Methow River (RM 40.6-62.3) Reach Assessment & Restoration Strategy Update

Final Report

May 2026



PREPARED FOR
Yakama Nation Fisheries

PREPARED BY
Inter-Fluve, Inc.

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SUBMITTED TO
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May 2026

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List of Abbreviations

DBH – Diameter at Breast Height
DSM – Digital Surface Model
ESA – Endangered Species Act
LiDAR – Light Detection and Ranging
LWM – Large Woody Material
REI - Reach-Based Ecosystem Indicators
RM – River Mile
UCHRP – Upper Columbia Habitat Restoration Project
UCRTT – Upper Columbia Regional Technical Team
UCSRB – Upper Columbia Salmon Recovery Board
USBR – US Bureau of Reclamation
USFS – US Forest Service
WDFW – Washington Department of Fish & Wildlife
YN – Yakama Nation

1. Introduction

1.1 OVERVIEW

This assessment evaluates aquatic habitat and watershed process conditions for the Methow River between river miles (RM) 40.6 – 62.3 and identifies habitat restoration opportunities. The Methow River has been the focus of past assessments, restoration strategies, and implemented restoration projects over the past two decades. The current effort summarizes key findings from the previous assessments relevant to RM 40.6-62.3, and integrates data collected in 2024-2025 to characterize current conditions, including areas influenced by implemented restoration projects. Based on the findings of this assessment, a new restoration strategy for the study area is provided, which includes updated recommendations for restoration and conservation actions that help achieve the objectives of the Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan (UCSRB 2007) and its associated Biological Strategy (UCRTT 2021).

This reach assessment builds on to the technical foundation for understanding the existing conditions of the Methow River and for identifying areas that would benefit most from restoration strategies to improve aquatic habitat and stream ecological functions. Conditions are assessed at multiple scales, including the habitat unit scale (e.g. habitat assessment), reach-scale (e.g. REI analysis), segment (geomorphically similar reaches), and study area scale (e.g. hydraulic modeling). The aim of this assessment is to identify areas for restoration actions that address factors limiting the productivity of native salmonids and to ensure that the identified actions fit within the appropriate geomorphic and ecological context of the river system. An emphasis is placed on understanding the underlying biological and physical processes at work and how human impacts have affected these processes and the habitats they support. Restoration measures focus on recovering these impaired processes to the extent possible. Additionally, areas of minimal human impact, or areas at particular risk of further degradation, are identified to promote conservation of ecological processes. Although the proposed restoration and conservation measures are expected to benefit a large suite of native aquatic and terrestrial species, there is a particular emphasis on recovery of Endangered Species Act (ESA) listed Upper-Columbia summer steelhead (*Oncorhynchus mykiss*), Upper-Columbia Spring Chinook (*Oncorhynchus tshawytscha*), and Columbia River Bull Trout (*Salvelinus confluentus*).

The report includes the following components:

- Assessment area summary (Section 2): Description of the assessment area, fish use, and geophysical settings.
- Hydrology and Hydraulic modeling summary (Section 3): 2-dimensional hydraulic modeling of the study area, and related hydrologic summary. Detailed methods and results provided in Appendix D.
- Habitat assessment summary (Section 4): Summary of the 2024-2025 aquatic habitat inventory, presented at the reach scale. Detailed methods and results provided in Appendix A.

- Reach-based Ecosystem Indicators (REI) summary (Section 5): Summary and table of habitat conditions ratings of established functional thresholds. Detailed methods and results provided in Appendix B.
- Channel conditions (Section 6): Review and descriptions of geomorphic and habitat conditions at the reach and segment (combined geomorphically similar reaches) scale.
- Restoration strategy (Appendix C): Identification of recommended restoration treatment options to improve habitat and ecological processes within the river's geomorphic context and a prioritization evaluation of the projects, based on existing conditions compared to target conditions and potential uplift (benefit).

1.2 PURPOSE AND APPROACH

This assessment project was developed under the direction of the Yakama Nation Fisheries Upper Columbia Habitat Restoration Project (UCHRP) to help guide habitat restoration prioritization in the Upper Columbia Basin. The UCHRP works within the framework of the Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan (UCSRB, 2007) and its associated Biological Strategy (UCRTT, 2021) to help establish and accomplish tribal fisheries management goals based on robust technical information.

This assessment utilizes field data collected throughout the assessment area as well as existing available information including past watershed assessments and reach-scale assessments. The previous assessments are summarized in Section 2.2. This assessment relies heavily on the past work to inform certain basin- and reach-scale conditions that assumed to be relatively unchanged, such as geophysical setting, hydrologic regimes, and past human impacts. New data collection and analysis included a habitat survey, preliminary hydraulic modeling, geomorphic observations of modern conditions, updated vegetation characterization, and a REI analysis. Thus, this current reach assessment differs from other reach assessments in that its emphasis is on providing an update to reflect current conditions and providing an updated restoration strategy that reflects modern conditions. The presence of past restoration projects is considered throughout this undertaking. Over the past 20+ years, several restoration projects have been implemented in the assessment area. The location of those projects is documented in this assessment. The restoration strategy evaluates potential adaptive management of these projects, additional potential work in existing project areas, and opportunities to address areas that have not been previous targets for restoration.

The purpose of this assessment is to:

- Summarize relative watershed- and reach-scale conditions characterized as part of previous assessments.
- Evaluate current conditions through updated field data collection and technical analyses, including an aquatic habitat inventory, preliminary hydraulic modeling, vegetation characterization, and an REI analysis.
- Document the location of past restoration projects within the study area.

- Develop an updated habitat restoration strategy that identifies and prioritizes actions for aquatic habitat improvement.
- Act as a resource for coordinating efforts with local landowners, resource managers, and other stakeholders to establish collaborative efforts that contribute to the success of restoration strategies.

2. Assessment Area Summary

This section provides a brief overview and description of the assessment area, including orientation to geography, a summary of past assessments and projects, of fish use, and a description of the geophysical setting. Detailed information on basin history, geography, geology, and ecologic setting is well-covered in other sources, including the past assessments described below in Section 2.2. As described previously, this report does not re-state this information, but rather builds upon and updates the information as it relates to specific habitat and river process conditions. Section 2 of this report is a summary of existing relevant information and a summary description of the assessment area's geomorphology to provide context to the bio-physical conditions of the study area. The sections that follow (Sections 3 through 5, plus relevant appendices) describe the data collected and analyzed as part of this current effort to provide an updated assessment and restoration strategy. This includes a hydrology and hydraulics analysis, habitat assessment, and the REI analysis. Section 6 describes specific conditions at the segment scale. The updated restoration strategy is included as Appendix C.

2.1 ASSESSMENT AREA DESCRIPTION

The assessment area includes the Methow River and its floodplain, extending from downstream of Twisp, WA at RM 40.6 to RM 62.3, slightly upstream of the Weeman Bridge. The Methow Basin is on the east side of the Cascade Range in northcentral Washington, within Okanogan County (Figure 1). The Methow River is a primary tributary to the Columbia River that provides important migration, spawning, and rearing habitat for salmonids. Major tributaries to the Methow River include Lost River, Early Winters Creek, Wolf Creek, Chewuch River, Twisp River, and Beaver Creek. An overview map of the assessment area is provided as Figure 2.

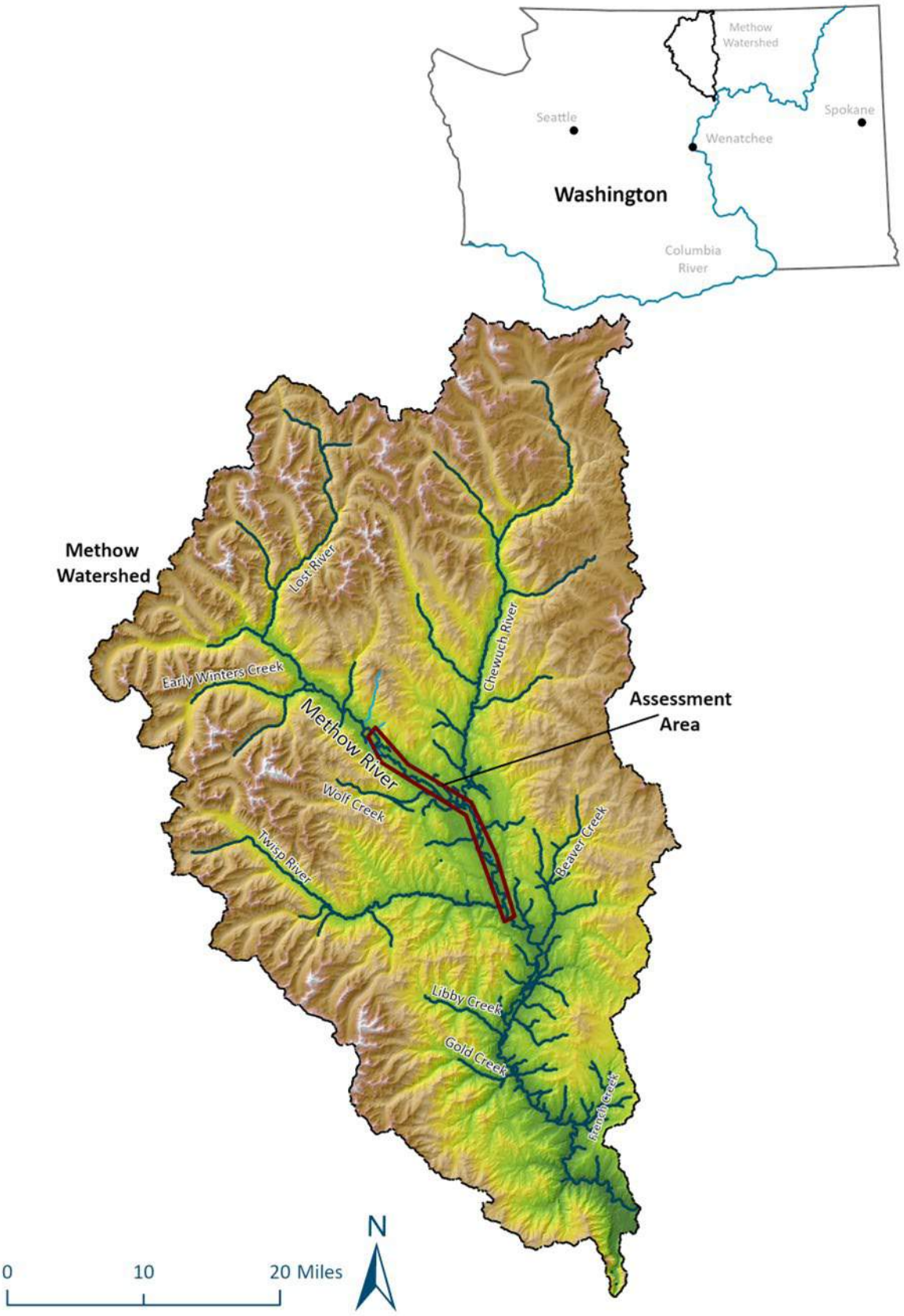


Figure 1. Locator map of the Methow Reach Assessment RM 40.6 – 62.3.

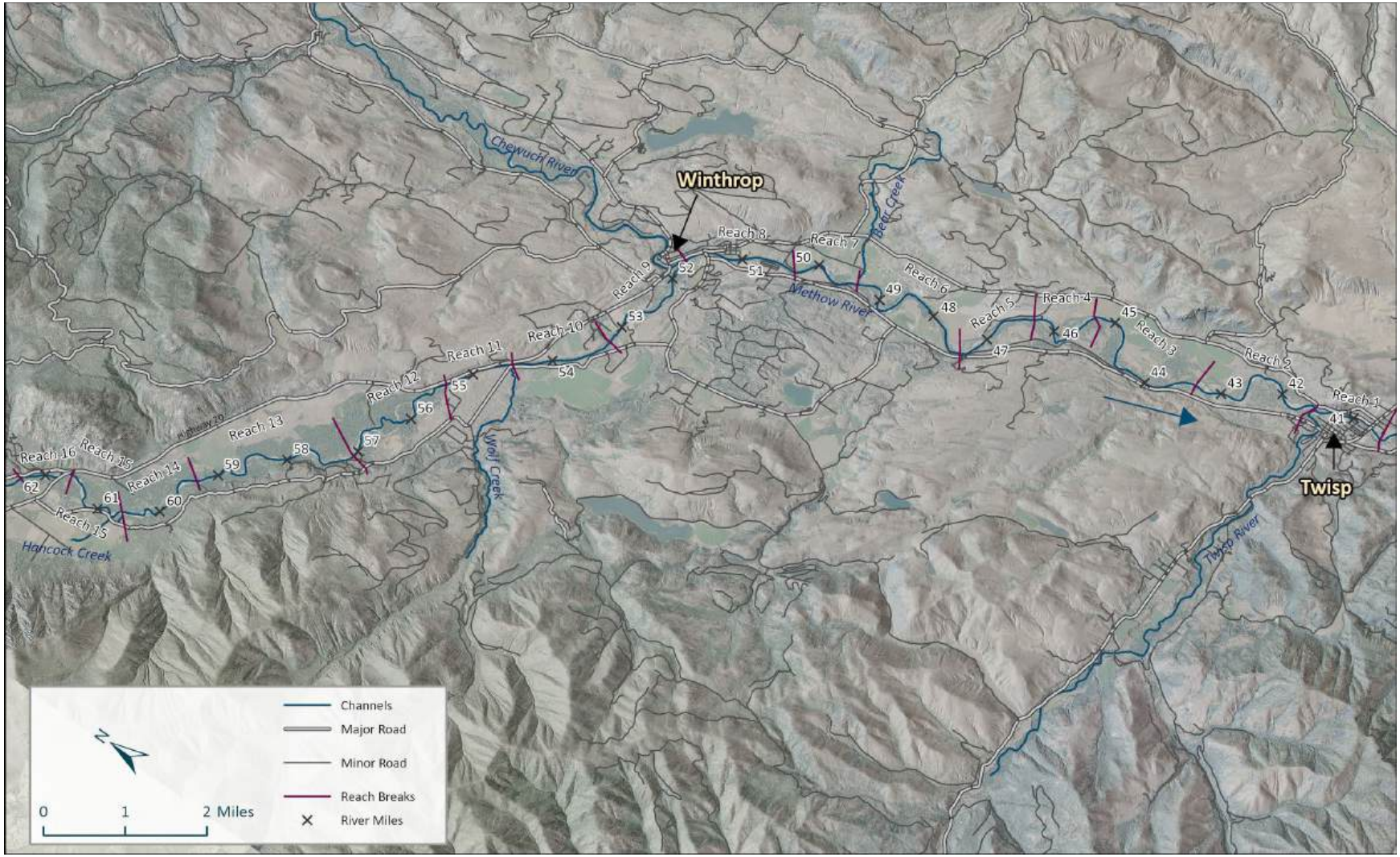


Figure 2. Overview of the Methow River assessment area.

2.1.1 Anthropogenic Impacts and Influences

The Methow River Basin has a long history of human occupation and influence. Indigenous people have lived, hunted, fished, and gathered in the Methow for "over 500 generations." U.S. policies and colonialism over the last 250 years attempted to remove them but, descendants and native tribes continue to be a part of fabric and restoration efforts in the watershed (Hart, 2017).

Euro-American presence within the watershed grew rapidly during the 1800's, initially driven by the international fur trade, which brought trappers to the region. Removal of beaver from the Methow is associated with historical loss of floodplain wetlands, degraded water storage, reduced resilience, and reduced aquatic habitat function (Brazier et al., 2021).

Mining operations beginning in the mid-1800s led to white settlement of the region and greatly impacted sediment and ecologic conditions. Notable impacts of historical mining operations on the Methow River include contamination resulting from rock treatment as hard rock mining waste was washed into the Methow River in the 1840s (Wilson, 1990) and dumping of large volumes of sediment onto existing gravel bars in the lower watershed during gold extraction in the 1860s.

Timber extraction and land conversion for agriculture/livestock accelerated during the mid- to late-1800s. The history of timber harvest and log drives down the river resulted in persistent legacy effects on the river, including within the assessment area. Upland timber harvest and associated road building likely increased runoff and fine sediment contributions to the river. Historical log drives to transport harvested lumber downriver to mills in Winthrop, Twisp, and beyond removed large wood and jams from the channel and scoured out spawning gravels, resulting in the simplification and incision of channels. The enduring legacy of the removal of mature forests from the valley for timber harvest and/or agriculture continues to disrupt important functions historically provided by mature riparian forests such as flood moderation, regulation of inundation processes, shade to moderate stream temperature, nutrients that support diverse ecosystems, and a source of effective large wood material to the channel. During the 1900s, sections of the Methow River and its tributaries became channelized for agricultural and development purposes, and several irrigation ditches were installed (USFS, 1999). In 1911, the Nixon-Kimmel Company began construction of a hydropower dam near the mouth of the Methow that diverted the water into a flume and pipe to run through their powerhouse. Although operations only lasted for about a decade, the dam blocked the river from 1912 until the 1930s and acted as a barrier for salmon, ending the coho salmon run (Wissmar et al., 1994).

There are numerous types of infrastructure that impact sections of the modern channel and floodplain processes in the assessment area. These include roads, bridges, armored banks, levees, trails, powerlines, culverts, irrigation withdrawals/piping, utility crossings, and private homes. The towns of Twisp and Winthrop and the area between have the highest density of structures, paved surfaces, and related infrastructure. The contributing watershed to the assessment is 5.3% privately owned but the majority of land ownership along the channel is primarily private. The remainder of land ownership in the watershed is federal, state, local, or conservation lands. A landownership map of the assessment area is provided in Figure 3.

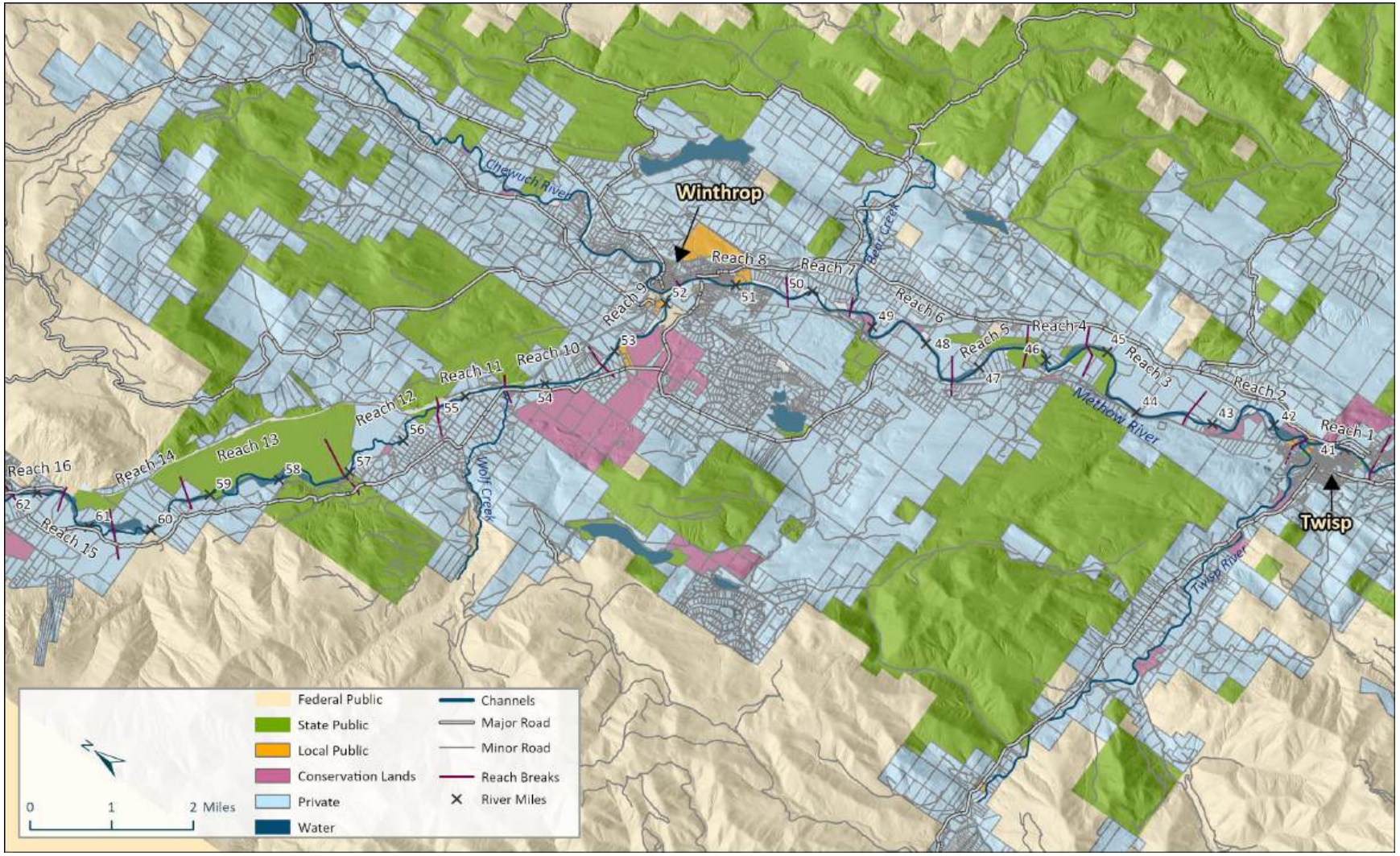


Figure 3. Landownership in and around the Methow River RM assessment area 40.6 – 62.3.

2.1.2 Fire History Summary

The Methow River basin has a long history of natural and tribe-managed low-intensity wildfires. Fire suppression, which began in 1911, altered the fire regime and, in combination with climate change impacts, has notably increased the risk of moderate to high intensity burns in modern times. Widespread fire suppression coupled with intensive logging resulted in growth of dense understories, debris loading, and dense similar-aged second growth, which has increased the intensity and spatial extent of fires (Barnes, n.d.). Changes to the fire regime impact channel and floodplain processes through increases in hillslope instability and sediment inputs. Several large wildfires have occurred within the Methow watershed in the recent past. According to data compiled by the Methow Conservancy (Grialou, 2023), wildfires greater than 1,000 acres in size burned a total of 59% of the Methow Watershed between 2000-2022. During this period, an average of 32,396 acres burned per year, with

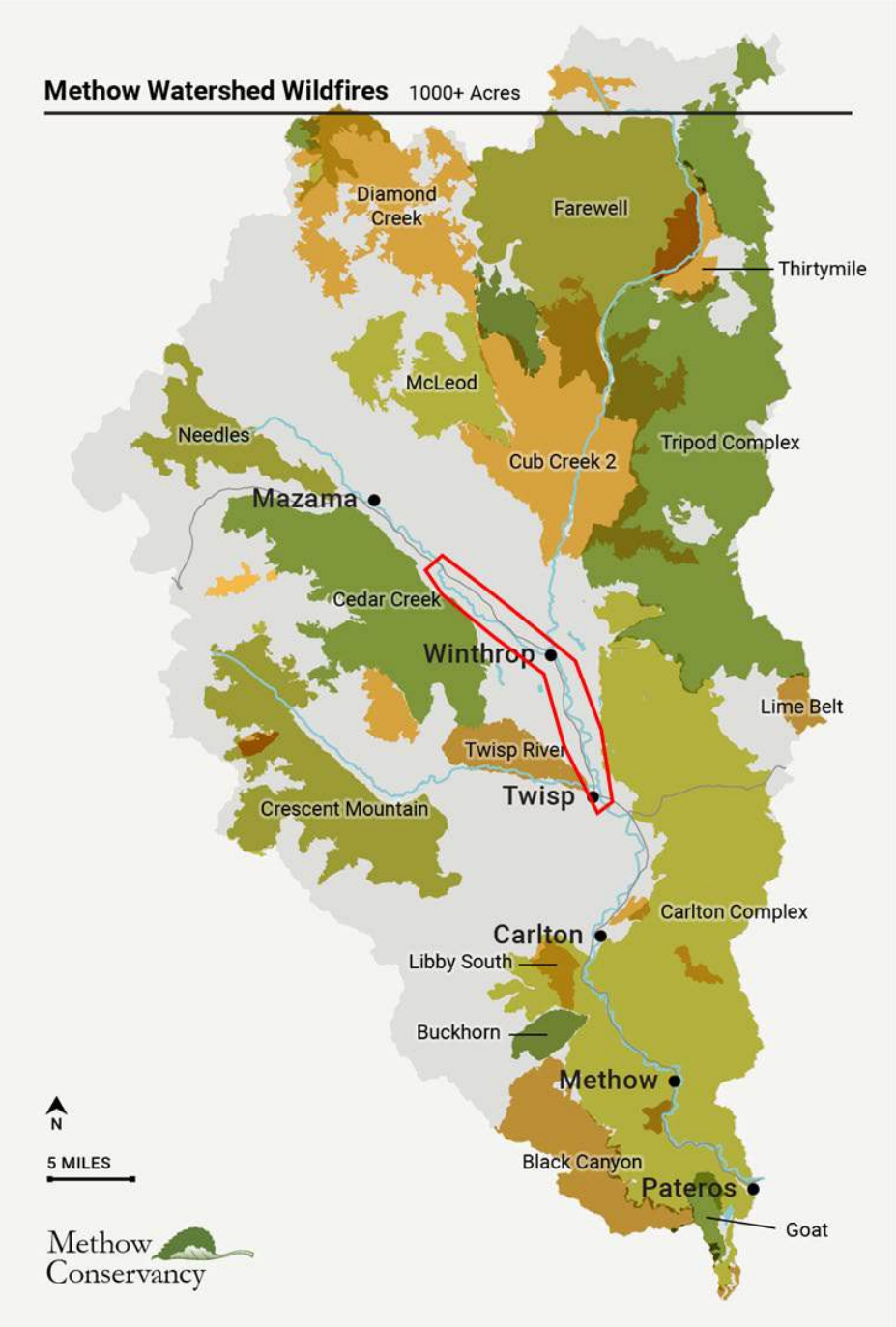


Figure 4. Figure created by Methow Conservancy (Grialuo, 2023) depicting 1,000+ acre wildfires between 2000-2022. The assessment area is annotated on the map as a red polygon.

29% of those acres classified as "high" severity. For comparison, between 1970-1999, 1,000+ acre fires burned 3.7% of the watershed with an average of 5,392 acres burned per year. A map of the 1,000+ acre fires in the Methow watershed from 2000-2022 is provided as Figure 4, with the assessment area identified by the red polygon. An additional large wildfire, not included in Figure 4 but within the contributing watershed to the assessment area is the Crater Creek fire (2023) which burned 5,145 acres. Wildfires less than 1,000 acres reported in or partially in the Methow since 2023 are included in Table 1.

Table 1. Reported wildfires less than 1,000 acres in the Methow (2023-2025).

Wildfire	Year	Acres Burned
Pete Creek	2024	4
Beaver Pond	2024	3
Mazama	2024	0.1
French Creek	2024	29
Gold Creek	2024	278
Frazer Crossing	2024	220
Alta Ridge	2025	1.4
Gun Dog Road	2025	40[†]
Study Horse	2025	532
Buckhorn	2025	6.3

[†+ -] Reported as 40 acres, but GIS polygon analysis was 23 acres.

2.2 PAST REACH ASSESSMENTS

Several previous assessments have been completed for portions of the Methow River Basin, including a few that overlap with the assessment area of interest (RM 40.6 to RM 62.3) in this report. The past assessments are listed in Table 2, with year completed and river miles assessed. This current assessment references and builds upon the past assessments. Where appropriate, the previous assessment and material are referenced throughout this report.

Table 2. Past assessments of the Methow River basin. Listed in chronological order. Assessments that overlap with this assessment are shaded gray.

Year	Name	Agency	Area of coverage	Types Assessments Performed
2008	Big Valley Reach Assessment Methow River	US Bureau of Reclamation	Big Valley Reach, Wolf Creek alluvial fan (RM 55) to the confluence of Cassal Creek (RM 62)	Habitat Project Identification, Prioritization and Sequencing, Reach-Based Indicator Reach Characterization, Construction Feasibility, Habitat Assessment
2008	Methow Subbasin Geomorphic Assessment	US Bureau of Reclamation	Methow River (RM 28.1 to RM 75); Twisp River (RM 0 to RM 18.1); Chewuch River (RM 0 to Rm 14.3)	Geomorphic Assessment, Hydraulic Analysis, Sediment Transport analysis, Habitat Project Recommendation, and Vegetation Assessment.
2010	Middle Methow Reach Assessment Methow River	US Bureau of Reclamation	RM 41.0 to RM 50.0	Reach Characterization, Project Identification and Recommendations, Vegetation Assessment, Habitat Assessment.
2011	Winthrop Area (W2) Assessment of Geomorphic and Ecologic Indicators	US Bureau of Reclamation	Winthrop (RM 50) to Wolf Creek (RM 55)	Geomorphic Assessment, Reason and Prudent Alternative Analysis, Reach Characterization, Vegetation Assessment, Reach Characterization, Hydraulic Analysis, Habitat Improvement Project Recommendations.
2015	Upper Methow River Reach Assessment RM 61 – RM 80	Yakama Nation	Weaman Bridge (RM 61) to Trout Creek (RM 80)	Geomorphic Assessment, Stream Habitat Assessment, Habitat project recommendations, Hydrologic Analysis, Hydraulic Analysis, Restoration strategy framework,
2017	Methow River; Assessment of the Twisp to Carlton Reach	Cascade Columbia Fisheries Enhancement Group	Carlton (RM 28.1) to Twisp (RM 41.3)	Habitat Assessment, Geomorphic Assessment, Restoration Strategy, Hydrologic Analysis, Hydraulic Analysis, Restoration Prioritization.
(2019)	Lower Methow River Reach Assessment	Methow Salmon Recovery Foundation	Mouth (RM 0) to Carlton (RM 28)	Geomorphic Assessment, Hydraulic Analysis, Habitat Assessment, Past Project Analysis, Habitat Restoration Strategy and Prioritization.

2.3 PAST AND PLANNED RESTORATION PROJECTS

Numerous restoration projects have been implemented in the assessment area, several of which were a result of recommendations from past assessments. Multiple entities have completed restoration projects in the area over the past two decades. Past and planned reported projects in or partially in the assessment area are listed in ***Table 3***. The information about the past and planned projects was obtained from a combination of sources including shared personal knowledge and

communication with sponsor entities (or their design consultants), the publicly available Salmon Recovery Portal and Methow Salmon Recover Foundation databases, and field-based observations during the 2024-2025 surveys. Overview maps of the past and planned projects are included as Figure 5 and Figure 6.

Table 3. Reported past or planned projects and project-areas within the assessment area.

Year	Name	Sponsor	Area of coverage	Project Components
1989	Foghorn Diversion Dam[1]	USFWS	Reach 9; RM 53.2	Construction of Foghorn Diversion Dam for Foghorn Irrigation Company[i]
2003	Foghorn Diversion Dam, Fish Screen[1]	USFW	Reach 9 and Reach 10; RM 53.15 - RM 53.4	Fish Screen installation; Fish passage enhancement[1]
2007	Rockview Diversion[1]	Cascade Fisheries	Reach 16; RM 61.7	Restored irrigation capability; Construction of an irrigation well and well pump; Fish screen installation[1]
2009	Wolf Creek Road Project[2,4]	Yakama Nation	Reach 15; RM 61.1	Large wood structures and bank armoring; Bank stabilization
2009	Hancock Springs[1,2]	Yakama Nation	Reach 15; Tributary	Off-channel habitat restoration of upstream extent; Riparian vegetation; Culvert replacement; Installation of three rocked livestock watering points[1]
2009	MSRF Sletton and Green Habitat Complexity Projects[ii]	WDFW	Reach 12; RM 57; Reach 14; RM 59.7	Large wood structures and bank barbs; Bank stabilization; Increase bank complexity
2010; 2024	Methow Valley Irrigation District (MVID) East Diversion Modification Project[1]	MSRF	Reach 5: RM 46.3 - RM 46.5	Modification to existing diversion intake, canal, headgate, sediment wasteway and fish screen bypass; Removal of channel-spanning diversion dam and dam foundation; Improvement to water diversion; Side channel reactivation; Fish return improved in 2024[1]
2012	Methow Valley Large Wood Enhancement: Site B[2,4]	Yakama Nation	Reach 3; RM 44.15	Large wood structures; Bank stability
2012	RM 46[2]	MSRF	Reach 4; RM 46	Large wood structure; Floodplain roughness
2012-2013	Whitefish Island Project[iii]	MSRF	Reach 7; RM 48.8-49.25	Large wood structure; side channel construction and reactivation; Removal of bank armoring; Installation of large wood crib structure; Riparian vegetation; Channel fill
2013	Methow Valley Large Wood Enhancement: Site D[2,4]	Yakama Nation	Reach 2; RM 42.3	Large wood structures ballasted in riprap bank; Bank stability
2013	Wolfridge Riparian Project[1]	MSRF	Reach 12; RM 56.45	Large wood structure; Bank stabilization; Large wood structure revetment; Riparian vegetation[1]
2013	Winthrop Confluence Project: Riparian[1]	MSRF	Reach 8; RM 51.64	Large wood structure; Riparian vegetation
2013	M2 WDFW Project Area[1,4]	Yakama Nation	Reach 4 and Reach 5: RM 45.8 - RM 46.5	Instream large wood structures; Off-channel habitat reconnection and enhancement; Riparian vegetation[1]

Year	Name	Sponsor	Area of coverage	Project Components
2013	Witte Riparian Project[1]	MSRF	Reach 2; RM 42.2	Bank stabilization; Riparian revegetation[1]
~2011-2015	River Runn Inn [iv]	Cascade Fisheries	Reach 9; RM 52.7	Ballasted large wood structures in riprap; Bank stability
2014	Methow Valley Large Wood Enhancement: Site C[2]	Yakama Nation	Reach 2; RM 42.8	Large wood structure ballasted in riprap; Channel backwater enhancement
2014	Methow Valley Large Wood Enhancement: Two Channel and Riprap Enhancement[2,4]	Yakama Nation	Reach 4; RM 45.5	Large wood structure; Large wood piling installation; Large wood ballasted within bank armoring[1]
2014	1890's Side Channel[4]	Yakama Nation	Reach 2; RM 41.65	Construction of side channel; Installation of groundwater gallery with large wood structures and pilings; Installation of groundwater pipe outlet; Floodplain large wood structures; Riparian revegetation
2014	Browse Exclusion[2]	Yakama Nation	Reach 3; RM 44.4	Information not available
2015	Fender Mill [v]	Yakama Nation	Reach 15; RM 60.2	Installation of groundwater gallery with large wood structures; Riparian vegetation; Channel excavation through remnant mill pond dam and creation of side channel habitat; Removal of concrete spillway; Highway protection, removal and replacement of woody debris; Closing and sealing of abandoned headworks; Relocating utilities
2015; 2018	Big Valley Project Area[2]	Yakama Nation	Reach 13; RM 57.2 - RM 57.8	Large wood structure; Pool enhancement; Channel alcove enhancement with large wood installation; Side channel habitat enhancement; Removal of concrete and steal "people mover" and riprap; Removal of irrigation headgate
2015	Cottonwood Restoration[2]	Yakama Nation	Reach 3; RM 43.6	Riparian vegetation
2017	Riparian Planting[2]	MSRF	Reach 3; RM 44.25	Riparian vegetation
2019	M23R[1,2]	MSRF	Reach 6; RM 47.8 - RM 48	Large wood structures; Side channel habitat enhancement; Riparian vegetation; Instream habitat complexity
2019	Hancock Springs[2]	USFW & Cascades Fisheries	Reach 15; Tributary	Off-channel habitat restoration of downstream extent; Riparian vegetation; Culvert replacement
2020	Barkley Irrigation Project[1]	Cascade Fisheries	Reach 6 and Reach 7	Move Barkley Diversion point; reconnect Bear Creek with the Methow River
2020	Sugar Small Project[2]	MSRF	Reach 2; RMM 42.5	Large wood structures; bank stability; Riparian vegetation
2020-2025	Barkley Bear Habitat Improvement Project[3]	MSRF	Reach 7; RM 49.4 - RM 49.9	Excavated island side channels; Large wood structures; Bank barbs; Large wood structure roughness; Bear Creek realignment; Bear Creek large wood structures; Excavation and removal of levee and levee armoring; Removal of anthropogenic features; Riparian vegetation

Year	Name	Sponsor	Area of coverage	Project Components
2024	Eagle Rocks[3]	MSRF	Reach 2 and Reach 3; RM 43.1 - RM 43.7	Floodplain connectivity enhancement; Instream channel complexity; Riparian vegetation; Excavation of side channel; Channel grading; Large wood structures
2025	Sugar Reach Project[2]	MSRF	Reach 2; RM 41.55 – 42.15	In Progress. Project includes subproject areas of Sugar Left and Sugar Right.
2025 - 2028	Foghorn Project[2]	Yakama Nation	Reach 9 and Reach 10; RM 52.8 – 53.4	Proposed project with project elements including the relic side channel; Large wood structures; Pool enhancement
2026	Sugar Reach Project[2]	MSRF	Reach 2; RM 42 - RM 42.75	Proposed project area with four subproject areas: WDFW, Eagle Rocks, Sugar Right and Sugar Left (combined Sugar)
2026	WDFW Phase 2[2]	MSRF	Reach 5 and Reach 6; RM 46.3 – RM 46.45	Proposed project
2027	3R[2]	MSRF	Reach 6; RM 47.55 – RM 48.8	Proposed project
2027	3R Phase 2[2]	MSRF	Reach 6; 47.5-48.8	Proposed project include subprojects of (M2) River Rock Reach (3R) Floodplain and Side Channel
2027	Two Channels[2]	Yakama Nation	Reach 4 and Reach 5; RM 44.5-48.8	Proposed project with elements of large wood structures and side channel habitat enhancement
2027	1890's Outlet and FBD[2]	Yakama Nation	Reach 2; RM 41.65	Proposed project with elements of channel grading and riparian protection
2028	WDFW Floodplain Project[2]	MSRF	Reach 5 and Reach 6; RM 45.8 – 46.8	Proposed Project
2028	Big Valley Phase 2[2]	Yakama Nation	Reach 13, Reach 14 and Reach 15; RM 58.8 – 61	Proposed Project with elements of large wood structures
2029	Salmon Cassel Project[ii]	MSRF	Reach 16; RM 61.75-62.75	Proposed Project to enhance thermal refugia and habitat complexity upstream of the Weaman Bridge with elements including large wood structures and improvements to pool and alcove habitat.

[i] Source from Salmon Recovery Portal (2025)
[ii] Source from communication with Yakama Nation Fisheries Staff
[iii] Source from Methow Salmon Recovery Foundation ((2021)
iv Source information not available
[v] Source from Inter-Fluve previous projects.

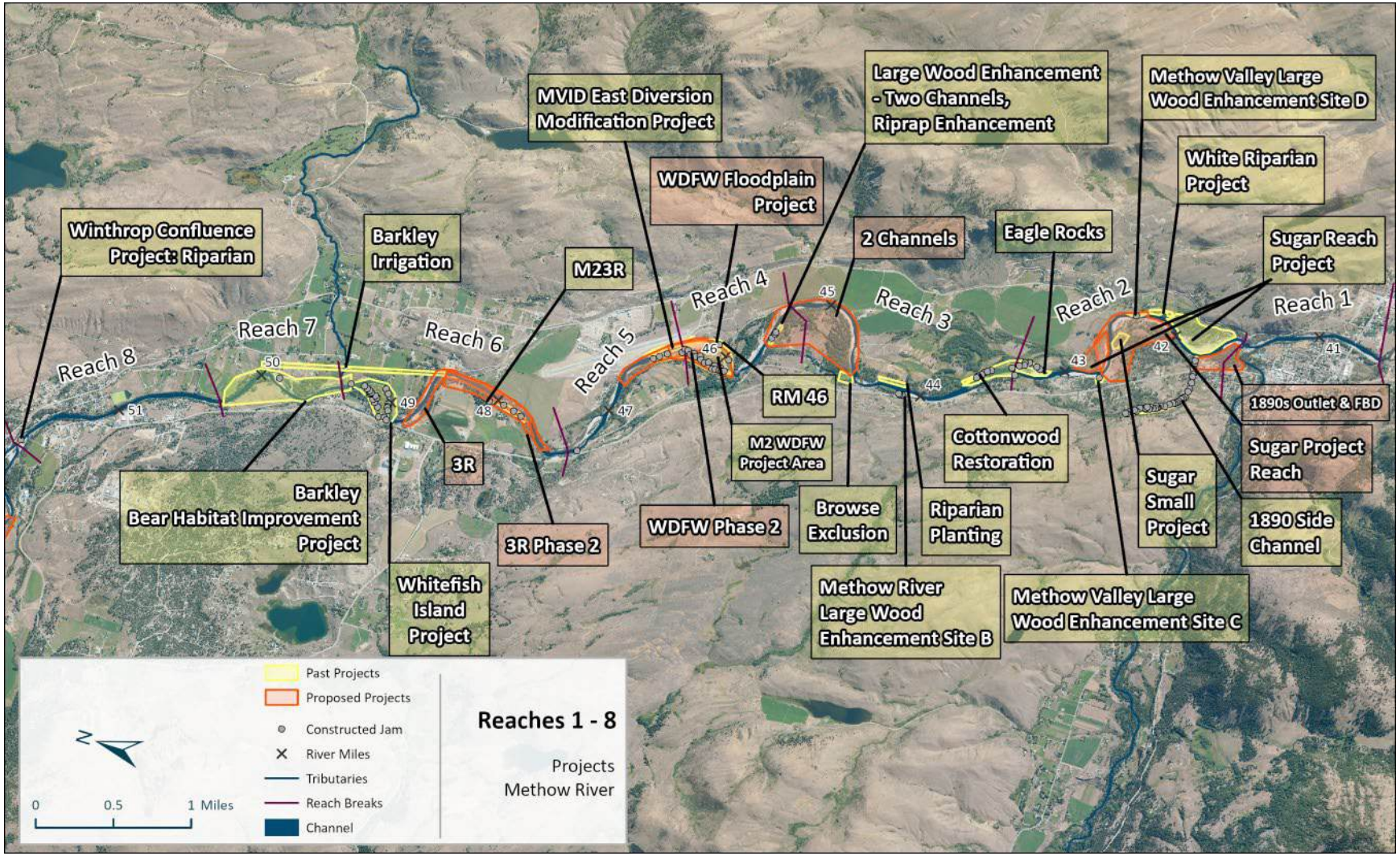


Figure 5. Past and Planned restoration project in Reach 1-8 in the assessment area (RM 40.6 – 51.7).

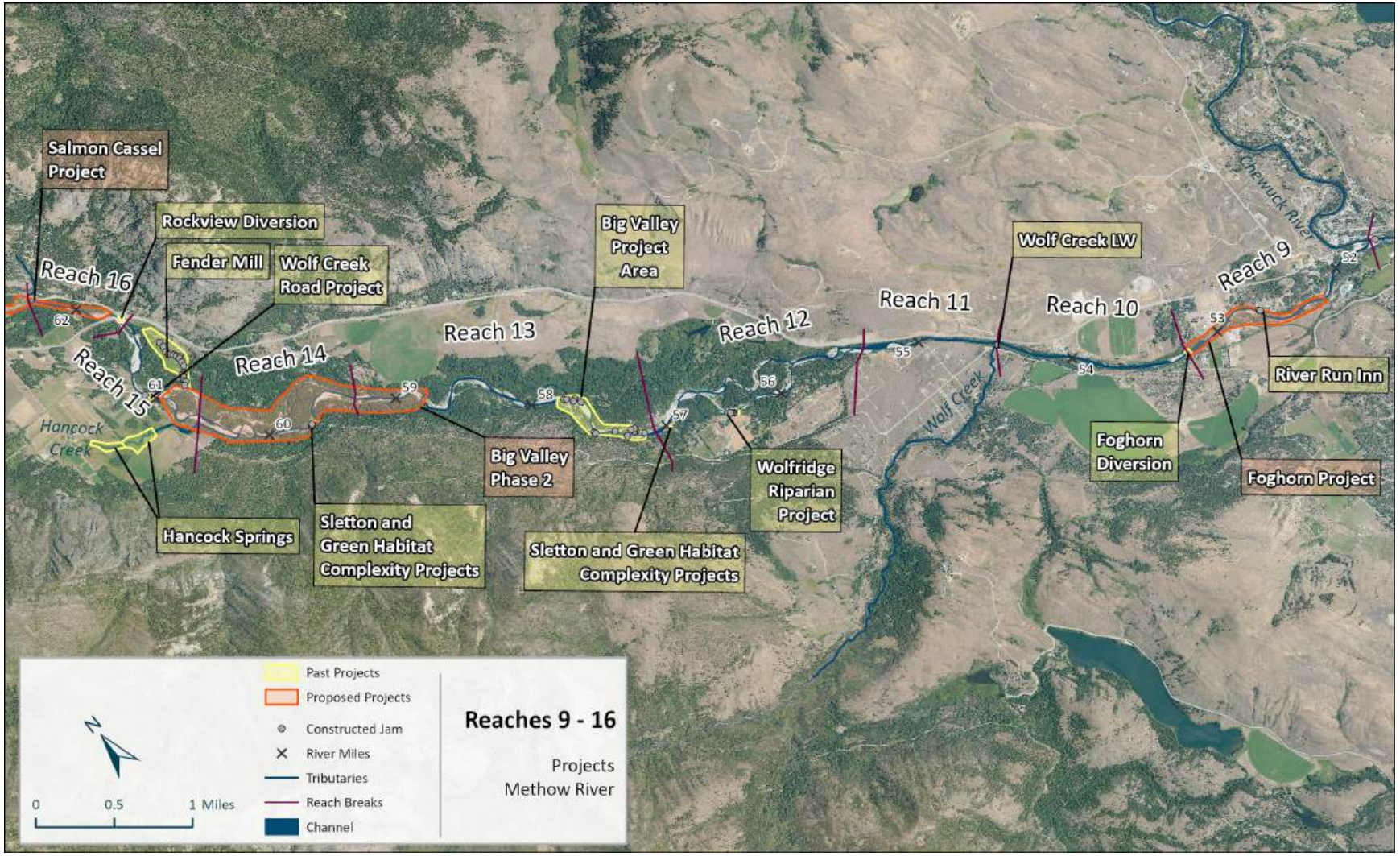


Figure 6. Past and planned restoration projects in Reach 9 - 16 in the assessment area (RM 51.7 – 62.3).

2.4 FISH USE

The Methow River supports a diverse assemblage of native fish species, including several that are listed under the Endangered Species Act (ESA). Listed species in the Methow River include Upper Columbia River (UCR) spring Chinook salmon (*Oncorhynchus tshawytscha*), UCR steelhead (*O. mykiss*), and Columbia River bull trout (*Salvelinus confluentus*). Other non-listed anadromous species of interest in the Methow River include summer Chinook salmon (*O. tshawytscha*), Pacific lamprey (*Entosphenus tridentatus*) and Coho salmon (*O. kisutch*).

The Methow River within the assessment area functions as an important migratory corridor for spring and summer Chinook salmon, steelhead, and bull trout to access spawning habitats in the upper watersheds. Additionally, this reach supports key life stages such as adult holding, spawning, rearing, foraging, and winter refugia for both Chinook and steelhead (USBR, 2008; USBR, 2011) (Figure 7.) Groundwater upwelling in some sections of the assessment area (See Section 3.2.5 Temperature Data) provides potential thermal refugia for native fish species in the Methow River by contributing cooler water during summer low flows and warmer conditions in early spring, which may benefit all species by buffering against seasonal extremes (USBR, 2011).

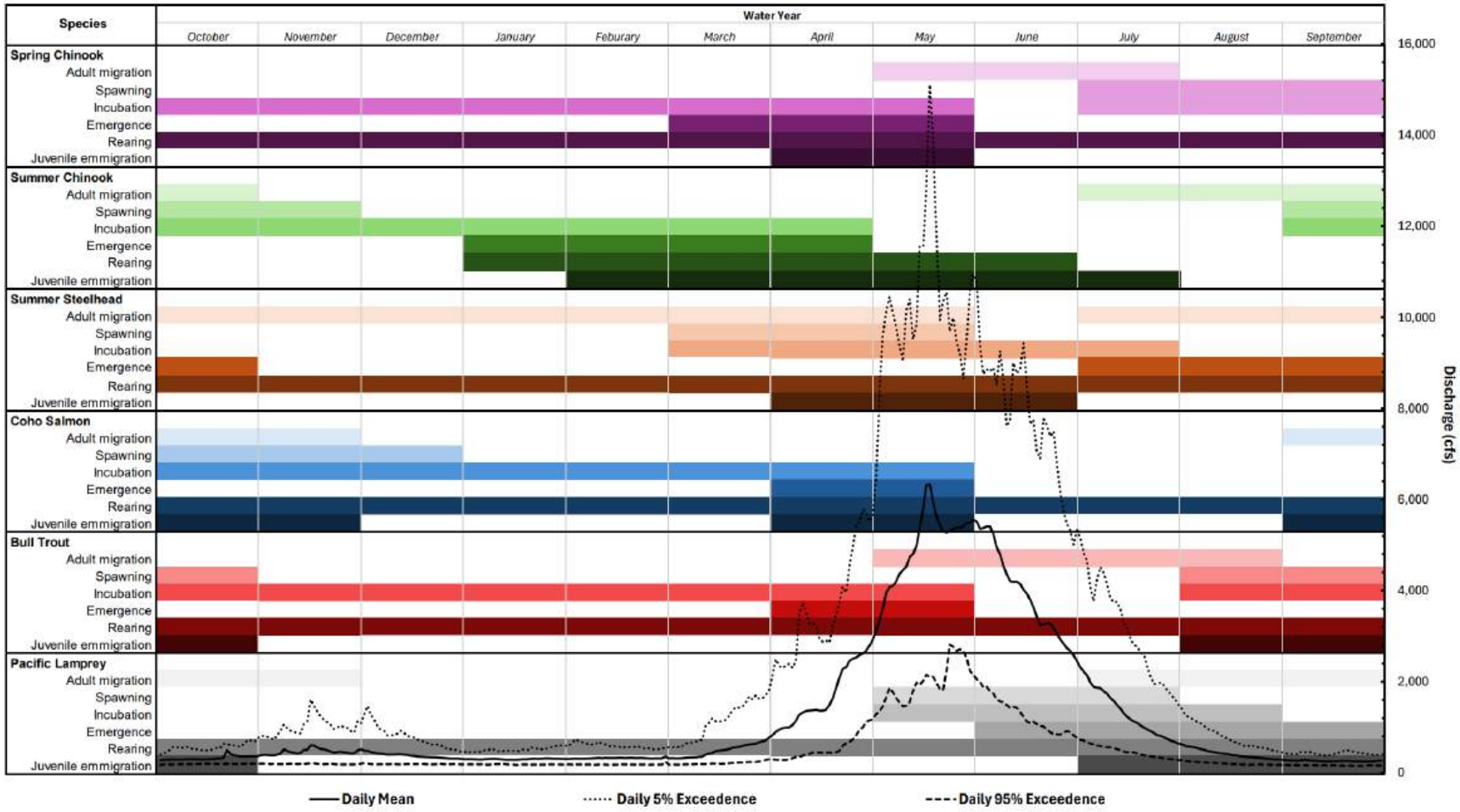


Figure 7. Summary of the life history timing of spring Chinook, summer Chinook, steelhead, coho salmon, bull trout, and Pacific lamprey in the Methow River, overlaid on an annual hydrograph depicting daily mean discharge as well as the daily 5% and 95% exceedance discharges in the Methow River for water years 1993 through 2023 (USGS gage 12447383 and 12448500). Life history references cited in the species descriptions in Section 2.4.

2.4.1 Steelhead

Methow River steelhead are one of four populations within the Upper Columbia River (UCR) distinct population segment (DPS), which was listed as endangered under the ESA in 1997 and later reclassified to threatened in 2006 (NOAA, 2006). The production of UCR steelhead is generally considered depressed and impacted by loss of habitat and downstream dams (Andonaegui, 2000a). The most recent species status update for the UCR DPS suggests that natural origin abundance has recently decreased, and populations within the DPS are threatened by high levels of hatchery genetic introgression and a lack of genetic diversity amongst populations, in addition to low ocean survival and poor habitat conditions (NMFS, 2024). The most recent available data for Methow basin steelhead suggests 809 wild origin adult returned and 1,490 hatchery origin fish returned in 2024 (Niemeyer & Edwards, 2026).

Summer steelhead (*O. mykiss*) enter fresh water from the Pacific Ocean between May and October. UCR steelhead do not move upstream quickly to tributary spawning locations and instead overwinter in the mainstem Columbia River or deep pools and glides in the lower Methow before returning to the upstream portions of the Methow basin to spawn (UCRTT, 2017). Steelhead destined for the Methow basin pass Wells Dam between July and the following May, with peak migration occurring in September (NPCC, 2004). Spawning in the Methow and its tributaries primarily occurs between March and May of the year following freshwater entry (Andonaegui, 2000a) (Figure 6), peaking in late March and early April. Fry emerge from the gravels between July and early October, typically six to ten weeks after spawning (Andonaegui, 2000a). Steelhead spawn throughout the Methow Basin, including the entire assessment reach (UCSRB, 2025).

Age-0 juveniles spend their first year primarily in shallow riffle habitats, feeding on invertebrates and utilizing overhanging riparian vegetation and undercut banks for cover (Moyle, 2002). Older juveniles prefer faster moving water, including deep pools that run over cobble and boulder substrate. Juveniles typically out-migrate to the ocean between ages one and three, though seven-year-old smolts have been reported from the Methow basin (Mullan et al., 1992). Other juveniles may remain in freshwater, displaying a resident life history form (i.e., rainbow trout). The majority of smolts migrate downstream to the ocean from their natal freshwater areas in May (Figure 7; NMFS, 1997; UCRTT, 2017; USFWS, 2007).

2.4.2 Spring Chinook Salmon

T The National Marine Fisheries Service (NMFS) listed the upper Columbia River spring Chinook Salmon (including the Methow Basin populations) ESU as Endangered on March 9, 1999 (NOAA, 1999). The Methow population makes up one of three independent populations within this ESU. The historic wild origin population size based on data from the 1930's has been estimated at 200-400 spawning individuals (NPCC, 2004). Recent data suggest wild origin returns average less than three hundred spawning adults per year. In 2024, 152 wild origin adults and 794 hatchery origin adults returned to the Methow (Niemeyer & Edwards, 2026).

Adult spring Chinook Salmon (*O. tshawytscha*) enter the Methow basin from May through July, holding in deep pools under overhead cover until spawning occurs from very late July through September (Andonaegui, 2000b;) Figure 7). Fry emergence begins in March and continues until late April or May, coinciding with the rising hydrograph. During higher flows, juveniles seek backwater or margin areas with lower velocities, dense cover, and abundant food (Quinn, 2005). Fry in these systems are vulnerable when they emerge because their swimming ability is poor and flows are high. Near-shore areas with eddies, large woody debris, undercut tree roots, and other cover are particularly important for post-emergent fry (Healy, 1991; Hillman & Miller, 1989). Older juveniles utilize deeper pools with resting cover in mainstem habitats more than post-emergent individuals. Spring Chinook typically rear for one year within the Methow River and its tributaries before out-migrating to the estuary and ocean as yearlings. Out-migration typically peaks between mid-April and mid-May (Andonaegui, 2000a).

Spring Chinook Salmon are most frequently documented spawning in the assessment area upstream of the Winthrop Fish Hatchery up to the mouth of the Lost River approximately 22 miles upstream. There is significant spawning upstream of the confluence of Wolf Creek and its associated alluvial fan where valley bottom conditions offer better hyporheic exchange and spawning substrate. A map of Spring Chinook distributions is provided in Figure 8.

Interactions with hatchery spring Chinook Salmon may be common in the Winthrop area, where the Winthrop Leavenworth Fish Hatchery and the Douglas County PUD Hatchery operate and release hatchery-produced juvenile Chinook salmon into the Methow River through hatchery outfall channels that attract returning hatchery-origin adults. Because of the hatchery presence, this area is likely to have more hatchery progeny spawning than other parts of the assessment area.

2.4.3 Summer Chinook Salmon

A run of summer Chinook Salmon (*O. tshawytscha*) is also present in the Methow River. Summer Chinook are not listed under the ESA and exhibit a different life-history strategy than spring Chinook Salmon, although both runs overlap in their use of the assessment area. This alternative life history is referred to as “ocean-type”, which is characterized by rapid downstream migration to the ocean within their first three months of emergence.

Adult summer Chinook Salmon return to the Methow River primarily in July and August, although individuals may enter the river as late as October. Spawning begins in late September in the upstream reaches and proceeds downstream to the lower reaches through early November. Fry begin to emerge from redds in early January through April and begin to move downstream in the mainstem Methow, rearing for up to four months before out-migrating to the lower Columbia Estuary and ultimately the ocean. Some Chinook fry may emigrate very soon after emergence and may rear within the downstream reservoirs on the mainstem Columbia River (Andonaegui, 2000a).

Summer Chinook distribution in the Methow basin occurs primarily within the mainstem river from its confluence with the Columbia upstream to the Foghorn Diversion Dam at the Winthrop Fish Hatchery. They are not known to utilize tributaries for spawning or rearing (Figure 8). Both summer Chinook Salmon spawning and rearing occur in the assessment reach downstream of the hatchery.

Though there is some overlap in time and space between spring and summer Chinook runs, spring Chinook generally spawn upstream of the Foghorn Diversion Dam at the Winthrop Fish Hatchery, and summer Chinook almost always spawn downstream of this location. Additionally, spring-run Chinook spawning typically extends until late September, whereas summer-run Chinook spawning typically begins in late September and extends through late fall.

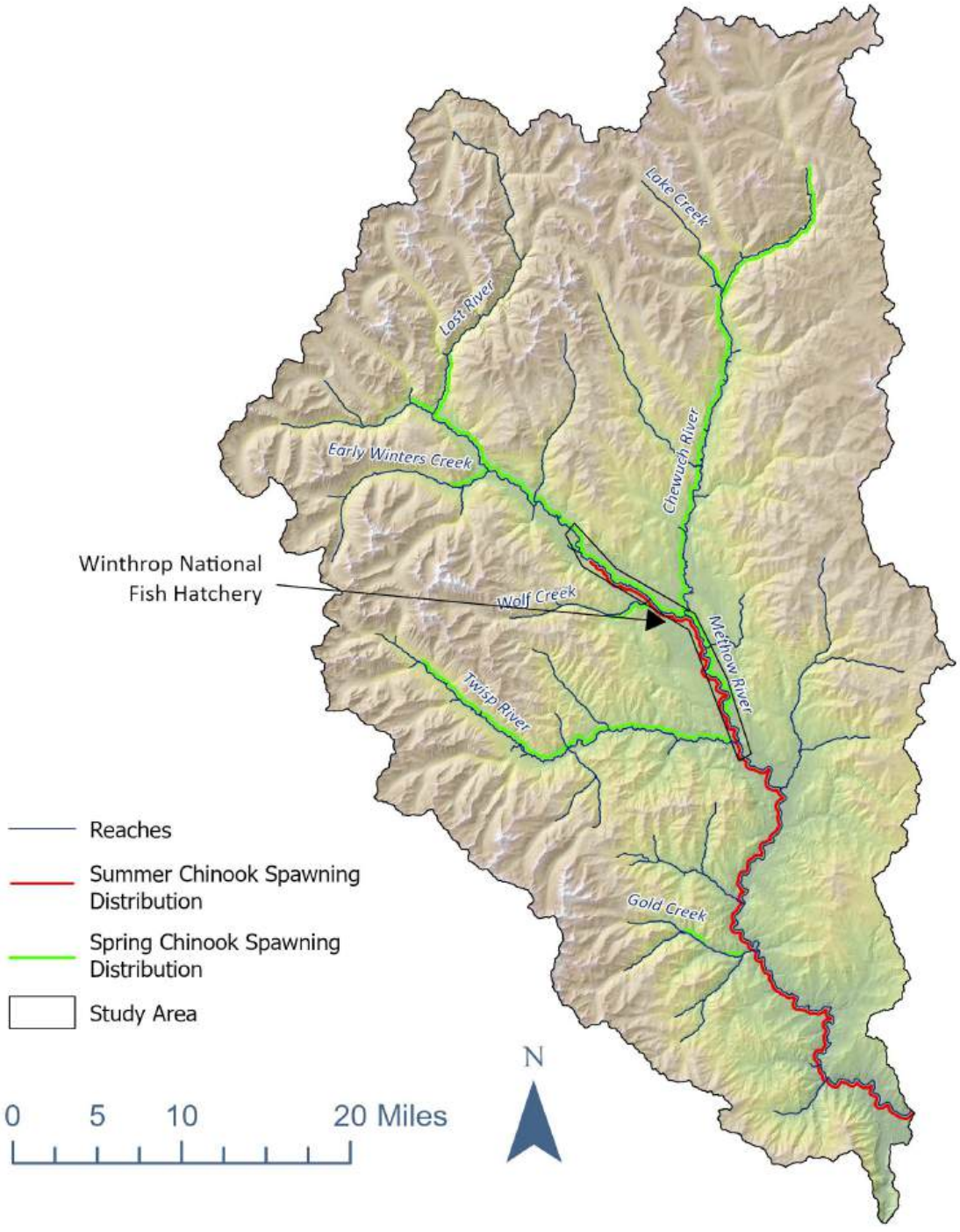


Figure 8. Spring and summer Chinook spawning distribution in the Methow Basin. Data are based on the Upper Columbia Salmon Recovery Board (UCSRB) Spawning Redds by Year (UCSRB, 2025).

2.4.4 Coho Salmon

Historically, Coho Salmon (*O. kisutch*) were one of the most abundant salmon species in the Methow watershed. However, due to the construction of dams, overfishing, unscreened irrigation diversions, and habitat degradation, Coho disappeared from the Methow by the early 20th century, with extinction in the basin recognized by the 1930s. The Yakama Nation began reintroduction efforts to the Methow Basin in 1997, with further reintroduction efforts to the Wenatchee Basin starting in 1999. These efforts began using lower-Columbia River Coho stocks and later transitioning to fully in-basin broodstock as returns increased. Since reintroduction efforts began, adult Coho returns to the Wenatchee and Methow basins combined have ranged between 1,751 and 30,341 fish (CRITFC & YN, 2012). By comparison, historic estimates suggest the Methow once hosted annual Coho returns numbering 23,000 to 31,000 fish (Mullan, 1984). This population is not protected by the ESA because the reintroduced population originated from a non-indigenous lower Columbia River stock (YNFRM, 2017).

Adult Coho migrate back into the Methow River in early September through late November. Adults spawn in the tributaries between mid-October and late December (YNFRM, 2017). Eggs incubate over the winter, and fry typically emerge from the gravel in April and May. As with other salmonid species, Coho egg survival is highly sensitive to intra-gravel flow, siltation, high-flow scour, and dewatering or freezing (Peven, 2003; YNFRM, 2017). Compared to steelhead trout and Chinook Salmon, juvenile Coho tend to seek off-channel habitats and tributaries with lower velocities and more overhanging cover. Most juvenile Coho salmon rear in their natal tributaries for a year before migrating downstream in April and May, though a portion may migrate downstream in the fall of their first year, likely seeking overwintering habitat in the larger riverine systems or estuary (YNFRM, 2017).

2.4.5 Bull Trout

Bull Trout (*S. confluentus*) were listed as threatened under the ESA in 1999 (USFWS, 1999). Compared to other salmonids, Bull Trout have more specific habitat requirements that appear to significantly influence their distribution and abundance. Critical parameters include water temperature, cover, channel form and stability, valley form, spawning and rearing substrates, and migratory corridors (USFWS, 1999). Bull Trout are slow growing, long-lived, reach sexual maturity in 4 to 7 years, and can live 12 or more years. The Methow population of Bull Trout is considered one of four "core areas" in the Upper Mid-Columbia Basin and is characterized by a rapidly declining population trend (USFWS, 2015).

Bull Trout are iteroparous, meaning they can spawn multiple times over their lifespan, unlike Pacific salmon that die after spawning once (semelparous). Spawning begins in headwater streams in late August and continues through mid-October (Goetz, 1989). Redd location data suggest that Bull Trout do not spawn within the reach assessment area; Methow basin spawning occurs in higher elevation tributaries including the upper Twisp River, Wolf Creek, Goat Creek and the West Fork Methow (UCSRB, 2025). Preferred spawning habitats are generally low gradient stream reaches, or areas of loose, clean gravel in higher gradient streams (Fraley & Shepard, 1989; Goetz, 1989).

Spawning areas are often associated with cold-water springs or groundwater infiltration, and are typically the coldest areas in a watershed (USFWS 1999).

Fry normally emerge from early April through May, depending upon water temperatures and increasing stream flows (USFWS, 1999). Fry and juveniles can be found in pools or runs in close proximity with cover provided by boulders, cobble, or large woody debris. Age 1+ and older juveniles utilize deeper, faster water than fry, often in pools with shelter-providing large organic debris or clean cobble substrate. In large rivers, the highest abundance of juveniles can be found near rocks, along the stream margin, or in side channels (Andonaegui, 2000a).

Bull Trout within the Methow Basin may exhibit fluvial, adfluvial, or resident life history strategies. Adfluvial Bull Trout are found in the Lost River and Lake Creek, whereas fluvial populations and resident populations are found throughout the basin (NPCC 2004). Resident Bull Trout complete their life cycles in the tributary streams in which they spawn and rear, whereas migratory Bull Trout spend several years rearing near their natal origin before migrating to larger bodies of water– in this case, the lower Methow River or the Columbia River—to rear (Figure 7; UCRTT 2017). The Methow River within the assessment area is primarily a migration corridor, though it is also used as adult foraging and juvenile rearing by the Methow River Bull Trout population (USFS 2005).

2.4.6 Pacific Lamprey

Pacific Lamprey (*E. tridentatus)* within the Methow Basin are part of the Upper Columbia Regional Management Unit (RMU), which includes watersheds that drain into the Columbia River from the Snake River Confluence to the Chief Joseph Dam (Grote & Lampman, 2025). A 2004 petition to list Pacific Lamprey under the Endangered Species Act found that the petition did not warrant listing (Federal Register 27 December 2004), and range-wide, Pacific Lamprey are considered "Apparently Secure" (NatureServe, 2026). However, the local Pacific Lamprey populations within the Upper Columbia RMU range from "Critically Imperiled" to "Presumed Extirpated," with the Methow population considered to be "Critically Imperiled" (NatureServe, 2026). Threats include artificial barriers to migration, poor water quality, predation by native and non-native species, stream and floodplain degradation, loss of estuarine habitat, decline in prey, ocean conditions, dredging, and dewatering (Luzier et al., 2011).

Reliable historic population estimates for Pacific Lamprey in the Methow Basin are unavailable. However, historic occupancy was believed to be high within the Upper Columbia, with the Methow likely hosting a large number of Pacific Lamprey(US Fish and Wildlife Service & Poirier, 2017). The current natural-origin adult population size of Pacific Lamprey within the Methow River is estimated to be less than 50 adults, with populations on a declining trend and limited evidence of new larval recruitment. Starting in 2008, collaborative efforts including the Yakama Nation, Confederated Tribes of the Colville Reservation (CTCR), the Grant County Public Utilities District (GCPUD), the Douglas County Public Utility District) (DCPUD), the Columbia River Inter-Tribal Fish Commission (CRITFC), and the U.S. Fish and Wildlife Service (UFSWS) have undertaken reintroduction of Pacific Lamprey in the Upper Columbia RMU under the Pacific Lamprey Project. Adult Pacific Lamprey have been translocated into the Methow Basin every year from 2015 to 2025,

totaling 3,397 Lamprey translocations during this period. The vast majority (3,302) of translocations were placed into the Lower Methow River mainstem, with small single-year releases occurring in the Upper Methow River (2017), Twisp River (2017), and Chewuch River (2018). Since translocation efforts began, successful recruitment of larval Lamprey has increased in the Methow River and its tributaries (Grote & Lampman, 2025).

Pacific Lamprey distribution within the Methow basin is known to occur in the lower 78.5km of the mainstem Methow River (which includes the entirety of the assessment reach) and the lower 50.9km of the Chewuch River (Lampman et al., 2016). Adult upstream migration of Pacific Lamprey occurs from late spring through fall in the Columbia River Basin. Pacific Lamprey pass through Wells Dam, immediately downstream of the Methow River from early July through late November, with peak passage times from mid-August to late October (DCPUD, 2009). Preferred spawning habitat is in low gradient runs and pool tail-outs, and occurs in the spring to early summer, typically May - July. Hatching date varies according to water temperature and is typically around 15 days after spawning. Larval lamprey (commonly termed ammocetes) spend a short period of time (~15 days) in the redd after hatching before drifting downstream to suitable rearing habitats. Rearing habitat typically consists of low gradient areas with low water velocity, soft substrate, and organic material. Larval Lamprey rear in freshwater for up to 7 years as they grow, during which time they filter feed on diatoms and suspended organic material. Downstream migration occurs between July and October and includes metamorphosis from the larval life stage into the "transformer" life stage (also referred to as macrophthalmia). This transformer stage is similar to the smoltification process in salmonids and includes the development of a functional eye, a disk-shaped sucker mouth, a silver body color, and the ability to survive in saltwater. Transformers migrate to the ocean during high flows in late winter or early spring where they mature into adults. Once in the ocean, adult Pacific Lamprey parasitize other fish for 18-40 months until they return to freshwater to spawn. Unlike salmon, Pacific Lamprey do not home to their natal streams for spawning and instead appear to be drawn to pheromones released by ammocetes in streams with high densities of lamprey (USFWS, 2025).

2.4.7 Other Resident Fish of Interest

In addition to the three ESA-listed species, Coho Salmon, and Pacific Lamprey, fish communities in the Methow River basin also include Mountain Whitefish (*Prosopium williamsoni*), Westslope Cutthroat Trout (*O. clarki lewisi*), several species of sculpin (*Cottus sp.*), Brideglip Sucker (*Catostomus columbianus*), Longnose Dace (*Rhinichthys cataractae*), and Redside Shiner (*Richardsonius balteatus*).

Eastern Brook Trout (*S. fontinalis*) are a non-native invasive species that poses a substantial threat to Bull Trout productivity through competition, predation, and especially through hybridization. Within the project area, the low abundance of Brook Trout likely does not pose an elevated threat to Bull Trout populations, as there is no known Bull Trout spawning and thus no potential for hybridization. Eastern Brook Trout occupying off-channel habitats in the project area likely pose a predation and competition threat to rearing juvenile salmonids.

