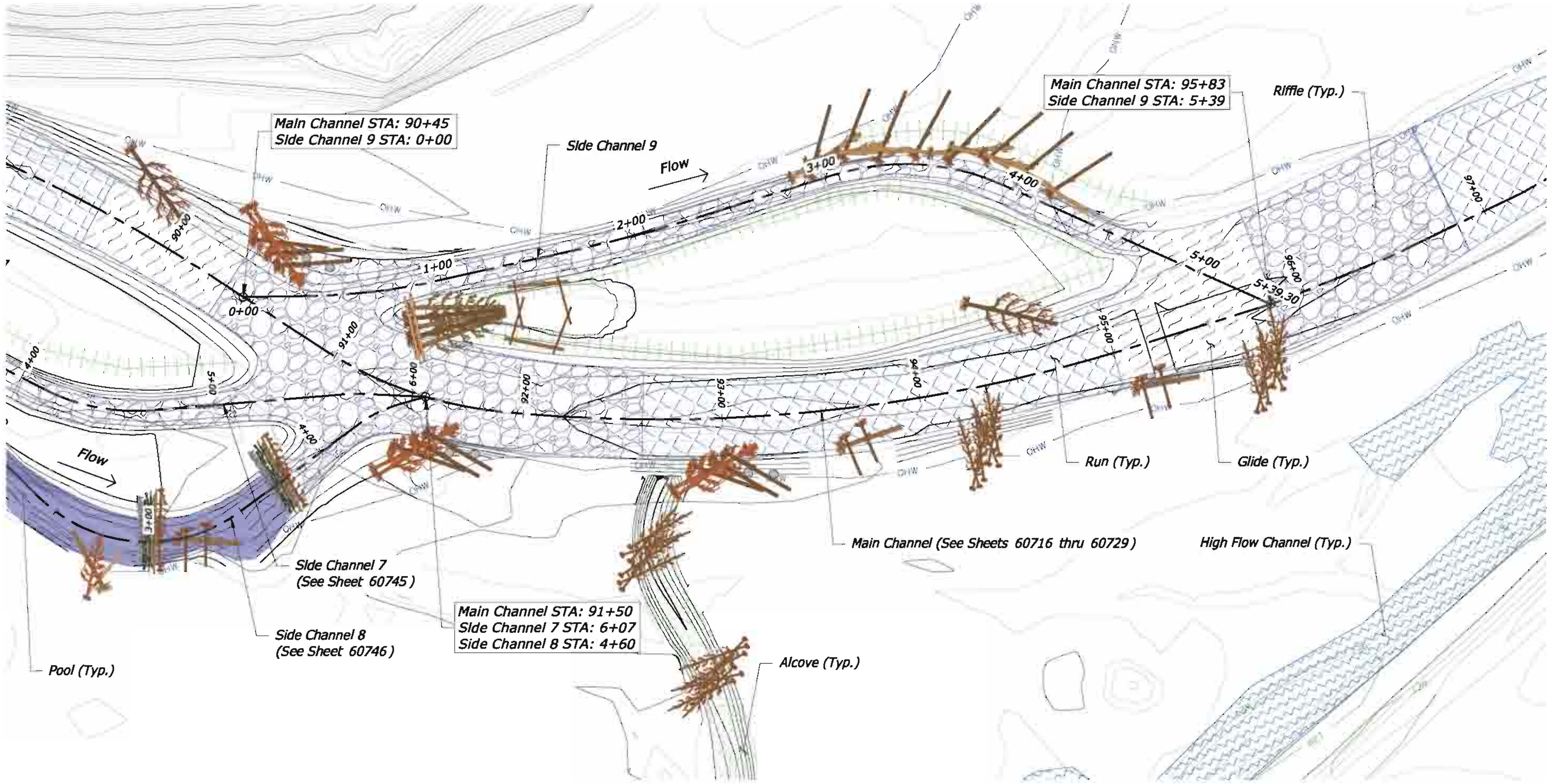
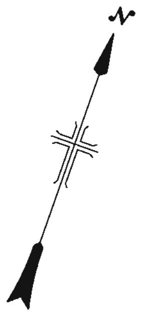


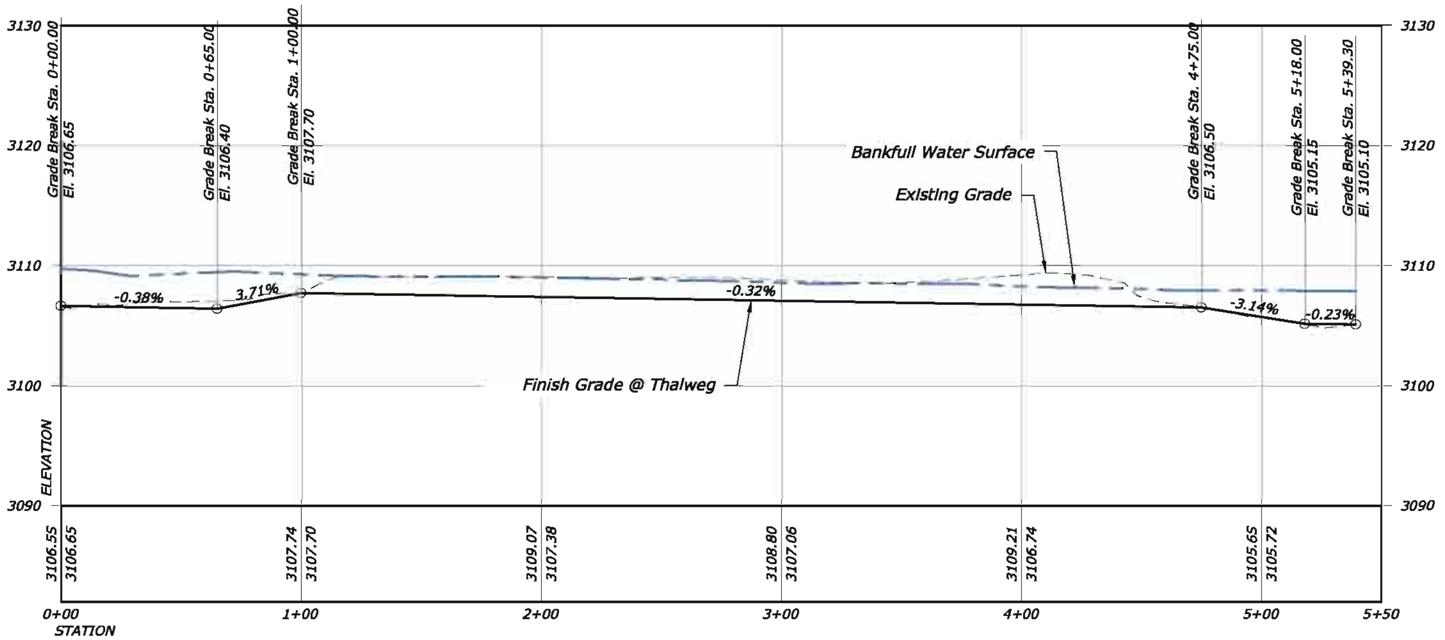


SIDE CHANNEL 9 - PLAN

STA 0+00 TO STA 5+50

LEGEND

ELEV	OG Major Contour
	OG Minor Contour
ELEV	FG Major Contour
	FG Minor Contour
	Thalweg
	Existing Wetlands
OHW	Ordinary High Water (OHW)
	Property Line
	Finish Grade Profile
	Existing Grade Profile
	Bankfull Water Surface Profile



SIDE CHANNEL 9 - THALWEG PROFILE

STA 0+00 TO STA 5+50

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SIDE CHANNEL 9 PLAN
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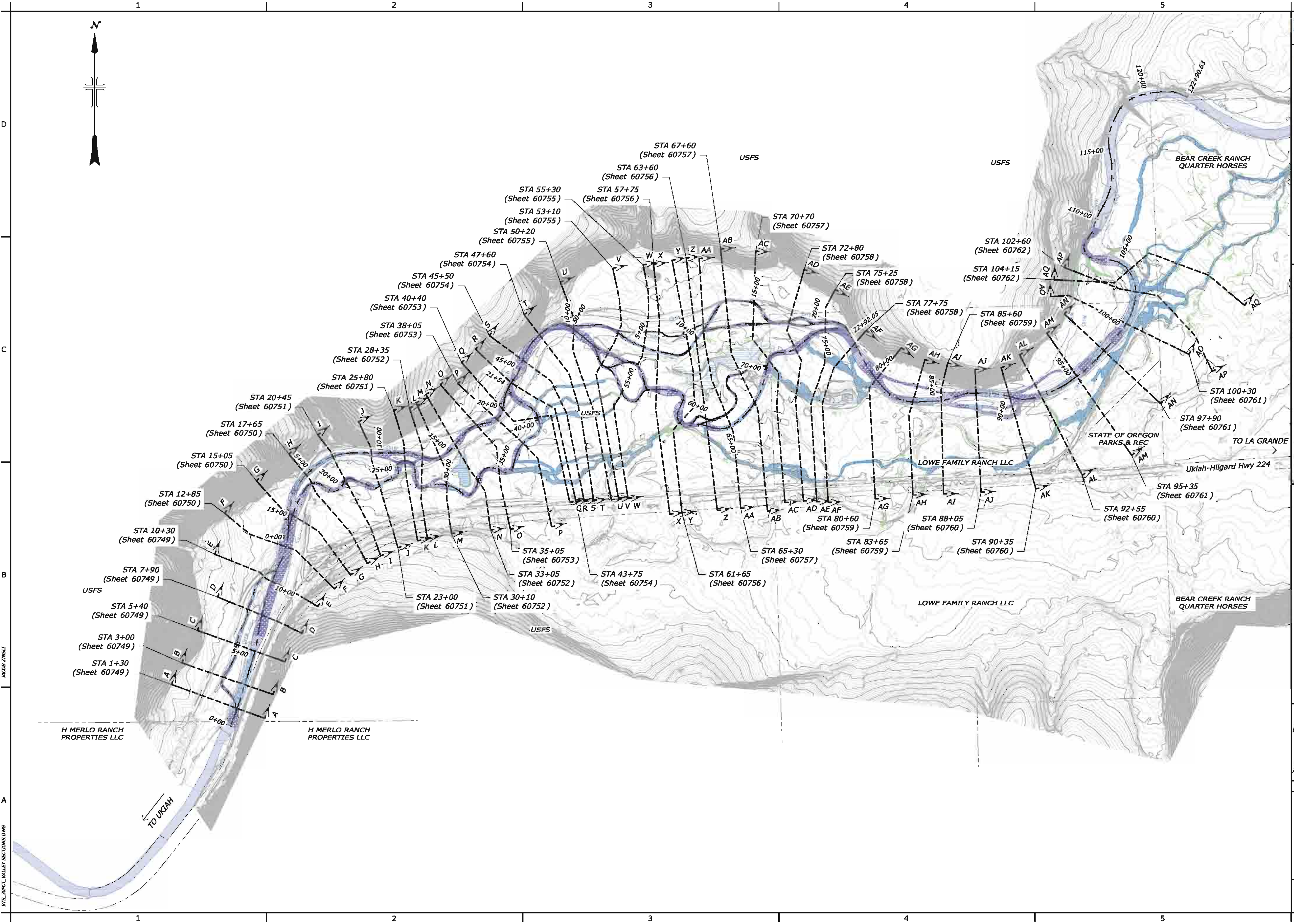

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VALLEY SECTIONS

KEY MAP

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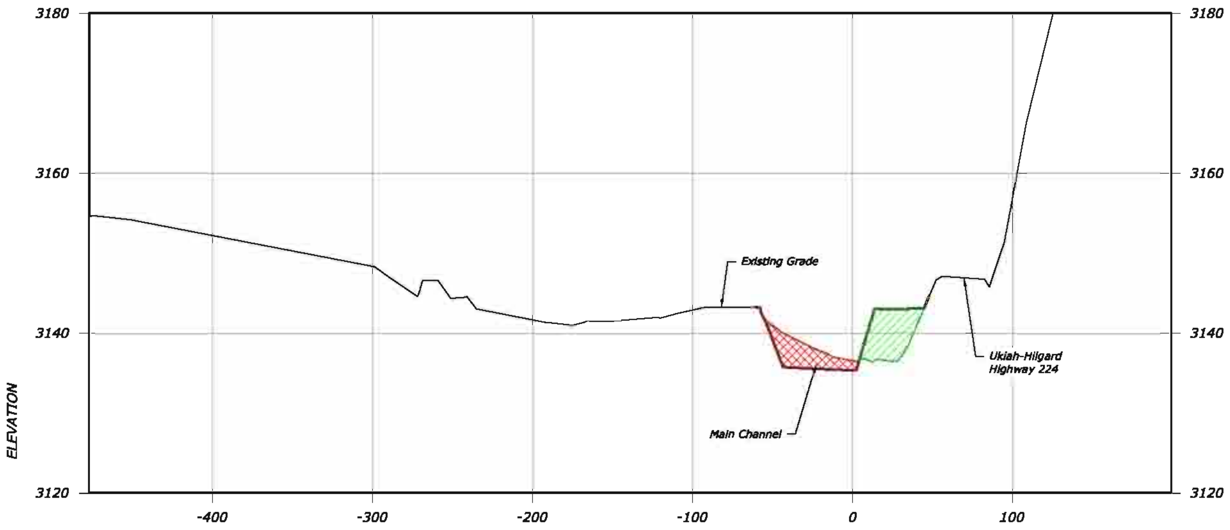
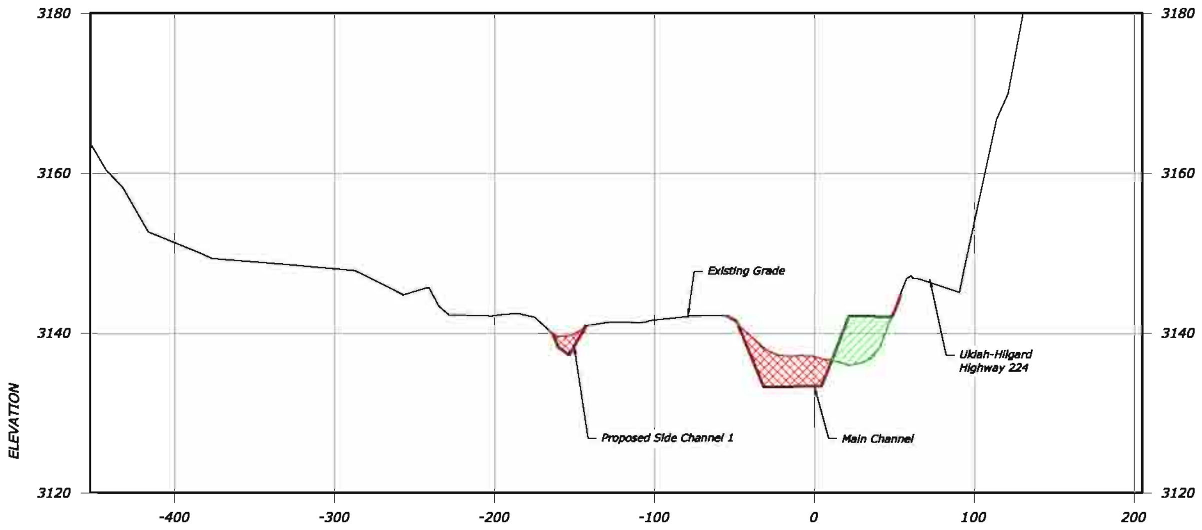


VALLEY SECTION A-A (STA 1+30)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

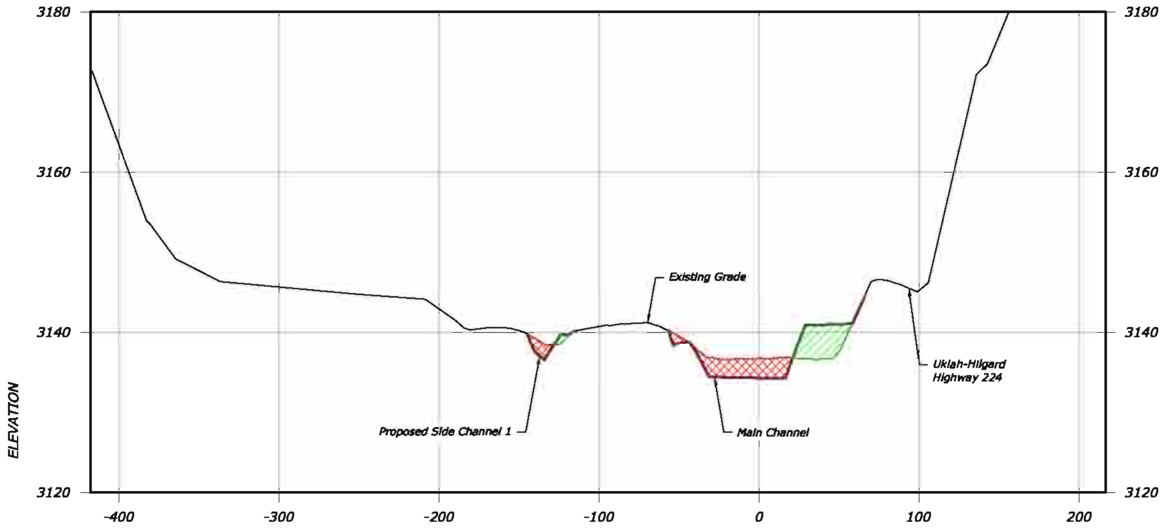
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION B-B (STA 3+00)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

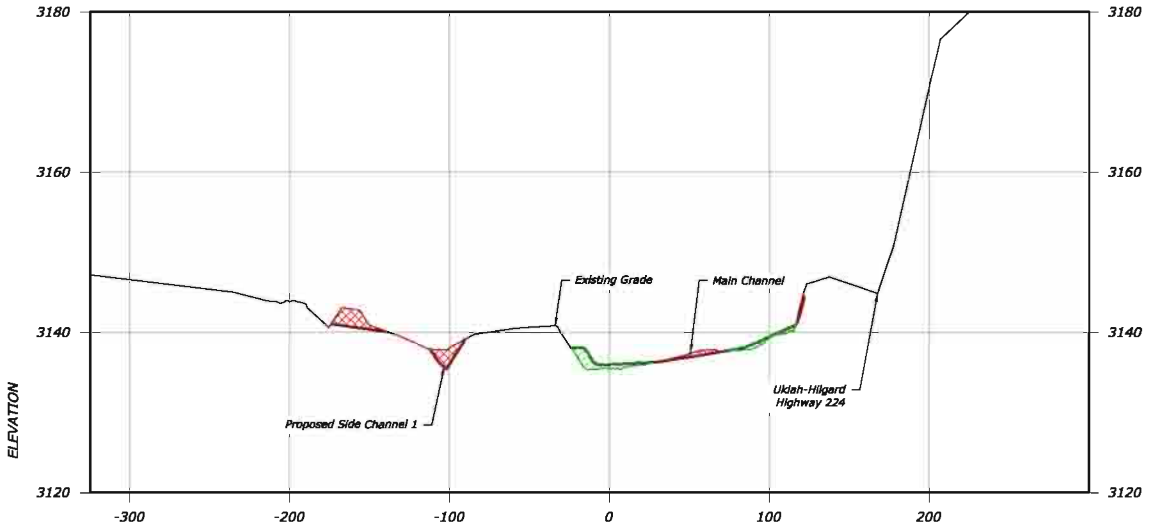
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION C-C (STA 5+40)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

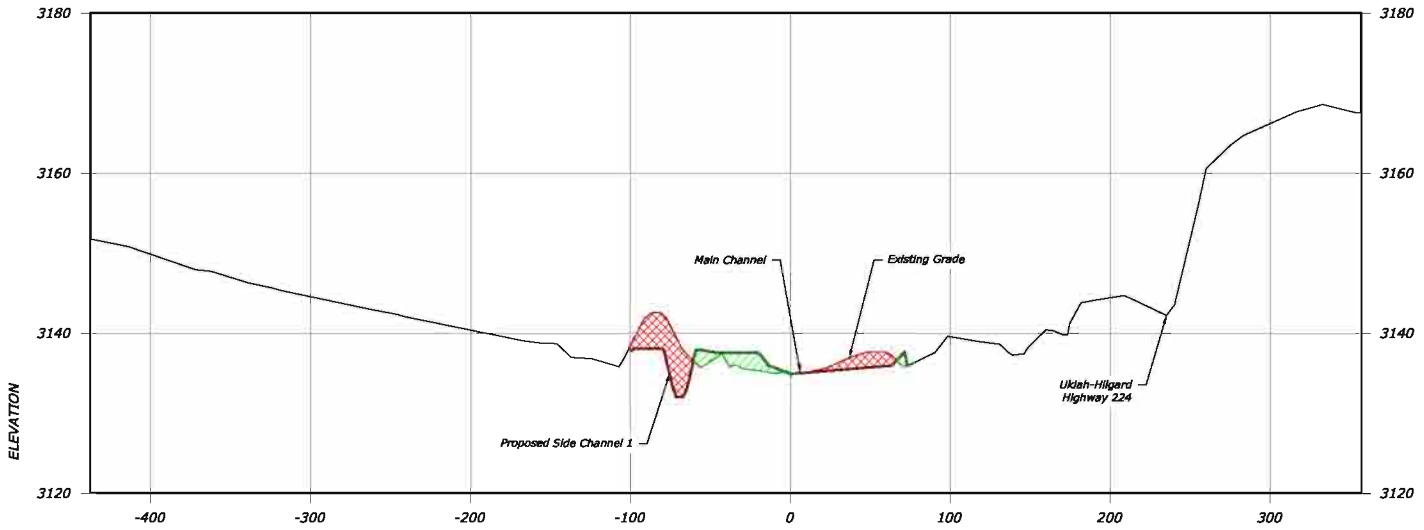
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION D-D (STA 7+90)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION E-E (STA 10+30)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET

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LEGEND

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▨	Fill

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VALLEY SECTIONS

A-A thru E-E

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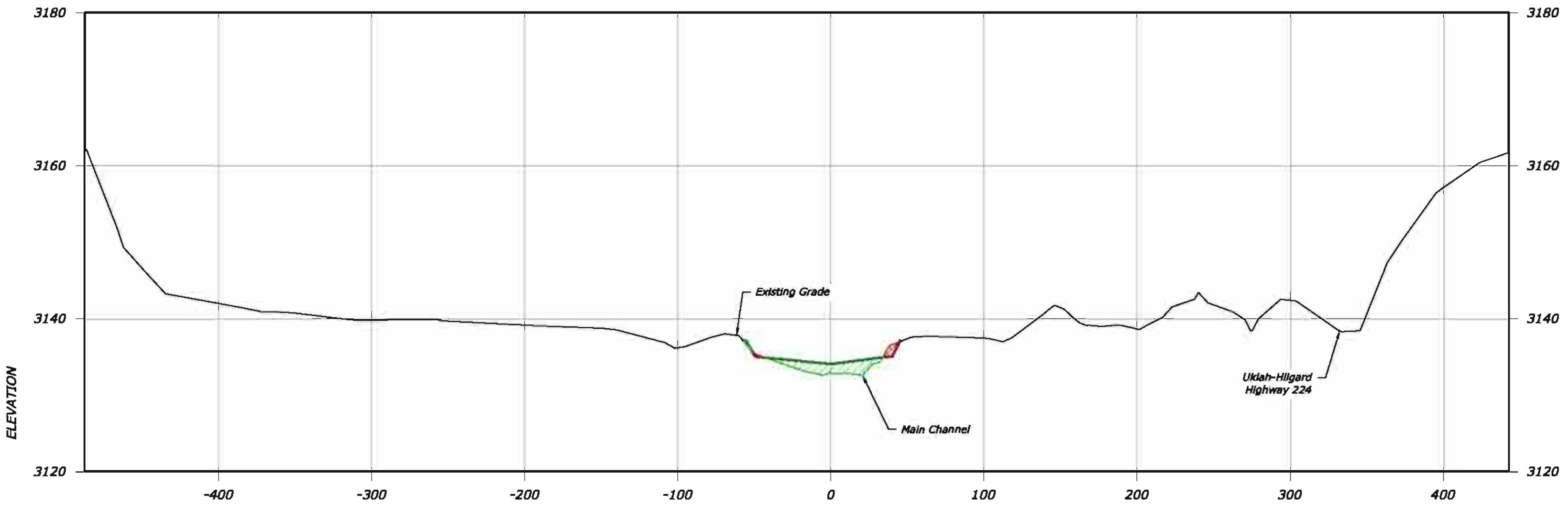
SHEET 2 of 15



VALLEY SECTION F-F (STA 12+85)

HORIZONTAL SCALE
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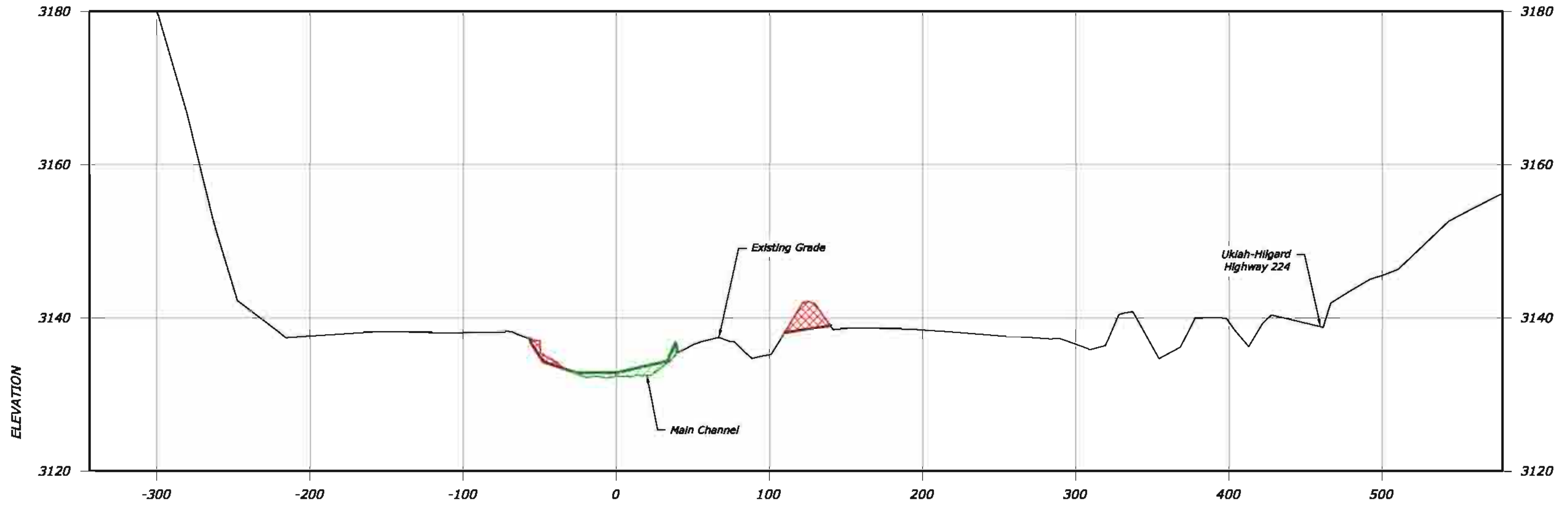
SCALE OF FEET

VERTICAL SCALE
12 0 12 24 36
SCALE OF FEET



VALLEY SECTION G-G (STA 15+05)

HORIZONTAL SCALE
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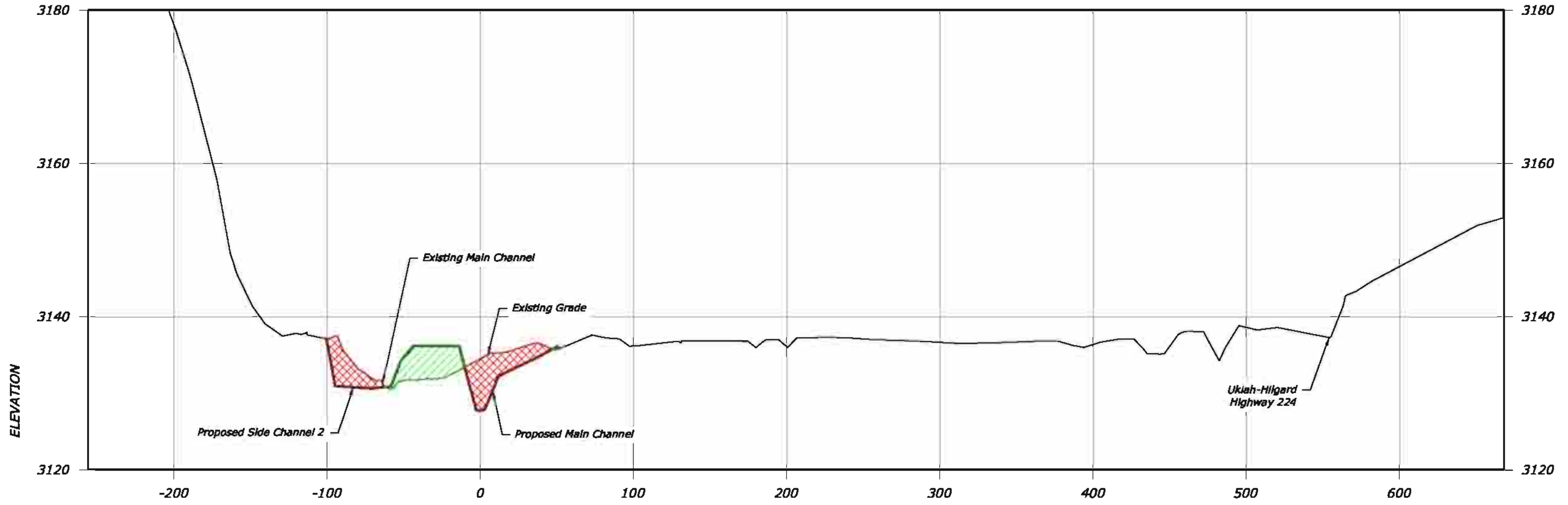
SCALE OF FEET

VERTICAL SCALE
12 0 12 24 36
SCALE OF FEET



VALLEY SECTION H-H (STA 17+65)

HORIZONTAL SCALE
60 0 60 120 180
SCALE OF FEET

VERTICAL SCALE
12 0 12 24 36
SCALE OF FEET

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LEGEND

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🟩	Fill

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VALLEY SECTIONS

F-F thru H-H

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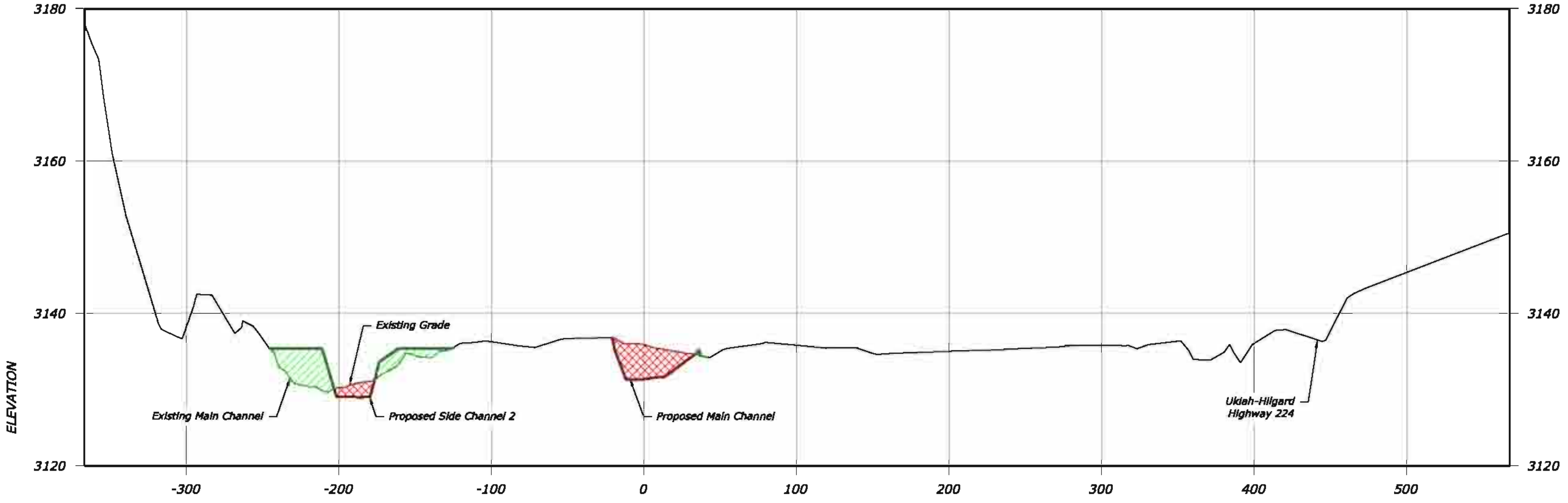
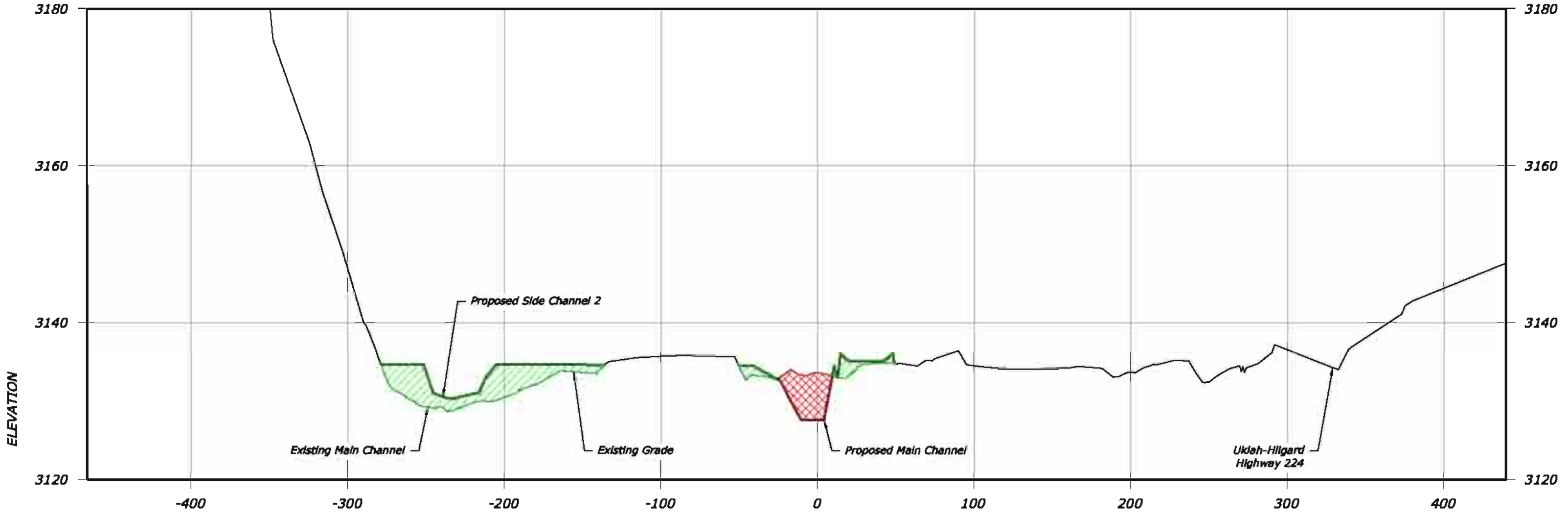


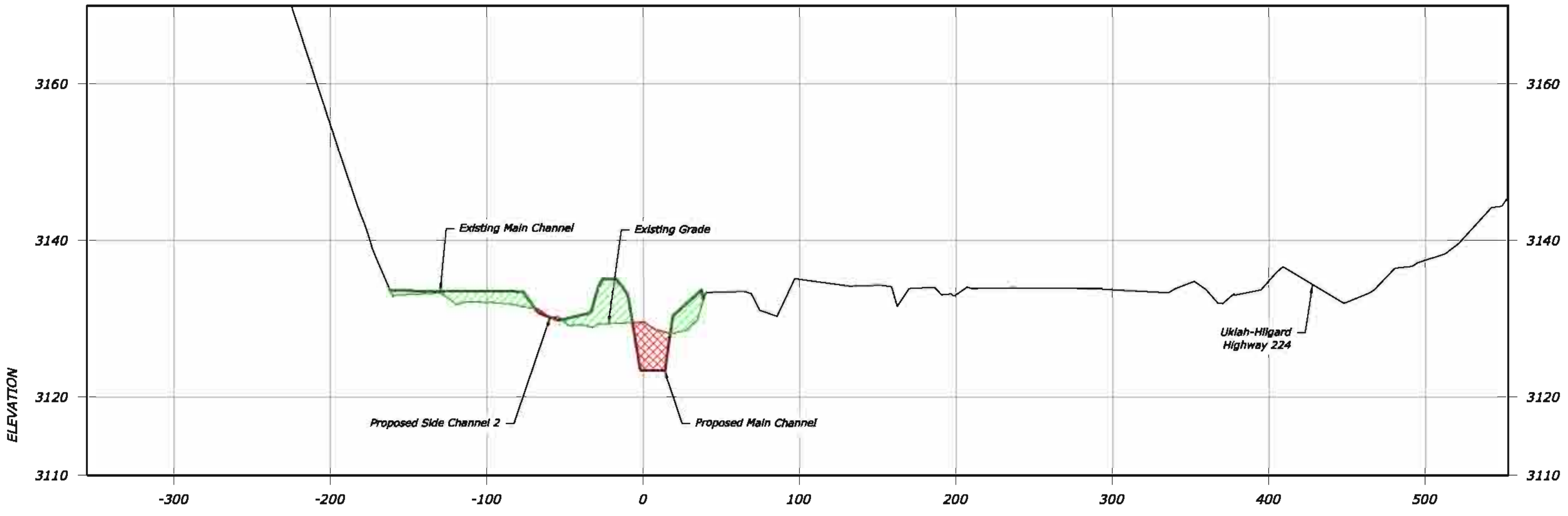
VALLEY SECTION I-I (STA 20+45)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION J-J (STA 23+00)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION K-K (STA 25+80)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET

