RECLAMATION
Managing Water in the West

QUALITY OF WATER

COLORADO RIVER BASIN

Progress Report No. 25

U.S. Department of the Interior
Bureau of Reclamation
Upper Colorado Region

2017

Mission Statements

The U.S. Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Acronyms and Abbreviations

Af	acre feet
ACEC	Area of critical environmental concern
AMD	acid mine drainage
ARC	Application Review Committee
BLM	Bureau of Land Management
BSP	Basin State Program
CFS	Cubic feet per second
CRB	Colorado River Basin
CWP	Colorado Parks and Wildlife
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FLPMA	Federal Land Management Policy Act of 1976
FOA	Funding Opportunity Announcement
Forum	Colorado River Basin Salinity Control Forum
FWS	Fish and Wildlife Service
GLCA	Glen Canyon Recreation Area
GKM	Gold King Mine
Maf	million acre feet
MWD	Metropolitan Water District
NEPA	National Environmental Policy Act
NPS	National Park Service
NRCS	Natural Resources Conservation Service
PCR	Polymerase Chain Reaction
PPM	Parts per Million
Reclamation	Bureau of Reclamation
Review	2014 Review, Water Quality Standards for Salinity, Colorado River System
RFP	Request for Proposal
SCP	Colorado River Basin Salinity Control Program
Secretary	Secretary of Interior
TDS	Total Dissolved Solids (salinity)
TMDL	Total Maximum Daily Load
UCRB	Upper Colorado River Basin
UDAF	Utah Department of Agriculture and Food
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USDI	United States Department of Interior
USGS	United States Geologic Survey
WMIDD	Wellton-Mohawk Irrigation & Drainage District
WWDC	Wyoming Water Development Commission

TABLE OF CONTENTS

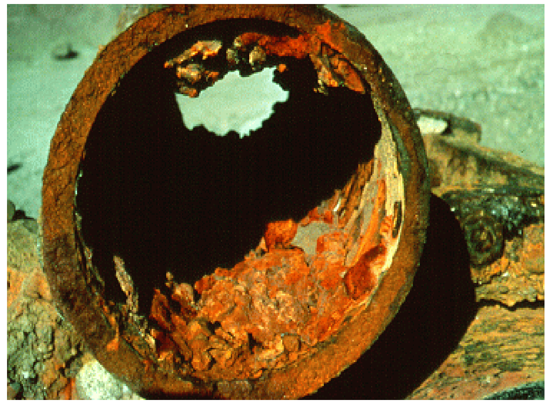
TABLES

FIGURES

Figures Continued

SUMMARY

The Colorado River and its tributaries provide water to about 35 - 40 million people and irrigation water to nearly 4.5 million acres of land in the United States (Moving Forward, 2015;). The river also serves about 3.3 million people and 500,000 acres in Mexico (Cohen, 2011). The effect of salinity is a major concern in both the United States and Mexico. Salinity damages in the United States are presently estimated to be about $382 million per year at 2014 salinity concentrations, which includes 1.3 million tons of implemented salinity controls. This biennial report on the quality of water in the Colorado River Basin is required by Public Laws 84-485, 87-483, and the Colorado River Basin Salinity Control Act (Salinity Control Act) (Public Law 93-320, as amended by Public Laws 98-569, 104-20, 104-127, and 106-459).



Salinity damages to municipal water pipe.

The Salinity Control Act authorizes the Secretaries of the U.S. Department of the Interior (Interior) and U.S. Department of Agriculture (USDA) to enhance and protect the quality of water available in the Colorado River for use in the United States and the Republic of Mexico.

Title I of the Salinity Control Act authorized the construction and operation of a desalting plant, brine discharge canal, and other features to enable the United States to deliver water to Mexico having an average salinity no greater than 115 parts per million (ppm) plus or minus 30 ppm over the annual average salinity of the Colorado River at Imperial Dam. The Title I program (administered by the Bureau of Reclamation [Reclamation]) continues to meet the requirements of Minute No. 242 of the International Boundary and Water Commission, United States and Mexico.

Salinity damages to crop production.

Title II of the Salinity Control Act authorizes the Secretary of the Interior (Secretary) and the Secretary of Agriculture to implement the Title II, Colorado River Basin Salinity Control Program (SCP). Through a broad range of specific and general salinity control measures the Salinity Control Program prevents further degradation of water quality to meet the objectives and standards set by the Clean Water Act. Salinity control measures implemented by Reclamation, Bureau of Land Management (BLM), and USDA - Natural Resources Conservation Service (NRCS) through the Salinity Control Program are currently (2015) controlling over 1.3 million tons of salt per year from entering the Colorado River System.

The Colorado River Basin Salinity Control Forum (Forum) in accordance with the requirements of the Clean Water Act, prepared the "2014 Review, Water Quality Standards for Salinity, Colorado River System" (Review) (Colorado River Salinity Control Forum, 2014). The Review reported that by 2035 a target of 1.68 million tons per year of salt will need to be controlled from entering the Colorado River system in order to meet the water quality standards in the Lower Basin, below Lees Ferry, AZ. This program goal is the combined target for the Forum and participating agencies within Interior and USDA. In order to meet the 1.68 million tons of salt per year goal, it will be necessary to fund and implement potential new measures which ensure the removal of an approximate additional 340,000 tons by 2035.

With the reported existing salt controlled, and assuming no reduction of the existing salinity control projects, then over 17,000 tons of new or additional controls will need to be implemented each year to maintain the standards with increased future water development.

The Upper Colorado River Basin regularly experiences significant year to year hydrologic variability. During the recent 16-year period 2000 to 2015, however, the unregulated inflow to Lake Powell, which is a good measure of hydrologic conditions in the Colorado River Basin, was above average in only 3 out of the past 16 years. This has been the lowest 16-year period since the closure of Glen Canyon Dam in 1963, with an average unregulated inflow of 8.51 maf, or 79% of the 30-year average (1981-2010). For comparison, the 1981-2010 total water year average is 10.83 maf. The unregulated inflow during the 2000-2015 period has ranged from a low of 2.64 maf (24% of average) in water year 2002 to a high of 15.97 maf (147% of average) in water year 2011. The water year 2015 unregulated inflow volume to Lake Powell was 10.17 maf (94% of average), which, though still below average, was significantly higher than inflows observed in 2012 and 2013 (45% and 47% of average, respectively). At the end of water year 2015, total system storage in the Colorado River Basin was 30.3 maf (51% of 59.6 maf total system capacity). Since the beginning of water year 2000, total Colorado Basin storage has experienced year to year increases and decreases in response to wet and dry hydrology, ranging from a high of 94% of capacity at the beginning of 2000 to a low of 50% of capacity at the beginning of water year 2005. One wet year can significantly increase total system reservoir storage, just as persistent dry years can draw down the system storage.

Salinity concentration has varied during this recent period (with a downward trend), but has not exceeded the numeric salinity criteria on the Colorado River below Hoover Dam, Parker Dam and at Imperial Dam; 723, 747 & 879 mg/L respectively. Reclamation's short term future salinity modeling scenarios indicate that the numeric salinity criteria should be maintained even with an additional 1-2 years of drought. The salinity criteria could have been exceeded in 2005 - 2007 without the Salinity Control Program and other salt reductions. Nevertheless, salinity damages are still very high at the 2015 salinity levels.

CHAPTER 1 – INTRODUCTION

Reclamation prepared this report in cooperation with State water resource agencies and other Federal agencies involved in the Salinity Control Program. This Progress Report 25 is the latest in a series of biennial reports that commenced in 1963.

The authorization for these reports and the legal aspects can be found in Chapter 1 of prior Progress Reports http://www.usbr.gov/uc/progact/salinity/pdfs/PR24final.pdf

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CHAPTER 2 – SALINITY CONDITIONS

CAUSES OF SALINITY

The Colorado River System is naturally very saline. Historically at the United States Geologic Survey (USGS) gauge below Hoover Dam, between 1940 and 1980, an annual average of approximately 9.3 million tons of salt was carried down the river. From 2005 to 2015, an annual average of approximately 7.5 million tons of salt are being measured in the river, including years of high flows and drought, with the trend going down. The flow of the river dilutes this salt, and depending upon the quantity of flow, salinity can be relatively dilute or concentrated. Since climatic conditions directly affect the flow in the river, salinity in any one year may double (or halve) due to extremes in runoff. Because this natural variability is virtually uncontrollable, the seven Basin States adopted a non-degradation water quality standard.

Nearly half of the salinity concentration in the Colorado River System is from natural sources. Saline springs, erosion of saline geologic formations, and runoff all contribute to this background salinity. The EPA (EPA, 1971) estimated that the natural salinity in the Lower Colorado River at Imperial Dam was 334 milligrams per liter (mg/L). Irrigation, reservoir evaporation, and municipal and industrial (M&I) sources make up the balance of the salinity in the Colorado River Basin. Figure 1 shows the relative amount each source contributes to the salinity of the Colorado River, as estimated by the Environmental Protection Agency (EPA) in 1973. Table 1, on the following page, quantifies the salinity from several of the known sources.

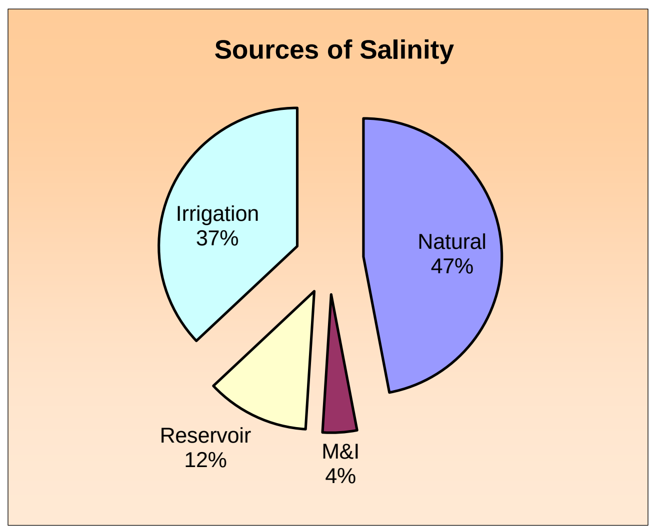

Figure 1 – Salinity Sources

Salinity of the Colorado River has increased due to the development of water resources in two major ways: (1) the addition of salts from water use and (2) the consumption (depletion) of water. The combined effects of water use and consumption have had a significant impact on salinity in the Colorado River Basin. The basin-wide drought, since 1999, has also had an influence on the present salinity of the Colorado River.

Any potential health concerns from the salinity levels in the Colorado River have previously been addressed in the health section of Progress Report 21 http://www.usbr.gov/uc/progact/salinity/pdfs/PR21.pdf

Table 1 – 1971 Quantified Sources of Salt Loading

Source	Type of Source	Salt Loading (tons per year)
Paradox Springs	Springs / point	205,000
Dotsero Springs	Springs / point	182,600
Glenwood Springs	Springs / point	335,000
Steamboat Springs	Springs / point	8,500
Pagosa Springs	Springs / point	7,300
Sinbad Valley	Springs / point	6,500
Meeker Dome	Springs / point	57,000
Other minor springs in the Upper Basin	Springs / point	19,600
Blue Springs	Springs / point	550,000
La Verkin Springs	Springs / point	109,000
Grand Valley	Irrigation / non-point	580,000
Big Sandy	Irrigation / non-point	164,000
Uncompahgre Project	Irrigation / non-point	360,000
McElmo Creek	Irrigation / non-point	119,000
Price-San Rafael	Irrigation / non-point	258,000
Uinta Basin	mostly irrigation / non-point	240,000
Dirty Devil River Area	Irrigation / non-point	150,000
Price-San Rafael Area	Irrigation / non-point	172,000
Other, non-regulated areas	Various	5,200,000
Total		8,724,000

Values listed are pre salinity control project loading

ECONOMIC EFFECTS OF SALINITY

Salinity related damages are primarily economical and due to reduced agricultural crop yields, corrosion, and plugging of pipes and water fixtures in housing and industry. Figure 2 breaks down the percentage of total damages. The seven Basin States have agreed to limit this impact and adopted numeric criteria, which require that salinity concentrations not increase (from the 1972 levels) due to future water development. Salinity levels measured in the river may be low or high due to hydrologic conditions, but the goal of the Water Quality Criteria for the Colorado River Basin and the Salinity Control Program is to offset (eliminate/reduce) the salinity effects of additional water development.

Reclamation has developed an economic model that calculates damages for a given level of salt. The Salinity Damages Model estimates the quantitative damages that are incurred in the metropolitan and agricultural areas in the lower Colorado Basin that receive

Colorado River water. The model estimates the impacts from salinity levels greater than 500 mg/L TDS on household water using appliances, damages in the commercial sector, industrial sector, water utilities, and agricultural crop revenues. It also estimates the additional costs related to meeting state wide water quality standards for ground water and recycled water use in the MWD service area.

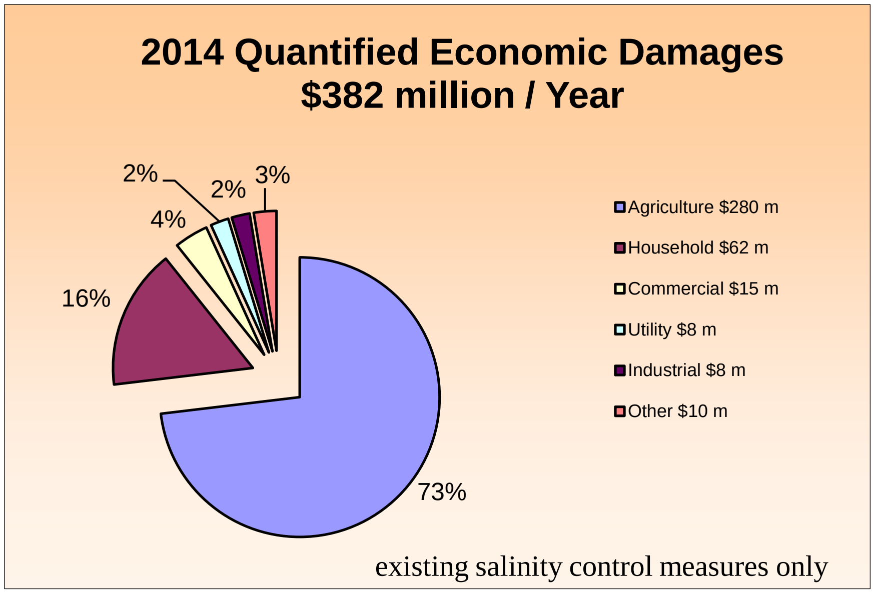

Figure 2 - Salinity Damages

In FY14 the Salinity Damages Model was updated with actual 2010 data and projections on 5-year intervals to 2040 (BOR, 2014).

HISTORICAL SALINITY CONDITIONS

Salinity in the Colorado River is monitored at 20 key stations throughout the Colorado River Basin. A map of station location is presented in Appendix A. Salt loads and concentrations are calculated from daily conductivity and flow records using methods developed jointly between Reclamation and USGS (Liebermann et al., 1986), Appendix B provides a methods summary. Historical annual streamflow, and salinity concentrations from 1940 through 2013 are included in graphical form in Appendix C. Monthly and annual data may be obtained by request from Reclamation, Salt Lake City, Utah or by going to Reclamation's Upper Colorado Regional Office Salinity Program web page; http://www.usbr.gov/uc/progact/salinity/index.html.

The salinity of the 3 lower basin compact points (Hoover, Parker and Imperial Dams) since 1940 is shown in Figure 3. As Figure 3 shows, the last time the TDS exceeded or reached the salinity criteria at any of the compact points, was in 1972 – the year that the salinity standard was established for the Colorado River.

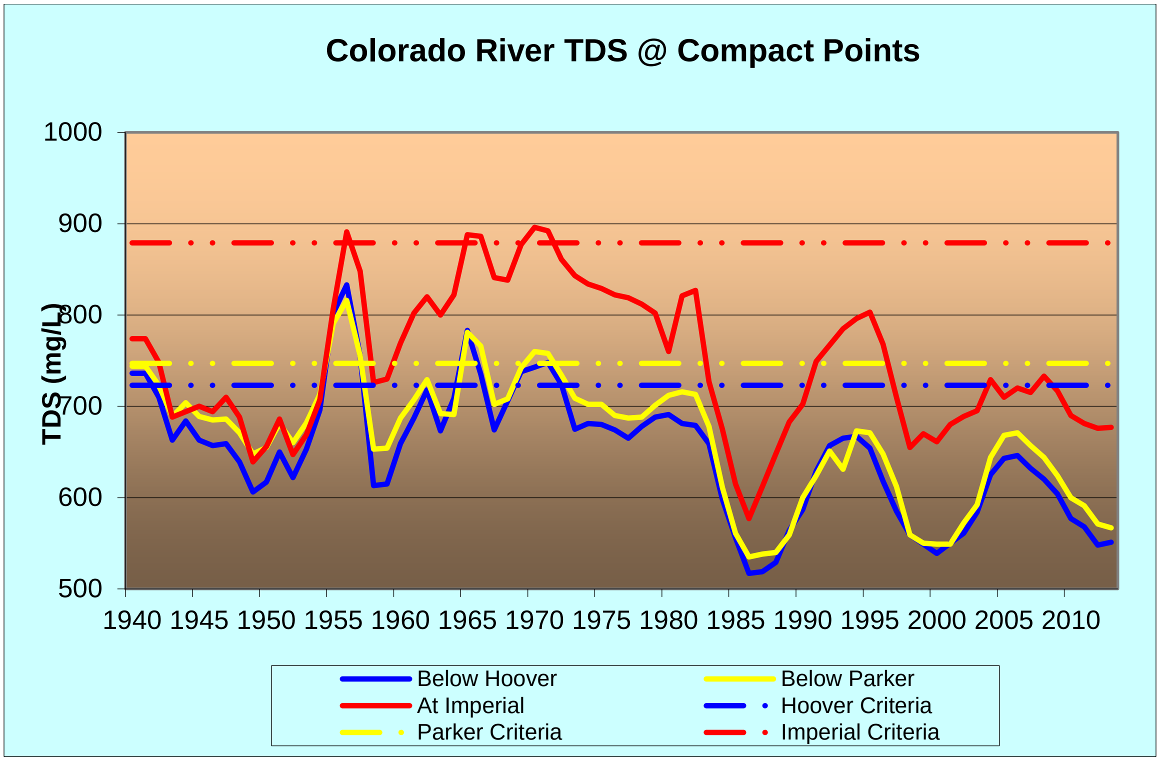

Figure 3 – Colorado River TDS

FACTORS INFLUENCING SALINITY

Stream flow, reservoir storage, water resource development, salinity control, climatic conditions, and natural runoff directly influence salinity in the Colorado River Basin. Before water development, the salinity of spring runoff was often below 200 mg/L throughout the Colorado River Basin. However, salinity in the lower mainstem was often well above 1,000 mg/L during the low flow months (most of the year), since no reservoirs existed to catch and store the spring runoff.

Streamflow

Streamflow directly influences salinity. For the most part, higher flows (or reservoir releases) dilute salinity. The top graph in Figure 4 shows streamflow at two key points in the mainstem. In 1983, Lake Powell (Glen Canyon Dam) filled for the first time and spilled.

This spill went through Lake Mead (Hoover Dam) and on downstream through Imperial Dam. In 1983 and on through 1987, flows in the system were again extremely high and sustained, reducing salinity to historic lows. As shown in the bottom graph of Figure 4, returning to average flows in the system after 1987 returned the salinity in the reservoir system to average levels.

