RECLAMATION

Managing Water in the West

Forrest Conservation Area Reach Assessment Middle Fork John Day River

Grant County, Oregon

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Pacific Northwest Regional Office, Boise, Idaho

August 2010

U.S. DEPARTMENT OF THE INTERIOR

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MISSION OF THE BUREAU OF RECLAMATION

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.

Cover Photo: View is to the northwest looking downstream at rock spurs placed along the Middle Fork John Day River. Subreach FR-IZ-4 – Middle Fork John Day Subbasin, Oregon – Bureau of Reclamation. July 20, 2007. Photo by Robert McAffee.

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EXECUTIVE SUMMARY

The Bureau of Reclamation (Reclamation) produced this reach assessment to assist in meeting tributary habitat commitments contained in the 2008 Federal Columbia River Power System Biological Opinion (NOAA Fisheries 2008a). The Biological Opinion includes a Reasonable and Prudent Alternative (RPA), or a suite of actions, to protect salmon and steelhead across their life cycle. This report provides scientific information to Federal, Tribal, State, and local partners that can be used to develop and monitor field actions that are intended to improve the survival and recovery of salmon and steelhead listed under the Endangered Species Act (ESA) (NOAA Fisheries 2008a).

Located in Grant County, Oregon, the Middle Fork John Day subbasin has a drainage area of about 800 square miles with elevations ranging from 2,200 feet at its mouth to over 8,100 feet in the headwaters (Young 1986). The subbasin originates in the Blue Mountains of the Malheur National Forest and flows 75 miles to its confluence with the North Fork John Day River north of Monument, Oregon.

The Forrest Conservation Area reach is located between river miles (RM) 67.55 and 63.48 on the Middle Fork John Day River. The reach is within a 4th field Hydrologic Unit Code (HUC) watershed (#170702030201) between RM 67.55 and 65.51 and a 5th field HUC watershed (#170702030202) between RM 65.51 and 63.48. Based on geologic valley constraints, the reach is characterized as moderately confined and unconfined geomorphic reach types separated by a short confined geomorphic reach type.

The species of concern found in the river include Middle Columbia River (MCR) Chinook salmon (*Oncorhynchus tshawytscha*), MCR steelhead (*Oncorhynchus mykiss*), and Columbia River (CR) bull trout (*Salvelinus confluentus*). MCR steelhead and CR bull trout are included in the Endangered Species Act Threatened and Endangered list. The Middle Fork John Day River has Class I waters as categorized by the Blue Mountain Stream Survey Program and the priority actions are rehabilitation and protection (NOAA Fisheries 2008b).

Limiting factors, the "condition that limit the ability of habitat to fully sustain populations of salmon" (State of Washington 1998 Engrossed Substitute House Bill 77RCW), affecting the Middle Fork John Day River watershed habitat conditions include the following (Carmichael 2006):

- Several areas within the watershed with very wide grassy valley bottoms have been altered by past overgrazing and road construction within floodplains (MNF 1999). Entrenched channels have become disconnected from their floodplains in areas (MNF 1999). Mining operations have altered many of the stream channels and floodplains along the Middle Fork and its tributaries.

- Excessive fine sediment loading is a significant limiting factor in the watershed. Poor riparian conditions, riparian roads, grazing activities, and past forestry, mining, and channel alterations all contribute sediment to streams in the watershed.

- Oregon Department of Environmental Quality (ODEQ) has identified several streams in the Middle Fork watershed as water quality limited for high temperatures, dissolved oxygen, or biological criteria. The most serious water quality problem is elevated summer water temperatures caused by vegetation disturbance, stream straightening/relocation, livestock grazing, timber harvest, road building, irrigation water withdrawals, and historical mining and dredging (NPCC 2005).

An analysis was conducted on the Forrest Conservation Area reach using reach-based ecosystem indicators (REI) (Appendix A). The indicators used were adapted from the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries Service) and the U. S. Fish and Wildlife Service (USFWS) matrix of pathways and indicators (NOAA 1996 and USFWS 1998), and those contained in the *Monitoring Strategy for the Upper Columbia Basin* (Hillman 2006). The lateral channel migration indicator was modified in the REI, and the vertical channel stability indicator was added to provide more clarity on channel dynamics. Although the interpretation of the condition of each indicator is somewhat subjective, the data upon which the interpretation is based has been quantified in many cases. The quantified data provides an environmental baseline condition that can be repeated to establish a time series that can be used to conduct an intervention or trend analysis (i.e., effectiveness monitoring).

The condition of each indicator for the Forrest Conservation Area reach was interpreted to be in the following conditions by a technical team composed of a geologist, a hydraulic engineer, and biologist who were familiar with the Middle Fork John Day River (Appendix A):

1. **Unacceptable Condition:**
    a. Water temperature due to past clearing of the riparian buffer zone, reduced instream flows, and reduced floodplain connectivity caused by agricultural development and infrastructure
    b. Large wood due to the lack of instream wood and reduced recruitment potential because of artificial channel stability and floodplain development
    c. Off-channel habitat because of reduced floodplain connectivity, restricted lateral channel migration, and loss of beaver activity that creates complex aquatic habitats
    d. Floodplain connectivity due to railroad and road grades, channelization, and bank protection

   e. Bank stability/channel migration due to artificial channel stability caused by bank protection restricting lateral channel migration and unstable channel sections that erode laterally into banks where riparian vegetation has been removed for floodplain development
   f. Vegetation condition (disturbance) due to past floodplain clearing for agriculture and the removal of beaver activity within the floodplain that creates and maintains complex vegetation structures
   g. Vegetation condition (canopy cover) due to clearing and grazing of riparian vegetation along the streambanks that provides shading and moderates the local climate (i.e., air temperature) along the river

2. **At Risk Condition:**
   a. Chemical contamination/nutrients due to cattle grazing along streambanks, road locations within the floodplain, and past or current mining activities in several tributaries
   b. Pools due to the lack of fish cover typically provided by appropriate riparian vegetation and large wood
   c. Vertical channel stability due to channelization, bank protection that may result in bed scour, and instream hydrologic impacts from loss of floodplain connectivity
   d. Vegetation condition (structure) due to past clearing of the riparian buffer zone for agricultural development and removal of beavers and their activities that help create and maintain complex riparian vegetation structure

3. **Adequate Condition:**
   a. Turbidity based on Oregon Department of Ecology water quality determinations
   b. Main channel physical barriers because there are no fish passage barriers at all biologically significant flows
   c. Channel substrate based on Wolman pebble counts and volumetric samples conducted in several locations along the river throughout the reach
   d. Fine sediment based on visual estimates of the percentage of surface fines and volumetric samples

The geomorphic potential, which is a measure of the stream’s capability to dynamically adjust to changes in the hydrologic, geomorphic, and biotic regimes, was interpreted to be moderate from RM 67.55 to 66.68; low from RM 66.68 to 66.45; and high from RM 66.45 to 63.48. Geomorphic potential for the reach is interpreted to be in a degraded condition primarily due to (1) past floodplain development for agriculture and commercial uses that restricts floodplain connectivity and has altered the riparian vegetation structure; (2) the railroad grade that disconnects historic channel paths and floodplain; (3) bank protection that restricts lateral channel migration and affects hydraulics and sediment transport that could result in localized scour; and (4) past large wood removal from the river and along the riparian buffer zone that reduces channel complexity and roughness and reduces large wood recruitment potential.

Based on the indicator condition analysis and geomorphic potential, the following prioritized habitat action classes, adapted from Roni (Roni et al. 2002 and Roni 2005), are recommended to achieve a cumulative reach scale response. These recommendations are discussed further in the **Subreach Profiles** section of this report:

1. **Protect and maintain current habitat**: This habitat action class includes protecting intact tracts of quality habitats throughout the reach. The quality aquatic and terrestrial habitats are fragmented in the reach and protection of these habitats will maintain current physical and ecological processes. Some examples of quality habitats include tracts of intact riparian vegetation, cold water sources, off-channel habitats, and beaver colony areas.
2. **Reconnect isolated habitat**: This habitat action class includes reconnecting both aquatic and terrestrial fragmented habitats throughout the reach. A continuous riparian buffer zone (maximize width where possible, otherwise a minimum width of 30 meters) along the alluvial area of the reach and along all secondary waterways (minimum width of 10 meters) should be re-established and protected. Historic channel paths that are blocked by the railroad grade should be reconnected. Some examples of actions to reconnect isolated habitats include connecting fragmented tracts of riparian vegetation with plantings and reconnecting off-channel habitats.
3. **Reconnect processes**: This habitat action class includes improving the physical and ecological processes that create and maintain habitats. Some examples of actions to improve processes include strategic placement of large wood that contributes to side channel development and creates channel complexity; removal or modification of anthropogenic features that disconnect the floodplain and restrict lateral channel migration; and riparian rehabilitation to provide channel/floodplain roughness and increase biotic energy transfer (i.e., food web improvements).
4. **Reconnect isolated habitat units**: This habitat action class includes increasing low velocity resting areas, improving channel complexity, increasing fish cover, and improving habitat unit connectivity. Some examples of actions include placing large wood or boulders to provide roughness elements; placing large wood along the margins of the channel and on the floodplain; and placing large wood in low-energy off-channel areas (i.e., side channels and alcoves) to provide habitat complexity, increase biomass, and improve fish cover.

This report summarizes these habitat action classes at relevant spatial scales to provide the necessary information to identify appropriate actions within a reach concept. Once actions have been identified for implementation, further analysis will need to be completed (i.e., alternative evaluations) to address the appropriateness of the action, biological benefit, socio-economic considerations, construction and cost considerations, and liabilities to life, property, and the resources.

OVERVIEW

The Bureau of Reclamation (Reclamation), U.S. Army Corps of Engineers, and Bonneville Power Administration contribute to the implementation of salmonid habitat improvement projects in Columbia River Basin tributaries to help meet commitments contained in the 2008 Federal Columbia River Power System Biological Opinion (NOAA Fisheries 2008a). This Biological Opinion includes a Reasonable and Prudent Alternative (RPA), or a suite of actions, to protect salmon and steelhead across their life cycle. Habitat improvement projects in various Columbia River tributaries are one aspect of this RPA. Reclamation provides technical assistance to States, Tribes, Federal agencies, and other local partners for identification, design, and construction of stream habitat improvement projects that primarily address streamflow, access, entrainment, and channel complexity limiting factors. This report provides scientific information that can be used to help identify, prioritize, implement, and monitor sustainable fish habitat improvement projects and to help focus those projects on addressing key limiting factors to protect and improve survival of salmon and steelhead listed under the Endangered Species Act (ESA).

The tributary and reach assessments maximize the potential to implement successful improvement actions that benefit anadromous species and native aquatic and terrestrial species listed under the ESA in consideration of the physical and ecological processes at work in the watershed. Assessments also define environmental baseline conditions that can complement monitoring activities designed to evaluate the physical and biological responses associated with implemented actions.

Many authors have documented strategies that emphasize physical and ecological relationships that need to be addressed prior to identifying and implementing actions in order to improve their sustainability and biological benefits (Beechie et al. 1996, 2010; Kauffman et al. 1997; Beechie and Bolton 1999; Montgomery and Bolton 2003). In addition, Roni has proposed a hierarchical strategy to implement habitat action classes at the watershed and reach scales that should maximize process-based ecological benefits versus cost of implementation (Roni et al. 2002 and Roni 2005). Based on understanding of these hierarchical relationships, this assessment uses the conceptual model in Figure 1 to analyze physical and ecological processes across the landscape and for identifying and monitoring actions within an adaptive management framework.

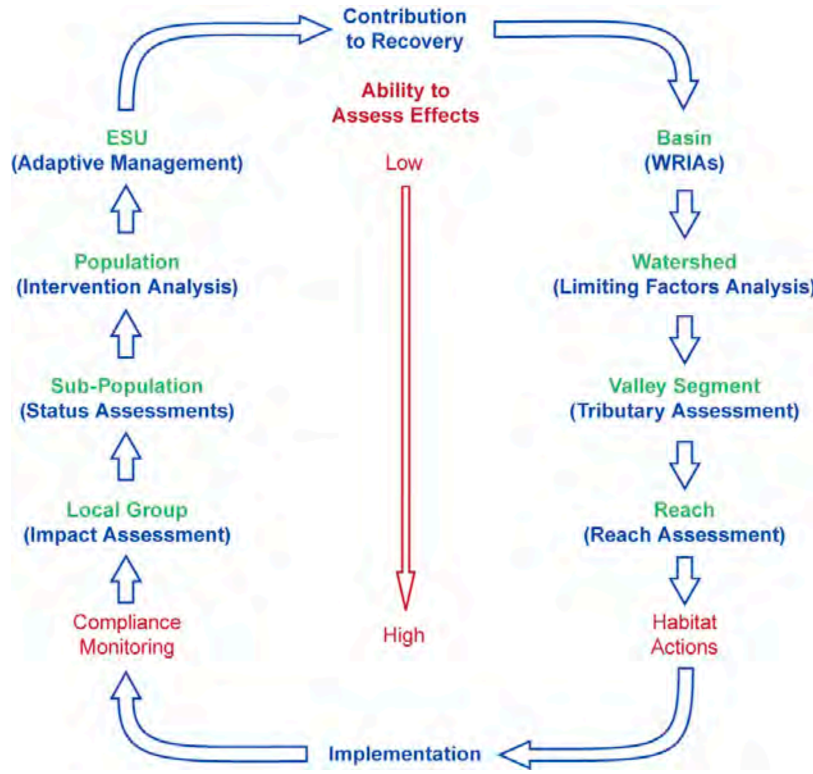

Figure 1. Conceptual model showing how assessments and monitoring are hierarchically nested and related. Compiled from Hillman (2006), UCSRB (2007), and Stewart-Oaten and Bence (2001).

LOCATION AND PURPOSE

Located in Grant County, Oregon, the Middle Fork John Day subbasin has a drainage area of about 800 square miles with elevations ranging from 2,200 feet at its mouth to over 8,100 feet in the headwaters (Young 1986). The subbasin originates in the Blue Mountains of the Malheur National Forest and flows 75 miles to its confluence with the North Fork John Day River north of Monument, Oregon (Figure 2).

The Forrest Conservation Area reach is between river miles (RM) 67.55 and 63.48 on the Middle Fork John Day River. The reach is within a 4th field Hydrologic Unit Code (HUC) watershed (#170702030201) between RM 67.55 and 65.51 and a 5th field HUC watershed (#170702030202) between RM 65.51 and 63.48. The reach is characterized as moderately confined (RM 67.55 to 66.68), confined (RM 66.68 to 66.45) and unconfined (RM 66.45 to 63.48) based on valley constraints.

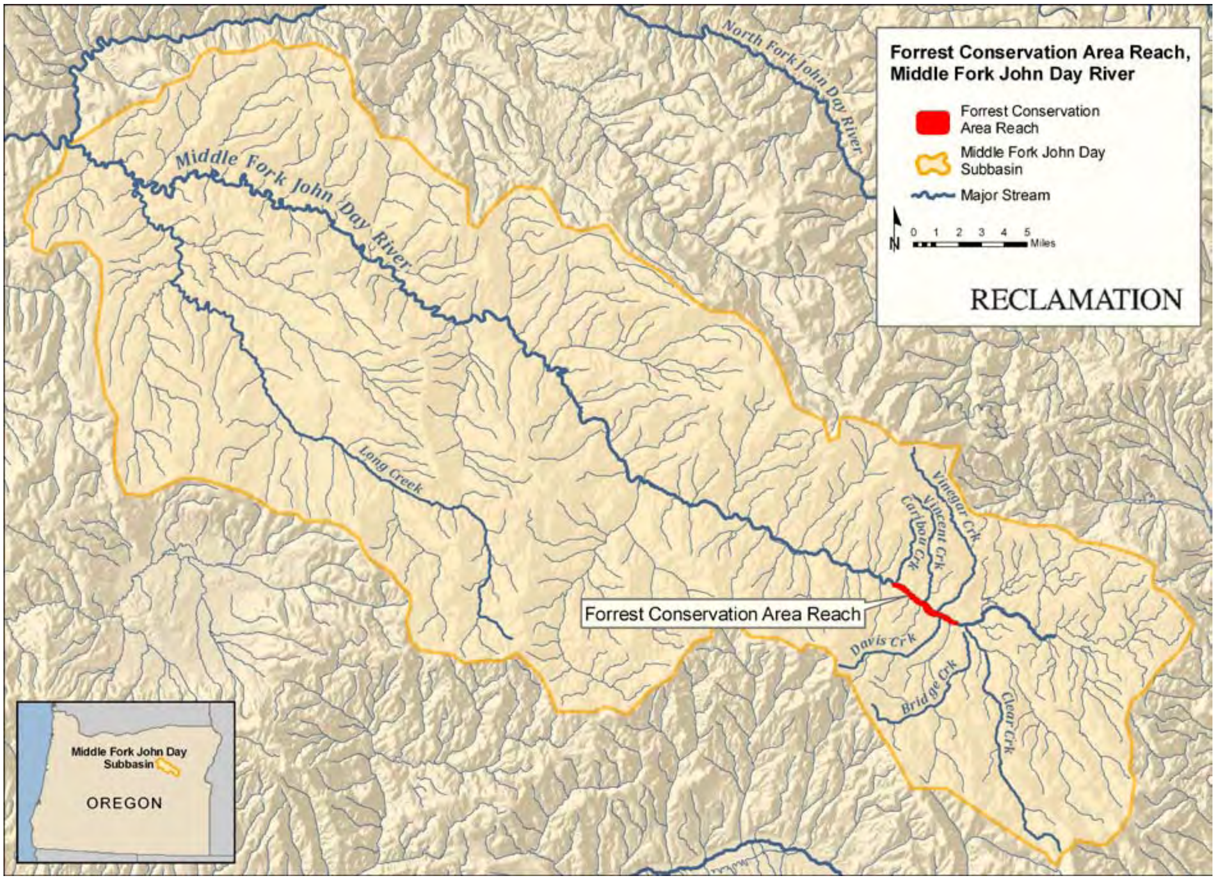

Figure 2. Location of the Forrest Conservation Area reach, Grant County, Oregon.

The species of concern found in the Middle Fork John Day River include Middle Columbia River (MCR) Chinook salmon (*Oncorhynchus tshawyscha*), MCR steelhead (*Oncorhynchus mykiss*), and Columbia River (CR) bull trout (*Salvelinus confluentus*). MCR steelhead and CR bull trout in the Endangered Species Act Threatened and Endangered list. The Middle Fork John Day River is a major spawning area for MCR spring Chinook salmon and MCR steelhead and a migration corridor for CR bull trout.

The Forrest Conservation Area reach has Class I waters as categorized by the Blue Mountain Stream Survey Program. The *Proposed Middle Columbia River Steelhead Distinct Population Segment ESA Recovery Plan*, referred to in this report as the *Recovery Plan*, recommends Protection and Restoration actions (NOAA Fisheries 2008b). Reclamation recognizes that Restoration to conditions prior to the influx of Western civilization is not attainable in most cases and uses the term Rehabilitation in which the physical and ecological processes are improved, but are not necessarily restored to their “natural” condition.

The purpose of this reach assessment is to refine the scientific understanding of physical and ecological processes at a reach scale, establish environmental baseline conditions for future monitoring, and describe potential actions for implementation at the reach scale. Several limiting factors were identified in the *Recovery Plan* (NOAA Fisheries 2008b). Many of these limiting factors were based on professional judgment, local expertise, and biological models, but much of the data had not been quantified. This reach assessment documents environmental baseline conditions, identifies the condition of the indicators, and quantifies several indicators for future monitoring. When possible, quantifiable data was collected and entered in a reach-based ecosystem indicators (REI) table for evaluation (Appendix A). A qualitative condition ranking was assigned to each specific and general indicator. Although these condition rankings are qualitative, much of the data upon which they are based have been quantified and, in some cases, have been georeferenced (i.e., channel units and anthropogenic features) for future monitoring efforts. Upon evaluation of the REI, protection and rehabilitation approaches were proposed that could address long-term and short-term improvements to physical and ecological processes.

REACH CHARACTERIZATION

The following sections provide context for the Forrest Conservation Area reach at the watershed and reach scales. Watershed characteristics were evaluated to understand physical processes including geologic and hydraulic processes, geomorphic reaches, and common geomorphic and hydraulic attributes (Reclamation 2008). Reach scale characteristics were evaluated to refine the physical and ecological processes, including geologic and geomorphic mapping, hydraulic modeling, and stream inventory. Geomorphic potential, defined for this report as the capability of streams to form, connect, and sustain fluvial systems (including fish habitat) by dynamically adjusting longitudinally, vertically, and laterally to changes in the hydrologic, geomorphic, and biotic regimes over time, is evaluated at the reach scale.

Watershed Scale Context

To place the Forrest Conservation Area reach into a watershed context, a summary of the *Middle Fork and Upper John Day River Tributary Assessments, Grant County, Oregon* (Reclamation 2008), referred to in this report as the *Tributary Assessment*, is provided in the next section. A summary of the limiting factors and recommended management objectives for the Middle Fork John Day River based on the *Recovery Plan* is provided as well. A summary of watershed limiting factors from Carmichael (2006) that were incorporated into the *Proposed Middle Columbia River Steelhead Distinct Population Segment ESA Recovery Plan* (NOAA Fisheries 2008b) is also provided in this report.

Summary of the 2008 Tributary Assessment

The *Tributary Assessment* was completed by a multidisciplinary team of hydraulic engineers, geologists, hydrologists, biologists, and botanists (Reclamation 2008). The focus of the assessment was to evaluate watershed influences on flow and sediment inputs. These influences were further refined along 23 miles of the Middle Fork John Day River and 3 miles of the Upper John Day River (Figure 3).

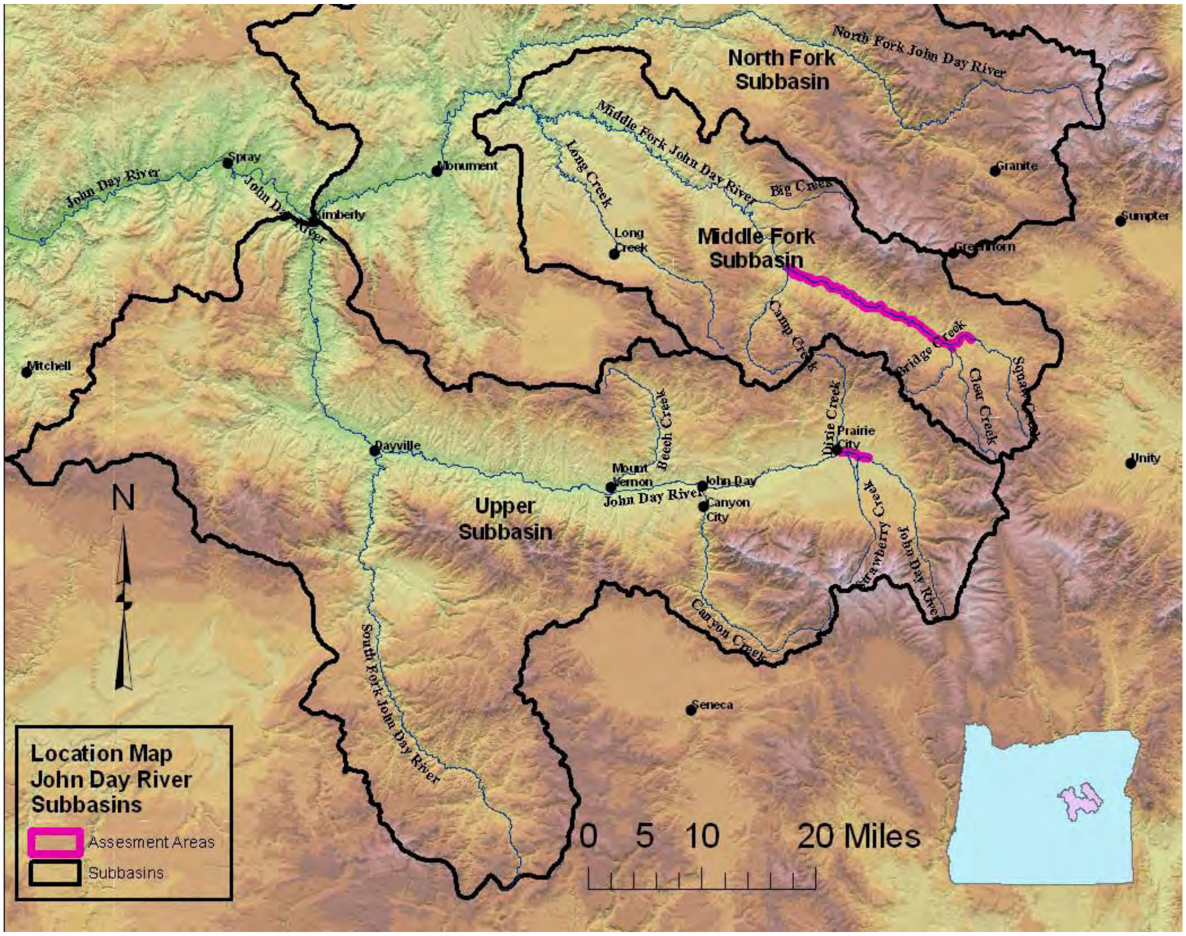

Figure 3. Location map of the *Tributary Assessment* areas on the Middle Fork and Upper John Day rivers within the Middle Fork and Upper John Day subbasins. The sections in violet denote the valley segments where the tributary assessments were conducted (Reclamation 2008).

The purpose of the *Tributary Assessment* was to identify geologic and hydraulic processes active within the valley segments; explore whether geomorphic and hydraulic conditions upstream and downstream affect conditions within each segment; and identify geomorphic reaches that share common geologic and hydraulic physical attributes. The *Tributary Assessment* identified 20 geomorphic reaches on the Middle Fork John Day River (Table 1). These geomorphic reaches were characterized into three general reach types based on valley confinement: confined, moderately confined, and unconfined. The Forrest Conservation Area reach was characterized as a moderately confined (MF 14) to unconfined (MF 13) geomorphic reach that is bounded by a confined geomorphic reach (MF 15) and a moderately confined geomorphic reach (MF 12) (Table 1).

The *Tributary Assessment* found there were no large-scale changes to the balance between incoming water and sediment loads that would indicate a potential for incision or aggradation on a decadal scale. However, a slight tendency for degradation in the downstream direction may be present during flood events. Some minor impacts to the sediment regime were detected, including short-term increases in fine sediments from anthropogenic activities, localized changes in channel slopes resulting from channelization, and possibly mild localized degradation or bed coarsening in small portions of a few reaches.

Table 1. Geomorphic reach designation, location by river mile, reach type, and geomorphic potential for Middle Fork John Day River between RM 48.0 and 70.8 (Reclamation 2008). Geomorphic potential was evaluated during the *Tributary Assessment*. The green shaded rows denote the geomorphic reaches evaluated for this *Reach Assessment*.

Reach Designation	River Miles	Reach Type	Geomorphic Potential
MF1	48.0 - 48.2	Moderately Confined	Moderate
MF2	48.2 - 51.1	Unconfined	High
MF3	51.1 - 52.7	Moderately Confined	Moderate
MF4	52.7 - 53.9	Confined	Low
MF5	53.9 - 55.3	Moderately Confined	Moderate
MF6	55.3 - 55.6	Confined	Low
MF7	55.6 - 56.2	Unconfined	High
MF8	56.2 - 58.0	Unconfined	High
MF9	58.0 - 59.1	Unconfined	High
MF10	59.1 - 60.8	Moderately Confined	Moderate
MF11	60.8 - 62.5	Confined	Low
MF12	62.5 - 63.5	Moderately Confined	Moderate
MF13	63.5 - 66.5	Unconfined	High
MF14	66.5 - 67.7	Moderately Confined	Moderate
MF15	67.7 - 68.1	Confined	Low
MF16	68.1 - 69.0	Unconfined	High
MF17	69.0 - 69.2	Confined	Low
MF18	69.2 - 69.7	Moderately Confined	Moderate
MF19	69.7 - 70.2	Confined	Low
MF20	70.2 - 70.8	Unconfined	High

Summary of Limiting Factors and Management Objectives

The *Recovery Plan* for the MCR steelhead ESU covers Oregon and Washington (NOAA Fisheries 2008b) and since no recovery plans were available for MCR Chinook salmon or CR bull trout, this report assumes the limiting factors for MCR steelhead would also be similar for other salmonids.

Limiting factors affecting the Middle Fork John Day River watershed habitat conditions include the following (Carmichael 2006):

- Several areas within the watershed with very wide grassy valley bottoms have been altered by past overgrazing and road construction within floodplains (MNF 1999). Entrenched channels have become disconnected from their floodplains in areas (MNF 1999). Mining operations have altered many of the stream channels and floodplains along the Middle Fork and its tributaries.

- Excessive fine sediment loading is a significant limiting factor in the watershed. Poor riparian conditions, riparian roads, grazing activities, and past forestry, mining, and channel alterations all contribute sediment to streams in the watershed.

- Oregon Department of Environmental Quality (ODEQ) has identified several streams in the Middle Fork watershed as water quality limited for high temperatures, dissolved oxygen, or biological criteria. The most serious water quality problem is elevated summer water temperatures caused by vegetation disturbance, stream straightening/relocation, livestock grazing, timber harvest, road building, irrigation water withdrawals, and historical mining and dredging (NPCC 2005).

- Riparian corridors and levels of instream large wood have changed significantly from historic conditions. Reduction in large wood has resulted in fewer pools, increased stream velocities, reduced sediment trapping, and an overall reduction in channel diversity and key habitat (MNF 1999).

The prioritized considerations for the implementation of management strategies and actions for recovery of MCR steelhead populations in Oregon consist of the following (Carmichael 2006):

- Actions that provide long-term protection for the major life history strategies

- Actions that provide long-term protection of habitat conditions that support the viability of priority extant populations and their life history strategies throughout their entire life cycle

- Actions that enhance the viability of priority extant populations
- Actions that protect or enhance viability of multiple listed populations
- Actions that enhance habitat and restore natural processes to increase survival, connectivity, and reproductive success of priority extant populations
- Actions that target the key limiting factors and that contribute the most to closing the gap between current status and desired future status of priority populations
- Actions that are required to protect and enhance habitats for populations that are not critical for viability, but must be maintained

REACH SCALE CONTEXT

Several assessments were conducted on the Forrest Conservation Area reach to determine the current physical processes, the condition of aquatic and terrestrial habitat, and the historical and ongoing anthropogenic activities that have impacted physical and ecological processes. These assessments are summarized in the following sections.

Summary of 2007-2008 Reach Documentation

An assessment was conducted during the fall of 2007 and 2008 to document anthropogenic, geologic, and geomorphic features (Appendix C). Geology includes predominantly igneous rocks that are further defined as the Strawberry Volcanics (Brown and Thayer 1966). Landforms typically include alluvial deposits comprising terraces and alluvial fans. Alluvial fan deposits provide lateral and vertical channel controls near Bridge Creek, Davis Creek, Vinegar Creek, Vincent Creek, and Caribou Creek. The valley bottom of the reach is classified as a wide mainstream valley (F4) from RM 67.55 to 66.45 and a wide mainstream valley (F3) from RM 66.45 to 63.51, with an average valley bottom gradient of less than 3 percent and a generally unconstrained, moderately sinuous channel (Naiman et al. 1992). The geomorphic reach-types were further refined to moderately confined (RM 67.55 to 66.68), confined (RM 66.68 to 66.45) and unconfined (RM 66.45 to 63.48) with a "pitch point," or short constriction, at RM 63.48. The stream type was classified in the 2008 Stream Inventory (Appendix B) as predominantly a C-type channel (Rosgen 1996). The bedforms are predominantly pools, riffles, and runs with gravel-to-cobble substrate.

The reach assessment area encompasses about 165 acres along the Middle Fork John Day River from RM 67.55 to 63.48. The reach was further broken down into two types of morphologically distinct areas that include the active channel and floodplain areas to describe greater local control and variability. Referred to as inner (active channel) and outer (floodplain) zones, these areas represent existing riverine habitat within the reach.

The inner zone is characterized by the presence of primary and secondary channels, a repetitious sequence of channel units, and relatively uniform physical attributes indicative of localized transport, transition, and deposition. They are generally associated with ground-disturbing flows with sufficient frequency that mature deciduous and coniferous trees are rare (adapted from USDA 2008). For this reach assessment, the inner zone was primarily mapped based on the physical presence of ground disturbing flows, such as gravel bars and fine sediment deposition, because most of the riparian vegetation was removed by agriculture development. The active main channel was subdivided into four inner zones based on local trends of transport, transition, and deposition interpreted from the channel unit mapping, channel gradient, channel confinement, hydraulics, and dominant substrate. Inner zones that are not hydraulically connected to the river because of anthropogenic features are described as disconnected inner zones.

In contrast, an outer zone is typically a terrace tread(s) and generally coincidental with the historic channel migration zone unless the channel has been modified or incised, leading to the abandonment of the floodplain. This zone includes ephemeral side channels, overflow channels, and oxbows. An outer zone is further distinguished from an inner zone by the presence of flood deposits, a change in vegetation (mature deciduous and coniferous trees are present unless removed for development), and bounding geologic landforms such as older terraces, valley walls, alluvial fans, colluvium, or glacial deposits. However, in the Forrest Conservation Area reach, this definition was difficult to determine due to the level of riparian disturbance and that the reach may have been more of a wet-meadow type of community prior to human disturbance. Outer zones that are not hydraulically connected or have physical obstructions because of anthropogenic features are described as disconnected outer zones (Table 2).

Table 2. Acres by zone type on the Forrest Conservation Area reach, Middle Fork John Day River, Grant County, Oregon.

Inner Zone (IZ)	Disconnected Inner Zone (DIZ)	Outer Zone (OZ)	Disconnected Outer Zone (DOZ)
27.0 acres	2.5 acres	82.3 acres	53.5 acres

These inner and outer zones were further refined as subreaches and subreach complexes that are delineated by longitudinal, lateral, and vertical controls (Figure 4). Subreaches that have several anthropogenic impacts that affect physical processes in multiple areas are identified as subreach complexes. These areas are identified in a subreach context in order to sequence potential actions to address complicated anthropogenic impacts.

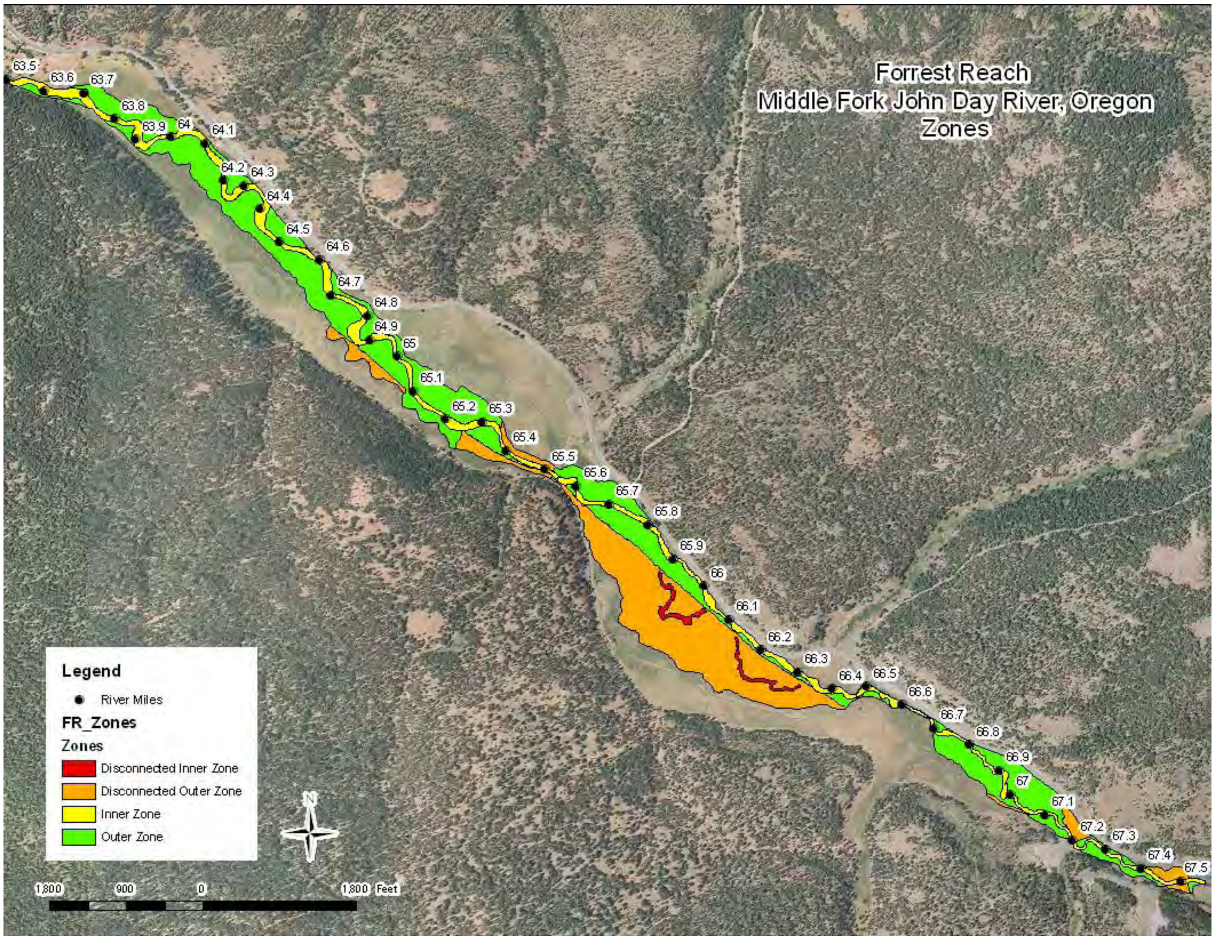

Figure 4. Locations of zones, subreaches, and parcels (i.e., subunits of the subreach) and their connectivity to the river.

Based on the Reach Documentation (Appendix C) and the *Tributary Assessment*, there are four natural river constrictions in the Forrest Conservation Area reach:

1. The upstream extent of the reach (RM 67.55) where the floodplain is constricted between a higher terrace on river right and the Bridge Creek alluvial fan on river left

2. Between about RM 66.68 and 66.45 where the floodplain is constricted between bedrock and Vinegar Creek alluvial fan on river right and the Davis Creek alluvial fan on river left

3. Near RM 65.55 where the floodplain is constricted between Vincent Creek alluvial fan on river right and the Dead Cow Gulch alluvial fan on river left

4. The downstream extent of the reach (RM 63.48) where the floodplain is constricted between the Caribou Creek alluvial fan on river right and bedrock on river left

Historically, the river most likely migrated between these floodplain constrictions and across the moderately confined and unconfined floodplains; however, in the early 1900s, railroad construction and stream channelization occurred within the Forrest Conservation Area reach. These anthropogenic impacts created artificial floodplain constrictions between RM 66.45 and 65.55.

The reach may have been a wet-meadow type community where beavers were probably more prevalent than they are presently. Anthropogenic impacts have disrupted floodplain connectivity, resulting in a reduction of floodplain-type side channels that are suitable for beaver colonization. The absence of beaver populations are qualitatively interpreted to have lead to a reduction in complex habitats provided by beaver activities and potentially a reduction in groundwater recharge.

Summary of 2008 Channel Unit Mapping

Channel unit mapping was conducted for this reach assessment (detailed channel unit maps appear in Appendix C). Channel unit mapping is a useful tool in interpreting subreach scale hydraulic conditions in addition to sediment movement through a given reach or channel segment at channel forming flows. Channel units are mapped in the field based on observed physical characteristics and then each unit is redrawn on rectified aerial photographs in ArcGIS (Figure 5). “Channel units” should not be confused with “habitat units” that are a measure of habitat type and quantity available at low flows. For example, the habitat assessment includes the long pool tail-out in the glide-pools (usually lateral scour pools) as pool habitat even though this area of the pool is functioning as a run hydraulically. For channel unit mapping, the pools (area of pool scour) and runs are spatially defined and mapped separately as geomorphic channel units.

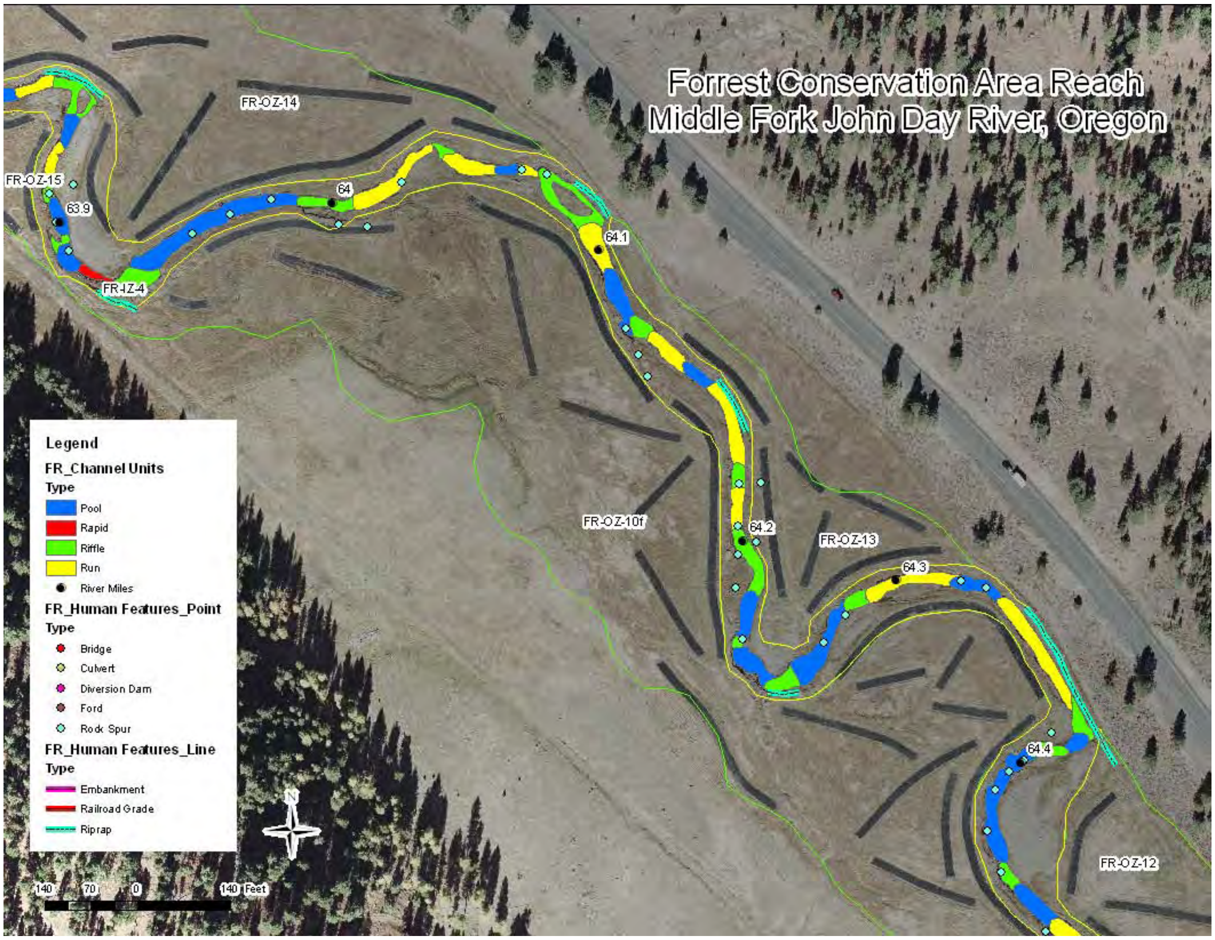

Figure 5. Example of the channel unit mapping conducted on the Forrest Conservation Area reach (map scale 1:2,000). Complete channel unit coverage is contained in Appendix C and the Forrest Reach geodatabase (Appendix D).

The channel units were charted using the percentage of total area occupied by each unit to graphically illustrate the existing conditions and to help interpret current trends in sediment transport and deposition (Figure 6). The reach includes a combination of channel types, including moderately confined plane-bed to pool-riffle and unconfined pool-riffle segments. Conceptually, confined channel segments should have more pools and runs (scour and transport channel units); moderately confined segments should have a balance of runs (transport channel unit) with riffles and bars (depositional channel units); and unconfined segments should also have a balance of different types of channel units, but with increasing area of riffles and bars (depositional channel units).

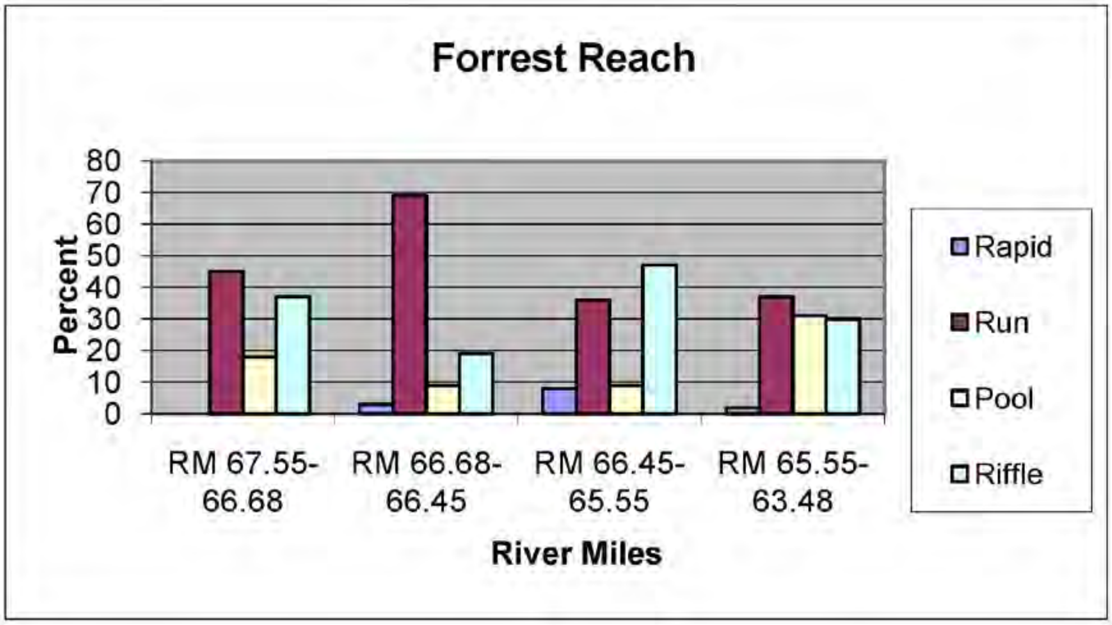

Figure 6. Percent of channel units for each inner zone subreach based on modified classifications from the Stream Inventory Handbook (USFS 2008).

Moderately confined and confined channels with higher gradients and more plane-bed type morphology do not typically form pools except where forced by significant hydraulic structures such as bedrock outcrops or stable large wood complexes. In the moderately confined section from RM 67.55 to 66.68 and the confined section from RM 66.68 to 66.45, the reduction in lateral channel migration capability combined with the effect this has on sediment transport may be the most important factor since pool formation is typically associated with energy concentration at the meander bend apex. A balance of transport and depositional channel units would be expected in this plane-bed/pool-riffle system.

In the unconfined section of the reach from RM 66.45 to 63.48, depositional channel units would be expected to increase in the downstream direction in this pool-riffle type system as the channel gradient decreases. The channel section from RM 66.45 to 65.55 has a high percentage of riffles and runs that may be due to artificial confinement by the railroad grade, channelization, and bank protection (i.e., riprap and rock spurs) that has reduced lateral channel migration and may cause vertical channel instability (i.e., scour). The impact on channel processes caused by the bank protection is interpreted to be a reduction in the sediment supply due to artificially stable streambanks and an increase in channel transport capacity at channel forming flows due to a change in channel geometry caused by scour. The channel section from RM 65.55 to 63.48 is unconfined and has a balance of runs, pools, and riffles which would be expected for a pool-riffle type stream. There is some bank protection (i.e., riprap and rock spurs) that has forced bed scour creating pools.

Summary of the 2008 Stream Inventory Survey

At the tributary scale for the Middle Fork John Day River, the following indicator conditions were identified from the Middle Fork John Day River, 2008 Stream Survey Report, Malheur National Forest, Blue Mountain Ranger District (Appendix B). The stream inventory survey was conducted by the U.S. Forest Service for this reach assessment.

- Water temperature
    - The Middle Fork John Day River is listed on the 303(d) list for water quality due to exceeding the following criteria for water temperature during the summer months.
        - From RM 70.8 to Clear Creek at RM 68.0, the Middle Fork John Day River is designated by the State water quality standards for bull trout and juvenile rearing which has optimal temperatures below 12° C (Sturdevant 2008).
        - From Clear Creek at RM 68.0 to 48.0, the Middle Fork John Day River is designated fish use of core coldwater habitat by the State of ODEQ (Sturdevant 2008). This means that the water is expected to maintain temperatures usually considered optimal for salmon and steelhead rearing, or that are suitable for bull trout migration.
- Large Wood
    - Wood counts from RM 70.8 to 48.0 did not meet the criteria of 20 pieces of medium- and large-sized wood combined per mile of stream. Of the countable wood found throughout the habitat assessment area, 59 percent was small, 32 percent was medium, and 9 percent large.
- Pools
    - The criteria for the number of pools per mile vary by channel width. From RM 70.8 to 48.0, the number of pools per mile did not meet criteria contained in the REI table (Appendix A).
- Riparian Vegetation
    - The riparian vegetation is predominantly in a grassland/forbs-to-shrub/seedling condition, implying that there is poor large wood recruitment potential and canopy cover along the stream.

- Habitat Complexity
  - The largest impacts to physical processes are from dredging, channelization, bank protection, and riparian vegetation clearing. These impacts include reduced channel migration, reduced floodplain connectivity, altered sediment and large wood delivery and retention, and disconnected groundwater sources from the main channel.

Summary of the 2007-2008 Hydraulic Modeling

A two-dimensional hydraulic model was developed to evaluate floodplain processes, side channel connectivity, and tributary inputs for conditions observed during the 2007 and 2008 field seasons (Reclamation 2010, in preparation). Simplified hydraulic parameters, including depth-averaged velocity, bed shear stress, and depth, were determined along the channel thalweg and across the areal extent of the floodplain.

The model was simulated for the 2-year through 100-year discharges (Table 3). Connected floodplain was defined as the area with depths exceeding 0.5 feet outside of the low flow channel. In general, the floodplain is well-connected under existing conditions between Bridge, Vinegar, Vincent, and Caribou creeks (Figure 7). Downstream from Vincent Creek, there are localized areas of floodplain that are disconnected by the railroad grade. Reconnecting these areas would provide only limited improvement to floodplain connectivity.

Table 3. 2- through 100-year discharges for the Middle Fork John Day River, inlet flows from contributing tributaries, and the outlet flows (Reclamation 2010, in preparation).

Flow Input Location	Discharge (CFS)					
	Q2	Q5	Q10	Q25	Q50	Q100
Model Inlet	562	857	1,064	1,304	1,542	1,744
Bridge Creek	78	117	144	176	207	235
Placer Creek	11	17	21	27	32	37
Davis Creek	23	34	43	52	61	70
Vinegar Creek	54	81	100	122	142	162
Vincent Creek	41	60	73	88	103	116
Model Outlet	769	1,166	1,445	1,769	2,087	2,364

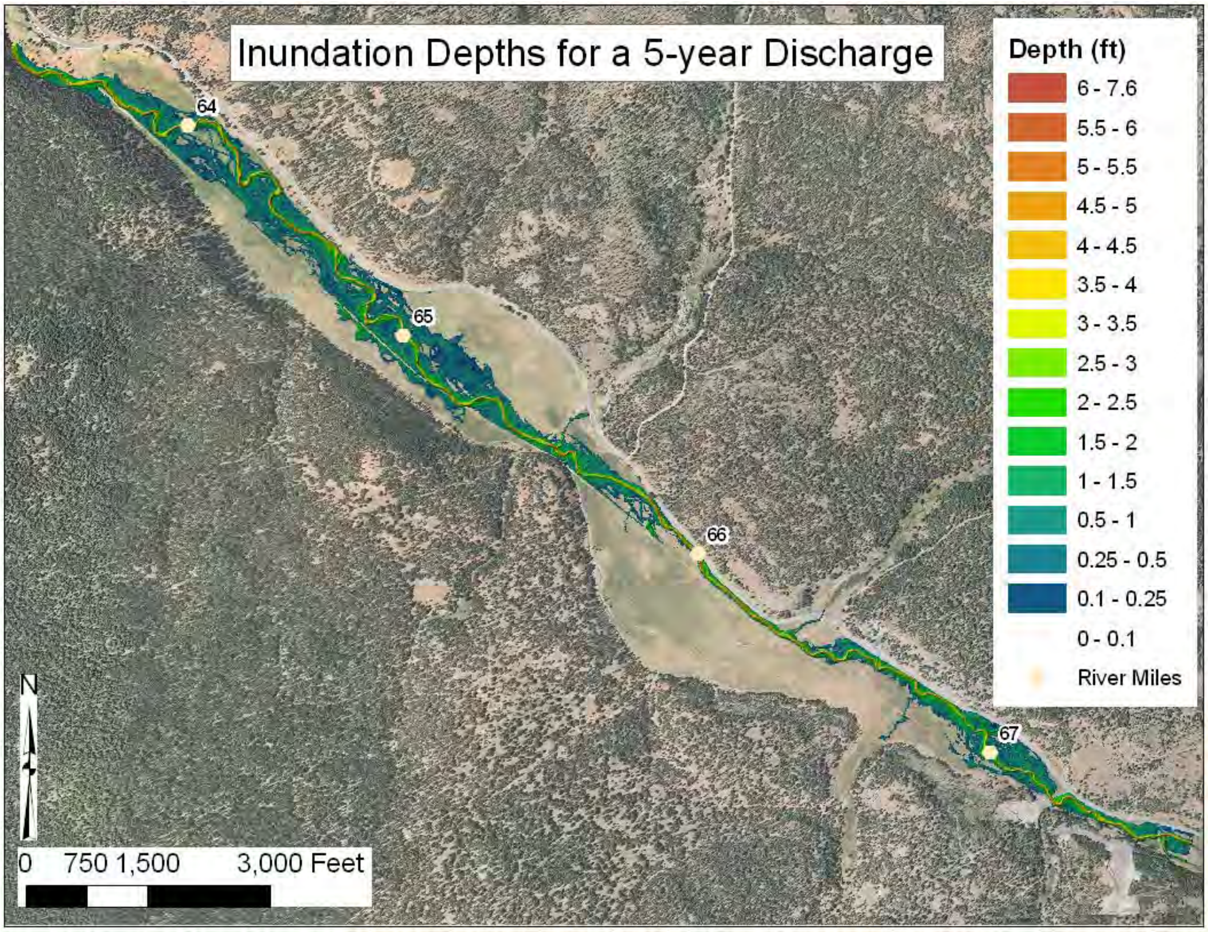

Figure 7. Floodplain inundation in the Forrest Conservation Area reach modeled at a 5-year discharge (Reclamation 2010, in preparation).