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LEGEND

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VALLEY SECTIONS

I-I thru K-K

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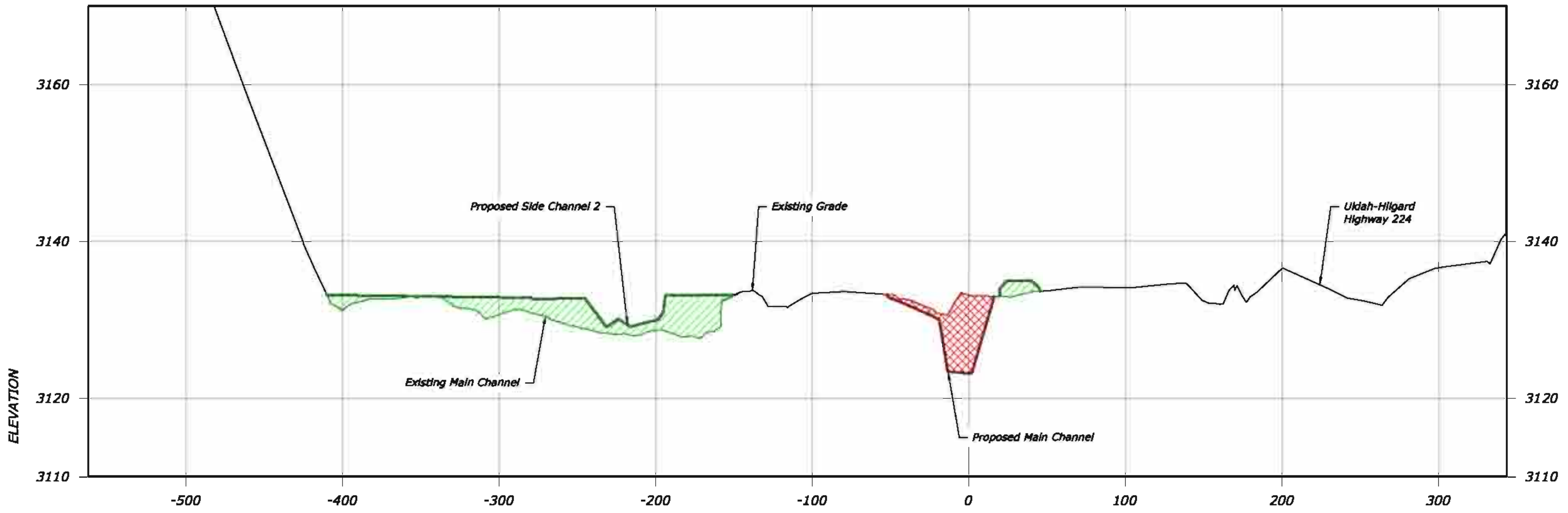
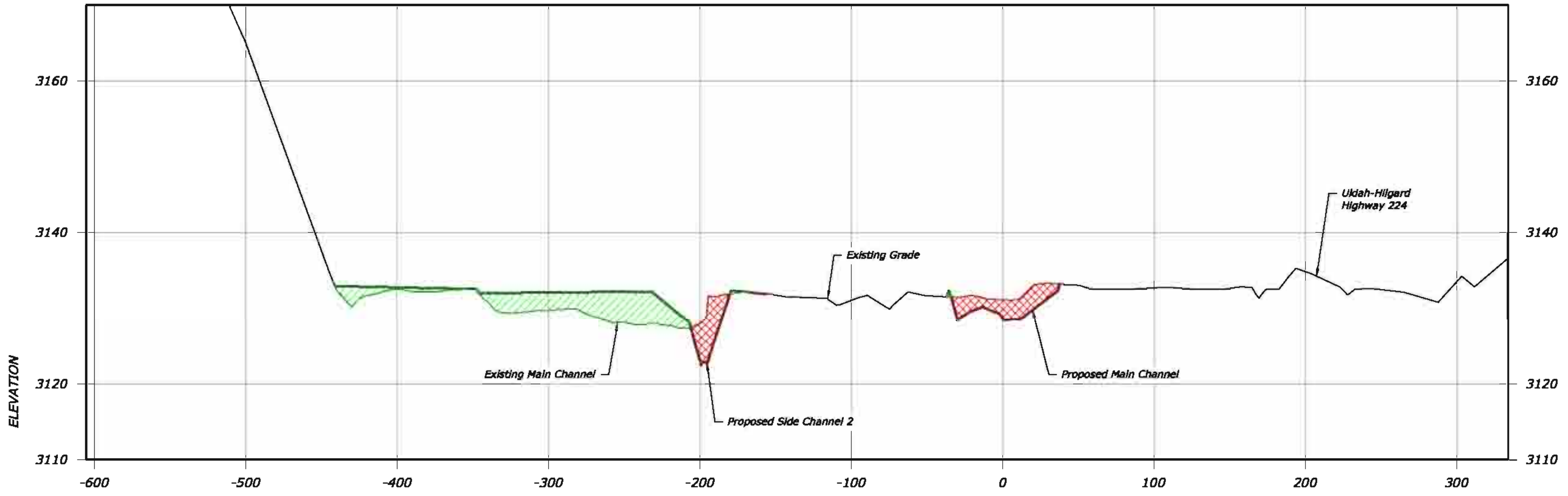


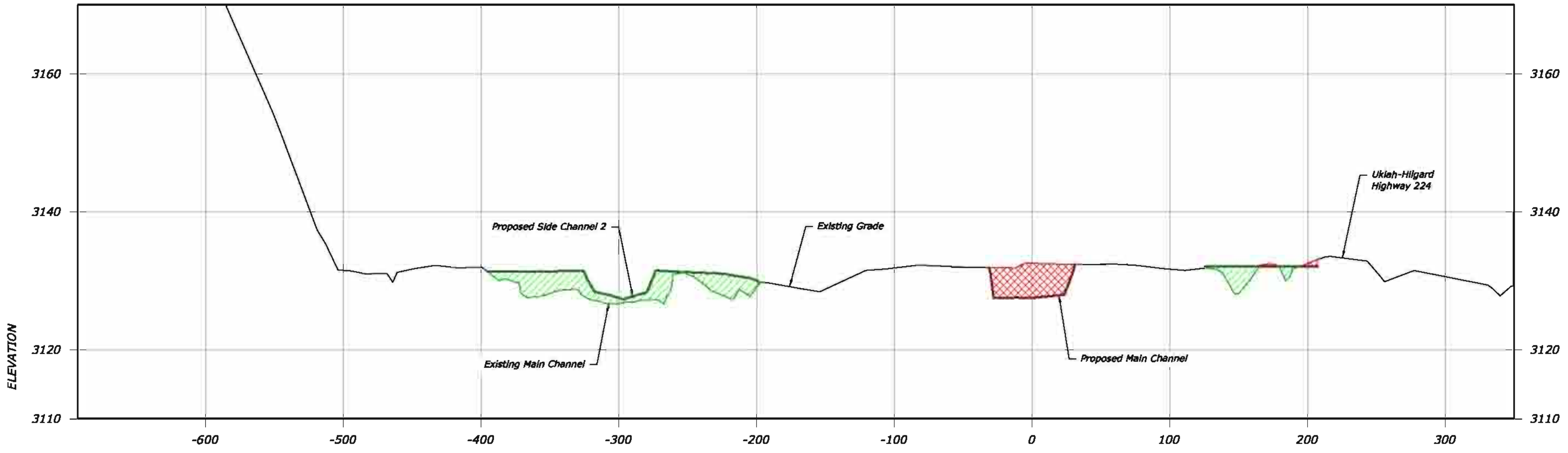
VALLEY SECTION L-L (STA 28+35)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION M-M (STA 30+10)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION N-N (STA 33+05)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET

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LEGEND

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VALLEY SECTIONS

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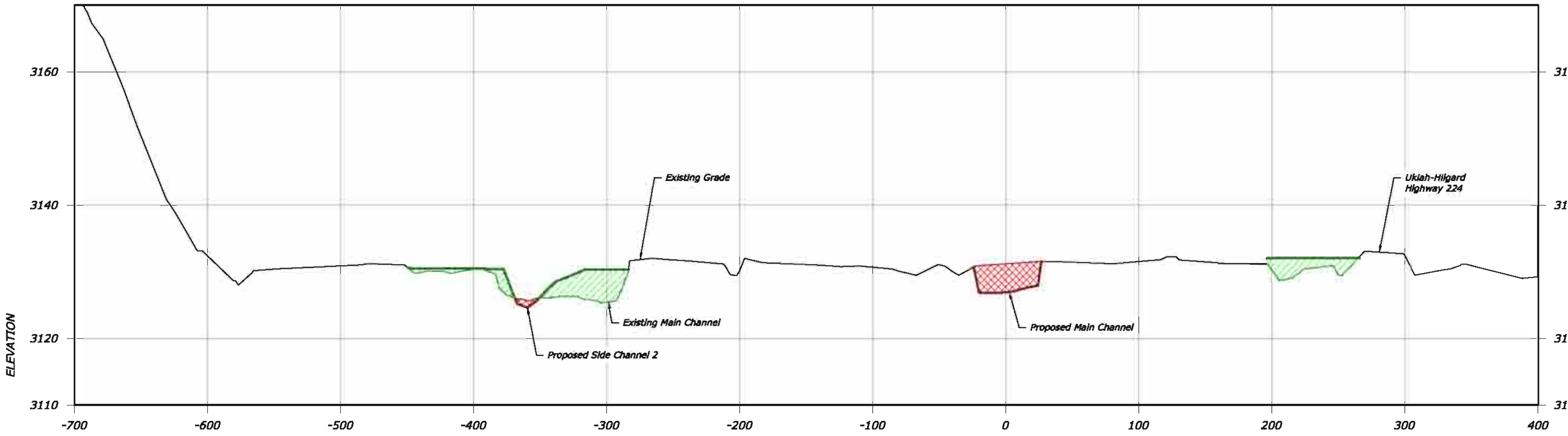
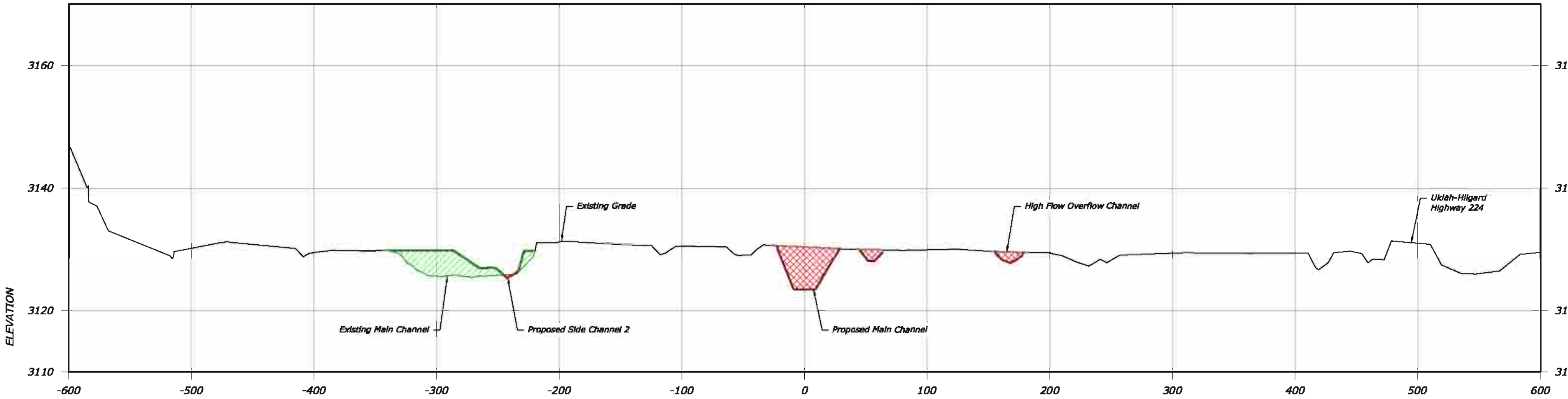


VALLEY SECTION O-O (STA 35+05)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

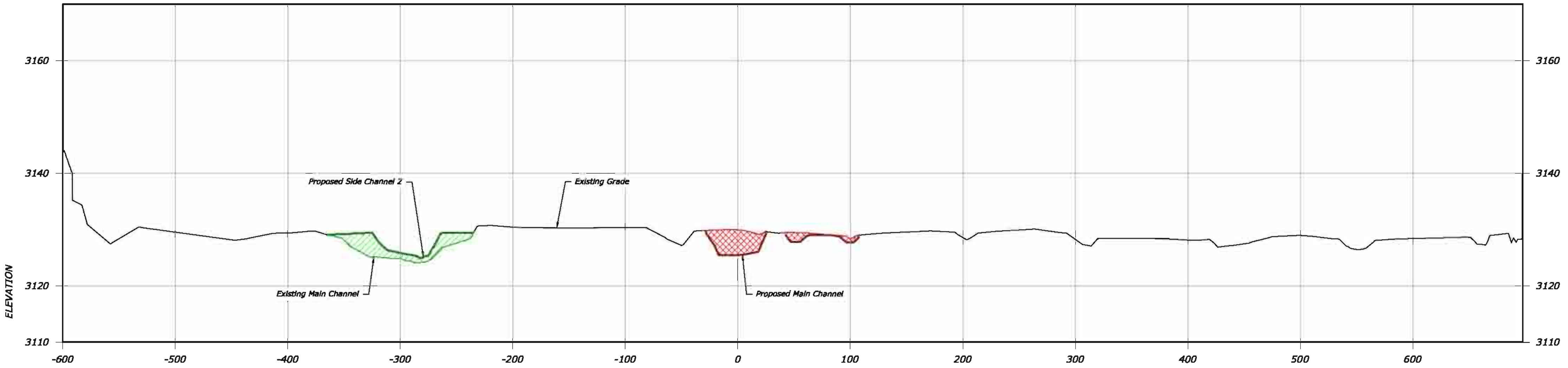
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION P-P (STA 38+05)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION Q-Q (STA 40+40)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET

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LEGEND

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🟩 Fill

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O-O thru Q-Q

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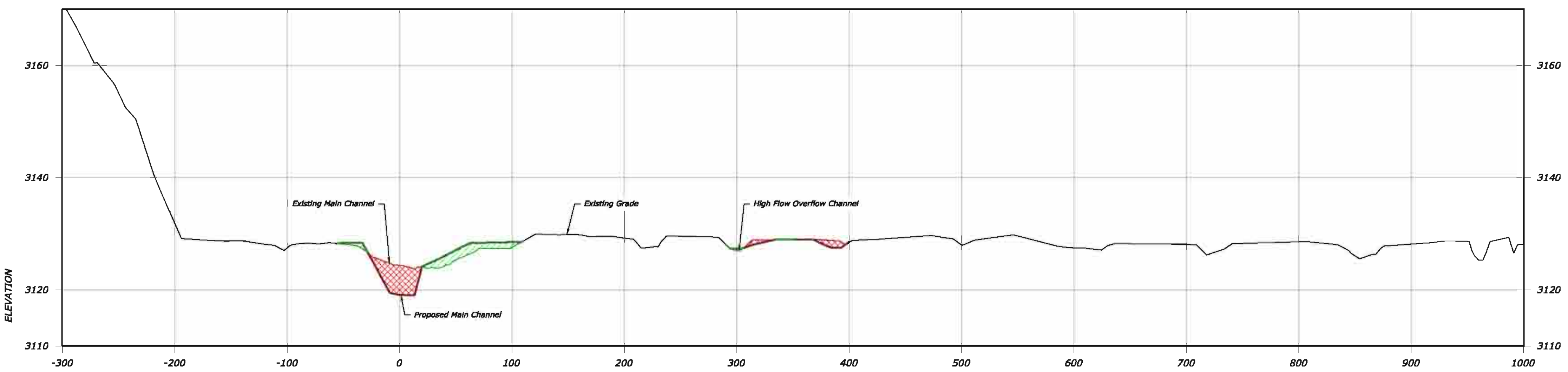

VALLEY SECTION R-R (STA 43+75)

HORIZONTAL SCALE
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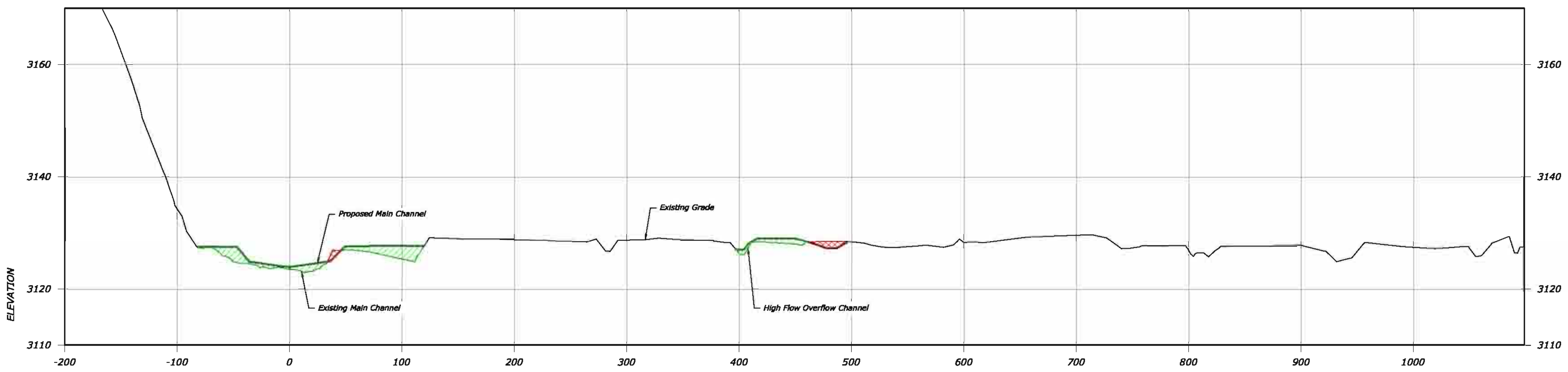
SCALE OF FEET

VERTICAL SCALE
12 0 12 24 36
SCALE OF FEET



VALLEY SECTION S-S (STA 45+50)

HORIZONTAL SCALE
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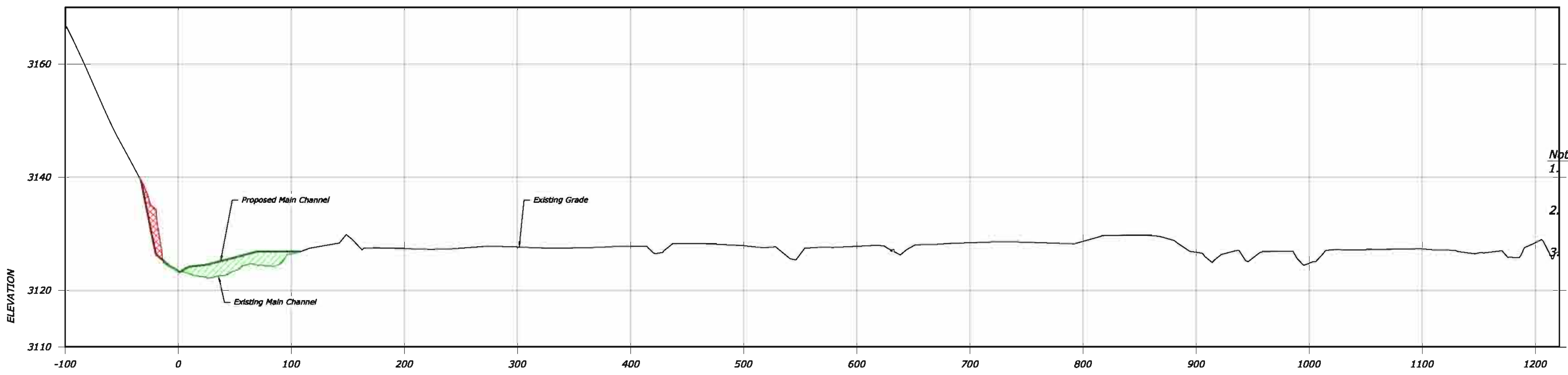
SCALE OF FEET

VERTICAL SCALE
12 0 12 24 36
SCALE OF FEET



VALLEY SECTION T-T (STA 47+60)

HORIZONTAL SCALE
60 0 60 120 180
SCALE OF FEET

VERTICAL SCALE
12 0 12 24 36
SCALE OF FEET

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LEGEND	
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VALLEY SECTIONS

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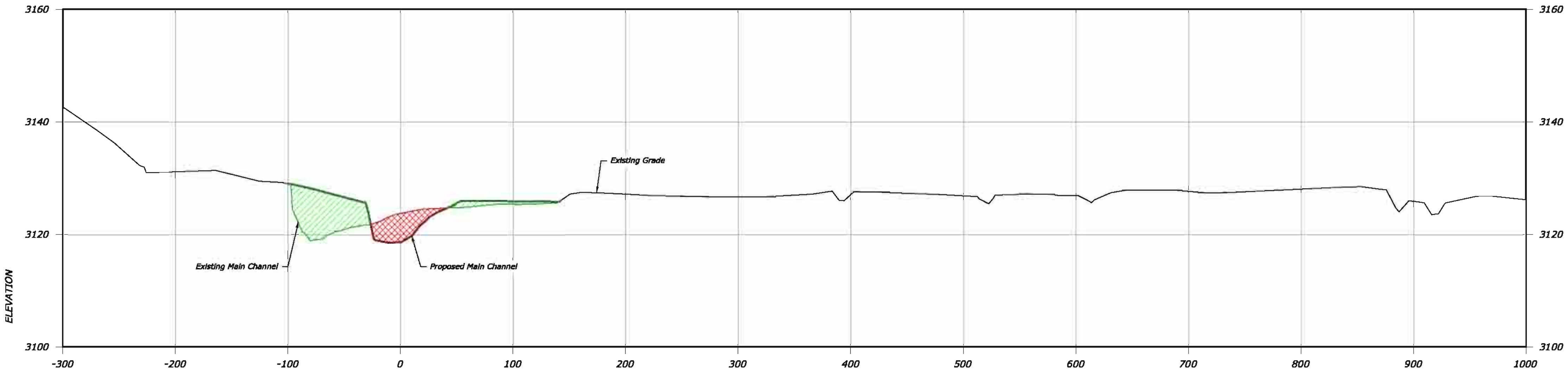
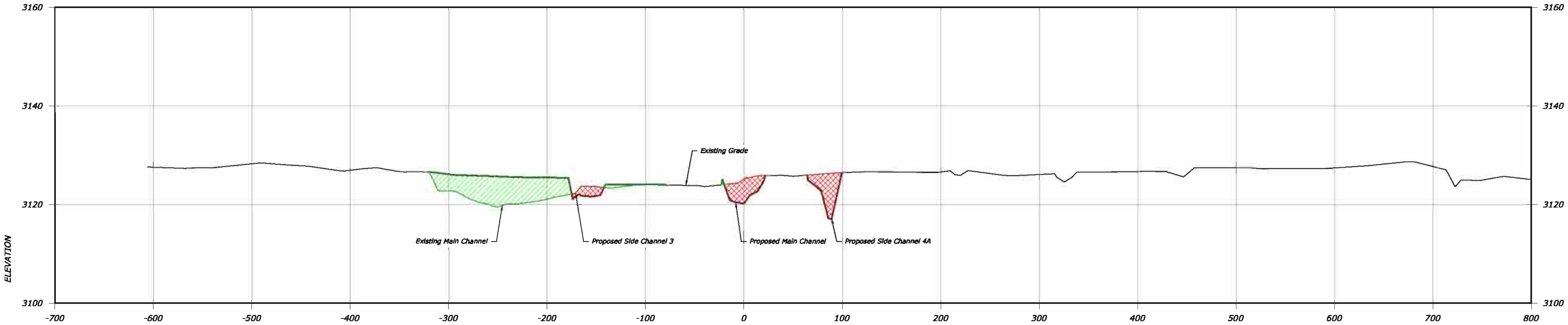


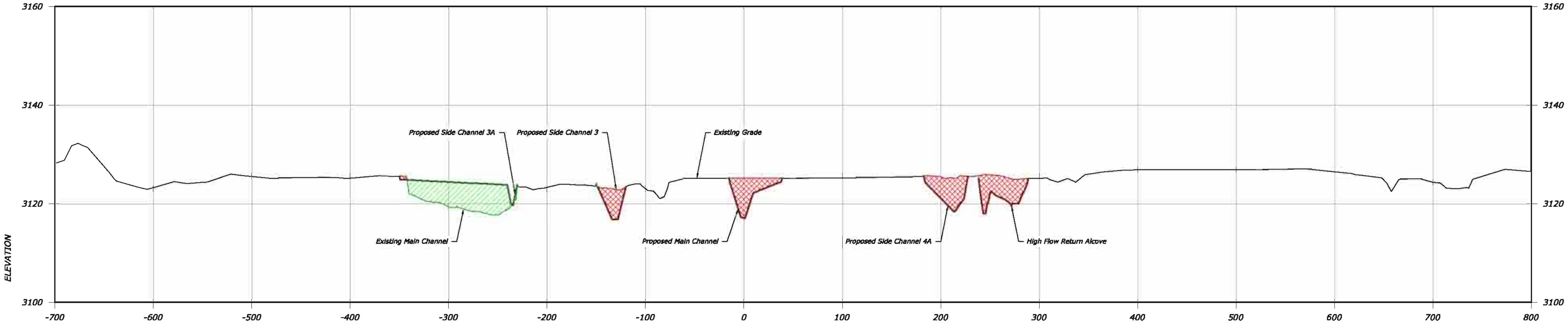
VALLEY SECTION U-U (STA 50+20)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION V-V (STA 53+10)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION W-W (STA 55+30)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET

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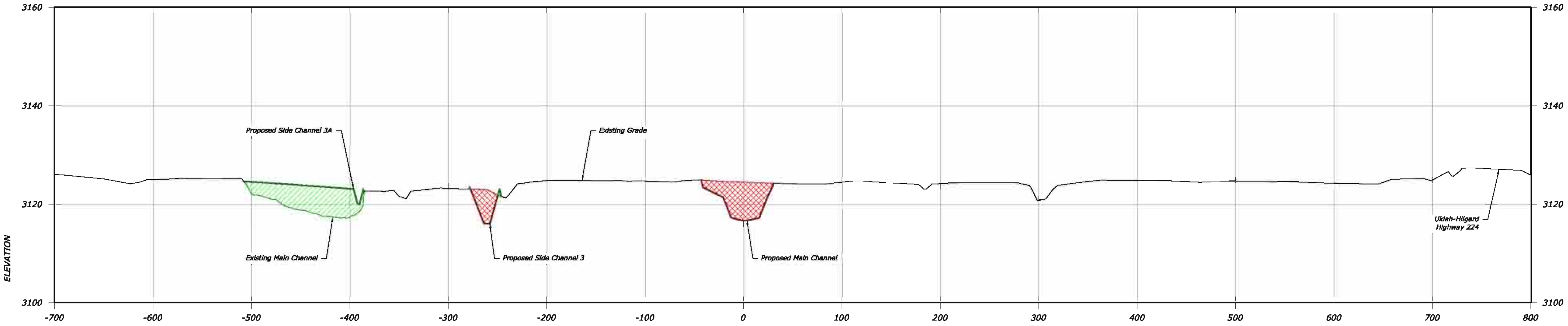
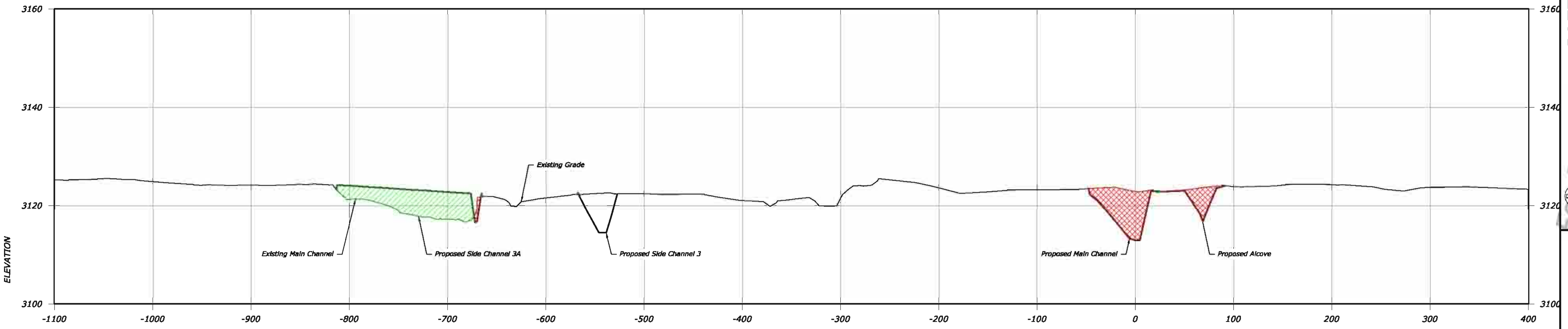


VALLEY SECTION X-X (STA 57+75)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

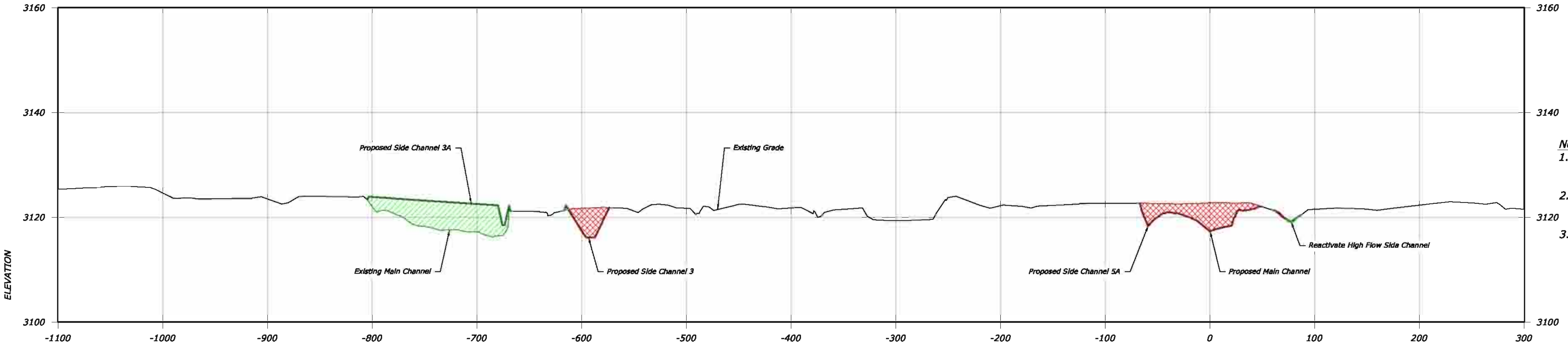
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION Y-Y (STA 61+65)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION Z-Z (STA 63+60)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET

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VALLEY SECTIONS

X-X thru Z-Z

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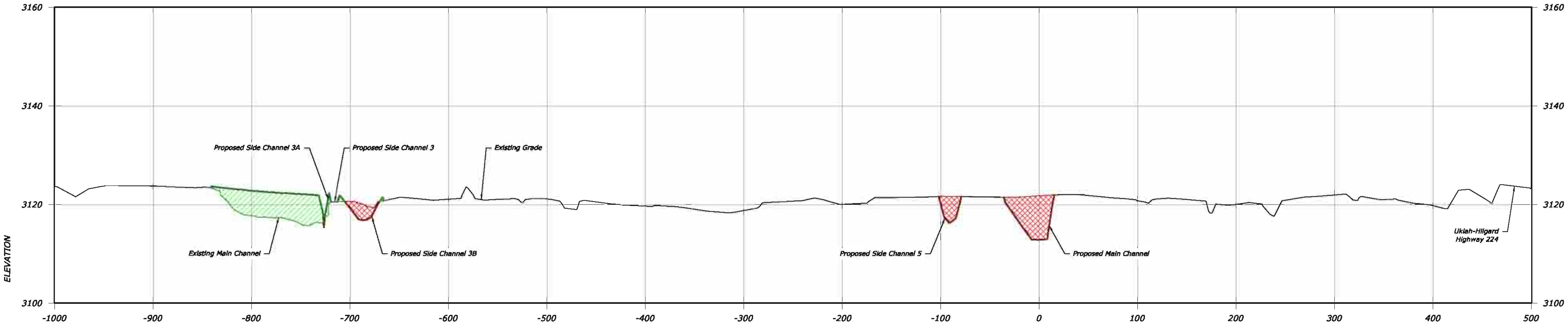

VALLEY SECTION AA-AA (STA 65+30)

HORIZONTAL SCALE
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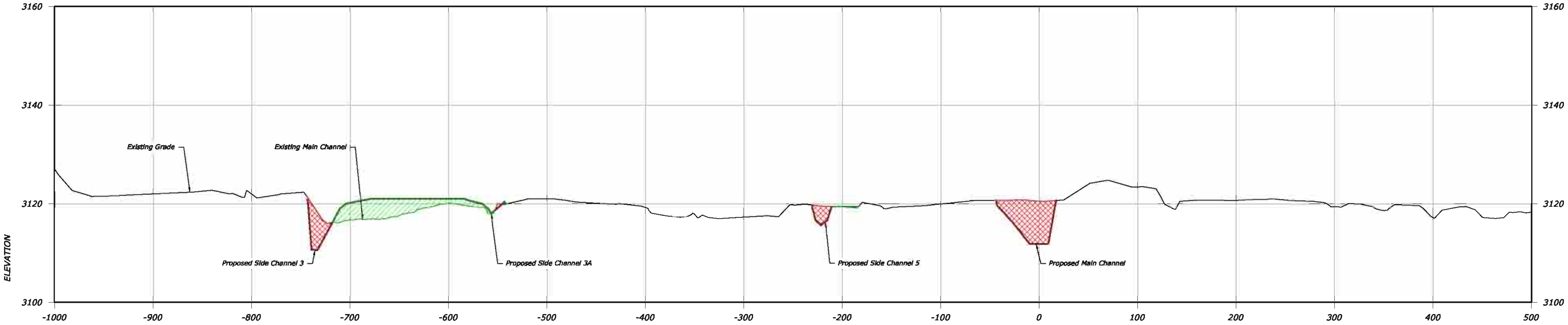
SCALE OF FEET

VERTICAL SCALE
12 0 12 24 36
SCALE OF FEET



VALLEY SECTION AB-AB (STA 67+60)

HORIZONTAL SCALE
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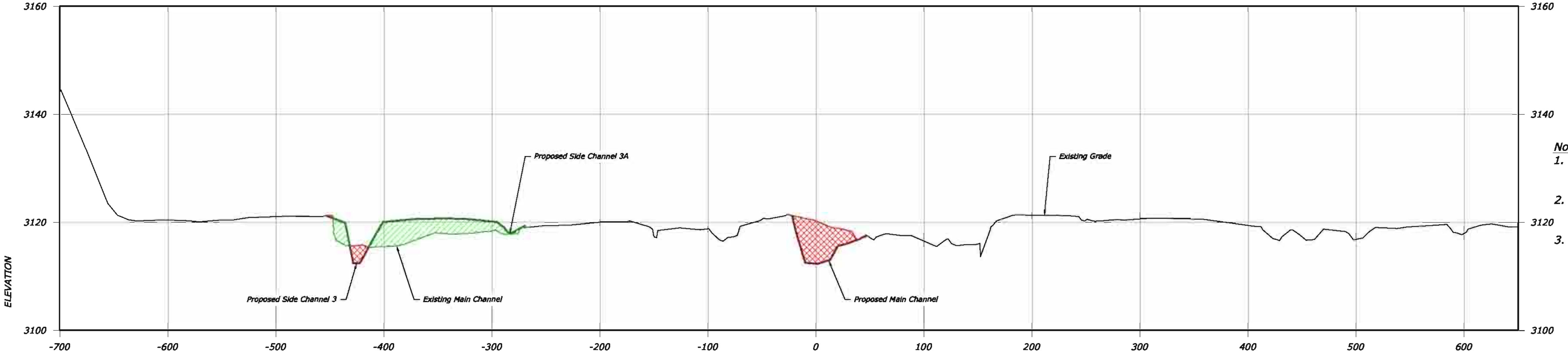
SCALE OF FEET

VERTICAL SCALE
12 0 12 24 36
SCALE OF FEET



VALLEY SECTION AC-AC (STA 70+70)

HORIZONTAL SCALE
60 0 60 120 180
SCALE OF FEET

VERTICAL SCALE
12 0 12 24 36
SCALE OF FEET

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VALLEY SECTIONS

AA-AA thru AC-AC

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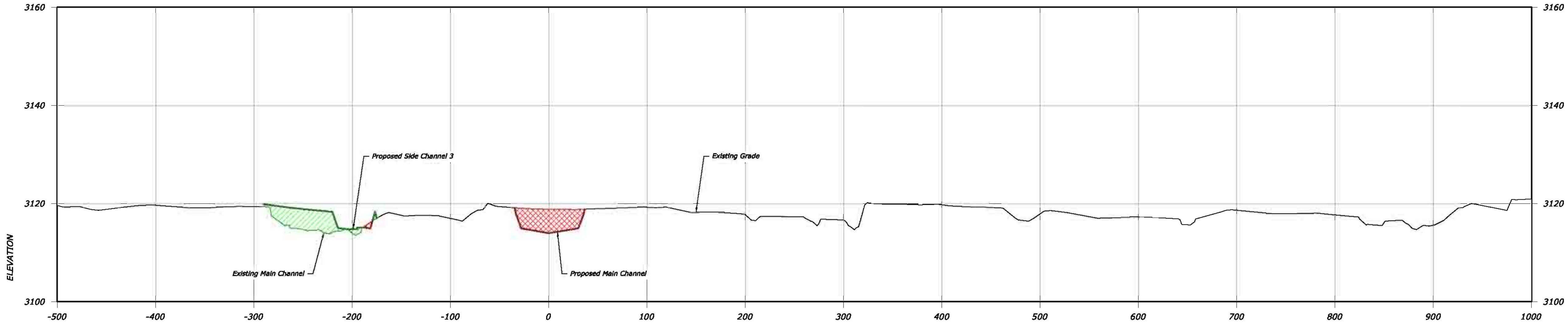
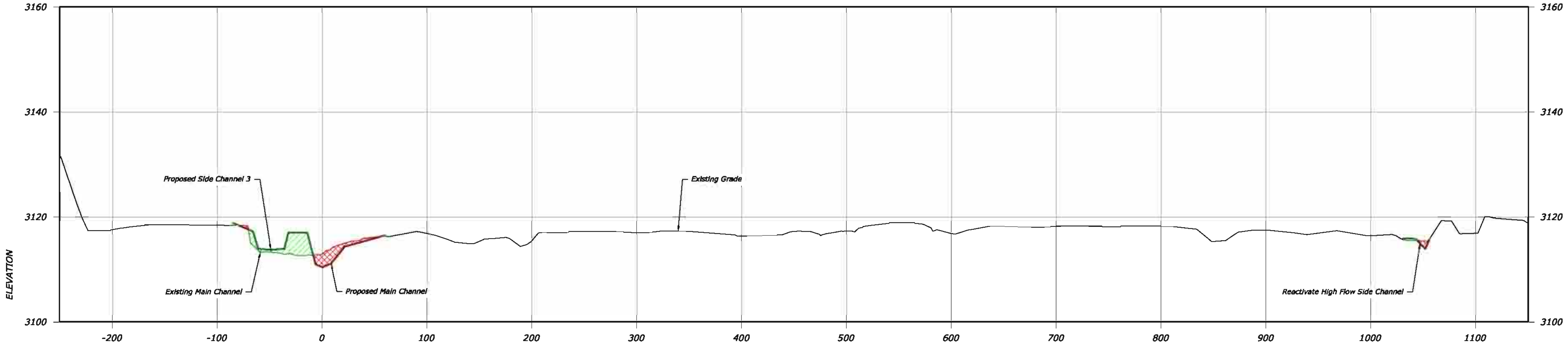


VALLEY SECTION AD-AD (STA 72+80)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

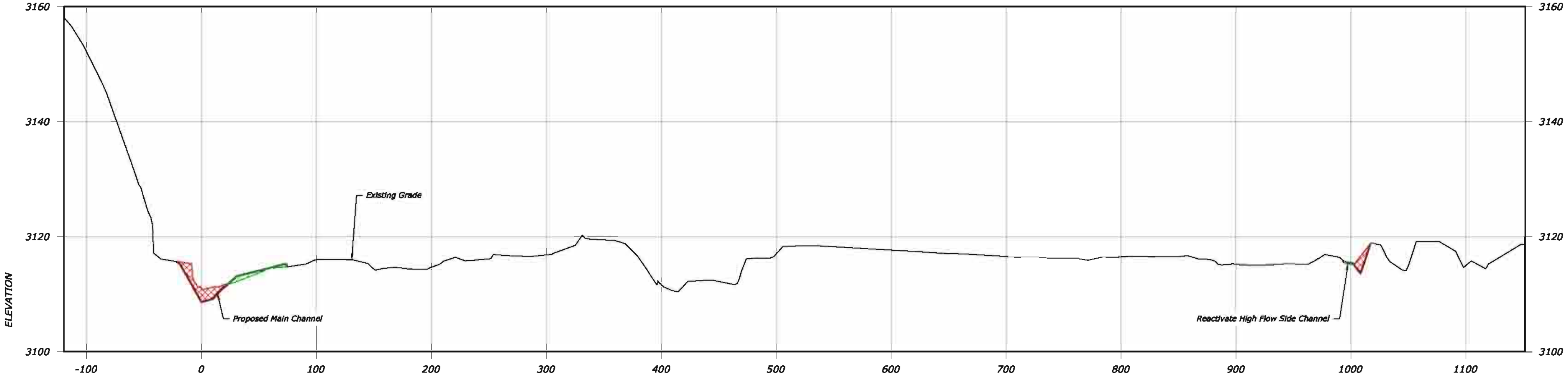
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION AE-AE (STA 75+25)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION AF-AF (STA 77+75)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET

