LIST OF PRIORITIZED REACHES

Lower Mainstem Touchet

Prescott to Coppei Creek

Project Areas: MS-1 to MS-6

Tier 1 Projects: MS-1
Tier 2 Projects: MS-4
Tier 3 Projects: MS-2, MS-3, MS-5, MS-6

Upper Mainstem Touchet

Waitsburg to Dayton

Project Areas: MS-9 to MS-15

Tier 1 Projects: MS-9, MS-10, MS-12, MS-13, MS-14, MS-15
Tier 2 Projects: MS-11
Tier 3 Projects:

Upper Coppei Creek

Meinberg Road to North Fork/South Fork Coppei Creek

Project Areas: C-3 to C-7

Tier 1 Projects: C-3, C-7
Tier 2 Projects:
Tier 3 Projects: C-4, C-5, C-6

Lower North Fork Touchet

Mainstem Confluence to Wolf Fork Confluence

Project Areas: NF-1 to NF-5

Tier 1 Projects: NF-2, NF-3
Tier 2 Projects:
Tier 3 Projects: NF-1, NF-4, NF-5

Upper North Fork Touchet

Wolf Fork Confluence to Spangler Creek

Project Areas: NF-6 to NF-16

Tier 1 Projects: NF-8, NF-11, NF-13, NF-15
Tier 2 Projects: NF-6, NF-9, NF-10, NF-14, NF-16
Tier 3 Projects: NF-7, NF-12

South Fork Touchet

Mainstem Confluence to Rainwater Wildlife Area

Project Areas: SF-1 to SF-8

Tier 1 Projects:
Tier 2 Projects: SF-1, SF-3, SF-6, SF-7
Tier 3 Projects: SF-2, SF-4, SF-5, SF-8

Lower Wolf Fork Touchet

North Fork Confluence to Robinson Fork Confluence

Project Areas: WF-1 to WF-3

Tier 1 Projects: WF-1
Tier 2 Projects: WF-2, WF-3
Tier 3 Projects:

Upper Wolf Fork Touchet

Robinson Fork Confluence to Coates Creek

Project Areas: WF-4 to WF-9

Tier 1 Projects: WF-8
Tier 2 Projects: WF-4, WF-6, WF-7
Tier 3 Projects: WF-5, WF-9

Robinson Fork Touchet

Wolf Fork Confluence to End of Road

Project Areas: RF-1 to RF-4

Tier 1 Projects: RF-1
Tier 2 Projects: RF-2, RF-3
Tier 3 Projects: RF-4

ABBREVIATIONS

ac/rm	acres per river mile
CREP	Conservation Reserve Enhancement Program
ELJ	engineered log jam
LiDAR	Light Detection and Ranging
mi	mile
psf	pounds per square foot
SCE	Standardized Complexity Evaluation
VM	valley mile

REFERENCES

Ecology (Washington State Department of Ecology), 2020. Flow Monitoring Network: Touchet River at Bolles. Available at: https://fortress.wa.gov/ecy/eap/flows/station.asp?sta=32B100.

Lower Mainstem Touchet Reach

Reach Description

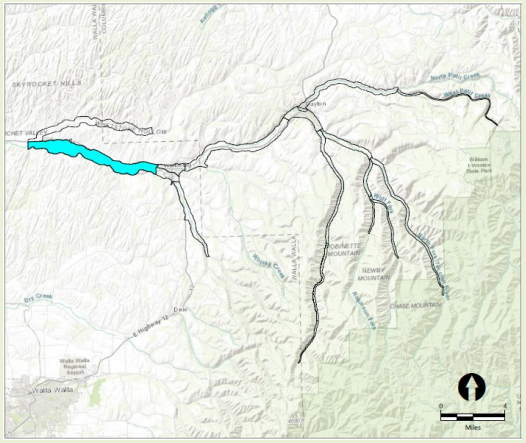
The Lower Mainstem Touchet reach runs from the Highway 125 bridge just below the city of Prescott that marks the downstream end of this assessment, to the downstream end of the Waitsburg levee. This reach includes six project areas from MS-1 to MS-6. Two significant tributaries enter the system in this reach: Coppei Creek, which enters at the upstream end of the reach on the left bank, and Whetstone Creek, which enters at the downstream end on the right bank. These tributaries provide the only significant changes in hydrology through the reach.

Floodplain and Riparian Area

Land use through most of the reach is characterized by agricultural fields and occasional associated agricultural infrastructure such as barns, irrigation ditches, and irrigation withdrawals, as well as several homesteads. However, for much of this reach, a moderately wide channel migration corridor exists, with many fields set back up to several hundred feet from the active channel. Riparian vegetation through this corridor is mixed, but in many places very little mature or established vegetation exists in the riparian area. Riparian plantings are evident in several of these reaches. Although much of the river has a channel migration area, several stretches of river, notably in project areas MS-3 and MS-4, are still highly confined through levees and incision and have very little riparian area.

Lower Mainstem Touchet

Vicinity Map



Reach Characteristics

River	Touchet River
Parent River	Walla Walla River
River Distance to Confluence (mi)	41.14
Valley Distance to Confluence (mi)	33.49
River Length (mi)	10.19
Valley Length (mi)	8.56
Sinuosity	1.18
Average Slope	0.41%
Delineated Project Areas	MS-1 to MS-6 (6)
Total Levee Length (mi)	5.09
Notable Tributaries	Coppei Creek Whetstone Creek

Channel Conditions

Observed channel complexity through most of this reach was relatively high with several side channels and split flows, notably in project areas MS-2, MS-5, and MS-6. Project areas MS-3 and MS-4 were more highly confined with less opportunity for side channels and split flows. Instream wood in the reach was relatively low throughout, with the exception of several large jams in MS-5 and MS-6 where recent major avulsions had occurred. While these avulsions have formed split flows and side channels, many have formed large gravel and cobble bars and islands that do not currently support riparian vegetation. Engineered log jams were observed in project area MS-5 and were providing some additional instream complexity. Scour pools did form where instream wood was observed, but this occurred infrequently due to the lack of large instream wood. In the confined reaches of MS-3 and MS-4, several large deep pools had formed from localized sediment deposition, effectively damming the confined reach. These deep pools were generally very warm with little overhanging cover or riparian vegetation. Several large bedrock-dominated reaches occur in MS-3 and MS-4 along with a 3-foot bedrock drop in MS-4 that completely spans the active channel.

Influencing Anthropogenic Features

Agriculture plays a large role in this section of the Touchet valley and is a factor in most influencing features. More than 4.7 miles of levee protect both residential and agricultural infrastructure and fields. Levees and incision play a large role in the confinement of the reach, particularly in project areas MS-3 and MS-4. Currently there are relatively few residential structures in the active floodplain and channel migration area. At the downstream end of the reach in project areas MS-1 and MS-2, the current extents of the city of Prescott are set back far enough from the river to have little effect on the dominant geomorphic processes, although development along the Blue Mountain rail line and the Railroad bridge itself has forced some confinement on the river's channel migration area. Several bridges cross the river in this reach and likely influence the geomorphic processes through floodplain constriction, hydraulic backwater, and sediment transport continuity. These bridges include the following:

- Highway 125 in project area MS-1
- Blue Mountain Railroad between project areas MS-1 and MS-2
- Brown Road in project area MS-2
- Hart Road between project areas MS-2 and MS-3
- Bolles Bridge (Highway 124) between project areas MS-4 and MS-5

Qualitative Factors and Reach Priority

The Lower Mainstem Touchet reach falls in Reach Priority 2 (out of 3) for reaches included in the Touchet watershed prioritization framework. This Reach Priority ranking is for the Lower Mainstem Touchet reach as a whole; individual project areas within this reach may rank differently in the prioritization. This Reach Priority is meant to provide some overall insight into factors that are not considered in the project area prioritization and are likely very different between the reaches in this assessment.

Water Quantity

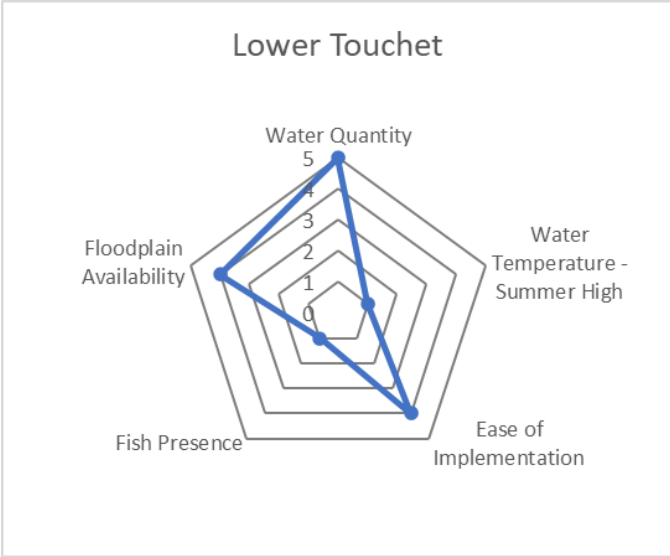
The mainstem of the Touchet River has significant flow during most of the hydrograph. This flow amount is enough to support multiple habitat units in a single cross section. Where low-lying floodplain is available, large areas can be inundated and swampy even at the lowest flows, as was observed during field site visits in 2019. The volume of flow in this reach also has high potential to cause geomorphic change and will likely respond quickly to restoration actions targeting side channels and split flows. This reach receives a score of 5 (out of 5) for water quantity.

Summer High Water Temperature

The mainstem of the Touchet River is widely regarded as being almost too warm for salmonid survivability. Temperature observations are made at the U.S. Geological Survey Bolles

Lower Mainstem Touchet

Qualitative Factors



Reach Score (_/5)	3.0
Reach Rank (_/9)	5
Reach Priority (_/3)	2
Primary Reach Concerns:	High Summer Temperatures Fish Presence

This reach has ample opportunities to reconnect floodplain and expand channel migration and abundant water quantity. The overall ranking was reduced by high summer water temperatures above the threshold for salmonids.

bridge gage operated by the Washington State Department of Ecology (Ecology 2020), and sustained in-channel temperatures reach above 25°C between June and July for most years. Survivability for salmonids is likely limited to deep pools during the hottest months, and providing these temperature refugia should be a prominent target in restoration actions in this reach. This reach receives a score of 1 (out of 5) for high water temperatures.

Ease of Implementation

Land ownership in the Lower Mainstem Touchet reach is generally characterized as being large, private parcels. Landowner willingness to participate in restoration work is unknown, but fewer parcels in this reach means that projects that cover more distance could be completed. Additionally, the Lower Mainstem Touchet reach has many bridges and farm roads that would provide relatively easy access to the floodplain for construction equipment. This reach receives a score of 4 (out of 5) for ease of implementation.

Fish Presence

Fish use data in this reach of the river are relatively limited. While few juvenile salmonid studies have been completed through this reach, a few summer steelhead juveniles have occasionally been spotted. Summer steelhead are also known to migrate through this reach and spawn throughout the mainstem Touchet River. Fish presence is the largest concern for this reach and receives a score of 1 (out of 5).

Floodplain Availability

Land uses in the Lower Mainstem Touchet reach are primarily engaged in agriculture practices, and there are very few buildings or other infrastructure bordering the active floodplain. Additionally, many sections of the Lower Mainstem Touchet reach have an unofficially established channel migration area. These floodplain areas are likely regularly flooded and have been either planted with riparian species or left without active agricultural practices. Restoration actions in these areas would be easy to implement with little risk to infrastructure and could provide high geomorphic and habitat value. This reach receives a score of 4 (out of 5) for floodplain availability.

Summary of Restoration Strategies

The following restoration actions are recommended based on the above information, as well as field observations and the desktop analysis and prioritization results. While other restoration actions should be considered at a project implementation level, the following should all be considered for any project in this reach. Details on how these restoration actions might be applied on a project area level are provided in the next section.

Establish Channel Migration Area

Much of this reach already has a large channel migration area, which provides room for natural geomorphic processes, flood inundation, and the establishment of riparian vegetation. While these areas often require additional restoration due to lack of instream complexity and established vegetation, an established channel migration area provides an excellent first step for restoration of natural processes. Over time, these channel migration areas often suffer from the creep of development or the establishment of new fields. In addition, particularly large floods may prompt the construction of new levees that protect established fields and infrastructure, which can impinge on this channel migration area and limit the natural geomorphic and ecological processes.

Therefore, protection against future development and confinement should be a high priority among restoration actions in reaches where channel migration areas currently exist. These protections can involve the establishment of setback levees to protect against future migration or flooding outside of this channel migration area, along with legal protections and easements against further development. Limiting bank erosion and avulsions with placement of large woody material can help to establish these boundaries.

Establish Riparian Vegetation

While there are several sections of this reach that have an established channel migration area, most of these sections have very little mature vegetation. Riparian vegetation has been shown to be critical to ecological and geomorphic processes. For this reach in particular, riparian vegetation is critically needed to provide a renewable and constant source of instream wood, as well as to provide overhanging cover and shade. Additionally, in reaches with more recent avulsions, large gravel bars have formed but are barren of all but small (<4 feet) shrub vegetation.

Establishing mature stands of vegetation in the immediate riparian area and channel migration areas should be a restoration target for this reach. Restoration actions should target establishing vegetated gravel bars and may require stabilizing features such as large apex engineered log jams. Additionally, restoration actions should seek to establish stands of riparian species in locations where the floodplain has been

reconnected through restoration and active channel migration. Finally, some agricultural grazing was observed through this reach and likely has an effect on establishing riparian vegetation. Grazing exclusions should be considered as part of any vegetation-focused restoration actions.

Add Instream Wood and Complexity

While some localized avulsions have caused large jams to form in a few project areas in this reach, much of this section is characterized by relatively low amounts of in-channel large woody material. Where instream wood does exist, scour pools and geomorphic complexity are almost always evident. As in many systems, large wood in this reach is a key part of the geomorphic and ecological processes. However, most of the project areas in this reach lack the volume of large woody material necessary to initiate these processes. A lack of planform and in-channel complexity was observed in most of the project areas in this reach, and all project areas had some sections that lacked channel complexity associated with instream wood.

Adding large woody material in strategic locations that will most benefit the natural processes should be a primary restoration action in all project areas in this reach. Instream wood should be placed primarily to help restore the geomorphic processes that result in side channel formation, split flow and vegetated gravel bar building, sediment storage, channel aggradation, and pool formation. In addition, large wood can be placed to provide in-channel complexity and habitat, as well as hardpoints against erosion in places where critical infrastructure must be protected. Using large wood to deter erosion at the edge of the aforementioned channel migration areas should be considered as a way to establish boundaries against further development.

Remove Confinement (Encroachments and Incision)

All six project areas in the Lower Mainstem Touchet reach have some impacts from levees and other encroachments, including five major road or rail bridges. In several sections of this reach, particularly in project areas MS-3 and MS-4, the channel has incised and confined to the point of running on bedrock. The analysis results for connectivity (provided in the next section) demonstrate the effects of these levees and incision on available floodplain. In addition, the analysis results for excess transport capacity demonstrate that confinement of the channel and floodplain leads to increased sediment transport capacity for the project areas within this reach.

Providing room for the river to actively migrate and inundate is vital to the natural processes in the reach and will have a large effect on the success of the other restoration actions listed. Where possible, levees and encroachments should be removed or set back to reconnect low-lying floodplain and relic side channels. Incised channels should be targeted for sediment deposition and floodplain benching to reconnect these areas.

Tier 1

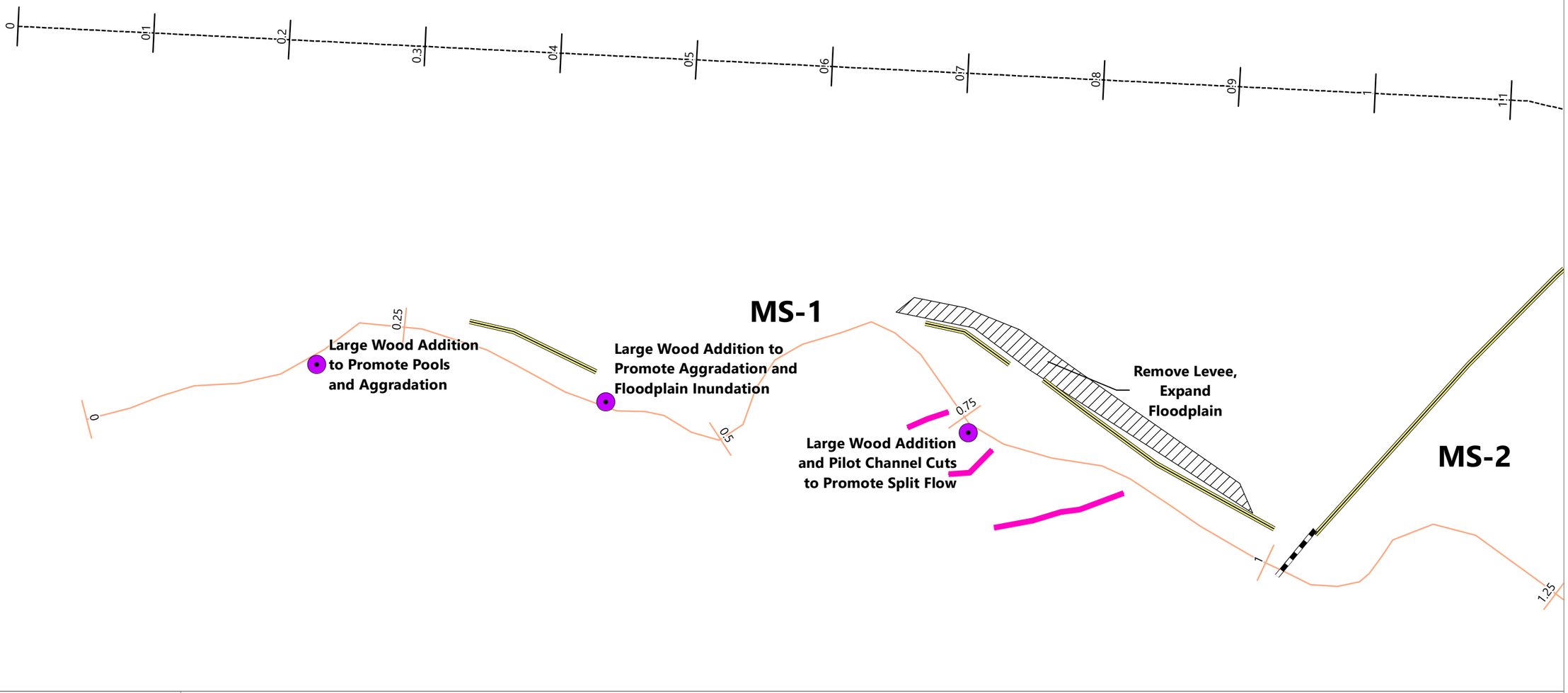
Project Areas in the Lower Mainstem Touchet Reach

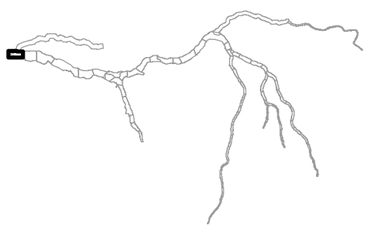
Project Area MS-1

River Length (mi)	1.00
Valley Length (mi)	1.00
Sinuosity	1.00
Average Slope	0.39%
Total Levee Length	0.54
Project Area Score	3.0
Basin Rank	13
Connectivity Score	0.30
Encroachment Removal Potential	21%
Aggradation Potential	34%
Total Potential	42%
2-year Connected Area (ac/rm)	22.3
Total Potential Area (ac/rm)	16.04
Complexity Score (SCE)	0.13
Excess Transport Capacity (psf)	-0.061

Recommended Restoration Actions

- ELJs to promote aggradation and sinuosity in straight bedrock reaches
- Remove or breach levees through VM 0.7 to VM 0.9
- Pilot channel cuts to activate side channels





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 0
RIVER MILE END: 1
VALLEY MILE START: 0
VALLEY MILE END: 1

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MS-1
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Tier 2

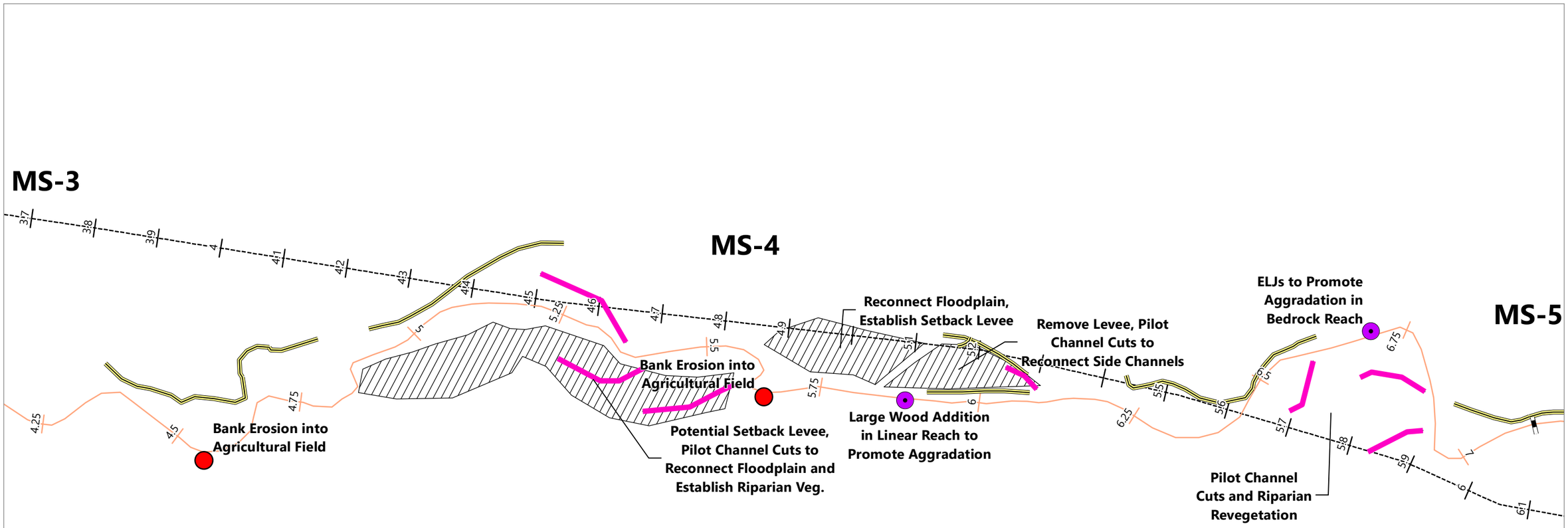
Project Areas in the Lower Mainstem Touchet Reach

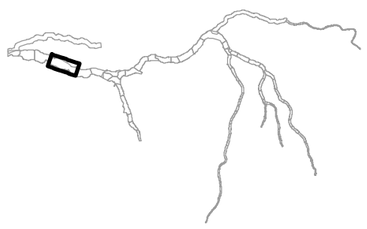
Project Area MS-4

River Length (mi)	2.90
Valley Length (mi)	2.36
Sinuosity	1.23
Average Slope	0.41%
Total Levee Length	1.60
Project Area Score	2.4
Basin Rank	22
Connectivity Score	0.19
Encroachment Removal Potential	11%
Aggradation Potential	15%
Total Potential	43%
2-year Connected Area (ac/rm)	21.6
Total Potential Area (ac/rm)	16.01
Complexity Score (SCE)	0.27
Excess Transport Capacity (psf)	-0.084

Recommended Restoration Actions

- ELJs to promote aggradation and sinuosity in straight bedrock reaches
- Remove or set back levees through VM 5.1 to VM 5.3
- Pilot Channel Cuts and Riparian Restoration





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain
- Riparian Enhancement
- Placemark

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

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RIVER MILE END: 7.1
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Feet

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MS-4
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Tier 3

Project Areas in the Lower Mainstem Touchet Reach

Project Area MS-2

River Length (mi)	1.53
Valley Length (mi)	1.23
Sinuosity	1.24
Average Slope	0.45%
Total Levee Length	0.38
Project Area Score	0.8
Basin Rank	53
Connectivity Score	0.14
Encroachment Removal Potential	3%
Aggradation Potential	20%
Total Potential	23%
2-year Connected Area (ac/rm)	36.6
Total Potential Area (ac/rm)	10.72
Complexity Score (SCE)	0.76
Excess Transport Capacity (psf)	-0.141

Recommended Restoration Actions

- ELJs to stabilize existing split flow and maintain existing complexity
- Pilot channel cuts to activate side channels

Project Area MS-3

River Length (mi)	1.67
Valley Length (mi)	1.5
Sinuosity	1.11
Average Slope	0.37%
Total Levee Length	0.85
Project Area Score	1.0
Basin Rank	49
Connectivity Score	0.15
Encroachment Removal Potential	6%
Aggradation Potential	17%
Total Potential	28%
2-year Connected Area (ac/rm)	19.2
Total Potential Area (ac/rm)	7.56
Complexity Score (SCE)	0.17
Excess Transport Capacity (psf)	-0.036

Recommended Restoration Actions

- Remove or breach levees through VM 2.8 to VM 2.9
- Remove old cars from right bank VM 3.6 to VM 3.7
- Add large woody material to promote in-channel complexity
- Establish channel migration protection area

Project Area MS-5

River Length (mi)	1.43
Valley Length (mi)	1.32
Sinuosity	1.08
Average Slope	0.46%
Total Levee Length	1.02
Project Area Score	1.3
Basin Rank	43
Connectivity Score	0.10
Encroachment Removal Potential	3%
Aggradation Potential	10%
Total Potential	23%
2-year Connected Area (ac/rm)	24.1
Total Potential Area (ac/rm)	7.29
Complexity Score (SCE)	0.24
Excess Transport Capacity (psf)	-0.144

Recommended Restoration Actions

- Establish mature deciduous riparian canopy
- ELJs to help vegetate large gravel bars

Tier 3

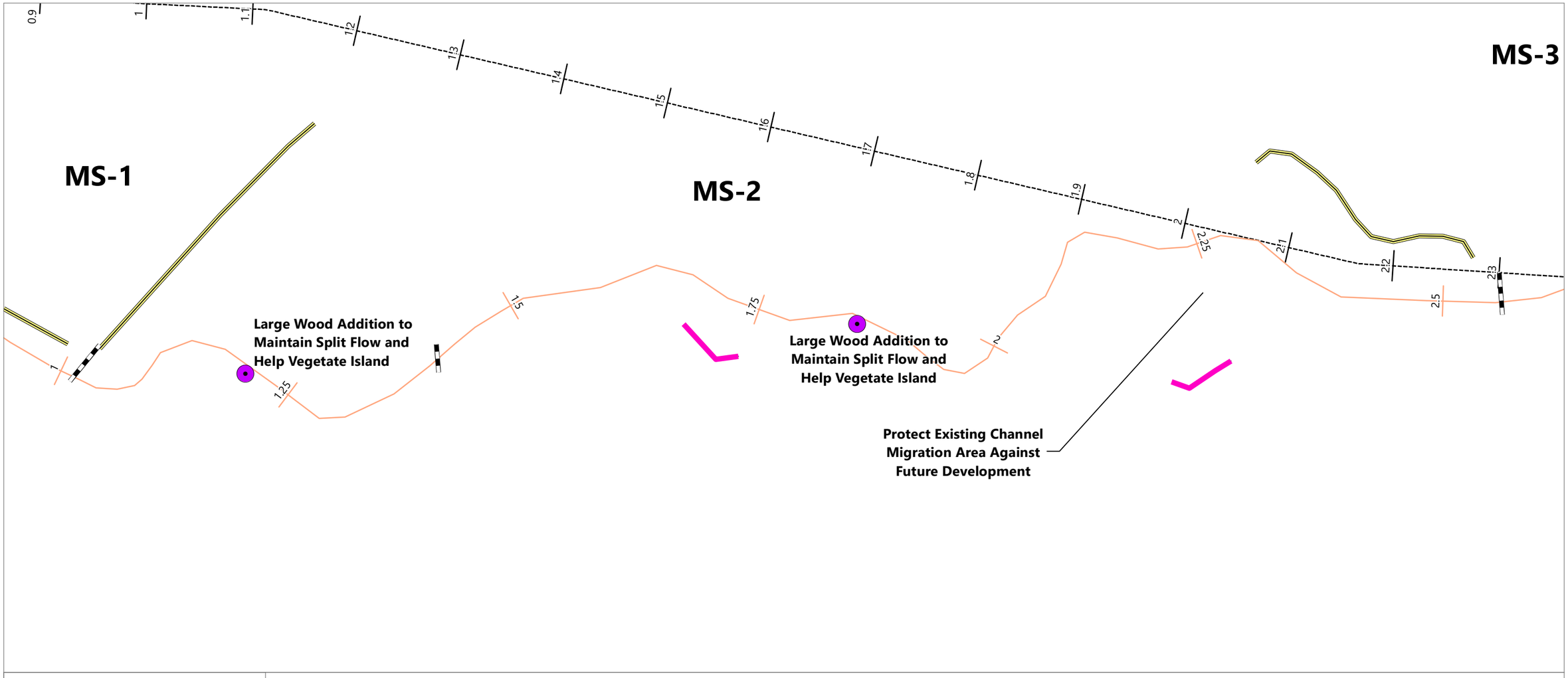
Project Areas in the Lower Mainstem Touchet Reach

Project Area MS-6

River Length (mi)	1.66
Valley Length (mi)	1.15
Sinuosity	1.44
Average Slope	0.40%
Total Levee Length	0.70
Project Area Score	1.1
Basin Rank	46
Connectivity Score	0.10
Encroachment Removal Potential	5%
Aggradation Potential	10%
Total Potential	20%
2-year Connected Area (ac/rm)	28.5
Total Potential Area (ac/rm)	7.25
Complexity Score (SCE)	0.48
Excess Transport Capacity (psf)	0.064

Recommended Restoration Actions

- ELJs to stabilize existing split flow and maintain existing complexity
- Vegetate large gravel bars



LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Riparian Enhancement

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

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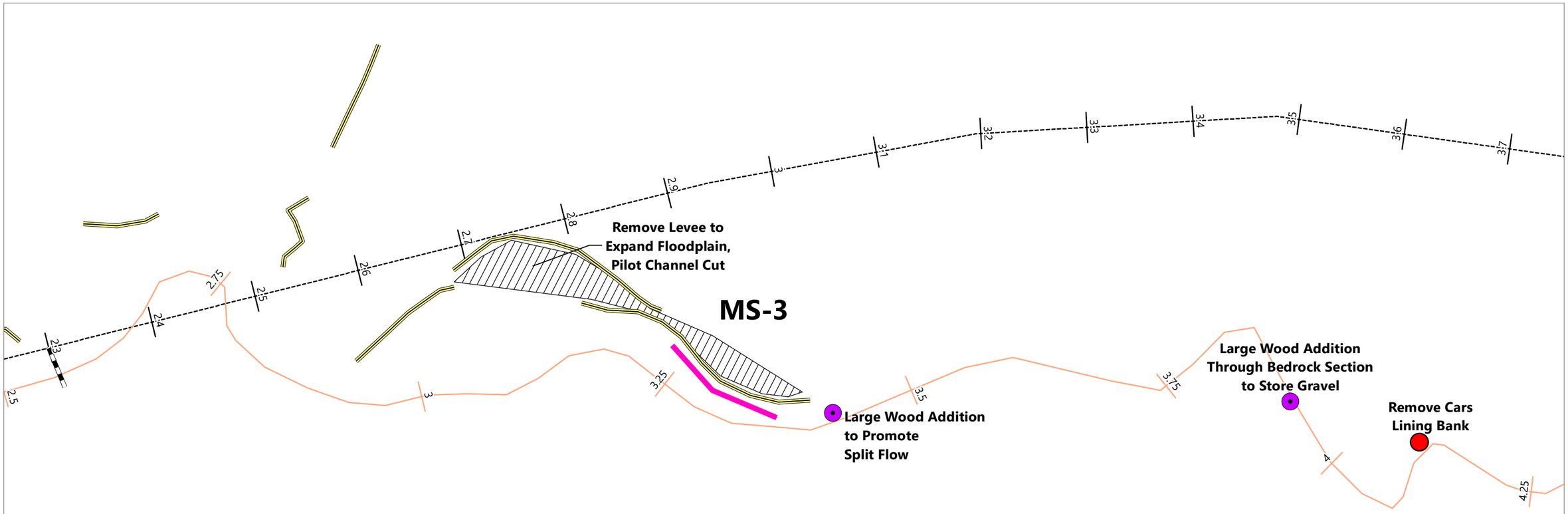
MS-2
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration



LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain
- Placemark

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

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VALLEY MILE START: 2.23
VALLEY MILE END: 3.73

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MS-3
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

MS-4

MS-5

MS-6

Recently Constructed WWCCD Restoration Project

Riparian Restoration

ELJs to Store Gravel and Promote Complexity

ELJs to Promote Floodplain Inundation and Help Vegetate Bars

Side Channel Pilot Cuts to Reconnect Floodplain

1 7.25 7.5 7.75 8 8.25 8.5 8.75

6.1 6.2 6.3 6.4 6.5 6.6 6.7 6.8 6.9 7 7.1 7.2 7.3 7.4 7.5

LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain
- Riparian Enhancement
- Placemark

Relative Elevation in Feet

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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

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RIVER MILE END: 8.53
VALLEY MILE START: 6.09
VALLEY MILE END: 7.41

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Feet

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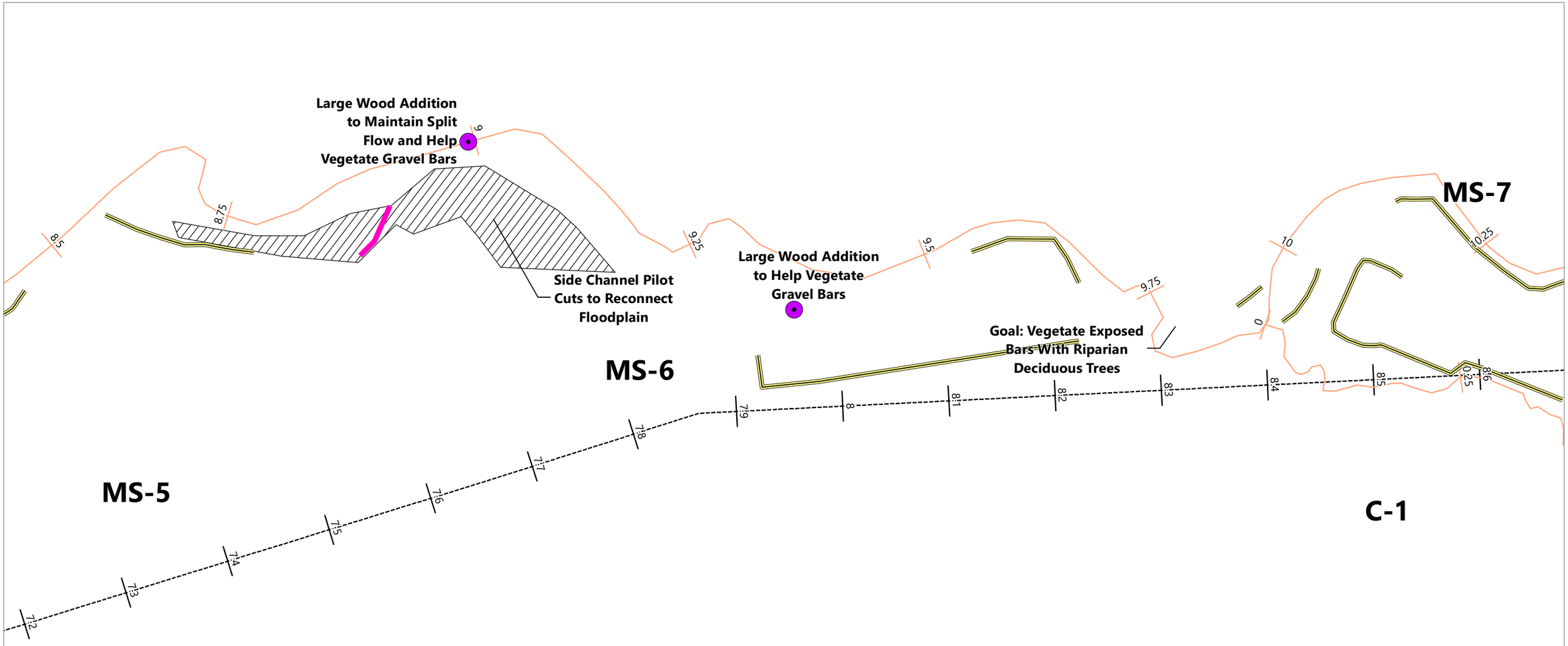
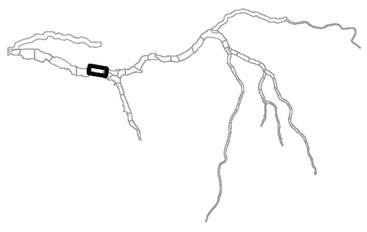
MS-5
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration





LEGEND:

- Delineated Levees
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain
- Riparian Enhancement

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 8.53
RIVER MILE END: 10.19
VALLEY MILE START: 7.41
VALLEY MILE END: 8.56

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MS-6
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Upper Mainstem Touchet Reach

Reach Description

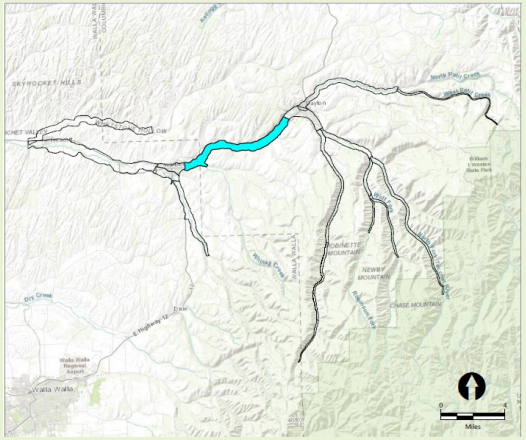
The Upper Mainstem Touchet reach runs from the downstream end of the Dayton levee to the upstream end of the Waitsburg levee. This reach includes seven project areas from MS-9 to MS-15. The minor tributary Whisky Creek enters the mainstem at the lower end of the reach on the left bank, providing the only minor hydrologic influx in the reach.

Floodplain and Riparian Area

Land use through the reach is characterized by agricultural fields and irrigation ditches in addition to private residences and a large rock quarry at Rose Gulch midway down the reach on the right bank. The reach also includes the forested Lewis and Clark Trail State Park. Much of the reach is confined by levees and steep valley walls, inducing long bedrock sections in MS-9, MS-10, and MS-13. Riparian vegetation through this corridor is dominated by large alders and cottonwoods with some scattered ponderosa pines. In some places, very little mature or established vegetation exists in the riparian area, with large unvegetated island complexes adjacent to the quarry in MS-14 and the state park in MS-12. The channel migration area is largely confined in this reach, but unconfined stretches of river exist in project areas MS-11, MS-13, and parts of MS-14.

Upper Mainstem Touchet

Vicinity Map



Reach Characteristics

River	Touchet River
Parent River	Walla Walla River
River Distance to Confluence (mi)	53.44
Valley Distance to Confluence (mi)	43.1
River Length (mi)	8.42
Valley Length (mi)	7.63
Sinuosity	1.14
Average Slope	0.61%
Delineated Project Areas	MS-9 to MS-15 (7)
Total Levee Length (mi)	7.65
Notable Tributaries	Whisky Creek

Channel Conditions

Observed channel complexity through most of this reach was low to moderate. Areas of high complexity and multiple side channels were noted in project areas MS-11, MS-12, and MS-14. MS-9 and MS-10 were highly confined between the valley wall on river left and agricultural and residential levees on river right. Instream wood in the reach was very low throughout, and significantly lower than the Lower Mainstem Touchet reach. There were no large jams in the entire reach, but scattered large wood was observed in the lower end of MS-14 and the upper end of MS-13, as well as a short section in lower MS-10. Two small engineered log jams and a submerged rock weir were observed at the downstream end of MS-10 in the section between Gallaher and Hogeye Hollow roads. The general lack of large woody material has led to poor in-channel complexity in most project areas and few large pools throughout the reach. Bedrock reaches were observed in MS-13 as the river abutted the valley wall on river right, forming multiple bedrock terraces and a deep pool in the bend. Nearly all of MS-9 and most of MS-10 were confined between levees on river right and the valley wall on river left, forming a bedrock reach with a long, linear plane-bed reach downstream adjacent to the gun range.

Influencing Anthropogenic Features

Agricultural and industrial uses including the quarry are the dominant land use types in the reach. Levees have been built to protect a variety of land uses including residences and recreational uses such as a gun range near Waitsburg and an RV park near Rose Gulch. More than 7.6 miles of levee protect both residential and agricultural infrastructure and fields. Levees and incision play a large role in the confinement of the reach, particularly in project areas MS-9, MS-10, MS-13, and MS-15 where the river has been confined to less than a bankfull width of floodplain and significantly straightened. Residential structures occur often in the disconnected floodplain and channel migration area and are at a high risk of impact from the river. Several of these residences were significantly impacted by flooding and erosion that occurred in spring of 2019 and 2020. Signs of emergency levees and riprap installed to protect these structures from past events are evident in several locations on the reach. Another notable anthropogenic impact is the irrigation ditch, which draws water from the right bank in MS-11, circumvents the Touchet Valley Airport, and returns to the river downstream in MS-10. The ditch diverts a significant amount of flow, and its discharge was far greater than any of the natural tributary creeks in the basin during summer low flow. Several bridges cross the river in this reach and likely influence the geomorphic processes through floodplain constriction, hydraulic backwater, and sediment transport continuity. These bridges include the following:

- Hogeye Hollow Road between project areas MS-9 and MS-10
- Gallaher Road in project area MS-10
- Highway 12 between project area MS-11 and MS-12

- Rose Gulch Road between project areas MS-13 and MS-14
- Ward Road in project area MS-15

Qualitative Factors and Reach Priority

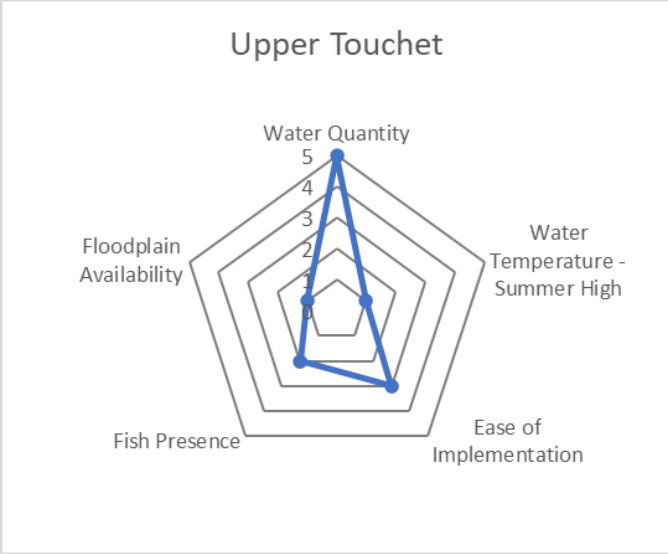
The Upper Mainstem Touchet reach falls in Reach Priority 3 (out of 3) for reaches included in the Touchet watershed prioritization framework. This Reach Priority ranking is for the Upper Mainstem Touchet reach as a whole; individual project areas within this reach may rank differently in the prioritization. This Reach Priority is meant to provide some overall insight into factors that are not considered in the project area prioritization and are likely very different between the reaches in this assessment.

