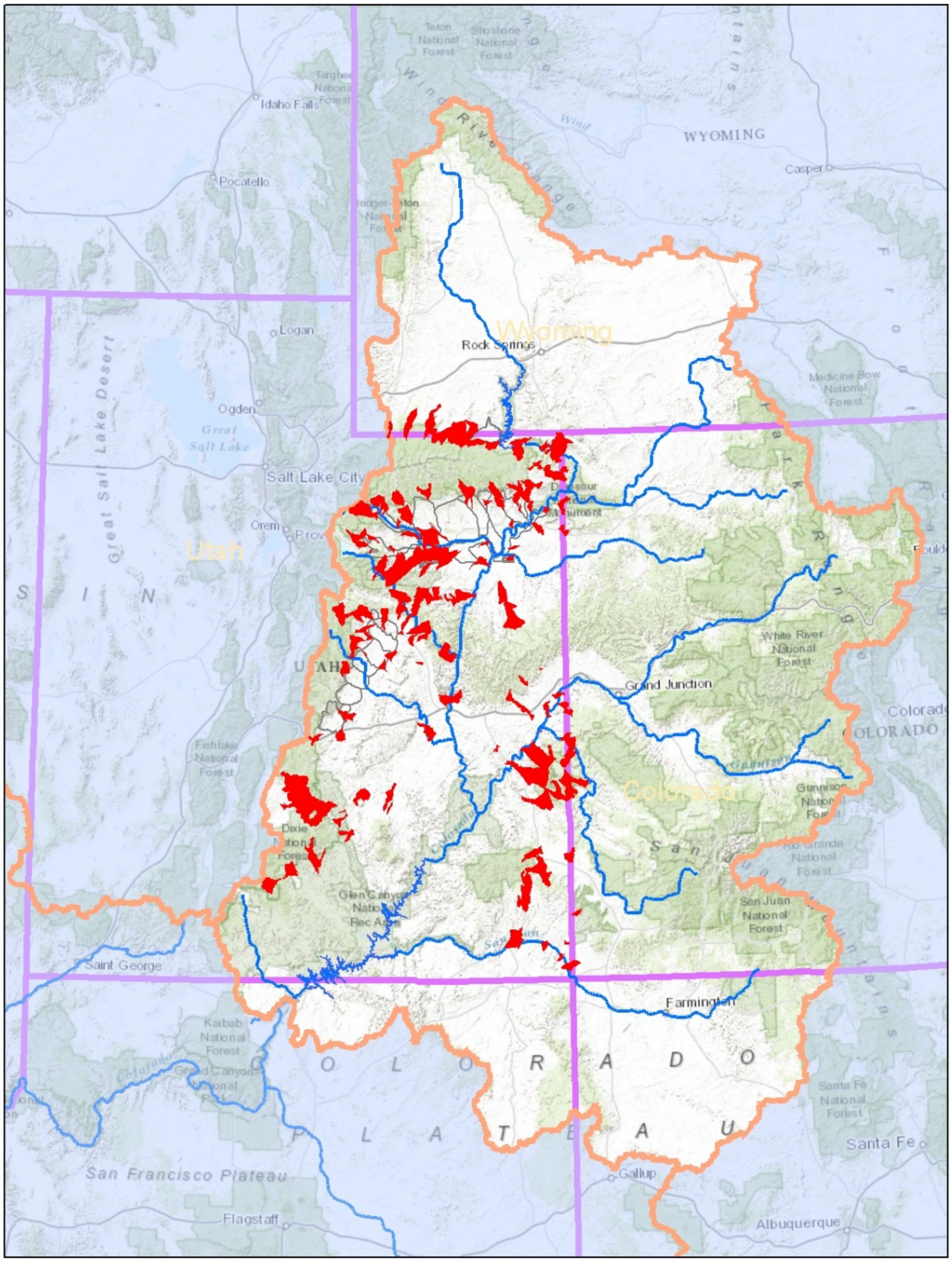
Colorado River Basin Salinity Control Program

Utah Basin-wide Salinity

Monitoring and Evaluation Report, FY2012



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Executive Summary

Project Status

- In FY2010, Utah NRCS started funding salinity projects inside the Colorado River Basin, but outside established Salinity Units using salt load reduction values derived from the USGS' SPARROW Model for salt loading.
- In FY2012, 46 contracts obligated $1.66 million to treat 2,420 acres. Calculated salt load reduction is 1,310 tons/year, resulting in a cost of $135/ton FA+TA.
- In FY2012, $1.05 million was applied to treat 1,462 acres. Calculated salt load reduction is 1,159 tons/year, resulting in a cost of $97/ton FA+TA.
- For FY2010-FY2012, $2.89 million (2012 dollars) in 84 contracts has been obligated to treat 4,324 acres, reducing salt loading by 3,211 tons/year at a cost of $97/ton (2012 dollars).
- For FY2010-FY2012, $1.86 million (2012 dollars) has been paid out to treat 2,902 acres, reducing salt loading by 2,393 tons/year at a cost of $84/ton (2012 dollars).
- In Utah, there are 50,000-60,000 acres of irrigated land inside the Upper Colorado River Basin but outside approved salinity units. The SPARROW model estimates that these acres load about 94,000 tons/year of on-farm salt to the Colorado River.
- Cumulatively, 23% of obligated funds were contracted with limited resource, beginning, or historically underserved participants.

