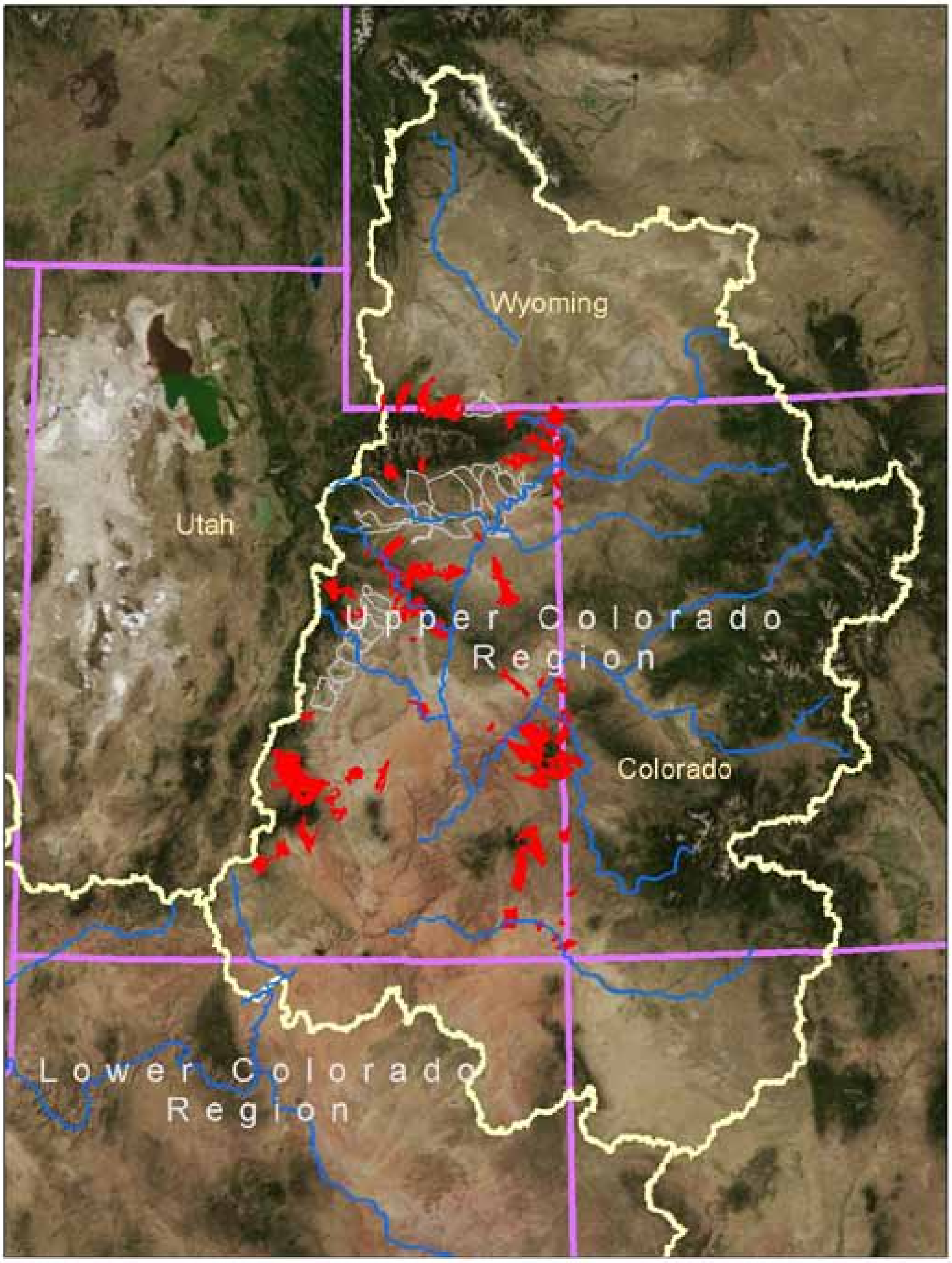
Colorado River Basin Salinity Control Program

