GRANDE RONDE MODEL WATERSHED
Watershed Enhancement Project Proposal
August 2011

1. **Project Name:** Willow Creek Restoration and Enhancement Project (Oregon Agriculture Foundation)

2. **Applicant:** Confederated Tribes of the Umatilla Indian Reservation, Grande Ronde Subbasin Fish Habitat Restoration Project

3. **Participating Landowner(s) and Agencies:**

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   Oregon Agriculture Foundation, Bill Howell, Chairman
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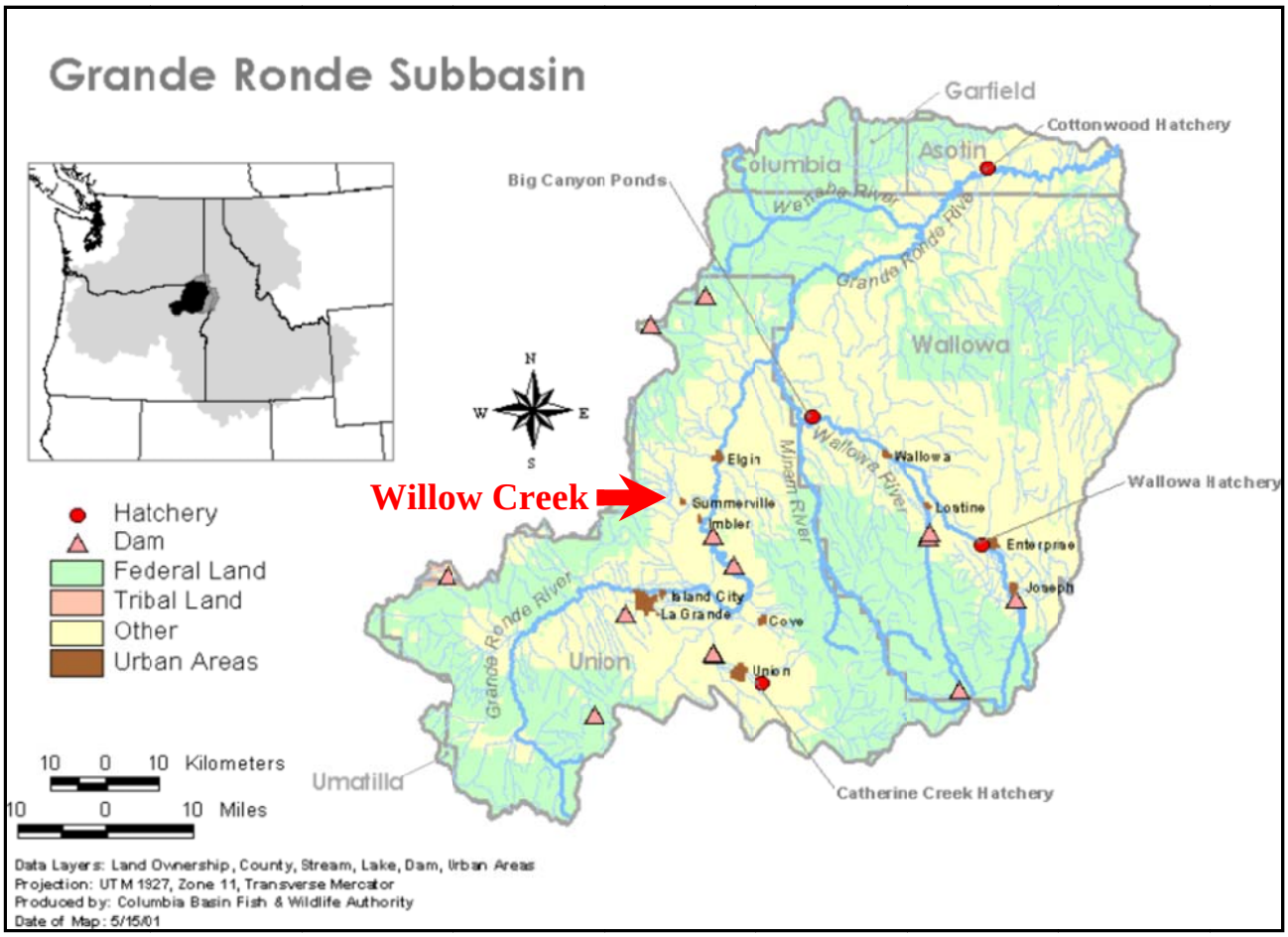
5. Project Location:

The Willow Creek Restoration and Enhancement Project is located in the upper Willow Creek watershed near Summerville in the northwest portion of the Grande Ronde Valley within the Upper Grande Ronde River Subbasin (6th Field HUC 17060104803). The legal description of the project is: Township 1 South, Range 38 East, all or portions of Sections 11 and 14, Willamette Meridian. The project encompasses approximately 0.58 miles of Dry Creek, 0.38 miles of Fir Creek, 0.35 miles of Coon Creek 3.28 miles of Willow Creek, and 1.06 miles of spring-fed tributaries within the 854 acre McKenzie Farm which is held in trust and managed by the Oregon Agriculture Foundation (Figure 1).

Figure 1 Project Vicinity Map



6. Project Vision, Goals, and Objectives:

Project sponsors propose to restore natural channel and floodplain morphology by re-connecting abandoned channel meanders, enhance instream structural diversity and complexity by adding large wood, stabilize streambanks through bio-engineering techniques, converting agricultural fields within the project area to native plant communities, and replace existing culverts on Willow Creek and spring-fed tributaries to improve fish passage and floodplain connectivity.

The Vision of the project is a working farm with healthy, richer, and more abundant populations of fish, wildlife and plants for future generations. The overall goal is to protect and enhance fish and wildlife habitat, maintain farm commodity production, contribute to the Eastern Oregon University Foundation, and provide educational opportunities.

A number of previously completed assessments commissioned by the GRMW and others have identified factors limiting the health of the Willow Creek watershed, and on a larger scale, the Grande Ronde River system including:

- Willow Creek Watershed Assessment (GRMWP 2001)
- Willow Creek Coordinated Resource Management Plan (CRMP) (Union SWCD 2002)
- Upper Grande Ronde Subbasin Water Quality Management Plan (ODA 1990)
- Upper Grande Ronde TMDL (ODEQ 2000)
- Grande Ronde Model Watershed Action Plan (GRMWP 1994)
- Grande Ronde Subbasin Plan (NPCC, 2004)

Key limiting factors include high summer water temperatures, elevated sediment and nutrient inputs, loss of wetlands, stream channelization and stream flow depletion. The Willow Creek Watershed Assessment specifically identified lack of shade, large wood deficiencies, channelization, wetland drainage, high stream temperatures, and high nutrient levels. The Assessment also identified opportunities to restore channelized streams to natural, stable channels. The Willow Creek CRMP identified seven (7) goals including: 1) Make the stream more hospitable to fish (restore streamside vegetation, reestablish desirable cover, increase shade, reduce streambank erosion); and 2) Improve fish habitat. Landowners within the watershed identified the number one concern as lack of streamside vegetation.