The area of greatest impact from anthropogenic activities is between Vinegar and Vincent Creeks, where the river is channelized and disconnected from its floodplain. The hydraulic model suggests the railroad grade has the greatest impact on channel dynamics and floodplain connectivity. The removal or modification of the railroad grade in this location along with blocking portions of the channelized section could increase floodplain connectivity, reconnect side channels, and improve high-flow refugia.

REACH CONDITION – REACH-BASED ECOSYSTEM INDICATORS

An analysis was conducted on the Forrest Conservation Area reach using reach-based ecosystem indicators (REI) (Appendix A). The indicators used were adapted from the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries Service) and United States Fish and Wildlife Service (USFWS) matrix of pathways and indicators and those contained in the Monitoring Strategy for the Upper Columbia Basin (Hillman 2006), referred to as the Monitoring Strategy. The lateral channel migration indicator was modified in the REI and a vertical channel stability indicator was added to provide more clarity on channel dynamics. Although the interpretation of the condition of each indicator is somewhat subjective, the data upon which the interpretation is based has been quantified in many cases. The quantified data provides an environmental baseline condition that can be repeated at a later date to establish a time series that can be used to conduct an intervention or trend analysis (i.e., effectiveness monitoring) following implementation of habitat improvements.

The REI table is a compilation of information and data collection from multidisciplinary analyses that were conducted prior to or during this investigation. Specific data collected and utilized in the analyses came from the Geomorphology and Hydraulic Modeling of the Forrest Conservation Area (Reclamation 2010, in preparation), the Reach Documentation (Appendix C), the Stream Inventory Survey (Appendix B), and the Forrest Conservation Area Reach Geodatabase (described in Appendix D). Based on the criteria contained in the REI, each indicator was determined to be functioning in one of three conditions: **Adequate**, **At Risk**, or **Unacceptable** (Table 4). The condition determinations were made by a technical team comprised of Edward Lyon, Jr. (geologist), Elaina Gordon (hydraulic engineer), and Mark Croghan (subbasin liaison). Indicators described in the REI table record an environmental baseline that reflects the condition of higher-level indicators.

The condition of each indicator for the reach was interpreted for this report to be in the following conditions:

1. **Unacceptable Condition:**
    a. Water temperature due to past clearing of the riparian buffer zone, reduced instream flows, and reduced floodplain connectivity caused by agricultural development and infrastructure
    b. Large wood due to the lack of instream wood and reduced recruitment potential because of artificial channel stability and floodplain development
    c. Off-channel habitat because of reduced floodplain connectivity, restricted lateral channel migration, and loss of beaver activities that created complex aquatic habitats
    d. Floodplain connectivity due to railroad and road grades, channelization, and bank protection
    e. Bank stability/channel migration due to artificial channel stability caused by bank protection restricting lateral channel migration and unstable channel sections that erode laterally into banks where riparian vegetation has been removed for floodplain development
    f. Vegetation condition (disturbance) due to past floodplain clearing for agriculture and the removal of beaver activities within the floodplain that created and maintained complex vegetation structures
    g. Vegetation condition (canopy cover) due to clearing and grazing of riparian vegetation along the streambanks that provided shading and moderated the local climate (i.e., air temperature) along the river
2. **At Risk Condition:**
    a. Chemical contamination/nutrients due to cattle grazing along streambanks, road locations within the floodplain, and past or current mining activities in several tributaries
    b. Pools due to the lack of fish cover typically provided by appropriate riparian vegetation and large wood
    c. Vertical channel stability due to channelization, bank protection that may result in bed scour, and instream hydrologic impacts from loss of floodplain connectivity
    d. Vegetation condition (structure) due to past clearing of the riparian buffer zone for agricultural development and past removal of beavers and their activities that helped create and maintain complex riparian vegetative structure

3. **Adequate Condition:**
    a. Turbidity based on Oregon Department of Ecology water quality determinations
    b. Main channel physical barriers because there are no fish passage barriers during all biologically significant flows
    c. Channel substrate based on Wolman pebble counts and volumetric samples conducted in several locations along the river throughout the reach
    d. Fine sediment based on visual estimates on the percentage of surface fines and volumetric samples

Reclamation recognizes that there may be systemic watershed limiting factors that impact the reach. However, these systemic factors are, in general, poorly understood and have not been determined if they are from natural processes or anthropogenic impacts. As such, all reach-scale deficiencies are described with the assumption that rehabilitation of the reach and adjacent reaches will have cumulative benefit toward addressing potential watershed limiting factors.

Table 4. Reach-based ecosystem indicators (REI) for the Forrest Conservation Area reach. Each indicator was interpreted to be in one of three conditions: Adequate, At Risk, or Unacceptable.*

Spatial Scale	General Indicator	General Indicator Condition
Watershed Characteristics	Effective Drainage Network and Watershed Road Density	At Risk
	Disturbance Regime (Natural/Human)	At Risk
	Flow/Hydrology	At Risk
	Water Quality	At Risk
	Habitat Access	Adequate

Spatial Scale	General Indicator	General Indicator Condition	Specific Indicator	Specific Indicator Condition
Reach Characteristics	Water Quality and Quantity	At Risk	Water Temperature	Unacceptable
			Turbidity	Adequate
			Chemical Contamination/Nutrients	At Risk
	Habitat Access	Adequate	Main Channel Physical Barriers (Natural/Human)	Adequate
	Habitat Quality	At Risk	Channel Substrate	Adequate
			Fine Sediment	Adequate
			Large Wood	Unacceptable
			Pools	At Risk
			Off-channel Habitat	Unacceptable
	Channel Condition and Dynamics	Unacceptable	Floodplain Connectivity	Unacceptable
			Bank Stability/Channel Migration	Unacceptable
			Vertical Channel Stability	At Risk
	Riparian/Upland Vegetation	Unacceptable	Vegetation Condition (Structure)	At Risk
			Vegetation Condition (Disturbance)	Unacceptable
			Vegetation Condition (Canopy Cover)	Unacceptable

* Existing conditions at the reach scale are based on criteria defined in the REI table (Appendix A). Existing conditions at the subreach scale may be substantially different.

DISCUSSION

Based on the analysis conducted by Reclamation for the reach and input from local scientists, the following prioritized habitat action classes, adapted from Roni (Roni et al. 2002 and Roni 2005), are recommended. These recommendations and appropriate actions are further discussed in the **Subreach Profiles** section of this report:

1. **Protect and maintain current habitat**: this habitat action class includes protecting intact tracts of quality habitats throughout the reach. The quality aquatic and terrestrial habitats are fragmented and protection of these fragmented habitats would maintain current physical and ecological processes. Some examples of quality habitats include tracts of intact riparian vegetation, cold water sources, off-channel habitats, and beaver colony areas.

2. **Reconnect isolated habitat**: this habitat action class includes reconnecting both aquatic and terrestrial fragmented habitats throughout the reach. Some examples of actions to reconnect isolated habitats include connecting fragmented tracts of riparian vegetation with riparian plantings and reconnecting off-channel habitats (i.e., side channels).

3. **Reconnect processes**: this habitat action class includes improving the physical and ecological processes that create and maintain habitats. Some examples of actions to improve processes include strategic placement of large wood key members that contribute to side channel development and create channel complexity; removal or modification of anthropogenic features inhibiting lateral channel migration and floodplain connectivity; beaver re-introduction to improve groundwater recharge by storing surface water on the floodplain and creating complex off-channel habitat; and riparian rehabilitation to provide channel/floodplain roughness and increase biotic energy transfer (i.e., food web improvements).

4. **Reconnect isolated habitat units**: this habitat action class includes increasing low velocity resting areas, improving channel complexity, increasing fish cover, and improving habitat unit connectivity. Some examples of actions include placing large wood or boulders to provide roughness elements in high energy channel sections; placing large wood along the margins of the channel and on the floodplain; and placing large wood in low energy off-channel areas (i.e., side channels and alcoves) to provide habitat complexity, increase biomass, and improve fish cover.

The ongoing anthropogenic activities that limit geomorphic potential are as follows:

1) Floodplain development for agriculture and infrastructure that limit physical and ecological processes

2) Railroad grade and road embankments that disconnect historical channel paths and floodplain processes

3) Bank protection that restricts lateral channel migration, resulting in localized bed scour and potentially channel incision

4) The lack of large wood, both instream and on the floodplain, which contributes to side channel creation and provides channel complexity

SUBREACH PROFILES

In this section, the anthropogenic features and existing conditions of the inner zone and adjoining outer zones are summarized. Additionally, strategies for rehabilitation and/or protection are suggested to improve reach-based ecosystem indicators.

The habitat action classes are adapted from Roni (Roni et al. 2002 and Roni 2005) and provide a hierarchical structure for implementing potential actions. The potential actions will require additional evaluation to determine the risk and liability to property owners, and the risk and benefits to resources and species.

Each potential action is relatively ranked as (1) “Maintain” for protection only, (2) “Maintain/High” for protection and enhancement, and (3) “High,” ”Moderate,” or ”Low” for potential actions based on their importance in achieving a reach-scale rehabilitation response. The overall strategy is structured around process-based principles that are applied at the reach scale (Beechie et. al 2010; Roni et. al 2005). Process-based principles target the systematic causes of ecosystem change and then (or concurrently) the symptomatic changes. The potential actions and the relative rankings are based solely on physical and ecological parameters. Socioeconomic elements such as landowner participation, increased risk to communities, and infrastructure and physical feasibility of implementation are not considered at this stage. These socioeconomic elements will need to be addressed as projects are selected and developed. Although the ultimate goal is full “restoration” of ecosystem processes throughout the reach, socioeconomic constraints may only allow partial “rehabilitation,” thereby improving selected or partial ecosystem processes.

Beginning at the upstream boundary of the reach and working downstream, the inner zone was analyzed by channel segments to understand local trends in sediment movement through the reach. Channel segments were interpreted to have one of the following trends: transport, transition, or deposition. These trends can be the result of geologic or anthropogenic controls and how the river interacts with its floodplain. The inner zone was divided into subreaches based on the interpreted trends in sediment movement and channel dynamics.

Outer zones were divided into subreaches based on lateral and longitudinal geologic controls (i.e., bedrock, alluvial fans, higher terraces, etc.). Some subreaches were further subdivided into parcels (or subunits) and are addressed as subreach complexes because of compounding anthropogenic impacts. Potential actions are discussed for each subreach or parcel, and the order in which actions should be implemented is sequenced to achieve a cumulative benefit.

Large wood is recommended in many of the potential actions and these actions will need further analysis during an alternatives evaluation to determine the appropriate type of treatment (i.e., wood, rock, bioengineering, etc.). The general term “large wood” is used to denote wood with a minimum diameter of 20 inches and a length of about 30 feet or more. In some instances, medium wood with a minimum diameter of 12 inches and a length of about 30 feet or more could be used. These large wood size classes are primarily based on general habitat evaluation protocols for the forests east of the Cascades (USFS 2006).

Channel Segment RM 67.55 – 66.68

Characteristics

Between RM 67.55 and 66.68, the channel is transitioning from a confined reach into a moderately confined reach where flows begin to access the floodplain, thereby dissipating stream power (Figure 8). The upstream valley constriction is near RM 67.65 where the floodplain is confined between the Bridge Creek alluvial fan and a higher terrace. The downstream valley constriction is near RM 66.68 where the floodplain becomes confined between the Davis Creek alluvial fan and bedrock. The average channel slope is about 0.5 percent with an average bankfull width of about 20 feet. The predominant channel units are runs and riffles with gravel-to-cobble substrate.

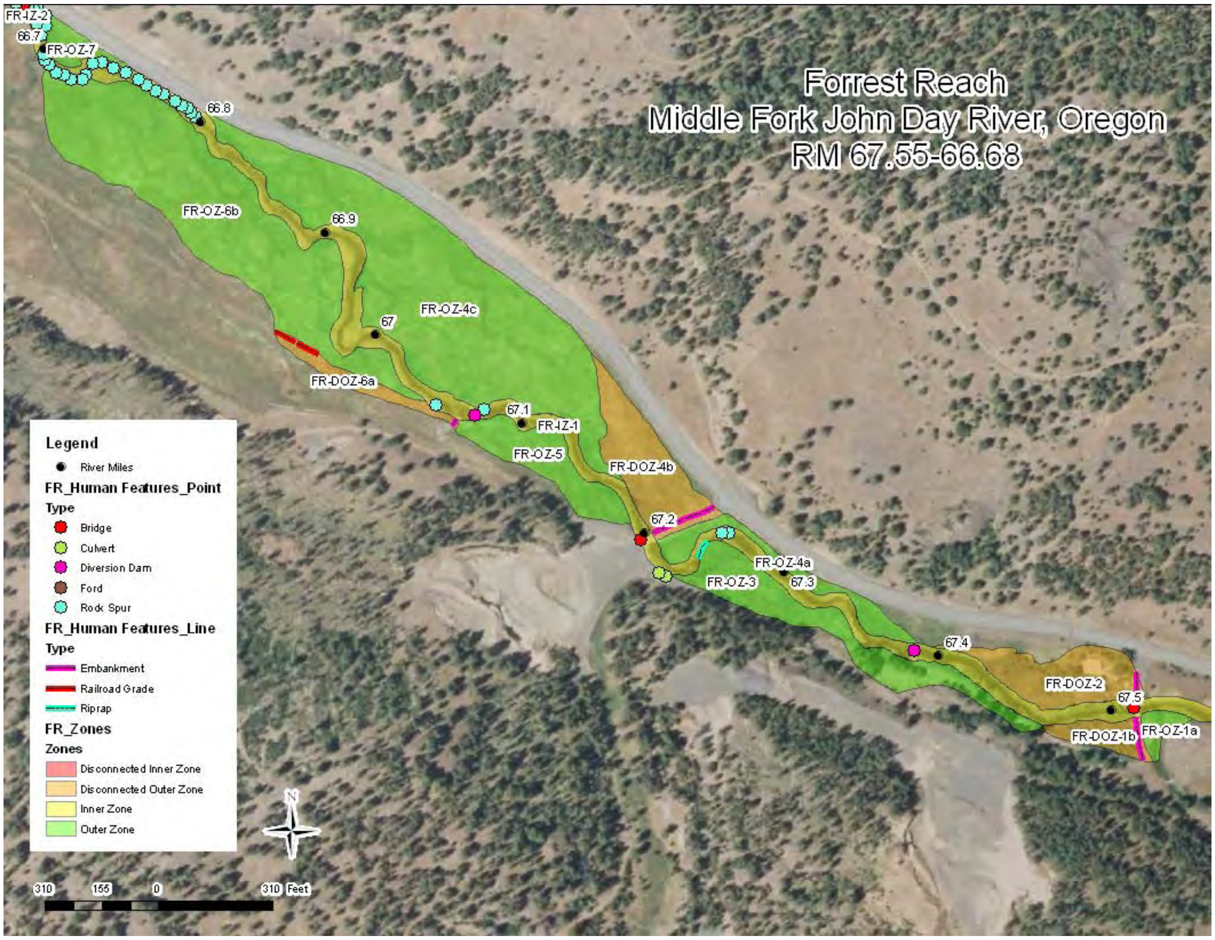

Figure 8. Aerial photograph showing the locations of subreaches and existing natural and anthropogenic features between RM 67.55 and 66.68 and anthropogenic features (map scale 1:3,600).

Anthropogenic features that negatively impact geomorphic potential of this channel segment include the following:

1. Rock spurs, riprap, and bridge abutments that artificially restrict lateral channel migration along subreach FR-IZ-1.

2. Embankments that disconnect about 3.6 acres of floodplain in subreach FR-DOZ-2 and in subreach complexes FR-OZ-1 (e.g., FR-DOZ-1b), FR-OZ-4 (e.g., FR-DOZ-4b), and FR-OZ-6 (e.g., FR-DOZ-6a) (Table 5).

The most notable impacts to physical and ecological processes in this area include (1) the reduction in floodplain connectivity due to bridge abutments (Figure 9), (2) streambank stability and reduction in lateral channel migration due to bank protection (Figure 10), (3) streambank instability along sections that do not have bank protection or appropriate riparian vegetation, and (4) lack of large instream wood and woody riparian buffer zone to provide streambank stability, fish cover, and shading

Table 5. Summary of subreaches between RM 67.55 and 66.68

Parcel	River Mile (RM)	Acreage	Anthropogenic Features
FR-IZ-1 SUBREACH			
FR-IZ-1 (inner zone)	RM 67.55 – 66.68	4.17 acres	Bridge (2) Diversion (2) Rock Spur (31) Riprap (~57 feet)
FR-OZ-1 SUBREACH COMPLEX			
FR-OZ-1a (outer zone)	RM 67.53 – 67.51 (river left)	0.20 acres	None
FR-DOZ-1b (disconnected outer zone)	RM 67.51 – 67.46 (river left)	0.44 acres	Embankment (~120 feet)
FR-DOZ-2 SUBREACH			
FR-DOZ-2 (disconnected outer zone)	RM 67.51 – 67.40 (river right)	1.29 acres	Embankment (~70 feet)
FR-OZ-3 SUBREACH			
FR-OZ-3 (outer zone)	RM 67.45 – 67.21 (river left)	1.77 acres	None
FR-OZ-4 SUBREACH COMPLEX			
FR-OZ-4a (outer zone)	RM 67.39 – 67.20 (river right)	0.71 acres	None
FR-DOZ-4b (disconnected outer zone)	RM 67.20 – 67.10 (river right)	1.49 acres	Embankment (~183 feet)
FR-OZ-4c (outer zone)	RM 67.16 – 66.80 (river right)	6.93 acres	None
FR-OZ-5 SUBREACH			
FR-OZ-5 (outer zone)	RM 67.20 – 67.06 (river left)	1.11 acres	None
FR-OZ-6 SUBREACH COMPLEX			
FR-DOZ-6a (disconnected outer zone)	RM 67.06 – 66.90 (river left)	0.41 acres	Embankment (~22 feet) Railroad Grade (~128 feet)
FR-OZ-6b (outer zone)	RM 67.05 – 66.71 (river left)	5.64 acres	None
FR-OZ-7 SUBREACH			
FR-OZ-7 (outer zone)	RM 66.73 – 66.69 (river right)	0.33 acres	None

Figure 9. View is to the northwest looking downstream at bridge crossing that restricts lateral channel migration. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Figure 10. View is to the northwest looking downstream at a series of rock spurs placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Rehabilitation Strategy

The objectives for implementing the proposed actions between RM 67.55 and 66.68 are as follows:

1. Protecting the fragmented tracts of riparian vegetation and reconnecting these tracts by rehabilitating the cleared areas between them. Explore burying cottonwood cuttings (or similar woody vegetation) that rely on ground-disturbing flows for regeneration along gravel bars and side channels. This would provide a long-term cumulative benefit to both the physical and ecological processes.

2. Reconnecting floodplain processes by removing or modifying riprap, increasing bridge spans, and modifying rock spurs to allow lateral channel migration and side channel creation. Large wood could be strategically placed at the head of overflow channels to contribute to the creation of side channels, along meanders to force pool development, and along channel margins for bank stability and fish cover. These large wood placements should incorporate planting appropriate vegetation reliant on ground-disturbing flows for colonization (i.e., cottonwoods). Explore the possible utilization of existing boulders in rock spurs as key members, or anchors, for large wood placements. Appropriate vegetation could be planted where ground-disturbing flows have formed point-bars and ephemeral side channels (i.e., cottonwoods). In the long term, this strategy could improve beaver colonization, resulting in complex off-channel habitat, increased groundwater recharge, and riparian vegetation complexity.

3. Connecting habitat units using large wood to stabilize streambanks in conjunction with re-establishing the appropriate vegetation, increasing channel boundary roughness, and improving habitat complexity. Large wood could be strategically placed to increase fish cover, channel shading, and biomass along side channels and alcoves.

Only the potential actions that were identified through field observations are described. Many other potential actions could be implemented that are identified during an alternatives evaluation.

Channel Segment RM 66.68 – 66.45

Characteristics

Between RM 66.68 and 66.45, the channel could be transitioning or has been locked in a mode of stasis due to channel confinement and restricted lateral channel migration. The channel is confined between bedrock and Vinegar Creek alluvial fan on river right and the Davis Creek alluvial fan on river left. Lateral channel migration is restricted by 36 rock spurs that provide bank protection (Figure 11). The average channel slope is about 0.5 percent with an average bankfull width of about 20 feet. The predominant channel units are runs and riffles with gravel-to-cobble substrate.

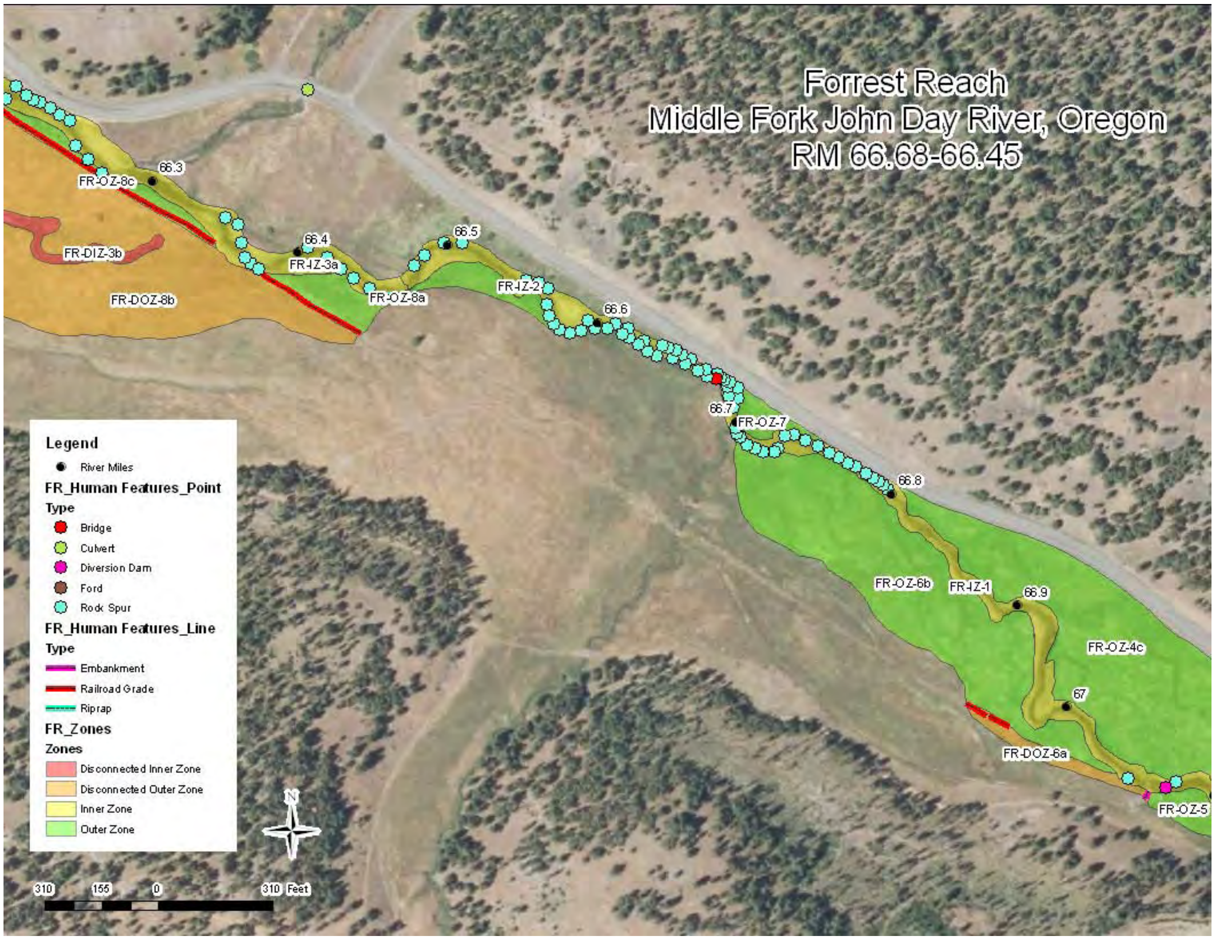

Figure 11. Location map of subreaches between RM 66.68 and 66.45 and anthropogenic features (scale 1:3,600).

Anthropogenic features that negatively impact geomorphic potential of this channel segment include the following:

1. Rock spurs and riprap that artificially restrict lateral channel migration and bridge abutments that disconnect floodplain processes along subreach FR-IZ-2 (Table 6).

Table 6. Summary of subreaches between RM 66.68 and 66.45.

Parcel	River Mile	Acreage	Anthropogenic Features
FR-IZ-2 SUBREACH			
FR-IZ-2 (inner zone)	RM 66.68 – 66.45	1.13 acres	Rock Spur (36) Bridge (1)

The most notable impacts to physical and ecological processes in this area include (1) stream bank stability and reduction in lateral channel migration due to bank protection (Figure 12), (2) lack of a woody riparian buffer zone to provide stream bank stability and shading, and (3) lack of instream large wood.

Figure 12. View is to the northwest looking downstream at a series of rock spurs. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Rehabilitation Strategy

The objectives for implementing the proposed actions between RM 66.68 and 66.45 are as follows:

1. Reconnecting floodplain processes by removing or modifying riprap and rock spurs to allow lateral channel migration and side channel creation. Explore the possible utilization of boulders in existing rock spurs as key members for large wood placements. Large wood placements should incorporate planting appropriate vegetation reliant on ground-disturbing flows for colonization (i.e., cottonwoods). In the long term, this strategy could improve beaver colonization, resulting in complex off-channel habitat, improved groundwater recharge, and increased riparian vegetation complexity.

2. Connecting habitat units using wood to stabilize streambanks in conjunction with re-establishing appropriate riparian vegetation, increasing channel boundary roughness, and improving habitat complexity. Large wood could be strategically placed to increase fish cover, channel shading, and biomass along side channels and alcoves.

Only the potential actions that were identified through field observations are described. Many other potential actions could be implemented that are identified during an alternatives evaluation.

Channel Segment RM 66.45 – 65.55

Characteristics

Between RM 66.45 and 65.55, the channel could be transitioning or has been locked in a mode of stasis due to a railroad embankment that artificially confines the floodplain (Figure 13). The upstream geomorphic valley constriction is near RM 66.45 where the floodplain is confined by the Davis Creek alluvial fan, opposing bedrock, and the upper extent of Vinegar Creek alluvial fan. The downstream geomorphic valley constriction near RM 66.55 is where the floodplain is confined by the Vincent Creek alluvial fan and bedrock. The average channel slope is about 0.6 percent with an average bankfull width of about 30 feet. The predominant channel units are riffles and runs with gravel-to-cobble substrate.

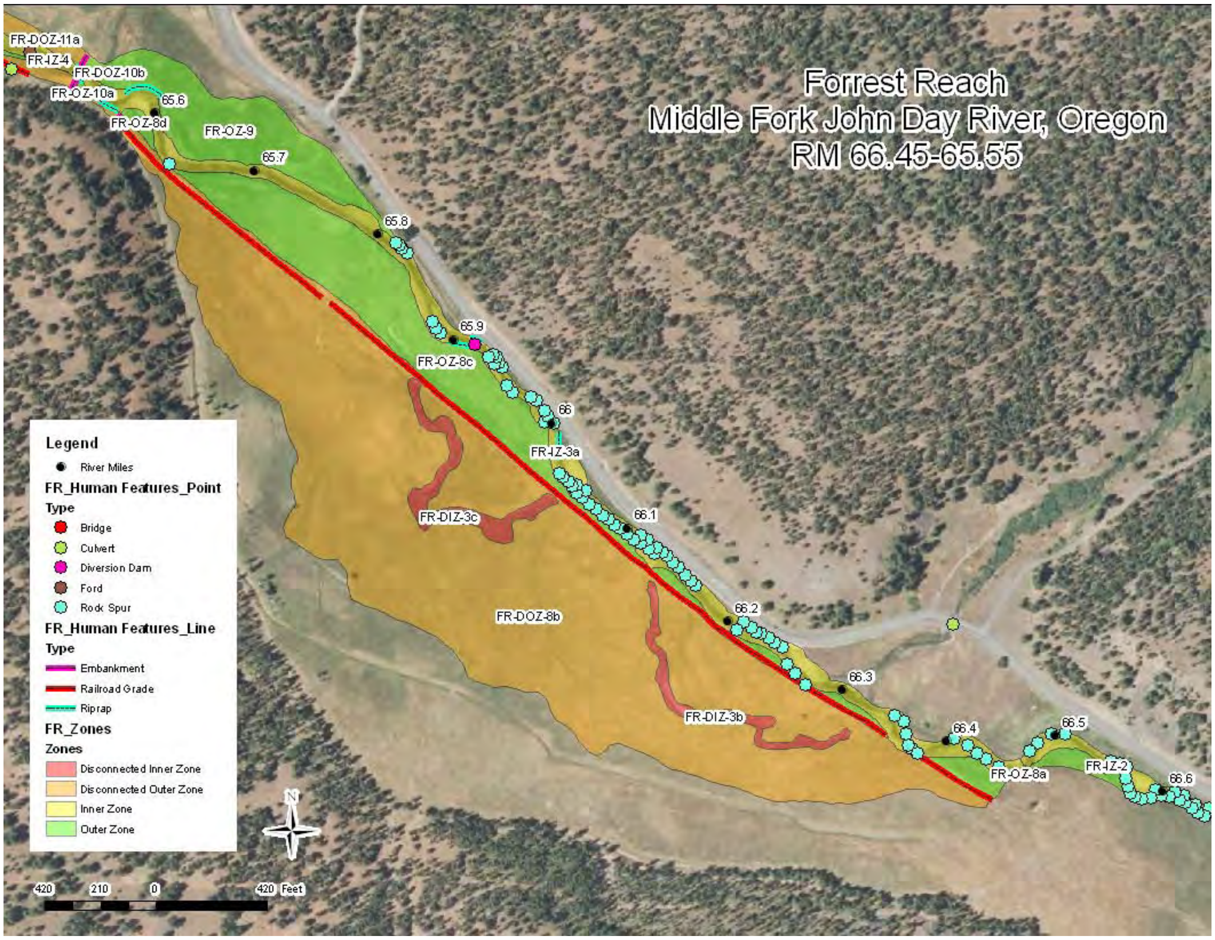

Figure 13. Aerial photograph showing the locations of subreaches, and existing natural and anthropogenic features between RM 66.45 and 65.55 and anthropogenic features (scale 1:5,000).

Anthropogenic features that negatively impact geomorphic potential of this channel segment include the following:

1. Railroad grade disconnecting about 2.5 acres of historic channels in subreach complex FR-IZ-3 (e.g., FR-DIZ-3a and FR-DIZ-3b).

2. River channelization between about RM 66.35 and 65.90.

3. Rock spurs and riprap that artificially restrict lateral channel migration along subreach complex FR-IZ-3.

4. Embankments and railroad grade that disconnect about 43.4 acres of floodplain in subreach complex FR-OZ-8 (e.g., FR-DOZ-8b) (Table 7).

Table 7. Summary of subreaches between RM 66.45 and 65.55.

Parcel	River Mile	Acreage	Anthropogenic Features
FR-IZ-3 SUBREACH COMPLEX			
FR-IZ-3a (inner zone)	RM 66.45 – 65.55	6.10 acres	Rock Spur (~73) Riprap (~561 feet)
FR-DIZ-3b (disconnected inner zone)	RM 66.31 – 66.11 (river left)	1.04 acres	Fill (Upstream and Downstream Connections)
FR-DIZ-3c (disconnected inner zone)	RM 66.05 – 65.90 (river left)	1.43 acres	Fill (Upstream and Downstream Connections)
FR-OZ-8 SUBREACH COMPLEX			
FR-OZ-8a (outer zone)	RM 66.58 – 66.39 (river left)	1.12 acres	Riprap (~96 feet)
FR-DOZ-8b (disconnected outer zone)	RM 66.44 – 65.51 (river left)	43.44 acres	Railroad Grade (~4,002 feet) Embankment (~34 feet)
FR-OZ-8c (outer zone)	RM 66.34 – 65.64 (river left)	9.17 acres	None
FR-OZ-8d (outer zone)	RM 65.61 – 65.59 (river left)	0.19 acres	None
FR-OZ-9 SUBREACH			
FR-OZ-9 (outer zone)	RM 65.81 – 65.51 (river right)	4.94 acres	None

The most notable impacts to physical and ecological processes in this area include (1) stream channelization disconnecting historic channel paths, (2) reduction in floodplain connectivity due to the railroad grade (Figure 14), (3) restricted lateral channel migration due to bank protection (Figure 15), (4) stream bank instability along sections that do not have bank protection and lack woody riparian vegetation, (5) lack of a woody riparian buffer zone to provide shading and fish cover, and (6) lack of instream large wood.

Figure 14. View is to the northwest looking downstream along the railroad grade where it bisects historic channel path in subreach FR-DIZ-3c. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Figure 15. View is to the northwest looking downstream at rock spurs placed along river left and boulders placed along river right along road embankment. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Rehabilitation Strategy

The objectives for implementing the proposed actions between RM 66.45 and 65.55 are as follows:

1. Protecting the fragmented tracts of riparian vegetation and reconnecting these tracts by rehabilitating the cleared areas between them. Explore burying cottonwood cuttings (or similar woody vegetation) that are reliant on ground-disturbing flows for regeneration along gravel bars and side channels. This would provide a long-term cumulative benefit to both the physical and ecological processes.

2. Reconnecting floodplain processes by removing or strategically breaching the railroad grade so the river can access its historic channel path. This action should be further evaluated during the alternatives evaluation processes. Also consider exploring removing or modifying riprap and rock spurs to allow lateral channel migration and side channel creation. Large wood could be strategically placed at the head of overflow channels that contribute to side channel formation. These large wood placements should incorporate planting appropriate vegetation reliant on ground-disturbing flows for colonization (i.e., cottonwoods). Explore the possible utilization of boulders in existing rock spurs as key members for large wood placements. Appropriate vegetation (i.e., cottonwoods) could be planted where ground-disturbing flows have formed point-bars and ephemeral side channels. In the long term, this strategy could improve beaver colonization, resulting in complex off-channel habitat, increased groundwater recharge, and improved riparian vegetation complexity.

3. Connecting habitat units using wood to stabilize banks in conjunction with re-establishing appropriate vegetation, increasing channel boundary roughness, and increasing habitat complexity. Large wood could be strategically placed to improve fish cover, shading, and biomass along and within side channels and alcoves.

Only the potential actions that were identified through field observations are described. Many other potential actions could be implemented that are identified during an alternatives evaluation.

Channel Segment RM 65.55 – 63.48

Characteristics

Between RM 65.55 and 63.48, the channel is transitioning as it flows from a confined valley segment into an unconfined valley segment and flows can access the floodplain, thereby dissipating stream power (Figure 16). The upstream valley constriction is near RM 65.55 where the floodplain is confined between the Vincent Creek alluvial fan and bedrock. The average channel slope is about 0.4 percent with an average bankfull width of about 35 feet. The predominant channel units are runs, pools, and riffles with gravel-to-cobble substrate.

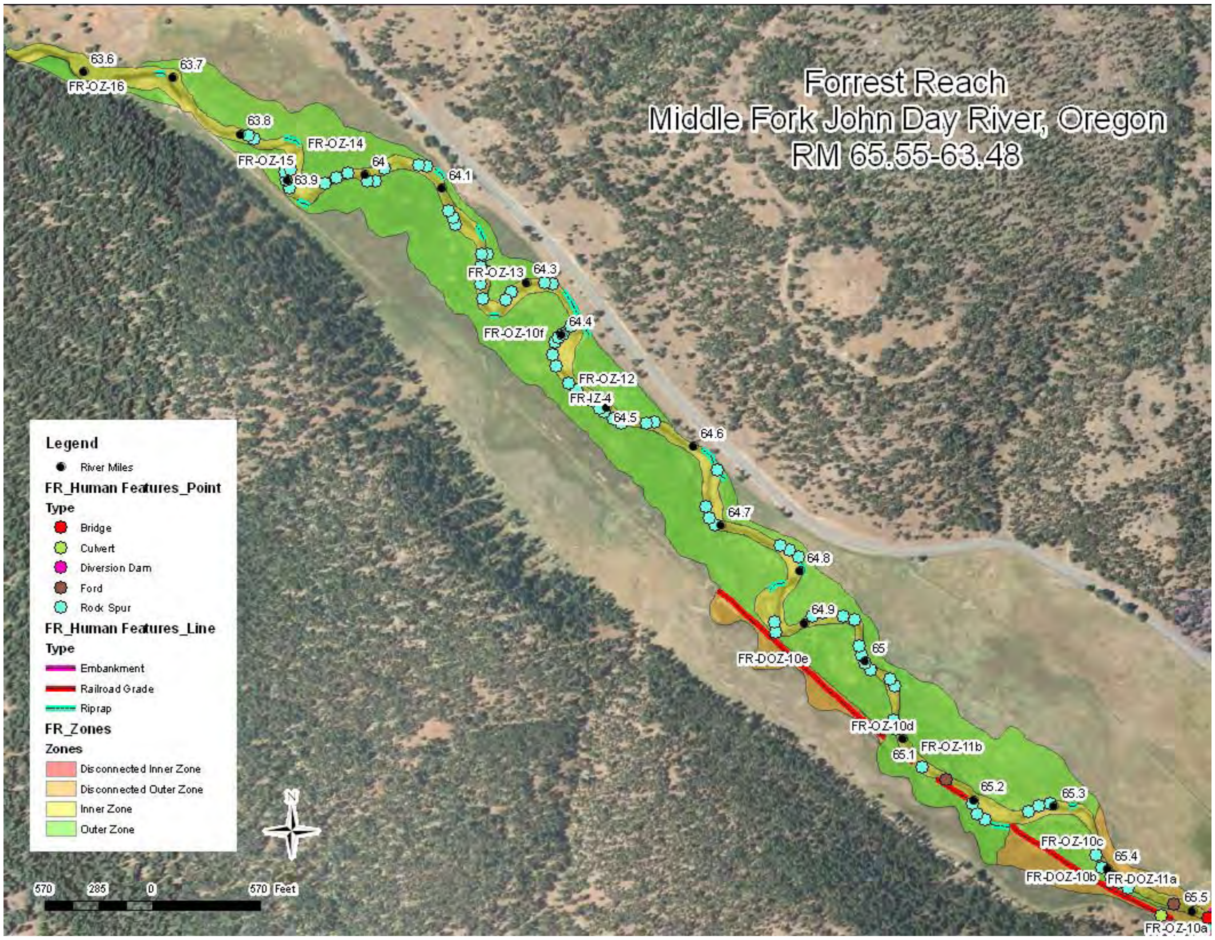

Figure 16. Aerial photograph showing the locations of subreaches, and existing natural and anthropogenic features between RM 65.55 and 63.48 and anthropogenic features (scale 1:7,000).

Anthropogenic features that negatively impact geomorphic potential of this channel segment include the following:

1. Rock spurs and riprap that artificially restrict lateral channel migration along subreach FR-IZ-4.

2. Embankments and railroad grade that disconnect about 11.0 acres of floodplain in subreach complex FR-OZ-10 (e.g., FR-DOZ-10b and FR-DOZ-10e) (Table 8).

Table 8. Summary of subreaches between RM 65.55 and 63.48.

Parcel	River Mile	Acreage	Anthropogenic Features
	FR-IZ-4 SUBREACH		
FR-IZ-4 (inner zone)	RM 65.55 – 63.48	15.48 acres	Riprap (~1,190 feet) Rock Spur (75) Ford Crossing (1) Bridge (1)
	FR-OZ-10 SUBREACH COMPLEX		
FR-OZ-10a (outer zone)	RM 65.55 – 65.51 (river left)	0.04 acres	None
FR-DOZ-10b (disconnected outer zone)	RM 65.51 – 65.24 (river left)	2.62 acres	Railroad Grade (~982 feet) Embankment (~41 feet)
FR-OZ-10c (outer zone)	RM 65.49 – 65.24 (river left)	2.05 acres	None
FR-OZ-10d (outer zone)	RM 65.24 – 64.89 (river left)	5.94 acres	Railroad Grade (~307 feet)
FR-DOZ-10e (disconnected outer zone)	RM 65.10 – 64.75 (river left)	2.43 acres	Railroad Grade (~1,183 feet)
FR-OZ-10f (outer zone)	RM 64.89 – 63.91 (river left)	19.32 acres	Rock Spur (1)
	FR-OZ-11 SUBREACH COMPLEX		
FR-DOZ-11a (disconnected outer zone)	RM 65.51 – 65.32 (river right)	1.35 acres	Embankment (~49 feet)
FR-OZ-11b (outer zone)	RM 65.32 – 64.91 (river right)	11.01 acres	Riprap (~34 feet)
	FR-OZ-12 SUBREACH		
FR-OZ-12 (outer zone)	RM 64.58 – 64.39 (river right)	2.24 acres	Riprap (~40 feet)
	FR-OZ-13 SUBREACH		
FR-OZ-13 (outer zone)	RM 64.31 – 64.10 (river right)	1.59 acres	None
	FR-OZ-14 SUBREACH		
FR-OZ-14 (outer zone)	RM 64.07 – 63.65 (river right)	6.39 acres	None
	FR-OZ-15 SUBREACH		
FR-OZ-15 (outer zone)	RM 63.91 – 63.79 (river left)	0.73 acres	None
	FR-OZ-16 SUBREACH		
FR-OZ-16 (outer zone)	RM 63.71 – 63.51 (river left)	0.87 acres	None

The most notable impacts to physical and ecological processes in this area include (1) reduction in floodplain connectivity, (2) restricted lateral channel migration due to bank protection (Figure 17), (3) stream bank instability along sections that lack appropriate woody riparian vegetation, (4) lack of woody riparian buffer zone to provide fish cover and shading, and (5) lack of instream large wood.

Figure 17. View is to the west looking downstream at riprap placed along river left. – Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Rehabilitation Strategy

The objectives for implementing the proposed actions between RM 65.55 and 63.48 are as follows:

1. Protecting the fragmented tracts of riparian vegetation and reconnecting these tracts by rehabilitating the cleared areas between them. Explore burying cottonwood cuttings (or similar woody vegetation) that rely on ground disturbing flows for regeneration along gravel bars and side channels. This would provide a long-term cumulative benefit to both the physical and ecological processes.

2. Reconnecting floodplain processes by removing or modifying riprap and rock spurs to allow lateral channel migration and side channel creation. Large wood could be strategically placed on bars and at the head of overflow channels that contribute to side channel formation. These large wood placements should incorporate planting

appropriate vegetation reliant on ground-disturbing flows for colonization (i.e., cottonwoods). Explore the possible utilization of boulders in existing rock spurs as key members for large wood placements. Some rock spurs already function as key members that contribute to side channel formation. Explore developing these locations into large wood complexes (i.e., log jams). Appropriate vegetation (i.e., cottonwoods) could be planted where ground-disturbing flows have formed point-bars and ephemeral side channels. In the long term, this strategy could improve beaver colonization resulting in complex off-channel habitat, increased groundwater recharge, and improved riparian vegetation complexity.

3. Connecting habitat units using wood to stabilize banks (in conjunction with re-establishing appropriate vegetation), increasing channel boundary roughness, and improving habitat complexity. Strategically place large wood to improve fish cover, shading, and biomass along and within side channels and alcoves.

Only the potential actions that were identified through field observations are described. Many other potential actions could be implemented that are identified during an alternatives evaluation.

SUMMARY AND CONCLUSIONS

The Forrest Conservation Area reach, located between RM 67.55 and 63.48 on the Middle Fork John Day River, is within 4th and 5th field HUC watersheds. Between RM 67.55 and 65.51, it is a 4th field HUC watershed (#170702030201) and between RM 65.51 and 63.51, it is a 5th field HUC watershed (#170702030202). Valley confinement for the Forrest reach is characterized as follows:

- RM 67.55 to 66.68 moderately confined
- RM 66.68 to 66.45 confined
- RM 66.45 to 65.55 unconfined (artificially confined by railroad grade)
- RM 65.55 to 63.48 unconfined

In its pre-disturbance condition, the Middle Fork John Day River likely maintained dynamic equilibrium by actively migrating laterally across its floodplain within the unconfined to moderately confined valley segments. In addition, it probably supported a robust beaver colony that may have maintained a wet-meadow type community that created complex off-channel habitat. The geomorphic potential, which is a measure of the stream's capability to dynamically adjust to changes in the hydrologic, geomorphic, and biotic regimes, was interpreted to be moderate from RM 67.55 to 66.68; low from RM 66.68 to 66.45; and high from RM 66.45 to 63.48. Geomorphic potential for the reach is interpreted to be in a degraded condition primarily due to floodplain development, reduced floodplain connectivity, restricted lateral channel migration, lack of instream large wood, and reduced large wood recruitment potential. The primary anthropogenic impacts that limit geomorphic potential are (1) floodplain development for agricultural uses limits vegetation condition; (2) a railroad grade disconnects historic channel paths and artificially confines valley segment; (3) bank protection restricts lateral channel migration; and (4) lack of instream large wood reduces channel complexity and roughness.

Field surveys and evaluations were conducted in the reach during the 2007 and 2008 field seasons to determine the condition and interaction of the hydrologic, geomorphic, and biotic regimes. The 2007/2008 river condition provides an environmental baseline for comparisons with future assessments to establish a time series and integration with monitoring activities. The general and specific indicators were organized in a REI table for analysis (Appendix A). Based on available data, the general indicators at the watershed scale interpreted to be in an **At Risk Condition** were effective drainage network and watershed road density; disturbance regime (natural/human); flow/hydrology; and water quality. The habitat access general indicator was interpreted to be in an **Adequate Condition**.

General indicators at the reach scale interpreted to be in an **Unacceptable Condition** included channel condition and dynamics and riparian/upland vegetation. **At Risk Condition** general indicators included water quality and quantity and habitat quality. The habitat access general indicator was in an **Adequate Condition**. The condition rankings of the indicators identify potential systematic and symptomatic deficiencies to physical and ecological processes at the watershed and reach scales. These condition rankings are used to guide development of potential actions to improve the processes that benefit the species of concern. In addition, the data collected for each indicator documents the baseline environmental conditions which can also be used to monitor future actions that are implemented and the system's response through time (i.e., intervention analysis and effectiveness monitoring).

The Forrest Conservation Area reach scale indicators were interpreted to be in the following conditions:

1. **Unacceptable Condition**

    a. Water temperature due to past clearing of the riparian buffer zone, reduced instream flows, and reduced floodplain connectivity caused by agricultural development and infrastructure.

    b. Large wood due to the lack of instream wood and reduced recruitment potential because of artificial channel stability and floodplain development.

    c. Off-channel habitat because of reduced floodplain connectivity restricted lateral channel migration and loss of beaver activity that created complex aquatic habitats.

    d. Floodplain connectivity due to railroad and road grades, channelization, and bank protection.

    e. Bank stability/channel migration due to artificial channel stability caused by bank protection restricting lateral channel migration and unstable channel sections that erode laterally into banks where riparian vegetation has been removed for floodplain development.

    f. Vegetation condition (disturbance) due to past floodplain clearing for agriculture and the removal of beaver activity within the floodplain that created and maintained complex vegetation structure.

    g. Vegetation condition (canopy cover) due to clearing and grazing of riparian vegetation along the streambanks that provided shading and moderated the local climate (i.e., air temperature) along the river.

2. **At Risk Condition**

    a. Chemical contamination/nutrients due to cattle grazing along streambanks, road locations within the floodplain, and past/current mining activities in several tributaries.

    b. Pools due to the lack of fish cover typically provided by appropriate riparian vegetation and large wood.

    c. Vertical channel stability due to channelization, bank protection that may result in bed scour, and instream hydrologic impacts from loss of floodplain connectivity.

    d. Vegetation condition (structure) due to past clearing of the riparian buffer zone for agricultural development and past removal of beaver activities that helped create and maintain complex riparian vegetation structure.

3. **Adequate Condition**

    a. Turbidity based on Oregon Department of Ecology water quality determinations.

    b. Main channel physical barriers because there are no fish passage barriers during all biologically significant flows.

    c. Channel substrate based on Wolman pebble counts and volumetric samples conducted in several locations along the river throughout the reach.

    d. Fine sediment based on visual estimates of the percentage of surface fines and volumetric samples.

Based on the indicators analysis for the reach, the following prioritized habitat action classes are recommended:

1. **Protect and reconnect isolated habitat**: this habitat action class includes reconnecting both aquatic and terrestrial habitats throughout the reach. Re-establish and protect a continuous riparian buffer zone (maximize width where possible, otherwise a minimum width of 30 meters) along the alluvial area of the reach and along all secondary waterways (minimum width of 10 meters). These actions address most of the reach scale deficiencies and will help provide long-term resiliency to all species reliant on riverine habitat and processes. Some benefits include (1) aquatic re-colonization of disconnected habitat, (2) transfer of energy (i.e., food web), (3) expanding macroinvertebrate habitat, (4) improving water quality, (5) increasing

channel complexity, and (6) increasing habitat connectivity of terrestrial dependent species (i.e., amphibian, avian, reptilian, and mammalian species).

2. **Reconnect processes**: this habitat action class includes improving fluvial and ecological interactions between the channel and its floodplain. Remove or modify anthropogenic features (i.e., railroad grade) that presently disconnect floodplain processes. Reconnection of the floodplain processes improves groundwater recharge, expands the hyporheic zone, and increases off-channel habitat. Beaver re-introduction in suitable floodplain-type side channels would further increase these processes and habitat quantity and improve diversification of aquatic and vegetation species. These actions include (1) modifying or removing railroad grade and bank protection, where appropriate, that disconnect the floodplain and restrict lateral channel migration and may cause vertical channel migration resulting in the possible disconnection of the floodplain; (2) install large wood (i.e., instream and floodplain wood loading) that contribute to the creation and maintenance of side channels, provide fish cover, and increase biomass; and (3) re-introduction of beavers where appropriate to create complex off-channel habitat and riparian vegetation structure and to store water on the floodplain for additional groundwater recharge.

3. **Reconnect isolated habitat units**: this habitat action class includes the placing of large wood to provide habitat connectivity, fish cover, and increase biomass. Large wood placements could be considered along side channels and alcoves to provide additional channel complexity, fish cover, and biomass. Creation of habitat, such as alcoves and off-channel area, could be considered to provide rearing habitat and high-flow refugia.

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GLOSSARY

Some terms in this glossary appear in this reach assessment report.

TERM	DEFINITION
2D-hydraulic analysis	A two-dimensional computer model that simulates hydraulic variables, such as depth-averaged velocity, depth, and bed shear stress, both longitudinally and laterally across an input terrain. Model results are used to produce calculates the water surface profiles and innundation areas for discharges of interest
adaptive management	A management process that applies the concept of experimentation to design and implementation of natural resource plans and policies.
alluvial fan	A low, outspread, relatively flat to gently sloping mass of loose rock material, shaped like an open fan or a segment of a cone, deposited by a stream at the place where it issues from a narrow mountain valley upon a plain or broad valley, or where a tributary stream is near or at its junction with the main stream, or wherever a constriction in a valley abruptly ceases or the gradient of the stream suddenly decreases; it is steepest near the mouth of the valley where its apex points upstream, and it slopes gently and convexly outward with a gradually decreasing gradient (Neuendorf et al. 2005).
alluvium	A general term for clay, silt, sand, gravel, or similar unconsolidated detrital material, deposited during comparatively recent geologic time by a stream, as a sorted or semi-sorted sediment on the river bed and floodplain (Neuendorf et al. 2005).
anadromous (fish)	A fish, such as the Pacific salmon, that spawns and spends its early life in freshwater but moves into the ocean where it attains sexual maturity and spends most of its life span.
anthropogenic	Caused by human activities.
bedrock	A general term for the rock, usually solid, that underlies soil or other unconsolidated, superficial material (Neuendorf et al. 2005). The bedrock is generally resistant to fluvial erosion over a span of several decades, but may erode over longer time periods.
canopy cover (of a stream)	Vegetation projecting over a stream, including crown cover (generally more than 1 meter (3.3 feet) above the water surface) and overhang cover (less than 1 meter (3.3 feet) above the water).
cfs	Cubic feet per second; a measure of water flows
channel morphology	The physical dimension, shape, form, pattern, profile, and structure of a stream channel.
channel planform	Characteristics of the river channel that determine its two-dimensional pattern as viewed on the ground surface, aerial photograph, or map.

