

**Mapping Tributary Habitat Restoration Projects in the Upper Grande Ronde  
River to Support Landscape Analysis**

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## Acknowledgements

I would like express my sincere gratitude to Dr. Seth White, Fishery Scientist, for providing me with the opportunity to do my internship and project at the Columbia River Inter-Tribal Fish Commission, and for his advice and guidance throughout.

I would like to thank Dr. Dale McCullough, Ms. Denise Kelsey, and Mr. Casey Justice from the Columbia River Inter-Tribal Fish Commission, for their continued support and valuable contributions throughout my internship.

I would like to thank my head advisor, Dr. Kelly Burnett, and committee member, Dr. Carolyn Fonyo Boggess, for providing me with the tools needed to navigate the PSM program, and for their significant contributions to my final project.

In addition, a thank you to Ted Sedell and Winston Morton from the Oregon Department of Fish and Wildlife, Mason Bailie and Jesse Steel from the Grande Ronde Model Watershed, Katie Barnas and Monica Diaz from the National Oceanic and Atmospheric Administration, Tommy Franzen and Aaron Maxwell from The Freshwater Trust, Paul Kennington from the Oregon Department of Transportation, Jeff McLaughlin from the United States Bureau of Reclamation, Kayla Morinaga and Joe Platz from the United States Forest Service, Les Naylor from the Confederated Tribes of the Umatilla Indian Reservation, and Lawrence Preston-McBride and Russell Scranton from the Bonneville Power Administration for their responses to requests for restoration data and their assistance with project logistics.

This research was supported by the Bonneville Power Administration's 2008 Columbia Basin Fish Accords Memorandum of Agreement between the Three Treaty Tribes and FCRPS Action Agencies.

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## Abstract

Stream restoration is increasingly being administered in the Pacific Northwest to improve salmon habitat function and fish abundance, among other goals. Although numerous restoration projects have been completed, many consisting of multiple sites and activity types, few projects have been consistently monitored for effectiveness. Furthermore, monitoring is often conducted at the spatial scale of individual sites, which fails to account for larger scale watershed functions. To support the evaluation of potentially far reaching effects of restoration, restoration project information was compiled and mapped and a method for assessing restoration intensity across work sites was developed. This project is the first step in evaluating the cumulative effect of decades of restoration efforts on habitat condition across a large project area. Restoration project information, including restoration type and associated metrics, was collected for the Upper Grande Ronde River watershed. A total of 4,449 work sites were compiled for the study area, coming from 10 different data archives, with a total of 71 unique metrics relevant to stream habitat function. The predominant time period of projects was from 1994-2014, although some projects were completed in 2015. Metrics include measurements and descriptions of restoration work completed. A data table was created to organize separate work sites, with metrics organized by the type of restoration, referred to as the sub-category. Information about spatial location was available for most work sites and was uploaded into a geographic information system (GIS) to generate a shapefile of work site mid-points. The mid-points were subsequently used to analyze the correspondence between mapped restoration efforts and restoration detected during field visits. Habitat monitoring reaches from the Columbia Habitat Monitoring Program (CHaMP) were visually surveyed for the presence of restoration activities expected based on the GIS map. Of projects that were mapped in GIS, there was a wide range of correspondence in detecting those activities in the field, from 100 percent for floodplain reconnection projects, to 33 percent for planting projects. Stream length treated per work site sub-category is proposed as one means of describing restoration intensity across all work sites, based on that being the most commonly reported and therefore consistently available metric. Further investigation into the statistical significance of using the stream length treated per work site sub-category, and the development of ratings or rankings as a means of assessing restoration, is needed to determine the usefulness in predicting habitat improvements achieved through different restoration techniques.

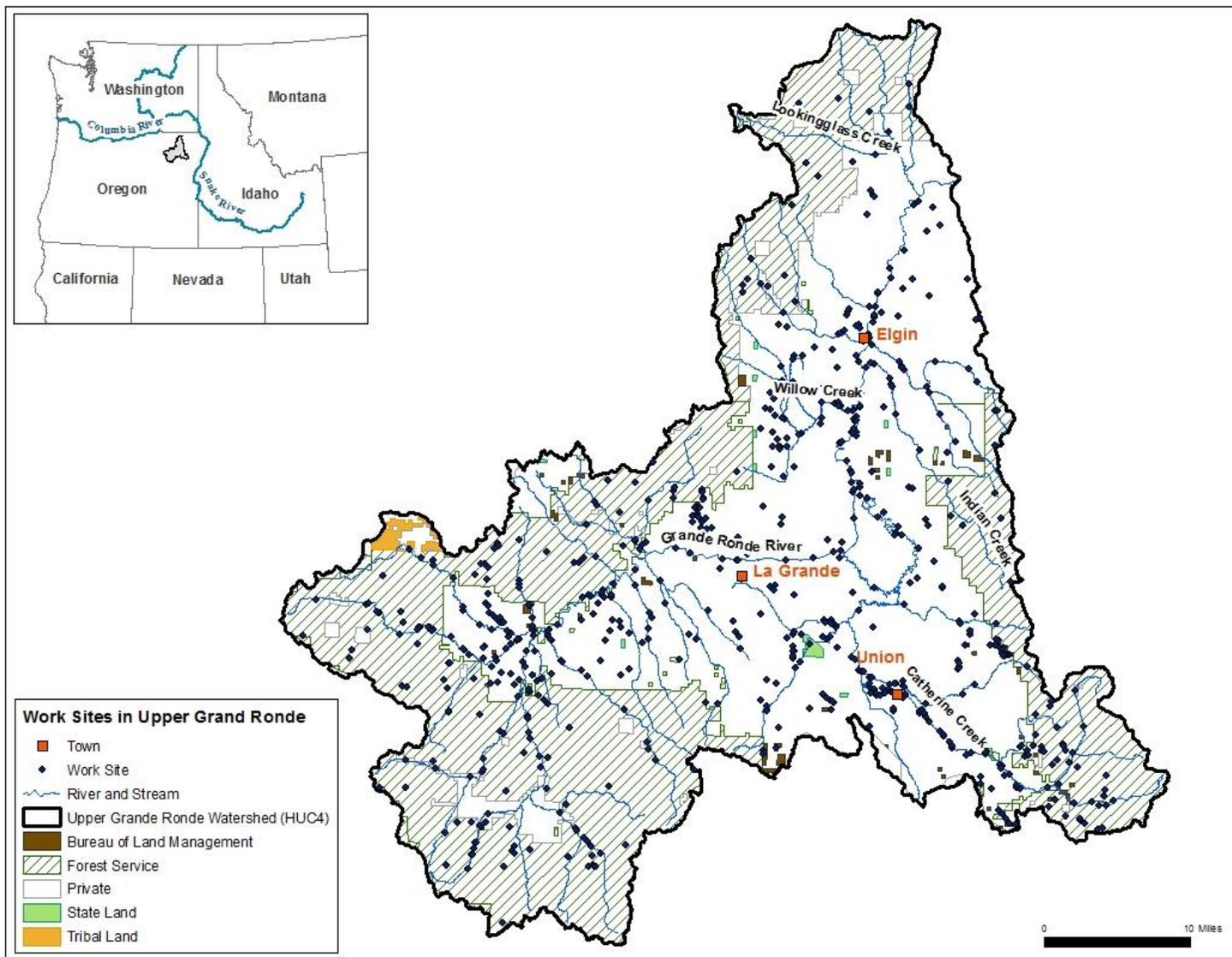
## I. Introduction

The decline of endangered salmon populations in the Columbia River basin has led to extensive efforts to restore these populations through habitat restoration. Stream restoration projects have been used as a way of recovering salmon habitat to improve fish productivity and meet requirements of the endangered species act (ESA) (Roni, Pess, Beechie, & Hanson, 2014). Although this method of salmon recovery has been widely accepted, few quantitative studies have been completed to confirm the intended results (Whiteway, Biron, Zimmermann, Venter, & Grant, 2010). Furthermore the monitoring that is conducted typically focuses on site-specific responses of habitat conditions, not including biological responses or an evaluation of change across a watershed (Roni, Pess, Beechie, & Hanson, 2014). Evaluating stream restoration projects from a landscape perspective—as opposed to individual sites—can offer insights into habitat actions required to address factors affecting freshwater salmon production (Fausch, Torgersen, Baxter, & Li, 2002).

A landscape refers to an area of land (at any scale) containing a pattern that affects and is affected by an ecological process of interest (McGarigal, 2001). A landscape perspective, then, involves the study of these landscape patterns, the interactions among the elements of this pattern, and how these patterns and interactions change over time. A preliminary step in evaluating restoration from a landscape perspective is compiling existing information on where restoration actions occurred, what type of restoration was completed, and the intensity of restoration actions across the study area. This can be challenging, as many stream restoration projects are implemented independently, with little coordination between agencies on the types of data collected (Palmer & Allen, 2006). While some project-level effectiveness monitoring data are available for a few restoration projects, most projects have implementation information that can be compiled in assessing the extent and intensity of past restoration over a larger area. These data can be used to develop restoration intensity metrics, which may be linked to biological responses. Such efforts will likely provide key information for understanding fish-habitat relationships and eventually assist in the development of a salmon life cycle model.

This work is part of the Columbia River Inter-Tribal Fish Commission's (CRITFC) Monitoring Recovery Trends project (McCullough D. , 2009), which is funded by the 2008 Columbia Basin Fish Accords Memorandum of Agreement between the Three Treaty Tribes and the Federal Columbia River Power System (FCRPS) Action Agencies. The Monitoring Recovery Trends project evaluates the status and trends of spring Chinook Salmon habitat in the Upper Grande Ronde River (including Catherine Creek and Minam River) of NE Oregon (Figure 1). Instream and riparian monitoring is conducted using the Columbia Habitat Monitoring Program (CHaMP) by CRITFC, in collaboration with Oregon Department of Fish and Wildlife's (ODFW) La Grande field office. The CHaMP program includes the collection of topographic information and habitat metrics critical to salmon health. The CHaMP data is separate from the stream restoration information compiled for this project. However, having both data for the same area will ultimately allow for an analysis of the relationships between stream restoration and habitat metrics. The spatial scope of both of these data also supports the overall goal of evaluating stream restoration from a landscape perspective.

Figure 1. Map of the Upper Grande Ronde River watershed showing 705 restoration work sites implemented between the years 1986 and 2014. This map does not show work sites that only implemented invasive plant removal due to that information being incomplete.



The objectives of this project were to:

- 1) Compile restoration project information from all known data sources for the Upper Grand Ronde River basin, including metrics by restoration type.
- 2) Create a spatial data layer directly corresponding to the compiled restoration information.
- 3) Assess the correspondence between restoration locations reported by agencies and restoration projects visually identified while in the field.
- 4) Propose alternative methods of assessing restoration intensity across a study area when metrics reported by agencies are inconsistent.

## II. Methods

### a. Compilation of projects

#### *Study Area*

The study area for this project is the Upper Grande Ronde River watershed (Figure 1), part of the Grande Ronde River Subbasin located in northeastern Oregon. The area encompasses both the Upper Grande Ronde River and Catherine Creek spring Chinook Salmon populations, which are the main focus of this project and listed under the Endangered Species Act (ESA). The study area also serves as important habitat for Lookingglass spring Chinook Salmon, and the watershed boundary replicates the extent of the Upper Grande Ronde steelhead population (McCullough D. A., et al., 2015). Restoration work sites extend throughout the Upper Grande Ronde River watershed, distributed within local fish populations. The watershed lies mostly within Union County, with La Grande being the largest city in the catchment. Property ownership in the watershed is mostly split between private landowners and the Forest Service, with small parcels held by the state, the Bureau of Land Management (BLM), and the tribes. The Grande Ronde River Subbasin is part of the larger Snake River Basin, a tributary of the Columbia River. Intensive land use in this area, including timber harvest, livestock grazing, and agricultural production, has led to declines in Chinook populations (McIntosh, et al., 1994). These land use changes have generated a need for stream restoration and effectiveness monitoring (McCullough D. A., et al., 2015).

#### *Data Sources*

Sources of restoration project information were identified and recorded in a data table. Data sources were found through online research; contacting federal, state, and tribal land management agencies; meetings with CRITFC staff; personal contacts made at the 2015 River Restoration Northwest symposium, and correspondence with members of the Grande Ronde Atlas Science Technical Advisory Committee meeting on July 31<sup>st</sup>, 2014. See Table 1 for a list of restoration project sources, range of dates captured, and number of work sites per source. The Department of State Lands removal-fill/general authorizations permits for Union County were also reviewed for potentially unaccounted for restoration projects, but no permits were filed for the study area.

**Table 1. Source information for the restoration work site data table within the Upper Grande Ronde River watershed.**

<b>Agency</b>	<b>Source</b>	<b>Data Archive</b>	<b>Year Range</b>	<b>Total Number Of Unique Work Sites</b>
<b>Oregon Watershed Enhancement Board</b>	oregonexplorer.info	Oregon Watershed Restoration Inventory	1992-2013	3837
<b>Grande Ronde Model Watershed</b>	Mason Bailie & grmw.org/projectdb	Grande Ronde Model Watershed Project Database	1987-2013	348
<b>National Oceanic and Atmospheric Administration</b>	Monica Diaz	Pacific Northwest Salmon Habitat Project Database	1986-2012	174
<b>Oregon Department of Fish and Wildlife Grande Ronde Watershed District</b>	Winston Morton	Grande Ronde Fish Habitat Database	1985-2012	32
<b>Bureau of Land Management, Vale District</b>	blm.gov/or/gis/data.php	Interagency Restoration Database	1993-2014	20
<b>The Confederated Tribes of the Umatilla Indian Reservation</b>	Les Naylor	CTUIR Fish Accord Habitat Projects, Limiting Factors and Accomplishments 2008-2014 project information spreadsheets	2008-2014	13
<b>The Freshwater Trust, Flow Restoration for Northeast Oregon</b>	Aaron Maxwell	Freshwater Trust Accomplishments Reports	2013-2014	10
<b>U.S. Forest Service, Wallowa-Whitman National Forest</b>	Kayla Morinaga & Joe Platz	2010-2012 La Grande Ranger District Aquatics Program Accomplishment Reports & Wallowa-Whitman National Forest La Grande Ranger District Restoration Projects within the Grande Ronde River Watersheds (2008-2014) & (1988-2008) project information spreadsheets	1988-2014	8
<b>Bonneville Power Administration</b>	cbfish.org	Taurus Database	1984-2014	6
<b>National Oceanic and Atmospheric Administration</b>	map.critfc.org/flexviewers/p_csrftribal	Pacific Coastal Salmon Recovery Fund	2005-2011	1
		<b>Total Work Sites</b>	<b>1984-2014</b>	<b>4449</b>

**The total number of work sites identifies the number of unique work sites incorporated into the data table from each source; duplicate projects were consolidated.**

### *Data Table Development and Mapping*

Restoration project information was compiled into a comprehensive data table for the study area. The predominant time period of projects is from 1994-2014, although some projects from 2015 are also included in the final data table. Restoration data from 2015 was incomplete due to the timing of this project, therefore it was not the focus and is not included in the analysis or work site counts. Work sites were listed as separate records (i.e., rows in the spreadsheet), displaying project information per site (i.e., columns). Restoration action types and sub-categories for all projects in the database were identified based on project titles, project descriptions, project notes, and the type of metrics reported. Restoration actions are defined as broad restoration categories (e.g., fish passage or instream structures), while sub-categories are more specific ways of carrying out each action (e.g., large woody debris addition as a sub-category of instream structures). Actions and sub-categories were modified from the Bonneville Power Administration's (BPA) Action Effectiveness Monitoring (AEM) program, which accounts for most types of restoration in the study area (Roni, Scranton, & O'Neal, 2013). Each project was categorized into these actions and sub-categories, signifying each type of restoration for each work site (see Appendix 1 for metadata on the restoration project data table). Further modifications to BPA's AEM actions and sub-categories list have been detailed in the project work flow, attached as Appendix 2. The metrics 'site length' and 'site area' are based on the largest reported treatment length or area metric per work site. Information about the intensities of individual sub-categories is still within the data table, but is not comparable across numerous work sites due to inconsistent reporting. If only one value of site length or area treated was reported for projects with multiple sites, that measurement was evenly split between each work site.

