FINAL REPORT
MORRO BAY ON-FARM COASTAL WATER QUALITY IMPLEMENTATION PROJECT ("PROJECT CLEARWATER")
November 15, 2005 to December 31, 2008
Grant Agreement No: 06-128-553-0

Progress Report # Draft Final Report

Reporting Period: 11/15/05 to 12/31/08

Submittal Date 2/6/09

Grant Agreement No:	06-128-553-0
Project Name:	MORRO BAY ON-FARM COASTAL WATER QUALITY IMPLEMENTATION PROJECT (PROJECT CLEARWATER)
Watershed:	MORRO BAY ESTUARY, CALIFORNIA
Contractor Name:	COASTAL SAN LUIS RESOURCE CONSERVATION DISTRICT
Total Project Cost:	$ 1,306,230
319h Funding:	$ 470,245
Match Funding:	$ 835,984

I certify under penalty of law that this document and any attachment was prepared by me or under my direction in accordance with the terms and conditions of each Grant Agreement Exhibit. Based on my inquiry of the persons or persons who manage the project or those directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. All information submitted in this document and all attachments conform to and is in accordance with the state and federal laws and I so here certify with my signature. I am aware that there are significant penalties for submitting false or misleading information.

Project Director: JULIE THOMAS _____

Printed Name Signature

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Executive Summary

The three-year Morro Bay On-Farm Coastal Water Quality Implementation Project ("Project Clearwater") completed an array of water quality improvement projects incorporating a total of 74 best management practices (BMPs) in accordance with USDA Natural Resource Conservation Service (NRCS) standards. These projects included installation of off-creek watering systems for cattle and corresponding riparian fencing, stream headcut remediation, road improvement to prevent erosion, and habitat enhancement for red-legged frogs. The project resulted in protection of over 55,000 feet of streambank via riparian fencing to exclude cattle, accompanied by installation of 34,898 feet of pipeline and 34 watering troughs with corresponding well development, as well as installation of tanks and pumps, to provide off-creek watering. Improvement of 5,972 feet of field road on one ranch, and repair of a stream headcut and improved drainage on another ranch will reduce future sediment erosion on these properties.

Altogether, these implementation projects will provide estimated benefits to the Morro Bay estuary and its watershed, over a ten year period, of reduction in sedimentation by 860 cubic yards, and prevention of deposition into streams of over 3,600 tons of manure, with a corresponding reduction in nitrogen input of 49,101 pounds, and of phosphorus input of 2,454 pounds, as well as large reductions in fecal coliform and fecal streptococci.

The project's education and outreach component engaged a total of 157 growers, ranchers and environmental community members through a series of workshops, watershed tours, and tailgate meetings. Workshops and meetings offered included Range Water Quality, Irrigation and Nutrient Management, Creek Maintenance, Properly Functioning Streams, and Farm and Ranch Roads Workshop. A number of local agencies and municipalities partnered with the RCD in these outreach programs, including the San Luis Obispo County Farm Bureau, Cal Poly State University, the City of Morro Bay, and University of California Cooperative Extension.

In all, a total of $1,306,230 was spent to implement water quality improvement and protection projects on seven ranches, incorporating 74 best management practices (BMPs). The SWRCB 319h grant provided $470,245 of the funds, while $835,984 was provided by match sources, including the Morro Bay National Estuary Program (MBNEP), NRCS, California Department of Conservation (DOC), Sustainable Conservation "Partners in Restoration" program (SUSCON), and the individual landowners with whose partnership and on whose property the projects were brought to fruition.

Problem Statement & Relevant Issues

Morro Bay has been called the most biologically important estuary on the Central Coast, and is recognized as both a State and National Estuary. The RWQCB has established Sediment TMDLs for Chorro Creek, Los Osos Creek and Morro Bay Estuary, and has established Nutrients and Dissolved Oxygen TMDLs for Chorro Creek and Los Osos Creek. In addition, the Comprehensive Conservation and Management Plan for Morro Bay (MBNEP 2000), the primary watershed plan for Morro Bay estuary, identifies the following seven priority issues:

- Sedimentation
- Bacteria
- Nutrients
- Loss of freshwater flow
- Heavy metals and toxic pollutants
- Loss or degradation of habitat
- Loss of steelhead

Agriculture is the primary land use within the Morro Bay estuary, and had been identified as a source of water quality impairments within the watershed.

Project Goals

The RCD, in partnership with the NRCS, is uniquely adapted to working with agricultural landowners in addressing land use and conservation concerns. The primary objective of Project Clearwater and NRCS staff in this project was to work with individual landowners to develop site-specific conservation plans that would include at least fourteen BMPs for their properties. The BMPs would be designed and implemented according to standards and specifications contained in the Natural Resources Conservation Service (NRCS) Field Office Technical Guide. Specifically, the projects were targeted at reducing sediment, bacteria, and nutrient loading to the Morro Bay estuary, and restoring and protecting aquatic and riparian habitat within the watershed.

Program success would be measured by the number of landowners involved in Project Clearwater outreach and education workshops and tours, the number and scale of BMPs and conservation plans implemented through Project Clearwater, and by the effectiveness of those BMPs in reducing pollutant loads of sediment, nutrients, and pathogens to the watershed.

Monitoring of each BMP installation would include pre- and post installation photo monitoring, estimated reductions in nonpoint source loads of sediment and nutrients, and appropriate BMP-specific measures such as feet of stream bank protected, feet of riparian areas fenced, and number of native species planted.

Total Project Costs

The table below shows total costs, by funding source, for activities completed under this grant agreement:

Final Expenditure Table by Funding Source for Grant Agreement 06-128-553-0 (11/15/05 - 12/31/08)						
Funding Source*	**Personnel Services & Overhead**	**Operating Expenses**	**Professional Services**	**Construction**	**Total Match**	**Grand Total: Match plus 319h**
SWRCB 319h	$70,500	$4,400	$110,954	$304,891		$470,245
MBNEP	$30,752	$2,142	$101,947	$425,595	$509,203	$509,203
DOC	$136,807	$6,480			$143,287	$143,287
SUSCON	$8,613				$8,613	$8,613
NRCS		$23,508	$91,454		$114,962	$114,962
Landowner			$5,739	$54,181	$59,920	$59,920
TOTAL	**$246,671**	**$36,530**	**$310,094**	**$784,668**	**$835,984**	**$1,306,230**

* MBNEP = Morro Bay National Estuary Program; DOC = California Department of Conservation Watershed Coordinator Grant; SUSCON = Sustainable Conservation; NRCS = Natural Resources Conservation Service.