Assessments of the project area conditions indicate that many of the limiting factors identified in these assessments are applicable and have been incorporated into development of project objectives discussed in the following.

Objective 1. Protect habitat and improve the quality and quantity of habitat for salmonids, including adult spawning, and juvenile summer and winter rearing areas.
Employ the use of passive (protection) and active restoration techniques to restore and enhance instream diversity and complexity. Establish approximate 329 acre conservation area through the Federal Wetland Reserve Program in cooperation with project partners and NRCS.

Subbasin Plan Reference: Habitat Protection. (page 258):
• Protect high quality habitat, restore degraded habitats, and provide connectivity between functioning habitats.
• Manage for healthy ecosystems to support aquatic resources and native species

Objective 2. Reduce streambank erosion rates
Streambank stability assessments indicate that the bulk of the sediment supply is from localized streambank erosion. Streambank stabilization may be achieved using several techniques including rest from overgrazing, or physically reshaping some banks and adding native material such as large woody debris (LWD), and planting sedges, rushes, shrubs, and trees. This should greatly reduce the sediment supply, decrease percentage of fines in the substrate and provide complex habitat.

Subbasin Plan Reference: Sediment Conditions. (page 261):

- Identify sediment sources
- Stabilize active erosion sites
- Reestablish riparian vegetation by plant trees
- Promote/implement minimum tillage practices
- Promote/implement grazing plans to improve upland vegetation
- Create wetlands

Objective 3. Restore natural, stable stream channels and wetland habitat.
Restore and enhance stream channel dimension, pattern, and profile to facilitate watershed processes and function in a dynamic state of equilibrium. A diversity of habitat types (riffles, runs, pool, and glides), lowered width:depth ratios, increased sinuosity and decreased gradient, increases floodplain connectivity, stable streambanks, and decreased erosion and sediment are key outcomes of the objective and the basis for enhancing instream and wetland habitats..

Subbasin Plan Reference: Channel Conditions (page 260):
•Maintain existing LWD by promoting BMP's for forestry practices. Add LWD where deficient and appropriate to meet identified short term deficiencies.
• Reconnect channels with floodplain or historic channels where appropriate and feasible. •Install in-channel structures (LWD, boulders).

Objective 4. Decrease summer stream water temperatures and increase winter temperatures
Decreased water temperatures may result from: decreasing channel width/depth ratios; increasing shade from a healthy riparian plant community; from a higher water table and improved groundwater interaction.

Subbasin Plan Reference: Other Attributes (page 263):
•High and low water temperatures and dissolved oxygen conditions shall be restored as near as possible to historic conditions, as a result of restoring channel conditions, reducing sediment loads, and improving riparian conditions , and by improving low flow conditions.

Objective 5. Develop a management plan that allows for the long-term recovery and protection of the stream, riparian and wetland habitat improvements (WRP Management Plan).
Develop detailed management plan to protect project investment and outline short and long-term management activities to facilitate and maintain habitat enhancement and recovery which integrates the goals of the McKenzie Trust in maintaining a working farm.

Subbasin Plan Reference: Riparian Conditions (page 262):
• Improve the density, condition and species composition of riparian vegetation through planting, seeding, improved grazing and forest management practices.
Subbasin Plan Reference: Sediment Conditions (page 261):
• Manage grazing in riparian areas following grazing plans designed to improve riparian condition; could include exclusion, partial season use, development of off-site water, herding.
• Reestablish riparian vegetation by planting trees, shrubs, sedges (native species preferred)
• Stabilize active erosion sites, where appropriate, through integrated use of wood structures (limited use of rock if necessary) and vegetation reestablishment.
• Encourage landowner participation in riparian management incentive programs, e.g. CREP, WRP, EQIP.
• Promote/implement development of grazing plans to improve upland vegetative condition.

Objective 6. Meet visual/aesthetic values by creating a natural functioning stream.
A healthy stream is much more visually appealing and often enhances property values

Objective 7. Provide educational opportunities for local students
Work in cooperation with Eastern Oregon University and others to provide opportunities to study/monitor stream processes such as state of the art habitat restoration techniques, channel evolution processes, water quality, groundwater interactions, plant succession, etc.

7. Project Description

Introduction

The project is located in the lower 3rd of the approximate 53,000 acre Willow Creek Watershed at approximately river mile 9.2 at the lower reach of the project upstream to river mile 12.5. The watershed contains over 125 miles of stream habitat and is composed of 67% private lands. The area was homesteaded in 1862 and has extensive historic and current agricultural uses, including orchards, livestock production and crop production (wheat, alfalfa, mint, sugar beets, and grass seed).

The watershed provides significant habitat for federally listed Snake River summer steelhead, potential spawning and rearing habitat for spring Chinook salmon, and a supports a variety of native resident fish. The project includes over 4 miles of spawning and rearing habitat with forested, higher gradient, C4 channel type in the upper portion of the project area and low gradient, wetland meadow, C4/C5 and E channel forms in the lower 2/3's of the project area. The area presents extensive potential to provide summer and winter rearing habitat for salmonids with suitable spawning habitat for steelhead in the upper project reaches.

A variety of restoration and enhancement strategies are proposed to address habitat limiting factors, including: 1) Large wood additions, 2) Streambank stabilization/bio-engineering, 3) Re-connection of historic channel scrolls, 4) removal/replacement of culverts, and 5) conversion of cultivated lands to native plant communities.

Funding secured for instream habitat implementation through this proposal will be administered by the CTUIR under its' existing BPA-Accord contract. BPA-Remand funds will be entirely "pass through expenses" and be applied directly to on the ground actions.

Habitat Limiting Factors and Existing Conditions

Habitat assessments and field surveys were initiated by CTUIR and ODFW staff during the summer of 2010. Generally, the project area exhibits the effects of decades of agricultural practices within the historic floodplain habitats and adjacent to streams that have led to poor streambank stability and severe bank erosion, channel incision and head cutting in localized reaches, straightened reaches resulting in loss of sinuosity (reduced stream length), high channel width:depth ratios, lack of floodplain connectivity, poor groundwater interaction, lowered water table, low summer flows, poor riparian and wetland vegetation, and high summer water temperatures. Following is a summary of specific habitat limiting factors with additional discussion.

- **Channel Habitat Conditions** – Channel instability associated with removal of streamside cover and channelization has resulted in channel incision/down cutting, increased gradient, reduced channel length, elevated erosion, increased width-to-depth ratios, and loss of channel complexity. The quality of instream habitat has correspondingly been altered within the project area.

- **Sediment** – Loss of upland and streamside vegetative cover has increased the rates of erosion. Soils lost from upland areas has overwhelmed hydraulic processes resulting in decreased availability of large pool habitat, spawning areas, riffle food production, and hiding cover.