Spatial location was collected for each work site, corresponding to the midpoints of restoration projects. The inconsistent reporting of treatment boundaries (upstream and downstream edges) limited what could be used to represent site locations. Once added into a GIS, the data table was converted into a shapefile (a spatial data layer used in the creation of GIS maps).

Duplicate information about individual projects was identified through mapped locations, project descriptions, and project names. When duplicate information was found, only data from the primary source was reported in the table. The primary source is the land management agency that conducted the restoration work, therefore the originator of the data. In cases where multiple agencies reported different values for a metric, it was assumed the primary source reported the most accurate information. Data from secondary sources was incorporated into the table when it provided additional detail. A combination of data from multiple sources was recorded when different metrics were reported by different agencies (e.g., if the primary source reported 3 km of large woody debris installation and a secondary source reports 2 km of tree planting for same work site).

## **b. Comparison of mapped versus observed restoration**

In the summer of 2014, CRITFC and ODFW habitat crews conducted visual assessments for the presence of restoration activities. These field assessments occurred during regularly-scheduled visits to 54 CHaMP reaches for surveys of fish abundance and benthic macroinvertebrates. The locations were annual and rotating panel 1 CHaMP sites (visited annually or once every three years for habitat monitoring, respectively). CHaMP reaches range from 120 meters to 600 meters in length, depending on bankfull channel width. A restoration field checklist (Appendix 3) was developed based on the format of the Oregon Department of Environmental Quality's (ODEQ) Human Disturbance Index Reach Checklist. Restoration activities were rated on a Likert scale (0, 1, 3, or 5) to document the effect of restoration on stream function for each restoration sub-category. The restoration assessment field checklist contained instructions on use, how to assess restoration function, a notes section, and a separate column of sub-categories requiring prior site knowledge for identification. One constraint in developing the field checklist was that filling out the sheet should take no longer than 5-10 minutes per site, considering the existing time constraints of field crews. To alert field crews to potential restoration work that may be encountered during their visits to stream reaches, restoration work sites were identified in a GIS within a 500 meter buffer of each CHaMP site extent polygon. The 500 meter buffers extend above and below the stream reach, as well as into the adjacent riparian area. A list of these restoration work sites was provided to crews prior to their field visits.

For selected restoration sub-categories, percent match was calculated as the proportion of mapped projects that were also detected in the field. Sub-categories were chosen based on prevalence and interest from restoration implementers and researchers. Results of this comparison have implications for the accuracy of restoration work site reporting, including the type of work completed and the location of the work site; whether or not mapped restoration is actually present, and if it is not, making sure it is reflected in the data table when conducting future analysis; and the longevity of restoration types, checking the true timeframe of projects in the field.

## **c. Restoration intensity**

Inconsistent reporting within and between agencies constrained what could be used to develop a uniform measure of restoration intensity. Because site length and/or area treated was most commonly reported across agencies, those metrics were most likely to serve as consistent measure of restoration intensity across the project area.

Each restoration action sub-category was assigned a corresponding response time and longevity in the data table to express when a work site is expected to affect stream and streamside habitat. Response time refers to how quickly restoration provides beneficial effects to habitat function, while longevity indicates how long restoration lasts before becoming ineffectual. For example, an engineered pool may have an immediate effect on fish cover (quick response time), but may deteriorate and lose function rapidly (short longevity). Alternatively, a planting project may take 10-20 years before effectively shading a waterway (lengthy response time), but potentially last for decades to centuries (prolonged longevity). To account for this in the restoration assessment method, a table of response time and

longevity information was developed based on the work of Beechie, et al. (2013). Response time and longevity descriptions not derived from Beechie, et al. (2013) were extrapolated from related sub-categories and expert opinion. Table 2 shows the time frames for each sub-category. For further details see the work flow document (Appendix 2).

Table 2. Table of response time, longevity, probability of success, processes, and habitat restored per sub-category, modified from Beechie, et al., (2013).

Sub-Categories	Response Time in Years	Longevity in Years	Probability of Success	Success Notes	Processes Restored Connectivity	Processes Restored Sediment	Processes Restored Hydrology	Processes Restored Riparian	Habitat Restored Floodplain	Habitat Restored Riffle	Habitat Restored Pool	Habitat Restored Spawning	Habitat Restored Cover	Habitat Restored Area
Fish Passage - Diversion Screening	1-5	<10	moderate*	based on other fish passage ratings	x									
Fish Passage - Removal of Barriers	1-5	>50	high		x									x
Instream Structures - Large Woody Debris Additions	1-5	10-50	moderate to high	originally rated low to high		x	x			x	x	x	x	
Instream Structure - Bank Stabilization	1-5	10-50	moderate to high	originally rated low to high		x		x						x
Instream Structures - Boulder Addition	1-5	10-50	moderate to high	originally rated low to high						x	x			x
Instream Structure - Beaver Activity	1-5	10-50	moderate to high*	based on instream structures ratings, originally rated low to high	x	x	x	x	x		x			
Instream Structures - Engineered Pools	1-5	<10	moderate to high*	based on instream structures ratings, originally rated low to high			x				x			
Instream Structures - Modification/Removal of Bank Armoring	5-20	>50	moderate to high*	based on instream structures ratings, originally rated low to high	x	x	x		x					
Instream Structure - Nutrient Addition	1-5	<10	moderate to high											
Off-Channel/Floodplain - Levee Set-Back or Removal	5-20	>50	high*	based on other fish passage ratings	x	x	x	x	x					
Off-Channel/Floodplain - Floodplain Reconnection or Creation	1-5	>50	moderate		x	x	x	x	x					
Off-Channel/Floodplain - Remeandering	1-5	>50	moderate*	based on other off-channel ratings	x		x	x	x	x	x	x		

Sub-Categories	Response Time in Years	Longevity in Years	Probability of Success	Success Notes	Processes Restored Connectivity	Processes Restored Sediment	Processes Restored Hydrology	Processes Restored Riparian	Habitat Restored Floodplain	Habitat Restored Riffle	Habitat Restored Pool	Habitat Restored Spawning	Habitat Restored Cover	Habitat Restored Area
Off-Channel/Floodplain - Side-Channel/Alcove Construction	1-5	>50	moderate		x	x	x	x	x	x	x	x	x	x
Off-Channel/Floodplain - Thermal Refugia	5-20	>50	moderate*	based on other off-channel ratings			x		x				x	
Off-Channel/Floodplain - Wetland Restoration	5-20	>50	moderate*	based on other off-channel ratings				x	x					
Riparian Improvement - Installed Fencing	>50	>50	moderate to high			x		x	x					
Riparian Improvement - Planting	>50	>50	moderate to high			x		x	x					
Riparian Improvement - Invasive Plant Removal	1-5	<10	moderate*	based on personal observation				x	x					
Sediment Reduction/Addition - Road Decommissioning	5-20	>50	high		x	x			x					
Sediment Reduction/Addition - Improving Agricultural/Forestry Practices	5-20	10-50	moderate			x		x				x	x	
Sediment Reduction/Addition - Spawning Gravel Addition	1-5	10-50	moderate to high*	based on personal observation					x	x	x	x	x	
Acquisition & Protection - Land Acquisition, Lease, or Easement	>50	>50	moderate*			x		x	x				x	
Flow Augmentation - Water Lease or Purchase	1-5	>50	high		x		x							x
Flow Augmentation - Irrigation Improvement	1-5	10-50	moderate*			x	x					x		
Flow Augmentation - Mitigate Point Source Impacts	1-5	10-50	high*				x							x

\* indicates an estimated value or a deviation from reference materials, based on restoration project experience and knowhow

### **III. Results and Discussion**

#### **a. Compilation of projects**

Overall, 4,449 work sites were identified reporting 71 different restoration metrics. Several of the ten data archives reported multi-agency collaboration on individual projects, with a total of 36 individual grantees taking part in the restoration on the Upper Grande Ronde River watershed. Table 3 summarizes the restoration sub-categories and reported metrics incorporated in the data table. A programmatic approach to reporting restoration activities between all land management agencies could reduce the numerous different ways that work sites are currently documented, allowing agencies to compare data for similar types of projects.

In December of 2015, the final map and table of restoration from this project was used to supplement information on restoration efforts for the Upper Grande Ronde River Expert Panel process. The Expert Panel process is a multi-agency work group that assesses the benefit of restoration to fish habitat as directed by the Federal Columbia River Power System (FCRPS) Biological Opinion. The restoration map provided invaluable information on the location and intensity of restoration that otherwise would have been missing from the Expert Panel meeting (Seth White, pers. comm.).

**Table 3. Number of restoration projects and work sites by action and sub-category, and the number of times each project has an associated metric measurement reported (labeled No. Instances Metric Reported). The total number of work sites and projects are less than the sums of No. of Work Sites and No. Projects columns because multiple restoration activities were conducted at several projects.**

Action	Sub-Category	No. Projects	No. of Work Sites	Metric	No. Instances Metric Reported by Project
<b>Fish Passage</b>	Diversion Screening	17	17	Cubic Feet per Second Diverted	15
				Number of Passage Improvements	3
	Removal of Barriers	67	84	Miles Unblocked Stream	34
				Number of Passage Improvements	59
<b>Instream Structures</b>	Large Woody Debris Additions	127	160	Miles Large Woody Debris	96
				Log Weirs (# Installed)	9
				Acres Large Woody Debris	8
				Number Logs Pieces	31
	Bank Stabilization	78	97	Miles Streambank Stabilization	68
				Acres Streambank Stabilization	8
				Jetties, Barbs (Number of)	15
				Rock Weirs, Cross Veins (Number of)	15
	Boulder Addition	36	46	Miles Boulders	25
				Acres Boulders	2
				Number Boulder Structures	5
				Boulders (Number of)	11
	Beaver Activity Observed	1	1		0
Engineered Pools	8	9	Number Pools Created	4	
Modification/Removal of Bank Armoring	0	0		0	
Nutrient Addition	0	0		0	
<b>Off-Channel / Floodplain</b>	Levee Set-Back or Removal	13	13	Acres Riparian Habitat Created	1
				Miles of Dike Removal or Modification Riparian	2
	Floodplain Reconnection or Creation	36	36	Miles Floodplain Restored	16
				Acres Floodplain Restored	15
	Remeandering	28	39	Acres Channel Reconfiguration	2
				Miles Channel Reconfiguration	16
				Miles Main Channel Created	9
	Side-Channel/Alcove Construction	15	22	Acres Side Channel Created	1
				Miles Side Channel Created	8
				Backwater Alcoves in Feet	4
New Spring/Tributary Channels in Feet				2	
Thermal Refugia	1	1		0	
Wetland Restoration	19	25	Acres Wetland Habitat Restored	11	
<b>Riparian Improvement</b>	Installed Fencing	189	227	Stream Miles Fenced	151
				Planting Miles Fenced	6
				Upland Miles Fenced	4