A summary of expenditures for each implementation project, showing 319h costs and match, is provided in Attachment D. In all, a total of $1,306,230 was spent to implement projects from seven (7) conservation plans, with a total of 74 BMPs implemented. The 319h grant provided $470,245 of the funds, while $835,984 was provided by match sources, including the MBNEP, NRCS, DOC, SUSCON, and landowners.

Project Descriptions: Management Practices and Measures Implemented

A total of seven (7) water quality improvement projects were completed under this grant in the Morro Bay Estuary watershed (Map 1, Attachment E), which included implementation of a total of 74 BMPs (Summary Table in Attachment C). BMPs ranged from riparian fencing and off-creek watering systems on grazing land to hardened stream crossings to manure management systems.

Photographs and other graphics illustrating before, during and after conditions of projects are provided in Attachment E.

Below are detailed descriptions of each project.

PC-04-10: SAN BERNARDO CREEK MANAGED GRAZING PROJECT[1]

Resource Concern

Water quality issues associated with livestock grazing on rangelands such as sediment, nutrient and pathogen loading to creeks, as illustrated in Attachment E, Figures 1 and 2.

Project Description

Location: This project is located approximately 1 mile east of Morro Bay. The project area borders San Bernardo Creek. San Bernardo Creek is tributary to Chorro Creek, which flows directly into the Morro Bay Estuary.

Goal: To exclude cattle access to San Bernardo Creek and a tributary to San Luisito Creek and provide a reliable off-creek water supply for the cattle.

Solution: To exclude cattle from the creek, 14,700 feet of riparian fencing was installed along San Bernardo Creek and the tributary to San Luisito Creek. See Attachment E, Figure 3.

The off-creek watering system consisted of developing a well next to San Bernardo Creek. A submersible pump was installed within the well. The power source is a generator. The landowner manually starts the generator and fills four 5,000 gallon water tanks as needed upon inspection of troughs and suitable grazing areas.

From the water tanks the water gravity flows through HDPE pipe to ten water troughs strategically placed for optimal grazing utilization. See Attachment E, Figures 4-13c.

Best Management Practices Implemented

Item	NRCS Conservation Practice Standard (BMP)			Unit	Quantity
	Practice Name	Component	Spec no.		
1	Watering Facility	Trough	614	No	10
2	Watering Facility	Water tank	614	No	4
3	Water Well	HDPE plastic pipe	642	No	1
4	Fence	Barbed wire	382	Ft	14,700
5	Pumping Plant	Pump submersible	533	No	1
6	Pipeline	HDPE plastic pipe	516	Ft	13,000

[1] Planning for the San Bernardo Creek project began in 2004, with project implementation beginning after November 15, 2005. Documentation related to inclusion of this project for purposes of meeting "match" funding commitments is provided in Attachment L.

Project Partners

The RCD partnered with the NRCS to develop a Comprehensive Conservation Plan for the landowner.

Pollutant Reduction/ Project Benefits

Based on "Fact Sheet No. 25: Manure Loading into Streams from Direct Fecal Deposits" by the University of California Cooperative Extension (UCCE), assume a 1,000 lb beef cow produces the following[2]:

60 lb manure/day	0.11 lb P/day
12 defecations/day	3.84×10^{10} FC/day
5 lbs manure/defecation	7.2×10^{8} FS/day
0.34 lb N/day	0.19 instream fecal deposits per day

Based on an average of 86 cows at San Bernardo Creek Ranch, then pollution reduction for 86 cows over a 10 year period would be as follows:

Manure = 5 lbs manure/defecation @ 0.19 instream defecations/day
@ 86 cows @ 365 days/yr @ 10 years =
Lbs Manure in creek over a 10 year period = 298,250 lbs or 149 Tons

Nitrogen = 0.34 lb N/day @ day/12 defecations
@ 0.19 instream defecations/day @ 86 cows @ 365 days/yr @ 10 years =
Lbs Nitrogen over a 10 year period = 1,690 lbs

Phosphorus = 0.11 lb P/day @ day/12 defecations
@ 0.19 instream defecations/day @ 86 cows @ 365 days/yr @ 10 years =
Lbs Phosphorus over a 10 year period = 547 lbs

Fecal Coliform (FC) = 3.84×10^{10} FC Colonies/day @ day/12 defecations
@ 0.19 instream defecations/day @ 86 cows @ 365 days/yr @ 10 years =
FC Colonies over a 10 year period = 1.9×10^{14} Colonies

Fecal Streptococci (FS) = 7.2×10^{8} FS Colonies/day @ day/12 defecations
@ 0.19 instream defecations/day @ 86 cows @ 365 days/yr @ 10 years =
FS Colonies over a 10 year period = 3.6×10^{12} Colonies

[2] The UCCE Fact Sheet No. 25 estimates of cattle time spent in the creek and instream defecation are based on non-replicated observations for a two-day period within each season of spring, summer, fall, and winter in eastern Oregon. More study would be needed to verify the applicability of these estimates for the Morro Bay watershed; however, the Oregon data does provide the basis for a meaningful estimate of loading to the creek.

PC-05-15: GRADE STABILIZATION TURRI ROAD RANCH HOUSE

Resource Concern

A headcut on a tributary to Warden Creek was contributing to sediment into Warden Creek, as well as providing a potential sediment source for loading into the Morro Bay Estuary. In addition, by undermining the stability of the creek bank, the head cut was causing the bank to slough, generating more sediment into Warden Creek. Lastly, the sloughing of the banks was beginning to collapse a fence line of the paddock above the top of the right bank of the tributary. See Attachment E, Figures 14-17.

Project Description

Location: This project is located along an unnamed tributary of Warden Creek, which flows west to Warden Lake and then into the Morro Bay estuary.

