Tucannon River Stream/Riparian Restoration

Habitat Projects

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TUCANNON RIVER STREAM/RIPARIAN RESTORATION

Fiscal Year 1998 Habitat Projects

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TUCANNON STREAM/RIPARIAN RESTORATION

BPA PROJECT #94-18-6
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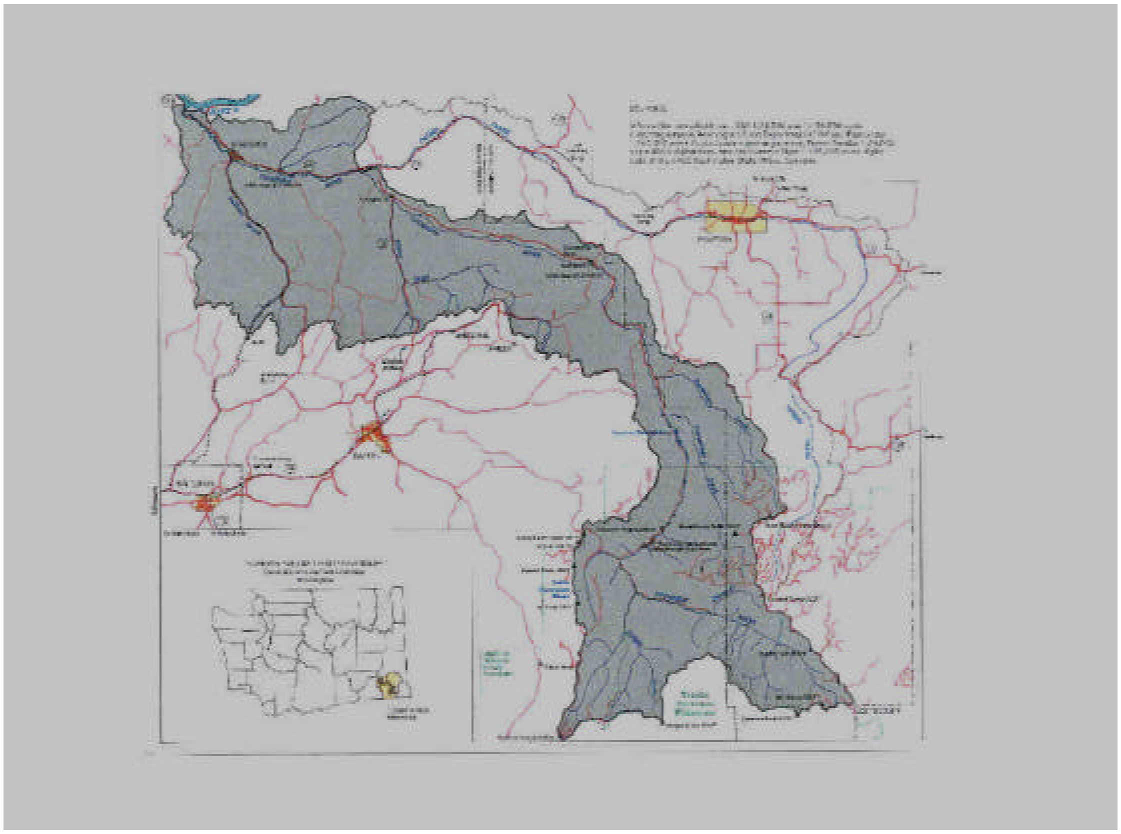

BACKGROUND

The Tucannon River, a major tributary to the Snake River, begins in the Tucannon-Wenaha Wilderness. The river runs through public lands managed by U.S. Forest Service (USFS) and Washington Department of Fish and Wildlife (WDFW), before entering private ownership. Primary watershed land use is range, production agriculture and forest. Starbuck, a small municipality, is located near the river's mouth.

The Tucannon River is currently home to ESA listed stocks of spring Chinook salmon, fall Chinook salmon, Snake River steelhead, and bull trout. The impacts of human activities and catastrophic natural events such as floods, droughts, and fires have negatively impacted the resources affecting these critical listed stocks.