Reservoir Storage

The Colorado River Storage Project Reservoirs produce not only major hydrologic modifications downstream, but they also significantly alter the salinity variability of the downstream river. The overall long term salinity effects of the reservoirs are beneficial and have greatly reduced the salinity peaks and annual fluctuation (Figure 5). The high concentration low flow waters are mixed with low concentration spring runoff, reducing the month-to-month variation in salinity below dams (Mueller et al., 1988). At Glen Canyon Dam, the pre and post dam peak monthly salinity has been reduced by nearly 600 mg/L. Similar effects can be seen below Flaming Gorge, Navajo, and Hoover Dams, greatly improving the quality of water during the summer, fall and winter.

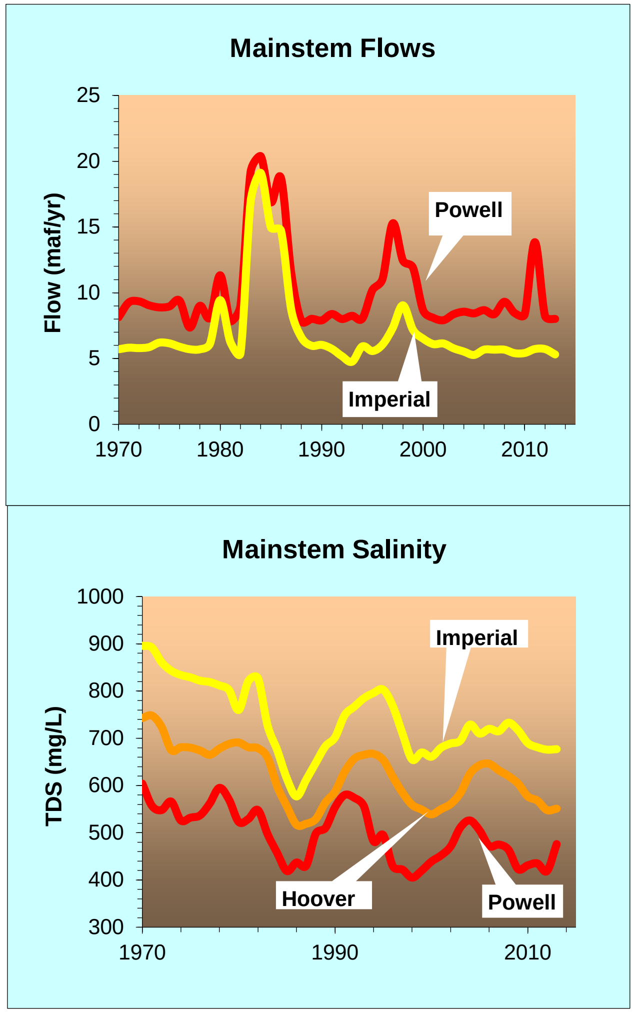

Figure 4- Colorado River Flow and TDS

Large reservoirs like Lake Powell selectively route less saline water while holding more saline waters during low inflow periods. The poorer quality waters are then slowly released after the inflows have begun to increase, which helps to prevent exceeding the salinity

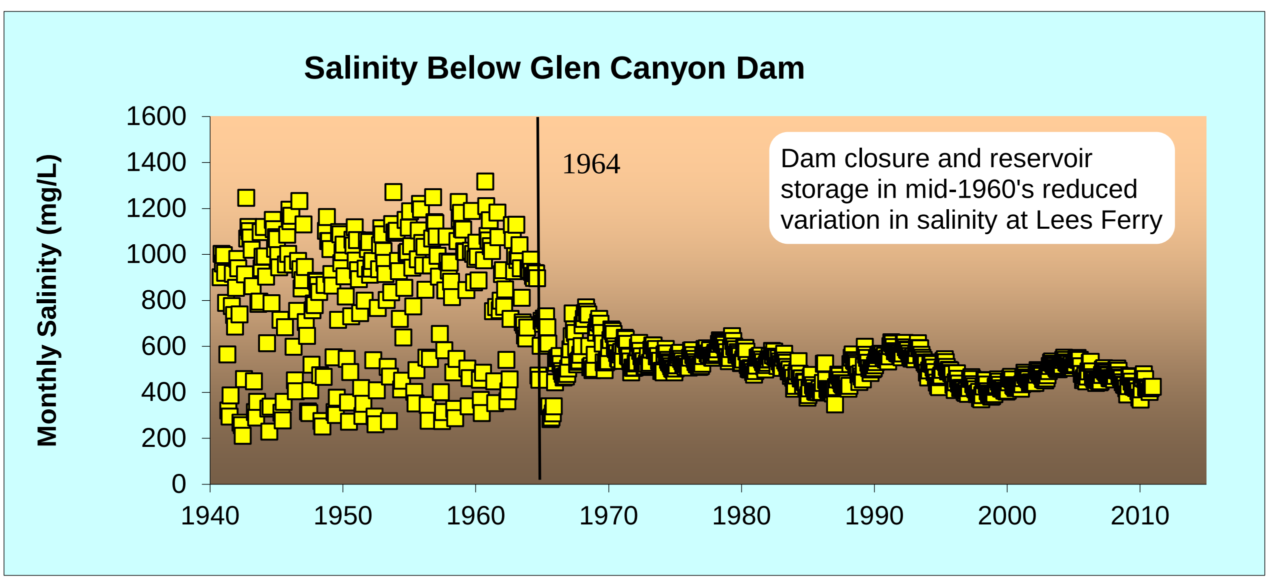

Figure 5 – Salinity below Glen Canyon Dam

criteria during drought years. The large reservoirs selectively retain higher salinity winter inflows in the bottom of the pool and route lower salinity overflow density currents from the spring runoff. The seasonal and long term effects of this selective retention and routing of salt has been shown below Glen Canyon Dam in Figure 5.

Figure 6 further displays this retention. Figure 6 is a long-term depth vs. time profile of salinity in the forebay of Glen Canyon Dam and is an illustrated history of the salinity. The Y (vertical) axis is depth in the water column and the X axis is time in years. The color scale is the change in salinity.

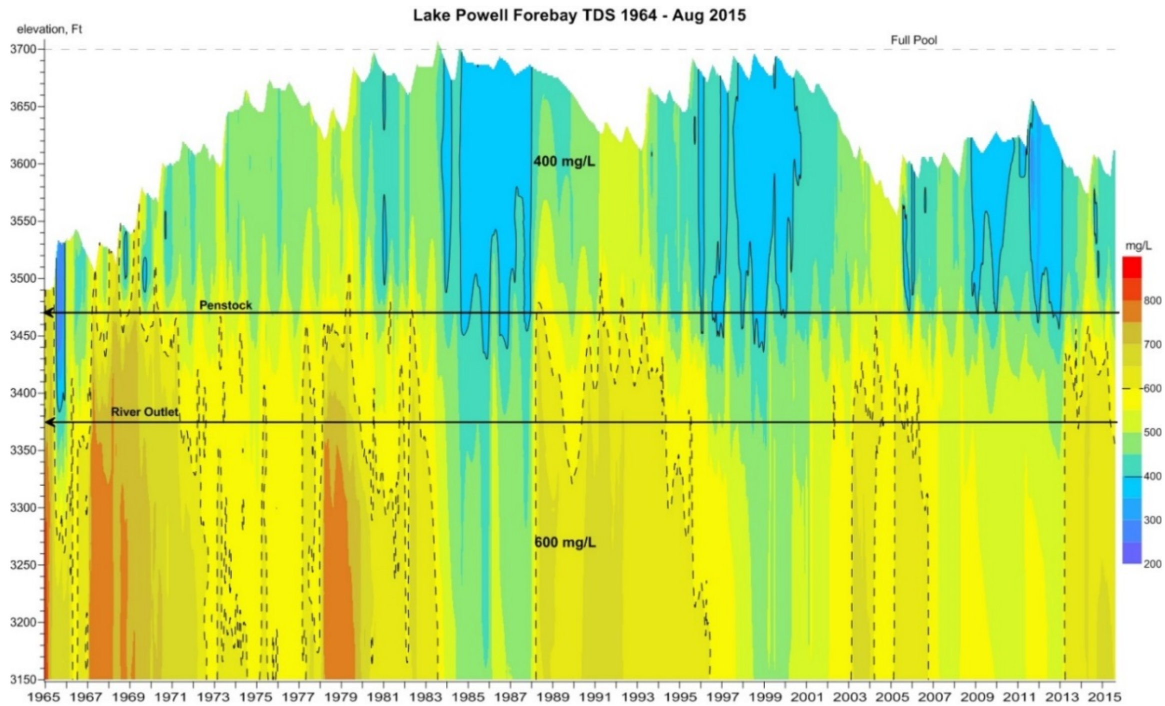

Figure 6 - Lake Powell TDS

Figures 6, 7 and 8 illustrate that Glen Canyon Dam causes Lake Powell to selectively retain higher salinity water during drier years of drought, and then routes it out with the increased mixing and shorter hydraulic retention times of wetter cycles as seen particularly in 1983 and 1999. During these wetter cycles there is a significant mixing and dilution of these previously stored salts.

There are 4 periods or trends, with regards to salt loads and concentration, which can be seen in the Colorado River salinity for the inflow to and outflow from Lake Powell which can be seen in Figures 7 & 8 (yellow and green trend lines). The overall inflow line (red) in Figures 7 & 8 is the sum of TDS for the inflow stations to Lake Powell; Colorado River at Cisco, Green River at Green River, UT, San Rafael River near Green River and

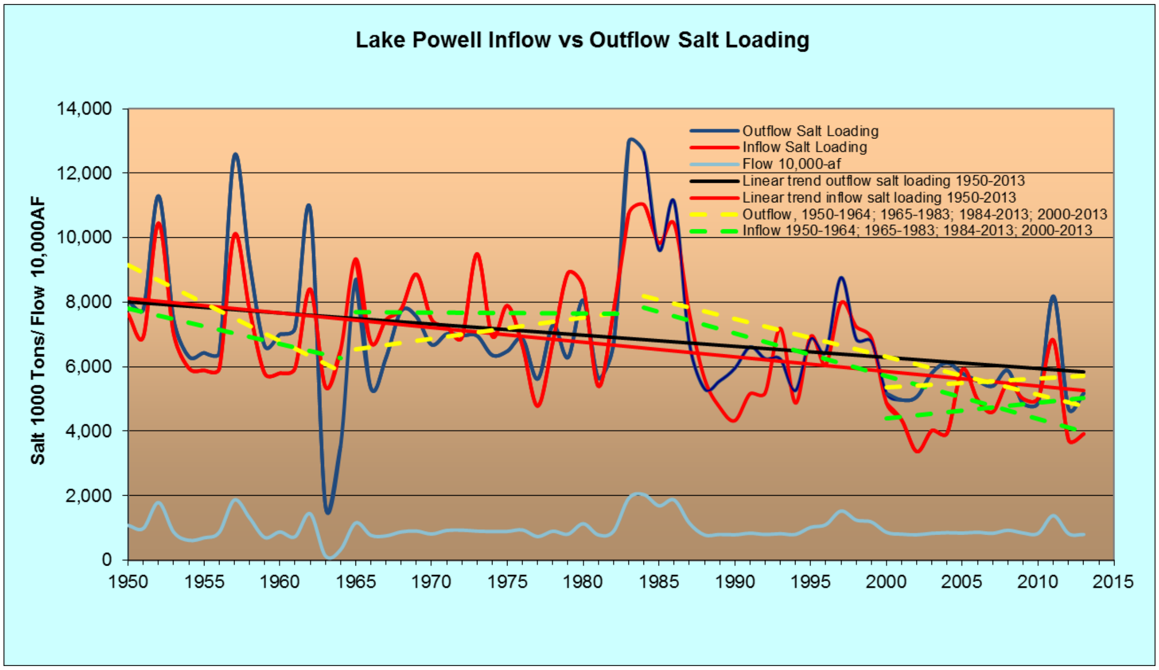

Figure 7 – Lake Powell Inflow and Outflow Salt Loading and Flow

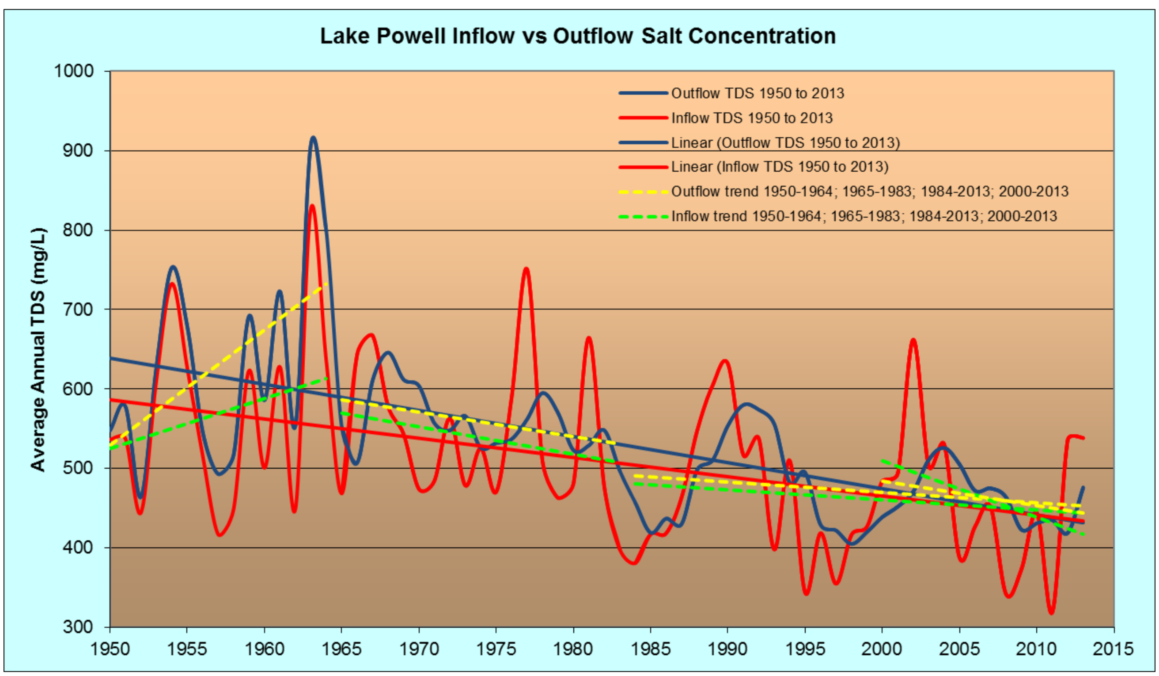

Figure 8 – Lake Powell Inflow and Outflow TDS

San Juan River near Bluff. The overall outflow line (blue) is the TDS load and dam period, 1950 – 1964, the average salinity trend was increasing with divergence between the average annual inflow and outflow salinity levels and the inflow concentration generally being less than the outflow concentration. This difference between outflow and inflow may be impacted by the beginning hydraulic conditions, since the actual annual levels appear to track each other fairly closely.

Next there was the dam filling period where Lake Powell and the Upper Basin reservoirs were completed and filling, 1965-1983. The average annual salinity during this time decreased with a convergence occurring between the inflow and outflow concentrations.

The outflow concentration decreased more than the inflow concentration, which could be due to the reservoir storing the higher TDS waters. Then there was the period, 1983 to 2000, when the basin hydrology went through both wet and dry periods and the salinity control projects in the upper basin were coming online. The declining trend of the average annual salinity concentration over this time is seen to be constant between the inflow and outflow stations. Since 1980 there appears to be an equilibrium between the salt entering the reservoir and what is being released. The last period, since 2000, covers the basinwide drought. The trend shows that the inflow TDS has declined, while the outflow TDS from Lake Powell has stayed constant with the 1983 to present TDS trend.

Lake Powell (and other reservoirs in the basin) went through an initial filling salt leach out which actually began with temporary water retention behind the coffer dam during construction in the mid 1950's. Long-term linear regression trend lines on the inflow and outflow salinity concentrations at Lake Powell indicate that internal salt leaching seems to have declined to a minimum by the mid-1990's suggesting a long-term salinity leach out which is approaching a dynamic equilibrium (Figures 7 & 8, red and blue trend line).

The natural variation in salinity as well as the agricultural sources, energy development, and the municipal and industrial use impacts on salinity have been discussed in the prior Progress Report 24 http://www.usbr.gov/uc/progact/salinity/pdfs/PR24final.pdf

FUTURE WATER DEVELOPMENT

Tables 8 and 9 summarize the projected demand scenarios used by Reclamation to evaluate the effects of water use and depletions in the recently completed Colorado River Basin Study (Reclamation, 2012). These water demand estimates were compiled as an initial step in the evaluation process and have not yet been updated.

Table 8 summarizes the projected demand by water uses in the Upper Colorado River Basin as adopted for planning purposes in the *Colorado River Basin Water Supply and Demand Study, Technical Report C – Water Demand Assessment December 2012*. Figure 10 illustrates the historical annual consumptive use by water uses in the Upper Basin as reported in Reclamation's *Colorado River System Consumptive Uses and Losses Reports* (CUL), and the total projected demands by water uses in the Upper Basin that are included as input into Reclamation's Colorado River System Simulation (CRSS) model with 3 scenarios for projected water use (Technical Report C, 2012). The consumptive uses and projected demands shown in Figure 9 exclude evaporation losses from Lake Powell, Flaming Gorge Reservoir and the Aspinall Unit reservoirs, which along with evaporation losses from Colorado River mainstem reservoirs in the Lower Basin are modeled within CRSS.