2.5 GEOPHYSICAL SETTING

2.5.1 Geology

The Methow River Basin is located within the geologically complex North Cascades province, characterized by a mélange of tectonically accreted terranes of volcanic, metamorphic, and sedimentary rock formed over the past 400 million years (Figure 11). At the heart of the Methow Valley lies the Methow Terrane, consisting of marine and nonmarine sedimentary rocks such as shale, sandstone, siltstone, argillite, and conglomerate, deposited during the Jurassic and Cretaceous periods, between ~200 and ~100 million years ago (Barksdale, 1975; Haugerud & Tabor, 2009; Konrad et al., 2005). These rocks represent sedimentary fill of the ancient Methow Ocean and are interbedded with volcanic lithologies(Barksdale, 1975; Haugerud & Tabor, 2009; Konrad et al., 2005). The volcanic lithologies include extrusive events of andesitic breccia and tuff (~90 million years ago), as well as intrusive igneous rocks like tonalite and granodiorite, emplaced during mid-to-late Cretaceous volcanic episodes (WDNR, 2010).

Surrounding this terrane are more resistant metamorphic and igneous rocks that make up the crystalline core of the North Cascades (Tennyson & Cole, 1987). Major structural features such as the Pasayten, Rose Lake, and Hozameen fault zones delineate the terrane boundaries and exert significant influence on valley orientation, topography, and river course. These faults have also contributed to the formation of distinct geomorphic features, such as slope breaks and topographic steps, especially where graben structures intersect the valley floor (Smith et al. 2000).

The area has experienced multiple glacial periods through its geological development. However, the Pleistocene glaciations (2.6 million to 9,500 years ago) played a dominant role in shaping the Methow Valley's present geomorphology. At approximately 17,000-14,000 years before present, the Okanogan lobe of the Cordilleran Ice Sheet advanced into the Methow Basin to an extent just south of the modern-day mouth of Lake Chelan. The ice sheet covered the valley floor with approximately 2,000 feet of glacial ice near the town of Winthrop, in the middle of the assessment area. At this time alpine glaciers developed on the surrounding peaks that stood above the ice sheet. At the end of the last glacial maximum, relatively rapid glacial recession in the area produced copious amounts of water and sediment that, combined with proglacial and ice-marginal lakes in the Methow Valley, created prominent kame terraces and draped valley-margin hillslopes with glacial till and outwash terraces. The recessional moraine (last glacial stand during recession) in the Methow is the Winthrop Moraine, near the town of Winthrop, WA. These deposits form a complex of stepped geomorphic surfaces, including both paired terraces along the valley and broad tributary alluvial fans composed of cobble, gravel, sand, and silt. (Booth et al., 2003; Haugerud & Tabor, 2009; Konrad et al., 2005; Riedel, 2017).

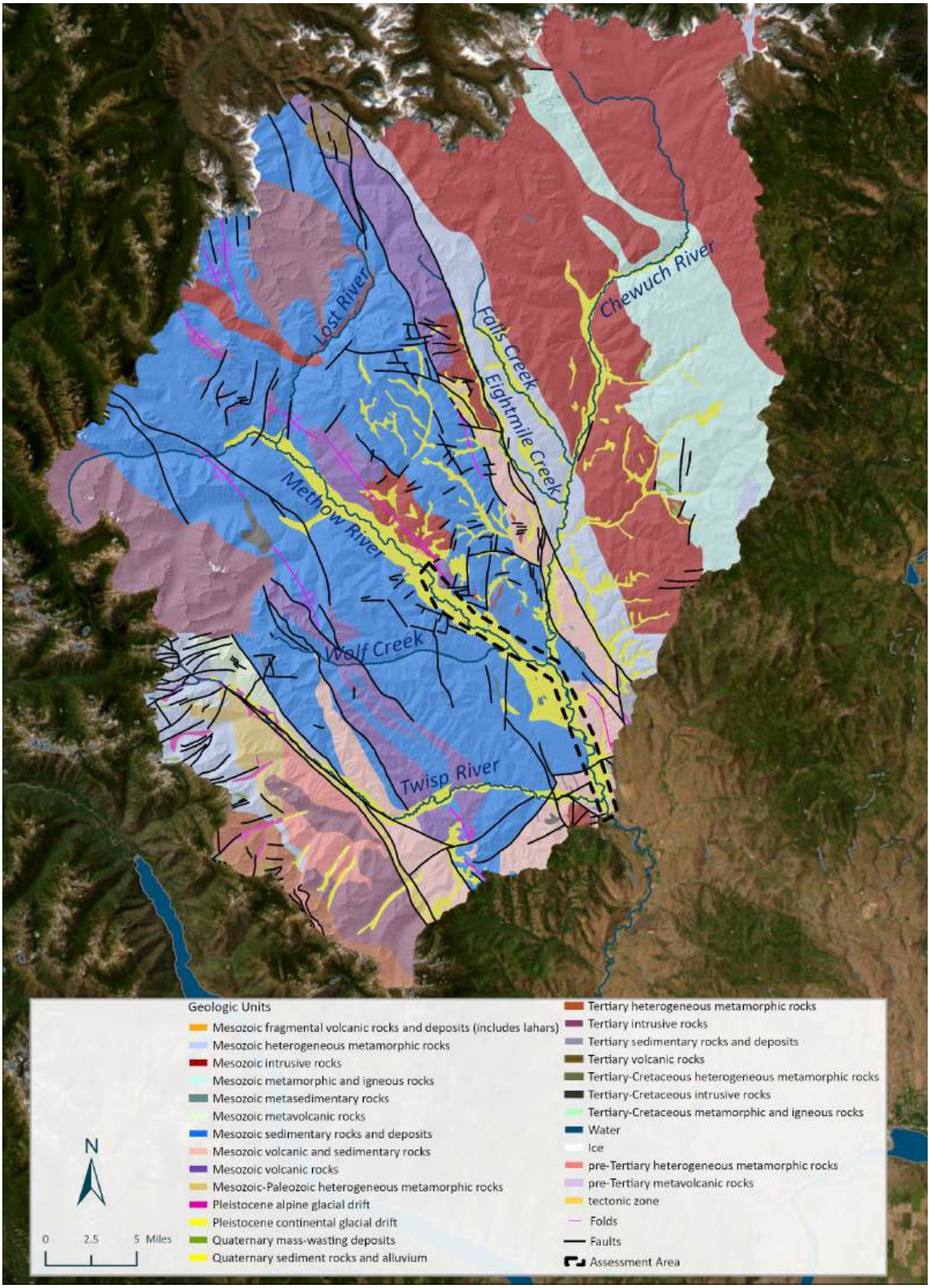


Figure 9. Geology of the assessment area and contributing watershed. GIS geology layers from Washington Division of Geology and Earth Resources (2016).

2.5.2 Geomorphology

The glacial processes created a U-shaped morphology with a wide valley floor and steep adjacent hillslopes. During glacial retreat the relatively high hydrologic and sediment regimes delivered plentiful glacial outwash that filled the valley floor. At this time tributaries created substantial alluvial fans across the valley fill. Post glacial retreat and inputs (~9,500 years ago), the seasonal streamflow adjusted and sediment supply of the Methow River reduced notably. As a result, the channel developed an inset floodplain between glacial deposits, outwash terraces, and outwash tributary fans. The width of the inset floodplain varies notably throughout the assessment area depending on natural morphologic evolution of the channel to these conditions and anthropogenic forcing.

The stratigraphy of the valley floor is underlain primarily by unconsolidated Quaternary sediments derived from the glacial drift and alluvium, including glacial till, outwash sands and gravels, and reworked terrace materials. These soils tend to be coarse-textured, well-drained, and derived from resistant parent materials such as granite, gneiss, and quartzite. Along the floodplain and active channel margins, finer-grained alluvial soils dominate, formed by overbank flood deposits, alluvial reworking, and lateral channel migration (USDA & NRCS, 2008). Overall, the interplay between tectonics, glaciation, and fluvial processes has shaped the Methow River's current form, producing a channel that reflects both its deep geological history and recent geomorphic evolution.

Through the assessment area, the channel's form, gradient, confinement, and sinuosity are controlled primarily by the valley's inherited glacial topography as well as the presence of lateral landforms such as bedrock, alluvial fan, terraces, and human built features. For example, the available floodplain widths range from 154-ft wide along the straight and entrenched section of channel in Reach 11, which is confined between the Wolf Creek alluvial fan on river right and the road prism along the toe of a glacial terrace on river left, compared to a maximum floodplain width of 2,063 ft in unconfined Reach 13 (Figure 10). The gradient of the channel through the assessment area averages to 0.29% but ranges from 0.18% in confined Reach 8 to 0.52% in Reach 10. The higher gradient in Reach 10 is associated with the drop in grade created by the Foghorn Irrigation impoundment structure at its downstream end. The longitudinal profile of the channel through the assessment area with reach-averaged slope annotations is presented in Figure 11.

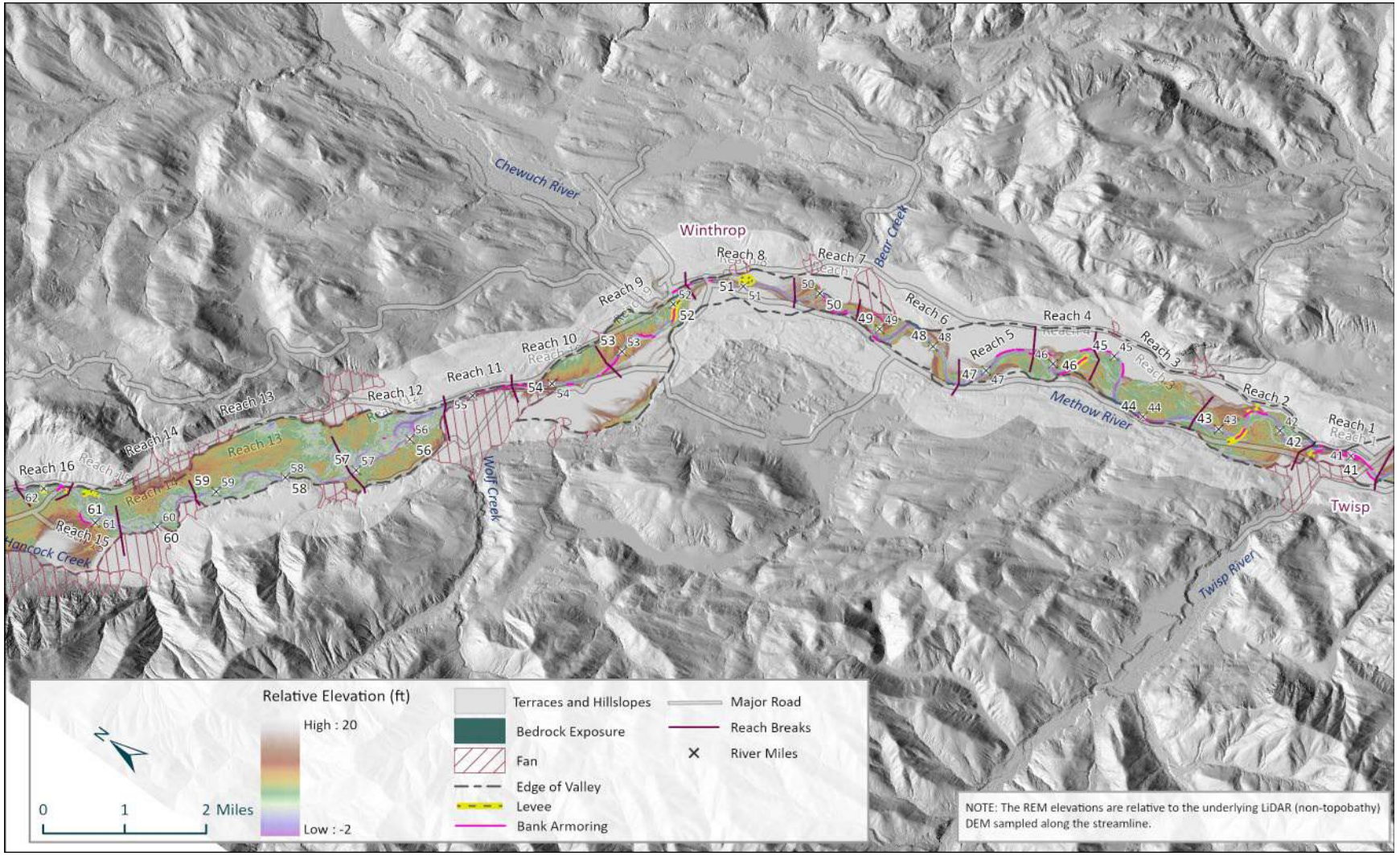


Figure 10. Modern floodplain through the valley floor depicted as relative elevation to the channel shows variability of confinement and valley width through the project area. Terraces and hillslopes are grey and valley confinement influencing fans, bedrock contacts, and roads are displayed.

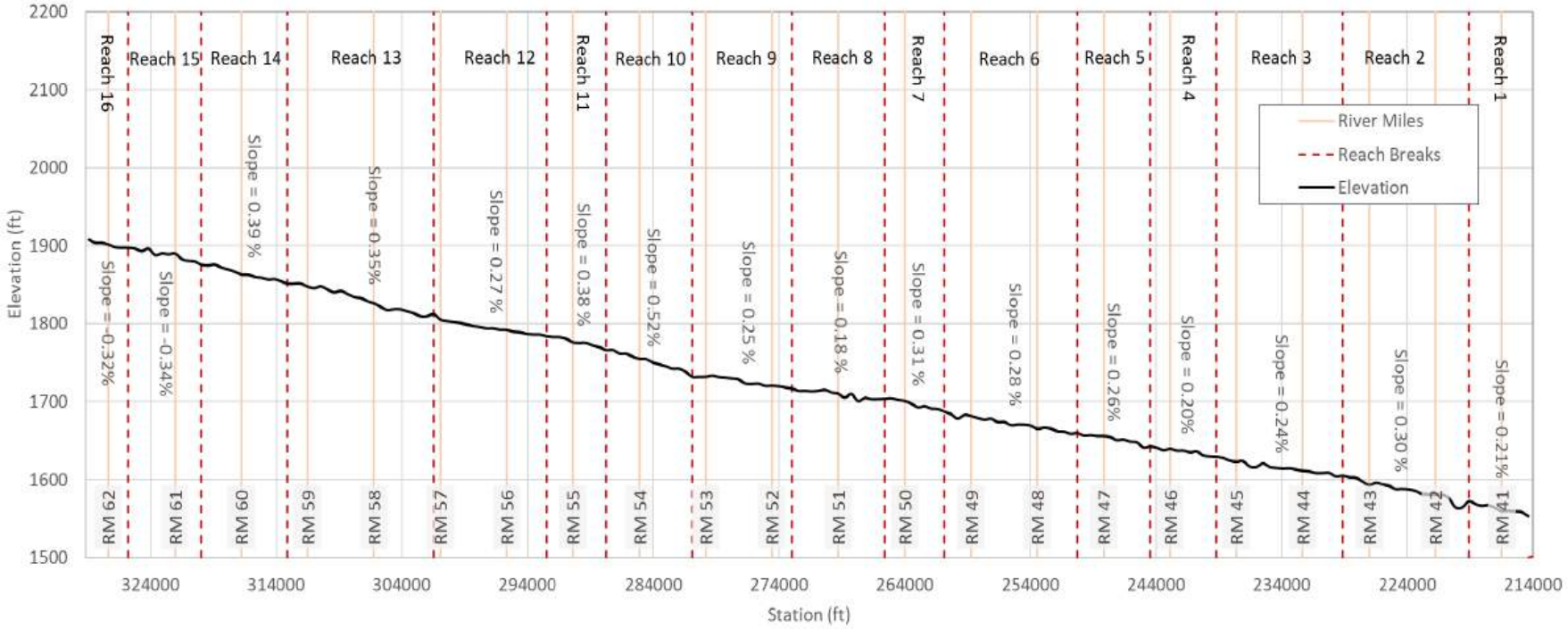


Figure 11. Longitudinal profile of the Methow River (RM 40.6- 62.3). Channel's water surface elevation extracted from 2018 and 2022 LiDAR at 0.1-mile increments.

3. Hydrology and Hydraulic Modeling

3.1 INTRODUCTION

A hydrologic and hydraulic analysis of the study area were conducted to support the ecological and geomorphological interpretations of the site and to inform the identification of restoration opportunities. This analysis consisted of hydrologic characterization of the assessment area, estimates of typical seasonal flow conditions, and estimates of peak flows for a range of recurrence interval floods. A preliminary-level 2-dimensional (2-D) hydraulic model developed for the assessment area used 2018 and 2022 LiDAR for the surfaces (channel and floodplain) in the model. Section 3.2 of this report characterizes hydrologic conditions and presents the flood frequency analysis and Section 3.3 provides a brief overview of the hydraulic model and its results. More detailed methods and results of the preliminary hydraulic model are presented in Appendix D.

3.2 HYDROLOGY

3.2.1 Basin Characteristics

The Methow River flows approximately 80 miles from the eastern slopes of the North Cascades just south of the United States-Canada border to its confluence with the Columbia River at Pateros, WA. The drainage area of the Methow River watershed is approximately 1,820 square miles, initiating in the Pasayten Wilderness and Okanogan National Forest. Elevations range from 783 to 8,890 feet above sea level, with a mean basin elevation of 4,650 ft (USGS, 2022). The precipitation in the Methow valley is highly variable. Average annual precipitation in the upper headwaters of the Methow exceeds 80 inches per year but it drops to only 10 inches at the confluence with the Columbia River. A map of the watershed and its major stream systems is provided as Figure 12. Five perennial streams flow into the Methow River within the assessment area (RM 40.6 to 62.3): Little Falls Creek, Wolf Creek, Chewuch River, Bear Creek, Thompson Creek, Davis Creek, and Twisp River.

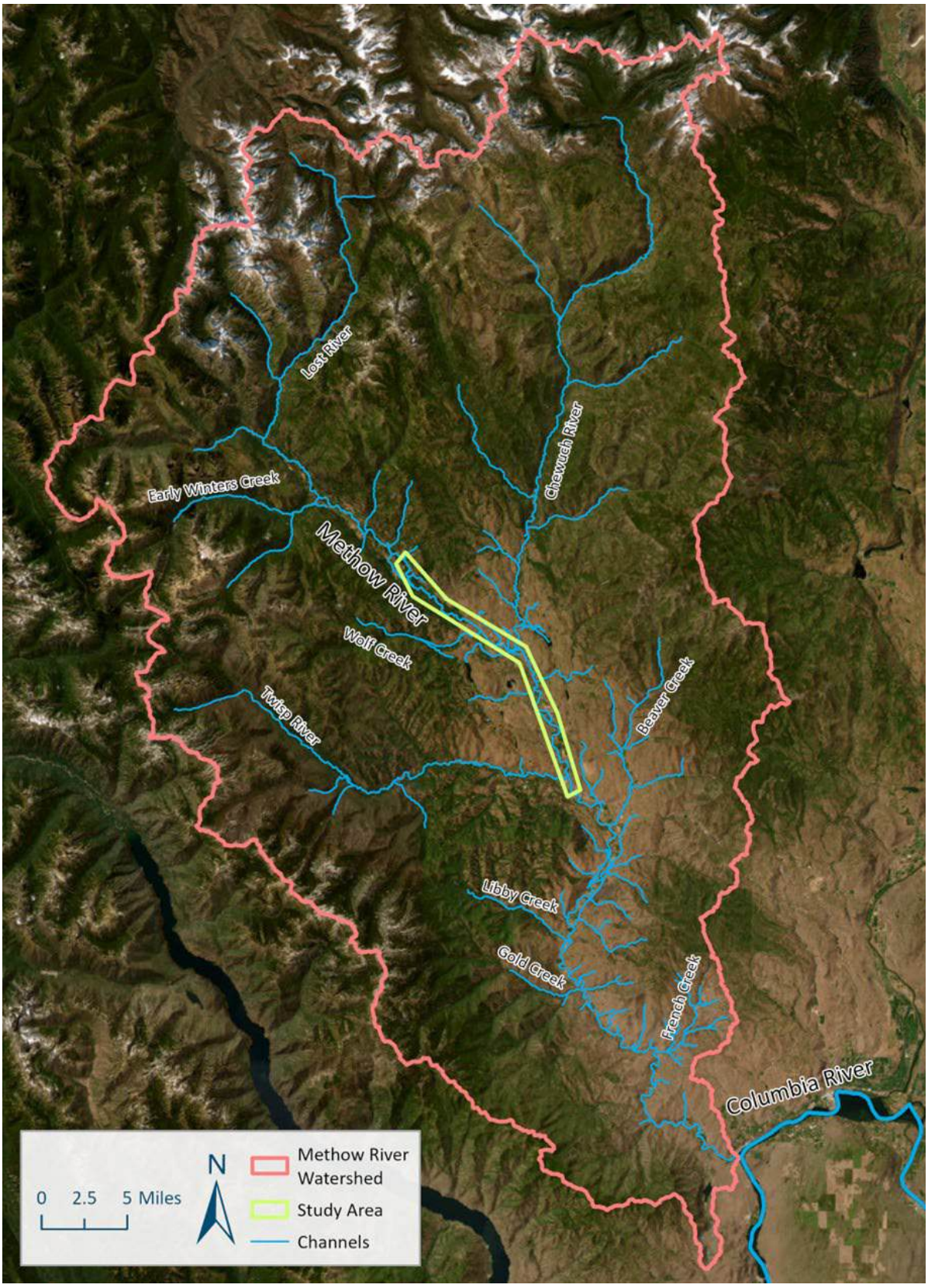


Figure 12. Map of the Methow River Basin and its primary tributaries. The assessment area is outline in bright light green.

3.2.2 Available Streamflow Data

Three mainstem Methow USGS gages were used for hydrologic analysis: Methow River above Goat Creek near Mazama, WA (USGS 12447383), Methow River at Winthrop, WA (USGS 12448500), and Methow River at Twisp, WA (USGS 12449500). The Methow River above Goat Creek gage is located just under 3-miles upstream of the assessment area and has a period of record from 1991 to present (USGS, 2025b). Due to its location, this gage was used to estimate the peak flows for the upstream extent of the assessment area. The Methow River at Winthrop gage is located near the mid-point of the study area, just downstream of the Chewuch River confluence; it has a period of record from 1990 to present (USGS, 2025d). This gage was used in combination with the upstream gage to estimate tributary inputs between the upstream extent of the project area and Winthrop. The Methow River at Twisp gage is located near the downstream extent of the assessment area, just downstream of the Twisp River confluence; it has a period of record from 1920 to present – with a gap in data from 1965 to 1990 (USGS, 2025c). This gage was used in combination with the Winthrop gage to estimate tributary inputs between Winthrop and Twisp.

Discharge gages on the Chewuch and Twisp rivers, largest tributaries to the assessment area, were evaluated for use in the hydrologic analysis for the mainstem Methow River. The Chewuch River at Winthrop, WA gage (USGS 12448000) has a period of record from 1991 to present and is located close to the confluence with the Methow River (USGS, 2025a). The Twisp River near Twisp, WA gage (USGS 12448998) has a longer period of record from 1975 to present (USGS, 2025e). Review of the data from these gages and comparing them to the Methow River gages revealed that peak flows in these tributaries typically occur at different times than those in the mainstem, limiting their utility for model inputs for mainstem flows. For this reason, model input flows relied on the mainstem gages, apportioning flow inputs based on tributary basin-area contribution along the river.

Stream withdrawals are not included in the hydrologic analysis or preliminary hydraulic model because they are not readily available.

3.2.3 Seasonal Flows

The Methow River's annual hydrograph follows a typical pattern for east-slope Cascade Mountain streams, with snowmelt runoff-driven peak annual discharge typically occurring in the late spring to early summer. Baseflows are normally relatively constant from late August through October, with smaller precipitation-driven peaks in late fall. Although precipitation increases in late fall, precipitation in November or early December often comes as snow and is held on the landscape during cold months, resulting in less discharge in the channels. Therefore, flows during the winter months from December through early March usually remain low, as most or all of the precipitation falls as snow. Figure 13 shows the daily flow statistics for the last thirty years including the daily mean, 5% exceedance, and 95% exceedance as well as the monthly mean for the Methow River gages within or near the assessment area. These data demonstrate how discharge increases in a downstream trend with tributary inputs. Flows during the month of May (the month with the highest average discharge) are often over 2,500 cfs from above Goat Creek to Winthrop and then increases another 650 cfs between Winthrop and Twisp due to contributing tributary inputs.

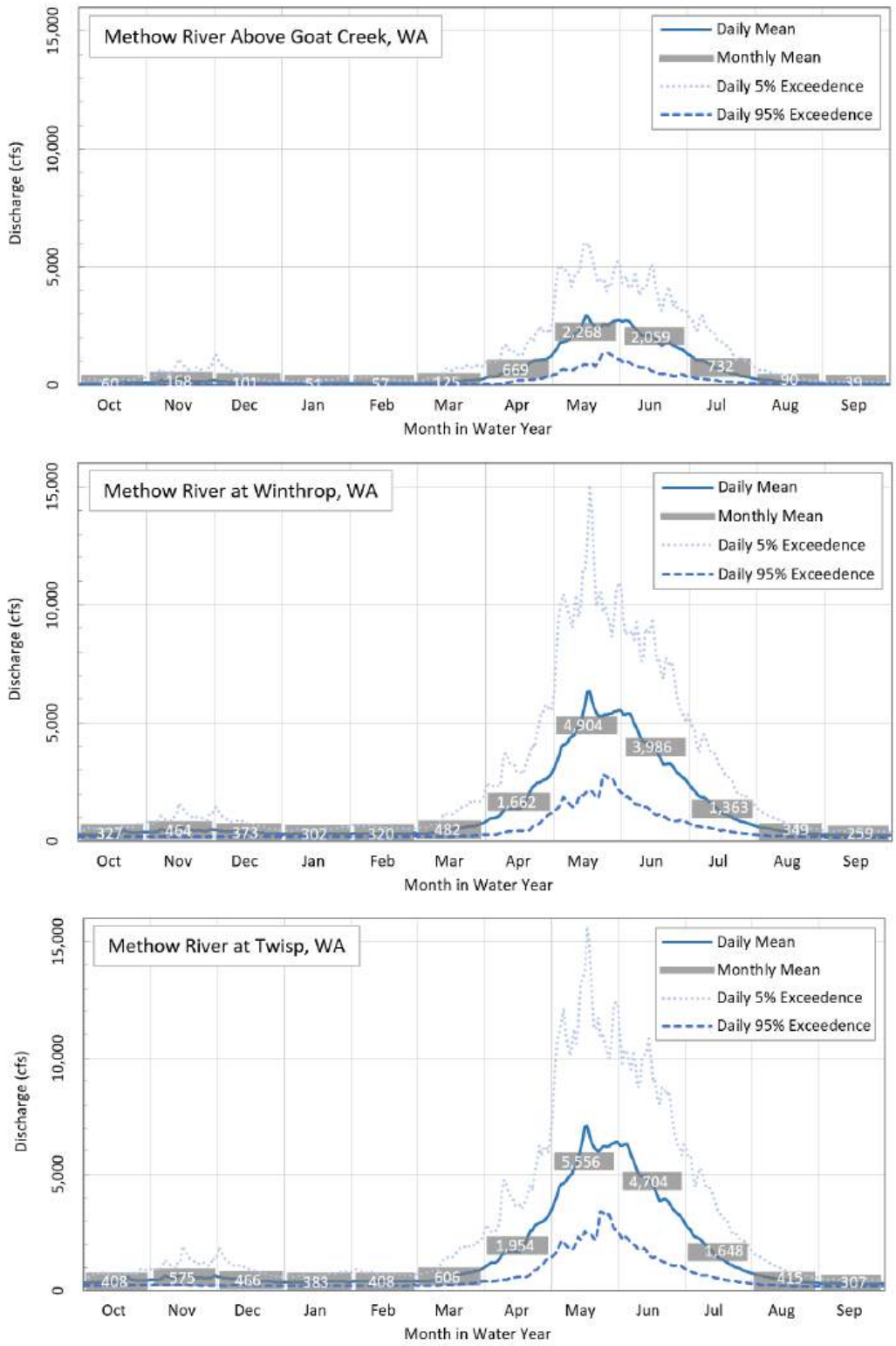


Figure 13. Daily flow statistics at the A) Methow River Above Goat Creek, WA gage (USGS 12447383), B) Methow River at Winthrop, WA (USGS 12448500), and C) Methow River at Twisp, WA (USGS 12449500) for water years 1993 through 2023 showing the daily average, 5% exceedance, and 95% exceedance discharge and monthly average discharge for the period of record.

3.2.4 Peak Flows

According to the Methow River USGS gages situated in and around the project area, peak flows typically occur in late spring (typically in May and June). Minimal peak flow data is available between the water years 1965 and 1990. Known large floods that occurred in the assessment area include the 1948 and 1972 floods, each of which were only captured at one of the gages, which could impact the accuracy of the peak flow analysis (BOR, 2010). Flood frequency estimates for the Methow River were calculated using the available peak flow data (see Figure 14) from the USGS gages using a Log Pearson Type III flood frequency analysis from the entire period of record for each gage. The analysis was performed using the Bulletin 17C flood frequency analysis method with the HEC-SSP software (USACE, 2023). The weighted regional skew of -0.07 and a regional skew MSE of 0.18 was applied, following the guidelines in Mastin et al. (2017). The results are shown in Table 4.

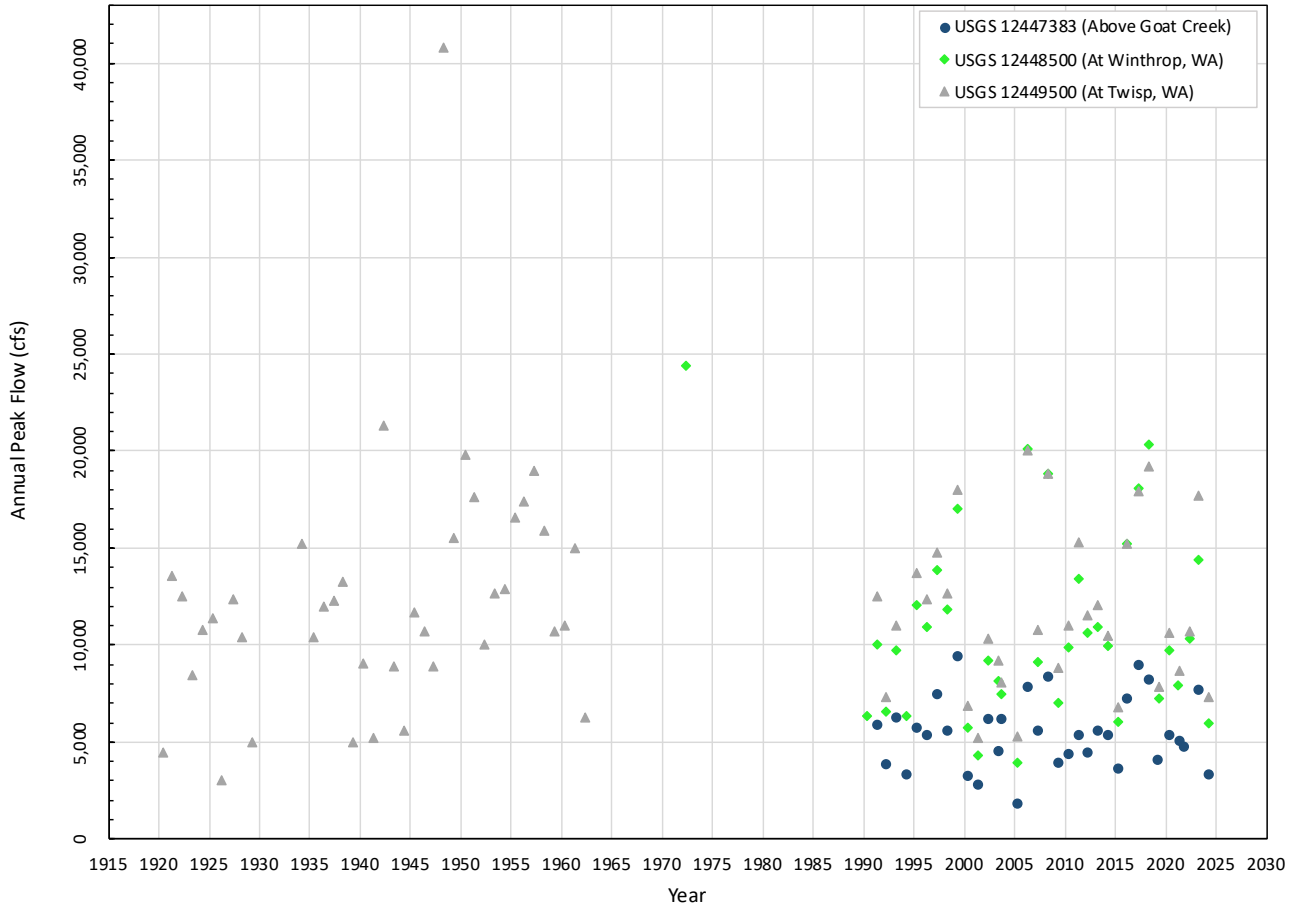


Figure 14. Peak flow history of the Methow River at three USGS gages in and around the project area from 1920 to 2024 (USGS gages 12447383, 12448500, and 12449500).

Table 4. Methow River flood frequency analysis results in cubic feet per second for USGS 12447383, USGS 12448500, and USGS 12449500 (USGS, 2025c, 2025d, 2025b).

Flood Return Interval	Methow Above Goat (USGS Gage 12447383)	Methow at Winthrop (USGS Gage 12448500)	Methow at Twisp (USGS Gage 12449500)
2-Year	5,256	9,978	11,178
5-Year	6,964	14,416	15,886
10-Year	8,050	17,424	19,037
25-Year	9,379	21,279	23,041
50-Year	10,343	24,184	26,036
100-Year	11,287	27,112	29,039

The flood frequency analysis was then used to estimate the flows at different locations in the assessment area. The Mastin et al. (2017) equation 11 for Region 2 in Washington was applied to estimate peak flows at the upstream end of the assessment area (RM 62.3) by scaling peak flows from the nearby gage (Above Goat Creek). The same method was used to estimate peak flows at the downstream end of the assessment area near the town of Twisp at RM 40.6 by scaling the nearby Methow at Twisp gage (see Table 4). These Peak flow estimates were used as flow inputs for the preliminary hydraulic model of the assessment area – see Section 3.3, and in Appendix D.

Table 5. Methow River project area estimated peak flood events based on weighted flood frequency analysis results for the USGS gages 12447383 and 12449500.

Flood Return Interval	Methow River Peak Discharge at RM 62.2 (cfs)	Methow River Peak Discharge at RM 40.6 (cfs)
2-Year	5,860	11,180
5-Year	7,750	15,890
10-Year	8,940	19,040
25-Year	10,400	23,040
50-Year	11,450	26,040
100-Year	12,490	29,040

3.2.5 Temperature Data

Over the past century, land use changes in the Methow have contributed to increased water temperatures with potential impacts on salmonids. Reduced flows, primarily related to development and agricultural diversions, create a channel prone to heating during the increasingly dry, hot summers (NPCC, 2004). Cleared riparian areas for development and timber harvest have reduced the amount of shade available and have altered sediment and large wood regimes, minimizing the availability of deep scour pools that provide thermal refugia. Fire suppression has resulted in higher intensity fires that further reduce riparian vegetation and alter sediment regimes, likely exacerbating stream temperature increases and limiting availability of thermal refugia. Most of the assessment area is currently listed on the Washington State 303(d) list for temperature (WDOE, 2023).

Based on climate change modeling, the risk of elevated summer stream temperatures will continue to increase into the future. Climate change models predict an increase in precipitation falling as rain rather than snow, resulting in a decreased snowpack and earlier spring runoff timing. An earlier snow-melt runoff is expected to lead to lower summer base flows and a longer low-flow period, creating a channel more prone to heating. See Section 3.2.6 for more information on climate change within the Methow basin.

Thermal infrared (TIR) aerial imagery collected in August of 2009 along 76 miles of the Methow River, from the mouth to the confluence with the Lost River (Watershed Sciences, 2009). A longitudinal profile of the channel and the TIR data collected in this study are provided in Figure 15 with the reach assessment area identified. The TIR data shows a warming trend moving downstream, with significant temperature variability in the upper portion of the assessment area and upstream (Watershed Sciences, 2009). The assessment area included in Reaches 12 - 15 (RM 57.1 – 61.7) has floodplain connectivity, groundwater seeps, developing riparian forests, and wetlands - likely resulting in the cooler water temperatures plotted in the figure (Watershed Sciences, 2009). Moving downstream, water temperature increases as the river flows along the toe of the Wolf Creek Fan. Warming here is likely the result of a lack of modern groundwater hydrology through the fan, reduced channel complexity, lack of a riparian forest, and channel confinement between the fan and SR 20 (Washington State Route highway 20). Increasing water temperatures continue downstream through the town of Winthop. Just upstream of the Twisp River confluence near RM 46, the 2009 data show another increase in water temperatures. The Mid-Valley Irrigation District diversion is located just upstream of this warming trend, potentially contributing to the increase in temperatures. The TIR study found that both the Twisp and Chewuch rivers were contributing warming flows to the Methow River at the time of data collection.

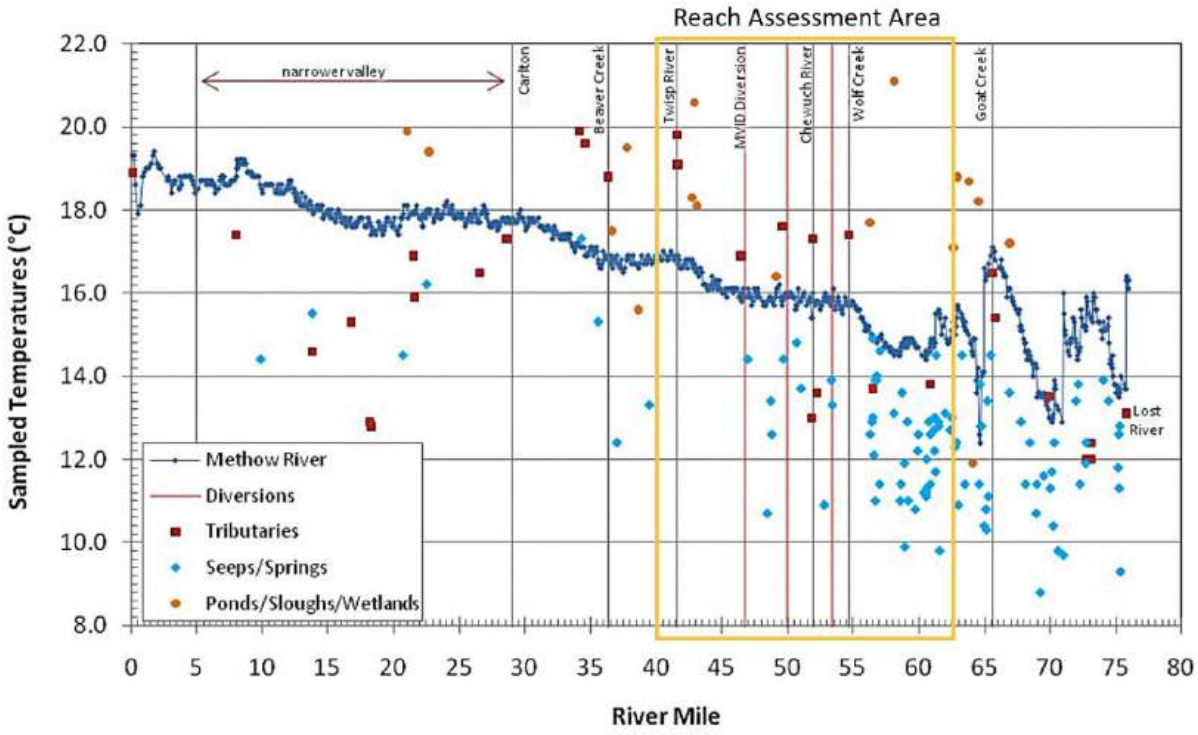


Figure 15. Longitudinal profile of the TIR data plotted as figure 10 in the Watershed Sciences report (2009) and annotated to identify the assessment area (yellow box). These data show the warming trend moving downstream from the confluence with the Lost River (RM 75.1) to the mouth of the Methow River (RM 0).

Salmonids require stream temperatures within certain ranges to thrive, depending on species and life stage (Richter & Kolmes, 2005). Temperatures that exceed tolerable thresholds can inhibit growth and survival. The REI analysis performed as part of this reach assessment evaluates stream temperature suitability based on the 7DAD-Max (7-day rolling average of daily maximum temperature), with thresholds of 13°C for salmonid spawning and 15°C for salmonid rearing, holding, and migration (see Appendix B for more details). Temperature data from WDOE gage #48A140, located downstream of the Twisp SR 20 Bridge near the downstream end of the assessment area, contained 7DAD-Max data from 2002-2019. During the 17-year period, the 7DAD-Max temperatures frequently surpassed the 13°C and 15°C thresholds in the summer months, often for weeks at a time (Figure 16). Data reported by Richter and Kolmes (2005) suggests the lethal limit for salmonids is near 26°C, but above 24°C mortality can occur with sufficient duration of exposure. The 24°C threshold was not exceeded in the available data during the period of record presented in Figure 16.

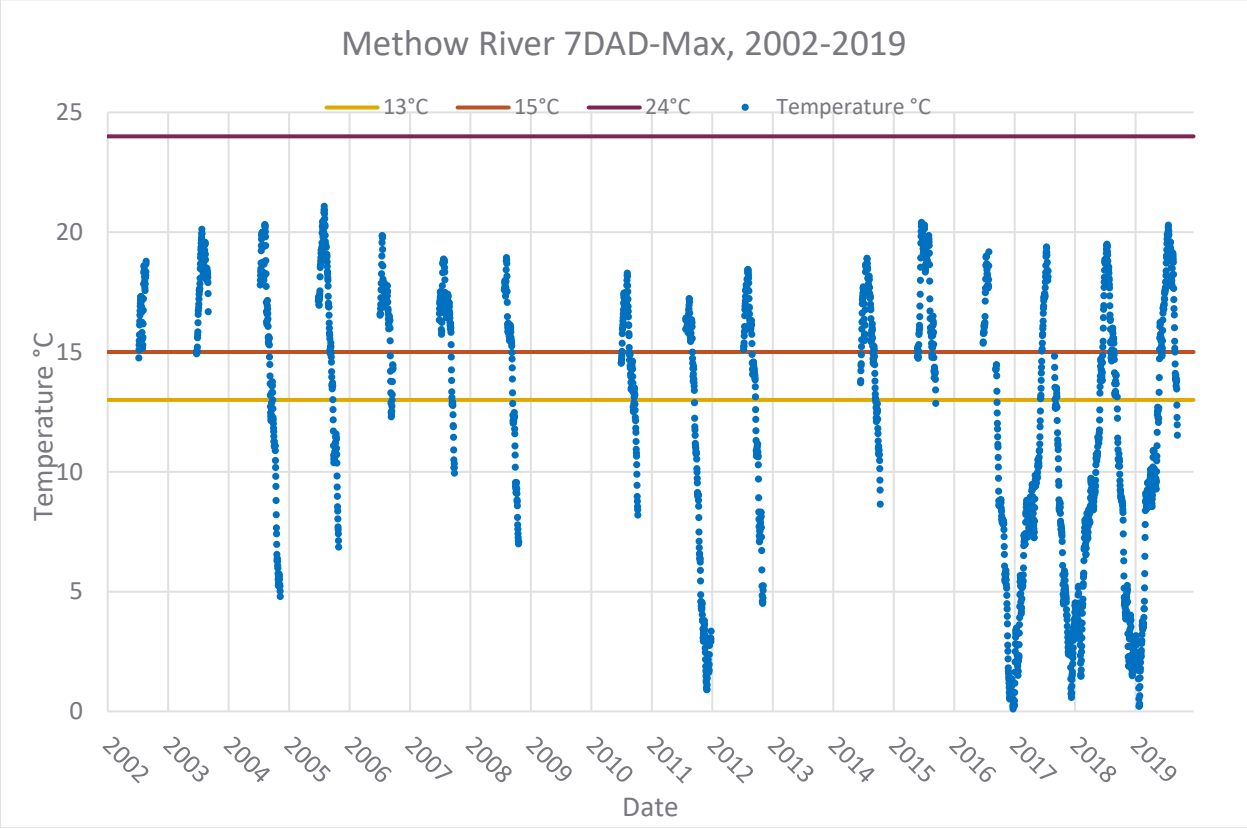


Figure 16. Graph of the 7DAD-Max data from USGS gage #48A140 (at the downstream end of the assessment area) from 2002-2019. The spawning threshold (13°C) and the rearing, holding, and migration threshold (15°C) are both routinely exceeded during the summer months. The low end of the lethal limit (24°C) is shown for reference as the maroon line.

Cold water patches (CWP) are critical for salmonid survival and reproduction as thermal refugia during periods of severe warm temperatures. The Methow Thermal Refugia Restoration Assessment (Crandall, 2022) identified CWPs on the Methow River using the 2009 TIR aerial imagery (Watershed Sciences, 2009) and field verification in 2022. In the study, CWPs were defined as having a differential of ≥ 2°C lower than surrounding water temperatures. Based on the 2009 TIR data, 131 CWPs were identified, but only 108 were field sampled in 2022 due to access constraints (wildfire smoke limitations). Ninety-four percent of the field-sampled CWPs were still present during the 2022 field surveys. And, an additional 17 CWPs were identified during the surveys, with 7 of them believed to be "new" sites that had developed since 2009. Twenty-five of the CWPs from the study are located within the reach assessment area, although not all of them were connected to the mainstem at low flows. Most of the CWPs were found at lateral seeps or spring brooks, although a few were located in alcoves and one was from a tributary confluence (Crandall, 2022). Some of the Cold Water Patches (CWPs) identified in the Crandall (2022) study were found in Reaches 6-8 but the highest density occurred in Reaches 13-16 of the assessment area (Figure 17). The upstream Big

Valley area (Reaches 12-16) has better floodplain connectivity and presumably more surface and groundwater exchange.

Restoration actions in the reaches with CWPs should evaluate opportunities to enhance the function and access to cold-water resources and/or implement conservation measures for these areas if warranted. Improved habitat conditions in the colder water areas, especially in the form of habitat complexity (e.g. large wood, cover, pool depth) and improved connectivity to the mainstem during summer months could be valuable for salmonids and other cold-water aquatic species in the assessment area. Reach-scale hydrology, water quality, access for fish, and conservation of the cold-water resource(s) should be considered when prioritizing a restoration approach.

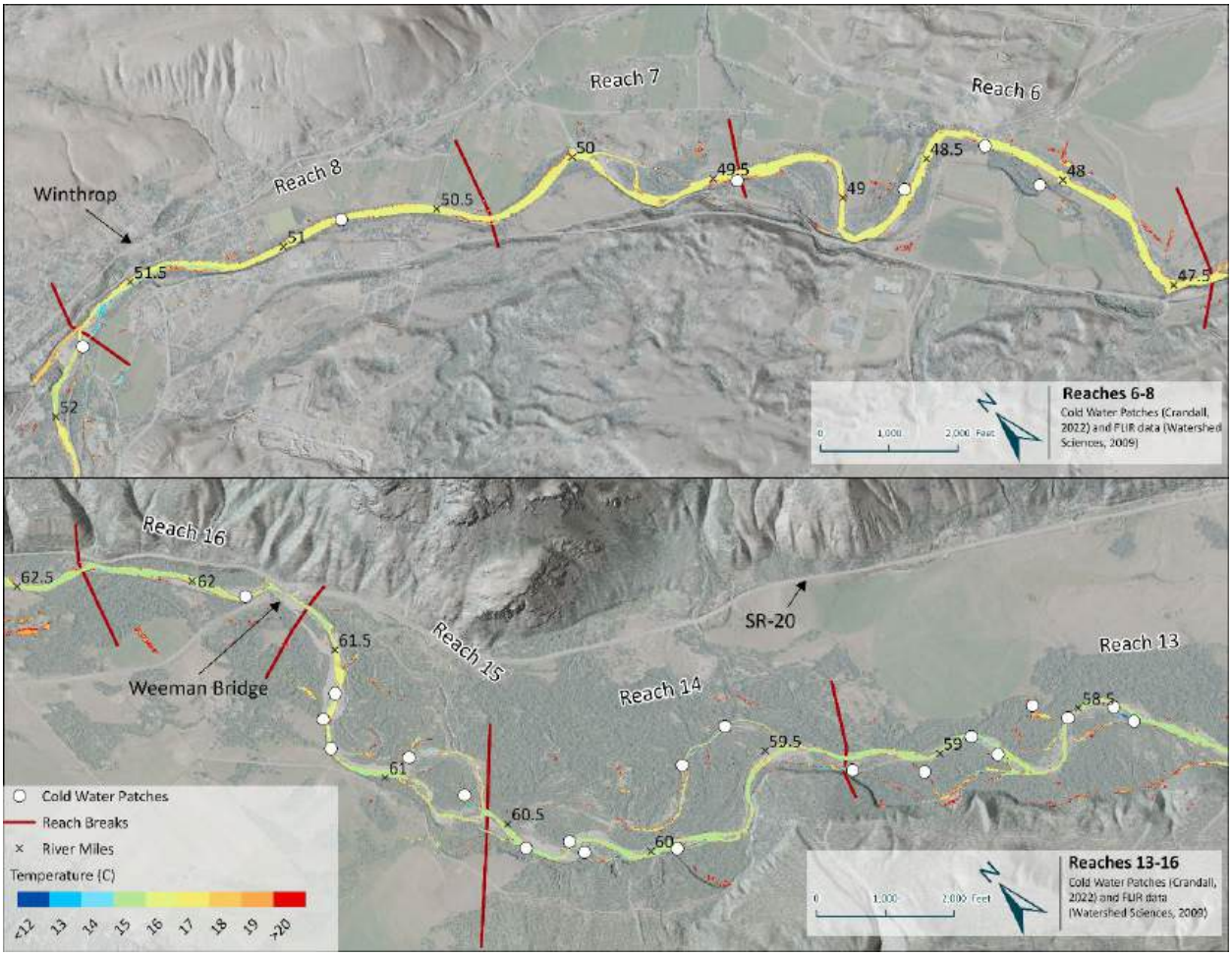


Figure 17. Approximate location of the 25 Cold Water Patches of at least 2°C lower than surrounding surface water (from Crandall, 2022) recorded in the reach assessment area between July and Sept 2021 and 2022. In this map, the CWPs are overlayed on Methow TIR aerial imagery collected in August 2009 (from Watershed Sciences, 2009).

3.2.6 Climate Change

Climate change is likely to impact aquatic conditions throughout the Pacific Northwest through changes to dominant hydrologic regimes and elevated stream and air temperatures. Mean annual stream temperatures in the Pacific Northwest are predicted to increase by 0.99°F in the 2020's to 3.02°F by the 2080's(Wu et al., 2012). Climate change models used in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) project a 3.2°F increase in annual temperature across the Pacific Northwest by mid-century (2040s), and a 5.3°F increase by late century (2080s) relative to historical conditions (1970 to 1999) (Mote & Salathé, 2010; Randall et al., 2007). Although predicted changes in precipitation vary by model, there is consensus that precipitation is trending towards wetter fall and winter seasons and drier summers (Mote & Salathé, 2010). This is likely to shift snow-dominated and transitional (mixed rain and snow) basins towards a rain-dominated regime.

The Methow River basin's hydrological regime is historically snow-dominated, with peak annual discharge occurring in the spring during combined snowmelt and rainfall inputs. However, hydrological simulations by Tohver et al. (2014) using the Variable Infiltration Capacity hydrological model suggest that the Methow River basin may shift to a transitional regime by late century if global emissions are similar to those under the A1B (medium) and B1 (low) scenarios. Transitional basins typically have two periods of elevated flows, one in the fall and early winter associated with peak rainfall, and another in the spring/summer from rainfall plus snowmelt.

Projected increases in winter precipitation are expected to cause more extensive flooding in basins such as the Methow through the 2080s (Tohver et al., 2014). Warmer air temperatures combined with shifts in seasonal precipitation are predicted to result in earlier snowmelts, lower summer baseflows, and earlier peak flow timing. Rain events in the early season (late fall / early winter) in these high elevation basins often result in higher runoff compared to similar type events in later winter or spring due to a lower snowpack available to absorb the rainfall and buffer the runoff. This may be exacerbated by climate change-related impacts causing more precipitation falling as rain as opposed to snow, especially in the fall before there has been significant snow accumulation – as predicted by the climate modeling. This is related to, and further exacerbated by, lower fall snowpack, which is also predicted by the modeling. More winter precipitation falling as rain instead of snow and a diminished snowpack are important to consider for habitat conditions, as winter precipitation and snowpack are essential for moderating stream temperature and regulating flow in spring and summer.

Changes to the dominant hydrological regime could also have impacts on habitat conditions. A reduction in the snowmelt runoff duration has the potential to diminish channel dynamism and related stream habitat complexity. Lower summer baseflows may increase the risk for summer water temperature exceedances for the salmonid and trout species that reside in the Methow River and its tributaries. Changes in runoff timing and magnitude also have the potential to affect fish life history patterns, including spawning run timing. The hydrological and habitat changes are crucial to consider as the climate continues to change in and around the Methow River.

The National Climate Change Viewer (NCCV) is a USGS tool developed by Alder & Hostetler (2013) for visualizing and graphing projected climate change impacts from the Climate Model Intercomparison Program (CMIP) across the conterminous United States. This tool downscales projections from 27 Global Climate Models (GCMs) to 6km spatial resolution to visualize specific climate change impacts in watersheds. The climate change impacts are organized by Shared Socioeconomic Pathways (SSPs). SSPs represent various human development potentials and their impact on the amount of radiative forcing, or warming, projected to occur. Radiative forcing occurs when the amount of energy entering our atmosphere is larger than the energy exiting our atmosphere. A larger, positive radiative forcing value signals more warming. The SSP scenarios serve as a baseline to compare how the climate is predicted to change based on various social, economic, and policy factors.

In the Methow River basin between 2025 - 2099, the climate models show an increase in mean temperature, a decrease in the amount of snow received, an increase in late fall and winter precipitation, and a decrease in summer precipitation in all SSPs (Figure 18, Figure 19, Figure 20).

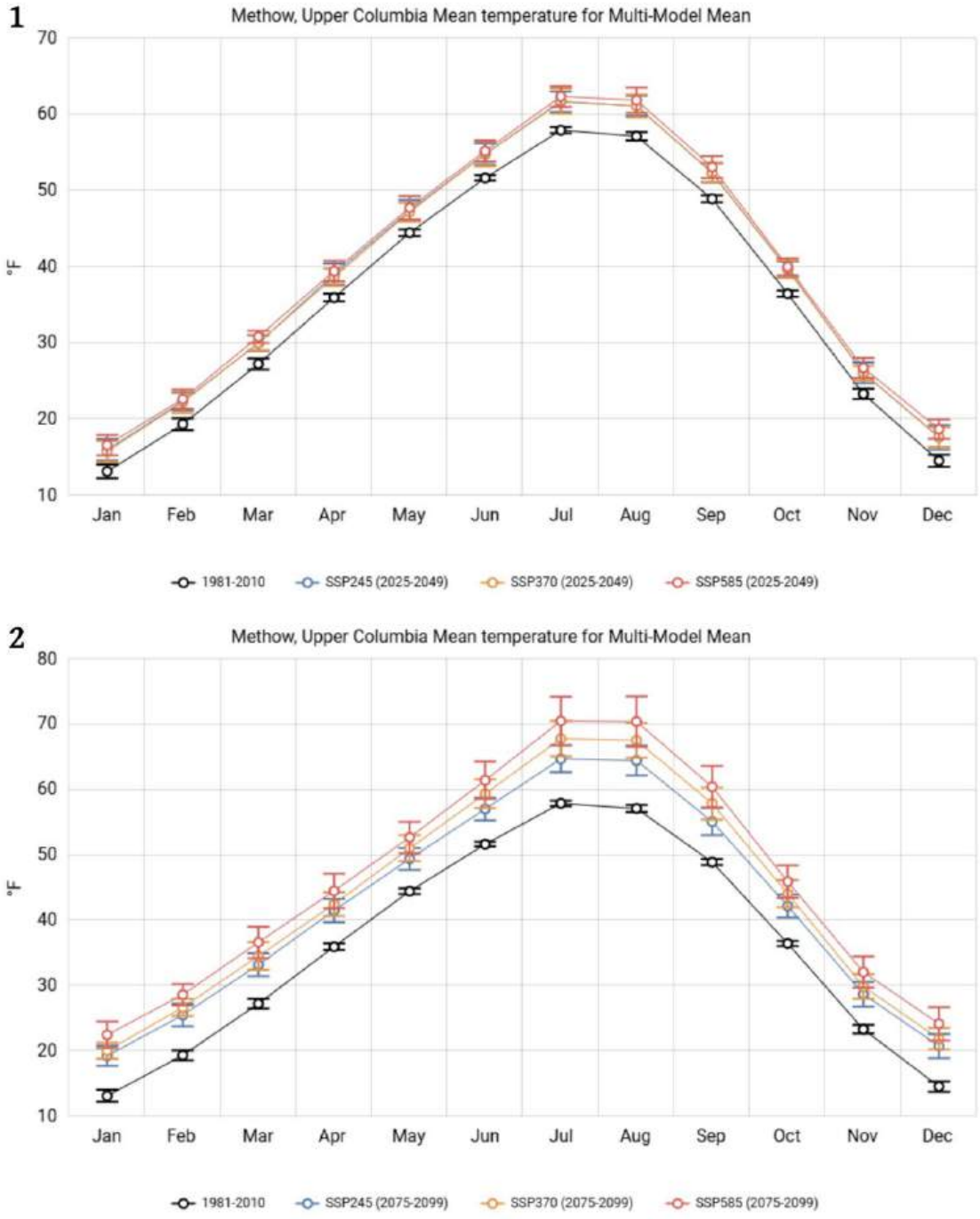


Figure 18. Climate change scenario graphs for mean temperature in the Methow River basin. Source: Alder & Hostetler (2013), generated via USGS NCCV. The multi-model mean for mean temperature in the watershed from 1) 2025 – 2049 and 2) 2075 – 2099. The three scenarios are the 3 Shared Socioeconomic Pathways. SSP245 represents a 'middle of the road' scenario with an additional 4.5W/m^2 of radiative forcing by 2100. SSP370 represents an upper-middle scenario with an additional 7.0W/m^2 of radiative forcing by 2100. SSP585 represents the worst-case scenario akin to RCP 8.5 with an additional radiative forcing 8.5W/m^2 by 2100.

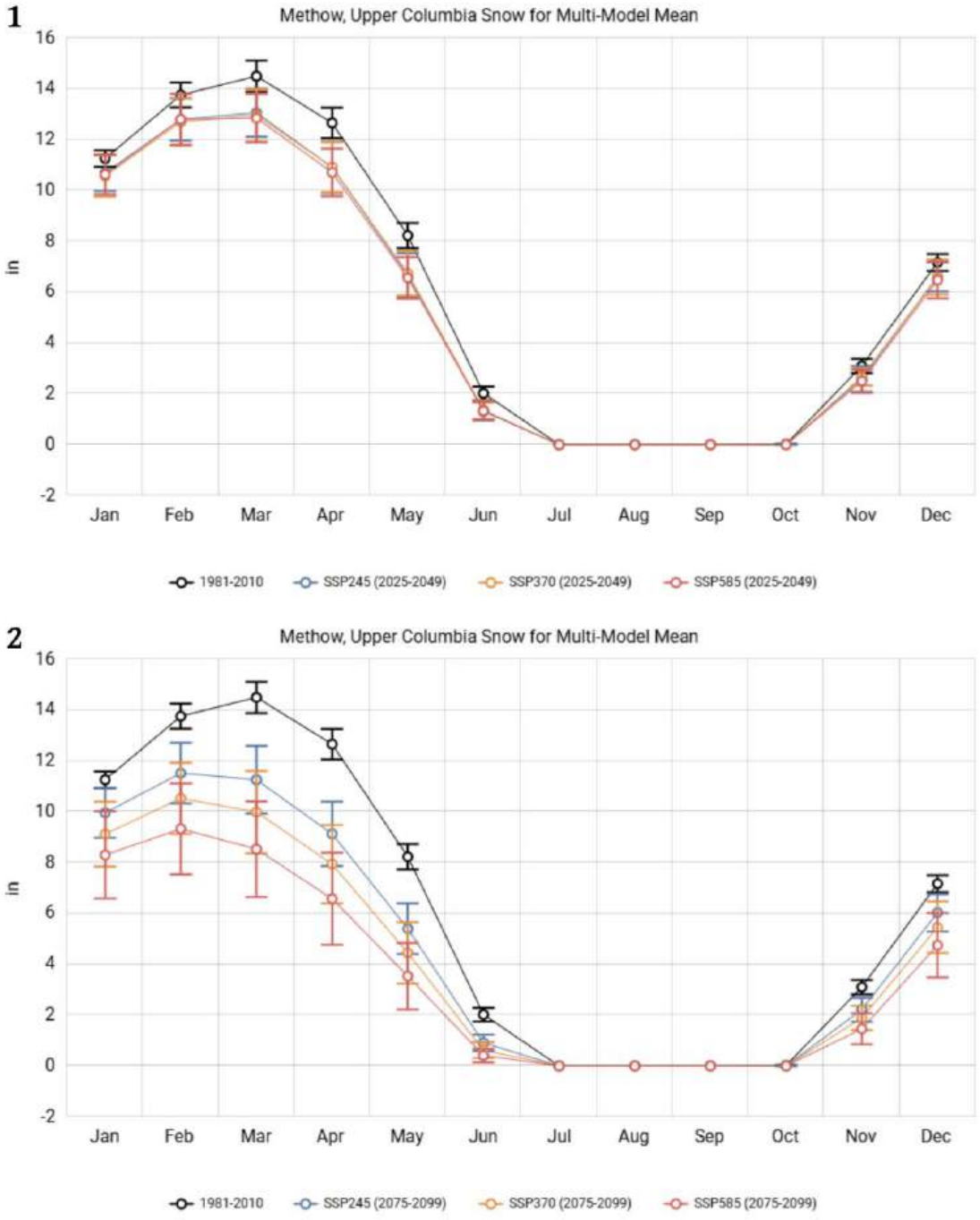


Figure 19. Climate change scenario graphs for snow in the Methow River basin. Source: Alder & Hostetler (2013), generated via USGS NCCV. The multi-model mean for snow in the watershed from 1) 2025 – 2049 and 2) 2075 – 2099. The three scenarios are the 3 Shared Socioeconomic Pathways. SSP245 represents a 'middle of the road' scenario with an additional 4.5W/m^2 of radiative forcing by 2100. SSP370 represents an upper-middle scenario with an additional 7.0W/m^2 of radiative forcing by 2100. SSP585 represents the worst-case scenario akin to RCP 8.5 with an additional radiative forcing 8.5W/m^2 by 2100.

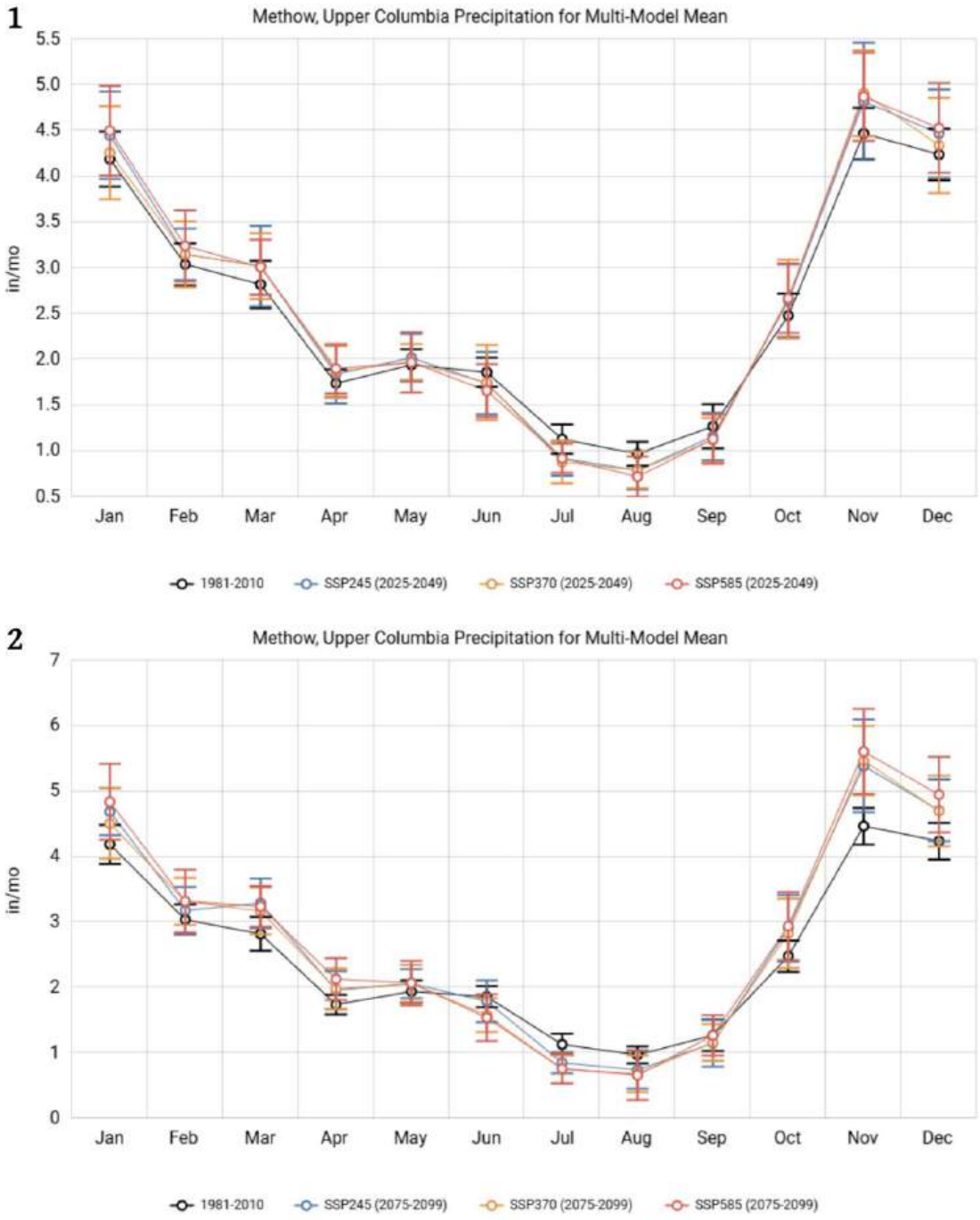


Figure 20. Climate change scenario graphs for precipitation in the Methow River basin. Source: Alder & Hostetler (2013), generated via USGS NCCV. The multi-model mean for precipitation in the watershed from 1) 2025 – 2049 and 2) 2075 – 2099. The three scenarios are the 3 Shared Socioeconomic Pathways. SSP245 represents a 'middle of the road' scenario with an additional 4.5W/m^2 of radiative forcing by 2100. SSP370 represents an upper-middle scenario with an additional 7.0W/m^2 of radiative forcing by 2100. SSP585 represents the worst-case scenario akin to RCP 8.5 with an additional radiative forcing 8.5W/m^2 by 2100.

The climate change predictions from the modeling described above are expected to occur later in the Methow River basin (2080's) compared to the nearby Wenatchee and Entiat basins (2040's). The streamflow data for the Methow River at Twisp USGS gage (USGS 12449500) supports this prediction of a later transition. Data from this gage has two gaps—one between 1929 – 1933 and another from 1962 – 1991. The 1962 – 1991 gap is used to separate the historical period of record from the recent period of record to make comparisons and evaluate the climate change modeling predictions since 1991. More specific information on this gage and the other gages listed above is provided in Section 3.2.2. The comparison of historical and recent data is presented as mean monthly flows from the USGS gage near Twisp from water years (WYs) 1920 – 2024 and 1992 – 2024 are shown in Figure 21. Based on this analysis, there does not appear to be any significant change in baseflows between the two periods.

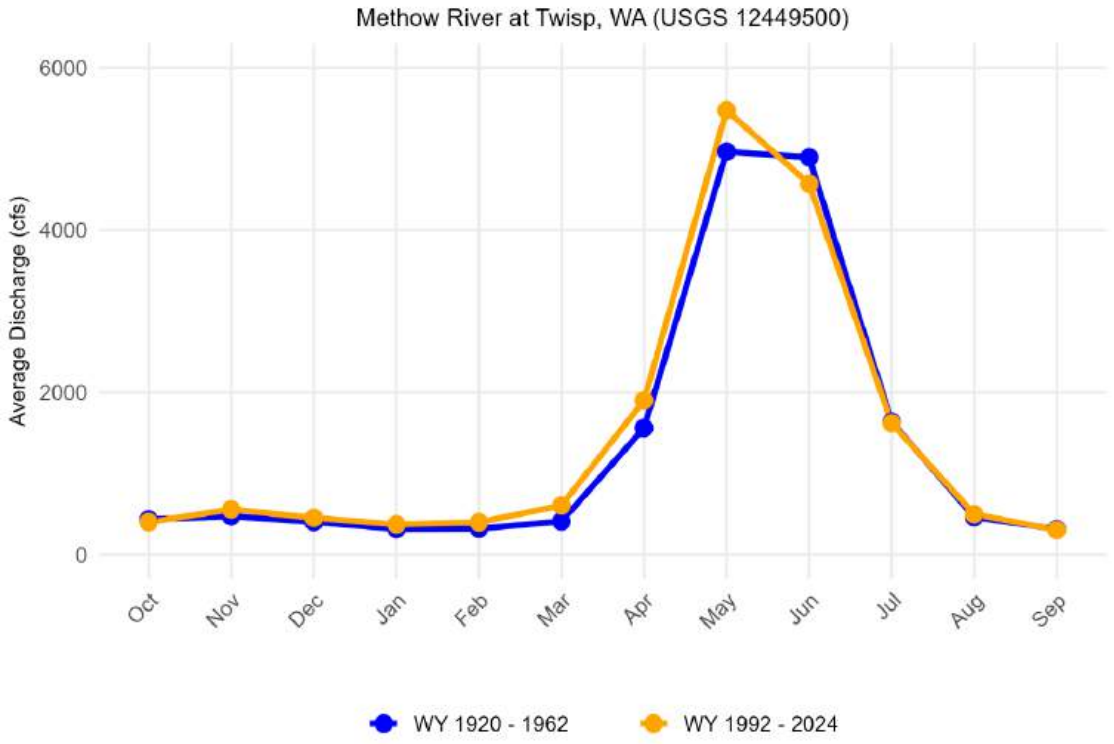


Figure 21. Comparison of mean monthly flows at the USGS gage (Methow River at Twisp, WA - 12449500).