TERM	DEFINITION
channel stability	The ability of a stream, over time and under the present climatic conditions, to transport the sediment and flows produced by its watershed in such a manner that the stream maintains its dimension, pattern, and profile without either raising or lowering the level of the streambed.
channel units	Morphologically distinct areas within a channel segment that are on the order of one to many channel widths in length. Channel units are somewhat stage dependent and observers may yield inconsistent classifications. To minimize the inconsistencies, channel units are interpreted in the field based on the fluvial processes that created them during channel forming flows and mapped in the geographic information system (GIS) which provides geospatial reference.
channelization	Alteration of a natural channel typically by straightening and deepening the stream channel to permit the water to move faster, to reduce flooding, or to drain wetlands.
constructed features	Human-made features that are constructed in the river and/or floodplain areas (e.g., levees, bridges, riprap).
controls	A feature that is highly resistant to erosion by flowing water and limits the ability of a river or stream to migrate across a valley in either the lateral (horizontal) or vertical direction or both. Geologic controls are naturally occuring features such as bedrock outcrops, landslides, or alluvial fans that erode slowly over long periods of time. Human-constructed features such as highways, railroads, bridge abutments, or riprap may also act as controls and limit the ability of a river to migrate.
degradation	Wearing down of the land surface through the processes of erosion and/or weathering
depositional areas (stream)	Local zones within a stream where the energy of flowing water is reduced and sediment settles out, accumulating on the streambed.
diversity	Genetic and phenotypic (life history traits, behavior, and morphology) variation within a population.
ecosystem	A unit in ecology consisting of the environment with its living elements, plus the non-living factors, that exist in and affect it (Neuendorf et al. 2005).
floodplain	The surface or strip of relatively smooth land adjacent to a river channel constructed by the present river in its existing regimen and covered with water when the river overflows its banks. It is built on alluvium, carried by the river during floods and deposited in the sluggish water beyond the influence of the swiftest current. A river has one floodplain and may have one or more terraces representing abandoned floodplains (Neuendorf et al. 2005).

Term	Definition
fluvial process	Those processes related to the movement of flowing water that shape the surface of the earth through the erosion, transport, and deposition of sediment, soil particles, and organic debris.
general indicator	Interpretation of one or more specific indicators (i.e., water quality) that is used to define or refine potential environmental deficiencies caused by natural or anthropogenic impacts that negatively affect a life stage(s) of the species of concern (i.e., limiting factor). General indicators Pathways are typically analyzed at the reach, valley segment, watershed, and basin scales.
geomorphic potential	The streams capability to dynamically adjust longitudinally, vertically and laterally to changes in the hydrologic, geomorphic, and biotic regimes.
geomorphic reach	An area containing the active channel and its floodplain bounded by vertical and/or lateral geologic controls, such as alluvial fans or bedrock outcrops, and frequently separated from other reaches by abrupt changes in channel slope and valley confinement. Within a geomorphic reach, similar fluvial processes govern channel planform and geometry through driving variables of flow and sediment. A geomorphic reach is comprised of a relatively consistent floodplain type and degree of valley confinement. Geomorphic reaches may vary in length from 100 meters in small, headwater streams to several miles in larger systems (Frissell et al. 1986).
geomorphology	The study of the classification, description, nature, origin, and development of present landforms and their relationships to underlying structures, and of the history of geologic changes caused by the actions of flowing water.
GIS	Geographical information system. An organized collection of computer hardware, software, and geographic data designed to capture, store, update, manipulate, analyze, and display all forms of geographically referenced information.
habitat action	Proposed restoration or protection strategy to improve the potential for sustainable habitat upon which endangered species act (ESA) listed salmonids depend on. Examples of habitat actions include the removal or alteration of project features to restore floodplain connectivity to the channel, reconnection of historic side channels, placement of large woody debris, reforestation of the low surface, or implementation of management techniques.
habitat connectivity (stream)	Suitable stream conditions that allow fish and other aquatic organisms to access habitat areas needed to fulfill all life stages.
habitat units	A channel-wide segment of a stream which has a distinct set of characteristics. Habitat units and channel units are used interchangeably in the literature, however, habitat units are identified and measured during low-flows and sometimes include several channel units. For example, “pool habitat” is measured from the head of the pool scour to the crest of the pool tailout, which technically includes the following “channel units”, pool, run, and riffle.

TERM	DEFINITION
indicator	A variable used to forecast the value or change in the value of another variable; for example, using temperature, turbidity, and chemical contaminents or nutrients to measure water quality.
inner zone (IZ)	Area where ground-disturbing flows take place; characterized by the presence of primary (perennial) and secondary (ephemeral) side channels, a repetitious sequence of channel units, and relatively uniform physical attributes indicative of localized transport, transition, and deposition.
intevention analysis	Consists of computer models and methods based on samples collected at an impact site before and after an intervention, such as a habitat action, so that effects of the intervention may be determined.
large woody debris (LWD)	Large downed trees that are transported by the river during high flows and are often deposited on gravel bars or at the heads of side channels as flow velocity decreases. The trees can be downed through river erosion, wind, fire, or human-induced activities. Generally refers to the woody material in the river channel and floodplain whose smallest diameter is at least 12 inches and has a length greater than 35 feet in eastern Cascade streams.
limiting factor	Any factor in the environment that limits a population from achieving complete viability with respect to any Viable Salmonid Population (VSP) parameter.
overflow channel	A channel that is expressed by no or little vegetation through a vegetated area. There is no evidence for water at low stream discharges. The channel appears to have carried water recently during a flood event. The upstream and/or downstream ends of the overflow channel usually connect to the main channel.
outer zone (OZ)	Area that may become inundated at higher flows but does not experience a ground-disturbing flow; generally coincidental with the historic channel migration zone unless the channel has been modified or incised leading to the abandonment of the floodplain. (also knows as the floodprone zone)
parcel	A smaller unit within a subreach that has differing impacts on physical and/or ecological processes than an adjacent unit, and the need to sequence or prioritize potential rehabilitation actions within the context of the subreach and reach.
peak flow	Greatest stream discharge recorded over a specified period of time, usually a year, but often a season.
reach-based ecosystem indicators (REI)	Measure of qualitative and quantifiable of physical indicators variables that are referenced to watershed characteristics and reach characteristics.
Reclamation	U.S. Department of the Interior, Bureau of Reclamation

TERM	DEFINITION
response reach	A reach that is more responsive to change and often characterized by unconfined and moderately confined alluvial plains/channels that lack lateral geologic controls within close proximity to the channel which often define confined channels. A response reach can be further broken down to individual subreach units that comprise finer morphologically distinct areas providing geomorphic control and transitional habitat and biological potential.
riparian area	An area with distinctive soils and vegetation community/composition adjacent to a stream, wetland, or other body of water.
riprap	Large angular rocks that are placed along a river bank to prevent or slow erosion.
river mile (RM)	Miles from the mouth of a river or its confluence with the next downstream river.
side channel	A channel that is not part of the main channel, but appears to have water during low-flow conditions and has evidence for recent higher flow (e.g., may include unvegetated areas (bars) adjacent to the channel). At least the upstream end of the channel connects to, or nearly connects to, the main channel. The downstream end may connect to the main channel or to an overflow channel. May also be referred to as a secondary channel.
spawning and rearing habitat	Stream reaches and the associated watershed areas that provide all habitat components necessary for adult spawning and juvenile rearing for a local salmonid population. Spawning and rearing habitat generally supports multiple year classes of juveniles of resident and migratory fish, and may also support subadults and adults from local populations.
subbasin	A subbasin represents the drainage area upslope of any point along a channel network (Montgomery & Bolton 2003). Downstream boundaries of subbasins are typically defined in this assessment at the location of a confluence between a tributary and mainstem channel. An example would be the Middle Fork John Day River Subbasin.
subreach	Distinct areas are comprised of the floodplain and off-channel and active-channel areas. They are delineated by lateral and vertical controls with respect to position and elevation based on the presence/absence of inner or outer riparian zones.
terrace	A relatively stable, planar surface formed when the river abandons the floodplain that it had previously deposited. It often parallels the river channel, but is high enough above the channel that it rarely, if ever, is covered by water and sediment. The deposits underlying the terrace surface are alluvial, either channel or overbank deposits, or both. Because a terrace represents a former floodplain, it can be used to interpret the history of the river.
tributary	A stream feeding, joining, or flowing into a larger stream or lake (Neuendorf et al. 2005).

TERM	DEFINITION
valley segment	An area of river within a watershed sometimes referred to as a subwatershed that is comprised of smaller geomorphic reaches. Within a valley segment, multiple floodplain types exist and may range between wide, highly complex floodplains with frequently accessed side channels to narrow and minimally complex floodplains with no side channels. Typical scales of a valley segment are on the order of a few to tens of miles in longitudinal length.
vertical migration	Movement of a stream channel in a vertical direction; the filling and raising or the removal or erosion of streambed material that changes the elevation of the stream channel.
viable salmonid population	An independent population of Pacific salmon or steelhead trout that has a negligible risk of extinction over a 100-year time frame. Viability at the independent population scale is evaluated based on the parameters of abundance, productivity, spatial structure, and diversity (ICBTRT 2007).
watershed	The area of land from which rainfall (and/or snow melt) drains into a stream or other water body. Watersheds are also sometimes referred to as drainage basins. Ridges of higher ground form the boundaries between watersheds. At these boundaries, rain falling on one side flows toward the low point of one watershed, while rain falling on the other side of the boundary flows toward the low point of a different watershed.

APPENDICES

APPENDIX A

Reach-based Ecosystem Indicators Tables

Appendix A

Reach-based Ecosystem Indicators (REI) Version 1.1

This Reach-based Ecosystem Indicators (REI) table was compiled from literature reviews, data contained in the *Middle Fork and Upper John Day River Tributary Assessments* (Reclamation 2008), *Geomorphology and Hydraulic Modeling of the Forrest Conservation Area* (Reclamation 2010, in preparation), and from new data collected for the *Forrest Conservation Area Reach Assessment* and is intended for discussion purposes only. The ranges of criteria presented here are not absolute and should be adjusted to each unique subbasin as data become available. Evaluation and rating of each indicator was performed through an iterative process in a work group setting by the interdisciplinary multi-agency team. Edward W. Lyon, Jr. was principal author in compiling data for the REI table; and Mark Croghan, Brian Cochran, and Elaina Gordon are acknowledged for providing selected input pertaining to their individual disciplines.

General Regional Characteristics

At the regional spatial scale, characteristics evaluated included the ecoregion, drainage basin, valley segments, and channel segments that informed planners and evaluators on the regional setting where the reach assessment occurred. These regional characteristics are recommended by NOAA Fisheries Services and U.S. Fish and Wildlife Service (Skidmore et al. 2009).

Watershed Characteristics

At the watershed/subwatershed spatial scales, several reach-based ecosystem indicators were evaluated as pathways to inform planners and evaluators on the condition of the watershed/subwatershed. At this scale, an overall watershed/subwatershed condition could be addressed to determine if deficiencies at the reach-scale are symptomatic of a larger problem that should be addressed that would impact the sustainability and effectiveness of implemented habitat actions.

Reach Characteristics

Physical Variables

At the reach spatial scale, individual reach-based ecosystem indicators are evaluated to inform planners and evaluators about the indicators that are in an Adequate Condition and those that could use improvement (i.e., At Risk Condition or Unacceptable Condition). These reach-based ecosystem indicators are typically the focus of implementation habitat actions.

GENERAL REGIONAL CHARACTERISTICS

REGIONAL SETTING

Ecoregion	**Bailey Classification**	Domain – Dry Domain	Division – Temperate Steppe Regime Mountains	Province – Middle Rocky Mountain Steppe-Coniferous Forest-Alpine Meadow Province	Section – Blue Mountains Section

DRAINAGE BASIN CHARACTERISTICS

Geomorphic Features	Middle Fork John Day Basin Area	Basin Relief	Drainage Density	Hydrologic Unit Code		Stream Order (HUC)		Stream Classification	Land Ownership
	~800 mi^2	2,200'-8,100'	1.8	RM 63.51 – 65.51: 170702030202	RM 65.51 – 67.55: 170702030201	RM 63.51 – 65.51: HUC 5	RM 65.51 – 67.55: HUC 4	Classification I: municipal watershed and/or fish-bearing stream	>50% Private; Headwaters predominantly Public

VALLEY SEGMENT CHARACTERISTICS

Valley Characteristics	Valley Bottom Type (Naiman et al. 1992)		Valley Bottom Width (Avg.) (USFS 2008)		Valley Bottom Gradient (Avg.) (USFS 2008)		Valley Confinement			Channel Patterns	
	RM 63.51-66.45: F3–Wide mainstream valley	RM 66.45-67.55: F4–Wide mainstream valley	RM 63.51-66.45: ~950 feet	RM 66.45-67.55: ~350 feet	RM 63.51 - 66.45: 0.44%	RM 66.45 - 67.55: 0.50%	RM 63.51-66.45: Unconfined	RM 66.45-66.68: Confined	RM 66.68 - 67.55: Moderately confined	RM 63.51-66.45: Moderate to high sinuosity	RM 66.45-67.55: Variable

CHANNEL SEGMENT CHARACTERISTICS

Channel Characteristics	Valley Type	Elevation	Channel Type	Bed-form Type	Channel Gradient (Avg.)	Sinuosity (Avg.)
	Alluvial	3,965'-4,058'	C	Pool-riffle	0.46%	1.19

WATERSHED CHARACTERISTICS

GENERAL INDICATOR: EFFECTIVE DRAINAGE NETWORK AND WATERSHED ROAD DENSITY

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

General Characteristics	General Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Watershed Condition	Effective Drainage Network and Watershed 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: U.S. Department of Agriculture, 2005, Draft Environmental Impact Statement and Proposed Forest Plan Amendment, Middle Fork John Day Range Planning Project (http://www.fs.fed.us/r6/malheur/projects/mfjd-range/documents/chapter-3-roads-specialuses.pdf).

	Upper Middle Fork	Lower Middle Fork	Elk	Sullens	Blue Mountain	Bear Creek	Camp Creek	Austin
Open Road Miles	176.66	221.12	0.56	320.37	65.79	7.33	3.30	2.70
Closed Road Miles	204.18	278.14	0.00	109.12	103.80	9.07	1.45	1.23
Total Road Miles	380.84	499.26	0.56	429.49	169.59	16.4	4.75	3.93

Data: Analysis of watershed road density using basin area divided by total road miles.

MFJD Basin Area	792.1 mi^2
MFJD Total Road Miles (Minimum)	1,504.8 mi
Watershed Road Density (Minimum)	1.9 mi/mi^2

Narrative:

Minimum road density for the Middle Fork John Day River watershed is 1.9 mi/mi^2 which meets the **At Risk Condition** of the criterion. High road densities within the watershed negatively impact the routing of overland flows. This is primarily due to road embankments that re-direct or pond overland flows and re-directs stream flows for road maintenance and crossings.

Overall, the effective drainage network and road density general indicators are qualitatively interpreted to be in an **At Risk Condition** primarily based on road densities and field observations.

GENERAL INDICATOR: DISTURBANCE REGIME (NATURAL/HUMAN)

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

General Characteristics	General Indicator	Adequate Condition	At Risk Condition	Unacceptable Condition
Watershed Condition	Disturbance Regime	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.

Data: Fire disturbance summarized from the Tributary Assessment (Reclamation 2008).

Names	Year	Area of fire (acres)	Number of years of Recovery	Percentage of watershed area disturbed by this event	Successional Class (estimate)
Fire 20 and 23	1910	32,844	~100	28%	Large Tree
Ditch Creek	1961	27,269	~50	23%	Small Tree
Buck	1981	460	~30	<1%	Sapling/ Pole – Small Tree
Grouse Knob and Jumpoff	1986	1,378	~25	1%	Sapling/Pole
Road Creek	1988	12	~20	<1%	Sapling/Pole
Indian Rock and Reed	1994	3,749	~15	3%	Shrub/Seedling – Sapling/Pole
Phipps and Summit	1996	38,029	~15	33%	Shrub/Seedling – Sapling/Pole
Easy	2002	5,842	~10	5%	Shrub/Seedling
Bull Spring 2	2003	1,268	~5	1%	Grass/Forbs – Shrub/Seedling
Sharps Ridge	2006	5,466	<5	5%	Grass/Forbs

Narrative:

Fires are a relatively short-term, but frequent natural disturbance on the landscape. Fires are an integral part of the ecosystem. They rejuvenate vegetation and provide fine-to-coarse sediment and large wood to the fluvial system. After an area burns, there is generally an increase in soil erosion and mass wasting until the soils are re-stabilized by vegetation. Burn areas have also been associated with increased water temperatures. In the Middle Fork John Day watershed, burned areas are recovering from these natural disturbances at varying successional stages. For example, 116,317 acres have burned since 1910 (assuming the same area has not been burnt more than once, which is typically not the case) and about 47 percent of these burned areas are interpreted to be in the grass/forbs-to-sapling/pole conditions and are now providing some soil and hillslope stability.

Historic grazing, dredge mining, timber harvests, road density, and fires have impacted much of the Middle Fork John Day River watershed (additional information can be found in the *Tributary Assessment* [Reclamation 2009]). Anthropogenic impacts generally have long-term negative environmental impacts. The cumulative effects of these activities have not been quantified.

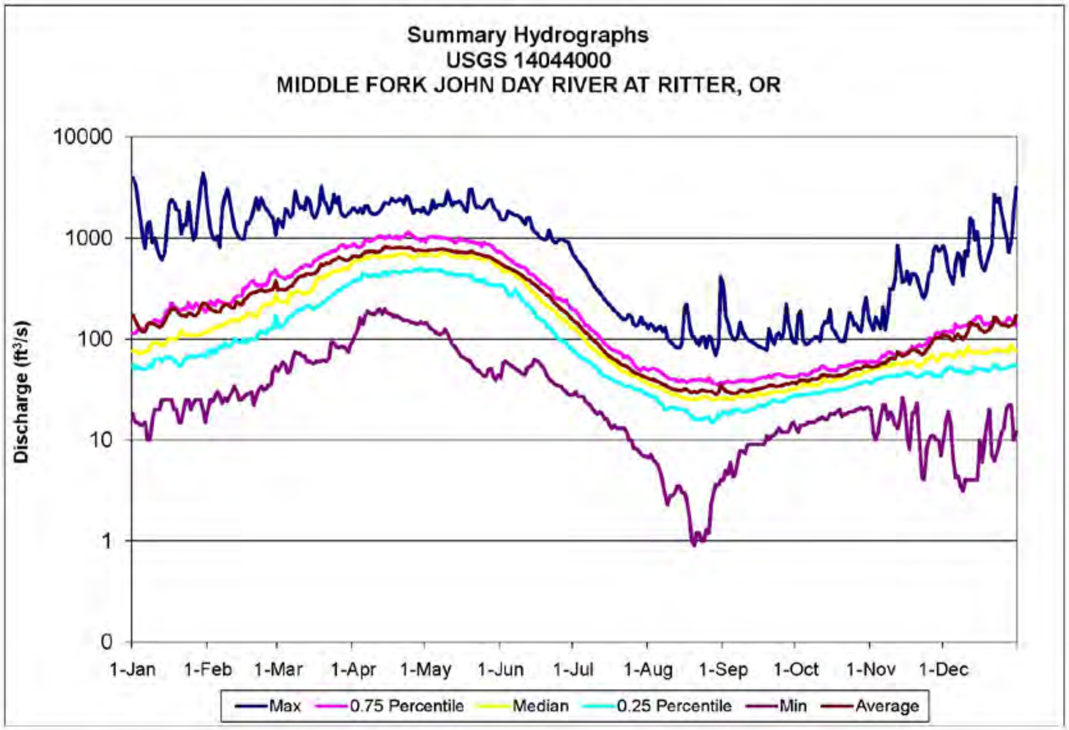
The interpretation is that fire is a relatively short-term, but frequent, environmental disturbance. However, anthropogenic impacts generally have long-term direct and indirect adverse impacts on the ecosystem within the watershed. Overall, the disturbance regime general indicator is qualitatively interpreted to be currently in an **At Risk Condition** due to continued anthropogenic activities.

GENERAL INDICATOR: FLOW/HYDROLOGY

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

General Characteristics	General Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Watershed Condition	Flow/hydrology	Magnitude, timing, duration and frequency of peak/base 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/base 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/base flows relative to natural conditions of an undisturbed watershed of similar size, geology and geography.

Figure 1. Mean daily flow statistics for the Middle Fork John Day River at the Ritter stream gage.



Data: Annual peak flow in cubic feet per second (cfs) recorded during flood events on the Mainstem and Middle Fork of the John Day River. The instantaneous peak was likely higher than the flows presented here.

Gage Location	1894	1955	1964
John Day River at McDonald's Ferry	39,100	24,900	42,800
Upper Mainstem John Day River at Prairie City	NA	962	2,400
Middle Fork John Day River at Ritter	NA	3,330	4,730

Narrative:

The Middle Fork John Day River is a snowmelt-dominated system that is characterized by a spring snowmelt runoff with low summer and winter flows, except for occasional rain-on-snow events that occur in November and December (Figure 1). Results of a paleoflood study conducted on the John Day River suggest that historical floods occurring in the past 2,000 years have been similar in magnitude to flood events of the past 73 years (Orth 1998). Only two floods in the past 2,000 years were determined to be greater than the discharge recorded for the 1964 flood.

Forestry practices in the upper watershed can result in immediate and significant changes in the discharge, duration, and timing of flow events, especially if a dense road network accompanies the operations (Burton 1997). Existing roads continue to have an impact and, to a lesser degree, timber harvests still have an impact although practices have improved over the last decade. In addition, agricultural land use changes the watershed controls that determine rates of precipitation interception, infiltration, and evapotranspiration. When combined with associated changes in surface roughness, these alterations have multiple impacts on the rainfall-runoff relationship (Skidmore et al. 2009). Much of the valley bottoms have been maintained for agricultural and, to a lesser degree, residential uses along the Middle Fork John Day River.

There are 9.78 cfs of water rights above the Forrest Conservation Area that are active prior to July 20th each year. In addition, there is a water right for 3.65 cfs out of Vinegar Creek that irrigates ground along the Middle Fork above Bates, which is also deactivated by July 20th. These withdrawals impact base flows most substantially during the month of July, when flows over 40 miles downstream at the Ritter gage only range between 50 and 150 cfs on average.

Indirect impacts on the high flow regime are pervasive and include forest practices, floodplain development, mining activities, and the routing of flows due to higher road densities. Impacts to base flows are primarily due to water withdrawals for irrigation purposes. Overall, the flow/hydrology general indicator is qualitatively interpreted to be in an **At Risk Condition**.

GENERAL INDICATOR: WATER QUALITY

Criteria: The following criteria were adapted and modified from the USFWS (1998) and Oregon Department of Environmental Quality.

General Characteristics	General Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Water Quality	Quantity/Temperature/Chemical Contamination/ Nutrients	Adequate instream flows for habitat, low levels of water quality impairments from landuse sources, no excessive nutrients, no CWA 303d designated reaches. Or Oregon Department of Environmental Quality standards.	Inadequate instream flows for habitat, moderate levels of water quality impairments from landuse sources, some excess nutrients, CWA 303d designated reaches.	Inadequate instream flows for habitat, high levels of water quality impairments from landuse sources, high levels of excess nutrients, CWA 303d designated reaches.

Narrative:

The Middle Fork John Day River is on the 303(d) list for temperature for (1) salmon and steelhead spawning, (2) core cold water habitat, and (3) Bull trout spawning and juvenile rearing. A Total Maximum Daily Load (TMDL) report is currently being written by the Oregon Department of Environmental Quality (ODEQ). Based on the 303(d) listing for temperature and reduction in shading along the river this general indicator is interpreted to be in an **At Risk Condition**.

GENERAL INDICATOR: HABITAT ACCESS

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

General Characteristics	General Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Habitat Access	Main Channel Physical 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.

Narrative:

There are no manmade barriers on the mainstem Middle Fork John Day River that limit upstream or downstream migration. Therefore, the main channel physical barriers general indicator is interpreted to be in an **Adequate Condition**.

REACH CHARACTERISTICS

GENERAL INDICATOR: WATER TEMPERATURE

Criteria: The following criteria were developed by Hillman and Giorgi (2002), USFWS (1998), and Oregon Department of Environmental Quality.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Water Quality	Water Temperature	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 (ODEQ): Salmon spawning Sep-May 13°C Core cold-water summer salmonid habitat 16°C (rearing and migration) Bull trout (all stages): 12°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: U.S. Forest Service Stream Survey (Appendix B).

River Mile	RM 63.5 – 66.5	RM 66.5 – 67.7
Habitat Reach	**HR 13**	**HR 14**
Avg. Temp °C	19.2°C	16.0°C
Max. Temp °C	24.0°C	19.0°C
Date(s) Surveyed	07/08/2008 – 07/09/2008	07/10/2008
Time Range Readings	1242 - 1633	0840 – 1230
Number of Readings	13	4

Narrative:

The Forrest Conservation Area reach on the Middle Fork John Day River is on the 303(d) list for temperature for (1) salmon and steelhead spawning and (2) core cold water habitat. A TMDL report is currently being written by the Oregon Department of Environmental Quality (ODEQ). Additional water temperature data are being collected within the reach as part of the Intensively Monitored Watershed Program (contact Mark Croghan, Reclamation's Middle Fork John Day Subbasin Liaison for information). In addition, the riparian canopy cover (10-meter buffer zone along both banks) that provides shading has been severally impacted by agricultural disturbances and livestock grazing. However, no pre-disturbance temperature data are available to indicate the degree of departure from natural conditions. Based on the 303(d) listing for temperature, this specific indicator is interpreted to be in an ***Unacceptable Condition***.

GENERAL INDICATOR: TURBIDITY

Criteria: The performance standard for this indicator is from Hillman and Giorgi (2002), and Oregon State Department Environmental Quality.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Water Quality	Turbidity	Nephelometric Turbidity Units (NTU)	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: 10 percent increase over natural turbidity (ODEQ – OAR 340-041).	15-50% exceedance.	>50% exceedance.

Data: Environmental Protection Agency STORET Database (http://iaspub.epa.gov/waters10/attains_get_services.storet).

Station	Location	Date	Turbidity
WORP99-0794	Lat: 44.62, Long: -118.57, NAD27	07/16/2001	1.84 NTU
WORP99-0973	Lat: 44.77, Long: -118.87, NAD27	06/11/2003	1.28 NTU
	Lat: 44.77, Long: -118.87, NAD27	08/25/2003	0.643 NTU

Narrative:

Turbidity is measured in Nephelometric Turbidity Units (NTU) which is a measure of the cloudiness of the water caused by suspended solids. The Environmental Protection Agency (EPA) has measured turbidity at two locations that bracket the Forrest reach. Sampling results suggest the turbidity general indicator is interpreted to be in an **Adequate Condition**.

GENERAL INDICATOR: CHEMICAL CONTAMINATION/NUTRIENTS

Criteria: The following criteria were developed by USFWS (1998) and Oregon State Department of Environmental Quality.

General Characteristics	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 303(d) designated reaches. Or Oregon State Department of Environmental Quality standards – OAR 340-041.	Moderate levels of chemical contamination from landuse sources, some excess nutrients, one CWA 303(d) designated reach.	High levels of chemical contamination from landuse sources, high levels of excess nutrients, more than one CWA 303(d) designated reach.

Data: Environmental Protection Agency STORET Database (http://iaspub.epa.gov/waters10/attains_get_services.storet).

Station: WORP99-0794 **Location: Lat: 44.62, Long: -118.57, NAD27**			**Station: WORP99-0973** **Location: Lat: 44.77, Long: -118.87, NAD27**				
Characteristic	**Date**	**Value**	**Characteristic**	**Date**	**Value**	**Date**	**Value**
Calcium	07/16/2001	.4005 meq/L	Calcium	06/11/2003	.3267 meq/L	08/25/2003	.6682 meq/L
Carbon, inorganic	“	13190 ug/l	Carbon, inorganic	“	7720 ug/l	“	13910 ug/l
Carbon, organic	“	1480 ug/l	Carbon, organic	“	1660 ug/l	“	2510 ug/l
Chloride	“	.0223 meq/L	Chloride	“	.0104 meq/L	“	.0262 meq/L
Dissolved Oxygen	“	8600 ug/l	Dissolved Oxygen	“		“	8300 ug/l
Magnesium	“	.4379 meq/L	Magnesium	“	.2441 meq/L	“	.5178 meq/L
Nitrogen, ammonia as N	“	.001 meq/L	Nitrogen, ammonia as N	“	0 meq/L	“	.001 meq/L

Station: WORP99-0794 **Location: Lat: 44.62, Long: -118.57, NAD27**			**Station: WORP99-0973** **Location: Lat: 44.77, Long: -118.87, NAD27**				
Characteristic	**Date**	**Value**	**Characteristic**	**Date**	**Value**	**Date**	**Value**
NO3	“	0 meq/L	Nitrogen, nitrate (NO3) as N	“	0 meq/L	“	0 meq/L
pH	“	8.65	pH	“	8.19	“	9.27
Potassium	“	.0776 meq/L	Potassium	“	.0214 meq/L	“	.0548 meq/L
Selenium	“	0 ug/l	Selenium	“	0 ug/l	“	0 ug/l
Sodium	“	.2436 meq/L	Sodium	“	.1343 meq/L	“	.2561 meq/L
Solids, Total Suspended (TSS)	“	2700 ug/l	Solids, Total Suspended (TSS)	“	4400 ug/l	“	2200 ug/l
Specific conductance	“	118 uS/cm	Specific conductance	“	72 uS/cm	“	141 uS/cm
Sulfur, sulfate (SO4) as S	“	.015 meq/L	Sulfur, sulfate (SO4) as S	“	.028 meq/L	“	.04 meq/L
Zinc	“	4 ug/l	Zinc	“	0 ug/l	“	2 ug/l

Narrative:

Lode and placer mining has occurred in several tributaries of the Middle Fork John Day River. Lode mining may produce/release acid mine drainage and both dredge mining and placer mining may use mercury for separating gold from other compounds (i.e., “quick silver”). These mining activities have and could continue to occur suggesting a continued risk to the Middle Fork and the Forrest reach.

Livestock have limited access to the river within the Forrest Conservation Area reach. However, livestock are able to access the river and its tributaries upstream of the reach which may be increasing nutrient and sediment loads. Currently there is insufficient data for dissolved oxygen (DO), pH, sedimentation, and flow modification for the Middle Fork John Day River. These indicators have been added to the Oregon’s 2004/2006 Integrated Report Database for monitoring and a TMDL report is currently being written by the Oregon Department of Ecology.

Improved roads were constructed along some lengths of the Middle Fork John Day River with some crossing locations within and upstream of the Forrest reach. Roads are maintained during the winter by applying sand and magnesium chloride (MgCl) that pose uncertain risks to the river. In addition, spills from vehicles traveling along the roads pose an unknown risk to the river.

The Middle Fork John Day River and its tributaries will probably have impacts from continued mining activities. Livestock best management practices are being used along the Forrest Conservation Area reach, but livestock use in the tributaries and on upstream properties along the mainstem may provide elevated nutrient levels to the Middle Fork John Day River. Road locations along the river pose uncertain hazards to the river from road maintenance and possible spills from vehicle accidents. Overall, the chemical contamination/nutrients general indicator is qualitatively interpreted to be in an **At Risk Condition**.

GENERAL INDICATOR: MAIN CHANNEL PHYSICAL BARRIERS (NATURAL/HUMAN)

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

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Habitat Access	Main Channel Physical Barriers	Barriers (Natural/Human)	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.

Narrative:

There are irrigation diversions along the Middle Fork John Day River and its tributaries. Overall, physical barriers have adequate fish passage at all biologically significant flows. Therefore, the main channel physical barriers general indicator is interpreted to be in an **Adequate Risk Condition**.

GENERAL INDICATOR: CHANNEL SUBSTRATE

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

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Habitat Quality	Channel 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: U.S. Forest Service Stream Survey (Appendix B).

River Mile	**RM 63.5 – 66.5**	**RM 66.5 – 67.7**
Habitat Reach	**HR 13**	**HR 14**
Percent Sand (<2 mm)	13.1%	11.25%
Percent Gravel (2-64 mm)	37.8%	46.25%
Percent Cobble (64-256 mm)	44.9%	40.0%
Percent Boulder (256-4096 mm)	4.2%	2.5%
Percent Bedrock (>4096 mm)	0.0%	0.0%

Data: U.S. Forest Service Stream Survey (Appendix B).

River Mile	**RM 63.5 – 66.5**	**RM 66.5 – 67.7**
Habitat Reach	**HR 13**	**HR 14**
D16	<2 mm	<2 mm
D50	32-45 mm	22.6-32 mm
D84	90-128 mm	64-90 mm

Data: Tributary Assessment Pebble Count Data (Reclamation 2008).

River Mile	Pebble Count	Location	Northing (NAD 83)	Easting (NAD 83)	Percent Fines (<6 mm)	D16 (mm)	D35 (mm)	D50 (mm)	D84 (mm)	D95 (mm)	Max. Size (mm)
64.4	MF-06-07	Bar	352086.2	8707223	7%	10.3	18.7	24.7	39.9	49.1	64.0
65.6	MF-06-19	Bar	348857.2	8711099	0%	16.2	25.8	32.3	71.1	99.4	128.0
65.9	MF-06-18	Bar	348225.3	8712192	2%	15.7	23.6	30.1	55.6	81.4	128.0
66.4	MF-06-17	Channel	346720.8	8714060	2%	12.6	24.5	31.6	64.8	94.9	180.0
66.7	MF-06-16	Channel	346238.6	8715468	3%	12.8	20.3	27.6	54.5	74.2	128.0
67.0	MF-06-03	Bar	345597.1	8716223	6%	11.6	20.4	25.5	41.1	57.2	90.0
67.5	MF-06-15	Channel	344682.1	8718097	1%	23.0	42.1	60.0	106.1	142.6	180.0

Data: Tributary Assessment Volumetric Samples (Reclamation, 2008)

RM	Sample Name	Sample Description	Percent < 2mm	Percent < 6mm	D16	D35	D50	D84	D90	D95
64.4	MF-06-07	Surface	4%	9%	10.00	19.50	25.48	43.18	49.50	57.80
64.4	SS-MF-06-07	Subsurface	22%	39%	1.38	4.52	8.69	25.90	30.80	38.65
67.0	MF-06-03	Surface	11%	17%	4.65	18.56	25.74	43.40	49.07	56.32
67.0	SS-MF-06-03	Subsurface	22%	34%	1.16	5.97	11.61	33.07	45.97	62.74

Narrative:

The channel substrate indicator describes the dominant material that makes up the composition of material along the streambed in spawning and rearing areas (Hillman 2006). Cobble and gravel are the dominant substrate types in the Forrest Conservation Area reach. Embeddedness is a measure of the degree to which fine sediments surround or bury larger particles and is an indicator of the quality of over-wintering habitat for juvenile salmonids (Hillman 2006). Substrate embeddedness was not measured in the reach. The percent surface fines (less than 6 mm) based on visual estimations and in-channel pebble count data are adequate, but one volumetric surface sample indicates fines of 17 percent. The Forrest Conservation Area reach is interpreted to be in an **Adequate Condition** for dominant substrate and fine sediment specific indicators.

GENERAL INDICATOR: LARGE WOOD

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

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Habitat Quality	Large Wood	Pieces Per Mile at Bankfull	>20 pieces/mile >12" diameter >35 feet 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: U.S. Forest Service Stream Survey (Appendix B).

River Mile	**RM 63.5 – 66.5**	**RM 66.5 – 67.7**
Habitat Reach	**HR 13**	**HR 14**
Miles	2.9 mi	1.24 mi
Large Wood	0	0
Medium Wood	0	0
Small Wood	2.9	0
Total	2.9	0
Frequency of Large Wood	0	0

Data: Tributary Assessment (Reclamation 2008).

Tributary Assessment Reach	LWD-sized Trees Along Buffer Zone (82 feet along both banks)
MF 13	1.9 acres
MF 14	0.9 acres

Narrative:
Amounts of large wood in the channel are at very low levels for an unconfined valley segment based on data recorded in the habitat assessment (Appendix B). Only about 3 small wood pieces per mile were surveyed. Large wood recruitment potential is considered poor due to the lack of woody vegetation in the floodplain (refer to Specific Indicator: Vegetation Condition [Disturbance]). Although the pre-disturbance vegetation condition is unclear and may have been characterized as more of a wet meadow environment, woody vegetation and beaver dams have been evidenced through soils investigations along the floodplain. The Forrest Conservation Area reach is interpreted to be functioning in an **Unacceptable Condition** for the large wood general indicator.

GENERAL INDICATOR: POOLS

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

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable 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 feet 39 5-10 feet 60 10-15 feet 48 15-20 feet 39 20-30 feet 23 30-35 feet 18 35-40 feet 10 40-65 feet 9 65-100 feet 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: U.S. Forest Service Stream Survey (Appendix B).

River Mile	**RM 63.5 – 66.5**	**RM 66.5 – 67.7**
Habitat Reach	**HR 13**	**HR 14**
Miles	2.9 miles	1.24 miles
Number of Pools	68	16
Number of Pools/Surveyed Mile of Stream	23.4	12.9
Frequency of Pools	0.078	0.05
Number of Pools > 3 Feet Deep/Surveyed Mile of Stream	16.9	0.81
Avg. Residual Pool Depth	0.073 feet	0.003 feet
Avg. Bankfull Width (feet)	35.7 feet	21.0 feet
Percentage of Pools Formed By:		
Beaver	0	0
Wood	0	3
Bedrock	0	0
Boulder	34	27
Stream Bend	32	36
Tributary	0	0
Culvert	0	0
Dam	1	9
Restoration	32	21
Other	1	3
Unknown	0	0

Narrative:
Pool depth provides cover from predators, buffers against wide fluctuations in water temperatures, and acts as a refuge during fire, drought, and cold water temperatures. About 23.4 pools per mile were documented between RM 63.5 to 66.5, and about 12.9 pools per mile between RM 66.5 to 67.7. The number of pools per mile averaged over the reach is 20 pools per mile with an average bankfull width of about 31.5 feet. Based on average bankfull width, the criterion is 18 pools per mile, so the number of pools per mile is adequate. Boulders and meander bends were the primary pool-forming agents. Several of the pools, particularly those associated with boulders, were formed through channelization of the historical channel and are characterized by high velocities and shear stresses. There is inadequate fish cover associated with the pools due to the lack of large wood, woody vegetation along the banks, and minimal complexity. Therefore, the pools general indicator is interpreted to be in an **At Risk Condition**.

GENERAL INDICATOR: OFF-CHANNEL HABITAT

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

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable 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: U.S. Forest Service Stream Survey (Appendix B).

River Mile	RM 63.5 – 66.5	RM 66.5 – 67.7
Habitat Reach	**HR 13**	**HR 14**
Slow Water (%)	52.3%	38.1%
Number of Slow Water Units	68	16
Fast Water (%)	40.0%	47.6%
Number of Fast Water Units	52	20
Fast Water/Slow Water Ratio	0.76	1.25
Side Channel (%)	3.8%	2.4%
Number of Side Channel Units	5	1
Tributary (%)	3.80%	11.9%
Number of Tributaries	5	5
Entrenchment Ratio	2.2	8.0

Data: Modeled lengths of connected and disconnected side channels at flows between a 2-year and 10-year discharge. Hydraulic Modeling and Geomorphology Report (Reclamation 2010, in preparation)

Total Length of Connected Side Channels	Total Length of Disconnected Side Channels
2.8 miles	1.97 miles

Narrative:

At low flow, about 4 percent of available habitats were side channels observed from RM 63.5 to 66.5, and about 2 percent were side channels observed from RM 66.5 to 67.7 that provide off-channel habitat (Appendix B). Distinctly connected channels at flows between the 2- and 10-year discharges located outside of the main channel were mapped based on hydraulic model results (Reclamation 2010). Results of the mapping found that approximately 2.8 miles of side channels are accessible at flows between a 2-year and 10-year discharge, but almost 2 miles have been disconnected. Floodplain disturbance (see Specific Indicator: Vegetation Condition [Disturbance] for acreage or percents), floodplain connectivity, lateral channel migration, and the lack of instream wood and recruitment potential, have most likely reduced the instream complexity and fish cover of the off-channel habitat areas. Manmade barriers are present that disconnect some of the off-channel areas. In addition, while beavers are active in some areas, their populations have greatly diminished. Their low numbers are also a cause of reduced off-channel habitat quantity and quality. Therefore, the off-channel habitat general indicator is interpreted to be in an **Unacceptable Condition**.

SPECIFIC INDICATOR: FLOODPLAIN CONNECTIVITY

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

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Channel 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: U.S. Forest Service Stream Survey (Appendix B).

River Mile	RM 63.5 – 66.5	RM 66.5 – 67.7
Habitat Reach	**HR 13**	**HR 14**
Mapped Gradient	0.5%	0.4%
Mapped Sinuosity	1.1	1.1
Avg. Bankfull W/D ratio	21.0	12.0
Entrenchment Ratio	2.2	8.0
Rosgen Stream Class	C	C
Dominant Substrate	Cobble	Gravel

Data: Summary of anthropogenic features (Geodatabase).

River Mile	RM 63.51-65.55	RM 65.55-66.45	RM 66.45-66.68	RM 66.68-67.55
Subreach	**FR-IZ-4**	**FR-IZ-3**	**FR-IZ-2**	**FR-IZ-1**
Rock Spurs	75	73	36	31
Riprap (linear feet)	1190 feet	561 feet	0	57 feet
Diversion Dam	0	0	0	2
Bridge	1	0	1	2
Ford	1	0	0	0

Data: Two-dimensional hydraulic model analysis of floodplain connectivity (Reclamation 2010, in preparation).

Subreach	Acres	2 yr–flood inundation (acres)	2 yr-flood inundation (percent)	5 yr–flood inundation (acres)	5 yr-flood inundation (percent)	10 yr–flood inundation (acres)	10 yr-flood inundation (percent)	100 yr–flood inundation (acres)	100 yr-flood inundation (percent)
FR-IZ-1	4.17	4.10	96%	4.10	98%	4.13	99%	4.16	100%
FR-IZ-2	1.13	1.11	99%	1.13	100%	1.13	100%	1.13	100%
FR-IZ-3	8.57	5.56	65%	5.84	68%	6.44	75%	8.05	94%
FR-IZ-4	15.48	14.36	93%	15.03	97%	15.18	98%	15.34	99%
FR-OZ-1	2.82	0.38	13%	0.52	18%	0.55	20%	0.94	33%
FR-DOZ-2	1.29	0.37	29%	0.88	68%	1.12	86%	1.26	97%
FR-OZ-3	1.77	0.48	27%	0.79	45%	0.98	55%	1.11	63%
FR-OZ-4	9.12	3.22	35%	5.09	56%	6.08	67%	8.21	90%
FR-OZ-5	1.11	0.42	38%	0.68	62%	0.83	75%	1.06	96%
FR-OZ-6	6.05	1.56	26%	2.47	41%	3.11	51%	4.45	74%
FR-OZ-7	0.33	0.22	68%	0.32	97%	0.33	98%	0.33	100%
FR-OZ-8	53.91	1.22	2%	3.11	6%	4.99	9%	13.58	25%
FR-OZ-9	4.94	1.15	23%	2.24	45%	2.64	53%	3.47	70%
FR-OZ-10	32.40	6.81	21%	14.17	44%	18.37	57%	27.22	84%
FR-OZ-11	12.36	2.46	20%	5.14	42%	7.10	57%	11.23	91%
FR-OZ-12	2.24	0.64	29%	1.50	67%	1.93	86%	2.18	97%
FR-OZ-13	1.59	0.26	16%	0.75	47%	1.06	66%	1.50	94%
FR-OZ-14	6.40	0.85	13%	2.89	45%	4.23	66%	5.67	89%
FR-OZ-15	0.73	0.27	37%	0.50	69%	0.64	88%	0.70	96%
FR-OZ-16	0.87	0.33	38%	0.68	78%	0.82	94%	0.85	97%

Narrative:

Physical barriers disconnect several parcels of the floodplain. The extent to which each subreach is disconnected varies across discharges. The railroad grade (about 6,100 linear feet) disrupts floodplain connectivity in inner zone parcels FR-DIZ-3b and FR-DIZ-3c, and outer zone parcels FR-DOZ-8b, FR-DOZ-10b, and FR-DOZ-10e. The largest impact is in parcel FR-DOZ-8b where most of the floodplain has been disconnected at all flows less than the 100-year discharge. Other areas that are at least partially disconnected at some or all flows by road embankments include parcels FR-DOZ-1b, FR-DOZ-2, FR-DOZ-4b, and FR-DOZ-11a.

The two-dimensional hydraulic model (Reclamation 2010, in preparation) indicates that inner zone subreaches FR-IZ-1, FR-IZ-2, and FR-IZ-4 are well connected at a 5-year flood with 97 to 100 percent being inundated. In subreach FR-IZ-3, inner zone parcel FR-IZ-3a is inundated about 68 percent possibly due to channelization and/or localized incision; and disconnected inner zone parcels FR-DIZ-3b and FR-DIZ-3c are not inundated due to the railroad grade. Greater than 40 percent of the outer zones are inundated during the 5-year flood, except for subreaches FR-OZ-1 (18 percent) and FR-OZ-8 (6 percent). In subreach FR-OZ-1, parcel FR-DOZ-1b is disconnected by a road embankment. In subreach FR-OZ-8, parcel FR-DOZ-8b is disconnected by the railroad grade.

Specific outer zones within the Forrest Conservation Area reach show substantial disconnectivity, particularly the floodplain areas between Vincent and Vinegar Creeks. Based on field observations and the hydraulic model results, the floodplain connectivity specific indicator for the Forrest Conservation Area is interpreted to be in an **Unacceptable Condition**.

SPECIFIC INDICATOR: BANK STABILITY/CHANNEL MIGRATION

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

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Channel 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: Summary of anthropogenic features (Geodatabase).

River Mile	**RM 63.51-65.55**	**RM 65.55-66.45**	**RM 66.45-66.68**	**RM 66.68-67.55**
Subreach	**FR-IZ-4**	**FR-IZ-3**	**FR-IZ-2**	**FR-IZ-1**
Rock Spurs	75	73	36	31
Riprap (linear feet)	1190 feet	561 feet	0	57 feet
Diversion Dam	0	0	0	2
Bridge	1	0	1	2
Ford	1	0	0	0

Data: U.S. Forest Service Stream Survey (Appendix B).

River Mile	**RM 63.5 – 66.5**	**RM 66.5 – 67.7**
Habitat Reach	**HR 13**	**HR 14**
Miles	2.90	1.24
Unstable Right Bank (%)	0.9%	1.6%
Unstable Left Bank (%)	1.2%	1.8%
Unstable Both Banks (%)	2.1%	3.0%
Undercut Right Bank (%)	2.7%	2.1%
Undercut Left Bank (%)	3.7%	4.9%
Undercut Both Banks (%)	6.4%	7.0%

Data: Tributary Assessment (Reclamation 2008)

Reach	**Area (acres) of HCMZ* impacted due to an inability of flow to inundate the surface**	**Area (acres) of HCMZ impacted due to an inability of the channel to migrate laterally**	**Total Area (acres) of HCMZ impacted**	**Area (acres) of Floodplain Disconnected Within the HCMZ**	**Area (acres) of Floodplain Disconnected Outside the HCMZ**	**Total Area (acres) of Floodplain Disconnected**
MF13	24.47	65.41	89.88	24.47	45.44	69.91
MF14	4.71	17.62	22.33	4.71	0.61	5.32

*** HCMZ= historical channel migration zone**

Narrative:

In sections of the Forrest Conservation Area reach, the channel cannot physically migrate as a result of the channelization. The flows in these sections are not capable of reworking the floodplain because they are entrenched and in some areas do not overtop the railroad grade at flows up to 100-year discharge. The disconnected floodplain prevents the process of floodplain reworking and the potential for the channel to migrate laterally.

Bank stability and channel migration rates can be impacted by such variables as bank protection, topographic features, channelization, changes in streamflow, and the type vegetation along the riparian buffer zone (30 meter width along both banks). These impacts can be either positive allowing a "natural" rate of channel migration, or negative by inhibiting the "natural" rate of migration. Riprap (about 1,800 linear feet), rock spurs (215), and bridges (3) have artificially stabilized the banks and restricted lateral channel migration in much of the Forrest reach. Large wood is not available along the riparian corridor for future recruitment as the riparian buffer zone is in a predominantly grass/forbs condition (see specific indicator Vegetation [Condition]). About 18 percent of the streambanks are actively eroding, possibly at a higher than "natural" rate because woody root masses are not present to further stabilize the streambanks. Therefore, the bank stability and channel migration specific indicators for the Forrest Conservation Area are interpreted to be in an **Unacceptable Condition**.

SPECIFIC INDICATOR: VERTICAL CHANNEL STABILITY

Criteria: The criterion for vertical channel stability was developed by Reclamation.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Channel	Dynamics	Vertical Channel Stability	No measurable or observable trend of aggradation or incision and no visible change in channel planform.	Measurable or observable 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: U.S. Forest Service Stream Survey (Appendix B).

River Mile	RM 63.5 – 66.5	RM 66.5 – 67.7
Habitat Reach	HR 13	HR 14
Valley Form	9-Moderate flat-floored floor width 100 – 300 feet with moderate to steep side slopes >30%	8-Narrow flat-floored floor width 100-300 feet wide with side slopes >30%
Surveyed Length (feet)	15,297 feet	6,561 feet
Side Channel Length (feet)	900 feet	96 feet
Mapped Channel Length (feet)	14,256 feet	6,019 feet
Min. Elevation (feet)	3,965 feet	4,034 feet
Max. Elevation (feet)	4,034 feet	4,058 feet
CFS	21.62 cfs	14.90 cfs
Avg. Wetted Width (feet)	22.9 feet	20.7 feet
Avg. Bankfull Depth (feet)	1.27 feet	1.43 feet
Avg. Bankfull Max. Depth (feet)	1.70 feet	1.75 feet
Avg. Bankfull Width (feet)	35.7 feet	21.0 feet
Avg. Floodprone Width (feet)	80 feet	168 feet
Valley Width (feet)	941 feet	359 feet
Valley Length (feet)	12,672 feet	5,650 feet
Mapped Gradient	0.5%	0.4%
Mapped Sinuosity	1.1	1.1
Avg. Bankfull W/D Ratio	21.0	12.0
Avg. Entrenchment Ratio	2.2	8.0
Rosgen Stream Class	C	C
Dominant Substrate	Cobble	Gravel

Data: Average zone widths rounded to the nearest 5-foot interval determined using GIS measurements (Geodatabase).

River Miles	RM 63.48-65.55	RM 65.55-66.45	RM 66.45-66.68	RM 66.68-67.55
Avg. Outer Zone Widths	415 feet	615 feet	90 feet	280 feet
Avg. Inner Zone Widths	75 feet	50 feet	30 feet	40 feet

Data: Summary of anthropogenic features (Geodatabase).

River Mile	RM 63.51-65.55	RM 65.55-66.45	RM 66.45-66.68	RM 66.68-67.55
Subreach	**FR-IZ-4**	**FR-IZ-3**	**FR-IZ-2**	**FR-IZ-1**
Rock Spurs	75	73	36	31
Riprap (linear feet)	1190 feet	561 feet	0	57 feet
Diversion Dam	0	0	0	2
Bridge	1	0	1	2
Ford	1	0	0	0

Data: Channel unit mapping and summary by inner zone subreaches (Geodatabase). Channel slope calculated from thalweg survey (Reclamation 2008).

