RCD
SHASTA VALLEY
RESOURCE CONSERVATION DISTRICT

Shasta River Tailwater Reduction: Demonstration and Implementation Project

Final Project Report

Proposition 40/50- Agricultural Water Quality Grant

State Water Resources Control Board

Grant Agreement No. 06-271-551-2

Total Grant Funds $735,490.00

March 2012

Presented by:
AquaTerra Consulting
Weed, California

For:
Shasta Valley Resource Conservation District
Yreka, CA

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GRANT SUMMARY

Completed Grant Summaries are made available to the public on the State Water Resources Control Board's (SWRCB) website at http://www.waterboards.ca.gov/funding/grantinfo.html
Use the tab and arrow keys to move through the form. If field is not applicable, please put N/A in field.
Date filled out: 12/23/11

Grant Information: *Please use complete phrases/sentences. Fields will expand as you type.*

1. Grant Agreement Number: 06-271-551-2

2. **Project Title:** Shasta River Tailwater Reduction: Demonstration and Implementation Project

3. **Project Purpose – Problem Being Addressed:** improving water quality in the Shasta River by decreasing temperatures and increasing dissolved oxygen through improved agricultural water management.

4. Project Goals

a. **Short-term Goals:** Reduce the amount of agricultural run-off (tailwater) that returns to the Shasta.

b. **Long-term Goals**: Improved water quality.

5. **Project Location**: (lat/longs, watershed, etc.) Shasta River, Klamath Watershed.

a. **Physical Size of Project**: (miles, acres, sq. ft., etc.) 790 sq miles

b. Counties Included in the Project: Siskiyou County

c. **Legislative Districts:** (Assembly and Senate) State Assembly=2 State Senate=4

6. Which SWRCB program is funding this grant? Please "X" box that applies.

☐ Prop 13 ☒ Prop 40 ☒ Prop 50 ☐ EPA 319(h) ☐ Other

Grant Contact: Refers to Grant Project Director.

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Grant Time Frame: Refers to the implementation period of the grant.

From: January 2007 **To:** March 2012

Project Partner Information: Name all agencies/groups involved with project. U.S. Fish and Wildlife Service, The Nature Conservancy, CA Department of Fish and Game, and Natural Resources Conservation Service

Nutrient and Sediment Load Reduction Projection: (If applicable) NA

Please provide a hard copy to your Grant Manager and an electronic copy to your Program Analyst for SWRCB website posting. All applicable fields are mandatory. Incomplete forms will be returned.

Executive Summary

This project included the development of a watershed-wide planned and prioritized approach that guided efforts to reduce tailwater's negative impacts to water quality. This watershed-wide planning approach was accomplished by capturing detailed topographic data via aerial survey (LiDAR) for the use in defining tailwater neighborhood drainage areas, as well as the creation of tailwater accumulation and tailwater impact models. A Technical Advisory Committee (consisting of landowners, agencies, and other stakeholders) met numerous times to develop criteria to prioritize tailwater impacts in the watershed; based on estimated quantity, temperature impacts and location of a return in relation to salmonid rearing habitat.

Once neighborhoods were prioritized for impacts, outreach to individuals in high priority tailwater areas was initiated to solicit the planning and development of tailwater reduction projects. A list of potential projects was created and scored based on the screening criteria to ensure the project would be aligned with the goals of the project. Once screening was completed more in-depth project planning was initiated and project scoring was finalized. A total of six projects were funded through this agreement and went through this scoring process. Five of the projects were irrigation efficiency projects, where open ditches were replaced with pipeline and/or leaky turn-outs were replaced. One project was a riparian buffer project in an area where sheet flow returns to the river.

Piping of the irrigation ditches is intended to improve water use efficiency for landowners (reducing the amount of water needed for irrigation), thus reducing the amount of tailwater returning to the Shasta River. The riparian buffer project is a demonstrating how a riparian zone can shade and cool tailwater before it re-enters the waterway. All projects were implemented after the last irrigation season of the grant term and pre-project monitoring data is all we have available at this time. Post project monitoring will occur in 2012.

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Introduction

This project is located in the Shasta River Watershed, an important cold-water tributary to the Klamath River Basin in Northern California (see Figure 1). The Shasta River Watershed encompasses over 790 square miles and includes over 120 miles of streams. In 2005 the Southern Oregon and Northern California Coho (SONCC) salmon was listed as threatened by the State of California. In 2007, the Environmental Protection Agency formally adopted a Total Maximum Daily Load (TMDL) for the Shasta River, which lists the river as being impaired for elevated temperature and low dissolved oxygen levels. A majority of the Shasta River Watershed is in private ownership with some federal land-holdings mostly in the headwaters. Private lands adjacent to the Shasta River consist of small cow-calf and hay operations, which predominantly depend on numerous surface water diversions from the Shasta River and tributary streams and springs to flood irrigate pastures.

Agricultural run-off or "tailwater" is identified in the Shasta River TMDL as being major contributor to the poor water quality conditions in the river. Since its inception in 1991, the Shasta Valley RCD (SVRCD) has been looking at ways to reduce tailwater return flows and improve water quality throughout the valley while ensuring that agricultural operations would remain solvent. Prior to the funding of this grant the SVRCD (and other agencies) had no watershed-wide planned approach to tackle tailwater return impacts.

This final report represents the conclusion of this multi-year and multi-partner effort to plan, design and implement tailwater reduction efforts focusing primarily on areas of the watershed accessible to anadromous fish. The planning efforts and prioritization criteria developed with this funding will assist the SVRCD and other agencies at addressing tailwater impacts well into the future and throughout the entire watershed. Projects funded through this grant provide both an example to other irrigators, and make substantative improvements to water quality.

Other contributing funders for this project include: the CA Department of Fish and Game, the Natural Resources Conservation Service, the U.S. Fish and Wildlife Service and the Shasta Valley Resources Conservation District.

1.0 Problem Statement

Pursuant to Section 303(d) of the Clean Water Act, the EPA listed the Shasta River as impaired for organic enrichment/dissolved oxygen in 1992, and as impaired for temperature in 1994. Low dissolved oxygen concentrations and elevated water temperatures in the Shasta River and its tributaries have negatively affected the river's ability provide adequate spawning, reproduction, and rearing habitat for salmonid species, including ESA listed Coho salmon, along with Steelhead and Chinook. It is believed that elevated stream temperature and low dissolved oxygen levels are primary reasons that anadromous salmonid populations in the Shasta River and throughout the Klamath River watershed have declined dramatically over the last half-century.

The North Coast Regional Water Quality Control Board has identified tailwater return flows as one of the five primary factors affecting both elevated stream temperatures and nutrient enrichment/depressed dissolved oxygen levels in the Shasta River watershed. Accordingly, in order to improve habitat conditions in the Shasta Valley watershed, tailwater reduction planning efforts are imperative.

In the Shasta Valley, most farmland is flood irrigated. Water is diverted from the river and travels in irrigation ditches or pipelines, sometimes many miles to it's place of use. It's then "turned out" sheet flows across fields as a means of irrigating. Whatever water that does not get used by the plants, evaporate or go to deep percolation, runs-off as tailwater. Tailwater is not simply a case of over-application of water. In order to apply water from a ditch across a field, excess must be applied. Depending on local conditions, that excess generally ranges from 25-50% more than is actually required by the plants themselves. Hence, tailwater creation is directly related to flood irrigation and a variety of unintended water quality impacts come into play as a result:

