



TECHNICAL MEMORANDUM



To: Arden Thomas, Kittitas County

From: Inter-Fluve

Date: June 12, 2025

Project: Lower Kittitas Floodplain Reconnection Project

Re: Recommended Concept Design Revisions

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1. OVERVIEW

1.1. PURPOSE OF MEMO

This memo describes proposed modifications to the existing concept-level designs for the Lower Kittitas Floodplain Reconnection Project based on additional analysis and updated site information. In April 2024, Kittitas County and the Bureau of Reclamation developed a set of conceptual design drawings and a basis of design report to advance restoration goals along the Yakima River. In late 2024, Kittitas County solicited professional services by a consultant team led by Inter-Fluve to provide additional site survey and analysis and to carry the conceptual designs forward through final design and permitting. Informed by the new site information, the consultant team was asked to take a fresh look at the concept designs and to consider modifications that would optimize project goals and objectives. This was performed in collaboration with the County and key project partners, including Reclamation, MCFEG, and BLM. This memo describes the recommended modifications as well as the new data collection, analysis, and supporting rationale for the changes and serves as a bridge between the conceptual and preliminary (30%) design.

1.2. PROJECT DESCRIPTION

The Lower Kittitas Reach Floodplain Reconnection Project aims to restore habitat and habitat-forming processes along 2.7 miles of the Yakima River by removing failing flood protection infrastructure on County-owned property between Hansen Pits and Ringer Loop Road. Key components within the 700-acre project area include reconnecting the river to its historical floodplain, reactivating side channels, addressing impacts from past gravel mining, enhancing aquatic habitat, and mitigating potential off-site flood risks. This is a multi-objective project focused on improving ecological function and resilience while reducing flood hazards through process-based restoration techniques. The project must balance active restoration interventions with allowing natural river processes to reestablish to the extent possible in this constrained environment. There are opportunities but also constraints related to existing infrastructure, public safety considerations, and adjacent land uses that require an integrated design. The project area, site characteristics, and related infrastructure can be seen in Figure 1.

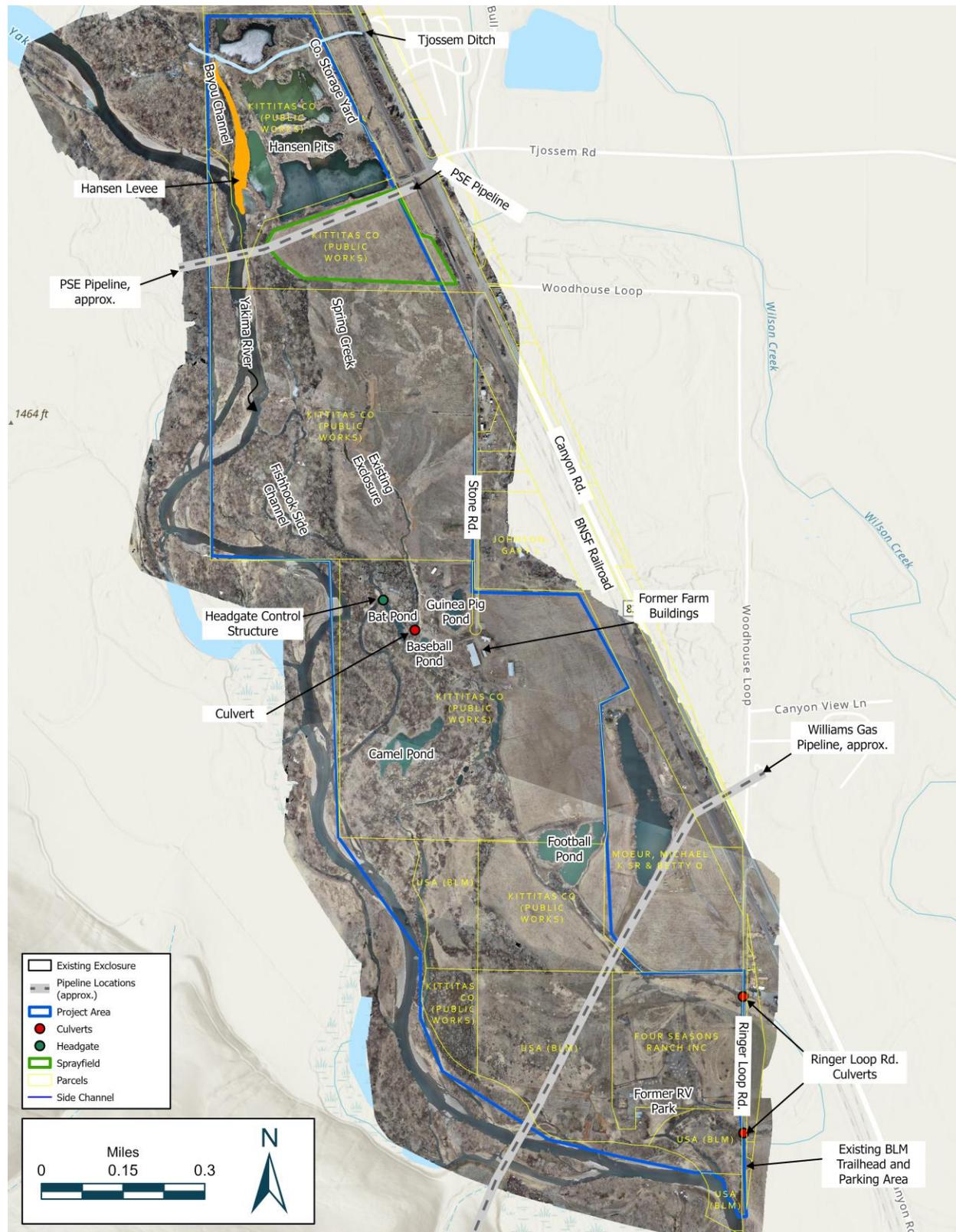


Figure 1. Lower Kittitas Floodplain Reconnection Project site overview.