The annual depletions for the Lower Colorado River Basin shown in Table 9 include only depletions resulting from the use of water from the mainstem of the Lower Colorado River. Reclamation's CRSS model does not model or include as input consumptive uses made from tributaries to the Colorado River within the Lower Colorado River Basin. Fixed inflow values are used in the CRSS model for the Lower Basin tributaries. More detailed data on historical Colorado River Basin consumptive uses and losses (including tributary uses in the Lower Basin and reservoir evaporation losses) may be found in Reclamation's *Colorado River System Consumptive Uses and Losses Reports* or on the web at: www.usbr.gov/uc/library/envdocs/reports/crs/crsul.html

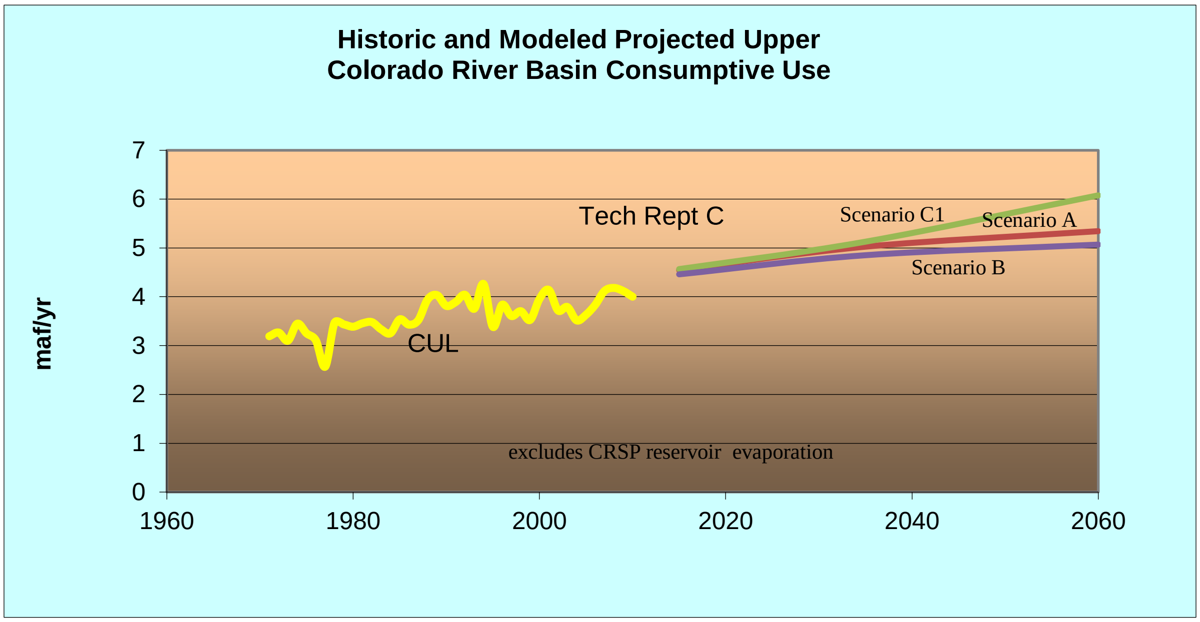

Figure 9 – Historic and Modeled Consumptive Use

Table 2 - Upper Basin Total Projected Depletion Demand Scenarios (1000 af/yr)

UPPER BASIN	2015[1]	2035[1]	2060[1]	2015[2]	2035[2]	2060[2]	2015[3]	2035[3]	2060[3]
Arizona									
Agricultural	0	0	0	0	0	0	0	0	0
Municipal and Industrial	2	2	2	2	2	2	2	2	2
Energy	0	0	0	0	0	0	0	0	0
Minerals	0	0	0	0	0	0	0	0	0
Fish, Wildlife and Recreation	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Tribal	44	43	43	38	55	71	44	43	43
Total Potential Colorado River Demand	46	46	46	40	57	73	46	46	46
Colorado									
Agricultural	1,875	1,875	1,875	1,875	1,791	1,728	1,875	1,875	1875
Municipal and Industrial	455	617	732	455	579	1,007	455	555	661
Energy	30	78	118	30	65	66	30	51	58
Minerals	32	59	60	32	65	66	31	59	60
Fish, Wildlife and Recreation	0	0	0	0	0	0	0	0	0
Tribal	0	0	0	0	0	0	0	0	0
Total Potential Colorado River Demand	2,391	2,629	2,784	2,391	2,535	2,979	2,391	2,540	2,653
New Mexico									
Agricultural	111	111	111	111	111	111	111	111	111
Municipal and Industrial	141	183	230	141	187	293	141	153	169
Energy	40	42	42	40	42	42	40	42	42
Minerals	0	0	0	0	0	0	0	0	0
Fish, Wildlife and Recreation	5	5	5	5	5	5	5	5	5
Tribal	303	363	367	309	413	529	303	363	367
Total Potential Colorado River Demand	600	703	754	606	758	979	600	673	693
Utah									
Agricultural	457	459	493	457	446	466	457	458	492
Municipal and Industrial	236	311	342	236	341	409	236	280	274
Energy	47	53	60	47	55	66	47	53	60
Minerals	0	0	0	0	0	0	0	0	0
Fish, Wildlife and Recreation	0	0	0	0	0	0	0	0	0
Tribal	259	259	259	272	299	337	170	241	259
Total Potential Colorado River Demand	999	1,082	1,154	1,012	1,141	1,277	911	1,033	1,084
Wyoming									
Agricultural	398	402	406	400	410	423	400	410	423
Municipal and Industrial	30	47	67	30	57	74	28	32	36
Energy	52	65	65	52	103	171	52	65	65
Minerals	29	42	59	34	57	91	29	42	59
Fish, Wildlife and Recreation	2	10	10	2	10	10	2	10	10
Tribal	0	0	0	0	0	0	0	0	0
Total Potential Colorado River Demand	511	566	606	518	637	769	512	559	592

Note 1: These demand scenarios do not attempt to interpret the Colorado River Compact, the Upper Colorado River Basin Compact, or any other element of the "Law of the River." These scenarios should not be construed as an acceptance of any assumption that limits the Upper Colorado River Basin's depletion.
Note 2: These demand scenarios are for planning purposes only. Their estimates do not constitute an endorsement of the Bureau of Reclamation's 2007 Hydrologic Determination and should not be construed as in any way limiting the Upper Division States use of Colorado River water in accordance with the Commission's resolution of 6/5/06.
Note 3: These demand scenarios exclude shared CRSP evaporation.
Option [1]. Scenario A; (Current projected use), continuation of growth, development patterns, and institutions follow long-term trends. *Colorado River Basin Water Supply and Demand Study. Technical Report C – Water Demand Assessment*.
Option [2]. Scenario C1; (Rapid Growth) Economic resurgence (population and energy) and current preferences toward human and environmental values (greatest water demand model). *Colorado River Basin Water Supply and Demand Study. Technical Report C – Water Demand Assessment.*
Option [3]. Scenario B; (Slow Growth) Slow growth with emphasis on economic efficiency (lowest water demand model). *Colorado River Basin Water Supply and Demand Study. Technical Report C – Water Demand Assessment*

Table 3 - Lower Basin Depletion Projections (1000 af/yr)

LOWER MAINSTEM	2015[1]	2035[1]	2060[1]	2015[2]	2035[2]	2060[2]	2015[3]	2035[3]	2060[3]
Arizona									
Agricultural	1,124	703	703	1.082	703	703	1,145	724	724
Municipal and Industrial	760	1,099	1,460	816	1,305	2,060	823	1,075	1,164
Energy	1	1	2	1	2	2	1	1	2
Minerals	42	54	55	42	53	54	42	60	60
Fish, Wildlife and Recreation	16	16	16	16	16	16	16	16	16
Tribal	997	1,216	1,215	1,013	1,288	1,337	881	1,100	1,100
Total Potential Colorado River Demand	2,940	3,088	3,447	2,967	3,364	4,170	2,906	2,975	3,064
California									
Agricultural	3,230	3,103	3,159	3,230	3,103	3,159	3,229	3,103	3,158
Municipal and Industrial	1,433	1,589	1,690	1,433	1,591	1,695	1,431	1,581	1,669
Energy	53	108	156	61	171	284	53	108	156
Minerals	0	0	0	0	0	0	0	0	0
Fish, Wildlife and Recreation	124	24	32	124	24	32	124	24	32
Tribal	92	92	92	92	92	92	92	92	92
Other	48	58	75	48	58	75	48	58	75
Total Potential Colorado River Demand	4,979	4,974	5,203	4,987	5,039	5,336	4,977	4,966	5,182
Nevada									
Agricultural	0	0	0	0	0	0	0	0	0
Municipal and Industrial	289	374	506	289	416	589	289	346	479
Energy	0	0	0	0	0	0	0	0	0
Minerals	0	0	0	0	0	0	0	0	0
Fish, Wildlife and Recreation	2	2	2	2	2	2	2	2	2
Tribal	9	9	9	9	9	9	9	9	9
Total Potential Colorado River Demand	300	385	517	300	427	600	300	357	490

Note: In the LC Basin, demands are from mainstem diversions of the Colorado River only. Does not include demands from diversions of Colorado River tributaries or evaporation from mainstem reservoirs.

Option [1] . Scenario A; (Current projected use), continuation of growth, development patterns, and institutions follow long-term trends. *Colorado River Basin Water Supply and Demand Study. Technical Report C – Water Demand Assessment*.
Option [2] . Scenario C1; (Rapid Growth) Economic resurgence (population and energy) and current preferences toward human and environmental values (greatest water demand model). *Colorado River Basin Water Supply and Demand Study. Technical Report C – Water Demand Assessment.*
Option [3] . Scenario B; (Slow Growth) Slow growth with emphasis on economic efficiency (lowest water demand model). *Colorado River Basin Water Supply and Demand Study. Technical Report C – Water Demand Assessment.*

COMPLIANCE WITH THE SALINITY STANDARDS

Reclamation and the Basin States conducted salt-routing studies for the *2014 Triennial Review of the Water Quality Standards for Salinity, Colorado River Basin*. As part of the triennial review process, Reclamation used the Colorado River Simulation System (CRSS) river system model to evaluate whether sufficient salinity control measures are in place to offset the effects of development. The information provided in the next two sections of the report was used to evaluate compliance with the water quality standards.

In response to the Clean Water Act, the States have adopted water quality (salinity) criteria for the Colorado River Basin and the Environmental Protection Agency (EPA) has approved them at all three locations in the Lower Colorado River Basin. The standards call for maintenance of flow-weighted average annual salinity concentrations (numeric criteria) in the lower mainstem of the Colorado River and a plan of implementation for future controls.

The water quality standards are based on the *Water Quality Standards for Salinity, Including Numeric Criteria and Plan of Implementation for Salinity Control, Colorado River System*, prepared by the Colorado River Basin Salinity Control Forum, June 1975. The document was adopted by each of the Basin States and approved by EPA. A summary of the report follows:

The numeric criteria for the Colorado River System are to be established at levels corresponding to the flow-weighted average annual concentrations in the lower mainstem during calendar year 1972. The flow-weighted average annual salinity for the year 1972 was used. Reclamation determined these values from daily flow and salinity data collected by the USGS and Reclamation. Based on this analysis, the numeric criteria are 723 mg/L below Hoover Dam, 747 mg/L below Parker Dam, and 879 mg/L at Imperial Dam.

It should be recognized that the river system is subject to highly variable annual flow. The frequency, duration, and availability of carryover storage greatly affect the salinity of the lower mainstem; and, therefore, it is probable that salinity levels will exceed the numeric criteria in some years and be well below the criteria in others. However, under the above assumptions, the average salinity will be maintained at or below 1972 levels.

Periodic increases above the criteria as a result of reservoir conditions or periods of below normal long-time average annual flow also will be in conformance with the standards. With satisfactory reservoir conditions and when river flows return to the long-time average annual flow or above, concentrations are expected to be at or below the criteria level.

The standards provide for temporary increases above the 1972 levels if control measures are included in the plan. Should water development projects be completed before control measures, temporary increases above the criteria could result and these will be in conformance with the standard. With completion of control projects, those now in the plan or those to be added subsequently, salinity would return to or below the criteria level.

The goal of the Salinity Control Program is to maintain the flow-weighted average annual salinity at or below the numeric criteria of the salinity standards. The Program is not, however, intended to counteract the salinity fluctuations that are a result of the highly variable flows caused by climatic conditions, precipitation, snowmelt, and other natural factors.

SALINITY CONTROL

Existing salinity control measures prevent nearly 1.31 million tons of salt per year from reaching the river. In 2015 the Salinity Control Program for Reclamation has controlled approximately 570,000 tons of salt, while the NRCS program has reduced around

612,000 tons of salt, and the BLM has controlled an estimated 126,000 tons of salt per year from entering the Colorado River. In 2014 Triennial Review it was determined that salinity control units will need to prevent nearly 1.68 million tons of salt per year from entering the Colorado River by 2035, in order to meet the standard and keep the economic damages minimized. To reach this objective, as shown in Table 4, the Salinity Control Program needs to implement 372,000 tons of new controls beyond the existing 1,308,000 tons of salinity control presently in place (2015) as reported by Reclamation, NRCS & BLM. About 18,600 tons per year of new salinity control measures must be added each year if the Program is to meet the cumulative target of 1,680,000 tons per year by 2035, assuming no degradation of existing salinity projects.

To achieve this goal, a variety of salinity control methods are being investigated and constructed. Saline springs and seeps may be collected for disposal by evaporation, industrial use, or deep-well injection. Other methods include both on-farm and off-farm delivery system and irrigation improvements, which reduce the loss of water and reduce salt pickup by improving irrigation practices and by lining canals, laterals, and ditches.

Table 4 - Salinity Control Requirements and Needs Through 2035

Salinity control needs (2035)	1,680,000 tons
Measures in place (2014)	- 1,308,000 tons
Plan of Implementation Target	372,000 tons

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CHAPTER 3 – TITLE I SALINITY CONTROL PROGRAM

The Salinity Control Act, as amended, authorized the Secretary of the Interior (Secretary) to proceed with a program of works of improvement for the enhancement and protection of the quality of water available in the Colorado River for use in the United States and the Republic of Mexico. Title I enables the United States to comply with its obligation under the agreement with Mexico of August 30, 1973 (Minute No. 242 of the International Boundary and Water Commission, United States and Mexico [Minute No. 242]), which was concluded pursuant to the Treaty of February 3, 1944 (TS 994).

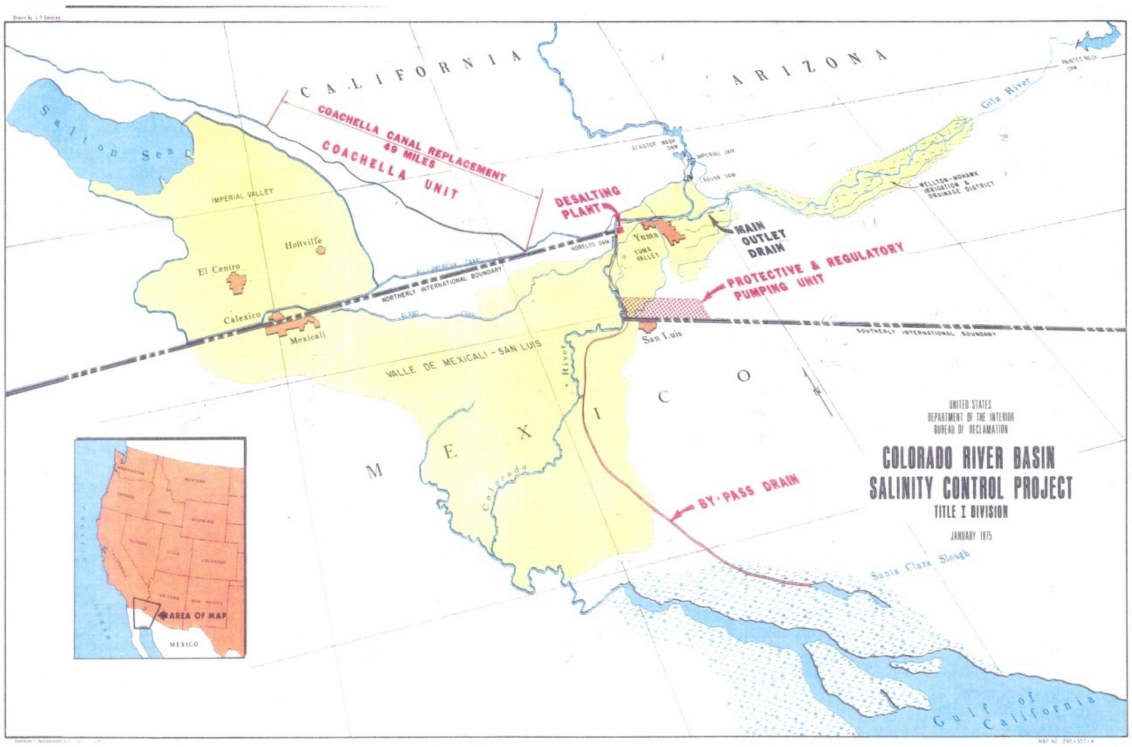

Figure 10 – Title I Salinity Control Projects

These facilities enable the United States to deliver water to Mexico with an average annual salinity concentration no greater than 115 parts per million (ppm) plus or minus 30 ppm (United States count) over the average annual salinity concentration of the Colorado River water at Imperial Dam.

The background and history of the Title I projects (Coachella Canal Lining, Protective and Regulatory pumping, Yuma Desalting Plant, Wellton-Mohawk Irrigation & Drainage District) can be found in Progress Report 22, chapter 4 at; http://www.usbr.gov/uc/progact/salinity/pdfs/PR22.pdf

Updates for the Title I projects since last Progress Report:

Coachella Canal

No new activity or change since last progress report.

Protective and Regulatory Pumping

No new activity or change since last progress report.

Yuma Desalting Plant

No new activity or change has occurred since the last progress report.

Wellton-Mohawk Irrigation and Drainage District (WMIDD)

Total crop acres have remained relatively stable since the early 1970's because more acreage is double-cropped than when the program was initiated. In particular, more vegetable crops are being grown in the district than in the past, with lettuce (iceberg and romaine) now the major crop. Irrigation efficiency levels and return flow levels for 1990-2014 are shown in Table 5.

With the use of monthly groundwater table monitoring using observation well measurements as well as input from land users, WMIDD is able to maintain a drainage-pumping program that sufficiently maintains the agriculture root zone. Land users continue to maintain water efficient farming techniques with the use of sprinkler, drip, dead level, high heads, and short runs.

Table 5 - WMIDD Irrigation Efficiency

Year	Drainage Return Flow (acre-feet)	Irrigation Efficiency, % (note: data provided by WMIDD)
1991	144,900	68.8
1992	116,200	70.4
1993	8,970	68.8
1994	49,820	65.4
1995	121,500	64.3
1996	119,600	60.4
1997	91,695	62.2
1998	98,972	61.9
1999	94,869	63.0
2000	110,287	59.7
2001	107,908	60.9
2002	119,410	61.2
2003	116,477	57.8
2004	106,002	63.3
2005	110,770	64.6
2006	103,810	62.3
2007	112,910	62.6
2008	120,190	63.0
2009	105,482	62.7
2010	111,170	66.1
2011	108,140	64.9
2012	115,630	64.1
2013	107,860	67.5
2014	111,390	64.6

CHAPTER 4 - TITLE II SALINITY CONTROL PROGRAM

Title II of the Salinity Control Act authorizes the Secretary of the Interior (Secretary) and the Secretary of Agriculture to implement a broad range of specific and general salinity control measures in an ongoing effort to prevent further degradation of water quality in the United States. These efforts are shown on the map below. The NRCS, Reclamation and BLM have a combined goal of controlling 1.68M tons of salt/per year, by the year 2035. These federal agencies are required to work together under the Salinity Control Act, as amended; with Reclamation being the lead federal agency. The Salinity Control Act also calls for periodic reports on this effort. The report is to include the effectiveness of the units, anticipated work to be accomplished to meet the objectives of Title II with emphasis on the needs during the 5 years immediately following the date of each report, and any special problems that may be impeding an effective salinity control program. Title II also provides that this report may be included in the biennial Quality of Water Colorado River Basin, Progress Report. New activities since the last progress report as well as ongoing and active projects are listed in this report.