- *Temperature gain: During the daytime, as the irrigation water sheet flows across a pasture or field, the temperature of that water increases. So the water that is not consumed (used by plants, evaporated or percolated to groundwater) flows back to the river with elevated temperature, observed as high as 37 degrees Celsius.*
- *Nutrient Loading: As the water sheets across the pastures, it dissolves minerals, fertilizer elements, and organic matter, and it suspends organic and inorganic fine materials. Tailwater returning to the river then delivers those materials to the waterway.*
- *Low Dissolved Oxygen Levels: The increase nutrient loading encourages aquatic vegetation growth, which was identified by the North Coast Regional Water Quality Control Board (North Coast Regional Water Board) as the primary source of low levels of dissolved oxygen observed in the Shasta River at night when plant metabolism requires oxygen to sustain those plants. Oxygen levels can be reduced to the point that salmonids and other aquatic organisms cannot survive.*
- *Coho Rearing: Cold water is imperative for Coho and steelhead survival because they rear in fresh water for at least one year prior to migrating to the ocean. Those rearing in the Shasta River must find cool water throughout the summer months when the above irrigation practices are underway. Tailwater returns have a cumulative effect on river temperatures. It was found that much of the Shasta has Mean Weekly Maximum Temperatures above 18 degrees C, which has been found to be above the long-term temperature tolerance of Coho (Welsh et al. 2001).*
- *Improved water use efficiency: With most irrigation systems, owners and operators divert water into open ditches. To operate efficiently, those ditches require maintenance in the form of periodic reconstruction, regular vegetation control with herbicides, and ongoing minor repairs. Poorly maintained open ditches contributed to increased water consumption and water losses to percolation/leakage. Beyond the conveyance losses, the transfer of water from ditches to the fields to be irrigated is difficult to control precisely, resulting in areas of over and under irrigation, and/or increases in tailwater creation. Replacing ditches with pipelines and associated risers or gated pipe allows the water users to better manage and distribute their water across their fields in a shorter amount of time, in more equal quantities and without the risks to water quality associated with herbicide use.*

2.0 Project Goals

The overarching goal of the Shasta River Tailwater Reduction: Demonstration and Implementation Project was to implement projects based on a prioritized approach that would meet TMDL water quality objectives while insuring that water users meet anticipated regulatory requirements and can maintain the economic viability of their agricultural operations. The summarized goal was to keep warm tailwater out and cold water in the Shasta (and its tributaries).

The following steps accomplished these goals:

1. Capture detailed topographic data via aerial survey (LiDAR) for use in defining tailwater neighborhood drainage areas, and planning for earthmoving activities. LiDAR data may also prove useful in documenting baseline conditions (riparian trees and stream width).

2. Collection of tailwater quantity and quality data, river water quality data and continuous dissolved oxygen data from several locations for watershed-wide and project specific planning purposes.

3. Tracking stream flow at established gauging stations on the Shasta River.

4. Outreach to individuals in high priority tailwater areas to solicit their suggestions for the planning and development of tailwater reduction projects.

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5. Utilizing all the above information, development of watershed-wide tailwater reduction plan that prioritizes and guides efforts to reduce tailwater's negative impacts to water quality.

6. Development of a feasibility study that specifically addresses reducing tailwater on a high-priority ranch or irrigation district.

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7. Installation of two to five projects in high priority areas to meet the objectives of the tailwater reduction plan that can serve as a demonstration to the community on different ways to reduce tailwater.

3.0 Project Description

To assist landowners with the requirements identified in the ShastaTMDL, the SVRCD was awarded this grant in order to develop a strategic and planned approach to addressing water quality impacts associated with tailwater returns. Tailwater can be defined as run-off from agricultural irrigation practices, usually related to flood irrigation. (Tailwater can also run onto a neighboring property, from where it may eventually return to the river). In terms of management, a discrete area contributing to a single tailwater return flow has been given the name "Tailwater Neighborhood", which can be defined as a geographic area, mini-basin or watershed that produces tailwater; where one to several landowners contribute to a single tailwater return to the river. Approaching tailwater reduction efforts from a "neighborhood" perspective requires shared responsibility for reducing tailwater impacts and can result in the development of the most efficient tailwater reduction program. The main goal of this project was identifying and prioritizing tailwater neighborhoods, based on potential impacts to water quality and salmonid rearing habitat.

The State Water Resources Control Board approved this grant agreement in 2007 and grant implementation began immediately. The LiDAR survey was completed early in 2008, along with a hydro-accumulation model which were used to identify tailwater neighborhoods based on presence of irrigation, slope, topography, etc. Once the neighborhoods were identified, prioritization was completed. In order to have a transparent approach to prioritization, landowners, agencies and other stakeholders were invited to participate in a Technical Advisory Committee (TAC). This committee helped identify key issues and reviewed scoring criteria, collectively called tailwater neighborhood impact criteria. The tailwater neighborhood impact criteria that were developed consisted of a weighted scoring matrix that scored a return based on where the return was located in relation to known salmonid rearing habitat, estimated (or measured) amount of tailwater that could be/was produced from a neighborhood and what potential impact that return had on river temperatures. The neighborhood impact scoring matrix is included Tailwater Reduction Plan in the Appendix A.

After the criteria for prioritizing neighborhoods was established, estimates for tailwater quantity and temperature impacts for each neighborhood had to be developed via a combination of existing data and modeling. Just as that process began, the state budget crisis occurred and grant spending was frozen (for about fourteen months). The SVRCD received emergency funds from the California Department of Fish and Game via the Pacific States Marine Fishery Commission (PSMFC) to finish the modeling effort while all other funds were frozen. What resulted was a color-coded map prioritizing neighborhoods based on the impact criteria, which is included in the Appendix D (Unkefer, 2011a).

Once the state spending freeze was lifted, work was re-initiated and the neighborhood prioritization that was created during the freeze was used to direct landowner outreach to plan tailwater reduction projects. All conceptual projects were screened using criteria created by the TAC, to ensure the proposed projects met the goals of the tailwater reduction project. A list of 25 projects was conceptualized and screened, six projects were selected for implementation and project scoring was completed using the criteria determined by the TAC (included in the Appendix A). A few other projects were initially identified for implementation, however due to time lost as a result of the above mentioned spending freeze, permitting and design requirements would have exceeded remaining time available under the grant terms, so those projects were replaced by other projects where design/planning was already underway. Four of these projects had matching funds and technical assistance through Natural Resources Conservation Service (NRCS).

The following is a description of the completed demonstration and implementation projects, and includes their prioritization scores:

- Lemos Tailwater Re-use Improvement Project: (41°43'32" N latitude, 122°33'35" W longitude) This project included the installation of approximately 1,980-feet of buried mainline pipe for connection to an existing tailwater pump. The pipe was fitted with twenty-five 8 to 10-inch flood irrigation valves, and 600-feet of gated pipe to facilitate the re-use of tailwater in an existing pond that the landowner was unable to fully utilize prior to the project. A concrete pipe inlet structure and drainage ditch were also needed to re-use tailwater that flowed onto the property by utilizing a new gravity conveyance piping system. The areas addressed had previously been irrigated with water drawn directly from the river. Tailwater neighborhoods associated with this project are 03-083 and 03-004[(1)].
  Neighborhood Score= 262 Screening Score= 782 Project Score= 995

- Hidden Valley Westside Pipeline Efficiency Project: (41°33'29"N latitude, 122°24'2" W longitude)This project consisted of installing approximately 3,500 linear feet of buried main pipeline fitted with flood irrigation valves and 600-feet of gated pipe, all of which replaced an existing irrigation ditch and allows for better management of flood irrigation. The intent of this project was to increase efficiency by replacing leaky ditches with pipe, with the hope of reducing the amount of cold spring water used for irrigation purposes and reducing tailwater created from neighborhoods 07_122, 07_148, 07_103, 07_163, and 07_019.
  Neighborhood Score= 476 Screening Score= 996 Project Score= 1282

- Hidden Valley Bunkhouse Pipeline Efficiency Project: (41°33'29"N latitude, 122°24'2" W longitude) This site included installation of approximately 2,400 linear feet of buried main pipe fitted with flood irrigation valves, within an existing irrigation ditch. This project also consisted of relocation of a wooden fence, which tended to concentrate flood irrigation water and increase tailwater run-off. The intention of this project was to allow the landowner to manage irrigation water more efficiently, use less water and create less tailwater. Neighborhoods 07_191, 07_216, 07_015, 07_237 and 07_198 are associated with this project.
  Neighborhood Score= 760 Screening Score=1180 Project Score= 1445

