RECLAMATION

Managing Water in the West

Big Valley Reach Assessment

Methow River

Okanogan County, Washington

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region

August 2008

Cover Photograph – Overview of lower Big Valley reach during the spring 2006 flood.

Bureau of Reclamation Photograph by D. Walsh, May 23, 2006.

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Methow River

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U.S. Department of the Interior, Bureau of Reclamation:

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U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region

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Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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The following Reclamation employee is acknowledged for his peer review of this report: regional geologist Richard A. Link, Geology, Exploration & Instrumentation Group, Pacific Northwest Regional Office, Boise, ID.

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Appendix A
Reach-based Ecosystem Indicators (REI)
Version 1.1

A results compilation of the Reach-based Ecosystem Indicators (REI) for the Big Valley Reach (RM 56 – 62.4). The Big Valley reach assessment team was comprised of Edward W. Lyon, Jr., L.G. (Reclamation geologist), Jennifer Molesworth (Reclamation Methow Subbasin liaison; formerly U.S. Forest Service fisheries biologist), Cassie Klumpp, P.E. (Reclamation hydraulic engineer), and Dave Hopkins (U.S. Forest Service fisheries technician). The REI was developed collaboratively with a workgroup recommended by the Upper Columbia Regional Technical Team (UCRTT) during this reach assessment to evaluate the appropriate core indicators and utility of the REI. Rating of each indicator was done as an iterative process by integrating new data collected for this reach assessment, data contained in the *Geomorphic Assessment* (Reclamation, 2008a), and literature review. The ranges of criteria presented here are not absolute and should be adjusted to each unique subbasin as data become available.

Appendix B
Initial Site Assessments

This appendix provides results for the initial site assessments for each project area within the Big Valley reach assessment area in 2006. The purpose of this information was to evaluate the functionality of each project area and provide photographic documentation of primary features. Work and documentation by Ed Lyon and Rob McAffee.

Appendix C
Habitat Assessment

This appendix focuses on description of existing habitat conditions of the Big Valley reach assessment area. The habitat assessment was conducted by the U.S. Forest Service Methow Valley Ranger District in accordance with the Pacific Northwest Region, Region 6, Stream Inventory Handbook Level I & II, Version 2.6 (2006). Work and documentation by Dave Hopkins.

Appendix D
Numerical Modeling Results

This appendix focuses on describing the two-dimensional (2D) modeling results for the Big Valley reach assessment area. The 2D modeling was conducted by Reclamation's Technical Service Center. Main author was Cassie Klumpp, P.E., (Reclamation, Hydraulic Engineer, Technical Service Center, Denver), with peer review provided by Jennifer Bounty, P.E., (Reclamation, Hydraulic Engineer, Technical Service Center, Denver).

Appendix E
GIS Databases

The GIS (Geographic Information System) geodatabase was produced in support of the document, *Big Valley Reach Assessment, Methow River, Okanogan County, Washington*. More geodatabases at the valley segment spatial scale are contained in the *Methow Subbasin Geomorphic Assessment, Okanogan County, Washington* (Reclamation, 2008a). All work for this appendix completed Ed Lyon and Rob McAffee with assistance from Melanie Paquin.

The ***BigValleyReach*** geodatabase includes one feature data set: Project Features. The Project Features data set includes seven feature classes: BVRA_Area, ProjectAreas, ProtectionAreas, FloodplainConnectivity, WetlandAreas, Photopoints, and RiverMiles. The BVRA_Area, ProtectionAreas, and WetlandAreas feature classes contain one shapefile each. The ProjectAreas and Photopoints feature classes each contain eight shapefiles and the FloodplainConnectivity feature class contains sixteen shapefiles. The River Miles feature class contains one layer.

For more information or to request a copy of the GIS database on DVD, contact Melanie Paquin at the Reclamation's Pacific Northwest Regional Office, mpaquin@pn.usbr.gov.

Executive Summary

The primary objectives of this reach assessment are to identify project areas based on environmental baseline conditions, and develop an overall reach-based implementation and sequencing strategy that informs subsequent monitoring and adaptive management activities. The implementation and sequencing strategy is based on findings of the reach-based ecosystem indicators (REI), a scientific synthesis of data collected from several individual/independent parameter-based investigations. The Big Valley reach assessment was conducted by the Bureau of Reclamation (Reclamation) in the fall 2006 and summer 2007. The Big Valley reach is located on the Upper Methow River, a 6th field Hydrologic Unit Code (HUC) watershed, between the towns of Winthrop and Mazama, Okanogan County, Washington (Figure 1). The reach begins at the Wolf Creek alluvial fan about river mile (RM) 55 and ends near the confluence of Cassal Creek about RM 62. The assessment area covers about 1,400 acres of floodplain and river channels. The species of concern found in the Big Valley reach include Upper Columbia River (UCR) spring and summer Chinook salmon (*Oncorhynchus tshawysha*), UCR steelhead (*Oncorhynchus mykiss*), Columbia River Bull Trout (*Salvelinus confluentus*) (Andonaegui, 2000), and non-native brook trout (*Salvelinus fontinalis*) that are also found in off-channel areas.

Concurrently with the Big Valley reach assessment a collaborative effort was conducted by Reclamation to develop REIs to document environmental baseline conditions that are utilized for project identification, implementation and monitoring. Based on the analysis performed for this reach assessment, about 50 percent of the reach-based ecosystem indicators are in an *adequate* condition and 40 percent are in an *at risk* condition for the Big Valley reach. Only one indicator, water temperature, was found to be in an *unacceptable risk* condition because it did not meet Washington State Department of Ecology water standards. However, the Big Valley reach is located in a "gaining" section of the Methow River that currently provides a thermally favorable environment for salmonids making it one of the most productive spawning areas in the subbasin. The reach exhibits the ecosystem resilience necessary to maintain its current functionality for salmonids, but is threatened by development within the floodplain. Of the eight project areas identified in the Big Valley reach two of them are protection areas and six are primarily restoration areas. The priority habitat action is to protect areas that will maintain core habitat connectedness (about 65 percent of the reach or about 940 acres).

To improve the Big Valley reach's ecosystem resilience, potential, and connectedness, the habitat actions should be sequenced as follows: (1) protect core habitat areas (i.e., protection areas) to maintain current functionality of the reach; (2) at a subwatershed scale, address water temperature issues, and evaluate

the impact of floodplain development (i.e., riparian vegetation clearing, diversions and domestic wells); (3) evaluate the mainstem physical barrier, Foghorn Diversion Dam, for fish passage at all biologically significant flows; (4) reconnect isolated habitats for a cumulative ecosystem benefit; (5) address floodplain development and its impact on river processes (i.e., risk of bank hardening); (6) complete alternatives evaluations for each project area where project implementation is feasible to expand the core habitat areas; and (7) monitor the ecosystem/physical indicators listed in the REI to ensure the reach's potential is maintained or improved to sustain salmonid populations for an indefinite period of time.

The assessment team's overarching hypotheses on the ecosystem processes are:

the proposed potential habitat actions presented in this reach assessment will provide a cumulative benefit that will improve ecosystem resilience at the reach scale; and the processes that naturally create and sustain habitat upon which the species of concern depend will be maintained or restored resulting in a net increase in abundance, productivity, spatial diversity and structure of the populations.

Purpose and Location

The primary purpose of a reach assessment is to characterize and diagnose reach conditions to establish context for habitat protection and restoration. The ultimate by-product of this effort is to identify project areas based on environmental baseline conditions and develop an overall reach-based implementation and sequencing strategy that informs subsequent monitoring and adaptive management activities (Reclamation, 2008b). An implementation strategy for project area prioritization is introduced and based on the geomorphic potential and an integration of local habitat conditions. The strategy is presented as a project selection guide for use at the local level by end users. The reach assessment and the recommended potential habitat actions are intended to improve the survival and recovery of anadromous fish listed under the Endangered Species Act (ESA) as part of Federal Columbia River Power System Biological Opinions issued by National Marine Fisheries Service (NMFS). Reclamation provides technical assistance in partnership with private parties, states, tribes, other Federal agencies, and others to implement streamflow improvement, fish screen, access, and channel complexity actions.

The *Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan* (UCSRB, 2007) has identified potential restoration strategies based on professional judgment of a panel of scientists, but further technical evaluation was recommended to refine the level of detail needed to implement projects, and determine if the recommendations are sustainable and compatible with the geomorphic conditions of the river. Regarding physical processes, the Upper Columbia Salmon Recovery Board (UCSRB) recommends conducting additional research to identify priority locations for protection and restoration, and examining fluvial geomorphic processes to assess how these processes affect habitat creation and loss.

The *Methow Subbasin Geomorphic Assessment, Okanogan County, Washington* (Reclamation, 2008a), referred to as the ***Geomorphic Assessment***, used a physical-processes based analysis of the fluvial system and found no system-wide trends of degradation (incision or aggradation), except in localized areas, on a decadal time-scale. In addition, the *Geomorphic Assessment*, at a coarse-scale (valley segment), identified and prioritized geomorphic reaches that could be potentially protected or restored, and the anthropogenic features associated with each reach.

The Big Valley reach is located in the Methow subbasin on the Methow River in Okanogan County, Washington (Figure 1). The Big Valley reach assessment, referred to as the ***Reach Assessment***, was conducted by Reclamation at a finer-scale (geomorphic reach) to identify project areas, both protection and restoration areas, based on environmental baseline conditions. It also develops an overall reach-based implementation and sequencing strategy that informs the UCSRB implementation plan, and subsequent monitoring and adaptive management activities. Ongoing work is being done to work with stakeholders to share information and cooperate on project selection and initiation.

The Big Valley reach assessment was conducted by Reclamation in the fall 2006 and summer 2007. The Big Valley reach is located on the Upper Methow River, a 6^{th} field Hydrologic Unit Code (HUC) watershed, between the towns of Winthrop and Mazama, Okanogan County, Washington. The reach begins at the Wolf Creek alluvial fan about river mile (RM) 55 and ends near the confluence of Cassal Creek about RM 62. It needs to be noted that the Big Valley reach assessment area does not cover the entire geomorphic reach (M9 between RM 55 and RM 65.5) as identified in the *Geomorphic Assessment*. This is because many of the concepts in both the geomorphic and reach assessments were being developed concurrently. Another reach assessment is scheduled to be conducted in the future between RM 62 and RM 65.5 to complete the coverage in the geomorphic reach (M9). The Big Valley assessment area covers about 1,400 acres of floodplain and river channels. In the Big Valley reach the species of concern include Upper Columbia River (UCR) spring and summer Chinook salmon (*Oncorhynchus tshawysha*), UCR steelhead (*Oncorhynchus mykiss*), Columbia River Bull Trout (*Salvelinus confluentus*) (Andonaegui, 2000), and non-native brook trout (*Salvelinus fontinalis*) that are also found in off-channel areas. Life histories for these species can be found in the *Geomorphic Assessment* in Appendix F – Biological Setting, (Reclamation, 2008a).

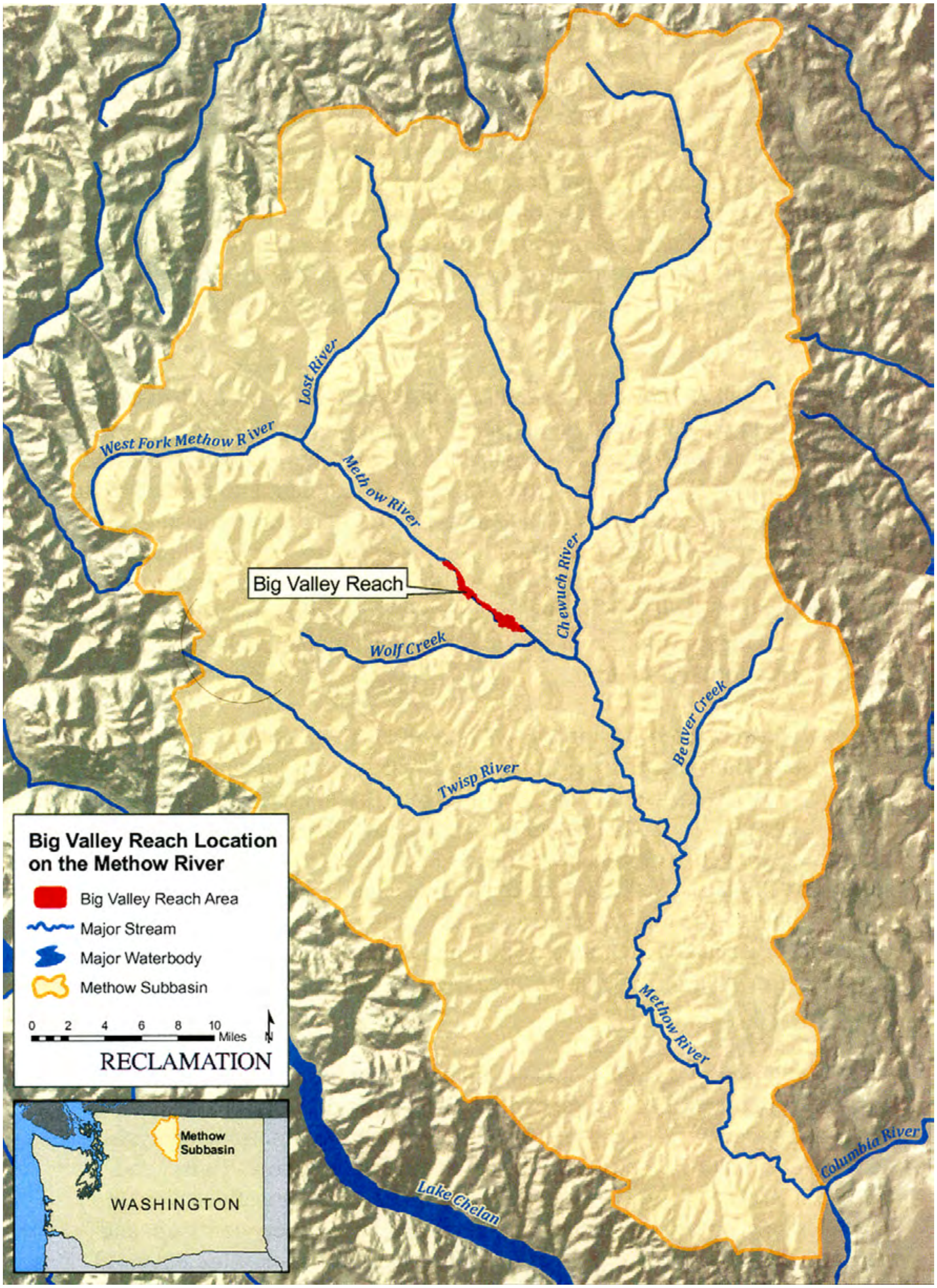


Figure 1 - Location Map for the Methow Subbasin in Okanogan County, Washington, and the Big Valley Reach Assessment Area on the Upper Methow River

Watershed Context

The *Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan* (UCSRB, 2007), referred to as the ***Recovery Plan***, contains five key objectives: (1) to protect areas with ecological integrity and natural ecosystem processes; (2) to protect and restore water quality where feasible and practical; (3) to protect and restore floodplain processes, off-channel habitat, riparian habitat and channel migration processes where appropriate; (4) to restore natural sediment delivery processes; and (5) to reduce the abundance and distribution of non-native species that compete and interbreed with or prey on listed species.

The Upper Methow River as defined in *A Biological Strategy to Protect and Restore Salmonid Habitat in the Upper Columbia Region* (UCRTT, 2007a), referred to as the ***Biological Strategy***, begins at the Chewuch River confluence with the Methow River at Winthrop and extends upstream into the headwaters covering about 322,385 acres. This section of the river encompassing the Big Valley reach has a Category 2 Status, which means protecting and restoring ecosystem functions and connectivity within the watershed is priority, and that it is a stronghold for one or more listed species. In addition, the Upper Methow River is a major spawning area for UCR spring Chinook and UCR steelhead, and is a core area for CR bull trout.

The *Biological Strategy* identifies the following causal and limiting factors that affect habitat conditions in the Upper Methow River: (1) the mainstem Methow River between RM 59 and 74 periodically goes dry in areas during low flow years; (2) reaches of the mainstem Upper Methow River have large woody debris levels below levels expected based on extensive data collected in the subbasin; (3) several small dikes disconnect important side channel habitats; (4) bridge locations and residential construction in flood prone areas have resulted in clearing of riparian habitat; and (5) non-native aquatic species (i.e., brook trout) are present in existing off-channel areas and are a threat to native aquatic species (UCRTT, 2007a).

The *Geomorphic Assessment* was completed by an interdisciplinary team of hydraulic engineers, geologists, hydrologists, biologists and botanists. The focus of the assessment was to complete a comprehensive geomorphic analysis of the fluvial system along 80 miles of river including the Methow, Twisp, and Chewuch Rivers. Two of the *Geomorphic Assessment* objectives were to characterize geomorphic reaches (i.e., confined, moderately confined, and unconfined) and prioritize reaches according to their geomorphic potential. Based on the *Geomorphic Assessment's* findings and the needs of the local stakeholders, the Big Valley reach assessment was initiated in the fall of 2006.

Geomorphic Assessment

Reclamation completed the *Geomorphic Assessment* that evaluated the physical river processes and associated salmonid habitat for about 80 river miles (Figure 2). The assessment area included a 46.9-mile-long section of the Methow River (RM 28.1 to 75), the downstream-most 18.1 river miles of the Twisp River (a tributary to the Methow River) and the downstream-most 14.3 river miles of the Chewuch River (also a tributary to the Methow River).

The goal of the *Geomorphic Assessment* was to provide resource managers with a method to prioritize and sequence protection and restoration opportunities for twenty-three geomorphic reaches evaluated in the assessment area. Potential habitat actions are based on the analysis of trends in physical processes and habitat over the last century. Prioritization of geomorphic reaches is based on the current habitat quantity and quality, potential habitat improvements, and how the proposed habitat actions meet established objectives.

The twenty-three reaches were delineated and characterized into three general geomorphic reach types based on natural channel constraints. These reach types are referred to as ***confined***, ***moderately confined***, and ***unconfined*** reaches. The primary limiting factors to habitat function in the confined reaches are historical conversion of the riparian buffer zone to riprap, levees, or embankments along the boundary of the floodplain. In moderately confined and unconfined reaches the primary limiting factors are floodplain development and anthropogenic activities that limit connectivity between the channel and floodplain, lateral channel migration and reworking processes (e.g. bank hardening), and the availability of habitat complexity features.

Despite impacts from anthropogenic activities, the channel planform and bed elevations appear consistent in most reaches with no detectable trends of channel-bed incision or aggradation on a decadal time-scale. The river hydraulics and sediment sizes are dominated by geologic features that control the channel-bed slope, and the width of the active channel and floodplain. The predominant substrate is gravel to cobble (40 to 140 mm) for all three rivers, with the larger sizes present in the reaches with steeper slopes. Except for a few steep, confined reaches, the floodplain can be reworked at the more frequent 2- and 5-year floods. Stream energy in most reaches does not exceed the sediment supply, which combined with findings from historical channel analysis and field observations indicates there is a limited tendency for continued incision.

Even though anthropogenic impacts can not be detected on reach-based hydraulics and sediment characteristics, they have impacted localized hydraulics, habitat features formed by large woody debris and riparian vegetation, and spawning-sized sediment recruitment and retention. Hydraulic conditions have been most impacted by reduced flow access to off-channel areas, and altered channel and floodplain connectivity.

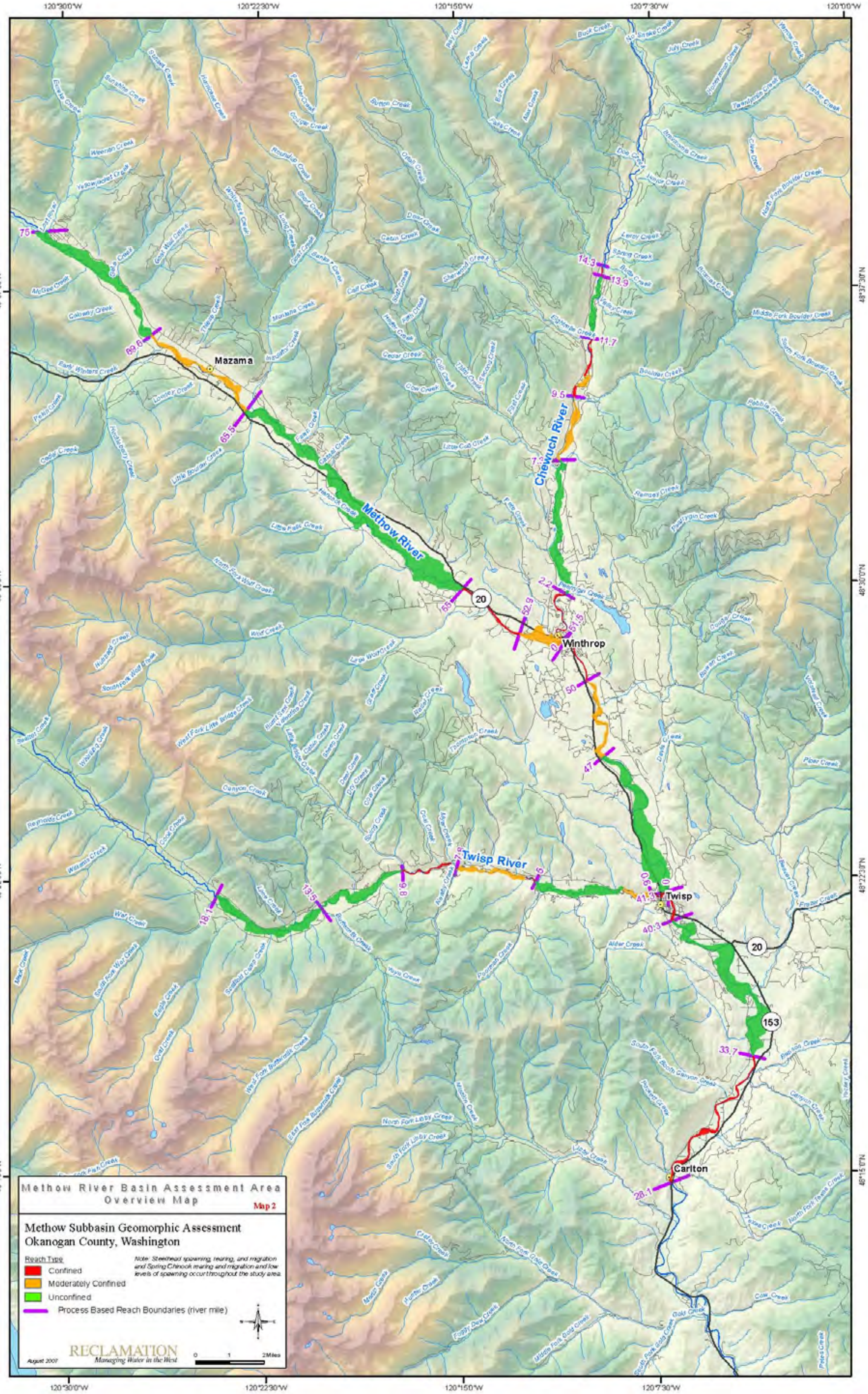


Figure 2. Location map of the *Geomorphic Assessment* area (Reclamation, 2008a)

In the upper Methow valley segment the *Geomorphic Assessment* identified five geomorphic reaches (Table 1). The unconfined and moderately confined reaches were ranked based on their geomorphic potential. The Big Valley reach, M9, had the highest geomorphic potential and the largest number of anthropogenic features within the low surface. Based on the initial *Geomorphic Assessment's* findings, the Big Valley reach assessment was conducted to further define the types of potential habitat actions and their relative ranking to attain a cumulative habitat benefit. By maintaining or improving the physical processes, the habitat actions should be resilient and sustainable.

Table 1: Location, reach type, geomorphic potential score, and number of anthropogenic features mapped within the low surface and along the low surface boundary for the Methow River between RM 51.5 and RM 75 (Reclamation, 2008).

Reach Designation	River Miles	Reach Type	Total Floodplain Area (acres)	Geomorphic Potential Score	Total Number of Anthropogenic Features
M7	51.5 – 52.9	Moderately confined	~180	0	14
M8	52.9 – 55.0	Confined	NA	NA	4
M9	55.0 – 65.5	Unconfined	~1,400	88	67
M10	65.5 – 69.6	Moderately confined	~190	36	10
M11	69.6 – 75.0	Unconfined	~500	25	16

Reach Characterization

The reach-based approach utilizes an interdisciplinary team comprised of geologists, biologists, design engineers and hydraulic engineers. The reach assessment is a finer-scale investigation that generally provides more detail and validation (either on the ground or computationally) than a geomorphic assessment. The reach-based approach includes qualitative and quantitative tasks to investigate questions or problems relevant at the reach-scale. The approach integrates the biological conditions with the ecosystem/physical conditions to identify habitat actions that will produce the maximum ecosystem benefit, greatest sustainability and lowest implementation costs.

The Big Valley reach is in a U-shaped glacial trough with a valley bottom type-*U1* (Naiman et al., 1992) that is in an unconfined valley segment on the Upper Methow River between Wolf Creek alluvial fan (RM 55) and the confluence of Cassal Creek (RM 62.4) (Figure 3). The valley type is alluvial and the channel patterns are sinuous with braids and side channels. The channel type is a low gradient channel with meanders, point-bars and broad floodplains. Bed materials are predominantly gravel and small cobbles with a pool-riffle bed-form type (Montgomery and Buffington, 1993).

Unconfined geomorphic reaches generally have flatter slopes and a complex network of channels and large woody debris that result in a high degree of floodplain interaction with a dynamic cycle of conversion from river to floodplain and vice versa. Erosion and deposition is common as the channel migrates across the floodplain. The average channel bed elevations within the reach do not change over time such that there is no net change in the total volume of sediment stored in the reach beyond a natural range of fluctuation (Reclamation, 2008a).

In its natural state (dynamic equilibrium), the Methow River actively migrates laterally across its floodplain in the Big Valley reach. This lateral channel migration helps the river maintain a flatter channel profile as sediment is stored on the floodplain before being eroded and transported through a natural constriction, the Wolf Creek alluvial fan and glacial deposits. Lateral channel migration and floodplain connectivity are especially critical in the Big Valley reach to maintain the following: (1) riparian corridor, (2) groundwater recharge, (3) water quality, (4) stream power, (5) large woody debris and spawning gravel recruitment, (6) nutrient supply and storage, and (7) hyporheic zone.

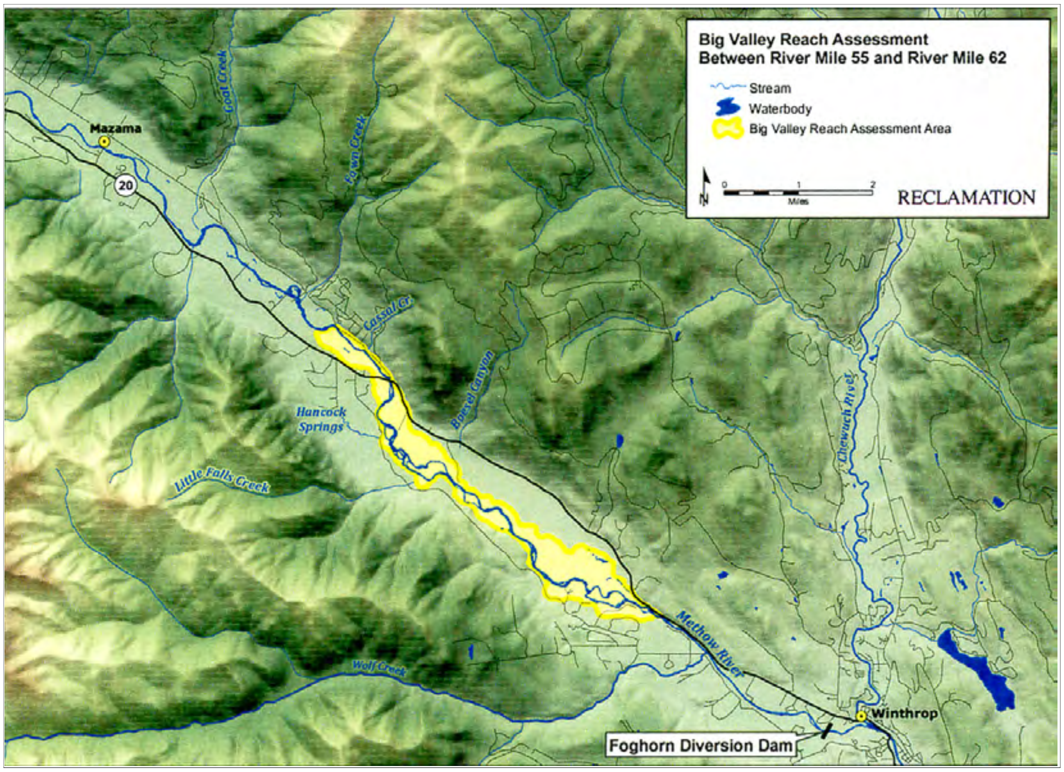


Figure 3. Big Valley reach assessment area and location of Foghorn diversion dam.

A hydrologic analysis was conducted for eight U.S. Geological Survey (USGS) gaging stations in the Methow Subbasin during the *Geomorphic Assessment* (Reclamation, 2008a; Appendix J). The closest USGS gaging station (station 12447383) to the Big Valley reach is located at RM 65 near Mazama. Using results from the *Geomorphic Assessment*, discharges were determined for four flood stages (Table 2). These discharges were used in the Big Valley two-dimensional (2D) hydraulic model (Appendix D) to characterize floodplain connectivity, flood inundation areas, flow velocities and shear stresses.

Table 2: Peak flow discharges for return period floods based on reference gage 12447383, Methow River near Mazama at RM 65.5 (Reclamation, 2008a; Appendix J).

Discharge (cfs)	Flood Description
5,935	2-year
7,841	5-year
10,277	25-year
12,043	100-year

Based on the 2D hydraulic model results, the most prominent anthropogenic features in the reach are the Weeman Bridge and Highway 20 embankment near RM 61 that disconnect the river from its floodplain and restricts lateral channel migration. Another anthropogenic feature that is impacting floodplain connectivity is the cable tram at RM 57. The east abutment is located within the active channel that is constricting streamflow. It also restricts lateral channel migration that may be causing localized scour and channel steepening disconnecting the channel from the floodplain and should be further evaluated. There are many other features (i.e., bank hardening, road embankments, undersized culverts, etc.) that have lesser impacts that involve floodplain connectivity and habitat access throughout the reach.

Reach Condition

The complete integrated REI analysis conducted by the Big Valley reach assessment team is included in Appendix A. Additional documentation of baseline conditions is included in Appendix B (Initial Site Assessments), Appendix C (Habitat Assessments), Appendix D (Hydraulic Analysis) and Appendix E (GIS Geodatabase).

Table 3 summarizes the results of the REI analysis. Each REI indicator was given a score such as “3” if the indicator was in an *adequate* condition; “2” if the indicator was in an *at risk* condition; and “1” if the indicator was in an *unacceptable risk* condition. The scores for each indicator were averaged to determine a *reach average* score for each indicator. Then the indicators were summed for each project area and the reach average. The total maximum score is 45 for the REI which provides a relative scale against which the project area scores can be compared to determine their degree of departure. This type of “ranking” methodology provides a strategy for prioritizing project area implementation by rating project areas by their degree of departure.

The following are the assessment team’s reach-based conclusions:

- Over fifty percent of the ecosystem/physical indictors are in an *adequate* condition.
- Forty percent of the indicators received an *at risk* condition for physical barriers (mainstem), large woody debris, off-channel habitat, floodplain connectivity, riparian vegetation condition and canopy cover.
- One indicator received an *unacceptable risk* condition for water quality (temperature) based on Washington State Department of Ecology. However, this may be a natural condition and needs further evaluation to determine if groundwater withdrawals and floodplain development throughout the subwatershed have exacerbated the problem.

Table 3 - Project area prioritization based on the total maximum score of 45 for Reach-based Ecosystem Indicators (REI). Each indicator was given a score of (3) if it was in an *adequate* condition; (2) if it was in an *at risk* condition; and (1) if it was in an *unacceptable risk* condition. Each column was summed and received a “score”; and each row was averaged (rounded to the nearest whole number) to determine the overall condition of the reach.

Pathway:	Indicator:	MR Prj-56.0	MR Prj-56.5	MR Prj-58.6	MR Prj-58.9	MR Prj-59.6	MR Prj-60.25	MR Prj-60.85	MR Prj-62.4	Reach Average
Water Quality	Temperature	1	1	1	1	1	1	1	1	1
	Turbidity	3	3	3	3	3	3	3	3	3
	Chemical Contamination/ Nutrients	3	3	3	3	3	3	3	3	3
Habitat Access	Physical Barriers (Mainstem)	2	2	2	2	2	2	2	2	2
Habitat Elements	Substrate	3	3	3	3	3	3	3	3	3
	Large Woody Debris	2	2	2	2	2	2	2	2	2
	Pool Frequency and Quality	3	3	3	3	3	3	3	3	3
	Off-Channel Habitat	2	2	2	3	3	2	2	1	2
Channel Condition	Characterization	3	3	3	3	3	3	3	3	3
Channel Dynamics	Floodplain Connectivity	2	2	1	3	3	2	2	1	2
	Bank Stability/Channel Migration	2	3	3	3	3	2	2	2	3
	Vertical Channel Stability	3	3	2	3	3	3	3	2	3
Riparian Vegetation	Structure	3	3	3	3	3	3	3	2	3
	Condition	2	2	2	3	3	2	2	2	2
	Canopy Cover	2	3	1	3	2	3	1	2	2
Score		36	38	34	41	40	37	35	32	37

Overall, the reach exhibits the ecosystem resilience necessary to maintain and sustain its current function for salmonid populations. However, it is on a trajectory toward an *at risk* condition due to floodplain development. Of the eight project areas identified in the reach assessment two are protection areas and six are restoration areas. Protecting habitat is the priority habitat action to maintain core habitat connectedness. Restoration habitat actions should be prioritized with the following objectives:

1. Water quality – a limiting factor that affects abundance, productivity, diversity and structure VSP parameters.
   a. It is unclear if the elevated water temperatures are a "natural" condition. At a subwatershed-scale the assessment team suggests evaluating the potential water quantity available versus the amount diverted for irrigation and groundwater withdrawals from domestic wells; also an evaluation of floodplain connectivity and riparian vegetation condition should be completed. These two evaluations should indicate if the water temperature issue is "natural" or exacerbated by anthropogenic impacts.
   b. At the reach-scale water temperatures do not meet Washington State Department of Ecology water quality standards. The assessment team suggests collecting Forward Looking Infra-Red (FLIR) data to identify cool water springs, and protecting and restoring all springs, wetlands and other off-channel habitat areas that provide cool water refugia.
   c. Re-vegetate and protect the inner riparian zone (recommended 10 m width around all waters) to improve canopy cover and reduce solar heating.
2. Physical barriers (mainstem) – a limiting factor that affects abundance, productivity, spatial diversity and structure VSP parameters.
   d. The channel spanning Foghorn diversion dam (Photograph No. 1) located near RM 52.1 on the mainstem Methow River downstream of the Big Valley reach needs further evaluation to determine if it is or is not a partial fish passage barrier at all biologically significant flows.

Photograph No. 1. View is looking upstream along the Methow River at Foghorn Dam that diverts water to the Winthrop fish hatchery located about RM 52.1.

Bureau of Reclamation photograph by L. Piety, June 2005.

3. Large woody debris, off-channel habitat, floodplain connectivity and riparian vegetation structure – limiting factors that affect abundance and productivity VSP parameters.
    e. Habitat quantity and quality are dependent on the condition of the above indicators to maintain and/or increase the reach's potential to provide habitat for salmonids. The assessment team suggests improving the condition of these indicators wherever practicable.
4. All indicators should be monitored to ensure that they do not degrade toward an *at risk* or *unacceptable risk* condition. The assessment team suggests that monitoring these indicators may provide pro-active opportunities to maintain or improve the overall ecosystem resiliency.
5. Existing data gaps:
    – Quantity Issue: Instream related to baseflow, (i.e., exempted wells, temperature, nutrients and Foghorn Dam)
    – Specifically, also dewatering due to domestic water supply

Prioritizing Project Area Implementation

The assessment team's overarching hypotheses on the condition of ecosystem processes are that the proposed potential habitat actions presented in this reach assessment will provide a cumulative effect through the protection or improvement of ecosystem resilience. The processes that naturally create and sustain habitat upon which the species of concern depend will be maintained or restored resulting in maintenance of or improvement to existing habitat capable of producing and rearing all fish species.

More specifically the assessment team's multiple hypotheses on the ecosystem processes are as follows:

1. Protecting areas with ecological integrity and natural ecosystem processes will provide sustainable "core" habitat upon which the populations of concern depend.
2. Restoring natural ecosystem processes where they are in an *at risk* or *unacceptable risk* condition will increase the reach's potential to sustain salmonid populations for an indefinite period of time. Improving the floodplain connectivity, condition, and fluvial processes will result in a net increase in salmonid habitat quantity and quality, and capability to increase the abundance, productivity, spatial diversity and structure of the populations.
3. Sequencing of habitat actions with emphasis on protecting habitat in an *adequate* condition and expanding these areas by restoring ecosystem processes will result in a cumulative benefit to the salmonid populations.

Reclamation necessarily telescopes its investigations in two stages to prioritize actions—initially from a coarse resolution at the watershed or tributary—then to a finer resolution of the individual reach to directly factor biological needs into a practical implementation scale. For over the last fifteen years, an understanding of watershed processes has become widely accepted as the key to reestablishing watershed health and high-quality fish habitat. The traditional individualistic or site-specific structures and techniques have fallen into disfavor since they tend to focus on repairing specific conditions absent the knowledge of the causes responsible for the habitat degradation in the first place. Alternative project types are evaluated by site-level design considerations at a separate third stage outside of the scope of this reach assessment.

Many authors have documented strategies that emphasize restoring processes that form, connect, and sustain habitats (Beechie et al, 1996; Kauffman et al, 1997; Beechie and Bolton, 1999; Roni et al, 2002; Montgomery and Bolton, 2003; UCRTT, 2007a). Habitat actions of this nature often occur at the site or reach scale. Roni et al (2002) has introduced a hierarchical strategy that places site-specific actions within a watershed context. The Reclamation reach assessment purposely feeds into this strategy by further telescoping options through several filters of consideration for a recommended sequencing both among and within individually identified project areas. The strategy is stratified in priority beginning with protection and transitioning through several forms of active restoration. The stratified sequence, which is illustrated in Figure 4, is tied into a gradational color scheme to assist with correspondence throughout the project selection fact sheets, which follow this section. Supporting appendices should be referred to for detail and additional background.

Habitat actions that achieve these objectives starting with the highest immediate priority are protection and maintaining high-quality habitats and secondarily, reconnecting high-quality habitats; third, restore disrupted habitat-forming processes over the long-term. Last, the restoration of habitat features such as large woody debris should be considered when these types of features are consistent with the natural setting.

The Big Valley reach project areas were differentiated as project types based on their associated potential habitat actions (Figure 5). By applying a "cumulative benefits" approach, the preferred method to sequence project area implementation is included in Table 4 under the column 'Relative Ranking for Cumulative Benefits.' This sequencing strategy is adapted from Roni (2005) and consistent with the Upper Columbia Biological Strategy. It includes the following definitions at the reach scale based on the use of Reach-based Ecosystem Indicators (REI):

1. **Protect and Maintain Processes: off channel and riparian areas such as wetland, channel network, side channel, and riparian buffers possessing "adequate" ecological conditions and a present or potential high biological benefit.**
2. **Protect and Reconnect Isolated Habitats: off channel and riparian areas possessing "adequate" ecological conditions, but are fragmented by anthropogenic disturbances.**
3. **Reconnect Processes (Long Term): through the restoration of channel dynamics and riparian interactions for areas possessing "adequate" or "at risk" ecological conditions that have a high present or potential high biological benefit.**
4. **Reconnect Processes and Habitats: through the restoration of channel dynamics and riparian interactions for areas possessing "at risk" ecological conditions that have a moderate to low present or potential high biological benefit.**
5. **Reconnect Habitats (Short Term): through in-channel placement or restoration of wood and rock habitat features or structures.**

However, this sequencing strategy does not consider landowner willingness, construction feasibility, and costs and there are alternative methods that can be used to sequence project area implementation (i.e., degree of departure, landowner willingness, and construction costs).

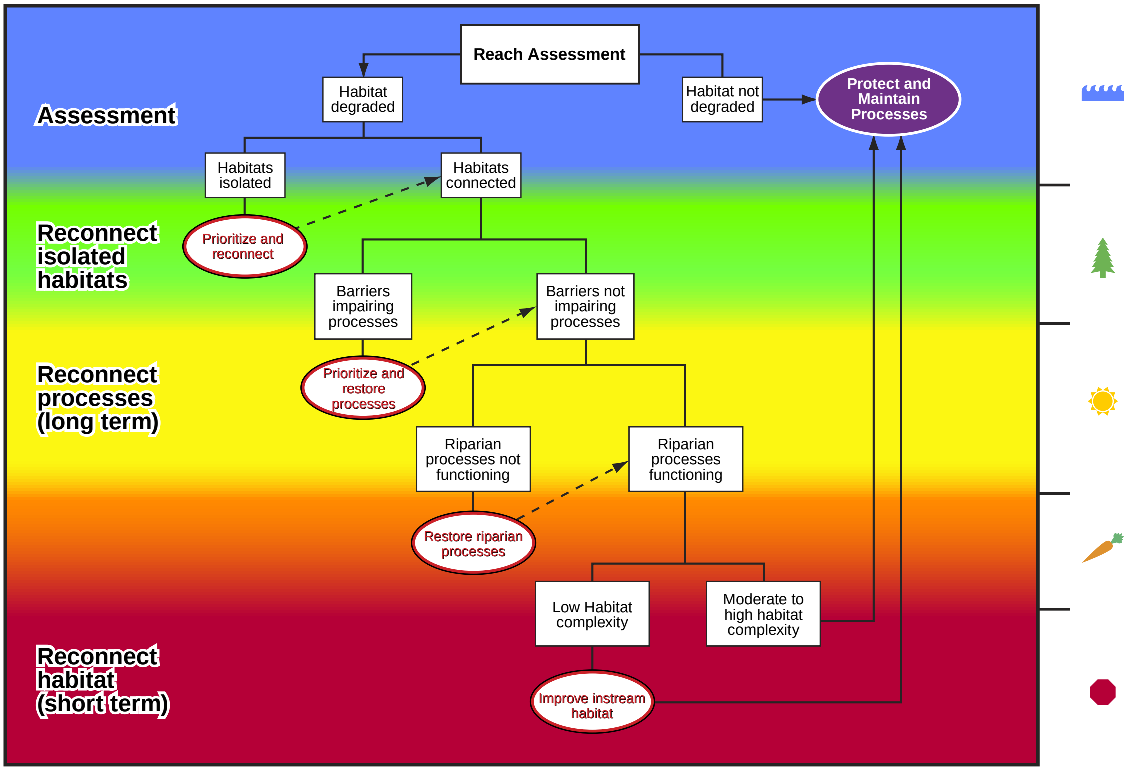


Figure 4 – Flow chart depicting hierarchical strategy for prioritizing habitat actions from protection to restoration, where ovals indicate stratified decision making (modified from Roni et al, 2005). For the color-challenged, please refer to the symbols to the right and throughout the document for color differentiation.

Project Area Characterization

Eight project areas (Figure 4) were identified and their geomorphic extents defined based on connectivity of channel paths within the floodplain as interpreted from Light Distancing and Ranging (LiDAR) hillshade data. Natural ecosystem processes are maintaining the ecological integrity of the riverine system throughout most of the Big Valley reach. There are numerous areas that have been identified as protection areas that are not directly impacted by anthropogenic influences and providing quality salmonid habitat. Development of the floodplain continues to reduce riverine processes and fragment habitat areas. Continued degradation of the floodplain may result in a net decrease in the reach potential of the salmonid populations for an indefinite period of time. Project areas are sequenced and discussed in priority order. The potential habitat actions are prioritized based on their benefit to viable salmonid population (VSP) parameters and limiting factors. Photographic documentation (i.e., photopoints) and location of human features for each project area are contained in Appendix B (Initial Site Assessments).

Table 4 – Preferred method for sequencing project area implementation based on a maximum possible score of 45 for the REI.

Project Area Identifier	Prioritization for Cumulative Benefits	Relative Score	Reach Average	Degree of Departure	Primary Habitat Action Class	Secondary Habitat Action Class	Primary Limiting Factor
MR Prj-58.9	1	41	37	-4	Protect/Maintain Processes	None	None
MR Prj-59.6	2	40	37	-5	Protect/Maintain Processes	None	None
MR Prj-56.0	3	36	37	-9	Protect/Maintain Processes	Reconnect Processes	Development
MR Prj-56.5	4	38	37	-7	Protect/Maintain Processes	Reconnect Isolated Habitats	Physical Barriers
MR Prj-58.6	5	34	37	-11	Protect/Maintain Processes	Reconnect Processes	Floodplain Connectivity
MR Prj-60.85	6	35	37	-10	Protect/Maintain Processes	Reconnect Processes	Floodplain Connectivity
MR Prj-62.4	7	32	37	-13	Protect/Maintain Processes	Reconnect Processes	Development
MR Prj-60.25	8	37	37	-8	Protect/Maintain Processes	Road Maintenance	Development

Summary Descriptions of Appendices

Appendix A—Reach-based Ecosystem Indicators (REI) Version 1.1

A results compilation of the Reach-based Ecosystem Indicators (REI) for the Big Valley Reach (RM 56 – 62.4).

Appendix B—Initial Site Assessments

This appendix provides results for the initial site assessments for each project area within the Big Valley reach assessment area in 2006.

Appendix C—Habitat Assessment

Assessment conducted in 2006 of the existing habitat conditions of the Big Valley reach assessment area.

Appendix D—Numerical Modeling Results

Two-dimensional (2D) modeling results for the Big Valley reach assessment area. The 2D

Appendix E—GIS Databases

The GIS (Geographic Information System) geodatabase was produced in support of the document, *Big Valley Reach Assessment, Methow River, Okanogan County, Washington.*

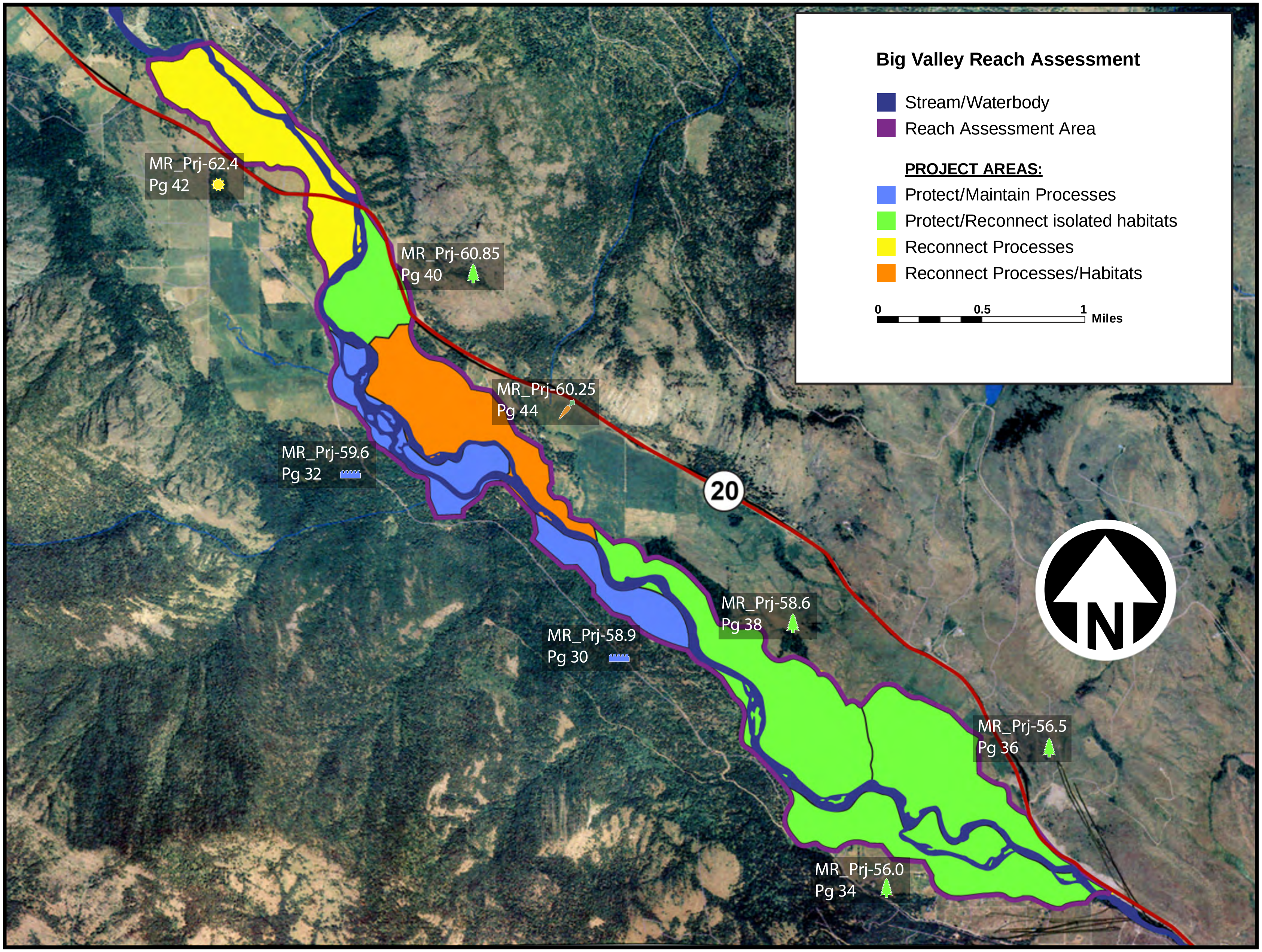


Figure 5 – Location map of project areas and project types within the Big Valley reach.

PROJECT SELECTION GUIDE

The guide is organized first by Project Area, according to a river mile designation and then according to Habitat Action Class, which serve as guiding principles for implementation sequencing. Each page of the guide is presented in a common format that begins with statement of the guiding principle followed by a primary potential habitat action. In some circumstances, a secondary potential habitat action is provided. The guide should serve primarily as a navigational tool to assist the user in selecting projects with the greatest benefit.

Project Area ID

River mile designation

Potential Habitat Action

This is a guiding objective, which identifies one way to achieve the habitat action class

Description

Explains how potential habitat action fulfills the habitat action class

Habitat Action Class

These are the primary guiding principles, which are tied into project sequencing

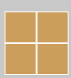
- *Protect floodplain habitat with high complexity*
- *Restore the floodplain*
- *Reconnect side channels and wetland complexes*
- *Retrofit roadways to remove obstructions*
- *Restore riparian vegetation*
- *Restore instream structural features*

Secondary Habitat Action Class

These are secondary guiding principles

VSP Parameters

Viable salmonid population parameters include abundance, diversity, productivity, and spatial structure and are defined by the Recovery Plan and generally differ for every habitat action class.



Locator and Ranking View

Schematic of Figure 5 map of project areas with sequencing emphasis

Details

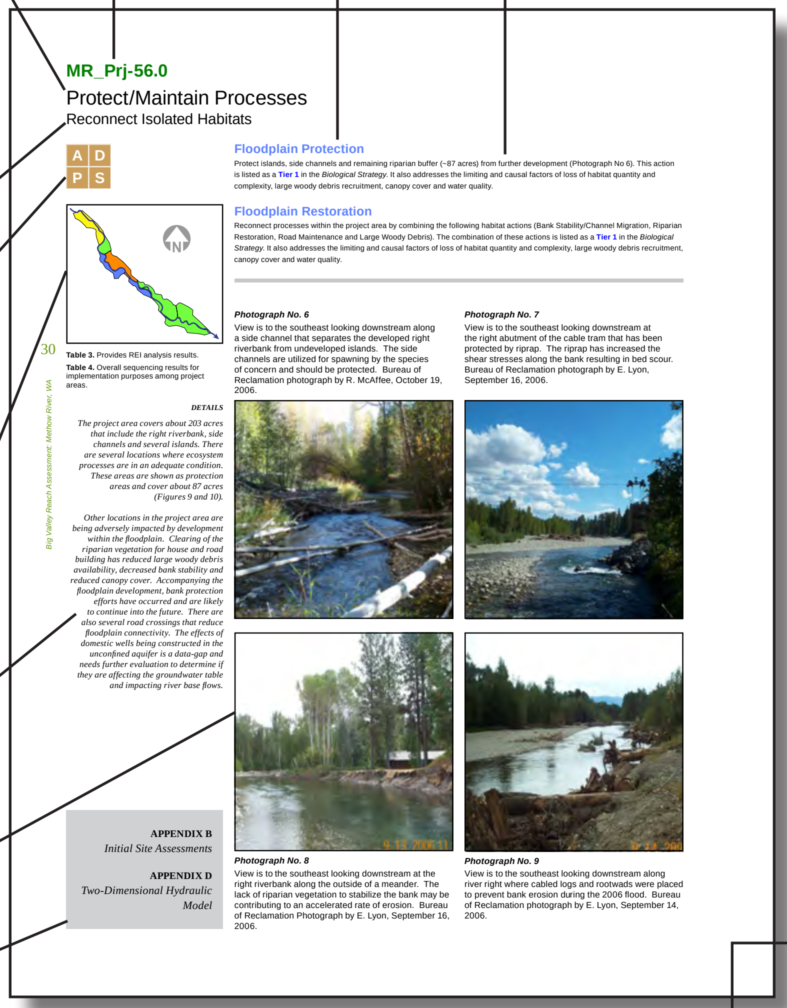
This provides specific information on how to achieve the guiding objective providing additional explanation or secondary objectives

Diagram

Representative photos and maps of the project area

Relevant Appendices

Further cross referencing for background information on the page



MR_Prj-56.0

Protect/Maintain Processes

Reconnect Isolated Habitats

A D
P S

Floodplain Protection

Protect islands, side channels and remaining riparian buffer (~87 acres) from further development (Photograph No 6). This action is listed as a **Tier 1** in the *Biological Strategy*. It also addresses the limiting and causal factors of loss of habitat quantity and complexity, large woody debris recruitment, canopy cover and water quality.

Floodplain Restoration

Reconnect processes within the project area by combining the following habitat actions (Bank Stability/Channel Migration, Riparian Restoration, Road Maintenance and Large Woody Debris). The combination of these actions is listed as a **Tier 1** in the *Biological Strategy*. It also addresses the limiting and causal factors of loss of habitat quantity and complexity, large woody debris recruitment, canopy cover and water quality.

30

Big Valley Reach Assessment: Methow River, WA

Table 3. Provides REI analysis results.

Table 4. Overall sequencing results for implementation purposes among project areas.

DETAILS

The project area covers about 203 acres that include the right riverbank, side channels and several islands. There are several locations where ecosystem processes are in an adequate condition. These areas are shown as protection areas and cover about 87 acres (Figures 9 and 10).

Other locations in the project area are being adversely impacted by development within the floodplain. Clearing of the riparian vegetation for house and road building has reduced large woody debris availability, decreased bank stability and reduced canopy cover. Accompanying the floodplain development, bank protection efforts have occurred and are likely to continue into the future. There are also several road crossings that reduce floodplain connectivity. The effects of domestic wells being constructed in the unconfined aquifer is a data-gap and needs further evaluation to determine if they are affecting the groundwater table and impacting river base flows.

Photograph No. 6

View is to the southeast looking downstream along a side channel that separates the developed right riverbank from undeveloped islands. The side channels are utilized for spawning by the species of concern and should be protected. Bureau of Reclamation photograph by R. McAffee, October 19, 2006.

Photograph No. 7

View is to the southeast looking downstream at the right abutment of the cable tram that has been protected by riprap. The riprap has increased the shear stresses along the bank resulting in bed scour. Bureau of Reclamation photograph by E. Lyon, September 16, 2006.

Photograph No. 8

View is to the southeast looking downstream at the right riverbank along the outside of a meander. The lack of riparian vegetation to stabilize the bank may be contributing to an accelerated rate of erosion. Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.

Photograph No. 9

View is to the southeast looking downstream along river right where cabled logs and rootwads were placed to prevent bank erosion during the 2006 flood. Bureau of Reclamation photograph by E. Lyon, September 14, 2006.

APPENDIX B
Initial Site Assessments

APPENDIX D
Two-Dimensional Hydraulic Model

Additional Guidelines

Secondary and Tertiary potential habitat actions that are generally found on the next page

Notes:

MR_Prj-58.9

Protect/Maintain Processes

A	D
P	S

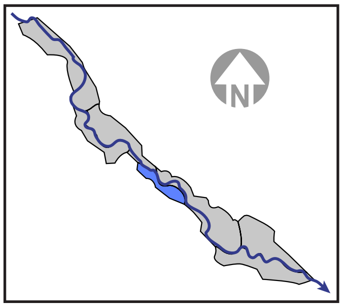


Table 3. Provides REI analysis results.

Table 4. Overall sequencing results for implementation purposes among project areas.

DETAILS

The project area covers about 77 acres that include the left riverbank, side channels and about 2.5 acres of wetland areas. The entire project area is in an adequate condition in that the ecosystem and natural processes are not directly impacted by anthropogenic effects. This project area is within the low surface and is shown as a protection area in Figures 5 and 6.

Floodplain Protection

Protect and maintain wetlands, side channels and remaining riparian buffer zones (~77 acres) from development (Photograph Nos. 2 and 3). The mainstem and side channels are currently being utilized by ESA listed species for spawning, rearing, migration and refugia. This action is listed as a **Tier 1** in the *Biological Strategy.* It also addresses the limiting and causal factors of loss of habitat quantity and complexity, large woody debris recruitment, canopy cover and water quality.

Photograph No. 2

View is to the southeast looking downstream at a beaver dam impounding a wetland area that provides off-channel habitat. Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.

Photograph No. 3

View is to the east looking downstream at large woody debris deposited during the 2006 spring flood. Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.

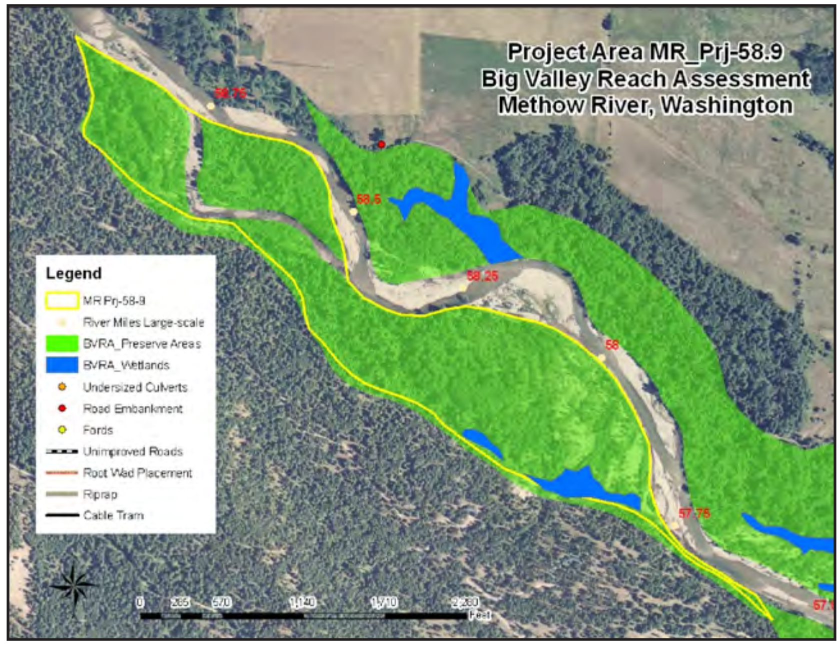


Figure 5
Overview map on aerial photograph of the project area MR_Prj-58.9 in the middle section of the Big Valley reach

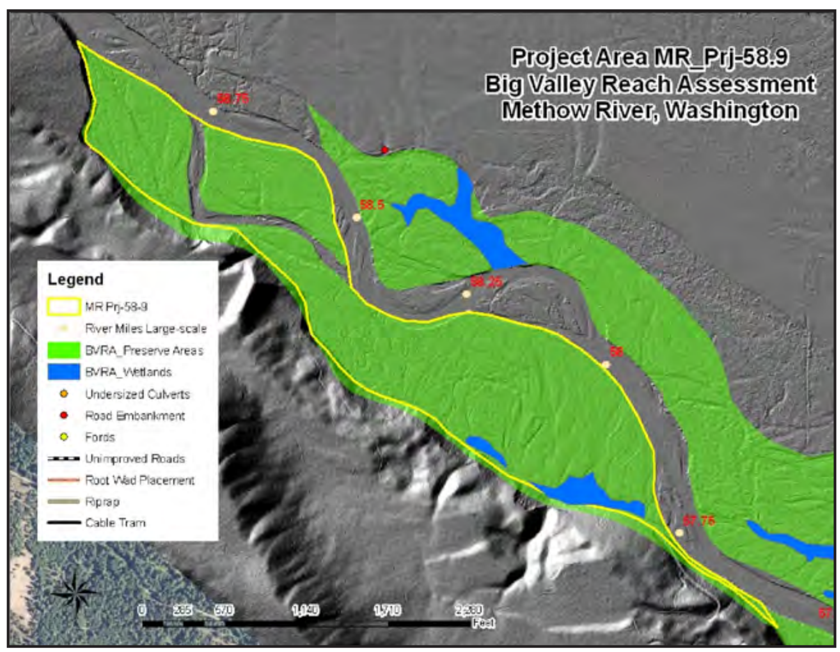
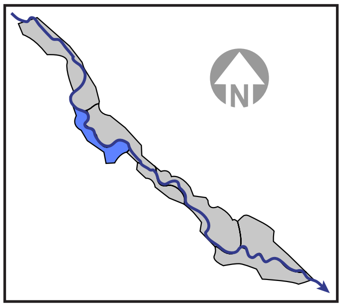


Figure 6
Overview map on LiDAR hillshade of the project area MR_Prj-58.9 in the middle section of the Big Valley reach

MR_Prj-59.6

Protect/Maintain Processes



Floodplain Protection

Protect wetlands (~3 acres), side channels and remaining riparian buffer zones (~120 acres) from development (Photograph Nos. 4 and 5). The mainstem and side channels are currently being utilized by ESA listed species for spawning, rearing and refugia. This action is listed as a **Tier 1** in the *Biological Strategy.* It also addresses the limiting and causal factors of loss of habitat quantity and complexity, large woody debris recruitment, canopy cover and water quality.

Table 3. Provides REI analysis results.

Table 4. Overall sequencing results for implementation purposes among project areas.

DETAILS

The project area covers about 120 acres that include the right riverbank, islands, right split flow channel, side channels and about 3 acres of wetland areas. The entire project area is in an adequate condition in that the ecosystem and natural processes are not directly impacted by anthropogenic effects (there is about 50 feet of riprap along river right that has very little impact). This project area is within the low surface and is shown as a protection area in Figures 7 and 8.

Photograph No. 4

View is to the southeast looking downstream where the active channel avulsed during the 2006 spring flood. Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.

Photograph No. 5

View is to the northwest looking upstream along the mainstem. Bureau of Reclamation Photograph by R. McAffee, October 13, 2006.

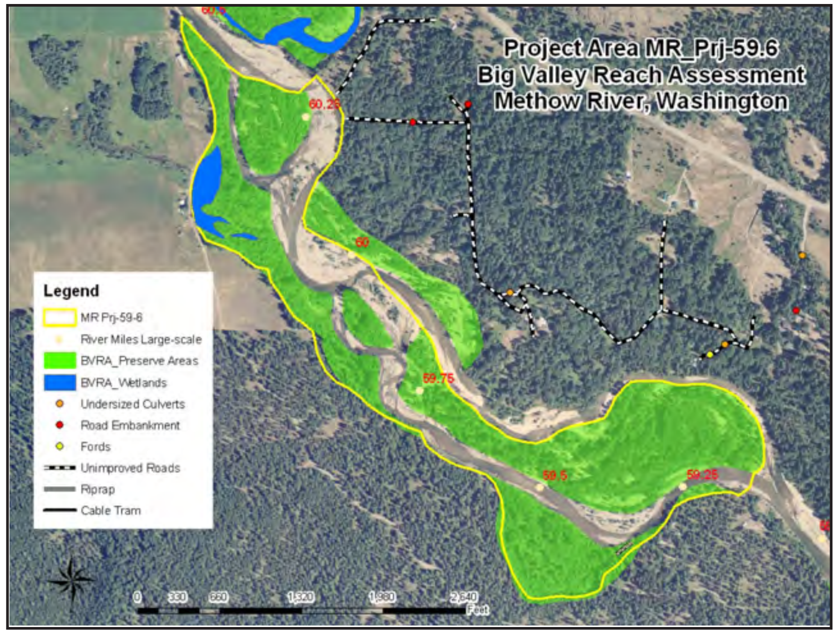


Figure 7
Overview map on aerial photograph of the project area MR Prj-59.6 in the middle section of the Big Valley reach

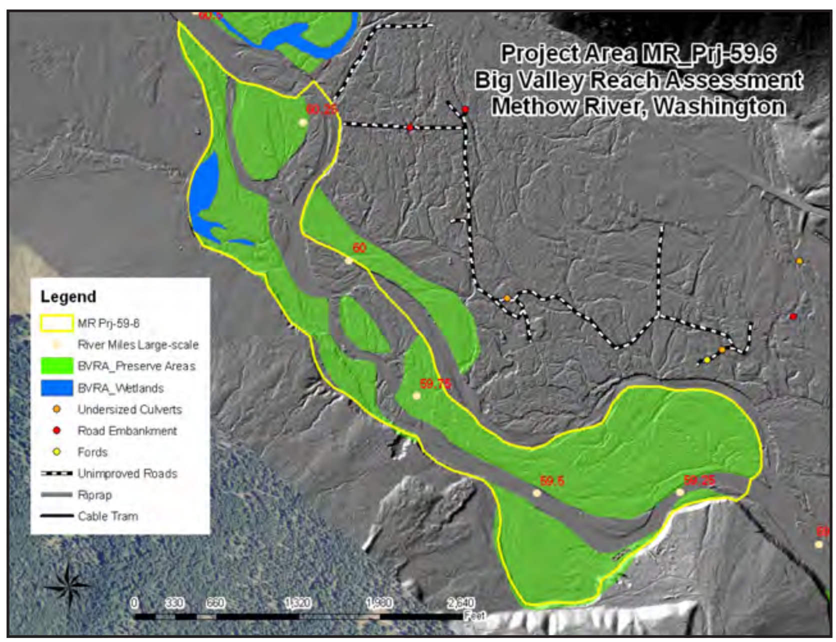


Figure 8
Overview map on LiDAR hillshade of the project area MR_Prj-59.6 in the middle section of the Big Valley reach

MR_Prj-56.0

Protect/Maintain Processes

Reconnect Isolated Habitats

A D
P S

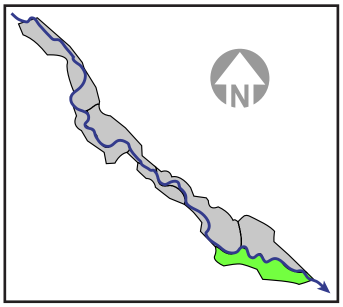


Table 3. Provides REI analysis results.

Table 4. Overall sequencing results for implementation purposes among project areas.

DETAILS

The project area covers about 203 acres that include the right riverbank, side channels and several islands. There are several locations where ecosystem processes are in an adequate condition. These areas are shown as protection areas and cover about 87 acres (Figures 9 and 10).

Other locations in the project area are being adversely impacted by development within the floodplain. Clearing of the riparian vegetation for house and road building has reduced large woody debris availability, decreased bank stability and reduced canopy cover. Accompanying the floodplain development, bank protection efforts have occurred and are likely to continue into the future. There are also several road crossings that reduce floodplain connectivity. The effects of domestic wells being constructed in the unconfined aquifer is a data-gap and needs further evaluation to determine if they are affecting the groundwater table and impacting river base flows.

APPENDIX B
Initial Site Assessments

APPENDIX D
Two-Dimensional Hydraulic Model

Floodplain Protection

Protect islands, side channels and remaining riparian buffer (~87 acres) from further development (Photograph No 6). This action is listed as a **Tier 1** in the *Biological Strategy*. It also addresses the limiting and causal factors of loss of habitat quantity and complexity, large woody debris recruitment, canopy cover and water quality.

Floodplain Restoration

Reconnect processes within the project area by combining the following habitat actions (Bank Stability/Channel Migration, Riparian Restoration, Road Maintenance and Large Woody Debris). The combination of these actions is listed as a **Tier 1** in the *Biological Strategy*. It also addresses the limiting and causal factors of loss of habitat quantity and complexity, large woody debris recruitment, canopy cover and water quality.

Photograph No. 6

View is to the southeast looking downstream along a side channel that separates the developed right riverbank from undeveloped islands. The side channels are utilized for spawning by the species of concern and should be protected. Bureau of Reclamation photograph by R. McAffee, October 19, 2006.

Photograph No. 7

View is to the southeast looking downstream at the right abutment of the cable tram that has been protected by riprap. The riprap has increased the shear stresses along the bank resulting in bed scour. Bureau of Reclamation photograph by E. Lyon, September 16, 2006.

Photograph No. 8

View is to the southeast looking downstream at the right riverbank along the outside of a meander. The lack of riparian vegetation to stabilize the bank may be contributing to an accelerated rate of erosion. Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.

Photograph No. 9

View is to the southeast looking downstream along river right where cabled logs and rootwads were placed to prevent bank erosion during the 2006 flood. Bureau of Reclamation photograph by E. Lyon, September 14, 2006.

Bank Stability/Channel Migration

(Short-term) Remove or modify riprap protecting the right abutment of the cable tram (Photograph No. 7). The increased shear stresses are scouring the channel bed, preventing lateral channel migration and may be resulting in floodplain abandonment upstream.

(Long-term) Remove the cable tram and appurtenant structures; stabilize riverbanks with large woody debris and restore the riparian buffer zone (30 m width) (also see MR Prj-58.6).