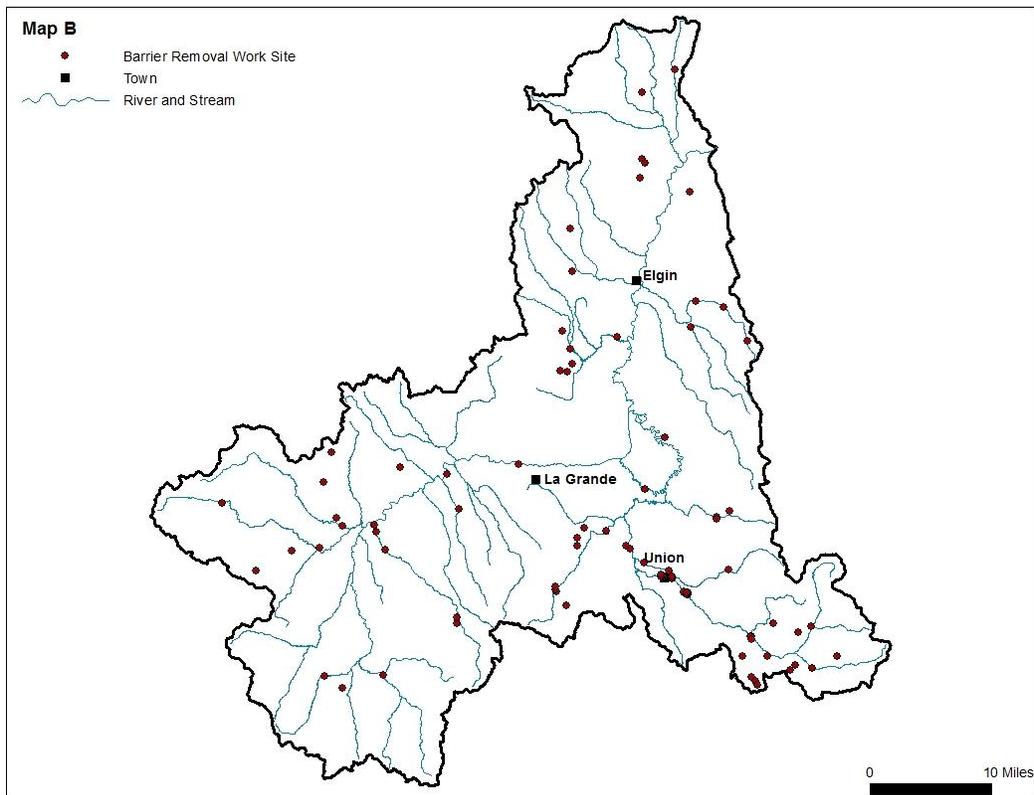
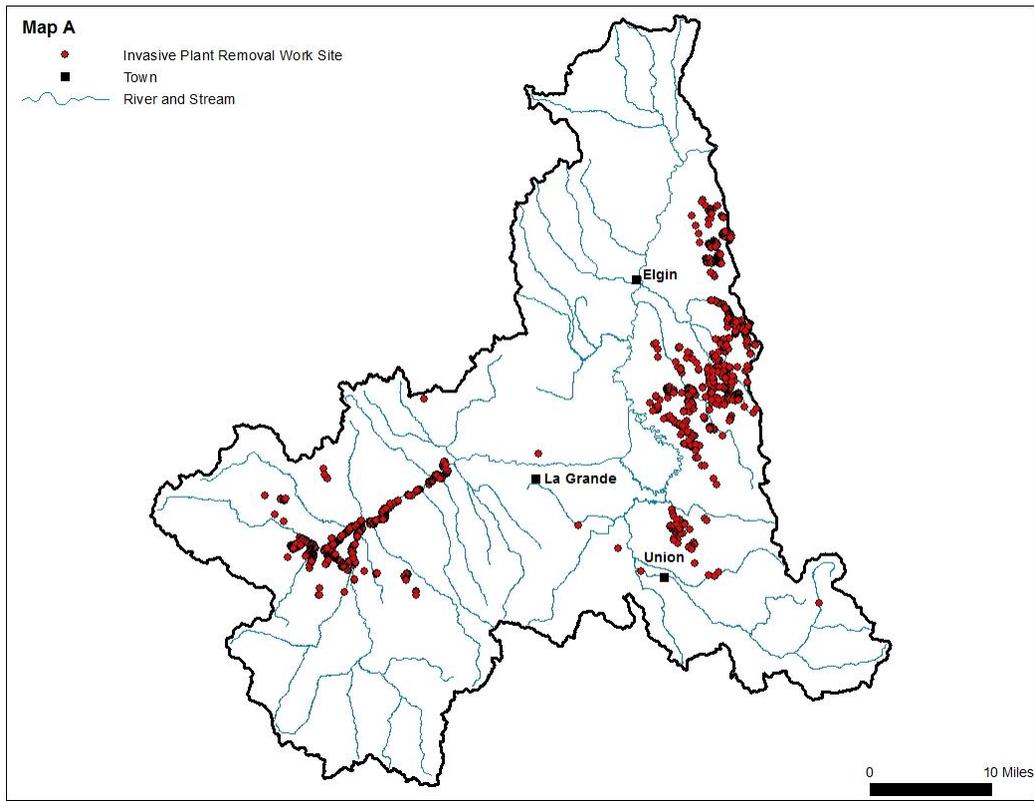
Action	Sub-Category	No. Projects	No. of Work Sites	Metric	No. Instances Metric Reported by Project
				Average Buffer Width Fencing	4
				Riparian Acres Protected by Fencing	144
				Upland Acres Protected by Fencing	16
				Acres Wetland Habitat Protected by Fencing	2
				X-Fencing (Number of)	19
	Planting	180	215	Number Plants Planted	25
				Riparian Miles Planted and/or Seeded	123
				Acres Riparian Planted and/or Seeded	99
				Upland Miles Planted and/or Seeded	5
				Acres Upland Planted and/or Seeded	17
				Wetland Acres Planted and Seeded	4
				Seeding in Pounds	18
				Sedge/Rush Mats in Feet	5
	Invasive Plant Removal	17	3762	Miles Upland Invasive Control	0
				Miles Riparian Invasive Control	12
				Acres Riparian Invasive Control	11
				Acres Upland Invasive Control	8
<b>Sediment Reduction / Addition</b>	Road Decommissioning	54	73	Feet Average Buffer Width Road Obliteration	3
				Miles of Trail/Road Recontoured/Removed	45
				Miles Trail/Road Recontoured/Removed Upland Acres Road Obliterated	3
					8
	Improving Agricultural/Forestry Practices	77	109	Acres Improved Agriculture	57
	Spawning Gravel Addition	5	5	Miles Treated Spawning Gravel	2
<b>Acquisition &amp; Protection</b>	Land Acquisition, Lease, or Easement	54	56	Acres of Acquisition, Lease, or Easement	31
				Stream Miles of Acquisition, Lease, or Easement	32
				Years out Acquisition, Lease, or Easement	2
<b>Flow Augmentation</b>	Water Lease or Purchase	27	28	CFS Purchased or Leased	10
				Acres of Acquisition, Lease, or Easement Pertaining to Water Lease or Purchase	8
				Instream Dates	8
	Irrigation Improvements	12	15	Acres Improved Irrigation	1
	Mitigate Point Source Impacts	4	4	Miles Toxic Cleanup	1
				Acres Toxic Cleanup	1
		546	4449	Site Length	380
		546	4449	Site Acres	316

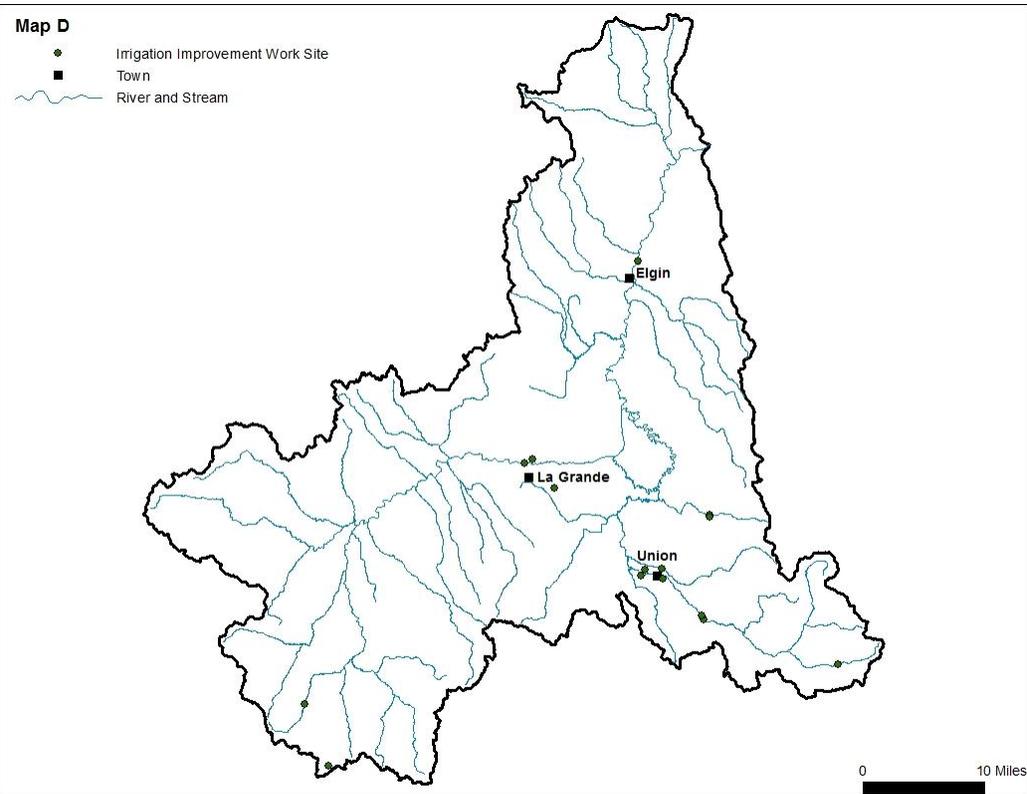
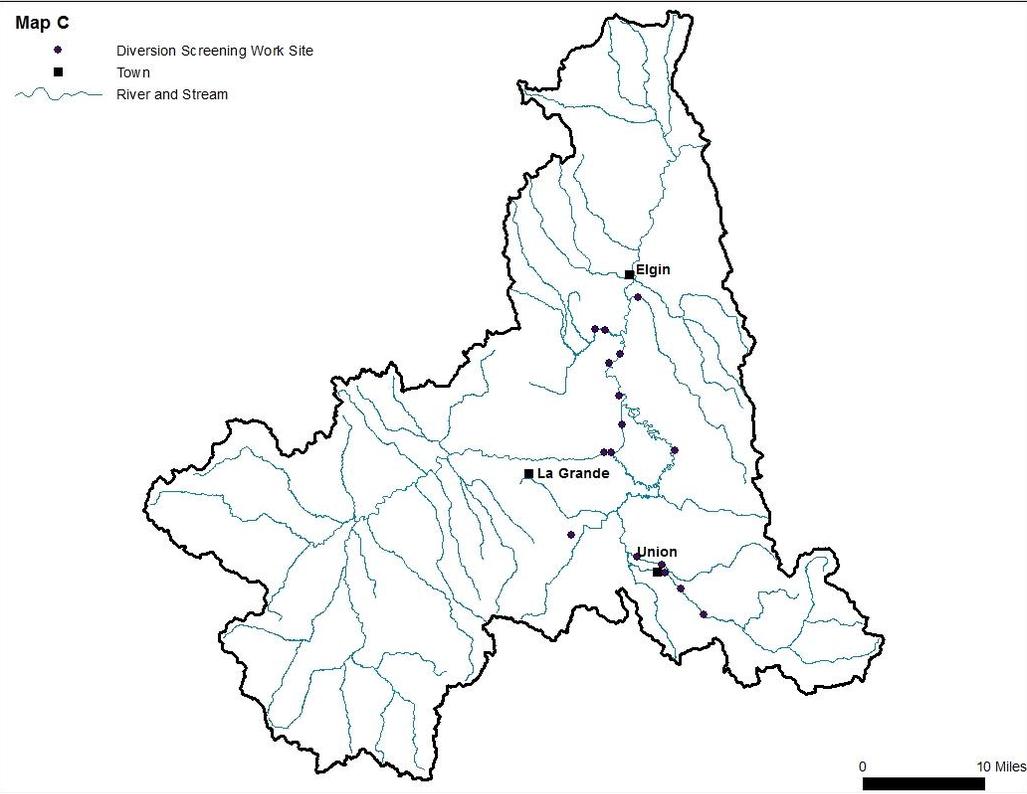
Sub-categories with 0s in the Projects and Work Sites columns indicate that none of those types of projects occurred in the study area.

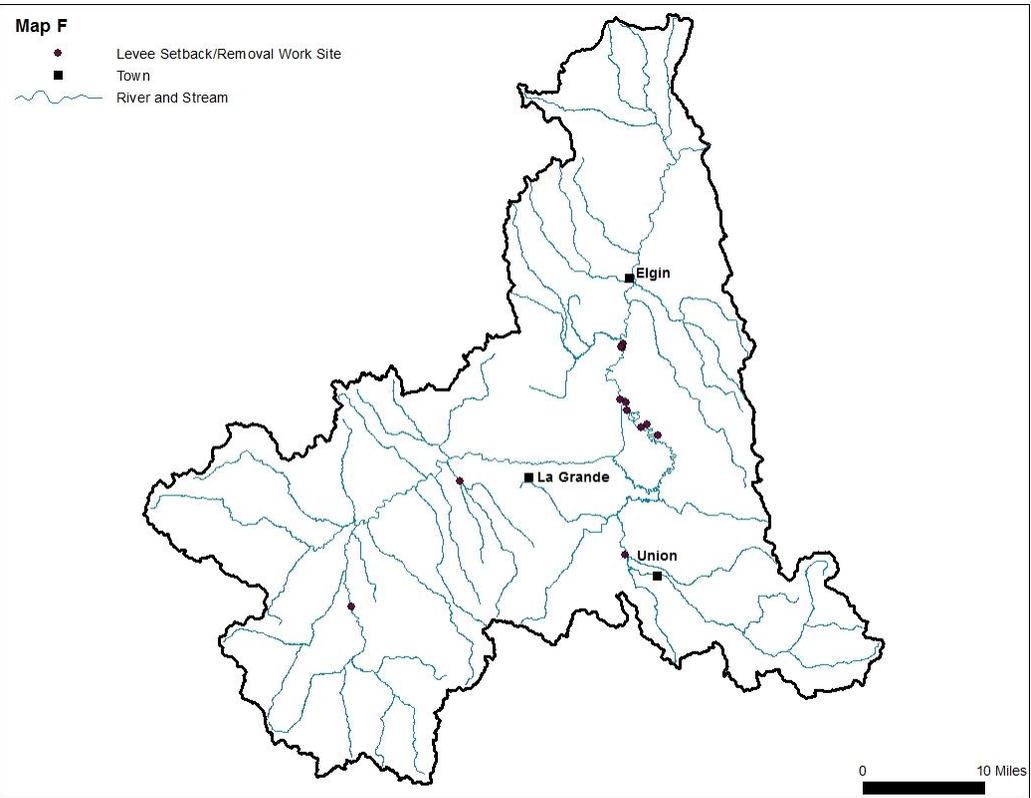
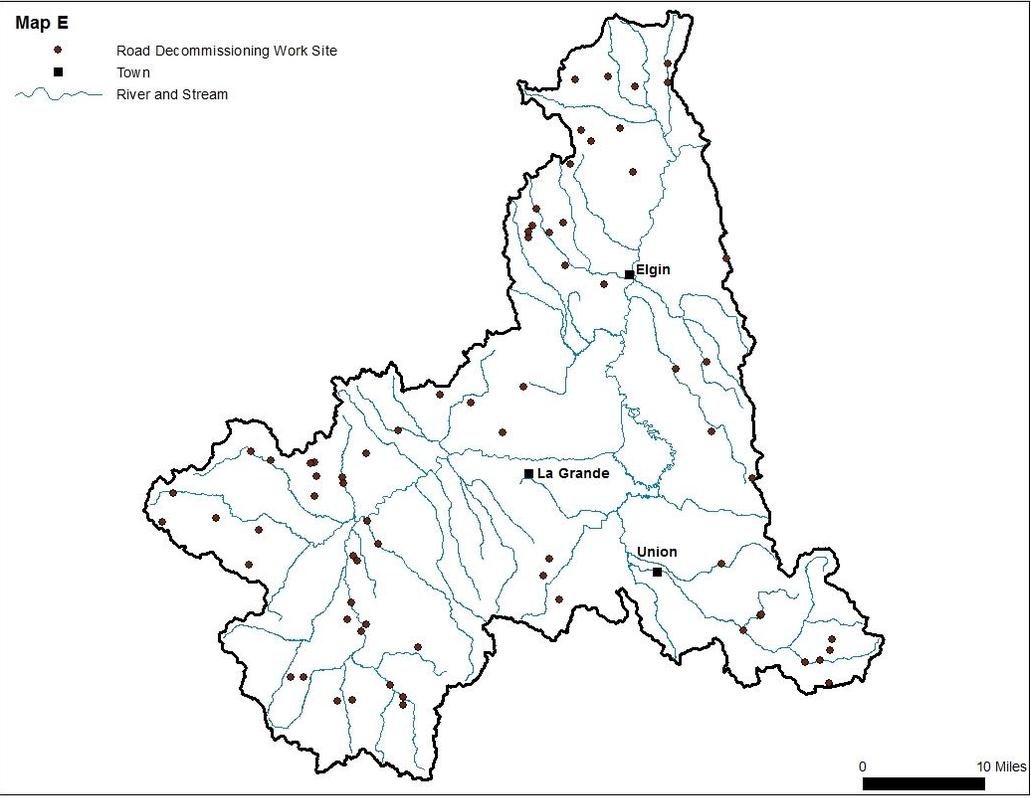
The map of work sites (Figure 1) shows the extensive, uniformly distributed restoration work sites completed in the Upper Grande Ronde watershed. This map does not include exclusive invasive plant removal projects because of incomplete data for that restoration activity. Because invasive plant removals have only an indirect effect on instream habitat for salmonids, there was no concerted effort to fill in this missing information. A large portion of these projects were mapped along the northeastern border of the Upper Grande Ronde basin, as well as along the mainstem Grande Ronde River upstream of La Grande, and just northeast of Union along Catherine Creek (Figure 2A).