Goal: To eliminate the head cut and significantly reduce or eliminate erosion from this section of the tributary. In addition, buttress the existing bank side slopes, thus reducing the risk of bank failure and future sedimentation as well as preventing the fence line above the bank from failing. See Attachment E, Figure 18.

Solution: The head cut was eliminated by installing a grade stabilization drop structure just upstream of an existing historic stone culvert and about 20 feet downstream of the head cut. A 48 inch diameter x 6.7 foot long corrugated metal pipe was utilized as the drop structure riser. The riser is connected to the existing stone culvert by way of an 8 foot long 36"x 24" reducing nipple welded on one side to the riser with the other side extending into the existing stone culvert. Grout was used to fill any voids between the stone culvert and the conduit nipple making the connection water tight. An 8-inch thick concrete floor was be poured to support the drop structure riser. To minimize debris clogging, a conical grate was constructed and placed on the riser entrance. See Attachment E, Figures 19-25b.

Soil material excavated immediately downstream of the existing culvert as well as soil scraped from the side of a nearby hill was backfilled and compacted around the drop structure and the scour area created by the head cut. After finish grading, the entire disturbed area was revegetated as per NRCS Conservation Practice Critical Area Planting (342).

Best Management Practices Implemented

Item	NRCS Conservation Practice Standard (BMP)			Unit	Quantity
	Practice Name	Component	Spec no.		
1	Grade Stabilization	Drop structure	410	No	1
2	Critical Area Planting	Seed, straw, mulch	342	Ac	0.5

Project Partners

The RCD partnered with the NRCS to develop a Comprehensive Conservation Plan for the landowner.

Pollutant Reduction/ Project Benefits

Based on the volume of soil eroded by the head cut and assuming the head cut continued to move upstream at a rate of 10 feet per year, the reduction in sediment loading to Warden Creek due to the Turri Road Ranch House project is estimated to be about 370 CY or 600 Tons over a 10 year period, calculated as follows:

CF Sediment = 10 ft/yr @ 5 ft deep @ 20 ft wide @ 10 yr = 10,000 CF

Tons Sediment = 10,000 CF @ 120 lbs/CF @ 1 ton/2,000 lbs = 600 Ton

CY = 10,000 CF @ 1 CY/27 CF = 370 CY

PC-06-08: LOS OSOS VALLEY HORSE MANURE COMPOSTING PROJECT

Resource Concern

This horse boarding facility in Los Osos Valley has the capacity to board 50 horses. The primary resource concern is proper management and containment of that manure as a means to protect the water quality of Los Osos Creek, which borders the project area. According to the circular titled, "Horse Stable Manure Management" from Pennsylvania State University, a typical 1,000 lb horse produces 51 lbs of manure per day plus up to 15 lbs of bedding per day. This equates to over 65 lbs or 2.4 cubic feet of stall waste per day per horse. Therefore, the project facility would have the potential to produce 120 cubic feet of manure per day.

Project Description

Location: This project is located about 1/2 miles east of Los Osos. The horse boarding facility is bordered to the south by hills with slopes greater than 50% and to the north by Los Osos Creek which flows directly into the Morro Bay estuary. See Attachment E, Figure 26.

Goal: Design and installation of a composting facility to reduce the pollution potential of organic agricultural wastes to surface and ground water.

Solution: Development of a Comprehensive Conservation Plan that addressed not only minimizing the volume of waste produced per year but also addressed the water quality issues associated with storm water runoff. The Conservation Plan will be implemented in three phases; phase 1 was implemented in December of 2008; phases 2 and 3 will be implemented as funding becomes available and according to the ability of the landowner to match that funding. See Attachment E, Figure 27.

The primary project in phase 1 was the construction of a five bin compost facility. The design strategy of the compost facility was to provide enough storage capacity and bins so that by the time one filled up the last bin, the composting in the first bin would be complete. The compost facility consisted of five 15' x 15' x 5' high bins. The bins were constructed utilizing interlocking 5' x 2.5' x 2.5' concrete blocks manufactured by inter-Block Retaining Systems, Inc. The blocks were placed on an 8" thick 90'x 17.5' concrete pad. See Attachment E, Figures 28 – 35.

Composting is a biological process. It requires a combination of art and science for success. The operation will need to undergo some trial and error in the start-up of the new composting facility. To function properly, the compost facility must be operated correctly. The following are components of the Operation and Maintenance plan submitted to the landowner:

- **Aeration or Turning**: Adequate aeration is critical to proper composting. The more often a pile is turned (or aerated), the faster it will compost. Turning the pile mixes the ingredients, provides oxygen to microbes, rebuilds the porosity of the pile, and exposes all of the pile equally to air in the outer layer and to the high temperatures in the center of the pile. Turning the pile also eliminates anaerobic organisms that cause foul odors. For optimal composting, the pile should be turned 3 times per week.

  As an additional method to aerate or turn the pile, when the first compost bin fills up, transfer the compost "slug" to the next bin and then continue filling the first bin with the most recent manure. All new manure is placed in the first bin. The initial compost "slug" is continually moved to the bin to the right until it reaches the 5th and last bin.
- **Carbon to Nitrogen ratio**: The desired Carbon to Nitrogen ratio is 30:1; a lab analysis of manure will let you know where you are relative to this ratio.
- **Water Content**: An ideal compost mixture contains 50-60% moisture. You can test for moisture by squeezing a handful of compost. It is wet enough if a small amount of water comes out between your fingers. A compost pile too wet or too dry will cause the microbes to die. If necessary, add water when adding compost or turning the pile (transferring the slug).
- **Temperature**: The optimal temperature range of the pile should be between 122˚F and 145˚ F. When the temperature reaches 140˚F, start turning the pile and remember to keep it moist. Temperature readings should be taken from the middle of the pile; long probed compost thermometers can be purchased in many garden catalogs and at some gardening stores.
- The compost bins are to be covered with a tarp during storm events.