Table 1. Project Progress Summary

Utah Basinwide Salinity, All Programs, FY2012				
CONTRACTS PLANNED	**UNIT (S)**	**CURRENT FY**	**CUMULATIVE**	**POTENTIAL**
1. CONTRACT STATUS				
A. Contracts Approved	Number	46	84	
	Dollars	$ 1,657,461	$ 2,780,684	
	Acres	2,420	4,324	50,000
On-farm	Tons/Year	1,310	3,211	94,000
Off-farm	Tons/Year	-	-	-
B. Active Contracts	Number		69	
	Dollars		$ 2,264,014	
	Acres		3,494	
On-farm	Tons/Year		2,533	
Off-farm	Tons/Year		-	
PRACTICES APPLIED	UNIT(S)	CURRENT FY	CUMULATIVE	
2. EXPENDITURES				
Financial Assisstance (FA)	Dollars	$ 1,049,266	$ 1,790,266	
3. Irrigation Systems				
A. Sprinkler	Acre	1,156	2,201	50,000
B. Improved Surface System	Acre	306	701	
C. Drip System	Acre	-	-	
4. Salt Load Reduction				
A. Salt Load Reduction, On-farm	Tons/Year	1,159	2,393	94,000
B. Salt Load Reduction, Off-farm	Tons/Year	-	-	-

For further information, please contact:

Jim Spencer, Wildlife Biologist
USDA-NRCS
240 West Highway 40 (333-4)
Roosevelt, UT 84066
(435)722-4621 ext 128
jim.spencer@ut.usda.gov

Ed Whicker, Civil Engineer
USDA-NRCS
240 West Highway 40 (333-4)
Roosevelt, UT 84066
(435)722-4621 ext 124
ed.whicker@ut.usda.gov

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Historical Background

With settlement of the Colorado River Basin, demands on the Colorado River grew rapidly. In the late 1800s and early 1900s, hundreds of canal companies were created and millions of acres of land were irrigated to sustain growing populations. In the mid-1900s, dozens of dams and water projects were constructed on the Colorado River and its tributaries.

By the 1960s, concern over increasing water consumption and decreasing water quality led to a national effort to direct environmental policy at the federal level. In 1969, the National Environmental Protection Act (NEPA) was signed into law, requiring extensive public involvement and analysis of environmental impacts when planning federally funded projects (federal actions). As part of NEPA, the Council on Environmental Quality (CEQ) was created in the Executive Branch.

In 1970, the Environmental Protection Agency (EPA) was created by a Nixon executive order (Reorganization Plan No. 3 of 1970), which also created National Oceanic and Atmospheric Administration). In the early 1970s, salinity control was driven by the EPA.

The Colorado River Basin Salinity Control Forum (Forum) was created in 1973, when the governors of each of the seven Colorado River Basin States appointed three water resource professionals to coordinate salinity control efforts among the states, federal agencies, and other major water management agencies. The Forum has been instrumental in promoting salinity control to the benefit of all.

It is estimated that in the 1960s, more than two-thirds of water taken from the Colorado River was used to irrigate agricultural lands. Nearly all of this irrigation was by flooding, resulting in massive amounts of salt being dissolved by excess irrigation water and carried back to the river. With irrigation being the largest contributor to salt load in the river, it was determined that irrigation improvements, both on-farm and off-farm, would provide the most economical opportunity to reduce salt loading by improving irrigation efficiencies to reduce deep percolation and seepage.

The Colorado River Basin Salinity Control Act of 1974 authorized federal funding of salinity control projects to manage salinity in the Colorado River.

Federal funding of salinity control practices began in the early 1980s in the Grand Valley of Colorado and the Uinta Basin of Utah. Before 2010, federal salinity funding for on-farm practices was confined to approved salinity control units established by NEPA procedures.

In 2009, USGS released Scientific Investigations Report 2009-5007,"Spatially *Referenced Statistical Assessment of Dissolved-Solids Load Sources and Transport in Streams of the Upper Colorado River Basin*" (SPARROW91). This report, which includes a user-interfaced GIS model to access and review data, provided opportunity to estimate salt-loading for use in salinity cost/ton calculations.

In FY2010, Basin Wide Salinity (BWS) funding of on-farm practices began, outside of approved salinity units, but within the Colorado River drainage, using Environmental Quality Incentive Program (EQIP) funds.

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).
- The 2002 and 2008 Farm Bills have funded EQIP through FY2012.

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.