Approximately 18,000 linear feet of Dry Creek and Willow Creek are poorly vegetated with vertical banks ranging in height from 4-8 feet. Soils are generally composed of cohesive ash and clay which appears to minimize extensive lateral migration, but sediment delivery to the channels is readily apparent. Turbidity from fine sediment particles during high flow periods is excessive.

• **Riparian Function, Low Flow and Water Quality** – Riparian habitat degradation is the most serious habitat problem in the subbasin for fish (McIntosh 1994, ICBEMP 2000). Loss of floodplain connectivity by roads, dikes, and channel incision, and in many streams reduced habitat suitability for beaver, has altered dynamically stable floodplain environments, which has contributed to degradation and limited habitat recovery. This loss leads to secondary effects that are equally harmful and limiting, including increased water temperature, low summer flows, excessive winter runoff, and sedimentation.

Water temperature monitoring was initiated by the CTUIR in 2010 on Dry Creek, Fir, Willow, and spring-fed tributaries. Figure 2 illustrates monitoring locations. Hourly temperature data was collected for up to 235 days from late March through early November 2010. Data indicates that during 2010, water temperatures in project area streams remain below the DEQ salmonid lethal temperature limit of 25°C during summer baseflow conditions but do frequently and for long periods exceed 20°C, which can result in behavioral changes and no growth of salmonid spp. As illustrated in Table 1, water temperatures ranged between 10° - 15.6°C for 15,515 hours (about 40% of the time) with 37 total days where mean daily temperatures exceeded 17.8°C.

For the six probes deployed along Willow and Fir creeks in 2010 there were a total of 609 records of water temperature >=20°C – a temperature that can cause zero growth and behavioral changes in salmonid spp. Dry Creek temperatures remained below the 20°C threshold throughout 2010. A summary of the probe records at this temperature range is presented below.

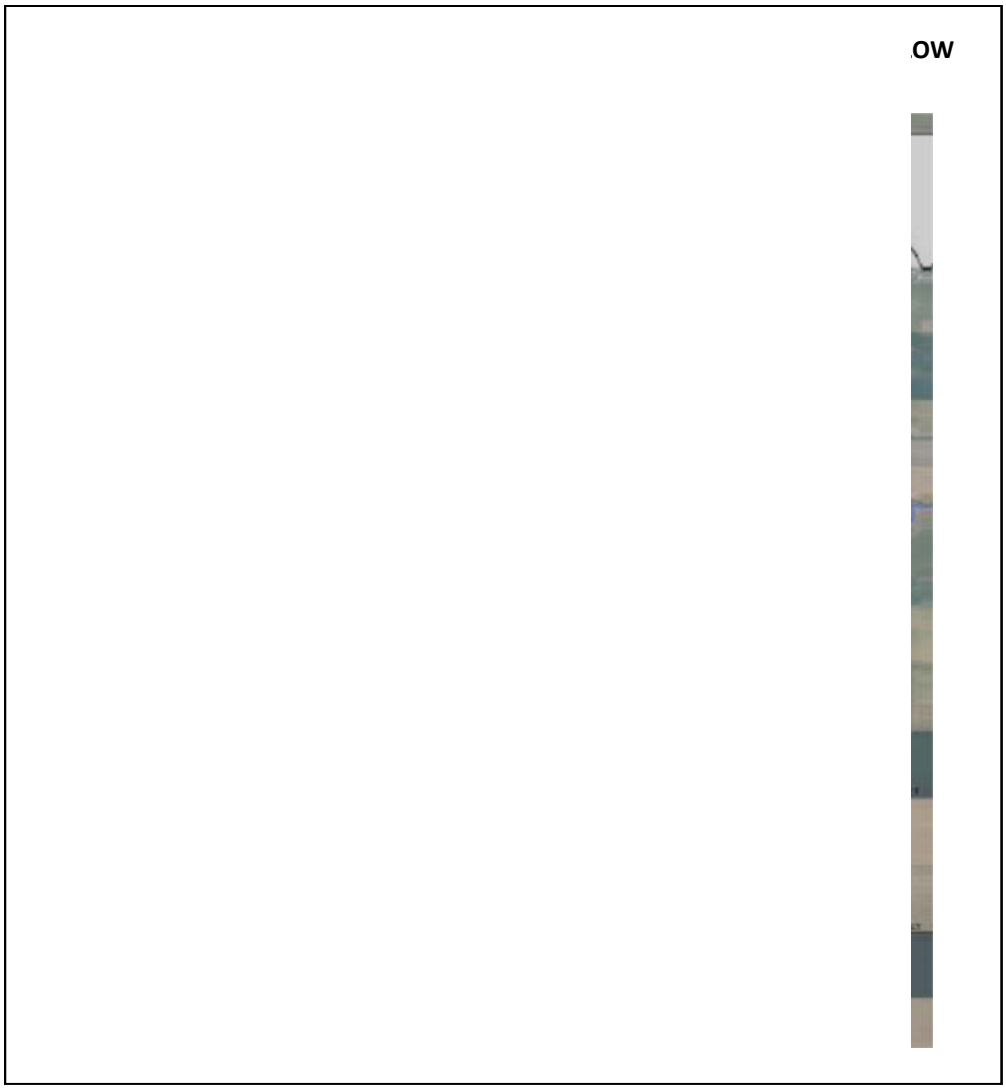
- Fir Creek: Located at river mile 0.03 had 75 records within this range, with the longest continuous period of temperatures >=20°C for 8 hours on 7/30/2010 between 16:00hrs and 23:00hrs.
- WILL5 (Willow 5): Located at river mile 10.76 below the confluence of Fir Cr. had 4 records >=20°C on 7/30/2010 between 18:00hrs and 21:00hrs. This comparatively short period of higher temperatures is possibly a function of the colder water and higher flow from Dry Cr. negating the warmer water from Fir Cr. thereby keeping the stream temperature down at this site.
- WILL4 (Willow 4): Located at river mile 9.6 below the McKenzie road bridge had 53 records >=20°C with the longest consecutive period at these temperatures of 7 hours on 7/30/2010 between 15:00hrs and 21:00hrs.
- WILL3 (Willow 3): Located at river mile 9.12 had 108 records >=20°C with periods of 8 continuous hours at these temperatures occurring on 7/30/2010, 8/5/2010, and 8/6/2010. These probe temperatures were possibly influenced by the warm water entering the main channel from a right bank spring tributary (Spring Trib 2).
- WILL2 (Willow 2): Located at river mile 7.89 had 58 records >=20°C with 12 consecutive hours at this range on 7/30/2010, and 8 consecutive hours in this range on 7/25/2010, 7/29/2010, and 7/31/2010.
- WILL1 (Willow 1): Located near the property boundary at river mile 7.65 had 8 hours >=20°C on 6/18/2010. Data for this probe was not available after 6/18/2010 due to battery issues and disturbances to the probe.