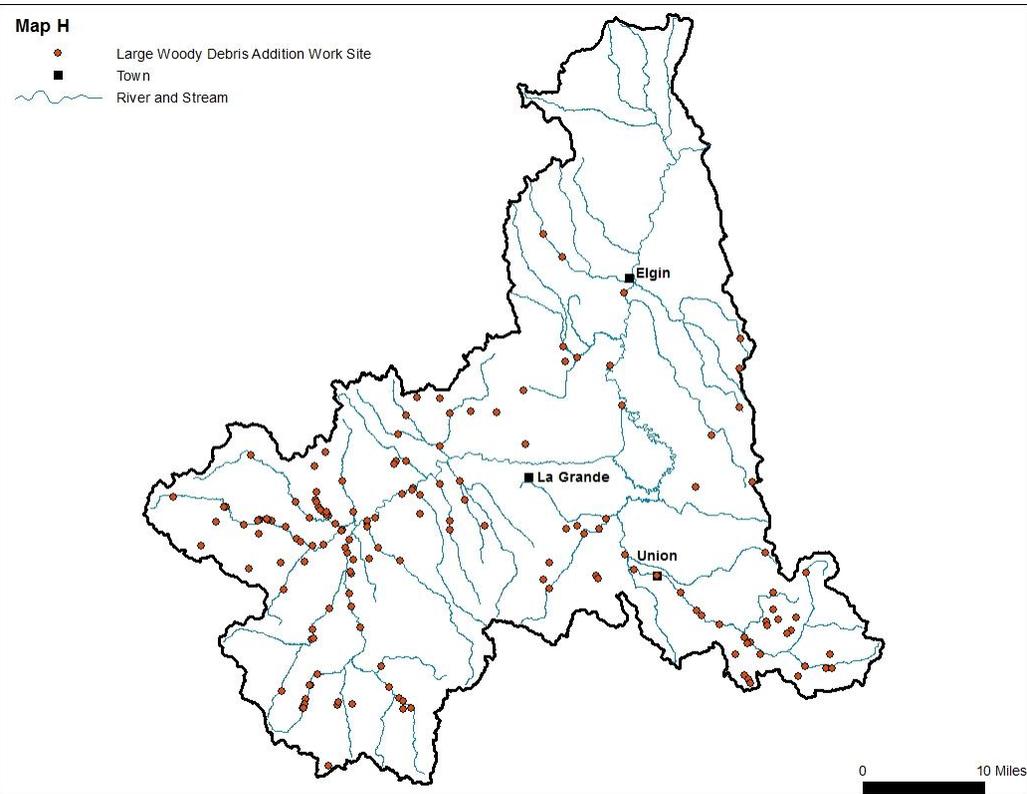
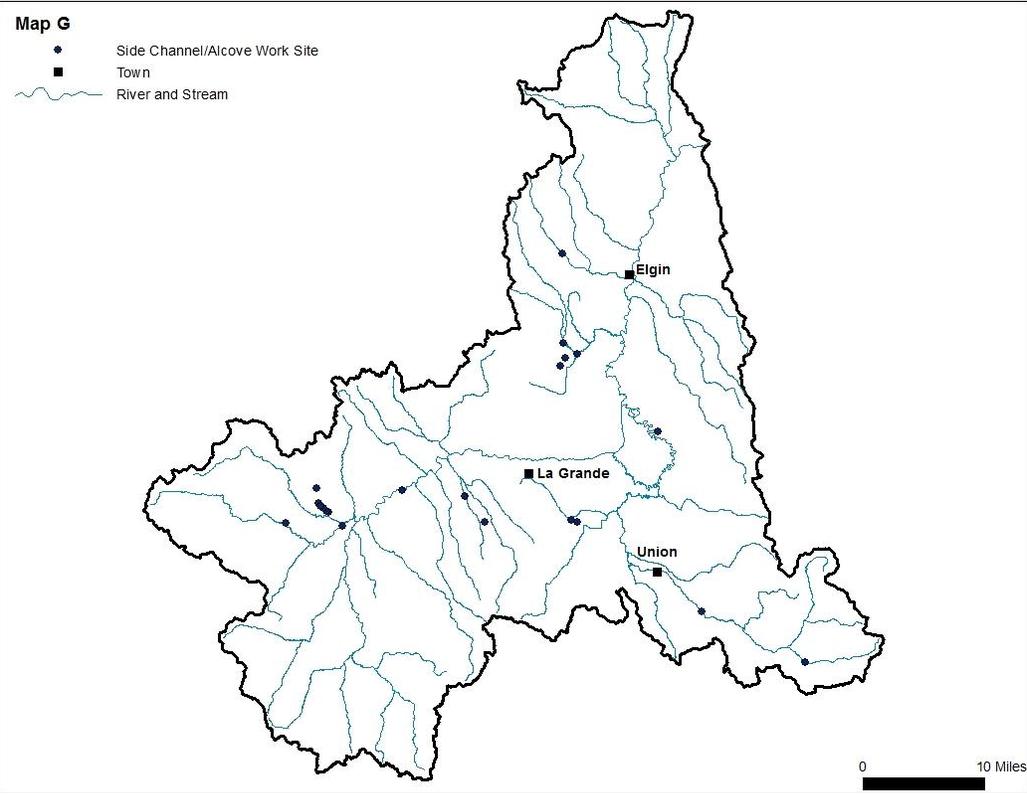
A large cluster of barrier removal projects were mapped in the lower reaches of mainstem Catherine Creek, but were overall spread throughout the watershed (Figure 2B). Diversion screening projects were mapped exclusively in the upper portions of Catherine Creek and middle sections of the Upper Grande Ronde River (Figure 2C). Irrigation improvements were clustered around Union and near the confluence of Catherine and Little Catherine Creeks, with a few notable exceptions in the headwaters of both the Grande Ronde River and Catherine Creek (Figure 2D). Most road decommissioning projects were mapped in the Upper Grande Ronde and within headwater streams of the study area (Figure 2E). Levee setback or removal projects were focused along the lower reaches of Catherine Creek, near its confluence with the Grande Ronde River (Figure 2F). A cluster of side channel/alcove projects were mapped along the lower portions of McIntyre Creek, but overall appear evenly dispersed throughout the watershed (Figure 2G). When comparing project types a considerable amount of overlap exists between large woody debris and planting projects (Figure 2H & 3I respectively).

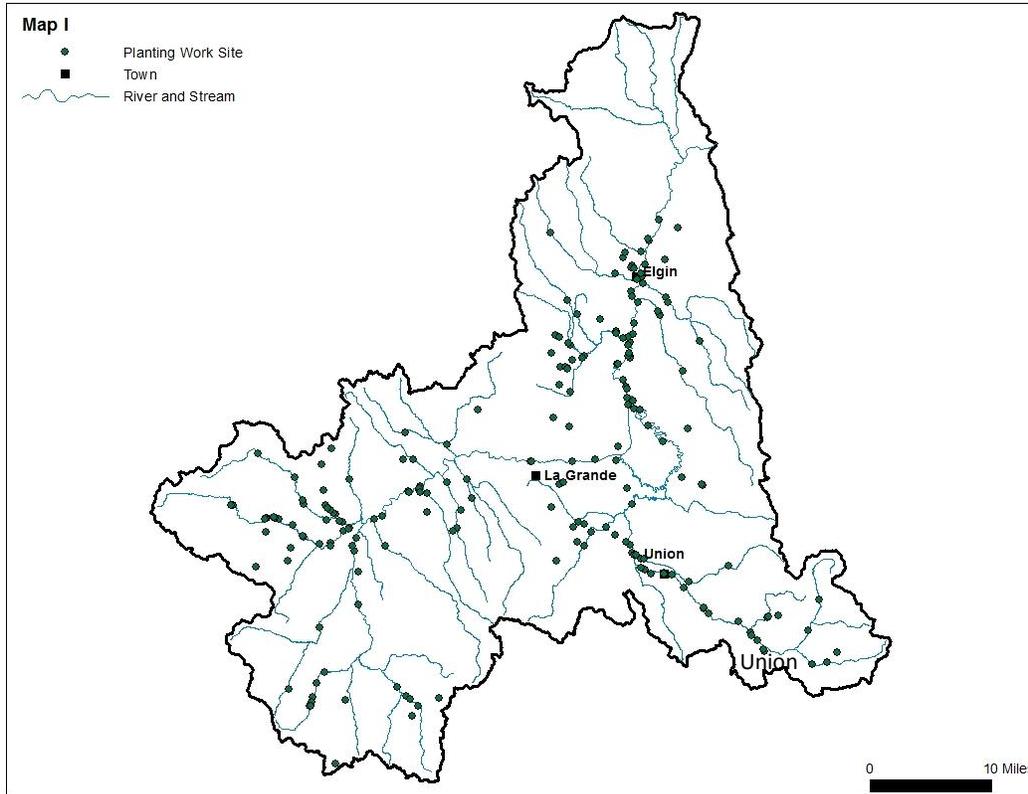
Figure 2. Maps A-I showing the location of restoration work sites by sub-category in the Upper Grande Ronde.











## b. Comparison of mapped versus observed restoration

Visits to CHaMP sites allowed for the evaluation of whether field crews could detect restoration work compiled in the data table and mapped in GIS. Actual time spent filling out the restoration assessment sheet was approximately 5-10 minutes per site visit, and therefore did not place a significant burden on field crews. Table 4 shows the results for a sample of sub-categories, indicating restoration sub-categories mapped within 500 meters of CHaMP reaches and restoration sub-categories observed during 2014 field visits. Discrepancies between restoration work mapped in GIS and observed in the field may be due to missing or inaccurate information about the project or its location, restoration activities becoming undetectable to field crews over time, or field crews mistakenly identifying natural features as restoration.

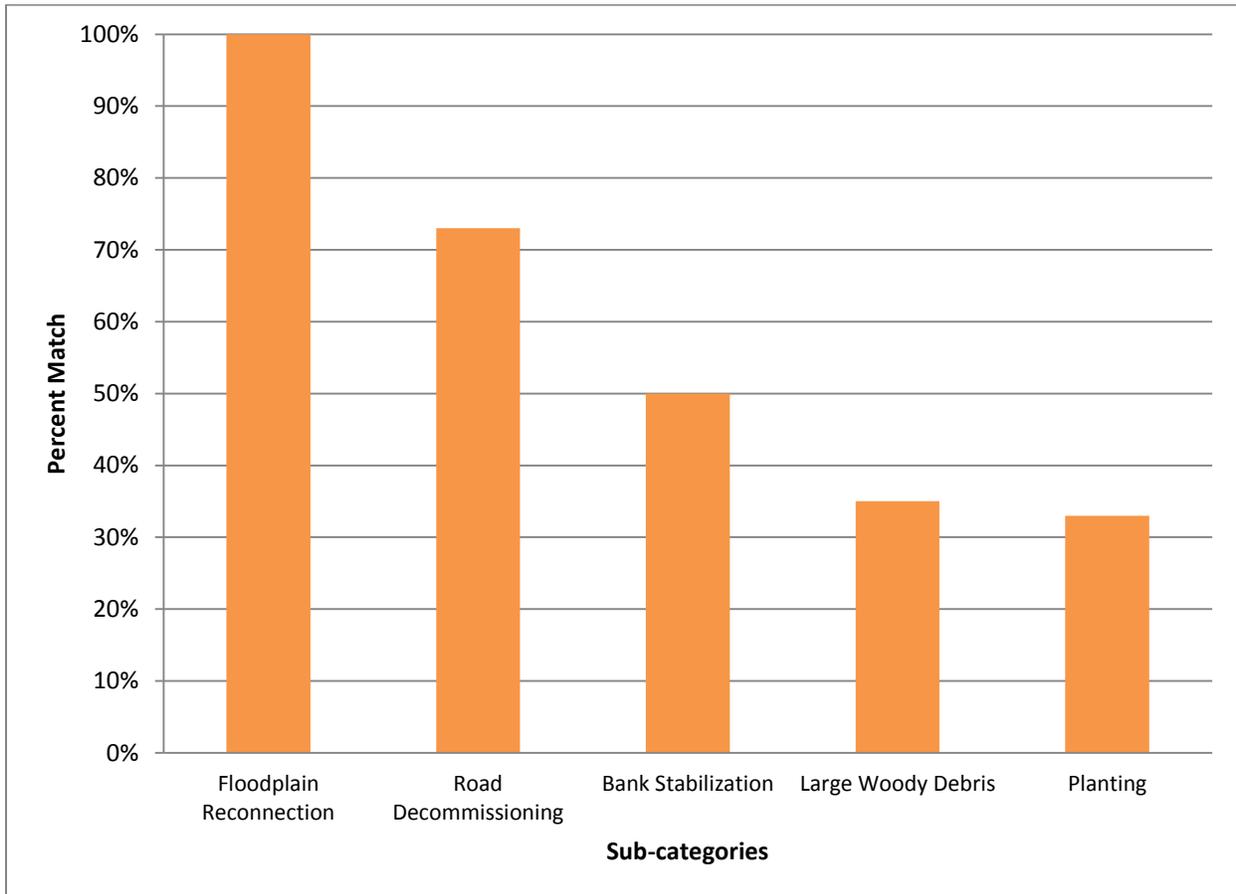
Table 4. Table of indicators showing the presence (1) and absence (0) of five selected sub-categories at mapped restoration work sites within 500 meters of CHaMP reaches and at observed CHaMP reaches during 2014 field visits.

SiteID	Floodplain Reconnection		Road Decommissioning		Bank Stabilization		Large Woody Debris		Planting	
	Mapped	Observed	Mapped	Observed	Mapped	Observed	Mapped	Observed	Mapped	Observed
CBW05583-013882	0	0	0	0	0	0	0	0	0	0
CBW05583-090282	0	0	0	0	0	1	1	0	1	0
CBW05583-092986	0	0	0	1	0	0	0	0	0	0
CBW05583-095642	0	0	0	0	0	0	0	0	0	0
CBW05583-108010	0	0	0	1	0	0	0	0	0	0
CBW05583-135615	0	0	0	0	0	1	0	1	0	0
CBW05583-138554	0	0	1	1	0	0	1	1	0	0
CBW05583-138666	0	0	0	0	0	0	0	0	0	0
CBW05583-142490	0	0	0	0	0	0	0	0	0	0
CBW05583-148970	0	0	0	1	0	0	1	1	1	1
CBW05583-149594	0	0	0	1	0	0	0	0	0	1
CBW05583-155818	0	0	0	0	0	0	0	0	0	1
CBW05583-199103	0	0	0	0	0	1	0	0	0	0
CBW05583-206314	0	0	0	0	0	0	0	0	0	0
CBW05583-217258	0	0	0	0	1	1	0	0	0	0
CBW05583-228666	0	0	0	0	0	0	0	0	0	0
CBW05583-235322	0	0	0	1	0	0	0	0	0	0
CBW05583-240730	0	0	0	0	0	0	0	0	0	0
CBW05583-252730	1	1	1	1	1	1	1	1	0	0
CBW05583-269114	0	0	1	1	0	0	1	0	0	0
CBW05583-275866	0	0	0	1	0	0	0	0	0	1
CBW05583-280042	1	1	1	1	1	0	1	1	1	0
CBW05583-288410	0	0	0	0	0	0	0	0	0	0
CBW05583-316330	0	0	0	0	0	0	1	0	1	1
CBW05583-321338	0	0	1	1	0	1	0	0	0	0
CBW05583-368042	0	0	0	0	0	1	0	0	0	0
CBW05583-382778	0	0	0	0	0	0	0	0	0	0
CBW05583-384154	0	0	0	0	0	0	0	1	0	0
CBW05583-405674	0	0	0	1	1	0	1	0	0	0
CBW05583-420954	0	0	0	0	0	1	0	0	0	1
CBW05583-430250	0	0	0	0	1	1	0	0	0	0
CBW05583-449626	0	0	1	0	0	0	1	1	0	0
CBW05583-456106	0	0	0	0	0	1	1	0	0	0
CBW05583-457530	0	0	1	1	1	0	1	0	0	0
CBW05583-480666	0	0	0	0	0	0	0	0	0	0
CBW05583-489882	0	0	0	0	0	0	0	0	0	1
CBW05583-490810	0	0	1	1	1	0	1	0	0	0
CBW05583-512938	0	0	0	0	0	0	0	1	0	1
CBW05583-514458	0	0	0	0	0	0	0	0	0	0
CBW05583-527786	0	0	1	0	0	1	0	0	0	0