Watershed-wide program interest in the Tucannon River basin began in the 1980's when the Columbia Conservation District installed the first instream habitat enhancement projects on a cost-share basis. The success of these demonstration projects lead to increased awareness of instream restoration. An early Washington

Department of Ecology (DOE) grant funded demonstration projects consisting of rock and boulder placement, cabled trees, riparian fencing, limited access water facilities, off site watering facilities, and dormant stock plantings (DSP) by volunteer sportsmen and students. USDA Natural Resource Conservation Service (NRCS) initiated the PL-566 program in the Tucannon Watershed to cost-share resource management conservation systems, which reduced erosion and thus the overall deterioration of watershed health. Landowners continued to adjust upland management systems with positive impact the river's riparian and instream environment. Grant money from the Washington Conservation Commission (WCC) and DOE continued to positively impact conservation through cost-share programs and NRCS technical support in-kind made major strides with landowners.

In 1993 the Tucannon River was selected by the Bonneville Power Administration to be one of the three Washington Model Watersheds. The Columbia Conservation District (district) received funding, through WCC, from BPA, to develop a watershed based habitat restoration plan. The *Plan* was developed to identify, protect, and restore fish habitat by utilizing sound technical information and citizen input. To produce the *Plan*, the district coordinated a planning process that combined the concerns and knowledge of local landowners with technical support from an interagency advisory group. The Tucannon River Model Watershed Program (Program) was born.

During the *Plan's* preparation the Technical Lead (TL), Landowner Steering Committee (LOC), and Technical Advisory Committee (TAC) made extensive use and comparison of existing literature, technical reports from state and federal natural resource agencies, personal communications with local residents intimately familiar with the watershed, and facilitated an assessment of resource conditions. The initial assessment included extensive research on historical conditions as well as current condition of instream fish habitat, fish data, and water quality. A walk-the-stream resource inventory was included in the current condition assessment.
Limiting factors for salmonid habitat productivity, identified throughout the watershed assessment and *Plan* development are; high stream temperature, high bacterial levels, high turbidity during periods of rain and snow melt, high levels of sediment in spawning gravels, low number of large rearing and resting pools with cover, and stream bank and geomorphic instability.

Habitat restoration for target ESA listed species, under the guidance of the *Plan* began in 1996 following a major flood, which accelerated habitat degradation. Adding ESA listing of Snake River steelhead and bull trout expanded the scope and value of identified habitat restoration needs and actions to encompass the entire river basin. WDFW research has identified the upper reaches, river mile 24.8 and up stream, as spring Chinook utilization and the lower reaches, river mile 13.7 and down stream, as fall Chinook utilization. WDFW research has identified steelhead utilization throughout the basin, depending on activity (i.e. spawning, rearing). WDFW research has also identified entire basin utilization by bull trout, depending on the season (i.e. upper reaches in spring and summer, lower reaches during fall and winter).

HABITAT RESTORATION PROJECTS

Projects, addressing multiple species habitat needs are located throughout the river basin. Corrective actions were identified on project-by-project bases by the Inter-Disciplinary Team (IDT), consisting of TL, NRCS and WDFW staff, and landowner. When available, staff representing USFS, USF&WS and NMFS joined the team.

Projects funded were designed to make incremental improvements toward desired habitat conditions within the Tucannon River Watershed, while addressing habitat and management activities identified in the 1994 Fish and Wildlife Program (FWP) Section 7.6D, as follows; large pools, large woody debris, riparian vegetation, sediment, stream morphology, bank stability, and water quality.

All projects consisted of two segments: instream and riparian. Instream restoration actions used addressed the identified limiting factors by reducing stream temperature, decrease the width/depth ration, increasing resting/rearing pools, enhancing habitat complexity, increasing stream bank and geomorphic stability, and sorting gravels in spawning areas.

Proposed instream actions include the bioengineering techniques of rock vortex weirs, rock/log barbs, vane/sill, large woody debris (LWD) placement, root wad revetments, large woody debris jams, and off channel rearing as identified by NRCS Watershed Planning Team (WPT) referencing Reckendorf, Frank and Michael VanLiew. 1988. and Rosgen, D.L., and B.L. Fittante. 1986. All practices identified are designed and installed to USDA NRCS Standards and Specifications to meet 25 to 100 year flow events.