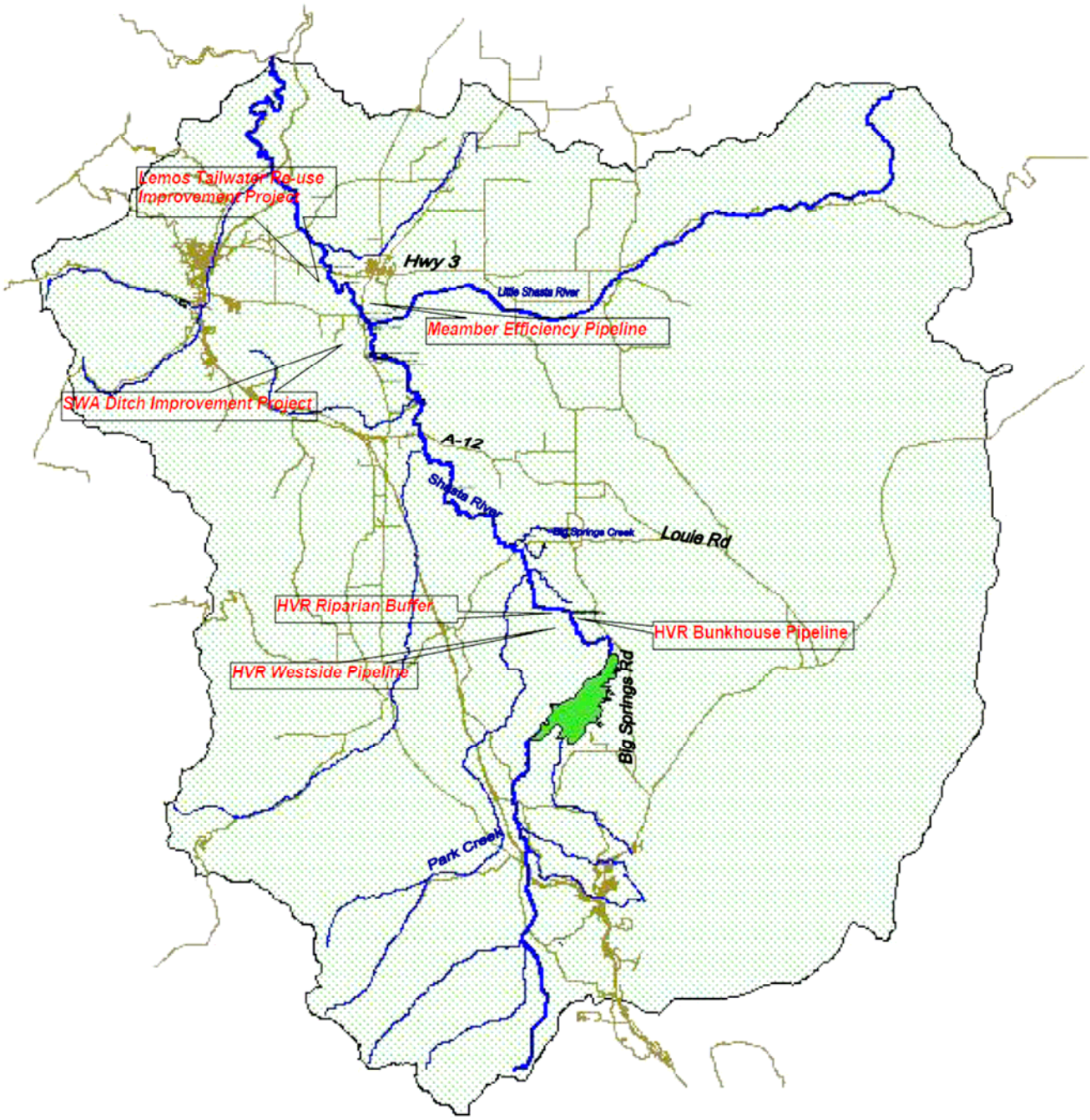
- Meamber Pipeline Efficiency Project: (41°42'32" N latitude, 122°32'11" W longitude) An existing river diversion pump was connected to newly installed 2,500 feet of buried mainline pipe fitted with hydrants and gated pipe for irrigation use to improve irrigation efficiency, reduce the amount diverted from the river and reduce the amount of tailwater created. Tailwater neighborhood 03-192 is associated with this project and pre-project monitoring occurred in 2011. This project will be complete with a tailwater capture and re-use component in 2012, to ensure all tailwater produced from the neighborhood is completely reused in-lieu of river water.
  Neighborhood Score= 256 Screening Score= 776 Project Score= 1013

Note (1): The 5 digit neighborhood number as identified for each project can be found on the SVRCD tailwater neighborhood prioritization maps.

- Hidden Valley Riparian Buffer Project: (41°33'29"N latitude, 122°24'2" W longitude) A total of 3,913-feet of riparian fence was installed for cattle exclusion to demonstrate how riparian buffer zones can reduce temperature and nutrient loads of sheeting tailwater flows. Two separate stretches of river were fenced. Two stock water trough systems were constructed near each fenced area in order to provide the landowner a post-construction livestock watering method.
  Neighborhood Score= 476 Screening Score=996 Project Score= 1296

- Shasta River Water Association Turn-out and Lateral Replacement: (41°41'45"N latitude, 122°32'44" W longitude)An area within the Shasta River Water Association was identified during neighborhood outreach meetings as needing water-tight gates and new laterals to reduce tailwater creation and reduce direct diversion from the river. Tailwater neighborhoods associated with this project are 03-070, 03-071 and 03-237, which have been monitored in 2008, 2009, and 2011, prior to implementation.
  Neighborhood Score= 540 Screening Score= 1000 Project Score=1316

Pre-project, Construction and Post project photos are provided in the Appendix E. All projects were constructed in Fall/Winter 2011/2012. The locations of these construction projects are identified on Figure 1.



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Shasta Valley RCD- Tailwater Reduction Project

Figure 1

Tailwater Reduction Project Location Map

A. Project Type

This project was funded as an Implementation and Planning Grant by the State Water Resources Control Board (State Water Resources Control Board) through the Proposition 40/50 Agricultural Water Quality Grant program. This project is consistent with the Shasta River TMDL, the Recovery Strategy for California Coho Salmon, and the Shasta River Watershed Plan.

B. Project Costs

A total of $1,076,125.22 was spent to implement this project. Table 1 below summarizes project expenses by category and a summary of specific construction related contracted services performed.

Project Line Item	Total Budget	Match $$	Prop 40/50
RCD Personnel	$ 155,340.88	$ 2,774.12	$ 152,566.76
RCD Direct Project Expenses (supplies, utilities, travel, monitoring equip., etc)	$ 58,527.50		$ 58,527.50
Professional Services (TW model, LiDAR, Engineering, CEQA prep, Permitting)**	$ 382,833.50	$ 98,600.00	$ 284,233.50
Construction Projects			$ -
-HVR Bunkhouse Pipeline (North Rivers Construction)**	$ 86,544.00	$ 35,721.59	$ 50,822.41
-HVR Westside Pipeline (Woody Tanacci Backhoe)**	$ 74,927.00	$ 42,903.49	$ 32,023.51
-HVR Change Order for Fence Removal for Bunkhouse Pipeline (Woody Tanacci Backhoe)	$ 6,200.00		$ 6,200.00
-Meamber Pipeline Efficiency Project (Peter's Enterprises)**	$ 92,793.08	$ 80,084.10	$ 12,708.98
-Lemos Tailwater Re-use Improvement Project (North River Construction)**	$ 85,683.00	$ 26,990.67	$ 58,692.33
-Schedule 1- SRWA South LMD Improvement Project (North River Construction)	$ 74,111.00		$ 74,111.00
-Schedule 2- SRWA North LMD Improvement Project (Woody Tannaci Backhoe)**	$ 67,421.00	$ 67,421.00	$ -
-HVR Riparian Buffer Fence and Stockwater Project (Landowner)**	$ 29,347.57	$ 29,347.57	$ -
-SRWA- TW intake Structure Project **	$ 9,725.88	$ 9,725.88	$ -
Construction Labor Compliance	$ 4,614.57		$ 4,614.57
Total	$ 1,128,068.98	$ 393,568.42	$ 734,500.56

Funding provided by the Prop 40/50-Ag Water Quality program totaled $735,490. Table 2 summarizes other federal and state funds acquired for project implementation. The $327,517.24 of matching funds declared as part of this Prop 40/50 program came from partnership programs from Natural Resources Conservation Service's (NRCS), US Fish and Wildlife Service (USFWS), Pacific Sates Marine Fisheries Counsel (PSMFC), and The Nature Conservancy.

