CORRIDOR PLAN

YAKIMA RIVER
JEFFRIES LEVEE TO YAKIMA CANYON
HABITAT ENHANCEMENT AND
FLOOD RISK MANAGEMENT PLAN

Prepared for
Kittitas County Flood Control Zone District

Prepared by
Watershed Science & Engineering, Inc.
and
Herrera Environmental Consultants, Inc.

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Prepared for
Kittitas County Flood Control Zone District
411 North Ruby Street, Suite 1
Ellensburg, Washington 98926

Prepared by
Watershed Science and Engineering, Inc.
110 Prefontaine Place S., Suite 508
Seattle, Washington 98104
Telephone: 206/521-3000

and
Herrera Environmental Consultants, Inc.
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
Telephone: 206/441-9080

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Landowners

- The neighbors and stewards of the Yakima River Corridor

Technical Advisory Group (TAG)

- DC Consulting Representing Yakima Basin Joint Board
- Kittitas County Conservation District
- Mid-Columbia Salmon Enhancement Group
- National Marine Fisheries Service
- Trout Unlimited - Washington Water Project
- Washington State Department of Ecology
- Washington State Department of Fish & Wildlife
- Washington State Department of Natural Resources
- U.S. Bureau of Land Management
- U.S. Bureau of Reclamation
- U.S. Fish and Wildlife Service
- Yakima Basin Fish and Wildlife Recovery Board
- Yakama Nation

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1. INTRODUCTION

The Kittitas County Flood Control Zone District (FCZD) led a reach-scale corridor assessment of four miles of the Yakima River near Ellensburg, Washington. The project reach begins at the entrance to the Yakima River Canyon and extends upstream to the head of Jeffries Levee (Figure 1). The project purpose is to develop a focused strategy and a list of viable projects and management actions that can be cooperatively implemented to improve aquatic habitat and manage flood risk over the next 50 years.

1.1. Corridor Plan Objectives

Primary corridor plan objectives are:

- Identify opportunities to protect and restore salmonid habitat
- Identify opportunities to manage or reduce flood/erosion risk
- Engage landowners, resource managers, and elected officials in the identification of a set of habitat and flood risk reduction opportunities/projects that have broad community support and can be cooperatively implemented

1.2. Background

The project was carried out to address two key issues:

1. The Yakima River has been designated as critical habitat for the Mid-Columbia Summer Steelhead (*Oncorhynchus mykiss*) and Spring Chinook salmon (*Oncorhynchus tshawytscha*), species listed as threatened under the Endangered Species Act (ESA). Resource agencies have identified the project reach as critical for survival and health of salmonids. While habitat quality within the reach is considered good, there is significant opportunity for improvement.
2. Lateral erosion is threatening public facilities and private agricultural land. The river has eroded a large breach through the Hansen Pits Levee, is threatening to migrate to and through Ringer Loop Road, and is eroding banks along agricultural lands.

Rather than treat habitat needs and flood/erosion issues individually, the FCZD and partner resource agencies determined that the reach is so important to salmonid populations that a reach-scale investigation was needed to collectively assess both habitat and flood/erosion risk management needs. The knowledge gained from this assessment could then be used to develop a corridor plan guiding future actions that seek to strike a reasonable balance between habitat preservation/restoration and flood risk management.

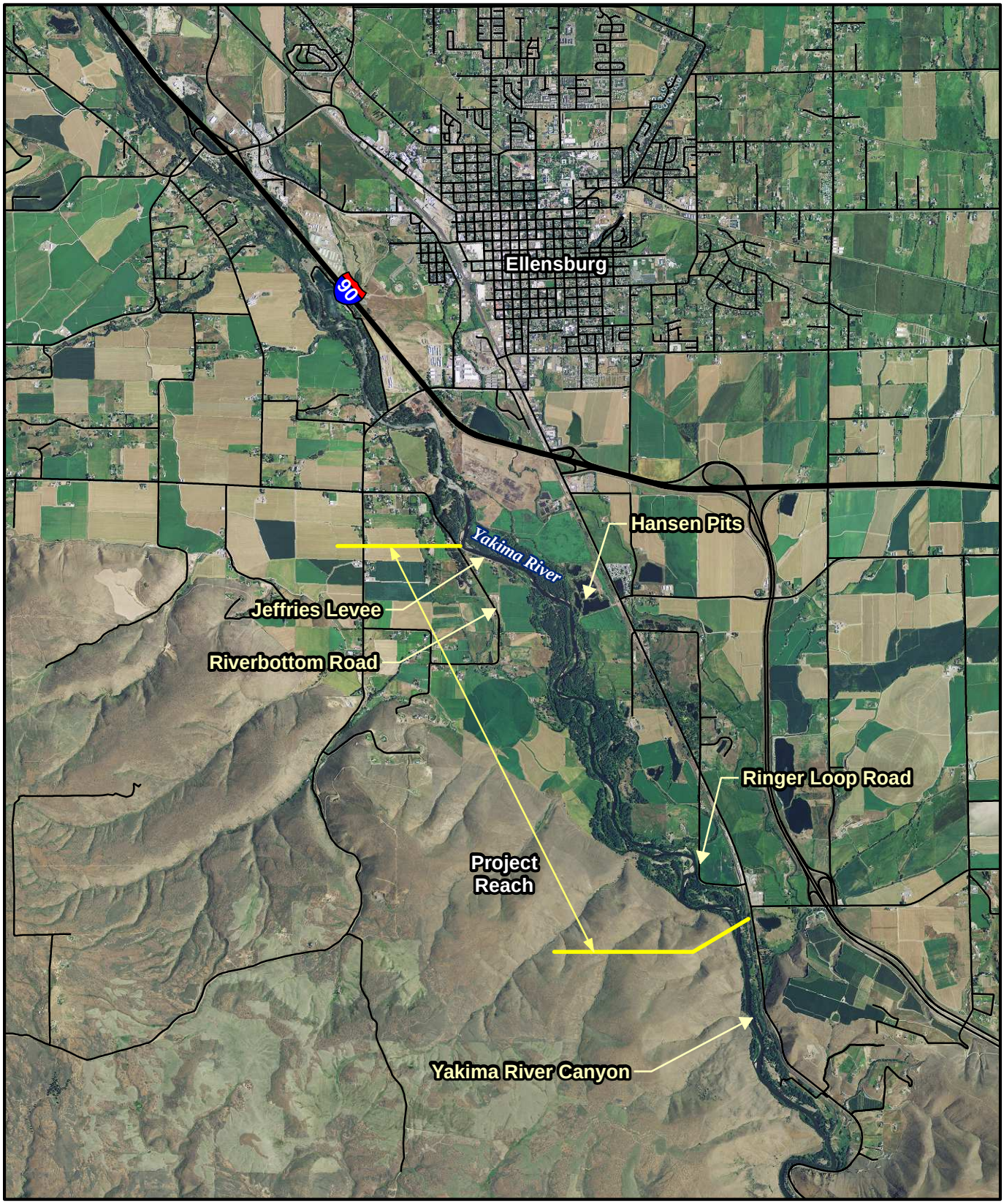
1.3. Definitions

Flood Risk Management: The term flood risk management is used throughout this report in place of flood/erosion protection or flood/erosion control. A key project objective is to

identify flood and erosion hazards and determine the most prudent way to manage or reduce risk, where risk is defined as the potential to lose something of value. Flood protection or flood control usually implies that an action is taken to reduce or prevent damage to land, structures, or people. However, it is often neither economically feasible nor prudent to prevent flooding or erosion at any cost, especially now that such a high value is placed on preservation or creation of habitat for threatened or endangered salmonids. Flood risk management is an all-inclusive phrase that encompasses flood protection and flood control actions, but it also includes other forms of flood and erosion risk reduction such as education, restrictions on land-use, or moving items of value and people out of flood and erosion hazard areas.

Off-Channel: The term off-channel refers to habitat located within the floodplain landward of the main river channel.

Side-Channel: The term side-channel refers to a physical channel located within the floodplain landward of the main river. The channels are often remnant waterways or excavated channels. They typically, but not always, contain water throughout the year.



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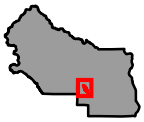

Yakima River Corridor Plan:
Jeffries Levee to Canyon
Vicinity Map Showing the Project Reach
Kittitas County, WA

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C:\Egnyte\Private\shaina\13-028 Yakima River Corridor Plan\ArcGIS\MXD\Figures\Draft Corridor Plan\Final Draft Corridor Plan\Figure 1 - Project Vicinity.mxd 7/16/2015 9:31:39 AM

Figure 1

1.4. Existing Project Reach Conditions

Existing habitat and flood/erosion conditions were assessed during a previous project phase, with the results documented in the two reports:

- Technical Memorandum: Habitat Assessment, Yakima River Hansen Pits to Ringer Loop Road (Herrera, June 2014).
- Technical Memorandum: Flood & Erosion Assessment, Yakima River Hansen Pits to Yakima Canyon (WSE, June 2014).

Key findings and recommendations based upon these investigations are summarized below.

1.4.1. Habitat Limiting Factors

The existing condition habitat assessment identified the following primary factors as limiting salmonid habitat quantity/quality within the project reach (Herrera, June 2014).

- **Floodplain and Off-Channel Habitat** -- While degraded relative to historical conditions, the project reach contains some of the most productive remaining floodplain and off-channel habitat in the Yakima River watershed.

  Recommendation: Place a high priority on conservation, protection, and restoration of existing habitats and open space.

- **Access to Side Channel and Pond Habitat --** Multiple levee and small-scale channel filling/diversion projects have resulted in a significant decrease in access to and the degradation of side channel habitat relative to historical conditions.

  Recommendation: Many cut-off areas have potential to be highly productive due to significant groundwater upwelling within the project reach. A high priority should be given to reconnecting and restoring cut-off side channels and ponds.

- **Lack of Cover and Invasive Species --** While many off-channel habitat areas still exist within the project reach, the quality of the habitat has been degraded due to a shift towards dominance by non-native plant species that do not provide the degree of cover, complexity, and food (insects) that native wood vegetation provides. The vegetation shift, along with physical removal of woody debris in some areas, has resulted in a decrease in shading and cover for juvenile salmonids, and increases in summer water temperatures.

  Recommendation: Increase bank and riparian vegetation adjacent to side channels and within the floodplain. Plant native wood vegetation to increase shade, bank stability, and wood recruitment. Manage or eradicate non-native vegetation such as reed canary grass.

- **Flow Regime --** The natural flow regime has been altered to supply water for irrigation. The summer irrigation "flip-flop" as it is known, has a significant impact on salmonid habitat. It produces extended high flows through summer months which reduce the quality and quantity of summer instream rearing habitat for juvenile salmonids. The

"flip-flop" also produces during this time high velocities in most areas of the main stem and in many side channels that exceed the limits of juvenile fish swimming ability.

During flood season, attenuation of peak flood flows by upstream storage at four large irrigation reservoirs has reduced overbank flow frequency and magnitude. This has reduced geomorphic complexity through reduced bank erosion, meander migration, sediment transport, and gravel/wood debris recruitment. It has likely decreased groundwater recharge which may reduce cool water hyporheic flow to active side channels later during the summer. It has also decreased the effectiveness of anadromous smolt outmigration.

Even though the altered flow regime has impacted salmonids, it has helped produce a healthy trout population, a key fishery that is important to the local economy.

Recommendation: Continue to support on-going efforts to refine irrigation flow management practices to benefit salmonids and their habitat.

1.4.2. Flood and Erosion Countermeasures & Hazards

1.4.2.1. Flood and Erosion Countermeasures

The discussion of hazards, which follows in the next section, will benefit if the reader is first aware of the flood and erosion countermeasures that exist within the project reach. The countermeasures are described below and identified in Figure 2.

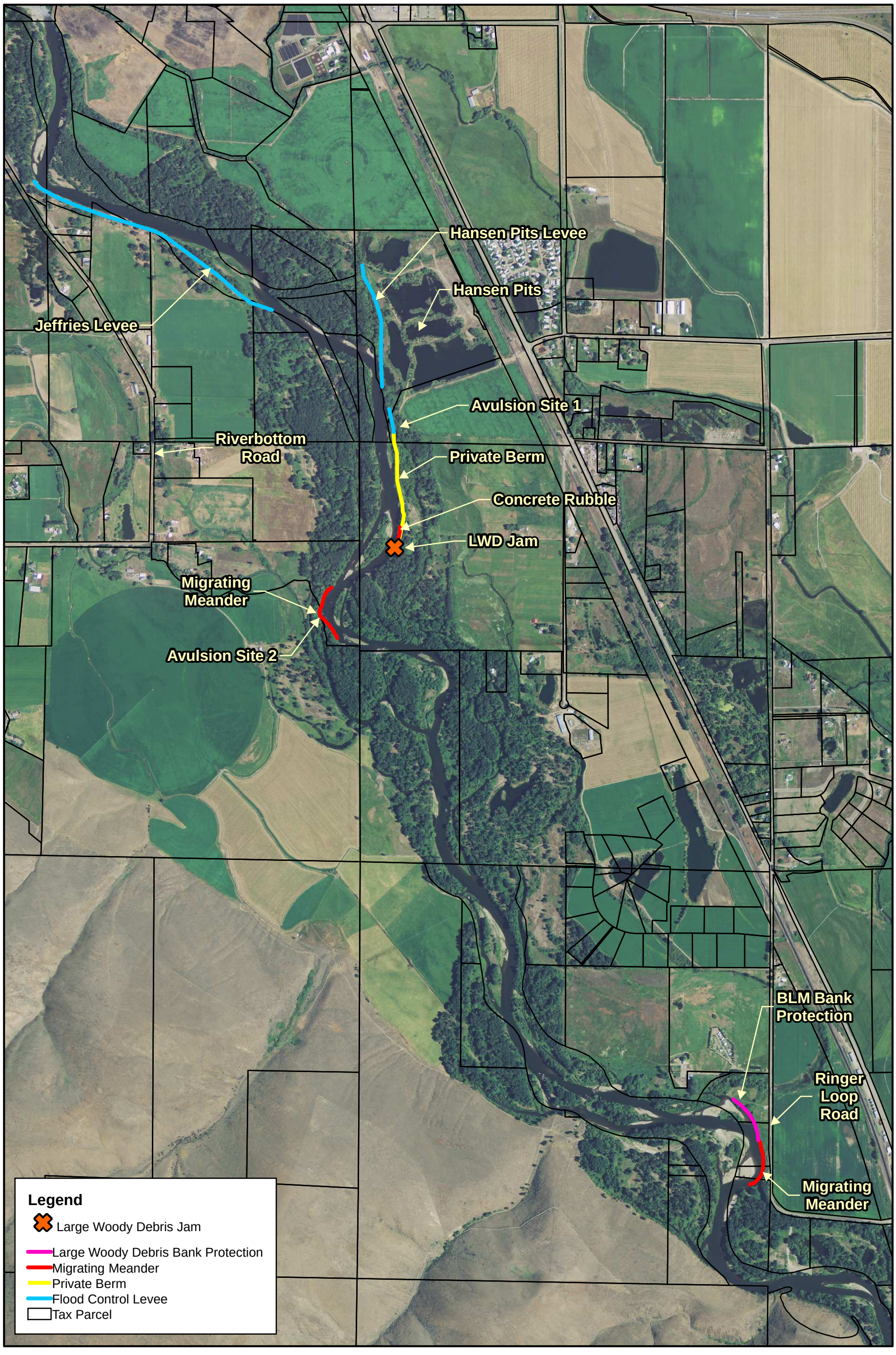
- **Jeffries Levee** – The Jeffries Levee is a 3500-foot long river training levee and revetment originally built in the 1940s and subsequently repaired/upgraded multiple times. The levee is enrolled in the U.S. Army Corps of Engineers (USACE) PL 84-99 program, a law allowing the USACE to rehabilitate flood control works threatened or destroyed by flood.

- **Hansen Pits Levee** – The Hansen Pits Levee is a 2100-foot long river training levee and revetment originally built in the 1940s. A 500-foot long section of the levee has been severely damaged by erosion including a large section that has been completely washed away. This levee is not in the USACE PL 84-99 levee maintenance program and has received no significant maintenance in many years.

- **Private Berm** (downstream extension of the Hansen Pits levee) – The Private Berm is a 1200-foot long private berm that connects to and extends downstream from the Hansen Pits Levee. The berm includes a large pile of concrete rubble and a constructed large woody debris (LWD) jam near the downstream end. The berm was built in the late 1970s. The concrete rubble and LWD jam were added at an unknown time.

- **BLM Bank Protection** – There are a series of small LWD rock riprap barb structures present on Bureau of Land Management (BLM) property near Ringer Loop Road. They were installed in the late 1990s to slow migration of the river into BLM land.

- **Miscellaneous revetments** – Several small local revetments exist at different locations, each installed by landowners to reduce bank erosion along agricultural land.



Kittitas County

Yakima River Corridor Plan:
Jeffries Levee to Canyon
Existing Flood and Erosion Countermeasures,
Migrating Meanders, and Potential Avulsion Sites

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C:\Egnyte\Private\shana\13-028 Yakima River Corridor Plan\ArcGIS\MXD\Figures\Draft Corridor Plan\Final Draft Corridor Plan\Figure 2 - Existing Flood and Erosion Couter Measures Active Bank Erosion Sites and Potential Avulsion Sites.mxd 7/16/2015 9:22:39 AM

Figure 2

1.4.2.2. Flood and Erosion Hazards

The following flood and erosion hazards were identified during the existing condition evaluation (WSE, June 2014):

- **Flooding** -- Flood magnitude and frequency have decreased due to flow attenuation during flood season by the four water supply (irrigation) reservoirs. This has reduced flooding, bank erosion and channel migration within the project reach; however, significant risk remains. The project reach has experienced several small to moderate floods in recent memory, but it has not experienced a major flood, such as approaching the regulatory 100-year event.

  Recommendations:

  - The County should continue to strengthen floodplain management regulations to limit development within the floodplain.
  - The FEMA Flood Insurance Rate Maps (FIRMs) should be updated using the hydraulic model that was created for this investigation.
  - The County should continue to educate floodplain residents of risks.
  - Residents living in the floodplain need to take appropriate action to prepare for a major flood.

- **Bank Erosion and Channel Migration** -- Bank erosion and channel migration are active along the outside bank of most meander bends. Migration currently threatens public infrastructure and/or active agricultural land at two bends (see Figure 2). A large meander is migrating toward Ringer Loop Road and currently is less than 20 feet from the edge of pavement. It is migrating 15 to 25 feet per year and will likely reach the road in one to two years. A large meander near the middle of the project reach is moving west toward agricultural land, and is currently approximately 120 feet from such land. It is migrating 10 to 15 feet per year and may reach the farmland within 10 years or sooner depending upon future flood magnitude and frequency.

  The project reach contains numerous small scale bank erosion sites, some along agricultural lands and others along riparian buffers.

  Recommendations: For Ringer Loop Road, an independent investigation has been completed in which alternative solutions were identified, evaluated, and ranked (WSE 2015). The top ranked and recommended alternative is presented and discussed in Chapters 3 and 4 of this corridor plan.

  For the migrating meander near mid-reach, install LWD or other habitat-suitable bank erosion reduction countermeasures.

  Local erosion sites along riparian areas should be allowed to continue to erode, for this natural geomorphic process produces healthy and complex habitat. Erosion sites that threaten agricultural land, such as the one discussed above, should be stabilized using techniques that promote habitat (e.g. vegetation, LWD, etc.).

- **Avulsions** -- An avulsion of the main river channel into an existing side channel is possible at several locations. Two locations are of particular concern because an avulsion would cause significant erosion of agricultural land. The first is located at the Hansen Pits Levee (see Avulsion Site 1, Figure 2). Here a large section of levee has been washed away allowing the main channel direct access to a side channel. An avulsion is not imminent; however, one may occur if the river continues to migrate toward the head of an adjacent side channel. If the main channel avulses into the side channel, erosion may eventually threaten adjacent agricultural land and developed parcels further downstream. The second and more imminent avulsion site is located at the entrance to a large side channel, near the downstream end of the mid-reach meander (see Avulsion Site 2, Figure 2). An avulsion here would cause significant erosion of agricultural land.

  Recommendation: LWD jams should be designed and installed to reduce the likelihood of an avulsion at both sites. (Note – the Kittitas County Sheriff has expressed recreational safety concerns over the placement of wood within the river, an issue that will need to be addressed).

- **Jeffries Levee, Hansen Pits Levees, and Private Berm** – The Jeffries Levee extends diagonally across the west floodplain along the right (west) bank of the river. During floods, a majority of flow that would naturally spread onto the west floodplain is redirected by the levee to the east. This change in the flow direction is revealed in Figure 3, a figure that was produced using the project reach hydraulic model. It shows the increase (red) and decrease (blue) in 100-year flood depth that would be caused by the Jeffries Levee if the Hansen Pits Levee and Private Berm were removed. Figure 4 shows that when the Hansen Pits Levee and the Private Berm are added back into the hydraulic model, the two structures intercept most of the Jefferies Levee redirected flow turning it south to follow the main river channel. This confirms that the Hansen Pits Levee and the Private Berm are important structures because they reduce impacts caused by the Jeffries Levee on the east floodplain.

  Another impact of the Jeffries Levee is that the flow redirection increases erosive forces at the Hansen Pits Levee, and this is a primary cause of the erosion that has breached the levee.

  These findings reveal that the Jeffries Levee has a major impact on flow and flooding within the project reach. If the levee can be setback or removed to allow flow to spread naturally across the west floodplain, risk on the east floodplain will be reduced which may allow the Hansen Pits Levee and Private Berm to be removed.

  The Jeffries Levee, Hansen Pits Levee, and Private Berm all have a significant impact on channel morphology and therefore, salmonid habitat. They each:

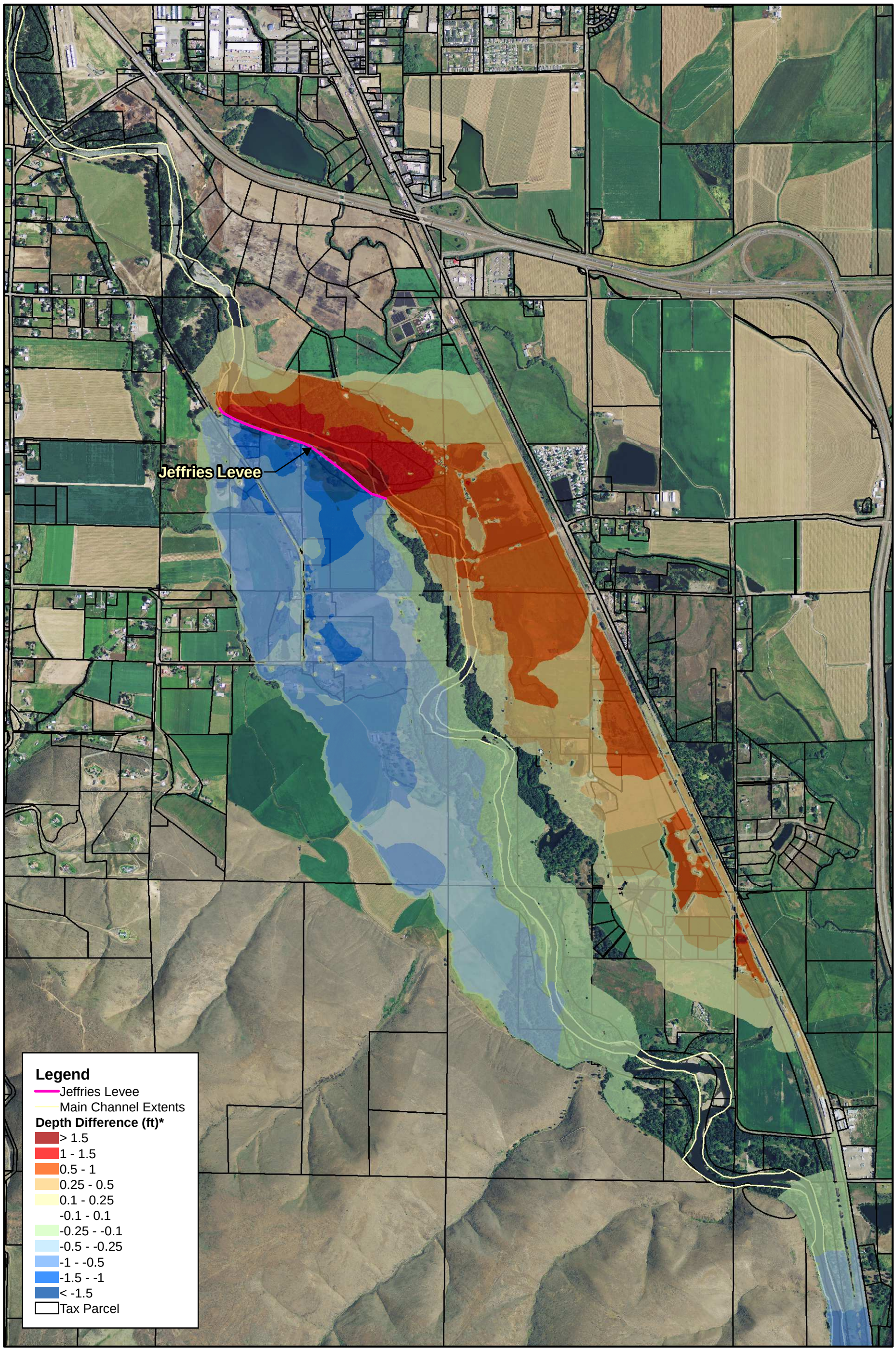
  - restrict natural geomorphic processes that create and sustain high quality habitat (e.g. gravel and large wood recruitment through bank erosion).
  - cause river bed substrate to coarsen which reduces the quality and quantity of areas for spawning. The structures intercept and concentrate the flow, which increases velocity and scour of the river bed. This reduces the area

suitable for spawning, or if spawning has occurred, salmonid redds (nests) are more likely to be damaged or destroyed during high water.