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VALLEY SECTIONS

AD-AD thru AF-AF

1678-100-60758

SHEET 11 of 15

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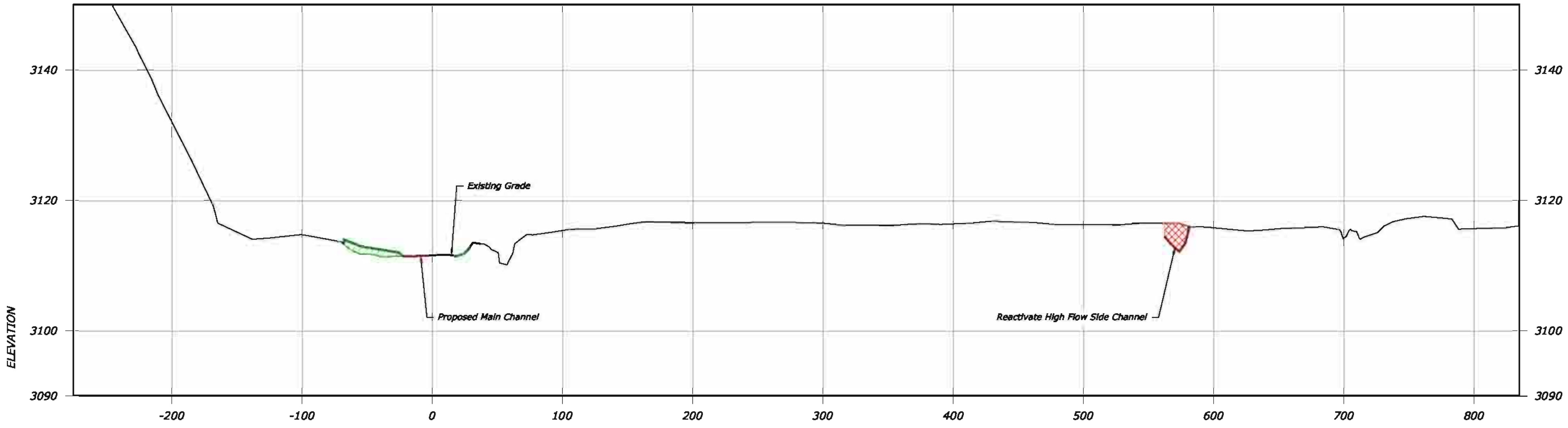
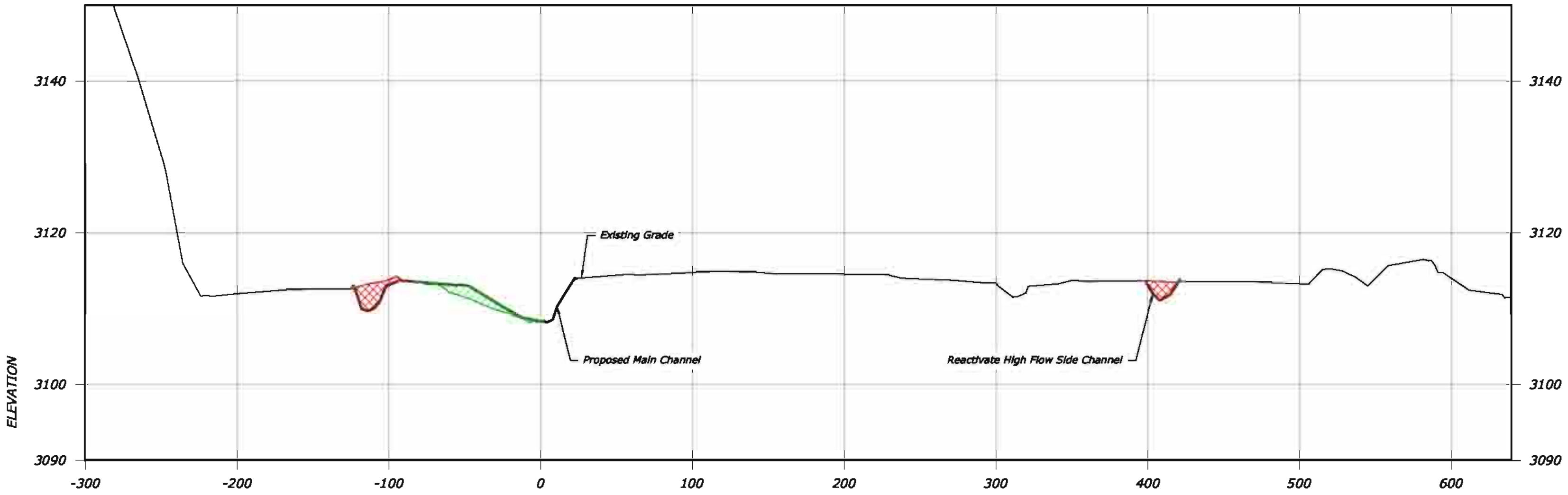


VALLEY SECTION AG-AG (STA 80+60)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

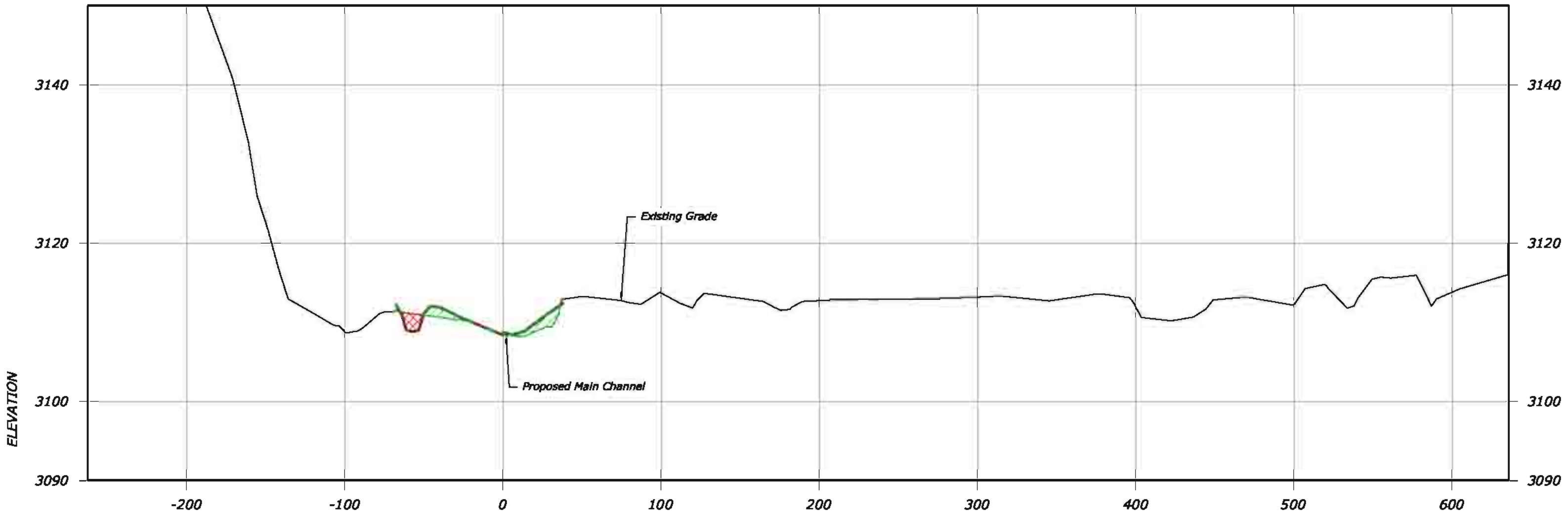
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION AH-AH (STA 83+65)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION AI-AI (STA 85+60)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET

Notes:

1. All fill areas to be constructed of suitable material as directed by the C.O.
2. All fill areas to be compacted with equipment as directed by the C.O. and to the minimum specifications.
3. Cross sections shown on this sheet that do not catch are to be carried through horizontally until intersection with existing ground.

LEGEND

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🟩	Fill

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VALLEY SECTIONS

AG-AG thru AI-AI

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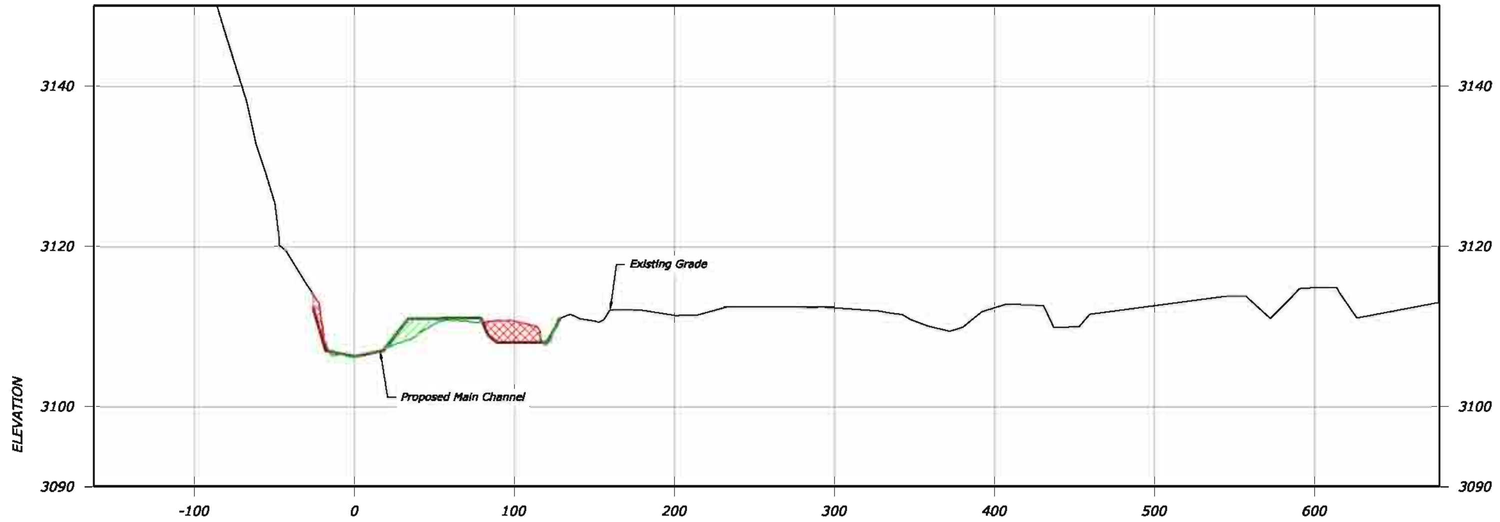
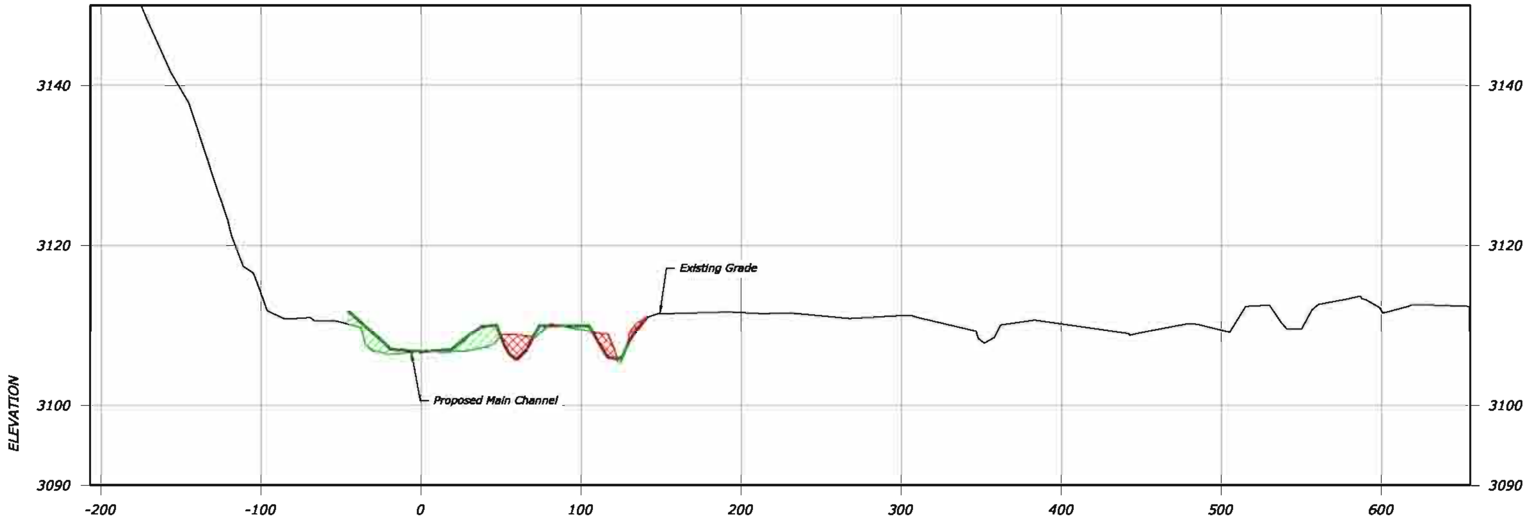


VALLEY SECTION AJ-AJ (STA 88+05)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION AK-AK (STA 90+35)

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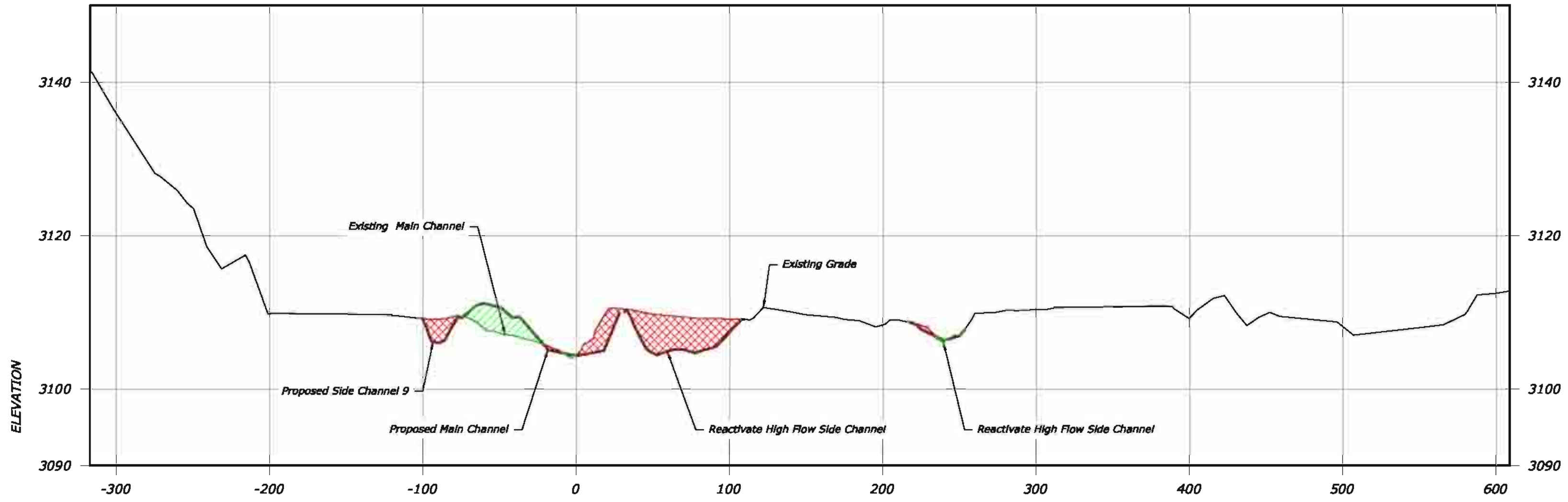
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION AL-AL (STA 92+55)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET

VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET

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LEGEND

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🟩	Fill

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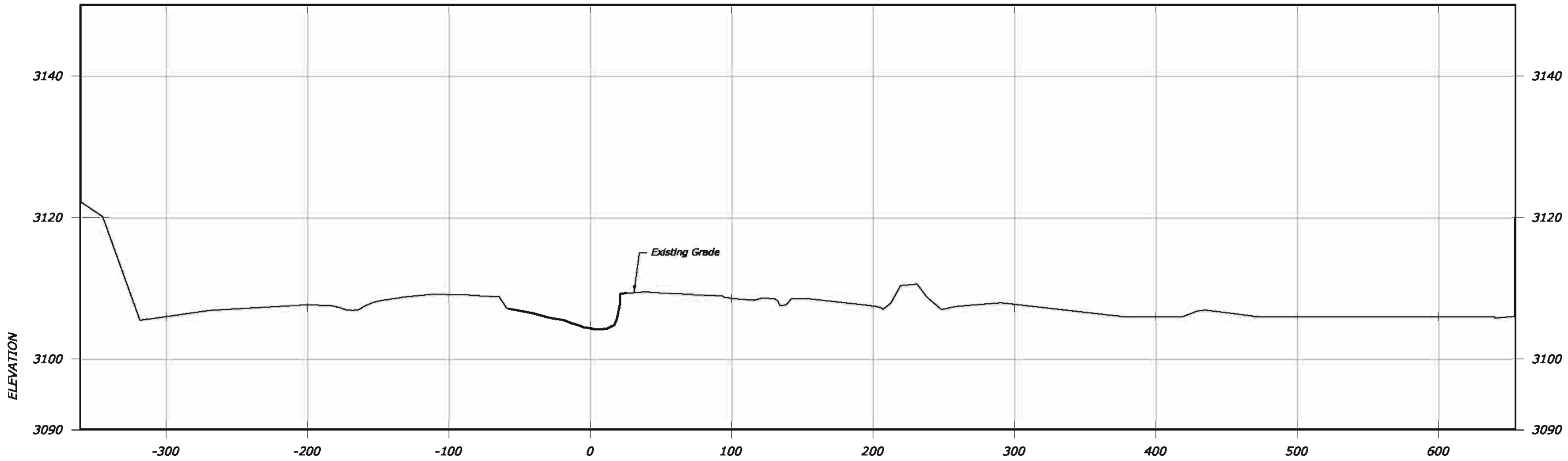
VALLEY SECTIONS

AJ-AJ thru AL-AL

1678-100-60760

SHEET 13 of 15



VALLEY SECTION AM-AM (STA 95+35)

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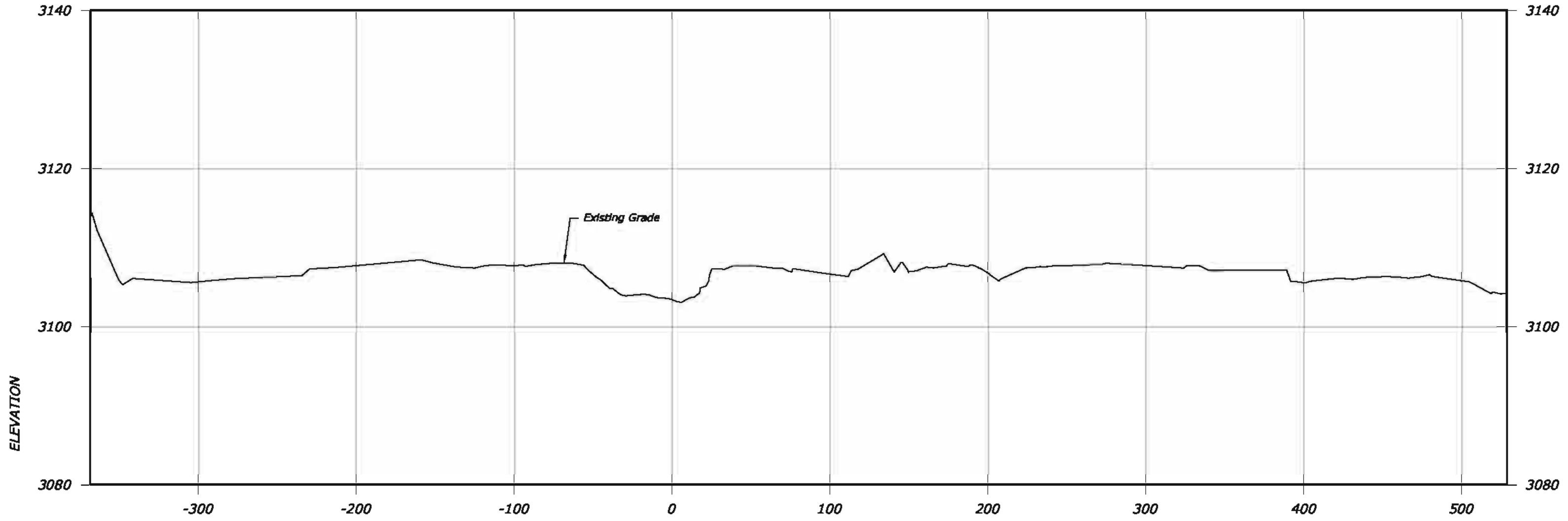
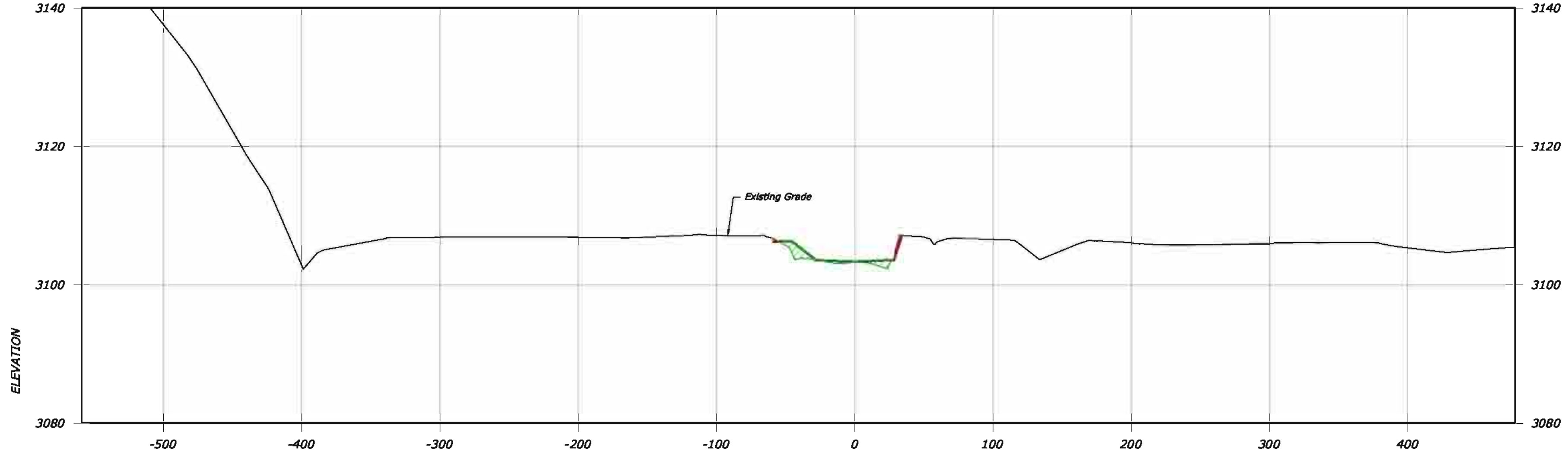
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION AN-AN (STA 97+90)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET



VALLEY SECTION AO-AO (STA 100+30)

HORIZONTAL SCALE 60 0 60 120 180 SCALE OF FEET
VERTICAL SCALE 12 0 12 24 36 SCALE OF FEET

Notes:
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2. *All fill areas to be compacted with equipment as directed by the C.O. and to the minimum specifications.*
3. *Cross sections shown on this sheet that do not catch are to be carried through horizontally until intersection with existing ground.*

LEGEND
🟥 Cut
🟩 Fill

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VALLEY SECTIONS

AM-AM thru AO-AO

1678-100-60761

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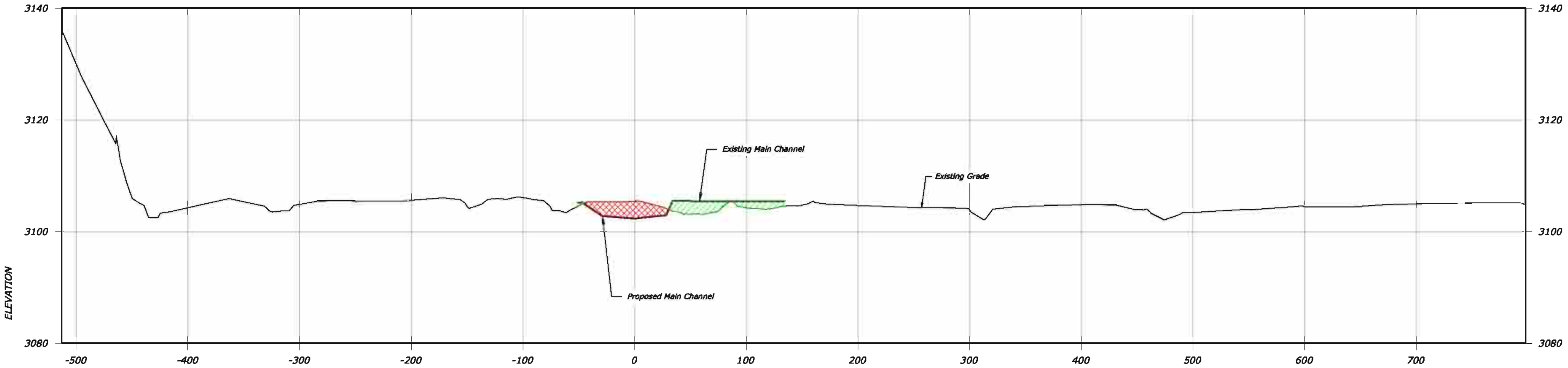
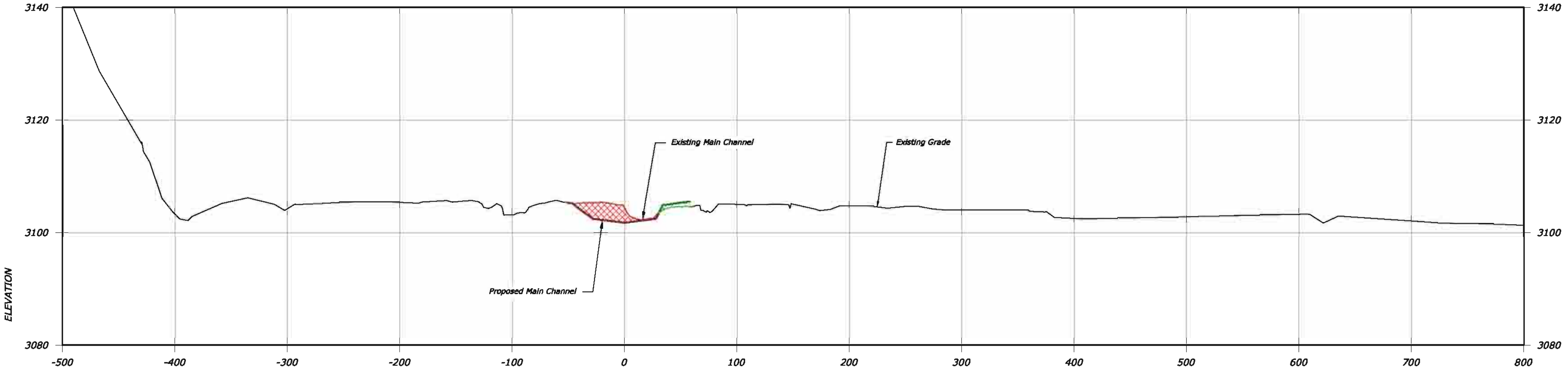


VALLEY SECTION AP-AP (STA 102+60)

HORIZONTAL SCALE
60 0 60 120 180
SCALE OF FEET

VERTICAL SCALE
12 0 12 24 36
SCALE OF FEET



VALLEY SECTION AQ-AQ (STA 104+15)

HORIZONTAL SCALE
60 0 60 120 180
SCALE OF FEET

VERTICAL SCALE
12 0 12 24 36
SCALE OF FEET

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LEGEND

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VALLEY SECTIONS

AP-AP thru AR-AR

1678-100-60762

SHEET 15 of 15

Notes:

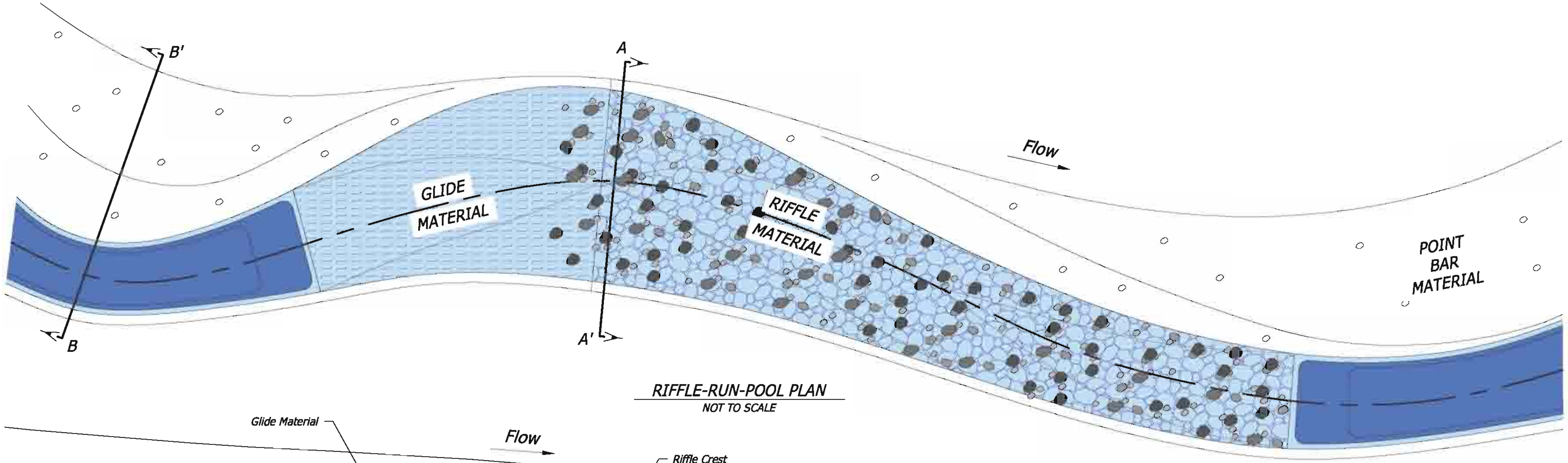
1. This project has been designed to have specific channel units for both stability and habitat objectives. It is important for the contractor to pay particular attention to channel materials and specifications as shown in these plans. Finish grading requires an "artistic touch" and shall be directed by the contracting officer (C.O.)

2. Pools are designed to be self-maintaining within native materials and additional large wood for stability and habitat cover as shown in habitat plans.

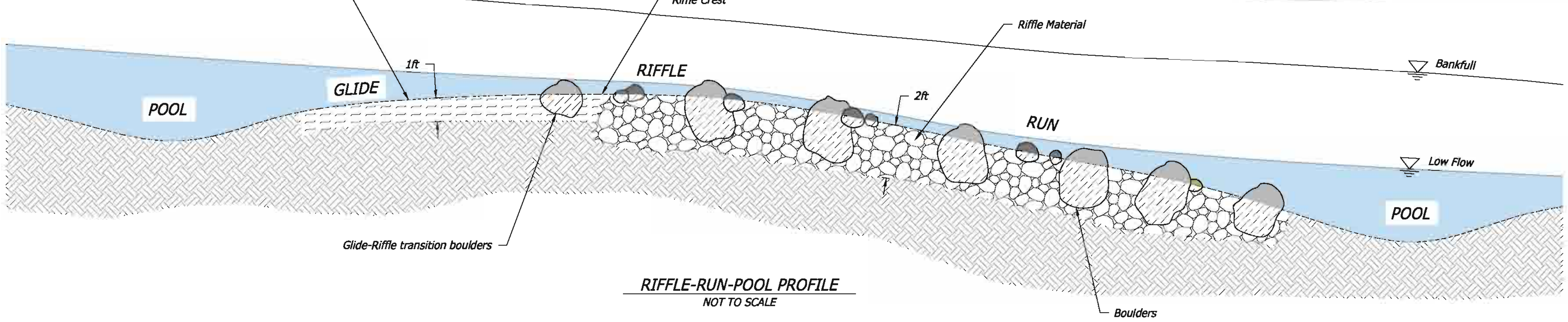
3. Glides are designed to provide lightly packed gravel-cobble of specific size with minimal fines for spawning substrate. Additionally, glides are to provide a transition from pool to riffle crest with boulders placed near riffle crest transition as directed by C.O.

4. Riffles are designed to provide a hardened and rough surface made of specific-well-graded material. Riffles are designed to withstand hydraulic forces and provide fish passage through chutes created by side slopes and boulder features.

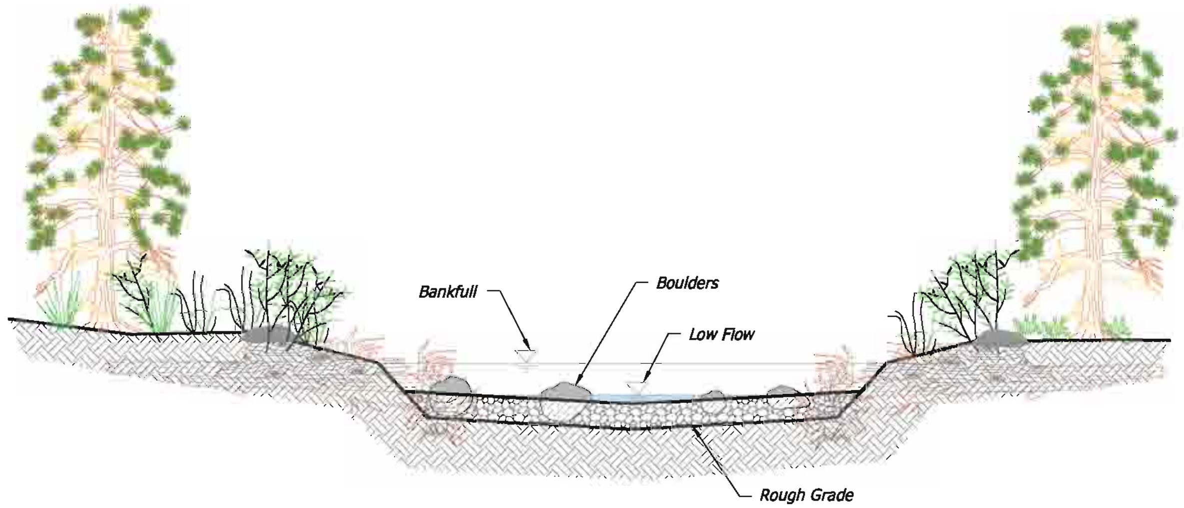
5. Runs are designed as riffle transitions to pools and are formed by both riffle and point bar features. Grading of these transitions is essential and the Contractor must refer to grading plans and additional direction by the C.O.



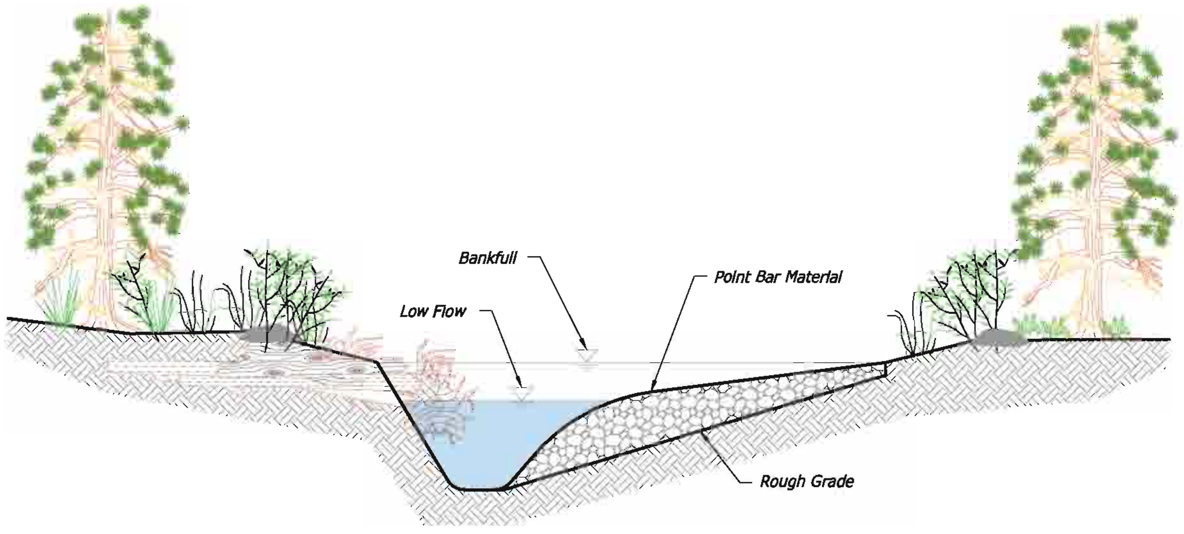
RIFFLE-RUN-POOL PLAN
NOT TO SCALE



RIFFLE-RUN-POOL PROFILE
NOT TO SCALE



SECTION A-A'
RIFFLE CREST SECTION SCHEMATIC
NOT TO SCALE



SECTION B-B'
POOL SECTION SCHEMATIC
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M.BERGSTROM
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X
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TYPICAL CHANNEL
SCHEMATIC

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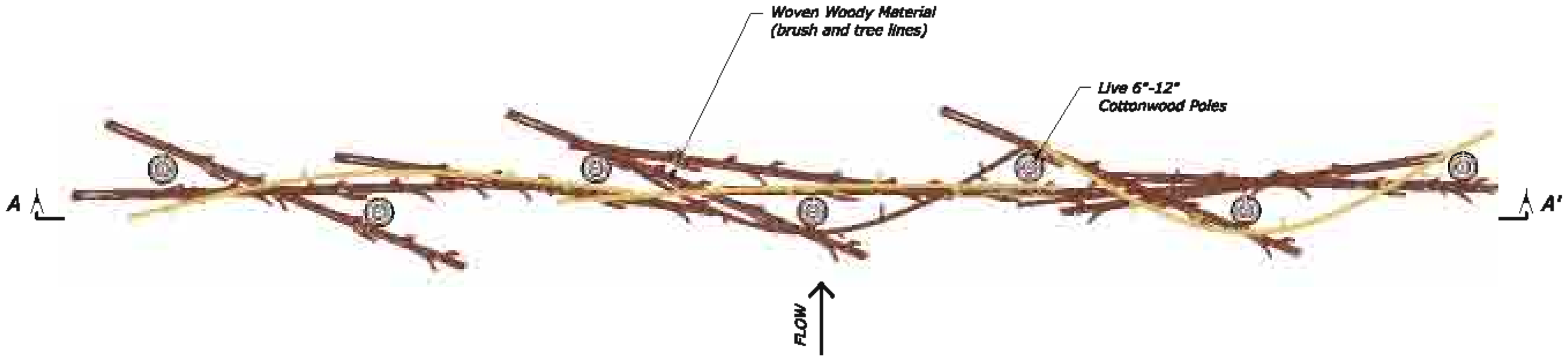
Flood Fence

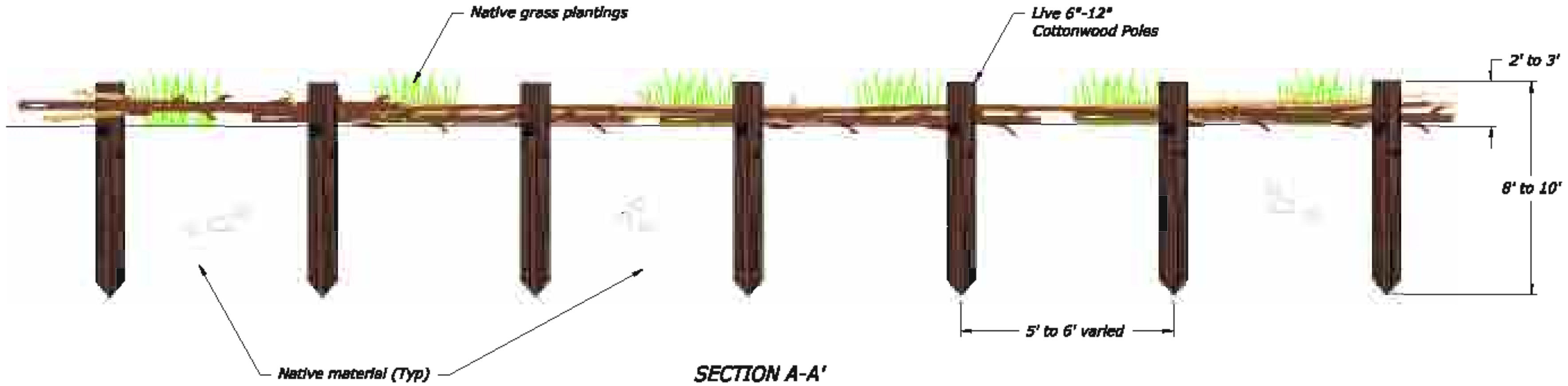
The purpose of the flood fence is to slow flood waters and to trap sediment and debris in flood prone areas that have been cleared of native riparian vegetarian. Live pole cuttings are used to provide immediate benefits and to re-establish woody riparian vegetation. Woody material can be woven between poles to simulate rafted flotsam and provide rapid results.