Table 2. FY2012 results

Project Status

FY2012 Project Results

In FY2012, $1.66 million was obligated to treat 2,420 acres at a cost of $135/on. (Table 2)

FY2012	Units	Planned	Applied
Irrigation Improvements	acres	2,420	1,460
Federal cost share, FA	2012$	$1,657,000	$1,049,000
Amortized federal cost share, FA+TA	2012$ /year	$176,800	$111,900
Salt load reduction	tons /year	1,310	1,160
Federal cost, FA+TA	2012$ /ton	$135	$97

Cumulative Project Results

Cumulatively, $2.88 million (2012 dollars) has been obligated to treat 4,320 acres at a cost of $97/ton. (Table 3)

Table 3. Project cumulative results

FY2012 Cumulative Improvements	Units	Planned	Applied
Irrigation improvements	acres	4,320	2,900
Federal cost share, FA	2012$	$2,883,000	$1,864,000
Amortized federal cost share, FA+TA	2012$ /year	$310,800	$201,200
Salt load reduction, tons/year	tons /year	3,210	2,390
Federal cost/ton, FA+TA	2012$ /ton	$97	$84

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 2009, USGS released Scientific Investigations Report 2009-5007,"Spatially *Referenced Statistical Assessment of Dissolved-Solids Load Sources and Transport in Streams of the Upper Colorado River Basin*" (SPARROW91). This report, which includes a user-interfaced GIS model to access and review data, provides opportunity to estimate salt-loading for use in salinity cost/ton calculations.

As published, SPARROW91 reports the estimated agricultural salt load in 1991. Procedures have been developed to adapt SPARROW91 data to estimate average loads over longer periods of record by applying correction factors. The latest corrections are based on comparisons of long term average salt loading at USGS gauge stations and have been given the name "Anning 2.2".

Pre-project salt loading for Basin-wide Salinity (BWS) projects is based on the USGS SPARROW91 Model created for the Upper Colorado River Basin in 2009, modified with Anning 2.2 correction factors. In Utah, for Colorado River Basin (CRB) areas outside of established Salinity Control Units, total on-farm salt loading is about 94,000 tons/year from 50,000 to 60,000 acres of irrigated agricultural lands, or about 1.71 tons/acre-year, on-farm.

A review of aerial-photos indicates that about half of this acreage is already under sprinkler irrigation. It is assumed that none of these sprinklers were funded with salinity funds and no salt load reduction has ever been claimed. Most are past their useful lives.

Salinity Control Practices

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

Salinity control treatments in BWS are funded under the 2009 Programmatic Environmental Assessment for EQIP. A concurrent, local environmental evaluation (EE) is completed for each system funded by NRCS.

Planned Practices

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.

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.

Three years of salinity funding have resulted in a cumulative obligated cost of $97/ton (2012 dollars). (Table 4)

Table 4. Planned practices, cost/ton, nominal and 2012 dollars

FY	Federal Water Project Discount Rate	Contracts Planned	FA Planned Nominal	Acres Planned	Salt Load Reduction Planned	Amortized FA+TA Nominal	$/ton FA+TA Nominal	2012 PPI Factor	FA Planned 2012$	Amortized FA+TA 2012$	$/ton 2012$	Cum $/ton 2012$
2010	4.375%	14	$470,570	742	511	$52,213	$102	114%	$534,624	$59,320	$116	$116
2011	4.125%	24	$652,653	1,162	1,390	$70,552	$51	106%	$690,863	$74,683	$54	$70
2012	4.000%	46	$1,657,461	2,420	1,310	$176,829	$135	100%	$1,657,461	$176,829	$135	$97
Totals		84	$2,780,684	4,324	3,211	$299,594	$93		$2,882,947	$310,832	$97	

FY2012 Obligation

In FY2012, $1.66 million was obligated in 46 contracts to treat 2420 acres with improved irrigation.

Salt Load Reduction Calculation

The estimated salt load reduction from FY2012 planned practices is 1,310 tons/year, calculated by multiplying the original tons/acre for each catchment, by the acres to be treated and a percentage reduction based on change in irrigation practice. For BWS, the initial estimate of on-farm irrigation salt loading varies by location. Salt load is determined by mapping the field to be treated and overlaying a shapefile containing catchments with an attribute indicating the agricultural tons/acre from the SPARROW91 model, modified using Anning 2.2 factors. Sixty percent of the total agricultural load is allocated to on-farm.

For example, assuming an agricultural factor of 1.63 tons/acre-year, if 40 acres are converted from wild flood to periodic-move sprinklers, an estimated 84% of the original salt load will be eliminated. Hence, 40 acres x 1.63 tons/acre-year x 0.60 x 84% = 33 tons/year on-farm salt load reduction.

Cost/Ton Calculation

The federal cost/ton for salt load reduction is calculated by amortizing federal financial assistance (FA) over 25 years at the federal discount rate for water projects (4.000% for FY2012). Two-thirds of FA is added for technical assistance (TA) and the amortized total cost is divided by tons/year to yield cost/ton.

Funds are normalized to 2012 dollars using the Producer Price Index (PPI) for agricultural equipment purchased, tracked by the National Agricultural Statistics Service (NASS).

Obligation Analysis

In FY2012, $1.66 million was obligated to treat 2,420 acres, reducing salt loading by 1,310 tons/year. The resulting average cost is $135/ton.

Cumulatively, $2.89 million (2012 dollars) has been obligated on 4,324 acres to reduce salt loading by 3,211 tons/year. The cumulative cost is $97/ton in 2012 dollars.

Environmental Benefit

Eligibility for EQIP Salinity funding for Irrigation improvements is based on definable environmental benefit. The most significant factor is annual cost per ton of salt load reduction (cost effectiveness).