River Mile	RM 63.51 – 65.55	RM 65.55 – 66.45	RM 66.45 – 66.68	RM 66.68 – 67.55
Subreach	**FR-IZ-4**	**FR-IZ-3**	**FR-IZ-2**	**FR-IZ-1**
Channel Slope	0.4%	0.6%	0.5%	0.5%
Total Acres	4.937	2.009	0.345	2.685
Percent Pools	31%	9%	9%	18%
Percent Rapids	2%	8%	3%	0%
Percent Riffles	30%	47%	19%	37%
Percent Runs	37%	36%	69%	45%

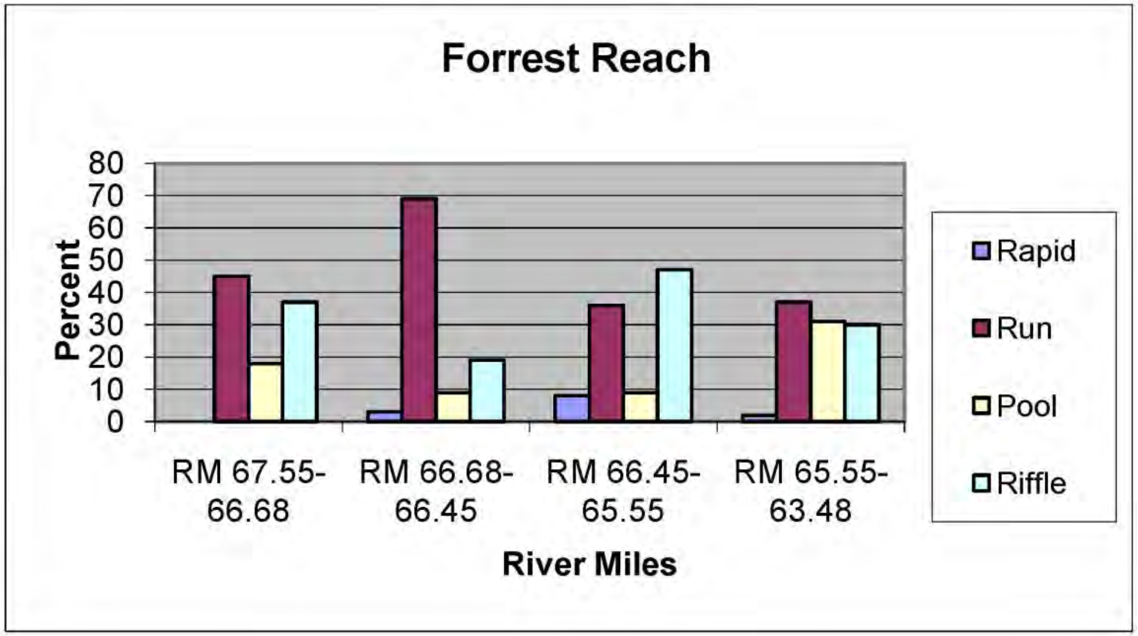


Figure 2: Percent of channel units by river mile (Appendix C).

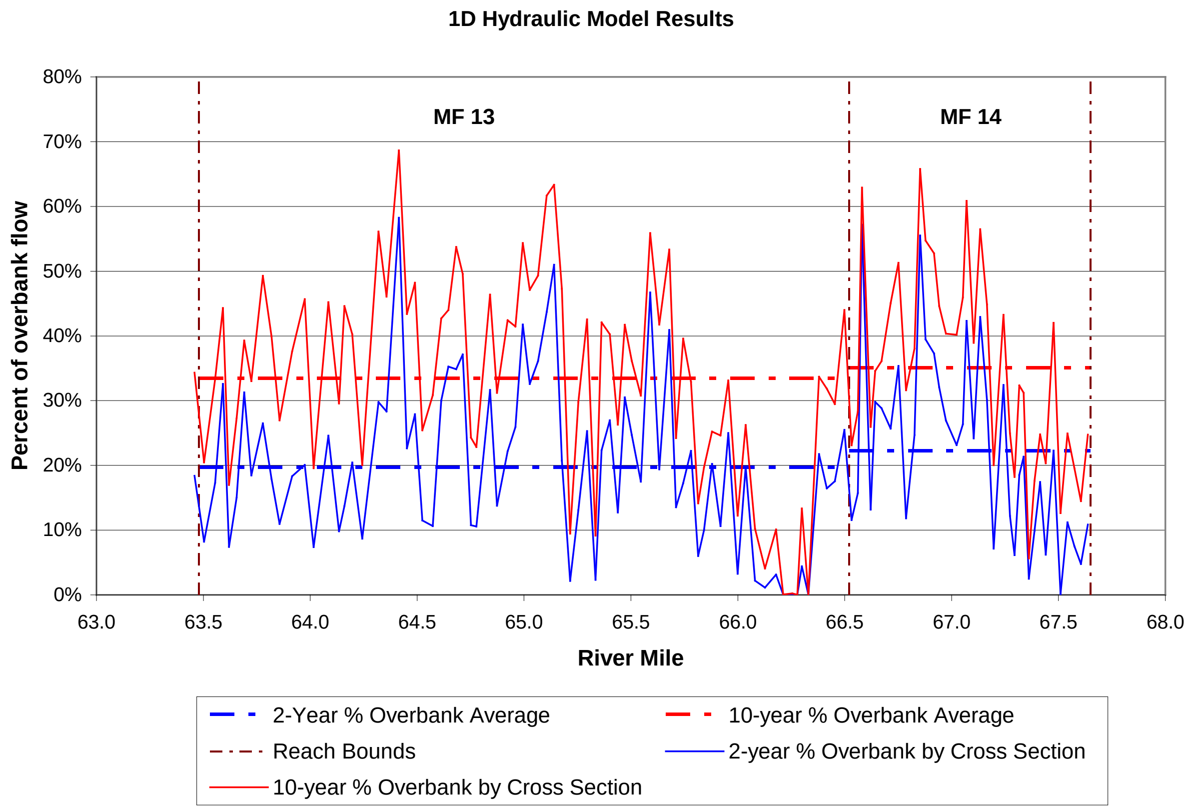


Figure 3. Percent of flows out of bank based on 1D hydraulic model (Reclamation 2008). Provides evidence of locations characterized by localized incision.

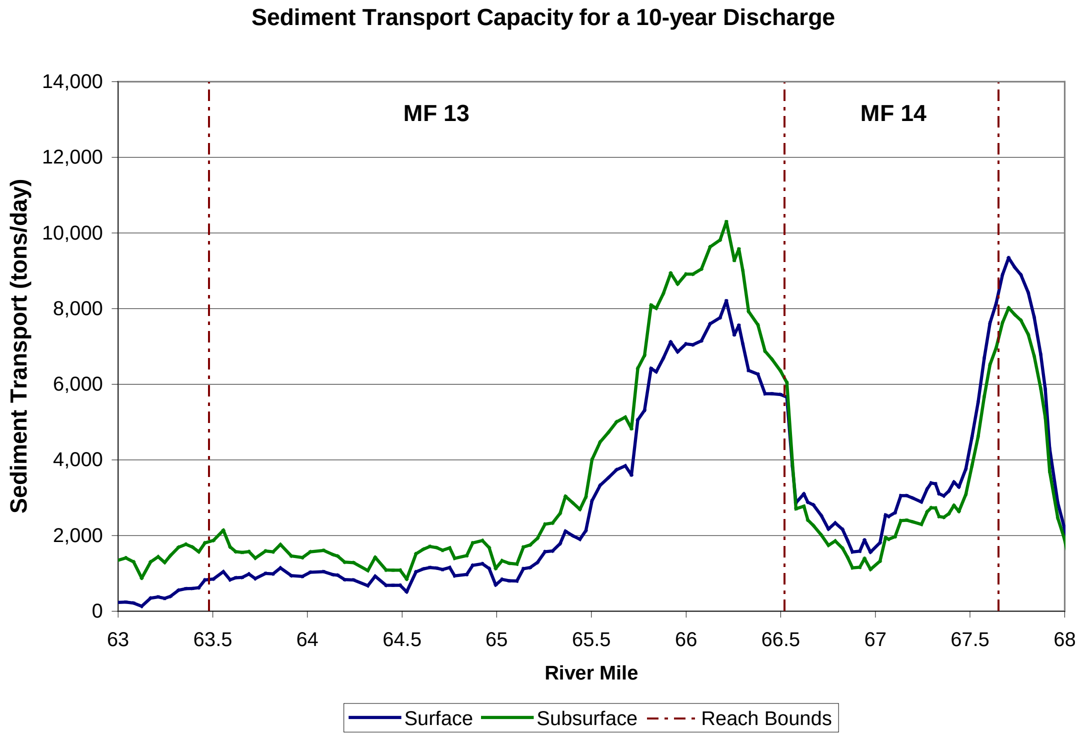


Figure 4. Parker (1990) Sediment Transport Capacity for the 10-Year Discharge. High sediment transport capacity indicates areas of higher erosive forces.

Narrative:

Tributary Assessment:

Compared to sediment transport capacity throughout the Upper Middle Fork John Day River, reach MF14 (RM 66.5 to 67.7) is characterized by an average ability to transport sediment, with a slightly higher transport capacity upstream of Placer Creek (Figures 3 and 4). Pebble counts suggest that bed material of the river through the channelized segment is much greater than in the downstream portion of the reach. A surface and subsurface sample conducted in the reach indicates that the reach is not substantially armored downstream from Placer Creek. Incipient motion computations demonstrate that the bed and bar material in the downstream portion of the reach are mobilized under a 2-year event, while larger material comprising the bed of the upstream portion of the river is initially mobilized during 5- to 10-year flood events. High erosive forces upstream from Placer Creek may result from channel straightening associated with the construction of the historic town of Bates. Hydraulic model results reveal that water surface elevations during the 2-year event are generally close to or overtopping the channel banks throughout the entire reach. This indicates a normally functioning system that has not experienced significant incision.

Unconfined reach MF13 (RM 63.5 to 66.5) is characterized by two distinct regions of sediment transport. The break in the sediment transport through this reach coincides with a change in the degree of channelization and floodplain disconnection. The upstream section was modified from a highly sinuous channel to a straight river, and the railroad cuts off access to approximately 80 percent of the floodplain. Sediment transport through this section is high relative to similarly unconfined reaches. The downstream section of reach MF13 is much less channelized, and a single-thread meandering planform is present. Sediment transport capacity through the downstream segment is much lower than upstream and downstream reaches. Incipient motion computations show that the material present in the bed and bars of the study areas will generally be mobilized under a 2-year event. A surface and subsurface sample collected at the downstream end of the reach indicates mild channel armoring with the surface material median grain size (D50) three times greater than the subsurface D50. Water surface elevations for the 2-year event are close to the bank height for most cross-sections in the reach, which indicates conditions consistent with a normally functioning system. Upstream from the confluence with Vincent Creek, flows generally do not overtop the railroad levee and are unable to access a large portion of the floodplain for events as large as the 100-year event. Despite installations of river-training structures and other constructed features, the channel does not appear to be notably incised. Comparison of the geometry of the present channel with the historic channel on the south side of the railroad embankment indicates that the present channel is slightly deeper and has a greater area than the historic channel. Differences in the channel geometries may be the result of the channel design of the present channel and natural adjustment to the transport of higher flow events resulting from floodplain disconnection.

Reach Assessment:

Channel unit mapping is a useful tool in determining how sediment is moving through a given reach or channel segment at channel forming flows (Figure 2). Channel units are interpreted and mapped in the field based on fluvial processes, and then each channel unit is mapped on rectified aerial photographs in ArcGIS. “Channel units” should not be confused with “habitat units.” Habitat units are a measure of habitat quantity available at low flows. For example, the habitat assessment includes the long pool tail-out in the glide-pools (usually lateral scour pools) as pool habitat even though this area of the pool is functioning as run habitat. The entire habitat unit is included as a pool, from the pool tail crest to the end of the pool at the top of the scour (USFS 2008). In many cases, most of the habitat area in a pool is run habitat with a smaller area comprised of the pool scour. In the channel unit mapping, the pools (area of pool scour) and runs are spatially defined and mapped separately as different channel units.

Channel unit mapping was conducted for the Forrest Conservation Area reach assessment (Appendix C) and charted to graphically illustrate the existing condition and to help interpret current trends in sediment transport and deposition (Figure 2). Conceptually, confined channel segments should have more rapids and runs (transport channel units), be characterized by higher slopes, and have larger sediment sizes than unconfined and moderately confined reaches; moderately confined segments should have a balance of runs (transport channel unit) with riffles and bars (depositional channel units); and unconfined segments should have more riffles and bars (depositional channel units), be characterized by lower slopes, and have smaller sediment sizes than confined and moderately confined reaches. This conceptual model can be used in conjunction with an understanding of sediment transport processes in each reach to help interpret the degree of departure from pre-disturbance conditions due to anthropogenic impacts.

Along inner zone FR-IZ-1, the valley is moderately confined, but there are three bridge constrictions at RM 67.5, RM 67.2, and RM 65.5 that constrain lateral channel migration. The associated road embankments (about 420 linear feet) disconnect the floodplain in parcels FR-DOZ-1b, FR-DOZ-2, FR-DOZ-4b, and FR-DOZ-11a, confining much of the flood flows to the channel. Channel units are predominantly runs and riffles with some scour pools suggesting the channel could be actively adjusting (transitioning) to the artificial constrictions (bridge abutments) and rock spurs (31).

The valley along inner zone FR-IZ-2 is confined by the Davis Creek alluvial fan and bedrock, and the opposing Vinegar Creek alluvial fan. There are 36 rock spurs along the subreach that may inhibit lateral channel migration. Channel units are predominantly runs with some riffles suggesting the stream is transporting the sediment through this channel section.

The valley along inner zone FR-IZ-3 is geologically unconfined, but due to the location of a railroad grade (about 6,100 linear feet) transecting the floodplain, the valley is artificially confined. The railroad grade disconnects inner zone parcels FR-DIZ-3b and FR-DIZ-3c and outer zone parcels FR-DOZ-8b, FR-DOZ-10b, and FR-DOZ-10e. There are rock spurs (73) and riprap (about 560 linear feet) that inhibit lateral channel migration. Channel units are predominantly riffles and runs with some rapids suggesting the sediment is being transported through this channel segment.

The valley along inner zone FR-IZ-4 is unconfined. There are rock spurs (75) and riprap (about 1,200 linear feet) that inhibit lateral channel migration. The predominant channel units are runs and riffles with a high percentage of lateral scour pools forced by the rock spurs and riprap. Scour has occurred around several of the rock spurs and is providing pool habitat, but the habitat lacks the large wood component for fish cover. Riprap along meander bends has artificially stabilized the streambanks, constraining lateral channel adjustment which may have caused the channel to adjust in the vertical dimension. The presence of riprap and any other constructed features along the channel bank or within the channel causes three-dimensional hydraulic flows that direct high velocities and shear stresses along the channel bed, resulting in scour.

Riprap (about 1,800 linear feet), rock spurs (215), bridge constrictions, channelized river sections, and disconnected floodplains are the primary causal factors for vertical channel adjustments in the Forrest Conservation Area reach. No measureable vertical adjustment information, such as profile data, is available to determine long-term changes in the elevations of the channel bed. Based on field observations, the railroad grade (about 6,100 linear feet) at least partially disconnects about 2.4 acres of historical channel paths in parcels FR-DIZ-3b and FR-DIZ-3c and about 48.4 acres of floodplain in parcels FR-DOZ-8b, FR-DOZ-10b, and FR-DOZ-10e. Due to the extent of constructed features within this reach, the lack of lateral migration and the disconnected floodplain, the vertical channel stability specific indicator is interpreted to be in an **At Risk Condition**.

SPECIFIC INDICATOR: VEGETATION CONDITION (STRUCTURE)

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.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Riparian/Upland Vegetation	Vegetation Condition	Vegetation 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: U.S. Forest Service Stream Survey (Appendix B).

Understory Cover:	**Left Bank (Percent)**	**Right Bank (Percent)**
Woody Shrub Cover	3.03%	3.26%
Grass/Forb Cover	3.03%	2.58%
Ground Cover:		
Woody Cover	5.38%	1.97%
Grass/Forb Cover	63.79%	67.65%
Barren/Rock Cover	11.21%	15.98%

Data: U.S. Forest Service Stream Survey (Appendix B).

	Left Bank Plots				Right Bank Plots			
Species	**0**	**3**	**6**	**9**	**0**	**3**	**6**	**9**
Annual Forb	0.00	0.00	0.09	0.76	0.00	0.00	0.00	1.00
Alnus incana	0.00	0.65	0.00	0.00	0.00	1.37	0.43	0.43
Alopecurus pratensis	10.16	9.76	22.54	9.24	1.02	5.48	23.71	9.05
barren	0.00	0.00	1.58	1.53	0.00	1.45	1.55	0.00
Bromus tectorum	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.26
Carex aquatilis	0.32	0.00	0.00	0.00	1.25	0.00	0.00	0.00
Calamagrostis canadensis	0.00	0.81	0.00	0.00	0.00	0.00	0.26	0.00
Carex lasiocarpa	0.00	0.00	0.00	0.00	0.00	0.00	1.03	0.00
Carex lenticularis	0.56	0.00	0.00	0.00	1.02	0.00	0.00	0.00
Carex nebrascensis	2.42	0.00	0.00	0.42	5.86	4.03	1.29	0.60
Carex spp.	3.15	5.65	0.00	1.95	6.33	3.06	3.79	9.57
Carex utriculata	0.00	0.00	0.96	0.00	0.00	0.65	0.00	0.00
Cirsium arvense	0.00	0.56	0.70	0.42	0.00	0.40	0.86	1.64
Deschampsia cespitosa	0.00	0.00	0.96	0.25	0.00	0.00	0.00	0.00
Eleocharis	7.98	0.65	0.00	0.00	4.14	0.81	0.00	0.00
Equisetum	0.81	0.24	0.09	0.59	0.63	0.48	0.52	0.00
forb	13.39	18.31	13.07	6.10	4.84	10.89	11.29	6.90
Festuca spp.	0.00	0.81	0.79	0.00	0.00	0.00	0.00	0.43
Juncus arcticus	0.89	1.37	1.05	0.00	0.47	1.94	0.00	0.00
Juncus spp.	7.10	10.97	5.79	5.93	7.19	2.10	3.10	2.76
Phalaroides arundinacea	0.00	0.00	1.14	0.00	0.00	1.21	0.00	0.00
Pinus ponderosa	0.00	0.00	1.49	0.00	0.00	0.00	0.00	0.00
planting mat	0.00	5.81	39.47	24.41	0.00	5.81	13.97	24.83
Poa spp.	0.24	0.97	1.84	2.37	0.00	1.37	0.78	0.69
Prunus virginiana	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00
rock	0.00	5.81	0.00	0.00	0.00	0.00	1.55	6.21
Salix spp.	0.00	0.00	0.00	0.00	0.00	0.24	0.60	0.00

	Left Bank Plots				Right Bank Plots			
Species	**0**	**3**	**6**	**9**	**0**	**3**	**6**	**9**
Scirpus microcarpus	10.24	0.24	0.79	0.76	7.97	3.63	0.95	2.84
Symphoricarpos spp.	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00
Thinopyrum	0.00	3.55	1.14	1.78	0.00	0.24	0.00	3.28
Trisetum	0.00	0.48	0.26	0.00	0.00	0.00	0.00	0.43

Data: U.S. Forest Service Stream Survey (Appendix B).

Invasive and Noxious Species Present	
Common Name	**Scientific Name**
Canadian thistle	*Cirsium arvense*
Reed Canary grass	*Phalaroides arundinacea*
Cheatgrass	*Bromus tectorum*
Yellow Flag iris	*Iris pseudacorus*

Data: U.S. Forest Service Stream Survey (Appendix B).

Density of Species Within Belt Transects			
Species	**Count**	**Density/m^2**	**Species Density (%)**
Alnus incana	56	1.87	29.9
Artemisia tridentata	4	0.13	2.1
Betula spp.	5	0.17	2.7
Ceanothus spp.	1	0.03	0.5
Crataegus douglasii	2	0.07	1.1
Pinus contorta	1	0.03	0.5
Pinus ponderosa	11	0.37	5.9
Populus trichocarpa	5	0.17	2.7
Prunus virginiana	6	0.20	3.2
Ribes spp.	9	0.30	4.8
Rosa woodsii	12	0.40	6.4
Salix boothii	15	0.50	8.0
Salix eriocephela	31	1.03	16.6

Density of Species Within Belt Transects			
Species	**Count**	**Density/m^2**	**Species Density (%)**
Salix exigua	11	0.37	5.9
Salix geyeriana	1	0.03	0.5
Salix lucida	8	0.27	4.3
Salix melanopsis	6	0.20	3.2
Symphoricarpos spp.	3	0.10	1.6

Data: U.S. Forest Service Stream Survey (Appendix B).

River Mile	**RM 63.5 – 66.5**	**RM 66.5 – 67.7**
Habitat Reach	**HR 13**	**HR 14**
Riparian Classes	- grassland/forbs	- grassland/forbs
Understory	-ponderosa pine -grassland/forbs -alder sagebrush	-alder -grassland/forbs
Overstory	- grassland/forbs	- grassland/forbs

Interpretation:

River Mile	**RM 63.5 – 66.5**	**RM 66.5 – 67.7**
Habitat Reach	**HR 13**	**HR 14**
Successional Class	At Risk Condition	At Risk Condition

Narrative:

Throughout the Forrest Conservation Area reach the successional class is predominantly in a grassland/forbs condition. Conservation Reserve Enhancement Program (CREP) plantings are in a shrub/seedling condition, but will mature overtime to provide increased vegetation structure diversity. The CREP plantings will need to be protected and maintained over a relatively long time to become effective. Therefore, the riparian vegetation structure specific indicator for the Forrest Conservation Area reach is interpreted to be in an **At Risk Condition**.

SPECIFIC INDICATOR: VEGETATION CONDITION (DISTURBANCE)

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.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Riparian/Upland Vegetation	Vegetation Condition	Vegetation Disturbance (Natural/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: Tributary Assessment (Reclamation 2008).

Tributary Assessment Reach	Percent Negative Tree/Shrub Change (based on 1939 and 2006 aerial photographs)
MF 13	88.2%
MF 14	86.8%

Narrative:

Livestock grazing, timber harvests, and road/railroad construction are the primary human disturbances that have impacted most of the Forrest reach. There has been a decrease of about 87 percent of trees and shrubs based on 1939 and 2006 aerial photographs analysis. There are a low percentage of mature trees (i.e., successional classes Large and Mature Trees) in the riparian buffer zone available for recruitment by the stream. Overall, this specific indicator is interpreted to be in an **Unacceptable Condition**.

SPECIFIC INDICATOR: VEGETATION CONDITION (CANOPY COVER)

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.

General Characteristics	General Indicators	Specific Indicators	Adequate Condition	At Risk Condition	Unacceptable Condition
Riparian/Upland Vegetation	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: U.S. Forest Service Stream Survey (Appendix B).

River Mile	RM 63.5 – 67.7
Center	0.03%
Left	0.00%
Right	0.00%

Data: Tributary Assessment (Reclamation 2008).

Tributary Assessment Reach	Percent of Stream Shaded by Trees/Shrubs
MF 13	3.3%
MF 14	8.9%

Narrative:

Canopy cover, predominantly trees and shrubs, based on densiometer measurements was less than 1 percent (Appendix B). During the Tributary Assessment (Reclamation 2008), the percent of the stream shaded by trees and shrubs was determined to be about 3 percent for geomorphic reach MF 13 and about 9 percent for geomorphic reach MF 14. Based on these factors and the listed criteria, this specific indicator for the Forrest Conservation Area is interpreted to be in an **Unacceptable Condition**.

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APPENDIX B

2008 Stream Survey

MIDDLE FORK JOHN DAY RIVER

2008 Stream Survey Report
Malheur National Forest
Blue Mountain Ranger District

Prepared by: United States Forest Service, Stream Survey
La Grande Ranger District- Wallowa-Whitman National Forest
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CHAPTER 1: STREAM SURVEY

OVERVIEW

Dates Surveyed: July 8th – July 28th, 2008
Survey Type: Region 6 Stream Inventory Methodology, Version 2.8, Level II
Mouth Location: 044º 54.9600' N, 119º 18.0412' W
Headwater Location: 044º 35.0795' N, 118º 25.7258' W
USGS Quadrangle: Susanville, Boulder Butte, Bates and Austin
Watershed (4th field): Middle Fork John Day
Subwatershed (6th field): Coyote Creek/Balance Creek, Granite Boulder Creek, Little Boulder Creek/Deerhorn, Vinegar Creek and Mill Creek
Tributary To: North Fork John Day River
NFS Watershed No.: 170702030205, 170702030203, 170702030202, 170702030201, 170702030106
Stream Class at Mouth: I
Distance Surveyed: 20.6 miles (mainstem channel)
Stream Length: 75 miles (approximate)
Surveyors: Christine Maxwell, Matthew Nightengale and Tara Thomas

SUMMARY

The Middle Fork John Day River runs approximately 75 miles from the headwaters at over 8,100 feet in elevation until it empties in to North Fork John Day River at an elevation just less than 2,200 feet. The section of river surveyed in July of 2008 was a mix of National Forest Land, Nature Conservancy Land (Dunstan Homestead Preserve), Forrest and Oxbow Property (Confederated Tribes of the Warm Springs) as well as private land. The survey began at the confluence with Camp Creek and was surveyed until approximately one mile upstream of where State Highway 7 crosses the river. The Middle Fork John Day River is home to spring Chinook salmon (*Oncorhynchus tshawytscha)*, summer steelhead (*Oncorhynchus mykiss),* resident redband trout (*Oncorhynchus mykiss)* and some bull trout (*Salvelinus confluentus)* populations. Having no dams or fish hatcheries the John Day River system is imperative and need be preserved for native fish migration, spawning and rearing. The John Day River is one of the longest free flowing rivers in the continental United States.

Numerous flows were taken on the section of river surveyed that ranged from 4.19 cubic feet per second to 47.26 cubic feet per second (ignoring an outlier). A flow was measured at the beginning of each reach, and a few additional ones were taken upstream of significant tributaries. Flows were measured with a Marsh McBirney Flowmate and sites were marked on the GPS.

This survey was not conducted continuously from reach one through twenty due to two sections being of higher priority than others. Habitat reach breaks were established at geomorphic reaches identified by Reclamation in the Middle Fork and Upper John Day River Tributary Assessments (May 2008). Additional habitat reach breaks were established within the geomorphic reaches when required. The survey crew used maps and changes in geomorphology to duplicate the reach breaks and there was a small deviation from those that the Reclamation determined. See Appendix G for survey maps. The Forrest Property section was conducted first followed by starting at the downstream end of the Oxbow Property (reach five) and continuing upstream to the bottom of the Forrest Property (reach eleven). Next, reaches one through four were completed and then reaches fifteen through twenty. The out of order reaches are the reason why the sequence order (SO) numbers are not continuous throughout the survey. Within reach eight there is a channel running parallel to the Middle Fork John Day River that appears to just be a tributary, but is contributed to by the mainstem river and is known as the south channel, while the main channel is known as the north channel. This section of channel was additionally surveyed. Furthermore, part of reach two that was on private property was not surveyed because permission was not granted from the land owner to do so.

This was a Level II survey conducted along the Pacific Northwest Stream Inventory Program protocol. Many parameters were added to the basic Level II protocol for this survey. Reach one is at the downstream end and reach twenty is at the uppermost end of the survey. Bank orientation in the data is all facing downstream, unless otherwise noted. GPS coordinates were saved for numerous points throughout the survey including the start and end of reaches, measured habitat units, pools greater then three feet deep, side channels, large pieces of wood and Wolman Pebble Counts. Some of the coordinates did not save properly and were therefore entered manually using other habitat units to approximate their location. The GPS points for the start of reach thirteen and reach fourteen were not saved and therefore were manually entered into the GIS layer as well as measured units at SO 3 and SO 4 within reach 12 (see Appendix G).

The Middle Fork John Day River stream survey runs through four sixth level hydrologic unit codes (HUC). Level one (i.e. 17) is the region level and level six (i.e. 05) is the subwatershed level. Starting at the downstream end, Camp Creek to just downstream of Ragged Creek is within the HUC 17,07,02,03,02,05. From there upstream to Vincent Creek the HUC is 17,07,02,03,02,02. Vincent Creek through Bridge Creek has a HUC of 17,07,02,03,02,01 and Bridge Creek through the end of the survey is within the 17,07,02,03,01,06 HUC boundary.

BASIN DESCRIPTION

Watershed and Flow Regime

General Characteristics

- **Location:** Surveyed section of Middle Fork John Day River is located due north of Prairie City, Oregon, and runs along County Highway 20.

- **Stream Order:** Strahler method (Handbook 2008)
    - o Sixth order from the confluence with Camp Creek upstream to Big Boulder Creek.
    - o Fifth order from Big Boulder Creek to Vinegar Creek.
    - o Fourth order from Vinegar Creek through the end of the survey (reach twenty).

- **Flow:** Many discharge measurements were taken throughout the surveyed area with a Marsh McBirney flow meter. The accuracy of the Marsh McBirney Flo-Mate Model 2000 is ± 2% of the reading (Marsh-McBirney 1990).

Table 1.1. Discharge locations, readings, dates and times.

Location – at start of reach unless otherwise noted	**Ft^3/Second**	**Date**	**Time**
Reach 1	35.20	07/30/2008	0757
Reach 2	40.25	07/30/2008	0839
Reach 3	47.26	07/30/2008	0913
Reach 4	47.18	07/30/2008	0945
Reach 5	34.85	07/30/2008	1022
Reach 5 – upstream of confluence w/ Sunshine Creek	68.97	07/10/2008	1521
Reach 6	31.64	07/30/2008	1048
Reach 7	31.12	07/30/2008	1325
Reach 8 – north channel	28.81	07/30/2008	1404
Reach 9	22.78	07/30/2008	1434
Reach 10	25.77	07/30/2008	1450
Reach 11	21.21	07/30/2008	1513
Reach 12	22.06	07/24/2008	1335
Reach 12 – upstream of confluence w/ Deerhorn Creek	36.65	07/07/2008	1450
Reach 13	21.62	07/24/2008	1305
Reach 13 – upstream of confluence w/ Vincent Creek	36.11	07/07/2008	1415
Reach 13 – upstream of confluence w/ Vinegar Creek	29.44	07/07/2008	1200
Reach 14	14.90	07/24/2008	1211
Reach 14 – upstream of confluence w/ Davis Creek	25.93	07/07/2008	1324
Reach 14 – upstream of confluence w/ Bridge Creek	20.78	07/07/2008	1130
Reach 15	13.02	07/24/2008	1100
Reach 16	5.84	07/30/2008	1549

Location – at start of reach unless otherwise noted	**Ft^3/Second**	**Date**	**Time**
Reach 17	5.17	07/30/2008	1611
Reach 18	5.31	07/30/2008	1642
Reach 19	4.39	07/30/2008	1620
Reach 20	4.19	07/30/2008	1541

- **Note:** The discharge for reach 5 above Sunshine Creek is an outlier and it is unknown why the total discharge is so high.
- There was active restoration being done on Granite Boulder Creek during part of the survey in which they were holding back water that could have affected some of the discharge readings.

• **Elevation and General Gradient:** The survey began at 3,448 feet in elevation and ended at 4,173 feet, making the gradient for the entire survey 0.7%.

• **Sinuosity:** The sinuosity for the length of the survey was 1.06.

- Elevation, gradient and sinuosity were all determined using Maptech® Pro computer program features.

Interim Riparian Management Objectives

• Interim Riparian Management Objective (RMOs) applies to all watershed with anadromous fish bearing stream. For general habitat conditions to be considered good for anadromous fish the following objectives must be met or exceeded (USDA 1995).

Table 1.2. Summary of interim riparian management objectives (RMOs) (USDA 1995).

Habitat Feature	**Interim Objectives**								
Pool Frequency (kf) (all systems)	Varies by channel width, see below.								
Wetted Width in Feet	10	20	25	50	75	100	125	150	200
Number of Pools Per Mile	96	56	47	26	23	18	14	12	9
Water Temperature (sf) (all systems)	Compliance with state water quality standards, or maximum <68ºF/20ºC								
Large Woody Debris (sf) (forested systems)	East of Cascade Crest in Oregon, Washington and Idaho. >20 pieces per mile; >12 inch diameter; >35 foot length.								
Bank Stability (sf) (non-forested systems)	>80 percent stable								
Lower Bank Angle (sf) (non-forested systems)	>75 percent of banks with <90 degree angle (i.e. undercut)								
Width/Depth Ratio (sf) (all systems)	<10; mean wetted width divided by mean depth								

kf = key feature sf = supporting feature

Reach Summaries

- **Definition of Stream Classification:** The Blue Mountain Stream Survey Program (Wallowa-Whitman, Malheur and Umatilla National Forests) uses the three-class system.
    - o **Classification I =** municipal watershed and/or fish-bearing stream (perennial or intermittent).
    - o **Classification III =** non fish-bearing, perennial streams
    - o **Classification IV** = non fish-bearing, intermittent streams

- All of the reaches in the Middle Fork John Day River stream survey were of stream class I.

Tributaries

- **Access to Fish out of the Mainstem:** Forty six tributaries entered Middle Fork John Day River throughout the survey, but not all provide access to fish.

Table 1.3. Tributaries encountered on Middle Fork John Day River.

Tributary Name/ Number	Reach	SO	% Flow Contribu-tion*	Tributary Temperature ºC**	Downstream Bank Orientation	% Gradient At Mouth+
1 – Camp Creek	1	2	15	14	LB	6
2 – Cress Creek	1	10	1	16	RB	10
3 – Coyote Creek	2	41	1	16	RB	6
4 – Big Boulder Creek	4	95	30	20	RB	6
1 - Sunshine Creek	5	12	5	15	LB	6
2	6	36	1	20	RB	10
3 – Rugged Creek	6	46	1	18	LB	5
4	7	61	1	15	RB	5
5 – Beaver Creek	7	69	5	15	RB	6
6	7	72	5	15	RB	5
7	7	76	1	16	LB	5
8	8	80	1	18	LB	5
9 - Ruby Creek	8	82	10	20	LB	6
10	8	95	10	21	LB	5
11	8	98	1	20	LB	6
12	8	111	25	21	LB	5
13 – Granite Boulder Cr.	8	123	45	17	RB	5
14 – Butte Creek	8	137	1	17	LB	6
15 – Windlass Creek	10	204	1	19	RB	5
16	10	243	1	12	LB	10
17	10	247	10	14	LB	5
18	11	258	5	16	LB	6
19 - Murdock Creek	11	293	1	16	RB	6

Tributary Name/ Number	Reach	SO	% Flow Contribu-tion*	Tributary Temperature ºC**	Downstream Bank Orientation	% Gradient At Mouth+
20 – Little Boulder Creek	11	304	10	15	RB	7
21 – Deerhorn Creek	11	316	10	17	LB	5
1	13	109	5	24	LB	5
2 – Vincent Creek (split entrance)	13	118	5	19	LB	5
3 – Vincent Creek (split entrance)	13	120	10	21	RB	5
4	13	123	5	21	LB	6
5 – Vinegar Creek	13	151	30	20	RB	7
6 – Davis Creek	14	174	10	12	LB	10
7	14	190	1	19	RB	10
8	14	192	1	19	RB	10
9	14	196	5	19	RB	5
10 – Bridge Creek	14	203	30	21	LB	6
1	15	13	1	15	LB	5
2	15	14	1	17	LB	7
3 – Clear Creek	16	17	50	20	LB	6
4	16	20	5	20	LB	7
5	16	30	1	20	LB	5
6	16	42	1	20	LB	5
7	16	51	1	20	LB	5
8	16	54	2	20	LB	5
9	17	86	2	24	RB	5
10 – Mill Creek	17	89	1	16	LB	6
11	17	90	1	14	RB	5

* = percent flow contribution is an estimate of the tributaries contribution to the Middle Fork John Day River
** = temperature was measured with a handheld thermometer
+ = gradient was measured with a clinometer

- No discharge was taken on reach 8 – south channel.

Special Cases

- Two culverts were encountered throughout the survey.

Table 1.4. Special case units on Middle Fork John Day River.

Reach #	Sequence Order #	Channel Unit Type	Type of Struc-ture	Length of Structure (ft)	Diameter (ft)	% Gradient	Jump Distance	Spill Pool Depth	Height (ft)
15	6	ARTIF	Open arch	83	17	2	0	0	11
19	129	ARTIF	Open arch	100	18	4	0	0	10

- There were no baffles present in the two culverts (they had open bottoms) and they were not migration barriers.

IN-CHANNEL HABITAT

Temperature

- The temperature was taken at the start of every day and at every measured unit. Temperature readings were taken with a handheld thermometer and were submerged for at least one minute to ensure an accurate reading.

- The range of temperatures recorded throughout the Middle Fork John Day River survey was from 13ºC to 24ºC.

Table 1.4. Average and maximum temperature readings by reach.

Reach	Average Temp ºC	Maximum Temp ºC	Date(s) Surveyed	Time Range Readings Collected In	Number of Readings
1	15.5	16.0	07/22/2008	0803-1004	6
2	16.0	16.0	07/22/2008	1248-1400	2
3	14.5	18.0	07/22/2008 – 07/23/2008	0809-1513	3
4	16.2	21.0	07/23/2008 – 07/24/2008	0925-1609	4
5	17.0	19.0	07/14/2008	1047-1400	3
6	20.0	20.0	07/14/2008	1534-1548	2
7	15.7	16.0	07/15/2008	1011-1038	2
8 – North	19.3	20.0	07/15/2008	1253-1530	4
8 – South	19.0	20.0	07/23/2008	1148-1440	5
9	16.7	17.0	07/16/2008	0900-1322	6
10	16.0	21.0	07/16/2008 – 07/17/2008	0851-1037	3
11	16.8	17.0	07/17/2008 – 07/18/2008	1135-1524	5
12	14.1	16.0	07/08/2008	0730-1051	7
13	19.2	24.0	07/08/2008 – 07/09/2008	1242-1633	13
14	16.0	19.0	07/10/2008	0840-1230	4
15	17.0	18.0	07/24/2008	1127-1238	3
16	18.0	20.0	07/24/2008 – 07/25/2008	1020-1234	9
17	20.7	21.0	07/25/2008	1342-1413	3
18	21.0	21.0	07/25/2008	1436-1528	4

Reach	Average Temp ºC	Maximum Temp ºC	Date(s) Surveyed	Time Range Readings Collected In	Number of Readings
19	22.0	22.0	07/25/2008	1608-1614	2
20	23.0	23.0	07/25/2008	1710-1758	4

- From reach one through Clear Creek (reach fifteen) the Middle Fork John Day River has a designated fish use of core coldwater habitat by the State of Oregon Department of Environmental Quality (Sturdevant 2008). This means that the water is expected to maintain temperatures usually considered optimal for salmon and steelhead rearing, or that are suitable for bull trout migration. Temperature are optimally not supposed to exceed 16.0ºC in this habitat, but in this survey the maximum temperature reached at least 16ºC for reaches one through fifteen, and in most circumstances exceeded that value (see Table 1.4).

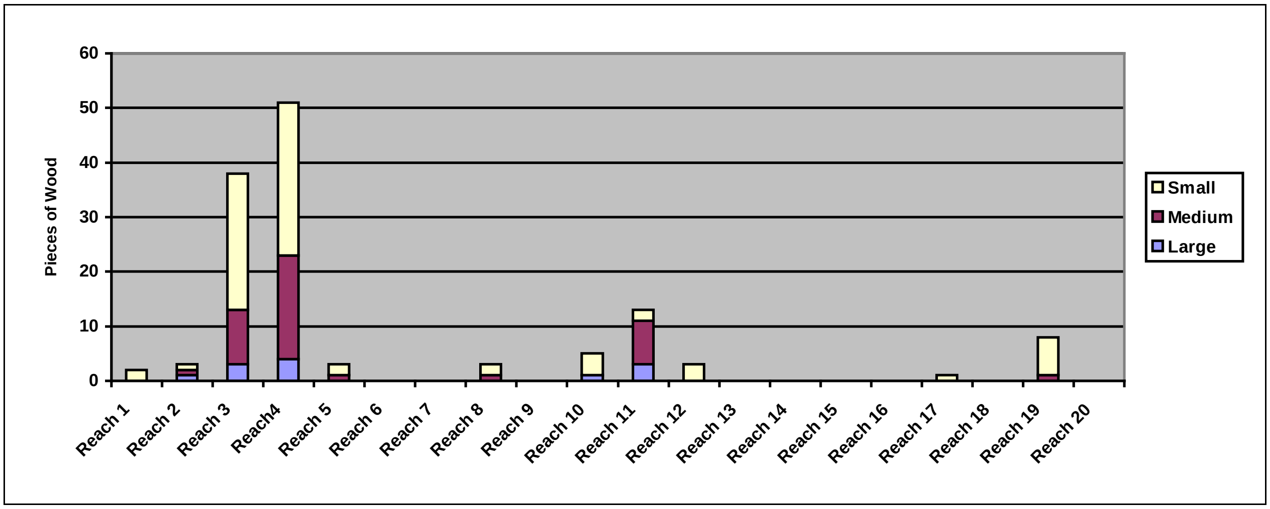
- Clear Creek through the end of the survey is designated by the state water quality standards as bull trout spawning and juvenile rearing, which has optimal temperatures below 12ºC (Sturdevant 2008). Reaches sixteen through twenty exceeded this parameter (see Table 1.4).

Woody Debris

- Woody debris size categories for the east side of the Cascade Mountains can be found in the table below.

Table 1.5. Definitions of woody debris size categories (Handbook 2008).

Size	Diameter	Length
Small	>6 inches at 20 feet from large end	>20 feet or 2X bankfull width
Medium	>12 inches at 35 feet from large end	>35 feet or 2X bankfull width
Large	>20 inches at 35 feet from large end	>35 feet or 2X bankfull width



Graph 1.1. Wood distribution by reach.

- The wood found in Middle Fork John Day River did not meet the criteria for the RMO's. To meet the RMO's for wood there needed to be greater then twenty pieces of medium and large sized wood combined per mile of stream. See Wood Summary in Chapter 2.

- Of the countable wood found throughout this survey, 59% of the wood was small sized, 32% was medium and 9% was large.

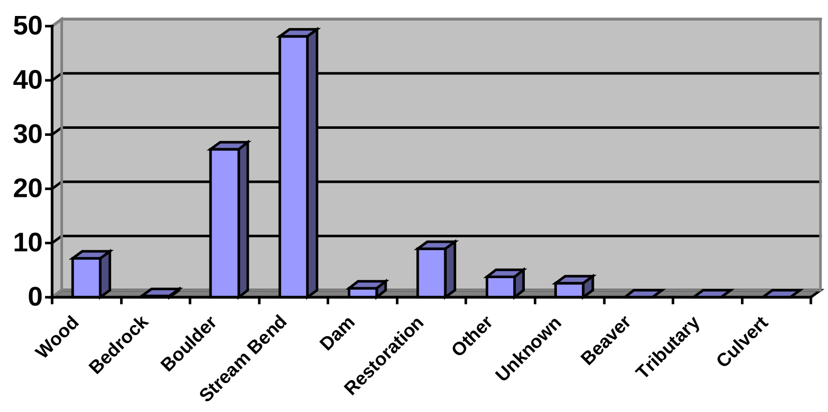
<u>Pools</u>

- A pool, or slow water unit, is defined as a portion of the stream that usually has reduced surface turbulence and has an average depth greater than fast water units when observed during low flow conditions. There is always a hydraulic control on the downstream end of a pool, better known as the pool tail crest. This hydraulic control functions as a dam which will retain water in the pool even after streamflow has ceased (Handbook 2008).

- **Pool Quality:** The average residual pool depth, which is the difference between the maximum pool depth and the maximum depth along the pool tail crest, for this survey was 1.72 feet. This is the depth of water that would be persisting if water stopped flowing out of the pool.

- **Pool Forming Forces:** For each pool the major pool forming forces were noted, oftentimes with more then one factor playing a part (Graph 1.2).

- The pool per mile criteria varies by channel width, but the RMOs were not met for pool frequency. See Table 1.2 and the Pool Summary in Chapter 2.



Graph 1.2. Average percent total of pool formation factors for survey.

<u>Pebble Counts</u>

- For each reach two Wolman Pebble Counts were performed, the first being approximately 1/3 and a second 2/3 of the way through each reach. The site chosen should be fast water and representative of what is perceived to be normal conditions for fast water units already observed.

- The procedure for performing a pebble count is that you randomly select at least one hundred pebbles (without bias) from the streambed along a transect that traverses the stream from the edge of the bankfull channel on one bank to that on the opposite bank. The first particle touched is measured and tallied for each sample. (Handbook 2008)

- The D16, D50 and D84 were determined for each reach. At bankfull flow particles smaller then the D50 (50^{th} percentile) will be mobile. Substrate larger then the D84 (84^{th} percentile) are considered immobile during bankfull flow (Handbook 2008). See Appendix 1A for these values.

- Graphs representing each reach's pebble counts can be found in Appendix 1A.

- Some of the coordinates did not save properly on the GPS and we therefore had to insert them into the GIS layer manually based on their proximity to other habitats with GPS coordinates. Those that did not save accurately were:
    - Reach 6 – wolman #1
    - Reach 8 (North Channel) – wolman #2
    - Reach 9 – wolman #2
    - Reach 12 – wolman #1
    - Reach 14 – wolman #1
    - Reach 19 – wolman #2 (the sequence order number was not noted for this particular pebble count, therefore there is no reference to plot it's approximate location)

Percent Substrate Composition

- The percent substrate composition is a visual estimate of the make up of the substrate on measured units of the wetted channel. Size class categories are: sand (<2 mm), gravel (2-64 mm), cobble (64-256 mm) boulder (256-4096 mm) and bedrock (>4096 mm). All estimates were rounded to 10 percent and the streambed substrate is to total 100 percent for each unit (Handbook 2008).

Table 1.6. Average percent substrate composition per reach.

Reach	**Sand** <2 mm	**Gravel** 2-64 mm	**Cobble** 64-256 mm	**Boulder** 256-4096 mm	**Bedrock** >4096 mm
1	18.3	35	37.5	9.2	0
2	20	35	35	10	0

Reach	Sand <2 mm	Gravel 2-64 mm	Cobble 64-256 mm	Boulder 256-4096 mm	Bedrock >4096 mm
3	20	43.3	30	6.7	0
4	16.7	40	33.3	10	0
5	10	28	44.7	17.3	0
6	12.5	35	42.5	10	0
7	10	25	45	20	0
8 – North	16.7	20	33.3	30	0
8 – South	24	37	34	5	0
9	11.7	38.3	41.5	8.5	0
10	11.25	36.25	35	17.5	0
11	16	30	31.6	22.4	0
12	14.2	44.2	40	1.7	0
13	13.1	37.8	44.9	4.2	0
14	11.25	46.25	40	2.5	0
15	16.7	23.3	33.3	26.7	0
16	26.7	58.9	14.3	0.1	0
17	13.3	50	30	6.7	0
18	10	37.5	49.75	10.25	0
19	10	40	32.5	17.5	0
20	17.5	63.75	18.25	0.5	0

Special Habitats

- **Side Channels:** A side channel is a secondary channel that flows roughly parallel to the mainstem channel with an island that will not be breached during bankfull condition between the two. Oftentimes woody plants and/or a well developed soil layer and vegetation are in indicator that an island is stable (Handbook 2008).

- Side channels comprised 7.4% of the total habitat units in Middle Fork John Day River stream survey. See the Percent Area Habitat Summary in Chapter 2 for more detailed information by reach.

RIPARIAN HABITATS

Riparian Vegetation

- The riparian vegetation was noted on measured habitat units for the inner riparian zone only (100 feet on both banks). The class is broken down by diameter at breast height (dbh) and the classes are as follows (Handbook 2008):
    - NV = No Vegatation (bare rock/soil, dbh not applicable)
    - GF = Grassland/Forb Condition (dbh not applicable)
    - SS = Shrub/Seedling Condition (1.0 – 4.9 in. dbh)

- SP = Sapling/Pole Condition (5.0 – 8.9 in. dbh)
- ST = Small Trees Condition (9.0 – 20.9 in. dbh)
- LT = Large Trees Condition (21 – 31.9 in. dbh)
- MT = Mature Trees Condition (>32 in. dbh)

- The overstory vegetation is defined by the species that from an overhead view occupies the most overstory area along both banks. It is an average of both banks' condition.

- The understory is denoted by which species are growing in this lower vegetative layer. It too is an average of both banks' condition.

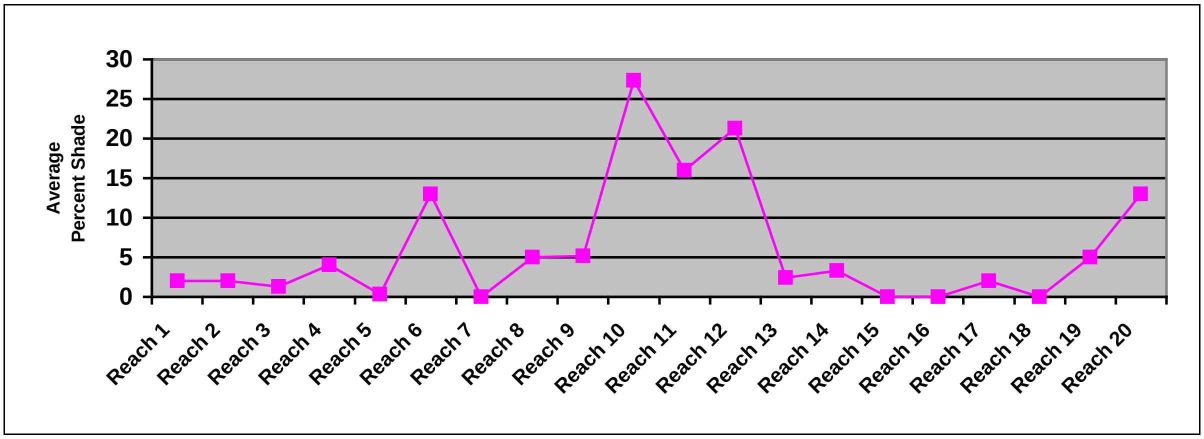
Table 1.7. Riparian vegetation classes and species observed.

Reach	Riparian Class	Overstory	Understory
1	▪ shrub/seedling ▪ grassland/forbs	▪ willow (*Salix s.)* ▪ hawthorn (*Crataegus sp.)* ▪ grassland/forbs	▪ ponderosa pine (*Pinus ponderosa)* ▪ cottonwood (*Poplus sp.)* ▪ hawthorn (*Crataegus sp.)* ▪ willow (*Salix sp.)* ▪ grassland/forbs
2	▪ grassland/forbs	▪ grassland/forbs	▪ cottonwood (*Poplus sp.)* ▪ lodgepole pine (*Pinus contorta)*
3	▪ grassland/forbs ▪ shrub/seedling	▪ hawthorn (*Crataegus sp.)* ▪ grassland/forbs	▪ cottonwood (*Poplus sp.)* ▪ lodgepole pine (*Pinus contorta)*
4	▪ small tree ▪ grassland/forbs	▪ lodgepole pine (*Pinus contorta)* ▪ grassland/forbs ▪ ponderosa pine (*Pinus ponderosa)*	▪ alder (*Alnus sp.)*
5	▪ shrub/seedling ▪ grassland/forbs	▪ alder (*Alnus sp.)* ▪ grassland/forbs	▪ ponderosa pine (*Pinus ponderosa)* ▪ alder (*Alnus sp.)*
6	▪ small tree	▪ lodgepole pine (*Pinus contorta)* ▪ ponderosa pine (*Pinus ponderosa)*	▪ hawthorn (*Crataegus sp.)*
7	▪ grassland/forbs	▪ grassland/forbs	▪ alder (*Alnus sp.)*
8 – North	▪ grassland/forbs	▪ grassland/forbs	▪ alder (*Alnus sp.)*
8 – South	▪ grassland/forbs	▪ grassland/forbs	▪ ponderosa pine (*Pinus ponderosa)* ▪ grassland/forbs ▪ alder (*Alnus sp.)*

Reach	Riparian Class	Overstory	Understory
9	▪ grassland/forbs ▪ shrub/seedling	▪ grassland/forbs ▪ alder (*Alnus sp.)*	▪ alder (*Alnus sp.)* ▪ grassland/forbs ▪ lodgepole pine (*Pinus contorta)*
10	▪ small tree ▪ shrub/seedling	▪ lodgepole pine (*Pinus contorta)* ▪ alder (*Alnus sp.)* ▪ Englemann spruce (*Picea engelmannii)*	▪ alder (*Alnus sp.)* ▪ ponderosa pine (*Pinus ponderosa)*
11	▪ small tree ▪ shrub/seedling	▪ lodgepole pine (*Pinus contorta)* ▪ alder (*Alnus sp.)*	▪ alder (*Alnus sp.)* ▪ ponderosa pine (*Pinus ponderosa)* ▪ grassland/forbs
12	▪ grassland/forbs ▪ shrub/seedling	▪ grassland/forbs ▪ ponderosa pine (*Pinus ponderosa)*	▪ grassland/forbs ▪ alder (*Alnus sp.)* ▪ ponderosa pine (*Pinus ponderosa)* ▪ lodgepole pine (*Pinus contorta)*
13	▪ grassland/forbs	▪ grassland/forbs	▪ ponderosa pine (*Pinus ponderosa)* ▪ grassland/forbs ▪ alder (*Alnus sp.)* ▪ sagebrush (*Artesmisia sp.)*
14	▪ grassland/forbs	▪ grassland/forbs	▪ alder (*Alnus sp.)* ▪ grassland/forbs
15	▪ grassland/forbs	▪ grassland/forbs	▪ grassland/forbs
16	▪ grassland/forbs	▪ grassland/forbs	▪ grassland/forbs ▪ ponderosa pine (*Pinus ponderosa)*
17	▪ small tree ▪ grassland/forbs	▪ ponderosa pine (*Pinus ponderosa)* ▪ grassland/forbs	▪ alder (*Alnus sp.)* ▪ grassland/forbs
18	▪ grassland/forbs	▪ grassland/forbs	▪ grassland/forbs
19	▪ small tree	▪ ponderosa pine (*Pinus ponderosa)*	▪ alder (*Alnus sp.)*
20	▪ grassland/forbs	▪ grassland/forbs	▪ grassland/forbs ▪ alder (*Alnus sp.)*

<u>Solar Radiation</u>

- Solar radiation was taken at every measured unit with a solar pathfinder to determine the percent of shade and was normalized for the latitude in which it was used and the month of July. The surveyor stood in the middle of the channel while assessing the shade.