Matching Funding Source	Totals
Prop 50 - IRWM Grant (State)	$ 67,421.00
2009 KRA-26 & 16 (PSMFC- Federal)	$ 12,500.00
2008 TNC- Contract with NRG (Private)	$ 7,000.00
NRCS- EQIP Partnership (Federal)	$ 277,299.85
USFWS- Partnership for Fish & Wildlife (Federal)	$ 29,347.57
Totals	**393,568.42**

C. Project Methodologies:

Since this is a diverse project with many elements and methodologies the only way to synthesize them all is to summarize the project timeline describing all elements and how they fit together to meet the project goals. A list of project submittals is included in Appendix B. The SVRCD received the final Prop 40/50 grant agreement in January 2007; project initiation began in March 2007 and finished with tailwater reduction project implementation in fall 2011/Winter 2012. Appendix E includes project photos, which documents the construction activities on all selected projects.

The following is a brief timeline and description of all project activities that took place between March 2007 and March 2012.

March 2007-August 2007

- Monitoring protocol was formulated (QAPP, Monitoring Plan, PAEP etc). Monitoring equipment research was started and quotes were obtained.

- Began researching LiDAR vendors and consult with Regional Water Quality Control Board staff regarding LiDAR specifications
- Outreach and Technical Advisory Group was initiated.

August 2007-October 2008

- Facilitated three meetings with TAC (landowners, regulatory agencies, other stakeholders) and the RCD to begin formulation of the tailwater impact prioritization criteria.
- Facilitated three additional meetings with subcommittee to formulate project screening and scoring criteria.

September 2007

- Started outreach to CRMP and RCD Board about project goals.
- Initial outreach with Irrigation District Boards (Shasta River Water Association and Montague Water Conservation District) to inform members of tailwater reduction opportunities.

October 2007

- Request for Proposals for LiDAR survey was distributed to recommended vendors

November 2007- December 2007

- LiDAR contract was negotiated and finalized with TerraPoint.

January 2008

- LiDAR Flight

February 2008- April 2008

- LiDAR data was processed and sample data was issued to RCD for review.
- Monitoring equipment for measuring tailwater flow, water temperature and dissolved oxygen was ordered for 2008 irrigation season.

April 2008-November 2008

- Final LiDAR data processing and hydro-accumulation model was completed by GIS consultant for the identification of tailwater neighborhoods valley-wide.
- All data was presented to TAC and SVRCD board.
- Tailwater Temperature Impact and Tailwater Accumulation Models were initiated.
- Monitoring data was collected throughout the valley (where landowners were willing), data used to calibrate the model.

September 2008- January 2009

- SRWA Tailwater collection vault was installed as part of the SRWA pump replacement project, funded through the Pacific States Marine Fisheries Commission with funds provided by the California Department of Fish and Game.

December 2008 – January 2010

- State Budget Crisis- No invoices could be submitted to RWQCB for work completed.
- SVRCD was able to obtain Pacific States Marine Fisheries Commission Grant with funds provided by the Department of Fish and Game to finish tailwater models and prioritize identified neighborhoods valley-wide for potential impacts.

February 2010- November 2010

- Spending freeze lifted, project was re-initiated.
- Landowner outreach for monitoring and project conceptualization was started again.
- Tailwater monitoring for temperature, volume and nutrients was performed to assist in prioritizing projects.
- Hole-in-the ground Ranch Tailwater Reduction Feasibility Study was completed by subcontractor: Davids Engineering.

November 2010 – March 2011

- Project Planning (CEQA, Cultural Resources and Wetland Delineations) and designs for the Hidden Valley Tailwater Projects were completed.

March 2011 – November 2011

- Pre-project Monitoring was completed for all projects identified for implementation.

April 2011-December 2011 (2011 Construction Activities- All Design work was completed by NRCS)

- Invites to bid on Hidden Valley Ranch (HVR) Bunkhouse and Westside Pipeline Projects were published on April 13, 2011
- Pre-Bid Walk Thru for HVR Pipeline Projects was on April 22, 2011 (photos in Appendix)
- HVR Projects Bid Opening was done on May 2, 2011
- Contracts awarded to North Rivers Construction (HVR Bunkhouse) and Woody Tannaci Backhoe (HVR Westside) on May 4, 2011.
- HVR Project start delayed due to not receiving ACOE letter of exemption until much later than promised.
- Notice to Proceed was given to both HVR contractors on July 8th, 2011
- HVR Riparian Buffer Project was planned and funded with USFWS funds August 2011.
- Riparian Buffer Project was sub-granted to landowner on August 17, 2011.
- Invite to bid for Meamber Pipeline Project was published on August 19, 2011.
- Westside Pipeline began on August 26, 2011
- Meamber pre-bid walk thru was held on August 31, 2011.
- Bunkhouse Pipeline began on September 6, 2011
- Bids for Meamber Pipeline were opened on September 9 and awarded to Peters Construction on September 14, 2011.
- Invite to Bid for Lemos Tailwater Re-use Improvement Project was published on September 15, 2011.
- Final walk-thru for both HVR projects was held on September 23, 2011.
- Lemos pre-bid contractor walk-thru was held on September 26, 2011.
- HVR Fence was completed September 30, 2011
- The notice to proceed was given to Peters on September 20th and project activities began on September 30, 2011.
- Lemos Bids were opened on October 7th and project awarded to North River Construction on October 12, 2011.
- The Notice to Proceed on Lemos Project was given October 27, 2011.
- Meamber project was completed on November 7, 2011.
- Lemos Construction Activities started November 16th and the final walk thru was held on December 12, 2011.

September 2011 –February 2012

- Outreach to SRWA for project planning on the SRWA Turn-out and Lateral Replacement Project- Attended District Board Meeting September 6, 2011.
- Outreach to all involved landowners and contract with Forsgren Associates for engineering services to complete designs.
- Designs completed and reviewed by irrigation district, landowners and Grant Manager- January 2012

- Invite to bid published for SRWA Project on January 16, 2012
- Schedule 1 & 2 SRWA Lower Middle Ditch Improvement Projects pre-bid walk-thru was held on January 19, 2012, bids were opened January 30th and project was awarded to North River Construction and Woody Tannaci Backhoe on February 8, 2012.
- Notice to proceed for SRWA project was given on February 14, 2012, project activities began on February 27th and completed on March 26, 2012.

Section 5- Conclusions include a discussion of the project's Performance Assessment and Evaluation Program (PAEP), which describes the originally stated project goals, desired project outcomes, outcome indicators and targets along with a 2012 Final Project Assessment which compare pre-project targets with post-project results.

D. Pre-Project Conditions

Tailwater Conditions

Pre-project tailwater monitoring (water quality, tailwater flow and tailwater temperature) on at least one tailwater return associated with each of the implementation project was performed in 2011 or earlier, location identified on Figure 2. A table summarizing the Mean Weekly Average Flows (MWAF) and Mean Weekly Maximum Flows (MWMF) of tailwater returns associated with each project site is shown below. The table also includes the Mean Weekly Maximum Temperatures (MWMT) and Mean Weekly Average Temperatures (MWAT) for each tailwater return. These averages can be used to evaluate project success once post project monitoring data is obtained in 2012.