The timing and magnitude of annual peak flows have also been consistent across both periods of record at Twisp USGS gage on the Methow River. Peak flows generally occur mid-April to the end of June (Figure 22). From WY 1920 to 1962, 64% of peak flows occurred before June 1st, and 36% occurred after. From WY 1992 – 2024, 72% of peak flows occurred before June 1st and 28% occurred after. The Methow data suggest there may be relatively small changes occurring currently due to climate change. The minor changes in the Methow are notably less than those depicted for the Entiat and Wenatchee basins during similar periods of record for a similar analysis completed by Inter-Fluve, Inc. (White River, 2025, Icicle Creek 2026, and Entiat 2026). This may be due to the slower

predicted transition of the Methow Basin from a snow-dominated regime to a transitional regime (mixed rain and snow dominated), as predict by (Tohver et al., 2014)). They predicted that the transition of the Methow Basin from snow-dominated to transitional will occur by the 2080s, whereas the Entiat and Wenatchee basins are predicted to transition by the 2040s.

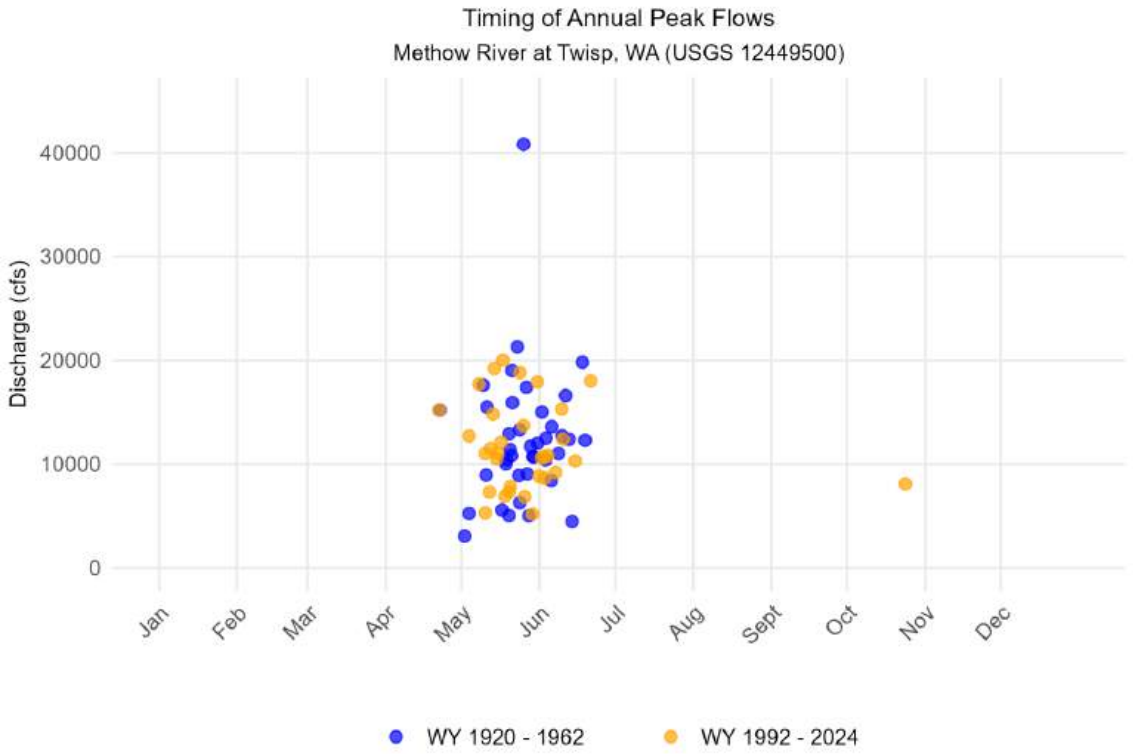


Figure 22. Annual peak flow timing and magnitude at Methow River at Twisp, WA stream gage (USGS 12449500). Months are labeled on the 1st of the month.

In summary, climate modeling predicts hydrologic processes in Methow River basin to include less snowpack, earlier and lower spring snowmelt peaks, elevated winter flows, and lower summer base flows (Alder & Hostetler, 2013; Tohver et al., 2014). Thus far, the Methow River has shown minor hydrologic signals indicative of climate change impacts. The Methow River basin's high elevation and potential to transition from a snowmelt-dominated system to a rain and snowmelt-dominated system is expected to be more pronounced moving towards the 2080's.

3.3 HYDRAULIC MODEL OVERVIEW

3.3.1 2-D Hydraulic Modeling

The preliminary-level 2-D hydraulic model of the Methow River study area was developed for existing conditions using the estimated flood discharges described in Section 3.2.4 and Appendix D. The hydraulic model was developed in the U.S. Army Corps of Engineers HEC-RAS 6.6 software

(USACE, 2024), which computes hydraulic properties related to the physical processes governing water flow through natural rivers and other channels. Existing conditions were based on the most recent available LiDAR data, including topographic and bathymetric data from 2022 and topographic LiDAR from 2018 (NV5 Geospatial, 2022; WGS, 2020). The goal of this preliminary model is to assess the current channel and floodplain dynamics, as well as assess the impacts of flood flows on the existing landscape.

3.3.2 Model Results

Modeled velocities and depths for the 2-year, and 100-year flood events show trends across the Methow River study area. Floodplain inundations and connectivity vary, with floodplains activated in the upstream portion of the study area during the 2-year flood event (as well as many side channels), and much of the valley bottom of reaches 1 to 7 and 12 to 16 inundated with 0.5 ft or more of water at the 100-year flood. Reaches 1 to 11, especially the more confined reaches 8 through 11, show high channel velocities (over 10 feet per second) and main channel depths exceeding 10 feet. Model results indicate that roads and small structures are likely to be impacted by the 100-year flood event in reaches, 4, 9, 12, 14, and 15. Model results are mapped and displayed in Figures 4 to 7 of Appendix D.

3.3.3 Model Considerations

This preliminary model was built using readily available data, with model topography built from LiDAR data. It therefore lacks the detail to be used to design individual restoration projects. Further surveys of the river and the surrounding landscape and infrastructure are needed to confirm the accuracy of the LiDAR and to represent key features such as bridges and floodplain structures. Additionally, flow inputs from groundwater or small tributaries are not included in this analysis and may need to be investigated to inform more detailed model development for restoration design.

4. Habitat Assessment Summary

Habitat surveys using the 2020 U.S. Forest Service Region 6 Level II protocols were performed in the assessment area between September 28 and October 30, 2024 (USFS, 2020). The full Methow Habitat Assessment (Appendix A) provides an inventory of the habitat conditions in the Methow River assessment area at the time of the survey. A summary table o provides an overview of the habitat assessment findings (Table 6).

Within the assessment area (RM 40.6 – RM 62.2), the Methow River channel habitat units are composed of elongated pools, followed by short riffles and glides. Side channels were more commonly observed in reaches with less anthropogenic influence; reaches with little to no off-channel habitats included Reaches 8-11, which flow through the town of Winthrop and along SR 20. Similarly, Reach 1 has no side channel habitat and it flows through the town of Twisp.

There were 7,653 pieces of large woody material (LWM) observed in the assessment area in total, which averages 352 total pieces per mile and 208 medium and large (M+L) pieces per mile (used for comparison to regional standards). Medium pieces are defined as greater than 12 inches in diameter and ≥35 feet in length, whereas large pieces are defined as greater than 20 inches in diameter and ≥35 feet in length. Reach 15 had the most LWM of any reach, with 529 M+L pieces per mile, largely due to a constructed side channel which contained nearly half of the jams in the reach. Reach 11 had the lowest amount of LWM of any reach, with only 12 M+L per mile. Although certain reaches have high amounts of LWM, those pieces are frequently concentrated in constructed jams that are partially bank-buried or in off-channel habitat.

Riparian vegetation throughout the study area is primarily forested with Cottonwood in the Small Trees size class category (9.0-20.9-inch diameter at breast height [dbh]). Understory vegetation is primarily in the Sapling/Pole (5.0-8.9-inch dbh) size class and dominated by willow, alder, dogwood, cottonwood and other non-woody riparian shrubs (Table 5). Large swaths of the riparian vegetation had been cleared throughout the assessment area related to floodplain land uses, residential use, roads adjacent to the channel, and within the towns of Twisp and Winthrop. Riparian vegetation throughout the study area is primarily Cottonwood in the Small Trees size class category (9.0-20.9-inch diameter at breast height [dbh]). Understory vegetation is primarily Sapling/Pole (5.0-8.9-inch dbh) dominated by willow, alder, dogwood, cottonwood and other non-woody riparian shrubs (Table 5).

Table 6. Summary of habitat assessment results. The habitat assessment is included as Appendix A.

Habitat Metric	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9	Reach 10	Reach 11	Reach 12	Reach 13	Reach 14	Reach 15	Reach 16
Unit Composition																
Pool	57%	49%	38%	48%	58%	29%	56%	24%	42%	25%	12%	33%	43%	26%	52%	43%
Glide	0%	0%	15%	6%	7%	29%	32%	51%	22%	49%	16%	21%	20%	39%	14%	51%
Riffle	43%	43%	41%	24%	35%	37%	9%	24%	34%	26%	71%	18%	19%	15%	2%	4%
Side Channel	0%	7%	6%	22%	1%	5%	2%	1%	2%	0%	0%	28%	18%	20%	32%	2%
Medium & Large LWM/mile (includes jams)	22	345	113	337	142	261	77	29	65	18	12	491	282	222	529	52
Pools/mile	4	5	2	7	4	4	3	4	5	2	2	6	8	5	7	6
No. Pools with Residual Depth ≥3ft	0	5	2	4	2	5	2	1	3	1	0	4	5	4	5	1
No. of Side Channels	0	2	2	3	1	3	1	1	1	0	0	14	11	10	12	3
Riparian Conditions																
Large Tree	0%	0%	64%	11%	33%	18%	14%	10%	0%	14%	0%	13%	35%	33%	17%	63%
Small Tree	100%	83%	18%	67%	50%	65%	71%	80%	93%	71%	83%	50%	52%	67%	58%	13%
Sapling/Pole	0%	17%	9%	22%	17%	18%	0%	10%	7%	0%	0%	19%	13%	0%	8%	13%
Shrub/Seedling	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%
Grassland/Forb	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Other/No Veg	0%	0%	9%	0%	0%	0%	14%	0%	7%	14%	17%	19%	0%	0%	8%	13%

Note: *LWM/mile includes natural and constructed jams*

5. Reach-Based Ecosystem Indicators Summary

A Reach-Based Ecosystem Indicators (REI) analysis was performed to support the reach assessment. The REI evaluates biological and physical conditions of a watershed in relation to regional standards and known habitat requirements for aquatic biota. The REI results include functional ratings for a range of attributes at the reach- and watershed-scale. Functional ratings include Adequate, At Risk, or Unacceptable. The REI analysis helps to summarize habitat impairments and to distill the impairments down to a consistent value that can be compared among reaches. This assessment was informed by multiple surveys and analysis, including a habitat survey, geomorphology survey, hydraulic modeling, and with reference to remote sensing data and existing studies. The full REI analysis methods and results are provided in Appendix B. A summary of the REI ratings is provided as Table 7.

At the watershed scale, REI ratings for the Methow River (RM 40.6-62.2) ranged from Unacceptable to Adequate. Watershed-scale impairments are primarily related to historical or ongoing anthropogenic disturbance to the watershed.

At the reach scale, the most impaired indicators occurred in the Riparian Vegetation and Habitat Quality categories. High-quality riparian vegetation conditions that support aquatic ecosystem processes, such as mature, old-growth trees in the riparian zone that offer channel shading and contribute large wood to the channel are limited within the assessment area, largely due to the presence of roads, agriculture and land uses, and residential infrastructure in the towns of Winthrop and Twisp, Washington. Riparian Vegetation condition indicators were predominantly rated Unacceptable, with Disturbance (Human) rating Adequate in the upstream reaches where anthropogenic impacts to the riparian buffer zone are minimal. The Foghorn Diversion is a potential fish passage barrier at certain flows, thus Reach 10 is rated At Risk for Habitat Access while all other reaches rate Adequate.

Habitat Quality indicators ranged from Adequate to Unacceptable with the most Unacceptable ratings occurring in Pool Frequency/Quality indicator. However, the upper to mid-reaches (Reach 12 – Reach 15) offer some high-quality, deep pool habitat. Off-channel habitat is intermittently available within the assessment area, with Unacceptable and At Risk ratings in reaches where anthropogenic impacts to the channel and floodplain are relatively high, such as near Winthrop and Twisp. The Off-Channel Habitat indicator did receive Adequate ratings in the Big Valley area, from Reach 12 to Reach 15. Suitable-sized substrates where natural channel form and stream power support the development of spawning areas occurred in most upstream reaches. Spawning gravels were observationally limited between Reach 1 and Reach 10. Geomorphic channel conditions were rated At Risk to Unacceptable within the assessment area, except the upper reaches (Reach 12 to 15) where anthropogenic impacts to the channel are minimal, and floodplain connectivity is adequate (Table 7).

Table 7. Summary REI rating for the Methow reach assessment (Reach 1-Reach 16). Ratings are color-coded, with green shading for Adequate condition, yellow for At Risk condition, and red for Unacceptable condition.

Pathway	General Indicators	Specific Indicators	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9	Reach 10	Reach 11	Reach 12	Reach 13	Reach 14	Reach 15	Reach 16
Habitat Access	Physical Barriers	Main Channel Barriers	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	At Risk	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
Habitat Quality	Substrate	Dominant Substrate/ Fine Sediment	Unacceptable	At Risk	At Risk	At Risk	At Risk	At Risk	At Risk	At Risk	Unacceptable	At Risk	At Risk	Adequate	At Risk	At Risk	Adequate	Adequate
	LWM	Pieces per Mile at Bankfull	Unacceptable	Adequate*	At Risk	Adequate*	At Risk	At Risk	At Risk	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Adequate*	Adequate*	Adequate*	Adequate*	Unacceptable
	Pools	Pool Frequency and Quality, Presence of Large Pools	Unacceptable	At Risk	Unacceptable	At Risk	Unacceptable	At Risk	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	At Risk	At Risk	Unacceptable	At Risk	Unacceptable
	Off-Channel Habitat	Connectivity with Main Channel	Unacceptable	Unacceptable	At Risk	At Risk	Unacceptable	At Risk	Unacceptable	Adequate	Unacceptable	At Risk	At Risk	Adequate	Adequate	Adequate	Adequate	At Risk
Riparian Vegetation	Condition	Structure	Unacceptable	Unacceptable	At Risk	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	At Risk
		Disturbance (Human)	Unacceptable	Adequate	Unacceptable	At Risk	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Adequate	Adequate	Adequate	Adequate	Unacceptable
		Canopy Cover	Unacceptable	Unacceptable	At Risk	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable	At Risk
Channel	Dynamics	Floodplain Connectivity	At Risk	At Risk	At Risk	At Risk	At Risk	Unacceptable	At Risk	Unacceptable	Unacceptable	Unacceptable	At Risk	Adequate	Adequate	Adequate	At Risk	At Risk
		Bank Stability/ Channel Migration	Unacceptable	Unacceptable	Unacceptable	Unacceptable	At Risk	At Risk	Unacceptable	At Risk	Unacceptable	Unacceptable	At Risk	Adequate	Adequate	Adequate	At Risk	Unacceptable
		Vertical Channel Stability	At Risk	Adequate	At Risk	At Risk	Adequate	At Risk	At Risk	At Risk	At Risk	At Risk	At Risk	Adequate	Adequate	Adequate	Adequate	At Risk

**Although the LWM may be adequate from a habitat/cover perspective, this indicator does not consider the geomorphic function of LWM. An asterisk indicates a LWM reach rating where the rating would potentially be lowered if geomorphic function of the LWM was considered.*

6. Channel Conditions

The following section contains segment-scale descriptions of channel and floodplain geomorphology, large wood material conditions, riparian vegetation, prior restoration projects, and summaries of project opportunities. The assessment area is divided into nine segments, some of which include multiple reaches. The reach boundaries, established in 2021 and retrieved from the Upper Columbia Salmon Recovery Board's Upper Columbia Spatial Framework, are reused in this assessment to accommodate comparison and continuity with past assessments. The numbering and naming of the reaches and segments are specific to this assessment for tracking. The Habitat Assessment (Appendix A) utilizes the same reach breaks. The segments in this assessment were defined by similarities and differences of geomorphic characteristics amongst adjacent reaches. Segment 1 (Twisp) includes Reaches 1; Segment 2 (White Sugar) includes Reach 2; Segment 3 (Mink) includes Reaches 3-5, Segment 4 (Bear) includes Reaches 6-7; Segment 5 (Winthrop) includes Reach 8; Segment 6 (Hatchery) includes Reaches 9-10; Segment 7 (Wolf) includes Reach 11, Segment 8 (Lower Big Valley) includes Reaches 12-13; and Segment 9 (Mid Big Valley) includes Reaches 14-16. Table 7 presents the metrics for each reach in the assessment area and indicates which reaches are included in each segment.

Table 8. Metrics table by reach for the Methow River assessment area (RM 40.6 – 62.3). Channel segments defined by boxes and described below.

Metric	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7	Reach 8	Reach 9	Reach 10	Reach 11	Reach 12	Reach 13	Reach 14	Reach 15	Reach 16	Totals
Length (miles)	0.9	1.9	1.9	1	1.1	2	0.9	1.4	1.5	1.3	0.9	1.7	2.2	1.3	1.1	0.6	21.7
River Mile	40.6-41.5	41.5-43.4	43.4-45.3	45.3-46.3	46.3-47.4	47.4-49.4	49.4-50.3	50.3-51.7	51.7-53.2	53.2-54.5	54.5-55.4	55.4-57.1	57.1- 59.3	59.3-60.6	60.6-61.7	61.7-62.3	40.6-62.3
Stream Gradient (%)	0.21%	0.30%	0.24%	0.20%	0.26%	0.28%	0.31%	0.18%	0.25%	0.52%	0.38%	0.27%	0.35%	0.39%	0.34%	0.32%	0.30%
Sinuosity	1.01	1.28	1.27	1.33	1.10	1.32	1.14	1.04	1.08	1.06	1.05	1.19	1.13	1.29	1.41	1.05	1.17
Dominant Channel Habitat Unit Type	Pool	Pool	Riffle	Pool	Pool	Riffle	Pool	Glide	Pool	Glide	Riffle	Pool	Pool	Glide	Pool	Glide	Pool
Average Bankfull Width (ft)	226	238	204	206	206	197	189	187	176	141	122	174	140	131	156	156	178
Confinement	Confined	Partially Confined	Partially Confined	Unconfined	Partially Confined	Partially Confined	Partially Confined	Confined	Partially Confined	Confined	Confined	Unconfined	Unconfined	Unconfined	Unconfined	Partially Confined	
Dominant Substrate	Cobble	Cobble & Gravel	Cobble	Gravel	Cobble	Cobble	Cobble	Cobble	Boulder	Cobble	Cobble	Cobble & Gravel	Cobble	Cobble	Gravel	Cobble	Cobble
% Pool Habitat	57%	49%	38%	48%	58%	29%	56%	24%	42%	25%	12%	33%	43%	26%	52%	43%	40%
% Glide Habitat	0%	0%	15%	6%	7%	29%	32%	51%	22%	49%	16%	21%	20%	39%	14%	51%	23%
% Riffle Habitat	43%	43%	41%	24%	35%	37%	9%	24%	34%	26%	71%	18%	19%	15%	2%	4%	28%
% Side Channel	0%	7%	6%	22%	1%	5%	2%	1%	2%	0%	0%	28%	18%	20%	32%	2%	9%
% Other Habitat	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Segment 1 (Twisp) = Reach 1

Segment 2 (White Sugar) = Reach 2

Segment 3 (Mink) = Reaches 3-5

Segment 4 (Bear) = Reaches 6-7

Segment 5 (Winthrop) = Reach 8

Segment 6 (Hatchery) = Reaches 9-10

Segment 7 (Wolf) = Reach 11

Segment 8 (Lower Big Valley) = Reaches 12-13

Segment 9 (Mid Big Valley) = Reaches 14-16

6.1 SEGMENT 1: TWISP (RM 40.6 – RM 41.5)

6.1.1 Overview

Segment 1 (Twisp) is equivalent to Reach 1 and extends from the downstream end of the town of Twisp at RM 40.6 to the confluence with the Twisp River at RM 41.5. General metrics of the reach/segment are provided in Table 9. The channel is confined by bedrock (river left) and the Twisp River fan (river right) at the upstream end, bedrock at the downstream end (river right), and anthropogenic features throughout. The channel is straight and entrenchment (maintained state of floodplain disconnection). The banks are steep and bank tops are sparsely vegetated, where private property management or public infrastructure maintenance have not removed it. Although extended pools occupy 57% of the channel, the habitat they provide is low quality (shallow depth and minimal cover). There is no record of past restoration projects in this segment. Due to the existing infrastructure and recreational uses, restoration opportunities are likely limited to stable habitat enhancement projects in designated areas. Representative photos of Segment 1 (Twisp) are in Figure 23.

Table 9. Metrics table for Segment 1 (Twisp).

Twisp	Length (miles)	River Mile	Stream Gradient (%)	Sinuosity	Dominant Channel Habitat Unit Type	Average Bankfull Width (ft)	Confinement	Dominant Substrate	% Pool Habitat	% Glide Habitat	% Riffle Habitat	% Side Channel Habitat
Reach 1	0.9	40.6-41.5	0.21%	1.01	Pool	226	Confined	Cobble	57%	0%	43%	0%



Figure 23. Representative photos of the Methow River in Segment 1 (Reach 1). A) looking downstream from RM 41.3. B) looking upstream from RM 40.75. July 14, 2025.

Channel and floodplain processes, riparian vegetation conditions, and habitat availability in Segment 1 (Twisp) continue to be impacted by anthropogenic features (Figure 24). The channel and mouth of the Twisp River were straightened and confined post Euro-settlement and the large wood was cleared from to facilitate log drives to downstream mills.

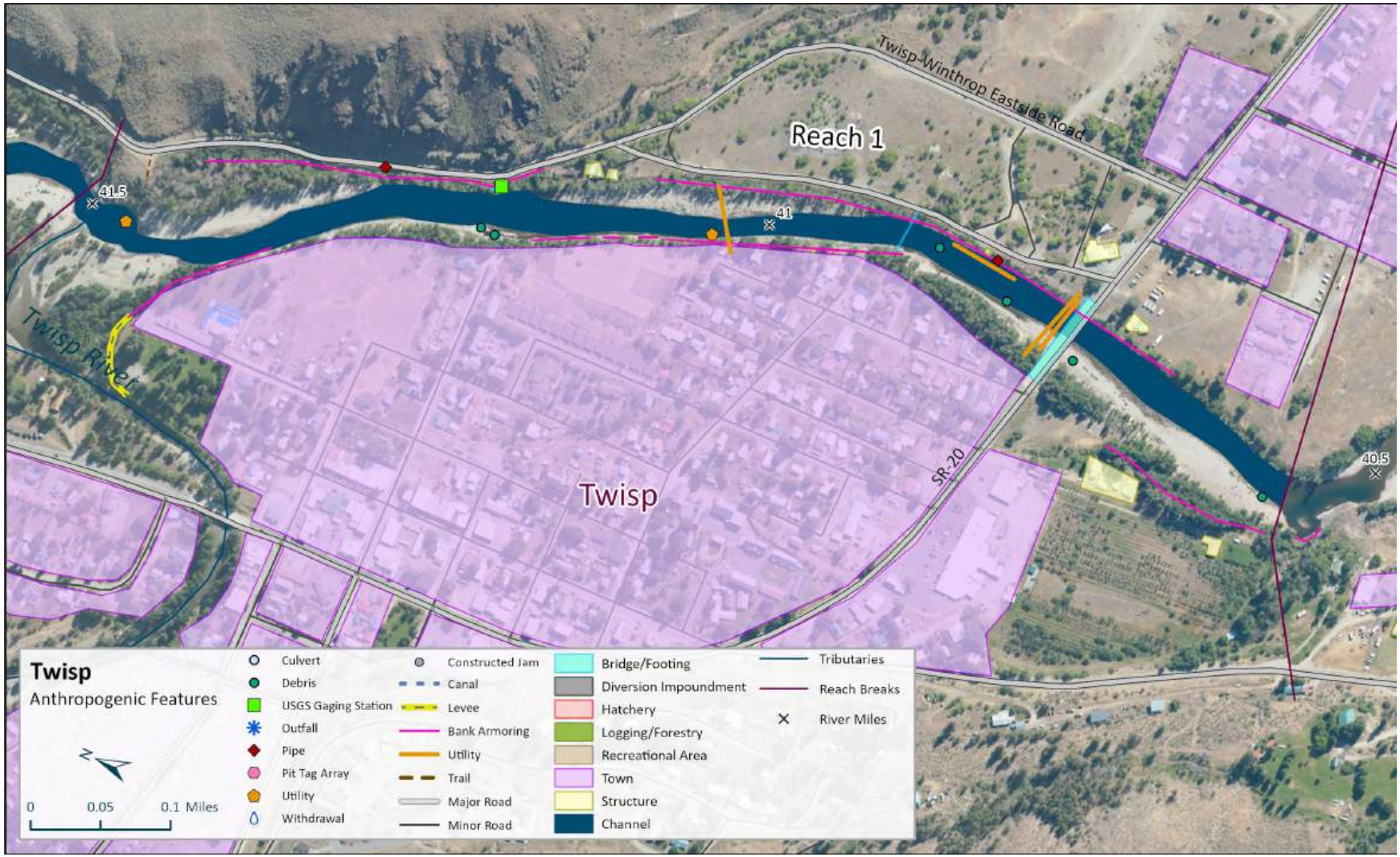


Figure 24. Segment 1 (Twisp): mapped anthropogenic features.

Localized infrastructure development along the banks of the channel inspired bank armoring and continued forced entrenchment. If loose large wood finds its way into this river segment today, it is presumed that efforts are taken to remove the loose wood for infrastructure and private property protection. Extended sections of bank armoring along both sides of the channel, a levee on river right at the confluence of the Twisp and Methow Rivers, and the SR 20 bridge and associated footings eliminate natural lateral channel processes through the segment. The bank armoring is constructed of large boulder riprap and, in a few locations, pieces of concrete. As a result, the channel will remain straightened, oversimplified, and disconnected from its floodplain.

The disconnected floodplain adjacent to the Methow River is occupied by the town of Twisp on the west side and rural-residential development including roads, parks, homes, infrastructure, utilities, and bridge crossings on the east. Recreational access is relatively informal but heavily used. Anthropogenic debris such as metal pipes (~RM 40.85), a car embedded in the banks (RM 41.25), cement blocks, and drainage pipes (RM 40.8 and RM 41.3) were noted. A steel footbridge and utility crossing at RM 40.9 and old bridge footings on both sides of the channel at RM 41.25 impose channel confinement. The modern road bridge located at RM 40.8 includes riprap armored side footings and a mid-channel footing. The USGS stream gauge (USGS gauge #12448998) is located just downstream of the bridge footing on the left bank. Throughout the reach, riparian and floodplain vegetation has beem cleared for public parks, residential properties, and road infrastructure, resulting in exposed banks and reduced habitat quality. Photos of selected anthropogenic features in the Segment 1 - Twisp are mapped in Figure 25. Public recreational use (swimming, fishing, etc.) at the Twisp River confluence is high-use during summer months.



Figure 25. Photos of prominent anthropogenic features in Segment 1 (Twisp): A) steel utility crossing, footbridge access (RM 41.85) and riprapped banks; B) historical bridge abutment at RM 40.3 on river left with riprapped bank, a similar abutment exists on river right; C) Cement and steel gage building and historical withdrawal with riprapped bank, and ; D) modern East Methow Valley Road (SR Hwy 20) bridge crossing with riprapped banks and footings.

6.1.2 Channel and Floodplain Geomorphology

Segment 1 (Twisp) is relatively straight and lacking in habitat complexity. Although valley width is available, the channel is confined and entrenched (maintained state of floodplain disconnection). Extended low-quality (shallow with minimal cover) pools occupy 57% of the available habitat while the remainder is extended riffle units (Figure 26). No side-channel or off-channel habitat is present in Segment 1. The delta at the confluence mouth of the Twisp River at the upstream boundary of the segment and a bedrock-contact with a pool immediately downstream of the segment boundary offer some habitat complexity in this otherwise degraded segment.

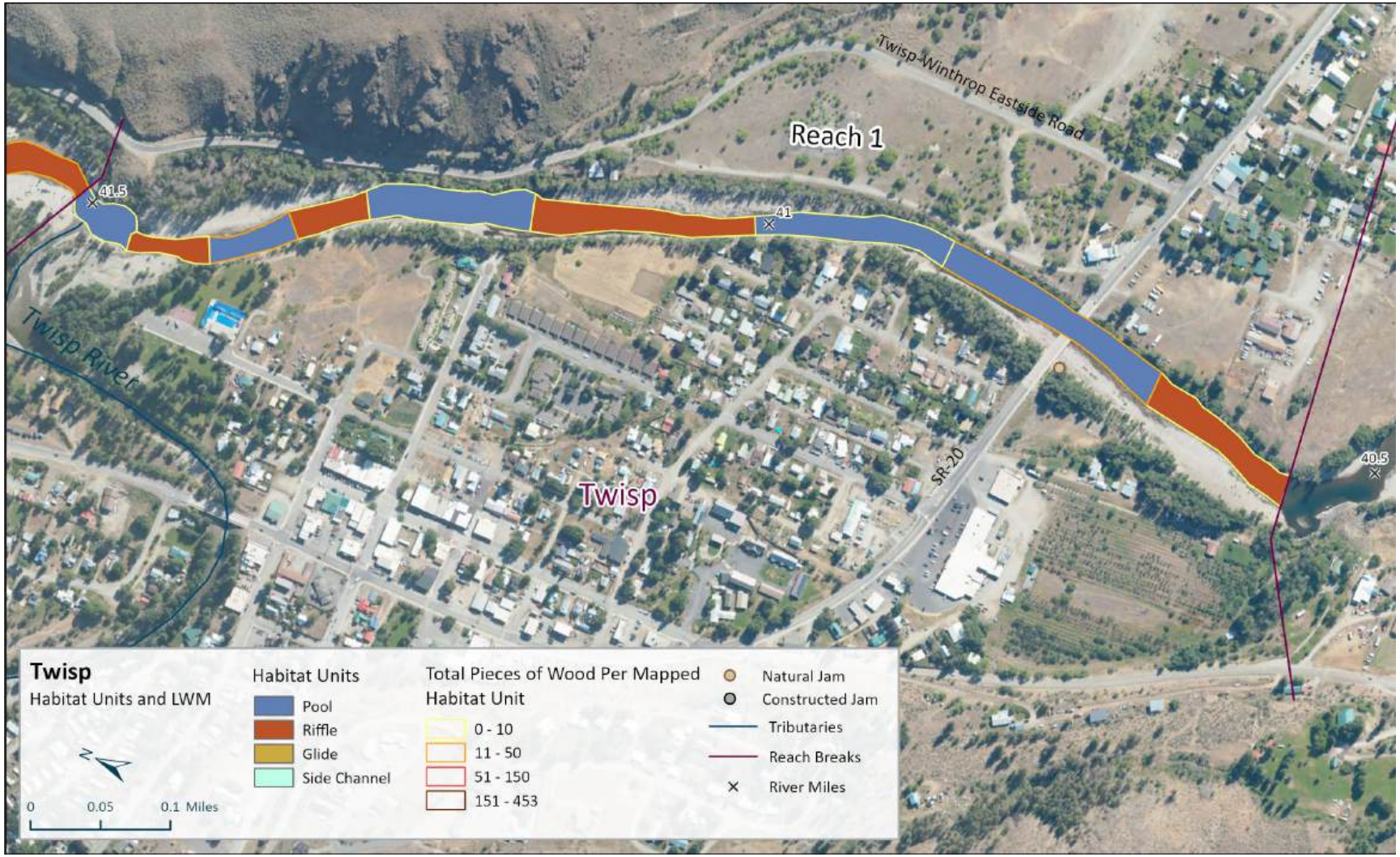


Figure 26. Segment 1 - Twisp (Reach 1): mapped habitat units with large wood quantities of each unit delineated - Habitat Survey, 2024.

Bedrock occurs as short channel contacts at the upstream boundary across from the Twisp River confluence and immediately downstream of the downstream boundary. The bedrock contacts provide a consistent point of scour and pool maintenance. Otherwise, the active channel is bound by high banks composed of abandoned paleo and historical floodplains and terraces armored in several sections with riprap. A relative elevation map of the channel and floodplain in Segment 1, with bank armoring and riprap is provided as Figure 27. Elongate and narrow cobble bars along the edges of the channel are exposed during low-flow conditions. In some locations, the top and back of the bars are vegetated and functioning as narrow strips of inset floodplain. Bars and riparian vegetation on the delta at the mouth of the Twisp River appear to still be relatively dynamic even though a levee (river right) and other infrastructure confine the Twisp River near its delta. The Twisp River contributes both sediment (fines, gravels, and cobbles) and perennial discharge to the Methow mainstem at the upstream boundary of this segment.

Bedload in the mainstem channel is dominated by cobble with boulders and sparse gravel throughout. A few boulders in riffle sections and pool areas provide the only in-channel habitat complexity in Segment 1. Gravels are present along channel margins, including elongate channel-margin bars. Vegetation establishing on bars between RM 40.8 – 41.5 suggests the occurrence of very subtle lateral processes at some time in the last 100 years, likely instigating the visible bank armoring. The active elongate bar and thin set-back floodplain on river right downstream of RM 40.8 appear to be related to hydraulic and depositional conditions created by the SR 20 road bridge footings.

Preliminary hydraulic modeling reinforces that the channel is entrenched and laterally confined in its existing location, up to at least the estimated 100-yr flood event (Figure 28). Only the non-leveed portion of the Twisp River delta area expresses any dynamic process or floodplain inundation. Modeled flow velocities through this segment show that it experiences relatively high velocities, confirming that Segment 1 is primarily a transport reach (Figure 29) – cobble and gravel received at the upstream end is transported through, not stored in the segment.

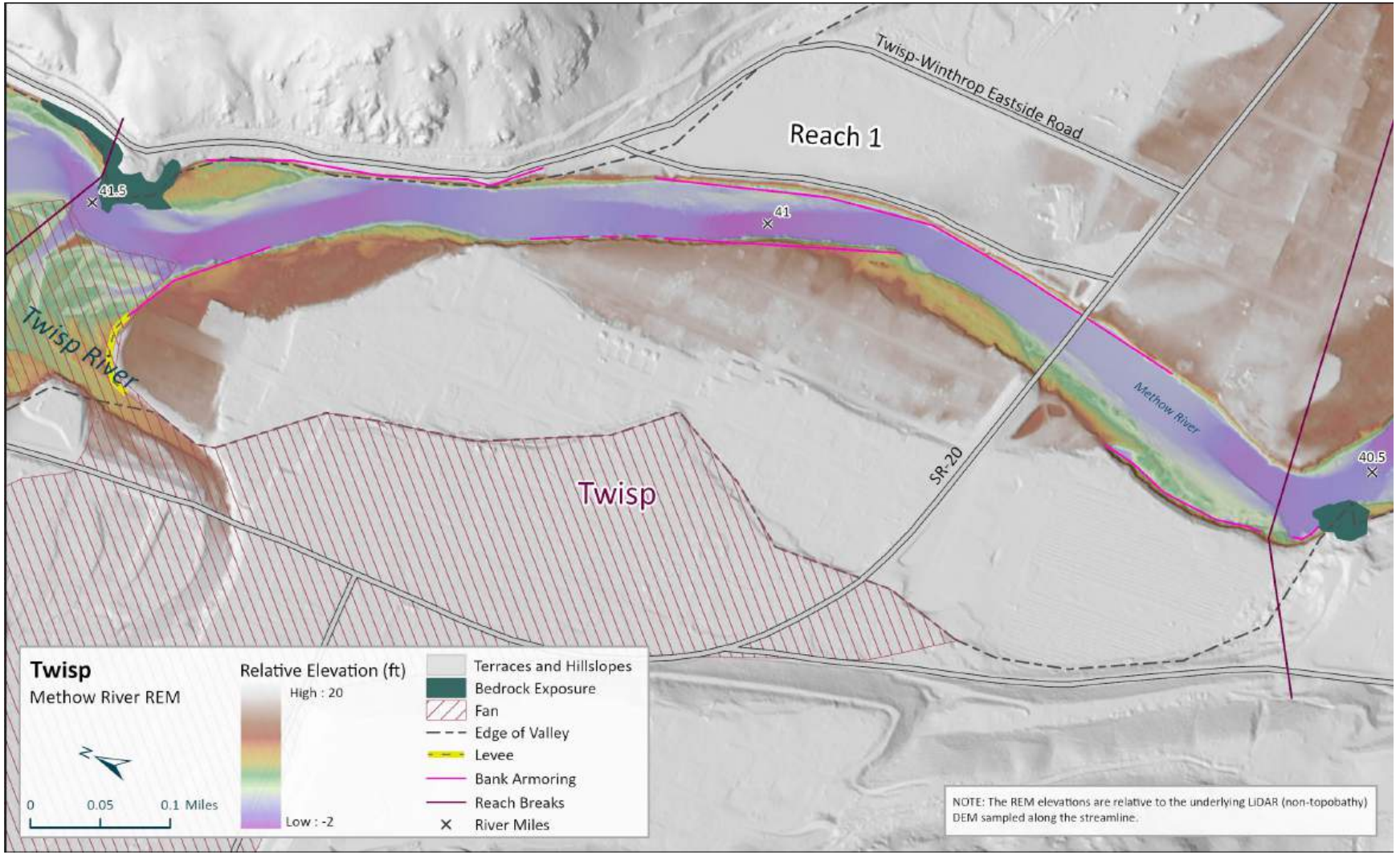


Figure 27. Segment 1 - Twisp (Reach1): Relative elevation map of existing floodplain and channel with channel confining fans, bedrock, terraces, and roads identified.

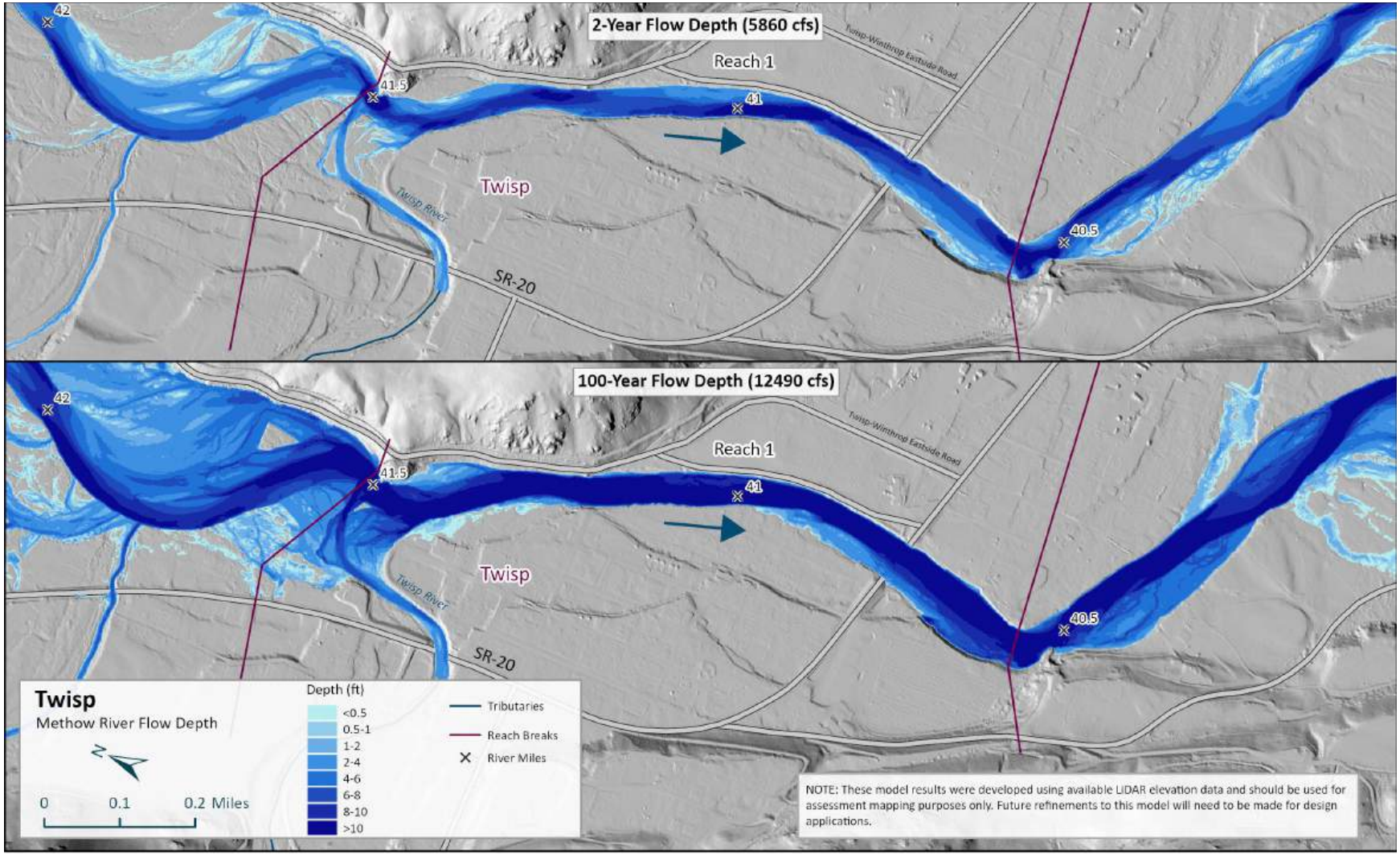


Figure 28. Segment 1 - Twisp (Reach 1): Preliminary hydraulic model (Hec-Ras 2D) depth results for the estimated 2-yr and 100-yr flood event. See Appendix D – Preliminary Hydraulic Model Results for more information.

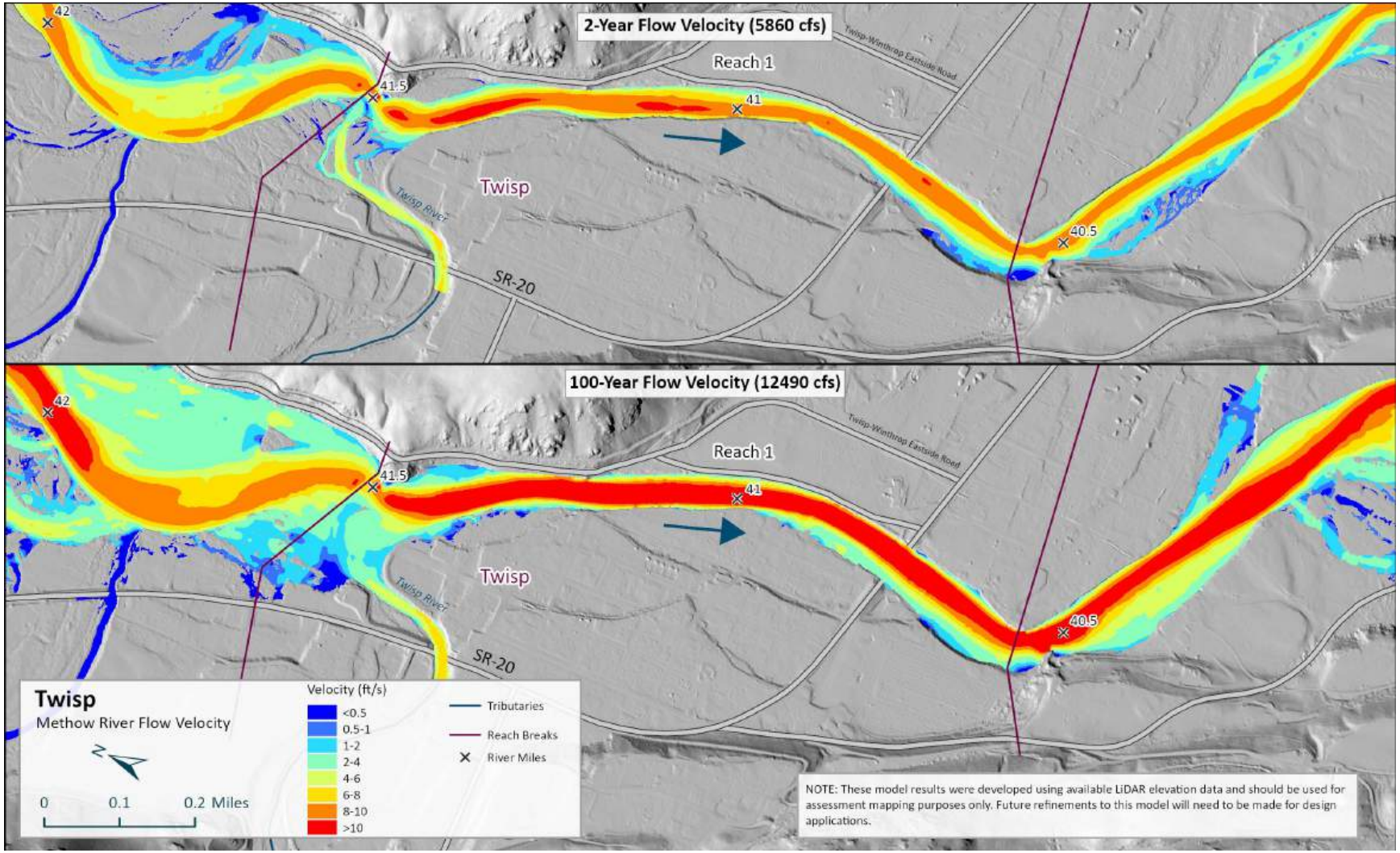


Figure 29. Segment 1 (Reach 1): Preliminary hydraulic model (Hec-Ras 2D) flow velocity results for the estimated 2-yr and 100-yr flood event. See Appendix D – Preliminary Hydraulic Model Results for more information.

6.1.3 Large Wood Material

The role of large wood in Segment 1 (Twisp) has been diminished by anthropogenic confinement, channel clearing, and riparian vegetation removal. During the 2024 Habitat Survey (see Appendix A), only forty-five wood pieces were counted in the segment and only one jam (3+ pieces of medium or large) pieces). The wood that was present occurred on bar tops as drifted single pieces and provided little to no geomorphic utility to the channel or to habitat function (Figure 30). The existing large wood and debris may potentially provide some nutrients, hydraulic roughness, or protection for vegetation establishing on a bar top. A map of the distribution of large wood observed in Segment 1 - Twisp during the 2024 survey is provided as Figure 31. It is assumed that unballasted large wood was and potentially still is removed from the channel, depending on perceived risk to infrastructure and recreational safety requirements.



Figure 30. Large wood on top of river left bar at RM 41.4. (10/29/2024)

Large wood recruitment potential in this reach is poor because of anthropogenic channel confinement that minimizes lateral processes combined with an impaired riparian forest condition. A few small pockets of narrow inset vegetated floodplain exist along the back of active lateral bars. These areas contribute a small quantity of debris and wood to the channel. However, the existing riparian forests are immature thus contributions are not expected to provide substantial or long-term geomorphic influence or habitat function. A discontinuous narrow strip of trees and shrubs line the top of banks that confine the channel, but bank armoring throughout the reach limits recruitment potential.

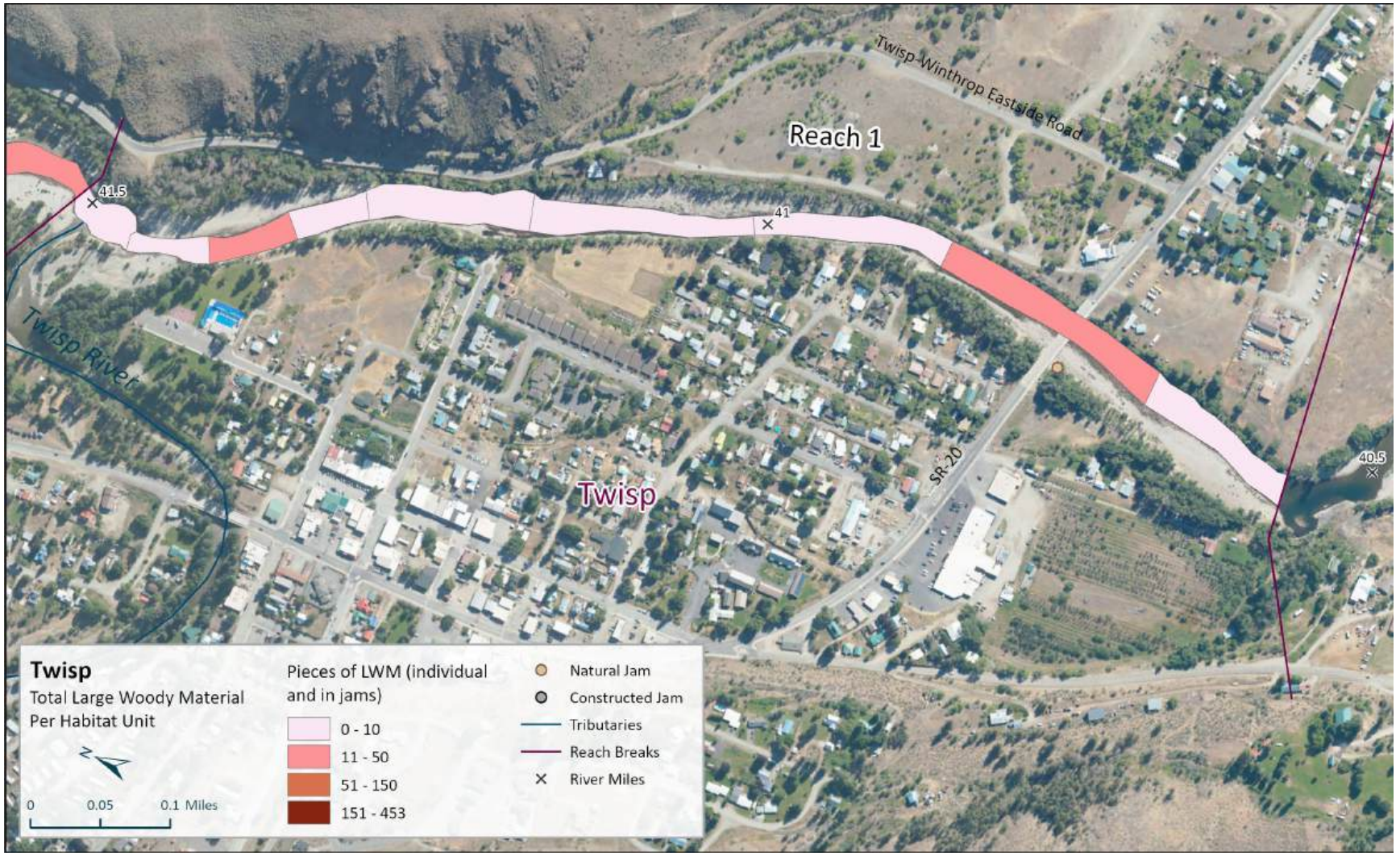


Figure 31. Segment 1 - Twisp: Distribution of large wood per mapped habitat unit and location of jams (≥ 3 pieces) from 2024 Habitat Survey

6.1.4 Vegetation

Riparian vegetation in Segment 1 - Twisp (Reach 1) is dominated by small cottonwood trees and riparian shrubs on bars and the bank margin of the stream, as well as several small conifers on the banks. Willow and forbs regenerate seasonally atop channel-margin bars, but periodic high-water events usually remove the small riparian shrubs before they reach maturity. A representative photo of the vegetation in Segment 1 is provided as Figure 32. The diverse native forests that occupied the floodplains historically have long been cleared and replaced with homes, roads, agricultural fields, public recreation areas, personal gardens, small orchards, and urban enhancement plants – some of which is not native to the area. The historical floodplain is occupied by the town of Twisp on river right and rural properties on river left. Adjacent hillslopes are vegetated with grasses and shrubs and sparse ponderosa pine. Vegetation height and distribution along the channel, valley floor, and adjacent hillslopes in Segment 1 are mapped in Figure 33.



Figure 32. Segment 1 - Twisp: Representative photo of riparian vegetation at RM 40.95 on river left. Narrow strip of small cottonwood forest with cottonwood and willow shrubs. July 14th, 2025.

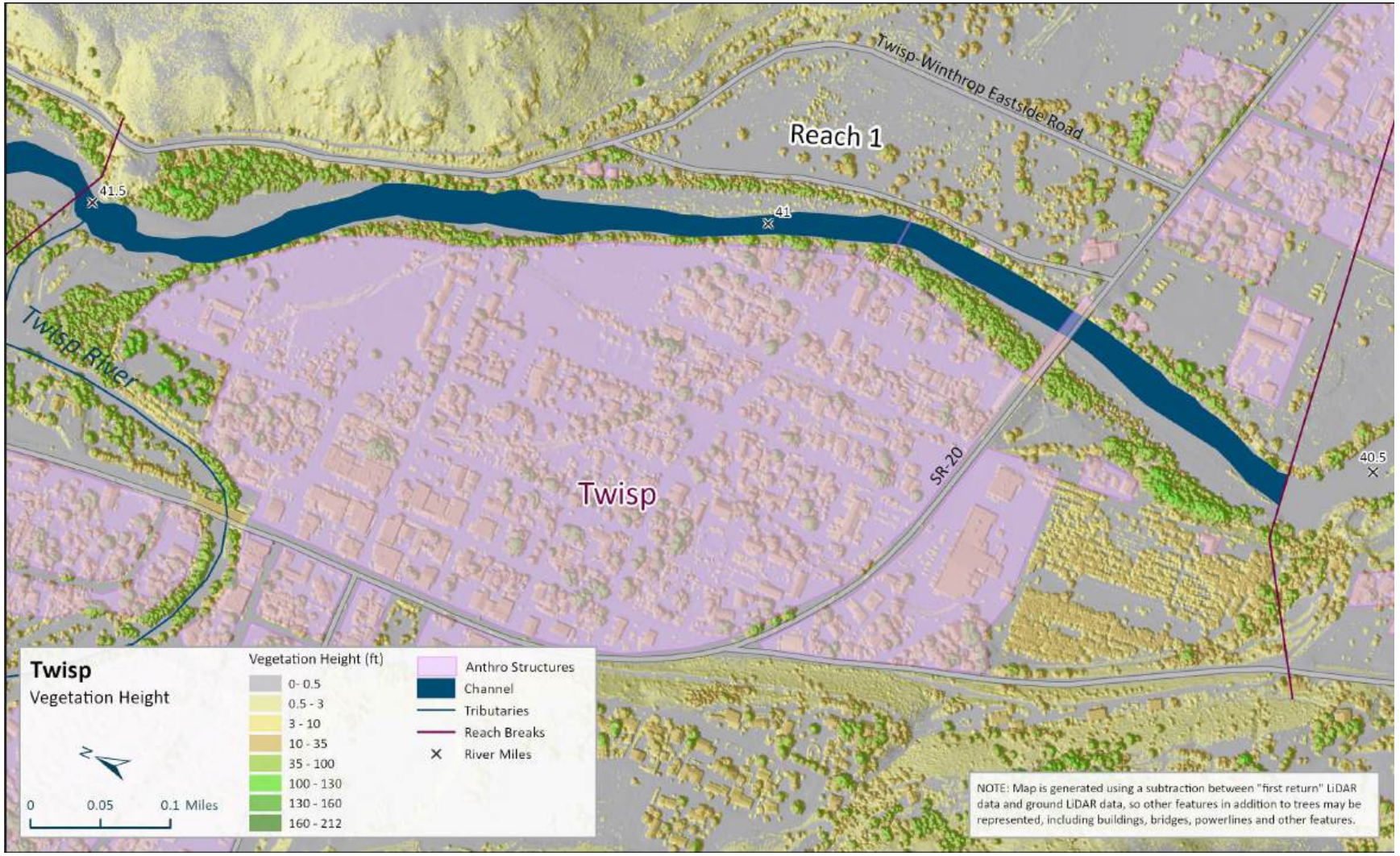


Figure 33. Segment 1 - Twisp: Vegetation height and distribution map.

6.1.5 Past or Planned Restoration Projects

No past or present habitat restoration projects were reported for Segment 1 – Twisp: Reach 1.

6.1.6 Project Opportunities

Project opportunities in Segment 1 – Twisp consist of localized enhancement of channel complexity and restoration of riparian vegetation. Channel complexity opportunities include installation of large wood jams and boulder placement to provide cover and improve habitat complexity. Installation of large wood is assumed to require bank-ballasted or buried for structure stability due to the proximity of infrastructure. The structures will be designed to provide localized in-channel habitat uplift in an otherwise simplified reach. Modification of anthropogenic features, such as bank riprap, should be considered wherever possible to improve channel condition, but may not be feasible due to proximity of roads and other infrastructure adjacent to the channel. Existing private land uses and infrastructure may limit overall recovery potential. Riparian restoration where banks have been cleared can support long-term recovery of riparian forest processes. A description of the project opportunities and a map showing general locations are provided in Appendix C – Project Opportunities & Restoration Strategy.

6.2 SEGMENT 2: WHITE SUGAR (RM 41.5 – 43.4)

6.2.1 Overview

Segment 2 - White Sugar is equivalent to Reach 2 and extends from the confluence with the Twisp River at RM 41.5, upstream to RM 43.4. General metrics this segment are provided in Table 9. Sections of the channel are confined by levees and bank armoring that restrict lateral processes, even though the segment is located in a relatively wide valley section. At the downstream end, a bedrock outcrop on river left and the Twisp River fan and confluence on river right impose additional control to lateral process while also partially inhibiting vertical incision processes that could otherwise extend upstream from the impaired downstream Segment 1 – Twisp Town. Channel form is low-sinuosity meandering with cobble and gravel bars occurring along the inside of the meander bends (Figure 34). The channel is a pool-riffle sequence, but the extended pools lack cover and complexity. Large wood quantities in the reach meet the habitat requirements but offer minimal geomorphic function. Vegetation density and composition along the channel varies, depending on land-use and level of disturbance. Reported past and planned projects (2013-2027) include large wood installations, side channel and floodplain reconnection projects, and riparian revegetation efforts. The existing infrastructure and recreational use of the Segment 2 – White Sugar will limit the types of restoration treatment options considered along the mainstem.

Table 10. Metrics table for Segment 2: White Sugar (Reach 2).

White Sugar	Length (miles)	River Mile	Stream Gradient (%)	Sinuosity	Dominant Channel Habitat Unit Type	Average Bankfull Width (ft)	Confinement	Dominant Substrate	% Pool Habitat	% Glide Habitat	% Riffle Habitat	% Side Channel Habitat
Reach 2	1.9	41.5-43.4	0.30%	1.28	Pool	238.3	Partially Confined	Cobble & Gravel	49%	0%	43%	7%



Figure 34. Representative photo of the Methow River in Segment 2 at RM 42.4, looking downstream. July 15, 2025.

Channel and floodplain processes, riparian vegetation conditions, and habitat availability in Segment 2 - White Sugar have been and continue to be impacted by anthropogenic features and land management. Levees and bank armoring between RM 42.2-42.8 confine lateral processes, control channel position, and disconnect portions of the historical floodplain (Figure 35). The bank armoring near RM 42.3 failed in the past, evidenced by large riprap boulders distributed in a parallel line on the bed of the channel. Additional armoring was since added along the bank to reinstate control on lateral processes at this meander. The lateral confinements are related to anthropogenic development on the floodplain such as homes, agricultural fields, irrigation, trails, and roads. Patchy riparian vegetation and cleared floodplain forests similarly reflect the anthropogenic development in the segment. Past clearing of riparian vegetation as well as removal of large wood from the channel has further simplified habitat and geomorphic complexity and limited the presence of side channels or other off-channel refugia. To mitigate for this, a constructed groundwater-supported channel known as "1890's Side Channel" was constructed to create connected off-channel cool-water refugia

for salmonids and other aquatic species, including beaver. The confluence of the 1890's groundwater channel to the mainstem is located at RM 41.75, along the outside bend of the laterally migrating meander.



Figure 35. Segment 2 – White Sugar: A) Riprap armored levee on river right meander and floodplain at RM 42.6-42.8, and B) riprap armored bank on river left near RM 42.4. July 15, 2025.

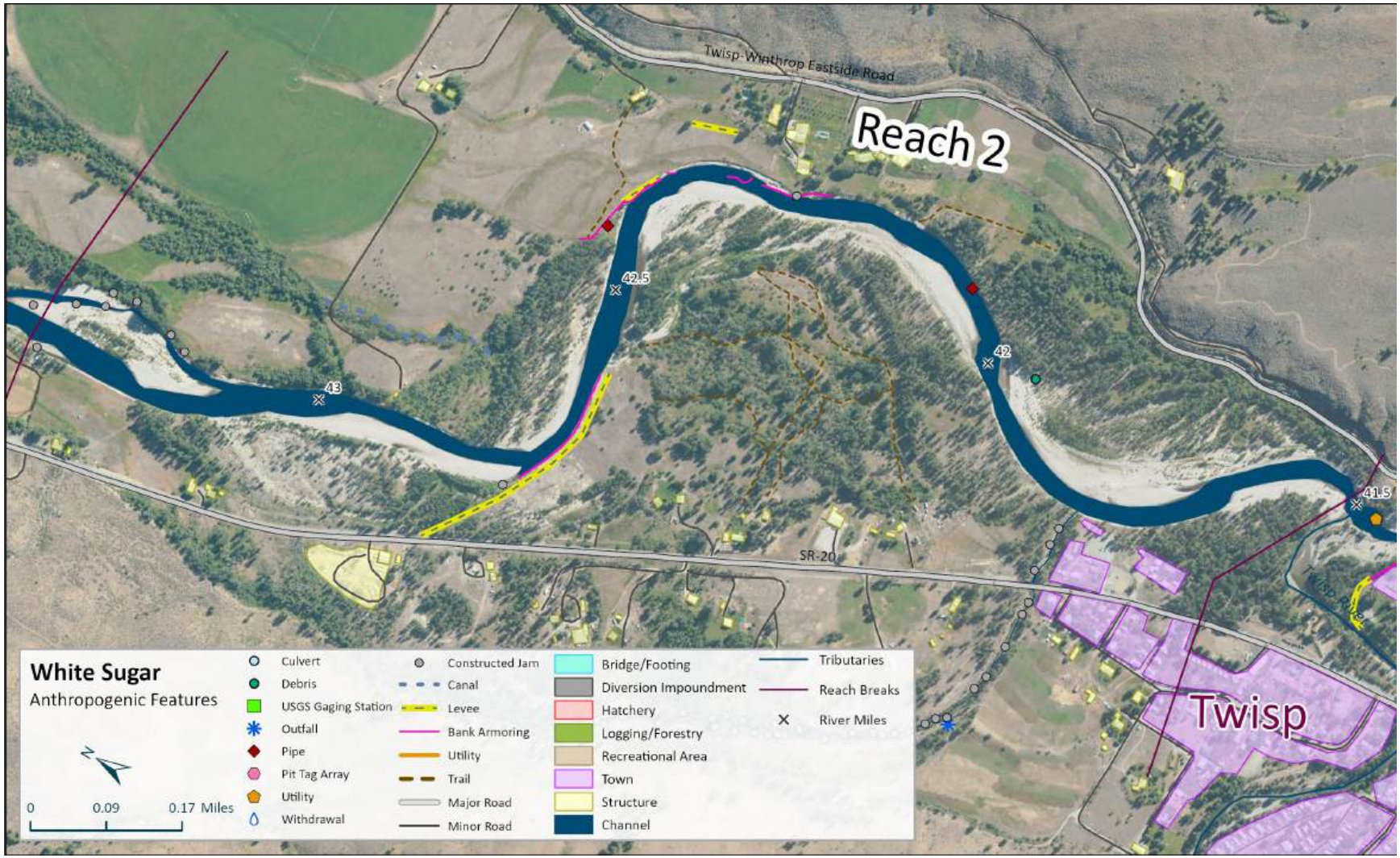


Figure 36. Segment 2 (White Sugar): mapped anthropogenic features.

6.2.2 Channel and Floodplain Geomorphology

Segment 2 – White Sugar is a low-sinuosity meandering channel with relatively steep banks along the outside of its three main meander bends and cobble/gravel bars on the inside of the bends. Two of the three meanders are armored with large riprap boulders, impeding natural lateral process and forcing localized vertical incision. The downstream meander at RM 41.8 is not armored and is laterally active, potentially at an exaggerated rate as a result of the upstream lateral confinement. A migration rate study has not been done as part of this assessment, but it may be useful when restoration efforts are initiated in this section of the river. Channel units (habitat units) mapped in the 2024 survey reveal a pool-riffle sequence. The extended pools occupied 49% of the available habitat and riffles 43%, with side channels representing approximately 7% (Figure 38). The one perennial side channel is located at the upstream end of the segment where split flow conditions and side channel complexity are maintained and enhanced primarily by constructed large wood jams. Otherwise, split-flow condition side channels occur only during high-flow conditions and where the floodplain is not disconnected by a levee. The constructed, groundwater-supported "1890's Side Channel" meets the mainstem channel on river left at RM 41.75

The floodplain is composed of alluvial cobbles and gravels with a fraction of coarse sand that, in general, is topped with a relatively thin layer of semi-organic sandy-loam (Figure 37). Historically, the channel was unconfined in Segment 2 with an available floodplain that extended across the valley. The modern channel is partially confined by levee, bank, and SR 20, which have reduced the modern floodplain width by approximately 25%. A bedrock exposure on river-left extends into the bed of the channel and the Twisp River fan at RM 43.4 impose natural confinements at the downstream end of the segment. Disconnected floodplains and terrace surfaces are evident in the relative elevation analysis shown in Figure 39. The modern channel and floodplain are inset below the historical conditions.



Figure 37. Alluvial (cobble, gravel, topped with sandy loam) floodplain bank exposure at RM 41.8. July 15, 2025

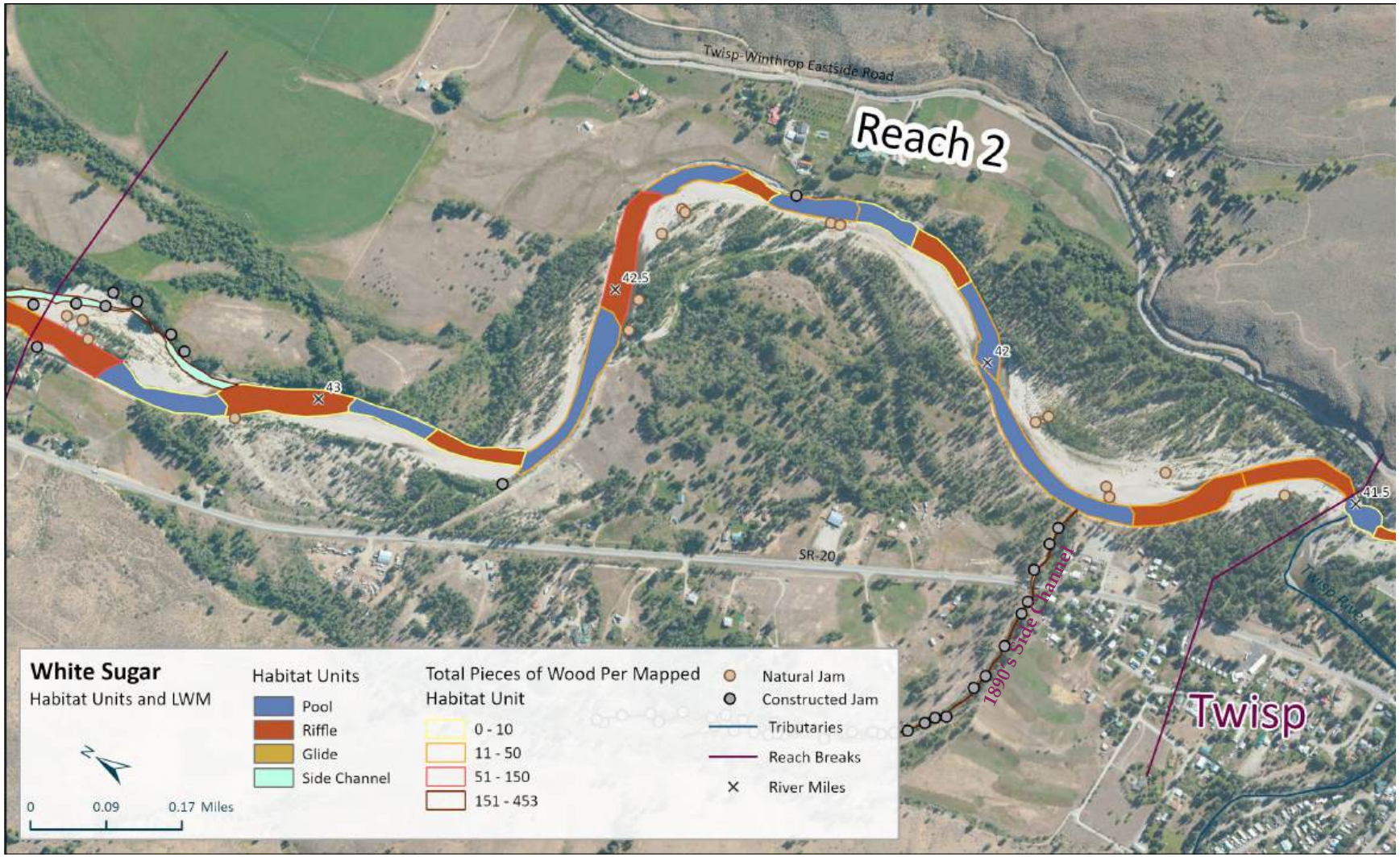


Figure 38. Segment 2 (White Sugar): mapped habitat units with total number of large wood pieces per unit (Habitat Survey, 2024: Appendix A).

