

**Upper Middle Fork John Day River  
Intensively Monitored Watershed:  
Experimental Design and Implementation Plan**

**DRAFT  
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# Executive Summary

## Introduction

This report represents a re-working of a draft Study Design for the Upper Middle Fork John Day River Intensively Monitored Watershed (IMW) completed in February 2009. The original report was compiled by the Upper Middle Fork John Day Working Group (UMFWG). Eco Logical Research Inc was contracted to further develop the study design to incorporate design concepts central to the core objectives of the IMW program, namely to *implement restoration activities in an experimental fashion to improve our ability to learn how restoration actions influence fish populations*.

There are several major challenges complicating the development and implementation of the Middle Fork IMW:

1. Large-scale restoration projects have been implemented along the mainstem Middle Fork and in over 15 tributaries in the project area since 2007 prior to the completion of an experimental design,
2. Restoration activities in both the mainstem and tributaries are diverse, ranging from channel alignment and engineered log jam placements, to aspen fencing and juniper removal,
3. Many these restoration activities have often been implemented in the same area (i.e., not grouped in discrete reaches or tributaries),
4. Many of the restoration projects along the mainstem and tributaries were implemented without several years of pre-treatment monitoring of either fish or stream habitat, and
5. The data regarding the restoration and monitoring activities has not been collected in a standardized way that allows easy data sharing, and there is no formal system in place to compile, store, and manage the data.

These challenges are common to many other large-scale restoration and monitoring programs and it is recognized that they may make it difficult to develop and test specific hypotheses about the affects of restoration on fish populations. The Middle Fork IMW will be a test of our ability to implement an experimental design within these challenging circumstances.

The Middle Fork IMW study area includes the Middle Fork John Day River (hereafter the Middle Fork), the North Fork John Day River (hereafter the North Fork), and the South Fork John Day River (hereafter the South Fork; Figure 1). The Middle Fork is designated as a treatment stream where significant restoration activities will be implemented and the North Fork and South Fork will be used as control streams. Physical setting, geomorphic and hydrologic conditions, and landuse and past development area summarized for the study basins.

The Middle Fork IMW study area supports several species of fish including spring and fall Chinook salmon *Oncorhynchus tshawytscha*, summer steelhead *O. mykiss*, bull trout *Salvelinus*

*confluentus*, Pacific lamprey *Lampetra tridentata*, and westslope cutthroat trout *O. clarkii lewisi*. Spring Chinook salmon and summer steelhead are the predominate salmonids inhabiting the Middle Fork watershed. Both steelhead and bull trout are listed as threatened species. Spring Chinook salmon are not currently listed. Steelhead are the most widely distributed salmonid species occupying most tributaries and mainstem habitats. Chinook distribution is slightly more confined to mainstem habitats and larger tributaries compared to steelhead although juvenile Chinook often migrate into cool-water tributaries during warm summer periods. Both steelhead and Chinook will be the focus of fish monitoring for this IMW. Limiting factors for both species are temperature, key quantity, and sediment. Chinook spawning has been increasing over time but not smolt production and steelhead spawning has been decreasing.

The limiting factors identified form the basis for the type of restoration planned by Working Group partners. Restoration actions have been divided into SIX separate categories: 1) channel reconfiguration and floodplain reconnection; 2) fish passage, 3) flow increase, 4) grazing/upland management, 5) instream habitat enhancement, and 6) riparian fencing and planting.

Four different experimental designs are proposed to determine the effects of restoration at different scales: watershed design, mainstem treatment control design, tributary design, and temperature modeling design at the watershed and reach scale. These designs are still in the development stage and will require more planning to ensure that the appropriate levels of monitoring and response variables are measured in distinct treatment and control areas.

To complete the implementation plan the following general ongoing issues need to be addressed and then a series of steps are required to finalize the design and timeline for restoration and monitoring implementation:

#### *Issues*

- GIS data is not in standard format (line, polys, and points) for each restoration and monitoring activity
- GIS data is not in sufficient detail to sum up basic design metrics like the amount of a particular restoration (area, length, or total count) of restoration activities and in some cases determine when the activities were implemented
- There is no common reach classification and naming convention used across agencies and partners, and stream locations (i.e., rKM) are also inconsistent making transferring data from one source to another difficult
- There are “unknown” restoration projects that have not been accounted for (what are they, when were they completed or proposed)
- Monitoring activities have been implemented in an adhoc fashion in some cases and only after restoration activities have already been completed
- Monitoring levels and locations have changed from year to year reducing time series data

- There has not been a predetermination of the restoration activities to be implemented, the level required to have a likelihood of creating a fish response, and explicit treatment and control sections identified (this report has completed this step at a course scale only)
- It appears that there is a focus on implementing restoration activities without a concerted effort to adhere to experimental design principles

### *Steps to complete the Implementation Plan*

- Review and convert all existing GIS data into appropriate format (e.g., instream structures should be cataloged individually as point data, riparian fencing should be catalog and mapped as line data, and forest management practices like juniper removal should be mapped as polygons).
- Reclassify or remove all unknown restoration projects and audit the existing database to make sure projects are not duplicated or missing (this will require an extensive review by partners familiar with particular areas of the study area)
- GIS resources and assessments need to be extended to North Fork and South Fork to avoid potential disruption of these subbasins as control streams
- The starting conditions (as of 2007) need to be documented for the basic attributes of interest (riparian cover, channel alignment, instream structures, presence of LWD, pools, etc). Most of this information is available in the BOR and TMDL assessments
- Once the starting conditions are documented the appropriate level of restoration can be determined. For example, if there was 1 LWD piece per 100 m pre-treatment, a goal of 10 pieces may be selected based on references or historic conditions. Literature from other sites can then be used to predict the potential effect of this treatment
- Adoption of BOR (2008) reach classifications and summary data is recommended. Their approach should be applied to the remaining study area (i.e., Big Creek to Camp); GIS resources from BOR should be acquired and combined with existing IMW layers
- Treatment and control areas have to be selected and maintained as best as possible to allow long-term monitoring to be implemented while limiting confounding factors
- Need to have the group review and adopt the next version of the experimental design. Once the design has been adopted, ALL future restoration activities will have to be compatible with the adopted design – this will require a LISTING of all proposed restoration projects and prioritizing the projects based on the design. This will require that future restoration needs to be implemented within TREATMENT areas only, and COTROL areas are to be left UNTREATED. A framework for coordinating these activities is essential to moving forward.
- A future restoration condition needs to be described to allow planning and coordination. Applying different levels of restoration to treatment areas will confound the experiment (e.g., the goal in each treatment area will be to realign 1000 m of channel, reconnect 2 side channels, and construct 25 ELJ)
- A complete review of monitoring activities should be conducted before the next field season and prior to any more restoration. Long-term spatially extensive sampling such as redd counts, macro invertebrate, and temperature monitoring appear to be adequate; however, juvenile salmon monitoring, and stream habitat monitoring sites

may not be located in optimal areas. Permanent treatment and control sites have to be selected first before monitoring plans can be finalized

- A key question EXTERNAL reviewers will have is “How much restoration will you need to complete to detect an effect of X”. This will require a Power Analysis and review of the potential fish response per unit of X restoration. The draft Power Analysis conducted provides measures of variability for juvenile and adult abundance BUT does incorporate the an experimental design or PROPOSED effect sizes.
- Once a experimental and monitoring framework is finalized a timeline needs to be developed that outlines each years activities and the responsibilities of group members
- Data Management, analysis, and reporting – these responsibilities need to be reviewed in order to deal with all the data streaming in and how is it going to be managed.

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## Abbreviations

BLM	Bureau of Land Management
BOR	Bureau of Reclamation
CBMRCD	Columbia-Blue Mountain Resource Conservation & Development Area
CTWSRO	Confederated Tribes of Warm Springs Reservations of Oregon
ELJ	Engineered log jam
FWS	US Fish and Wildlife Service
GSWCD	Grant Soil and Water Conservation District
IMW	Intensively Monitored Watershed
ISEMP	Integrated Status and Effectiveness Monitoring Program
LWD	Large woody debris
MNF	Malheur National Forest
NMFS	National Marine Fisheries Service
NFJDWC	North Fork John Day Watershed Council
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish & Wildlife
OWEB	Oregon Watershed Enhancement Board
PIBO	PACFISH/INFISH Biological Opinion
TNC	The Nature Conservancy
UMFWG	Upper Middle Fork (John Day) Working Group
U of O	University of Oregon

# **Section 1: Middle Fork Intensively Monitored Watershed Design Background**

## **Introduction**

### ***Purpose of the Report***

This report represents a re-working of a draft Study Design for the Upper Middle Fork John Day River Intensively Monitored Watershed (IMW) completed in February 2009. The original report was compiled by the Upper Middle Fork John Day Working Group (UMFWG). Eco Logical Research Inc was contracted to further develop the study design to incorporate design concepts central to the core objectives of the IMW program, namely to *implement restoration activities in an experimental fashion to improve our ability to learn how restoration actions influence fish populations.*

### ***Intensively Monitored Watershed Rationale***

In the Pacific Northwest, stream restoration has been and will continue as a major approach to recover salmon and steelhead populations that have exhibited significant declines over the past several decades. For example, between 2000 and 2003, the Pacific Coastal Salmon Recovery fund alone spent over \$170 million for salmon habitat restoration projects (Roni 2005). Both the 2000 and 2004 Biological Opinions that outline the recovery strategy for steelhead and salmon within the Columbia Basin rely on stream restoration as the primary approach to recovery. However, past restoration efforts have rarely included effectiveness monitoring programs to determine if projects have provided a benefit to the target population (Roni et al. 2002; Roni et al. 2005; Bernhardt et al. 2005). As such, recommendations for what types of projects are effective are largely based on intuition rather than empirical information.

Project evaluations that have been conducted have produced equivocal results of their effectiveness because they have not accounted for other factors (Thompson 2006); have looked at local effects that may simply reflect preference rather than benefits to the population; are conducted at insufficient spatial and temporal scales to observe a population benefit; or have not used proper experimental approaches. Evaluating whole watershed responses to restoration in an experimental fashion has been suggested as a means to overcome these problems (Roni et al. 2002; Bilby et al. 2005; Roni et al. 2005; Reeve et al. 2006). Watershed scale coordinated restoration efforts with the associated effectiveness monitoring programs have been initiated in the Pacific Northwest to evaluate population level responses to restoration, and are referred to as Intensively Monitored Watershed (IMW) studies (Bilby et al. 2004; Bilby et al. 2005; PNAMP 2005; Nelle et al. 2006). Coordination at the regional scale has been initiated to develop a network of IMWs assessing a variety of actions, limiting factors, and watershed types. This coordination should lead to a better understanding of fish-habitat relationships and empirically based recommendations on how restoration should be prioritized and implemented as a recovery strategy.

The goal of the IMW program is to measure the effect of habitat restoration on salmon and trout productivity. (Bilby et al. 2004; PNAMP 2005). Financial and logistical constraints make

the IMW approach impractical for all restoration actions. Therefore, the IMW approach must be implemented in the framework of experimental management where the goals are to benefit the resource while maximizing learning so that the result can be extrapolated to other situations (Walters 1986). Generalization beyond a single system requires knowledge of mechanistic interactions or multiple ecosystem studies (Carpenter et. al. 1995). Directed research within an IMW might reveal the mechanisms by which the environment influences population performance of salmonids in a cost effective manner. In addition, the lessons learned from this network of IMWs, will enable the region to implement further restoration with greater confidence without the rigorous effectiveness monitoring of the IMW approach.

### ***Middle Fork IMW Development***

The National Oceanic and Atmospheric Administration (NOAA), in coordination with the Oregon Watershed Enhancement Board (OWEB), has funded an IMW in the upper Middle Fork of the John Day River basin, Oregon. The Middle Fork John Day IMW (hereafter Middle Fork IMW) is coordinated by the UMFWG which is made up of agencies, conservation groups, and private land owners who implement restoration and monitor restoration in the project area.

In May of 2007 the UMFWG convened and began to develop a plan for the implementation of the Middle Fork IMW. The group determined that it will take a minimum of 5-10 years for the effects of restoration activities on salmonids populations to be detected. Therefore, an anticipated study length of at least 10 years was assumed during the design of the initial plan. This time period was used in determining both the items to be monitored and the methods to be used. This newly established program for watershed scale effectiveness monitoring builds on a variety of collaborative restoration and monitoring projects in the basin including; ODFW's Chinook salmon and steelhead monitoring, USFS temperature and PIBO monitoring, NFJDWC water quality monitoring, CTWSRO conservation area programs and monitoring performed by TNC.

Despite the formation of a working group and drafting of study design there are several major challenges complicating the development and implementation of the Middle Fork IMW:

- Large-scale restoration projects have been implemented along the mainstem Middle Fork and in over 15 tributaries in the project area since 2007 prior to the completion of an experimental design,
- Restoration activities in both the mainstem and tributaries are diverse, ranging from channel alignment and engineered log jam placements, to aspen fencing and juniper removal,
- Many these restoration activities have often been implemented in the same area (i.e., not grouped in discrete reaches or tributaries),
- Many of the restoration projects along the mainstem and tributaries were implemented without several years of pre-treatment monitoring of either fish or stream habitat, and

- The data regarding the restoration and monitoring activities has not been collected in a standardized way that allows easy data sharing, and there is no formal system in place to compile, store, and manage the data.

These challenges are common to many other large-scale restoration and monitoring programs and it is recognized that they may make it difficult to develop and test specific hypotheses about the affects of restoration on fish populations. The Middle Fork IMW will be a test of our ability to implement an experimental design within these challenging circumstances.

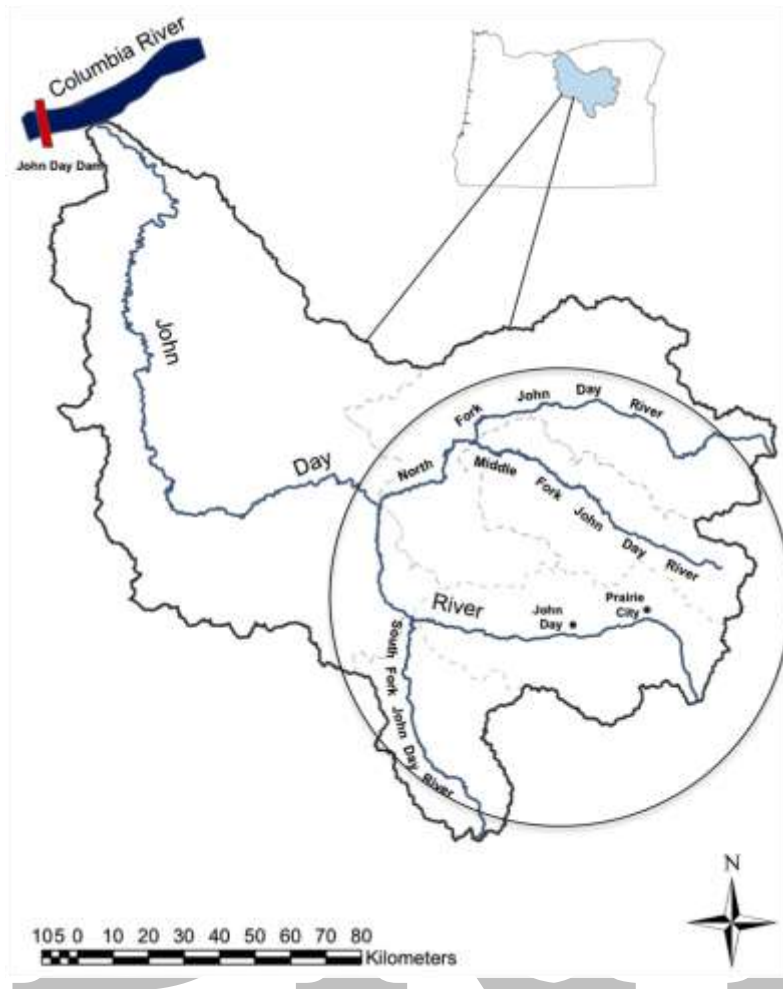
The first section of this document contains the background information relevant to the Middle Fork IMW including a description of the goals of the Middle Fork IMW, study area, focal species, limiting factors, and historic and proposed restoration actions. The second section of this document presents the Implementation Plan for the IMW including specific objectives, hypotheses to be tested, experimental, restoration, and monitoring designs, and data management, analysis, and reporting procedures.

### ***Goals of the Middle Fork IMW***

The goals of the Middle Fork IMW are to improve adult and juvenile salmonid freshwater habitat in the Middle Fork IMW study area using a variety of restoration actions, to assess how restoration actions alter stream habitat conditions, and to understand the casual mechanisms between stream habitat restoration and changes in salmonids production at the watershed scale.

### **Study Area**

The John Day Basin lies in the Mid-Columbia Plateau Region in Northeastern Oregon (Figure 1). The basin consists of five main watersheds: the Lower John Day, the Upper John Day, the South Fork John Day, the North Fork John Day, and the Middle Fork John Day. The Middle Fork IMW study area includes the Middle Fork John Day River (hereafter the Middle Fork), the North Fork John Day River (hereafter the North Fork), and the South Fork John Day River (hereafter the South Fork; Figure 1). The Middle Fork is designated as a treatment stream where significant restoration activities will be implemented and the North Fork and South Fork will be used as control streams (see Section 2 – Experimental Design for more details). The following sections describe the physical setting, geomorphic and hydrologic conditions, and land management and development activities in the three subbasins.



**Figure 11.** Location of the John Day watershed in Oregon and the general location of the Middle Fork IMW study area (area in circle), including the North Fork, Middle Fork, and South Fork John Day Rivers (modified from McCormick et al. 2009).

### *Physical Setting*

The John Day Basin [Hydrologic Unit Code (HUC) 170702] is the largest undammed tributary to the Columbia River in the United States and is bordered by large mountains on the eastern and southern highlands. The drainage ranges in elevation from just over 9,000 feet (2,750 m) at the headwaters to 200 feet at the mouth where it enters the Columbia River just upstream of the John Day Dam. The lower mainstem John Day River dissects the Deschutes-Umatilla Plateau. The largest rivers in the Basin are the John Day River, and the North, Middle and South Forks, in order of volume (DEQ 2010). The John Day River is the largest un-dammed tributary to the Columbia River, in the United States. The North Fork and Middle Fork basins have a plateau form with some areas of wide floodplains, interspersed with confined reaches and narrow valley floors. The South Fork drainage has a more narrow valley form than the mainstem and is mostly trough or v-shaped. The upper reaches of the South Fork are also more arid than the upper reaches of either the Middle or North Forks (DEQ 2010).

The Middle Fork restoration area has been defined as the mainstem and all of the tributaries entering the Middle Fork from the confluence of Big Creek upstream to the confluence of Summit Creek. The Middle Fork originates in the Blue Mountains of the Malheur National Forest, south of the North Fork, flows westerly for 75 miles, and merges with the North Fork about 18 miles above the town of Monument. The Middle Fork is a fourth field watershed (USGS cataloging unit 17070203) that drains 806 mi<sup>2</sup> with a perimeter of 158 miles. Watershed elevations range from 2200 feet near the mouth to over 8200 feet in the headwater areas.

The North Fork of the John Day River drains approximately 1,800 square miles and ranges from 1,830 ft at the mouth to over 8,300 ft in the headwater areas. There are 32 major tributaries to the North Fork system. Precipitation ranges from approximately 13 to 20 inches annually. The North Fork historically supplies 60% of the total stream flow to the lower John Day River. The South Fork originates in the southwest portion of the Malheur National Forest and flows 60 miles north until it merges with the mainstem near Dayville. The South Fork sub-watershed drains approximately 600 mi<sup>2</sup> and ranges in elevation from 2300 feet to 7400 feet.

*\*Need some more description about the similarities and differences between the subbasins*

### ***Geomorphic and Hydrologic Conditions***

The John Day River has a snow-melt dominated hydrograph (90% of total annual precipitation) and varies widely between peak and low flows. Infrequent, but intense summer thunder storms account for the remainder of the annual precipitation. Seasonal peak flows occur between March and May and seasonal low flows usually occur between August and October (see discharge summaries in BOR 2008 and DEQ 2010). The Middle Fork watershed receives approximately 15-25 inches of precipitation each year. Stream flow is typical of the John Day Watershed and is snowmelt dominated with an average stream flow of 255 cfs as measured by the USGS stream gauge near Ritter (river kilometer, RKM 24).

The Middle Fork channel and valley morphology are described in detail in McDowell (2001) and BOR (2008). Three reach types have been identified in the mainstem Middle Fork based on valley width, floodplain connectivity, and substrate. These reaches are dominated by different geomorphic processes that provide different habitats for salmonids. Each reach type is also suited for different types of restoration activities based on its specific characteristics. Mapping of the reach types has been completed for 23 miles of the mainstem Middle Fork from Camp Creek to Clear Creek (BOR 2008). We expect to map the remainder of Middle Fork reaches between Big Creek and Camp Creek to further aid in the designing and implementation of the IMW. The three reach types are defined in detail in McDowell (2001) and BOR (2008) and briefly reviewed here:

- Unconfined - wide, unconfined floodplain, high floodplain connectivity, greater sinuosity, high instream habitat complexity, gravel dominated substrate, and sediment storage,

- Moderately Confined – moderately confined floodplain, less sinuosity and floodplain connectivity, moderate level of instream complexity, gravel and cobble substrate, and sediment storage and transport, and
- Confined – narrow floodplain with low connectivity, non-sinuosity, low instream habitat complexity, more boulder substrate, and predominately a sediment transport reach.

### ***Land Management and Development***

The majority of the upper Middle Fork IMW study area is on the Malheur National Forest managed by the U.S. Forest Service (USFS), several large parcels are managed by restoration focused organizations such as the Confederated Tribes of Warm Springs Reservation of Oregon, The Nature Conservancy, and the Confederated Tribes of the Umatilla. The Middle Fork John Day Rivers have been impacted by development of the region for gold mining, ranching, grazing, and timber harvest. Historical accounts of the basin date back to the early 1800s (see BOR 2008 for a detailed review).

Large tracks of the lower North Fork are managed by the Bureau of Land Management (BLM), private land is scattered throughout, and much of the upper watershed is on the Umatilla and Wallowa-Whitman National Forest (CBMRCD 2005). Much of the lower South Fork are managed by the Bureau of Land Management (BLM), private land is scattered throughout, and much of the upper watershed is on the Umatilla and Wallowa-Whitman National Forest (CBMRCD 2005).