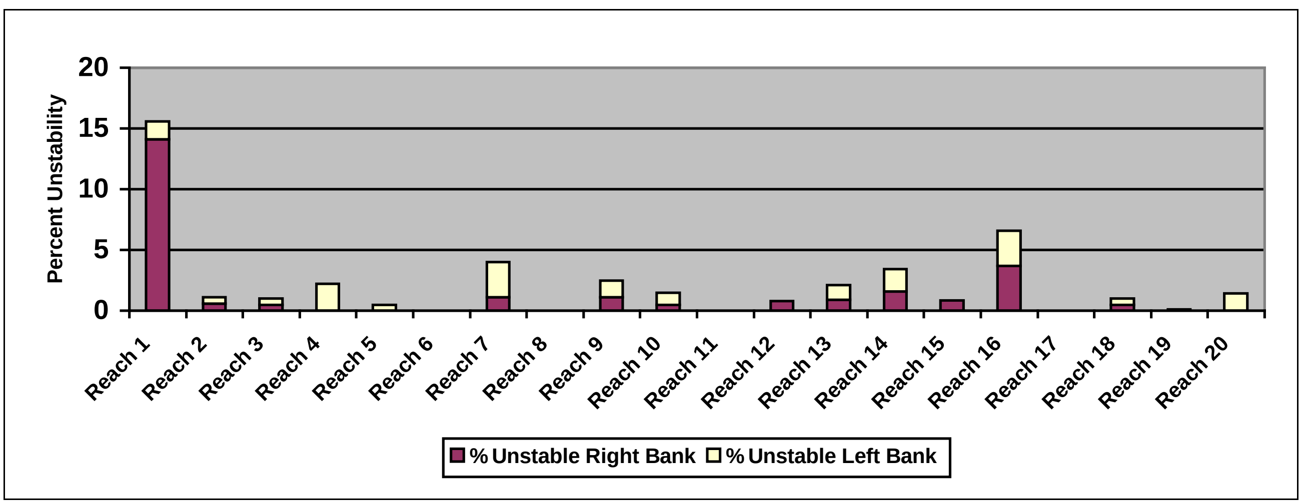
Graph 1.3. Average percent solar radiation for each reach.

MANAGEMENT ACTIVITIES / IMPACTS

Bank Stability

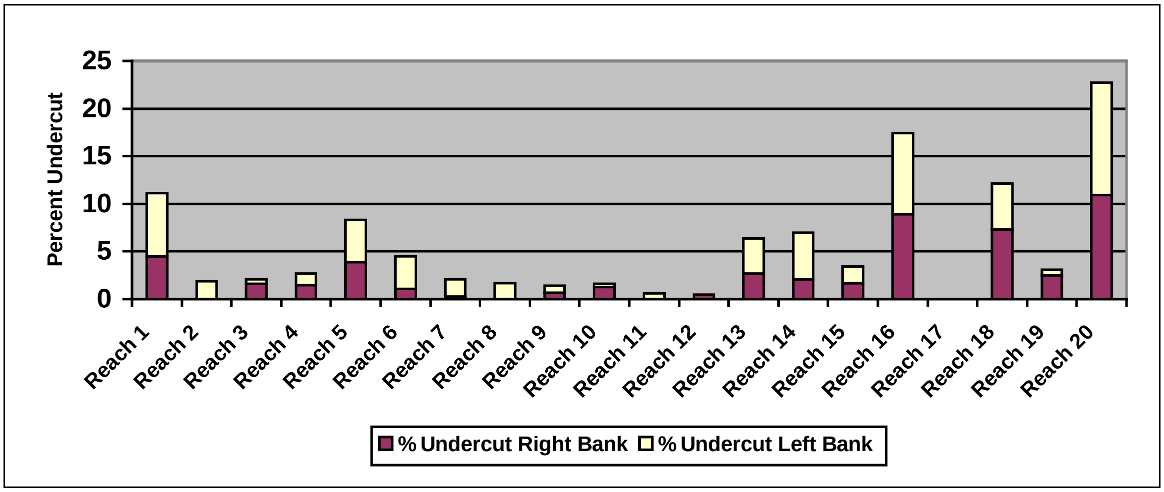
- The banks on Middle Fork John Day met the RMOs for bank stability, being more then 80% stable (Graph 1.4).

- For more detailed information by reach see the Unstable and Undercut Bank Summary in Chapter 2.



Graph 1.4. Percent of unstable banks observed by reach.

- The RMOs were met for undercut banks (lower bank angle) being greater then 75% stable (Graph 1.5).



Graph 1.5. Percent of undercut banks found on Middle Fork John Day River.

<u>Roads</u>

- County Highway 20 runs along Middle Fork John Day River for the first 16 reaches of the survey, then it crosses the river and State Highway 7 runs close by partway through reach 19. Highway 7 crosses the river and it is followed by a private road for the remainder of the survey.

- There were very few road crossings that had culverts rather then bridges, but those culverts were located in reach 15 at SO 6 and in reach 19 at SO 129. They were both open arch culverts.

<u>Mining</u>

- Historically parts of the Middle Fork John Day River were dredged for gold. This dredging in the 1940's straightened the channel and has prohibited the river from reaching the floodplain at high flows, in turn increasing sediment transport capacity and the water velocity (Reclamation 2008).

<u>Stream Enhancement Projects</u>

- Stream restoration projects have been and are in the process of being completed on this section of the Middle Fork John Day River. Restoration has been done on The Nature Conservancy land and on land owned by the Confederated Tribes of the Warm Springs (Oxbow Property and Forrest Property). These projects are done to enhance fish habitat as well as restore typical channel processes to the river. Changes in land use and roads have impacted the river (Reclamation 2008).

- The Dunstan Homestead Preserve (The Nature Conservancy land), near Boulder Creek Ranch, improved 2.5 miles of the river in the summer of 2007.

Log structures were installed, vegetation was planted and rock barbs were removed from the river. (The Nature Conservancy 2007)

Grazing

- Grazing was present on portions of the survey. Within the Oxbow and Forrest Properties there were cattle access points to the river for water, but for the most part they were kept out of the river and off the banks. Unrestricted grazing occurs in other reaches of this survey and cattle have free access to the river (Reclamation 2008).

CHAPTER 2: STREAM SURVEY SUMMARY REPORTS

Hydrology Summary

Stream Name: Middle Fork John Day River

Hydrologic Unit Code: 170702030205, 170702030203, 170702030202, 170702030201, 170702030106

LLID: 1193015449167

Protocol Name: R6 Eastside AI

Date: 7/08/2008-7/28/2008

Reach	Valley Form	Mapped Gradient	Mapped Sinuosity	Average Bankfull Width/Depth Ratio	Average Entrench-ment Ratio	Rosgen Stream Class	Remarks
1	6	0.9	1.3	26.9	2.3	C	Survey began at the confluence with Camp Creek and reach 1 ended at the private property boundary.
2	5	1.0	1.2	12.0	1.3	C	Reach broken because channel became more confined; ended at a tributary on the right bank.
3	5	0.3	1.0	28.3	4.5	C	Reach ended due to channel becoming more confined.
4	6	0.7	1.2	38.1	1.3	F	Reach ended due to channel becoming less confined.
5	7	0.5	1.1	41.3	2.5	C	Reach 5 ended due to channel becoming more confined. Lower portion of reach is on National Forest Property and upper end is on Oxbow property.
6	7	0.7	1.1	56.9	1.3	F	Reach 6 ended due to channel becoming less confined and also ended at Rugged Creek confluence. Reach is entirely within Oxbow Property boundary.
7	7	0.4	1.2	21.3	3.8	C	Reach ends at a tributary on the left bank and entire reach is within Oxbow Property.
8 - North	8	0.6	1.1	12.4	20.0	C	Reach is entirely within Oxbow Property.
9	6	0.5	1.2	14.2	2.6	C	Reach 9 was broken due to the channel becoming more confined. The bottom portion of the reach is in Oxbow Property and the upper portion is on National Forest Property.
10	6	0.6	1.1	22.4	2.0	F	Reach was broken due to the channel becoming even more confined.
11	5	1.2	1.1	18.0	2.3	C	Reach 11 was broken due to channel becoming less confined and also ends at the confluence with Deerhorn Creek.
12	6	0.7	1.1	20.0	4.8	C	Reach 12 was broken because the channel became unconfined; the upper end of the reach is in Forrest Property boundary
13	9	0.5	1.1	21.0	2.2	C	Reach entirely w/ in Forrest Property boudary and is broken where the channel becomes moderately confined.
14	8	0.4	1.1	12.0	8.0	C	Bottom portion of reach in Forrest Property boundary
15	7	0.7	1.0	13.0	1.7	F	Reach 15 broken due to the channel becoming less confined.
16	8	0.7	1.2	15.8	6.4	C	Reach broke due to channel becoming more confined, at confluence w/ Clear Creek
17	7	0.8	1.1	8.4	27.7	C	Valley floor opens up where reach ends.
18	9	1.0	1.1	12.9	16.8	C	Reach ended at a fence just short of where the trees starts to appear and channel becomes more confined
19	7	1.5	1.1	0.0	0.0	C	Reach ends where the valley floor opens up.
20	7	0.5	1.1	12.4	3.8	C	Survey ended at the upstream end of private property.
Average		**0.7**	**1.1**	**20.4**	**5.8**		
8 - South	8	0.5	1.3	15.6	2.6	C	This is a side channel that runs parallel to reach 8 for just less then 1 mile. It was surveyed from where it entered M. Fk. John Day River to where it exited the river.

Hydrology Summary (continued)

Stream Name: Middle Fork John Day River

Hydrologic Unit Code: 170702030202, 170702030203, 170702030202, 170702030201, 170702030106

LLID: 1193015449167

Protocol Name: R6 Eastside AI

Date: 07/08/2008-07/28/2008

Reach	Surveyed Length in Feet	Side Channel Length in Feet	Mapped Channel Length in Feet	Mapped Minimum Elevation in Feet	Mapped Maximum Elevation in Feet	Stream Order	Discharge Cubic Feet per Second	Average Corrected Wetted Width	Average Bankfull Depth in Feet	Average Bankfull Max Depth in Feet	Average Bankfull Width in feet	Average Floodprone Width in Feet	Mapped Valley Width in Feet	Mapped Valley Length in Feet
1	2,734	400	1,272	3,448	3,460	6	35.20	39.2	1.18	2.25	60.5	140	1,007	988
2	6,251	130	5,560	3,503	3,559	6	40.25	33.8	2.63	3.00	36.0	46	974	4,764
3	7,323	160	8,057	3,559	3,586	6	47.26	35.8	1.58	1.75	49.5	225	393	7,867
4	6,910	300	7,054	3,586	3,631	6	47.18	41.5	1.43	1.60	61.0	81	489	5,982
5	5,905	720	5,914	3,631	3,663	5	34.85	41.3	1.25	1.35	55.8	142	414	5,280
6	2,377	130	2,277	3,663	3,678	5	31.64	44.2	1.17	1.30	74.0	94	288	2,106
7	3,068	325	3,405	3,678	3,693	5	31.12	33.4	1.53	2.00	42.5	160	843	2,731
8 - North	9,308	419	8,976	3,693	3,749	5	28.81	21.6	1.87	2.10	26.0	521	827	8,448
9	5,747	100	5,182	3,749	3,774	5	22.78	24.1	1.39	2.20	31.3	83	551	4,488
10	8,758	240	8,488	3,774	3,825	5	25.77	28.5	1.50	1.73	38.7	76	396	7,920
11	9,244	1,730	8,606	3,825	3,931	5	21.21	28.6	1.56	2.13	38.3	89	276	7,920
12	5,514	0	4,907	3,931	3,965	5	22.09	26.9	1.73	1.90	38.0	183	505	4,346
13	15,297	900	14,256	3,965	4,034	5	21.62	22.9	1.27	1.70	35.7	80	941	12,672
14	6,561	96	6,019	4,034	4,058	4	14.90	20.7	1.43	1.75	21.0	168	359	5,650
15	1,756	0	1,646	4,058	4,069	4	13.02	17.8	1.83	2.15	28.0	48	683	1,577
16	4,368	180	4,120	4,069	4,096	4	5.84	14.4	1.21	1.48	23.3	149	835	3,593
17	1,630	40	1,357	4,096	4,107	4	5.17	14.4	1.70	1.80	15.0	415	431	1,263
18	1,840	200	1,972	4,107	4,127	4	5.31	12.7	1.28	1.40	18.0	303	973	1,785
19	2,591	427	2,587	4,127	4,166	4	4.39	14.4	0.00	0.00	0.0	0	309	2,405
20	1,748	100	1,370	4,166	4,173	4	4.19	10.9	1.33	1.65	20.5	78	330	1,260
Total / Average	**108,930**	**6,597**	**103,025**				**23.13**	**26.4**	**1.44**	**1.76**	**35.7**	**154**	**591.2**	**93,045**
8 - South	5,926	550	4,858	3,691	3,713	5		16.70	1.22	1.35	21.0	54	817	3,852

Percent Habitat Area Summary

Stream Name: Middle Fork John Day River

Hydrologic Unit Code: 170702030202, 170702030203, 170702030202, 170702030201, 170702030106

LLID: 1193015449167

Protocol Name: R6 Eastside AI

Date: 07/08/2008-07/28/2008

Reach	% Slow Water	Number of Slow Water Units	% Fast Water	Number of Fast Water Units	Fast Water/Slow Water Ratio	% Side Channel	Number of Side Channel Units	% Special Habitat	Number of Special Habitats	% Tributary	Number of Tributaries
1	40.0	6	40.0	6	1.00	6.7	1	0.0	0	13.3	2
2	38.5	10	53.8	14	1.40	3.8	1	0.0	0	3.8	1
3	46.2	18	48.7	19	1.06	5.1	2	0.0	0	0.0	0
4	40.6	13	50.0	16	1.23	6.3	2	0.0	0	3.1	1
5	30.0	9	60.0	18	2.00	6.7	2	0.0	0	3.3	1
6	18.8	3	56.2	9	3.00	12.5	2	0.0	0	12.5	2
7	43.3	13	3.0	9	0.69	13.3	4	0.0	0	13.3	4
8 -North	34.8	23	43.9	29	1.26	10.6	7	0.0	0	10.6	7
9	45.1	23	52.9	27	1.17	2.0	1	0.0	0	0.0	0
10	31.0	18	58.6	34	1.89	5.2	3	0.0	0	5.2	3
11	29.2	19	43.1	28	1.47	21.5	14	0.0	0	6.2	4
12	48.5	16	51.5	17	1.06	0.0	0	0.0	0	0.0	0
13	52.3	68	40.0	52	0.76	3.8	5	0.0	0	3.8	5
14	38.1	16	47.6	20	1.25	2.4	1	0.0	0	11.9	5
15	33.3	5	46.7	7	1.40	0.0	0	6.7	1	13.3	2
16	48.2	26	37.0	20	0.77	3.7	2	0.0	0	11.1	6
17	52.9	9	35.3	6	0.67	5.9	1	0.0	0	5.9	1
18	39.1	9	43.5	10	1.11	8.7	2	0.0	0	8.7	2
19	32.1	9	35.7	10	1.11	28.6	8	3.6	1	0.0	0
20	54.5	12	40.9	9	0.75	4.5	1	0.0	0	0.0	0
Total / Average	**39.8**	**325**	**44.4**	**360**		**7.6**	**59**	**0.5**	**2**	**6.3**	**46**
8 - South	48	33	35	24	0.75	16	11	0	0	1	1

Slow water (pool) = A habitat unit with a hydraulic control, usually with reduced surface turbulence and has an average depth greater than riffles when viewed during low flow conditions.

Fast Water = A habitat unit without a hydraulic control, usually with relatively fast velocity and usually relatively shallow.

Side Channel = A lateral (i.e., secondary) channel with an axis of flow roughly parallel to the mainstem channel. This secondary channel transports water from an upstream confluence with the mainstem channel to a downstream confluence with the mainstem channel.

Special Habitats = A category for other habitats, waterfalls, chutes, culverts, marshes, braids, dry sections, man-made dams and structures.

Tributary = A secondary channel system that occupies a distinct drainage basin and has a unique headwater origin. The drainage basin of a tributary is a portion of the larger drainage basin of the mainstem channel.

Wood Summary

Stream Name: Middle Fork John Day River

Hydrologic Unit Code: 170702030202, 170702030203, 170702030202, 170702030201, 170702030106

Protocol Name: R6 Eastside AI

LLID: 1193015449167

Date: 07/08/2008-07/28/2008

			Number of Pieces of Wood per Mile				
Reach	Miles		Large	Medium	Small	Total	Frequency of Large Pieces of Wood*
1	0.52		0	0	3.8	3.8	0
2	1.18		0.9	0.9	0.9	2.5	0.03
3	1.39		2.2	7.2	18	27.3	0.08
4	1.31		3.1	14.5	21.4	38.9	0.02
5	1.12		0	0.9	1.8	2.7	0
6	0.45		0	0	0	0	0
7	0.58		0	0	0	0	0
8 - North	1.76		0	0.57	1.1	1.7	0
9	1.09		0.9	0	3.6	5	0.003
10	1.66		0	0	0	0	0
11	1.75		0.6	0	2.4	3	0.003
12	1.04		1.7	4.6	1.1	7.4	0.009
13	2.9		0	0	2.9	2.9	0
14	1.24		0	0	0	0	0
15	0.33		0	0	0	0	0
16	0.83		0	0	0	0	0
17	0.31		0	0	1	1	0
18	0.35		0	0	0	0	0
19	0.49		0	1	7	8	0
20	0.33		0	0	0	0	0
Total	**20.63**	**Average**	**9.4**	**29.7**	**65**	**104.2**	**0.00725**
8 - South	1.12		0.9	0	3.6	4.5	0.047

* Frequency of Wood = Number of Large Pieces of Wood/(Corrected Channel Length/Average Corrected Wetted Channel Width).

Pool Summary

Stream Name: Middle Fork John Day River

Hydrologic Unit Code: 170702030202, 170702030203, 170702030202, 170702030201, 170702030106

Protocol Name: R6 Eastside AI

LLID: 1193015449167

Date: 07/08/2008-07/28/2008

									Percentage of Pools Formed By											
Reach	Miles		Number of Pools	Number of Pools/Surveyed Mile of Stream	Frequency of Pools*	Number of Pools > 3 feet Deep/Surveyed Mile of Stream	Frequency of Pools > 3 Feet Deep *	Average Residual Pool Depth**	Beaver	Wood	Bedrock	Boulder	Stream Bend	Tributary	Culvert	Dam	Restoration	Other	Unknown
1	0.52		6	11.5	0.086	3.85	0.029	1.66				27	36				9	18	9
2	1.18		10	8.5	0.054	6.78	0.043	2.18				33	33				33		
3	1.39		18	12.9	0.088	3.6	0.024	1.61		24		27	18				30		
4	1.31		13	9.9	0.078	3.05	0.024	1.82		38		44	19						
5	1.12		9	8	0.063	0	0	1.36				36	55						9
6	0.45		3	6.7	0.056	2.2	0.019	1.73				25	75						
7	0.58		13	22.4	0.142	8.62	0.054	1.76		3		32	32				32		
8 - North	1.76		23	13.1	0.053	8.52	0.035	2.33		15		11	52			2		15	7
9	1.09		23	21.1	0.096	1.83	0.008	1.4		8		23	65					4	
10	1.66		18	10.8	0.059	0.6	0.003	1.24		5		32	58						5
11	1.75		19	10.9	0.059	2.29	0.012	1.17				76	5			14			5
12	1.04		16	15.4	0.078	2.88	0.015	1.77		5.5	5.5	28	39				22		
13	2.9		68	23.4	0.078	16.9	0.073	2.35				34	32			1	32	1	
14	1.24		16	12.9	0.05	0.81	0.003	1.65		3		27	36			9	21	3	
15	0.33		5	15.2	0.051	3.03	0.01	1.72				37.5	25					25	12.5
16	0.83		26	31.3	0.086	3.61	0.01	1.77					96						4
17	0.31		9	29	0.08	0	0	1.18		10		20	60					10	
18	0.35		9	25.7	0.062	0	0	1.04					100						
19	0.49		9	18.4	0.05	0	0	0.76		25		33	33			8			
20	0.33		12	36.4	0.075	0	0	1.11		8			92						
Total/ Average	**5**		**14.2**	**14.26**	**0.082**	**4.234**	**0.0232**	**1.716**	**0**	**13**	**5.5**	**32**	**48**	**0**	**0**	**6.8**	**26**	**11**	**7.4**
8 - South	1.12		33	29.5	0.093	11.6	0.037	0.037		7		2	70			2		2	16

* Frequency of Pools = Number of Pools/(Corrected Channel Length/Average Corrected Wetted Channel Width).

** Residual Pool Depth = Maximum Depth – Depth at Pools Tail Crest

Unstable and Undercut Bank Summary

Stream Name: Middle Fork John Day River

Hydrologic Unit Code: 170702030202, 170702030203, 170702030202, 170702030201, 170702030106

LLID: 1193015449167

Protocol Name: R6 Eastside AI

Date: 07/08/2008-07/28/2008

Reach		Miles	% Unstable Right Bank	% Unstable Left Bank	% Unstable Both Banks		% Undercut Right Bank	% Undercut Left Bank	% Undercut Both Banks
1		0.52	14.1	1.5	15.5		4.5	6.6	11.0
2		1.18	0.6	0.5	1.0		0.0	1.9	1.9
3		1.39	0.5	0.5	1.1		1.6	0.5	2.0
4		1.31	0.0	2.2	2.2		1.5	1.2	2.7
5		1.12	0.0	0.5	0.5		3.9	4.4	8.3
6		0.45	0.0	0.0	0.0		1.1	3.4	4.5
7		0.58	1.1	2.9	4.1		0.3	1.8	2.1
8 - North		1.76	0.0	0.0	0.0		0.0	1.7	1.7
9		1.09	1.1	1.4	2.5		0.7	0.7	1.4
10		1.66	0.5	1.0	1.5		1.3	0.3	1.7
11		1.75	0.0	0.0	0.0		0.0	0.6	0.6
12		1.04	0.8	0.0	0.8		0.5	0.0	0.5
13		2.90	0.9	1.2	2.1		2.7	3.7	6.4
14		1.24	1.6	1.8	3.0		2.1	4.9	7.0
15		0.33	0.9	0.0	0.9		1.7	1.7	3.4
16		0.83	3.7	2.9	6.5		8.9	8.5	17.4
17		0.31	0.0	0.0	0.0		0.0	0.0	0.0
18		0.35	0.5	0.5	1.1		7.3	4.8	12.1
19		0.49	0.1	0.0	0.1		2.5	0.6	3.1
20		0.33	0.0	1.4	1.4		10.9	11.8	22.7
Total/Average		**20.63**	**1.3**	**0.9**	**2.2**		**2.6**	**3.0**	**5.5**
8 - South		1.12	1.2	1.1	2.3		5.1	6.8	11.9

Count of Special Habitat Units

Stream Name: Middle Fork John Day River

Hydrologic Unit Code: 170702030202, 170702030203, 170702030202, 170702030201, 170702030106

Protocol Name: R6 Eastside AI

LLID: 1193015449167

Date: 07/08/2008-07/28/2008

Reach	Number of Waterfalls	Maximum Height of Waterfalls	Number of Chutes	Number of Braids	Number of Marshes	Number of Dams	Number of Dry Channels	Total Length of Dry Channels	Number of Culverts
1	0		0	0	0	0	0	0	0
2	0		0	0	0	0	0	0	0
3	0		0	0	0	0	0	0	0
4	0		0	0	0	0	0	0	0
5	0		0	0	0	0	0	0	0
6	0		0	0	0	0	0	0	0
7	0		0	0	0	0	0	0	0
8 - North	0		0	0	0	0	0	0	0
9	0		0	0	0	0	0	0	0
10	0		0	0	0	0	0	0	0
11	0		0	0	0	0	0	0	0
12	0		0	0	0	0	0	0	0
13	0		0	0	0	0	0	0	0
14	0		0	0	0	0	0	0	0
15	0		0	0	0	0	0	0	1
16	0		0	0	0	0	0	0	0
17	0		0	0	0	0	0	0	0
18	0		0	0	0	0	0	0	0
19	0		0	0	0	0	0	0	1
20	0		0	0	0	0	0	0	0
Total	**0**		**0**	**0**	**0**	**0**	**0**	**0**	**2**
8 - South	0		0	2	0	0	0	0	0

CHAPTER 3: RIPARIAN VEGETATION CONDITION

SUMMARY

Forrest Property-

Riparian vegetation data on the Forrest Property was surveyed from July 28, 2008 to July 30, 2008. The survey was done at three representative vegetation reaches delineated by dominant species present and channel geomorphology features. Reach delineation is shown in Maps 2 in Appendix G. A total of 1.2 stream miles were surveyed.

Riparian vegetation structure composed of 3% understory shrub cover with no cover from big or small trees. The dominant woody riparian shrubs were *Salix eriocephala* and *Alnus incana.* The ground cover was composed of approximately 65% grass/forb cover. For detailed summary of the riparian vegetation structure by reach, see Riparian Vegetation Structure Section, Tables 3.4-3.11.

Riparian vegetation disturbance was assessed based on the human influences present and proximity to the channel. The dominant influences consisted of planting strips (40 locations), road (14 locations), and hardened riprap (13 locations). A detailed summary of the disturbance presence per reach and proximity to the channel are in the Riparian Vegetation Disturbance Section, Graph 3.6.

Riparian vegetation canopy cover was assessed through densitometer readings, characterization, and cover of big tree and small tree. Channel canopy cover was 0.03%, while left bank was 0% and right bank 0%.

Oxbow Property-

Riparian vegetation data on the Oxbow Property was surveyed from July 21, 2008 to July 23, 2008. The survey was done at three representative vegetation reaches delineated by dominant species present and channel geomorphology features. Reach delineation is shown in Maps 4 in Appendix G. A total of 1.3 stream miles were surveyed.

Riparian vegetation structure composed of 0-9% cover of deciduous big and small type trees, with approximately 5% understory shrub cover. The dominant woody riparian shrubs were *Salix exigua* and *Symphoricarpos spp.* The ground cover was composed of approximately 70% grass/forb cover. For detailed summary of the riparian vegetation structure by reach, see Riparian Vegetation Structure Section, Tables 3.12- 3.23.

Riparian vegetation disturbance was assessed based on the human influences present and proximity to the channel. The dominant influences consisted of planting strips (39 locations), mine tailings (20 locations), and fence (13 locations). A detailed summary of the disturbance presence per reach and proximity to the channel are in the Riparian Vegetation Disturbance Section, Tables 3.7.

Riparian vegetation canopy cover was assessed through densitometer readings, characterization, and cover of big tree and small tree. Channel canopy cover was 0.66%, while left bank was 1.79% and right bank 7.97%.

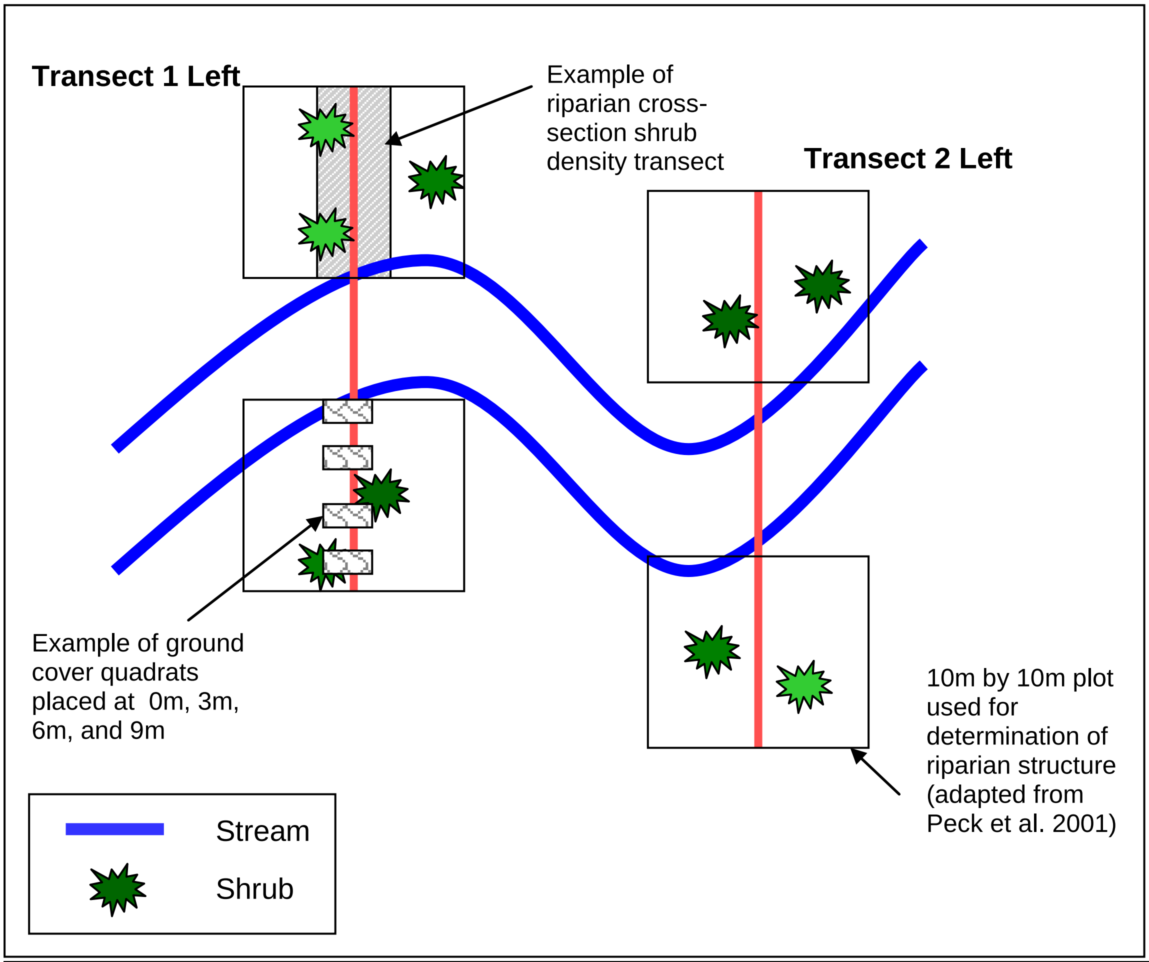
METHODS

Field Survey Design

Riparian condition data collection was completed over two consecutive weeks from July 21st to July 31st, 2008. Field sampling setup followed protocol described by Peck et al. (2001). Three riparian condition assessments were completed on each piece of the Forrest and Oxbow Properties. These assessments were considered a reach. The reach delineation was made based on changes in vegetative structure, geomorphology, and human impacts, such as mining or roads. (Geomorphic delineation was done by Reclamation 2008). Measurements of riparian condition were sampled along 11 channel transects (perpendicular to the direction of the valley bottom) placed 50 meters apart, resulting in 33 transects per stream property. Measurements were made on both left and right bank to reduce the variation caused by difference in fluvial surfaces. Left and right bank were determined facing downstream.

Each of the 33 channel transects was paired with vegetation cover transects, vegetation belt transects, and vegetation plots for the purpose of corresponding analysis. Vegetation cover transects stretched the length of water's edge to 10 meters on left and right bank. Measurements of understory cover were taken along each of the vegetation cover transects at 0, 3, 6, and 9 meters. The vegetation belt transect stretched from water's edge to 10 meters placed over the vegetation cover transect. Overstory shrub species density was sampled in the vegetation belt transects. Riparian vegetation structure, disturbance, and canopy cover outlined by Peck et al. (2001) were measured within a 10 meter by 10 meter plot placed over the vegetation and channel transect. Graph 3.1 displays the difference between the channel, vegetation cover, vegetation belt transects, and vegetation plots.

Forrest and Oxbow properties were planted in the spring of 2006 by a contractor for the Warm Springs Tribe with funding and oversight from the NRCS CREP program. These plantings were encountered within the vegetation survey. The planting mat and species were recorded as "planting mat" within the understory cover plots and shrub species were recorded within understory cover and density as a planted species. The CREP planting were considered a human influence and recorded as a vegetation disturbance.



Graph 3.1: Model of field sampling with two transects. Transects are depicted as lines stretching 10 meters each side of the stream.

<u>Riparian Vegetation Structure</u>

Canopy, Understory, and Ground Layers

Riparian structure was assessed following Peck et al. (2001) protocol. Type and amount of riparian vegetation at three layers: a canopy, an understory, and ground cover layer were measured at each vegetation plot. Vegetation type for each layer was recorded followed by an estimate of aerial cover. The cover classes are list in Table 3.1. Type of each riparian vegetation layer is listed in Table 3.2. Appendix F contains the codes and associated species name or vegetation type used for data entry and observation.

Table 3.1- Cover Classes (adapted from Daubenmire 1959)	
Class	**Percent Cover**
0	Absent
1	1-10%
2	10-25%
3	25-50%
4	50-75%
5	75-90%
6	90% >

Table 3.2- Riparian Vegetation Types
Canopy Layer
None
Mixed
Broadleaf Evergreen
Coniferous
Deciduous
Understory Layer
Woody Shrub and Sapling
Forbs, Grasses, Sedge, and Rush
Ground Cover Layer
Woody Shrub and Sapling
Forbs, Grasses, Sedge, and Rush
Bareground, Rock, and Barren

Woody Riparian Shrub Density

Woody riparian species density was measured within the 33, 3-meter belt transects, per stream property. Individual plants rooted within the belt transect were recorded by species with the exception of the clonal species *S. exigua* and *S. melanopis* where individual stems were recorded. It was characteristic of many of the species to form clumps, so an individual plant was counted based on the distance of separation between the plant bases. Plant base separations greater than 10 cm (approximant width of observer's hand) were considered a separate individual.

Species density was counted within the 10 meter length starting at water's edge. Species counts were divided by the area (30 m^2) for density calculations. Species density was calculated for each channel transect, each vegetation assessment reach, and each stream property. Density classes were established for the purpose of analysis (Table 3.3).

Table 3.3- Shrub Density Classes	
Class	**Density**
0	Absent
1	0.0-0.1
2	0.1-0.5
3	0.5-1
4	1-5
5	5-10
6	10+

Understory Cover

Understory plant community composition was assessed using plant population measuring techniques adapted from of United States Forest Service-PIBO (Coles-Ritchie 2006). Understory foliar cover was measured using a 50 cm x 20 cm quadrant frame of Daubenmire (1959) along the 22 vegetation cover transects per stream. The tape stretched from 0 to 10 m, along which a reading of cover was taken at 0 m, 3 m, 6 m, and 9 m. Foliar cover was recorded as the vegetation cover of the dominant and sub-dominant species for each plot. Data were summarized with species cover to determine the species weighted average cover for each vegetation reach and stream.

Riparian Vegetation Disturbance

Riparian disturbance was measured following the protocol of Peck et al. (2001). Presence and proximity of various types of human land-use activities disturbances present in the riparian area were assessed. The list of human influences proposed by Peck et al. (2001) was expanded for the survey to include human influences present on the Forrest and Oxbow Properties. Human influences included:

- Bridge
- Buildings
- Gravel Pit
- Grazing (current activity)
- Hayfield
- Inlet/outlet pipes
- Landfill/trash
- Logging operations
- Mine tailings
- Pasture
- Park/lawn
- Pavement
- Plantings (planting strip mats)
- Railroad (including old grades)
- Restoration (current excavation)
- Roads (paved and gravel)
- Rock weirs
- Row crops
- Utility (telephone, electrical, etc.)
- Walls/dikes

The proximity classes were determined by relationship to the riparian area transects (Peck et al. 2001). These classes included: present at or on stream bank, present between the bank and 10m from the bank, and present between 10m and 30m from the bank.

Riparian Vegetation Canopy Cover

Canopy cover was measured with a spherical convex densitometer Model A following the protocols established by Kelley and Krueger (2005) and Peck et al. (2001). Densitometer readings were taken at the center of the channel, left bank, and right bank on the 33 vegetation transects per stream property. Left and right bank canopy cover readings provided an estimate of canopy cover within the bank and riparian area. At each location, four densitometer readings were taken facing north, south, east, and west. The four readings were averaged providing one value of canopy cover for each location, for a total of 33 center, 33 left, and 33 right readings per stream. The average canopy cover, at center and along the banks, was calculated from the 33-densitometer readings per stream.

RIPARIAN VEGETATION STRUCTURE

Forrest Property Summary

The understory (0.5 to 5 m height) on the Forrest Property was determined with semi-quantitative visual assessment to be less than 5% shrub and herbaceous aerial cover, respectively (Tables 3.4 and 3.5). The ground layer structure was predominantly composed of herbaceous cover less than 0.5 m in height (Tables 3.6, 3.7, and 3.8). The canopy layer was not present on this channel reach within the surveyed plots. The densiometer value for the stream was less than 1% cover. The following tables and graphs display the quantitative summaries for this channel reach of the Middle Fork John Day River. The values used to make the reach summary graphs are displayed in Appendix B.

Riparian vegetation cover was also quantified in cover plots at 0, 3, 6, and 9 meters from the channel. The *Alopecurus pratensis* and forb were the most common species within the plots, followed by *Juncus spp., Carex spp,* and *Scirpus microcarpus.* Planting mats comprised 23% of the cover within all the plots, but were only present at 3, 6, and 9 meters from the channel. Table 3.9 displays the percent cover of each understory species within the cover plots.

The density of the woody species within the surveyed transects was less than 2 plants/ m^2. The dominant species were *Alnus incana, Salix boothii,* and *Salix eriocephela.* Table 3.11 displays the woody density and the percent of the total density for each species, while Appendix C shows the woody species density summarized for left and right bank and amount of density from planted woody shrubs. In addition, Appendix C includes the woody species density by reach.

Throughout the survey, invasive and noxious species were noted when present within or in between transects. Species that were present along the three reach of the Upper John Day River are displayed in Table 3.10. *Iris pseudacorus* was observed along the banks in stream survey reach 13 and 14. The species currently is not documented Grant County and only in few locations with Eastern Oregon, yet surveyor identification stated its presence within the Forrest Property.

From the surveyed transects, the Forrest Property of the Middle Fork John Day River exhibited species that are part of the Meadow Foxtail plant association (Crowe and Clausnitzer 1997). This plant community is often a result of seeded meadows (1997). The dominant species present within the riparian area surveyed were considered obligate wetland or facultative wetland species (USDA, NRCS 2008). Appendix F displays the wetland indicator rating for each species, which provides an indication of the species riparian characteristics. This rating is the based on the probabilities of the species occurring in wetlands versus non-wetland (USDA, NRCS 2008).

There were few overstory or establishing shrub species excluding the planted shrubby species (Table 3.11). Plantings introduced a diversity of woody species including: *Alnus incana, Betula spp., Crataegus douglasii, Populus trichocarpa, Pinus ponderosa, Prunus virginiana, Ribes spp., Rosa woodsii,* and *Symphoricarpos spp.* On the three reaches the planted shrub species were the majority of the overall woody species density for the reach (Appendix C). It was observed the health of the plantings depended on location to the stream channel, where riparian species were more vigorous when planted near the stream channel and facultative species had higher vigor when farther from the stream channel.

The overall riparian vegetation condition displayed characteristics of the desired indicators for a Proper Functioning channel. This observation is based on the vegetation component of proper functioning condition streams (Prichard et al. 1998). First, the species or rock bank cover was adequate to dissipate and protect the banks from energy of a flowing stream (Table 3.7 and 3.8). Second, vegetation displayed high vigor and diverse age distribution. The presence of meadow foxtail species impacted the diversity of riparian understory herbaceous species, where sedges and rushes were not the dominant ground cover species. The streambank vegetation was not strongly comprised of species with bank stabilizing root masses and did not provide current sources of coarse or large woody material (Tables 3.9 and 3.11). These two characteristics may be considered less than desirable for the functionality of a healthy riparian system.

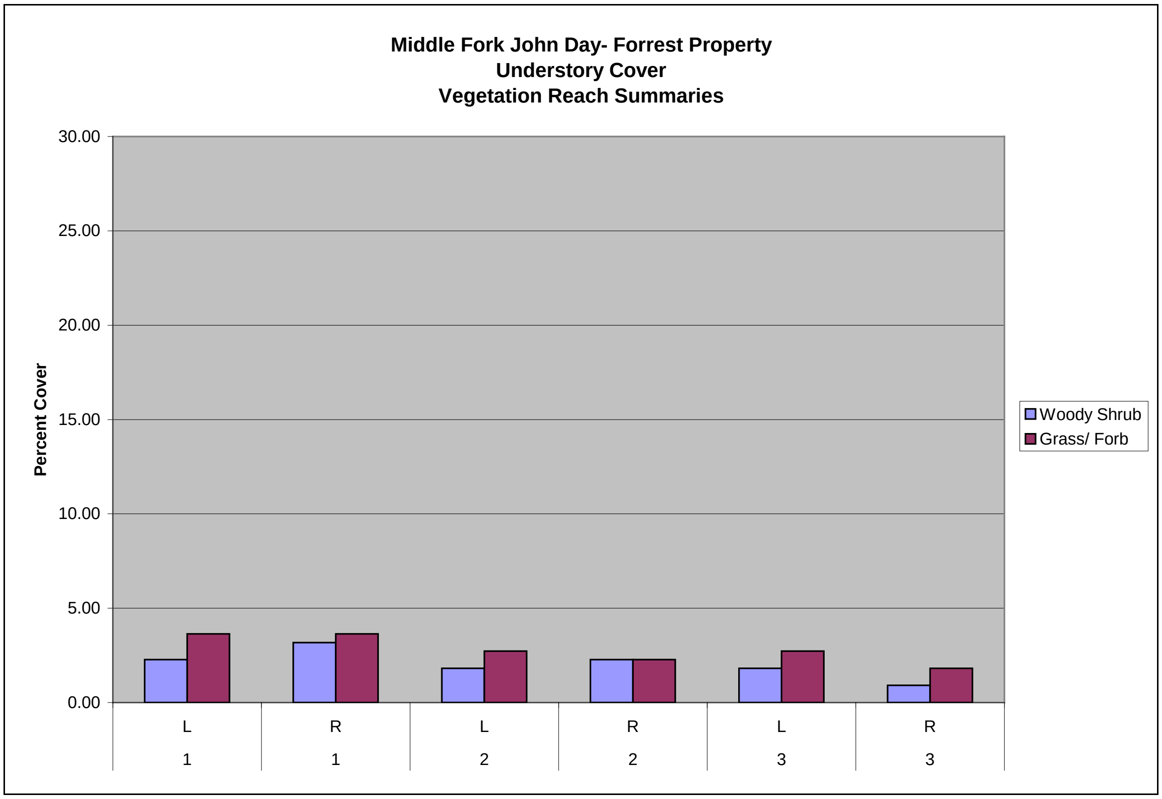
Understory Cover

Table 3.4 Woody Shurb Understory Cover- Stream Summary

Stream	Bank	Cover
FP	L	3.03
FP	R	3.26

Table 3.5 Grass/Forb Understory Cover- Stream Summary

Stream	Bank	Cover
FP	L	3.03
FP	R	2.58



Graph 3.2: Percent understory cover on left (L) and right (R) bank summarized for each vegetation reach within the Forrest Property. Reach 1 (1), Reach 2 (2), Reach 3 (3).

Ground Cover

Table 3.6 Woody Ground Cover- Stream Summary

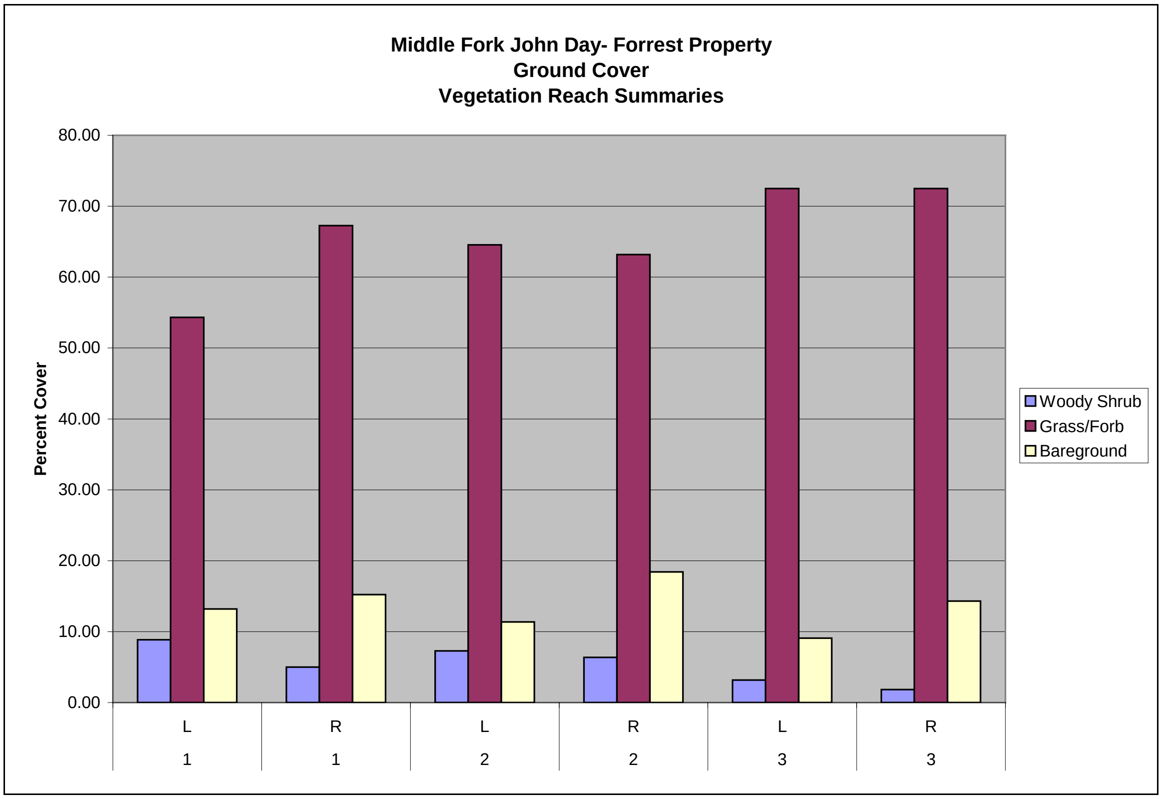
Stream	Bank	GrWoody_Cover
FP	L	5.38
FP	R	1.97

Table 3.7 Grass/Forb Ground Cover- Stream Summary

Stream	Bank	GF_Cover
FP	L	63.79
FP	R	67.65

Table 3.8 Barren/Rock Ground Cover- Stream Summary

Stream	Bank	BG_Cover
FP	L	11.21
FP	R	15.98



Graph 3.3: Percent ground cover on left (L) and right (R) bank summarized for each vegetation reach within the Forrest Property. Reach 1 (1), Reach 2 (2), Reach 3 (3).

Understory Species Cover

Table 3.9- Understory Species Percent Cover - Within Cover Plots Middle Fork John Day-Forrest Property									
		L				R			
Species	**CODE**	**0**	**3**	**6**	**9**	**0**	**3**	**6**	**9**
annual Forb	AF	0.00	0.00	0.09	0.76	0.00	0.00	0.00	0.00
Alnus incana	ALIN	0.00	0.65	0.00	0.00	0.00	1.37	0.43	0.43
Alopecurus pratensis	ALPR	10.16	9.76	22.54	9.24	1.02	5.48	23.71	9.05
barren	BARREN	0.00	0.00	1.58	1.53	0.00	1.45	1.55	0.00
Bromus tectorum	BRTE	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.26
Carex aquatilis	CAAQ	0.32	0.00	0.00	0.00	1.25	0.00	0.00	0.00
Calamagrostis canadensis	CACA4	0.00	0.81	0.00	0.00	0.00	0.00	0.26	0.00
Carex lasiocarpa	CALA11	0.00	0.00	0.00	0.00	0.00	0.00	1.03	0.00
Carex lenticularis	CALE8	0.56	0.00	0.00	0.00	1.02	0.00	0.00	0.00
Carex nebrascensis	CANE	2.42	0.00	0.00	0.42	5.86	4.03	1.29	0.60
Carex spp.	CAREX	3.15	5.65	0.00	1.95	6.33	3.06	3.79	9.57
Carex utriculata	CAUT	0.00	0.00	0.96	0.00	0.00	0.65	0.00	0.00
Cirsium arvense	CIAR4	0.00	0.56	0.70	0.42	0.00	0.40	0.86	1.64
Deschampsia cespitosa	DECE	0.00	0.00	0.96	0.25	0.00	0.00	0.00	0.00
Eleocharis	ELEOC	7.98	0.65	0.00	0.00	4.14	0.81	0.00	0.00
Equisetum	EQUIS	0.81	0.24	0.09	0.59	0.63	0.48	0.52	0.00
forb	F	13.39	18.31	13.07	6.10	4.84	10.89	11.29	6.90
Festuca spp.	FESTU	0.00	0.81	0.79	0.00	0.00	0.00	0.00	0.43
Juncus arcticus	JUARL	0.89	1.37	1.05	0.00	0.47	1.94	0.00	0.00
Juncus spp	JUNCU	7.10	10.97	5.79	5.93	7.19	2.10	3.10	2.76
Phalaroides arundinacea	PHAR3	0.00	0.00	1.14	0.00	0.00	1.21	0.00	0.00
Pinus ponderosa	PIPO	0.00	0.00	1.49	0.00	0.00	0.00	0.00	0.00
planting mat	plmat	0.00	5.81	39.47	24.41	0.00	5.81	13.97	24.83
Poa spp.	POA	0.24	0.97	1.84	2.37	0.00	1.37	0.78	0.69
Prunus virginiana	PRVI	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00
rock	ROCK	0.00	5.81	0.00	0.00	0.00	0.00	1.55	6.21
Salix spp.	SA	0.00	0.00	0.00	0.00	0.00	0.24	0.60	0.00
Scirpus microcarpus	SCMI2	10.24	0.24	0.79	0.76	7.97	3.63	0.95	2.84
Symphoricarpos spp.	SYMPH	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00
Thinopyrum	THINO	0.00	3.55	1.14	1.78	0.00	0.24	0.00	3.28
Trisetum	TRISE	0.00	0.48	0.26	0.00	0.00	0.00	0.00	0.43

Table 3.10: Middle Fork John Day River- Forrest Property Observed Invasive and Noxious Species	
Common Name	**Scientific Name**
Canada thistle	*Cirsium arvense*
Reed Canary grass	*Phalaroides arundinacea*
Cheatgrass	*Bromus tectorum*
Yellow Flag iris	*Iris pseudacorus*

Shrub Density

Table 3.11. Middle Fork John Day- Forrest Property Density of species within belt transects				
Species	**Code**	**Count**	**Density/m^2**	**Percent Species Density**
Alnus incana	ALIN	56	1.87	29.9
Artemisia tridentata	ARTR	4	0.13	2.1
Betula spp.	BETUL	5	0.17	2.7
Ceanothus spp.	CEANO	1	0.03	0.5
Crataegus douglasii	CRDO2	2	0.07	1.1
Pinus contorta	PICO	1	0.03	0.5
Pinus ponderosa	PIPO	11	0.37	5.9
Populus trichocarpa	POBAT	5	0.17	2.7
Prunus virginiana	PRVI	6	0.20	3.2
Ribes spp.	RIBES	9	0.30	4.8
Rosa woodsii	ROWO	12	0.40	6.4
Salix boothii	SABO2	15	0.50	8.0
Salix eriocephela	SAER	31	1.03	16.6
Salix exigua	SAEX	11	0.37	5.9
Salix geyeriana	SAGE2	1	0.03	0.5
Salix lucida	SALUL	8	0.27	4.3
Salix melanopsis	SAME2	6	0.20	3.2
Symphoricarpos spp.	SYMPH	3	0.10	1.6

Oxbow Property Summary

The understory (0.5 to 5 m height) on the Oxbow Property was determined with semi-quantitative visual assessment to be approximately 5% shrub cover and 11% herbaceous aerial cover (Tables 3.12 and 3.13). The vegetation structure was predominantly composed of herbaceous ground cover less than 0.5 m in height (Tables 3.14, 3.15, and 3.16). The canopy layer was determined to be approximately 10% deciduous big and small tree with less than 1% conifer big tree. The densiometer value for the stream was less than 1% cover. The Canopy Cover Section (page 45) provides more detail on the canopy layer. The following tables and graphs display the quantitative summaries for this channel reach of the Middle Fork John Day River. The values used to make the reach summary graphs are displayed in Appendix B.

Riparian vegetation cover was also quantified in cover plots at 0, 3, 6, and 9 meters from the channel. The *Carex lenticularis* and forb were the most common species within the plots, followed by *Alopecurus pratensis, Carex spp,* and wheatgrass. Planting mats comprised 30% of the cover within all the plots, but were only present at 6 and 9 meters from the channel. Table 3.17 displays the percent cover of each understory species within the cover plots.