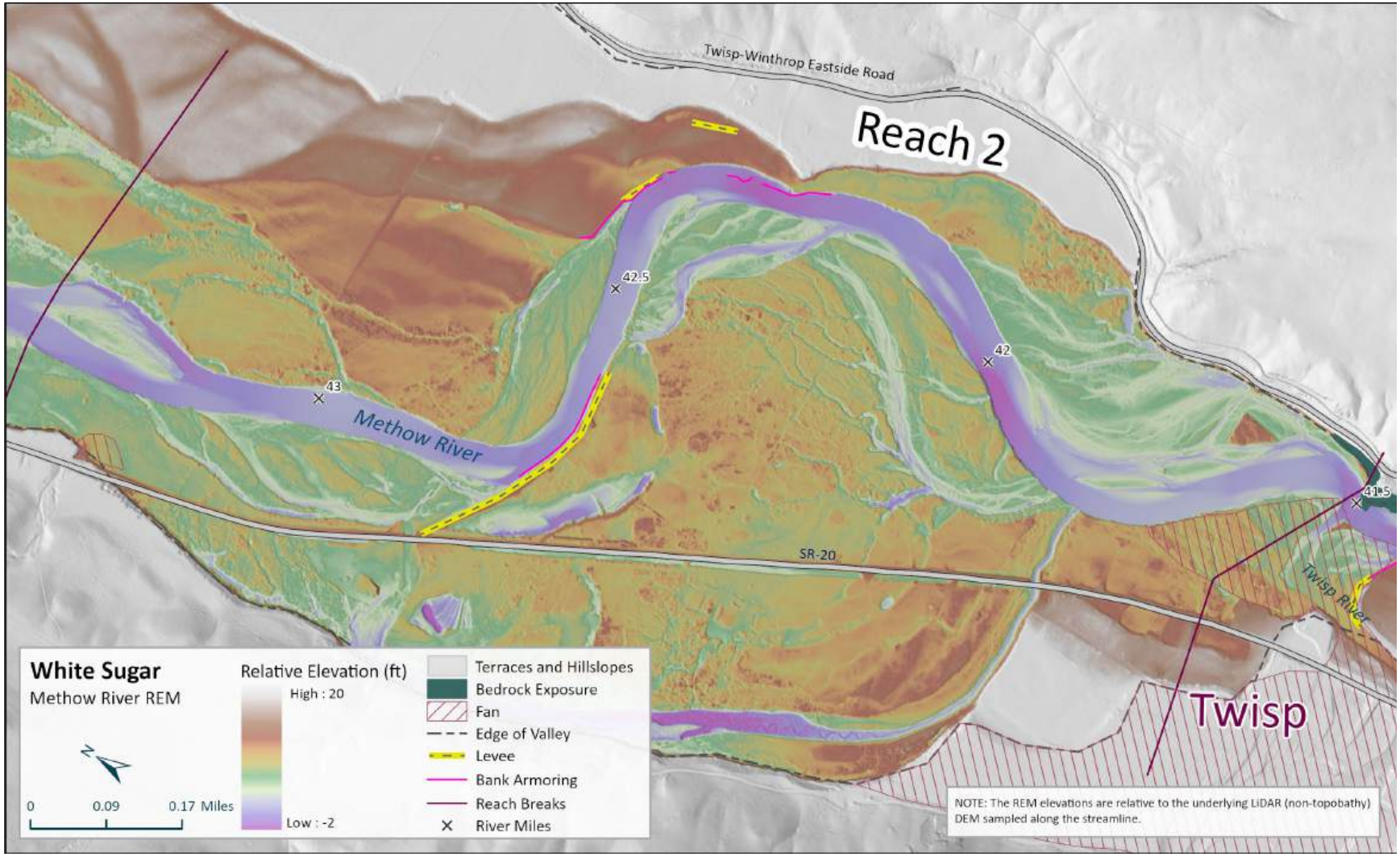


Figure 39. Segment 2 (White Sugar): Relative elevation map of floodplain and channel with confining fans, bedrock, terraces, roads, and levees identified.

Similar to floodplain composition, bedload in the mainstem channel is dominated by cobble and gravel. Small boulders are occasionally present at riffle crests and coarse sand is found along the back of bars or atop cobbles and gravel in slow-moving sections of the channel. The large point bars and lateral bars are primarily composed of cobbles with gravel (Figure 40). The bar material is not embedded, and only sparse vegetation establishes on them annually. This suggests that although lateral processes are reduced, the incoming sediment supply to this segment is sufficient to regenerate bars and thus somewhat reduce processes of incision that otherwise commonly occur in laterally confined reaches. This assessment does not include a sediment transport analysis.

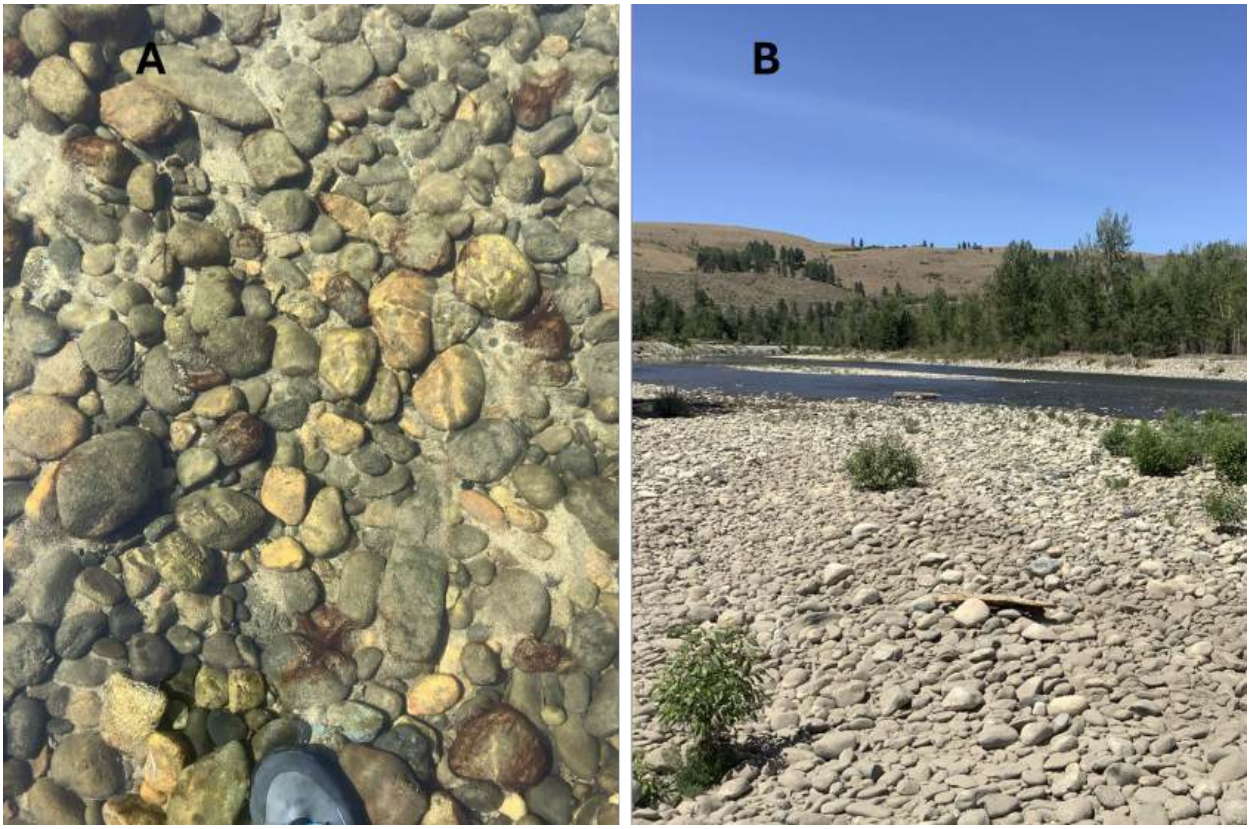


Figure 40. Cobble-gravel dominated bedload and bars. A) Bedload at pool tailout at RM 42.6, B) cobble-gravel bars (point bar in foreground, mid-channel bar and lateral bar in foreground) at RM 42.5. July 15, 2025

Preliminary hydraulic modeling results reinforce that the bank armoring, levees, and road prism reduce floodplain connectivity and inhibit local lateral processes (Figure 41). Flood velocities are highest in the straight sections of the channel and at the armored meanders (Figure 42). The imposed confinements exaggerate localized depth and velocities during flood events, as expected. Where available, side channel activation and floodplain connectivity are possible. Floodplain scars and modeling suggest that the channel is simplified compared to its historical condition and potential. A lack of large wood in the segment, reduced sinuosity, and imposed partial confinement contribute to the simplification.

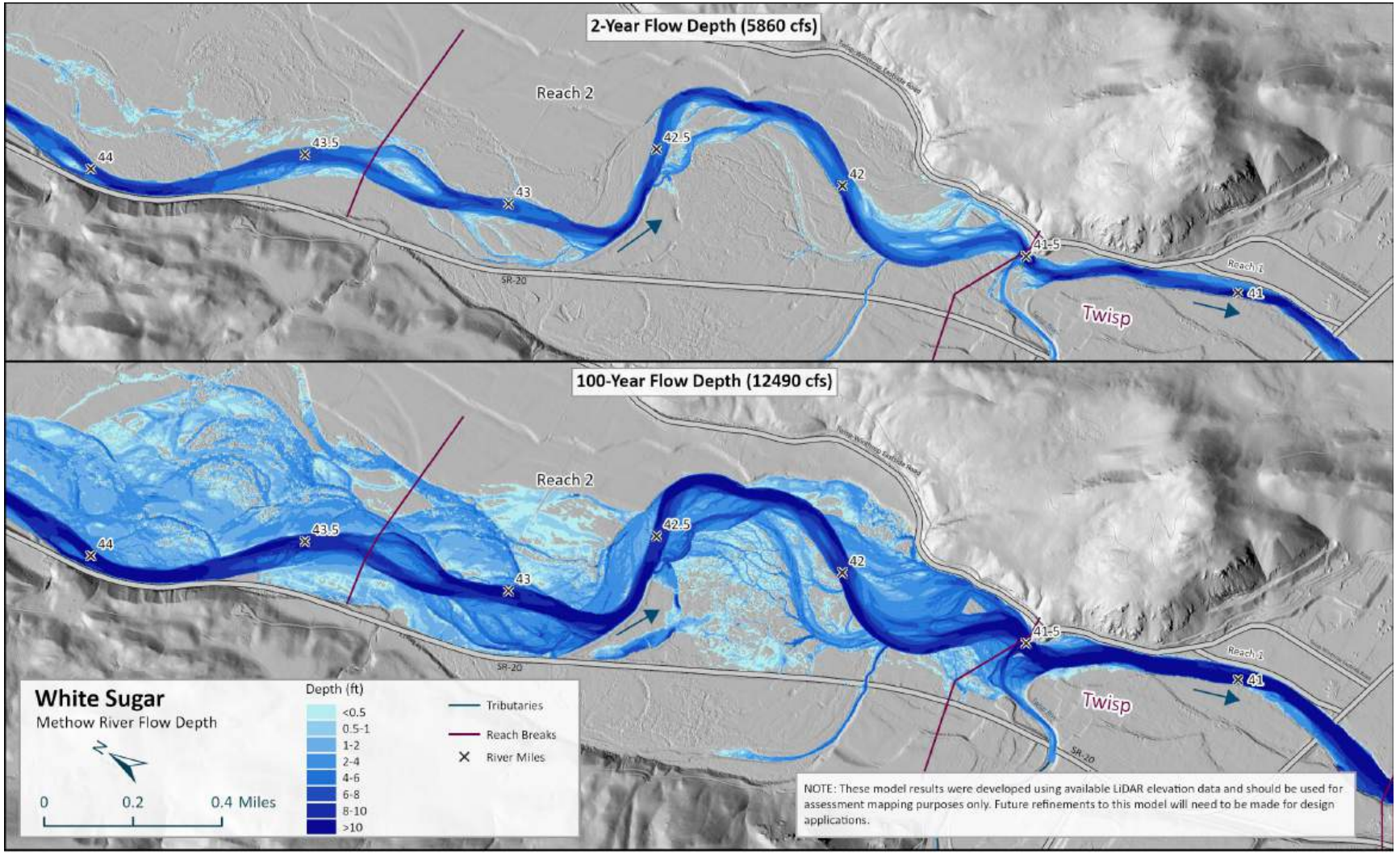


Figure 41. Segment 2 (White Sugar): Preliminary hydraulic model (Hec-Ras 2D) depth results for the estimated 2-yr and 100-yr flood event. See Appendix D for more information.

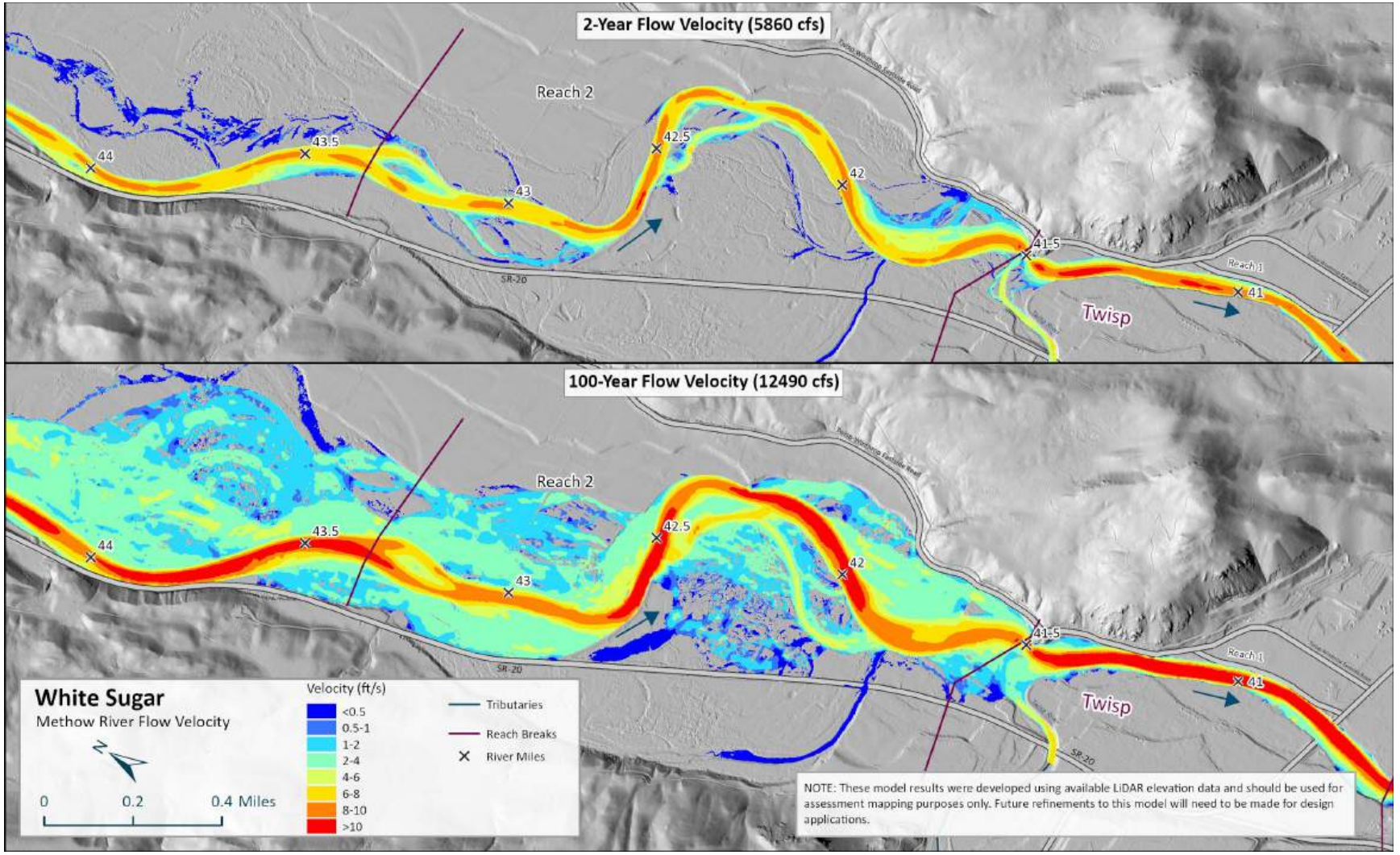


Figure 42. Segment 2 (White Sugar): Preliminary hydraulic model (Hec-Ras 2D) flow velocity results for the estimated 2-yr and 100-yr flood event. See Appendix D for more information.

6.2.3 Large Wood Material

The role of large wood in Segment 2 (White Sugar) has been diminished by anthropogenic confinement, channel clearing, and riparian vegetation clearing. During the 2024 Habitat Survey (see Appendix A) a total of 214 individual wood pieces and 60 log jams (3+ logs) were recorded within the segment. However, only 26 of the jams were located along the mainstem channel and 8 of those were constructed. The constructed jams are ballasted into banks and provide localized habitat uplift. Most of the natural wood that was present occurred on bar tops as drifted pieces and were providing little geomorphic influence or habitat function (Figure 43). The existing natural large wood and debris may provide some nutrients and potentially some hydraulic roughness or protection for establishing bar tops or floodplain riparian vegetation. A map of the distribution of large wood observed in the reach during the 2024 survey is provided as Figure 44. It is assumed that unballasted large wood was and potentially still is removed from the channel, depending on perceived risk to infrastructure and recreational safety requirements.

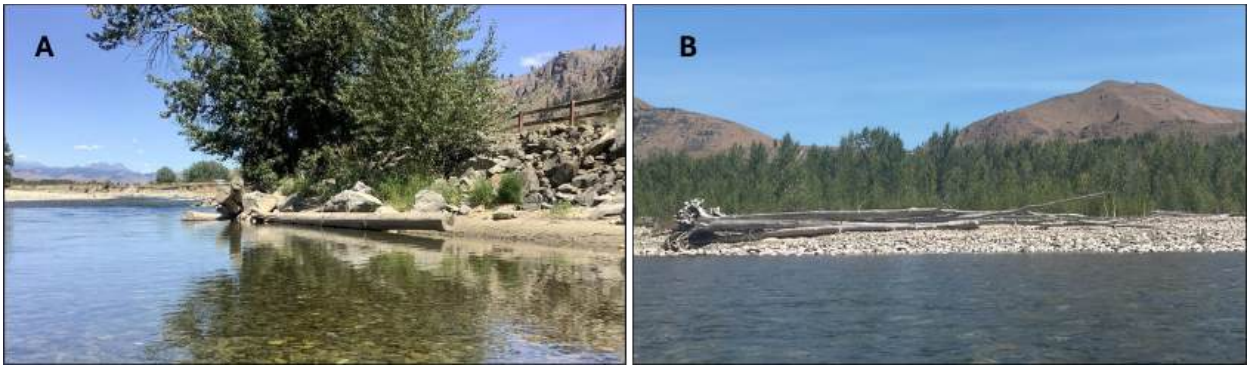


Figure 43. A) Constructed large wood jam ballasted to bank in riprap barb on river left at RM 42.3; B) LWM resting on bar top on river left at RM 41.8. July 15, 2025.

Large wood recruitment potential in this segment is poor because of the lack of mature riparian forests coupled with bank armoring that inhibits lateral processes. A few small pockets of narrow inset vegetated floodplain exist along the back of active lateral bars. These areas contribute a small quantity of debris and wood to the channel. Where riparian forests occur along the channel, they consist primarily of medium-small size trees. Thus, local contributions of woody material are not expected to provide substantial or long-term geomorphic influence or habitat function.

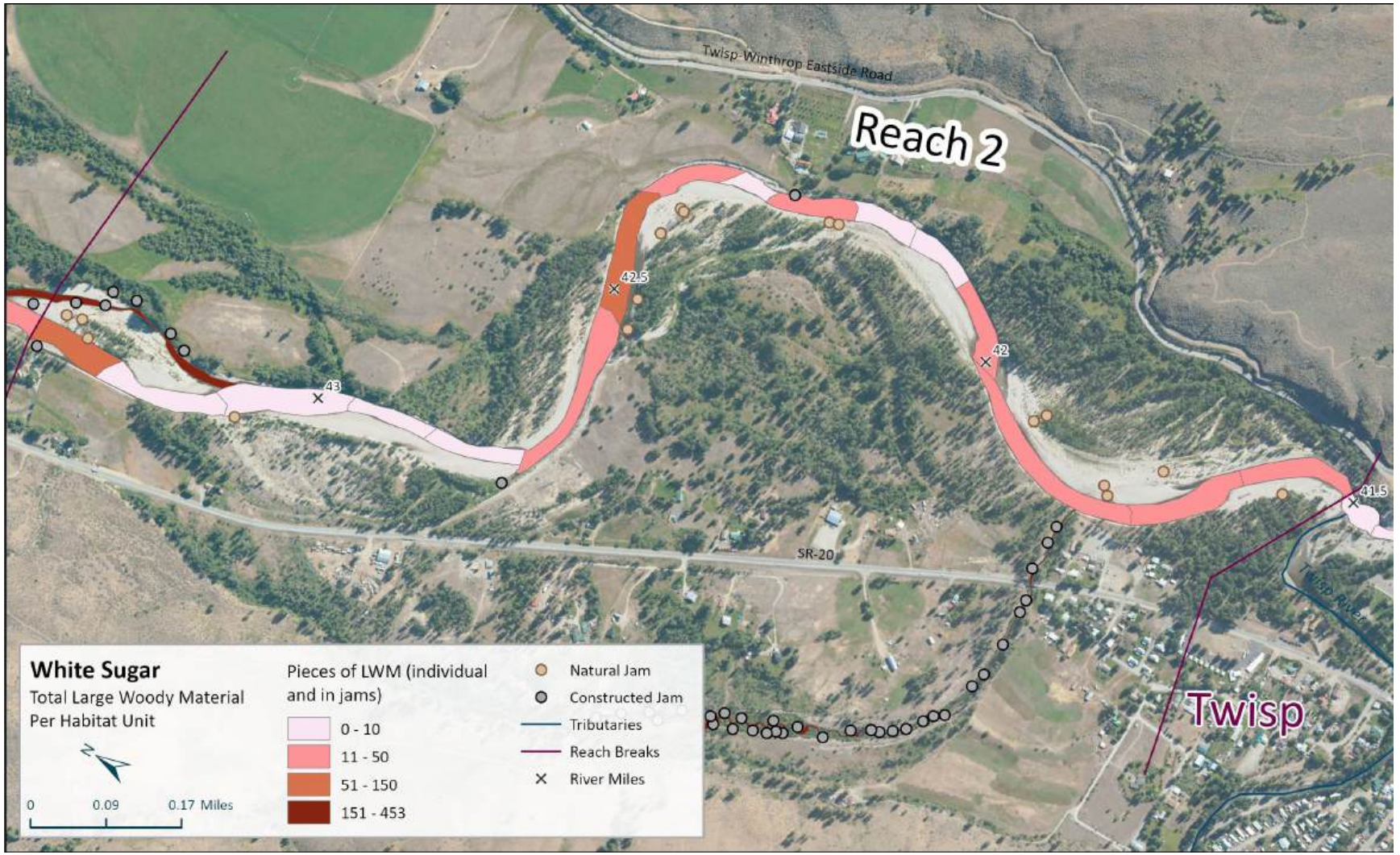


Figure 44. Segment 2 (White Sugar): Distribution of large wood per mapped habitat unit and location of jams (> 3 pieces), natural and constructed - from 2024 Habitat Survey

6.2.4 Vegetation

Riparian vegetation in Segment 2 (White Sugar) occurs along some adjacent floodplains and some bank tops. Where it has not been cleared, the dominant floodplain forest overstory is cottonwood and alder. The understory is primarily small cottonwood, willows and alder with forbs and grasses. Representative photos of the vegetation in this segment area are provided in Figure 45. Several banks and floodplains have been cleared of vegetation for development and agriculture. As a result, a portion of the channel does not have adjacent riparian vegetation. Where allowed to mature, riparian cottonwood forests establishing on the available floodplain surfaces. Forest maturity is young but recovering. Due to the small forest size and distribution relative to the channel width, the modern riparian forest provides minimal shade to the main channel. The vegetated floodplains and banks may provide shade and nutrients to perennial side channels, if/where they exist. Vegetation distribution and height-classification along the channel, valley floor, and adjacent hillslopes in Segment 2 (White Sugar) are mapped in Figure 46.

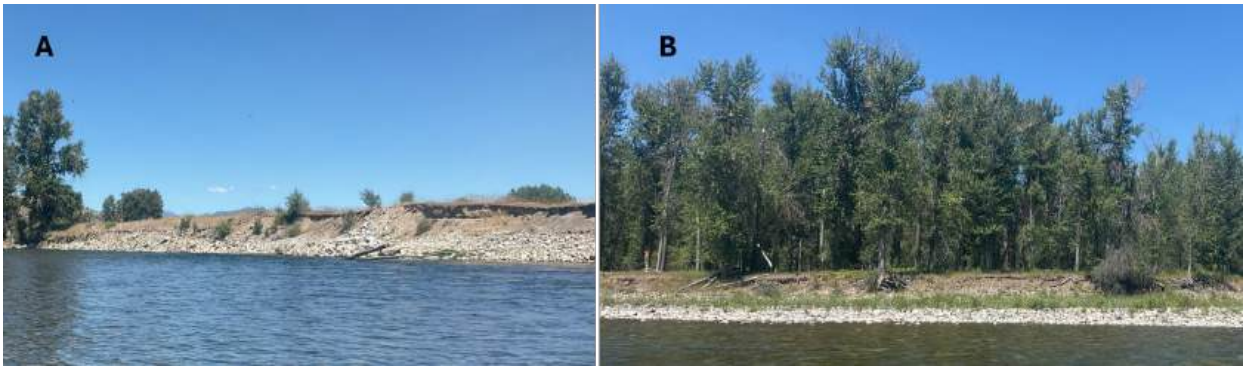


Figure 45. Segment 2 – White Sugar: Riparian vegetation; A) cleared bank on river left at RM 32.45; B) vegetated floodplain on river right at RM42. July 15, 2025

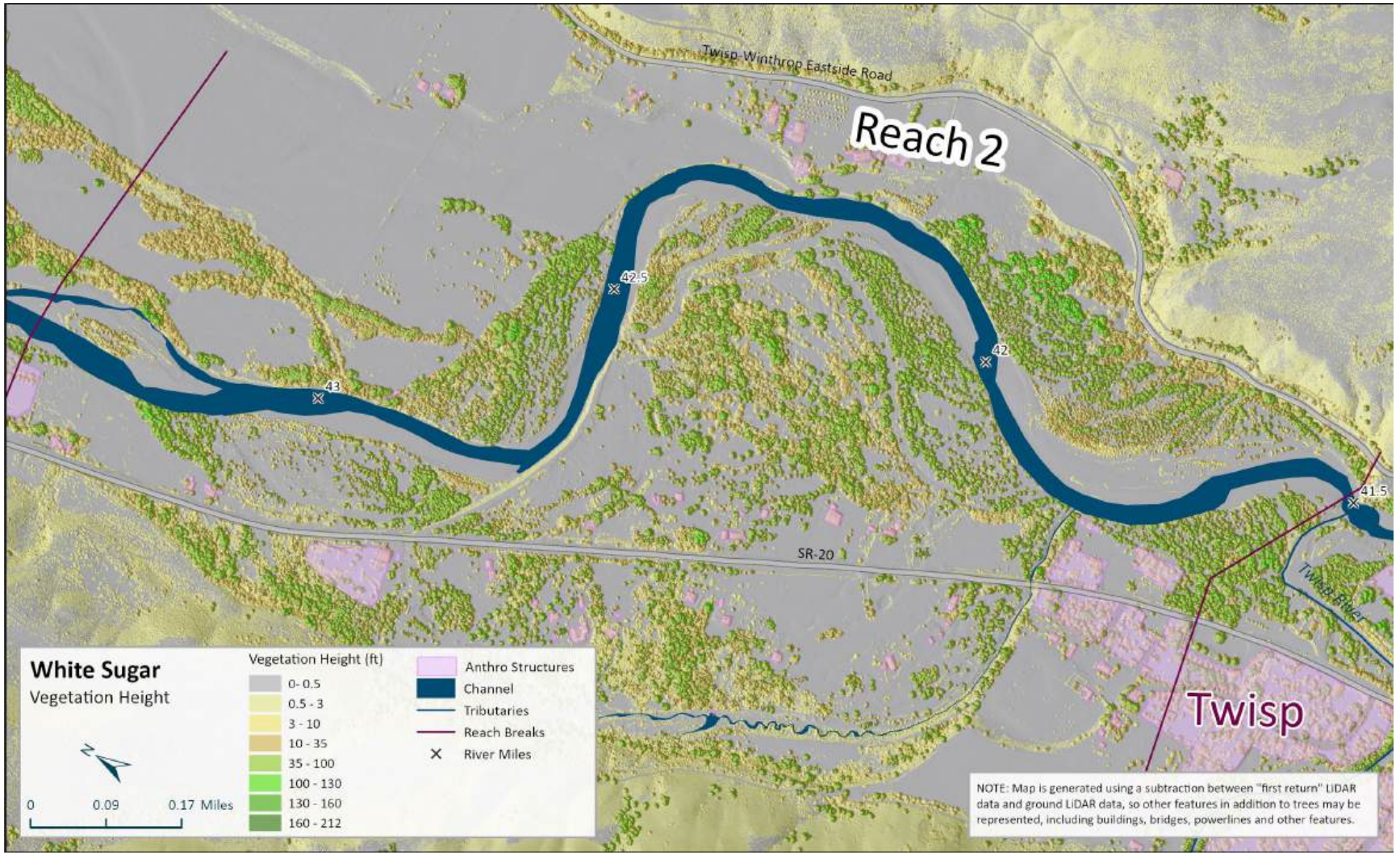


Figure 46. Segment 2 (White Sugar): Vegetation height and distribution map.

6.2.5 Past and Planned Restoration Projects

Past and planned restoration projects reported or observed in this segment are included in Table 10. See map of past and planned projects as Figure 47.

Table 11. List and description of reported past and planned projects in Segment 2 (White Sugar).

Year	Name	Sponsor	Area of coverage	Project Components
2013	Methow River Large Wood Enhancement: Site D	Yakama Nation	Reach 2; RM 42.3	Large wood structures ballasted in riprap bank; Bank stability
2013	Witte Riparian	MSRF	Reach 2: RM 42.2	Bank stabilization; Riparian revegetation
2014	1890 Side Channel	Yakama Nation	Reach 2; RM41.75	Construction of side channel; Installation of groundwater gallery with large wood structures and pilings; Installation of groundwater pipe outlet; Floodplain large wood structures; Riparian revegetation
2014	Methow River Large Wood Enhancement: Site C	Yakama Nation	Reach 2; RM 42.8	Large wood structure ballasted in riprap; Channel backwater enhancement
2020	Sugar Small Project	MSRF	Reach 2; RMM 42.5	Large wood structures; bank stability; Riparian vegetation
2024	Eagle Rocks	USBR	Reach 2 and Reach 3; RM 43.1 to RM 43.7	Floodplain connectivity enhancement; Instream channel complexity; Riparian vegetation; Excavation of side channel; Channel grading; Large wood structures
2025	Sugar Reach Project	MSRF	Reach 2; RM 41.55 to RM 42.15	In Progress. Project includes subproject areas of Sugar Left and Sugar Right.
2026	Sugar Reach Project	MSRF	Reach 2; RM 42 to RM 42.75	Proposed Project area with four subproject areas: WDFW, Eagle Rocks, Sugar Right and Sugar Left (combined Sugar).
2027	1890's Outlet & FBD	Yakama Nation	Rech 2; RM 41.65	Proposed Project with elements of channel grading and riparian protection

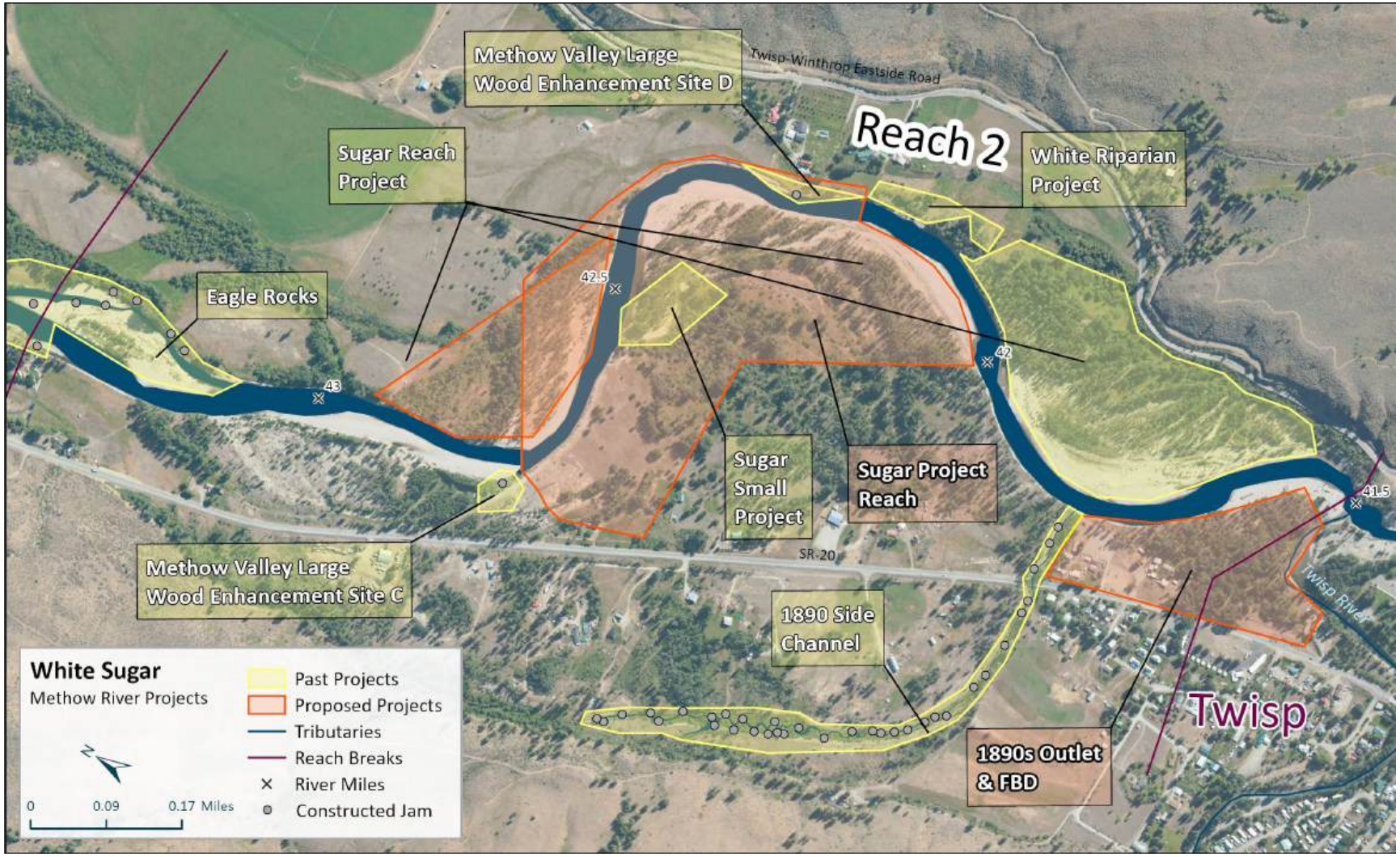


Figure 47. Segment 2 – White Sugar (Reach 2): Past and planned restoration projects map.

Several past mainstem restoration projects focused on localized habitat creation and enhancement efforts with bank-ballasted large wood installations and riparian vegetation. The Eagle Rocks side channel and floodplain reconnection project at the upstream end of Segment 2 is maintained and supported by large wood (Figure 48). The 1890's Side Channel is a groundwater-supported gallery channel that provides perennial off-channel refugia for fish as well as diverse riparian and beaver habitats. The mouth of the 1890's side channel (RM 41.75) is currently being eroded by mainstem lateral processes, but the tributary remains connected to the mainstem and providing off-channel habitat for fish and beaver (Figure 49).



Figure 48. Past large wood habitat and side-channel project (Eagle Rocks): A) Left bank of side channel with installed LW jams that are connected and functional (RM 43.2); B) floodplain jam that aids in supporting split during high-flow conditions at RM 43.4. July 14th, 2025



Figure 49. Past groundwater gallery channel at RM 41.75 (1890's Side Channel). A) outlet of the 1890s constructed groundwater channel on river right of mainstem at RM 42.8, B) the 1890's channel approximately 0.4 miles upstream from its mouth. July 15, 2025

6.2.6 Project Opportunities

Persistent recreational use and infrastructure constraints will continue to impact the long-term trajectory of the channel and influence the types and extent of project opportunities in Segment 2. However, several restoration project opportunities exist in this segment. Opportunities include enhancement/improvement of mainstem channel complexity via large wood placements, the creation or enhancement of side channel habitats, floodplain reconnections via improved side channel engagement, groundwater channel enhancement and development, riparian revegetation, and conservation of targeted areas to support restoration efforts. Evaluation of potential to replace armored banks with large wood or integrating LW into the armoring for improved in-channel habitat conditions should be considered. The proposed mainstem and off-channel projects aim to maximize habitat uplift potential in conjunction with, or as adaptive management to, previous or planned restoration actions in the segment and the consideration of existing infrastructure. Additional mainstem complexity, increased connectivity or reconnection of off-channel areas, and expansion of riparian revegetation is expected to improve long-term habitat and riparian conditions. A description of the project opportunities and a map showing general locations are in Appendix C.

6.3 SEGMENT 3: MINK (RM 43.4 – 47.4)

6.3.1 Overview

Segment 3 - Mink is equivalent to Reaches 3-5 in the Habitat Assessment (Appendix A) and extends from RM 43.4 to RM 47.4. General metrics for Segment 3 are provided in Table 11. The channel is partially confined by levees, bank armoring, and periodic bedrock contacts that impede lateral processes, even though the segment is in a wide alluvial valley. Channel planform is sinuous meandering with cobble and gravel bars. The channel is generally an elongate pool-riffle sequence throughout the segment (Figure 50). The quantity of large wood surveyed for habitat requirements is adequate in Reach 4 but marginal in Reaches 3 and 5. Vegetation density and composition is in poor-marginal condition, depending on level of disturbance. Reported past and planned projects (2013-2027) include modification to an existing diversion, large wood installations, side channel and floodplain reconnection, and riparian revegetation. The existing infrastructure and recreational use of the segment influences the types of restoration treatment options considered in the mainstem channel.

Table 12. Metrics table for Reach 3, 4 & 5 – Segment 3 (Mink).

Mink	Length (miles)	River Mile	Stream Gradient (%)	Sinuosity	Dominant Channel Habitat Unit Type	Average Bankfull Width (ft)	Confinement	Dominant Substrate	% Pool Habitat	% Glide Habitat	% Riffle Habitat	% Side Channel Habitat
Reach 3	1.9	43.4-45.3	0.24%	1.27	Riffle	203.5	Partially Confined	Cobble	38%	15%	41%	6%
Reach 4	1	45.3-46.3	0.20%	1.33	Pool	206.3	Partially Unconfined	Gravel	48%	6%	24%	22%
Reach 5	1.1	46.3-47.4	0.26%	1.10	Pool	206.0	Partially Confined	Cobble	58%	7%	35%	1%



Figure 50. Segment 3 – Mink: Representative photos A) Reach 3, looking downstream at RM 44.4 – bedrock bank on river right; B) Reach 4, looking downstream at RM 45.6; C) Reach 5, looking upstream at RM 46.5. July 14, 2025

Channel and floodplain processes, riparian vegetation conditions, and habitat availability in Segment 3 - Mink (Reach 3 - 5) have been and continue to be impacted by anthropogenic features and land management (Figure 54). Extensive bank armoring occurs throughout the segment for infrastructure and property protection, impeding natural lateral processes at RM 47.3 on river right, in discontinuous sections between RM 46.21 – 46.8 on river left, at RM 45.6 – 45.7 on river right, again on river left at RM 45 – 45.2, extending across the floodplain to RM 45.45 and RM 44.7 – 44.85, and along the road prism at RM 43.7 – 44.1 on river right. The Methow Valley Airport is located on the on the left side of the channel at RM 46.8 to 46.3. Armored banks, gabions, car-embedded bank armoring and concrete embankments occur along the river-left bank adjacent to the airport. The East Diversion Canal intake is within the bank-armoring near RM 46.5. (Figure 51).

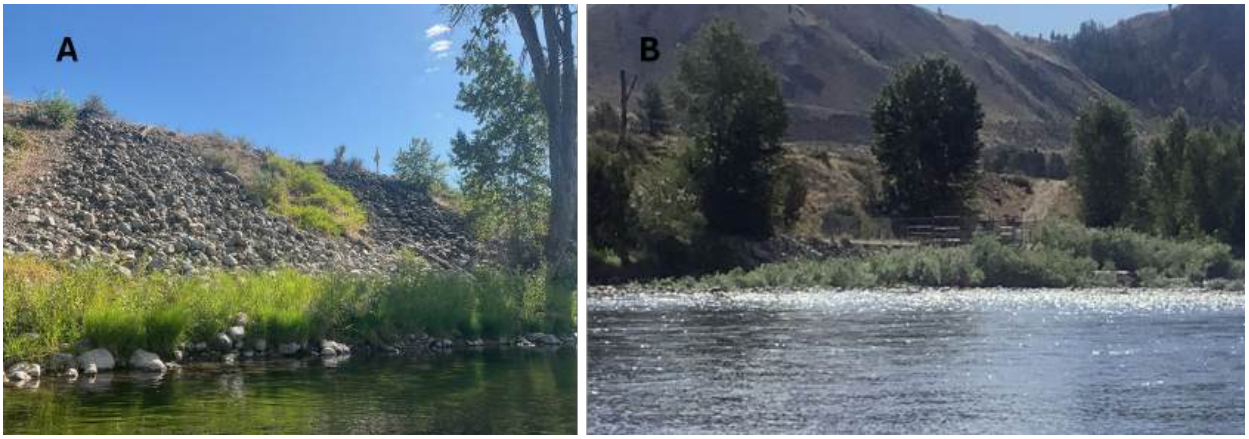


Figure 51. Bank armoring and infrastructure along the bank adjacent to the Methow Valley Airport: A) cleared and rock-armored bank on river-left at RM 46.5-46.75; B) East Diversion Canal intake structure on river-left at RM 46.5. July 14, 2025

The East Diversion canal screened fish return outfall culvert is located on the bank of the channel at RM 46.3. The irrigation canal fed by the diversion runs adjacent and parallel to the channel atop the floodplain through both valley-left (east side) meanders in this segment, protected by the bank armoring. A constructed levee on river left at RM 45.4 – 45.65, with a riprap toe reinforcement, disconnects a side channel and floodplain while also locally controlling channel location and lateral processes (Figure 52). The SR Highway 20 road prism that runs parallel along river-right between RM 43.7 – 44.1 exaggerates valley edge confinement and limits hillslope inputs to the channel (Figure 53). Land-use through Segment 3 is a mix of agriculture, residential, recreational parks, and campgrounds. As a result of excessive bank armoring, residential and agricultural land-use, and transportation infrastructure, much of the riparian vegetation has been cleared. Constructed log jams buried into channel banks make up a notable portion of the large wood in this segment, and some act as additional bank protection.



Figure 52. Bank armoring; A) riprap armored bank and culvert (fish-screen outfall) on river-left at RM 46.25; B) riprap armored bank along the toe of a constructed levee on river right at RM 45.65. July 14, 2025



Figure 53. lateral confinement: A) bank armoring on river left at RM 45.2, B) riprap-armored Hwy 20 embankment river right at RM 43.7 – 44.1. July 14, 2025

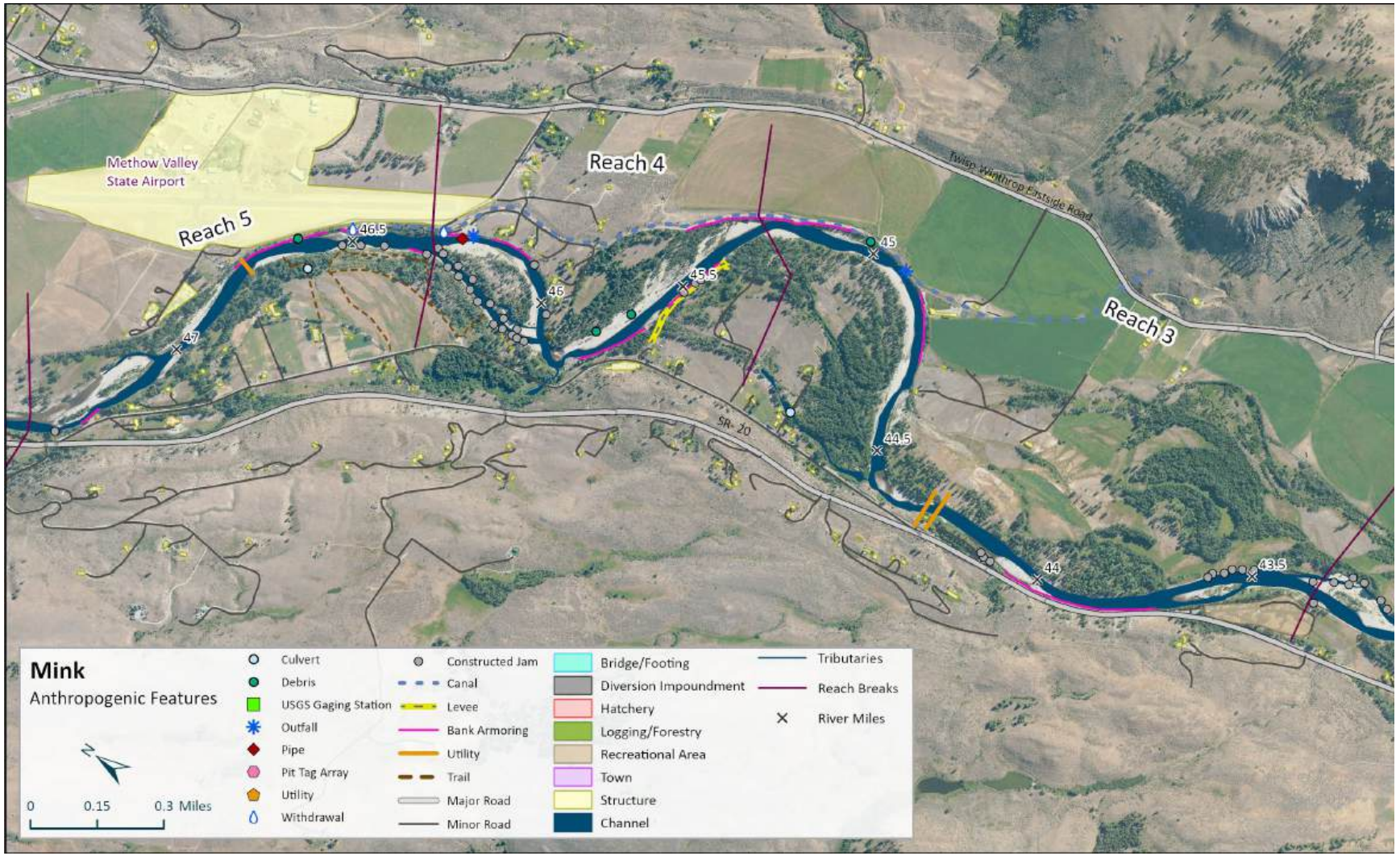


Figure 54. Segment 3 (Mink): mapped anthropogenic features.

6.3.2 Channel and Floodplain Geomorphology

Segment 3 (Mink) is a moderately sinuous meandering channel. Channel habitat units mapped in the 2024 survey reveal a pool-riffle sequence with sparse glides. Pools occupied 48% of the available habitat within the segment, riffles 33%, glides 9%, and side channels represented approximately 10% (Figure 56). The pools are extended and offer relatively low complexity and depth. The exception is a deep pool at the downstream end of an island at RM 45.9 where split flow convergence maintains scour that supports downstream bar development. The pool is deep but lacking in habitat complexity and cover (Figure 55).



Figure 55. Deep scour pool at RM 45.9; downstream end of island at split-flow convergence with no habitat cover or complexity -- looking downstream. July 14, 2025

Four side channels of varied sizes and complexity were mapped in Segment 3. Split-flow side-channel conditions occur at RM 47.2, where bedrock confines the outside of a meander bend on river right and a well-maintained mid-channel cobble bar of approximately 0.25 river miles long hosts a narrow strip of maturing vegetation along its top. At low-flow, the primary flow route is on the river-right side of the island and habitat conditions of the side channel on the river-left side are of low quality due to an adjacent wide unvegetated bar, lack of in-stream effective large wood, and only marginal riparian vegetation. Two additional persistent but narrow mid-channel bars result in side channels of approximately 0.1 miles length on the river right side of the mainstem channel at RM 44 and 43.6 (Figure 56).

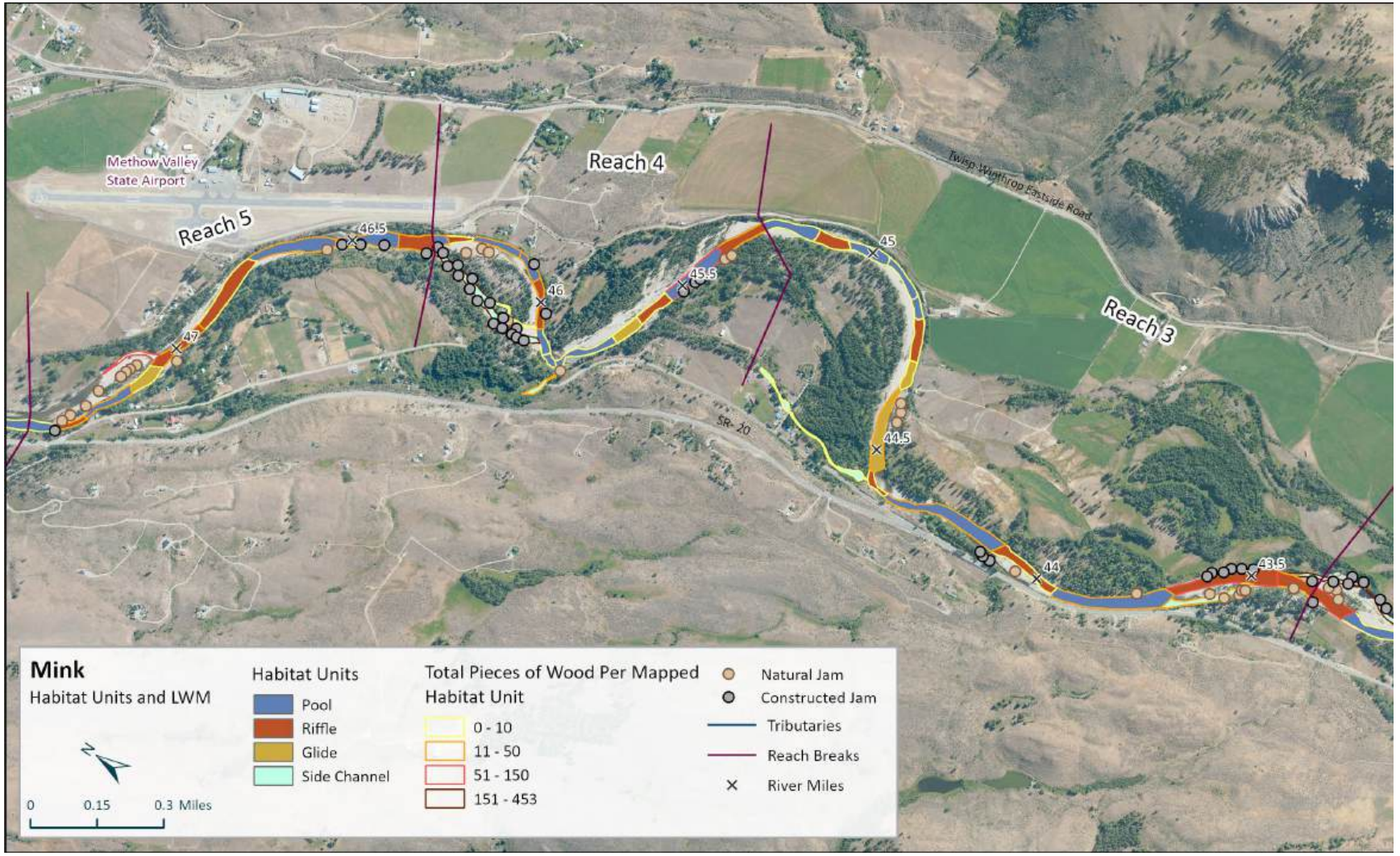


Figure 56. Segment 3 (Mink): mapped habitat units with total number of large wood pieces per unit (Habitat Survey, 2024: Appendix A).

The vegetated island of approximately 0.3 miles length at RM 46 provides perennial split flow conditions. Constructed log jams support split-flow conditions and habitat complexity in the side channel on river right of the island. A secondary side channel, created at the downstream portion of the island side channel, is also maintained with constructed large wood structures. The mainstem channel on the river left (east side) of the island flows along a bank-armored meander bend.

Off-channel refugia is currently marginal in Segment 3, but potential to uplift and create quality off-channel refugia does exist. For example, an existing high-flow side-channel on the river-right floodplain between RM 45.3 – 44.6 could provide off-channel refugia if reconnected upstream and downstream as a perennial flow route. Portions of the flow route host small groundwater wetted pools into the summer. Within that same floodplain, a groundwater supported floodplain tributary that today occupies an abanonded flow route, blocked at the upstream end by a constructed levee (RM 45.6), has an outlet to the mainstem channel at RM 44.45. However, surface water contributions are small because of a 4-8 ft tall, stabilized beaver dam plug that currently impedes connectivity at the outlet. On the day of survey (July 14, 2025) small fish gathered in the mainstem near the outlet where cold water seeped through the vegetation at the base of the beaver dam (Figure 57-A). The dam plug does create ponded wetlands on its upstream side (Figure 57-B) and a sequence of road crossings and route filling impound other ponds in this flow route across the floodplain. An additional off-channel, groundwater supported refugia potential is located on the river right floodplain with an outlet to the mainstem at RM 45.8. Currently, connectivity to the mainstem is impeded by the SR 20 road prism.



Figure 57. Groundwater supported floodplain tributary at RM 44.45. A) Cold water seep into the mainstem channel over/through beaver dam plug at mouth of outlet; B) backwatered wetland pond behind stabilized beaver dam near outlet. July 14, 2025

Floodplains in Segment 3 are composed of alluvial cobbles and gravels with a fraction of coarse sand topped with sandy-loam. Historically, the channel was naturally unconfined with available floodplain that extended across the valley floor. Today, the modern channel and floodplain are inset below the historical floodplain - only utilizing approximately half of the valley floor (Figure 58).

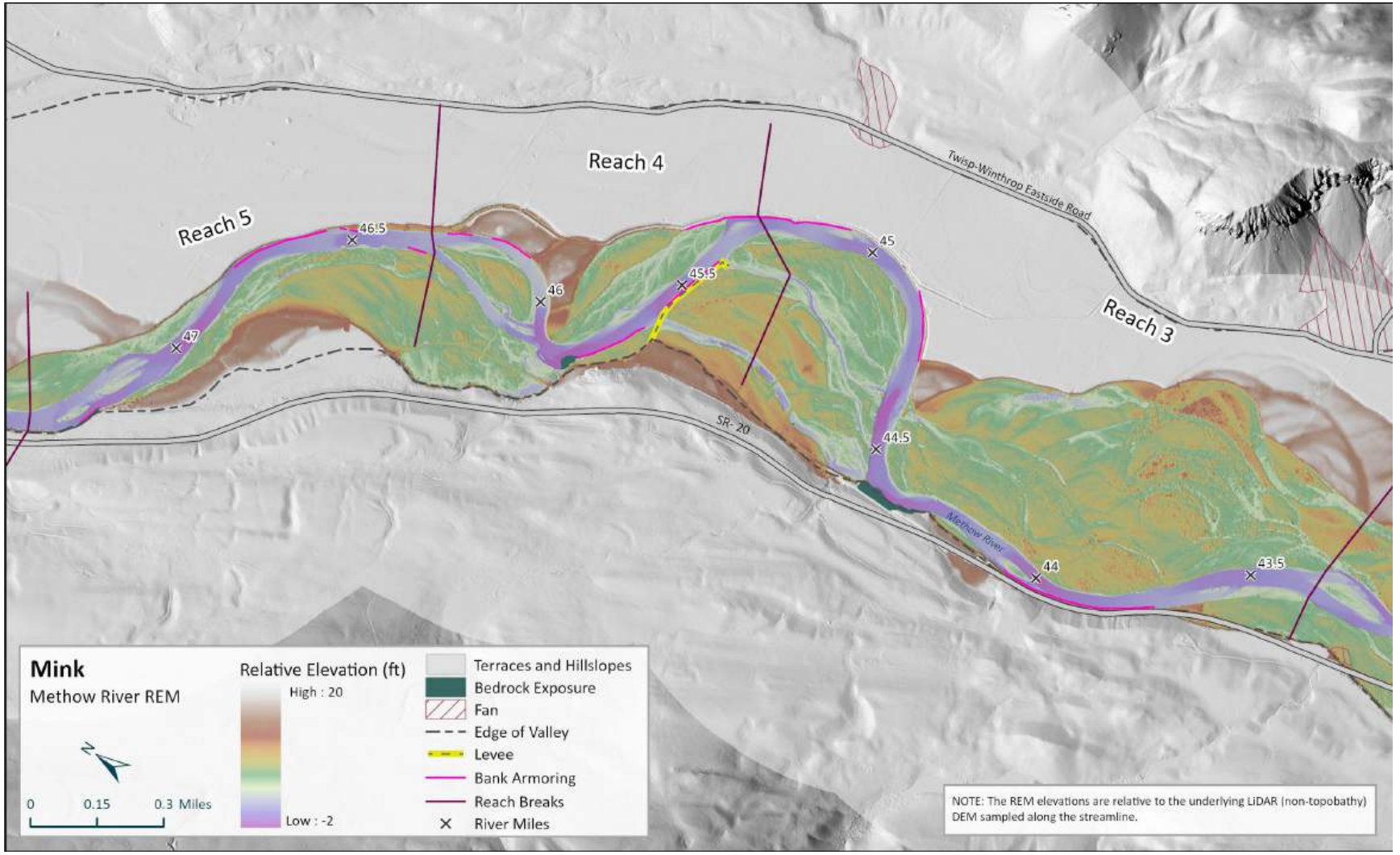


Figure 58. Segment 3 (Mink): Relative elevation map of floodplain and channel with confining fans, bedrock, terraces, roads, and levees identified.

Several of the floodplain terraces were abandoned as a result of reduced sediment and hydrologic regimes compared to early Holocene conditions (glacial retreat and outwash) that created them. Increased confinement imposed on the channel by bank armoring and levees, combined with riparian forest clearing and the removal of large wood from the channel exaggerates modern channel disconnection that will continue to influence the trend of floodplain disconnection and channel simplification in this segment. The bedrock contacts on the river right at RMs 44.4, 45.8 and 47.4 are "hard points" that attract the channel to the west side of the valley.

Bedload in the mainstem channel is dominated by cobble with gravels. Small boulders occur at riffles, most commonly near laterally confined meander bends (reinforced scour), and occasionally in glides or pools. Elongate active lateral bars and point bars composed primarily of cobbles with some gravel occur along the mainstem through much of the segment. At the laterally confined meanders, the point bars are notably smaller and show no scrolling or related back-bar forest regeneration sequencing, more like lateral bar processes. A few mid-channel bars composed of cobbles and gravel are visible during low-flow conditions, indicating sufficient sediment supply in some sections of the segment (Figure 59). Areas of cobble imbrication and a general lack of embeddedness of the bedload through the segment suggest mobilization of cobble-sized material likely almost annually. The sediment load received from upstream appears to be reducing the amount of incision that would be expected to occur to a laterally confined channel such as Segment 3.



Figure 59. Mid-channel cobble bars at RM 45.8 – looking upstream. July 14, 2025

Preliminary hydraulic modeling results reinforce that the bank armoring and levees inhibit local lateral processes and the channel current state of entrenchment has reduced floodplain connectivity (Figure 60). Modeled flood velocities are lowest where split-flow conditions and mid-channel bars occur (Figure 61). Floodplain topography (scars, scrolls, and flow routes) and the preliminary modeling suggest the channel is simplified compared to its historical condition and its modern potential. A lack of effective large wood in the segment and imposed partial confinements contribute to the simplification.

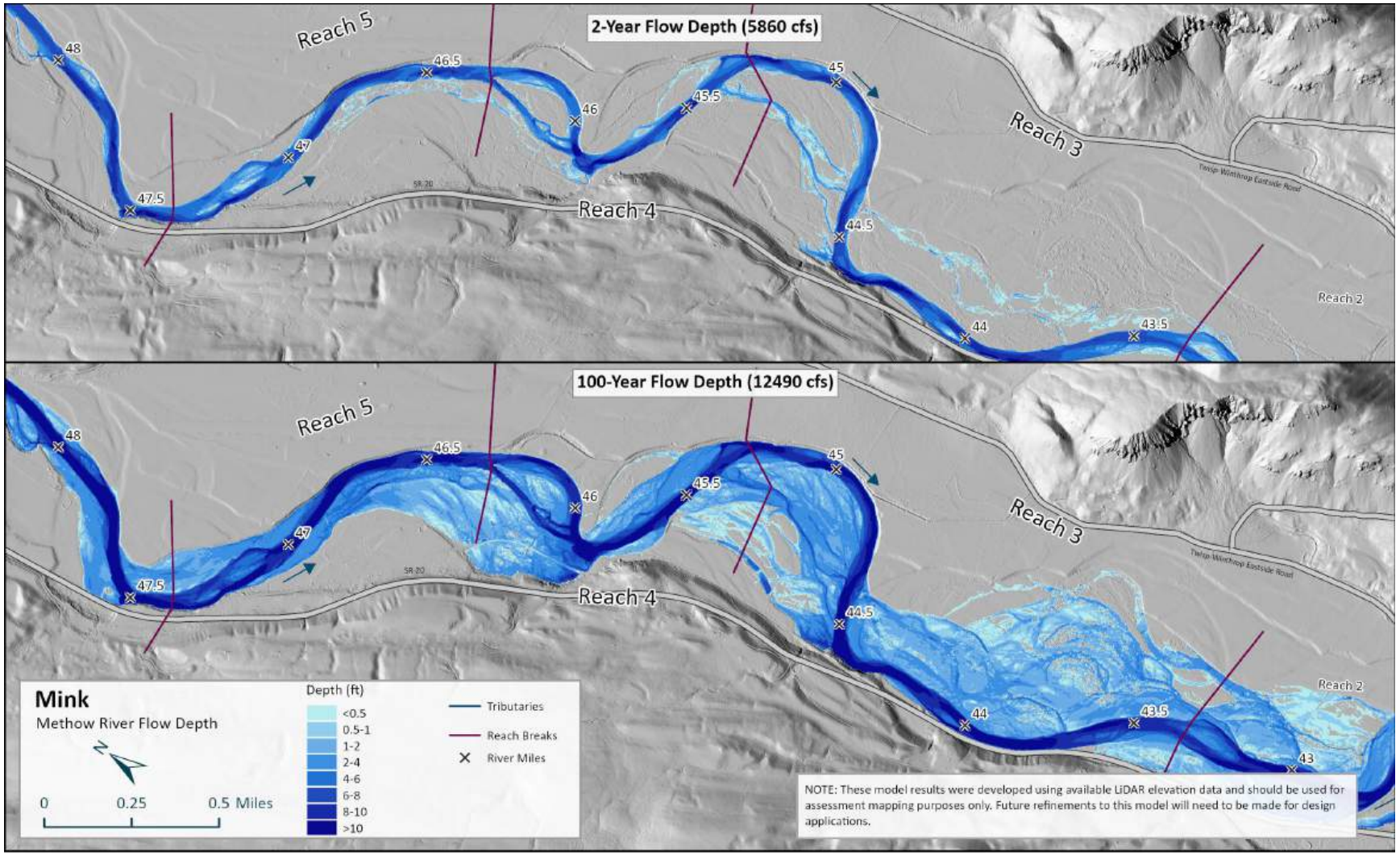


Figure 60. Segment 3 (Mink): Preliminary hydraulic model (Hec-Ras 2D) depth results for the estimated 2-yr and 100-yr flood event. See Appendix D for more information.

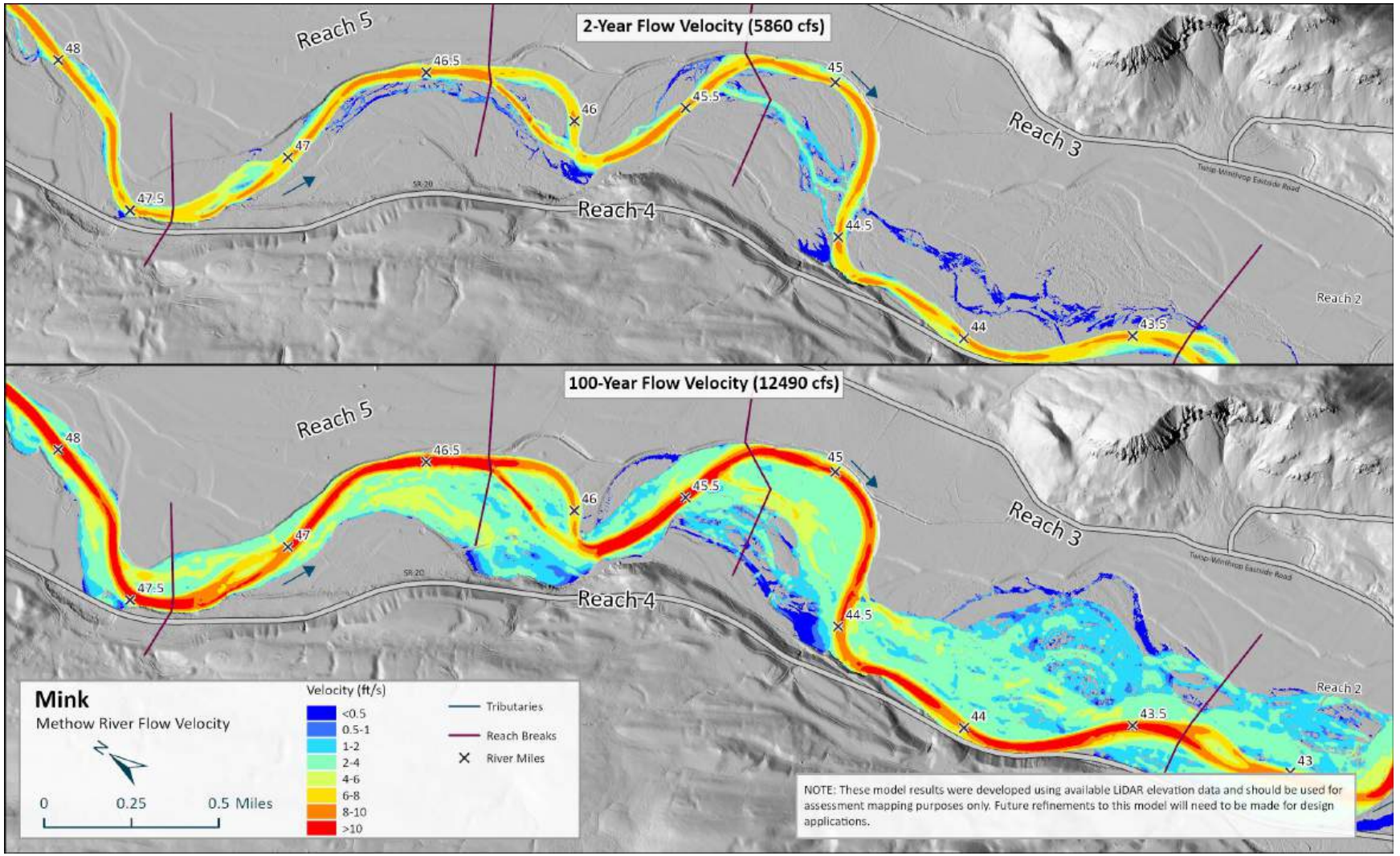


Figure 61. Segment 3 (Mink): Preliminary hydraulic model (Hec-Ras 2D) flow velocity results for the estimated 2-yr and 100-yr flood event. See Appendix D for more information.

6.3.3 Large Wood Material

The role of large wood in Segment 3 (Mink) has been diminished by anthropogenic confinement, channel clearing, and riparian vegetation clearing. During the 2024 Habitat Survey (see Appendix A) a total of 185 individual wood pieces and an additional 63 log jams (3+ logs) were recorded through the segment. Only 30 of the jams were naturally formed. The 33 constructed jams are ballasted into banks and provide localized habitat uplift, and some provide geomorphic function. Most of the natural wood and jams that were present occurred on bar tops as drifted pieces and were providing little or only temporary geomorphic influence at the time of the assessment, although they likely provide nutrients and hydraulic roughness or protection for establishing bar tops or floodplain vegetation (Figure 62). The width and size of the mainstem channel in Segment 3 produces hydraulics that require installed smaller jams be stabilized via bank burial or ballasting, identification of hydraulically appropriate locations for non-stabilized jams, or very-large log jam structures to impose geomorphic influence and maintain complexity. A map of the distribution of large wood observed in the reach during the 2024 survey is provided as Figure 63. It is assumed that unballasted large wood was and potentially still is removed from the channel, depending on perceived risk to infrastructure and recreational safety requirements.



Figure 62. Example of large wood piece rafted on bank - river left at RM 47.1. July 14, 2025

Large wood recruitment potential in this segment is poor because riparian forests are not mature, coupled with bank armoring that inhibit lateral processes. Where riparian forests occur along the channel, they primarily consist of medium-small tree sizes, although some large trees are available in Reaches 4 and 5. The lack of mature riparian forests means that when large wood recruitment does occur the contributions are not expected to provide substantial or long-term geomorphic influence or habitat function.