Water Quantity

The mainstem of the Touchet River has significant flow during most of the hydrograph. This flow amount is enough to support multiple habitat units in a single cross section. Where low-lying floodplain is available, large areas can be inundated and swampy even at the lowest flows, as was observed during field site visits in 2019. The volume of flow in this reach also has high potential to cause geomorphic change and will likely respond quickly to restoration actions targeting side channels and split flows. This reach receives a score of 5 (out of 5) for water quantity.

Upper Mainstem Touchet

Qualitative Factors



Reach Score (_/5)	2.4
Reach Rank (_/9)	9
Reach Priority (_/3)	3
Primary Reach Concerns:	High Summer Temperatures Floodplain Availability

Low floodplain availability due to agricultural and residential infrastructure reduced the score in this reach. Although water quantity is high, high summer water temperatures above the threshold for salmonids also detracted from the score.

Summer High Water Temperatures

The mainstem of the Touchet River is widely regarded as being almost too warm for salmonid survivability. Temperature observations are not made in this reach, but in-channel temperatures are likely similar to those in the Lower Mainstem Touchet reach below Waitsburg, where sustained in-channel temperatures reach above 25°C between June and July for most years. Survivability for salmonids is likely limited to deep pools during the hottest months, and providing these temperature refugia should be a prominent target in restoration actions in this reach. This reach receives a score of 1 (out of 5) for high water temperatures.

Ease of Implementation

Land ownership in the Upper Mainstem Touchet reach is almost entirely private parcels (with the exception of Lewis and Clark State Park). While there are some larger parcels in this reach, there are also many other small parcels that include short stretches of the river. Landowner willingness to participate in restoration work is unknown, but gaining permission and access to multiple parcels presents a challenge for implementing larger projects. The Upper Mainstem Touchet reach does have many bridges and farm roads that would provide relatively easy access to the floodplain for construction equipment. This reach receives a score of 3 (out of 5) for ease of implementation.

Fish Presence

Several counts of juvenile fish use have been performed in this reach. Juvenile summer steelhead are shown to occasionally rear in this reach and a very small amount of yearling summer steelhead have also been documented. Adult steelhead are known to migrate through this reach and spawn throughout the mainstem Touchet River. This reach receives a score of 2 (out of 5) for fish presence.

Floodplain Availability

Much of the land use in the Upper Mainstem Touchet reach is engaged in agriculture practices; however, there are also many instances of infrastructure in or bordering the active floodplain. Unlike the Lower Mainstem Touchet reach, few areas within this reach have any riparian buffer, and residential or agricultural land use often immediately borders the active channel. These areas are often protected by levees or embankments that confine and limit the floodplain availability. In several areas, significant incision has also led to steep banks with little or no floodplain. Floodplain availability and high summer temperatures are the biggest concerns for restoration work in this reach. This reach receives a score of 1 (out of 5) for floodplain availability.

Summary of Restoration Strategies

The following restoration actions are recommended based on the above information, as well as field observations and the desktop analysis and prioritization results. While other restoration actions should be considered at a project implementation level, the following should all be considered for any project in this reach. Details on how these restoration actions might be applied on a project area level are provided in the next section.

Establish Channel Migration Area

Most of this reach lacks a substantial channel migration area, which provides room for natural geomorphic processes, flood inundation, and the establishment of riparian vegetation. While these areas often require additional restoration due to lack of instream complexity and established vegetation, an established channel migration area provides an excellent first step for restoration of natural processes. Over time, these channel migration areas often suffer from the creep of development or the establishment of new fields. In addition, particularly large floods may prompt the construction of new levees that protect established fields and infrastructure, which can impinge on this channel migration area and limit the natural geomorphic and ecological processes.

Therefore, protection against future development and confinement should be a high priority among restoration actions in reaches where channel migration areas currently exist. These protections can involve the establishment of setback levees to protect against future migration or flooding outside of this channel migration area, along with legal protections and easements against further development. Limiting bank erosion and avulsions with placement of large woody material can help to establish these boundaries.

Establish Riparian Vegetation

While there are several sections of this reach that have an established channel migration area, most of these sections have very little established or mature vegetation. Riparian vegetation has been shown to be critical to ecological and geomorphic processes. For this reach, riparian vegetation is critically needed to provide a renewable and constant source of instream wood, as well as to provide overhanging cover and shade. The need for shade and vegetation to combat high summer water temperatures is especially important in large unvegetated gravel bars in the MS-14 quarry reach where the channel abuts sheer south-facing cliffs that radiate summer heat.

Establishing mature stands of vegetation in the immediate riparian area, channel migration areas, and island complexes should be a restoration target for this reach. Restoration actions should target establishing vegetated gravel bars and may require stabilizing features such as large apex engineered log jams. Additionally, restoration actions should seek to

establish stands of riparian species in locations where the floodplain has been reconnected through restoration and active channel migration.

Add Instream Wood and Complexity

This entire section is characterized by low amounts of in-channel large woody material. Minimal instream wood is present, and the reach lacks wood-forced scour pools and geomorphic complexity. As in many systems, large wood in this reach is a key part of the geomorphic and ecological processes. However, most of the project areas in this reach lack the volume of large woody material necessary to initiate these processes. A lack of planform and in-channel complexity was observed in most of the project areas in this reach, and all project areas had some sections that lacked channel complexity associated with instream wood.

Adding large woody material in strategic locations that will most benefit the natural processes should be a primary restoration action in all project areas in this reach. Instream wood should be placed primarily to help restore the geomorphic processes that result in side channel formation, split flow and vegetated gravel bar building, sediment storage, channel aggradation, and pool formation. In addition, large wood can be placed to provide in-channel complexity and habitat, as well as hardpoints against erosion in places where critical infrastructure must be protected. Using large wood to deter erosion at the edge of the aforementioned channel migration areas should be considered as a way to establish boundaries against further development.

The use of engineered log jams to store sediment should be emphasized in the bedrock sections of this reach. Linear confinements have incised the channel in multiple locations, especially in MS-9 and MS-13. Lack of alluvium presents a challenge for installing robust engineered log jams, but alternatives exist to construct non-pile supported engineered log jams in bedrock reaches to promote sediment storage. For optimal results, sediment storage structures should be coupled with levee removal and setbacks, to reverse the incision process.

Remove Confinement (Encroachments and Incision)

All seven project areas in the Upper Mainstem Touchet reach have some impacts from levees and other encroachments including five major road bridges. In several sections of this reach, particularly in project areas MS-9, MS-10, and MS-13, the channel has incised and is confined to the point of running on bedrock. The analysis results for connectivity (provided in the next section) demonstrate the effects of levees and incision on available floodplain. In addition, the analysis results for excess transport capacity demonstrate that confinement of the channel and floodplain leads to increased sediment transport capacity for the project areas within this reach.

Providing room for the river to actively migrate and inundate is vital to the natural processes in the reach and will have a large effect on the success of the other restoration actions listed. Where possible, levees and encroachments should be removed or set back to reconnect low-lying floodplain and relic side channels. Incised channels should be targeted for sediment deposition and floodplain benching to reconnect these areas.

Tier 1

Project Areas in the Upper Mainstem Touchet Reach

Project Area MS-9

River Length (mi)	1.26
Valley Length (mi)	0.88
Sinuosity	1.43
Average Slope	0.54%
Total Levee Length	0.82
Project Area Score	2.8
Basin Rank	18
Connectivity Score	0.21
Encroachment Removal Potential	13%
Aggradation Potential	21%
Total Potential	39%
2-year Connected Area (ac/rm)	16.7
Total Potential Area (ac/rm)	10.84
Complexity Score (SCE)	0.10
Excess Transport Capacity (psf)	0.001

Recommended Restoration Actions

- Remove or set back levees through VM 10.4 to VM 10.7 and VM 11.0 to VM 11.1
- ELJs to promote aggradation and sinuosity in straight bedrock reaches
- Pilot channel cuts to reconnect side channels

Project Area MS-10

River Length (mi)	1.40
Valley Length (mi)	1.41
Sinuosity	0.99
Average Slope	0.55%
Total Levee Length	1.2
Project Area Score	3.8
Basin Rank	5
Connectivity Score	0.24
Encroachment Removal Potential	26%
Aggradation Potential	3%
Total Potential	65%
2-year Connected Area (ac/rm)	16.6
Total Potential Area (ac/rm)	30.66
Complexity Score (SCE)	0.11
Excess Transport Capacity (psf)	0.326

Recommended Restoration Actions

- Remove or set back levees through VM 11.1 to VM 11.4 and VM 12.1 to VM 12.5
- Add large woody material to promote in-channel complexity

Project Area MS-12

River Length (mi)	1.28
Valley Length (mi)	1.33
Sinuosity	0.96
Average Slope	0.59%
Total Levee Length	0.79
Project Area Score	3.8
Basin Rank	4
Connectivity Score	0.33
Encroachment Removal Potential	47%
Aggradation Potential	3%
Total Potential	64%
2-year Connected Area (ac/rm)	28.7
Total Potential Area (ac/rm)	51.22
Complexity Score (SCE)	0.20
Excess Transport Capacity (psf)	0.092

Recommended Restoration Actions

- Remove or breach levees through VM 13.4 to VM 13.5
- ELJs to stabilize existing split flow and maintain existing complexity

Tier 1

Project Areas in the Upper Mainstem Touchet Reach

Project Area MS-13

River Length (mi)	0.67
Valley Length (mi)	0.67
Sinuosity	1.01
Average Slope	0.65%
Total Levee Length	1.10
Project Area Score	3.8
Basin Rank	3
Connectivity Score	0.23
Encroachment Removal Potential	16%
Aggradation Potential	20%
Total Potential	42%
2-year Connected Area (ac/rm)	24.9
Total Potential Area (ac/rm)	18.41
Complexity Score (SCE)	0.36
Excess Transport Capacity (psf)	0.103

Recommended Restoration Actions

- Remove or breach levees through VM 14.5 to VM 15.1
- ELJs to promote aggradation and sinuosity in straight bedrock reaches
- Pilot channel cuts to reconnect side channels

Project Area MS-14

River Length (mi)	1.59
Valley Length (mi)	1.42
Sinuosity	1.12
Average Slope	0.69%
Total Levee Length	1.33
Project Area Score	3.2
Basin Rank	11
Connectivity Score	0.21
Encroachment Removal Potential	24%
Aggradation Potential	7%
Total Potential	42%
2-year Connected Area (ac/rm)	25.8
Total Potential Area (ac/rm)	19.02
Complexity Score (SCE)	0.32
Excess Transport Capacity (psf)	-0.168

Recommended Restoration Actions

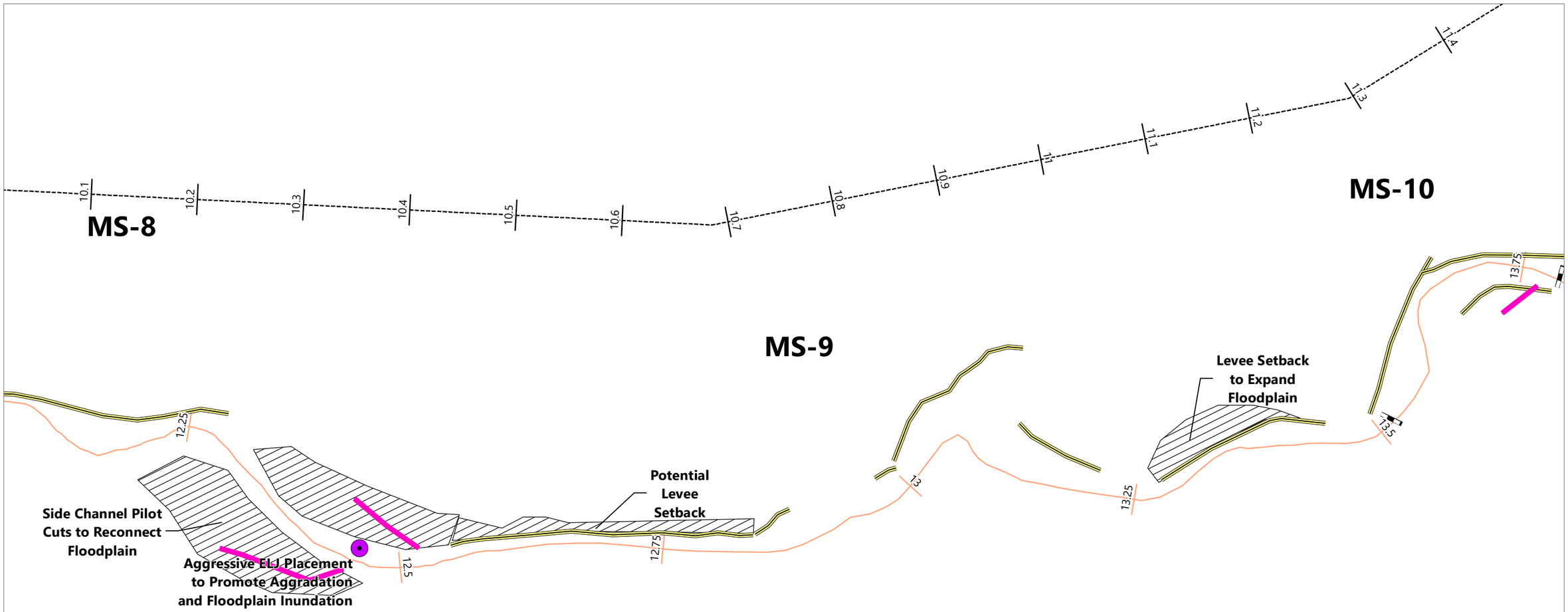
- ELJs to help vegetate large gravel bars
- Add large woody material to promote in-channel complexity
- Remove or set back levees through VM 15.2 to VM 15.6 and VM 16.4 to VM 16.6

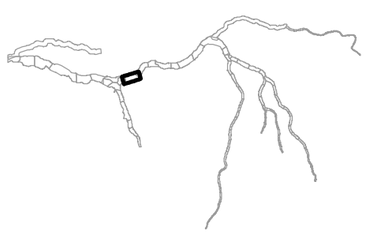
Project Area MS-15

River Length (mi)	1.36
Valley Length (mi)	1.31
Sinuosity	1.03
Average Slope	0.61%
Total Levee Length	1.88
Project Area Score	3.4
Basin Rank	7
Connectivity Score	0.21
Encroachment Removal Potential	22%
Aggradation Potential	4%
Total Potential	52%
2-year Connected Area (ac/rm)	19.1
Total Potential Area (ac/rm)	20.88
Complexity Score (SCE)	0.17
Excess Transport Capacity (psf)	0.184

Recommended Restoration Actions

- Remove or set back levees through VM 16.6 to VM 16.9 and VM 17.3 to VM 17.8
- ELJs to promote aggradation and sinuosity in straight bedrock reaches
- ELJs to vegetate large gravel bars





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 12.3
RIVER MILE END: 13.56
VALLEY MILE START: 10.29
VALLEY MILE END: 11.17

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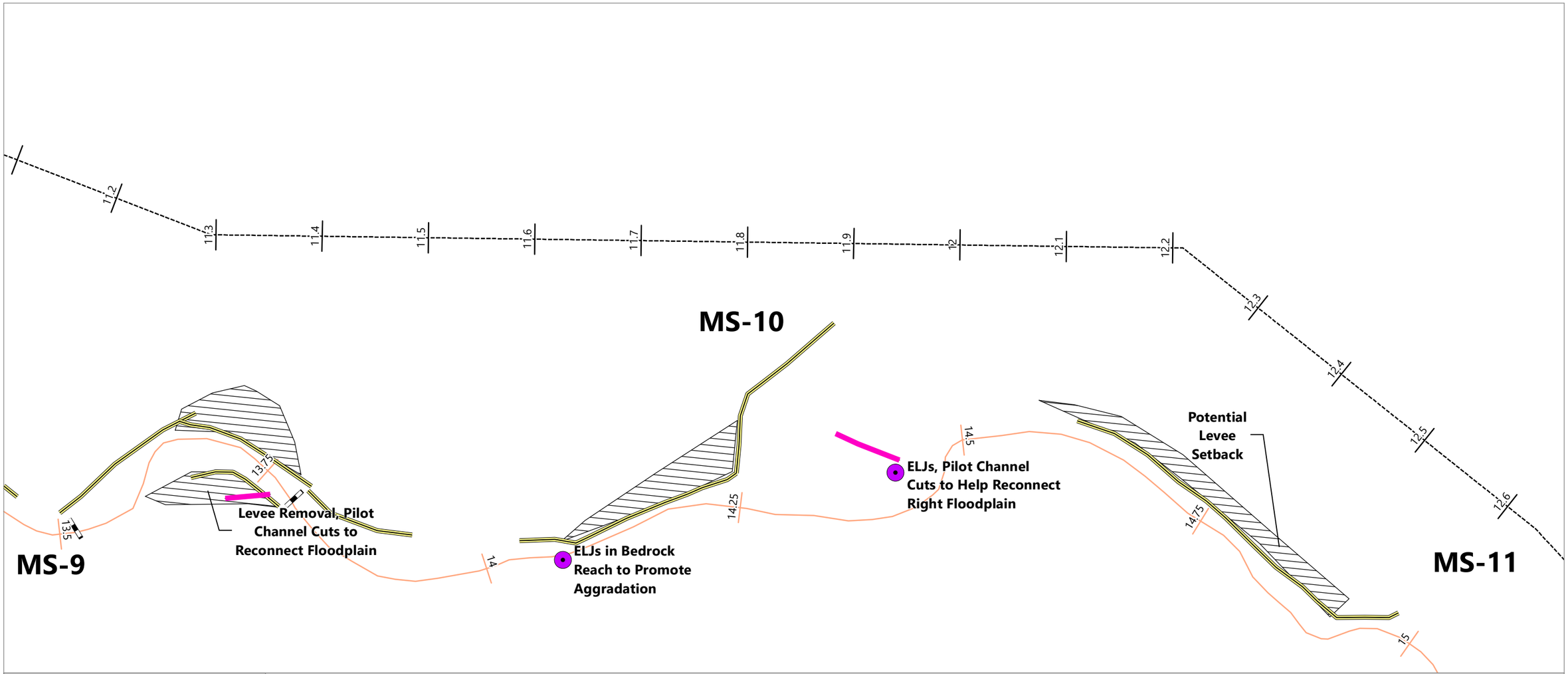
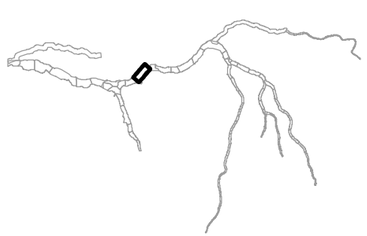
MS-9
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 13.56
RIVER MILE END: 14.95
VALLEY MILE START: 11.17
VALLEY MILE END: 12.58

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Feet

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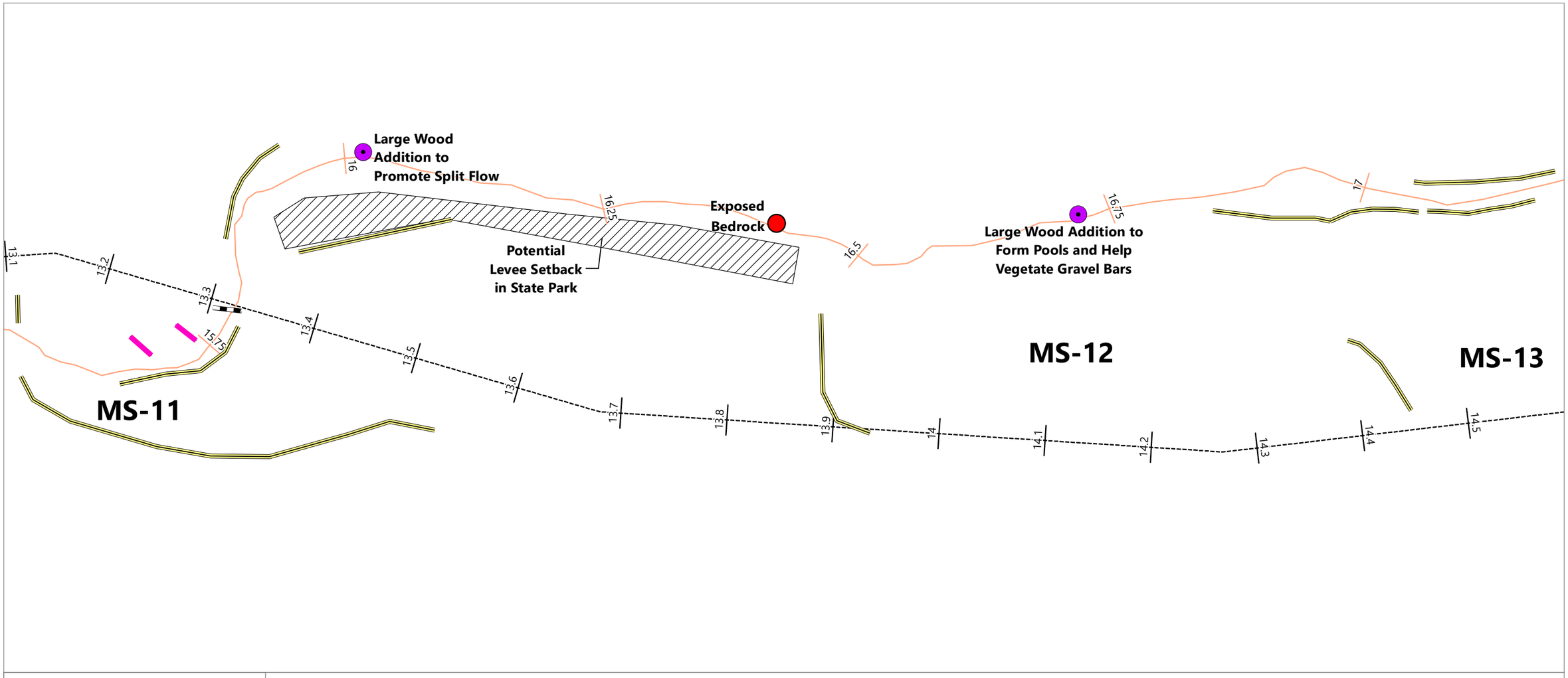
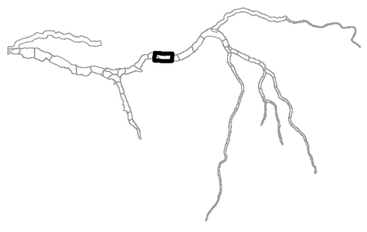
MS-10
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain
- Placemark

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

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VALLEY MILE START: 13.19
VALLEY MILE END: 14.52

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MS-12
Conceptual Restoration Map
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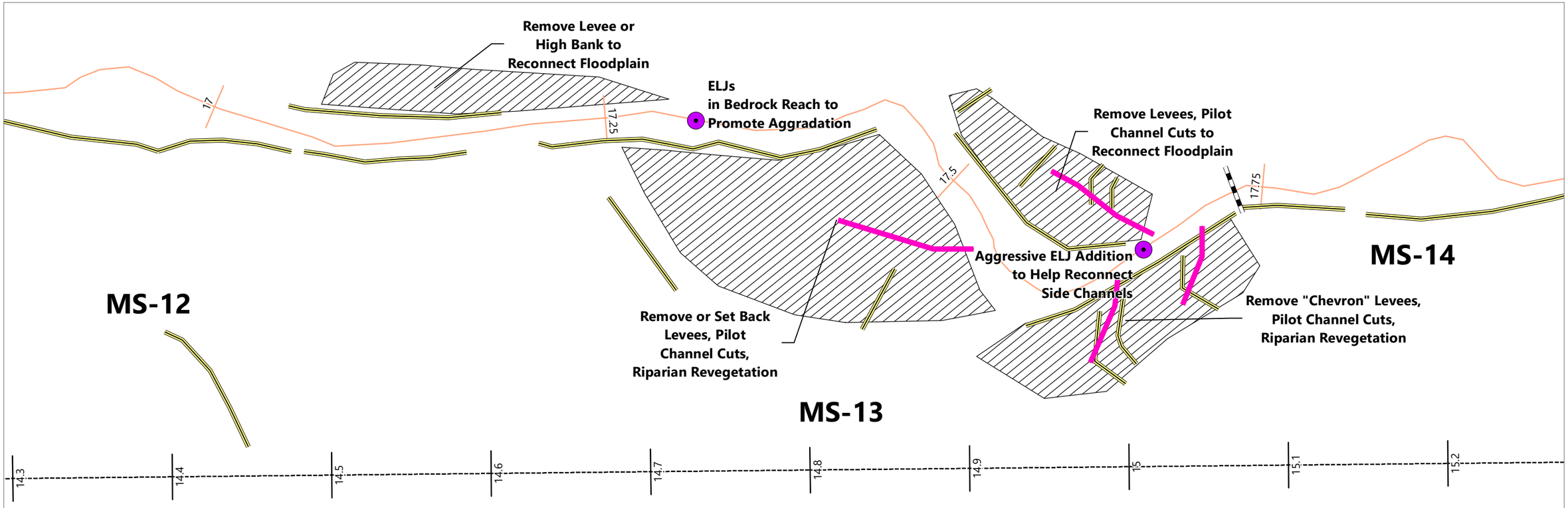
Touchet River Conceptual Restoration



LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

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5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 17.1
RIVER MILE END: 17.77
VALLEY MILE START: 14.52
VALLEY MILE END: 15.18

0 500
Feet

Publish Date: 2020/09/02, 10:30 AM | User: thutchison
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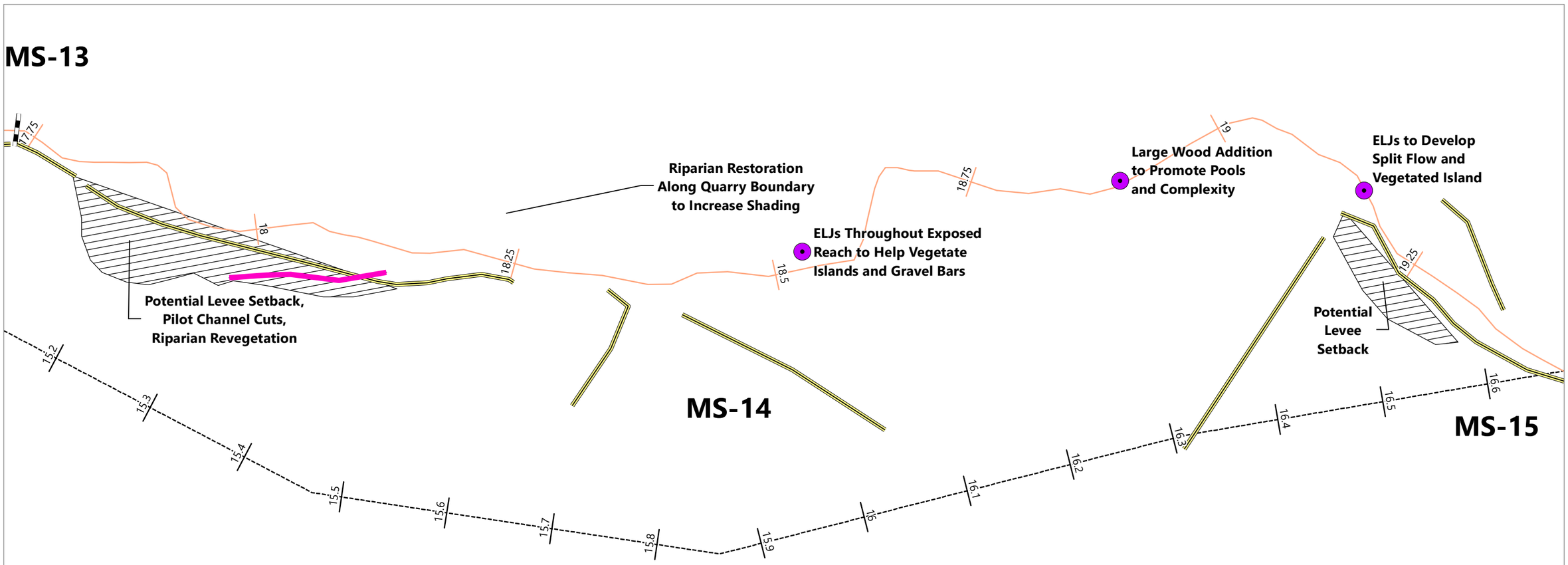
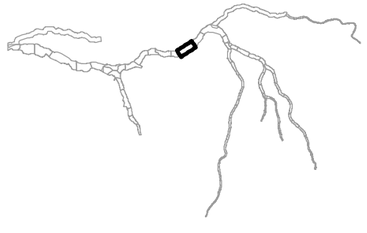
MS-13
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain
- Riparian Enhancement

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 17.77
RIVER MILE END: 19.36
VALLEY MILE START: 15.18
VALLEY MILE END: 16.61

0 500
Feet

Publish Date: 2020/09/02, 10:31 AM | User: thutchison
Filepath: Q:\Jobs\Columbia_Conservation_District_0687\Touchet River Conceptual Restoration\Working\TAH\Conceptual Restoration Maps\Touchet Conceptual Restoration Maps.mxd

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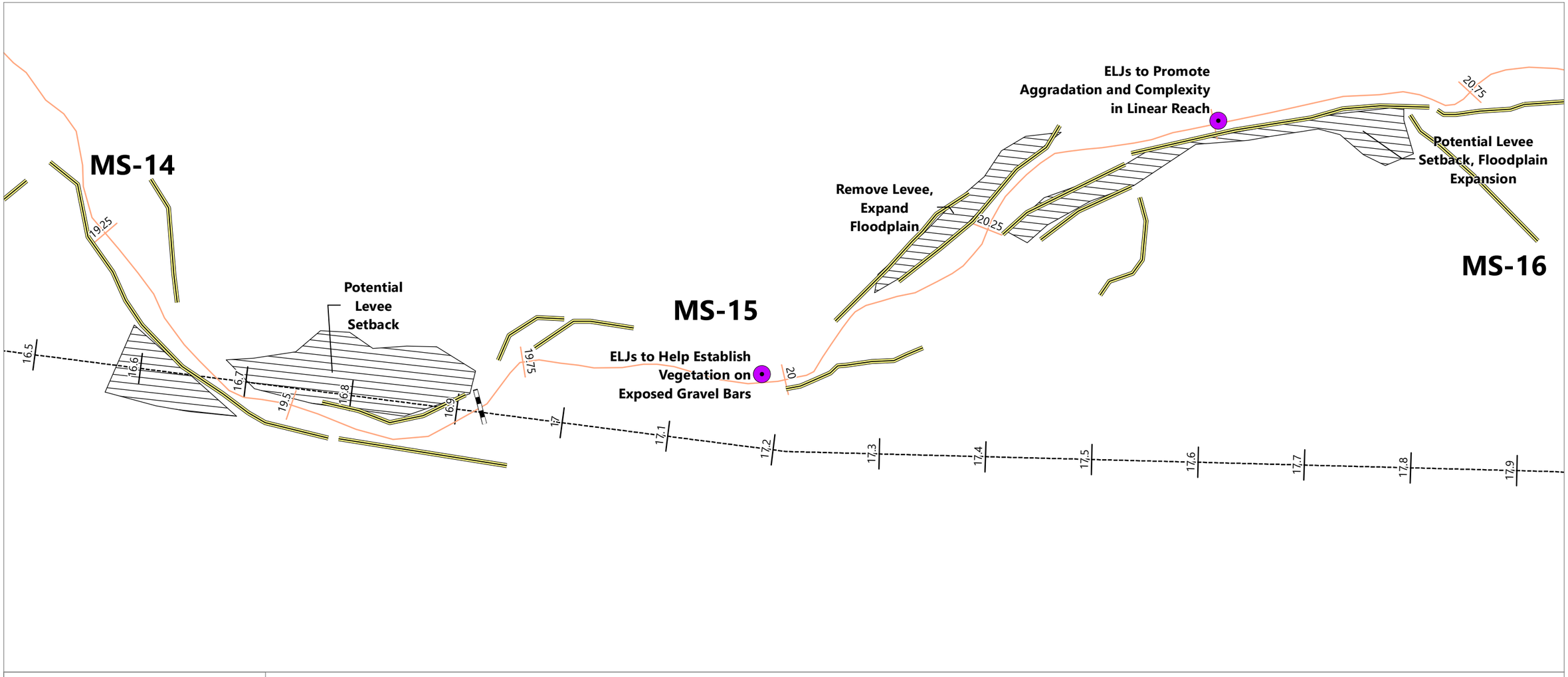
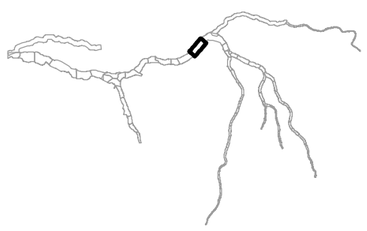
MS-14
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 19.36
RIVER MILE END: 20.72
VALLEY MILE START: 16.61
VALLEY MILE END: 17.92

0 500
Feet

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MS-15
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Tier 2

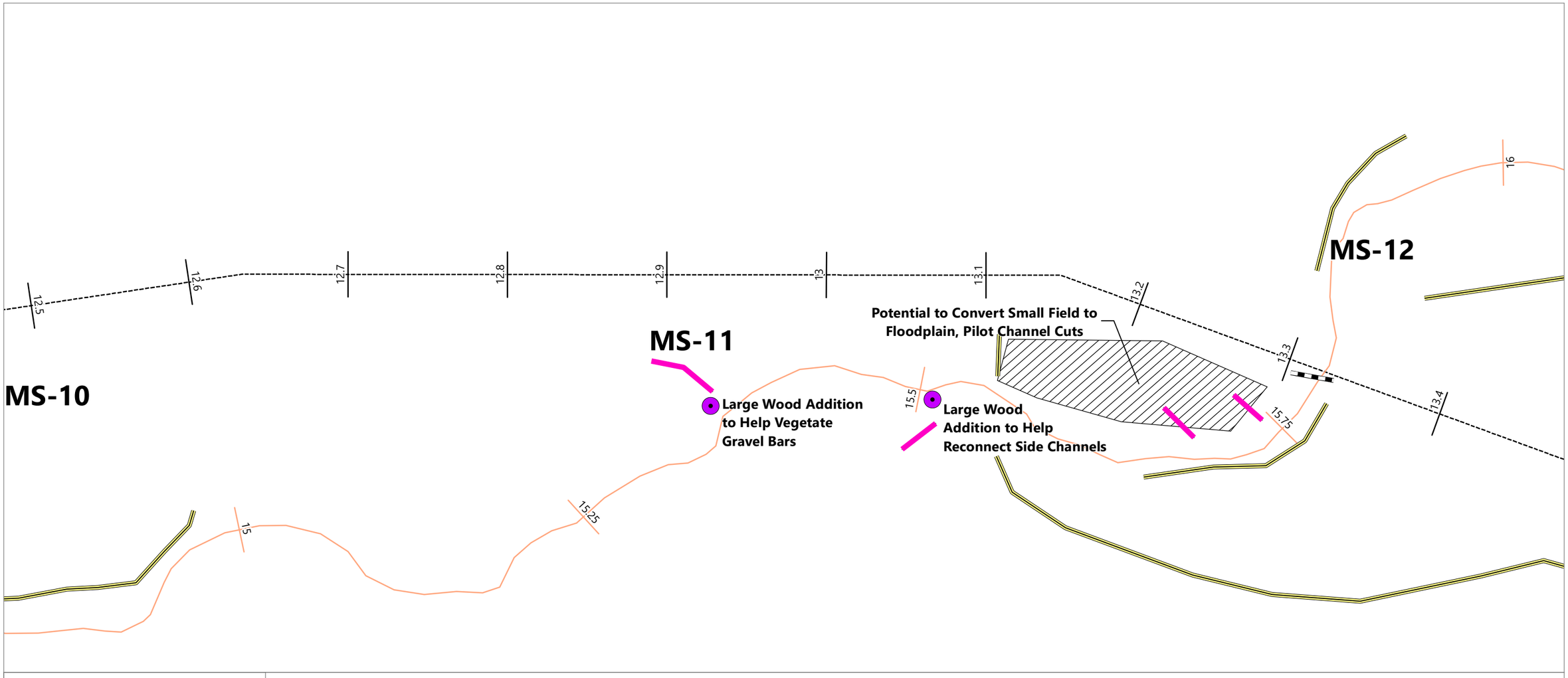
Project Areas in the Upper Mainstem Touchet Reach

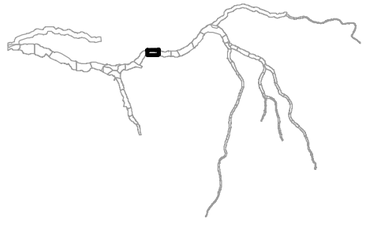
Project Area MS-11

River Length (mi)	0.87
Valley Length (mi)	0.60
Sinuosity	1.44
Average Slope	0.60%
Total Levee Length	0.55
Project Area Score	1.8
Basin Rank	35
Connectivity Score	0.18
Encroachment Removal Potential	10%
Aggradation Potential	14%
Total Potential	41%
2-year Connected Area (ac/rm)	24.9
Total Potential Area (ac/rm)	17.58
Complexity Score (SCE)	0.57
Excess Transport Capacity (psf)	0.093

Recommended Restoration Actions

- ELJs to promote split flow and help vegetate gravel bars
- Pilot channel cuts to reconnect side channels





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 14.95
RIVER MILE END: 15.82
VALLEY MILE START: 12.58
VALLEY MILE END: 13.19

0 500
Feet

Publish Date: 2020/09/02, 10:30 AM | User: thutchison
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MS-11
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Upper Coppei Creek Reach

Reach Description

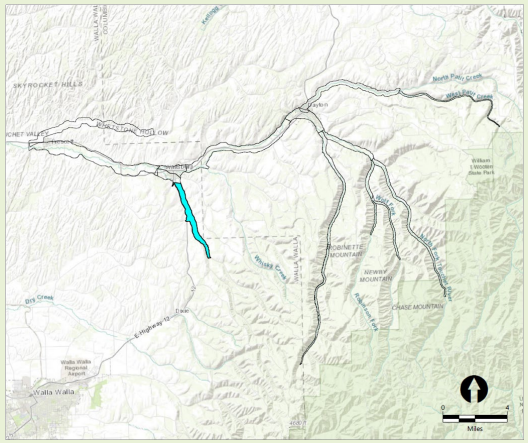
The Upper Coppei Creek reach runs from the confluence of the North Fork and South Fork of Coppei Creek to the Meinberg Road bridge on the southern outskirts of Waitsburg. This reach includes five project areas from C-3 to C-7. No significant tributaries enter the creek in this reach, and the North Fork and South Fork of Coppei Creek feed the reach. The creek flows through agricultural fields within a small riparian strip and parallels Highway 12 throughout the reach.

Floodplain and Riparian Area

Land use through most of the reach is characterized by agricultural fields and a few rural residences with occasional associated agricultural infrastructure such as barns. The riparian buffer is narrow, and the creek is highly incised and linear with a few exceptions in the upstream project areas. Much of the riparian buffer is within the CREP program and is dominated by planted ponderosa pines with black erosion and weed protection matting covering the soil. Within the incised creek channel, invasive reed canarygrass dominates the immediate riparian vegetation with a few areas of native alders and cottonwoods. In some locations the abundance of grass also appeared to promote siltation of fine sediment, and greater turbidity was observed in the areas that were choked with reed canarygrass. Much of the reach lacks adequate shade. Field

Upper Coppei Creek

Vicinity Map



Reach Characteristics

River	Coppei Creek
Parent River	Touchet River
River Distance to Confluence (mi)	2.20
Valley Distance to Confluence (mi)	1.71
River Length (mi)	5.91
Valley Length (mi)	5.10
Sinuosity	1.16
Average Slope	1.26%
Delineated Project Areas	C-3 to C-7 (5)
Total Levee Length (mi)	3.86
Notable Tributaries	North and South Forks Coppei Creek

surveys confirmed C-3, C-5, and C-6 are highly incised and isolated from the floodplain, and the relative elevation map suggests the same pattern for all the project areas except C-7.

Channel Conditions

Observed channel complexity through most of this reach was extremely low. The channel was confined by levees and systematic incision to a steeply sloped ditch with the water surface elevation 5 to 15 feet below the floodplain elevation for most of project areas C-3 to C-6. The anomaly is a long split flow in C-7 that spans most of the project area and a shorter split flow section at the downstream end of C-6. Instream wood in the reach was low throughout, with the exception of a channel-spanning jam midway through C-6 and some beaver-caused jams at the downstream end of C-3. The massive channel-spanning jam in C-6 traps most of the sediment load from upstream, causing a quarter-mile long bedrock reach just downstream of the jam. Bedrock reaches were observed frequently during the field survey. It is expected that the whole reach is afflicted by scouring to bedrock and lack of coarse sediment retention. Suitable pool habitat is infrequent due to the lack of instream wood and sinuosity. The healthiest geomorphic conditions in the reach were observed at the downstream end of project area C-3. Channel width, complexity, and sediment storage increased in this section but the flow was intermittent and went subsurface through gravel bars during the observed low flow conditions. Some salmonids were observed concentrated in these isolated stagnant pools.