In FY2012, the payment schedule for BWS was based on typical government payment percentage of 65%. Ranking was based on actual practice change. To be consistent with the Uintah Basin Unit, salt calculations for upgrades and replacements, for this report, are on the basis of the Prior Treated type, meaning that salt load is calculated from the unimproved flood level.

Different contract types result in different costs/ton. (Table 5) Upgrades involve replacing a worn out improved irrigation system with a new system of increased application efficiency, such as worn-out wheel line to center pivot. A replacement involves replacing a worn-out existing sprinkler with another sprinkler of the same type, such as worn-out wheel line to new wheel line.

Table 5. Obligations by project type

FY2012	Contracts	FA	Acres	Tons	$/ton,
Flood to Sprinkler	7	$256,280	257	419	$71
Improved Flood	4	$189,633	129	231	$92
Upgrade	3	$177,840	350	235	$83
Replacement	55	$1,663,990	2,758	1,648	$109

Cost-Share Enhancement

Typical federal payment percentage for FY2012 was about 65% for BWS contracts (the State-wide payment percentage). A feature of the 2002 and 2008 Farm Bills is cost-share enhancement, increasing the federal cost-share to 90% of total cost for limited resource, beginning, or socially disadvantaged farmers or ranchers..

Twenty-three percent of funds were obligated with historically underserved farmers and ranchers or socially disadvantaged minorities. The cost/ton for enhanced contracts is about 33% higher than for unenhanced contracts. (Table 7) Twenty-three percent of obligations were contracted with limited resource, beginning, or socially disadvantaged farmers or ranchers.

Table 7. Obligations by enhancement type

Type	Contracts	FA, 2011$	Acres	Tons /year	$/ton, FA+TA
Enhanced	11	$645,680	667	708	$105
Unenhanced	73	$2,135,003	3,577	2,503	$95
All	84	$2,780,683	4,244	3,211	$97

Applied Practices

FY2012 Expenditures

For purposes of this report, acres and salt load reduction are deemed to be applied in the same proportion as funds are expended.

For FY2012, applied salt load reduction cost is $97/ton.

Since FY2010, the cumulative cost is $84/ton (2012 dollars). (Table 8)

Table 8. Applied practices, cost/ton, nominal and 2012 dollars

FY	Federal Water Project Discount Rate	FA Applied Nominal	Acres Applied	Salt Load Reduction Applied	Amortized FA+TA Nominal	$/ton FA+TA Nominal	2012 PPI Factor	FA Applied 2012$	Amortized FA+TA 2012$	$/ton 2012$	Cum $/ton 2012$
2010	4.375%	$387,117	591	420	$42,953	102	114%	$439,811	$48,800	$116	$116
2011	4.125%	$353,883	849	814	$38,255	47	106%	$374,601	$40,495	$50	$72
2012	4.000%	$1,049,266	1,462	1,159	$111,943	97	100%	$1,049,266	$111,943	$97	$84
Totals		$1,790,266	2,902	2,393	$193,151	81		$1,863,678	$201,237	$84	

Hydro Salinity Monitoring

It is estimated that 50,000-60,000 acres of irrigated Utah agricultural land within the Upper Colorado River Basin and outside of approved salinity units contribute about 94,000 tons of salt per year into the Colorado River.

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 on-farm 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%.

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

As a result of labor intensive testing in the Uintah Basin Unit, it was confirmed that irrigation systems installed and operated as originally designed, produce 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

Cooperator questionnaires, interviews, and training sessions

No cooperator questionnaires have been done in Basin Wide Salinity. It is anticipated that it will take a few 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.

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 cooperator. 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 contractually obligating those who accept federal grants for salinity control practices to learn and apply Irrigation Water Management techniques to their farming operation. 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.

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. (Figures 2 and 3)

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 order to receive incentive payment for IWM, irrigators must

1. attend a two hour IWM training session or a water conference
1. with help, augur a hole and determine the soil moisture by the feel method
2. present their 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 FY2011, 27 IWM spreadsheets were received from BWS participants. By acreage, 55% had normal or low deep percolation. Calculated deep percolation for all IWM spreadsheets received was 74% of normal. (Figure 1)