1.3. GOALS AND OBJECTIVES

The following vision statement, goals, and objectives were identified in the Lower Kittitas Reach Floodplain Reconnection Project Concept Basis of Design Report (Reclamation 2024) and have been updated based on design team discussions, as well as client and project partner input.

Vision Statement: Divest from failing flood infrastructure and restore natural riverine processes for the purposes of creating and maintaining salmonid habitat, while allowing for flood compatible uses.

Goal 1: Habitat restoration

- Promote natural fluvial processes to create and maintain spatial complexity and dynamicity through the removal of bank revetments, reconnection of side-channel habitats, and floodplain recontouring to promote floodplain engagement and support floodplain gallery forest establishment.
- Improve the quantity and quality of salmonid habitat, with an emphasis on year-round rearing habitat and consideration of non-normative summer high flow hydrology.
- Address potential negative effects of floodplain gravel pit ponds (water warming, warm water fisheries production, fish stranding) and restore to habitat suitable for salmonids where feasible.

Objectives:

- Reconnect the disconnected floodplain for the purposes of floodplain engagement and dynamicity and to support cottonwood gallery forest development and maintenance. Improve floodplain connectivity by removing levees, berms, bank revetments, and other artificial floodplain features to provide floodplain engagement during and above the 1.5-year recurrence interval flood.
- Recontour areas of the floodplain to provide a continuous bandwidth of connected floodplain at an inundation frequency that promotes the long-term, dynamic floodplain processes required to create and maintain functioning side-channel and off-channel (overflow and groundwater channel) areas, wetland areas, and support development and maintenance of mesic cottonwood galleries of various successional stages, providing opportunities to recruit wood for instream habitat complexity.
- Improve connectivity to existing side channels and off-channel habitat suitable for year-round juvenile rearing and non-normative flow conditions by providing perennial surface water connections from the main channel or other existing active side channels to existing relic side channel features and their accessible floodplains.
- Create new side channels and off-channel habitat suitable for year-round juvenile rearing and during non-normative high summer flow conditions by grading new, perennially connected side channels and frequently connected floodplains into the recontoured floodplain areas.
- Address floodplain degradation from gravel pits and artificial floodplain ponds by:
 - a. Creating connected side-channel habitat with appropriate flows and depths to support salmonids and not warm-water species.
 - b. Create riparian habitat at suitable elevations to support cottonwood and other riparian forest vegetation to provide shading and cover of riverine and open-water habitat. Provide sufficient width to allow an approximately 50-year riparian buffer to anticipated channel migration.
 - c. If ponds are retained, reduce potential negative impacts on fisheries (e.g., groundwater warming supporting warm-water fisheries, potential stranding).

Goal 2: Divest from failing flood infrastructure

Objectives:

- The Kittitas County Flood Control Zone District is not maintaining the failing Hansen Pits levee and seeks to strategically manage flood flows across its land holdings.
- Inform stakeholders and nearby landowners of the likely impacts and outcomes of the project.
- Address increases in off-site flood risk impacting private property that are directly associated with proposed site modifications/restoration plans.

Goal 3: Maintain flood compatible agricultural uses

Objectives:

- Reconfigure the existing spray field to align with areas reserved for flood compatible agriculture.
Additional Information: The western portion of the existing agricultural spray field will be reconfigured so that it is no longer adjacent to the Yakima River, allowing for the establishment of a riparian corridor. This reconfiguration will also support the long-term sustainability of agricultural use, given the risk of channel migration and avulsion. The location and orientation of the field will be adjusted, with the final layout informed by riverine processes and the restrictive covenants associated with land purchased using Floodplains by Design funding. The spatial extent of the field will not be reduced and may be expanded.
- Preserve or provide new stock watering opportunities on agricultural lands.

Goal 4: Provide passive recreational opportunities where provision of access does not impact key riparian resources including listed salmonids and critical habitat

Objectives:

- Improve pedestrian site access to Bureau of Land Management (BLM) property.
Additional Information: The Bureau of Land Management (BLM) manages its land for recreation and fish and wildlife habitat as part of its multiple-use program under the Federal Land Policy and Management Act of 1976 (FLPMA), following direction in the Spokane District Resource Management Plan (RMP; BLM 1988) and the 1992 RMP Amendment (BLM 1992a, 1992b). BLM has identified this reach as critical for the survival and health of salmonids, with significant improvement opportunities across both BLM and County ownerships within the project area. BLM also identified management needs related to increasing recreational use and past flood damage, which rendered portions of the trail system unusable or disconnected. In 2017, BLM issued the Ringer Site Enhancement and Recreation Management Environmental Assessment, in which it proposed to designate approximately two additional miles of trail to be maintained by BLM. A trail system layout was proposed, specifying that trails would be developed and maintained by mowing paths. If groundwater channels were constructed for habitat restoration purposes, water crossings would be added where trails intersected the channels. These crossing structures were envisioned as a meandering series of boulders.
- Identify appropriate locations for trailheads and parking.
Additional Information: Trailheads, parking lots, or trails on the “RV Park” property need to be consistent with the Recreation and Conservation Office (RCO) Compatible Use and Allowable

Use requirements and must obtain approval through either RCO or the Salmon Recovery Funding Board.