These temperature profiles indicate a warming of the main water body as it travels downstream with the tributaries contributing to the trend. It is probable that there are cold pockets within the system that provide thermal refuge for fish, however, the overall stream temperature gradient below the bridge could have a detrimental effect on salmonid spp.

Table 1. Water temperature probe metrics for Willow Creek and tributaries within the boundaries of the Mackenzie Trust property for 2010

Probe ID	River Mile	Year	Total Hours	Hours @ 10 – 15.6 °C	Hours >=25 °C	Hours >= 20 °C	# Days $\bar{x}$ >= 17.8 °C	Total Days
WILL1	9.07	2010	2160	605	0	0	0	90
WILL2	9.43	2010	3216	1005	0	58	13	134
WILL3	10.53	2010	5640	2149	0	108	10	235
WILL4	12.01	2010	5610	2266	0	53	6	235
WILL5	14.34	2010	5472	2299	0	4	0	228
DRYCR1	0.44	2010	5640	2333	0	0	0	235
FIRCR1	0.03	2010	5640	2625	0	75	5	235
COONCR1	0.01	2010	5063	2233	0	311	3	211

Examples of diurnal fluctuations in water temperature are displayed below in Figures 3 and 4. Considerable differences in tributary water temperatures and their related effects on Willow Creek are shown during the months of July and August. Downstream thermal loading is depicted by the uppermost probe on Willow Creek at river mile 12.54 (WILL5), which is relatively cooler during the summer months than the probes located at river mile 10.9 (WILL3) and river mile 9.67 (WILL2). These data indicate cold water inputs at the upper reaches of the project area from Dry Creek. The lower most probe (WILL1) is not depicted due to large data gaps.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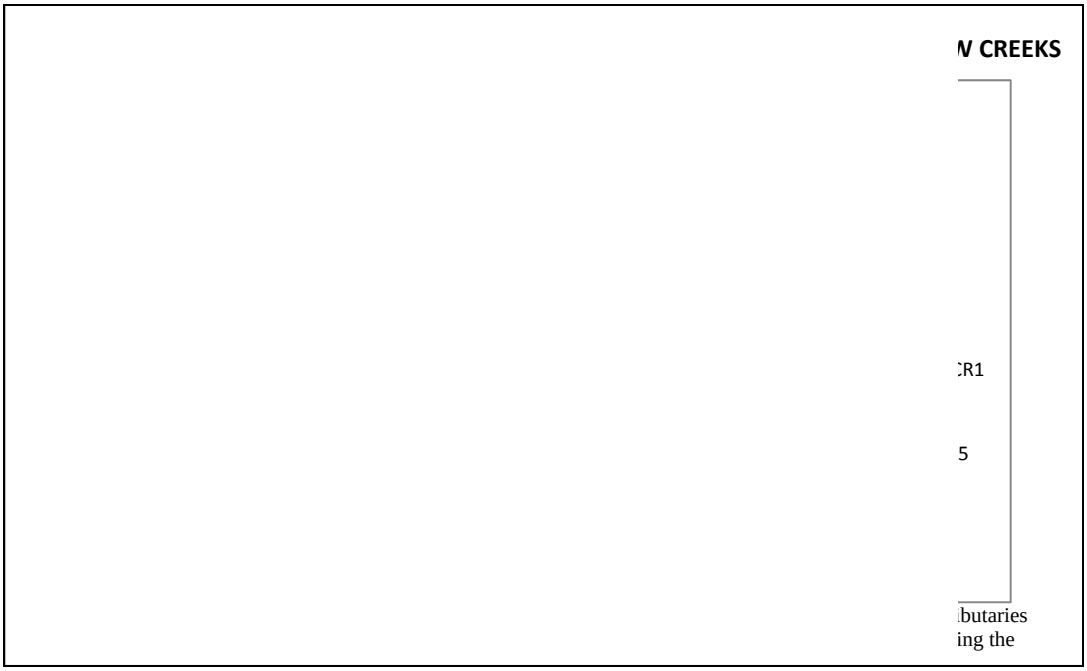
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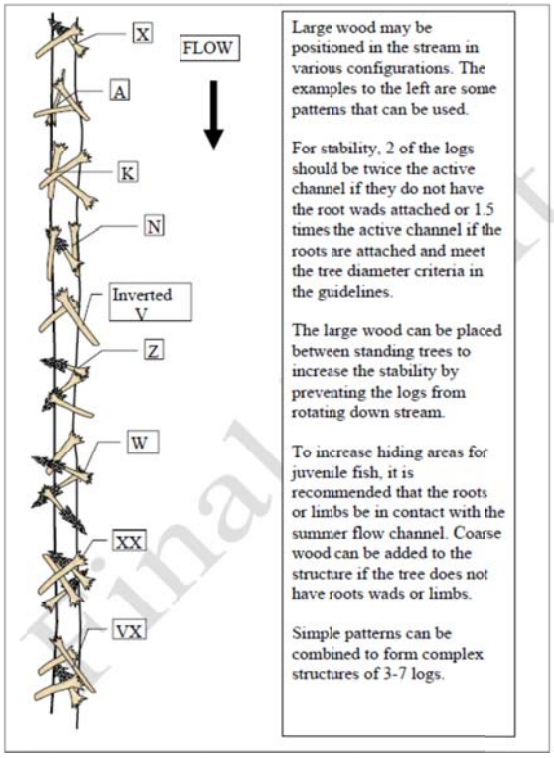
Specific Actions – Project activities funded under this BPA-BiOP Remand proposal include: Instream habitat enhancement (installation of large wood placement for complexity), streambank stabilization through bio-engineering and planting techniques, re-activation of historical channel scrolls, and removal and/or replacement of existing undersized culverts to improve fish passage and floodplain connectivity. Figure 4 illustrates locations of planned actions. Following is a description of planned treatments.

1. **Large Wood Additions** – Approximately 73 large wood addition sites have been identified along project area streams to enhance instream habitat complexity. See project overview map. Sixteen (16) sites along Dry Creek and upper Willow Creek will include installation of larger, 4-8 piece engineered large wood structures in conjunction with re-enforced earth locations (described in item #2 below) to increase diversity and contribute to streambank stability. Large wood sites have also been identified along lower Willow Creek, Fir Creek, Coon Creek, and spring-fed tributaries that are fish bearing to increase complexity, trap sediment, and improve width/depth ratios and floodplain connectivity in conjunction with planting efforts described in work item #3 below. Typical wood placement configurations (illustration to right referenced from "Guide to Placement of Wood, Boulders, and Gravel for Habitat Restoration, ODSL et., al January 2010) will mimic natural debris accumulations and be strategically located within the lower 3rd of existing pools in complexes of 2-6 wood pieces per site. Larger wood complexes with key member pieces greater than 18 inches diameter and 35 feet in length will be utilized on larger streams (Dry, Willow, and Fir Creek) while smaller wood material (12-18 inches diameter and >25 feet in length) can be used on Coon Creek and spring-fed tributaries. Large wood complexes will be stabilized using rock ballast in lieu of pinning and/or keying into streambanks due to cultural resource concerns which are prominent throughout the project area.