Example - Live Cottonwood Flood Fence (after first flood)

(Note - Woven brush not added to this structure)



FLOOD FENCE PLAN VIEW
(NOT TO SCALE)



SECTION A-A'
(NOT TO SCALE)

Flood Fence				
Log Type	Size (Dia)	Min. Length (ft)	Branches	Quantity
Post	6"-12"	8'-10'	No	7
Woven	1.5"-3"	10'-15'	Optional	20

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FLOOD FENCE DETAIL

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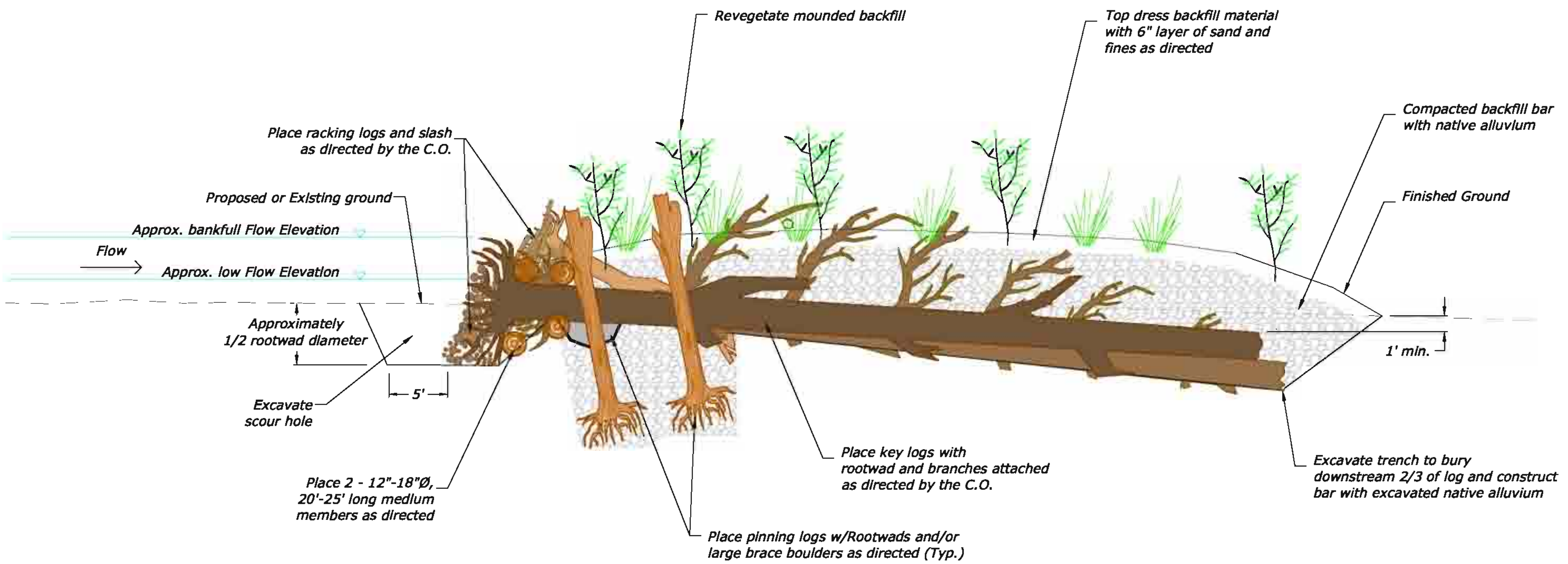

SECTION A-A'

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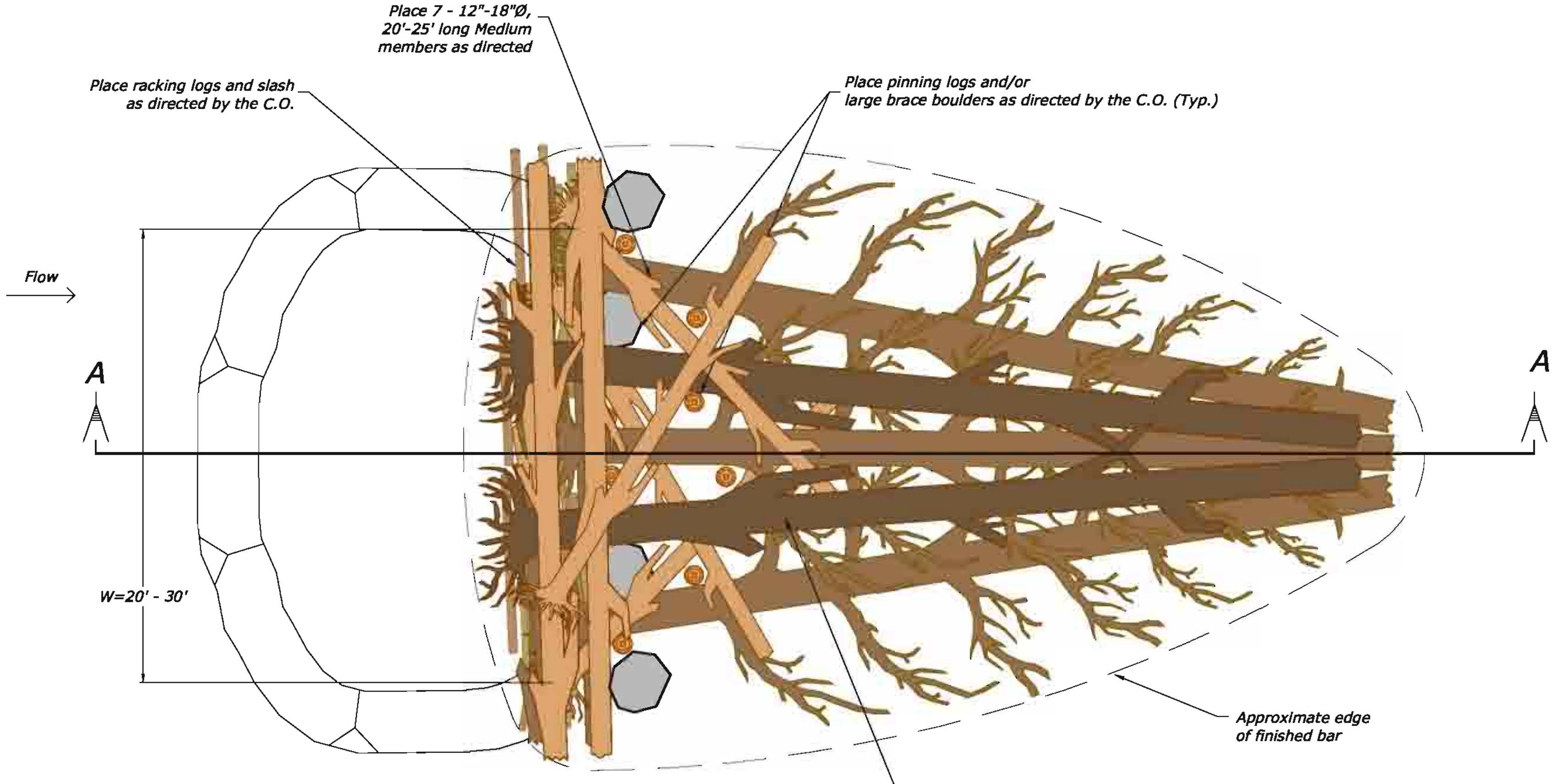

PLAN VIEW

TYPE A1 - APEX JAM

NOT TO SCALE

TYPE A1 - APEX JAM

Log Type	Size (DBH)	Min Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	45'	Yes	6'	Yes	5
Medium	12" - 18"	25'	Optional	-	Optional	7
Racking	6" - 12"	20'	Optional	-	Optional	25
Pinning	12"	20'	Yes	3'	No	8
Tree Tops & Branches (CY)	1"-6"	5'	-	-	Yes	20
Large Boulders	>24"	-	-	-	-	-

* DBH = Diameter at Breast Height

Notes:

Purpose:

- Create split flow, and protect or create vegetated island or gravel bar.
- Narrow channel width.
- Create scour pool and sort sediment.
- Accumulate debris over time.
- Enhance fish habitat complexity and diversity.

Design Specifics:

1. Top of rootwad should not exceed more than 2 feet above top of mound.
2. Place at head of island or developing gravel bar.
3. Key Members secured into island with compacted native alluvium and boulder ballast.
4. Medium and racking logs wedged between key members and brace boulders.
5. Pinning logs to be excavated with rootwad buried.
6. All visible ends of logs shall be cut or broken off to create natural appearance. No flat cuts allowed.
7. Racking logs and slash shall have irregular and natural appearance and not stacked.
8. Backfill with stream substrate and top dress backfill with 6" layer of sand and fines. Plant vegetation on top of island or gravel bar.
9. Install vegetation among rootwads (not shown) while installing rootwads.
10. Structure location may be field adjusted by the CO.

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TYPE A1 - APEX JAM

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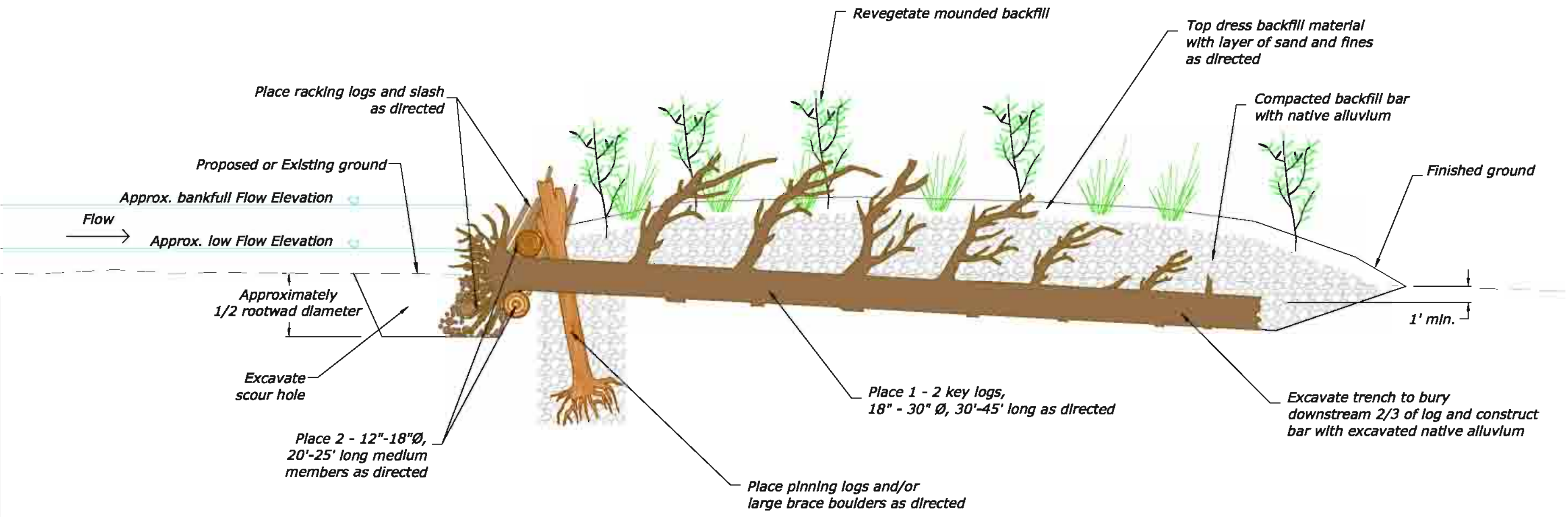

SECTION A-A'
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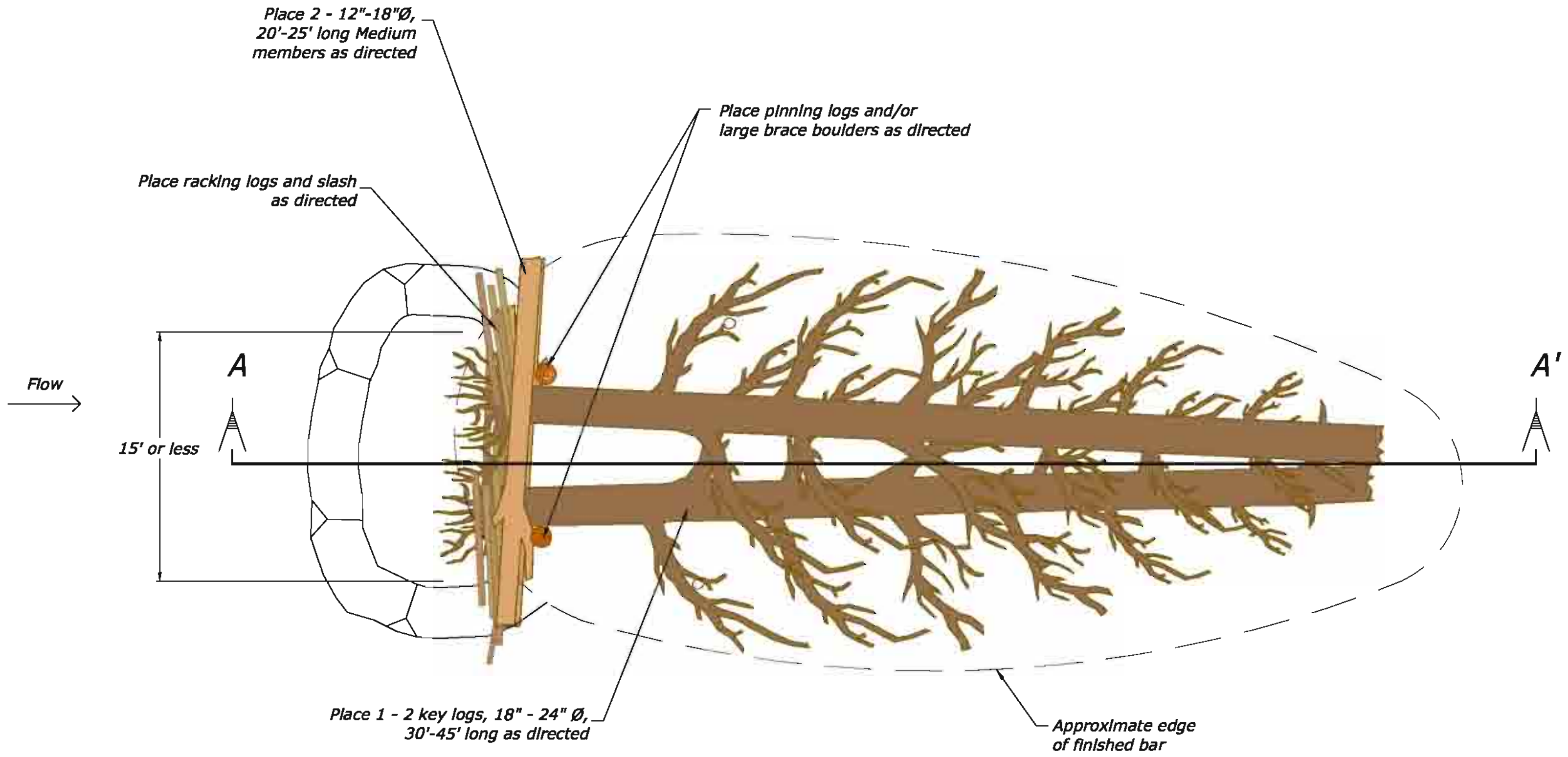

PLAN VIEW

TYPE A2 - APEX JAM (NARROW)

NOT TO SCALE

TYPE A2 - APEX JAM (NARROW)

Log Type	Size (DBH)	Min Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	45'	Yes	6'	Yes	2
Medium	12" - 18"	25'	Optional	-	Optional	2
Racking	6" - 12"	20'	Optional	-	Optional	16
Pinning	12"	20'	Yes	3'	No	2
Tree Tops & Branches (CY)	1"-6"	5'	-	-	Yes	10
Large Boulders	>24"	-	-	-	-	-

* DBH = Diameter at Breast Height

Notes:

Purpose:

- * Create split flow, and protect or create vegetated island or gravel bar.
- * Create scour pool and sort sediment.
- * Accumulate debris over time.
- * Enhance fish habitat complexity and diversity.

Design Specifics:

1. Top of rootwad should not exceed more than 2 feet above top of mound.
2. Place at head of island or developing gravel bar.
3. Key Members secured into island with compacted native alluvium and boulder ballast.
4. Medium and racking logs wedged between key members and brace boulders.
5. Pinning logs to be excavated with rootwad buried.
6. All visible ends of logs shall be cut or broken off to create natural appearance. No flat cuts allowed.
7. Racking logs and slash shall have irregular and natural appearance and not stacked.
8. Backfill with stream substrate and top dress backfill with 6" layer of sand and fines. Plant vegetation on top of island or gravel bar.
9. Install vegetation among rootwads (not shown) while installing rootwads.
10. Structure location may be field adjusted by the CO.

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TYPE A2 - APEX JAM
(NARROW)

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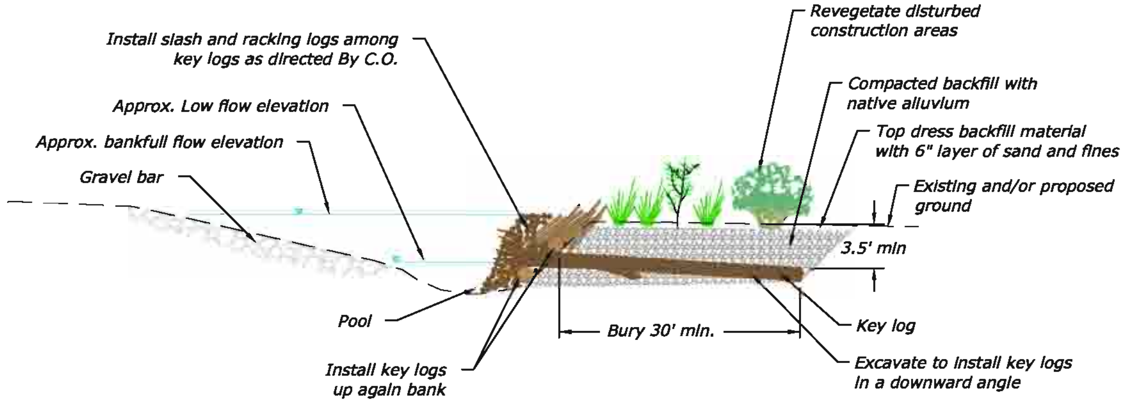

SECTION A-A'
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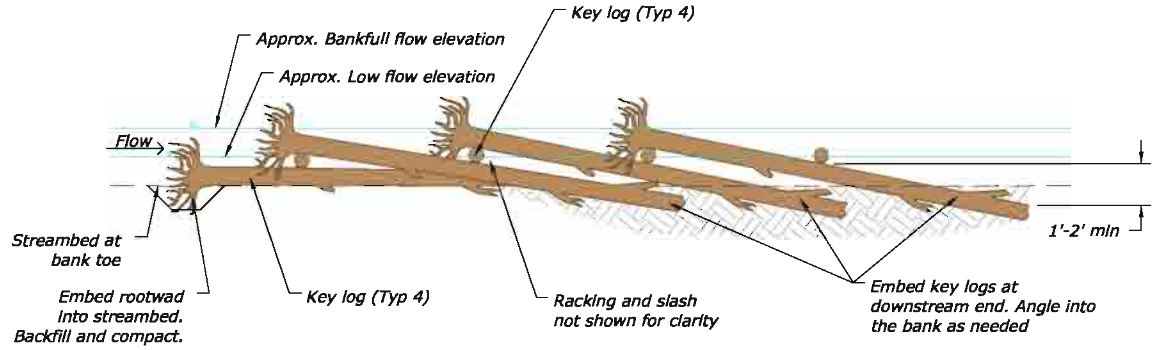

SECTION B-B'
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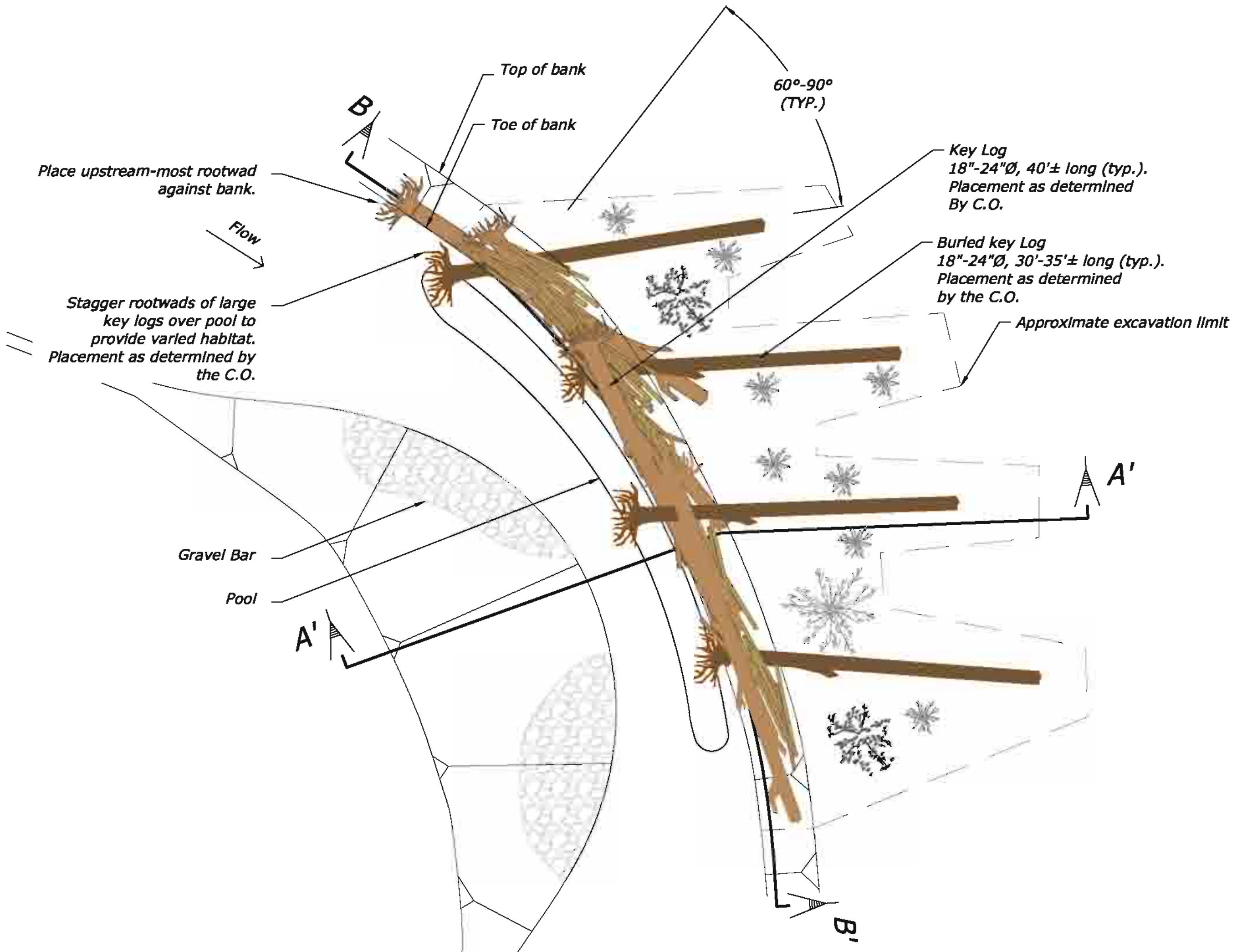

PLAN VIEW

TYPE B1 - MEANDER JAM
NOT TO SCALE

TYPE B1 - MEANDER JAM						
Log Type	Size (DBH)	Min Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	45'	Yes	4'	Yes	4
Key	18" - 24"	30'	Yes	4'	Yes	4
Medium	12" - 18"	25'	-	-	-	-
Racking	6" - 12"	20'	Optional	-	Optional	40
Pinning	12"	-	-	-	-	-
Tree Tops & Branches (CY)	1" - 6"	5'	-	-	Yes	80
Large Boulders	>24"	-	-	-	-	-

* DBH = Diameter at Breast Height
** See note 7

Notes:

Purpose:
- * Limits channel migration in the short term to restore aquatic and riparian habitat.
- * Enhances fish habitat by creating large bankside pools for fish holding and sediment sorting.
- * Accumulates debris over time.

Design Specifics:
1. Top of rootwad should not exceed more than 1/2 foot above top of bank.
2. Place along outsides of channel bends.
3. Key members secured into banks with native backfill.
4. Racking logs and branches wedged between key members.
5. Backfill with native alluvium. Top dress backfill material with 6" layer of sand and fines. Plant dense vegetation on top of bank.
6. Install vegetation among logs (not shown) while installing logs.
7. If located in Side Channels, Meander Jam can be constructed with smaller logs as directed by C.O.
8. Length of structure will vary by locations. Structures will have variable number of logs. Limits of structure and number of logs to be determined by C.O.
9. Structure location may be field adjusted by C.O.

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TYPE B1 - MEANDER JAM

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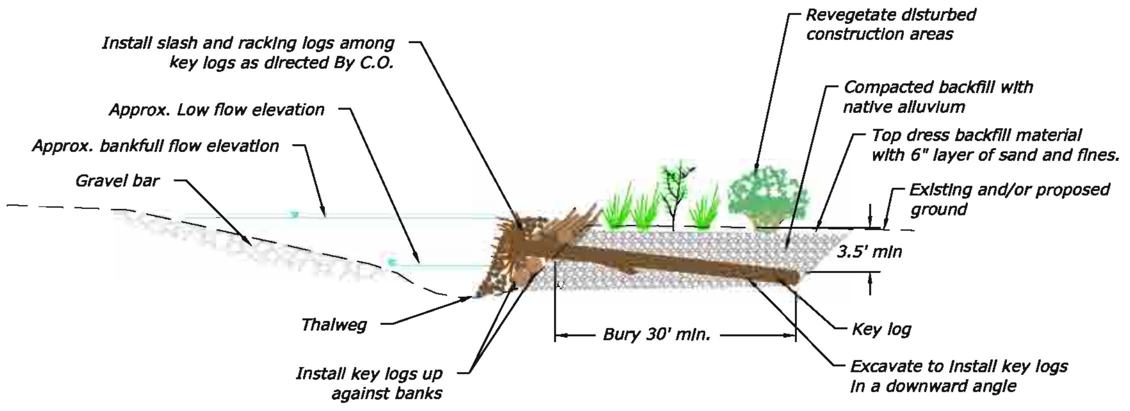
CAD FILENAME
MEANDER JAM.DWG



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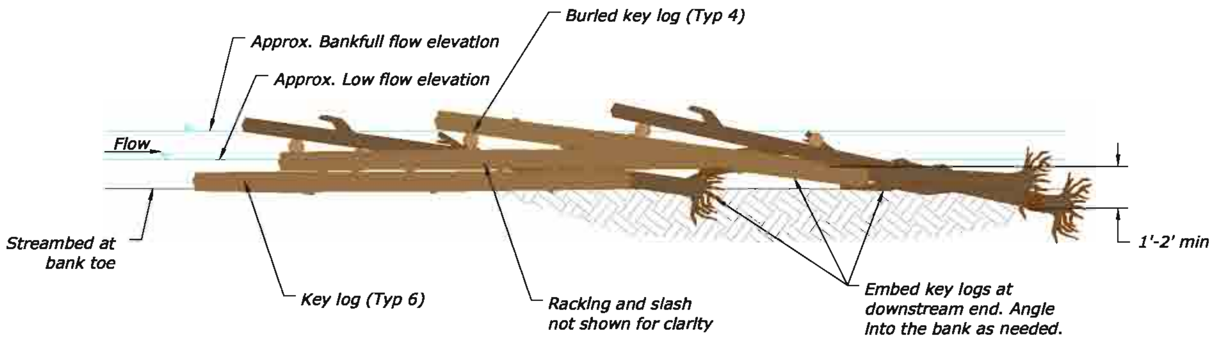

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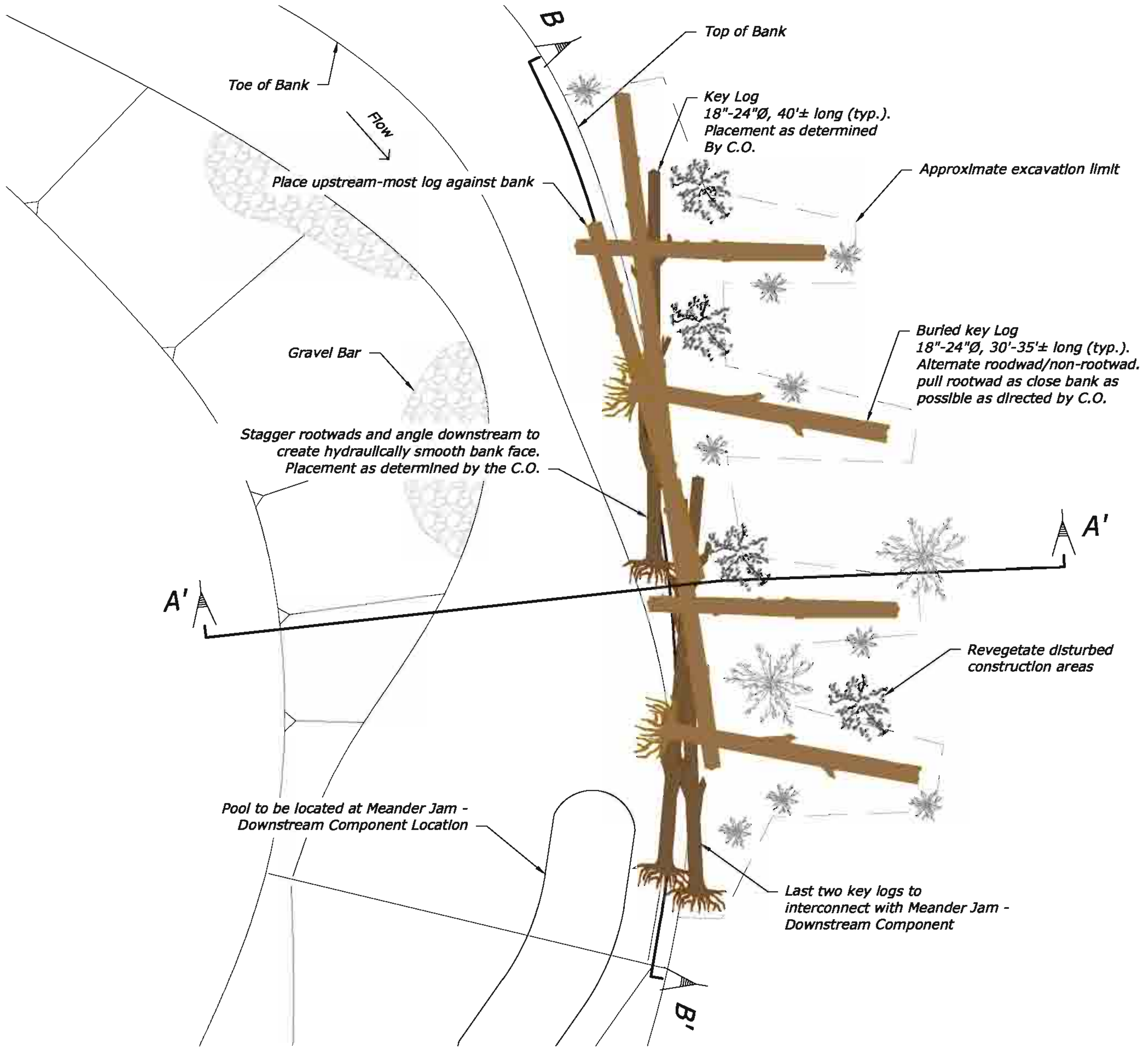

PLAN VIEW

TYPE B2 - MEANDER JAM - UPSTREAM COMPONENT

NOT TO SCALE

TYPE B2 - MEANDER JAM

Log Type	Size (DBH)	Min Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	40'	Yes	4'	Yes	3
Key	18" - 24"	40'	No	-	Yes	3
Key	18" - 24"	30'	Optional	4'	Yes	4
Medium	12" - 18"	-	-	-	-	-
Racking	6" - 12"	20'	Optional	-	Optional	10
Pinning	12"	-	-	-	-	-
Tree Tops & Branches (CY)	1" - 6"	5'	-	-	Yes	40
Large Boulders	>24"	-	-	-	-	-

* DBH = Diameter at Breast Height

Notes:

Purpose:

- * Limits channel migration in the short term to restore aquatic and riparian habitat.
- * Enhances fish habitat by creating large bankside pools for fish holding and sediment sorting.
- * Increases velocities in channel leading up to downstream component of meander jam to force larger scour hole.

Design Specifics:

1. Top of rootwad should not exceed more than 1/2 foot above top of bank.
2. Place along outsides of channel bends.
3. Key members secured into banks with native backfill.
4. Racking logs and slash wedged between key members.
5. Backfill with native alluvium. Top dress backfill material with 6" layer of sand and fines. Plant dense vegetation on top of bank.
6. Install vegetation among logs (not shown) while installing logs.
7. If located in Side Channels, Meander Jam can be constructed with smaller logs as directed By C.O.
8. Length of structure will vary by locations. Structures will have variable number of logs. Limits of structure and number of logs to be determined By C.O.
9. Stru cture location may be field adjusted By C.O.

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TYPE B2 - MEANDER JAM

UPSTREAM COMPONENT

1678-100-60768

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CAD FILENAME
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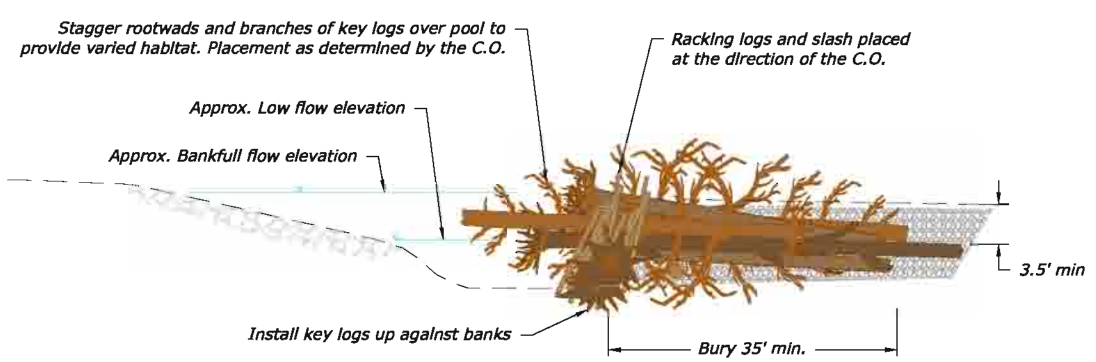

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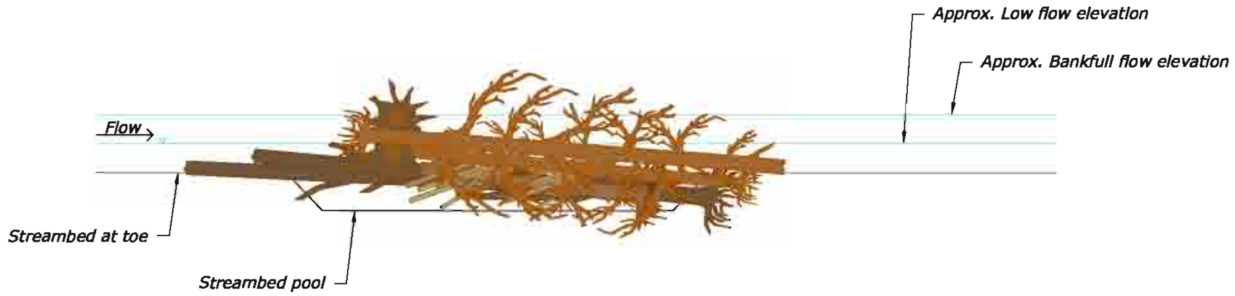

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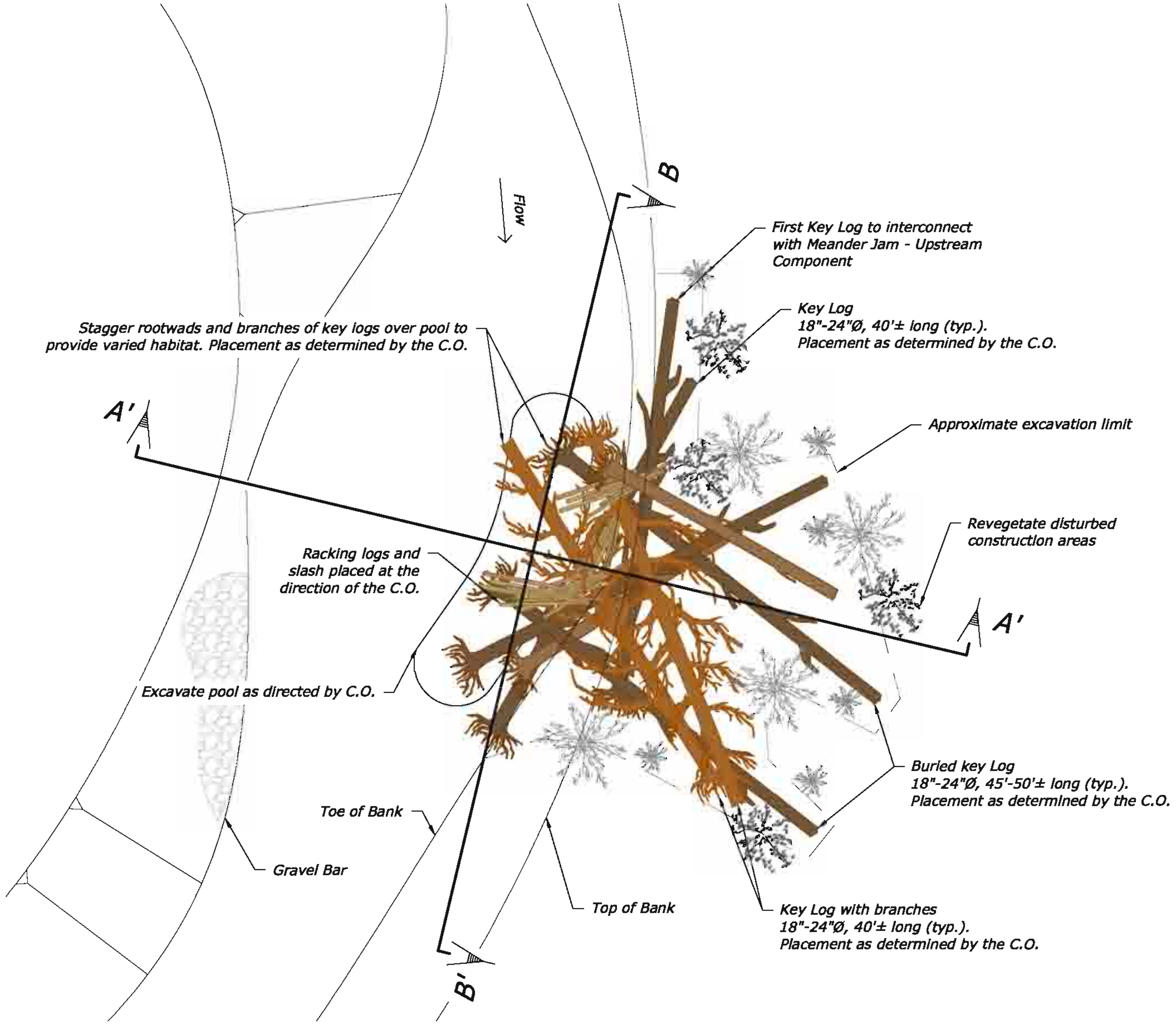

PLAN VIEW

TYPE B3 - MEANDER JAM - DOWNSTREAM COMPONENT
NOT TO SCALE

TYPE B3 - MEANDER JAM

Log Type	Size (DBH)	Min Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	45"	Yes	4'	Yes	2
Key	18" - 24"	45"	No	-	Yes	5
Key	18" - 24"	30'	Optional	4'	Yes	2
Medium	12" - 18"	-	-	-	-	-
Racking	6" - 12"	20'	Optional	-	Optional	30
Pinning	12"	-	-	-	-	-
Tree Tops & Branches (CY)	1" - 6"	5'	-	-	Yes	60
Large Boulders	>24"	-	-	-	-	-

* DBH = Diameter at Breast Height

Notes:

Purpose:
- * Limits channel migration in the short term to restore aquatic and riparian habitat.
- * Enhances fish habitat by creating large bankside pools for fish holding and sediment sorting.
- * Angles stream power into bed creating sustainable scour hole.
- * Accumulates debris over time.