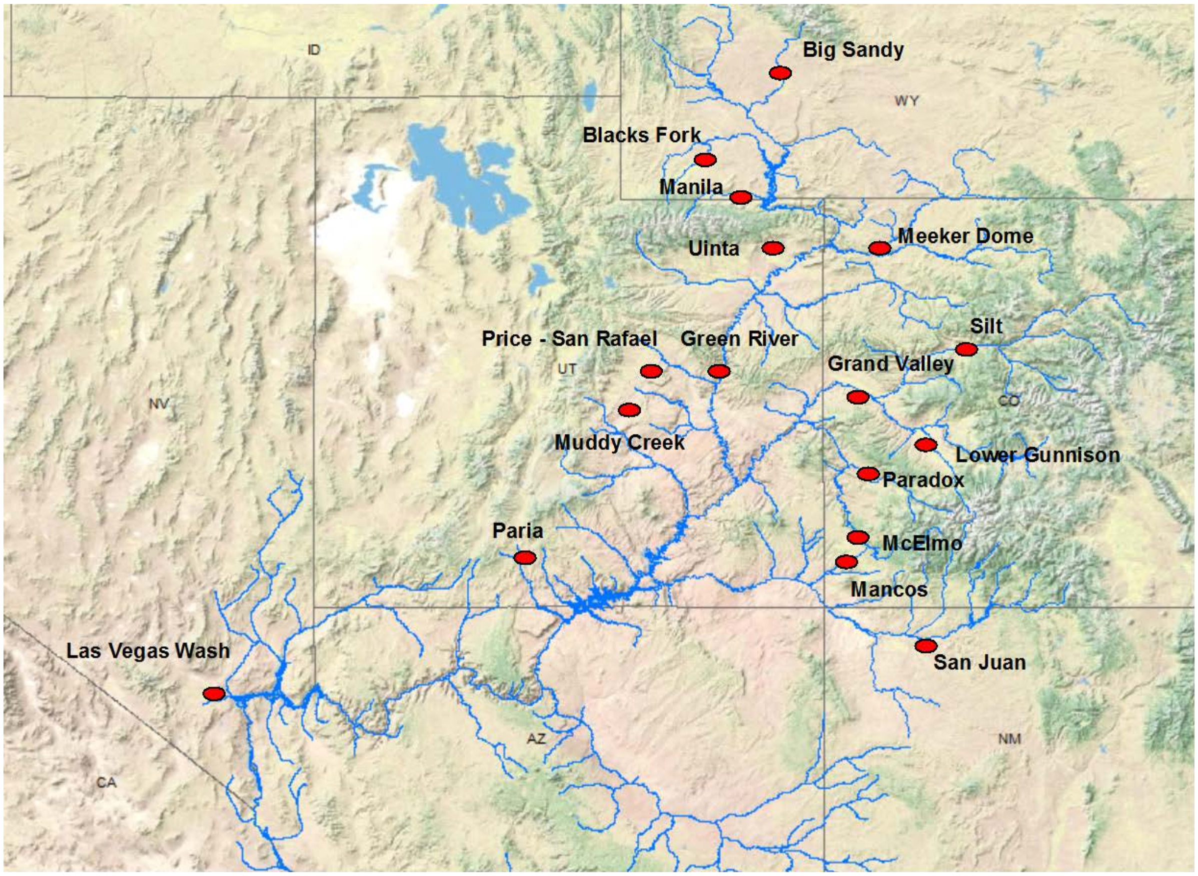

Figure 11 – Title II Salinity Control Projects

U.S. Bureau of Land Management (BLM)

The background for the BLM salinity program can be found in Progress Report 21
http://www.usbr.gov/uc/progact/salinity/pdfs/PR21.pdf

Reports from BLM State Offices reference many of the salinity activities that the BLM is engaged in with partner agencies to improve future ability to quantify salinity reductions. To address these challenges, the BLM is co-developing a system of tools/models: RHEM-APEX-AGWA ((Rangeland Hydrology and Erosion Model; Al-Hamdan et al., 2011); (Agricultural Policy EXtender model; Sharpley and Williams, 1990); (Automated Geospatial Watershed Assessment Tool; Hernandez et al, 2000)). The integration and linking of these tools/models was completed during FY2015.

Program Administration

The BLM established a Salinity Coordinator position in 2003. The BLM allocated $1,125,000 in FY2015 from its Soil/Water/Air (SWA) Program to support projects specifically relating to salinity control subactivity objectives. Projects funded in FY2015 are described below in the State Reports section. In addition to the funding allocated from the Salinity subactivity, millions of dollars are expended annually by other BLM programs and authorized users of public lands on watershed management, restoration, and mitigation activities that retain sediment/salt and/or reduce/retain erosion/sediment and salt transport efforts. The salinity coordinator's position is funded separately from the salinity funding. BLM allocates the funding to its field offices. The budget allocation is predominantly distributed to implementation projects with some funding still given to planning projects according to need and availability of personnel to successfully accomplish projects.

Basin Wide Activities

Included in the funded projects is the BLM contracted work with USDA-ARS for multiple rainfall sediment and salinity transport projects. Data are being collected from Utah, Colorado, and other locations and will continue to be collected through 2017. This work continues from the previous BLM funded work to collect physical data to validate the tools co-developed during FY2015. This tool can eventually be taught to field offices to answer the public's questions regarding salinity.

A new approach to establishing a baseline from which to move forward was funded by BLM in December, 2012. Due to the lapsed labor funds from the vacant Salinity Coordinator position, BLM invested $100,000 in a joint USDA ARS-USDOI BLM project to conduct a study to improve the current understanding and identify the gaps in knowledge regarding the sources and transport mechanisms in rangeland catchments that deliver TDS to streams. A literature review ensued that is discussed in detail in the USDA-ARS section. The BLM, Reclamation, and NRCS management practices were included in the search for their relationship to salinity reduction.

Thus far, the findings have demonstrated that: (1) TDS is a good surrogate of salinity; (2) It is generally accepted that practices that reduce soil erosion and sediment transport might also reduce salt loading; (3) Minimal literature exists on the relationship between rangeland management practices and runoff or sediment; (4) Limited literature found on direct impact of land management practices (i.e., gully plugs, contour farming, chaining); (5) Currently relationship on salt-management practices inferred from assumed impact of practice on runoff and sediment loading (partly because of lack of supporting data) through changes in vegetation type and distribution, canopy and ground cover, and soil surface/hydraulic roughness; and, (6) Literature indicates that all practices that were evaluated for reducing salt loading have a defined lifespan and must be maintained (sediment removed from gully plug) or redone to be effective (contour furrow).

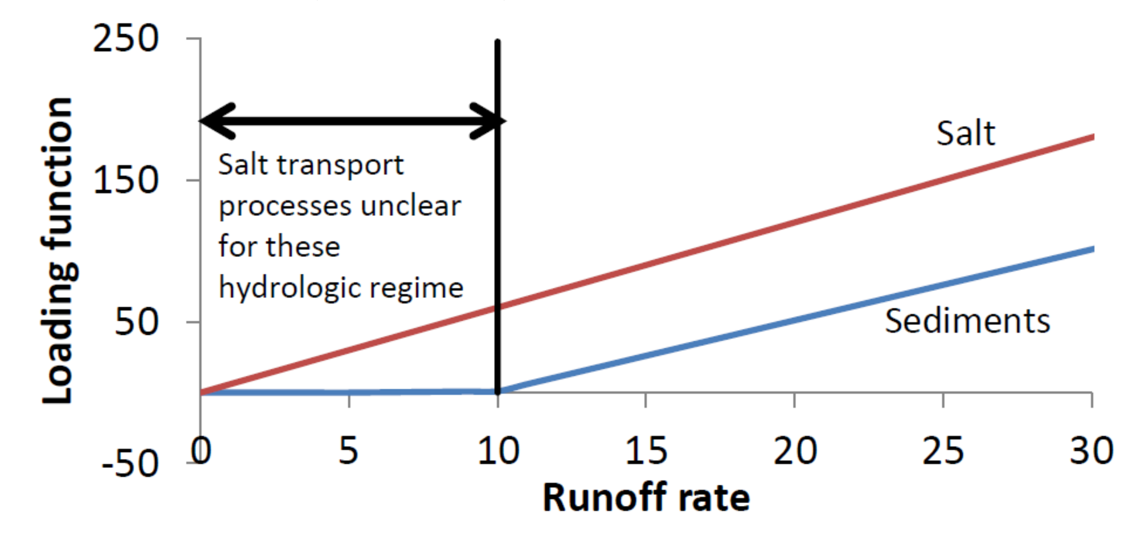

Figure 12 – Relationship between Range Runoff and Salt Loading

It has been assumed there is a hypothetical linear relationship between runoff and salt/sediments, Figure 13. This relationship needs to be quantified for various dominant Ecological Sites due to inherent difference in salts in the soils across the basin and will change as a function of vegetation type, density, and canopy and ground cover (i.e. management).

The BLM continues to co-develop a plot to watershed tool, which includes water quality, to quantify management actions of sediment, and/or salt retained, by program management across the CRB. The expected completion period is approximately 2018 and BLM expects to be able to report on the quantification of effectiveness at this time. The collaboration with USDA-ARS has already resulted in multiple publications, books, and conference presentations (see USDA-ARS section).

Eventually the tool will lead us from BLM and BLM-collaboration funded plot or sub-catchment scale to watershed and, if needed, to regional scale. Our rainfall/salinity projects will be included in the tool and will be utilized for the combination of linked models as well. The sources and inputs of salinity data are now being received from more than just the Salinity sub activity. Other programs that indirectly or directly have been affecting salinity in the CRB are: Recreation-OHV; Rangeland; Acid Mine Land; Riparian; Wild Horse and Burro Management; Fire and Revegetation Emergency Stabilization Recovery; Renewable Energy (rights-of-ways); Fluid Mineral (orphaned wells); Hazardous Fuels Reduction (Thinning Forests, Urban Interface); and, Forests and Wetlands (grazed, unmanaged lands, Christmas tree plots).

The BLM is not able to report reductions accomplished through many of these efforts to the Forum because of technical and programmatic issues, but is working to develop approaches needed to quantify reductions. Most programs should be integrated into the tool. This year's accomplishment report includes a limited number of programs.

Rangeland Program

The BLM has established and continues to improve upon its policies and practices to maintain and restore land-health based on key standards reflecting vegetation (erosion, conservation-sediment retained), ecological attributes, watershed function, and biotic integrity. So far the Land Health Standards have 90 standards that relate to assessing sediment retention/erosion.

Within the CRB, the numbers of BLM rangelands that are meeting all Rangeland Health Standards, as inventoried and reported last in 2012 are in the table below.
We start with the CRB and 472 rangeland allotments totaling 2,990,441 acres, already meeting or making significant progress toward the standards in the CRB (Figure 13).

Fuels Treatment Effectiveness Monitoring Program

Vegetation left on the ground inhibits the transport of sediment and salts. The BLM's Fuels Treatment Effectiveness Monitoring Program manages areas that are likely to intersect with wildfires leading to the destruction of vegetation and leaving paths for sediment and salinity surficial movement.

Within the Fuels Treatment Effectiveness Monitoring database (FTEM) and per IM-2015-001 which states that "offices will complete a fuels treatment effectiveness assessment and input appropriate information into FTEM for all wildfires which start in, burn into, or burn through any portion of a fuel treatment area that has been completed and reported in the Hazardous Fuels Module of the National Fire Plan Operations and Reporting System from fiscal year 2003 to present." Utah has 171 records where a record for example would be the Scipio Summit Wildfire in which there is 90 days to report it into the FTEM database. The records for Utah account for 21 percent of all of BLM's records. Since 2003, BLM has accomplished millions of acres of fuels management treatments including thinning, mastication, and lop and scatter. Wildfires have intersected many of these fuels treatments therefore, demonstrating fuels program effectiveness for a minimum of 17,363 acres (70.3 km_2) burned in Utah.

Emergency Stabilization and Rehabilitation Program

Another BLM Program that impacts sediment and salinity transport is the Emergency Stabilization and Rehabilitation. Plans after the Toquerville Fire, Utah, in FY2012 were approved for reseeding to minimize soil erosion at a cost of $478,000 over a 4 year period; it burned 113 acres of public land. The action plan would not only establish a desired plant community but also suppress invasive annuals that can create a burn/re-burn cycle. The plan investigates understory and recovery to minimize erosion and reestablishment, fences, monitoring, soil stabilization, and road/trail diversions.

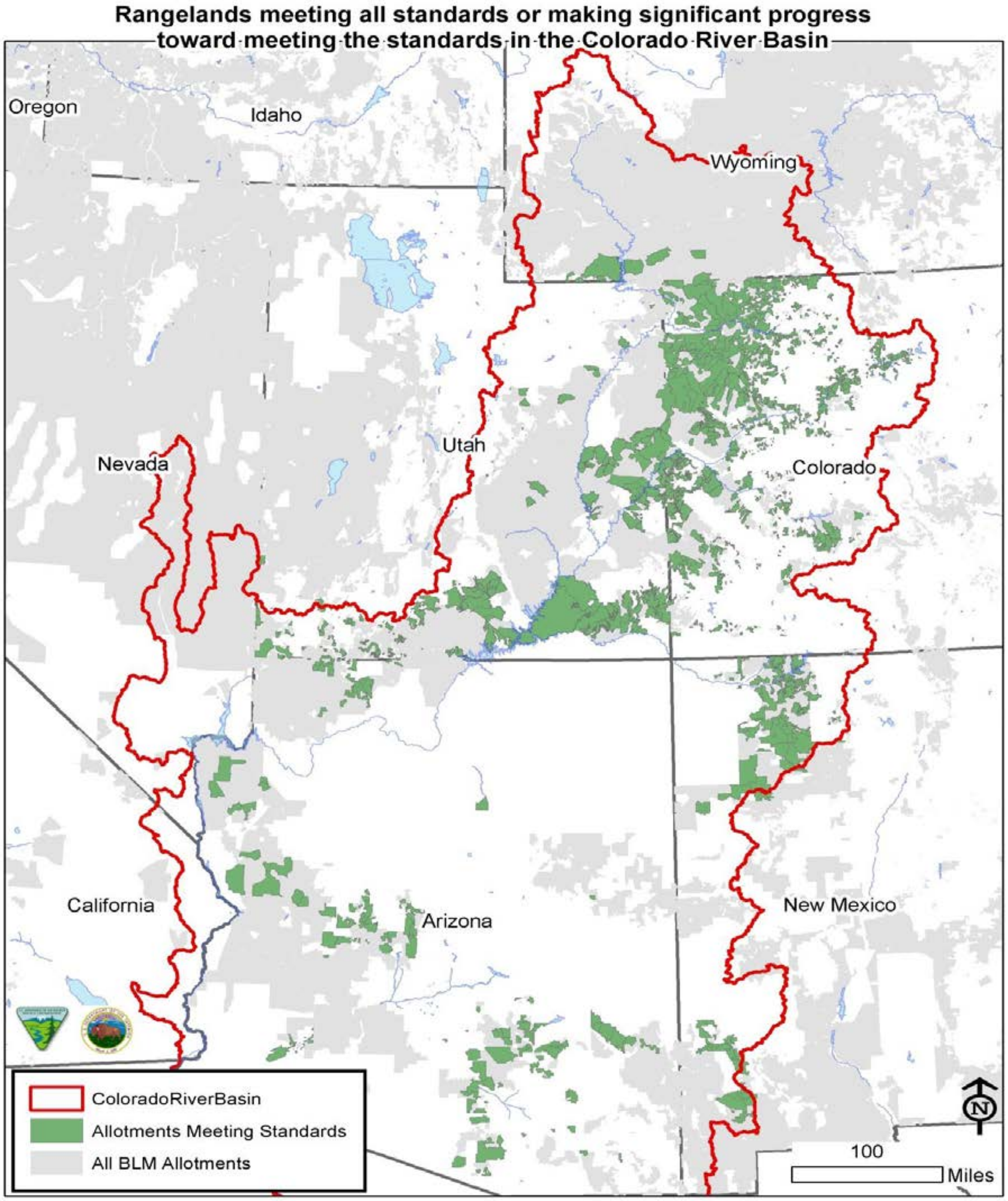

Figure 13 - Colorado River Basin Rangeland Status

*Standards for Rangeland Health are ecologically-based goals that conform to the Fundamentals of Rangeland Health found in 43 Code of Federal Regulations Subpart 4180. Fundamentals of Rangeland Health are fundamental requirements for achieving functional healthy public lands. The Fundamentals, and the Standards for Rangeland Health that conform to the Fundamentals, address the necessary physical components of functional watersheds, ecological processes required for healthy biotic communities, water quality standards, and habitat for threatened and endangered species or other species of special interest.**

Another fire in Utah (White Rock Fire) was approved for $1,636,000 in the BLM Program (FY2012): Emergency Stabilization and Rehabilitation. Its plan of actions over 3 years was to apply a seed mix aerially, then use chaining to cover the seed. All livestock were to be removed for two growing seasons so that the seeding could take effect. Based on site characterization of slope, topography, and ecology no additional measures were needed. The BLM was treating 3,542 acres that included 263 State acres and 212 private acres for a total of 4,017 acres for a total cost of $950,000.

While the monitoring data from the other programs continue to be updated and eventually reported, the total number of tons of salt retained by FY2015 Salinity sub activity accomplishments is 1,248. (Previous years accomplishments are being reviewed and recalculated.)

State Activities since last Progress Report

BLM State Offices submitted the following reports describing activities funded by the Salinity sub activity

Arizona

ASFO/Salinity Control Structures: Structures built to slow runoff, salinity, erosion to Colorado River are now degrading (50 year lifetime). Supports the Arizona Strategic Goal of Water for water quality. Project reports a minimum 312 tons of salt savings per year.

Mittry MSU Salinity Control: Riparian buffer established in 2014. Soils tested across 80 acres of land and Mittry Lake; soil data indicate decrease in salinity concentration. The buffer continues to be managed.

Colorado

Colorado River Salinity Summary of Monitoring Activities White River Field Office (2008-2015): The Colorado River Salinity funding (CRS Funds) for the White River have been used to augment existing USGS Streamflow monitoring sites, support USGS reports based on data collected, purchased equipment for BLM monitoring, and hire seasonal personal for field work. This funding resulted in an unprecedented amount of baseline data being collected and analyzed for the White River, Piceance Creek, and Yellow Creek drainages. The reports and data generated can be used to contributions of anthropogenic impacts to salinity in surface waters specifically, the salinity loads from the White River.

The BLM funded a data repository were completed to collect and assess existing water resource information (http://rmgsc.cr.usgs.gov/cwqdr/Piceance/). Data from the repository is being migrated to the Colorado Data Share Network (http://www.coloradowaterdata.org/). The aforementioned publication contributed invaluable data for WRFO’s Resource Management Plan Amendment and Final Environmental Impact Statement (PRMPA/FEIS) impact analysis in-terms of the effects of oil/gas activities contribution to salinity including understanding processes of surface runoff and soil erosion’s contribution to salinity loads in surface waters. The impact analysis also identified that freshwater use by oil and gas development within valid water rights may decrease surface flows in streams and increase the proportion of base flow from groundwater and thereby increase salinity concentrations in surface waters.

Accomplishments:

USGS Yellow Creek Streamflow Site:
1. Establishment of a new USGS streamflow site above Crooked Wash to bracket an area on the White River (White River Dome and Piceance and Yellow Creeks) known to be responsible for increasing salinity loads in the White River. Summary of all data available and funded by BLM is available at:
http://waterdata.usgs.gov/nwis/nwisman/?site_no=09306224&agency_cd=USGS.

2. Collection of additional water quality sampling in the White River, Piceance Creek and Yellow Creek. Water quality sampling and measurements were taken.

3. Six new streamflow measurement sites were established in the Mesa Verde Play Area and are maintained by the BLM to measure stream discharge, conductivity, air and water temperature and conduct water quality and macroinvertebrate sampling. Two precipitation measurement sites and one weather station were established and maintained by the BLM for this area.

4. Over 500 groundwater springs were inventoried over four seasons including the collection of field water quality parameters. Information from this inventory can be used to identify springs with high salinity and monitor future anthropogenic impacts.

Mancos Shale Oil and Gas Monitoring
The USGS in cooperation with the BLM will study the distribution, storage, and release of sediment, salinity, and selenium in area of Mancos Shale under two different land uses. The study will include 2 basins in Stinking Water Gulch near Rangely, CO, where one basin is dominated by oil and gas land use (Basin A) and the other basin is dominated by grazing/ranching land use (Basin B). The two basins are of similar size (~1.4 square miles) and similar slopes (~16 percent). This approach will provide insight into how different land uses effect the distribution, storage, and release of sediment, salinity, and selenium in surface-water systems.

Project Update:

2013 – Due to a shortage in funding at the district and field office level, the one-time funds were not applied to the project.

2014 – First year of funding applied to the project. Funds were used to conduct a field inventory with BLM and USGS staff in Rangley, CO. The USGS produced a statement of work. The statement of work includes 5 tasks and a peer reviewed publication. The USGS intends to seek additional funding in 2016 from the Salinity control forum to finish the project and produce the publication.

2015 – Existing remote sensing data will be used to evaluate the land use history of each basin and provide the timing and occurrence of changes in channel morphology (channel width, sinuosity, and drainage density).