*\*Need some more description about the potential management actions in the control streams that could influence the IMW*

### **Existing Technical Assessments and Recovery Plans**

The following section briefly summarizes the findings of key habitat and fisheries assessments and planning processes that are relevant to the Middle Fork IMW. See the Upper South Fork of the John River Watershed Assessment (Cole et al. 2003), John Day Subbasin Plan (CBMRCD 2005), Middle Fork and Upper John River Tributary Assessment (BOR 2008), and John Day River Basin TMDL and Water Quality Management Plan (DEQ 2010).

### ***Habitat Assessments***

In general, subbasins within the John Day watershed have all been impacted by past land management practices, particularly grazing, mining, forestry, water development, and road and railway right-of-ways (CBMRCD 2005, BOR 2008, DEQ 2010). These activities have combined to increase the size of peak runoff and summer water temperatures, and decreased summer low flows, riparian vegetation, floodplain connectivity, and instream habitat complexity. High quality stream and riparian habitat is still present in the upper watersheds

### **Riparian Conditions**

These need to be determined using BOR 2008

## Stream Conditions

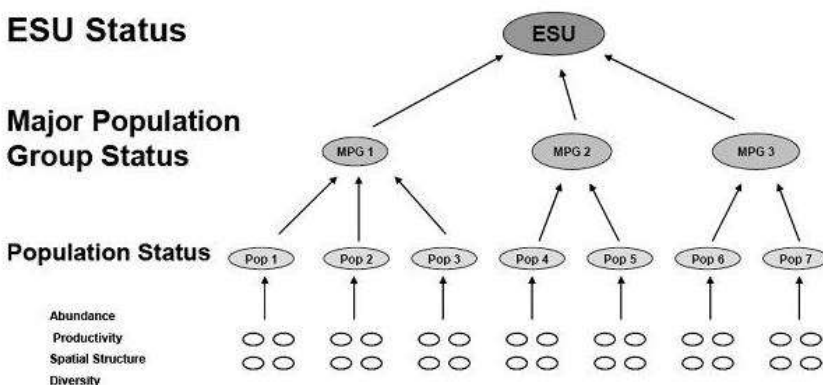
These need to be determined using BOR 2008

## Upland Conditions

These need to be determined using BOR 2008

## Fisheries Assessments

The Interior Columbia Basin Technical Recovery Team (ICTRT) is responsible for developing biological viability criteria used to classify populations of anadromous salmonids under the Endangered Species Act (ESA) and to inform long-term regional recovery planning efforts. The ICTRT uses a hierarchical description of population structure (Figure 2). The Evolutionarily Significant Unit (ESU) is used to describe groups of populations of Pacific salmon with similar characteristics and is the level at which ESA listings are made. A Distinct Population Segment (DPS) is similar to an ESU, except that an ESU can only be applied to stocks of Pacific salmon. Because steelhead are considered a trout species based on their life history characteristics (semelparous vs. iteroparous), they are listed as DPSs instead of ESUs. Discrete populations that share similar genetic, geographic (hydrographic), and habitat characteristics within an ESU/DPS, but are demographically independent from other such groups over a 100-year time period, are termed Major Population Groups (MPGs; McElhany et al. 2000). Viability criteria are analyzed at the population level, expressed in terms of abundance, productivity, spatial structure, and diversity. The structure and diversity criteria include major spawning areas (MaSAs) and minor spawning areas (MiSAs).



**Figure 22.** Diagram illustrating the hierarchy of ESU, MPG, and population level viability criteria.

Format  
spelling

## Fish Species Presence and Distribution

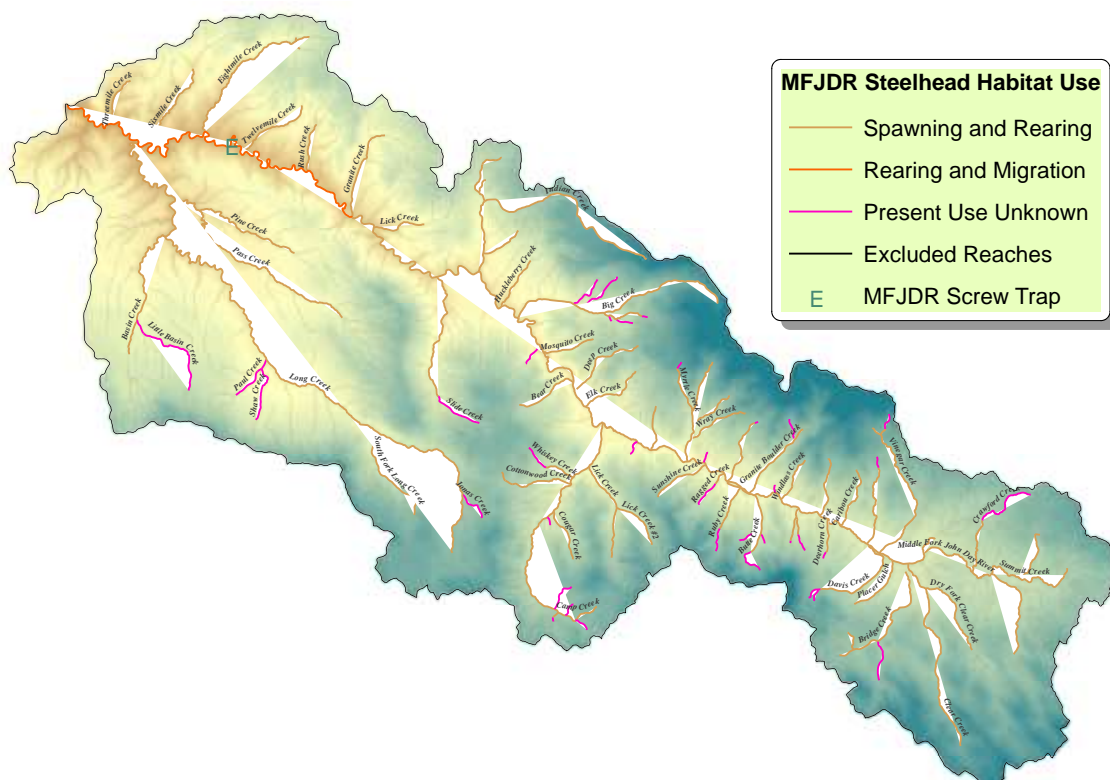
The John Day River supports several species of fish including spring and fall Chinook salmon *Oncorhynchus tshawytscha*, summer steelhead *O. mykiss*, bull trout *Salvelinus confluentus*, Pacific lamprey *Lampetra tridentata*, and westslope cutthroat trout *O. clarkii lewisi*. Spring

Chinook salmon and summer steelhead are the predominate salmonids inhabiting the Middle Fork watershed although bull trout are also found in tributaries with limited seasonal use of mainstem habitats by fluvial adults. Both steelhead and bull trout are listed as threatened species. Spring Chinook salmon are not currently listed. Steelhead are the most widely distributed salmonid species occupying most tributaries and mainstem habitats. Chinook distribution is slightly more confined to mainstem habitats and larger tributaries compared to steelhead although juvenile Chinook often migrate into cool-water tributaries during warm summer periods. Bull trout distribution is limited by their temperature tolerance to only the upper reaches of tributaries, especially Granite Boulder, Clear, and Big Creeks.

### **Steelhead Status**

Steelhead in the John Day River subbasin are part of the Mid-Columbia River DPS and were listed as a threatened species on March 25, 1999. The DPS includes all naturally spawned populations of steelhead in streams from above the Wind River in Washington and the Hood River in Oregon to and including the Yakima River in Washington.

Steelhead in the John Day River are considered an MPG based primarily on subbasin topography and distance from other spawning aggregates (NOAA Fisheries 2003b). The John Day River subbasin contains one of the few remaining summer steelhead MPGs in the interior Columbia Basin that have had relatively little influence from introduced hatchery fish. Within this MPG, the ICTRT defined five populations on the basis of genetic, demographics, and habitat information including the Lower mainstem, the North Fork, the South Fork, the Upper Mainstem, and the Middle Fork. Of relevance to this IMW is the Middle Fork population which is found in the Middle Fork John Day River and select tributaries (Figure 3).

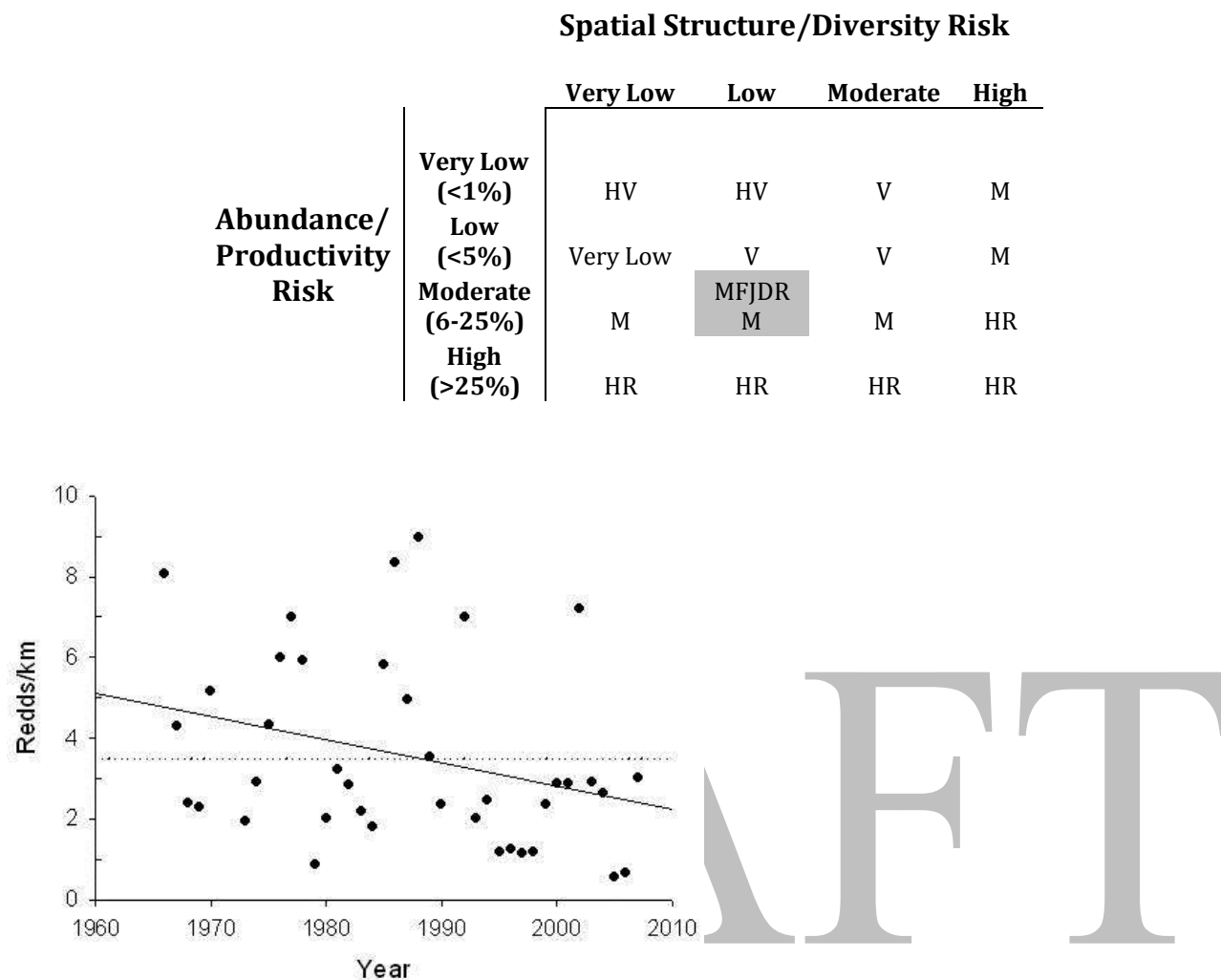


**Figure 3. Summer steelhead habitat used distribution in the Middle Fork John Day River subbasin. The Middle Fork Rotary Screw trap is shown for reference (adapted from James et al. 2010).**

The Middle Fork John Day River steelhead population does not currently meet the ICTRT recommended viability criteria (Table 1). In addition, long term surveys conducted since 1966 suggest a declining trend in redd densities for this population (Figure 4). Recent redd densities have indicated that escapement goals set by ODFW have not been met in 13 of the last 15 years (Figure 4).

Only summer steelhead (enters fresh water in a sexually immature condition and requires several months in fresh water to mature and spawn) are present in the John Day River subbasin. They migrate inland toward spawning areas during summer and fall, and overwinter in the larger rivers. They resume migration to natal streams in early spring, and then spawn (Meehan and Bjornn 1991, Nickelson *et al.* 1992).

**Table 1. Abundance & productivity and spatial structure & diversity integration table. HV=Highly Viable; V=Viable; M=Maintained, HR=High Risk (Carmichael 2006).**



**Figure 4. Trends in steelhead redd densities observed at annual index spawning ground surveys conducted by ODFW in the Middle Fork John Day River watershed. ODFW management goal is shown as a dotted horizontal line. A linear regression line, shown as a solid line, has also been fit to the data (P=0.059).**

Unlike Pacific salmon, steelhead are capable of spawning more than once before death and thus their classification as a trout. However, it is rare for steelhead to spawn more than twice before dying, and most that do spawn more than once are females (Nickelson *et al.* 1992). Steelhead spawn in cool, clear streams with suitable gravel size, depth and current velocity. Steelhead enter streams and arrive at spawning grounds weeks or even months before they spawn. Intermittent streams may also be used for spawning (Barnhart 1986, Everest 1973).

Depending on water temperature, steelhead eggs may incubate for one and a half to four months before hatching. Juveniles rear in fresh water from one to four years, and then migrate to the ocean as smolts. Summer rearing takes place primarily in the faster parts of pools, although young-of-the-year are abundant in glides and riffles. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (Nickelson *et al.* 1992). The

most productive steelhead habitat is characterized by channel complexity and instream structures, primarily in the form of large and small wood.

*O. mykiss* can either be anadromous (steelhead) or resident (redband) trout, and research has shown that under some circumstances they can yield offspring of the opposite form. Those that are anadromous usually spend 2 years (range=1-4 yrs) in fresh water prior to smoltification, and then spend up to 3 years in salt water prior to first spawning. However, summer steelhead in the John Day River MPG generally return to spawn after spending one year in the ocean (1-Ocean). Conversely, redband trout populations complete their entire life-cycles within freshwater habitats, and can often be found above barriers to steelhead. However, steelhead and redband trout are still known to occur sympatricly (occupying the same range without loss of identity from interbreeding) in all subbasins that contain steelhead. Recent studies (Kostow 2003, Ruzycki unpublished data) indicate that the different life history patterns of steelhead and redband are not reproductively isolated; each morphology appears to be able to produce offspring of the other type. Therefore, it is assumed that measures for protecting and enhancing steelhead will also benefit redband.

### **Spring Chinook Status**

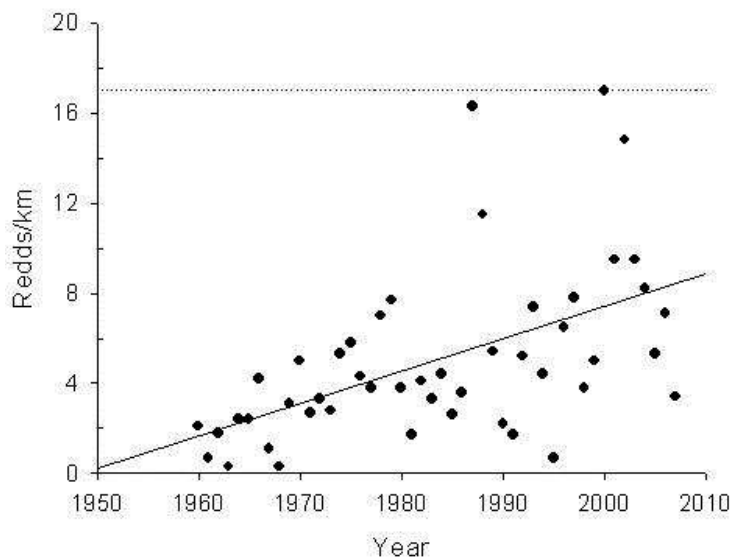
The spring run of Chinook salmon in the John Day River subbasin is grouped into the Mid-Columbia River ESU. This ESU includes all naturally spawned populations of spring-run Chinook salmon in Columbia River tributaries from the Klickitat River upstream to and including the Yakima River (excluding the Snake River Basin). In the John Day River subbasin, adult spring Chinook salmon migrate upstream into and within the subbasin during April, May, and June. Most spring Chinook return as 4-year-olds (75%), with 3-year-old (2.5%) and 5-year-old (22.5%) returns comprising the remainder (Lindsay *et al.* 1985). They arrive at holding and spawning areas in the Upper John Day River subbasin, Middle Fork John Day River subbasin, North Fork John Day River subbasin, and Granite Creek (a tributary to the North Fork) by early July (USBR 2003). Adults are consistently found in deep pools with cover such as undercut banks, fallen trees or other debris, boulders, or vegetation (Lindsay *et al.* 1985). Although average stream temperatures often rise above lethal temperatures in the Middle Fork John Day, Chinook are often able to locate and hold in cold-water refugia (Torgersen *et al.* 2001). Except during the most extreme conditions, daytime temperatures of the John Day are warm while night time temperatures cool sufficiently to allow the adults to move within the system to the next cool water holding area. The adults are found in these locations until they spawn in late August through late September (USBR 2003).

Emergence of fry commences in March and April following high water (USBR 2003). Distribution extends downstream after emergence; then as water temperatures increase and flows decrease, juveniles move into cooler tributaries and mainstem areas. By late September and early October, a shift back to the mainstem usually takes place concurrent with decreasing water temperatures and increasing flows (Lindsay *et al.* 1985). Juveniles reside in rearing areas for approximately 12 months before migrating downstream the following spring, with migration peaking past Spray (RM 170) on the mainstem John Day River during the second week in April (Lindsay *et al.* 1985).

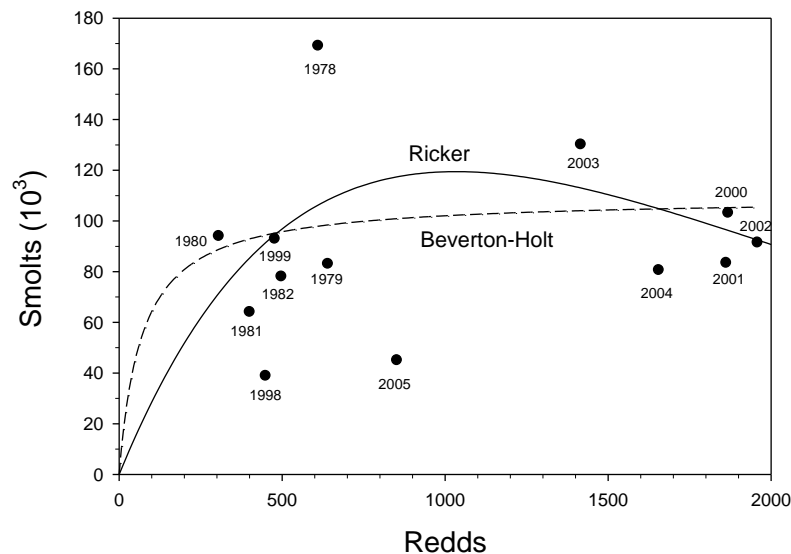
Rearing habitats are both on the mainstem reaches and the lower reaches of significant tributaries. (USBR 2003). The majority of rearing is in the lower portions of the cooler water tributaries, and not in the mainstem river where spawning occurs. Recapture data in the Columbia River indicate that smolts from the John Day River enter the Columbia from April through May and enter the Columbia River estuary in May and June (Lindsay *et al.* 1985).

Since 1960, Chinook salmon have shown a significant increase in annual redd densities observed on index spawning ground surveys in the Middle Fork John Day River (Figure 5). However, these densities generally remain well below management goals which were achieved only once during the past twenty years. It is unclear as to why the long-term trends in steelhead and Chinook redd densities appear to be diverging (see Figure 5). One hypothesis is that most restoration activities have focused on Chinook habitat on mainstem reaches.

It has become increasingly apparent that habitat conditions (including water temperatures) are limiting productivity of Chinook in the John Day River subbasin. Surveys of Chinook adults conducted during 2007 suggest that nearly 50% of the spawners present during early summer died in the Middle Fork due to temperature extremes experienced in early July. This evidence indicates that temperature remains a limiting factor for adult Chinook survival. Chinook salmon abundance in the John Day River subbasin appears to be limited by freshwater productivity. The number of smolts produced by spawners during any brood year appears to be limited to approximately 100,000 smolts despite a four-fold change in redd densities over the past 25 years (Figure 6). This limitation suggests that Chinook production should respond to habitat restoration activities and that this response should be measurable by estimating smolt production in the Middle Fork watershed.



**Figure 5. Trends in Chinook redd densities observed on annual index spawning ground surveys conducted by ODFW in the Middle Fork John Day River watershed. ODFW management goal is shown as a dotted horizontal lines. A linear regression line, shown as a solid line, has also been fit to the data ( $P < 0.001$ ).**



**Figure 6. The number of spring Chinook smolts produced as a function of redd counts in the John Day River basin. Points indicate brood years. Beverton-Holt and Ricker stock-recruitment curves are fit to the data.**

### Bull Trout Status

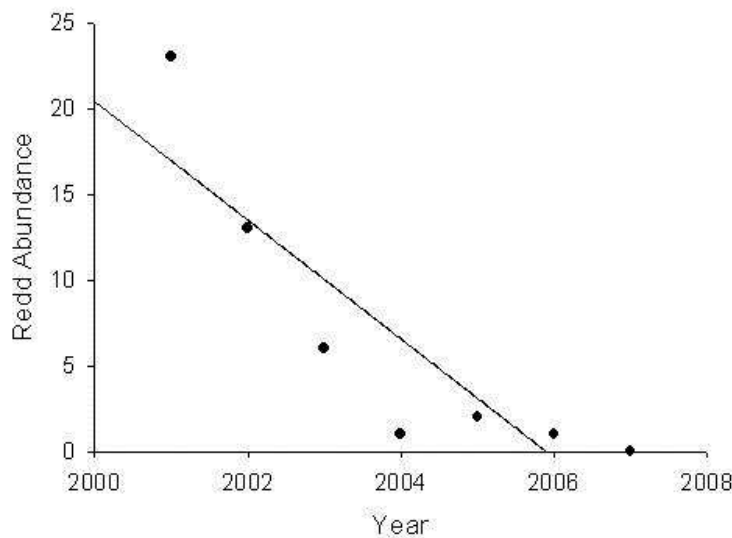
The U.S. Fish and Wildlife Service issued a final rule listing the Columbia River and Klamath River populations of bull trout as a threatened species under the Endangered Species Act on June 10, 1998 (63 FR 31647). Five populations are listed as distinct population segments (DPS) and the U.S. Fish and Wildlife Service identified the John Day Subbasin as one of 22 recovery units within the Columbia River DPS (USFWS 2003). The John Day Recovery Unit identified three core areas: the North Fork John Day River, the Middle Fork John Day River, and a portion of the Upper Mainstem John Day River. The Middle Fork John Day River Core Area is at high risk of extinction since the contingent is only found in tributaries, and is thought to be extinct in the Middle Fork John Day River itself (Ratliff and Howell 1992).