- reduce the number of resting pools with low water velocities. The river has migrated to and effectively hugs long sections of each structure, creating a swift linear water course devoid of pools.

Recommendations:

- The County should develop a policy that defines the extent of its role and responsibility in maintaining flood and river training levees.
- All three structures should be modified to reduce their impact on flow, channel morphology and habitat.



Kittitas County

Yakima River Corridor Plan: Jeffries Levee to Canyon

Jeffries Levee - Impact on Depth

100-year Flood (35,300cfs)

*Plot shows difference in flow depth for a model simulation where the Jeffries Levee is in-place and the Hansen Pits Levee and Private Berm have been removed compared to a simulation where the Jeffries Levee, Hansen Pits Levee, and Private Berm have all been removed, assuming all upstream levees remain intact.

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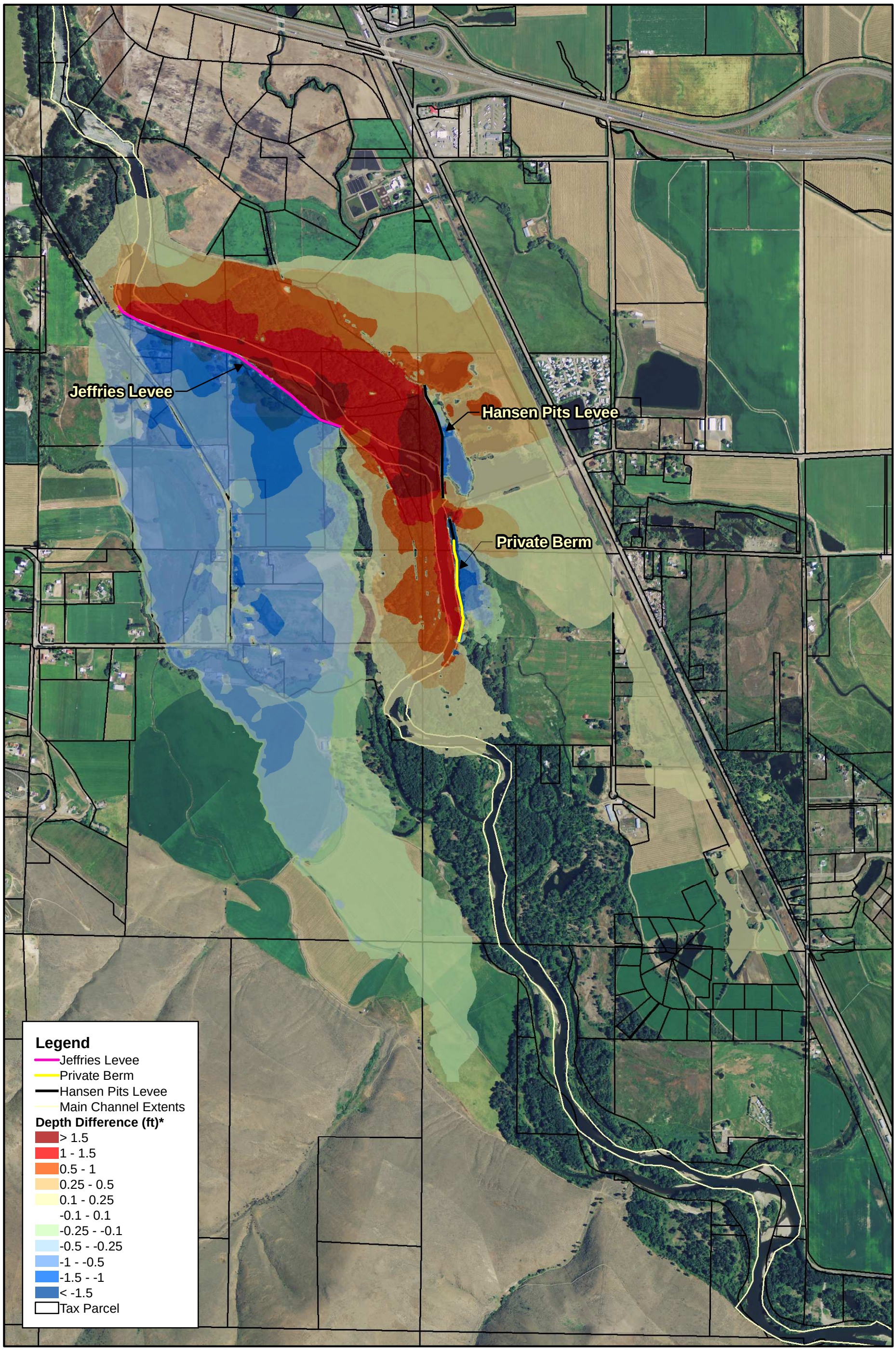
Figure 3



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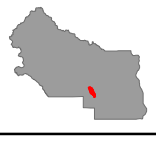

Yakima River Corridor Plan: Jeffries Levee to Canyon

Jeffries Levee, Hansen Pits Levee, and Private Berm - Impact on Depth

100-year Flood (35,300cfs)

*Plot shows difference in flow depth for a model simulation where the Jeffries Levee, Hansen Pits Levee, and Private Berm are all in-place compared to a simulation where the Jeffries Levee, Hansen Pits Levee, and Private Berm have all been removed, assuming all upstream leees remain intact.

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C:\Egnyte\Private\shaina\13-028 Yakima River Corridor Plan\ArcGIS\MXD\Figures\Draft Corridor Plan\Final Draft Corridor Plan\Figure 4 - Jeffries Levee Hansen Pits Levee and Private Berm - Impact on Depth.mxd 7/24/2015 9:19:02 AM

Figure 4

2. STAKEHOLDER ENGAGEMENT

2.1. Engagement During Plan Development

Stakeholder engagement was a high priority throughout development of the plan. Stakeholders included County staff and elected officials, landowners, partner organizations, resource agency representatives, non-profit habitat groups, and the Yakama tribe.

A Technical Advisory Group (TAG) provided input and guidance to the project. Representation on the TAG included:

- Kittitas County Conservation District (KCCD)
- City of Ellensburg
- Washington State Department of Fish and Wildlife (WDFW)
- Washington State Department of Ecology (WDOE)
- Washington State Salmon Recovery Funding Board (SRFB)
- Washington State Department of Transportation (WSDOT)
- Washington State Department of Natural Resources (WDNR)
- U.S. Bureau of Reclamation (USBR)
- U.S. Bureau of Land Management
- National Oceanic and Atmospheric Administration Fisheries (NOAA)
- U.S. Fish and Wildlife Services (USFWS)
- Yakama Indian Tribe
- Mid-Columbia Fish Enhancement Group (MCFEG)
- Trout Unlimited
- Yakima Basin Joint Board

Landowner involvement was conducted through individual and small group meetings, and landowner guided site visits. Landowners participated in a general project kick-off public meeting and they will be invited to participate in the corridor plan presentation public meeting. A complete list of TAG and landowner engagement meetings is provided in Appendix A. The appendix also includes a letter written by a group of landowners, which recommends several flood relief actions. The actions focus primarily on the Schaake Levee which is located immediately upstream from the project reach. The USBR is proposing to setback the levee and construct several habitat restoration projects. The County and the USBR are coordinating proposed actions.

2.2. Engagement During Plan Implementation

The recommended projects proposed later in this document endeavor to strike a reasonable and acceptable balance for both habitat preservation/restoration and flood risk management. Many projects, particularly those with a habitat focus, are widely supported by stakeholders; therefore, stakeholder engagement will mainly require coordination with

the landowners where the projects will be built. On the other hand, many proposed flood risk management actions will have a direct impact on landowners and, therefore, significant stakeholder engagement will be required for both detailed design and implementation.

3. Potential Projects and Screening

This chapter presents the projects considered to improve habitat and reduce flood and erosion risk. It also presents the results of the screening process used to rank projects in order of overall benefit.

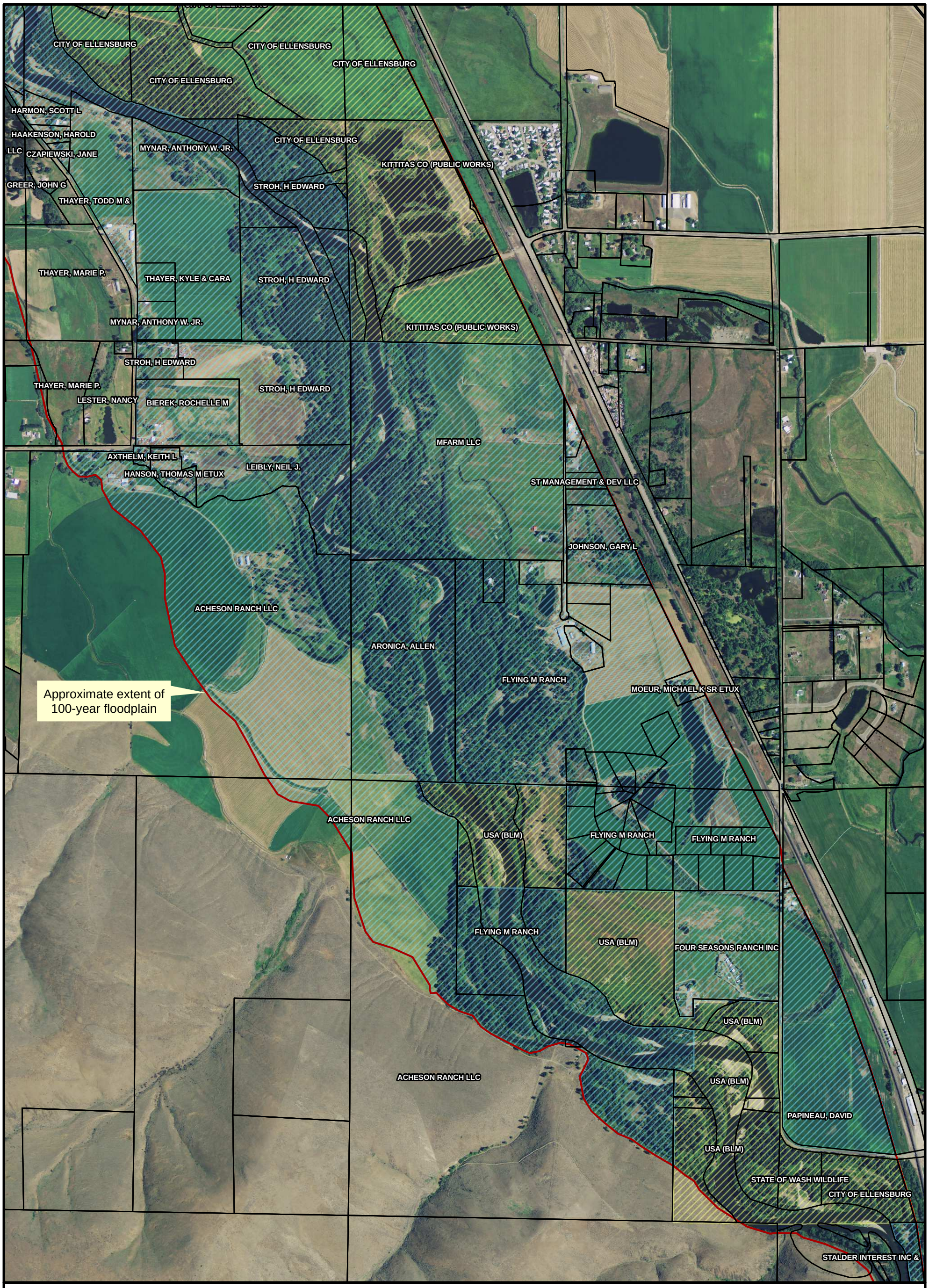
3.1. Potential Habitat Projects

Thirty-one habitat focused projects were identified to preserve and restore salmonid habitat and all of them are recommended. They are listed in Table 1 and locations presented in Figures 5 and 6. Four projects are general actions that can be applied throughout the project reach as opportunities arise. Twenty-seven projects enhance/restore habitat at specific sites, ranging from planting native woody vegetation to construction of groundwater-fed rearing channels.

Three landowners that have sizeable riverfront holdings have openly expressed a willingness to consider installation of the proposed habitat projects on their property. The projects that lie within each of the three land areas are identified by a number in the second column in Table 1, where the numbers 1 to 3 refer to each land area. For example, projects 3, 4, and 24 all are located within property number 1. This column in the table also has the heading "Early-Action Group No.," which signifies that design and implementation of the habitat projects within these three areas should begin right-away since the landowners appear to be willing to consider restoration projects on their land. These "Early-Action" projects are discussed in greater detail in Chapter 4 and in Appendix B.

Table 1. Potential Habitat Projects

Project No.	Property ID / Early Action Group No.	Potential Project
Priority Habitat Restoration Projects		
General Reach-Wide Projects		
N/A		Protect and increase habitats through agriculture, habitat, or open-space conservation easements, land purchases, or other alternatives.
N/A		Control reed canary grass, revegetate with native woody species in key off channel habitat areas such as groundwater channels and overflow channel outlets.
N/A		Work with partner agencies to seek opportunities to refine the flow regime to reduce impacts created by summer irrigation "flip-flop".
N/A		Selectively place LWD key pieces and engineered habitat structures in side channels, groundwater channels, and overflow channels.
Site Specific Projects		
1		Control reed canary grass and revegetate with native species throughout the woodland area.
2		Encourage river to develop natural meanders within woodland area to improve mainstem habitat forming processes. Initiate meanders by setting back upstream one-third of the Jefferies Levee. (Note this may require modifications to City of Ellensburg wastewater outfall).
3	1	Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion, and investigate LWD opportunities in side channels. Control reed canary grass and revegetate with native species throughout the woodland area.
4	1	Enhance habitat within constructed channel. Install LDW and remove existing spoil piles.
5	2	Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion, and investigate LWD placement opportunities in adjacent side channel.
6	2	Investigate presence of a water control structure in north fork ditch that may be acting as a fish passage barrier. Expand riparian zone width by planting native vegetation to improve shading and add a source of LWD. Investigate LWD placement opportunities for habitat enhancement. Investigate potential water quality issues at ditch return and address using BMPs or modified irrigation practices.
7	2	Restore connectivity to the large groundwater channel by replacing existing outlet culvert with engineered open channel. Enhance habitat in the reconnected groundwater channel through revegetation and LWD placement. Investigate potential water quality issues at ditch return and address using BMPs or modified irrigation practices.
8	2	Install LWD structures, river cobbles, and vegetation to improve habitat and reduce bank eosion within side channel. Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion.
9	2	Install LWD structures, river cobbles, and vegetation to improve habitat and reduce bank erosion within side channel. Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion.
10	2	Determine if water quality issues are a concern at ditch return and if they are, work with landowner to address using BMPs.
11	2	Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion.
12	2	Work with landowner to increase native woody species to enhance understory vegetation conditions on the active floodplain.
13	2	Remove spoils berm to restore flow conditions across the active floodplain.
14		Develop habitat restoration plan for Hansen Pits that compliments future County Park proposal. Consider revegetation, connecting ponds to the river via culverts or bridges, etc.
15		If private berm is removed, river may eventually occupy this area. Determine what actions should be taken to maximize habitat if / when river migrates into area.
16		Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion.
17		Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion, and investigate LWD placement opportunities in adjacent side channel.
18		Improve connectivity to and enhance habitat in "Spring Creek". Through native plantings and LWD placement. Expand riparian zone width by planting native vegetation to improve shading and provide a source of LWD. Install complex LWD structures to enhance habitat conditions. Investigate potential water quality issues at ditch return and address using BMPs or modified irrigation practices.
19		Investigate opportunities for side channel reconnection including modification of the way the headgate is operated such that it 1) delivers irrigation water and 2) maximizes habitat quality, quantity, and access.
20		Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion.
21	3	If viable, construct groundwater channel(s) in available floodplain area. Revegetate surrounding area with native species to provide shade and sources of LWD recruitment.
22	3	If viable, construct groundwater channel(s) in available floodplain area. Revegetate surrounding area with native species to provide shade and sources of LWD recruitment.
23	3	Control reed canary grass and revegetate with native species throughout the woodland area.
24	1	Control reed canary grass and revegetate with native species throughout the woodland area.
25		Investigate/confirm accessibility to juvenile fish over a wide range of river flows. Investigate potential water quality issues and address using BMPs or modified irrigation practices. Expand riparian zone width of off-channel pond by planting native vegetation to improve shading and install complex LWD structures to enhance habitat conditions.
26		Purchase property east of Ringer Loop Road, and restore and revegetate the active floodplain. If viable, construct groundwater channel(s) in restored floodplain area.
27		Where appropriate, construct groundwater channel(s) and augment native plant species to impove shade and sources of LWD recruitment. Purchase private property. May need to consider future protection for the railroad.



Legend

- Property boundary
- Publicly owned parcel
- Privately owned land - seek conservation easement and/or purchase to protect land for agriculture, fish & wildlife, and open space

Yakima River Corridor Plan: Jeffries Levee to Canyon

Priority Conservation Easement or Purchase Areas

0 500 1,000 Feet

N

16 Jul 2015

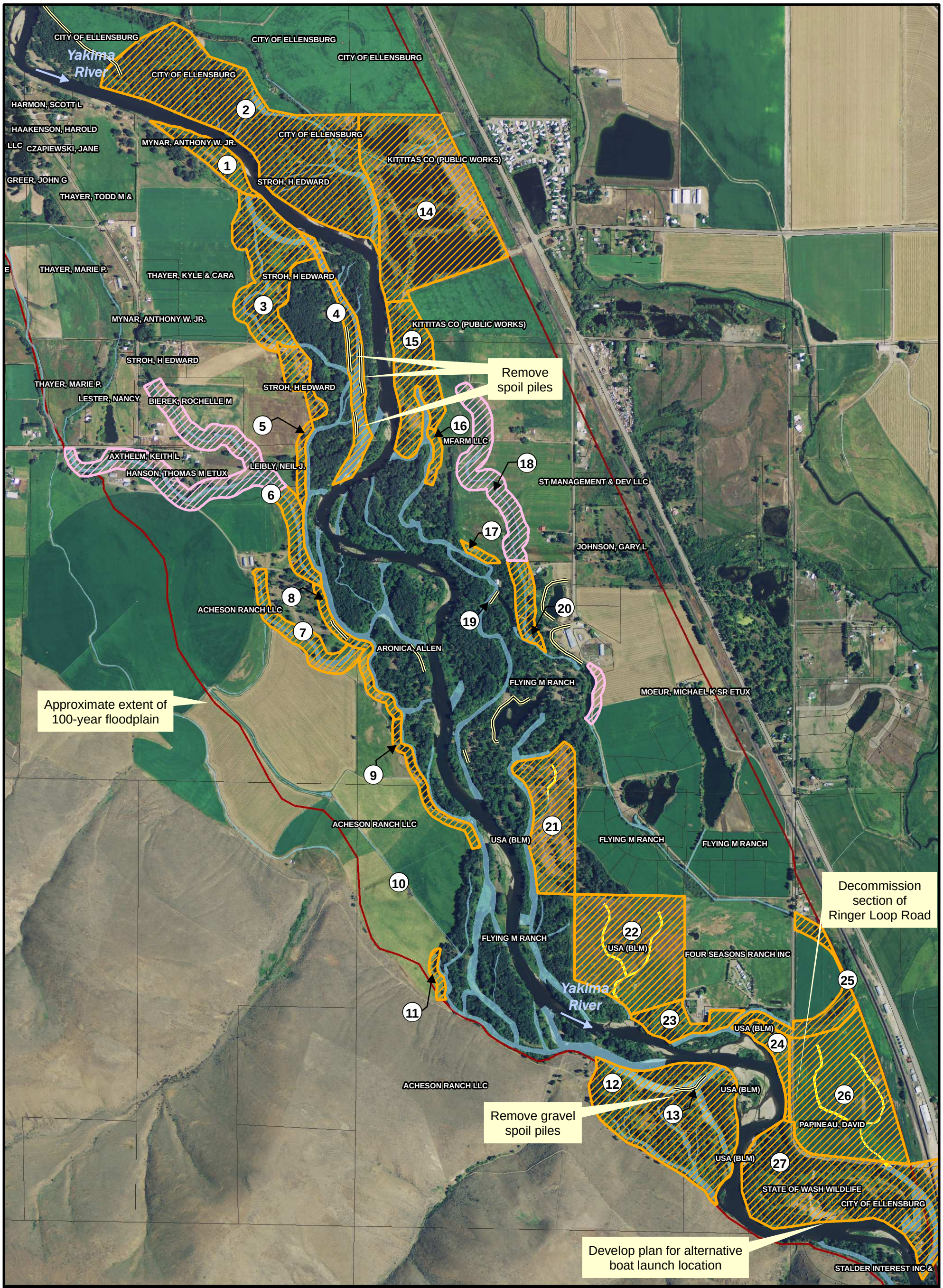
HERRERA

WATERSHED SCIENCE & ENGINEERING

NAD 1983 StatePlane Washington South FIPS 4602 Feet

C:\Egnyte\Private\shaina\13-028 Yakima River Corridor Plan\ArcGIS\MXD\Figures\Draft Corridor Plan\Final Draft Corridor Plan\Figure 5 - Priority Conservation Easement or Purchase Areas.mxd (7/16/2015)

Figure 5



Legend

Habitat Alternatives

- Property boundary
- Spoil piles
- Existing side channel, groundwater channel, overflow channel, or ditch
- Proposed constructed groundwater channel
- Priority habitat restoration area
- Future priority habitat restoration area
- # Habitat restoration site ID

Note: These actions can be implemented independent of flood and erosion control facility modifications.

Yakima River Corridor Plan: Jeffries Levee to Canyon

Site Specific Habitat Restoration Projects

0 500 1,000 Feet

N

30 Jun 2015

HERRERA

WATERSHED SCIENCE & ENGINEERING

NAD 1983 StatePlane Washington South FIPS 4602 Feet

C:\Egnyte\Private\shaina\13-028 Yakima River Corridor Plan\ArcGIS\MXD\Figures\Draft Corridor Plan\Final Draft Corridor Plan\Figure 6 - Site Specific Habitat Restoration Projects.mxd (6/30/2015)

Figure 6

3.2. Potential Flood & Erosion Risk Management Projects

Potential flood risk management projects are divided into three categories: 1) Policy projects, 2) Reach-wide projects, and 3) Site specific projects. Policy recommendations are intended to improve clarity with respect to County floodplain development regulations and maintenance responsibilities. Reach-wide projects are actions that can be applied to different locations within the project reach as opportunities arise. Site specific projects involve the design and construction of capital projects at specific locations to address a specific known impact or risk.

Policy Flood and Erosion Risk Management Projects

1. The County is actively working to improve floodplain management polices to reduce risk, improve public safety, and to comply with requirements of the Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP). This effort should be continued for it has significant relevance to the project reach. A key element of the effort should be the creation of new Flood Insurance Rate Maps (FIRMs) for the project reach. These maps should be created using the project reach hydraulic model that has been developed for this project.

2. The County should develop a policy that directs future maintenance of river training and flood hazard reduction levees throughout the County. This policy should then be applied to the Jeffries and Hansen Pits levees. Policy development should consider questions such as the following:

    - What is at risk - critical infrastructure (important roads, railroads, utilities), buildings (commercial, private residence, out building), open land (agricultural, range, riparian)?
    - Who is at risk, i.e. how serious and extensive is the risk to public safety – human injury or death?
    - What will be the impact on the economy – regional economy (loss of critical transportation corridors, loss of land critical to employment, loss of large tracts of farm and range land), or will the impacts affect the livelihood of individuals, etc.?
    - How do existing facilities affect endangered species and do the impacts create a liability for the County? Will future repairs be permitted?
    - How much will future maintenance cost, who will pay for it, and is it in the public interest to spend public funds for repairs?

Reach-Wide Flood and Erosion Risk Management Projects

1. Conservation Easement and/or Voluntary Land Sale Program – Develop a program to educate and encourage landowners to preserve floodplain land as open space through establishment of conservation easements (agricultural, habitat, open space), or through voluntary land sales (Figure 5).

2. Dangerous LWD Management – Develop a program that allows for the reasonable removal and redistribution of LWD debris (while targeting no net system-wide reduction in LWD) when it is has been identified as a significant public safety risk to those that float the river in drift boats, inner tubes, or other watercraft.