Phase 1 Best Management Practices Implemented:

Item	NRCS Conservation Practice Standard (BMP)			Unit	Quantity
	Practice Name	**Component**	**Spec no.**		
1	Compost Facility	Manure	317	Ea	1
2	Waste Storage Facility		313	Ea	1
3	Filter Strip		393	Ac	0.2
4	Field Border		386	Ac	0.2

Phase 2 Best Management Practices Planned:

Item	NRCS Conservation Practice Standard (BMP)			Unit	Quantity
	Practice Name	**Component**	**Spec no.**		
1	Access Roads		560	Ft	1,500
2	Vertical Drain		630	No	2
3	Wastewater Treatment Strip	Biodetention cell	635	Ac	0.2
4	Riparian Herbaceous Cover		386	Ac	0.5

Phase 3 Best Management Practices Planned:

Item	NRCS Conservation Practice Standard (BMP)			Unit	Quantity
	Practice Name	**Component**	**Spec no.**		
1	Diversion		362	Ft	450
2	Roof Runoff Structure	Collect roof runoff	630	No	1
3	Structure for Water Control	Basin	635	No	1

Project Partners

The RCD partnered with the NRCS to develop a Comprehensive Conservation Plan for the landowner.

Pollutant Reduction/ Project Benefits

Based on the potential for boarding 50 horses per day, and assuming the volume of the composted material is 50% of the volume of the waste manure produced by the horses, an estimate in the reduction in waste material due to the completion of this compost facility over a 10 year period is as follows:

CF of Manure waste produced over 10 year period =
50 horses @ 2.4 CF/horse-day @ 1 CY/27 CF @ 365 days/yr @ 10 yr = 16, 222 CY

Composting reduction in CF = 0.5 x 16,222 CY = 8,111 CY

Tons of Manure waste produced over 10 year period =
50 horses @ 65 lbs/horse-day @ 1 Ton/2000 lbs @ 365 days/yr @ 10 yr = 5,931 Tons

Composting reduction in Tons = 0.5 x 5,931 Tons = 2,966 Tons

Assume 14 lbs Total Nitrogen/Ton Horse Manure bedding mix
Assume that previously to the construction of compost facility, all compost or manure was spread onto pasture fields, then

Reduction of Nitrogen applied to fields over 10 year period =

5,931 tons manure produced in 10 years @ 0.5 volume reduction due to composting @ 14 lbs nitrogen/ton manure bedding mix = 41, 517 lbs

PC-07-02: CHORRO VALLEY CAMP SLO MANAGED GRAZING PROJECT

Resource Concern

Water quality issues associated with livestock grazing on rangelands such as sediment, nutrient and pathogen loading to creeks. See Attachment E, Figures 40 and 41.

Project Description

Location: This project is located at Camp San Luis Obispo (Camp SLO) approximately 5 miles west of San Luis Obispo. The upper most tributaries of Chorro Creek and the Morro Bay watershed lie within the boundaries of Camp SLO.

Goal: To provide a reliable off creek water supply for the cattle once the cattle are prevented from access to the creeks by the installation of riparian fencing.

Solution: Available water is limited in all four pastures (See Attachment E, Figures 42 and 43). The design strategy was to develop springs, identified in the Land Management Plan for Camp San Luis prepared by the NRCS in 1994, in pastures 1 and 4, and to tie into Camp SLO's existing fire hydrants in pastures 5A and 7.

In the pastures with springs, from each developed boxless spring, water gravity flows through a pipeline to a 2,500 gallon water tank. From the water tank, water gravity flows through a pipeline to fill water troughs on demand.

The original design in pasture 1 was to develop three potential spring sites; the upper spring, the middle spring and the lower spring. The upper spring was successfully developed with a spring, a 2,500 gallon water tank, and one trough.

The middle spring in pasture 1 was initially going to have one 5,000 gallon storage tank with two troughs being gravity fed from the water tank. However, exploratory excavation deemed the middle spring unworthy of development due to the minimal flow produced from the spring and the low benefit/cost ratio of developing a spring in such a remote and steep ravine.

The lower spring in pasture 1 was initially going to have one 5,000 gallon storage tank with three troughs being gravity fed from the water tank. However, several months before construction began, Camp SLO began constructing the upgrade of its existing fire suppression system which included utilizing an existing million gallon steel storage tank that has been unused and empty for many years. The RCD was given permission to connect our pipeline directly to the million gallon tank from which the water supply gravity flows to two troughs. Connecting to the million gallon water tank made more since then attempting to develop the lower spring, for spring development is much more costly. In addition, it negated the need to pipe from the spring location to the trough locations across ground the Camp SLO environmental specialist reported had sensitive plant species.

Camp SLO's upgrade of their existing fire suppression system significantly altered the pipe routes and trough locations in pasture 5A. Initially, pasture 5A was to have 6 troughs; in the final design pasture 5A received 3 troughs directly connected to two different fire hydrants.

As initially designed, pasture 7, the bull pasture, received one trough piped from the trough to a fire hydrant.

The initial design strategy in pasture 4 was to develop two springs, one on each side of the ridge. The spring on the east side of the ridge was to feed one water tank and two troughs. However, excavation and assessment of the east spring showed that the spring was producing very little water. In addition, the depth to the water was about eight feet which made the development of the spring unsafe as well as expensive. In the end it was decided to abandon the spring development and associated water system on the east side of the ridge.

On the west side of the ridge one spring was developed with one 2,500 gallon water tank and two troughs.

Figures 44 – 53 in Attachment E provide photographs of various stages of project implementation.

Best Management Practices Implemented:

Item	NRCS Conservation Practice Standard (BMP)			Unit	Quantity
	Practice Name	**Component**	**Spec no.**		
1	Watering Facility	Trough	614	No	12
2	Watering Facility	Water tank	614	No	3
3	Pipeline	HDPE plastic pipe	516	Ft	3,528
4	Spring Development	Spring < 5 gpm	574	No	3
5	Critical Area Planting	Seed, straw, mulch	342	Ac	0.5
6	Fencing (funded by MBNEP)	barbed wire	382	Ft	13,200

Project Partners

The RCD partnered with the NRCS to develop a Comprehensive Conservation Plan for the landowner. In addition, the Land Management Plan for Camp San Luis was prepared by the NRCS in 1994. The off-creek watering system was done in conjunction with the Morro Bay National Estuary Program hiring and funding the California Conservation Corps to install the riparian fencing.