Field work will be conducted in September to collecting cross section data. It will be used to understand differences in channel geometry to facilitate assessment of storage of sediment, salinity, selenium for each basin. Up to 20 cross-sections in each of the basins will be surveyed using GNSS-RTK survey techniques to determine the cross sectional profile of the channel.

Figure 14 – Basin A

Figure 15 – Basin B

Water Quality Data

The Colorado River Valley Field Office:
This funding was essential to have water quality laboratory work completed and partially support one AmeriCorps Volunteer (hired in partnership with the Middle Colorado Watershed Council (MCWC)), who have been successful at on-the-ground watershed assessment work and target accomplishments.

A draft sampling and analysis plan has been written to address data gaps and initial field reconnaissance during the summer of 2015 included water quality sampling, discharge measurements, riparian and rangeland conditions assessments, and documenting historic mining impacts. A GIS analysis has been initiated to identify possible sources of selenium and other impaired parameters, and formulate potential restoration efforts that may address load reduction goals.

Overview of the Middle Colorado Watershed Boundary showing the Water Quality Impaired or Monitoring & Evaluation listed stream segments. In FY2014, BLM funding supported a comprehensive analysis of existing water quality data (2000-2013) and major findings and recommendations were published. In FY2015, BLM funding supported field reconnaissance

and baseline watershed assessment work in the Rifle Creek sub-basin, water quality sampling and lab analysis, where data gaps had been identified.
Water chemistry (salinity, conductivity, pH, DO, and TDS) was measured in the field to support data gaps and help direct which locations in-depth lab analysis may be important for future monitoring.

New Mexico
San Juan River Basin Erosion Reduction

Project Update:
Focus is on noxious weed removal that threatens native riparian habitat, cutting trees, and indicating lack of understory plant growth leading to loss of top soils due to rain/snowmelt events that lead to surface products in the stream. Sediment fences are being built, Youth Conservation Corps are involved to restore native vegetation, and soil erosion and salinity should be reduced. Work is progressing.

La Manga Canyon Watershed Improvement

Degraded rangelands including sagebrush grasslands and Pinyon/Juniper woodlands are on steep hillsides. The trees have minimal understory and excessive soil erosion. Sediment retention dams are being built with an estimated salt savings of 13.5 tons of salt per year with life expectancy of 10-12 years.

Brush clearing as directed from WO
To support brush clearing in conjunction with fire relief and revegetation to retain sediment/minimize erosion (also results in salinity reduction). Salt and sediment savings data unknown as of September 15, 2015.

Utah
Onion Creek Road Stabilization

Project Update:
Onion Creek Road is a dirt road maintained in Grand County, Utah which travels along Onion Creek for over 8 miles. The road prism is often located adjacent to or within the active channel, and involves 27 low water stream crossings. Grand County Road Department maintains this road regularly, providing access to private land and BLM recreation opportunities.

Onion Creek is a tributary to the Colorado River, with a relatively short distance from the La Sal Mountains to the Colorado River (14 miles). This situation lends itself to large flood events on a regular basis and the road is washed out repeatedly. Historically the Grand County Road Department would rebuild washed out portions of the road using material from the stream channel. This has led to many sections of destabilized stream banks which are even more susceptible to flooding damage.

In 1999, Onion Creek was listed by the State of Utah on the List of Impaired Waters as not meeting state water quality standards for stream temperature and Total Dissolved Solids (TDS). In 2002, the Utah Division of Water Quality completed a Total Maximum Daily Load analysis (TMDL) with management recommendations to improve water quality conditions.

These recommendations include restricting vehicle traffic within the stream channel, establishing vegetation on streambanks through plantings, and any work that will help improve stream channel morphology and riparian conditions.

As a result of the TMDL report, a cooperative effort began between the BLM, Grand County Road Department and the Utah Division of Water Quality (UDWQ) in 2002. Several streambank stabilization structures were constructed which were successful at protecting the road from flood damage during most storms. These gabion baskets and large boulder barbs are useful techniques that may be installed at up to 12 more unstable locations on the Onion Creek Road.

Figure 16 – Large rock barbs in foreground, gabion baskets in background

In September, 2013, a series of extreme flood events damaged the road and streambanks in many places, including previously stabilized sites. Although the road was temporarily relocated around new channel locations and erosion obstacles, the road and stream channel are both in highly unstable condition. The damage from the large 2013 floods has not been repaired, leaving several long stretches of road within the active channel (almost a mile in total). There are at least 10 sites where the road is unstable and ready to fail during the next flood event, causing significant erosion and sedimentation.

The Moab Field Office is actively coordinating with the Grand County Road Department and UDWQ to evaluate all potential road relocation options, to identify high priority sites for road stabilization work and to identify which stabilization structural designs are appropriate at these locations. BLM salinity funding in FY2014 was contributed to a new assistance agreement with the Grand County Road Department to conduct an in-depth engineering feasibility study. The study has evaluated several different routes to avoid stream crossings, but those options are limited, extremely expensive, and have other resource concerns.

In FY2015, future stabilization work was necessary, as determined by the BLM and the Grand County Road Department, over the next year. Constructing one stabilization structure can cost up to $40,000 or more as all materials need to be hauled in from distant sources. Installing the simpler gabion structures can be an involved process as they need to be seated deep in the channel or sometimes bedrock. This funded work is expected to be completed in the fall of 2015. Additional stabilization work could continue over the next 5 years or more, as funding is available.

Ongoing Grazing Exclosure Project

Project update:
The Moab Field Office manages 315,000 acres of moderately saline soils, mainly derived from the Mancos Shale Formation. Grazing permits are authorized on these sensitive soils. In order to better understand the range of impacts from different grazing systems on saline soils, the BLM has been constructing grazing exclosures and conducting baseline data collection efforts as part of an extensive assessment of saline soils.

The Moab Field Office has an assistance agreement with the local Canyon Country Youth Corps (CCYC) to construct 3-to 5-acre grazing exclosures on moderately saline soils. Each year for the last 5 years, three or more exclosures have been constructed with the goal of at least one exclosure in each grazing allotment with more than 10 percent saline soils. The exclosures are located adjacent to long-term range study sites maintained as part of the grazing monitoring program. These sites are addressed in a National Environmental Policy Act (NEPA) document and undergo thorough archeological clearance before construction begins.

The Moab Field Office has established an Interagency Agreement (IGO) with the local USGS Biological Sciences Center and research ecologist and soil scientist Mike Duniway. Over the last several years, USGS staff has conducted intensive soil and vegetation studies both inside and outside of the exclosures to establish baseline conditions at this time. Detailed data collected includes: vegetation species composition, vegetation cover and density, soil crust cover and development stage, soil surface stability (slake tests), soil compaction, testing with impact penetrometer, detailed soil pedon data, canopy gap data, and chlorophyll A content in soil crusts. Soil pedon and composite soil surface samples from each trend plot will be archived for potential future analyses.

In FY2015, the USGS compiled, summarized, and analyzed data collected thus far by plot and across plots using an ecological site frame work. A summary report will be provided to BLM by Dec. 31, 2015. We are also collaborating on future analysis that incorporates finer temporal resolution and time frames through integration with remote sensing, analysis of historical trend data and photos, and other approaches as appropriate.

These studies will be repeated over time, every 3-5 years, to assess changes to soil and vegetation conditions. These data will help BLM manage these grazing allotments more efficiently to ensure good and stable watershed conditions and minimize salinity contributions to the Upper Colorado River Basin.

Figure 17 – Typical grazing exclosure in moderately saline soils

Ongoing Protection Fencing in Ten Mile ACEC

Project update:
The Ten Mile Wash Area of Critical Environmental Concern (ACEC) is located northwest of Moab and drains into the Green River. This 5,000-acre area contains perennial and intermittent stream flows that maintain ecological diversity in both upland and riparian zones. Ten Mile Wash is subject to extreme flooding, increasing potential safety hazards to vehicle and camping activities. The potential for floods is great because the Ten Mile Wash watershed basin drains 176,000 acres. The canyon bottoms are filled with moderately saline soils which are extremely mobile and are redistributed during flood events.

The Moab Field Office received funding in FY2015 for this project. This funding went to an assistance agreement with American Conservation Experience (ACE) to monitor 5,000 acres of Ten Mile ACEC which is constantly struggling with trespass cattle and illegal off-road travel. These actions are impacting the ecological values of the ACEC as well as the moderately saline soils throughout the canyon bottom.

Watershed Conditions are monitored and documented, while additional fencing needs and their construction are assessed. This is in a very remote area with little vehicle access, so all materials and tools need to be hand carried to each site.

Wyoming

High Desert District:

The following information is an estimate of the amount of salt retained on the landscape because of actions taken by the Rock Springs, Rawlins, Kemmerer, and Pinedale Field Offices in FY2015. The numbers presented are estimations for one potential outcome. As the actions taken are designed to prevent erosion and associated salinity increases they are estimates only. Soil surveys are presently being conducted but have not yet been completed. Exact areas and extent of existing disturbance are unknown.

Salinity sub activity funded two other projects to establish salinity baseline data prior to the development and installation of oil and gas pads in the Green River area and along specific Colorado Basin tributaries; however, the work completed is currently being reported under the State Reports, but will eventually be accounted for under the Basinwide Activity Section when the watershed tool is fully operational.

The two projects that the BLM Rawlins Office undertook for FY2015 included: the repair of a nonfunctioning reservoir and the stabilizing of a head cut. Exact measurements and salt savings for these projects are unknown. The amount of salt retained by a reservoir or a head cut structure is highly variable.

Nonpoint Sources

Nonpoint sources are addressed through regular maintenance of BLM roads and facilities as well as reclamation of well pads and other disturbances. During FY2015, this area has received unusually high amounts of precipitation. There have been increased levels of stream bank erosion. At the same time, broad scale vegetation cover has improved, which reduces nonpoint erosion and aids in grazing distribution.

The Wyoming Lands Conservation Initiative (WLCI) http://www.wlci.gov/ and Jonah Interagency Office (JIO) http://www.wy.blm.gov/jio-papo/index.htm provided funding for several projects http://www.wy.blm.gov/jio-papo/whatsgoingon.htm in the area that, while not focused directly on salt reductions, have the potential to reduce salt volumes by improving wildlife habitat and thus focus primarily on vegetation, which also benefits salinity. The volume and cost savings of these projects is currently unknown.

A variety of activities occurred as part of normal activities in FY 2015 that had the secondary impact of reducing nonpoint erosion on public lands. Because of the nature of these activities and nature of monitoring, exact volumes of salt saved and the efficiency of each activity are general estimates. All the tabulations below are for the Green River Basin southwestern corner of Wyoming that is covered the Rock Springs, Kemmerer, Pinedale, and portions of the Rawlins Field Offices.

The standard practices of road maintenance and grazing management help to reduce potential erosion. The costs and salt savings vary. These practices are key to broad scale erosion reduction and salt retention. The following assumptions were made for the calculations below: (a) an average work month costs $8,500; (b) soil averages estimated to be about 3 percent salt by weight for most soils in the area; (c) average bulk density of soil is 2.65 g/cc (165.4 lb/cu ft) (4,467 lb/cu yd).

1. Road Maintenance and Reclamation
(Approximately the same as 2006 - 2014). The road maintained was 350 miles long with approximately two work months used and two cubic yards of soil retained per mile of road maintained at a cost of $362 per ton of salt resulting in the retention of 47 tons of salt.

2. Reservoir Repair near Rawlins Field Office
The structure repair was required due to retaining sediment/salt. It required one week of work time and 100 cubic yards of soil at a cost of $317.14 per ton of salt resulting in 6.7 tons of salt retained.

3. Headcut
Structures mentioned in previous reports for this area are still operating and have not required any maintenance expenditures. Given that they are still preventing the upstream advancement of channel drops (head cuts), these structures could be considered to be highly cost efficient in preventing salinity contributions. The BLM is cooperating with the Wyoming Game and fish in the installation of a fish passage structure on private land in Trout Creek on Little Mountain, a tributary to Sage Creek, which contributes directly to Flaming Gorge. This structure will slow the upward progression of an existing head cut. This activity was designed as a fish passage and irrigation structure, not as an erosion reduction project. Given the unknown volume and content of the soil and rate of erosion, no calculations of soil salt content and volumes that will be retained by the structure were made.

The Rawlins Field office undertook one head cut repair. It required two work months and 1000 cubic yards of soil at a cost of $235 per ton of salt resulting in the retention of 67 tons of salt.

4. Grazing Management
(Same as 2006-2014). The area managed includes 28,000 acres of land and used 20 work months for grazing management. Based on livestock and the weather variables, the numbers provided can fluctuate. At a cost of $808 per ton of salt, the result was 208 tons of salt retained.

USDA – Natural Resources Conservation Service (NRCS)

The NRCS of the USDA conducts Colorado River Basin salinity control activities primarily under the authorities of the Environmental Quality Incentives Program (EQIP). EQIP was authorized with funding from the passage of PL104-127, Federal Agricultural Improvement Act of 1996, a.k.a. “1996 Farm Bill.”

EQIP has been reauthorized in each “farm bill” through 2018. Through EQIP, NRCS offers voluntary technical and financial assistance to agricultural producers, including Native American tribes, to reduce salt mobilization and transport to the Colorado River and its tributaries. Within the 12 approved salinity project areas, producers may be offered additional financial incentives to implement salinity control measures with the primary goal of reducing offsite and downstream damages and to replace wildlife habitat impacted as a result of the salinity measures.

In FY 2015 $12 million was obligated into new land treatment contracts with agricultural producers in project areas in Colorado, Utah, and Wyoming. These new contracts, when fully implemented will provide more than 10,000 tons of annual salt control.

New Salinity Projects and Investigations

Henrys Fork (of the Green River), Wyoming

The Henrys Fork Salinity Control Project was adopted by NRCS in May 2013. This project area encompasses 69,929 acres in Sweetwater and Uinta Counties, Wyoming, and Daggett and Summit Counties, Utah. The entire Henrys Fork watershed is about 306,000 acres and is a tributary to the Green River which is a major tributary to the Colorado River.

Of the 20,709 irrigated acres within the project area, NRCS expects to improve on-farm irrigation application systems and reduce deep percolation and salt loading from about 14,000 acres, resulting in a salt load reduction of 6,540 tons annually. The first contract was developed on 141 acres in 2015.

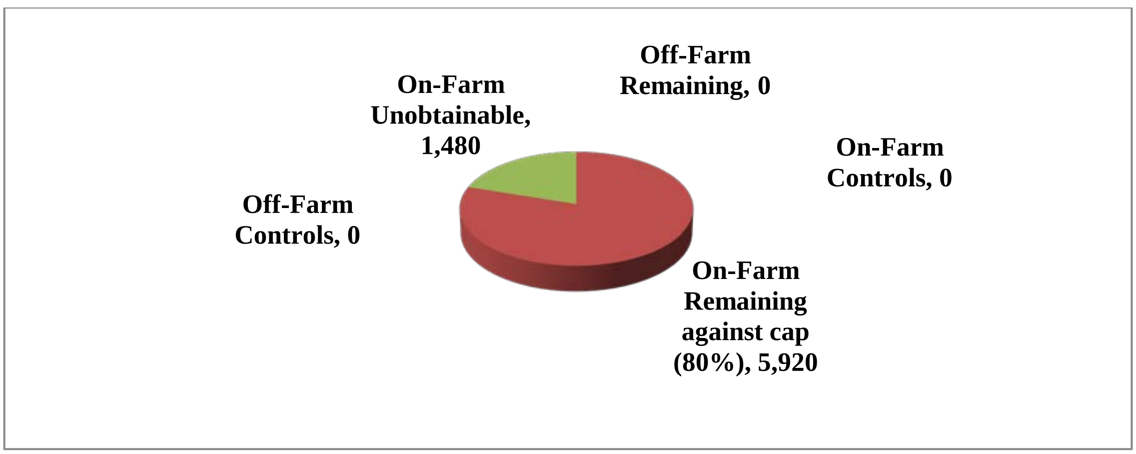

Figure 18 – Henrys Fork Salinity

West Black's Fork, Wyoming

An area of some 28,000 acres of irrigated pasture and hayland near Lyman, Wyoming, contribute salt to the Blacks Fork River, tributary to the Green River. While a large portion of the geology contributes little salt, about 10,000 acres may contribute significant amounts of salt from canal and ditch seepage and deep percolation from water applied to fields.

The Wyoming Water Development Commission provided a significant grant to the Austin-Wall Canal Company resulting in a comprehensive plan to modernize the irrigated areas within their service area. NRCS anticipates that, in the near future, the Company will begin replacing earthen canals with buried pipelines that will provide pressure to operate sprinklers on the irrigated lands. NRCS intends to use its regular EQIP authority to assist producers in the area who want to modernize their irrigation systems. Such improved systems will provide significant salt control benefits.

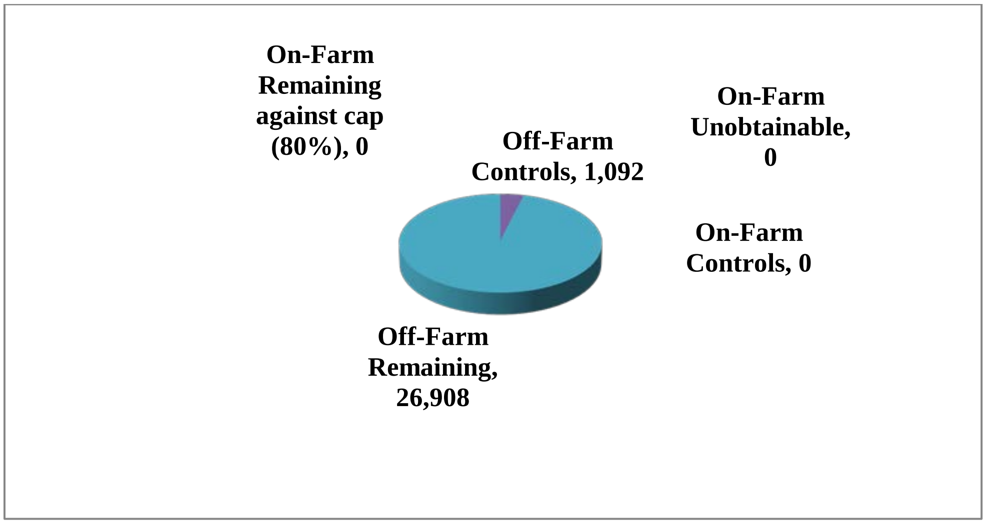

Figure 19 – West Black's Fork Salinity

San Juan Basin, New Mexico and Arizona

The first phase of the "Shiprock Pilot Project" to control salt was completed by the San Juan River Dineh Water Users, Inc. (SJRDWU, Inc.) in 2011. A leaky earthen lateral supplied water to 12 Navajo Nation farmers on 168 acres of cropland. The SJRDWU, Inc. completed the construction using their own resources and a grant from Reclamation. The SJRDWU, Inc. also reserved an eight acre parcel of land and has completed practices to replace wildlife habitat values that were lost due to the pipeline installation.

NRCS anticipates that the SJRDWU, Inc. will begin construction of a significant project with assistance from Reclamation in 2016. This project should enable NRCS to proceed with developing EQIP salinity projects with individual native farmers.

Areas Beyond Current Project Boundaries

NRCS has undertaken to identify salt loading and salinity control from irrigated crop, pasture and haylands scattered widely throughout the Upper Colorado River Basin but outside of the existing project areas. With the assistance of the USGS and Reclamation, NRCS has been able to make use of the SPARROW model to assess salt loads outside of the existing salinity project areas. While the assessment is ongoing and will require considerable refinement, preliminary analysis indicates that as much as 50,000 tons of salt control has occurred in Utah and Colorado outside the project areas.