Site Specific Flood and Erosion Risk Management Projects

Five specific locations have been identified for flood and erosion hazard risk reduction projects based upon the results of the existing condition flood and erosion hazard risk analysis (WSE, June 2014). Each site is identified below followed by the list of potential projects that were considered to reduce flood and erosion risk.

1. ***Jeffries Levee*** – This large levee has a significant impact on both habitat and flooding. The levee should be modified to reduce its impact on both habitat and flow redistribution. Thirteen potential projects were examined, ranging from do nothing to a full setback of the levee to Riverbottom Road combined with floodplain acquisition and restoration (Table 2).

Table 2. Jeffries Levee Potential Projects.

Site Project ID	Potential Project
Jefferies Levee	
JL1	Do Nothing
JL2	Setback All to Riverbottom Road & Prevent Migration by Retaining Bank Revetment
JL3	Setback All to Riverbottom Road with Floodplain Acquisition, Restoration, & Revegetation
JL4	Remove Downstream One-Half (or variation) & Prevent Migration by Retaining Bank Revetment
JL5	Remove Downstream One-Half with Floodplain Property Acquisition, Restoration, & Revegetation
JL6	Remove Downstream Tip
JL7	Remove Downstream Tip with Floodplain Property Acquisition, Restoration, & Revegetation
JL8	Remove Completely and Armor Riverbottom Road & Prevent Migration by Retaining Bank Revetment
JL9	Remove Completely, Armor Riverbottom Road, Floodplain Acquisition, Restoration, and Revegetation
JL10	Setback Upstream One-Third of Levee to Initiate Meanders and Lower Top of Levee
JL11	Lower Top of Levee
JL12	Roughen Levee Face with LWD
JL13	Construct LWD Jams in River to Deflect Flow to North into Riparian Area

2. ***Hansen Pits Levee*** – The river has eroded a large breach in the levee which has increased flood risk on the east floodplain and the potential for the river to avulse into and capture an existing side channel. The levee should be modified to reduce its impact on both habitat and flow. Sixteen potential projects were examined. They range from do nothing to complete removal and floodplain acquisition and restoration (Table 3).

Table 3. Hansen Pits Levee Potential Projects.

Site Project ID	Potential Project
Hansen Pits Levee	
HP1	Do Nothing
HP2	Rebuild in Place
HP3	Install LWD to Reduce Lateral Migration and Avulsion Potential & Do Nothing to Levee
HP4	Remove All (Leave D/S Private Berm In-Place)
HP5	Remove All with Floodplain Restoration, & Revegetation (Leave D/S Private Berm In-Place)
HP6	Remove Downstream 800 feet (Leave D/S Private Berm In-Place)
HP7	Remove Downstream 800 feet with Floodplain Restoration, & Revegetation (Leave D/S Private Berm In-Place)
HP8	Setback to Closest (west) Interior Pit Road and Tie into Downstream Private Berm
HP9	Setback to Closest (west) Interior Pit Road and Tie into New Private Berm East of Wooded Riprarian Area
HP10	Setback to Closest (west) Interior Pit Road Tie into New Private Berm East of Spring Channel & Purchase Easement
HP11	Setback to Second Interior Pit Road and Tie into Downstream Private Berm
HP12	Setback to Second Interior Pit Road and Tie into New Private Berm East of Wooded Riprarian Area
HP13	Setback to Second Interior Pit Road and Tie into New Private Berm East of Spring Channel & Purchase Easement
HP14	Remove All Including Private Berm and Setback to East of Pits and tie into New Private Berm East of Wooded Riparian Area
HP15	Remove All Including Private Berm and Setback to east of pits and extend along Stone Road
HP16	Remove All Including Private Berm & Setback east of pits and along Stone Road, Floodplain Acquisition & Restoration

3. ***Private Berm*** – The berm impacts both habitat and flooding. Seven potential projects were initially examined ranging from do nothing to complete removal combined with floodplain acquisition and restoration, with one dismissed and six remaining (Table 4).

Table 4. Private Berm Potential Projects.

Site Project ID	Potential Project
Private Berm	
PB1	Do Nothing
PB2	Remove All
PB3	Remove All with Floodplain Acquisition, Restoration, & Revegetation
PB4	Setback East of Wooded Riparian Area
PB5	Setback East of Spring Channel & Purchase Easement
PB6	Construct LWD Jams in River to Deflect Flow Away from Berm
	Dismissed due to Clear Lack of Benefit, Obviously Infeasible, or Absolute Opposition:
PB7	Increase height /upgrade/improve/ fortify berm

4. ***Meander Migration and Avulsion Site*** – Migration of the mid-reach meander or the avulsion of the main channel into an adjacent side channel would cause significant erosion of agricultural land along the west floodplain. To reduce the rate of migration and the likelihood of an avulsion, two alternatives were considered – do nothing or install LWD jams. Actions using conventional hardscape treatments such as rock riprap were not considered because they likely would not be permitted.

Table 5. Avulsion Site Potential Projects.

Site Project ID	Potential Project
Avulsion Site	
AS1	Do Nothing
AS2	Install LWD jams in inlet to side channels and on bank

5. ***Ringer Loop Road*** - Meander migration will eventually erode through Ringer Loop Road if nothing is done. The County determined that it may be possible to abandon the section of road that is at risk and therefore, potential projects ranged from do nothing to abandonment of a section of the road combined with acquisition and restoration of the parcel east of the road (Table 6).

Table 6. Ringer Loop Road Potential Projects.

Site Project ID	Potential Project
Ringer Loop Road	
	Channel Migration - Allow Channel to Continue to Migrate
RL1	Do Nothing - Clean up after-the-fact
RL2	Remove Section of Ringer Loop Road
RL3	Remove Section of Ringer Loop Road and Revegetate Channel Bank and Road Prism
RL4	Remove Section of Ringer Loop Road, Floodplain Acquisition, Restoration, and Revegetation
	Bank Protection - Prevent Channel Migration
RL5	Series of Large Engineered Log Jams (ELJs) to Reroute Channel Planform
RL6	Series of Large Rock Spurs to Reroute Channel Planform
RL7	Excavate Major Channel through Bar Opposite Ringer Loop Road, Design for Both Habitat and Conveyance
RL8	Scalp Gravel Bar(s) Opposite Ringer Loop Road
RL9	Rock Revetment
RL10	Rock Barbs
RL11	Rock-Filled Trench (Adjacent to Ringer Loop Road)
RL12	Timber Crib
RL13	Timber Revetment (Bank Roughening)
RL14	Armored Toe with Bioengineered Soil Lifts
RL15	Plantings Alone (No Toe Protection)
RL16	Sheetpile Bank Protection
RL17	Manufactured Systems (Placed on River Bank with Toe in Riverbed)

3.3. Project Screening and Ranking

Potential projects were evaluated and compared to identify preferred solutions and prioritize implementation. Projects were numerically scored in three general categories: 1) ecological benefits, 2) flood and erosion hazard risk reduction benefits, and 3) apparent community support. Each category was scored for a distinct set of evaluation criteria representing core project objectives which reflect key stakeholder values. The criteria and score range are presented below.

Ecological: (Score range: 0 (No Benefit) to 5 (High Benefit))

- Protect or Improve Existing Off-Channel Rearing Habitat
- Increase Quantity of Off-Channel Rearing Habitat
- Protect or Improve Terrestrial Habitat
- Improve Mainstem Habitat or Habitat Forming Processes
- Improve Water Quality

Flood and Erosion Risk Reduction: (Score range: 0 (No Benefit) to 5 (High Benefit))

- Reduce Risk to Human Life
- Reduce Impacts to Regional Economy
- Protect Critical Transportation Facilities
- Protect Private Property
- Protect Public Land

Community Support (Score range: 0 (No support or clear Opposition) to 5 (full support))

- Landowners
- Habitat Focused Groups
- Recreational Users (River Guides etc.)
- Political

3.3.1. Potential Habitat Projects

All potential habitat projects were scored for each evaluation criteria under each category. Table 7 presents the projects as two groups, general reach-wide and site specific projects. Scores are shown for each individual criteria, for the sum under each general category, and the sum of all categories i.e. a total ecological, flood/erosion, and community support score. Potential projects are ranked according to the total score with the highest scoring projects listed first. Red to blue color gradations have been added to aid in comparing relative benefits for each general category and the total combined score. The last column in the table lists a relative capital/maintenance cost for each action (L=low, M=medium, H=high, VH=very high). These values are approximate and not based upon calculated opinions of cost.

The full suite of potential habitat projects presented in Table 7 is generally supported by stakeholders and therefore, all are recommended for implementation regardless of rank.

Table 7. Potential Habitat Restoration Projects Screening Matrix

				Ecological Guiding Criteria						Flood/Erosion Risk Reduction Criteria						Current Community Criteria						
Relative Rank	Project No.	Property ID. / Early Action Group No.	Potential Projects	Protect or Improve Existing Off-Channel Rearing Habitat	Increase Quantity of Off-Channel Rearing Habitat	Protect or Improve Terrestrial Habitat	Improve Mainstem Habitat or Habitat Forming Processes	Improve Water Quality	Ecological Score	Reduce Risk to Human Life	Reduce Impacts to Regional Economy	Protect Critical Transportation Facilities	Protect Private Property	Protect Public Land	Flood/Erosion Hazard Reduction Score	Landowners	Habitat Focused Groups	Recreational Users (River Guides etc.)	Political	Community Support Score	Combined Score	Relative Capital & Maintenance Cost
				0-5	0-5	0-5	0-5	0-5	0-25	0-5	0-5	0-5	0-5	0-5	0-25	0-5	0-5	0-5	0-5	0-20	0-70	L,M,H,VH
Priority Habitat Restoration Projects																						
General Reach-Wide Projects																						
1	N/A		Protect and increase habitats through agriculture, habitat, or open-space conservation easements, land purchases, or other alternatives.	4	4	4	4	4	20	3	1	1	3	2	10	2	5	3	3	13	43	M
2	N/A		Control reed canary grass, revegetate with native woody species in key off channel habitat areas such as groundwater channels and overflow channel outlets.	4	0	1	0	1	6	0	0	0	1	1	2	3	4	3	4	14	22	L
3	N/A		Work with partner agencies to seek opportunities to refine the flow regime to reduce impacts created by summer irrigation "flip-flop".	4	0	2	3	2	11	1	0	0	1	1	3	2	3	1	1	7	21	H
4	N/A		Selectively place LWD key pieces and engineered habitat structures in side channels, groundwater channels, and overflow channels.	4	0	0	2	0	6	1	0	0	1	2	4	2	4	2	2	10	20	L
Site Specific Projects																						
1	27		Where appropriate, construct groundwater channel(s) and augment native plant species to impove shade and sources of LWD recruitment. Purchase private property. May need to consider future protection for the railroad.	2	4	5	2	1	14	2	0	4	3	2	11	2	5	3	3	13	38	M
2	26		Purchase property east of Ringer Loop Road, and restore and revegetate the active floodplain. If viable, construct groundwater channel(s) in restored floodplain area.	3	4	5	4	1	17	2	0	2	1	1	6	1	5	3	2	11	34	M
3	2		Encourage river to develop natural meanders within woodland area to improve mainstem habitat forming processes. Initiate meanders by setting back upstream one-third of the Jefferies Levee. (Note this may require modifications to City of Ellensburg wastewater outfall).	4	4	2	5	2	17	2	0	0	1	1	4	3	4	2	3	12	33	L
4	15		If private berm is removed, river may eventually occupy this area. Determine what actions should be taken to maximize habitat if / when river migrates into area.	4	4	2	4	1	15	0	0	0	1	0	1	2	5	3	3	13	29	L
5	14		Develop habitat restoration plan for Hansen Pits that compliments future County Park proposal. Consider revegetation, connecting ponds to the river via culverts or bridges, etc.	4	5	0	0	1	10	0	0	0	0	1	1	4	4	4	4	16	27	L
6	22	3	If viable, construct groundwater channel(s) in available floodplain area. Revegetate surrounding area with native species to provide shade and sources of LWD recruitment.	0	4	5	0	1	10	0	0	0	0	0	0	4	5	3	3	15	25	L
7	18		Improve connectivity to and enhance habitat in "Spring Creek". Through native plantings and LWD placement. Expand riparian zone width by planting native vegetation to improve shading and provide a source of LWD. Install complex LWD structures to enhance habitat conditions. Investigate potential water quality issues at ditch return and address using BMPs or modified irrigation practices.	4	3	1	0	3	11	0	0	0	1	0	1	1	5	3	3	12	24	L
8	21	3	If viable, construct groundwater channel(s) in available floodplain area. Revegetate surrounding area with native species to provide shade and sources of LWD recruitment.	2	4	5	0	1	12	0	0	0	0	0	0	2	4	3	3	12	24	L
9	4	1	Enhance habitat within constructed channel. Install LDW and remove existing spoil piles.	4	3	1	0	1	9	0	0	0	1	0	1	3	4	3	3	13	23	L
10	6	2	Investigate presence of a water control structure in north fork ditch that may be acting as a fish passage barrier. Expand riparian zone width by planting native vegetation to improve shading and add a source of LWD. Investigate LWD placement opportunities for habitat enhancement. Investigate potential water quality issues at ditch return and address using BMPs or modified irrigation practices.	4	2	1	0	3	10	0	0	0	1	0	1	1	5	3	2	11	22	L
11	8	2	Install LWD structures, river cobbles, and vegetation to improve habitat and reduce bank eosion within side channel. Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion.	4	1	1	0	1	7	0	0	0	3	0	3	3	2	3	3	11	21	L
12	24	1	Control reed canary grass and revegetate with native species throughout the woodland area.	0	0	4	0	1	5	0	0	1	1	2	4	3	3	3	3	12	21	L
13	25		Investigate/confirm accessibility to juvenile fish over a wide range of river flows. Investigate potential water quality issues and address using BMPs or modified irrigation practices. Expand riparian zone width of off-channel pond by planting native vegetation to improve shading and install complex LWD structures to enhance habitat conditions.	3	1	1	0	3	8	0	0	0	1	0	1	2	4	3	3	12	21	L
14	7	2	Restore connectivity to the large groundwater channel by replacing existing outlet culvert with engineered open channel. Enhance habitat in the reconnected groundwater channel through revegetation and LWD placement. Investigate potential water quality issues at ditch return and address using BMPs or modified irrigation practices.	0	4	1	0	3	8	0	0	0	0	0	0	1	5	3	3	12	20	L
15	10	2	Determine if water quality issues are a concern at ditch return and if they are, work with landowner to address using BMPs.	2	0	0	0	4	6	0	0	0	0	0	0	2	5	3	3	13	19	L
16	3	1	Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion, and investigate LWD opportunities in side channels. Control reed canary grass and revegetate with native species throughout the woodland area.	0	0	4	0	1	5	0	0	0	1	0	1	3	3	3	3	12	18	L
17	13	2	Remove spoils berm to restore flow conditions across the active floodplain.	1	0	1	2	0	4	0	0	1	1	0	2	1	5	3	3	12	18	L
18	17		Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion, and investigate LWD placement opportunities in adjacent side channel.	3	0	1	0	1	5	0	0	0	1	0	1	2	4	3	3	12	18	L
19	19		Investigate opportunities for side channel reconnection including modification of the way the headgate is operated such that it 1) delivers irrigation water and 2) maximizes habitat quality, quantity, and access.	5	1	0	0	0	6	0	0	0	0	0	0	1	5	3	3	12	18	M
20	23	3	Control reed canary grass and revegetate with native species throughout the woodland area.	0	0	4	0	1	5	0	0	0	1	0	1	3	3	3	3	12	18	L
21	1		Control reed canary grass and revegetate with native species throughout the woodland area.	0	0	3	0	1	4	0	0	0	1	0	1	3	3	3	3	12	17	L
22	5	2	Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion, and investigate LWD placement opportunities in adjacent side channel.	4	0	0	0	0	4	0	0	0	1	0	1	2	4	3	3	12	17	L
23	9	2	Install LWD structures, river cobbles, and vegetation to improve habitat and reduce bank erosion within side channel. Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion.	2	0	1	0	1	4	0	0	0	1	0	1	2	4	3	3	12	17	L
24	11	2	Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion.	2	0	1	0	1	4	0	0	0	1	0	1	2	4	3	3	12	17	L
25	16		Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion.	2	0	1	0	1	4	0	0	0	1	0	1	2	4	3	3	12	17	L
26	20		Expand riparian zone width by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion.	2	0	1	0	1	4	0	0	0	1	0	1	2	4	3	3	12	17	L
27	12	2	Work with landowner to increase native woody species to enhance understory vegetation conditions on the active floodplain.	0	0	4	0	1	5	0	0	0	1	0	1	1	3	3	3	10	16	L

Table 8. Potential Flood Hazard Management Projects Screening Matrix

Relative Rank	Site Project ID	Potential Projects	Ecological Criteria: Protect or Improve Existing Off-Channel Rearing Habitat	Increase Quantity of Off-Channel Rearing Habitat	Protect or Improve Terrestrial Habitat	Improve Mainstem Habitat or Habitat Forming Processes	Improve Water Quality	Ecological Score	Flood/Erosion Risk Reduction Criteria: Reduce Risk to Human Life	Reduce Impacts to Regional Economy	Protect Critical Transportation Facilities	Protect Private Property	Protect Public Land	Flood/Erosion Hazard Reduction Score	Community Support Criteria: Landowners	Habitat Focused Groups	Recreational Users (River Guides etc.)	Political	Community Support Score	Combined Score	Relative Capital & Maintenance Cost
			0-5	0-5	0-5	0-5	0-5	0-25	0-5	0-5	0-5	0-5	0-5	0-25	0-5	0-5	0-5	0-5	0-20	0-70	L,M,H,VH
		General Reach-Wide Projects																			
1	N/A	Conservation Easement and/or Voluntary Land Sale Program	4	4	4	4	4	20	3	1	1	3	2	10	2	5	3	3	13	43	M
2	N/A	Dangerous LWD Management	0	0	0	0	0	0	5	1	1	2	2	11	5	1	4	4	14	25	L
		Site Specific Projects																			
		Jefferies Levee																			
1	JL3	Setback All to Riverbottom Road with Floodplain Acquisition, Restoration, & Revegetation	2	5	5	4	3	19	2	1	3	5	0	11	0	5	4	2	11	41	VH
2	JL9	Remove Completely, Armor Riverbottom Road, Floodplain Acquisition, Restoration, and Revegetation	2	5	5	4	3	19	1	1	3	3	0	8	0	5	4	2	11	38	VH
3	JL5	Remove Downstream One-Half with Floodplain Property Acquisition, Restoration, & Revegetation	1	4	4	2	2	13	1	1	3	4	0	9	0	4	3	2	9	31	VH
4	JL10	Setback Upstream One-Third of Levee to Initiate Meanders and Lower Top of Levee	2	1	1	3	2	9	1	1	3	3	0	8	2	2	2	3	9	26	H
5	JL7	Remove Downstream Tip with Floodplain Property Acquisition, Restoration, & Revegetation	1	1	1	1	1	5	0	1	3	4	0	8	1	2	1	3	7	20	M
6	JL1	Do Nothing	0	0	0	0	0	0	1	1	3	4	0	9	4	1	2	3	10	19	L
7	JL6	Remove Downstream Tip	1	0	1	1	1	4	0	1	3	3	0	7	1	1	1	3	6	17	L
8	JL12	Roughen Levee Face with LWD	1	0	0	1	0	2	1	1	3	4	0	9	3	1	1	1	6	17	L
9	JL4	Remove Downstream One-Half (or variation) & Prevent Migration by Retaining Bank Revetment	0	0	0	1	2	3	1	1	3	2	0	7	0	2	2	1	5	15	H
10	JL13	Construct LWD Jams in River to Deflect Flow to North into Riparian Area	2	0	0	2	0	4	0	1	3	4	0	8	2	1	0	0	3	15	M
11	JL11	Lower Top of Levee	0	0	0	1	1	2	1	1	2	3	0	7	1	1	1	2	5	14	M
12	JL2	Setback All to Riverbottom Road & Prevent Migration by Retaining Bank Revetment	0	0	0	1	1	2	0	1	3	1	0	5	0	2	2	2	6	13	VH
13	JL8	Remove Completely and Armor Riverbottom Road & Prevent Migration by Retaining Bank Revetment	0	0	0	1	1	2	0	1	3	1	0	5	0	2	2	2	6	13	VH
		Hansen Pits Levee																			
1	HP14	Remove All Including Private Berm and Setback to East of Pits and tie into New Private Berm East of Wooded Riparian Area	4	4	3	4	3	18	1	1	0	4	3	9	4	3	3	3	13	40	VH
2	HP12	Setback to Second Interior Pit Road and Tie into New Private Berm East of Wooded Riprarian Area	3	3	3	3	3	15	1	1	0	3	4	9	4	2	3	3	12	36	VH
3	HP9	Setback to Closest (west) Interior Pit Road and Tie into New Private Berm East of Wooded Riprarian Area	3	3	2	3	3	14	1	1	0	3	4	9	4	2	3	3	12	35	H
4	HP16	Remove All Including Private Berm & Setback east of pits and along Stone Road, Floodplain Acquisition & Restoration	4	5	4	5	3	21	1	1	0	4	0	6	0	4	3	1	8	35	VH
5	HP10	Setback to Closest (west) Interior Pit Road Tie into New Private Berm East of Spring Channel & Purchase Easement	3	4	3	3	3	16	1	1	0	3	4	9	0	3	3	2	8	33	H
6	HP13	Setback to Second Interior Pit Road and Tie into New Private Berm East of Spring Channel & Purchase Easement	3	3	3	3	3	15	1	1	0	3	4	9	0	3	3	2	8	32	VH
7	HP15	Remove All Including Private Berm and Setback to east of pits and extend along Stone Road	4	4	3	4	3	18	1	1	0	1	0	3	0	4	3	1	8	29	VH
8	HP3	Install LWD to Reduce Lateral Migration and Avulsion Potential & Do Nothing to Levee	2	2	1	2	1	8	1	1	0	3	4	9	2	2	2	3	9	26	M
9	HP11	Setback to Second Interior Pit Road and Tie into Downstream Private Berm	1	1	1	1	1	5	1	1	0	4	4	10	4	0	2	2	8	23	VH
10	HP8	Setback to Closest (west) Interior Pit Road and Tie into Downstream Private Berm	0	0	0	0	1	1	1	1	0	4	5	11	4	0	2	2	8	20	M
11	HP2	Rebuild in Place	0	0	0	0	0	0	1	1	0	4	5	11	4	0	1	1	6	17	H
12	HP5	Remove All with Floodplain Restoration, & Revegetation (Leave D/S Private Berm In-Place)	2	3	3	3	1	12	0	0	0	0	0	0	1	2	1	1	5	17	H
13	HP4	Remove All (Leave D/S Private Berm In-Place)	2	3	2	3	1	11	0	0	0	0	0	0	1	2	1	1	5	16	H
14	HP7	Remove Downstream 800 feet with Floodplain Restoration, & Revegetation (Leave D/S Private Berm In-Place)	1	2	2	1	1	7	0	0	0	0	2	2	1	3	2	1	7	16	M
15	HP6	Remove Downstream 800 feet (Leave D/S Private Berm In-Place)	1	2	1	1	1	6	0	0	0	0	2	2	1	3	2	1	7	15	M
16	HP1	Do Nothing	2	2	1	2	0	7	1	1	0	1	1	4	0	2	1	0	3	14	L
		Private Berm																			
1	PB3	Remove All with Floodplain Acquisition, Restoration, & Revegetation	2	4	5	5	4	20	1	1	0	5	0	7	0	5	3	1	9	36	H
2	PB4	Setback East of Wooded Riparian Area	2	2	2	2	2	10	1	1	0	3	0	5	2	2	3	2	9	24	H
3	PB5	Setback East of Spring Channel & Purchase Easement	2	2	3	2	2	11	1	1	0	3	0	5	0	3	3	2	8	24	H
4	PB2	Remove All	2	3	2	4	2	13	0	1	0	1	0	2	0	4	3	1	8	23	M
5	PB1	Do Nothing	0	0	0	0	0	0	1	1	0	4	0	6	4	1	2	2	9	15	L
6	PB6	Construct LWD Jams in River to Deflect Flow Away from Berm	0	0	0	2	0	2	0	1	0	4	0	5	1	1	0	1	3	10	M to H
		Dismissed due to Clear Lack of Benefit, Obviously Infeasible, or Absolute Opposition:																			
	PB7	Increase height /upgrade/improve/ fortify berm																			
		Avulsion Site																			
1	AS2	Install LWD jams in inlet to side channels and on bank	2	0	0	0	0	2	1	1	0	4	0	6	5	2	2	3	12	20	M
2	AS1	Do Nothing	1	0	0	0	0	1	0	0	0	0	0	0	1	4	3	3	11	12	L
		Ringer Loop Road																			
1	RL4	Remove Section of Ringer Loop Road, Floodplain Acquisition, Restoration, and Revegetation	0	2	4	4	3	13	1	0	0	2	0	3	2	5	3	2	12	28	M
2	RL3	Remove Section of Ringer Loop Road and Revegetate Channel Bank and Road Prism	0	1	3	3	2	9	1	0	0	0	0	1	2	4	2	2	10	20	M
3	RL14	Armored Toe with Bioengineered Soil Lifts	0	0	2	1	1	4	1	0	0	4	2	7	3	1	2	2	8	19	M
4	RL12	Timber Crib	0	0	2	1	1	4	1	0	0	4	2	7	3	2	1	1	7	18	M
5	RL13	Timber Revetment (Bank Roughening)	0	0	2	1	1	4	1	0	0	3	2	6	3	2	1	1	7	17	M
6	RL2	Remove Section of Ringer Loop Road	0	1	0	2	1	4	1	0	0	0	0	1	2	3	2	2	9	14	L
7	RL10	Rock Barbs	0	0	0	0	0	0	1	0	0	4	2	7	3	1	1	2	7	14	M
8	RL9	Rock Revetment	0	0	0	0	0	0	1	0	0	4	2	7	3	0	1	1	5	12	M
9	RL5	Series of Large Engineered Log Jams (ELJs) to Reroute Channel Planform	0	0	0	1	0	1	1	0	0	3	2	6	2	1	0	1	4	11	M
10	RL16	Sheetpile Bank Protection	0	0	0	0	0	0	1	0	0	5	2	8	2	0	0	1	3	11	M
11	RL6	Series of Large Rock Spurs to Reroute Channel Planform	0	0	0	1	0	1	1	0	0	3	2	6	2	0	0	1	3	10	M
12	RL11	Rock-Filled Trench (Adjacent to Ringer Loop Road)	0	0	0	0	0	0	1	0	0	3	2	6	3	0	0	1	4	10	M
13	RL17	Manufactured Systems (Placed on River Bank with Toe in Riverbed)	0	0	0	0	0	0	1	0	0	4	2	7	2	0	0	1	3	10	M
14	RL1	Do Nothing - Clean up after-the-fact	0	1	0	2	0	3	0	0	0	0	0	0	2	2	1	1	6	9	L
15	RL15	Plantings Alone (No Toe Protection)	0	0	2	1	0	3	0	0	0	1	2	3	0	0	1	0	1	7	M
16	RL7	Excavate Major Channel through Bar Opposite Ringer Loop Road, Design for Both Habitat and Conveyance	0	1	0	0	0	1	0	0	0	1	1	2	1	0	1	1	3	6	M
17	RL8	Scalp Gravel Bar(s) Opposite Ringer Loop Road	0	0	0	0	0	0	0	0	0	1	1	2	2	0	1	1	4	6	M

3.3.2. Potential Flood & Erosion Risk Management Projects

Potential projects to manage or reduce flood and erosion risk were scored for each evaluation criteria under each category, with the results presented in Table 8. Similar to the habitat projects, the projects are split into two groups, general reach-wide and site specific projects. Scoring, conditional color formatting, rankings, and relative costs were established using the same methods used for the habitat projects. Policy flood projects were not screened because many of the evaluation criteria are not directly relevant.

