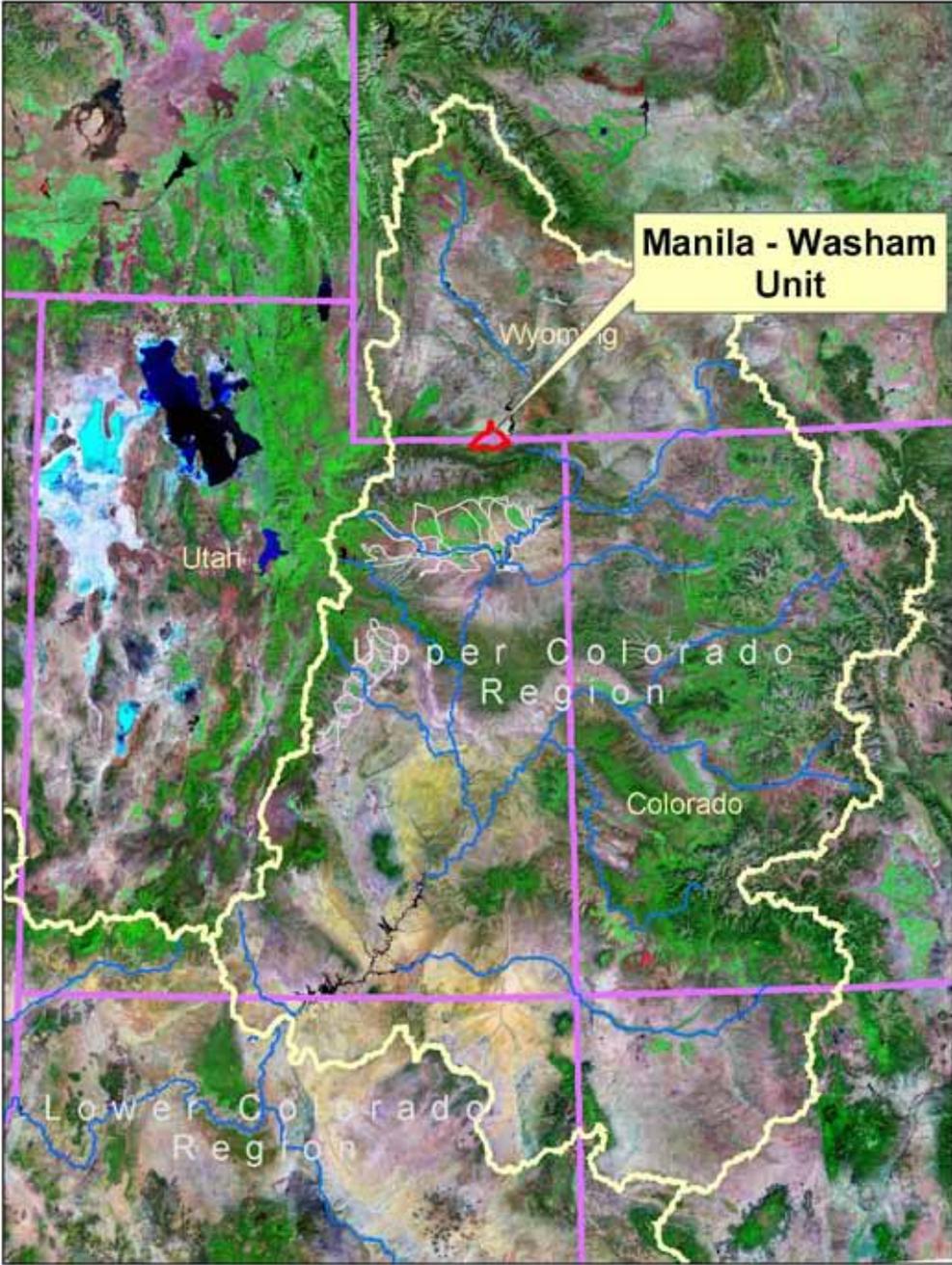


Manila - Washam Unit

Monitoring and Evaluation Report, FY2010



*U.S. Department of Agriculture
Natural Resources Conservation Service*

Executive Summary

Project Status

- NRCS and Reclamation have reviewed and concurred on an initial agricultural salt loading of 27,000 tons on-farm and 13,000 tons off-farm pre-project salt loading. The calculated cost, from data in the 2006 EA, is estimated to be \$78/ton in 2010 dollars.
- For FY2010, \$425,000 FA was obligated planning 406 acres to reduce salt loading by 973 tons/year at an amortized cost of \$48/ton.
- Cumulative federal obligation planned through FY2010 is \$6.59 million FA (2010 dollars), planned on 4,455 acres, reducing salt loading by 9,931 tons/year at an average cost of \$77/ton FA+TA.
- In FY2010, \$775,000 FA was applied treating 494 acres, reducing salt loading by 1,198 tons/year at an amortized cost of \$72/ton FA+TA.
- Cumulative funds applied are \$3.89 million FA (2010 dollars), on 2,955 acres, reducing salt loading by 7,087 tons/year at an average cost of \$63/ton.
- Of 11,100 water-rights acres, 7,780 acres are projected to be improved, reducing salt loading by 16,800 tons/year.
- Ongoing USGS salt load monitoring is inconclusive.
- Passage of the 2008 Farm Bill has extended EQIP through 2012.

Hydro-salinity

- IWM record keeping reports indicate that average deep percolation on treated fields is less than anticipated.

Wildlife Habitat and Wetlands

- There was one irrigation contract with a wildlife component planned and funded in FY2010 for a total of two acres of upland wildlife habitat replacement.
- US Bureau of Reclamation has completed piping Peoples Canal in FY2010. USFS Wetland Complexes are to be monitored.

Economics

- Alfalfa production is in an upward trend.
- Interest in salinity control projects is moderate.

Table 1, Project Progress Summary

Manila Washam Unit, All Programs				
CONTRACTS PLANNED	UNITS	CURRENT FY	CUMULATIVE	TARGET
1. CONTRACT STATUS				
A. Contracts Approved	Number	6	48	
	Dollars	424,759	5,897,157	
	Acres	406	4,455	7,780
	On-farm Tons/Year	973	9,931	18,500
	Off-farm Tons/Year	-	-	
B. Active Contracts				
	Number		34	
	Dollars		3,308,901	
	Acres		2,766	
	On-farm Tons/Year		6,585	
	Off-farm Tons/Year		-	
PRACTICES APPLIED				
2. EXPENDITURES				
Financial Assistance (FA)	Dollars	775,107	3,714,165	
3. IRRIGATION SYSTEMS				
A. Sprinkler	Acres	494	2,949	7,780
B. Improved Surface System	Acres	-	-	
C. Drip System	Acres	-	6	
4. SALT LOAD REDUCTION				
A. Salt load reduction, on-farm	Tons/Year	1,198	7,087	18,500
B. Salt load reduction, off-farm	Tons/Year	-	-	
*Note: On-farm Salt Load Reduction has been calculated using the procedure adopted in FY2007 by three Upper Basin States.				
NRCS Salinity Control Programs in Manila - Washam Unit				
Program Name		Acronym	Start Year	End Year
Environmental Quality Incentive Program		EQIP	2007	Current
Basin States Parallel Program		BSPP	2007	Current

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Monitoring and Evaluation History and Background

The Colorado River Basin Salinity Control Program was established by the following Congressional Actions:

- The Water Quality Act of 1965 (Public Law 89-234) as amended by the Federal Water Pollution Control Act of 1972, mandated efforts to maintain water quality standards in the United States.
- Congress enacted the Colorado River Basin Salinity Control Act (PL 93-320) in June, 1974. Title I of the Act addresses the United States' commitment to Mexico and provided the means for the U.S. to comply with the provisions of Minute 242. Title II of the Act created a water quality program for salinity control in the United States. Primary responsibility was assigned to the Secretary of Interior and the Bureau of Reclamation (Reclamation). USDA was instructed to support Reclamation's program with its existing authorities.
- The Environmental Protection Agency (EPA) promulgated a regulation in December, 1974, which established a basin wide salinity control policy for the Colorado River Basin and also established a water quality standards procedure requiring basin states to adopt and submit for approval to the EPA, standards for salinity, including numeric criteria and a plan of implementation.
- In 1984, PL 98-569 amended the Salinity Control Act, authorizing the USDA Colorado River Salinity Control Program. Congress appropriated funds to provide financial assistance through Long Term Agreements administered by Agricultural Stabilization and Conservation Service (ASCS) with technical support from Soil Conservation Service (SCS). PL 98-569 also requires continuing technical assistance along with monitoring and evaluation to determine effectiveness of measures applied.
- In 1995, PL 103-354 reorganized several agencies of USDA, transforming SCS into Natural Resources Conservation Service (NRCS) and ASCS into Farm Service Agency (FSA).
- In 1996, the Federal Agricultural Improvement and Reform Act (PL 104-127) combined four existing programs, including the Colorado River Basin Salinity Control Program, into the Environmental Quality Incentives Program (EQIP).