Utah Basinwide Salinity

Monitoring and Evaluation Report, FY2011



U.S. Department of Agriculture

Natural Resources Conservation Service

Executive Summary

Project Status

- In FY2010, Utah NRCS started funding salinity projects outside of established Salinity Units using salt load reductions derived from the USGS' SPARROW Model for salt loading.
- In FY2011, 24 contracts obligated $653,000 to treat 1,162 acres. Calculated salt load reduction is 1,390 tons/year, resulting in a cost of $51/ton FA+TA.
- In FY2011, $354,000 was applied to treat 849 acres. Calculated salt load reduction is 814 tons/year, resulting in a cost of $47/ton FA+TA.
- 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.
- Thirty-seven percent of planned acres were with limited resource or beginning farmers/ranchers.

Table 1. Project Progress Summary

Utah Basinwide Salinity, All Programs				
CONTRACTS PLANNED	**UNIT (S)**	**CURRENT FY**	**CUMULATIVE**	**POTENTIAL**
1. CONTRACT STATUS				
A. Contracts Approved	Number	24	38	
	Dollars	652,653	1,123,223	
	Acres	1,162	1,904	46,000
On-farm	Tons/Year	1,390	1,901	79,000
Off-farm	Tons/Year	-	-	52,000
B. Active Contracts	Number		30	
	Dollars		873,024	
	Acres		1,431	
On-farm	Tons/Year		1,683	
Off-farm	Tons/Year		-	
PRACTICES APPLIED	UNIT(S)	CURRENT FY	CUMULATIVE	
2. EXPENDITURES				
Financial Assisstance (FA)	Dollars	353,883	741,000	
3. Irrigation Systems				
A. Sprinkler	Acre	454	1,045	46,000
B. Improved Surface System	Acre	395	395	
C. Drip System	Acre	-	-	
4. Salt Load Reduction				
A. Salt Load Reduction, On-farm	Tons/Year	814	1,234	79,000
B. Salt Load Reduction, Off-farm	Tons/Year	-	-	52,000

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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).
- 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.

Project Status

FY2011 Project Results

FY2011 project results for all Basinwide Salinity contracts (BWS) are summarized in table 2.

Cumulative Project Results

Cumulative results through FY2011 are tabulated in Table 3. Dollar amounts are expressed in 2011 dollars.

Table 2. FY2011 results

FY2011	Units	Planned	Applied
Irrigation Improvements	acres	1,160	850
Federal cost share, FA	2011$	$653,000	$354,000
Amortized federal cost share, FA+TA	2011$ /year	$70,600	$38,300
Salt load reduction	tons /year	1,390	810
Federal cost, FA+TA	2011$ /ton	$51	$47

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.

Table 3. Project cumulative status

FY2011 Cumulative Improvements	Units	Planned	Applied
Irrigation improvements	acres	1,900	1,440
Federal cost share, FA	2011$	$1,163,000	$773,000
Amortized federal cost share, FA+TA	2011$ /year	$127,100	$84,800
Salt load reduction, tons/year	tons /year	1,900	1,230
Federal cost/ton, FA+TA	2011$ /ton	$67	$69

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 BWS 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 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 aglands, 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

There is no specific environmental assessment for salinity control treatments in BWS. The general EIS for EQIP applies, and an environmental evaluation is performed for each practice funded by NRCS.

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.

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.