Influencing Anthropogenic Features

Agriculture plays a major role in this section of Coppei Creek and is the cause of most influencing features. More than 3.7 miles of levees protect agricultural infrastructure and fields. Levees and riprap play a large role in the confinement of the reach, but the reach became systemically incised as a result of historical channelization. Highway 12 is another significant structure that confines the left bank floodplain at the downstream end of the reach, forcing a sheer, eroding cliff at least 20 feet tall on the left bank. Currently there are no residential structures in the active floodplain and channel migration area for most of the creek. At the downstream end of C-3, the channel becomes level with the floodplain, providing an opening for the creek to flood fields, residences, and the city fairgrounds. Road bridges and gravel road stream fords represent important sources of confinement and fine sediment, respectively. Several bridges cross the river in this reach and likely influence the geomorphic processes through floodplain constriction, hydraulic backwater, and sediment transport continuity. These bridges and crossings include the following:

- Meinberg Road at the downstream end of project area C-3
- Mccown Road between project areas C-4 and C-5
- Private bridges in project areas C-3 and C-4
- Gravel road fords in project areas C-3 and C-6

Qualitative Factors and Reach Priority

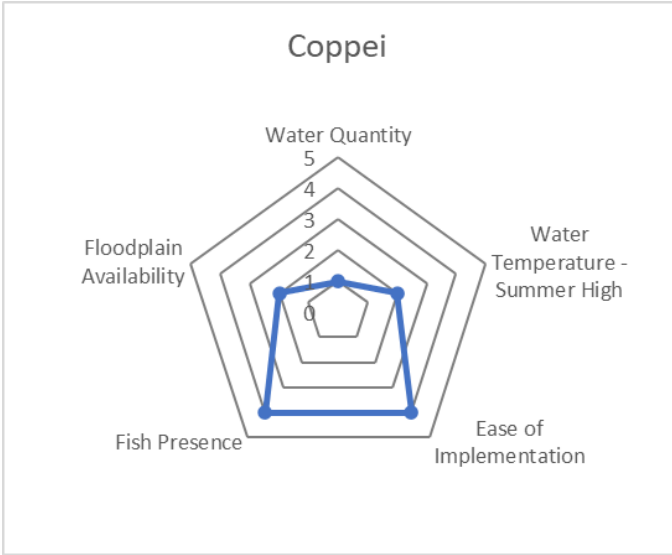
The Upper Coppei Creek reach falls in Reach Priority 3 (out of 3) for reaches included in the Touchet watershed prioritization framework. This Reach Priority ranking is for the Upper Coppei Creek reach as a whole; individual project areas within this reach may rank differently in the prioritization. This Reach Priority is meant to provide some overall insight into factors that are not considered in the project area prioritization and are likely very different between the reaches in this assessment.

Water Quantity

Coppei Creek is a smaller tributary to the mainstem Touchet River with confluence in the city of Waitsburg; as such, it carries much lower flows than most of the other reaches in this assessment. Despite the lower flows, Coppei Creek is not known to go completely subsurface for a significant time or distance. This amount of flow typically only supports one habitat condition in a typical cross section and is unlikely to have side channels or inundated floodplain during low flows. Where low-lying floodplain is available, inundation does happen during spring freshet and higher flow events. These higher flows are also likely enough to initiate geomorphic change when suitable sediment material and floodplain are available. Water quantity is the biggest concern for Coppei Creek, with a score of 1 (out of 5).

Upper Coppei Creek

Qualitative Factors



Reach Score (_/5)	2.6
Reach Rank (_/9)	8
Reach Priority (_/3)	3
Primary Reach Concerns:	Water Quantity Floodplain Availability High Summer Temperatures

This reach scored poorly because the channel is systemically incised and intensive measures would be required to recover floodplain. Low summer discharge and high water temperatures also limit salmonid populations.

Summer High Water Temperature

No exact temperature data are available for Coppei Creek, but during the highest temperature months much of Coppei Creek is likely too warm for adult salmonids. However, pocket locations of deep pools, overhanging banks and vegetation, and cold groundwater inputs do exist where conditions are survivable year-round, and providing these temperature refugia should be a prominent target in restoration actions in this reach. Coppei Creek receives a score of 2 (out of 5) for summer high water temperatures.

Ease of Implementation

Land ownership in the Upper Coppei Creek reach is generally characterized as being large, private parcels. Landowner willingness to participate in restoration work is unknown, but fewer parcels in this reach means that projects that extend for longer reaches could be completed. Additionally, the Upper Coppei Creek reach has many bridges and farm roads that would provide relatively easy access to the floodplain for construction equipment. This reach receives a score of 4 (out of 5) for ease of implementation.

Fish Presence

Several counts of juvenile fish use have been performed in this reach. Juvenile summer steelhead are shown to occasionally rear in this reach and a very small amount of yearling summer steelhead have also been documented. Adult steelhead are known to migrate through this reach and spawn throughout Coppei Creek. This reach receives a score of 4 (out of 5) for fish presence.

Floodplain Availability

Much of the land use in the Coppei Creek basin is engaged in agriculture practices, and while there are a few instances of infrastructure in or bordering the active floodplain most areas have a strip of riparian planting and buffer. However, much of Coppei Creek is highly incised, and often times the active channel is limited to even more narrow spaces than these riparian buffers. In other areas where little riparian buffer exists, the channel is either confined by embankment or incised such that little floodplain area is available for inundation or geomorphic change. Some small pockets of larger riparian area are the exception to this trend and exist mostly in the upstream end of the Upper Coppei Creek reach. This reach receives a score of 2 (out of 5) for floodplain availability.

Summary of Restoration Strategies

The following restoration actions are recommended based on the above information, as well as field observations and the desktop analysis and prioritization results. While other restoration actions should be considered at a project implementation level, the following should all be considered for any project in this reach. Details on how these restoration actions might be applied on a project area level are provided in the next section.

Establish Riparian Vegetation

One of the primary factors contributing to the decline in habitat quality in this reach of Coppei Creek is the lack of a mature deciduous canopy to provide shade and woody material to promote beneficial geomorphic processes. Unfortunately, one of the primary barriers to establishing a healthy riparian zone is the infestation of reed canarygrass that prevents natural re-seeding of exposed areas. The CREP plantings have been successful in the surrounding floodplain, but planting and seeding of native deciduous trees such as willows and alders within the active channel should be a targeted restoration action. These planting efforts could be augmented with reed canarygrass removal measures such as mechanical removal, herbicide, or weed control matting. Establishment of healthier riparian ecosystem would help create shade, pools, and cover. Removal of the invasive grass may benefit water quality by reducing siltation, and water quantity by removing the water-thirsty grass.

Add Instream Wood and Complexity

Excluding a few notable jams, much of this section is characterized by relatively low amounts of in-channel large woody material and a lack of flow structure diversity and sinuosity. At the downstream end of the reach, instream wood is more prevalent and provides pools and cover for fish. Due to the lack of a mature riparian canopy, this reach is incapable of generating enough woody debris to promote geomorphic change. In a naturally incised channel, bank failure adds large wood to the channel, promoting aggradation, and a new active floodplain is formed below the former floodplain terrace as part of the channel evolution model. Large wood should be added to this reach of Coppei Creek to add instream complexity and, in areas were floodplain expansion is acceptable, expedite this process and help establish a new floodplain and channel migration area.

Adding large woody material in strategic locations that will most benefit natural processes should be a primary restoration action in all project areas in this reach. Instream wood should be placed to form instream habitat structures and where possible to help restore the geomorphic processes that result in formation of meanders, sediment storage, channel aggradation and pool formation. Large wood structures on the scale of the

naturally existing channel-spanning jam in C-6 can be installed downstream of multiple bedrock reaches to help promote aggradation and storage of coarse sediment. Together these wood additions will help develop channel complexity and sinuosity, provide increased pool habitats, and help reverse the detrimental incision in the reach.

Remove Confinement (Encroachments and Incision)

All five project areas in Coppei Creek have some impacts from levees and other confining structures such as riprap. The channel is significantly incised and confined to the point of running on bedrock throughout this reach. Unfortunately, because the current channel is so far below the former floodplain, the analysis results for connectivity (provided in the next section) reveal that removal of many of these levees may have little effect on the connectivity of the creek. The results from this analysis should be used to prioritize the setback and removal of levees that would increase connectivity during frequent flood events. Other restoration actions intended to combat incision will render these levee removals more effective and help reconnect former floodplain features.

Create Inset Floodplain

Providing room for the river to actively migrate and inundate is vital to the natural processes in the reach. Where possible, removing levees and encroachments should be the priority action to reconnect low-lying floodplain and relic side channels. However, in some locations, incision from encroachments and channelization may have progressed past the point where removing these encroachments is likely to provide a geomorphic response in a realistic timeframe.

In these cases, other options for adding riparian area should be considered. Floodplain benching should be considered as a restoration action to increase connected floodplain area in locations where incision is so great that channel aggradation is not a realistic option, as may be the case in several project areas of the Upper Coppei Creek reach. As noted above, in a naturally incised channel, bank failure adds large wood to the channel, promoting aggradation, and a new active floodplain is formed below the former floodplain terrace as part of the channel evolution model. The action of floodplain benching essentially moves the channel to a later stage of the stream evolution model to a state where more ecosystem benefits are provided. However, while this method provides hydraulic connection within the inset floodplain, it will not raise the groundwater table in the surrounding area. Additionally, because of the earth moving involved, this can potentially be a high-cost restoration action. Riparian vegetation establishment and adding instream wood will be vital restoration actions to accompany floodplain benching in order to ensure natural processes are restored.

Tier 1

Project Areas in the Upper Coppei Creek Reach

Project Area C-3

River Length (mi)	1.24
Valley Length (mi)	1.04
Sinuosity	1.20
Average Slope	1.02%
Total Levee Length	1.28
Project Area Score	2.8
Basin Rank	17
Connectivity Score	0.50
Encroachment Removal Potential	77%
Aggradation Potential	2%
Total Potential	93%
2-year Connected Area (ac/rm)	4.3
Total Potential Area (ac/rm)	59.59
Complexity Score (SCE)	0.10
Excess Transport Capacity (psf)	0.092

Recommended Restoration Actions

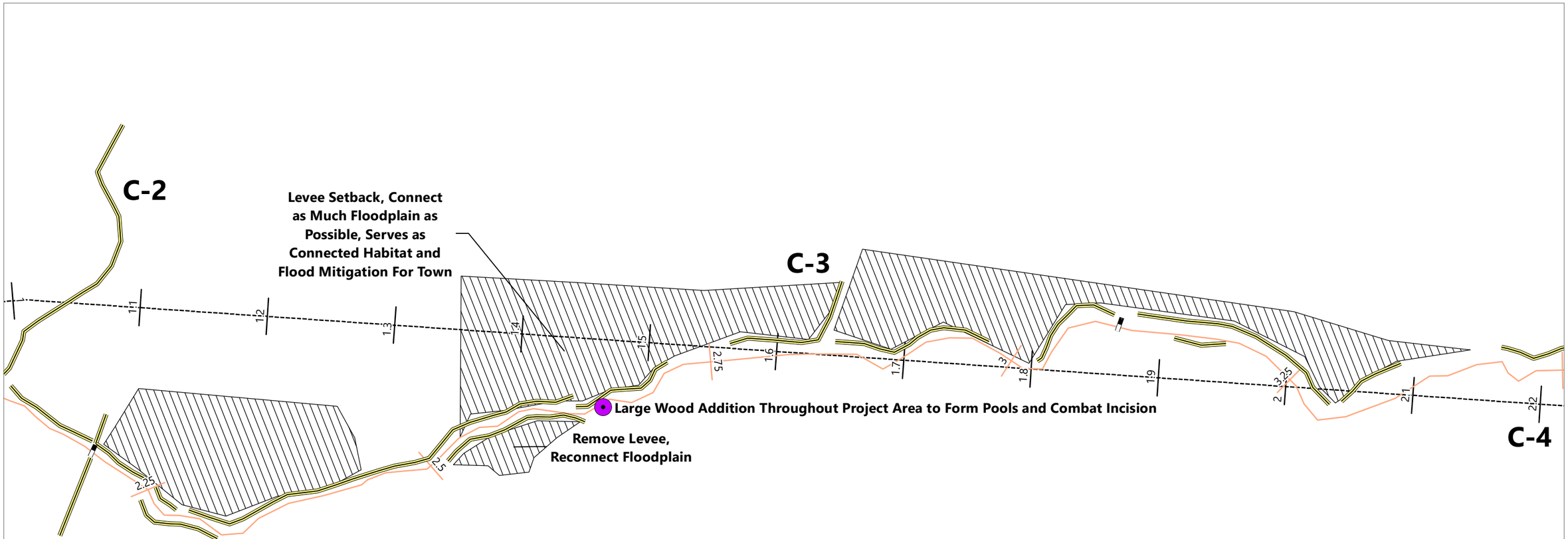
- Remove or set back levees through VM 1.1 to VM 2.1
- Add large woody material to promote in-channel complexity and deeper pools

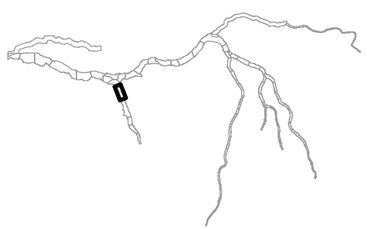
Project Area C-7

River Length (mi)	1.08
Valley Length (mi)	0.91
Sinuosity	1.19
Average Slope	1.37%
Total Levee Length	0.85
Project Area Score	3.2
Basin Rank	10
Connectivity Score	0.24
Encroachment Removal Potential	9%
Aggradation Potential	32%
Total Potential	37%
2-year Connected Area (ac/rm)	6.6
Total Potential Area (ac/rm)	3.86
Complexity Score (SCE)	0.42
Excess Transport Capacity (psf)	-0.249

Recommended Restoration Actions

- ELJs to stabilize left side channel gravel bars and promote establishment of riparian vegetation
- Establish riparian vegetation in left channel of split flow via planting





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 2.2
RIVER MILE END: 3.44
VALLEY MILE START: 1.71
VALLEY MILE END: 2.74

0 500
Feet

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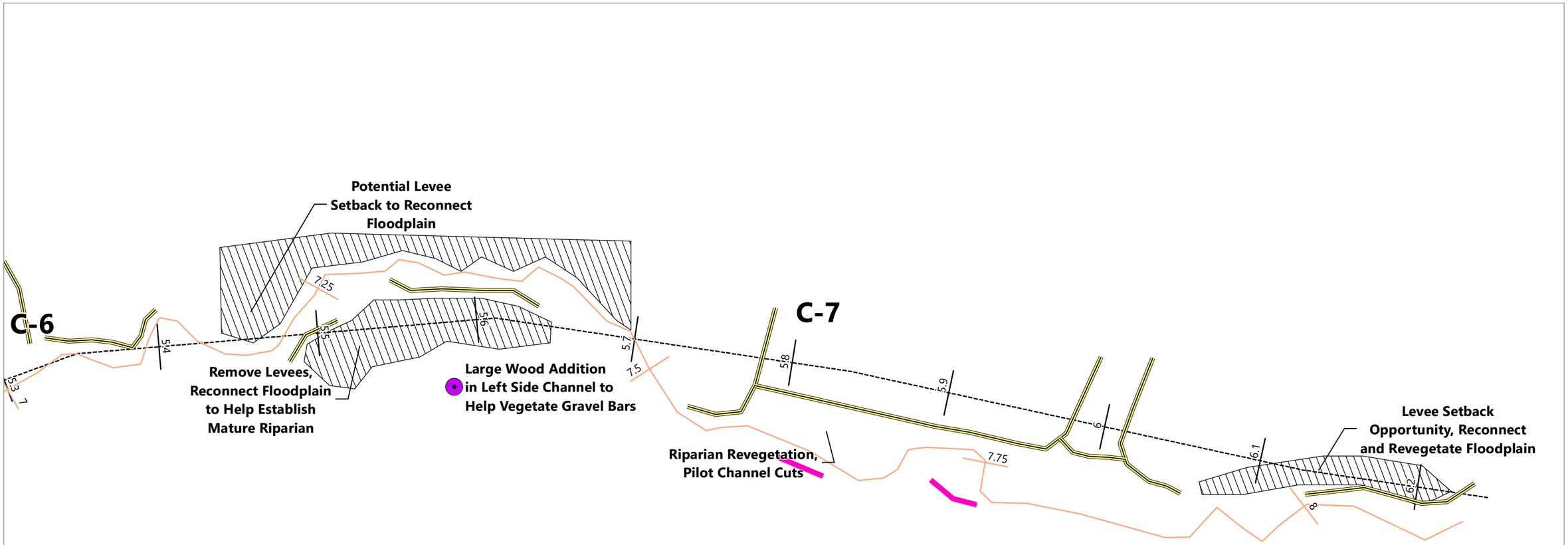
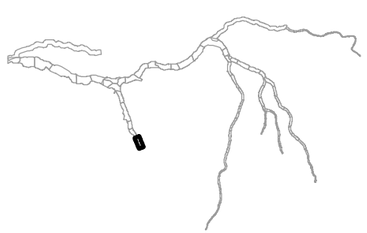
C-3
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration





LEGEND:

- Delineated Levees
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain
- Riparian Enhancement

Relative Elevation in Feet

- Touchet River Centerline By Fork
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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 7.02
RIVER MILE END: 8.1
VALLEY MILE START: 5.9
VALLEY MILE END: 6.81

0 500
Feet

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C-7
Conceptual Restoration Map
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Tier 3

Project Areas in the Upper Coppei Creek Reach

Project Area C-4

River Length (mi)	1.82
Valley Length (mi)	1.63
Sinuosity	1.11
Average Slope	1.16%
Total Levee Length	1.02
Project Area Score	1.3
Basin Rank	42
Connectivity Score	0.12
Encroachment Removal Potential	0%
Aggradation Potential	19%
Total Potential	20%
2-year Connected Area (ac/rm)	4.3
Total Potential Area (ac/rm)	1.04
Complexity Score (SCE)	0.11
Excess Transport Capacity (psf)	0.215

Recommended Restoration Actions

- ELJs to promote aggradation, sinuosity, and pool formation
- Establish riparian vegetation by planting deciduous trees and removing invasive grass

Project Area C-5

River Length (mi)	0.73
Valley Length (mi)	0.66
Sinuosity	1.11
Average Slope	1.26%
Total Levee Length	0.42
Project Area Score	0.3
Basin Rank	55
Connectivity Score	0.09
Encroachment Removal Potential	0%
Aggradation Potential	15%
Total Potential	16%
2-year Connected Area (ac/rm)	4.1
Total Potential Area (ac/rm)	0.78
Complexity Score (SCE)	0.07
Excess Transport Capacity (psf)	0.025

Recommended Restoration Actions

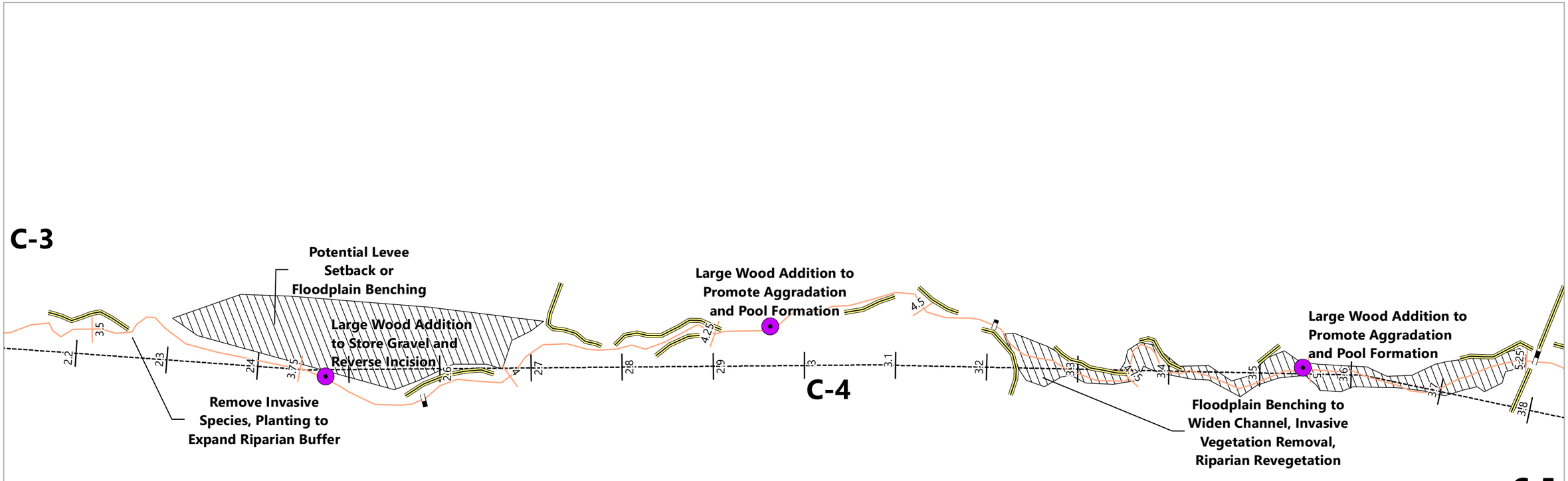
- ELJs to promote aggradation, sinuosity, and pool formation
- Establish riparian vegetation by planting deciduous trees and removing invasive grass

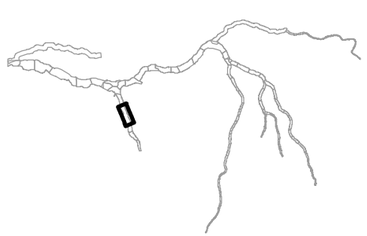
Project Area C-6

River Length (mi)	1.03
Valley Length (mi)	0.86
Sinuosity	1.20
Average Slope	1.47%
Total Levee Length	0.30
Project Area Score	1.0
Basin Rank	48
Connectivity Score	0.13
Encroachment Removal Potential	0%
Aggradation Potential	21%
Total Potential	22%
2-year Connected Area (ac/rm)	4.7
Total Potential Area (ac/rm)	1.29
Complexity Score (SCE)	0.16
Excess Transport Capacity (psf)	0.009

Recommended Restoration Actions

- Large ELJs downstream of bedrock reaches to promote aggradation and combat incision
- Establish riparian vegetation by planting deciduous trees and removing invasive grass





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Floodplain
- Riparian Enhancement

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 3.44
RIVER MILE END: 5.25
VALLEY MILE START: 2.74
VALLEY MILE END: 4.38

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Feet

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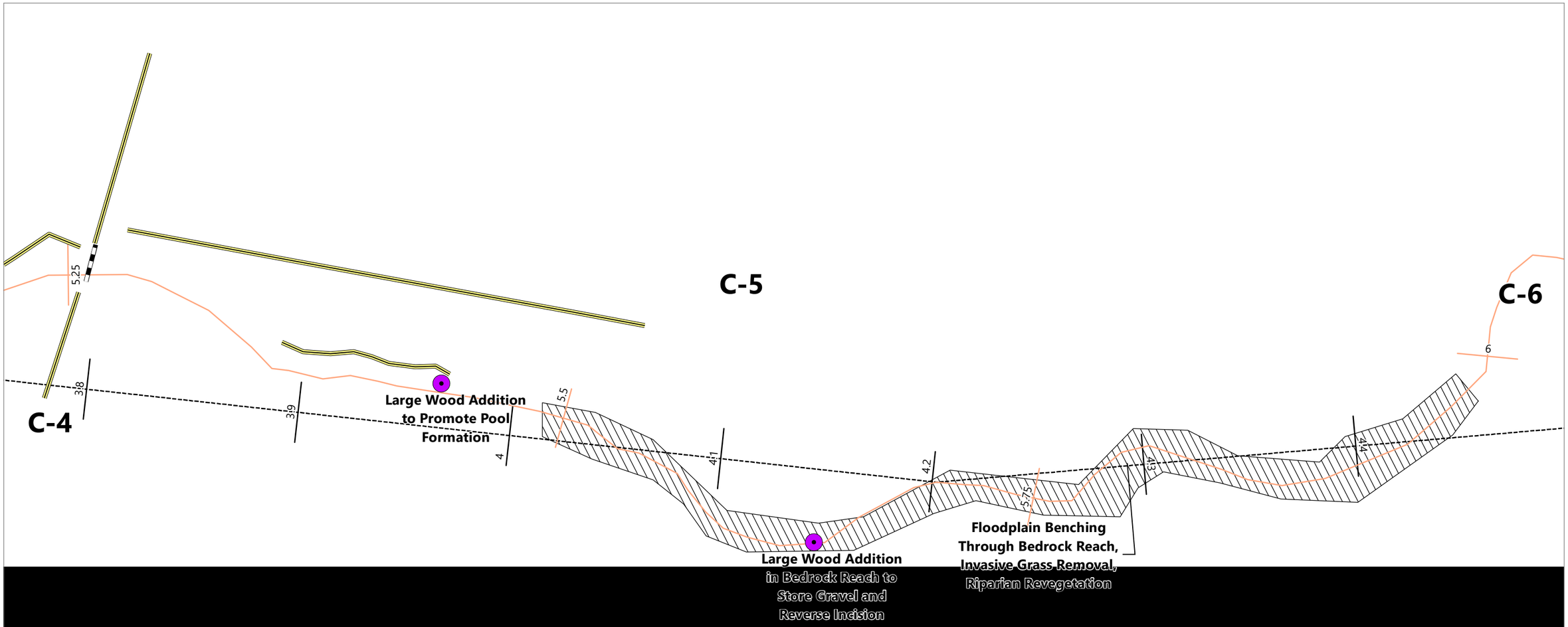

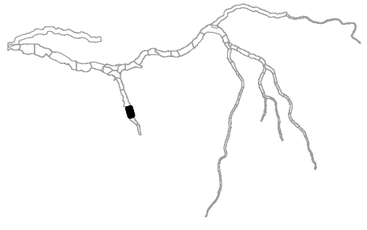

LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 5.25
RIVER MILE END: 5.99
VALLEY MILE START: 4.38
VALLEY MILE END: 5.04

0 500
Feet

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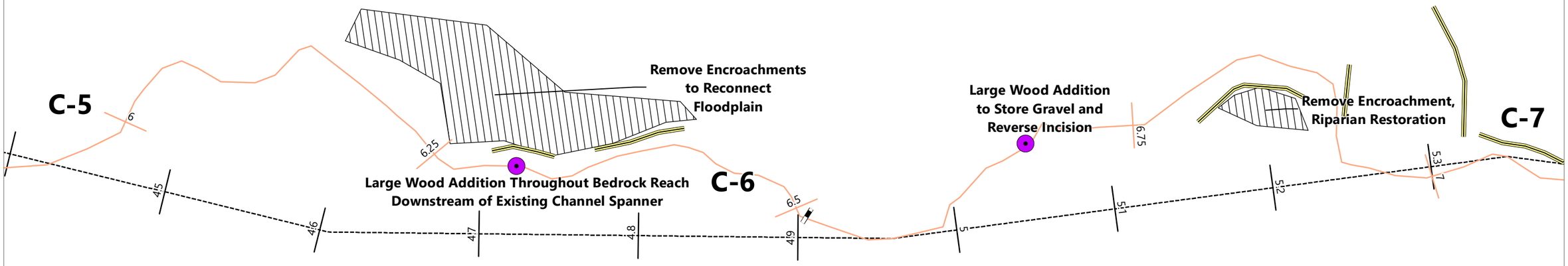
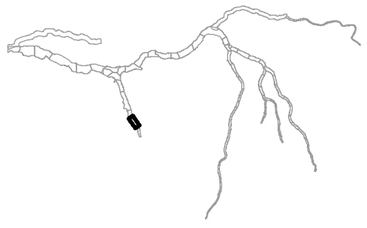
C-5
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 5.99
RIVER MILE END: 7.02
VALLEY MILE START: 5.04
VALLEY MILE END: 5.9

0 500
Feet

Publish Date: 2020/09/02, 10:34 AM | User: thutchison
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Lower North Fork Touchet Reach

Reach Description

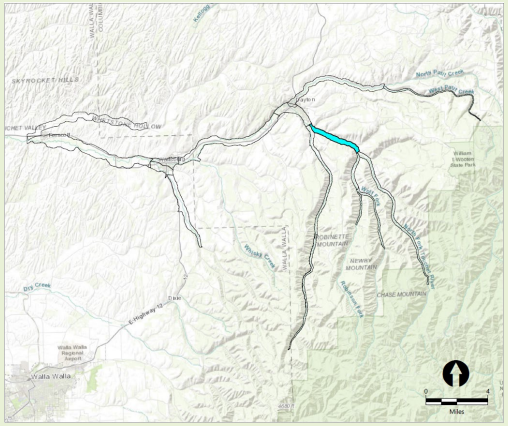
The Lower North Fork Touchet reach runs from the confluence of North Fork and Wolf Fork to the confluence of the North Fork and South Fork at the upstream end of Dayton. This reach includes five project areas from NF-1 to NF-5. The major tributary feeding this section is the Wolf Fork, entering on the left bank. One minor tributary, Hatley Creek, enters the system in this reach on the right bank. This reach is highly confined by levees and the North Touchet Road. In-channel stream surveys were only conducted on NF-1 due to challenges with obtaining landowner permissions, and the following descriptions are based primarily on aerial and Light Detection and Ranging (LiDAR) evaluations. A recent restoration project was constructed just downstream of the confluence with the Wolf Fork in NF-5 during the summer of 2019.

Floodplain and Riparian Area

Land use through most of the reach is characterized by agricultural fields, orchards, and private residences. Agricultural uses including irrigation withdrawals were noted within this reach. The reach is confined to a narrow riparian buffer as the channel is constricted by both agricultural levees and roads. Riparian vegetation through this corridor is dominated by cottonwoods, willows, and alders, and very few stands of riparian vegetation exist outside of a narrow riparian buffer

Lower North Fork Touchet

Vicinity Map



Reach Characteristics

River	North Fork Touchet River
Parent River	Touchet River
River Distance to Confluence (mi)	0.00
Valley Distance to Confluence (mi)	0.00
River Length (mi)	4.03
Valley Length (mi)	3.68
Sinuosity	1.12
Average Slope	1.11%
Delineated Project Areas	NF-1 to NF-5 (5)
Total Levee Length (mi)	4.80
Notable Tributaries	Wolf Fork Touchet Hatley Creek

separating fields and the channel. The only notable areas of this reach that have well-established channel migration areas are the downstream end of project area NF-1 and some parts of N-5. NF-2, NF-3, and NF-4 are highly confined, disconnected from the floodplain, and have very little riparian area.

Channel Conditions

Observed channel complexity through most of this reach was low with few side channels and islands and low sinuosity. The channel has a plane-bed morphology for most of the reach. Islands and split flows were observed at the confluence in NF-1 during field surveys at low-flow conditions. The complexity analysis also identified some islands and split flows in NF-5 and NF-4 during the 1-year event. Much of the reach is highly confined and there is limited area to promote split flow and side channel formation. Instream wood in NF-1 was limited to the split flow area just above the confluence. Aerial imagery shows some wood accumulation downstream of the Wolf Fork confluence in NF-5 and some log jams in NF-3. Engineered log jams and single logs have been placed into the river in the NF-5 reach as of summer 2019. Additional rock weir restoration structures were observed in NF-1, which have formed deep scour pools.

Influencing Anthropogenic Features

Agriculture plays a large role in this section of the Touchet valley and is a factor in most influencing features. More than 4.8 miles of levees protect both residential and agricultural infrastructure and fields. Levees and the North Touchet Road play a large role in the confinement of the reach, particularly in project areas NF-2 to NF-4. The river abuts the North Touchet Road on its right bank at multiple locations in the reach. This confines the channel migration area and has led to the formation of steep banks in these locations. Levees on both sides of the river protect fields and residences, limiting the channel migration area and reducing the reach's sinuosity. Project area NF-4 is most affected by these confinements and is almost completely linear. Riprap was also observed protecting existing levees, bridges, roads, and irrigation intakes. The Dayton levee at the downstream end of the reach is a heavily armored levee managed by the U.S. Army Corps of Engineers. There is also a water intake diversion channel on the far-right bank where the North Fork intersects the levee. Several bridges cross the river in this reach and likely influence the geomorphic processes through floodplain constriction, hydraulic backwater, and sediment transport continuity. These bridges include the following:

- South Touchet Road between project areas NF-1 and NF-2
- Baileysburg Road between project areas NF-2 and NF-3
- Vernon Lane between project areas NF-3 and NF-4

Qualitative Factors and Reach Priority

The Lower North Fork Touchet reach falls in Reach Priority 2 (out of 3) for reaches included in the Touchet watershed prioritization framework. This Reach Priority ranking is for the Lower North Fork Touchet reach as a whole; individual project areas within this reach may rank differently in the prioritization. This Reach Priority is meant to provide some overall insight into factors that are not considered in the project area prioritization and are likely very different between the reaches in this assessment.

Water Quantity

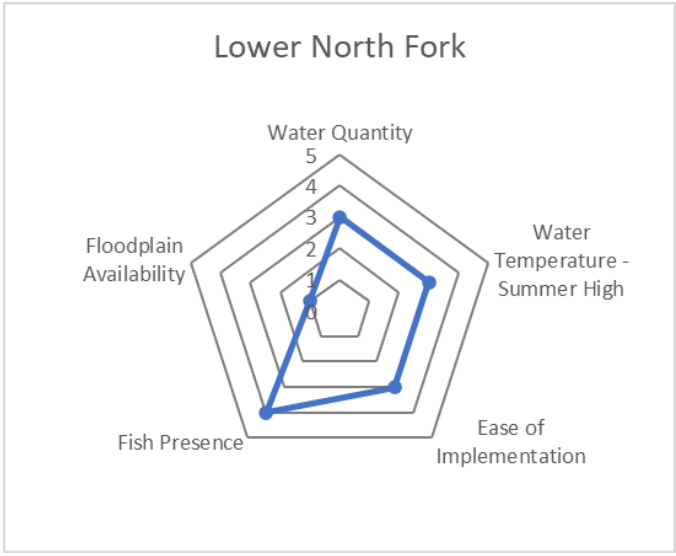
The Lower North Fork Touchet reach has adequate flow during most of the hydrograph. This flow amount is usually enough to support more than one habitat condition within a typical cross section. Where low-lying floodplain is available, side channels and split flow can exist even at low flows, but large inundated areas of floodplain are unlikely at the lowest flow conditions. The volume of flow in this reach also has potential to cause geomorphic change where there is suitable sediment material and available floodplain. This reach receives a score of 3 (out of 5) for water quantity.

Summer High Water Temperature

The North Fork Touchet basin generally has cooler temperatures than other reaches in this assessment, making it a good candidate for habitat restoration work. Temperature

Lower North Fork Touchet

Qualitative Factors



Reach Score (_/5)	2.8
Reach Rank (_/9)	7
Reach Priority (_/3)	2
Primary Reach Concerns:	Floodplain Availability

This reach scored highly for water temperature and quantity, but the numerous agricultural and residential properties along the banks and their associated levees limit the potential to expand the channel migration area.

observations are made at the Washington State Department of Ecology gage near the confluence with the mainstem show that high summer month temperatures are typically near or below 20°C (Ecology 2020). While this temperature is not ideal for salmonids, it is likely survivable. Additionally, these temperatures likely decrease at the upstream end of the reach and are closer to ideal temperatures in deep pools, under overhanging cover, and near groundwater inputs. This reach receives a score of 3 (out of 5) for summer high water temperatures.

Ease of Implementation

Land ownership in the Lower North Fork Touchet reach is a mix of small- and large-sized private parcels. While there are some larger parcels in this reach, there are also many other small parcels that include short stretches of the river. Landowner willingness to participate in restoration work is unknown, but gaining permissions and access to multiple parcels presents a challenge for implementing larger projects. The Lower North Fork Touchet reach does have many bridges and farm roads that would provide relatively easy access to the floodplain for construction equipment. This reach receives a score of 3 (out of 5) for ease of implementation.

Fish Presence

Several counts of juvenile fish use have been performed in this reach. Juvenile summer steelhead are shown to occasionally rear in this reach and over-wintering 1+-year-old juvenile steelhead are also present in this reach. Bull trout and Chinook salmon are not documented rearing in this reach. Adult steelhead are known to migrate through this reach and spawn throughout the North Fork basin. This reach receives a score of 4 (out of 5) for fish presence.

Floodplain Availability

Land use in the Lower North Fork Touchet reach is mixed between agricultural use and residential use, and there are many instances of buildings and infrastructure bordering or in the floodplain, especially in the downstream half of the reach. Land use in the upstream half of the reach is more typically open agriculture with several orchard fields in the area. However, this reach is the most leveed of all reaches in this assessment with on average more than 1 mile of levee per mile of river (accounting for levees on both sides). This reach is highly confined with almost no floodplain area and very little riparian growth. The exceptions are at the upstream and downstream end near the confluences with the Wolf Fork and South Fork, respectively, which have more floodplain area and decent riparian growth. Floodplain availability is the biggest concern for the Lower North Fork Touchet reach, with a score of 1 (out of 5).

Summary of Restoration Strategies

The following restoration actions are recommended based on the above information, as well as field observations and the desktop analysis and prioritization results. While other restoration actions should be considered at a project implementation level, the following should all be considered for any project in this reach. Details on how these restoration actions might be applied on a project area level are provided in the next section.

Remove Confinement (Encroachments and Incision)

All five project areas in the Lower North Fork Touchet reach have significant impacts from levees and other encroachments including riprap and North Touchet Road. Several sections of this reach, particularly in project areas NF-2, NF-3, and NF-4, are highly confined by encroachments on both banks. The analysis results for connectivity (provided in the next section) demonstrate the effects of these levees and incision on available floodplain. In addition, the analysis results for excess transport capacity demonstrate that confinement of the channel and floodplain leads to increased sediment transport capacity for the project areas within this reach.

Providing room for the river to actively migrate and inundate is vital to the natural processes in the reach and will have the largest benefit to the potential effectiveness of the other restoration actions listed. Where possible, levees and encroachments should be removed or set back to reconnect low-lying floodplain and relic side channels. Incised reaches should be targeted for sediment deposition and floodplain benching to reconnect these areas.

Add Instream Wood and Complexity

While some localized high-complexity areas have accumulated large wood, much of this section is characterized by relatively low amounts of in-channel large woody material and a plane-bed morphology. Where instream wood does exist, scour pools and geomorphic complexity are more prevalent. Most of the project areas in this reach lack the volume of large woody material necessary to initiate these processes or the sinuosity for large wood to accumulate and naturally form jams. A lack of planform and in-channel complexity is observed in most of the project areas in this reach, and all project areas had some sections that lacked channel complexity associated with instream wood.

Adding large woody material in strategic locations that will most benefit the natural processes should be a primary restoration action in all project areas in this reach. Instream wood should be placed primarily to help restore the geomorphic processes that result in side channel formation, split flow and vegetated gravel bar building, sediment storage, channel aggradation, and pool formation. Large wood can be placed to provide in-channel complexity and habitat while

simultaneously acting as erosion prevention in places where critical infrastructure must be protected. This dual functionality could be appealing to landowners in this reach. Using large wood to deter erosion at the edge of the aforementioned channel migration areas should be considered as a way to establish boundaries against further development.

Establish Riparian Vegetation

While there are several sections of this reach that have an established channel migration area with mature vegetation, most of these sections are very narrow. Riparian vegetation is critically needed to provide a renewable and constant source of instream wood, as well as to provide overhanging cover and shade. There are some areas in this reach with large unvegetated gravel bars that would provide more habitat benefit if vegetated. Establishing mature stands of vegetation in the immediate riparian area and channel migration areas should be a restoration target for this reach. Restoration actions should target establishing vegetated gravel bars and may require stabilizing features such as large apex engineered log jams.