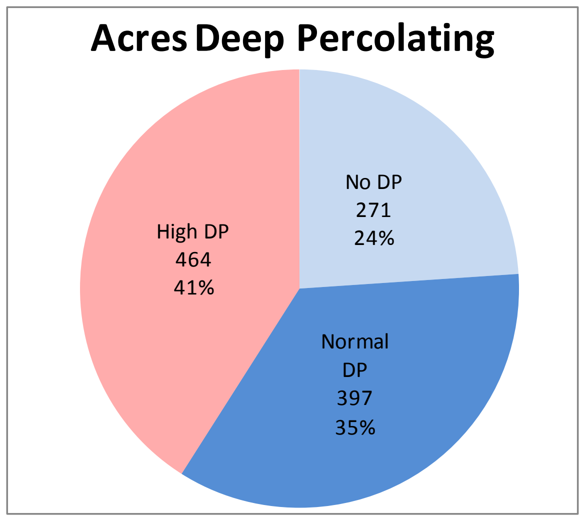


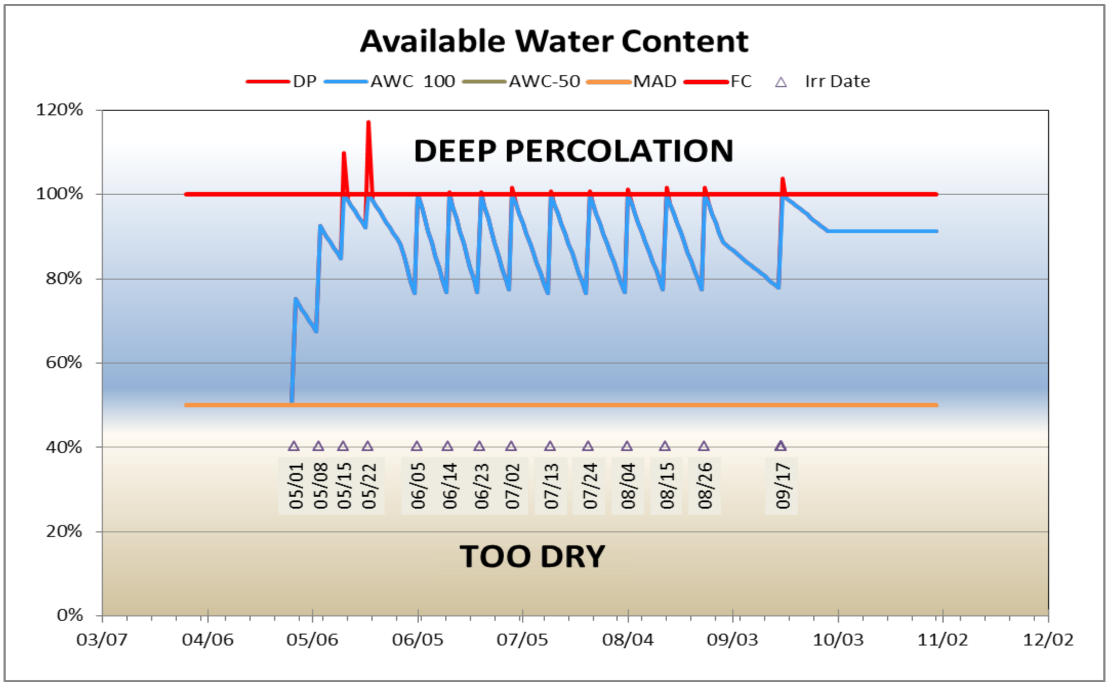
Figure 1. Deep percolation

Irrigation Water Use Record - Farmer Self Certification

Cooperator:	NRCS Cooperator	**Crop:**	Alfalfa	**Year:**	2012
Tract/Field:		**Root Depth, ft:**	5.00		
Date:	10/15/2012	**Station:**	LOA	**CU:**	26 inches
		Contract Eligible Acres:	40.00		
Soil Texture:	Clay Loam	**Irrigation method:**	Pivot		
AWC, In/Ft:	1.80	**Efficiency:**	75%		
AWC Max, in:	9.00	**Evaluated Acres:**	125.66		
MAD, in:	4.50	**Evaporation %:**	10%		
Pre-season AWC, In.	4.50	**Cycle Hours:**	168		
		Flow rate, gpm:	900		

Start date of irrigation cycle	End date of irrigation cycle	Total Cycle Hours	Alternate Cycle Hours	Flow, gpm	Inches Applied Cycle	Inches Applied Season	CU Season (Table)	Irrigation Balance	AWC	Deep Perc
05/01/13	05/08/13	168		900.0	2.39	2.39	0.12	0.00	4.50	0.00
05/08/13	05/15/13	168		900.0	2.39	4.79	0.95	1.56	6.06	0.00
05/15/13	05/22/13	168		900.0	2.39	7.18	1.78	1.56	7.62	0.00
05/22/13	05/29/13	168		900.0	2.39	9.57	2.61	1.56	9.00	0.19
06/05/13	06/12/13	168		900.0	2.39	11.96	4.98	0.02	9.00	0.02
06/14/13	06/21/13	168		900.0	2.39	14.36	7.33	0.05	9.00	0.05
06/23/13	06/30/13	168		900.0	2.39	16.75	9.68	0.05	9.00	0.05
07/02/13	07/09/13	168		900.0	2.39	19.14	11.92	0.15	9.00	0.15
07/13/13	07/20/13	168		900.0	2.39	21.54	14.23	0.08	9.00	0.08
07/24/13	07/31/13	168		900.0	2.39	23.93	16.55	0.08	9.00	0.08
08/04/13	08/11/13	168		900.0	2.39	26.32	18.84	0.10	9.00	0.10
08/15/13	08/22/13	168		900.0	2.39	28.71	21.08	0.15	9.00	0.15
08/26/13	09/02/13	168		900.0	2.39	31.11	23.33	0.15	9.00	0.15
09/17/13	09/24/13	168		900.0	2.39	33.50	25.38	0.34	9.00	0.34
Total inches of water applied during the season (total of all lines above):								33.50		1.35
Total Acre Feet Applied during the Season:								350.8		
Seasonal Irrigation Efficiency (CU requirement/inches of water applied per acre):								76%		