Over the years, Monitoring and Evaluation (M&E) has evolved from a mode of labor/cost intensive detailed evaluation of a few farms and biological sites to a broader, but less detailed evaluation of many farms and environmental concerns, driven by budgetary restraints and improved technology.

M&E is conducted as outlined in "The Framework Plan for Monitoring and Evaluating (M&E) the Colorado River Salinity Control Program", last revised in 2001.

Project Status

FY2010 Project Results

FY2010 project results for the Manila-Washam Unit (MW) are summarized in table 2.

Cumulative Project Results

Cumulative results through FY2010 are tabulated in Table 3, along with EA projections. Dollar amounts are expressed in 2010 dollars.

Table 2, FY2010 results

FY2010	Units	Planned	Applied
Irrigation Improvements	acres	406	494
Federal cost share, FA	\$	\$425,000	\$775,000
Amortized federal cost share, FA+TA	\$/year	\$47,100	\$86,000
Salt load reduction	tons/year	973	1,200
Federal cost, FA+TA	\$/ton	\$48	\$72

Detailed Analysis of Status

Pre-Project Salt Loading

Agricultural irrigation is a major source of salt loading into the Colorado River and is completely human induced. Irrigation improvements have great potential to control salt loading.

In 2007 NRCS and Reclamation reviewed available literature and came to a consensus agreement on the most reasonable pre-project salt contribution from agriculture prior to implementing federal salinity control measures in the Manila – Washam Unit (MW). The result of this effort is depicted in figure 1.

Salinity Control Practices

On-farm practices used to reduce salt loading include improved flood systems, sprinkler systems, and advanced irrigation systems, along with diversions, water delivery systems, pumps, ponds, etc., required for the proper operation of irrigation systems. On-farm salt load reduction is achieved by reducing over-irrigation and deep percolation.

Off-farm practices used to reduce salt loading are associated with the reduction and/or elimination of canal/ditch seepage, usually by installing pipelines.

Planning Documents

For the Manila-Washam Salinity Area (MW), in 2006, NRCS developed an Environmental Assessment (EA) for which a Finding of No Significant Impact (FONSI) was issued by the NRCS State Conservationist for Utah. Development of salinity control contracts started in FY2007.

In FY2010, recalculation of potential salt load reduction was reduced from 24,900 tons/year to 18,500 tons/year, based on a reanalysis of data in the EA.

The EA and NRCS plans address only on-farm practices in MW. In FY2009, Peoples Canal Company received a Reclamation grant to pipe the entire Peoples Canal using American Recovery and Reinvestment Act (ARRA) funds. The pipeline was completed in 2010.

It is anticipated that the remaining canal company, Sheep Creek Canal Company, will continue to seek funding for off-farm improvements.

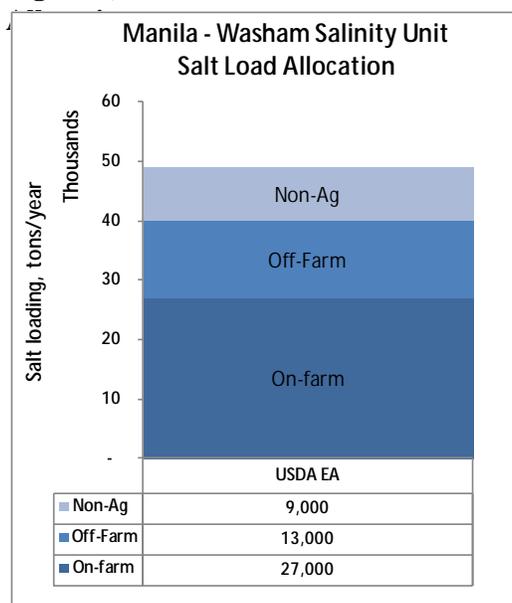
Planned Practices (Obligations)

Planned practices (obligations) represent contracts with participants to apply improved irrigation practices to the participant’s agricultural activities. Only the federal share of project cost is analyzed in this section.

Table 3, Project goals and cumulative status

FY2010 Cumulative Improvements	Units	NEPA	Planned	Applied
Irrigation improvements	acres	7,780	4,455	2,955
Federal cost share, FA	2010\$	\$12,040,000	\$6,590,000	\$3,890,000
Amortized federal cost share, FA+TA	2010\$/yr	1,442,000	761,200	443,600
Salt load reduction, tons/year	tons/year	18,500	9,931	7,087
Federal cost/ton, FA+TA	2010\$	\$78	\$77	\$63

Figure 1, Consensus Initial Salt Load



The installation of salinity control practices is voluntary on the part of landowners. An incentive to participate is created by cost-sharing on practice purchase and installation using federal grants. In essence, federal cost-share purchases salt load reductions in the Colorado River, while the participant's cost-share buys him/her reduced operating costs and increased production.

Federal cost-share is obligated when a contract is signed with the participant, assuring timely installation to federal standards, of salt load reducing irrigation practices.

FY2010 Obligation

In FY2010, \$425,000 was obligated in 6 contracts to treat 406 acres with improved irrigation.

Salt Load Reduction Calculation

The estimated salt load reduction from FY2010 planned practices is 973 tons/year, calculated by multiplying the original tons/acre for the entire basin, by the acres to be treated and a percentage reduction based on change in irrigation practice. For MW, the initial estimate of on-farm irrigation salt loading is 2.67 tons/acre-year. As an example, if 135 acres are converted from wild flood to center pivot sprinkler, an estimated 91% of the original salt load will be eliminated. Hence, 135 acres x 2.67 tons/acre-year x 91% = 328 tons/year salt load reduction.

Cost/Ton Calculation

The federal cost/ton for salt load reduction is calculated by amortizing the federal financial assistance (FA) over 25 years at the federal discount rate for water projects (4.375% in FY2010). Two-thirds of FA is added for technical assistance (TA) and the amortized total cost is divided by tons/year to yield cost/ton. TA covers the cost of contract administration, project design and construction inspection, and contract review and maintenance through the life of the project.

Normalization to 2010 dollars is based on the Producer Price Index (PPI) for agricultural equipment purchased.

Obligation Analysis

In FY2010, \$425,000 was obligated to treat 406 acres, reducing salt loading by 973 tons/year. The resulting cost is \$48/ton.

In 2010 dollars, cumulative obligation thru FY2010 is \$6.59 million, planned on 4,455 acres, with a salt load reduction of 9,931 tons/year, resulting in an overall cost of \$77/ton. See table 4.

Table 4 lists annual planned obligations and costs in nominal and 2010 dollars.

Table 4, Planned practices, cost/ton, nominal and 2010 dollars

FY	Federal Water Project Discount Rate	Contracts Planned	FA Planned Nominal	Acres Planned	Salt Load Reduction Planned	Amortized FA+TA Nominal	\$/ton FA+TA Nominal	2010 PPI Factor	FA Planned 2010\$	Amortized FA+TA 2010\$	\$/ton 2010 \$	Cum \$/ton 2010 \$
2007	4.875%	17	\$2,596,059	1,835	3,609	\$303,160	\$84	121%	\$3,138,278	\$366,479	102	102
2008	4.875%	9	\$802,932	708	1,700	\$93,764	\$55	108%	\$866,454	\$101,182	60	88
2009	4.625%	16	\$2,073,407	1,506	3,649	\$236,055	\$65	104%	\$2,164,039	\$246,374	68	80
2010	4.375%	6	\$424,759	406	973	\$47,130	\$48	100%	\$424,759	\$47,130	48	77
Totals		48	\$5,897,157	4,455	9,931	\$680,109	\$68		\$6,593,530	\$761,164	77	

Cost-Share Enhancement

Typical federal cost-share, over the last several years, has been about 75% of total installation cost. A feature of the 2002 and 2008 Farm Bills is cost-share enhancement, increasing the federal cost-share, from 75% to 90% of total cost for beginning farmers (those who have not claimed agricultural

deductions on income tax for 10 years), limited resource farmers (a farmer with gross farm income below a specified level), and producers from historically underserved minorities.

In MW, 18 contracts on 756 acres for \$1.16 million (2010 dollars) are cost-share enhanced. Estimated salt load reduction is 1,779 tons/year. The average salt load reduction cost is \$88/ton FA+TA (2010 dollars), compared to \$77/ton for all contracts and \$74/ton for unenhanced contracts. The incremental cost of enhancements is \$226,000 FA, about 3.4% of total FA. All 20 enhanced contracts are beginning farmers.

Figure 2 depicts the cost of enhanced and non-enhanced contracts in 2010 dollars/ton.

Figure 3 depicts comparative acreage of enhanced contracts.

Applied Practices

FY2010 Expenditures

In FY2010, \$775,000 FA was expended applying practices to 494 irrigated acres. The estimated salt load reduction is 1,198 tons/year, at an amortized cost of \$72/ton FA+TA.