2. **Re-enforced Earth/Streambank Bio-Engineering** – Field assessment indicates that upper Dry Creek and Willow Creek reaches upstream of McKenzie Lane exhibit extensive vertical streambanks (average height of 6 vertical feet), excessive erosion, and lack riparian vegetation and associated instream habitat complexity. With a higher gradient and greater near-bank shear compared to vertical streambanks found in lower gradient project reaches, sponsors propose an aggressive treatment to facilitate streambank stability and recovery of riparian vegetation. Planned actions include treatment along approximately 2,610 linear feet of streambank. The treatment involves excavation and streambank contouring, installing re-enforced earth wraps (consisting of geo-coir 700 fabric which is filled with streambank spoils and rolled and staked into place then back-filled), and planting dormant willow whips. Due to the existing height of the streambanks, each site will be treated using a double layer of the re-enforced earth rolls to ensure stability throughout the streambank profile. The photo above illustrates an example streambank along Dry Creek. The typical drawing illustrates our planned re-enforced earthwork technique. Photos below depict similar pre-project conditions at McCoy Meadows and the post-construction condition with re-enforced earth treatment installed.

The following table summarizes planned streambank treatments in the upper project reach. Figure 6 illustrates treatment unit locations. Note that several of the treatment sites will also include large wood additions which will provide habitat complexity and structural stability in association with the streambank treatment.

Table 2 Dry and Willow Creek Streambank Stabilization Summary

Willow Creek/McKenzie Bank Stabilization:					
Site	**Bank**	**Length**	**Height[1]**	**No. LWD**	**Treatment**
1	n/a	75	8	3	LWD only
2	Lbank	150	6	3	Bank shaping, pt. bar
3	Lbank	115	8	3	Double reinforced bank
4	Lbank	40	6	2	Double reinforced bank
5	Lbank	130	5	5	Bank shaping, pt. bar
6	Rbank	285	10	6	Double reinforced bank
7	Rbank	300	9	8	Double reinforced bank
8	Lbank	120	5	3	Single reinforced bank
9	Rbank	135	7	3	Double reinforced bank
10	Rbank	195	6	3	Double reinforced bank
11	Lbank	75	5	2	Bank shaping, near bank
12	Rbank	50	6	2	Double reinforced bank
13	Rbank	110	6	6	Double reinforced bank
14	Rbank	75	4	0	Single reinforced bank
15	Rbank	75	6	3	Double reinforced bank
16	Lbank	315	5	5	Double reinforced bank
17	Rbank	65	4	5	Bank shaping, near bank
18	Lbank	150	5	0	Double reinforced bank
19	Rbank	150	6	0	Double reinforced bank
Total		2610		62	
Total stream length = 4,000 ft (0.75 miles)					

3. **Streambank and Floodplain Re-vegetation** – The project area has experienced a significant loss of riparian and wetland vegetation during the past century. Historic aerial photography indicates that project area riparian habitat was historically more abundant compare to current condition. As illustrated in the 1956 aerial photo to the left and 2009 photography to the right. Evaluation of historic photos dating back to the early 1950's clearly document that significant alterations have led to current conditions with extensive vertical and eroding streambanks throughout the project area.

Approximately 18,000 linear feet of lower Willow Creek has un-vegetated, eroding streambanks. From McKenzie Lane downstream, the

gradient of Willow Creek decreases which translates to less stream power and streambank stress. A less aggressive streambank stabilization approach is proposed downstream of McKenzie Lane to reduce project costs and avoid extensive streambank excavation associated with re-enforced earth work. To facilitate riparian development and stabilization of streambanks, project sponsors propose mechanical and manual planting of containerized, rooted plant stock and willow whips. Mechanical planting will be completed with a track-mounted excavator equipped with a stringer and/or small auger to create a small hole (<4 inches) to install both containerized and live whip plant materials. The preference for stinging plants is to utilize an expandable, duck-bill shaped stringer to minimize air pockets and maximize plant survival. However, the technology could be less cost effective than typical stringer and auger techniques. Plants will be installed on a variable width spacing guide in a diamond-shaped pattern. The outside radiuses of the stream will typically be planted at a higher density with tighter spacing than the straight channel segments and areas with limited risk of erosion. Planting will be completed during fall dormancy periods on dry and/or frozen ground conditions to limit disturbance and maximize plant survival.

Additional tree and shrub planting is proposed within the conservation easement boundary adjacent to project area streams to restore floodplain diversity and stability. Approximately 60 acres of floodplain forest planting units have been delineated to compliment activities associated with agricultural field conversion to native grasslands described in item #4 below. Both streambank and floodplain planting areas are illustrated in Figure 4.

Tables 3 and 4 illustrate species lists, size/stock type, and quantities planned for streambank planting and floodplain forest planting units respectively. For planning purposes, approximately 18,000 linear feet of streambank will be mechanically planted with a combination of large, containerized plants and conditioned live-whip willows on a roughly 6'x6' variable width spacing. The planting area encompasses approximately 4 acres (18,000' x 10'), which requires approximately 5,000 plants of locally derived (Grande Ronde Valley) plant stock. Additional revegetation activities associated with additional live-whip willow planting and sedge/rush plugs and mattes will be accomplished with CTUIR and ODFW field crews.

Table 3 Streambank Planting Summary (Species list, stock type, and quantities)

Common Name	Scientific Name	Size/Stock	Quantity
Black Cottonwood	*Populus trichocarpa*	3" x 18" Long Tube	250
Red-Osier Dogwood	*Cornus sericea*	3" x 18" Long Tube	2,000
Willow Species (Mackenzie and Pacific)	*Salix mackenziana/ Salix lasiandra*	Conditioned live whips	1,500
Nootka Rose	*Rosa nutkana*	3" x 18" Long Tube	250
Black Hawthorne	*Crataegus douglasii*	3" x 18" Long Tube	500
Golden Currant	*Ribes aureum*	3" x 18" Long Tube	500
Total			**5,000**