Pollutant Reduction/Project Benefits

Based on the above-referenced UCCE Fact Sheet No. 25, "Manure Loading into Streams from Direct Fecal Deposits" by the University of California Cooperative Extension, assume a 1,000 lb beef cow produces the following:

60 lb manure/day	0.11 lb P/day
12 defecations/day	3.84×10^{10} FC/day
5 lbs manure/defecation	7.2×10^{8} FS/day
0.34 lb N/day	0.19 instream fecal deposits per day

Assume 180 cows at Camp San Luis, then pollution reduction for 180 cows over a 10 year period is as follows:

Manure = 5 lbs manure/defecation @ 0.19 instream defecations/day
@180 cows @ 365 days/yr @ 10 years =
Lbs Manure in creek over a 10 year period = 624,150 lbs or 312 Tons

Nitrogen = 0.34 lb N/day @ day/12 defecations
@ 0.19 instream defecations/day @180 cows @ 365 days/yr @ 10 years =
Lbs Nitrogen over a 10 year period = 3,537 lbs

Phosphorus = 0.11 lb P/day @ day/12 defecations
@ 0.19 instream defecations/day @180 cows @ 365 days/yr @ 10 years =
Lbs Phosphorus over a 10 year period = 1,144 lbs

Fecal Coliform (FC) = 3.84×10^{10} FC Colonies/day @ day/12 defecations @ 0.19 instream defecations/day @180 cows @ 365 days/yr @ 10 years = FC Colonies over a 10 year period = 4×10^{14} Colonies

Fecal Streptococci (FS) = 7.2×10^{8} FS Colonies/day @ day/12 defecations @ 0.19 instream defecations/day @180 cows @ 365 days/yr @ 10 years = FS Colonies over a 10 year period = 7.5×10^{12} Colonies

PC-07-04: CAL POLY FROG TROUGHS-UPPER WALTERS AND CHUMASH CREEK

Resource Concern

Water quality issues associated with livestock grazing on rangelands, such as sediment, nutrient and pathogen loading to creeks, and providing critical habitat for California red-legged frogs.

The California red-legged frog (*Rana aurora draytoni*) is considered threatened under the Endangered Species Act. It is thought the decline of the California red-legged frog may be due to exotic predators such as bullfrogs as well as decreased habitat opportunities.

Project Description

Location: This project is located at Cal Poly's Escuela Ranch approximately 2 miles east of Morro Bay. One frog trough was placed on the upper section of Walter's Creek, a tributary to Chorro Creek. The second frog trough was located on Chumash Creek a tributary to Pennington Creek which is tributary to Chorro Creek which flows directly into the Morro Bay estuary.

Goal: To increase habitat and protect the California red-legged frog (frog) from predation from bullfrogs by modifying a typical water trough to make it suitable for the habitation of red- legged frogs but unsuitable for bull frogs. According to Norman Scott, a red-legged frog expert, the proposed trough design appeared to provide shelter for juvenile red-legged frogs and some adult red-legged frogs in the summer. He did not believe adult bullfrogs, the main predator of red-legged frogs, will use the troughs, for the troughs are too small.

Also, because this project will be often be frequented by Cal Poly students and classes, it is hoped the project will stimulate students to think how they can innovatively design projects that meet both the concerns of the environmental community as well as the ranching community.

Solution: The water troughs were placed such that the riparian fencing bisects the trough length wise. Thus, the cattle will only be able to access the trough from the side of the trough farthest from the creek. In the actual design, the creek side of the trough was to be backfilled at a maximum of a 3:1 slope creating a frog access ramp to the trough. However, through an error in communication, the troughs were placed in an excavated hole such that only about four inches of the side of the troughs extended above the ground level. I was hoping to demonstrate to ranchers that very little modifications to a trough were required to make them "frog friendly"; that

included installing the trough how it would be typically installed on a ranch, that is, with no excavation. It was deemed not worth the trouble to have the trough placed as shown in the design drawing; however, it was still required to provide an earthen ramp up the four inch side of the trough. The ramps were vegetated to provide cover for the frogs.

Redwood planks were secured in the tank allowing easy frog access to varying water depths in the trough. The planks also provide cover protection from frog predators such as birds and raccoons. See Attachment E, Figures 54 - 61.

Best Management Practices Implemented:

Item	NRCS Conservation Practice Standard (BMP)			Unit	Quantity
	Practice Name	Component	Spec no.		
1	Watering Facility	Trough	614	No	2
2	Critical Area Planting	Seed, straw, mulch	342	Ac	0.002

Project Partners

The RCD partnered with the NRCS and Cal Poly to develop a Comprehensive Conservation Plan for the landowner. Much of the riparian fencing and water system at the Escuela Ranch was funded by the MBNEP. This particular project required a landowner who was not afraid of adverse regulatory consequences of inviting redlegged frogs into their water troughs; Cal Poly was the perfect partner for this endeavor.

Pollutant Reduction/Project Benefits

Created habitat for an endangered species; provided off-creek watering for cattle thereby reducing the loading of sediment, nutrients and pathogens associated with livestock grazing on rangelands to Chumash and Walters Creeks as estimated below.

Based on the above-referenced UCCE Fact Sheet No. 25, "Manure Loading into Streams from Direct Fecal Deposits" by the University of California Cooperative Extension, assume a 1,000 lb beef cow produces the following:

60 lb manure/day	0.11 lb P/day
12 defecations/day	3.84×10^{10} FC/day
5 lbs manure/defecation	7.2×10^{8} FS/day
0.34 lb N/day	0.19 instream fecal deposits per day

Assume 10 cows per day are prevented access to both Walter's and Chumash Creeks in the locations were the troughs are located, then
Pollution reduction for 10 cows over a 10 year period is as follows:

Manure = 5 lbs manure/defecation @ 0.19 instream defecations/day
@10 cows @ 365 days/yr @ 10 years =
Lbs Manure in creek over a 10 year period = 34,675 lbs or 17 Tons

Nitrogen = 0.34 lb N/day @ day/12 defecations
@ 0.19 instream defecations/day @10 cows @ 365 days/yr @ 10 years =
Lbs Nitrogen over a 10 year period = 196 lbs