Bull trout in the Middle Fork John Day River persist at low abundance levels. Distribution information for the Middle Fork John Day River indicates that three local populations currently exist within this drainage: Big Creek, Clear Creek and Granite Boulder Creek (Buchanan et al. 1997). The Malheur National Forest has identified an additional five areas as potential habitat for bull trout local populations (potential local populations) (1998a), including Big Boulder Creek, Butte Creek, Davis Creek, Upper Middle Fork John Day River, and Vinegar Creek.

Current distribution in the Middle Fork John Day River is based on isolated sightings with the primary distribution restricted to tributaries and limited to 22% of stream miles previously known to support bull trout (Claire and Gray 1993, Buchanan et al. 1997). Data from 1990 and 1992 Oregon Department of Fish and Wildlife Aquatic Inventory Project surveys indicate that

bull trout occupy approximately 16 miles of stream in the Middle Fork John Day River watershed, including 5.5 miles in Big Creek, 2.5 miles in Deadwood Creek (a tributary to Big Creek), 4 miles in Granite Boulder Creek; and 4 miles in Clear Creek. Presence/absence surveys conducted by ODFW in 2001 and 2002 in Davis Creek and Vinegar Creek, respectively, detected no bull trout in Davis Creek and only one bull trout in Vinegar Creek.

Bull trout migration from these tributary streams during the summer is highly unlikely due to high water temperatures and habitat modifications in the mainstem. Aquatic inventory surveys conducted by the Oregon Department of Fish and Wildlife in 1990 and 1991 detected 60 bull trout in the Middle Fork John Day River watershed; two fish were measured at 10 inches and 14 inches, all others were less than eight inches in length (Buchanan et al. 1997). In the 1999 and 2000 surveys of Clear Creek, eight redds were observed each year (MNF 2001). Annual bull trout redd surveys conducted by ODFW over a two kilometer reach of upper Big Creek show a strong decline in redd abundances ( $P < 0.01$ ; Figure 7).



**Figure 7. Trend in bull trout redd abundance in upper Big Creek from 2001 to 2007.**

Adults usually spawn from August through November in the coldest headwater tributaries of a river system, and require water temperatures less than 50° F for spawning, incubation and rearing (Weaver and White 1985). Although migratory bull trout (fluvial) may use much of a river basin through their life cycle, rearing and resident fish often live only in smaller watersheds or their tributaries (second to fourth order streams) (Ziller 1992).

Juvenile bull trout are closely associated with stream channel substrates, often using interstitial (space between substrate) spaces for cover (Fraley and Shepard 1989). A close association with channel substrates appears more important for bull trout than for other species. This specific rearing habitat requirement suggests that highly variable streamflows, bed movements, and channel instability will influence the survival of young bull trout, especially since embryos and alevins incubate in substrate during winter and spring (Rieman

and McIntyre 1993).

## ***Limiting Factors***

### **Steelhead Limiting Factors**

The John Day Subbasin Revised Draft Plan (March 2005) identified limiting factors for summer steelhead using an Ecosystem Diagnosis and Treatment model (EDT). “Limiting Factors” are conditions that inhibit populations, ecological processes and functions relative to their restoration and protection potential (John Day SubBasin Plan, 2005). The Subbasin Plan identified sediment load, key habitat quantity, and temperature as needing restoration and protection for summer steelhead (John Day SubBasin Plan, 2005; Table 2). The Oregon Department of Environmental Quality (ODEQ) has also identified water temperature as being the most serious water quality problem in the Middle Fork John Day (DEQ 2010).

In addition to the SubBasin planning process, the recovery planning team identified both limiting factors and threats for Middle Fork John Day steelhead. The primary limiting factors identified in the Draft Recovery Plan include water temperature, degraded floodplain, channel structure, altered sediment routing, and altered hydrology (Table 3). The primary threats, which are identified as human actions that may influence one or multiple life stages and may occur in the present or future or have occurred in the past, were identified as hatchery management; current land use practices (riparian disturbance, stream channelization and relocation, grazing, timber harvest, road building, passage barriers, irrigation withdrawals, mining and dredging); and the Columbia River mainstem hydropower system (Carmichael, 2006).

**Table 2. Top quartile protection and restoration geographic areas with important restoration attributes as determined by EDT (black), with additional attributes listed by the subbasin planners (gray) for Middle Fork John Day summer steelhead (modified from John Day Subbasin Revised Draft Plan, 2005)**

<b>MF John Day Summer Steelhead</b>							
<b>Geographic area priority</b>			<b>Attribute for restoration</b>				
<b>Geographic area</b>	<b>Protection benefit</b>	<b>Restoration benefit</b>	<b>Flow</b>	<b>Habitat diversity</b>	<b>Sediment load</b>	<b>Temperature</b>	<b>Key habitat quantity</b>
Big Creek	X	X					
Camp Creek	X	X					
Upper MF JDR	X						

**Table 3. Habitat limiting factors summary for the Middle Fork John Day River steelhead population (modified from Carmichael, 2006).**

Population MaSA and MiSA	Major Limiting Factors	Sites Affected*	VSP Characteristics Impacted	Threats	Life Stages Affected
<b>MIDDLE FORK JOHN DAY POPULATION</b>					
<b>Middle Fork John Day Population</b>	degraded floodplain and channel structure (connectivity, diversity, complexity); altered hydrology; altered sediment routing; water quality (temp); impaired fish passage	MaSAs and MiSAs	Productivity, abundance, spatial structure and diversity	Stream channelization and relocation, grazing, forest practices, road building, culverts and other passage barriers, irrigation withdrawals, mining and dredging	All life stages, especially fry-to-smolt survival, egg incubation; egg-to-parr survival, spawning
Upper MF John Day MaSA	Altered sediment routing; degraded floodplain and channel structure; altered hydrology; water quality (temp)	MF mainstem [T (RM 0-69.8), F,CS, S, H,R]	Productivity, abundance, spatial structure and diversity	Stream channelization and relocation, grazing, forest practices, road building, culverts and other passage barriers, irrigation withdrawals	All life stages, especially fry-to-smolt survival, egg incubation; egg-to-parr survival
Camp Creek MiSA	Degraded floodplain and channel structure; altered hydrology; water quality (temp); altered sediment routing	Lower Camp Cr. [T (RM 0 to 15.6), F,CS, S,T,R]	Productivity, abundance, spatial structure and diversity	Stream channelization and relocation, grazing, forest practices, road building, culverts and other passage barriers, irrigation withdrawals	All life stages, especially fry-to-smolt survival, egg incubation; egg-to-parr survival
Big Creek MiSa	Altered sediment routing; degraded floodplain and channel structure; altered hydrology; water quality (temp)	[T (RM 0-11.6), F,CS,S,T,R]	Productivity, abundance, spatial structure and diversity	Stream channelization and relocation, grazing, forest practices, road building, culverts and other passage barriers, irrigation withdrawals	All life stages, especially fry-to-smolt survival, egg incubation; egg-to-parr survival, spawning

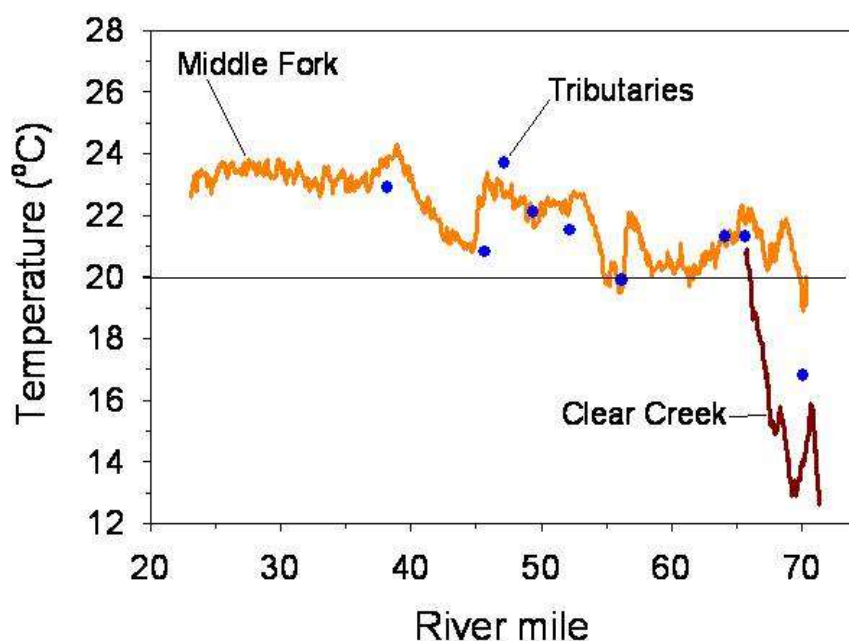
### Spring Chinook Limiting Factors

The Subbasin Plan identified habitat diversity, sediment load, and key habitat quantity as the highest attributes needing restoration and protection and temperature and flow and attributes of secondary importance for spring Chinook in the Upper Middle Fork (Table 4). Key habitat quantity refers to the key habitat type required of each life stage for each species (John Day Subbasin Revised Draft Plan, 2005). One specific key habitat area that has been identified as lacking is habitat complexity, such as those areas containing large woody debris (LWD).

**Table 4. Top quartile protection and restoration geographic areas with important restoration attributes as determined by EDT (black), with additional attributes listed by the subbasin planners (gray) for Middle Fork John Day spring Chinook (modified from John Day Subbasin Revised Draft Plan, 2005).**

MF John Day Spring Chinook						
Geographic area priority			Attribute for restoration			
Geographic area	Protection benefit	Restoration benefit				
			Flow	Habitat diversity	Sediment load	Temperature
Big Creek	X	X				
Camp Creek	X	X				
Upper MF JDR	X	X				

The Middle Fork Working Group has identified temperature as the most important attribute needing restoration and protection. TIR (thermal infrared) flights indicate that temperature is potentially a leading cause for limiting parr production in mainstem habitats during summer months. Surface water temperatures during 2003 FLIR flights on the mainstem Middle Fork exceeded 20 °C throughout many of the stream reaches that were occupied by salmonids during other periods of the year (Figure 8). In assessing the TIR data (Figure 8), it appears that a modest 1-2°C decrease in summer temperatures to near 20°C could expand summer rearing habitat in the mainstem Middle Fork by more than two-fold thereby providing the potential for a significant increase in smolt production. Spawning surveys for Chinook salmon in August and September 2007 discovered high pre-spawning mortality in the Middle Fork subbasin due to warm temperature in July (Ruzycki et al. 2007). This discovery supports the hypothesis that summer water temperatures in the Middle Fork mainstem produce a bottleneck and therefore limits smolt production especially after years of high escapement.



**Figure 8. Longitudinal profiles of surface water temperatures from TIR surveys conducted during August 2003 by Watershed Sciences LLC. The horizontal line indicates the warmest temperature (adjusted to surface temp.) where we have observed Chinook parr during summer surveys of the past three years. Temperature and location of important tributary confluences is also shown.**

## **Development of the Middle Fork IMW Framework**

The limiting factors identified through the Recovery Planning, Subbasin Planning, and BOR assessment processes, as well as those identified by the Working Group, form the basis for the type of restoration planned by Working Group partners. Restoration actions have been divided into SIX separate categories: 1) channel reconfiguration and floodplain reconnection; 2) fish passage, 3) flow increase, 4) grazing/upland management, 5) instream habitat enhancement, and 6) riparian fencing and planting.

Each of these restoration types has a specific time scale that needs to be explicitly recognized. For example, riparian fencing, planting, and upland management (e.g., fencing riparian areas) will likely take much more time to detect an influence on the stream channel and instream habitat complexity because vegetation, especially trees, will take a decade or more to grow large enough to provide shade and LWD recruitment, whereas instream structures will likely have a more immediate influence (e.g., 1-3 years). These time scale issues need to be reflected in the experimental and monitoring design on the IMW.

### ***Middle Fork IMW Scope***

The challenge facing the Middle Fork IMW is that multiple restoration treatments have and will be implemented throughout the Upper Middle Fork John Day River. This is not an ideal situation for detection of a population level response and attributing the response to a specific action or mechanistic function. To complicate things further, some restoration activities have been implemented without pre-treatment monitoring and control sites are not always available for some restoration actions. However, many watersheds have had multiple restoration actions implemented with limited pre-treatment data collected, and hence the Middle Fork IMW is a good test case for whether these types of multi-project restoration efforts are able to detect a population changes and elucidate the cause and effect relationships present. Given this complexity, we are proposing multiple experimental designs to help achieve the IMW goals and objectives. Each experimental design will have its own scope, scale of inference, set of hypotheses to test, and specific monitoring requirements.

### ***Scope of Inference and Testable Hypotheses***

We used a series of questions to help refine broad management goals into specific hypotheses which will dictate the experimental and monitoring designs (Marmorek et al. 2006). For each experimental design we identified a set of design elements (Table 5).

**Table 5. Summary and description of experimental design elements used to develop specific experimental designs for the Middle Fork IMW.**

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<b>Focal species</b>	What species is the focus of the experiment
<b>Life history group</b>	What life stage is the focus of the experiment
<b>Spatial Scope</b>	What is the spatial scale of the experiment (watershed, reach, habitat unit, etc.)
<b>Restoration type</b>	What is the type of restoration being studied
<b>Final restoration condition</b>	What is the proposed desired condition the restoration is intended to create (e.g., historic riparian conditions, 50% increase in fish cover, etc.)
<b>Hypotheses tests</b>	What are the hypotheses that are to be tested with the experimental design (e.g., Ho: 50% increase in fish cover will not increase smolt production; Ha: 50% in fish cover will increase smolt production).
<b>Response variables (dependent variable)</b>	What are the response variables that are going to be used to determine if the restoration had the intended affect (e.g., smolts per spawner)
<b>Effect size</b>	What is the magnitude of effect you wish to detect (i.e., what is the minimum % increase in smolt survival that you hope to detect)
<b>Factors to attribute population response (independent variables)</b>	What are the hypothesized causal mechanisms of the response (e.g., does an increase in fish cover lead to reduced predation and water temperature, which increases the number of Chinook smolts that are produced per spawner).
<b>Statistical design</b>	What is the type of statistical design used to test the hypotheses.
<b>Type I and II errors</b>	What are the levels of Type I and Type II statistical error that will be used for statistical tests (Type I error = detecting an effect when there was no real effect; Type II error = failure to detect an effect that was real).
<b>Power</b>	Statistical power is the probability of detecting an effect when one is present and is influenced by sample size, variance, and effect size.

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## Section 2: Middle Fork John Day River Implementation Plan

# Experimental Design

## *Design Selection Process*

We used a review of experimental design literature, experience from ongoing IMW projects, and discussions with the UMFWG to develop experimental design suited to the Middle Fork IMW. One of the simplest and most common types of experimental design is to evaluate the effect of a restoration activity at a single site before and after (BA) the restoration is implemented (Green 1979, Downes et al. 2002). This design can be improved by replicating the number of sites that are treated within a specific watershed (replication at the reach scale) and by using multiple sites across multiple watersheds (replication within reaches and watersheds). Although adding replicates of the restoration increases the ability to determine its effect, the results from BA experimental designs are susceptible to misinterpretation because there is no way to know if the results are due to the restoration or some other factor that happened to coincide with implementation of restoration (Downes et al. 2002).

A more powerful experimental design involves the use of control areas. In the simplest case, two sites can be chosen, where one site has a restoration activity implemented (treatment) and the other site is untreated (control). These two sites are followed through time and changes in the response variable (e.g., fish abundance; see below for more discussion of response variables) are monitored. Again replication of treatment and control sites can increase the ability to infer whether the results are due to the treatment or are due to some other factor. In most cases, the use of control(s) greatly increases the power of detecting restoration effect; however, poorly chosen controls sites can actually decrease the power of the experiment to detect an effect (Korman and Higgins 1997, Roni et al. 2002). Suitable control sites in the context of the Middle Fork IMW need to have similar stream morphology, limited restoration or management actions planned, and Chinook and/or summer steelhead population trends that are correlated with populations in the treatment stream(s).

A common treatment and control designs that is used to detect changes from a treatment is commonly referred to as a before-after-treatment-control or BACI design. This design monitors proposed treatment and control sites prior to the implementation of restoration. Ideally, the pre-treatment monitoring should occur for a minimum of a complete life cycle of the species of interest (e.g., for Chinook salmon in the John Day River this would be 4-5 years). However, one possible weakness of BACI design is that treatments (i.e., restoration) are often implemented in a single year and hence, the potential effects of the treatment may be influenced by the particular year effects (e.g., stream condition or size of adult escapement for that particular year). One approach that has been suggested to deal with possible year effects is the “staircase” design whereby treatments are staggered over multiple years (Walters et al. 1988, Loughin 2006, Loughin et al. 2007). There are several advantages to using a staircase design. First, the staggering of the treatments over time allows for the distinction between the random effects of year and year x treatment interactions. This prevents random initial environmental or biological conditions from having an overriding effect on the ability of the experiment to detect true treatment effects. Second, by staggering treatments within the treatment area, treatment sections can be used as controls until they are treated, guarding against loss of other control areas and eventually allowing treatment of the whole watershed

resulting in greater watershed scale restoration effects and benefits. Third, from a logistical standpoint, manipulation of a subset of treatment reaches is more feasible than manipulation of all treatment reaches within a year.

Where possible we will use BACI type designs in the Middle Fork IMW; however, there are many other experimental design approaches that could be used, including time-series designs such as Intervention Analyses (IA) (Box and Tiao 1974, Stewart-Oaten et al. 1986, Carpenter et al. 1989, Stewart-Oaten and Bence 2001). The following section proposes possible experimental designs based on the available information on restoration activities and locations and the suitability of the controls sites. If more information is provided that changes our current assumptions more appropriate experimental designs will be selected.

### ***Control Watersheds***

The Middle Fork IMW is proposing to use both the North Fork and South Fork John Day Rivers as control watersheds. It will not be possible to have both the North and the South Fork act as true controls because of the scale of the Middle Fork IMW and the number of different agencies and restoration programs present in these watersheds. Restoration activities have recently, and will likely continue to be implemented in the North Fork and South Fork. For example the CTWSR has plans to improve riparian areas in the South Fork in 2011 (S. Banks, Pers. Comm.), juniper removal projects on several thousand acres are planned in the South Fork (C. James, Pers. Comm.), and riparian restoration and mine tailings recontouring projects are ongoing in the North Fork (Pers. Comm., J. Ruzyski). However, these are the best control options available and the basic assumption we are making for the Middle Fork IMW is that the amount of restoration planned for the Middle Fork is larger and more extensive than the restoration planned in the North and South Forks (\*we are still trying to confirm this). Both these proposed control watersheds also have some long-term fish and habitat data that are comparable to the data available in the Middle Fork and there are reasonably strong correlations between populations of adult Chinook and steelhead between watersheds (see specific designs outlined below). We propose that coordination of restoration actions and monitoring efforts between the three watersheds be formalized so that, where possible, the proposed IMW is not compromised by actions in the control watersheds.

### ***Response Variables***

We propose to use a variety of response variables to evaluate whether fish are responding to changes in habitat as expected (Table 6). The type of response variable used will be determined by the proposed experimental design and the type of monitoring currently being conducted. Some response variables may be of insufficient precision to be useful in modeling fish response to restoration and further power analysis will be required to determine which variables will provide the most robust assessment of treatment effects.