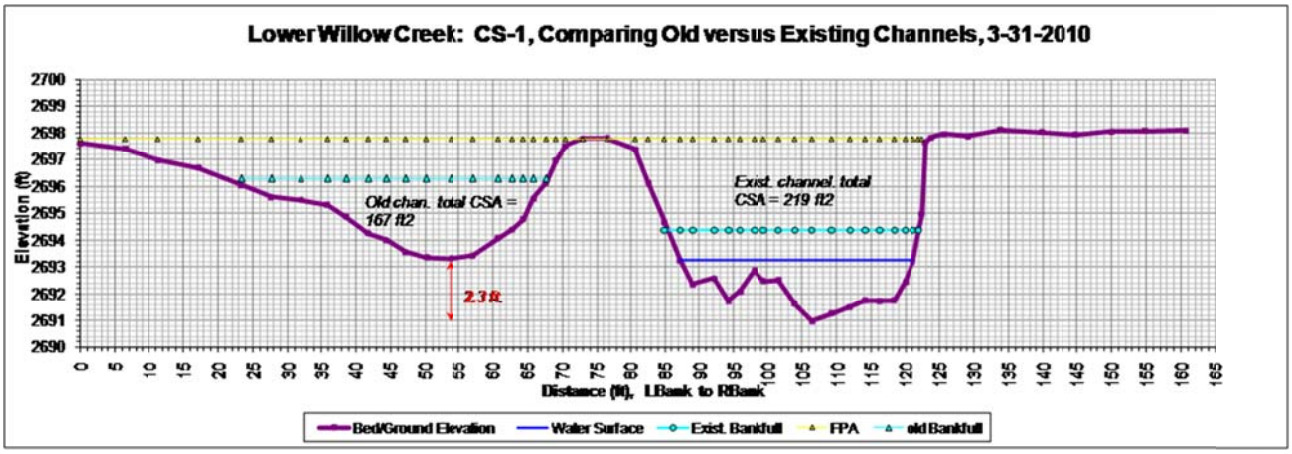
Floodplain planting efforts will be focused on approximately 30 acres distributed throughout the lower project area within small units. A combination of trees and shrubs will be planted to facilitate small patches of floodplain forests. Planting density will be based on approximately 100 stems/acre and a variable width spacing guide. Floodplain planting units will be hand planted with small augers using locally derived, containerized plant stock as shown in the following table.

Table 4 Floodplain Forest Planting Summary

Common Name	Scientific Name	Size	Quantity
Ponderosa Pine	*Pinus ponderosa*	Tall One Gallon	1,500
Black Hawthorne	*Crataegus douglasii*	3" x 18" Long Tube	600
Chokecherry	*Prunus virginiana*	3" x 18" Long Tube	300
Blue Elderberry	*Sambucus cerulea*	3" x 18" Long Tube	100
Golden Currant	*Ribes aureum*	3" x 18" Long Tube	100
Woods Rose	*Rosa woodsii*	3" x 18" Long Tube	100
Common Snowberry	*Symphoricarpos albus*	3" x 18" Long Tube	100
Black Cottonwood	*Populus trichocarpa*	3" x 18" Long Tube	100
Mockorange	*Philadelphus lewisii*	3" x 18" Long Tube	100
		Total	**3,000**

In conjunction with tree and shrub planting along streambanks and within the floodplain, approximately 85 acres of existing agricultural fields and an additional 33 acres that are currently dominated by foxtail will be seeded and planted with small patches of trees and shrubs during fall periods to restore native grasslands and floodplain forest habitat. The 87 acres of agricultural fields are currently in fallow and ready for seed drilling and planting as early as Fall 2011. The additional 33 acres of foxtail units will be initially treated during late Spring 2012 with haying and herbicide application, followed by disking and seeding and planting during Fall 2012. Planned grass seed mix includes a mixture of locally derived Great basin wild rye, blue-bunch wheatgrass, Idaho fescue, and tufted hair grass.

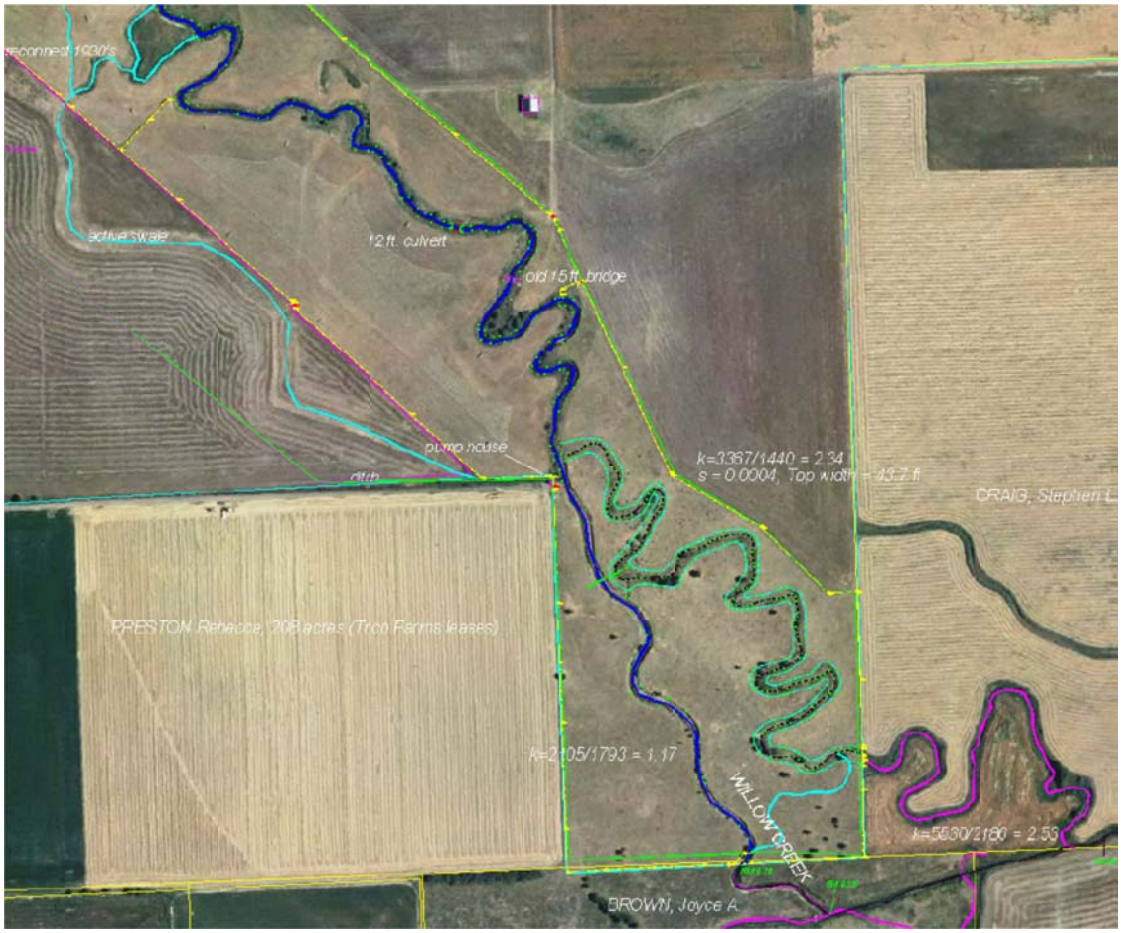
4. **Re-connection of Historic Channel Segment** – An historic channel meander along lower Willow Creek within the project area will be re-activated as part of the project. Assessment of historic aerial photography indicates that the channel was abandoned in the 1960's either through direct human manipulation or indirectly as a result of irrigation ditch construction and inadvertent channel diversion. The historic channel alignment provides an opportunity to decrease channel gradient, reconnect the floodplain, and relocate Willow Creek from within a channelized reach to a segment with high sinuosity, low width/depth ratio, and complex habitat. The historic channel scroll currently has approximately 167 square feet of cross sectional area compared to the channelized reach which is roughly 219 square feet as illustrated in the following graph. Note that Willow Creek has down-cut about 2.3 feet compared to the historic channel.