Cumulative expenditure FY2007-FY2010 is \$3.89 million FA (2010 dollars), applied to 2,955 irrigated acres, reducing salt loading by 7,087 tons/year at a cost of \$63/ton FA+TA (2010 dollars).

Table 5 details cumulative applied practices.

Figure 2, Cost of Contract Enhancement

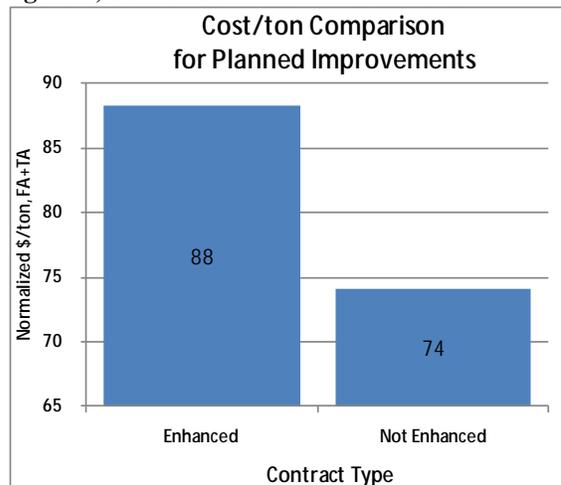


Figure 3, Enhanced Acres

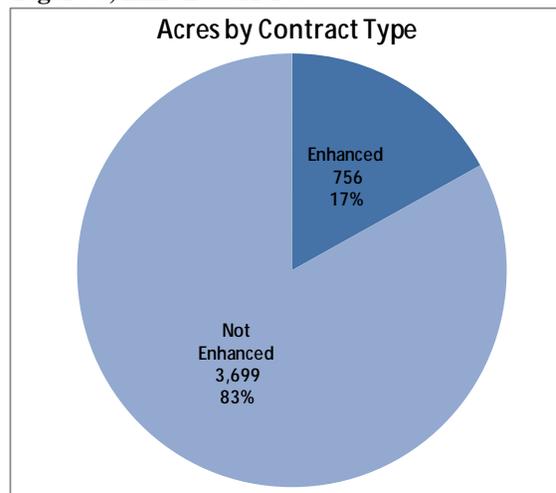


Table 5, Applied practices, cost/ton, nominal and 2010 dollars

FY	Federal Water Project Discount Rate	FA Applied Nominal	Acres Applied	Salt Load Reduction Applied	Amortized FA+TA Nominal	\$/ton FA+TA Nominal	2010 PPI Factor	FA Applied 2010\$	Amortized FA+TA 2010\$	\$/ton 2010\$	Cum \$/ton 2010\$
2007	4.875%	\$32,363	32	72	\$3,779	52	121%	\$39,122	\$4,569	63	63
2008	4.875%	\$1,068,816	859	2,046	\$124,813	61	108%	\$1,153,373	\$134,687	66	66
2009	4.625%	\$1,837,879	1,570	3,771	\$209,241	55	104%	\$1,918,215	\$218,387	58	61
2010	4.375%	\$775,107	494	1,198	\$86,003	72	100%	\$775,107	\$86,003	72	63
Totals		\$3,714,165	2,955	7,087	\$423,836	60		\$3,885,818	\$443,646	63	

Application of salinity control practices lags planning by the time required for installation. Between planning and application, a few contracts are de-obligated for various reasons such as design modification, change in ownership or cancellation.

For tracking, acres treated and salt load reductions are assumed to be proportional to dollars paid out.

Salt load reduction in this report is calculated using "Calculating Salt Load Reduction", July 30, 2007.

Figure 4 compares cumulative planned and applied acres. The orange, dashed line at 7,780 acres depicts the treatment goal for MW.

Figure 5 compares planned and unplanned acres with respect to the EA target of 7,780 acres.

Figure 6 compares calculated cost/ton, planned and applied, with the recalculated cost/ton from EA data, in 2010 dollars.

Figure 7 is a map displaying planned and applied acres.

Figure 4, Planned and applied acres

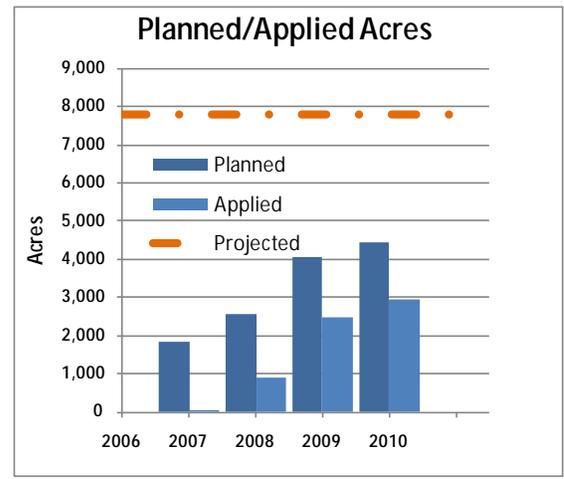


Figure 5, Planned and unplanned acres

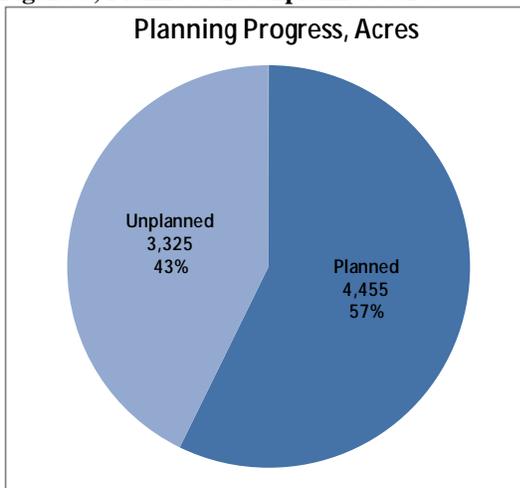


Figure 6, Cost/ton, planned, applied, projected

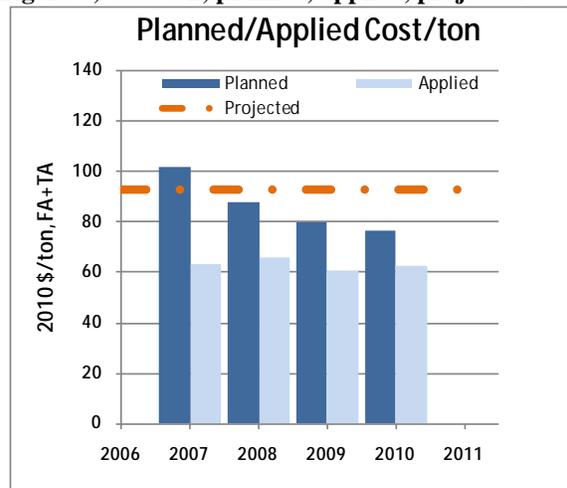
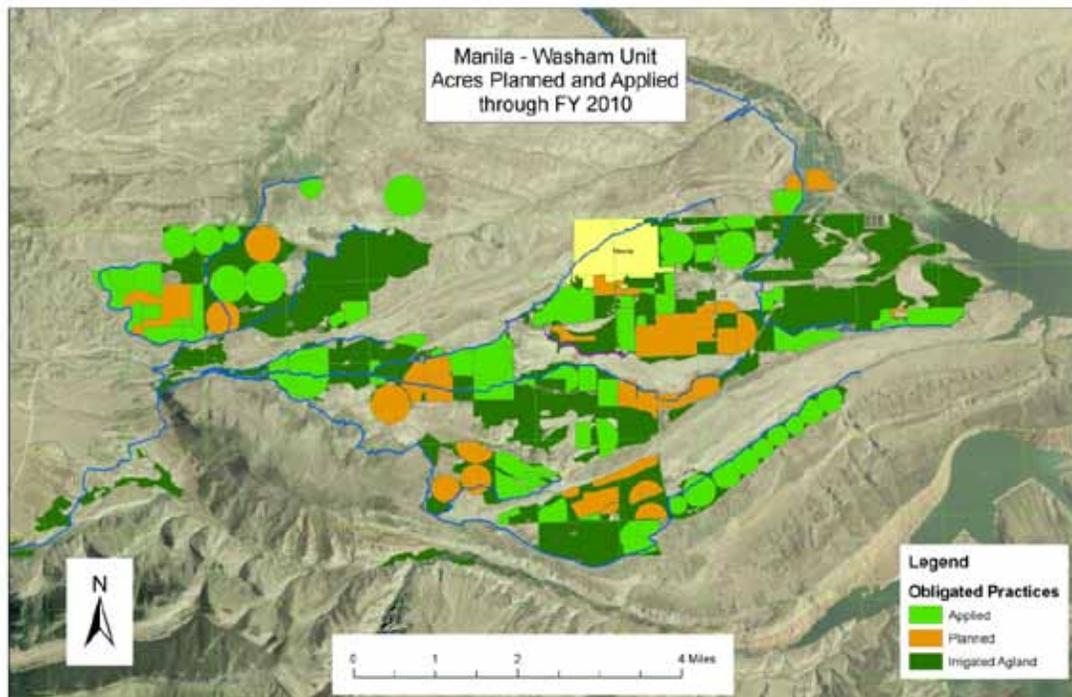


Figure 7, Planned and applied acres.