INSTREAM BIOENGINEERING TECHNIQUES:

Code Description	Code
Site Work Type	**C: Instream & Bank Construction**
Specific Work Type	**27: Implementation**
Site Type	**S: Stream**
General Work Type	**3: Habitat/Watershed**
Category	**A: Anadromous Fish**
Subbasin	**57: Tucannon**

Vortex Weir

Description:

A vortex rock weir is constructed from very large rocks (~48" dia.) placed in a "V: shape pointing up-stream. Vortex rock weirs are used to create a scour pool and help develop the thalweg (area of stream with the deepest and fastest moving water).
Construction:

Initially trenches are dug into the banks on the end of each leg of the "V" and filled with graded riprap, to prevent water from scouring a new channel around the weir. Trenches are then dug at approximately 45-degree angles form the bank up-stream to the planned apex of the weir. Footer rocks are placed into the trenches to act as supports for the upper rock layer and provide a hard surface for the cascading water. The header rocks are then placed directly onto the slightly up-stream of the footer rocks. Header rocks are arranged so water flows over the center rocks and the height of the weir rises as it approaches each bank. Gaps of approximately 8-12 inches are left between the header rocks to provide for fish and debris passage.

Hydraulic Action:

The gaps between the header rocks concentrate flows during low water periods to scour gravels below the weir and creating small eddies behind rocks. During high flow, the water cascades over the weir, creating a crest or wave that may be three feet high. As the water tumbles over each "leg" of the weir into the center of the stream, a scour pool is created. Gravels are sorted on the tail-out area of the pool making a suitable site for spawning salmonids. Depending on the intended result of weir, the “legs” of the weir can be of different lengths to concentrate flows to certain areas of the channel.

Benefits:

Vortex weirs will result in a narrower and deeper channel, minimizing thermal input, and providing increased cross sectional area for periods of high flow. The eddies and interstitial spaces between the rocks provide cover and resting areas for juveniles. Scoured gravels tail-out into spawning areas and the hole scoured during high flows provides hiding areas. Root wads anchored under the footer rocks or cabled to a rock and set into the pool of the weir, add complex cover.

ROCK BARB

Description:

A rock barb is designed as a dual function structure: diverting the thalweg away from an eroding bank and to create a scour pool as the water rushes around the barb end. The structure is composed of a key trench, an area dug back into the bank at a depth below the streambed, filled with graded riprap and a rock mass (barb) projecting into the stream a planned distance and angled up-stream. The length of the barb and the up-stream angle area dependent on the planned result of the barbs actions. Typically the barb extends 1/3 to1/2 of the stream width at a 20-90 degree angle to the up-stream bank line.

Construction:

A key trench is excavated 8-10 feet into the bank at a depth approximately 2-3 feet below the existing streambed. Because of the volatile water action at the intersection of the barb and the bank line, proper key trench installation is crucial in preventing the water from washing behind the barb. The graded riprap in the key trench prevents erosion during low and high flow events.

The portion of the barb in the stream may be composed of graded riprap (usually 48" minus) or solely constructed of large boulders (48"-72") placed with footer and header rocks. Barbs constructed of graded riprap (48" minus) typically have the benefit of increased stability (less rock movement within the stream portion) but, decreased interstitial spaces for juvenile fish. Boulder constructed barbs have interstitial spaces but, may have a greater tendency to scour beneath the footer rock on the down-stream side increasing the potential for partial failure of the structure. Both types of structures have been installed with great success and will be monitored for effectiveness.

Hydraulic Action:

Redirecting the thalweg around a barb can/may result in a tremendous scour pool at the tip and immediately down-stream of the barb tip. This creates an eddy at the down-stream bank line resulting in deposition of suspended materials. Barbs placed along the bank line, but not into the thalweg also create pools and eddies at a reduced size, while still preventing bank sloughing. Barbs will also create a narrow and deeper channel, increasing the cross sectional area at this point. Depending on the planned results of barb installation, the barbs can be used to redirect flows reducing the radius of curvature on a meander corner, or to produce meanders in straight stream sections.

Benefits:

Scour pools formed at the barb tip, interstitial spaces within the barb rocks, and root wads placed within the scour pool all provide increased cover. Bank erosion is slowed or stopped resulting in less suspended sediment. Deposition along the downstream bank line provides tree planting opportunities leading to a complex riparian habitat community.