Phosphorus = 0.11 lb P/day @ day/12 defecations
@ 0.19 instream defecations/day @10 cows @ 365 days/yr @ 10 years =
Lbs Phosphorus over a 10 year period = 64 lbs

Fecal Coliform (FC) = 3.84×10^{10} FC Colonies/day @ day/12 defecations
@ 0.19 instream defecations/day @10 cows @ 365 days/yr @ 10 years =
FC Colonies over a 10 year period = 2.2×10^{13} Colonies

Fecal Streptococci (FS) = 7.2×10^{8} FS Colonies/day @ day/12 defecations
@ 0.19 instream defecations/day @10 cows @ 365 days/yr @ 10 years =
FS Colonies over a 10 year period = 4.2×10^{11} Colonies

PC-08-06: CAL POLY ROAD IMPROVEMENT PROJECT- WALTER'S CREEK RANCH

Resource Concern

Because Chorro Creek and the Morro Bay Estuary are considered waters impaired by sedimentation, a Sediment Total Maximum Daily Load (TMDL) was approved by the Regional Water Quality Control Board in January of 2004. The worry was that eventually the sediment would fill up Morro Bay; much of the sediment loading is thought to be caused by "anthropogenic watershed disturbances." For example, the "Erosion and Sediment Study of the Morro Bay Watershed" (1989) identified that improperly designed and maintained roads are major sources of sediment loading into the Chorro Creek watershed.

Project Description

Location: This project is located at Cal Poly's Escuela Ranch approximately 2 miles east of Morro Bay. The project's access roads parallel Walter's Creek, a tributary to Chorro Creek which flows directly into the Morro Bay estuary.

Goal: To reduce sediment loading to Walter's Creek due to poorly maintained and poorly constructed access roads. See Attachment E, Figures 62-65.

Solution: Eliminate gulley erosion (caused by a concentration of storm water runoff and steep roads) by outsloping roads, removing berms on the outside edge of the road, constructing rolling dips, and seeding the finish graded roads. Outsloped roads disperse and drain runoff along the

entire outside edge of the road. Rolling dips and a smooth road surface are the key to maintaining an outsloped road. See Attachment E, Figure 66.

Rolling dips are breaks in the grade of the road; the downstream side of a rolling dip actually has a reverse slope. The dips are sloped to the outside edge of the road to drain and disperse surface runoff. The proper installation and spacing of rolling dips is critical to properly drain the road surface and prevent rilling and surface erosion. In a section of the project area where the access road had slopes from 8% to 11%, four rolling dips were installed in a span of 800 feet. In that same section of road, the road was outsloped at angle as great as 7%. All disturbed surfaces were seeded. See Attachment E, Figures 67 – 70.

Best Management Practices Implemented

Item	NRCS Conservation Practice Standard (BMP)			Unit	Quantity
	Practice Name	Component	Spec no.		
1	Access Roads	Out slope	560	Ft	3,972
2	Structure for Water Control	Rolling dips	587	No	5

Project Partners

The RCD partnered with the NRCS and Cal Poly to develop a Comprehensive Conservation Plan for the landowner.

Pollutant Reduction/ Project Benefits

Assume the following:

All gully erosion eventually deposits sediment into Walter's Creek
Average depth of a gulley is 6 inches
Average width of a gulley is 8 inches
Assume one long gulley the entire length of the access road project area develops each year.
Assume the road is graded each year removing the previously developed gulley

Then the reduction in sediment loading to Walter's Creek is as follows:

3,972 ft of gulley/yr @ 0.5 ft deep @ 0.67 ft wide @ 1 cy/27 cf @ 10 yr = 490 cy sediment

PC-08-07: SAN LUISITO CREEK MANAGED GRAZING PROJECT

Resource Concern

Water quality issues associated with livestock grazing on rangelands such as sediment, nutrient and pathogen loading to creeks. See Attachment E, Figures 71 - 74.

Project Description

Location: This project is located along San Luisito Creek Road approximately 1.5 miles east of Morro Bay. The project parallels both sides of San Luisito Creek for approximately 2 miles. San Luisito Creek is tributary to Chorro Creek which flows directly into the Morro Bay Estuary.

Goal: To exclude cattle access to San Luisito Creek and provide a reliable off creek water supply for the cattle.

Solution: Prior to installation of riparian fencing, a water development strategy was developed and initiated. Available water was limited; pastures had no available water other than the creek. One spring was identified for potential development but its location at the southern bottom of the property made its utility limited. A Water Development Specialists was hired to aide in locating well development sites on the north and south sides of the creek. Sites on each side of the creek were identified and then developed for a well and installation of a pump. The well capacity on the south side of the creek was estimated at 15 gpm while the capacity for the well on the north side of the creek was estimated at 5 gpm. Both wells have a depth of 60 feet. In addition, both well sites are equipped with telemetry and controls that allow the pumps to automatically turn on and off, on demand, which is based on the water level in the tanks.

On the north side of the creek, solar power and a solar pump was used to pump water through 3,600 feet of 1.25 inch diameter HDPE pipe to 3-5,000 gallon water tanks on a hill 220 feet above the location of the well and pump station. From the tanks, the water supply gravity flows through HDPE pipe to six water troughs.

On the south side of the creek, solar power and a solar pump was used to pump water through 2,450 feet of 1.25 inch diameter HDPE pipe to 1-5,000 gallon and 1-2,500 gallon water tanks on a hill 280 feet above the location of the well and pump station. From the tanks, the water supply gravity flows through HDPE pipe to six water troughs. Because there was not a line of site between the pump station and the water tanks, a telemetry repeater was installed on a ridge directly across from the pump station and then 1,000 feet of communication wire and conduit was trenched in from the repeater to the water tanks. See Attachment E, Figures 75 – 87.

The RCD financed the installation of the entire south side of the creek within the project area, while the MBNEP financed the installation of the entire north side of the creek within the project area, for a total of 18,832 feet of fencing.