Hydro Salinity Monitoring

Before implementation of salinity control measures, Manila - Washam Unit agricultural operations contributed an estimated 40,000 tons of salt per year to the Colorado River (on-farm and off-farm), from an average of 10,100 acres of annually irrigated land. Salt loading of 27,000 Tons/year was allocated to on-farm activities and 13,000 tons to off-farm canals and large laterals.

Three assumptions guide the calculation of salt load reduction from irrigation improvements:

1. Salt concentration of subsurface return flow from irrigation is relatively constant, regardless of the amount of canal seepage or on-farm deep percolation.
2. The available supply of mineral salts in the soil is essentially infinite and salinity of out-flowing water is dependent only on solubility of salts in the soil. Therefore, salt loading is directly proportional to the volume of subsurface return flow.
3. Water that percolates below the root zone of the crop and is not consumed by plants or evaporation will eventually find its way into the river system. Salt loading into the river is reduced by reducing deep percolation. (Hedlund, 1994).

Deep percolation and salt load reductions are achieved by reducing or eliminating canal/ditch seepage/leakage and by improving the efficiency and uniformity of irrigation. It is estimated that upgrading an uncontrolled flood irrigation system to a well designed and operated sprinkler system will reduce deep percolation and salt load by 84-91%. (See appendix I.)

NRCS salinity control programs focus on helping cooperators improve irrigation systems, better manage water use, and sharply reduce deep percolation/salt loading.

Salinity Monitoring Methods

The 1991, "...*Framework Plan for Monitoring and Evaluating (M&E) the Colorado River Salinity Control Program*" as utilized in the Uintah Basin and adopted by the EIS for the Price – San Rafael Rivers Unit, focused on:

- Intensive instrumentation and analysis on several irrigated farms, requiring expensive equipment and frequent field visits to ensure and validate collected data
- Detailed water budgets to determine/verify deep percolation reductions
- Multi-level soil moisture measured weekly, with a neutron probe
- Detailed sprinkler evaluations, using catch cans, ran annually on selected farms
- Crop yields physically measured and analyzed

As a result of labor intensive testing in the Uintah Basin Unit, it was confirmed that irrigation systems installed and operated as originally designed, produced the desired result of improved irrigation efficiencies and sharply reduced deep percolation rates, concurrent with reduced farm labor and improved yields.

A new "*Framework Plan for Monitoring and Evaluating (M&E) the Colorado River Salinity Control Program*" was adopted in 2001. Having established that properly installed and operated practices yield predictable and favorable results, the 2001 Framework Plan addresses hydro-salinity by:

- Utilizing random cooperator surveys to collect and evaluate cooperator understanding, and impressions concerning contracts and equipment
- Formal and informal Irrigation Water Management (IWM) training and encouragement
- Equipment spot checks and operational evaluations
- Agricultural statistics collected by government agencies

In MW, virtually all salinity program irrigation improvements are sprinkler systems. Center Pivot systems are preferred by three to one over wheel lines, on an acreage basis, presumably due to large average field size. The average contract size is 94 acres.

Cooperator questionnaires, interviews, and training sessions

No cooperator questionnaires have been done in the Manila – Washam Unit. It is anticipated that it will take two or three years for cooperators to become familiar with system operations before interviews would become practical.

Irrigation Water Management (IWM)

The goal of IWM is to assure that irrigated crops get the right amount of water at the right place at the right time, which will accomplish the goal of minimizing deep percolation and salt loading in the river. Proper IWM is achieved by careful equipment design, cooperator education, and maintenance resulting in implementation of effective water management techniques.

In general, sprinkler systems designed by NRCS are capable of irrigating the most water-consumptive projected crop in the hottest part of the year. When growing crops with lower water needs, or at other times in the growing season, these systems are capable of over-irrigating to some extent.

Over-irrigating in early spring and late fall is mitigated by water storage aspects of the soil. Crops generally use water before irrigation begins and after irrigation ends, leaving the soil moisture profile partially depleted. Filling the soil with water requires additional irrigation, over and above crop needs, in the spring.

Preventing over-irrigation is a contractual obligation of the cooperators. To help cooperators fulfill this obligation they must be educated and coached in the proper use and maintenance of their irrigation systems.

This is achieved by creating financial incentives for IWM, initial IWM training sessions, periodic water conferences, and developing IWM tools that simplify record keeping and help cooperators properly time irrigation cycles. Incentive IWM payments have resulted in greater interest in keeping records and understanding soil/water relationships.

Water management seminars and conventions are sponsored by various government, educational, and commercial groups, encouraging everyone to manage and conserve water. NRCS is a willing and eager participant in these partnership educational endeavors.

Additionally, personal guidance is available to cooperators, on request, at local NRCS field offices.

Intensive and continuous IWM training is essential to successful long term salt load reduction.

To help cooperators with irrigation timing, a major part of IWM, NRCS demonstrates two simple, low-cost approaches:

1. Irrigation record keeping, wherein the cooperator keeps track of water put on the field and compares the volume used to the volume required by the crop
2. Soil moisture monitoring, wherein the cooperator determines when to irrigate, based on measured available water content (AWC) of the soil

Irrigation Record Keeping

To help with irrigation timing, NRCS has developed and provided the, "IWM Self Certification Spreadsheet" which allows cooperators to graphically evaluate available water content (AWC) of the soil and compare actual irrigation with projected average crop water requirements and/or with modeled crop evapotranspiration. Evapotranspiration is calculated from climate data collected by NRCS and other public agencies, using Penman-Montieth procedures outlined by the Food and Agriculture Organization of the United Nations (FAO). The final output of the spreadsheet is two graphs comparing water applied, with water required, on a seasonal basis. See figures 8 and 9.

Figure 8 is the input form, on which the irrigator enters data into the blue shaded cells. The spreadsheet then calculates the remaining data.

Figure 9 consists of two graphs created by the spreadsheet. In the first graph of figure 9, available water content (AWC) of the soil is plotted. If AWC reaches 100% (the soil/water profile is full), any additional irrigation water applied becomes deep percolation, expressed as red line above the normal AWC interval. A modest amount of deep percolation is designed into all irrigation systems to compensate for distribution anomalies and to leach accumulated salt from the root zone.

In the second plot in figure 9, if the red actual application line is above and to the left of the blue consumptive use line, the crop is over-irrigated. The purple line is from near-real-time ET calculations.

In order to receive incentive payment for IWM, each irrigator must do the following:

1. attend a two hour IWM training session or a water conference,
2. with help, augur a hole and determine the soil moisture by the feel method, and
3. bring his irrigation records to the local field office, where data is entered into the spreadsheet and results are calculated, graphed, and discussed. Graphs are printed for the farmer's reference.

In general, cooperators respond positively to this training and work hard to irrigate more efficiently.