LOG BARB

Description:

This structure is a log, with or without a root wad that is partially buried into the stream bank and extends into the rivers current. The purpose of the log is to have the current scour a pool beneath the log as the water rushes under it or to create a pool and redirect the current away form the bank. Depending on the desired results, the log may be pointed up-stream or perpendicular to the bank. It might also be parallel to the water surface or may be at the water surface at the bank and angle slightly downward toward the end. The top of the log is placed a few inches to a foot below the water surface.

Construction:

A trench is dug back into the bank 5-10 feet and below the depth of the existing streambed. The log is laid into the trench, secured in place with large boulders, and the trench is back filled with the excavated materials. Depending on the log length, it may extend into the current five to 15 feet.

Hydraulic Action:

The current is forced over and under the log developing and maintaining a pool. If the log is angled up-stream the water current is redirected away from the bank. If a root wad is attached to the log the water flow is more disrupted and an eddy and pool are formed.

Benefits:

The scour pool and the log both provide cover for fish. This structure is a very low impact way of developing pools and breaking unruffled flows along the bank.

ROCK VANE

Description:

A rock vane is constructed from very large rocks (~48” dia.) placed at an acute angle to the stream bank and extending to or near the center of the stream.

Construction:

A key trench is dug at the bank-vane intersection and filled with graded riprap to prevent water from scouring a new channel around the vane. Then a deep trench is dug at an angle from 25-45 degrees from the rock key, up-stream to a planned distance. Footer rocks are placed into the trench; these rocks act as support for the upper rock layer and provide a hard surface for the cascading water to strike. The upper, or header, rocks are then placed onto and slightly up-stream of the footer rocks. Header rocks are placed so the water surface is just flowing over rocks at the end and gradually raised approaching the banks. Gaps of approximately 8-12 inches are left between the header rocks to provide for fish and debris passage.

Hydraulic Actions:

The gaps between the header rocks concentrate flows during low water periods, scouring gravel below the vane and creating small eddies behind each rock. Because the vane creates resistance to the water flow, a thalweg is developed at the end of the vane. During high flow the water shoots over the vane creating a crest or standing wave. As the water tumbles over the vane it strikes the thalweg, scouring out a pool and potentially redirecting the high flow toward the opposite bank. Vanes have the potential, if installed in a series of opposite bank installation, to create a narrow and deep thalweg that meanders within a straight stream section.

Benefits:

Vanes result in a narrower and deeper channel minimizing thermal input and increasing cross sectional area for periods of high flow. The eddies and interstitial spaces created provide cover and resting areas for juveniles. Scoured gravels tail-out into spawning areas and the hole scoured during high flows provides hiding areas and pools of cool water. The addition of root wads to the vane pool provided increased complex cover.

WOODY DEBRIS

Description:

Large woody debris may be placed within or in conjunction with other structures or independently depending on the site conditions. It is usually composed of root wads or logs but may also be bundles of brush. For this description, a root wad refers to a root mass with a 4-10 foot long log stem attached.

Construction:

Root wads with the log stem attached are placed within the barb, weir, or vane by excavating a trench below the expected depth of the footer rock and aligning the root mass so it will be within the scour pool. The stem is laid parallel or slightly downward to the streambed and slightly up-stream. Large rocks are placed onto the stem to secure the root wad within the bank. Root wads with short stems can be cabled directly to a large boulder and placed within the scour pool after construction of the weir, vane, or barb. Woody debris placed independently consists of excavating a small trench into the stream bank, placing the root wad into the stream, with the root mass 2-6 feet from the bank line, and back filling the trench with large rock and graded riprap. The rock secures the root wad and prevents bank scouring as the water flows over and under the log stem. At sites where bank disturbance is unwanted woody debris can be laid along the bank line and either be cabled to a deadman or tree, or have large rock placed at points along it's length to secure it in place.

Hydraulic Actions:

Root wads or logs projecting from the bank line into the stream flow force the water over and around the root wad scouring a hole and creating eddies. Brush, logs, or root wads placed along the bank line decrease erosion of a bank line while adding the benefit of interrupting a straight flow along the bank.