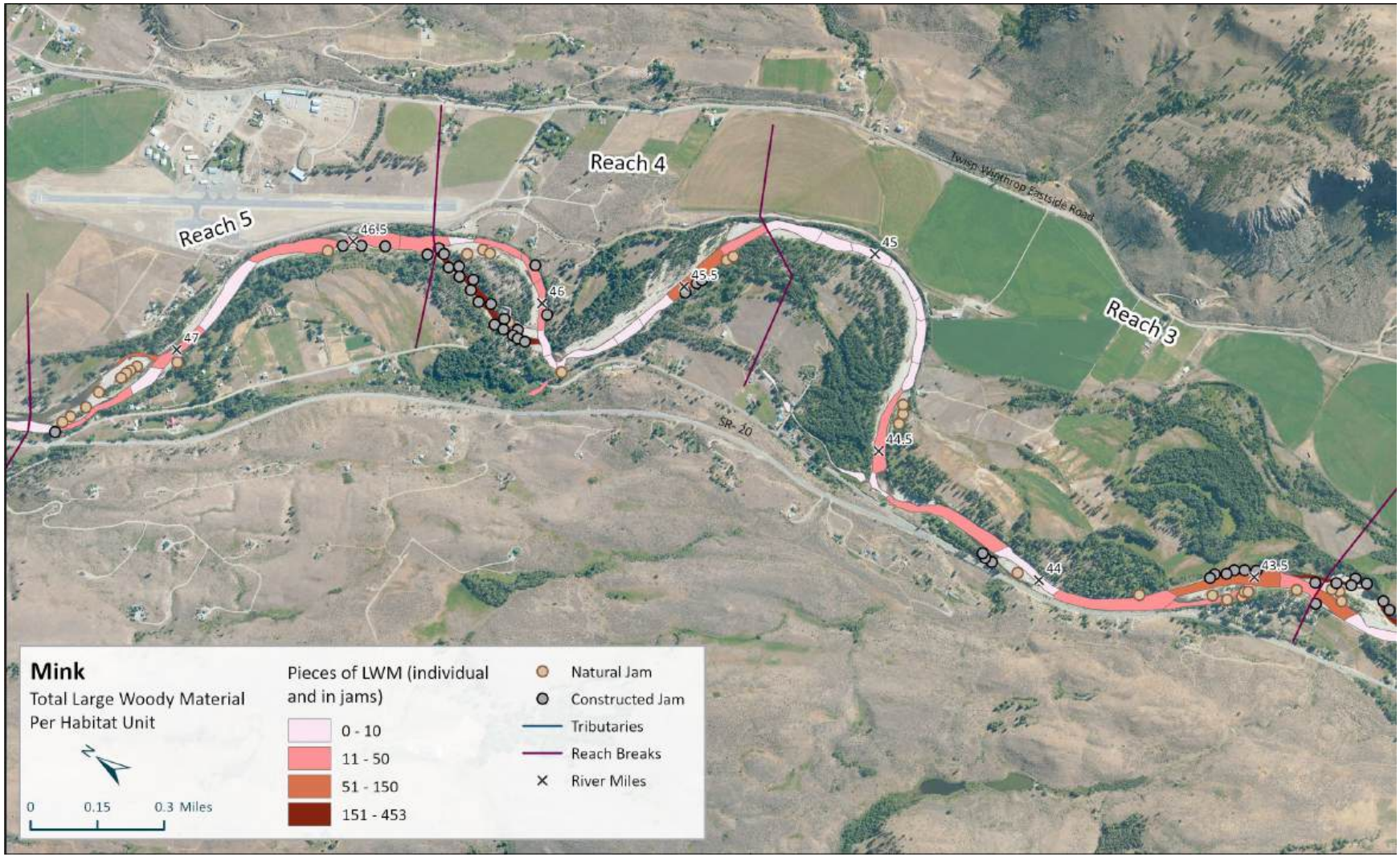


Figure 63. Segment 3 (Mink): Distribution of large wood per mapped habitat unit and location of jams (> 3 pieces), natural and constructed - from 2024 Habitat Survey (see Appendix A)

6.3.4 Vegetation

Riparian vegetation in Segment 3 (Mink) does occur along most of the adjacent floodplains. The armored bank tops are mostly cleared of vegetation. Where riparian and floodplain forests occur, the dominant overstory is cottonwood, ponderosa pine, and alder. The understory is primarily small cottonwood, willows, dogwood, grasses and forbs. Representative photos of the riparian vegetation in this segment area are provided in Figure 64. The tops of the wide bars regenerate sparse willow and forbs seasonally but, annual high-water events tend to keep the bar tops relatively unvegetated. As a result, a large portion of the channel does not have adjacent riparian vegetation. A maturing riparian cottonwood forest is establishing on available floodplain surfaces. Forest maturity is young but recovering. The width of the mainstem channel compared to the modern riparian forest tree size results in minimal shade provided to the mainstem by the existing riparian vegetation. Side channels offer potential for riparian forest shading. Vegetation distribution and height-classification along the channel, valley floor, and adjacent hillslopes in this segment are mapped in Figure 65.



Figure 64. Representative floodplain riparian vegetation in Segment 3 – Mink. A) River left floodplain at RM 44.1, partial cleared but large – small tree size range; B) River right floodplain at RM 46.3 with large – small tree size range.

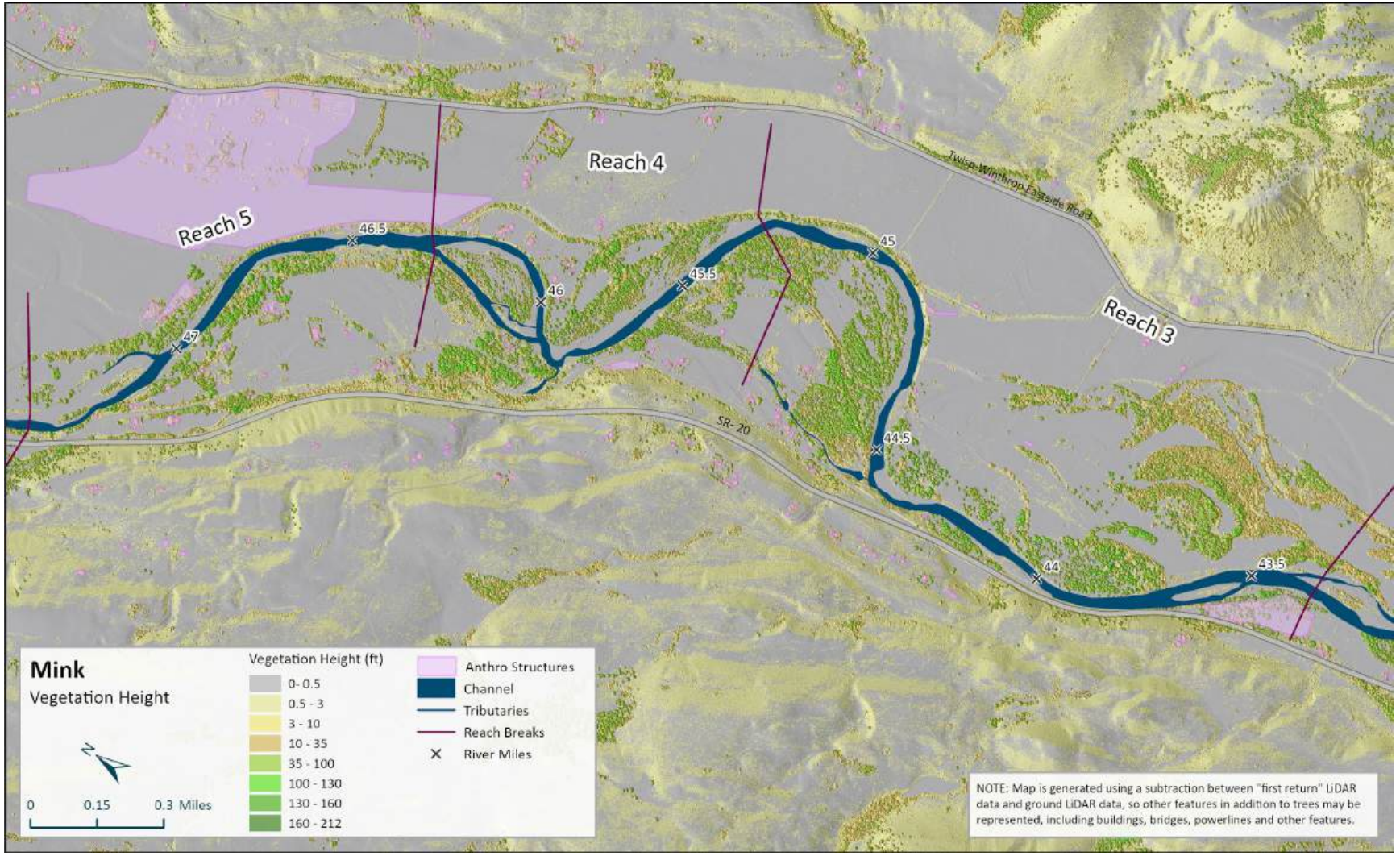


Figure 65. Segment 3 (Mink): Vegetation height and distribution map.

6.3.5 Past and Planned Restoration Projects

The past and planned restoration projects reported or observed in this segment are listed in Table 12. See the map of past and planned projects as Figure 66.

Table 13. List and description of reported past and planned projects in Segment 3 (Mink).

Year	Name	Sponsor	Area of coverage	Project Components
2010	Methow River Large Wood Enhancement: Site B	Yakama Nation	Reach 3; RM 44.15	Large wood structures; Bank stability
2010	MVID East Diversion Modification Project	MSRF	Reach 5: RM 46.3 to RM 46.5	Modification to existing diversion intake, canal, headgate, sediment wasteway and fish screen bypass; Removal of channel-spanning diversion dam and dam foundation; Improvement to water diversion; Side channel reactivation; Fish return improved in 2024
2012	RM 46	MSRF	Reach 4; RM 46	Large wood structure; Floodplain roughness
2013	M2 WDFW Project area	MSRF	Reach 4 and Reach 5: RM 45.8 to RM 46.5	Instream large wood structures; Off-channel habitat reconnection and enhancement; Riparian vegetation.
2012	Methow River Large Wood Enhancement: Two Channels, Riprap Enhancement	Yakama Nation	Reach 4; RM 45.5	Large wood structure; Large wood piling installation; Large wood ballasted within bank armoring
2014	Browse Exclusion	Yakama Nation	Reach 3; RM 44.5	fencing
2015	Cottonwood Restoration	Yakama Nation	Reach 3; RM 43.6	Riparian revegetation
2017	Riparian Planting	MSRF	Reach 3; RM 44.25	Riparian revegetation
2024	Eagle Rocks	USBR	Reach 2 and Reach 3; RM 43.1 to RM 43.7	Floodplain connectivity enhancement; Instream channel complexity; Riparian vegetation; Excavation of side channel; Channel grading; Large wood structures
2026	WDFW Phase 2	MSRF	Reach 5 and Reach 6; RM 46.3 – RM 46.45	Refinements to WDFW Phase I
2027	Two Channels	Yakama Nation	Reach 3 and Reach 4; RM 44.4 - RM 45.6	Proposed Project with elements of large wood structure implementation and side channel enhancement
2028	WDFW Floodplain Project	MSRF	Reach 4 and Reach 5: RM 45.8 to RM 46.6	Riparian revegetation and connection

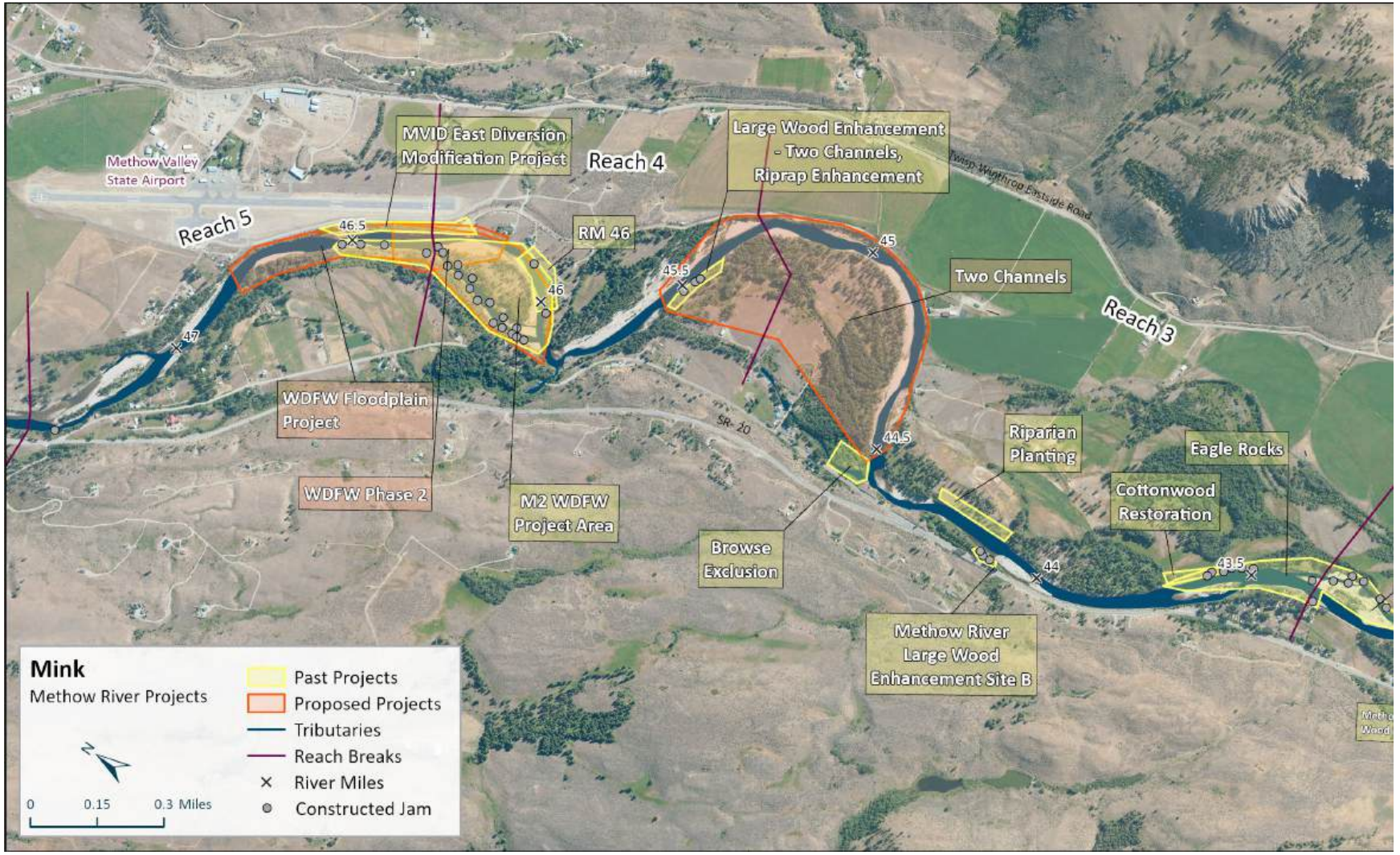


Figure 66. Segment 3 (Mink): Past and planned restoration projects map.

Past and planned restoration projects in Segment 3 (Mink) range from improved irrigation diversion features and removal of an impoundment structure to large wood installations, side channel enhancement/creation, and riparian revegetation efforts. The most obvious in-channel past habitat enhancement projects are the M2 WDFW project area (2013), Methow River Large Wood Enhancement: Two Channels, Riprap Enhancement (2012), and Methow River Large Wood Enhancement: Site B (2010). The M2 WDFW project installed ballasted large wood structures to maintain split flow around the existing vegetated island, uplift available habitat quality, and provide bank protection, as well as create a secondary side channel with large wood feature. Refinements to this project area for enhanced spawning gravel capture and additional habitat uplift could be made but the project appears to be relatively functional (Figure 67). The Large Wood Enhancement projects installed bank-ballasted large wood structures along the mainstem channel to create and enhance local habitat quality. The structures include "bumper" logs to minimize recreational user risks (Figure 68). Both of these projects remain functional.



Figure 67. Upstream end of constructed secondary side channel and large wood structures in the M2 WDFW Project Area at RM 46.1 – looking upstream. Racked material shown captured on the secondary side channel inlet structure in this photo. July 15, 2025



Figure 68. Methow Large Wood Enhancement Projects A) Bank-ballasted habitat structure in riprap at RM 45.5; B) Bank ballasted habitat structure in SR 20 road bank. July 15, 2025

6.3.6 Project Opportunities

Persistent recreational use and infrastructure along adjacent banks will likely continue to impact the long-term trajectory of the channel and influence the types and extent of project opportunities in this segment. Actions proposed in this segment include enhancement/improvement of channel complexity via large wood placement, increased pool habitat complexity via boulder placement, the creation or enhancement of side channel habitats, floodplain reconnections via side channel engagement and levee removal, creation or enhancement of groundwater channel connectivity, riparian revegetation, and conservation of targeted areas to support restoration efforts. Several project areas aim to maximize habitat uplift potential in conjunction with, or as adaptive management to, previous or planned restoration actions in the segment. Evaluation of the potential for groundwater-fed gallery channels connected to the mainstem channel to provide both off-channel refugia and cool water resources are recommended for consideration. Side channel development opportunities in areas where perennial connection to the mainstem and groundwater inputs are expected should be considered. A description of the project opportunities and a map showing general locations are provided in Appendix C – Project Opportunities & Restoration Strategy.

6.4 SEGMENT 4: BEAR (RM 47.4 – 50.3)

6.4.1 Overview

Segment 4 (Bear) is equivalent to Reaches 6 - 7 and extends from RM 47.4 to RM 50.3. General metrics of the reaches in this segment are provided in Table 13. The channel is partially confined by bank armoring and periodic bedrock contacts that define lateral meander extent. Channel planform is low-moderate sinuosity meandering with cobble bars (Figure 69). The channel is generally a pool-riffle-glide type, but the channel units are elongated through the segment. The quantity of large wood surveyed (2024) for habitat requirements is marginal throughout. Riparian vegetation density and composition are poor. Reported past and planned projects (2013-2027) include modification to an existing diversion, modifications to the outlet of Bear Creek, large wood installations, side channel and floodplain reconnection projects, and riparian revegetation. The existing infrastructure and recreational use limit the types of restoration treatment options considered in the mainstem channel in Segment 4.

Table 14. Metric table for Reach 6 to Reach 7 – Segment 4 (Bear).

Bear	Length (miles)	River Mile	Stream Gradient (%)	Sinuosity	Dominant Channel Habitat Unit Type	Average Bankfull Width (ft)	Confinement	Dominant Substrate	% Pool Habitat	% Glide Habitat	% Riffle Habitat	% Side Channel Habitat
Reach 6	2	47.4-49.4	0.28%	1.32	Riffle	197.3	Partially Confined	Cobble	29%	29%	37%	5%
Reach 7	0.9	49.4-50.3	0.31%	1.14	Pool	189.3	Partially Confined	Cobble	56%	32%	9%	2%



Figure 69. Representative photos of the channel in Segment 4 - Bear: A) Reach 7 at RM 49.6, looking downstream; B) Reach 6 at RM 48.8, looking upstream. July 13, 2025

Channel and floodplain processes in Segment 4 – (Bear) have been and continue to be impacted by anthropogenic features and land management. Bank armoring with boulder riprap, installed with the intent of protecting infrastructure and private property, impedes lateral processes beyond the natural confinement imposed at bedrock contact points. Bank armor or bank toe reinforcement with boulders occurs at RM 48.45 on river left, 48.8-48.85 on river right, 49.15-49.25 on river left, RM 49.55-49.65 and 49.7-49.85 on river right, 49.6 on river left, and four large boulder riprap barbs on river right between RM 49.85-49.9. Examples of riprap and boulder bank armoring are provided as photos in Figure 70 and Figure 71.



Figure 70. Bank armoring in Segment 4 (Bear): A) riprap along toe of SR 20 road prism at RM 48.8 on river right; B) boulder reinforced bank toe on river left at RM 49.1-49.2. July 13, 2025



Figure 71. Bank armoring examples in Segment 4 (Bear): A) Riprap barbs on river right at RM 49.9; B) riprap armoring on toe of SR 20 road prism on river right at RM 49.6. July 13, 2025

State Route (SR) 20 and the Witte Road prisms run parallel along river-right at RM 48.9 and RM 49.5-49.7 exaggerating valley edge confinement and limiting hillslope inputs to the channel. Land-use through Segment 4 is a mix of agriculture, residential, recreational parks, and campgrounds. The agricultural fields and lawns on the east side are watered by irrigation. As a result of the development and continued land-uses, much of the riparian and floodplain vegetation is cleared. Along most banks, a very narrow strip of sparse trees or shrubs defines modern riparian vegetation.

Bear Creek, a primary tributary in this segment, and its alluvial fan have also been impacted by anthropogenic confinements, irrigation canaling and diversion, and riparian vegetation clearing. The mouth of Bear Creek was diverted into an irrigation canal instead of meeting the Methow River. Recent efforts to reconnect Bear Creek to the Methow River, remove levees, and replant vegetation along its new river outlet were completed (2025). The new confluence of Bear Creek is at RM 49.35 on river left, immediately downstream from a constructed bank-ballasted large wood jam (Figure 72). Anthropogenic features in Segment 4 are mapped in Figure 73.



Figure 72. Realigned and constructed outlet of Bear Creek (2020-2025) at RM 49.35 on river right, downstream side of constructed log structure. July 13, 2025

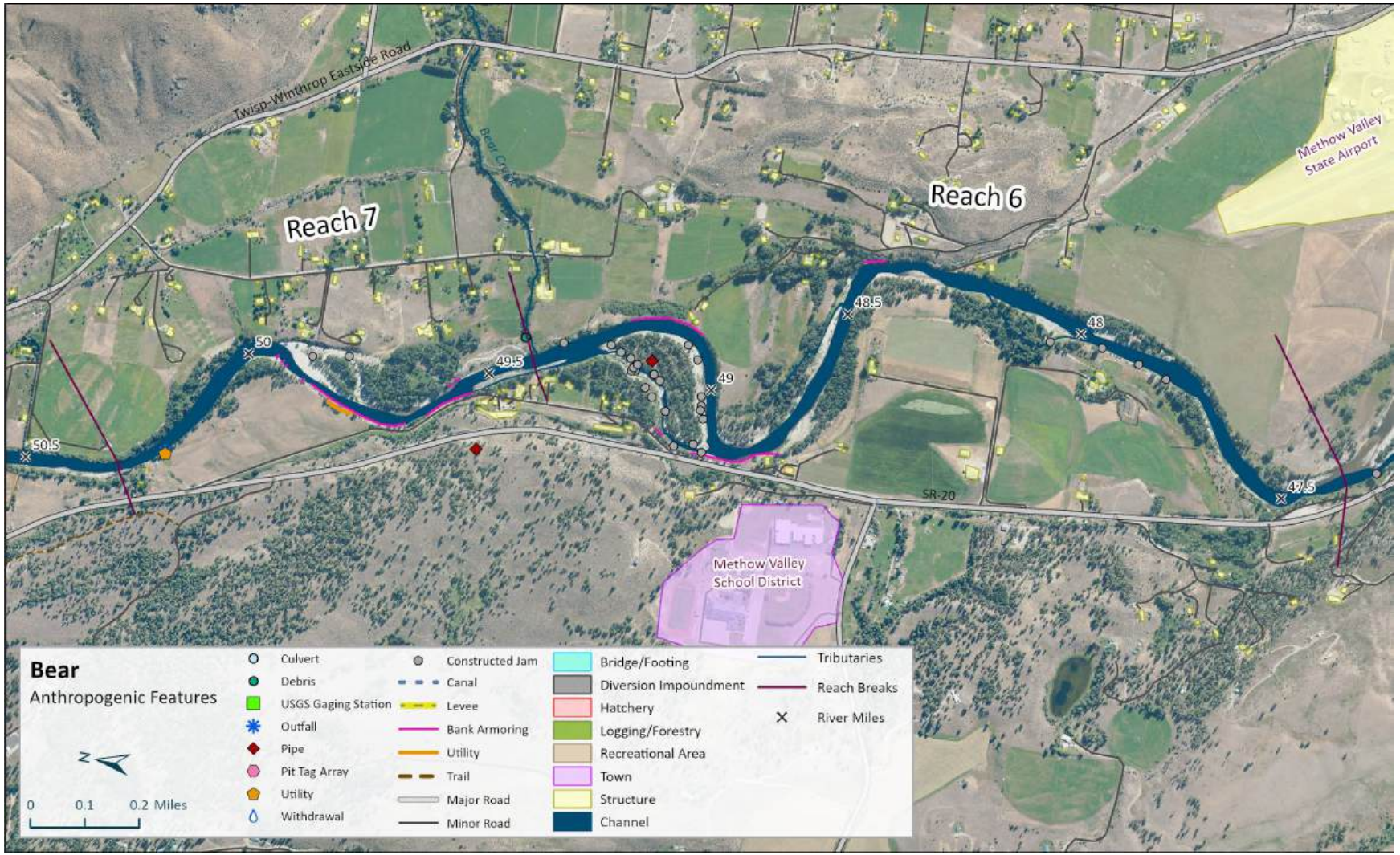


Figure 73. Segment 4 (Bear): mapped anthropogenic features.

6.4.2 Channel and Floodplain Geomorphology

Segment 4 – Bear (Reach 6 -7) is a moderately sinuous meandering channel. Habitat units mapped in the 2024 survey reveal a pool-riffle-glide channel type. Pools occupied 42% of the available habitat, glides 31%, riffles 23%, and side channels approximately 4% (Figure 75). All the mainstem habitat units are elongate. Most of the pools are of low habitat complexity and depth, except for deep pool sections at RM 47.5, 48.4, 48.8, and 50 – at bedrock contact points where scour is promoted. Most of the deep pool sections lack habitat complexity and cover.

Off-channel refugia is currently marginal in Segment 4, but potential to uplift and create quality off-channel refugia does exist in these reaches. Three side channels were mapped during the habitat survey (2024). The perennially connected side channel on river right of Whitefish Island and its habitat complexity are maintained by constructed large wood jams (Figure 74A). The Whitefish Island side channel is approximately 0.3 miles long. The constructed large wood structures offer local habitat complexity (pool scour and cover). Two high-flow side channels maintain connectivity at their downstream end during low-flow conditions with outlets to the Methow River at RM 48.5 on river left and RM 48 on river right. The side channel at RM 48 is wetted with groundwater during low-flow conditions but has the potential for perennial connectivity at the upstream end (Figure 74B).



Figure 74. A) Perennial side channel with constructed large wood jams on west side of Whitefish Island at RM 49; B) groundwater supported seasonal side channel on river right with outlet at RM 48. July 13, 2025

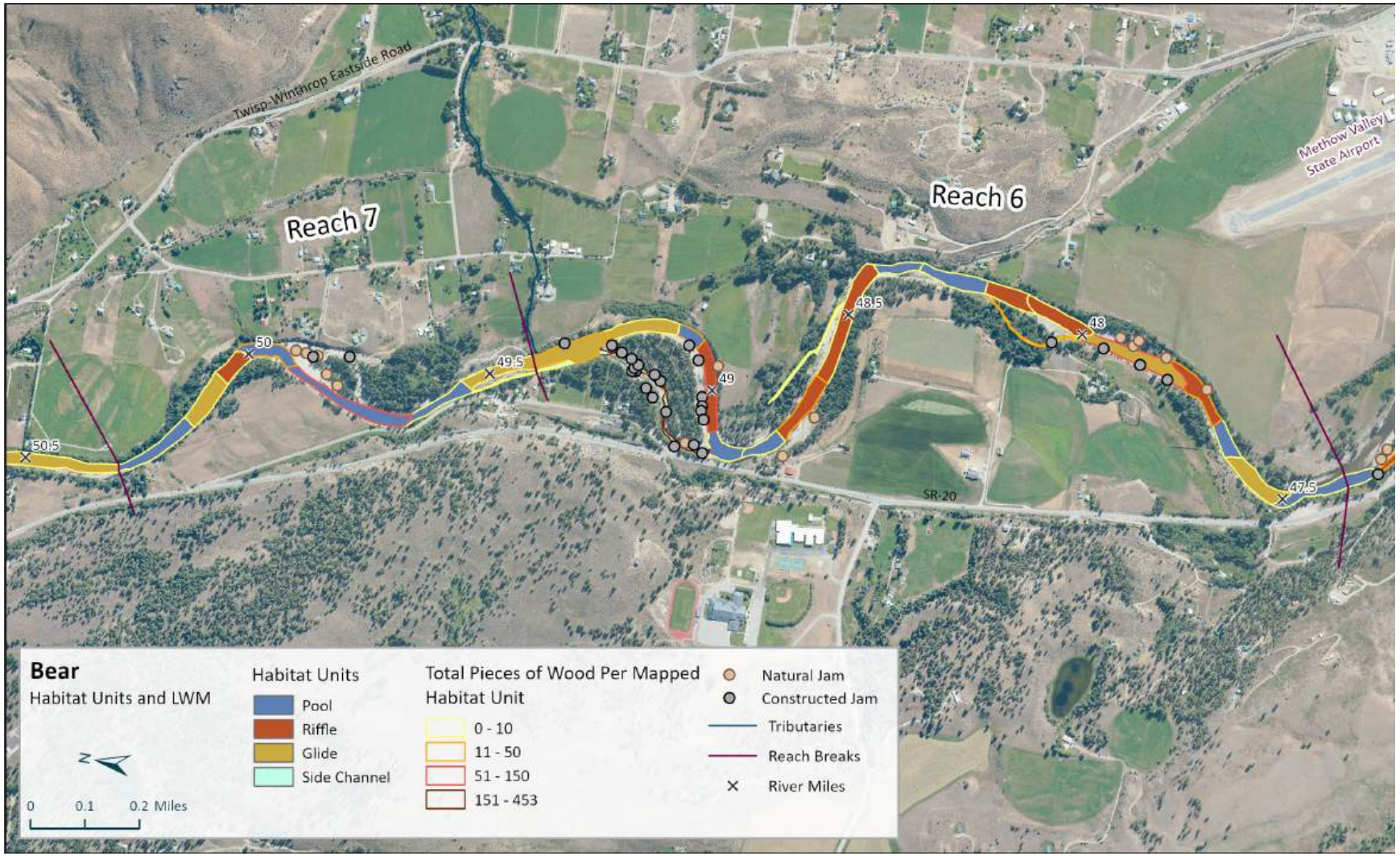


Figure 75. Segment 4 (Bear): mapped habitat units with total number of large wood pieces per unit (Habitat Survey, 2024: Appendix A).

The side channel with its outlet at RM 48.5 is also groundwater supported and functions more like a groundwater floodplain tributary. At the time of the geomorphic survey (2025), the outlet flowed across an active bar top to drop about three feet into the Methow River (Figure 76). Past aerial imagery (GoogleEarth 1996-2024) shows that the outlet location and form of this side channel can vary, depending on the previous season's bar deposition. Habitat condition is currently marginal in this side channel. Based on the side channel's proximity to irrigated fields and its lack of connectivity to the mainstem, even at flood flows, it is presumed that the summer groundwater supply is augmented or influenced to some degree by the water applied to the nearby pastures.



Figure 76. Groundwater supported side channel or floodplain tributary to the Methow River with an outlet at RM 48.5 on river left. A) the side channel at 0.1 miles upstream from its outlet; B) the side channel ~100 feet upstream from its outlet into the Methow. July 13, 2025

The set of side channels onthe river left floodplain between RM 49.4 and 49.9 were seasonally disconnected from the mainstem channel at low-flow conditions during the 2024 and 2025 surveys. Some hyporheic wetting was observed but this side channel complex is not groundwater supported. These side channels were enhanced with large wood structures and the downstream outlet was extended to its new location at RM 49.4 as part of the larger Barkley Bear Habitat Improvement Project (2020-2025).

Floodplains in Segment 4 are composed of alluvial boulders, cobbles, and gravels topped with sandy-loam. The modern channel is slightly entrenched (maintained state of incision) below its floodplain, which itself is inset into glacial outwash terraces and the Bear Creek alluvial fan toe. A relative elevation map of the channel and floodplain in Segment 4 is provided as Figure 77. Bedrock contacts at the apex of the channel meanders define the lateral extent of sinuosity through the segment (Figure 78). The added anthropogenic bank armoring and lack of geomorphically effective large wood in the channel has resulted in channel bed lowering (incision) – probably in the last 150 years, based on topographic scarring.

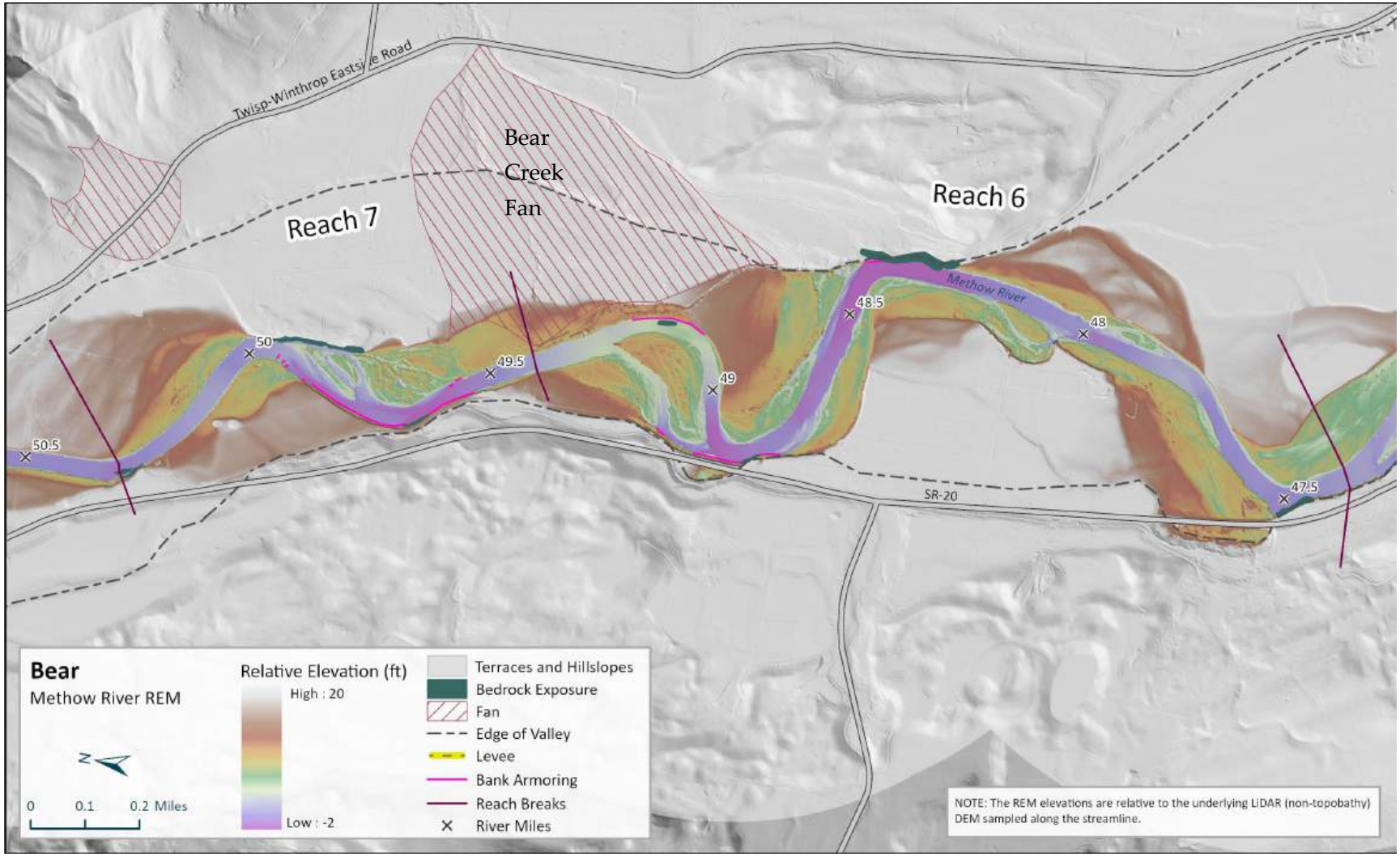


Figure 77. Segment 4 (Bear): Relative elevation map of floodplain and channel with confining fans, bedrock, terraces, roads, and levees identified.

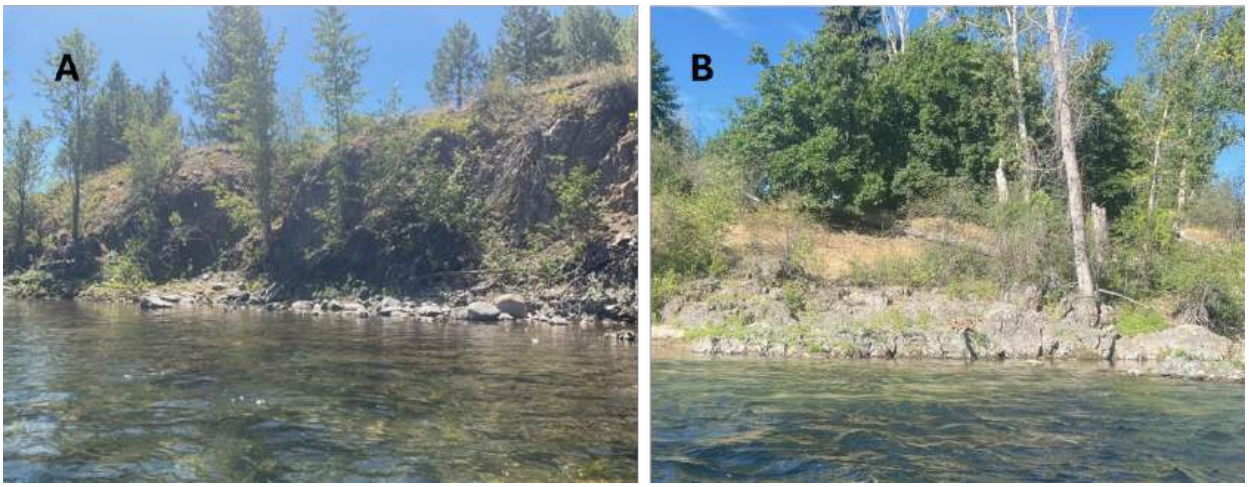


Figure 78. A) Bedrock bank contact on river right at RM 48.8, extends ~20ft into the channel. B) Bedrock bank contact on river right at RM 50.3. July 12, 2025

Bedload in the mainstem channel is dominated by cobbles with sparse gravel. Boulders are present as added riprap or natural hillslope and glacial outwash terrace contributions from adjacent banks. The cobble bars exposed during low-flow conditions are relatively narrow, elongate, and discontinuous. The bars are composed primarily of cobbles with sparse gravel. A few mid-channel bars composed of cobbles are visible during low-flow conditions, indicating that sediment supply is not deficient.

Preliminary hydraulic modeling results reinforce that the bank armoring and modern entrenched (incised) condition reduce floodplain connectivity, especially at the downstream end (Figure 79). Modeled flood velocities are lowest where split-flow conditions occur (Figure 80). However, in general, the segment regularly (2yr) produces flood velocities capable of mobilizing cobble-sized material. Floodplain topography (scars, scrolls, and flow routes) and the preliminary modeling suggest the channel is simplified compared to its historical condition and its modern potential.

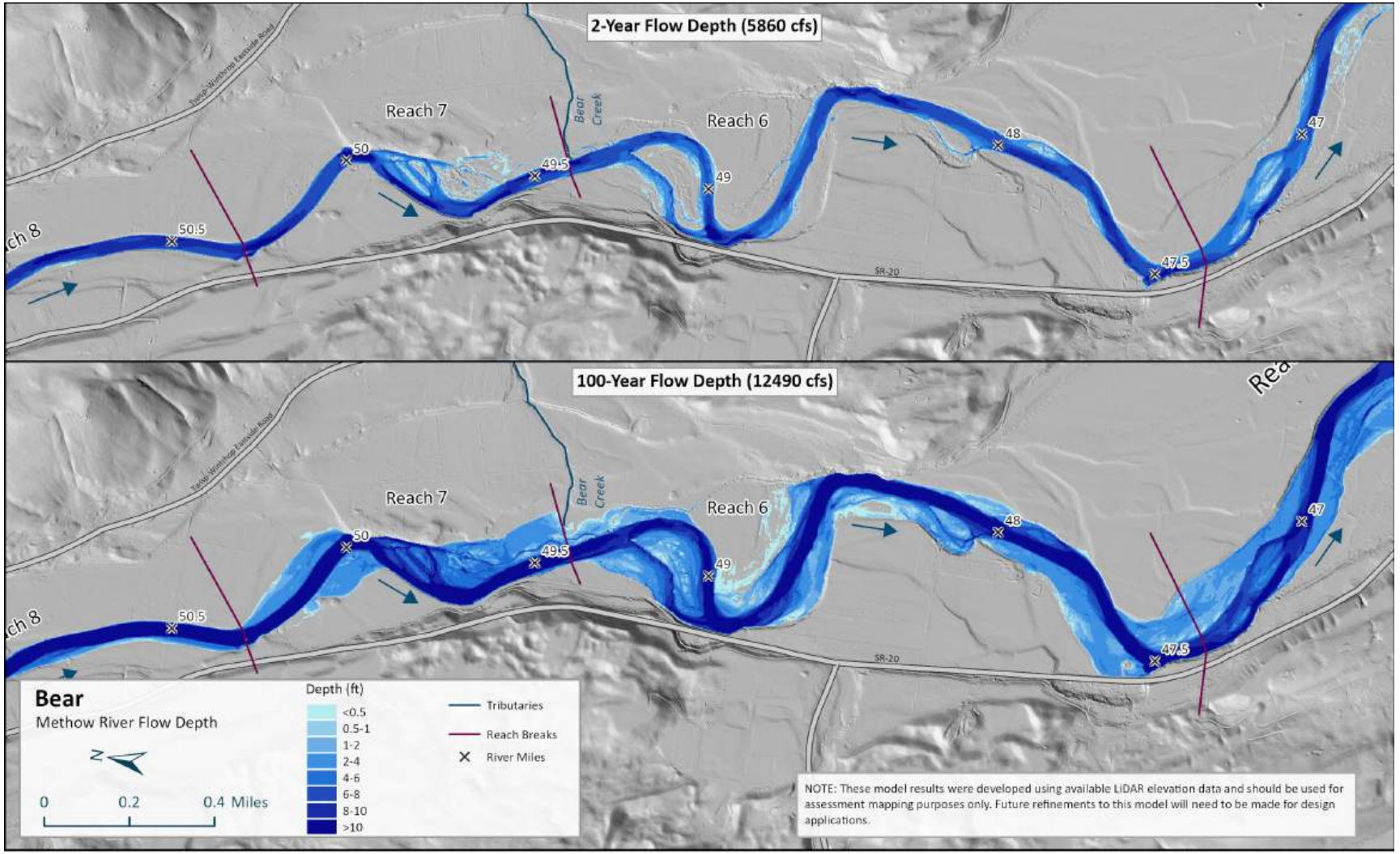


Figure 79. Segment 4 (Bear): Preliminary hydraulic model (Hec-Ras 2D) depth results for the estimated 2-yr and 100-yr flood event. See Appendix D for more information.

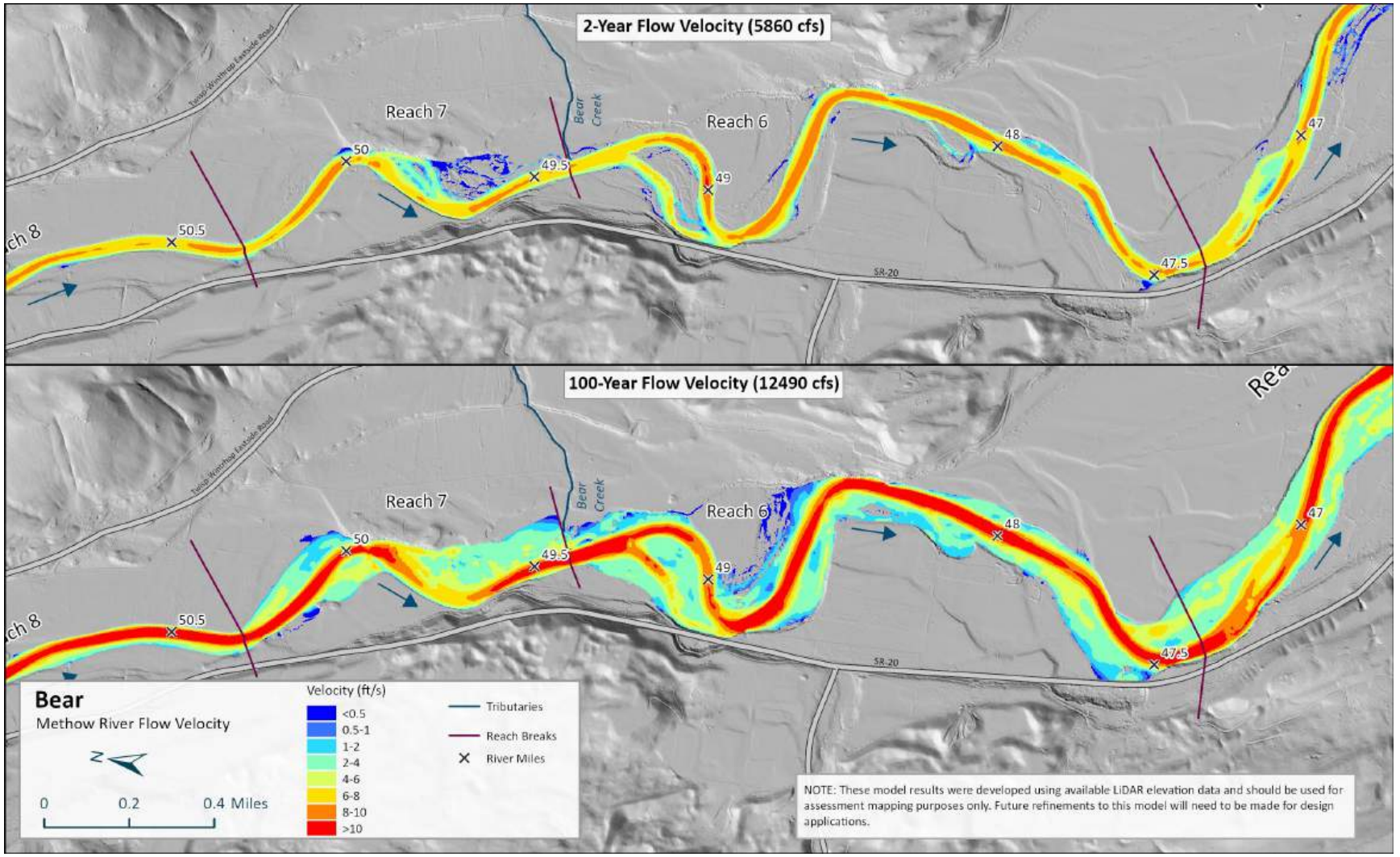


Figure 80. Segment 4 (Bear): Preliminary hydraulic model (Hec-Ras 2D) flow velocity results for the estimated 2-yr and 100-yr flood event. See Appendix D for more information.

6.4.3 Large Wood Material

The role of large wood in Segment 4 (Bear) has been diminished by anthropogenic confinement, past channel clearing, and riparian vegetation clearing. During the 2024 Habitat Survey (see Appendix A) a total of 128 individual pieces of wood and an additional 42 log jams (3+ logs) were recorded through the segment. Fourteen of the jams were naturally formed. The twenty-eight constructed jams are ballasted into banks and provide localized habitat uplift. Most of the natural wood and jams that were present occurred on bar tops as drifted pieces and provided little or only temporary geomorphic influence (Figure 81). Large wood pieces and jams as margin wood do provide nutrients and potentially some hydraulic roughness or protection for establishing bar tops or floodplain riparian vegetation. The width and size of the channel in Segment 4 requires that large wood jams be stabilized (i.e. bank ballasted, boulder backfills, horizontal pile attached) or be very large self-ballasted structures to influence and maintain geomorphic complexity over time. A map of the distribution of large wood observed in the reach during the 2024 survey is provided as Figure 82. It is assumed that unballasted large wood was and potentially still is removed from the channel, depending on perceived risk to infrastructure and recreational safety requirements.

Large wood recruitment potential in this segment is poor because of the reduced mature riparian forests coupled with bank armoring that inhibit lateral processes. Where riparian vegetation exists, it is often a narrow band of trees and shrubs.



Figure 81. Side margin large wood at upstream end of bar at RM 49.9. July 12, 2025

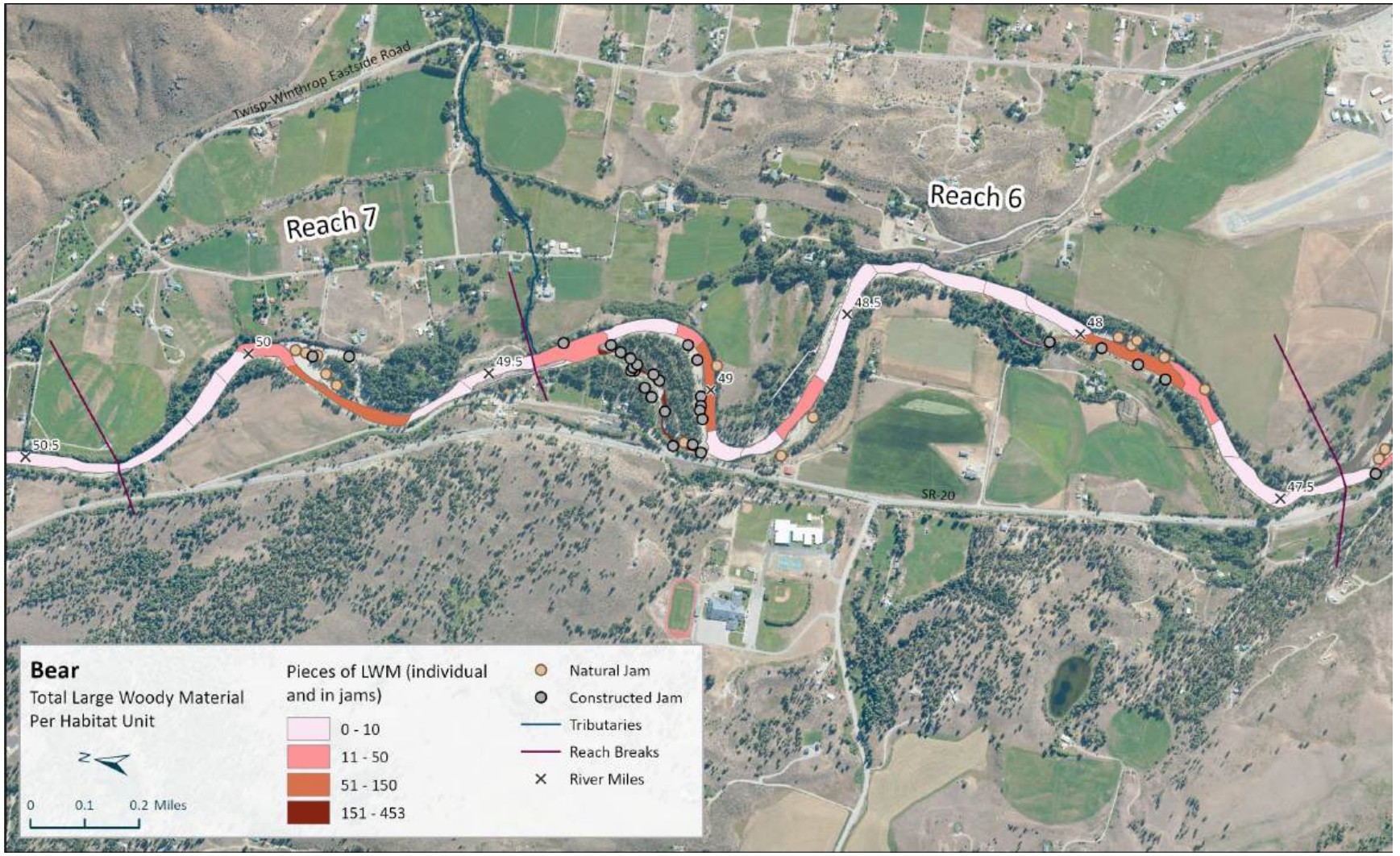


Figure 82. Segment 4 (Bear): Distribution of large wood per mapped habitat unit and location of jams (> 3 pieces), natural and constructed - from 2024 Habitat Survey (see Appendix A)

6.4.4 Vegetation

Riparian vegetation in Segment 4 (Bear) occupies a narrow discontinuous band along bank tops and atop adjacent floodplain surfaces. It is presumed that historically the valley floor and channel banks were vegetated with mature (old-growth) native conifer and deciduous forests, prior to Euro-colonial clearing and development. Today, the modern riparian forest is a single strip of trees and shrubs. The biggest section of riparian forest is located on Whitefish Island, though the forest age is still relatively young. Where riparian forests occur, the dominant overstory is ponderosa pine, cottonwood, and aspen. The understory is primarily willow, dogwood, small cottonwood, grasses, and forbs. A representative photo of the active floodplain vegetation in Segment 4 is provided in Figure 83. The cobble bars along the channel host young sparse willows and seasonal forbs. Flood hydraulics through the segment appear to regularly clear bar vegetation while replenishing bar material. Large portions of the channel do not have adjacent riparian vegetation. The width of the mainstem channel compared to the modern riparian forest tree size results in minimal shade provided to the mainstem by the existing riparian vegetation. Side channels offer potential for riparian forest shading. Vegetation distribution and height-classification along the channel, valley floor, and adjacent hillslopes in this segment are mapped in Figure 84.



Figure 83. Representative photo of riparian vegetation in Segment 4 – Bear, near RM 48.7. July 12, 2025

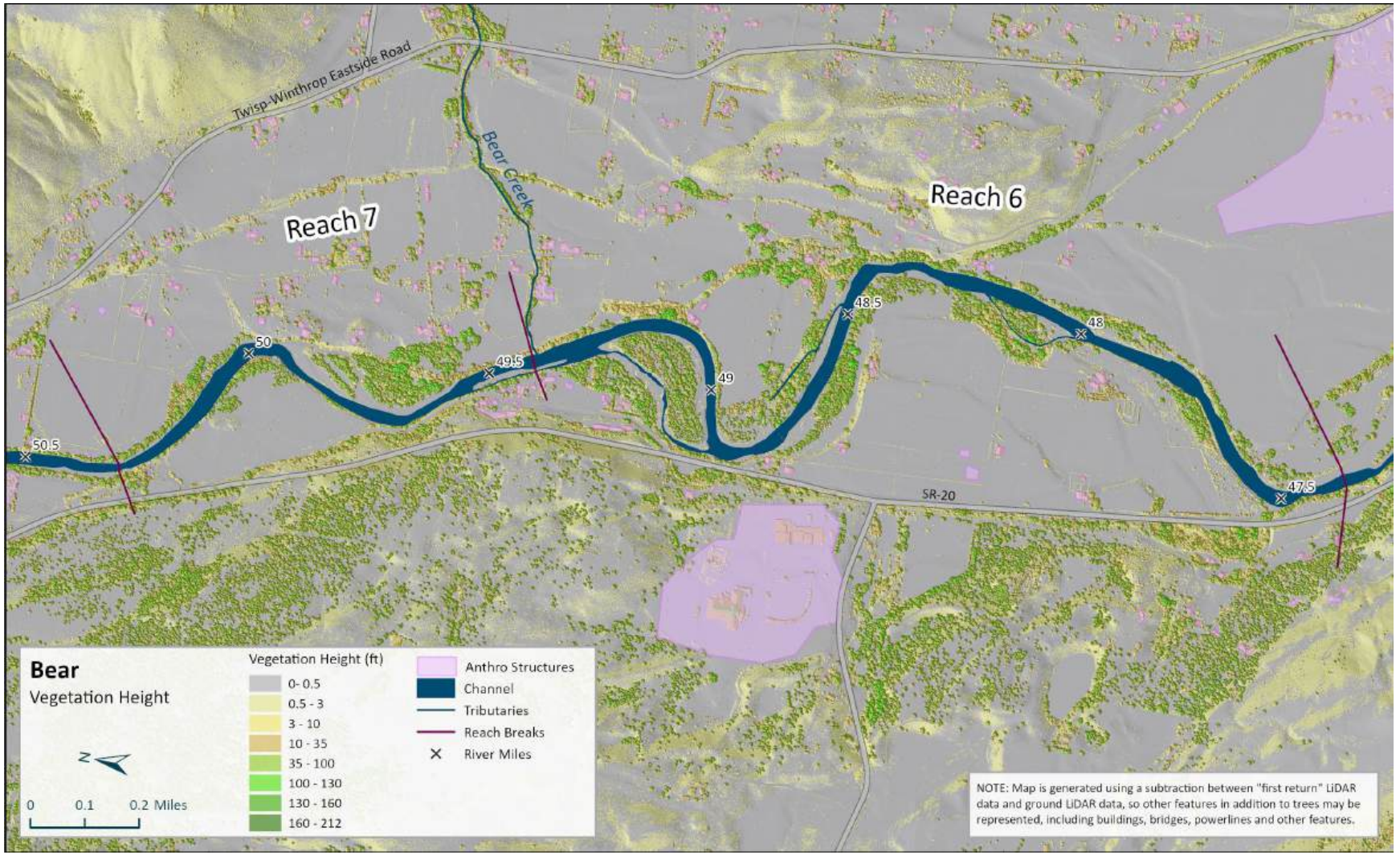


Figure 84. Segment 4 (Bea): Vegetation height and distribution map.

6.4.5 Past and Planned Restoration Projects

The past and planned restoration projects reported or observed in Segment 4 are listed in Table 14. See the map of past and planned projects in Figure 85.

Table 15. List and description of reported past and planned projects in Segment 4 (Bear).

Year	Name	Sponsor	Area of coverage	Project Components
2012-2013	Whitefish Island Project	MSRF	Reach 6; RM 48.8 to RM 49.25	Large wood structure; side channel construction and reactivation; Removal of bank armoring; Installation of large wood crib structure; Riparian vegetation; Channel fill
2019	M23R	USBR	Reach 6; RM 47.8 to RM 48	Large wood structures; Side channel habitat enhancement; Riparian vegetation; Instream habitat complexity
2020	Barkley Irrigation	Trout Unlimited	Reach 6 and Reach 7	Move Barkley Diversion point; reconnect Bear Creek with the Methow River
2020-2025	Barkley Bear Habitat Improvement Project	MSRF	Reach 7; RM 49.4 to RM 49.9	Excavated island side channels; Large wood structures; Bank barbs; Large wood structure roughness; Bear Creek realignment; Bear Creek large wood structures; Excavation and removal of levee and levee armoring; Removal of anthropogenic features; Riparian vegetation
2027	3R	MSRF	Reach 6; RM 47.5 RM 48.8	Proposed Project
2027	3R Phase 2	MSRF	Reach 6; 47.5-48.8	Proposed Project includes subprojects of (M2) River Rock Reach (3R) Floodplain and Side Channel

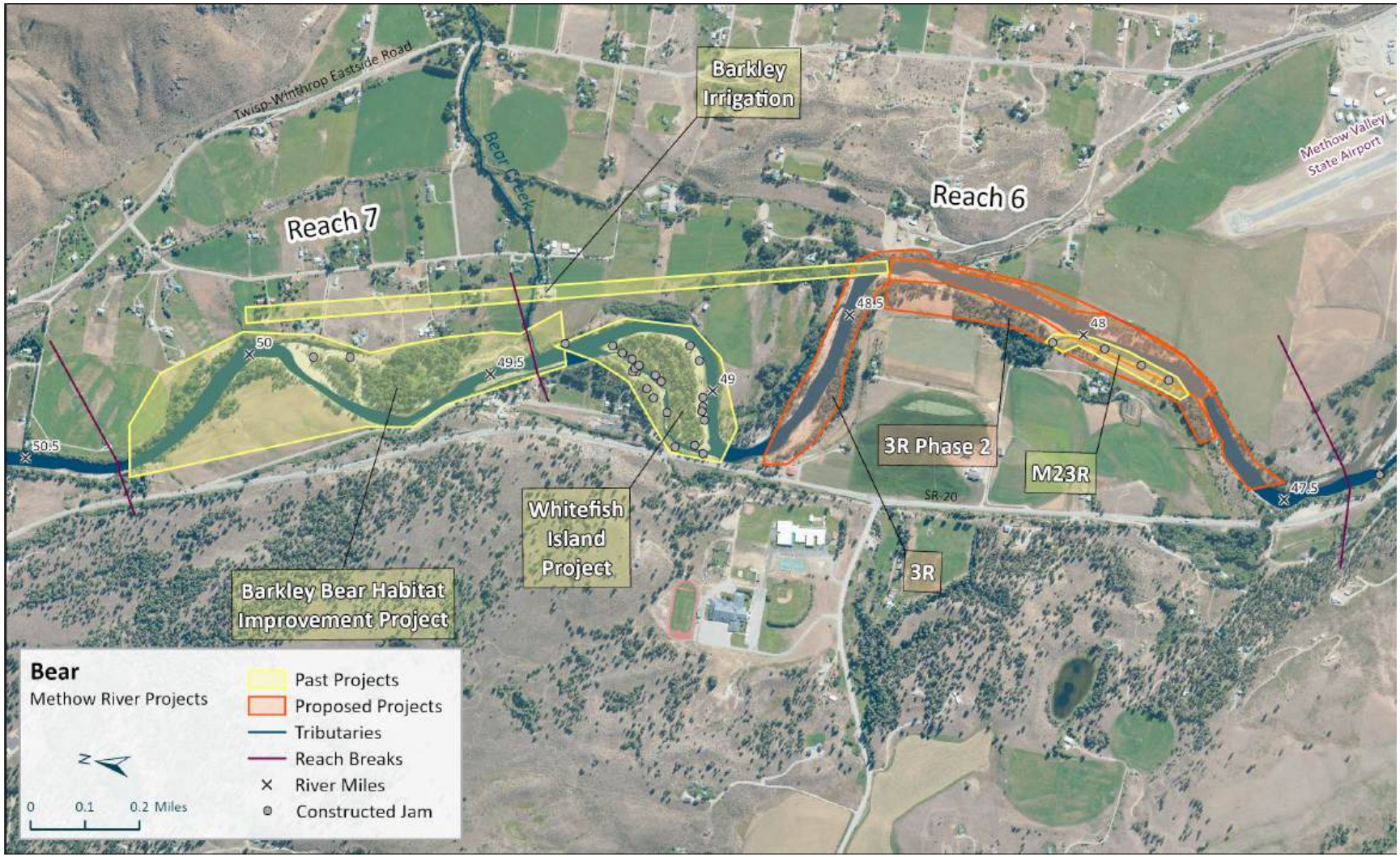


Figure 85. Segment 4 – Bear (Reach 6 - 7): Past and planned restoration projects map.

The most obvious projects in Segment 4 are Whitefish Island, M23R and Barkley Bear. Whitefish Island (2012-2013) continues to host a side channel on the west side of the island, supported by a large apex jam at the upstream end of the island, intended to maintain split flow. The side channel contains multiple constructed large wood jams that provide local habitat complexity uplift and maintenance functions (Figure 86A). At the downstream end of the side channel, large wood structures serve as bank protection with habitat features (Figure 86B). On the mainstem channel, the Whitefish Island project added large wood structures to the bar top to provide roughness to support riparian forest extension. Additional large wood structures could be added to improve upstream split-flow conditions, gravel retention in designated locations in the side channel, and a constructed secondary side channel constructed at the downstream end of the island.



Figure 86. Whitefish Island side channel and large wood project; A) At upstream end of side channel at RM 49.2 looking downstream; B) side channel bank protection and habitat structures on river right at RM 48.9. July 13, 2025

The M23R project (2019) added a set of habitat enhancement large wood structures to a straight section of the mainstem channel and to an existing high-flow side channel outlet between RM47.7 – 48.1 on river right. The existing side channel outlet improvements look to have increased seasonal connectivity potential (Figure 87A). The mainstem constructed large wood structures are ballasted into the bank and include "bumper" or deflection logs on the upstream side to reduce recreational user risk (Figure 87B). Riparian shrub regeneration atop each jam was also successful. Additional project opportunities at the side channel outlet to further improve connectivity were identified, as well as potential to improve connectivity at the upstream (inlet) end of the side channel.



Figure 87. M23R project area elements photos: A) Side channel outlet on river right at RM48; B) Habitat large wood structure with bumper logs and riparian revegetation along river right between RM 47.8-47.95. July 13, 2025

The Barkley Bear project (2020-2025) was successful at removing and re-routing the Barkley irrigation intake and canal/pipe off the mainstem channel and reconnecting the Bear Creek from an irrigation ditch back to the Methow River. Part of the overall project included habitat enhancement log structures added to an existing high-flow side channel through the river left floodplain between RM 49.4 – 49.95 (Figure 88A) and a newly constructed extension side channel with large wood features (Figure 88B). As part of this project, riprap spurs with large wood were added on the river right side of the mainstem, potentially to attempt to deflect flow into the existing floodplain and/or reduce lateral erosion processes on the river right bank. Currently, the side channel complex is activated at high-flow conditions only. Additional treatments to increase flow routing into the side channel could be evaluated. However, this project area is immediately downstream from a sediment transport reach that will continue to deliver and deposit material in this area. Any additional restoration treatment should consider sediment inputs as well as geomorphic and hydrologic trends.



Figure 88. Barkley Bear high-flow side channels with large wood: A) large wood jam in existing side channel on river left at RM 49.7; B) Constructed side channel in floodplain on river left at RM 49.5. July 12, 202

6.4.6 Project Opportunities

Persistent recreational use and infrastructure along adjacent banks will likely continue to impact the long-term trajectory of the channel and influence the types and extent of project opportunities in this segment. Potential actions proposed in this segment include enhancement/improvement of channel complexity via large wood placements at identified locations along the mainstem channel, the creation or enhancement of side channel habitats, potential enhancement and improved connection of groundwater channels, and native riparian revegetation. In addition to flow hydraulics and geomorphic trends, the Cold Water Patches in this segment (see Section 3.2.5) are considered in project identification to boost habitat benefits of restoration actions. The project opportunities are recommended with the intent of maximizing habitat uplift potential in conjunction with the already installed or planned features. A description of the project opportunities and a map showing general locations are provided in Appendix C – Project Opportunities and Restoration Strategy.

6.5 SEGMENT 5: WINTHROP (RM 50.3 – 51.7)

6.5.1 Overview

Segment 5 (Winthrop) is equivalent to Reach 8 and extends from a river right bedrock contact at RM 50.3 to the confluence with the Chewuch River on river left at RM 51.7. General metrics of the reach in this segment are provided in Table 15. The channel is confined by terraces, anthropogenic development, and periodic bedrock contacts. Channel planform is straight. Except for bars and a side channel outlet at the upstream end of the segment, no other side channels and almost no bar features exist. Bedload is dominated with cobbles, but boulders are present. Channel unit type is pool-riffle in the upstream third then it transitions into an extended simplified glide in the lower two-thirds of the reach. A representative photo of the segment is provided in Figure 89. The quantity of large wood surveyed in the habitat assessment (2024) is low and does not meet habitat requirements. Vegetation density and composition are in poor condition. Reported past and planned projects (2013-2027) in this segment are limited to the installation of a couple of constructed log structures into the bank and related revegetation immediately downstream of the Chewuch River confluence. The existing infrastructure and recreational use of the segment limits the types of restoration treatment options considered in the mainstem channel.

Table 16. Metrics table for Segment 5 (Winthrop).

Winthrop	Length (miles)	River Mile	Stream Gradient (%)	Sinuosity	Dominant Channel Habitat	Average Bankfull Width (ft)	Confinement	Dominant Substrate	% Pool Habitat	% Glide Habitat	% Riffle Habitat	% Side Channel Habitat
Reach 8	1.4	50.3-51.7	0.18%	1.04	Glide	186.7	Confined	Cobble	24%	51%	24%	1%



Figure 89. Representative photo of Segment 5 (Winthrop), looking downstream at RM 51.1 July 13, 2025

Channel and floodplain processes, riparian vegetation conditions, and habitat availability in Segment 5 (Winthrop) have been and continue to be impacted by anthropogenic features and land management. At the upstream end, lateral channel confinement is exaggerated by two bridge crossings and their related footings and bank armoring. The Spring Creek footbridge at RM 51.65 is a steel framed suspension bridge with decking. It is secured to cement footings placed on the terraces on both sides of the channel, with boulder reinforced bank toes (Figure 90 A). The Methow River Bridge (Riverside Road) crossing at RM 51.45 is a concrete and steel bridge with utilities piped along it and concrete footings on and three sets of pilings that interact with the channel and banks. The west-side approach to the bridge is constructed into the floodway and reduces available floodplain by ~175 feet (Figure 90 B). The town and community of Winthrop and their related infrastructure, including the wastewater treatment facility, are located on the adjacent terraces that border both sides of the channel. A map of anthropogenic features in Segment 5 is provided in Figure 91.

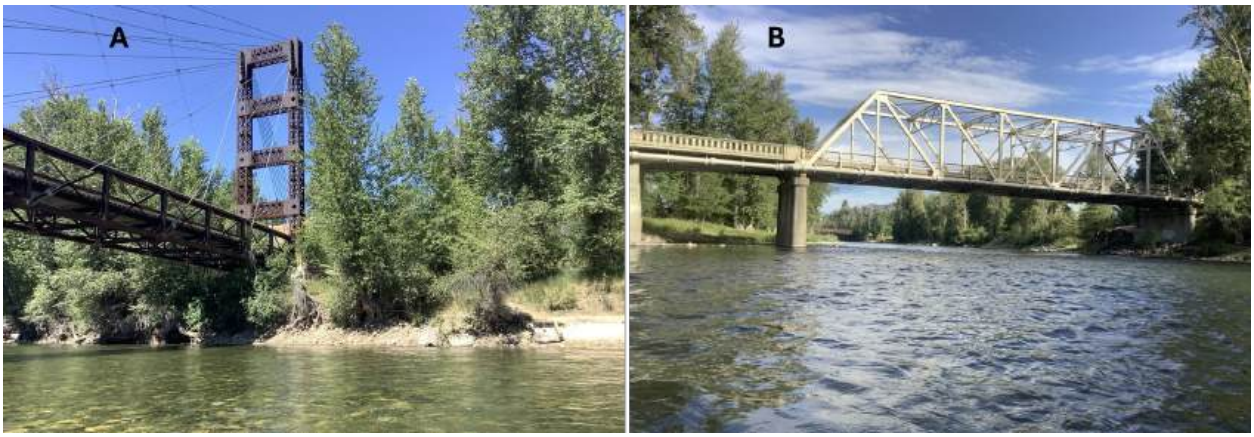


Figure 90. Channel crossings in segment 5: A) Partial suspension footbridge at RM 51.65; B) Road Bridge RM 51.45. July 12, 2025

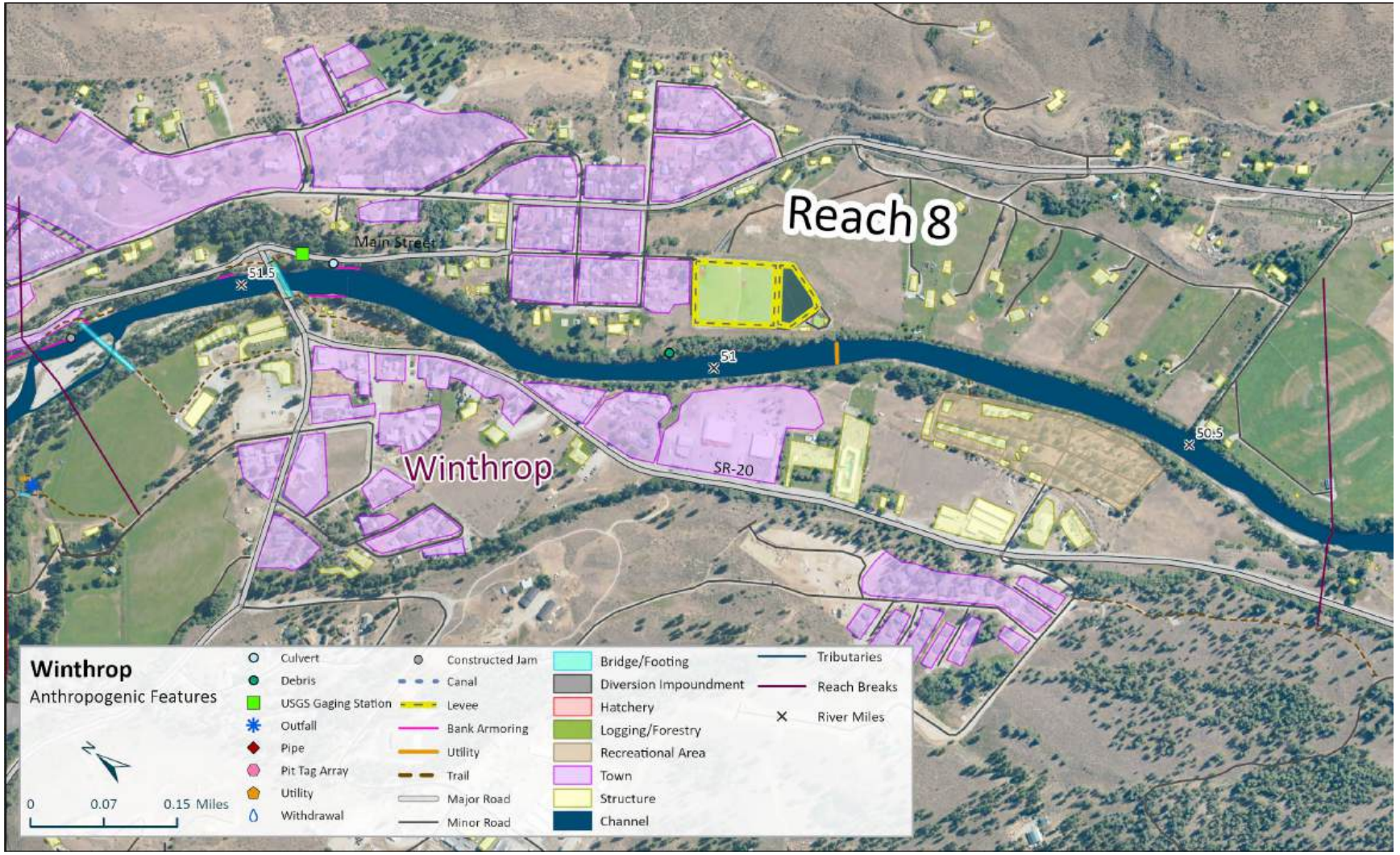


Figure 91. Segment 5 (Winthrop): mapped anthropogenic features.