Figure 2. IWM Self Certification Spreadsheet input page



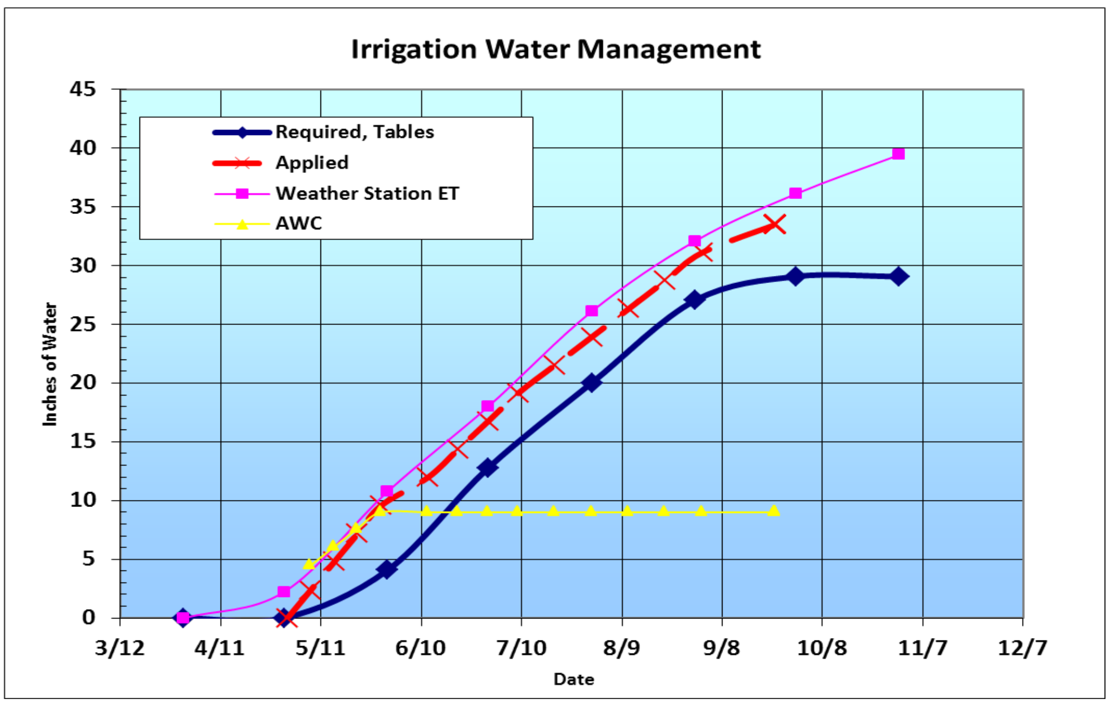


Figure 3. Sample graphs from the IWM Self Certification Spreadsheet

The blue line indicates Available Water Content (AWC). Red spikes above the 100% line are deep percolation. For maximum crop growth, AWC should not be allowed to fall below the Managed Allowable Depletion (MAD) orange line.

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.

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 $700, giving the cooperator information on the water content of his soil at several different depths, without time-consuming augering.

Figure 4. Sample Soil Moisture Data Logger with graphing

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 4)

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. Installed data recorders indicate that deep percolation occurs less than 3% of the time on monitored fields.

Soil moisture data recorders typically store ten 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. (Figure 5)

The M&E team is not aware of any data recorders installed in BWS.

NRCS payment schedules include an additional IWM Intense (449) practice offering increase compensation for participants who agree to install and use a soil moisture monitor.