- Allow for a cross-property trail network, potentially to be part of a future City to Canyon Trail from Ellensburg to the Yakima Canyon. Restoration plans will consider logistics required for trail establishment and maintenance.

Additional Information: The City of Ellensburg and Kittitas County have both incorporated the City to Canyon Trail plan into their comprehensive plans. The plan proposes a non-motorized trail connecting Irene Rinehart Riverfront Park to the mouth of the Yakima River Canyon at Helen McCabe State Park, utilizing existing public lands. This trail aims to link existing parks, support wildlife corridors, and provide access to the scenic Yakima River. The potential alignment for a section of the City to Canyon Trail through the project area should be considered in the restoration layout to ensure compatibility between recreation goals and other project objectives.

1.4. CONSTRAINTS

The following constraints will be considered during all phases of the design process.

- Flood risk: The project should not increase flood damage risk to infrastructure, neighboring private property, or structures. If changes in flood elevations or velocities occur, appropriate mitigation measures should be implemented.
- Railroad: Restoration efforts should avoid modifications to floodplain hydrology and conveyance that would increase flood risk to the adjacent railroad.
- Gas pipelines: Two major gas pipelines, including a Williams natural gas pipeline and a Puget Sound Energy pipeline, traverse the project area (Figure 1). Restoration actions should not compromise the integrity or operation of these utilities. Data surrounding the location and elevation of each pipeline requires refinement in future design phases.
- Hansen Pits Parcel: The parcel of land occupied by the Hansen Pits is a Public Works Road asset and is currently used as a storage yard. The continued use of this area must be compatible with the restoration design. Establishing parking near the Hansen Pits site is outside the scope of this effort.
- Continued access to Bureau of Land Management (BLM) property: The Federal Government holds a non-exclusive easement to use, maintain, and repair an existing road to access the Bureau of Land Management Property. Continued coordination with the Bureau of Land Management is needed to make sure the project is consistent with ongoing access and maintenance needs.

2. UPDATED PROJECT INFORMATION

The sections below describe the additional analyses and coordination that have been performed since the completion of the conceptual designs in April 2024. These are briefly summarized here. Additional detailed information will be provided in the Basis of Design Report for the Preliminary (30%) design. These new sources of information, especially the geomorphology analysis, updated site survey, and coordination with the pipeline companies, have informed the proposed modifications to the conceptual designs described in Section 3.

2.1. TOPOGRAPHIC AND BATHYMETRIC SURVEY

New topographic and bathymetric survey data were required to support preliminary design development due to outdated survey data. This was especially the case for bathymetric survey data. Although recent topographic survey data were used for concept design, the bathymetry was based on data from 2012, and channel movement since that time has significantly affected the bathymetry in several locations. To support the development of the designs and hydraulic model, Inter-Fluve collected topographic and bathymetric survey data in November 2024 and May 2025. The data were collected to supplement and update existing available data for the site, which includes LiDAR data, bathymetry data, and ground survey data collected by the County, Reclamation, and others over the past 13 years. A combination of these data was used to develop the existing conditions surface (Digital Terrain Model), which is described in Section 2.2. The November 2024 and May 2025 survey data were collected using Real Time Kinematic (RTK) Global Positioning System (GPS) instruments. The bathymetry data were collected via a combination of wading-based survey and use of a boat-based single beam echo-sounder (Seafloor Systems HydroLite™) paired with the RTK-GPS.

2.2. DESIGN SURFACE DEVELOPMENT

The digital terrain model (DTM) used in Reclamation concept designs was updated with IFI topobathymetric data to represent most recent channel alignments. Valuable additional resolution was provided at areas of critical project elements, such as grading of side channel inlets.

The digital terrain model (DTM) was constructed using multiple data sources to support hydraulic modeling, grading plans, and other site analysis and design components. The primary source for non-bathymetric floodplain data was Kittitas County's UAV-based LiDAR flight from March 2023. These data cover the core project area and additional areas within the river-left floodplain covering the County and BLM properties. However, the data do not extend west of the Yakima River or very far upstream or downstream, areas that are needed to support hydraulic modeling. To supplement gaps in the County's LiDAR coverage, 2019 LiDAR data were integrated. A critical component of the bathymetric dataset was provided by IFI's survey effort conducted from November 11-15, 2024 and May 12-13, 2025 (see previous Section 2.1). This included echo sounder bathymetry and RTK data, which were used to construct the Yakima River and floodplain pond bathymetric surfaces and define side channels and alcoves not covered by other recent data sources. Additional bathymetric data were incorporated to refine the surface, including various floodplain bathymetric datasets provided by the County, which were used to fill in missing data for pits, ponds, swales, and creeks. There was also a boat and sonar-based bathymetric survey of the Yakima River performed by Reclamation in 2012. The river has changed

shape and position since this survey, but these data were used in some cases to help inform data interpolation in areas missing newer data.