Project Name	Neighborhood Code	Tailwater Flow		Tailwater Temperatures	
		MWMF	MWAF	MWMT	MWAT
HVR Bunkhouse Pipeline Efficiency Project	07_191	5.01	4.04	26.85	19.3
HVR Westside Pipeline Efficiency & Riparian Buffer Project	07_103	0.27	0.19	27.8	22.17
HVR Westside Pipeline Efficiency Project	07_163	0.22	0.03	29.8	26.4
Meamber Pipeline Efficiency Project	03_192	1.62	0.44	34.5	25.16
Lemos Tailwater Re-use Improvement Project	03_083	1.82	0.5	29.8	27.5
SRWA Turn-out and Lateral Improvement Project	03_171	3.15	1.16	28.02	26.7
	03_237	2.6	1.07	28.2	22.4

River Conditions

Three Dissolved Oxygen (DO) meters were deployed in the Shasta River under this agreement over the last four years. Figure 3 highlights the locations where dissolved oxygen and river temperature were monitored. They all recorded the standard diurnal dissolved oxygen fluctuations, where the lowest concentrations of DO are between 23:00 and 11:00 when respiration of aquatic vegetation occurs. In all locations where the water temperatures peak from mid-afternoon to late evening, and are then followed by the lowest DO concentrations (Unkefer, 2011). Detailed graphs of DO levels and river temperature

fluctuations are included in the Tailwater Reduction Project Monitoring and Shasta River Monitoring Water Quality Improvement Report, which is included in Appendix D.

When assessing river temperature improvements, ambient air temperatures need to be considered, the Mean Weekly Maximum Air Temperature by month for all the years monitoring has been performed is shown in the table below.

Month	***2008***	***2009***	***2010***	***2011***
April	20.17	25.85	21.15	18.13
May	31.09	29.62	23.57	23.39
June	31.28	31.86	30.89	29.96
July	35.14	35.90	34.58	32.93
August	34.59	36.26	32.61	32.54
September	31.37	30.84	29.08	32.40

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Shasta Valley RCD- Tailwater Reduction Project

Figure 3

Dissolved Oxygen Monitoring Location Map

The Mean Weekly Average Temperatures (MWAT), Mean Weekly Maximum Temperatures (MWMT), and Mean Weekly Minimum Temperatures (MWMinT) for river conditions at Araujo Dam, Montague Weir, and Nelson Ranch, as well as river temperatures adjacent to each project site are shown below. In determining project benefits based on water temperature reduction, it is difficult to evaluate change by using averages, but a metric for this evaluation had to be chosen. A study was conducted that suggested that Mean Weekly Maximum Temperatures (MWMT) greater that 18.1° C or Mean Weekly Average Temperatures (MWAT) greater than 16.8° C may completely eliminate the presence of Coho in another northern California river (Welsh et al.2001). Since one of the main objectives for reducing tailwater impacts is to protect the Coho Salmon that over summer in the Shasta River, the MWAT and MWMT metric was selected for evaluating project benefits.

Site	***Year***	***MWAT***	***MWMT***	***MWMinT***
Araujo Dam	2008	24.03	25.96	7.09
	2009	25.37	27.4	8.24
	2011	22.3	24.5	11.89
Montague Weir	2008	23.17	27.03	13.2
	2009	23.98	27.19	7.87
	2011	21.52	23.67	14.04
Nelson Ranch	2008	18.36	22.96	10.73
	2009	18.42	23.43	7.67
	2011	18.45	21.51	11.98
Air Temps	2008	25.92	35.14	0.02
	2009	27.5	36.26	-0.64
	2011	23.69	32.93	-3.39

River temperatures adjacent to the project sites, as well as the above mentioned DO monitoring locations, were also monitored in 2011 for pre-project conditions, to determine if tailwater reduction efforts (or other watershed efforts) reduce river temperatures. All pre-project monitoring data is summarized in the following table, as well as explained in greater detail in the Tailwater Reduction Project Monitoring and Shasta River Monitoring Water Quality Improvement Report dated November 2011, which is included in Appendix D. Project photos are included in Appendix E.

Project Name	Neighborhood Code	MWMT	MWAT
HVR Bunkhouse Pipeline Efficiency Project	07_191US	21.3	17.9
	07_191DS	21.7	18.05
HVR Westside Pipeline Efficiency & Riparian Buffer Project	07_103US	21.6	18.1
	HIGF	22.1	18.2
HVR Westside Pipeline Efficiency Project	07_191DS	21.7	18.05
	07_163DS	21.7	18.1
Meamber Pipeline Efficiency Project	03_192US	23.5	21.47
	03_192DS	23.67	21.5
Lemos Tailwater Re-use Improvement Project	03_083US	23.4	21.5
	03_083DS	23.4	21.72
SRWA Turn-out and Lateral Improvement Project	03_171US	23.7	21.5
	03_237US	23.5	21.4

E. Post Project Conditions

All tailwater reduction projects were implemented in fall 2011/Winter 2012; post project conditions were not evaluated before the termination of this grant agreement (March 2012). Shasta River water quality conditions that were monitored over the term of this grant have been thoroughly documented in the Tailwater Reduction Project Monitoring and Shasta River Monitoring Water Quality Improvement Report dated November 2011, which is included in Appendix D. Project photos are included in Appendix E. Post Project monitoring will be completed in 2012 under Shasta River Tailwater Reduction Project- Phase 2.

F. Data Evaluation

Tailwater Reduction

In reviewing the pre-project tailwater return data, substantial tailwater is often returning to the river with temperatures in the upper 20s (MWMT), which can contribute to cumulative elevated river temperatures. Any benefits realized from project activities will not be assessed until 2012 and beyond. A project would be considered successful if post project conditions at the project sites either had a reduced amount of tailwater returning to the river or reduced tailwater temperatures returning to the Shasta. The success of any implementation project is not inherent; the project has to be managed properly in order for project benefits to be realized fully.

River Temperature

All of the river temperatures shown in this report are above the target temperatures (MWAT< 16.8 and MWMT<18.1). River temperatures are influenced by several factors (air temperature, tailwater returns, solar gain, management, flows, spring inflow) and any river improvements from the tailwater reduction efforts implemented under this grant agreement will not be able to be assessed until 2012 and beyond. It must be stated that reducing a few tailwater returns by increasing efficiency could see some localized river improvements, however to meet TMDL targets it will not necessarily improve river temperatures significantly throughout the system. Due to the dynamic and complex nature of the Shasta River along with annual variation in climatic conditions, it may be difficult to document a direct improvement in river temperatures due to this project's activities. A broad approach to water management (including tailwater reduction) and finding more water to stay in the system are necessary steps to reducing river temperatures to within the thresholds and maintaining a healthy Coho population. Another alternative is to identify suitable Coho habitat areas (refugia) where the thresholds are easily maintained and focus on establishing sufficient flow and reducing localized tailwater impacts.

Dissolved Oxygen

In reviewing DO data from the three years of reliable data collected, it would appear that conditions in the Shasta are improving slightly. At the Nelson Ranch monitoring station in 2008 and 2009 DO levels were as low as five and four ppm and in 2011 minimum DO levels were staying closer to six ppm. At the Montague Weir station, minimum DO levels were closer to five ppm in 2008 and 2009 and in 2011 they were above six for the majority of the season. The minimum DO levels at the Araujo Dam site during the 2008 and 2009 irrigation seasons were dropping below four ppm and in 2011 DO levels were staying above five ppm. It should be noted that climatic temperatures and river discharge were generally more favorable during the 2011 irrigation season than during previous years, the DO improvements can not be attributed to tailwater reduction implementation projects since projects were implemented after the 2011 monitoring season. Ongoing monitoring will further identify change over time.

4.0 Public Outreach:

One important aspect of this project was to provide the community with opportunities to have input into the prioritization process involved in this project and be informed about the projects intended goals. Over the course of implementing this project numerous Technical Advisory Committee meetings were held, as well as many outreach meetings with individual landowners and tailwater neighborhoods. Periodic progress presentations were made at public RCD meetings. In addition the RCD has made presentations about this project at a variety of different public forums, including a Regional Water Quality Control Board workshop on the Shasta River. After implementation of tailwater reduction projects a press release was published in the local newspapers to educate landowners about the project completion and encourage participation in future tailwater reduction. Copies of the newsletters, and articles that highlight this project are included in the Appendix F.