The density of the woody species within the surveyed transects was less than 6 plants/ m^2. The dominant species were *Salix exigua, Symphoricarpos* *spp.,* and *Rosa woodsii.* Table 3.19 displays the woody density and the percent of the total density for each species, while Appendix C shows the woody species density summarized for left and right bank and amount of density from planted woody shrubs. In addition, Appendix C includes the woody species density by reach.

Throughout the survey, invasive and noxious species were noted when present within or in between transects. Species that were present along the three reach of the Upper John Day River are displayed in Table 3.18.

From the surveyed transects, the Oxbow Property of the Middle Fork John Day River exhibited species that are part of the several different plant associations, yet the dominant species present were not specifically described as a plant association by Crowe and Clausnitzer (1997). The dominant species present within the riparian area surveyed were considered obligate wetland or facultative wetland species (USDA, NRCS 2008). Appendix F displays the wetland indicator rating for each species, which provides an indication of the species riparian characteristics. This rating is the based on the probabilities of the species occurring in wetlands versus non-wetland (USDA, NRCS 2008).

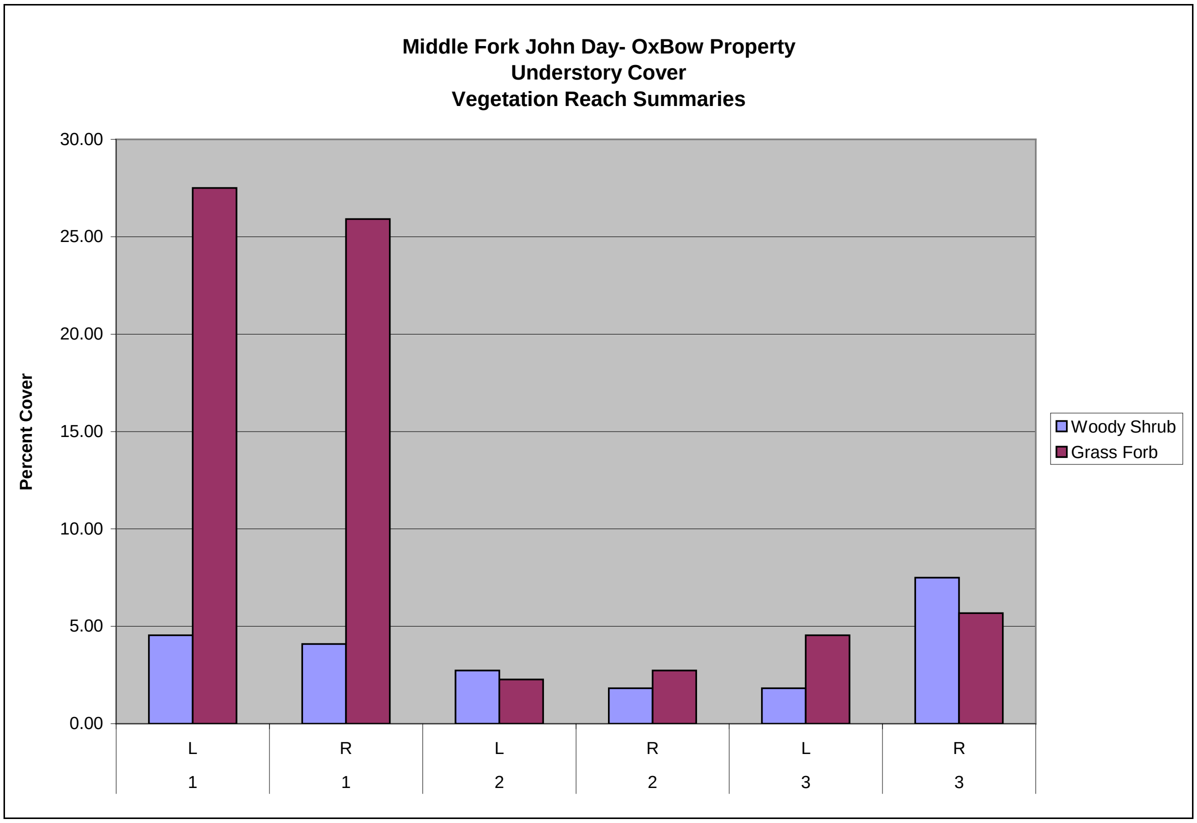
Plantings introduced a diversity of woody species including: *Alnus incana, Crataegus douglasii, Populus trichocarpa, Prunus virginiana, Pinus ponderosa, Ribes spp., Rosa woodsii, Salix boothii, Salix melanopis,* and *Symphoricarpos spp.* It was observed the health of the plantings depended on location to the stream channel, where riparian species were more vigorous when planted near the stream channel and facultative species had higher vigor when farther from the stream channel. The planted species were less than 50% of the average woody species density for the Oxbow Property (Appendix C). Non-planted species were riparian species that exhibited bank stabilization and riparian woody diversity. The dense transects with numerous woody shrubs were transects in Reach 3 with young and mature *Alnus incana, Cornus stolonifera,* and *Salix eriocephala,* and transects over depositional bars establishing with *Salix exigua and Salix melanopsis* (Appendix C).

The overall riparian vegetation condition displayed characteristics of the desired indicators for a Proper Functioning channel. This observation is based on the vegetation component of proper functioning condition streams (Prichard et al. 1998). First, the species bank cover was adequate to dissipate and protect the banks from energy of a flowing stream (Table 3.15 and 3.16). Second, vegetation displayed high vigor and diverse age distribution. Third, the streambank vegetation was comprised of species with bank stabilizing root masses (Table 3.17). Specifially, the dominance of *Carex spp*. within the riparian area exhibit high density of root mass and bank cover. The high diversity of riparian herbaceous species and woody riparian species indicated ecosystem stability and riparian soil moisture characteristics.

Understory Cover

Table 3.12: Woody Shurb Understory Cover- Stream Summary		
Stream	**Bank**	**Woody_Cover**
OB	L	5.68
OB	R	5.00

Table 3.13: Grass/Forb Understory Cover- Stream Summary		
Stream	**Bank**	**GF_Cover**
OB	L	11.44
OB	R	11.44



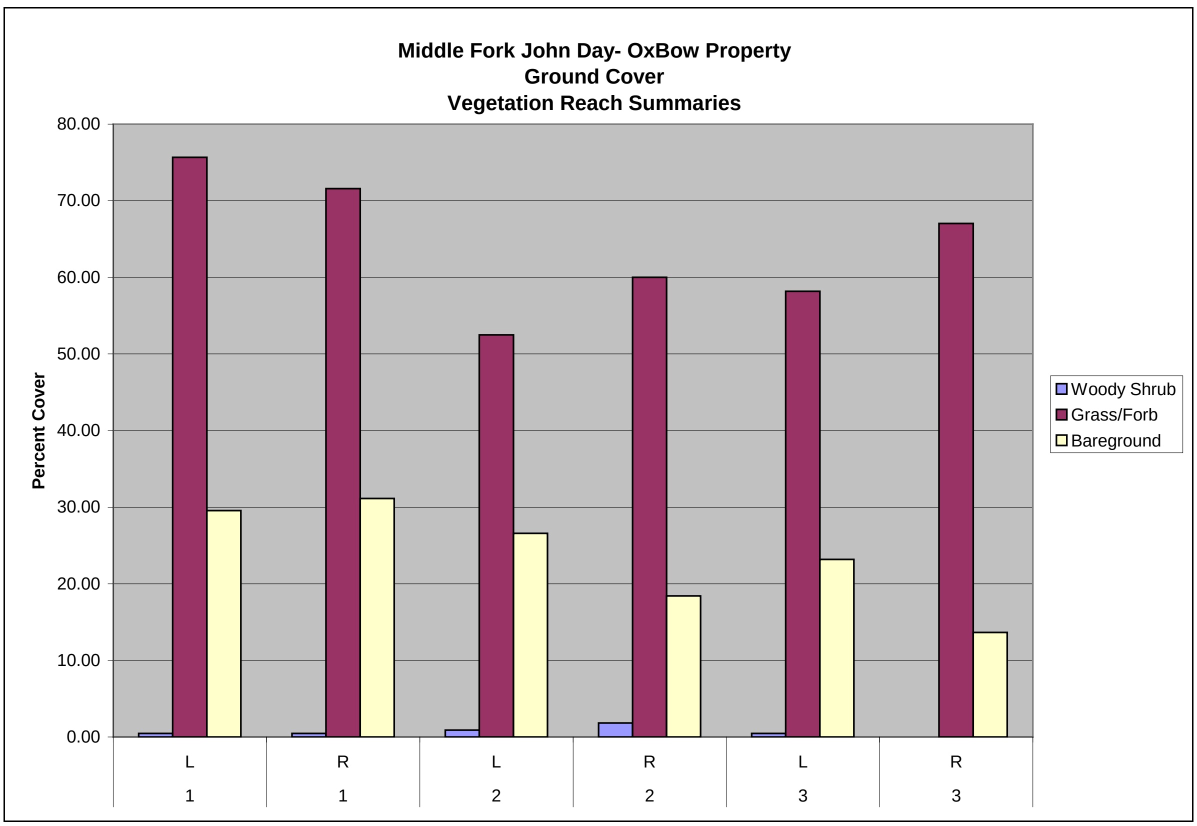
Graph 3.4: Percent understory cover on left (L) and right (R) bank summarized for each vegetation reach within the Forrest Property. Reach 1 (1), Reach 2 (2), Reach 3 (3).

Ground Cover

Table 3.14: Woody Ground Cover- Stream Summary		
Stream	**Bank**	**GrWoody_Cover**
OB	L	0.61
OB	R	0.76

Table 3.15: Grass/Forb Ground Cover- Stream Summary		
Stream	**Bank**	**GF_Cover**
OB	L	62.12
OB	R	66.21

Table 3.16: Barren/Rock Ground Cover- Stream Summary		
Stream	**Bank**	**BG_Cover**
OB	L	26.44
OB	R	21.06



Graph 3.5: Percent ground cover on left (L) and right (R) bank summarized for each vegetation reach within the Forrest Property. Reach 1 (1), Reach 2 (2), Reach 3 (3).

Understory Species Cover

Table 3.17: Understory Species Percent Cover - Within Cover Plots									
Oxbow Property									
		L				R			
Species	**CODE**	**0**	**3**	**6**	**9**	**0**	**3**	**6**	**9**
annual Forb	AF	0.00	0.00	0.45	0.04	0.00	0.00	0.44	1.20
Alopecurus pratensis	ALPR	1.08	5.40	4.55	4.64	0.00	13.44	5.88	0.28
Bromus tectorum	BRTE	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.00
Carex aquatilis	CAAQ	1.08	0.97	0.00	0.00	0.00	0.00	0.00	0.00
Carex lasiocarpa	CALA11	0.00	0.32	1.45	0.18	0.41	0.00	0.00	0.00
Carex lenticularis	CALE8	75.41	0.81	0.45	0.63	33.38	1.31	0.00	0.00
Carex nebrascensis	CANE	0.00	0.00	0.00	0.00	0.81	0.57	0.00	0.00
Carex spp.	CAREX	4.32	3.79	0.45	3.75	10.68	5.74	17.63	2.69
Carex utriculata	CAUT	0.95	3.63	1.73	1.16	0.68	0.57	0.44	2.13
Cirsium arvense	CIAR4	0.00	2.18	0.00	0.63	0.00	2.54	0.26	0.83
Crataegus douglasii	CRDO2	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00
Deschampsia cespitosa	DECE	1.22	1.29	1.36	0.00	0.00	2.21	0.88	1.39
Eleocharis	ELEOC	0.00	0.00	0.00	0.00	0.68	0.16	0.00	0.00
Equisetum	EQUIS	0.00	2.18	0.00	0.00	0.00	0.16	0.35	0.28
forb	F	7.57	19.35	21.27	16.61	3.51	11.64	13.86	11.11
Festuca spp.	FESTU	0.00	0.00	0.18	1.43	0.00	0.00	0.44	0.00
Juncus arcticus	JUARL	0.00	1.37	0.00	0.89	0.68	1.89	0.00	0.00
Juncus spp	JUNCU	2.03	2.58	4.45	0.80	6.49	2.54	1.32	2.04
Phalaroides arundinacea	PHAR3	0.68	0.56	0.00	0.00	0.00	2.30	1.14	0.28
Calamagrostis rubescens	Pine grass	0.00	0.00	0.82	0.00	0.00	0.00	0.00	0.00
planting mat	plmat	0.00	0.00	6.55	78.75	0.00	0.00	6.32	106.67
Poa spp.	POA	0.00	0.97	2.64	1.88	0.00	0.82	8.86	2.59
rock	ROCK	0.00	0.00	1.64	0.00	0.00	1.48	1.58	1.67
Rumex crispus	RUCR	0.00	0.00	1.36	0.00	0.00	0.00	0.00	0.00
Rosa woodsii	ROWO	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.19
Salix spp.	SA	0.00	0.00	0.00	0.00	0.00	0.57	0.44	1.39
Scirpus microcarpus	SCMI2	4.59	0.65	1.09	0.80	8.92	4.59	0.44	0.46
Symphoricarpos spp.	SYMPH	0.00	0.00	1.27	0.71	0.00	0.00	0.00	0.28
Thinopyrum	THINO	0.00	4.35	4.64	5.00	0.00	2.46	9.74	4.35
Trisetum	TRISE	0.00	0.00	0.64	0.00	0.00	0.00	0.44	0.00
water	WATER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.67

Table 3.18: Middle Fork John Day River- Oxbow Property Observed Invasive and Noxious Species	
Common Name	**Scientific Name**
Canada thistle	*Cirsium arvense*
Reed Canary grass	*Phalaroides arundinacea*
Cheatgrass	*Bromus tectorum*

Shrub Density

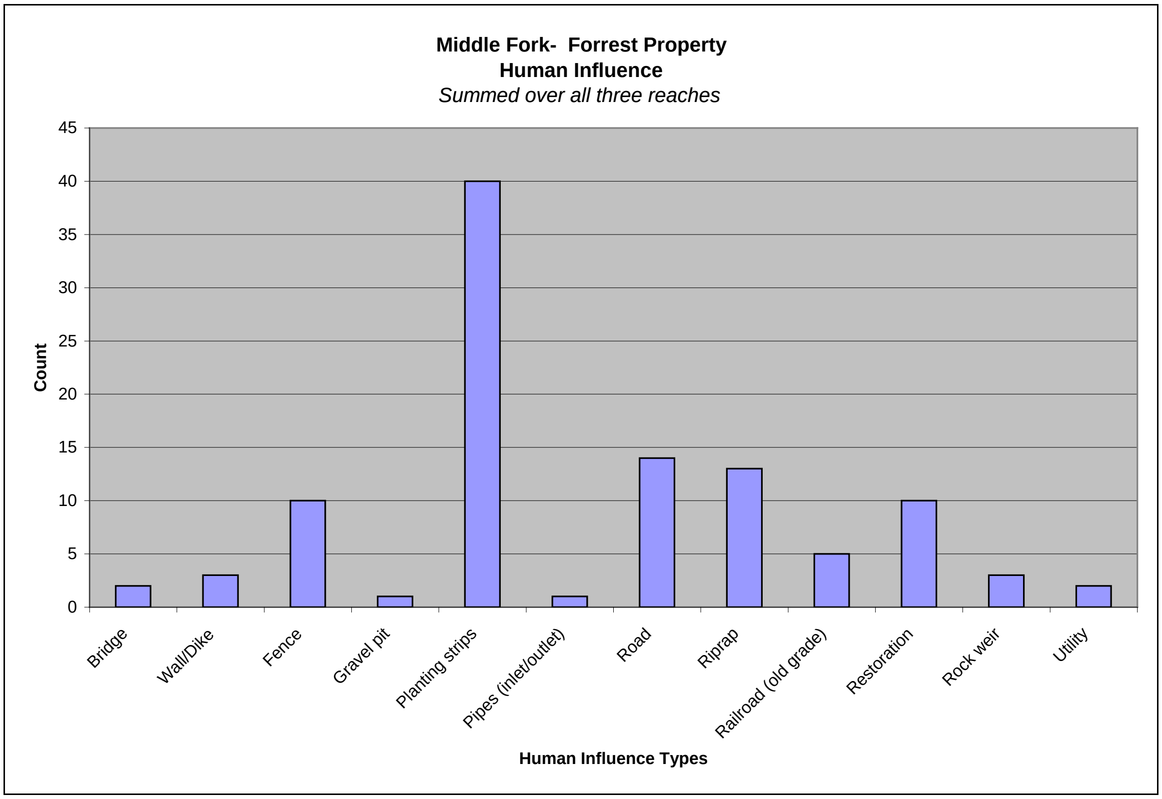
Table 3.19: Middle Fork John Day- Oxbow Property Density of species within belt transects				
Species	**Code**	**Count**	**Density/m^2**	**Percent Species Density**
Alnus incana	ALIN	47	1.57	6.1
Amleanchier alnifolia	AMALA	2	0.07	0.3
Betula spp.	BETUL	7	0.23	0.9
Cornus stolonifera	COSES	14	0.47	1.8
Crataegus douglasii	CRDO2	40	1.33	5.2
Junipercus occidentalis	JUOC	1	0.03	0.1
Pinus ponderosa	PIPO	10	0.33	1.3
Populus trichocarpa	POBAT	8	0.27	1.0
Prunus virginiana	PRVI	10	0.33	1.3
Ribes spp.	RIBES	15	0.50	1.9
Rosa woodsii	ROWO	73	2.43	9.5
Salix boothii	SABO2	47	1.57	6.1
Salix drummundiana	SADR	1	0.03	0.1
Salix eriocephela	SAER	47	1.57	6.1
Salix exigua	SAEX	191	6.37	24.8
Salix geyeriana	SAGE2	10	0.33	1.3
Salix lemmonii	SALE	1	0.03	0.1
Salix lucida	SALUL	4	0.13	0.5
Salix melanopsis	SAME2	60	2.00	7.8
Symphoricarpos spp.	SYMPH	182	6.07	23.6

RIPARIAN VEGETATION DISTURBANCE

Forrest Property Summary

Human influence within the riparian zone was determined by visual assessment of presence, type, and proximity to the stream channel. Planting strips had the highest occurrence within the vegetation transects, followed by road and riprap disturbances (Graph 3.6). The road influences were only present in Reach 1 and Reach 2, while riprap was present in Reach 2 and Reach 3 (Appendix D). Rock weirs and riprap were human influences to the bank, while other influences were close (within the 10 x 10m plot) or were present (outside plot area).

Planting strips created a disturbance to the riparian area, first restricting of vegetation under the black mats, and second disturbing the soil, where early seral vegetation species were observed to establish in failed plantings. The paved road was a disturbance to the riparian area, by constraining the active channel and effective riparian zone. Both the rock weirs and riprap are often considered a human disturbances present to ameliorate bank degradation and create stream habitat.

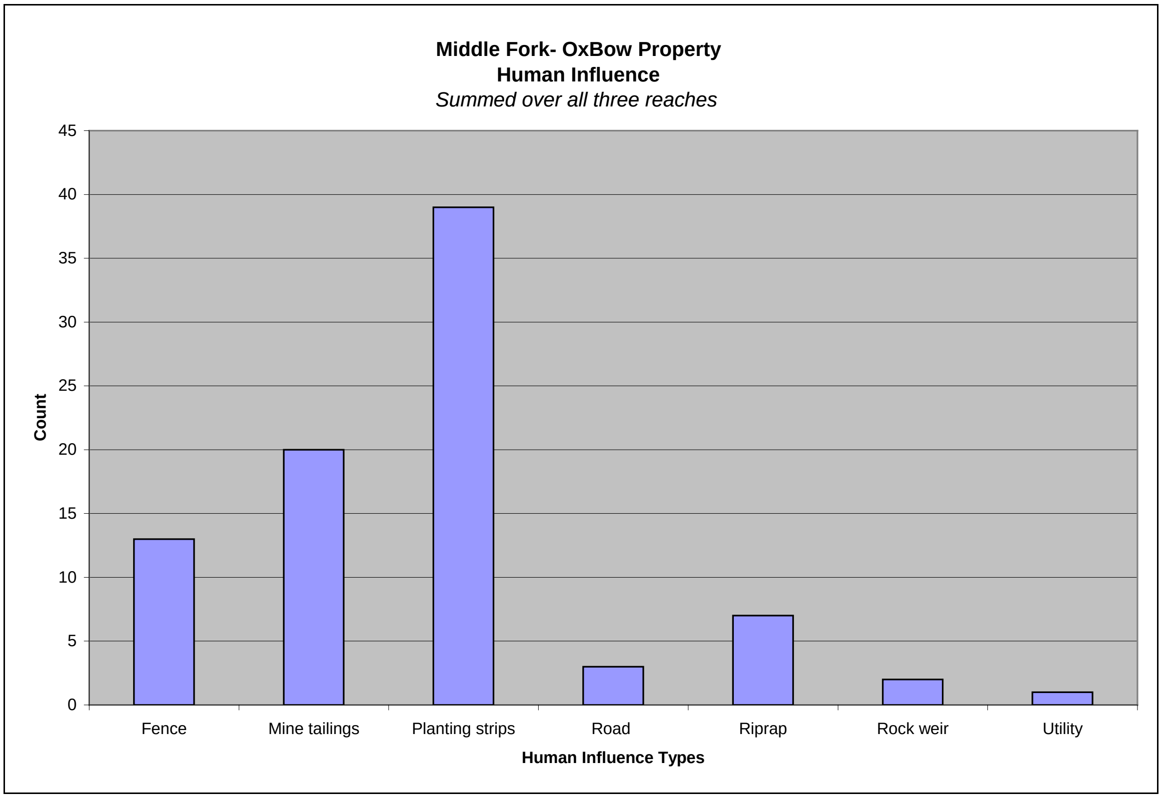


Graph 3.6: Human influence counts on Middle Fork John Day- Forrest Property, summarized over all three reaches.

<u>Oxbow Property Summary</u>

Planting strips had the highest occurrence within the vegetation transects, followed by mine tailings and fence disturbances (Graph 3.7). The mine tailing influences were only present in Reach 2 and Reach 3, while riprap and planting strips were present throughout (Appendix D). Riprap was the human influences to the bank, while other influences were close (within the 10 x 10m plot) or were present (outside plot area).

Planting strips created a disturbance to the riparian area, first restricting of vegetation under the black mats, and second disturbing the soil, where early seral vegetation species were observed to establish in failed plantings. The mine tailings were a disturbance to the riparian area and stream, constraining the active channel and effective riparian zone, while restricting vegetation growth. Riprap is often a human disturbances present to ameliorate bank degradation and create stream habitat, while the fence is often present to restrict cattle from the riparian area.



Graph 3.7: Human influence counts on Middle Fork John Day- Forrest Property, summarized over all three reaches.

RIPARIAN VEGETATION CANOPY COVER

Forrest Property Summary

As mentioned in vegetation structure canopy cover of the stream channel was less than 1% cover (Table 3.20). The low level of canopy cover was verified in the vegetation transects, where the canopy layer was not present.

Table 3.20 Densitometer Summary-Canopy Cover			
Forrest Property			
	Center	*Left*	*Right*
Upper John Day	8.19	15.38	19.00
MF John Day	0.03	0.00	0.00
OxBow Property			
OxBow	0.66	1.79	7.97

OxbowProperty Summary

Canopy cover of the stream channel was less than 1% cover, while the left and right bank had higher percent cover 2% and 8% cover (Table 3.21). The canopy layer was made up of predominately small trees (8% cover, less than 0.3

m DBH) and less than 1% big trees (greater than 0.3 m DBH). Graph 3.8 displays the big tree and small tree canopy cover for each bank, summarized in Tables 3.22 and 3.23.

Table 3.21: Densiometer Summary-Canopy Cover			
Forrest Property			
	Center	*Left*	*Right*
Upper John Day	8.19	15.38	19.00
MF John Day	0.03	0.00	0.00
OxBow Property			
OxBow	0.66	1.79	7.97

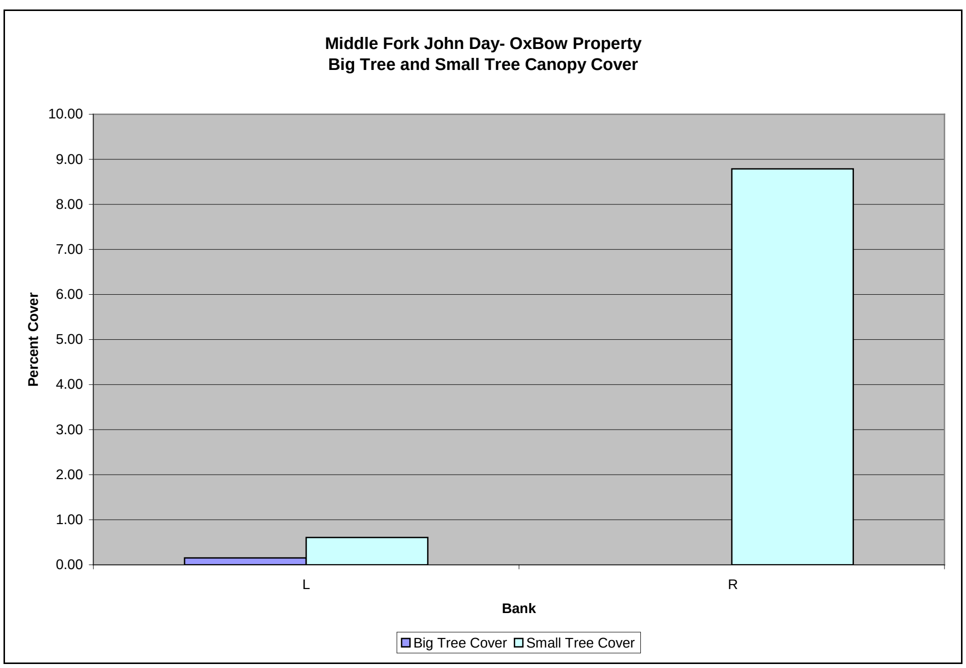
Canopy Cover

Table 3.22: Big Tree Canopy Cover- Stream Summary
(ST, small tree, BT, Big Tree)

Stream	Bank	BT_type	BT_Cover
OB	L	C	0.15

Table 3.23: Small Tree Canopy Cover- Stream Summary
(ST, small tree, BT, Big Tree)

Stream	Bank	ST_type	ST_Cover
OB	L	D	0.61
OB	R	D	8.79



Graph 3.8: Canopy cover on left (L) and right (R) bank summarized the Forrest Property- Middle Fork John Day.

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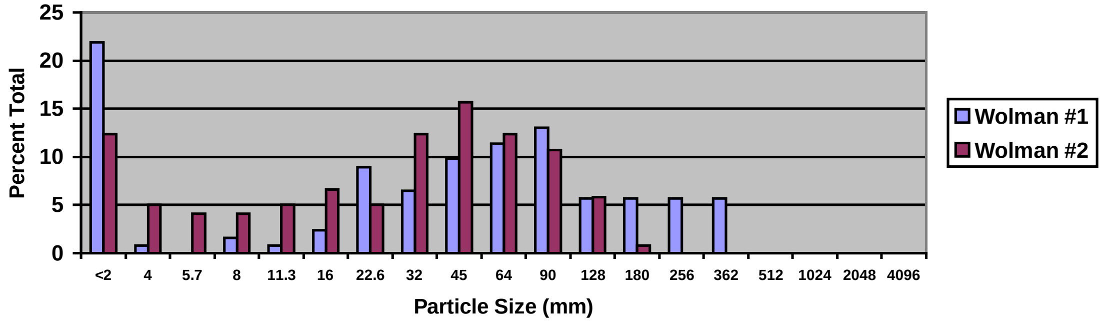
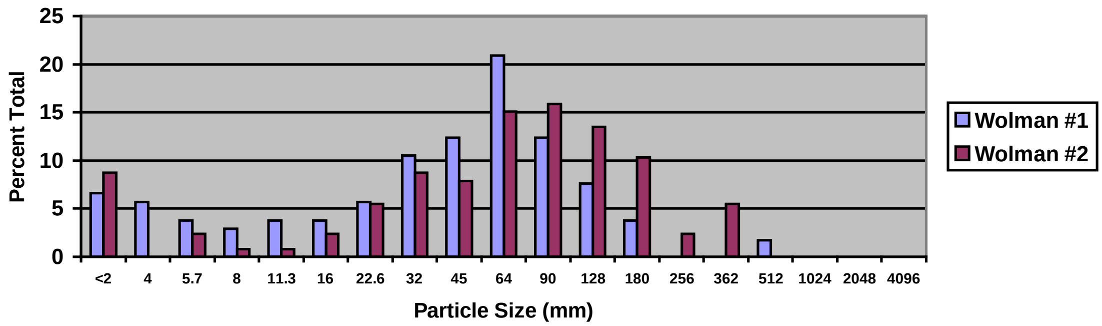
APPENDICES

APPENDIX A: Wolman Pebble Count Graph by Reach

Reach 1
D16 – <2 mm
D50 – 32-45 mm
D84 – 64-90 mm

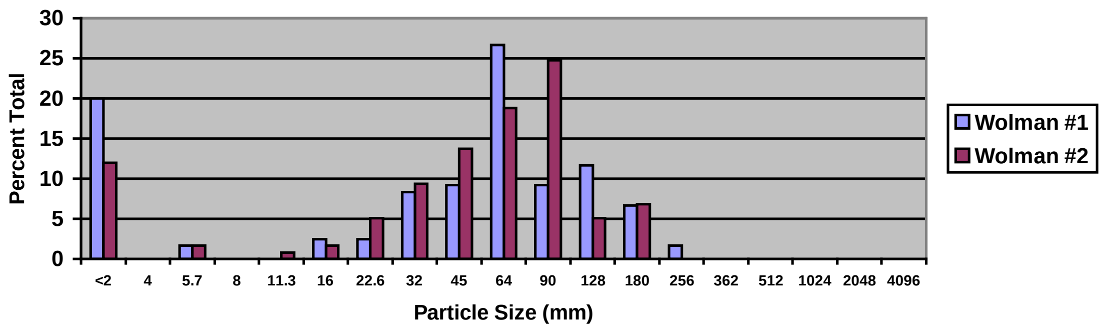


Reach 2
D16 – 2-4 mm
D50 – 45-64 mm
D84 – 90-128 mm

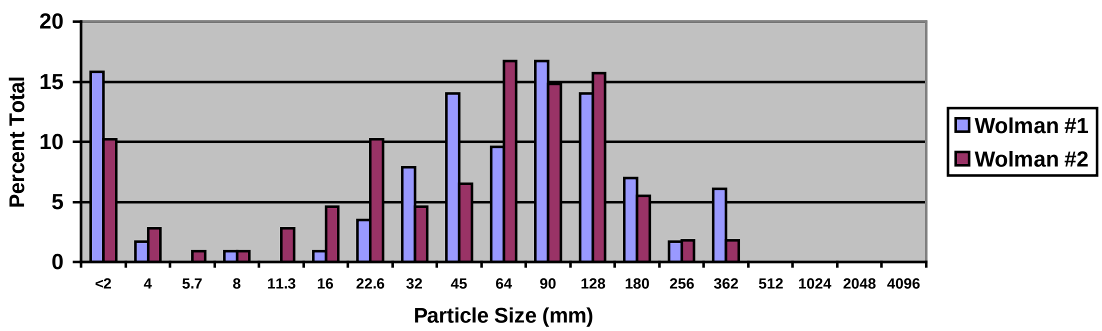


APPENDIX A (Continued)

Reach 3
D16 – <2 mm
D50 – 45-64 mm
D84 – 64-90 mm

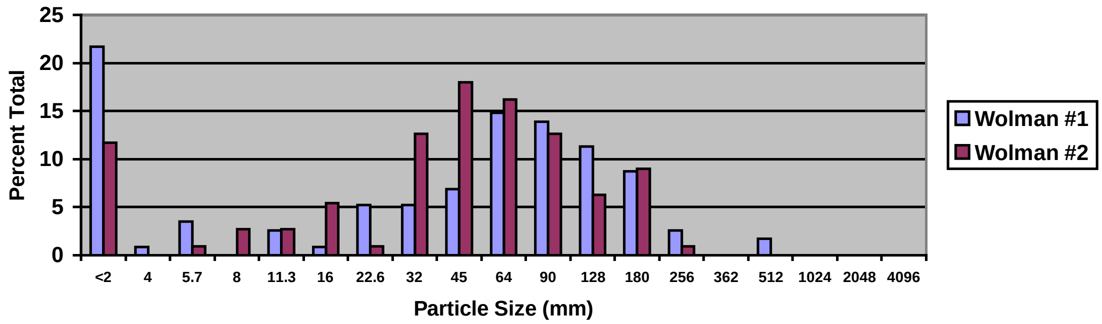


Reach 4
D16 – 5.7-8 mm
D50 – 45-64 mm
D84 – 90-128 mm

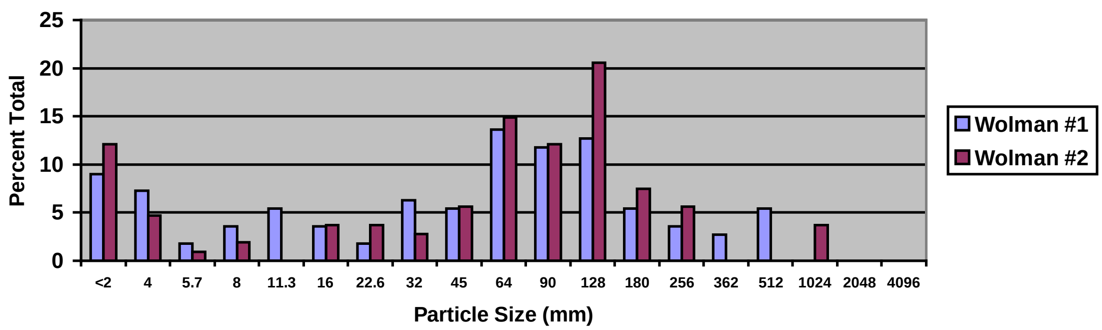


APPENDIX A (Continued)

Reach 5
D16 – <2 mm
D50 – 32-45 mm
D84 – 90-128 mm

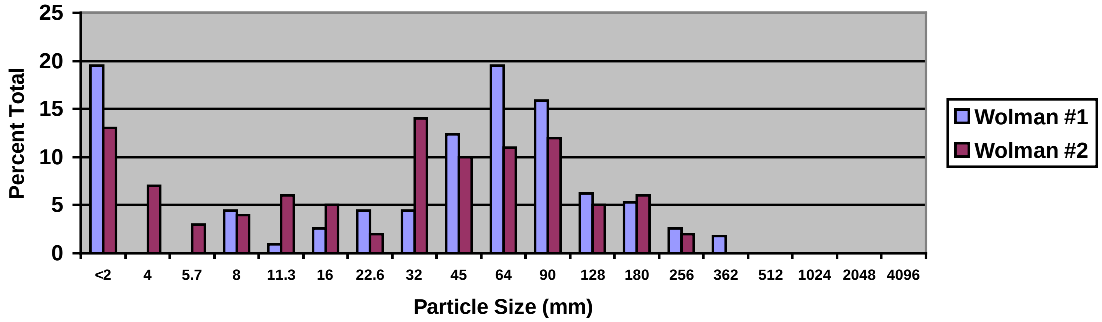


Reach 6
D16 – 2-4 mm
D50 – 45-64 mm
D84 – 128-180 mm

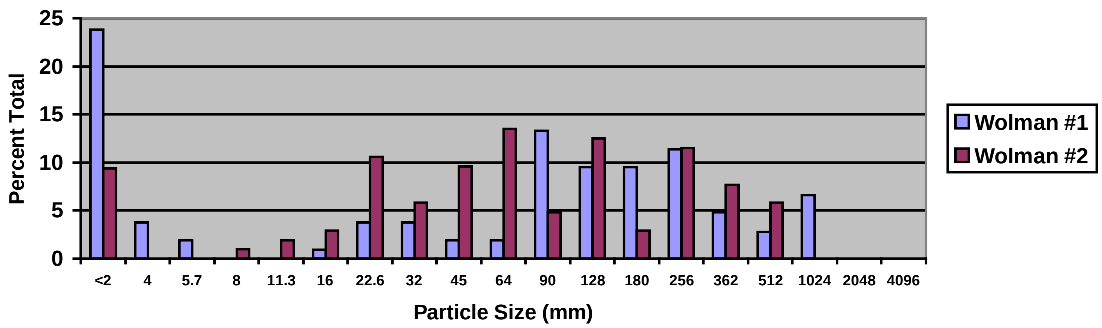


APPENDIX A (Continued)

Reach 7
D16 – <2 mm
D50 – 32-45 mm
D84 – 64-90 mm

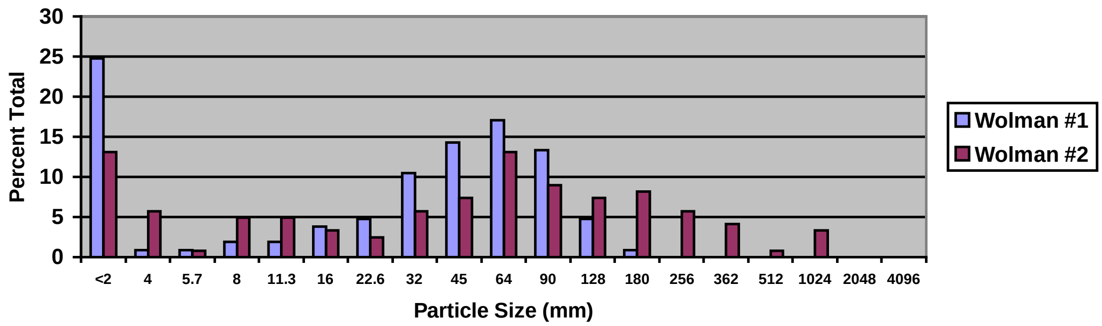


Reach 8 – North Channel
D16 – <2 mm
D50 – 64-90 mm
D84 – 180-256 mm

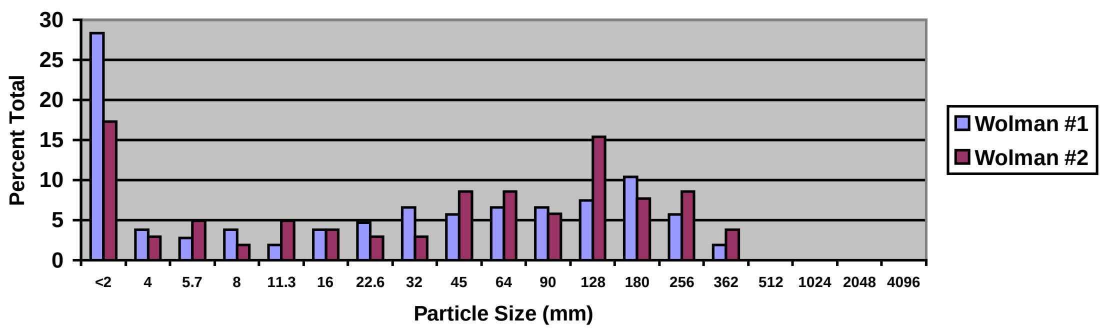


APPENDIX A (Continued)

Reach 9
D16 – <2 mm
D50 – 32-45 mm
D84 – 90-128 mm

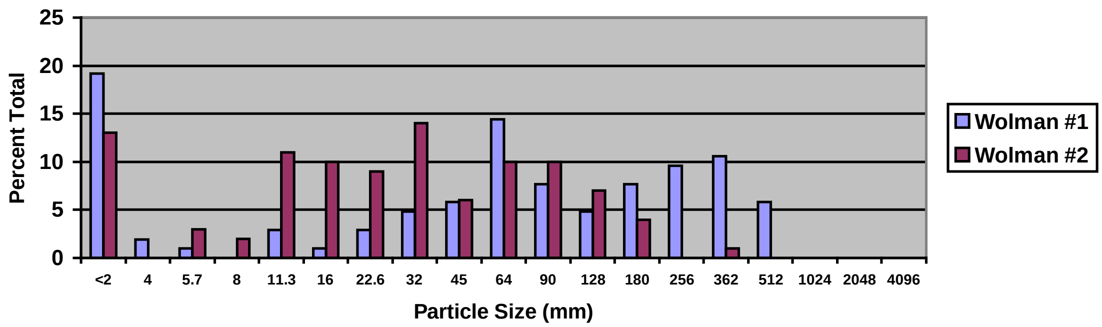


Reach 10
D16 – <2 mm
D50 – 32-45 mm
D84 – 128-180 mm

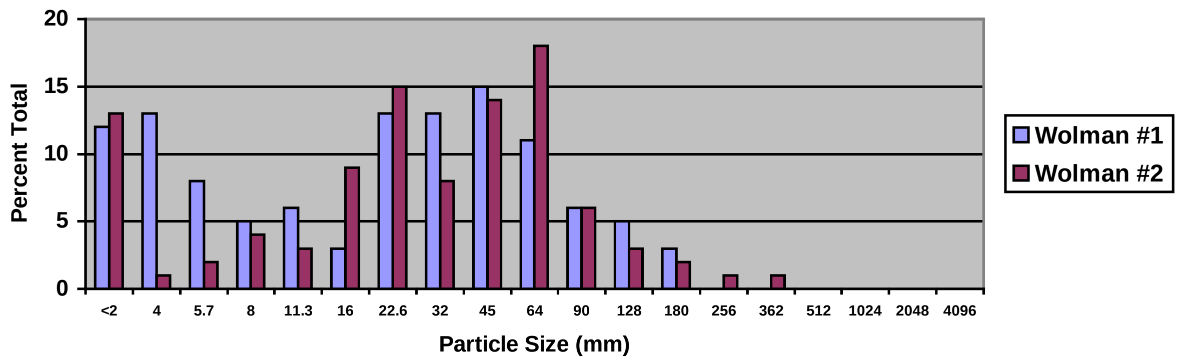


APPENDIX A (Continued)

Reach 11
D16 – <2 mm
D50 – 32-45 mm
D84 – 128-180 mm

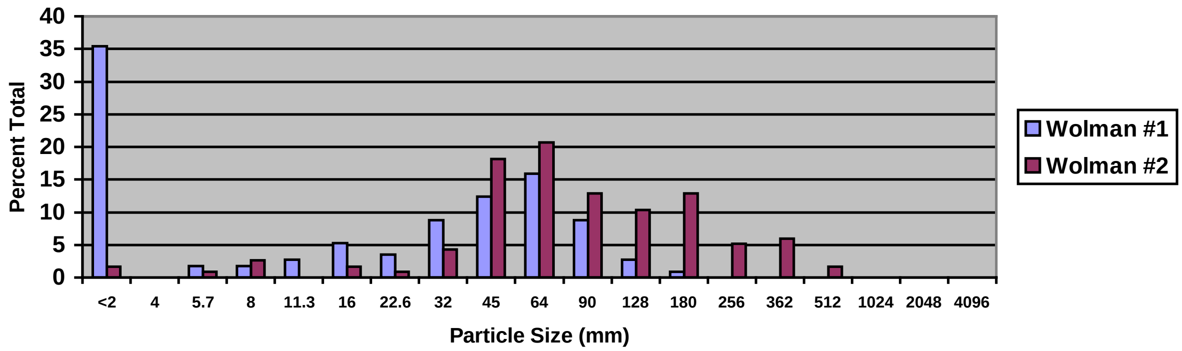


Reach 12
D16 – 2-4 mm
D50 – 16-22.6 mm
D84 – 45-64 mm

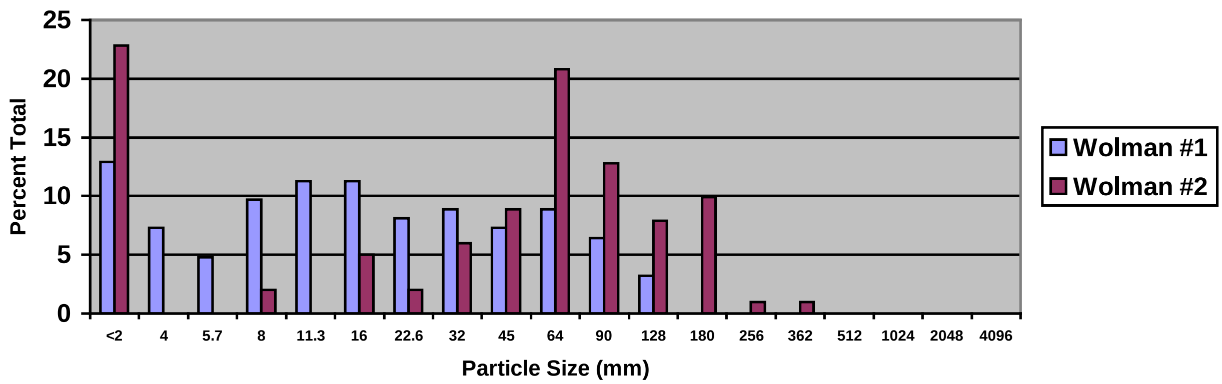


APPENDIX A (Continued)

Reach 13
D16 – <2 mm
D50 – 32-45 mm
D84 – 90-128 mm

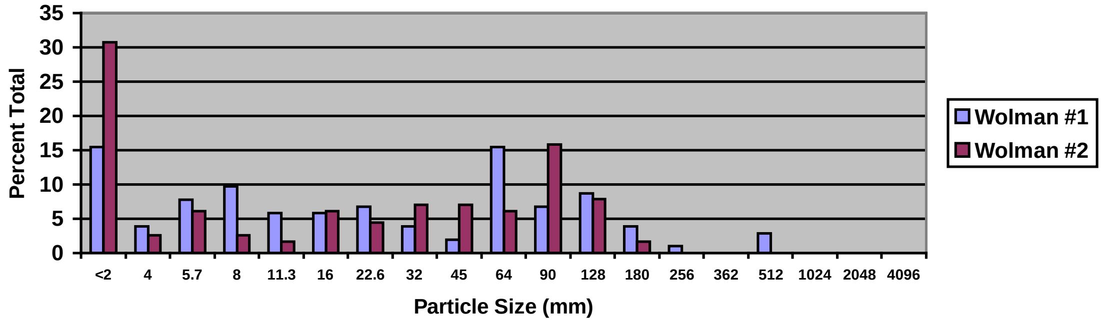


Reach 14
D16 – <2 mm
D50 – 22.6-32 mm
D84 – 64-90 mm

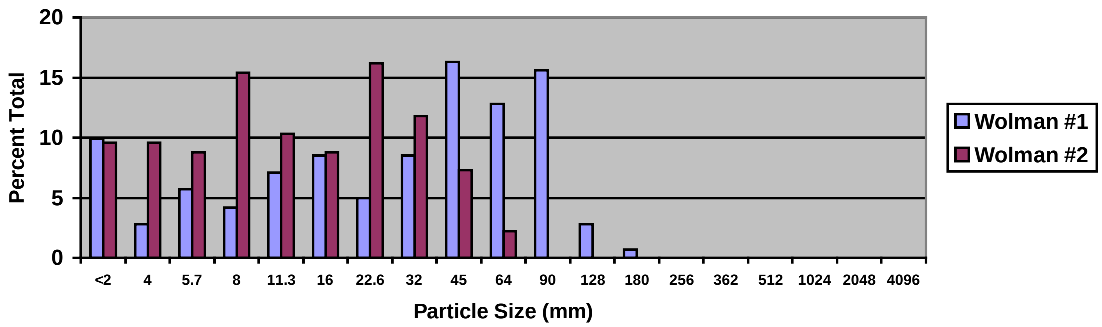


APPENDIX A (Continued)

Reach 15
D16 – <2 mm
D50 – 16-22.6 mm
D84 – 64-90 mm

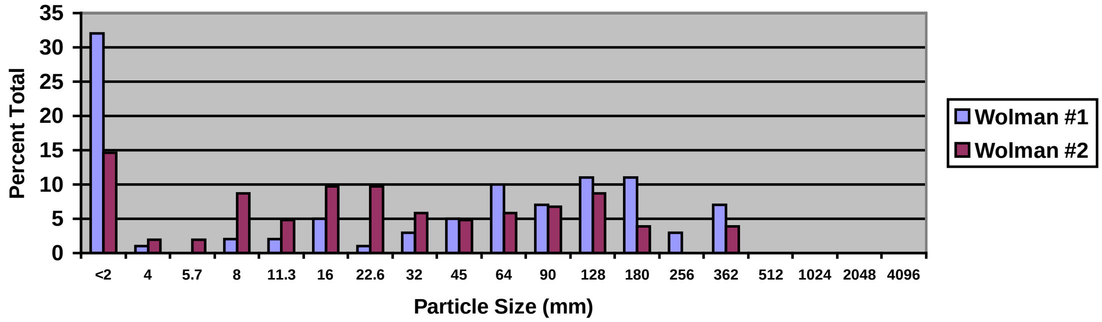


Reach 16
D16 – 4-5.7 mm
D50 – 11.3-16 mm
D84 – 45-64 mm

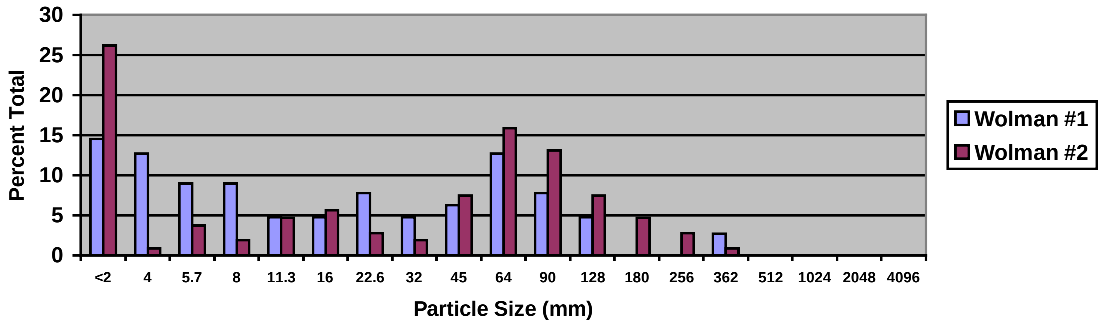


APPENDIX A (Continued)

Reach 17
D16 – <2 mm
D50 – 22.6-32 mm
D84 – 128-180 mm

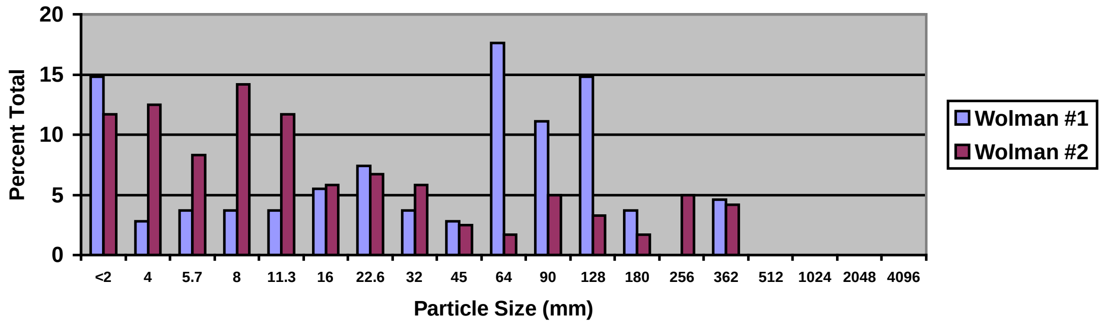


Reach 18
D16 – <2 mm
D50 – 16-22.6 mm
D84 – 64-90 mm

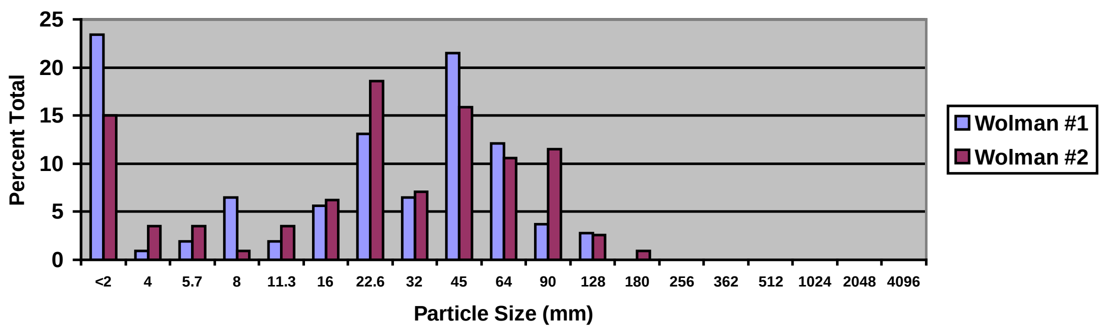


APPENDIX A (Continued)

Reach 19
D16 – 2-4 mm
D50 – 16-22.6 mm
D84 – 90-128 mm

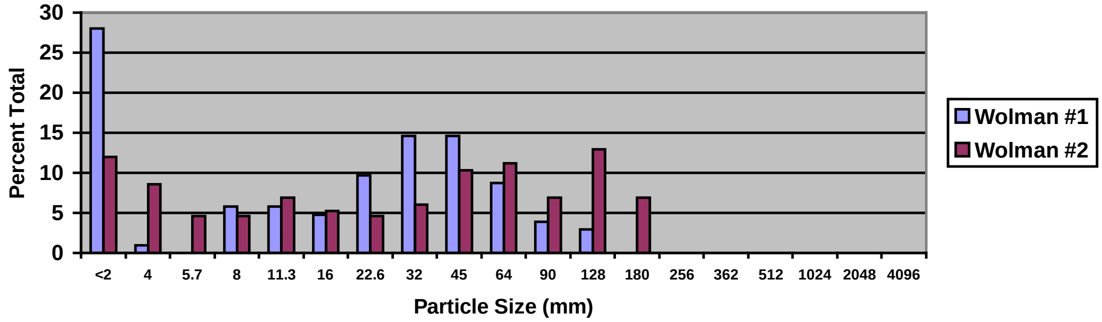


Reach 20
D16 – <2 mm
D50 – 16-22.6 mm
D84 – 45-64 mm



APPENDIX A (Continued)