SiteID	Floodplain Reconnection		Road Decommissioning		Bank Stabilization		Large Woody Debris		Planting	
	Mapped	Observed	Mapped	Observed	Mapped	Observed	Mapped	Observed	Mapped	Observed
DSGN4-000001	0	0	0	0	0	0	0	0	0	0
DSGN4-000006	0	0	0	1	0	0	0	0	0	0
DSGN4-000009	1	1	1	1	1	1	1	1	1	0
DSGN4-000010	0	0	1	0	0	0	1	0	0	0
DSGN4-000092	0	0	0	0	0	0	0	0	0	0
DSGN4-000094	0	0	1	1	0	0	0	1	0	0
DSGN4-000161	0	0	0	0	0	0	0	0	0	0
DSGN4-000168	0	0	0	0	0	0	0	0	0	0
DSGN4-000202	0	0	1	1	0	0	1	0	0	0
DSGN4-000204	0	0	1	0	0	1	1	0	0	0
DSGN4-000205	0	0	0	0	0	0	0	0	0	0
DSGN4-000213	0	1	0	0	0	0	0	1	0	0
DSGN4-000245	0	0	1	1	0	0	1	0	0	0
DSGN4-000277	0	0	0	1	0	0	0	1	1	0

The proportion of mapped restoration projects that were also observed during field visits was calculated for five selected sub-categories (Figure 3). The highest correspondence between mapped restoration versus observed was noted with floodplain restoration, where all three of the mapped projects were also detected in the field (100% correspondence). The next highest correspondence was noted for road decommissioning (73%), followed by bank stabilization (50%), large woody debris (35%), and plantings (33%). This outcome may be a result of certain types of restoration being more difficult to observe in the field. For example, a floodplain reconnection project is typically large in scope, contains features that are easily recognizable as human activity, and is therefore more likely to be identified as restoration by the field crew. Conversely, a riparian planting project may be more difficult to distinguish from natural vegetation recruitment unless field crews have specific knowledge of the site. The high correspondence for floodplain reconnections could also be the result of the small sample size, with only 3 of the 54 CHaMP sites visited in 2014 having that sub-category mapped. Sample sizes for the selected sub-categories are reported in Figure 3.

Figure 3. Bar graph showing percent of mapped projects also detected in the field. There were a total of 3 floodplain reconnections, 15 road decommissioning projects, 8 bank stabilization projects, 17 large woody debris additions, and 6 planting projects for analysis.



### c. Restoration intensity

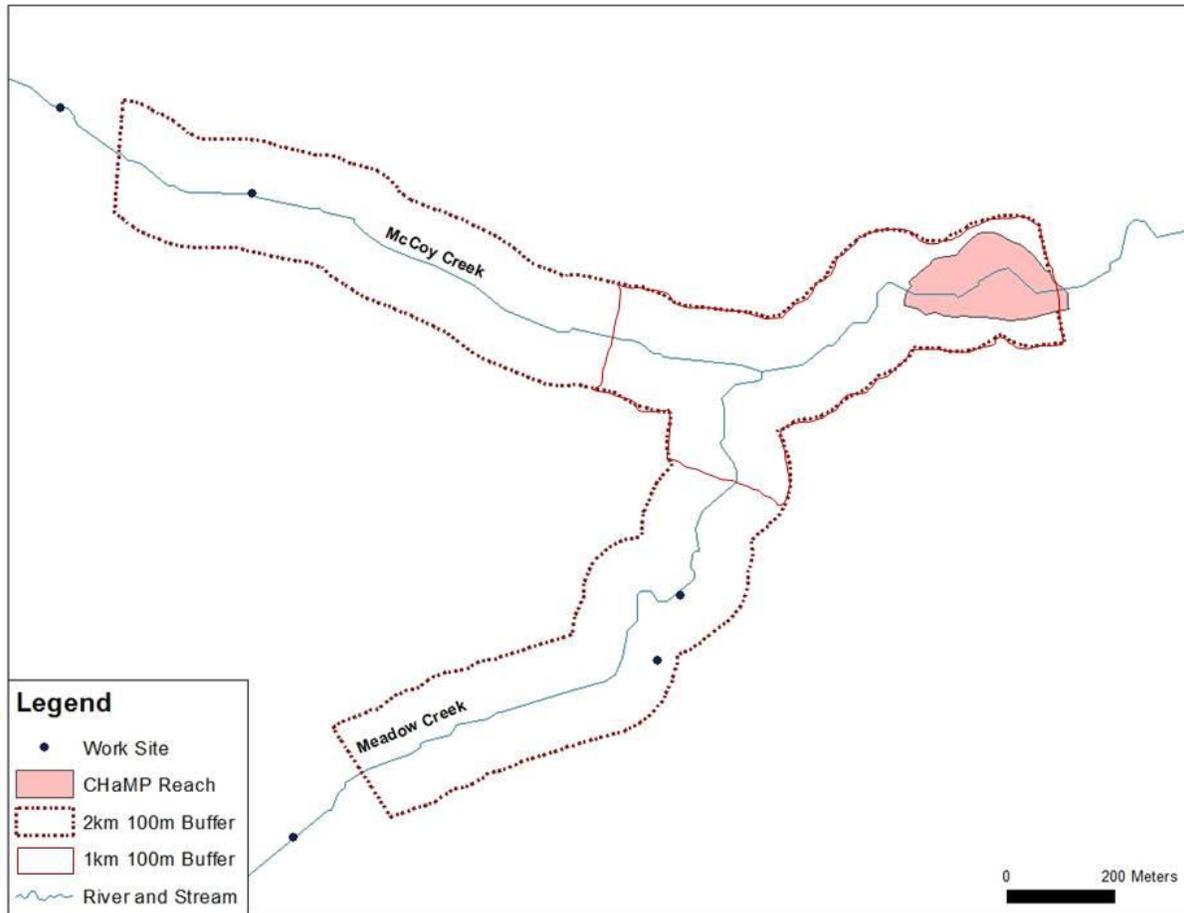
Site length was a metric reported in 95% of the work sites in the final data table. Stream length treated is derived from the reported length metrics for each work site, shown in Table 3 (ex. Miles Unblocked Stream or Miles Channel Reconfiguration). Site length is based on the largest reported length metric per work site, regardless of restoration type, therefore providing one measure of restoration intensity across most work sites. With few metrics reported consistently, this appears to be one of the only ways of assessing restoration intensity across the majority of work sites using the current data (Table 3).

## IV. Future Analyses

Using the restoration data table and associated products documented in this report, several future analyses are expected to provide insight on the relationship between restoration actions and fish habitat. In all cases, the goal of further analysis is to demonstrate empirical relationships between restoration intensity, instream and riparian metrics as measured in CHaMP surveys, and biotic indices such as juvenile Chinook rearing capacity or benthic macroinvertebrate indices.

For example, restoration activities are expected to occur in “syndromes,” with certain subcategories—such as large wood additions, riparian plantings, and riparian fencing—occurring simultaneously. Using cluster analysis (Madeira & Oliveira, 2004) of presence-absence of subcategories can help clarify which restoration actions typically co-occur. Work sites can be grouped according to similarity in their syndrome of restoration types and used to rate restoration intensity along with stream length treated, which in the case of intensity refers to the number or diversity of restoration actions at a site. There is also intention to use cluster analysis to help interpolate missing values of stream length treated in cases where those values were not reported.

Figure 4. Map of different buffer lengths above an example CHaMP reach, encompassing restoration work sites upstream.



It is also expected that stream restoration activities conducted nearby will have cumulative downstream effects on fish habitat. At any given CHaMP survey site, restoration activities may occur either immediately upstream or far up into the headwaters, which may in turn affect stream habitat conditions, depending on the intensity and proximity of restoration. Using several different buffer lengths (e.g., 100m, 200m, entire tributary, whole watershed) above each CHaMP site (Figure 4), alternative hypotheses regarding the effect of intensity and proximity of restoration activities on site-specific habitat conditions can be tested. These varying buffer lengths can be evaluated in combination with different restoration assessment methods in a model selection context (Burnham & Anderson, 2002) to help elucidate the effects of restoration on fish habitat.

Additional restoration metrics can be derived using tables of the expected effects of stream restoration sub-categories on stream and habitat function (Table 2) (Beechie, et al., 2013) and their expected relationship to NOAA's ecological concerns (National Oceanic and Atmospheric Administration, 2014). By combining a matrix of restoration subcategories by location with matrices of expected stream function or habitat improvement by subcategory—analogueous to trait-based analysis in community ecology (Legendre, Galzin, & Mireille, 1997)—restoration intensity can be characterized in terms of its

expected function (e.g., restoration of soil water holding capacity, or actions that provide direct cover for fish), rather than the title it has been given by project sponsors (e.g., large woody debris addition).

## V. Relevance of Internship to CRITFC Goals

This work is a starting point to better understand the effects of restoration on stream conditions, and the spatial extent of those effects. This project indirectly addresses CRITFC’s first goal of putting fish back in the rivers and protecting watersheds where fish live (Columbia River Inter-Tribal Fish Commission). Table 5 lists the products completed during this project that contributed to CRITFC goals.

**Table 5. Value-added products and services of internship. Appendix 4 defines the project task numbers included in the Value Added to Columbia Basin Fish Accords column.**

<b>Products</b>	<b>Description</b>	<b>Direct Benefits to Organization</b>	<b>Value Added to Columbia Basin Fish Accords</b>
Project Proposal	Outline of internship, presented to CRITFC staff	-Input on internship outcomes	
Restoration Data Table	Comprehensive data table of restoration work sites in the Upper Grande Ronde River watershed with accompanying project details	-Comprehensive account of restoration project data -Restoration assessment tool for improving salmon habitat	Monitoring Recovery Trends: project tasks 3-6
Restoration Assessment Field Checklist	Tool for assessing the function of different stream restoration project types in the field	-Joint use by CRITFC and ODFW -Form available for CRITC field crews and biologists -Ground truth of reported restoration	Monitoring Recovery Trends: project task 3
Restoration Work Sites Shapefile	Spatial data layer with all identified work site midpoints worked on between 1986-2014	-Analyze and display work sites spatially -Assessing restorations effect on habitat	Monitoring Recovery Trends: project tasks 3-6
Preliminary Analysis	Review of collected data and identification of patterns	-Foundation for trends, outcomes, and further analysis	Monitoring Recovery Trends: project tasks 3 & 4
Project Report	Report outlining the methods and results of this project	-Replicable methods -Interpretation of results -Starting point for restoration from landscape perspective	Monitoring Recovery Trends: project tasks 3-6

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## Appendix 1. Metadata on the restoration work sites data table.

	Definition	Data Type	Field Codes	Comments
CRITFCID	Unique CRITFC identifier given to each restoration project site.	text	CRITFC_XXXX, where XXXX is a number between 0001 and 4485	Identifiers ranges from CRITFC_0001 to CRITFC_4485, but are not in complete ascending order.
OneSite	Identifying if the project is comprised of one or multiple sites.	text	Y=yes (or only one site for specific project), N=no (or multiple sites for specific project)	
DataSrc	Data source	text	BLM=Bureau of Land Management, BPA=Bonneville Power Administration, CRITFC=Columbia River Inter-Tribal Fish Commission, CTUIR=Confederated Tribes of the Umatilla Indian Reservation, GRMW=Grande Ronde Model Watershed, ODFW=Oregon Department of Fish and Wildlife, OWEB=Oregon Watershed Enhancement Board, PCSRF=Pacific Coastal Salmon Recovery Fund, PNSHPD=Pacific Northwest Salmon Habitat Project Database, TFT=The Freshwater Trust, USFS=United States Forest Service	Project information coming from a certain data source in our data table doesn't indicate that the project information doesn't exist in another source.
ProjNum	Project number given by data source	text		Numerous project sites may be categorized by one of these project numbers.
OWRIObjID	Unique identifiers for project sites specifically from the Oregon Watershed Restoration Inventory.	text		These project come from OWEB
ProjTitl	Project title, as stated by each restoration project information source.	text		
Year	Year of project milestone	text	Years range from 1986 to 2033	Years can be singular, or within a defined range
YearType	Type of milestone the project year is describing.	text	Completed=year project was completed, Fiscal=year used for yearly financial statements, Initiated=year the project was started, Load=, Primary=year when most work was accomplished on the project, Review Cycle=, Term of Deal=, Treatment=year treatment was administered	
Grantee	Group or agency given grant funds to implement a restoration project.	text	BLM=Bureau of Land Management, Boise Cascades, BPA=Bonneville Power Administration, CBFWA=Columbia Basin Fish and Wildlife Authority, City of La Grande, DU=, ODFW=Oregon Department of Fish and Wildlife, La Grande RD=La Grande Ranger District, City of Union, Contractor= independent contractor, CTUIR= Confederated Tribes of the Umatilla Indian Reservation, DR Johnson, ODF Union Co= Oregon Department of Fish and Wildlife Union County, FSA Union Co= Farm Service Agency Union County, NRCS Union Co= Natural Resource Conservation Service Union County, Union SWCD= Union County Soil and Water Conservation District, FSA Wallowa Co= Farm Service Agency Wallowa County, NRCS Wallowa Co= Natural Resource Conservation Service Wallowa County, Wallowa SWCD= Wallowa County Soil and Water Conservation District, GRMWP= Grande Ronde Model Watershed Project, OWRD= Oregon Water Resource Department, USWCD= Union Soil and Water Conservation District, La Grande HS= La Grande High School, Nez Perce Tribe, NOAA= National Oceanic and Atmospheric Administration, NRCS= Natural Resource Conservation Service, ODA= Oregon Department of Agriculture, ODEQ= Oregon Department of Environmental Quality, ODF Union Co= Oregon Department of Forestry Union County, Private ind/bus= private industry or business, ODOT= Oregon Department of Transportation, OPRD= Oregon Parks and Recreation Department, OR Water Trust, OWHP= Oregon Watershed Health Program, OWRI= Oregon Watershed Restoration Inventory, REO=, TFT= The Freshwater Trust, Union Co NWC=, Union Co PW= Union County Public Works, UPWD=, USBR= United States Bureau of Reclamation, USFS= United States Forest Service, USWCD= Union Soil and Water Conservation District, Walla Walla RD= Walla Walla Ranger District	
ProjDesc	Project description	text		