The Shasta Valley RCD has also hosted numerous tours to the implementation project sites for various agencies, and organizations. Below is a short list of agencies/groups who have requested tours of the project site over the course of this grant contract.

CA Department of Fish and Game	U.S. Fish and Wildlife Service
National Oceanic Atmospheric Administration	CA Department of Water Resources
Regional Water Quality Control Board	State Water Resources Control Board
Siskiyou County	Independent landowners.

5.0 Conclusions:

A. Project Evaluation & Effectiveness Results (PAEP)

The PAEP included below describes the pre-project targets and the post-project achievements. Project targets included an increase in the Dissolved Oxygen and a reduction in the temperatures in the Shasta River and its tributaries. These project targets could not be fully evaluated due to the delayed timing of implementation, however some water quality improvements have been measured during the monitoring of this project. Although these targets were not necessarily achieved as a result of this project the activities conducted will most likely lead to eventual achievement of targeted goals and data collected under this funding will provide essential baseline data for that evaluation. The following includes a brief discussion of what goals were included in the PAEP, how the goals were accomplished and if not why. There is also a discussion on what actions may be needed to achieve targeted goals in the future.

Category of Project Activities: Planning, Research, Monitoring and Assessment

PAEP Goal: Identify highest priority tailwater reduction projects throughout the Shasta Valley

2007 Desired Outcomes:

a. A comprehensive list of potentially significant tailwater inputs into the Shasta River.
b. A planning tool for assessing and prioritizing tailwater projects
c. A list of highest priority project areas.

Post Project Assessment:

In January 2008 a LiDAR survey was performed. The LiDAR data was used to create a Digital Elevation Model (DEM), which was used for the Hydro-Accumulation Model in ArcGIS. The Hydro-Accumulation Model identified all the lowest spots along the Shasta River and it's tributaries, tracing flow lines up hill to identify all the tailwater neighborhoods that could potentially return irrigation tailwater back to the rivers. This process gave the SVRCD a comprehensive list of potential tailwater inputs. This process identified both significant and insignificant (in terms of acreage and location) neighborhoods. Field observations and discussions with irrigators have all confirmed the accuracy of this approach.

The Technical Advisory Committee (TAC) was formed in 2007, which consisted of landowners, agency representatives, and other stakeholders. The TAC discussed what criteria needed to be used to evaluate tailwater neighborhood impacts, as well as tailwater reduction project prioritization. Draft prioritization criteria were developed from these discussions and thoroughly reviewed by the TAC for fairness and effectiveness. These criteria were incorporated into a Shasta Valley Tailwater Reduction Plan (submitted June 2011), which outlines how to use the criteria and planning tools for project identification with the main intent to enhance water quality. This outcome was met, without any major issues and this outcome seems to be straightforward and effective.

Once the neighborhood criteria were reviewed and approved by the TAC, all the identified neighborhoods had to be evaluated for each of the criteria (Neighborhood Impact Criteria is included in Appendix A). Since there were many neighborhoods identified (significant and insignificant), a Tailwater Accumulation Model (TWAM) and a Tailwater Impact Model (TWIM) were created to estimate potential impacts associated with each neighborhood for impact scoring. The TWAM used the

field unit acres, crop type, field slope, and hydraulic conductivity, to determine a run-off coefficient, which was multiplied by the estimated amount of water applied (based on NRCS tables, included in Appendix A). The TWIM used the amounts of tailwater estimated in the TWAM, the average temperatures and flows measured in different reaches of the river to calculate potential temperature increases from each neighborhoods tailwater return. Once these estimates were modeled for each identified neighborhood, the impact scoring criteria could be completed throughout the watershed. This process generated a color-coded map, which identifies the highest priority tailwater areas. The process completed to reach the desired outcome is only a model, based on estimations and does not take into account water management, changes in water years or in ambient air temperature, all of which have a great impact on tailwater production and tailwater impact in the stream system. Never the less, it does allow reliable comparisons between neighborhoods. There is not much that could have been changed in this process due to the lack of access to a great percentage of the watershed, as well as the changing nature of how the ground is managed. As more neighborhoods are monitored pre-project and post project the model can be adjusted as needed.

PAEP Goal: Identify clear and implementable solutions for a High Priority Ranch's tailwater.
2007 Desired Outcomes:

a. Development of specific alternatives to consider for ranch tailwater reduction.
b. Agreement between project team and high priority ranch's owner or representative on preferred alternatives for implementation.

Post Project Assessment:
The original agreement scope of work identified a need to develop a tailwater reduction planning study for the Shasta Water Association. As the project began and outreach was initiated it became obvious that many things had to happen in the Shasta Water Association prior to developing a specific tailwater reduction plan. After the state spending freeze was lifted in 2010, attention had shifted to a ranch on the upper Shasta River to reduce its impact to rearing Coho salmon associated with tailwater production. The grant agreement was amended to allow the RCD to hire Davids Engineering to prepare an Irrigation Improvements Feasibility Study for this ranch. The study identified specific ways to reduce the ranch's tailwater impacts, but also ways to manage water on the ranch in order to reduce impacts to known Coho Salmon rearing areas. The development of specific alternatives outcome was achieved, however due to lack of adequate landowner incentive (regulatory or profit driven) an agreement between the project team and landowner for implementation planning could not be reached. More outreach to this landowner would be needed to reach an agreement than this grant allowed. The feasibility study was submitted to the RWQCB Grant Manager in April 2011.

PAEP Goal: Increase the scientific understanding and knowledge about the Shasta River tailwater problem to inform solutions.

2007 Desired Outcome:
Foundation (via LiDAR) to broaden planning to roll out watershed-wide tailwater reduction to the project level.

Post Project Assessment:
During the tailwater neighborhood and project prioritization planning process a lot of outreach to landowners was accomplished. Through the outreach process a lot of conceptual and on the ground planning occurred, which informed the recommended strategies identified in the watershed-wide

Tailwater Reduction Evaluation Matrix (Table 4) included in the Shasta Valley Tailwater Reduction Plan date September 2011. This matrix is a watershed-wide effort, which is the foundation that informed implementation project planning.

Shasta River Tailwater Reduction Project *Category of Project Activites: Planning, Research, Monitoring and Assessment*						
Project Goals	**Desired Outcomes**	**Output Indicators**	**Outcome Indicators**	**Measurement Tools and Methods**	**Targets**	**2012 Target Assessment**
Identify highest priority tailwater reduction projects throughout the Shasta River watershed.	1. Comprehensive list of all potentially significant tailwater inputs into the Shasta River between Dwinnell Dam to the mouth + 6 miles of the Little Shasta River and 10 miles of Parks Creek 2. Decision making tool for analyzing highest priority tailwater inputs for reduction. 3. List of highest priority project areas and maps of general locations.	1. Digitized map of tailwater drainage areas and likely quantity of inputs based on drainage area and other features. 2. List of criteria for ranking and prioritizing tailwater input areas for restoration.	1. Acceptance of ranking criteria based on peer review. 2. Acceptance of initial list of high priority tailwater reduction project areas based on peer review.	1. Digitized map showing general locations of highest priority tailwater reduction project areas.	1. List approved and adopted by project team of high priority tailwater reduction project areas in the Shasta River between Dwinnell Dam to the mouth, + 6 miles of the Little Shasta River, and 10 miles of Parks Creek. 2. List used by RCD for field verification, outreach and project development, and by the local NRCS office for assisting interested landowners with project development and to use to rank tailwater reduction projects for funding by their agency	1. A color coded map of high priority tailwater impact area was prepared and submitted. The prioritization criteria is in cluded in the Appendix. 2. A list of conceptualized projects was compiled and screened for outreach use and project development.
Identify clear and implementable solutions for High Priority Ranch or Irrigation District	1. Development of specific alternatives for High Priority Randistrict-wide tailwater reduction 2. High Prioirty Ranch reviews the tailwater reduction plan and gives comments as needed.	1. Conceptual tailwater reduction plan for High Priority Ranch.	1. Approval of implementing tailwater reduction strategies.	1. Detailed written project description(s) suitable for seeking funding that addresses high priority tailwater.	1. Schedule for implementation of preferred alternatives to tailwater reduction.	1. Due to political issues surrounding the high priority ranch, an implementation schedule was not achievable within the grant agreement schedule.