2.3. HYDRAULIC MODELING

A two-dimensional (2D) hydraulic model was developed using the U.S. Army Corps of Engineers HEC-RAS 6.6 software (USACE 2024), which can compute hydraulic properties related to the physical processes governing water flow through natural rivers and other channels. This model utilized roughness and hydrology data from the 2024 Reclamation HEC-RAS model (Reclamation 2024). The updated hydraulic model provides confirmation on outputs of the Reclamation model with some areas of refinement due to more recent and complete survey data. An existing conditions 2D hydraulic model was developed to assess the current channel/floodplain dynamics as well as assess the overall impacts of a wide range of flows on the existing landscape. A proposed conditions model is under development in the 30% design phase to assess the impacts of the project on the landscape and to guide the design elements such as channel excavation, large wood placement, and revegetation areas.

The results of the hydraulic model will be used to inform the project design through an iterative process to optimize the design in respect to design objectives while minimizing risk to surrounding infrastructure.

The existing model results show that the floodplain begins to inundate outside of side channels between the 3,500 cfs (summer irrigation flow) and 7,170 cfs (2-year flood). The channel is multithreaded, even at low flows. Velocities begin to exceed 10 ft/s at the 2-year flood event.

2.4. WATER LEVEL AND TEMPERATURE MONITORING

Inter-Fluve installed 4 groundwater and 6 surface water monitoring stations in the project area in November 2024. These data will be used to understand the seasonal elevations of water levels and the interactions between surface and groundwater at the site. Water level data are critical for informing side channel and floodplain wetland excavation, recontouring for desired plant communities, and potential for groundwater-fed channels. The data loggers (Onset U20L) used at the stations were set to collect temperature and pressure at 15-minute intervals. The pressure data are used in combination with survey data at a benchmark point at the station to determine water level. Two additional loggers were deployed that record ambient air temperature and pressure. The ambient air pressure is required to correct the station logger data due to the natural fluctuations in ambient air pressure.

The station locations were selected to spatially cover the project area and to take advantage of existing floodplain ponds that are believed to represent groundwater levels. There are 3 surface water level stations on the river, one at the upstream end, one mid-way through the site, and one at the downstream end. Three additional surface water stations are located in floodplain ponds, including baseball pond, football pond, and in a ponded area of lower Spring Creek. The four groundwater stations include one near the upstream end of Spring Creek and 3 in the downstream portion of the floodplain. In the Hansen Pits, there is not a data logger, but there is a staff gage (surveyed) where occasional visual observations of water level can be made. The Hansen Pits are believed to be well-correlated with river levels recorded at the upstream river level station.

The monitoring stations were visited on April 29, 2025 and data were downloaded for preliminary analysis. Groundwater levels track closely with surface water levels. Preliminary data suggest that the floodplain aquifer tracks closely with the river and there is relatively shallow groundwater throughout the floodplain. Additional data throughout the summer will help to more fully characterize groundwater and surface water interactions. The data so far suggest there may be sufficient groundwater resources for creating groundwater-fed off-channel habitats in some locations. These data will help inform elevations to target for channel grading.

2.5. GEOTECHNICAL INVESTIGATIONS

A geotechnical survey was performed to evaluate the geotechnical and geological conditions at the site to inform the feasibility and design of restoration features. The study was performed by GeoEngineers, Inc. The survey work occurred in November 2024. The investigations included the following:

- Reviewing geologic and soil maps, and domestic well logs.
- Conducting a geologic reconnaissance.
- Completing 27 test pit excavations across the site to depths of up to nearly 10 feet.
- Collecting and analyzing soil samples for moisture content, grain-size distribution, Atterberg limits, and plasticity.
- Interpreting the suitability of native materials for reuse as structural fill or pond backfill.
- Developing preliminary recommendations for excavation, fill placement, slope stability, and dewatering needs.

The study reported that the site is composed primarily of alluvial deposits laid down by the Yakima River. These consist of sand, gravel, and cobble overlying finer-grained topsoil. Subsurface investigations revealed consistent granular soils across the site, with some fine-grained layers present, particularly in upper layers and localized zones. Groundwater was encountered as shallow as 3½ feet, highlighting the need for dewatering considerations during construction.

The preliminary findings indicate that the on-site soils are generally suitable for reuse in restoration earthwork, including backfilling pits and constructing levees. Further evaluations will be needed as the project moves into detailed design, but the results support the feasibility of using native materials and implementing standard construction practices for erosion control and dewatering. The report recommends sump pumping and erosion control practices such as hydroseeding and erosion control blankets to stabilize slopes and levees.

2.6. WETLANDS DELINEATION

A wetland delineation for the project area was completed by Inter-Fluve in late April of 2025. This delineation revealed a variety of wetland types in agricultural areas, historical channels scars, swales, depressions, and other low points in the floodplain. Many wetlands were influenced by human disturbance. This information will be used to inform locations and types of excavations for floodplain

and side channel connectivity, as well as vegetation enhancement actions. In general, project actions are anticipated to increase the extent and quality of wetlands at the site.

2.7. CULTURAL RESOURCES

The project should avoid detrimental impacts to cultural resources. For ground disturbing activities, cultural resources investigations have, and will continue, to occur. For initial subsurface investigations in Fall 2024, an archeological Monitoring and Inadvertent Discovery Plan (MIDP) was developed, and an archeological monitor was present during the field work. An MIDP was also developed for the wetland delineation, which required digging with a shovel to assess soil conditions. An archeologist accompanied the wetland survey team during the delineation. A cultural resources survey will occur in advance of building demolition planned for the house and other structures in the former RV park area, which will occur in advance of restoration project implementation. In addition, cultural resources investigation will occur for the project as a whole, once the footprint of ground-disturbing activities is further developed during design. The findings of these investigations could potentially affect project actions and may require an archeological monitor to be present during project implementation.