3.3.2.1. General Reach-Wide Flood Projects

Two projects are included in this category, conservation easement/voluntary land sale and dangerous LWD management programs. The conservation easement/voluntary land sale program received the highest combined score of all flood risk reduction projects. The LWD management program received a zero ecological score, but relatively high scores for both flood/erosion risk reduction and community support. Both projects are recommended.

3.3.2.2. Site Specific Flood Projects

Unlike the habitat projects, the screening scores played a key role in deciding which project to recommend for each site. In each case the recommended projects received the highest score and therefore ranked first (highlighted in red text in Table 8). In the case of the Jeffries Levee, Hansen Pits Levee, and Private berm, a second alternative is highlighted in blue text which is a recommended interim project. At each of these sites, the recommended alternative (red) requires the voluntary sale of multiple land parcels, which may delay or prevent implementation; therefore, an interim project is identified at each site which does not require or greatly reduces the need to purchase land. The recommended projects for each site are described below. The project rank and ID are listed in parenthesis following the site name, values which can be found in the first two columns of Table 8. A simple plan view illustration of each project is depicted in Figures 7 and 8.

1. ***Jeffries Levee*** -- (Rank 1, Project JL3) & (Rank 4, Project JL10)

   The highest ranked and therefore, recommended project is to setback the entirety of the Jeffries Levee to Riverbottom Road, combined with acquisition and restoration of the floodplain immediately adjacent and downstream (Project JL3). This project will require voluntary land sales, which may affect the ability to implement the project. The County should discuss the project with the affected landowners to determine if it can be implemented in the near future. If it is likely to take a decade or more to purchase the land, then the following interim project is recommended. The interim project provides significant flood reduction benefits for downstream landowners, and also improves habitat and reduces erosive forces on the Hansen Pits Levee and impacts to the east floodplain. The project includes setting back and reorienting the alignment of the upper third of the Jeffries levee, and reducing the height or removing a section of the downstream two-thirds (Project JL10). Setting back and reorienting the upper third of the levee will encourage the river to migrate into the northern riparian area where it is likely to re-establish a natural meander planform and therefore improve habitat by creating geomorphic complexity. The City of Ellensburg's waste water treatment plant return flow pipe is located within the riparian area and may need to be modified or relocated if this

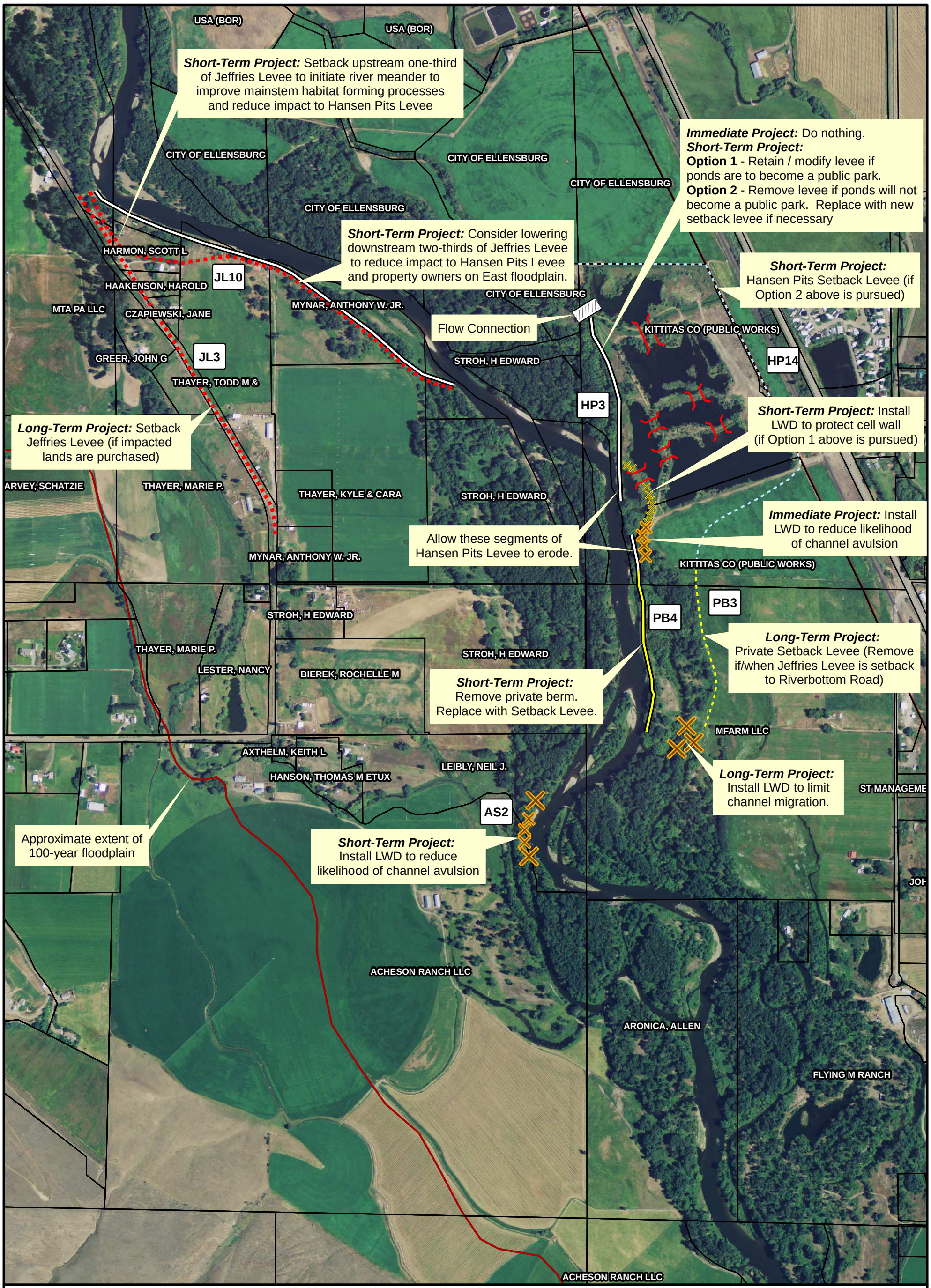
alternative is implemented. Modifying the downstream two-thirds of the levee will allow a higher percentage of flow to spread onto the west floodplain during large events which will reduce erosive forces at the Hansen Pits levee and risk on the east floodplain. This interim project is the forth ranked Jeffries Levee project in Table 8 (Project JL10). The second and third ranked projects require significant voluntary land sales and therefore, have the same land acquisition issue as the recommended alternative.

2. ***Hansen Pits Levee*** – (Rank 1, Project HP14) & (Rank 8, Project HP3)

Two different projects are presented for Hansen Pits because the community must first decide whether the site will or will not become a public park. The idea of a park has been considered in conjunction with an on-going trail master plan effort, which was put on hold until the conclusion of this corridor plan project. If the site will become a park, some form of river training facility will be required to prevent the river from migrating into the pits. This river training structure would likely include a modified form of the existing Hansen Pit Levee that remains intact along the northern portion of the pits, along with some form of habitat-friendly bank re-enforcement along the riverward side of the pit dividing wall immediately landward of the current eroded section of the levee.

If the site will not become a park, the recommendation is to encourage the river to interact with the pits in a manner that creates significant geomorphic complexity and therefore habitat. This would be achieved by allowing the river to migrate into and capture part or all of the pits. However, given the potential presence of nonnative predatory fish species (which pray upon juvenile salmonids) in the pits, design alternatives will need to consider predation. If the river captures the pits, a new levee ringing the pits may be required to reduce flood impacts to adjacent agricultural land, homes, and structures.

It will take time for the community to decide whether the site will or will not become a park and to undertake the required planning and engineering design required to develop a master plan for the site. In the interim, there is a slight risk that the river could avulse into the existing side channel that is located in the riparian area immediately east of the private berm. Landowners have expressed concern and, therefore, it is recommended that LWD structures be designed and installed at the side channel inlet to reduce the likelihood of an avulsion. During the course of the project, several downstream landowners expressed a desire to have the breached levee repaired in place or patched with a setback levee. However, it was determined that such a solution will not be permitted based upon input received from resource agency personnel.



Legend

- Property boundary
- Current County Levee
- Existing Private Berm
- Excavated Cell Wall
- Flow Connection Channel
- Flow Connection (type to be determined)
- Jeffries Levee Setback
- Hansen Pits Setback Levee
- Private Berm Setback
- # Project ID (see potential projects screening matrix)

Yakima River Corridor Plan: Jeffries Levee to Canyon

Flood and Erosion Hazard Management Projects (Sheet 1)

0 350 700 Feet

N

03 Sep 2015

HERRERA

WATERSHED SCIENCE & ENGINEERING

NAD 1983 StatePlane Washington South FIPS 4602 Feet

C:\Egnyte\Private\shaina\13-028 Yakima River Corridor Plan\ArcGIS\MXD\Figures\Draft Corridor Plan\Final Draft Corridor Plan\Figure 7 - Flood and Erosion Hazard Reduction Areas - Sheet 1.mxd (9/3/2015)

Figure 7

Legend

- Property boundary
- Section of Ringer Loop Road to remove
- # Project ID (see potential projects screening matrix)

Yakima River Corridor Plan:
Jeffries Levee to Canyon
Flood and Erosion Hazard Management Projects
(Sheet 2)

0 350 700 Feet

N

30 Jun 2015

HERRERA

WATERSHED SCIENCE & ENGINEERING

NAD 1983 StatePlane Washington South FIPS 4602 Feet

C:\Egnyte\Private\shaina\13-028 Yakima River Corridor Plan\ArcGIS\MXD\Figures\Draft Corridor Plan\Final Draft Corridor Plan\Figure 8 - Flood and Erosion Hazard Reduction Areas - Sheet 2.mxd (6/30/2015)

Figure 8

3. ***Private Berm*** – (Rank 1, Project PB3) & (Rank 2, Project PB4)

   The highest ranked and therefore recommended project is to remove the private berm combined with acquisition and restoration of the floodplain immediately adjacent to and downstream (Project PB3). However, as with the Jeffries Levee, this would require the voluntary sale of private land, which may affect the ability to implement the project.

   If after talking with the landowners, the County determines that it may take a decade or more to implement the recommended project, then an interim project is recommended. The interim project would include removing the existing berm and concrete, setting back the berm to the eastern edge of the adjacent woody riparian area and installing several LWD structures to reduce avulsion and lateral migration potential near the downstream end of the new berm (Project PB4). At some time in the future, if and when adjacent and downstream landowners are willing to sell their land, the recommended project could be implemented by removing the setback berm and restoring the floodplain.

4. ***Avulsion Site*** – (Rank 1, Project AS2)

   The recommended project is to take action versus do nothing, by installing a series of large woody debris structures to slow bank erosion and meander migration, and to reduce the likelihood of a main channel avulsion into one of the two side channels that connect to the eroding bank.

5. ***Ringer Loop Road*** – (Rank 1, Project RL4)

   The recommended project is to allow the river to continue to migrate east, which requires abandonment of a 1500-foot long section of Ringer Loop Road. The preferred project also includes the purchase and restoration of the field east of the road and an investigation to identify an alternative location for WDFW's existing boat launch facility.

4. Implementation & Recommended Projects

4.1. Implementation Strategy

Implementation of the recommended projects will need to be completed in stages. Some can be acted upon right-away while others may take several decades to complete. The projects can be grouped into four implementation categories:

- **On-going** – Projects that are currently underway and should be continued.
- **Immediate** – Projects that can or should be acted on immediately.
- **Short-term** – Projects that require additional planning, design, or funding prior to implementation. These may take several years or longer before construction can begin.
- **Long-term** – Projects that seek the overall greatest benefit but involve voluntary land sales or a commitment to riparian conservation easements, which many residents are not willing to consider at this time. The intent of this corridor plan is to guide the implementation of projects over the next 50 years, a sufficient time for projects that may seem impossible to implement now but may be achievable decades into the future.

The recommended projects are presented below grouped according to implementation category.

Note – because this plan will guide implementation of projects over the next 50 plus years, detailed design of individual projects will need to consider both current and future (climate change) hydrologic conditions.

4.1.1. On-Going Projects

The following projects are currently in progress and should be continued:

1. **Strengthen Floodplain Development Polices** - The County is actively working to improve floodplain development polices to reduce risk, improve public safety, and comply with FEMA NFIP requirements. This effort should be continued and it should include the creation of new FIRMs for the project reach.
2. **Coordinate Projects with USBR** – The County should continue to coordinate projects with the USBR and their on-going Schaake Levee setback design project located immediately upstream on the east floodplain.

4.1.2. Immediate Projects

The following projects should be initiated immediately. The first task for most will be to identify, apply for, and obtain grant funding, with design to follow.

4.1.2.1. Habitat Restoration Focus

1. **Land Acquisition** – Several landowners have expressed an interest in selling or at least discussing the sale of property located within the conservation easement or purchase areas identified in Figure 5. Priority acquisition areas include those lands that would be affected by projects proposed in this plan, such as land on the west floodplain that would be impacted by changes to the Jeffries Levee or land on the east floodplain that would be impacted if a section of Ringer Loop Road is decommissioned. Other high priority areas would be lands that would be impacted by changes to the Hansen Pits Levee or the Private Berm, lands that contain structures or infrastructure that could be damaged by lateral migration of the river, or lands that have a high riparian habitat or restoration potential such as lands that have river frontage or are within the existing riparian corridor that boarders the river.

2. **Conservation Easements** – The County or a willing agency partner should work with land owners to facilitate creation of conservation easements within the area identified in Figure 5. Priority conservation areas would include any land that this is not acquired under No. 1 above. The purpose is to limit future development and preserve floodplain land as agricultural or riparian open space (see Figure 5).

3. **Early Action Habitat Restoration Projects** – The County should seek partners to lead and fund the design and construction of three early action habitat restoration group packages. During the course of the investigation, three property owners with large riverfront land holdings expressed a willingness to consider construction of restoration projects on their land. The land area(s) included in each group are identified on the first page of Appendix B. Two groups are on the west floodplain and one on the east. The projects proposed within each group consist of the individual habitat enhancement projects from Table 1 that are located within the areas defining each group (see Figure 6). The second column in Table 1 and third column in Table 7 identify which projects are included in each group. A complete set of conceptual drawings for each group are presented in Appendix B along with a preliminary opinion of cost to design, permit, and construct each set of projects.

4. **Habitat Restoration Projects that are Not Part of the Three Early Action Group Packages** – The County should seek partners to lead and fund the design and construction of the remaining habitat restoration projects which are not included in the Early Action Group packages, starting with the higher ranked actions (see Tables 1 and 7).

5. **Hansen Pits Habitat Restoration** – The County should initiate the actions required to determine if the site will become a public park for this will steer habitat restoration opportunities and flood hazard protection needs. Two basic concepts for projects are illustrated in Figure 7.

6. **Installed Ground Water Monitoring Equipment** – In areas where ground water habitat channels are proposed, install ground water monitoring equipment to collected water level data required for channel design.

4.1.2.2. Flood and Erosion Hazard Risk Reduction Focus

1. **County Levee Policy** – The County should develop policies to clarify their role and responsibility for ownership and maintenance of river training and flood hazard reduction levees throughout the County. The Jeffries and Hansen Pits levees should be evaluated based upon these policies, then the landowners that benefit from the levees should be informed of the County's long-term level of commitment to each facility.

2. **Jefferies Levee Landowner Discussions** – The County should talk with all landowners impacted by the proposed Jefferies Levee modifications to gauge their interest in selling their property. The outcome will determine whether the County should pursue the recommended alternative or the interim project.

3. **LWD Design, Funding, and Installation at Inlet to Hansen Pits Breach Side Channel** – Initiate a project to design and install LWD to reduce the likelihood of the main channel avulsing into the existing side channel east of the private berm. This project is identified in Figure 7 as an interim project.

4. **Ringer Loop Road Decommissioning** – The County should initiate a project to decommission/remove a 1500 foot section of Ringer Loop Road (see Figure 8). The project should include discussions with the adjacent landowner regarding the sale of the land. The County should seek a public and/or private organization partner that may be willing to purchase and restore the land. Because the river is so close to the road, this project is considered worthy of early action and should be implemented as soon as possible. A conceptual level drawing of the proposed project along with a preliminary opinion of cost is included in Appendix C.

5. **Dangerous LWD Management Policy** – The County should work in collaboration with emergency response personnel and resource agencies to develop a program that allows for removal and redistribution of LWD when it poses significant public safety risk.

4.1.3. Short-Term Projects

The following projects are relatively complex and require significant planning, design, stakeholder engagement, and funding. The ground work required to initiate each should begin immediately, for many projects will take several years or longer to complete.

4.1.3.1. Habitat Restoration Focus

1. **Jeffries Levee Interim Setback and Modification** – If after talking with the landowners, the County determines that the recommended alternative cannot be implemented for a decade or more, the County should initiate a phased investigation to determine if the proposed interim project is feasible and to construct it if it is. The project includes setting back the upper third and modifying the downstream two-thirds of the levee (see Figure 7). Setting back the upper third is primarily a habitat restoration project which seeks to initiate natural geomorphic processes. A secondary flood benefit is that it may change the alignment of the river at the Hansen Pits levee which would reduce erosion. If the downstream two-thirds of the levee can be lowered or a portion removed to allow more flood water to access the west floodplain, this would reduce erosive forces at the Hansen Pits levee and reduce risk on the east floodplain. Project implementation will require completion of the following tasks.

    a. **General Feasibility -** Determine if the project is feasible by answering following questions: 1) Can the required property be purchased? 2) Is the City of Ellensburg willing to allow the river to meander into their property north of the river (note the City's wastewater treatment plant return outfall pipe is buried in this area and may need to be protected and/or modified)? 3) If the river begins to migrate into the north riparian area, will it create the types of habitat desired? 4) Can funding be secured to construct the project?

    b. **Stakeholder Engagement** – An advisory group consisting of landowner, resource agency and specialist interest group representatives should be formed to provide input and review of proposed alternatives.

    c. **Design and Permitting** – If the project is feasible, a detailed design investigation would be completed. Design alternatives would be identified, evaluated and a preferred solution selected. Preliminary plans and permit applications would be prepared and submitted. Detailed plan, specifications, estimates, and bid documents would follow.

    d. **Construction Funding** – Funds would be sought to construct the project.

    e. **Construction** – The project would be constructed.

    f. **Post Project Monitoring** – Monitor the response of the river to the change to determine/document habitat benefits.

2. **Private Berm Interim Setback** – If setting back the Jeffries Levee to Riverbottom Road cannot be implemented in the near future, then the interim project should be implemented which includes removing the existing private berm, replacing it with a setback berm east of the adjacent riparian area, and adding several LWD structures near the downstream end of the new berm (see Figure 7). This is primarily a habitat project because the main purpose is to allow the river freedom to migrate into and interact with the adjacent riparian floodplain, while maintaining a similar level of flood protection as is

provided by the existing berm.

3. **Hansen Pits Restoration** – Once it is determined whether the site will become a park or not, seek funding to conduct technical investigations, engage stakeholders, develop designs, apply for and obtain permits, and build the project.

4. **Habitat Improvements at Sites Not included in Early Acton Group Project Packages -** Work with project partners and landowners to develop designs, obtain funding and implement habitat restoration projects in areas that are not included in the early action projects (see Tables 1 and 7).

4.1.3.2. Flood and Erosion Hazard Risk Reduction Focus

1. **West Bank LWD Design and Installation** along Mid-Reach Meander - Initiate a project to design, fund, and construct LWD structures to reduce bank erosion and the likelihood of a channel avulsion (see Figure 7).

4.1.4. Long-Term Projects

The following projects seek the greatest benefit for both flood/erosion hazard risk reduction and habitat preservation/restoration. However, they are likely to require decades to complete.

4.1.4.1. Habitat Restoration Focus

1. **Flow Management Refinements** – Flow within the river is highly regulated, especially during the irrigation season. The County and its partners should continue to work with the USBR and other resource agencies to refine irrigation flow adjustments to improve conditions for endangered and threatened salmonids.

2. **Floodplain Restoration** – As willing landowners sell their land or place it into conservation easements, seek opportunities to increase the extent and widen of the riparian corridor *bordering* the river.

4.1.4.2. Habitat Restoration and Flood Hazard Risk Reduction

1. **Jeffries Levee Setback to Riverbottom Road and Restoration of the Floodplain** – Work with project funding partners to develop a program to purchase and restore the private parcels that will be significantly impacted by a setback of the levee to Riverbottom Road. Purchase would be through voluntary sale. If lands are purchased, design, permit, and implement a full setback of the levee to Riverbottom Road (Figure 7). Note -- if the levee is setback to Riverbottom Road, flood characteristics on the west floodplain will change. These changes will need to be thoroughly analyzed to determine if additional countermeasures are needed to reduce impacts to downstream residential and agricultural land.

   Setting back the Jeffries Levee would be a dual benefit project in that it would free up the river to create and sustain high quality habitat through geomorphic complexity

through erosion and migration. It would reduce flood/erosion risk by removing people and structures from the regulatory floodway and floodplain and allow flood water to spread out more evenly across the floodplain which will reduce flood levels east of the river.

2. **Removal of the Private Setback Berm and Restoration of the Floodplain** – Constructing the interim project does not preclude implementing the recommended project in the future if and when the landowners adjacent to and downstream from the berm are willing to sell their land. The recommended project would be completed by removing the interim setback berm and restoring the floodplain. Even if the landowners are unwilling to sell their land, it may be possible to remove the setback berm if and when the Jeffries Levee is setback to Riverbottom Road. Setting back the Jefferies Levee will allow the river access to the west floodplain which will reduce risks on the east floodplain.

   This too would be a dual benefit project in that it would free up the river to create and sustain high quality habitat through geomorphic complexity created by erosion and migration. It would reduce flood/erosion risk by removing people and structures from the regulatory floodway and floodplain and would allow flood water to spread out more evenly across the floodplain which will reduce flood levels west of the river.

3. **Monitoring and Future Project Opportunities** - The river will continually adjust and change; therefore, monitoring of flood hazards and habitat conditions will be required, which will present future project opportunities that are not present at the time of this publication.