Benefits:

Woody debris, root wads, logs or brush, adds complexity to the pools developed by structure installation or along "sterile" bank lines. Debris provides cover as well as habitat for aquatic insects. Scour pools provide deep cover and cooler water holding areas.

Root Wad Revetment

Description:

Revetments are typically used to reinforce a vertical bank on a riffle or meander stream section. Meander bends can also be reconstructed using revetments. The most visible parts of the revetment are the root wads extending from the bank into the stream flow and the header logs. Header logs may or may not be used depending on the application. Log stems with root wads attached are placed with the root portion out of the constructed bank and facing slightly up-stream. The log stem extends into the bank 10-15 feet and is secured with large boulders. The footer logs placed parallel to the stream support the root wad. Optional header log stems cross the root wad logs and point downstream.

Construction:

A trench is dug parallel to the stream flow and well below the existing streambed for the length of the project. A footer log is placed in this trench and secured with large boulders: the footer logs established the new bank line. Root wads are placed on top of the footer log a approximately 10-15 foot spacing with the root mass pointing up-stream and the stem nearly perpendicular to the footer log with 10-15 feet into the constructed bank. The root mass extends 2-4 feet into the stream flow and approximately 1/2 of the root mass is below the water surface during flows experienced during construction periods. Head logs, if used, are then placed across the root wad stem and point down-stream: header logs may only be submerged during very high flows. Typically 6-10 cubic yards of very large boulders are placed on top of the stems to secure the root wad revetment in place. Rock may also be placed between the root wads to protect this area and also to act as small deflectors. Finally river cobbles or available soil materials are placed or the stems and rock anchors and graded to design specifications.

Hydraulic Action:

Root wads extending into the stream result in turbulent flows scouring pools and creating eddies. The combination of woody materials secured with large boulders has been successfully used in places that had highly erosive banks, piled river cobbles, or where no bank line existed.

Benefits:

Root wads add complexity to the pools developed by structure installation or along "sterile" bank lines. Root materials provide interstitial spaces for complex cover as well as habitat for aquatic insects. Scour pools provide deep cover and cooler water holding areas. Root wad revetment allows the thalweg to be maintained at the near bank region without erosion and interrupting flows at the bank line providing increased cover.

OFF-CHANNEL REARING AREAS

Description:

An off-channel rearing area is side pool, back channel, side channel or other areas that provides relatively still water during normal flows and are particularly important during high flows. Recent snorkeling surveys have shown that some stream flow must be maintained through a side channel if summer juvenile salmonid habitat is being developed. Side channels typically develop when a large woody debris (LWD) jam diverts the mainstream flow into a new channel around the woody materials and a partial flow is maintained through the jam. Recently constructed off-channel rearing areas have been side channels with continuous flows because they provide the best overall habitat.

Construction:

The planned channel is laid out for the most effective habitat development and to be the least vulnerable to degradation during high flows. The channel is dug below an existing or newly constructed LWD jam that will maintain summer flows. Secured woody materials are placed on the banks or span the channel to provide complex cover. The exit point behind the LWD jam and the elevation of the channel re-entering the stream determines the depth of the channel.

Hydraulic Action:

Constructed side channels are developed to maintain a continuous water flow throughout the year with limited velocities during the high flow events. The velocities are controlled by placement of LWD at the head of the channel and LWD in the channel to increase roughness. Side channels have little effect on the mainstream channel.

Benefits:

Side channels provide low velocity off-channel areas for both adults and juveniles during high flows. The complexity of cover and low velocity of the side channel make it an ideal area for juvenile rearing.

LARGE WOODY DEBRIS JAMS

Description:

A debris jam is a collection of large woody debris (LWD) that blocks a significant amount of flow to redirect the thalweg, provide bank and side channel protection, develop habitat, and drop stream bedload developing point bars. Layout of the LWD jam can also be used at the head of an off-channel rearing area to allow a continuous flow of water through the channel while limiting the amount of water during high flows. The appearance and placement of LWD jams is based on the natural occurring jams formed by LWD "racked" against root wads or key logs.

Construction:

Initially a trench is dug into the bank and/or the streambed and the key member logs laid at various angles to support the additional woody materials that will be placed perpendicular to and parallel to the stream flow. The height of the jam is based on the bank full discharge, floodplain height, and expected high flows. To secure the LWD in place, large rock and logs are placed at key locations to provide stable anchor points.