Thus far, no significant cultural resources have been found, though a full site survey has yet to be conducted. The Ringer Loop Road historic ditches in the southern portion of the site were determined not eligible for listing in the National Register of Historic Places (NRHP) in 1995.

2.8. GEOMORPHIC ANALYSIS

The geomorphic analysis conducted by Northwest Hydraulic Consultants (NHC, 2025) provides a detailed assessment of conditions at the Lower Kittitas project site in support of the ongoing restoration design efforts. The report highlights the role of infrequent, high-flow events—now reduced compared to historical levels—in shaping complex river and floodplain morphology. In highly confined areas, these events concentrate flow energy, forming narrow, deep channels. In contrast, unconfined areas experience distributed floodplain flow, which drives partial avulsions, the primary mechanism for side channel formation.

Floodplain sedimentation and side channel closure rates are slow, meaning that the morphological complexity established during major flood events tends to persist over time. As a result, the excavation of floodplain channels as part of the restoration project is expected to provide lasting habitat and river process benefits. By diffusing flood-flow energy across the floodplain, these excavations can help maintain and enhance system complexity.

The Hansen Pits within the project area are expected to continue to connect to the main channel through lateral migration rather than avulsion, causing only minor local upstream changes in channel profile. However, because the total volume of connected pits is large compared to the sediment transport rate, infilling—whether through mechanical means or natural sediment deposition—could significantly impact the bed material budget in the reach. Hydraulically connected features like the Hansen Pits act as sediment sinks, capturing coarse material that would otherwise support downstream bar formation, bank building, and habitat complexity. This loss of bed material can create sediment-starved conditions downstream, limiting channel dynamism and reducing the effectiveness of process-

based restoration. The geomorphic analysis suggested that restoration designs should consider the trade-offs between leaving the pits open and partially or fully infilling them to maintain sediment continuity. Both the concept designs and the proposed modifications include partially filling the pits and configuring the fill to minimize capture of coarse bedload, thereby allowing for bedload transport continuity through the reach. This supports the beneficial dynamic processes downstream and helps to avoid channel incision that could jeopardize the effectiveness of downstream restoration actions including side-channel and floodplain reconnections.

Additional considerations include the role of existing pits (Hansen Pits and others) as groundwater exfiltration features that support floodplain channels. Completely filling these pits could disrupt this function, while partial filling to support emergent wetland vegetation may optimize ecological benefits. Given the slow floodplain sedimentation rates, sustaining groundwater-fed floodplain channels appears very feasible and should remain a strategy.

Potential effects of project actions on channel migration and avulsion should continue to be carefully evaluated, particularly regarding their impact on the pipelines. Even if direct interactions with pipelines are avoided, the design may influence natural processes in ways that warrant further mitigation or acceptance decisions.

The potential design element that has been discussed by the design team, where the Hansen Pits are partially filled to resemble an abandoned oxbow with a downstream connection to the mainstem channel, would allow for high-flow backwater inundation of the Hansen Pits. This approach would encourage gradual sediment deposition, maintaining off-channel habitat, and enhancing wetland conditions. Preliminary analysis suggests this would not pose an avulsion risk while also reducing the material needed for infilling.

Overall, the currently proposed design elements are supported by geomorphic analysis. It will be crucial to continue geomorphic analysis as the designs are refined in future stages.

3. CONCEPTUAL DESIGN REVIEW – HABITAT DESIGN ELEMENTS

3.1. SUMMARY OF EXISTING CONCEPTUAL DESIGN

The 2024 Reclamation conceptual designs (Figure 2) include numerous actions that achieve the project objectives and satisfy constraints. The major conceptual design elements include the following:

- Excavation and removal of existing levees and berms
- Flood mitigation features
- Removal of headgate structures
- Partially fill Hansen Pits
- Floodplain recontouring for connection at 1.5-year flood events
- New side channels and side channel connections
- Restoration of former homesites

- Floodplain roughness

These proposed design elements enhance the connection between the Yakima River and its adjacent floodplain, restoring more natural flood dynamics and improving key floodplain processes such as surface disturbance, juvenile fish habitat access, and side channel evolution. The designs align well with the proposed land uses, balancing habitat restoration, recreation, agriculture, and private land considerations. An overview sheet of these concept designs is attached below.