Riparian Restoration

Restore the riparian buffer (30 m width) by planting trees and shrubs to provide shade, improve bank stability and improve the long-term large woody debris recruitment potential (Photograph No. 8).

Road Maintenance

Place appropriately-sized culverts or bridges where road embankments (11crossings) disconnect overflow channels on the floodplain and modify ford crossings (4) to reduce fine sediment inputs into the river. (Long-term) Remove the cable tram and appurtenant structures; stabilize riverbanks with large woody debris and restore the riparian buffer zone (30 m width) (also see MR Prj-58.6).

Large Woody Debris

Evaluate potential relocation of existing large woody debris in conjunction with constructing large woody debris complexes to reduce the rate of lateral channel migration to natural rates, increase large woody debris habitat elements and stabilize riverbanks (Photograph No. 9). Development within the floodplain has put the remaining fluvial processes at risk. As houses become threatened by the river there is a risk that bank hardening using rock will occur. By being proactive and working with landowners to reduce the loss of property by placing wood structures and restoring the riparian buffer zone (30m); the threat of loosing protected habitat will be reduced. (Long-term) Remove the cable tram and appurtenant structures; stabilize riverbanks with large woody debris and restore the riparian buffer zone (30 m width) (also see MR Prj-58.6).

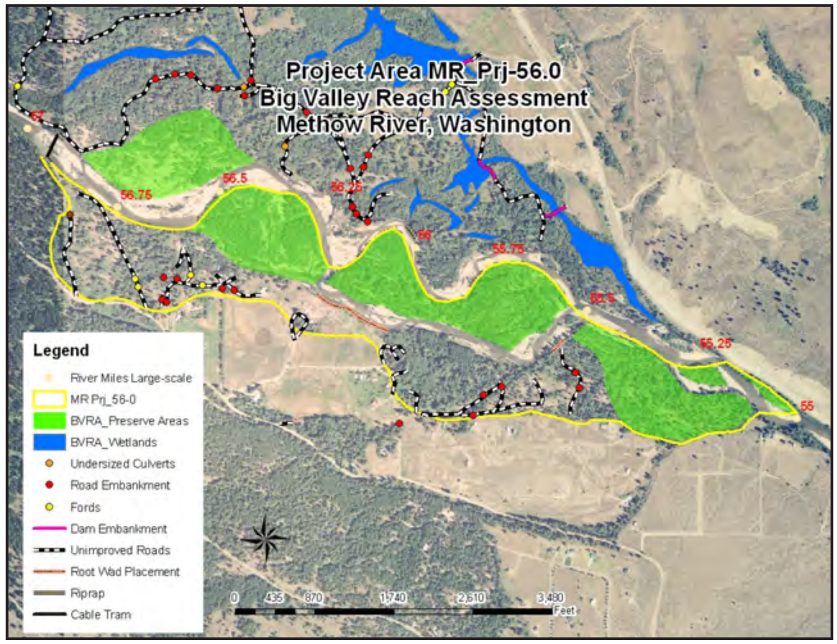


Figure 9

Overview map on aerial photograph of the project area MR_Prj-56.0 in the lower section of the Big Valley reach

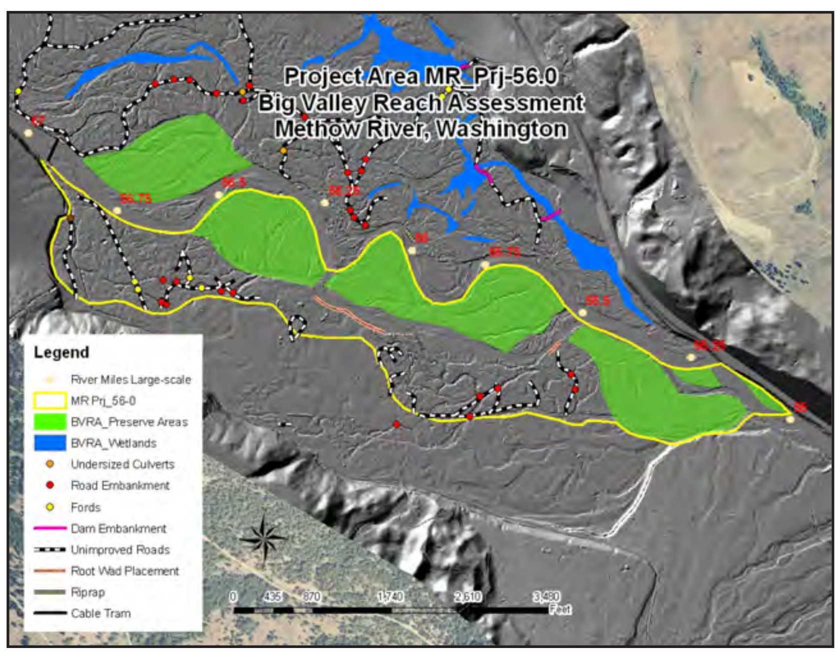


Figure 10

Overview map on LiDAR hillshade of the project area MR_Prj-56.0 in the lower section of the Big Valley reach

MR_Prj-56.5

Protect/Maintain Processes

Reconnect Isolated Habitats

A	D
P	S

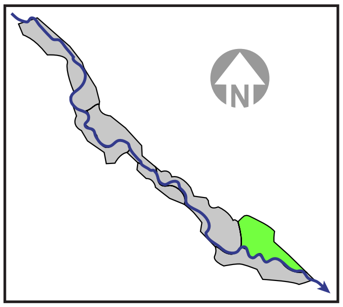


Table 3. Provides REI analysis results.

Table 4. Overall sequencing results for implementation purposes among project areas.

DETAILS

The project area covers about 219 acres that include the left riverbank, side channels and about 26 acres of wetlands. Historically, this was a spring-fed wetland with a complex of beaver dams. Three of the historic beaver dams have been modified into embankment dams that impound small reservoirs. Brook trout, a non-native species, now inhabit these reservoirs. Elevated culverts were placed through the embankments as outlets which flow into historic overflow channels that drain into the Methow River. In addition, floodplain connectivity in this project area has been reduced due to the numerous road crossings that block and/or inhibit overflow channels (Figures 11 and 12).

Floodplain Protection

Protect wetlands, side channels and remaining riparian buffer zones (~220 acres) from further development (Photograph Nos. 10 and 11). The wetlands and side channels are currently being utilized by ESA listed species for rearing and refugia. This action is listed as a **Tier 1** in the *Biological Strategy.* It also addresses the limiting and causal factors of loss of habitat quantity and complexity, large woody debris recruitment, canopy cover and water quality.

Floodplain Restoration

Reconnect processes within the project area by combining the following habitat actions (Obstruction Restoration, Road Maintenance, Riparian Restoration and Bank Stability/Channel Migration). The combination of these actions is listed as a **Tier 1** in the *Biological Strategy.* It also addresses the limiting and causal factors of loss of habitat quantity and complexity, large woody debris recruitment, canopy cover and water quality.

Photograph No. 10

View is to the southeast looking downstream along a side channel that is also connected to the outlet of the downstream impoundment (Photograph No. 8). Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.

Photograph No. 11

View is to the northwest looking across reservoir from embankment dam. Bureau of Reclamation Photograph by E. Lyon, August 15, 2006.

Photograph No. 12

View is to the west looking across the lower embankment dam that has a culvert as its primary outlet (center of photograph). Bureau of Reclamation Photograph by E. Lyon, August 15, 2006.

Photograph No. 13

View is to the northwest looking at a ford crossing a reservoir outlet channel. When crossed fine sediment is released into the outlet channel. Bureau of Reclamation Photograph by E. Lyon, August 15, 2006.

Obstruction Restoration

Remove, modify or replace embankment dams (3 dams) that restrict access to groundwater fed off-channel habitat for rearing and refugia (Photograph No. 12).

Road Maintenance

Place appropriately-sized culverts, bridges or modified fords where road embankments without culverts or undersized culverts (10 crossings) disconnect overflow channels or where fords (Photograph No. 13) are contributing fine sediments (2 crossings).

Riparian Restoration

Plant trees and shrubs to maintain riparian buffer zones along wetland areas, side channels, overflow channels and mainstem where appropriate. Numerous locations around the wetlands and mainstem would benefit from riparian augmentation to maintain canopy cover.

Bank Stability/Channel Migration

Remove riprap (150 ft) to improve lateral channel migration, and large woody debris and spawning gravel recruitment. This action should be combined with riparian restoration to improve the canopy cover and to stabilize the streambank.

Ecological Interactions/Non-native Species

Eradicate non-native predators (brook trout) from wetland areas. This action is listed as a Tier 2 in the *Biological Strategy* and addresses productivity and abundance VSP parameters. It also addresses limiting and causal factors such as predation and competition with native species.

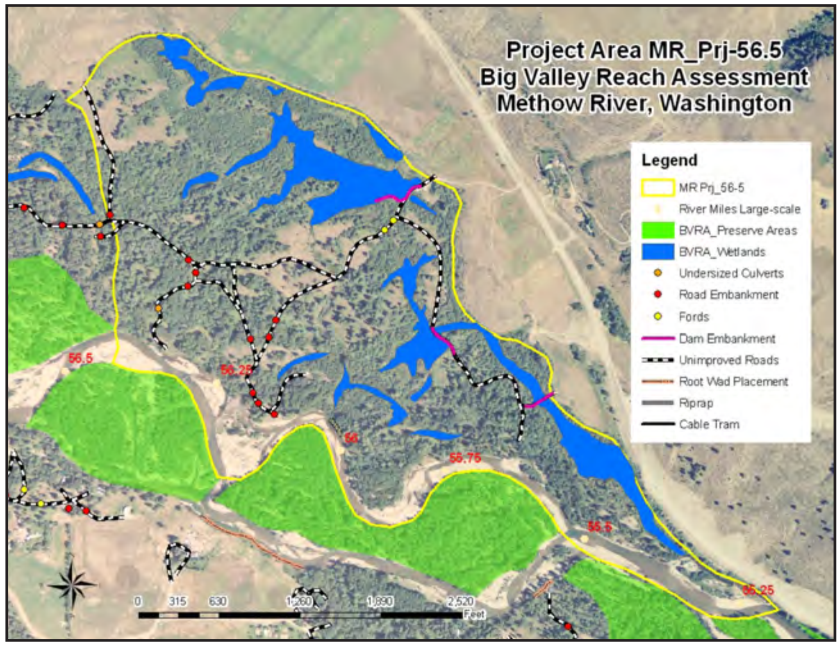


Figure 11

Overview map on aerial photograph of the project area MR_Prj-56.5 in the lower section of the Big Valley reach

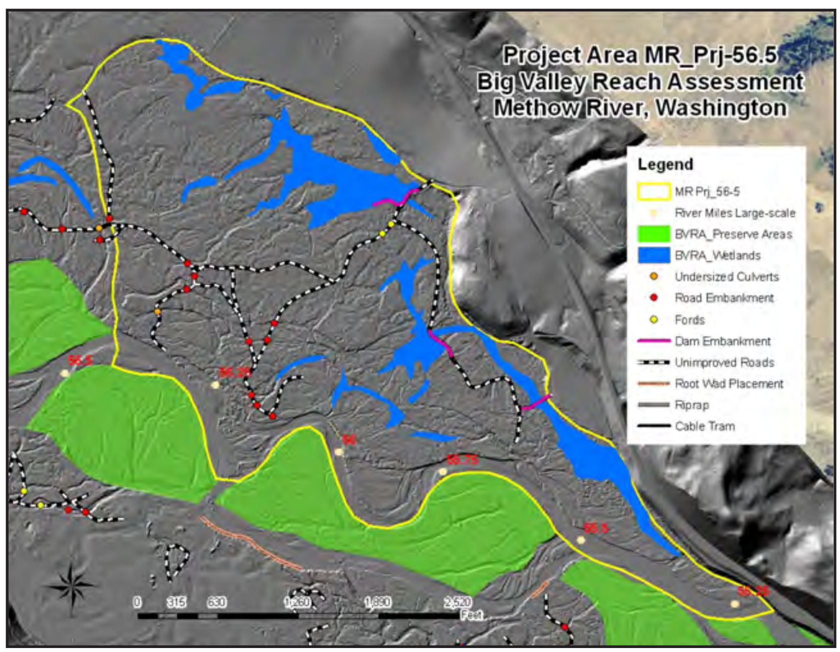


Figure 12

Overview map on aerial photograph of the project area MR_Prj-56.5 in the lower section of the Big Valley reach

MR_Prj-58.6

Protect/Maintain Processes

Reconnect Processes

A D
P S

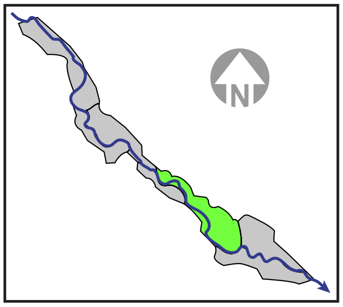


Table 3. Provides REI analysis results.

Table 4. Overall sequencing results for implementation purposes among project areas.

The project area covers about 311 acres that include the left riverbank, side channels and about 12 acres of wetlands. There are several locations where the ecosystem and natural processes are still in an adequate condition. These areas are shown in Figures 13 and 14 as protection areas within the low surface that are covering about 120 acres. Other locations within the low surface of this project area are being adversely impacted by channel confinement, and unimproved road crossings that reduce floodplain connectivity and disconnect off-channel habitat.

A cable tram is located at about RM 57 that was constructed across the Methow River in the mid 1990s. The cable tram was placed within about a 2,400 feet wide floodplain and spans about 300 feet across the active channel. The right abutment of the cable tram is located within the active channel and is protected by riprap; and the left abutment blocks an overflow channel path. This structure impacts the physical processes by (1) constricting the river resulting in increased flow velocities and shear stresses, (2) restricting lateral channel migration, and (3) accelerating flow velocities along the right abutment resulting in local scour. The Geomorphic Assessment determined that the floodplain within the Big Valley reach is typically inundated by the 2-5 year floods; however, the 2D hydraulic model analysis conducted for this reach assessment determined that directly upstream of the cable tram the floodplain is being accessed by the 15+-year floods. It appears that the cable tram has caused localized channel-bed incision due to the constriction, resulting in the river abandoning its floodplain upstream of the structure. This constriction needs further evaluation to determine its full impact on the river processes.

APPENDIX B
Initial Site Assessments

APPENDIX D
Two-Dimensional Hydraulic Model

Floodplain Protection

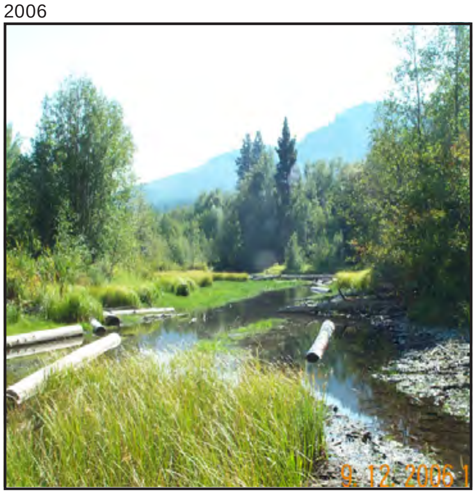
Protect wetlands (Photograph Nos. 14 and 15), side channels and remaining riparian buffer zones (~120 acres) from development. The wetlands and side channels are currently being utilized by ESA listed species for spawning, rearing and refugia. This action is listed as a **Tier 1** in the *Biological Strategy*. It also addresses the limiting and causal factors of loss of habitat quantity and complexity, large woody debris recruitment, canopy cover and water quality.

Floodplain Restoration

Reconnect processes within the project area by combining the following habitat actions (Obstruction Restoration, Riparian Restoration and Bank Stability/Channel Migration). The combination of these actions is listed as a **Tier 1** in the *Biological Strategy*. It also addresses the limiting and causal factors of loss of habitat quantity and complexity, large woody debris recruitment, canopy cover and water quality.

Photograph No. 14

View is to the south looking downstream at a wetland area along river left. Note the logs are "trimmed" suggesting they have been either placed during a restoration project or are from a historic mill. Bureau of Reclamation Photograph by E. Lyon, September 12, 2006



Photograph No. 15

View is to the south looking at a historic beaver dam in the wetland area of a historic channel path (oxbow). Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.

Photograph No. 16

View is to the west looking at a road embankment with an elevated, undersized culvert that disconnects a historic channel path (oxbow). Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.

Photograph No. 17

View is to the southeast looking downstream along the mainstem at the cable tram crossing. The right abutment of the cable tram has been protected with riprap where flow shear stresses are increased causing bed scour. The overall effect the cable tram has on the river is unclear. However, the floodplain which is believed to have been accessed during 2-5 year floods now only gets accessed during the 15 year or greater floods. Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.

Obstruction Restoration

Restore and reconnect wetlands and floodplain to the riverine system. Remove or modify road crossings (3) to reconnect wetlands to river (Photograph No. 16).

Riparian Restoration

Plant trees and shrubs to maintain riparian buffer zones along wetland areas, side channels, overflow channels and mainstem where appropriate. Numerous locations around the wetlands and mainstem would benefit from riparian augmentation to maintain canopy cover.

Bank Stability/Channel Migration

Remove cable tram (Photograph No. 17) that constricts the river and restricts lateral channel migration, and may be causing channel steepening and floodplain abandonment.

Ecological Interactions/Non-native Species

Eradicate non-native predators (brook trout) from wetland areas, if present. This action is listed as a Tier 2 in the *Biological Strategy* and addresses productivity and abundance VSP parameters. It also addresses limiting and causal factors such as predation and competition with native species.

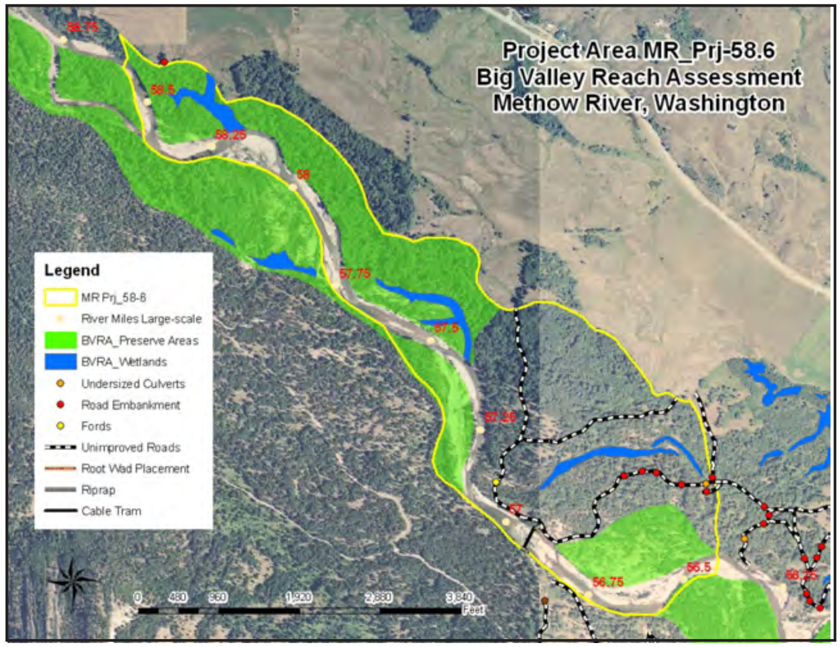


Figure 13
Overview map on aerial photograph of the project area MR_Prj-58.6 in the middle section of the Big Valley reach

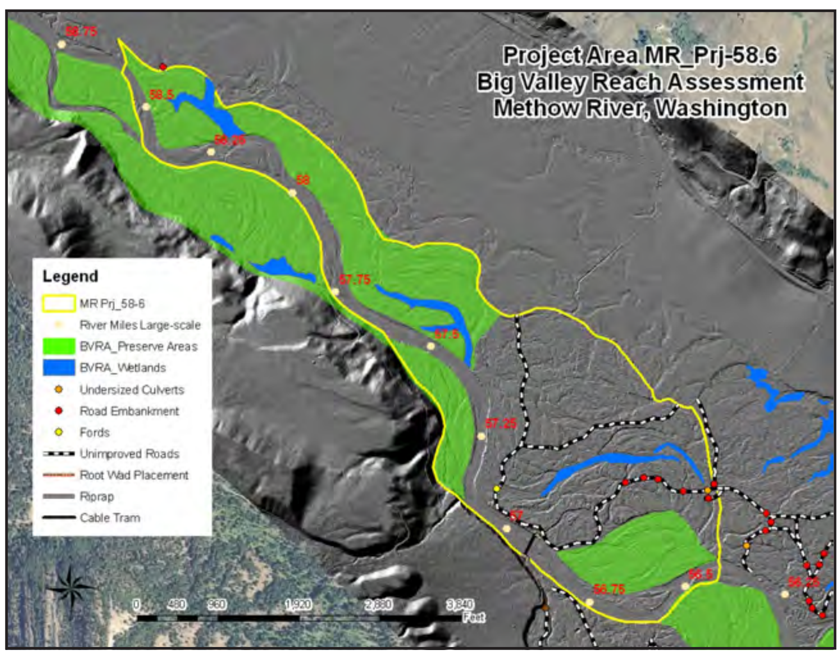


Figure 14
Overview map on LiDAR hillshade of the project area MR_Prj-58.6 in the middle section of the Big Valley reach

MR_Prj-60.85

Protect/Maintain Processes

Reconnect Processes

A D
P S

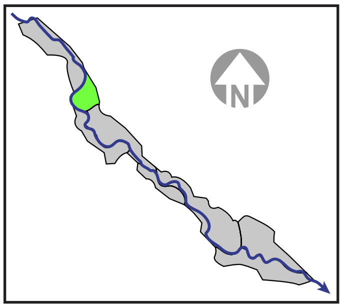


Table 3. Provides REI analysis results.

Table 4. Overall sequencing results for implementation purposes among project areas.

DETAILS

The project area covers about 96 acres that include the left riverbank, side channels and about 5 acres of wetland areas. Most of the project area is in an at risk condition because of anthropogenic impacts. However, about 32 acres have been identified as a protection area in Figures 15 and 16.

Floodplain Protection

Protect wetlands, side channels and remaining riparian buffer zones (~32 acres) from development (Photograph No. 18). The mainstem and side channels are currently being utilized by ESA listed species for spawning, rearing and refugia. This action is listed as a **Tier 1** in the *Biological Strategy.* It also addresses the limiting and causal factors of loss of habitat quantity and complexity, large woody debris recruitment, canopy cover and water quality.

Floodplain Restoration

Reconnect processes within the project area by combining the following habitat actions (Obstruction Restoration, Road Maintenance and Riparian Restoration). The combination of these actions is listed as a **Tier 1** in the *Biological Strategy.* It also addresses the limiting and causal factors of loss of habitat quantity and complexity, large woody debris recruitment, canopy cover and water quality.

Photograph No. 18

View is to the northeast looking upstream at wetlands that occupy an oxbow. Bureau of Reclamation Photograph by E. Lyon, September 15, 2006

Photograph No. 19

View is to the northwest looking at a berm that historically impounded the Fender Mill pond. Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.

Photograph No. 20

View is to the west looking at a ford crossing along the fish return channel of the decommissioned Rockview irrigation ditch during the November 7, 2006 high flows. Bureau of Reclamation Photograph by E. Lyon, November 7, 2006.

Photograph No. 21

View is to the northwest looking upstream at bank protection (riprap) placed along river right. Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.

Obstruction Restoration

Restore and reconnect wetlands and floodplain to the riverine system. Remove or breach berms (750 ft) (Photograph No. 19) and push-up levees (330 ft), and seal decommissioned irrigation ditch where it crosses Highway 20.

Clear decommissioned fish-return channel of debris, restore flows, place habitat cover and re-vegetate where appropriate.

Road Maintenance

Remove, modify or replace ford crossing (1) to reduce fine sediments (Photograph No. 20).

Riparian Restoration

Restore riparian buffer (30m width) by planting trees and shrubs to provide shade and bank stability.

Large Woody Debris

Construct large woody debris complexes that will stabilize riverbanks and protect infrastructure (~1350 ft riprap) (Photograph No. 21). The riprap placed along river right is failing. The recommendation would be to be proactive and repair with large wood structures. If the repair is completed using rock, the increased flow velocities may put the downstream protection area at risk of degradation. This habitat action should be taken in conjunction with riparian restoration for a long-term benefit. This action is listed as **Tier 3** in the *Biological Strategy* and addresses productivity and abundance VSP parameters. Limiting and causal factors addressed are unstable banks and large woody debris recruitment.

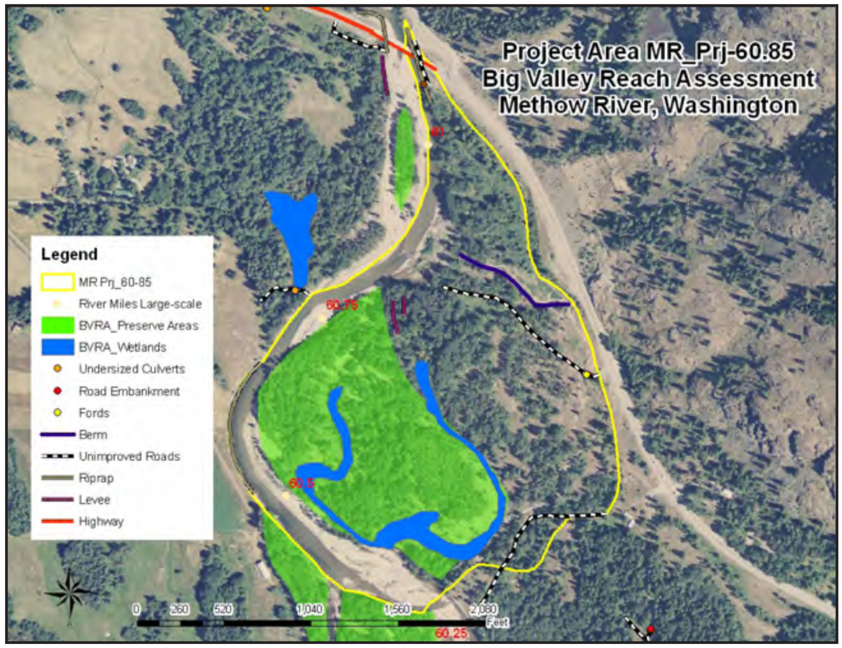


Figure 15
Overview map on aerial photograph of the project area MR_Prj-60.85 in the upper section of the Big Valley reach

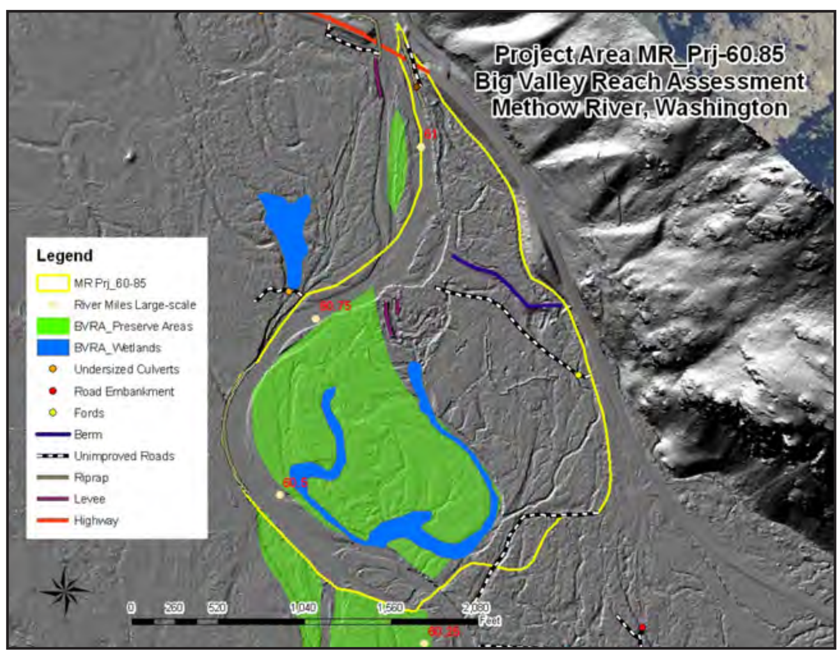


Figure 16
Overview map on LiDAR hillshade of the project area MR_Prj-60.85 in the upper section of the Big Valley reach

MR_Prj-62.4

Protect/Maintain Processes

Reconnect Processes

A D
P S

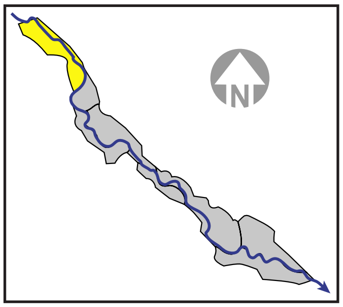


Table 3. Provides REI analysis results.

Table 4. Overall sequencing results for implementation purposes among project areas.

DETAILS

The project area covers about 218 acres that include the left and right riverbanks, side channels and about 3 acres of wetland areas. The project area is in an unacceptable risk to at risk condition because of development and infrastructure (Highway 20). About 32 acres have been identified as protection areas where the riparian buffer zone is still in an adequate condition shown in Figures 17 and 18..

Floodplain Protection

Protect wetlands (Photograph No. 22), side channels and remaining riparian buffer zones (~30 acres) from development. The mainstem and side channels are currently being utilized by ESA listed species for spawning, rearing and refugia. This action is listed as a **Tier 1** in the *Biological Strategy*. It also addresses the limiting and causal factors of loss of habitat quantity and complexity, large woody debris recruitment, canopy cover and water quality.

Floodplain Restoration

Reconnect processes within the project area by combining the following habitat actions (Obstruction Restoration and Riparian Restoration). The combination of these actions is listed as a **Tier 1** in the *Biological Strategy*. It also addresses the limiting and causal factors of loss of habitat quantity and complexity, large woody debris recruitment, canopy cover and water quality.

Obstruction Restoration

Restore and reconnect wetlands and floodplain (~100 acres) to the riverine system. Remove, modify or replace road embankments (1200 ft of Highway 20 and 10 road crossings) (Photograph No. 23), undersized culverts (6 culverts) (Photograph No. 24) and push-up levees (315 ft) (Photograph No. 25).

Photograph No. 22
View is to the north looking at wetland area downstream of Weeman Bridge along river right. Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.

Photograph No. 23
View is to the east looking at the west approach to Weeman Bridge along Highway 20 where it bisects the floodplain. Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.

Photograph No. 24
View is to the northeast looking at an undersized culvert through Highway 20 embankment along the west approach to Weeman Bridge. Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.

Photograph No. 25
View is to the south looking downstream from a push-up levee along a historic side channel on river right. Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.

Riparian Restoration

Restore riparian buffer (30m width) by planting trees and shrubs to provide shade and bank stability.

Large Woody Debris

Construct large woody debris complexes to stabilize riverbanks where appropriate to protect infrastructure (~890 ft). This habitat action should be taken in conjunction with riparian restoration for a long-term benefit. This action is listed as **Tier 3** in the *Biological Strategy* and addresses productivity and abundance VSP parameters. Limiting and causal factors addressed are unstable banks and large woody debris recruitment.

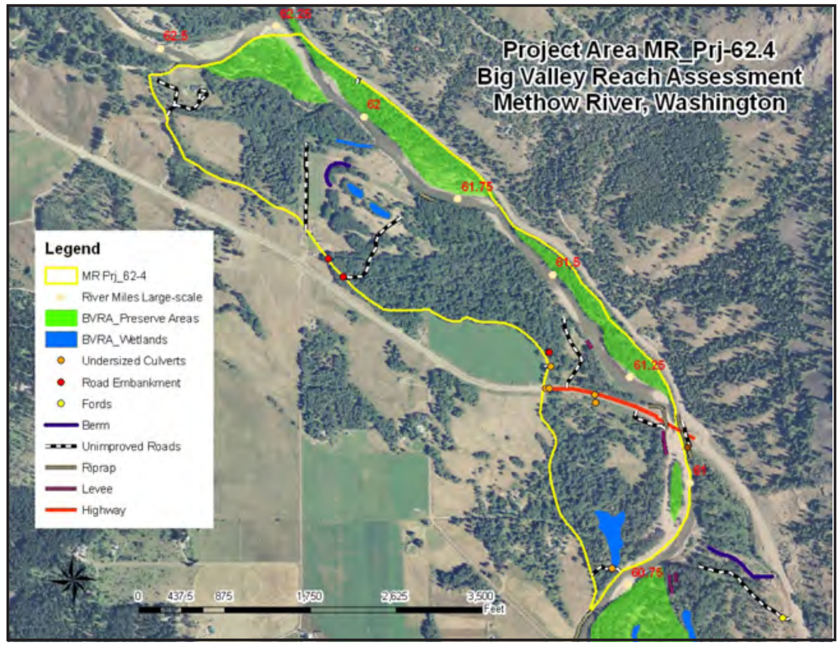


Figure 17

Overview map on aerial photograph of the project area MR_Prj-62.4 in the upper section of the Big Valley reach

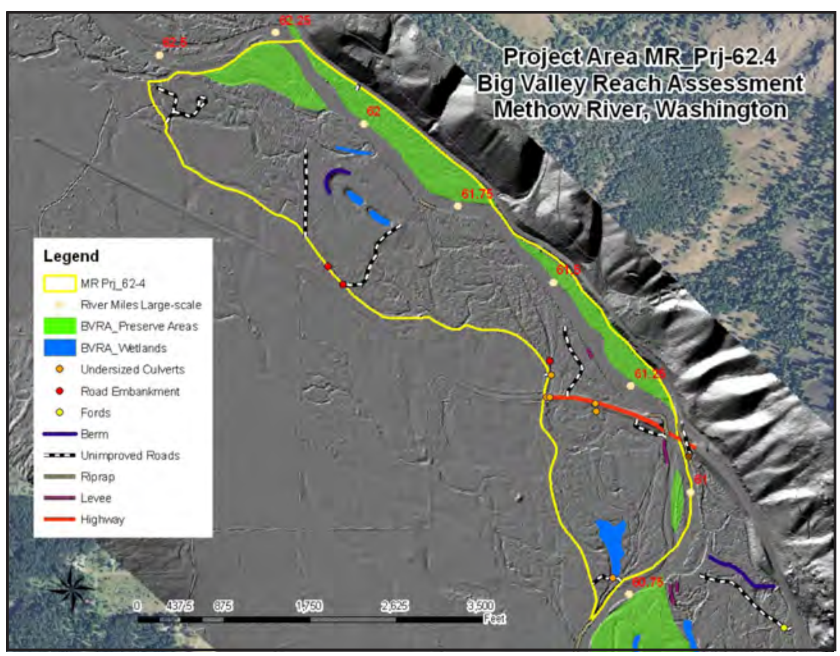


Figure 18

Overview map on LiDAR hillshade of the project area MR_Prj-62.4 in the upper section of the Big Valley reach

MR_Prj-60.25

Protect/Maintain Processes

Reconnect Processes

A D
P S

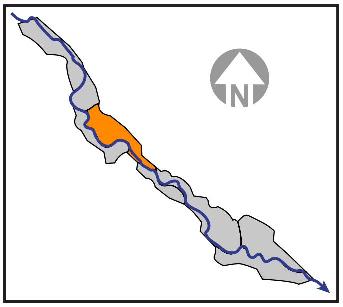


Table 3. Provides REI analysis results.

Table 4. Overall sequencing results for implementation purposes among project areas.

DETAILS

The project area covers about 200 acres that include the left riverbank and side channels. Almost the entire project area is impacted by development within the floodplain and is in an at risk condition. About 10 acres are comprised of a side channel and island that are identified as a protection areas as shown in Figures 19 and 20.

Floodplain Protection

Protect side channel and remaining riparian buffer zones (~10 acres) from development. The mainstem and side channel are currently being utilized by ESA listed species for spawning, rearing and refugia. This action is listed as a **Tier 1** in the *Biological Strategy.* It also addresses the limiting and causal factors of loss of habitat quantity and complexity, large woody debris recruitment, canopy cover and water quality.

Road Maintenance

Place appropriately-sized culverts, bridges or modified fords where road embankments (4) disconnect overflow channels (Photograph No. 26) and where a ford (1) is contributing fine sediments (Photograph No. 27). This action is listed as a Tier 2 in the *Biological Strategy* and addresses productivity and abundance VSP parameters. It also addresses the limiting and causal factors of loss of floodplain connectivity and increased fine sediment delivery to spawning area.

Photograph No. 26

View is to the north looking upstream at a road crossing with an undersized culvert encased in concrete along an overflow channel. Bureau of Reclamation Photograph by R. McAffee, October 16, 2006.

Photograph No. 27

View is to the west looking across a ford crossing through an overflow channel along an unimproved road. Bureau of Reclamation Photograph by R. McAffee, October 17, 2006.

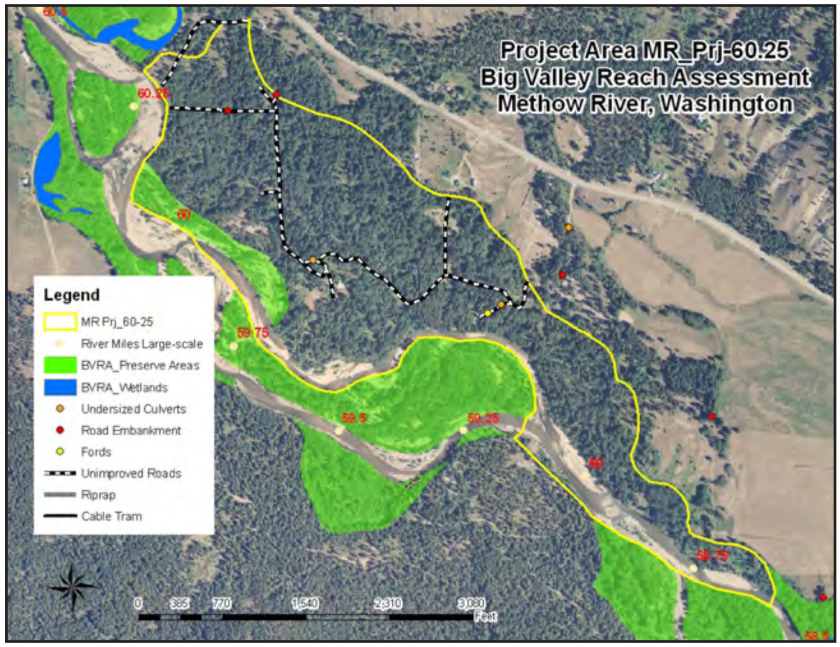


Figure 19
Overview map on aerial photograph of the project area MR_Prj-60.25 in the upper section of the Big Valley reach

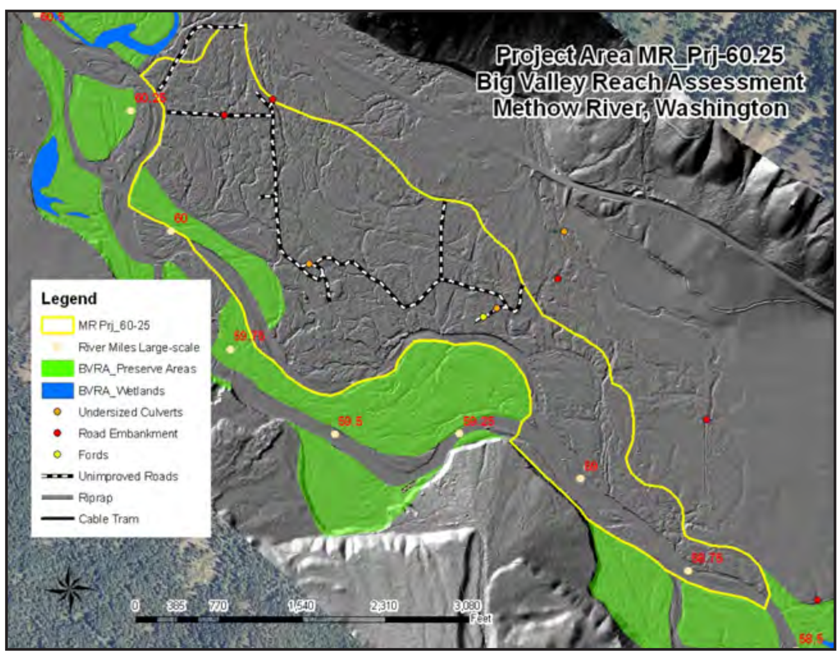


Figure 20
Overview map on LiDAR hillshade of the project area MR_Prj-60.25 in the upper section of the Big Valley reach

Conclusion and Recommendations

The Big Valley reach assessment covers about 1,400 acres of floodplain and river channels. Based on the reach-based ecosystem indicators, about 50 percent of the indicators are in an *adequate* condition and 40 percent are in an *at risk* condition. Only one indicator, water temperature, was found to be in an *unacceptable risk* condition based on Washington State Department of Ecology water standards. However, this may be a “natural” condition providing thermal refugia in both summer and winter months.

Overall, the reach exhibits the ecosystem resilience necessary to maintain its current capability to sustain salmonid habitat. Of the eight project areas identified in this assessment, two are protection areas and six are restoration areas. The priority habitat action is to protect habitat identified as protection areas that will maintain core habitat connectedness (about 65% of the reach or 939 acres).

Restoration habitat actions should be sequenced as follows: (1) protect core habitat areas (i.e., protection areas) to maintain current functionality of the reach; (2) at a subwatershed scale, address water temperature issues and evaluate the impact of floodplain development (i.e., riparian vegetation clearing, diversions and domestic wells); (3) evaluate the mainstem physical barrier, Foghorn Diversion Dam, for fish passage at all biologically significant flows; (4) reconnect isolated habitats for a cumulative ecosystem benefit; (5) address floodplain development and its impact on river processes; (6) complete alternatives evaluations for each project area where project implementation is feasible to expand the core habitat areas; and (7) monitor the ecosystem/physical indicators listed in the REI to ensure the reach’s potential is maintained or improved to sustain salmonid populations for an indefinite period of time.

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Appendix A

Reach-based Ecosystem Indicators (REI) Version 1.1

The Big Valley reach assessment team was comprised of Edward W. Lyon, Jr., L.G. (Reclamation geologist), Jennifer Molesworth (Reclamation Methow Subbasin liaison; formerly U.S. Forest Service fisheries biologist), Cassie Klumpp, P.E. (Reclamation hydraulic engineer), and Dave Hopkins (U.S. Forest Service fisheries technician). The REI was developed collaboratively with an Upper Columbia Regional Technical Team (UCRTT) subcommittee and other interested stakeholders during this reach assessment to evaluate the appropriate core indicators and utility of the REI. Rating of each indicator was done as an iterative process by integrating new data collected for this reach assessment, data contained in the *Geomorphic Assessment* (Reclamation, 2008), and literature review. The ranges of criteria presented here are not absolute and should be adjusted to each unique subbasin as data become available.

PATHWAY: WATERSHED CONDITION

INDICATOR: WATERSHED ROAD DENSITY AND EFFECTIVE DRAINAGE NETWORK

Criteria: The following criteria were developed by USFWS (1998).

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Watershed Condition	Effective Drainage Network and Watershed Road Density	Increase in Drainage Network/ Road Density	Zero or minimum increases in active channel length correlated with human caused disturbance. And Road density <1 miles/miles^2.	Low to moderate increase in active channel length correlated with human caused disturbances. And Road density 1-2.4 miles/miles^2.	Greater than moderate increase in active channel length correlated with human caused disturbances. And Road density >2.4 miles/miles^2.

Data: Percentage of the Upper Mainstem Methow Subwatershed in each road density category received from the Methow Valley Ranger District stream survey crew (information received from D. Hopkins, Methow Valley Ranger District).

Road Density	Open Roads
No roads	15%
0.1 to 2 miles/miles^2	25%
2.1 to 5 miles/miles^2	39%
>5 miles/miles^2	21%

Narrative:

Forest, state, county and private roads are typically located in the floodplains of the mainstem and their tributaries. These road location practices may result in multiple habitat impacts including reduced riparian canopy, increased fine sediment loads, reduced pool habitat and lost off-channel habitats. Such roads also directly reduce watershed storage capacity by rapidly routing run-off into stream channels and by compacting floodplain soils, and also indirectly by discouraging beaver pond construction. Additionally, some tributary channels (i.e. Early Winters and Goat Creeks) have been straightened to maintain bridge crossings. Currently about 94% of the Methow Watershed is in public ownership and the upper watershed is primarily within the Okanogan-Wenatchee National Forest. "Multiple-use" is the dominant factor on the forest land and the Okanogan-Wenatchee National Forest has developed its *Land and Resource Management Plan* (1989) and a *Record of Decision* (1994) for the northern spotted owl that strongly influences how the lands will be managed (CCPUD, 1998). Road densities are high (60% greater than 2.0 miles/miles^2) in the Upper Middle Methow River subwatershed between Wolf Creek and Early Winters Creek, and in the Goat Creek drainage. Overall the assessment team's interpretation is that the effective drainage network and road density indicators are in an "at risk" condition do to timber harvest, road locations and residential development.

INDICATOR: DISTURBANCE REGIME

Criteria: The following criteria were modified from USFWS (1998).

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Watershed Condition	Disturbance Regime	Natural/ Human Caused	Environmental disturbance is short lived; predictable hydrograph, high quality habitat and watershed complexity providing refuge and rearing space for all life stages or multiple life-history forms. Natural processes are stable.	Scour events, debris torrents, or catastrophic fires are localized events that occur in several minor parts of the watershed. Resiliency of habitat to recover from environmental disturbances is moderate.	Frequent flood or drought producing highly variable and unpredictable flows, scour events, debris torrents, or high probability of catastrophic fire exists throughout a major part of the watershed. The channel is simplified, providing little hydraulic complexity in the form of pools or side channels. Natural processes are unstable.

Narrative:
About 400 fires have been recorded in the Upper Methow Watershed with about 75% of them being caused by lightening (MVRD, 1996). In general, severe fires have burned in the Upper Methow Watershed every 100 to 300 years and fire frequency has not changed significantly since the 1920s. Recent fires include the Needles Creek Fire (2003), Whiteface Fire (1994), Eureka Fire (1986) and Quartz Mountain Fire (2004). Two significant fires are the Needles Creek Fire that burned about 21,300 acres between Rattlesnake Creek (RM 3) and Brush Creek (RM 10) in the West Fork Methow River drainage and the Whiteface Fire that burned about 3,670 acres in the Goat Creek drainage. After an area burns there is generally an increase in soil erosion and mass wasting until soils are re-stabilized by vegetation. Burn areas are also associated with increased water temperatures as was the case of the Needles Fire on the West Fork Methow River. Fires are an integral part of the ecosystem. They rejuvenate vegetation, and provide coarse-fine sediment and large woody debris to the fluvial system. For further discussion on the fire history in the Methow Subbasin the reader is referred to the *Geomorphic Assessment – Appendix L*.

Historically the basin's economy was primarily agriculture, forestry and mining. The basin is now experiencing a demographic shift to tourism, recreation and general goods and services industries. This shift is resulting in the conversion of agricultural areas to residential and commercial development. Development along the floodplain and adjacent valley bottoms increases the percentage of cleared and impervious areas that have a cumulative impact on streamflows, vegetation and overall water quality.

The assessment team's interpretation is that fire is a short lived environmental disturbance, but development in the valley bottoms could have a negative impact. Overall the watershed is currently environmentally resilient suggesting that this indicator is in an "adequate" condition. However, the increasing development in the valley bottoms could move this indicator toward an "at risk" condition.

PATHWAY: FLOW/HYDROLOGY

INDICATOR: STREAMFLOW

Criteria: The following criteria were developed by USFWS (1998).

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Flow/ Hydrology	Streamflow	Change in Peak/Base Flows	Magnitude, timing, duration and frequency of peak flows within a watershed are not altered relative to natural conditions of an undisturbed watershed of similar size, geology and geography.	Some evidence of altered magnitude, timing duration and/or frequency of peak flows relative to natural conditions of an undisturbed watershed of similar size, geology and geography.	Pronounced changes in magnitude, timing, duration and/or frequency of peak flows relative to natural conditions of an undisturbed watershed of similar size, geology and geography.

Narrative:
From Weeman Bridge to Mazama the Methow River "naturally" dewaters in late summer and fall, but may be exacerbated by water use for irrigation (CCPUD, 1998). Dewatering is primarily due to the geology (depth of alluvial valley fill), but only limited studies have been conducted on the surface water and ground water interactions (Konrad, Drost, and Wagner, 2003). Until these interactions are quantified (including the influences of floodplain development and ground water pumping) the assessment team interprets this indicator to be in an "at risk" condition.

PATHWAY: WATER QUALITY

INDICATOR: TEMPERATURE

Criteria: The following criteria were developed by Hillman and Giorgi (2002), USFWS (1998), and WDOE (2008).

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Water Quality	Temp.	MWMT/ MDMT/ 7-DADMax	Bull Trout: Incubation: 2-5°C Rearing: 4-10°C Spawning: 1-9°C Salmon and Steelhead: Spawning: June-Sept 15°C Sept-May 12°C Rearing: 15°C Migration: 15°C Adult holding: 15°C Or, 7-DADMax performance standards (WDOE): Salmon spawning 13°C Core summer salmonid habitat 16°C Salmonid spawning, rearing and migration 17.5°C Salmonid rearing and migration only 17.5°C	MWMT in reach during the following life history stages: Incubation: <2°C or 6°C Rearing: <4°C or 13-15°C Spawning: <4°C or 10°C Temperatures in areas used by adults during the local spawning migration sometimes exceed 15°C. Or 7-DADMax performance standards exceeded by ≤15%	MWMT in reach during the following life history stages: Incubation: <1°C or >6°C Rearing: >15°C Spawning: <4°C or >10°C Temperatures in areas used by adults during the local spawning migration regularly exceed 15°C. Or 7-DADMax performance standards exceeded by >15%

Data: The source of the following information is the 2005 temperature summary for the Upper Middle Methow River from Early Winters Creek to Wolf Creek collected by the Methow Ranger Valley District (information received from D. Hopkins, Methow Valley Ranger District) and the *Geomorphic Assessment – Appendix I* (Reclamation, 2008).

	RM 71.8	**RM 66.8**	**RM 63.3**	**RM 61.8**	**RM 58.5**	**RM 56.2**
Highest Temperature (Date)	16.41° C (07-18-20005)	19.96° C (07-28-2005)	18.54° C (08-08-2005)	17.36° C (07-28-2005)	18.07° C (07-28-2005)	18.71° C (08-08-2005)
Highest 7-day Max. Temp. (Date)	15.82° C (07-24-2005)	19.57° C (07-25-2005)	17.95° C (08-05-2005)	16.88° C (07-25-2005)	17.58° C (07-25-2005)	17.96° C (08-04-2005)
Highest 7-day Avg. Temp. (Date)	12.57° C (07-25-2005)	14.92° C (07-25-2005)	14.36° C (08-05-2005)	13.58° C (07-25-2005)	14.01° C (07-25-2005)	14.32° C (08-05-2005)
# of Days >16° C	4	23	41	23	34	39
# of Days >17.8° C	0	16	12	0	2	9
NOAA Fisheries Temp. Indicator Rating:						
Spring Chinook Salmon Spawning	Adequate Condition	Unacceptable Risk Condition	Unacceptable Risk Condition	Unacceptable Risk Condition	Unacceptable Risk Condition	Unacceptable Risk Condition
Spring Chinook Salmon and Steelhead Rearing	Adequate Condition	Unacceptable Risk Condition	Unacceptable Risk Condition	At Risk Condition	At Risk Condition	At Risk Condition
WDOE Fisheries Temp. Performance Standard Rating:						
Salmon spawning 13°C	Unacceptable Risk Condition	Unacceptable Risk Condition	Unacceptable Risk Condition	Unacceptable Risk Condition	Unacceptable Risk Condition	Unacceptable Risk Condition
Core summer salmonid habitat 16°C	Adequate Condition	Unacceptable Risk Condition	At Risk Condition	At Risk Condition	At Risk Condition	Adequate Condition
Salmonid spawning, rearing and migration 17.5°C	Adequate Condition	At Risk Condition	At Risk Condition	Adequate Condition	At Risk Condition	At Risk Condition
Salmonid rearing and migration only 17.5°C	Adequate Condition	At Risk Condition	At Risk Condition	Adequate Condition	At Risk Condition	At Risk Condition

Data: The source of the following information is from a habitat assessment conducted by the Methow Ranger Valley District for this reach (Appendix C).

Temperature	RM 54.2-55.0	RM 55.0-56.6	RM 56.6-59.1	RM 59.1-60.0	RM 60.0-61.0
Highest recorded temperature	18.7°C (7/28/2005)	No data	18.1°C (2005)	17.4°C (2005) 17.1°C (2006)	18.5°C (2005) 18.3°C (2006)
Number of days >14°C (at risk condition for rearing)	64	No data	63	55 (2005) 49 (2006)	70 (2005) 54 (2006
Number of days >17.8°C (unacceptable risk condition for rearing)	6	No data	0	0 (2005) 0 (2006)	5 (2005) 4 (2006)
Highest temperature during Chinook spawning	17.3°C	No data	16.8°C	16.1°C (2005) 14.7°C (2006)	17.4°C (2005) 16.5°C (2006)
Avg. daily high temp. during Chinook spawning -last 3 weeks in Aug. -first 3 weeks in Sept.	16.3°C 13.4°C	No data	15.6°C 12.4°C	14.8°C (2005) 13.8°C (2006) 12.1°C (2005) 11.5°C (2006)	16.5°C (2005) 15.1°C (2006) 14.1°C (2005) 13.0°C (2006)
Number of days during Chinook spawning >15°C (unacceptable risk condition for spawning)	21	No data	16	7 (2005) 0 (2006)	22 (2005) 17 (2006)

Interpretation: Washington Department of Ecology water quality indicators (WDOE, 2008) were used to determine the water temperature condition for the reach assessment. “At risk” and “unacceptable risk” conditions criteria are based on percent the performance standards are exceeded.

Temp.	MR Prj-56.0	MR Prj-56.5	MR Prj-58.6	MR Prj-58.9	MR Prj-59.6	MR Prj-60.25	MR Prj-60.85	MR Prj-62.4
Salmon spawning	Unacceptable Risk Condition	Unacceptable Risk Condition	Unacceptable Risk Condition	Unacceptable Risk Condition	Unacceptable Risk Condition	Unacceptable Risk Condition	Unacceptable Risk Condition	Unacceptable Risk Condition
Core summer salmonid habitat	Adequate Condition	Adequate Condition	At Risk Condition	At Risk Condition	At Risk Condition	At Risk Condition	At Risk Condition	At Risk Condition
Salmonid spawning, rearing and migration	At Risk Condition	At Risk Condition	At Risk Condition	At Risk Condition	At Risk Condition	At Risk Condition	At Risk Condition	Adequate Condition
Salmonid rearing and	At Risk Condition	At Risk Condition	At Risk Condition	At Risk Condition	At Risk Condition	At Risk Condition	At Risk Condition	Adequate Condition

Temp.	MR Prj-56.0	MR Prj-56.5	MR Prj-58.6	MR Prj-58.9	MR Prj-59.6	MR Prj-60.25	MR Prj-60.85	MR Prj-62.4
migration only								

Narrative:

Water quality of the upper Methow River is classified as AA (extraordinary); however, water temperatures at times exceed Washington Department of Ecology water quality standards during the summer (WDOE, 1990). The habitat assessment conducted by the Methow Valley Ranger District for this reach found the water temperatures to be at “close to natural conditions”. The Big Valley reach is located in a “gaining” section of the Methow River which provides a thermally favorable environment for salmonids making it one of the most productive spawning areas in the subbasin. However, the higher water temperatures may be exacerbated by degradation of the riparian vegetation, reduced floodplain connectivity caused by development in the floodplain and water quantity (six irrigation diversions/ditches upstream of Winthrop reported in CCPUD, 1998). Additional temperature data was collected during the *Geomorphic Assessment* (Appendix I). Based on the Washington Department of Ecology water quality standards, the reach is in an “unacceptable risk” condition for spawning, and “at risk” condition for migration and rearing.

INDICATOR: TURBIDITY

Criteria: The performance standard for this indicator is from Hillman and Giorgi (2002), and Washington State Department of Ecology.

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Water Quality	Turbidity	Turbidity	Performance Standard: Acute <70 NTU Chronic <50 NTU For streams that naturally exceed these standards: Turbidity should not exceed natural baseline levels at the 95% CL. <15% exceedance. Or, Turbidity shall not exceed: 5 NTU over background when the background is 50 NTU or less; or a 10 percent increase in turbidity when the background turbidity is more than 50 NTU (WDOE – 173-201A-200).	15-50% exceedance.	>50% exceedance.

Data: Washington State Department of Ecology 1989 water quality testing (WDOE, 1990).

Turbidity	**Bridge below Winthrop**	**Bridge below Mazama**
	0.2-0.8 NTU	0.2-0.3 NTU

Interpretation:

Turbidity	**MR Prj-56.0**	**MR Prj-56.5**	**MR Prj-58.6**	**MR Prj-58.9**	**MR Prj-59.6**	**MR Prj-60.25**	**MR Prj-60.85**	**MR Prj-62.4**
	condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition

Narrative:

Results from the Washington State Department of Ecology (WDOE, 1990) water quality testing show this indicator is in an “adequate condition”.

Adequate

INDICATOR: CHEMICAL CONTAMINATION/NUTRIENTS

Criteria: The following criteria were developed by USFWS (1998) and Washington State Department of Ecology.

Pathway	**General Indicators**	**Specific Indicators**	**Adequate Condition**	**At Risk Condition**	**Unacceptable Condition**
Water Quality	Chemical Contamination/ Nutrients	Metals/ Pollutants, pH, DO, Nitrogen, Phosphorous	Low levels of chemical contamination from landuse sources, no excessive nutrients, no CWA 303d designated reaches. Or, Washington State Department of Ecology standards – 173-201A-200.	Moderate levels of chemical contamination from landuse sources, some excess nutrients, one CWA 303d designated reach.	High levels of chemical contamination from landuse sources, high levels of excess nutrients, more than one CWA 303d designated reach.

Data: Washington Department of Ecology 1989 water quality survey (WDOE, 1990).

Indicator	**Bridge below Winthrop**	**Bridge below Mazama**
Conductivity	124-140 umhos/cm	73-118 umhos/cm
Copper	<0.50-<2.0 ug/L	<0.50-<2.00 ug/L
Dissolved Oxygen	10.20-12.75 mg/L	9.70-12.10 mg/L
Fecal Coliform	<1-2 #col/100ml	<1-6 #col/100ml
Lead	<0.50-3.7 ug/L	<0.5-1.0 ug/L
Mercury	<0.06 ug/L	<0.06 ug/L
Nitrite-Nitrate	0.079-0.086 mg/L	0.022-0.056 mg/L
Ortho-Phosphate	0.002-0.003 mg/L	<0.001 mg/L
pH	6.7-8.4 pH	7.4-8.2 pH
Silver	<0.15-<0.5 ug/L	<0.15-<0.50 ug/L
Total Hardness	59-77 mg/L	48-65 mg/L
Total Kjeldahl Nitrogen	0.075-0.322 mg/L	<0.050-0.151 mg/L
Total Organic Carbon	0.88-5.83 mg/L	0.66-6.42 mg/L
Total Phosphorous	<0.001-0.005 mg/L	<0.001-0.007 mg/L
Total Suspended Solids	<1-1 mg/L	<1-1 mg/L
Zinc	<2.0-6.8 ug/L	<2.0-9.3 ug/L
Ammonia	<0.010-0.025 mg/L	0.011-0.024 mg/L
Biochemical Oxygen Demand	<3 mg/L	<3 mg/L
Cadmium	<0.20 ug/L	<0.20-0.33 ug/L

Interpretation:

Chemical Contamination/ Nutrients	**MR Prj-56.0**	**MR Prj-56.5**	**MR Prj-58.6**	**MR Prj-58.9**	**MR Prj-59.6**	**MR Prj-60.25**	**MR Prj-60.85**	**MR Prj-62.4**
	condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition

Adequate

Narrative:
The Washington Department of Ecology water quality testing results (WDOE, 1990) found that this indicator is in an "adequate condition".

PATHWAY: HABITAT ACCESS

INDICATOR: PHYSICAL BARRIERS

Criteria: The following criteria have been modified from USFWS (1998).

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Habitat Access	Physical Barriers	Main Channel Barriers	No manmade barriers present in the mainstem that limit upstream or downstream migration at any flow.	Manmade barriers present in the mainstem that prevent upstream or downstream migration at some flows that are biologically significant.	Manmade barriers present in the mainstem that prevent upstream or downstream migration at multiple or all flows.

Data:
There is a potential physical barrier on the main channel at RM 51.5 (Foghorn Diversion Dam) downstream from the reach assessment area that may be impeding fish passage during low flows. There are no physical barriers along the main channel in the reach assessment area.

Interpretation:

Physical Barriers	MR Prj-56.0	MR Prj-56.5	MR Prj-58.6	MR Prj-58.9	MR Prj-59.6	MR Prj-60.25	MR Prj-60.85	MR Prj-62.4
	At risk condition	At risk condition	At risk condition	At risk condition	At risk condition	At risk condition	At risk condition	At risk condition

Narrative:
Due to the potential physical barrier (Foghorn Diversion Dam) that may be impeding fish migration upstream and downstream of the Big Valley reach assessment area at some biologically significant flows this indicator is considered to be "at risk". Further evaluation

of the structure is needed to prove that it is not a fish passage barrier. If such an evaluation concludes that Foghorn Diversion Dam is not a fish passage barrier at all biologically significant flows, this indicator would change to an "adequate" condition.

PATHWAY: HABITAT QUALITY

INDICATOR: SUBSTRATE

Criteria: Performance standards for these criteria are from Hillman and Giorgi (2002).

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Habitat Quality	Substrate	Dominant Substrate/ Fine Sediment	Gravels or small cobbles make-up >50% of the bed materials in spawning areas. Reach embeddedness in rearing areas <20%. <12% fines (<0.85mm) in spawning gravel or ≤12% surface fines of ≤6mm.	Gravels or small cobbles make-up 30-50% of the bed materials in spawning areas. Reach embeddedness in rearing areas 20-30%. 12-17% fines (<0.85mm) in spawning gravel or 12-20% surface fines of ≤6mm.	Gravels or small cobbles make-up <30% of the bed materials in spawning areas. Reach embeddedness in rearing areas >30%. >17% fines (<0.85mm) in spawning gravel or >20% surface fines of ≤6mm.

Data: The source of the following summary is from 2005 pebble count data for the Upper Middle Methow River from Early Winters Creek to Wolf Creek collected by the Methow Ranger Valley District for Reclamation (Appendix C) and by Reclamation (Appendix D).

	RM 56.1	RM 56.7	RM 57.4	RM 64.0	RM 65.2	RM 66.1	RM 67.4	RM 68.6	RM 69.5
Surface fines (<6mm)	1%	1%	5%	1%	13%	8%	25%	28%	4%
D50	79.2	129.7	72.7	96.6	54.9	67.4	35.5	45.6	102.1
Sand (<2mm)	1%	1%	4%	1%	11%	4%	24%	28%	4%
Gravel (2-64mm)	37%	14%	36%	26%	45%	43%	59%	35%	23%
Cobble (64-256mm)	56%	81%	60%	68%	43%	49%	17%	37%	64%
Boulder (>256mm)	6%	4%	0%	5%	1%	4%	0%	0%	9%
Bedrock	-	-	-	-	-	-	-	-	-

Data: The following information was gathered during the habitat assessment conducted by the Methow Valley Ranger District for this reach (Appendix C) and by Reclamation (Appendix D).

Substrate	RM 54.2-55.0	RM 55.0-56.6	RM 56.6-59.1	RM 59.1-60.0	RM 60.0-61.0
2005 pebble count data:					
River mile	54.?	55.5	56.6	59.?	No data
Pebble count data on bar:	MR36	MR37	MR38	MR41	No data
-D35: D50: D84	56: 73: 124	27: 42: 93	50: 61: 116	39: 51: 92	No data
-% substrate (sa, gr, co, bo)	1, 14, 79, 6%	3, 62, 35, 0%	4, 49, 47, 0%	8, 58, 36, 0%	No data
Pebble count wetted width					
-D35: D50: D84	104: 130: 214	60: 79: 170	64: 79: 141	No data	No data
-% substrate (sa, gr, co, bo)	1, 14, 79, 6%	0, 38, 56, 6%	4, 36, 60, 0%	No data	No data
Pebble count data on bar:	No data	No data	MR39	No data	No data
-D35: D50: D84	No data	No data	42: 59: 161	No data	No data
-% substrate (sa, gr, co, bo)	No data	No data	2, 51, 47, 0%	No data	No data
Pebble count wetted width:					

Substrate	RM 54.2-55.0	RM 55.0-56.6	RM 56.6-59.1	RM 59.1-60.0	RM 60.0-61.0
-D35: D50: D84	No data	No data	58: 73: 114	No data	No data
-% substrate (sa, gr, co, bo)	No data	No data	7, 49, 44, 0%	No data	No data
Ocular est.:					
Sand, gravel, cobble, bldr. (includes pools)	5, 20, 65, 10% (2006)	5, 35, 60, 0% (2006)	5, 45, 50, 0% (2006)	5, 40, 50, 5% (2006)	5, 35, 55, 5% (2005)
Sieve data surface (2007) -D35: D50: D84	No data	45: 65: 103	70: 80: 125	63: 75: 115	39: 70: 140
-% substrate (sa, gr, co, bo)	No data	1, 60, 39, 0%	2, 25, 75, 0%	0, 35, 65, 0%	2, 43, 55, 0%
Sieve data subsurface (2007) -D35: D50: D84	No data	34: 45: 79	32: 50: 120	27: 31: 45	55: 68: 130
-% substrate (sa, gr, co, bo)	No data	6, 60, 34, 0%	5, 55, 40, 0%	1, 99, 0, 0%	6, 40, 54, 0%

Interpretation:

Substrate	MR Prj-56.0	MR Prj-56.5	MR Prj-58.6	MR Prj-58.9	MR Prj-59.6	MR Prj-60.25	MR Prj-60.85	MR Prj-62.4
Dominant Substrate	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition
Embeddedness	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition
Fine Sediment	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition

Narrative:

The dominant substrate in the reach is comprised of gravel and small cobbles and is considered to be in an "adequate" condition. None of the pool crests or pools were judged to be embedded (>20% buried in fine sediment) by the habitat survey crew. Interstitial sediments (fines) within spawning gravels have not been measured using McNeal core samples. However, the USFWS and NOAA Fisheries also use the percent surface fines as an indicator of how well a stream is functioning for sediment and turbidity. An "adequate" condition rating is given to streams with less than 12% surface fines (<6 mm diameter). Based on the above information the reach is considered to be in an "adequate" condition.

INDICATOR: LARGE WOODY DEBRIS

Criteria: The following criteria were developed by USFWS (1998).

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Habitat Quality	Large Woody Debris (LWD)	Pieces Per Mile at Bankfull	>20 pieces/mile >12" diameter >35 ft length; and adequate sources of woody debris available for both long- and short-term recruitment.	Currently levels are being maintained at minimum levels desired for "adequate", but potential sources for long-term woody debris recruitment is lacking to maintain these minimum values.	Current levels are not at those desired values for "adequate", and potential sources of woody debris for short- and/or long-term recruitment are lacking.

Data: The following information was gathered during the habitat assessment conducted by the Methow Valley Ranger District for this reach (Appendix C). Additional information can be found in the *Geomorphic Assessment – Appendix O*.

LWD	RM 54.2-55.0	RM 55.0-56.6	RM 56.6-59.1	RM 59.1-60.0	RM 60.0-61.0
Large wood per mile:					
Large (>35' long, >20" diameter)	0	7.6	7.2	4.2	4
Medium (>35' long, 12-20" diameter)	3.7	28.8	30.2	14.6	28
Total large and medium	3.7	36.4	37.4	18.8	33
Small (>20' long, >6" diameter)	8.7	110.0	35.5	37.6	77
LWD recruitment potential	Poor	Good	Good	Good	Good

Interpretation:

LWD	MR Prj-56.0	MR Prj-56.5	MR Prj-58.6	MR Prj-58.9	MR Prj-59.6	MR Prj-60.25	MR Prj-60.85	MR Prj-62.4
	At risk condition	At risk condition	At risk condition	At risk condition	At risk condition	At risk condition	At risk condition	At risk condition

Narrative:

The criteria for amounts of large wood were met throughout the reach assessment area, but the size category is probably smaller than it was historically. In the habitat assessment large woody debris recruitment potential was considered "good". However, past selective harvest of large trees along the riverbank and in the floodplain, removal of in-channel wood for flood control and residential development of the floodplain have reduced the long-term large woody debris recruitment potential and have reduced the availability of very large trees (over 30-inch dbh) for recruitment. Very large trees provide key structural members necessary for "stable" log complexes. Therefore the assessment team believes the large woody recruitment indicator is "at risk".

INDICATOR: POOLS

Criteria: The following criteria were developed by USFWS (1998).

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Habitat Quality	Pools	Pool Frequency and Quality Large Pools (in adult holding, juvenile rearing, and over-wintering reaches where streams are >3 m in wetted width at base flow)	Pool frequency: Channel width — No. pools/mile 0-5 ft — 39 5-10 ft — 60 10-15 ft — 48 15-20 ft — 39 20-30 ft — 23 30-35 ft — 18 35-40 ft — 10 40-65 ft — 9 65-100 ft — 4 Pools have good cover and cool water and only minor reduction of pool volume by fine sediment. Each reach has many large pools >1 m deep with good fish cover.	Pool frequency is similar to values in “functioning adequately”, but pools have inadequate cover/temperature, and/or there has been a moderate reduction of pool volume by fine sediment. Reaches have few large pools (>1 m) present with good fish cover.	Pool frequency is considerably lower than values for “functioning adequately”, also cover/temperature is inadequate, and there has been a major reduction of pool volume by fine sediment. Reaches have no deep pools (>1 m) with good fish cover.

Data: The following information was gathered during the assessment conducted by the Methow Valley Ranger District for this reach (Appendix C).