Hydraulic Action:

A LWD jam increases the roughness and decreases the velocities as the water flows through the complex woody materials. If placed at the bank line the LWD jam will shift the thalweg away from the bank reducing the near bank velocities and encouraging aggradations downstream of the jam. Jams placed in a series beginning at the crossover section can be used to redefine the thalweg for developing meander patterns or to provide direct bank protection. The jams will grow as wood and sediment or cobbles are caught in the complex mass.

Benefits:

LWD jams are major channel forming and habitat forming structures. Jams can develop rearing pools, protect side channels used by juveniles, and provide refuge areas for both adults and juveniles during high flows. The eddies and interstitial spaces between the rocks, logs, and root wads provide complex cover and resting areas for juvenile salmonids. Scoured gravels tail-out into spawning areas and the holes scoured during high flows provide hiding areas. LWD jams may also result in a narrower and deeper stream channel minimizing thermal input, and providing increased cross sectional area for periods of high flow.

RIPARIAN RE-VEGETATION:

Code Description	Code
Site Work Type	**C: Instream & Bank Construction**
Specific Work Type	**27: Implementation**
Site Type	**F: Riparian Zone**
General Work Type	**3: Habitat/Watershed**
Category	**A: Anadromous Fish**
Subbasin	**57: Tucannon**

RIPARIAN PLANTING

Riparian Restoration, the second segment of each project, will address the limiting factors by reducing stream temperature, increasing stream bank and geomorphic stability, reducing sediments in spawning gravels, reducing contaminants, and increasing water quality.

The conservation district has had an active planting program on both riparian areas and uplands for a number of years. During the initial phase of the Model Watershed planning process an agreement was developed between the NRCS, and districts to propagate selected native species to insure an abundant supply of riparian plant materials. Native trees and shrubs were harvested during the winters of 1995 and 1996, from the local area and are being propagated at the Washington Association of Conservation District Nursery in Bow, Washington (WACD PMC). Species include: Black Cottonwood, Red Osier Dogwood, Clematis, Blue Elderberry, willow varieties, conifer species, and other native shrubs.

Riparian plantings are an important component of all project sites, not only to provide stream shading, but also as an initial development of a healthy riparian community. Native trees and shrubs are planted on every project site, as well as, at other locations along the river where vegetation is lacking.

The soil types along the Tucannon River vary from very cobble loam to very deep silt loam soils. Riparian plantings in the past have been marginally successful because of: difficult soil planting conditions, flood events, and the extreme temperatures during summer months. Cottonwood poles, 3-6 inch diameter and 10 feet long, are now being grown at the nursery to try to speed up the plant establishment period by providing larger materials that can be buried to the subsurface water table. Planting materials of this size will require heavy equipment to either punch a hole into the streambank or to trench away from the streambank until a water table is found.

These buffers are an important component of the project site. Filtering surface runoff, providing stable streambanks, and maintaining riparian vegetation are a few of the riparian buffer benefits. Benefits that lead to complex habitat for salmonid populations.

1998 Projects

LOWER REACH PROJECTS:

General Description: This area is utilized by fall Chinook salmon for spawning and rearing, bull trout during the winter months and for steelhead rearing. These sites lacked pools, habitat complexity, and shading. Eroding banks and lack of riparian vegetation contributed to excess sediments in spawning gravels.

General Objectives: Create medium pools with complexity for juvenile rearing and large pools with complexity for adult resting. Reduce sediments and increase fluvial action to sort gravels for spawning. Reduce water temperature by decreasing the width to depth ratio and re-establishing a functioning riparian. Increase geomorphic stability of the river system.