Reach 8 – South Channel
D16 – <2 mm
D50 – 16-22.6 mm
D84 – 64-90 mm



APPENDIX B: Understory and Ground Cover Summaries by Reach

Woody Shurb Understory Cover- Vegetation Reach Summary			
Stream	**VegReach**	**Bank**	**Woody_Cover**
FP	1	L	2.27
FP	1	R	3.18
FP	2	L	1.82
FP	2	R	2.27
FP	3	L	1.82
FP	3	R	0.91

Grass/Forb Understory Cover- Vegetation Reach Summary			
Stream	**VegReach**	**Bank**	**GrFo_Cover**
FP	1	L	3.64
FP	1	R	3.64
FP	2	L	2.73
FP	2	R	2.27
FP	3	L	2.73
FP	3	R	1.82

Woody Ground Cover- Vegetation Reach Summary			
Stream	**VegReach**	**Bank**	**GrWoody_Cover**
FP	1	L	8.86
FP	1	R	5.00
FP	2	L	7.27
FP	2	R	6.36
FP	3	L	3.18
FP	3	R	1.82

Grass/Forb Ground Cover- Vegetation Reach Summary			
Stream	**VegReach**	**Bank**	**GrFo_Cover**
FP	1	L	54.32
FP	1	R	67.27
FP	2	L	64.55
FP	2	R	63.18
FP	3	L	72.50
FP	3	R	72.50

Barren/Rock Ground Cover- Vegetation Reach Summary			
Stream	**VegReach**	**Bank**	**BG_Cover**
FP	1	L	13.18
FP	1	R	15.23
FP	2	L	11.36
FP	2	R	18.41
FP	3	L	9.09
FP	3	R	14.32

APPENDIX C: Woody Species Density

Woody Species Density- Overall Stream Summary
Forrest Property

Bank	L	R	*MIN*	*MAX*	*AVERAGE*	*Planting Average*
ALIN	0.83	1.03	0.83	1.03	0.93	0.133
AMALA	0.00	0.00	0.00	0.00	0.00	0.000
ARTR	0.00	0.13	0.00	0.13	0.07	0.000
BETUL	0.10	0.07	0.07	0.10	0.08	0.083
CEANO	0.03	0.00	0.00	0.03	0.02	0.000
COSES	0.00	0.00	0.00	0.00	0.00	0.000
CRDO2	0.07	0.00	0.00	0.07	0.03	0.067
JUOC	0.00	0.00	0.00	0.00	0.00	0.000
PICO	0.03	0.00	0.00	0.03	0.02	0.000
PIPO	0.20	0.17	0.17	0.20	0.18	0.167
POBAT	0.10	0.07	0.07	0.10	0.08	0.083
PRVI	0.10	0.10	0.10	0.10	0.10	0.100
RIBES	0.20	0.10	0.10	0.20	0.15	0.150
ROWO	0.10	0.30	0.10	0.30	0.20	0.083
SAAM2	0.00	0.00	0.00	0.00	0.00	0.000
SABO2	0.13	0.37	0.13	0.37	0.25	0.000
SADR	0.00	0.00	0.00	0.00	0.00	0.000
SAER	0.17	0.87	0.17	0.87	0.52	0.000
SAEX	0.30	0.07	0.07	0.30	0.18	0.000
SAGE2	0.03	0.00	0.00	0.03	0.02	0.000
SALE	0.00	0.00	0.00	0.00	0.00	0.000
SALU2	0.00	0.27	0.00	0.27	0.13	0.000
SAME2	0.10	0.10	0.10	0.10	0.10	0.000
Salix spp.	0.00	0.00	0.00	0.00	0.00	0.000
SYMPH	0.07	0.03	0.03	0.07	0.05	0.050
		TOTALS	**0.00**	**1.03**	**0.12**	**0.104**

Woody Species Density- Overall Stream Summary

Stream	**Oxbow Property**

Bank	**L**	**R**	*MIN*	*MAX*	*AVERAGE*	*Planting Average*
ALIN	0.73	0.83	0.73	0.83	0.78	0.17
AMALA	0.07	0.00	0.00	0.07	0.03	0.00
ARTR	0.00	0.00	0.00	0.00	0.00	0.00
BETUL	0.07	0.17	0.07	0.17	0.12	0.07
CEANO	0.00	0.00	0.00	0.00	0.00	0.00
COSES	0.20	0.27	0.20	0.27	0.23	0.00
CRDO2	1.00	0.33	0.33	1.00	0.67	0.13
JUOC	0.03	0.00	0.00	0.03	0.02	0.00
PICO	0.00	0.00	0.00	0.00	0.00	0.00
PIPO	0.17	0.17	0.17	0.17	0.17	0.13
POBAT	0.13	0.13	0.13	0.13	0.13	0.10

Woody Species Density- Overall Stream Summary Forrest Property						
PRVI	0.27	0.07	0.07	0.27	0.17	0.27
RIBES	0.20	0.30	0.20	0.30	0.25	0.17
ROWO	0.97	1.47	0.97	1.47	1.22	0.13
SAAM2	0.00	0.00	0.00	0.00	0.00	0.00
SABO2	0.33	1.23	0.33	1.23	0.78	0.10
SADR	0.00	0.03	0.00	0.03	0.02	0.00
SAER	0.53	1.03	0.53	1.03	0.78	0.00
SAEX	1.57	4.80	1.57	4.80	3.18	0.00
SAGE2	0.33	0.00	0.00	0.33	0.17	0.00
SALE	0.03	0.00	0.00	0.03	0.02	0.00
SALU2	0.07	0.07	0.07	0.07	0.07	0.00
SAME2	0.47	1.53	0.47	1.53	1.00	0.03
Salix spp.	0.00	0.00	0.00	0.00	0.00	0.00
SYMPH	5.77	0.30	0.30	5.77	3.03	0.17
		TOTALS	**0.00**	**5.77**	**0.51**	**0.13**

WOODY RIPARIAN DENSITY- REACH SUMMARY

Stream	FP						OB						UJD					
VegReach	1		2		3		1		2		3		1		2		3	
Bank	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R
ALIN	0.53	0.13	0.03	0.77	0.27	0.13	0.33	0.13	0.07	0.13	0.33	0.57	0.40	0.10	0.33	0.60	0.30	0.30
AMALA											0.07							
ARTR				0.13														
BETUL	0.03	0.07	0.03		0.03		0.03	0.13	0.03	0.03								
CEANO			0.03															
COSES									0.07	0.10	0.13	0.17	0.03	0.07				
CRDO2	0.03				0.03		0.80	0.17		0.03	0.20	0.13	0.03	0.03				0.13
JUOC									0.03									
PICO	0.03																	
PIPO	0.10	0.03	0.07		0.03	0.13	0.10	0.17			0.07							
POBAT	0.03		0.03	0.03	0.03	0.03	0.07		0.07	0.07		0.07	0.77	1.53	3.97	9.17	4.83	8.37
PRVI	0.03	0.10	0.03		0.03		0.13	0.03	0.10		0.03	0.03						
RIBES	0.10		0.03	0.03	0.07	0.07	0.03	0.17	0.13	0.07	0.03	0.07						
ROWO	0.07	0.23		0.03	0.03	0.03	0.07	0.10	0.07	0.03	0.83	1.33	0.43	0.93	0.03	0.03	0.30	0.53
SAAM2													0.13	0.10	0.13	0.33	0.13	0.03
SABO2	0.03	0.10	0.07	0.03	0.03	0.23	0.13	0.10	0.20	0.10		1.03	0.03				0.43	0.03
SADR										0.03								
SAER	0.03	0.83	0.13			0.03	0.40	0.37	0.10	0.30	0.03	0.37	0.17		0.30	0.70	1.47	0.40
SAEX	0.07		0.23			0.07	1.10	1.37	0.17	3.43	0.30		1.27	0.03	0.03	0.17	0.80	0.60
SAGE2			0.03								0.33		0.13					
SALE							0.03											
Salix spp													0.17					
SALU2		0.07		0.20				0.03	0.07			0.03	0.47	0.10	0.23	1.03	1.20	0.80
SAME2		0.10	0.07		0.03			0.03	0.47	1.50								0.10
SYMPH	0.03				0.03	0.03	0.13	0.07		0.03	5.63	0.20	0.27					

APPENDIX D: Human Influence Summary Tables by Reach

Reach 1

Middle Fork- Forrest Property					
Stream	**VegReach**	**Reach**	**Type**	**Prox.**	**Count**
FP	1	15	Bridge	C	0
FP	1	15	Bridge	P	2
FP	1	15	Bridge	B	0
FP	1	15	Fence	C	0
FP	1	15	Fence	P	4
FP	1	15	Fence	B	0
FP	1	15	Gravel pit	C	0
FP	1	15	Gravel pit	P	1
FP	1	15	Gravel pit	B	0
FP	1	15	Planting strips	C	10
FP	1	15	Planting strips	P	4
FP	1	15	Planting strips	B	0
FP	1	15	Restoration	C	7
FP	1	15	Restoration	P	3
FP	1	15	Restoration	B	0
FP	1	15	Road	C	0
FP	1	15	Road	P	7
FP	1	15	Road	B	0
FP	1	15	Utility	C	0
FP	1	15	Utility	P	1
FP	1	15	Utility	B	0
FP	1	15	Wall/Dike	C	0
FP	1	15	Wall/Dike	P	1
FP	1	15	Wall/Dike	B	0

APPENDIX D (Continued)

Reach 2

Middle Fork- Forrest Property					
Stream	**VegReach**	**Reach**	**Type**	**Prox.**	**Count**
FP	2	14	Fence	C	2
FP	2	14	Fence	P	3
FP	2	14	Fence	B	0
FP	2	14	Pipes (inlet/outlet)	C	0
FP	2	14	Pipes (inlet/outlet)	P	1
FP	2	14	Pipes (inlet/outlet)	B	0
FP	2	14	Planting strips	C	6
FP	2	14	Planting strips	P	7
FP	2	14	Planting strips	B	0
FP	2	14	Railroad (old grade)	C	1
FP	2	14	Railroad (old grade)	P	0
FP	2	14	Railroad (old grade)	B	0
FP	2	14	Riprap	C	4
FP	2	14	Riprap	P	1
FP	2	14	Riprap	B	5
FP	2	14	Road	C	1
FP	2	14	Road	P	6
FP	2	14	Road	B	0
FP	2	14	Rock weir	C	0
FP	2	14	Rock weir	P	0
FP	2	14	Rock weir	B	2
FP	2	14	Utility	C	0
FP	2	14	Utility	P	1
FP	2	14	Utility	B	0
FP	2	14	Wall/Dike	C	0
FP	2	14	Wall/Dike	P	2
FP	2	14	Wall/Dike	B	0

APPENDIX D (Continued)

Reach 3

Middle Fork- Forrest Property					
Stream	**VegReach**	**Reach**	**Type**	**Prox.**	**Count**
FP	3	14	Fence	C	1
FP	3	14	Fence	P	0
FP	3	14	Fence	B	0
FP	3	14	Planting strips	C	6
FP	3	14	Planting strips	P	7
FP	3	14	Planting strips	B	0
FP	3	14	Railroad (old grade)	C	3
FP	3	14	Railroad (old grade)	P	1
FP	3	14	Railroad (old grade)	B	0
FP	3	14	Riprap	C	0
FP	3	14	Riprap	P	1
FP	3	14	Riprap	B	2
FP	3	14	Rock weir	C	0
FP	3	14	Rock weir	P	0
FP	3	14	Rock weir	B	1
FP	3	14	Wall/Dike	C	0
FP	3	14	Wall/Dike	P	0
FP	3	14	Wall/Dike	B	0

APPENDIX E: Oxbow Property Canopy Cover Summarized by Reach

Big Tree Canopy Cover- Vegetation Reach Summary				
Stream	**VegReach**	**Bank**	**BT_type**	**BT_Cover**
OB	3	L	C	0.45

Small Tree Canopy Cover- Vegetation Reach Summary				
Stream	**VegReach**	**Bank**	**ST_type**	**ST_Cover**
OB	1	R	D	1.59
OB	3	L	D	1.82
OB	3	R	D	24.77

APPENDIX F: Vegetation Key

Human Influence	
Wall/Dike/Revetment/Dam	DIKE
Riprap	RP
Building	BD
Pavement/Lot	PV
Road	RD
Railroad	RR
Pipes(inlet/outlet)	PP
Landfill/Trash	LD
Park/Lawn	PARK
Row Crops	CROP
Pasture	PS
Hayfield	HAY
Logging Operations	LOG
Mine tailings	MINE
Rock Weirs	RW
Plantings	PL
Utility	U
Bridge	BG
Gravel Pit	GP
Restoration	RS
Grazing	GR

Riparian Vegetation Type	
None	N
Mixed	M
Broadleaf Evergreen	E
Coniferous	C
Deciduous	D

Name	CODE	Wetland Rating
Annual forb	AF	FAC
Thinleaf Alder	ALIN	FACW
meadow foxtail	ALPR	FACW
Serviceberry	AMALA	FAC
Sage brush	ARTR	UPL
Water Birch	BETUL	FACW
Bareground	BG	
cheatgrass	BRTE	UPL
water sedge	CAAQ	FACW
Bluejointed Reed Grass	CACA4	FACW+
woolyfruit sedge	CALA11	OBL

Name	CODE	Wetland Rating
lakeshore sedge	CALE8	FACW+
Carex spp.	CAREX	FACW
bladder sedge	CAUT	OBL
ceanothus	CEANO	UPL
Canada thistle	CIAR4	FACU+
Red-Osier Dogwood	COSES	FACW
Hawthorn	CRDO2	FACW
tufted hairgrass	DECE	FACW
Spike rush	ELEOC	OBL
Horsetail	EQUIS	FAC
Forb	F	FACW-
Fescue spp.	FESTU	FACW
Baltic Rush	JUARL	OBL
Juncus spp.	JUNCU	OBL
Western Juniper	JUOC	UPL
Reed Canary grass	PHAR3	FACW
lodgepole pine	PICO	FAC-
Ponderosa Pine	PIPO	FACU-
Planting mat	plmat	
Poa spp.	POA	FACU+
Black Cottonwood	POBAT	FACW
chokecherry	PRVI	FACW
Ribes spp.	RIBES	FAC
Rock	ROCK	
Wild Rose	ROWO	FACU
Curly dock	RUCR	FAC
Salix spp.	SA	FACW
peachleaf willow	SAAM	FACW
Booth's willow	SABO2	OBL
Drummund's willow	SADR	FACW
Mackenzie's willow	SAER	OBL
Coyote willow	SAEX	OBL
Geyer's willow	SAGE2	FACW
Lemmon's willow	SALE	FACW-
Pacific willow	SALUL	FACW
Dusky willow	SAME2	OBL
Panicle Bulrush	SCMI2	OBL
snowberry	SYMPH	FAC
wheatgrass	THINO	FACU-
Oatgrass	TRISE	UPL

Wetland Indicator Categories

Indicator Code	Wetland Type	Comment
OBL	Obligate Wetland	Occurs almost always (estimated probability 99%) under natural conditions in wetlands.
FACW	Facultative Wetland	Usually occurs in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands.
FAC	Facultative	Equally likely to occur in wetlands or non-wetlands (estimated probability 34%-66%).
FACU	Facultative Upland	Usually occurs in non-wetlands (estimated probability 67%-99%), but occasionally found on wetlands (estimated probability 1%-33%).
UPL	Obligate Upland	Occurs in wetlands in another region, but occurs almost always (estimated probability 99%) under natural conditions in non-wetlands in the regions specified. If a species does not occur in wetlands in any region, it is not on the National List.

A positive (+) or negative (-) sign was used with the Facultative Indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).

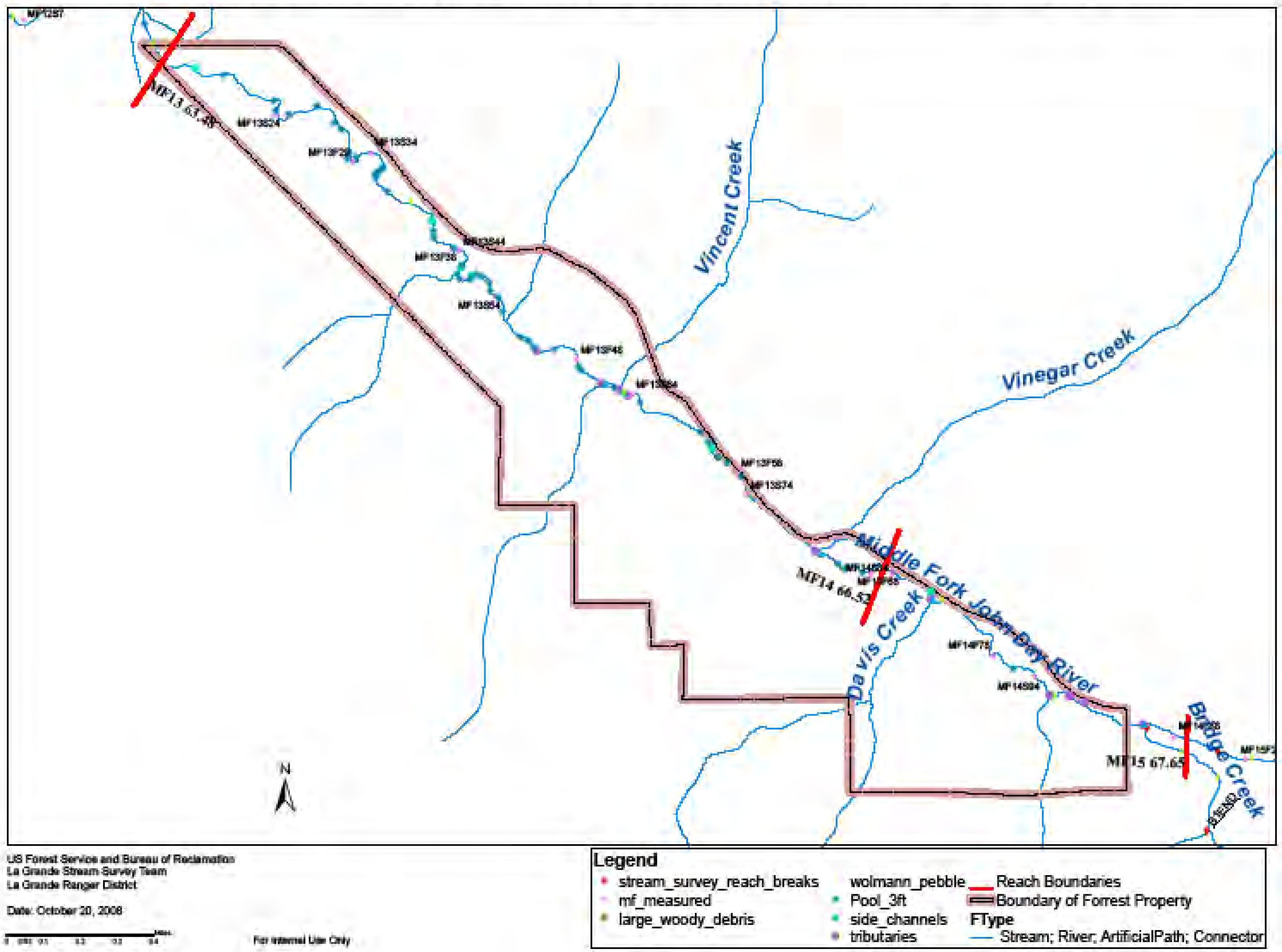
Wetland Indicator Categories Table and explanation from:

USDA, NRCS. 2008. The PLANTS Database (http://plants.usda.gov, 28 October 2008). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

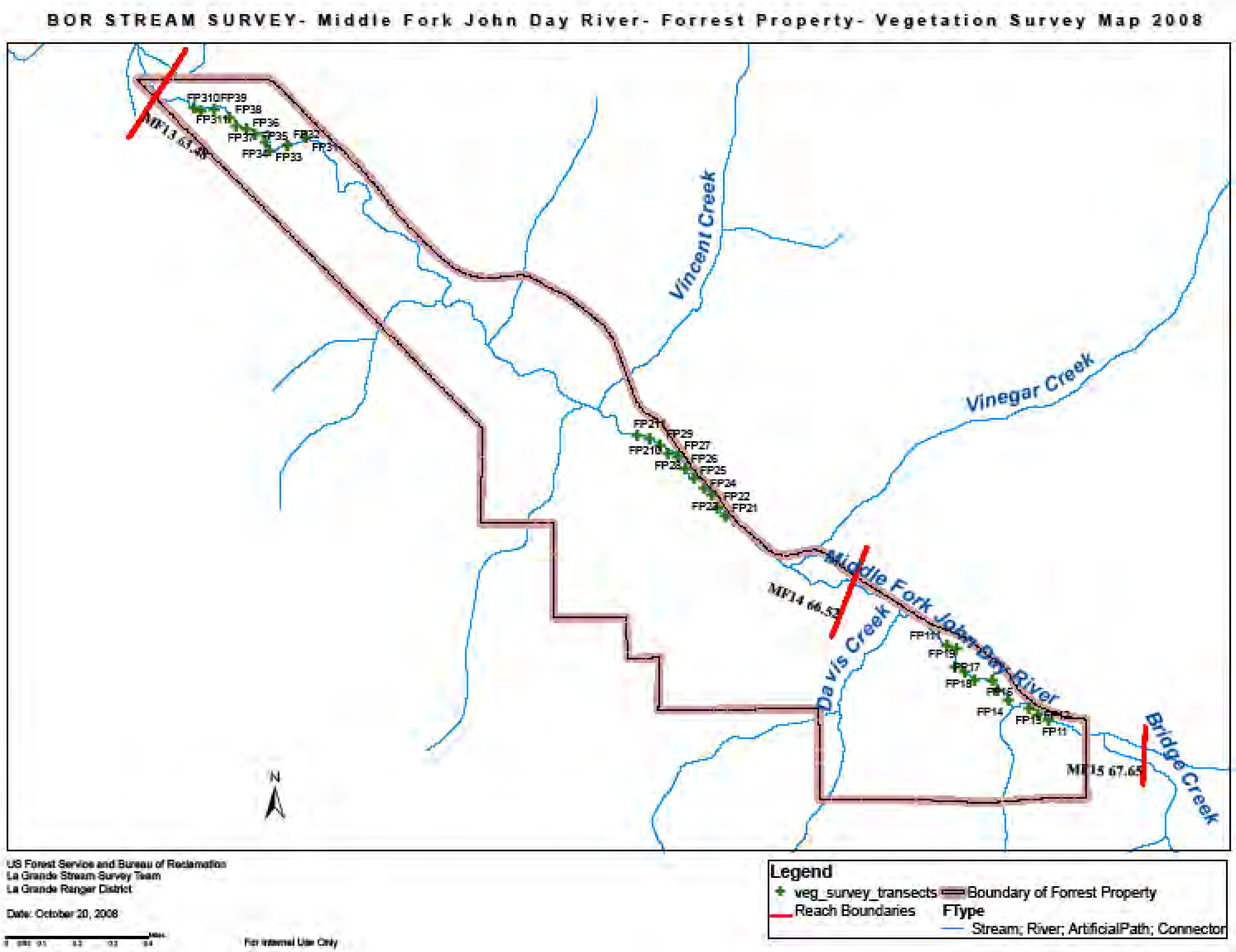
APPENDIX G- Maps

Map 1

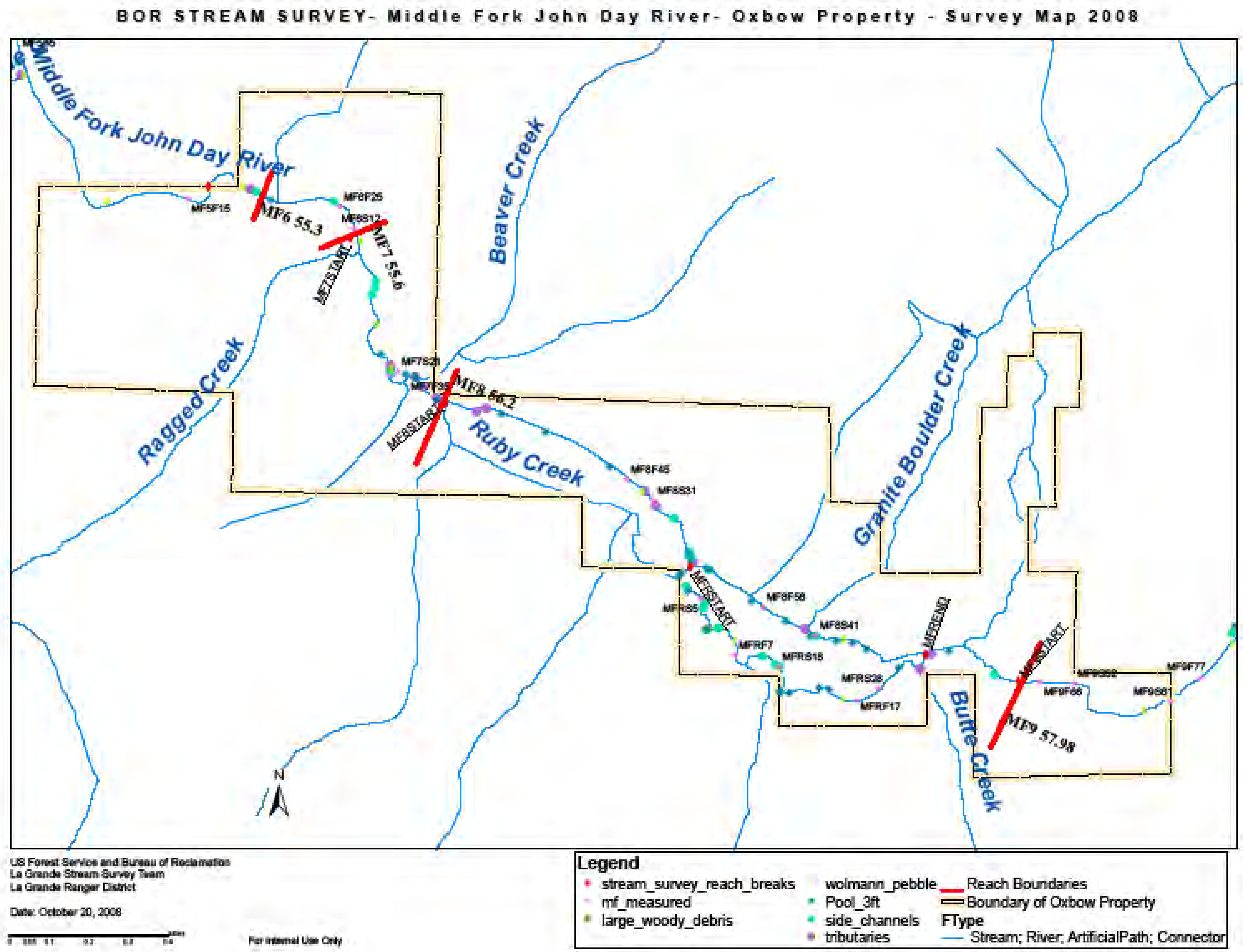
BOR STREAM SURVEY- Middle Fork John Day River- Forrest Property- Survey Map 2008



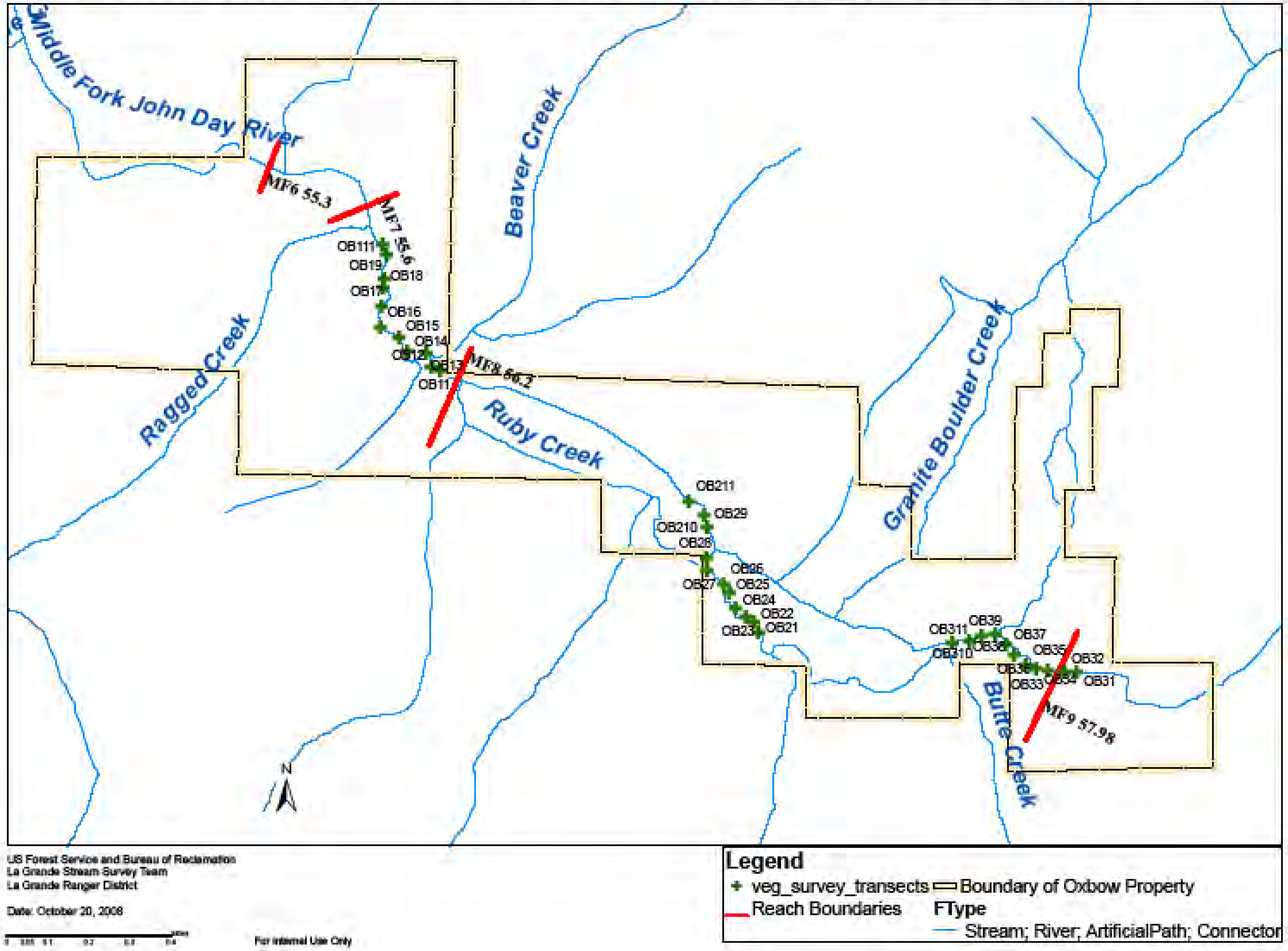
Map 2


BOR STREAM SURVEY- Middle Fork John Day River- Forrest Property- Vegetation Survey Map 2008
Vincent Creek
Vinegar Creek
Middle Fork John Day River
Davis Creek
Bridge Creek
MF14 66.53
MF15 67.65
US Forest Service and Bureau of Reclamation
La Grande Stream Survey Team
La Grande Ranger District
Date: October 20, 2008
For Internal Use Only
Legend
veg_survey_transects
Boundary of Forrest Property
Reach Boundaries
FType
Stream; River; ArtificialPath; Connector

Map 3


BOR STREAM SURVEY- Middle Fork John Day River- Oxbow Property - Survey Map 2008
Middle Fork John Day River
Beaver Creek
Ragged Creek
Ruby Creek
Granite Boulder Creek
Butte Creek
MF6 55.3
MF7 55.6
MF8 56.2
MF9 57.98
MF7START
MF8START
MF9START
MF8END
MF5F15
MF6F25
MF6S12
MF7S21
MF7F35
MF8F45
MF8S31
MF8F56
MF8S41
MFRS5
MFRF7
MFRS18
MFRS28
MFRF17
MF9F68
MF9S81
MF9F77
US Forest Service and Bureau of Reclamation
La Grande Stream Survey Team
La Grande Ranger District
Date: October 20, 2008
For Internal Use Only
Legend
stream_survey_reach_breaks
mf_measured
large_woody_debris
wolmann_pebble
Pool_3ft
side_channels
tributaries
Reach Boundaries
Boundary of Oxbow Property
FType
Stream; River; ArtificialPath; Connector
N

BOR STREAM SURVEY- Middle Fork John Day River- Oxbow Property - Vegetation Survey Map 2008



APPENDIX C

Reach Documentation

REACH DOCUMENTATION

FORREST REACH ASSESSMENT

MIDDLE FORK JOHN DAY RIVER, OREGON

Introduction

This Reach Documentation appendix was used to populate the Reach-based Ecosystem Indicators (REI) table in Appendix A as part of the analysis to determine the condition of each indicator. The data collected in the field was redrawn in ArcGIS and is contained in the Forrest Reach Geodatabase (Appendix D) to document baseline conditions which could be used to support effectiveness monitoring efforts. The following sections are contained in this appendix:

- Subreaches and Anthropogenic Impacts – contains location maps of subreaches and existing natural and anthropogenic features. Each map is followed by a summary table that contains a subreach identifier, river miles, acreage, and anthropogenic features.

- Channel Unit Mapping – contains a chart showing the percent of channel units for each channel segment based on acreage and channel unit location maps.

- Photographic Documentation – contains photopoint location maps and captioned photographs.

Each map was generated using the Forrest Reach Geodatabase and acreages and lengths included in the summary tables were generated using ArcGIS software. Location of photopoints were documented on aerial photographs and then redrawn as a point file in ArcGIS which could be used to generate coordinates for future monitoring.

SUBREACHES AND ANTHROPOGENIC IMPACTS

RM 67.55 – 66.68 SUBREACHES

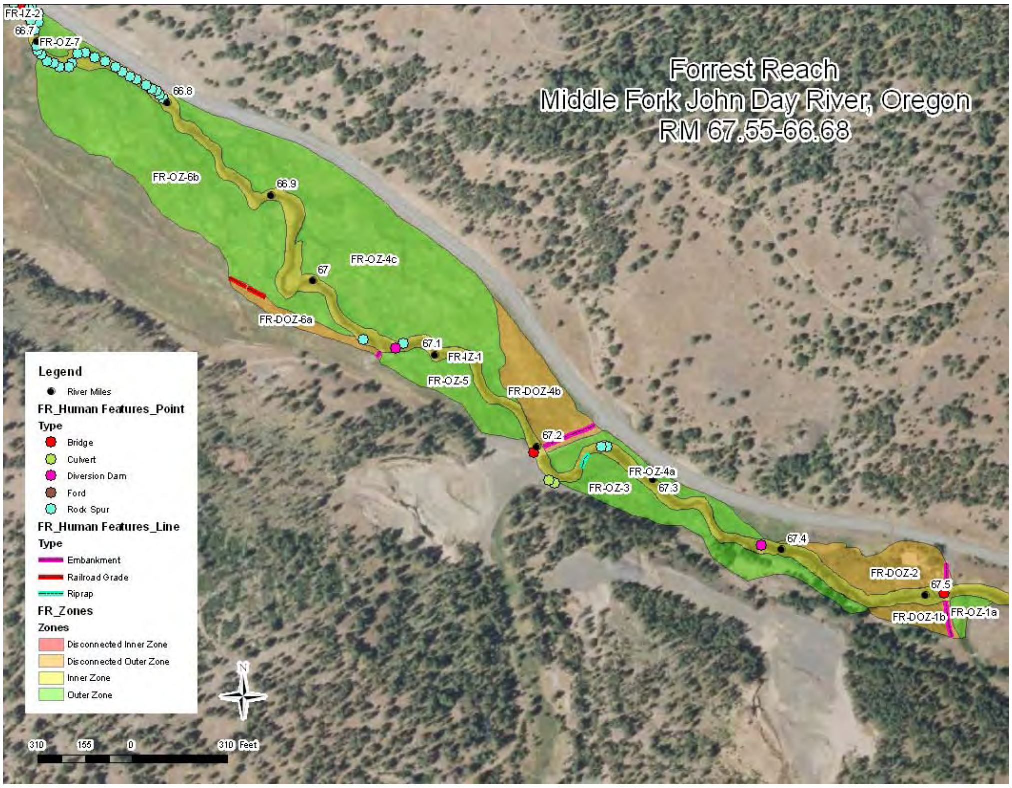


Figure 1: Location map of subreaches between RM 67.55 and 66.68, and anthropogenic features (map scale 1:3,600).

Table 1. Summary of subreaches between RM 67.55 and RM 66.68.

Parcel	River Mile (RM)	Acreage	Anthropogenic Features
		FR-IZ-1 SUBREACH	
FR-IZ-1 (inner zone)	RM 67.55 – 66.68	4.17 acres	Bridge (2) Diversion (2) Rock Spur (31) Riprap (57 ft)
		FR-OZ-1 SUBREACH COMPLEX	
FR-OZ-1a (outer zone)	RM 67.53 – 67.51 (river left)	0.20 acres	None

Parcel	River Mile (RM)	Acreage	Anthropogenic Features
FR-DOZ-1b (disconnected outer zone)	RM 67.51 – 67.46 (river left)	0.44 acres	Embankment (120 ft)
FR-DOZ-2 SUBREACH			
FR-DOZ-2 (disconnected outer zone)	RM 67.51 – 67.40 (river right)	1.29 acres	Embankment (70 ft)
FR-OZ-3 SUBREACH			
FR-OZ-3 (outer zone)	RM 67.45 – 67.21 (river left)	1.77 acres	None
FR-OZ-4 SUBREACH COMPLEX			
FR-OZ-4a (outer zone)	RM 67.39 – 67.20 (river right)	0.71 acres	None
FR-DOZ-4b (disconnected outer zone)	RM 67.20 – 67.10 (river right)	1.49 acres	Embankment (183 ft)
FR-OZ-4c (outer zone)	RM 67.16 – 66.80 (river right)	6.93 acres	None
FR-OZ-5 SUBREACH			
FR-OZ-5 (outer zone)	RM 67.20 – 67.06 (river left)	1.11 acres	None
FR-OZ-6 SUBREACH COMPLEX			
FR-DOZ-6a (disconnected outer zone)	RM 67.06 – 66.90 (river left)	0.41 acres	Embankment (22 ft) Railroad Grade (128 ft)
FR-OZ-6b (outer zone)	RM 67.05 – 66.71 (river left)	5.64 acres	None
FR-OZ-7 SUBREACH			
FR-OZ-7 (outer zone)	RM 66.73 – 66.69 (river right)	0.33 acres	None

RM 66.68 – 66.45 SUBREACHES

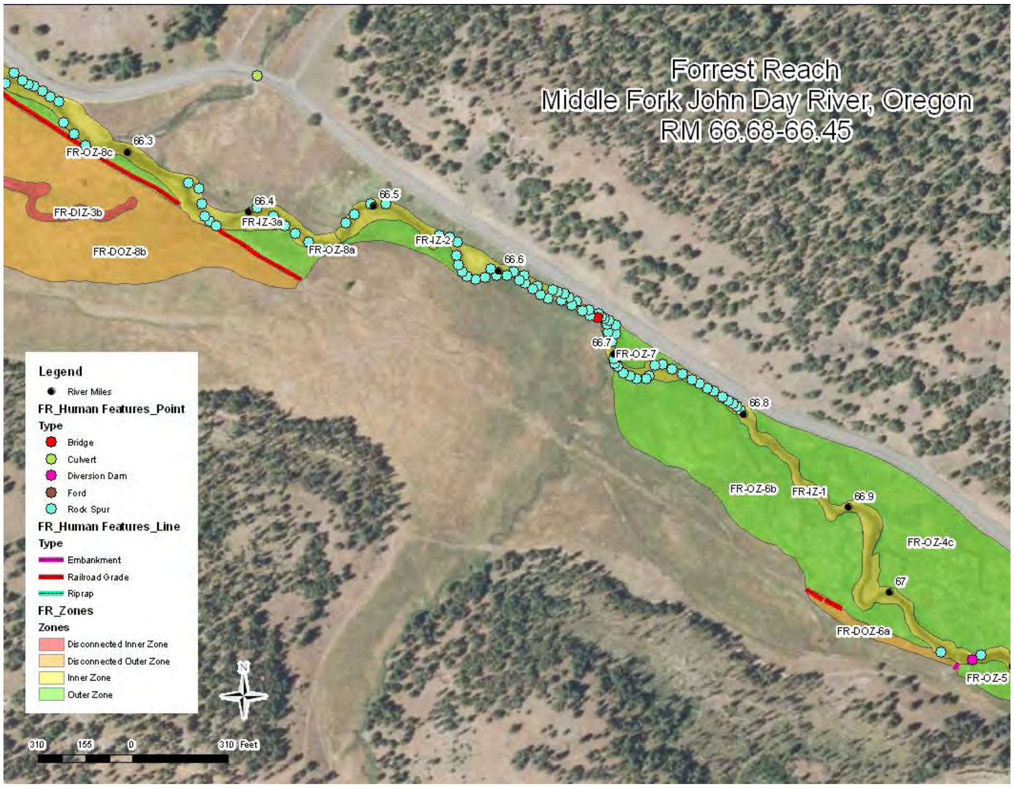


Figure 2. Location map of subreaches between RM 66.68 and 66.45, and anthropogenic features (scale 1:3,600).

Table 2. Summary of subreaches between RM 66.68 and RM 66.45.

Parcel	River Mile	Acreage	Anthropogenic Features
FR-IZ-2 SUBREACH			
FR-IZ-2 (inner zone)	RM 66.68 – 66.45	1.13 acres	Rock Spur (36) Bridge (1)

RM 66.45 – 65.55 SUBREACHES

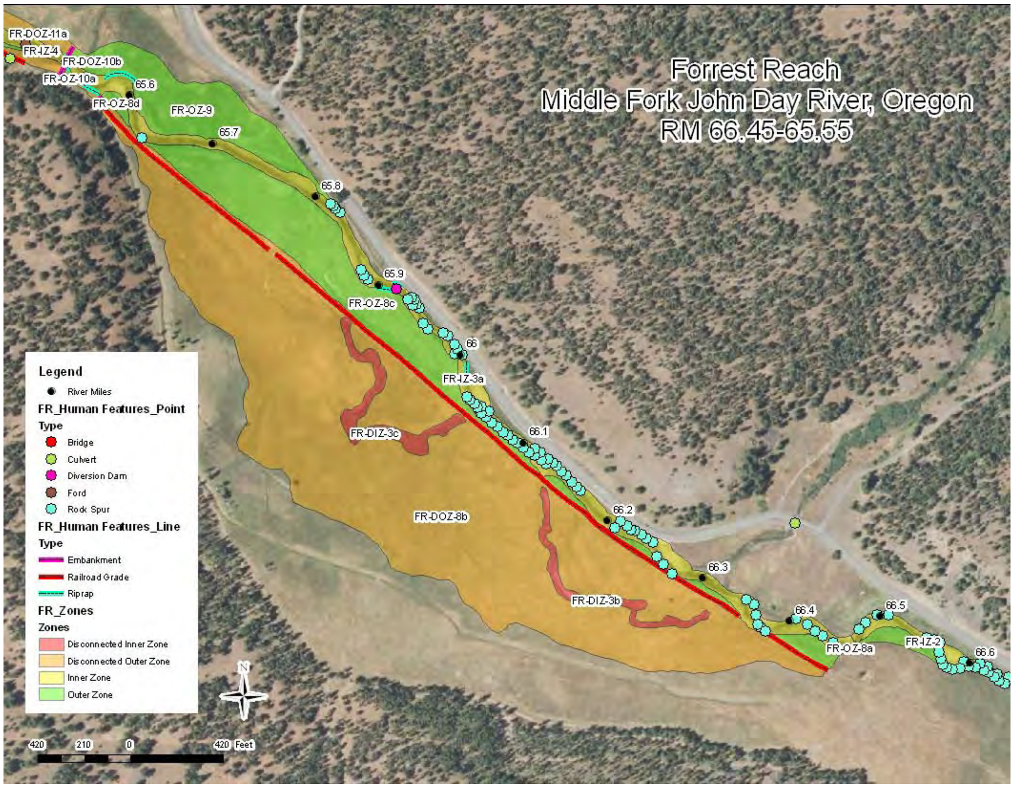


Figure 3. Location map of subreaches between RM 66.45 and 65.55, and anthropogenic features (scale 1:5,000).

Table 3. Summary of subreaches between RM 66.45 and RM 65.55.

Parcel	River Mile	Acreage	Anthropogenic Features
FR-IZ-3 SUBREACH COMPLEX			
FR-IZ-3a (inner zone)	RM 66.45 – 65.55	6.10 acres	Rock Spur (73) Riprap (561 ft)
FR-DIZ-3b (disconnected inner zone)	RM 66.31 – 66.11 (river left)	1.04 acres	Fill (Upstream and Downstream Connections)
FR-DIZ-3c (disconnected inner zone)	RM 66.05 – 65.90 (river left)	1.43 acres	Fill (Upstream and Downstream Connections)
FR-OZ-8 SUBREACH COMPLEX			
FR-OZ-8a (outer zone)	RM 66.58 – 66.39 (river left)	1.12 acres	Riprap (96 ft)
FR-DOZ-8b (disconnected outer zone)	RM 66.44 – 65.51 (river left)	43.44 acres	Railroad Grade (4002 ft) Embankment (34 ft)

Parcel	River Mile	Acreage	Anthropogenic Features
FR-OZ-8c (outer zone)	RM 66.34 – 65.64 (river left)	9.17 acres	None
FR-OZ-8d (outer zone)	RM 65.61 – 65.59 (river left)	0.19 acres	None
FR-OZ-9 SUBREACH			
FR-OZ-9 (outer zone)	RM 65.81 – 65.51 (river right)	4.94 acres	None

RM 65.55 – 63.48 SUBREACHES

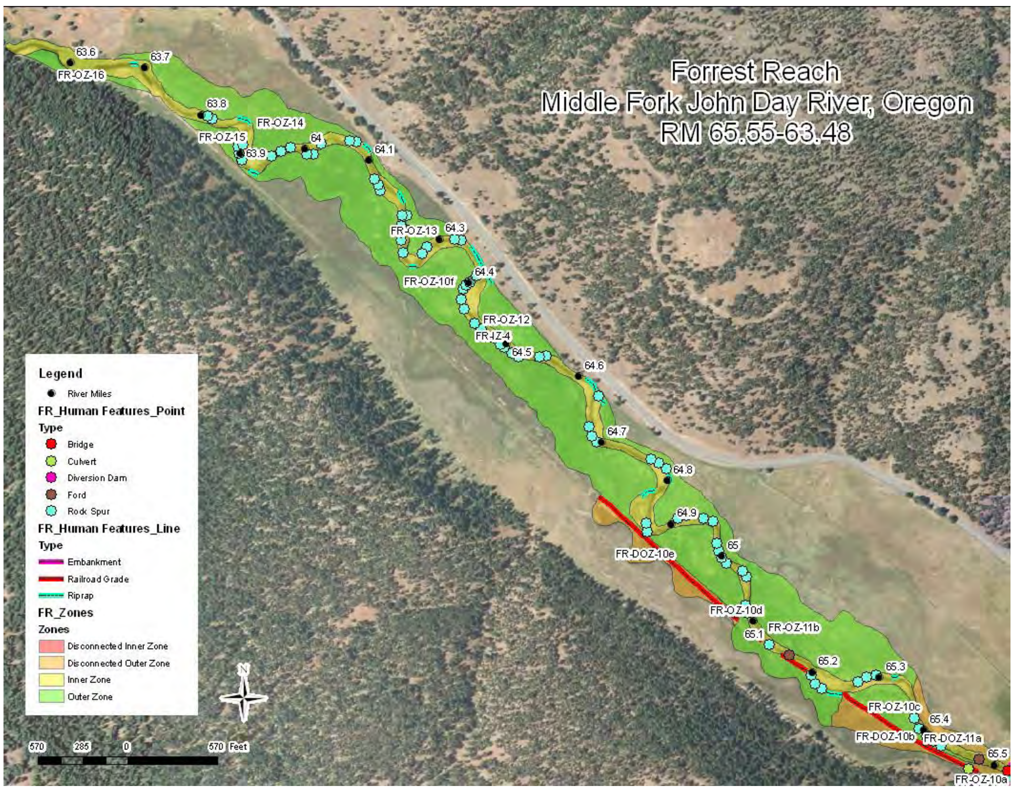


Figure 4. Location map of subreaches between RM 65.55 and 63.48, and anthropogenic features (scale 1:7,000).

Table 4. Summary of subreaches between RM 65.55 and RM 63.48.

Parcel	River Mile	Acreage	Anthropogenic Features
FR-IZ-4 SUBREACH			
FR-IZ-4 (inner zone)	RM 65.55 – 63.48	15.48 acres	Riprap (1190 ft) Rock Spur (75) Ford Crossing (1) Bridge (1)
FR-OZ-10 SUBREACH COMPLEX			
FR-OZ-10a (outer zone)	RM 65.55 – 65.51 (river left)	0.04 acres	None
FR-DOZ-10b (disconnected outer zone)	RM 65.51 – 65.24 (river left)	2.62 acres	Railroad Grade (982 ft) Embankment (41 ft)
FR-OZ-10c (outer zone)	RM 65.49 – 65.24 (river left)	2.05 acres	None
FR-OZ-10d (outer zone)	RM 65.24 – 64.89 (river left)	5.94 acres	Railroad Grade (307 ft)
FR-DOZ-10e (disconnected outer zone)	RM 65.10 – 64.75 (river left)	2.43 acres	Railroad Grade (1183 ft)
FR-OZ-10f (outer zone)	RM 64.89 – 63.91 (river left)	19.32 acres	Rock Spur (1)
FR-OZ-11 SUBREACH COMPLEX			
FR-DOZ-11a (disconnected outer zone)	RM 65.51 – 65.32 (river right)	1.35 acres	Embankment (49 ft)
FR-OZ-11b (outer zone)	RM 65.32 – 64.91 (river right)	11.01 acres	Riprap (34 ft)
FR-OZ-12 SUBREACH			
FR-OZ-12 (outer zone)	RM 64.58 – 64.39 (river right)	2.24 acres	Riprap (40 ft)
FR-OZ-13 SUBREACH			
FR-OZ-13 (outer zone)	RM 64.31 – 64.10 (river right)	1.59 acres	None

Parcel	River Mile	Acreage	Anthropogenic Features
FR-OZ-14 SUBREACH			
FR-OZ-14 (outer zone)	RM 64.07 – 63.65 (river right)	6.39 acres	None
FR-OZ-15 SUBREACH			
FR-OZ-15 (outer zone)	RM 63.91 – 63.79 (river left)	0.73 acres	None
FR-OZ-16 SUBREACH			
FR-OZ-16 (outer zone)	RM 63.71 – 63.51 (river left)	0.87 acres	None

CHANNEL UNIT MAPPING

Channel unit mapping is a useful tool in interpreting how sediment is moving through a given reach or channel segment at channel forming flows. Channel units are mapped in the field based on fluvial processes, and then each channel unit is redrawn on rectified aerial photographs in ArcGIS. "Channel units" should not be confused with "habitat units" that are a measure of habitat quantity available at low flows. For example, the habitat assessment includes the long pool tail-out in the glide-pools (usually lateral scour pools) as pool habitat even though this area of the pool is functioning as run habitat. The entire habitat unit is included as a pool, from the pool tail crest to the end of the pool at the top of the scour (USDA 2008). In many cases, most of the habitat area in a pool is run habitat with a smaller area comprised of the pool scour. In the channel unit mapping the pools (area of pool scour) and runs are spatially defined and mapped separately as channel units.

Channel unit codes are defined in Table C-1 and are modified from the USDA (2008) Stream Survey in that the aerial extent of each channel unit is mapped separately (scour pool and run are not combined as in the habitat assessment).

Table C-1. Channel unit mapping codes adapted from USDA 2008.

Channel Unit Code	Description
FTRP	Rapid
FTRF	Riffle
FNRN	Run
SDDD/ARTIF	Pool/Artificial Dam
SSLS	Lateral Scour Pool
SSMC	Mid-channel Pool

Channel unit mapping was conducted for the Forrest Reach Assessment and charted to graphically illustrate the existing condition and to help interpret current trends in sediment transport and deposition (Figure 1). Hypothetically, confined channel segments should have more rapids and runs (transport channel units); moderately confined segments should have a balance of runs (transport channel unit) with riffles and bars (depositional channel units); and unconfined segments should have more riffles and bars (depositional channel units). The confined section (subreach FR-IZ-2) has a high percent of runs and a small percent of rapids and pools that suggest the channel is supply limited and is transporting a majority of the sediment through the section. In the moderately confined section (subreach FR-IZ-1) and artificially confined section (subreach FR-IZ-3) of the reach there is a balance of runs with riffles (bars were not mapped for the Forrest reach due to spatial scale problems) that suggest the channel is actively adjusting. And in the unconfined section (subreach FR-IZ-4) there are essentially equivalent percentages of pools, runs and riffles that suggest the channel is in dynamic equilibrium.