Riprap bank armoring associated with the Methow River Bridge also extends up and downstream of the crossing on both sides of the channel. Other features that imposed bank hardening were a culvert, abandoned cement structures, and bank reinforcement with boulders. See Figure 92 for example photos.



Figure 92. Bank hardening: A) abandoned cement structures on river right at RM 51.15; B) Boulders as bank reinforcement on river left RM 51.4. July 12, 2025

6.5.2 Channel and Floodplain Geomorphology

Segment 5 (Winthrop) is generally a straight confined channel. Channel habitat units mapped during the habitat survey (2024) reveal a pool-riffle channel type at the upstream end that transitions into an extended glide through the lower two-thirds of the segment. Pools occupied 24% of the available in-stream habitat, glides 51%, riffles 24%, and side channels only 1% (Figure 93). Most of the pools and glides have relatively low habitat complexity and pools lack depth. The upstream end of the segment is at the confluence with the Chewuch River, a primary tributary in the Methow watershed. As a result, discharge in the mainstem channel is notably increased, compared to upstream segments. The Chewuch River sediment inputs are also received by this segment. Development extends from the top of the adjacent banks to the edge of the valley floor on both sides.

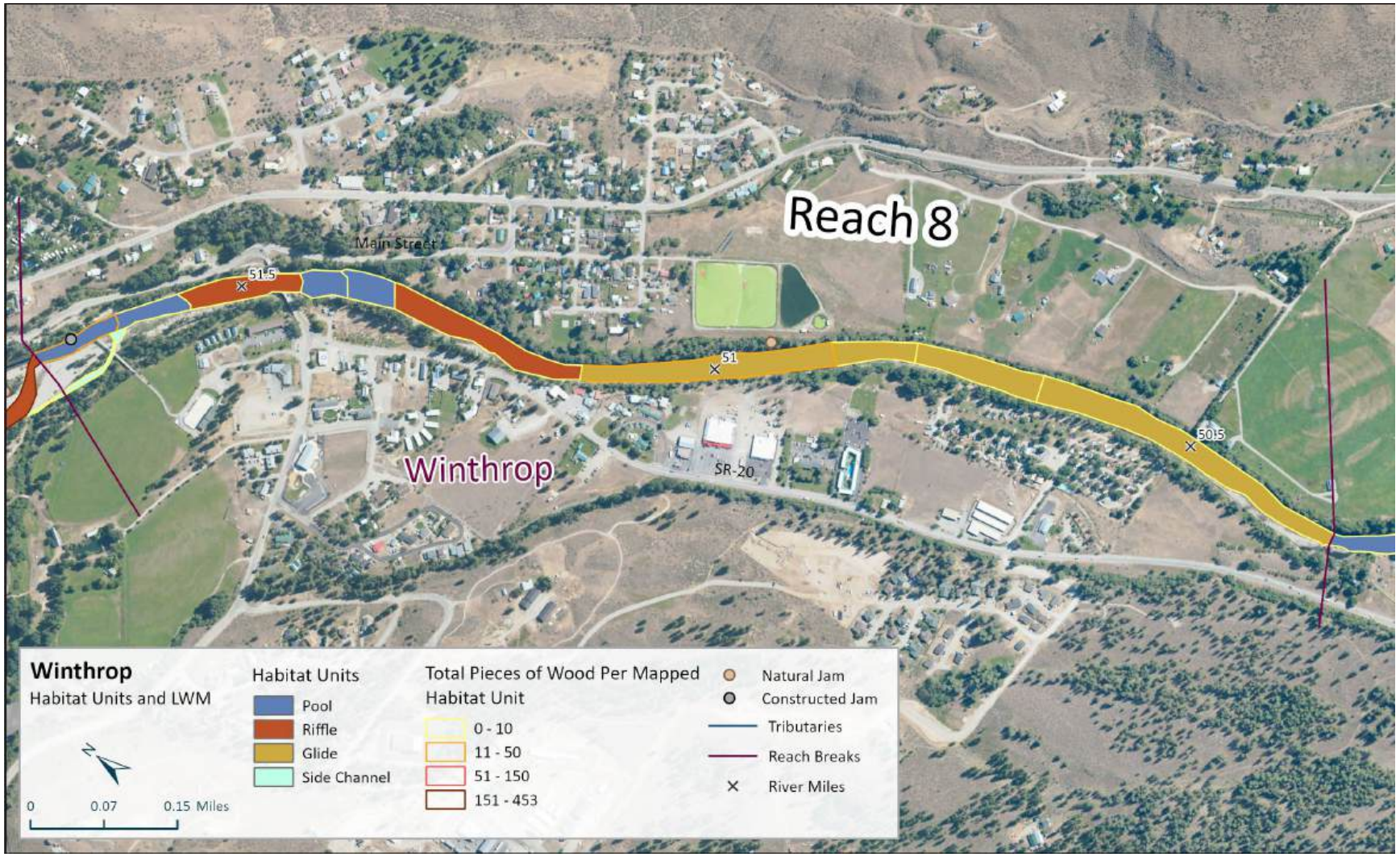


Figure 93. Segment 5 (Winthrop): mapped habitat units with large wood quantities of each unit delineated - Habitat Survey, 2024.

Off-channel refugia in this segment is limited to the downstream portion of the Spring Creek / Hatchery Canal outlet on river right at RM 51.63. In the summer the side channel flows shallowly across a cobble and gravel bar/delta to meet the Methow River (Figure 94 A). No other side channels, alcoves, or pools with adequate cover existing in this reach.



Figure 94. A) Hatchery canal delta at confluence with the mainstem Methow River on river right at RM 51.4. B) Representative bedload composition (cobbles and small boulders with coarse sand and sparse gravels, embedded) RM51.3. July 12, 2025

Bedload in Segment 5 (Winthrop) is dominated by cobbles but small boulders are present. In areas of ineffective flow (channel margins) through the glide, coarse sand was observed between the clasts (Figure 94 B). The small boulders and large cobbles through the glide were embedded. Cobble bars occur at the upstream end of the reach near the confluence with the Chewuch and the outlet of Spring Creek/Hatchery Canal. A narrow cobble bar on river right between RM 50.3 – 50.45, immediately upstream of a bedrock contact, is persistent and relatively stable. At low-flow conditions, the river right side of the riffle at RM 51.3 shows exposed cobbles.

The straightened channel form in Segment 5 is the product of confinement from natural bedrock contacts, adjacent glacial outwash terraces, and channel entrenchment below its floodplain (Figure 96). Bedrock exposures along the toe of the bank on river left at RM 51.35-51.45 extend a hardened bank downstream of the Methow River Bridge crossing and it is the confining counterpoint to the bridge approach that restricts floodplain width in the same area (Figure 95 A). Downstream of the bridge, channel entrenchment into the abandoned floodplain terraces (river left – east side) and higher glacial outwash terraces (river right – west side) is most prominent. At the downstream end of the segment another bedrock bank and bed exposure on river right (RM 51.7) imposes additional control on channel location and form (Figure 95 B). This bedrock maintains a pool, but the pool lacks cover or habitat complexity. Without added complexity, a continued trend of channel entrenchment and simplification is expected to persist in Segment 5.



Figure 95, Bedrock exposures in Segment 5 - Winthrop: A) Bedrock along toe of river left bank at RM 51.4; B) Bedrock bank and mid-channel features on river right at RM 51.7. July 13, 2025

The channel is ~186 feet wide and inset below natural glacial outwash terraces and entrenched into a narrow-abandoned floodplain surfaces. The floodplains in Segment 5 are composed of alluvial cobbles and small boulders topped with gravels and a thin layer of sandy-loam. The glacial outwash terrace banks tend to have more boulders exposed at the base and are often ten feet higher than the abandoned floodplain and 12-15 feet higher than the thin discontinuous strips of modern inset floodplain. The relative elevation model map showing channel and floodplain relationships with bedrock exposure and crossing confinements is provided as Figure 96.

Preliminary hydraulic modeling results reinforce that the modern channel is entrenched below its floodplain, including the estimated 100-year flood event (Figure 97). Modeled floods in this segment produce relatively high velocities (Figure 98). With very little variability in channel form, flood hydraulics depicted in the model are relatively uniform and produce velocities capable of regularly (2 yr modeled discharge) mobilizing cobble-sized material. Segment 5 – Winthrop is considered a sediment transport reach for the material delivered to it from upstream on Methow as well as the Chewuch River.

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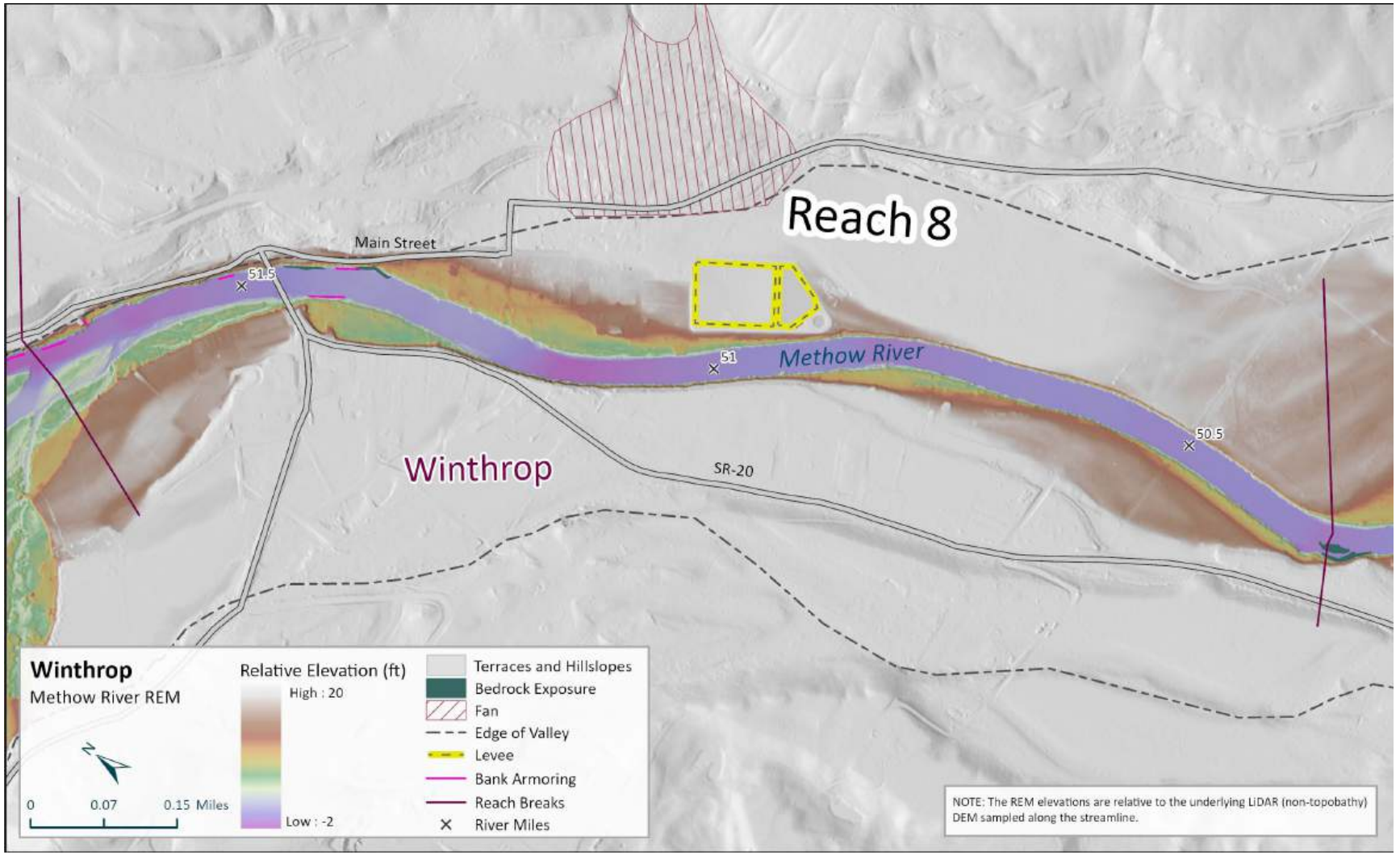


Figure 96. Segment 5 (Winthrop): Relative elevation map of floodplain and channel with confining fans, bedrock, terraces, roads, and levees identified.

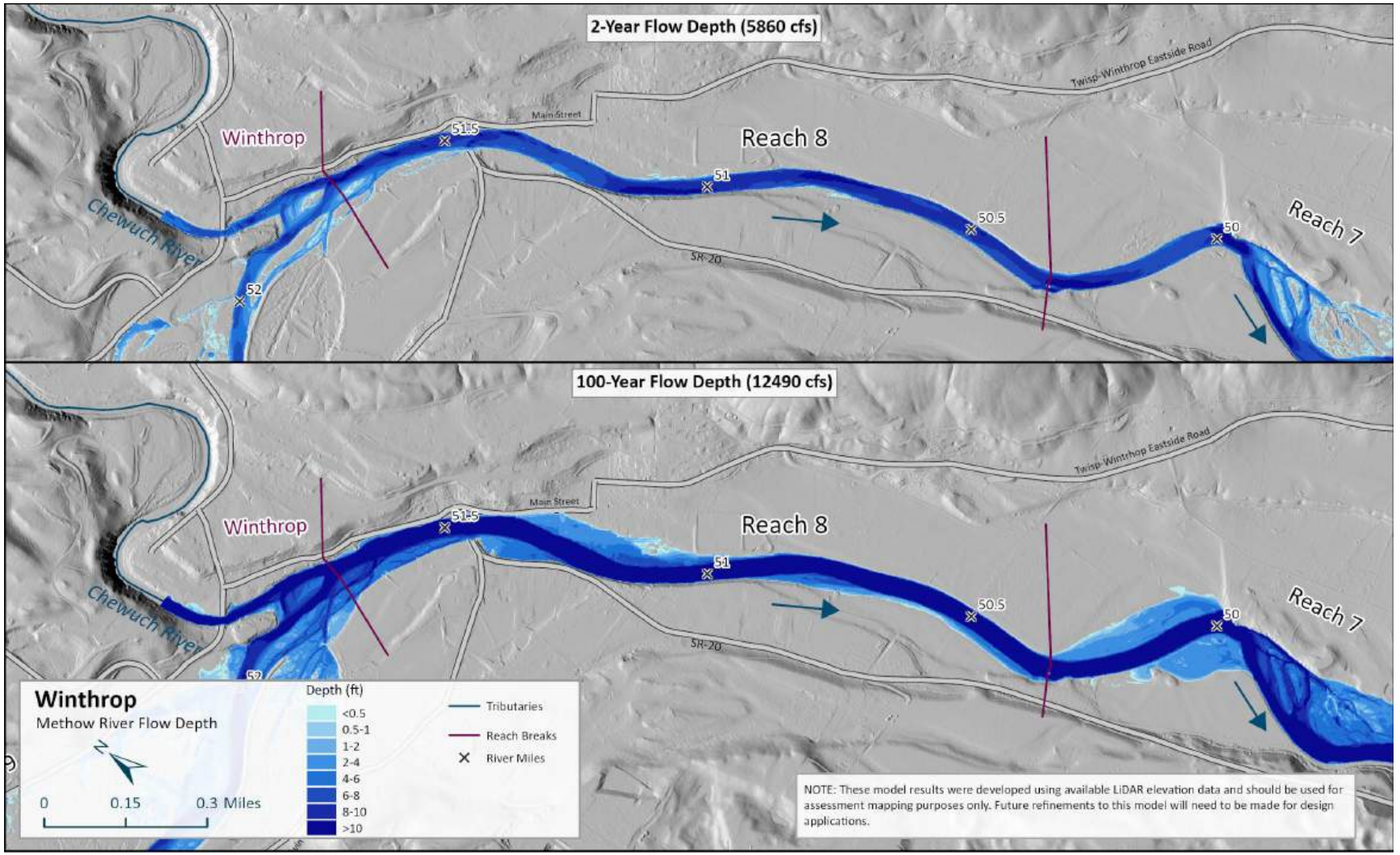


Figure 97. Segment 5 (Winthrop): Preliminary hydraulic model (Hec-Ras 2D) depth results for the estimated 2-yr and 100-yr flood event. See Appendix D for more information.

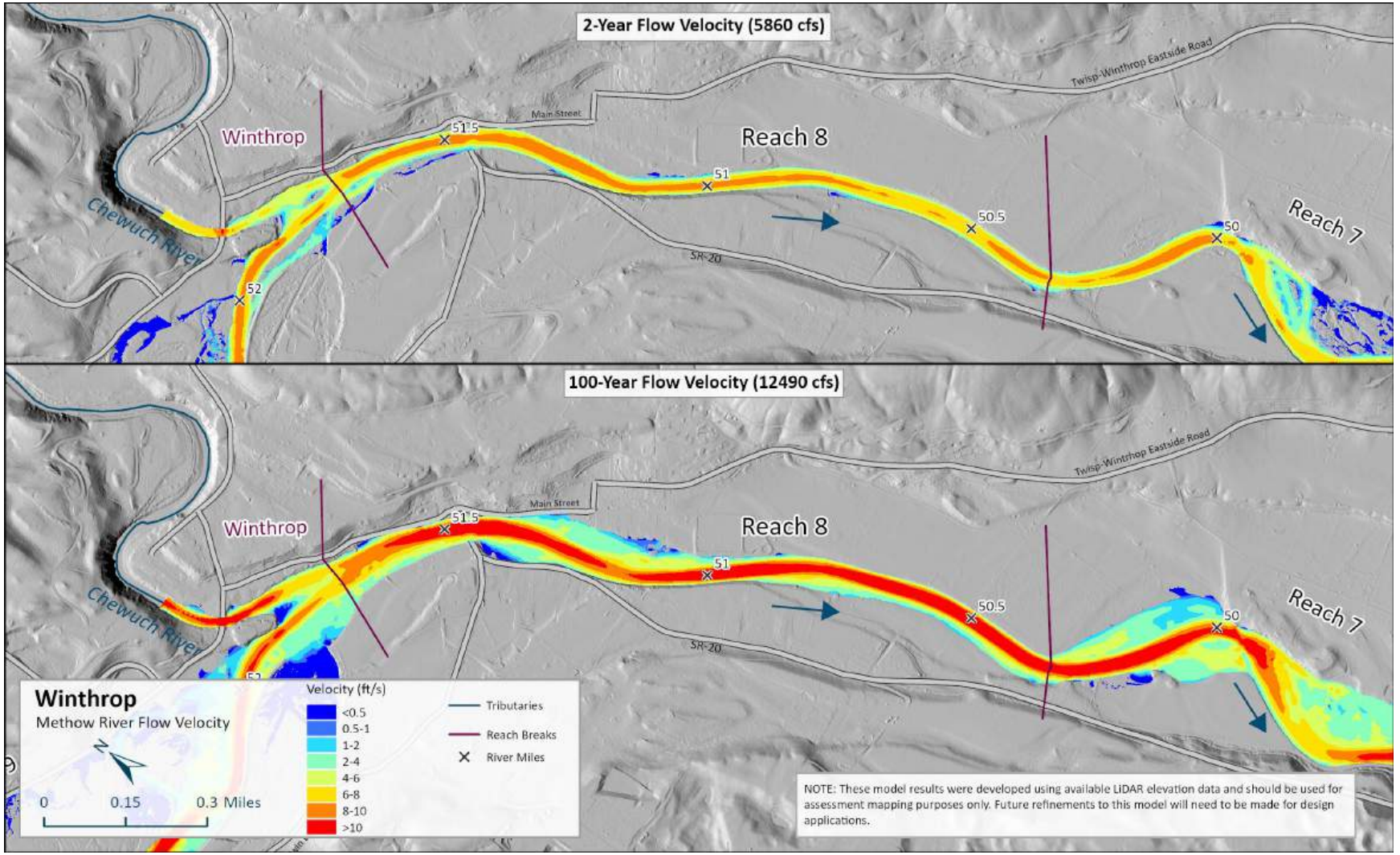


Figure 98. Segment 5 (Winthrop): Preliminary hydraulic model (Hec-Ras 2D) flow velocity results for the estimated 2-yr and 100-yr flood event. See Appendix D for more information.

6.5.3 Large Wood Material

The role of large wood in Segment 5 (Winthrop) has been diminished by channel clearing and vegetation removal. During the 2024 Habitat Survey (see Appendix A) a total of 49 individual pieces of wood and an additional 2 log jams (3+ logs) were recorded through the segment. One of the log jams was constructed. The natural wood that was present occurred as rafted logs along the bank margins and provided little to no geomorphic utility to the channel or to habitat function. A photo of bank-rafted margin wood is provided in Figure 99. A map of the distribution of large wood observed in the reach during the 2024 survey is provided as Figure 100. It is assumed that unballasted large wood was and potentially still is removed from the channel, depending on perceived risk to infrastructure and recreational safety requirements.



Figure 99. Bank-rafted pieces of large wood on river left at RM 50.9. July 13, 2025

Large wood recruitment potential in this segment is poor because its impaired riparian forest condition, generally straight channel form, and confinement that minimizes lateral processes. Where riparian vegetation exists, it is often a narrow, sparse band of trees and shrubs. The existing riparian forests along the banks are generally not mature thus, contributions that do occur are not expected to provide substantial or long-term geomorphic influence or habitat function, especially in a transport-effective and simplified channel form like Segment 5.



Figure 100. Segment 5 (Winthrop): Distribution of large wood per mapped habitat unit and location of jams (> 3 pieces), natural and constructed - from 2024 Habitat Survey (see Appendix A)

6.5.4 Vegetation

Riparian vegetation in Segment 5 (Winthrop) occupies a very narrow and often sparse band along the banks of the channel. It is presumed that historically the valley floor and channel banks were vegetated with mature (old-growth) native conifer and deciduous forests, prior to Euro-colonial clearing and development. The modern riparian forest is a single strip of trees and shrubs. Where riparian forests occur, the dominant overstory is cottonwood and alder with ponderosa pine present along the higher terrace surfaces. A few of the ponderosa are mature. The understory is primarily willow, dogwood, alder, small cottonwood, grasses, and forbs. A representative photo of the riparian vegetation in this segment is shown in Figure 101. The width of the mainstem channel compared to the modern riparian forest tree size results in minimal shade provided to the mainstem by the existing riparian vegetation. Vegetation distribution and height-classification along the channel, valley floor, and adjacent hillslopes in this segment are mapped in Figure 102.



Figure 101. Segment 5 (Winthrop): Representative riparian vegetation - narrow band of trees. RM 50.7. July 12, 2025

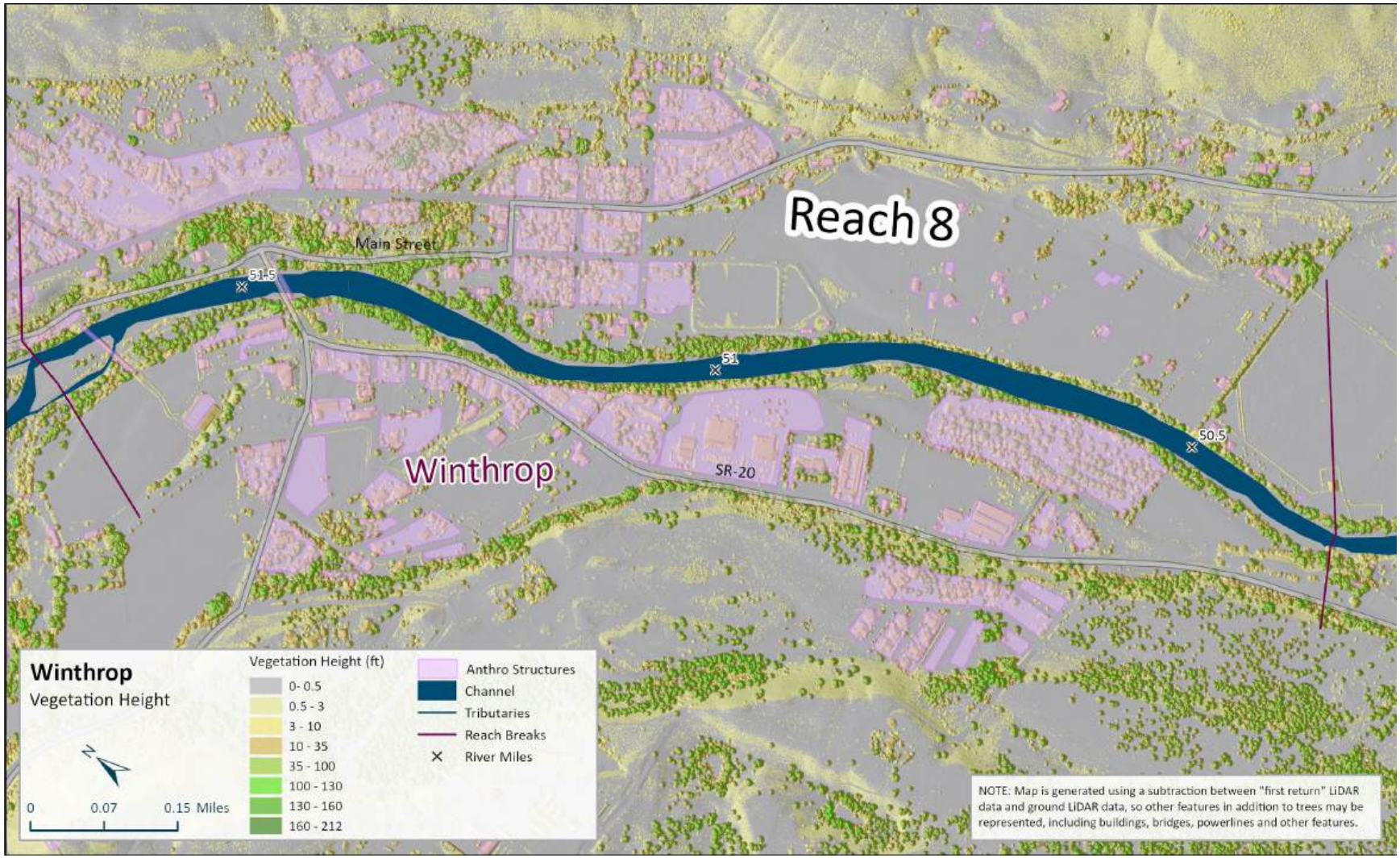


Figure 102. Segment 5 (Winthrop): Vegetation height and distribution map.

6.5.5 Past and Planned Restoration Projects

The past and planned restoration projects reported or observed in Segment 5 are listed in Table 16. See map of the past and planned projects in Figure 103.

Table 17. List and description of reported past and planned projects in Segment 5 (Winthrop).

Year	Name	Sponsor	Area of coverage	Project Components
2013	Winthrop Confluence Project Riparian	MSRF	Reach 8; RM 51.64	Large wood structure; Riparian vegetation

The only reported and observed past restoration project in this segment is the Winthrop Confluence large wood structure and riparian vegetation project (2013) on river left at RM 51.64. The wood structure is ballasted via burial to the bank and riparian vegetation has established around it.



Figure 103. Segment 5 (Winthrop): Past and planned restoration projects map.

6.5.6 Project Opportunities

Recreational use and infrastructure constraints related to the town of Winthrop are present and assumed to persist in Segment 5. They will continue to impact the long-term trajectory of the channel and influence the types and extent of project opportunities in this segment. Potential actions proposed in this segment include enhancement/improvement of channel complexity via bank-buried or ballasted large wood structure and riparian revegetation, especially in the over-simplified downstream portion of the segment. At the upstream end of the segment, prioritization of connectivity and habitat improvements to the Spring Creek/Hatchery Canal side channel outlet/delta is recommended. A description of the project opportunities and a map showing general locations are provided in Appendix C – Project Opportunities and Restoration Strategy.

6.6 SEGMENT 6: HATCHERY (RM 51.7 – 54.4)

6.6.1 Overview

Segment 6 (Hatchery) extends from the Chewuch River confluence at RM 51.7 up to the Wolf Creek confluence at RM 54.5. General metrics of the reaches in this segment are provided in Table 17. The channel is partially confined to confined by terraces, alluvial fans, and anthropogenic development. Channel planform is straight to low sinuosity meandering. Bedload is dominated by small boulders and cobble with sparse gravel. Channel unit type is a simplified riffle-glide in Reach 10 and pool-riffle-glide in Reach 9. Representative photos of this segment are provided in Figure 104. The quantity of large wood surveyed is low and does not meet habitat requirements. Riparian vegetation density and composition are in poor condition. Reported past and planned projects (2013-2027) in this segment are limited to improvements made to the Foghorn diversion structures in the middle of the segment and a small bank treatment with large wood at RM 52.65. The existing infrastructure and development within the segment will limit the types of restoration treatment options considered.

Table 18. Metrics table for Reach 9 and Reach 10.

Hatchery	Length (miles)	River Mile	Stream Gradient (%)	Sinuosity	Dominant Channel Habitat Unit Type	Average Bankfull Width (ft)	Confinement	Dominant Substrate	% Pool Habitat	% Glide Habitat	% Riffle Habitat	% Side Channel Habitat
Reach 9	1.5	51.7-53.2	0.25%	1.08	Pool	176.0	Partially Confined	Boulder	42%	22%	34%	2%
Reach 10	1.3	53.2-54.5	0.52%	1.06	Glide	140.5	Confined	Cobble	25%	49%	26%	0%



Figure 104. Representative photos of Segment 6 – Hatchery: A) Reach 9 at RM 52.2 looking downstream; B) Reach 10 at RM, looking downstream at RM 53.6. July 12, 2025

Channel processes in Segment 6 (Hatchery) have been and continue to be impacted by anthropogenic features and land management (Figure 105). The US Fish and Wildlife Service operates the Methow State Fish Hatchery, located on the river-right side floodplain. The hatchery is supplied by water (18 cfs from the mainstem Methow River) via the Foghorn Diversion (RM 53.2) and ditch. According to the USFWS, the hatchery was constructed by the US Bureau of Reclamation between 1940-1994 and has been releasing fish since 1943 (USFWS, 2011). The diverted water is used at the hatchery for a multitude of purposes and excess is returned to the mainstem downstream (Figure 106). An additional 25cfs of surface water for irrigation (May – October) is withdrawn from the mainstem channel at the Foghorn diversion and managed by the Douglas County public utility district. The Foghorn diversion is a rock and cement structure that impounds the mainstem Methow River. Some of the rock elements have adjusted positions and woody debris was rafted on it during the 2025 assessment survey. An evaluation of the diversion, its potential impacts to aquatic species, and alternatives for withdrawal and fish passage are recommended.

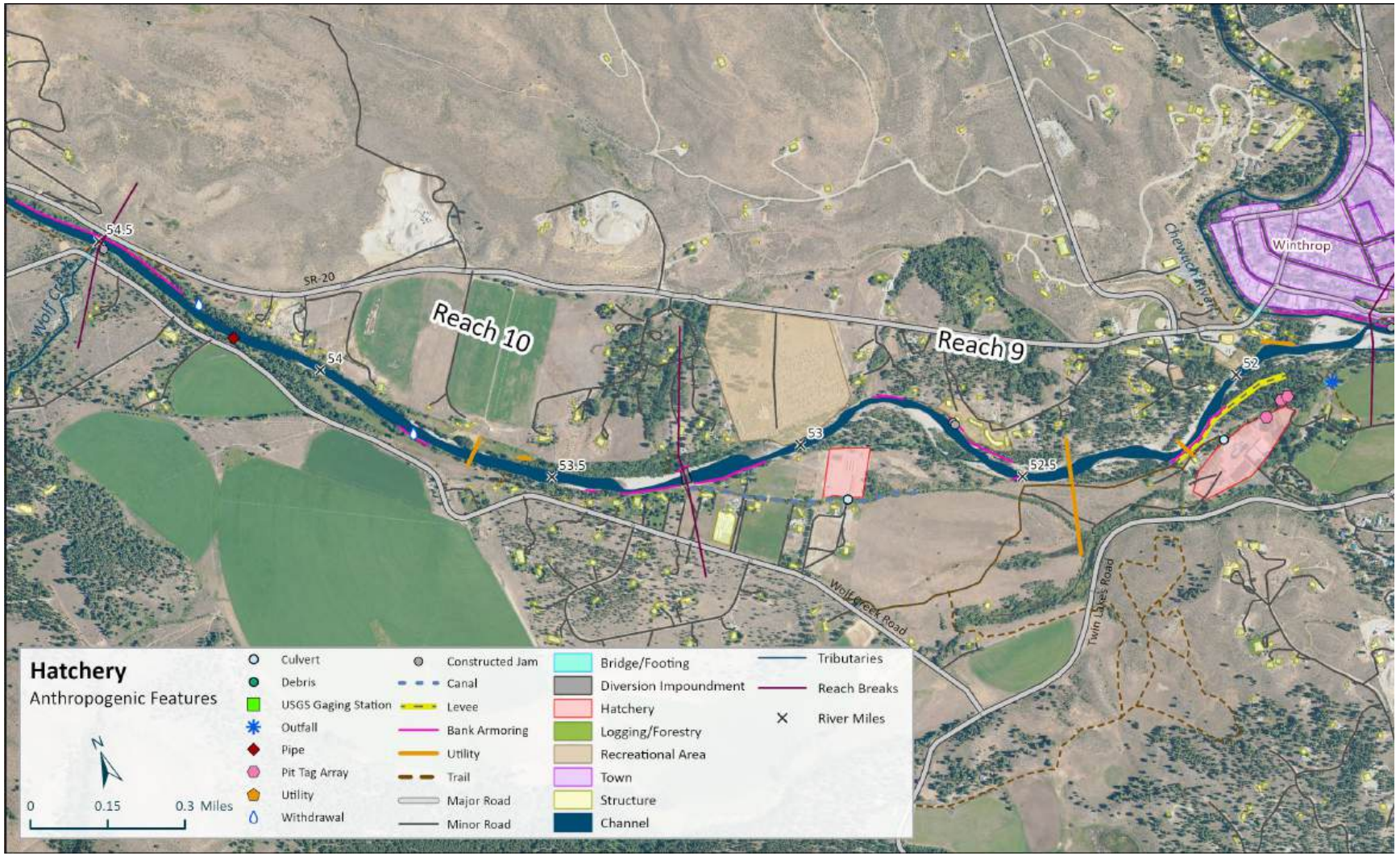


Figure 105. Segment 6 (Hatchery): mapped anthropogenic features.



Figure 106. Fish Hatchery ladder connected to canal. July 14, 2025



Figure 107. Foghorn Diversion Impoundment Structure at RM 53.25 – from downstream of the structure looking upstream. July 12, 2025

Used and excess water from the Methow Valley Fish Hatchery and the county PUD irrigation control facility (also located on the river right floodplain) is returned to the mainstem channel through constructed canals. The constructed Hatchery Canal has sections that are cement lined, facilitate crossings, include fish exclusions and counters, and eventually earthen banks (Figure 108). Once the return flow reaches the floodplain of the Methow, the canal intersects Spring Creek and a

seasonal side channel prior to reaching the mainstem channel again at RM 51.5 (in Segment 5). During the 2025 survey, up-migrating fish were observed in the canal. The ditched return flow from the PUD facility is a much smaller ditch that intersects with a seasonal side channel on the river's floodplain before returning to the mainstem channel at RM 52.6.



Figure 108. Fish Hatchery canal/channel on river right floodplain: A) concrete canal at hatchery facility near fish screen; B) constructed canal channel that intersects Spring Creek and a seasonal side channel on the floodplain before flowing to the mainstem channel in Segment 5. July 14, 2025

Along the mainstem channel, bank armoring with boulder riprap, installed with the intent of protecting infrastructure and private property, impedes lateral processes in several locations. Bank armor and bank toe reinforcement with boulders occurs at RM 52.1 – 52.25 on river right in front of a floodplain levee, RM 52.5 on river right and RM 52.5 – 52.75 on river left, 52.8 on river left, at RM 53.1 – 53.4 on river right (including the Foghorn diversion structures), on river right at RM 53.25 – 53.3, and as boulder reinforcement associated with the SR 20 road prism on river left at RM 54.35 – 54.65. Examples of riprap and boulder bank armoring in Segment 6 are provided as photos in Figure 109.

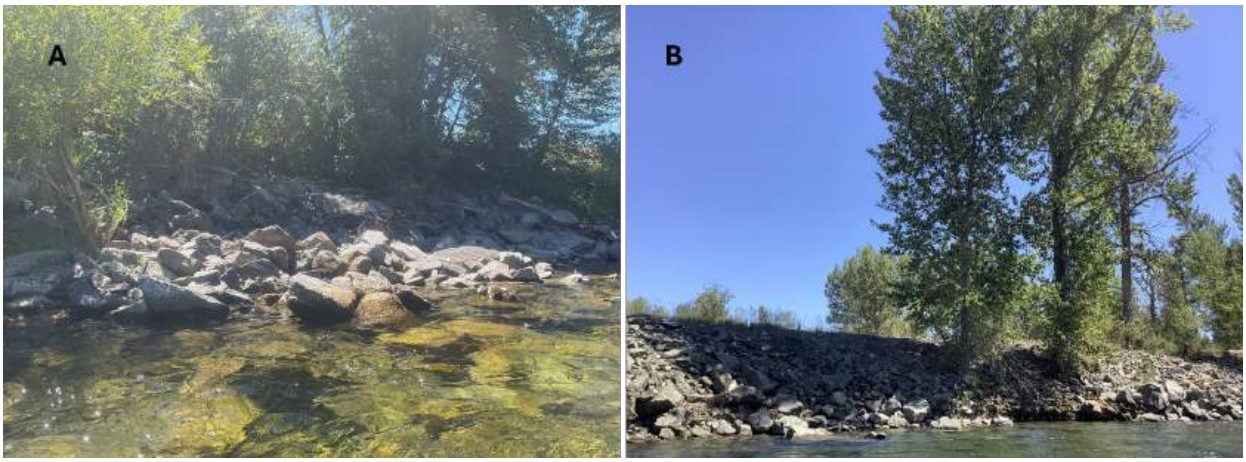


Figure 109. Examples of riprap armored channel banks: A) river right at RM 52.2; B) river left at RM 52.8

6.6.2 Channel and Floodplain Geomorphology

Segment 6 (Hatchery) is a straight to low sinuosity channel. Channel habitat units mapped in the 2024 survey reveal a pool-riffle-glide channel type. Within Segment 6, pools occupied 33.5% of the available habitat, glides 35.5%, riffles 30%, and side channels approximately 1% (Figure 110). Most of the pools are of low habitat complexity and depth, with the exception of the scour pool downstream of the Foghorn diversion structure which lacks habitat complexity and cover.

Off-channel refugia in Segment 6 currently includes two seasonal groundwater and facility return-flow supplemented side channels. The side channels are connected to the mainstem channel at the upstream end during high-flow events. Connection at the downstream end of the side channels to the mainstem is perennial. Although a short portion of the Hatchery Canal/Spring Creek seasonal side channel is in Segment 6 the majority of the channel including the outlet is in Segment 5. This side channel was receiving return flow from the Hatchery and hyporheic groundwater through the floodplain at the segment boundary in July of 2025 (Figure 111). It was broad, lined with reed canary grass, and hosting up-migrating salmon. The other existing side channel is similarly hydrologically supported by hyporheic groundwater and PUD canal return flow with its outlet on river right at RM 52.6. The banks of this side channel have been colonized by reed canary grass (Figure 112). Both existing side channels have potential for off-channel habitat uplift and perennial connectivity.

Other existing high-flow side channels that should be evaluated for improved connectivity and development of off-channel habitat are located on the river left floodplain near RM 52 – 52.4, a small pocket floodplain on river right near RM 52.4, potentially on river left around the Foghorn diversion structures at RM 53.1-53.4, and through river left and river right floodplains between RM 53.5 – 54.

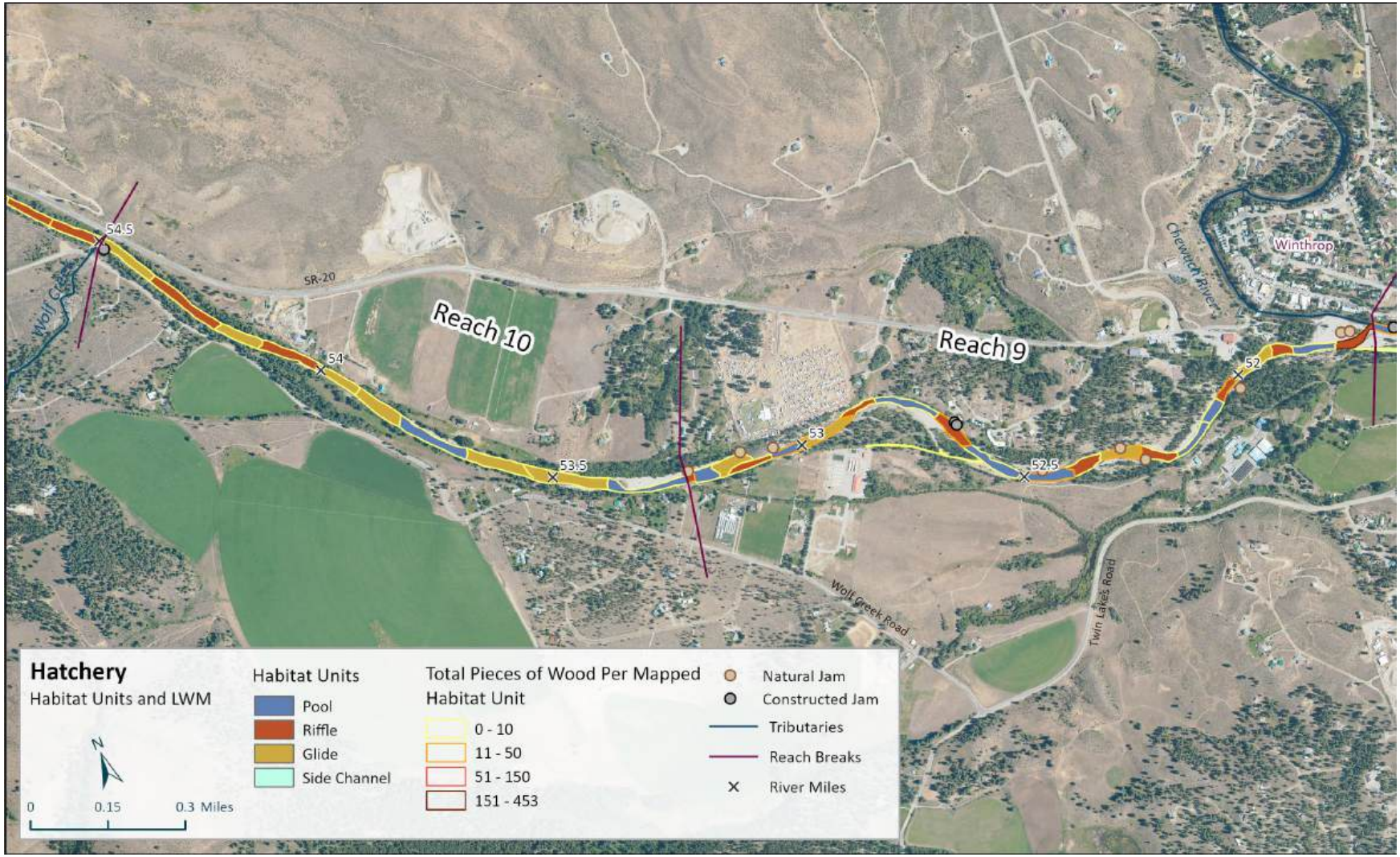


Figure 110. Segment 6 (Hatchery): mapped habitat units with large wood quantities of each unit delineated - Habitat Survey, 2024



Figure 111. Side channel sourced from hyporheic, groundwater, and Hatchery Canal return flow - on river right at RM 51.7. July 12, 2025



Figure 112. Side channel sourced from hyporheic, groundwater, and PUD return flow - on river right floodplain with outlet at RM 52.6. July 12, 2025

Floodplains in Segment 6 are composed of alluvial boulders, cobbles, and gravels topped with sandy-loam. The one bedrock bank contact on river left at RM 51.95 is a natural hard point that defines the confluence of the Chewuch River at the downstream end of the segment. The modern channel is confined in Reach 10 and partially confined in Reach 9. It is in a state of entrenchment (incised) below abandoned floodplain surfaces and glacial outwash terraces, though the segment rests in a relatively wide valley (Figure 110). Combined with prevalent bank armoring, the channel is expected to perpetuate a trend of simplification and floodplain disconnection in response to the imposed confinements.

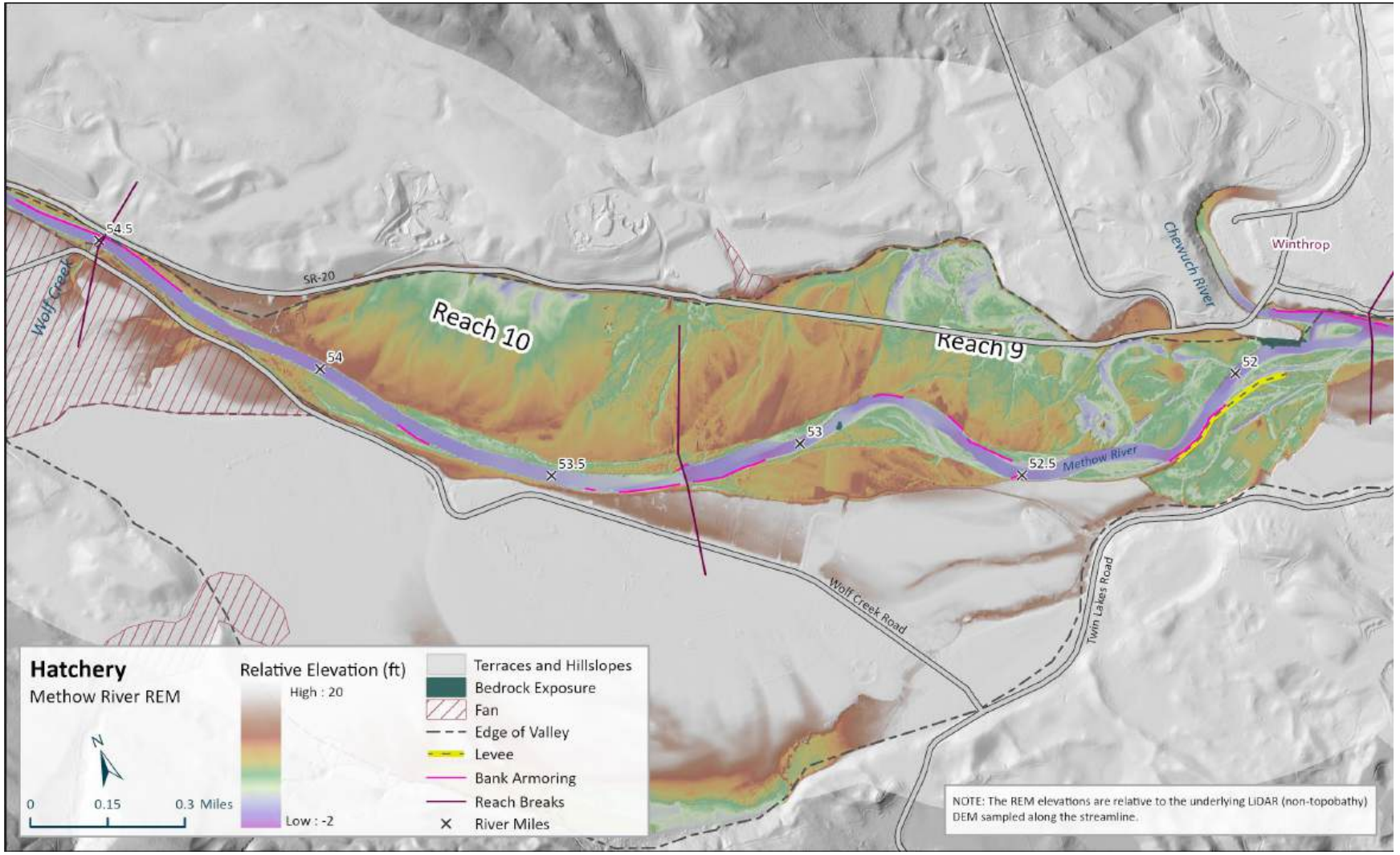


Figure 113. Segment 6 (Hatchery): Relative elevation map of floodplain and channel with confining fans, bedrock, terraces, roads, and levees identified.

Bedload in Segment 6 (Hatchery) is dominated by small boulders with plentiful cobbles and gravel in Reach 9 and primarily cobbles in Reach 10. The bars throughout the segment are composed mostly of cobbles with gravel. The difference in bedload material size compared to depositional bar material size suggests that sediment is transported (gravel and cobble) through the reach more frequently than the bed material (small boulders) is mobilized.

Preliminary hydraulic modeling results reinforce that the bank armoring and modern entrenchment and confinement limit floodplain connectivity, especially at the upstream end (Figure 114). Model results also show side channel activation during floods, supporting the recommendation to consider improved side channel activation to increase the quantity and quality of off-channel habitat. Modeled flood velocities of the 2-yr estimated event reveal that the channel is capable of mobilizing cobble-sized material relatively regularly (Figure 115). Segment 6 (Hatchery) is considered a transport-dominant section of the channel. When the Foghorn Diversion Structure is evaluated, its influence on sediment storage (upstream) and transport capacity should be considered.

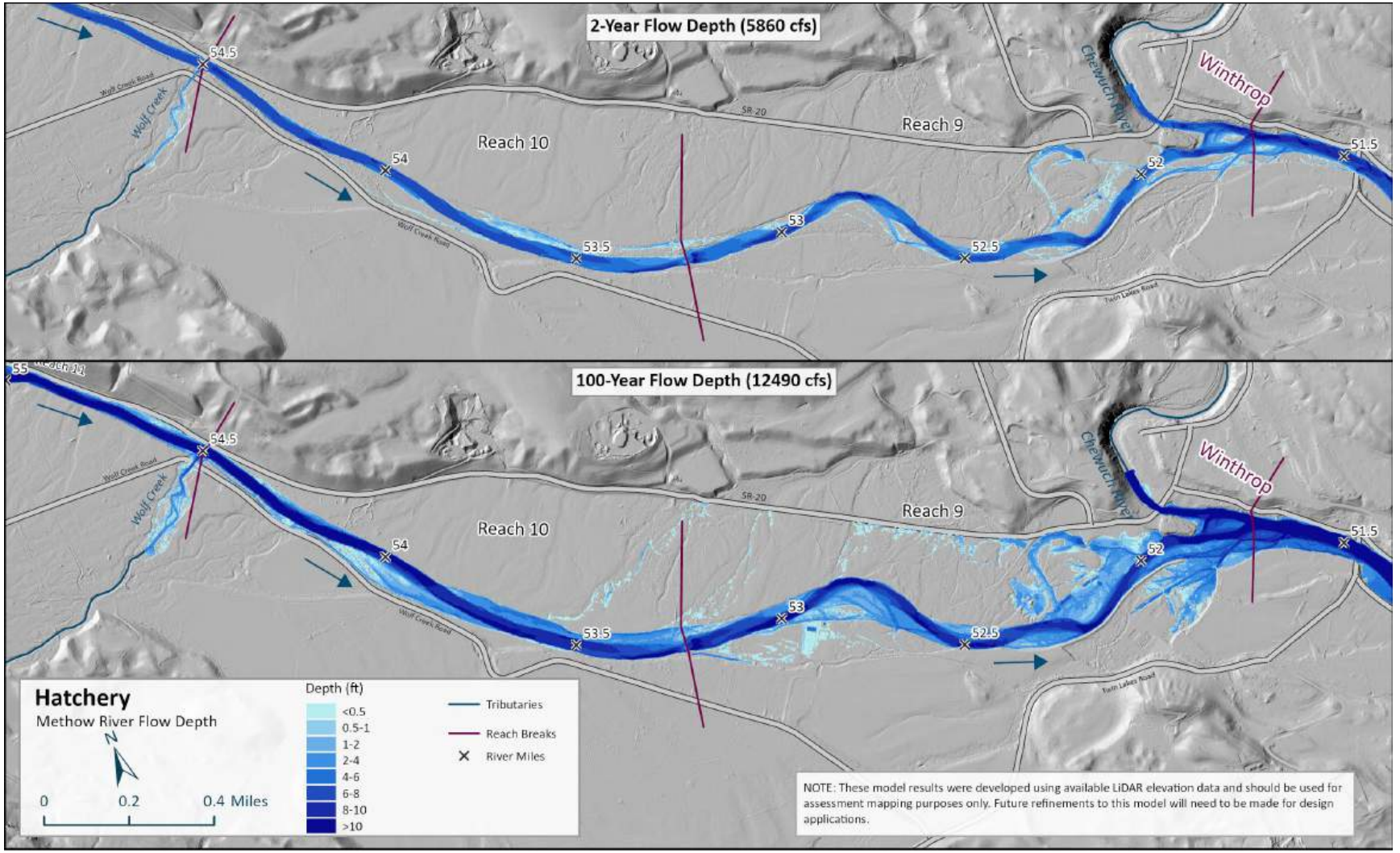


Figure 114. Segment 6 (Hatchery): Preliminary hydraulic model (Hec-Ras 2D) depth results for the estimated 2-yr and 100-yr flood event. See Appendix D for more information.

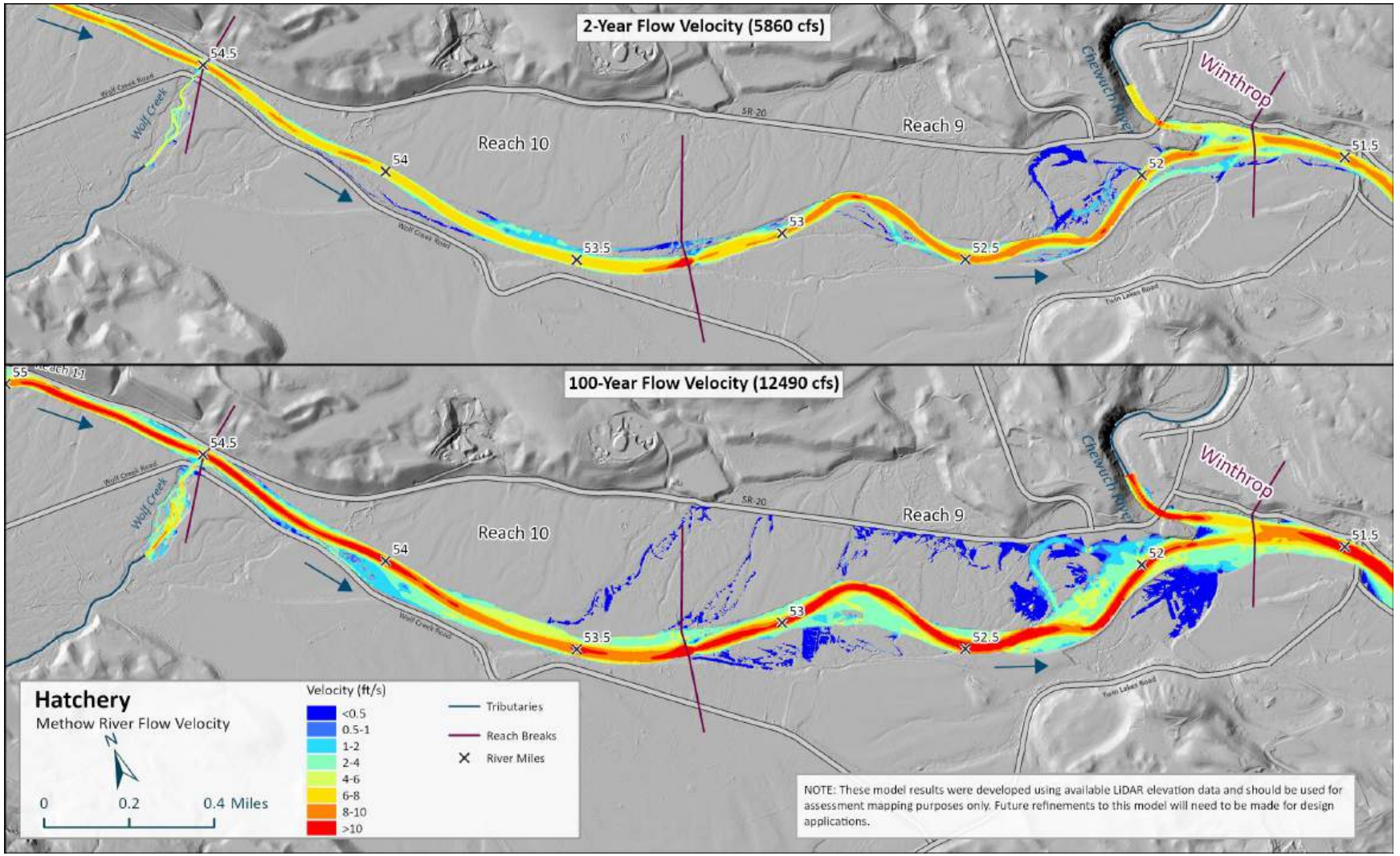


Figure 115. Segment 6 (Hatchery): Preliminary hydraulic model (Hec-Ras 2D) flow velocity results for the estimated 2-yr and 100-yr flood event. See Appendix D for more information.

6.6.3 Large Wood Material

The role of large wood in Segment 6 (Hatchery) has been diminished by channel clearing and vegetation removal. During the 2024 Habitat Survey (see Appendix A) a total of 106 individual pieces of wood and an additional 11 log jams (3+ logs) were recorded through the segment. Three of the log jams were constructed bank-ballasted structures. The natural wood that was present occurred as rafted logs along the bank margins and provided little to no geomorphic utility or habitat function to the channel. Pieces of rafted wood were observed on the riprap boulders that impound the channel at the Foghorn Diversion structures (Figure 116). A map of the distribution of large wood observed in the reach during the 2024 habitat survey is provided as Figure 117. It is assumed that unballasted large wood was and potentially is still periodically removed from the channel, depending on perceived risk to infrastructure.



Figure 116. Rafted bank-margin large wood piece(s) on river left at RM 52.3. Oct 13, 2024

Large wood recruitment potential in this segment is poor because of the impaired riparian forest condition, generally straight channel form, and confinement (natural and anthropogenically imposed) that minimizes lateral processes. Where riparian vegetation exists, it is often a narrow band of trees and shrubs. The existing riparian forest is not mature, thus contributions that do occur are not expected to provide substantial or long-term geomorphic influence or habitat function, especially in a transport-effective and simplified channel form like Segment 6.

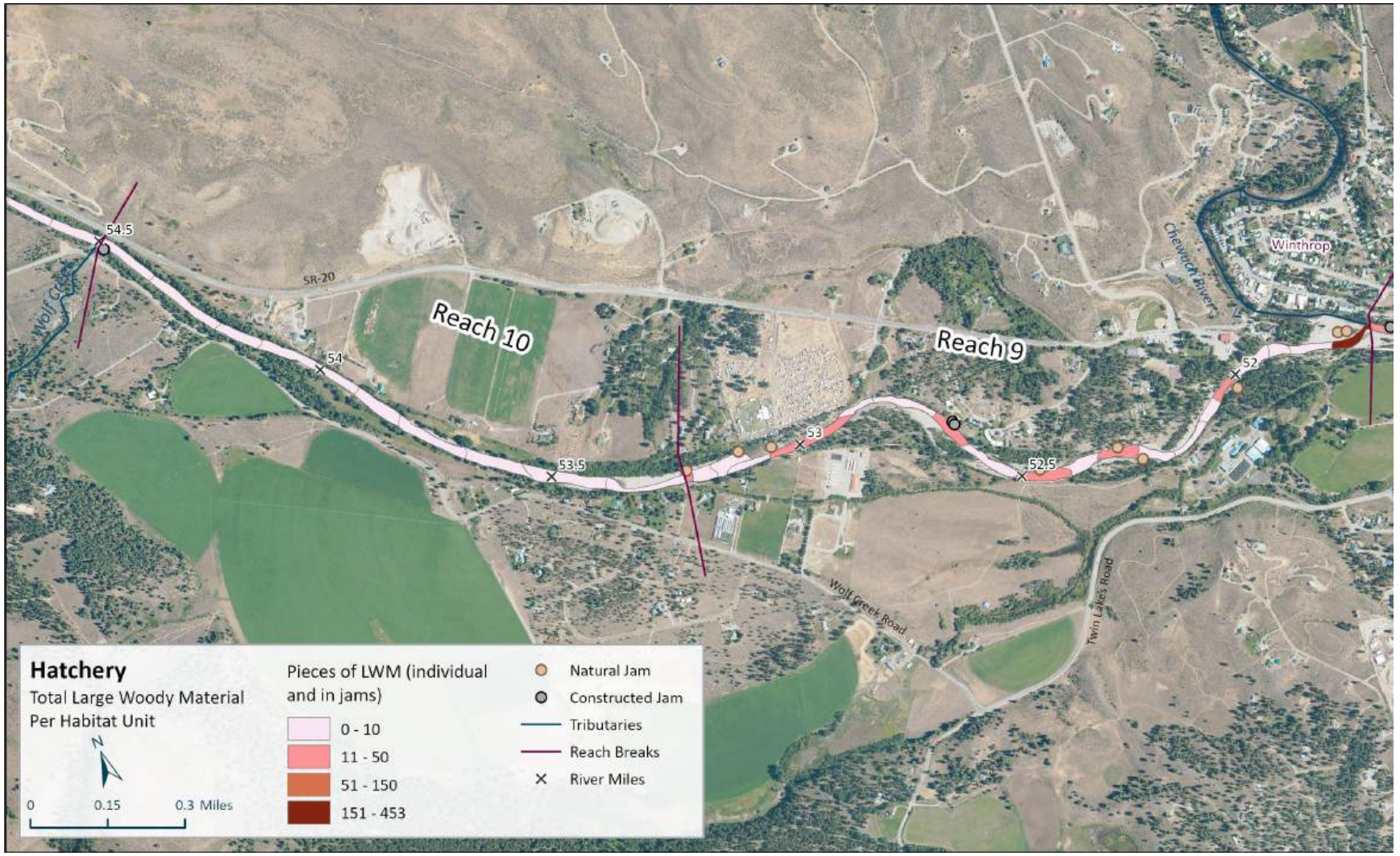


Figure 117. Segment 6 – Hatchery (Reach 9 - 10): Distribution of large wood per mapped habitat unit and location of jams (> 3 pieces), natural and constructed - from 2024 Habitat Survey (see Appendix A)

6.6.4 Vegetation

Riparian vegetation in Segment 6 (Hatchery) occupies the strips of modern inset floodplains and a narrow band along the bank tops. It is presumed that the valley floor and channel banks were vegetated with mature (old-growth) native conifer and deciduous forests, prior to Euro-colonial clearing and development. Where riparian forests do occur, the dominant overstory is small-medium sized cottonwood with small-medium ponderosa pine present along the higher terrace surfaces. The understory is primarily willow, small cottonwood, alder, grasses (dominated by reed canary grass), and forbs. Representative photos of the riparian vegetation in this segment are provided in Figure 118. The width of the mainstem channel compared to the modern riparian forest tree size results in minimal riparian shading of the mainstem. Vegetation distribution and height-classification along the channel, valley floor, and adjacent hillslopes in this segment are mapped in Figure 119.



Figure 118. Segment 6 (Hatchery): Representative riparian vegetation: A) floodplain and bar vegetation on River left at RM 54.5; B) terrace vegetation on river right at RM 54.2 - young ponderosa pine. July 12, 2025

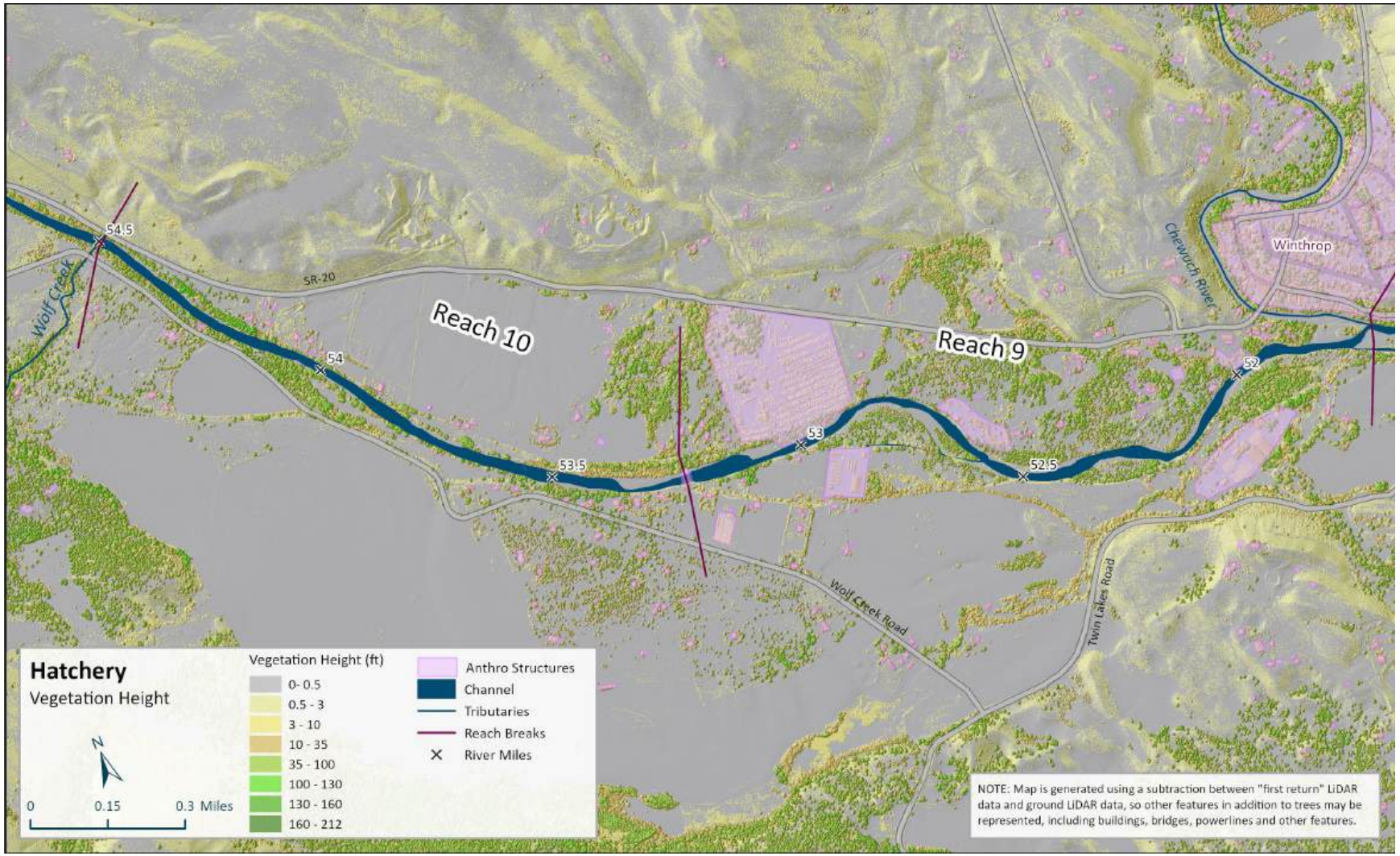


Figure 119. Segment 6 (Hatchery): Vegetation height and distribution map.

6.6.5 Past and Planned Restoration Projects

The past and planned restoration projects reported or observed in Segment 6 are listed in Table 18. See a map of the past and planned projects in Figure 120.

Table 19. List and description of reported past and planned projects in Segment 6 (Hatchery).