Pool Frequency and Quality	RM 54.2-55.0	RM 55.0-56.6	RM 56.6-59.1	RM 59.1-60.0	RM 60.0-61.0
Pools per mile	1.2	11.8	7.9	11.5	10
Average wetted channel width	76’	69’	67’	75’	55’
Average thalweg depth	1.8’	1.4’	1.6’	1.2’	1.4’

Pool Frequency and Quality	RM 54.2-55.0	RM 55.0-56.6	RM 56.6-59.1	RM 59.1-60.0	RM 60.0-61.0
(riffles)					
# of pools >5' deep/mile	0	4.7	3.8	3.1	1.1
Average pool max. depth	3.0'	4.5'	4.4'	4.0'	3.5'
Average pool residual depth	1.2'	3.3'	3.1'	2.9'	2.6'
Riffle to pool ratio (main channel)	7.0 : 1	0.54 : 1	0.93 : 1	1.24 : 1	0.78 : 1
% Glide (non-turbulent riffles)	5.2%	1.8%	10.8%	12.8%	11%
% Side channel	0%	41.6%	7.8%	1.5%	29%
Required # of pools per mile (criteria)	4	4	4	4	9
LWD recruitment potential	Poor	Good	Good	Good	Good

Interpretation:

Pool	MR Prj-56.0	MR Prj-56.5	MR Prj-58.6	MR Prj-58.9	MR Prj-59.6	MR Prj-60.25	MR Prj-60.85	MR Prj-62.4
Frequency and Quality	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition
Large Pools	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	At risk condition	At risk condition

Narrative:

The habitat assessment found that over one-third of the habitat in the reach consisted of pools and concluded that this reach is probably at natural levels for numbers of pools. In the reach assessment area the criteria for pool frequency and quality were met, but as noted in the Large Woody Debris indicator section the availability of very large trees (over 30-inch dbh) for recruitment has been affected by historic practices and floodplain development. The assessment team believes the system is currently "adequate", but future floodplain development could change this indicator to "at risk".

The habitat assessment measured the number and depth of all pools in the main channel in the reach assessment area. Based on their findings the assessment team believes that most of the reach is in an "adequate" condition. However, the number of large pools declines between RM 59.1-61.0 suggesting that this area is in an "at risk" condition. This interpretation also considers floodplain connectivity and riparian condition that have been impacted by floodplain development and transportation corridors (i.e., Highway. 20).

INDICATOR: OFF-CHANNEL HABITAT

Criteria: The following criteria have been modified from USFWS (1998).

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Habitat Quality	Off-channel Habitat	Connectivity with Main Channel	Reach has many ponds, oxbows, backwaters, and other off-channel areas with cover, and side channels are low energy areas. No manmade barriers present along the mainstem that prevent access to off-channel areas.	Reach has some ponds, oxbows, backwaters, and other off-channel areas with cover, and side channels are generally high energy areas. Manmade barriers present that prevent access to off-channel habitat at some flows that are biologically significant.	Reach has few or no ponds, oxbows, backwaters, and other off-channel areas. Manmade barriers present that prevent access to off-channel habitat at multiple or all flows.

Data: The following information was gathered during the habitat assessment conducted by the Methow Valley Ranger District for this reach (Appendix C).

Off-channel Habitat:	RM 54.2-55.0	RM 55.0-56.6	RM 56.6-59.1	RM 59.1-60.0	RM 60.0-61.0
Percent habitat side channels	0%	41.6%	7.8%	1.5%	29%
Backwater pool habitat	None	Frequent	Frequent	Infrequent	Frequent (?)

Data: The following information was generated by Reclamation using a 2D hydrodynamic model at a 2-year and 5-year floods (Appendix E).

Connectivity with Main Channel	**MR Prj-56.0**	**MR Prj-56.5**	**MR Prj-58.6**	**MR Prj-58.9**	**MR Prj-59.6**	**MR Prj-60.25**	**MR Prj-60.85**	**MR Prj-62.4**
Side Channel Connectivity:								
Wetted length	4,200 ft	10,000 ft	2,200 ft	5,000 ft	5,000 ft	3,100 ft	7,900 ft	1,200 ft
Total length	11,100 ft	17,400 ft	10,400 ft	7,200 ft	6,200 ft	10,000 ft	9,600 ft	8,170 ft
Percent wetted area	38%	57%	21%	69%	81%	31%	82%	15%
Overflow Areas:								
Actual habitat (acres)	32.5	31.5	13.5	18.6	21.5	24.1	21.8	7.1
Potential habitat (acres)	37.8	35.8	29.3	18.6	21.5	26.1	23.8	17.7
Percent accessible	86%	88%	46%	100%	100%	92%	92%	40%

Data: The following information was gathered during the initial site assessments conducted by Reclamation for this reach (Appendix B).

Physical Barriers:	**MR Prj-56.0**	**MR Prj-56.5**	**MR Prj-58.6**	**MR Prj-58.9**	**MR Prj-59.6**	**MR Prj-60.25**	**MR Prj-60.85**	**MR Prj-62.4**
Road embankment crossings	11	10	6	0	0	2	0	10 (?)
Embankment dams	0	3	0	0	0	0	0	0
Culverts	0	1	1	0	0	2	0	6
Levees/Berms/ Embankments	0	0	0	0	0	0	1080 ft	1515 ft
Residential Development	Yes	No (one abandoned house)	No	No	No	Yes	No	Yes

Interpretation:

Connectivity With Main Channel	MR Prj-56.0	MR Prj-56.5	MR Prj-58.6	MR Prj-58.9	MR Prj-59.6	MR Prj-60.25	MR Prj-60.85	MR Prj-62.4
	At risk condition	At risk condition	At risk condition	Adequate condition	Adequate condition	At risk condition	At risk condition	Unacceptable risk condition

Narrative:

Access to off-channel habitat was determined by the areas inundated during 2- and 5-year floods using a 2D hydrodynamic model coupled with field observations of obstructions (i.e., road embankments, dam embankments, etc.). This reach has some of the most complex and dynamic side channel and off-channel habitat in the Methow River and is heavily used by spring Chinook, summer Chinook and steelhead species for spawning. During the spring freshet these backwater areas provide alcoves and quiet areas that are less turbid than the main channel where newly emerged fry can be seen in abundance in emergent grasses, detritus and fine wood complexes. Beavers are very active in the reach. Many of these off-channel areas are also spring-fed as well as connected to the main channel.

Two areas were identified as being in an “adequate” condition (MR Prj-58.9 and Prj-59.6). These areas do not have any human features affecting the floodplain or access to off-channel habitat areas and should be considered for protection. Five areas were identified as in an “at risk” condition (MR Prj-56.0, Prj-56.5, Prj-58.6, Prj-60.25 and Prj-60.85). These areas have physical barriers that prevent access into the off-channel habitat areas and/or have residential development. One area was identified as being in an “unacceptable risk” condition (MR Prj-62.4) because a highway embankment bisects the floodplain and the highway bridge restricts channel migration.

PATHWAY: CHANNEL

INDICATOR: CONDITION

Criteria: The following criteria have been modified from Rosgen (1996) as listed in Hillman (2006).

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Channel	Condition	Valley Segment & Channel Segment Characterization	Informative; no criteria presented.	Informative; no criteria presented.	Informative; no criteria presented.

Data: The following data was collected by Reclamation and the Methow Valley Ranger District stream survey crew. Categories are listed in Hillman (2006) and Rosgen (1996).

	RM 56.0-56.8	RM 56.8-58.4	RM 58.4-61.0	RM 61.0-62.2	RM 62.2-63.3	RM 63.3-67.3	RM 67.3-71.8
Valley Bottom Type	U1: U-shaped trough	U1: U-shaped trough	U1: U-shaped trough	U1: U-shaped trough	U1: U-shaped trough	U1: U-shaped trough	U1: U-shaped trough
Channel Patterns	Unconstrained; high sinuosity with braids and side channels common	Unconstrained; high sinuosity with braids and side channels common	Unconstrained; high sinuosity with braids and side channels common	Unconstrained; high sinuosity with braids and side channels common	Unconstrained; high sinuosity with braids and side channels common	Unconstrained; high sinuosity with braids and side channels common	Unconstrained; high sinuosity with braids and side channels common
Valley Type	Alluvial	Alluvial	Alluvial	Alluvial	Alluvial	Alluvial	Alluvial
Bed-form Types	Pool-riffle	Pool-riffle	Pool-riffle	Pool-riffle	Pool-riffle	Pool-riffle	Pool-riffle
Predominant Bed Material	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel	Gravel
Typical Confinement	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined	Unconfined
Bankfull W/D Ratio	35.2	60.0	107.0	53.7	No data	No data	50.0
Channel Type	B3c	C3	C3	C3	C3	C3	C3
Width/Depth Ratio Value (+/- 2.0)	>12 (range 11.7-38.0)	>12 (range 10.3-90.0)	>12 (range 10.3-90.0)	>12 (range 10.3-90.0)	>12 (range 10.3-90.0)	>12 (range 10.3-90.0)	>12 (range 10.3-90.0)

Interpretation:
The Upper Middle Methow River is in a U-shaped trough that is unconstrained. The valley type is alluvial that is predominantly gravel and small cobbles that create pool-riffle bed-forms. The average peak flow at the USGS gage in Mazama between 1991 and 2006 is 5,360 cfs (the spring high flow in 1999 exceeded 9,400 cfs). Low flow ranges from 0 cfs in the upper half of the Upper Middle Methow River segment, to about 30 cfs at the Weeman Bridge, to about 135 cfs above Wolf Creek. The above factors create a very wide channel in the unconfined reaches of the river. Based on professional judgment, the assessment team interprets that the Upper Middle Methow River is in an "adequate" condition.

INDICATOR: DYNAMICS

Criteria: The following criteria have been modified from USFWS (1998).

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Channel	Dynamics	Floodplain Connectivity	Floodplain areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession.	Reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession.	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly.

Data: The following information was gathered during the habitat assessment conducted by the Methow Valley Ranger District for this reach (Appendix C).

Floodplain Connectivity:	**RM 54.2-55.0**	**RM 55.0-56.6**	**RM 56.6-59.1**	**RM 59.1-60.0**	**RM 60.0-61.0**
Bankfull data (main channel):					
Bankfull width	111'	123'	198'	117'	No data
Bankfull depth	3.15'	2.05'	1.85'	2.18'	No data
W/D ratio	35.2	60.0	107.0	53.7	No data

Floodplain Connectivity:	RM 54.2-55.0	RM 55.0-56.6	RM 56.6-59.1	RM 59.1-60.0	RM 60.0-61.0
Entrenchment ratio	1.3	>10	>10	>10	No data

Data: The following information was generated by Reclamation using a 2D hydrodynamic model (Appendix D).

Floodplain Connectivity	MR Prj-56.0	MR Prj-56.5	MR Prj-58.6	MR Prj-58.9	MR Prj-59.6	MR Prj-60.25	MR Prj-60.85	MR Prj-62.4
Floodplain Area (acres):								
Actual wetted area (acres)	31.4 acres	58.7 acres	58.7 acres	75.9 acres	156.1 acres	37.6 acres	54.2 acres	15.5 acres
Potential wetted area (acres)	43.1 acres	156.7 acres	229.2 acres	84.9 acres	161.1 acres	104.1 acres	60.9 acres	52.4 acres
Percent of wetted area (actual/potential)	73%	37%	26%	89%	97%	36%	89%	30%

Data: The following information was gathered during the initial site assessments conducted by Reclamation for this reach (Appendix B).

Floodplain Connectivity	MR Prj-56.0	MR Prj-56.5	MR Prj-58.6	MR Prj-58.9	MR Prj-59.6	MR Prj-60.25	MR Prj-60.85	MR Prj-62.4
Physical Barriers:								
Road embankment crossings	11	10	6	0	0	2	0	10 (?)
Embankment dams	0	3	0	0	0	0	0	0
Culverts	0	1	1	0	0	2	0	6
Levees/Berms/ Embankments	0	0	0	0	0	0	1080 ft	1515 ft
Cable Tram	1	0	1	0	0	0	0	0
Highway Bridge	0	0	0	0	0	0	0	1

Interpretation:

Floodplain Connectivity	**MR Prj-56.0**	**MR Prj-56.5**	**MR Prj-58.6**	**MR Prj-58.9**	**MR Prj-59.6**	**MR Prj-60.25**	**MR Prj-60.85**	**MR Prj-62.4**
	At risk condition	At risk condition	Unacceptable risk condition	Adequate condition	Adequate condition	At risk condition	At risk condition	Unacceptable risk condition

Narrative:

Floodplain connectivity was determined by the areas inundated during 2- and 5-year floods using a 2D hydrodynamic model coupled with field observations of obstructions (i.e., road embankments, dam embankments, etc.). Two areas were identified as "adequate" (MR Prj-58.9 and Prj-59.6) because they do not have any human features affecting the floodplain and a high percentage of the available floodplain (>80%) is hydrologically connected to the main channel. Four areas were identified as "at risk" (MR Prj-56.0, Prj-56.5, Prj-60.25 and Prj-60.85) because these areas have human features that reduce floodplain connectivity and/or have residential development. Two areas were identified as "unacceptable risk" (MR Prj- 58.6 and Prj-62.4) because they have constrictions (cable tram or highway crossing) that appear to have disconnected their floodplain from the main channel according to results from the 2D hydrodynamic model.

INDICATOR: DYNAMICS

Criteria: The criteria for bank stability/channel migration were agreed upon by the assessment team as a relative condition of the specific indicator.

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Channel	Dynamics	Bank Stability/ Channel Migration	Channel is migrating at or near natural rates.	Limited amount of channel migration is occurring at a faster/slower rate relative to natural rates, but significant change in channel width or planform is not detectable; large woody debris is still being recruited.	Little or no channel migration is occurring because of human actions preventing reworking of the floodplain and large woody debris recruitment; or channel migration is occurring at an accelerated rate such that channel width has a least doubled, possibly resulting in a channel planform change, and sediment supply has noticeably increased from bank erosion.

Data: The following information was gathered during the habitat assessment conducted by the Methow Valley Ranger District for this reach (Appendix C).

Bank Erosion:	RM 54.2-55.0	RM 55.0-56.6	RM 56.6-59.1	RM 59.1-60.0	RM 60.0-61.0
Linear length per mile	405’	1,556’	1,962’	768’	435’
% Eroding banks	4.8%	14.7%	18.6%	7.3%	4.1%

Data: The following information was gathered by Reclamation during the initial site assessments (Appendix B).

Bank Stability/ Channel Migration	**MR Prj-56.0**	**MR Prj-56.5**	**MR Prj-58.6**	**MR Prj-58.9**	**MR Prj-59.6**	**MR Prj-60.25**	**MR Prj-60.85**	**MR Prj-62.4**
Riprap (linear feet)	0	150 ft	0	0	50 ft	0	1350 ft	890 ft
Rootwads (linear feet)	1000 ft	0	0	0	0	0		
Other	Cable tram Residential development	0	Cable tram	0	0	Residential development	Hwy. bridge	Hwy. bridge Road embankment 1200 ft Push-up levee 315 ft

Interpretation:

Bank Stability/ Channel Migration	**MR Prj-56.0**	**MR Prj-56.5**	**MR Prj-58.6**	**MR Prj-58.9**	**MR Prj-59.6**	**MR Prj-60.25**	**MR Prj-60.85**	**MR Prj-62.4**
	At risk condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	At risk condition	At risk condition	At risk condition

Narrative:

The river is dynamic in the Big Valley reach and the recruitment of gravel and large woody debris by lateral channel migration is very important to salmonids that utilize this area for spawning. The assessment team classified four areas as “adequate” (MR Prj-56.5, Prj-58.6, Prj-58.9, and Prj-59.6) because there were no (or very limited) bank protection that would prevent lateral channel migration. Four areas were considered to be “at risk” (MR Prj-56.0, Prj-60.25, Prj-60.85 and Prj-62.4) primarily due to residential development, and the location and protection of transportation infrastructures that limit channel migration.

INDICATOR: DYNAMICS

Criteria: The criteria for bank stability/channel migration were agreed upon by the assessment team as a relative condition of the specific indicator.

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Channel	Dynamics	Vertical Channel Stability	No measurable trend of aggradation or incision and no visible change in channel planform.	Measurable trend of aggradation or incision that has the potential to but not yet caused disconnection of the floodplain or a visible change in channel planform (e.g. single thread to braided).	Enough incision that the floodplain and off-channel habitat areas have been disconnected; or, enough aggradation that a visible change in channel planform has occurred (e.g. single thread to braided).

Data: The following information was gathered during the habitat assessment conducted by the Methow Valley Ranger District for this reach assessment (Appendix C).

Vertical Channel Stability:	**RM 54.2-55.0**	**RM 55.0-56.6**	**RM 56.6-59.1**	**RM 59.1-60.0**	**RM 60.0-61.0**
Bankfull data (main channel):					
Bankfull width	111’	123’	198’	117’	No data
Bankfull depth	3.15’	2.05’	1.85’	2.18’	No data
W/D ratio	35.2	60.0	107.0	53.7	No data
Entrenchment ratio	1.3	>10	>10	>10	No data

Data: The following information was gathered by Reclamation during the initial site assessments (Appendix B).

Bank Protection and Channel Constrictions	**MR Prj-56.0**	**MR Prj-56.5**	**MR Prj-58.6**	**MR Prj-58.9**	**MR Prj-59.6**	**MR Prj-60.25**	**MR Prj-60.85**	**MR Prj-62.4**
Riprap (linear feet)	0	150 ft	0	0	50 ft	0	1350 ft	890 ft
Rootwads (linear feet)	1000 ft	0	0	0	0	0		
Cable tram	1	0	1	0	0	0	0	0
Highway bridge	0	0	0	0	0	0	1	1

Data: The following information is from the results of the 2D hydrodynamic model (Appendix D).

Vertical Channel Stability:	**RM 55.0-56.5**	**RM 56.5-59.5**	**RM 59.5-60.5**	**RM 60.5-62.0**	**RM 62.0-63.0**	**RM 63.0-65.0**
Channel slope:	0.0041	0.0041	0.0040	0.0043	0.0043	0.0049
Avg. velocity @ 5935 cfs (2-yr event)	~5.5 cfs	~4.4 cfs	~4.5 cfs	~5.8 cfs	~4.6 cfs	~5.0 cfs
Incipient motion @ 5935 cfs (S: Shield's method; M: Meyer-Peter, Muller)	RM 55.5 S: 50 mm M: 76 mm RM 56.25 S: 28 mm M: 43 mm	RM 57 S: 26 mm M: 39 mm RM 57.5 S: 17 mm M: 26 mm RM 57.75 S: 29 mm M: 45 mm RM 58.75 S: 63 mm M: 101 mm	RM 59.75 S: 34 mm M: 52 mm RM 60.25 S: 32 mm M: 50 mm	RM 60.75 S: 28 mm M: 43 mm RM 61.75 S: 33 mm M: 53 mm	RM 62.0 S: 33 mm M: 52 mm RM 62.25 S: 27 mm M: 44 mm	No data.
Gradation (sieve data) D15: D35:	RM 56.0 D15: 36.41mm	RM 57.0 D15: 21.83 mm	RM 60.0 D15: 42.97 mm	RM 61.0-62.0 D15:16.20 mm	No data.	No data.

Vertical Channel Stability:	**RM 55.0-56.5**	**RM 56.5-59.5**	**RM 59.5-60.5**	**RM 60.5-62.0**	**RM 62.0-63.0**	**RM 63.0-65.0**
D50: D84: D95	D35: 70.71 mm D50: 82.94 mm D84: 124.64 mm D95: 159.15 mm	D35: 35.00 mm D50: 45.80 mm D84: 100.03 mm D95: 151.79 mm	D35: 63.17 mm D50: 75.23 mm D84: 114.95 mm D95: 145.49 mm	D35: 39.16 mm D50: 70.70 mm D84: 140.51 mm D95: 166.59 mm		

Interpretation:

Vertical Channel Stability	**MR Prj-56.0**	**MR Prj-56.5**	**MR Prj-58.6**	**MR Prj-58.9**	**MR Prj-59.6**	**MR Prj-60.25**	**MR Prj-60.85**	**MR Prj-62.4**
	Adequate condition	Adequate condition	At risk condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	At risk condition

Narrative:

Five areas (MR Prj-56.0, Prj-56.5, Prj-58.9, Prj-59.6 and Prj-60.85) are interpreted to be "adequate" because incipient motion calculations did not indicate scour and sediment gradation analysis in conjunction with field observations did not indicate any unnatural armoring or channel incision/aggradation. Three areas are interpreted to be "at risk" because incipient motion calculations suggest potential scour of the river bed and sediment gradation analysis in conjunction with field observations suggest armoring of the channel bed most likely due to river constrictions (cable tram and highway bridge).

PATHWAY: RIPARIAN VEGETATION

INDICATOR: CONDITION

Criteria: The criteria for riparian vegetation structure were agreed upon by the assessment team as a "relative" indication to the functionality of the specific indicator.

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Riparian Vegetation	Condition	Structure	>80% species composition, seral stage, and structural complexity are consistent with potential native community.	50-80% species composition, seral stage, and structural complexity are consistent with potential native community.	<50% species composition, seral stage, and structural complexity are consistent with potential native community.

Data: The following riparian buffer zone information was computed utilizing the geographic information system (GIS) vegetation mapping from the *Geomorphic Assessment.*

Riparian Structure:	MR Prj-56.0	MR Prj-56.5	MR Prj-58.6	MR Prj-58.9	MR Prj-59.6	MR Prj-60.25	MR Prj-60.85	MR Prj-62.4
Agriculture	0.03%	8.51%	0.08%	0%	5.31%	3.99%	0.32%	14.12%
Residential	9.51%	0%	0%	0%	1.14%	7.02%	1.13%	3.03%
Road (Hwy 20)	0%	0%	0%	0%	0%	0%	0.52%	2.45%
River channel	5.42%	5.42%	9.58%	2.48%	10.62%	5.70%	7.88%	6.94%
Black Cottonwood	16.72%	9.24%	3.53%	0%	7.25%	7.67%	41.35%	18.31%
Black Cottonwood w/ mixed coniferous/deciduous	0%	0%	0%	0%	3.04%	0%	0.96%	15.60%
Black Cottonwood w/ mixed shrubs	4.21%	0%	0.05%	0%	0%	0%	0%	0%
Bars w/forbs or no vegetation	5.83%	6.13%	9.37%	12.68%	26.02%	7.35%	7.46%	8.00%
Upland forest	17.42%	0%	0.11%	1.06%	0.19%	0.70%	19.73%	0%
Shrub steppe	2.40%	0%	0%	0%	0%	0%	0%	0%
Mixed coniferous/deciduous	31.23%	32.99%	40.30%	43.10%	14.60%	63.06%	7.75%	27.43%
Bars w/deciduous shrubs	3.28%	2.09%	4.10%	0%	4.18%	2.10%	1.46%	0%

Riparian Structure:	MR Prj-56.0	MR Prj-56.5	MR Prj-58.6	MR Prj-58.9	MR Prj-59.6	MR Prj-60.25	MR Prj-60.85	MR Prj-62.4
Mixed deciduous shrubs (not bar)	0.49%	28.69%	32.31%	36.57%	20.37%	2.40%	6.63%	3.18%
Wetlands (other than river)	0%	6.94%	0.58%	4.10%	5.43%	0%	1.86%	0.23%
Quaking Aspen	0%	0%	0%	0%	1.85%	0%	2.94%	0.72%
Percent Natural Structure: (total composition less agriculture, residential and roads)	90%	91%	99%	100%	94%	89%	98%	80%

Interpretation:

Structure	MR Prj-56.0	MR Prj-56.5	MR Prj-58.6	MR Prj-58.9	MR Prj-59.6	MR Prj-60.25	MR Prj-60.85	MR Prj-62.4
	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	At risk condition

Narrative:

Based on structure computations (total composition minus human disturbances) five areas are interpreted to be in an “adequate” condition (MR Prj-56.0, Prj-56.5, Prj-58.6, Prj-58.9, Prj-59.6, Prj-60.25, and Prj-60.85) because less than 20% of the areas have been disturbed for residential development, agriculture and roads. One area is interpreted to be in an “at risk” condition (MR 62.4) because 20% of the area has been disturbed for residential development, agriculture and roads. None of the areas were interpreted to be in an “unacceptable risk” condition.

INDICATOR: CONDITION

Criteria: The criteria for riparian vegetation disturbance were agreed upon by the assessment team as a "relative" indication to the functionality of the specific indicator.

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Riparian Vegetation	Condition	Disturbance (Human)	>80% mature trees (medium-large) in the riparian buffer zone (defined as a 30 m belt along each bank) that are available for recruitment by the river via channel migration; <20% disturbance in the floodplain (e.g., agriculture, residential, roads, etc.); <2 mi/mi^2 road density in the floodplain.	50-80% mature trees (medium-large) in the riparian buffer zone (defined as a 30 m belt along each bank) that are available for recruitment by the river via channel migration; 20-50% disturbance in the floodplain (e.g., agriculture, residential, roads, etc.); 2-3 mi/mi^2 road density in the floodplain.	<50% mature trees (medium-large) in the riparian buffer zone (defined as a 30 m belt along each bank) that are available for recruitment by the river via channel migration; >50% disturbance in the floodplain (e.g., agriculture, residential, roads, etc.); >3 mi/mi^2 road density in the floodplain.

Data: The following riparian buffer zone information was computed utilizing the geographic information system (GIS) vegetation mapping from the *Geomorphic Assessment*.

Riparian Disturbance	MR Prj-56.0	MR Prj-56.5	MR Prj-58.6	MR Prj-58.9	MR Prj-59.6	MR Prj-60.25	MR Prj-60.85	MR Prj-62.4
Riparian Buffer (~30 m width):								
Agriculture	14%	4%	0%	0%	0%	0%	48%	10%
Residential	19%	0%	0%	0%	0%	2%	0%	1%
Roads	0%	0%	0%	0%	0%	0%	5%	1%
Black Cottonwood	1%	15%	10%	0%	0%	0%	32%	35%
Bars w/forbs or no vegetation	3%	1%	13%	3%	0%	0%	0%	11%
Upland forest	25%	0%	5%	0%	5%	12%	0%	0%

Riparian Disturbance	**MR Prj-56.0**	**MR Prj-56.5**	**MR Prj-58.6**	**MR Prj-58.9**	**MR Prj-59.6**	**MR Prj-60.25**	**MR Prj-60.85**	**MR Prj-62.4**
Mixed coniferous/deciduous	38%	66%	30%	83%	55%	83%	8%	29%
Bars w/deciduous shrubs	0%	5%	1%	0%	0%	3%	1%	0%
Mixed deciduous shrubs (not bar)	0%	9%	40%	10%	23%	0%	2%	1%
Wetlands (other than river)	0%	0%	1%	4%	3%	0%	3%	12%
Quaking Aspen	0%	0%	0%	0%	14%	0%	1%	0%
Percent Medium-Large Wood Available in Riparian Buffer:	64%	81%	45%	83%	74%	96%	41%	65%

Data: The following riparian disturbance information was computed utilizing the geographic information system (GIS) vegetation mapping from the *Geomorphic Assessment* and road mapping in GIS during the initial site assessments (Appendix B).

Riparian Disturbance:								
Agriculture	0.03%	8.51%	0.08%	0%	5.31%	3.99%	0.32%	14.12%
Residential	9.51%	0%	0%	0%	1.14%	7.02%	1.13%	3.03%
Road (Hwy 20)	0%	0%	0%	0%	0%	0%	0.52%	2.45%
River channel	5.42%	5.42%	9.58%	2.48%	10.62%	5.70%	7.88%	6.94%
Black Cottonwood	16.72%	9.24%	3.53%	0%	7.25%	7.67%	41.35%	18.31%
Black Cottonwood w/ mixed coniferous/deciduous	0%	0%	0%	0%	3.04%	0%	0.96%	15.60%
Black Cottonwood w/ mixed shrubs	4.21%	0%	0.05%	0%	0%	0%		0%
Bars w/forbs or no vegetation	5.83%	6.13%	9.37%	12.68%	26.02%	7.35%	7.46%	8.00%
Upland forest	17.42%	0%	0.11%	1.06%	0.19%	0.70%	19.73%	0%
Shrub steppe	2.40%	0%	0%	0%	0%	0%	0%	0%
Mixed coniferous/deciduous	31.23%	32.99%	40.30%	43.10%	14.60%	63.06%	7.75%	27.43%
Bars w/deciduous shrubs	3.28%	2.09%	4.10%	0%	4.18%	2.10%	1.46%	0%
Mixed deciduous shrubs (not bar)	0.49%	28.69%	32.31%	36.57%	20.37%	2.40%	6.63%	3.18%
Wetlands (other than	0%	6.94%	0.58%	4.10%	5.43%	0%	1.86%	0.23%

Riparian Disturbance:								
river)								
Quaking Aspen	0%	0%	0%	0%	1.85%	0%	2.94%	0.72%
Percent Floodplain Disturbance: (agriculture, residential, road)	9.54%	8.51%	0.08%	0%	6.45%	11.01%	1.97%	19.60%
Road Density in Floodplain:	1.86 mi/ 0.32 mi^2 (5.81 mi/mi^2)	2.17 mi/ 0.34 mi^2 (6.38 mi/mi^2)	1.50 mi/ 0.49 mi^2 (3.06 mi/mi^2)	0 mi/ 0.12 mi^2 (0.00 mi/mi^2)	0 mi/ 0.19 mi^2 (0.00 mi/mi^2)	1.41 mi/ 0.31 mi^2 (4.55 mi/mi^2)	0.42 mi/ 0.15 mi^2 (2.80 mi/mi^2)	0.99 mi/ 0.34 mi^2 (2.91 mi/mi^2)

Data: Road locations in floodplain obtained from the Methow Valley Ranger District stream survey crew (information received from D. Hopkins, Methow Valley Ranger District).

River Mileage	Road Number	River Bank	Road Effects
56.0-56.8	Highway 20	North	River is naturally constricted here. Potential sediment delivery and input of road chemicals may impact river.
62.6-62.8	County 1131	South	Riprap placed to protect road. The riprap is constraining the channel, possibly preventing migration to the north side of the floodplain.
63.3-64.6	County 1163	North	Riprap placed to protect bridge has constrained the channel preventing channel migration.
67.6-68.2	Highway 20	South	Riprap placed to protect road and houses is preventing channel migration.

Interpretation:

Disturbance	MR Prj-56.0	MR Prj-56.5	MR Prj-58.6	MR Prj-58.9	MR Prj-59.6	MR Prj-60.25	MR Prj-60.85	MR Prj-62.4
Riparian Buffer:	At risk condition	Adequate condition	Unacceptable risk condition	Adequate condition	At risk condition	Adequate condition	Unacceptable risk condition	At risk condition
Floodplain Disturbance:	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition	Adequate condition
Road Density in Floodplain:	Unacceptable risk condition	Unacceptable risk condition	Unacceptable risk condition	Adequate condition	Adequate condition	Adequate condition	At risk condition	At risk condition
Diagnosis:	At risk condition	At risk condition	At risk condition	Adequate condition	Adequate condition	At risk condition	At risk condition	At risk condition

Narrative:

Further analysis of the vegetation mapping completed during the *Geomorphic Assessment* and the road mapping completed during the initial site assessments (Appendix B) suggest the following: two areas are “adequate” (MR Prj-58.9 and Prj-59.6) and should be considered for protection; six areas are “at risk” (MR Prj-56.0, Prj-56.5, Prj-58.6, Prj-60.25, Prj-60.85, and Prj-62.4); and no areas are at “unacceptable risk” . This interpretation is based on the presence of a riparian buffer, percentage of floodplain disturbance, and the road density within the floodplain areas.

INDICATOR: CONDITION

Criteria: The criteria for riparian vegetation canopy cover were agreed upon by the assessment team as a "relative" indication to the functionality of the specific indicator.

Pathway	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Risk Condition
Riparian Vegetation	Condition	Canopy Cover	Trees and shrubs within one site potential tree height distance have >80% canopy cover that provides thermal shading to the river.	Trees and shrubs within one site potential tree height distance have 50-80% canopy cover that provides thermal shading to the river.	Trees and shrubs within one site potential tree height distance have <50% canopy cover that provides thermal shading to the river.

Data: The following riparian buffer zone information was computed utilizing the geographic information system (GIS) vegetation mapping from the *Geomorphic Assessment*. The percent large available wood in riparian buffer is used as a surrogate to interpret the percent canopy cover by mature trees.

Canopy Cover	**MR Prj-56.0/56.35 /56.8**	**MR Prj-56.5**	**MR Prj-58.6**	**MR Prj-58.9**	**MR Prj-59.6/60.5**	**MR Prj-60.25**	**MR Prj-60.85**	**MR Prj-62.4**
Percent Medium-Large Wood Available in Riparian Buffer:	64%	81%	45%	83%	74%	96%	41%	65%

Interpretation:

Canopy Cover	**MR Prj-56.0**	**MR Prj-56.5**	**MR Prj-58.6**	**MR Prj-58.9**	**MR Prj-59.6**	**MR Prj-60.25**	**MR Prj-60.85**	**MR Prj-62.4**
	At risk condition	Adequate condition	Unacceptable risk condition	Adequate condition	At risk condition	Adequate condition	Unacceptable risk condition	At risk condition

Narrative:

Based on the vegetation mapping completed during the *Geomorphic Assessment* and using the percent medium-large wood available in the riparian buffer as a surrogate, the riparian canopy cover is "adequate" in MR Prj-56.5, Prj-58.9, and Prj-60.25; "at risk" in MR Prj-56.0, Prj-59.6 and Prj-62.4; and at "unacceptable risk" in MR Prj-58.6 and Prj-60.85.

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Appendix B

Initial Site Assessments

This appendix provides results for the initial site assessments for each project area within the Big Valley reach assessment area in 2006. The purpose of this information is to evaluate the functionality of each project area and provide photographic documentation of primary features.

METHOW SUBBASIN, WASHINGTON
Big Valley Initial Site Assessment
Project Area MR Prj – 56.0

Personnel: PNRO geologists E. Lyon and R. McAffee

Purpose: Photographic documentation of baseline conditions and geologic mapping of anthropogenic features associated with floodplain connectivity.

Observations:

- During the 2006 spring freshet fairly severe bank erosion occurred along river right and in some of the side channels (Photograph Nos. 9, 13, 17, 31, 41, 45-47, 49-51, and 57-58).
- About 1000 linear feet of rootwads and cabled logs were placed to reduce bank erosion (Photograph Nos. 6-8, 10, 11, 16, 53, and 54).
- A cable tram with riprap protecting the right abutment is located at about RM 56.9 (Photograph Nos. 36 and 37).
- There are four ford road crossings in the floodplain.
- There are eleven road embankment crossings in the floodplain (Photograph Nos. 3, 4, 5, 28, 29, and 48).
- There is one footbridge crossing an overflow channel.
- There is one bridge crossing an overflow channel.
- There is a headgate along a decommissioned irrigation ditch (Photograph No. 44).
- There are numerous side channels and overflow channels that are still functioning and are being utilized by the salmonids for spawning, rearing and high water refugia (Photograph Nos. 1, 2, 14, 18-27, 30, 32-35, 39, 40, 42, 43, 52, 55, and 56).
- An active slide area along river right provides sediment to the system during high flows (Photograph No. 38).
- The river avulsed during the 2006 spring freshet and abandoned its historic channel path (Photograph Nos. 12 and 15).

Summary Table: Features used in the Reach-based Ecosystem Indicators (REI)

Pathway:	**Indicator:**	**Features:**
Habitat Access	Physical Barriers (Mainstem)	None
Habitat Elements	Wetlands	0 Acres
	Off-Channel Habitat	Side Channels & Overflow Channels
	Refugia	Side Channels & Overflow Channels
Channel Condition & Floodplain Dynamics	Floodplain Connectivity (Potential Physical Barriers)	1 Cable Tram 4 Ford Crossings 11 Road Embankments 1 Footbridge 1 Road Bridge 1000 ft. Rootwads
Watershed Conditions	Road Density & Location (Floodplain)	1.86mi/0.32mi^2
	Riparian Corridor	70% Meets Criteria (Visual Estimate)
	Protection Areas	87 Acres
	Total Area	203 Acres

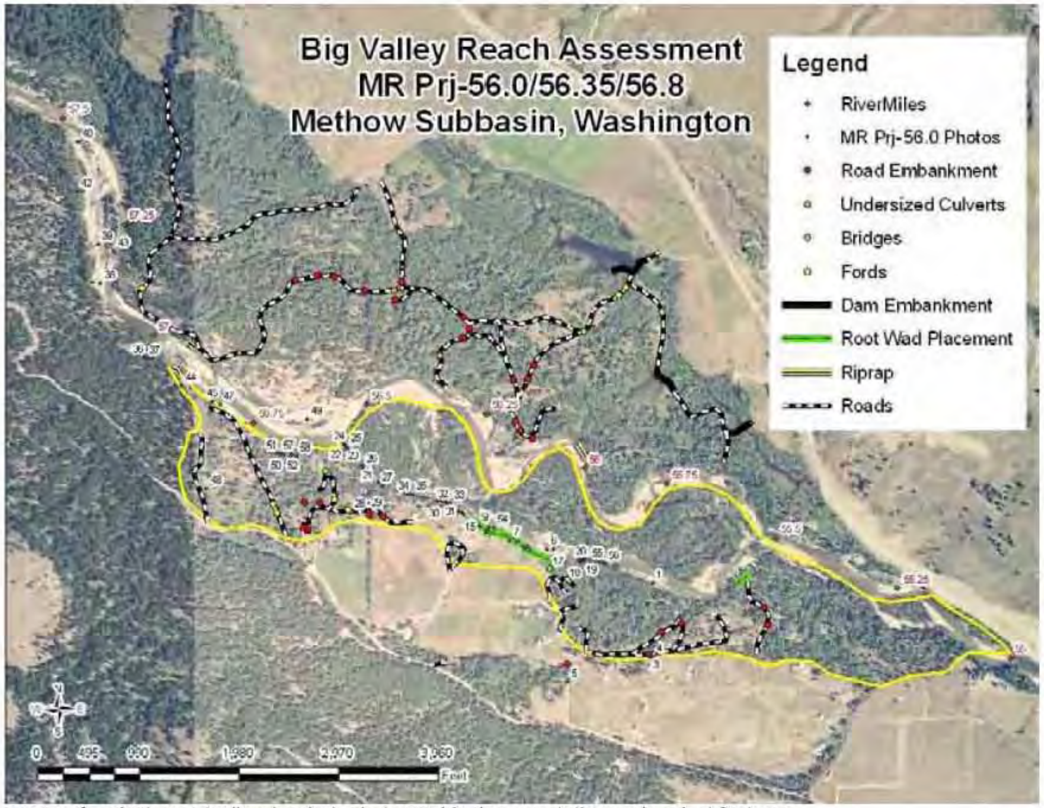

Figure 1. Location map of project area (yellow border), photographic documentation and project features.

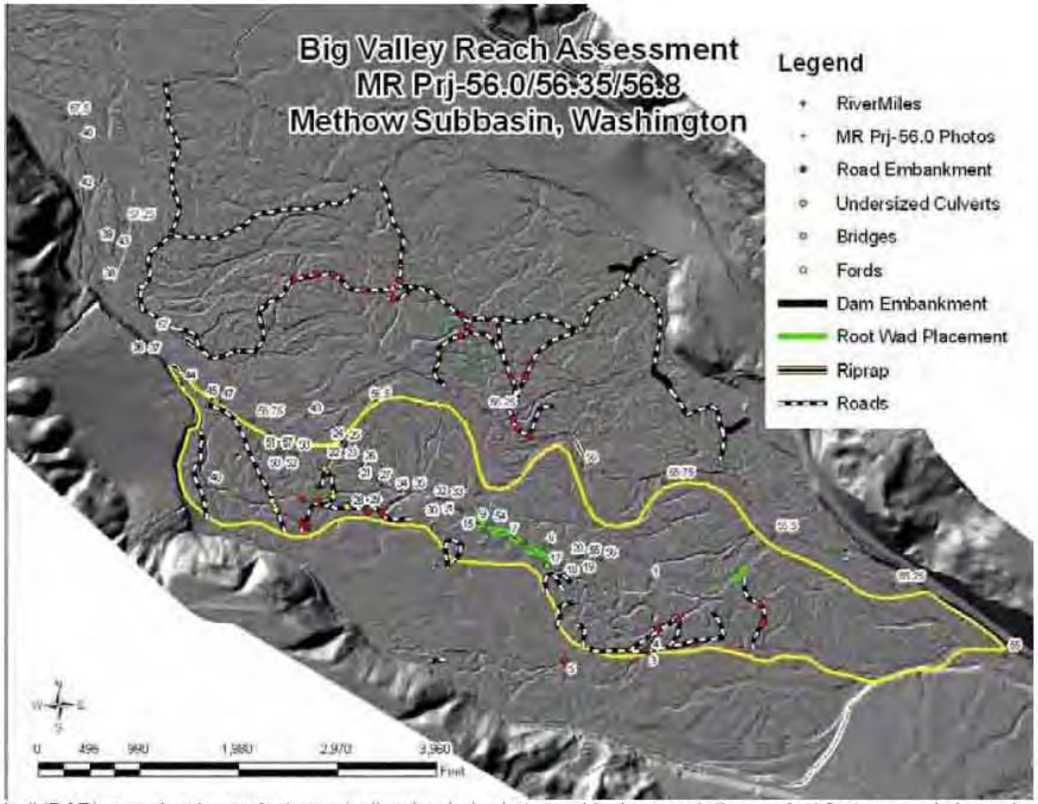

Figure 2. Hillshade (LiDAR) map showing project area (yellow border), photographic documentation, project features and channel paths.

Photographic Documentation

Photograph No. 1. View is the northwest looking upstream along a side channel that has a logjam at the head of the channel. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 17, 2006.**

Photograph No. 2. View is to the west looking upstream along overflow channel in the floodplain. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 17, 2006.**

Photograph No. 3. View is to the northeast looking at a road embankment crossing an overflow channel in the floodplain. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 17, 2006.**

Photograph No. 4. View is to the southwest looking upstream along an overflow channel with a road embankment crossing (refer to Photograph No. 3). **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 17, 2006.**

Photograph No. 5. View is to the east looking at a channel swale with a road embankment crossing. The swale could be a historic tributary channel or overflow channel. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 17, 2006.**

Photograph No. 6. View is to the southeast looking downstream along river right where cabled logs and rootwads have been installed for bank protection. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 14, 2006.**

Photograph No. 7. View is to the southeast looking downstream along river right where cabled logs and rootwads have been installed for bank protection. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 14, 2006.**

Photograph No. 8. View is to the northwest looking upstream along river right where cabled logs and rootwads have been installed for bank protection. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 14, 2006.**

Photograph No. 9. View is to the southwest looking at the riverbank along river right showing the thick flood deposits comprised of silty sand. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 14, 2006.**

Photograph No. 10. View is to the northeast looking at cabled logs installed for bank protection along river right. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 14, 2006.**

Photograph No. 11. View is to the southeast looking downstream along river right where cabled logs and rootwads have been installed for bank protection. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 14, 2006.**

Photograph No. 12. View is to the north looking upstream where the river has avulsed. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 14, 2006.**

Photograph No. 13. View is to the southeast looking downstream along river right where severe erosion occurred during the 2006 spring freshet. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 14, 2006.**

Photograph No. 14. View is to the northwest looking upstream along river right at active side channel that has a channel spanning log jam at its head. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 14, 2006.**

Photograph No. 15. View is to the north looking upstream from river right where the river has avulsed. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 14, 2006.**

Photograph No. 16. View is to the southeast looking at cabled log anchors along river right. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 14, 2006.**

Photograph No. 17. View is to the east looking downstream along river right below the cabled logs and rootwads where severe erosion occurred during 2006 spring freshet. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 14, 2006.**

Photograph No. 18. View is to the east looking downstream along river right where large woody debris has accumulated at the head of an overflow channel. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 14, 2006.**

Photograph No. 19. View is to the south looking downstream from the head of an overflow channel that has large woody debris accumulated at head of overflow channel (Photograph No. 18). **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 14, 2006.**

Photograph No. 20. View is to the west looking upstream along river right below the large woody debris accumulation at head of overflow channel (Photograph No. 18). Note the accumulation of sediment downstream of large woody debris that moved during the 2006 spring freshet. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 14, 2006.**

Photograph No. 21. View is to the southeast looking downstream along a side channel where erosion occurred during the 2006 spring freshet. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 19, 2006.**

Photograph No. 22. View is to the northeast looking across a logjam at the head of an active side channel. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 19, 2006.**

Photograph No. 23. View is to the northwest looking upstream along an overflow channel that appears to have been accessed during the 2006 spring freshet. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 19, 2006.**

Photograph No. 24. View is to the northeast looking across an overflow channel near the logjam in Photograph No. 22. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 19, 2006.**

Photograph No. 25. View is to the southeast looking downstream along a side channel below the logjam in Photograph No. 22. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 19, 2006.**

Photograph No. 26. View is to the northwest looking upstream at bank erosion that occurred during the 2006 spring freshet along the side channel. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 19, 2006.**

Photograph No. 27. View is to the southeast looking downstream along the side channel where fairly severe erosion occurred during the 2006 spring freshet along river right. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 19, 2006.**

Photograph No. 28. View is to the northeast looking at an overflow channel that has been disconnected by a road embankment. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 19, 2006.**

Photograph No. 29. View is to the west looking at an overflow channel that has been disconnected by a road embankment. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 19, 2006.**

Photograph No. 30. View is to the north looking across the side channel at an overflow channel that was accessed during 2006 spring freshet. Salmon were observed spawning in this section of the side channel. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 19, 2006.**

Photograph No. 31. View is to the southeast looking downstream at an eroded bank along river right. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 19, 2006.**

Photograph No. 32. View is to the southeast looking downstream toward confluence of side channel and mainstem along gravel bar on river right. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 19, 2006.**

Photograph No. 33. View is to the north looking across the side channel from river right toward secondary side channel. Salmon were observed spawning in this section of the side channel. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 19, 2006.**

Photograph No. 34. View is to the southeast looking downstream along side channel toward confluence with mainstem on river right. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 19, 2006.**

Photograph No. 35. View of salmon utilizing side channel for spawning. Note dorsal fin in the center of photograph. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 19, 2006.**

Photograph No. 36. View is to the southeast looking downstream along river right where a cable tram crosses the river. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.**

Photograph No. 37. View is to the southeast looking downstream along river right where cable tram is located. Note riprap protecting the right abutment of the cable tram. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.**

Photograph No. 38. View is to the south looking downstream along river right where a slide area was re-activated during the 2006 spring freshet. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.**

Photograph No. 39. View is to the south looking downstream along side channel on river right near its confluence with the mainstem. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.**

Photograph No. 40. View is to the south looking downstream along side channel on river right near its head. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.**

Photograph No. 41. View is to the southeast looking downstream along river right where the bank experienced some relatively severe erosion during the 2006 spring freshet. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.**

Photograph No. 42. View is to the south looking downstream along an overflow channel along river right where overbank flows accessed the channel during the 2006 spring freshet. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.**

Photograph No. 43. View is to the east looking across the river to the left bank a historic channel flowed and created an oxbow. The bank height is about 3 feet. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.**

Photograph No. 44. View of a headgate near the cable tram on river right. Irrigation ditch appears to have been decommissioned. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.**

Photograph No. 45. View is to the southeast looking downstream along river right where severe bank erosion occurred during the 2006 spring freshet. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.**

Photograph No. 46. View is to the east looking downstream along river right where severe bank erosion occurred during the 2006 spring freshet. Note the well casing along the active channel. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.**

Photograph No. 47. View is to the southeast looking downstream along river right where a large conifer fell into the river. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.**

Photograph No. 48. View is to the southeast looking downstream along an irrigation ditch(?) that is believed to head near the cable tram. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.**

Photograph No. 49. View is to the southeast looking downstream from river left at the severe bank erosion that occurred during the 2006 spring freshet. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 16, 2006.**

Photograph No. 50. View is to the northwest looking upstream from river right at abandoned well and eroded bank. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 20, 2006.**

Photograph No. 51. View is to the northwest looking upstream along river right at abandoned well and eroded bank. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 20, 2006.**

Photograph No. 52. View is to the east looking downstream from river right at logjam at head of side channel. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 20, 2006.**

Photograph No. 53. View is to the southeast looking downstream during the November 8, 2006 rain event along river right at rootwads placed during the 2006 spring freshet. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, November 8, 2006.**

Photograph No. 54. View is to the northwest looking upstream during the November 8, 2006 rain event along river right at rootwads placed during the 2006 spring freshet. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, November 8, 2006.**

Photograph No. 55. View is to the north looking upstream along a side channel that was accessed during the November 8, 2006 rain event along river right. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, November 8, 2006.**

Photograph No. 56. View is to the southeast looking downstream along a side channel that was accessed during the November 8, 2006 rain event along river right. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, November 8, 2006.**

Photograph No. 57. View is to the southeast looking downstream along river right during the November 8, 2006 rain event. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, November 8, 2006.**

Photograph No. 58. View is to the east looking downstream along river right during the November 8, 2006 rain event. **MR Prj_56.0 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, November 8, 2006.**

METHOW SUBBASIN, WASHINGTON
Big Valley Initial Site Assessment
Project Area MR Prj – 56.5

Personnel: PNRO geologists E. Lyon and R. McAffee

Purpose: Photographic documentation of baseline conditions and geologic mapping of anthropogenic features associated with floodplain connectivity.

Observations:

- Three embankment dams were observed that impound a groundwater charged wetland complex (Photograph Nos. 1, 3 and 4). These embankment dams appear to be fish passage barriers into the wetland complex.
- Ten road embankments bisect overflow channels disconnecting them from the wetland complex (Photograph Nos. 30-32 and 40-42).
- Two fords and one bridge cross outlet channels connecting the wetland complex (Photograph Nos. 5 through 7).
- One house (abandoned?) is located within the floodplain (Photograph No. 29).
- One culvert of sufficient size was observed at a road crossing (Photograph No. 9).
- About 150 linear feet of riprap was noted along river left (Photograph Nos. 26, 27 and 37).
- The wetland complex could provide excellent rearing habitat and high water refugia (Photograph Nos. 2, 8, 10 and 11). However, the wetland complex has resident brook trout and consideration will have to be given to remove or eradicate them.
- There are numerous beaver dams within the wetland complex and primary outlet channel (Photograph Nos. 13-14, 16 and 19-25). Some of these dams appear to be partial fish passage barriers.
- The mainstem of the Methow River is very active in this reach. Lateral channel migration provides spawning gravels and large woody debris to the system (Photograph Nos. 33 through 36).

Summary Table: Features used in the Reach-based Ecosystem Indicators (REI)

Pathway:	Indicator:	Features:
Habitat Access	Physical Barriers (Mainstem)	None
Habitat Elements	Wetlands	26 Acres
	Off-Channel Habitat	Side-Channels & Overflow Channels
	Refugia	~70% Wetlands Not Accessible (Visual Estimate)
Channel Condition & Floodplain Dynamics	Floodplain Connectivity (Potential Physical Barriers)	3 Embankment Dams 10 Road Embankments 2 Ford Crossings 1 Culvert 150' Riprap 1 Abandoned House
Watershed Conditions	Road Density & Location (Floodplain)	2.17mi/0.34mi^2
	Riparian Corridor	95% Meet Criteria (Visual Estimate)
	Protection/Restoration Area	219 Acres
	Total Area	219 Acres

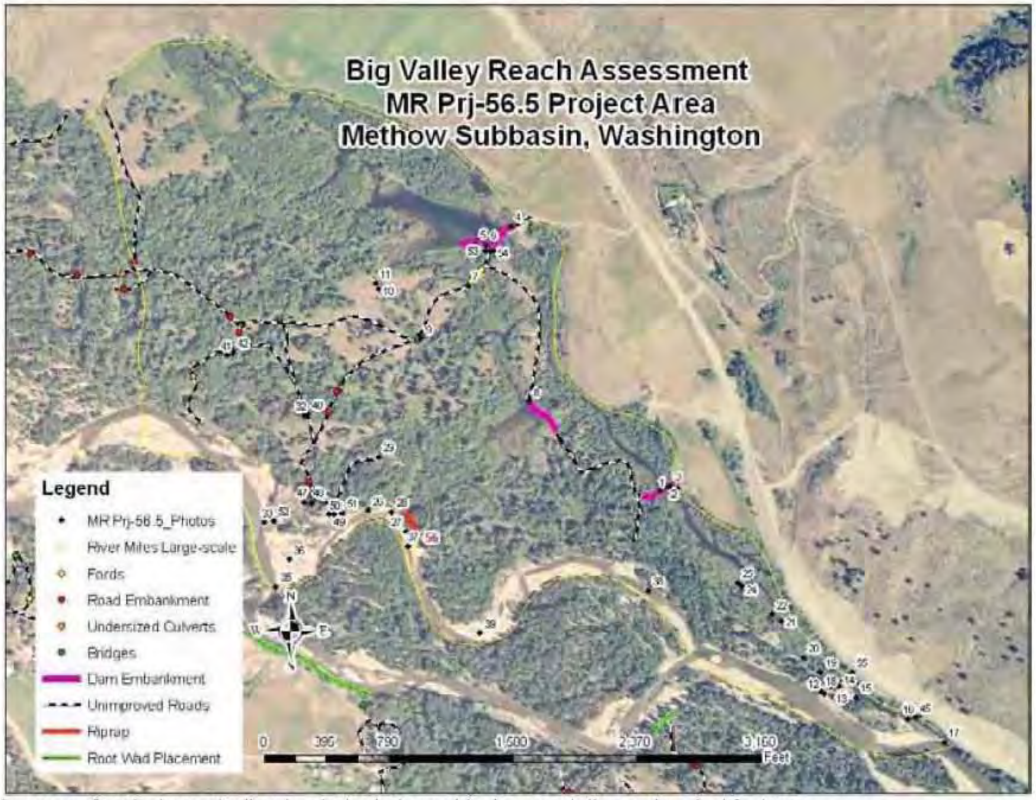

Figure 1. Location map of project area (yellow border), photographic documentation and project features.

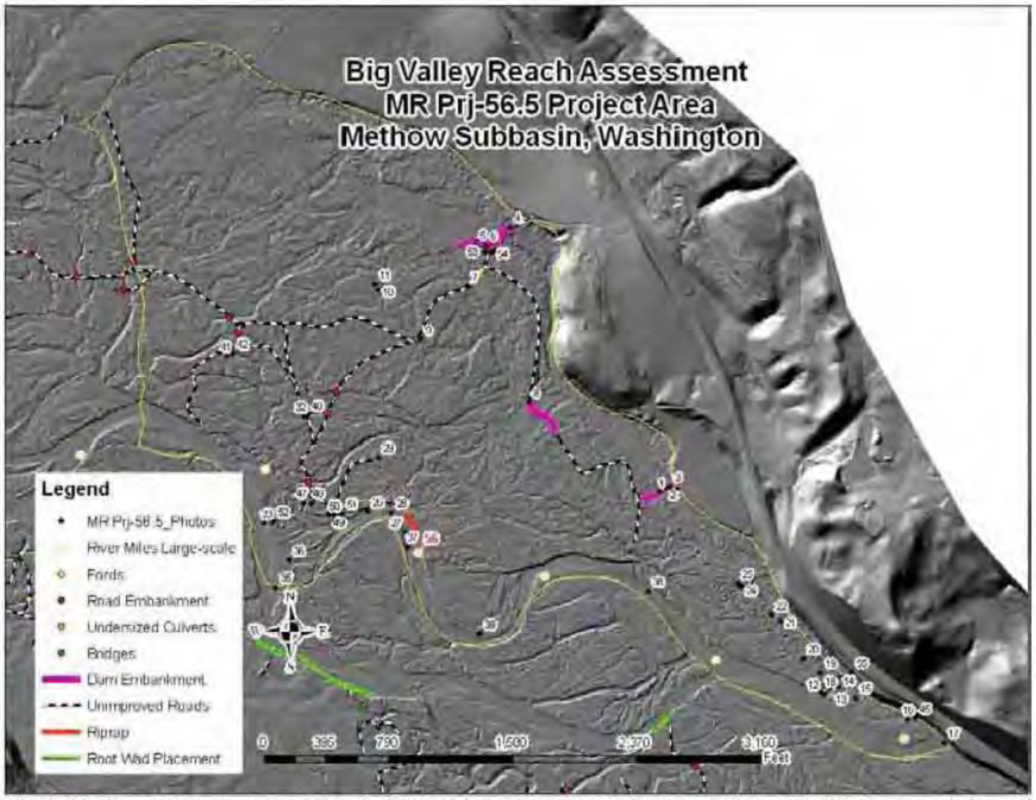

Figure 2. Hillshade (LiDAR) map showing project area (yellow border), photographic documentation, project features and channel paths.

Photographic Documentation

Photograph No. 1. View is to the west looking across embankment dam that has a culvert as its primary outlet and dual culverts as emergency spillways. This dam was breached at the dual culverts during the 2006 spring freshet on the west side. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 15, 2006.**

Photograph No. 2. View is to the southeast looking downstream from embankment dam in Photograph No. 1. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 15, 2006.**

Photograph No. 3. View of breach in embankment dam that had dual culverts for an emergency spillway. The breach occurred during the 2006 spring freshet. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 15, 2006.**

Photograph No. 4. View is to the north looking along embankment dam that has an elevated culvert as its outlet to maintain pond's water level. No emergency spillway was observed. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 15, 2006.**

Photograph No. 5. View is to the northwest looking at an overflow channel from pond crossing road. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 15, 2006.**

Photograph No. 6. View is to the northwest looking at a ford crossing an overflow channel flowing from pond. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 15, 2006.**

Photograph No. 7. View is to the north looking upstream at a bridge over the pond's outlet channel. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 15, 2006.**

Photograph No. 8. View is to the northwest looking across pond from embankment dam. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 15, 2006.**

Photograph No. 9. View is to the southwest looking at a road crossing with culvert at overflow channel. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 15, 2006.**

Photograph No. 10. View is to the northwest looking upstream at a small beaver dam impeding overflow channel from pond. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 15, 2006.**

Photograph No. 11. View is to the north looking across pond impounded by embankment dam with overflow channels impeded by beaver dams. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 15, 2006.**

Photograph No. 12. View is to the east looking downstream at an apex log jam that separates the river from a side channel. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 13. View is to the northwest looking upstream along a side channel at a beaver dam that could be a potential fish passage barrier to wetland complex. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 14. View is to the east looking downstream at beaver dam that could be a potential fish passage barrier along side channel to beaver pond complex. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 15. View is to the southeast looking downstream along a side channel. Juvenile salmonids were observed in the side channel. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 16. View is to the north looking upstream at dam along side channel. Dam was most likely breached during 2006 spring freshet. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 17. View is to the northwest looking upstream along side channel at trail crossing. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 18. View is to the north looking downstream at head of side channel where flows are diverted into the side channel by an apex log jam. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 19. View is to the north looking downstream at beaver dam that appears to be a potential fish passage barrier. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 20. View is to the northeast looking downstream at pond impounded by a beaver dam. The beaver dam appears to be a potential fish passage barrier. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 21. View is to the northeast looking downstream at a pond impounded by a beaver dam. The beaver dam appears to be a potential fish passage barrier. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 22. View is to the northwest looking upstream into a complex of beaver ponds and dams. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 23. View is to the east looking downstream at a pond impounded by a beaver dam. The beaver dam appears to be a potential fish passage barrier. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 24. View is to the northeast looking downstream at a pond impounded by a beaver dam. The beaver dam appears to be a potential fish passage barrier. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 25. View is to the north looking across a pond impounded by a beaver dam. The beaver dam appears to be a potential fish passage barrier. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 26. View is to the southeast looking downstream at riprap placed along river left. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 27. View is to the southeast looking downstream at riprap placed along river left. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 28. View is to the northeast looking at the mouth of an outlet from the wetlands complex entering the river along river left. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 29. View is to the northeast looking a structure found within the river's floodplain. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 30. View is to the west looking upstream along an overflow channel entering the floodplain that is disconnected by a road embankment. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 31. View is to the north looking at road embankment that disconnects an overflow channel. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 32. View is to the northwest looking at an overflow channel that is disconnected by a road embankment. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

Photograph No. 33. View is to the northwest looking upstream at an area where the channel has avulsed. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 34. View is to the south looking downstream where channel has avulsed. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 35. View is to the south looking downstream at structure along river right where channel has avulsed. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 36. View is to the northeast looking downstream at a channel path that is being abandoned by the river except during high flows. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 37. View is to the northwest looking upstream at riprap placed along river left. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 38. View is to the southwest looking downstream toward confluence of abandoned channel and the active channel. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 39. View is to the west looking across at an overflow channel along river right. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 40. View is to the northwest looking at an overflow channel that is disconnected by a road embankment (same as in Photograph No. 32). **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 41. View is to the northwest looking at an overflow channel that is disconnected by a road embankment. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 42. View is to the west looking at a road embankment that disconnects an overflow channel as viewed in Photograph No. 41. **MR Prj_56.5 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, August 16, 2006.**

METHOW SUBBASIN, WASHINGTON
Big Valley Initial Site Assessment
Project Area MR Prj – 58.6

Personnel: PNRO geologists E. Lyon and R. McAffee

Purpose: Photographic documentation of baseline conditions and geologic mapping of anthropogenic features associated with floodplain connectivity.

Observations:

- Six road embankments bisect overflow channels and disconnect flows from accessing the floodplain (Photograph Nos. 3, 4, 7-9, 21-23, 25-28, 30, and 40).
- There is one undersized and elevated culvert through a road embankment that disconnects the wetland area (Photograph Nos. 1, 2, and 24).
- One ford crosses a historic channel path and water flowed over the crossing during the 2006 spring freshet (Photograph Nos. 10 and 11).
- The left abutment of the cable tram has been eroded exposing concrete (Photograph Nos. 12 and 14).
- There is a wetland area that appears to have been restored (Photograph Nos. 5 and 6).
- An active slide area along river right is providing sediment to the system (Photograph No. 13).
- There has been bank erosion along river left probably from the 2006 spring freshet (Photograph Nos. 15, 16, 17, and 29).
- There are some active side channels within the project area (Photograph Nos. 18 and 19).
- A wetland area is present along a historic channel path. There are three road crossings along the length of the channel path disconnecting the wetlands from the channel. This wetland area could be reconnected to the river (Photograph Nos. 20, 31-39, and 41-44).
- There are some overflow channels the feed into the lower section of the wetland area (Photograph Nos. 45 and 46).

Summary Table: Features used in the Reach-based Ecosystem Indicators (REI)

Pathway:	Indicator:	Features:
Habitat Access	Physical Barriers (Mainstem)	None
Habitat Elements	Wetlands	12 Acres
	Off-Channel Habitat	Side Channels, Overflow Channels & Wetlands
	Refugia	~35% Wetlands Not Accessible (Visual Estimate)
Channel Condition & Floodplain Dynamics	Floodplain Connectivity (Potential Physical Barriers)	1 Cable Tram 6 Road Embankments 1 Ford Crossing 1 Culvert
Watershed Conditions	Road Density & Location (Floodplain)	1.50mi/0.49mi^2
	Riparian Corridor	95% Meet Criteria (Visual Estimate)
	Protection Areas	120 Acres
	Total Area	311 Acres

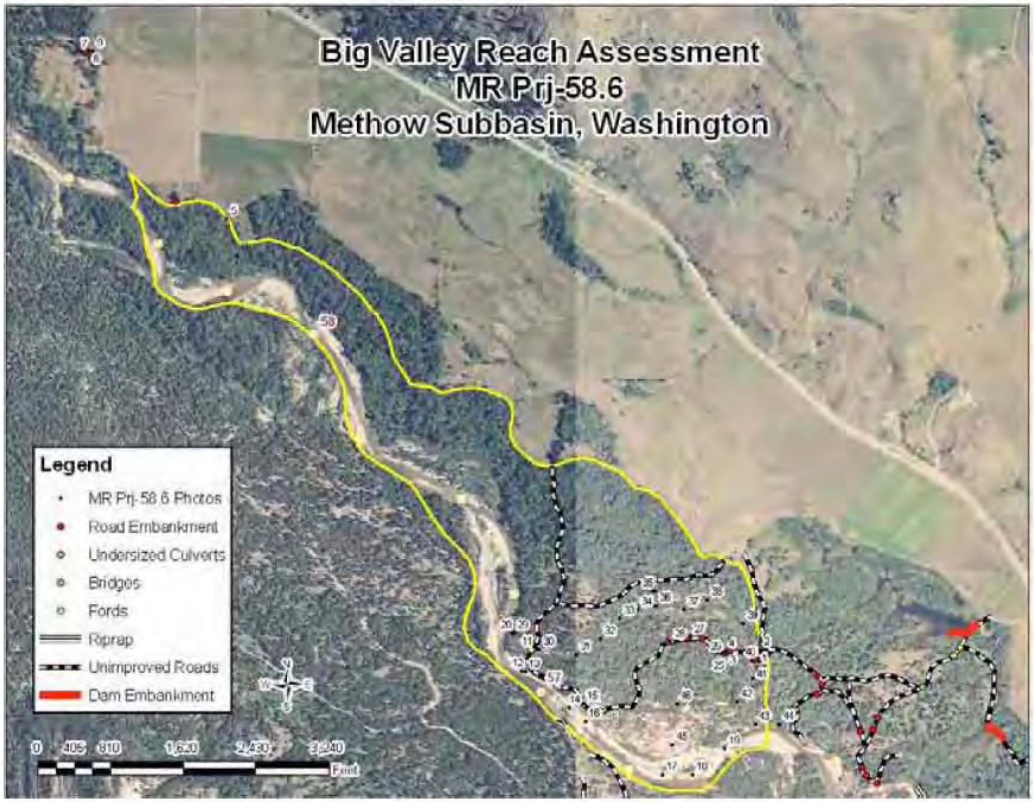

Figure 1. Location map of project area (yellow border), photographic documentation and project features.

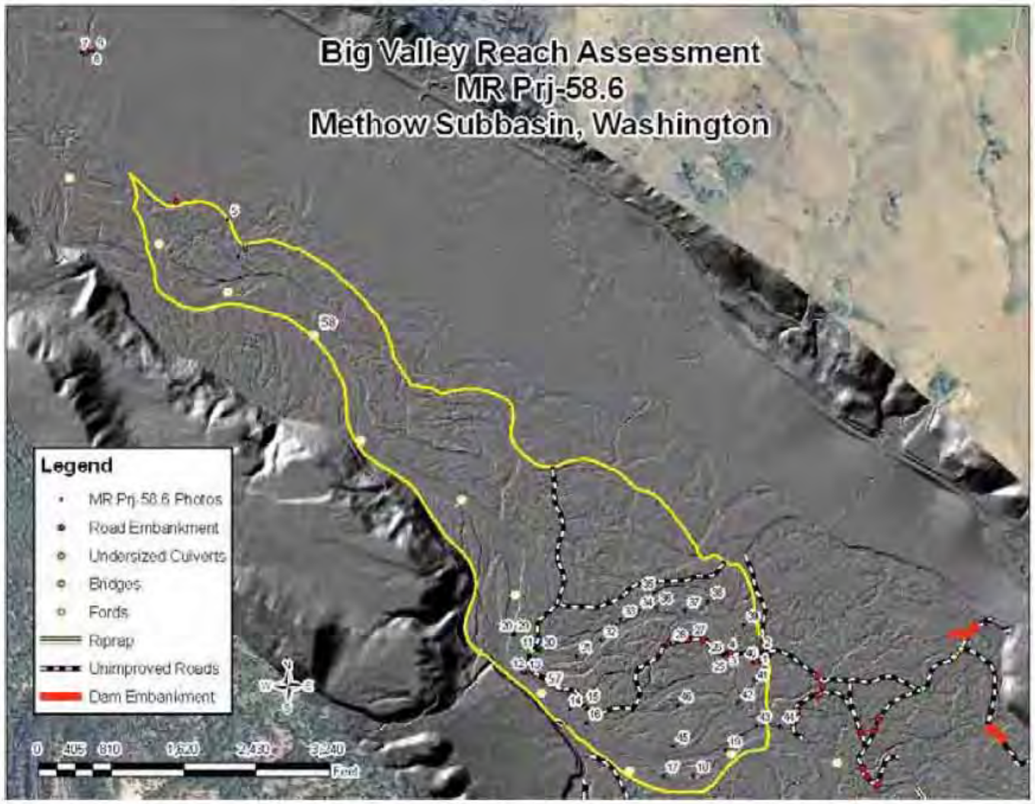

Figure 2. Hillshade (LiDAR) map showing project area (yellow border), photographic documentation, project features and channel paths.

Photographic Documentation

Photograph No. 1. View is to the northwest looking upstream toward road embankment that has an elevated and undersized culvert. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 2. View is to the east looking at road embankment shown in Photograph No. 1. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 3. View is to the east looking at road embankment without a culvert that bisects a historical channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 4. View is to the north looking upstream from road embankment in Photograph No. 3 at historical channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 5. View is to the south looking downstream at wetlands area that is being fed by an irrigation return and groundwater. Note logs are “trimmed” suggesting they have either been placed during a restoration project or could be from a historic mill. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 6. View is to the southeast looking downstream toward historic logjam that is being utilized by beavers to pond water. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 7. View is to the northwest of a road embankment without culvert that blocks the Rockview Irrigation Ditch (?). **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 8. View is to the north looking upstream from a road embankment without a culvert along the Rockview Irrigation Ditch (?). Water flowed in the ditch during the 2006 spring freshet. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 9. View is to the south looking downstream from road embankment at the channelized Rockview Irrigation Ditch (?). **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 12, 2006.**

Photograph No. 10. View is to the northeast looking downstream from a partially washed-out road embankment near the head of a historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 13, 2006.**

Photograph No. 11. View is to the south looking at the partially washed-out road embankment.
MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 13, 2006.

Photograph No. 12. View is to the southeast looking downstream toward cable tram crossing.
MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 13, 2006.