Design Specifics:
1. Top of rootwad should not exceed more than 1/2 foot above top of bank.
2. Place along outsides of channel bends.
3. Key members secured into banks with native backfill.
4. Racking logs and slash wedged between key members.
5. Backfill with native alluvium. Top dress backfill material with 6" layer of sand and fines. Plant dense vegetation on top of bank.
6. Install vegetation among logs (not shown) while installing logs.
7. If located in Side Channels, Meander Jam can be constructed with smaller logs as directed By C.O.
8. Length of structure will vary by locations. Structures will have variable number of logs. Limits of structure and number of logs to be determined by C.O.
9. Stru cture location may be field adjusted by C.O.

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TYPE B3 - MEANDER JAM

DOWNSTREAM COMPONENT

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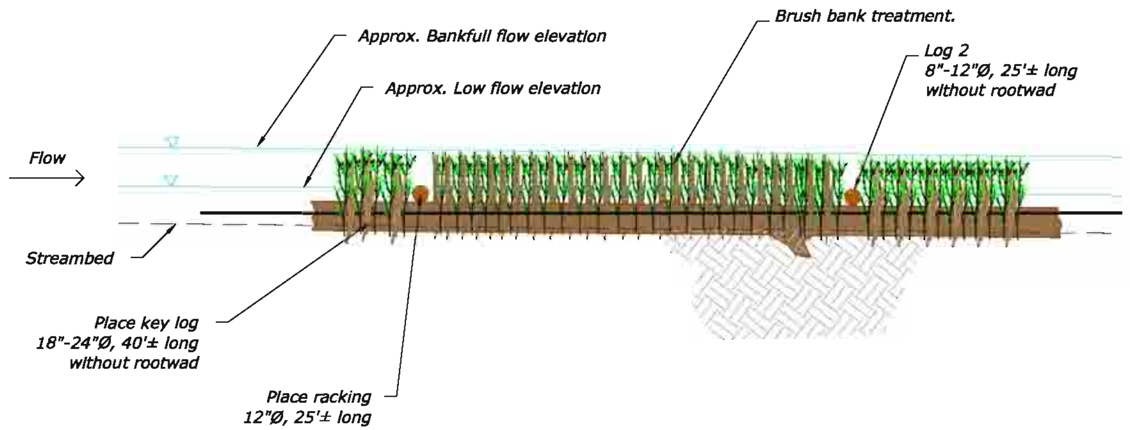
MEANDER JAM.DWG



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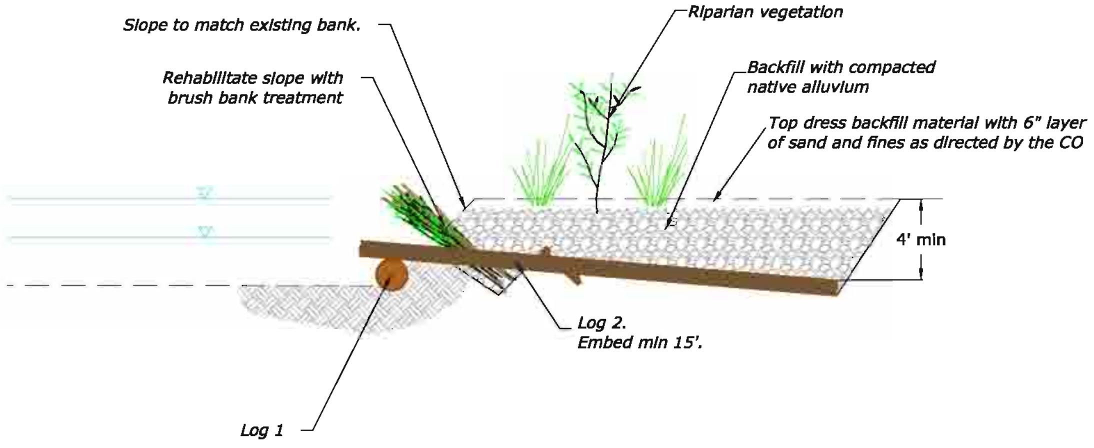

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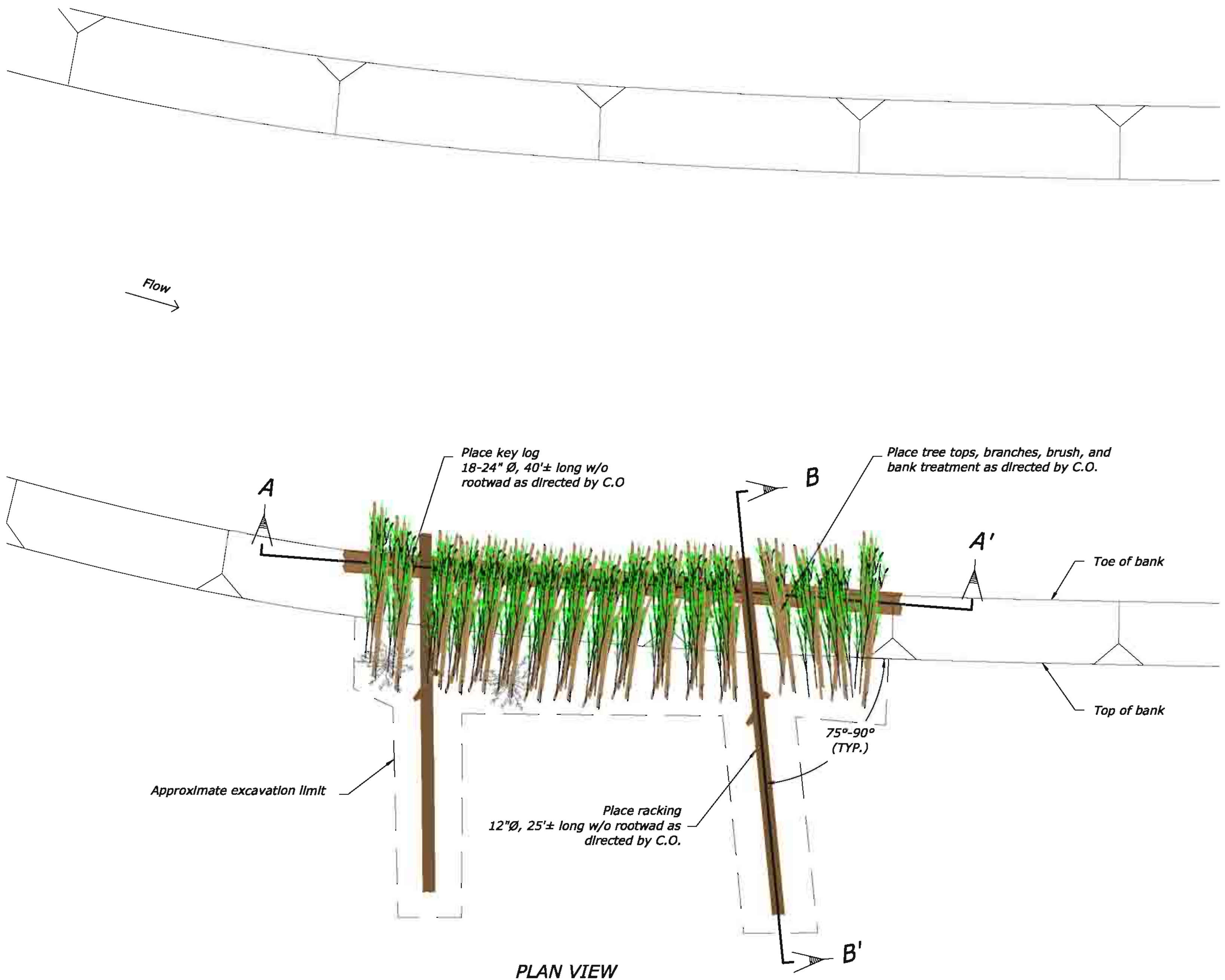

PLAN VIEW

TYPE C1 - LONGITUDINAL CHANNEL MARGIN JAM

NOT TO SCALE

TYPE C1 - LONGITUDINAL CHANNEL MARGIN JAM

Log Type	Size (DBH)	Min Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	-	-	-	-	-
Medium	12" - 18"	30'	No	-	No	1
Racking	6" - 12"	25'	No	-	No	2
Pinning	12"	-	-	-	-	-
Tree Tops & Branches (CY)	1" - 6"	5'	-	-	Yes	10
Large Boulders	>24"	-	-	-	-	-

* DBH = Diameter at Breast Height

Notes:

Purpose:

- * Temporarily stabilize new banks in the short term to restore aquatic and riparian habitats.
- * Maintain scour holes.
- * Sort and retain gravel.
- * Create diverse fish habitat on river margin.
- * Provide cover.
- * Divert high flows into side channels and floodplain.

Design Specifics:

1. Key log shall be placed so its upstream end rests on stream bed, and its downstream end is embedded up to 6". Backfill and compact around key log with riffle material.
2. Racking logs shall be installed on top of key log.
3. Place in areas where bank protection is required.
4. All visible ends of logs shall be cut or broken off to create natural appearance. No flat cuts allowed.
5. If located in Side Channels, Medium Logs could be used (configuration may also change).
6. Structure location may be field adjusted by C.O.

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TYPE C1 -
LONGITUDINAL
CHANNEL MARGIN JAM

1678-100-60770

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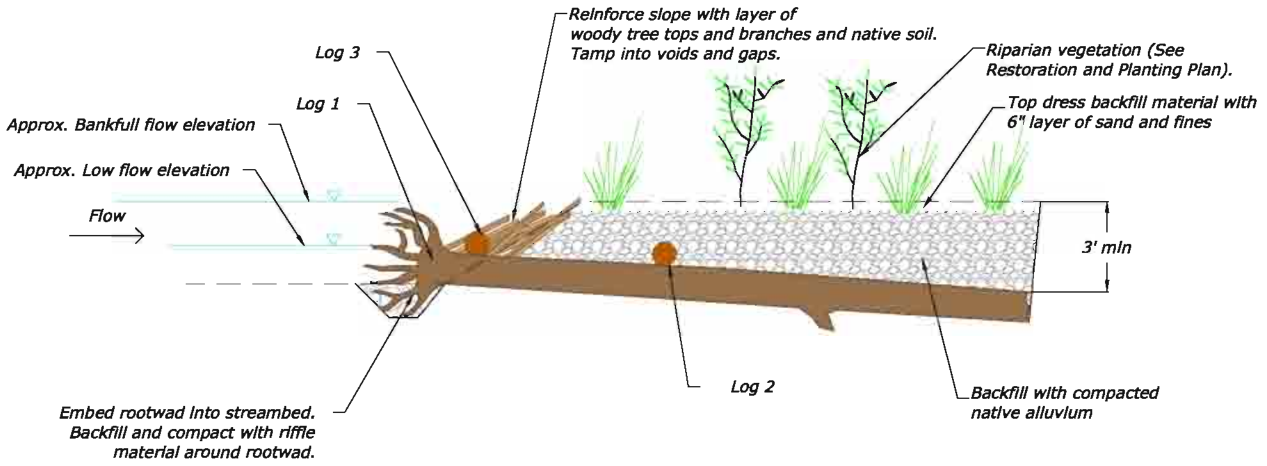

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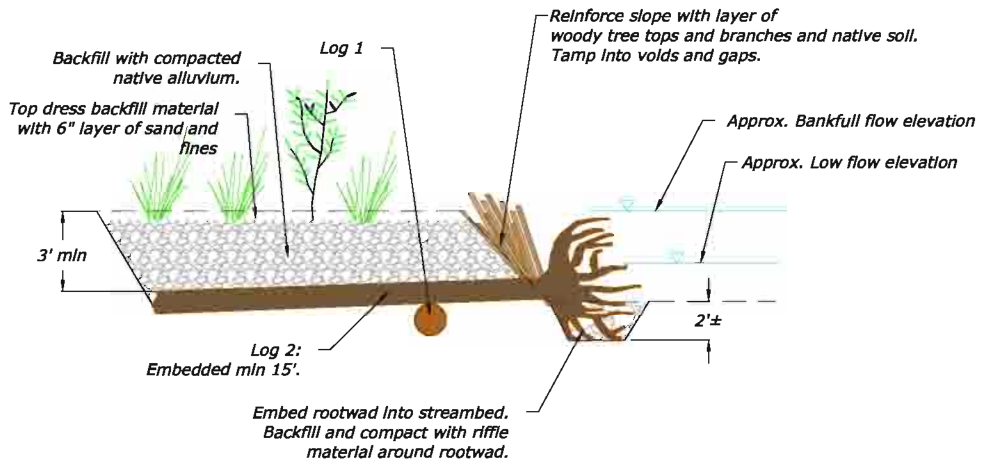

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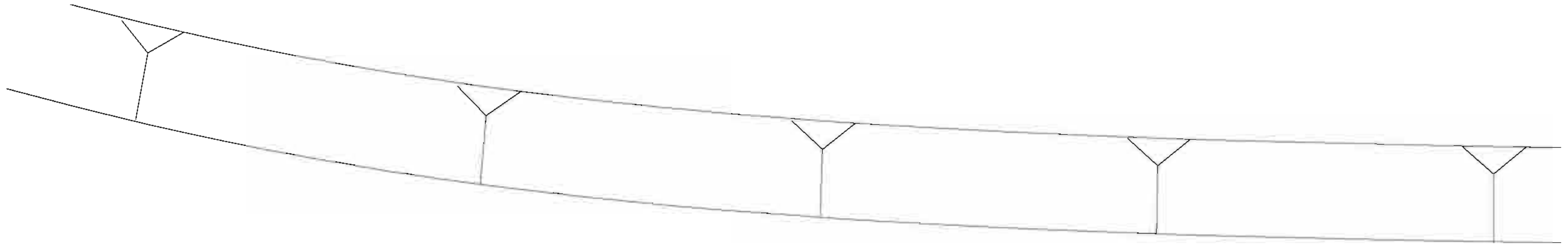

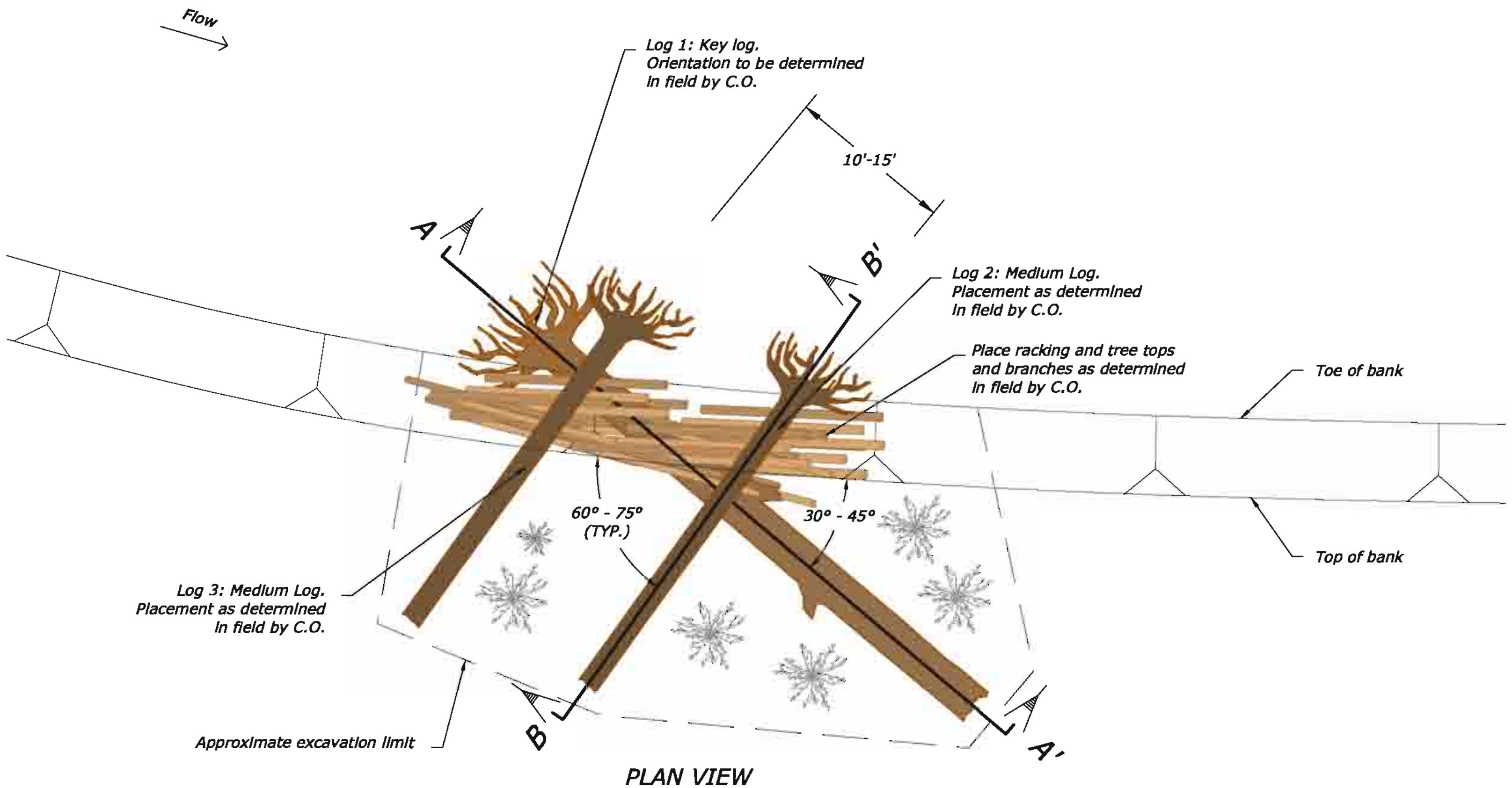

PLAN VIEW

TYPE C2 - ANGLED CHANNEL MARGIN JAM

NOT TO SCALE

TYPE C2 - ANGLED CHANNEL MARGIN JAM

Log Type	Size (DBH)	Min Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	40'	Yes	5'	Yes	1
Medium	12" - 18"	25'	Optional	3'	No	2
Racking	6" - 12"	25'	Optional	-	Optional	20
Pinning	12"	-	-	-	-	-
Tree Tops & Branches (CY)	1" - 6"	5'	-	-	Yes	20
Large Boulders	>24"	-	-	-	-	-

* DBH = Diameter at Breast Height

Notes:

Purpose:

- * Temporarily stabilize new banks in the short term to restore aquatic and riparian habitats.
- * Maintain scour holes by flow convergence.
- * Sort and retain gravel.
- * Create diverse fish habitat along channel margin.
- * Provide cover.
- * Divert high flows into side channels and floodplain.

Design Specifics:

1. Place through straight reaches.
2. Place rootwad on or in stream bed.
3. Trees with branches or multiple trunks preferred.
4. Log 1 shall be placed so its upstream end rests on stream bed with its rootwad embedded. Backfill and compact around Log 1 with riffle material.
5. Log 1 orientation shall be directed in field by C.O.
6. Log 2 and Log 3 shall be installed on top of Log 1.
7. tree tops and branches material shall be placed between key members.
8. If located in Side Channels, Medium Logs with rootwads could be used.
9. Structure location and construction may be field adjusted by the C.O.

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TYPE C2 - ANGLED
CHANNEL MARGIN JAM

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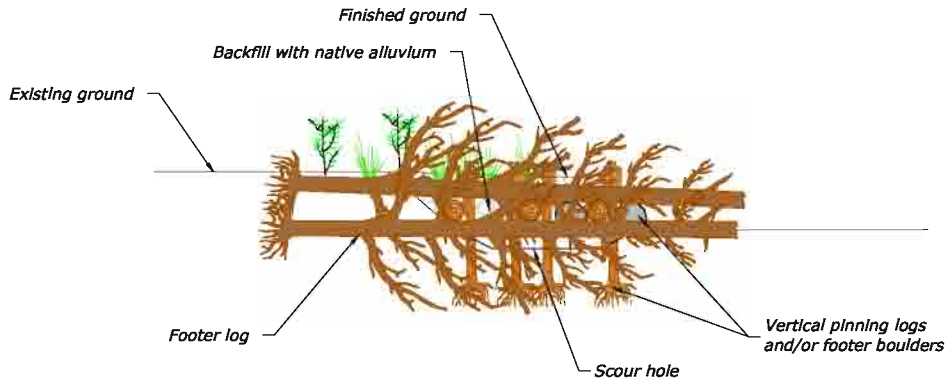
LONGITUDINAL JAM.DWG



SECTION A-A'

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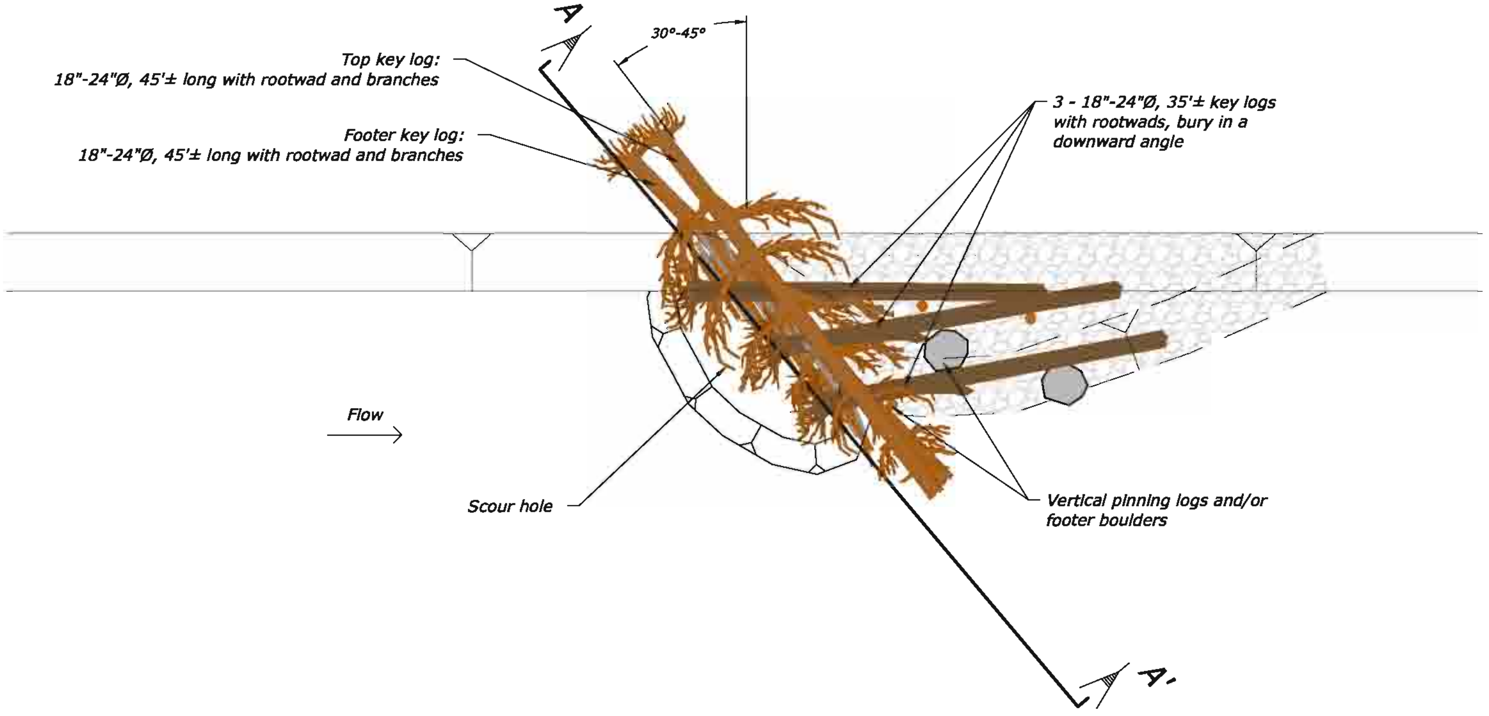

PLAN VIEW

TYPE D1 - DEFLECTOR JAM - SMALL

NOT TO SCALE

TYPE D1 - DEFLECTOR JAM

Log Type	Size (DBH)	Min. Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	45'	Yes	5'	Yes	2
Key	18" - 24"	35'	Yes	5'	No	3
Medium	12" - 18"	-	-	-	-	-
Racking	6" - 12"	20'	Optional	-	Optional	10
Pinning	12"	20'	Yes	3'	No	5
Tree Tops & Branches (CY)	1" - 6"	5'	-	-	Yes	20
Large Boulders	>24"	-	-	-	-	2

* DBH = Diameter at Breast Height

Notes:

Purpose:
- * Redirect high flows.
- * Create scour pools.
- * Provide cover and shade.

Design Specifics:
1. Placed on the outside of channel bends.
2. Trees with branches or multiple trunks preferred.
3. Racking logs and slash shall have irregular and natural appearance and not stacked.
4. Backfill with native alluvium. Top dress backfill material with 6" layer of sand and fines and plant vegetation per Restoration and Planting Plan.
5. Structure location may be field adjusted by C.O.

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TYPE D1 - DEFLECTOR JAM

SMALL

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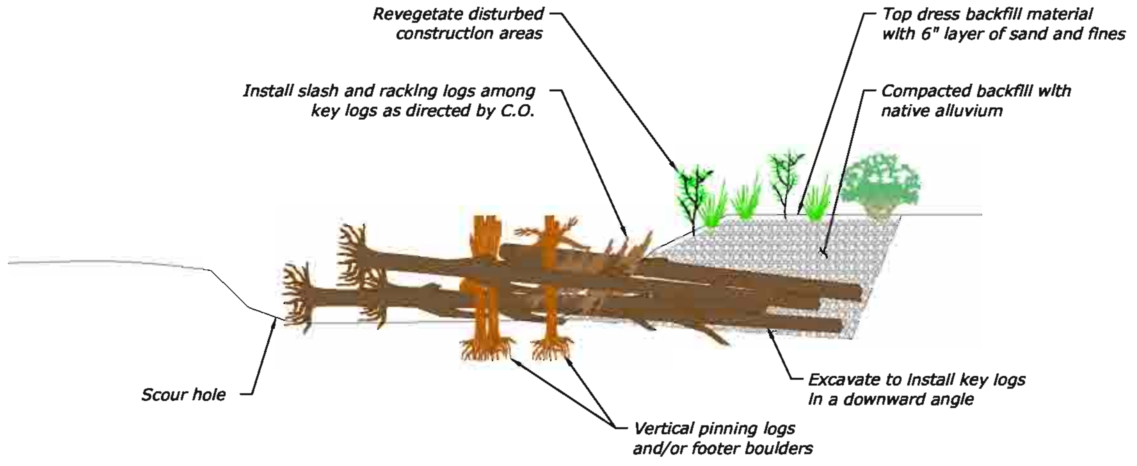

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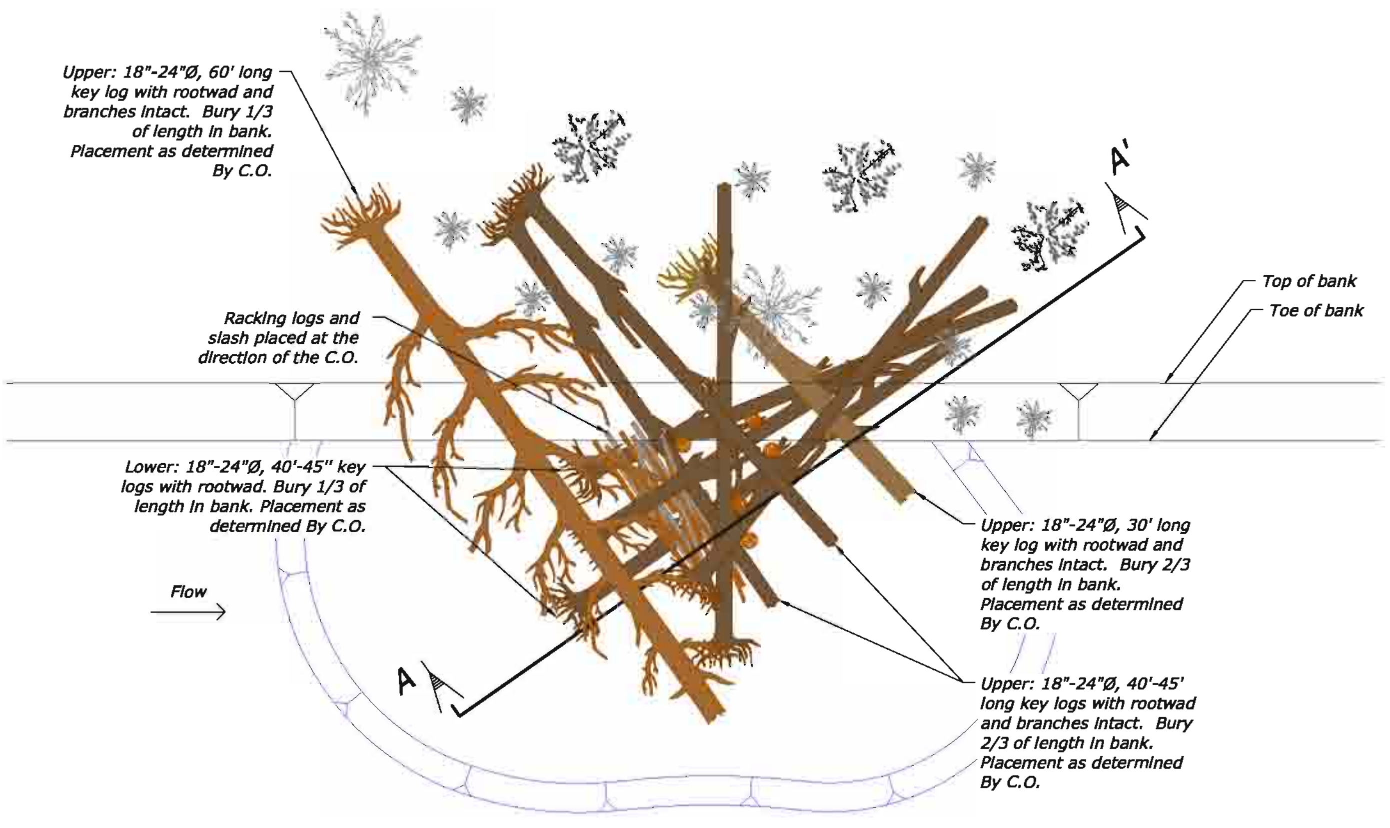

PLAN VIEW

TYPE D2 - DEFLECTOR JAM - LARGE
NOT TO SCALE

TYPE D2 - DEFLECTOR JAM

Log Type	Size (DBH)	Min. Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	60'	Yes	5'	Yes	1
Key	18" - 24"	45'	Yes	5'	Optional	7
Key	18" - 24"	30'	Yes	5'	Optional	1
Medium	12" - 18"	-	-	-	-	-
Racking	6" - 12"	20'	Optional	-	Optional	30
Pinning	12"	20'	Yes	3'	No	5
Tree Tops & Branches (CY)	1" - 6"	5'	-	-	Yes	30
Large Boulders	>24"	-	-	-	-	-

* DBH = Diameter at Breast Height

Notes:

Purpose:
- * Redirect high flows.
- * Create scour pools.
- * Provide cover and shade.
- * Enhance fish habitat complexity and diversity.

Design Specifics:
1. Placed on the outside of channel bends.
2. Trees with branches or multiple trunks preferred.
3. Racking logs and slash shall have irregular and natural appearance and not stacked.
4. Backfill with native alluvium. Top dress backfill material with 6" layer of sand and fines and plant vegetation per Restoration and Planting Plan.
5. Structure location may be field adjusted by C.O.

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TYPE D2 - DEFLECTOR JAM

LARGE

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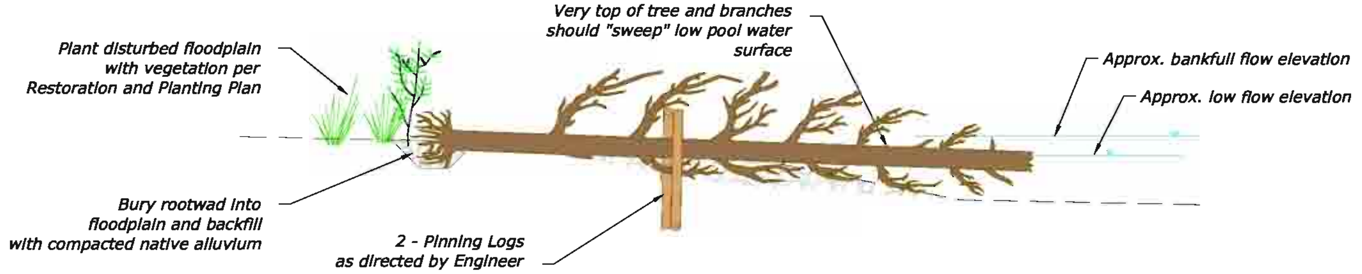

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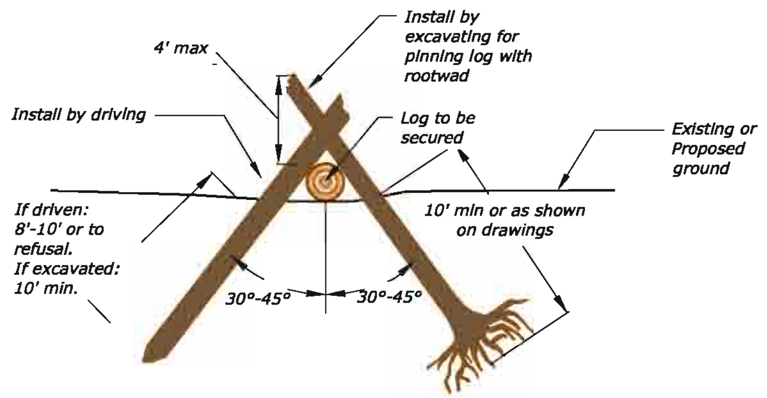

PINNING LOGS
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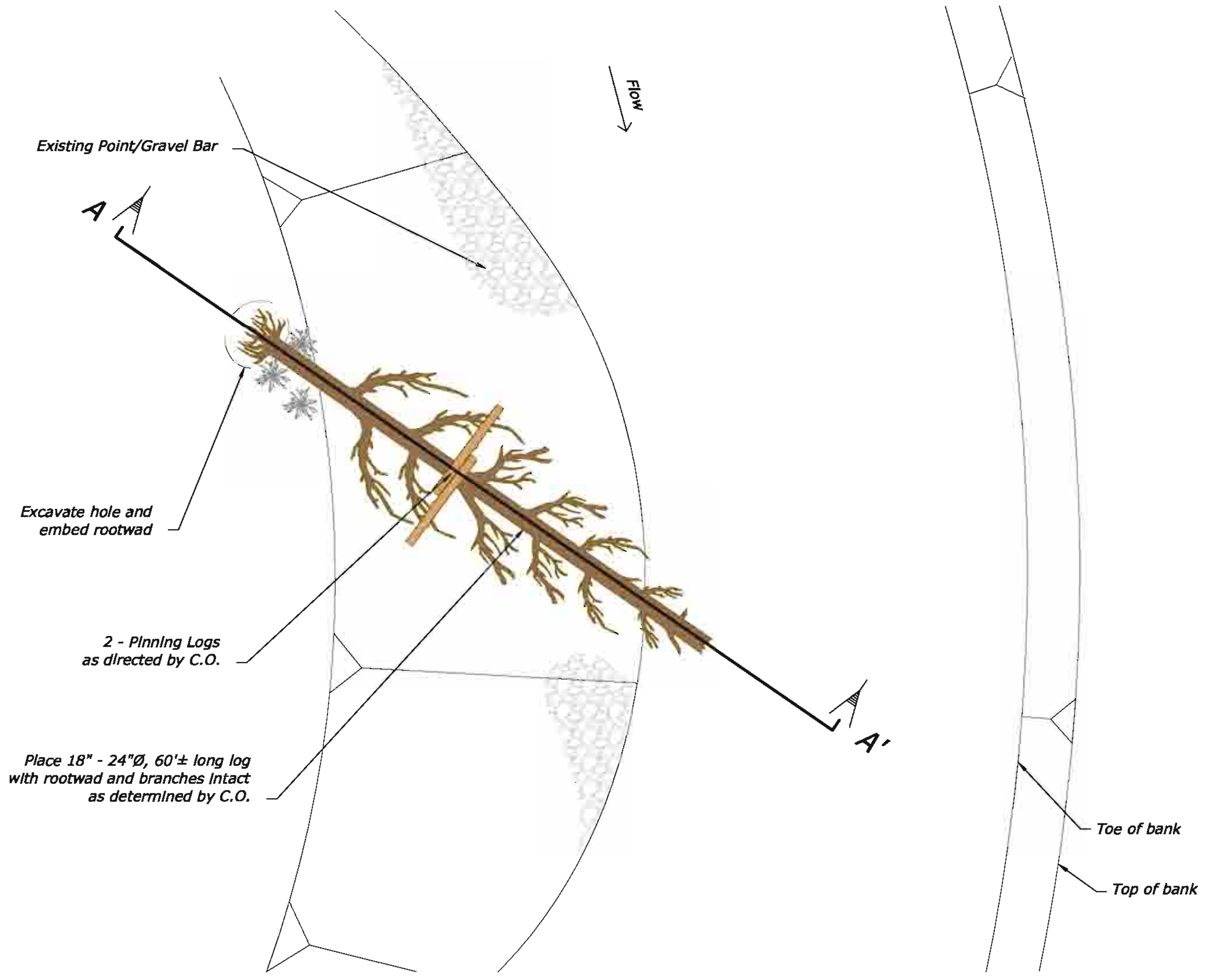

PLAN VIEW

TYPE E - SINGLE LOG SWEEPER JAM
NOT TO SCALE

TYPE E - SINGLE LOG SWEEPER JAM

Log Type	Size (DBH)	Min Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	60'	Yes	6'	Yes	1
Medium	12" - 18"	-	-	-	-	-
Racking	6" - 12"	-	-	-	-	-
Pinning	12"	20'	Optional	-	No	2
Tree Tops & Branches (CY)	1" - 6"	-	-	-	-	-
Large Boulders	>24"	-	-	-	-	-

* DBH = Diameter at Breast Height

Notes:

Purpose:
- * Redirect flow.
- * Create scour holes.
- * Encourage gravel deposition.