DownLong	Downstream longitude in decimal degrees	1.0000000		precision varies from 5 to 7 decimal places
DownLat	Downstream latitude in decimal degrees	1.0000000		precision varies from 5 to 8 decimal places
UpLong	Upstream longitude in decimal degrees	1.0000000		precision varies from 5 to 7 decimal places
UpLat	Upstream latitude in decimal degrees	1.0000000		precision varies from 6 to 8 decimal places
Long	Longitude for center point of a restoration project site, in decimal degrees.	1.0000000		precision varies from 4 to 7 decimal places
Lat	Latitude for center point of a restoration project site, in decimal degrees.	1.0000000		precision varies from 4 to 8 decimal places
BPAContr	Bonneville Power Administration's contract numbers for project they fund.	text		
Tribal BiOp		1.0		
CTUIRprojects	Projects executed by the Confederated Tribes of the Umatilla Indian Reservation.	1.0	1= yes, project site completed by CTUIR, 0= no, project site not completed by CTUIR	
Beschta	Projects reported in Beschta, Platts, Kauffman, (1991), which reviewed restoration projects in the Grande Ronde and John Day river basins.	1.0	1= yes, project site in the report, 0= no, project site not in the report	
FPRemBar	FPRemBar= Fish Passage - Remove Barrier. Fish passage restoration activity type, specifically a barrier removal project.	1.0	1= yes, a barrier removal project site, 0= no, not a barrier removal project site	
FPDivScr	FPDivScr= Fish Passage - Diversion Screen. Fish passage restoration activity type, specifically a diversion screening project.	1.0	1= yes, a diversion screening project site, 0= no, not a diversion screening project site	
ISLWDAdd	ISLWDAdd= Instream - Large Woody Debris Addition. Instream restoration activity type, specifically a large woody debris addition project.	1.0	1= yes, a large woody debris addition project site, 0= no, not a large woody debris addition project site	
ISBldrAd	ISBldrAd= Instream - Boulder Addition. Instream restoration activity type, specifically a boulder addition project.	1.0	1= yes, a boulder addition project site, 0= no, not a boulder addition project site	
ISEngPol	ISEngPol= Instream - Engineered Pools. Instream restoration activity type, specifically an engineered pool project.	1.0	1= yes, an engineered pool project site, 0= no, not an engineered pool project site	
ISRmBkAr	ISRmBkAr= Instream - Remove Bank Armoring. Instream restoration activity type, specifically a bank armoring removal project.	1.0	1= yes, a bank armoring removal site, 0= no, not a bank armoring project site	
ISBnkStb	ISBnkStb= Instream - Bank Stabilization. Instream restoration activity type, specifically a bank stabilization project.	1.0	1= yes, a bank stabilization project site, 0= no, not a bank stabilization project site	
ISBvrAct	ISBvrAct= Instream - Beaver Activity. Instream restoration activity type, specifically a project that encourages beaver activity.	1.0	1= yes, a beaver activity project site, 0= no, not a beaver activity project site	
ISNutr	ISNutr= Instream - Nutrient. Instream restoration activity type, specifically a nutrient addition project.	1.0	1= yes, a nutrient addition project site, 0= no, not a nutrient addition project site	
OCFSdCnl	OCFSdCnl= Off Channel/Floodplain - Side Channel/Alcove Construction. Off channel/floodplain restoration activity type, specifically a side channel or alcove creation project.	1.0	1= yes, a side channel/alcove creation project site, 0= no, not a side channel/alcove creation project site	
OCFLVStb	OCFLVStb= Off Channel/Floodplain - Levee Set-Back or Removal. Off channel/floodplain restoration activity type, specifically a levee set-back or removal project.	1.0	1= yes, a levee set-back or removal project site, 0= no, not a levee set-back or removal project site	
OCFFldRn	OCFFldRn= Off Channel/Floodplain - Floodplain Reconnection or Creation. Off channel/floodplain restoration activity type, specifically a floodplain reconnection or creation project.	1.0	1= yes, a floodplain reconnection or creation project site, 0= no, not a floodplain reconnection or creation project site	
OCFWtRst	OCFWtRst= Off Channel/Floodplain - Wetland Restoration. Off channel/floodplain restoration activity type, specifically a wetland restoration project.	1.0	1= yes, a wetland restoration project site, 0= no, not a wetland restoration project site	
OCFRmdr	OCFRmdr= Off Channel/Floodplain - Remeandering. Off channel/floodplain restoration activity type, specifically a channel remeandering project.	1.0	1= yes, a remeandering project site, 0= no, not a remeandering project site	
OCFTmRf	OCFTmRf= Off Channel/Floodplain - Thermal Refugia. Off channel/floodplain restoration activity type, specifically a thermal refugia creation project.	1.0	1= yes, a thermal refugia project site, 0= no, not a thermal refugia project site	
RIFnc	RIFnc= Riparian Improvement - Installed Fencing. Riparian improvement restoration activity type, specifically a fencing project.	1.0	1= yes, a fencing project site, 0= no, not a fencing project site	
RIPInt	RIPInt= Riparian Improvement - Planting. Riparian improvement restoration activity type, specifically a planting project.	1.0	1= yes, a planting project site, 0= no, not a planting project site	
RInvsRm	RInvsRm= Riparian Improvement - Invasive Plant Removal. Riparian improvement restoration activity type, specifically an invasive plant removal project.	1.0	1= yes, an invasive plant removal project site, 0= no, not an invasive plant removal project site	

SRARdDcm	SRARdDcm= Sediment Reduction/Addition - Road Decommissioning. Sediment Reduction/Addition restoration activity type, specifically a road decommissioning project.	1.0	1= yes, a road decommissioning project site, 0= no, not a road decommissioning project site	
SRAIprAg	SRAIprAg= Sediment Reduction/Addition - Improving Agricultural/Forestry Practices. Sediment Reduction/Addition restoration activity type, specifically an improved agricultural or forestry practices project.	1.0	1= yes, an improving agricultural/forestry practices project site, 0= no, not an improving agricultural/forestry practices project site	
SRASpnGr	SRASpnGr= Sediment Reduction/Addition - Spawning Gravel Addition. Sediment Reduction/Addition restoration activity type, specifically a spawning gravel addition project.	1.0	1= yes, a spawning gravel addition project site, 0= no, not a spawning gravel addition project site	
APLndAqs	APLndAqs= Acquisition & Protection - Land Acquisition, Lease, or Easement. Acquisition and protection restoration activity type, specifically a land acquisition, lease, or easement project.	1.0	1= yes, a land acquisition, lease, or easement project site, 0= no, not a land acquisition, lease, or easement project site	
FAWtrLs	FAWtrLs= Flow Augmentation - Water Lease or Purchase. Flow augmentation restoration activity type, specifically a water lease or purchase project.	1.0	1= yes, a water lease or purchase project site, 0= no, not a water lease or purchase project site	
FAIrgImp	FAIrgImp= Flow Augmentation - Irrigation Improvements. Flow augmentation restoration activity type, specifically a irrigation improvement project.	1.0	1= yes, an irrigation improvement project site, 0= no, not an irrigation improvement project site	
FAMtgPt	FAMtgPt= Flow Augmentation - Mitigate Point Source Impacts. Flow augmentation restoration activity type, specifically a project that mitigates point source impacts.	1.0	1= yes, a mitigate point source impacts project site, 0= no, not a mitigate point source impacts project site	
Cat_Totl	Total number of sub-categories present at each project site.	1.0	Sub-category totals range from 0 to 12	
RTRemBar	RTRemBar= Response Time - Remove Barrier. A filter displaying barrier removal projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive barrier removal project site, 1= active barrier removal project site with a response time of 1-5 years	Response times based on Beechie, et al. (2013)
RTDivScr	RTDivScr= Response Time - Diversion Screen. A filter displaying diversion screening projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive diversion screening project site, 1= active diversion screening project site with a response time of 1-5 years	Response times based on Beechie, et al. (2013)
RTLWDAdd	RTLWDAdd= Response Time - Large Woody Debris Addition. A filter displaying large woody debris addition projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive large woody debris addition project site, 1= active large woody debris addition project site with a response time of 1-5 years	Response times based on Beechie, et al. (2013)
RTBldrAd	RTBldrAd= Response Time - Boulder Addition. A filter displaying boulder addition projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive boulder addition project site, 1= active boulder addition project site with a response time of 1-5 years	Response times based on Beechie, et al. (2013)
RTEngPol	RTEngPol= Response Time - Engineered Pools. A filter displaying engineered pool projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive engineered pool project site, 1= active engineered pool project site with a response time of 1-5 years	Response times based on Beechie, et al. (2013)
RTRmBkAr	RTRmBkAr= Response Time - Modification/Removal of Bank Armoring. A filter displaying modification/removal of bank armoring projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive modification/removal of bank armoring project site, 3= active modification/removal of bank armoring project site with a response time of 5-20 years	Response times based on Beechie, et al. (2013)
RTBnkStb	RTBnkStb= Response Time - Bank Stabilization. A filter displaying bank stabilization projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive bank stabilization project site, 1= active bank stabilization project site with a response time of 1-5 years	Response times based on Beechie, et al. (2013)
RTBvrAct	RTBvrAct= Response Time - Beaver Activity. A filter displaying beaver activity promotion projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive beaver activity project site, 1= active beaver activity project site with a response time of 1-5 years	Response times based on Beechie, et al. (2013)
RTNutr	RTNutr= Response Time - Nutrient Addition. A filter displaying nutrient addition projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive nutrient addition project site, 1= active nutrient addition project site with a response time of 1-5 years	Response times based on Beechie, et al. (2013)
RTSdCnl	RTSdCnl= Response Time - Side-Channel/Alcove Construction . A filter displaying side-channel/alcove construction projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive side-channel/alcove construction project site, 1= active side-channel/alcove construction project site with a response time of 1-5 years	Response times based on Beechie, et al. (2013)
RTLvStb	RTLvStb= Response Time - Levee Set-back or Removal. A filter displaying levee set-back or removal projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive levee set-back or removal project site, 3= active levee set-back or removal project site with a response time of 5-20 years	Response times based on Beechie, et al. (2013)
RTFldRn	RTFldRn= Response Time - Floodplain Reconnection or Creation. A filter displaying floodplain reconnection or creation projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive floodplain reconnection or creation project site, 1= active floodplain reconnection or creation project with a response time of 1-5 years	Response times based on Beechie, et al. (2013)

RTWtrSt	RTWtrSt= Response Time - Wetland Restoration. A filter displaying wetland restoration projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive wetland restoration project site, 3= active wetland restoration project site with a response time of 5-20 years	Response times based on Beechie, et al. (2013)
RTRmDr	RTRmDr= Response Time - Remeandering. A filter displaying remeandering projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive remeandering project site, 1= active remeandering project site with a response time of 1-5 years	Response times based on Beechie, et al. (2013)
RTTrmRf	RTTrmRf= Response Time - Thermal Refugia. A filter displaying thermal refugia projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive thermal refugia project site, 3= active thermal refugia project site with a response time of 5-20 years	Response times based on Beechie, et al. (2013)
RTFnc	RTFnc= Response Time - Installed Fencing. A filter displaying fencing projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive fencing project site, 5= active fencing project site with a response time of >50 years	Response times based on Beechie, et al. (2013)
RTPlnt	RTPlnt= Response Time - Planting. A filter displaying planting projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive planting project site, 5= active planting project site with a response time of >50 years	Response times based on Beechie, et al. (2013)
RTInvsRm	RTInvsRm= Response Time - Invasive Plant Removal. A filter displaying invasive plant removal projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive invasive plant removal project site, 1= active invasive plant removal project site with a response time of 1-5 years	Response times based on Beechie, et al. (2013)
RTRdDcm	RTRdDcm= Response Time - Road Decommissioning. A filter displaying road decommissioning projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive road decommissioning project site, 3= active road decommissioning project site with a response time of 5-20 years	Response times based on Beechie, et al. (2013)
RTIprAg	RTIprAg= Response Time - Improved Agricultural/Forestry Practices. A filter displaying improved agricultural/forestry practices projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive improved agricultural/forestry practice project site, 3= active improved agricultural/forestry practice project site with a response time of 5-20 years	Response times based on Beechie, et al. (2013)
RTSpnGr	RTSpnGr= Response Time - Spawning Gravel Addition. A filter displaying spawning gravel addition projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive spawning gravel addition project site, 1= active spawning gravel addition project site with a response time of 1-5 years	Response times based on Beechie, et al. (2013)
RTLndAqs	RTLndAqs= Response Time - Land Acquisition, Lease, or Easement. A filter displaying land acquisition, lease, or easement projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive land acquisition, lease, or easement project site, 5= active land acquisition, lease, or easement project site with a response time of >50 years	Response times based on Beechie, et al. (2013)
RTWtrLs	RTWtrLs= Response Time - Water Lease or Purchase. A filter displaying water lease or purchase projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive water lease or purchase project site, 1= active water lease or purchase project site with a response time of 1-5 years	Response times based on Beechie, et al. (2013)
RTIrgImp	RTIrgImp= Response Time - Irrigation Improvement. A filter displaying irrigation improvement projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive irrigation improvement project site, 1= active irrigation improvement project site with a response time of 1-5 years	Response times based on Beechie, et al. (2013)
RTMtGpt	RTMtGpt= Response Time - Mitigate Point Source Impacts. A filter displaying mitigation of point source impacts projects having a current effect on ecosystems, based on its response time.	1.0	0= inactive mitigate point source impacts project site, 1= active mitigate point source impacts project site with a response time of 1-5 years	Response times based on Beechie, et al. (2013)
RT_Totl	Total number of active sub-categories present at each project site based on the response time alone.	1.0	Sub-category totals range from 0 to 13	
LGRemBar	LGRemBar= Longevity - Remove Barrier. A filter displaying barrier removal projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive barrier removal project site, 1= active barrier removal project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGDivScr	LGDivScr= Longevity - Diversion Screening. A filter displaying diversion screening projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive diversion screening project site, 1= active diversion screening project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGLWDAdd	LGLWDAdd= Longevity - Large Woody Debris Addition. A filter displaying large woody debris addition projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive large woody debris addition project site, 1= active large woody debris addition project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGBldrAd	LGBldrAd= Longevity - Boulder Addition. A filter displaying boulder addition projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive boulder addition project site, 1= active boulder addition project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGEngPol	LGEngPol= Longevity - Engineered Pools. A filter displaying engineered pool projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive engineered pool project site, 1= active engineered pool project site, based on response time and longevity	Response times based on Beechie, et al. (2013)