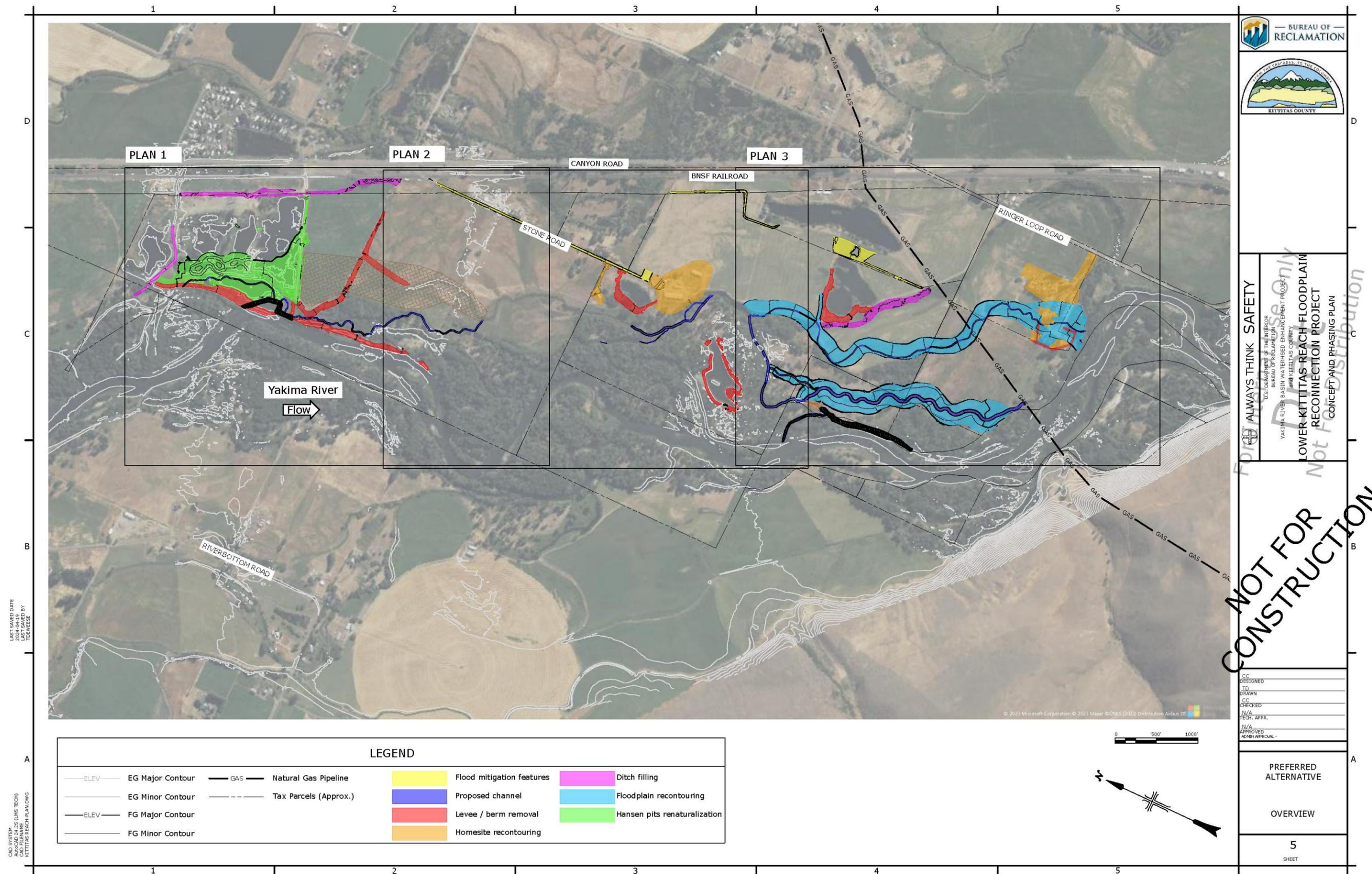


Figure 2. Overview sheet from the USBR Concept designs (2024).

3.2. PROPOSED MODIFICATIONS

The proposed suite of actions to move forward to Preliminary Design retain most of the existing concepts due to their effectiveness in achieving project goals while achieving compatibility with surrounding land uses. Adjustments are being made based on the new information described above including infrastructure considerations (e.g. pipelines) and additional data collection and analysis that refine flood dynamics and characterize geomorphic conditions.

The modifications are described below using the same framework as how the concept design elements were presented in the Concept Design Report. The design elements are listed under their corresponding Habitat Objective; and where applicable, proposed modifications and their rationale are described. A site map summary of these modifications is included in Figure 3.

Habitat Objective 1: Reconnect the disconnected floodplain for the purposes of floodplain engagement and dynamicity, and to support cottonwood gallery forest development and maintenance.

Design Element 1: Regrade the Hansen Pits levee, the downstream private berm, bank revetments, and farm roads to allow for floodplain connectivity at 6,000 cubic feet per second (cfs), the 1.5-year flood recurrence interval at this location. The Hansen Pits levee is effectively disconnecting the northern half of the project area from frequent flood events.

Proposed Modification:

Evaluate potential for the removal of the downstream end of the Jeffries levee across the mainstem Yakima.

Rationale:

Removing a portion of this levee could open floodplain and side-channel connectivity. This modification would likely increase inundation on the river right, while easing pressure of erosion on the Hansen ponds. This modification and additional alternatives has yet to be thoroughly evaluated due to feasibility of landowner cooperation remaining uncertain.

Design Element 2: Establish a floodplain revegetation strategy that identifies locations where traditional planting methods are desired and locations where novel revegetation strategies, such as the utilization of agricultural practices (field preparation, tilling, and irrigation) may be appropriate.

Habitat Objective 2: Recontour areas of the floodplain to provide a continuous bandwidth of connected floodplain.

Design Element 3: Recontour elevated floodplain sections within the southern half of the project area. This section of the project area is too high in elevation to support riparian vegetation and is not engaged by project components described in Design Element 1. Floodplain recontouring for floodplain engagement will be informed by elevations that correspond to 6,000 cfs.

Proposed Modification: Modify existing and perform *additional* excavation for floodplain topography within cottonwood recruitment elevation range. Create floodplain topographic complexity and target floodplain elevations in select areas to align with conditions that can support cottonwood seed dispersal and establishment. This complexity may take the form of floodplain wetlands and alcoves connected to new or existing channels, strategically graded to promote variable inundation thresholds.