Two years of salinity funding have resulted in an obligated cost of $67/ton (2011 dollars). (Table 4)

Table 4. Planned practices, cost/ton, nominal and 2011 dollars

FY	Federal Water Project Discount Rate	Contracts Planned	FA Planned Nominal	Acres Planned	Salt Load Reduction Planned	Amortized FA+TA Nominal	$/ton FA+TA Nominal	2011 PPI Factor	FA Planned 2011$	Amortized FA+TA 2011$	$/ton 2011$	Cum $/ton 2011$
2010	4.375%	14	$470,570	742	511	$52,213	$102	108%	$509,986	$56,586	111	111
2011	4.125%	24	$652,653	1,162	1,390	$70,552	$51	100%	$652,653	$70,552	51	67
Totals		38	$1,123,223	1,904	1,901	$122,765	$65		$1,162,639	$127,139	67	

FY2011 Obligation

In FY2011, $653,000 was obligated in 24 contracts to treat 1,162 acres with improved irrigation.

Salt Load Reduction Calculation

The estimated salt load reduction from FY2011 planned practices is 1,390 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 on-farm 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 on-farm 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 84% = 55 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 (4.125% for FY2011). 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 2011 dollars using the Producer Price Index (PPI) for agricultural equipment purchased.

Obligation Analysis

In FY2011, $653,000 was obligated to treat 1,162 acres, reducing salt loading by 1,390 tons/year. The resulting average cost is $51/ton.

Cumulatively, $1.16 million (2011 dollars) has been obligated on 1,904 acres to reduce salt loading by 1,901 tons/year. The cumulative cost is $67/ton in 2011 dollars.

Contract type

Salinity funding for Irrigation improvements outside of salinity units falls under a full range of situations. NRCS, Utah has designated five types of irrigation improvement contracts that result in salt load reduction. (Table 6)

In FY2011, 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.

Table 5. Obligations by project type

FY2011	Contracts	FA	Acres	Tons /year	$/ton, FA+TA
Flood to Sprinkler	11	387,489	564	571	80
Improved Flood	3	135,542	92	193	74
Upgrade	5	253,943	454	334	87
Replacement	19	349,239	794	802	48

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 6. Contract funding types

Salinity Based Irrigation Improvement Contract Types					
	Qualification	**Practice Change**	**Example**	**Approximate Federal Participation**	**Salt basis**
Conventional	Unimproved flood	Unimproved flood (UF) to improved irrigation system	UF to Side roll	75%	Salt load change based on reducing deep percolation by efficiency and uniformity improvement
Prior Treated	Existing improved irrigation systems, beyond the NRCS practice life, that have never had federal funding or salt load reduction claimed	Any	Worn out Pivot to New Pivot	65%	Same as conventional - UF to new practice.
Refurbish	Existing improved irrigation systems, beyond the NRCS practice life that can be brought into full efficency with moderate expenses	None	New wheels, sprinklers, mover, etc.	75%	Assumed Starting point at 10% reduced efficiency - e.g. an old wheel line is at 55% efficency before refurbishment
Upgrade	Existing improved irrigation systems, beyond the NRCS practice life that can be brought into full efficency with moderate expenses	IF to Sprinkler or Wheel line to Pivot	IF to Center Pivot	65%	Assumed Starting point at 10% reduced efficiency - e.g. an old wheel line is at 55% efficency before refurbishment
Replace	Existing improved irrigation systems, beyond the NRCS practice life that can be brought into full efficency with moderate expenses	None	Old Pivot to New Pivot	45%	Assumed Starting point at 10% reduced efficiency - e.g. an old wheel line is at 55% efficency before refurbishment

Cost-Share Enhancement

Typical federal payment percentage for FY2011 was about 65% for Basin Wide Salinity contracts (the State-wide payment percentage). A feature of the 2002 and 2008 Farm Bills is cost-share enhancement, increasing the federal cost-share, from 65% 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.

Table 7. Obligations by enhancement type

Type	Contracts	FA, 2011$	Acres	Tons /year	$/ton, FA+TA
Enhanced	6	$421,565	462	595	$81
Unenhanced	29	$724,497	1,442	1,305	$61
All	35	$1,146,062	1,904	1,900	$69

The cost/ton for enhanced contracts is about 33% higher than for unenhanced contracts. (Table 7) Twenty-four percent of practices by acre are enhanced.