4.2. Adaptive Management

It should be understood that the projects described in this plan, and the scoring and prioritization of those projects, are current as of the plan's publication date. Additional project opportunities may be identified, and conditions may change that lead to a shift in priorities.

4.3. Project Funding Sources

There are many potential funding sources for habitat restoration and enhancement and for flood and erosion hazard reduction, including federal government agencies, State of Washington, local agencies and districts, and nonprofit organizations and foundations. Potential funding sources include:

- **Washington State Department of Fish and Wildlife (WDFW)** – Land acquisition, restoration, research, education, access, and artificial production projects.
- **Washington State Salmon Recovery Funding Board (SRFB)** – Habitat restoration projects benefiting threatened and endangered salmon.
- **Washington State Department of Natural Resources (WDNR)** - Land acquisition, restoration, research, education, access, and artificial production projects.
- **Washington State Conservation Commission (WSCC)** – Riparian vegetation, water

conservation, and irrigation efficiency projects.

- **Washington Department of Ecology (Ecology)** – Ecology manages the state's Floodplain by Design (FbD) initiative which provides funding for multi-benefit flood hazard reduction and habitat enhancement projects. Ecology also provides money for water delivery and water quality projects, and water acquisition.
- **US Fish and Wildlife Service (USFWS)** – Conservation, land acquisition, and habitat conservation projects.
- **US Bureau of Reclamation (Reclamation)** – Yakima River Basin Water Enhancement Program - Water supply; improvement, protection, and enhancement of fish and wildlife resources; water quality projects. *Yakima River Basin Water Enhancement Project, Tributary Enhancement Program, Manastash Creek Investigation Report* (USBR 2013), *Kittitas Reclamation District Water Conservation Plan Irrigation Water Conservation Plan of System Improvements (*CH2MHILL 1999).
- **USDA Natural Resources Conservation Service (NRCS**) – Technical assistance, water conservation and irrigation projects, riparian revegetation, conservation easements.
- **National Oceanic and Atmospheric Administration (NOAA) Fisheries** – Technical assistance with removal of barriers and community-based restoration, NOAA American Rivers, RC National and Regional Partnership Grants, and the Open Rivers Initiative.
- **Bonneville Power Administration (BPA)** – Critical habitat restoration including fish screening, barrier removal, habitat enhancement, and irrigation efficiency projects.
- **National Fish and Wildlife Foundation (NFWF)** – Water acquisition and land conservation projects.
- **American Sportfishing Association** – Habitat restoration projects.
- **The Nature Conservancy (TNC)** – Conservation, community-based restoration.
- **Trout Unlimited** – Watershed restoration projects and water acquisition.
- **Kittitas County Conservation District** – Technical assistance, financial assistance to private landowners.
- **Kittitas County Public Works** – Public infrastructure protection projects.
- **Kittitas County Flood Control Zone District** – Flood reduction projects and programs.
- **Federal Emergency Management Agency (FEMA)** – Hazard Mitigation Assistance.
- **Title II – Special Projects on Federal Land** – Funds projects on BLM and US Forest Service land including, but not limited to road, trail, and infrastructure maintenance or obliteration; soil productivity improvement; improvements in forest ecosystem health; watershed restoration and maintenance; restoration, maintenance and improvement of wildlife and fish habitat; control of noxious and exotic weeds; and re-establishment of

native species.

- **Washington State – Family Forest Fish Passage Program (FFFPP)** - The Family Forest Fish Passage Program provides funding to small forest landowners to repair or remove fish passage barriers.
- **Endangered Species Tax Deduction** - Farmers and ranchers implementing conservation actions that contribute to the recovery of threatened and endangered species may now be eligible for a tax deduction. The 2008 Farm Bill established a tax deduction for expenditures paid or incurred for the purpose of achieving site-specific management actions recommended in recovery plans for species listed as threatened or endangered under the Endangered Species Act (ESA).

5. REFERENCES

Herrera, June 2014. "Technical Memorandum: Habitat Assessment, Yakima River Hansen Pits to Ringer Loop Road." Prepared for Kittitas County Flood Control District by Herrera Environmental Consultants, Inc., Seattle, Washington.

WSE, June 2014. "Technical Memorandum: Flood & Erosion Assessment, Yakima River Hansen Pits to Yakima Canyon." Prepared for Kittitas County Flood Control District by Watershed Science & Engineering Inc., Seattle, Washington.

WSE, April 2015. "Technical Memorandum: Yakima River bank Erosion at Ringer Loop Road, Alternative Analysis." Prepared for Kittitas County Public Works by Watershed Science & Engineering Inc., Seattle, Washington.

APPENDIX A

TAG and Landowner Meetings

Record of TAG and Landowner Meetings

Technical Advisory Group Meetings

Date	Method	Topic
Dec. 13, 2013	Physical	Project kick-off meeting
May 22, 2014	Physical Meeting	Presentation of Existing Conditions Evaluation
June 13, 2014	Conference Call	Discussion focused on habitat opportunities
July 29, 2014	Conference Call	Discussed proposed projects & screening criteria
Aug. 12, 2014	Conference Call	Discussed proposed habitat actions & screening criteria
Nov. 13, 2014	Physical Meeting	Discussed proposed projects
Mar. 3, 2015	Physical Meeting	Discussed proposed projects
May 1, 2015	Conference Call	Discussed proposed projects
June 12, 2015	Conference Call	Discussed proposed projects

Landowner Meetings

Date	Method	Topic
Dec. 13, 2013	Physical Meeting	Project kick-off meeting
Mar. 28, 2014	Site Visit	Landowner provided tour of his property
May 22, 2014	Physical Meeting	Presentation of Existing Conditions Evaluation
May 22, 2014	Physical Meeting	Discussed flooding concerns with landowner
Feb. 13, 2015	Physical Meeting	Discussed proposed projects with landowner
Feb. 17, 2015	4 Physical Meetings	Four separate meetings with landowners
Mar. 3, 2015	Physical Meeting	Discussed proposed habitat projects with landowner
Mar. 27, 2015	Site Visit	Discussed proposed project in field with landowner

This letter, which was written by a group of landowners, recommends several flood relief actions for the project reach and for the reach immediately upstream. Variations of the recommendations have been considered in the development of this plan and the County continues to coordinate actions with the USBR who is leading the effort to setback the Schaake Levee, a flood control levee located just upstream from the project reach.

February 27, 2015

To: Kittitas County Public Works Department

Attention: Christina Wollman

411 North Ruby Street

Ellensburg, WA 98926

From: Concerned Property Owners of Lower Kittitas Valley Yakima River Flood Zone

Ellensburg, WA 98926

RE: Yakima River Assessment-Hansen Pits to Yakima Canyon

Phase 1, 2, and 3 proposed projects and habitat enhancement

Dear Ms. Wollman:

We appreciate your time and effort developing the proposals presented to mitigate flood events, river restoration, and acquire private properties located in the flood zone. Our understanding is that the Schaake property, which was purchased with tax-payer's dollars, was acquired for this exact purpose. As a group the following are our recommendations to alleviate the issues brought forth:

1. Remove and set back the Schaake dike/levee as proposed by the Bureau of Reclamation and extend berms south to tie in with the Hansen Pit levee.
2. Reinforce Hansen Pit levee and make permanent with ample material the proposed levee repair between the Hansen Pit levee and "Private" levee.
3. On the former Schaake property, now under The Bureau of Reclamation care, a side channel watered at all stages of the river should be created as well as other minor channels necessary to provide the desired fish habitat and prevent stranded fish after a high water event. As a result, when this project is implemented and the proposed

measures advocated by Trout Unlimited on the Anderson property (directly adjacent to the Bureau of Reclamation land) including a live stream, additional habitat for fish will be realized.

Together, these actions would substantially reduce the pressure to the Jeffries dike during flood events and consequently decrease the energy directed at the Hanson Pit area. The water would be running parallel rather than at adverse angles.

We feel if these steps are taken, the removal of the Jeffries dike and the Hanson Pit dike (which currently provides some protection to our properties) will then be unnecessary and considerable habitat will be realized.

For complete accuracy prior to performing any of these procedures we would advocate ground surveys as well as relying on the LIDAR imaging. We are not adverse to some of the other less costly and invasive suggestions to our individual properties that have been proposed.

Regards,

Marv and Scott Harmon

Todd, Kyle, Cara, and Marie Thayer

Mark Anderson

Nancy Lester

Mike and Kelly Moeur (Flying M)

Rob Stewart (M Farm LLC)

Rochelle Bierek

Keith Axthelm

Neil Leibly

Anthony Mynar

James and Edward Stroh

Robert and Charlie Acheson

APPENDIX B

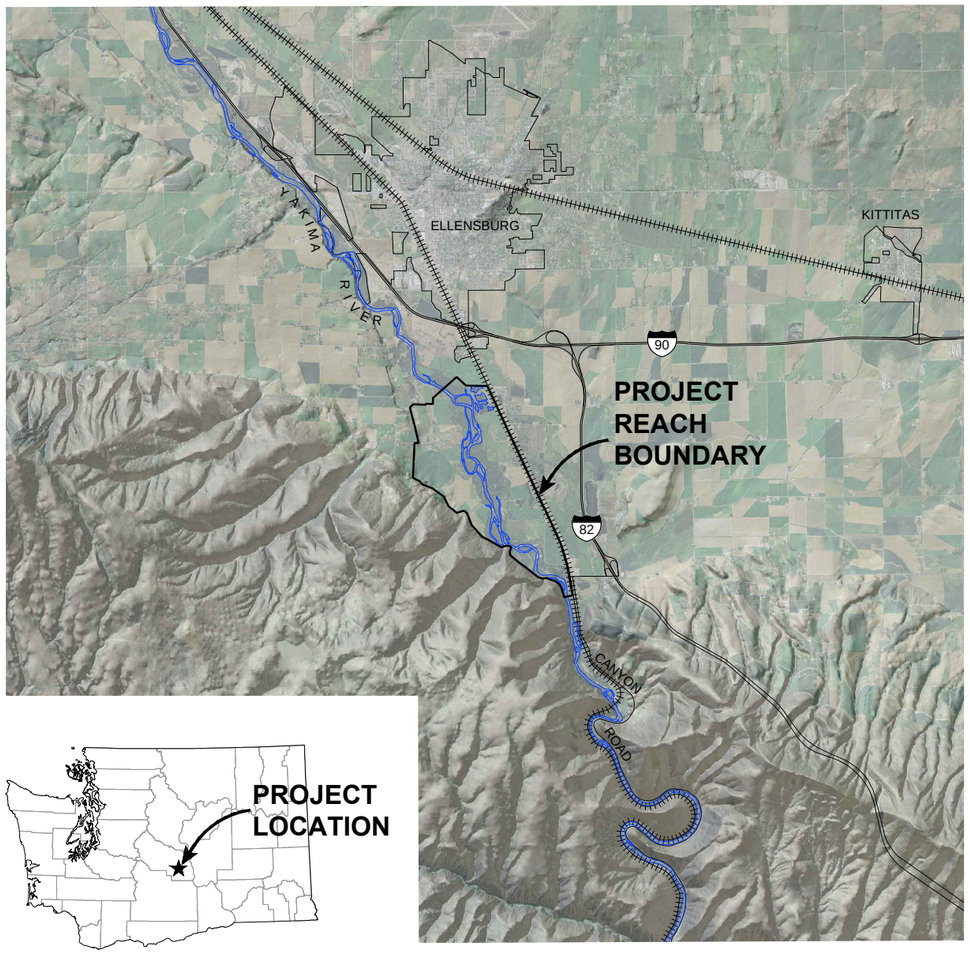
Early Action Habitat Restoration Group Packages

KITTITAS COUNTY FLOOD CONTROL ZONE DISTRICT

CONCEPTUAL DESIGN PLANS FOR

RESTORATION OF THE YAKIMA RIVER FROM HANSEN PITS TO THE YAKIMA CANYON EARLY ACTION GROUP 1

CITY OF ELLENSBURG AND KITTITAS COUNTY, WASHINGTON



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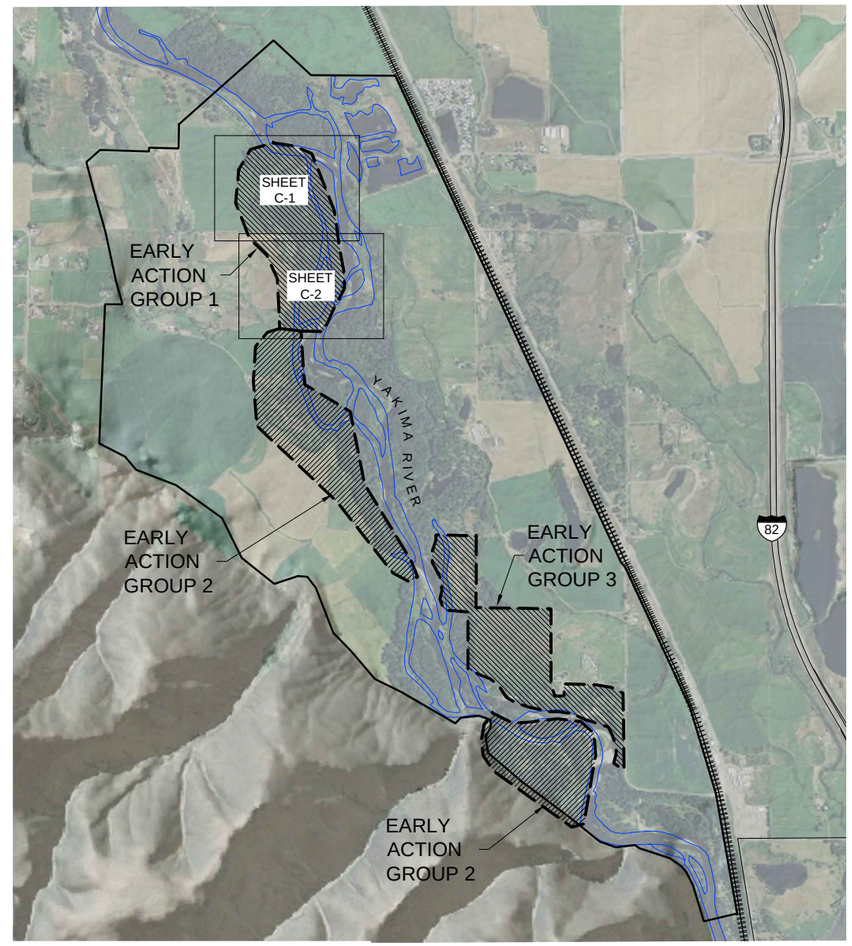
SCALE: 1" = 2 MILES



SHEET LAYOUT KEY
SCALE: 1" = 1/2 MILE

SHEET INDEX

SHEET	DRAWING	TITLE
1	G-1	COVER SHEET
2	C-1	PLAN VIEW - SHEET 1 OF 2
3	C-2	PLAN VIEW - SHEET 2 OF 2

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

ONE INCH
FULL SIZE 11" x 17" SHEET

No.	REVISION	BY	APP'D	DATE

HERRERA

FROM THE CASCADES...TO THE COLUMBIA
KITTITAS COUNTY

DESIGNED: M. KLARA	DRAWN: A. RHODE
DESIGNED: A. RHODE	DRAWN: R. HULME
DESIGNED:	CHECKED: M. KLARA
SCALE: AS NOTED	APPROVED: J. CARRASQUERO

RESTORATION OF THE YAKIMA RIVER FROM HANSEN PITS TO THE YAKIMA CANYON
EARLY ACTION GROUP 1
COVER SHEET

DATE:
PROJECT NO: 14-05594-000
DRAWING NO: G-1
SHEET NO: 1 OF 3

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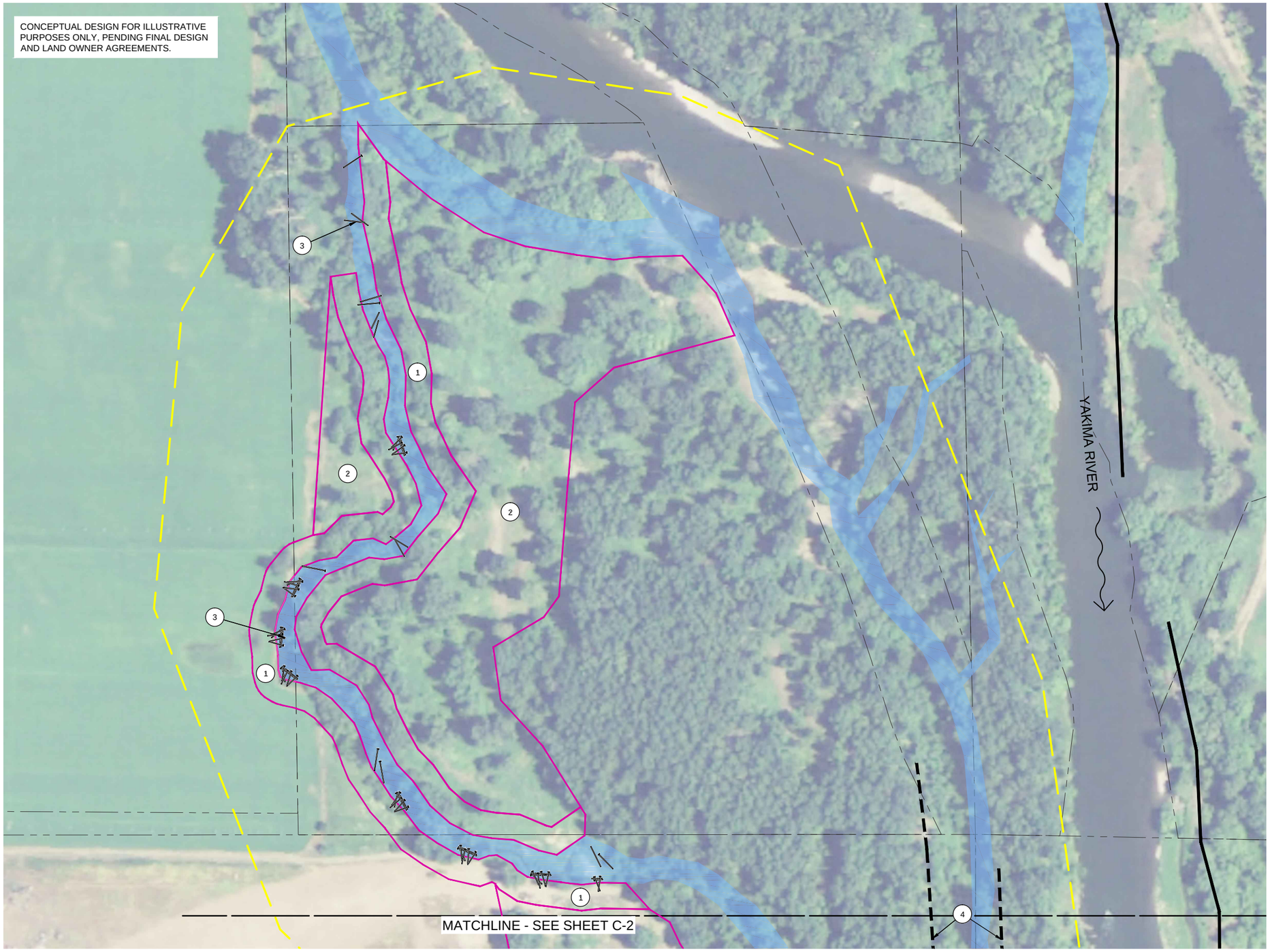
Cad User: Abbey Rhode



CONCEPTUAL PROJECT OPPORTUNITIES

1. BANK/RIPARIAN REVEGETATION – EXPAND/ENHANCE RIPARIAN ZONE BY PLANTING NATIVE VEGETATION TO IMPROVE SHADING AND MINIMIZE EROSION RISK THROUGH IMPROVED ROOT COHESION. MANAGE OR ERADICATE EXISTING CONCENTRATIONS OF NON-NATIVE VEGETATION SUCH AS REED CANARYGRASS. INSTALL WITH A HIGH PLANTING DENSITY TO ENSURE HIGH RATE OF SURVIVAL IN THESE CRITICAL AREAS. INCLUDE FENCING WHERE NEEDED TO PROTECT PLANTINGS FROM LIVESTOCK, ELK, DEER, BEAVER, ETC.
2. FLOODPLAIN FOREST REVEGETATION – WORK WITH LANDOWNERS TO IMPLEMENT EFFECTIVE AND ACCEPTABLE FLOODPLAIN REFORESTATION. IMPROVE CANOPY COVER AND UNDERSTORY DIVERSITY IN SPARSELY FORESTED AREAS, OR REESTABLISH FLOODPLAIN FOREST COVER IN DEFORESTED AREAS. SPECIES SELECTION WILL LIKELY BE THE SAME AS, OR SIMILAR TO BANK/RIPARIAN REVEGETATION BUT AT A REDUCED PLANTING DENSITY. INCLUDE FENCING WHERE NEEDED TO PROTECT PLANTINGS FROM LIVESTOCK, ELK, DEER, BEAVER, ETC.
3. DESIGN AND INSTALL ENGINEERED LARGE WOODY DEBRIS (LWD) HABITAT STRUCTURES TO ENHANCE EXISTING SIDE CHANNEL HABITAT
4. INVESTIGATE FEASIBILITY OF REMOVING OR REGRADING EXISTING SPOIL PILES TO IMPROVE FLOW CONDITIONS ACROSS THE ACTIVE FLOODPLAIN AND REVEGETATE THE DISTURBED AREA.