Photograph No. 13. View is to the northwest looking upstream at a 15+ meter high glacial bluff that is eroding and providing sediment to the system. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 13, 2006.**

Photograph No. 14. View is to the northeast looking at the left abutment of the cable tram. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 13, 2006.**

Photograph No. 15. View is to the southeast looking downstream along a road that has experienced severe erosion on river left. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 13, 2006.**

Photograph No. 16. View is to the east looking at river left from the main channel where the floodplain was accessed during the 2006 spring freshet. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 13, 2006.**

Photograph No. 17. View is to the south looking downstream from a gravel bar on river left at erosion that occurred along river right during the 2006 spring freshet. Note well casing near center of picture is almost in the active channel. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 13, 2006.**

Photograph No. 18. View is to the south looking downstream from gravel a bar on river right toward a log jam the spans the entrance of a side channel. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 13, 2006.**

Photograph No. 19. View is to the west looking upstream at a side channel along river left. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 13, 2006.**

Photograph No. 20. View is to the southeast looking downstream along historic channel path where the floodplain was accessed during the 2006 spring freshet. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 13, 2006.**

Photograph No. 21. View is to the north looking upstream from road embankment with elevated culvert where the embankment has created a wetland area. The November 8, 2006 high flows did not appear to have affected the water levels. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, November 8, 2006.**

Photograph No. 22. View is to the north looking upstream from road embankment where the embankment has created a wetland area. The November 8, 2006 high flows appear to have significantly impacted the water levels. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, November 8, 2006.**

Photograph No. 23. View is to the north looking at a road embankment that disconnects a historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 24. View is to the west looking at a road embankment that disconnects historic channel path. Note water is flowing over the road. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 25. View is to the west looking at a road embankment that disconnects historic channel path. Note water is flowing over the road. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 26. View is to the northeast looking at a road embankment that disconnects an overflow channel. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 27. View is to the northeast looking at a road embankment that disconnects an overflow channel. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 28. View is to the south looking at a road embankment that disconnects an overflow channel. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 29. View is to the south looking at head of historic channel path. Note this area was accessed by the river during the 2006 spring freshet. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 30. View is to the southeast looking at a road embankment that impedes flood flows along historic channel path. Note this area was accessed by the river during the 2006 spring freshet. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 31. View is to the west looking along historic channel path. Note the groundwater daylights in this vicinity and begins to flows into the oxbows. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 32. View is to the northeast looking along the historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 33. View is to the east looking at an oxbow along historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 34. View is to the south looking at a beaver dam along the historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 35. View is to the east looking downstream at a historic side channel. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 36. View is to the south looking at a beaver dam along the historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 37. View is to the south looking at a beaver dam along historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 38. View is to the southeast looking at a beaver dam along historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 39. View is to the southeast looking at a beaver dam along historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 40. View is to the east looking at a road embankment that bisects historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 41. View is to the south looking along the historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 42. View is to the south looking along historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 43. View is to the southeast looking at mouth of historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 44. View is to the west looking upstream at the mouth (low surface between the two trees in the river) of historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 45. View is to the east looking along an overflow channel that feeds into the wetland area along historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

Photograph No. 46. View is to the east looking along an overflow channel that feeds into the wetland area along historic channel path. **MR Prj-58.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, April 8, 2007.**

METHOW SUBBASIN, WASHINGTON
Big Valley Initial Site Assessment
Project Area MR Prj – 58.9

Personnel: PNRO geologists E. Lyon and R. McAffee

Purpose: Photographic documentation of baseline conditions and geologic mapping of anthropogenic features.

Observations:

- No anthropogenic features affecting the floodplain's connectivity were observed and the floodplain appears to be functioning properly.
- Overbank flows generally coalesce into overbank channels that feed into wetland complexes (Photograph Nos. 4 through 10).
- There is extensive spawning along the mainstem and side channels. The wetland complex provides exceptional rearing and overwintering habitat.
- The riverbank along river left at the Williams' abandoned homestead experienced fairly severe erosion during the 2006 spring freshet (Photograph No. 17).
- Large woody debris retention appears to be good (Photograph Nos. 11, 13, 19 and 26).
- Large woody debris recruitment potential appears to be good (Photograph Nos. 2, 14, 15, 18, 27 and 28).
- Spawning gravel recruitment appears to be good (Photograph Nos. 17 and 23).
- There are several overflow and side channels that appear to be in adequate condition (Photograph Nos. 1, 3, 12, 16, 19-22, 24 and 25).

Summary Table: Features used in the Reach-based Ecosystem Indicators (REI)

Pathway:	Indicator:	Features:
Habitat Access	Physical Barriers (Mainstem)	None
Habitat Elements	Wetlands	3 Acres
	Off-Channel Habitat	Side Channels, Overflow Channels & Wetlands
	Refugia	0% Wetlands Not Accessible
Channel Condition & Floodplain Dynamics	Floodplain Connectivity (Potential Physical Barriers)	None
Watershed Conditions	Road Density & Location (Floodplain)	0mi/0.12mi^2
	Riparian Corridor	100% Meet Criteria
	Protection Areas	77 Acres
	Total Area	77 Acres

Figure 1. Location map of project area (yellow border), photographic documentation and project features.

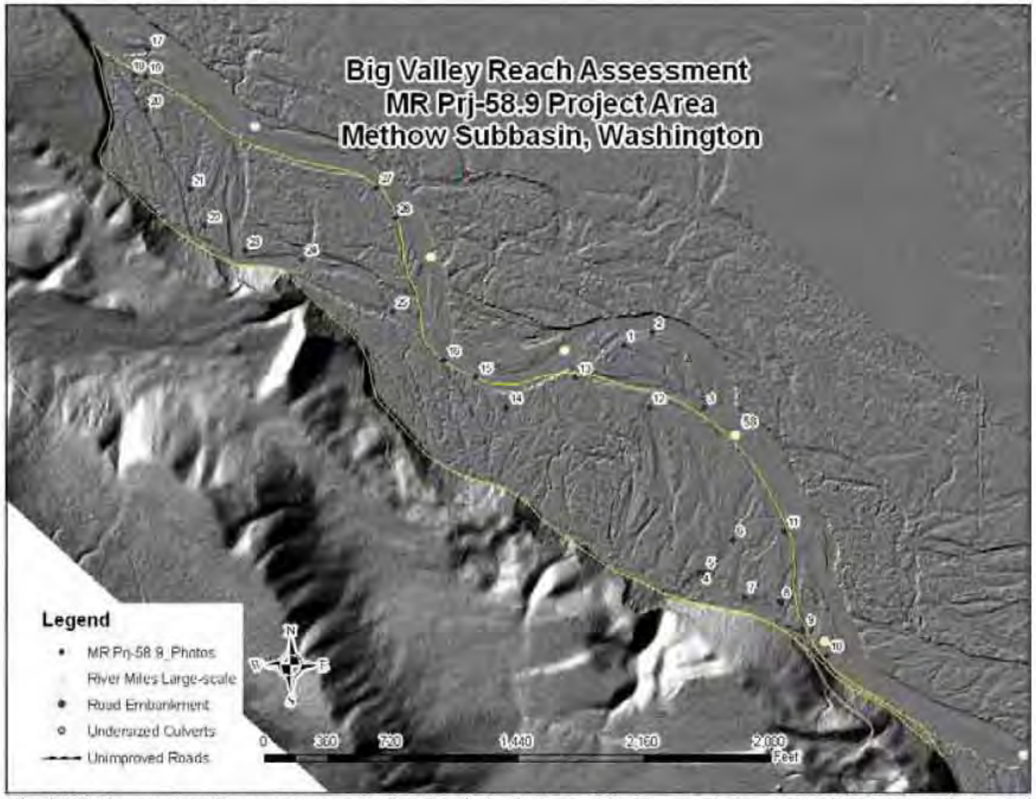

Figure 2. Hillshade (LiDAR) map showing project area (yellow border), photographic documentation, project features and channel paths.

Photographic Documentation

Photograph No. 1. View is to northwest looking across the river at an outlet to the wetland area on river left. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 2. View is to the southeast looking downstream along gravel bar on river right at the bank erosion on river left. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 3. View is to the northwest looking upstream along side channel on river right. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 4. View is to the southeast looking downstream at beaver dam impounding a wetland area. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 5. View is to the south looking across wetland complex at landslide in glacial deposit. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 6. View is to the north looking upstream along an overflow channel feeding into the wetland complex. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 7. View is to the south looking across beaver dam in the lower section of the wetland complex. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 8. View is to the northwest looking upstream at beaver dam on lower section of wetland. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 9. View is to the southwest looking across a small beaver dam near the outlet of the wetland complex. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 10. View is to the southeast looking downstream along outlet channel of the wetland complex. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 11. View is to the south looking across a gravel bar on river right where large woody debris was deposited during the 2006 spring freshet. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 12. View is to the northeast looking upstream along an overflow channel on river right. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 13. View is to the east looking downstream at large woody debris deposited during the 2006 spring freshet along river right. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 14. View is to the southeast looking downstream where there was overbank flow along river right that eventually feeds into wetland complex. The riverbank in this location is about 6-8-feet in height. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 15. View is to the southeast looking downstream at bank erosion that occurred along river right during the 2006 spring freshet. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 16. View is to the southeast looking downstream at overflow channel along river right that eventually feeds into wetland complex. The riverbank in this location is about 6-8 feet in height. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 25, 2006.**

Photograph No. 17. View is to the north looking at the Williams' homestead (abandoned) on river left where fairly severe bank erosion occurred during the 2006 spring freshet. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 18. View is to the southeast looking downstream at apex log jam that splits the river flow and diverts water down a side channel along river right. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 19. View is to the southeast looking downstream along overflow channel on river right. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 20. View is to the southeast looking downstream along overflow channel on river right. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 21. View is to the southeast looking downstream at log jam along overflow channel on river right. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 22. View is to the southeast looking downstream along overflow channel on river right as it flows against a slide area. Note the large boulders along the toe of the slide. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 23. View is to the south looking across overflow channel at slide area on river right. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 24. View is to the east looking downstream along a side channel on river right. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 25. View is to the southeast looking downstream at confluence of side channel and mainstem. Note the bear on gravel bar near center of photograph. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 26. View is to the east looking downstream at head of side channel and wetland complex on river left. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 27. View is to the northwest looking upstream at bank erosion along river left. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 28. View is to northwest looking upstream along river left. **MR Prj-58.9 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

METHOW SUBBASIN, WASHINGTON
Big Valley Initial Site Assessment
Project Areas MR Prj – 59.6

Personnel: PNRO geologists E. Lyon and R. McAffee

Purpose: Photographic documentation of baseline conditions and geologic mapping of anthropogenic features associated with floodplain connectivity.

Observations:

- About 50 feet of bank protection was observed in the project area (Photograph No. 7).
- Upstream of the project area about 850 feet of riprap has been placed along river right (Photograph Nos. 9 through 12).
- Remainder of the project area is in an adequate condition and is being heavily utilized by salmonids (Photograph Nos. 1-6, 8, and 13-33).

Summary Table: Features used in the Reach-based Ecosystem Indicators (REI)

Pathway:	**Indicator:**	**Features:**
Habitat Access	Physical Barriers (Mainstem)	None
Habitat Elements	Wetlands	3 Acres
	Off-Channel Habitat	Side Channels, Overflow Channels & Wetlands
	Refugia	0% Wetlands Not Accessible
Channel Condition & Floodplain Dynamics	Floodplain Connectivity (Potential Physical Barriers)	50’ Riprap
Watershed Conditions	Road Density & Location (Floodplain)	0mi/0.19mi^2
	Riparian Corridor	75% Meet Criteria (Visual Estimate)
	Protection Areas	120 Acres
	Total Area	120 Acres

Figure 1. Location map of project area (yellow border), photographic documentation and project features.

Figure 2. Hillshade (LiDAR) map showing project area (yellow border), photographic documentation, project features and channel paths.

Photographic Documentation

Photograph No. 1. View is to the south looking downstream along river right at head of side channel. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 13, 2006.**

Photograph No. 2. View is to the northeast looking across the river from river right where Mr. Imes mentioned that the river has incised a few feet. This incision appeared to be localized. Based on antidotal information salmon have been spawning in the channel. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 13, 2006.**

Photograph No. 3. View is to the south looking downstream along river right at head of side channel. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 13, 2006.**

Photograph No. 4. View is to the northwest looking upstream along a side channel on river right that has a logjam at its head (refer to Photograph Nos. 1 and 3). **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 13, 2006.**

Photograph No. 5. View is to the southeast looking downstream along side channel on river right near its confluence with the mainstem. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 13, 2006.**

Photograph No. 6. View is to the northwest looking upstream from river right at the floodplain. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 13, 2006.**

Photograph No. 7. View is to the northeast looking downstream along river right where rock spurs and rootwads have been placed for bank protection. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 13, 2006.**

Photograph No. 8. View is to the west looking upstream along river right at bank erosion. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 13, 2006.**

Photograph No. 9. View is to the northwest looking upstream at riprap placed along river right. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 10. View is to the south looking downstream where the riprap ended and the bank eroded during the 2006 spring freshet. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 11. View is to the northwest looking upstream at riprap along river right where the riprap was eroded and deposited during the 2006 spring freshet. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 12. View is to the southeast looking downstream along river right where bank erosion occurred during the 2006 spring freshet. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 13. View is to the south looking downstream along an overflow channel on river right that was accessed during the 2006 spring freshet. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 14. View is to the southeast looking across at the head of Hancock side channel from river right. Note a salmon was observed in the near riffle and there were “redds” flagged in the area. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 15. View is to the northwest looking upstream at the head of Hancock side channel. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 16. View is to the southwest looking at the head of Hancock side channel from an abandoned river channel. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 17. View is to the east looking downstream at historic channel path near the head of Hancock side channel. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 18. View is to the south looking downstream at a side channel that was accessed during the 2006 spring freshet. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 19. View is to the east looking at river left in the historic channel path where erosion occurred during the 2006 spring freshet. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 20. View is to the south looking downstream along historic channel path. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 21. View is to the south looking downstream where the historic channel path feeds into the mainstem of the river. Note the large deep pool in center of photograph. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 22. View is to the north looking upstream at an overflow channel feeding into the mainstem. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 23. View is to the south looking downstream at the confluence of Hancock side channel and the mainstem. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 24. View is to the southeast looking downstream at historic channel path. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 25. View is to the south looking downstream at the mainstem of the river where salmon spawning is prevalent. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 20**

Photograph No. 26. View is to the south looking downstream along the mainstem of the river where salmon spawning is prevalent. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 27. View is to the southeast looking downstream where the active channel has cut a new path during the 2006 spring freshet. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 28. View is to the southeast looking downstream at historic channel path along river left. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 29. View is to the northwest looking upstream at overflow channel along river left. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 30. View is to the north looking upstream at the confluence of historic channel path and Hancock side channel. Note the deep pool (about 15-feet deep) that provides overwintering habitat. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 31. View is to the south looking downstream at Hancock side channel that is presently the active river channel. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 32. View is to the west looking upstream at Hancock Springs where it flows under the road embankment through an arch culvert. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

Photograph No. 33. View is to the southeast looking downstream at Hancock Springs where it flows under the road embankment through an arch culvert. **MR Prj-59.6 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 17, 2006.**

METHOW SUBBASIN, WASHINGTON
Big Valley Initial Site Assessment
Project Area MR Prj – 60.25

Personnel: PNRO geologists E. Lyon and R. McAffee

Purpose: Photographic documentation of baseline conditions and geologic mapping of anthropogenic features associated with floodplain connectivity.

Observations:
- Lack of landowner access was problematic during our field mapping and photographic documentation.
- The floodplain is being developed and there are numerous houses.
- Two culverts were observed (Photograph Nos. 8 and 9).
- One ford crossing (Photograph No. 10).
- Two road embankments disconnecting floodplain (Photograph Nos. 4, 5, and 6).
- A tributary entering
- + from the north had two road embankments (Photograph No. 11) and one culvert (Photograph Nos. 1, 2, and 3).

Summary Table: Features used in the Reach-based Ecosystem Indicators (REI)

Pathway:	**Indicator:**	**Features:**
Habitat Access	Physical Barriers (Mainstem)	None
Habitat Elements	Wetlands	0 Acres
	Off-Channel Habitat	Side Channels & Limited Access to Overflow Channels
	Refugia	Limited Access to Overflow Channels
Channel Condition & Floodplain Dynamics	Floodplain Connectivity (Potential Physical Barriers)	Residential Development Limited Access 2 Culverts 1 Ford Crossing 2 Road Embankments
Watershed Conditions	Road Density & Location (Floodplain)	$1.41mi/0.31mi^2$
	Riparian Corridor	80% Meet Criteria (Visual Estimate)
	Protection Areas	10 Acres
	Total Area	200 Acres

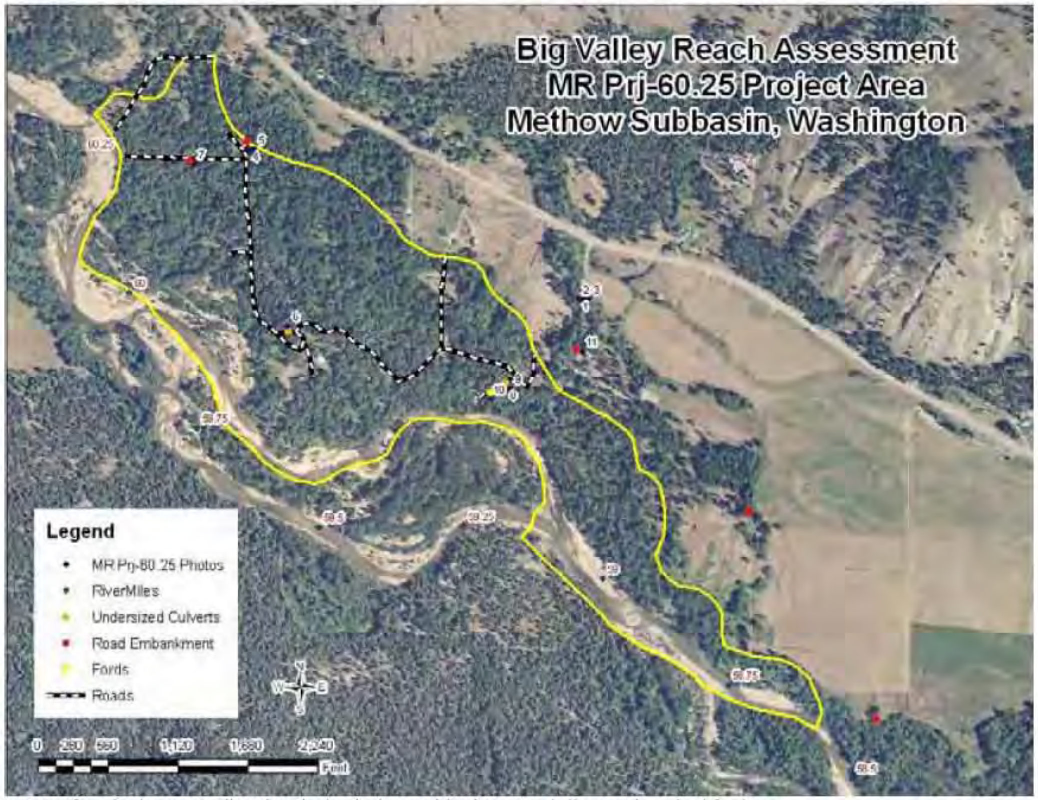

Figure 1. Location map of project area (yellow border), photographic documentation and project features.

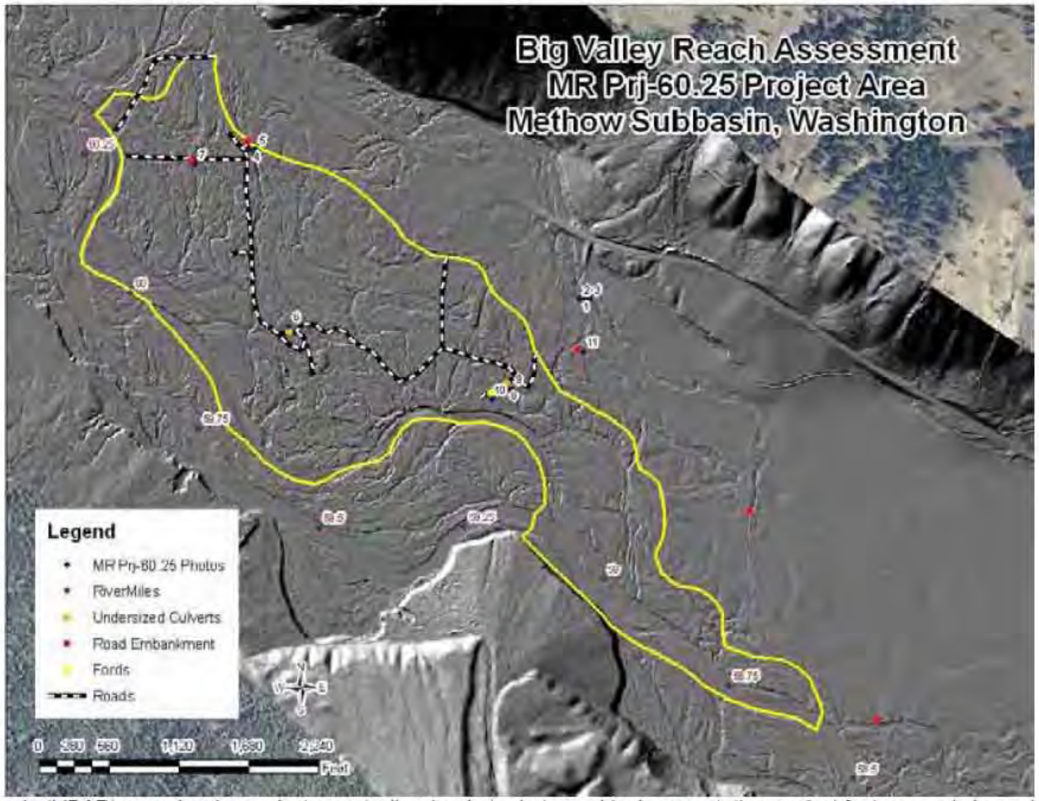

Figure 2. Hillshade (LiDAR) map showing project area (yellow border), photographic documentation, project features and channel paths.

Photographic Documentation

Photograph No. 1. View is to the northwest looking upstream along tributary channel(?) from road embankment with undersized culvert. **MR Prj-60.25 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 16, 2006.**

Photograph No. 2. View is to the northwest looking upstream at undersized culvert through road embankment. **MR Prj-60.25 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 16, 2006.**

Photograph No. 3. View is to the southeast looking downstream along tributary channel from road embankment with undersized culvert. **MR Prj-60.25 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 16, 2006.**

Photograph No. 4. View is north looking upstream along overflow channel from road embankment with no culvert. **MR Prj-60.25 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 16, 2006.**

Photograph No. 5. View is to the south looking downstream along overflow channel from road embankment with no culvert. **MR Prj-60.25 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 16, 2006.**

Photograph No. 6. View is to the north looking upstream along overflow channel at road embankment with undersized culvert. **MR Prj-60.25 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 16, 2006.**

Photograph No. 7. View is to the north looking upstream along overflow channel from road embankment with no culvert. **MR Prj-60.25 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 16, 2006.**

Photograph No. 8. View is to the north looking upstream along overflow channel with concrete encased culvert. **MR Prj-60.25 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 16, 2006.**

Photograph No. 9. View is to the north looking upstream along overflow channel from road embankment. **MR Prj-60.25 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 17, 2006.**

Photograph No. 10. View is to the west looking across ford crossing along unimproved road. **MR Prj-60.25 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 17, 2006.**

Photograph No. 11. View is to the north looking upstream along overflow channel from road embankment without culvert. **MR Prj-60.25 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 17, 2006.**

METHOW SUBBASIN, WASHINGTON
Big Valley Initial Site Assessment
Project Area MR Prj – 60.85

Personnel: PNRO geologists E. Lyon and R. McAffee

Purpose: Photographic documentation of baseline conditions and geologic mapping of anthropogenic features associated with floodplain connectivity.

Observations:

- Weeman Bridge constricts the river at RM 61.1 and its abutments are protected with riprap (Photograph Nos. 1 and 26).
- There is about 1350 linear feet of riprap placed in the project area.
- There are two levees (about 300 linear feet) in the floodplain that have been breached in a couple of locations.
- There is a berm about 750 linear feet in the floodplain that used to impound the historic Fender Mill pond. The height of the berm varies between about 3 to 5 feet (Photograph No. 7).
- There is an inlet pipe that has been sealed near Weeman Bridge for the decommissioned Rockview irrigation ditch (Photograph No. 27).
- An overflow channel feeds into the historic mill pond area and its head is elevated about 2 feet above the active channel (Photograph Nos. 2, 4, 6, and 8).
- There is an active side channel at about RM 60.85 that has large woody debris accumulated at its head (Photograph Nos. 3 and 5).
- The decommissioned Rockview irrigation ditch feeds into the mill pond area (Photograph No. 9) and where it is diverted toward the highway there are concrete blocks in the channel (Photograph No. 10). At the time of the site assessment there was a fish-screen present along the irrigation ditch (Photograph No. 13), since then the screen has been removed.
- The fish return channel from the Rockview irrigation ditch flows down into a wetland complex (Photograph Nos. 16 through 22). There is one ford crossing the fish return channel (Photograph Nos. 15 and 18) and a power-pole within the channel (Photograph No. 11). Timbers have been placed in the fish return channel (Photograph No. 12) that impedes the flows, forcing the water to access the floodplain (Photograph No. 14).
- The wetland area has a downstream connection with the active channel (Photograph Nos. 23 through 25).

Summary Table: Features used in the Reach-based Ecosystem Indicators (REI)

Pathway:	**Indicator:**	**Features:**
Habitat Access	Physical Barriers (Mainstem)	None
Habitat Elements	Wetlands	5 Acres
	Off-Channel Habitat	Side Channels, Overflow Channels & Wetlands
	Refugia	All Accessible
Channel Condition & Floodplain Dynamics	Floodplain Connectivity (Potential Physical Barriers)	1 Road Bridge 1350’ Riprap 330’ P/U Levees 750’ Berm 1 Ford 1 Irrigation Ditch (Decommissioned)
Watershed Conditions	Road Density & Location (Floodplain)	0.42mi/0.15mi^2
	Riparian Corridor	85% Meet Criteria (Visual Estimate)
	Protection Areas	32 Acres
	Total Area	96 Acres

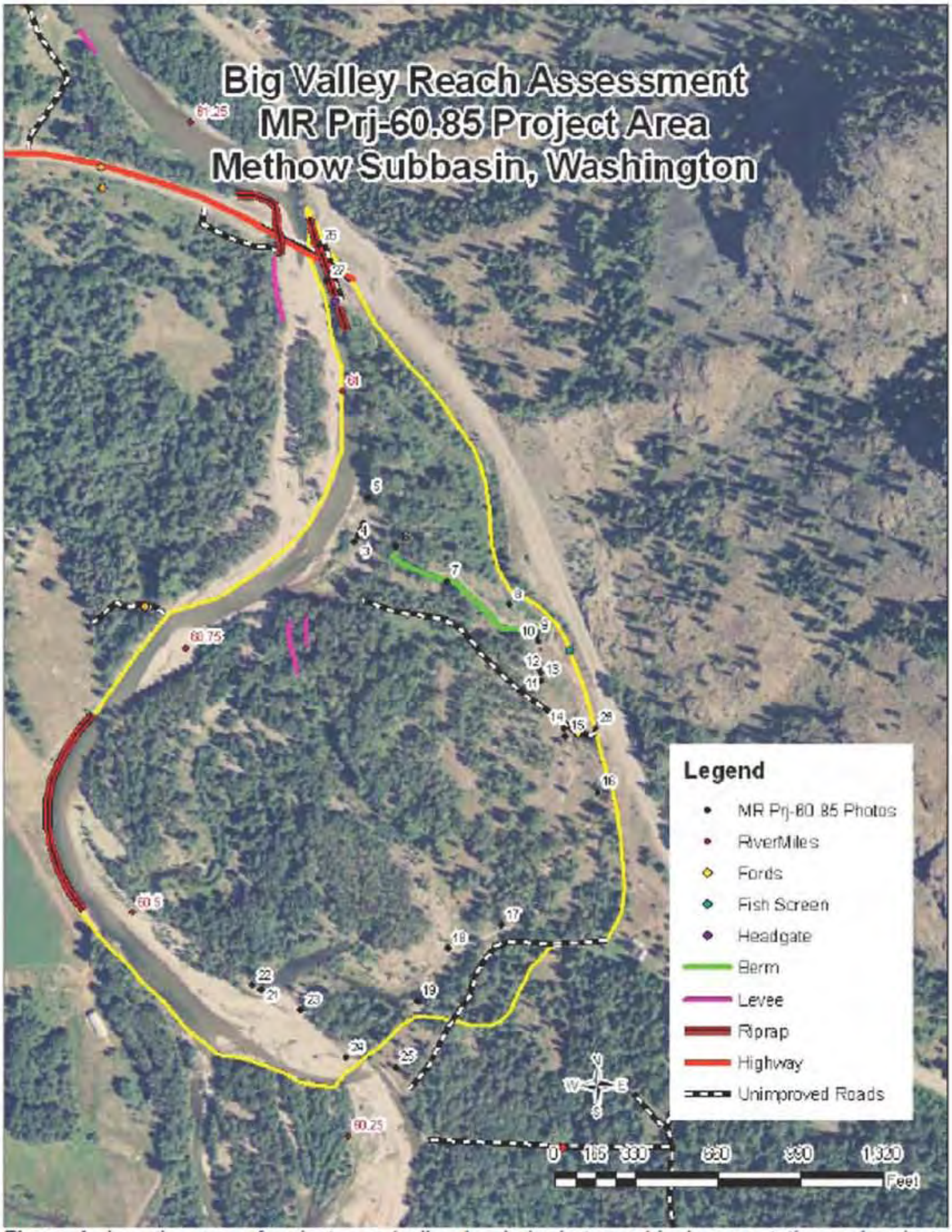

Figure 1. Location map of project area (yellow border), photographic documentation and project features.

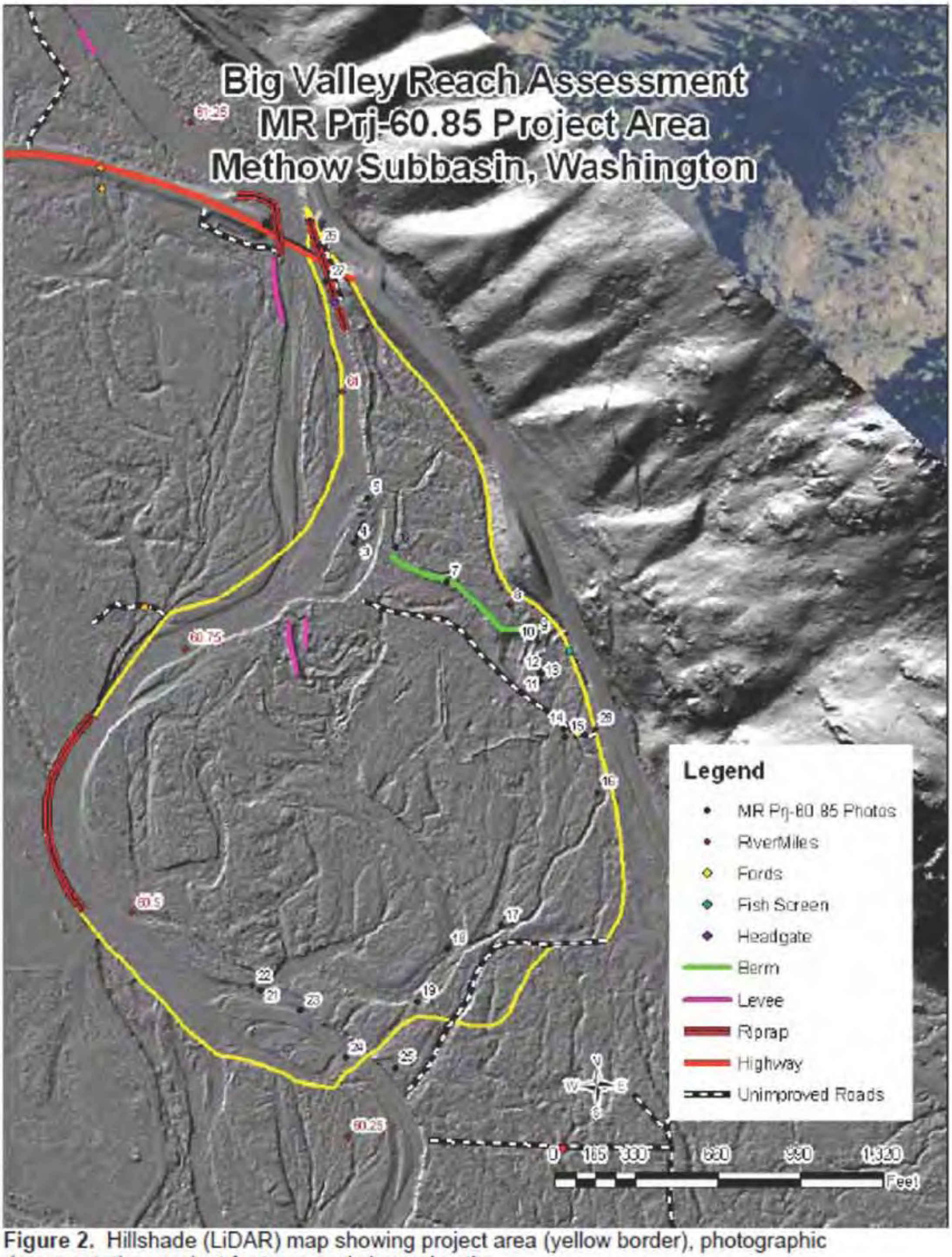

Figure 2. Hillshade (LiDAR) map showing project area (yellow border), photographic documentation, project features and channel paths.

Photographic Documentation

Photograph No. 1. View is to the north looking upstream toward the Weeman Bridge. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 2. View is to the east looking at head of overflow channel that is elevated less than 2 feet above the active river channel. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 3. View is to the southeast looking downstream from a log jam near the head of the overflow and side channel. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 4. View is to the east looking downstream at the head of an overflow channel. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 5. View is to the south looking downstream at large woody debris deposited at the head of a side channel. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 6. View is to the southeast looking downstream along overflow channel. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 7. View is to the northwest looking at a berm that historically impounded the Fender Mill pond. Height of the berm varies from about 3-5 feet. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 8. View is to the southeast looking downstream at the historic mill pond area. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 9. View is to the north looking upstream along the decommissioned Rockview irrigation ditch fish return channel. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 10. View is to the north looking upstream along the Rockview irrigation ditch fish return channel where it exits the mill pond area. Note the numerous concrete blocks in the channel. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 11. View is to the northwest looking upstream along the fish return channel at a power-pole that is in the channel. Note the high water mark at the base of the power pole. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 12. View is to the south looking downstream along the fish return channel that has been filled with timbers. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 13. View is to the northeast looking at the Rockview irrigation ditch fish-screen. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 14. View is to the south looking downstream where flows were impeded in the fish return channel by timbers. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 15. View is to the southeast looking downstream along the fish return channel at a ford crossing. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 16. View is to the southwest looking downstream along the fish return channel. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 17. View is to the southwest looking downstream along the fish return channel as it enters a wetland area (oxbows). **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 18. View is to the southwest looking downstream at the wetland area (oxbows). **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 19. View is to the west looking downstream at the wetland area (oxbows). **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 20. View is to the north looking upstream from the active river channel into the wetland area (oxbows). Sediment has accumulated at the confluence, but does not create a complete barrier as there is a small beaver dam on the right side of the gravel bar. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 21. View is to the northeast looking upstream from the confluence at the wetland area (oxbows). **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 22. View is to the west looking at a small beaver dam that helps maintain the water level in the wetland area. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 23. View is to the southeast looking downstream along historic channel path where flows exit the wetland area. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 24. View is to the southeast looking downstream along historic channel path. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 25. View is to the southeast looking downstream along historic channel path. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 15, 2006.**

Photograph No. 26. View is to the south looking downstream at the left abutment of the Weeman Bridge toward the inlet pipe for the decommissioned Rockview irrigation ditch. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 20, 2006.**

Photograph No. 27. View is to the south looking downstream along the left abutment of Weeman Bridge where the inlet to the Rockview irrigation ditch has been sealed. Also note the riprap placed along the left bank to protect the inlet. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, September 20, 2006.**

Photograph No. 28. View is to the west looking at a ford crossing the fish return channel during the November 7, 2006 high flows. **MR Prj-60.85 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by E. Lyon, November 7, 2006.**

METHOW SUBBASIN, WASHINGTON
Big Valley Initial Site Assessment
Project Area MR Prj – 62.4

Personnel: PNRO geologists E. Lyon and R. McAffee

Purpose: Photographic documentation of baseline conditions and geologic mapping of anthropogenic features associated with floodplain connectivity.

Observations:

- Seven potential barriers were identified using the LiDAR hillshade that have not been field checked due to landowner access issues.
- Two footbridges cross overflow channels in the project area (Photograph Nos. 26, 31 and 33).
- Weeman Bridge constricts the river.
- The highway embankment (about 1200 linear feet) bisects the floodplain disconnecting overflow channels (Photograph No. 7).
- Six culverts were observed in the project area (Photograph Nos. 1-6, 16, 35, 42, and 43).
- About 315 linear feet of push-up levees are present (Photograph Nos. 8-9 and 20-23).
- About 890 linear feet of riprap are present (Photograph No. 28).
- There are two excavated ponds with the spoil pile acting as a levee on the floodplain (Photograph Nos. 37 through 39).
- Three embankments disconnect overflow channels (Photograph Nos. 24, 25, 34, 40, and 41).
- There are some areas along river right that did experience bank erosion during the 2006 spring freshet (Photograph No. 12).
- A wetland area impounded by a road embankment with an undersized culvert is on river right near RM 60.75 (Photograph No. 15).
- A significant percentage of the floodplain was accessed during the 2006 spring freshet (Photograph Nos. 10, 11, 13, 14, 17-19, 27, 29, 30, 32, and 36).

Summary Table: Features used in the Reach-based Ecosystem Indicators (REI)

Pathway:	**Indicator:**	**Features:**
Habitat Access	Physical Barriers (Mainstem)	None
Habitat Elements	Wetlands	3 Acres
	Off-Channel Habitat	Limited Side Channels, Overflow Channels & Wetlands
	Refugia	Side Channels, Overflow Channels. About 70% of Wetlands Not Accessible (Visual Estimate)
Channel Condition & Floodplain Dynamics	Floodplain Connectivity (Potential Physical Barriers)	7 Barriers(?) Type Unk. 2 Footbridges 1 Road Bridge 1200' Road Embank. 6 Culverts 3 Road Embankments 315' P/U Levees 890' Riprap
Watershed Conditions	Road Density & Location (Floodplain)	0.99mi/0.34mi^2
	Riparian Corridor	60% Meet Criteria (Visual Estimate)
	Protection Areas	32 Acres
	Total Area	218 Acres

Figure 1. Location map of project area (yellow border), photographic documentation and project features.

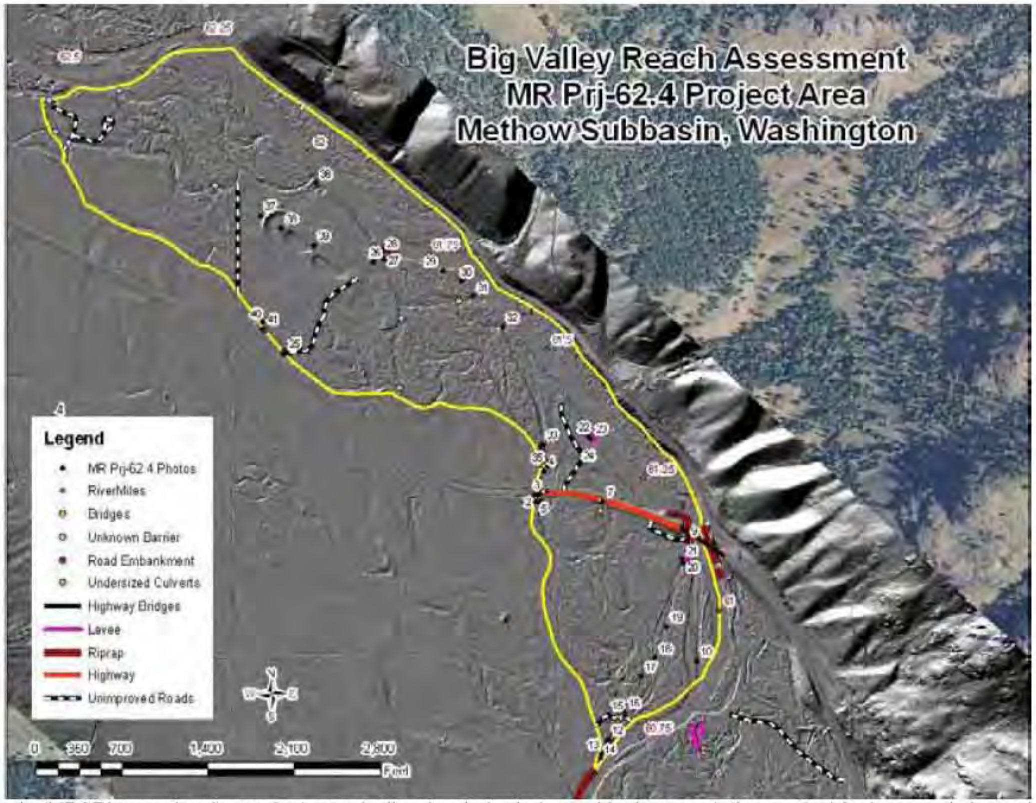

Figure 2. Hillshade (LiDAR) map showing project area (yellow border), photographic documentation, project features and channel paths.

Photographic Documentation

Photograph No. 1. View is to the northeast looking at an undersized culvert placed through the Highway 20 embankment along the west approach to Weeman Bridge. Note the new rock placed along the road embankment where water flowed over the road during the 2006 spring freshet. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 2. View is to the northeast looking at an undersized culvert installed to help drain overflow channel along the road embankment. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 3. View is to the south looking at an undersized culvert installed through the Highway 20 embankment along the west approach to Weeman Bridge. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 4. View is to the south looking at undersized dual culverts installed through Highway 20 embankment along the west approach to Weeman Bridge. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 5. View is to the southwest looking at undersized dual culverts installed through Highway 20 embankment along the west approach to Weeman Bridge. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 6. View is to the south looking downstream from dual culverts at floodplain. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 7. View is to the east looking at the west approach to Weeman Bridge where the Highway 20 embankment and undersized culverts disconnect the floodplain. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 8. View is to the northwest looking upstream along river right near Weeman Bridge at a push-up levee (center of photograph). **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 9. View is to the south looking downstream along river right at a push-up levee downstream of Weeman Bridge. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 10. View is to the west looking toward the right bank where the river accessed the floodplain during the 2006 spring freshet. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 11. View is to the north looking at the mouth of an overflow channel along river right. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 12. View is to the southwest looking downstream along river right where the river bank was actively eroding during the 2006 spring freshet. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 13. View is to the north looking upstream at an overflow channel or irrigation ditch return along river right. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 14. View is to the south looking downstream along river right where overflow channel or irrigation return enters river. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 15. View is to the north looking upstream at wetland area in the floodplain. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 16. View is to the west looking at a culvert through the road embankment that impounds wetland area in Photograph No. 15. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 17. View is to the west looking at an overflow channel on floodplain. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 18. View is to the north looking at an overflow channel on floodplain. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 19. View is to the north looking upstream at an overflow channel and small woody debris piles deposited during the 2006 spring freshet. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 20. View is to the north looking upstream at a push-up levee that disconnects an overflow channel from river. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 21. View is to the south looking downstream from a push-up levee along an overflow channel. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 14, 2006.**

Photograph No. 22. View is to the northwest looking upstream along river right at a push-up levee disconnecting floodplain. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 17, 2006.**

Photograph No. 23. View is to the southeast looking downstream along river right below push-up levee (Photograph No. 22) where bank erosion occurred during the 2006 spring freshet. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 17, 2006.**

Photograph No. 24. View is to the southeast looking at a road embankment that disconnects an overflow channel. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 17, 2006.**

Photograph No. 25. View is to the west looking at a road embankment that disconnects an overflow channel. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 17, 2006.**

Photograph No. 26. View is to the south looking at a trail crossing an overflow channel. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.**

Photograph No. 27. View is to the south looking downstream along an overflow channel where small woody debris was deposited during the 2006 spring freshet.
MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.

Photograph No. 28. View is to the east looking downstream at riprap placed along river right.
MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.

Photograph No. 29. View is to the west looking upstream along an overflow channel in floodplain. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.**

Photograph No. 30. View is to the northwest looking upstream along a side channel on river right. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.**

Photograph No. 31. View is to the west looking upstream along an overflow channel with trail crossing. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.**

Photograph No. 32. View is to the north looking upstream along an overflow channel. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.**

Photograph No. 33. View is to the south looking downstream along an overflow channel with trail crossing. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.**

Photograph No. 34. View is to the southwest looking downstream at fill placed in an overflow channel. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.**

Photograph No. 35. View is to the south looking downstream at dual culverts and road embankment across overflow channel. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.**

Photograph No. 36. View is to the northeast looking downstream toward confluence of side channel and mainstem. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.**

Photograph No. 37. View is to the east looking at spoil pile from pond excavation that acts like a levee directing the floodwaters back toward the river. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.**

Photograph No. 38. View is to the southeast looking at the excavated west pond. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.**

Photograph No. 39. View is to the southeast looking at excavated east pond. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.**

Photograph No. 40. View is to the southeast looking downstream along overflow channel that has been filled. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.**

Photograph No. 41. View is to the northwest looking upstream along overflow channel at fill material. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, October 18, 2006.**

Photograph No. 42. View is to the north looking upstream from Highway 20 embankment at dual culverts in Photograph Nos. 4 and 5 where flows were impeded during the November 8, 2006 rain event. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, November 8, 2006.**

Photograph No. 43. View is to the south looking downstream from Highway 20 embankment at single culvert in Photograph No. 1. Ponded water is from flows through the dual culverts in Photograph Nos. 4, 5 and 42 during the November 8, 2006 rain event. **MR Prj-62.4 Project Area – Methow Subbasin, Washington – Bureau of Reclamation Photograph by R. McAffee, November 8, 2006.**

Appendix C

Habitat Assessment

This appendix focuses on describing the existing habitat conditions of the Big Valley reach assessment area. The habitat assessment was conduct by the U.S. Forest Service Methow Valley Ranger District in accordance with the Pacific Northwest Region, Region 6, Stream Inventory Handbook Level I & II, Version 2.6 (2006).

METHOW RIVER HABITAT ASSESSMENT
STREAM SURVEY OF THE BIG VALLEY REACH
(Wolf Creek to Hancock Springs)
OCTOBER 2006

Prepared by the Methow Valley Ranger
Okanogan-Wenatchee National Forest
December 2006

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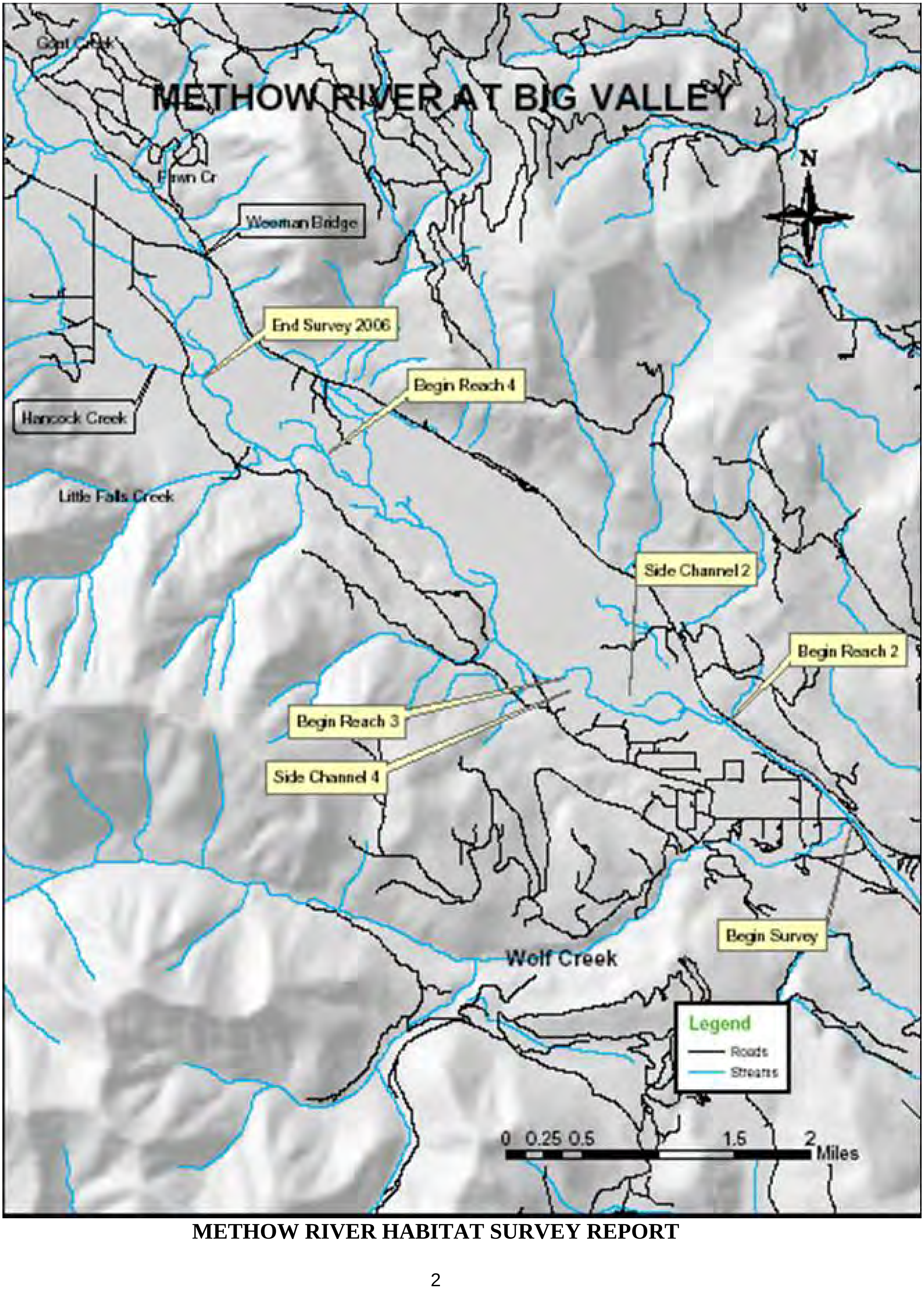

METHOW RIVER HABITAT SURVEY REPORT

Wolf Creek to Hancock Springs
October 2006

Methodology and Objectives: A modified Hankin-Reeves Level II habitat survey (USDA Forest Service *Stream Inventory Handbook, 2005, Version 2*.5, Pacific Northwest Region) was conducted on a 6 mile segment of the Methow River located between the confluence with Wolf Creek (river mile (RM) 54.2) and the confluence with Hancock Springs (RM 60.0). The survey was conducted to help determine fish habitat quantity and quality in the surveyed area. The surveyed stream area was broken into six segments, four on the main stem Methow River, and two major side channels, shown below:

Main Stem Methow River:

-Reach 1: A 0.8 mile segment of river on the Wolf Creek alluvial fan located from the confluence with Wolf Creek to the bottom of the Heath Ranch, where the floodplain widens and the river is further away from the highway (RM 54.2 to 55.0).

-Reach 2: A 1.6 mile segment of the river located from the bottom of the Heath Ranch to the outflow of a major right bank side channel located above Wolf Ridge Resort (RM 55.0 to 56.6).

-Reach 3: A 2.5 mile segment of the river located from the top of the major side channel that flows by the Wolf Creek Resort to the bottom of a major right bank side channel located just above the upper end of the Big Valley Ranch (RM 56.6 to RM 59.1)..

-Reach 4: From the confluence of a major left bank channel (dry at low flow) to the confluence with Hancock Springs (RM 59.1 to 60.0).

Major Side Channels:

-Side Channel 2: A 0.8 mile long side channel in reach 2 that enters the left bank of the river at RM 55.5 and exits the left bank of the river at RM 56.2 (shown on BOR maps as the main channel).

-Side Channel 4: A 0.3 mile long side channel in reach 2 that enters the right bank of the river at RM 56.1 and exits the right bank of the river at RM 56.6. The side channel re-enters the river at the Wolf Creek Resort.

Habitat data was collected and compared in the six surveyed stream segment areas.

Data Attributes: The following data attributes were collected during the habitat survey conducted between October 23 and October 27, and on November 2, 2006.

●Stream Habitat Type: Habitat in the main channel and all the wetted side channels were broken into 4 main habitat unit types; riffles, pools, runs (glides), and side channels. The % habitat type was compared in the three surveyed stream segments.

●Habitat Area: The length and wetted width of all habitat units were measured. The % area (square footage) of all 4 habitat unit types was calculated. Total habitat area was calculated.

●Pools: Pools were counted and pools per mile were calculated. The average maximum depth and average residual depth (max depth minus pool crest) were calculated. Pool data was compared in the surveyed stream segments.

●Riffles and Runs: Habitat dimensions, average thalweg depth, and maximum thalweg depth in riffles and runs were measured.

●Large woody debris: Pieces of large wood that intersected the bankfull channel width were counted in three size categories; small (> 20' long with a diameter of at least 6"), medium (> 35' long with a diameter between 12" and 20"), and large (> 35' long with a diameter greater than 20"). Pieces of large wood were compared in the four surveyed main channel stream segments and two surveyed side channels by calculating the number of pieces of large wood per mile.

●Bank Erosion: The linear distance of eroding banks above the bankfull width was measured and compared by stream segment (bank erosion per mile, % eroding banks).

●Substrate: Substrate was ocularly estimated in every habitat unit in 5 size categories (sand, gravel, cobble, boulder, bedrock) based on size categories from Wolman pebble counts.

●Chinook salmon redds: The number of spring and summer Chinook salmon redds in the channel were counted during the survey.

●One to two bankfull width/depth measurements were taken in each surveyed stream segment.

Stream Flow: The stream survey was conducted at low flow. The flow in the Methow River at the USGS gage in Winthrop was 226 cfs on October 23, 2006, the first day of the survey. The USGS gage is located below the confluence with the Chewuch River. The flow in the Chewuch River at the USGS gage site at the mouth was 92 cfs on October 23. Based on USGS gage data, the flow in the Methow River at the bottom of the project area was approximately 125 to 130 cfs upstream of Wolf Creek.

Fish Distribution: Fish distribution surveys were not conducted in main channel in the survey area. Fish distribution surveys were conducted in the Beaver ponds in the lower part of the Heath Ranch (see Table 3 on page). Data from WDFW spawning surveys show that the stream segment from the bottom of the Heath Ranch to the Weeman Bridge is a very important spawning and rearing area in the Methow River Sub-basin for Upper Columbia River spring Chinook salmon (Oncorhynchus tshawysha) and Upper Columbia River summer steelhead (Oncorhynchus mykiss). The reach is also important for Upper Columbia River bull trout (Salvelinus confluentus) migration (and possibly rearing) based on USFS redd surveys conducted higher in the watershed. Summer steelhead and bull trout are listed as threatened and spring Chinook salmon are listed as endangered under the Endangered Species Act. Some of the highest densities of spring Chinook salmon and summer steelhead redds in the Methow River Sub-basin have been observed in this reach during redd surveys conducted by the WDFW and Yakama Indian Nation. About 52% (136 out of a total of 259) of the spring Chinook salmon redds in the Methow River counted in 2005 were found in this river segment (*Spring Chinook Spawning Ground Surveys in the Methow River Basin in 2005,* WDFW). About 24% of the total spring Chinook redds in the entire Methow River Basin counted in 2005 were found in this reach (136 out of a basin-wide total of 566 redds). Abundant steelhead spawning also occurs in this reach. The greatest concentration of summer steelhead spawning in the upper Methow River sub-basin in 2005 occurred in the 9km downstream of the Weeman Bridge. The table below is from the WDFW report *Methow River Basin Steelhead Spawning Ground Surveys in 2005.*

Appendix 2. Historic (2003 – 2005) Upper Methow River expanded steelhead redd totals by reach.

Upper Methow River Section	Code	Dist (km)	2003	2004	2005
Ballard CG - Lost R.	M15	4.0	15	27	17
Lost R. - Gate Cr.	M14	4.8		10	51
Gate Cr. - Early Winters Cr.	M13	4.2	215[a]	23	60
Early Winters Cr. - Mazama Br.	M12	3.2		0	43
Mazama Br. - Susp. Br.	M11	4.0	44[b]	12	25
Susp. Br. - Weeman Br.	M10	5.3		8	52
Weeman Br. - Along Hwy 20	**M9**	**9.0**		**93**	**180**
Along Highway 20 - Wolf Cr.	M8	2.2	**325[c]**	0	9
Wolf Cr. - Foghorn Dam	M7	1.8		0	9
Foghorn Dam - Winthrop Br.	M6	2.7		0	34
Upper Methow River total		41.1	599	173	480

I. HABITAT ASSESSMENT: MAIN CHANNEL METHOW RIVER REACH 1
From Wolf Creek to the bottom of the Heath Ranch (RM 54.2 to 55.0)

Summary of Habitat Data:

●**Habitat Area:** This 0.8 mile reach is a fairly straight channel segment with no off-channel habitat. The habitat area in the reach is about 36,000 square yards (45,000 square yards per mile), consisting of about 88% riffle and run habitat. (See table 1 on page for a summary of attributes by reach.)

●**Large Wood:** Large wood is scarce in the 0.8 mile segment of stream, likely due to the past removal of wood from the stream for flood control and because of transport in the straight, confined channel. Only 3 pieces of wood (3.7 per mile) greater than 35' long with a diameter of at least 12" was counted in the reach. The future recruitment potential for large wood is poor due to the removal of trees in the riparian area for past agriculture and the construction of highway 20, which parallels the left bank throughout the entire reach.

●**Pool Habitat:** Only one pool was observed in the reach. The pool had a max depth of 3 feet and had little hiding cover for fish. The 0.8 mile reach is straight and confined, with no scour agents such as stream bend, large wood or large substrate. This is mainly a natural condition due to channel confinement by the Wolf Creek alluvial fan.

●**Riffle Habitat:** About 88% of the total habitat area consisted of riffles. Hiding cover in the riffles was generally fair to poor due to the lack of wood and large substrate. The average thalweg depth in the riffles was 1.8', the deepest in the survey, and excellent for migrating fish.

●**Side Channel and Off-Channel Habitat:** No side channel habitat exists in the 0.8 mile stream reach due to the confinement of the stream. No backwater pools or oxbows were observed in the reach.

●**Fish Spawning Habitat:** Three spring Chinook salmon redds were observed near the end of the reach, in and just above the pool. Spawning habitat is lacking in the riffles and runs due mainly to channel confinement, sediment transport and the lack of wood and stream bends, which gather spawning gravels. Pebble count data collected in the stream channel in October, 2005 shows that this reach has the highest D50 of any of the reaches in the survey area (D50 of 130 mm).

●**Fish Rearing Habitat:** Fish rearing habitat is limited in the reach due to the lack of slow water habitat, off-channel habitat, and fish hiding cover, mainly a natural condition.

●**Substrate and Fine Sediment:** Amounts of fine sediments were very low due to the high energy channel and lack of large wood, which gathers fine sediments. Substrate consisted mainly of medium to large size cobbles throughout most of the surveyed stream segment.

●**Bank Erosion:** The banks in reach 1 are more stable than in any of the other stream reaches due mainly to the lack of stream bends in the channel. Some erosion was observed where bank vegetation had been removed along the stream banks. Less than 5% of the stream banks were actively eroding.

●**Bankfull Area:** Very limited bankfull data was gathered during the survey due to the lack of time. One bankfull width measurement was taken in the reach, in a straight riffle near the beginning of the reach. The bankfull width was 111', with the average bankfull depth 3.15' (7 bankfull depth measurements were taken). The estimated bankfull area was about 350 square feet. The estimated bankfull width/depth ratio is about 35 to 1. The channel is confined, with an entrenchment ratio of about 1.3 (floodprone width divided by bankfull width; floodprone width is calculated at two times the maximum bankfull depth). The average wetted width in the stream reach at low flow is about 76'.

●**Stream Temperatures:** Water temperature data was collected at a site about 0.1 miles above Wolf Creek during the summer of 2005. Water temperatures were warmer than upstream reaches but are probably close to natural conditions due to the relatively undisturbed upstream riparian areas and lack of upstream water diversions. The highest recorded temperature in the reach during the summer of 2005 was 18.7◦C (66◦F) (see Appendix C for complete temperature data).

Methow River above the confluence with Wolf Creek

Reach break between reaches 1 and 2

II. HABITAT ASSESSMENT: MAIN CHANNEL METHOW RIVER REACH 2
From the bottom of the Heath Ranch to the top of a major side channel above Wolf Ridge Resort (RM 55.0 to 56.6)

Summary of Habitat Data:

●**Habitat Area:** The 1.6 mile reach had much more complex habitat than reach 1, with three large side channels and abundant backwater pool habitat. The habitat area in the reach is about 117,000 square yards (73,300 square yards per mile), consisting of about 37% pool habitat, 22% riffle and run habitat, and about 41% side channel and off-channel habitat.

●**Large Wood:** This 1.6 mile reach segment had the highest amount of large wood of all the surveyed stream segments in the main channel. About 36 pieces of wood per mile greater than 35' long with a diameter of at least 12" counted in the reach. In addition, about 110 pieces of wood per mile greater than 20' long with a diameter of at least 6" was counted in the reach. Much of the wood counted in the reach was in log jams on bars near RM 56.2, near the Wolf Ridge Resort. The jams have redirected much of the stream flow to a channel flowing to the south (towards Wolf Ridge Resort). Most of the flow to a major left bank side channel at RM 56.2 has been cut-off, resulting in poor quality fish habitat in the channel (see page for survey data in the side channel). The wood count in this reach is undercounted as many pieces of wood in the middle of the jams likely could not have been seen by surveyors. Large wood in all the surveyed reaches of the river was relocated during the high spring run-off in the spring of 2006. Large wood in the reach is deepening pools by creating larger areas of scour, providing good hiding cover for fish and capturing gravels used by steelhead and Chinook salmon for spawning.

●**Pool Habitat:** This reach had the highest amount of pool habitat of any of the stream segments in the survey area. About 63% of the total habitat area in the main channel consisted of pools. Most of the habitat in the side channel/off-channel habitat area was pool habitat. Pool habitat in the reach was deep, with about 40% of the pools in the reach having a max depth greater than 5' deep. Large wood and depth provided excellent hiding cover for fish. Many of the pools had long tail-outs which provided excellent spawning habitat for steelhead and Chinook salmon. Pools were formed predominantly at the bends of the river and by large wood, which had often gathered into log jams.

●**Riffle Habitat:** About 37% of the total habitat area in the main channel consisted of riffles. Excellent spawning habitat was observed in many of the riffles, as substrate consisted of more gravels and less coarse cobble than in reach 1. Large wood provided good hiding cover in some of the riffles. The average thalweg depth in the riffles was 1.4', excellent for migratory fish.

●**Side Channel and Off-Channel Habitat:** Off-channel habitat was abundant in the reach, consisting of about 41% of the total habitat area. A 2/3 mile long side channel that enters the left bank of the Methow River at the bottom of the Heath Ranch (RM 55) consists of a series of 9 beaver ponds, most at least 4 feet deep, with excellent hiding cover provided by vegetation and pieces of wood. Although brook trout is the dominant fish species in the ponds, spring Chinook juveniles were observed in the lower 2 ponds during snorkel surveys conducted in the ponds on 09-28-06 (see table 3 on page for fish snorkel data in the ponds). The river is not connected at the top of the side channel, possibly due to reduced flow to the area from the accumulation of log jams upstream along the left bank of the main channel during the 2006 high spring run-off. A 0.8 mile long left bank side channel originating at the top of the log jams (side channel 2, see habitat survey data in table 1 and 2 on pages) was flowing at less than 5 cfs at low flow (visual estimate). This side channel used to have considerably more flow and possibly provided year round flow into the top of the beaver ponds. A 0.3 mile long side channel enters the right bank of the river at RM 56 (at Wolf Ridge Resort, see habitat survey data in table 1 and 2 on pages). This side channel had excellent fish habitat, with more Chinook salmon redds per mile than any other stream segment in the survey area. Backwater pools were abundant in the reach.

●**Fish Spawning Habitat:** Excellent fish spawning habitat is found throughout the reach, both in the main channel and in a 0.3 mile side channel that flows by Wolf Ridge Resort. A total of 20 Chinook salmon redds per mile were counted in the1.6 mile long reach, the highest concentration of salmon redds in the main stem in the surveyed segment of the river.

●**Fish Rearing Habitat:** This river segment probably has some of the best fish rearing habitat for steelhead and Chinook salmon in the entire Methow River basin, with deep and complex pool habitat, abundant backwater pool habitat, and numerous large and deep beaver ponds in the side channels.

●**Substrate and Fine Sediment:** Substrate consisted almost entirely of cobbles and gravels, ideal for anadromous fish spawning. One pebble count was conducted in the survey area in the wetted channel during pebble counts conducted by the USFS during the fall of 2005. The D50 of the pebble count was 79 mm, about 40% smaller than a pebble count conducted in reach 1. A D50 value of 42 mm was generated from a pebble count conducted on a point bar, over 40% smaller than on a similar bar in reach 1. Fine sediments less than 6 mm were infrequent in riffles, with most of the fines mobilized into the upper (deep) end of the pools or downstream during high spring run-off.

●**Bank Erosion:** Much of the banks in reach 2 are actively eroding. Over 1,500' linear feet of bank erosion was counted per mile (about 15% of the total banks). Some of the erosion is attributed to channel migration during the 2006 spring run-off. The main channel above Wolf Ridge Resort widened from increased spring flows, causing much of the banks to erode. Bank erosion was prevalent along much of the right bank below the Wolf Ridge Resort from channel migration due to bed load and woody debris accumulations upstream. The river is migrating toward the floodplain on the right bank below and above the Wolf Ridge Resort. Some buildings could be in jeopardy if another heavy spring run-off occurs. The heaviest concentration of Chinook redds are also in the areas with the highest amount of bank erosion. Bank erosion (reworking of the forested floodplain) appears to be necessary for gravel recruitment necessary for the construction of fish redds.

●**Bankfull Area:** Very limited bankfull data was gathered during the survey due to the lack of time. One bankfull width measurement was taken in the reach, in a straight riffle near the middle of the reach. The bankfull width was 123', with the average bankfull depth 2.05' (7 bankfull depth measurements were taken). The estimated bankfull area in the main channelwas about 250' (a major side channel is on the north side of the floodplain where the bankfull measurement was taken). The estimated bankfull width/depth ratio is about 60 to 1. The channel is unconfined throughout the reach. The average wetted with in the stream reach at low flow is about 69'.

●**Stream Temperatures:** No water temperature monitor was installed in this reach during either the summer of 2005 or 2006. Water temperatures are probably close to near natural conditions due to the relatively undisturbed upstream riparian areas and lack of upstream water diversions.

●**Fish Passage:** There are no fish passage barriers in the reach.

Accumulation of woody debris at outflow of side channel 2

Log structures cabled on banks at Wolf Ridge Resort

III. HABITAT ASSESSMENT: MAIN CHANNEL METHOW RIVER REACH 3
From the top of a major side channel above Wolf Ridge Resort to a major left bank side channel above the Big Valley Ranch (RM 56.6 to 59.1)

Summary of Habitat Data:

●**Habitat Area:** The 2.5 mile reach features abundant complex fish habitat, with a total of 9 side channels and abundant backwater pool habitat. The habitat area in the reach is about 112,000 square yards (44,400 square yards per mile), consisting of about 48% pool habitat, 44% riffle and run habitat, and about 8% side channel and off-channel habitat.

●**Large Wood:** This stream segment has the highest amount of medium and large size wood of all the surveyed stream segments in the main channel, with about 37 pieces of wood per mile greater than 35' long with a diameter of at least 12" counted in the reach. The amount of small size pieces (>20' long with a diameter of at least 6") was significantly less than in reach 2 (35 pieces per mile compared with 110 pieces per mile) as most of the small pieces of wood were mobilized during the spring run-off of 2006 and captured in large log jams in the lower reach. Large wood in the reach is deepening pools by creating larger areas of scour, providing good hiding cover for fish and capturing gravels used by steelhead and Chinook salmon for spawning.

●**Pool Habitat:** This reach had about equal amounts of pools and riffles. Most of the habitat in the side channel/off-channel habitat area was pool habitat. Pool habitat in the reach was deep, with almost half of the pools in the reach having a max depth greater than 5' deep. Large wood and depth provided excellent hiding cover for fish. Many of the pools had long tail-outs which provided excellent spawning habitat for steelhead and Chinook salmon. Pools were formed predominantly at the bends of the river and by large wood, which deepened the scour at the stream bends.

●**Riffle Habitat:** About 48% of the total habitat area in the main channel consists of riffles. Excellent spawning habitat was observed in many of the riffles, as substrate consisted of more gravels and less coarse cobble than in reach 1. Large wood provides good hiding cover in some of the riffles. Some very long runs were observed in the reach. The runs are generally wide and deep with coarser substrate not conducive for anadromous fish spawning. The average thalweg depth in the riffles is 1.6', excellent for migratory fish.

●**Side Channel and Off-Channel Habitat:** Off-channel habitat was abundant in the reach, consisting of about 8% of the total habitat area. A total of 6 side channels were counted in the reach. A total of 9 beaver ponds (the deepest was 5' deep) were observed in the side channels. A 0.4 mile long side channel that exits the river at RM 58.75 appears to have less flow than in past years due to substrate and wood that is building up along the right bank at the channel exit, probably during the spring run-off in 2006. Good fish rearing habitat was observed in the side channel, which features several large and deep pools. A beaver pond formed by a beaver dam in a side channel that enters the river at RM 57.4 has numerous submerged logs, possibly from the old Fender Mill. This beaver pond was the largest observed in the reach.

●**Fish Spawning Habitat:** Excellent fish spawning habitat is found throughout the reach. A total of 18 Chinook salmon redds per mile were counted in the 2.5 mile long reach, the second highest concentration of salmon redds in the main stem in the surveyed segment of the river.