Applied Practices

FY2011 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 FY2011, salt load reduction cost $47/ton.

Since FY2010, the cumulative cost is $69/ton (2011 dollars). (Table 8)

Table 8. 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	$/ton FA+TA Nominal	2011 PPI Factor	FA Applied 2011$	Amortized FA+TA 2011$	$/ton 2011$	Cum $/ton 2011$
2010	4.375%	$387,117	591	420	$42,953	102	108%	$419,543	$46,551	111	111
2011	4.125%	$353,883	849	814	$38,255	47	100%	$353,883	$38,255	47	69
Totals		$741,000	1,440	1,234	$81,208	66		$773,426	$84,806	69	

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 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

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

Cooperator questionnaires, interviews, and training sessions

No cooperator questionnaires have been done in Basin Wide Salinity. 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.

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 Basinwide salinity participants. By acreage, 55% had normal or low deep percolation. Calculated deep percolation for all IWM spreadsheets received was 74% of normal. (Figure 1)

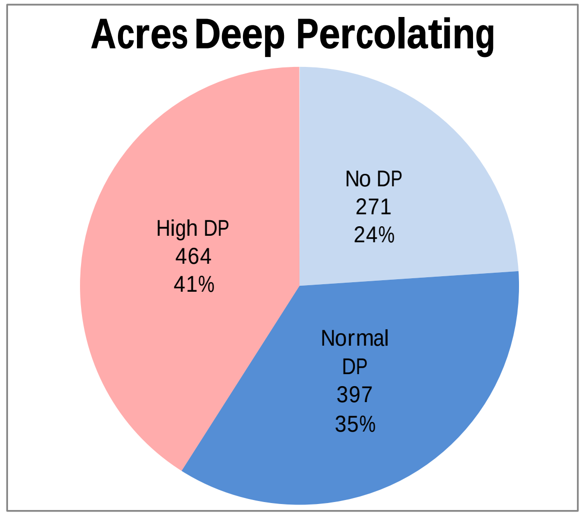

Figure 1. Deep percolation

Irrigation Water Use Record - Farmer Self Certification

Cooperator:		**Crop:**	Grass Hay/Pasture	**Year:**	2010
Tract/Field:		**Root Depth, ft:**	2.50		
Date:	02/02/11	**Station:**	Manila	**CU:**	24 inches

Soil Texture:	Loam	**Irrigation method:**	Pivot
AWC, In/Ft:	2.16	**Efficiency:**	75%
AWC Max, in:	5.40	**Acres:**	69.74
MAD, in:	2.70	**Evaporation %:**	10%
Pre-season AWC, In.	2.70	**Cycle Hours:**	168
		Flow rate, gpm:	450

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 2. IWM Self Certification Spreadsheet input page