Design Specifics:
1. Place sweeper at upstream or downstream end of bend; and on the inside of bend.
2. Place sweeper in areas of low shear stress or low scouring risk.
3. Trees with branches or multiple trunks preferred.
4. Pinning logs to be driven. If pinning logs cannot be driven, then pinning logs with rootwads shall be used and installed by excavation.
5. All visible ends of logs shall be cut or broken off to create natural appearance. No flat cuts allowed.
6. Structure location may be field adjusted by the C.O.

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SWEEPER JAM.DWG

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TYPE E - SINGLE LOG SWEEPER JAM

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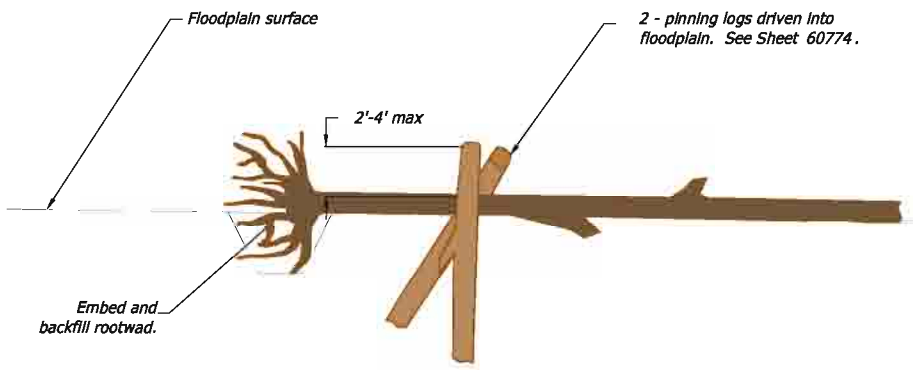

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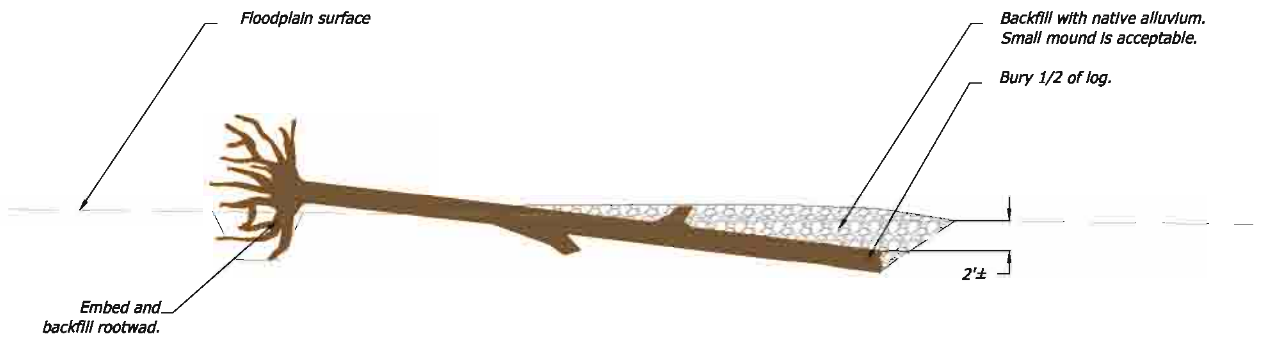

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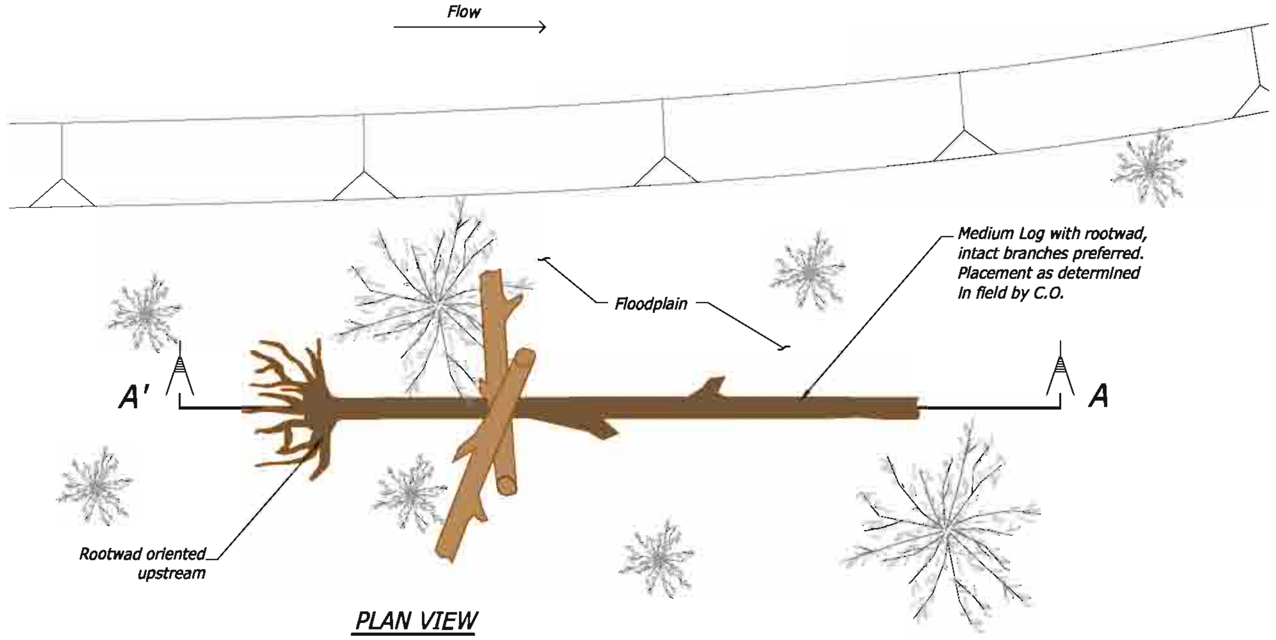
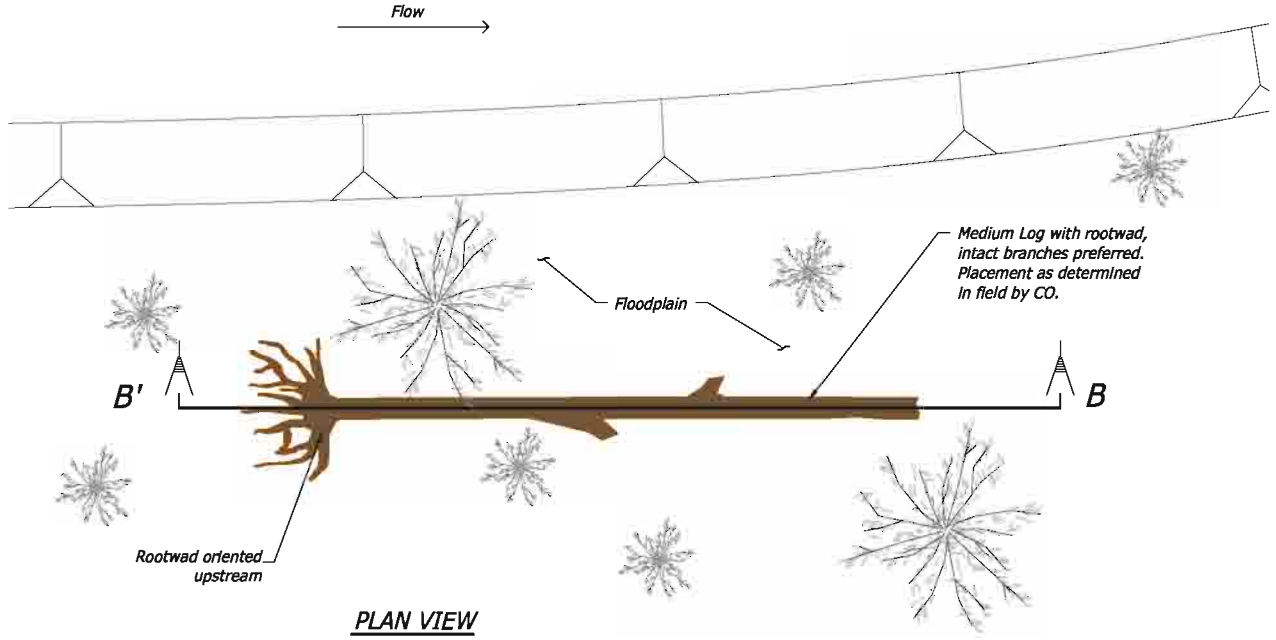


PLAN VIEW



PLAN VIEW

TYPE F - FLOODPLAIN ROUGHNESS (PINNED)

NOT TO SCALE

TYPE F - FLOODPLAIN ROUGHNESS (PARTIALLY BURIED)

NOT TO SCALE

TYPE F - FLOODPLAIN ROUGHNESS

Log Type	Size (DBH)	Min Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	-	-	-	-	-
Medium	12" - 18"	30'	Yes	3'	Optional	1
Racking	6" - 12"	-	-	-	-	-
Pinning	12"	20'	Optional	-	No	2**
Tree Tops & Branches (CY)	1" - 6"	-	-	-	-	-
Large Boulders	>24"	-	-	-	-	-

* DBH = Diameter at Breast Height
** 2 Pinning logs required in locations where roughness log is pinned

Notes:

Purpose:

- * Increase hydraulic roughness of floodplain.
- * Encourage sediment deposition

Design Specifics:

1. Install on floodplains with low shear stress.
2. Pinning logs to be driven or excavated.
3. All visible ends of logs shall be cut or broken off to create natural appearance. No flat cuts allowed.
4. Structure location may be field adjusted by the C.O.

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GRANDE RONDE RIVER SUBBASIN
BIRD TRACK SPRINGS FISH HABITAT
ENHANCEMENT PROJECT

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TYPE F - FLOODPLAIN
ROUGHNESS

1678-100-60775

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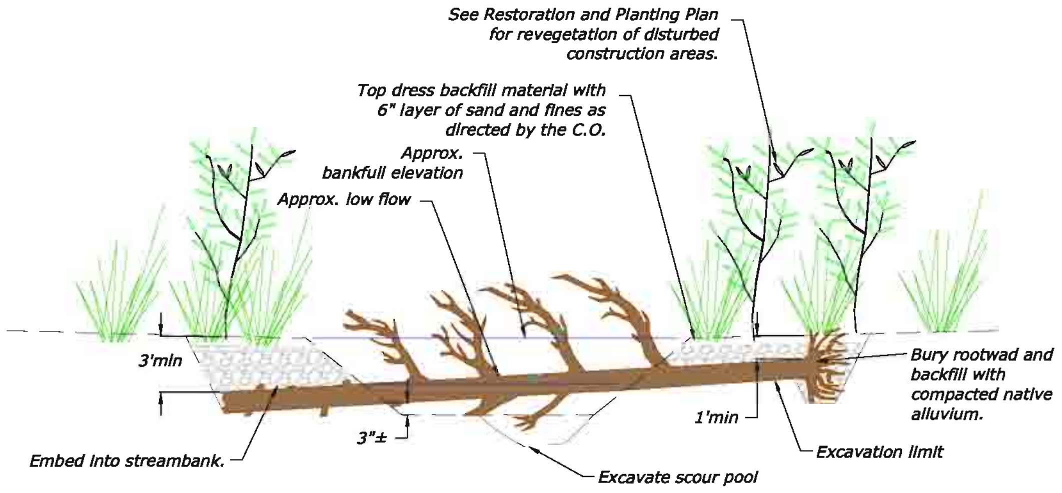
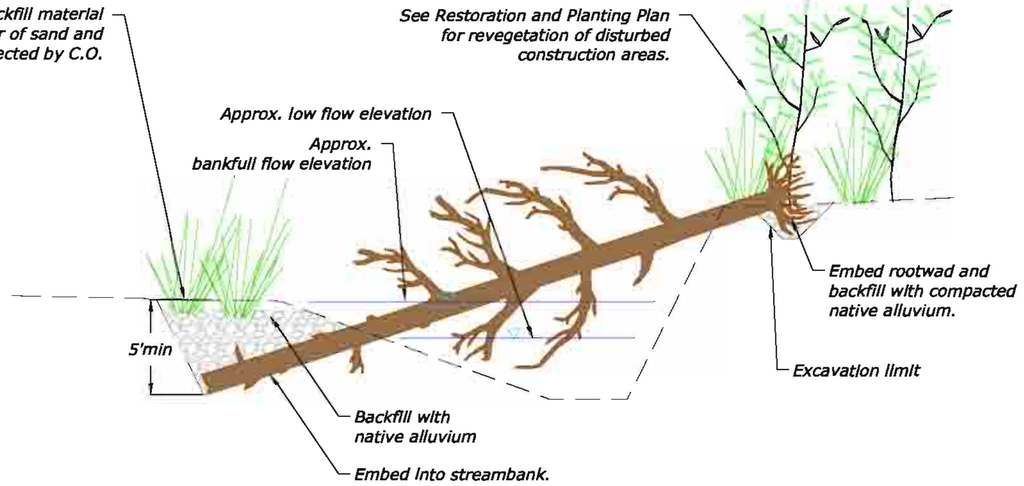


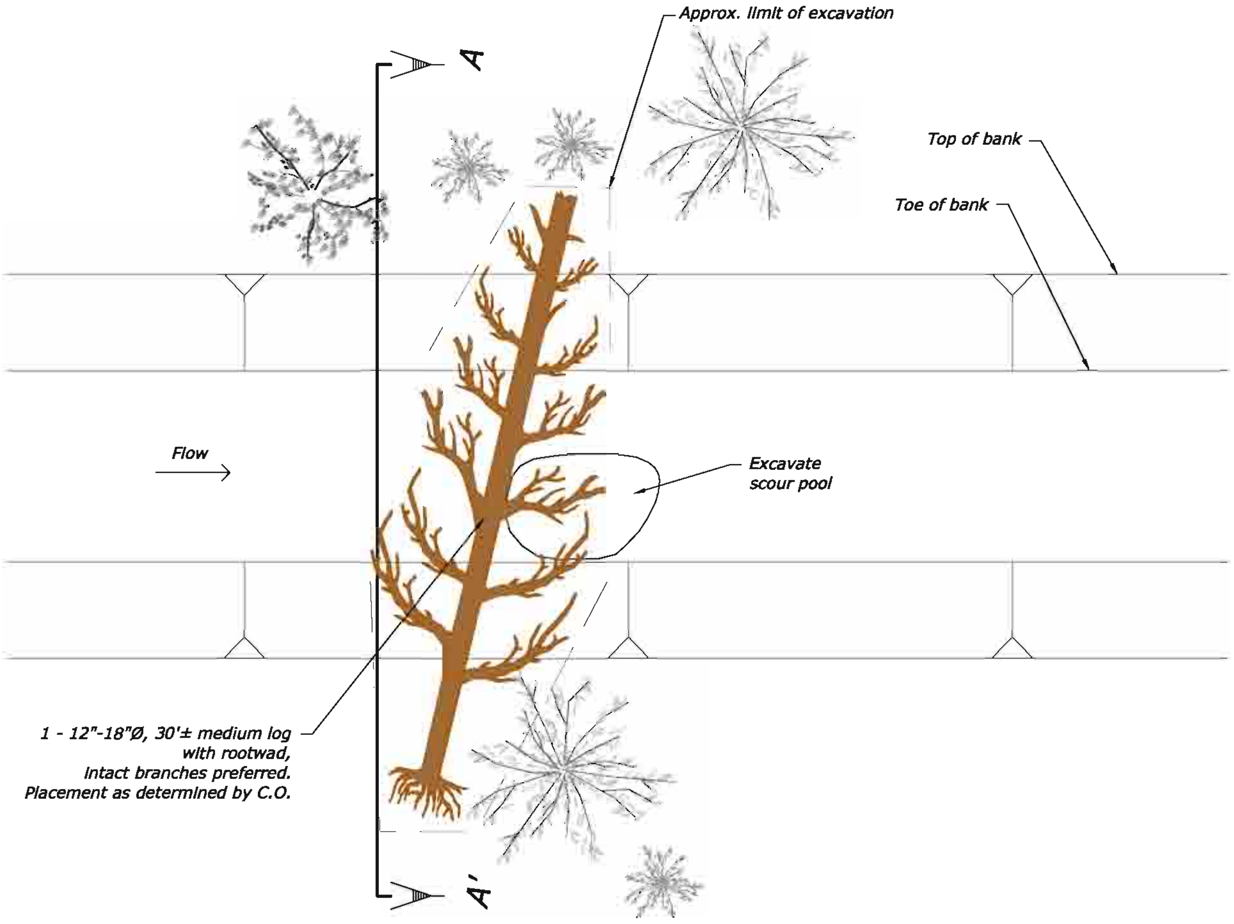
SECTION A-A' ON LOW BANK

NOT TO SCALE



SECTION A-A' ON HIGH BANK

NOT TO SCALE



PLAN VIEW

TYPE G1 - SC HABITAT - SINGLE LOG

NOT TO SCALE

TYPE G1 - SC HABITAT - SINGLE LOG

Log Type	Size (DBH)	Min. Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	-	-	-	-	-
Medium	12" - 18"	30'	Yes	3'	Yes	1
Racking	6" - 12"	-	-	-	-	-
Pinning	12"	-	-	-	-	-
Tree Tops & Branches (CY)	1" - 6"	-	-	-	-	-
Large Boulders	>24"	-	-	-	-	-

* DBH = Diameter at Breast Height

Notes:

Purpose:
- * Mimic trees falling into the channel.
- * Create scour holes.
- * Provide cover.

Design Specifics:
1. Placed in Side Channels only.
2. Crossing logs shall be in contact with water at low flow to create scour pool.
3. Trees with branches intact preferred.
4. Structure location may be field adjusted by the C.O.

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CHANNEL SPANNING JAMS.DWG

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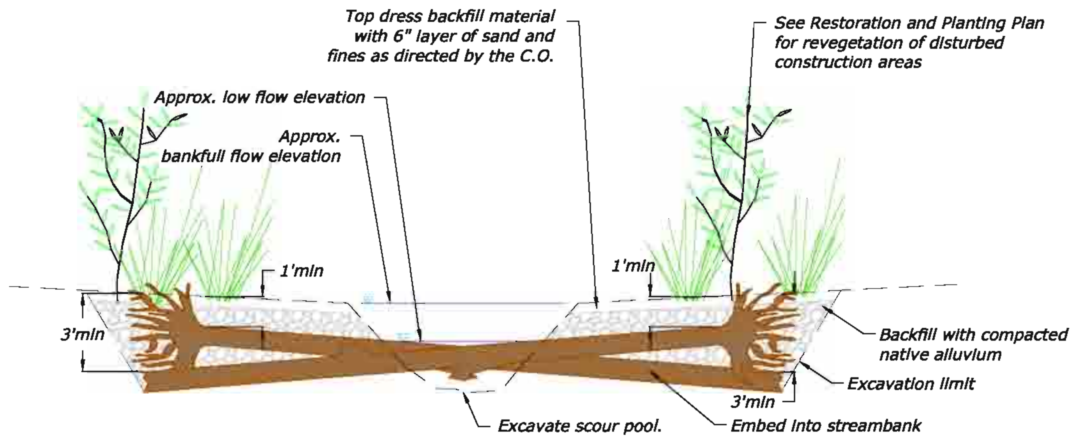
TYPE G1 - SC
HABITAT

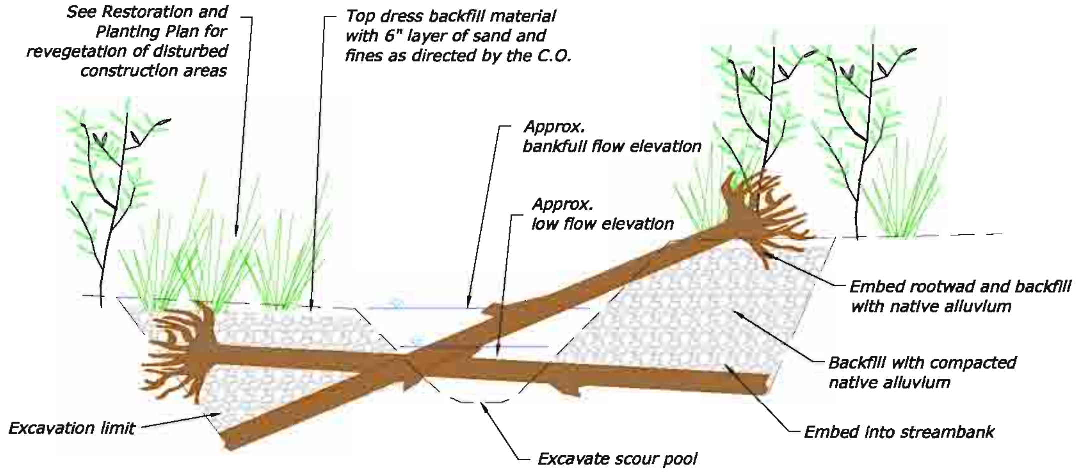
SINGLE LOG

1678-100-60776



SECTION A-A' ON LOW BANK

NOT TO SCALE



SECTION A-A' ON HIGH BANK

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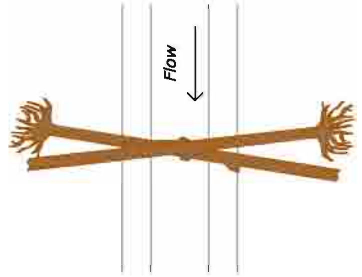
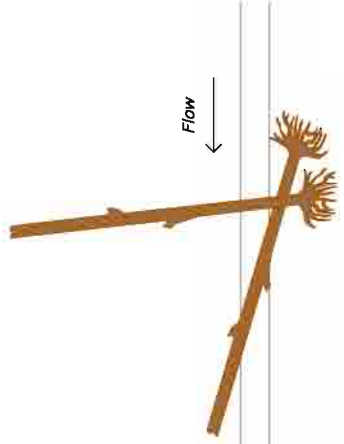
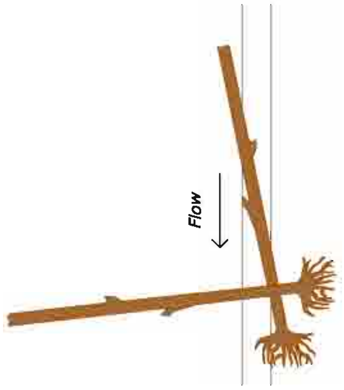


CHANNEL SPANNING OPTION

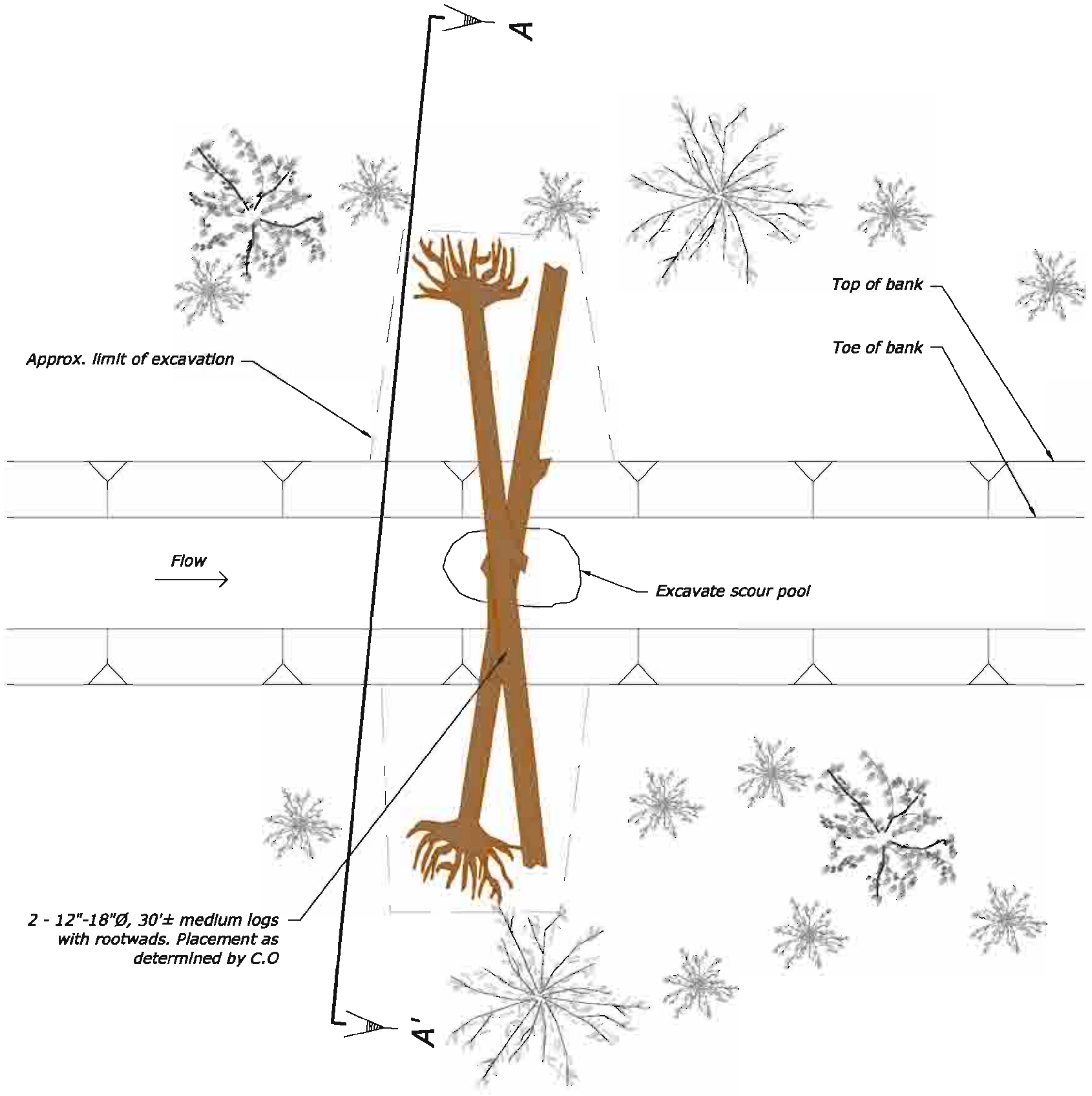


NON SPANNING OPTION 1



NON SPANNING OPTION 2

SC HABITAT DOUBLE LOG CONFIGURATIONS



PLAN VIEW

TYPE G2 - SC HABITAT - DOUBLE LOG

NOT TO SCALE

TYPE G2 - SC HABITAT - DOUBLE LOG

Log Type	Size (DBH)	Min. Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	-	-	-	-	-
Medium	12" - 18"	30'	Yes	3'	No	2
Racking	6" - 12"	-	-	-	-	-
Pinning	12"	-	-	-	-	-
Tree Tops & Branches (CY)	1" - 6"	-	-	-	-	-
Large Boulders	>24"	-	-	-	-	-

* DBH = Diameter at Breast Height

Notes:

Purpose:

- Mimic trees falling into the channel.
- Create scour holes.
- Provide cover.

Design Specifics:

1. Placed in Side Channels as directed by C.O.
2. Crossing logs shall be in contact with water at low flow to create scour pool.
3. Structure will be field located by the C.O.
4. Use existing standing trees for bracing.

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TYPE G2 - SC
HABITAT

DOUBLE LOG

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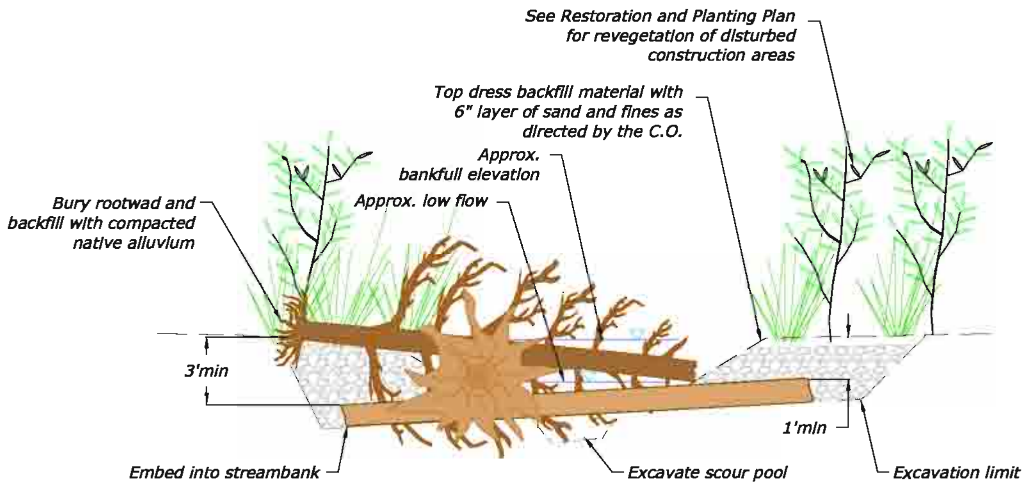
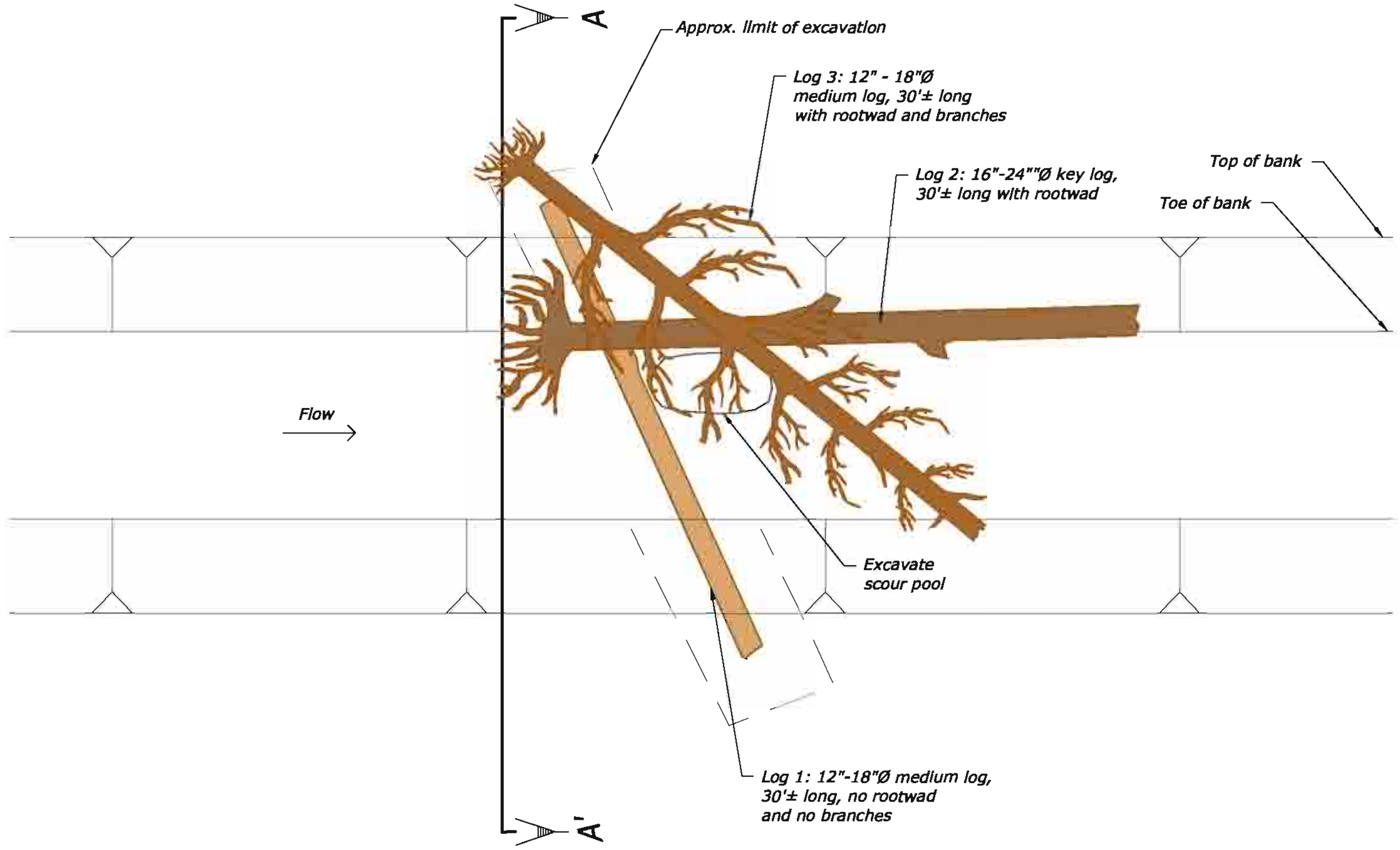


SECTION A-A'

NOT TO SCALE



PLAN VIEW

TYPE G3 - SC HABITAT - TRIPLE LOG

NOT TO SCALE

TYPE G3 - SC HABITAT - TRIPLE LOG						
Log Type	Size (DBH)	Min. Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	30'	Yes	5'	No	1
Medium	12" - 18"	30'	Yes	3'	Yes	1
Medium	12" - 18"	30'	No	-	No	1
Racking	6" - 12"	-	-	-	-	-
Pinning	12"	-	-	-	-	-
Tree Tops & Branches (CY)	1" - 6"	-	-	-	-	-
Large Boulders	>24"	-	-	-	-	-

* DBH = Diameter at Breast Height

Notes:

Purpose:

- Mimic trees falling into the channel.
- Create scour holes.
- Provide cover.

Design Specifics:

1. Placed in Side Channels only.
2. Crossing logs shall be in contact with water at low flow to create scour pool.
3. Trees with branches intact preferred.
4. Structure location may be field adjusted by the C.O.

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CHANNEL SPANNING JAMS.DWG

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TYPE G3 - SC
HABITAT

TRIPLE LOG

1678-100-60778

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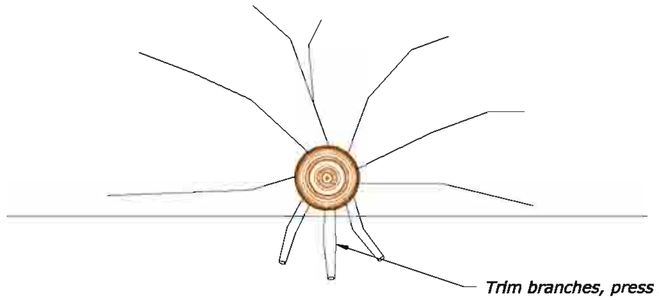
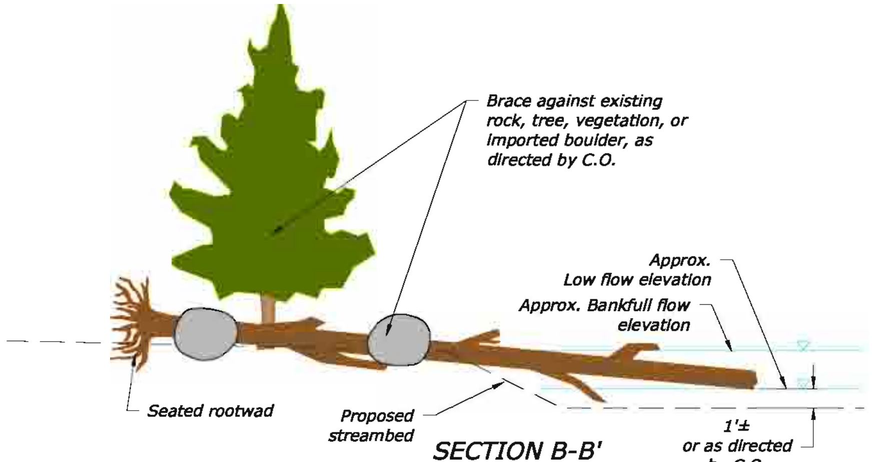


SECTION A-A'
NOT TO SCALE



SECTION B-B'
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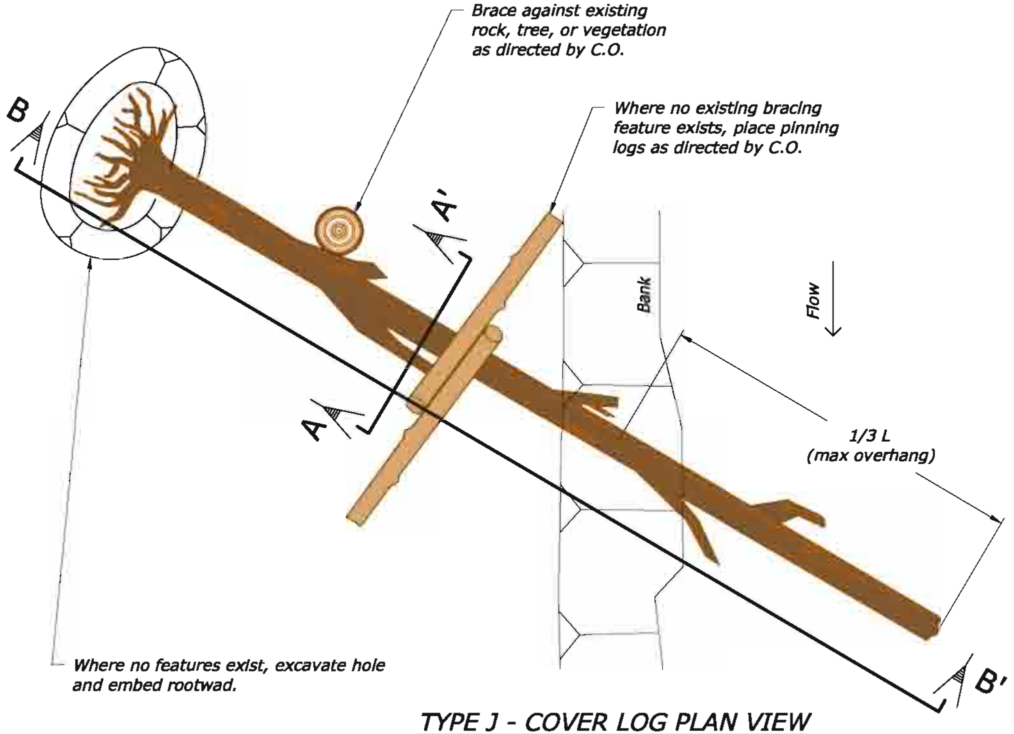
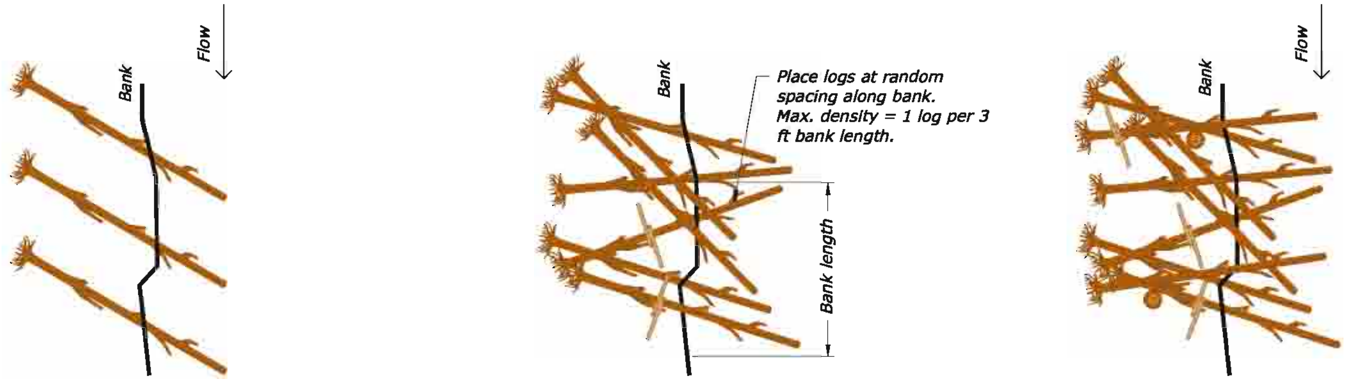


TYPE J - COVER LOG PLAN VIEW
NOT TO SCALE

TYPE H - COVER LOG						
Log Type	Size (DBH)	Min. Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	-	-	-	-	-
Medium	12" - 18"	-	-	-	-	-
Racking	6" - 12"	20'	Optional	-	Optional	3-6
Pinning	12"	20'	Optional	-	No	3-4
Tree Tops & Branches (CY)	1" - 6"	-	-	-	-	-
Large Boulders	>24"	-	-	-	-	-

* DBH = Diameter at Breast Height



NOT ACCEPTABLE
Uniform spacing
Parallel angles

ACCEPTABLE
Random spacing
Predominantly angled downstream
Varied angles

WHERE EXISTING FEATURES PERMIT
Bunch and cluster cover logs around existing vegetation, trees, or rock features.
Hook branches on existing features.
Lace logs through existing features.