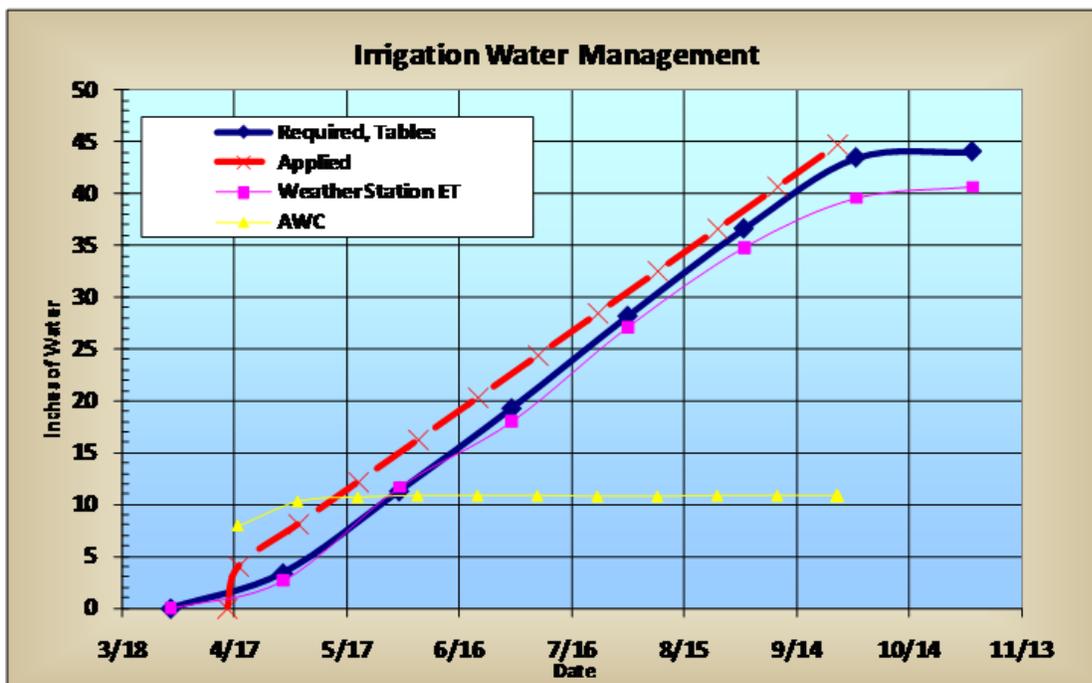
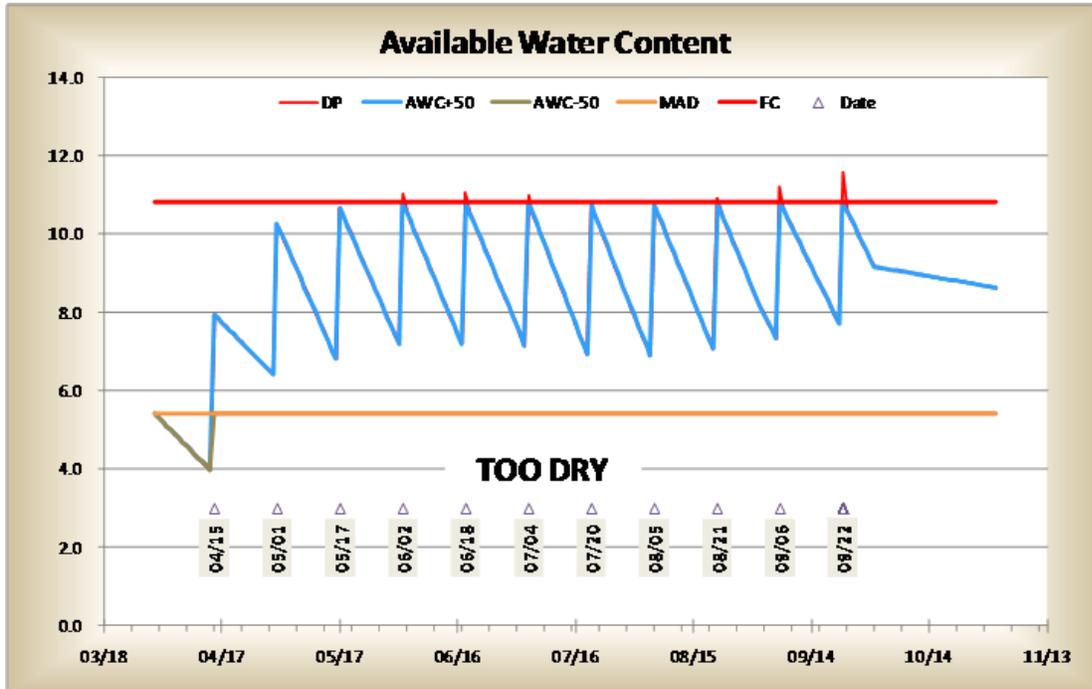
In FY2008 – FY2010, 17 IWM Self Certification Spreadsheets were submitted for payment. One project, representing 40 acres, was deep percolating excessively. Total deep percolation from all 17 fields was about 34% of design, suggesting that estimated salt load reduction in conservative.

Figure 8, IWM Self Certification Spreadsheet input page.

Irrigation Water Use Record - Farmer Self Certification										
Cooperator: _____				Crop: <u>Grass Hay/Pasture</u>		Year: <u>2010</u>				
Tract/Field: _____				Root Depth, ft: <u>2.50</u>						
Date: <u>02/02/11</u>				Station: <u>Manila</u>		CU: <u>24</u> inches				
Soil Texture: <u>Loam</u>				Irrigation method: <u>Pivot</u>						
AWC, In/Ft: <u>2.16</u>				Efficiency: <u>75%</u>						
AWC Max, in: <u>5.40</u>				Acres: <u>69.74</u>						
MAD, in: <u>2.70</u>				Evaporation %: <u>10%</u>						
Pre-season AWC, In. <u>2.70</u>				Cycle Hours: <u>168</u>						
				Flow rate, gpm: <u>450</u>						
Start date of irrigation cycle	End date of irrigation	Total Cycle Hours	Alternate Cycle Hours	Flow, gpm	Inches Applied Cycle	Inches Applied Season	CU Season (Table)	Irrigation Balance	AWC	Deep Perc
05/18/10	05/25/10	168		450.2	2.42	2.42	3.27	-1.09	1.61	0.00
05/25/10	06/01/10	168		450.2	2.42	4.84	4.06	1.39	3.00	0.00
06/01/10	06/08/10	168		450.2	2.42	7.26	5.10	1.13	4.13	0.00
06/08/10	06/15/10	168		450.2	2.42	9.68	6.15	1.13	5.26	0.00
06/19/10	06/26/10	168		450.2	2.42	12.10	7.79	0.54	5.40	0.40
06/30/10	07/07/10	168		450.2	2.42	14.52	9.68	0.29	5.40	0.29
07/11/10	07/18/10	168		450.2	2.42	16.94	11.71	0.15	5.40	0.15
07/22/10	07/29/10	168		450.2	2.42	19.37	13.73	0.15	5.40	0.15
08/02/10	08/09/10	168		450.2	2.42	21.79	15.69	0.23	5.40	0.23
08/13/10	08/20/10	168		450.2	2.42	24.21	17.62	0.24	5.40	0.24
08/24/10	08/31/10	168		450.2	2.42	26.63	19.56	0.24	5.40	0.24
09/04/10	09/11/10	168		450.2	2.42	29.05	21.02	0.72	5.40	0.72
09/15/10	09/22/10	168		450.2	2.42	31.47	22.48	0.72	5.40	0.72
Total inches of water applied during the season (total of all lines above):								31.47		3.14
Total Acre Feet Applied during the Season:								182.9		
Seasonal Irrigation Efficiency (CU requirement/inches of water applied per acre):								71%		

Figure 9, Sample graphs from the IWM Self Certification Spreadsheet.

The blue lines indicate the Managed Allowable Depletion (MAD). For maximum crop growth, soil moisture should be kept in this interval at all times. Red lines indicate deep percolation. In the second graph, the blue line is a long-term average water requirement, based on location and crop. The red line is the actual water applied. Where data is available, the purple line is modeled from current local data collected at a nearby weather station, using the FAO-56 Penman—Montieth evapotranspiration model.



Soil Moisture Monitoring

A time-tested method for timing irrigation involves augering a hole and determining the water content of the soil to decide when to apply the next irrigation. This may well be the best method available for irrigation timing, both simple and inexpensive. However, few irrigators take time to do it.

NRCS is demonstrating and guiding cooperators in the use of modern soil moisture monitoring systems, utilizing electronic probes and data recorders. Such systems can now be installed for about \$600, giving the cooperator information on the water content of his soil at several different depths, without time-consuming augering.

In a typical case, electrical resistance based probes are installed at various depths, such as 12", 24" and 48". Using a simple data recorder, indicated soil pore pressure (implied soil moisture content) is read and recorded multiple times per day. With some recorders, soil pore pressure is presented graphically on an LCD display in the field, making it a simple matter to estimate when the next irrigation will be required (figure 10).

Figure 10, Sample Soil Moisture Data Logger.



Since gravimetric drainage generally does not occur unless the soil horizon is nearly saturated (above field capacity), it is assumed that deep percolation is not occurring if the deepest probe reading is greater than - 10 centibars. In MW, one installed data recorder indicates that deep percolation occurs less than 3% of the time on the monitored field.