Tier 1

Project Areas in the Lower North Fork Touchet Reach

Project Area NF-2

River Length (mi)	0.69
Valley Length (mi)	0.61
Sinuosity	1.14
Average Slope	1.03%
Total Levee Length	0.73
Project Area Score	2.8
Basin Rank	16
Connectivity Score	0.27
Encroachment Removal Potential	33%
Aggradation Potential	5%
Total Potential	60%
2-year Connected Area (ac/rm)	12.2
Total Potential Area (ac/rm)	18.56
Complexity Score (SCE)	0.08
Excess Transport Capacity (psf)	-0.077

Recommended Restoration Actions

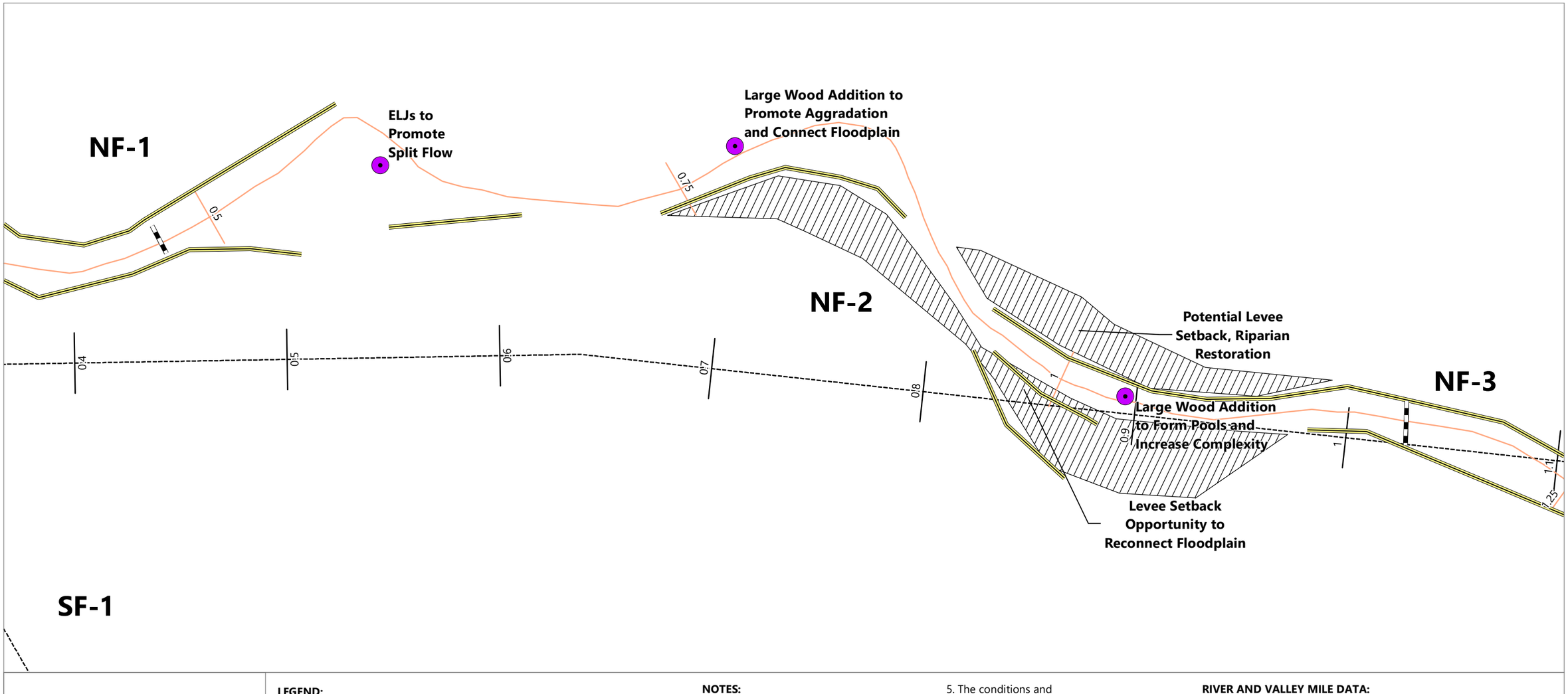
- Remove or set back levees through VM 0.7 to VM 0.9
- ELJs to promote aggradation and sinuosity

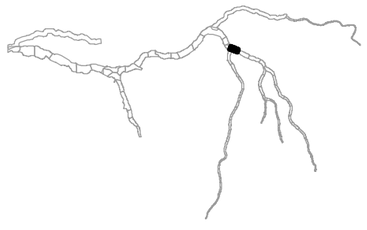
Project Area NF-3

River Length (mi)	1.20
Valley Length (mi)	1.08
Sinuosity	1.11
Average Slope	1.07%
Total Levee Length	1.79
Project Area Score	3.2
Basin Rank	9
Connectivity Score	0.28
Encroachment Removal Potential	35%
Aggradation Potential	3%
Total Potential	66%
2-year Connected Area (ac/rm)	12.2
Total Potential Area (ac/rm)	24.22
Complexity Score (SCE)	0.15
Excess Transport Capacity (psf)	0.001

Recommended Restoration Actions

- Remove or breach levees through VM 1.2 to VM 1.7
- ELJs to help vegetate gravel bars





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 0.47
RIVER MILE END: 1.16
VALLEY MILE START: 0.36
VALLEY MILE END: 0.97

0 500
Feet

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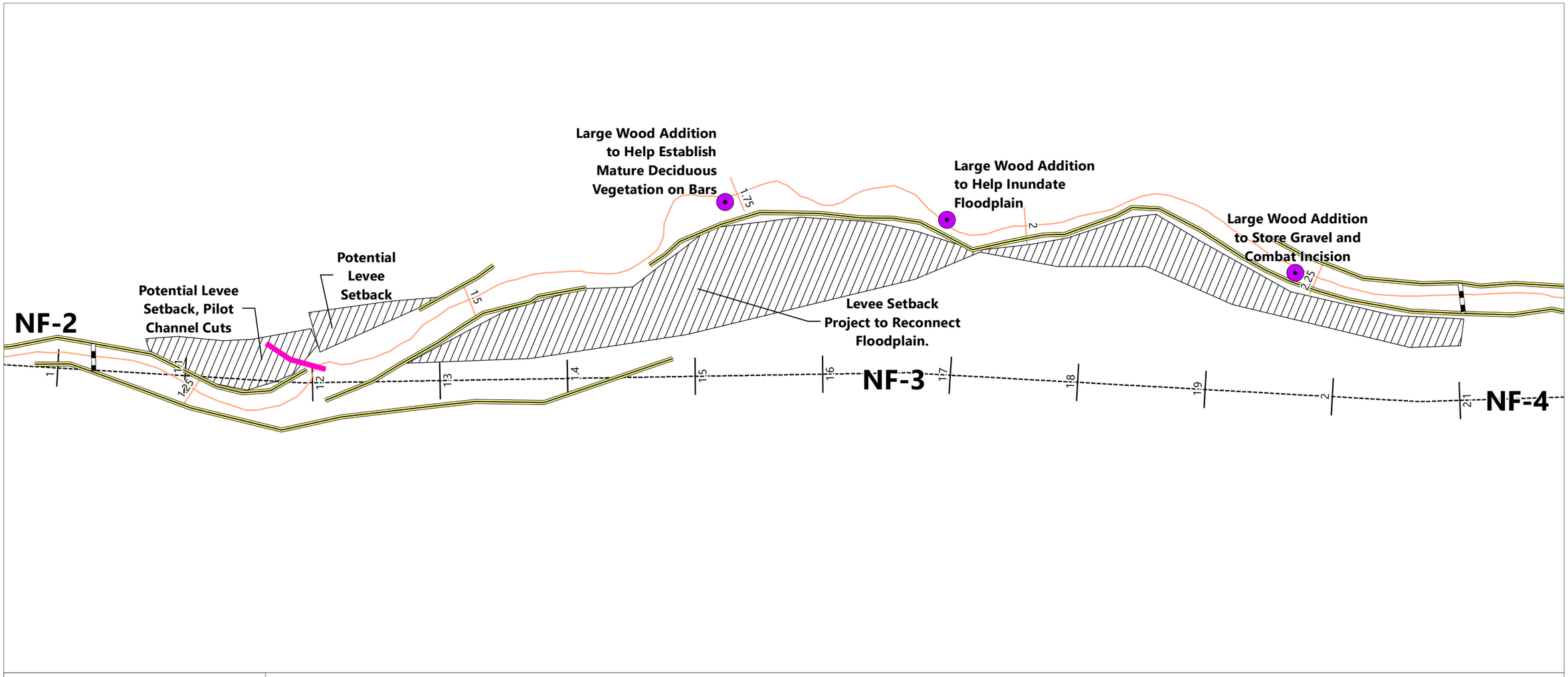
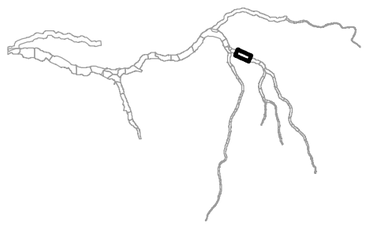
NF-2
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 1.16
RIVER MILE END: 2.37
VALLEY MILE START: 0.97
VALLEY MILE END: 2.06

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Feet

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NF-3
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Tier 3

Project Areas in the Lower North Fork Touchet Reach

Project Area NF-1

River Length (mi)	0.47
Valley Length (mi)	0.36
Sinuosity	1.29
Average Slope	1.05%
Total Levee Length	0.44
Project Area Score	1.1
Basin Rank	45
Connectivity Score	0.06
Encroachment Removal Potential	1%
Aggradation Potential	9%
Total Potential	10%
2-year Connected Area (ac/rm)	14.6
Total Potential Area (ac/rm)	1.69
Complexity Score (SCE)	0.46
Excess Transport Capacity (psf)	0.043

Recommended Restoration Actions

- Add large woody material to promote cover and complexity
- ELJs to promote complexity and connectivity with available floodplain

Project Area NF-4

River Length (mi)	1.00
Valley Length (mi)	0.99
Sinuosity	1.01
Average Slope	1.18%
Total Levee Length	1.48
Project Area Score	1.5
Basin Rank	39
Connectivity Score	0.12
Encroachment Removal Potential	4%
Aggradation Potential	14%
Total Potential	22%
2-year Connected Area (ac/rm)	11.2
Total Potential Area (ac/rm)	3.14
Complexity Score (SCE)	0.20
Excess Transport Capacity (psf)	0.271

Recommended Restoration Actions

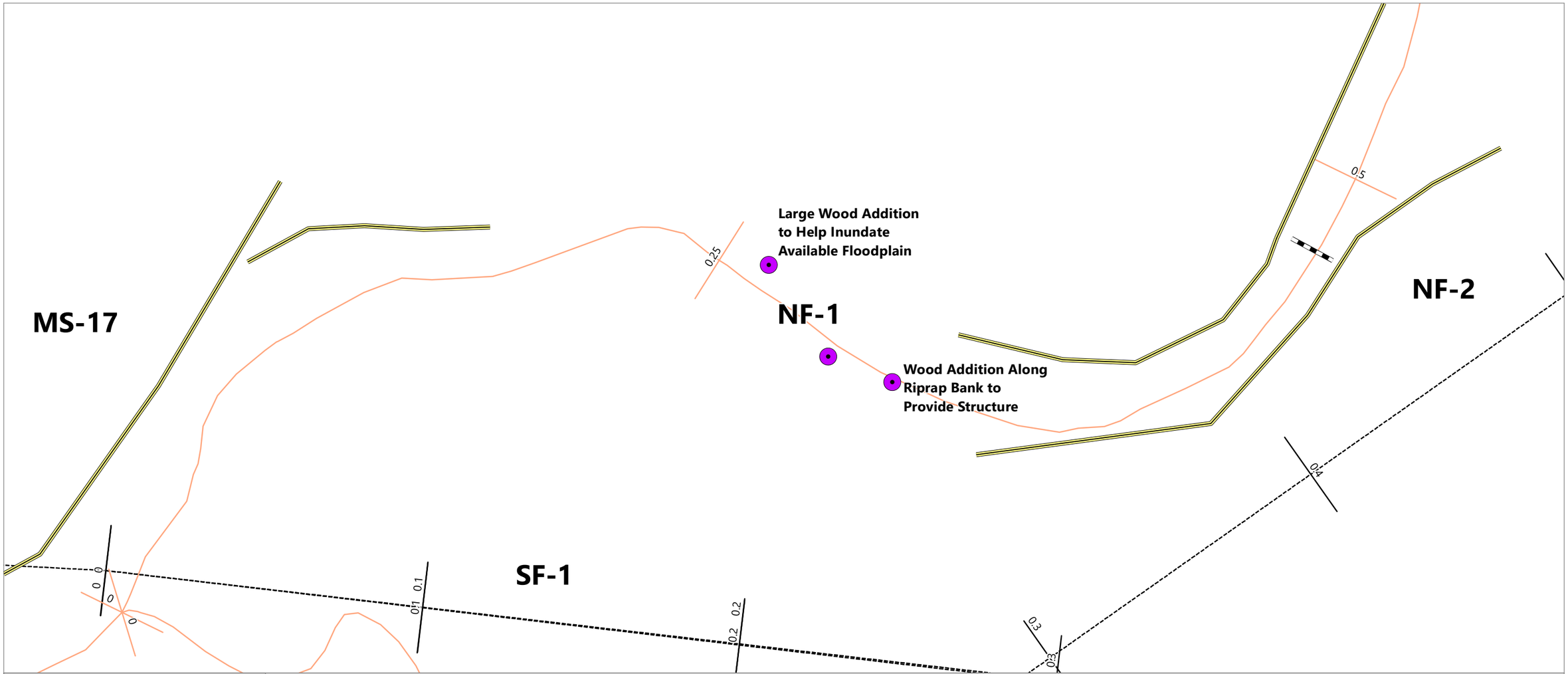
- Remove or set back levees through VM 2.1 to VM 3.0
- ELJs to promote aggradation and sinuosity

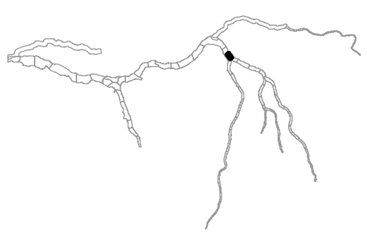
Project Area NF-5

River Length (mi)	0.66
Valley Length (mi)	0.63
Sinuosity	1.06
Average Slope	1.20%
Total Levee Length	0.37
Project Area Score	0.9
Basin Rank	51
Connectivity Score	0.08
Encroachment Removal Potential	4%
Aggradation Potential	9%
Total Potential	16%
2-year Connected Area (ac/rm)	18.0
Total Potential Area (ac/rm)	3.39
Complexity Score (SCE)	0.34
Excess Transport Capacity (psf)	-0.009

Recommended Restoration Actions

- Maintain existing restoration project
- Monitoring and maintenance for 2019 plantings





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

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RIVER MILE END: 0.47
VALLEY MILE START: 0
VALLEY MILE END: 0.36

0 500
Feet

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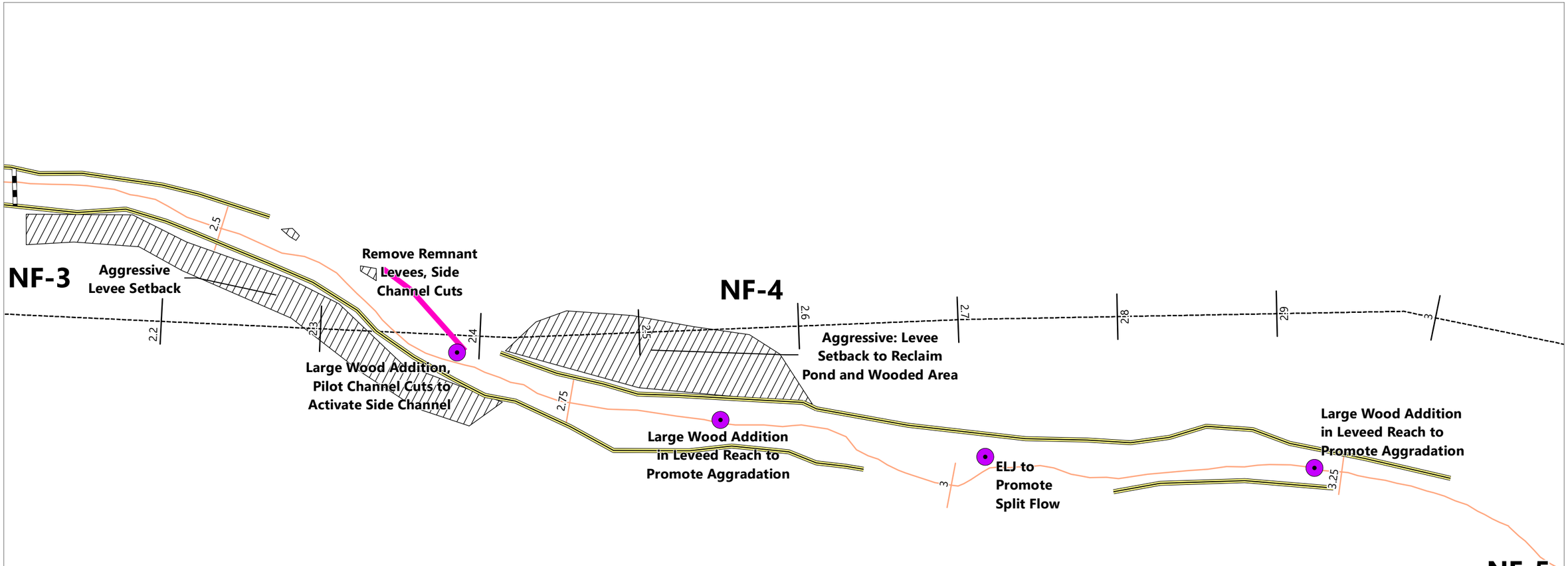
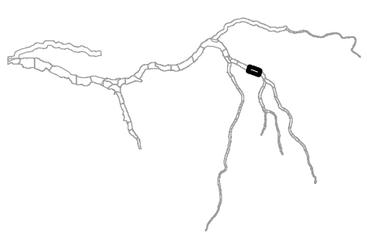
NF-1
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 2.37
RIVER MILE END: 3.37
VALLEY MILE START: 2.06
VALLEY MILE END: 3.05

0 500
Feet

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NF-4
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

NF-4

NF-5

NF-6

WF-1

3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.75
3.8
4
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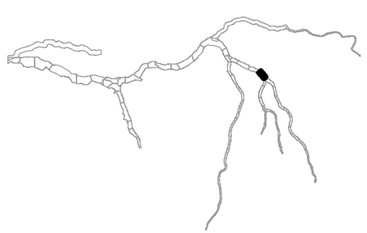
Monitor and Maintain 2019 Plantings and LWD Structures

Monitor and Maintain 2019 Restoration Project

Downstream Extent of Restoration Project (Summer '19)



LEGEND:

- Delineated Levees
- Riparian Enhancement
- Placemark

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 3.37
RIVER MILE END: 4.03
VALLEY MILE START: 3.05
VALLEY MILE END: 3.68

0 500
Feet

Publish Date: 2020/09/02, 10:37 AM | User: thutchison
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NF-5
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Upper North Fork Touchet Reach

Reach Description

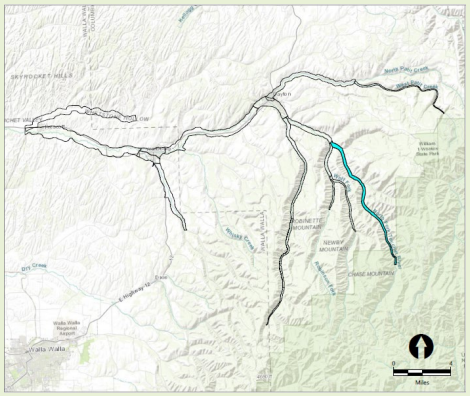
The Upper North Fork Touchet reach runs from the mouth of Spangler Creek downstream to the confluence of North Fork and Wolf Fork. This reach includes 11 project areas from NF-6 to NF-16. Three significant tributaries enter the system in this reach. Spangler Creek enters the North Fork at the upstream boundary of the reach on the right bank at NF river mile 15.4, Lewis Creek enters on the right bank at NF river mile 11.9, and Jim Creek enters on the right bank at NF river mile 8.2. All three tributaries are of similar stream order and provide the only significant changes in hydrology through the reach. In-channel stream surveys were not conducted due to challenges with obtaining landowner permissions, and the following descriptions are based on aerial and LiDAR evaluations.

Floodplain and Riparian Area

Land use through most of the reach is characterized by agricultural fields and transitions to private residences upstream of the mouth of Jim Creek (project areas NF-10 and above) as well as a large campground area. North Touchet Road parallels the entire reach and is a dominant encroachment on the available floodplain. The channel is more confined by agricultural levees, and riparian buffers are narrow through project areas NF-6 to NF-9. Riparian vegetation extent and density increases and channel confinement decreases in

Upper North Fork Touchet

Vicinity Map



Reach Characteristics

River	North Fork Touchet River
Parent River	Touchet River
River Distance to Confluence (mi)	4.03
Valley Distance to Confluence (mi)	3.68
River Length (mi)	11.35
Valley Length (mi)	10.39
Sinuosity	1.09
Average Slope	2.11%
Delineated Project Areas	NF-6 to NF-16 (11)
Total Levee Length (mi)	1.93
Notable Tributaries	Spangler Creek Lewis Creek Jim Creek

project areas NF-10 and above. The riparian vegetation through NF-6 to NF-9 is composed of mature deciduous trees surrounded by fields and pastures. The lack of riparian density and greater percent of unshaded area in this lower section makes establishment of riparian vegetation a priority for project areas NF-6 to NF-9. The riparian vegetation transitions to a mixed conifer and ponderosa forest with excellent forest cover upstream of Jim Creek. Although much of the river has a channel migration area, several stretches of river, notably in project areas NF-9 and NF-6, are still highly confined through levees and incision and have very little riparian area.

Channel Conditions

Channel complexity through most of this reach varied from no complexity in project area NF-9 to high to moderate complexity with large channel migration areas in NF-10, NF-8, and the remainder of the upper project areas. Upstream of project area NF-9, North Touchet Road represents the main channel confinement and the river can migrate through most of the valley. Aerial imagery analysis reveals instream wood in the reach is low to moderate, with significant wood accumulation in NF-15 and some scattered throughout NF-12 to NF-16. Of the reaches downstream of Jim Creek, NF-8 has many side channels and split flows, but the large area of unvegetated gravel bars makes this reach a target for restoration. NF-9 is the most degraded project area in the reach and is confined between the valley wall on river left and levees on river right.

Influencing Anthropogenic Features

Agriculture plays a large role in this section of the Touchet valley and agricultural levees and the North Touchet Road are the primary anthropogenic features. More than 1.9 miles of levees protect both residential and agricultural infrastructure and fields. Levees and incision play a large role in the confinement of the reach, particularly in project areas NF-6 and NF-9. Upstream of NF-9, there are many residential structures in the active floodplain and channel migration area. There are also a number of manmade ponds and reservoirs throughout this reach, which represent a potentially important water withdrawal and encroachment on channel migration. Another anthropogenic influence is some apparent channel-spanning boulder weirs at the downstream end of NF-9. Throughout the upper part of this reach, North Touchet Road is the dominant structure influencing geomorphic processes. Several bridges cross the river in this reach and likely influence the geomorphic processes through floodplain constriction, hydraulic backwater, and sediment transport continuity. These bridges include the following:

- Wolf Fork Road in project area NF-6
- North Touchet Road between project areas NF-10 and NF-11
- North Touchet Road between project areas NF-11 and NF-12
- North Touchet Road between project areas NF-13 and NF-14
- Private bridges in project areas NF-8, NF-9, NF-10 (two bridges), and NF-12

Qualitative Factors and Reach Priority

The Upper North Fork Touchet reach falls in Reach Priority 2 (out of 3) for reaches included in the Touchet watershed prioritization framework. This Reach Priority ranking is for the Upper North Fork Touchet reach as a whole; individual project areas within this reach may rank differently in the prioritization. This Reach Priority is meant to provide some overall insight into factors that are not considered in the project area prioritization and are likely very different between the reaches in this assessment.

Water Quantity

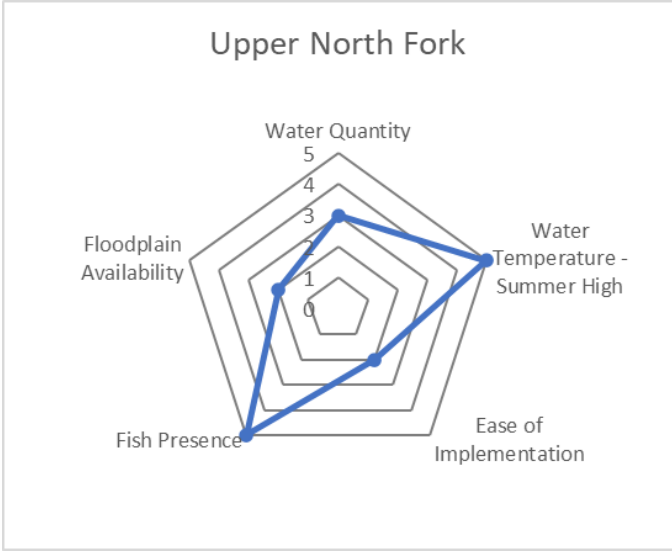
The Upper North Fork Touchet reach has adequate flow during most of the hydrograph. This flow amount is usually enough to support more than one habitat condition within a typical cross section. Where low-lying floodplain is available, side channels and split flows can exist even at low flows, but large inundated areas of floodplain are unlikely at the lowest flow conditions. The volume of flow in this reach also has potential to cause geomorphic change where there is suitable sediment material and available floodplain. This reach receives a score of 3 (out of 5) for water quantity.

Summer High Water Temperature

The North Fork Touchet basin generally has cooler temperatures than other reaches in this assessment, making it a good candidate for habitat restoration work. Temperature

Upper North Fork Touchet

Qualitative Factors



Reach Score (_/5)	3.4
Reach Rank (_/9)	4
Reach Priority (_/3)	1
Primary Reach Concerns:	Floodplain Availability Ease of Implementation

This reach scored highly for cold water temperatures capable of supporting all target species of salmonids. The smaller parcel size makes implementation more challenging and there are many residences in the floodplain, limiting floodplain expansion opportunities. That places this reach as a low Tier 1.

observations are not made on this reach, but temperatures are likely significantly cooler than the Lower North Fork Touchet reach, which has high summer month temperatures typically near or below 20°C. Assuming the temperatures are lower in the Upper North Fork Touchet reach, temperature conditions are likely very good for adult salmonids. Any restoration work in the Upper North Fork Touchet reach would benefit from already having good temperature habitat conditions and could focus on other aspects of improving habitat. This reach scores a 5 (out of 5) for summer high water temperatures.

Ease of Implementation

Land ownership in the Upper North Fork Touchet reach is a mix of small- and large-sized private parcels. Near the downstream end of the reach are several larger properties engaged in agricultural activities. Upstream of the Jim Creek tributary, most bordering properties are private residences and are much smaller parcels. Landowner willingness to participate in restoration work is unknown, but gaining permissions and access to multiple parcels presents a challenge for implementing larger projects. At the farthest upstream end of the reach, some public land does exist in the riparian area, which may allow for easier implementation. However, much of the upstream part of the Upper North Fork Touchet reach has little or no existing access to the river, making any restoration project involving construction equipment more difficult. This reach receives a score of 2 (out of 5) for ease of implementation.

Fish Presence

Several counts of juvenile fish use have been performed in this reach. Juvenile summer steelhead are shown to occasionally rear in this reach and over-wintering 1+-year-old juvenile steelhead are also present in this reach. Juvenile and adult bull trout also have a presence in this reach, especially at the upstream end. Chinook salmon have not been explicitly documented in this reach, but this may be due to a lack of documentation because instream habitat conditions are similar to other reaches (Wolf Fork and Robinson Fork) where juvenile Chinook salmon have been observed. This reach receives a score of 5 (out of 5) for fish presence.

Floodplain Availability

Land use in the Upper North Fork Touchet reach is mixed between agricultural use, residential use, and public land. In sections with high residential use, there are many instances of buildings and infrastructure bordering or in the floodplain. For much of the reach, the channel is highly confined with little floodplain area. The exception is at the upstream end of the reach, where some floodplain is available with decent riparian growth. This reach receives a score of 2 (out of 5) for floodplain availability.

Summary of Restoration Strategies

The following restoration actions are recommended based on the above information, as well as field observations and the desktop analysis and prioritization results. While other restoration actions should be considered at a project implementation level, the following should all be considered for any project in this reach. Details on how these restoration actions might be applied on a project area level are provided in the next section.

Remove Confinement (Encroachments and Incision)

All 11 project areas in the Upper North Fork Touchet reach have some impacts from levees and other encroachments with the most significant impact being North Touchet Road. Project areas NF-6 and NF-9 are particularly afflicted by confinement from levees. North Touchet Road confines the floodplains of upstream project areas NF-10 to NF-16. The analysis results for connectivity (provided in the next section) demonstrate the effects of these levees and incision on available floodplain. In addition, the analysis results for excess transport capacity demonstrate that confinement of the channel and floodplain leads to increased sediment transport capacity for the project areas within this reach.

Providing room for the river to actively migrate and inundate is vital to the natural processes in the reach and will have a large effect on the success of the other restoration actions listed.

Where possible, levees and encroachments should be removed or set back to reconnect low-lying floodplain and relic side channels. This action will be critical in the lower project areas of the reach to initiate channel migration processes in highly confined reaches. Incised channels should be targeted for sediment deposition and floodplain benching to reconnect these areas.

Add Instream Wood and Complexity

Imagery shows that instream wood is more prevalent in the upper project areas but sparse in the lower project areas from NF-6 to NF-9. Project area NF-15 notably has a large amount of wood available in the channel and surrounding floodplain. Structures in this reach and reaches just downstream may be designed to collect this abundance of wood. As seen in other reaches in the system, wood tends to coincide with more sinuous and complex reaches in both a cause and effect relationship. Sinuous reaches have less stream power and more bends for wood to accumulate, while wood helps drive geomorphic processes that contribute to sinuosity and complexity. A lack of planform and in-channel complexity is evident in many project areas in this reach, including NF-6, NF-7, and NF-9.

Adding large woody material in strategic locations that will most benefit the natural processes should be a primary restoration action in all project areas in this reach. Instream

wood should be placed to promote split flow and side channel formation, as well as in-channel complexity and habitat diversity. The addition of large woody material will also promote the process of aggradation and pool formation in plane bed areas in highly confined reaches like NF-9. In reaches that are already complex but poorly vegetated, such as NF-8, adding large wood will help to stabilize bars and establish mature vegetation. While not ideal, in locations where infrastructure is within the riparian area, placement of large wood should be targeted towards instream habitat complexity and providing cover and pools.

Establish Channel Migration Area

The lower portion of the reach has a reduced channel migration area confined by levees and incision, and encroachment removal should be considered a primary restoration action there. However, the upper portion of this reach has several project areas with a large existing channel migration area, which already provide room for natural geomorphic processes, flood inundation, and the establishment of riparian vegetation. While actions such as adding instream wood may be necessary to jumpstart these processes, protection against future development and confinement should also be a high priority among restoration actions. Measures to limit further development at the interface of private residences and riparian forests should be prioritized in the upper project areas of this reach so that future development does not adversely impact the area available for river processes to occur. These protections can involve the establishment of setback levees to protect against future migration or flooding outside of this channel migration area, along with legal protections and easements against further development. Limiting bank erosion and avulsions with placement of large woody material can help to establish these boundaries.

Establish Riparian Vegetation

The upper portion of the reach appears to be a stronghold for riparian vegetation in the Touchet basin based on aerial imagery. The lower portion of the reach from project area NF-6 to NF-10 has a thin buffer of mature riparian trees, but should be targeted for vegetation restoration. Many parts of the reach are bordered by fields and lack any riparian trees between the channel and fields to provide shade. Land is limited in the lower project areas to expand riparian vegetation, but project area NF-8 has numerous unvegetated gravel bars that should be targeted for establishment of vegetation. Riparian vegetation has been shown to be critical to ecological and geomorphic processes and is especially needed in this less densely vegetated lower section to provide shade to reduce summer water temperatures. Log jams are more evident in the forested upper section of the reach, and more large wood will help provide cover and complexity throughout the reach.

Restoration actions should target establishing vegetated gravel bars because little available floodplain land exists outside the channel. Stabilizing features such as large apex engineered log jams could promote vegetation of bars. Levee setbacks should also be considered to expand the available zone for channel migration and riparian vegetation.

Tier 1

Project Areas in the Upper North Fork Touchet Reach

Project Area NF-8

River Length (mi)	1.37
Valley Length (mi)	1.22
Sinuosity	1.12
Average Slope	1.72%
Total Levee Length	0.03
Project Area Score	3.6
Basin Rank	6
Connectivity Score	0.27
Encroachment Removal Potential	25%
Aggradation Potential	22%
Total Potential	42%
2-year Connected Area (ac/rm)	12.8
Total Potential Area (ac/rm)	9.13
Complexity Score (SCE)	0.44
Excess Transport Capacity (psf)	-0.347

Recommended Restoration Actions

- Pilot channel cuts to reconnect side channels
- ELJs to promote complexity and help vegetate gravel bars

Project Area NF-11

River Length (mi)	0.67
Valley Length (mi)	0.65
Sinuosity	1.02
Average Slope	2.14%
Total Levee Length	0.00
Project Area Score	2.8
Basin Rank	15
Connectivity Score	0.18
Encroachment Removal Potential	21%
Aggradation Potential	10%
Total Potential	29%
2-year Connected Area (ac/rm)	9.8
Total Potential Area (ac/rm)	3.91
Complexity Score (SCE)	0.32
Excess Transport Capacity (psf)	0.046

Recommended Restoration Actions

- ELJs to promote split flow and complexity
- Pilot channel cuts to reconnect side channels

Project Area NF-13

River Length (mi)	1.13
Valley Length (mi)	0.97
Sinuosity	1.17
Average Slope	2.14%
Total Levee Length	0.06
Project Area Score	3.0
Basin Rank	12
Connectivity Score	0.16
Encroachment Removal Potential	15%
Aggradation Potential	12%
Total Potential	26%
2-year Connected Area (ac/rm)	8.4
Total Potential Area (ac/rm)	2.96
Complexity Score (SCE)	0.22
Excess Transport Capacity (psf)	-0.076

Recommended Restoration Actions

- Add large woody material to promote pools and split flow
- Pilot channel cuts to reconnect side channels

Tier 1

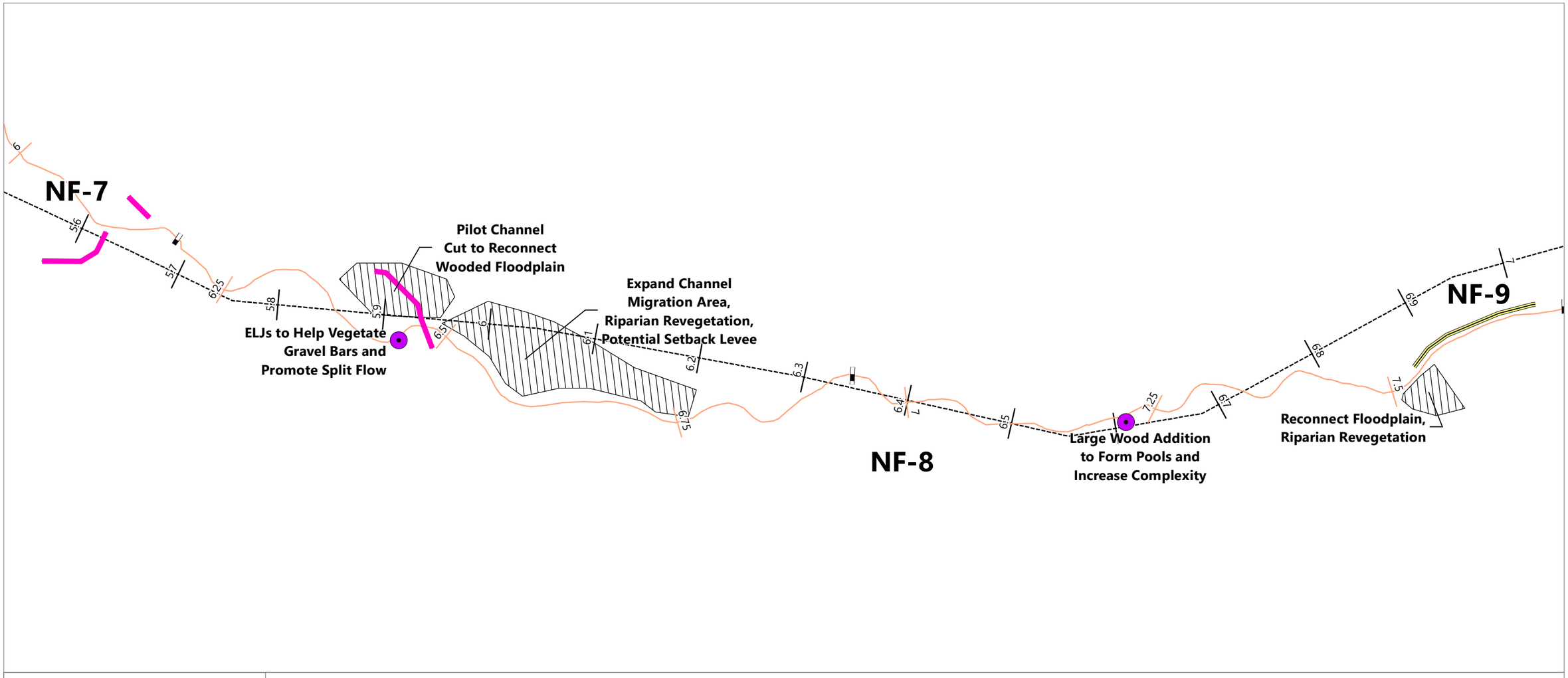
Project Areas in the Upper North Fork Touchet Reach

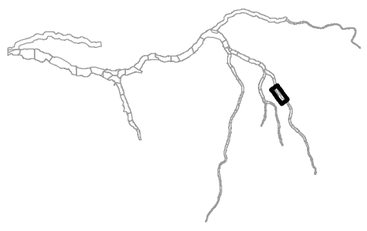
Project Area NF-15

River Length (mi)	1.01
Valley Length (mi)	0.93
Sinuosity	1.08
Average Slope	2.71%
Total Levee Length	0.00
Project Area Score	2.8
Basin Rank	14
Connectivity Score	0.17
Encroachment Removal Potential	21%
Aggradation Potential	6%
Total Potential	30%
2-year Connected Area (ac/rm)	6.4
Total Potential Area (ac/rm)	2.80
Complexity Score (SCE)	0.18
Excess Transport Capacity (psf)	0.130

Recommended Restoration Actions

- ELJs to collect existing abundant woody debris
- ELJs to promote split flow and side channel formation
- Establish mature riparian vegetation





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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3. Aerial Imagery is NAIP (2017).
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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 6.19
RIVER MILE END: 7.56
VALLEY MILE START: 5.7
VALLEY MILE END: 6.93

0 500
Feet

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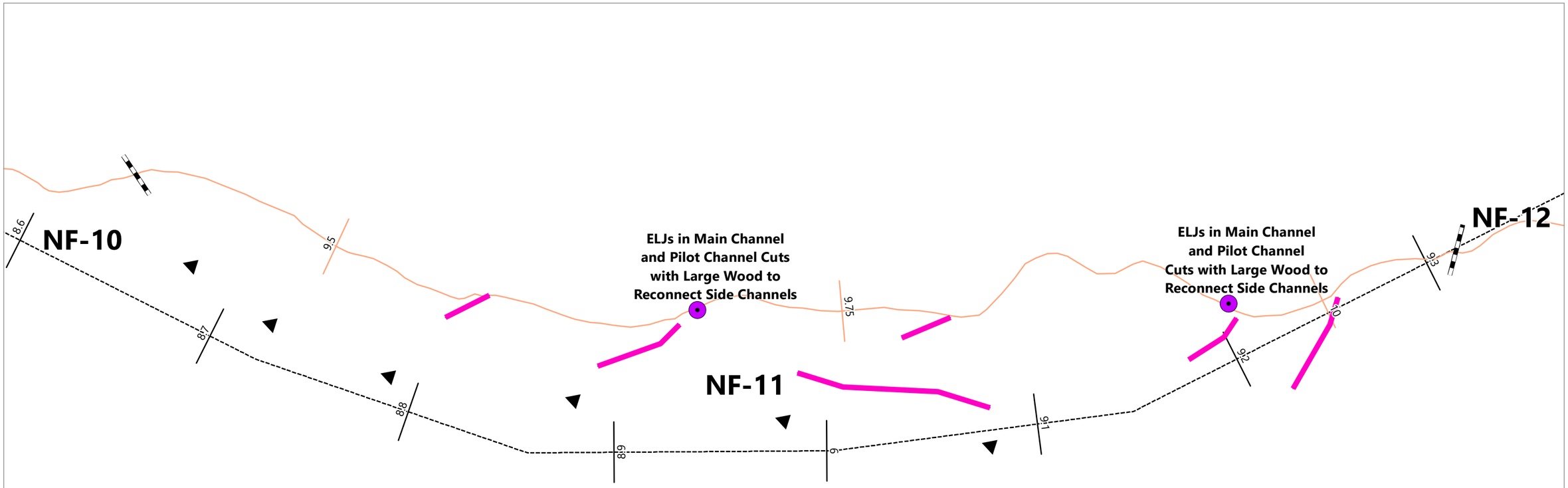
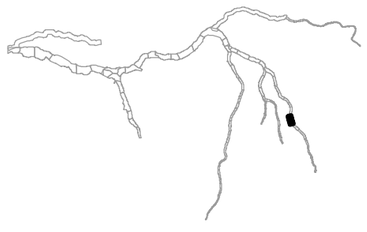
NF-8
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration





LEGEND:

- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Long Term: Set Back Road

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 9.4
RIVER MILE END: 10.07
VALLEY MILE START: 8.68
VALLEY MILE END: 9.33

0 500
Feet

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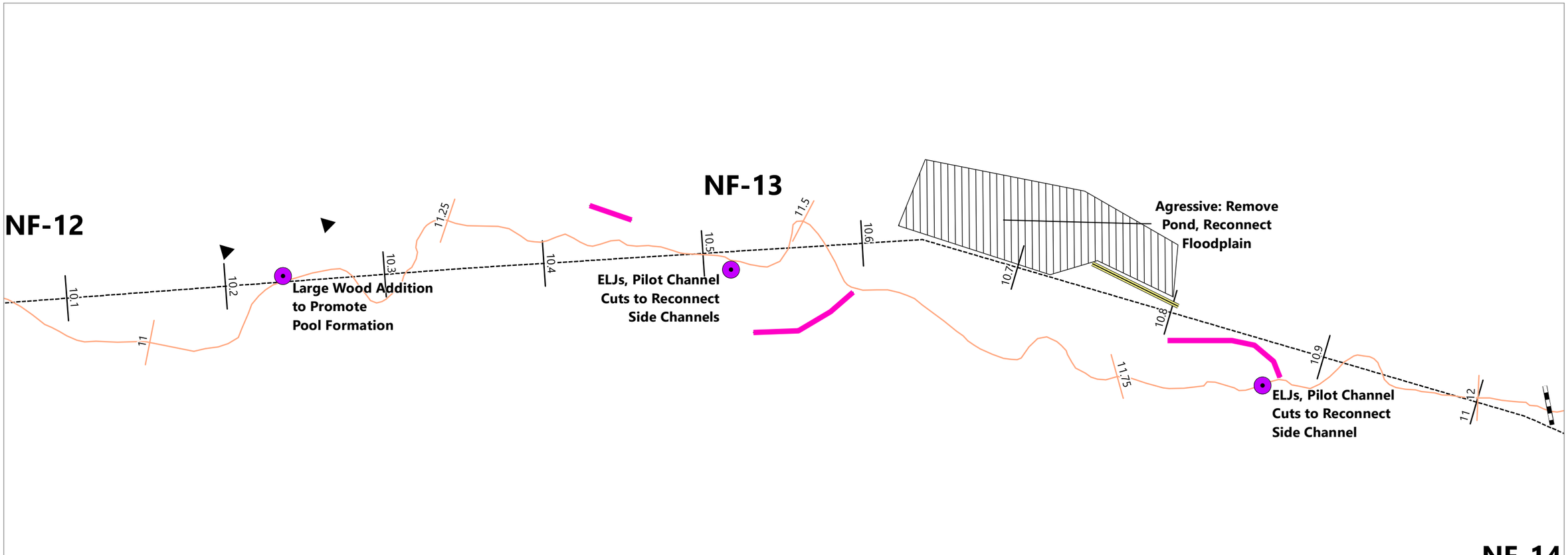
NF-11
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration



LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain
- Long Term: Set Back Road

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

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5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 10.92
RIVER MILE END: 12.05
VALLEY MILE START: 10.1
VALLEY MILE END: 11.07