TYPE H - COVER LOG
NOT TO SCALE

Notes:

Purpose:

- Provide cover.

Design Specifics:

1. Whole coniferous trees with rootwads and limbs intact are preferred. Limbs not shown for clarity.
2. Bottom of cover logs shall be in contact with water at low flow.
3. Number of cover logs will vary by location and will be determined in the field by the C.O.
4. Cover logs will be field located by the C.O.
5. Protect existing trees. Remove only trees as marked or directed by C.O.

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COVER LOGS DETAIL.DWG

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TYPE H - COVER LOG

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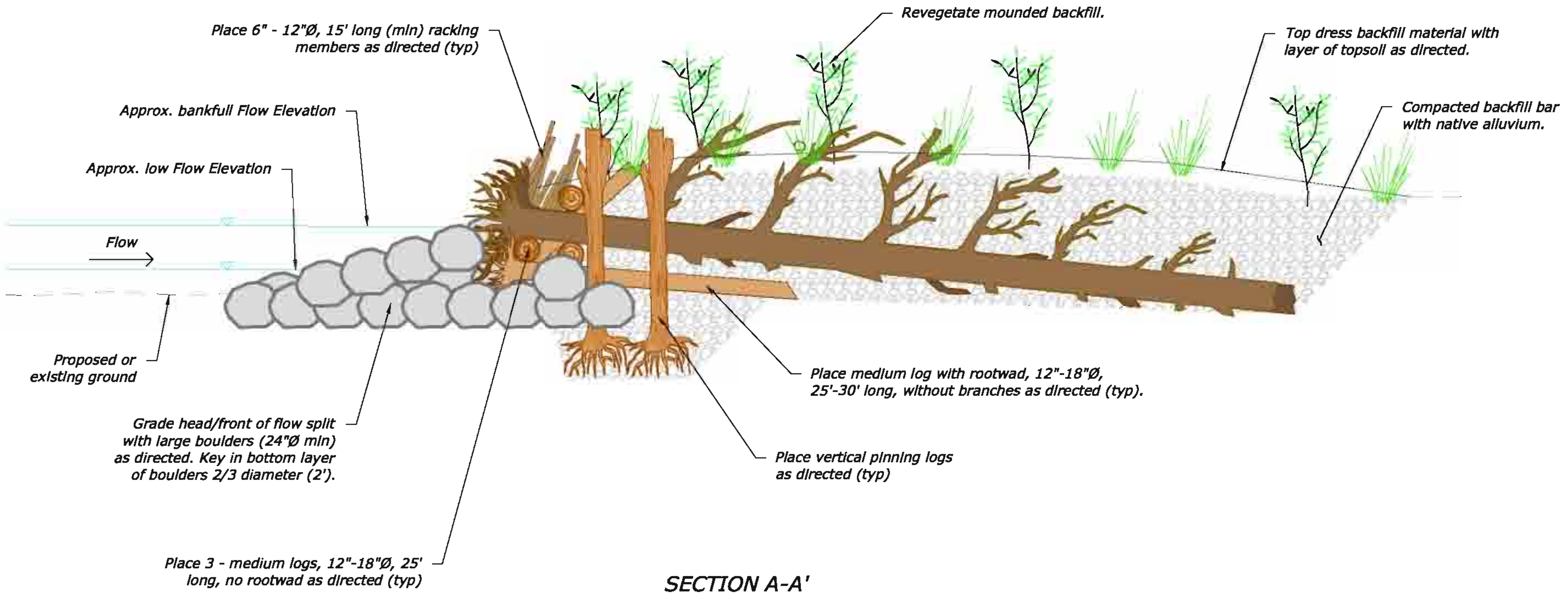
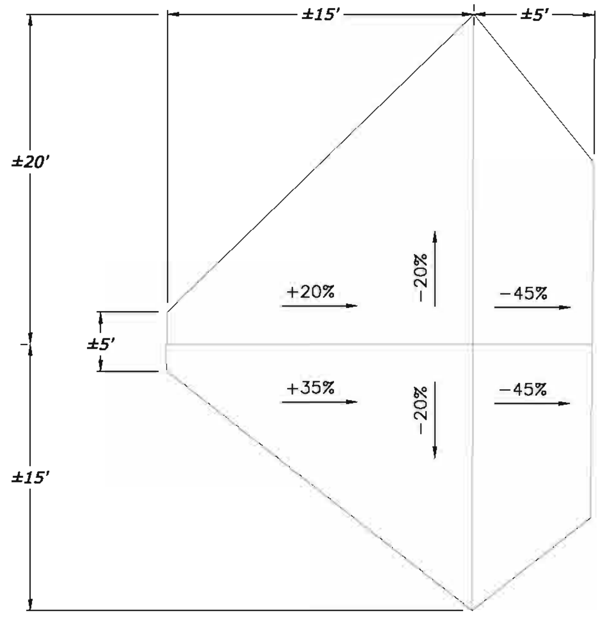


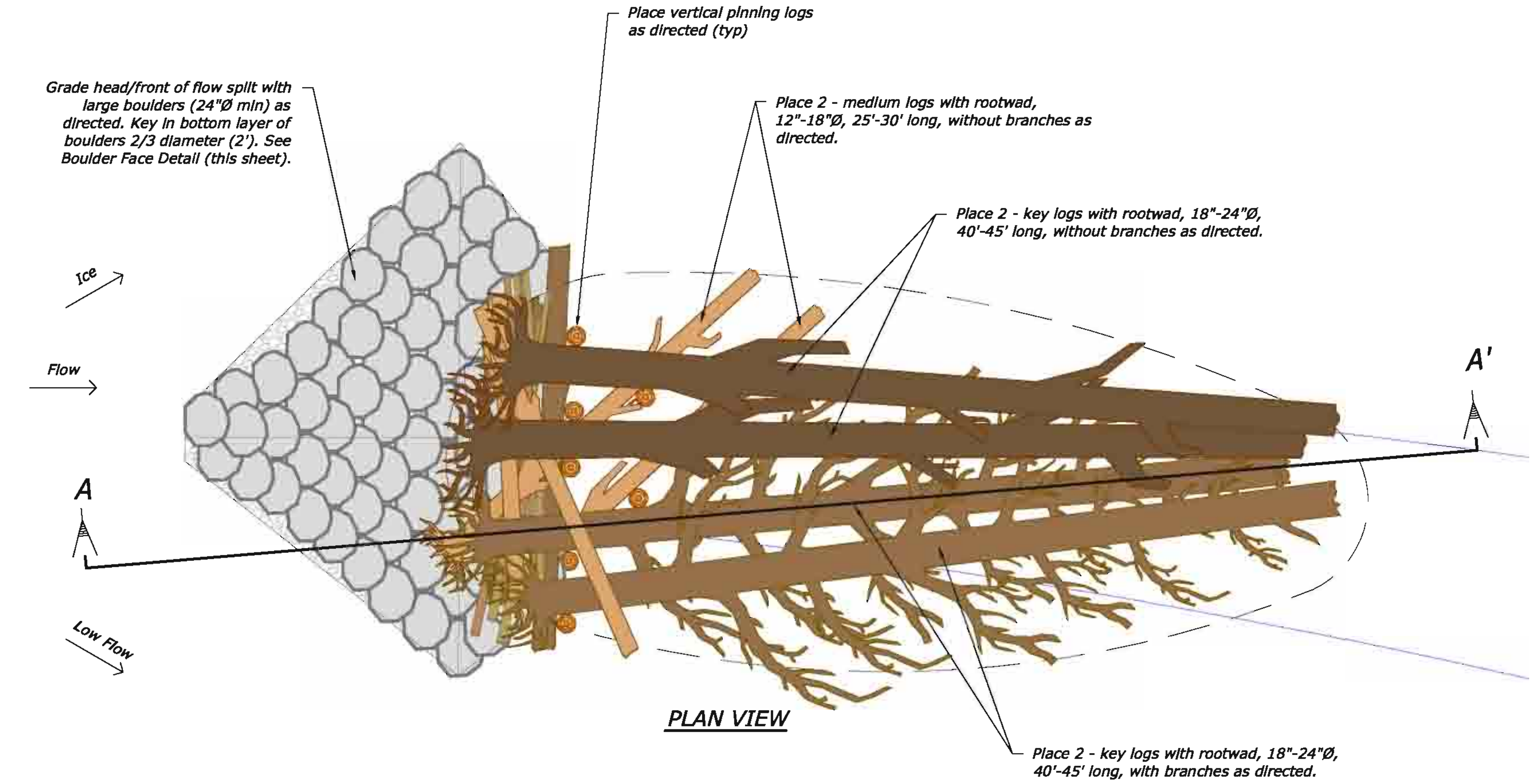
SECTION A-A'

NOT TO SCALE



BOULDER FACE DETAIL

NOT TO SCALE



PLAN VIEW

TYPE I - ICE DEFLECTION JAM

NOT TO SCALE

TYPE I - ICE DEFLECTION JAM

Log Type	Size (DBH)	Min. Length (ft)	Rootwad	Min. Rootwad Diameter (ft)	Branches	Quantity
Key	18" - 24"	45'	Yes	6'	Yes	2
Key	18" - 24"	45'	Yes	6'	No	2
Medium	12" - 18"	30'	Optional	4'	No	6
Racking	6" - 12"	15'	Optional	-	Optional	10
Pinning	12"	20'	Yes	3'	No	7
Tree Tops & Branches (CY)	1" - 6"	5'	-	-	Yes	20
Large Boulders	>24"	-	-	-	-	65

* DBH = Diameter at Breast Height

Notes:

Purpose:

- * Break-up and deflect ice.
- * Withstand impact from heavy ice flow.
- * Create split flow, and protect or create vegetated island or gravel bar.
- * Create scour pool and sort sediment.

Design Specifics:

1. Top of rootwad should not exceed more than 2 feet above top of mound.
2. Boulders shall be placed in layers. Voids within boulders shall be backfilled with native alluvium. Care shall be taken to ensure contact between large boulders is maintained.
3. Pinning logs shall be excavated and placed vertically with intact rootwad facing down.
4. Backfill material shall be well-graded mix (fines to boulders). Backfill material shall be approved. Backfill shall be placed in maximum 12" lifts and each lift compacted with bucket or tracks. Top dress backfill with 6" layer of topsoil.
5. All visible ends of logs shall be cutor broken off to create natural appearance. No flat cuts allowed.
6. North side of structure (river left) shall be hydraulically smooth to reduce potential ice snag and debris accumulation. Trees shall be limbed and logs shall not protrude out from structure.

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TYPE I - ICE
DEFLECTION JAM

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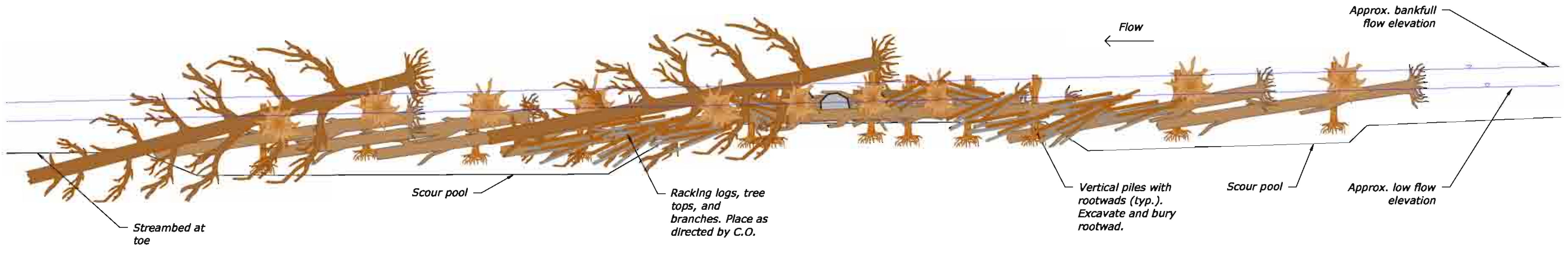
ICE JAM WITH ROCK.DWG



SECTION A-A'
NOT TO SCALE

PLAN VIEW

* DBH = Diameter at Breast Height

TYPE J - HIGHWAY PROTECTION JAM
NOT TO SCALE

Notes:

Purpose:

- Stabilize bank to protect highway.
- Deflect flow energy away from bank.
- Create scour pools.
- Mid-deflector and boulders create a large bank eddy current.
- Boulders intended to stabilize logs against rotation at design flows.
- Enhance fish habitat and complexity.

Design Specifics:

1. Topography and contours are proposed condition.
2. Pinning logs with rootwad should be excavated.
3. All visible end of logs shall be cut or broken off to create natural appearance. No flat cuts allowed.
4. Racking, treetops, and branches to have an irregular and natural appearance, not stacked.
5. Structure will be field located by the C.O.
6. Logs will be backfilled with compact engineered riffle material. Riffle material will be top dressed with a 6" layer of sand and fines.

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TYPE J - HIGHWAY PROTECTION JAM

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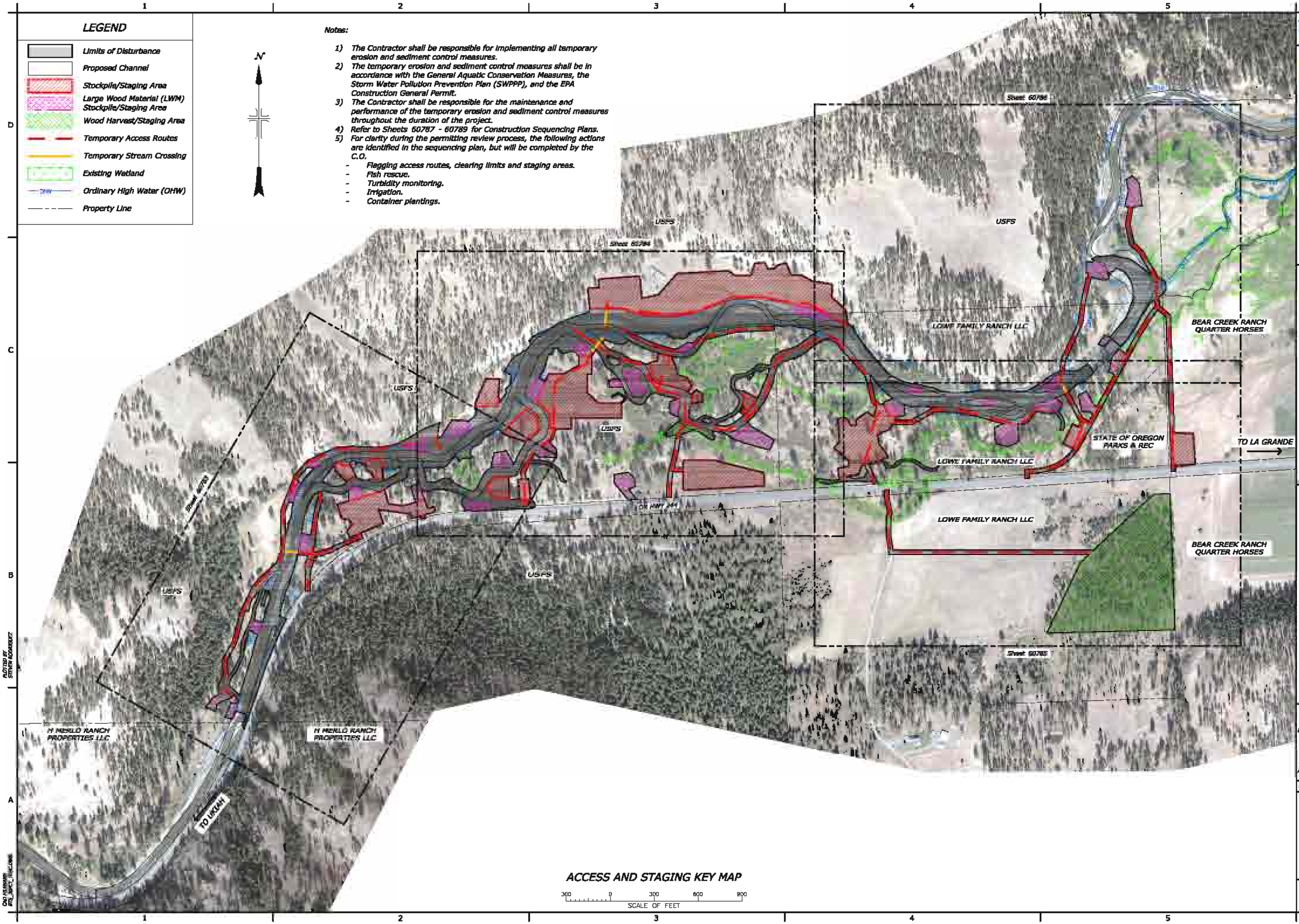

LEGEND

▭	Limits of Disturbance
▭	Proposed Channel
▨	Stockpile/Staging Area
▨	Large Wood Material (LWM) Stockpile/Staging Area
▨	Wood Harvest/Staging Area
— —	Temporary Access Routes
—	Temporary Stream Crossing
▭	Existing Wetland
—OHW—	Ordinary High Water (OHW)
— - - —	Property Line

Notes:

1) The Contractor shall be responsible for implementing all temporary erosion and sediment control measures.
2) The temporary erosion and sediment control measures shall be in accordance with the General Aquatic Conservation Measures, the Storm Water Pollution Prevention Plan (SWPPP), and the EPA Construction General Permit.
3) The Contractor shall be responsible for the maintenance and performance of the temporary erosion and sediment control measures throughout the duration of the project.
4) Refer to Sheets 60787 - 60789 for Construction Sequencing Plans.
5) For clarity during the permitting review process, the following actions are identified in the sequencing plan, but will be completed by the C.O.
   - Flagging access routes, clearing limits and staging areas.
   - Fish rescue.
   - Turbidity monitoring.
   - Irrigation.
   - Container plantings.

ACCESS AND STAGING KEY MAP

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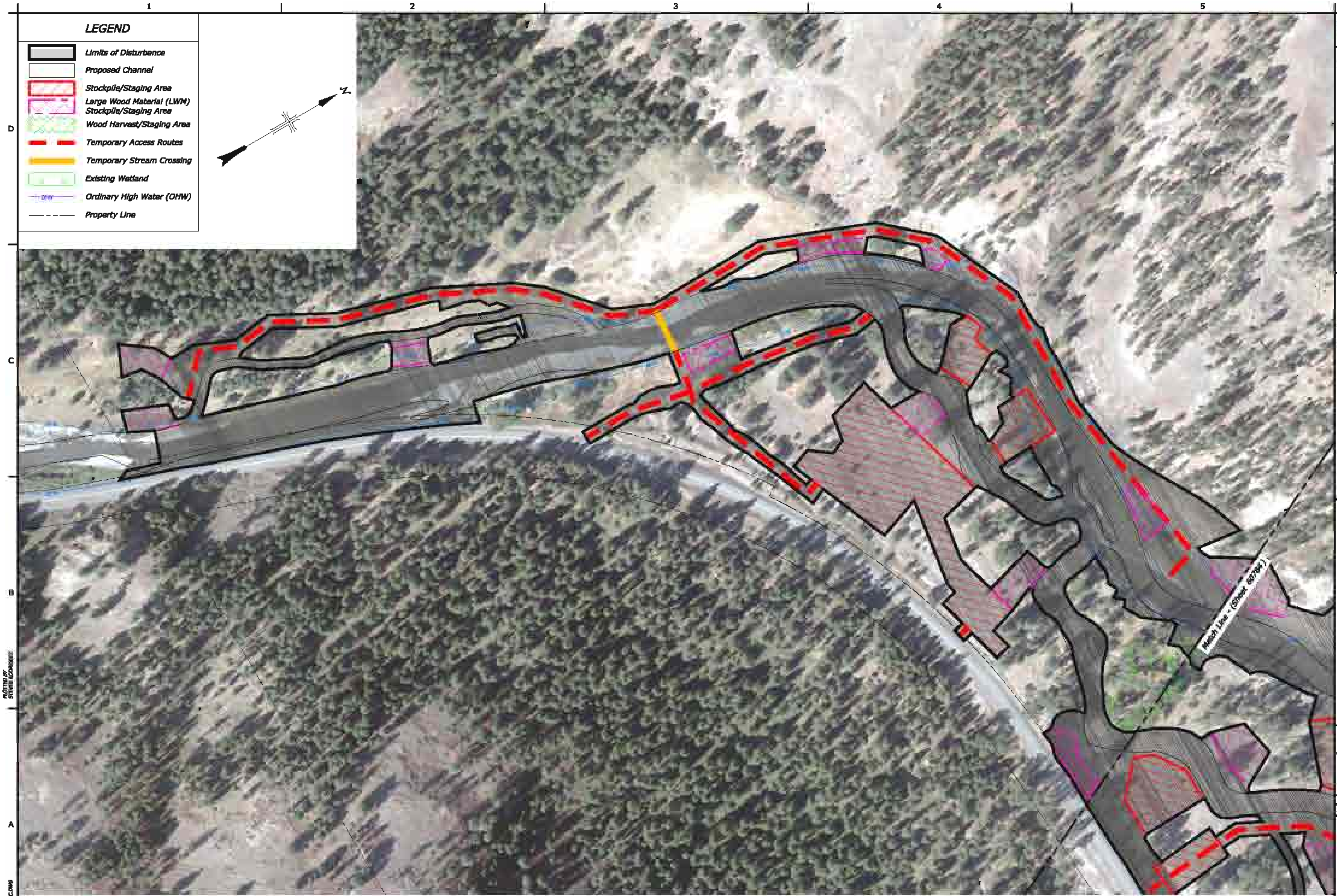
ACCESS AND STAGING
KEY MAP

1678-100-60782

SHEET 1 of 5

LEGEND

▬	Limits of Disturbance
☐	Proposed Channel
🟥	Stockpile/Staging Area
▨	Large Wood Material (LWM) Stockpile/Staging Area
🟩	Wood Harvest/Staging Area
‒ ‒	Temporary Access Routes
▬	Temporary Stream Crossing
☐	Existing Wetland
— OHW —	Ordinary High Water (OHW)
— - —	Property Line



ACCESS AND STAGING PLAN 1

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ACCESS AND STAGING
PLAN 1

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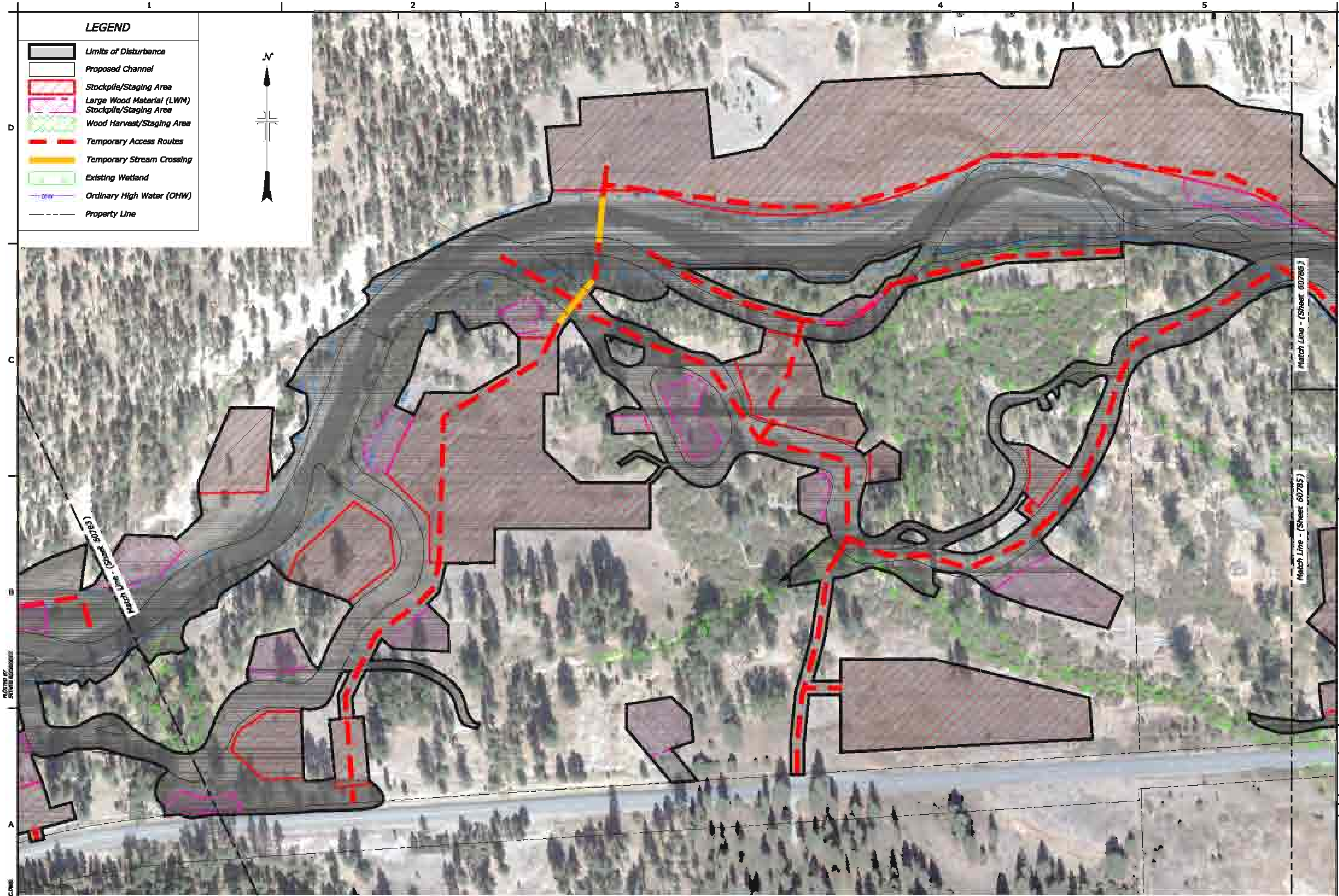

ACCESS AND STAGING PLAN 2

100 0 100 200 300
SCALE OF FEET

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ACCESS AND STAGING
PLAN 2

1678-100-60784

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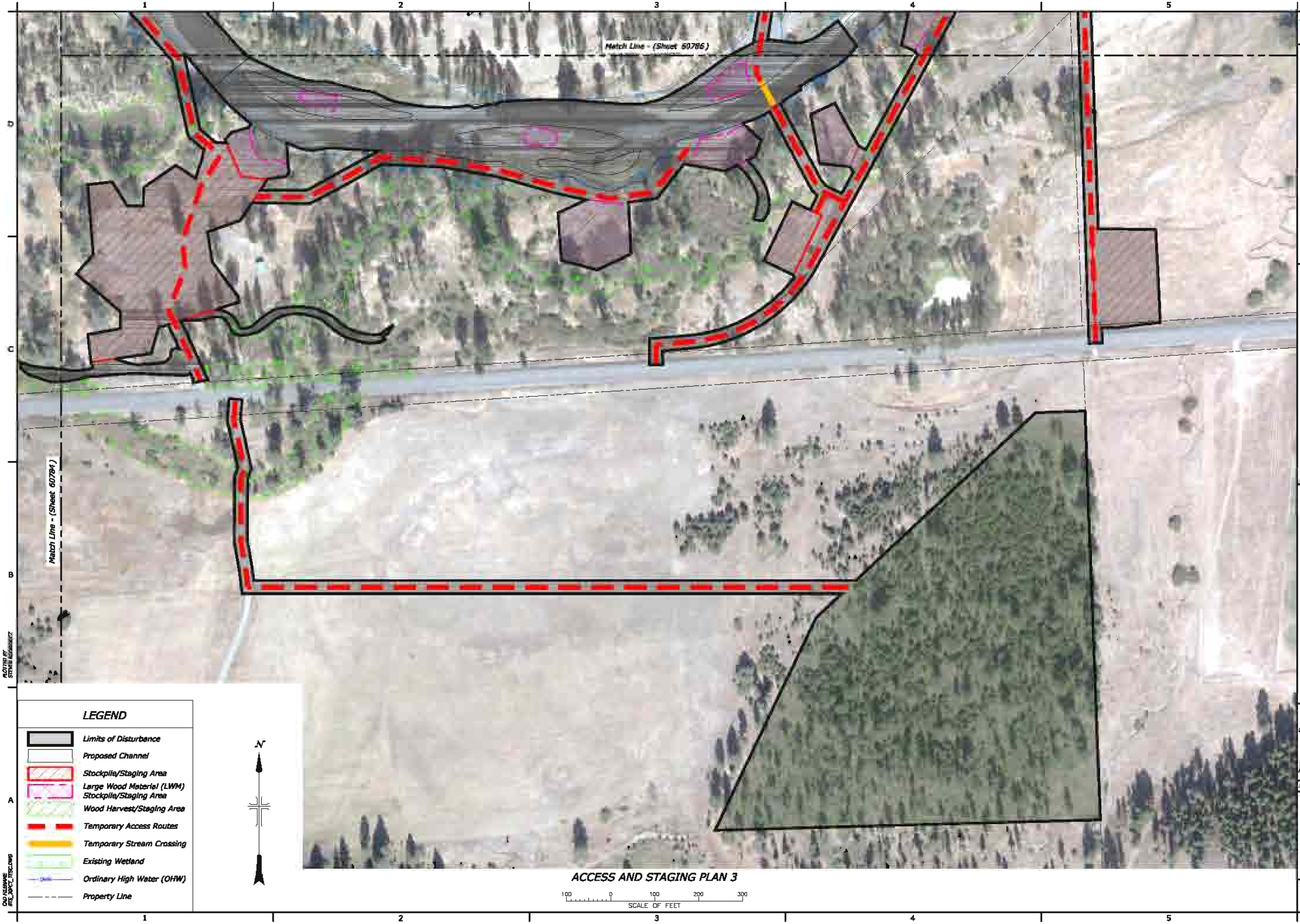

ACCESS AND STAGING PLAN 3

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ACCESS AND STAGING PLAN 3

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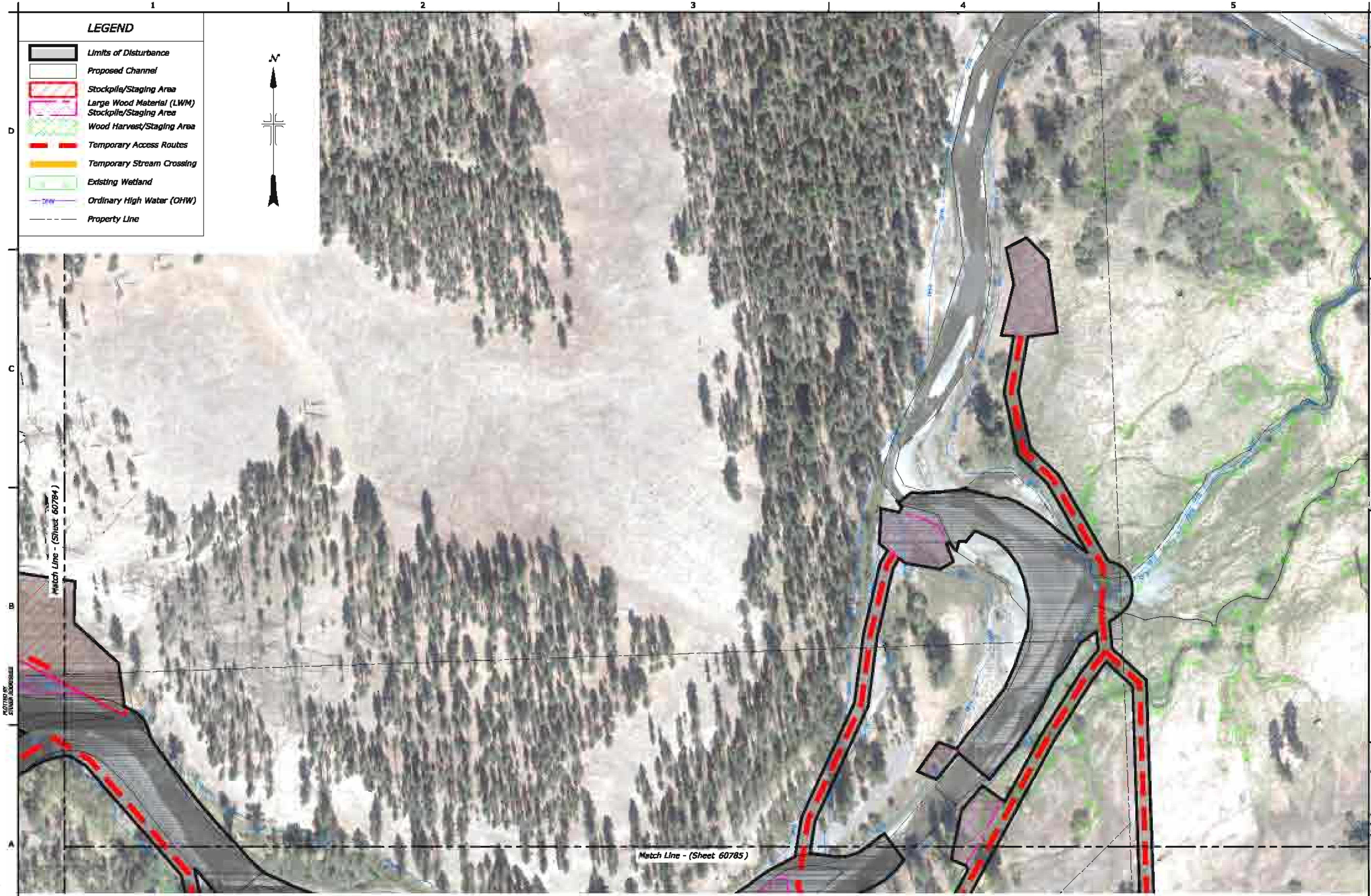

ACCESS AND STAGING PLAN 4

100 0 100 200 300
SCALE OF FEET

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GRANDE RONDE RIVER SUBBASIN
HOT SPRINGS FISH HABITAT
ENHANCEMENT PROJECT

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ACCESS AND STAGING
PLAN 4

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SHEET 5 of 5

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LEGEND

- ▨ Year 1 Construction Area
- ▨ Year 2 Construction Area
- ▨ Construction Areas for Year 1 and 2
- ■ Newly Constructed Channel
- — — Thalweg
- —·— Existing Wetlands
- —OHW— Ordinary High Water (OHW)
- — - — Property Line

Construction Timeline - Bird Track Springs

Notice to Proceed

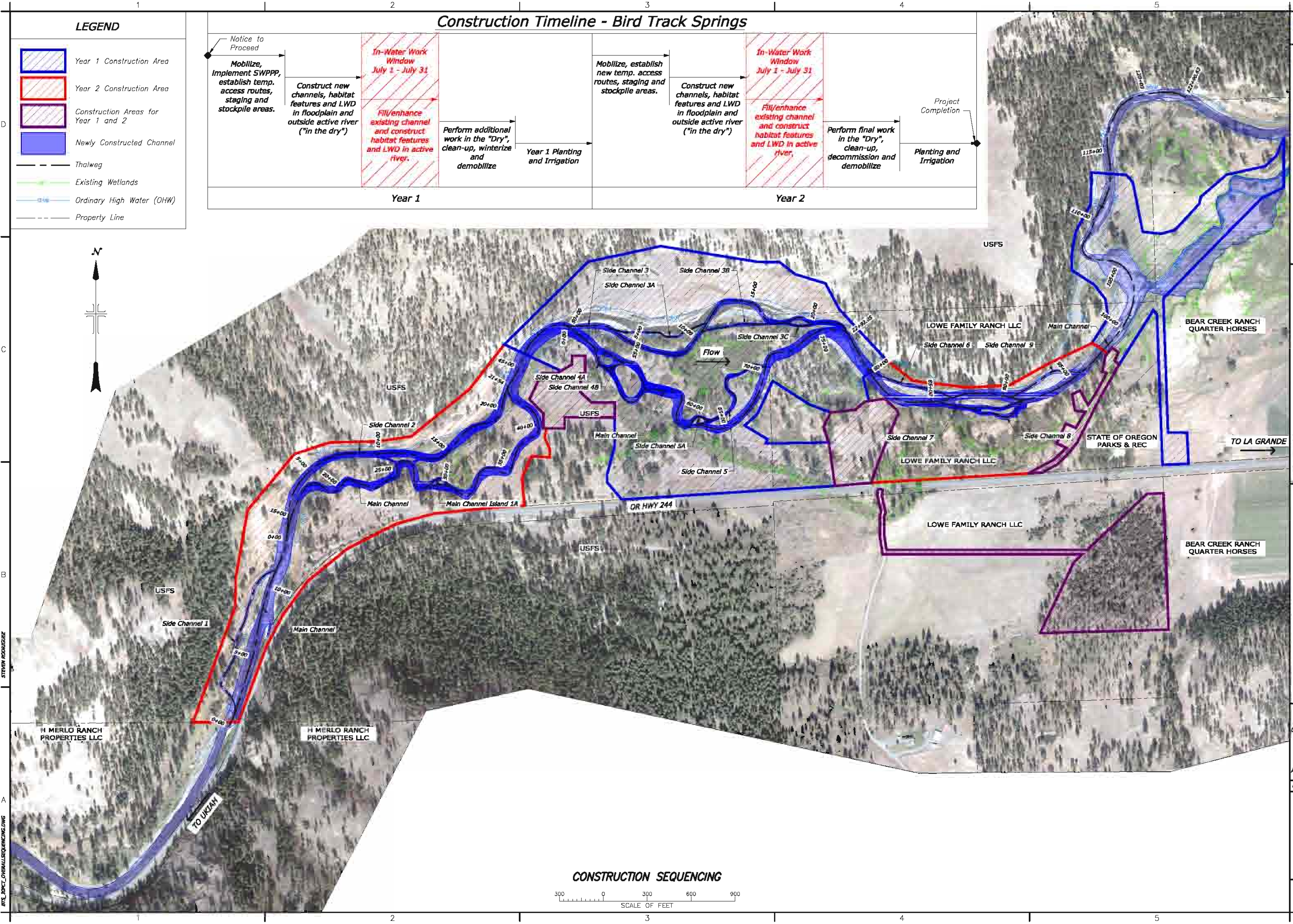
Year 1

- Mobilize, implement SWPPP, establish temp. access routes, staging and stockpile areas.
- Construct new channels, habitat features and LWD in floodplain and outside active river ("in the dry")
- In-Water Work Window July 1 - July 31: Fill/enhance existing channel and construct habitat features and LWD in active river.
- Perform additional work in the "Dry", clean-up, winterize and demobilize
- Year 1 Planting and Irrigation

Year 2

- Mobilize, establish new temp. access routes, staging and stockpile areas.
- Construct new channels, habitat features and LWD in floodplain and outside active river ("in the dry")
- In-Water Work Window July 1 - July 31: Fill/enhance existing channel and construct habitat features and LWD in active river.
- Perform final work in the "Dry", clean-up, decommission and demobilize
- Planting and Irrigation

Project Completion



CONSTRUCTION SEQUENCING

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CONSTRUCTION SEQUENCING

OVERVIEW PLAN

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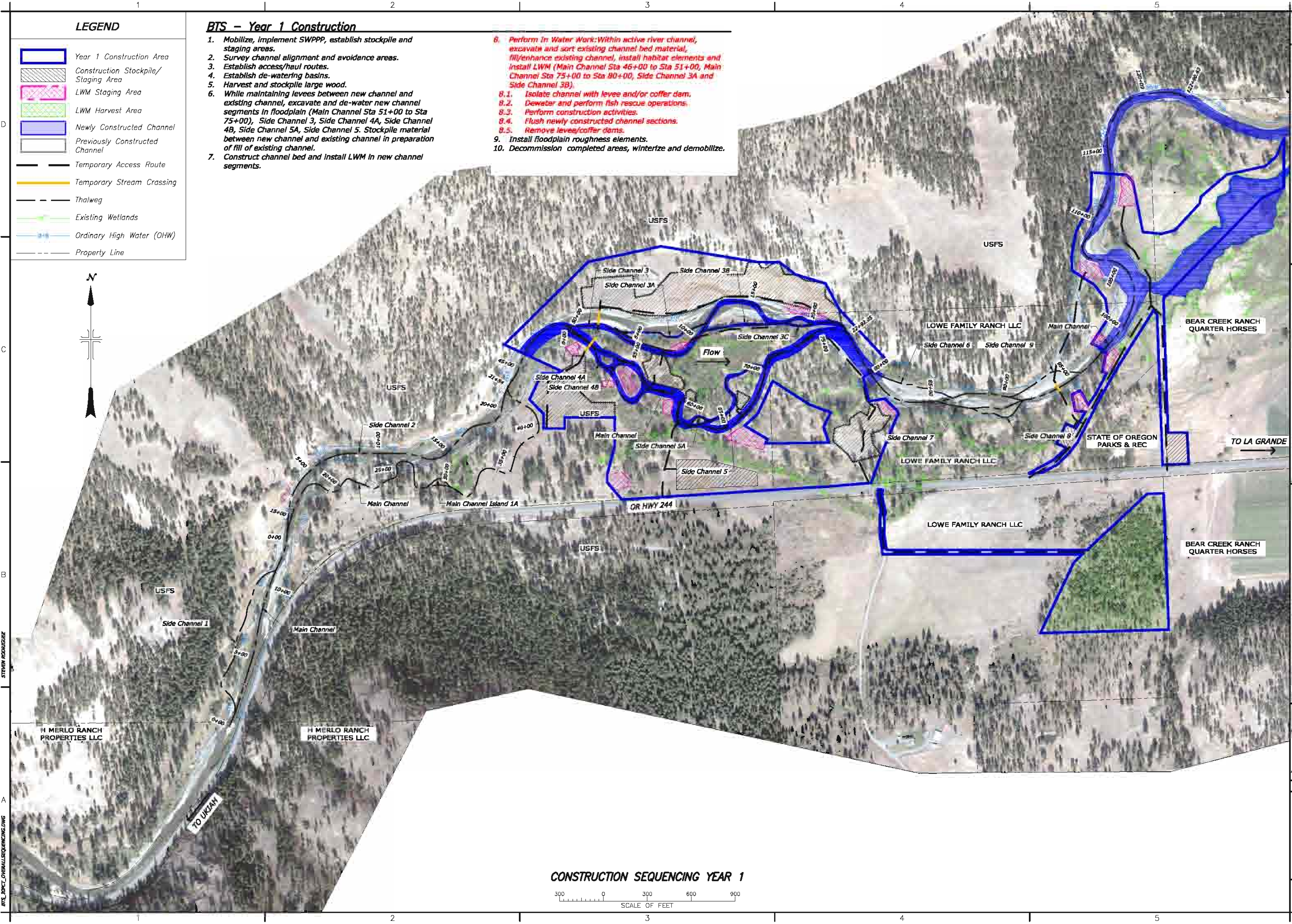
LEGEND

▭	Year 1 Construction Area
▨	Construction Stockpile/ Staging Area
▨	LWM Staging Area
▨	LWM Harvest Area
▭	Newly Constructed Channel
▭	Previously Constructed Channel
— —	Temporary Access Route
—	Temporary Stream Crossing
— - —	Thalweg
—	Existing Wetlands
—	Ordinary High Water (OHW)
- - -	Property Line

BTS – Year 1 Construction

1. Mobilize, implement SWPPP, establish stockpile and staging areas.
2. Survey channel alignment and avoidance areas.
3. Establish access/haul routes.
4. Establish de-watering basins.
5. Harvest and stockpile large wood.
6. While maintaining levees between new channel and existing channel, excavate and de-water new channel segments in floodplain (Main Channel Sta 51+00 to Sta 75+00), Side Channel 3, Side Channel 4A, Side Channel 4B, Side Channel 5A, Side Channel 5. Stockpile material between new channel and existing channel in preparation of fill of existing channel.
7. Construct channel bed and install LWM in new channel segments.
8. Perform In Water Work: Within active river channel, excavate and sort existing channel bed material, fill/enhance existing channel, install habitat elements and install LWM (Main Channel Sta 46+00 to Sta 51+00, Main Channel Sta 75+00 to Sta 80+00, Side Channel 3A and Side Channel 3B).
   - 8.1. Isolate channel with levee and/or coffer dam.
   - 8.2. Dewater and perform fish rescue operations.
   - 8.3. Perform construction activities.
   - 8.4. Flush newly constructed channel sections.
   - 8.5. Remove levee/coffer dams.
9. Install floodplain roughness elements.
10. Decommission completed areas, winterize and demobilize.