In 2015, Colorado developed EQIP contracts with water quality benefits including salt control outside of the approved project areas but within the Colorado River Basin. Colorado, obligated slightly more than $1/2 million into 14 contracts on 500 acres in in Montrose, LaPlata, Garfield, and Eagle Counties. When fully implemented, these contracts will control about 800 tons of salt annually.

Monitoring and Evaluation

Project offices continue to monitor and evaluate the effectiveness and quantity of salinity control, wildlife habitat, and economic performance replacement in order to improve the overall performance and management of the program. Generally, the program continues to function effectively and economically, though the overall cost per ton of salt control continues to rise in some areas however, when adjusted for inflation the current cost effectiveness compares favorably with the projected costs at the time of the adoption of the respective projects. It is also noted that additional efforts are needed to identify and implement valuable, low-maintenance, sustainable wildlife habitat replacement. The individual Monitoring and Evaluation reports for FY 2014 for each project can be found on the world-wide-web at; http://www.usbr.gov/uc/progact/salinity/index.html

Active Salinity Control Projects

NRCS is providing technical and financial assistance to landowners and operators to implement on-farm salinity control measures in eleven approved project areas in three Upper Basin states.

Table 6 – Active Salinity Control Projects

		Project Area	
State	Project	(Potential Irrigated Acres)	NRCS Servicing Office
Colorado	Grand Valley	50,000	Grand Junction
	Lower Gunnison River	171,000	Delta and Montrose
	McElmo Creek	29,000	Cortez
	Mancos Valley	11,700	Cortez
	Silt	7,400	Glenwood Springs
Utah	Uinta Basin	226,000	Roosevelt, Vernal
	Price/San Rafael Rivers	66,000	Price, Castle Dale
	Muddy Creek	6,000	Castle Dale
	Manila-Washam	8,000	Vernal
	Green River	2,600	Price
Wyoming	Big Sandy River	18,000	Rock Springs
	Henrys Fork	20,700	Lyman
	Total	**616,4700**	

Grand Valley, Colorado

Implementation has been underway in this unit since 1979 and NRCS considers that the salt control measures of the project have been successfully completed as planned. In 2010, a status report was compiled from field visits and observations. The report indicated that at least 12,000 irrigated acres are no longer in agricultural production. Of the remaining 44,700 acres still in production, 42,435 acres or 95 percent had received varying levels of treatment.

As of October, 2015 the salt reduction goal of 132,000 tons had been exceeded and more than 143,000 tons had been reported as controlled. In 2015, 10 new contracts were enacted on 175 acres that will deliver an additional 269 tons of salt control.

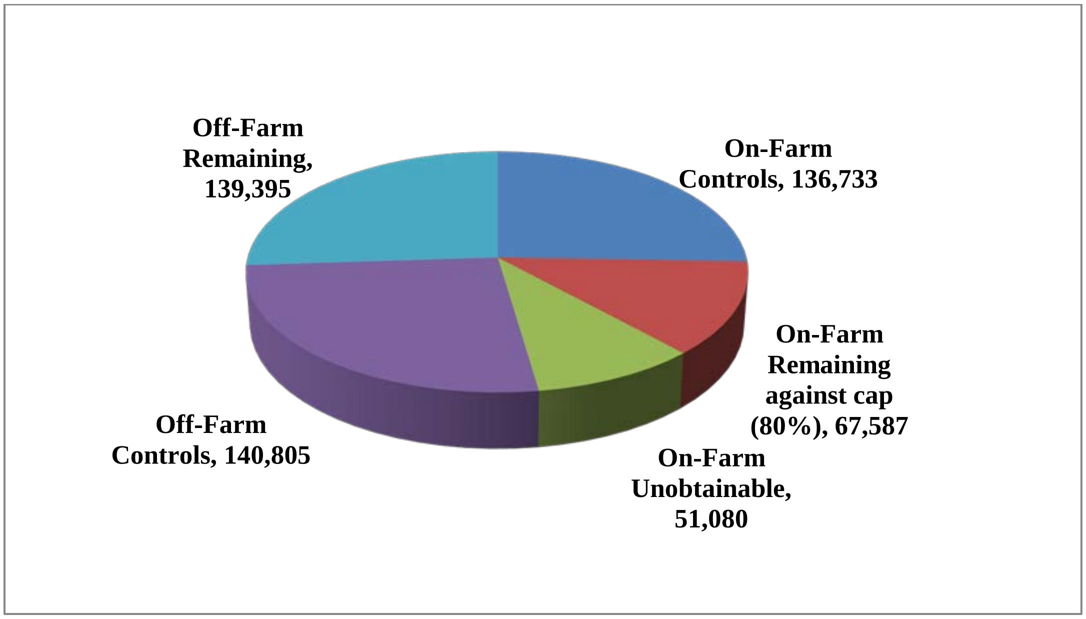

Figure 20 – Grand Valley Salinity

Lower Gunnison Basin, Colorado

This project encompasses the irrigated farmland in the Gunnison and Uncompahgre River valleys. With the expansion into the upper headwaters of the Uncompahgre River in 2010, implementation is now proceeding in Delta, Montrose, and Ouray Counties. Implementation was initiated in 1988 in this unit. About 64 percent of the salt control goal has been achieved.

Interest remains high in the project area. Forty four new contracts for about $3.9 M were developed in 2015 on 1,878 acres for planned salt control of 2,312 tons.

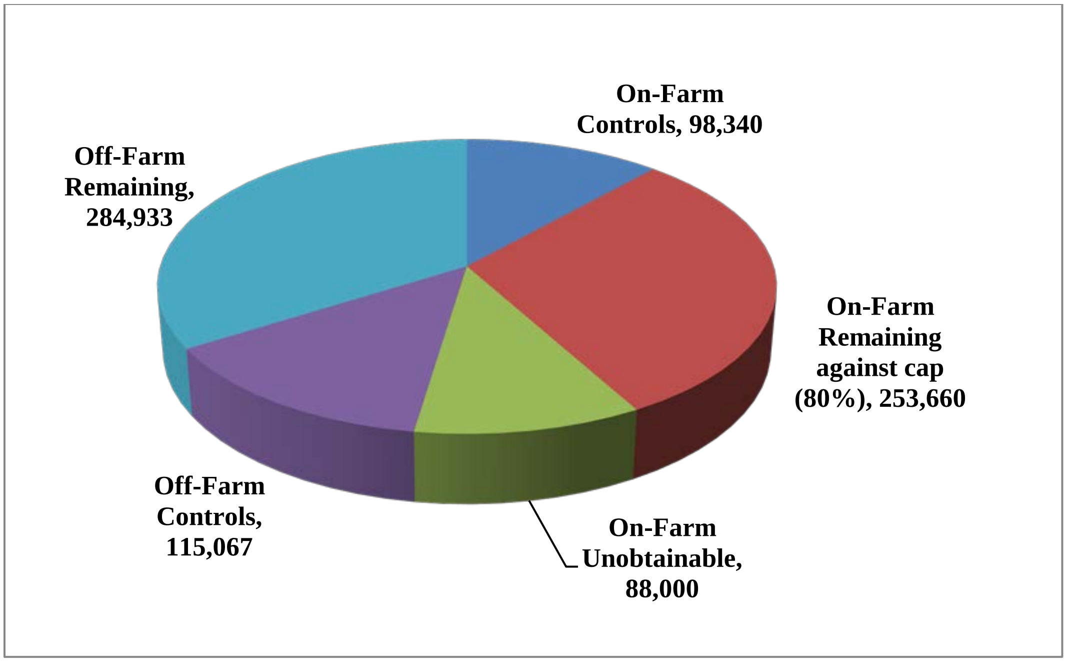

Figure 21– Lower Gunnison Basin Salinity

Mancos River, Colorado

This project, near the town of Mancos, Colorado, was initiated and approved for funding and implementation by NRCS in April 2004. Currently, about 108 contracts have been developed with EQIP and BSP funds. Five new contracts for $314,503 were developed on 59 acres in 2015. Planned salt control from these new contracts is 118 tons annually.

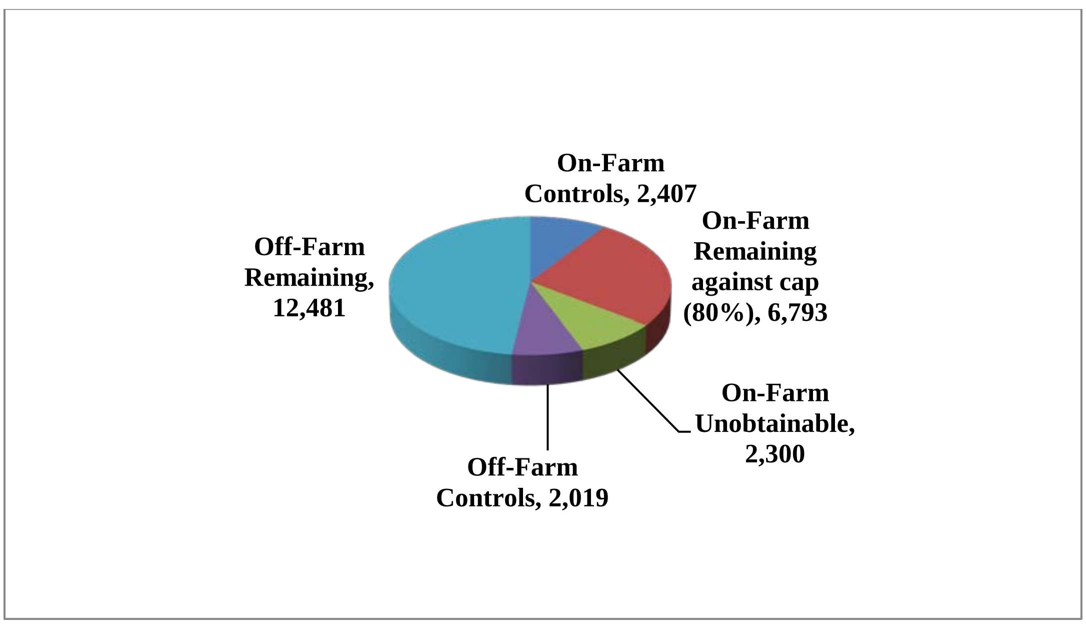

Figure 22 – Mancos River Salinity

McElmo Creek, Colorado

Implementation was initiated in this unit in 1990. Application of salinity reduction and wildlife habitat replacement practices continue to be implemented in this area with sprinkler systems, underground pipelines, and gated pipe being installed. In 2015, 32 new contracts were developed on 732 acres that will provide 952 tons of salt control when fully implemented. The project has attained slightly over 64 percent of its salt control goal.

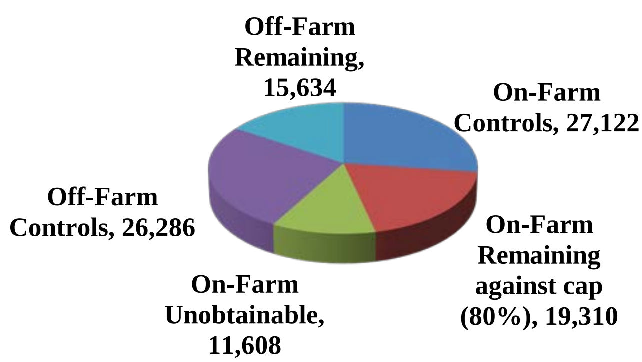

Figure 23 – McElmo Creek Salinity

Silt, Colorado

The first applications were funded in 2006. Currently, there are 50 active contracts on 951 acres in the project. When fully implemented, these contracts will control about 1,500 tons of salt annually.

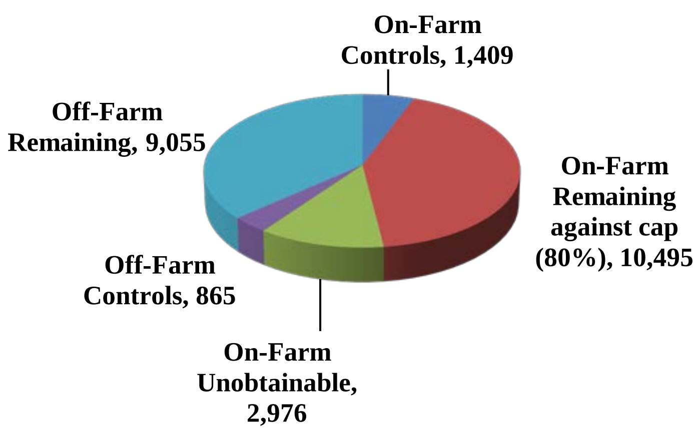

Figure 24 – Silt Salinity

Uinta Basin, Utah

Implementation began in this unit in 1980. The original salt control goal was reached several years ago but about 60,000 acres might still be improved. A predominant portion of the unimproved acres are within the jurisdiction of the Ute Indian Tribe. Opportunities for new contracts are diminishing as the project "matures." Sixteen new contracts were developed in 2015 on 560 acres for about $1.4 M. When fully implemented, these contracts will control 873 tons of salt annually. All irrigation improvements were either sprinklers, buried pipelines or a combination of the two.

A significant number of systems have reached or are nearing the end of their useful life. While these systems are a lower priority than first-time improvements, NRCS has begun providing incentives for replacement or up-grading.

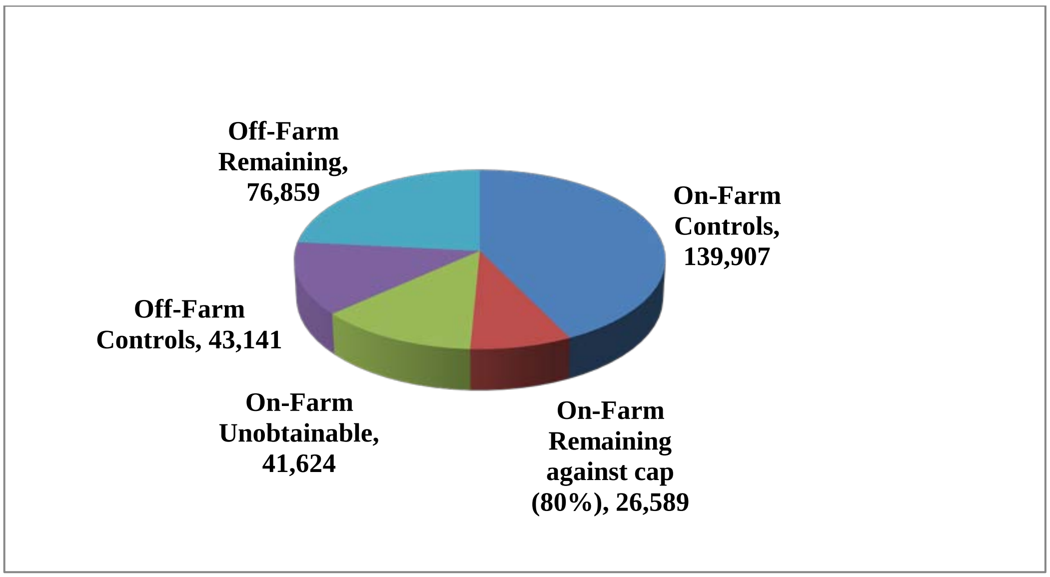

Figure 25 – Uinta Basin Salinity

Price-San Rafael, Utah

This project is approaching 70 percent achievement of its salt control goal. In 2015, 26 new contracts obligated about $2.2 M on 1,151 irrigated acres. When implemented, these measures will control about 4,400 tons of salt annually.

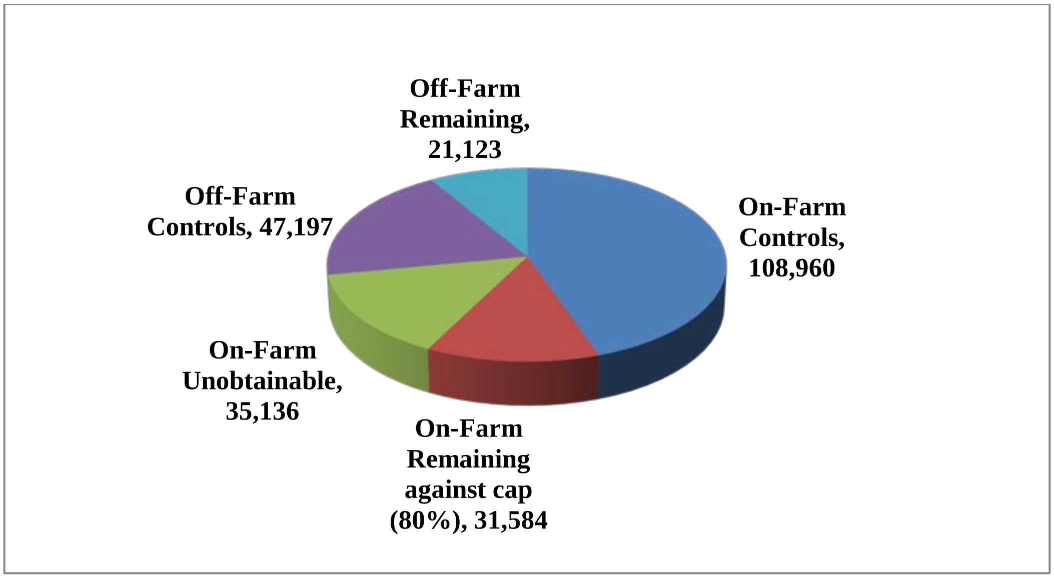

Figure 26 – Price San Rafael Salinity

Muddy Creek, Utah

There was one new contract developed in the Muddy Creek area in 2015, bringing the total to three contracts on 251 acres to control 358 tons of salt. On-farm progress in the project area awaits improvement and piping of the century-old earthen canal.

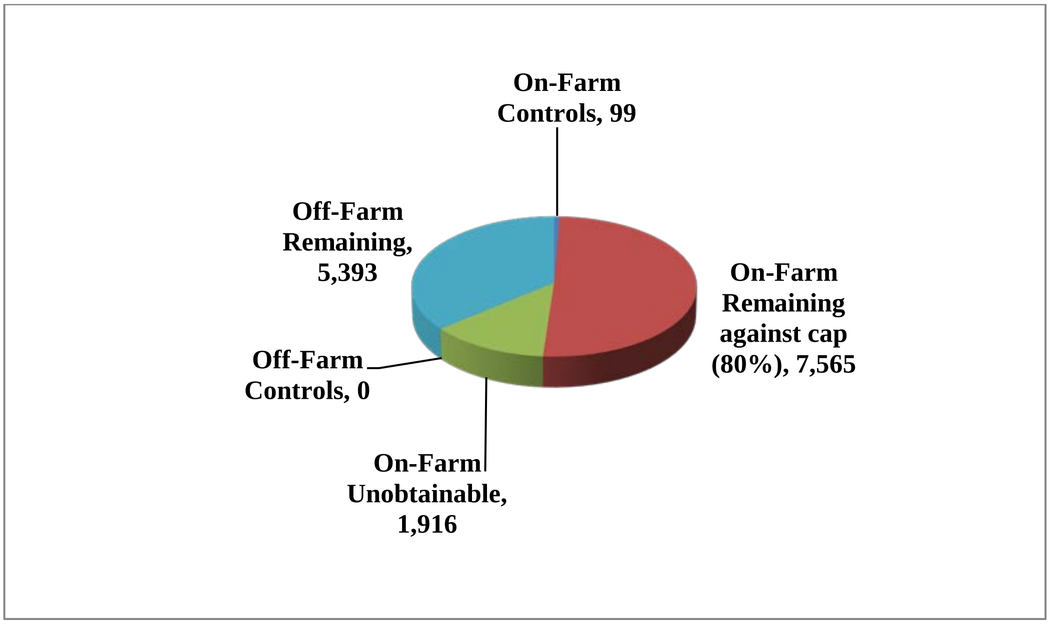

Figure 27 – Muddy Creek Salinity

Green River, Utah

One EQIP contract was developed in the project area in 2012 that will control 1,310 tons when fully implemented. Interest remains high but off-farm infrastructure improvements are needed to allow on-farm systems to operate properly and efficiently. Irrigation continues to expand, particularly on the plateau to the east of the Green River but, as all of the new irrigation systems are high-efficiency sprinklers, NRCS does not anticipate a significant increase in salt loading to the river. These expansions are not eligible for EQIP assistance.