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Feet

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NF-13
Conceptual Restoration Map
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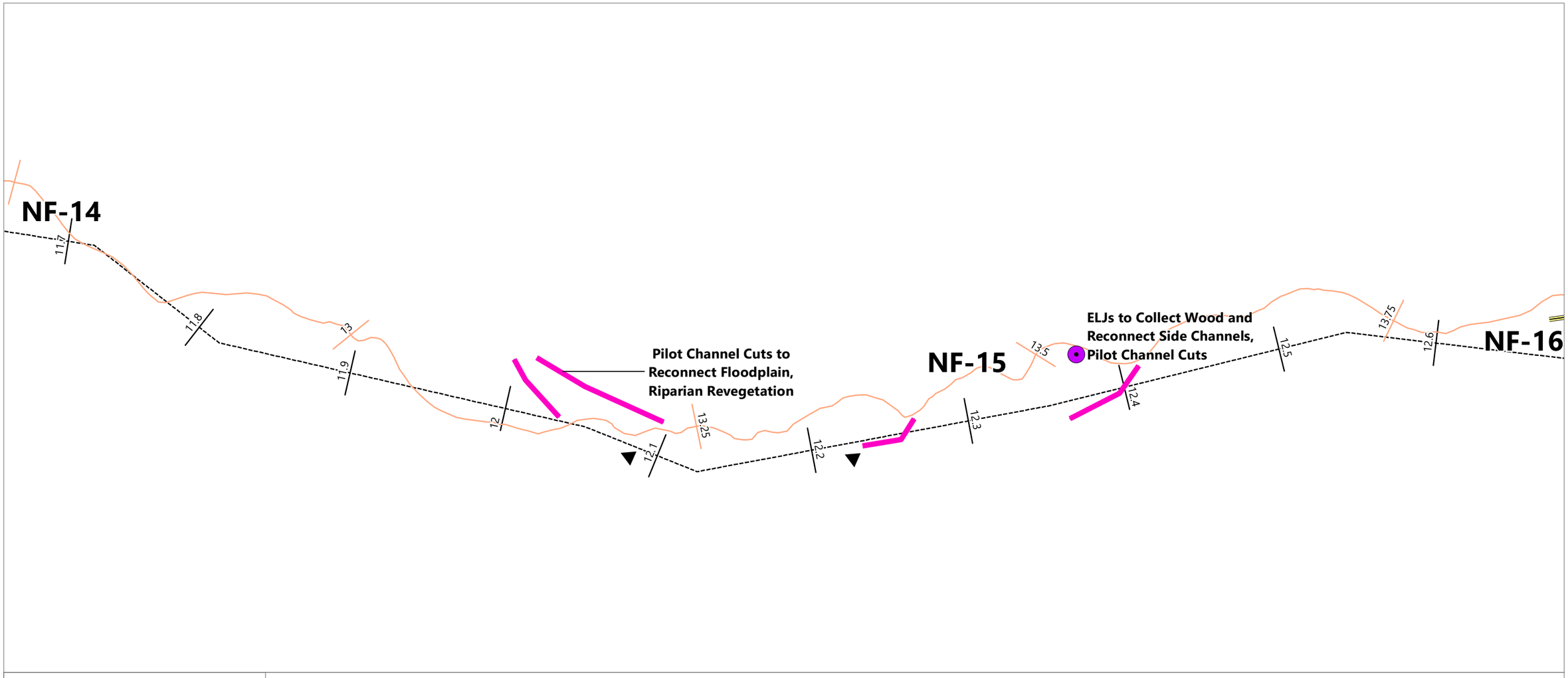
Touchet River Conceptual Restoration



LEGEND:

- Delineated Levees
- Wood Addition
- Reconnect Side Channel
- Long Term: Set Back Road
- Riparian Enhancement

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 12.82
RIVER MILE END: 13.83
VALLEY MILE START: 11.74
VALLEY MILE END: 12.67

0 500
Feet

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NF-15
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Tier 2

Project Areas in the Upper North Fork Touchet Reach

Project Area NF-6

River Length (mi)	1.22
Valley Length (mi)	1.17
Sinuosity	1.04
Average Slope	1.56%
Total Levee Length	0.79
Project Area Score	2.6
Basin Rank	20
Connectivity Score	0.17
Encroachment Removal Potential	21%
Aggradation Potential	3%
Total Potential	37%
2-year Connected Area (ac/rm)	12.1
Total Potential Area (ac/rm)	7.08
Complexity Score (SCE)	0.32
Excess Transport Capacity (psf)	-0.123

Recommended Restoration Actions

- Remove or set back levees through VM 3.9 to VM 4.5
- ELJs to promote split flow and complexity
- Pilot channel cuts to reconnect floodplain

Project Area NF-9

River Length (mi)	0.52
Valley Length (mi)	0.55
Sinuosity	0.96
Average Slope	1.72%
Total Levee Length	0.39
Project Area Score	2.0
Basin Rank	30
Connectivity Score	0.13
Encroachment Removal Potential	13%
Aggradation Potential	7%
Total Potential	28%
2-year Connected Area (ac/rm)	6.5
Total Potential Area (ac/rm)	2.48
Complexity Score (SCE)	0.06
Excess Transport Capacity (psf)	0.225

Recommended Restoration Actions

- Remove or set back levees through VM 7.1 to VM 7.3
- ELJs to promote aggradation and sinuosity in straight bedrock reaches

Project Area NF-10

River Length (mi)	1.32
Valley Length (mi)	1.21
Sinuosity	1.09
Average Slope	2.05%
Total Levee Length	0.40
Project Area Score	1.6
Basin Rank	36
Connectivity Score	0.14
Encroachment Removal Potential	16%
Aggradation Potential	6%
Total Potential	25%
2-year Connected Area (ac/rm)	15.2
Total Potential Area (ac/rm)	5.21
Complexity Score (SCE)	0.47
Excess Transport Capacity (psf)	-0.067

Recommended Restoration Actions

- ELJs to stabilize existing split flow and maintain existing complexity
- Establish channel migration protection area

Tier 2

Project Areas in the Upper North Fork Touchet Reach

Project Area NF-14

River Length (mi)	0.77
Valley Length (mi)	0.67
Sinuosity	1.15
Average Slope	2.44%
Total Levee Length	0.00
Project Area Score	2.2
Basin Rank	25
Connectivity Score	0.16
Encroachment Removal Potential	22%
Aggradation Potential	4%
Total Potential	29%
2-year Connected Area (ac/rm)	6.9
Total Potential Area (ac/rm)	2.79
Complexity Score (SCE)	0.18
Excess Transport Capacity (psf)	-0.127

Recommended Restoration Actions

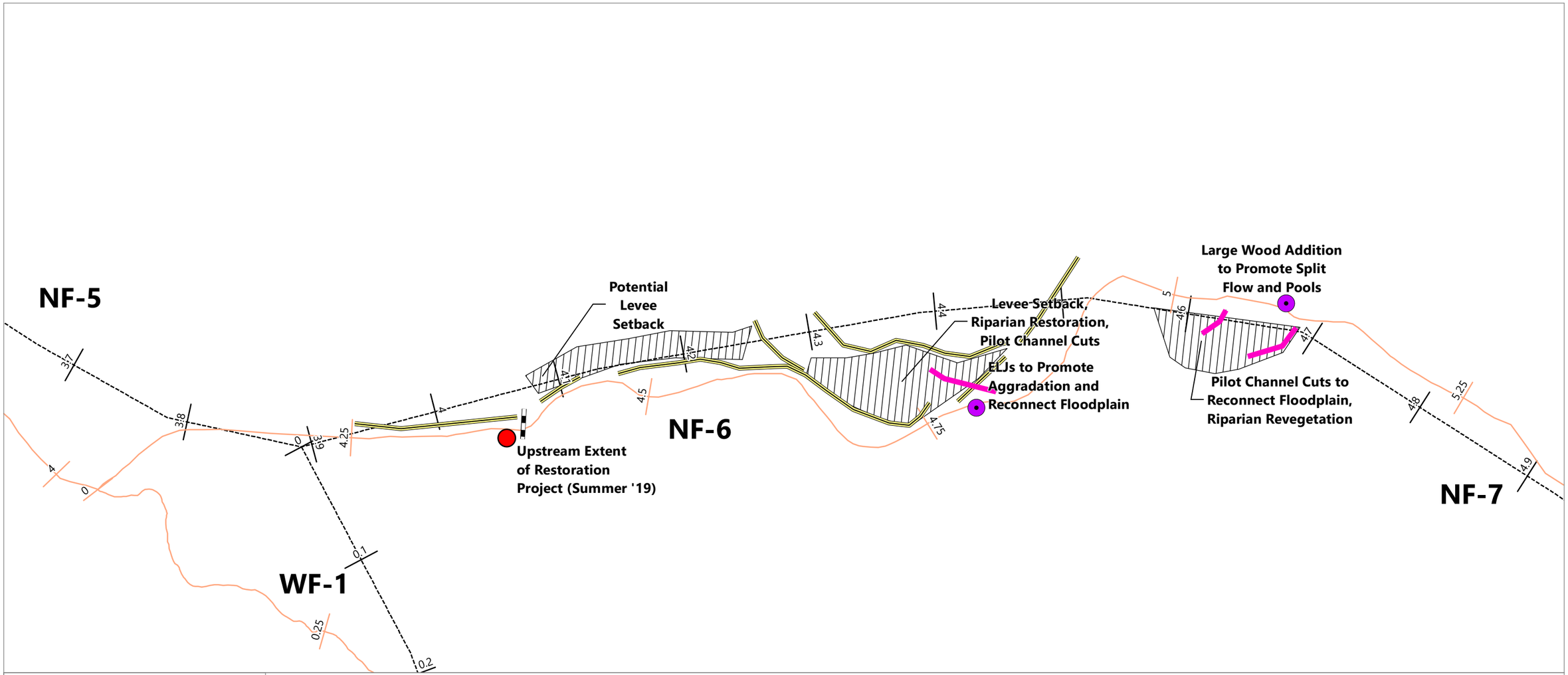
- Large wood addition to promote pool formation and strategically benefit residential infrastructure
- Add large woody material to promote in-channel complexity

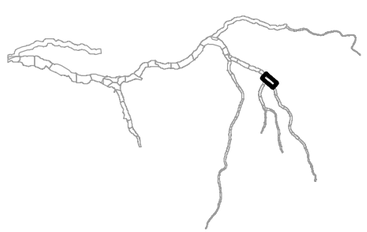
Project Area NF-16

River Length (mi)	1.55
Valley Length (mi)	1.40
Sinuosity	1.11
Average Slope	2.91%
Total Levee Length	0.23
Project Area Score	2.6
Basin Rank	19
Connectivity Score	0.13
Encroachment Removal Potential	14%
Aggradation Potential	8%
Total Potential	23%
2-year Connected Area (ac/rm)	7.5
Total Potential Area (ac/rm)	2.28
Complexity Score (SCE)	0.25
Excess Transport Capacity (psf)	0.150

Recommended Restoration Actions

- ELJs to stabilize existing split flow and maintain existing complexity
- Establish channel migration protection area





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain
- Placemark

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 4.03
RIVER MILE END: 5.25
VALLEY MILE START: 3.68
VALLEY MILE END: 4.84

0 500
Feet

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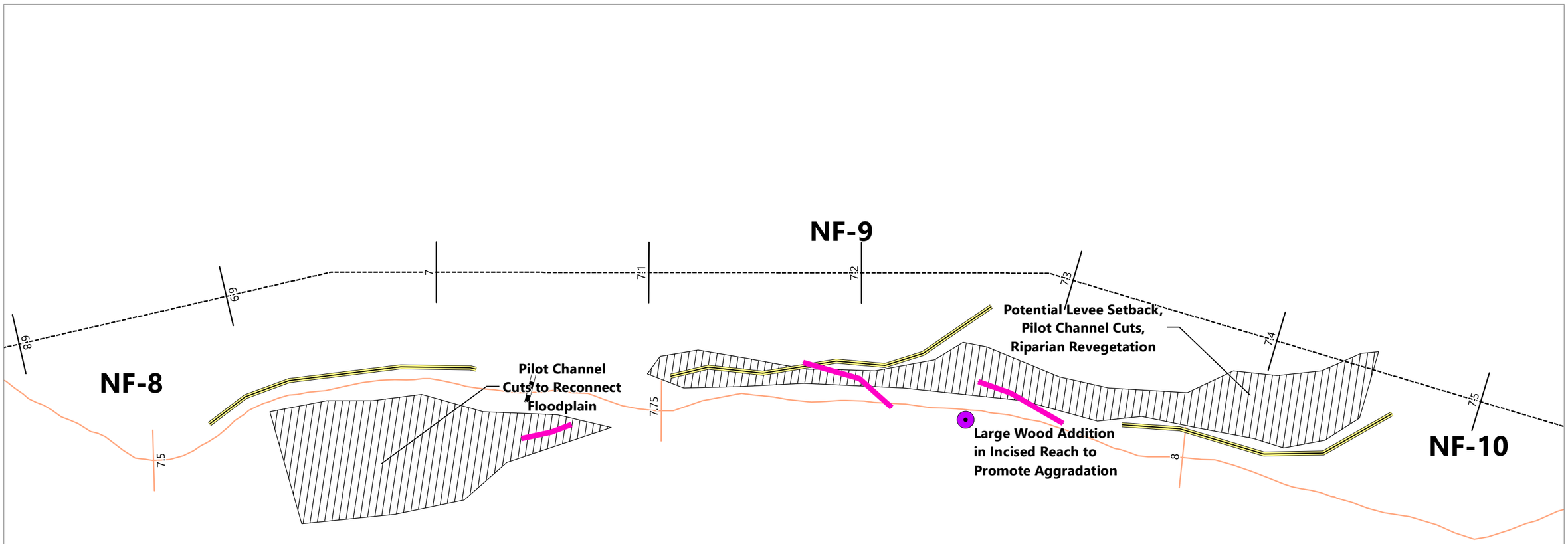
NF-6
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration



LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 7.56
RIVER MILE END: 8.08
VALLEY MILE START: 6.93
VALLEY MILE END: 7.47

0 500
Feet

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NF-9
Conceptual Restoration Map
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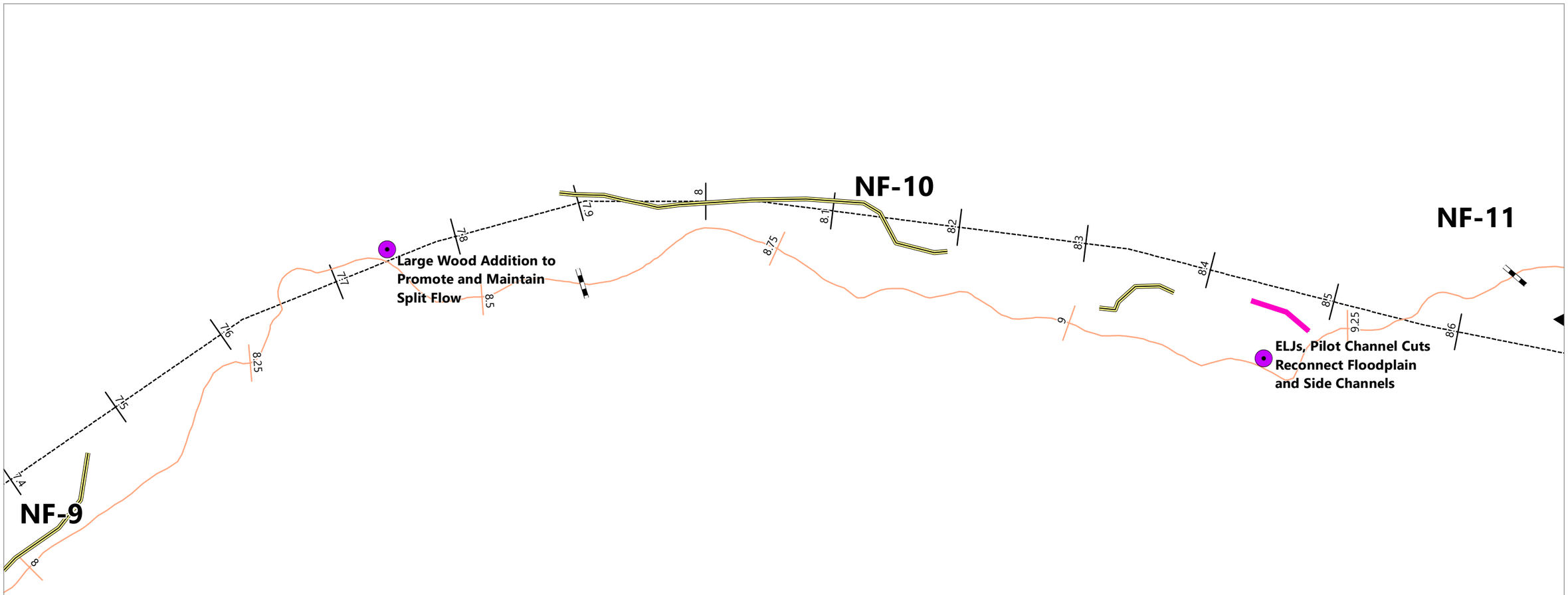
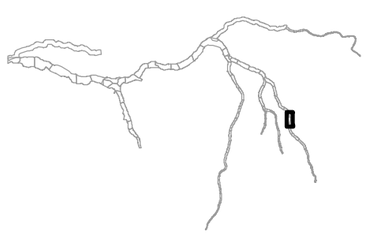
Touchet River Conceptual Restoration





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Long Term: Set Back Road

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 8.08
RIVER MILE END: 9.4
VALLEY MILE START: 7.47
VALLEY MILE END: 8.68

0 500
Feet

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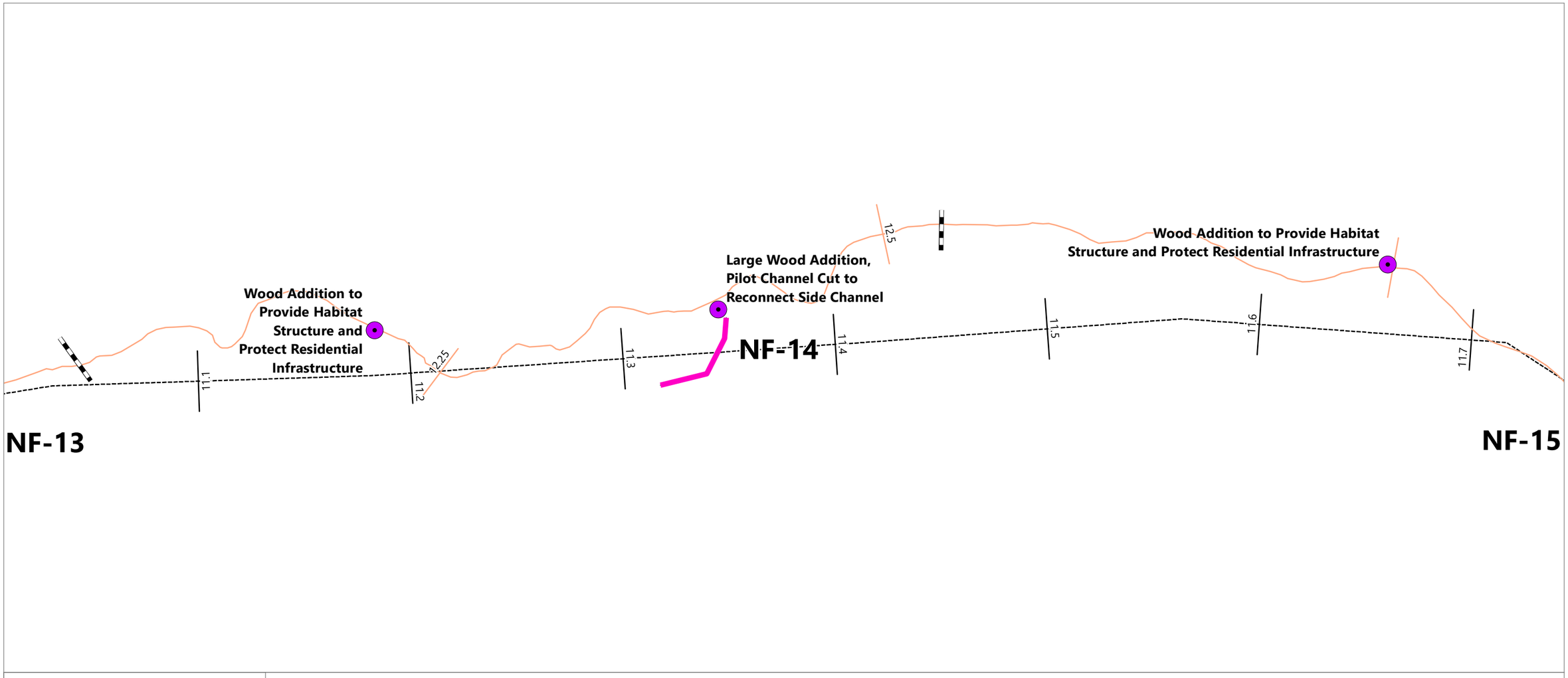
NF-10
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration



LEGEND:

- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 12.05
RIVER MILE END: 12.82
VALLEY MILE START: 11.07
VALLEY MILE END: 11.74

0 500
Feet

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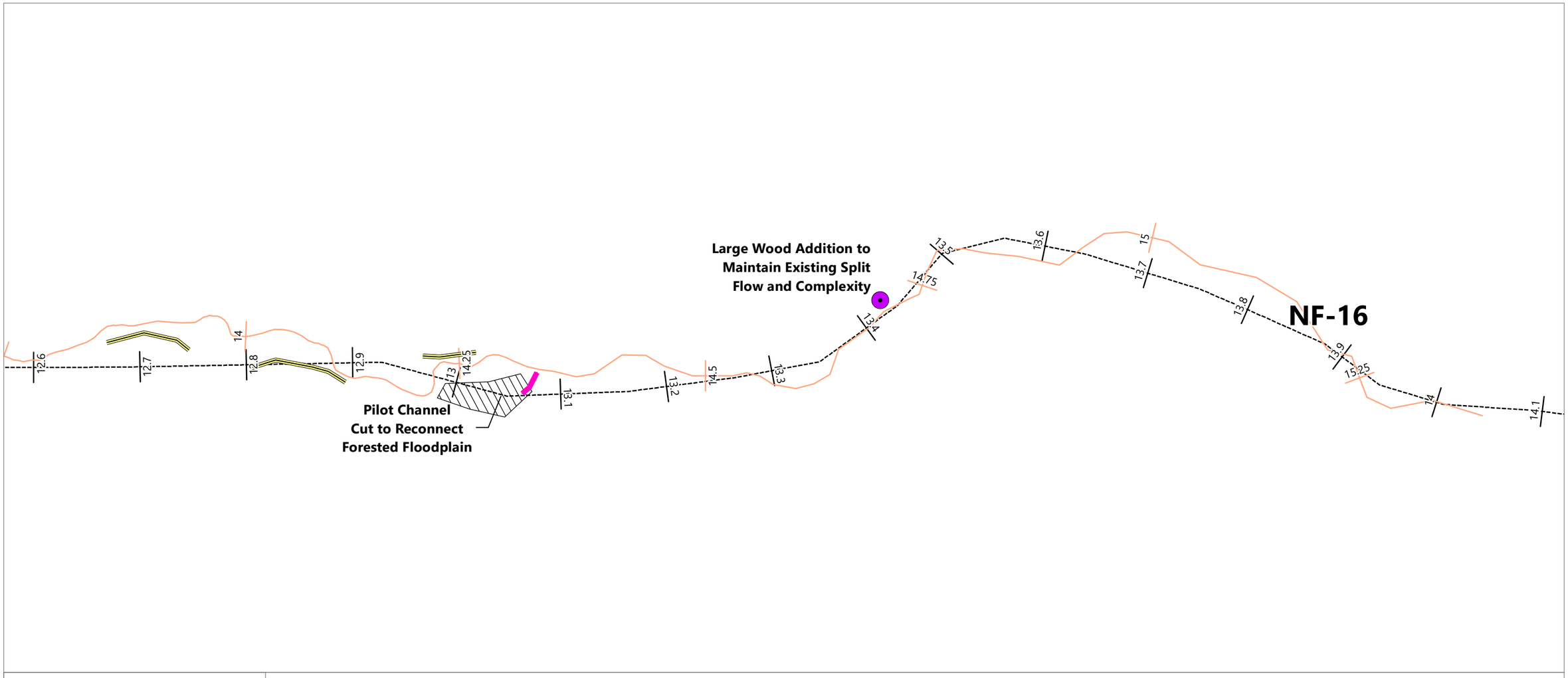
NF-14
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration



LEGEND:

- Delineated Levees
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 13.83
RIVER MILE END: 15.38
VALLEY MILE START: 12.67
VALLEY MILE END: 14.06

0 500
Feet

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NF-16
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Tier 3

Project Areas in the Upper North Fork Touchet Reach

Project Area NF-7

River Length (mi)	0.93
Valley Length (mi)	0.86
Sinuosity	1.08
Average Slope	1.69%
Total Levee Length	0.04
Project Area Score	1.3
Basin Rank	41
Connectivity Score	0.09
Encroachment Removal Potential	5%
Aggradation Potential	9%
Total Potential	16%
2-year Connected Area (ac/rm)	8.0
Total Potential Area (ac/rm)	1.56
Complexity Score (SCE)	0.20
Excess Transport Capacity (psf)	0.162

Recommended Restoration Actions

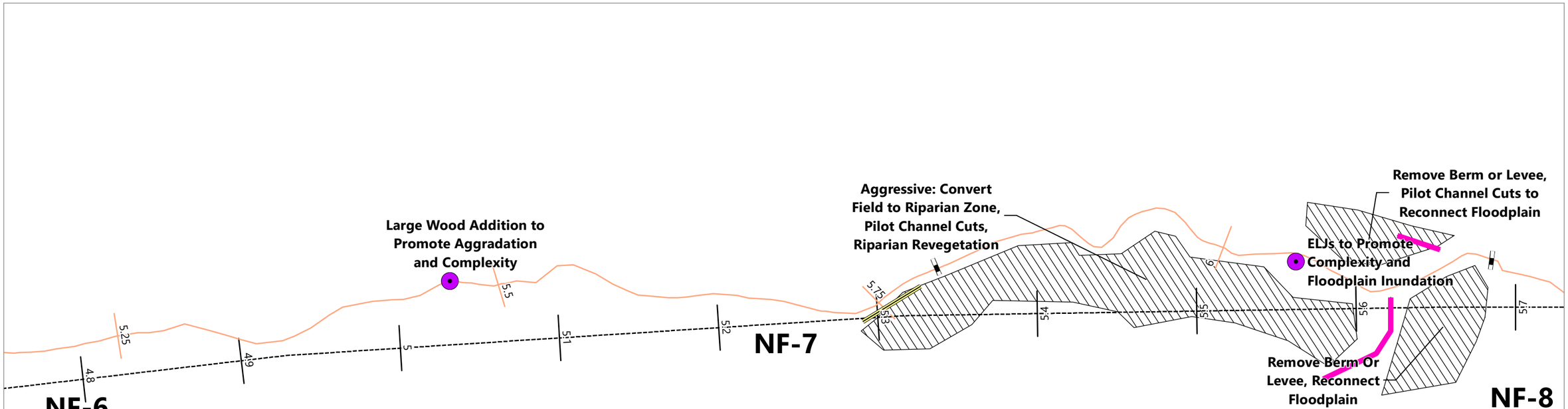
- Pilot channel cuts to reclaim floodplain
- ELJs to promote aggradation and sinuosity in linear reaches

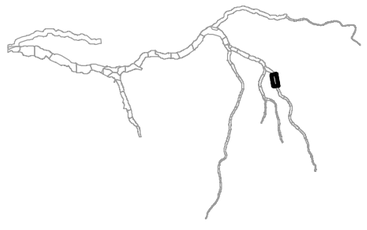
Project Area NF-12

River Length (mi)	0.85
Valley Length (mi)	0.77
Sinuosity	1.11
Average Slope	2.10%
Total Levee Length	0.00
Project Area Score	1.1
Basin Rank	44
Connectivity Score	0.11
Encroachment Removal Potential	11%
Aggradation Potential	6%
Total Potential	22%
2-year Connected Area (ac/rm)	12.1
Total Potential Area (ac/rm)	3.37
Complexity Score (SCE)	0.28
Excess Transport Capacity (psf)	-0.094

Recommended Restoration Actions

- ELJs to promote aggradation and sinuosity in linear reaches
- ELJs to promote pool formation and strategically benefit residential infrastructure





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 5.25
RIVER MILE END: 6.19
VALLEY MILE START: 4.84
VALLEY MILE END: 5.7

0 500
Feet

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NF-7
Conceptual Restoration Map
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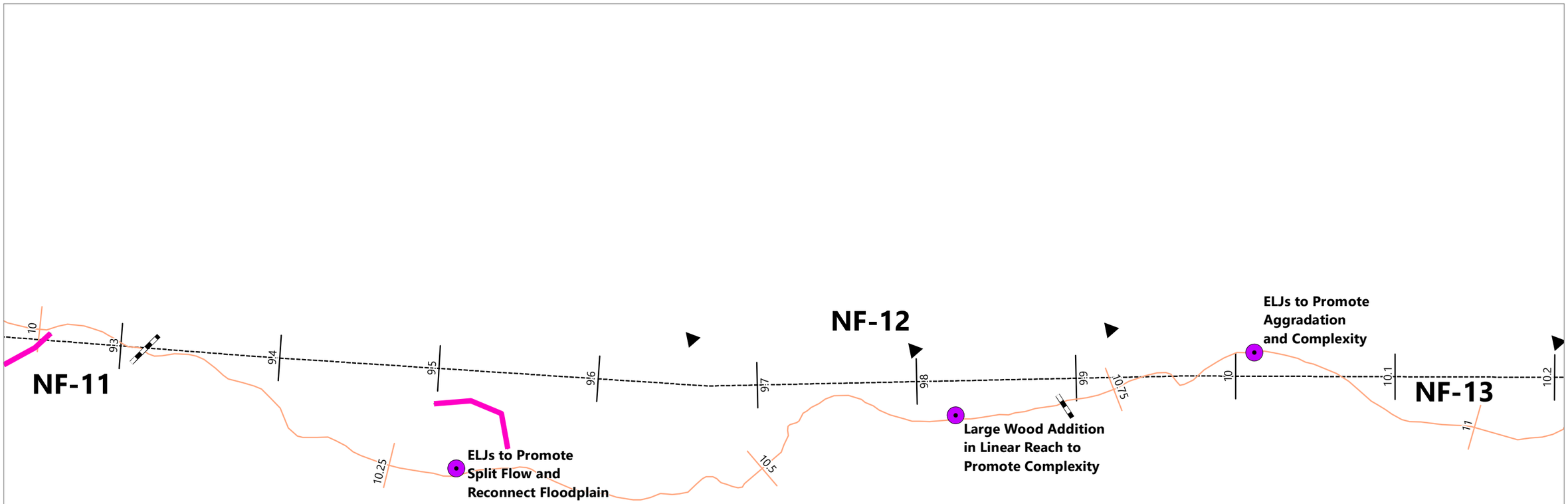
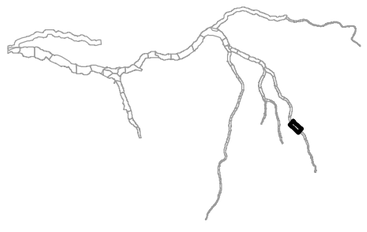
Touchet River Conceptual Restoration





LEGEND:

- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Long Term: Set Back Road

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

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5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 10.07
RIVER MILE END: 10.92
VALLEY MILE START: 9.33
VALLEY MILE END: 10.1

0 500
Feet

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NF-12
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

South Fork Touchet Reach

Reach Description

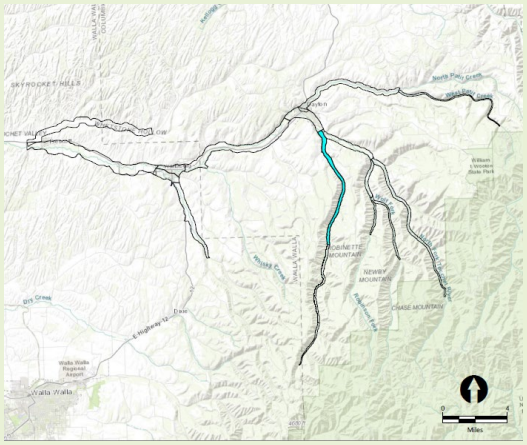
The South Fork Touchet reach runs from the downstream border of the Rainwater Wildlife Area operated by the Confederated Tribes of the Umatilla Indian Reservation to the confluence with the North Fork at the upstream end of Dayton. This reach is 8.9 river miles long and has no notable tributaries. The Rainwater Wildlife Area reach is a 9.34-mile reach upstream that contains the major tributaries to the South Fork: the Green Fork, Burnt Fork, and Griffin Fork of the Touchet River. The South Fork Touchet reach includes eight project areas from SF-1 to SF-8.

Floodplain and Riparian Area

Land use through most of the reach is characterized by agricultural fields in the lower portion, and rangeland and private residences in the upper portion. Relative to other forks of similar discharge, much of the South Fork Touchet reach has well-established channel migration area. The number of levees increases from upstream to downstream within the reach, coinciding with reaches surrounded by irrigated fields. The river is more connected with its floodplain in project areas SF-2, SF-4, SF-6, and SF-8 while the opposite trend is true and the river is more confined in the odd numbered project areas. Riparian vegetation through this corridor is mixed and transitions from coniferous to deciduous from upstream to downstream. Young alders and cottonwoods were the

South Fork Touchet

Vicinity Map



Reach Characteristics

River	South Fork Touchet River
Parent River	Touchet River
River Distance to Confluence (mi)	0.00
Valley Distance to Confluence (mi)	0.00
River Length (mi)	8.90
Valley Length (mi)	7.61
Sinuosity	1.18
Average Slope	1.21%
Delineated Project Areas	SF-1 to SF-8 (8)
Total Levee Length (mi)	3.04
Notable Tributaries	N/A

predominant trees in the surveyed reaches of SF-1, SF-3, and SF-4. Cottonwood recruitment is a well-known ecological indicator of connected floodplain, and the range of ages of observed cottonwoods indicates that these reaches are regularly inundated. Blackberries exist in riparian thickets throughout the reach and may be preventing establishment of native riparian trees. A large thicket of blackberries lined the lower right bank of SF-1. In areas of the South Fork Touchet reach that have room to inundate the floodplain, large gravel bars often form, and significant opportunity exists to vegetate these large gravel bars throughout the reach.

Channel Conditions

Channel complexity throughout the reach was varied, with several side channels and split flows in unconfined project areas SF-4, SF-6, and SF-8. Other project areas including SF-3 and SF-7 lacked complexity and had more linear confinements. Bedrock reaches were observed in the downstream sections of SF-4 and in multiple sections of SF-3 where the river encountered the valley wall. Bedrock pools were prevalent in the bedrock reaches of SF-3 and SF-4. Instream wood in the surveyed reaches was low in SF-1 and SF-3, while more natural log jams were observed in the middle part of SF-4. These log jams were associated with side channel formation and helped create pools that were the only usable refugia for salmonids during summer low-flow conditions.

Beaver activity is present in this reach and the location of a former beaver dam was observed in SF-4, although it appeared to be recently altered by machinery. The right floodplain was inundated at the former site of the dam, and the section upstream of the former dam revealed signs of aggradation. Engineered bank protection was observed in this reach, particularly on the lower end of SF-4 where multiple scrap cars had been placed as bank protection.

Influencing Anthropogenic Features

Agriculture and grazing play a large role in this section of the Touchet basin and is a factor in most influencing features. More than 3.0 miles of levees protect both residential and agricultural infrastructure and fields. Levees and incision play a large role in the confinement of the reach, particularly in project areas SF-3 and SF-7. Grazing by cattle was observed adjacent to both the SF-3 and SF-4 reaches, presenting a potential impact on riparian vegetation, erosion, and stream nutrient loading. The South Touchet Road is another notable encroachment in the reach. Several bridges cross the river in this reach and likely influence the geomorphic processes through floodplain constriction, hydraulic backwater, and sediment transport continuity. These bridges include the following:

- Magill Lane in project area SF-1
- Harting Grade Road in project area SF-2
- Pettyjohn Grade Road in project area SF-3
- South Touchet Road between project areas SF-3 and SF-4

- Private bridges in SF-7 and SF-8
- South Touchet Road at the upstream boundary of SF-8

Qualitative Factors and Reach Priority

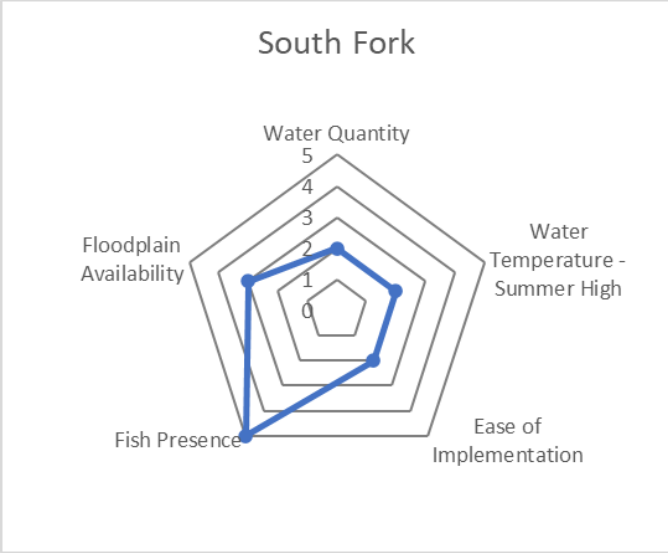
The South Fork Touchet reach falls in Reach Priority 2 (out of 3) for reaches included in the Touchet watershed prioritization framework. This Reach Priority ranking is for the South Fork Touchet reach as a whole; individual project areas within this reach may rank differently in the prioritization. This Reach Priority is meant to provide some overall insight into factors that are not considered in the project area prioritization and are likely very different between the reaches in this assessment.

Water Quantity

While the South Fork is a larger tributary to the mainstem Touchet River, the flows vary greatly from a medium-sized river to nearly no flow. During the lowest flow periods, the South Fork is known to go completely subsurface for short stretches, which greatly limits the habitat viability. For the majority of the reach, the amount of flow typically only supports one habitat condition in a typical cross section and is unlikely to have side channels or inundated floodplain during low flows. Where low-lying floodplain is available, inundation does happen during spring freshet and higher flow events. These higher flows do initiate geomorphic change when suitable sediment material and floodplain is available. This reach receives a score of 2 (out of 5) for water quantity

South Fork Touchet

Qualitative Factors



Reach Score (_/5)	2.8
Reach Rank (_/9)	6
Reach Priority (_/3)	2
Primary Reach Concerns:	Floodplain Availability Water Quantity High Summer Temperatures Ease of Implementation

This reach scored in Tier 2 because of low summer flows in the lower reach with temperatures near the survivability threshold. Residential and agricultural infrastructure limits floodplain availability in areas.

Summer High Water Temperature

Temperatures are not gaged regularly on the South Fork Touchet reach, but temperatures are generally regarded as warmer than in the North Fork where the high summer month temperatures are typically near or below 20°C. This temperature borders on the survivability limit for salmonids, and it is likely that stretches of the South Fork are sub-optimal temperature habitat. However, these temperatures likely decrease at the upstream end of the reach and more ideal temperatures likely exist there and in deep pools, under overhanging cover, and near groundwater inputs throughout the reach. The South Fork Touchet reach receives a score of 2 (out of 5) for summer high water temperatures.

Ease of Implementation

Land ownership in the South Fork Touchet reach is a mix of small- and large-sized private parcels. Near the downstream end of the reach are several larger properties engaged in agricultural activities. Landowner willingness to participate in restoration work is unknown, but gaining permissions and access to multiple parcels presents a challenge for implementing larger projects. While some bridges and access routes exist, much of the South Fork has little or no existing access to the river, making any restoration project involving construction equipment more difficult. This reach receives a score of 2 (out of 5) for ease of implementation.

Fish Presence

Several counts of juvenile fish use have been performed in this reach. Juvenile summer steelhead are shown to occasionally rear in this reach and over-wintering 1+-year-old juvenile steelhead are also present in this reach. Bull trout and Chinook salmon are not documented rearing in this reach. Adult steelhead are known to migrate through this reach and spawn throughout the North Fork basin. This reach receives a score of 5 (out of 5) for fish presence.

Floodplain Availability

Land use in the South Fork Touchet reach is mixed between agricultural use and residential use, and there are many instances of buildings and infrastructure bordering or in the floodplain. There are stretches in the upstream sections of the reach were the river has a channel migration area and established riparian vegetation. However, other sections of the reach are leveed or incised to bedrock with little to no floodplain availability. This reach receives a score of 3 (out of 5) for floodplain availability.

Summary of Restoration Strategies

The following restoration actions are recommended based on the above information, as well as field observations and the desktop analysis and prioritization results. While other restoration actions should be considered at a project implementation level, the following should all be considered for any project in this reach. Details on how these restoration actions might be applied on a project area level are provided in the next section.

Establish Channel Migration Area

Much of this reach already has a large channel migration area, which provides room for natural geomorphic processes, as well as room for flood inundation and the establishment of riparian vegetation. While these areas often require additional restoration due to lack of instream complexity and established vegetation, an established channel migration area provides an excellent first step for restoration of natural processes. A significant issue in this reach is formation of meander bends that continue to erode agricultural land. This is detrimental to stream habitat because eroding banks are a fine sediment source and are not vegetated or shaded. Landowners also desire to limit losses of fields and rangeland to these meanders. Current landowner actions, including beaver dam removal and reworking the channel, have already been taken in the SF-4 reach to counteract locations of bank erosion, and it is in the best interest of salmonid habitat to discourage further need for earthwork in the active channel.

A compromise should be made in these locations to establish a boundary to protect the existing channel migration area while installing log structures or conducting levee setbacks to establish a boundary between the channel and agricultural land. These measures will contribute to fish habitat while benefiting landowners.

Establish Riparian Vegetation

Many of the sections of this reach that have an established channel migration area have large unvegetated gravel bars or banks with very little mature vegetation. Riparian vegetation has been shown to be critical to ecological and geomorphic processes. For this reach in particular, riparian vegetation is critically needed to provide a renewable and constant source of instream wood, as well as to provide overhanging cover and shade.

Establishing mature stands of vegetation in the immediate riparian area and channel migration areas should be a restoration target for this reach. Restoration actions should target establishing vegetated gravel bars and may require stabilizing features such as large apex engineered log jams. Additionally, restoration actions should seek to establish stands of riparian species in locations where the floodplain has been reconnected through restoration and active channel migration.

Finally, some agricultural grazing was observed through this reach and likely influences establishment of riparian vegetation. Grazing exclusions should be considered as part of any vegetation-focused restoration actions.

Add Instream Wood and Complexity

Much of this section is characterized by relatively low amounts of in-channel large woody material. Where instream wood does exist, scour pools and geomorphic complexity are almost always evident. As in many systems, large wood in this reach is a key part of the geomorphic and ecological processes. However, most of the project areas in this reach lack the volume of large woody material necessary to initiate these processes. Large woody material would be useful to promote aggradation in bedrock reaches and maintain existing split flows in the more complex sections of this reach.

Adding large woody material in strategic locations that will most benefit the natural processes should be a primary restoration action in all project areas in this reach. Instream wood should be placed primarily to help restore the geomorphic processes that result in side channel formation, split flow and vegetated gravel bar building, sediment storage, channel aggradation, and pool formation. Large wood will be key to providing erosion protection in eroding banks while simultaneously providing cover and pools for salmonids. Large wood placement should be considered as a way to establish boundaries between fields and the channel migration area.

Remove Confinement (Encroachments and Incision)

Most of the project areas in the South Fork Touchet reach have some impacts from levees and other encroachments. In several sections of this reach, the channel has incised and confined to the point of running on bedrock, particularly in project area SF-3. The analysis results for connectivity (provided in the next section) demonstrate the effects of these levees and incision on available floodplain. In addition, the analysis results for excess transport capacity demonstrate that confinement of the channel and floodplain leads to increased sediment transport capacity for the project areas within this reach.