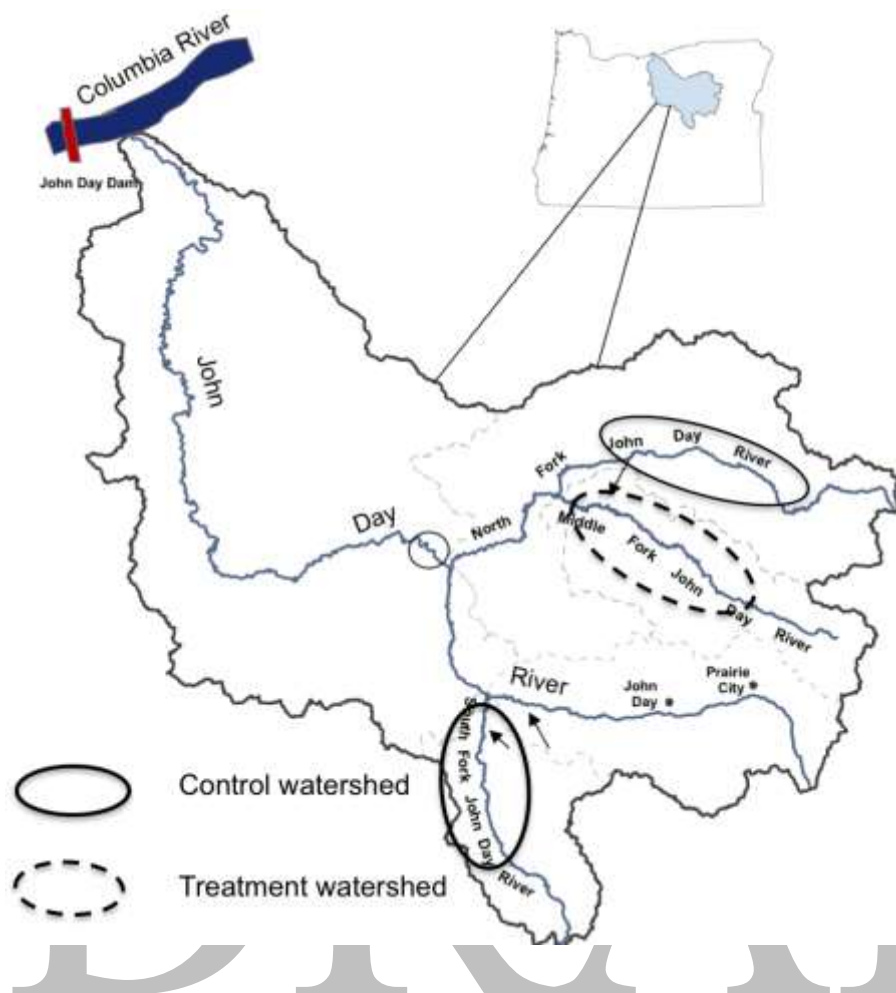
**Table 6. Potential response variables to be used to detect the effects of stream restoration on Chinook and steelhead populations in the Middle Fork IMW study area.**

Population Performance	Response variable	Description	Data types
Abundance	Population Abundance	Number of fish per unit area or length (redds/km)	Mark-recapture, depletion estimates, spawner survey
Productivity	Growth and Size	Growth rates by age class and season, size at out-migration	Length and/or weight at two time periods
	Juvenile Survival	Measure of freshwater production (e.g., egg to smolt); seasonal survival (% survival from summer to fall)	PIT tagging, Mark-recapture, program MARK modeling
	Migratory Timing	Date of out-migration, age at out-migration, age at spawning	Smolt trap captures, scale analysis
	Recruiting adults (R/S)	Number of returning adults from a spawner. Population production. Can also get maximum production and carrying capacity based on Ricker, Beverton-Holt, etc.	Yearly escapement, harvest, marine survival
	Smolt to adult return ratio (SAR)	Measure of out-of-basin survival; number of adults return from number of smolts leaving subbasin, Bonneville Dam, etc.	Adult escapement and juvenile out-migration estimates
	Smolts/Redd or Spawner	Measure of freshwater survival which would be the number of smolts per spawner	Redd counts, eggs per redd, spawners per redd, smolt out-migration
Spatial Structure	Distribution	% of available habitat occupied, changes in relative density by location within distribution	Presence/absence surveys, relative abundance surveys
	Species composition	changes in relative abundance of salmonid and non-salmonid fish species	Relative abundance surveys

### ***Watershed Comparisons***

At the largest scale of comparisons, we plan to evaluate the response of Chinook and steelhead populations to all restoration activities implemented in the Middle Fork IMW study area to two potential control watersheds (Figure 9). A BACI-like design will be employed to maximize spatial and temporal contrast and to help filter noise caused by factors such as out-of-basin effects (e.g., Columbia River hydrosystem, ocean conditions, harvest, etc.) and climatic variation when possible. The experimental design will be different for each species because of the distribution of each species within watersheds, types of monitoring currently in place, and logistical constraints.

**Figure 9. Watershed level experimental design schematic for the Middle Fork IMW. Arrows indicate approximate locating of smolt traps and circle indicates approximate location of seining site used for juvenile emigration monitoring (figure modified from Wilson et al. 2009).**



### Steelhead Watershed Design

ODFW has been conducting steelhead spawning surveys and has been operating rotary screw traps in the Middle and South Fork John Day watersheds since 2004 (Figure 9). This provides an opportunity to use these data for both before (B) and control (C) comparisons in a BACI design. This ongoing monitoring will allow for comparisons of spawner abundance, total juvenile production, and **smolts per spawner**, perhaps the most relevant standardized population metrics to evaluate changes in freshwater production as a response to stream restoration. The specific design elements for the steelhead watershed scale design are summarized in Table 7.

**Table 7. Summary of experimental design elements used to develop a watershed level design for steelhead in the Middle Fork IMW.**

Design Element Type	Description
<i>Focal species</i>	Steelhead
<i>Life history group</i>	Smolts
<i>Spatial Scope</i>	Watershed
<i>Restoration type</i>	All restoration categories

<i>Final restoration condition</i>	*This has not been described yet.
<i>Hypotheses tests</i>	Ho: There is no difference in the smolts/spawner between watersheds; Ha: there is an increase in smolts/spawner after restoration
<i>Response variables Primary (Secondary)</i>	Smolts/Redd or Spawner (adult escapement)
<i>Effect size</i>	25% increase in smolts/spawner
<i>Factors to attribute population response</i>	Not definable for this design
<i>Statistical design</i>	BACI
<i>Statistical Model</i>	ANOVA
<i>Type I and II errors</i>	$\alpha = 0.1$ , $\beta = 0.9$
<i>Power</i>	Has not been calculated but target is 80%

The South Fork appears to be a suitable control for the Middle Fork IMW for this design because it has substantial public lands where the steelhead production occurs, it is similar in size to the Middle Fork, has limited restoration activities planned (NEED TO CONFIRM THIS), and the yearly estimates of steelhead escapement are correlated to the Middle Fork John Day River steelhead escapements ( $r = 0.4$ ).

In addition, juvenile tagging and assessment programs have been conducted within the mainstem and some tributaries of both the Middle Fork and South Fork John Day Rivers since 2004. These assessments may provide information on density, movement, survival, growth, and foraging patterns of juvenile steelhead and can be used to explain changes in overall production due to restoration activities.

### **Chinook Watershed Design**

We can currently only determine smolts/spawner for Chinook populations in the Middle Fork John Day River. The South Fork John Day River has a smolt trap but Chinook spawning in the South Fork is rare ( $< 1$  redd per year since 1998; McCormick et al. 2009). The North Fork John Day River has comparable Chinook spawning densities as the Middle Fork and redd counts are strongly correlated ( $r = 0.74$ ; McCormick et al. 2009). However, there is no smolt trap currently operated on the North Fork. This precludes the use of a BACI design to compare freshwater productivity in the Middle Fork to a control watershed. We therefore propose to compare returning adults/spawner (R/S) between the Middle Fork and North Fork John Day Rivers to determine the overall effect of restoration in the Middle Fork on Chinook.

ODFW is proposing to install a smolt trap in the North Fork John Day River upstream of Desolation Creek in 2011. If this trap is installed, comparison could be made between the freshwater production (e.g., smolts/spawner) in the Middle Fork (treatment) and North Fork

John Day Rivers. However, this analysis will not have a before treatment component (i.e., can only compare freshwater production in two watersheds post restoration).

ODFW has conducted redd surveys for Chinook in the Middle Fork and North Fork John Day Rivers since 1959 (McCormick et al. 2009). Redd survey data can be used to produce R/S estimates. These estimates will be used in a time series design to assess restoration affects. The specific design elements for the Chinook watershed scale design are summarized in Table 8.

**Table 8. Summary of experimental design elements used to develop a watershed level experimental design for Chinook in the Middle Fork IMW.**

<b>Design Element Type</b>	<b>Description</b>
<i>Focal species</i>	Chinook
<i>Life history group</i>	Adults
<i>Spatial Scope</i>	Watershed
<i>Restoration type</i>	All restoration categories
<i>Final restoration condition</i>	*This has not been described yet.
<i>Hypotheses tests</i>	Ho: There is no difference in the spawner/spawner between watersheds; Ha: there is an increase in spawner/spawner after restoration
<i>Response variables Primary (Secondary)</i>	Recruiting Adults/Spawner (Redd density)
<i>Effect size</i>	25% increase in R/S
<i>Factors to attribute population response</i>	Not definable for this design
<i>Statistical design</i>	Intervention Analysis
<i>Statistical Model</i>	Regression
<i>Type I and II errors</i>	$\alpha = 0.1, \beta = 0.9$
<i>Power</i>	Has not been calculated but target is 80%

### ***Mainstem Treatment and Control Comparison***

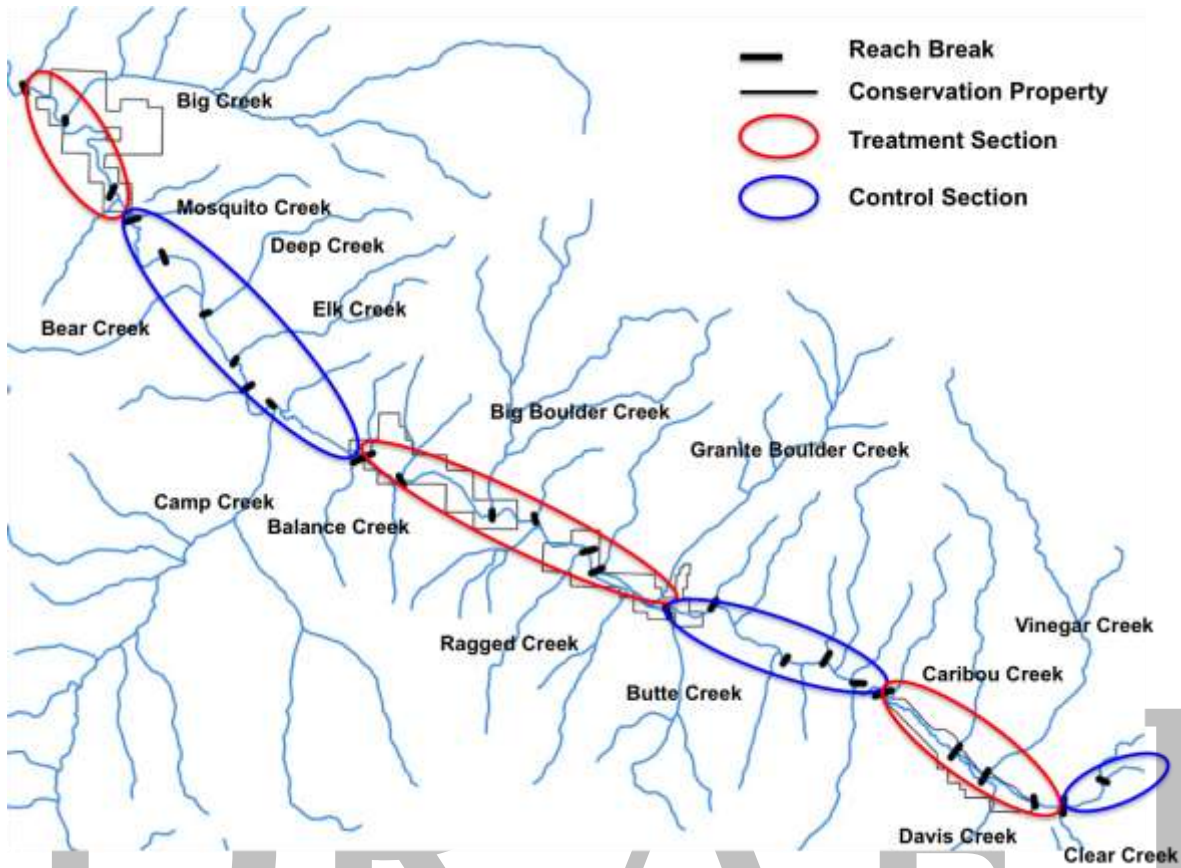
The watershed design will only allow us to determine if the overall production of Chinook and steelhead has changed the Middle Fork John Day River. Therefore, to assess the specific mechanisms that cause changes in fish populations and stream habitat we will use reach level experimental designs on the mainstem Middle Fork and comparisons of treatment and control tributaries (see below). Comparisons in the mainstem will be made between the major restoration actions at replicate treatment and control sections within the Middle Fork John Day River (Figure 10, Table 9). These comparisons have a higher replication than the watershed level designs and hence a greater ability to infer cause and effect. Each section is

approximately 10 km with three treatment and three control sections in alternating order starting at Huckleberry Creek. The total stream length of all treatment sections is 29.3 km, as is the total length of all control section. The entire length of each treatment and control section will not necessarily be restored or monitored. The sections define whether restoration will or will not take place. Within each of these sections, smaller reaches will be restored and appropriate monitoring performed. These reaches are defined by channel confinement and tributary junctions locations similar to McDowell (2001) and BOR (2008). There are more confined reaches in the control sections and more moderately confined reaches in the treatment sections (Table 9). The design could potentially take into account channel confinement as a strata, but that will require further planning to ensure restoration activities and monitoring are stratified by channel type.

This design will focus on ***channel reconfiguration and instream structure*** restoration types as these projects are expected to have the most impact on fish habitat in the next 1-5 years. Other restoration activities, such as fish passage, flow increase, grazing/upland management, and riparian fencing/planting are expected to have less immediate effects on fish habitat (e.g., > 5-10 years), are relatively small projects compared to magnitude of channel reconfiguration and instream structure restoration, and/or will be assessed using a temperature modeling approach (see below).

There are different levels of restoration in each treatment reach (Table 9). We propose that additional restoration projects be designed to balance as much as possible the level of restoration in each treatment section analogous to a staircase design (i.e., restoration occurs over several years to minimize year effects). This will allow for better replication of the restoration efforts and provide a more robust design. For example, the total length of channel reconfiguration, rip-rap removal, and large woody debris structures should be similar in all treatments by year X.

We propose to use redd density as the primary fish response to compare treatment and control sections. Chinook will be used as the primary response species as Chinook adult spawning is greater in the mainstem than tributaries in general (James et al. 2010). Other responses that will be assessed include juvenile distribution using ongoing rearing distribution surveys (James et al. 2010). The specific design elements for the Chinook mainstem reach scale design are summarized in Table 10.



**Figure 10. Location of treatment and control sections for assessing the effect of restoration activities on the mainstem of the Middle Fork John Day River. Note the furthest upstream control reach (near Clear Creek) is longer than depicted and ends at Summit Creek.**

**Table 9. Summary of the timing, location, and amount of restoration activities in the mainstem of the Middle Fork John Day River by reach and treatment/control section.**

See attached Excel data sheet

**Table 10. Summary of experimental design elements used to develop a mainstem treatment and control level experimental design for Chinook in the Middle Fork IMW.**

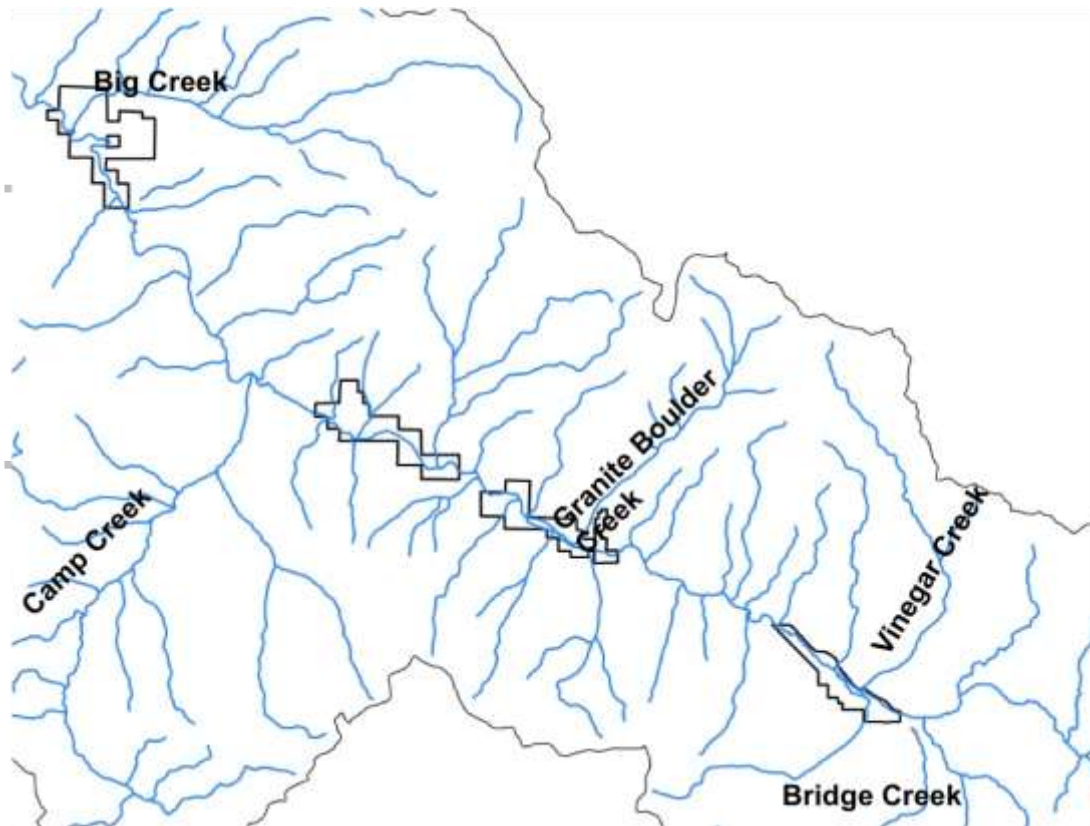
<b>Design Element Type</b>	<b>Description</b>
<i>Focal species</i>	Chinook
<i>Life history group</i>	Adults (juveniles)
<i>Spatial Scope</i>	Reach scale within mainstem
<i>Restoration type</i>	Channel reconfiguration and large woody debris additions (including artificially created pools)
<i>Final restoration condition</i>	<b><i>Has not been determined yet</i></b>
<i>Hypotheses tests</i>	Ho: There is no difference in the redd density between treatment and control reaches; Ha: redd density is higher in treatment reaches
<i>Response variables Primary (Secondary)</i>	Redd density (juvenile distribution)
<i>Effect size</i>	25% increase in redd density
<i>Factors to attribute population response</i>	Increased habitat availability (thermal refuge), greater floodplain connectivity (hyporheic flow), increased cover
<i>Statistical design</i>	BACI
<i>Statistical Model</i>	ANOVA (regression with variety of independent variables)
<i>Type I and II errors</i>	$\alpha = 0.1$ , $\beta = 0.9$
<i>Power</i>	Has not been calculated but target is 80%

### ***Tributary Treatment and Control Comparisons***

Within the Middle Fork IMW study area there are a significant number of restoration activities that are occurring in the tributaries (Figure 11, Table 11). There is not an adequate monitoring infrastructure in place to separate the effects of the tributary restorations from the mainstem restorations; however, we are proposing a separate tributary design that can determine the effects of the most common tributary restoration on select group of tributaries.

We have chosen to focus the tributary experimental design on **two** of the most common restoration categories to simplify the experimental design and future analysis: ***fish passage and flow increases***. As with the mainstem, numerous other restoration categories have been implemented in the tributaries. We are assuming these restoration categories (channel reconfiguration, grazing/upland management, instream structures, and riparian fencing/planting) will have effects that are realized after 5-10 years, or are in low enough density to not cause a significant increase in fish populations. These “non-focal” restoration categories will also be assessed with a temperature modeling approach if enough data is available (see below).

**Figure 11. Location of the primary tributaries to be used for assessing the response of Chinook and steelhead to restoration activities in tributaries to the Middle Fork John Day River.**



**Table 11. Summary of the timing, location, and amount of restoration activities in named tributaries of the Middle Fork John Day River.**

See attached Excel data

The tributary experimental design will assess the effects of restoration activities on both Chinook and steelhead populations and primarily focus on ***distribution and abundance response variables***. This design will be implemented primarily in the Big Creek, Bridge Creek, Camp Creek, Granite Boulder Creek, and Vinegar Creek watersheds because they have the most fish passage and flow increase restoration occurring, they are used by both Chinook and steelhead, and there is existing fish and habitat monitoring (Figure 11, Table 12).

**Table 12. Summary of experimental design elements used to develop a tributary level experimental design for Chinook and steelhead in the Middle Fork IMW.**

<b>Design Element Type</b>	<b>Description</b>
<i>Focal species</i>	Chinook, steelhead
<i>Life history group</i>	Adults and juveniles
<i>Spatial Scope</i>	Tributary
<i>Restoration type</i>	Fish passage, Flow increase
<i>Final restoration condition</i>	<b><i>*This has not been described yet – need to know how many km will be opened up in what streams</i></b>
<i>Hypotheses tests</i>	Ho: fish distribution is not limited by culvert xings X,Y, Z; Ha: fish distribution increases after xing X,Y,Z are upgraded
<i>Response variables Primary (Secondary)</i>	Fish distribution (relative density upstream and downstream of barrier)
<i>Effect size</i>	NA
<i>Factors to attribute population response</i>	Juvenile or adult migration barriers (physical block, reduced flows, or temperature related impediment to habitat use)
<i>Statistical design</i>	NA
<i>Statistical Model</i>	NA
<i>Type I and II errors</i>	NA
<i>Power</i>	NA

## ***Temperature Modeling***

The Middle Fork IMW is complicated by the variety of restoration projects being implemented and the scope of the projects (mainstem and tributary). One promising alternative approach to assessing the effects of all each restoration category and location is to use a temperature modeling approach. The Oregon Department of Environmental Quality (ODEQ) has been conducting monitoring in the John Day basin since 2002 in support of Clean Water Act Total Maximum Daily Load (of pollutants) establishment (DEQ 2010). Total maximum daily loads (TMDL) are target water quality standards. Standards typically contain threshold values for water quality conditions such as pollutant concentration, pH, dissolved oxygen, or temperature. The temperature standard numeric criteria in the John Day is based on salmonid life cycles as the most sensitive beneficial use of basin waters. TMDL monitoring in the MF John Day subbasin has been designed to address temperature concerns of the Clean Water Act 303(d) Listing.

One of the main objectives of the TMDL in the John Day is to quantify the conditions leading to high temperature. For temperature, the TMDL process assesses the existing and estimated natural potential heat loads. Further, these heat loads are translated into more intuitive measurable targets such as percent effective shade and channel width. Because temperature is the major limiting factor for salmonids found in the Middle Fork subbasin, the TMDL process can be highly informative to synthesize how many of the habitat processes that will be manipulated will affect the overall temperature profile of the Middle Fork John Day.

In order to implement this process, a calibrated model has been developed by ODEQ and ISEMP with the following data from ongoing Middle Fork IMW monitoring programs and analysis of available geospatial data including:

- flow volume and velocity, wetted channel width and depth, and effective shade (daily solar radiant energy blocked by vegetation and topography),
- temperature, temporally and spatially, based on all relevant heat transfer processes including evaporation, bed conduction, convection, mass transfer, short wave (direct and diffuse) and long wave radiation.