●**Fish Rearing Habitat:** This river segment has excellent fish rearing habitat, containing deep and complex pool habitat, abundant backwater pool habitat, and numerous large and deep beaver ponds and other pools in the side channels.

●**Substrate and Fine Sediment:** Substrate consisted almost entirely of cobbles and gravels, ideal for anadromous fish spawning. Two pebble counts were conducted in the reach in both the wetted channel and on bars during pebble counts conducted by the USFS during the fall of 2005. The D50 of the pebble counts in the channel averaged 70 mm, with an average D50 value on the bars of 60 mm. Fine sediments less than 6 mm were infrequent in riffles, with most of the fines mobilized into the upper (deep) end of the pools or downstream during high spring run-off.

●**Bank Erosion:** Much of the banks in reach 3 are actively eroding. Over 1,950' linear feet of bank erosion was counted per mile (about 18.5% of the total banks). Some of the erosion is attributed to channel migration during the 2006 spring run-off. The river is threatening to cut into the floodplain on the right bank below and above the Wolf Ridge Resort. Some structures could be in jeopardy when another heavy spring run-off occurs. The amount of bank erosion coincides with the amount of bank erosion, with the heaviest concentration of redds found in the areas with the highest amount of bank erosion. Bank erosion appears to be necessary for gravel recruitment necessary for the construction of fish redds.

●**Bankfull Area:** Very limited bankfull data was gathered during the survey due to the lack of time. Two bankfull width measurements were taken in the reach, in riffles about 1/3 and 2/3 through the reach. The bankfull width in the reach was wider than in any of the other surveyed stream reaches. Bars were often wider than the river's wetted width. The bankfull width averaged 198', with the average bankfull depth 1.85' (7 bankfull depth measurements were taken). The estimated bankfull area in the main channel was about 365' (no side channels were in the floodplain where the measurement was taken). The estimated bankfull width/depth ratio is close to 100 to 1. The channel is unconfined throughout the reach. The average wetted width in the stream reach at low flow is about 67'.

●**Stream Temperatures:** One water temperature monitor was installed within the reach during the summer of 2005, with a high temperature of 18.1◦C (64.5◦F). Water temperatures are probably close to near natural conditions due to the relatively undisturbed upstream riparian areas and lack of upstream water diversions. See Appendix C for complete water temperature data.

●**Fish Passage:** There are no fish passage barriers in the reach.

Chinook salmon redd in reach 3

Sand deposit in side channel near confluence with Methow River

Downed trees in channel near the end of reach 3

IV. HABITAT ASSESSMENT: MAIN CHANNEL METHOW RIVER REACH 4
From a major left bank side channel above the Big Valley Ranch to the confluence with Hancock Springs (RM 59.1 to 60.0)

Summary of Habitat Data:

●**Habitat Area:** The lower 0.6 miles of the 0.9 mile reach is a fairly straight, wide channel with less pool habitat, few pieces of large wood, and fewer and smaller bars. The upper 0.3 mile segment of the reach has much more complex fish habitat, with abundant large wood and deep pools. A major channel that used to flow along the north side of the floodplain in this reach is now dry at low flow. This channel had over 50% of the flow in 2005 (USFS flow measurement data, October 2005). The habitat area in the reach is about 42,800 square yards (47,800 square yards per mile), consisting of about 37% pool habitat, 61% riffle and run habitat, and about 2% side channel and off-channel habitat.

●**Large Wood:** 19 pieces of large wood greater than 35' long with a diameter of at least 12" were counted in the reach. Most of the pieces of wood are found in the upper third segment of the reach. The channel makes a major turn to the east about 0.3 mile below Hancock Springs, and is fairly straight for the rest of the reach. About 38 pieces of wood in the small size category (>20' long with a diameter of at least 6") were counted in the reach, with the majority found in the upper 0.3 miles.

●**Pool Habitat:** Four pools were counted in the lower 0.6 miles of the reach. Only one of the four pools was > 4' deep. Fish hiding cover was only fair, with few pieces of wood. Boulders formed a 5' deep pool with good cover near the middle of the reach. A total of 7 pools were counted in the upper 0.3 miles of the reach, with good cover from large wood and depth.

●**Riffle Habitat:** Most of the habitat in the lower 0.6 miles consists of wide and relatively shallow riffles and runs. Short riffles are found in between the large, deep pools in the upper 0.3 miles. The average thalweg depth in the riffles was 1.2', the shallowest of the four surveyed main stem river reaches.

●**Side Channel and Off-Channel Habitat:** One side channel was observed in the reach, at the bend where the river makes a sharp turn easterly. Very little off-channel habitat was observed in the lower 0.6 miles of the reach, as the river is generally straight and wide, with few bars. Several backwater pools were observed in the upper 0.3 miles, with a large backwater pool formed at the confluence with Hancock Springs.

●**Fish Spawning Habitat:** Some good Chinook salmon spawning habitat is found in the reach, especially in the upper 0.3 miles. Nine spring Chinook salmon redds and one summer Chinook redd was observed in the lower 0.6 miles (15 redds per mile); five spring Chinook salmon redds and one summer Chinook salmon redd were observed in the upper 0.3 miles (17 redds per mile).

●**Fish Rearing Habitat:** The upper 0.3 miles has good fish rearing habitat, with good hiding cover provided by log jams in the pools. Fish rearing habitat in the lower 0.6 miles of the reach is fair at best, with cover provided mainly by some boulders and a few pieces of large wood.

●**Substrate and Fine Sediment:** Substrate again consisted mainly of cobbles and gravels, ideal for anadromous fish spawning. Small size boulders were found in some segments of the lower 0.6 miles of the reach. One pebble count was conducted in the reach on a bar during pebble counts conducted by the USFS during the fall of 2005. The D50 of the pebble count was 51 mm. Fine sediments less than 6 mm were infrequent in riffles, with most of the fines mobilized into the upper (deep) end of the pools or downstream during high spring run-off.

●**Bank Erosion:** Stream banks in the reach were relatively stable, with about 768 linear feet of bank per mile actively eroding (7.3% of the total banks). Much of the erosion is attributed to the increased flow from the 2006 spring run-off in the upper 0.3 miles of the reach. This area of the stream channel appears to have widened and deepened, as the channel that flows along the north side of the floodplain is now dry at low flow. Some bank erosion was observed in the lower 0.6 miles of the reach, but most of this erosion occurred in previous years and is now healing.

●**Bankfull Area:** Very limited bankfull data was gathered during the survey due to the lack of time. One bankfull width measurements was taken in the reach, in a riffles about half way through the reach. The bankfull width at this location measured 117', with an average bankfull depth of about 2.2' (7 bankfull depth measurements were taken. The estimated bankfull area in the main channel was about 250' (a major channel is found on the north side of the floodplain in this area). The estimated bankfull width/depth ratio is about 54 to 1. The channel is unconfined throughout the reach. The average wetted with in the stream reach at low flow is about 75', wider than the two reaches below.

●**Stream Temperatures:** One water temperature monitor was installed within the reach during the summers of 2005 and 2006, with recorded high temperatures of 18.3◦C (65◦F) in 2005 and 18.5◦C (65.3◦C) in 1006. Water temperatures are probably close to near natural conditions due to the relatively undisturbed upstream riparian areas and lack of upstream water diversions. See Appendix C for complete water temperature data.

●**Fish Passage:** There are no fish passage barriers in the reach.

Typical habitat in lower section of reach 4

Log jam in pool in upper segment of reach 4

Top of reach; major side channel on north side of floodplain is dry at low flow

V. HABITAT ASSESSMENT: SIDE CHANNEL #2 - METHOW RIVER REACH 2
Side channel exits at RM 56.1, re-enters at RM 55.5

Summary of Habitat Data:

●**Habitat Area:** Much of the flow was cut off to the side channel during the high run-off during the spring of 2006. Although the bankfull channel is similar in size to the main channel, less than 5 cfs was flowing in the channel at the time of the survey (visual estimate). Large wood was deposited by spring flows along the left side of the river at RM 56.1, forming large jams that aggraded the bank. The habitat area in the side channel is about 22,000 square yards (27,200 square yards per mile), consisting of about 59% pool habitat, 36% riffle and run habitat, and about 5% side channel and off-channel habitat.

●**Large Wood:** About 30 pieces of large wood per mile greater than 35' long with a diameter of at least 12" were counted in the side channel. Most of the pieces of wood are found in a huge log jam in a pool at a major bend in the river about ¼ mile from the mouth of the side channel, and in the log jams where the channel exits the main channel. Large wood is scarce in most of the other areas within the reach.

●**Pool Habitat:** Although nearly 60% of the habitat area consists of pools, most of the pools were shallow, due mainly to the lack of stream flow. The average pool residual depth was 2.8', with no pools > 5' deep found in the side channel. The deepest pool was formed by a huge log jam about ¼ mile from the mouth of the side channel. The pool was 760' long with a max depth of 4'. Only two of the other 9 pools in the side channel were > 1 meter deep.

●**Riffle Habitat:** About 36% of the habitat area consisted of riffles or runs. Poor fish habitat was observed in the riffles due mainly to the lack of flow and the lack of large wood. The average thalweg depth in the riffles was 0.7', the shallowest of the 6 stream segments in the survey.

●**Side Channel and Off-Channel Habitat:** A large side channel enters the right bank just above the long, deep pool described above. A pond about 300' long and 25' wide with a max depth of 2.8' was observed in the side channel. The 450' long side channel does not reconnect with the main channel. Two channels exit the main channel at RM 56.1, forming the side channel.

●**Fish Spawning Habitat:** Poor Chinook salmon spawning habitat exists in the side channel due mainly to the lack of stream flow. One spring Chinook redd (unflagged by WDFW) was observed near the top of the side channel.

●**Fish Rearing Habitat:** Fish rearing habitat was limited at low flow due to the lack of stream flow at the time of the survey. Some good rearing habitat exists at higher flows, especially within the log jams a quarter mile from the mouth and at the top of the side channel. The off-channel pond above the lower log jam provides good fish rearing habitat.

●**Substrate and Fine Sediment:** Substrate again consisted mainly of cobbles, with a smaller amount of gravels. Sand was more prevalent in the side channel than in any of the four reaches surveyed in the main channel, probably due to lower stream energy.

●**Bank Erosion:** Stream banks in the side channel were more stable than in most of the main stem, with about 864' linear feet of bank per mile actively eroding (8.2 % of the total banks). Much of the erosion was observed at the bends in the river.

●**Bankfull Area:** Very limited bankfull data was gathered during the survey due to the lack of time. One bankfull width measurements was taken in the reach, in a riffles about half way through the reach. The bankfull width at this location measured 98', with an average bankfull depth of about 1.8' (7 bankfull depth measurements were taken). The estimated bankfull area in the side channel was about 175'. The estimated bankfull width/depth ratio is about 54 to 1. The channel is unconfined throughout the reach. Rip-rap protects the left bank of the stream about 2/3 of a mile from the mouth. The average wetted with in the stream reach at low flow is about 43'.

●Stream Temperatures: No water temperature monitor was installed in this reach during either the summer of 2005 or 2006. Water temperatures are probably close to near natural conditions due to the relatively undisturbed upstream riparian areas and lack of upstream water diversions.

●Fish Passage: Log jams and bed load deposition at the top of the side channel may be a barrier to some fish.

Pool and riprap near top of side channel

Off-channel habitat in side channel

VI. HABITAT ASSESSMENT: SIDE CHANNEL #4 - METHOW RIVER REACH 2
Side channel exits at RM 56.6, re-enters at RM 56.0

Summary of Habitat Data:

●**Habitat Area:** This deep and relatively narrow 0.3 mile long side channel had the highest concentrations of spring and summer Chinook salmon redds of any of the river segments surveyed in 2006. The habitat area in the side channel is about 11,000 square yards (36,700 square yards per mile), consisting of about 29% pool habitat, 50% riffle and run habitat, and about 21% side channel and off-channel habitat.

●**Large Wood:** About 67 pieces of large wood per mile greater than 35' long with a diameter of at least 12" were counted in the side channel. Most of the pieces of wood are found in a large log jams at the top of the side channel where it exits the river.

●**Pool Habitat:** Three of the four pools in the main stem of the side channel had a depth of greater than 5.5'. Pools were formed at the bends in the river. Log jams increased scour depth in the uppermost pool and in pools in the side channels.

●**Riffle Habitat:** About 50% of the habitat area in the side channel consisted of riffles. Most of the Chinook salmon redds were in the riffles, which had substrate ideal for salmon spawning. The average thalweg depth in the riffles was 1.3', excellent for migratory fish.

●**Side Channel and Off-Channel Habitat:** Two beaver dammed side channels enter the left bank near the middle of the side channel. The beaver ponds create good fish rearing habitat.

●**Fish Spawning Habitat:** A total of 19 spring Chinook salmon redds and 5 summer Chinook salmon redds were counted in the reach (76 redds per mile). Almost 4 times as many redds per mile were counted in this reach than in any of the other river segments surveyed in 2006. Fourteen of the redds were counted in a 400' long riffle above a 5.5' deep pool near the mouth of the side channel. The riffle consisted mainly of gravel, with lesser amounts of cobble and sand.

●**Fish Rearing Habitat:** Some excellent fish rearing habitat is found in the side channels within the reach and in the log jams at the top of the side channel.

●**Substrate and Fine Sediment:** Fine sediments were more prevalent in the side channel than in any of the four reaches surveyed in the main channel, as nearly 25% of the banks are actively eroding. Substrate in the pool scour consisted mainly of fine sediments. Gravel was the predominant substrate in the side channel, with abundant cobbles at the top of the channel.

●**Bank Erosion:** More bank erosion was observed in this stream segment than in any of the other stream segments in the survey. A total of 2,458 linear feet of bank erosion per mile was measured in the reach (23.3% of the total banks). Much of the bank erosion could be from the high spring run-off which appears to have affected the channel.

●**Bankfull Area:** Very limited bankfull data was gathered during the survey due to the lack of time. One bankfull width measurements was taken in the side channel, in a riffles about half way through the reach. The bankfull width at this location measured 43', with an average bankfull depth of about 2.2' (7 bankfull depth measurements were taken). The estimated bankfull area in the side channel was about 95'. The estimated bankfull width/depth ratio is about 20 to 1. The channel is unconfined throughout the reach. .

●**Stream Temperatures:** No water temperature monitor was installed in this reach during either the summer of 2005 or 2006. Water temperatures are probably close to near natural conditions due to the relatively undisturbed upstream riparian areas and lack of upstream water diversions.

150’ long riffle in side channel with 6 Chinook redds

Off-channel beaver pond in side channel

Table 1: METHOW RIVER STREAM SURVEY DATA SUMMARY
WOLF CREEK TO HANCOCK SPRINGS: MAIN CHANNEL
10-23-06 to 10-27-06

	Reach 1	Reach 2	Reach 3	Reach 4	Total
Reach Mileage (BOR maps)	54.2 to 55.0	55.0 - 56.6	56.6 -59.1	59.1 -60.0	54.2 to 60.0
Reach Length (measured distance)	0.8 miles	1.7 miles	2.6 miles	1.0 miles	6.0 miles
Average Wetted Width:	76’	69’	67’	75’	70’
Average Thalweg Depth (riffles):	1.8’	1.4’	1.6’	1.2’	1.5’
Habitat Area:					
% Pool	11.8%	37.0%	48.0%	37.3%	39%
% Riffle	83.0%	19.6%	33.4%	48.4%	39%
% Glide (non-turbulent riffles)	5.2%	1.8%	10.8%	12.8%	7%
% Side Channel	0%	41.6%	7.8%	1.5%	15%
Pools:					
Pools per Mile in main channel	1.2	11.8	7.9	11.5	8.8
Pools > 5’ deep per mile	0	4.7	3.8	3.1	3.5
Avg. Pool Maximum Depth	3.0’	4.5’	4.4’	4.0’	4.3’
Avg. Pool Residual depth	1.2’	3.3’	3.1’	2.9’	3.1’
Riffle to Pool Ratio (main channel)	7.0 to 1	0.54 to 1	0.93 to 1	1.24 to 1	1.18 to 1
Large Wood per Mile:					
Small (>20’ Long, > 6” diameter)	8.7	110.0	35.5	37.6	54
Medium (>35’Long, 12-20” diam.)	3.7	28.8	30.2	14.6	24
Large (>35’ Long, >20” diameter)	0	7.6	7.2	4.2	6
Bank Erosion:					
Linear Length per Mile	405’	1,556’	1,962’	768’	1,470’
% Eroding Banks	4.8%	14.7%	18.6%	7.3%	14%
Bankfull Data (main channel):[1]					
Bankfull Width	111’	123’	198’	117’	-
Bankfull Depth	3.15’	2.05’	1.85’	2.18’	-
W/D Ratio	35.2	60.0	107.0	53.7	-
Entrenchment ratio[2]	1.3	>10	>10	>10	-
Substrate (Ocular estimate):					
% Sand	5%	5%	5%	5%	5%
% Gravel	20%	35%	45%	40%	39%
% Cobble	65%	60%	55%	50%	54%
% Boulder	10%	-		5%	2%
# of Chinook Salmon Redds	3	34	47	16	100
# Chinook Salmon Redds per mile	3.7	20.0	17.8	16.7	16.7

[1]Very rough estimate, one to two bankfull measurements were taken per reach.
[2]Floodprone width (width at 2 x max bankfull depth) divided by bankfull width.

Table 2: METHOW RIVER STREAM SURVEY DATA SUMMARY
WOLF CREEK TO HANCOCK SPRINGS: MAJOR SIDE CHANNELS
10-23-06 to 10-27-06

	Side Channel 2 (Heath Ranch)	**Side Channel 4 (Wolf Ridge)**
Reach Length (measured distance)	0.8 miles	0.3 miles
River Mile entering main channel	55.5 (left bank)	56 (right bank)
Reach number in Main Channel	2	2
Average Wetted Width:	42.6’	47.7’
Average Thalweg Depth (riffles):	0.7’	1.3’
Habitat Area:		
% Pool	59.3%	28.6%
% Riffle	33.2%	49.7%
% Glide (non-turbulent riffles)	3.0%	-
% Side Channel	4.5%	21.7%
Pools:		
Pools per Mile	12.0	12.9
Pools > 5’ deep per mile	0	9.7
Avg. Pool Maximum depth	2.8’	5.1’
Avg. Pool Residual depth	2.3’	4.3’
Riffle to Pool Ratio	0.64 to 1	1.95 to 1
Large Wood per Mile:		
Small (>20’ Long, > 6” diameter)	70.4	171.2
Medium (>35’Long, 12-20” diam.)	27.4	63.4
Large (>35’ Long, >20” diameter)	2.4	3.2
Bank Erosion:		
Linear Length per Mile	864’	2,458’
% Eroding Banks	8.2%	23.3%
Bankfull Data:[1]		
Bankfull Width	98’	43’
Bankfull Depth	1.80’	2.20’
W/D Ratio	54.4	19.5
Substrate (Ocular estimate):		
% Sand	10%	15%
% Gravel	30%	45%
% Cobble	60%	40%
% Boulder	-	-
# of Chinook Salmon Redds	1	24
# Chinook Salmon Redds per mile	1.2	76.1

[1]Very rough estimate, one bankfull measurements was taken in each side channel.

Table 3: Snorkel Survey of Ponds on the Heath Ranch
T35N, R21E, Section 30
09-28-06

Area snorkeled	Estimated amt. of pond or pool snorkeled	Fish Species Observed	Number & Size of Fish Observed	Notes
Pool below side channel entrance	150' L x 60' W 5' max depth	Whitefish	4 > 16"	Only the deep area of the pool was snorkeled, not the tail-out.
		Bull Trout	1 18"	
Pond 1 - Side channel connected to river	250' L x 25' W 3' max. depth	Chinook salmon	1 4"	Small jam created pond in side channel. One Chinook redd.
		Rainbow trout	1 10"	
Pond 2 – Connected to river at top of pond.	400' L x 30' W	Shiners	20 0.5"	Beaver dam at pool crest. Three redds at crest (one Chinook redd, 2 possible brook trout redds)
		Chinook salmon	15 4"	
		Rainbow trout	1 5"	
Pond 3 – Flows into pond 2. Beaver dam.	Large pond. A 100' x 30' segment was snorkeled.	Brook trout	6 3-8"	Beaver dammed pond is elevated 2' above pond 2 (at low flow).
Pond 4 – Flows into pond 3. Beaver dam.	40' L x 40' W 5 – 6' max depth	Brook trout and Chinook salmon	About 14 total fish , 3-8"	The murkiness of the water made it impossible to identify all the fish. Recent beaver activity.
Pond 5 – Flows into pond 4. Beaver dam.	100' L x 30' W	Brook trout	6 5-8"	Beaver dammed pond is elevated 3' above pond 4. All Chinook were observed under the dam.
		Chinook salmon	10 4"	
Pond 6 – Flows into pond 5.	500' L x 60' W Max depth > 5'	Brook trout	>100 8-18"	Numerous brook trout 16" to 18". Spawning gravel at inlet (below road culvert). Water is murky.
Pond 7 – Flows into pond 6 through 2 culverts under road.	400' L x 100'W about 5' max depth	Brook trout	>50 3"-16"	A dirt road separates the two ponds. The water in this pond is crystal clear. There is a long, narrow, pond that connects to the river, dry at this time of year.
Pond 8 – Above pond 7. Connectivity to pond 7 is not known.	200' L x 500'W Shallow pond (2' or so).	Brook trout Painted turtle	6 3-4" one	A road crosses through the pond. The pond above the road was snorkeled. Few fish observed. High water channel on SW side, dry after 200'.
Pond 9 – Largest pond, not connected to other ponds	500'L x 200'W The pond is up to 10' deep	No fish observed.		Only about 25% of the pond was snorkeled.

Water temperatures were between 12◦C and 13.5◦C.

APPENDIX A –

Matrix of Pathways and Indicators completed by the U.S. Forest Service Methow Valley Ranger District.

TABLE 1. MATRIX OF PATHWAYS AND INDICATORS

(Remember, the ranges of criteria presented here are not absolute, they may be adjusted for unique watersheds.)

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Water Quality:	Temperature	50-57º F	57-60º (spawning) 57-64º (migration & rearing)[2]	>60º (spawning) >64º (migration & rearing)[2]
	Sediment/Turbidity	<12% fines (<0.85mm) in gravel[3], turbidity low	12-17% (west-side)[3] 12-20% (east-side)[2] turbidity moderate	>17% (west-side)[3]20% (east side)[2] fines at surface or depth in spawning habitat[2], turbidity high
	Chemical Contamination/Nutrients	Low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no CWA 303d designated reaches[5]	Moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients one CWA 303d designated reach[5]	High levels of chemical contamination from agricultural, industrial and other sources, high levels of excess nutrients, more than one CWA 303D designated reach[5]
Habitat Access:	Physical Barriers	Any man-made barriers present in watershed allow upstream and downstream fish passage at all flows	Any-man-made barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows	Any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows
Habitat Elements	Substrate	Dominant substrate is gravel or cobble (interstitial spaces clear), or embeddedness<20%[3]	gravel or cobble is subdominant, or if dominant embeddedness 20-30%[3]	Bedrock, sand, silt or small gravel dominant, or if gravel or cobble dominant, embeddedness >30%[2]
	Large Woody Debris	<u>Coast</u>: >80 pieces/mile >24" diameter >50 ft. length[4]; <u>East-side</u>: >20 pieces/mile >12" diameter >35 ft. length[2]; and adequate sources of woody debris recruitment in riparian areas	Currently meets standards for properly functioning, but lacks potential sources from riparian areas of woody debris recruitment to maintain that standard	Does not meet standards for properly functioning and lacks potential large woody debris recruitment
	Pool Frequency <u>Channel width</u> <u># pools/mile</u>[6] 5 feet 184 10 " 96 15" 70	Meets pool frequency standards (left) and large woody debris recruitment standards for properly functioning habitat (above)	Meets pool frequency standards but large woody debris recruitment inadequate to maintain pools over time	Does not meet pool frequency standards

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
	20" 56 25" 47 50" 26 75" 23 100" 18			
	Pool Quality	Pools>1 meter deep (holding pools) with good cover and cool water[e], minor reduction of pool volume by fine sediment	Few deeper pools (>1 meter) present or inadequate cover/temperature[3], moderate reduction of pool volume by fine sediment	No deep pools (>1 meter) and inadequate cover/temperature[3], major reduction of pool volume by fine sediment
	Off-Channel Habitat	Backwaters with cover, and low energy off-channel areas (ponds, osbows, etc.)[3]	Some backwaters and high energy side channels[3]	Few or no backwaters, no off-channel ponds[3]
	Refugia (important remnant habitat for sensitive aquatic species)	Habitat refugia exist and are adequately buffered (e.g., by intact riparian reserves); existing refugia are sufficient in size, number and connectivity to maintain viable populations or sub-populations[7]	Habitat refugia exist but are not adequately buffered (e.g., by intact riparian reserves); existing refugia are sufficient in size, number and connectivity to maintain viable populations or sub-populations[7]	Adequate habitat refugia do not exist[7]
Channel Condition & Dynamics:	Width/Depth Ratio	<10[2,4]	10-12 (we are unaware of any criteria to reference)	>12 (we are unaware of any criteria to reference)
	Streambank Condition	>90 % stable; i.e., on average, less than10% of banks are actively eroding[2]	80-90% stable	<80% stable
	Floodplain Connectivity	Off-channel areas are frequently hydrologically linked to main channel; overback flows occur and maintain wetland functions, riparian vegetation and succession	Reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation;/succession	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly
Flow/Hydrology:	Change in Peak/Base Flows	Watershed hydrograph indicates	Some evidence of altered	Pronounced changes in peak

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
		peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography	peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography	flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography
	Increase in Drainage Network	Zero or minimum increases in drainage network density due to roads[8,9]	Moderate increases in drainage network density due to roads (e.g., 5%)[8,9]	Significant increases in drainage network density due to roads (e.g., 20-25%)[8,9]
Watershed Conditions:	Road Density & Location	<2 mi/mi^2, no valley bottom roads	2-3mi/mi^2, some valley bottom roads	>3 mi/mi^2, many valley bottom roads
	Disturbance History	<15% ECA (entire watershed) with no concentration of disturbance in unstable or potentially unstable areas, and/refugia, and/or riparian area; and for NWFP area (except AMAs), 15% retention of LSOG in watershed[10]	<15% ECA (entire watershed) but disturbance concentrated in unstable or potentially unstable areas, and/refugia, and/or riparian area; and for NWFP area (except AMAs), 15% retention of LSOG in watershed[10]	<15% ECA (entire watershed) and disturbance concentrated in unstable or potentially unstable areas, and/refugia, and/or riparian area; does not meet NWFP standard for LSOG retention
	Riparian Reserves	The riparian reserve system provided adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds, and buffers or includes known refugia for sensitive aquatic species (>80% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition >50%[12]	Moderate loss of connectivity or function (shade, LWD recruitment, etc.) or riparian reserve system, or incomplete protection of habitats and refugia for sensitive aquatic species (70-80% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition 25-50% or better[12]	Riparian reserve system is fragemented, poorly connected, or provides inadequate protection of habitats and refugia for sensitive aquatic species (<70% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition <25%[12]

[1] Bjornn, T.C. and D.W. Reiser, 1991. Habitat Requirements of Salmonids in Streams. American Fisheries Society Special Publication 19:83-138. Meehan, W.R., ed.
[2] Biological Opinion on land and Resource Management Plans for the: Boise, Challis, Nez Perce, Payette, Salmon, Sawtooth, Umatilla, and Wallowa-Whitmand, National Forests. March 1, 1995.
[3] Washington Timer/Fish Wildlife Coorperative Monitoring Evaluation and Research Committee, 1993. Watershed Analysis Manual (Version 2.0). Washington Department of Natural Resources.
[4] Biological Opinion on Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH). National Marine Fisheries Service, Northwest Region, January 23, 1995.
[5] A Federal Agency Guide for Pilot Watershed Analysis (Version 1.2), 1994.
[6] USDA Forest Service, 1994. Section 7 Fish Habitat Monitoring Protocol for the Upper Columbia River Bash.
[7] Frissell, C.A., Liss, W.J., and David Bayles, 1993. An Integrated Biophysical Strategy for Ecological Restoration of Large Watersheds. Proceedings from the Symposium on

TABLE 2. MATRIX OF PATHWAYS AND INDICATORS INTERPRETATION.

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Water Quality:	Temperature	50-57º F (10◦-14C)	57-60ºF,14◦-15◦C (spawning) 57-64ºF, 14-17.8◦C (migration & rearing)[2]	>60ºF, >15◦C (spawning) >64ºF, >17.8◦C (migration & rearing)[2]

Water Quality: Temperature	Reach 1 RM 54.2 to 55.0	Reach 2 RM 55.0 - 56.6	Reach 3 RM 56.6 -59.1	Reach 4 RM 59.1 -60.0	Reach 5 RM 60.0 – 61.0	Side Channel 2 (Heath Ranch)[1]	Side Channel 4 (Wolf Ridge)[2]
Highest Recorded Temperature	18.7◦C (2005)	No data	18.1◦C (2005)	17.4◦C (2005) 17.1◦C (2006)	18.5◦C (2005) 18.3◦C (2006)	No data	No data
Number of Days > 14◦C (at risk for rearing)	64		63	55 (2005) 49 (2006)	70 (2005) 54 (2006)	-	-
Number of Days > 17.8◦C (Not Properly Functioning for rearing)	6	-	0	0 (2005) 0 (2006)	5 (2005) 4 (2006)	-	-
Highest Temperature during Chinook spawning	17.3◦C	-	16.8◦C	16.1◦C (2005) 14.7◦C (2006)	17.4 (2005) 16.5 (2006)	-	-
Avg daily high temperature during Chinook spawning				14.8◦C (2005) 13.8◦C (2006)	16.5◦C (2005) 15.1◦C (2006)	-	-
-Last 3 weeks in August	16.3◦C	-	15.6◦C	12.1◦C (2005)	14.1◦C (2005)		
-First 3 weeks in Sept.	13.4◦C	-	12.4◦C	11.5◦C (2006)	13.0◦C (2006)		
Number of Days during Chinook spawning > 15◦C (NPF for spawning)	21	-	16	7 (2005) 0 (2006)	22 (2005) 17 (2006)	-	-

[1]The 0.8 mile long side channel is in reach 2, on the left bank between river mile 55.5 to river mile 56.2.
[2]The 0.3 mile long side channel is in reach 2, on the right bank between river mile 56.1 and 56.6.

NARRATIVE SUMMARY

Although water temperatures exceed the temperature criteria for properly functioning anadromous fish habitat, water temperatures in this segment of the Methow River are likely close to natural conditions. Water is not being diverted in the reach or upstream in the Methow River, and it is unlikely that domestic wells reduce flow to a measurable degree. The river (and its major tributaries) largely flows through forest for much of its length above the Wolf Creek alluvial fan. WDFW spawning data shows that over the past few years, the six mile reach between the top of the Wolf Creek alluvial fan and the Weeman Bridge has had the greatest concentration of both spring Chinook salmon spawning and steelhead spawning in the main stem Methow River.

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Water Quality:	Chemical Contamination/Nutrients	Low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no CWA 303d designated reaches[5]	Moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients one CWA 303d designated reach[5]	High levels of chemical contamination from agricultural, industrial and other sources, high levels of excess nutrients, more than one CWA 303D designated reach[5]

Water Quality: Chemical contaminations	Reach 1 RM 54.2 to 55.0	Reach 2 RM 55.0 - 56.6	Reach 3 RM 56.6 -59.1	Reach 4 RM 59.1 -60.0	Reach 5 RM 60.0 – 61.0	Side Channel 2 (Heath Ranch)[1]	Side Channel 4 (Wolf Ridge)[2]
CWA 303d designation	Not a CWA 303d designated reach	Not a CWA 303d designated reach	Not a CWA 303d designated reach	Not a CWA 303d designated reach	Not a CWA 303d designated reach	Not a CWA 303d designated reach	Not a CWA 303d designated reach

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Habitat Elements	**Substrate**	Dominant substrate is gravel or cobble (interstitial spaces clear), or embeddedness<20%[3]	gravel or cobble is subdominant, or if dominant embeddedness 20-30%[3]	Bedrock, sand, silt or small gravel dominant, or if gravel or cobble dominant, embeddedness >30%[2]

Habitat Elements: Substrate	Reach 1 RM 54.2 to 55.0	Reach 2 RM 55.0 - 56.6	Reach 3 RM 56.6 -59.1	Reach 4 RM 59.1 -60.0	Reach 5 RM 60.0 – 61.0	Side Channel 2 (Heath Ranch)	Side Channel 4 (Wolf Ridge)
2005 Pebble Count Data:							
River Mile	54.?	55.5	56.6	59.?		No data	No data
Pebble Count data **on bar:**	MR 36	MR37	MR38	MR41			
-D35: D50: D84	56: 73: 124	27: 42: 93	50: 61: 116	39: 51: 92			
-% Substrate (sa, gr, co, bo)	2, 40, 57, 1%	3, 62, 35, 0%	4, 49, 47, 0%	8, 58, 36, 0%			
Pebble count **wetted width**							
-D35: D50: D84	104: 130: 214	60: 79: 170	64: 79: 141	No channel			
-% Substrate (sa, gr, co, bo)	1, 14, 79, 6%	0, 38, 56, 6%	4, 36, 60, 0%	pebble count			
River Mile							
Pebble Count data **on bar**:			MR39				
-D35: D50: D84			42: 59: 161				
-% Substrate (sa, gr, co, bo)			2, 51, 47, 0%				
Pebble count **wetted width**							
-D35: D50: D84			58: 73: 114				
-% Substrate (sa, gr, co, bo)			7, 49, 44, 0%				
Ocular Est.: 2006 survey							
Sand, gravel, cobble, bldr.	5, 25, 65, 10%	5, 35, 60, 0%	5, 45, 55, 0%	5, 40, 50, 5%		10, 30, 60, 0%	15, 45, 40, 0%
(includes pools)							

[1]The 0.8 mile long side channel is in reach 2, on the left bank between river mile 55.5 to river mile 56.2. [2]The 0.3 mile long side channel is in reach 2, on the right bank between river mile 56.1 and 56.6.

NARRATIVE SUMMARY

Pebble counts were conducted on bars and across the wetted width of the channel at several locations between Wolf Creek and the Weeman Bridge. The % of substrate in 5 size categories based on Wolman pebble count criteria was ocularly estimated on every habitat unit during the 2006 habitat survey (sand, gravel, cobble, boulder and bedrock). Both the pebble count data and the ocular estimates show that over 95% of the substrate in the Methow River between Wolf Creek and the Weeman bridge is either in the gravel or cobble size range. None of the substrate within the wetted width of the river was judged by surveyors to be embedded (> 20% buried in fine sediments).

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Habitat Elements	**Large Woody Debris**	Coast: >80 pieces/mile >24" diameter >50 ft. length[4]; East-side: >20 pieces/mile >12" diameter >35 ft. length[2]; and adequate sources of woody debris recruitment in riparian areas.	Currently meets standards for properly functioning, but lacks potential sources from riparian areas of woody debris recruitment to maintain that standard	Does not meet standards for properly functioning and lacks potential large woody debris recruitment

Habitat Elements: Large Wood	Reach 1 RM 54.2 to 55.0	Reach 2 RM 55.0 - 56.6	Reach 3 RM 56.6 -59.1	Reach 4 RM 59.1 -60.0	Reach 5 RM 60.0 – 61.0	Side Channel 2 (Heath Ranch)[1]	Side Channel 4 (Wolf Ridge)[2]
Large Wood per Mile:							
Large (>35' long, > 20" diameter)	0	7.6	7.2	4.2		2.4	3.2
Medium (>35' long, 12-20" dia.)	3.7	28.8	30.2	14.6		27.4	63.4
Total Large and Medium	3.7	36.4	37.4	18.8		29.8	66.6
Small (>20' long, > 6" diameter)	8.7	110.0	35.5	37.6		70.4	171.2
LWD Recruitment Potential[3]	Poor[3]	Good[3]	Good[3]	Good[3]	Good[3]	Good[3]	Good[3]

[1]The 0.8 mile long side channel is in reach 2, on the left bank between river mile 55.5 to river mile 56.2.
[2]The 0.3 mile long side channel is in reach 2, on the right bank between river mile 56.1 and 56.6.
[3]The future recruitment potential for large wood debris is discussed in the narrative below.

NARRATIVE SUMMARY

The criteria for amounts of large wood was met in every reach except reach 1 (Wolf Creek alluvial fan), where large wood was scarce due primarily from transport and past removal of wood for flood control. The 5 mile segment of the Methow River from the Heath Ranch to the Hancock Springs (RM 55 to 60) likely has more large wood than any other river stream segment on privately owned land in the Methow Valley (USFS and Pacific Watershed Institute stream survey data, 1993-2006). The highest concentrations of large wood was found in a half mile segment located between RM 56.1 (near Wolf Ridge Resort) and 56.6. Numerous log jams were formed here during the high spring run-off of 2006. The jams and cobble deposition blocked a significant amount of flow to a major river left side channel located at about 56.1. Log jams divert water into a river right side channel at RM 56.6. This side channel appears to have increased flow in 2006. The recruitment potential for large wood deposition was low in reach 1 due to the removal of trees for agriculture along the right bank, and from highway 20, which parallels the river along the left bank. The recruitment potential for large wood was good in 5 mile segment of the river located above the Heath Ranch as the river flows mainly through forest away from Highway 20. See Appendix A for a comparison of amounts of large wood (and other stream attributes) on the Methow River Big Valley reaches with similar river segments in the Methow River Basin.

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Habitat Elements	**Pool Frequency** Wetted Channel width — # pools/mile 5 feet — 184 10 “ — 96 15” — 70 20” — 56 25” — 47 50” — 26 75” — 23 100” — 18	Meets pool frequency standards (left) and large woody debris recruitment standards for properly functioning habitat (above)	Meets pool frequency standards but large woody debris recruitment inadequate to maintain pools over time	Does not meet pool frequency standards

Habitat Elements: Pool Frequency*	Reach 1 RM 54.2 to 55.0	Reach 2 RM 55.0 - 56.6	Reach 3 RM 56.6 -59.1	Reach 4 RM 59.1 -60.0	Reach 5 RM 60.0 – 61.0	Side Channel 2 (Heath Ranch)[1]	Side Channel 4 (Wolf Ridge)[2]
Pools per Mile*:	1.2	11.8	7.9	11.5		12.0	12.9
Wetted Channel Width	76’	69’	67’	75’		47’	43’
Required # of Pools per Mile to meet Criteria	23	24	24	23		27	32
LWD Recruitment Potential	Poor	Good	Good	Good	Good	Good	Good

*Habitat units with little or no surface gradient, a residual pool depth and a channel spanning hydraulic control.
[1]The 0.8 mile long side channel is in reach 2, on the left bank between river mile 55.5 to river mile 56.2.
[2]The 0.3 mile long side channel is in reach 2, on the right bank between river mile 56.1 and 56.6.

NARRATIVE SUMMARY

Although the 5 mile segment of the Methow River between the Heath Ranch and Hancock Springs (RM 55 to 60) does not meet the habitat element criteria for pool frequency, this stream segment is probably at a natural level for numbers of pools. Over half of the habitat % in the main channel in this stream segment consists of pools. Habitat units are very long, with pool lengths typically at least 300’ feet. The habitat criteria defined in the matrix does not appear to apply to this type of stream system. Only one pool exists in the 0.8 mile stream segment above Wolf Creek (reach 1 of the survey). This segment of the stream is fairly straight, with no scouring agents (stream bends, large wood or large substrate). This segment of the stream is not functioning appropriately due largely to past wood removal from the stream, trees cut for ranching and agriculture, and the construction of Highway 20 along the left bank. This stream segment is naturally confined, and may never have had many pools. See Appendix A for a comparison of pool habitat (and other stream attributes) on the Methow River Big Valley reaches with similar river segments in the Methow River Basin.

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Habitat Elements	**Pool Quality**	Pools>1 meter deep (holding pools) with good cover and cool water[e], minor reduction of pool volume by fine sediment	Few deeper pools (>1 meter) present or inadequate cover/temperature[3], moderate reduction of pool volume by fine sediment	No deep pools (>1 meter) and inadequate cover/temperature[3], major reduction of pool volume by fine sediment

Habitat Elements: Pool Quality	Reach 1 RM 54.2 to 55.0	Reach 2 RM 55.0 - 56.6	Reach 3 RM 56.6 -59.1	Reach 4 RM 59.1 -60.0	Reach 5 RM 60.0 – 61.0	Side Channel 2 (Heath Ranch)[1]	Side Channel 4 (Wolf Ridge)[2]
# of Pools per Mile	1.2	11.8	7.9	11.5		12.0	12.9
# of Pools > 5' deep/mile	0	4.7	3.8	3.1		0	9.7
Average pool max depth	3.0	4.5	4.4	4.0		2.8	5.1
Avg. pool residual depth	1.2	3.3	3.1	2.9		2.9	4.3

[1]The 0.8 mile long side channel is in reach 2, on the left bank between river mile 55.5 to river mile 56.2.
[2]The 0.3 mile long side channel is in reach 2, on the right bank between river mile 56.1 and 56.6.
[3]Maximum pool depth minus depth at pool crest.

NARRATIVE SUMMARY

Pool quality is excellent in the five mile stream segment located between the Heath Ranch and Hancock Springs (RM 55 to 60). About 40% of the pools in this stream segment are greater than 5' deep, with an average residual depth (maximum pool depth minus pool crest) of about a meter. Pools are formed mainly at the river bends, with large wood increasing the amount and depth of the pool scour. The 0.3 mile side channel that re-enters the main channel at RM 56.1 (at Wolf Ridge Resort) has very deep pool habitat, with 75% of the pools greater than 5 feet deep. Pool volume is not reduced by fine sediments in any of the surveyed reaches in the study area. There is a direct correlation between pool quality and numbers of Chinook salmon redds (see Appendix 1). See Appendix A for a comparison of pool habitat (and other stream attributes) on the Methow River Big Valley reaches with similar river segments in the Methow River Basin.

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Habitat Elements	**Off-Channel Habitat**	Backwaters with cover, and low energy off-channel areas (ponds, osbows, etc.)[3]	Some backwaters and high energy side channels[3]	Few or no backwaters, no off-channel ponds[3]

Habitat Elements: Off-Channel Habitat	Reach 1 RM 54.2 to 55.0	Reach 2 RM 55.0 - 56.6	Reach 3 RM 56.6 -59.1	Reach 4 RM 59.1 -60.0	Reach 5 RM 60.0 – 61.0	Side Channel 2 (Heath Ranch)[1]	Side Channel 4 (Wolf Ridge)[2]
% Habitat Side Channels	0%	41.6%[3]	7.8%	1.5%		4.5%	21.7%
Backwater Pool Habitat[4]	None[4]	Frequent[4]	Frequent[4]	Infrequent[4]		Infrequent[4]	Some[4]

[1]The 0.8 mile long side channel is in reach 2, on the left bank between river mile 55.5 to river mile 56.2.
[2]The 0.3 mile long side channel is in reach 2, on the right bank between river mile 56.1 and 56.6.
[3]Includes side channel 2 (Heath Ranch) and side channel 4 (Wolf Ridge).
[4]Habitat attribute not measured. Data based on surveyor notes and photographs.

NARRATIVE SUMMARY

Off-channel habitat is abundant with excellent fish hiding cover throughout much of the floodplain in the 5 mile long stream segment located between the Heath Ranch and Hancock Springs (RM 55 to 60). A 2/3 mile long side channel that enters the left bank of the Methow River at the bottom of the Heath Ranch (RM 55) consists of a series of 9 beaver ponds, most at least 4 feet deep, with excellent fish hiding cover. Although brook trout is the dominant fish species in the ponds, spring Chinook juveniles were observed in the lower 2 ponds during snorkel surveys conducted in the ponds on 9-28-06. The river is not connected to the ponds at the top end of the side channel, possibly due to reduced flow to the area from the accumulation of log jams upstream on the left bank during the high 2006 spring run-off. A 0.8 mile long side channel originating at the log jams at RM 56.2 (side channel 2) was flowing at less than 5 cfs at low flow (visual estimate). This side channel used to have considerably more flow and possibly provided year round flow to the beaver ponds. Two side channels with ponds created by beaver dams were observed in the 0.3 mile long side channel located at Wolf Ridge Resort (side channel 4). An adult summer Chinook salmon was observed in one of the beaver dammed side channels. A total of 6 side channels were observed in the stream segment located between RM 56.6 and 59.1 (reach 3). The 6 side channels comprised about 8% of the total habitat area in the reach. A total of 9 beaver ponds (the deepest was 5’ deep) were observed in these 6 side channels. Only one small side channel was observed between RM 59.1 and 60.0 (confluence with Hancock Springs). This segment of the river is fairly straight, with little off-channel habitat. A major channel on the left side of the floodplain in this reach has been disconnected at low flow due to an aggrading channel (from high spring run-off in 2006). The disconnected (dry) channel had 60% of the total river flow in the fall of 2005 (USFS flow measurement data, October 26, 2005). Several beaver ponds were observed in side channels located between Hancock Springs and the Weeman Bridge during a habitat survey conducted by the USFS in November, 2005. Backwater pools were frequently observed in many areas of the river segment located between RM 55 and RM 60. No side channels or backwater pools were observed in the 0.8 mile long stream segment located between Wolf Creek and the Heath Ranch.

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Channel Condition and Dynamics:	**Streambank Condition**	>90 % stable; i.e., on average, less than 10% of banks are actively eroding[2]	80-90% stable	<80% stable

Streambank Condition:	Reach 1 RM 54.2 to 55.0	Reach 2 RM 55.0 - 56.6	Reach 3 RM 56.6 -59.1	Reach 4 RM 59.1 -60.0	Reach 5 RM 60.0 – 61.0	Side Channel 2 (Heath Ranch)[1]	Side Channel 4 (Wolf Ridge)[2]
Linear Feet of Bank Erosion per Mile	405’	1,556’	1,962’	768’		864’	2,458’
% Eroding Banks (total of both banks)	4.8%	14.7%	18.6%	7.3%		8.2%	23.3%
Chinook Salmon Redds per Mile	3.7	20.0	17.8	16.7		1.2	76.1

[1]The 0.8 mile long side channel is in reach 2, on the left bank between river mile 55.5 to river mile 56.2.
[2]The 0.3 mile long side channel is in reach 2, on the right bank between river mile 56.1 and 56.6.

NARRATIVE SUMMARY

Although the criteria for streambank condition in the Matrix states that low amounts of bank instability equates to a properly functioning rating, the opposite appears to be true. The highest concentrations of Chinook salmon redds were found in the stream segments with the highest amount of bank erosion (see table above). This segment of the Methow River (and probably the entire river) is dependant on the streambanks and forested floodplains to supply gravels and other fine sediments that provide spawning substrate for spring and summer Chinook salmon and for steelhead. See Appendix A for a comparison of bank erosion (and other stream attributes) on the Methow River Big Valley reaches with similar river segments in the Methow River Basin.

APPENDIX B –

Fender Mill habitat survey (11-18-05) completed by the U.S. Forest Service Methow Valley Ranger District.

FENDER MILL HABITAT SURVEY SUMMARY
11-18-05

Survey Length: RM 60.1 to RM 61.1 (1.1 miles)

Survey Area: From the confluence with Hancock Creek to the Weeman Bridge.

SUMMARY OF HABITAT

Fish Spawning Habitat: Excellent spawning habitat was found in the avulsion in the lower 0.5 miles of the survey area. A dozen spring Chinook salmon redds were observed in this stream segment. No spring Chinook salmon redds were seen by surveyros in the 2/3 mile long stream segment located between the top of the avulsion and the Weeman Bridge. A total of 3 Chinook redds were seen in a run in the 0.22 mile stream segment above the Weeman Bridge.

●**Fish Rearing Habitat:** Good fish rearing habitat was observed in the avulsion in the lower 0.5 mile stream segment, both in the main channel and in the side channels. About ¾ of this habitat area in both the main channel and in the side channels consists of pools with good hiding cover provided mainly by large wood in the channel. Beaver dams are forming much of the pool habitat in the side channels. Rearing habitat was not as good in the upper 0.8 miles of the survey area, due largely to the lack of large wood in the channel. Much of the habitat in the upper 0.8 miles consists of riffles and swift flowing runs with little hiding cover. The best rearing habitat observed in the upper 0.8 miles was in the rip-rapped areas at RM 66.2 and under the Weeman Bridge (RM 67), and in two pools with large wood in a ¼ mile segment below the Weeman Bridge.

●**Large Wood:** Amounts of large woody debris were three times higher in the lower 0.5 mile stream segment than in the upper 0.8 miles. Most of the wood in the lower 0.5 miles was in the wetted channel while almost all the wood in the upper 0.8 miles was high on the bars. Wood has been cut and removed in the past from the channel above and below the Weeman Bridge

●**Pool Habitat:** Pool habitat was more abundant, deeper, and much more complex in the lower 0.5 miles than in the 0.8 mile stream segment above. Off-channel pool habitat was abundant in the lower 0.5 miles, nearly absent in the upper 0.8 miles. A huge log jam (area of about 1,000 square feet) about 600' above the mouth of Hancock Springs has creating a large, deep pool with excellent fish hiding cover. Spring Chinook salmon were spawning above and below the pool.

●**Side Channel Habitat:** A total of 6 (wetted) side channels were counted and walked in the lower 0.5 miles. No side channels were active (wetted at low flows) above the rip-rapped right bank at RM 66.2. Side channels comprise about half the habitat area in the lower 0.5 miles. Beaver dams in the side channels are creating large pools (ponds) which are storing large amounts of water.

●**Habitat Area:** Stream habitat is much more complex in the 0.5 mile segment below the rip-rapped right bank at RM 66.2 than in the 0.8 mile segment above. The total habitat area (per mile) in the lower 0.5 mile segment was about twice as high as in the upper 0.8 mile segment, due both to higher flow and to the extensive side channel habitat in the lower 0.5 miles.

See Table 1 on the next page for a statistical comparison of this reach with the four reaches of the Methow River surveyed in October 2006.

Table 1: METHOW RIVER STREAM SURVEY DATA SUMMARY
WOLF CREEK TO WEEMAN BRIDGE: MAIN CHANNEL
Survey Dates: 10-23-06 to 10-27-06 (Reach 5 11-18-2005)

	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5*
Reach Mileage (BOR maps)	54.2 to 55.0	55.0 - 56.6	56.6 -59.1	59.1 -60.0	60.0-61.1
Reach Length (measured distance)	0.8 miles	1.7 miles	2.6 miles	1.0 miles	1.1 miles
Average Wetted Width:	76’	69’	67’	75’	55’
Average Thalweg Depth (riffles):	1.8’	1.4’	1.6’	1.2’	1.4’
Habitat Area:					
% Pool	11.8%	37.0%	48.0%	37.3%	40%
% Riffle	83.0%	19.6%	33.4%	48.4%	20%
% Glide (non-turbulent riffles)	5.2%	1.8%	10.8%	12.8%	11%
% Side Channel	0%	41.6%	7.8%	1.5%	29%
Pools:					
Pools per Mile	1.2	11.8	7.9	11.5	10
Pools > 5’ deep per mile	0	4.7	3.8	3.1	1.1
Avg. Pool Maximum Depth	3.0’	4.5’	4.4’	4.0’	3.5’
Avg. Pool Residual depth	1.2’	3.3’	3.1’	2.9’	2.6’’
Riffle to Pool Ratio	7.0 to 1	0.54 to 1	0.93 to 1	1.24 to 1	0.78 to 1
Large Wood per Mile:					
Small (>20’ Long, > 6” diameter)	8.7	110.0	35.5	37.6	77
Medium (>35’Long, 12-20” diam.)	3.7	28.8	30.2	14.6	28
Large (>35’ Long, >20” diameter)	0	7.6	7.2	4.2	4
Bank Erosion:					
Linear Length per Mile	405’	1,556’	1,962’	768’	435’
% Eroding Banks	4.8%	14.7%	18.6%	7.3%	4.1%
Bankfull Data (main channel):[1]					
Bankfull Width	111’	123’	198’	117’	-
Bankfull Depth	3.15’	2.05’	1.85’	2.18’	-
W/D Ratio	35.2	60.0	107.0	53.7	-
Entrenchment ratio[2]	1.3	>10	>10	>10	-
Substrate (Ocular estimate):					
% Sand	5%	5%	5%	5%	5%
% Gravel	20%	35%	45%	40%	35%
% Cobble	65%	60%	55%	50%	55%
% Boulder	10%	-		5%	5%
# of Chinook Salmon Redds	3	34	47	16	12 (est.)
# Chinook Salmon Redds per mile	3.7	20.0	17.8	16.7	10.9

[1]Very rough estimate, one to two bankfull measurements were taken per reach.
[2]Floodprone width divided by bankfull width.
***November 2005 survey.**

APPENDIX C –

Comparison of Methow River at Big Valley data attributes with similar river segments in the Methow River Basin completed by the U.S. Forest Service Methow Valley Ranger District.

The table on the following page compares survey data on five river segments located in the Methow River Basin. The five river segments were chosen based on channel type (gradient, confinement and substrate), channel size (bankfull width), elevation, and disturbance history. The river segments that are compared are listed below:

-Methow River: a 6.0 mile segment located from the confluence with Wolf Creek to the confluence with Hancock Creek.

-Chewuch River: a 2.3 mile segment located from the confluence with Eightmile Creek where the channel becomes confined about 1/3 mile below Falls Creek.

-Twisp River: a 3.9 mile segment located from the confluence with Buttermilk Creek to the confluence with War Creek.

-Lost River: a 1.0 mile segment located from the mouth to about half a mile above the bridge crossing.

-Pasayten River: a 1.6 mile segment located from the Canadian Border to the confluence with the East Fork Pasayten River.

Table 1: METHOW RIVER AT BIG VALLEY STREAM SURVEY DATA COMPARED TO SIMILAR RIVER SEGMENTS IN THE METHOW RIVER BASIN

	Methow River: Wolf Cr to Hancock Cr.	Chewuch River: Above Eightmile	Twisp River: Buttermilk to War Cr	Lost River: Mouth to RM 1.0	Pasayten River: Border to East Fork Pasayten
Reach Mileage	54.2 to 60.0	11.8 to 14.1	13.7 - 7.6	0 to 1.0	13.5 – 15.1
Reach Length (measured distance)	6.0 miles	2.3 miles	3.9 miles	1.0 miles	1.6 miles
Est. Beginning Elevation of Reach	1,800’	2,100	2,280	2,350’	3,870’
Est. Ending Elevation of Reach	1,900’	2,140	2,400	2,400’	3,900’
Estimated Channel Gradient	0.3%	0.3%	0.6%	1.0%	0.3%
Average Bankfull Width:	110’ to 200’	95’	96’	114’	95’
Width/Depth Ratio:	35 to 100	35.6	49.2	56.5	38
Rosgen Channel Type:	C3	C4	C4	C3	C4
Habitat Area:					
% Pool	39%	51%	30%	13%	34%
% Riffle and Glide	46%	39%	59%	84%	61%
% Side Channel	15%	10%	11%	3%	5%
Pools:					
Pools per mile in main channel	8.8	8.4	14.7	6.2	8.6
Pools > 5’ deep per mile	3.5	2.6	2.0	1.0	4.4
Average pool residual depth	3.1’	3.0’	2.7’	3.0’	3.2’
Riffle to pool ratio (main channel)	1.18 to 1	0.76 to 1	1.97 to 1	6.46 to 1	1.79 to 1
Large Wood per Mile:					
Small (>20’ Long, > 6” diameter)	54	31	59	36	124
Medium (>35’Long, 12-20” diam.)	24	20	25	29	47
Large (>35’ Long, >20” diameter)	6	2	9	6	10
Bank Erosion:					
Linear Length per Mile	1,470’	753’	700’	640’	478’
% Eroding Banks	14%	7.1%	6.6%	6.1%	4.5%
Substrate (Ocular estimate and pebble count data):					
% Sand	5%	17%	6%	3%	10%
% Gravel	39%	44%	49%	38%	56%
% Cobble	54%	39%	44%	48%	33%
% Boulder	2%	-	1%	11%	1%
D-50 (pebble count data)	58 to 104	53	58	90	42
Pebble count method (width)	Wetted	Bankfull	Bankfull	Bankfull	Bankfull

[1]Very rough estimate, one to two bankfull measurements were taken per reach.

[2]Floodprone width (width at 2 x max bankfull depth) divided by bankfull width.

APPENDIX D –

Water temperature data collected by the U.S. Forest Service Methow Valley Ranger District.

MW1800 METHOW RIVER ABOVE WOLF CREEK (RM 54.3)
TEMPERATURE SUMMARY 2005

	2005
START DATE	6/27/05
END DATE	9/30/05
DATA DAYS	96
Daily Maximum > 14.4 °C, 1/1 to 12/30	65
Daily Maximum > 22.2 °C, 1/1 to 12/30	0
7 Day Avg Max > 15, 1/1 to 12/30	58
7 Day Avg Max > 17.8, 1/1 to 12/30	6

MONTHLY MAX TEMPERATURES	
January	
February	
March	
April	
May	
June	
July	18.36
August	18.71
September	15.22
October	
November	
December	

MW1800 2005
7 day average

7 DAYS STARTING	**2005**
28-Jun	12.21065
29-Jun	12.42161
30-Jun	12.57994
1-Jul	12.55673
2-Jul	12.40089
3-Jul	12.30571
4-Jul	12.22643
5-Jul	12.16905
6-Jul	12.24381
7-Jul	12.28107
8-Jul	12.38565
9-Jul	12.48714
10-Jul	12.66125
11-Jul	12.97369
12-Jul	13.28226
13-Jul	13.37899
14-Jul	13.42065
15-Jul	13.51262
16-Jul	13.65595
17-Jul	13.68333
18-Jul	13.68351
19-Jul	13.62905
20-Jul	13.61607
21-Jul	13.7144
22-Jul	13.82327
23-Jul	14.0969
24-Jul	14.28179
25-Jul	14.39708
26-Jul	14.32244
27-Jul	14.2175
28-Jul	14.07071
29-Jul	13.88827
30-Jul	13.81887
31-Jul	13.83762
1-Aug	13.87732
2-Aug	14.08607
3-Aug	14.24155
4-Aug	14.31958
5-Aug	14.32244
6-Aug	14.23679
7-Aug	14.12583
8-Aug	13.9622
9-Aug	13.77577
10-Aug	13.72774
11-Aug	13.58381
12-Aug	13.4722
13-Aug	13.34387
14-Aug	13.24929
15-Aug	13.22202

MW1800
7 day average max

7 DAYS STARTING	**2005**
28-Jun	15.06714
29-Jun	15.16857
30-Jun	15.31714
1-Jul	15.26714
2-Jul	15.01571
3-Jul	14.96571
4-Jul	14.61286
5-Jul	14.71143
6-Jul	14.96
7-Jul	15.01
8-Jul	15.15857
9-Jul	15.26
10-Jul	15.55857
11-Jul	16.21
12-Jul	16.46
13-Jul	16.51
14-Jul	16.61
15-Jul	16.81
16-Jul	16.91
17-Jul	16.91
18-Jul	16.91
19-Jul	16.86
20-Jul	16.91
21-Jul	17.06
22-Jul	17.16
23-Jul	17.71
24-Jul	17.86
25-Jul	17.96
26-Jul	17.71143
27-Jul	17.61143
28-Jul	17.46143
29-Jul	17.31143
30-Jul	17.31143
31-Jul	17.36143
1-Aug	17.41143
2-Aug	17.86
3-Aug	17.96
4-Aug	17.96
5-Aug	17.91
6-Aug	17.76
7-Aug	17.61
8-Aug	17.46
9-Aug	17.16
10-Aug	17.11
11-Aug	16.86143
12-Aug	16.76143
13-Aug	16.61143
14-Aug	16.56143
15-Aug	16.56143

16-Aug	13.21006	**16-Aug**	16.51143
17-Aug	12.9731	**17-Aug**	16.26286
18-Aug	12.88143	**18-Aug**	16.31143
19-Aug	12.82202	**19-Aug**	16.26143
20-Aug	12.81369	**20-Aug**	16.31143
21-Aug	12.76137	**21-Aug**	16.16143
22-Aug	12.69226	**22-Aug**	16.06143
23-Aug	12.57476	**23-Aug**	15.91286
24-Aug	12.45185	**24-Aug**	15.76143
25-Aug	12.37393	**25-Aug**	15.66286
26-Aug	12.35988	**26-Aug**	15.56429
27-Aug	12.3206	**27-Aug**	15.31429
28-Aug	12.11893	**28-Aug**	15.01429
29-Aug	11.81589	**29-Aug**	14.46286
30-Aug	11.55446	**30-Aug**	14.31143
31-Aug	11.45423	**31-Aug**	14.26143
1-Sep	11.35446	**1-Sep**	14.16
2-Sep	11.29083	**2-Sep**	14.16
3-Sep	11.1178	**3-Sep**	13.90857
4-Sep	10.99893	**4-Sep**	13.75714
5-Sep	10.93774	**5-Sep**	13.60571
6-Sep	10.9006	**6-Sep**	13.45571
7-Sep	10.84798	**7-Sep**	13.30571
8-Sep	10.81893	**8-Sep**	13.20571
9-Sep	10.6628	**9-Sep**	12.85286
10-Sep	10.61637	**10-Sep**	12.80286
11-Sep	10.59024	**11-Sep**	12.85429
12-Sep	10.61423	**12-Sep**	13.05714
13-Sep	10.64232	**13-Sep**	13.05714
14-Sep	10.53786	**14-Sep**	12.95571
15-Sep	10.33054	**15-Sep**	12.75429
16-Sep	10.12244	**16-Sep**	12.60286
17-Sep	9.88131	**17-Sep**	12.50143
18-Sep	9.680952	**18-Sep**	12.29857
19-Sep	9.550238	**19-Sep**	12.19714
20-Sep	9.389226	**20-Sep**	12.04429
21-Sep	9.385	**21-Sep**	11.99286
22-Sep	9.341905	**22-Sep**	11.89143
23-Sep	9.512143	**23-Sep**	11.94143

MW1800 2005
DAILY VALUES

DATE	AVG	MAX	MIN
6/28/05	11.4625	14.51	9.55
6/29/05	12.19792	15.22	9.19
6/30/05	12.80625	15.57	9.91
7/1/05	12.02458	14.51	9.91
7/2/05	12.4075	15.22	9.91
7/3/05	12.035	15.22	8.82
7/4/05	12.54083	15.22	9.91
7/5/05	12.93917	15.22	10.27
7/6/05	13.30625	16.26	11.33
7/7/05	12.64375	15.22	9.91
7/8/05	10.93375	12.75	10.27
7/9/05	11.74125	14.87	9.19
7/10/05	11.48	12.75	9.55
7/11/05	12.13917	15.91	9.19
7/12/05	13.4625	16.96	10.27
7/13/05	13.56708	16.61	10.62
7/14/05	13.37583	16.26	10.27
7/15/05	11.64417	13.46	10.98
7/16/05	12.96	16.96	9.91
7/17/05	13.66708	17.31	10.27
7/18/05	14.29917	17.66	10.98
7/19/05	14.13958	17.31	10.98
7/20/05	13.85875	17.31	10.62
7/21/05	14.01958	17.66	10.62
7/22/05	12.6475	14.16	11.69
7/23/05	13.15167	16.96	9.91
7/24/05	13.66833	17.31	10.27
7/25/05	13.91792	17.31	10.62
7/26/05	14.04875	17.66	10.62
7/27/05	14.54708	18.36	10.98
7/28/05	14.78167	18.36	11.33
7/29/05	14.56292	18.01	11.33
7/30/05	14.44583	18.01	10.98
7/31/05	14.47542	18.01	10.98
8/1/05	13.39542	15.57	11.33
8/2/05	13.31417	16.96	9.91
8/3/05	13.51958	17.31	9.91
8/4/05	13.50458	17.31	9.91
8/5/05	14.07708	18.01	10.27
8/6/05	14.57708	18.36	10.98
8/7/05	14.75333	18.36	11.33
8/8/05	14.85667	18.71	11.69
8/9/05	14.4025	17.66	10.98
8/10/05	14.06583	17.31	11.33
8/11/05	13.52458	16.96	10.62
8/12/05	13.4775	16.96	10.27
8/13/05	13.80042	17.31	10.62
8/14/05	13.60792	17.31	9.91

8/15/05	13.55167	16.61	10.62
8/16/05	14.06625	17.31	10.98
8/17/05	13.05833	15.57	11.33
8/18/05	12.74333	16.26	9.55
8/19/05	12.57917	15.91	9.19
8/20/05	13.13833	16.96	9.55
8/21/05	13.41708	17.31	9.91
8/22/05	13.46792	16.26	11.33
8/23/05	12.4075	15.57	9.91
8/24/05	12.41667	15.91	9.19
8/25/05	12.3275	15.91	8.82
8/26/05	12.52083	16.26	9.19
8/27/05	12.77208	15.91	9.55
8/28/05	12.93333	16.61	9.55
8/29/05	12.64542	15.22	10.62
8/30/05	11.54708	14.51	8.82
8/31/05	11.87125	15.22	8.82
9/1/05	12.22917	15.22	9.55
9/2/05	12.24583	14.51	9.91
9/3/05	11.36042	13.81	9.19
9/4/05	10.81208	12.75	9.19
9/5/05	10.81542	14.16	7.73
9/6/05	10.84542	14.16	7.73
9/7/05	11.17292	14.51	8.09
9/8/05	11.78375	15.22	8.82
9/9/05	11.03458	12.75	9.19
9/10/05	10.52833	12.75	8.82
9/11/05	10.38375	11.69	9.19
9/12/05	10.55542	13.11	8.82
9/13/05	10.47708	13.11	7.73
9/14/05	10.96958	13.81	8.46
9/15/05	10.69083	12.75	8.46
9/16/05	10.70958	12.4	9.55
9/17/05	10.34542	13.11	8.09
9/18/05	10.55167	13.11	8.09
9/19/05	10.75208	13.11	8.82
9/20/05	9.745833	12.4	7.36
9/21/05	9.518333	12.4	6.99
9/22/05	9.234167	11.69	6.99
9/23/05	9.021667	11.69	6.62
9/24/05	8.942917	11.69	6.24
9/25/05	9.636667	12.4	6.99
9/26/05	9.625	12.04	7.36
9/27/05	9.71625	12.04	7.36
9/28/05	9.216667	11.69	6.62
9/29/05	10.42583	12.04	9.19

MW1830 METHOW RIVER: LOWER BIG VALLEY RANCH (RM 56.5)
TEMPERATURE SUMMARY 2005

	2005
START DATE	6/27/05
END DATE	9/30/05
DATA DAYS	96
Daily Maximum > 14.4 °C, 1/1 to 12/30	63
Daily Maximum > 22.2 °C, 1/1 to 12/30	0
7 Day Avg Max > 15, 1/1 to 12/30	56
7 Day Avg Max > 17.8, 1/1 to 12/30	0

MONTHLY MAX TEMPERATURES	
January	
February	
March	
April	
May	
June	
July	18.07
August	17.74
September	14.73
October	
November	
December	

Methow River at Lower Big Valley Ranch 2005

MW1830		MW1830	
7 day average		**7 day average max**	
7 DAYS STARTING	**2005**	**7 DAYS STARTING**	**2005**
28-Jun	12.42458	**28-Jun**	15.31714
29-Jun	12.68589	**29-Jun**	15.47571
30-Jun	12.90429	**30-Jun**	15.63429
1-Jul	12.90667	**1-Jul**	15.58857
2-Jul	12.79702	**2-Jul**	15.38857
3-Jul	12.73012	**3-Jul**	15.27429
4-Jul	12.69685	**4-Jul**	14.98429
5-Jul	12.64964	**5-Jul**	14.96143
6-Jul	12.71071	**6-Jul**	15.18714
7-Jul	12.72512	**7-Jul**	15.21
8-Jul	12.85107	**8-Jul**	15.39
9-Jul	12.97548	**9-Jul**	15.45571
10-Jul	13.1619	**10-Jul**	15.70571
11-Jul	13.41042	**11-Jul**	16.08571
12-Jul	13.69583	**12-Jul**	16.33429
13-Jul	13.80774	**13-Jul**	16.31143
14-Jul	13.84327	**14-Jul**	16.37857
15-Jul	13.88512	**15-Jul**	16.33429
16-Jul	14.0219	**16-Jul**	16.49
17-Jul	13.96161	**17-Jul**	16.51143
18-Jul	13.90839	**18-Jul**	16.64714
19-Jul	13.77405	**19-Jul**	16.62429
20-Jul	13.64554	**20-Jul**	16.67
21-Jul	13.63649	**21-Jul**	16.78571
22-Jul	13.65875	**22-Jul**	17.01429
23-Jul	13.77881	**23-Jul**	17.35429
24-Jul	13.92107	**24-Jul**	17.49143
25-Jul	14.00583	**25-Jul**	17.58286
26-Jul	13.92482	**26-Jul**	17.31286
27-Jul	13.80964	**27-Jul**	17.2
28-Jul	13.66048	**28-Jul**	17.06143
29-Jul	13.47804	**29-Jul**	16.9
30-Jul	13.40411	**30-Jul**	16.92286
31-Jul	13.4069	**31-Jul**	16.92286
1-Aug	13.42738	**1-Aug**	16.94571
2-Aug	13.59298	**2-Aug**	17.30714
3-Aug	13.71345	**3-Aug**	17.42
4-Aug	13.76119	**4-Aug**	17.39714
5-Aug	13.73256	**5-Aug**	17.33
6-Aug	13.64286	**6-Aug**	17.17143
7-Aug	13.52274	**7-Aug**	17.01286
8-Aug	13.35548	**8-Aug**	16.87571
9-Aug	13.17679	**9-Aug**	16.60429
10-Aug	13.12268	**10-Aug**	16.49143
11-Aug	12.99589	**11-Aug**	16.17571
12-Aug	12.89976	**12-Aug**	16.04
13-Aug	12.77357	**13-Aug**	15.92714
14-Aug	12.68548	**14-Aug**	15.86
15-Aug	12.65839	**15-Aug**	15.81571
16-Aug	12.63857	**16-Aug**	15.79286