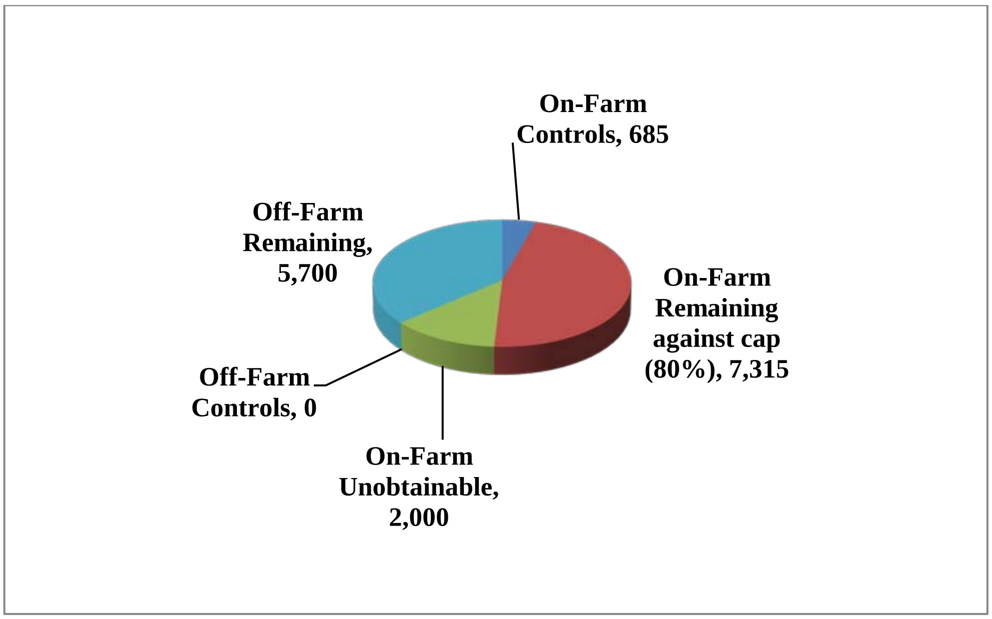

Figure 28 – Green River Salinity

Manila-Washam, Utah/Wyoming

Astride the Utah-Wyoming border, and adjacent to the shores of Flaming Gorge Reservoir, the Manila-Washam Project has achieved about 54% of its salt control goal. There are currently 51 contracts on 3,800 acres in various stages of implementation. All new irrigation systems have been some form of sprinkler system, such as side roll, pods, or center pivots. NRCS is also seeking opportunities for wildlife habitat replacement as the project is currently deficit.

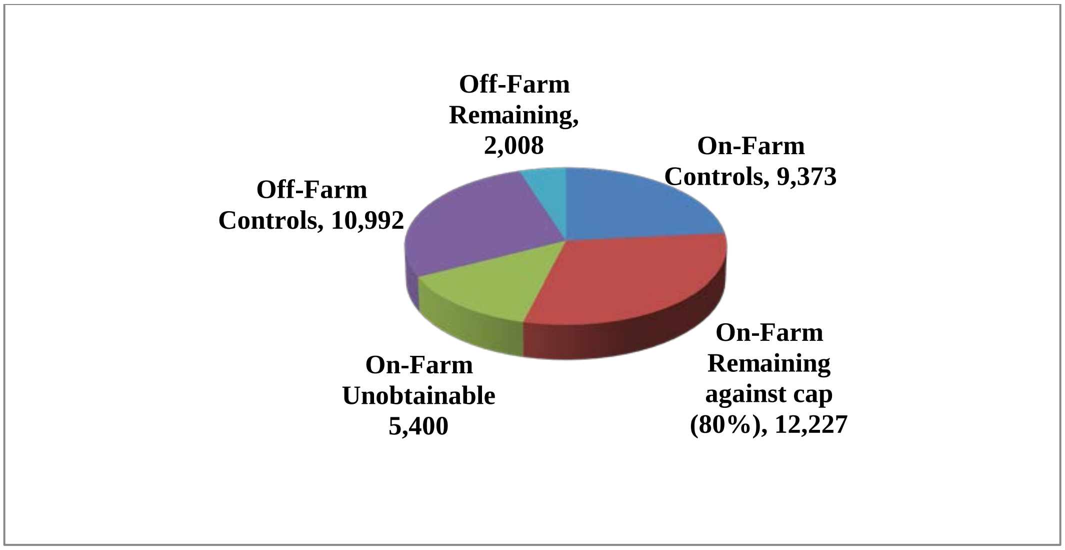

Figure 29 – Manila Washam Salinity

Big Sandy River, Wyoming

Implementation has been underway in this unit since 1988. Approximately 13,500 acres of the planned 15,700 acres have been treated (86 percent) and about 70 percent of the salt control goal has been reached. Producers also report that the water savings from improvements in irrigation systems now allows a full irrigation season of water for the entire irrigation district. In 2015, two new contracts were developed on 29 acres.

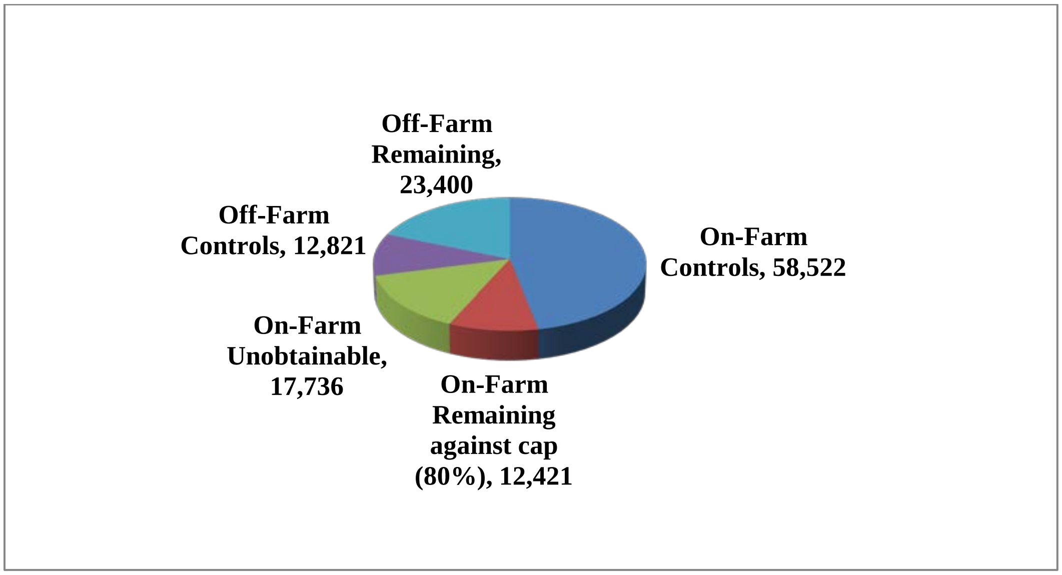

Figure 30 – Big Sandy Salinity

Table 7 - NRCS Salinity Control Unit Summary 2015

Unit	[1]Controls (tons)	Potential (tons)	Percent of Goal	Costs (FA+TA)	[2]Indexed cost/ton	[3]Cost/ton FY2015
Mancos River, CO	4,426	11,940	37%	$7,037,014	$66	$192
Muddy Creek, UT	99	11,677	1%	$187,475	$75	$n/a
Manila-Washam, UT	10,417	17,430	60%	$8,463,894	$53	$52
Silt, CO	2,274	3,990	57%	$4,466,241	$92	$232
McElmo Creek, CO	29,455	46,000	64%	$26,141,274	$98	$134
Uinta Basin, UT	157,217	140,500	112%	$122,634,864	$133	$186
L. Gunnison, CO	119,057	186,000	64%	$86,080,081	$86	$164
Price/San Rafael, UT	80,114	146,900	55%	$56,605,330	$36	$44
Grand Valley, CO[3]	143,495	132,000	109%	$59,701,529	$39	$150
Big Sandy, WY	58,180	83,700	70%	$13,844,400	$39	$23
Green River, UT	685	6,540	10%	$430,964	$103	$32
Henry's Fork, UT	0	6,540	0%	0		
Totals	**605,419**	**793,217**	**76%**	**$385,593,066**		

[1]Includes Off-farm funded with EQIP or BSP funds, not selected thru Reclamation FOA
[2]Cost per ton based as projected in NEPA document indexed by Bureau of Labor Statistics Consumer Price Index
[3]Nominal cost of current year practice installation

Bureau of Reclamation

Basinwide Salinity Control Program (Basinwide Program)

One of the greatest advantages of the Salinity Control Program comes from the integration of Reclamation's program with NRCS's program. Water conservation within irrigation projects on saline soils is the single most effective salinity control measure found in the past 30 years of investigations. By integrating NRCS's on-farm irrigation improvements with Reclamation's off-farm improvements, significantly higher efficiencies can be obtained. If landscape permits, pressure from piped delivery systems (laterals) may be used to drive sprinkler irrigation systems at efficiency rates far better than those normally obtained by flood systems. Reclamation now has much greater flexibility (in both timing and funding) to work with NRCS to develop these types of projects.

Another significant advantage of the Basinwide Program is that projects are "owned" by the proponent, not Reclamation. The proponent is responsible to perform on its proposal. Costs paid by Reclamation are controlled and limited by an agreement.

Funding Opportunity Announcement (FOA)

Applications to reduce salinity contributions to the Colorado River were solicited through a FOA for both the Basinwide Program and BSP. The FOA was released on April 27, 2015, and closed on July 17, 2015. Reclamation's Grants Officer received the applications and reviewed for responsiveness to the requirements as described in the FOA. The 28 acceptable applications were forwarded onto an Application Review Committee (ARC) for a detailed review.

The ARC was composed of Reclamation personnel, a member from the NRCS, and three advisors from the Colorado River Basin States. Reclamation convened a meeting of the ARC on August 3-5, 2015. The 28 applications totaling over $75 million came from all four Upper Basin States.

After reviewing and ranking the applications, the ARC recommended to the Grants Officer the awarding of about 15 projects totaling about $43.5 million. Ten projects totaling about $36 million and controlling over 31,000 tons of salt will be awarded cooperative agreements through Reclamation's Basinwide Program. Five projects totaling about $7.5 million and controlling over 5,600 tons of salt will be awarded agreements through the BSP. Reclamation executed most of the agreements in fiscal year 2016. The average cost effectiveness of the selected Basinwide Program projects is $48.72 and the average cost effectiveness of the selected BSP projects is $54.65

All salinity projects are required to replace incidental wildlife habitat losses concurrent with construction of salinity features and maintain this habitat for the life of the project.

Price – San Rafael River Basins, Utah

Huntington Cleveland Irrigation Company (HCIC) Project: The Project is located in northern Emery County, Utah, around the towns of Huntington, Lawrence, Cleveland, and Elmo. Approximately 350 miles of open earthen canals and laterals are being replaced with a pressurized pipeline distribution system (Distribution System) to accommodate sprinkler irrigation on about 16,000 acres. The Project, scheduled to be completed in 2016, will result in the annual reduction of 59,000 reportable tons of salt in the Colorado River at an anticipated cost of approximately less than $100/ton. Of the 59,000 tons of salt, 13,000 are attributed to the Off-Farm Distribution System and 46,000 tons are attributed to the On-Farm Distribution System and the on-farm salinity control measures (sprinklers).

Cottonwood Creek Irrigation Improvement Project: The $6,509,548 Cottonwood Creek Irrigation Improvement Project is located in Emery County, west of Castledale, Utah Construction began in May 2011, and the project was operational for the 2013 irrigation season. This project replaced approximately 31 miles of earthen canals and laterals with a pressurized pipeline system resulting in a reduction of 2,094 reportable tons of salt in the Colorado River. It is expected that the pressurized pipeline will induce on-farm improvements resulting in the annual reduction of an additional 9,100 reportable tons of salt. It is anticipated that the project will result in the total annual reduction of 11,194 reportable tons of salt in the Colorado River at an anticipated cost of approximately $59 per ton of salt. Construction is complete and the canals will be taken out of service in the fall of 2015 when all of the farms will be converted to sprinkler irrigation.

Blue Cut/Mammoth Unit, Cottonwood Creek Consolidated Irrigation Company Salinity Project: The $5,500,000 Blue Cut/Mammoth Unit, Cottonwood Creek Irrigation Company Irrigation Project was selected from the applications received in the 2012 FOA. A cooperative agreement was executed in August 2013. The Blue Cut phase has completed construction with on-farm improvements ongoing. The Mammoth phase of this project has begun and construction began in December of 2014. This project will replace approximately 45.6 miles of earthen canals and laterals with a pressurized pipeline system resulting in the reduction of 3,789 reportable tons per year of salt in the Colorado River at an anticipated cost of approximately $67.57 per ton of salt. The pressurized pipeline will serve 5,680 acres resulting in additional on farm salt savings.

Manila-Washam Salinity Area, Utah

South Valley Lateral Salinity Project: This project is located in Daggett County south of the town of Manila, Utah. It was selected from the applications received in the 2012 FOA and was submitted by the Sheep Creek Irrigation Company. A cooperative agreement was executed in May of 2013, for the amount of $4,026,264.75. This project will replace approximately 27,400 feet of earthen laterals with irrigation pipe resulting in the annual reduction of 3,373 reportable tons of salt in the Colorado River at an anticipated cost of approximately $55.57 per ton of salt. The project began in the fall of 2014. Project completion is scheduled for spring of 2016.

West Blacks Fork Salinity Area, Wyoming

Austin/Wall Off-Farm Irrigation Project: This project is located in Uintah County in the vicinity of Lyman, Wyoming. It was selected from the applications received in the 2012 FOA and was submitted by the Austin/Wall Irrigation District. A cooperative agreement was executed in May 2013, for the amount of $1,350,000. This project will replace approximately 32,000 feet of earthen canal and laterals with irrigation pipe resulting in the annual reduction of 1,092 reportable tons of salt in the Colorado River at an anticipated cost of approximately $57.55 per ton of salt. The project is scheduled to begin construction in the fall of 2015, and be completed in the spring of 2016.

Big Sandy Project, Sweetwater County, Wyoming

Eden Valley, Farson/Eden Pipeline Project: This project was selected in the 2008 FOA. A Cooperative Agreement was executed in February of 2009, for the amount of $6,453,072. This project will replace approximately 24 miles of earthen laterals with irrigation pipe resulting in the annual reduction of 6,594 reportable tons of salt in the Colorado River at an anticipated cost of approximately $52.57 per ton of salt. Laterals E-7, E-8, and E-13 are completed, and work on the West Side Canal was completed and operational in the spring of 2014. Some habitat work is still pending.

Gunnison Basin, Colorado

Uncompahgre Valley Water Users Association (UVWUA) Phase 5 Project: As a result of the 2010 FOA, the UVWUA was awarded a $4.3 million cooperative agreement for Phase 5 of the East Side Lateral (ESL). This phase involves an additional 19 miles of laterals under the Selig and East Canal systems and the reduction of about 5,034 tons of salt loading annually. Construction began in November 2011 and was completed in 2015.

UVWUA Phase 7 Project: As a result of the 2010 FOA, the UVWUA was awarded a $3.2 million cooperative agreement for Phase 7 of the ESL. This phase involves an additional 12.7 miles of laterals under the Selig and East Canal systems and the reduction of about 3,029 tons of salt loading annually. The cost is estimated at $52.11 per ton of salt. Construction began in the fall of 2012 and will continue through 2016.

UVWUA Phase 8 - East Side Laterals (ESL) Project: As a result of the 2012 FOA, the UVWUA was selected to be awarded a $3.5 million cooperative agreement for Phase 8 of the ESL. This phase involves an additional 14.1 miles of laterals under the South Canal, East Canal and the Loutzenhizer systems and the reduction of about 3,307 tons of salt loading annually. The cooperative agreement was executed in FY 2014, with construction beginning in the summer of 2015, and continuing through 2016.

Lower Stewart Pipeline Project: Awarded from the 2010 FOA, this project involves piping a portion of the Stewart Ditch & Reservoir Company (SDRC) existing unlined canals in a tributary to the North Fork of the Gunnison River near Paonia, Colorado. In September 2011, Reclamation entered into an agreement to provide up to $6.0 million to pipe 11.5 miles of existing canals with an expected salt load reduction of about 5,892 tons/year. Construction began in the fall of 2012, and was completed during the winter of 2014/2015.

Minnesota Canal Salinity Control Piping Project Phase II: Awarded from the 2012 FOA, this project involves piping the Minnesota Extension portion of the Minnesota Canal & Reservoir Company (MCRC) existing unlined canals in a tributary to the North Fork of the Gunnison River near Paonia, Colorado. In June of 2013, Reclamation entered into an agreement to provide up to $3.03 million to pipe 3.8 miles of existing canals with an expected salt load reduction of about 2,328 tons/year. Construction began in the fall of 2014 with an anticipated completion in the fall of 2015.

Clipper Irrigation Salinity Control – Project 4: Awarded from the 2010 FOA, this project involves piping a portion of the Crawford Clipper Ditch existing unlined canals in a tributary to the Cottonwood Creek drainage of the Gunnison River near Hotchkiss, Colorado. In September 2012, Reclamation entered into an agreement to provide up to $1.21 million to pipe 3.5 miles of existing canals with an expected salt load reduction of about 1,427 tons/years. Construction began in 2014 and is anticipated to be completed in the fall of 2015.

Slack/Patterson Laterals Piping Project: Awarded from the 2012 FOA, this project involves piping of the Slack and Patterson Laterals portion of the Roger’s Mesa Water Distribution Association’s existing, unlined laterals supplied by Fire Mountain Canal and Leroux Creek, a tributary to the North Fork of the Gunnison River near Hotchkiss, Colorado. In June 2013, Reclamation entered into an agreement to provide up to $3.39 million to pipe 9.1 miles of existing laterals with an expected salt load reduction of about

3,345 tons/year. Construction will begin in the fall of 2014 with an anticipated completion in the fall of 2015.

Cattleman's Harts, Hart/McLaughlin, Rockwell, Poulsen Ditch's: Awarded from the 2012 FOA, this project involves piping a portion of the Cattleman's earthen laterals, operated by the Cedar Canyon Iron Springs Irrigation Company and supplied by Crystal Creek, a tributary to the Gunnison River near Crawford, Colorado. In July 2013, Reclamation entered into an agreement to provide up to $2.01 million to pipe 6.3 miles of existing laterals with an expected salt load reduction of about 1,855 tons/year. Construction will begin in the fall of 2014 with an anticipated completion in 2016.

In order to complete the Lower Gunnison Basin mapping project, Reclamation submitted a funding modification in 2013 to the existing, financial assistance agreement with the Colorado State Soil Conservation Board. This additional funding is being used to complete the remaining, off-farm ditch mapping in the Colona and Ridgway areas. In cooperation with irrigation entities, quality assurance checks are also being performed on previously mapped and newly mapped systems in the Lower Gunnison Basin. Quality assurance has been completed and the remaining mapping is anticipated to be completed in the winter of 2015/16.