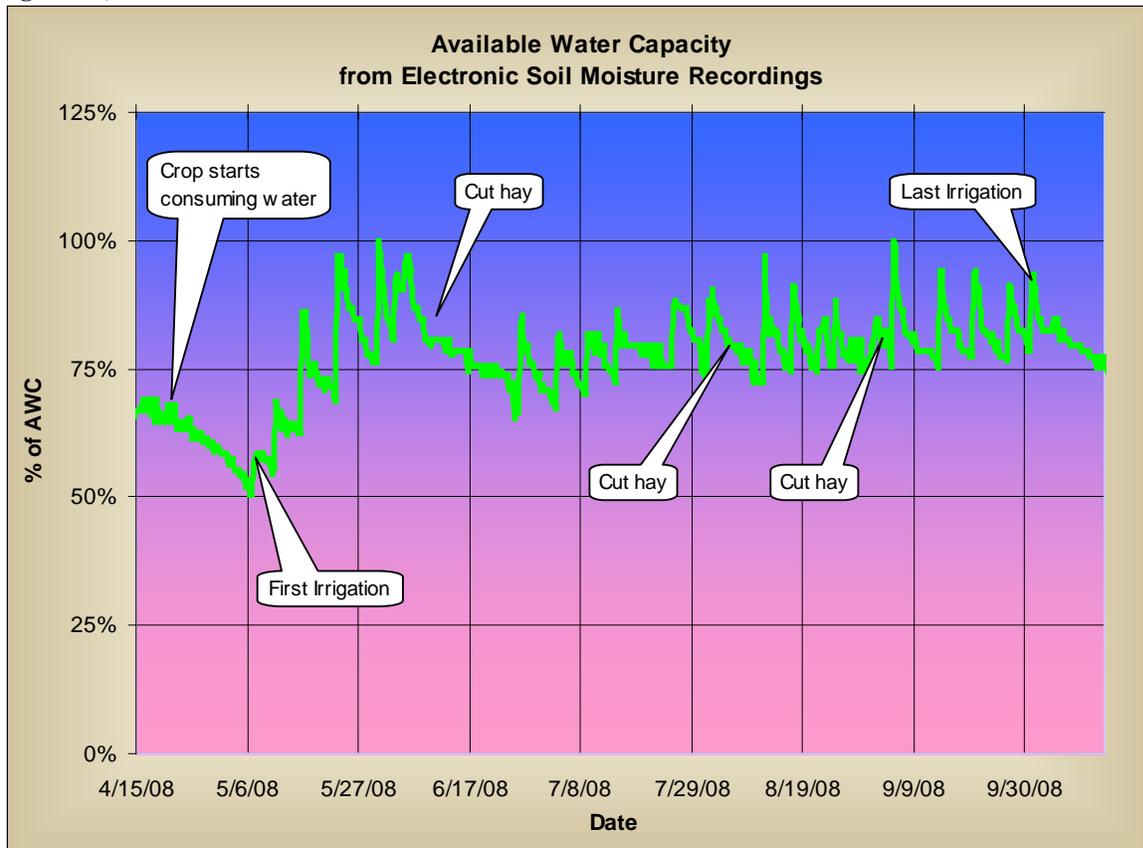
Soil moisture data recorders typically store 10 months of data or more in nonvolatile memory and can be downloaded using a laptop computer or PDA. Battery life is over a year, using AA or 9 volt batteries. When carefully installed, maintenance requirements are minimal.

Available water content (AWC), the soil moisture available to the plant, can be roughly estimated, using multiple probes. The AWC calculation is dependant on many soil and environmental parameters and is tedious to model accurately, but when an operator becomes familiar with the system, he will be able to use it well for irrigation timing. (See figure 11).

In the Manila – Washam Unit, four data recorders have been purchased and installed by Daggett Soil Conservation District members.

In the FY2010 payment schedule, an additional IWM Intense (449) practice was included that increased the IWM payment for participants who agree to install soil moisture monitoring equipment in addition to taking classes, attending workshops, and keeping records. It is hoped that future contracts will capitalize on this opportunity to enhance instrumentation and IWM interest at the field level.

Figure 11, AWC estimated from downloaded soil moisture data.



USGS Water Quality Monitoring

US Geological Survey (USGS) studied salt loading from the Manila-Washam Salinity Area (MW) from July 1, 2004 to June 30, 2005. From this data they prepared Scientific Investigations Report 2004-05, entitled "Characterization of Dissolved Solids in Water Resources of Agricultural Lands near Manila, Utah, 2004-2005". The amended final report estimated the total agricultural salt loading to be 31,200 tons/year. Of the 31,200 tons/year, NRCS estimates that 7,100 tons/year has been eliminated due to the installation of sprinkler systems.

Because MW is small in size, isolated, and with well defined water sources and drains, USGS continues to monitor the discharge of dissolved salts into Flaming Gorge Reservoir. Provisional data provided from USGS by email, is inconclusive as to salt reduction over the past four years. Since many factors affect salt loading, the actual amount can be expected to vary widely from year to year.

In 2009, USGS issued Scientific Investigations Report 2009-5007, Spatially Referenced Statistical Assessment of Dissolved-Solids Load Sources and Transport in Streams of the Upper Colorado River Basin (SPARROW), which models salt loading throughout the Upper Colorado River Basin. This model is based on water and weather data from 1991. The SPARROW model estimates the total agricultural salt load in MW to be 14,500 tons/year with a potential margin of error of 51%.

Wildlife Habitat and Wetlands

Background

In February, 2007, the Manila-Washam project was recognized as a Colorado River Basin Salinity Control Program (CRBSCP) Salinity Area. Salinity irrigation and wildlife habitat development plans are now eligible to compete for funds allocated to the CRBSCP. Impacts from this project to wildlife habitat and wetlands will be monitored and evaluated and subsequently compensated. Compensation is accomplished on a voluntary basis from private landowners through applications for funding from the Environmental Quality Incentives Program (EQIP). Impacts may include loss of wildlife habitat and wetlands, conversion of wetland habitats to upland areas such as agricultural fields, or other vegetation changes brought about by the more efficient use of irrigation water.

In the upper Colorado River Basin there are several Salinity Areas, each with its own unique methodology for monitoring and evaluating impacts and replacement of wildlife habitat and wetlands. The Manila-Washam Salinity Area is a relatively small project, and impacts from the project can be observed from project inception. The Monitoring and Evaluation Team (M&E) will create a series of land cover maps utilizing aerial photography from the National Agricultural Image Program (NAIP). The NAIP images are one meter resolution true color or color-infrared aerial photos intended to be re-flown tri-annually. With these high resolution photos, M&E has the ability to zoom in close and create a reasonably accurate land cover map which can be verified with minimal ground truthing. These images can be compared through time to monitor any land cover changes. By the use of Geographical Information System (GIS) software, estimates of gains or losses in wildlife habitat or wetlands can be quantified.

Representative photographic points will also be established, to be compared throughout the years, to assist with land cover mapping efforts, defining vegetation composition of the land cover elements and what impacts, if any, are occurring.

The U.S. Forest Service (USFS) has created two wetland complexes west of Flaming Gorge reservoir. The Henry's Fork complex, located north of the Utah-Wyoming border, has a secure water right which may need to be more carefully managed in the event that irrigation improvements reduce the amount of excess run-off now being collected and channeled through this USFS property. The Linwood Pond complex, located south of the Utah-Wyoming border has no secure water right and could be impacted by reduced tailwater availability associated with irrigation improvements.

USFS has been encouraged to obtain more secure water rights for this wetland complex. As irrigation improvements are planned, NRCS cooperators will be encouraged to work with USFS to assure an adequate water supply for the complex.

These wetland complexes represent an important aspect of wildlife habitat found in the Manila-Washam Salinity Area. Many species of plants and animals are found in these areas and they are also used by many members of the public for recreation such as wildlife viewing. These wetlands are located on federal, public land and provide access to all people wishing to enjoy their natural resources. M&E intends to work with USFS personnel and NRCS customers to help monitor the health of these systems, and provide input for solutions to the uncertain outcome of potential tailwater reduction.

Area-wide Wildlife Habitat Monitoring

As mentioned above, M&E will monitor aerial photography from the National Agricultural Image Program (NAIP). As new images become available, land cover maps will be presented in future versions of this document. The initial years will be baseline data as there will be no comparison photos. Photographs will also be taken near the same date annually, and compared.

Reclamation funded a project to pipe the Peoples Canal near the town of Manila in FY2009. This project was completed in FY2010. Piping of this canal, and the subsequent change of irrigation type (flood to sprinkler), may impact USFS constructed wetland complexes and other wetlands downstream from the development. Photographs of the areas below the canal were taken in late summer 2010, to attempt to capture changes (if any) in subsequent years. Changes will also be monitored using current and updated NAIP aerial photos. USFS wetlands are also being monitored by comparative photographs and plant species list comparisons, to determine if any impacts will be realized from the piping of the Peoples Canal and irrigation conversion.

Wildlife Habitat Contract Monitoring

FY2010 is the fourth year MW Salinity Unit has been eligible for CRBSCP funding. One Salinity Wildlife Only contract was planned and funded in FY2010 for a total of 2 acres (Table 6). Table 7 represents total cumulative acres of wildlife habitat improvement planned and applied in the MW Salinity Unit. The wildlife habitat improvement projects applied have all been sub-items included in irrigation projects. Land owners appear to be completing these practices in a timely manner.

Voluntary Habitat Replacement

NRCS continues to encourage replacement of wildlife habitat on a voluntary basis. Federal and State funding programs are in place to promote wildlife habitat replacement. This information is advertised annually in local newspapers, in Local Workgroup meetings, and Conservation District meetings throughout the Salinity Areas. The [Utah NRCS Homepage](#) also has information and deadlines relating to Farm Bill programs.