17-Aug	12.41768	**17-Aug**	15.52143
18-Aug	12.3247	**18-Aug**	15.63429
19-Aug	12.27	**19-Aug**	15.61143
20-Aug	12.25048	**20-Aug**	15.58857
21-Aug	12.19804	**21-Aug**	15.52
22-Aug	12.1281	**22-Aug**	15.38429
23-Aug	12.01036	**23-Aug**	15.22571
24-Aug	11.89667	**24-Aug**	15.11286
25-Aug	11.82161	**25-Aug**	15
26-Aug	11.79012	**26-Aug**	14.91
27-Aug	11.75488	**27-Aug**	14.73
28-Aug	11.55976	**28-Aug**	14.39429
29-Aug	11.29429	**29-Aug**	13.99286
30-Aug	11.08399	**30-Aug**	13.86
31-Aug	11.01417	**31-Aug**	13.81714
1-Sep	10.93107	**1-Sep**	13.72714
2-Sep	10.88649	**2-Sep**	13.68143
3-Sep	10.71923	**3-Sep**	13.41571
4-Sep	10.6369	**4-Sep**	13.26
5-Sep	10.58048	**5-Sep**	13.08286
6-Sep	10.54429	**6-Sep**	12.95
7-Sep	10.49167	**7-Sep**	12.81714
8-Sep	10.46774	**8-Sep**	12.73
9-Sep	10.33393	**9-Sep**	12.42
10-Sep	10.30452	**10-Sep**	12.42
11-Sep	10.25595	**11-Sep**	12.37571
12-Sep	10.2878	**12-Sep**	12.59714
13-Sep	10.29512	**13-Sep**	12.62
14-Sep	10.20464	**14-Sep**	12.53143
15-Sep	10.02661	**15-Sep**	12.35429
16-Sep	9.847917	**16-Sep**	12.24429
17-Sep	9.658988	**17-Sep**	12.15571
18-Sep	9.516845	**18-Sep**	12.11143
19-Sep	9.40869	**19-Sep**	12
20-Sep	9.29256	**20-Sep**	11.86571
21-Sep	9.294345	**21-Sep**	11.86571
22-Sep	9.267679	**22-Sep**	11.77714
23-Sep	9.408333	**23-Sep**	11.79857

Methow River at Lower End of Big Valley Ranch 2005

MW1830

DAILY VALUES

DATE	AVG	MAX	MIN
6/28/05	11.60333	14.57	9.61
6/29/05	12.33583	15.36	9.45
6/30/05	13.02417	15.84	10.23
7/1/05	12.21125	14.73	10.07
7/2/05	12.61458	15.68	10.23
7/3/05	12.29667	15.36	9.29
7/4/05	12.88625	15.68	10.38
7/5/05	13.4325	15.68	10.85
7/6/05	13.86458	16.47	11.93
7/7/05	13.04083	15.52	10.54
7/8/05	11.44375	13.33	10.69
7/9/05	12.14625	14.88	9.61
7/10/05	12.06375	13.33	10.23
7/11/05	12.55583	15.52	9.92
7/12/05	13.86	17.26	10.85
7/13/05	13.96542	16.63	11.16
7/14/05	13.9225	16.78	11.16
7/15/05	12.31458	13.79	11.47
7/16/05	13.45125	16.63	10.38
7/17/05	13.80333	15.99	10.85
7/18/05	14.55375	17.26	11.78
7/19/05	14.64333	17.1	12.09
7/20/05	14.21417	17.1	11.47
7/21/05	14.21542	16.47	11.47
7/22/05	13.27208	14.88	11.93
7/23/05	13.02917	16.78	9.92
7/24/05	13.43083	16.94	10.38
7/25/05	13.61333	17.1	10.54
7/26/05	13.74375	17.42	10.54
7/27/05	14.15083	17.91	11.01
7/28/05	14.37125	18.07	11.31
7/29/05	14.1125	17.26	11.31
7/30/05	14.025	17.74	10.85
7/31/05	14.02417	17.58	11.01
8/1/05	13.04625	15.21	11.01
8/2/05	12.9375	16.63	9.92
8/3/05	13.10667	16.94	9.92
8/4/05	13.09417	16.94	9.76
8/5/05	13.595	17.42	10.23
8/6/05	14.04458	17.74	10.85
8/7/05	14.1675	17.74	11.16
8/8/05	14.20542	17.74	11.31
8/9/05	13.78083	17.42	10.85
8/10/05	13.44083	16.78	11.01
8/11/05	12.89375	16.47	10.38
8/12/05	12.96708	16.31	10.23
8/13/05	13.20375	16.63	10.23
8/14/05	12.99667	16.78	9.76

8/15/05	12.95458	15.84	10.23
8/16/05	13.40208	16.63	10.69
8/17/05	12.55333	14.57	10.85
8/18/05	12.22083	15.52	9.29
8/19/05	12.08375	15.52	8.98
8/20/05	12.58708	16.16	9.45
8/21/05	12.80708	16.47	9.61
8/22/05	12.81583	15.68	10.69
8/23/05	11.85583	14.73	9.61
8/24/05	11.9025	15.36	8.98
8/25/05	11.83792	15.36	8.83
8/26/05	11.94708	15.36	8.98
8/27/05	12.22	15.68	9.29
8/28/05	12.3175	15.52	9.45
8/29/05	11.99167	14.57	10.23
8/30/05	11.06	13.94	8.52
8/31/05	11.37708	14.57	8.52
9/1/05	11.6175	14.73	9.14
9/2/05	11.70042	14.1	9.61
9/3/05	10.85417	13.33	9.14
9/4/05	10.45917	12.71	8.98
9/5/05	10.51958	13.64	7.91
9/6/05	10.57125	13.64	7.91
9/7/05	10.79542	13.94	8.06
9/8/05	11.30542	14.41	8.68
9/9/05	10.52958	12.24	8.83
9/10/05	10.27792	12.24	8.83
9/11/05	10.06417	11.47	8.98
9/12/05	10.26625	12.71	8.68
9/13/05	10.20292	12.71	7.91
9/14/05	10.62792	13.33	8.37
9/15/05	10.36875	12.24	8.52
9/16/05	10.32375	12.24	9.14
9/17/05	9.937917	11.93	8.06
9/18/05	10.28708	13.02	8.06
9/19/05	10.3175	12.87	8.68
9/20/05	9.569583	12.09	7.44
9/21/05	9.381667	12.09	7.28
9/22/05	9.117917	11.47	7.13
9/23/05	9.00125	11.62	6.97
9/24/05	8.942917	11.62	6.66
9/25/05	9.53	12.24	7.28
9/26/05	9.504583	11.93	7.44
9/27/05	9.582083	12.09	7.59
9/28/05	9.195	11.47	6.82
9/29/05	10.1025	11.62	8.98

MW1880 METHOW RIVER BELOW HANCOCK SPRINGS (RM 59.9)
TEMPERATURE SUMMARY 2005

	2005
START DATE	6/25/05
END DATE	9/30/05
DATA DAYS	98
Daily Maximum > 14.4 °C, 1/1 to 12/30	53
Daily Maximum > 22.2 °C, 1/1 to 12/30	0
7 Day Avg Max > 15, 1/1 to 12/30	37
7 Day Avg Max > 17.8, 1/1 to 12/30	0

MONTHLY MAX TEMPERATURES	
January	
February	
March	
April	
May	
June	
July	17.36
August	17.04
September	13.88
October	
November	
December	

Methow River below Hancock Springs 2005

MW1880		MW1880	
7 day average temp.		7 day average max	
7 DAYS STARTING	2005	7 DAYS STARTING	2005
26-Jun	11.51536	26-Jun	13.88714
27-Jun	11.56429	27-Jun	14.19714
28-Jun	11.73577	28-Jun	14.55143
29-Jun	11.93917	29-Jun	14.70714
30-Jun	12.07137	30-Jun	14.70714
1-Jul	12.05202	1-Jul	14.66286
2-Jul	11.915	2-Jul	14.42
3-Jul	11.86429	3-Jul	14.35286
4-Jul	11.79595	4-Jul	14.02
5-Jul	11.77196	5-Jul	14.06571
6-Jul	11.84185	6-Jul	14.26857
7-Jul	11.85994	7-Jul	14.40429
8-Jul	11.95268	8-Jul	14.51714
9-Jul	12.05071	9-Jul	14.56143
10-Jul	12.20929	10-Jul	14.80857
11-Jul	12.47893	11-Jul	15.39
12-Jul	12.73149	12-Jul	15.66143
13-Jul	12.79708	13-Jul	15.70714
14-Jul	12.8372	14-Jul	15.79714
15-Jul	12.91577	15-Jul	15.93286
16-Jul	13.0356	16-Jul	16.02143
17-Jul	13.03833	17-Jul	16.02143
18-Jul	13.04006	18-Jul	15.99857
19-Jul	12.97792	19-Jul	15.93
20-Jul	12.96071	20-Jul	15.95286
21-Jul	13.03131	21-Jul	16.02143
22-Jul	13.12327	22-Jul	16.13571
23-Jul	13.35982	23-Jul	16.67429
24-Jul	13.49452	24-Jul	16.78857
25-Jul	13.57536	25-Jul	16.88
26-Jul	13.50506	26-Jul	16.65429
27-Jul	13.39452	27-Jul	16.54143
28-Jul	13.2431	28-Jul	16.40429
29-Jul	13.05804	29-Jul	16.22143
30-Jul	12.97661	30-Jul	16.19857
31-Jul	12.96369	31-Jul	16.19857
1-Aug	12.9703	1-Aug	16.19857
2-Aug	13.11405	2-Aug	16.51571
3-Aug	13.21571	3-Aug	16.58286
4-Aug	13.26167	4-Aug	16.51571
5-Aug	13.22982	5-Aug	16.33571
6-Aug	13.14226	6-Aug	16.17714
7-Aug	13.02619	7-Aug	16.04143
8-Aug	12.8681	8-Aug	15.90571
9-Aug	12.70804	9-Aug	15.72429
10-Aug	12.65625	10-Aug	15.67857
11-Aug	12.53494	11-Aug	15.47571
12-Aug	12.43613	12-Aug	15.47571
13-Aug	12.30268	13-Aug	15.36286
14-Aug	12.21065	14-Aug	15.29429

15-Aug	12.17179	**15-Aug**	15.27143
16-Aug	12.12375	**16-Aug**	15.13571
17-Aug	11.90149	**17-Aug**	14.8
18-Aug	11.79071	**18-Aug**	14.84571
19-Aug	11.72976	**19-Aug**	14.80143
20-Aug	11.70214	**20-Aug**	14.77857
21-Aug	11.64375	**21-Aug**	14.68857
22-Aug	11.56244	**22-Aug**	14.57571
23-Aug	11.44577	**23-Aug**	14.42
24-Aug	11.33446	**24-Aug**	14.33143
25-Aug	11.26185	**25-Aug**	14.22
26-Aug	11.2331	**26-Aug**	14.08571
27-Aug	11.20333	**27-Aug**	13.97429
28-Aug	11.01161	**28-Aug**	13.59714
29-Aug	10.77435	**29-Aug**	13.15286
30-Aug	10.58851	**30-Aug**	13.02
31-Aug	10.5197	**31-Aug**	12.97571
1-Sep	10.44315	**1-Sep**	12.88714
2-Sep	10.39446	**2-Sep**	12.86571
3-Sep	10.2406	**3-Sep**	12.55714
4-Sep	10.17964	**4-Sep**	12.46857
5-Sep	10.13982	**5-Sep**	12.35857
6-Sep	10.10929	**6-Sep**	12.24857
7-Sep	10.07226	**7-Sep**	12.16
8-Sep	10.06571	**8-Sep**	12.09286
9-Sep	9.957976	**9-Sep**	11.87143
10-Sep	9.929464	**10-Sep**	11.84857
11-Sep	9.887679	**11-Sep**	11.80571
12-Sep	9.910476	**12-Sep**	11.91571
13-Sep	9.888095	**13-Sep**	11.78286
14-Sep	9.797857	**14-Sep**	11.65143
15-Sep	9.616488	**15-Sep**	11.43143
16-Sep	9.445238	**16-Sep**	11.27714
17-Sep	9.263214	**17-Sep**	11.14429
18-Sep	9.126726	**18-Sep**	11.07714
19-Sep	9.015179	**19-Sep**	10.99
20-Sep	8.920417	**20-Sep**	10.96714
21-Sep	8.906548	**21-Sep**	10.92143
22-Sep	8.889167	**22-Sep**	10.92143
23-Sep	9.005774	**23-Sep**	10.96571

Methow River below Hancock Springs 2005
MW1880
DAILY VALUES

DATE	AVG	MAX	MIN
6/26/05	11.23708	12.49	9.54
6/27/05	10.79875	12.18	9.69
6/28/05	11.06833	13.73	9.23
6/29/05	11.88292	14.98	9.08
6/30/05	12.23792	15.13	9.69
7/1/05	11.50042	13.88	9.54
7/2/05	11.88208	14.82	9.54
7/3/05	11.57958	14.66	8.62
7/4/05	11.99917	14.66	9.39
7/5/05	12.49208	14.82	10.01
7/6/05	12.80833	14.98	11.1
7/7/05	12.1025	14.82	9.69
7/8/05	10.54125	12.18	9.85
7/9/05	11.52708	14.35	8.93
7/10/05	11.10125	12.33	9.39
7/11/05	11.83125	14.98	9.08
7/12/05	12.98125	16.24	10.01
7/13/05	12.935	15.93	10.32
7/14/05	12.75167	15.61	10.01
7/15/05	11.2275	12.49	10.48
7/16/05	12.63708	16.08	9.85
7/17/05	12.98875	16.4	9.85
7/18/05	13.59917	16.88	10.63
7/19/05	13.44042	16.56	10.63
7/20/05	13.21583	16.56	10.32
7/21/05	13.30167	16.56	10.17
7/22/05	12.06625	13.11	11.41
7/23/05	12.65625	16.08	9.69
7/24/05	13.00083	16.24	10.01
7/25/05	13.16417	16.4	10.17
7/26/05	13.32	16.72	10.32
7/27/05	13.71	17.04	10.63
7/28/05	13.94542	17.36	10.94
7/29/05	13.72208	16.88	10.94
7/30/05	13.59917	16.88	10.63
7/31/05	13.56667	16.88	10.79
8/1/05	12.67208	14.82	10.79
8/2/05	12.54625	15.93	9.69
8/3/05	12.65	16.08	9.69
8/4/05	12.65	16.08	9.54
8/5/05	13.15208	16.72	10.17
8/6/05	13.50875	16.88	10.63
8/7/05	13.61292	16.88	10.79
8/8/05	13.67833	17.04	10.94
8/9/05	13.25792	16.4	10.63
8/10/05	12.97167	15.61	10.94
8/11/05	12.42708	14.82	10.32
8/12/05	12.53917	15.61	10.01

8/13/05	12.69625	15.93	10.01
8/14/05	12.50625	15.93	9.54
8/15/05	12.55792	15.77	10.01
8/16/05	12.89542	16.08	10.32
8/17/05	12.1225	14.19	10.63
8/18/05	11.73542	14.82	9.08
8/19/05	11.605	14.82	8.77
8/20/05	12.05208	15.45	9.23
8/21/05	12.23417	15.77	9.23
8/22/05	12.22167	14.82	10.32
8/23/05	11.33958	13.73	9.39
8/24/05	11.34708	14.51	8.77
8/25/05	11.30875	14.51	8.47
8/26/05	11.41167	14.66	8.62
8/27/05	11.64333	14.82	9.08
8/28/05	11.665	14.98	9.08
8/29/05	11.405	13.73	9.69
8/30/05	10.56042	13.11	8.31
8/31/05	10.83875	13.73	8.31
9/1/05	11.1075	13.57	8.77
9/2/05	11.20333	13.88	9.23
9/3/05	10.30125	12.18	8.93
9/4/05	10.00417	11.87	8.93
9/5/05	10.10417	12.8	7.85
9/6/05	10.07875	12.8	7.69
9/7/05	10.30292	13.11	7.85
9/8/05	10.76667	13.42	8.47
9/9/05	10.12625	11.72	8.62
9/10/05	9.874583	11.56	8.62
9/11/05	9.725417	11.1	8.77
9/12/05	9.890417	12.03	8.47
9/13/05	9.819583	12.18	7.69
9/14/05	10.25708	12.64	8.16
9/15/05	10.0125	11.87	8.31
9/16/05	9.926667	11.56	8.93
9/17/05	9.582083	11.26	7.85
9/18/05	9.885	11.87	7.85
9/19/05	9.73375	11.1	8.47
9/20/05	9.187917	11.26	7.38
9/21/05	8.9875	11.1	7.23
9/22/05	8.81375	10.79	7.23
9/23/05	8.6525	10.63	6.92
9/24/05	8.626667	10.79	6.61
9/25/05	9.104167	11.26	7.23
9/26/05	9.070417	10.94	7.23
9/27/05	9.090833	10.94	7.38
9/28/05	8.865833	11.1	6.77
9/29/05	9.63	11.1	8.62

MW1940 METHOW RIVER AT THE WEEMAN BRIDGE (RM 61)
TEMPERATURE SUMMARY 2005

	2005
START DATE	6/25/05
END DATE	9/30/05
DATA DAYS	98
Daily Maximum > 14.4 °C, 1/1 to 12/30	68
Daily Maximum > 22.2 °C, 1/1 to 12/30	0
7 Day Avg Max > 15, 1/1 to 12/30	50
7 Day Avg Max > 17.8, 1/1 to 12/30	5

MONTHLY MAX TEMPERATURES

January	
February	
March	
April	
May	
June	
July	18.38
August	18.54
September	15.52
October	
November	
December	

Methow River at Weeman Bridge 2005

MW1940		MW1940	
7 day average temp		7 day average max	
7 DAYS STARTING	2005	7 DAYS STARTING	2005
26-Jun	11.45601	26-Jun	13.99714
27-Jun	11.50911	27-Jun	14.35143
28-Jun	11.68595	28-Jun	14.72714
29-Jun	11.90613	29-Jun	14.88286
30-Jun	12.0453	30-Jun	14.88286
1-Jul	12.06839	1-Jul	14.92857
2-Jul	11.9397	2-Jul	14.68714
3-Jul	11.91464	3-Jul	14.66429
4-Jul	11.84381	4-Jul	14.31
5-Jul	11.83548	5-Jul	14.31
6-Jul	11.91899	6-Jul	14.56
7-Jul	11.95685	7-Jul	14.71857
8-Jul	12.05518	8-Jul	14.78571
9-Jul	12.17964	9-Jul	14.85286
10-Jul	12.35714	10-Jul	15.10286
11-Jul	12.68714	11-Jul	15.84286
12-Jul	13.02411	12-Jul	16.34286
13-Jul	13.15589	13-Jul	16.54714
14-Jul	13.24732	14-Jul	16.72857
15-Jul	13.39595	15-Jul	17.02429
16-Jul	13.54583	16-Jul	17.19857
17-Jul	13.57173	17-Jul	17.22
18-Jul	13.57298	18-Jul	17.08286
19-Jul	13.49339	19-Jul	16.92286
20-Jul	13.4778	20-Jul	16.85429
21-Jul	13.57274	21-Jul	16.9
22-Jul	13.66732	22-Jul	16.94571
23-Jul	13.95125	23-Jul	17.51143
24-Jul	14.14363	24-Jul	17.69429
25-Jul	14.28714	25-Jul	17.85429
26-Jul	14.26185	26-Jul	17.67286
27-Jul	14.16786	27-Jul	17.58143
28-Jul	14.02631	28-Jul	17.44429
29-Jul	13.86077	29-Jul	17.28429
30-Jul	13.80345	30-Jul	17.28429
31-Jul	13.82685	31-Jul	17.33
1-Aug	13.86601	1-Aug	17.39857
2-Aug	14.0619	2-Aug	17.78571
3-Aug	14.22595	3-Aug	17.9
4-Aug	14.3425	4-Aug	17.92286
5-Aug	14.3631	5-Aug	17.94571
6-Aug	14.2931	6-Aug	17.80857
7-Aug	14.18952	7-Aug	17.67143
8-Aug	14.05196	8-Aug	17.55714
9-Aug	13.91202	9-Aug	17.44286
10-Aug	13.85452	10-Aug	17.39714
11-Aug	13.69786	11-Aug	17.14857
12-Aug	13.58208	12-Aug	17.01286
13-Aug	13.46042	13-Aug	16.94571
14-Aug	13.38738	14-Aug	16.92286

15-Aug	13.35685	**15-Aug**	16.92286
16-Aug	13.28845	**16-Aug**	16.76429
17-Aug	13.05649	**17-Aug**	16.56
18-Aug	12.95637	**18-Aug**	16.65
19-Aug	12.90857	**19-Aug**	16.62714
20-Aug	12.89125	**20-Aug**	16.62714
21-Aug	12.82488	**21-Aug**	16.51429
22-Aug	12.72202	**22-Aug**	16.24143
23-Aug	12.59119	**23-Aug**	16.06
24-Aug	12.4525	**24-Aug**	15.87857
25-Aug	12.39131	**25-Aug**	15.81
26-Aug	12.35839	**26-Aug**	15.67429
27-Aug	12.35226	**27-Aug**	15.53857
28-Aug	12.16625	**28-Aug**	15.24429
29-Aug	11.94107	**29-Aug**	14.88857
30-Aug	11.76488	**30-Aug**	14.82
31-Aug	11.7481	**31-Aug**	14.82
1-Sep	11.68161	**1-Sep**	14.75286
2-Sep	11.64458	**2-Sep**	14.75286
3-Sep	11.46744	**3-Sep**	14.46286
4-Sep	11.40935	**4-Sep**	14.33143
5-Sep	11.36685	**5-Sep**	14.19857
6-Sep	11.33631	**6-Sep**	14.04286
7-Sep	11.31429	**7-Sep**	13.99857
8-Sep	11.30232	**8-Sep**	13.88571
9-Sep	11.20381	**9-Sep**	13.59571
10-Sep	11.19107	**10-Sep**	13.57286
11-Sep	11.18821	**11-Sep**	13.68286
12-Sep	11.23131	**12-Sep**	13.94714
13-Sep	11.24363	**13-Sep**	13.92571
14-Sep	11.15524	**14-Sep**	13.77143
15-Sep	10.9847	**15-Sep**	13.57429
16-Sep	10.80405	**16-Sep**	13.46429
17-Sep	10.61125	**17-Sep**	13.37714
18-Sep	10.44369	**18-Sep**	13.17857
19-Sep	10.33786	**19-Sep**	13.06857
20-Sep	10.23637	**20-Sep**	12.98143
21-Sep	10.23179	**21-Sep**	12.96
22-Sep	10.23018	**22-Sep**	12.91571
23-Sep	10.35012	**23-Sep**	12.89429

Methow River at Weeman Bridge 2005

MW1940

DAILY VALUES

DATE	AVG	MAX	MIN
6/26/05	11.19833	12.56	9.31
6/27/05	10.73208	12.09	9.61
6/28/05	11.00958	13.79	9.31
6/29/05	11.88792	15.36	8.84
6/30/05	12.10667	15.2	9.46
7/1/05	11.46083	13.94	9.46
7/2/05	11.79667	15.04	9.31
7/3/05	11.57	15.04	8.38
7/4/05	11.97	14.72	9.15
7/5/05	12.55083	14.88	9.92
7/6/05	12.86208	15.36	11.01
7/7/05	12.26833	15.52	9.46
7/8/05	10.56	12.25	9.77
7/9/05	11.62125	14.88	8.84
7/10/05	11.07417	12.56	9.15
7/11/05	11.91167	14.72	8.84
7/12/05	13.13542	16.63	9.92
7/13/05	13.12708	16.47	10.08
7/14/05	12.95667	15.99	9.77
7/15/05	11.43125	12.72	10.55
7/16/05	12.86375	16.63	10.08
7/17/05	13.38417	17.74	9.77
7/18/05	14.27042	18.22	10.71
7/19/05	14.05792	18.06	10.86
7/20/05	13.76708	17.74	10.39
7/21/05	13.99708	18.06	10.24
7/22/05	12.48042	13.94	11.78
7/23/05	13.045	16.78	9.92
7/24/05	13.39292	16.78	10.24
7/25/05	13.71333	17.1	10.55
7/26/05	13.94875	17.58	10.55
7/27/05	14.43167	18.06	11.01
7/28/05	14.65917	18.38	11.32
7/29/05	14.46792	17.9	11.32
7/30/05	14.39167	18.06	11.01
7/31/05	14.3975	17.9	11.01
8/1/05	13.53625	15.83	11.32
8/2/05	13.29083	16.94	9.92
8/3/05	13.44083	17.1	9.92
8/4/05	13.50042	17.26	9.77
8/5/05	14.06667	17.9	10.55
8/6/05	14.55542	18.38	11.32
8/7/05	14.67167	18.38	11.47
8/8/05	14.9075	18.54	11.63
8/9/05	14.43917	17.74	11.47
8/10/05	14.25667	17.26	11.78
8/11/05	13.64458	17.42	11.47
8/12/05	13.57667	16.94	10.71

8/13/05	13.83042	17.42	10.86
8/14/05	13.70875	17.58	10.55
8/15/05	13.92792	17.74	11.17
8/16/05	14.03667	17.42	11.47
8/17/05	13.16	15.52	11.63
8/18/05	12.83417	16.47	9.92
8/19/05	12.725	16.47	9.61
8/20/05	13.31917	17.26	10.24
8/21/05	13.495	17.58	10.24
8/22/05	13.44917	16.63	11.32
8/23/05	12.41292	15.99	10.24
8/24/05	12.45917	16.15	9.61
8/25/05	12.49958	16.31	9.31
8/26/05	12.60375	16.47	9.31
8/27/05	12.85458	16.47	9.77
8/28/05	12.775	15.67	9.92
8/29/05	12.53333	15.36	10.39
8/30/05	11.44208	14.72	9.31
8/31/05	12.03083	15.67	9.15
9/1/05	12.26917	15.36	9.77
9/2/05	12.56083	15.52	10.24
9/3/05	11.5525	14.41	9.92
9/4/05	11.19875	13.18	10.08
9/5/05	11.3	14.88	8.69
9/6/05	11.32458	14.72	8.69
9/7/05	11.56542	15.2	8.84
9/8/05	12.01	15.36	9.61
9/9/05	11.32083	13.49	9.61
9/10/05	11.14583	13.49	9.61
9/11/05	10.90125	12.25	9.92
9/12/05	11.08625	13.79	9.61
9/13/05	11.17042	14.41	8.69
9/14/05	11.48167	14.41	9.31
9/15/05	11.32042	13.33	9.77
9/16/05	11.23167	13.33	10.24
9/17/05	11.12583	14.26	8.99
9/18/05	11.20292	14.1	8.99
9/19/05	11.1725	13.64	9.77
9/20/05	10.55167	13.33	8.69
9/21/05	10.28792	13.03	8.38
9/22/05	10.05583	12.56	8.38
9/23/05	9.882083	12.72	8.07
9/24/05	9.952917	12.87	7.92
9/25/05	10.46208	13.33	8.53
9/26/05	10.46208	13.03	8.53
9/27/05	10.51958	13.18	8.84
9/28/05	10.27667	12.72	8.07
9/29/05	10.89542	12.41	10.08

Methow River below Hancock Springs 2006 (RM 59.8)

Date	Daily Minimum Min of Temperature	Daily Average Average of Temperature	Daily Max Max of Temperature	7-day av 7day av average	7-day max 7day av max
7/12/2006	9.74	11.30	13.32		
7/13/2006	9.43	11.30	13.01		
7/14/2006	9.59	11.99	14.4		
7/15/2006	9.59	12.13	14.87		
7/16/2006	9.59	12.22	15.03		
7/17/2006	9.9	12.38	15.19		
7/18/2006	9.74	12.21	15.03	11.93	14.41
7/19/2006	9.74	11.63	13.01	11.98	14.36
7/20/2006	9.9	12.60	15.67	12.17	14.74
7/21/2006	10.37	13.31	16.46	12.35	15.04
7/22/2006	11.15	13.33	15.67	12.53	15.15
7/23/2006	11.3	13.90	16.77	12.77	15.40
7/24/2006	11.46	14.22	17.09	13.03	15.67
7/25/2006	11.46	13.80	16.46	13.26	15.88
7/26/2006	11.3	13.85	16.62	13.57	16.39
7/27/2006	11.3	13.90	16.77	13.76	16.55
7/28/2006	10.84	13.34	15.83	13.76	16.46
7/29/2006	10.68	13.01	15.83	13.72	16.48
7/30/2006	9.9	11.52	13.47	13.38	16.01
7/31/2006	8.97	10.88	13.32	12.90	15.47
8/1/2006	9.59	11.69	14.4	12.60	15.18
8/2/2006	9.43	11.97	14.72	12.33	14.91
8/3/2006	9.9	11.99	14.24	12.06	14.54
8/4/2006	9.9	12.25	14.72	11.90	14.39
8/5/2006	9.74	12.12	14.87	11.77	14.25
8/6/2006	9.9	12.39	15.19	11.90	14.49
8/7/2006	10.22	12.69	15.51	12.16	14.81
8/8/2006	10.84	12.40	14.09	12.26	14.76
8/9/2006	10.68	12.16	13.93	12.28	14.65
8/10/2006	10.22	11.79	13.78	12.26	14.58
8/11/2006	9.9	11.92	14.56	12.21	14.56
8/12/2006	9.74	11.97	14.56	12.19	14.52
8/13/2006	9.74	11.92	14.56	12.12	14.43
8/14/2006	9.74	11.79	14.09	11.99	14.22
8/15/2006	10.06	12.15	14.72	11.96	14.31
8/16/2006	10.06	11.71	13.63	11.89	14.27
8/17/2006	9.59	11.61	14.09	11.87	14.32
8/18/2006	9.9	11.63	13.93	11.83	14.23
8/19/2006	9.59	11.64	14.09	11.78	14.16
8/20/2006	9.28	11.44	13.78	11.71	14.05
8/21/2006	9.43	11.46	13.78	11.66	14.00
8/22/2006	10.37	11.90	13.93	11.63	13.89
8/23/2006	9.74	11.75	14.24	11.63	13.98
8/24/2006	9.59	11.13	13.32	11.56	13.87
8/25/2006	9.28	11.48	13.93	11.54	13.87
8/26/2006	9.28	11.35	13.78	11.50	13.82
8/27/2006	9.28	11.40	13.78	11.50	13.82
8/28/2006	9.13	11.40	13.93	11.49	13.84

8/29/2006	9.74	11.13	12.86	11.38	13.69
8/30/2006	8.82	10.20	11.92	11.15	13.36
8/31/2006	8.36	10.31	12.54	11.04	13.25
9/1/2006	8.21	10.37	12.7	10.88	13.07
9/2/2006	8.36	10.50	13.01	10.76	12.96
9/3/2006	8.67	10.64	12.86	10.65	12.83
9/4/2006	9.28	10.88	12.86	10.57	12.68
9/5/2006	9.13	10.34	11.77	10.46	12.52
9/6/2006	9.13	10.58	12.23	10.52	12.57
9/7/2006	9.43	10.79	12.54	10.59	12.57
9/8/2006	8.97	10.82	13.01	10.65	12.61
9/9/2006	9.9	11.12	12.86	10.74	12.59
9/10/2006	8.82	10.43	12.23	10.71	12.50
9/11/2006	8.67	10.42	12.39	10.64	12.43
9/12/2006	8.82	10.45	12.54	10.66	12.54
9/13/2006	9.13	9.91	10.99	10.56	12.37
9/14/2006	8.52	9.27	10.22	10.35	12.03
9/15/2006	8.67	9.60	11.15	10.17	11.77
9/16/2006	4.17	7.75	10.99	9.69	11.50
9/17/2006	4.17	7.97	10.99	9.34	11.32
9/18/2006	6.98	8.52	10.22	9.07	11.01
9/19/2006	5.73	8.24	10.84	8.75	10.77
9/20/2006	5.27	7.60	9.59	8.42	10.57
9/21/2006	5.58	7.56	10.22	8.18	10.57
9/22/2006	4.02	7.62	10.99	7.89	10.55
9/23/2006	6.04	8.52	11.3	8.00	10.59
9/24/2006	5.27	8.46	11.46	8.07	10.66
9/25/2006	5.42	8.54	11.15	8.08	10.79
9/26/2006	6.04	8.80	11.3	8.16	10.86
9/27/2006	6.36	9.01	11.3	8.36	11.10
9/28/2006	6.51	9.01	11.15	8.56	11.24
9/29/2006	5.89	8.59	10.84	8.70	11.21
9/30/2006	5.11	8.01	10.53	8.63	11.10
10/1/2006	4.96	7.73	10.06	8.53	10.90
10/2/2006	3.39	6.93	9.9	8.30	10.73
10/3/2006	4.49	7.45	10.06	8.10	10.55
10/4/2006	5.27	8.02	10.06	7.96	10.37
10/5/2006	5.89	8.18	10.06	7.84	10.22
10/6/2006	5.27	6.71	7.75	7.58	9.77
10/7/2006	2.91	4.54	5.89	7.08	9.11
10/8/2006	4.17	5.22	6.67	6.72	8.63
10/9/2006	2.44	3.77	5.42	6.27	7.99
10/10/2006	2.28	4.18	6.36	5.80	7.46
10/11/2006	3.23	4.88	6.82	5.35	7.00
10/12/2006	3.39	4.82	6.51	4.87	6.49
10/13/2006	3.7	4.98	6.67	4.63	6.33
10/14/2006	3.39	5.30	7.13	4.73	6.51
10/15/2006	5.58	6.27	6.67	4.88	6.51
				5.76	8.18
				6.02	8.48
				6.25	8.81
				6.61	9.39
				7.15	10.30
				8.08	11.88

				9.89	17.09

Methow River at Fender Mill Site (RM 59.7) 2006

	Daily Minimum	Daily Average	Daily Maximum	7-day av	7-day max
Date	**Min of Temperature**	**Average of Temperature**	**Max of Temperature**	7day av av	7day av max
7/12/2006	9.82	11.39	13.38		
7/13/2006	9.36	11.38	13.69		
7/14/2006	9.51	12.19	15.26		
7/15/2006	9.51	12.36	15.73		
7/16/2006	9.51	12.49	15.89		
7/17/2006	9.82	12.69	16.21		
7/18/2006	9.67	12.49	15.89	12.14	15.15
7/19/2006	9.82	11.80	13.54	12.20	15.17
7/20/2006	9.98	13.01	16.68	12.43	15.60
7/21/2006	10.44	13.74	17.48	12.65	15.92
7/22/2006	11.37	13.66	16.37	12.84	16.01
7/23/2006	11.37	14.31	18.28	13.10	16.35
7/24/2006	11.68	14.71	18.28	13.39	16.65
7/25/2006	11.53	14.21	17.64	13.63	16.90
7/26/2006	11.53	14.37	17.96	14.00	17.53
7/27/2006	11.53	14.45	18.12	14.21	17.73
7/28/2006	11.06	13.78	16.68	14.21	17.62
7/29/2006	10.76	13.53	17.16	14.19	17.73
7/30/2006	9.98	11.90	14.63	13.85	17.21
7/31/2006	9.05	11.27	14.16	13.36	16.62
8/1/2006	9.67	12.27	15.89	13.08	16.37
8/2/2006	9.67	12.63	16.37	12.83	16.14
8/3/2006	9.98	12.51	15.42	12.56	15.76
8/4/2006	10.13	12.89	16.21	12.43	15.69
8/5/2006	9.82	12.77	16.37	12.32	15.58
8/6/2006	10.13	13.10	16.68	12.49	15.87
8/7/2006	10.44	13.45	17.16	12.80	16.30
8/8/2006	11.06	12.95	15.42	12.90	16.23
8/9/2006	10.91	12.70	15.1	12.91	16.05
8/10/2006	10.44	12.31	14.94	12.88	15.98
8/11/2006	10.13	12.61	16.37	12.84	16.01
8/12/2006	9.82	12.69	16.52	12.83	16.03
8/13/2006	9.82	12.59	16.21	12.76	15.96
8/14/2006	9.82	12.43	15.73	12.61	15.76
8/15/2006	10.13	12.87	16.52	12.60	15.91
8/16/2006	10.13	12.24	15.1	12.53	15.91
8/17/2006	9.67	12.33	16.21	12.54	16.09
8/18/2006	10.13	12.32	15.58	12.50	15.98
8/19/2006	9.82	12.29	15.73	12.44	15.87
8/20/2006	9.51	12.04	15.26	12.36	15.73
8/21/2006	9.67	12.09	15.1	12.31	15.64
8/22/2006	10.6	12.53	15.58	12.26	15.51
8/23/2006	9.98	12.43	16.21	12.29	15.67
8/24/2006	9.67	11.66	14.78	12.19	15.46
8/25/2006	9.51	12.11	15.89	12.16	15.51

8/26/2006	9.51	11.94	15.42	12.11	15.46
8/27/2006	9.51	12.03	15.42	12.11	15.49
8/28/2006	9.36	12.05	15.73	12.11	15.58
8/29/2006	9.98	11.63	14.78	11.98	15.46
8/30/2006	8.89	10.67	13.69	11.73	15.10
8/31/2006	8.43	10.92	14.31	11.62	15.03
9/1/2006	8.43	11.02	14.78	11.47	14.88
9/2/2006	8.43	11.08	14.63	11.34	14.76
9/3/2006	8.89	11.22	14.47	11.23	14.63
9/4/2006	9.36	11.37	14	11.13	14.38
9/5/2006	9.36	10.70	12.46	11.00	14.05
9/6/2006	9.36	11.02	13.08	11.05	13.96
9/7/2006	9.67	11.26	13.69	11.10	13.87
9/8/2006	9.05	11.32	14.31	11.14	13.81
9/9/2006	10.13	11.55	14.47	11.21	13.78
9/10/2006	9.05	10.89	13.69	11.16	13.67
9/11/2006	8.74	10.91	13.69	11.09	13.63
9/12/2006	9.05	11.01	14.16	11.14	13.87
9/13/2006	9.36	10.28	12.15	11.03	13.74
9/14/2006	8.74	9.65	11.37	10.80	13.41
9/15/2006	8.89	9.99	12.15	10.61	13.10
9/16/2006	4.17	8.02	12.92	10.11	12.88
9/17/2006	4.17	8.17	12.3	9.72	12.68
9/18/2006	6.98	8.69	10.91	9.40	12.28
9/19/2006	5.73	8.44	11.68	9.03	11.93
9/20/2006	5.27	7.77	10.13	8.67	11.64
9/21/2006	5.58	7.75	11.06	8.40	11.59
9/22/2006	4.02	7.88	12.77	8.10	11.68
9/23/2006	6.04	8.80	12.92	8.21	11.68
9/24/2006	5.27	8.72	13.38	8.29	11.84
9/25/2006	5.42	8.83	13.38	8.31	12.19
9/26/2006	6.04	9.09	13.23	8.41	12.41
9/27/2006	6.36	9.33	13.54	8.63	12.90
9/28/2006	6.51	9.32	13.38	8.85	13.23
9/29/2006	5.89	8.91	13.08	9.00	13.27
9/30/2006	5.11	8.36	13.08	8.94	13.30
10/1/2006	4.96	8.09	12.77	8.85	13.21
10/2/2006	3.39	7.31	12.15	8.63	13.03
10/3/2006	4.49	7.75	11.53	8.44	12.79
10/4/2006	5.27	8.39	12.61	8.30	12.66
10/5/2006	5.89	8.49	12.15	8.18	12.48
10/6/2006	5.27	6.71	7.75	7.87	11.72
10/7/2006	2.91	4.54	5.89	7.32	10.69
10/8/2006	4.17	5.22	6.67	6.92	9.82
10/9/2006	2.44	3.77	5.42	6.41	8.86
10/10/2006	2.28	4.18	6.36	5.90	8.12
10/11/2006	3.23	4.88	6.82	5.40	7.29
10/12/2006	3.39	4.82	6.51	4.87	6.49
10/13/2006	3.7	4.98	6.67	4.63	6.33
10/14/2006	3.39	5.30	7.13	4.73	6.51
10/15/2006	5.58	6.27	6.67	4.88	6.51
				5.81	8.35
				6.09	8.68
				6.33	9.05

6.71	9.69
7.28	10.69
8.27	12.48
10.27	18.28

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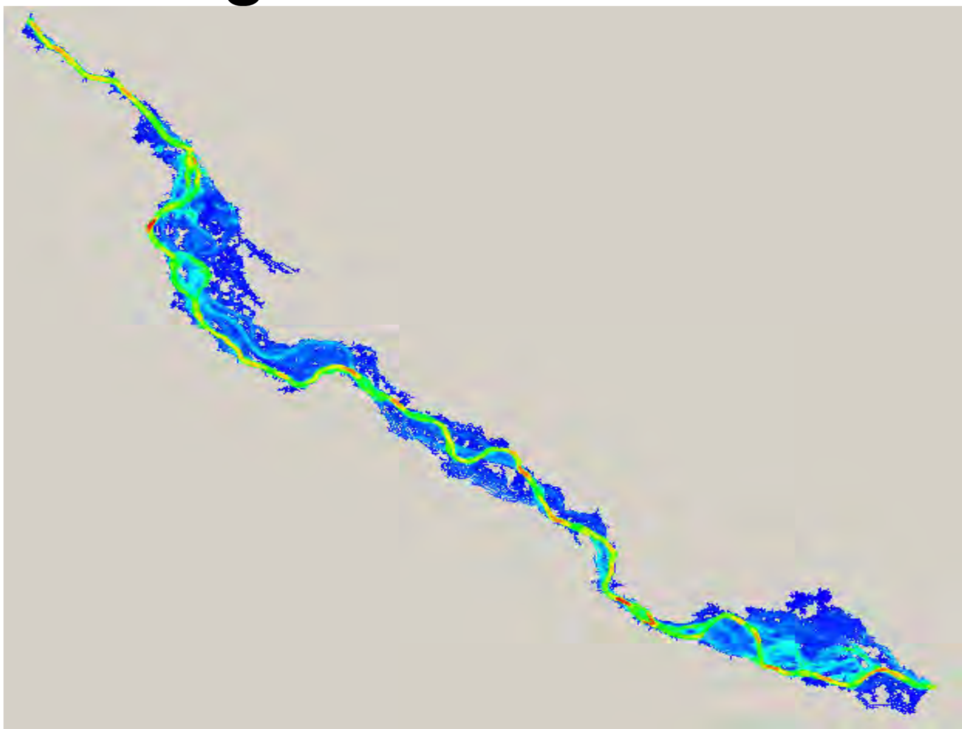
Appendix D

Numerical Modeling Results

This appendix focuses on describing the two-dimensional (2D) modeling results for the Big Valley reach assessment area. The 2D modeling was conducted by Reclamation's Technical Service Center.

Numerical Modeling Results for the Big Valley Reach Assessment, Methow River, Washington



Numerical Modeling Results for the Big Valley Reach Assessment, Methow River, Washington

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1.0 Introduction

The Methow Subbasin is located in North Central Washington in Okanogan County. The Methow River and its tributaries contain upper Columbia summer steelhead and spring Chinook salmon, which are both listed as endangered under the Endangered Species Act (ESA), and bull trout, which is listed as threatened. The Upper Columbia River spring Chinook salmon were listed as endangered in 1999 (NMFS, 1999). The Upper Columbia River steelhead were listed as endangered in 1997; their status was upgraded to threatened in January 2006, and then it was reinstated as endangered in June 2007 (NMFS, 2007) in accordance with a U.S. District Court decision. Bull trout were listed as threatened in 1999 (USFWS, 1999). These fish species are important to Washington, and their survival depends on the quality and quantity of fish habitat. Key uses in the Methow Subbasin by ESA-listed fish and other species of concern include:

- Spring Chinook spawning, rearing and migration
- Steelhead spawning, rearing and migration
- Bull trout rearing, foraging and migration.

The *Methow Subbasin Geomorphic Assessment, Okanogan County, Washington* (Reclamation, 2008), referred to as the *Geomorphic Assessment*, was completed for nearly 80 river miles (RM) representing four valley segments consisting of the Upper Methow (RM 50 to 75), Middle Methow (RM 28 to 50), Twisp (RM 0 to 18) and Chewuch Rivers (RM 0 to 14). The 80 river miles were evaluated concurrently to compare and prioritize potential protection and habitat restoration areas among the four valley segments. In the *Geomorphic Assessment* the primary action recommended to recover long-term habitat function and complexity was to restore the ability of the channel to migrate and access historic channels and floodplain where impacted by human features. Based on findings from the *Geomorphic Assessment* and discussions among local stakeholders, a *Reach Assessment* was recommended for the Methow River from RM 62 to 55, known as the Big Valley reach. Advantages of the Big Valley reach over other areas include high density spawning use, a geomorphic setting that naturally can support extensive off-channel habitat and large woody debris presence, and several functioning riparian areas that could be connected with generally minor restoration efforts to address human features impacting habitat. Location maps of the Methow Subbasin and Big Valley reach assessment area are shown on Figures 1 and 2.

The goal of the Big Valley reach assessment, herein referred to as the *Reach Assessment,* is to conduct a diagnostic investigation of the physical processes that create and maintain riparian and aquatic habitat to refine information developed for the larger-scale *Geomorphic Assessment*. The *Reach Assessment* is based on integration of findings from hydrologic, hydraulic, geomorphic, and biologic analyses. Methods at the reach scale include detailed mapping using additional field investigations and Light Distancing and Ranging (LiDAR) data from 2006 to define anthropogenic features affecting floodplain connectivity, analysis of current river dynamics using a two-dimensional (2D) hydraulic model and prediction of potential future river dynamics if anthropogenic features that impact river and floodplain processes are addressed. This report focuses on documenting results from the 2D model portion of the reach assessment.

The 2D hydraulic model was applied to the Big Valley reach to improve understanding of the interaction between the river and floodplain during bankfull and higher flows, and any impacts to these processes from human features in the reach. The results from the 2D model were utilized in a matrix of Reach-based Ecosystem Indicators (REI) to determine the reach's functionality. The REI provides a way to summarize and integrate findings from the various analyses. The REI combined with the geomorphic mapping and 2D model results helps identify which areas of the reach are presently functioning and only need to be protected from future development to avoid any future deterioration. This synthesis of information also refines restoration concepts within potential project areas, and identifies a potential grouping and sequencing of habitat actions based on technical findings.

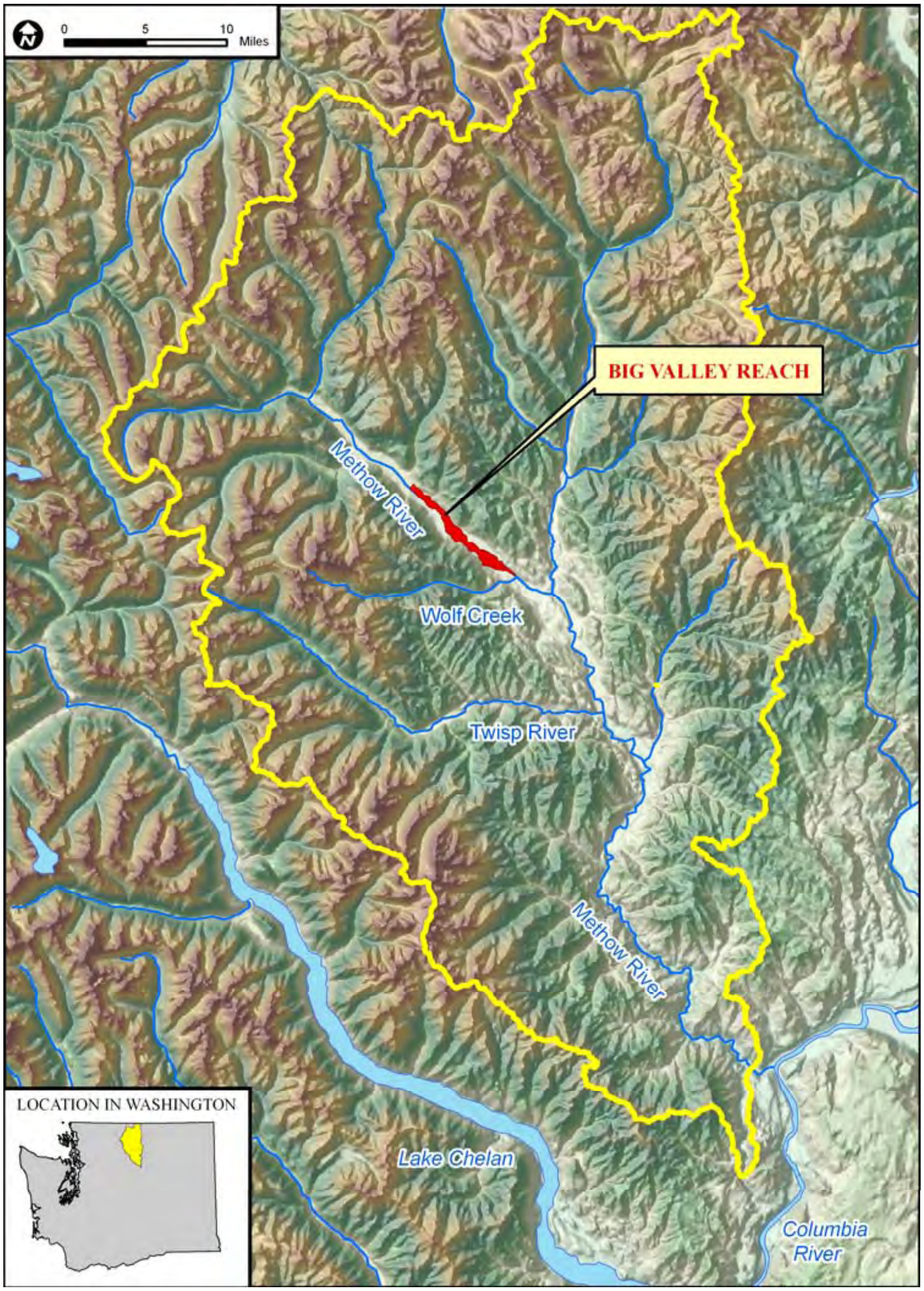

Figure 1-Methow Subbasin Location Map

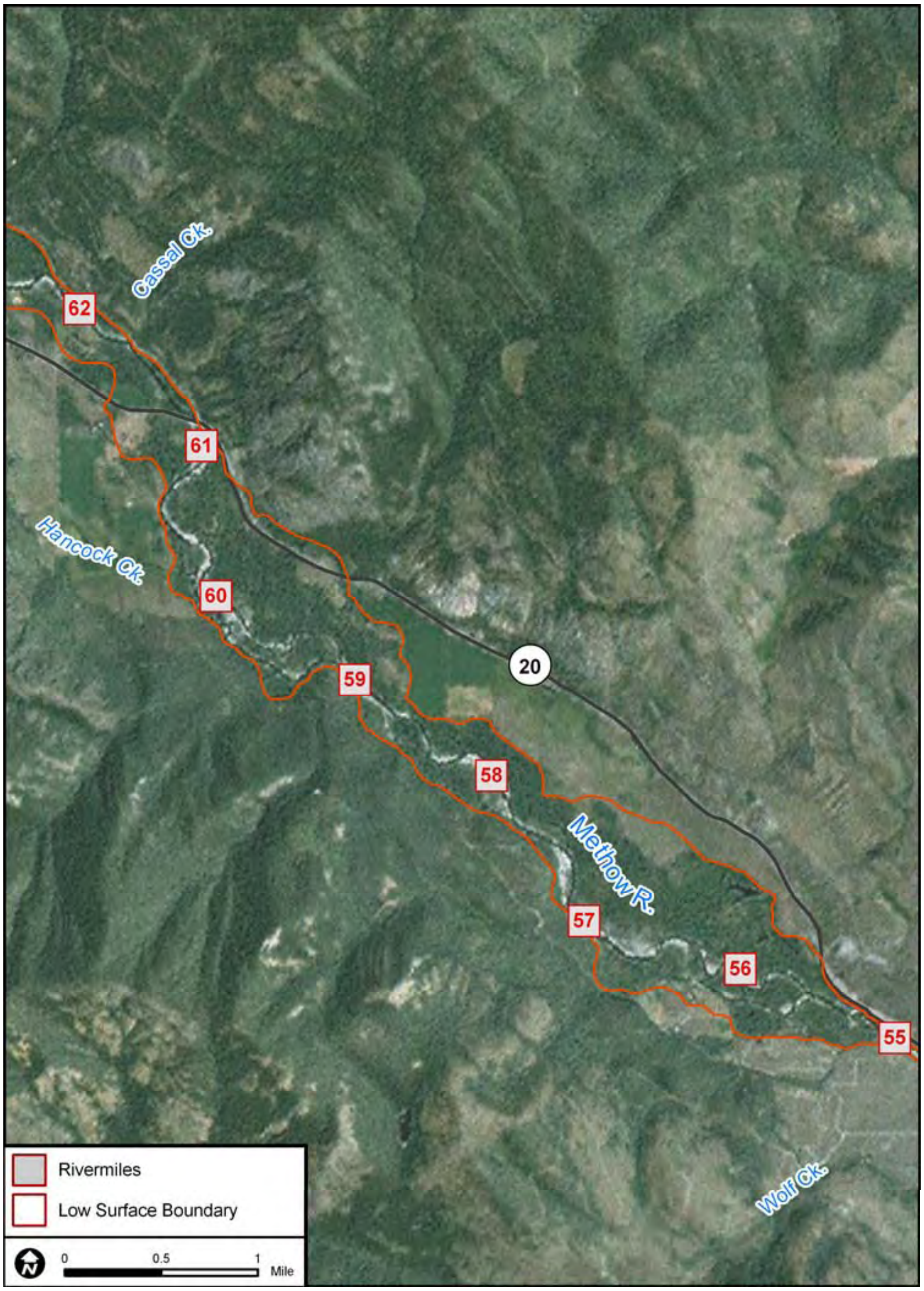

Figure 2-Location map of the Big Valley Reach. Low surface boundary represents the extent of active channels and floodplain, including off-channel habitat areas.

2.0 Assessment Questions

The *Reach Assessment* questions are:

- What is the present quality and quantity of spring Chinook and steelhead habitat features within the reach?

- How would the present habitat features differ in the historic setting (pre-European settlement in late 1800s)?
- What present geomorphic processes are responsible for producing the types of spring Chinook and steelhead habitat found in the reach?
- To what extent have these processes and reach habitat quality and quantity been affected by human features?
- What specific habitat actions and in what sequence can be taken to achieve sustainable improvement to habitat conditions?
- What is the overall potential for habitat improvement in the reach if the restoration actions are implemented?

To help answer these questions, the 2D model was utilized to analyze which hydraulic processes are affected by human features. However, many of the human features identified in the *Reach Assessment* were of such an insignificant size that their effect on hydraulics could not be detected. The 2D model was used to analyze existing hydraulics with human features in place and to predict potential future hydraulic conditions if habitat actions were taken to address human features. However, both model conditions represent snapshots in time. Sustainable habitat actions and sequencing would be defined as long term changes for habitat improvement. The 2D model in conjunction with other tools from the REI can be used to help estimate the potential for sustainable habitat actions and technical sequencing of those actions if they are implemented.

3.0 Numerical Model Methods

The prediction of existing and potential future hydraulics following restoration for the Big Valley reach was completed with a combination of a 2D model analysis and geomorphic analysis. Future channel and floodplain topography was developed by starting with the existing grid and land use assumptions, and then removing any human features that were raised in elevation above natural ground, such as the removal of dikes or berms or lowering and widening of culverts. SRH-2D was used to predict at what flood frequency side channel and off-channel habitats within the reach are presently inundated. All data presented in this report are in the horizontal projection of Washington State Plane North 1983 feet and vertical projection of NAVD 1988 feet. Model results are available in ASCII (comma delimited) format for each model run, SMS format (a post processing software), and also as ARC GIS shape files.

3.1 Model Description

SRH-2D is a 2D hydraulic model for river systems that was applied for *Reach Assessment* (Lai, 2006; formerly known as SRH-W). SRH-2D is particularly useful for problems where 2D hydraulic effects are important. Examples include rivers with in-stream structures, meander bends, perched rivers, and for split flow channel sections. The 2D model routes flow through independent mesh cells and can, therefore, handle multiple water surface elevations and flow paths, along with providing approximate local flow velocities and eddy patterns. SRH-2D has been developed primarily for use by Reclamation engineers to solve various hydraulic and sedimentation problems; SRH-2D has been successfully applied to several Reclamation projects in recent years. The model assumes static bed topography, and, therefore, does not predict vertical incision or aggradation, or lateral migration of the channel through bank erosion.

One of the major features of SRH-2D is the use of the arbitrarily shaped element method for geometry representation. This unstructured meshing strategy is flexible and allows development of non-uniform mesh cells that can vary in size and density across the modeled area depending on the detail needed. This approach allows larger areas to be modeled while still preserving a tight density of small mesh cells in critical areas where more detail is needed to represent the topography. Many other 2D models require uniform mesh cells which can increase run time or cause computational difficulties if the model area becomes too large.

Major capabilities of SRH-2D utilized in this analysis are listed below:

1. SRH-2D solves the 2D form of the dynamic wave equations that include the St. Venant depth-averaged equations; for the *Reach Assessment*, the dynamic wave model with depth averaged equations was applied.
2. Both steady and unsteady flows may be simulated; only steady flow was utilized for the *Reach Assessment*.
3. Unstructured and structured 2D meshes, with arbitrary element shapes, may be used with SRH-2D. In the *Reach Assessment*, a combination of quadrilateral and triangular element shapes in an unstructured mesh was utilized. Cartesian or raster mesh may also be used by SRH-2D;
4. All flow regimes, i.e., subcritical, transcritical, and supercritical flows, are simulated simultaneously; however, the flow regime for the *Reach Assessment* was primarily subcritical with a few locations where supercritical flow occurred.
5. Solution domain may include a combination of main channels, floodplains, and overland areas; for the *Reach Assessment* the solution domain was the main channel, side channels and floodplains.

The SRH-2D Model was applied to the Big Valley reach as a steady state model with an unstructured grid that included main channel and floodplain, and simulated mostly critical to sub-critical flows. The SRH-2D model utilized is state-of-the-art and provides one of the best available methods to simulate river hydraulics. However, even the most advanced modeling has uncertainties due to assumptions related to the theoretical model development (e.g., depth-averaged flow equations used and numerical discretization errors) and the input data used (e.g., uncertainty in topography data).

3.2 Flow Data

A peak flow analysis was conducted for 8 gages in the Methow Subbasin including the USGS gage (12447383) closest to the Big Valley reach, located on the Methow River above Goat Creek near Mazama at RM 65 (Sutley, 2007). Flows modeled for this *Reach Assessment* 2D model include the 2-, 25-, 50- and 100-year floods documented in Table 1.

Table 1-Peak flow discharges for return period floods based on the reference gage 12447383, Methow River above Goat Creek near Mazama near RM 65.5 (as measured from the mouth of the river)

Flood	(cfs)
2 Year	5,965
5 Year	7,841
10 Year	8,966
25 Year	10,277
50 Year	11,186
100 Year	12,043

3.3 Hydraulic Analysis Methods

Hydraulic analysis was completed using the dynamic wave solver of SRH-2D, with no sediment transport or groundwater modeling. Technical details of SRH-2D may be found in the SRH-2D manual (Lai, 2006).

Hydraulic analysis includes the following steps:

(1) Selection of the solution domain (model boundaries) for the project.
   1. The longitudinal boundary of the model was determined based on a reach that was analyzed from RM 62 to 55.
   2. A model width was selected that encompasses the floodplain inundated up to the 100-year flood, and areas of interest in terms of floodplain and channel connectivity.

(2) Boundary conditions for the model were established.
   1. Water discharge was specified at the upstream boundary of the domain
   2. Water surface elevation for each modeled flow was identified at the downstream boundary.

(3) Mesh generation for the solution domain.
   1. A preprocessor and post processor program known as SMS 9.0 was utilized to create a mesh for the model and for post processing of the data.

2. The SMS program is described in Lai (2007) and is also described in the manual for the program from Environmental System Modeling (EMS-I, 2007).

(4) Delineation of Manning's n roughness parameters on mesh using 2006 aerial photography.
   1. SRH-2D uses roughness values to determine flow resistance.
   2. The model utilizes a polygon to delineate roughness areas.
   3. Roughness areas were classified as channel, unvegetated floodplain areas and vegetated floodplain areas based on 2006 aerial photography (Figures 3 and 4).

(5) Topographic representation of the mesh (transforms mesh to a "grid" by applying elevations of available survey data).
   1. The topographic representation of the grid was based on a combination of survey data collected in 2005 and LiDAR data collected in 2006.

(6) Calibration of hydraulic model using previously determined roughness coefficients.

(7) Application of the calibrated hydraulic model to different flood flows and topographic scenarios.

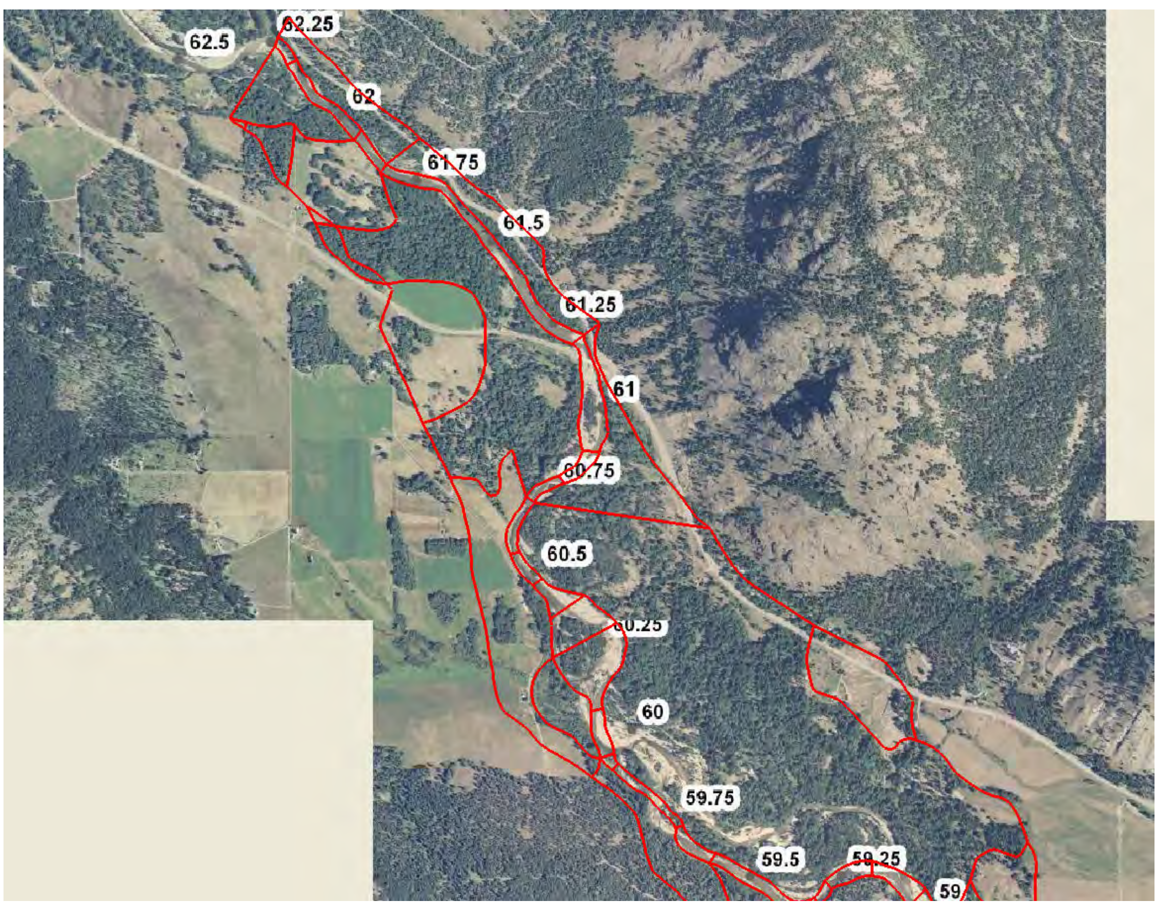

Figure 3-Delineation of different roughness areas for the upper portion of the model based on 2006 aerial photography.

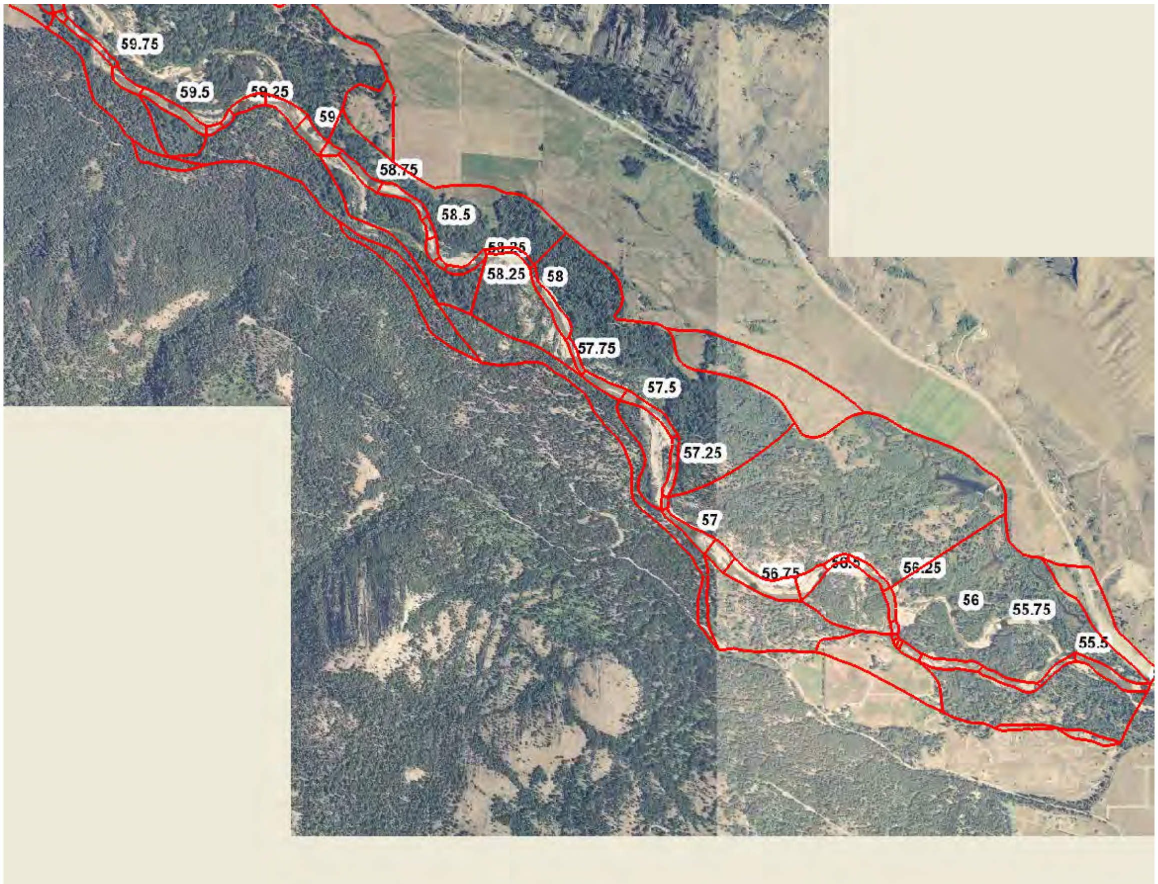

Figure 4- Delineation of different roughness areas for the lower portion of the model based on 2006 aerial photography.

3.4 Mesh Generation

A pre-processor program SMS (version 9.0) was used to generate the mesh for existing and future conditions. Polygons are delineated by the user to generate elements of the unstructured mesh. Polygon boundaries were initially based on roughness variations (e.g. main channel, vegetated floodplain, and unvegetated floodplain (Figures 3 and 4). Polygons were then further sub-divided to allow proper representation of flow lines, such as in meander bends. The final iteration was to sub-divide polygons in areas where tighter mesh cell density was needed to improve representation of hydraulic results.

The mesh contains 66,235 elements and 55,778 nodes, and is composed of an unstructured mesh of rectangular and triangular elements. The mesh generated for the 2D model is shown in Figures 5-7. The active channel was created from rectangular elements and was 10 cells across.

Both existing and future conditions were modeled with the same mesh. Both meshes contained approximately the same number of elements and nodes. The only difference between the two meshes was changes in elevations for certain anthropogenic effects.

These effects included the lowering of the elevations associated with berms, levees and culverts as described in the next section.