LGRmBkAr	LGRmBkAr= Longevity - Modification/Removal of Bank Armoring. A filter displaying modification/removal of bank armoring projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive modified/removal of bank armoring project site, 1= active modified/removal of bank armoring project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGBnkStb	LGBnkStb= Longevity - Bank Stabilization. A filter displaying bank stabilization projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive bank stabilization project site, 1= active bank stabilization project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGBvrAct	LGBvrAct= Longevity - Beaver Activity. A filter displaying beaver activity projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive beaver activity project site, 1= active beaver activity project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGNutr	LGNutr= Longevity - Nutrient Additions. A filter displaying nutrient addition projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive nutrient addition project site, 1= active nutrient addition project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGSdCnl	LGSdCnl= Longevity - Side-Channel/Alcove Construction. A filter displaying side-channel/alcove construction projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive side-channel/alcove construction project site, 1= active side-channel/alcove construction project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGLvStb	LGLvStb= Longevity - Levee Set-Back or Removal. A filter displaying levee set-back or removal projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive levee set-back or removal project site, 1= active levee set-back or removal project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGFldRn	LGFldRn= Longevity - Floodplain Reconnection or Creation. A filter displaying floodplain reconnection or creation projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive floodplain reconnection or creation project site, 1= active floodplain reconnection or creation project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGWtRst	LGWtRst= Longevity - Wetland Restoration. A filter displaying wetland restoration projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive wetland restoration project site, 1= active wetland restoration project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGRmDr	LGRmDr= Longevity - Remeandering. A filter displaying remeandering projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive remeandering project site, 1= active remeandering project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGTmRf	LGTmRf= Longevity - Thermal Refugia. A filter displaying thermal refugia projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive thermal refugia project site, 1= active thermal refugia project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGFnc	LGFnc= Longevity - Installed Fencing. A filter displaying fencing projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive fencing project site, 1= active fencing project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGPLnt	LGPLnt= Longevity - Planting. A filter displaying planting projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive planting project site, 1= active planting project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGINvsRm	LGINvsRm= Longevity - Invasive Plant Removal. A filter displaying invasive plant removal projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive invasive plant removal project site, 1= active invasive plant removal project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGRdDcm	LGRdDcm= Longevity - Road Decommissioning. A filter displaying road decommissioning projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive road decommissioning project site, 1= active road decommissioning project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGIprAg	LGIprAg= Longevity - Improved Agricultural/Forestry Practices. A filter displaying improved agriculture/forestry practices projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive improved agricultural/forestry practices project site, 1= active improved agricultural/forestry practices project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGSpnGr	LGSpnGr= Longevity - Spawning Gravel Addition. A filter displaying spawning gravel addition projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive spawning gravel addition project site, 1= active spawning gravel addition project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGLndAqs	LGLndAqs= Longevity - Land Acquisition, Lease, or Easement. A filter displaying land acquisition, lease, or easement projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive land acquisition, lease, or easement project site, 1= active land acquisition, lease, or easement project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGWtrLs	LGWtrLs= Longevity - Water Lease or Purchase. A filter displaying water lease or purchase projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive water lease or purchase project site, 1= active water lease or purchase project site, based on response time and longevity	Response times based on Beechie, et al. (2013)

LGirgImp	LGirgImp= Longevity - Irrigation Improvement. A filter displaying irrigation improvement projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive irrigation improvement project site, 1= active irrigation improvement project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LGMtgPt	LGMtgPt= Longevity - Mitigate Point Source Impacts. A filter displaying mitigate point source impacts projects having a current effect on ecosystems, based on its response time and longevity.	1.0	0= inactive mitigate point source impacts project site, 1= active mitigate point source impacts project site, based on response time and longevity	Response times based on Beechie, et al. (2013)
LG_Totl	Total number of active sub-categories present at each project site based on the response time and longevity of the project type.	1.0		
CFSDvrt	Cubic feet per second of water diverted back into a stream.	1.00		precision varies from 0 to 2 decimal places
MlsUnblkSt	Miles of unblocked stream due to the removal of a fish passage barrier.	1.00		precision varies from 0 to 3 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
NPsglmpv	Number of fish passage improvements accomplished.	1.00		a half project is included due to the equal splitting of project metrics when only 1 measurement is reported between multiple sites, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
FishPass	Fish passage notes	1.00		
LogWeirs	The number of installed log weirs.	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
MlsLWD	Miles of large woody debris installed.	1.00		precision varies from 0 to 3 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcrsLWD	Acres of large woody debris installed.	1.00		precision varies from 0 to 1 decimal place, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
NLgPcs	The number of log pieces installed.	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
NLgjmStrct	Number of logjam structures.	1.00		partial projects are included due to the equal splitting of project metrics when only 1 measurement is reported between multiple sites, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
MlsStbkStb	Miles of streambank stabilization installed using non-planting methods (ex. rip rap).	1.00		precision varies from 0 to 7 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcrStbkStb	Acres of streambank stabilization using non-planting methods (ex. rip rap).	1.00		precision varies from 0 to 2 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement

JtsBrbs	Number of jetties and barbs installed.	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
RckWrsCrsv	Number of rock weirs and/or cross veins installed.	1.00		
BioEngNote	Bioengineering notes, explaining construction taking place at restoration sites.	text		
MlsBldrs	Number of miles of boulders installed.	1.00		precision varies from 1 to 3 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcrsBldrs	acres of boulders installed.	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
NBldrStrct	Number of boulder structures installed.	1.00		partial projects are included due to the equal splitting of project metrics when only 1 measurement is reported between multiple sites, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
Bldrs	Number of boulders installed.	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
NPlsCrtcd	Number of pools created.	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcrsRprnCr	Acres of riparian habitat created.	1.00		
MlsDkRmvl	Miles of dike removal or modification.	1.00		precision varies from 0 to 2 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
MlsFldpln	Miles of floodplain restored.	1.00		precision varies from 0 to 2 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcFldplnRs	Acres of floodplain restored.	1.00		precision varies from 0 to 2 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
FldplnPnds	Number of floodplain ponds installed.	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcrsChnlRc	Acres of channel reconfiguration.	1.00		precision varies from 0 to 1 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement

MlsChnlRcn	Miles of channel reconfiguration.	1.00		precision varies from 0 to 3 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
MlsMnChnCr	Miles of main channel created.	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcrsSdChnl	Acres of side channel created.	1.00		precision varies from 0 to 2 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
MlsSdChnl	Miles of side channel created.	1.00		precision varies from 0 to 7 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
BkwrAlcFt	Backwater alcoves created in feet.	1.00		
NwSpngChFt	New spring/tributary channels in feet.	1.00		
AcrsWthbRs	Acres of wetland habitat restored	1.00		precision varies from 0 to 2 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
StrmMlsFnc	Stream miles fenced.	1.00		precision varies from 0 to 6 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
PlntMlsFnc	Planting miles fenced.	1.00		precision varies from 0 to 2 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
UplnMlsFnc	Upland miles fenced.	1.00		precision varies from 0 to 1 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AveBfWdtFn	Average buffer width of fencing project.	1.00		
RpAcrPrtFn	Riparian acres protected by fencing project.	1.00		precision varies from 0 to 2 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
UpAcrPrtFn	Upland acres protected by fencing.	1.00		precision varies from 0 to 2 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcrWtlPrFn	Acres of wetland habitat protected by fencing project.	1.00		precision varies from 0 to 1 decimal places
X_Fnc	The number of cross fences installed.	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
MlsRpUpXFn	Stream miles riparian/upland benefiting from cross fencing.	1.00		precision varies from 0 to 2 decimal places

AcrRpUpXFn	Acres riparian/upland benefiting from cross fencing	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
NPlntsPlnt	Number of plants planted	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
RprnMlsPln	Riparian miles planted and/or seeded	1.00		precision varies from 0 to 3 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcrsRprnPl	Acres riparian planted and/or seeded	1.00		precision varies from 0 to 2 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
UpldMlsPln	Upland miles planted and/or seeded	1.00		precision varies from 0 to 1 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcrsUpPlnt	Acres Upland Planted and/or Seeded	1.00		precision varies from 0 to 1 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
WtldAcrPS	Wetland acres planted and/or seeded	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
SdngLBS	Seeding in pounds	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
SdgRshMTFt	Sedge/rush mats in feet	1.00		
MlsUpInvs	Miles Upland Invasive Control	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
MlsRprnInv	Miles Riparian Invasive Control	1.00		precision varies from 0 to 3 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcrsRprnIn	Acres Riparian Invasive Control	1.00		precision varies from 0 to 3 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcrsUpInvs	Acres Upland Invasive Control	1.00		precision varies from 0 to 3 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement

FtAvBfWdRd	Feet Average Buffer Width Road Obliteration	1.00		
MlsTrlRctr	Miles of Trail/Road Recontoured/Removed	1.00		precision varies from 0 to 4 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
MlsTrlRcUp	Miles Trail/Road Recontoured/Removed Upland	1.00		
AcrsRdOblt	Acres road obliterated	1.00		precision varies from 0 to 2 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcrsImprAg	Acres improved agriculture	1.00		precision varies from 0 to 6 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
MlsTrtSpwn	Miles treated spawning gravel	1.00		precision varies from 2 to 3 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcrsAqstLE	Acres of acquisition, lease, or easement	1.00		precision varies from 0 to 1 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
StrmMlsAcq	Stream miles of acquisition, lease, or easement	1.00		precision varies from 0 to 3 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
YrsOutAcq	Years out acquisition, lease, or easement	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
CFSPrchsd	CFS purchased or leased	1.00		precision varies from 1 to 3 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcrsAqWtrL	Acres of acquisition, lease, or easement	1.00		precision varies from 0 to 2 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
InstrmDts	Instream dates of water acquisition, lease, or easement	text		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
MlsImprIrg	Miles improved irrigation	1.00		precision varies from 2 to 3 decimal places
AcrlmprIrg	Acres improved irrigation	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement

CFSConserv	Cubic feet per second of water flow conserved	1.00		
MlsTxcClnp	Miles toxic cleanup	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AcresTxcCln	Acres toxic cleanup	1.00		nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement
AltWtrSrcs	Number of alternative water source development	1.00		partial projects are included due to the equal splitting of project metrics when only 1 measurement is reported between multiple sites
AcresStplRh	Acres stockpile rehabilitation	1.00		flattening of old gold mining dredge piles, constricting the stream channel
StLgthMls	Site length miles	1.00		precision varies from 0 to 6 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement, site length is the longest reported metric measurement for a restoration project site
StAcres	Site acres	1.00		precision varies from 0 to 9 decimal places, nulls are included when the sub-category corresponding to this metric was executed without reporting this measurement, site area is the largest reported metric measurement for a restoration project site
TrtmtTyp	Treatment type	text	Treatment Codes: 1 = Upland/Timber Management, 2 = Grazing Management, 3 = Off-Channel Water Developments, 4 = Riparian Exclosure Fences, 5 = Plantings, 6 = Instream Habitat Structures, 7 = Channel Stability-Lateral, 8 = Channel Stability-Vertical, 9 = Meander Reconstruction, Bioengineering, 10 = Floodplain Access, 11 = Floodplain/Wetland Connectivity, 12 = Channel Relocation, 13 = Fish Passage, 14 = Flow	information came from ODFW's Grand Ronde Fish Habitat Database
WtrGps	Number of water gaps	1.00		information came from ODFW's Grand Ronde Fish Habitat Database
ImplmCmnts	Implementation comments	text		information came from ODFW's Grand Ronde Fish Habitat Database
FncMntFt	Fence maintenance in feet	1.00		precision varies from 0 to 1 decimal places, information came from ODFW's Grand Ronde Fish Habitat Database
WgMaint	Number of water gap maintenance projects	1.00		information came from ODFW's Grand Ronde Fish Habitat Database
InstrmMnt	Instream maintenance	text		descriptions of instream project maintenance types, information came from ODFW's Grand Ronde Fish Habitat Database
MntCmnts	Maintenance comments	text		information came from ODFW's Grand Ronde Fish Habitat Database

TotlPPT	Number of total photopoints	1.00		information came from ODFW's Grand Ronde Fish Habitat Database
ActvPPT	Number of active photopoints	1.00		information came from ODFW's Grand Ronde Fish Habitat Database
PPEstbDt	Photopoint establishment date	text		information came from ODFW's Grand Ronde Fish Habitat Database
ShootDate	Shoot date	text		information came from ODFW's Grand Ronde Fish Habitat Database
NmbrThrms	Number of thermographs created	1.00		information came from ODFW's Grand Ronde Fish Habitat Database
RcrdngIntv	Recording interval in hours	text		information came from ODFW's Grand Ronde Fish Habitat Database
DeplmtProd	Deployment period	text		information came from ODFW's Grand Ronde Fish Habitat Database
HabtTrnsN	Habitat transects number	1.00		information came from ODFW's Grand Ronde Fish Habitat Database
HabTrnDtEs	Habitat transects date established	text		information came from ODFW's Grand Ronde Fish Habitat Database
HabTrnDtRe	Habitat transects date repeated	text		information came from ODFW's Grand Ronde Fish Habitat Database
StrmSrvy	Stream surveys notes	text		information came from ODFW's Grand Ronde Fish Habitat Database
RsgnRfrExs	Rosgen reference and existing notes	text		information came from ODFW's Grand Ronde Fish Habitat Database
GPSSurvey	GPS survey notes	text		information came from ODFW's Grand Ronde Fish Habitat Database
BnkStbCvr	Bank stability, cover notes	text		information came from ODFW's Grand Ronde Fish Habitat Database
GrndwtrWls	Groundwater well notes	text		information came from ODFW's Grand Ronde Fish Habitat Database
PlntSrvys	Plant survey notes	text		information came from ODFW's Grand Ronde Fish Habitat Database
LrgWdPICTs	Large wood, pool count notes	text		information came from ODFW's Grand Ronde Fish Habitat Database
RbStSGS	Rainbow steelhead spawning ground survey notes	text		information came from ODFW's Grand Ronde Fish Habitat Database
FshSrvys	Fish survey notes	text		information came from ODFW's Grand Ronde Fish Habitat Database
OtherME	Other monitoring and evaluation notes	text		information came from ODFW's Grand Ronde Fish Habitat Database
MECmnts	Monitoring and evaluation comments	text		information came from ODFW's Grand Ronde Fish Habitat Database
Basin	Stream basin	text	UGR = Upper Grande Ronde	information came from ODFW's Grand Ronde Fish Habitat Database

County	County	text	Union = Union County, Oregon	information came from ODFW's Grand Ronde Fish Habitat Database
ODFWFshDst	Oregon department of fish and wildlife fish district	text	La Grande	information came from ODFW's Grand Ronde Fish Habitat Database
Notes	Additional project site notes	text		

## Appendix 2. Workflow outlining steps taken to create restoration work sites data table (pathways from local drive).

- Conducted research on restoration assessment methods prior to data gathering, selecting Bonneville Power Administration's (BPA) Action Effectiveness Monitoring (AEM) program as a framework. AEM uses a variety of restoration actions and sub-categories to describe restoration types, which were to be identified as absent or present in restoration projects having taken place in the Upper Grande Ronde and Catherine Creek watersheds.
- Developed Restoration Project Information Sources document identifying stream restoration project information for the Upper Grande Ronde and Catherine Creek watersheds.
  - Document found here: C:\Users\beng\Documents\Greg's Docs\Restoration Project Information Sources
  - Document logs source/database, # of projects, recorded since date, URL, agency, contact, phone #, email, & notes
  - Presented project to Restoration Atlas group, providing additional sources of restoration project information.
  - Presented proposal to project committee, gaining initial feedback and sources of data.
- Collected all available information pertaining to restoration projects in the study area, including spreadsheets, project layers, and geodatabases and placed C:\Users\beng\Documents\ArcGIS\Layers\Unaltered\_Project\_Layers
  - Copied data for editing and placed C:\Users\beng\Documents\ArcGIS.
  - Added copied project layers to a working map for data comparison/editing
  - Removed projects outside of AOI.
- Contacted agencies who work/may work in the study area for additional project information not readily available.
- Created project data table C:\Users\beng\Documents\Greg's Docs\Restoration Projects Attributes Table (previous name for restoration work sites data table).
  - Used identify tool in ArcGIS to check for project number repetition if multiple projects appeared in same area. If not applicable, looked for similar project description and year completed to confirm same project displayed multiple times.
  - Used available project reports to confirm multiple displays of same project recorded by different layer sources.
  - Went through projects in order displayed in Restoration Projects Attributes Table, highlighted project on map, clicked point with select feature tool to check for multiple treatments in the same location, removed repeat project reports and combined metrics reported by different agencies, leaving 1 row per site in the project spreadsheet.
  - Combined project data separated by year into 1 row.
  - Recorded info on number of sites, project ID, project name, year, data source, grantee, project description, and location.
  - Identified actions and sub-categories each project addresses, showing if each is addressed by using a 0 for no and a 1 for yes.
  - Recorded all available project metrics into the Restoration Projects Attributes Table, adding additional columns as new metrics were reported.
- Found midpoint locations using visual estimates and the GR Mixed Hydro stream layer for projects not already represented by a single point.
- Saved attribute table C:\Users\beng\Documents\Greg's Docs\Restoration Projects Database\Restoration\_Projects\_Attributes\_Table\_17Sep2014