Best Management Practices Implemented:

Item	NRCS Conservation Practice Standard (BMP)			Unit	Quantity
	Practice Name	Component	Spec no.		
1	Watering Facility	Trough	614	No	12
2	Watering Facility	Water tank	614	No	5
3	Water Well	HDPE plastic pipe	642	No	2
4	Fence	Barbed wire	382	Ft	8,223
5	Pumping Plant	Solar powered system	533	No	2

6	Pipeline	HDPE plastic pipe	516	Ft	18,470
7	Fencing (funded by MBNEP)	barbed wire	382	Ft	18,832

Project Partners

The RCD partnered with the NRCS to develop a Comprehensive Conservation Plan for the landowner. The RCD and the MBNEP partnered together with the landowner to develop a three party agreement that served as a mechanism to maximize the project scope, define the cost share agreement between the parties, and assure project completion.

Pollutant Reduction/Project Benefits

Based on the above-referenced UCCE Fact Sheet No. 25, "Manure Loading into Streams from Direct Fecal Deposits" by the University of California Cooperative Extension, assume a 1,000 lb beef cow produces the following:

60 lb manure/day	0.11 lb P/day
12 defecations/day	3.84×10^{10} FC/day
5 lbs manure/defecation	7.2×10^{8} FS/day
0.34 lb N/day	0.19 instream fecal deposits per day

Assume 110 cows at San Luisito Creek Ranch, then
Pollution reduction for 110 cows over a 10 year period is as follows:

Manure = 5 lbs manure/defecation @ 0.19 instream defecations/day
@110 cows @ 365 days/yr @ 10 years =
Lbs Manure in creek over a 10 year period = 381,425 lbs or 191 Tons

Nitrogen = 0.34 lb N/day @ day/12 defecations
@ 0.19 instream defecations/day @110 cows @ 365 days/yr @ 10 years =
Lbs Nitrogen over a 10 year period = 2,161 lbs

Phosphorus = 0.11 lb P/day @ day/12 defecations
@ 0.19 instream defecations/day @110 cows @ 365 days/yr @ 10 years =
Lbs Phosphorus over a 10 year period = 699 lbs

Fecal Coliform (FC) = 3.84×10^{10} FC Colonies/day @ day/12 defecations
@ 0.19 instream defecations/day @110 cows @ 365 days/yr @ 10 years =
FC Colonies over a 10 year period = 2.4×10^{14} Colonies

Fecal Streptococci (FS) = 7.2×10^{8} FS Colonies/day @ day/12 defecations
@ 0.19 instream defecations/day @110 cows @ 365 days/yr @ 10 years =
FS Colonies over a 10 year period = 4.6×10^{12} Colonies

Public Outreach

With support of the 319h grant, the CSLRCD completed public outreach activities ranging from educational workshops and watershed tours to regular active participation in stakeholder groups and distribution of brochures with information on availability of technical assistance to address land management issues affecting water quality.

Participation in Stakeholder Groups

The CSLRCD participated in numerous meetings and coordinated stakeholder efforts over the course of this grant, including regular participation on the MBNEP Implementation Committee, the MBNEP Technical Advisory Committee, the SLOSEA Advisory Committee, the Central Coast Steelhead Coalition, the Coast Oceans Regional Round Table (CORRT) coordinating committee, and regular meetings and document review to assist in creation of a county-wide permit coordination process for BMPs that are implemented as part of RCD and NRCS restoration projects.

Educational Workshops

Five workshops and tailgate meetings focused on the Morro Bay watershed were organized by the CSLRCD during the grant period, reaching a total of 157 participants:

- The CSLRCD facilitated a Range Water Quality Meeting in Morro Bay, held on January 31, 2007, with 43 attendees.
- A Nutrient and Irrigation Management Workshop for Growers focused on row crops and avocados was held in Morro Bay on September 9, 2008. Thirty-three landowners attended, nine of whom were from the Morro Bay watershed. This workshop led to requests from 7 growers for technical assistance from the RCD and NRCS on irrigation and nutrient management issues. Information from this workshop was posted on the CSLRCD website, and a follow-up informational mailer is planned to be sent to participants.
- A Creek Maintenance Tailgate meeting was held at a Los Osos Creek watershed ranch on September 27, 2007, focusing on creek maintenance; 20 landowners attended this meeting, including 10 cattle ranchers, 3 with avocado orchards, 4 with row crops, 2 with equestrian facilities, and 1 greenhouse operator.
- A "Farm and Ranch Roads" workshop was organized by the CSLRCD and held in November 2007 at Cal Poly, with 46 participants, 5 of whom were from the Morro Bay watershed.
- A "Properly Functioning Streams" workshop was held in June 2008 at the Cal Poly Beef Unit, with a total of 15 participants, including 11 landowners from throughout the county, 4 of whom were from the Morro Bay watershed.

Organizations working with the CSLRCD on the workshops included: SLO County Farm Bureau, SLO and SB Agricultural Water Quality Coalition, the SLO UC Cooperative Extension, NRCS, Cal Poly, City of Morro Bay, and the Morro Bay National Estuary Program, among

others. Most of these workshops offered RWQCB Agricultural Waiver Education units to participants.

Watershed Tours

Watershed tours organized by the CSLRCD during the course of this grant included the following:

- In November 2006, the CSLRCD led a tour for 7 people of a large managed grazing system in the Morro Bay watershed that included the implementation of an off-creek water system and riparian system.
- The CSLRCD planned and participated in a field tour for EPA staff of project sites in the Morro Bay watershed, focusing on BMPs installed to reduce erosion, nutrient and bacterial inputs to the watershed – there were a total of 15 participants.
- During 2006, the CSLRCD watershed coordinator gave two presentations and field demonstrations of water quality testing protocols for landowners at avocado ranches in Morro Bay and Cayucos. In addition to these field tours and presentations by the CSLRCD, the CSLRCD also participated in a tour of BMPs for MBNEP water quality projects.

Informational Materials

Publications addressing land and water management issues that were created and distributed during the grant period included (copies have been provided with earlier quarterly reports):

- "Range Water Quality" brochure.
- CSLRCD Technical and Financial Assistance Information Sheet.
- "Conservation Partnership: Assistance for Landowners through the CSLRCD and NRCS".
- NRCS September 2007 newsletter included a story highlighting the success of BMP's installed in a large farm in the Los Osos Creek watershed.
- California Beef Cattle Improvement Association's October 2007 newsletter included an article highlighting the CSLRCD's frog troughs installed on Cal Poly's Escuela Ranch.