A limited amount of excavation will be required to prepare the restoration channel for activation with the majority of required excavation occurring at the upstream and downstream intake and return points and areas where windblown sediment has accumulated. Less than 2,500 cubic yards of excavation is estimated to prepare the remnant channel and cut depths will be less than 1.5 feet in the pools. An additional 645 feet of complete new channel construction may be required at the downstream reach, depending on negotiations with the adjacent landowner regarding the potential to activate an additional 0.44 miles of the lowermost reach of the historic channel alignment. Because the opportunity and scope of that effort is unknown as this time, sponsors propose to proceed with reconnecting the planned channel scroll within this project and continue to develop the opportunity for additional work which would require a separate or modified project proposal at a future date.

The existing channel segment planned for abandonment will be partially backfilled to the extent feasible utilizing spoil materials from channel excavation and converted into 1 to 2 floodplain ponds. Channel diversion will be accomplished by constructing a compacted, earthen plug at the uppermost channel reach to divert Willow Creek into the restoration segment. The lower reaches of the channelized reach will be maintained to provide backwater rearing and wetland habitat. Restoration channel preparation will be completed during fall 2011 with activation during July 2012. The diversion process will include fish salvage and removal and water management to minimize resource damage.

Figure 5 Lower Willow Creek Channel Restoration Planview

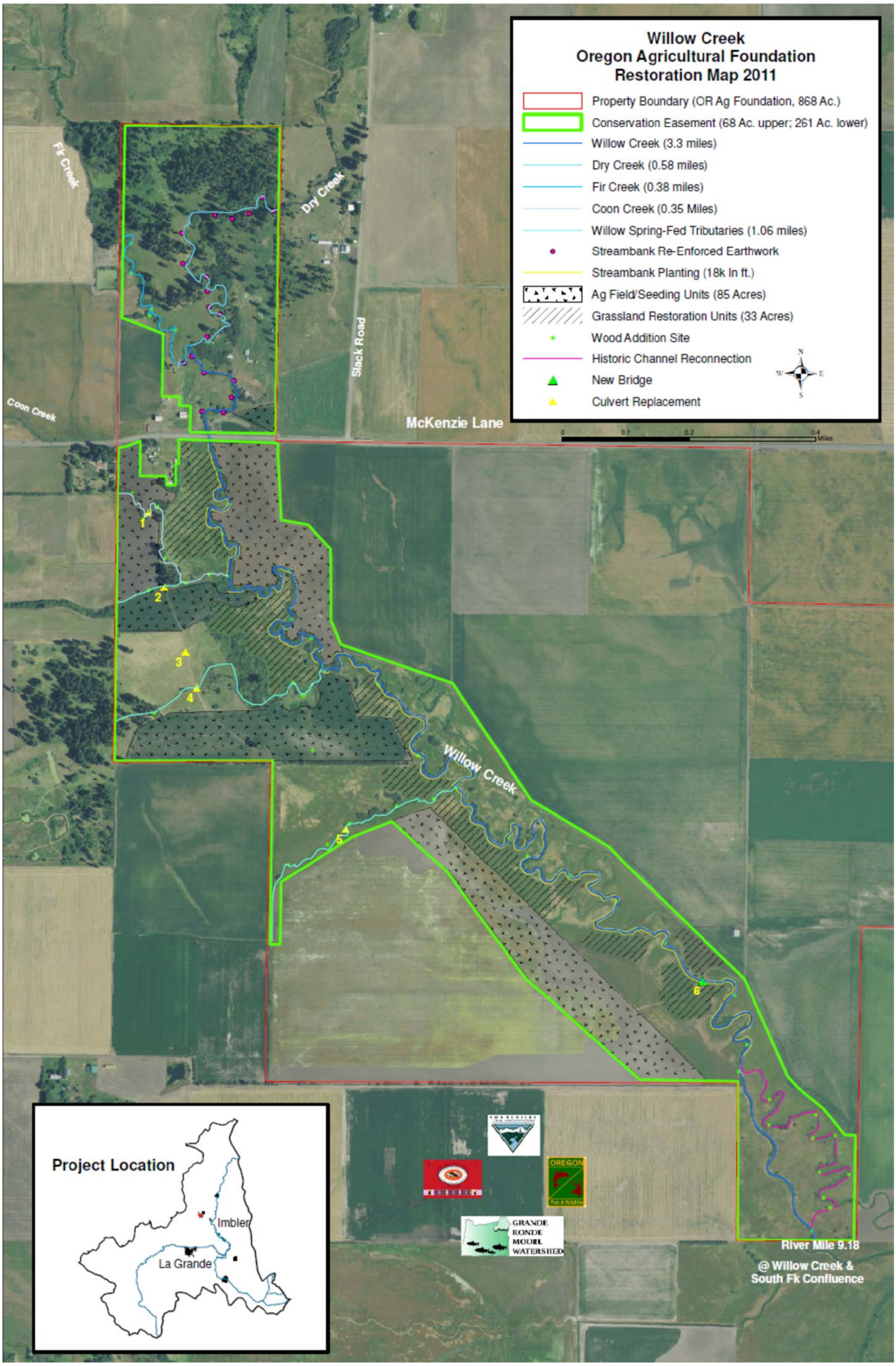


5. **Culvert Removal and Replacement** – Table 5 illustrates an inventory of existing culverts within the project that have been evaluated for removal and/or replacement to improve fish passage and floodplain connectivity. Five culverts are located on small tributaries to Willow Creek and provide access for small farm equipment and vehicles. Four of the culverts occur on fish bearing streams and are either undersized or not functioning properly, or both. Culverts 1, 2, 4, and 5 will be replaced with larger culverts, appropriately sized for the location and channel. Culverts 1 and 5 will require 48 inch culverts while culverts 2, 3, and 4 will require 30-36 inch culverts.