Providing room for the river to actively migrate and inundate is vital to the natural processes in the reach and will have a large effect on the success of the other restoration actions listed. Where possible, levees and encroachments should be removed or set back to reconnect low-lying floodplain and relic side channels. Incised channels should be targeted for sediment deposition and floodplain benching to reconnect these areas.

Tier 2

Project Areas in the South Fork Touchet Reach

Project Area SF-1

River Length (mi)	0.62
Valley Length (mi)	0.54
Sinuosity	1.14
Average Slope	1.04%
Total Levee Length	0.05
Project Area Score	2.2
Basin Rank	24
Connectivity Score	0.20
Encroachment Removal Potential	21%
Aggradation Potential	8%
Total Potential	43%
2-year Connected Area (ac/rm)	7.9
Total Potential Area (ac/rm)	5.95
Complexity Score (SCE)	0.18
Excess Transport Capacity (psf)	0.031

Recommended Restoration Actions

- Install a right bank setback levee to establish channel migration protection area
- ELJs to establish split flow and promote aggradation

  Add large woody material to promote in-channel complexity

Project Area SF-3

River Length (mi)	1.32
Valley Length (mi)	1.24
Sinuosity	1.07
Average Slope	1.21%
Total Levee Length	0.57
Project Area Score	1.8
Basin Rank	32
Connectivity Score	0.13
Encroachment Removal Potential	8%
Aggradation Potential	12%
Total Potential	26%
2-year Connected Area (ac/rm)	6.6
Total Potential Area (ac/rm)	2.29
Complexity Score (SCE)	0.09
Excess Transport Capacity (psf)	0.285

Recommended Restoration Actions

- ELJs to promote aggradation and sinuosity in straight bedrock reaches
- Remove or set back levees through VM 2.0 to VM 2.2 and VM 2.7 to VM 2.9

Project Area SF-6

River Length (mi)	0.68
Valley Length (mi)	0.51
Sinuosity	1.33
Average Slope	1.28%
Total Levee Length	0.23
Project Area Score	1.8
Basin Rank	31
Connectivity Score	0.17
Encroachment Removal Potential	15%
Aggradation Potential	11%
Total Potential	30%
2-year Connected Area (ac/rm)	14.3
Total Potential Area (ac/rm)	6.12
Complexity Score (SCE)	0.71
Excess Transport Capacity (psf)	-0.202

Recommended Restoration Actions

- ELJs to stabilize existing split flow and maintain existing complexity
- ELJs to help vegetate large gravel bars

  Remove levee VM 5.2 to 5.25

Tier 2

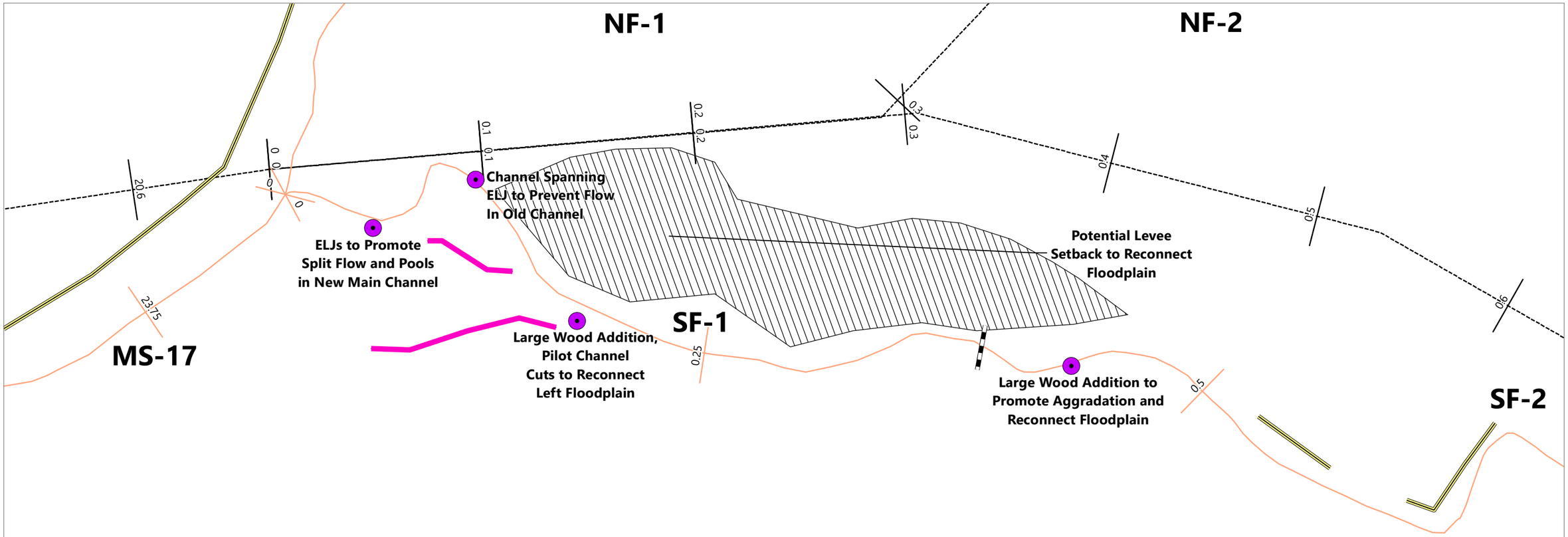
Project Areas in the South Fork Touchet Reach

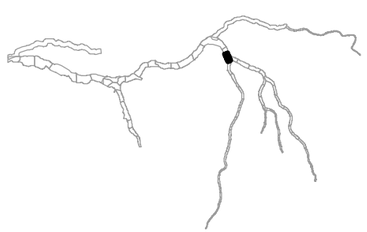
Project Area SF-7

River Length (mi)	1.26
Valley Length (mi)	1.12
Sinuosity	1.12
Average Slope	1.34%
Total Levee Length	0.29
Project Area Score	2.2
Basin Rank	23
Connectivity Score	0.17
Encroachment Removal Potential	13%
Aggradation Potential	15%
Total Potential	31%
2-year Connected Area (ac/rm)	8.5
Total Potential Area (ac/rm)	3.76
Complexity Score (SCE)	0.19
Excess Transport Capacity (psf)	0.011

Recommended Restoration Actions

- Add large woody material and pilot channel cuts to promote in-channel complexity
- Set back levees through VM 6.4 to VM 6.45





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 0
RIVER MILE END: 0.62
VALLEY MILE START: 0
VALLEY MILE END: 0.54

0 500
Feet

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SF-1
Conceptual Restoration Map
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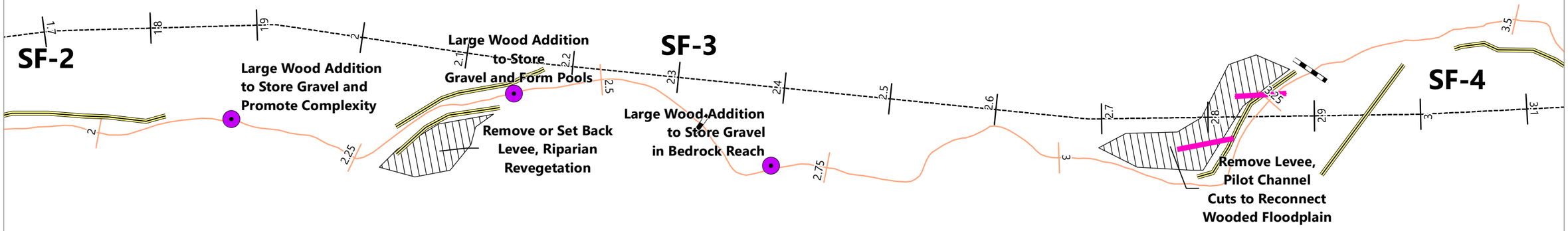

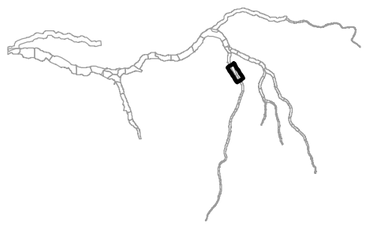

LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 1.98
RIVER MILE END: 3.3
VALLEY MILE START: 1.69
VALLEY MILE END: 2.93

0 500
Feet

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SF-3
Conceptual Restoration Map
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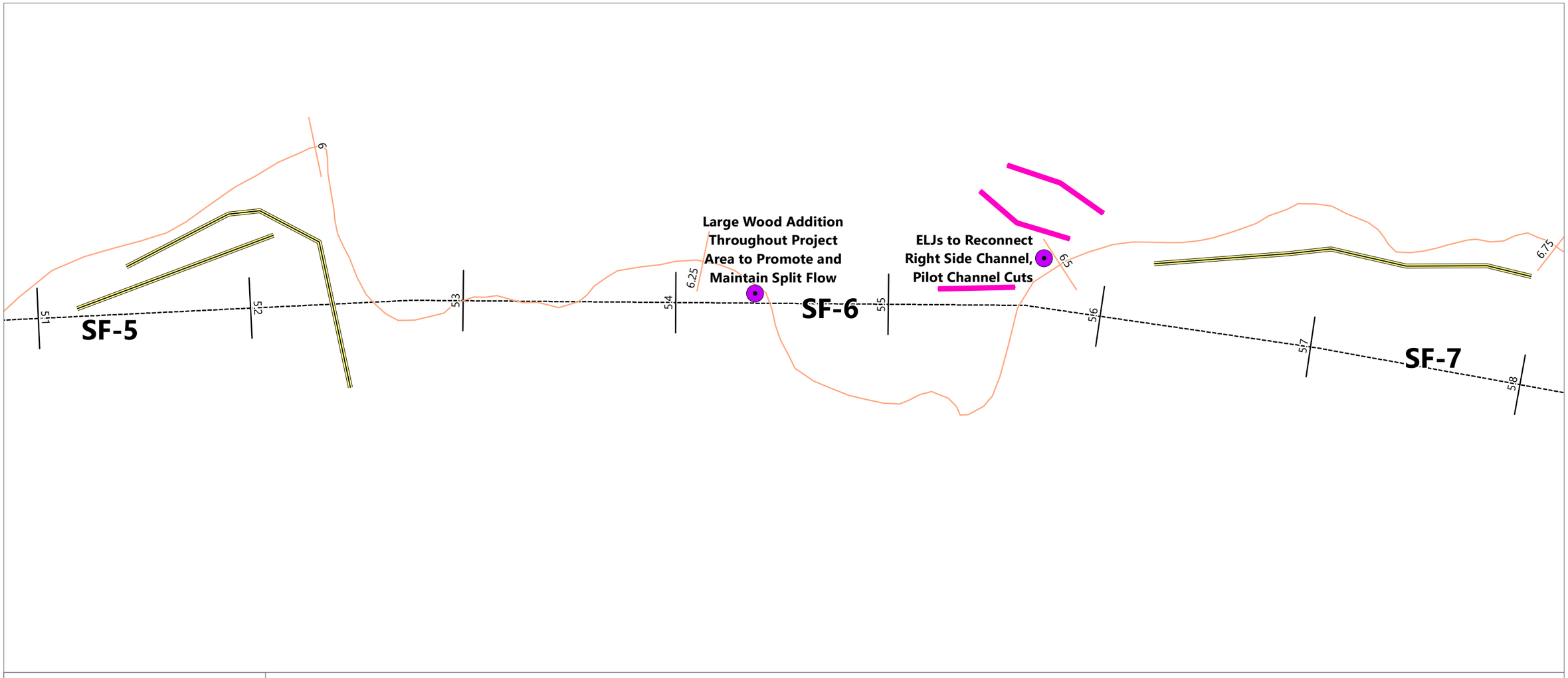
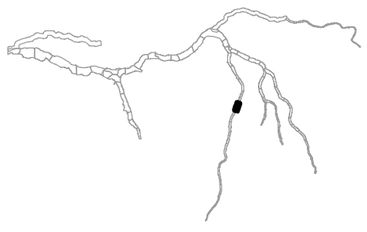
Touchet River Conceptual Restoration





LEGEND:

- Delineated Levees
- Wood Addition
- Reconnect Side Channel

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 5.93
RIVER MILE END: 6.61
VALLEY MILE START: 5.14
VALLEY MILE END: 5.65

0 500
Feet

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SF-6
Conceptual Restoration Map
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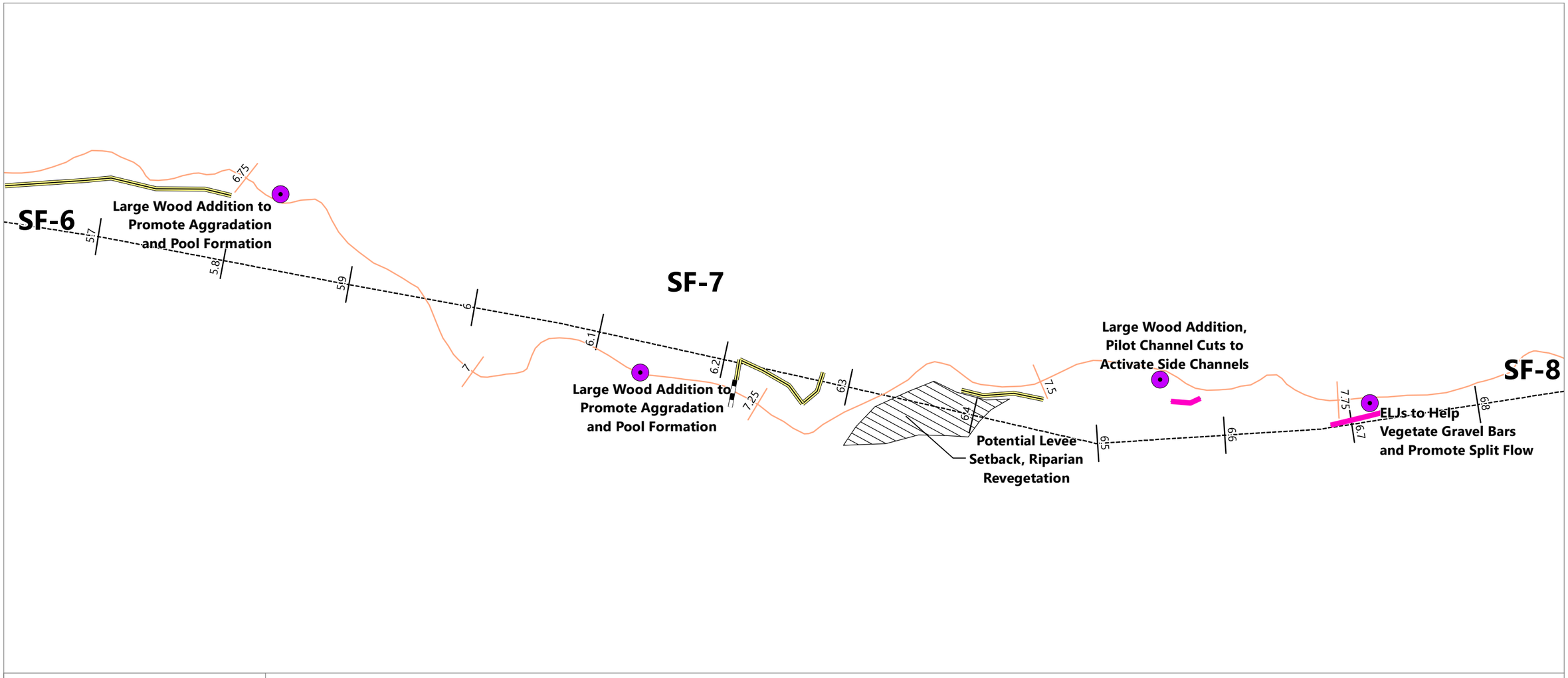

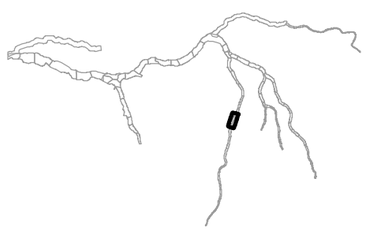

LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 6.61
RIVER MILE END: 7.88
VALLEY MILE START: 5.65
VALLEY MILE END: 6.77

0 500
Feet

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SF-7
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Tier 3

Project Areas in the South Fork Touchet Reach

Project Area SF-2

River Length (mi)	1.36
Valley Length (mi)	1.15
Sinuosity	1.19
Average Slope	1.10%
Total Levee Length	0.93
Project Area Score	1.4
Basin Rank	40
Connectivity Score	0.13
Encroachment Removal Potential	12%
Aggradation Potential	7%
Total Potential	27%
2-year Connected Area (ac/rm)	10.0
Total Potential Area (ac/rm)	3.63
Complexity Score (SCE)	0.29
Excess Transport Capacity (psf)	-0.039

Recommended Restoration Actions

- Remove or breach levees through VM 1.1 to VM 1.6
- ELJs to promote aggradation and sinuosity in straight bedrock reaches

Project Area SF-4

River Length (mi)	1.34
Valley Length (mi)	1.09
Sinuosity	1.23
Average Slope	1.22%
Total Levee Length	0.17
Project Area Score	0.8
Basin Rank	52
Connectivity Score	0.13
Encroachment Removal Potential	7%
Aggradation Potential	14%
Total Potential	24%
2-year Connected Area (ac/rm)	12.4
Total Potential Area (ac/rm)	3.93
Complexity Score (SCE)	0.60
Excess Transport Capacity (psf)	-0.126

Recommended Restoration Actions

- Remove left bank accumulation of old cars through VM 3.0 to VM 3.2
- Add large woody material to promote in-channel complexity
- ELJs to promote aggradation and sinuosity in straight bedrock reaches

Project Area SF-5

River Length (mi)	1.29
Valley Length (mi)	1.13
Sinuosity	1.15
Average Slope	1.21%
Total Levee Length	0.80
Project Area Score	1.5
Basin Rank	37
Connectivity Score	0.10
Encroachment Removal Potential	4%
Aggradation Potential	11%
Total Potential	19%
2-year Connected Area (ac/rm)	8.6
Total Potential Area (ac/rm)	1.98
Complexity Score (SCE)	0.23
Excess Transport Capacity (psf)	0.031

Recommended Restoration Actions

- ELJs to promote aggradation and sinuosity in straight bedrock reaches
- Set back levees through VM 4.0 to VM 4.4

Tier 3

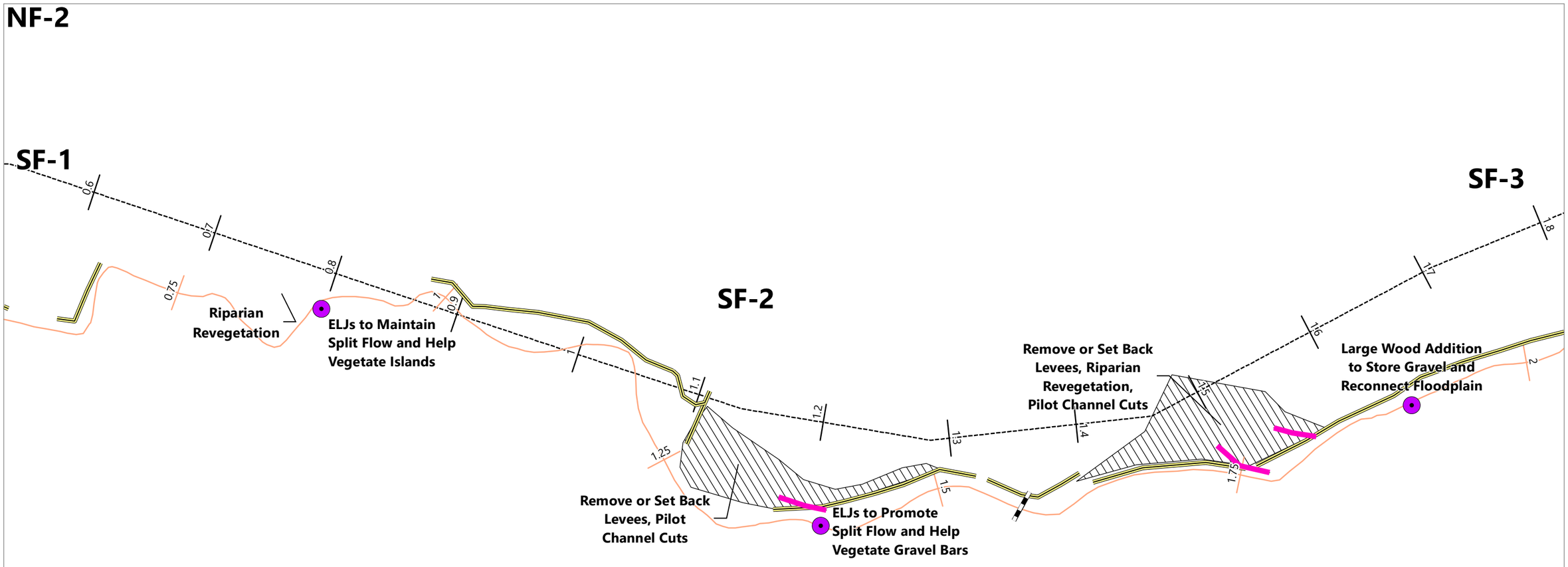
Project Areas in the South Fork Touchet Reach

Project Area SF-8

River Length (mi)	1.02
Valley Length (mi)	0.84
Sinuosity	1.22
Average Slope	1.31%
Total Levee Length	0.00
Project Area Score	1.0
Basin Rank	47
Connectivity Score	0.14
Encroachment Removal Potential	7%
Aggradation Potential	15%
Total Potential	25%
2-year Connected Area (ac/rm)	11.8
Total Potential Area (ac/rm)	3.85
Complexity Score (SCE)	0.55
Excess Transport Capacity (psf)	0.077

Recommended Restoration Actions

- ELJs to help vegetate large gravel bars
- ELJs to stabilize existing split flow and maintain existing complexity



LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain
- Riparian Enhancement

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 0.62
RIVER MILE END: 1.98
VALLEY MILE START: 0.54
VALLEY MILE END: 1.69

0 500
Feet

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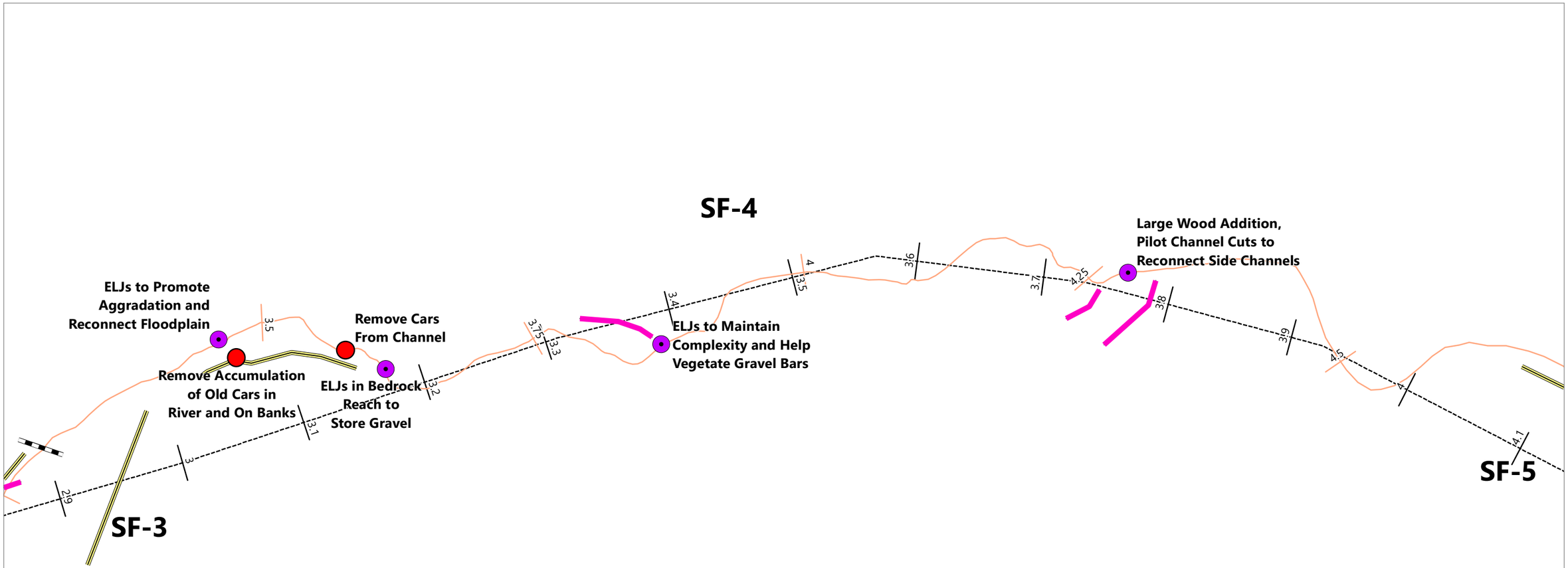
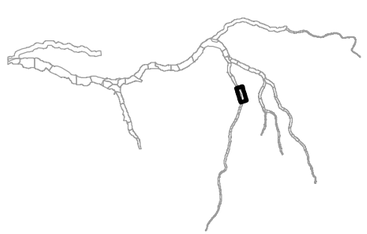
SF-2
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration





LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Placemark

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 3.3
RIVER MILE END: 4.64
VALLEY MILE START: 2.93
VALLEY MILE END: 4.01

0 500
Feet

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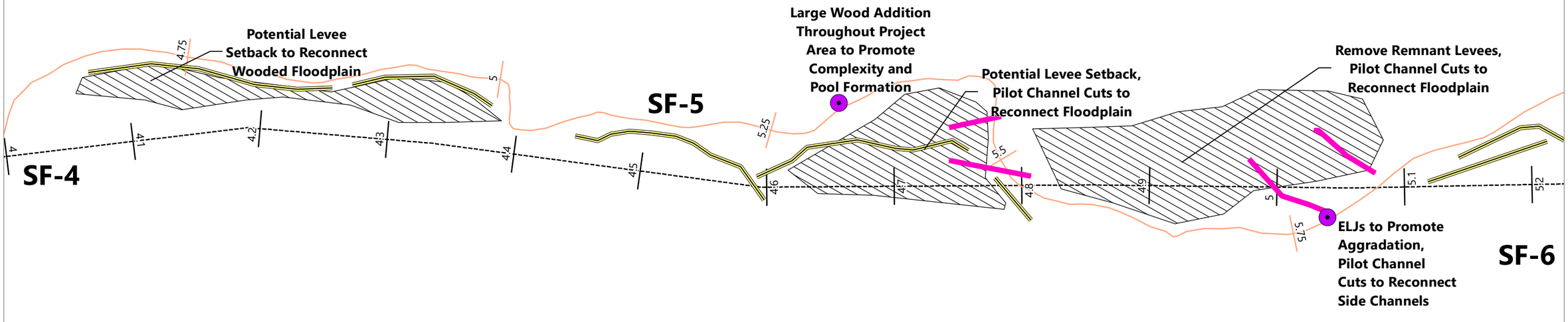
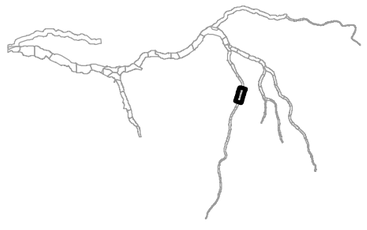
SF-4
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration





LEGEND:

- Delineated Levees
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 4.64
RIVER MILE END: 5.93
VALLEY MILE START: 4.01
VALLEY MILE END: 5.14

0 500
Feet

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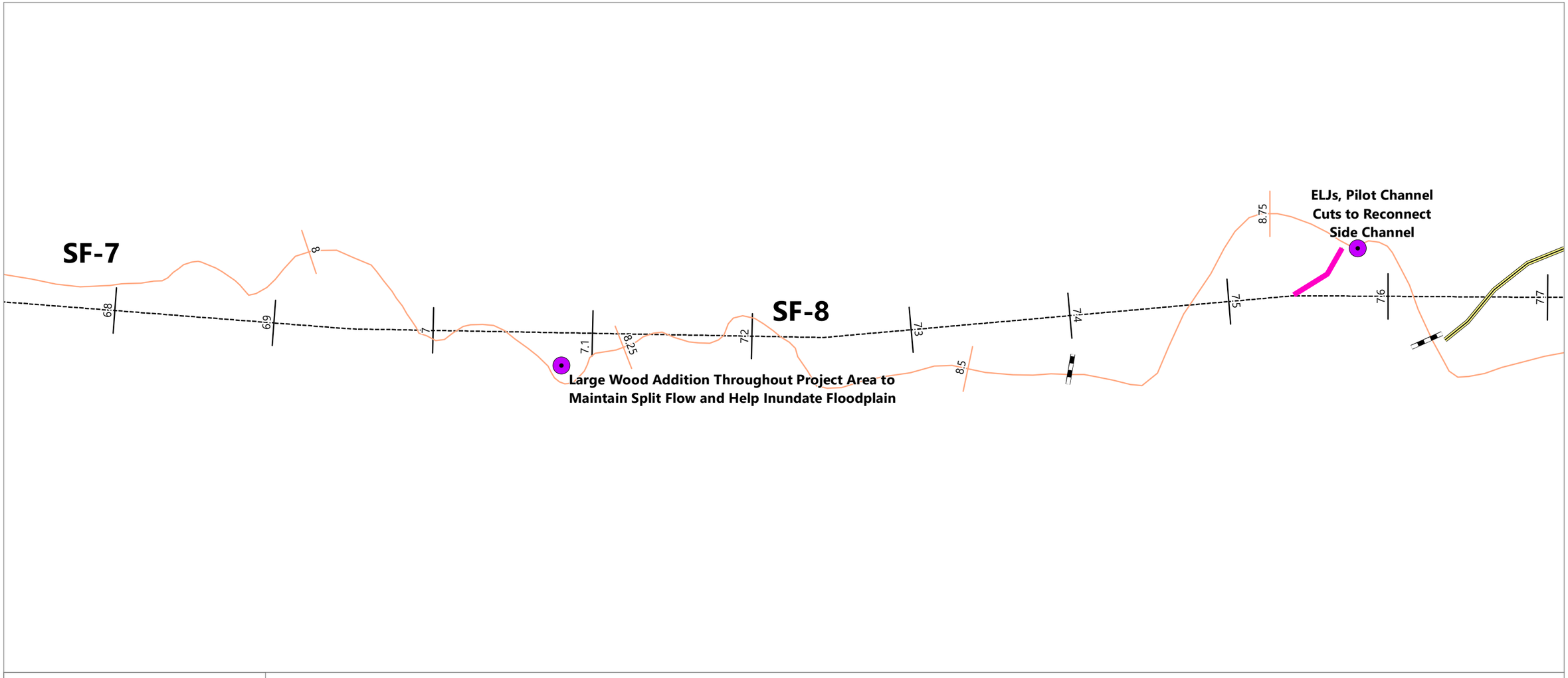
SF-5
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration



LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 7.88
RIVER MILE END: 8.9
VALLEY MILE START: 6.77
VALLEY MILE END: 7.61

0 500
Feet

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SF-8
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Lower Wolf Fork Touchet Reach

Reach Description

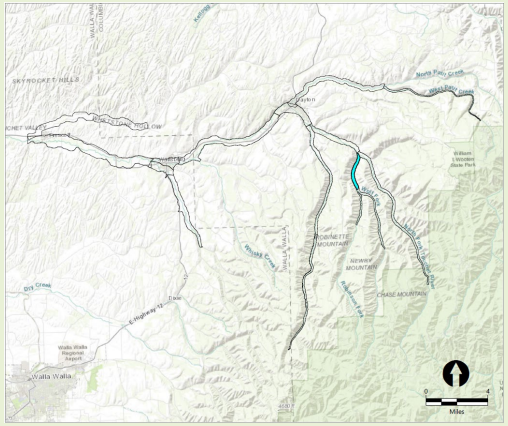
The Lower Wolf Fork Touchet reach runs from just below the confluence with the Robinson Fork downstream to the confluence of the Wolf Fork and North Fork. This reach includes three project areas from WF-1 to WF-3. No notable tributaries enter the river in this reach. In-channel stream surveys were not conducted due to challenges with obtaining landowner permissions, and the following descriptions are based on aerial and LiDAR evaluations.

Floodplain and Riparian Area

Land use through most of the reach is characterized by agricultural fields and private residences. A moderately wide channel migration corridor exists for most of this reach, and channel migration area contains mature riparian vegetation. Riparian vegetation is mixed with deciduous trees dominating the low-lying floodplain and mature ponderosa pines in the surrounding valley. Some eroding banks lack riparian vegetation, and there is room to improve the reach by establishing vegetation on abundant gravel bars. Most of the reach has a large channel migration area, but there are stretches of lower WF-2 and upper WF-1 that are disconnected from the floodplain and confined by levees. The lower section of WF-1 at the confluence has an extremely wide and densely vegetated riparian buffer and significant opportunity exists to

Lower Wolf Fork Touchet

Vicinity Map



Reach Characteristics

River	Wolf Fork Touchet River
Parent River	North Fork Touchet River
River Distance to Confluence (mi)	0.00
Valley Distance to Confluence (mi)	0.00
River Length (mi)	2.92
Valley Length (mi)	2.52
Sinuosity	1.14
Average Slope	1.41%
Delineated Project Areas	WF-1 to WF-3 (3)
Total Levee Length (mi)	0.56
Notable Tributaries	N/A

develop existing high flow paths into established side channels that traverse this heavily forested floodplain.

Channel Conditions

Average complexity within this reach is the highest among all reach groups in the basin. WF-3 has the highest complexity score in the basin due to an abundance of long split flows and island complexes. As compared to the Upper Wolf Fork Touchet reach, the Lower Wolf Fork Touchet reach has abundant sediment storage, which helps develop these side channels and has kept the river more connected with its floodplain. Instream wood in the reach appears relatively high throughout, and large wood additions should emphasize stabilizing existing complexity features. The Wolf Fork is one of the "strongholds" for cold water habitat and water supply in the Touchet basin during the hot summer months. The abundance of adequate spawning gravel and gentle slope of this reach make it a prime location for salmonid spawning, particularly for reintroduced spring Chinook salmon.

Influencing Anthropogenic Features

Agriculture and private residences are the primary land uses in this reach. Levees are relatively uncommon in this reach and only 0.5 mile of levees protect both residential and agricultural infrastructure and fields. There are some residential structures in the active floodplain and channel migration area notably at the upstream end of project area WF-2 and in the right floodplain of WF-1. Residential ponds at the downstream end of project area WF-3 are an additional encroachment on the floodplain. Bridges are the most significant confining feature in this reach. Two bridges cross the river in this reach and likely influence the geomorphic processes through floodplain constriction, hydraulic backwater, and sediment transport continuity. These bridges include the following:

- A private bridge in project area WF-3
- A private bridge between project areas WF-2 and WF-3

Qualitative Factors and Reach Priority

The Lower Fork Touchet reach falls in Reach Priority 1 (out of 3) for reaches included in the Touchet watershed prioritization framework. This Reach Priority ranking is for the Lower Wolf Fork Touchet reach as a whole; individual project areas within this reach may rank differently in the prioritization. This Reach Priority is meant to provide some overall insight into factors that are not considered in the project area prioritization and are likely very different between the reaches in this assessment.

Water Quantity

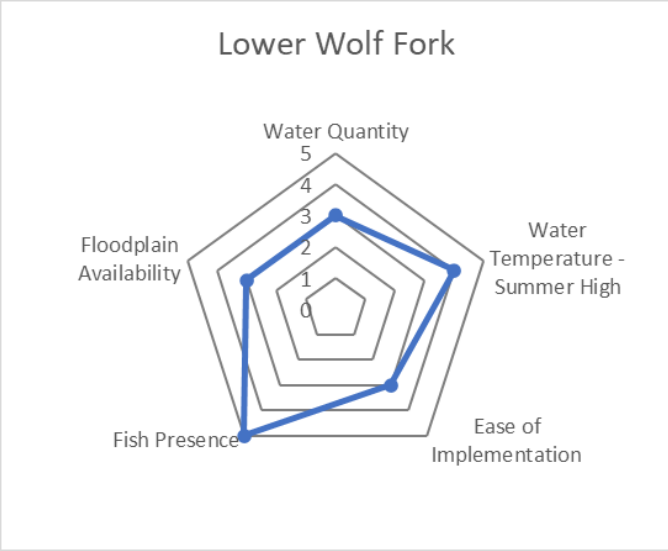
The Lower Wolf Fork Touchet reach has adequate flow during most of the hydrograph. This flow amount is usually enough to support more than one habitat condition within a typical cross section. Where low-lying floodplain is available, side channels and split flows can exist even at low flows, but large inundated areas of floodplain are unlikely at the lowest flow conditions. The volume of flow in this reach also has potential to cause geomorphic change where there is suitable sediment material and available floodplain. This reach receives a score of 3 (out of 5) for water quantity.

Summer High Water Temperature

The Wolf Fork basin is higher in the watershed and generally has cooler temperatures than other reaches in this assessment, making it a good candidate for habitat restoration work. Temperature observations are not made on this reach, but

Lower Wolf Fork Touchet

Qualitative Factors



Reach Score (_/5)	3.6
Reach Rank (_/9)	2
Reach Priority (_/3)	1
Primary Reach Concerns:	Floodplain Availability

This reach scored highly because it sustains a significant flow of cold water during the summer. It supports all species of salmonids as well as spawning habitat. Some residences along the banks could limit the potential to expand channel migration.

temperatures are likely significantly cooler than the Lower North Fork Touchet reach, which has high summer month temperatures typically near or below 20°C. Assuming the temperatures are lower in the Lower Wolf Fork Touchet reach, temperature conditions are likely very good for adult salmonids. Any restoration work in the Lower Wolf Fork Touchet reach would benefit from already having good temperature habitat conditions and could focus on other aspects of improving habitat. This reach receives a score of 4 (out of 5) for summer high water temperatures.

Ease of Implementation

Land ownership in the Lower Wolf Fork Touchet reach is a mix of medium- to large-sized private parcels mostly for residential and some agricultural use. Landowner willingness to participate in restoration work is unknown, but fewer parcels in this reach means that projects that cover more distance could be completed. However, much of the Lower Wolf Fork Touchet reach has little or no existing access to the river, making any restoration project involving construction equipment more difficult. This reach receives a score of 3 (out of 5) for ease of implementation.

Fish Presence

Several counts of juvenile fish use have been performed in this reach. Juvenile summer steelhead are shown to rear in this reach and over-wintering 1+-year-old juvenile steelhead are also present in this reach. Juvenile and adult bull trout also have a presence in this reach, especially at the upstream end. Counts show that some juvenile Chinook salmon can also be found in this reach. This reach receives a score of 5 (out of 5) for fish presence.

Floodplain Availability

Land use in the Lower Wolf Fork Touchet reach is mostly residential use with some small amounts of agriculture. Some infrastructure and buildings are bordering or in the floodplain, but there are also some stretches of little infrastructure in the floodplain. However, old levees and embankments exist throughout this reach and limit the floodplain availability further. This reach receives a score of 3 (out of 5) for floodplain availability.

Summary of Restoration Strategies

The following restoration actions are recommended based on the above information, as well as field observations and the desktop analysis and prioritization results. While other restoration actions should be considered at a project implementation level, the following should all be considered for any project in this reach. Details on how these restoration actions might be applied on a project area level are provided in the next section.

Establish Channel Migration Area

Much of this reach already has a large channel migration area, which provides room for natural geomorphic processes, flood inundation, and the establishment of riparian vegetation. These areas will require additional restoration in this reach to help establish vegetation on existing gravel bars, but protecting the established channel migration area provides an excellent first step for restoration of natural processes. Over time, these channel migration areas often suffer from the creep of development or the establishment of new fields. In addition, particularly large floods may prompt the construction of new levees that protect established fields and infrastructure, which can impinge on this channel migration area and limit the natural geomorphic and ecological processes.

Therefore, protection against future development and confinement should be a high priority among restoration actions in reaches where channel migration areas currently exist. These protections can involve the establishment of setback levees to protect against future migration or flooding outside of this channel migration area, along with legal protections and easements against further development. Limiting bank erosion and avulsions with placement of large woody material can help to establish these boundaries.

Establish Riparian Vegetation

Establishment of riparian vegetation in this reach should target existing unvegetated gravel bars and islands. It is likely that, with the high sediment load, it is difficult for trees to establish on these islands because they are constantly moved and redeposited by floods. Riparian vegetation has been shown to be critical to ecological and geomorphic processes. For this reach in particular, riparian vegetation will continue to establish a renewable and constant source of instream wood and provide overhanging cover and shade. Many large gravel bars exist in this reach and are barren of all but small (<4 feet) shrub vegetation.

Establishing mature stands of vegetation in the immediate riparian area and channel migration areas should be a restoration target for this reach. Restoration actions should target establishing vegetated gravel bars and may require stabilizing features such as large apex engineered log jams. Additionally, restoration actions should seek to establish stands

of riparian species in locations where the channel is eroding farm fields and lacks riparian vegetation on one or both banks.

Add Instream Wood and Complexity

Because the reach was not part of the river survey, estimates of woody material from aerial imagery show moderate to high in-channel large woody material. Due to the abundance of coarse sediment and cold stream temperatures in this reach, it has the potential to be used year-round by multiple life history stages of salmonids as both a spawning and rearing reach. The addition of woody debris should continue to promote and maintain existing complexity to maintain habitat diversity.

Adding large woody material in strategic locations that will maintain and develop beneficial geomorphic features should be a target in this reach. Instream wood should be installed to promote pool formation to help establish flow structure diversity between overwintering pool habitats and shallow spawning runs. Wood can also benefit spawning habitat by establishing grain size heterogeneity, which helps to develop gravels that are ideal for the spawning preferences of multiple species of salmonids. Large wood should also be used to promote continuous use of the numerous split flow paths in this reach. Finally, large wood can be placed to provide in-channel complexity and habitat as a beneficial means of bank protection where infrastructure must be protected.

Remove Confinement (Encroachments and Incision)

There are a few levees confining the channel in project areas WF-1 and WF-2. Providing room for the river to actively migrate and inundate is vital to the natural processes in the reach and will have a large effect on the success of the other restoration actions listed. Where possible, levees and encroachments should be removed or set back to reconnect low-lying floodplain and relic side channels.