Shasta River Tailwater Reduction Project *Category of Project Activites: Planning, Research, Monitoring and Assessment*						
Project Goals	**Desired Outcomes**	**Output Indicators**	**Outcome Indicators**	**Measurement Tools and Methods**	**Targets**	**2012 Target Assessment**
Increase scientific understanding and knowledge about Shasta River tailwater problem to inform solutions.	1. Foundation (via LiDAR surveys and experience gained with SWA) to broaden planning to roll out watershed-wide tailwater reduction to the project level.	1. Gain knowledge and experience with landscape scale tailwater estimating and conceptual project planning	1. List of lessons learned via SWA planning effort	1. Design for development of basin-wide approach to tailwater reduction planning, with timelines and estimated costs for planning effort.	1. Plan to be adopted by RCD to use to guide future efforts to minimize negative impacts of tailwater.	1. The Shasta Valley Tailwater Reduction Plan was submitted to RWQCB in September 2011 and was adopted by the RCD board in December of 2011.
		2. Avoid unforeseen or negative outcomes when operating at a larger scale.	2. List of lessons learned via monitoring process.		2. Plan to be used by RCD, NRCS and other funders to rank future tailwater reduction projects in Shasta Watershed.	2. The RCD staff is planning on utilizing the plan to idenitify suitable projects when they assist landowners in the Ranch planning process to meet TMDL requirements.

Category of Project Activities: Education, Outreach, and Capacity

PAEP Goal: Educate Shasta Valley irrigators about the importance of tailwater reduction projects for the health of the Shasta River.

2007 Desired Outcome:
Increase the number of irrigators who are willing to implement a tailwater reduction project on their land.

Post Project Assessment:
Throughout the implementation of this agreement, significant effort was dedicated to outreach and education. Landowners that were not aware of impacts associated with their tailwater returns, were informed of potential impacts and of regulatory issues that could ensue because of these impacts. Many of these landowners allowed tailwater monitoring to occur on their properties and some became willing to discuss conceptual projects for tailwater reduction project evaluation. A list of twenty-seven projects were conceptualized and included in the SVRCD 2011 Potential Tailwater Reduction Project Identification and Screening Results (dated September 2011). From this list six projects were selected for receiving funding through this agreement. The desired outcome was met and a list of projects is ready for additional planning and implementation.

Shasta River Tailwater Reduction Project *Category of Project Activites: Education, Outreach, and Capacity-building*						
Project Goals	**Desired Outcomes**	**Output Indicators**	**Outcome Indicators**	**Measurement Tools and Methods**	**Targets**	**2012 Target Assessment**
4. Educate Shasta Valley irrigators about the importance of tailwater reduction projects for the health of the Shasta River.	1. Increase number of Shasta Valley irrigators who are willing to implement a tailwater reduction project on their land.	1. Number of targeted meetings with people owning land in high priority projects areas. 2. Number of Shasta Valley irrigators in high priority project areas signed up to implement tailwater reduction projects on their land.	1. Increase in landowner understanding of NPS pollution related to agricultural production in the Shasta Valley. 2. Increase in landowner involvement in tailwater reduction projects in the Shasta Valley.	1. Survey of Shasta Valley irrigators.	1. Have 75% or > of the Shasta Valley irrigators with high priority tailwater reduction projects, willing to participate in the program on their property.	1. Additional high priority projects are scheduled for 2012, this is not a measure of the 75% target, however it does indicate increased landowner understanding of the need to reduce tailwater production

Category of Project Activities: Load Reduction

PAEP Goal: Demonstrate effective ways to alter on-farm practices that will result in water quality improvements.

2007 Desired Outcomes:

a. Implement tailwater reduction projects with 2 Shasta Valley landowners to demonstrate on-farm management practices that reduce tailwater inputs.

b. Reduce tailwater inputs to the Shasta River thereby improving water quality.

c. Additional Shasta Valley irrigators that want to implement tailwater reduction projects on their land.

Post Project Assessment:
During 2011 the two following projects were selected for funding and identified as "demonstrations projects".

- The Hidden Valley Westside Pipeline Project was intended to demonstrate improved irrigation efficiency, reduced tailwater production by providing better water management capabilities and reduced spring water diversion. This project was located within the high priority sub-area (Upper Shasta) and just upstream of valuable/known Coho rearing habitat. This project had matching funds from NRCS.
- The Lemos Tailwater Re-use Improvement Project was intended to demonstrate ways to improve an existing tailwater capture pond. By improving the ranches capacity to use the captured tailwater, the pond will overflow less frequently, meaning less hot water returning to the river, and reduced river diversion quantity. This project had matching funds from NRCS.

The desired outcome of constructing two tailwater projects that demonstrate different strategies to reduce tailwater was met, however the actual degree that the projects reduce tailwater inputs to the Shasta River is unknown at this time. The intentions for both projects are to reduce tailwater returns, however due to the grant budget freeze and the environmental review and permitting requirements, the projects were not implemented until the Fall of 2011 (after the 2011 irrigation season). Work under this grant agreement was to be completed by March 31, 2012 and irrigation season begins April 1, 2012, thus no post project monitoring data will be obtained to verify project success of meeting this outcome prior to the close of this grant.

The main intention of having "demonstration projects" was to generate interest among other landowners to participate in the tailwater project and potentially have "implementation projects" constructed on their lands. This was well intended, however due to the issues stated above (grant freeze, permitting, etc) all outreach, project identification and planning occurred within the same time period and all construction activities occurred in the Fall of 2011. In some ways the desired outcome of having additional irrigators implement projects occurred, but not due to the construction of the above listed demonstration projects. It should be noted that since state funded projects require CEQA review (which is a project specific process), to be time and budget efficient, all projects ("demonstration" and "implementation") were

combined into one Mitigated Negative Declaration. Taking this planning hurdle and time/budget constraints into account the project could not have been implemented as intended.

PAEP Goal: Implement 2-5 high priority tailwater reduction projects in the Shasta River Valley based on the prioritization process.

2007 Desired Outcome:
Reduce tailwater inputs to the Shasta River thereby improving water quality.

Post Project Assessment:
During 2011/2012 the four following projects were selected to receive funding under this grant agreement as "Implementation Projects":

- Hidden Valley Bunkhouse Pipeline Project was intended to improve irrigation efficiency, reduce water usage and reduce tailwater returns. This project is located within a large neighborhood (07_191TW) just upstream of known Coho rearing habitat and pre-project monitoring occurred during two irrigation seasons. This project had matching funds from NRCS.
- Meamber Efficiency Pipeline Project was intended to improve irrigation efficiency, reduce water usage and reduce tailwater returns. There are more tailwater reduction strategies planned for this site in 2012. This project had matching funds from NRCS.
- Hidden Valley Riparian Buffer Zone was intended as a test site to determine to what degree tailwater could be cooled, when passed through a riparian buffer. The fence was entirely funded by United State Fish and Wildlife Partners for Wildlife funding and doubles as a cattle exclusion fence.
- Shasta Water Association Turn-out Replacement Project was intended to reduce ditch loss from old leaky turn-outs, which kept the ground around the turn-outs saturated. When the landowner opened the gates to irrigate the entire field, the saturated pasture increased run-off and wasted water on an on-going basis. The lateral ditches were extremely eroded and there was no flow measuring capabilities, so the project replaced the ditch laterals with buried mainline and risers to ensure the landowners were getting their water right and not more.