Rationale: This modification more broadly applies the recontouring actions of conceptual design element 3 to the entire project site. It also highlights some alterations to the recontouring locations to avoid the Williams Pipeline alignment. After design team meetings and examination of the existing surface post additional survey data collection, it was made clear that there are some additional opportunities to target cottonwood recruitment elevations by expanding the recontouring actions beyond just the southern portion of the project. This would help achieve the objective of cottonwood gallery forest development throughout the whole floodplain. The expanded areas in the north would apply to the area in the concept plan identified for floodplain roughness (brown hatch on concept sheet) and possibly other nearby areas. In the south, the areas identified for recontouring would be modified to avoid the Williams Pipeline, and potentially increased in areal extent. Excavations would be preferentially associated with new side-channels (as before), but would have a different configuration due to realignment of the side-channels (see modifications under Design Element 5). The areal extent may be expanded to increase connectivity while also providing material for filling of additional pits (see modification under Design Element 7).

These actions, when paired with additional proposed filling of floodplain pits, can help achieve a grading cut-fill balance while also providing additional wetlands enhancement. The result is a tailored design that enhances native riparian forest regeneration while maintaining project goals for floodplain reconnection. These efforts are expected to enhance cottonwood establishment and contribute to the development of native and diverse riparian forests, which can help stabilize banks, increase shade, and enhance habitat complexity over time. Topographic complexity will also enhance floodplain hydraulic roughness, which dissuades rapid channel adjustments, and can also provide flood refuge habitat for salmonids.

Habitat Objective 3: Improve connectivity to existing side channels and off-channel habitat.

Design Element 4: In the northern half of the project area, off-channel habitat exists but has been disconnected by an irrigation headgate and old farm roads through the property. These features limit access to Spring Creek, a groundwater-fed floodplain side-channel that has the potential to provide excellent rearing habitat given stable, year-rounds flows.

Proposed Modification: Modify the proposed side channel inlet location downstream of the PSE pipeline to reduce interaction with infrastructure. A secondary inlet may be created downstream of river-left bars to support flow into the side channel under varying river conditions.

Rationale: With additional pipeline location information obtained through coordination with PSE and geotechnical survey updates, it became apparent that the side channel inlet should be moved downstream of the pipeline crossing. This adjustment maintains the function of the side channel

while avoiding the pipeline. Conceptual designs did not fully account for the subsurface depth and alignment of the PSE line, which has since been clarified through additional coordination. This modification can avoid interaction with infrastructure, help maintain more consistent flow into the side channel, reduce the likelihood of sediment deposition at the inlet, and provide additional aquatic habitat.

Proposed Modification: Construct additional connections between side channels to allow for greater hydrologic diversity. The exact configuration of these interconnections could take on numerous forms and patterns.

Rationale: The NHC geomorphic analysis supports multithreaded channels. This recommendation builds on survey data that clarified flow paths and identified areas where channel connections could improve floodplain activation and habitat complexity. Initial conceptual designs proposed limited channel interaction due to data gaps. This enhanced connectivity can improve the resiliency and persistence of surface water connections and fish passage. It also creates a more dynamic and complex aquatic environment, can provide more cottonwood recruitment opportunities, and supports water quality by increasing interaction between surface and groundwater.

Habitat Objective 4: Create new side channels and off-channel habitat.

Design Element 5: Side-channel and off-channel (i.e., floodplain) habitat is lacking in the southern half of the project area. Target grading elevations within this area will be informed by elevations that allow floods to re-establish off-channel and elevations that correspond with high summer irrigation flow and low summer post flip-flop flows. These target elevations are in development and will also consider riparian plant establishment, maintenance, and natural recruitment.

Proposed Modification: Redirect the currently proposed side channels to re-enter the mainstem or another side channel before reaching the Williams pipeline.

Rationale: With additional pipeline location information and internal risk management discussions, it became clear that the originally proposed channel alignment will need to re-enter the mainstem upstream of where the pipeline crosses under the river. Adjusting the alignment upstream of the pipeline reduces the need for armoring or ongoing maintenance, while still achieving hydrologic reconnection. This can reduce maintenance concerns, limit potential interaction with the pipeline, and support channel stability while maintaining hydrologic function.

Proposed Modification: Develop a side channel network and associated floodplain wetland and forest features in the floodplain downstream of the Williams pipeline crossing.

Rationale: This modification was developed after identifying constraints upstream due to pipeline alignment and cut-fill limitations. The design team identified downstream areas with favorable topography and hydrologic conditions for new channel and wetland development. This modification provides off-channel habitat and enhances floodplain connectivity in lieu of the previous channel and floodplain excavations that would have crossed over the pipeline.

Proposed Modification: Assess the feasibility of incorporating groundwater-fed channels, informed by recently collected groundwater data, to enhance floodplain connectivity and habitat complexity.

This assessment will include examining the feasibility of utilizing an existing swale that conveys flow under Ringer Loop Road to supplement discharge into a side channel complex.

Rationale: Site observations and groundwater monitoring stations both indicate areas of consistent groundwater expression that could support groundwater-fed channels. There is currently flow that is at least seasonally expressed in the channel that contributes to the abandoned oxbow that crosses Ringer Loop Road. If viable, tapping into this feature to feed a groundwater or high-flow surface water channel complex could provide cool-water habitat for fish, enhance seasonal flow variability, provide flood refuge habitat, and improve connectivity between wetlands and the river.

Habitat Objective 5: Address floodplain degradation from gravel pits/artificial floodplain ponds.