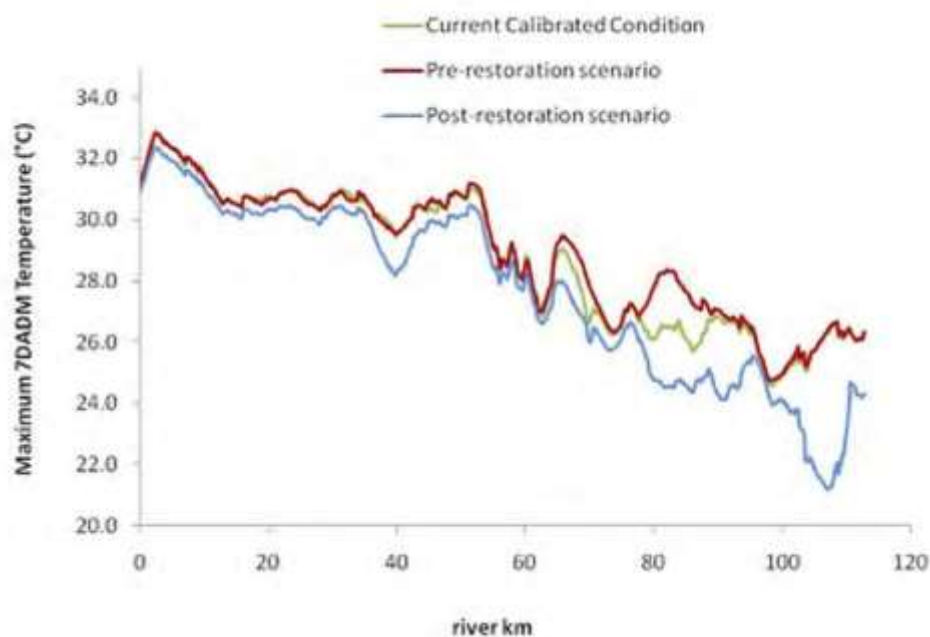
The existing model can be used to assess different levels of restoration within the watershed. A draft model has been completed that sums completed and proposed restoration activities as of 2007 and models the potential change to overall temperature profile of the stream (Figure 12). The predicted changes in temperature to the rolling average 7 day average daily maximum (7DADM) were 1.2 °C cooler during the model period (DEQ 2010). This decrease is based on restoration activities primarily on the TNC and CTWS properties which make up approximately 20% of the mainstem length. Modeling different levels of restoration and validating and recalibrating the model with temperature monitoring once more restoration projects have been completed will provide insights into the mechanisms by which restoration actions will impact this common limiting factor throughout the Columbia River basin, a goal of the IMW process. Other studies in the John Day pilot project will develop relationships

between stream reach temperature and salmon and steelhead productivity (e.g., Bridge Creek IMW; Jordan and Pollock 2007). The TMDL can then be used to evaluate how alternative habitat restoration efforts may affect stream temperatures and ultimately fish productivity.

Monitoring and assessment of vegetation, hydrology, morphology and meteorological conditions will provide input for temperature modeling (one-dimensional thalweg characterization). The temperature model will be calibrated spatially to airborne thermal infrared data and temporally to instream temperature data loggers (both part of the temperature monitoring component of this project; see Monitoring Design). Based on historical information including aerial photography, literature, local knowledge, and current undisturbed conditions, system potential channel shape and vegetation will be assessed. These estimated conditions will provide the basis for simulation of a more natural shading and temperature regime.

Specific analytical methods can be found in *Analytical Methods for Dynamic Open Channel Heat and Mass Transfer* (Boyd and Kasper 2003, [www.heatsource.info](http://www.heatsource.info)), and are summarized in TMDLs (e.g., Klamath, Umatilla) that can be found on ODEQ's website: <http://www.deq.state.or.us/wq/TMDLs/TMDLs.htm>.

The ISEMP John Day Pilot project is developing a model to map potential fish growth across stream reaches of the John Day by combining models that estimate heat budgets using physical inputs and bioenergetics models that use these heat budgets and invertebrate abundance information to estimate fish growth.



**Figure 12. Draft longitudinal maximum 7 day average daily maximum temperatures during model period from restoration scenarios at the conservation properties along the Middle Fork. Model results produced every 200 m (DEQ 2010).**

### Fine Scale Temperature Changes

To assess the fine-scale changes in water temperature associated with specific restoration techniques a Fiber Optic Distributed Temperature Sensor (DTS) will be deployed before and after project implementation, and at determined intervals in the future to monitor the effectiveness of specific restoration techniques in regard to water temperatures. This fine scale temperature analysis will also allow for the calibration of the Heat Source™ model 7.0 and provide a better understanding of the thermal characteristics of the river.

This technique reports the temperature of a fiber optic cable each meter at a precision of 0.01 °C. Dr. John Selker has pioneered this method in stream applications (Selker et al., 2006a, b), and will be involved as the lead investigator in the study. Each stream reach to be restored will be instrumented with two DTS cables, one parallel to each bank, to capture the local micro-habitats found on the inside and outside portions of serpentine stream channels. Each section will be monitored for two weeks prior to restoration efforts, then two weeks each for the two years following restoration. All monitoring will take place in the July 15- Sept 15 period during which peak temperatures are usually observed. Long-term observation points separated by 200m will be maintained over the entire duration of the grant using Onset Corp. Hobo data loggers, recording hourly temperatures.

In order to track climatic conditions and to provide additional data for the Heat Source model, two solar powered, wireless transmitting weather stations will be placed in the watershed. One will be placed on property owned by The Nature Conservancy near the mouth of Horse

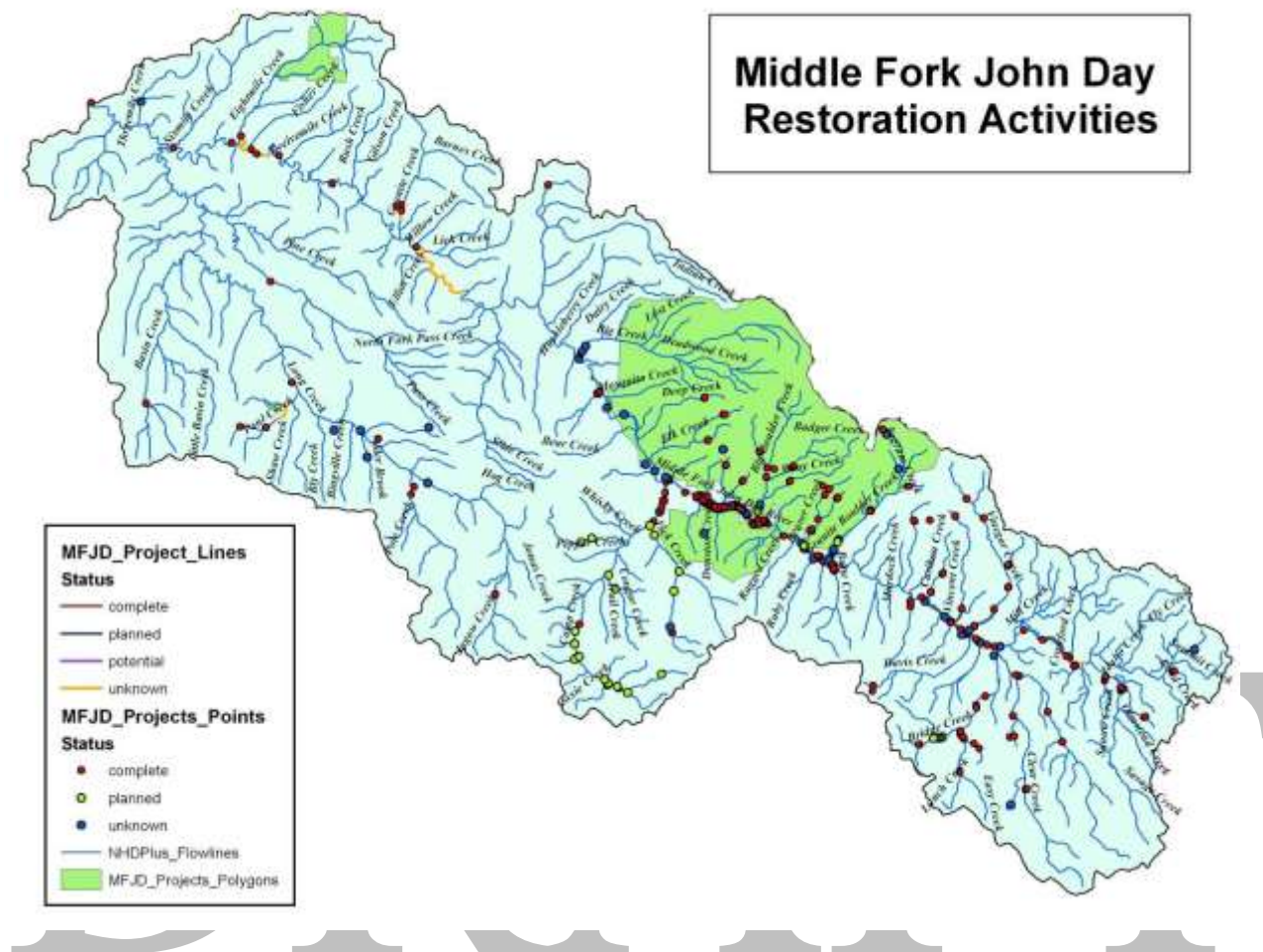
Creek, and another placed on property owned by CTWSRO near the mouth of Vinegar Creek. The weather stations will have Viasala WXT520 weather sensors which measure wind speed and direction, precipitation, barometric pressure, temperature, and relative humidity. Each station will also have a precipitation gage and precipitation collector, that will measure both rain and snow fall. In addition one of the weather stations will be equipped with a Kipp & Zonen Net radiometer that will measure the energy balance between incoming short-wave and long-wave infrared radiation versus surface-reflected short-wave and outgoing long-wave infrared radiation.

In 2008 the Confederated Tribes of the Warm Springs Reservation of Oregon will implement phase one of a long-term restoration project on their Forrest and Oxbow Conservation properties in the Middle Fork John Day River. This phase will target removal of rock barbs and associated bank armoring on the Forrest Property, between Placer and Davis Creeks, and on the Oxbow Property between Beaver and Ragged Creeks. The project will replace some of the rock structures with engineered log jam (ELJ) structures. The entire project reach will be monitored for fine scale changes in temperature caused by the restoration actions. Monitoring using the DTS technology will allow managers to evaluate the effectiveness of these restoration actions on water temperatures at the fine scale.

## **Restoration Design**

### ***Background***

The (UMFWG) partners have plans for a significant number of restoration projects of varying size and scope to be implemented over the next 10 years (Appendix A; Figure 13). Some of these projects were implemented before monitoring designs were implemented and we will not be able to directly assess their effect. However, a large number of projects were implemented between 2007 and present (2010) and many of these projects have monitoring programs in place (see Monitoring Designs below). These projects have been planned by the IMW partners based on 1) restoration priorities developed by IMW partner agencies and those identified in the John Day Subbasin Plan, 2) funding availability, 3) the likelihood of the restoration action impacting the limiting factors discussed in the previous section, and 4) constraints of the experimental designs.



**Figure 13. AT SOME POINT THIS FIGURE NEEDS A COMPLETE OVERHAUL ... Overview of Middle Fork John Day restoration activities.**

The restoration projects have been grouped into categories based on the anticipated effect each restoration type will have on biophysical and biological conditions in the watershed. The six restoration categories are:

- 1) Channel Reconfiguration
- 2) Fish Passage
- 3) Flow Increase
- 4) Grazing Upland/Management
- 5) In stream habitat enhancement
- 6) Riparian Fencing and Planting

Each restoration project may address multiple limiting factors. Descriptions of each restoration category and the benefits of each in relation to the limiting factors are considered below. Appendix A lists completed/proposed restoration projects, the restoration category,

the limiting factor(s) addressed, the completed/proposed implementation date, and whether there is project specific effectiveness monitoring associated with the restoration project. The following sections discuss the restoration types in general terms and not explicitly differentiating between the mainstem and tributary restoration actions in great detail. More work is needed to catalog all completed and proposed restoration, accurately determine the amount and extent, and map these projects in a consistent and repeatable fashion.

*We could/should add a fair amount of supporting literature cited to this section to support the ASSUMPTIONs that doing X will increase fish populations do to physical changes Y (this forms the basis for hypotheses to test).*

### **Channel Reconfiguration**

Channel reconfiguration projects include channel realignment, reconnecting the existing channel to old meanders, removing artificial structures, pulling back levees and/or roads.

Goals of channel reconfiguration are to (Roni et al. 2008):

- reconnect lateral habitats;
- allow natural migration of channel;
- reconnect migration corridors;
- restore longitudinal connectivity; and
- allow natural transport of sediment and nutrients goal of improving/restoring stream processes.

Limiting factors addressed:

- Temperature through increasing surface/groundwater interaction, restoring riparian shading to the river, and narrowing and deepening the channel;
- Habitat diversity by restoring fluvial and riparian processes (cover, spawning gravels, etc); and
- Sediment Load by reducing impacts from roads, improving upland agricultural practices, and restoring vegetation along channel margins.

Total proposed treatment amount and location:

- Since 2007, 2.9 km of the mainstem Middle Fork have been treated (Table 9)
- Another ### m of side channel will be reconnected, ## m of rip rap will be removed, by 201#

Project examples:

- USFS channel reconstruction Reach 1.
- Removal of single span log weirs to restore the channels natural shape, reduce the width:depth ratio, and reconnect the channel to the floodplain.
- Reconnecting the river to an old meander, decreasing channel slope, and increasing channel length and habitat availability.
- Removal of dredge tailings to provide access to old side channels.

Long-term studies have not been completed to assess the effectiveness of channel reconfiguration projects on fish populations (Roni et al. 2008) but it is expected that reconnecting the channel to old meanders will reduce the slope of the channel and increase the interaction of surface water with cooler hyporheic flows. This may result in cooler water temperatures. In addition, this process, often combined with grade control structures, generally increases floodplain interaction, resulting in increased water storage from high spring flows.

Removal of artificial structures can include rock barbs, log weirs, railroad grades, levees, and other structures placed in or near the stream. These structures have resulted in over-widened channels, and reduced potential for channel migration, and reduced connection to the floodplain. Removal of these types of structure combined with restoration of riparian vegetation allows the stream to naturally form its channel, generally resulting in a narrower and deeper channel which may reduce stream temperature, allow the channel to meander, and improve the connection to the floodplain resulting in longer water storage from spring run-off and lengthening the shape of the hydrograph.

**Table 13. Objectives and indicators for geomorphology and physical habitat. Expected direction of change is shown by symbols (↑ increase; ↓ decrease; ↔ dynamically stable)**

Goal	Indicators and hypothesis
Increase aquatic habitat quality/diversity and increase fish cover	Pools/km ↑ Deep pools/km ↑ Pools adjacent to LWD ↑ Fish cover rating ↑ % undercut bank ↑ Habitat units/km ↑ Gravel size and embeddedness ↓ % fines in gravels ↓
Move toward natural channel Morphology	Bankfull width ↓ and depth ↑ Low flow width ↓ and depth ↑ W:D ↓ Sinuosity ↑
Increase hydrologic access and connectivity to the floodplain	Stage for a given Q ↑ Frequency of flow in side channel ↑ (crest-stage gages and high water mark elevations)
Maintain dynamically stable reaches, with lateral migration	Cross-section morphology ↔ Bankfull cross-section area ↔ Bar area and frequency (from remotely-sensed imagery) ↔ Lateral migration rates ↑
Develop relatively stable and complex LWD accumulations	LWD location, persistence and form

## ***Fish Passage***

Fish passage restoration includes removal of barriers within a stream, such as culverts, weirs, small dams and screening irrigation diversions to prevent fish stranding.

The goals of fish passage restoration are to:

- Increase the distribution of adult spawning habitat or juvenile rearing habitat
- Increase fish movement between critical habitats (i.e., thermal refuges)
- Increase spatial structure of populations at reach, stream, subbasin, and watershed scale
- Access to upstream habitats that tend to be of higher quality
- Reduce channel width and increase water depth (i.e., weir removal)

Limiting factors addressed:

- Temperature through access to thermal refuges
- Habitat quality through access to diverse array of habitat types depending on life stage and species
- Spatial structure through increased spatial diversity of populations

Total proposed treatment amount and location:

- The majority of fish passage projects are located within the tributaries to Middle Fork
- 50 culvert and road crossings have been identified as full or partial barriers to juvenile and adult fish
- 

Project Examples:

- Replacement of the culvert on Granite Boulder Creek, which will provide adult and juvenile access to 5 km of habitat.
- Removal of Camp Creek log weirs (potential juvenile barriers)
- Irrigation ditch screening

Some of the PIBO sites are being utilized to evaluate the removal of stream spanning log weirs installed in Camp Creek in the 1980's. These weirs were installed with the intent of creating pool habitat; however, actual results showed the channel was locked in place by the structure, preventing the channel from recovering from other management activities. In addition, in some instances the weirs have created passage barriers preventing juvenile salmonids from moving upstream to rear in the cooler waters in the upper reaches of Camp Creek.

It is expected that removal of these structures will allow the channel to narrow and deepen, decreasing the width to depth ratio of the channel. In addition, the channel will have the ability to become more sinuous and develop a geomorphology similar to undisturbed reaches of the stream.

### ***Flow Increase***

Flow increase projects include the direct acquisition of water rights (i.e., returning X cfs to the river), reconnection of spring flows, and water diversion closures.

Goals of flow increases:

- To increase stream flow and available fish habitat
- Cool existing flows
- Provide a more natural hydrograph

Limiting Factors that flow increase restoration address include:

- Temperature
- Habitat quality and quantity

Total proposed treatment amount and location:

- 71 flow increase projects have been completed or are proposed in the next 10 years
- the majority of flow increase projects are within tributary streams, typically in the lower reaches of the tributaries

Examples of projects include:

- Acquisition of ## CFS of water rights, reconnecting spring or side channel flows
- ???

### ***Grazing and Upland Management***

Grazing and upland management projects are generally projects outside of the stream or floodplain habitat and are on drier more upslope habitats. Changes in forest harvesting/fire management, grazing practices, and road location are all types of grazing restoration projects. The types of restoration activities focus on eliminating or reducing upslope sediment supplies to the stream network.

Goals of grazing and upland management restoration increases:

- Decrease sediment supplies
- Increase flows
- Increase quality of spawning habitat

Limiting Factors that grazing and upland management restoration address include:

- Sediment supply
- Habitat quality and quantity
- Temperature through stream shading
- Stream channel stability though sediment routing

Total proposed treatment amount and location:

- There are 13 upland projects proposed or completed
- Most of these upland projects are proposed for the upper watersheds in the Middle Fork

Examples of grazing and upland management restoration projects include:

- Juniper removal
- Road relocation or stabilization
- Aspen fencing

These types of projects are dispersed, upslope, and often difficult to quantify or monitor their effectiveness. More work is needed to characterize these restoration projects in both the Middle Fork and control basins (North and South Fork).

### ***In Stream Habitat Enhancement***

In stream habitat enhancement includes projects such as placement of large woody debris (LWD), engineered log jams (ELJ), and construction of pool habitat (e.g., excavation of pools). These structures increase habitat complexity and may provide deeper, cooler water, hiding cover, and improved spawning areas (i.e., pool-tailouts).

Goals of instream habitat enhancement:

- Increase resting areas for migrating salmon
- Increase channel complexity and fish cover
- Increase channel migration potential and sediment sorting
- Change local gradient

Limiting factors addressed include:

- Temperature through increasing habitat complexity;
- Habitat diversity through habitat creation; and
- Sediment load and sorting through increased channel complexity.

Total proposed treatment amount and location:

- 77 ELJ, LWD, and instream flow control structures have been added to the mainstem Middle Fork since 2007
- very few structures have been installed in the tributaries
- 

Project examples include:

- The addition of LWD to the mainstem of the Middle Fork on Dunstan ranch to create pool habitat and shade.
- USFS channel reconstruction reach 1

### ***Riparian Fencing/Planting***

There is a large number of riparian fencing/planting projects that have and will be completed in the Middle Fork IMW study area. These projects include riparian fencing, cattle exclosures, CREP, and native vegetation planting. Riparian cover has been reduced from historic levels by as much as 100% in some reaches and in general unconfined reaches with wide floodplains have been most affected. Loss of riparian cover decreases shade, increases solar input, raises water temperature, and reduces channel stability due lack of root structures to protect the banks from erosion. Without riparian forest cover there is also no source of LWD to streams systems and nutrients can be reduced negatively influencing macroinvertebrate and fish production.

Goals of riparian restoration:

- Restore riparian vegetation and processes
- Improve bank stability
- Increase shade and reduce water temperature

Limiting Factors that Riparian Fencing/Planting address include:

- Temperature (provides shade)
- Habitat complexity (provides LWD)
- Sediment (acts as buffer)

Total proposed treatment amount and location:

- Unable to summarize the amount of riparian fencing with current data but is extensive in both mainstem and tributaries
- BOR (2008) report has riparian mapping of this from Camp to Clear creek and can be accessed in the future (historic to 1939 and current as of 2006?)

Examples of Riparian Fencing/Planting restoration are:

- Various planting and fencing projects

## **Monitoring Design**

### ***Biological Monitoring***

Current fish monitoring efforts by ODFW include monitoring of both adult and juvenile life history stages of spring Chinook salmon and summer steelhead. Additional information is incidentally collected for other species including Pacific lamprey and bull trout. Spawning ground surveys that count redds and spawning adults have been conducted for Chinook and steelhead in the John Day River basin for more than 45 years (McCormick et al. 2009). Rotary screw traps (RST) have been operated since 2004 near Ritter on the Middle Fork (RKM 24), and on the proposed control watershed of the South Fork John Day River. These traps enumerate juvenile Chinook and steelhead emigrating from the basins above the trap location. Juveniles are also implanted with passive integrated transponder (PIT) tags at trap sites

allowing for measures of abundance from mark/recapture and out-of-basin survival (e.g. smolt to adult returns [SAR]). As part of the Middle Fork IMW, macroinvertebrate monitoring was initiated in 2009 to augment fisheries surveys. Together the fisheries and macroinvertebrate monitoring programs will be used to determine biological responses to restoration activities. The primary objectives of the biological monitoring program in the Middle Fork IMW study area are to estimate:

- Spawner escapement of summer steelhead and spring Chinook to the MFJDR,
- Freshwater productivity (smolts/redd) of spring Chinook and summer steelhead,
- Parr-to-smolt survival for summer steelhead and spring Chinook,
- Summer distribution of Chinook and steelhead, and
- Estimate aquatic macroinvertebrate diversity and abundance.

The following sections describe biological monitoring techniques and schedules to accomplish each objective. Table 14 and 15 lists the monitoring activities performed in the mainstem and tributaries respectively.