Lower Reach Project #1 <u>**TUCANNON RANCH**</u>

Location: Physical: Site 1: NW ¼ Sec 13, T12N, R37E
River Mile 3.9
Site 2: NE ¼ Sec 14, T12N, R37E
River Mile 3.7
Site 3: NW ¼ Sec 13, T12N, R27E
River Mile 4.0
Hydrounit Number: 17060107
Quad Map: Starbuck West

Methods:

- 2 Vortex Weirs with root wads
- 6 vane
- 1 vane extension
- 3 Log barbs
- 415 ft. root wad revetment

Cost:	Total Cost:	$29,149.00
	BPA	$24,776.00
	Match	$ 4,372.00

Lower Reach Project #2 **<u>RUBENSER F & R FARMS SITE 1 & 2</u>**

Location:	Physical:	Site 1: NE ¼ Sec 19, T12N, R38E
		River Mile 5.5
		Site 2: NW ¼ Sec 19, T12N, R38E
		River Mile 5.0
	Hydrounit Number:	17060107
	Quad Map:	Starbuck East

Methods Used to accomplish objectives:

- 3 Vortex Weirs with root wads
- 1 vane
- 2 vane extension
- 270 ft. root wad revetment

Cost:	Total Cost:	$28,228.00
	BPA	$23,994.00
	Match	$ 4,234.00

Lower Reach Project #3 **<u>DUCHARME</u>**

Location:	Physical:	Site 1: SE ¼ Sec 23, T12N, R38E
		River Mile 10.2
		Site 2: SW ¼ Sec 23, T12N, R38E
		River Mile 10.1
	Hydrounit Number:	17060107
	Quad Map:	Starbuck West & Kellogg Creek

Methods:

- 3 Vortex Weirs with root wads
- 3 vane
- 2 vane with individually placed LWD
- 250 ft. root wad revetment

Cost:	Total Cost:	$21,162.00
	BPA	$17,988.00
	Match	$ 3,174.00

MIDDLE REACH PROJECTS:

General Description: Adult resting pools with complex habitat are needed throughout this area. Eroding banks increase the instability of the system, increase sedimentation, and allow for increased water temperature from a high width to depth ratio. The middle reaches have most often been utilized by steelhead for rearing. The middle reaches are also vital for spring Chinook salmon passage. WDFW have documented steelhead redds in this area thus extending their used of the river.

General Objectives: Stabilize the river system by reducing sediments and increase fluvial action to sort gravels for spawning. Reduce water temperature by decreasing the width to depth ratio and re-establishing a function riparian. Increase geomorphic stability of the river system. Create large pools with complexity for adult resting.

Middle Reach Project #1 **<u>MARTIN</u>**

Location:	Physical:	NE ¼ Sec 3, T11N, R39E
		River Mile 17.0
	Hydrounit Number:	17060107
	Quad Map:	Tucannon

Methods:

- 1 Vortex Weirs with root wads
- 1 vane
- 3 Log Barbs
- 400 ft. LWD

Cost:	Total Cost:	$18,927.00
	BPA	$16,088.00
	Match	$ 2,839.00

Middle Reach Project #2 **<u>TURNER</u>**

Location:	Physical:	NW ¼ Sec 9, T11N, R40E
		River Mile 22.5
	Hydrounit Number:	17060107
	Quad Map:	Turner

Methods:

- Large Woody Debris Placement

Cost:	Total Cost:	$2,988.00
	BPA	$2,241.00
	Match	$ 747.00

UPPER REACH PROJECTS:

General Description: This area is prime Spring Chinook Salmon spawning and rearing. Depending of the season, these reaches are also utilized by steelhead and bull trout. River through parts of this area lacks meander. Large adult resting pools with complex habitat are lacking. Small to medium complex pools are minimal. Eroding stream banks increase the instability of the system, increase sedimentation to spawning gravels, and allow for increased water temperature from a high width to depth ratio.

General Objectives: Increase geomorphic stability of the river system. Increase fluvial action to sort gravels for spawning and reduce sedimentation. Reduce water temperature by decreasing the width to depth ratio. Re-establish a functioning riparian area. Create various size pools with complexity for adult and juvenile usage.