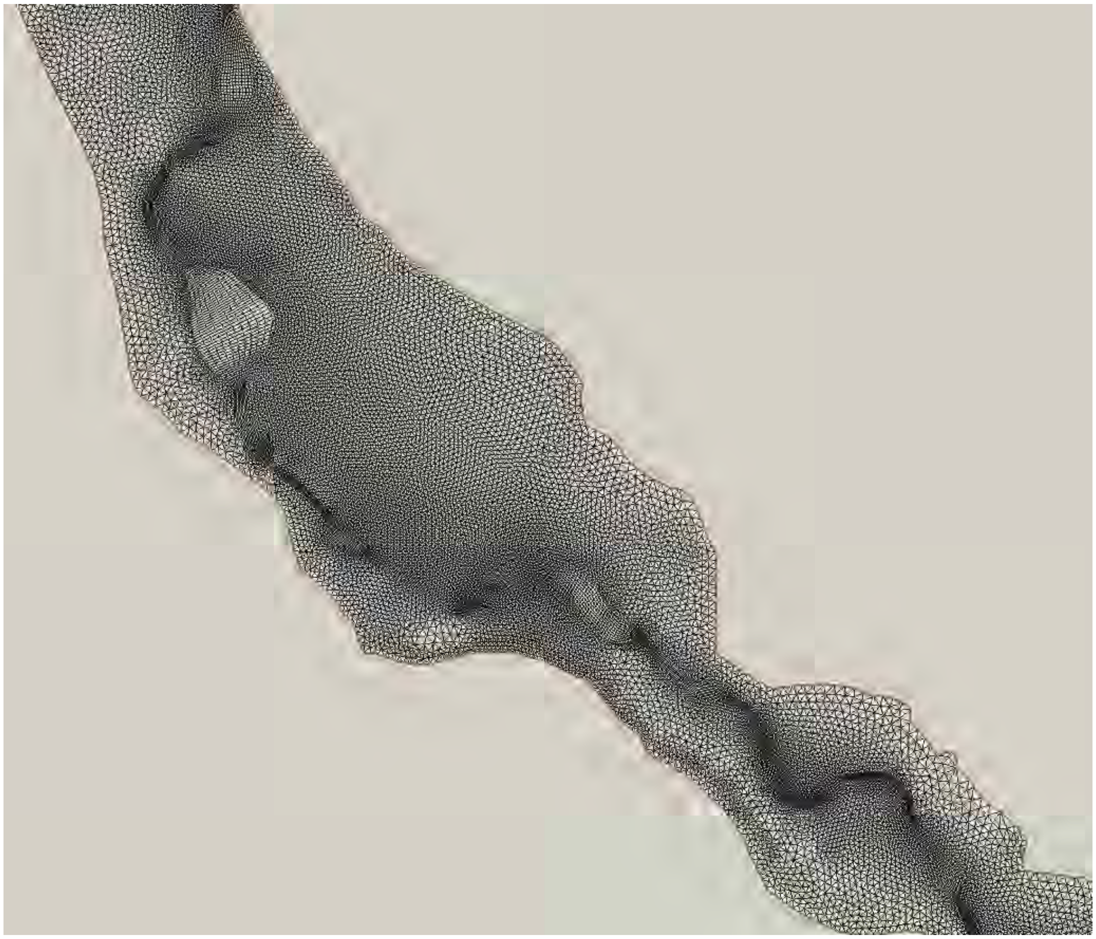

Figure 5- Existing conditions model mesh

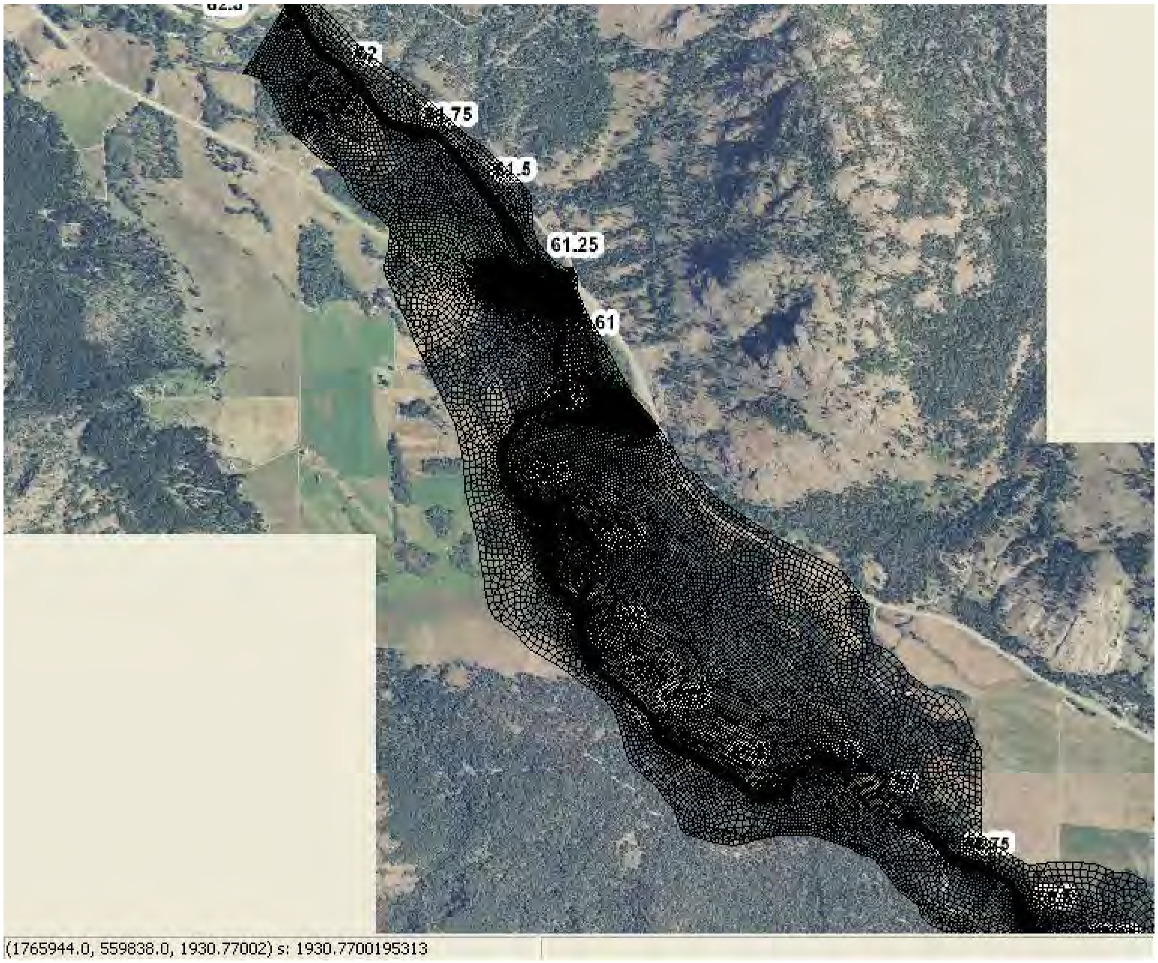

Figure 6-Upstream portion of existing conditions mesh

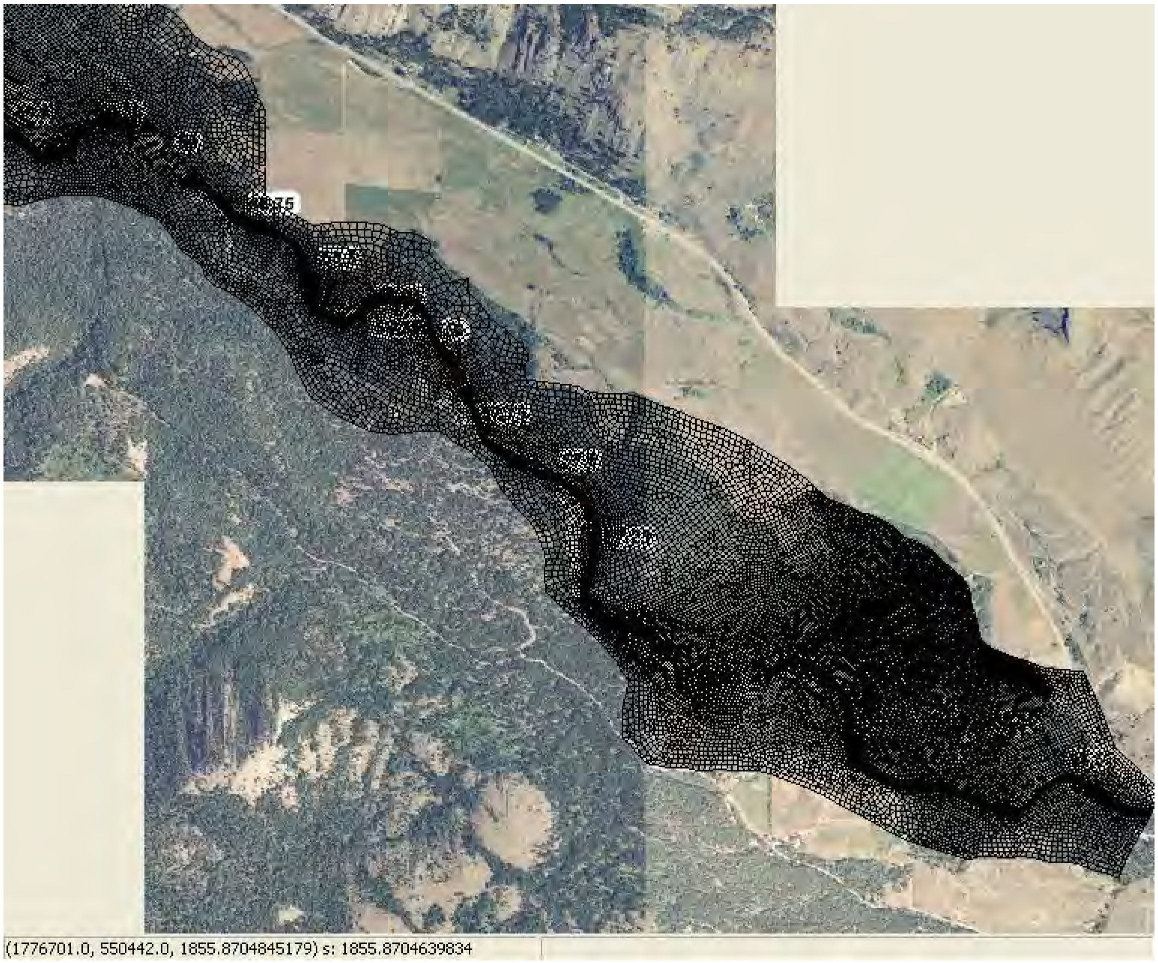

Figure 7-Downstream area of existing conditions mesh.

3.5 Model Topography

Topography data (composed of 2005 survey data and 2006 LiDAR data) were interpolated to the existing conditions grid using the SMS program. Representations of the model topography for existing conditions are shown in Figures 10 and 11.

The accuracy of the model results is largely dependent on the resolution and accuracy of topographic data used to generate the mesh. For existing conditions, LiDAR data in a 2-meter grid was available that was collected on November 8th and 9th, 2006. Unfortunately the Methow River LiDAR data was collected during an unanticipated high flow. The mean daily flow during the LiDAR data collection at the Winthrop gage was 1,980 cfs (USGS gage number 12448500). The Winthrop gage includes flows from a major tributary, the Chewuch River, and the mean daily flow from the Chewuch River near Winthrop, Washington (USGS gage number 124480000) was 420 cfs. Therefore, the estimated flow for the Big Valley reach would have been approximately 1,560 cfs, which is less than the 2-year flood and estimated to inundate the main channel and several of the side channels. LiDAR data does not provide any reliable data for elevations below the water surface at the time of data collection. Consequentially, higher-elevation islands within the main channel and floodplain areas that were not inundated had a high density of topographic LiDAR data available to generate the mesh. The topography in wetted channel areas had to be estimated using a limited amount of cross section and channel profile data collected in 2005, and survey data available from localized areas where design work has occurred near river mile 60. The combined data sets were utilized to generate the mesh. The typical available topographic data is shown in Figure 8.

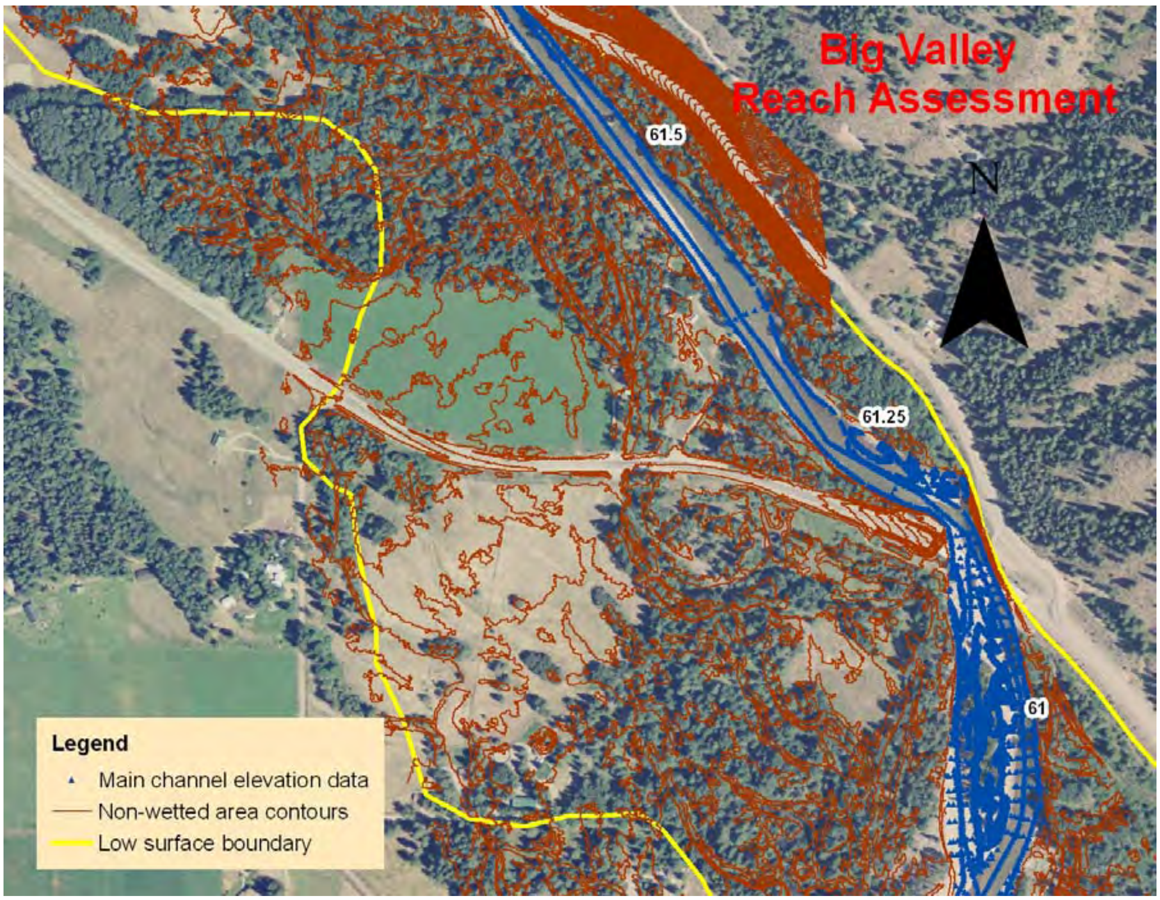

Figure 8-Area showing typical data used in model. Brown contours represent LiDAR data and blue area represents surveyed cross-section bottom data used in main channel.

Potential future conditions following restoration actions were generated by removing any man-made features from the existing conditions grid that artificially disconnect access to floodplain or off-channel habitat areas. The largest feature that was modified for modeling purposes was culverts through the Weeman Bridge embankment, located at RM 61 (Figure 9). The surface elevation of the culverts was reduced to allow greater flows through the embankment to help establish upstream and downstream channel connectivity. Note that SRH-2D does not model pressure flow through culverts. In this scenario the culvert was simulated as an open breach through the embankment. Several smaller human features were also removed including road embankments and levees

(Figure 9; refer to Figures 19-21 for locations of human features). Many of the human features have altered channel position and to a minor extent, channel elevations. Additional channel areas may have been filled historically. Because there is no certainty as to where and by how much this has occurred, no new channels or adjustment to existing channels were incorporated into the future conditions topography. Additional features that prevent lateral migration, such as riprap, were not adjusted for future conditions because this modeling effort does not account for channel migration impacts.

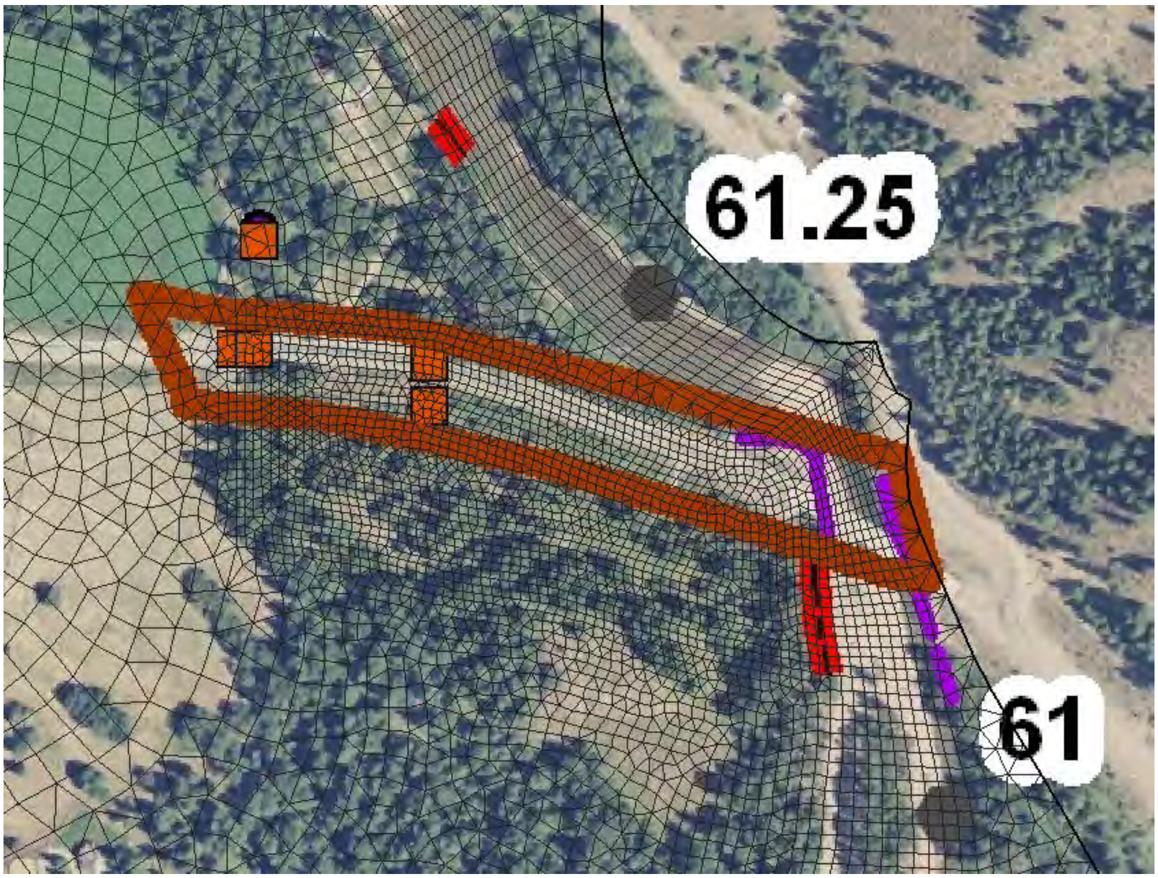

Figure 9- Detail of Weeman Bridge Area-This area shows the finer grid developed for this area. Culvert ground surface elevations were decreased to model increases in flow through culverts

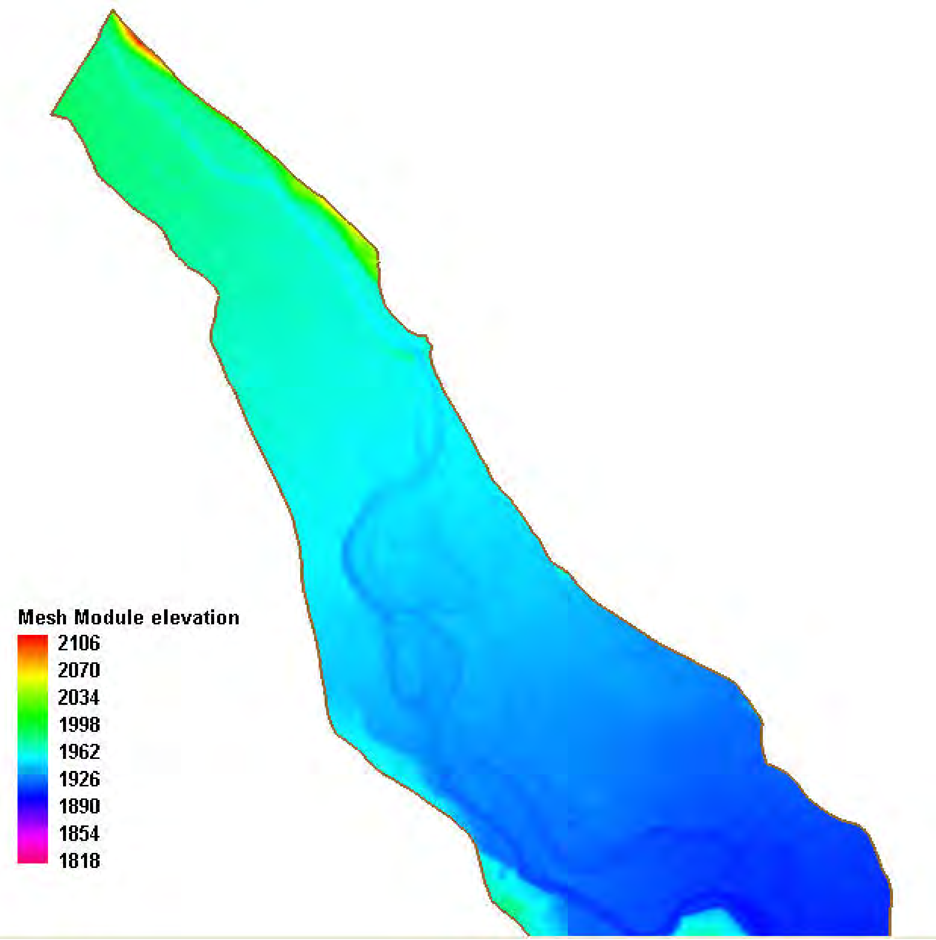

Figure 10-Topography of the Big Valley Reach-upstream

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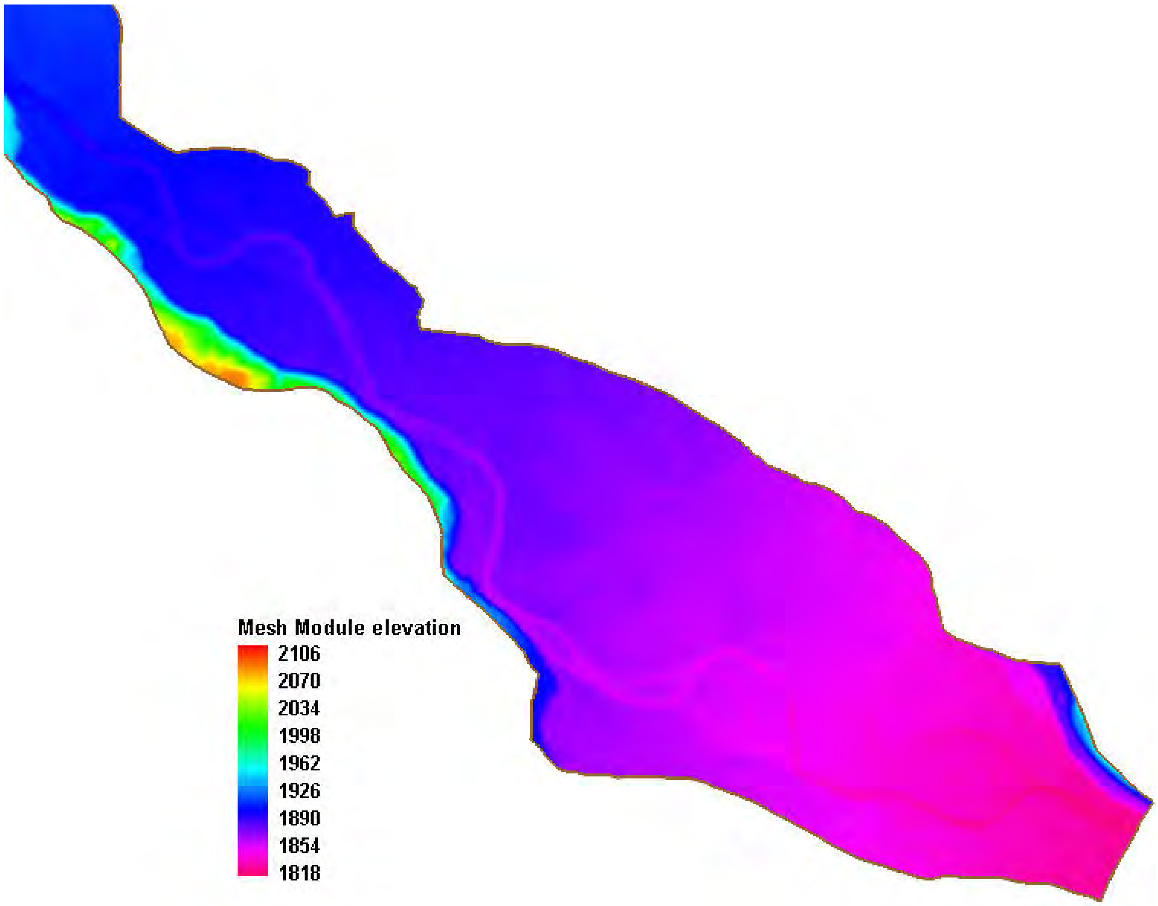


Figure 11- Topography of the Big Valley Reach-downstream

3.6 Roughness values

Delineation of roughness polygons was completed in ARC GIS version 9.1 using interpretation of vegetation type and density, infrastructure and/or developed areas where vegetation had been cleared, and locations of active, unvegetated channels based on a 2006 aerial photograph along with field observations from 2006. Roughness polygons were broken into three categories: 1) unvegetated channel area, 2) vegetated floodplain, and 3) mostly unvegetated floodplain. Roughness values were not altered from an unvegetated category to a vegetated category in areas where cleared vegetation has occurred and may be considered for replanting as part of a habitat action. If these features need to be incorporated into a model to improve predictions, this level of detail would need to be accounted for in more detailed assessments during project design.

Roughness values can vary depending on the flow being modeled. Lower flows typically have higher roughness values because the channel bed grain size and vegetation presence have more influence on hydraulics when water depths are small. This is particularly true in the mainstem Methow River where the channel bed-material surface is composed of gravel- to boulder-sized sediment that can influence hydraulics at low flows, but have a reducing influence as flow depths increase. A flood inundation assessment for this section of river used a range of channel n values of 0.032 to 0.045 and floodplain values from 0.04 to 0.016 (Beck, 1973; FEMA, 2003).

The *Reach Assessment* 2D model used roughness values that were based on a previous 2D model assessment by Reclamation on the Methow River, located near RM 46 approximately 10 miles downstream (Bountry, 2007). These values were 0.035 for the main channel, 0.09 for vegetated floodplain areas and 0.03 for unvegetated areas (Figure 12). For the *Reach Assessment* 2D model, only bankfull and higher flows were modeled, so only one set of roughness values was selected for all flows evaluated. In the previous assessment, water surface elevation data and inundation areas were available for both a low flow and a large flood that were used to calibrate the roughness values. A roughness sensitivity analysis was done in the previous assessment that showed a variation of water surface of 0.05 feet for lower flows with a variation in roughness of 0.05 and for higher flows water surface elevations varied by 0.5 feet for every 0.05 variation in roughness (Bountry, 2007).

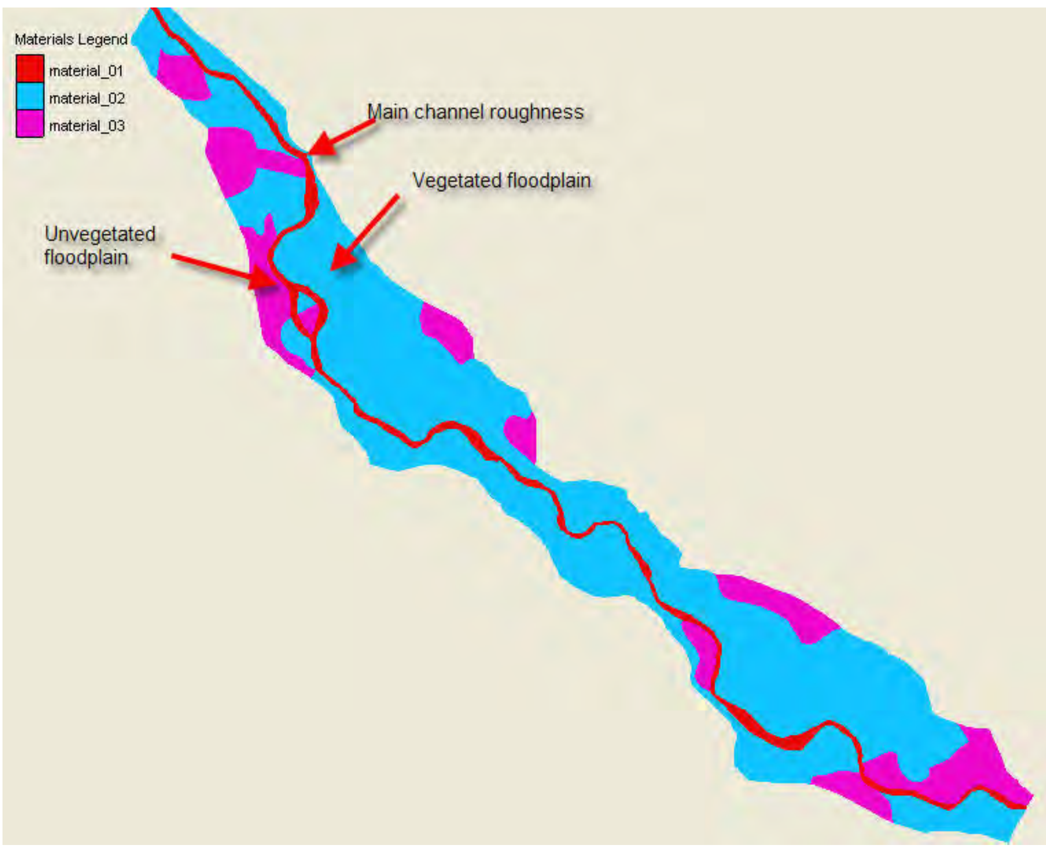


Figure 12-Depiction of roughness areas for the 2D model. Material 1 (red) is main channel areas; material 2(blue) is vegetated floodplain; material 3 (pink) is unvegetated floodplain.

3.7 Model Input Parameters and Calibration

Model runs were initialized with a dry bed in the channel. Simulations were made for a long enough time period to ensure that model results were not changing, or had reached a steady state solution. Model input includes time step, time duration, and upstream and downstream model boundaries. Previous steady state model runs with SRH-2D for similar sized meshes and channel conditions have used a simulation time of 432,000 seconds (5 days) with a time step of 5 seconds. One method to determine if steady state conditions have been reached includes comparison of model results at the half way point of total simulation time and at the end of the simulation to see if there are significant differences. Comparison of velocity and water surface elevation results for the 2-year flood of 6,000 cfs at both time intervals showed that the mean velocity difference was no more that 0.00005 ft/s and average water surface elevation differences were equal to about 0.000001 feet. The maximum difference in water surface elevation between the two solutions was only 0.02 ft. This is one indicator that the simulation time was long enough and had converged on a steady state solution. Additionally, hydraulic results were evaluated to determine that there were no areas of unreasonable flow depth, velocity, or Froude number that would indicate the model had not converged or had significant errors in computations.

A discharge at the upstream boundary was specified as uniform flow across the model boundary topography for each simulation of the 2-year, 5-year, 25-year and 100-year floods (Table 2). The downstream boundary water surface elevation was determined for each flow from a one-dimensional HEC-RAS model with cross sections derived from the same LiDAR floodplain data and surveyed channel data as used in the 2D model. The HEC-RAS downstream model boundary was 200 feet downstream of the 2D model boundary. A normal-depth boundary slope of 0.004 was used in HEC-RAS based on slope computations determined from a 2005 longitudinal profile at RM 55. The normal-depth slope was based on cross sections that were generated based on the LiDAR floodplain data and surveyed channel data.

Table 2- Input parameters

Upstream discharge (cfs)	Downstream elevation (ft)	Flood description
5,935	1822.05	2-year
7,841	1822.97	5-year
10,277	1824.0	25–year
12,043	1824.68	100-year

Longitudinal profiles of water surface elevation were developed along the centerline of the main channel for each flow to check and compare the model results. These profiles are shown in Figures 13-15. The profile line labeled thalweg may not represent the true thalweg in many cases due to limited surveys of channel bottom data and because the centerline does not always follow the thalweg. Generally, there is less than 5 ft of stage difference in the main channel between the 2- and 100-year floods.

To check if the highest flow modeled (100-year flood) had reasonable results, model results were compared to available delineation of the 100-year flood boundary from a previous floodplain inundation analysis (Beck, 1973). The 100-year flow modeled for the Big Valley reach was approximately 12,000 cfs. The 100-year flood boundary from Beck (1973) shown on Figures 16 and 17 were based on a much higher flow of 34,000 cfs, which included flows from the downstream Chewuch River. The 100-year boundary for the 12,000 cfs flow is much less than the larger flow as would be expected.

Based on the initial existing conditions results, there did not appear to be any need to further calibrate the model by adjusting roughness values used from a previous model effort.

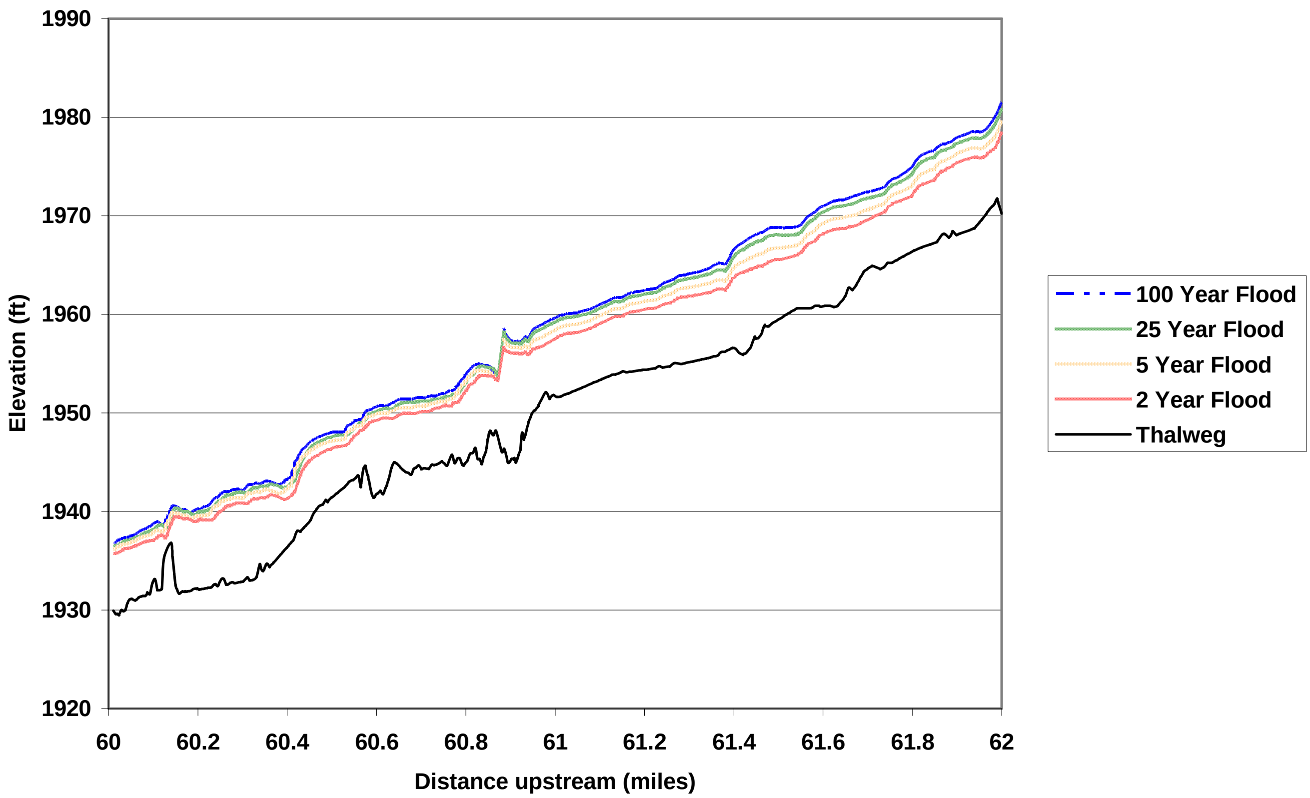


Figure 13-Water surface and thalweg profiles from RM 60 to 62

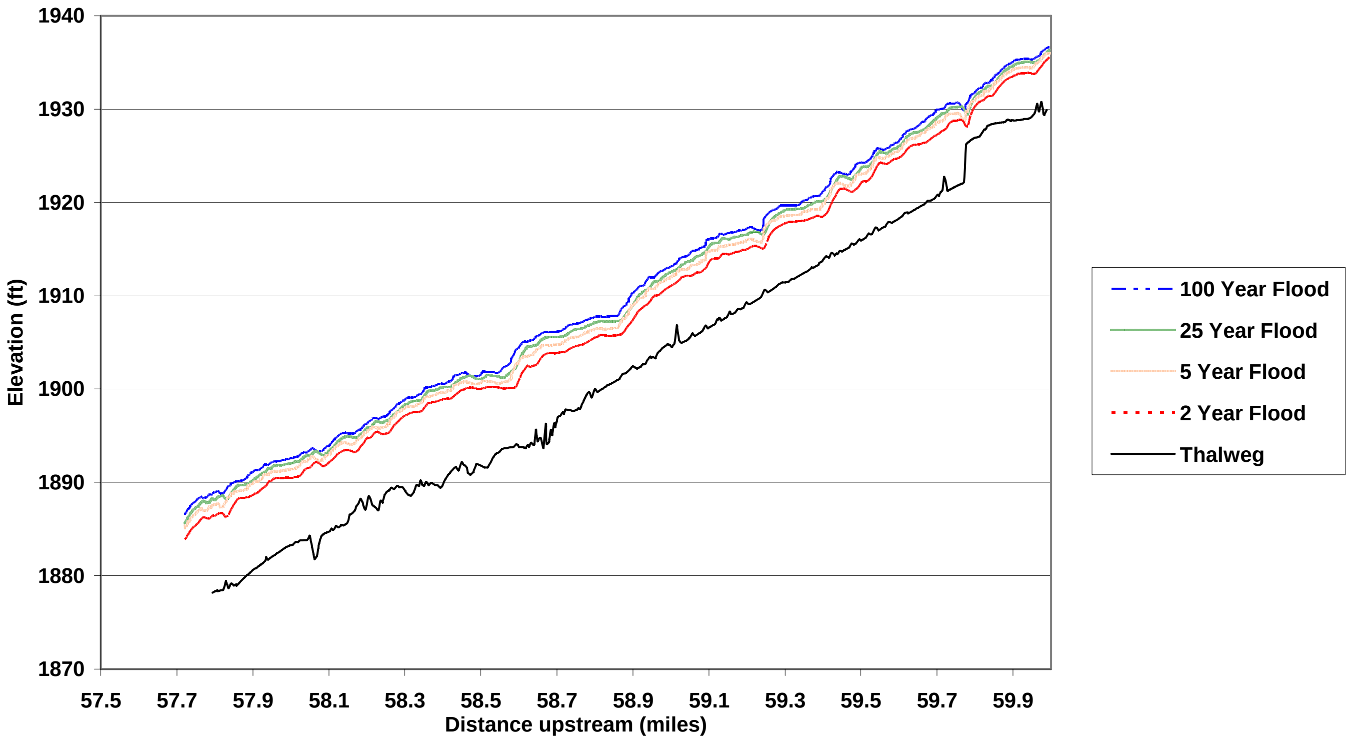


Figure 14- Water surface profile and thalweg plot from RM 58 to 60.

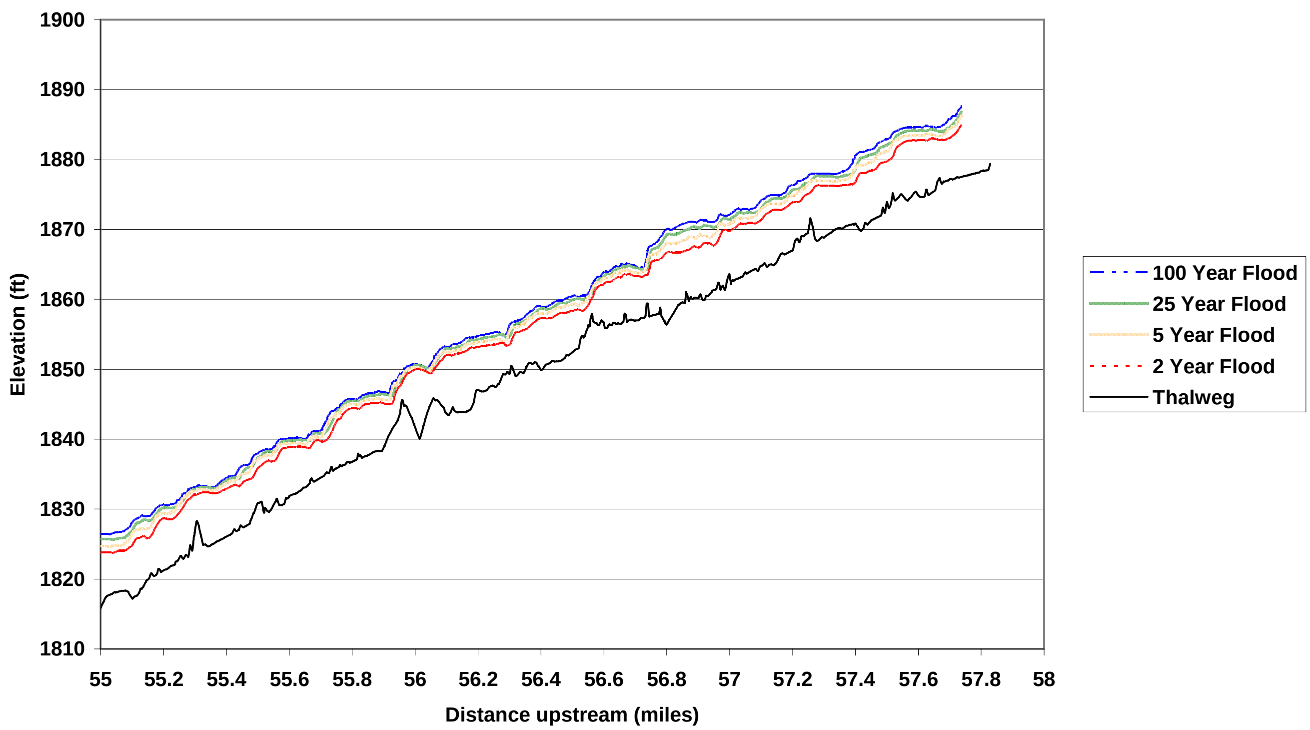


Figure 15- Water surface profile and thalweg plot from RM 55 to 58.

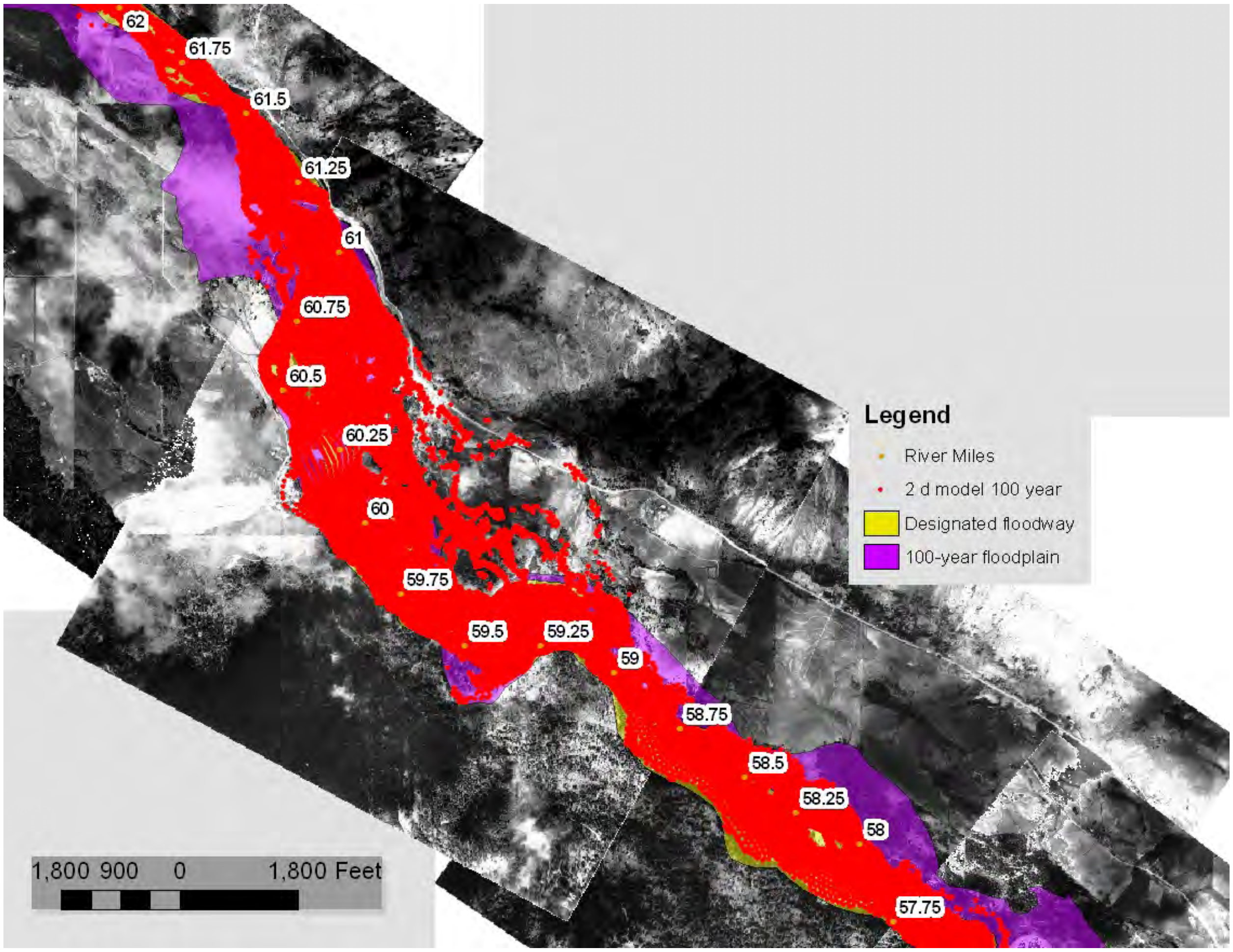


Figure 16- Comparison of 2-D 100 year flood results and previously mapped 100 year floodplain by Beck (1973). The floodway is a term used by FEMA to represent the maximum possible encroachment that will not result in more than 1 ft of change in the 100-year water surface elevation.

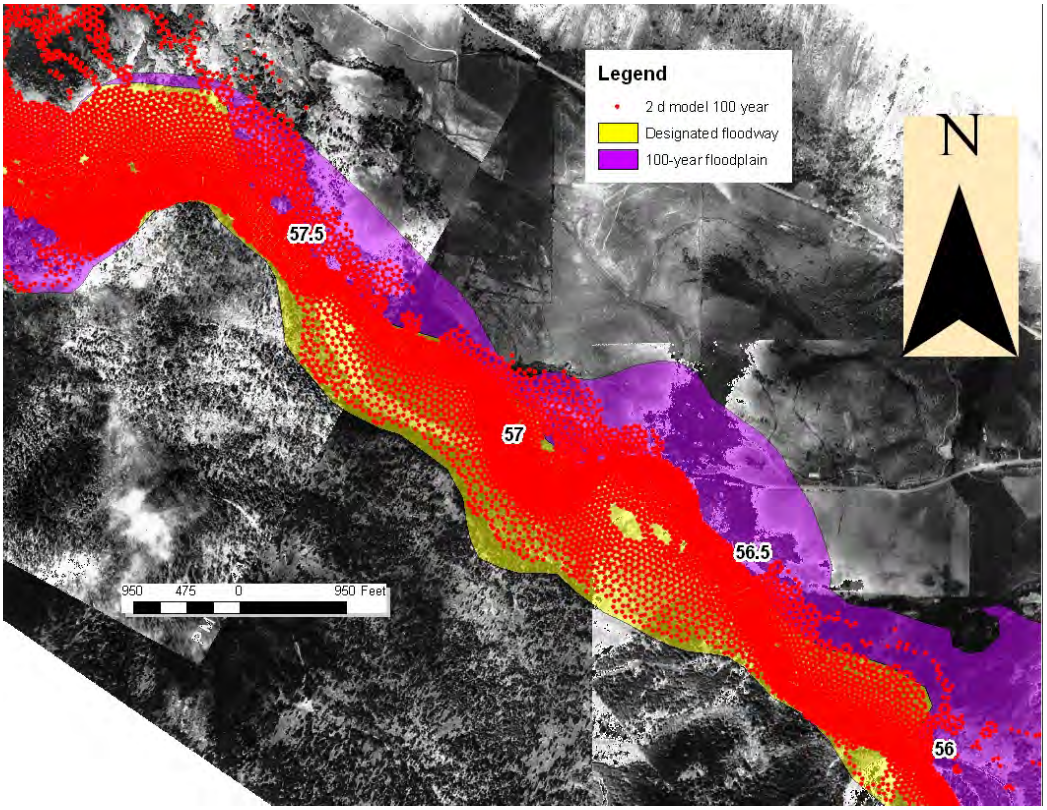


Figure 17 Comparison of 2D 100-year flood results and previously mapped 100 year floodplain boundary.

4.0 Human Features and Historical Channels in Project Areas

4.1 Project Areas and Human Feature Impacts

For evaluation of restoration strategies, eight project areas were identified by the technical assessment team within the Big Valley reach. Project area boundaries and man-made features that have been identified are shown in Figures 19-21. The *Geomorphic Assessment* documented that RM 55 through 65 has more than 54 human features located within the floodplain (low surface) and 14 human features located along the floodplain boundary. Human features like road embankments, levees and riprap have confined the river in places and prevented lateral migration of the channel and floodplain connectivity. The *Reach Assessment* (RM 55 to 62) has refined this mapping and identified nine areas of riprap placement within the reach, three dam and twelve road embankments, eight areas of riprap, ten undersized culverts, three bridges, and two berms (Figures 19 to 21). The embankment for the Weeman Bridge at RM 61 is the largest feature that artificially disconnects the floodplain. This embankment has limited the ability of the river to migrate and is believed to have reduced frequency of side channel connectivity both upstream and downstream of the bridge. Throughout the Big Valley reach, small dikes and levees are present and disconnect side channels. Additionally, removal of large woody debris from the main channel occurred during log drives down the river in the early part of the twentieth century and following the 1948 and 1972 floods (Figure 18).

In Figure 19, project areas MR-62.4 and MR-60.85 are shown. Human features that influence river migration and connectivity with the floodplain include berms, riprap, a road embankment, a dam embankment and undersized culverts. Project areas MR-60.25, MR-59.6, MR-58.9 and MR-58.6 are shown in Figure 20. Limited road embankments and undersized culverts exist in these project areas. Project areas MR-58.6, MR-56.6 and MR-56.0 are shown in Figure 21. Although project area MR-58.6 has few man-made effects, project areas MR-56.6 and MR-56.0 have a significant number of small man-made effects. In particular, project area MR-56.5 has a large number of undersized culverts, small dam embankments and road embankments. The cable tram, called the "People Mover", is a locally well-known landmark within project area MR-58.6. Project area MR-56.0 contains a long length of rootwads and riprap.

Figure 18-Historical photo showing extensive timber milling and log drive on the Methow River. Photograph courtesy of Schafer Historical Museum (Winthrop, WA).

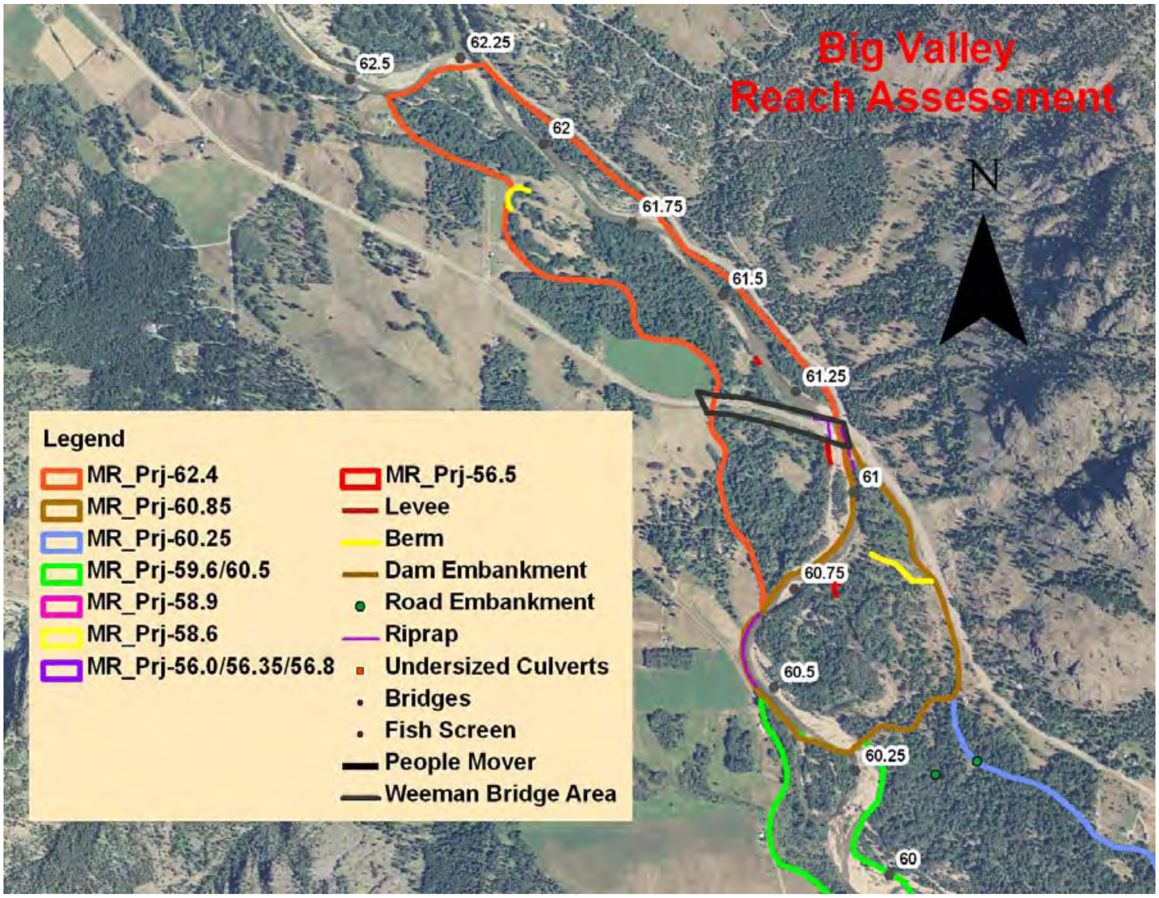


Figure 19-Project area location map for RM 60 to 62.25. The lateral extent of project area boundaries also represents the boundary of the floodplain (low surface).

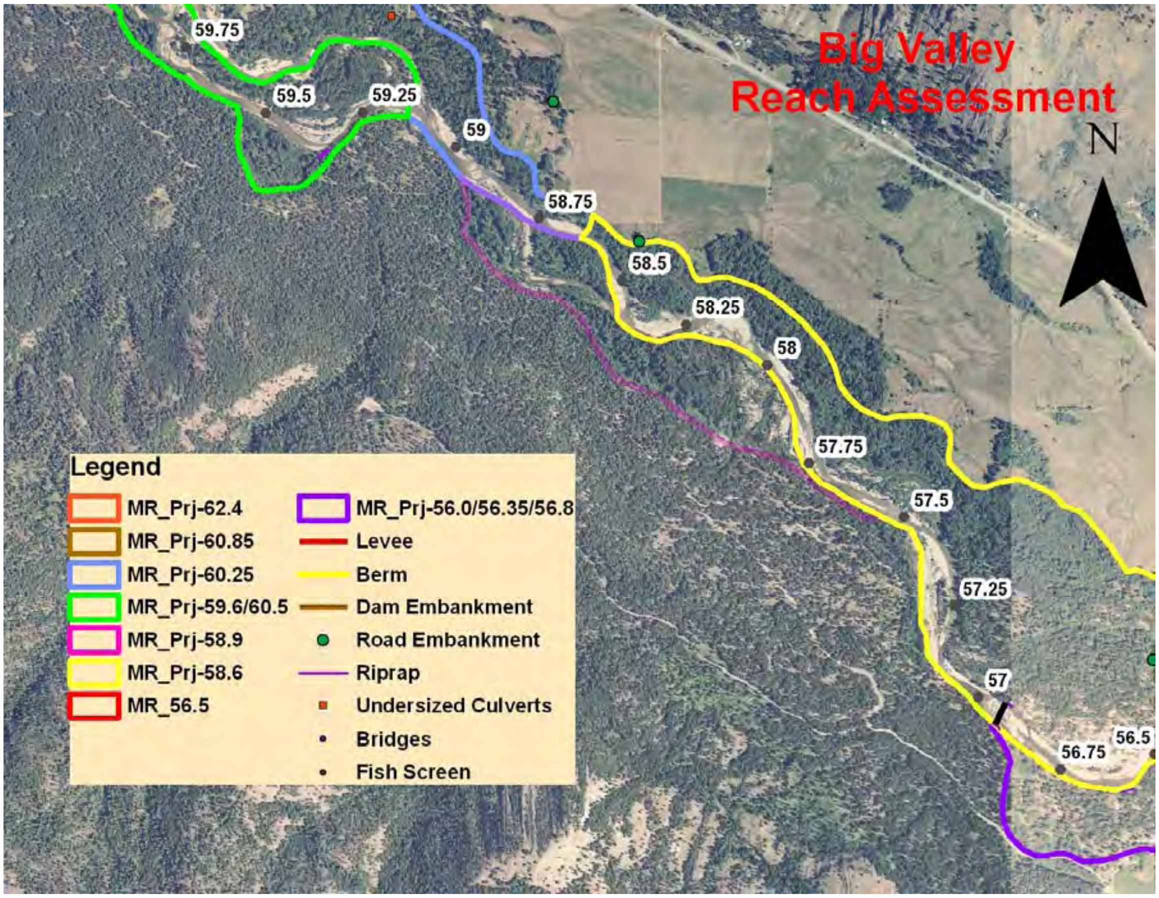


Figure 20-Project area location map for RM 57.5 to 59.75. The lateral extent of project area boundaries also represents the boundary of the floodplain (low surface).

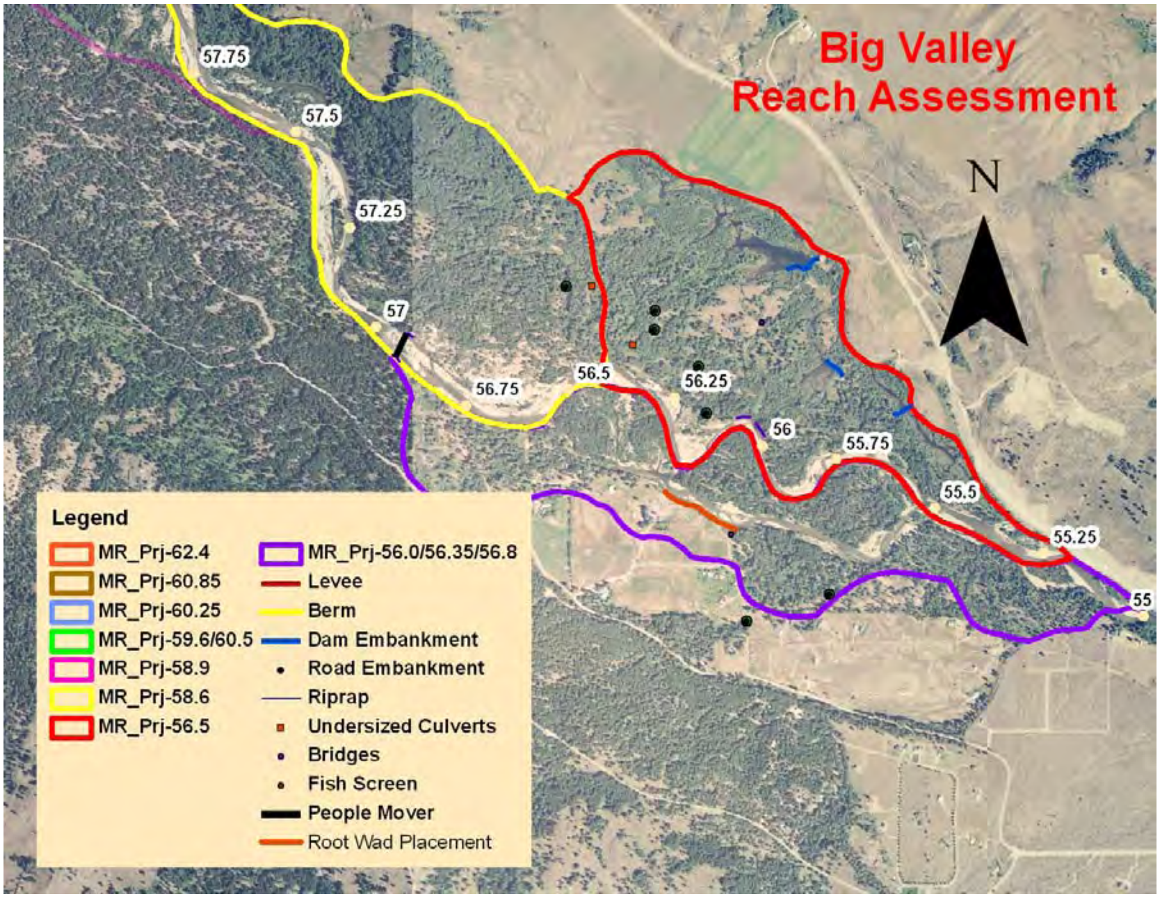


Figure 21-Project area location map for RM 55 to 57.75. The lateral extent of project area boundaries also represents the boundary of the floodplain (low surface).

4.2 Connectivity of Historical Channels during High Flows

Historical channels were mapped where they could be observed in 1945, 1948, 1954, 1964, 1974, and 2004 aerial photography (Figures 22 to 24). LiDAR data collected in 2006 shows additional channel locations that were not detected on the aerial photography, but presently exist. Channel locations can be compared to 2D model inundation results to determine if the channels are presently accessed and during what flow, and if removal of certain human features can improve access to these areas.

For the upper portion of the Big Valley reach (Figure 22), the main channel has remained on the left side of the floodplain since at least 1945 with no evidence of lateral channel migration. Small, narrow channels exist just above Weeman Bridge on river right, but the channels have tended to be only inundated during large flows possibly greater than the 5-year flood. Significant channels were not identified in this area except on aerial photography during the flood of record in 1948. Downstream of the bridge (Figure 23), the river becomes much more dynamic and has more evidence of active side channels.

However, due to the constriction by the Weeman Bridge embankment, the main channel has consistently been directed toward river right just downstream of the bridge.

Between RM 55 and 61, Figures 22 to 24 show how the channel has migrated across the floodplain historically, with the exception of a short section around RM 59. Downstream of RM 55, the channel is a single thread channel with a limited floodplain confined by Wolf Creek alluvial fan and glacial terraces. From RM 58 to 55, it is evident how dynamic the river has been historically moving through the floodplain. An important human effect in the valley that was constructed in the 1980’s is the cable tram near RM 57 (Figure 21). This cable tram across the river has been important as a landmark. The bank protection associated with the cable tram has locally limited channel migration. Embankments on either side of the river for the cable tram are no longer than a few 100 feet.

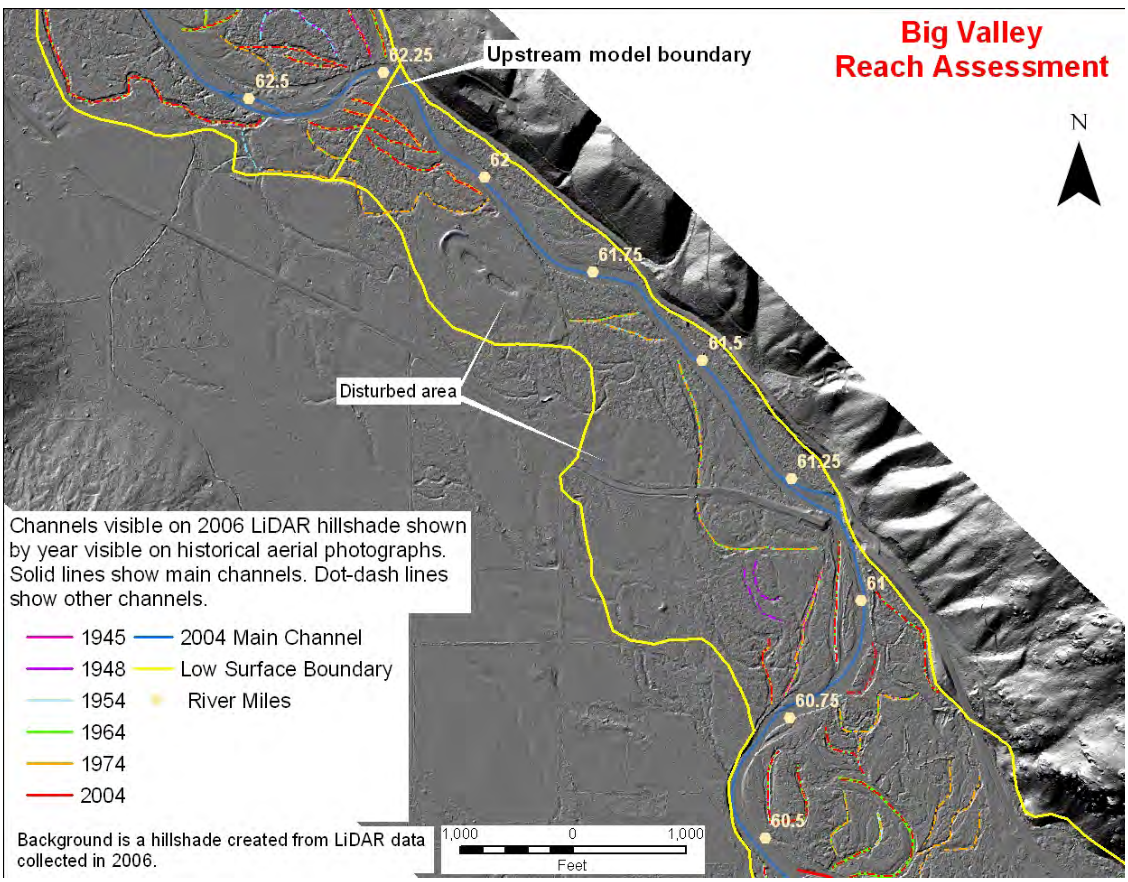


Figure 22-Historical channels mapped between RM 60 and 62.5

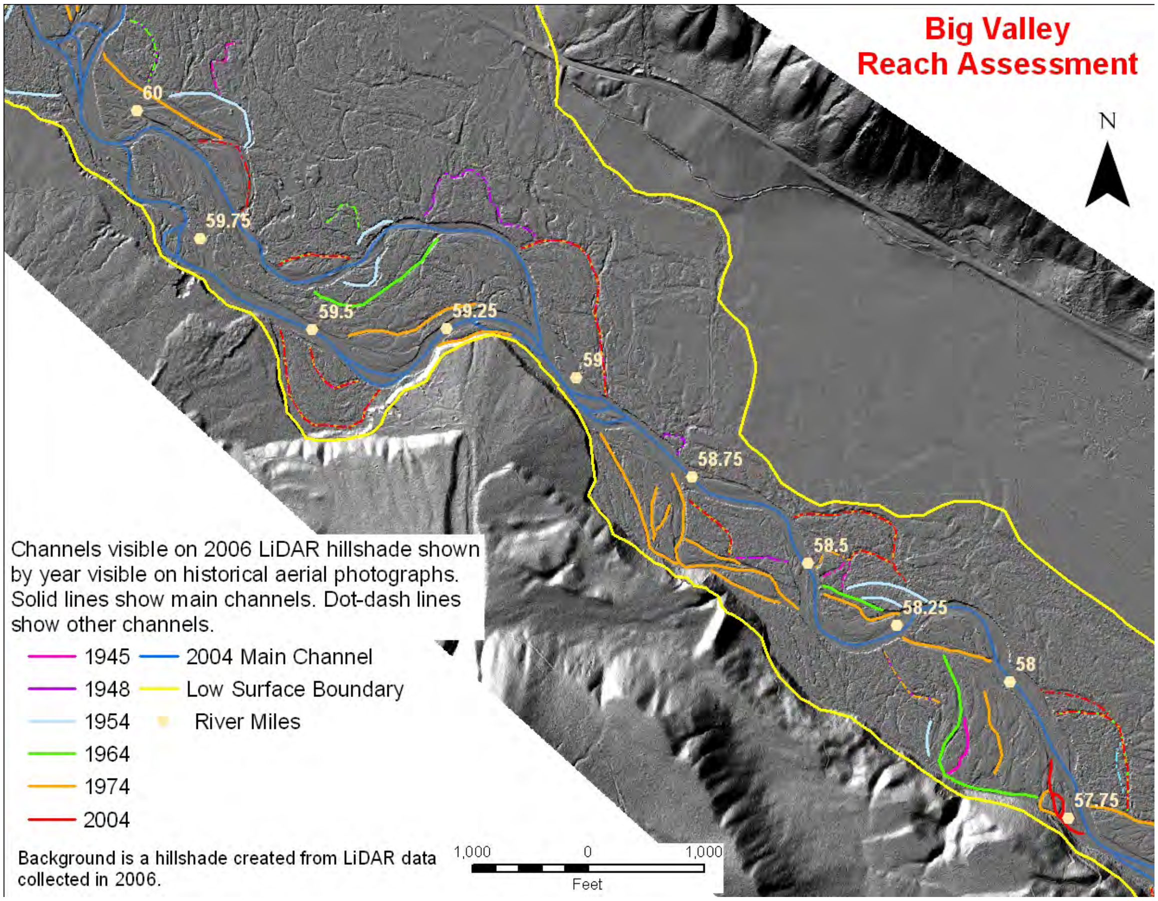


Figure 23-Historical Channels mapped in RM 58 to 60.5

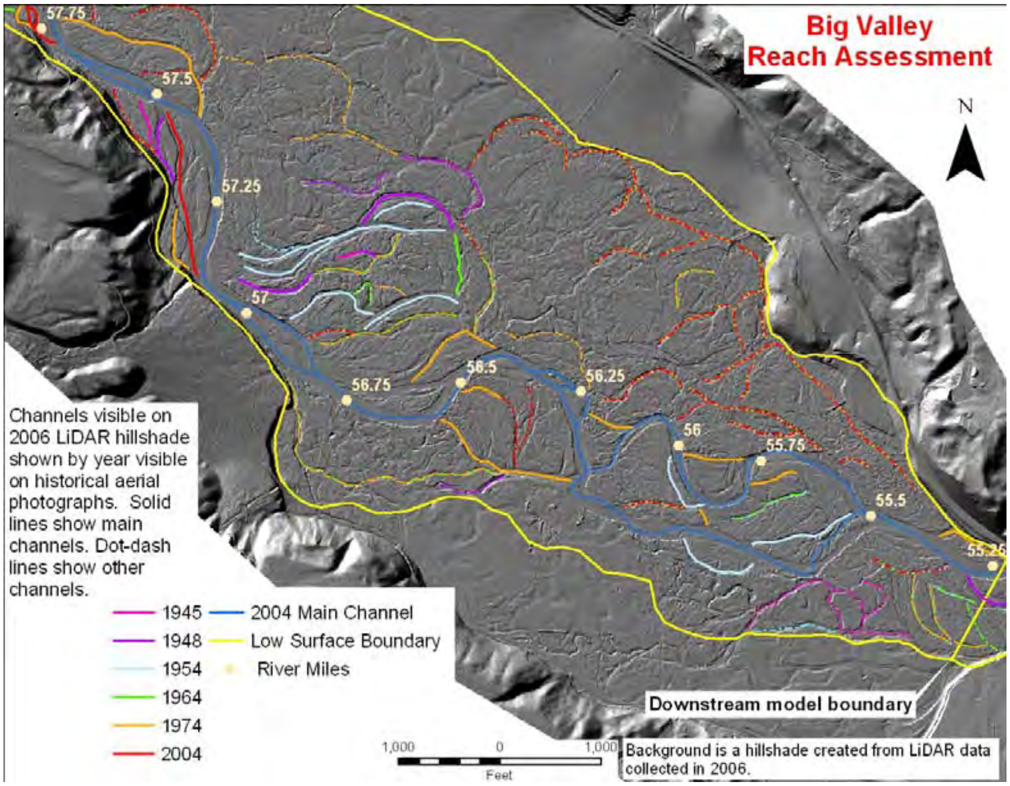


Figure 24-Historical channels mapped in RM 55 to 57.75

5.0 Model Results for Existing and Future Conditions

The 2D model results are summarized below for each project area location and include descriptions of existing conditions and potential future conditions without anthropogenic effects that reduce or block access to side channels and the floodplain. For future conditions human features were removed that block access to side and overflow channels or floodplain, such as berms, embankments with or without culverts, and bridges. For riprap and features that are not higher in elevation than surrounding ground elevations, modeled topography was not modified because the model does not account for channel migration. Within the Big Valley reach, model results indicate the Weeman Bridge embankment has the largest impact on channel migration and floodplain connectivity. Some anthropogenic effects are so small or are not inundated by modeled floods and, therefore, changes cannot be seen between existing and potential future conditions hydraulic results.