LEGEND

- EARLY ACTION HABITAT ENHANCEMENT AREA BOUNDARY
- PROPERTY BOUNDARY
- EXISTING SPOIL PILES
- EXISTING LEVEE OR BERM
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- (1) CONCEPTUAL PROJECT OPPORTUNITY NUMBER
- PROPOSED ENGINEERED LWD HABITAT STRUCTURES

100 0 100 200
1"=200'

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

ONE INCH
FULL SIZE 11" x 17" SHEET

No.	REVISION	BY	APP'D	DATE

HERRERA

FROM THE CASCADES...TO THE COLUMBIA
KITTITAS COUNTY

DESIGNED: M. KLARA	DRAWN: A. RHODE
DESIGNED: A. RHODE	DRAWN: R. HULME
DESIGNED:	CHECKED: M. KLARA
SCALE: AS NOTED	APPROVED: J. CARRASQUERO

RESTORATION OF THE YAKIMA RIVER FROM HANSEN PITS TO THE YAKIMA CANYON
EARLY ACTION GROUP 1
PLAN VIEW - SHEET 1 OF 2

DATE:
PROJECT NO: 14-05594-000
DRAWING NO: C-1
SHEET NO: 2 OF 3

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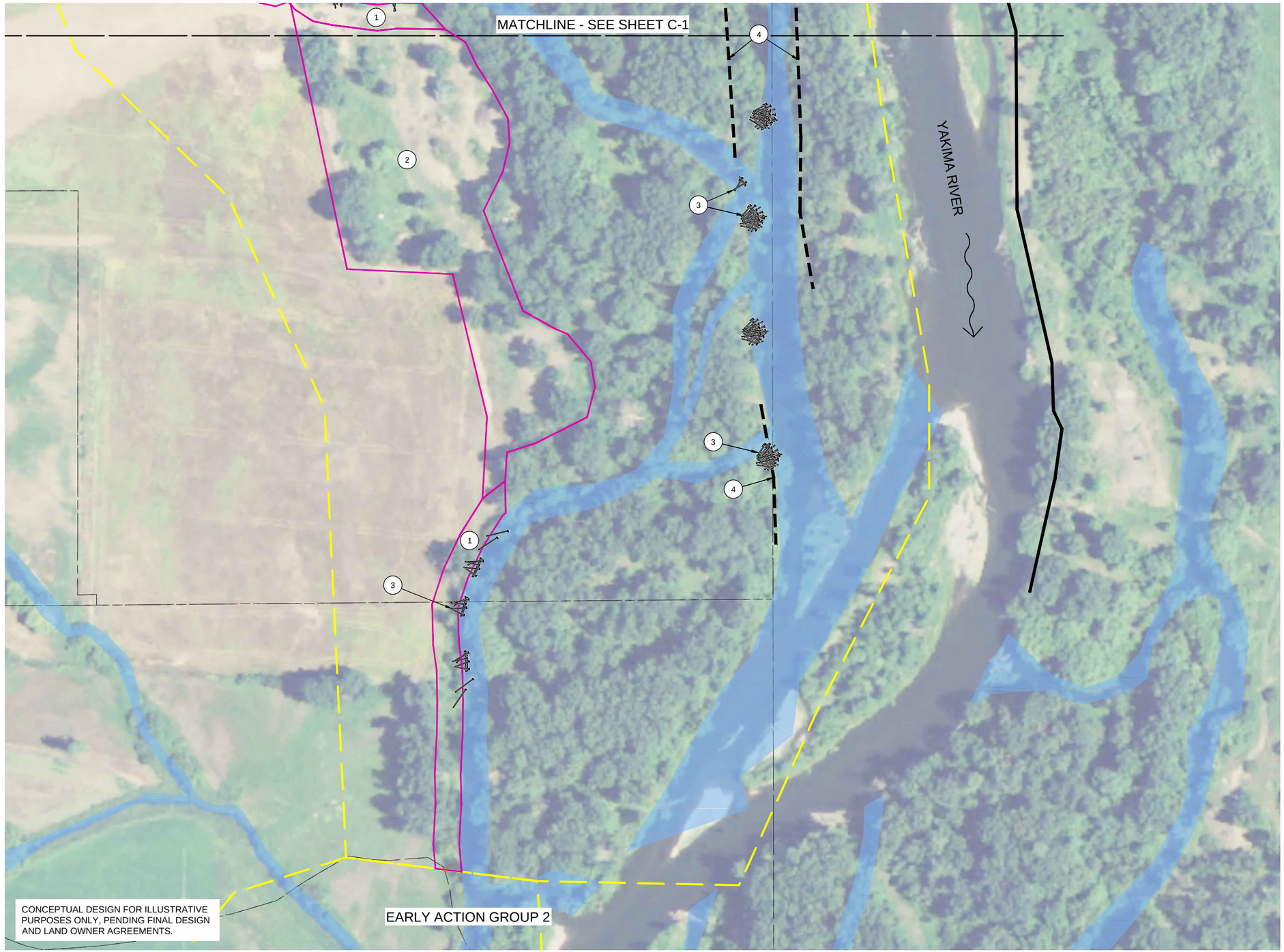

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- (1) CONCEPTUAL PROJECT OPPORTUNITY NUMBER
- PROPOSED ENGINEERED LWD HABITAT STRUCTURES

100 0 100 200
1"=200'

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

ONE INCH
FULL SIZE 11" x 17" SHEET

No.	REVISION	BY	APP'D	DATE

HERRERA

FROM THE CASCADES...TO THE COLUMBIA
KITTITAS COUNTY

DESIGNED: M. KLARA	DRAWN: A. RHODE
DESIGNED: A. RHODE	DRAWN: R. HULME
DESIGNED:	CHECKED: M. KLARA
SCALE: AS NOTED	APPROVED: J. CARRASQUERO

RESTORATION OF THE YAKIMA RIVER FROM HANSEN PITS TO THE YAKIMA CANYON
EARLY ACTION GROUP 1
PLAN VIEW - SHEET 2 OF 2

DATE:
PROJECT NO: 14-05594-000
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SHEET NO: 3 OF 3

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CLIENT: Kittitas County Flood Control Zone District
PROJECT: Yakima River - Hansen Pits to Yakima Canyon - Conceptual Restoration Design
SITE: Early Action Habitat Enhancement Project Group 1

Prepared by: M. Klara, A. Rhode
Checked by: M. Ewbank

Table 1. Early Action Habitat Enhancement Project Group 1 - Planning (10%) Level Cost Estimate

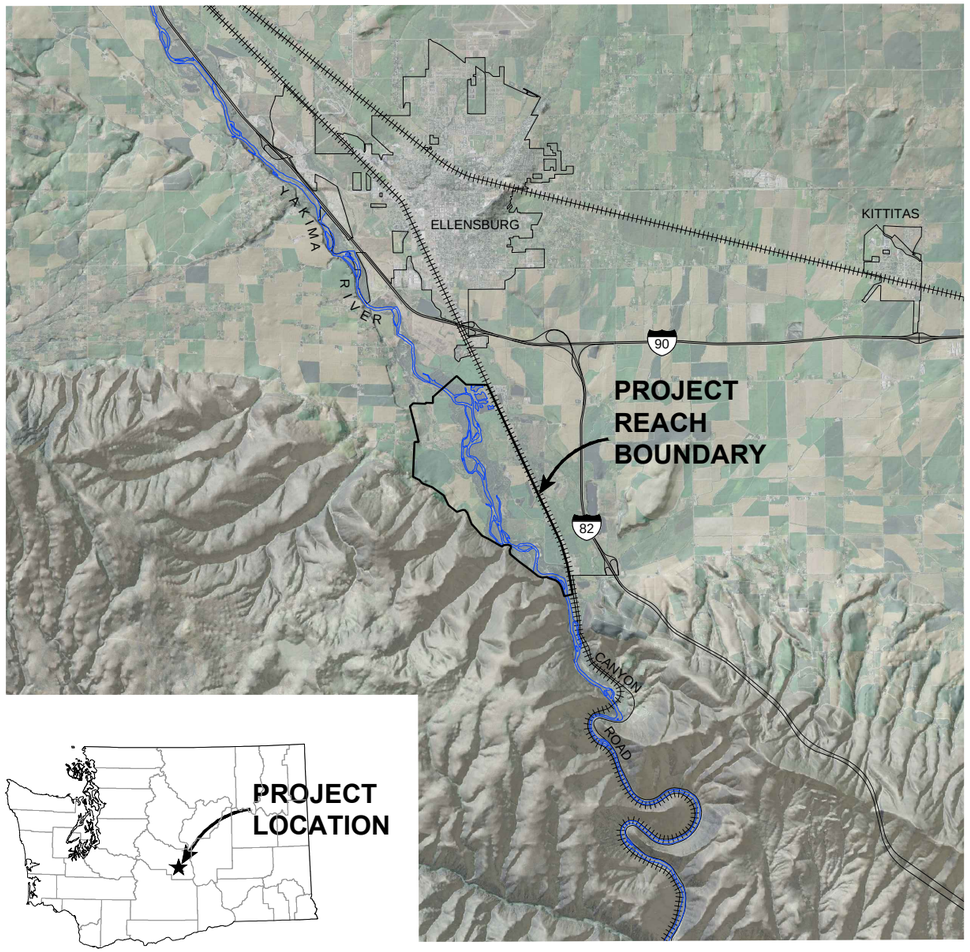
Item	Quantity	Unit	Unit Cost	Amount	Notes
DIRECT COSTS					
1 - Bank/Riparian Vegetation				**$78,000**	
Expand/enhance riparian zone by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion. Manage or eradicate existing concentrations of non-native vegetation such as reed canarygrass. Install with a high planting density to ensure high rate of survival in these critical areas. Include fencing or other methods where needed to protect plantings from livestock, deer, elk, beaver, etc.	5.2	AC	$15,000	$78,000	Unit cost assumes rate for site prep, planting materials, installation, and 2 years of adaptive management.
2 - Floodplain Forest Revegetation				**$143,000**	
Work with landowners to implement effective and acceptable floodplain reforestation. Improve canopy cover and understory diversity in sparsely forested areas, or reestablish floodplain forest cover in deforested areas. Species selection will likely be the same as or similar to bank/riparian revegetation but at a reduced planting density. Include fencing or other methods where needed to protect plantings from livestock, deer, elk, beaver, etc.	14.3	AC	$10,000	$143,000	Unit cost assumes rate for site prep, planting materials, installation, and 2 years of adaptive management.
3 - LWD Habitat Structures in Side Channels				**$268,800**	
Design and install engineered large woody debris (LWD) habitat structures to enhance existing side channel habitat.					
Single and double log structures:	18	EA	$800	$14,400	Engineer's est. Assumes $800 per log delivered and installed.
Small multi log structures (~6 logs):	10	EA	$4,800	$48,000	Engineer's est. Assumes $800 per log delivered and installed.
Small multi log structures (~4 logs):	2	EA	$3,200	$6,400	Engineer's est. Assumes $800 per log delivered and installed.
Large ELJ structures with pile anchors and rock ballast (~20 logs):	4	EA	$50,000	$200,000	Engineer's est. Assumes $50,000 per structure for material and construction costs based on related project experience.
4 - Investigate Feasibility of Spoils Pile Removal/Regrading				**$3,000**	
Investigate feasibility of removing or regrading existing spoil piles to improve flow conditions across the active floodplain and revegetating the disturbed area.	1	LS	$3,000	$3,000	Engineers estimate for site visit, estimate of material quantity on site, and feasibility of access for heavy equipment. Could potentially include modification of existing 2D hydrailc model to determine value of effort.
SUBTOTAL DIRECT COSTS:				**$492,800**	
CONTINGENCY			50%	$246,400	
TOTAL DIRECT COSTS:				**$739,200**	
ENGINEERING, PERMITTING, MOBILIZATION, AND OVERSIGHT					
ENGINEERING DESIGN AND REVEGETATION DESIGN	1	LS	$120,000	$120,000	Assumes engineering and revegetation design for all project elements listed above. Assumes design of log structures will require hydraulic modeling based on existing 2D models of the project reach. Includes site visit, survey, geotech analysis, hydrology, hydraulic modeling, and design PS&E to support public bid for construction. NOTE: The majority of the design budget (~75,000-$80,000) is related to the four proposed large ELJs.
PERMITTING	1	LS	$60,000	$60,000	Assumes permitting for all project elements. Assumes all project elements are permitted together. Permitting individual elements as separate projects would be significantly more expensive.
MOBILIZATION AND STAGING	1	%	5%	$37,000	Assumes mobilization for all engineered project elements.
CONSTRUCTION MANAGEMENT/OVERSIGHT	1	LS	$40,000	$40,000	Assumes CO for all engineered and revegetation project elements.
SUBTOTAL ENGINEERING, PERMITTING, AND OVERSIGHT COSTS:				**$257,000**	
CONTINGENCY			30%	$77,100	
TOTAL ENGINEERING, PERMITTING, AND OVERSIGHT COSTS:				**$334,100**	
TOTAL ESTIMATED PROJECT COSTS:				**$1,073,000**	

KITTITAS COUNTY FLOOD CONTROL ZONE DISTRICT

CONCEPTUAL DESIGN PLANS FOR

RESTORATION OF THE YAKIMA RIVER FROM HANSEN PITS TO THE YAKIMA CANYON EARLY ACTION GROUP 2

CITY OF ELLENSBURG AND KITTITAS COUNTY, WASHINGTON



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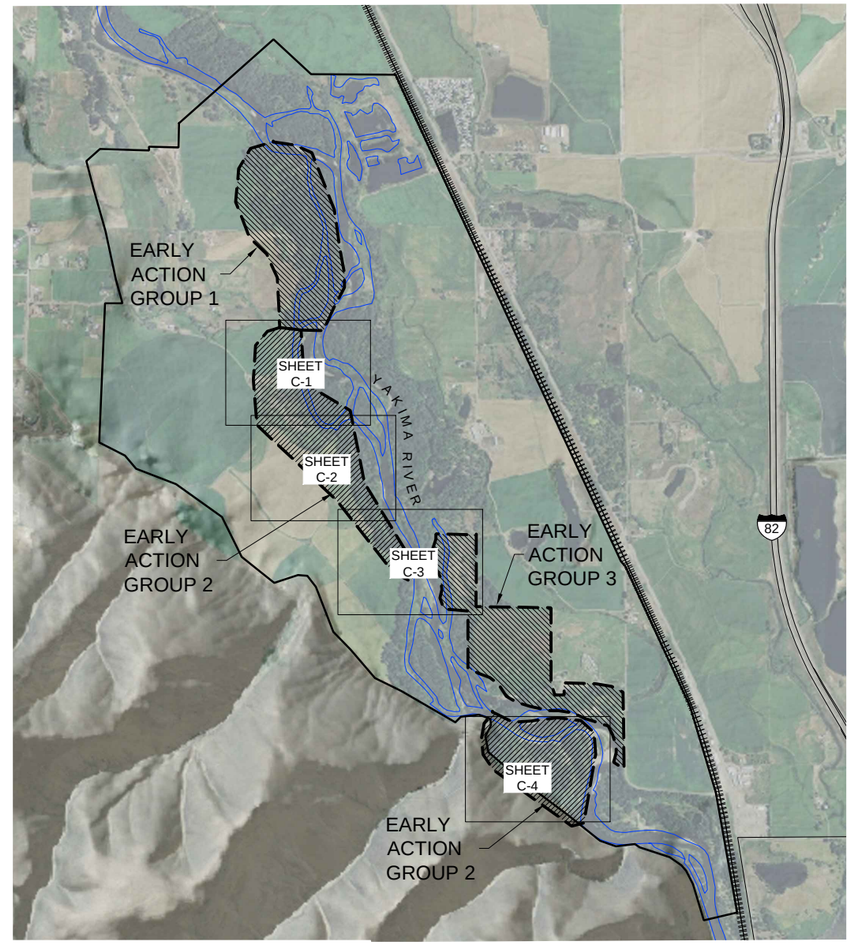

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SHEET INDEX

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2	C-1	PLAN VIEW - SHEET 1 OF 4
3	C-2	PLAN VIEW - SHEET 2 OF 4
4	C-3	PLAN VIEW - SHEET 3 OF 4
5	C-4	PLAN VIEW - SHEET 4 OF 4

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

ONE INCH
FULL SIZE 11" x 17" SHEET

No.	REVISION	BY	APP'D	DATE

HERRERA

FROM THE CASCADES...TO THE COLUMBIA
KITTITAS COUNTY

DESIGNED: M. KLARA	DRAWN: A. RHODE
DESIGNED: A. RHODE	DRAWN: R. HULME
DESIGNED:	CHECKED: M. KLARA
SCALE: AS NOTED	APPROVED: J. CARRASQUERO

RESTORATION OF THE YAKIMA RIVER FROM HANSEN PITS TO THE YAKIMA CANYON
EARLY ACTION GROUP 2
COVER SHEET

DATE:
PROJECT NO: 14-05594-000
DRAWING NO: G-1
SHEET NO: 1 OF 5

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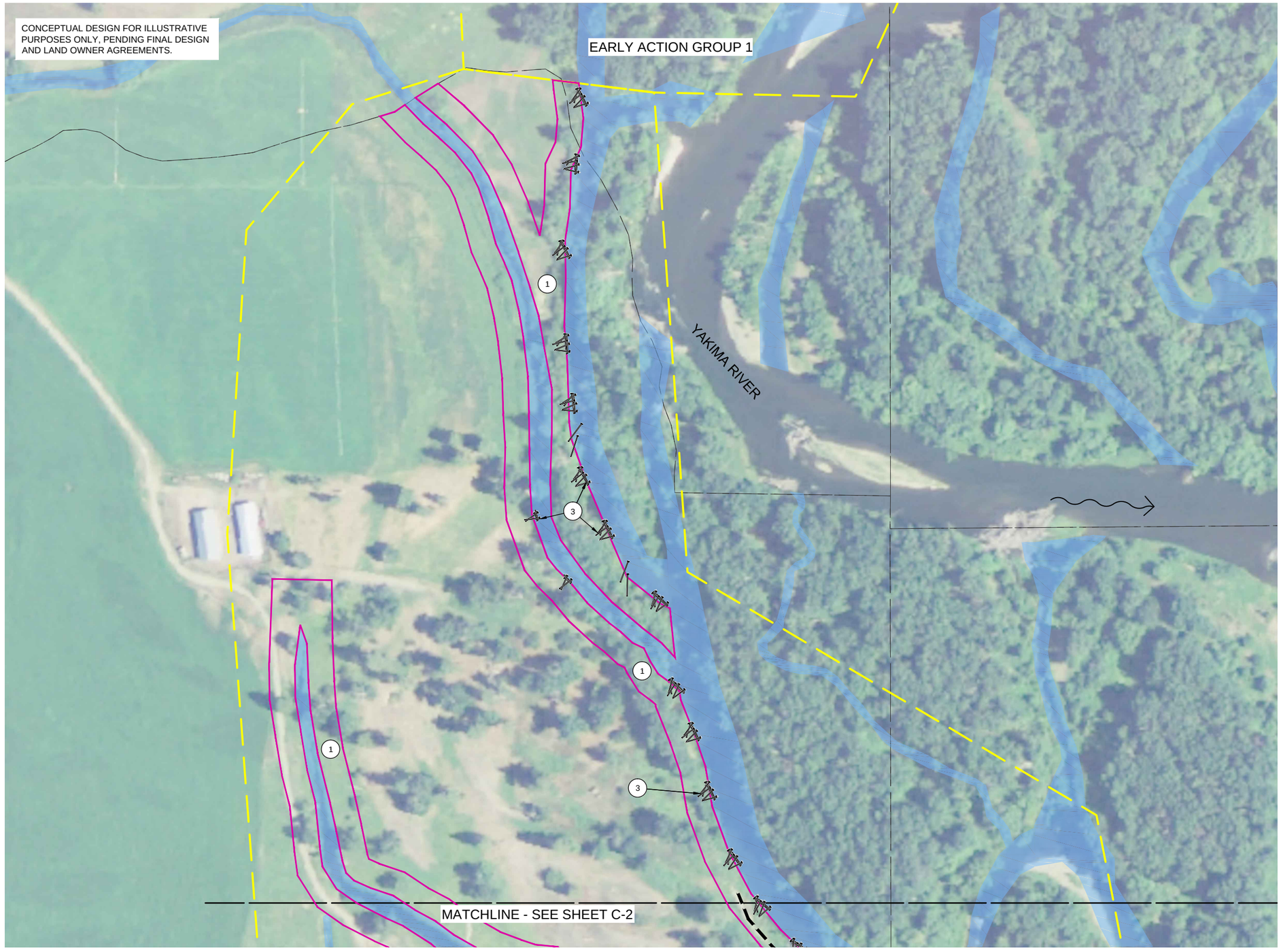

CONCEPTUAL PROJECT OPPORTUNITIES

1. BANK/RIPARIAN REVEGETATION – EXPAND/ENHANCE RIPARIAN ZONE BY PLANTING NATIVE VEGETATION TO IMPROVE SHADING AND MINIMIZE EROSION RISK THROUGH IMPROVED ROOT COHESION. MANAGE OR ERADICATE EXISTING CONCENTRATIONS OF NON-NATIVE VEGETATION SUCH AS REED CANARYGRASS. INSTALL WITH A HIGH PLANTING DENSITY TO ENSURE HIGH RATE OF SURVIVAL IN THESE CRITICAL AREAS. INCLUDE FENCING WHERE NEEDED TO PROTECT PLANTINGS FROM LIVESTOCK, ELK, DEER, BEAVER, ETC.

3. DESIGN AND INSTALL ENGINEERED LARGE WOODY DEBRIS (LWD) HABITAT STRUCTURES TO ENHANCE EXISTING SIDE CHANNEL HABITAT

LEGEND

- EARLY ACTION HABITAT ENHANCEMENT AREA BOUNDARY
- PROPERTY BOUNDARY
- EXISTING SPOIL PILES
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- FLOW DIRECTION
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- CONCEPTUAL PROJECT OPPORTUNITY AREA
- (1) CONCEPTUAL PROJECT OPPORTUNITY NUMBER
- PROPOSED ENGINEERED LWD HABITAT STRUCTURES

100 0 100 200
1"=200'

N

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

ONE INCH
FULL SIZE 11" x 17" SHEET

No.	REVISION	BY	APP'D	DATE

HERRERA

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SCALE: AS NOTED	APPROVED: J. CARRASQUERO

RESTORATION OF THE YAKIMA RIVER FROM HANSEN PITS TO THE YAKIMA CANYON
EARLY ACTION GROUP 2
PLAN VIEW - SHEET 1 OF 4

DATE:
PROJECT NO: 14-05594-000
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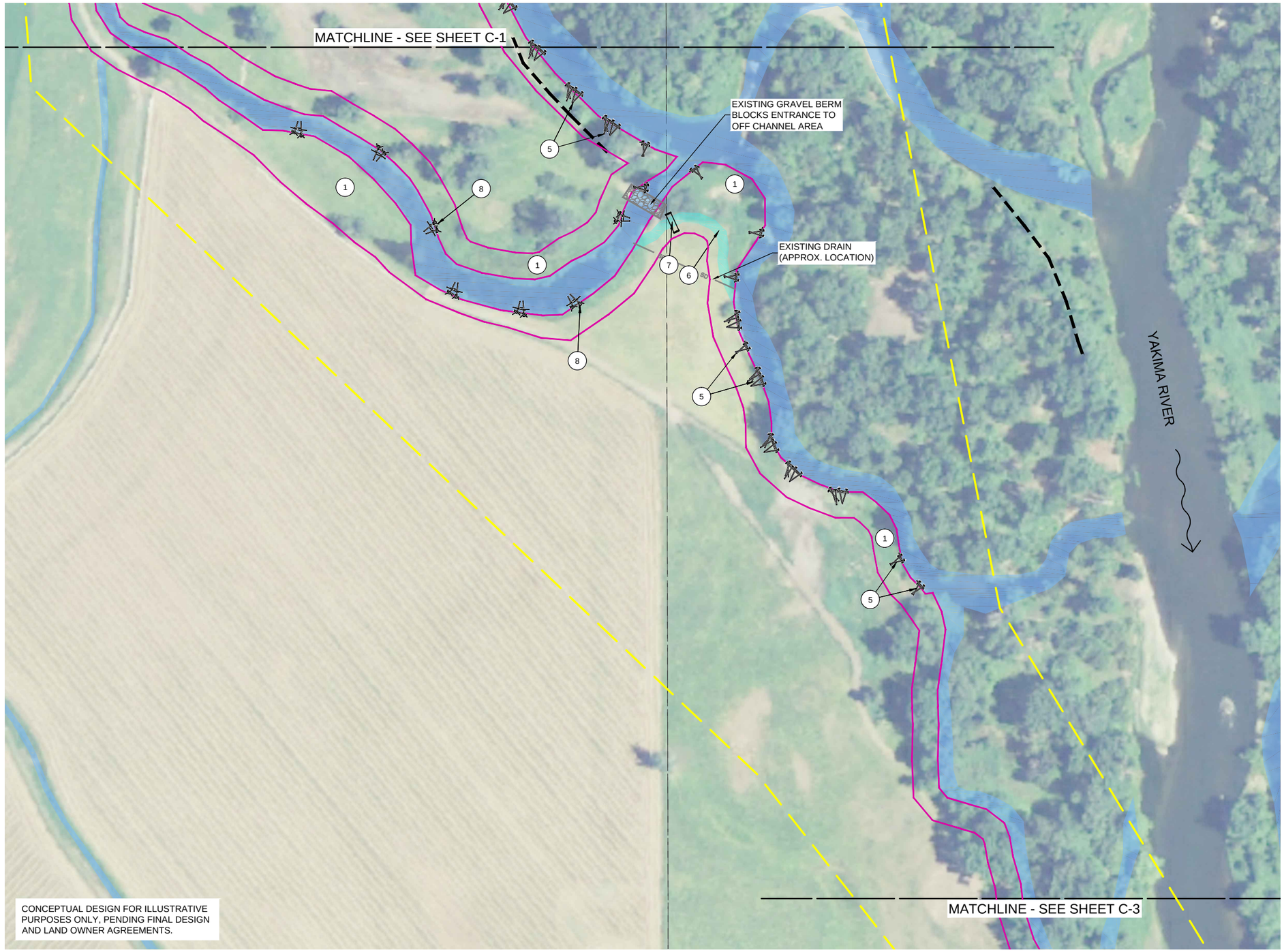

CONCEPTUAL DESIGN FOR ILLUSTRATIVE PURPOSES ONLY, PENDING FINAL DESIGN AND LAND OWNER AGREEMENTS.

CONCEPTUAL PROJECT OPPORTUNITIES

1. BANK/RIPARIAN REVEGETATION – EXPAND/ENHANCE RIPARIAN ZONE BY PLANTING NATIVE VEGETATION TO IMPROVE SHADING AND MINIMIZE EROSION RISK THROUGH IMPROVED ROOT COHESION. MANAGE OR ERADICATE EXISTING CONCENTRATIONS OF NON-NATIVE VEGETATION SUCH AS REED CANARYGRASS. INSTALL WITH A HIGH PLANTING DENSITY TO ENSURE HIGH RATE OF SURVIVAL IN THESE CRITICAL AREAS. INCLUDE FENCING WHERE NEEDED TO PROTECT PLANTINGS FROM LIVESTOCK, ELK, DEER, BEAVER, ETC.
5. INSTALL LWD STRUCTURES TO IMPROVE HABITAT AND PROVIDE BANK ROUGHNESS ALONG ACTIVELY ERODING PORTIONS OF THE SIDE CHANNEL.
6. RESTORE CONNECTIVITY TO THE LARGE GROUNDWATER CHANNEL AREA BY REPLACING THE EXISTING DRAIN PIPE WITH AN OPEN CHANNEL CONNECTION. RETAIN EXISTING BERM AS IT PLAYS A CRITICAL ROLE IN THE ACHESON'S RANCH OPERATIONS. THE NEWLY CONSTRUCTED CHANNEL MUST RECONNECT WITH THE SIDE CHANNEL AT A POINT FAR ENOUGH DOWNSTREAM THAT THE WATER SURFACE ELEVATIONS IN THE OFF CHANNEL AREA REMAIN LOW ENOUGH IN THE SUMMER TO NOT SATURATE THE GROUND IN ADJACENT FIELDS AND PASTURES.
7. INSTALL RAIL CAR BRIDGE OR OTHER PRE-FABRICATED CROSSING OVER THE NEWLY CONSTRUCTED CHANNEL TO PROVIDE A CROSSING FOR LIVESTOCK.
8. ENHANCE HABITAT IN THE RECONNECTED GROUNDWATER CHANNEL WITH ENGINEERED LWD HABITAT STRUCTURES.