Table 5 Willow Creek Fish Passage Structures

Willow Creek Fish Passage Structure Summary					
Culvert #	Dimensions/Composition	Notes	BKF Width	Aug 2011 Streamflow	Stream Location
Culvert #1	30" x 16' concrete	8" jump height, undersized. fish bearing	10	1.5 cfs	Coon Creek
Culvert #2	24" metal @ upper (12" metal downstream) x 20'	Partially collapsed, filled with sediment. fish bearing	5	< 0.5 cfs	Spring-fed tributary
Culvert #3	12" x 16'	Non-fish bearing	3	dry	Spring-fed tributary
Culvert #4	12" x 16' metal	Undersized, fish bearing	8	< 0.5 cfs	Spring-fed tributary
Culvert #5	32" x 16' metal	partially collapsed, undersized, fish bearing	23	< 0.5 cfs	Spring-fed tributary

Figure 6 Habitat Enhancement Site Locations



Benefits – Approximately 4 miles of summer steelhead spawning and rearing habitat will be protected and enhanced under a 30 year conservation easement. Project benefits also extend to spring Chinook with suitable rearing habitat. Expected project results include increased habitat complexity, decreased erosion and sediment delivery, and enhanced riparian and wetland habitat through a combination of active (large wood additions, streambank stabilization, re-activating historic channel alignment planting/seeding, and culvert removal/replacement) and passive (establishment of term conservation easement and elimination of livestock grazing and agricultural cultivation adjacent to streams). Additionally, the project could potentially lead to improved trends in water quality (long-term) with a decrease in diurnal water temperature variations and decreased summer maximum water temperatures with improving trends in channel morphology (decreased width:depth) and riparian vegetation. Finally, the project will compliment completed and ongoing habitat enhancement activities in the Willow Creek watershed (End Creek Restoration, passage projects, etc.)

Project Maintenance – CTUIR, ODFW, and landowner will maintain the project. Extensive maintenance is not anticipated. Maintenance associated with the term conservation easement includes annual fence inspection and repair and maintenance of planted materials consisting of managing competing vegetation and protection devices to minimize depredation.

Permits – CTUIR and GRMW staff will complete all environmental compliance needs in cooperation with BPA. ESA compliance has been completed by CTUIR through BPA's HIP2 for NOAA Fisheries species and a No Effect Determination for USFWS species. Cultural resource surveys were completed in July 2011 through GRMW subcontract, with SHPO consultation completed through BPA. A DSL/Corps permit application is under development by CTUIR staff.

Monitoring Plan – The following monitoring plan has been developed to evaluate project objectives:

a) **Protect Habitat:** Photo points were established in 2010 and 2011 to provide pre-implementation qualitative data on vegetation and channel conditions. These photo points will be repeated immediately post implementation then every 3 years thereafter until the riparian lease has expired.

b) **Enhance Instream Structural Diversity and Complexity:** A baseline longitudinal profile and channel cross sections and streambank hazard rating were completed by ODFW in 2010 which will provide an overview of morphological features and habitat complexity over time. Channel morphology surveys will be repeated in subsequent years post implementation to monitor changes in channel morphology and habitat complexity.

c) **Enhance Floodplain Connectivity:** This objective will be monitored through the establishment of photo points, as detailed in a) above.

d) **Enhance Riparian Habitat Condition:** Vegetation surveys (such as a shrub intercept or 'green-line' survey) will be undertaken during 2011 and repeated 3 and 5 years post project. In addition planting efforts implemented under the CREP program will be monitoring through stocking surveys.

e) **Water Quality** - In addition to the monitoring efforts listed above water quality (temperature) will be recorded for approximately 10 years. Temperature data was collected during 2010 and 2011 (Figure 1) and will be used in an EPT (extensive post treatment) monitoring design. It is anticipated that the analysis of these data would consist of summary statistics for each year/probe location with addition tests for differences in mean maximum weekly water temperatures between probe locations and between years using a paired t-test. The number of hour's water temperature reaches biologically detrimental limits such as >=20°C (no growth and behavioral changes), and DEQ standard lethal limits (25°C) a Generalized Linear Model analysis will be used (providing these data meet the assumptions of these tests).

Work Dates – Project implementation is scheduled to be initiated in November 2011 and completed in 2012. Specific dates for various project aspects include:

- Permitting - October 2011.
- Construction – Fall 2011, Summer/Fall 2012
- Monitoring – Initiated in 2010, continued through 2020.

8. Project Budget

Actions funded under funding agreements between GRMW, CTUIR, and ODFW include: planning/design, permitting, subcontracting, administration/inspection, and monitoring/evaluation. Additionally, CTUIR, ODFW, and GRMW staff will assist the landowner in preparing for WRP enrollment and assist in development of associated management plan in cooperation with NRCS.

Funds secured through this project proposal will be directed to on-the-ground activities associated with project construction.

Willow Creek Budget							
Work Item	Description	Detail	Cost Estimate	BPA-GRMW	CTUIR-BPA Accord	ODFW	Total
Item 1	Mobilization	Lump Sum	$10,000.00	$10,000.00	$0.00	$0.00	$10,000.00
Item 2	Large Wood Additions	73 Large Wood Addition Sites: Avg 4 pieces per site w/ 2 boulders for ballast per site. Total 292 logs @ $400/tree installed	$116,800.00	$116,800.00	$0.00	$0.00	$116,800.00
Item 3	Streambank Stabilization/Bioengineering	2,610 linear feet bankshaping/bio-engineering. Include bank shaping, coir fabric, planting/seeding, and labor: $25.00/ linear ft	$65,250.00	$65,250.00	$0.00	$0.00	$65,250.00
Item 4	Sreambank and Floodplain Planting	Streambank Planting (mechanical installation of 5,000 plants @ $11.50/plant); Floodplain planting (hand planting 3,000 trees/shubs @ $5.50/plant). Additional CTUIR and ODFW livewhip and sedge/rush planting (5,000 plants @ $2.00/plant	$84,000.00	$74,000.00	$5,000.00	$5,000.00	$84,000.00
		Agricultural Field Seeding (drilling), 85 Acres, 850# seed @ $15.00/#, seed drill @ $50.00/ac	$17,000.00	$17,000.00	$0.00	$0.00	$17,000.00
		Foxtail treatment units: Site preparation $100/ac, 330# seed @ $15.00/#, $50/acre to drill seed.	$9,900.00	$9,900.00	$0.00	$0.00	$9,900.00
Item 5	Re-Connection of Historic Channel Segment	3,022 linear feet channel construction w/in historic scroll (approx 2,500 cds @ $4.00/ft) 645 ft new channel (approx 2,300 cds @ $4.00/cyd), and 1050 linear feet channel reclamation ($5.00/ft)	$24,450.00	$24,450.00	$0.00	$0.00	$24,450.00
Item 6	Culvert Replacement	Replace 5 existing undersized culverts @ an avg of $1.940/ea.	$9,700.00	$9,700.00	$0.00	$0.00	$9,700.00
Item 8	Planning/Design/Admin/Mgt (Partners)	CTUIR/ODFW/GRMW	$60,000.00	$10,000.00	$25,000.00	$25,000.00	$60,000.00
TOTAL			$397,100	$337,100.00	$30,000.00	$30,000.00	$397,100