5.1 RM 60 – 62.5: Project Areas MR-62.4 and MR-60.85

In project area MR-62.4, the surface upstream of Weeman Bridge on river right between RM 61.5 and 62 is interpreted to be an older surface at the base of the alluvial fan that has not had the active channel passing through it since at least 1945, and possibly much longer. Little differences are observed between the present and the future conditions because there are no human features to remove that would improve floodplain connectivity (Figures 29, 32, 35, 38 and 39). Some overflow channels may be inundated for floods greater than the 5-year flood. LiDAR data show a few moderately well-defined channels that connect with the main channel under present conditions that would suggest these areas would provide off-channel habitat (Figure 26). Overflow channels are present, but are not inundated except during large floods greater than the 25-year flood (Figure 26).

At Weeman Bridge, ground surface elevations of the culverts were conceptually enlarged for future conditions by creating a breach in the embankment. In this modeling exercise, a portion of the embankment was left in place on either side of the breach. As a result, this model scenario does not evaluate full restoration of lateral channel migration processes. However, by simulating larger openings through the embankment, model results do show that this area has the potential to develop side channels that are better defined and more frequently inundated than under present conditions. Comparisons between existing and future conditions for this area show much greater channel connectivity for the 5-year and 25-year floods (Figures 29, 32, 35, 38 and 39) for the floodplain on river right. Historical information that has been discovered about the Weeman Bridge area suggests that it has been actively utilized since the 19th century for timber harvesting and other uses. For project area MR-60.85, several small levees and road embankments still exist on river left downstream of Weeman Bridge. Many of these features are attributed to be remnants of the Fender Mill, a historic log mill that operated here at the turn of the twentieth century. Despite historic activity at this area, floodplain connectivity is still active. Side channels are being accessed during the 2-year and 5-year floods (Figures 29 and 32).

5.2 RM 59-60: Project Areas MR-60.25, MR-59.6, and MR-58.9

This section of the river is very dynamic and few impacts to hydraulics are found due to man-made conditions. Project areas MR-60.25, MR-59.6, and MR-58.9 represent protection areas where no restoration actions are recommended. Channel processes are functioning well, and the only minor disruptions to floodplain processes are a few small road embankments and undersized culverts located on river left (Figure 27). No detectable hydraulic differences can be seen in comparison of existing and future channel conditions for all modeled floods (Figures 30, 33, 36, 38 and 39).

5.3 RM 59-55: Project Areas MR-58.6, MR-56.5, and MR-56.0

Project area MR-58.6 has infrequent inundation of the floodplain under existing conditions, but few anthropogenic effects can be identified for this area except for the cable tram (people mover) and two road embankments. Comparison of 2D model results for existing and future conditions show no discernible differences for the 2-, 5- and 25-year floods. Evaluation of historical mapping of side and overflow channels indicates that historically the river was accessing the floodplain on a more frequent basis, likely during the 2- and 5-year floods (Figure 24 and 28). Based on existing model results, the floodplain is presently not being accessed until a 25-year flood (Figures 31, 34, 37, 40 and 41). A possible explanation is that upstream and downstream effects have limited channel migration, thus controlling the alignment of the channel entering this project area. When combined with the localized bank protection at the cable tram near RM 57, the channel may have scoured on the order of a couple feet because of localized bank armoring (Figure 25). In the *Geomorphic Assessment*, it was noted that the main river channel in 2004 was a few feet lower than in 1970. The river channel shifted from the majority of the flow within the left channel to the right channel at RM 56.5 between 1974 and 2004. This could also contribute to scour and major channel re-working.

Project area MR-56.5 contains a large number of man-made effects including small dam and road embankments, undersized culverts within the embankments, and bridges. These features are all located within the left floodplain and limit channel and wetland connectivity within this area. Comparison of model results for the 2-, 5-, and 25-year floods shows no significant differences in inundation area between existing and future conditions (Figures 31, 34, 37, 40 and 41). An explanation for this result is that the man-man features are small and difficult to represent in the coarse grid utilized. In some instances, dam embankments are not inundated until flood conditions are greater than the 5-year flood. Elimination or changes in these anthropogenic effects will enhance habitat conditions and floodplain connectivity.

For project area MR-56.0, a few man-made effects were identified, including rootwads, road embankment and a culvert. The river is very dynamic in this project area and significant bank erosion occurred in 2006 because of changes in the main channel location (Figure 28). At present, this project area is functioning well, and no differences are shown between existing and future modeling conditions in terms of floodplain connectivity (Figures 31, 34, 37, 40 and 41). Local stakeholders have expressed concern that possible future development and associated roads would further disrupt channel and floodplain processes, and this area should be considered for protection.

Figure 25-Photograph looking upstream at main Methow river channel and left river bank near RM 57.

6.0 Conclusions

A 2D model was created for the Big Valley reach between RM 62 and 55. Two different grids were generated to determine hydraulic differences between existing and future conditions that represent topography with and without man-made effects that block access to side and overflow channels, and overbank flooding areas. Geomorphic mapping documents show that historically the main channel laterally migrated across the floodplain and off-channel habitat was present. Since the early 1900s, several human features have been constructed that are located throughout the reach that reduce lateral migration and floodplain connectivity. However, in many areas these features are small and there is little predicted change to floodplain inundation through their removal. The most significant impact based on model results is channel disruptions at the Weeman Bridge because of the road embankment and undersized culverts. Other detectable human impacts shown by the model include the lack of floodplain connectivity for the 2- and 5-year floods in the vicinity of project area MR-58.6. This is believed to occur due to local scour of the main channel near RM 57 due to bank protection and possibly upstream constrictions and filling of side channel entrances, which reduces frequency of access to side channels. Other changes that have occurred in project area MR-58.6 near RM 57 was a major flow shift after construction of the cable tram that would cause major reworking of the channel.

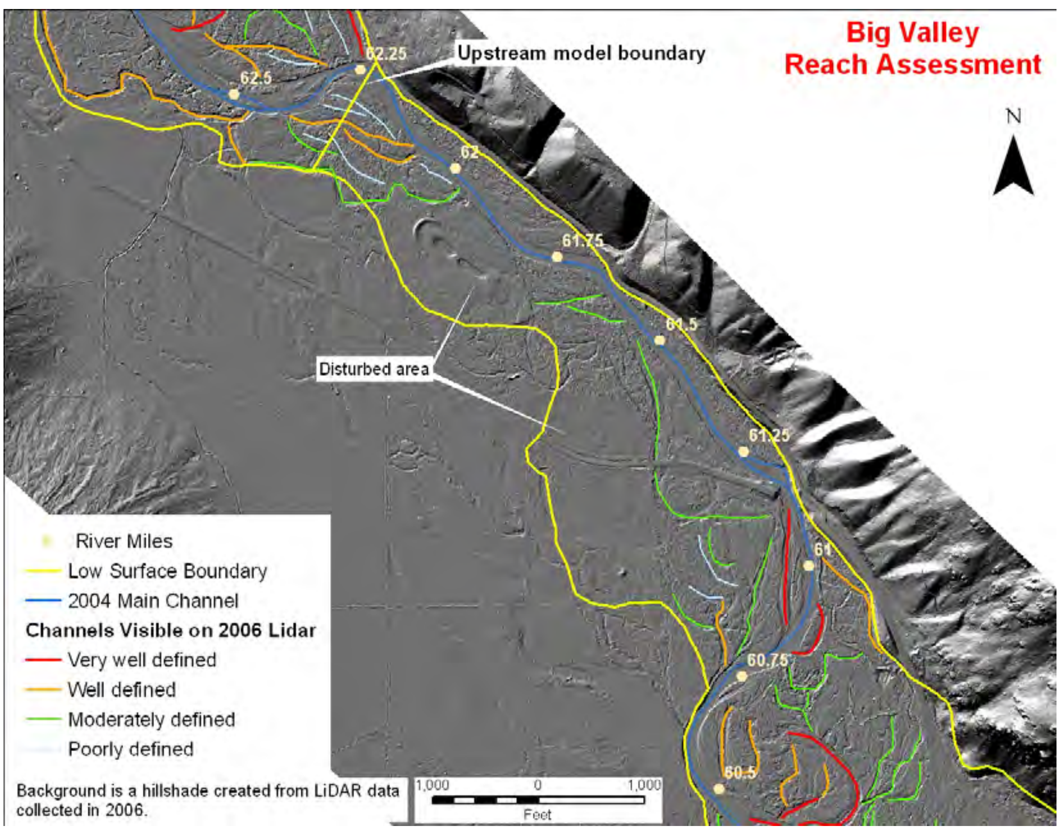


Figure 26 Channel visible for existing conditions for RM 60 to 62.25

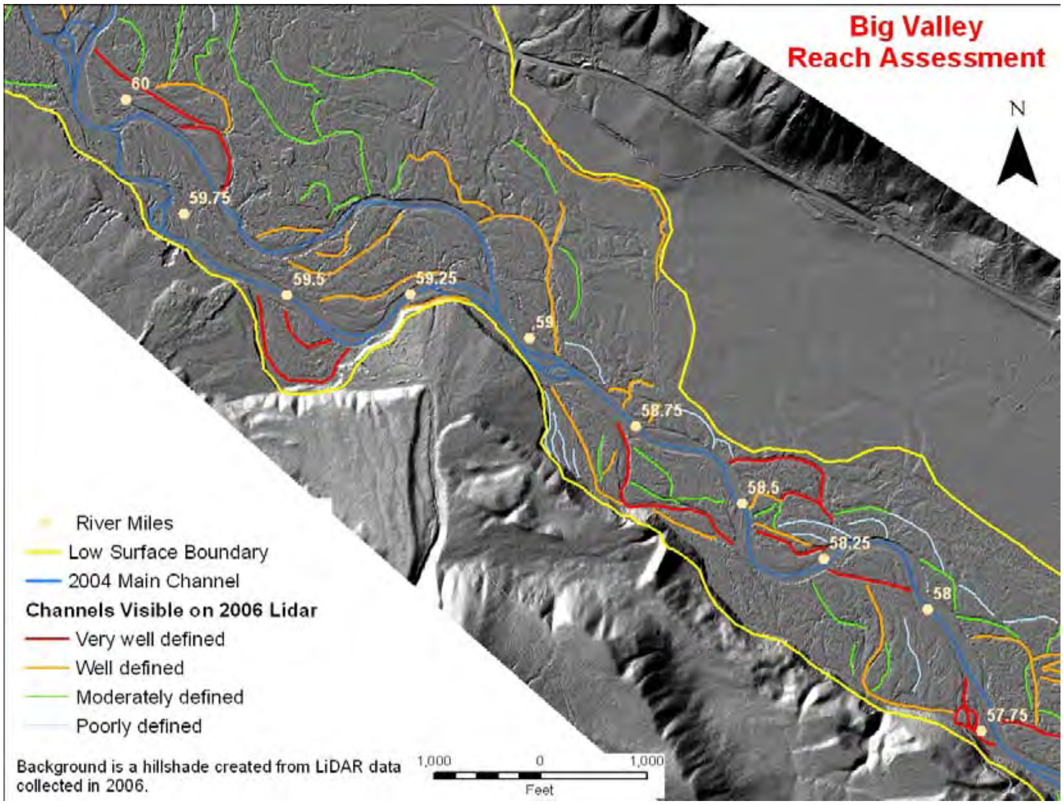


Figure 27-Channels visible for existing conditions for RM 57.75 to 60.

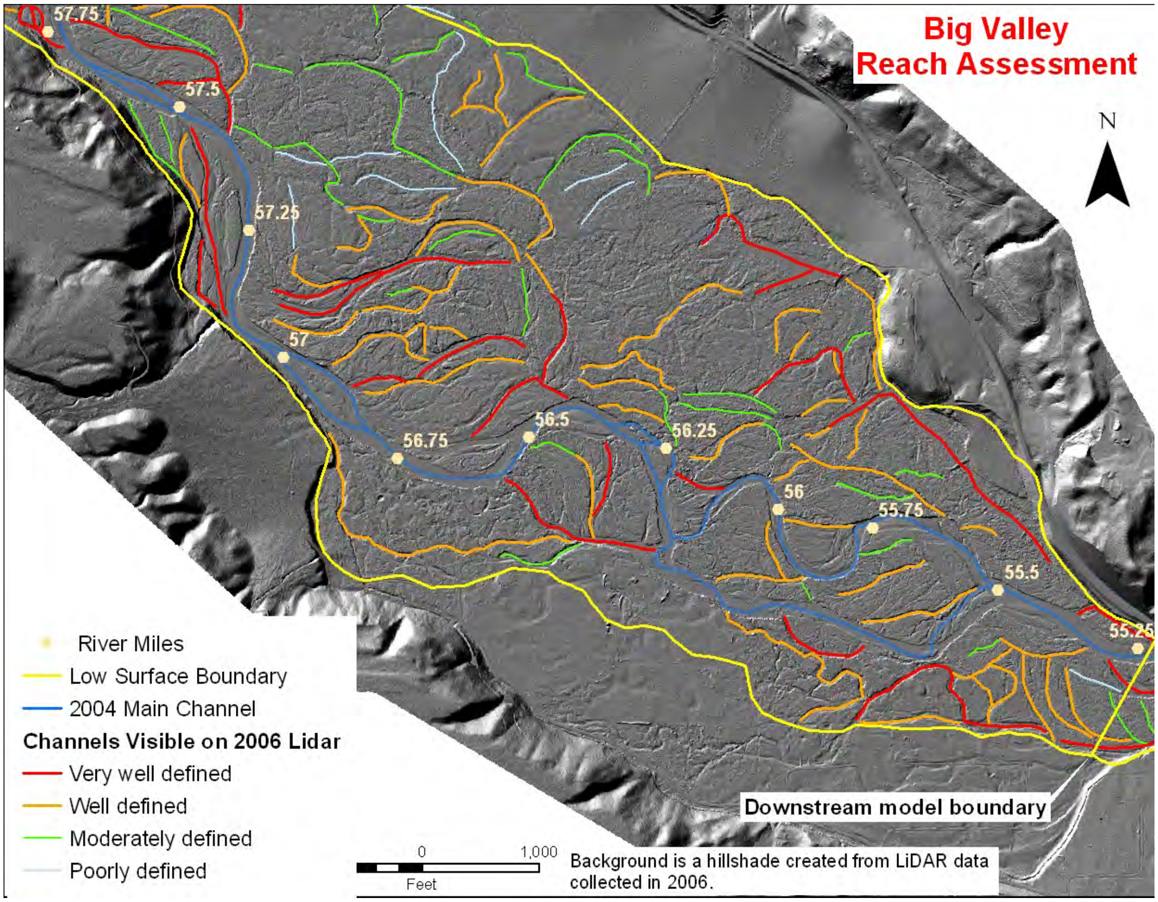
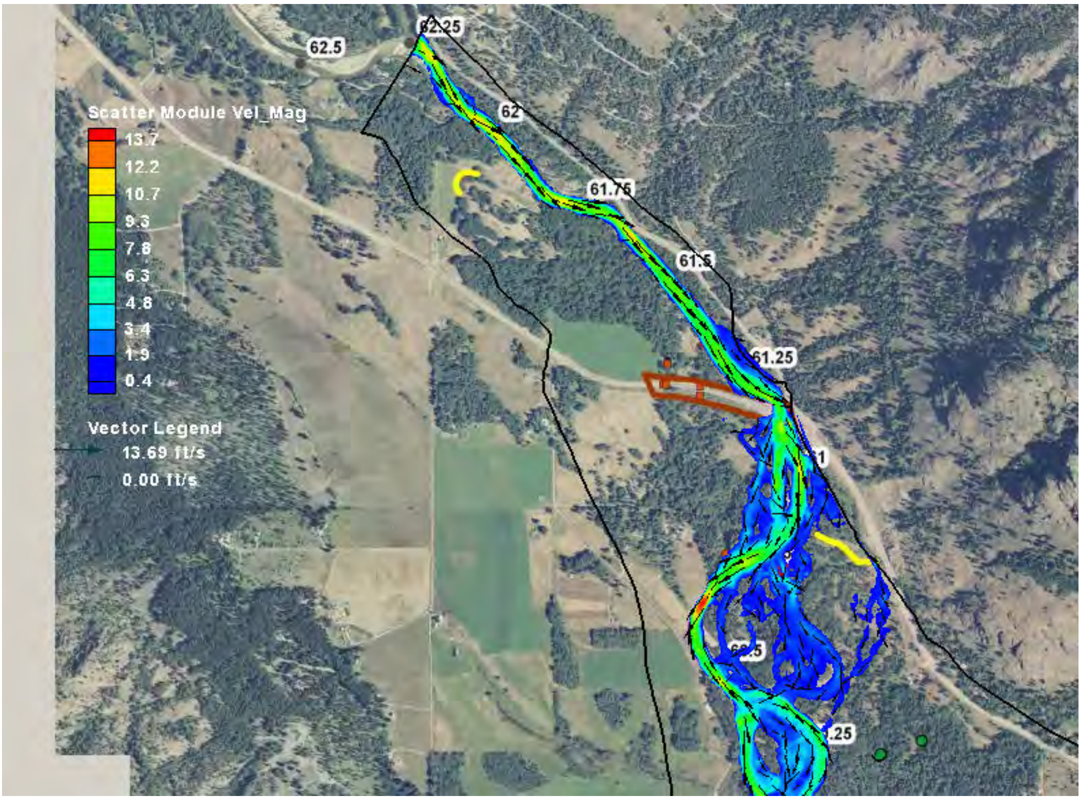


Figure 28-Channel visible for existing conditions RM 55 to 57.75.



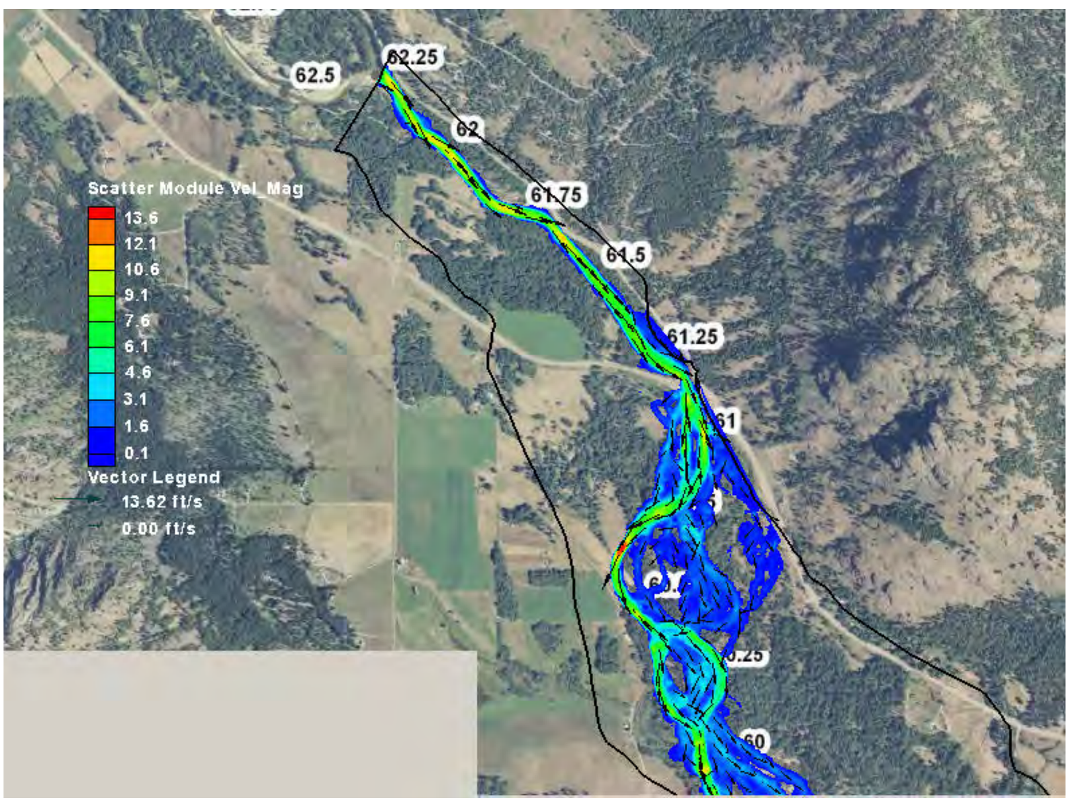


Figure 29-Velocity vectors for the 2 Year Model of existing (upper image) and future conditions (lower image), in the vicinity of Project Areas 62.4, 60.85, and 60.25 (upper section of BVRA).

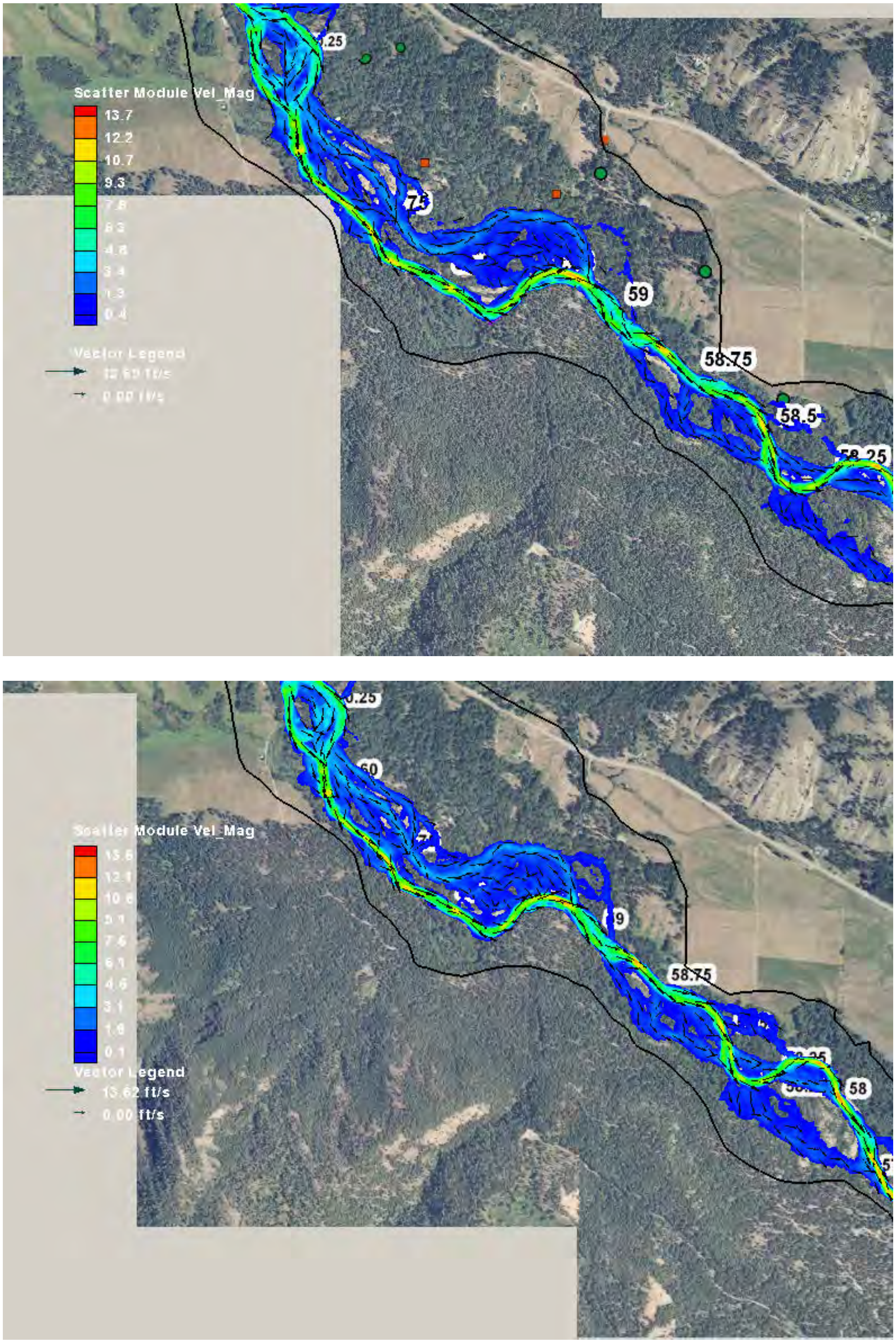


Figure 30- Velocity vectors for the 2 Year Model for existing and future conditions in the vicinity of Project Areas 60.25, 59.6/60.5, 58.9 and 58.6 (middle section of BVRA).

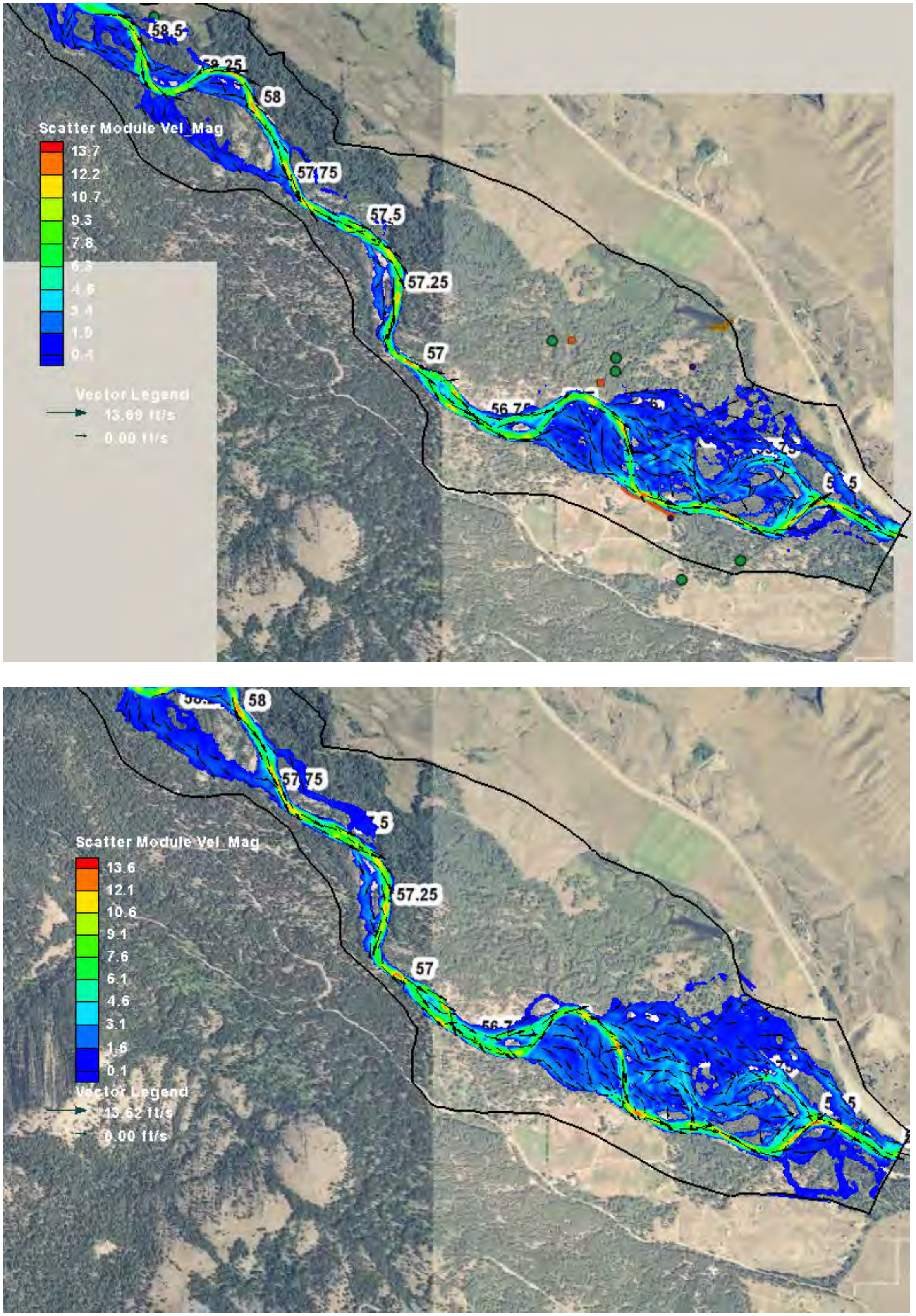


Figure 31- Velocity vectors for the 2 Year Model for existing and future conditions in the vicinity of Project Areas 58.6, 56.5, and 56.0/56.35/56.8 (lower section of BVRA).

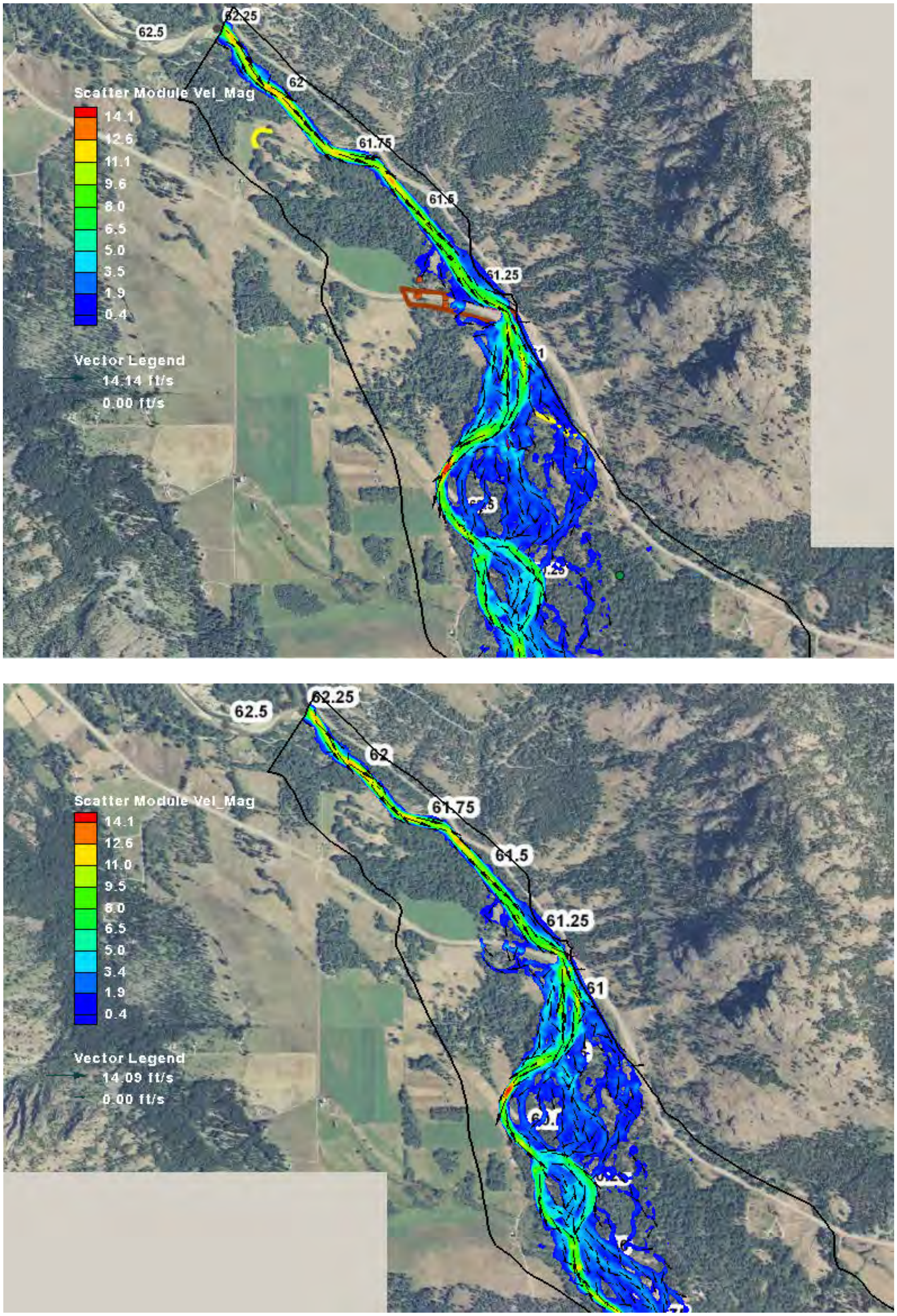


Figure 32- Velocity vectors for the 5 Year Model for existing and future conditions in the vicinity of Project Areas 62.4, 60.85, and 60.25 (upper section of BVRA).

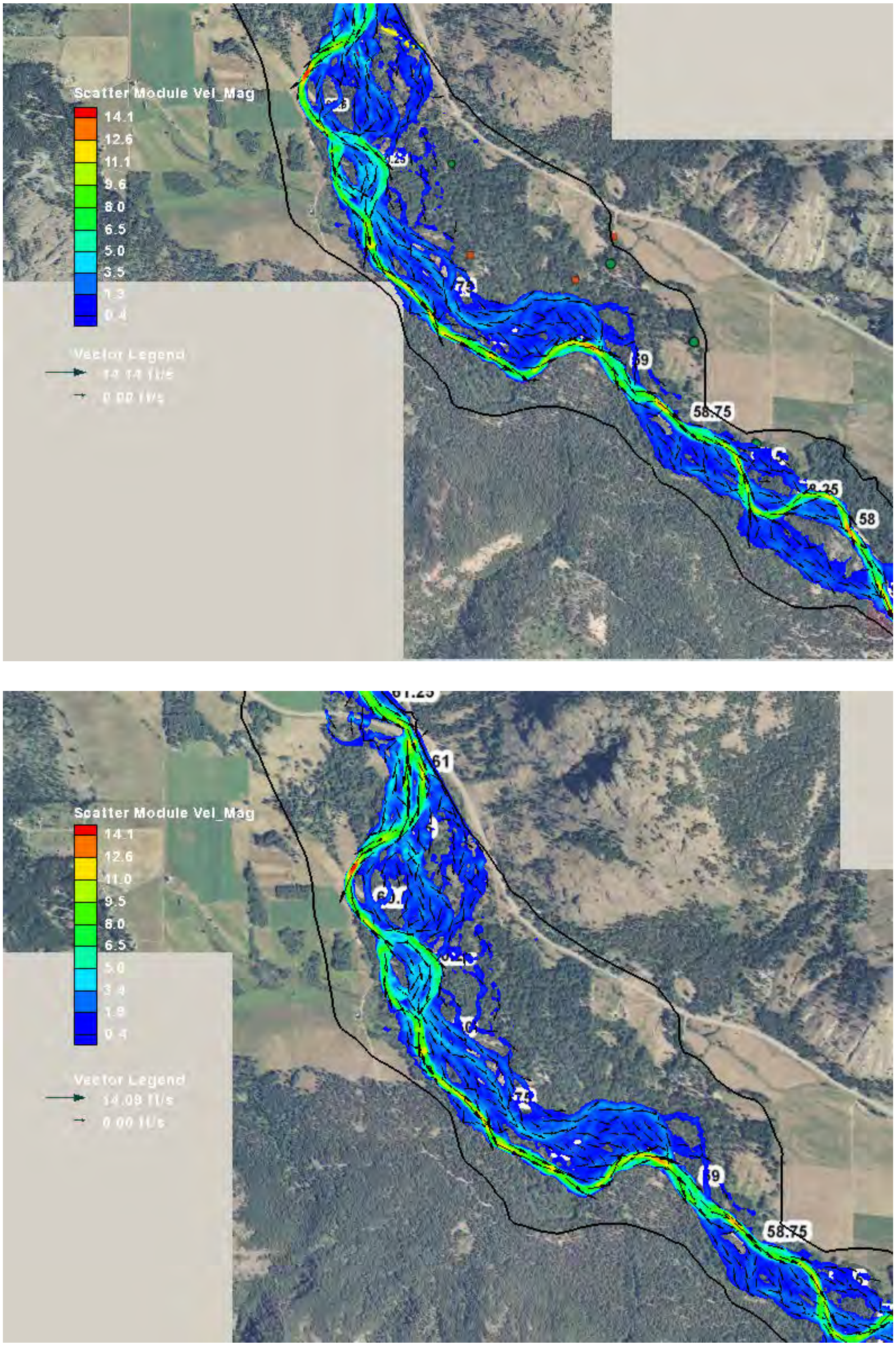


Figure 33- Velocity vectors for the 5 Year Model, for existing and future conditions in the vicinity of Project Areas 60.25, 59.6/60.5, 58.9 and 58.6 (middle section of BVRA).

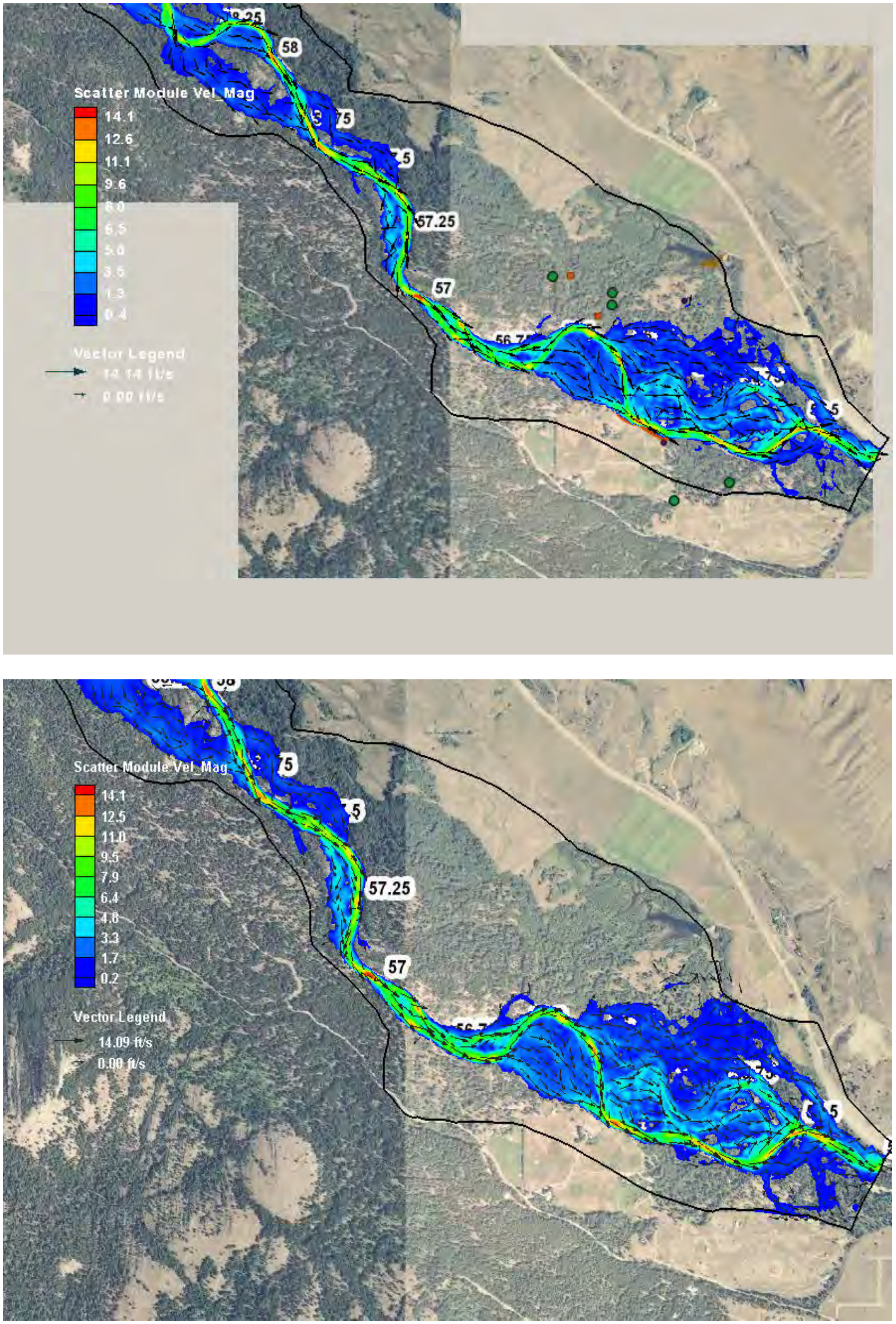


Figure 34- Velocity vectors for the 5 Year Model for existing and future conditions in the vicinity of Project Areas 58.6, 56.5, and 56.0/56.35/56.8 (lower section of BVRA).

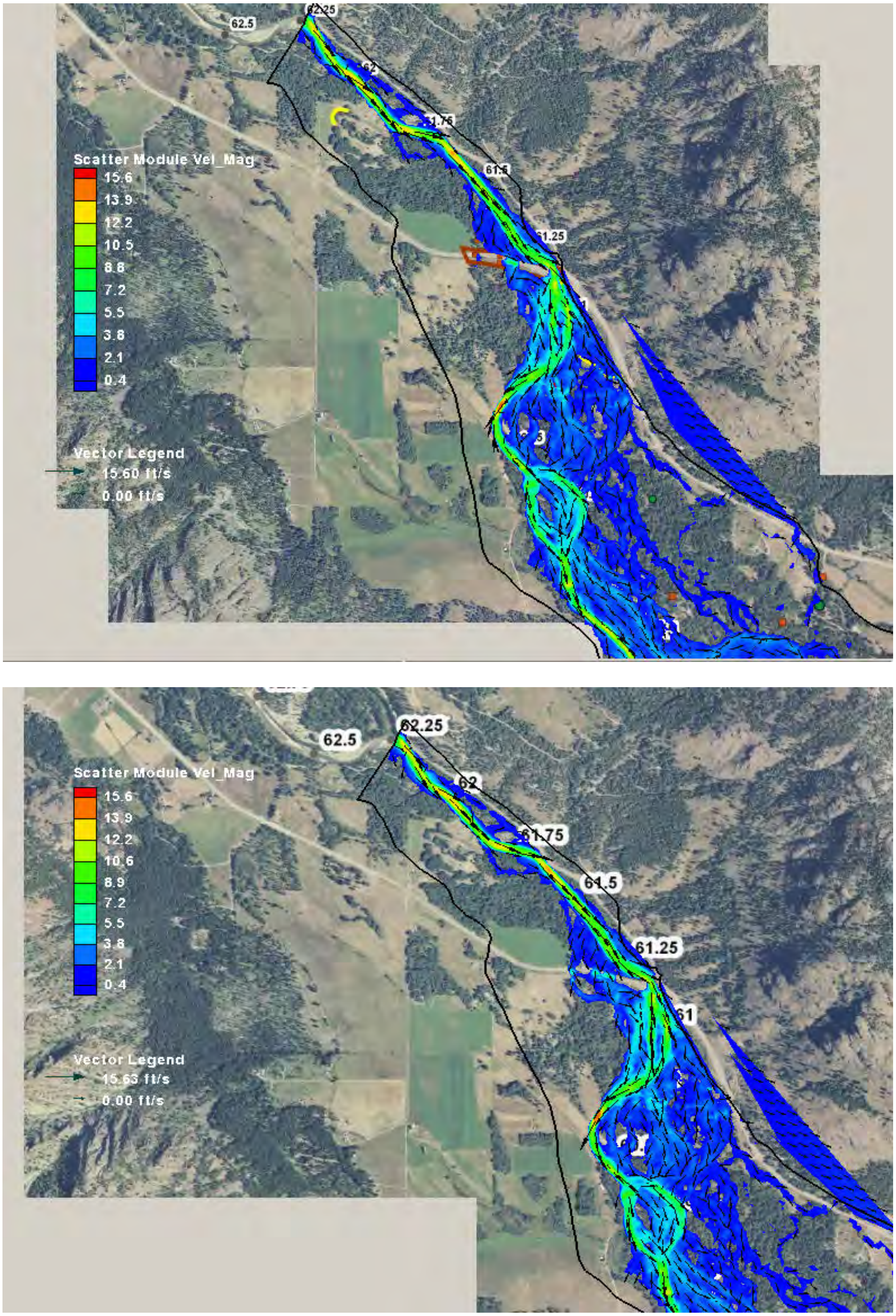


Figure 35-Velocity vectors for the 25 Year Model for existing and future conditions in the vicinity of Project Areas 62.4, 60.85, and 60.25 (upper section of BVRA).

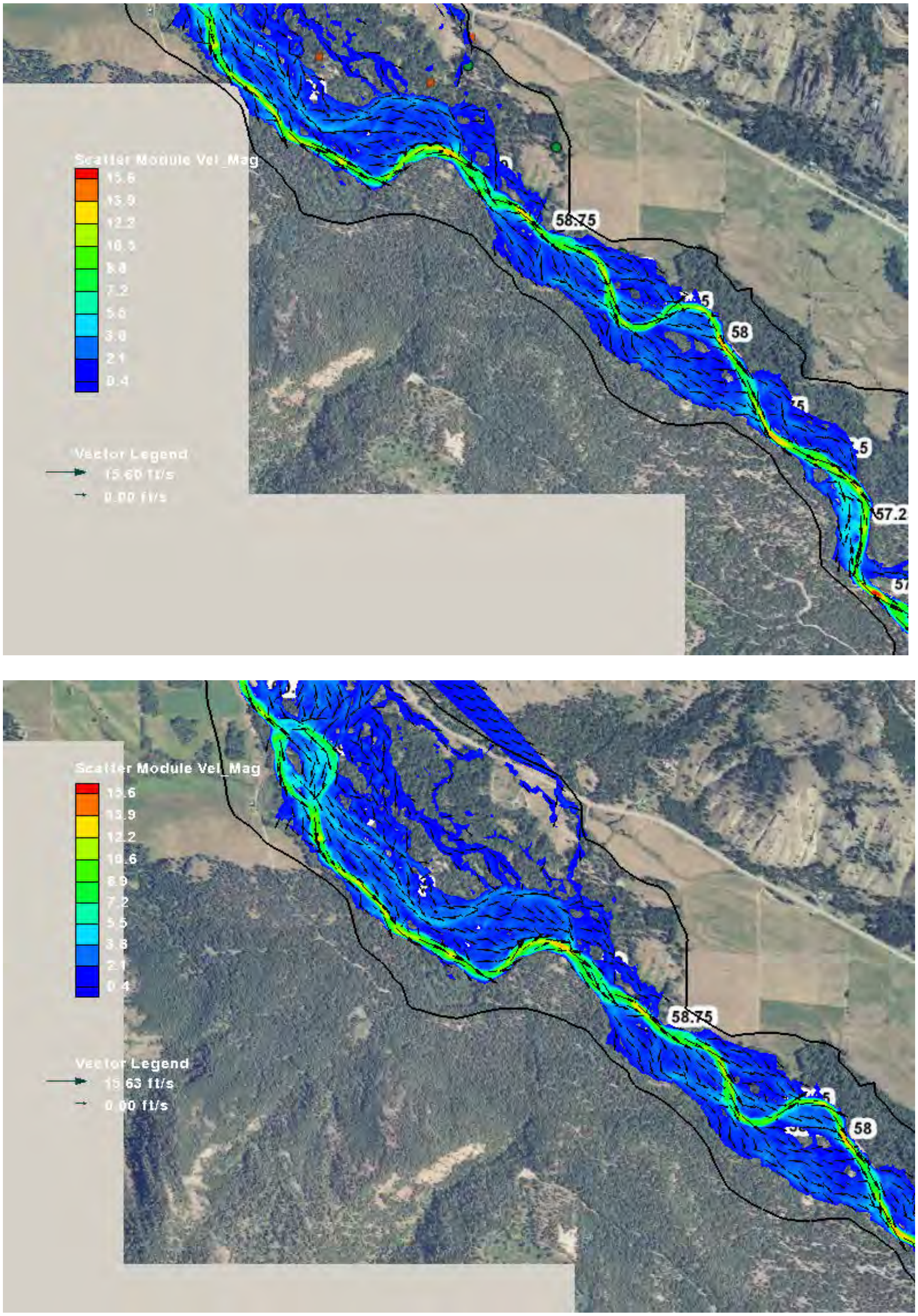


Figure 36- Velocity vectors for the 25 Year Model for existing and future conditions in the vicinity of Project Areas 60.25, 59.6/60.5, 58.9 and 58.6 (middle section of BVRA).

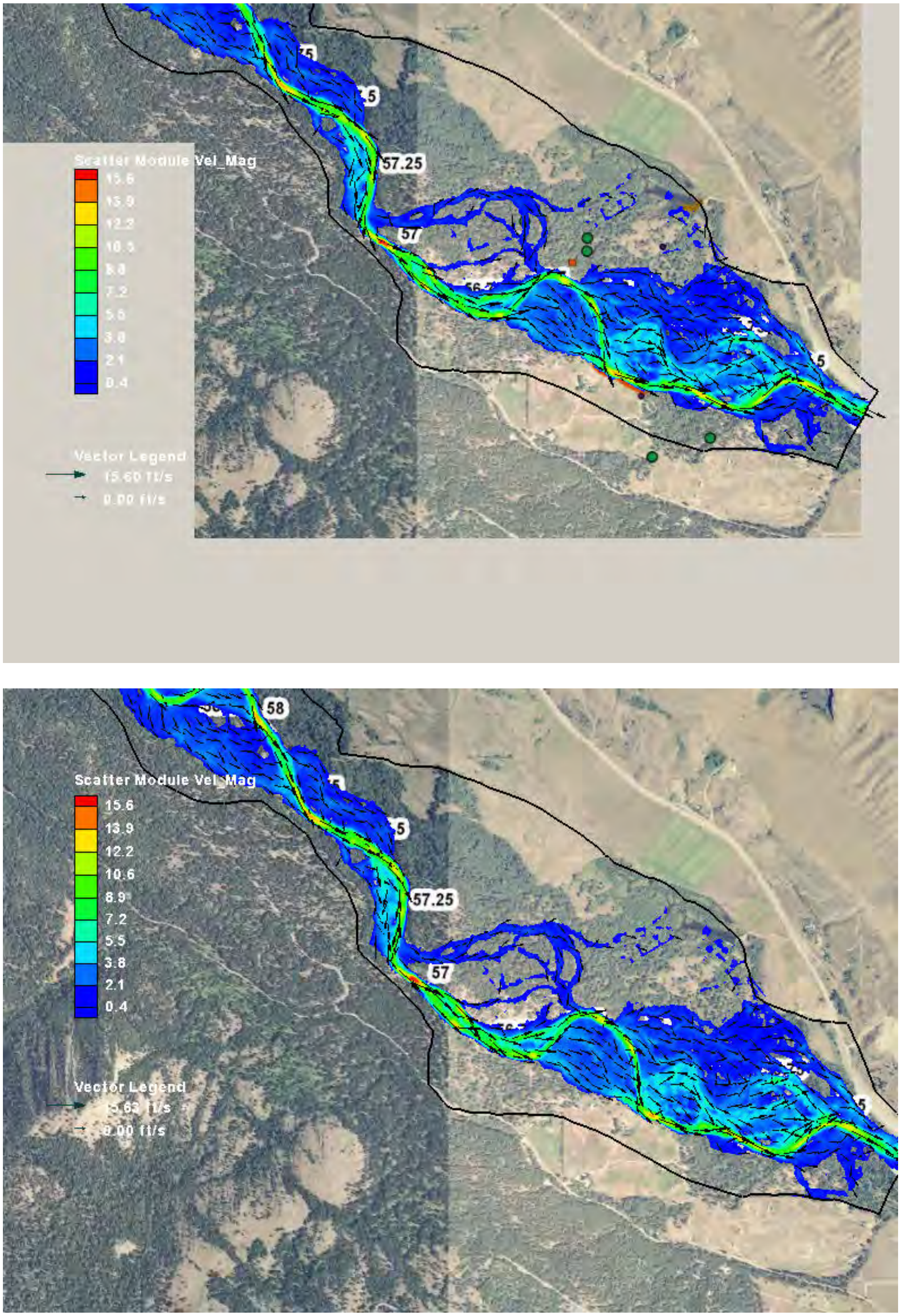


Figure 37- Velocity vectors for the 25 Year Model for existing and future conditions in the vicinity of Project Areas 58.6, 56.5, and 56.0/56.35/56.8 (lower section of BVRA).

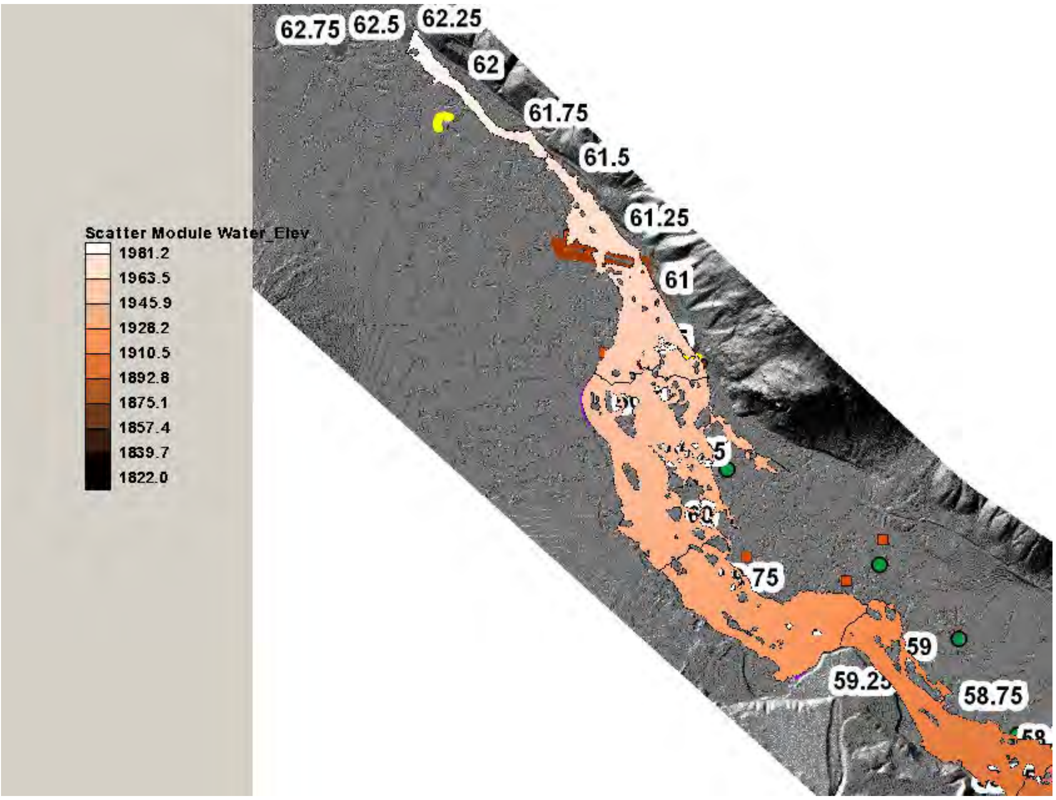


Figure 38-Water surface elevations for the 5 year flood for existing conditions in the vicinity of Project Areas 62.4, 60.25, 60.85, and 59.6/60.5 (upper section of BVRA).

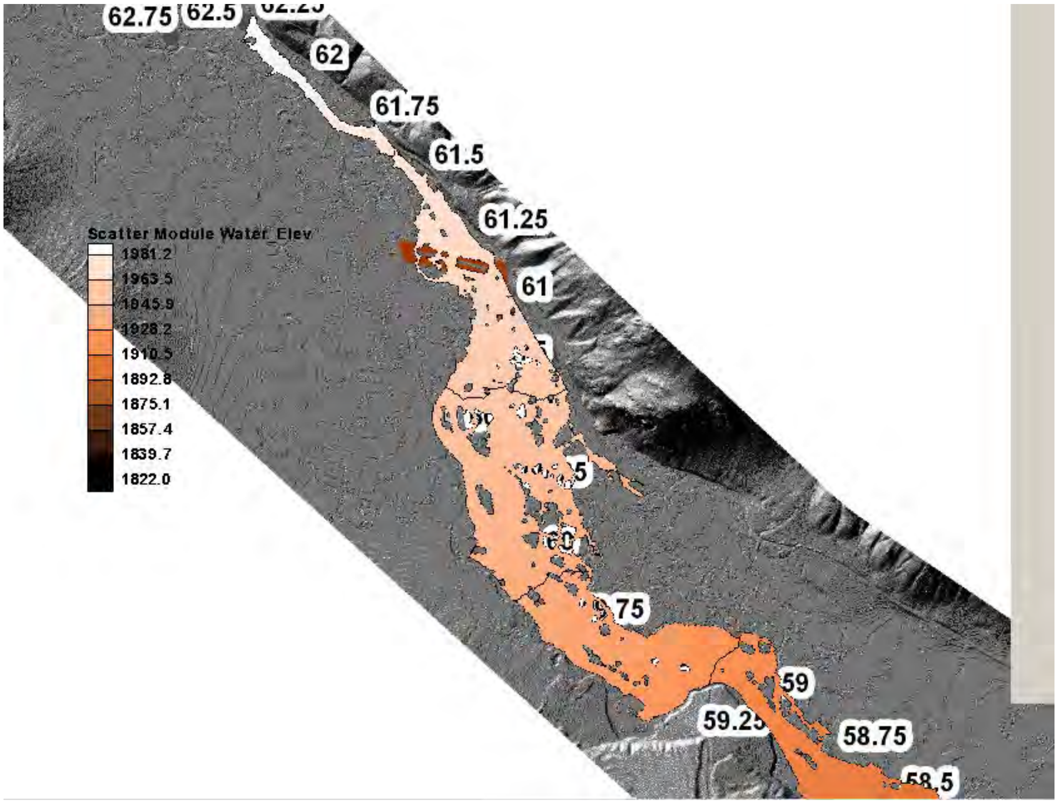


Figure 39- -Water surface elevations for the 5 year flood for future conditions in the vicinity of Project Areas 62.4, 60.25, 60.85, and 59.6/60.5 (upper section of BVRA).

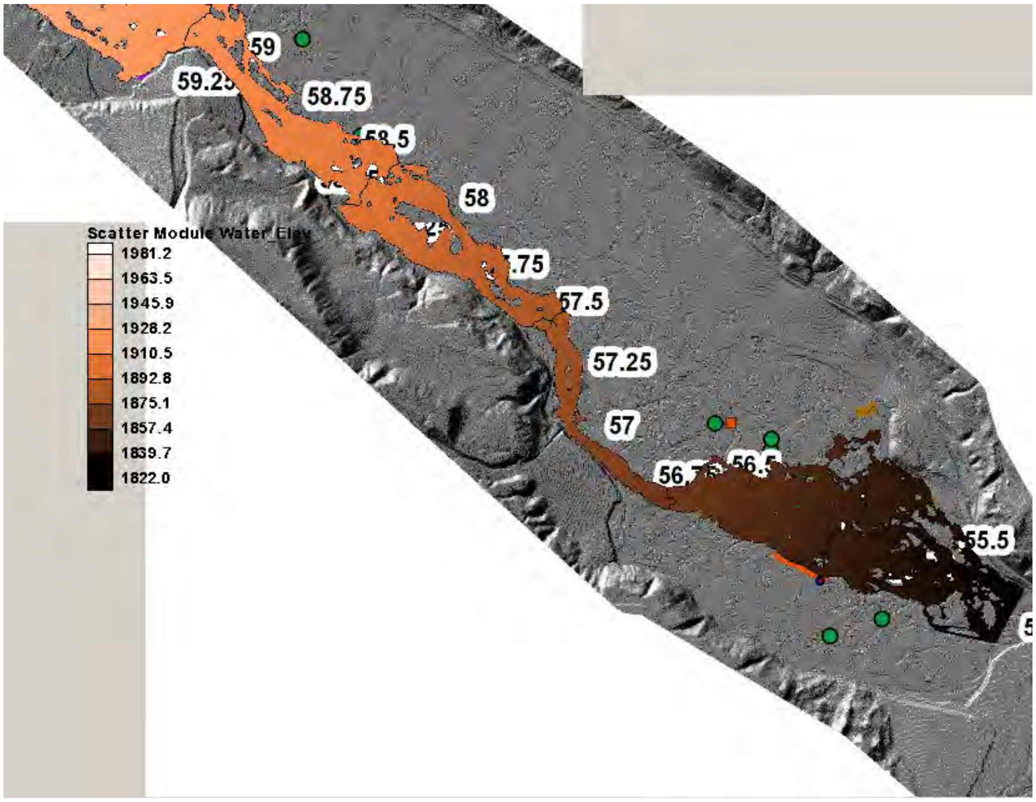


Figure 40- Water surface elevations for the 5 year flood for existing conditions in the vicinity of Project Areas 58.9, 58.6, 56.5 and 56.0/56.35/56.8 (lower section of BVRA).

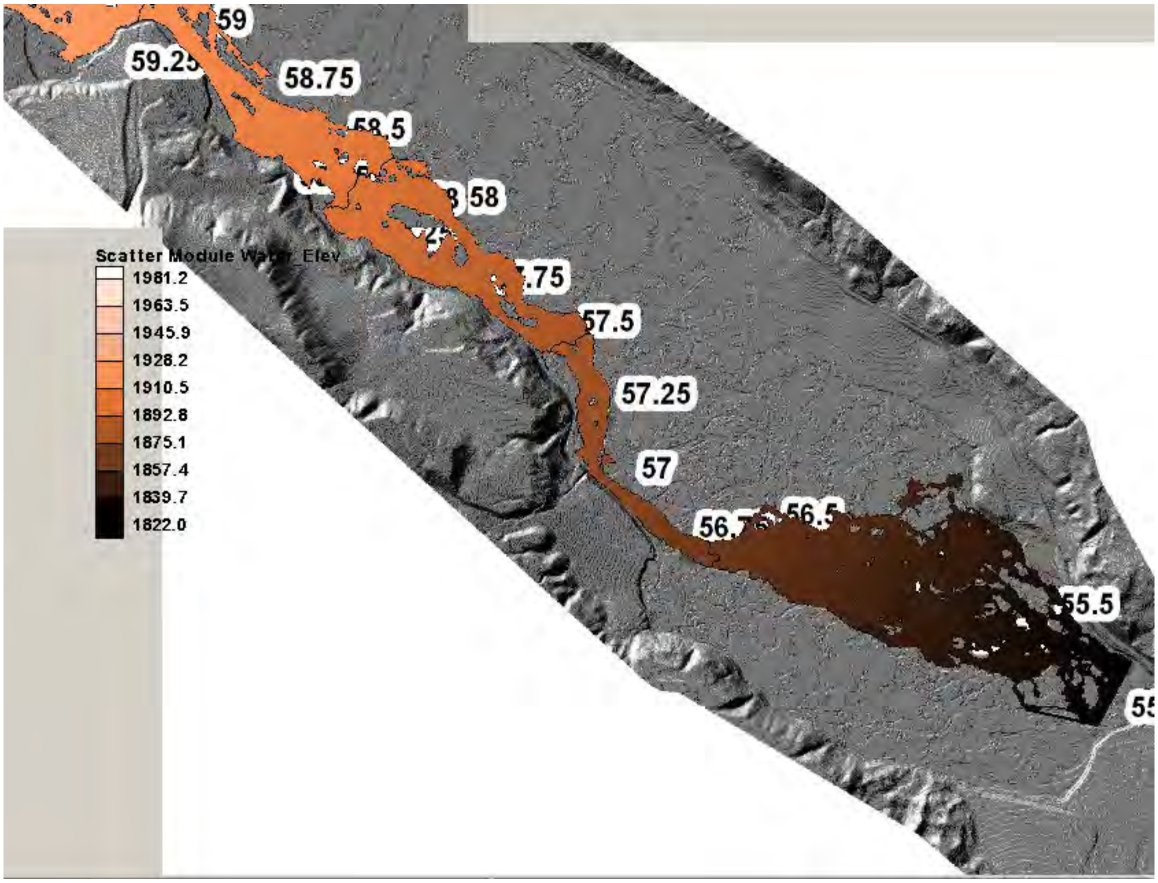


Figure 41- Water surface elevations for the 5 year flood for future conditions in the vicinity of Project Areas 58.9, 58.6, 56.5 and 56.0/56.35/56.8 (lower section of BVRA).

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Appendix E

GIS Databases

The GIS (Geographic Information System) geodatabase was produced in support of the document, *Big Valley Reach Assessment, Methow River, Okanogan County, Washington*. More geodatabases at the valley segment spatial scale are contained in the *Methow Subbasin Geomorphic Assessment, Okanogan County, Washington* (Reclamation, 2008)

The ***BigValleyReach*** geodatabase includes one feature data set: Project Features. The Project Features data set includes seven feature classes: BVRA_Area, ProjectAreas, ProtectionAreas, FloodplainConnectivity, WetlandAreas, Photopoints, and RiverMiles. The BVRA_Area, ProtectionAreas, and WetlandAreas feature classes contain one shapefile each. The ProjectAreas and Photopoints feature classes each contain eight shapefiles and the FloodplainConnectivity feature class contains sixteen shapefiles. The River Miles feature class contains one layer.

For more information or to request a copy of the GIS database on DVD, contact Melanie Paquin at the Reclamation's Pacific Northwest Regional Office, mpaquin@pn.usbr.gov.

Big Valley Reach Geodatabase

Project Features Data Set

Feature Class – BVRA_Area
Title – Big Valley reach assessment area: A data file created for the Big Valley Reach Assessment
Keyword – Reach assessment
Abstract – The data file contains a polygon that shows the location and extent of the Big Valley reach assessment area.
Shapefile – BVRA_Area

Feature Class – ProjectAreas
Title – Project areas: A data file created for the Big Valley Reach Assessment
Keyword – Project areas
Abstract – The data file contains polygons that show the location and extent of potential project areas within the Big Valley reach assessment area.
Shapefiles – MR Prj_56.0, MR Prj_56-5, MR Prj_58-6, MR Prj-58-9, MR Prj-59-6, MR Prj_60-25, MR Prj_60-85, MR Prj_62-4
Feature Class – ProtectionAreas
Title – Protection areas: A data file created for the Big Valley Reach Assessment
Keywords – Protection areas, anthropogenic impacts, floodplain connectivity
Abstract – The data file contains polygons that show the location and extent of areas that are not directly impacted by anthropogenic features. These areas are functioning adequately and providing quality habitat for the salmonids.
Shapefile – BVRA_Protection Areas

Feature Class – FloodplainConnectivity
Title – Project features: A data file created for the Big Valley Reach Assessment
Keywords – Project features, anthropogenic impacts, floodplain connectivity
Abstract – The data file contains points and polylines that show the location and extent of anthropogenic features that impact floodplain connectivity.
Shapefiles – Berm, Bridges, Dam Embankment, Fords, Headgate, Fish Screen, Highway, Highway Bridges, Levee, Cable Tram, Riprap, Road Embankment, Root Wad Placement, Undersized Culverts, Unimproved Roads, and Unknown Barrier.

Feature Class – WetlandAreas
Title – Wetland areas: A data file created for the Big Valley Reach Assessment
Keywords – Wetlands and off-channel habitat
Abstract – The data file contains polygons that show the location and extent of wetlands within the floodplain. These areas may or may not be directly connected to the main channel.
Shapefile – BVRA_Wetland

Feature Class – Photopoints
Title – Photos: A data file created for the Big Valley Reach Assessment
Keywords – Photographs and photopoints
Abstract – The data file contains points that show location and photograph number that correlate to the initial site assessments in Appendix B.
Shapefiles – MR Prj-56.0 Photos, MR Prj-56.5 Photos, MR Prj-58.6 Photos, MR Prj-58.9 Photos, MR Prj-59.6 Photos, MR Prj-60.25 Photos, MR Prj-60.85 Photos, and MR Prj-62.4 Photos

Feature Class – River Miles
Title – River Miles: A data file created for the *Methow Subbasin Geomorphic Assessment, Okanogan County, Washington* (Reclamation, 2008)
Keywords – River miles
Abstract – The data file contains points that show location of river miles along the active channel
Layer – RiverMiles

References

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