LEGEND

- EARLY ACTION HABITAT ENHANCEMENT AREA BOUNDARY
- PROPERTY BOUNDARY
- EXISTING SPOIL PILES
- EXISTING LEVEE OR BERM
- FLOW DIRECTION
- EXISTING SIDE CHANNEL, GROUNDWATER CHANNEL, OVERFLOW CHANNEL, OR DITCH
- PROPOSED CONSTRUCTED GROUNDWATER CHANNEL
- CONCEPTUAL PROJECT OPPORTUNITY AREA
- (1) CONCEPTUAL PROJECT OPPORTUNITY NUMBER
- PROPOSED ENGINEERED LWD HABITAT STRUCTURES

100 0 100 200
1"=200'

ONE INCH
FULL SIZE 11" x 17" SHEET

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

No.	REVISION	BY	APP'D	DATE

HERRERA

FROM THE CASCADES...TO THE COLUMBIA
KITTITAS COUNTY

DESIGNED: M. KLARA	DRAWN: A. RHODE
DESIGNED: A. RHODE	DRAWN: R. HULME
DESIGNED:	CHECKED: M. KLARA
SCALE: AS NOTED	APPROVED: J. CARRASQUERO

RESTORATION OF THE YAKIMA RIVER FROM HANSEN PITS TO THE YAKIMA CANYON
EARLY ACTION GROUP 2
PLAN VIEW - SHEET 2 OF 4

DATE:
PROJECT NO: 14-05594-000
DRAWING NO: C-2
SHEET NO: 3 OF 5

Path: P:\Proj\Y2013\13-05594-000\CAD\Dwgs\GROUP 2 PLAN VIEWS.dwg
Plot Date: 6/29/2015 3:01 PM
Cad User: Abbey Rhode

CONCEPTUAL PROJECT OPPORTUNITIES

1. BANK/RIPARIAN REVEGETATION – EXPAND/ENHANCE RIPARIAN ZONE BY PLANTING NATIVE VEGETATION TO IMPROVE SHADING AND MINIMIZE EROSION RISK THROUGH IMPROVED ROOT COHESION. MANAGE OR ERADICATE EXISTING CONCENTRATIONS OF NON-NATIVE VEGETATION SUCH AS REED CANARYGRASS. INSTALL WITH A HIGH PLANTING DENSITY TO ENSURE HIGH RATE OF SURVIVAL IN THESE CRITICAL AREAS. INCLUDE FENCING WHERE NEEDED TO PROTECT PLANTINGS FROM LIVESTOCK, ELK, DEER, BEAVER, ETC.

3. DESIGN AND INSTALL ENGINEERED LARGE WOODY DEBRIS (LWD) HABITAT STRUCTURES TO ENHANCE EXISTING SIDE CHANNEL HABITAT

LEGEND

- EARLY ACTION HABITAT ENHANCEMENT AREA BOUNDARY
- PROPERTY BOUNDARY
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1"=200'

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RESTORATION OF THE YAKIMA RIVER FROM HANSEN PITS TO THE YAKIMA CANYON
EARLY ACTION GROUP 2
PLAN VIEW - SHEET 3 OF 4

DATE:
PROJECT NO: 14-05594-000
DRAWING NO: C-3
SHEET NO: 4 OF 5

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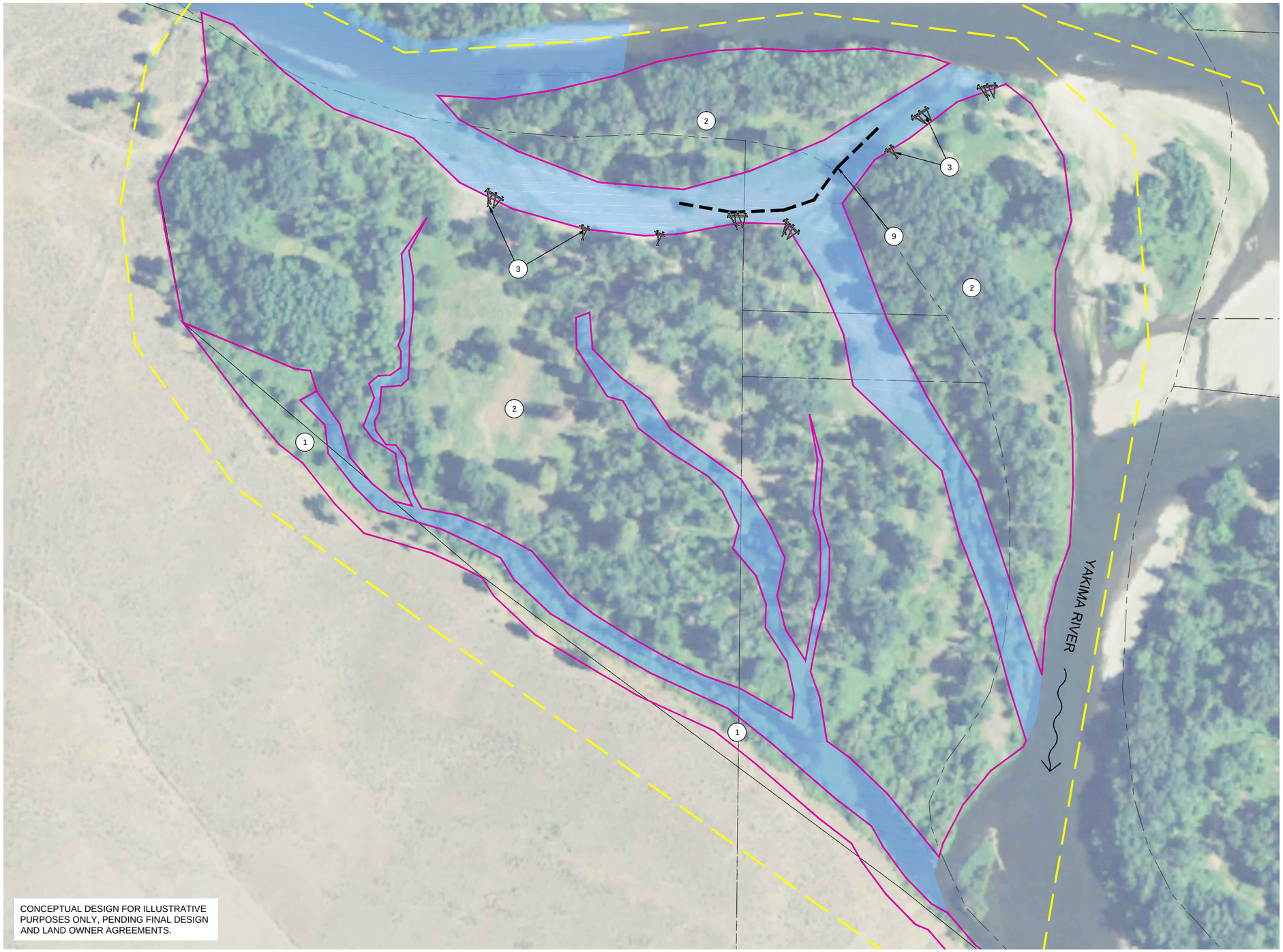

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9. REMOVE SPOILS BERM TO RESTORE FLOW CONDITIONS ACROSS THE ACTIVE FLOODPLAIN.

LEGEND

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- PROPERTY BOUNDARY
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- FLOW DIRECTION
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100 0 100 200
1"=200'

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ONE INCH
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FROM THE CASCADES...TO THE COLUMBIA
KITTITAS COUNTY

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RESTORATION OF THE YAKIMA RIVER FROM HANSEN PITS TO THE YAKIMA CANYON
EARLY ACTION GROUP 2
PLAN VIEW - SHEET 4 OF 4

DATE:
PROJECT NO: 14-05594-000
DRAWING NO: C-4
SHEET NO: 5 OF 5

Path: P:\Proj\Y2013\13-05594-000\CAD\Dwgs\GROUP 2 PLAN VIEWS.dwg
Plot Date: 6/29/2015 3:03 PM Cad User: Abbey Rhode

Herrera Environmental Consultants, Inc. **July 2015**

CLIENT: Kittitas County Flood Control Zone District
PROJECT: Yakima River - Hansen Pits to Yakima Canyon - Conceptual Restoration Design
SITE: Early Action Habitat Enhancement Project Group 2

Prepared by: M. Klara, A. Rhode
Checked by: M. Ewbank

Table 2. Early Action Habitat Enhancement Project Group 2 - Planning (10%) Level Cost Estimate

Item	Quantity	Unit	Unit Cost	Amount	Notes
DIRECT COSTS					
1 - Bank/Riparian Vegetation				**$234,000**	
Expand/enhance riparian zone by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion. Manage or eradicate existing concentrations of non-native vegetation such as reed canarygrass. Install with a high planting density to ensure high rate of survival in these critical areas. Include fencing or other methods where needed to protect plantings from livestock, deer, elk, beaver, etc.	15.6	AC	$15,000	$234,000	Unit cost assumes rate for site prep, planting materials, installation, and 2 years of adaptive management.
2 - Floodplain Forest Revegetation				**$342,000**	
Work with landowners to implement effective and acceptable floodplain reforestation. Improve canopy cover and understory diversity in sparsely forested areas, or reestablish floodplain forest cover in deforested areas. Species selection will likely be the same as or similar to bank/riparian revegetation but at a reduced planting density. Include fencing or other methods where needed to protect plantings from livestock, deer, elk, beaver, etc.	34.2	AC	$10,000	$342,000	Unit cost assumes rate for site prep, planting materials, installation, and 2 years of adaptive management.
3 - LWD Habitat Structures in Side Channels				**$128,000**	
Design and install engineered large woody debris (LWD) habitat structures to enhance existing side channel habitat.					
Single and double log structures:	6	EA	$800	$4,800	Engineer's est. Assumes $800 per log delivered and installed.
Small multi log structures (~6 logs):	21	EA	$4,800	$100,800	Engineer's est. Assumes $800 per log delivered and installed.
Small multi log structures (~4 logs):	7	EA	$3,200	$22,400	Engineer's est. Assumes $800 per log delivered and installed.
5 - LWD Structures Along Actively Eroding Side Channel Banks				**$60,800**	
Design and install engineered large woody debris (LWD) structures to improve habitat and provide bank roughness along actively eroding portions of the side channel.					
Small multi log structures (~6 logs):	8	EA	$4,800	$38,400	Engineer's est. Assumes $800 per log delivered and installed.
Small multi log structures (~4 logs):	7	EA	$3,200	$22,400	Engineer's est. Assumes $800 per log delivered and installed.
6 - Reconnect Groundwater Channel Habitat				**$15,200**	
Bulk Excavation	650	CY	$6	$3,900	Engineer's est. - Assumes a 300' long channel, 20' wide, and average of 3' deep. Assumes removal of all excavated spoils from the site
Spoils haul-off and disposal	650	CY	$12	$7,800	Engineer's est. See above note regarding volume. Assumes haul off-site to a local disposal area.
Additional direct costs	1.0	LS	$3,500	$3,500	Miscellaneous items such as erosion control fabric, dewatering, etc.
7 - Railcar Bridge Over New Channel				**$30,000**	
Install railcar bridge or other prefabricated crossing over the newly constructed channel (accessing the existing groundwater channe;) to provide a crossing for livestock.	1.0	LS	$30,000	$30,000	Engineers est. - Assumes basic 40 foot span with ecology block footers. Cost for materials, delivery, and installation.
8 - LWD Habitat Enhancement in Reconnected Groundwater Channel				**$44,800**	
Design and install engineered large woody debris (LWD) habitat structures in the reconnected groundwater channel to enhance habitat					
Meduim sized multi-log structures (~7-9 logs):	7	EA	$6,400	$44,800	Engineer's est. Assumes $800 per log delivered and installed.
SUBTOTAL DIRECT COSTS:				**$854,800**	
CONTINGENCY			50%	$427,400	
TOTAL DIRECT COSTS:				**$1,282,200**	
ENGINEERING, PERMITTING, MOBILIZATION, AND OVERSIGHT					
ENGINEERING DESIGN AND REVEGETATION DESIGN	1	LS	$75,000	$75,000	Assumes engineering and revegetation design for all project elements listed above. Assumes design of log structures will require hydraulic modeling. Includes site visit, survey, geotech analysis, hydrology, hydraulic modeling, and design PS&E to support public bid for construction.
PERMITTING	1	LS	$60,000	$60,000	Assumes permitting for all project elements. Assumes all project elements are permitted together. Permitting individual elements as separate projects would be significantly more expensive.

Prepared by: M. Klara, A. Rhode
Checked by: M. Ewbank

Table 2. Early Action Habitat Enhancement Project Group 2 - Planning (10%) Level Cost Estimate

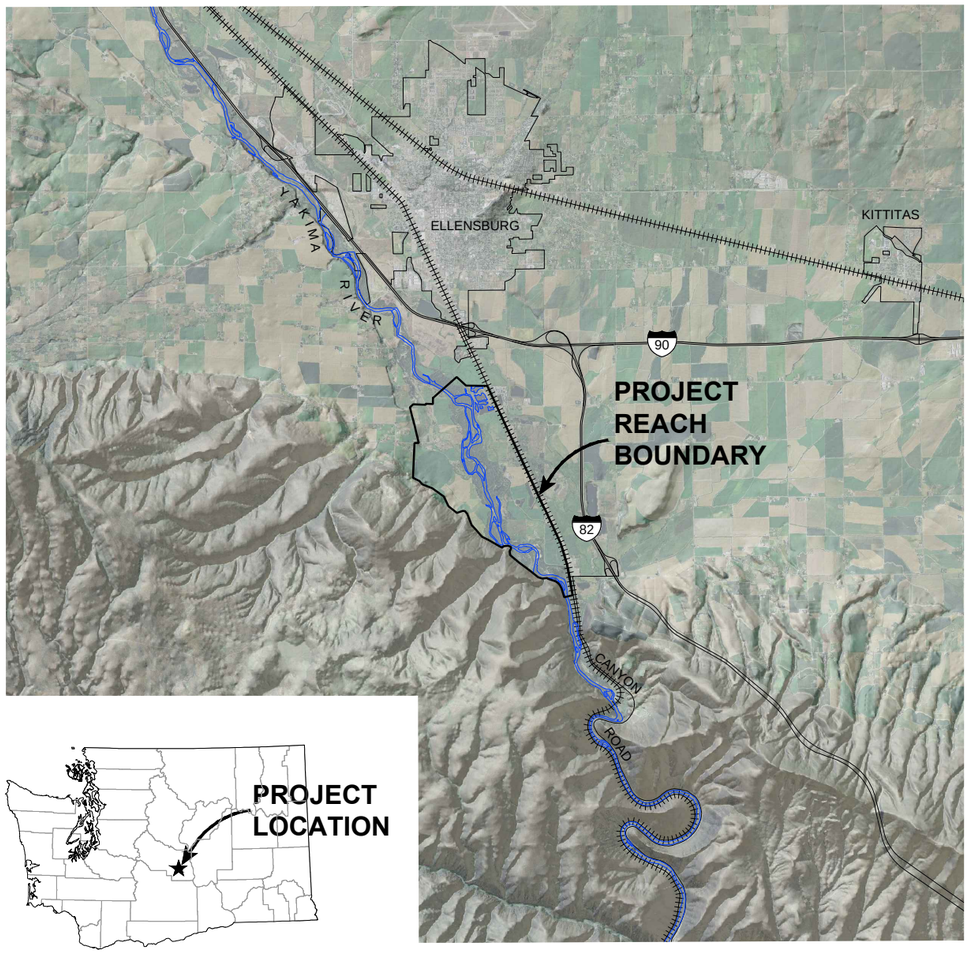
Item	Quantity	Unit	Unit Cost	Amount	Notes
MOBILIZATION AND STAGING	1	%	5%	$64,000	Assumes mobilization for all engineered project elements.
CONSTRUCTION MANAGEMENT/OVERSIGHT	1	LS	$35,000	$35,000	Assumes CO for all engineered and revegetation project elements.
SUBTOTAL ENGINEERING, PERMITTING, AND OVERSIGHT COSTS:				**$234,000**	
CONTINGENCY			30%	$70,200	
TOTAL ENGINEERING, PERMITTING, AND OVERSIGHT COSTS:				**$304,200**	
TOTAL ESTIMATED PROJECT COSTS:				**$1,586,000**	

KITTITAS COUNTY FLOOD CONTROL ZONE DISTRICT

CONCEPTUAL DESIGN PLANS FOR

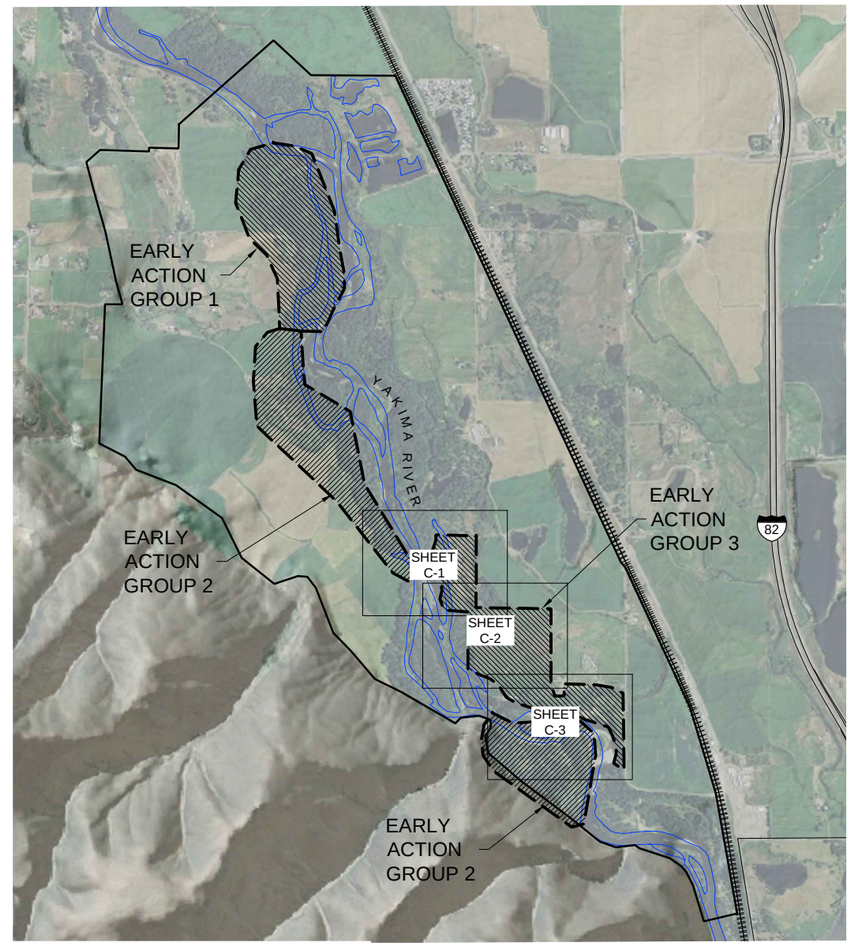
RESTORATION OF THE YAKIMA RIVER FROM HANSEN PITS TO THE YAKIMA CANYON EARLY ACTION GROUP 3

CITY OF ELLENSBURG AND KITTITAS COUNTY, WASHINGTON



VICINITY MAP

SCALE: 1" = 2 MILES



SHEET LAYOUT KEY

SCALE: 1" = 1/2 MILE

SHEET INDEX

SHEET	DRAWING	TITLE
1	G-1	COVER SHEET
2	C-1	PLAN VIEW - SHEET 1 OF 3
3	C-2	PLAN VIEW - SHEET 2 OF 3
4	C-3	PLAN VIEW - SHEET 3 OF 3

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

ONE INCH
FULL SIZE 11" x 17" SHEET

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RESTORATION OF THE YAKIMA RIVER FROM HANSEN PITS TO THE YAKIMA CANYON
EARLY ACTION GROUP 3
COVER SHEET

DATE:

PROJECT NO: 14-05594-000

DRAWING NO: G-1

SHEET NO: 1 OF 3

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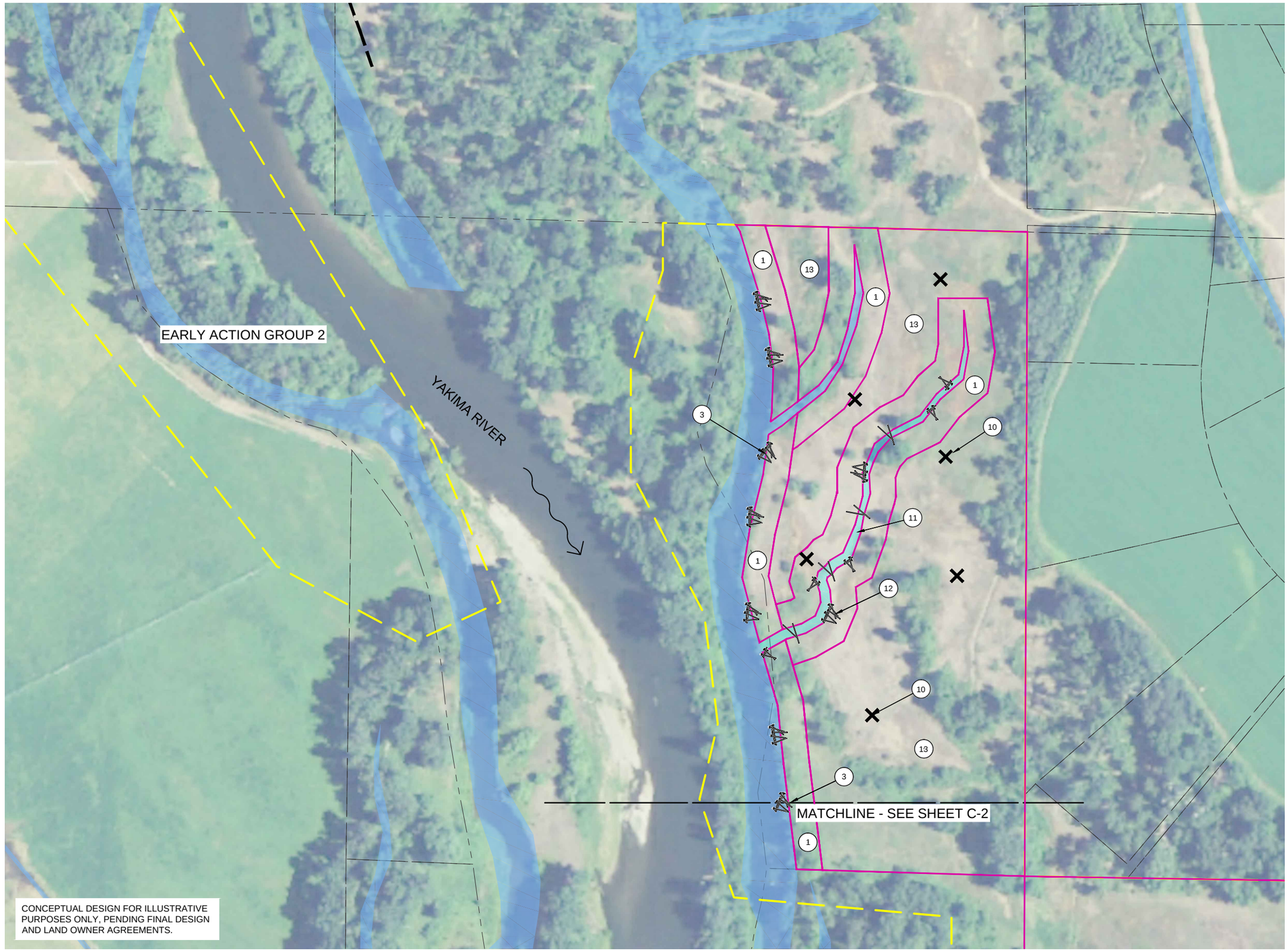
Plot Date: 6/29/2015 3:03 PM
Cad User: Abbey Rhode



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1. BANK/RIPARIAN REVEGETATION – EXPAND/ENHANCE RIPARIAN ZONE BY PLANTING NATIVE VEGETATION TO IMPROVE SHADING AND MINIMIZE EROSION RISK THROUGH IMPROVED ROOT COHESION. MANAGE OR ERADICATE EXISTING CONCENTRATIONS OF NON-NATIVE VEGETATION SUCH AS REED CANARYGRASS. INSTALL WITH A HIGH PLANTING DENSITY TO ENSURE HIGH RATE OF SURVIVAL IN THESE CRITICAL AREAS. INCLUDE FENCING WHERE NEEDED TO PROTECT PLANTINGS FROM LIVESTOCK, ELK, DEER,

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10. DESIGN AND IMPLEMENT A GROUNDWATER STUDY ACROSS THE SITE TO DETERMINE WATER TABLE ELEVATIONS, DEPTH, AND SEASONAL VARIATIONS. RESULTS OF THIS STUDY WILL INFORM THE DESIGN OF REVEGETATION EFFORTS AND ALLOW DESIGNERS TO DETERMINE THE FEASIBILITY/DETAILS OF GROUNDWATER CHANNEL CONSTRUCTION.