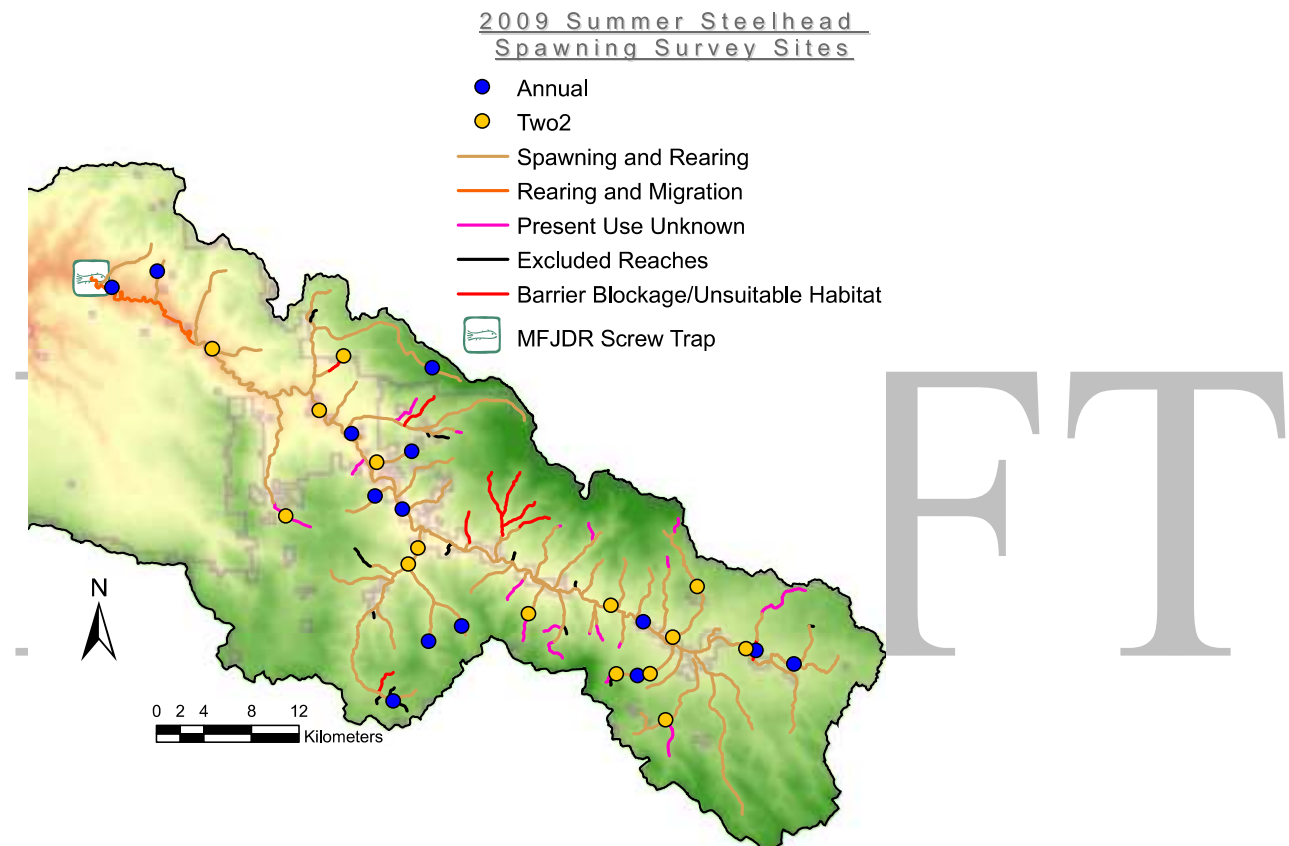
### **Escapement**

Chinook redd surveys are conducted over all known Chinook spawning habitat (e.g., a total census of mainstem). Steelhead redd surveys, based on standard ODFW methods (Susac and Jacobs 1999; Jacobs et al. 2000; Jacobs et al. 2001), are conducted during the spring (April to June) coinciding with steelhead spawn timing in the MFJDR. Survey sites were selected using a generalized random tessellation stratification (GRTS) design which randomly selects sites based on the spatial structure of the stream network of interest. Sites were then assigned to one of three different panels using the Environmental Monitoring and Assessment Protocol (EMAP): sites visited every year (Annual Sites), sites visited every other year beginning with year-1 (Two-1), or sites visited every other year beginning in year-2 (Two-2). Although assigning sites to a panel is usually performed in a random fashion, we were able to incorporate sites utilized by another steelhead monitoring project in the John Day River Basin into our site selection to utilize their previously collected data and increase personnel and resource efficiencies. Thirty sites were selected to be surveyed each year and were equally distributed between Annual (n=15) and Two-year sites (n=15 for each panel). Additional sites were selected within each panel as replacement sites in the event that a site had to be removed due to access restrictions, unidentified in-stream barriers, or unsuitable habitat conditions.

We used a 1:100,000 EPA river reach file of summer steelhead distribution in the MFJDR subbasin for site selection (Figure 14). This spatial dataset is based on best professional knowledge provided by ODFW managers as well as other local agency biologists. The actual dataset utilized for site selection was modified to meet the objectives of this project. Specifically, stream segments downstream of a rotary screw trap (RST) operated by ODFW at river kilometer (Rkm) 24 (River mile 15) were excluded since this area was outside of the target IMW area.

Sites were surveyed multiple times, at approximately two week intervals, to quantify the

number of unique redds constructed at each site, and to account for the temporal variation in spawning activity. Survey reaches were approximately 2 km in length and encompassed the sample point derived from the EMAP sampling design. Surveyors walked upstream from the downstream end of each reach and counted all redds, live fish, and carcasses observed. New redds were flagged and the location marked with a GPS unit (dd.dd – WGS84). During each visit, surveyors recorded the number of previously flagged and newly observed redds. Redd density are estimated using standard ODFW procedures (James et al. 2010, Flesher et al. 2005; Lance Clarke, Jim Ruzycki, ODFW, unpublished data).

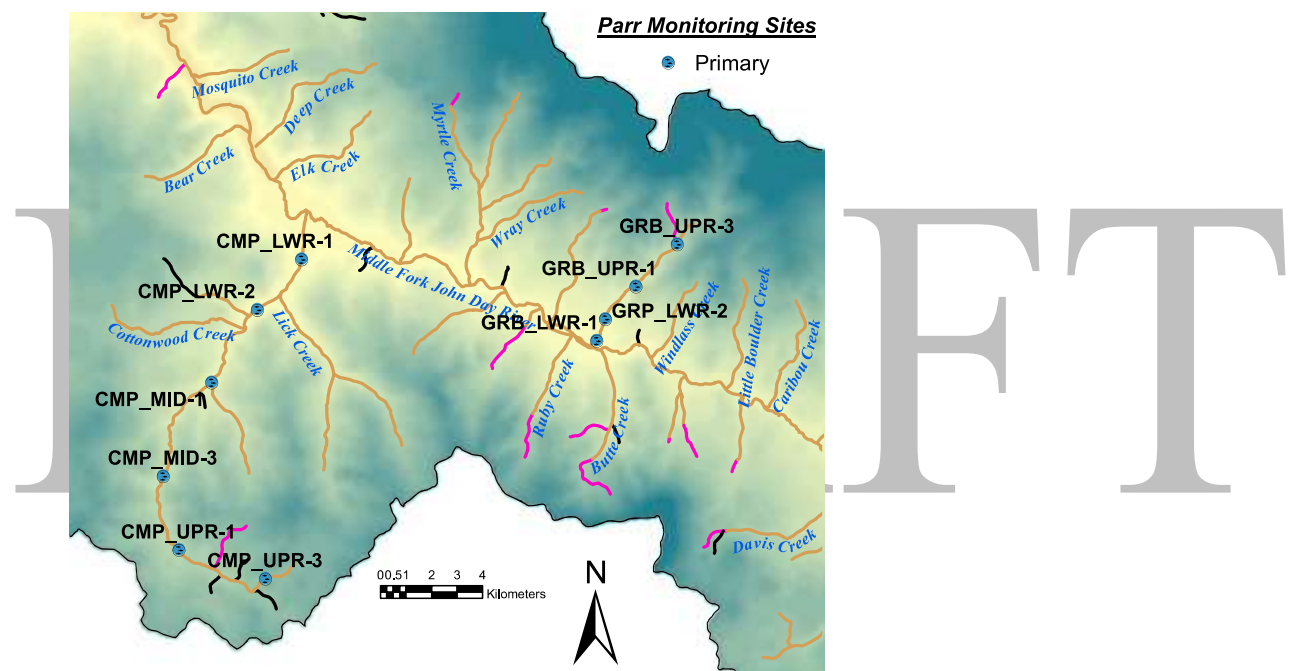


**Figure 14. Map of summer steelhead distribution used for selecting steelhead spawning survey sites, with Annual and Two-2 sites sampled in 2009. The rotary screw trap (MFJDR Screw Trap) near Ritter, OR, the lower extent for sampling, is shown for reference.**

### **Parr to Smolt Survival**

Granite Boulder Creek and Camp Creek were selected for intensive juvenile monitoring because there is substantial restoration efforts planned in these tributaries and they represent different temperature regimes. Camp Creek is generally warmer than Granite Boulder Creek during summer months. Each stream was divided into reaches based on the current summer steelhead distribution and topographical features from 1:24,000 quad topographic maps. Although both summer steelhead and spring Chinook were targeted in this sampling, summer steelhead distribution was utilized for both species because steelhead

distribution encompasses the entire known distribution of spring Chinook. Within each reach, three sites were selected for monitoring (Figure 15). Sites were determined by utilizing the GIS layer developed by EMAP for steelhead spawning surveys in the MF\_IMW. Specifically, the first point encountered in each reach proceeding in an upstream direction was selected as a sampling site. Depending on whether that point was in the first third, middle third, or latter third of the reach, all other site locations in the reach were located a distance equal to 1/3 of the reach distance from the other sampling points within that reach, resulting in one sampling site occurring in each third of the reach. Coordinates were extracted for each site from ArcGIS to locate sites in the field. Because of logistical and time constraints not all sites were sampled during the current year and only sites labeled as 'Primary' were sampled during 2009. To reach our tagging goal (Table 16) we also sampled fish within the MFJDR between Camp Creek and Butte Creek, primarily targeting juvenile Chinook.



**Figure 15. Juvenile PIT-tagging sites in Camp and Granite Boulder Creeks for the Middle Fork IMW monitoring program. Juveniles are also captured and PIT-tagged in the mainstem Middle Fork River between Camp Creek and Butte Creek.**

**Table 16. Juvenile PIT-tagging goals by tributary and mainstem for the Middle Fork IMW monitoring program.**

Stream	Chinook	Steelhead	Total Tags
Camp Creek	100	600	700
Granite Boulder	200	600	800
Middle Fork JDR	1500	0	1500
Total Tags	1800	1200	3000

Site lengths were 20 times the average ACW measured at five locations near the site point. The site point was considered the mid-point of the sampling section, however in some instances the section was moved upstream or downstream to avoid constraints from secondary channels or tributaries where possible. Block nets were employed at the upstream and downstream extents of each sample section to eliminate fish movement during sampling. Sites were sampled once a day for three consecutive days. Block nets remained in place until sampling was completed on the third day at each site.

Three different fish sampling techniques were employed, depending on the habitat condition encountered. At sites where habitat conditions were highly variable, more than one technique was employed to ensure the most efficient sampling of the site. In habitats with deep pools, fish were collected by snorling, in which a snorkeler would enter at the head of a pool and attempt to herd fish downstream into a 12' wide by 4' high seine with a 2'x2' bag anchored at the pool tail crest. In deeper swift water, fish were similarly collected by E-herding in which a crew member used an electrical current produced by a backpack electrofisher (Smith-Root LR24) to force fish downstream into an anchored seine. In shallower swift water, traditional spot electrofishing techniques were employed. During fall sampling, habitat conditions encountered at basal flows permitted all sampling to occur via spot electrofishing.

Once collected, fish were placed into an aerated bucket and transferred to instream live boxes where they were held until the entire site was sampled and tagging operations commenced. Captured juvenile spring Chinook, steelhead, and Bull trout *Salvelinus confluentus* were anesthetized with tricaine methane sulfonate (MS-222), interrogated for passive integrated transponder tags (PIT tags), weighed to the nearest 0.1 g, and fork length (FL) measured to the nearest millimeter (mm). Scales were taken from a subsample of steelhead collected that were larger than 60 mm. Subsamples were grouped into 10 mm bins and 15 samples were collected in each bin during summer sampling and 10 samples collected during fall sampling. All bull trout were sampled for scales. All anesthetized fish were allowed to recover in an aerated bucket until they regained equilibrium (~5-10 min). Once recovered, fish were released in small groups throughout the site and allowed to distribute themselves naturally within the sampling reach.

Encounter histories were developed for each steelhead tagged to estimate population abundance. A closed capture model (Otis et al. 1978) was used to analyze the encounter histories by site in Program MARK (White and Burnham 1999). This analysis utilizes a log maximum likelihood probability to estimate both capture (p) and recapture (c) probabilities as well as population abundances (N). Model variables for capture and recapture estimates can vary temporally or can be constant, either together or separately. For each site, three potential models were fit to the data (James et al. 2009). The most parsimonious model was selected based on the lowest Akaike Information Criteria (AICc) value. When AICc values of two or more potential models differed by less than two, the model with the fewest parameters was selected.

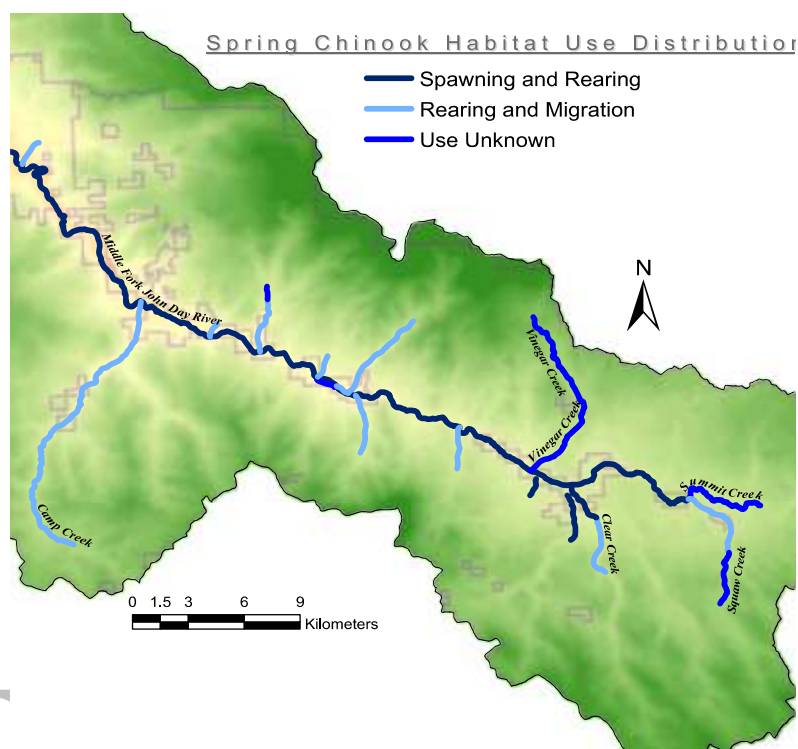
## **Smolt Abundance**

Juvenile spring Chinook and steelhead migrants will be captured using a 1.52 m rotary screw trap (RST) operated on the Middle Fork John Day River near Ritter (see Figure 9). Trap operation typically begins during early October and continues into June of the following year to encompass a migration year. The trap was either removed or stopped during times of ice formation, high discharge, and during warm summer months after fish ceased migrating.

The RST is typically fished four days/week by lowering cones on Mondays and raising cones on Fridays and is checked daily during these weekly fishing periods. We assumed that all fish captured were migrants. Non-target fish species were identified, enumerated, and returned to the stream. Captured juvenile spring Chinook and steelhead migrants were anesthetized with tricane methane sulfonate (MS-222), interrogated for passive integrated transponder tags (PIT tags) or pan jet paint marks, enumerated, weighed to the nearest 0.1 g, and measured (fork length, FL; mm). A subsample of fish was released above the trap to estimate migrant abundance using mark-recapture techniques. Further details of our RST operation are available (Wilson et al. 2007).

## **Summer Rearing Distribution**

Summer rearing distribution of juvenile Chinook salmon within the MFJDR\_IMW was assessed by snorkeling or electro-fishing pools. We began surveying in Big Creek at the downstream extent of Chinook distribution in the MFJDR\_IMW (Figure 16). Sampling proceeded upstream noting the presence or absence of juvenile Chinook, steelhead, or Bull trout. Locations of all pools sampled were determined with a handheld GPS along with focal fish presence/absence. Within tributary streams, we sampled every fifth pool beginning at the first pool upstream of the tributary confluence. In the event that no juvenile Chinook were observed in a sampled pool, we proceeded to sample every pool encountered, until a juvenile Chinook was encountered at which point we returned to sampling every fifth pool. If no juvenile Chinook were encountered after sampling five consecutive pools, sampling ceased in that tributary. In the mainstem MFJDR, we sampled every third pool upstream of Camp Creek to the confluence of Summit Creek and Squaw Creek. When no target fish were observed in a pool, sampling frequency was increased to every pool until a target fish was again observed and subsequent sampling frequency returned to every third pool. Every pool in the Middle Fork John Day River from Big Creek to Camp Creek was snorkeled regardless of observed fish species.

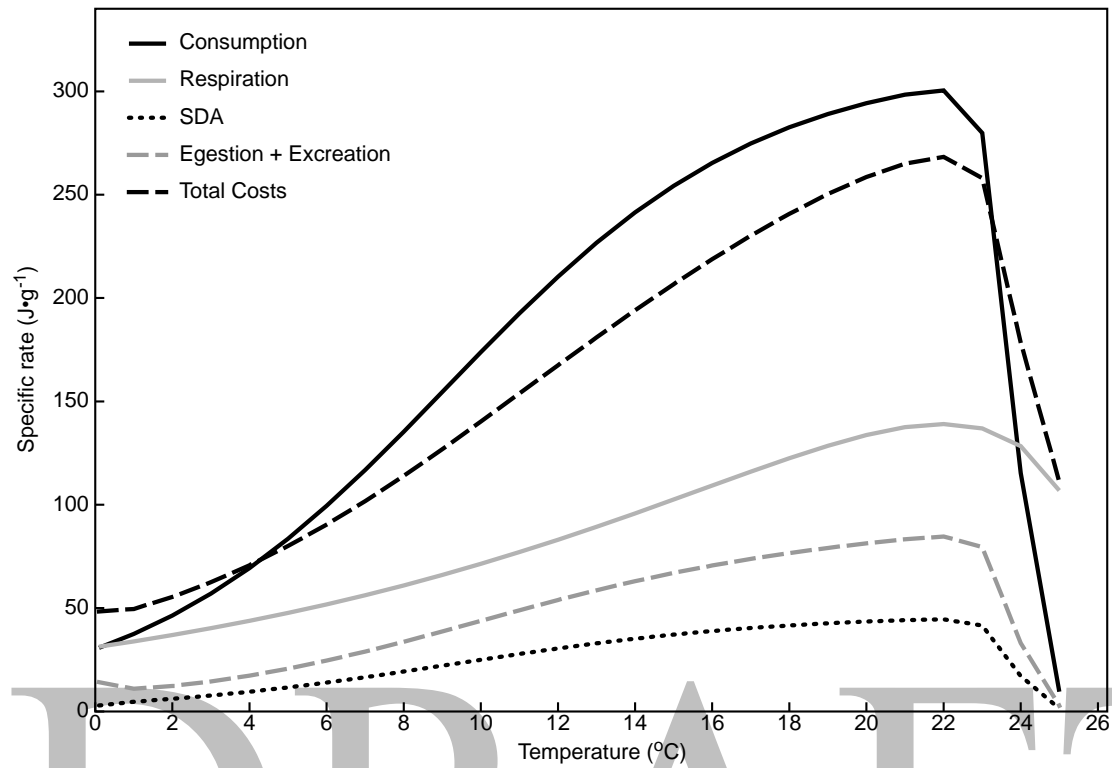


**Figure 16. Spring Chinook habitat use distribution in the Middle Fork John Day River Intensively Monitored Watershed upstream and including Big Creek.**

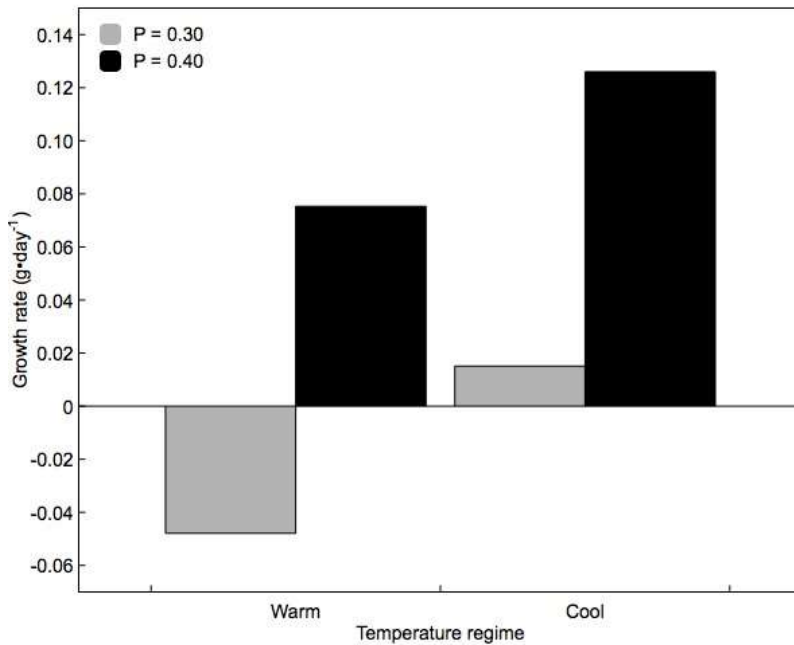
### **Aquatic Macroinvertebrate**

Restoration as part of the Middle Fork IMW has the potential to alter the basin water temperature regime. The relationship between the metabolic processes that determine potential growth for juvenile salmonids and temperature have been well described in bioenergetics models (Figure 17; Elliott 1976, Rand et al. 1993, Rodnick et al. 2004). Juvenile salmonid growth rates are also highly dependent on food availability in the form of invertebrates drifting in the water column. Thus, predictions of juvenile salmonid growth rates made using bioenergetics models are also highly dependent on parameters that describe food availability and consumption (Figure 18).