The intention of each of these implementation projects was to reduce tailwater inputs into the Shasta River and improve water quality. However, all these projects occurred after the 2011 irrigation season ended and post project monitoring data was not obtained prior to the close of the grant agreement (March 2012). At this time it is unknown if the desired outcome was met. In hindsight, these projects would have been implemented in 2010 and post project monitoring would have been completed in 2011, prior to the close of the grant. However, due to the spending freeze and later extremely slow ACOE permitting the necessary planning required to initiate these projects could not be completed in time for that to be possible.

Shasta River Tailwater Reduction Project *Category of Project Activites: Load Reduction*						
Project Goals	**Desired Outcomes**	**Output Indicators**	**Outcome Indicators**	**Measurement Tools and Methods**	**Targets**	**2012 Target Assessment**
Demonstrate effective ways to alter on-farm practices that will result in water quality improvements.	1. Implement tailwater reduction projects with 2 Shasta Valley landowners to demonstrate on-farm management practices that reduce tailwater inputs to the Shasta River.	1. Amount decrease in water temperature as a result of demonstration projects.	1. % change in water temperature returning to the river.	1. Photo documentation of demonstration projects. 2. Continuous temperature recorders	1. Describe the quantity and quality of all tailwater creation on both demonstration projects—both before and after implementation of projects.	1. Demonstration projects have been constructed, however due to the grant agreement schedule only pre-project monitoring data has been obtained.
	2. Reduce tailwater inputs to the Shasta River thereby improving water quality (increase DO, decrease temperature and increase flow).	2. Amount increase in DO levels as a result of demonstration projects. 3. Increase in water quantity of the Shasta River for in-stream benefits.	2. % reduction in NBOD elements originating from project sites 3. % change in water being diverted from the river.	3. Paired grab samples (river and tailwater) 2x/month. 4. Flumes or weirs with Flow Loggers (Aquarods) to measure quantity of tailwater return both pre- and post-project implementation.	2. 75% or higher decrease in the amount of tailwater returning to the river on each demonstration project site.	2. The amount of tailwater reduction is unknown at this point
	3. Additional Shasta Valley irrigators that want to implement tailwater reduction projects on their land.	4. Number of Shasta Valley irrigators willing to implement tailwater reduction projects on their land.	4. Number of Shasta Valley irrigators willing to implement a tailwater reduction project on their land.	5. List of Shasta Valley irrigators willing to participate. 6. Documentation of change in consumptive use by documenting changes in irrigated acreage before and after project.	3. Have 75% or > of the Shasta Valley irrigators with high priority tailwater reduction projects, willing to participate in the program on their property.	3. The RCD has a list of tailwater reduction projects ready for future implementation

Shasta River Tailwater Reduction Project *Category of Project Activites: Load Reduction*						
Project Goals	**Desired Outcomes**	**Output Indicators**	**Outcome Indicators**	**Measurement Tools and Methods**	**Targets**	**2012 Target Assessment**
Implement 2-5 high priority tailwater reduction projects in the Shasta River Valley based on the outcomes of steps 2 and 3	1. Reduce tailwater inputs to the Shasta River thereby improving water quality (increase DO, decrease temperature).	1. Amount decrease in water temperature as a result of implementation projects. 2. Amount increase in DO levels as a result of implementation projects. 3. Change in water quantity of the Shasta River for in-stream benefits.	1. % change in water temperature returning to the river. 2. % change in DO levels of water returning to the river. 3. % change in water being consumptively used from the river from the results of the implementation projects.	1. Photo documentation of implementation projects. 2. Continuous temperature recorders 3. Paired grab samples (river and tailwater) 2x/month. 4. Flumes with Flow Loggers (Aquarods) to measure quantity of tailwater return both pre- and post-project implementation. 5. Survey of Shasta Valley irrigators as to willingness to participate. 6. Documentation of change in consumptive use by documenting changes in irrigated acreage before and after project.	1. 75% or higher decrease in the amount of tailwater returning to the river on each implementation project site.	1. The tailwater reduction implementation projects were constructed in 2011/2012, pre-project monitoring was completed in 2011 irrigation season, however post-project monitoring was not obtained prior to the end of the grant agreement. The amount of tailwater reduced due to project activities is unknown at this time.

B. Next Steps

While projects funded by this grant are essentially complete, the overall work to reduce tailwater impacts in the Shasta River is far from completed. Planned future work includes:

Adaptive Management

One of the most relevant issues associated with tailwater production is water management. A missing component in all of the 2011 constructed tailwater projects were adaptive management plans or agreements. However, plans to assist landowners with managing the newly implemented tailwater reduction projects are underway for 2012 irrigation season. The SVRCD will begin adaptive management assistance on the two tailwater projects located on Hidden Valley Ranch with funding assistance from California Trout. SVRCD has included language in its draft tailwater reduction policy to call for an adaptive management agreement to be signed by any project participants that accept funding for tailwater reduction.

Individually identified projects:

Big Springs Ranch Big Ditch Irrigation Efficiency Project

Big Springs Ranch utilizes cold spring water from Big Spring Creek for irrigation water. Big Springs is also the single most important source of cold water for the entire watershed. This project will include a new head structure to ensure that the ranch is delivered a consistent diversion quantity. Other components include the construction of new turn-outs and gated pipe to reduce water usage and tailwater production. The total project budget is currently $155,000 and will be funded by the Tailwater Reduction Project- Phase 2 through the 319h CWA agreement that the SVRCD currently has with the State Water Resource Control Board in a phased approach. Construction is currently scheduled for March 2012. This project will also include adaptive management strategies (field moisture sensors and stream monitoring sensors) to ensure that the project goals are being met. Sensors and adaptive management planning will be funded with private donor money through The Nature Conservancy.

Meamber Tailwater Re-use Project

In 2011 the first phase of tailwater reduction was completed on the Meamber Ranch, focused on improving the ranch's irrigation efficiency. The second phase in reducing impacts associated with tailwater are planned for 2012, which include completing the tailwater capture and re-use facility. A tailwater intake structure will connect an existing tailwater capture pond with an existing river pump, to enable the landowner to fully utilize captured tailwater in-lieu of the river diversion. The project budget is approximately $15,000 and is scheduled for a Fall 2012 implementation. The construction of the pond embankment (which occurred in 2009) and the construction of the in-take structure will need a permit from the Army Corps of Engineers due to fill placed in the water way, subsequently a Water Quality Certification and a 1600 permit will be filed. The permits will be prepared with funds from this grant agreement, but construction of the intake structure will be funded by Tailwater Reduction Project – Phase 2 (319h CWA).

Freeman Efficiency West Project

The Freeman Efficiency West Project is planned for Fall 2012 and will consist of replacing earthen ditches with buried mainline and gated pipe. The intent is to reduce water usage and tailwater

production. Planning and design is currently being done by NRCS, which will provide matching funds for implementation, with a total budget of $145,000. The remaining construction budget will be from the Tailwater Reduction Project – Phase 2 and will be around $15,000.

Shasta River Water Association Tailwater Re-use Project

The Shasta River Water Association (SWA) Tailwater Re-use Project is a conceptual project that was identified during a neighborhood outreach meeting with SWA landowners. The premise of the project is to prevent tailwater from re-entering the Shasta River, co-mingling with river water, only to have the commingled water re-diverted by the SWA pump station. The project includes the construction of a tailwater pick-up ditch just upstream of the pump station, collecting tailwater from four different tailwater neighborhoods and directing the collected water into a drop inlet that is connected to the pump station. The tailwater will be used in-lieu of a similar quantity of river water, and will no longer be mixed with river water. The landowner agreements for preparing the designs have recently been obtained and engineering is scheduled for early 2012. Permits and CEQA will need to be fulfilled for this project and preliminarily project construction is scheduled for Spring 2013. The project has a budget of $60,000 and will be paid for by Tailwater Reduction Project- Phase 2 and/or the Prop 50 IRWM grant the SVRCD manages.

Other Future Plans

- Post project monitoring for all the projects funded under this grant agreement will be completed during the 2012 irrigation season. Funded by Tailwater Project – Phase 2.
- Investigate engineering considerations for a pilot underground detention/cooling system.
- Working with the Shasta Valley Water Trust to ensure there are incentives in place to encourage better water management practices.