Year	Name	Sponsor	Area of coverage	Project Components
1989	Foghorn Diversion Dam	USFWS	Reach 9; RM 53.2	Construction of Foghorn Diversion Dam for Foghorn Irrigation Company
2003	Foghorn Diversion Dam, Fish Screen	USFWS	Reach 9; RM 53.2	Fish Screen installation; Fish passage enhancement
~2011-2015	River Run Inn	Cascade Fisheries	Reach 9; RM 52.65	Ballasted large wood structures in riprap; Bank stability
2025-2028	Foghorn Project	Yakama Nation	Reach 9 and Reach 10; RM 53.15 to RM 53.4	Proposed project with project elements including the relic side channel; Large wood structures; Pool enhancement

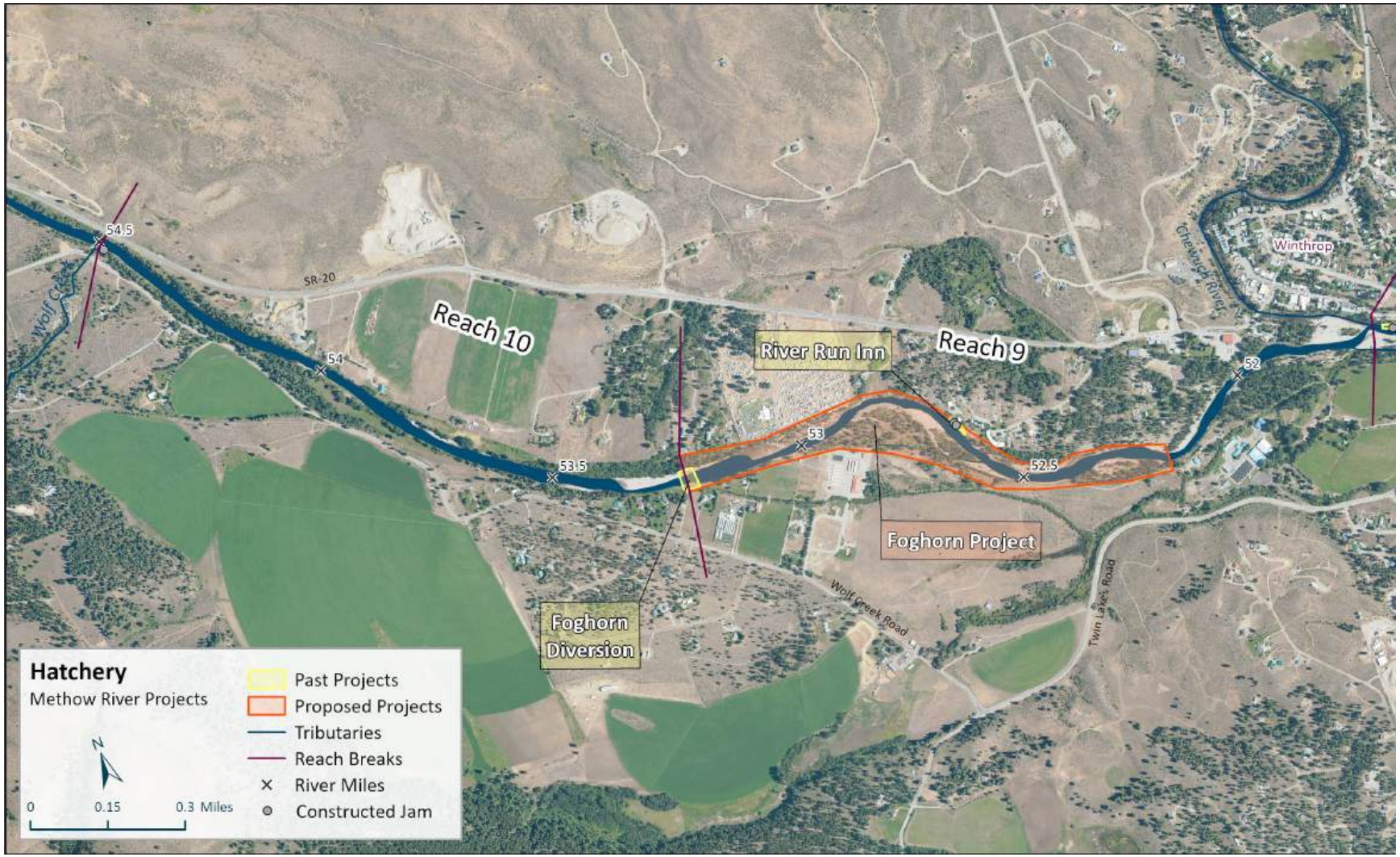


Figure 120. Segment 6 (Hatchery): Past and planned restoration projects map.

Other than the River Run Inn project on river left at RM 53.2, all past and currently planned projects in Segment 6 are associated with or in proximity to the Foghorn Diversion. The River Run project is presumed to have been installed between 2011-2015, but the exact date is not reported. The project included large wood features installed in bank-armoring riprap (Figure 121). The large wood currently does not interact with the channel at low-flow conditions and is providing minimal habitat uplift.



Figure 121. River Run Inn large wood in riprap project on river left at RM 53.2. July 12, 2025

Past project at the Foghorn Diversion and Dam (Figure 122) post installation in 1989, include an improved fish screen and enhanced fish passage (2003). Evaluation of alternatives that would allow for full or partial removal of the impoundment structure would benefit channel and habitat function the most over the long-term. Emphasis on resolving potential fish passage issues and decreasing the amount of infrastructure within the floodway is recommended. Future project opportunities, including the Foghorn Project (2025-2028), will evaluate assessing the potential of activating a side channel through the river left floodplain and around the diversion for improved connectivity and fish-passage, adding large wood structures in appropriate locations along/in the bank, and enhancing the existing pool habitat.



Figure 122. Foghorn diversion structure with woody debris racked on impoundment structure. RM 53.2. July 12, 2025

6.6.6 Project Opportunities

Existing infrastructure constraints will continue to impact the long-term trajectory of the channel and influence the types and extent of project opportunities that can be installed in this segment, especially if the Foghorn Diversion remains in place. Potential actions proposed in this segment include localized mainstem habitat uplift with bank ballasted large wood, riparian native vegetation establishment, and side channel creation, activation, and habitat uplift,. Opportunities to remove riprap that is no longer necessary or replace riprap with large wood should be considered. Where it is assumed that bank armoring will remain in place, adding large wood habitat enhancement structures is recommended. The opportunity to improve connectivity and available habitat in the Spring Creek/Hatchery Canal side channel is a priority project. The Hatchery Canal/Spring Creek side channel was identified as cold-water refugia (see Section 3.2.5) and prioritized. The potential to remove or improve the Foghorn Diversion dam should be evaluated, as should a potential fish-passable side channel around the diversion and impoundment. A description of the project opportunities and a map showing general locations are provided in Appendix C – Project Opportunities and Restoration Strategy.

6.7 SEGMENT 7: WOLF (RM 54.5-55.4)

6.7.1 Overview

Segment 7 (Wolf) is equivalent to Reach 11 and extends from the Wolf Creek confluence at RM 54.5 to the upstream border of the Wolf Creek alluvial fan terrace at RM 55.4. General metrics of the reach in this segment are provided in Table 19. The channel is confined by the fan terrace on river right and by a glacial terrace hillslope on river-left. The hillslope confinement on the left is exaggerated by the SR 20 road prism and boulder reinforcements. Channel planform is straight. Cobble bars occur at the upstream end. No perennial side channels currently exist. Bedload is dominated by cobbles with small boulders and gravel present. Channel habitat unit type is riffle-pool-glide. A representative photo of the segment is provided as Figure 123. The quantity of large wood surveyed is low and does not meet habitat requirements. Vegetation density and composition are in poor condition. No past or planned projects (2013-2027) were reported or observed in this segment. The existing downstream infrastructure, proximity of SR 20, and development on the fan surface influence the types of restoration treatment options considered.

Table 20. Metrics table for Segment 7 (Wolf).

Wolf	Length (miles)	River Mile	Stream Gradient (%)	Sinuosity	Dominant Channel Habitat Unit Type	Average Bankfull Width (ft)	Confinement	Dominant Substrate	% Pool Habitat	% Glide Habitat	% Riffle Habitat	% Side Channel Habitat
Reach 11	0.9	54.5-55.4	0.38%	1.05	Riffle	121.8	Confined	Cobble	12%	16%	71%	0%



Figure 123. Representative photo of Segment 10 (Wolf): narrow floodplain on river left / wolf Creek paleo-fan on river right at RM 54.6, looking downstream. July 11, 2025

Channel and floodplain processes, riparian vegetation conditions, and habitat availability in Segment 7 (Wolf) have been and continue to be impacted by anthropogenic features and land management. The Methow River through Segment 7 was historically cleared for log drives to downstream mills and potentially dredged for flood control. The SR 20 road prism that runs adjacent to the channel on the river left side exaggerates confinement and disconnects the channel from direct contributions or recruitment of hillslope sediment. The toe of the road prism is reinforced with boulders at RM 54.5 – 54.7 and RM 54.8 – 54.9 (Figure 124). A map of anthropogenic features in Segment 7 is provided as Figure 125.



Figure 124. Boulder armored/reinforced SR 20 road-prism toe on river left at RM 54.9. July 11, 2025

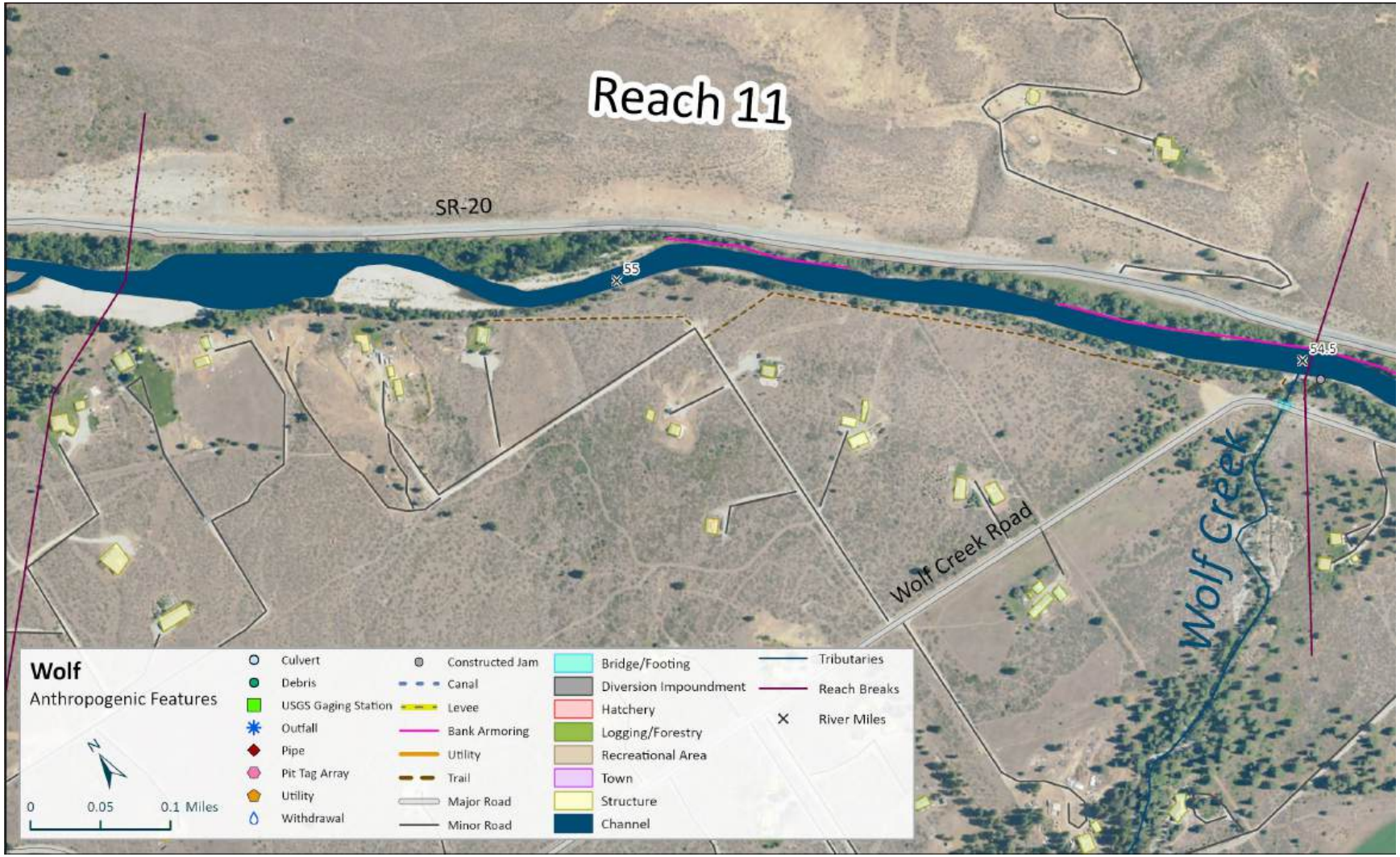


Figure 125. Segment 7 (Wolf): mapped anthropogenic features.

Development (homes, roads, infrastructure) on the Wolf Creek fan over the last 150 years has forced Wolf Creek through one preferred flow route under the Wolf Creek Road bridge and minimizes floodplain connectivity across the fan. Dredging of the creek, bank armoring, and levees have all contributed to the modern simplified condition of the creek, its fan, and its contributions to the Methow River. Wolf Creek now meets the Methow River shortly after passing under the confining Wolf Creek Road Bridge and flowing across a narrow, very simplified confluence delta.

6.7.2 Channel and Floodplain Geomorphology

The Methow River in Segment 7 (Wolf) is straight and confined. Subtle lateral processes combined with sediment inputs from upstream have produced a few bars and initiated slight meandering between RM 55 to RM 55.4. Channel habitat units mapped in the 2024 survey reveal a riffle-pool-glide channel type with extended riffles. Riffles occupied 71% of the available channel habitat, pools 12%, glides 16%. Segment 7 did not contain any side channel habitat (Figure 127). Most of the pools have low habitat complexity and depth. The glides are plane bed and also have very low habitat complexity. The channel is straight, confined, and entrenched below the Wolf Creek fan on its river right side and the SR 20 road prism constructed along the toe of a glacial outwash terrace hillslope on the river left side (Figure 126). Without added complexity, the trend of channel entrenchment and simplification will persist.



Figure 126. Methow River and banks at RM 54.7, looking downstream: straight planform, plane bed glide with cobble and boulder bed, Wolf Creek fan bank on right side with narrow strip of small-medium sized ponderosa pine, and toe of SR 20 on left vegetated with small- medium cottonwoods and shrubs. July 11, 2025

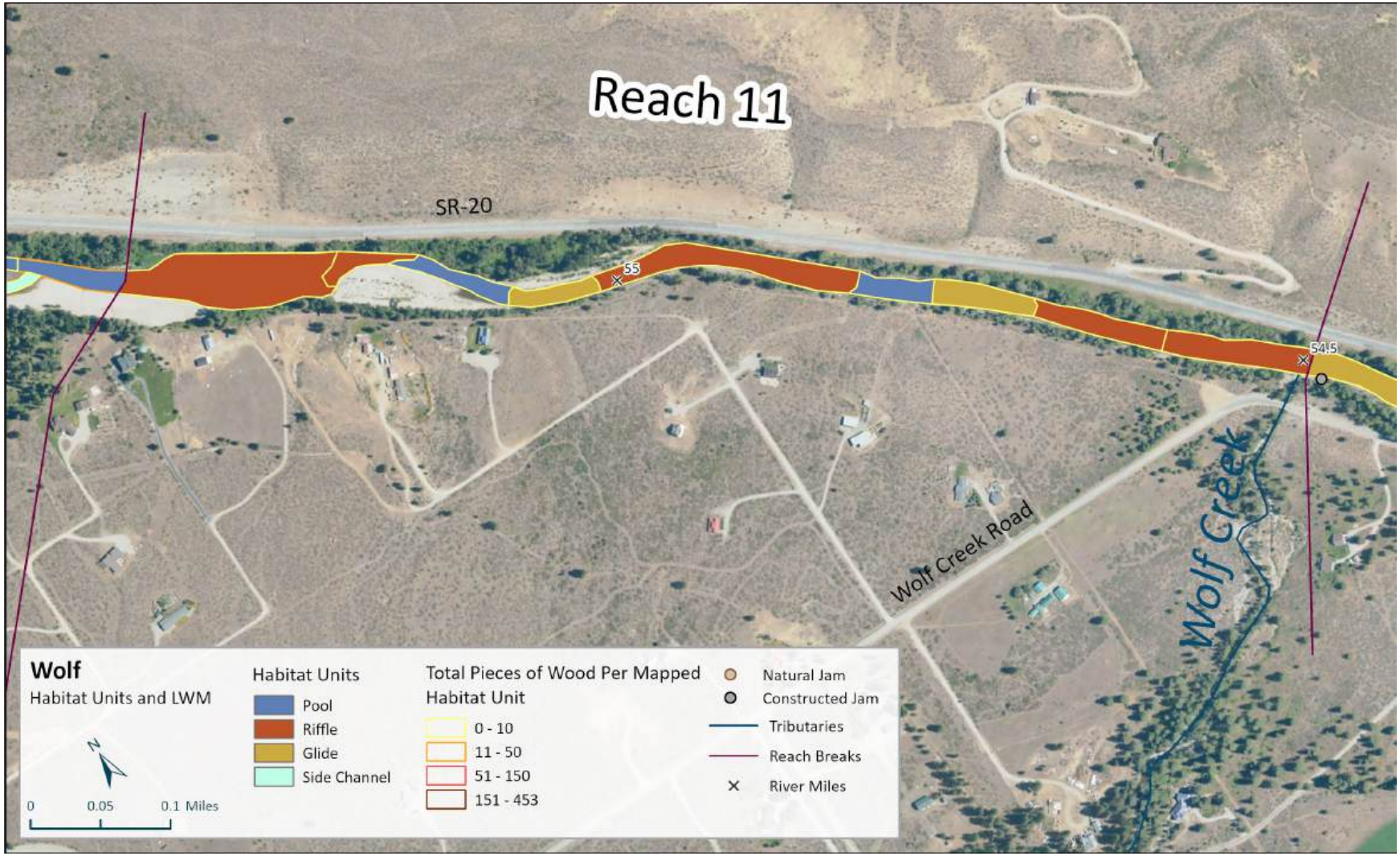


Figure 127. Segment 7 (Wolf): mapped habitat units with large wood quantities of each unit delineated - Habitat Survey, 2024

Bedload in Segment 7 is dominated by cobble-sized material, but small boulders are present throughout and sparse gravels were noted in the wider upstream section. The channel is approximately 230 ft wide in the upstream section, allowing for the formation of cobble bars with small boulders and gravel that are exposed during low-flow conditions. The bars form laterally along the edge of the channel and at mid-channel creating split-flow conditions (Figure 128). No bars formed in the narrower (125 ft wide) downstream section and bed material was embedded.



Figure 128. Mid-channel cobble bar at RM 55.25. July 11, 2025

Floodplains in Segment 7 occur as vegetated, narrow inset pockets composed of alluvial cobbles and small boulders topped with gravels and a thin layer of sandy-loam. The Wolf Creek fan terrace on the river right side is also composed of alluvial cobbles with small boulders at the base and gravelly sand at the top. The fan could provide a good source of sediment for the channel if lateral processes are initiated in the mainstem. State Route (SR) 20 impedes delivery of sediment from the glacial outwash terrace hillslope of cobble with gravels and coarse sand on the river left side of the channel. The relative elevation model map (Figure 129) shows the relationship of the channel to the confining Wolf Creek Fan (river right) as well as the SR 20 road prism and hillslope terrace (river left).

Preliminary hydraulic modeling results show that the modern channel is entrenched below the fan and SR 20 for at least the 100-year flood event (Figure 130). With very little variability in channel form, model results reveal relatively uniform flow hydraulics through the segment. In general, the segment regularly produces flood velocities (2-yr flood event) capable of mobilizing cobble-sized material (Figure 131). Segment 7 (Wolf) is considered a transport reach.

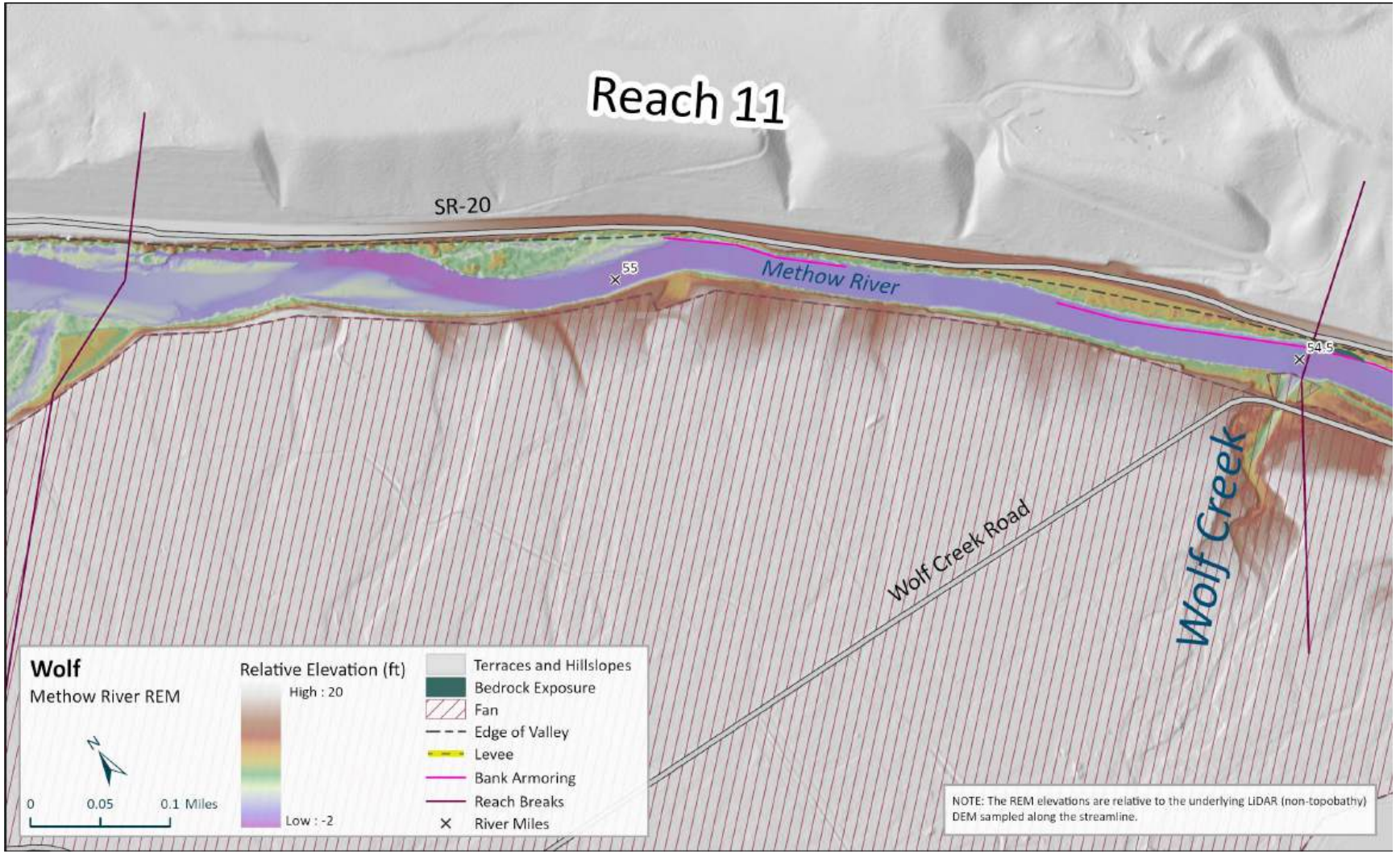


Figure 129. Segment 7 (Wolf): Relative elevation map of floodplain and channel with confining fans, bedrock, terraces, roads, and levees identified.

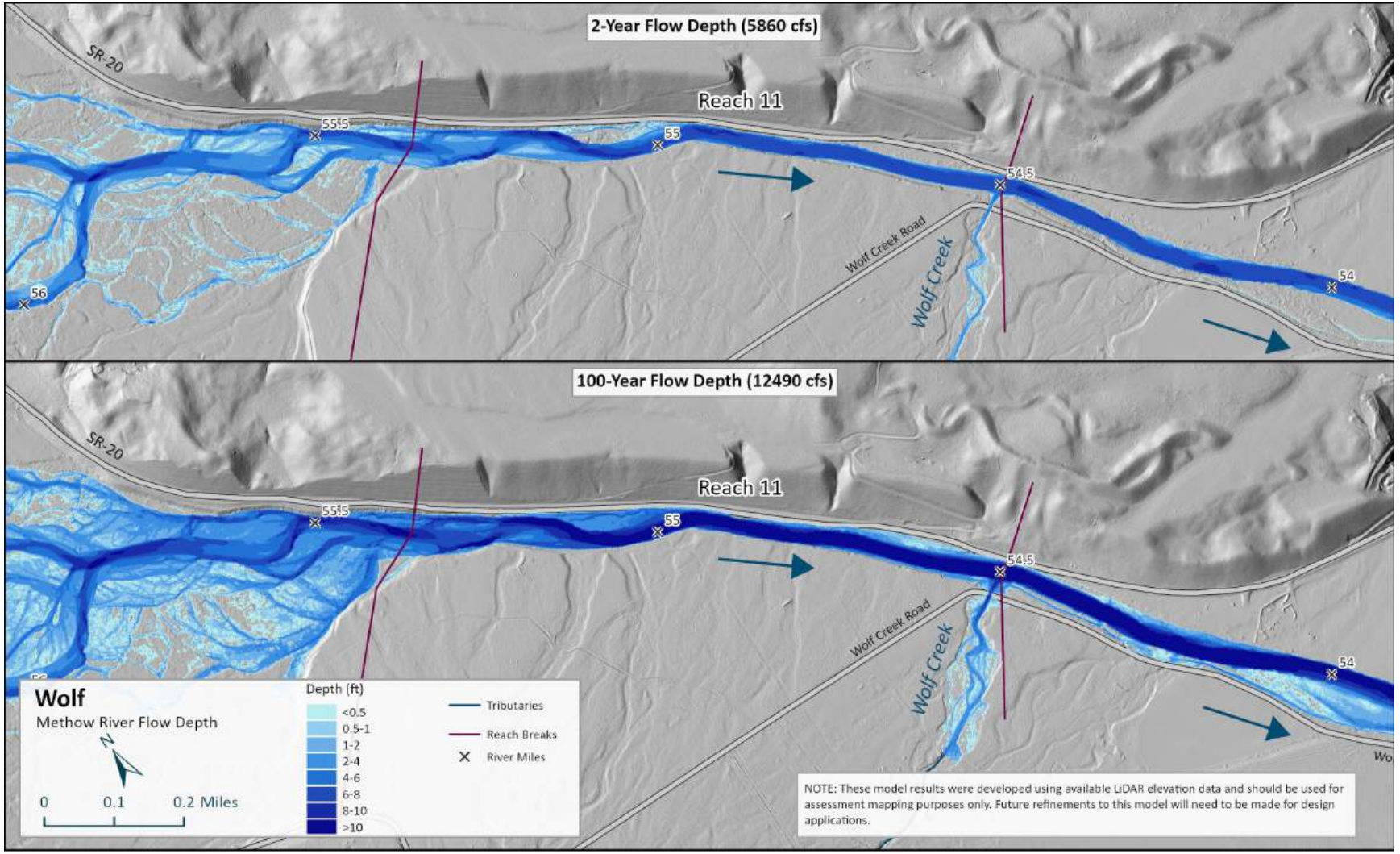


Figure 130. Segment 7 (Wolf): Preliminary hydraulic model (Hec-Ras 2D) depth results for the estimated 2-yr and 100-yr flood event. See Appendix D for more information.

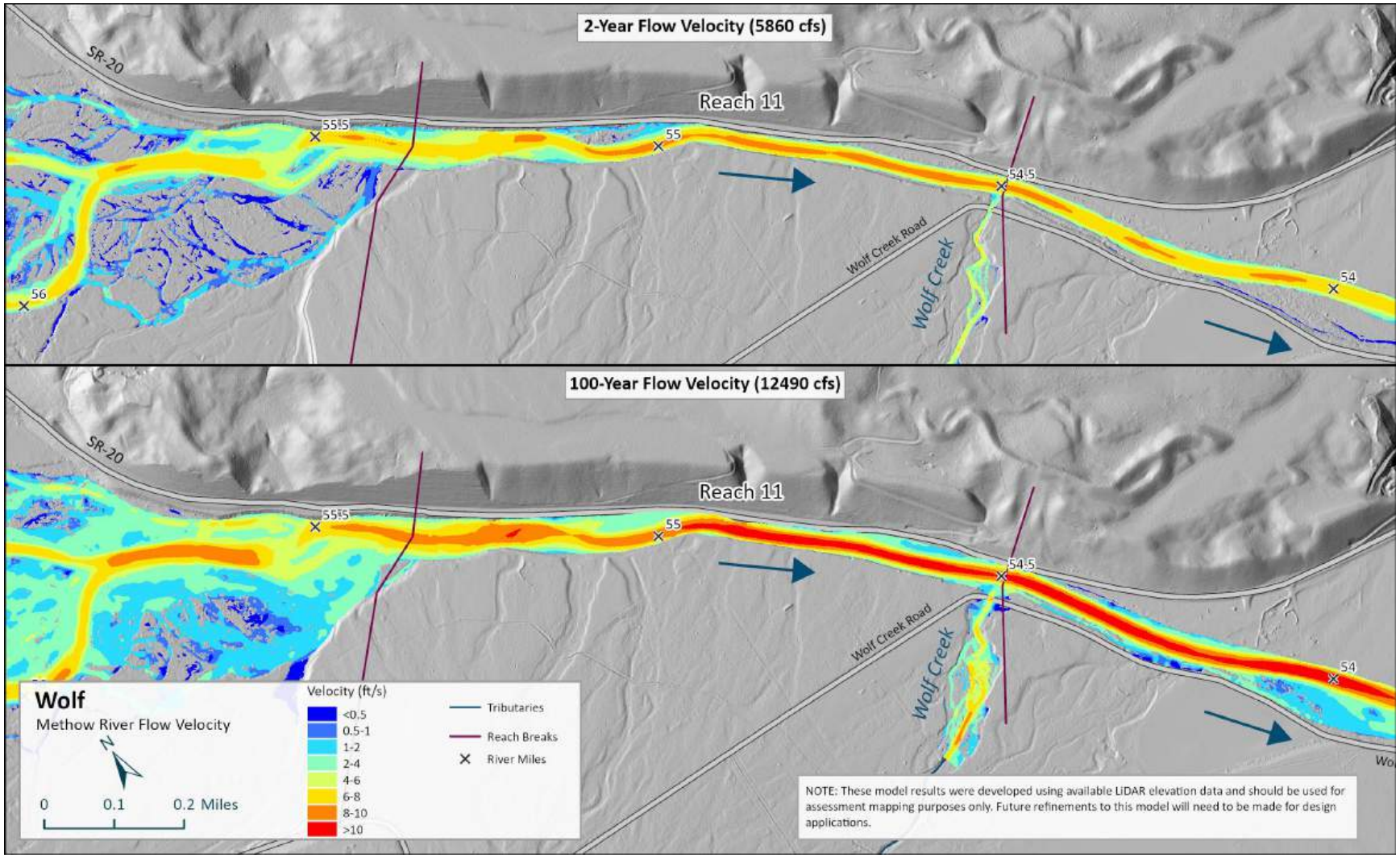


Figure 131. Segment 7 (Wolf): Preliminary hydraulic model (Hec-Ras 2D) flow velocity results for the estimated 2-yr and 100-yr flood event. See Appendix D for more information.

6.7.3 Large Wood Material

The role of large wood in Segment 7 (Wolf) has been diminished by channel clearing and vegetation removal. During the 2024 Habitat Survey (see Appendix A) a total of 22 individual pieces of wood and no log jams were recorded through the segment. The wood that was present occurred as rafted logs on bar tops in the upstream portion or as rafted bank margin large wood in the downstream portion. The existing wood in the segment provided marginal geomorphic utility to the channel or to habitat function during low flow. A photo of wood captured on a bar top is provided in Figure 132. A map of the distribution of large wood observed in Segment 7 during the 2024 survey is provided as Figure 133. It is assumed that unballasted large wood was and potentially is still periodically removed from the channel, depending on perceived risk to infrastructure.



Figure 132. Pieces of wood captured on bar top. RM 55.2. Oct. 12, 2024

Large wood recruitment potential in this segment is poor because of impaired riparian forest condition, generally straight channel form, and confinement that minimizes lateral processes. Where riparian vegetation exists, it is often a narrow, sparse band of trees and shrubs. The existing riparian forests along the banks are generally not mature thus, contributions that do occur are not expected to provide substantial or long-term geomorphic influence or habitat function, especially in a sediment transport segment with simplified channel form like Segment 7.

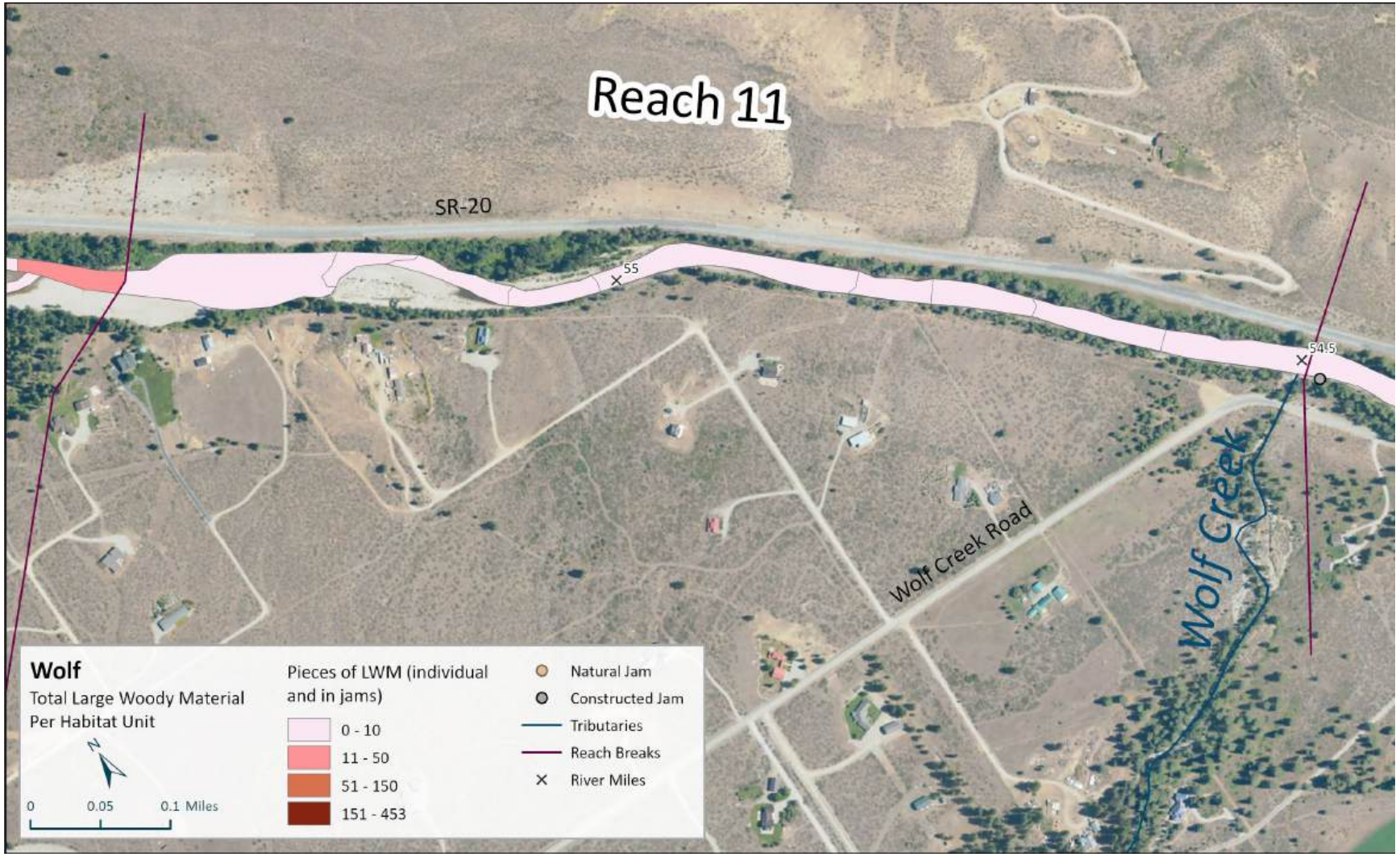


Figure 133. Segment 7 (Wolf): Distribution of large wood per mapped habitat unit and location of jams (> 3 pieces), natural and constructed - from 2024 Habitat Survey (see Appendix A)

6.7.4 Vegetation

Riparian vegetation in Segment 7 (Wolf) occupies the small pocket floodplains and the toe of the SR 20 road embankment (river left). A narrow strip of sparse trees and shrubs also occupies the bank of the Wolf Creek fan (river right). The existing riparian vegetation is composed of medium-sized cottonwood and an understory of dogwood and cottonwood saplings with grass and forbs where fringe surfaces occur. The bank top along the toe of the Wolf Creek fan hosts a sparse strip of young ponderosa pine trees and shrubs. The top of the fan has been cleared for development or vegetated with very sparse shrub-steppe plants. Representative photos of the riparian vegetation and bank top forests in this segment are provided in Figure 134. The existing young, sparse riparian strip on the southwest side of the channel bank top provides only marginal shade along the right (west) side the channel during summer. Vegetation distribution and height-classification along the channel, valley floor, and adjacent hillslopes in this segment are mapped in Figure 135.



Figure 134. Segment 7 (Wolf): representative riparian vegetation 11: A) floodplain vegetation; B) Fan terrace bank top vegetation. July 11, 2025

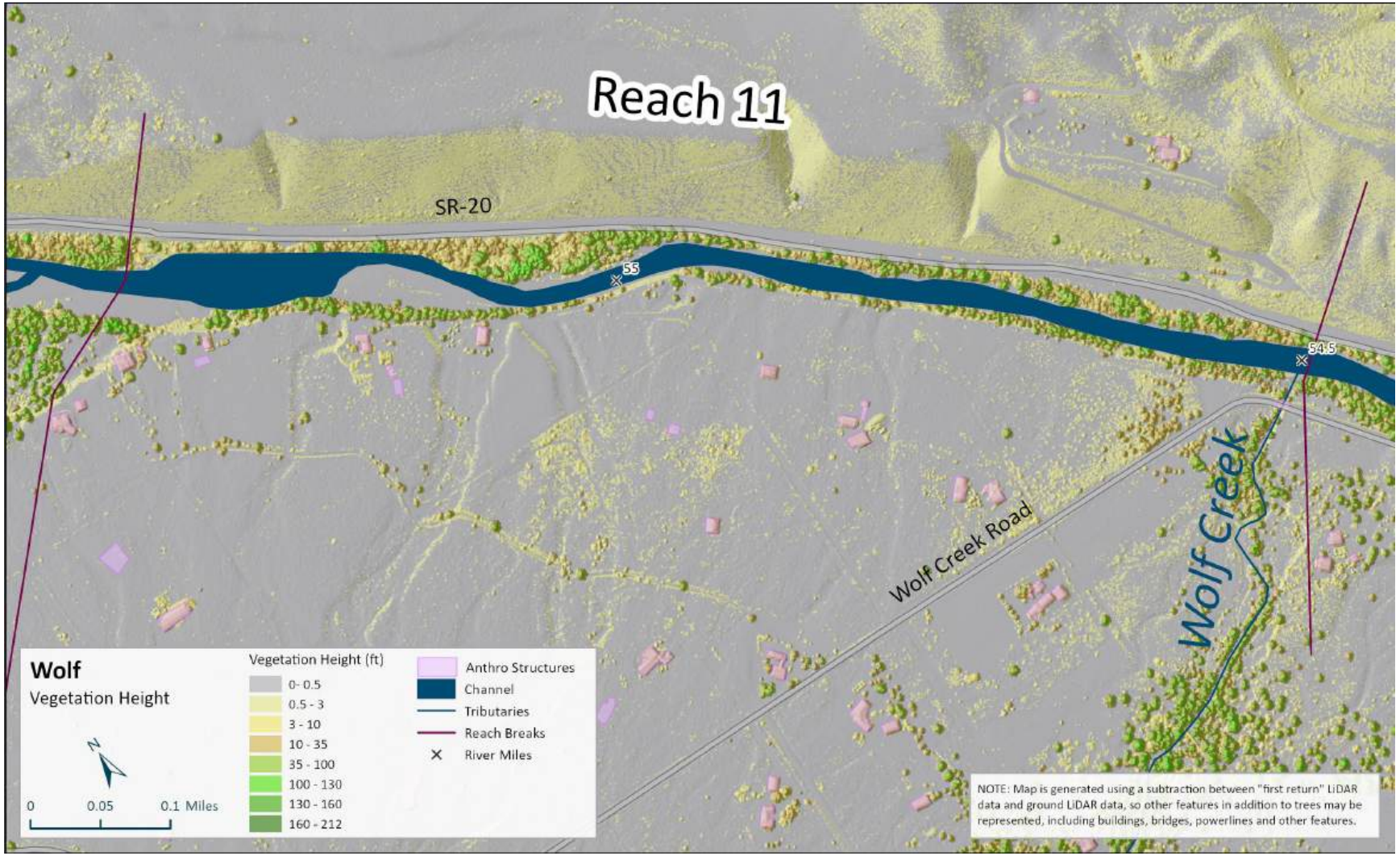


Figure 135. Segment 7 (Wolf): Vegetation height and distribution map.

6.7.5 Past and Planned Restoration Projects

No past or present habitat restoration projects were reported for Segment 7 (Wolf).

6.7.6 Project Opportunities

The proximity of SR 20 and infrastructure such as utility crossings will continue to impact the long-term trajectory of the channel and influence the types and extent of project opportunities that can be installed. Potential actions proposed in this segment include installation of bank-buried and mainstem complexity large wood structures to uplift habitat complexity, promote split flow around bars at the upstream end, and potentially initiate lateral extension into the toe of the Wolf Creek fan to support gradual meander evolution. There is also potential to uplift habitat and function of the Wolf Creek outlet fan (see the Wolf Creek Reach Assessment – (Inter-Fluve, 2020)). Riparian forest recovery and expansion would benefit the channel over the long-term, as well as the avian, terrestrial, and aquatic species that use it as a corridor.

6.8 SEGMENT 8: LOWER BIG VALLEY (RM 57.1 – 59.3)

6.8.1 Overview

Segment 8 (Lower Big Valley) includes Reaches 12 – 13 and extends from the upstream boundary of the Wolf Creek fan at RM 57.1 to RM 59.3. The segment occupies the downstream segment of the wide unconfined section of the Methow River known as Big Valley. General metrics of the reaches in this segment are provided in Table 20. Channel planform is meandering with areas of split-flow conditions around vegetated islands. Bedload is dominated by cobble and gravel. Channel unit type is generally a riffle-pool-glide type. Representative photos of this segment are provided in Figure 136. The quantity of large wood is adequate to meet habitat requirements but logs of sufficient size to function as key-logs are rare. Vegetation cover is adequate, but the size and age of the riparian forest is young. Reported past and planned projects (2013-2027) in this segment include large wood installations as habitat enhancement and bank stabilization, removal of machinery and riprap, and some riparian revegetation efforts. Site access and property ownership within the segment influence the types of restoration treatment options considered.

Table 21. Metrics table for Segment 8 (Lower Big Valley).

Lower Big Valley	Length (miles)	River Mile	Stream Gradient (%)	Sinuosity	Dominant Channel Habitat Unit Type	Average Bankfull Width (ft)	Confinement	Dominant Substrate	% Pool Habitat	% Glide Habitat	% Riffle Habitat	% Side Channel Habitat
Reach 12	1.7	55.4-57.1	0.27%	1.19	Pool	174.0	Unconfined	Cobble & Gravel	33%	21%	18%	28%
Reach 13	2.2	57.1- 59.3	0.35%	1.13	Pool	139.8	Unconfined	Cobble	43%	20%	19%	18%

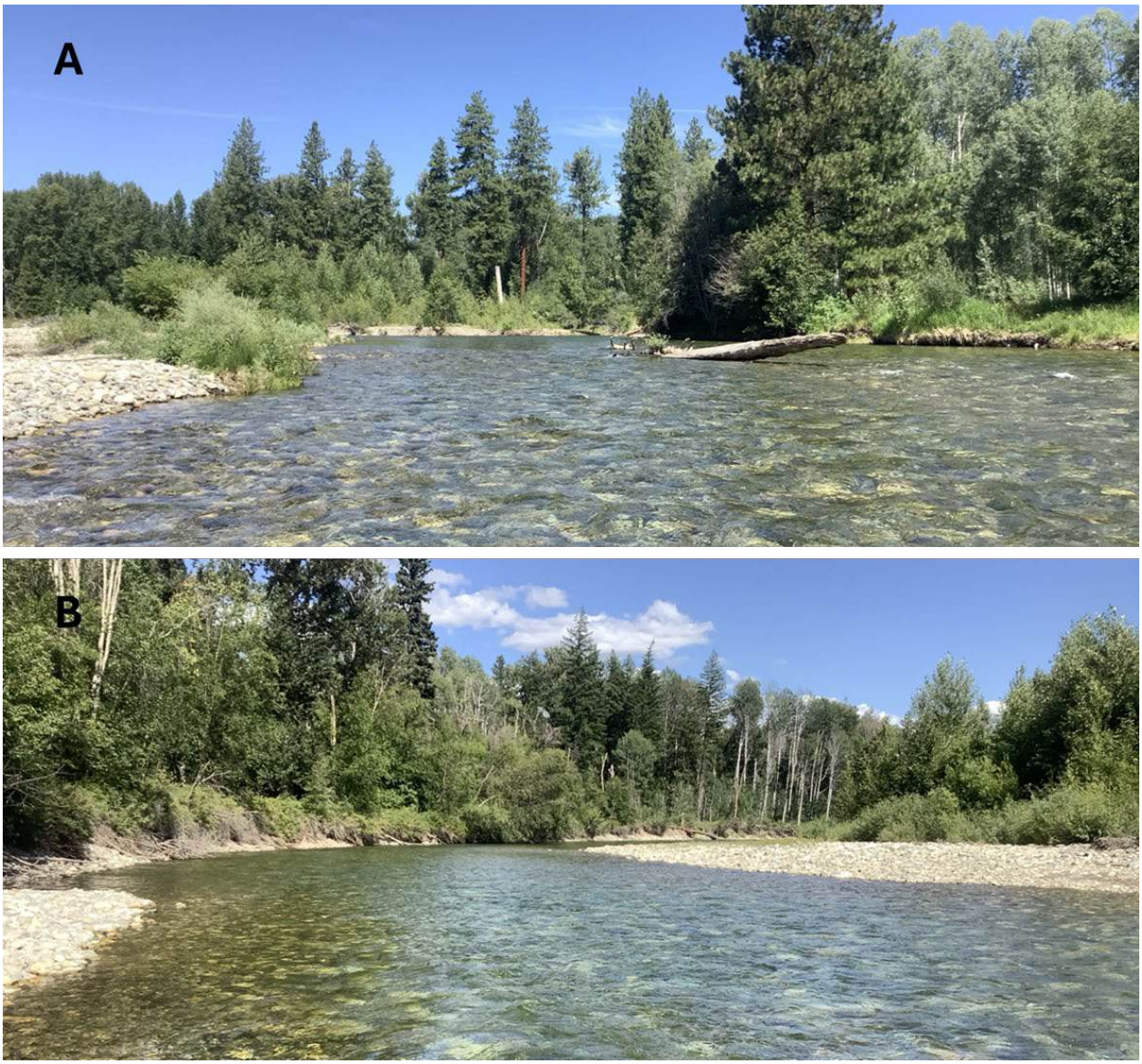


Figure 136. Representative photos of Segment 8 – Lower Big Valley: A) Reach 12 at RM 56.7, looking downstream; B) Reach 13 at RM 58.5, looking downstream. July 10, 2025

Channel processes in Segment 8 (Lower Big Valley) have been and continue to be impacted by anthropogenic features and land management (Figure 137), though notably less than most of the downstream segments in the assessment area. Historical logging of the floodplain forests and channel clearing removed large wood from the system. A good portion of the riparian forests along the channel are recovering but half of the valley floor remains cleared. Where riparian and floodplain forests are recovering, the tree/forest age and size are still decades away from being of sufficient size to produce adequate shade and effective key-log pieces that maintain geomorphic complexity that persist over time.

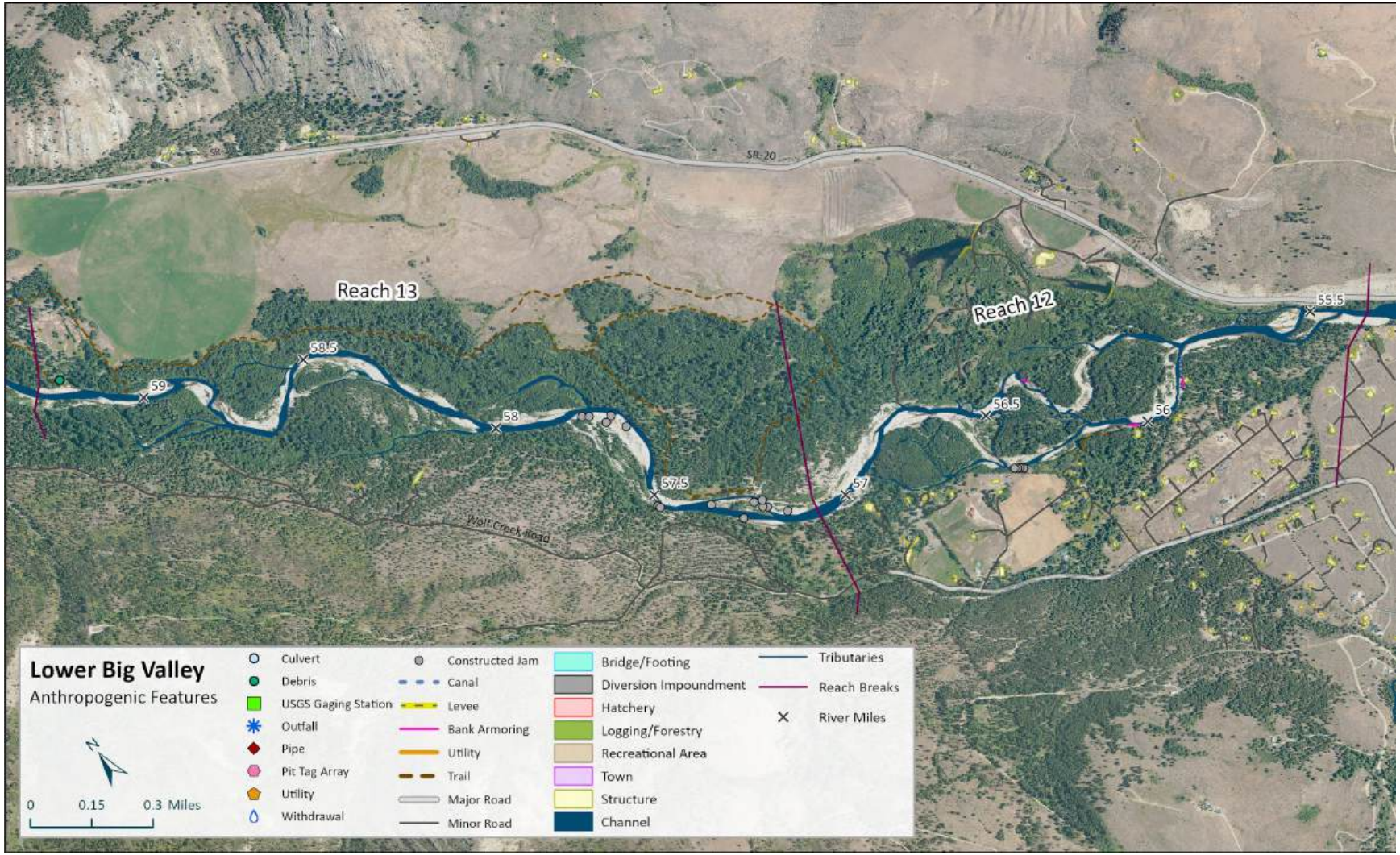


Figure 137. Segment 8 (Lower Big Valley): mapped anthropogenic features.

Bank armoring with large boulder riprap occurs in proximity to private property on the river-right side of the west channel near RM 55.9, 56, and 56.1 (Figure 138). Most of the development (homes, roads, etc.) in this segment are located atop floodplain terraces along the west side of the valley. Anthropogenic impacts on the east side of the valley include roads, trails, irrigated pastures, and a groundwater supported tributary and wetland complex that is dammed and ponded (east-side floodplain along RM 55 - 57).



Figure 138. Boulder riprap armoring bank at RM 56.1 along river-right side of west split channel. July 11, 2025

6.8.2 Channel and Floodplain Geomorphology

The channel in Segment 8 (Lower Big Valley) is low-moderately sinuous meandering with anastomosing split flow conditions between RM 55.8 – 56.1. The channel is laterally active at meander bends without bank armoring or hillslope toe confinement. Lateral processes recruit floodplain-stored sediment and wood contributions. Wide active bars are prevalent throughout and produce braided conditions at low flow in several locations (Figure 139). The habitat units mapped in the 2024 Habitat Survey (Appendix A) reveal a general pool-riffle-glide channel type along the mainstem with multiple side channels and groundwater supported tributaries. During the Habitat Assessment, pools occupied 38% of the available habitat in Segment 8, glides 20%, riffles 18%, and side channels 23% (Figure 140). Some of the pools were sufficiently deep to meet the habitat criteria and had wood complexity components, but others were of relatively low- habitat complexity and depth.



Figure 139. Lateral meander bank erosion and wood recruitment (RM 57.1 - looking upstream) and mid-channel bar development on the opposite side of the channel. July 11, 2025

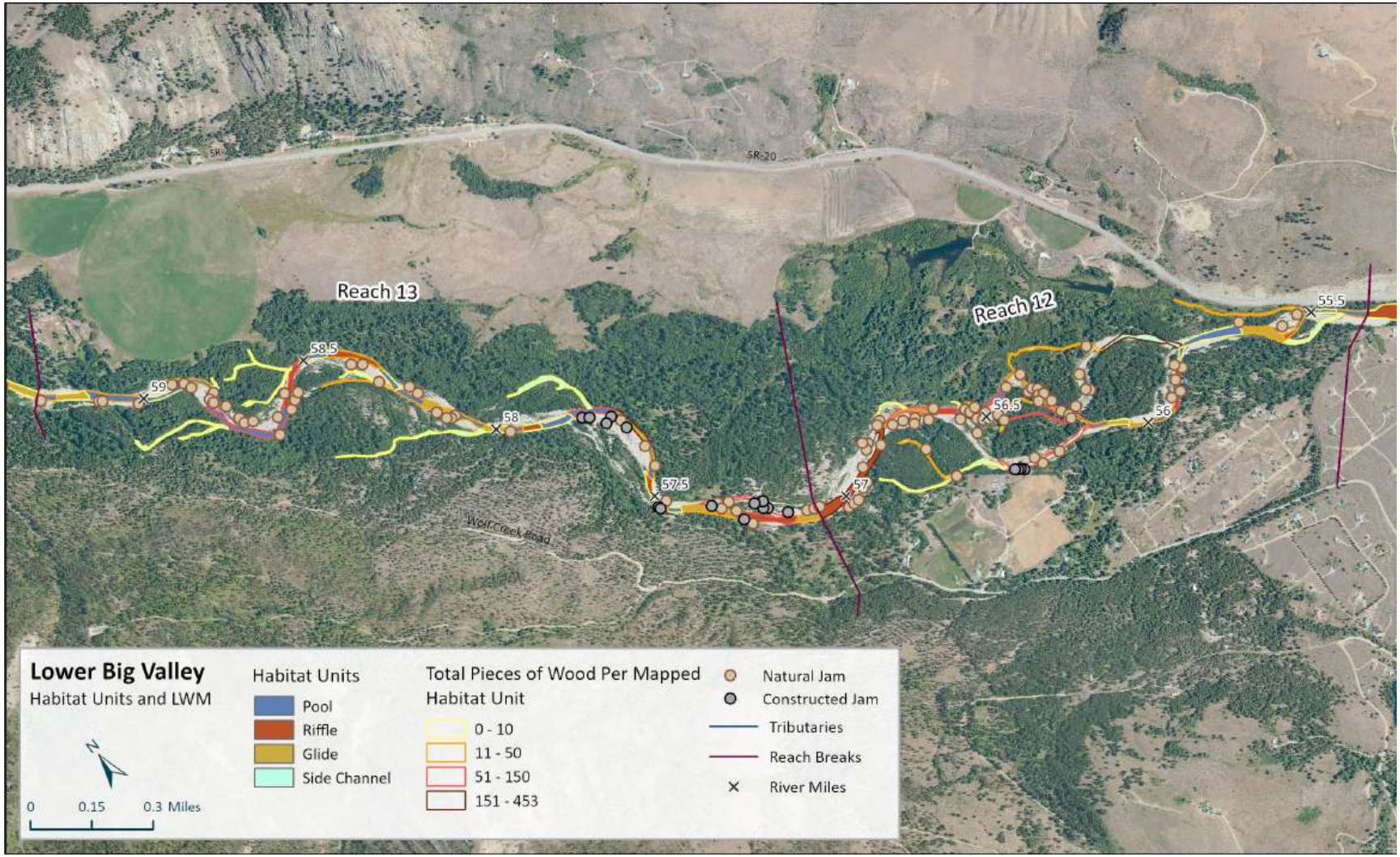


Figure 140. Segment 8 (Lower Big Valley): mapped habitat units with large wood quantities of each unit delineated - Habitat Survey, 2024

Perennial and seasonal side channels of varied connectivity occur throughout the segment, most of which were partially to fully supported by groundwater and/or hyporheic inputs during the survey (July 2025). Groundwater supported floodplain tributaries that initiate as springs or seeps on the floodplain provide additional off-channel cool-water refugia potential and surface water inputs into the Methow River on river right at RM 55.5, 55.9, 56.1, 56.75, 57.75, and 58.55 and on river left at RM 58.05 and 59.75. The size, discharge, and relative connectivity of the groundwater tributaries and side channels vary. Examples of two connected valuable groundwater floodplain tributary outlets are shown in Figure 141 and Figure 142. Cool-water contributions and off-channel refugia are critically important habitats to conserve, create, and enhance for salmonid habitat uplift.



Figure 141. Groundwater floodplain tributary, with confluence to mainstem at RM 55.5 river left. July 11, 2025



Figure 142. Groundwater floodplain tributary, with confluence to mainstem at RM 58.05, river right. July 10, 2025

Low-flow exposed side channels and alcoves supported by hyporheic or groundwater inputs occur in braided sections or behind point bars. The quality and persistence of these important habitats vary throughout the segment. Back-bar side channels with groundwater or hyporheic inputs can also provide refugia, if habitat complexity and connectivity to the mainstem is sustained. Example photos of low-flow back-bar or braided bar side channel and alcove complexity variability in Segment 8 are provided in Figure 143. Because the width of the active channel and bars at low flow (summer season) can be two or three times that of the most mature tree currently along the bank, maintaining and uplifting these types of habitats where shade and cover can be provided along the margins of the channel for rearing salmonids is valuable.



Figure 143. Examples of back-bar side channel and alcove without and with habitat complexity: A) low-flow created back-bar side channel at RM 58.2 with minimal habitat complexity or cover; B) low-flow alcove and side channel at RM 56.5 with vegetated bars, wood as cover and scour maintenance. July 10, 2025

A channel's lateral process rates and bar development/size are linked with a complex set of dynamic variables such as channel width, slope, sediment supply, available vegetation (root strength, roughness, influence of recruited wood on channel, etc.), bank composition, etc. (Inoue et al., 2025). In a system where the vegetation is regenerating and maturing, the lack of sufficiently mature/large-sized trees is expected to result in higher lateral rates and larger bar size (slower floodplain vegetation establishment on bars). Consideration of these relationships leads to recognizing the positive influence of installing large wood structures that mimic effective large wood jams designed to persist and influence geomorphic processes or provide roughness on broad open bars while the floodplain and riparian forest continue to mature.

Natural channel processes such as lateral erosion and avulsion can add to the diversity and complexity of the channel and the habitat it provides. For example, a neck cut-off channel avulsion at RM 57 (2012) and the currently active neck cut-off occurring at RM 56.7 have reduced the upstream connectivity of a few side channels on the left side adjacent floodplain. Those side channels are now groundwater supported, off-channel refugia that remain connected at the downstream end to the mainstem channel. The sediment and wood material generated by the neck-cutoffs were distributed downstream in the mainstem channel. Although the woody material is not

large enough to persist, there is enough of it that the accumulations created by it are temporarily resulting in increased connectivity of the adjacent floodplain (near RM 56.4), as well as temporarily reducing split-flow conditions at RM 56.5. Increased floodplain connectivity, including at summer low flows, provides an analogue floodplain condition for reactivation that supports off-channel aquatic habitat as well as beaver and riparian/wetland diversity (Figure 144). These are examples of dynamic channel responses in Segment 8 that produce channel complexity and resilience, if only temporarily due to undersized woody material.



Figure 144. Floodplain inundation and side channel activation at low-flow that provides high quality off-channel habitat – a split-flow island at RM 56.4. July 11. 2025

Floodplains in Segment 8 are composed of alluvial cobbles and gravels topped with sandy-loam. This segment of the Big Valley is considered unconfined (Figure 145). At the downstream, valley width and confinement gradually decrease as the channel approaches the Wolf Creek Fan. Bank armoring is limited and there are no known confining levees. Fans, terraces, and hillslope toes border the segment, but the broad valley floor is four times wider than the channel's modern meander band.

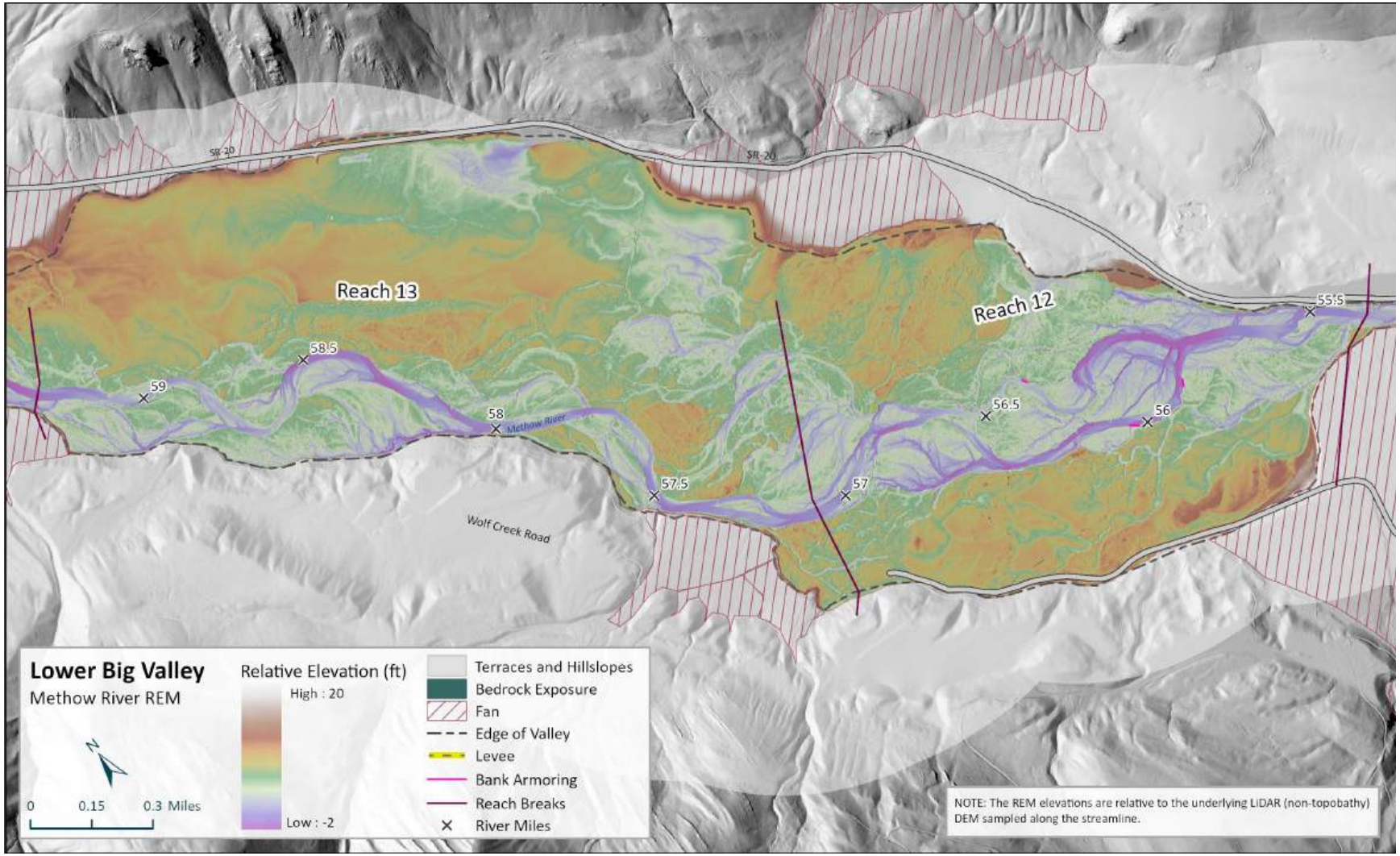


Figure 145. Segment 8 (Lower Big Valley): Relative elevation map of floodplain and channel with confining fans, bedrock, terraces, roads, and levees identified.

Bedload in the mainstem channel is dominated by cobbles with gravel. Boulders occur as added riprap along discrete channel banks and as contributions from terraces, bedrock, or hillslopes. The cobble bars exposed during low-flow conditions are wide and long. The bars, similar to channel bedload, are composed primarily of cobbles with sparse gravel (Figure 146). Braided bars in sections of Segment 8 indicate that sediment supply is not lacking.

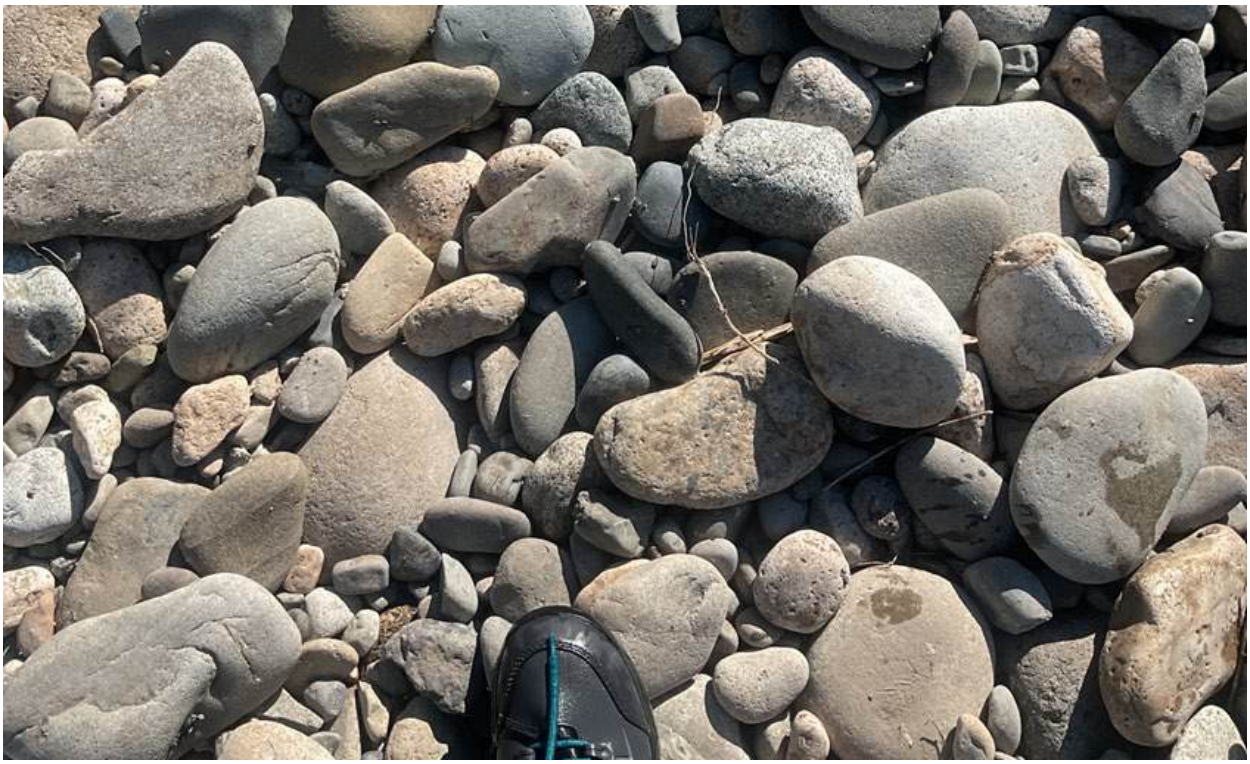


Figure 146. Bedload: cobble with gravels - RM 57.2. July 11. 2025

Preliminary hydraulic modeling confirms side channel activation at the 2-yr modeled flow of the low-flow groundwater-supported side channels identified during the survey. It also confirms relatively good floodplain connectivity in Reach 12 and the upstream end of Reach 13. During very large floods (100yr modeled flow) connectivity across half of the valley floor is expected, including at the upstream end due to flow routes from Segment 9 (Figure 147). Modeled flood velocities are expected to flush gravels and maintain connectivity in most of the side channels at the 2yr modeled flow, indicating that improving activation of several of the side channels is viable (Figure 148).