- Updated column headers to accommodate data transfer to ArcGIS.
  - Reduce titles to 10 characters with no symbols or spaces.
- Merged metrics represented in multiple columns
  - Verify new title for metric accurately accounts for what it's representing.
- Saved C:\Users\beng\Documents\Greg's Docs\Restoration Projects Database\Restoration\_Projects\_Attributes\_Table\_24Sep2014.
- Added unique CRITFC ID to each project site
- Created new tab in spreadsheet, labeled SubCat\_Dictionary
  - List of attribute and sub-category codes used in Restoration\_Projects\_Attributes\_Table with full descriptions of their meaning.
- Created new tab in spreadsheet, labeled Metrics\_by\_SubCat
  - Starting from the left hand column, Action, Sub-Category, Metric, Data Type, and Code are listed
  - Metrics are sorted first by Action, and then by Sub-Category, showing what measurement represents what restoration Actions and Sub-Categories.
  - Developed metric codes are clarified, listing what each code represents
  - Metrics reported but not representative of a certain Action or Sub-Category are clarified separately
- Saved C:\Users\beng\Documents\Greg's Docs\Restoration Projects Database\Restoration\_Projects\_Attributes\_Table\_25Sep2014
- Recorded nulls into cells not reporting a metric that could have been reported.
- Filled blank cells with 0s
- Saved C:\Users\beng\Documents\Greg's Docs\Restoration Projects Database\Restoration\_Projects\_Attributes\_Table\_29Sep2014.
- Deleted cells with over 255 characters for transfer to ArcGIS, adding the statement "refer to original" to those cells.
- Saved C:\Users\beng\Documents\Greg's Docs\Restoration Projects Database\Restoration\_Projects\_Attributes\_Table\_30Sep2014.
- Further combination of metrics for simplification of project data.
  - Created Restoration\_Projects\_Attributes\_Table\_6Oct2014 and Restoration\_Projects\_Attributes\_Table\_29Oct2014
    - The October 6th document features more original reported metrics left intact, while the October 29<sup>th</sup> document features a more aggressive simplification and combination of metrics.
  - Meeting with project committee confirmed use of Restoration\_Projects\_Attributes\_Table\_29Oct2014 as a better choice moving forward.
  - Miles improved stream complexity combined with miles of large woody debris; rock riprap in feet, root wad revetments in feet, bioengineering in feet, rock grade control structures, shaping and seeding, contour/stabilize/plant, rock vortex weirs, rock barbs, log revetment, repair/reconstruct road, erosion control mats, and sediment trapping were added to miles streambank stabilization; miles main channel remeandered was added to miles channel reconfiguration; riparian miles planted, riparian miles planted and seeded, and riparian miles seeded were added to riparian miles planted and/or seeded; riparian acres planted, riparian acres planted and seeded, and riparian acres seeded were added to riparian acres planted and/or seeded; acres upland planted, acres upland planted and seeded, and acres upland seeded were added to acres upland planted and/or seeded; miles upland planted, miles upland planted and seeded, and

miles upland seeded were added to miles upland planted and/or seeded; dike, road, RR removal in feet was added to miles of trail/road recontoured/removed; acres retired agriculture was added to acres improved agriculture.

- Specified what each project year represents
- Added Response Time and Longevity columns into projects spreadsheet, using time frames from Benefits of Tributary Habitat Improvement in the Columbia River Basin Results of Research, Monitoring and Evaluation, 2007-2012
  - Response times are: 1=1-5 years, 3=5-20 years, 5=>50 years
  - Longevity times are: 1=<10 years, 3=10-50 years, 5=>50 years
  - Each project gets a number for Response and Longevity in connection to its recorded date (ex. project completed in 2013, Response = 1 since it's been between 1 & 5 years from the project date till today, using January 1 2015, and Longevity = 1 since our project is less than 10 years old).
- Formulated Response and Longevity matrices to filter project sub-categories not yet showing a biologic response, or that have become older than the duration that type of project lasts.
  - Starting with a Response matrix, used an If AND OR formula to keep sub-categories at should be showing some response
    - If Response Time (for the project) = 1, then include sub-categories with a 1 rating. If Response Time = 3, then include sub-categories with a 1 or a 3 rating, if Response Time = 5, then include sub-categories with a 1, 3, or 5 rating.
    - Each sub-category has a different formula based on what its Response Time is.
    - Example formula is =IF(AND(U4412=1,OR(I4412=1,I4412=3,I4412=5)),1,0)
      - States that the sub-category needs to be present in the project and if the response time equals 1, 3, or 5, then that cell gets a 1 (sub-category response =1), otherwise it gets a 0
  - Used another IF AND OR formula to further filter project sub-categories based on their Longevity
    - If Longevity (for the project) =1, include all sub-categories, if Longevity = 3, remove sub-categories with a 1 for Longevity, if Longevity =5, remove sub-categories with a 1 or 3 for Longevity.
    - Each sub-category has a different formula based on what its Longevity Time is.
    - Example formula is =IF(AND(AU4425>0,I4425<6),1,0)
      - States that the referenced Response cell must be over 0 and that the Longevity column cell must be something below 6 (so 1, 3, or 5), to get a 1, signifying that this sub-category should be having an effect on the environment, and if these rules aren't met it gets a 0
- Saved C:\Users\beng\Documents\Greg's Docs\Restoration Projects Database\Restoration\_Projects\_Attributes\_Table\_4Dec2014
- Distributed reported metrics evenly through projects with multiple sites but only reporting one set of measurements.
- Swapped measurements for primary source information if available, except for USFS information due to their lack of detailed project information.

- Saved C:\Users\beng\Documents\Greg's Docs\Restoration Projects Database\Restoration\_Projects\_Attributes\_Table\_11Dec2014
- Removed remaining duplicate project sites leaving 1 row/marker per project site.
- Saved C:\Users\beng\Documents\Greg's Docs\Restoration Projects Database\Restoration\_Projects\_Attributes\_Table\_15Jan2015
- Added data from the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), also replacing duplicates with the CTUIR data (using as a primary source).
- Saved C:\Users\beng\Documents\Greg's Docs\Restoration Projects Database\Restoration\_Projects\_Attributes\_Table\_6Mar2015
- Given updated tribal project records from David Graves, adding missing project information he obtained from cbfish.org (Taurus database).
- Reviewed updated BPA Taurus database and added additional projects not featured when explored in the past.
  - Accessed database through cbfish.org, opening both the projects section, as well as the interactive map display of projects, both in different windows.
  - Once in the projects section, I scrolled through the table of projects, looking for Grande Ronde subbasin in the Province/Subbasin column.
  - Once a project was found for our project area, I checked the title and project info to see if it was a restoration project.
  - Restoration projects were entered into the interactive map window to check for duplicate projects and to separate projects by site.
    - Entered project numbers were separated by where each restoration activity took place, giving specific sites to be entered into our datasheet.
  - Missing projects were added to our datasheet, while some projects contained limited info and couldn't be added.
    - These project numbers were recorded and sent to Rosemary Mazaika from BPA to check for additional info.
- Given complete list (not only tribal projects) of records David Graves originally downloaded from Taurus database to double check all projects were included and to compare methods for obtaining information.
  - David obtained BPA restoration project information by browsing to cbfish.org and going through the below links.
    - Explore
    - Interactive Data and Reports
    - Show more
    - Habitat Metrics (select All (2005 and later), Expense and Capital, Calculate by Actual Work Location, All, All, Completed and In Progress Work, All, All)
    - View it
  - This will produce a .pdf report. At the very bottom of this report, there is an option to download the data in .xlsx or .txt formats.

- No additional information was found through this form of obtaining BPA restoration project information, and actually included less projects than what I found through this method.
- **Saved C:\Users\beng\Documents\Greg's Docs\Restoration Projects Database\Restoration\_Projects\_Attributes\_Table\_Final**
  - **This table represents the final product to be used for future analysis.**
- Potential additional project information sources were acquired through networking at the River Restoration Northwest Symposium, in which a poster of our work was presented.
  - Obtained CTUIR primary data for projects they have implemented, replacing project data for sites already reported, and adding sites not yet reported.
  - Checked into the Department of State Lands for pending and approved project information, but this appears to not be a useful source for our purposes.
- Replaced other reporting agencies data with USFS project information for potential use, but not moving forward with the data table C:\Users\beng\Documents\Greg's Docs\Restoration Projects Database\Restoration\_Projects\_Attributes\_Table\_Final\_Primary\_Sources
- Added two rows to the top of the data table with words and numbers to make sure all data is properly integrated into ArcGIS, saving as\Restoration\_Projects\_Attributes\_Table\_Final\_for\_ArcGIS
- Created new ArcGIS layer from Restoration\_Projects\_Attributes\_Table\_Final\_for\_ArcGIS, using midpoint latitude and longitude measurements to generate points, and adding the recorded project information into the attributes table.
  - Checked for project overlap and potential errors in location.

Modifications to the AEM program included a merger of the sub-categories “complete barrier removal” and “partial barrier removal”, to the new sub-category “removal of barriers”, and the breaking out of the sub-category “LWD/boulders/pools and complexity”, to “large woody debris additions”, “boulder additions”, and “engineered pools”. “Engineered logjam structures” was removed as a sub-category and instead reflected in “large woody debris additions”, and the “modification/removal of bank armoring” sub-category was added to the “instream structures” action. Sub-categories “side-channel/alcove construction” and “thermal refugia” were added to the action “off-channel/floodplain”, and the “agricultural practices” sub-category was changed to “improved agriculture/forestry practices”.

**Appendix 3.** Example Restoration Assessment Field Checklist form used for assessing restoration function.

**Restoration Assessment Field Checklist**  
 This field sheet is for gathering information regarding the implementation and function of restoration projects while conducting habitat monitoring. Restoration project information will be collected within habitat monitoring reaches, as well as 50 to 100 meters above and below each reach, depending on length of site and accessibility. Scores will be assigned to each sub-category per habitat monitoring site, based on the legend descriptors below. Scores are justified from visual estimates, liable to human error and subjective assessment.

Stream Name: Deer Creek SITE ID: CRW05583-123456  
 Crew: CRITEC DATE: 8/5/2014

Legend-Proximity Score	Examples (Large Woody Debris)
Activity absent in and adjacent to site	0 No added LWD present in site
Activity present but with no apparent function	1 A few insignificant pieces of LWD outside active channel
Activity present but with moderate apparent function	3 Moderate amount of LWD in channel
Activity present and having substantial function	5 Large amount of LWD and/or logjams in channel with rootwads intact

**Activity Checklist: Circle all that apply**

Fish Passage					Activities Requiring Knowledge of Project Area (Circle if Known)				
Diversion Screening	<u>0</u>	1	3	5	Removal of Barriers - Complete	0	1	3	5
<b>Instream Structures</b>					Removal of Barriers - Partial	0	1	3	5
Large Woody Debris Additions	0	1	3	<u>5</u>	Nutrient Addition	0	1	3	5
Bank Stabilization (ex. rock weir)	<u>0</u>	1	3	5	Wetland Restoration	0	1	3	5
Boulder Addition	<u>0</u>	1	3	5	Invasive Plant Removal	0	1	3	5
Beaver Activity	<u>0</u>	1	3	5	Improved Agricultural/Forestry Practices	0	1	3	5
Engineered Pools	<u>0</u>	1	3	5	Spawning Gravel Addition	0	1	3	5
Modification/Removal of Bank Armoring	<u>0</u>	1	3	5	Land Acquisition, Lease, or Easement	0	1	<u>3</u>	5
<b>Off-Channel/Floodplain</b>					Water Lease or Purchase	0	1	3	5
Levee set-back or removal	<u>0</u>	1	3	5	Irrigation Improvement	0	1	3	5
Floodplain Reconnection or Creation	0	1	<u>3</u>	5	Mitigate Point Source Impacts	0	1	3	5
Remeandering	<u>0</u>	1	3	5	<b>OTHER (DESCRIBE):</b>	0	1	3	5
Side-Channel/Alcove Construction	<u>0</u>	1	3	5					
Thermal refugia (spring reconnect, other)	<u>0</u>	1	3	5					
<b>Riparian Improvements</b>									
Installed Fencing	0	1	<u>3</u>	5					
Planting	0	<u>1</u>	3	5					
<b>Sediment Reduction/Addition</b>									
Road Decommissioning	<u>0</u>	1	3	5					

**Description of each restoration action in reach:**  
 Substantial LWD added to stream, including rootwads forming scour pools (approx. 20-30 large pieces). Recent grading of mine tailings to allow floodplain re-connection. Fenced from cattle grazing in bottom 1/3 of site (though elk can get in). A few scattered & poorly maintained plantings. Property under easement.

**Sketch of restoration at reach (Optional):**

**Appendix 4.** Monitoring Recovery Trends project description, including project tasks referenced in Table 5 (Columbia River Inter-Tribal Fish Commission).

### **Project Goal**

To develop a quantitative means to evaluate current and potential spring Chinook salmon viability factors (productivity, abundance, spatial structure, diversity) for selected listed populations, focusing on key limiting habitat factors.

### **Impacts**

This project will provide information to develop more effective habitat restoration strategies by describing the effect of habitat conditions on fish production.

### **Background**

NOAA adopted a method of calculation that simply averages all limiting factors as a means to gauge an overall percentage of potential function (i.e., productivity). This method is not amenable to providing realistic evaluations of habitat condition or restoration trends and their implications to salmon productivity. The tribes need more defensible methods that can provide more accurate assessments so that status and trends in habitat and viability can be meaningfully expressed in the next Accords review.

### **Project Tasks**

- 1) Collect LIDAR and FLIR data, which will allow us to accurately assess riparian vegetation and stream-side condition by remote sensing.
- 2) Build a model for predicting longitudinal patterns of water temperature on any day, based on solar radiation, local riparian cover, and other meteorological conditions.
- 3) Evaluate the spatial distribution of habitat conditions (water temperature, sediment, and flows) in the two test basins in order to integrate overall population productivity.
- 4) Trends in key habitat conditions and related freshwater survival over time will be viewed as a result of aggregate restoration actions at a basin level.
- 5) Measure juvenile chinook growth rates in relation to water temperature, food availability, riparian condition, and channel complexity measures.
- 6) Review and evaluate habitat analysis methods, develop new methods, and examine statistical aspects of sampling.