Table 6, Wildlife Habitat Replacement Planned and Applied in FY2010

Acres of Wildlife Habitat Creation or Enhancement				
FY2010 practices planned and applied				
Program	Acres Planned		Acres Applied	
	Wetland	Upland	Wetland	Upland
BSPP	-	-	-	-
EQIP	-	2	-	1
WHIP	-	-	-	-
Total	-	2	-	1

Table 7, Cumulative Wildlife Habitat Replacement since Project Inception

Acres of Wildlife Habitat Creation or Enhancement				
Cumulative practices planned and applied				
Program	Acres Planned		Acres Applied	
	Wetland	Upland	Wetland	Upland
BSPP	-	-	-	-
EQIP	-	8	-	6
WHIP	-	-	-	-
Total	-	8	-	6

Economics

Cooperator Economics

It is logical to expect that upgrading from flood to sprinkler irrigation improves profitability by increasing production while decreasing costs for water, fertilizer, labor, and field maintenance. Irrigation system maintenance may increase somewhat, but should be less variable on an annual basis.

Production Information

Farming in the Manila area is principally related to livestock production. Crops are generally forage related and alfalfa production is a reasonable indicator of output. In the Manila – Washam Unit, alfalfa yields have been cyclical over the past twenty years. A linear regression on production indicates an uptrend.

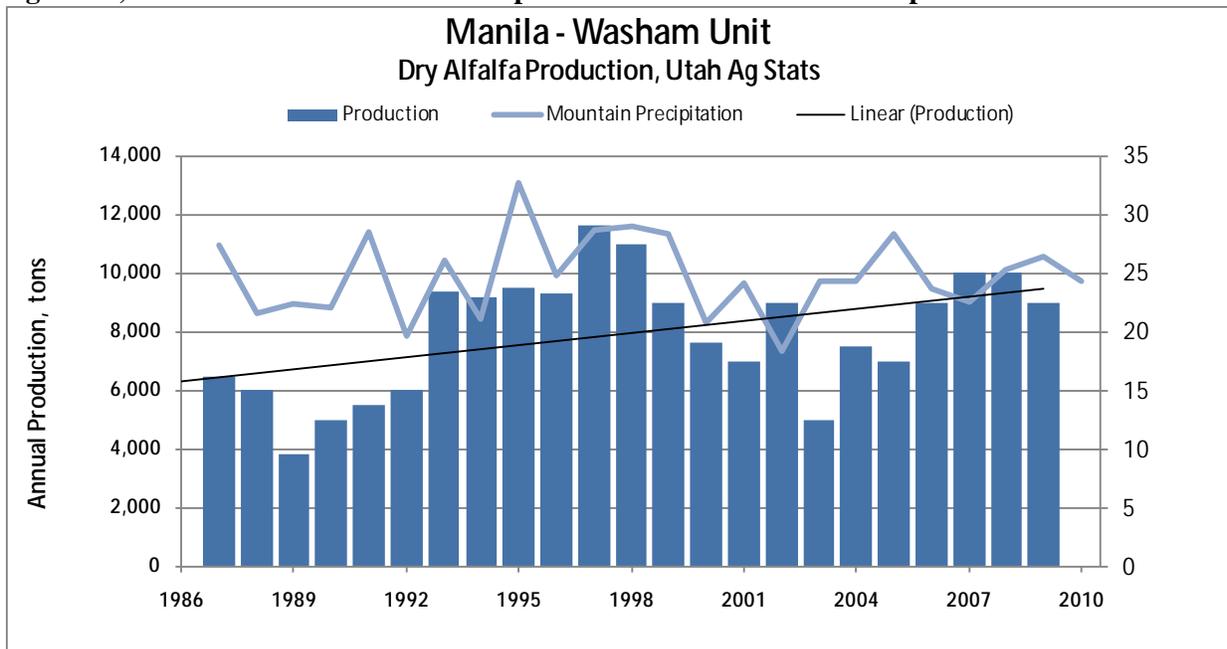
Figure 12 reflects total alfalfa production and mountain precipitation over a 22 year period.

Expense Information

Reliable expense information is difficult to obtain. Many of the farms are family operations and the cost of family labor is rarely evaluated or reported. From National Agricultural Statistics Service (NASS) data, labor benefits are elusive as both *Hired Farm Labor* and *Total Farm Production Expenses* have increased steadily over the 1987, 1992, 1997, 2002, and 2007 Agricultural Censuses.

From the 2007 Census of Agriculture, 85% of farmers hire no outside labor and 62% have full-time occupations other than farming, it is assumed that most cooperators are satisfied with their personal labor savings.

Figure 12, Manila - Washam Unit alfalfa production and Mountain Precipitation



Public Economics

No cooperator surveys have been complete in MW, but local farmers seem to have positive attitudes about the salinity program. Ninety-five percent of survey respondents, from other salinity areas, believe that salinity control programs have a positive economic affect on the area and region.

Positive public perceptions of the Salinity Control Program include:

- Reduced salinity in the Colorado River
- Lengthened irrigation season
- Increased flows in streams and rivers
- Economic lift to the entire community from employment and broadened tax base
- Aesthetically pleasing, green fields, denser, for longer periods of time
- Improved safety and control of water resources, with a reduction in open streams

Negative public perceptions of the Salinity Control Program include:

- Conversion of artificial wetlands to upland habitat and other shifts in wildlife habitat
- Changes in Water Related Land Use (WRLU)

Land Use Land Cover

Figure 13 is a graphical presentation of pre-project land use in the Manila-Washam Unit. This data was derived by comparing the Utah Division of Water Resources Water Related Land Use layer (for the Utah portion) with a cover map created by overlaying orthoimagery. Changes to land cover will be tracked in future reports.

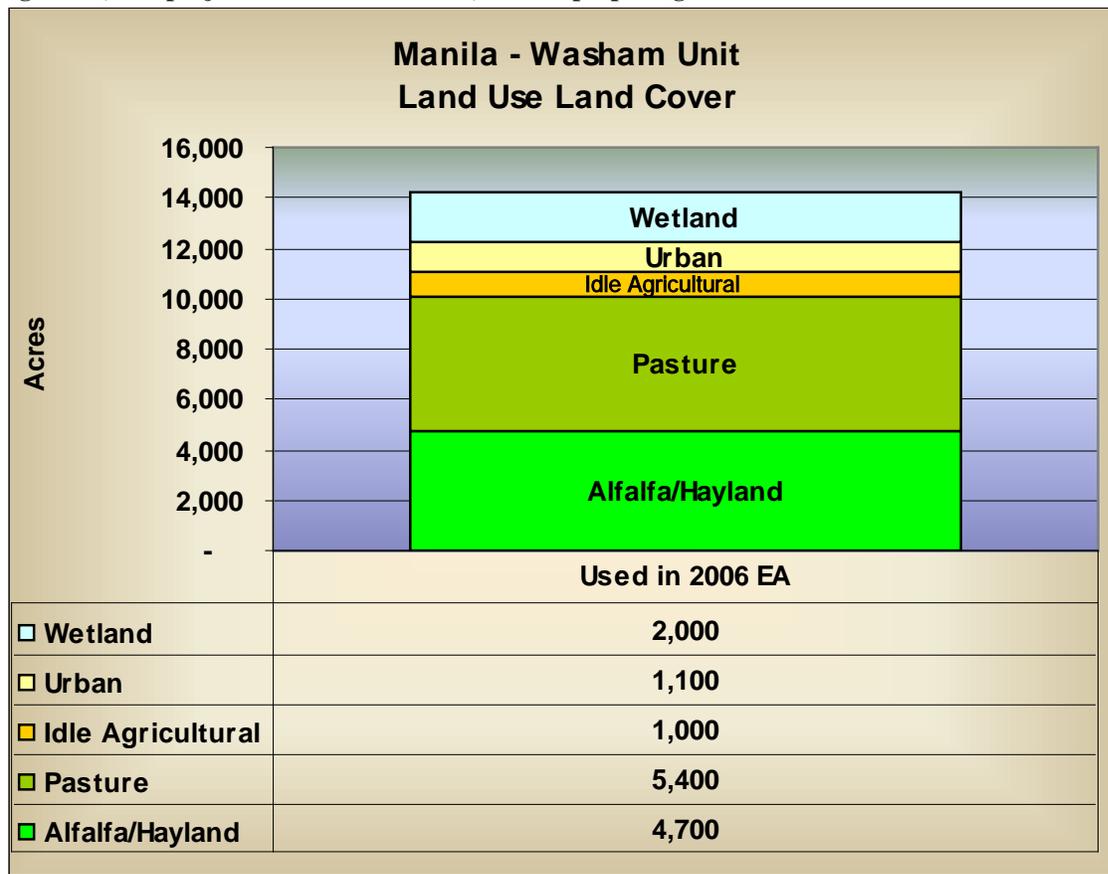
Summary

Local land owners are willing and able to participate in salinity control programs. At present funding levels, ample opportunities exist to install improved irrigation systems and reduce salt loading to the Colorado River system. Salinity programs in other areas indicate that participants are apparently satisfied with results and generally positive about salinity control programs.