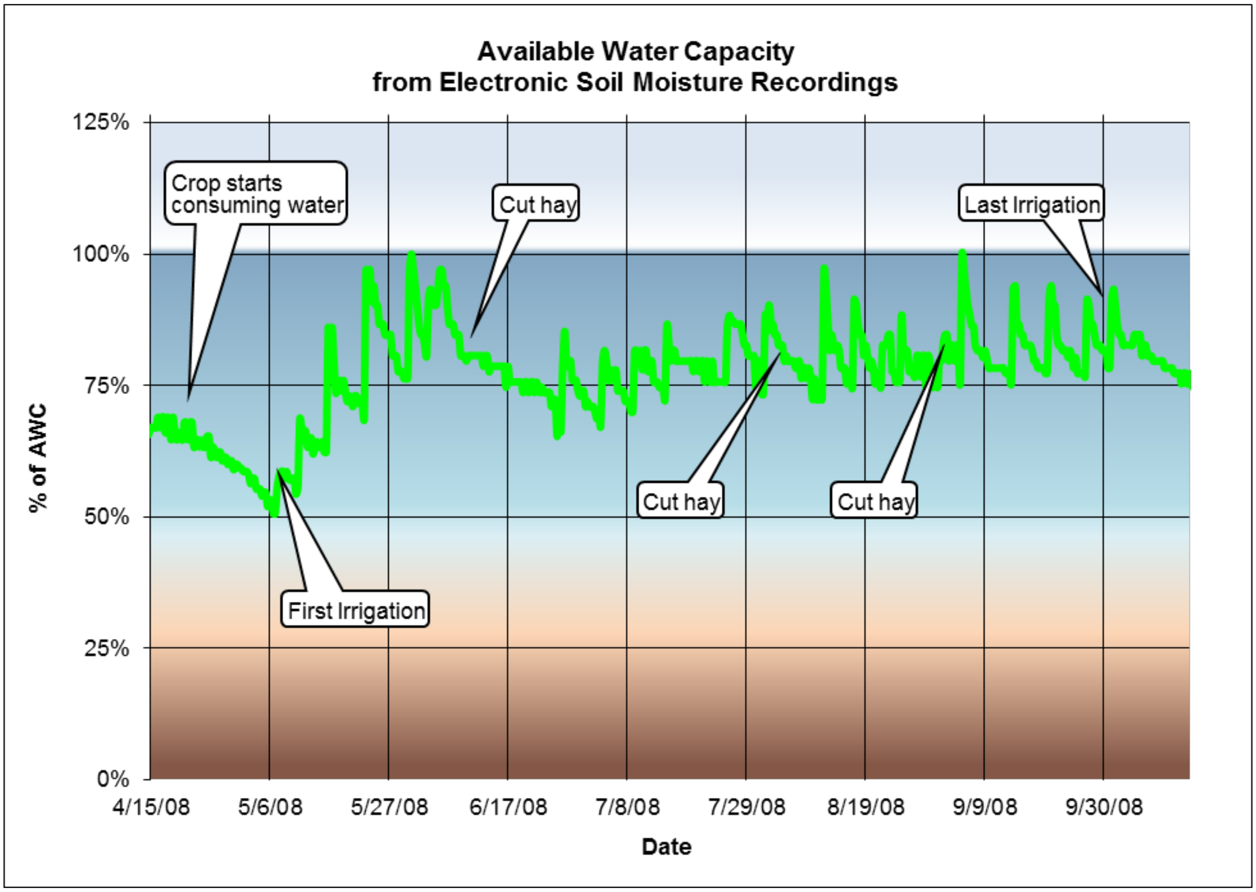


Figure 5. AWC estimated from downloaded soil moisture data

Wildlife Habitat and Wetlands

Background

Basin-wide salinity contracts are obligated on the basis of salt loading indicated by the SPARROW91 model. Salinity irrigation and wildlife habitat development plans are eligible to compete for funds allocated to the CRBSCP. Impacts from these irrigation upgrades, to wildlife habitat and wetlands, cannot be as closely monitored and evaluated as are similar contracts in approved salinity areas. Nevertheless, opportunities to compensate for habitat loss will be accommodated 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. The preferred vehicle for habitat improvement is individual wildlife only contracts separate and apart from irrigation improvement contracts.

On November 27, 2012 NRCS received a response to a letter sent to Ms. Patricia S. Gelatt, Western Colorado Supervisor for the USFWS regarding proposed changes in the assessment method of wildlife replacement needed to offset incidental fish and wildlife values foregone resulting from salinity control projects in the State of Utah. The Service supported the proposal for minimum habitat improvement to be greater than 2 percent of irrigation acres treated for salinity control, and that wildlife habitat losses resulting from irrigation improvements will be replaced on a 1:1 acreage basis. The Service also stated that they agree that permanent easements would be preferred, but if not possible the habitat practice lifespan will be as long as, if not longer, than the lifespan of irrigation improvement practices (see Appendix).

Utah Basin-wide Salinity has not achieved this proportion and as of this report the unit is not considered concurrent and proportional with salinity irrigation improvements. Efforts to plan and apply additional acres of habitat replacement will continue. When the habitat acres in the Unit are concurrent and proportional with the irrigation acres, NRCS will not relax by virtue of this change in assessment method. NRCS will continue to plan and apply real habitat improvements to offset the losses incurred by the Colorado River Salinity Control Program.

Table 9. Wildlife Habitat Replacement

Wildlife Habitat Contract Monitoring

In this third year of eligibility (FY2012) for salinity projects, there have been no awarded contracts for salinity wildlife only habitat improvement project funds. Table 9 represents annual acres of wildlife habitat improvement planned and applied with Basin-wide Salinity Funds.

Table 10 represents cumulative acres of wildlife habitat improvement planned and applied.

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.

Acres of Wildlife Habitat Creation or Enhancement				
FY2012 Annual practices				
Program	Acres Planned		Acres Applied	
	Wetland*	Upland	Wetland*	Upland
BSPP	-	-	-	-
EQIP	-	-	-	-
WHIP	-	-	-	-
Total	-	-	-	-

*Wetland acres include riparian habitat

Table 10. Wildlife Habitat Replacement

Acres of Wildlife Habitat Creation or Enhancement				
FY2012 Cumulative practices				
Program	Acres Planned		Acres Applied	
	Wetland*	Upland	Wetland*	Upland
BSPP	-	-	-	-
EQIP	-	-	-	-
WHIP	-	-	-	-
Total	-	-	-	-

*Wetland acres include riparian habitat

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

In Rural Utah, forage crops and grass pasture account for most producing irrigated acres.

Statistical analysis across broadly spread areas is not practical.

Expense Information

It is assumed that labor statistics for BWS projects would be similar to other areas in rural Utah. 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.

Public Economics

No cooperator surveys have been completed in BWS, but local farmers seem to have positive attitudes about the salinity program. There is fairly strong interest in installing sprinkler systems, which is expected to increase with time. Lack of water storage and delivery systems are the major impediment to progress on-farm.