Tier 1

Project Areas in the Lower Wolf Fork Touchet Reach

Project Area WF-1

River Length (mi)	0.69
Valley Length (mi)	0.64
Sinuosity	1.07
Average Slope	1.41%
Total Levee Length	0.08
Project Area Score	3.8
Basin Rank	2
Connectivity Score	0.21
Encroachment Removal Potential	24%
Aggradation Potential	8%
Total Potential	41%
2-year Connected Area (ac/rm)	10.5
Total Potential Area (ac/rm)	7.26
Complexity Score (SCE)	0.35
Excess Transport Capacity (psf)	0.016

Recommended Restoration Actions

- ELJs to help vegetate large gravel bars
- ELJs, pilot channel cuts to maintain split flow and complexity
- Remove or set back levees through VM 0.45 to VM 0.55

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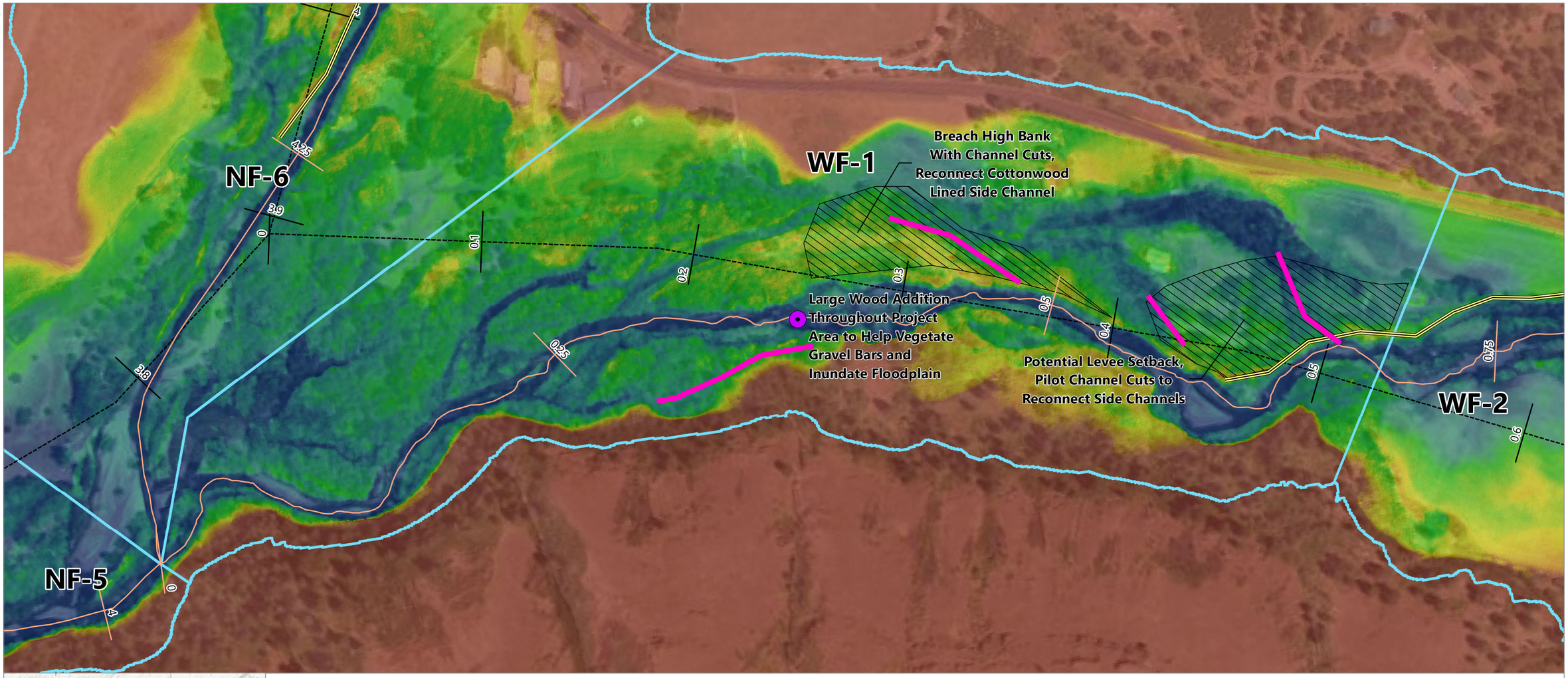

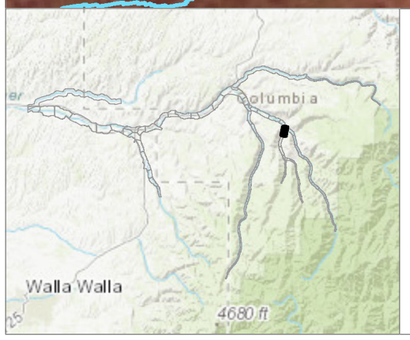

LEGEND:

- Delineated Levees
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 0
RIVER MILE END: 0.69
VALLEY MILE START: 0
VALLEY MILE END: 0.64

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Feet

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ANCHOR QEA

WF-1
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Tier 2

Project Areas in the Lower Wolf Fork Touchet Reach

Project Area WF-2

River Length (mi)	1.33
Valley Length (mi)	1.08
Sinuosity	1.23
Average Slope	1.35%
Total Levee Length	0.38
Project Area Score	1.8
Basin Rank	34
Connectivity Score	0.15
Encroachment Removal Potential	14%
Aggradation Potential	8%
Total Potential	30%
2-year Connected Area (ac/rm)	11.6
Total Potential Area (ac/rm)	5.06
Complexity Score (SCE)	0.48
Excess Transport Capacity (psf)	0.029

Recommended Restoration Actions

- ELJs to promote split flow
- Remove or set back levees through VM 0.45 to VM 0.8
- Riparian revegetation

Project Area WF-3

River Length (mi)	0.91
Valley Length (mi)	0.80
Sinuosity	1.13
Average Slope	1.47%
Total Levee Length	0.09
Project Area Score	2.0
Basin Rank	29
Connectivity Score	0.17
Encroachment Removal Potential	19%
Aggradation Potential	8%
Total Potential	34%
2-year Connected Area (ac/rm)	13.2
Total Potential Area (ac/rm)	6.84
Complexity Score (SCE)	0.78
Excess Transport Capacity (psf)	-0.143

Recommended Restoration Actions

- ELJs to help vegetate large gravel bars
- Pilot channel cuts to reconnect side channels
- Riparian revegetation

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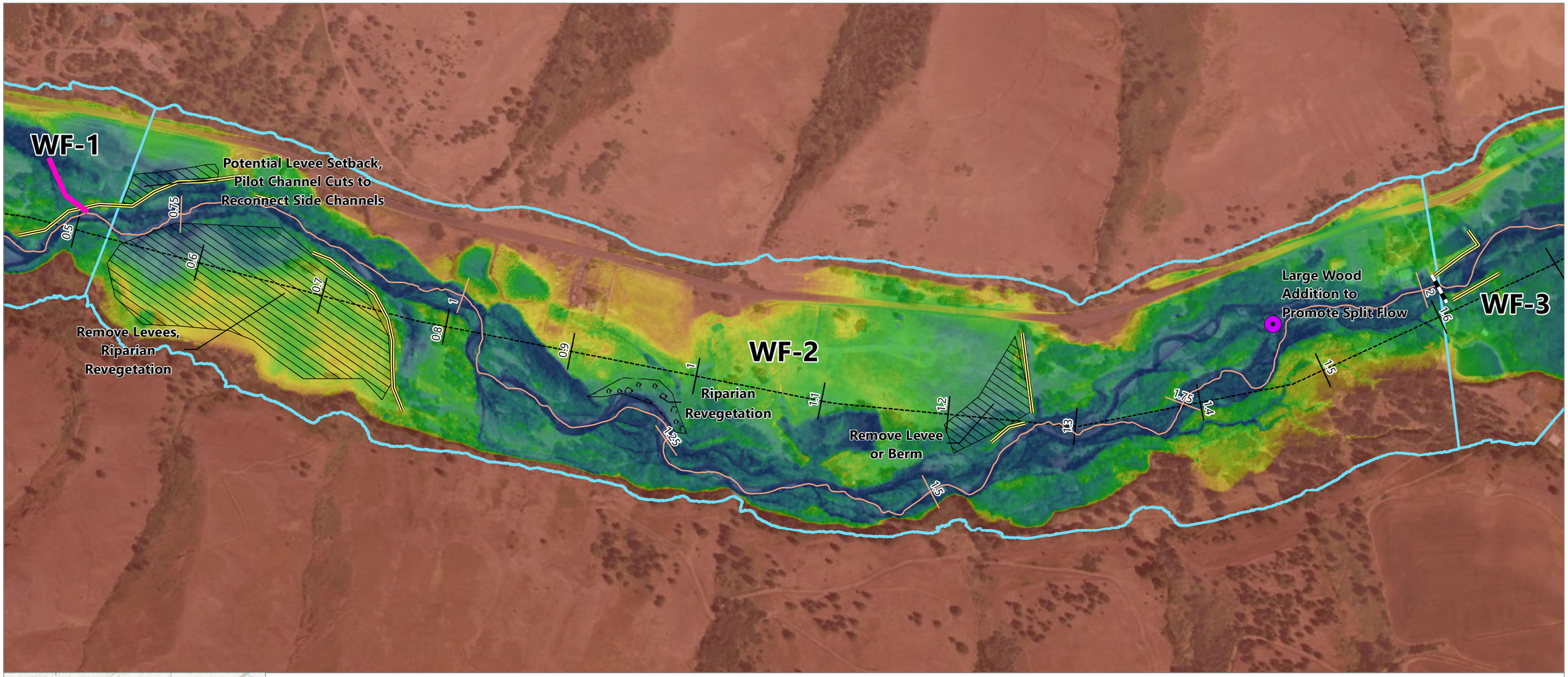

LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain
- Riparian Enhancement

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 0.69
RIVER MILE END: 2.01
VALLEY MILE START: 0.64
VALLEY MILE END: 1.72

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Feet

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WF-2
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

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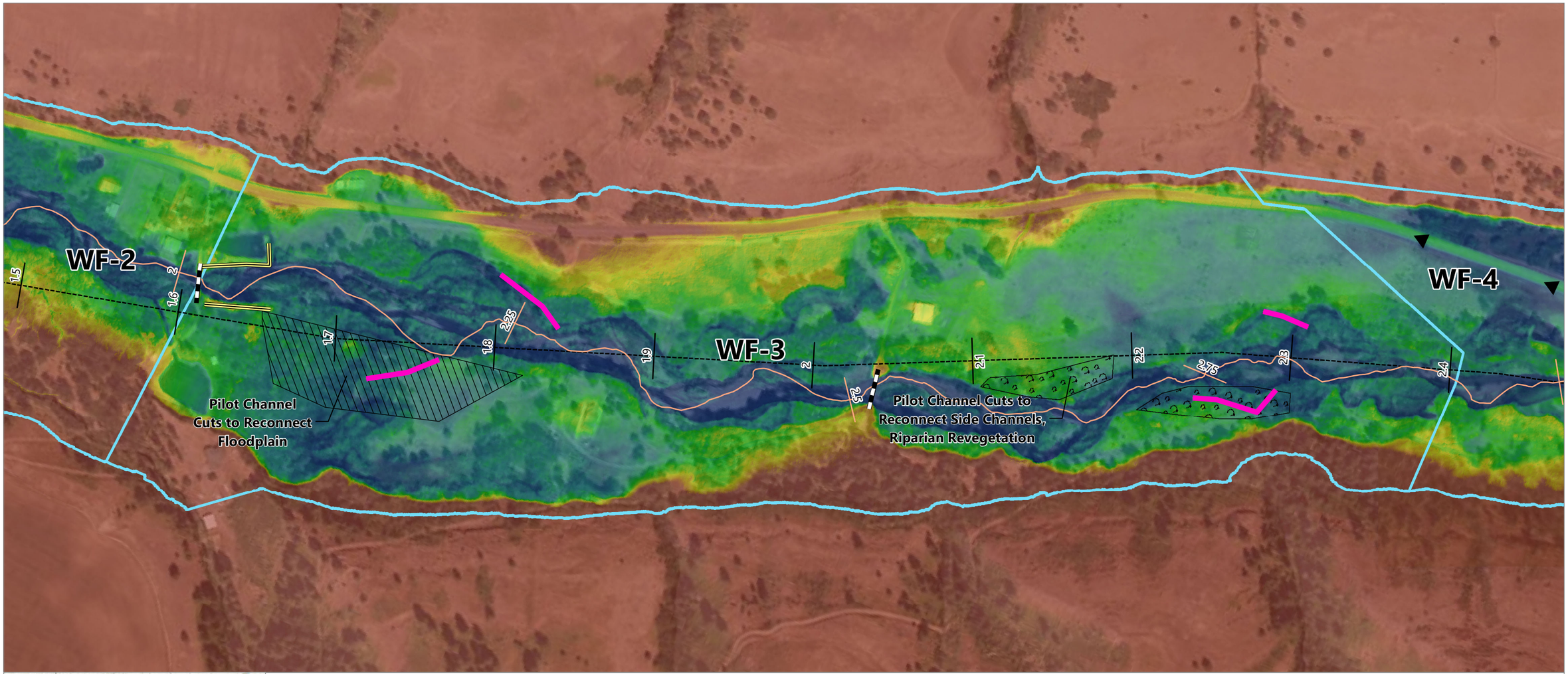

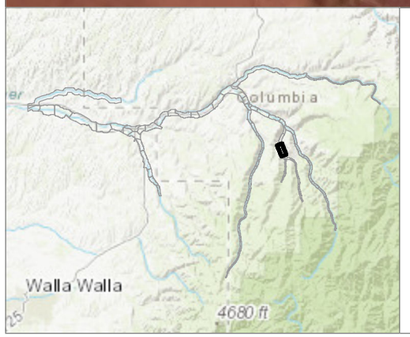

LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Reconnect Side Channel
- Reconnect Floodplain
- Long Term: Set Back Road
- Riparian Enhancement

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 2.01
RIVER MILE END: 2.92
VALLEY MILE START: 1.72
VALLEY MILE END: 2.52

0 500
Feet

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WF-3
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Upper Wolf Fork Touchet Reach

Reach Description

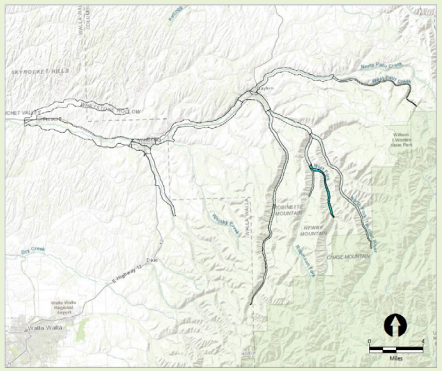
The Upper Wolf Fork Touchet reach runs from the mouth of Coates Creek approximately 5 river miles downstream to just below the confluence with the Robinson Fork. The tributary Whitney Creek enters the Wolf Fork on the right bank just upstream of project area WF-9. Coates Creek enters the Wolf Fork immediately downstream of Whitney Creek on the right bank and marks the upstream extent of the reach. The Robinson Fork enters the Wolf Fork on the left bank, but project area WF-4 continues slightly downstream of the confluence to maintain continuity in geomorphic characteristics within project areas. This reach includes six project areas from WF-4 to WF-9. An in-channel stream survey was conducted on parts of WF-6 and WF-5, and bank observations were made for the remainder of the reach.

Floodplain and Riparian Area

The channel migration corridor is narrow for most of the reach, and much of the reach has limited connectivity with the floodplain. This corridor has excellent riparian cover and the stream is well shaded for most of the reach. Most of the valley floor is covered with mature conifers including ponderosa pines, while small alders predominate along the banks. There are few levees and most levees are small, but the Wolf Fork Road is a primary confining feature. Stretches of WF-4, WF-7,

Upper Wolf Fork Touchet

Vicinity Map



Reach Characteristics

River	Wolf Fork Touchet River
Parent River	North Fork Touchet River
River Distance to Confluence (mi)	2.92
Valley Distance to Confluence (mi)	2.52
River Length (mi)	5.02
Valley Length (mi)	4.60
Sinuosity	1.09
Average Slope	2.23%
Delineated Project Areas	WF-4 to WF-9 (6)
Total Levee Length (mi)	0.31
Notable Tributaries	Whitney Creek Coates Creek Robinson Fork

and WF-9 are incised and linear with minimal channel migration area.

Channel Conditions

Observed channel complexity through most of this reach was relatively poor with few side channels and split flows. The reach has a relatively steep gradient high stream power, lacking zones of sediment storage and high complexity relative to the Lower Wolf Fork Touchet reach. Substrate size was large and pool depth and density was low in the observed sections of WF-5 and WF-6. Instream wood in the reach was low throughout, and there were few wood-forced pools to provide hydraulic refuge in this high-gradient reach. Relative to other tributaries of similar bankfull width, discharge in the Upper Wolf Fork Touchet reach was notably high during summer low-flow conditions, and water temperature was the coldest observed in the basin. Some more gradually sloped sections of project areas WF-6 to WF-9 were observed, but these reaches lacked planform and flow structure diversity.

Influencing Anthropogenic Features

The dominant land uses in the upper Wolf Fork valley are cattle grazing and private residences. Scattered small levees exist protecting residential infrastructure in the floodplain. Only 0.3 mile of levees protect residential infrastructure in this reach. Wolf Fork Road is a primary encroachment in the reach and confines the floodplain particularly in project areas WF-4 and WF-5. Currently many residential structures lie within the active floodplain and on the edge of the river, and this represents a major concern for project implementation in this reach. Efforts to promote aggradation and improve connectivity with the floodplain could cause flooding for several residences in this reach. During field surveys, an abandoned but functioning water diversion was observed in project area WF-6 contributing to a swampy pond in the left floodplain separated by a small levee. Other off-channel ponds also exist throughout the reach based on aerial imagery. Several bridges cross the river in this reach and likely influence the geomorphic processes through floodplain constriction, hydraulic backwater, and sediment transport continuity. These bridges include the following:

- Robinson Fork Road in project area WF-4
- Wolf Fork Road between project areas WF-4 and WF-5
- Wolf Fork Road in project area WF-6
- Wolf Fork Road between project areas WF-6 and WF-7
- Wolf Fork Road in project area WF-9
- Private road bridges in WF-5 and WF-7 (two bridges)

Qualitative Factors and Reach Priority

The Upper Wolf Fork Touchet reach falls in Reach Priority 1 (out of 3) for reaches included in the Touchet watershed prioritization framework. This Reach Priority ranking is for the Upper Wolf Fork Touchet reach as a whole; individual project areas within this reach may rank differently in the prioritization. This Reach Priority is meant to provide some overall insight into factors that are not considered in the project area prioritization and are likely very different between the reaches in this assessment.

Water Quantity

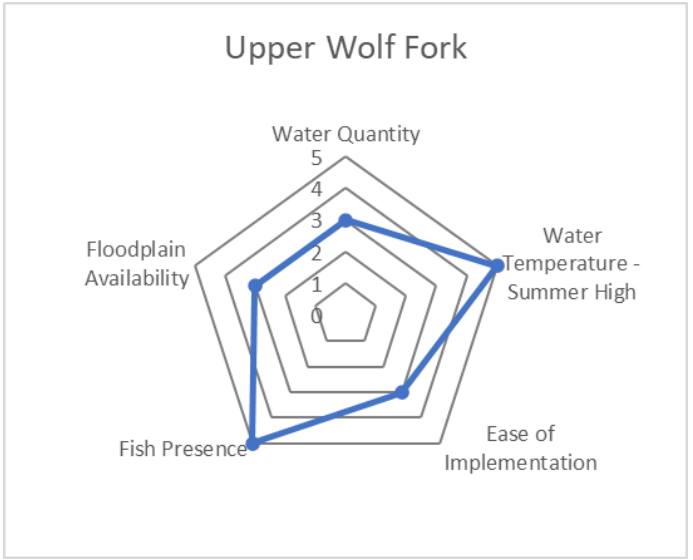
The Upper Wolf Fork Touchet reach has adequate flow during most of the hydrograph. This flow amount is usually enough to support more than one habitat condition within a typical cross section. Where low-lying floodplain is available, side channels and split flows can exist even at low flows, but large inundated areas of floodplain are unlikely at the lowest flow conditions. However, because this reach is higher up in the watershed, much of the bed material consists of larger material that is likely resistant to geomorphic change from these flows. This reach receives a score of 3 (out of 5) for water quantity.

Summer High Water Temperature

The Wolf Fork basin is higher in the watershed and generally has cooler temperatures than other reaches in this assessment, making it a good candidate for habitat restoration work.

Upper Wolf Fork Touchet

Qualitative Factors



Reach Score (_/5)	3.8
Reach Rank (_/9)	1
Reach Priority (_/3)	1
Primary Reach Concerns:	Floodplain Availability

This reach received the highest score because its cold flow can support all target species year-round. This reach shows the greatest potential increase in habitat through restoration actions to promote pools and sediment storage. Residences in the floodplain limit restoration actions in some areas.

Temperature observations are not made on this reach, but temperatures are likely significantly cooler than the Lower Wolf Fork Touchet reach, and generally thought to be the coldest of reaches in this assessment along with Robinson Fork. Any restoration work in the Upper Wolf Fork Touchet reach would benefit from already having good temperature habitat conditions and could focus on other aspects of improving habitat. This reach receives a score of 5 (out of 5) for summer high water temperatures.

Ease of Implementation

Land ownership in the Upper Wolf Fork Touchet reach is primarily medium-sized private parcels mostly for residential use. Landowner willingness to participate in restoration work is unknown, but fewer parcels in this reach means that projects that cover more distance could be completed. However, much of the Upper Wolf Fork Touchet reach has little or no existing access to the river, making any restoration project involving construction equipment more difficult. This reach receives a score of 3 (out of 5) for ease of implementation.

Fish Presence

Several counts of juvenile fish use have been performed in this reach. Juvenile summer steelhead are shown to rear in this reach and over-wintering 1+-year-old juvenile steelhead are also present in this reach. Juvenile and adult bull trout also have a presence in this reach, especially at the upstream end. Counts show that some juvenile Chinook salmon can also be found in this reach. This reach receives a score of 5 (out of 5) for fish presence.

Floodplain Availability

Land use in the Upper Wolf Fork Touchet reach is mostly residential use with larger patches of riparian growth. Some infrastructure and buildings are bordering or in the floodplain, but there are also some stretches of little infrastructure in the floodplain. However, old levees and embankments exist throughout this reach and limit the floodplain availability further. This reach receives a score of 3 (out of 5) for floodplain availability.

Summary of Restoration Strategies

The following restoration actions are recommended based on the above information, as well as field observations and the desktop analysis and prioritization results. While other restoration actions should be considered at a project implementation level, the following should all be considered for any project in this reach. Details on how these restoration actions might be applied on a project area level are provided in the next section.

Establish Channel Migration Area

Much of this reach has a limited channel migration area, but the surrounding floodplain has well-established riparian vegetation that the river is currently unable to access. The restoration process should involve working with landowners to set aside sections of property to expand the channel migration area. Once established, actions to promote aggradation and reconnect the river with these areas should be implemented.

Protection against future development and confinement should be a high priority among restoration actions in reaches where channel migration areas currently exist. These protections can involve the establishment of setback levees to protect against future migration or flooding outside of this channel migration area, along with legal protections and easements against further development. Placement of large woody material to simultaneously provide habitat and protect infrastructure can help to establish these boundaries.

Add Instream Wood and Complexity

Due to the high stream power, steep gradient, and low sinuosity, it is difficult for this reach to accumulate wood and naturally form log jams. This reach is characterized by low amounts of in-channel large woody material. Engineered log jams added to this reach would help address the pool deficit in the reach. Large wood jams would also address the reach's lack of suitable gravel by creating zones of aggradation upstream of jams and providing low velocity zones behind jams to promote bar building and accumulation of smaller substrate. This reach lacks large wood to initiate geomorphic processes including side channel and meander formation. Addition of large wood will help promote aggradation, reconnect the river with its floodplain, and initiate development of geomorphic complexity. Using large wood to deter erosion at the edge of the aforementioned channel migration areas should be considered as a way to establish boundaries against further development.

Establish Riparian Vegetation

Most of this reach has dense riparian vegetation, but some parts of project areas WF-4, WF-6, and WF-8 contain unvegetated gravel bars or have unvegetated banks bordering fields. Riparian vegetation has been shown to be critical to ecological and geomorphic processes. Current riparian

vegetation effectively shades and helps maintain cold water temperatures through this reach, but more mature stands of vegetation could help provide a renewable source of large wood.

Establishing mature stands of vegetation in the immediate riparian area and channel migration areas should be a restoration target for this reach. Restoration actions should target establishing vegetated gravel bars and may require stabilizing features such as large apex engineered log jams. Additionally, restoration actions should seek to establish stands of riparian species in locations where the floodplain has been reconnected through restoration and active channel migration. Finally, some agricultural grazing was observed through this reach and likely has an effect on establishing riparian vegetation. Grazing exclusions should be considered as part of any vegetation-focused restoration actions.

Remove Confinement (Encroachments and Incision)

Small levees exist throughout the Upper Wolf Fork Touchet reach and roads provide the major encroachments in the reach. If not essential to protecting existing infrastructure, these levees should be breached or removed. The analysis results for connectivity (provided in the next section) demonstrate the effects of these levees and incision on available floodplain. In addition, the analysis results for excess transport capacity demonstrate that confinement of the channel and floodplain leads to increased sediment transport capacity for the project areas within this reach.

Providing room for the river to actively migrate and inundate is vital to the natural processes in the reach and will be key to re-establishing connectivity and complexity in this reach. Where possible, levees and encroachments should be removed or set back to reconnect low-lying floodplain and relic side channels. Incised channels should be targeted for sediment deposition and floodplain benching to reconnect these areas.

Tier 1

Project Areas in the Upper Wolf Fork Touchet Reach

Project Area WF-8

River Length (mi)	0.64
Valley Length (mi)	0.61
Sinuosity	1.04
Average Slope	2.65%
Total Levee Length	0.00
Project Area Score	4.0
Basin Rank	1
Connectivity Score	0.22
Encroachment Removal Potential	32%
Aggradation Potential	3%
Total Potential	41%
2-year Connected Area (ac/rm)	6.6
Total Potential Area (ac/rm)	4.67
Complexity Score (SCE)	0.22
Excess Transport Capacity (psf)	-0.048

Recommended Restoration Actions

- ELJs, pilot channel cuts to reconnect side channels
- ELJs store spawning gravel and create pools

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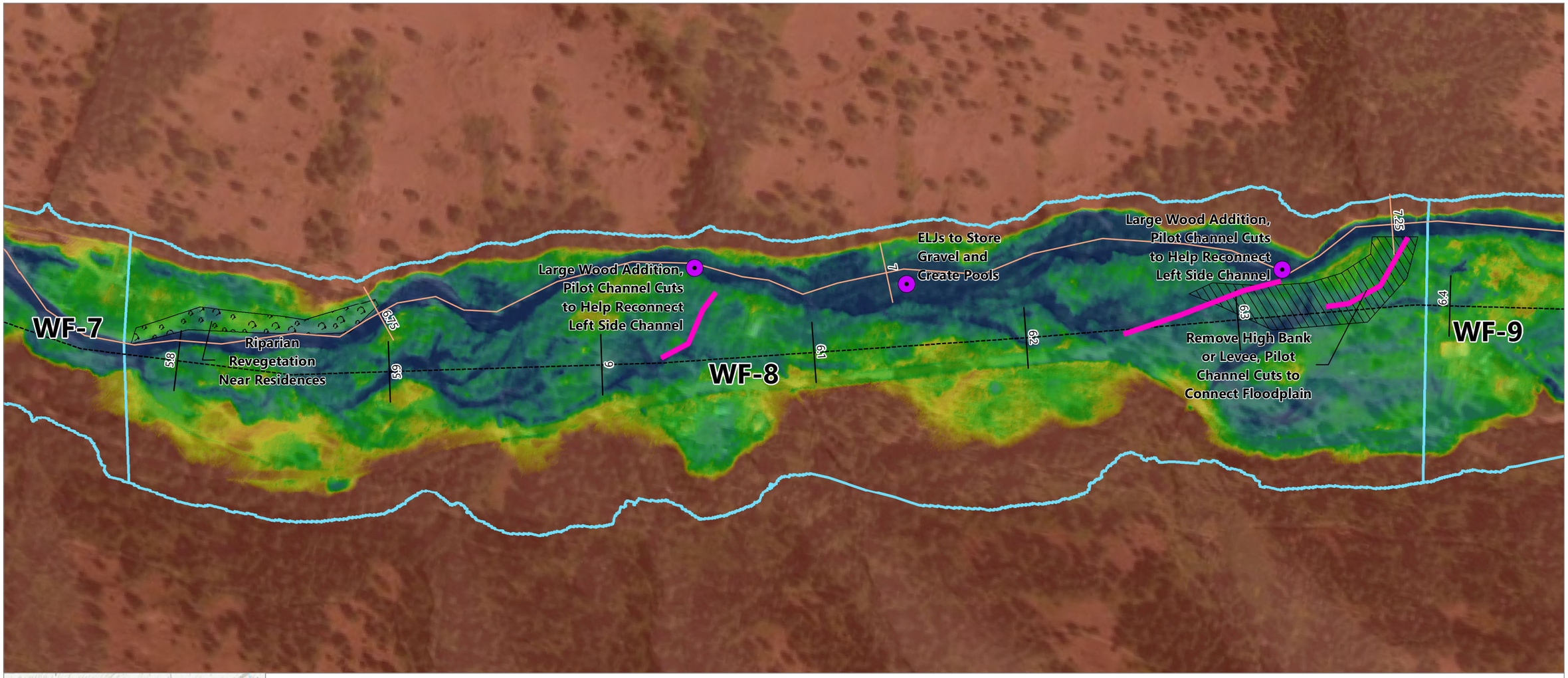

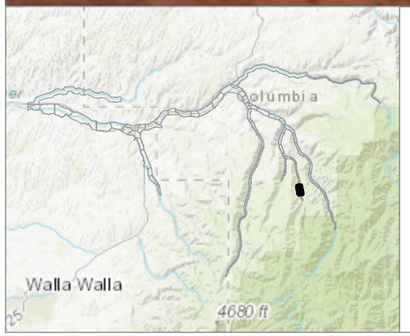

LEGEND:

- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain
- Riparian Enhancement

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 6.63
RIVER MILE END: 7.27
VALLEY MILE START: 5.87
VALLEY MILE END: 6.48

0 500
Feet

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WF-8
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Tier 2

Project Areas in the Upper Wolf Fork Touchet Reach

Project Area WF-4

River Length (mi)	1.02
Valley Length (mi)	0.92
Sinuosity	1.11
Average Slope	1.93%
Total Levee Length	0.00
Project Area Score	2.4
Basin Rank	21
Connectivity Score	0.18
Encroachment Removal Potential	21%
Aggradation Potential	7%
Total Potential	35%
2-year Connected Area (ac/rm)	6.4
Total Potential Area (ac/rm)	3.42
Complexity Score (SCE)	0.17
Excess Transport Capacity (psf)	0.071

Recommended Restoration Actions

- ELJs to promote aggradation and sinuosity in linear reaches
- ELJs, pilot channel cuts to reconnect side channels

Project Area WF-6

River Length (mi)	0.91
Valley Length (mi)	0.84
Sinuosity	1.09
Average Slope	2.10%
Total Levee Length	0.08
Project Area Score	1.8
Basin Rank	33
Connectivity Score	0.12
Encroachment Removal Potential	19%
Aggradation Potential	-1%
Total Potential	24%
2-year Connected Area (ac/rm)	8.0
Total Potential Area (ac/rm)	2.46
Complexity Score (SCE)	0.28
Excess Transport Capacity (psf)	0.010

Recommended Restoration Actions

- ELJs to help vegetate large gravel bars
- ELJs, pilot channel cuts to promote split flow and complexity
- ELJs to promote pool formation and storage of smaller substrate to improve spawning gravel
- Disconnect old diversion (left bank) at VM 4.1

Project Area WF-7

River Length (mi)	1.02
Valley Length (mi)	0.90
Sinuosity	1.13
Average Slope	2.17%
Total Levee Length	0.04
Project Area Score	2.1
Basin Rank	26
Connectivity Score	0.08
Encroachment Removal Potential	6%
Aggradation Potential	6%
Total Potential	14%
2-year Connected Area (ac/rm)	7.5
Total Potential Area (ac/rm)	1.19
Complexity Score (SCE)	0.21
Excess Transport Capacity (psf)	0.172

Recommended Restoration Actions

- ELJs to help vegetate large gravel bars and activate side channels
- ELJs to promote pool formation and storage of smaller substrate to improve spawning gravel

Riparian revegetation

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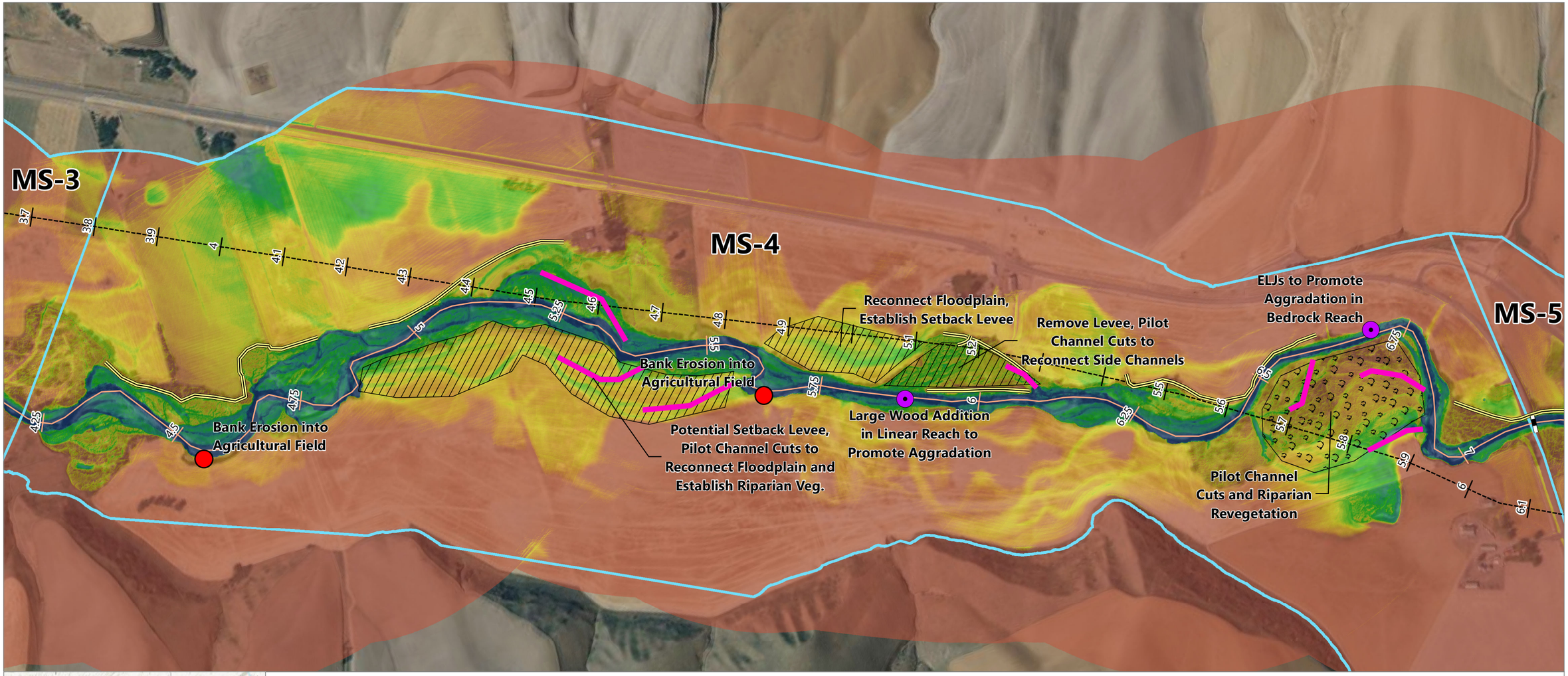

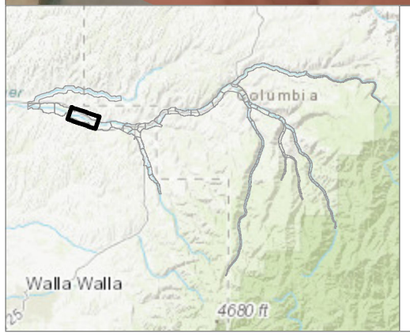

LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain
- Riparian Enhancement
- Placemark

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 4.2
RIVER MILE END: 7.1
VALLEY MILE START: 3.73
VALLEY MILE END: 6.09

0 500
Feet

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MS-4
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Touchet River Conceptual Restoration

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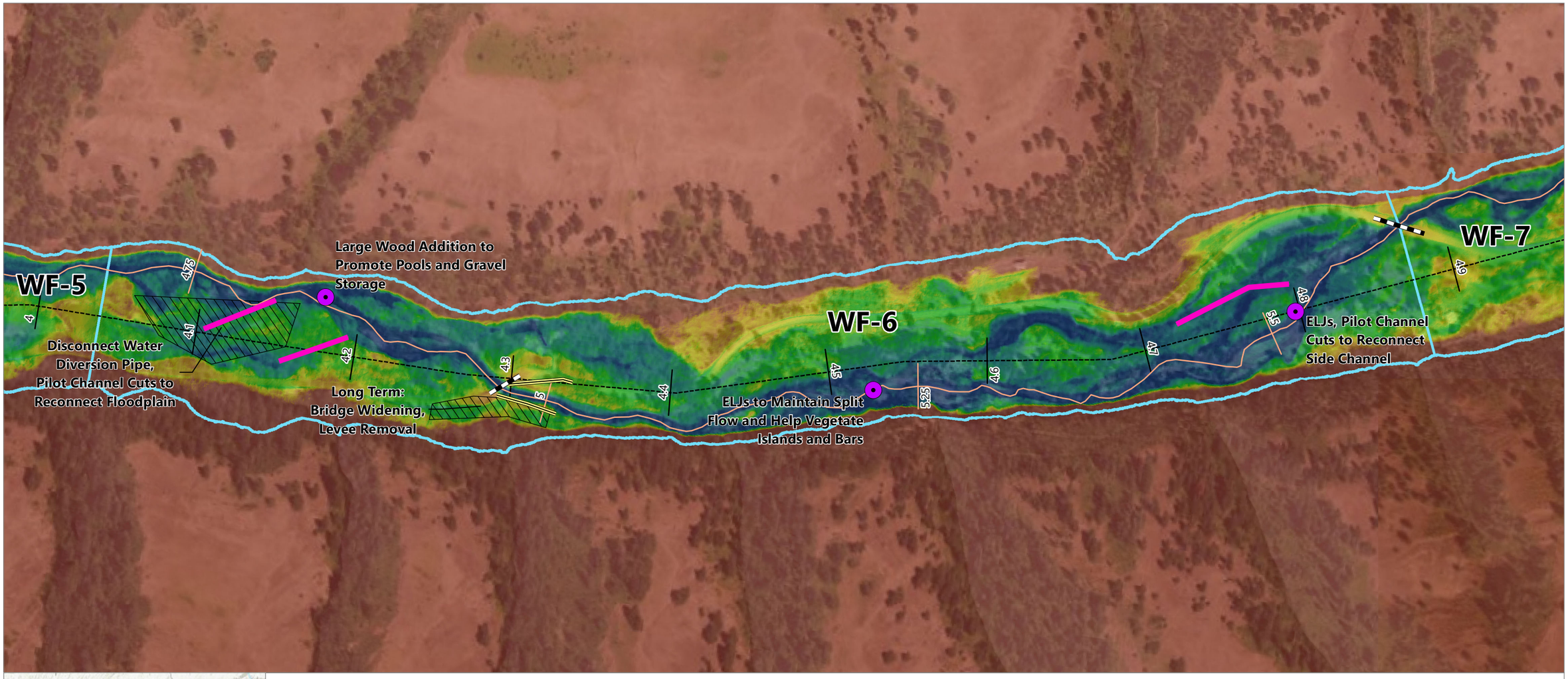

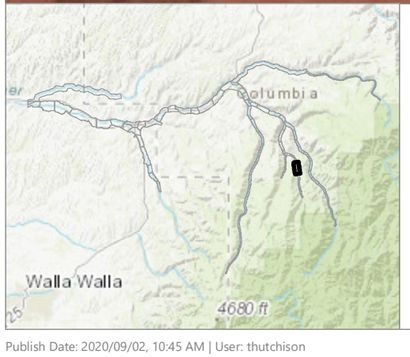

LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 4.69
RIVER MILE END: 5.61
VALLEY MILE START: 4.13
VALLEY MILE END: 4.97

0 500
Feet

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WF-6
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

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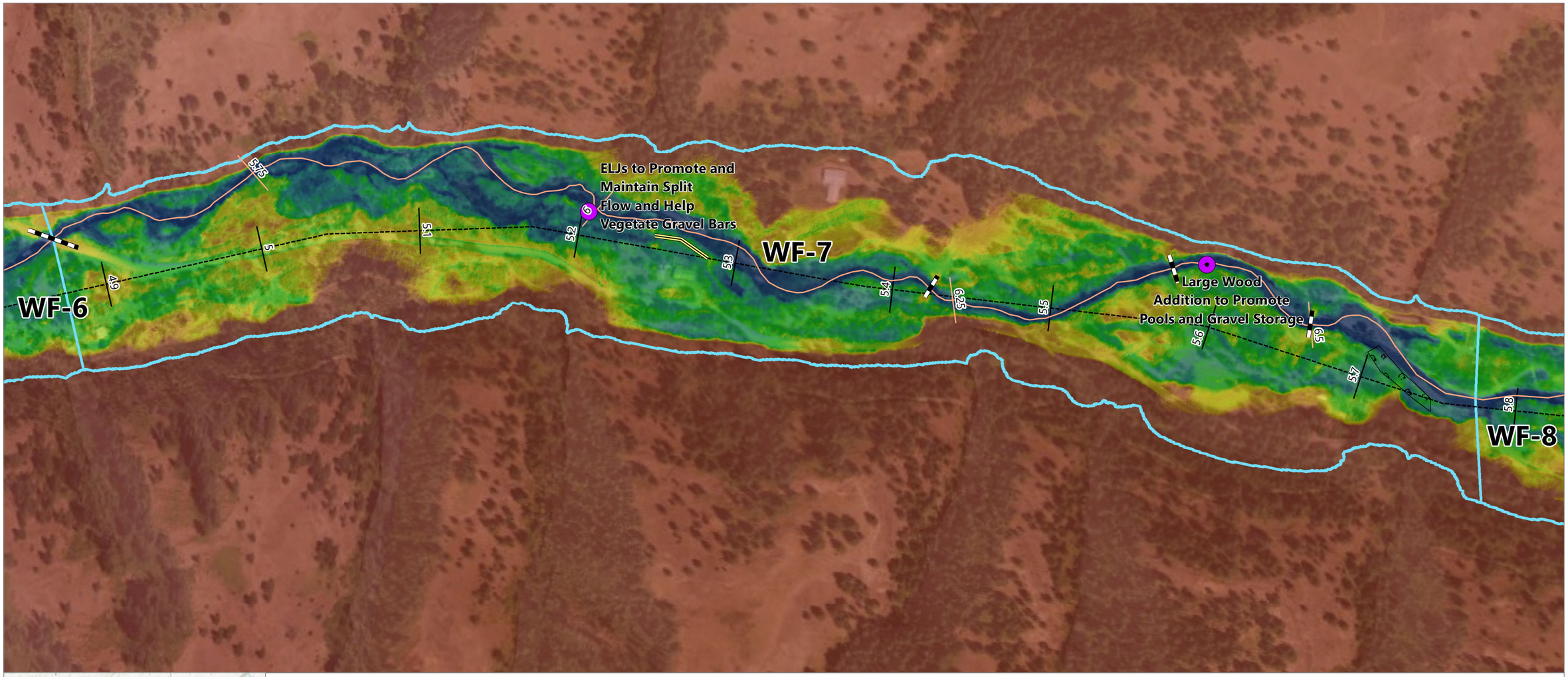