**Figure 17. Specific rates ( $J_{\text{g}}^{-1}$ ) for maximum consumption and metabolic costs predicted by the bioenergetics model in relation to temperature for a 10 g *O. mykiss*.**

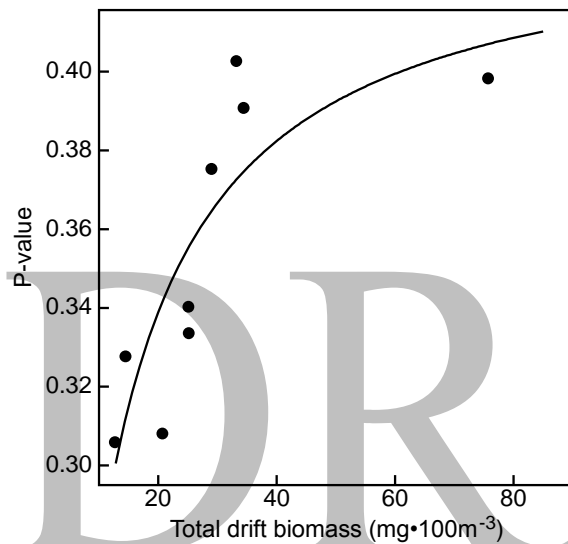


**Figure 18. Bioenergetics model predictions of growth rate ( $\text{g}\cdot\text{day}^{-1}$ ) for a 25 g *O. mykiss* at low consumption (P-value = 0.30) and high consumption (P-value = 0.40) values in streams featuring contrasting warm and cool temperature regimes.**

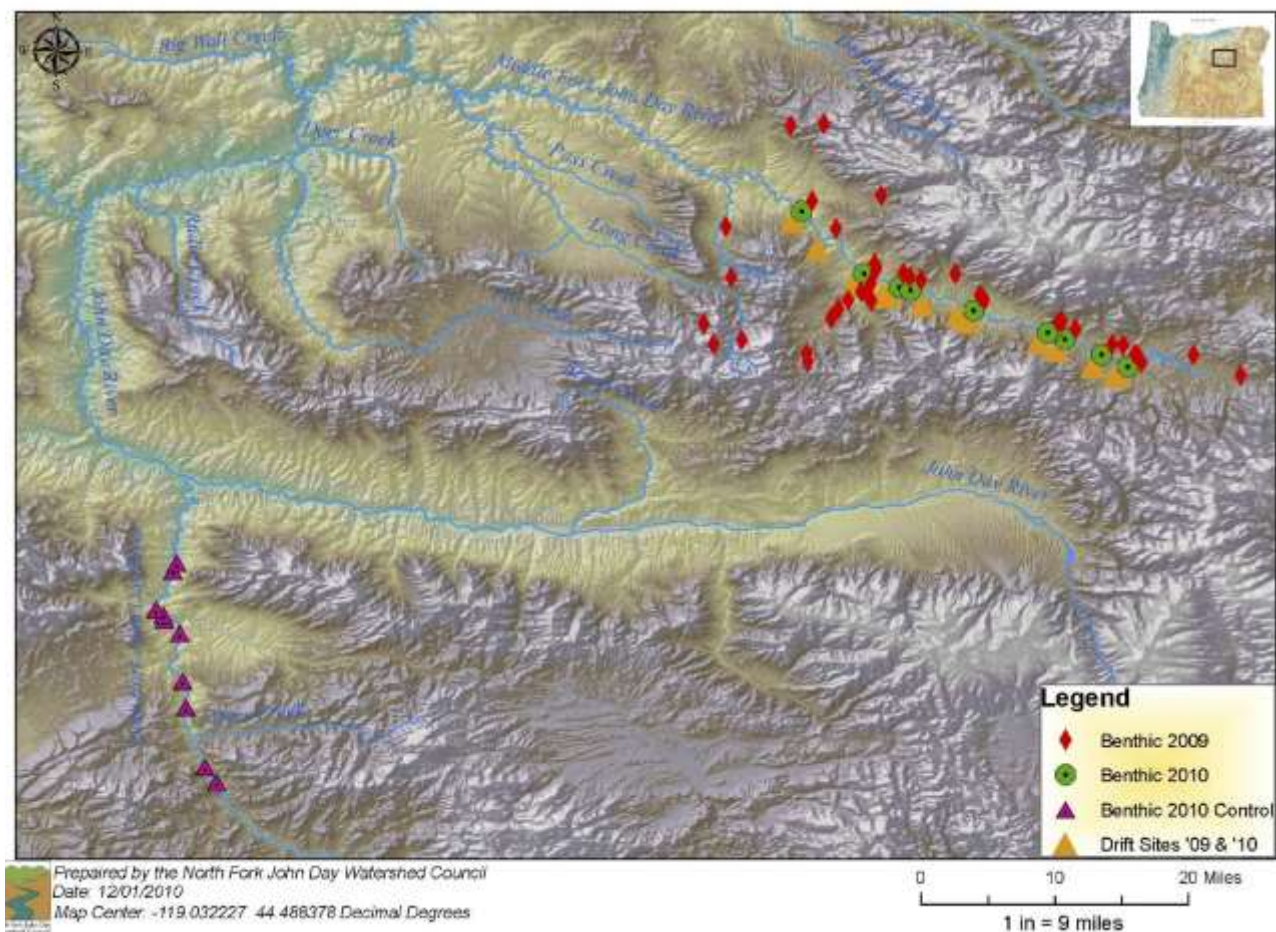


ISEMP researchers as part of the Bridge Creek IMW, OR and Asotin Creek IMW, WA have been developing methods for describing how juvenile salmonid consumption varies in response to food availability measured as invertebrate drift samples (Figure 19). Predictions of juvenile salmonid consumption from this relationship can be used in bioenergetics models that incorporate measure of stream temperature to make much more accurate predictions of fish growth. Thus, measures of invertebrate drift have the potential to increase the understanding of how juvenile salmonid populations may respond to restoration actions meant to alter stream temperature.

**Figure 19. Relationship *O. mykiss* consumption (P-values) and total drift biomass ( $\text{mg}\cdot 100\text{m}^{-3}$ ).**



The aquatic macroinvertebrate monitoring program aims to detect changes in macroinvertebrate community condition in the IMW and statistically relate these changes to restoration activities (Cole and Saltman 2010). A set for 10 monitoring sites were randomly selected from 15 existing PIBO monitoring along the mainstem of the Middle Fork. The original PIBO sites were selected using the GRTS sample site protocol (Figure 20). The South Fork will be used as the control watershed. The GRTS procedure was used to draw a set of 10 sample sites from the mainstem of the South Fork from the confluence with the mainstem John Day River upriver to its confluence with Venator Creek.



**Figure 20. Location of macroinvertebrate sample sites on the mainstem of the Middle Fork (treatment) and South Fork (control) John Day Rivers.**

Annual field sampling will occur annually each late summer or early fall between late August and early October. Sampling during this relatively narrow seasonal window will minimize variability in community composition introduced by seasonal turnover in taxa in the benthic community. Field sampling will be performed at each site using the kick-net sampling protocols as described Heitke et al. (2008). Following these protocols, two 0.09 m<sup>2</sup> benthic samples are collected from each of four riffle habitat units within the sample reach using a D-frame kick net. All 8 samples are combined into a single composite sample, which is preserved in 80% ethanol (dilution after adding to sample material) for later sorting and identification at a laboratory. A duplicate sample should be taken at one treatment site and at one control site each year to estimate variability associated with sampling error. For additional laboratory procedures see Cole and Saltman (2010).

### ***Habitat Monitoring***

The habitat monitoring program for the Middle Fork IMW includes surveys of hydrology, riparian vegetation, channel topography and bathymetry, **UPLAND** condition (**sediment sources?**), stream habitat and water temperature. Some of these monitoring programs have been conducted since the early 1990's (e.g., ODFW aquatic surveys) while others have been

established specifically to assess effect of Middle Fork IMW restoration activities (e.g., U of O topographic surveys). The primary objective of the habitat monitoring program is to detect changes in key habitat conditions at the site, reach, and basin scale. Examples of key habitat conditions include: abundance of pools, average depth of pools, elevation of groundwater and exchange rates between surface and hyporehic water, mean summer discharge, 7-day average maximum summer water temperature, ETC.

***We need another blurb here about the scale of each monitoring program ... what watershed scale monitoring do we have vs what reach/site scale***

***Watershed: PIBO, EMAP, ODFW, temperature***

***Basin: LiDAR, temperature, groundwater***

***Reach/Site: temperature, ground water, topographic/bathymetric, fish habitat, sediment, ...***

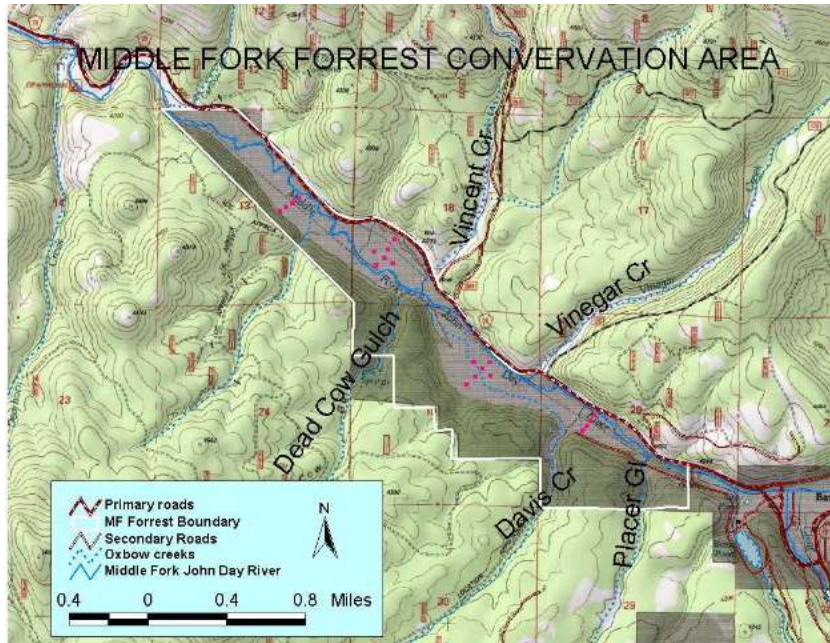
The following sections describe habitat monitoring techniques and schedules to accomplish each objective. Table 14 and 15 lists the monitoring activities performed in the mainstem and tributaries respectively.

## **Hydrology**

### ***Groundwater***

We established a network of 40 groundwater wells within three reaches of the Middle Fork to monitor groundwater levels relative to restoration activities and water temperature (Figure 21). The monitoring wells consist of a screened and slotted 2" diameter well pipe with a length of 5'. The wells are set up in eight arrays of five wells each that are either full-valley or partial valley cross-sections.

Understanding the role of groundwater, hyporheic flow, and subsurface exchange plays in influencing water temperatures and base flow in the MFJD is valuable information. Water temperature is a major limiting factor and will affect the long term viability of salmonid production in the watershed. Research that documents the physical processes influencing water temperatures can be used to design better restoration projects, and identify other areas in the watershed where restoration can and should occur to influence stream temperatures. Most importantly this knowledge can and should be used as an educational and outreach tool within the local school system and community to better explain the ecological processes that provide for quality salmonid habitat.



**Figure 21. Approximate location of the 40 groundwater monitoring wells on the two properties owned by CTWSRO. Two existing wells are not shown on the Oxbow property map. NEED to update this figure for all sites and stage height gages on properties.**

### ***Discharge***

A USGS station at Ritter will be utilized to monitor water discharge from the Middle Fork study area (Figure 9). We have also established eight stage height recorders to continually measure water surface elevation (Figure 21 – needs to be updated). Stream discharge will be measured and be used to develop a stage to discharge relationship. Analysis of this data will allow for the detection of changes in the quantity and timing of base flow pre and post restoration. Location of the stage height recorders WERE established in conjunction with the Geomorphology monitoring locations to allow us to control for water discharge when measuring stream habitat.

### **Topographic and Bathymetric Surveys**

Topographic and bathymetric surveys will be conducted by the University of Oregon (U of O) lead by Dr. Patricia McDowell, and will focus on the mainstem Middle Fork treatment and control areas (Figure 22). Geomorphological responses to the restoration actions will be evaluated at multiple scales –site (e.g., as-built surveys), reach (e.g., cross-sections), and watershed scale (LiDAR and aerial photography).

### ***Site Scale***

Description of U of O total station surveys of ELJ

### ***Reach Scale***

Description of U of O cross-section surveys within realignment reach

### ***Watershed Scale***

Description of LiDAR, aerial photography, and other geospatial resources available

**Figure 22. Location of the topographic and bathymetric monitoring sites in relation to the mainstem restoration activities in the Middle Fork River including treatment and control areas.**

**To be completed ...**

### **Riparian Vegetation**

The response of riparian habitat to fencing and planting will be assessed using a modified approach described by Winward (2000). A Proper Functioning Condition Assessment (PFC) was performed on both conservation areas covering 17.48 miles on 24 stream reaches in 2004, and at the same time grazing and haying operations were evaluated and monitoring suggestions were provided (***ARE THERE REPORTS FROM THIS WORK?***). Riparian monitoring was conducted on both conservation areas in 2008.

Aerial photography, ground surveys, and LiDAR will be used to assess the changes in riparian conditions over time. Both BOR (2008) and ODEQ (2010) have done extensive mapping and ground trothing of the floodplain area and can pre treatment data. They also have develop consistent and defensible methodologies for gathering riparian cover data using digital imagery and can apply the same methods post treatment to determine changes in riparian cover.

***Need description of the sample sites for riparian vegetation and objectives of the monitoring program***

### **Stream Habitat**

There are several stream habitat survey programs that have been conducted in the Middle Fork IMW study area. These stream habitat programs provide data on a variety of habitat components that are known to be related to the abundance, productivity and survival of salmonid populations including frequency, abundance, and quality of fish cover, large woody debris, pools, sediment, habitat units, as well as basic channel geometry (e.g., width to depth). Between 2004 and 2007, ODFW also performed aquatic inventory habitat surveys at EMAP sample sites, some of which were located within the Middle Fork John Day River subbasin. Between 1990 and 1997, Oregon Plan aquatic habitat surveys were conducted by ODFW on the Middle Fork John Day River, Bridge Creek, Big Boulder Creek, Big Creek, and Granite Boulder Creek. ***Need to map these sample sites and determine if we can integrate these into IMW monitoring design.***

Pacfish/Infish Biological Opinion (PIBO) monitoring has also occurred in the John Day River basin since ####. A total of [##31](#) of these historic PIBO sites plus an additional ### sites will be used as part of the Middle Fork IMW monitoring design (Figure 23). PIBO monitoring will be used to survey stream habitat in the mainstem, Bridge Creek, Camp Creek, and Clear Creek (Figure 23). PIBO sites will be re-measured every ### years to document changes in stream

habitat. A total of ### PIBO sites will surveyed in the mainstem in ## treatment and ## control sections where channel realignment and instream structures are the main treatment type. A total of ten PIBO sites will be monitored in Camp Creek to assess habitat changes due to the removal of log weirs (Figure 23).

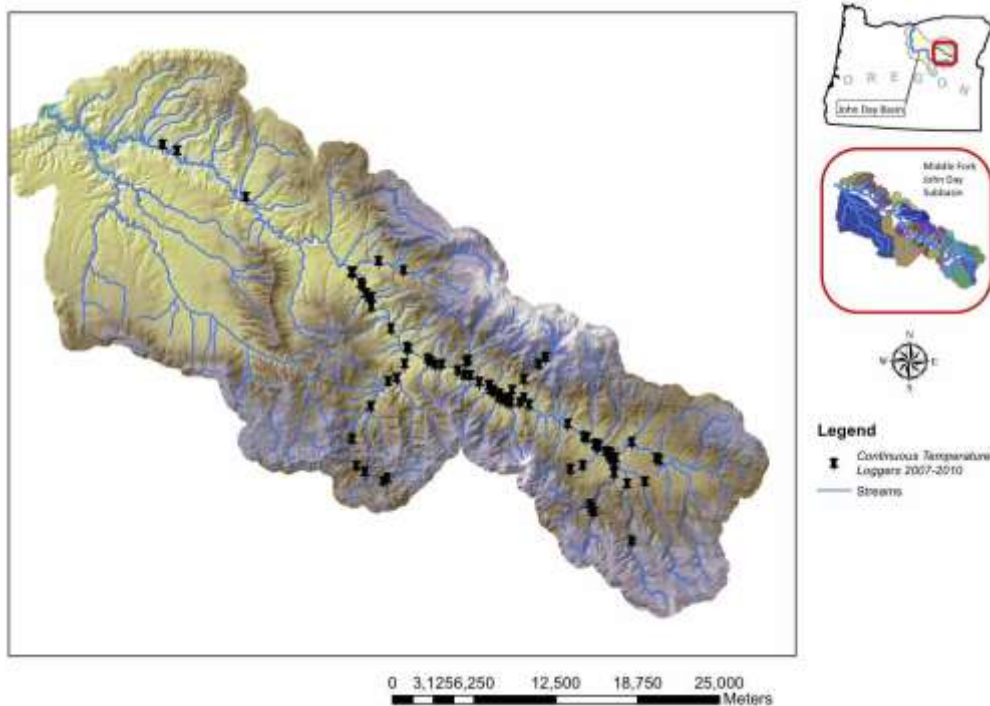
The University of Oregon (U of O) is also conducting fish cover surveys and gravel counts in the mainstem reaches ### and ### to enhance stream habitat information in these large treatment sections. ***MORE INFO here as to location and reason for monitoring.***

**Need to be updated ...**

**Figure 23. Location of PIBO monitoring sites in Camp Creek. NEED A NEW MAP OF ALL STREAM HABITAT MONITORING SITES IN STUDY AREA.**

### Water Temperature

A total of 74 water temperature probes have been deployed in the Middle Fork IMW study area (Figure 24). The majority of these probes are in the mainstem between Bridge Creek and Summit Creek, but there are also probes at the mouth of ## and ## and in upstream locations of Camp, Granite Boulder, Bridge, and Vinegar Creeks. These probes collect water temperature every ## mins and will be used to calibrate the Temperature Model and determine if water temperature changes as a result of restoration activities. Probes have been in place since 19## and we have ## years of pre-treatment data.



**Figure 24 . Temperature monitoring sites within Middle Fork IMW.**

## **Water Quality**

Water quality monitoring has been ongoing since 1996. The Tribes, Bureau of Reclamation, Grant Soil and Water Conservation District, and local natural resource agencies support the ongoing monitoring program. The overall goal of the water quality monitoring plan is .... ***We need more information about what WQ metrics are being measured, where are the locations of the monitoring sites, and how long have they been monitored***

## **Wildlife**

Avian spring census monitoring was done on the conservation areas from 2001-2008. Data has been used to assess long-term changes in breeding bird communities. A bird inventory is also maintained and added to as new species are observed and confirmed throughout the year by Tribal staff.

***Is this still being done? Could expand on as it is not studied in other IMWs and would be a good addition***

## ***Socio-Economic Monitoring***

The fundamental purpose of watershed programs is environmental maintenance, restoration, and enhancement. However, the policies and programs in support of watershed health also contribute to the socio-economic health of the community. One study of Oregon's watershed councils found that every dollar of administrative support supplied to a watershed council by the state generated more than five additional dollars for the watershed council's local economy (Hibbard and Lurie 2006). In monitoring the effectiveness of watershed programs it makes sense, then, to monitor socio-economic conditions as well as bio-physical conditions.

Direct dollar impact is only one indicator of the socio-economic health of a community. Other typical examples are net new jobs, net new family wage jobs, labor force participation rate, median household income as % of state and national medians, number of locally owned businesses with 5 or more employees, and housing affordability. The extensive literature on evaluation in sustainable development and integrated resource management argues that community indicators must respond to the local culture and therefore the process of developing them must meaningfully involve relevant members of the local community (see, e.g., Brennin 2007, Conley & Moote 2003, Phillips 2003, Rydin et al, 2003)

Socio-economic conditions of the IMW will be monitored by developing and systematically collecting data on a set of socio-economic indicators, using two guiding principles. First, both experts (including agency officials, scientists and academics) and residents should be involved in the process of developing the indicators. Second, the indicators should be useful for citizen action, management of the IMW, and policymaking.

In keeping with those guiding principles we propose a five step process for the MFJD, to be conducted over three months, beginning in January 2009.

1. Weeks 1 – 4. Develop a small (5-6) core group of locally involved people from diverse backgrounds who are known to have a good understanding of how restoration and

other watershed management activities connect to the socio-economic and social health of the community.

2. Weeks 5-6. Engage the core group in a workshop process to identify a set of socio-economic indicators for the Middle Fork John Day.
3. Weeks 6-8. Confirm the technical feasibility of the indicators (are the data available, etc.) and adjust them as necessary.
4. Weeks 9-13. Ground truth the indicators through a community education/public involvement process.
5. Weeks 6-13. Create a system to collect, assess, and report indicator data. To the extent possible we will collect historic data, to establish a baseline for the socio-economic indicators. We will collect current data so long as funding is available.

### MFJD Product: Null Hypothesis and Indicators

Technically, there is no hypothesis in community indicators work. The aim is to measure changes in the socio-economic health of the system, not the specific consequences of specific watershed restoration/management activities. Nevertheless, in an active area it is reasonable to assume that the restoration/management projects are influencing the socio-economic health of the watershed. Thus, a null hypothesis for socio-economic monitoring might be stated as:

**No change occurs in socio-economic indicators when active environmental restoration/management is being conducted.**

The product will be a set of 4-6 indicators. The specific indicators for the MFJD will be developed in collaboration with the community, through the process outlined above. Although it's not possible to predict exactly what indicators will emerge from the process, here are some examples developed in other, similar projects:

- Average pay and benefits in Grant County as a % of the Oregon (or rural Oregon) average
- Number of new businesses in the community
- Number of visitors (tourists) who come to Grant County to participate in natural resource based activities (hunting, fishing, hiking, etc.)
- Number of local contractors employed to work on watershed restoration projects
- Livestock sales
- Timber harvest
- Property (especially ranch) turnover
- Change in property (especially ranch) values

In addition to these economic indicators, the community might also want to develop some "civic engagement" indicators, to try to measure public involvement in restoration activities. Some examples are:

- Number of people involved with local watershed/environmental activities
- Number of private land owners who participate in WC activities/projects
- Number of volunteers participating in education and restoration activities

## Expected Outcomes and Contingencies

### *Power Analysis*

Our ability to detect a change in IMW fish production is partly dependent on the variance associated with our fish metrics. We proposed to measure fish production using smolt/redd ratios which require estimates of both smolts and redds and therefore, two potential sources of variance. Smolts are measured at our rotary screw trap near Ritter with associated variance estimated from boot-strapping techniques of the mark-recapture estimates. Redds are measured by conducting on the ground redd surveys. We census spring Chinook redds by surveying the entire known spawning distribution therefore, it incorporates no additional variance. For steelhead, we conduct a subsample of known distribution using an EMAP or GRTS sample selection protocol and calculate a nearest neighbor variance. Therefore for steelhead, we have two additive sources of variance for our estimates. All variance around our mean estimates are calculated as 95% confidence intervals (95% CIs;  $\alpha = 0.05$ ).