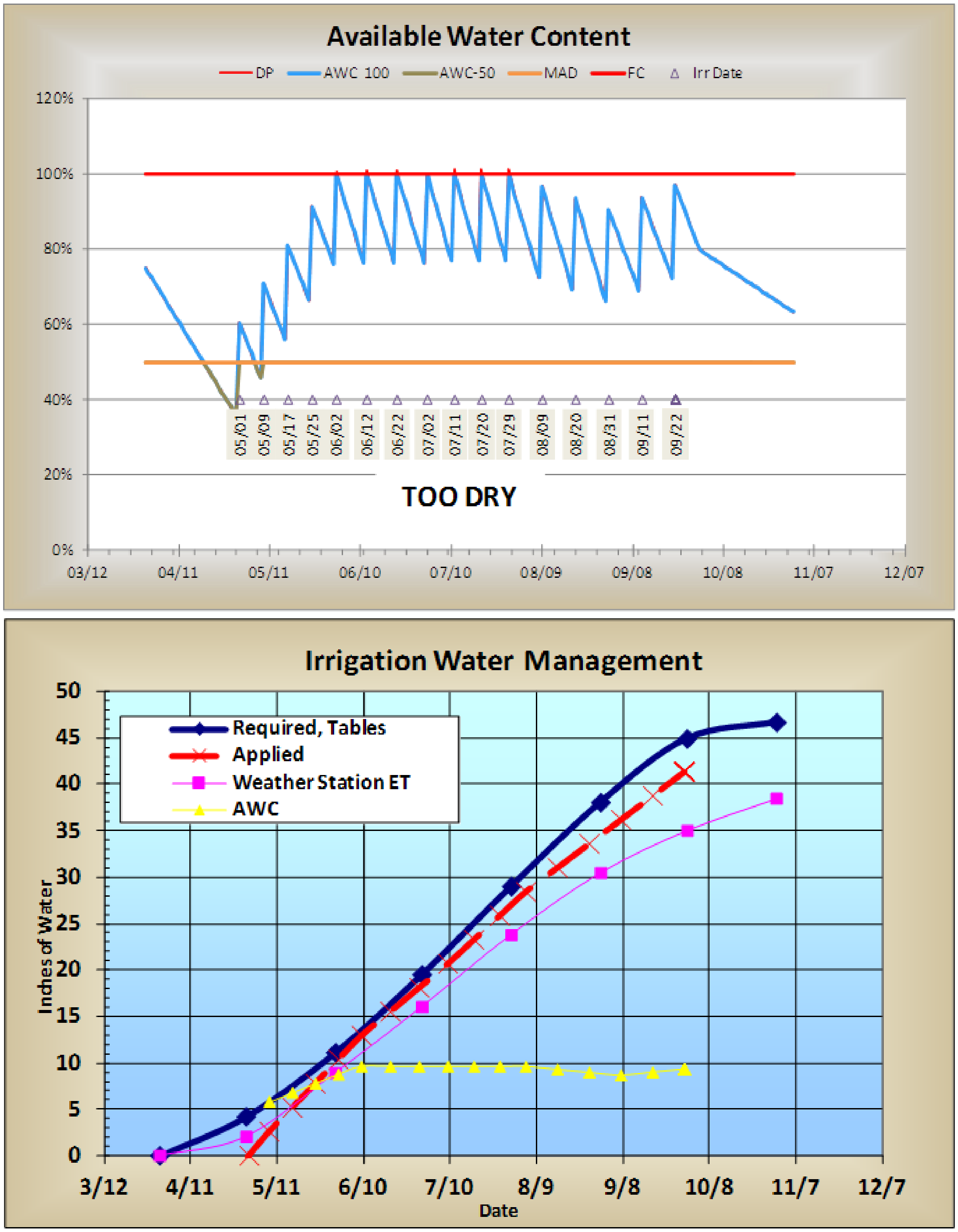

Figure 3. Sample graphs from the IWM Self Certification Spreadsheet

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.

Figure 4. Sample Soil Moisture Data Logger with graphing

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 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 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. (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.