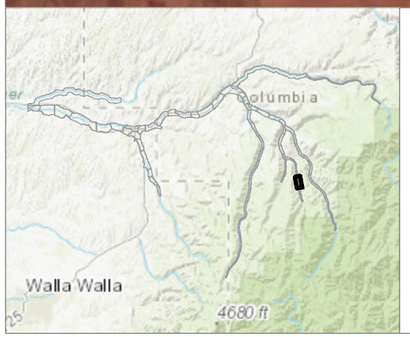

LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Riparian Enhancement

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
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RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 5.61
RIVER MILE END: 6.63
VALLEY MILE START: 4.97
VALLEY MILE END: 5.87

0 500
Feet

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WF-7
Conceptual Restoration Map
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Touchet River Conceptual Restoration

Tier 3

Project Areas in the Upper Wolf Fork Touchet Reach

Project Area WF-5

River Length (mi)	0.76
Valley Length (mi)	0.69
Sinuosity	1.09
Average Slope	1.99%
Total Levee Length	0.14
Project Area Score	1.5
Basin Rank	38
Connectivity Score	0.11
Encroachment Removal Potential	8%
Aggradation Potential	8%
Total Potential	22%
2-year Connected Area (ac/rm)	6.5
Total Potential Area (ac/rm)	1.80
Complexity Score (SCE)	0.25
Excess Transport Capacity (psf)	-0.049

Recommended Restoration Actions

- ELJs to help reconnect side channels
- ELJs to promote pool formation and storage of smaller substrate to improve spawning gravel
- Remove levees VM 3.3 to VM 3.4, pilot channel cuts to reconnect floodplain

Project Area WF-9

River Length (mi)	0.67
Valley Length (mi)	0.64
Sinuosity	1.06
Average Slope	2.52%
Total Levee Length	0.05
Project Area Score	0.7
Basin Rank	54
Connectivity Score	0.11
Encroachment Removal Potential	11%
Aggradation Potential	5%
Total Potential	21%
2-year Connected Area (ac/rm)	5.8
Total Potential Area (ac/rm)	1.52
Complexity Score (SCE)	0.18
Excess Transport Capacity (psf)	-0.038

Recommended Restoration Actions

- ELJs, pilot channel cuts to reconnect side channels
- ELJs to promote pool formation and storage of smaller substrate to improve spawning gravel

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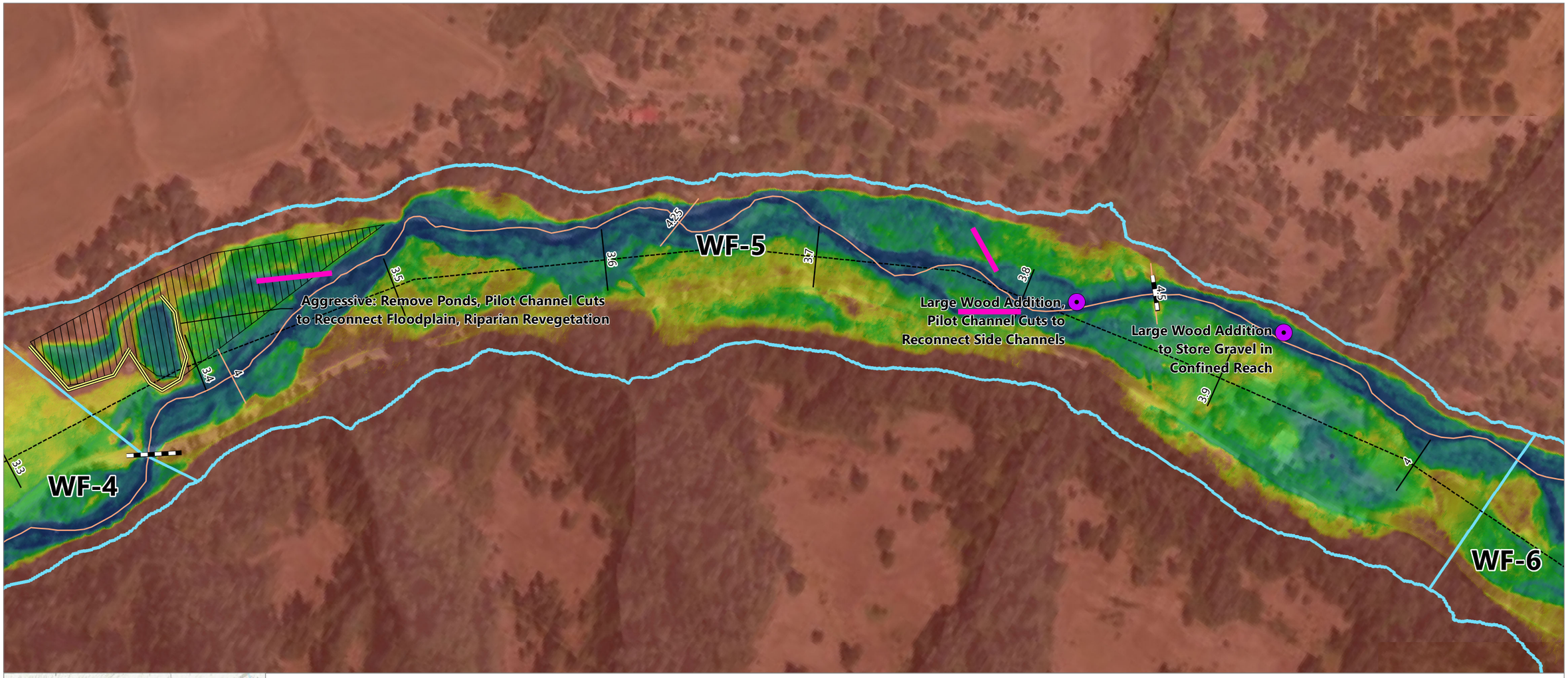

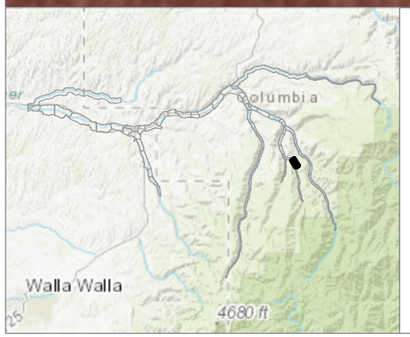

LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
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3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 3.94
RIVER MILE END: 4.69
VALLEY MILE START: 3.44
VALLEY MILE END: 4.13

0 500
Feet

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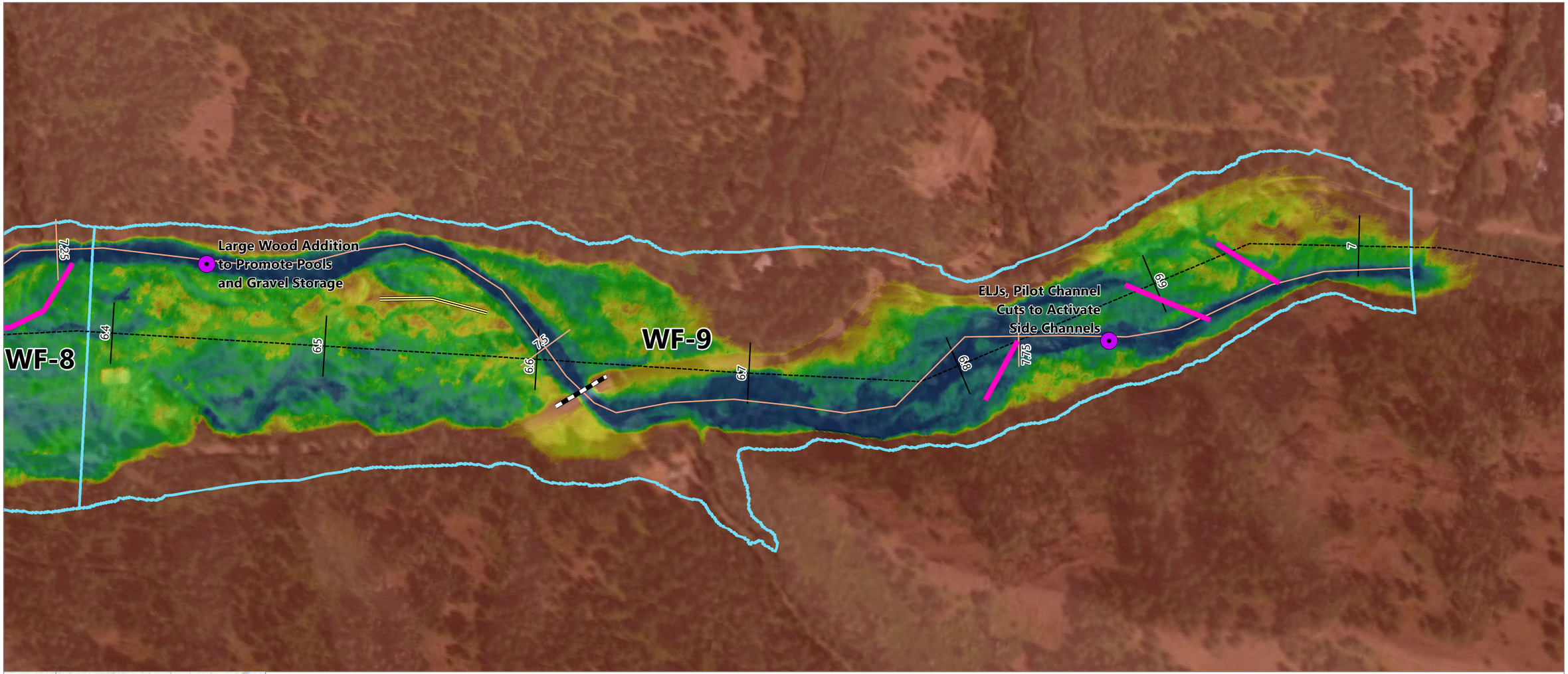

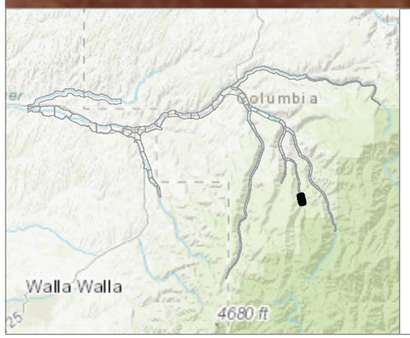

LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

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5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 7.27
RIVER MILE END: 7.94
VALLEY MILE START: 6.48
VALLEY MILE END: 7.12

0 500
Feet

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WF-9
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Robinson Fork Touchet Reach

Reach Description

The Robinson Fork Touchet reach runs from the confluence with the Wolf Fork upstream 2.52 miles to the third road crossing of the river on private property. This reach includes four project areas from RF-1 to RF-4. No significant tributaries enter the system in this reach. Stream surveys covered sections of project areas RF-1, RF-2, and RF-4.

Floodplain and Riparian Area

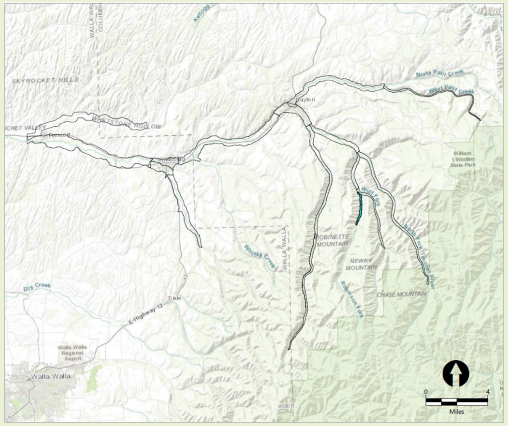
Grazing pasture is a notable land use that influences the floodplain and riparian area in this reach. A wide channel migration corridor exists for most of the reach, but the river is disconnected from some portion of the available floodplain in many areas. Low-lying floodplain is abundant in the upper parts of this reach, but the river is confined by levees and disconnected from the floodplain in project area RF-1 near the confluence. Riparian vegetation through this corridor is mixed and the river is bordered by open rangeland and lacks shade and mature riparian vegetation in many places.

Channel Conditions

Observed channel complexity through most of this reach was moderate with several side channels and split flows, notably in project areas RF-2 and RF-4. The lower sections of RF-1 and RF-3 have fewer side channels and are more disconnected from

Robinson Fork Touchet

Vicinity Map



Reach Characteristics

River	Robinson Fork Touchet River
Parent River	Wolf Fork Touchet River
River Distance to Confluence (mi)	0.00
Valley Distance to Confluence (mi)	0.00
River Length (mi)	2.52
Valley Length (mi)	2.22
Sinuosity	1.13
Average Slope	2.27%
Delineated Project Areas	RF-1 to RF-4 (4)
Total Levee Length (mi)	0.25
Notable Tributaries	N/A

the floodplain. Instream wood in the reach was relatively low throughout, and few large pools were observed. The river was extremely low during summer low-flow conditions and likely lacks sufficient streamflow to support large salmonids during the summer months. Large gravel bars were evident in reaches RF-2 and RF-4, and multiple opportunities existed to reconnect former side channels in these project areas. Sediment storage was high in all observed project areas of the reach providing opportunities to promote split flow, but most of the bars in the floodplain lacked mature vegetation. No major log jams were observed in this reach, and large wood additions to promote deep pool habitats will be essential in providing cold-water refugia during summer low flows.

Influencing Anthropogenic Features

Grazing and levees are the primary anthropogenic impacts throughout the reach. Only 0.25 mile of levees protect agricultural fields in this reach. The only notable levees besides the road are riprap levees observed in the lower portion of RF-1. Grazing has the largest effect on the entire reach, impacting riparian vegetation, soil infiltration capacity, and water quality and quantity. Fences designed to exclude cattle from the channel were observed downstream in project areas RF-1 and RF-2. The upper watershed from project area RF-4 upstream contains a private cattle grazing operation with cattle crossings at multiple points on the river. Livestock paths through the channel in project area RF-4 are sources of fine sediment and affect downstream water supply as the cattle use the creek as a water source. Grazing has resulted in many open fields throughout the reach with compromised riparian vegetation, elevating summer water temperatures. Several bridges cross the river in this reach and likely influence the geomorphic processes through floodplain constriction, hydraulic backwater, and sediment transport continuity. These bridges include the following:

- Robinson Fork Road between project areas RF-1 and RF-2
- Robinson Fork Road in project area RF-3
- Gravel road crossing in project area RF-4

Qualitative Factors and Reach Priority

The Robinson Fork Touchet reach falls in Reach Priority 1 (out of 3) for reaches included in the Touchet watershed prioritization framework. This Reach Priority ranking is for the Robinson Fork Touchet reach as a whole; individual project areas within this reach may rank differently in the prioritization. This Reach Priority is meant to provide some overall insight into factors that are not considered in the project area prioritization and are likely very different between the reaches in this assessment.

Water Quantity

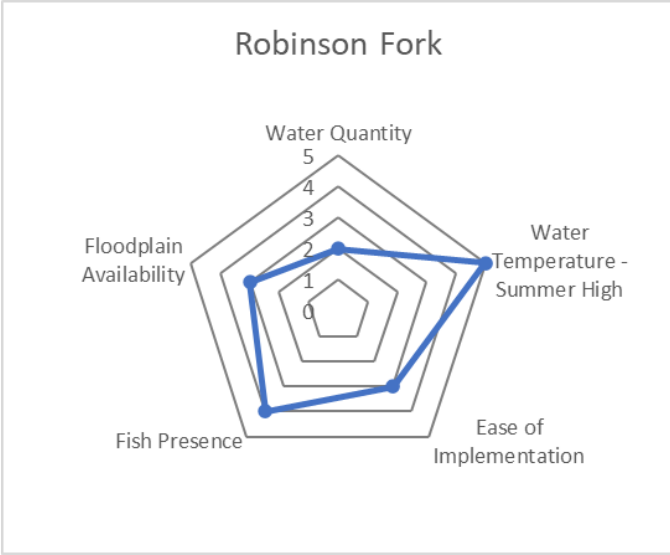
The Robinson Fork Touchet reach has adequate flow for most of the hydrograph, but flows greatly diminish in the summer months. The flow amount is sometimes enough to support more than one habitat condition within a typical cross section. Where low-lying floodplain is available, side channels and split flows can exist even at low flow, but larger sediment material and steeper narrower valleys make this unlikely. For these same reasons of large sediment material and narrow valleys, it is likely that geomorphic change is infrequent and episodic given the amount of flow in this reach. This reach receives a score of 2 (out of 5) for water quantity.

Summer High Water Temperature

The Robinson Fork basin is higher in the watershed and generally has cooler temperatures than other reaches in this

Robinson Fork Touchet

Qualitative Factors



Reach Score (_/5)	3.4
Reach Rank (_/9)	3
Reach Priority (_/3)	1
Primary Reach Concerns:	Water Quantity

This reach scored highly for cold water temperatures capable of supporting target species. Most of the floodplain is accessible to expand channel migration but some infrastructure is present. Low summer discharge detracted from the score in this reach.

assessment, making it a good candidate for habitat restoration work. Regular temperature observations are not made on this reach, but temperatures are likely significantly cooler than the Lower Wolf Fork Touchet reach, and generally thought to be the coldest of reaches in this assessment along with the Upper Wolf Fork Touchet reach. Any restoration work in the Robinson Fork Touchet reach would benefit from already having good temperature habitat conditions and could focus on other aspects of improving habitat. The Robinson Fork Touchet reach receives a score of 5 (out of 5) for summer high water temperatures.

Ease of Implementation

Land ownership in the Robinson Fork Touchet reach is primarily medium-sized private parcels mostly for residential use. Landowner willingness to participate in restoration work is unknown, but fewer parcels in this reach means that projects that cover more distance could be completed. However, much of Robinson Fork Touchet reach has little or no existing access to the river, making any restoration project involving construction equipment more difficult. This reach receives a score of 3 (out of 5) for ease of implementation.

Fish Presence

Several counts of juvenile fish use have been performed in this reach. Juvenile summer steelhead are shown to rear in this reach and over-wintering 1+-year-old juvenile steelhead are also present in this reach. Juvenile and adult bull trout also have a presence in this reach, especially at the upstream end. Counts show that some juvenile Chinook salmon can also be found in this reach. This reach receives a score of 4 (out of 5) for fish presence.

Floodplain Availability

Land use in the Robinson Fork Touchet reach is a mix of residential, public land, and forest management use. For much of the floodplain, large patches of riparian growth exist. Some infrastructure and buildings are bordering or in the floodplain, but there are also some stretches of little infrastructure in the floodplain. However, the narrow valley and large sediment size cause the flow to be locked into the channel for some stretches in the reach and limit the floodplain availability further. This reach receives a score of 3 (out of 5) for floodplain availability.

Summary of Restoration Strategies

The following restoration actions are recommended based on the above information, as well as field observations and the desktop analysis and prioritization results. While other restoration actions should be considered at a project implementation level, the following should all be considered for any project in this reach. Details on how these restoration actions might be applied on a project area level are provided in the next section.

Establish Channel Migration Area

Much of this reach already has a large channel migration area, which provides room for natural geomorphic processes, flood inundation, and the establishment of riparian vegetation. The primary action that should be taken regarding the channel migration area in this reach is establishing and maintaining fencing to prevent cattle from grazing within the riparian area. Due to the destructive effect of livestock on riparian plants and soils, establishing and expanding grazing exclusion areas should be prioritized in this reach. Where applicable, levee setbacks should also be prioritized to expand the channel migration area in confined reaches. Because there are few residences and little infrastructure in this reach, all encroachments excluding the Robinson Fork Road should be prioritized for removal or setback.

Establish Riparian Vegetation

Establishment of riparian vegetation will be critical to providing shade and reducing summer stream temperatures in this reach. This restoration strategy goes hand in hand with establishment of grazing exclusion zones to limit the impacts of cattle in the active channel. Restoring floodplain connectivity in confined reaches will also be key to expanding riparian vegetation. Engineered log jams that promote aggradation in the more confined sections can have a similar effect to beaver dams by promoting increased water storage in the floodplain. The increased floodplain storage upstream of log jams will help revegetate the riparian zone, increase summer baseflow, and provide cooler groundwater to combat summer high temperatures. These actions will be critical in this reach because it appears to be significantly flow-limited and likely temperature-limited during the summer. As riparian vegetation improves, the supply of woody debris will be restored, and this beneficial cycle will become self-sustaining.

Add Instream Wood and Complexity

Although complexity elements such as side channels and split flow are present, much of this section is characterized by relatively low amounts of in-channel large woody material. Where instream wood does exist, significant accumulations to force deep scour pools are not present and the reach is likely pool-limited.

Adding large woody material in strategic locations that will most benefit the natural processes should be a primary restoration action in all project areas in this reach. Instream wood should be placed primarily to help restore the geomorphic processes that result in side channel formation, split flow and vegetated gravel bar building, sediment storage, channel aggradation, and pool formation. Engineered log jams can be placed to help vegetate the many gravel bars and apex jams can be used to promote split flows where side channels already exist. Sediment supply is high in this reach, and channel spanning log jams can help promote aggradation in incised reaches to restore floodplain connectivity and sinuosity.

Remove Confinement (Encroachments and Incision)

Some levees exist in project area RF-1, and these levees and riprap should be targeted for removal or setback. These levees have confined the channel and it has incised 5 to 10 feet below the floodplain. Providing room for the river to actively migrate and inundate the floodplain is vital to the natural processes in the reach and will specifically benefit riparian revegetation throughout this reach. In addition, incised channels should be targeted for sediment deposition with engineered log jams to reverse the impacts of confinement.

Tier 1

Project Areas in the Robinson Fork Touchet Reach

Project Area RF-1

River Length (mi)	0.73
Valley Length (mi)	0.62
Sinuosity	1.17
Average Slope	1.96%
Total Levee Length	0.25
Project Area Score	3.2
Basin Rank	8
Connectivity Score	0.20
Encroachment Removal Potential	21%
Aggradation Potential	10%
Total Potential	36%
2-year Connected Area (ac/rm)	5.2
Total Potential Area (ac/rm)	2.97
Complexity Score (SCE)	0.25
Excess Transport Capacity (psf)	0.086

Recommended Restoration Actions

- Set back levees through VM 0.0 to VM 0.25
- ELJs to promote aggradation and sinuosity in confined reaches
- Add large woody material throughout to promote pool formation

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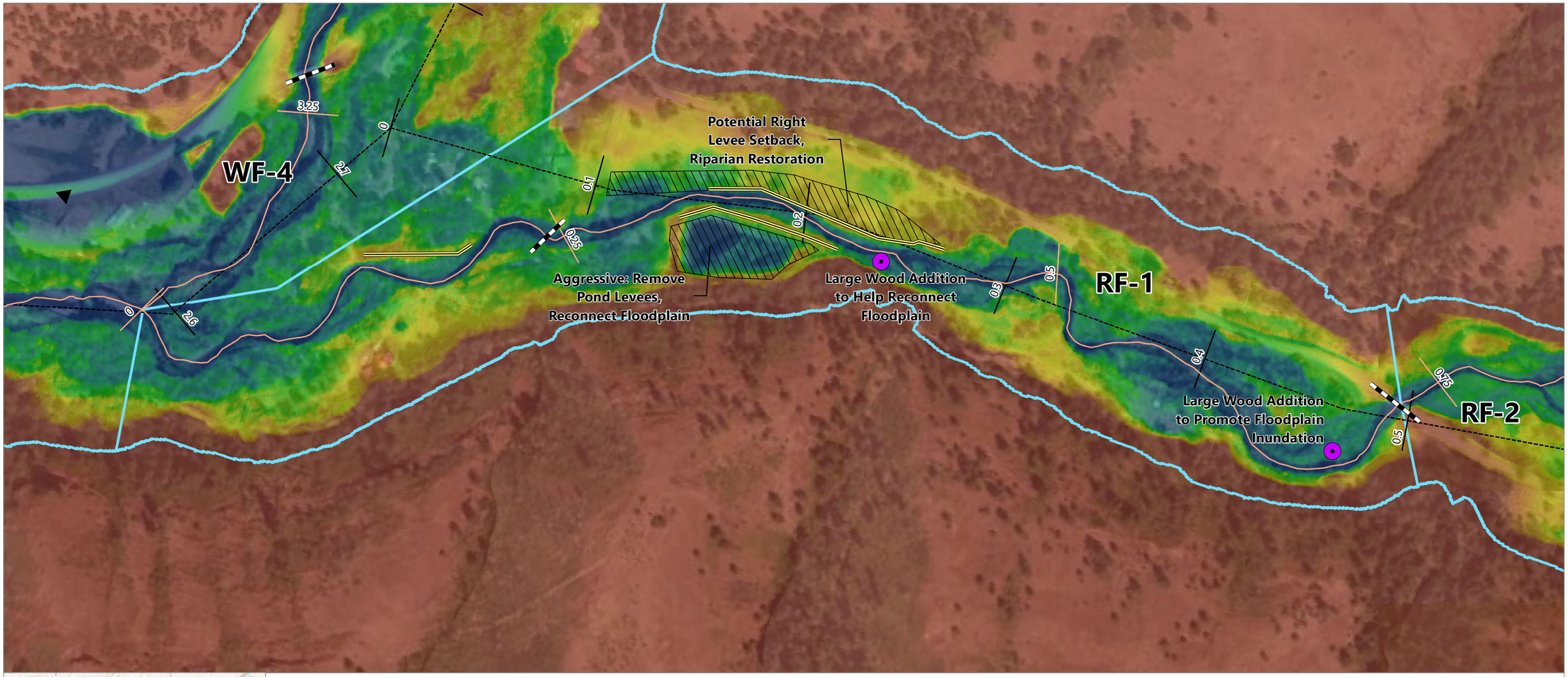

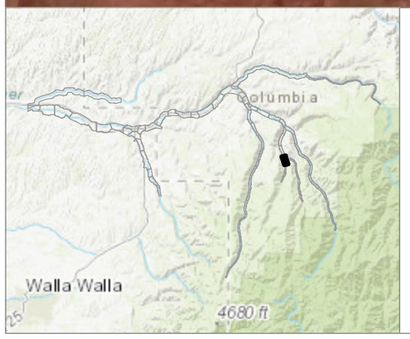

LEGEND:

- Delineated Levees
- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Floodplain
- Long Term: Set Back Road

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 0
RIVER MILE END: 0.73
VALLEY MILE START: 0
VALLEY MILE END: 0.62

0 500
Feet

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RF-1
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Tier 2

Project Areas in the Robinson Fork Touchet Reach

Project Area RF-2

River Length (mi)	0.60
Valley Length (mi)	0.49
Sinuosity	1.24
Average Slope	2.04%
Total Levee Length	0.00
Project Area Score	2.0
Basin Rank	28
Connectivity Score	0.15
Encroachment Removal Potential	6%
Aggradation Potential	17%
Total Potential	28%
2-year Connected Area (ac/rm)	4.6
Total Potential Area (ac/rm)	1.8
Complexity Score (SCE)	0.20
Excess Transport Capacity (psf)	-0.073

Recommended Restoration Actions

- ELJs to promote split flow and reconnect existing side channels
- Add large woody material to promote pool formation and help vegetate gravel bars

Project Area RF-3

River Length (mi)	0.58
Valley Length (mi)	0.54
Sinuosity	1.08
Average Slope	2.28%
Total Levee Length	0.00
Project Area Score	2.0
Basin Rank	27
Connectivity Score	0.15
Encroachment Removal Potential	11%
Aggradation Potential	12%
Total Potential	28%
2-year Connected Area (ac/rm)	4.9
Total Potential Area (ac/rm)	1.86
Complexity Score (SCE)	0.23
Excess Transport Capacity (psf)	-0.069

Recommended Restoration Actions

- Establish grazing exclusion area
- ELJs to promote inundation of the floodplain and riparian revegetation
- ELJs to promote split flow and reconnect existing side channels

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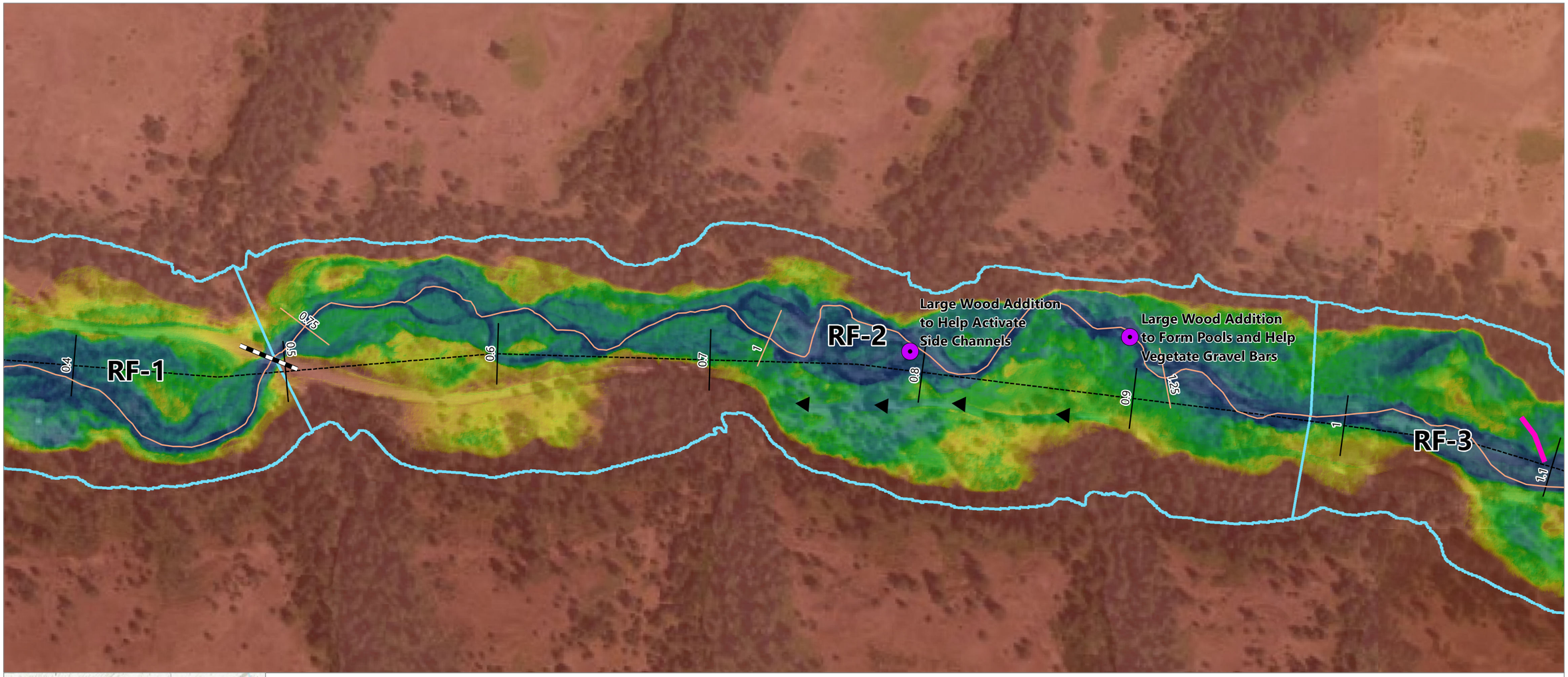

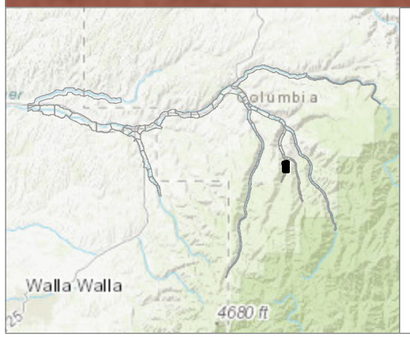

LEGEND:

- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Long Term: Set Back Road

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 0.73
RIVER MILE END: 1.33
VALLEY MILE START: 0.62
VALLEY MILE END: 1.11

0 500
Feet

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RF-2
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

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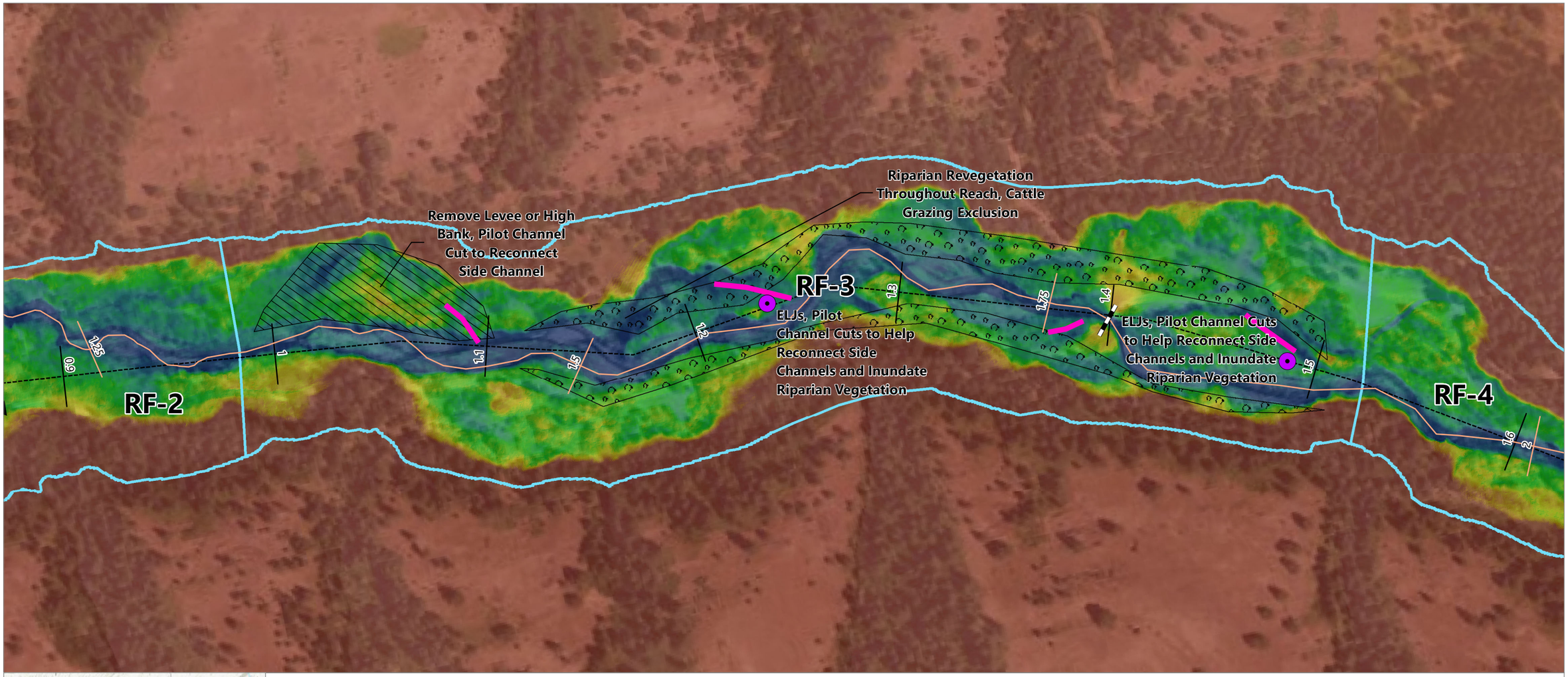

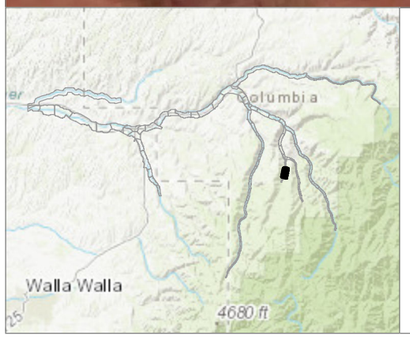

LEGEND:

- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel
- Reconnect Floodplain
- Long Term: Set Back Road
- Riparian Enhancement

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 1.33
RIVER MILE END: 1.91
VALLEY MILE START: 1.11
VALLEY MILE END: 1.65

0 500
Feet

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RF-3
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration

Tier 3

Project Areas in the Robinson Fork Touchet Reach

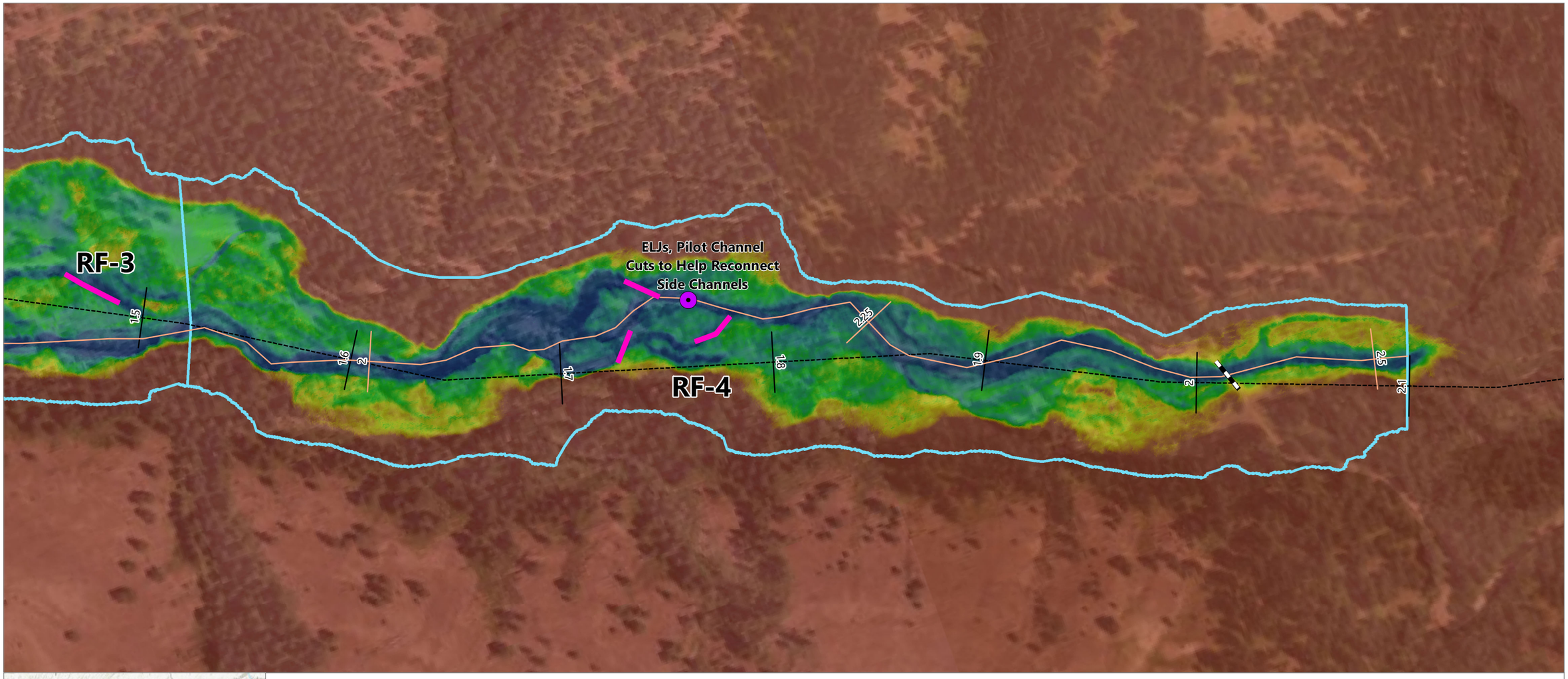
Project Area RF-4

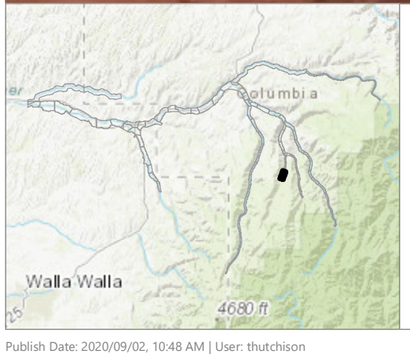
River Length (mi)	0.60
Valley Length (mi)	0.58
Sinuosity	1.08
Average Slope	2.79%
Total Levee Length	0.00
Project Area Score	0.9
Basin Rank	50
Connectivity Score	0.11
Encroachment Removal Potential	8%
Aggradation Potential	9%
Total Potential	20%
2-year Connected Area (ac/rm)	5.3
Total Potential Area (ac/rm)	1.30
Complexity Score (SCE)	0.19
Excess Transport Capacity (psf)	0.066

Recommended Restoration Actions

- ELJs, pilot channel cuts to promote split flow and reconnect existing side channels
- Establish grazing exclusion area

DRAFT





LEGEND:

- Bridges Limiting Channel Migration
- Wood Addition
- Reconnect Side Channel

Relative Elevation in Feet

- Touchet River Centerline By Fork
- Touchet Valley Line By Fork
- Touchet Project Areas

NOTES:

1. Horizontal datum is WA State Plane South, NAD83, U.S. Feet.
2. Vertical datum is North American Vertical Datum of 1988, feet.
3. Aerial Imagery is NAIP (2017).
4. LiDAR elevation data is WA DNR (2018).
5. The conditions and recommendations in this map are based on LiDAR data from 2018 and site visits in 2019. Flood events and geomorphic changes have occurred since then and may have changed the topography relative to what is shown.

RIVER AND VALLEY MILE DATA:
(Assuming Assessed Watershed Starts RM and VM 0 at Prescott)

RIVER MILE START: 1.91
RIVER MILE END: 2.52
VALLEY MILE START: 1.65
VALLEY MILE END: 2.22

0 500
Feet

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RF-4
Conceptual Restoration Map
2020 Geomorphic Assessment and Conceptual Restoration Plan
Touchet River Conceptual Restoration