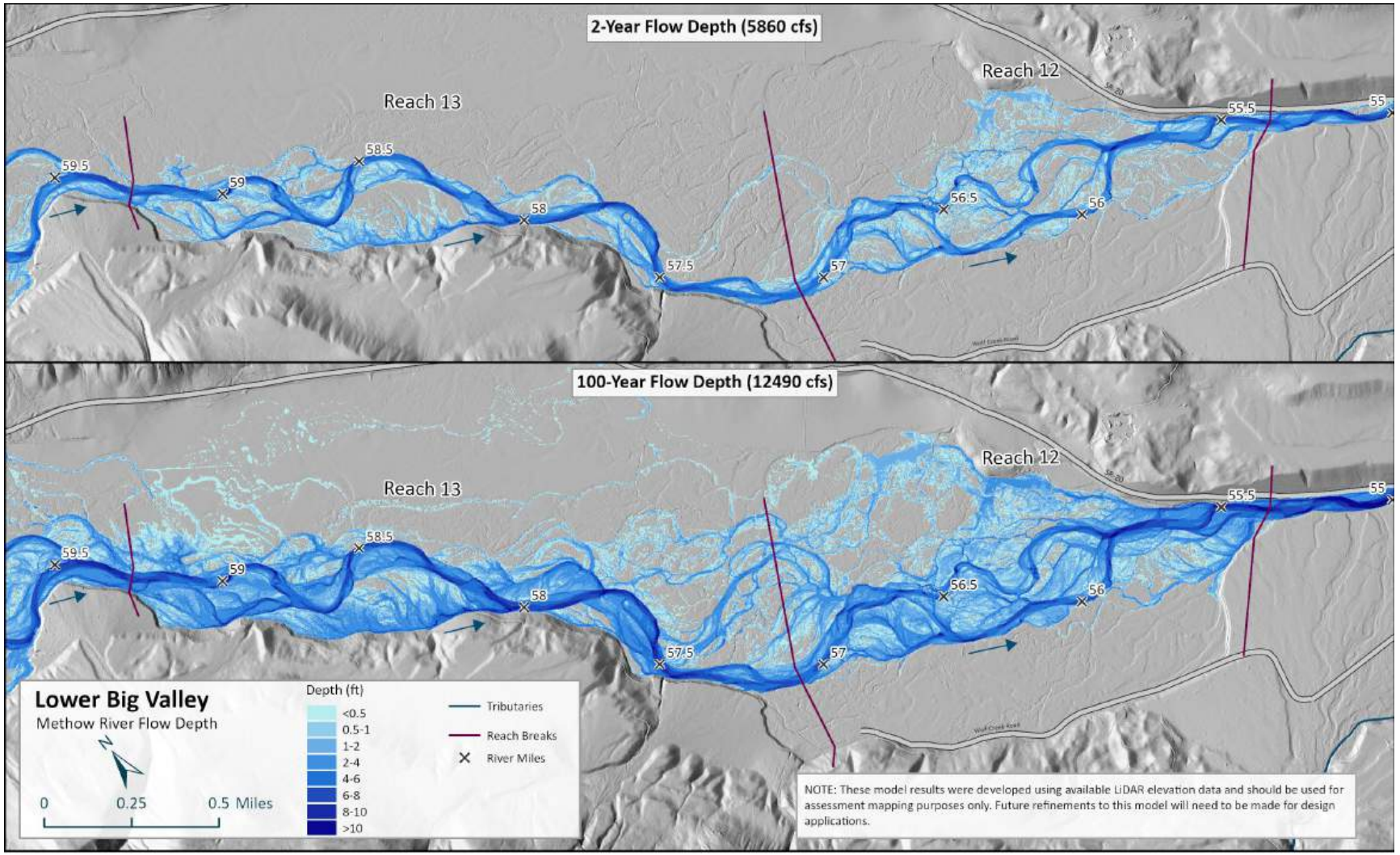


Figure 147. Segment 8 (Lower Big Valley): Preliminary hydraulic model (Hec-Ras 2D) depth results for the estimated 2-yr and 100-yr flood event. See Appendix D – Preliminary Hydraulic Model Results for more information

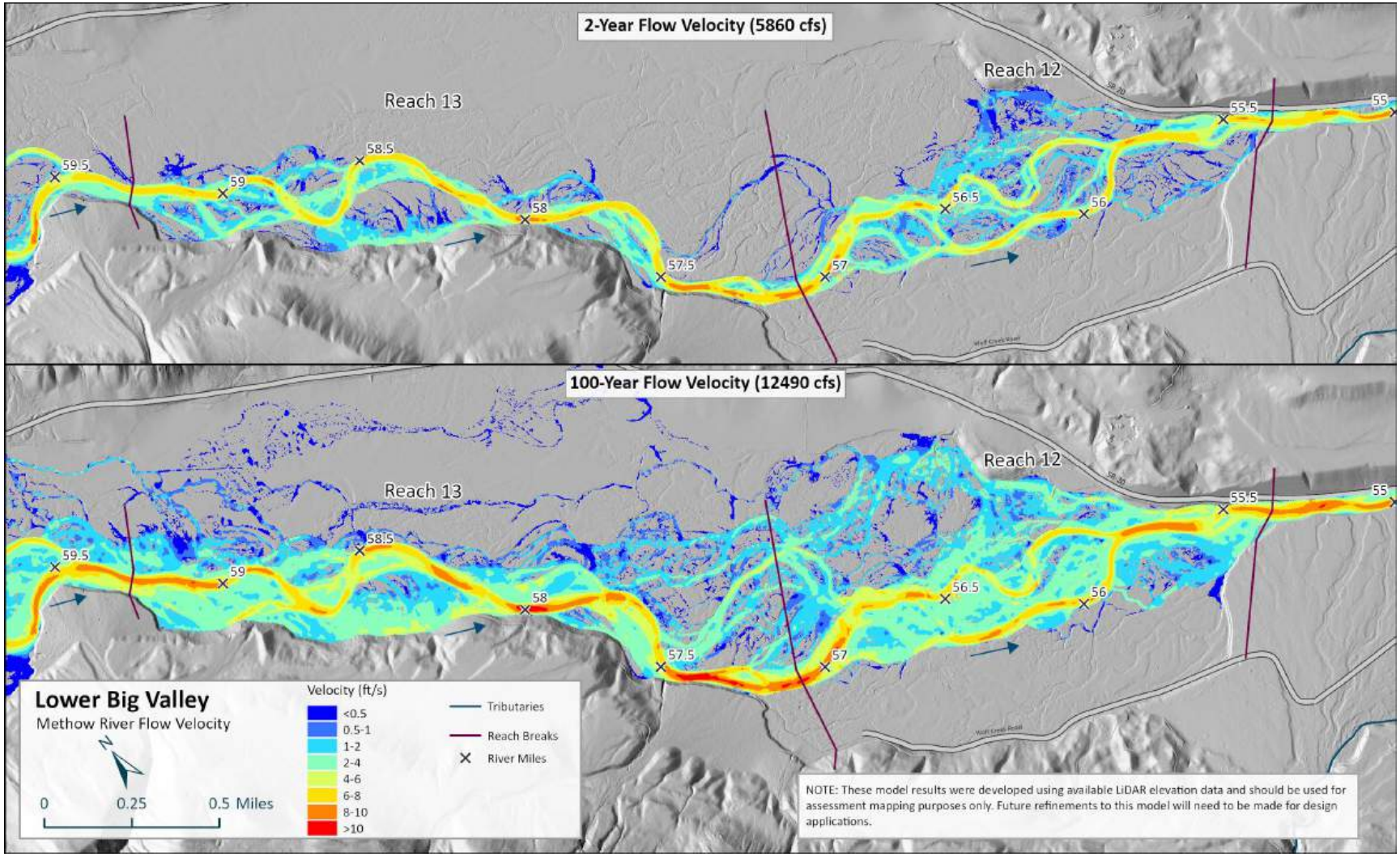


Figure 148. Segment 8 (Lower Big Valley): Preliminary hydraulic model (Hec-Ras 2D) flow velocity results for the estimated 2-yr and 100-yr flood event. See Appendix D – Preliminary Hydraulic Model Results for more information

6.8.3 Large Wood Material

Large wood in Segment 8 (Lower Big Valley) currently provides habitat complexity and some geomorphic function (Figure 149). During the 2024 Habitat Survey (see Appendix A) a total of 523 individual pieces of wood and an additional 115 log jams (3+ logs) were recorded through the segment. Only 18 of the jams were constructed structures. A map of the distribution of large wood observed in the reach during the 2024 survey is provided as Figure 150.

The existing constructed log structures are ballasted into banks or bars. The total quantity of large wood present exceeded the survey's minimum requirement for pieces of wood per mile. Some of the wood was not interacting with the channel at low flow conditions – rafted on bar tops, etc. Although the segment has plentiful wood material, much of it is not of sufficient size to be considered stable or to persist as a key log(s) that maintains complexity over time. The wood currently in the system does provide nutrients and transient and/or temporary complexity benefits. Recruitment potential of wood into this segment is good due to natural lateral processes and a vegetated floodplain. The addition of large wood structures able to maintain complexity as well as catch/retain the wood recruited from banks is expected to benefit the quality and quantity of habitat - and the persistence of both - in this segment.



Figure 149. Large wood (temporary) at split-flow apex on wide cobble bar- RM 56.5. July 11, 2025

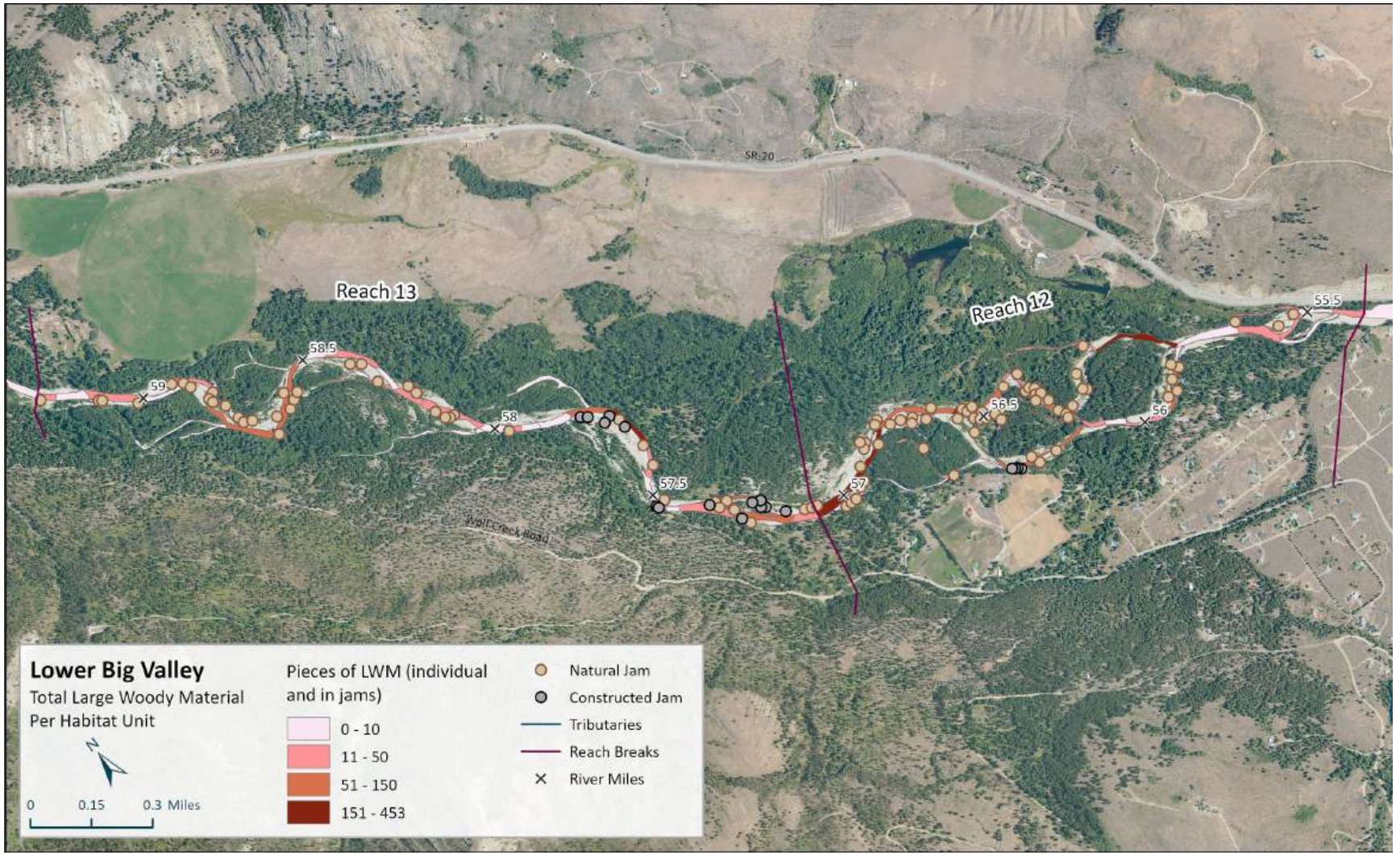


Figure 150. Segment 8 (Lower Big Valley): Distribution of large wood per mapped habitat unit and location of jams (> 3 pieces), natural and constructed - from 2024 Habitat Survey (see Appendix A)

6.8.4 Vegetation

Riparian vegetation and floodplain forests in Segment 8 (Lower Big Valley) occupy a relatively wide corridor along the channel. The exception is a terrace surface cleared for homes at approximately RM 56.5 on the right side of the channel. However, approximately half of the valley floor on the east side is cleared of floodplain forests for development (agriculture, homes, roads, etc.). It is presumed that the valley floor and channel banks were vegetated with mature (old-growth) native conifer and deciduous forests, prior to Euro-colonial clearing and development. Today the recovering floodplain forest along the channel is still relatively young. The dominant overstory is cottonwood, Douglas fir, ponderosa pine, and alder. The understory is primarily willow, dogwood, small cottonwood, aspen, alder, grasses, and forbs. Representative photos of the vegetation are provided in Figure 151. Vegetation distribution and height-classification along the channel, valley floor, and adjacent hillslopes in this segment are mapped in Figure 152.



Figure 151. Segment 8 (Lower Big Valley): Representative photos of riparian forest: A) RM 58.25 on river right B) RM 56.2. July 11, 2025

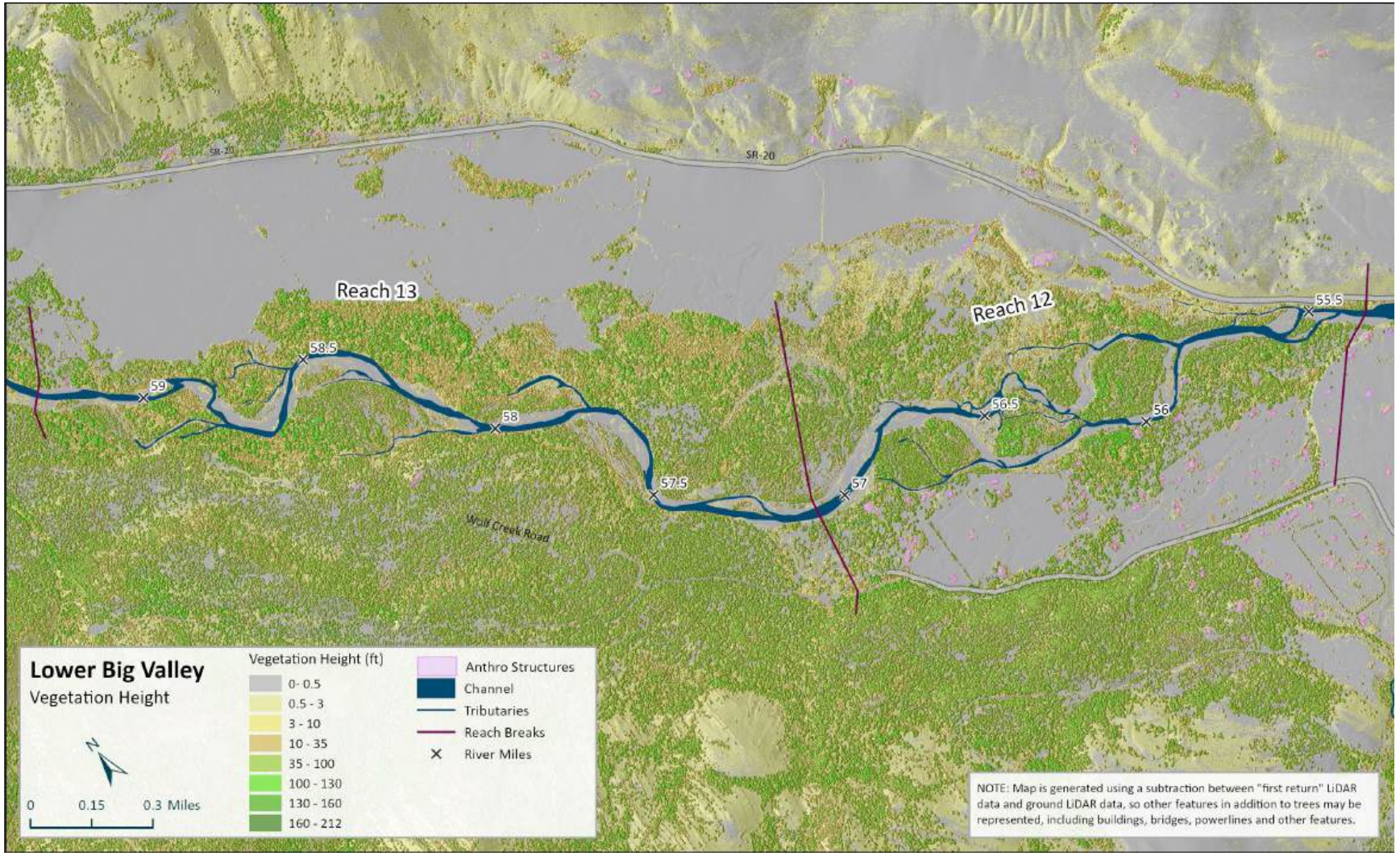


Figure 152. Segment 8 (Lower Big Valley): Vegetation height and distribution map.

6.8.5 Past and Planned Restoration Projects

The past and planned restoration projects reported or observed in Segment 8 are listed in Table 21. See the map of the reported past and planned projects in Figure 154.

Table 22. List and description of reported past and planned projects in Segment 8 (Lower Big Valley).

Year	Name	Sponsor	Area of coverage	Project Components
2009	Sletton and Green habitat complexity project	MSRF	Reach 12; RM 57; Reach 14; RM 59.7	Large wood structures and bank barbs; Bank stabilization; Increase bank complexity
2013	Wolfridge Riparian	MSRF	Reach 12; RM 56.45	Large wood structure; Bank stabilization; Large wood structure revetment; Riparian vegetation
2018	Big Valley Project Area	Yakama Nation	Reach 13; RM 57.2 to RM 57.8	Large wood structure; Pool enhancement; Channel alcove enhancement with large wood installation; Side channel habitat enhancement; Removal of concrete and steel "people mover" and riprap; Removal of irrigation headgate
2028	Big Valley Phase 2	Yakama Nation	Reach 13, Reach 14 and Reach 15; 58.8 - 61	Proposed Project with elements of large wood structures

The Wolfridge project (2013) installed large wood structures as revetment for bank stabilization and planted riparian vegetation (Figure 153). In modern conditions, the primary flow route of the channel shifted away from the structure. As a result, at low flow, the structures interact marginally with the water – though they do still provide shade.



Figure 153. Wolfridge Riparian Project – large wood as bank revetment – river-right side of west channel at RM 56.4. July 11, 2025

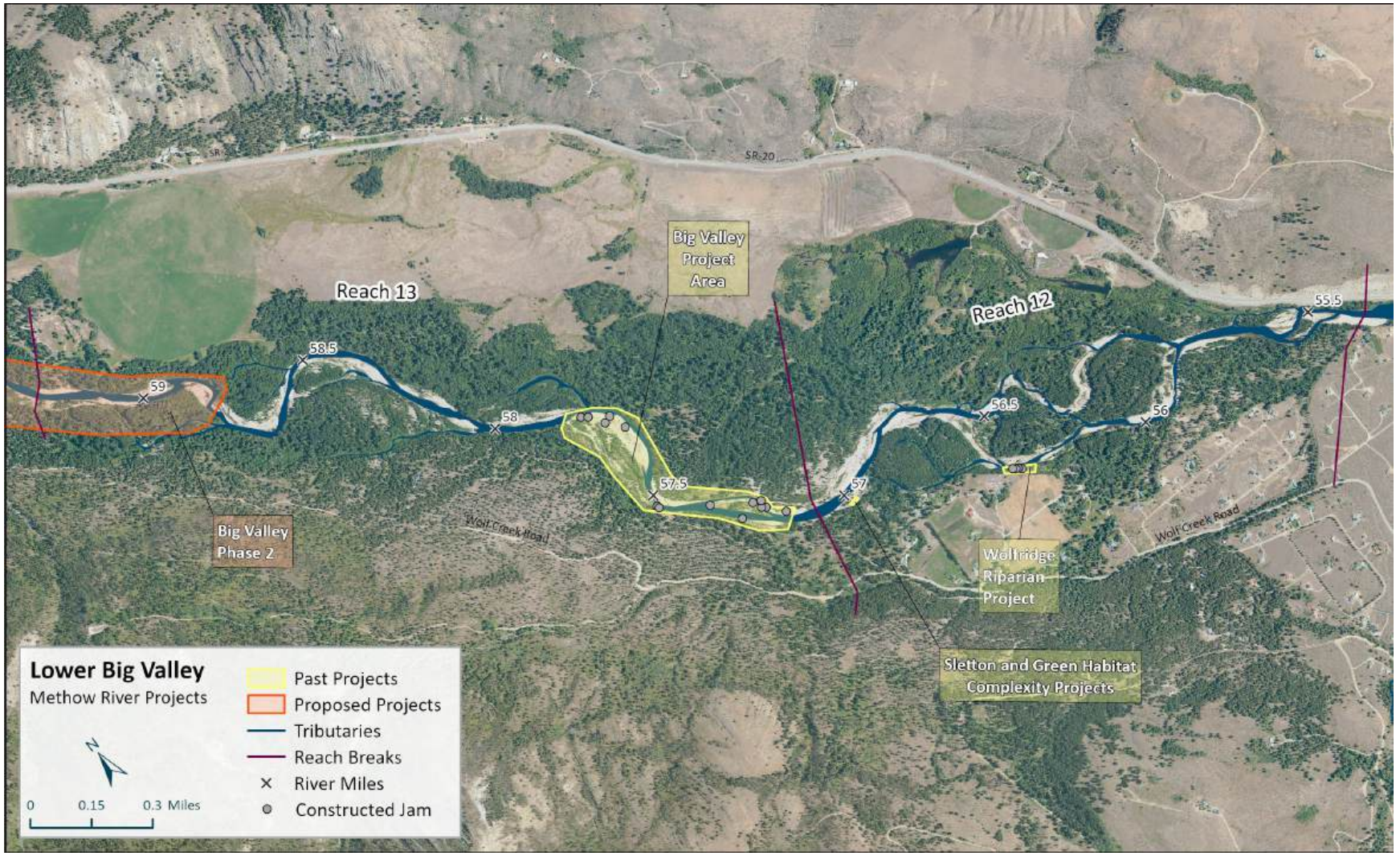


Figure 154. Segment 8 (Lower Big Valley): Past and planned restoration projects map.

The Sletton and Green Project in Reach 12 (2009) originally provided large wood as habitat enhancement to riprap barbs installed for bank stabilization or armoring. According to aerial imagery (GoogleEarth), by 2011 the channel had shifted east away from the project area to occupy a neck cut-off as its primary flow route. By 2025, the flow route that once went past the Sletton and Green Project was infilled and clogged by rafted pieces of wood and sediment (Figure 155). The original treatment area was not visible at the time of the Habitat and Geomorphic Assessments (2024-2025).



Figure 155. Sletton and Green Reach 12 project area –filled with wood and debris, near RM 57. July 11, 2025

The Big Valley project area (2018) included large wood structures in the mainstem channel, along a bar, and within a side channel and alcoves for habitat enhancement and riparian revegetation support. Pre-existing concrete and steel elements were also removed from the floodway during the project. At the time of the Geomorphic Assessment in 2025, the large wood treatments in the side channel and alcove were providing habitat uplift (Figure 156) and the large, engineered log jam structures along the bar near RM 57.6 were in place and providing bar roughness and high-flow split routing.



Figure 156. Big Valley project area - side channel, large wood habitat enhancement at RM 57.25. July 11, 2025

6.8.6 Project Opportunities

Potential actions in Segment 8 are expected to maximize uplift and encourage dynamic response. Identified restoration opportunities include mainstem habitat uplift and geomorphic complexity large wood structures, side channel activation, and uplift to floodplain groundwater tributary habitat and connectivity. Proposed projects are intended to uplift potential habitat in conjunction with the already installed project features. Several of the groundwater floodplain tributaries and side channels were identified as cold-water refugia and Cold Water Patches (see Section 3.2.5). The groundwater-supported floodplain tributaries and side channels are a valuable off-channel resource with sometimes impaired connectivity and complexity to the mainstem channel. Identified restoration opportunities include the addition of large wood to the mainstem and side channels, activation of perennial side channels, creating perennial connection to existing groundwater-supported off-channel habitat, and some revegetation effort. Consideration and analysis of groundwater hydrology in the segment during restoration project planning, distribution, and design is recommended for conservation of this valuable resource.

6.9 SEGMENT 9: MID BIG VALLEY (RM 59.3 – 62.3)

6.9.1 Overview

Segment 9 – Mid Big Valley is the upstream-most segment of the assessment area and equivalent to Reaches 14-16. It is the middle section of what is known as Big Valley. General metrics of the reaches included in this segment are provided in Table 22. Reach 16 is partially confined by the Weeman Bridge and associated road prisms of SRH 20 and Goat Creek Road. Reach 15 and 14 are considered unconfined. The channel is straight in Reach 16 and meandering in Reaches 15 and 14 with sections of split-flow. Bedload is dominated by cobble and gravel. Channel unit type is generally pool-glide. Representative photos of the reaches in this segment are provided in Figure 157. Based on the 2024 habitat survey, the quantity of large wood is adequate to meet habitat requirements but logs of sufficient size that function as key-logs are rare. Vegetation cover is adequate, but the size is small and the age of the floodplain forest is young. Past restoration projects in this segment range from large wood installations, tributary improvements, off-channel habitat connectivity, and improvements to existing infrastructure. Site access, existing infrastructure, and property ownership influence the types of restoration treatment options recommended in Segment 9.

Table 23. Metric table for Reach 14 to Reach 16.

Mid Big Valley	Length (miles)	River Mile	Stream Gradient (%)	Sinuosity	Dominant Channel Habitat Unit Type	Average Bankfull Width (ft)	Confinement	Dominant Substrate	% Pool Habitat	% Glide Habitat	% Riffle Habitat	% Side Channel Habitat
Reach 14	1.3	59.3-60.6	0.39%	1.29	Glide	130.8	Unconfined	Cobble	26%	39%	15%	20%
Reach 15	1.1	60.6-61.7	0.34%	1.41	Pool	156.0	Unconfined	Gravel	52%	14%	2%	32%
Reach 16	0.6	61.7-62.3	0.32%	1.05	Glide	156.0	Partially Confined	Cobble	43%	51%	4%	2%



Figure 157. Representative photos of the Methow River in Segment 9 (Reaches 14 - 16). Reach 14, looking upstream near RM 60.1 (July 10, 2025). Reach 15, looking downstream near RM 60.6 (July 10, 2025). Reach 16, looking upstream near RM 62 (July 9, 2025).

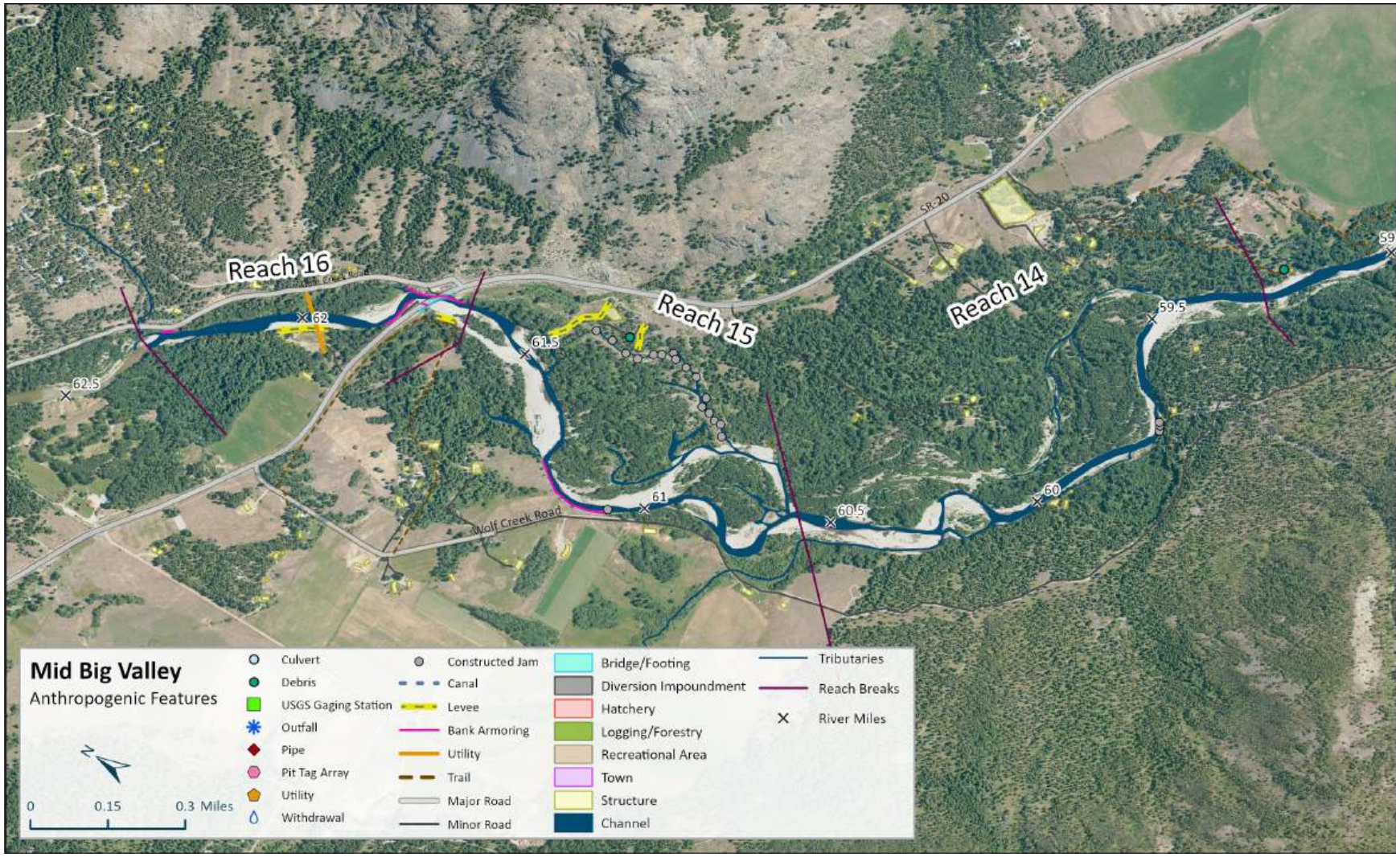


Figure 158. Segment 9 (Mid Big Valley): mapped anthropogenic features.

Channel and floodplain processes in Segment 9 (Mid Big Valley) have been and continue to be impacted by anthropogenic features and land management. Historical logging of the floodplain forests and channel clearing removed large wood from the system. A good portion of the riparian forests along the channel are recovering except for along portions of the adjacent terrace that remains cleared for development on the west side of the channel. Where riparian and floodplain forests are recovering, the tree/forest age and size are still decades away from being of sufficient size to produce adequate shade and effective key-log pieces that, when recruited to the channel, are able to maintain persistent geomorphic complexity.

The primary anthropogenic features imposing confinement occur in Reaches 15 and 16. The Weeman Bridge, located at RM 61.7, restricts the channel to a flow route that is only approximately 15% of the width of its historical floodplain. The bridge and its associated bank armoring extend along the SR 20 road embankment, perpendicularly and longitudinally dissecting the floodplain as it approaches Weeman Bridge (Figure 159). Goat Creek Road and its boulder reinforced embankment run parallel to the river left (east) side of the channel in Reach 16, exaggerating confinement and impairing hillslope contributions to the channel. On the river-right side of the channel upstream of Weeman Bridge a small levee reduces flood inundation frequency but does not eliminate it (Figure 160).



Figure 159. Weeman Bridge and associated upstream riprap bank armoring - RM 61.7. July 9, 2025



Figure 160. Rock levee along river right bank (photo at RM 62). July 9, 2025

Channel and floodplain confinements downstream of Weeman Bridge, in Reach 15, consist primarily of floodplain levees and an extended armored meander bend. The rock levee on river right immediately downstream of the bridge is a remanent of a much longer levee that original forced the channel in a straight pathway through the bridge. The levees and pits on the river-left floodplain at approximately RM 61.5 are assumed to be remnant surface grading associated with the historical Fender Mill, but no mill structures remain (Figure 161 A). An armored bank along the river left bend of a mender at RM 61.1-61.25 protects Wolf Creek Road, utility lines, and development located on the atop the adjacent floodplain terrace, which remains cleared of vegetation. The armored bank acts as a "hard" bank that holds the channel in its location, instigating incision and impeding natural lateral processes (Figure 161 B).



Figure 161. Anthropogenic features: A) remnant floodplain levees associated with the historical Fender Mill site; B) armored meander bend bank with cleared vegetation at RM 61.1-61.25. July 9, 2025

6.9.2 Channel and Floodplain Geomorphology

Segment 9 (Mid Big Valley) ranges from a straight channel to a moderately sinuous meandering channel. The channel is laterally active downstream of RM 61.7. Lateral processes recruit floodplain-stored sediment and wood contributions. Channel habitat units mapped in the 2024 survey reveal a general pool-glide channel type with intermittent riffles along the mainstem (Figure 162). During the Habitat Survey, pools occupied 40% of the available habitat, glides 35%, riffles 7%, and side channels 18%. However, pool frequency did not meet habitat requirements for a channel of this width in Reaches 14 and 16. Multiple side channels and groundwater supported tributaries exist. Wide active bars are present throughout much of the segment and, in some locations, produce braided conditions at low flow (Figure 163).

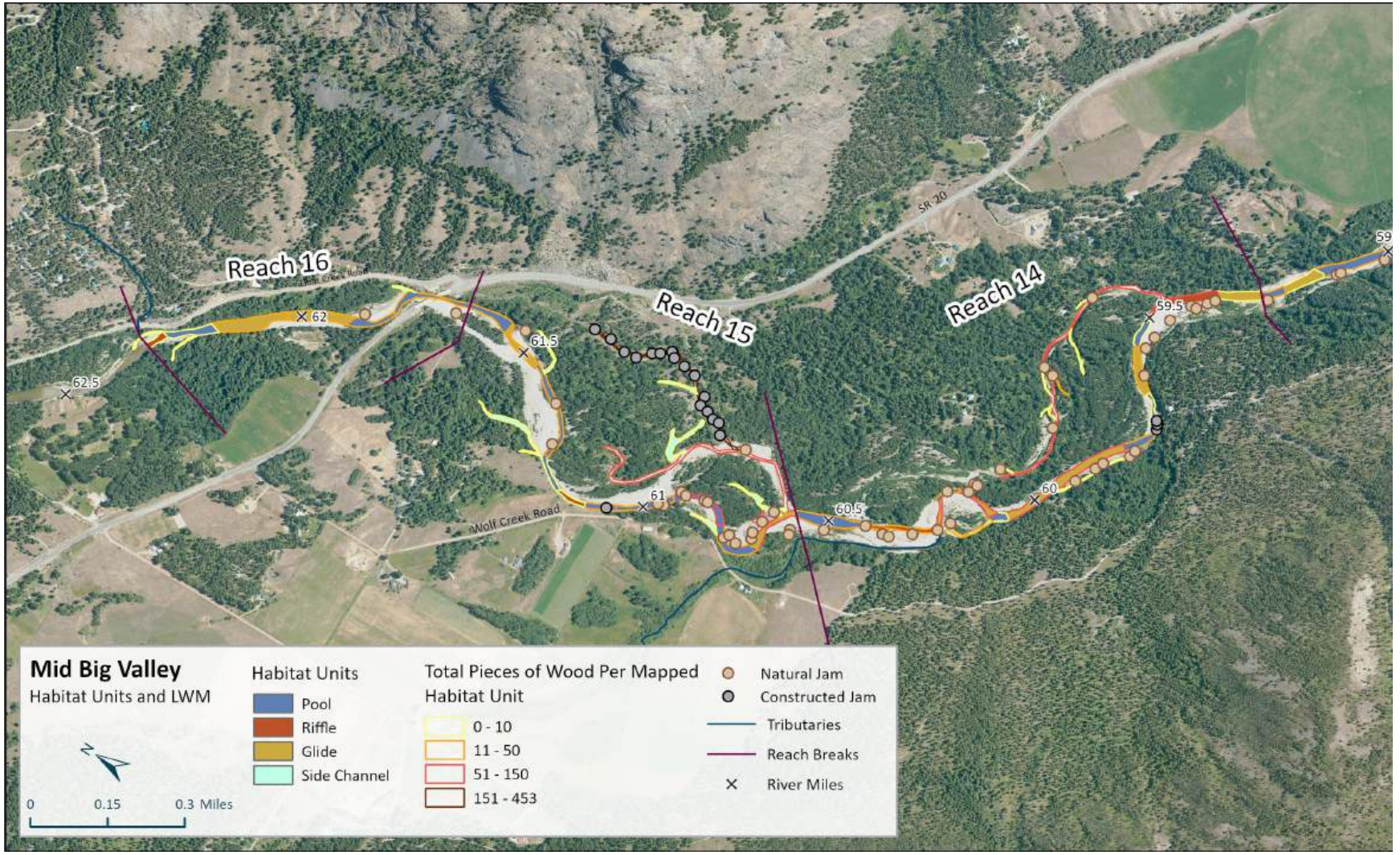


Figure 162. Segment 9 (Mid Big Valley): Mapped channel habitat units – 2024 Habitat Survey.



Figure 163. Example photo of low-flow bars and lateral meander bank erosion (background) -- RM 60.45. July 9, 2025

Perennial and seasonal side channels of varied connectivity can be found throughout the segment, most of which are partially to fully supported by groundwater and/or hyporheic inputs. Several side channels in Segment 9 are disconnected seasonally or perennially from the mainstem via surface water at the upstream end but perennially wetted via groundwater or hyporheic inputs and connected at the downstream end Figure 164. Groundwater supported floodplain tributaries that initiate as springs or seeps on the floodplain provide cool surface water inputs into the Methow River with surface water inlets along the mainstem on river right at RM 59.45, 60.75 (constructed Fender Mill gallery channel), 60.8, and on river left at RM 60.04 and 60.2 (in association with Hancock Springs), 61.3 and 62.2. The size, discharge, and relative connectivity of the groundwater tributaries and side channels vary (Figure 164 and Figure 165). Cool-water contributions and off-channel refugia are critically important habitats to conserve, create, and enhance for salmonid habitat uplift.



Figure 164. Groundwater supported side channel, disconnected at the upstream end during summer low-flow but wetted and connected at the outlet on river right at RM 61.4. July 9, 2025



Figure 165. Groundwater floodplain tributary outlet on river right at RM 59.45. July 9, 2025

Side channels and alcoves supported by groundwater or hyporheic inputs that appear within the active channel boundary during low-flow conditions occur in braided sections or behind point bars. The quality and persistence of these features vary throughout the segment. Back-bar side channels can provide important refugia when habitat complexity and connectivity to the mainstem is sustained and riparian vegetation provides shading. Because the width of the active channel can be

two or three times that of the modern riparian forest, maintaining and uplifting channel-margin habitat where shade and cover can be provided is valuable. The quality of existing habitat function and connectivity in back-bar or braided bar side channels currently varies widely in Segment 9 (Figure 166).



Figure 166. Examples of back-bar side channel complexity: A) low-flow created side channel at RM 60.5 with minimal habitat complexity or cover; B) low-flow side channel at RM 58.25 with vegetated bar. July 9, 2025

Segment 9 is in the broad valley floor section of the Methow River known as Big Valley. However, Reach 16 is confined by the Weeman Bridge / SR 20 crossing at the downstream end and Goat Creek Road on the right (east) side. Reach 15 is locally confined by the Weeman Bridge and its associated remnant levees and armoring, and the armored meander at RM 61.1-61.25. Otherwise, the channel is laterally active and Reach 14 is unconfined (Figure 167). Fans, terraces, and hillslopes border the segment, but the broad valley floor is still twice as wide as the channel's modern meander band. Channel scaring and floodplain topography indicates that broad meanders and active lateral processes are the natural state of condition for the channel and its floodplain throughout Big Valley. The bordering fans, terraces, and hillslopes have long contributed to the sediment and discharge that, when connected, support the complexity and dynamic nature of this portion of the Methow River.

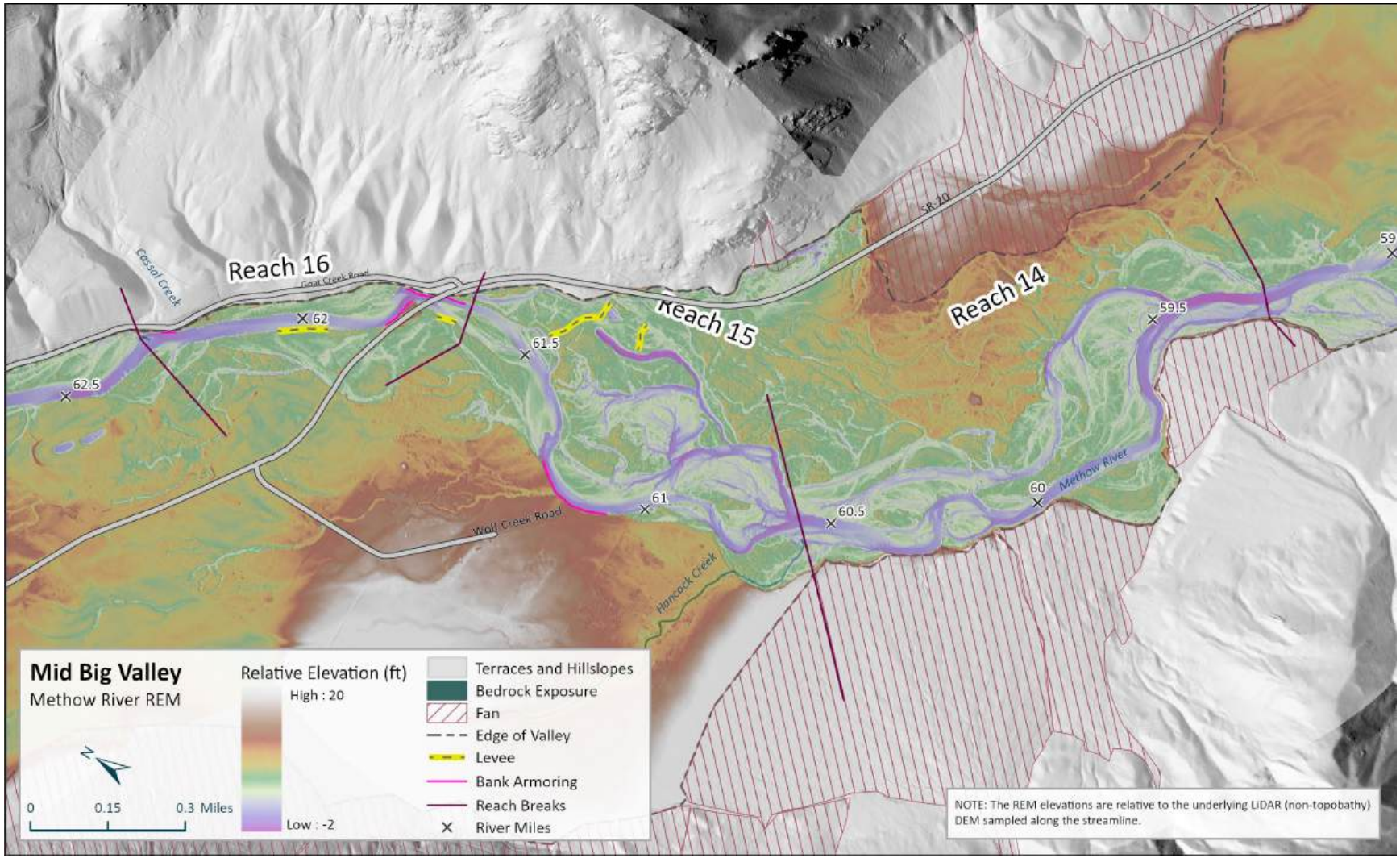


Figure 167. Segment 9 (Mid Big Valley): Relative elevation map with bedrock contacts and general geomorphic surfaces identified.

Floodplains in Segment 9 are composed of alluvial cobbles and gravels topped with sandy-loam. Bedload in the mainstem channel is dominated by cobbles and gravel. Boulders were noted as added riprap or natural hillslope or terrace bank contributions along the edge of the channel at contact points. The cobble and gravel bars exposed during low-flow conditions are wide and elongated. Braided bars in sections of Segment 9 at low flow indicate that sediment supply is not lacking in this segment.



Figure 168. Floodplain composition (cobbles topped with gravel and sandy loam) and bedload composition (cobble and gravel) - river left of east channel at RM 60.7. July 9, 2025

Preliminary hydraulic modeling confirms activation of several groundwater-supported side channels identified during the survey at the 2-yr modeled flow. At the 100-yr modeled flow, valley-wide floodplain connectivity via historical flow routes is expected in Reaches 14 and 15 (Figure 169). Modeled flood velocities at the 2yr flow through the more prominent seasonally disconnected side channels is expected to be sufficient to maintain connectivity, especially if they were reconnected perennially at the upstream end (Figure 170).

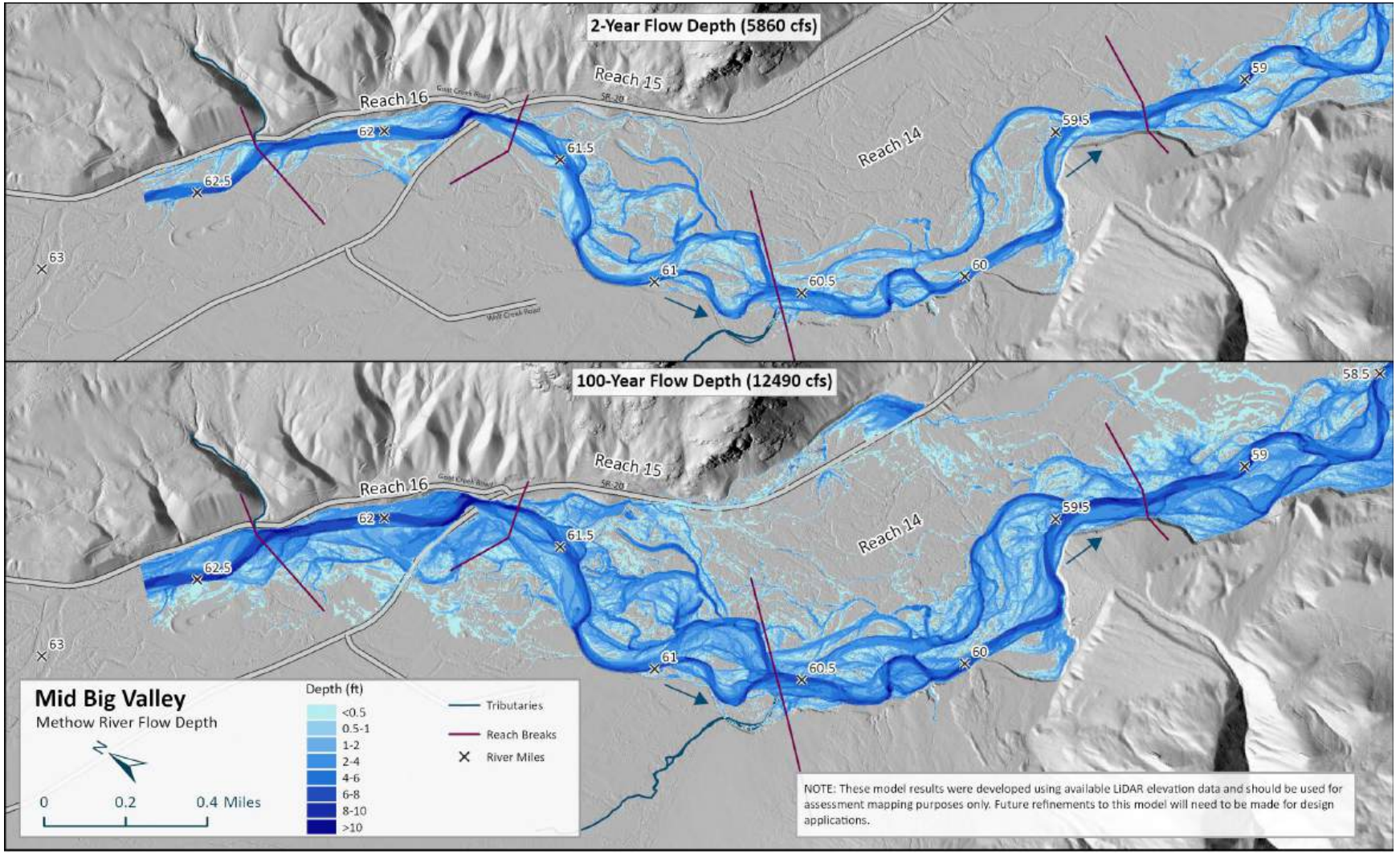


Figure 169. Segment 9 (Mid Big Valley): Preliminary hydraulic model (Hec-Ras 2D) depth results for the estimated 2-yr and 100-yr flood event. See Appendix D – Preliminary Hydraulic Model Results for more information.

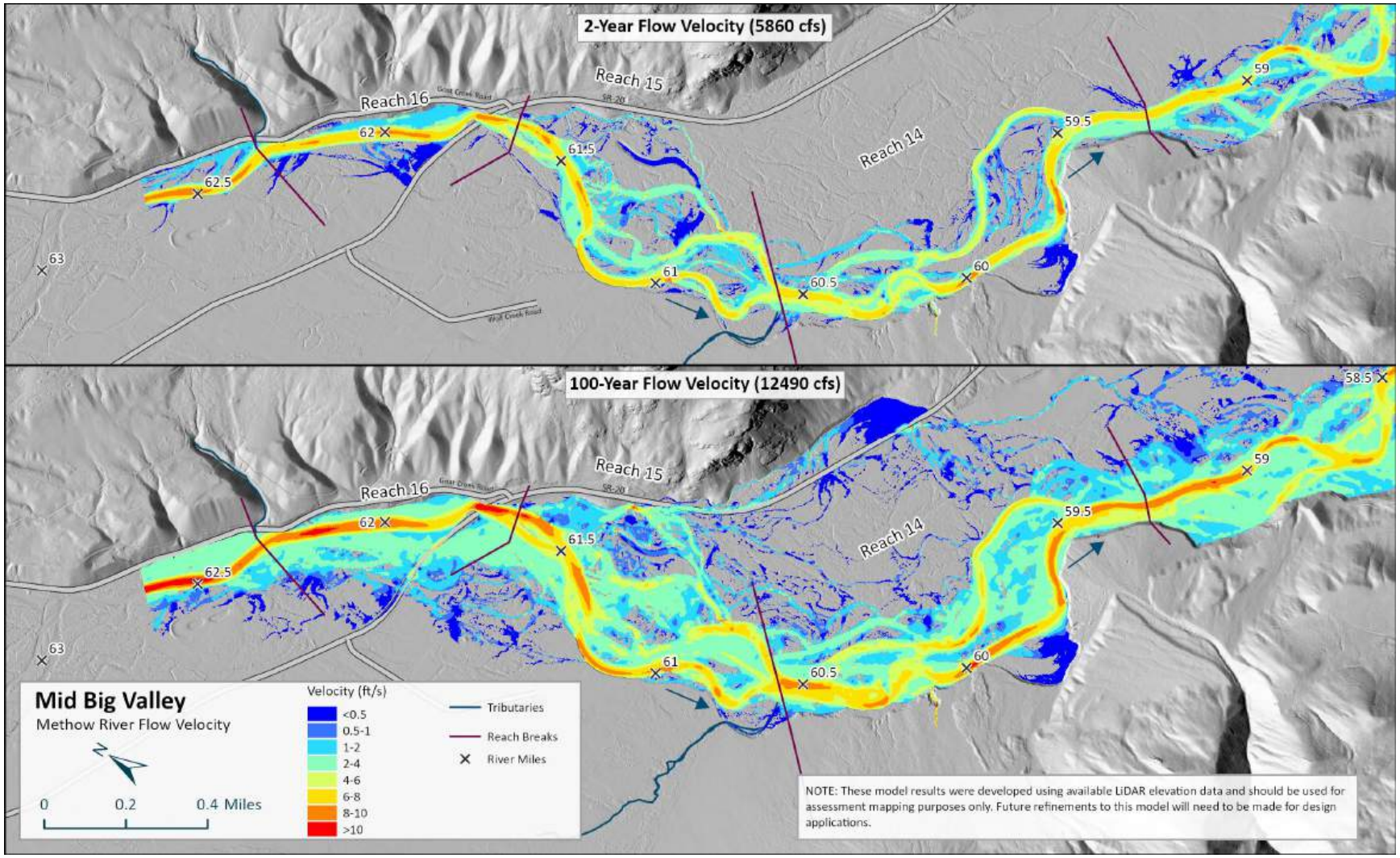


Figure 170. Segment 9 – Mid Big Valley (Reaches 14-16): Preliminary hydraulic model (Hec-Ras 2D) flow velocity results for the estimated 2-yr and 100-yr flood event. See Appendix D – Preliminary Hydraulic Model Results for more information.

6.9.3 Large Wood Material

Large wood in Segment 9 (Mid Big Valley) currently provides habitat complexity and some geomorphic function (Figure 171). During the 2024 Habitat Survey (see Appendix A) a total of 295 individual pieces of wood and an additional 72 log jams (3+ logs) were recorded through the segment. All but four mainstem jams and sixteen side channel jams were naturally formed. The sixteen side channel jams are in the machine-built Fender Mill groundwater gallery channel located on the river left floodplain near RM 61. A map of the distribution of large wood recorded during the 2024 Habitat Survey is provided as Figure 172. The total quantity of large wood present exceeded the minimum requirement for pieces of wood per mile in Reaches 15 and 14. Insufficient pieces per mile were counted in Reach 16. Some of the wood was rafted on bar tops and not interacting with the channel at low flow conditions. Only 28 large pieces (≥20 in diameter and 35 ft long) of wood were counted, thus much of the wood in this segment is not of sufficient size to be considered stable or to persist as a key log(s) that maintains complexity over time due to the lack of mature old-growth forests on the floodplain. The wood in the channel does provide nutrients and transient and/or temporary complexity benefits. Recruitment potential of wood into this segment is good in Reaches 14 and 15 due to natural lateral processes. The addition of large wood structures able to maintain complexity as well as retain the wood moving through the system is expected to uplift the quality of habitat in this segment while floodplain forests mature to a sufficient age/size.



Figure 171. Large wood as cover in pool at RM 60.8. July 9, 2025

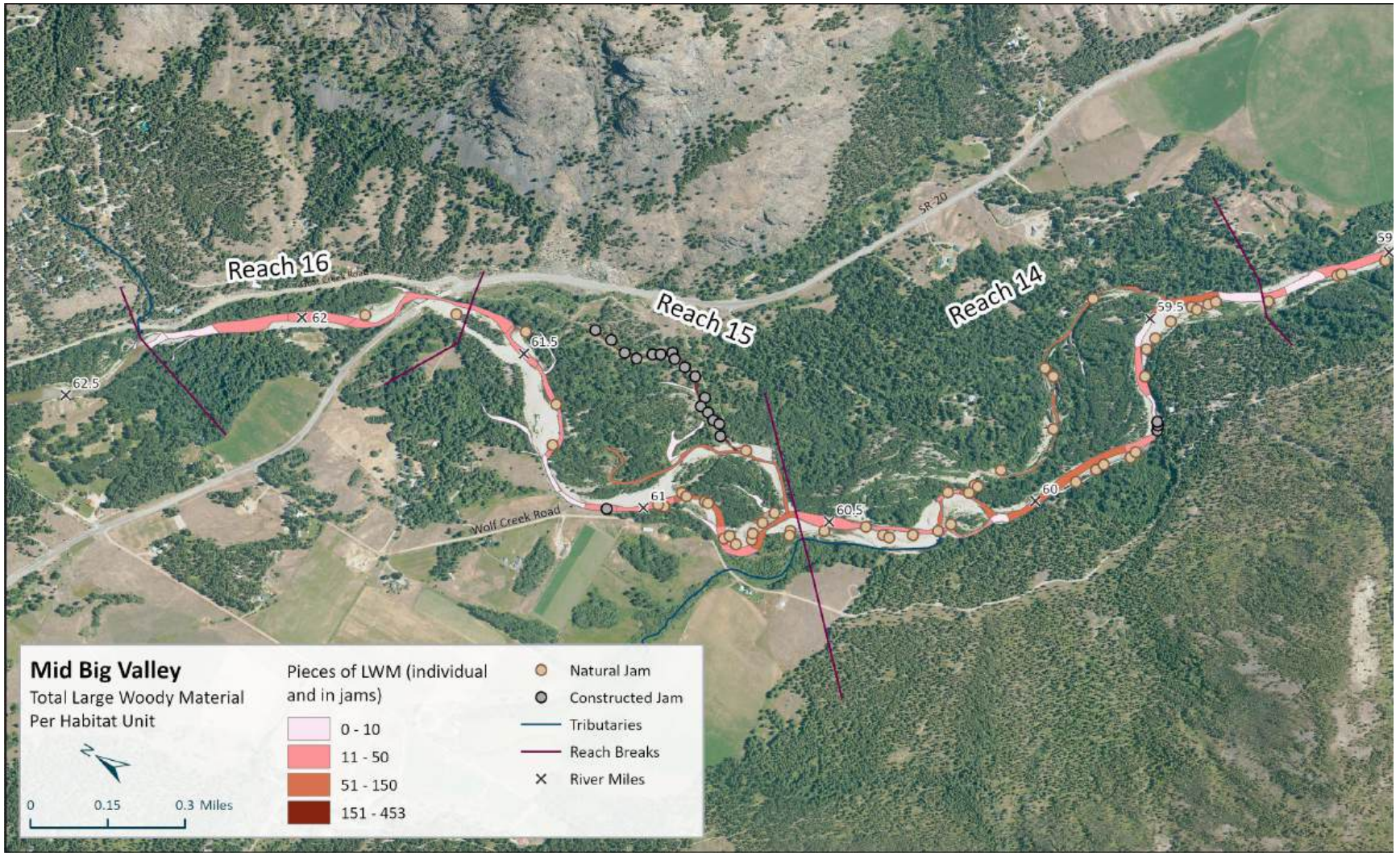


Figure 172. Segment 9 (Mid Big Valley): Distribution of large wood per mapped habitat unit and location of jams (> 3 pieces), natural and constructed - from 2024 Habitat Survey (see Appendix A)

6.9.4 Vegetation

Riparian and floodplain vegetation in the Mid Big Valley segment is mixed in both composition and seral stage, depending on level or timing of disturbance and height above available water. Areas cleared for anthropogenic purposes such as homesites, infrastructure, or agriculture are primarily vegetated with grasses, forbs, and occasional shrubs, or bare. It is presumed that historically the valley floor and channel banks were vegetated with mature (old-growth) native conifer and deciduous forests, prior to Euro-colonial clearing and development over the last 200 years. A floodplain occupied by old-growth forests with large mature trees would have provided more shade across the channel and would have provided geomorphically effective pieces of large wood capable of persisting while maintaining complexity in the channel. Today the recovering riparian and floodplain forests along the channel are still relatively young and small in size –compared to the channel width. The dominant overstory is cottonwood, Douglas fir, ponderosa pine, and alder. The understory is primarily willow, dogwood, small cottonwood, alder, grasses, and forbs. A representative photo of the riparian and floodplain vegetation is provided in Figure 173. Vegetation distribution and height-classification along the channel, valley floor, and adjacent hillslopes in this segment are mapped in Figure 174.



Figure 173. Representative photo of riparian and floodplain vegetation. RM 60. July 9, 2025

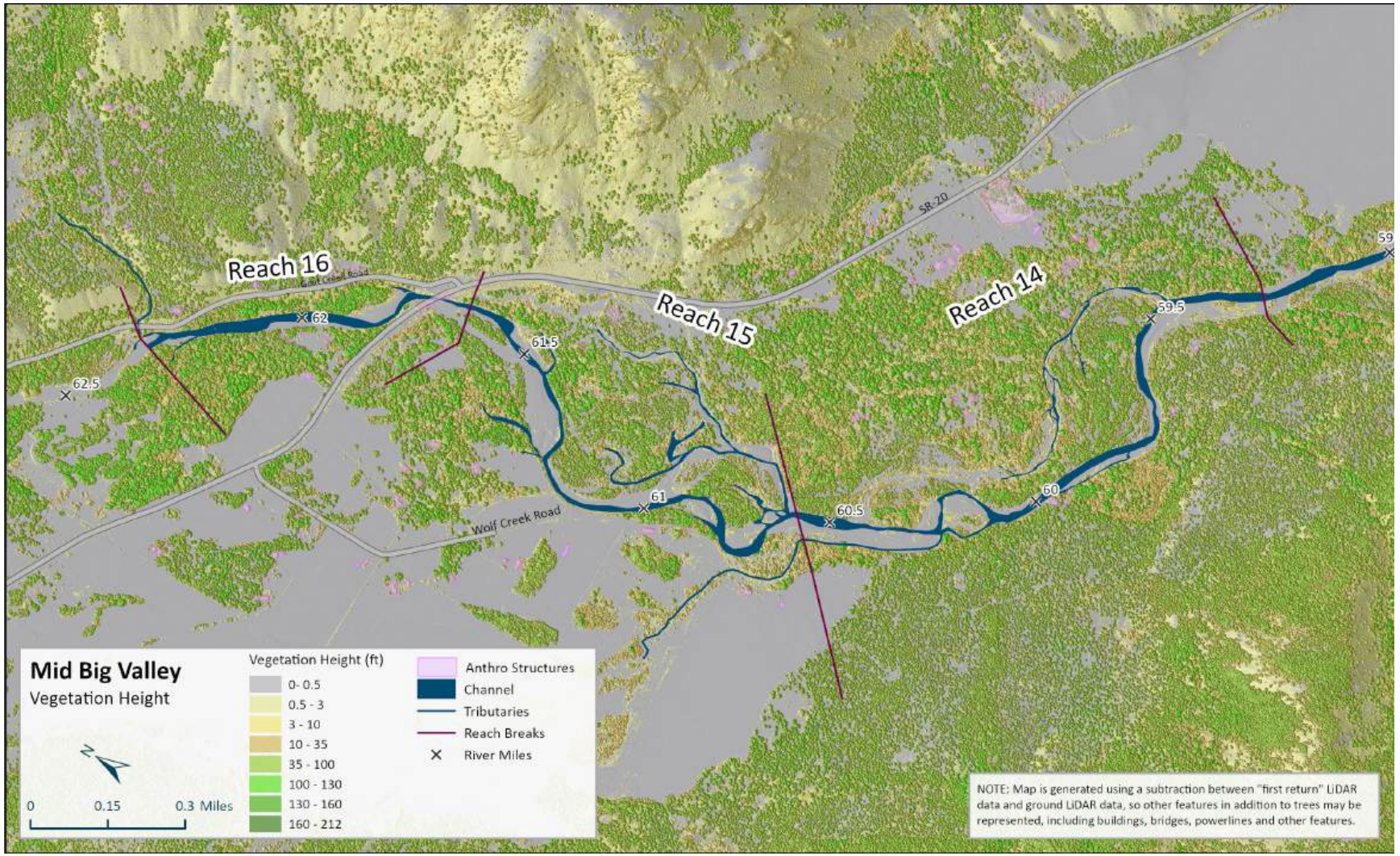


Figure 174. Segment 9 (Mid Big Valley): Vegetation height and distribution map.

6.9.5 Past and Planned Restoration Projects

The past and planned restoration projects reported or observed in Segment 9 are listed in Table 23. See the map of the reported past and planned projects in Figure 175.

Table 24. List and description of reported past and planned projects in Segment 9 (Mid Big Valley).

Year	Name	Sponsor	Area of coverage	Project Components
2007	Rockview Diversion	Cascade Fisheries	Reach 16; RM 61.7	Restored irrigation capability; Construction of an irrigation well and well pump; Fish screen installation
2009	Wolf Creek Road	Yakama Nation	Reach 15; RM 61.1	Large wood structures and bank armoring; Bank stabilization
2009	Hancock Springs (Upper)	Yakama Nation	Reach 15; Tributary	Off-channel habitat restoration of upstream extent; Riparian vegetation; Culvert replacement; Installation of three rocked livestock watering points
2009	Sletton and Green habitat complexity project	MSRF	Reach 12; RM 57; Reach 14; RM 59.7	Large wood structures and bank barbs; Bank stabilization; Increase bank complexity
2015	Fender Mill	MSRF	Reach 15; RM 60.2	Installation of groundwater gallery with large wood structures; Riparian vegetation; Channel excavation through remnant mill pond dam and creation of side channel habitat; Removal of concrete spillway; Highway protection, removal and replacement of woody debris; Closing and sealing of abandoned headworks; Relocating utilities
2019	Hancock Springs (Lower)	USFW & Cascades Fisheries	Reach 15; Tributary	Off-channel habitat restoration of downstream extent; Riparian vegetation; Culvert replacement
2029	Salmon Cassel Project	MSRF	Reach 16; RM 61.75-62.75	Proposed Project to enhance thermal refugia and habitat complexity upstream of the Weaman Bridge with elements including large wood structures and improvements to pool and alcove habitat.

The Wolf Creek Road (RM 61.1) and Sletton & Green (RM 57.9) projects (2009) are bank armoring projects that include large wood. The Sletton & Green project includes large wood pieces extending from riprap barbs (Figure 176 A). The Wolf Creek Road includes wood placed within a riprap-dressed bank (Figure 176 B). High water marks indicate that the large wood structures at the Wolf Creek Road project are engaged with the channel at higher flow conditions. At both projects, the wood structures only marginally interact with the channel during low flow, if at all. Although the overhanging root wads may provide a small amount of shade to the channel directly under it, habitat uplift is minimal.

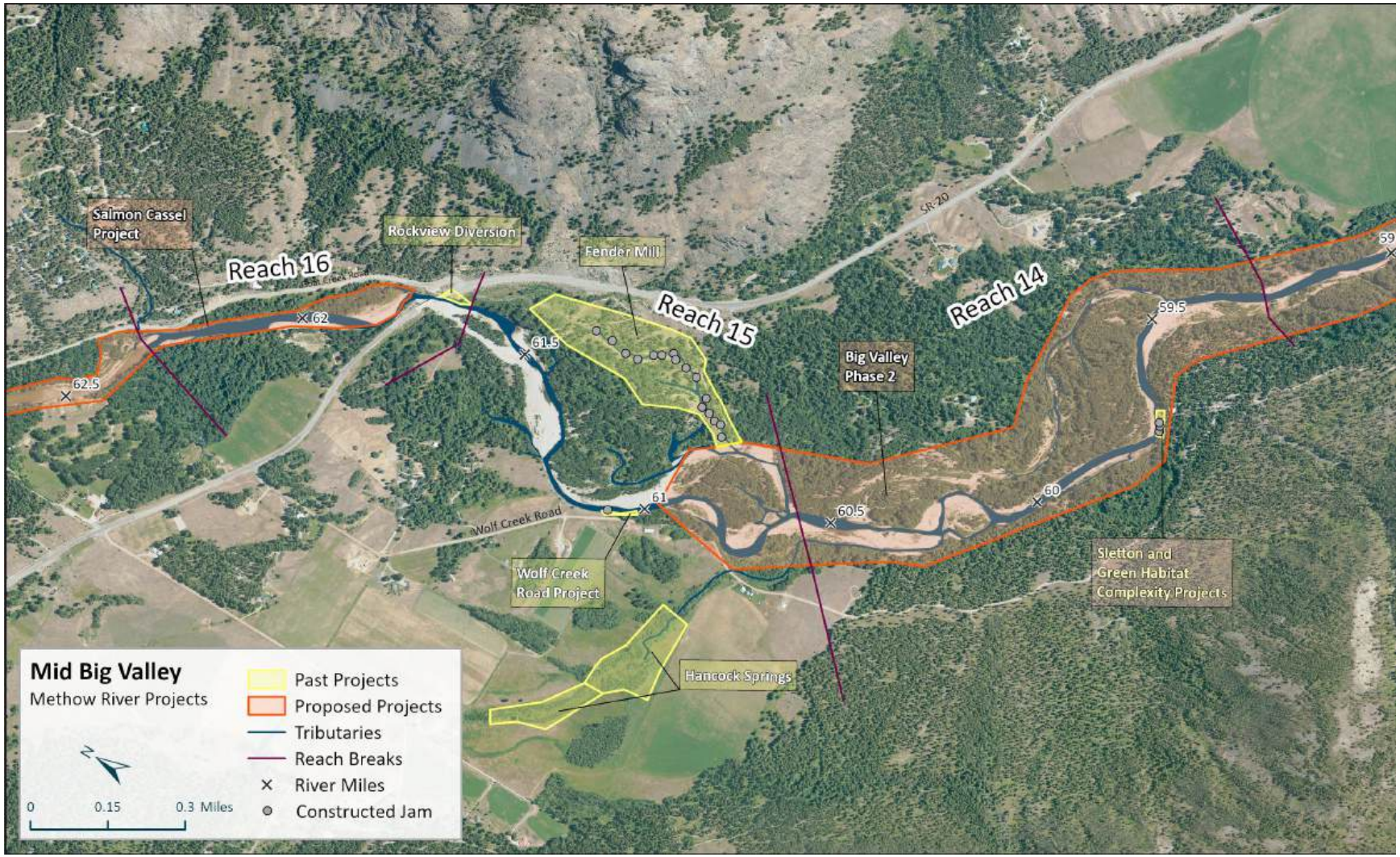


Figure 175. Segment 9 (Mid Big Valley): Map of past and proposed projects completed.



Figure 176. Bank stabilization/armoring projects that include large wood: A) Boulder barbs with large wood on river right at RM 59.7 (Sletton and Green – 2009). Note the lack of contact large wood has with the channel during low-flow conditions (white circle); and B) Boulder riprap with large wood bank armoring on river right at RM 61.1 (Wolf Road – 2009). Note the lack of contact the large wood has with the channel. July 10, 2025.

Habitat enhancement and creation projects have occurred in off-channel groundwater supplied tributaries of existing Hancock Springs and the Fender Mill constructed groundwater gallery channel. The Fender Mill groundwater gallery channel (2015) near RM 60.2 continues to function as a cool water off-channel refuge with plenty of wood cover and habitat complexity (see Figure 177). Riparian vegetation along the banks of the constructed channel is establishing well but patches of upland revegetation at the top of the banks are sparse in a few areas. Connectivity between the Fender Mill groundwater gallery channel and the mainstem channel was maintained via an existing side channel (previously the mainstem). At the time of the assessment the side channel was no longer connected at its upstream end during summer low-flow conditions, resulting in relatively low-quality habitat between the mainstem and the outlet of the groundwater gallery channel.

Additional restoration treatments to maintain connectivity here could improve and sustain confluence connectivity while adding complexity and maintaining split-flow conditions.



Figure 177. Representative photos of the Fender Mill (2015) constructed groundwater gallery channel (July 10, 2025).

6.9.6 Project Opportunities

Potential restoration actions in Segment 9 (Mid Big Valley) are expected to maximize uplift and encourage dynamic response. Identified restoration opportunities include enhancement of channel complexity, side and off-channel habitat creation and enhancement, floodplain reconnection, riparian vegetation restoration, and conservation of critical areas. Several of the groundwater floodplain tributaries and side channels were identified as cold-water refugia and Cold Water Patches (see Section 3.2.5). Groundwater-supported floodplain tributaries and side channels are a valuable off-channel resource with sometimes impaired habitat complexity and impaired connectivity to the mainstem channel. In Reach 14 and 15, active lateral processes are recruiting trees, but they are often second growth or quick-to decay cottonwood that are unable to act as structural key-logs capable of maintaining geomorphic complexity over the long term. Identified restoration opportunities in this area include the addition of large wood structures, reactivation of perennial side channels, and creating perennial connection to existing groundwater-supported off-channel habitat. Reach 16 is confined and entrenched at the downstream end by the Weeman Bridge/State Route 20 crossing. Identified restoration opportunities in this reach include localized mainstem habitat uplift, side channel activation – including reactivating flow via passage (culvert) under SR 20 to reconnect the river right floodplain and uplift existing wetlands downstream of the crossing/road. Replacement of the existing Hwy 20 bridge (Weeman Bridge) crossing with a longer-spanning bridge to reduce confinement trends of entrenchments is also an option. Identified project opportunities aim to work with and enhance previously implemented or planned restoration projects. Consideration and analysis of groundwater hydrology in the segment during restoration project planning, distribution, and design is recommended for conservation of this valuable resource. More thorough descriptions of each project opportunity and a map of their locations are provided in Appendix C – Project Opportunities.

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