Design Element 6: Restore the Hansen Pits Gravel Ponds by improving the river connection for the most-westward cell and filling the ponds for the purposes of creating areas of sufficient elevation to support riparian, riverine and depressional wetlands; potential side channel restoration; and eliminating warm-water habitat for predatory fish.

Proposed Modification: Adjust floodplain elevations and fill portions of the Hansen Pits in upper region of project site to reflect a historical oxbow feature, incorporating a mix of forested and wetland areas, while keeping the most northern pit available for recreational use.

Rationale: Design team meeting conversations, informed by geomorphic analysis and a review of historical aerial imagery, led to the development of this idea to align with historical floodplain patterns and accommodate recreational use. This is likely to support native riparian vegetation including cottonwood seedbed establishment, enhance seasonal groundwater exchange, and offer rearing and refuge opportunities for fish and wildlife.

Design Element 7: The design approach for the remaining floodplain ponds is under development. Ponds with a surface water connection sufficient for fish migration during the 1.5-year flood are prioritized for treatment, addressing stranding and predatory species concerns.

Proposed Modification: Modify or partially fill select ponds (including Camel, Football, Baseball, and Guinea Pig) and establish hydrologic connections to existing or new channels where feasible.

Rationale: This modification is supported by additional survey data and discussions with the design team on how to optimize accomplishing floodplain and off-channel objectives. These changes are aimed at improving floodplain connectivity, expanding wetland habitat, and creating off-channel features that may support fish, amphibians, and other wildlife. This is also expected to help with achieving an overall cut-fill balance for the project as a whole.

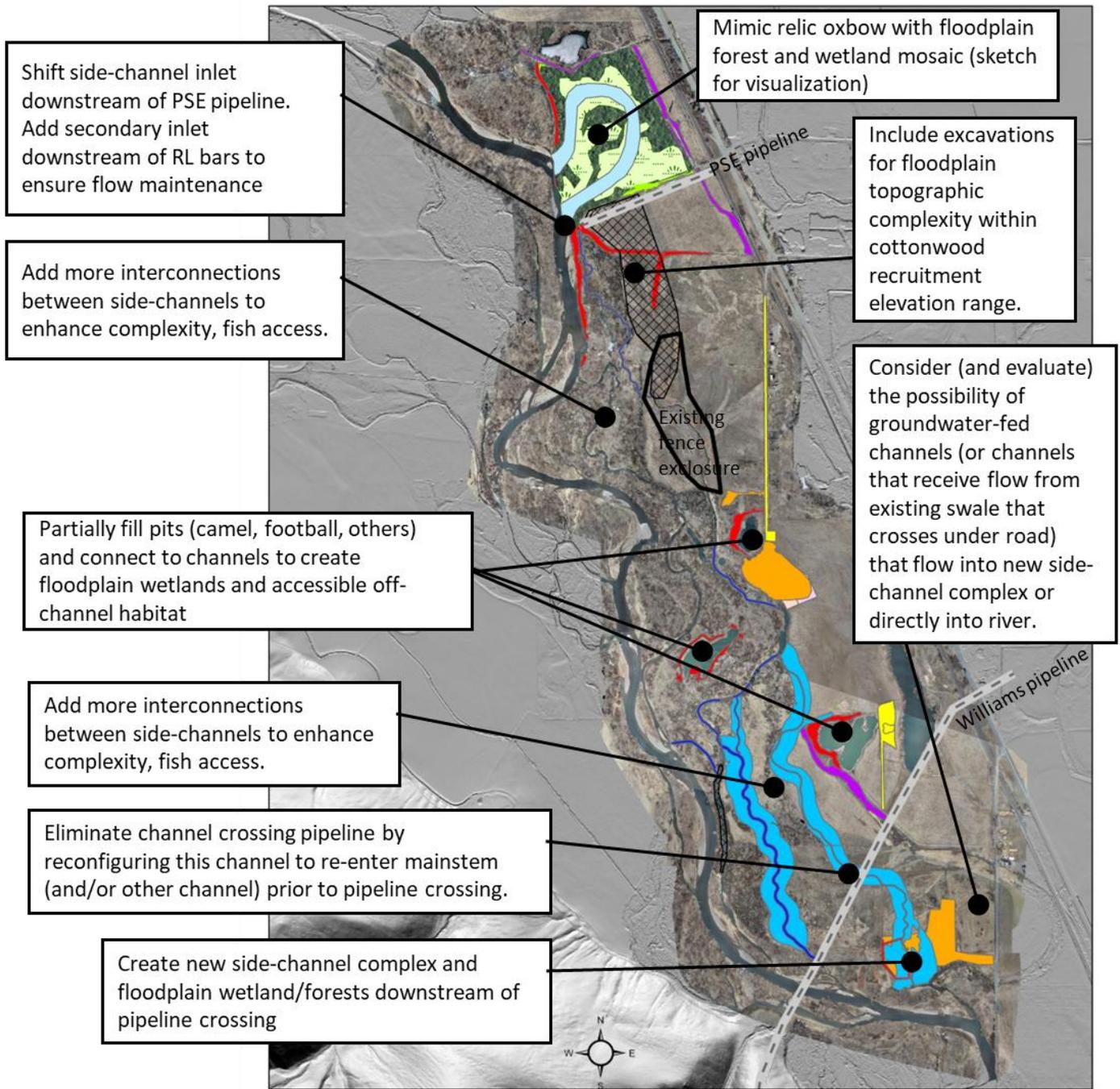


Figure 3. Visualization of design modifications being considered by the project team.

4. REFERENCES

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