Variances around our trapping estimates have varied over the past several years. Table (17) shows our abundance and productivity estimates for Chinook from the past five years. Over these years, 95% CIs of annual smolt abundances have averaged 19.1% (range 15–25%) of the means. Catches of steelhead smolts in the same trap have been more variable with 95% CIs averaging 30.4% (range 19–41%) of the means (Table 18). We can expect future variances to be similar to this average, however, we have continued to refine our techniques to reduce them.

Additional variance for estimating steelhead smolts/redd arises from our redd abundance estimate for the IMW. This variance should be similar to that of our basin-wide redd estimate for steelhead. The basin-wide 95% CIs have averaged 54% (range 32–66%) of the means (Table 19). Previous attempts have indicated that this variance appears to be very difficult to reduce without significant additional effort. When CIs from both smolt and redd counts are added to develop a smolt/redd variance for steelhead, the average CI would be ~ 84% of the mean.

**Table 17. Middle Fork John Day River smolt/redd ratios based on trap estimates of smolt abundance and census redd counts for spring Chinook salmon, 2002–2006 brood years.**

Brood Year	Number of redds	Migration Year	Trapping period	Smolt abundance	95% CI	Smolt/redd
2002	389	2004	10/29/03–6/23/04	23,901	19,449–30,188	61
2003	236	2005	10/6/04–6/17/05	21,957	18,747–25,489	93
2004	319	2006	3/6/06–6/22/06	18,465	14,423–24,186	58
2005	178	2007	10/31/06–6/14/07	16,901	14,279–20,755	95

**Table 18. Migration year, number PIT tagged, percent capture efficiency, and abundance estimates (95% confidence limits) for juvenile steelhead migrants captured at the rotary screw trap near Ritter on the Middle Fork John Day River.**

Migration Year	PIT tagged	Capture Efficiency	Abundance	95% CI
2006	806	7.7	20,720	14,401-30,870
2007	1,269	8.8	14,784	11,947-18,004
2008	204	6.3	6,248	3,657-10,970

**Table 19. Distance surveyed (km), number of unique redds observed, redd density (redds/km), estimated total number of redds, fish per redd estimate from Deer Creek, and spawner escapement with 95% C.I. for the John Day River basin from 2004 to 2008.**

Year	km	Redds	Redds/km	Total redds	Fish/redd	Spawner escapement	95% Lower	95% Upper
2004	94.7	66	0.70	3,071	1.46	4,484	1,657	7,310
2005	101.2	39	0.39	1,681	2.20	3,698	1,261	6,137
2006	90.5	67	0.74	3,202	1.66	5,315	2,189	8,441
2007	99.6	181	1.82	7,758	1.12	8,689	5,939	11,439
2008	105.0	56	0.53	2,277	4.07	9,260	4,742	13,775

The above estimates suggest we would need to increase smolt/redd production in the IMW by approximately one third for Chinook and two-fold for steelhead to be able to detect a significant increase over recent estimates. Determining how many restoration actions need to be implemented to produce this production gain is essentially the goal of this IMW study. Therefore, we have no realistic means of knowing how many individual restoration projects need to be implemented to realize a measurable change. We therefore take a different approach to estimate a collective boost in fish production.

An examination of Chinook smolt production as a function of redd abundance for the entire John Day River basin has indicated that smolt/redd ratios plateau above an abundance of approximately 1,000 redds. This suggests that early life stage survival may be limiting expansion of the Chinook population. TIR flights indicate that temperature is potentially a leading cause for limiting parr production in mainstem habitats during summer months. If this is true, then temperatures need to be reduced to increase smolt production. By examining a longitudinal temperature profile of the Middle Fork John Day River from TIR, it appears that a modest 1-2°C decrease in summer temperatures to near 20°C could expand summer rearing habitat in the mainstem Middle Fork by more than two-fold thereby providing the potential for a measurable increase in smolt production. Therefore, we expect to be able to detect a measurable fish production response if all recommended actions in the Mainstem of the Middle Fork are implemented. Additional conservation efforts, probably beyond current efforts, are needed to reduce temperatures that will eventually provide this measurable response.

***This analysis provides the variance estimates needed to calculate Power but does not provide a true power analysis.***

### ***Assumptions and Contingencies***

Once the design and monitoring plan are finalized, should draft a set of contingencies in case monitoring efforts are underfunded, variance is too high to detect changes, disturbances impact controls, landowner access denied, etc.

## **Data Management, Analysis, and Reporting**

The IMW group has decided to allocate funds for data management, analysis and reporting starting with the 2009 funds. These funds will pay for a staff person who will work for the North Fork John Day Watershed Council so that they are locally situated and will coordinate closely with all project partners. Currently the IMW partners have set-up a file sharing site and have scheduled regular data uploads to make all data collected accessible to all project partners.

Suggest using ISEMP tools for data storage and management ... data should be centrally housed, QA/QC required prior to analysis, standard formats that can be shared with other agencies, etc. Much more emphasis is required on standard data formats and reporting.

## **Timeline and Deliverables**

A list of expected project deliverables and a timeline for implementation and reporting is presented in Appendix B and C. The Middle Fork John Day IMW group has implemented many parts of the IMW project, including steelhead and Chinook monitoring, deployment of temperature loggers, installation of groundwater monitoring wells, mapping of both monitoring and restoration project locations, and overall project coordination. The IMW participants developed the attached timeline to guide implementation and reporting over the three years of the project. The timeline will be updated as projects are implemented and decisions on the IMW's objectives are updated. Specific To Date deliverables include the hiring of a Data Steward by September 2009 to act as overall data manager for the IMW, the final report of the Socio-Economic Indicators will be delivered to PSMFC by December 2009, the final report of the Macroinvertebrate Pilot Study will be delivered by Feb 2010, with recommendations for future macroinvertebrate monitoring within the IMW. In addition the IMW working group will submit a 5 year progress report to PSMFC on the IMW by March 2012.

A new timeline will need to be developed that looks something like Table 20.

**Table 20. Example of an IMW implementation timeline of the Asotin IMW including restoration activities and annual monitoring efforts.**

Start				
Year	Phase	Activity	Description	

2004	1	Design and project initiation	Select watersheds and reaches to conduct IMW, develop experimental and monitoring design
	1	Monitoring	Implement pre-treatment monitoring of fish and habitat
	1	Equipment	Install temperature probes throughout watershed
2009	2	Monitoring	Continue pre-treatment monitoring of fish and habitat
	2	Equipment	Install PIT tag antennas and water gauges
	2	Geomorphic Surveys	Conduct pre-treatment LiDAR, aerial photography, and total station survey of in-stream and floodplain areas
2010	3	Monitoring	Continue pre-treatment monitoring of fish and habitat
	3	Restoration	Develop a detailed restoration plan
	3	Restoration	Remove barrier to juv. migration at Headgate Dam on Asotin Ck
2011	4	Restoration	Implement restoration action - add LWD to 4 km treatment section in Charley Creek
	4	Restoration	Fence and plant the treatment portion of Charley Creek
	4	Monitoring	Implement post-treatment monitoring of fish and habitat in treatment and control sections
2012	4	Monitoring	Continue post-treatment monitoring of fish and habitat in treatment and control sections
	4	Monitoring	Conduct post-treatment implementation assessment
	4	Remote Sensing	Conduct post-treatment LiDAR, aerial photography, and total station survey of in-stream and floodplain
2013	5	Restoration	Implement restoration action - add LWD to second 4 km treatment section in Charley Creek
	5	Monitoring	Continue post-treatment monitoring of fish and habitat in treatment and control sections
2014	5	Monitoring	Continue post-treatment monitoring of fish and habitat in treatment and control sections
2015	6	Restoration	Implement restoration action - add LWD to third (and final) 4 km treatment section in Charley Creek
		Monitoring	Continue post-treatment monitoring of fish and habitat
	6	Remote Sensing	Conduct post-treatment LiDAR, aerial photography, and total station survey of in-stream and floodplain areas
2016	6	Monitoring	Continue post-treatment monitoring of fish and habitat
2017	6	Monitoring	Continue post-treatment monitoring of fish and habitat

## Conclusions and Recommendations

This report is a revision a draft IMW design from February 2009 and an assessment of the feasibility of the design to meet the primary objective of an IMW project, namely to *implement restoration activities in an experimental fashion to improve our ability to learn how restoration actions influence fish populations*. Updating the design was hindered by some issues related to data management and availability. The updated design should not be considered complete and is not ready to fully implement. Below we outline some of the issues that will hinder further development of the design if they are not addressed and we outline steps to complete the design based on sound experimental principles.

### ***Issues hindering completion of the Implementation Plan***

- GIS data is not in standard format (line, polys, and points) for each restoration and monitoring activity
- GIS data is not in sufficient detail to sum up basic design metrics like the amount of a particular restoration (area, length, or total count) of restoration activities and in some cases determine when the activities were implemented
- There is no common reach classification and naming convention used across agencies and partners, and stream locations (i.e., rKM) are also inconsistent making transferring data from one source to another difficult
- There are “unknown” restoration projects that have not been accounted for (what are they, when were they completed or proposed)
- Monitoring activities have been implemented in an adhoc fashion in some cases and only after restoration activities have already been completed
- Monitoring levels and locations have changed from year to year reducing time series data
- There has not been a predetermination of the restoration activities to be implemented, the level required to have a likelihood of creating a fish response, and explicit treatment and control sections of stream identified (this report has completed this step at a course scale only)
- It appears that there is a focus on implementing restoration activities without a concerted effort to adhere to experimental design principles

### ***Steps to complete the Implementation Plan***

- Review and convert all existing GIS data into appropriate format (e.g., instream structures should be cataloged individually as point data, riparian fencing should be catalog and mapped as line data, and forest management practices like juniper removal should be mapped as polygons).
- Reclassify or remove all unknown restoration projects and audit the existing database to make sure projects are not duplicated or missing (this will require an extensive review by partners familiar with particular areas of the study area)
- GIS resources and assessments need to be extended to North Fork and South Fork to avoid potential disruption of these subbasins as control streams
- The starting conditions (as of 2007) need to be documented for the basic attributes of interest (riparian cover, channel alignment, instream structures, presence of LWD, pools, etc). Most of this information is available in the BOR and TMDL assessments
- Once the starting conditions are documented the appropriate level of restoration can be determined. For example, if there was 1 LWD piece per 100 m pre-treatment, a goal of 10 pieces may be selected based on references or historic conditions. Literature from other sites can then be used to predict the potential effect of this treatment
- Adoption of BOR (2008) reach classifications and summary data is recommended. Their approach should be applied to the remaining study area (i.e., Big Creek to Camp); GIS resources from BOR should be acquired and combined with existing IMW layers
- Treatment and control areas have to be selected and maintained as best as possible to allow long-term monitoring to be implemented while limiting confounding factors

- Need to have the group review and adopt the next version of the experimental design. Once the design has been adopted, ALL future restoration activities will have to be compatible with the adopted design – this will require a LISTING of all proposed restoration projects and prioritizing the projects based on the design. This will require that future restoration needs to be implemented within TREATMENT areas only, and COTROL areas are to be left UNTREATED. A framework for coordinating these activities is essential to moving forward.
- A future restoration condition needs to be described to allow planning and coordination. Applying different levels of restoration to treatment areas will confound the experiment (e.g., the goal in each treatment area will be to realign 1000 m of channel, reconnect 2 side channels, and construct 25 ELJ)
- A complete review of monitoring activities should be conducted before the next field season and prior to any more restoration. Long-term spatially extensive sampling such as redd counts, macro invertebrate, and temperature monitoring appear to be adequate; however, juvenile salmon monitoring, and stream habitat monitoring sites may not be located in optimal areas. Permanent treatment and control sites have to be selected first before monitoring plans can be finalized
- A key question EXTERNAL reviewers will have is “How much restoration will you need to complete to detect an effect of X”. This will require a Power Analysis and review of the potential fish response per unit of X restoration. The draft Power Analysis conducted provides measures of variability for juvenile and adult abundance BUT does incorporate the an experimental design or PROPOSED effect sizes.
- Once a experimental and monitoring framework is finalized a timeline needs to be developed that outlines each years activities and the responsibilities of group members
- Data Management, analysis, and reporting – these responsibilities need to be reviewed in order to deal with all the data streaming in and how is it going to be managed.

This is a large and complicated IMW and although the list of issues and further steps is daunting, with a refocusing on IMW and experimental principles, many of these issues can be overcome.

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## **Appendix A**

## Proposed Restoration Projects Upper Middle Fork John Day River

<b>Restoration Project</b>	<b>Location</b>	<b>Partners</b>	<b>Planned/Proposed Implementation Year</b>	<b>Limiting factor(s) Addressed</b>	<b>Restoration Category</b>	<b>Related Monitoring</b>
Co Rd 20 Culvert	Mainstem	County		Key habitat quantity, Sediment load	reconnecting habitat	Steelhead and Chinook Status and Trend Monitoring: Delineate par rearing habitat
Austin Ranch Diversions	Mainstem	Private/CTWSO/BOR	Two completed 2007	Temperature, Altered hydrology	restoring hydrologic processes	Temperature Monitoring and Modeling
Austin Ranch Diversion	Mainstem	Private/CTWSO/BOR	One planned 2010	Temperature, Altered hydrology	restoring hydrologic processes	Temperature Monitoring and Modeling
Bates Mill Land Acquisition	Mainstem	Private/State Parks	Completed through State Parks 2008		restoring hydrologic and riparian processes	
Riprap Removal	Mainstem	CTWSO – Forrest Conservation Area	Completed 2008-2009	Habitat quantity, habitat quality, temperature	restoring hydrologic and riparian processes, instream habitat enhancement	
Large wood placement	Mainstem	CTWSO – Forrest Conservation Area	Completed 2008-2009	Habitat diversity	in stream habitat enhancement	
Riparian Plantings	Mainstem	CTWSO – Forrest Conservation Area	Completed 2008-2009	temperature, sediment load	restoring riparian processes	Temperature Monitoring and Modeling
Riparian Plantings	Mainstem	CTWSO - Oxbow Conservation Area	completed 2008	Temperature, Sediment load	restoring riparian processes	Temperature Monitoring and Modeling

## Proposed Restoration Projects Upper Middle Fork John Day River

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Restoration Project	Location	Partners	Planned/Proposed Implementation Year	Limiting factor(s) Addressed	Restoration Category	Project Specific Effectiveness Monitoring
Full channel restoration - Ruby-Beaver	Mainstem	CTWSO - Oxbow Conservation Area	2010	temperature, altered hydrology, habitat diversity/ quality	in stream habitat enhancement	yes
Large wood placement	Mainstem	CTWSO - Oxbow Conservation Area	2009	habitat diversity/quality, temperature, sediment load	in stream habitat enhancement	
Remove riprap, develop pools, install engineered logjams	Mainstem (upper 1/3 of Dunstan Homestead)	TNC/BOR/	completed 2007	Habitat diversity, sediment load	Restoring hydrologic processes, instream habitat enhancement	yes
Remove riprap, develop pools, install engineered logjams	Mainstem (lower 2/3 of Dunstan Homestead)	TNC	proposed for 2011 - 2013	habitat diversity, altered hydrology	restoring hydrologic processes, instream habitat enhancement	yes
Riparian Plantings	Mainstem (Dunstan Homestead)	TNC/NRCS	2008-2009	Temperature	Restoring riparian processes	Temperature Monitoring and Modeling
Camp Creek Gaging Station	Mainstem	OWT				
Channel Relocation	Mainstem	USFS/RPB/Oregon Trout/TNC	2009	Temperature, hydrology	restoring hydrologic processes	
Culvert/Channel Restoration	Bridge Ck	USFS	2011	habitat quantity	reconnecting habitat	Steelhead and Chinook Status and Trend Monitoring: Delineate par rearing habitat
Culvert Replacements	Bridge Ck	USFS	completed 2007	habitat quantity	reconnecting habitat	Steelhead and Chinook Status and Trend Monitoring: Delineate par rearing habitat

Culvert Replacements - Hwy 26 - Phase 1	Bridge Ck	USFS/ODOT	completed 2007	habitat quantity	reconnecting habitat	Steelhead and Chinook Status and Trend Monitoring: Delineate par rearing habitat
Culvert Replacements - Hwy 26 - Phase 2	Bridge Ck	USFS/ODOT	2009	habitat quantity	reconnecting habitat	Steelhead and Chinook Status and Trend Monitoring: Delineate par rearing habitat
Culvert Replacement	Placer Gulch	CTWSO – Forrest CA	completed 2007	habitat quantity	reconnecting habitat	Steelhead and Chinook Status and Trend Monitoring: Delineate par rearing habitat
Riparian Vegetation	Placer Gulch	CTWSO – Forrest CA	2012	Temperature, sediment load	restoring riparian processes	Temperature Monitoring and Modeling

## Proposed Restoration Projects Upper Middle Fork John Day River

Restoration Project	Location	Partners	Planned/Proposed Implementation Year	Limiting factor(s) Addressed	Restoration Category	Project Specific Effectiveness Monitoring
Confluence/Passage	Davis or Vinegar Cr.	CTWSO – Forrest CA	2009	habitat quantity	reconnecting habitat	
Culvert Replacement/Channel Restoration	Dead Cow Cr.	CTWSO – Forrest CA/BOR/SWCD	Completed 2008	habitat quantity, habitat quality	reconnecting habitat, in stream habitat enhancement	Steelhead and Chinook Status and Trend Monitoring: Delineate par rearing habitat
Culvert Replacement	Butte Cr.	USFS	Completed 2008	habitat quantity	reconnecting habitat	Steelhead and Chinook Status and Trend Monitoring: Delineate par rearing habitat
Install 3 fish screens	Granite Boulder	CTWSO – Oxbow CA	Completed 2008	habitat quality	instream habitat	

	Cr.				enhancement	
Austin Ranch Diversion	Vinegar Cr.	Private/CTWSO/SWCD/BOR	Completed 2007	Temperature, altered hydrology, habitat quantity	Restoring hydrologic processes	Temperature Monitoring and Modeling
Austin Ranch Diversion	Clear Cr.	Private/CTWSO/SWCD/BOR	Completed 2007	Temperature, altered hydrology, habitat quantity	Restoring hydrologic processes	Temperature Monitoring and Modeling
Austin Ranch Diversion	Clear Cr.	Private/CTWSO/SWCD/BOR	2010	Temperature, altered hydrology, habitat quantity	Restoring hydrologic processes	Temperature Monitoring and Modeling
Install Fish Screen	Beaver Cr.	CTWSO – Oxbow CA	2020	habitat quality	in stream habitat enhancement	
Culvert Replacements (3)	Beaver Cr.	USFS	2008	habitat quantity	reconnecting habitat	Steelhead and Chinook Status and Trend Monitoring: Delineate par rearing habitat
Channel Restoration	Big Boulder Cr.	Boulder CK Ranch/TNC/BOR	completed 2008	temperature, hydrology	restoring hydrologic and riparian processes	
Floodplain/Confluence Restoration	Dunston C.	TNC	2011	habitat diversity, altered hydrology	restoring hydrologic processes	
Culvert Replacements - Phase 1	Camp Cr.	USFS	2009	habitat quantity	reconnecting habitat	Steelhead and Chinook Status and Trend Monitoring: Delineate par rearing habitat
Culvert Replacements - Phase 2	Camp Cr.	USFS	2010	habitat quantity	reconnecting habitat	Steelhead and Chinook Status and Trend Monitoring: Delineate par rearing habitat
Culvert Replacements - Phase 3	Camp Cr.	USFS	2011	habitat quantity	reconnecting habitat	Steelhead and Chinook Status and Trend Monitoring: Delineate par rearing habitat

Weir Replacement - Phase 1	Camp Cr.	USFS	2009	Habitat quantity, habitat quality, temperature	in stream habitat enhancement	
Weir Replacement - Phase 2	Camp Cr.	USFS	2010	Habitat quantity, habitat quality, temperature	in stream habitat enhancement	

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## **Appendix B**

(as of February 2009)

### **IMW Component**

Macroinvertebrate

### **Project Lead**

Amy Charette  
North Fork John Day Watershed Council

Groundwater Monitoring

John Selker  
Oregon State University

Fish Monitoring

Jim Ruzycki  
Oregon Department of Fish and Wildlife

Temperature Monitoring

Amy Charette  
North Fork John Day Watershed Council

PIBO Monitoring

Tom Friedrichsen  
U.S. Forest Service

Economic

Michael Hibbard  
University of Oregon

Geomorphology Monitoring

Pat McDowell  
University of Oregon

## Appendix C

(as of February 2009)

### IMW Task Status

### Implementation Date(s)

IMW Planning

Jan – Dec 2007

Complete

Writing of Study Design Doc

Sep 2007 – Nov 2008

Complete

Revisions to Study Design Doc

Nov – Dec 2009

(based on 2008 & 2009 field seasons)

Revised Study Doc Submitted

Jan 2010

Restoration Project Implementation

Ongoing

Adult Steelhead Monitoring

Mar – Jun Annually

Ongoing

Juvenile Steelhead Monitoring

Jun – Jul & Oct Annually

Ongoing

Adult Chinook Monitoring

Sep Annually

Ongoing

Juvenile Chinook Monitoring

Jun – Sep & Oct Annually

Ongoing

Temperature Monitoring (loggers)

Jun – Oct Annually

Ongoing

Temperature Monitoring (fiber optic)

Jul – Sep Annually

Ongoing

Groundwater Monitoring

Jan – Aug Annually

Ongoing

PIBO Monitoring

2008, 2011, 2014

Geomorphology Monitoring

Weather Station Purchase/Installation	Apr 2009
Planning	
Benthic Macro Monitoring Pilot	Jul – Sep 2009
Planning	
Drift Macro Monitoring Pilot	Jul – Sep 2009
Planning	
Report on Macro Pilot Study	Feb 2010
Socio-Economic Indicators	
Report on Socio-Economic Indicators	Dec 2009
Hiring of Data Steward	Sep 2009
	Planning
5 Year Progress Report	March 2012

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