Figure C-2 through Figure C-11 show the results of the channel unit mapping by river mile through the Forrest reach assessment area.

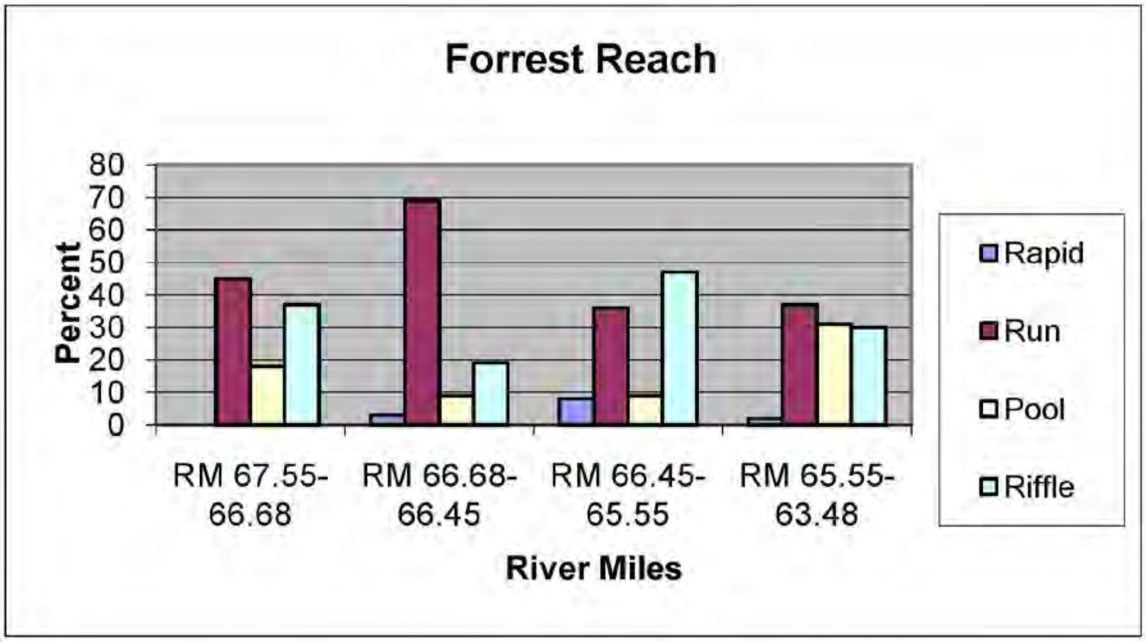


Figure C-1. Percent of channel units by river miles for each inner zone subreach based on modified classifications from the Stream Inventory Handbook (USFS 2008).

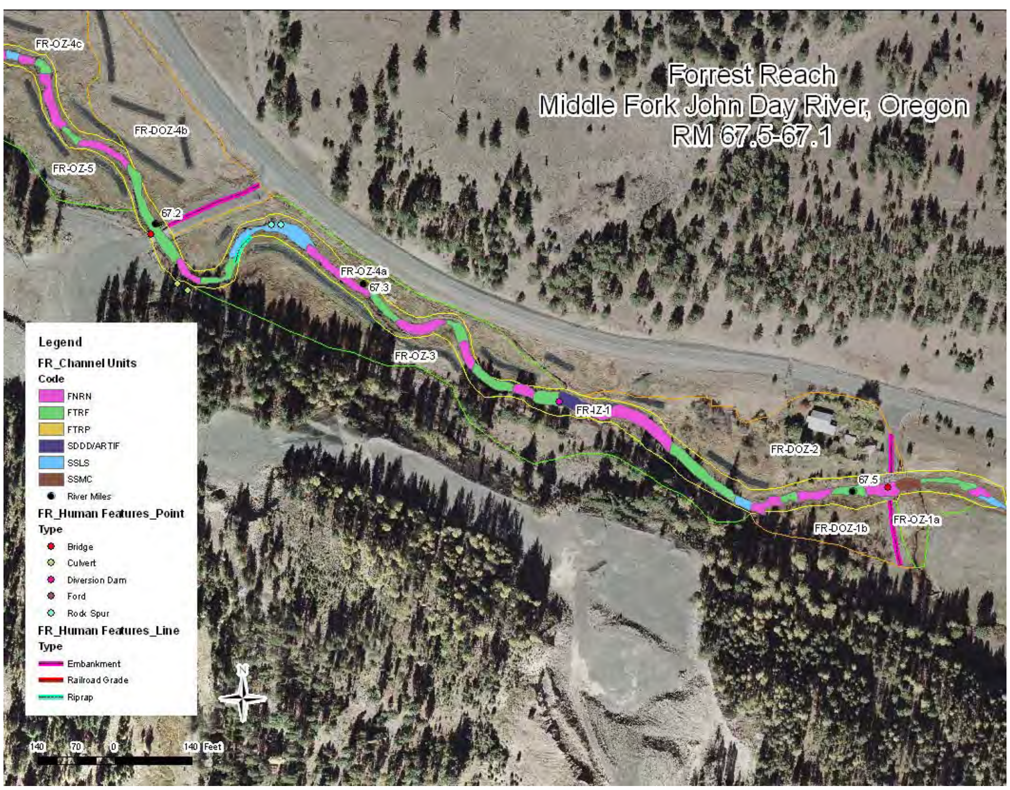


Figure C-2. Channel unit map for RM 67.5 – 67.1.

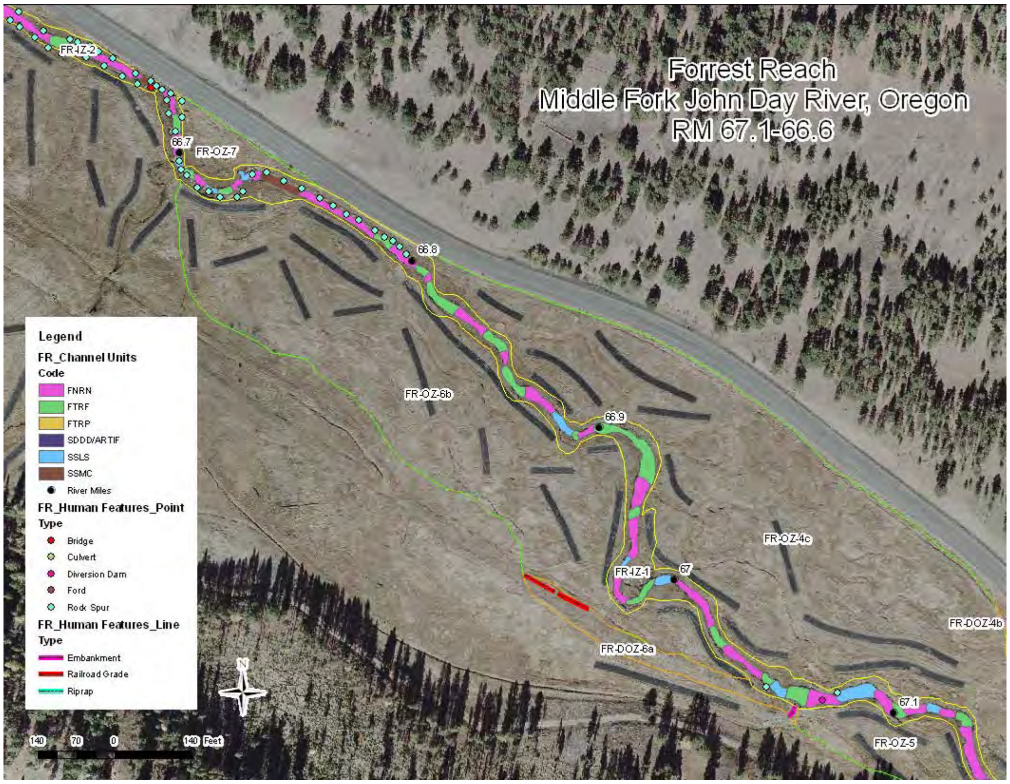


Figure C-3. Channel unit map for RM 67.1 – 66.6.

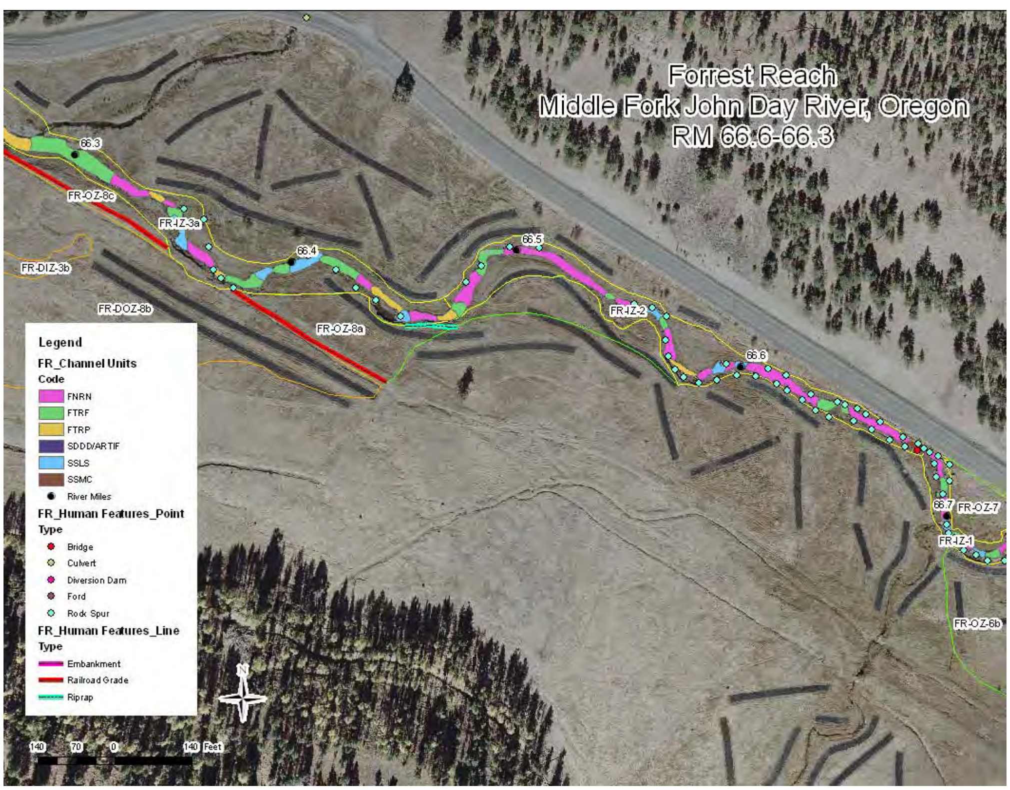


Figure C-4. Channel unit map for RM 66.6 – 66.3.

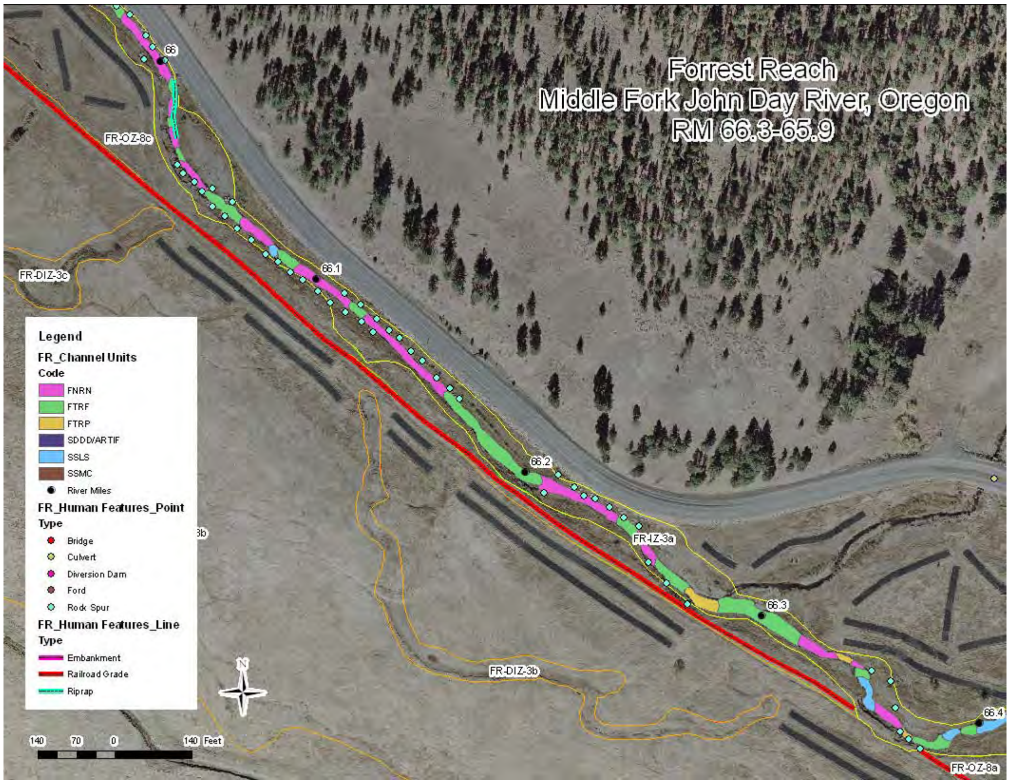


Figure C-5. Channel unit map for RM 66.3 – 65.9.

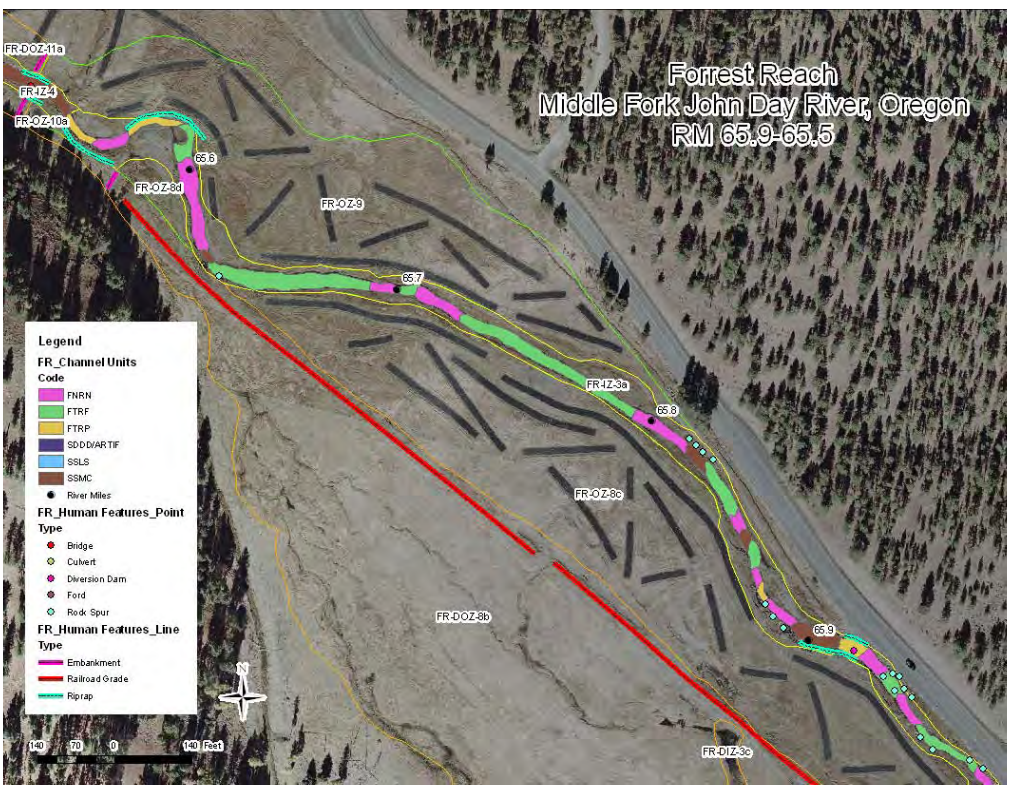


Figure C-6. Channel unit map for RM 65.9 – 65.5.

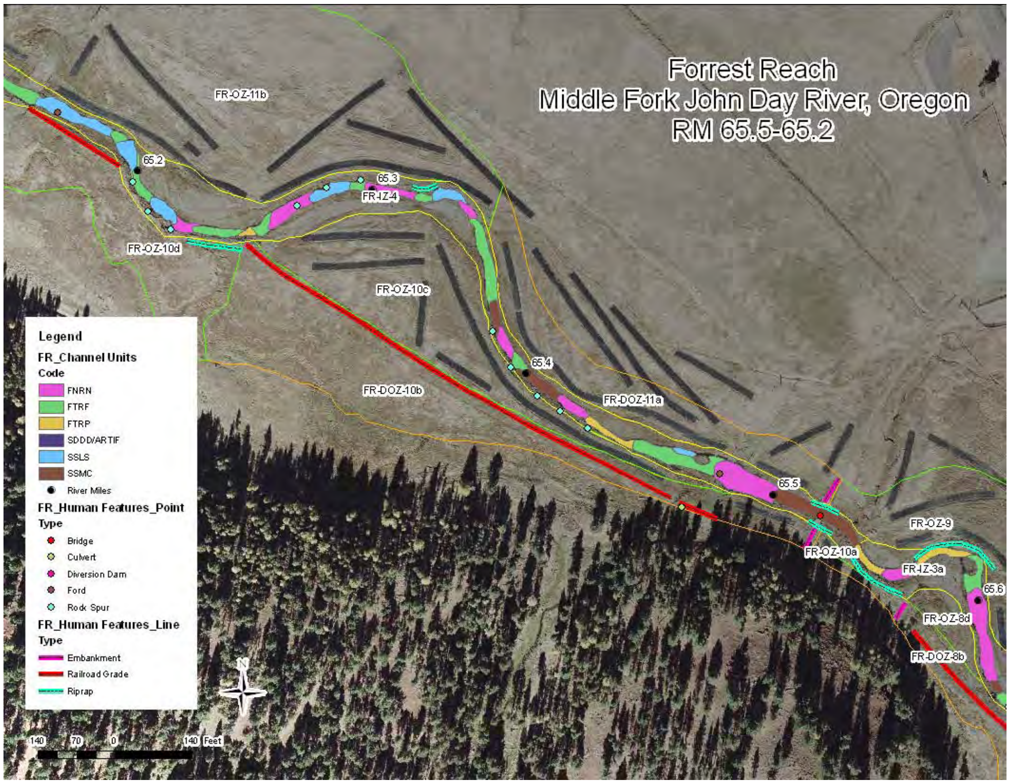


Figure C-7. Channel unit map for RM 65.5 – 65.2.

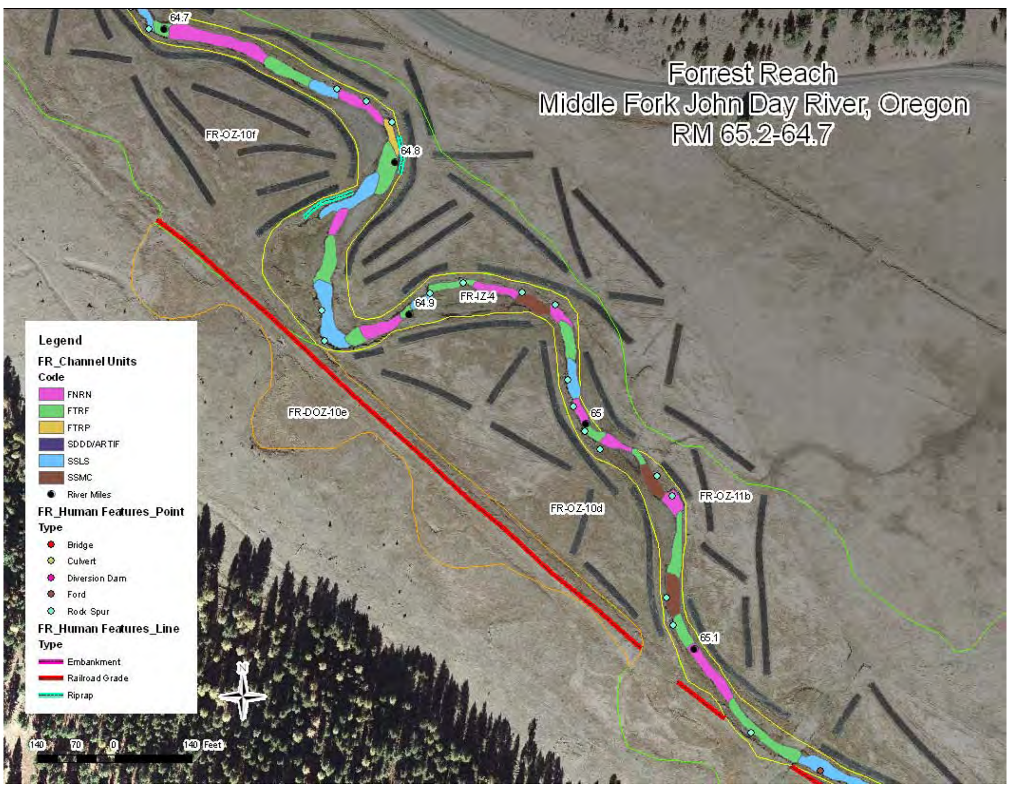


Figure C-8. Channel unit map for RM 65.2 – 64.7.

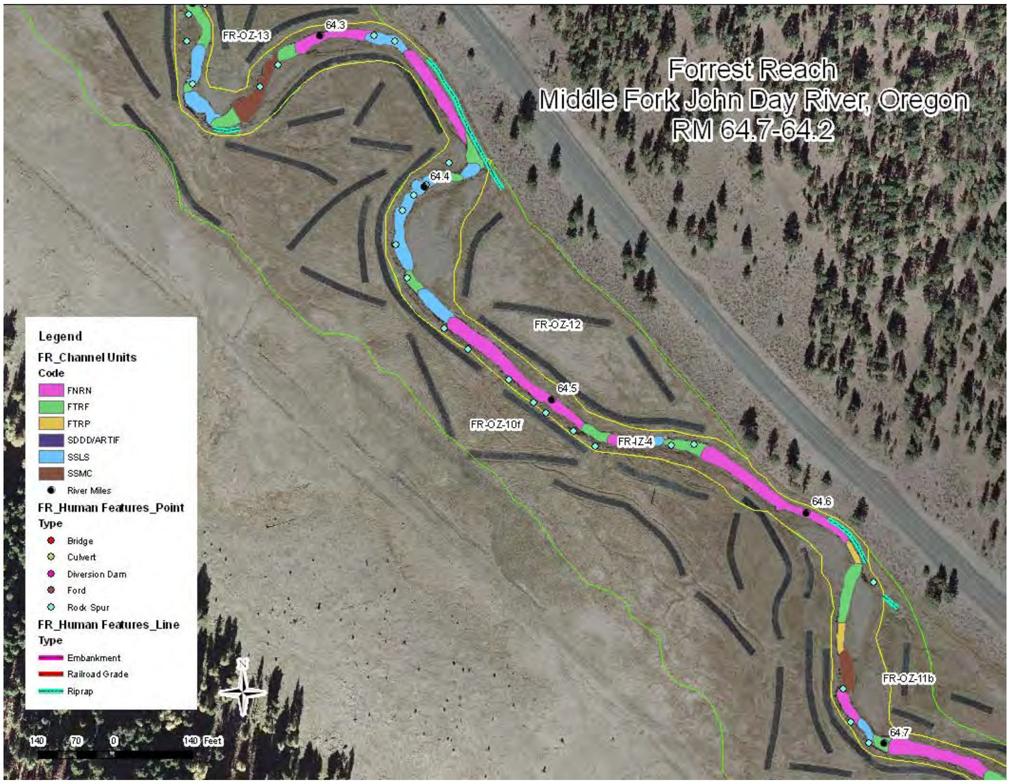


Figure C-9. Channel unit map for RM 64.7 – 64.2.

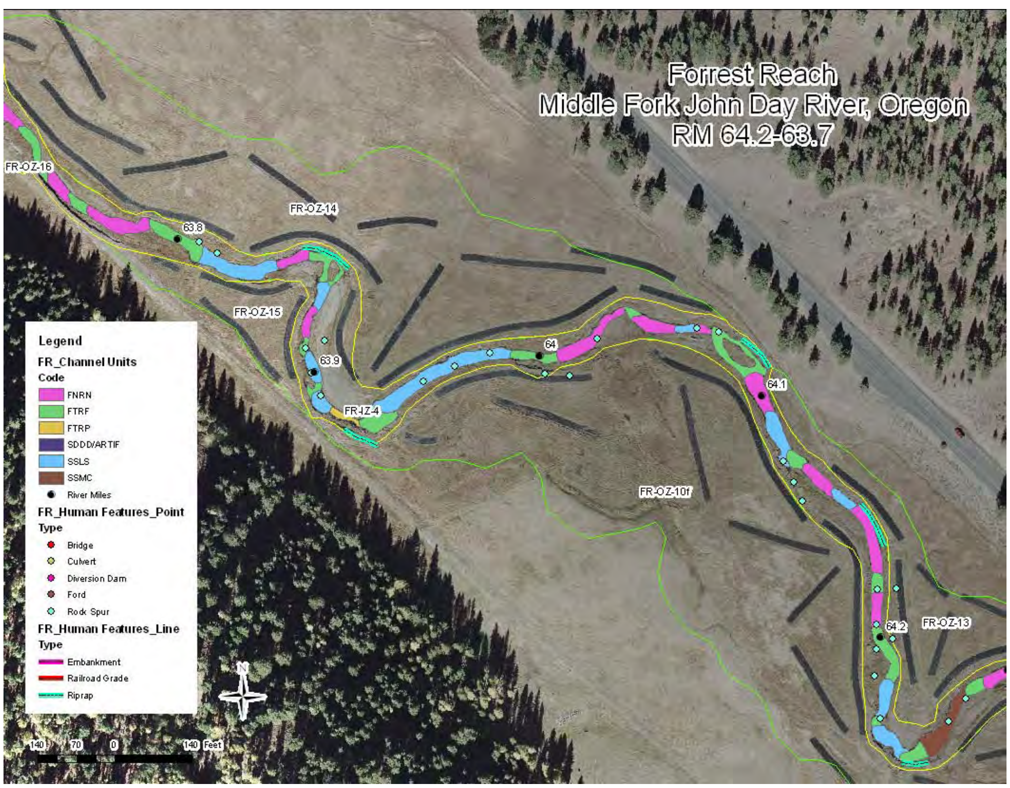


Figure C-10. Channel unit map for RM 64.2 – 63.7.

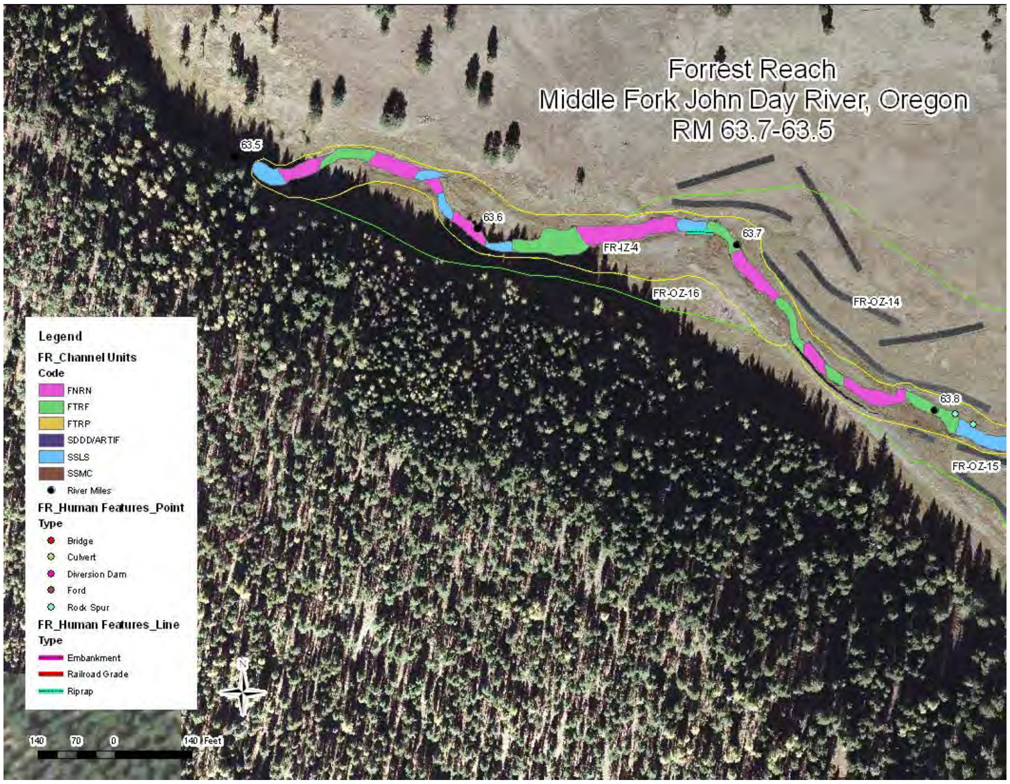


Figure C-11. Channel unit map for RM 63.7 – 63.5.

PHOTOGRAPHIC DOCUMENTATION

Photographic documentation of the Forrest reach was completed during the initial site assessment. Photographs were taken in the field and the location and direction were noted on aerial photographs. The locations (photopoints) were then mapped using ArcGIS (Figures 12 through 15). Each photograph was then captioned including the direction of the photograph, subject matter, and date. Captioned photographs are included in this assessment following the photopoint location maps in the Forrest Reach Photographic Documentation section.

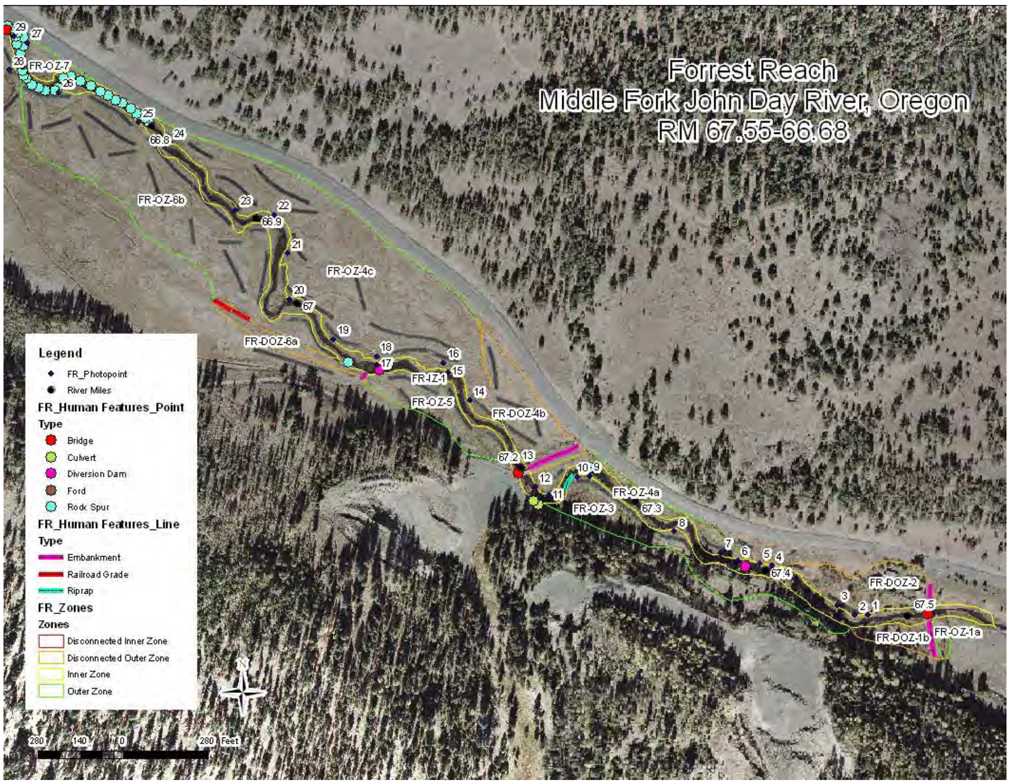


Figure C-12. Photopoint locations from RM 67.55 to 66.68.

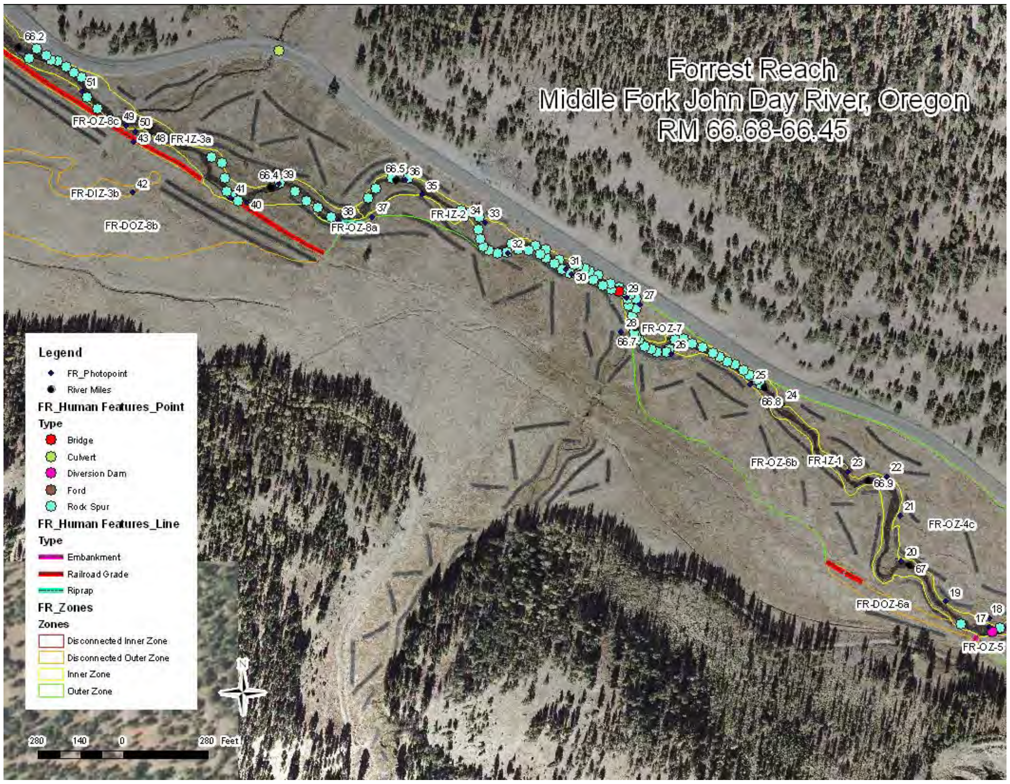


Figure C-13. Photopoint locations from RM 66.68 to 66.45.

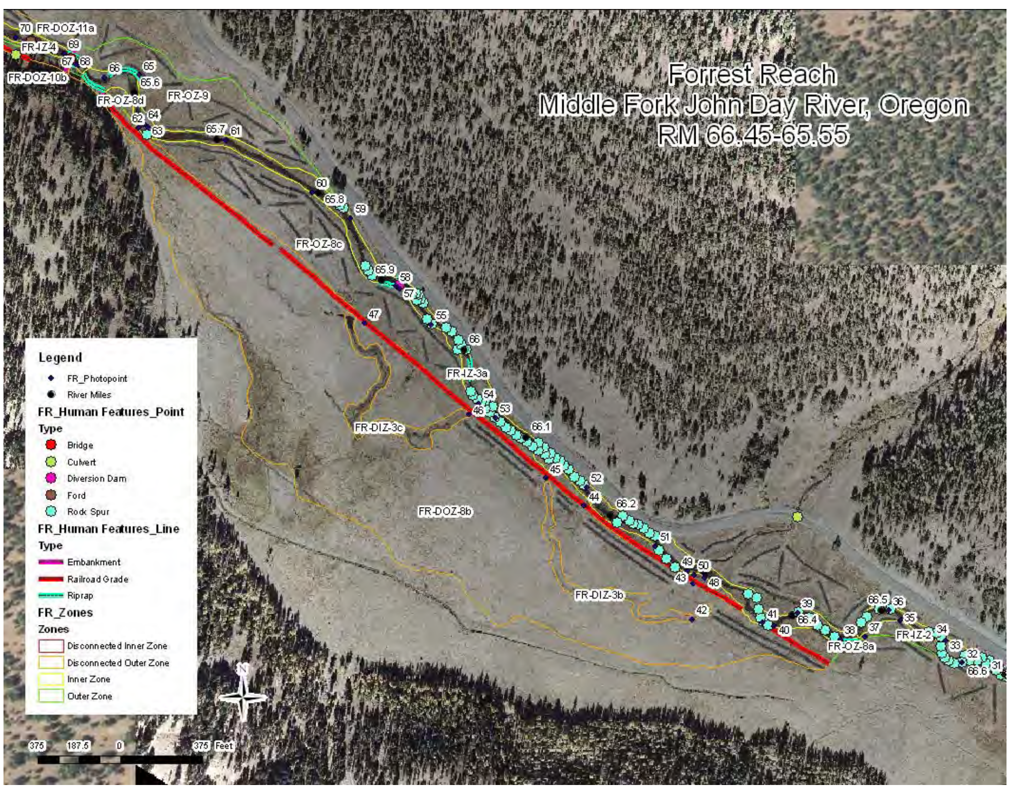


Figure C-14. Photopoint locations from RM 66.45 to 65.55.

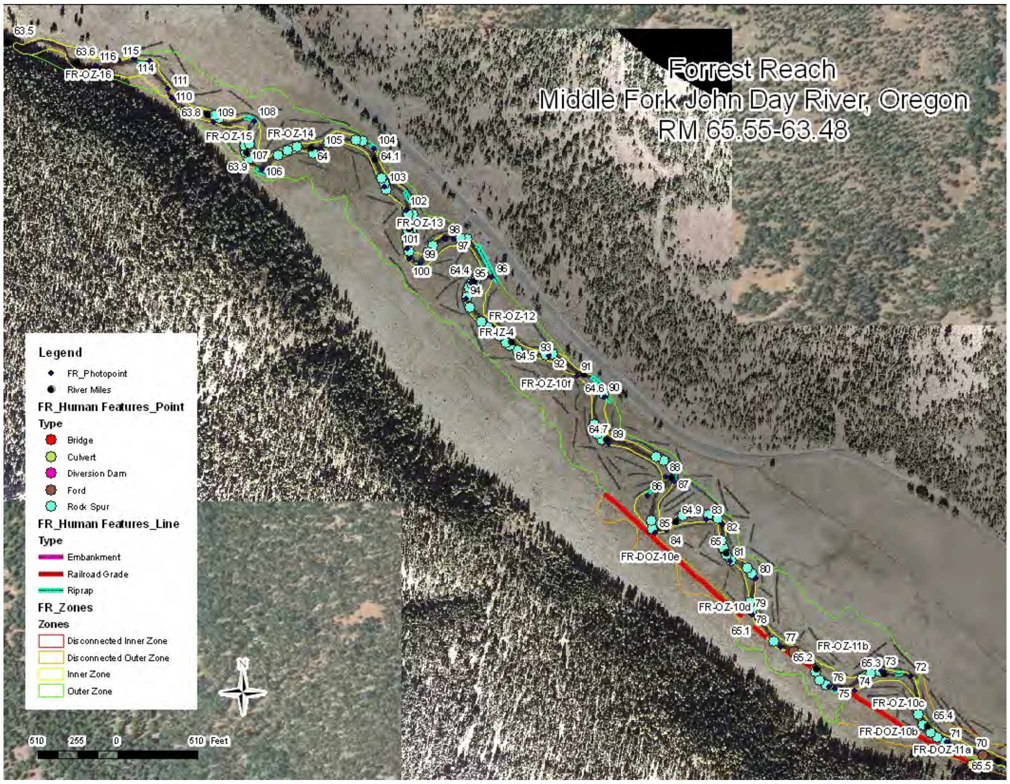


Figure C-15. Photopoint locations from RM 65.55 to 63.48.

Photograph No. 1. View is to the east looking upstream at bridge crossing. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 2. View is to the southeast looking upstream at wetland area (seep?) along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 3. View is to the northwest looking downstream from river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 4. View is to the south looking upstream at wetland area (seep?) along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 5. View is to the west looking downstream at irrigation diversion dam. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 6. View is to the southwest looking upstream at irrigation diversion dam that appears to be a partial fish passage barrier. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 7. View is to the west looking downstream at bank erosion occurring along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 8. View is to the northwest looking downstream at one of the few pieces of large wood observed in the assessment area. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 9. View is to the northwest looking downstream at rock spurs placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 10. View is to the west looking downstream at rock spurs placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 11. View is to the west looking at elevated culverts placed through road embankment that pass tributary flows. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 12. View is to the northwest looking downstream at bridge crossing that restricts lateral channel migration. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 13. View is to the northwest looking downstream at bank erosion along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 14. View is to the north looking downstream at bank erosion occurring along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 15. View is to the west looking downstream at bank erosion occurring along both riverbanks. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 16. View is to the west looking downstream along overflow channel on river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 17. View is to the west looking downstream at irrigation diversion dam. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 18. View is to the northwest looking downstream along historic overflow channel path or irrigation ditch. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 19. View is to the northwest looking downstream at bank erosion occurring along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 20. View is to the west looking at a potential river avulsion site. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 21. View is to the southeast looking upstream at historic overflow channel path or irrigation ditch. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 22. View is to the south looking upstream along overflow channel path. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 23. View is to the northwest looking downstream from river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 24. View is to the northwest looking downstream at bank erosion occurring along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 25. View is to the northwest looking downstream at a series of rock spurs placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 26. View is to the west looking downstream at rock spur placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 27. View is to the northwest looking downstream at a series of rock spurs placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 28. View is to the northeast looking downstream along Davis Creek as it enters the Middle Fork. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 29. View is to the northwest looking downstream at a series of rock spurs and footbridge. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 30. View is to the south looking upstream at bank erosion behind rock spurs along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 31. View is to the northwest looking downstream at a series of rock spurs. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 32. View is to the northwest looking downstream at a series of rock spurs. Note the bank erosion behind the rock spurs along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 33. View is to the northwest looking downstream at a series of rock spurs. Note bank erosion occurring behind the rock spurs along river right. Middle Fork John Day River – John Day Subbasin, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 34. View is to the northeast looking at rock spur with large woody debris. Note the pool (about 3-feet in depth) downstream and bank erosion behind the rock spur. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 35. View is to the northwest looking downstream at rock spur along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 36. View is to the northwest looking downstream at rock spurs placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 37. View is to the northwest looking downstream at riprap placed along river left. Note the bank erosion occurring downstream of riprap. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 38. View is to the northwest looking downstream at rock spurs placed along river left. Note the bank erosion occurring around the rock spurs along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 39. View is to the northwest looking downstream at rock spur along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 40. View is to the northwest looking downstream at rock spurs placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 41. View is to the north looking downstream where the railroad grade is being eroded along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 42. View is to the west looking downstream at historic channel path that appeared to be elevated above the active channel by about 2-feet. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 43. View is to the south looking at a historic stock pond. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 44. View is to the south looking upstream along historic channel path that is about 3-feet above the active channel. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 45. View is to the south looking upstream along historic channel path that is elevated about 2-feet above the active channel. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 46. View is to the southwest looking downstream along historic channel path that is elevated about 3-feet above active channel. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 47. View is to the northwest looking downstream along the railroad grade where it bisects historic channel path. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by E. Lyon, July 19, 2007.

Photograph No. 48. View is to the northwest looking downstream at rock spurs placed along river left and boulders placed along river right along road embankment. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 49. View is to the north looking at mouth of Vinegar Creek entering the Middle Fork. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 50. View is to the southwest looking at historic channel path behind the railroad grade. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 51. View is to the northwest looking downstream at boulders placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 52. View is to the northwest looking downstream at a rock spur placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 53. View is to the northwest looking downstream at rock spurs placed along both riverbanks. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 54. View is to the northwest looking downstream at rock spurs placed along river left and along the toe of the road embankment on river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 55. View is to the northwest looking downstream at rock spurs placed along both riverbanks and irrigation diversion near road embankment. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 56. View is to the northwest looking downstream at rock spurs used to raise water elevation for the irrigation diversion located out of view along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 57. View is to the north looking across irrigation diversion structure. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 58. View is to the northwest looking downstream at rock spurs placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 59. View is to the northwest looking downstream at rock spur placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 60. View is to the north looking across the river at fish return that no longer intercepts the river along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 61. View is to the northwest looking downstream at bank erosion occurring along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 62. View is to the southeast looking upstream at rock spur placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 63. View is to the south looking across the river at rock spur placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 64. View is to the northwest looking downstream at bank erosion occurring along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 65. View is to the west looking downstream at riprap placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 66. View is to the west looking downstream at riprap placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 67. View is to the north looking at a tributary entering the Middle Fork. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 19, 2007.

Photograph No. 68. View is to the north looking downstream at bridge crossing. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 69. View is to the northwest looking downstream at ford crossing. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 70. View is to the south looking at tributary entering the Middle Fork. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 71. View is to the northwest looking downstream at rock spurs placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 72. View is to the west looking downstream at bank erosion occurring along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 73. View is to the southwest looking downstream at rock spurs placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 74. View is to the west looking downstream at riprap placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 75. View is to the southeast looking upstream at ephemeral tributary channel. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 76. View is to the northwest looking downstream at rock spurs placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 77. View is to the northwest looking downstream at rock spur placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 78. View is to the south looking upstream at ephemeral tributary channel. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 79. View is to the north looking downstream at rock spur placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 80. View is to the northwest looking downstream at rock spur placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 81. View is to the northwest looking downstream at rock spurs placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 82. View is to the northwest looking downstream at rock spur placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 83. View is to the west looking downstream at head of a side-channel flowing along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 84. View is to the west looking downstream at bank erosion occurring along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 85. View is to the southeast looking upstream at ephemeral tributary channel. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 86. View is to the northeast looking downstream at riprap placed along the left bank of a historic channel path. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 87. View is to the north looking downstream at rock spurs placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 88. View is to the southwest looking at timber harvest area conducted on an alluvial fan. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 89. View is to the northwest looking downstream at rock spurs placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 90. View is to the northwest looking downstream at riprap placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 91. View is to the south looking at the mouth of a historic side-channel that appears to be elevated approximately 2' above the active channel. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 92. View is to the northwest looking downstream at rocks spurs placed along both riverbanks. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 93. View is to the northwest looking at rock spurs placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 94. View is to the north looking downstream at rock spurs placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 95. View is looking at a submerged log that provides protective cover for fish. Numerous fish were observed around the log and adjacent moss growth. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 96. View is to the north looking downstream at riprap placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 97. View is to the east looking upstream at rock spurs placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 98. View is to the west looking downstream at rock spurs placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 99. View is to the southwest looking downstream at riprap and rock spurs placed along river left. Note the bank erosion downstream of riprap. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 100. Eroding streambank comprised of clayey silt overlying gravels. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 101. View is to the north looking downstream at a rock spur along river left and bank erosion occurring along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 102. View is to the northwest looking downstream at riprap placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 103. View is to the northwest looking downstream at rock spurs placed along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 104. View is to the northwest looking downstream at riprap and rock spurs placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 105. View is to the west looking downstream at rock spurs placed along river left. Project Area RM 63.6-64. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 106. View is to the northwest looking downstream at rock spurs placed along river left and the bank erosion occurring downstream of the rock. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 107. View is to the north looking downstream at bank erosion around a rock spur. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 108. View is to the northwest looking downstream at riprap placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 109. View is to the northwest looking downstream at bank erosion along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 110. View of erosion occurring along the railroad grade on river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 111. View is to the northwest looking downstream at grass covered banks that are being undercut along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 112. View is to the west looking downstream at riprap placed along river right. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 113. View is to the south looking at the left abutment of a historic bridge along the railroad grade. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 114. View is to the northwest looking downstream at the right abutment of a historic bridge along the railroad grade. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 115. View is to the southwest looking downstream at undercutting occurring along river left. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

Photograph No. 116. View is to the west looking downstream at erosion occurring along both river banks. Middle Fork John Day River, Oregon – Bureau of Reclamation Photograph by R. McAffee, July 20, 2007.

APPENDIX D

Forrest Reach Geodatabase

Forrest Reach Geodatabase

The Forrest Reach Geodatabase was produced in support of the document, *Forrest Conservation Area Reach Assessment, Middle Fork John Day River, Grant County, Oregon*. More file geodatabases at the valley segment spatial scale are contained in the *John Day River Tributatary Assessments, Grant County, Oregon* (Reclamation, 2008), *Middle Fork John Day River, 2008 Stream Survey Report, Malheur National Forest, Blue Mountain Ranger District* (Appendix B), and *Geomorphology and Hydraulic Model Analysis of the Forrest Conservation Area, Middle Fork John Day River, Grant County, Oregon* (Reclamation 2010, in prep).

The ***ForrestReach*** File Geodatabase includes multiple feature classes:

Feature Classes	**Description**
FR_Channel Units	Physical attributes of the channel (polygon)
FR_HumanFeatures_Point	Human created features (point)
FR_HumanFeatures_Line	Human created features (polyline)
FR_Habitat Features_Line	Habitat features (polyline)
FR_Habitat Features_Point	Habitat features (point)
FR_Zones	Inner/outer zone divisions (polygon)
FR_Photopoint	Photograph locations (point)

For more information or to request a copy of the Forrest Conservation Area Reach GIS File Geodatabase on DVD, contact Kristin Swoboda at the Reclamation's Pacific Northwest Regional Office at kswoboda@usbr.gov.

Forrest Reach Geodatabase Feature Classes

Project Feature Classes

Feature Class – FR_Zones

Title – FR_Zones: This feature class was created for the *Forrest Conservation Area Reach Assessment, Middle Fork John Day River, Grant County, Oregon*

Keyword – Forrest Conservation Area Reach Assessment, Grant County, Oregon, Middle Fork John Day Subbasin

Abstract – This feature class contains polygons that show the location and extent of the inner and outer zones, and subreaches of the Forrest Conservation Area reach.

Feature Class – FR_Channel Units

Title – FR_Channel Units: This feature class was created for the *Forrest Conservation Area Reach Assessment, Middle Fork John Day River, Grant County, Oregon*

Keywords – Forrest Conservation Area Reach Assessment, Grant County, Oregon, Middle Fork John Day Subbasin

Abstract – This feature class contains polygons that show the location and extent of channel units within the Forrest Conservation Area reach.

Feature Class – FR_Human Features_Point

Title – FR_Human Features_Point: This feature class was created for the *Forrest Conservation Area Reach Assessment, Middle Fork John Day River, Grant County, Oregon*

Keywords – Forrest Conservation Area Reach Assessment, Grant County, Oregon, Middle Fork John Day Subbasin

Abstract – This feature class contains points that show the location of anthropogenic features that impact channel processes and floodplain connectivity.

Feature Class – FR_Human Features_Line

Title – FR_HumanFeatures_Line: This feature class was created for the *Forrest Conservation Area Reach Assessment, Middle Fork John Day River, Grant County, Oregon*

Keywords – Forrest Conservation Area Reach Assessment, Grant County, Oregon, Middle Fork John Day Subbasin

Abstract – This feature class contains polylines that show the location and extent of anthropogenic features that impact channel processes and floodplain connectivity.

Feature Class – FR_Habitat Features_Line

Title – FR_Habitat Features_Line: This feature class was created for the *Forrest Conservation Area Reach Assessment, Middle Fork John Day River, Grant County, Oregon*

Keywords – Forrest Conservation Area Reach Assessment, Grant County, Oregon, Middle Fork John Day Subbasin

Abstract – This feature class contains polylines that show the location and extent of bank erosion throughout the reach.

Feature Class – FR_Habitat Features_Point

Title – FR_Habitat Features_Point: This feature class was created for the *Forrest Conservation Area Reach Assessment, Middle Fork John Day River, Grant County, Oregon*

Keywords – Forrest Conservation Area Reach Assessment, Grant County, Oregon, Middle Fork John Day Subbasin

Abstract – This feature class contains polylines that show the location of physical and biological features (i.e. redds, pools) throughout the reach.

Feature Class – FR_Photopoints

Title – FR_Photopoints: This feature class was created for the *Forrest Conservation Area Reach Assessment, Middle Fork John Day River, Grant County, Oregon*

Keywords – Forrest Conservation Area Reach Assessment, Grant County, Oregon, Middle Fork John Day Subbasin

Abstract – This feature class contains points that display location and photograph number that correlate to the initial site assessments in Appendix B.

References

Parenthetical Reference	Bibliographic Citation
Reclamation 2008	Bureau of Reclamation. 2008. *Middle Fork and Upper John Day River Tributary Assessments, Grant County, Oregon*. U.S. Department of the Interior, Bureau of Reclamation. Denver, CO. May 2008.
Reclamation 2010, in preparation	Bureau of Reclamation. 2010. *Geomorphology and Hydraulic Model Analysis of the Forrest Conservation Area, Middle Fork John Day River, Grant County, Oregon*. In preparation. U.S. Department of the Interior, Bureau of Reclamation, Technical Service Center, Denver, CO.