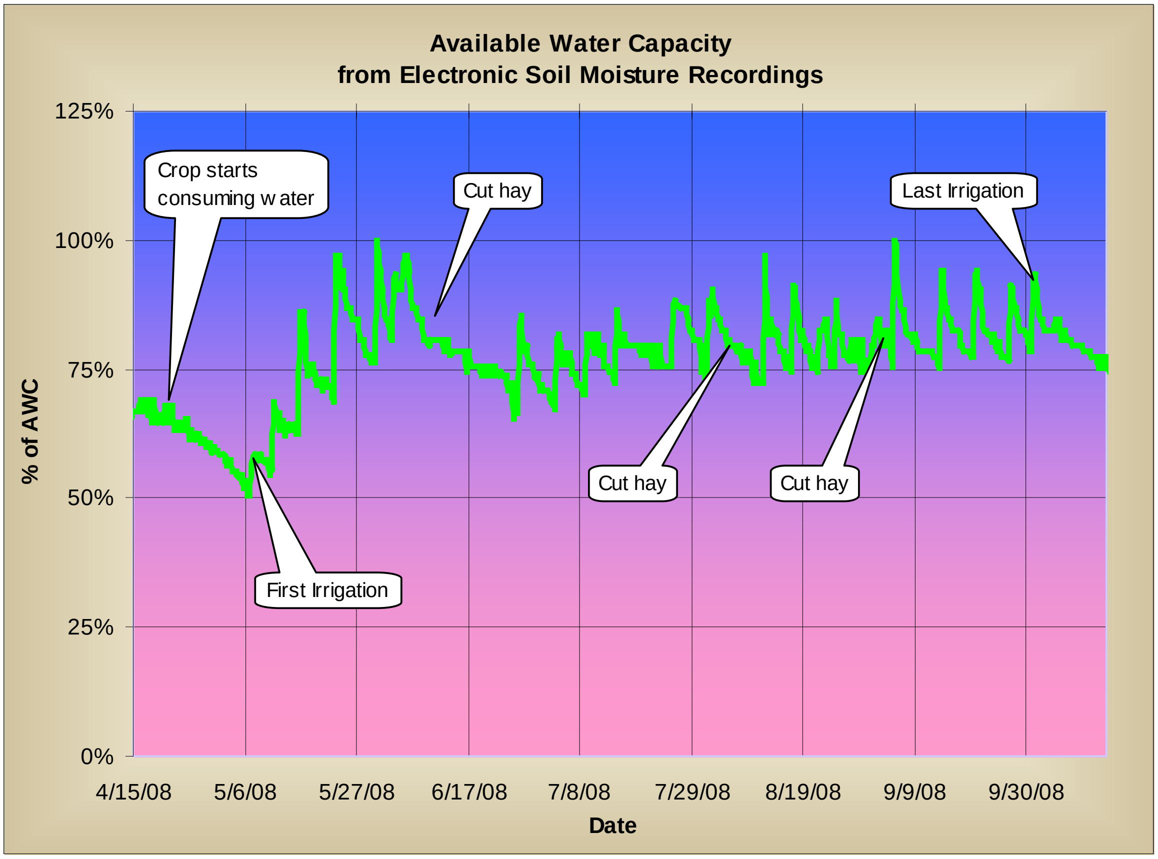

Figure 5. AWC estimated from downloaded soil moisture data

Wildlife Habitat and Wetlands

Background

Basinwide 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.

Wildlife Habitat Contract Monitoring

In this second year of eligibility (FY2011) 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 Basinwide Salinity Funds.

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

Table 9. Wildlife Habitat Replacement

Acres of Wildlife Habitat Creation or Enhancement				
FY2010 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				
FY2010 Cumulative practices				
Program	Acres Planned		Acres Applied	
	Wetland*	Upland	Wetland*	Upland
BSPP	-	-	-	-
EQIP	-	-	-	-
WHIP	-	-	-	-
Total	-	-	-	-

*Wetland acres include riparian habitat

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.

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 Eastern Utah, forage crops and grass pasture account for nearly most producing acres.

Statistical analysis across the 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 Eastern 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
- 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)

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

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 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/.
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. "QUALITY OF WATER COLORADO RIVER BASIN – Progress Report #20", U.S. Department of the Interior, 2001.
6. "Colorado River Salinity Control Program, Uintah Basin Unit, Monitoring and Evaluation, 2001 Report", Draper, Brent W., Goins, Donald J., Lundstrom, D. Nick.
7. "Colorado River Salinity Control Program, Uintah Basin Unit, Monitoring and Evaluation, 2005 Report", USDA-NRCS.
8. 1987, 1992, 1997, 2002, 2007 "Census of Agriculture", United Stated Department of Agriculture, National Agricultural Statistics Service.
9. Allen, Richard G. etal., FAO Irrigation and Drainage Paper No. 56, Crop Evapotranspiration, http://www.fao.org/docrep/X0490E/X0490E00.htm.