CONSTRUCTION SEQUENCING YEAR 1

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CONSTRUCTION
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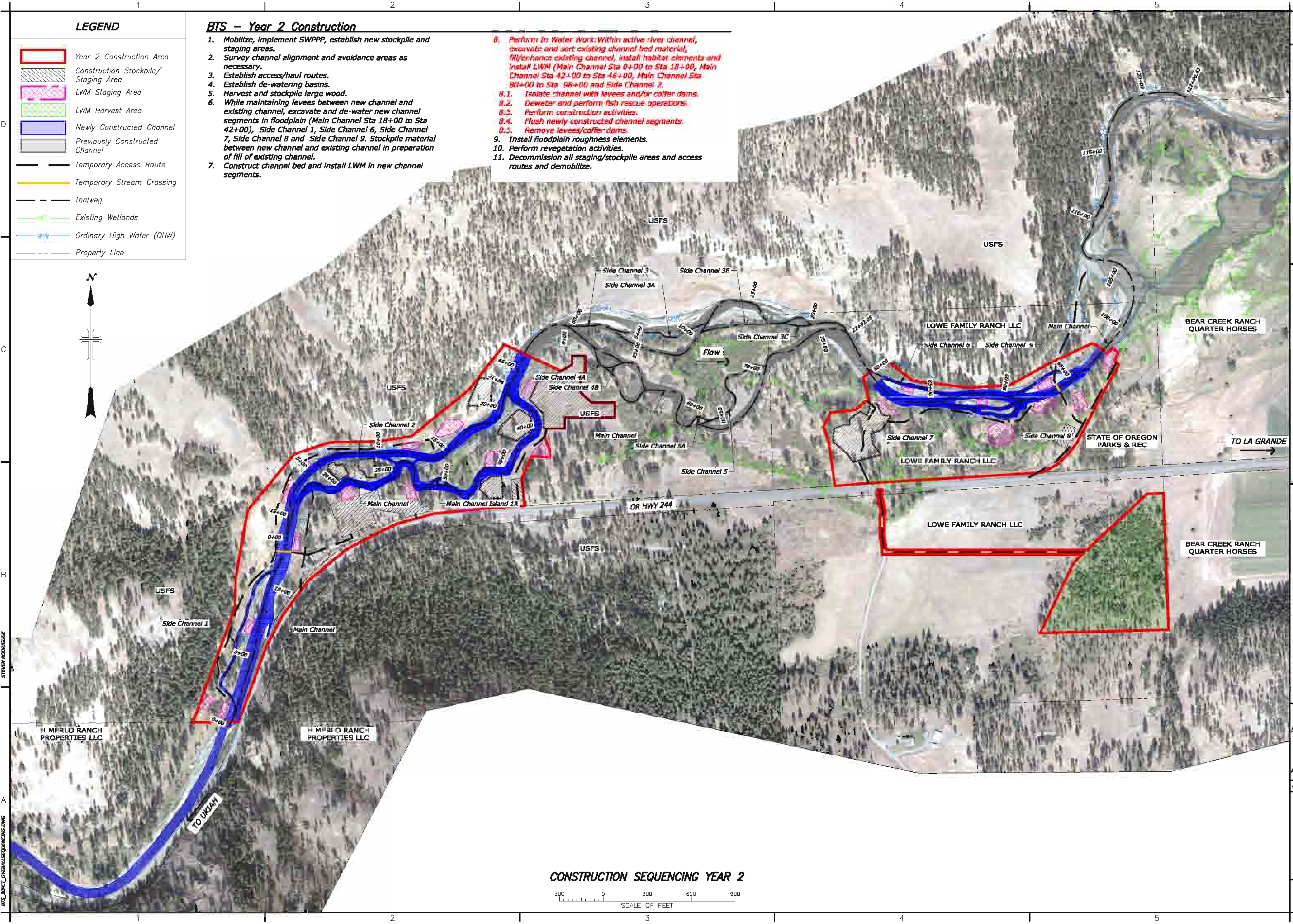
LEGEND

🟥	Year 2 Construction Area
▨	Construction Stockpile/ Staging Area
▨	LWM Staging Area
▨	LWM Harvest Area
🟦	Newly Constructed Channel
⬜	Previously Constructed Channel
— —	Temporary Access Route
—	Temporary Stream Crossing
— - —	Thalweg
—	Existing Wetlands
—	Ordinary High Water (OHW)
- - -	Property Line

BTS – Year 2 Construction

1. Mobilize, implement SWPPP, establish new stockpile and staging areas.
2. Survey channel alignment and avoidance areas as necessary.
3. Establish access/haul routes.
4. Establish de-watering basins.
5. Harvest and stockpile large wood.
6. While maintaining levees between new channel and existing channel, excavate and de-water new channel segments in floodplain (Main Channel Sta 18+00 to Sta 42+00), Side Channel 1, Side Channel 6, Side Channel 7, Side Channel 8 and Side Channel 9. Stockpile material between new channel and existing channel in preparation of fill of existing channel.
7. Construct channel bed and install LWM in new channel segments.
8. Perform In Water Work:Within active river channel, excavate and sort existing channel bed material, fill/enhance existing channel, install habitat elements and install LWM (Main Channel Sta 0+00 to Sta 18+00, Main Channel Sta 42+00 to Sta 46+00, Main Channel Sta 80+00 to Sta 98+00 and Side Channel 2.
   - 8.1. Isolate channel with levees and/or coffer dams.
   - 8.2. Dewater and perform fish rescue operations.
   - 8.3. Perform construction activities.
   - 8.4. Flush newly constructed channel segments.
   - 8.5. Remove levees/coffer dams.
9. Install floodplain roughness elements.
10. Perform revegetation activities.
11. Decommission all staging/stockpile areas and access routes and demobilize.



CONSTRUCTION SEQUENCING YEAR 2

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CONSTRUCTION
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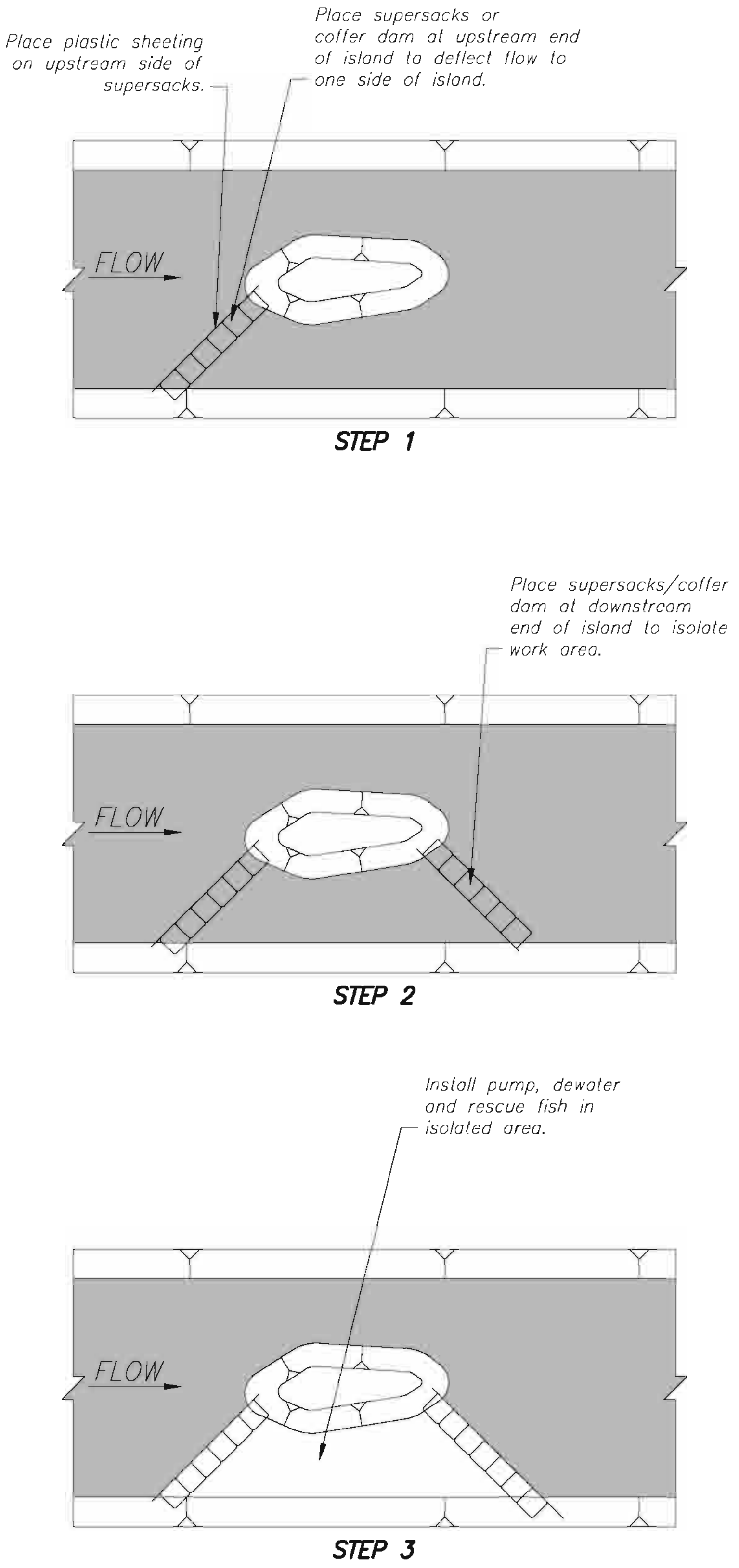
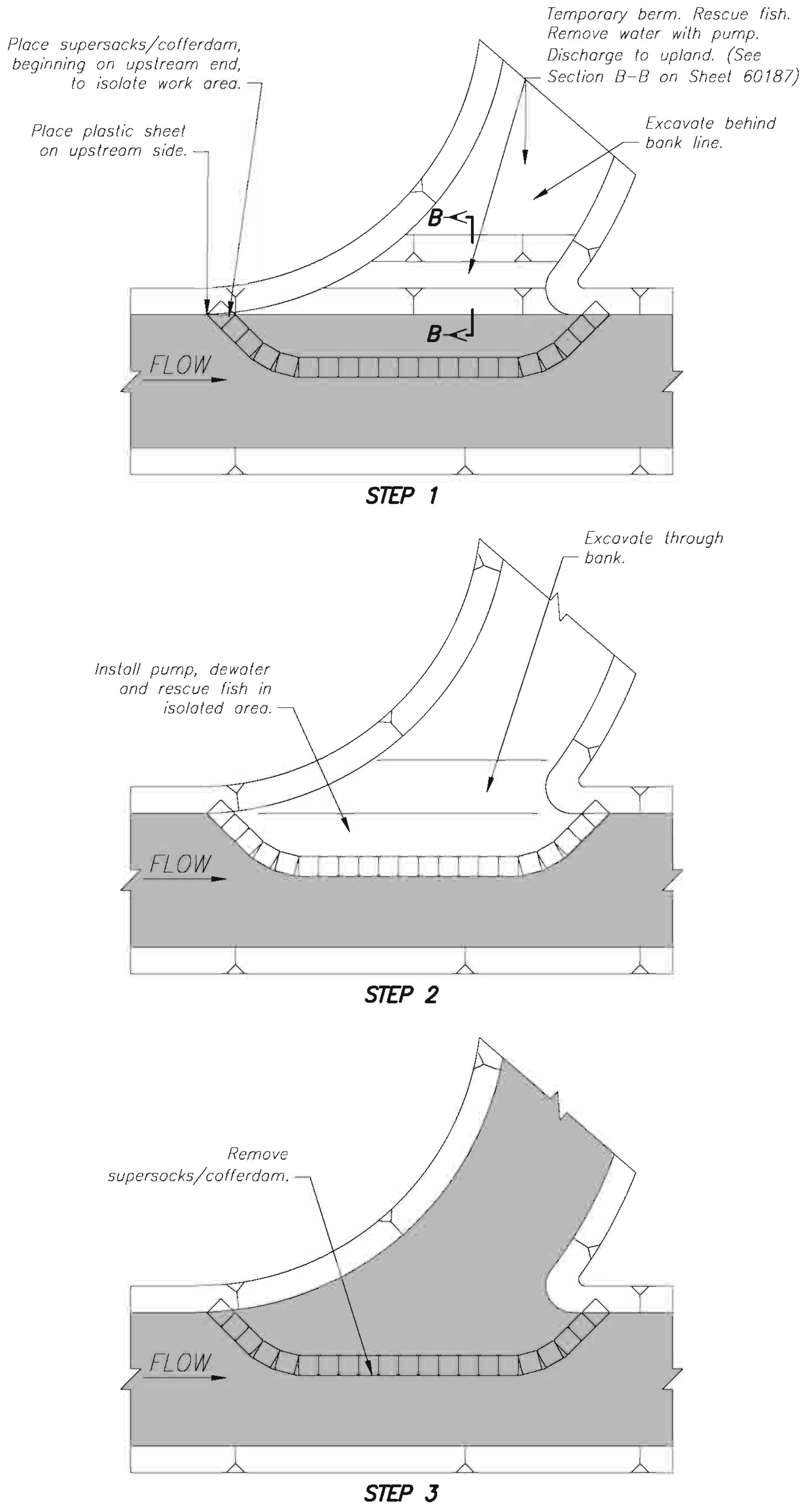


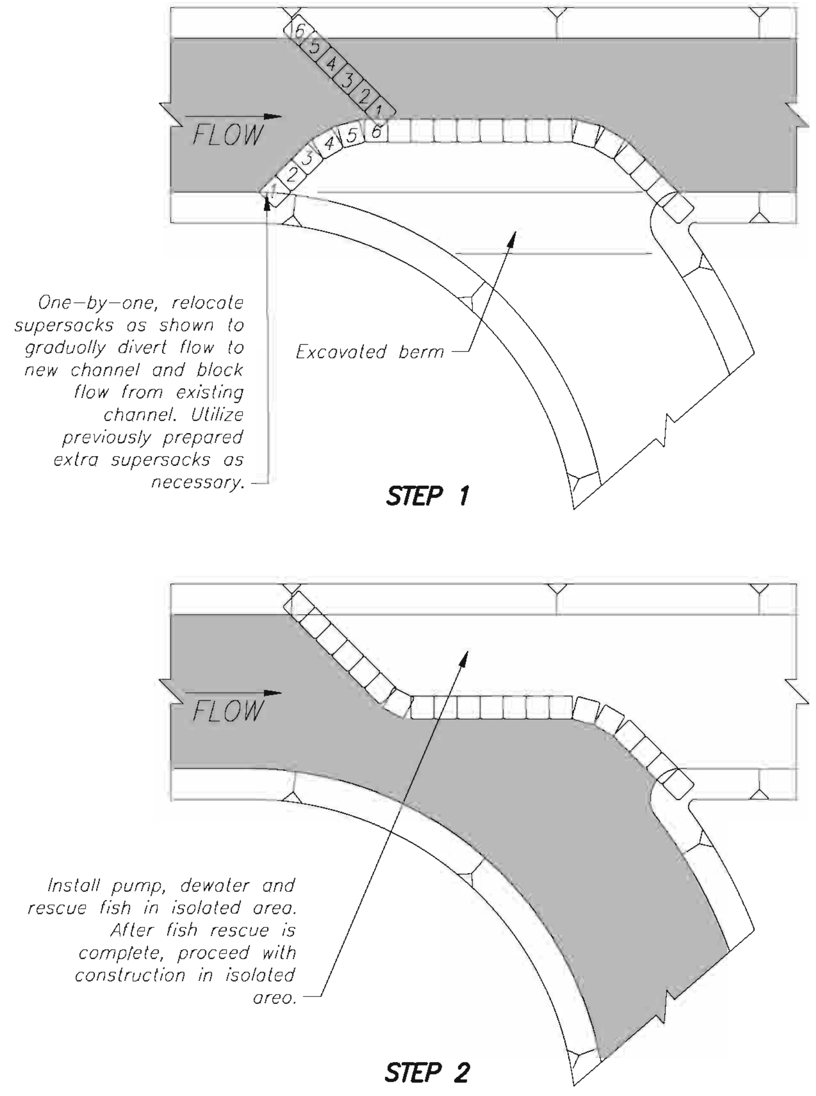
① **WATER REMOVAL AROUND ISLAND/SIDE CHANNEL**
NOT TO SCALE



② **WATER REMOVAL AT CONFLUENCE**
NOT TO SCALE

Notes for Removal of Water:

1. The contractor is solely responsible for designing and implementing measures to perform in-water work in compliance with work requirements and permit conditions.
2. The conceptual Removal of Water Plan has been submitted to the permitting agencies. If the Contractor chooses to substantially deviate from this plan, the Contractor will be responsible for notifying the Contracting Officer (C.O.) of intended changes and requesting review and amendment of approvals from permitting agencies previously granted. Contractor shall provide copies of permit modifications to the Contracting Officer.
3. **The anticipated combined flow of the mainstem Yankee Fork and West Fork during construction is less than 200 cfs.**
4. Maintain fish passage during project construction.
5. Material used for temporary access shall be removed from the channel upon completion of the project, and deposited in an upland location where it will not re-enter the river.
6. Deflectors shall be constructed of supersacks filled with spawning gravel.
7. Notify C.O. minimum 2 days prior to performing in-water work.
8. C.O. will monitor turbidity during construction. Turbidity sampling will be performed using a calibrated turbidimeter or by visual observation, every four hours while work is being implemented, or more often if turbidity disturbances vary greatly. Background samples or observations will be taken at a relatively undisturbed area approximately 100 feet upstream from the project area. The second turbidity sample or observation will take place immediately after the upstream observation 50 feet downstream from the project area in streams that are 30 feet wide or less, and 100 feet downstream from the project area in streams that are between 30 and 100 feet wide, every two hours. If the observed/measured turbidity downstream is more than background measurement (>10%), the activity must be modified to reduce turbidity. If the exceedance continues after the second monitoring interval, the activity must stop until the turbidity levels return to background.
9. Contractor to cooperate with C.O. who will conduct fish rescue.



③ **ADJUST COFFER DAMS**
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REMOVAL OF WATER PLAN

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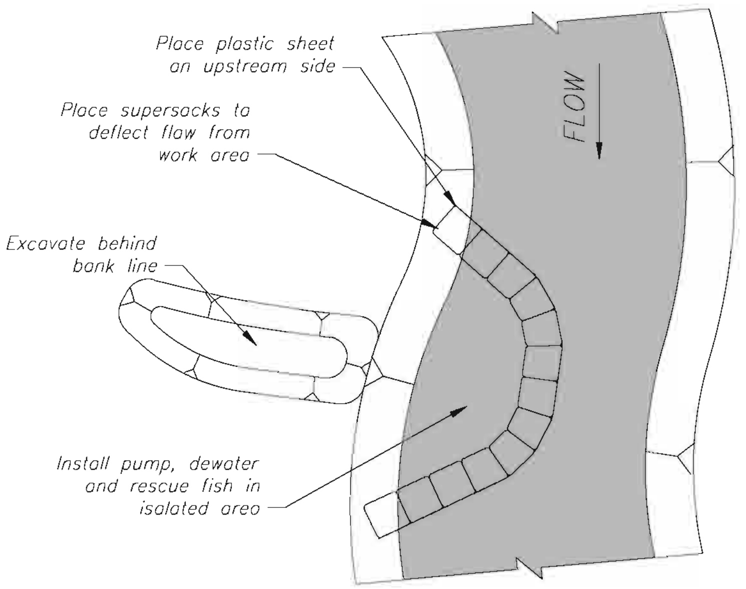
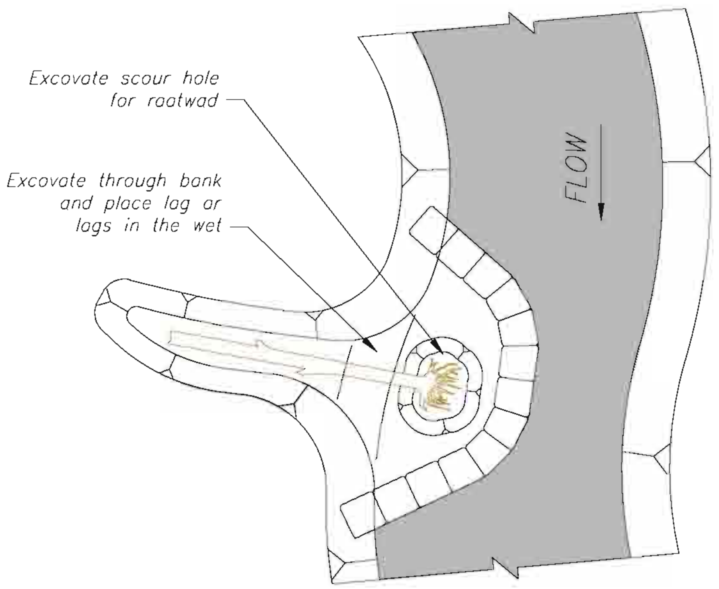
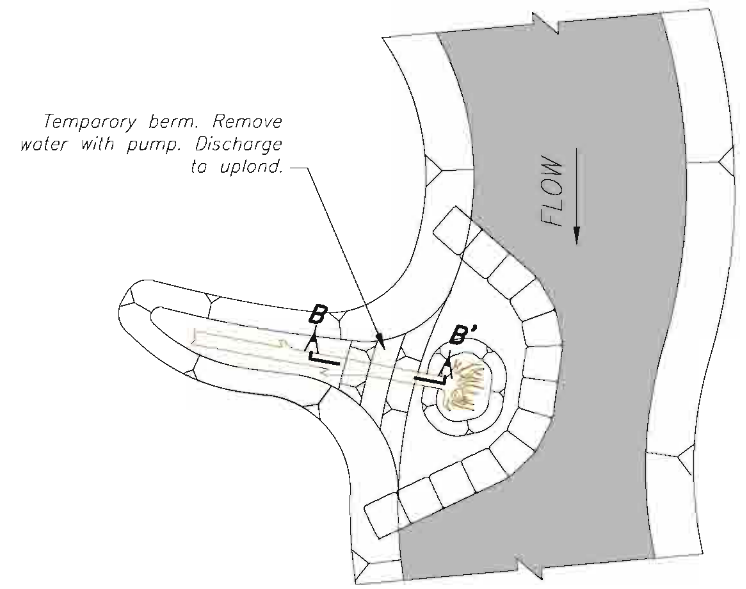


STEP 1



STEP 2



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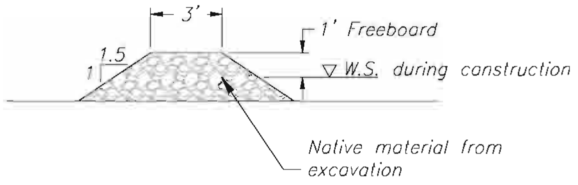

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① **WOOD STRUCTURE PLACEMENT**
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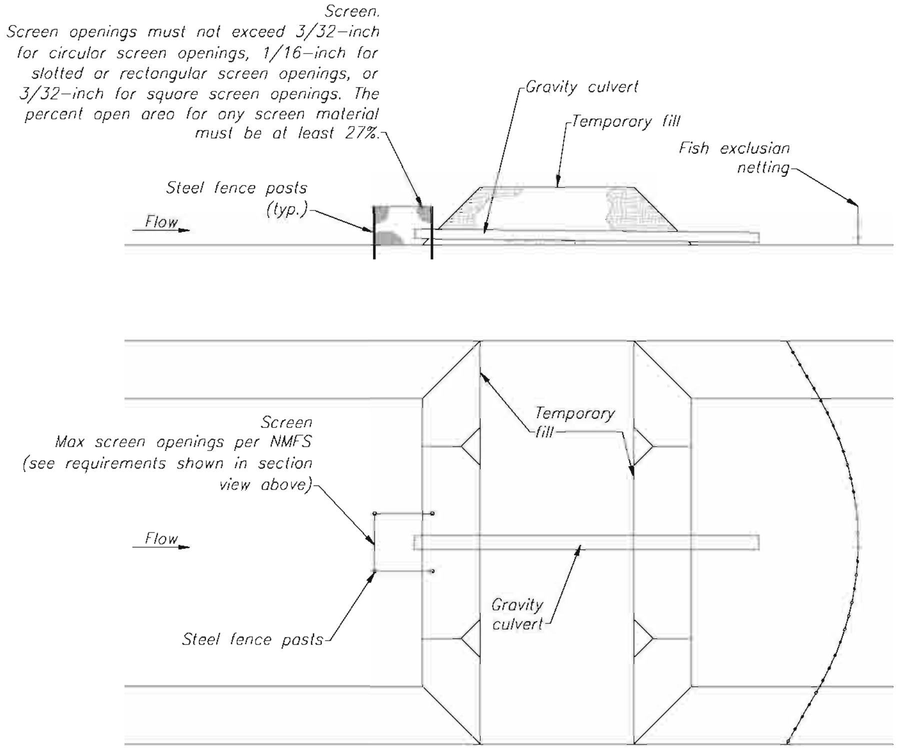

Note:
1. Culvert and screen furnished by C.O.

② **SCREENED CULVERT CROSSING**
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REMOVAL OF WATER PLAN

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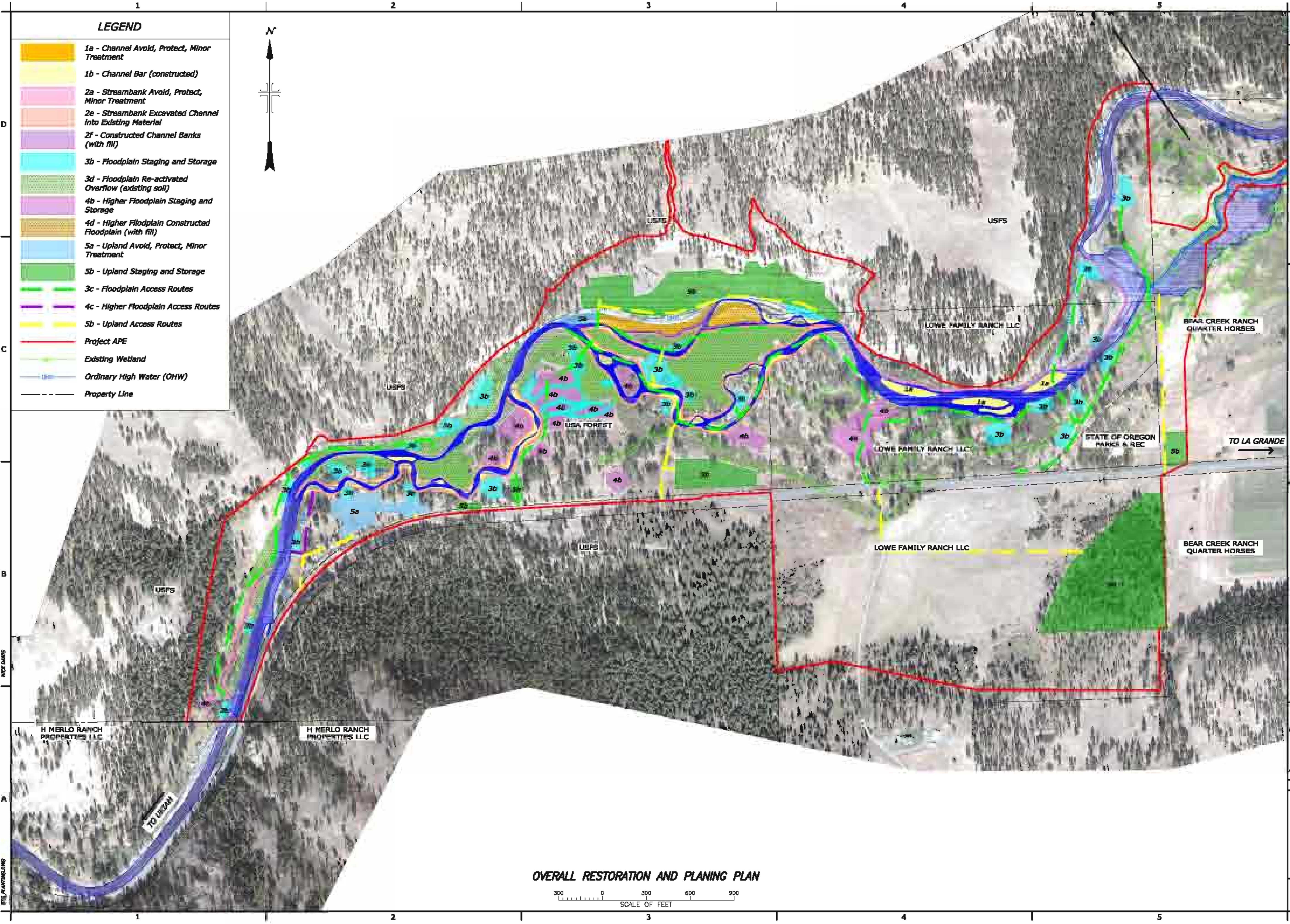

LEGEND

🟧	1a - Channel Avoid, Protect, Minor Treatment
🟨	1b - Channel Bar (constructed)
🟪	2a - Streambank Avoid, Protect, Minor Treatment
🟥	2e - Streambank Excavated Channel Into Existing Material
🟪	2f - Constructed Channel Banks (with fill)
🟦	3b - Floodplain Staging and Storage
▨	3d - Floodplain Re-activated Overflow (existing soil)
🟪	4b - Higher Floodplain Staging and Storage
▨	4d - Higher Floodplain Constructed Floodplain (with fill)
🟦	5a - Upland Avoid, Protect, Minor Treatment
🟩	5b - Upland Staging and Storage
— —	3c - Floodplain Access Routes
— —	4c - Higher Floodplain Access Routes
— —	5b - Upland Access Routes
——	Project APE
—·—	Existing Wetland
—OHW—	Ordinary High Water (OHW)
— - —	Property Line

OVERALL RESTORATION AND PLANING PLAN

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OVERALL RESTORATION
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Map Category	Treatment Type	Vegetation	
		Planting Method	Target Plant Communities
Channel			
1a	Avoid, protect, minor treatment	Protect and conserve existing vegetation (vegetated bars)	
1b	Bar (constructed)	Salvaged or propagated herbaceous	Willow Gravel Bar Shrubland
		Willow poles/stakes	Barren with partially vegetated herbaceous
		None	Barren

Map Category	Treatment Type	Vegetation	
		Planting Method	Target Plant Communities
Streambanks			
2a	Avoid, protect, minor treatment	Protect and conserve existing vegetation or leave barren for active sediment source	
		Inter-plant willow/alder poles and stakes	
2b	Wood structure	Inter-plant willow/alder/cottonwood poles and stakes	Alder Floodplain Shrubland
		Inter-plant willow brush layers	Open Tall Willow
		Inter-plant container alder and cottonwood	Open Black Cottonwood Forest
2c	Rock and wood	Inter - plant willow poles and stakes	Open Tall Willow
2d	Rock	Inter-plant willow poles and stakes	Open Tall Willow
		None	Barren
2e	Excavated channel into existing material (riffles and runs)	Inter-plant willow/alder/cottonwood poles and stakes	Alder Floodplain Shrubland
		Inter-plant container alder and cottonwood	Open Tall Willow
		Inter-plant willow brush layers	Open Black Cottonwood Forest
2f	Constructed channel banks (with fill)	Inter-plant willow/alder/cottonwood poles and stakes	Alder Floodplain Shrubland
		Inter-plant container alder and cottonwood	Open Tall Willow
		Inter-plant willow brush layers	Open Black Cottonwood Forest

Map Category	Treatment Type	Vegetation	
		Planting Method	Target Plant Communities
Floodplain (modeled area within 2-year flow)			
3a	Avoid, protect, or minor treatment	Protect and conserve existing vegetation	
		Control weeds	
		Inter-plant within protected vegetation to improve species and structural complexity (at variable spacing; approximately 10 x 10 foot spacing for riparian deciduous trees and 16 x 16 foot spacing for conifers)	
		None	
3b	Staging and storage	Decompaction (e.g., ripping and scarification to insure compacted surfaces are fractured in areas of intense construction related use)	Wet-Moist Graminoid Meadow Complex
		Seeding and mulching, weed control	Moist Graminoid Meadow Complex
		Tree container planting (if trees removed)	Alder Floodplain Shrubland
		Willow/ alder/ cottonwood poles/ stakes	Open Tall Willow
			Black Cottonwood/ Willow Floodplain
3c	Access routes	Decompaction (e.g., ripping and scarification to insure compacted surfaces are fractured in areas of intense construction related use)	Same as surrounding community
		Seeding and mulching, weed control (floodplain seed mix)	
3d	Re-activated overflow (existing soil)	Salvaged wetland	Wet-Moist Graminoid Meadow Complex
		Salvaged alders/willows	Moist Graminoid Meadow Complex
		Willow/ alder/ cottonwood poles/ stakes	Alder Floodplain Shrubland
		Container plantings	Open Tall Willow
			Black Cottonwood/ Willow Floodplain Forest
3e	Inset lower floodplain (constructed)	Salvaged or propagated sod	Wet-Moist Graminoid Meadow Complex
3f	No/Minor Treatment	Existing wetland areas	Wet-Moist Graminoid Meadow Complex
		Salvaged wetland, if degraded	
		Salvaged alders/willows, if degraded	
3g	Minor hand treatment	Protect and conserve existing vegetation	
		Inter-plant within protected vegetation to improve species and structural complexity (at variable spacing; approximately 10 x 10 foot spacing for riparian deciduous trees)	
		None	

Map Category	Treatment Type	Vegetation	
		Planting Method	Target Plant Communities
Higher Floodplain			
4a	Avoid, protect, or minor treatment	Leave un-vegetated	
		Control weeds	
		Protect and conserve existing vegetation	
		Inter-plant within protected vegetation to improve species and structural complexity (at variable spacing; approximately 10 x 10 foot spacing for riparian deciduous trees and 16 x 16 foot spacing for conifers)	
		None	
4b	Staging and storage	Decompaction (e.g., ripping and scarification to insure compacted surfaces are fractured in areas of intense construction related use)	Open Black Cottonwood Forest
		Seeding and mulching	Dry Graminoid Meadow
		Tree container planting (if trees removed)	Ponderosa Pine Forest/ Woodland
4c	Access routes	Decompaction (e.g., ripping and scarification to insure compacted surfaces are fractured in areas of intense construction related use)	Same as surrounding community
		Seeding and mulching, weed control (floodplain seed mix)	
4d	Constructed floodplain (with fill)	Willow/ alder/ cottonwood poles/ stakes	Black Cottonwood/ Willow Floodplain Forest
		Container plantings	Open Black Cottonwood Forest

Map Category	Treatment Type	Vegetation	
		Planting Method	Target Plant Communities
Upland			
5a	Avoid, protect, or minor treatment	Leave un-vegetated	
		Weed control	
		Protect and conserve existing vegetation	
		Inter-plant within protected vegetation to improve species and structural complexity (at variable spacing; approximately 16 x 16 foot spacing for conifers)	
		None	
5b	Staging and storage; access routes	Decompaction (e.g., ripping and scarification to insure compacted surfaces are fractured in areas of intense construction related use)	Ponderosa Pine Forest/ Woodland
		Seeding and mulching, weed control (upland seed mix)	Black Hawthorn Shrubland
		Tree and shrub container planting (if trees removed)	Dry Graminoid Meadow

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RESTORATION AND
PLANTING NOTES

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