11. INVESTIGATE FEASIBILITY OF, DESIGN, AND CONSTRUCT GROUNDWATER CHANNEL(S) TO PROVIDE CRITICAL OFF CHANNEL HABITAT. INCLUDE RIPARIAN REVEGETATION AND INSTALLATION OF ENGINEERED LWD HABITAT STRUCTURES IN THE DESIGN.

12. DESIGN AND INSTALL ENGINEERED LWD HABITAT STRUCTURES AS PART OF PROPOSED GROUNDWATER CHANNEL CONSTRUCTION

13. REVEGETATION OF DISTURBED SITES – IMPLEMENT A STUDY OF THE SOIL, DESIGN, AND IMPLEMENT A REVEGETATION PLAN THAT INCLUDES THE NECESSARY SOIL AMENDMENTS TO ENSURE SUCCESSFUL REVEGETATION WITH NATIVE RIPARIAN SPECIES. INCLUDE LIVESTOCK FENCING WHERE NEEDED TO PROTECT PLANTINGS. (AERIAL IMAGERY SHOW THAT SOME AREAS MAY HAVE BEEN DISTURBED TO THE POINT THAT LITTLE OR NO VEGETATION CAN ESTABLISH ITSELF NATURALLY.)

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RESTORATION OF THE YAKIMA RIVER FROM HANSEN PITS TO THE YAKIMA CANYON
EARLY ACTION GROUP 3
PLAN VIEW - SHEET 1 OF 3

DATE:
PROJECT NO: 14-05594-000
DRAWING NO: C-1
SHEET NO: 2 OF 4

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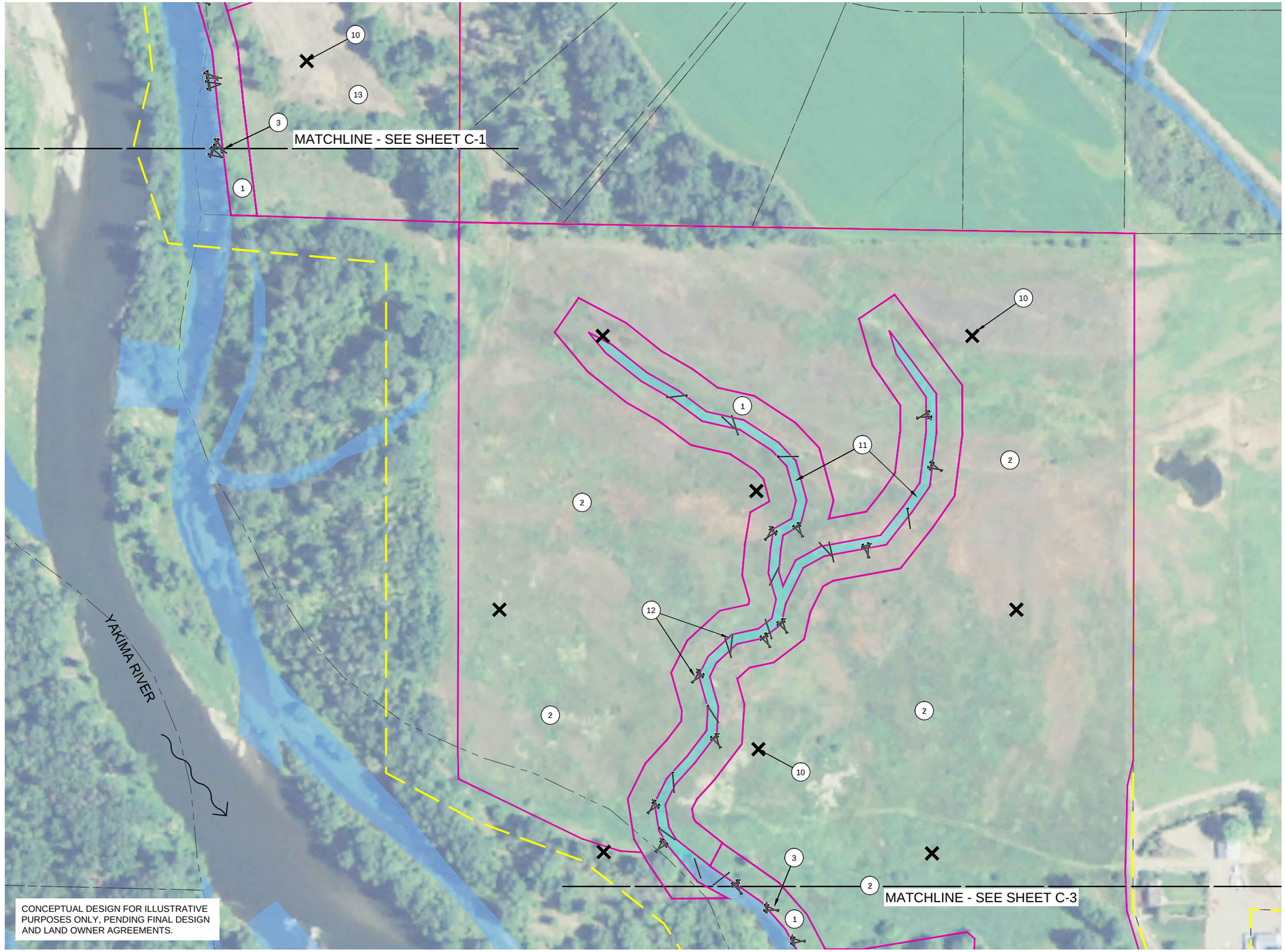

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RESTORATION OF THE YAKIMA RIVER FROM HANSEN PITS TO THE YAKIMA CANYON
EARLY ACTION GROUP 3
PLAN VIEW - SHEET 2 OF 3

DATE:
PROJECT NO: 14-05594-000
DRAWING NO: C-2
SHEET NO: 3 OF 4

Path: P:\Proj\Y2013\13-05594-000\CAD\Dwgs\GROUP 3 PLAN VIEW.dwg
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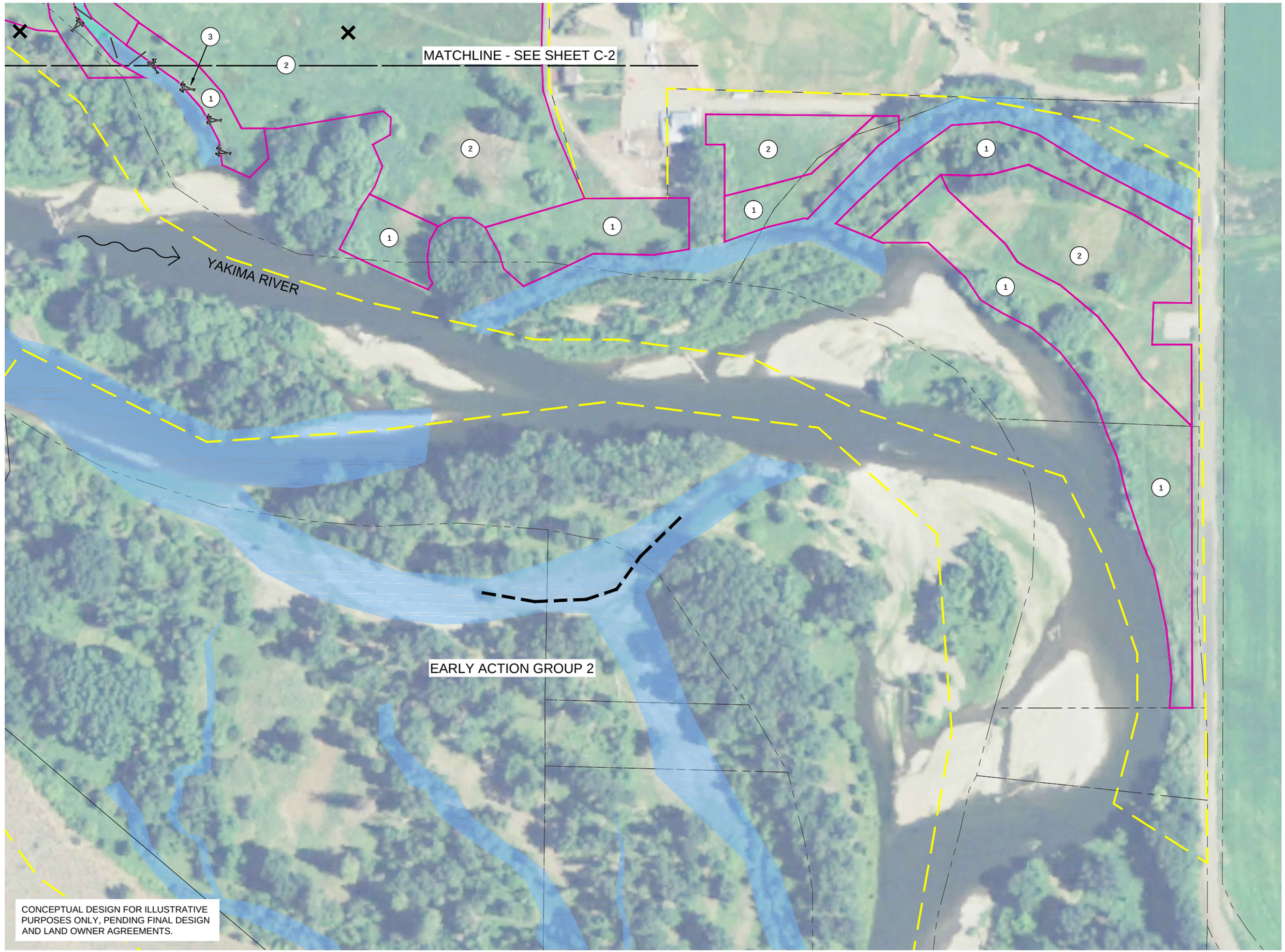

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RESTORATION OF THE YAKIMA RIVER FROM HANSEN PITS TO THE YAKIMA CANYON
EARLY ACTION GROUP 3
PLAN VIEW - SHEET 3 OF 3

DATE:
PROJECT NO: 14-05594-000
DRAWING NO: C-3
SHEET NO: 4 OF 4

Path: P:\Proj\Y2013\13-05594-000\CAD\Dwgs\GROUP 3 PLAN VIEW.dwg
Plot Date: 6/29/2015 3:06 PM Cad User: Abbey Rhode

CLIENT: Kittitas County Flood Control Zone District
PROJECT: Yakima River - Hansen Pits to Yakima Canyon - Conceptual Restoration Design
SITE: Early Action Habitat Enhancement Project Group 3

Prepared by: M. Klara, A. Rhode
Checked by: M. Ewbank

Table 3. Early Action Habitat Enhancement Project Group 3 - Planning (10%) Level Cost Estimate

Item	Quantity	Unit	Unit Cost	Amount	Notes
DIRECT COSTS					
1 - Bank/Riparian Vegetation				**$228,000**	
Expand/enhance riparian zone by planting native vegetation to improve shading and minimize erosion risk through improved root cohesion. Manage or eradicate existing concentrations of non-native vegetation such as reed canarygrass. Install with a high planting density to ensure high rate of survival in these critical areas. Include fencing or other methods where needed to protect plantings from livestock, deer, elk, beaver, etc.	15.2	AC	$15,000	$228,000	Unit cost assumes rate for site prep, planting materials, installation, and 2 years of adaptive management.
2 - Floodplain Forest Revegetation				**$371,000**	
Work with landowners to implement effective and acceptable floodplain reforestation. Improve canopy cover and understory diversity in sparsely forested areas, or reestablish floodplain forest cover in deforested areas. Species selection will likely be the same as or similar to bank/riparian revegetation but at a reduced planting density. Include fencing or other methods where needed to protect plantings from livestock, deer, elk, beaver, etc.	37.1	AC	$10,000	$371,000	Unit cost assumes rate for site prep, planting materials, installation, and 2 years of adaptive management.
3 - LWD Habitat Structures in Side Channels				**$118,400**	
Design and install engineered large woody debris (LWD) habitat structures to enhance existing side channel habitat.					
Single and double log structures:	6	EA	$800	$4,800	Engineer's est. Assumes $800 per log delivered and installed.
Small multi log structures (~6 logs):	21	EA	$4,800	$100,800	Engineer's est. Assumes $800 per log delivered and installed.
Small multi log structures (~4 logs):	4	EA	$3,200	$12,800	Engineer's est. Assumes $800 per log delivered and installed.
10 - Groundwater Study				**$25,000**	
Design and implement a groundwater study across the site to determine water table elevations, depth, and seasonal variations. Results of this study will inform the design of revegetation efforts and allow designers to determine the feasibility/details of proposed groundwater channel construction.	1.0	LS	$25,000	$25,000	Engineer's estimate - Assumes 14 wells all <10 feet deep to avoid Washingtons existing well construction and reporting requirements. Each well requires $250 in hardware, $420 logger. Also require a $420 barotroll, $200 docking station. Install 4 loggers per day by hand, 2 person crew. Plus data download field visits. Data analysis is included in design for projects 11 and 13.
11 - Construct Groundwater Channels				**$150,000**	
Investigate feasibility of, design, and construct groundwater channel(s) to provide critical off channel habitat. Include riparian revegetation and installation of LWD habitat structures in the design as accounted for in items 1 and 12. Engineer's estimate is for construction excavation only, excluding revegetation (1) and LWD habitat structure installation (12). Feasibility study and design are included in engineering costs detailed in the Engineering, Permitting, Mobilization, and Oversight section..					
Bulk Excavation	7,500	CY	$6	$45,000	Engineer's est. - Assumes 2900' of channel, 20' wide, and average of 3.5' deep. Assumes removal of all excavated spoils from the site
Spoils haul-off and disposal	7,500	CY	$12	$90,000	Engineer's est. See above note regarding volume. Assumes haul off-site to a local disposal area.
Additional direct costs	1.0	LS	$15,000	$15,000	Miscellaneous items such as erosion control fabric, dewatering, etc.
12 - LWD Habitat Structures in New Groundwater Channels				**$78,400**	
Design and install engineered LWD habitat structures as part of the proposed groundwater channel construction.					
Single and double log structures:	22	EA	$800	$17,600	Engineer's est. Assumes $800 per log delivered and installed.
Small multi log structures (~6 logs):	2	EA	$4,800	$9,600	Engineer's est. Assumes $800 per log delivered and installed.
Small multi log structures (~4 logs):	16	EA	$3,200	$51,200	Engineer's est. Assumes $800 per log delivered and installed.
13 - Revegetation of Disturbed Sites				**$312,000**	
Implement a revegetation plan that includes the necessary soil amendments and site prep to ensure successful revegetation with native riparian species. Include fencing or other methods where needed to protect plantings from livestock, deer, elk, beaver, etc.	10.4	AC	$15,000	$156,000	Unit cost assumes rate site prep, fertilization with biolsol organic fertilizer, planting materials, installation, and 2 years of adaptive management.
Soil amendment with organic compost	10.4	AC	$15,000	$156,000	Assumes 3-6" application. May not be necessary to achieve revegetation objectives.
SUBTOTAL DIRECT COSTS:				**$1,282,800**	

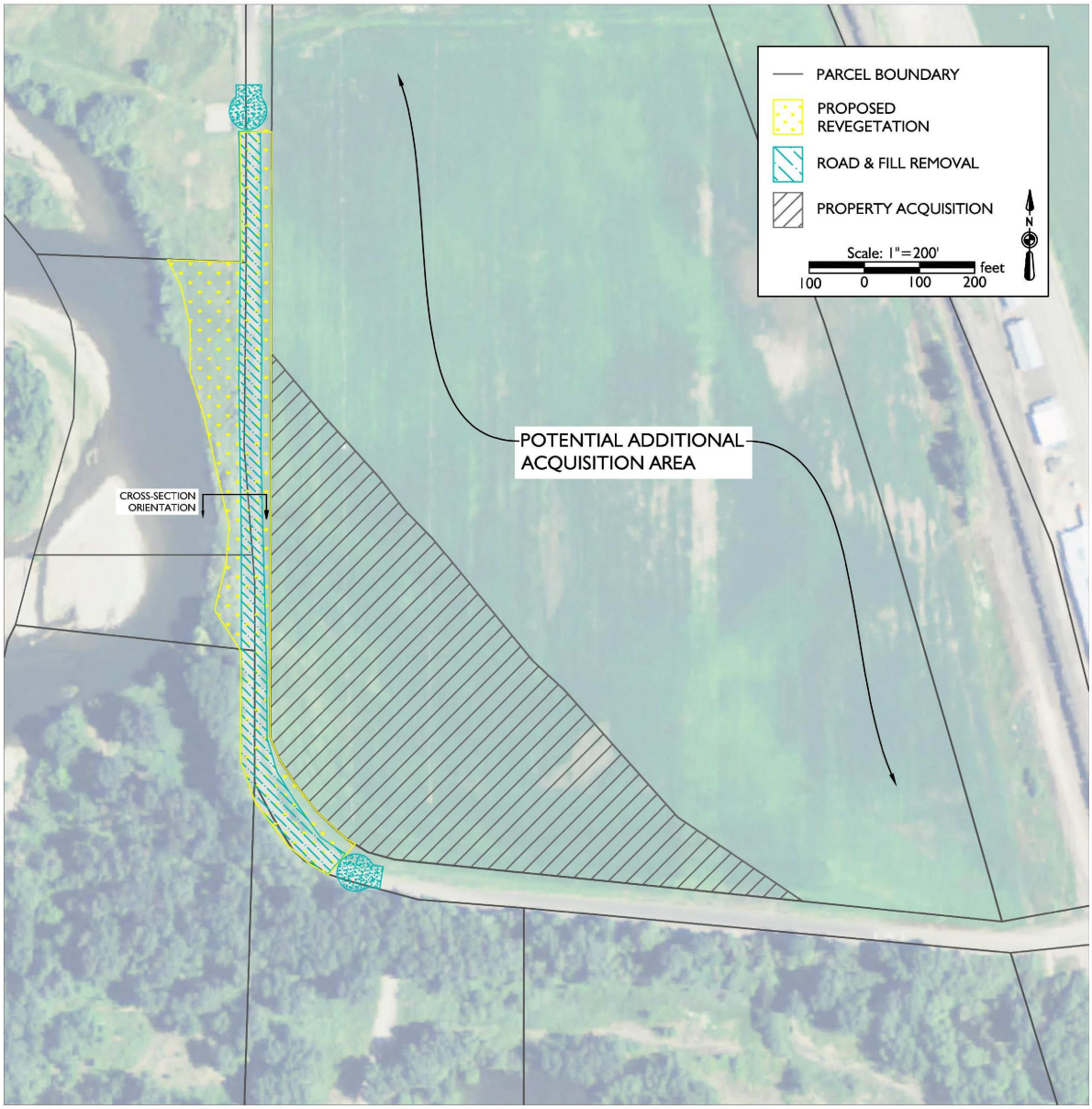
Prepared by: M. Klara, A. Rhode
Checked by: M. Ewbank

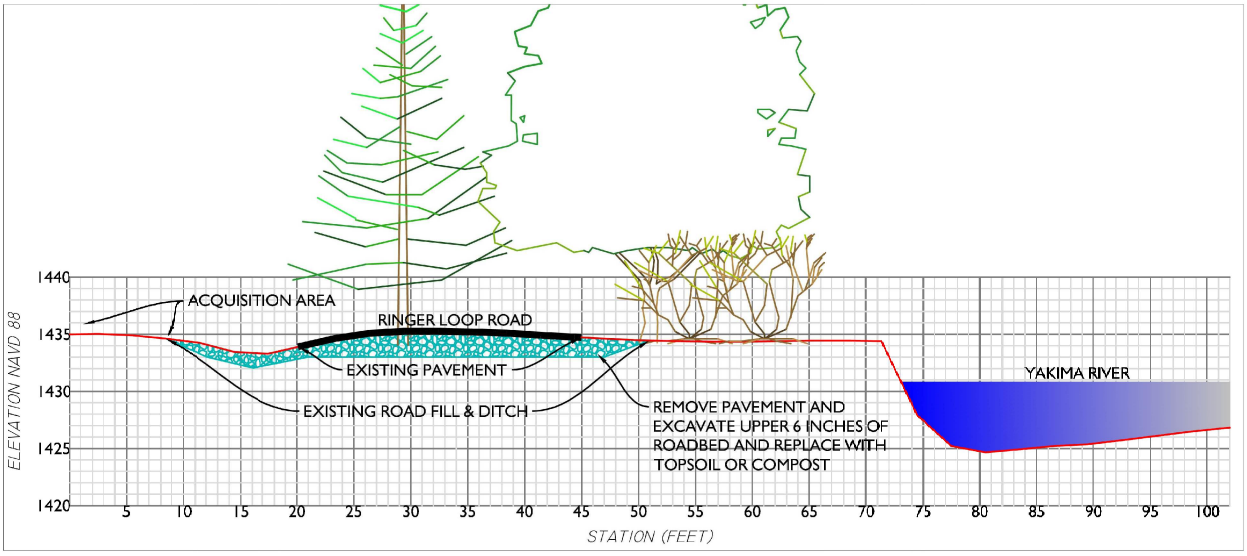
Table 3. Early Action Habitat Enhancement Project Group 3 - Planning (10%) Level Cost Estimate

Item	Quantity	Unit	Unit Cost	Amount	Notes
CONTINGENCY			50%	$641,400	
TOTAL DIRECT COSTS:				**$1,924,200**	
ENGINEERING, PERMITTING, MOBILIZATION, AND OVERSIGHT					
ENGINEERING DESIGN AND REVEGETATION DESIGN	1	LS	$110,000	$110,000	Assumes engineering and revegetation design for all project elements listed above. Assumes design of log structures will require hydraulic modeling. Includes site visit, survey, geotech analysis, hydrology, hydraulic modeling, and design PS&E to support public bid for construction.
PERMITTING	1	LS	$65,000	$65,000	Assumes permitting for all project elements. Assumes all project elements are permitted together. Permitting individual elements as separate projects would be significantly more expensive.
MOBILIZATION AND STAGING	1	%	5%	$96,000	Assumes mobilization for all engineered project elements.
CONSTRUCTION MANAGEMENT/OVERSIGHT	1	LS	$45,000	$45,000	Assumes CO for all engineered and revegetation project elements.
SUBTOTAL ENGINEERING, PERMITTING, AND OVERSIGHT COSTS:				**$316,000**	
CONTINGENCY			30%	$94,800	
TOTAL ENGINEERING, PERMITTING, AND OVERSIGHT COSTS:				**$410,800**	
TOTAL ESTIMATED PROJECT COSTS:				**$2,335,000**	

APPENDIX C

Early Action Flood Hazard Management Project





Kittitas County, WA

Yakima River Corridor Plan:
Jeffries Levee to Canyon
Ringer Loop Road Decommissioning, Acquisition, and Restoration

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30 Jun 2015

WATERSHED SCIENCE & ENGINEERING

C:\Egnyte\Private\shaina\13-028 Yakima River Corridor Plan\ArcGIS\MXD\Figures\Draft Corridor Plan\Final Draft Corridor Plan\Figure C1 - Ringer Loop Road Decommissioning and Floodplain Restoration.mxd 6/30/2015 2:16:36 PM

Figure C1

WATERSHED SCIENCE & ENGINEERING

Table C1. Ringer Loop Road Planning Level Cost Estimate Alternative RL4 - Road Removal, Acquistion, and Revegetation				
Construction Costs to County				
Item	**Unit**	**Quantity**	**Cost/unit**	**Total Cost**
Construction				
Mobilization (8% of construction cost)	LS	1	$14,000	$14,000
Clearing & Grubbing	AC	0.52	$4,100	$2,100
Silt Fence	LF	1550	$5	$8,000
Pavement demo	SY	4000	$4	$16,000
Road prism removal (upper 6"; excavate, haul & dispose)	CY	1300	$20	$26,000
Turn-around & signage	EA	2	$18,500	$37,000
Topsoil (6" spread over road prism)	CY	1300	$30	$39,000
Vegetation	AC	3.0	$12,000	$36,000
Construction Subtotal				*$178,100*
Professional Fees				
Design Drawings (concepts assumed sufficient)	HR	40	$130	$5,200
Professional Fees Subtotal				*$5,200*
Total				**$183,300**
Contingency (30%)				$55,000
County Construction Total				**$240,000**

Future Maintenance Costs to County				
Repair flood damage to remaining East-West portion of Ringer Loop Road (per incident)	SY	3200	10	$32,000
Acquisition & Restoration Costs to Others				
Real Estate Fees (Appraisal, etc)	LS	1	$10,000	$10,000
Property Acquisition (Assessed Land Value per acre + 50%)	AC	9.1	$6,791	$61,800
Habitat restoration on acquired land (via habitat restoration grant funding)	AC	10.5	24,000	$251,000

Possible Long-Term Costs to Others				
Re-locating WDFW boat ramp	LS	1	500,000	$500,000

NOTE:
If property acquisition is expanded to include all Papineau land south of meander scar, the land area would be approximately 40 acres and the estimated cost (assuming the assessed value plus 50%) may be in the range of $275,000.