Irrigation installation costs are escalating. Increased world energy prices have resulted in much higher costs for pipe, transportation, labor, and equipment. It can be assumed that the value of downstream damages will also be escalating due to energy impacts.

With labor, material, and equipment prices rising, it is expected that the cost/ton of salinity control measures will also increase. However, the FY2010 average planned cost of \$48/ton does not approach the cost of downstream damages from excess salt. Colorado River Basin Salinity Control Programs are successful and cost effective in reducing salt load in the Colorado River.

Figure 13, Pre-project land use land cover, used in preparing 2006 EA



Glossary and Acronyms

Average salt pickup – The increase in the amount of salt carried by a stream as it flows as a result of inflows containing increased salt from dissolution of the soil. Usually expressed as tons/acre-foot.

Annual average salt load – The average estimated annual salt load carried by a stream, based on a period of record of several years. Usually expressed as tons/year.

Application efficiency – The portion of the irrigation water delivered to the soil that is captured, stored, and available to the crop, expressed as a percentage of the total delivery volume.

Applied Practices – Functioning practices for which Federal cost share dollars have been expended.

BSPP – Basin States Parallel Program

Bureau of Reclamation (Reclamation) – A branch of the U.S. Department of Interior charged with water interests in the United States. Reclamation is the lead agency for salinity control in the Colorado River Basin.

Catch can testing – a procedure whereby dozens of containers are spread out under a sprinkler system in an array, to determine how much water is being applied to different spots of ground under the sprinkler to evaluate uniformity.

cfs – Cubic feet per second or second-feet.

Cover Map – a map categorizing land use based on surface cover, e.g. urban, crop type, wetlands, etc.

Crop Consumptive Use (CU) – The amount of water required by the crop for optimal production. It is dependant on many factors including altitude, temperature, wind, humidity, and solar radiation. CU and ET are generally synonymous.

CRBSCP – Colorado River Basin Salinity Control Program

Daubenmire cover class frame – An instrument used to quantify vegetation cover and species frequency occurrences within a sampling transect or plot.

Deep Percolation – The amount of irrigation water that percolates below the root zone of the crop, usually expressed in acre-feet.

Dissolved salt or Total Dissolved Solids (TDS) – The amount of cations and anions in a sample of water, usually expressed in milligrams/liter, but often expressed in Tons/Acre-foot for salinity control programs.

Distribution Uniformity (DU) – A measure of how evenly the irrigation water is applied to the field. If DU is poor, more water is needed to assure that the entire crop has an adequate supply.

EQIP – Environmental Quality Improvement Program

Evapotranspiration (ET) - The amount of water used by the crop. ET is generally synonymous with CU and is frequently mathematically modeled from weather station data.

Financial Assistance (FA) – The Federal cost share of conservation practices. FA is normally 60% of total cost of conservation practices.

Gated Pipe – Water delivery pipe with individual, evenly spaced gates to spread water evenly across the top of a field.

Hand line – An irrigation system composed of separate joints of aluminum pipe, each with one sprinkler, designed to irrigate for a period of time and be moved to the next parallel strip of land.

Improved Flood – Increasing the efficiency of flood irrigation systems with control and measurement structures, corrugations, land-leveling, gated pipe, etc.

Irrigation Water Management (IWM) – Using practices and procedures to maximize water use efficiency by applying the right amount of water at the right place at the right time.

Leakage – Water loss from ditches and canals through fissures, cracks or other channels through the soil, either known or unknown.

National Agricultural Statistics Service (NASS) - A branch of the U.S. Department of Agriculture (USDA) charged with the collection of agricultural data

Natural Resource Conservation Service (NRCS) A branch of the U.S. Department of Agriculture (USDA) charged with providing technical assistance to agricultural interests and programs.

Periodic Move – A sprinkler system designed to irrigate in one position for a set amount of time, then be periodically moved to a new position by hand or on wheels repeatedly until the field is covered.

Pivot or Center Pivot – A sprinkler system that uses moving towers to rotate a sprinkler lateral about a pivot point.

Planned Practices – Practices for which Federal cost share dollars have been obligated by contract.

Ranking – A process by which applications for federal funds are prioritized, based on their effectiveness in achieving Federal goals.

Return Flow – The fraction of deep percolation that is not consumed by plants, animals, or evaporation and returns to the river system, carrying salt.

Salts – Any chemical compound that is dissolved from the soil and carried to the river system by water. Salt concentration is frequently expressed as "Total Dissolved Solids" measured in parts per million (ppm) or milligrams per liter (mg/l). For salinity control work, it is often converted to Tons per acre-foot of water.

Salt load – The amount of dissolved salt carried by a flowing stream

Seepage – Fairly uniform percolation of water into the soil from ditches and canals.

Salt Load Reduction – A measure of the annual tons of salt prevented from entering the waters of the Colorado River. As applied to agriculture, salt load reduction is achieved by reducing seepage and deep percolation from over-irrigating.

Soil Conservation Service – The predecessor agency to NRCS.

Technical Assistance (TA) – The cost of technical assistance provided by Federal Agencies to design, monitor, and evaluate practice installation and operation, and to train and consult with cooperators. TA is generally assumed to be 40% of the total cost of conservation practices.

Uniformity – A mathematical expression representing how evenly water is applied to a plot of ground by a sprinkler system. The two most common measures used by NRCS are Christiansen Coefficient of Uniformity (CCU) and Distribution Uniformity (DU).

Utah Division of Wildlife Resources (UDWR or DWR) – The State of Utah's agency for managing wildlife resources.

Wheel line, Wheeline, Sideroll – A sprinkler system designed to be moved periodically by rolling the sprinkler lateral on large wheels.

WHIP – Wildlife Habitat Incentives Program, a Farm bill program instituted in 1997, designed to create, restore, and enhance wildlife habitat.

Water Budget – An accounting for the amount of water entering (irrigation and precipitation) and the amount of water leaving (evaporation, CU, deep percolation) a given plot of land to determine efficiency and estimate deep percolation.

Yield (or Crop Yield) – The amount of a given crop harvested from an acre of ground. Yield is usually expressed as Tons/Acre or Bushels/Acre, depending on the crop.

References

1. U.S. Department of the Interior, Bureau of Land Management, The Effects of Surface Disturbance on the Salinity of Public Lands in the Upper Colorado River Basin, 1977 Status Report, February, 1978.
2. U.S. Department of Agriculture, Natural Resources Conservation Service, Plan and Environmental Assessment, Manila – Washam Project Area of the Colorado River Salinity Control Program, July, 2006.
3. “Salt Primer – Water and Salt Budgets”, John C. Hedlund, Soil Conservation Service, 1992.
4. “FRAMEWORK PLAN FOR MONITORING AND EVALUATING THE COLORADO RIVER SALINITY CONTROLL PROGRAMS of the U.S. Department of Agriculture (USDA)-Natural Resources Conservation Service (NRCS)”, May, 2002.
5. U.S. Department of Agriculture, Natural Resources Conservation Service, “Calculating Salt Load Reduction”, internal memo, July 30, 2007, Frank Riggle, Colorado State Agronomist and Ed Whicker, Utah M&E Engineer.
6. “QUALITY OF WATER COLORADO RIVER BASIN – Progress Report #20”, U.S. Department of the Interior, 2001.
7. “Colorado River Salinity Control Program, Uintah Basin Unit, Monitoring and Evaluation, 2001 Report”, Draper, Brent W., Goins, Donald J., Lundstrom, D. Nick.
8. “Colorado River Salinity Control Program, Uintah Basin Unit, Monitoring and Evaluation, 2005 Report”, USDA-NRCS.
9. 1987, 1992, 1997, 2002, 2007 “Census of Agriculture”, United States Department of Agriculture, National Agricultural Statistics Service.
10. U.S. Department of the Interior, US Geological Survey, Scientific Investigations Report 2006-5211, entitled “Characterization of Dissolved Solids in Water Resources of Agricultural Lands near Manila, Utah, 2004-2005”, Gerner, Steve et al., <http://pubs.usgs.gov/sir/2006/5211/>.
11. U.S. Department of the Interior, US Geological Survey, Results of Water-Quality Monitoring during May 2007—May 2008 in Selected Sub-basins near Manila, Utah to Evaluate the Effect of Irrigation Improvements on Dissolved Solids Loads Discharged to Flaming Gorge Reservoir, Gerner, Steve et al.
12. U.S. Department of the Interior, US Geological Survey, Spatially Referenced Statistical Assessment of Dissolved-Solids Load Sources and Transport in Streams of the Upper Colorado River Basin, Scientific Investigations Report 2009-5007, <http://pubs.usgs.gov/sir/2009/5007/>.
13. Allen, Richard G. et al., FAO Irrigation and Drainage Paper No. 56, Crop Evapotranspiration, <http://www.fao.org/docrep/X0490E/X0490E00.htm>.