Upper Reach Project #1 **<u>LOWER FEEDER</u>**

Location:	Physical:	SE ¼ Sec 18, T11N, R41E
		River Mile 26.2
	Hydrounit Number:	17060107
	Quad Map:	Zumwalt

Methods:
- 3 Vanes

Cost:	Total Cost:	$ 4,912.00
	BPA	$ 3,782.00
	Match	$ 1,130.00

Upper Reach Project #2 **<u>DELBERT</u>**

Location:	Physical:	W ¼ Sec 19, T11N, R41E
		River Mile 26.9 – 27.8
	Hydrounit Number:	17060107
	Quad Map:	Zumwalt

Methods:
- 3 Vortex Weirs

Cost:	Total Cost:	$16,470.00
	BPA	$12,682.00
	Match	$ 3,788.00

Upper Reach Project #3 **<u>BOSLEY</u>**

Location:	Physical:	SW ¼ Sec 30, T11N, R41E
		River Mile 29.0
	Hydrounit Number:	17060107
	Quad Map:	Zumwalt

Methods:

- 1 Vortex Weir

Cost:	Total Cost:	$ 5,239.00
	BPA	$ 4,034.00
	Match	$ 1,205.00

Upper Reach Project #4 **WDFW**

Location:	Physical:	NW ¼ Sec 4, T10N, R41E River Mile 33 – 33.5
	Hydrounit Number:	17060107
	Quad Map:	Zumwalt & Hopkins Ridge

Methods:

- 1 Cut off trench
- 5 log jams
- 360 ft. of river mender improvement

Cost:	Total Cost:	$37,323.00
	BPA	$20,000.00
	Match	$17,323.00

Upper Reach Project #5 **RUSSELL FAMILY PARTNERSHIP PHASE I**

Location:	Physical:	SE ¼ Sec 16, T10N, R41E River Mile 34.3
	Hydrounit Number:	17060107
	Quad Map:	Hopkins Ridge

Methods:

- Off Channel Rearing
- 330 ft. LWD
- 160 ft. root wad revetment
- 2 J Hook Vanes

Cost:	Total Cost:	$26,420.00
	BPA	$17,955.00
	Match	$ 8,465.00

Upper Reach Project #6 **COW CAMP PHASE I**

Location:	Physical:	SE ¼ Sec 30, T9N, R41E River Mile 44.8
	Hydrounit Number:	17060107
	Quad Map:	Panjab Creek

Methods:

- 2 Vortex Weirs
- 360 ft. LWD placement

Cost:	Total Cost:	$17,637.00
	BPA	$14,815.00
	Match	$ 2,822.00

TREE AND SHRUB PLANTINGS:

Mechanical Stinger

Approximately 30,000 native trees and shrub plants and whips were planted at all instream project sites along with seven additional sites throughout the entire river basin. Plants were purchased form the WACD PMC and Potlatch Co. Some evergreens were donated by the USFS. Many willow whips were collected locally. Planting was performed by hand and by mechanical means. The district utilized the Nez Perce Tribal Salmon Corps and seasonal WDFW staff to perform hand plantings, however the majority of plants were planted mechanically using a local contractor with a stinger or a large ripper. The majority of plants were whips, bare root and rooted stock. A trial using large cottonwood poles was conducted at three sites.

Evaluation of the pole planting sites has noted an 80% survival rate with good vigor and minimal weed competition. This trial appears to support mechanical planting as a preferred method. Machines are used to trench next to the stream and then placing poles parallel or perpendicular to the stream. Poles are covered except for the top several buds. This method allows poles to establish root mater without having to support extensive above surface growth, thus giving a boost to plant establishment. Whips, bare root and rooted stock were also planted using mechanical means with more survival than those planted by hand.

The district conducted fall and spring plantings. Fall plantings were done after plants went dormant for the winter. The fall planting was done by hand. A second attempt is being made with mechanical planting so an evaluation can be done on time of year impact on plants.

Riparian Re-vegetation

Cost: Total BPA Cost: $32,920.00

Mechanical Ripping Planter

MONITORING & EVALUATION:

The district has contracted with Washington Department of Fish and Wildlife Snake River Lab (WDFW SRL) to perform pre and post construction habitat cross-sectional measurements on all project sites. Habitat measurements taken include; site length, maximum and mean site depth, mean wetted width, mean thalweg depth, quantitative and qualitative counts of woody debris, number of pools, quality of pools, pool area, pool depth and fluorescent dye and flow rate. These measurements will be taken at additional intervals of 5, 10, and 15 years. Reports are generated following each evaluation. WDFW SRL continually monitors salmonid utilization throughout the basin. New findings show increase utilization of project areas. This is encouraging.