Water Quality Benefits of Outreach and Education

Results of outreach and education efforts are often difficult to quantify in terms of environmental benefits. For example, many participants in the Farm and Ranch Road workshop will likely subsequently implement some or all of the best management practices learned at the workshop, with resulting diminution in erosion and sedimentation; however, there are no methods in place to measure those outreach benefits. However, one example of this project's outreach effectiveness was provided following the September 2008 Irrigation and Nutrient Management Workshop held in Morro Bay: over the ensuing 3 months, seven of the 33 attendees contacted the NRCS for technical and funding assistance with irrigation, nutrient management and erosion control issues. This is evidence of tremendous desire for information and technical assistance in

addressing water quality issues, and the effectiveness of the outreach platforms provided through this grant in helping ranchers and growers obtain the information they need.

Project Assessment and Evaluation Plan (PAEP) – Results

All PAEP Targets were met for this project. The table below summarizes project evaluation and effectiveness goals met corresponding with the grant agreement PAEP.

Table 1
Project Performance Measures for Planning, Research, Monitoring, or Assessment Activities

Project Goals	Measurement Tools and Methods	Targets	Results
1. Working with private property owners to develop farm and/or ranch conservation plans.	1. The number of trainings offered and the attendance at each training.	1. Completion of at least two (2) new conservation plans in the watershed.	Nine (9) workshops, tailgate meetings and presentations were offered, reaching a total of 157 participants. Seven new conservation plans were developed for the watershed. Additional landowners contacted the NRCS for technical assistance on BMPs.

Table 2
Project Performance Measures for Education, Outreach, and Capacity-building Activities

Project Goals	Measurement Tools and Methods	Targets	Results
1. Educate private landowners to increase their understanding of how agricultural land use activities may increase nonpoint sources of pollution.	1. The number of trainings offered and the attendance at each training. 2. Tour agendas; minutes of meetings, total number of attendees, type of agricultural operation, and a total number of Morro Bay Watershed attendees. 3. Meeting agendas and minutes. 4. Workshop agenda, summarize progress achieved on ranch plan development, total number of attendees, their type of agriculture operation, and a total number of Morro Bay Watershed attendees.	1. Provide at least one (1) Ranch WQ Short Course . 2. Provide at least one (1) "Tailgate Meeting. 3. Provide a "Roads" Workshop. 4. Provide a "Properly Functioning Stream" Workshop. New partnerships with landowners resulting in the design and installation of conservation plans and BMP's in the Morro Bay Watershed.	All of the targets were met. Number of trainings and attendance is described in Table 1, item 1. New partnerships with landowners resulted in 7 conservation plans and implementation of 74 BMPs, as enumerated in Attachment C.

Table 3
Project Performance for Conservation Planning and BMP Implementation

Project Goals	Measurement Tools and Methods	Targets	Results
1. Working with private property owners to design and implement management measures (or BMP's) that will reduce sediment , nutrient, and pathogen loads.	1. Assess the effectiveness of each individual BMP upon installation using pre, during and post photo documentation in accordance with SWRCB guidelines, estimates of the reduction in sediment, feet of stream bank protected, feet of riparian areas fenced. The Revised Universal Soil Loss Equation (RUSLE v. 1.05 will be used to estimate reductions sediment inputs to the watershed.	1. Completing the design and implementation of at least fourteen (14) management measures within the watershed. 2. New partnerships with landowners resulting in the design and installation of conservation plans and BMP's in the Morro Bay Watershed.	New partnerships with landowners resulted in 7 conservation plans and implementation of 74 BMPs, as enumerated in Attachments C & F.

Conclusions

This 319h-funded phase of Project Clearwater accomplished its goals in contributing to improved water quality in the Morro Bay estuary watershed through participation in stakeholder groups, outreach and education, development of conservation plans, and implementation of NRCS Best Management Practices.

Altogether, projects implemented under Project Clearwater over this three-year period will provide estimated benefits to the Morro Bay estuary and its watershed, over a ten year period, of reduction in sedimentation by 860 cubic yards, and prevention of deposition into streams of over 3,600 tons of manure, with a corresponding reduction in nitrogen input of 49,101 pounds, and of phosphorus input of 2,454 pounds, as well as large reductions in fecal coliform and fecal streptococci.

The project's education and outreach component engaged a total of 157 growers, ranchers and environmental community members through a series of workshops, watershed tours, and tailgate meetings. Workshops and meetings offered included Range Water Quality, Irrigation and Nutrient Management, Creek Maintenance, Properly Functioning Streams, and Farm and Ranch Roads Workshop. A number of local agencies and municipalities partnered with the RCD in these outreach programs, including the San Luis Obispo County Farm Bureau, Cal Poly State University, the City of Morro Bay, and University of California Cooperative Extension.

In all, a total of $1,306,230 was spent to implement water quality improvement and protection projects on seven ranches, incorporating 74 best management practices (BMPs). The SWRCB 319h grant provided $470,245 of the funds, while $835,984 was provided by match sources, including the Morro Bay National Estuary Program (MBNEP), NRCS, California Department of Conservation (DOC), Sustainable Conservation "Partners in Restoration" program (SUSCON), and the individual landowners with whose partnership and on whose property the projects were brought to fruition.

Next Steps

Partnerships created with Morro Bay watershed landowners resulted in successful projects, with the desire to continue. Many of the conservation plans developed during this process include plans for additional BMPs to be installed to improve water conservation and water quality protection in the watershed, as landowner finances and match funding allows.

The CSLRCD plans to continue partnering with the NRCS and other interested agencies and stakeholders in offering assistance to Morro Bay watershed farmers in improving nutrient and irrigation budgeting to minimize potential farm inputs of nitrate into groundwater.

The CSLRCD and NRCS plan to continue their successful longstanding partnership with the MBNEP to protect and restore riparian ecosystems in the watershed. The CSLRCD will seek additional funding for projects to accelerate improvements in on-farm and ranch practices that benefit water quality.