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
- Improvement in rural landscape with dense green fields for longer periods of time
- Improved safety and control of water resources, with a reduction in open streams
- Increased property values
- Improved water quality

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)

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.

Glossary and Acronyms

Available Water Content (AWC) – Water contained in the soil that can be utilized by the plant, defined to be the difference between Field Capacity and Permanent Wilting Point, usually expressed as inches/foot.

Average salt pickup – The increase in the amount of salt carried by a stream 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 field that is stored in the soil, 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 – managing LCRB matching funds from FY1997 to FY2012.

BSP – Basin States Program - managing LCRB matching funds starting in FY2012.

Bureau of Reclamation (Reclamation or USBR) – 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.

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.

Christiansen Coefficient of Uniformity (CCU) – a sprinkler uniformity rating. In a catch-can test, CU is the sum of the squares of the ratio of each catch to the average catch.

Continuous Move Sprinkler – a sprinkler system designed to move continuously, such as a center pivot, lateral move, or a big-gun on a reel.

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 dependent on many factors including altitude, temperature, wind, humidity, and solar radiation.

CRBSCP – Colorado River Basin Salinity Control Program

CRSC – Colorado River Salinity Control Program, a USDA funding program from FY1984 to FY1995.

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. Using a catch can test, DU is the ratio of the low quarter average catch to the total average catch.

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.

Field Capacity – The total volume of water contained in the soil after gravimetric drainage has occurred. The soil pore pressure is 0 to -33 cb.

Financial Assistance (FA) – The Federal cost share of conservation practices. For USDA funding, 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.

Gravimetric drainage – The volume of water that will drain from a saturated soil profile due to gravity alone.

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.

Management Allowable Depletion (MAD) – The fraction of AWC that allows for maximum production. Typically 50%, only the top 50% of AWC should be used for crop growth.

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

NEPA – National Environmental Policy Act which sets out requirements for Federal Agencies to evaluate impacts of Federal projects on the environment, prior to initiating the project.

Periodic Move – A sprinkler system designed to irrigate in one position for a set amount of time, then periodically moved to a new position by hand or on wheels repeatedly until the field is covered. (includes sprinkler systems such as hand-line, wheel-line (side-roll), pod, big-gun, etc.)

Permanent Wilting Point (PWP) – The volume of water in a soil profile that cannot be extracted by the plant. Normally, watering a plant at this point will not restore its vitality. Soil pore pressure is about -1,500 cb at the pwp.

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.

Readily Available Water (RAW) – water that a plant can easily extract from the soil. A synonym for Managed Allowable Depletion.

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

Salt Budget – Balancing the inflow and outflows of a salinity project to estimate unknown salt pickup.

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, usually expressed in tons/year.

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 in the salinity control program.

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 the Christiansen Coefficient of Uniformity (CCU) and Distribution Uniformity (DU).

Utah Division of Wildlife Resources (UDWR or DWR) – Managing division for wildlife resources in the State of Utah.

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.

Wheel line, Wheeline, Side-roll– A periodic-move 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.

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

Appendix

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
764 Horizon Drive, Building B
Grand Junction, Colorado 81506-3946

IN REPLY REFER TO:
ES/CO:NRCS Salinity Program Habitat Replacement
TAILS 06E24100-2013-CPA-0003

November 27, 2012

David C. Brown, Utah State Conservationist
Natural Resources Conservation Service
125 South State Street, Room 4010
Salt Lake City, Utah 84138-1100

Dear Mr. Brown:

This responds to your July 16, 2012, letter regarding the proposed changes in the assessment method of wildlife replacement needed to offset incidental fish and wildlife values foregone resulting from salinity control projects in the State of Utah. The Fish and Wildlife Service (Service) supports the proposal for minimum habitat improvement to be greater than 2 percent of irrigation acres treated for salinity control, and that wildlife habitat losses resulting from irrigation improvements will be replaced on a 1:1 acreage basis. We agree that permanent easements are preferred, but if not possible, that habitat practice lifespan will be as long or longer than the practice lifespan of irrigation improvements. This change is in line with Colorado Natural Resource Conservation Service (NRCS), and we trust that it will help the salinity program offset real habitat losses with real habitat improvements. We hope this change will allow NRCS biologists to focus their efforts on implementing quality habitat replacement projects with willing landowners.

The Service commends NRCS for the habitat replacements/improvements in both the Uintah Basin and Price San Rafael River Salinity Units, that are proportional and concurrent with salinity irrigation improvements, and exceed 2 percent of the irrigation improvements. We appreciate continuing efforts by NRCS field staff to pursue and implement new projects, as well as to monitor and evaluate ongoing and completed projects. Please let us know if there is any way we can assist NRCS in reaching the replacement needs associated with the Muddy Creek, Green River, and Manila-Washam Salinity Units.

For further assistance, please contact Barb Osmundson by phone at (970) 243-2778, extension 21, or by email at Barb_Osmundson@fws.gov.

Sincerely,

Patricia S. Gelatt
Western Colorado Supervisor

cc: NRCS-SLC Utah (Travis James, Pedro Ramos)
NRCS-Roosevelt Utah (Ed Whicker, Jim Spencer)

BOsmundson:NRCSUtahWildlifeReplacementCommentLetter.docx:112712:KM

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