Grand Valley, Colorado

Grand Valley Irrigation Company (GVIC) Canal Improvement Grant 2010: As a result of selection under the 2010 FOA, the GVIC was awarded a $2.8 million cooperative agreement to line about 1.9 miles of their main canal and pipe about 4,100 ft of ditch within the Grand Valley. A salt loading reduction of approximately 1,749 tons annually is expected. The canal lining will consist of a PVC membrane with a shotcrete cover and the pipe will be concrete. Construction began in December 2011, and will continue through 2015.

Grand Valley Irrigation Company (GVIC) Canal Improvement Grant 2012: As a result of selection under the 2012 FOA, the GVIC was awarded a $4.9 million cooperative agreement to line about 2.4 miles of their main canal within the Grand Valley. A salt loading reduction of approximately 4,001 tons annually is expected. The canal lining will consist of a PVC membrane with a shotcrete cover. The cooperative agreement was executed in FY 2014 and construction will begin in December 2014, and will continue through 2017.

Basin State Program (BSP)

Reclamation has determined that state agricultural (ag) agencies within the upper Basin states to be appropriate partners and has executed cooperative agreements to utilize the services of these state ag agencies to assist in seeking and funding cost-effective activities and projects to reduce salinity in the Colorado River system by improving water management and increasing irrigation efficiencies. Interagency agreements have been executed with the NRCS in the states of Colorado, Utah, and Wyoming to provide the technical assistance for the BSP.

Colorado State Conservation Board (CSCB)

In Colorado, the BSP is delivered through six local Conservation Districts that operate within the boundaries of the approved salinity control areas in the state. These salinity control areas include the Silt Mesa, Grand Valley, Lower Gunnison, McElmo Creek, and Mancos River salinity areas. The Bookcliff, Mesa, Delta, Shavano, Dolores, and Mancos Conservation Districts receive funds from the CSCB that in turn receives Financial Assistance (FA) funding based upon a contract agreement with Reclamation.

The projects are planned, designed and certified by NRCS or District employees. Thirteen District employees are paid from BSP Technical Assistance (TA) funding earned by NRCS in Colorado and provided to the CSCB and Conservation Districts.

All projects are planned, designed and certified based upon current NRCS Standards and Specifications. Each participant signs and Operation and Maintenance (O&M) agreement to remain in effect for the life of the irrigation and wildlife improvements installed (usually 25 years). Each participant is required to perform proper Irrigation Water Management on the fields in which irrigation improvements were installed. The projects are planned and contracted using the current NRCS EQIP payment schedule.

Applications are competitively screened and prepared by the NRCS. Applications are funded in order of the best cost effectiveness. All applications meeting NRCS planning standards that result in an annualized cost per ton of less than $150/ton and that were also not eligible for EQIP are considered for funding depending upon funds available. The cost effectiveness and salt loading data used for these calculations are standardized for all salinity control areas in the State of Colorado by the NRCS.

Progress in Colorado:

BSP Projects:
Reclamation has provided $5,960,000 in funding to Colorado. Nine EQIP-like BSP projects have been obligated totaling $1,239,206. These projects will result in salt control of 2,155.9 tons and treat and/or serve 611.5 acres at an average cost effectiveness of $51.37/ton. One of the approved projects is a wildlife habitat improvement project. Two projects were approved in the Grand Valley Area, and seven projects were approved in the Lower Gunnison area.

Grand Valley Wildlife Project:
The Colorado State Conservation Board has contracted with Colorado Parks and Wildlife (CPW) to fund approximately 491 acres of wildlife improvements along the Colorado River in the Grand Valley for a cost of $804,415, utilizing BSP special funding received from Reclamation in 2013. This project is now under construction, with all the brush control work now completed. $129,019 has been expended in this project to date. This project has been planned and designed as a joint effort with CPW, FWS, and NRCS. Completion of this project will satisfy the remaining acres of replacement habitat required in the Grand Valley salinity unit.

Reclamation Funding Opportunity Announcement (FOA):
Colorado was pleased to be involved in the 2012 and 2015 FOA process. The expansion of the ranking and selection criteria to include projects funder 1,000 tons of salt control

allowed more coordination with EQIP and BSP on-farm salinity control improvements. Colorado has contracted with three of the Reclamation projects approved through the FOA process, for a total cost of approx. $2.3M.
Construction has been completed for the irrigation portion in the Forked Tongue/Holman Ditch and Bostwick Park FOA projects. Construction of the required wildlife habitat features for these projects is underway and will be completed by October. Construction will continue in the Clipper Zanni Project in October 2015.

Ditch Mapping:
Colorado received $34,000 in special BSP funding to complete ditch mapping activities in Ouray County in the Lower Gunnison area, and to review and complete data for ditch mapping previously completed in other portions of the Lower Gunnison area. This project has been completed.

Utah Department of Agriculture and Food (UDAF)

With the BSP agreement in place with Reclamation, UDAF, working through NRCS's EQIP program has funded 3 projects for $3,452,009.00. One project came to UDAF through Reclamation's 2012 FOA. This project is with Sheep Creek Irrigation Company, Manila, Utah and is a canal piping project that will retain 2,220 tons of salt per year at a cost of $2,897,129.18. The other projects will treat 417 acres and control 1,083 tons of salt with a combined cost of $471,879.00. All 3 projects are essentially completed with minor clean-up and restoration planting in Sheep Creek and Irrigation Water Management for the on farm work.

From Reclamation's 2015 FOA, UDAF received two projects totaling $2,924,479 that will be expended over the next 2 years.

As requested by Reclamation, UDAF had contracted with Emery County Water Conservancy District for data collection of a long term study at Desert Lake, Emery County. UDAF paid Emery County Water Conservancy $11,368.85. This study has concluded and the contract with Emery has been closed.

UDAF has paid the Uintah basin salinity coordinator $38,537.96 during the past federal FY using BSP funds. The coordinator has been successful in helping several irrigation companies to submit successful applications for the 2015 FOA. These projects are competitive because of the coordinator's efforts to confederate historically opposing companies into accepting unified systems that improve each company. Improvements with the Ute Tribe have also been made and it is anticipated that in future FOA's the tribe will submit applications. UDAF feels that using BSP funds for this position has greatly benefited the Salinity Control Program in the Uintah Basin area.

Wyoming Water Development Commission (WWDC)
A new agreement has been put in place with the Wyoming Water Development Commission that will end in 2020. The agreement is similar to the agreements with Utah and Colorado and has a value of $2,800,000 of which $310,000 has been obligated. This

agreement will allow Wyoming to accept work from the 2015 FOA and any future EQIP pass-offs. From the 2015 FOA, WWDC received one project totaling $2,024,413 from BSP funds and an additional $2,024,413 from the WWDC. This project will take approximately 3 years to complete.

Paradox Valley Unit

The Paradox Valley Unit was authorized for investigation and construction by the Salinity Control Act. The unit is located in southwestern Colorado along the Dolores River in the Paradox Valley, formed by a collapsed salt dome (Figure31). Groundwater in the valley comes into contact with the top of the salt formation where it becomes nearly saturated with sodium chloride. This project intercepts extremely saline brine (260,000 mg/l total dissolved solids) before it reaches the Dolores River and disposes of the brine by deep well injection (injection interval about 14,000 feet below ground surface.

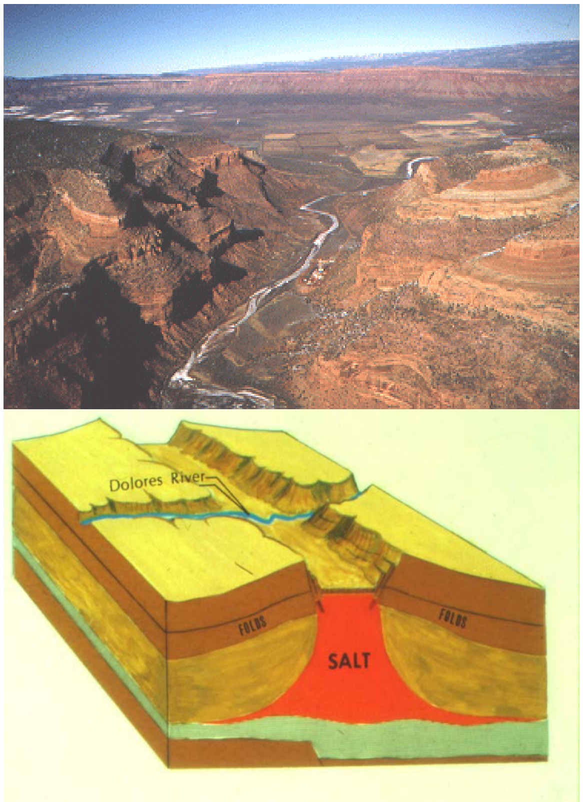

Figure 31 – Paradox Valley

The project continues to intercept and dispose of 100,000+ tons of salt annually (Figure 32). The pressure necessary to inject the brine into the disposal formation at 14,000 feet is increasing. Induced seismicity and the increasing pressure necessary to inject the brine into the disposal formation at are the limiting factors of the project. As the formation fills with brine, the pressure necessary to inject increases (Table 8).

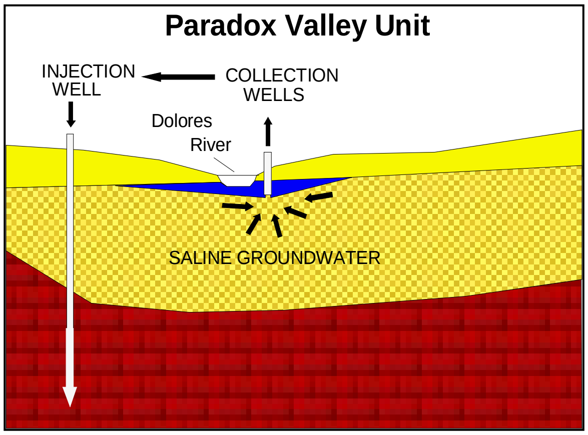

Figure 32 - Schematic of Paradox Project.

As the pressure increases, the potential for increased seismicity may exist. In January 2013, a M4.4 earthquake occurred that caused Reclamation to modify injection operations which included a new shut down schedule and injection rate reduction. Those modifications have significantly decreased the injection pressure which could result in additional life of the well. The current projected life of the well remains at 3 to 5 years. (Table 8).

Table 8 - Paradox Well Injection Evaluation

Injection Period	Operational Days[1]	Pressure Start	High Pressure During Period	Injection Period Net Pressure Change	Tons of Salt Injected[2]	No. of Induced Seismic Events		Maximum Magnitude of Induced Seismic Events	Estimated Tons of Salt Entering the River[3]
Jan-May '02[4]		148	1609	4432		52,860	25	2.9	8,469
June-Dec '02[5]		178	929	4593	161	58,953	34	2.2	8,333
Jan-May '03[5]		144	1172	4627	34	53,173	27	2.1	18,037
June-Dec '03[5]		184	1154	4675	48	59,530	106	2.3	11,185
Jan-May '04[6]		140	1201	4640	-35	51,449	47	2.4	20,225
June-Dec '04[7]		160	1091	4541	-99	51,589	57	3.9	6,442
Jan-May '05[5]		140	1038	4736	195	55,024	69	2.4	14,011
June-Dec '05[8]		148	1203	4750	14	46,551	31	2.6	38,582
Jan-June '06[9]		138	375	4680	-70	44,779	10[10]	2.4	53,039
July-Dec '06[5]		162	1084	4797	117	56,920	13[10]	2.1	18,605
Jan-June '07[5]		159	1066	4796	-1	56,068	7[10]	1.1	19,728
July-Dec '07[5]		163	1232	4712	-84	57,395	31	2.6	11,279
Jan-June '08[11]		160	1152	4813	101	54,720	47	1.3	15,305
July-Dec '08[5]		162	1263	4822	9	56,734	61	2.1	16,378
*Jan-Mar '09[5]		84	1246	4756	-66	29,163	20	2.6	22,029
Apr-Sept '09[12]		160	1157	4891	135	55,083	70	2.7	16,507
Oct '09-Mar '10[5]		153	970	4930	39	51,589	91	2.9	32,876
Apr '10-Sep '10[5]		162	1347	4990	60	55,747	75	2.7	17,223
Oct '10-Mar '11[5]		161	1378	5000	10	55,501	43	2.9	22,916
Apr '11-Sep '11[13]		158	1276	5102	102	54,422	63	2.7	11,591
Oct '11-Mar '12		162	1282	5115	6	56,531	59	2.5	21,003
Apr '12-Sep '12		161	1417	5108	-7	55,605	116	1.9	5,507

1. Operational days include partial days of operation which accounts for variations in tons of salt injected
2. Tons of salt injected based on 260,000 mg/L. Brine concentration varies slightly due to seasonal and environmental fluctuations
3. Tons of salt entering the river based on regression equations (Ken Watts, USGS Administrative Report – "Estimates of Dissolved Solids Load of the Dolores River in Paradox Valley, Montrose County, CO, 1988-2009, August 5, 2010"). The 2010 FAR contained erroneous estimated tons of salt entering the river.
4. Begin 100% brine injection
5. No problems
6. Down from 3/1/04 through 3/7/04 for mechanical problems
7. Implemented quarterly 10-day shutdown schedule from 9/22 to 10/22; M3.9 earthquake on 11/7; plant shut down until 11/18; discontinued 10-day shutdown schedule
8. Down from 11/13/05 through 12/31/05 for mechanical problems
9. Down from 1/1/06 through 1/19/06 and 2/16/06 through 3/2/06 for mechanical problems
10. Seismic data for 2006 and the first half of 2007 is likely incomplete due to seismic network problems
11. Down from 4/16-17/08 for mechanical problems
12. Down from 5/18-19/09 for mechanical problems
13. Down from 9/18-9/20 for communication link failure.

** Biannual shutdown schedule changed from winter/summer to spring/fall*

Injection Month	Min Injection Pressure	Max Injection Pressure	Monthly Pressure Change	Tons of Salt Injected[1]	Estimated Salt Load in tons[3]	# of Induced Seismic Events	Max Mag of Seismic Events	No. of Seismic Events in Past 12 Months	No. of Seismic Events in Past 12 Months, M ≥ 0.5
Jan-13	2,733	5,111		8,115	263	23	4.4	209	69
Feb-13	893	2,733	-2,378	0	1,324	9	1.7	213	70
Mar-13	500	893	-1,840	0	2,600	35	1.2	228	64
Apr-13	390	4,250	3,357	4,064	3,351	9	0.7	215	60
May-13	3,290	4,452	202	8,752	1,535	13	1.8	209	58
Jun-13	3,948	4,685	233	8,311	2,089	7	0.8	187	52
Jul-13	4,143	4,740	55	8,457	1,823	5	1.2	158	47
Aug-13	4,218	4,722	-18	8,629	289	4	0.5	155	47
Sep-13	3,513	4,770	48	7,557	659	2	0.3	141	43
Oct-13	3,683	4,770	0	9,610	195	6	1.2	126	35
Nov-13	4,208	4,803	33	8,814	577	5	0.7	127	36
Dec-13	4,195	4,758	36	8,713	778	6	0.8	121	34
Jan-14	4,202	4,739	-19	8,584	681	2	0.3	100	19
Feb-14	4,187	4,745	6	7,760	925	6	1.7	97	20
Mar-14	4,193	4,757	12	8,713	1,275	4	1.5	66	22
Apr-14	4,206	4,772	15	8,159	675	1	0.9	59	19
May-14	4,215	4,775	3	8,711	258	7	1.2	53	18
Jun-14	4,217	4,769	-6	8,381	186	0	N/A	46	16
Jul-14	4,218	4,778	9	8,428	236	5	2.3	46	17
Aug-14	4,212	4,781	3	8,645	-300	0	N/A	43	16
Sep-14	4,206	4,772	-9	8,215	-832	3	1.8	43	16
Oct-14	4,215	4,776	4	8,773	758	8	1.0	46	17
Nov-14	4,223	4,773	-3	8,297	2,992	3	1.1	44	18
Dec-14	4,205	4,778	5	8,272	4,202	6	0.4	44	17
Jan-15	4,202	4,766	-12	8,731	3,246	8	1.0	49	19
Feb-15	4,202	4,754	-12	7,775	4,353	3	1.1	46	17
Mar-15	4,228	4,766	12	8,457	6,282	0	N/A	42	14
Apr-15	4,196	4,760	-6	8,230	3,959	10	0.6	51	15

May-15	4,190	4,763	3	8,512	1,708	11	0.7	55	14
Jun-15	4,209	4,761	-2	8,279	174	16	0.9	71	16
Jul-15	4,227	4,777	16	8,637	-336	18	1.1	84	15
Aug-15	4,164	4,797	20	8,614	-478	9	1.6	93	18
Sep-15	4,239	4,787	-10	8,124	810	13	1.0	104	20
Oct-15	3,598	4,767	-20	7,863	733	7	0.9	103	21
Nov-15	4,206	4,737	-30	8,594	2,361	12	1.0	112	22
Dec-15	4,195	4,754	17	8,494	2,976	16	0.8	122	23
Jan-16	4,194	4,762	8	8,671	3,484	14	1.6	129	25
Previous 12 Months			8	100,250	26,026	129	1.6		
Previous 24 Months			17	201,335	39,647	180	2.3		
[1]Tons of salt injected based on 260,000 mg/l. PVB concentration varies slightly due to seasonal and environmental fluctuations.									
[2]Estimated salt load based on regression equations (Ken Watts, USGS Administrative Report - "Estimates of Dissolved Solids Load of the Dolores River in Paradox Valley, Montrose County, Colorado, 1988 through 2009, dated August 5, 2010") and provisional data provided by USGS. Some daily EC and streamflow discharge values are estimates.									

Alternative Study

At the request of the Salinity Control Forum, Reclamation initiated an Alternative Study/EIS Process to evaluate alternative methods for salt disposal at Paradox. A Notice of Intent was published in the Federal Register on September 10, 2012, and public scoping meetings were held in Paradox, Montrose, and Grand Junction in 2012. Reclamation prepared a Scoping Summary Report in early 2013. Reclamation continues to have meetings and discussions on the Alternatives Study with the BLM, EPA, Colorado Department of Public Health and Environment, and other stakeholders.

A Request for Information for commercial salinity control alternatives was published in 2015 to identify potential alternatives other than deep well injection and evaporation. One response was received for a brine crystallization process and a contract to evaluate that proposal is currently underway to determine its technical and economic viability.

A panel of experts was convened in March and presented a list of questions regarding the operation, regulation and design of evaporation ponds. A final report was received in July with the results of that meeting and recommendations on how to proceed. In response to the board’s recommendations, Reclamation has initiated several investigations including an ecological Risk Assessment to evaluate the Migratory Bird issue, evaporation pan tests to provide information on pond size, and a pond optimization study to investigate pond operation.

Preliminary evaporation pond cost estimates have been developed, but will be largely dependent on site selection and regulatory requirements. A Request for Information for commercial salinity control alternatives was published in 2015 to identify potential alternatives other than deep well injection and evaporation. One response was received for a brine crystallization process and a contract to evaluate that proposal is currently underway to determine its technical and economic viability.

A panel of experts was convened in March and presented a list of questions regarding the operation, regulation and design of evaporation ponds. A final report was received in July with the results of that meeting and recommendations on how to proceed. In response to the board's recommendations, Reclamation has initiated several investigations including an ecological Risk Assessment to evaluate the Migratory Bird issue, evaporation pan tests to provide information on pond size, and a pond optimization study to investigate pond operation.

Colorado River Basin Salinity Control Program Summary Data

The following tables summarize the Salinity Control Program using the latest available data.

Table 9 – Summary of Federal Salinity Control Programs (2015)

Salinity Unit		Tons / Year Removed
MEASURES IN PLACE BY RECLAMATION		
Basinwide Program		214,700
Basin States Program	1/	16,500
Meeker Dome		48,000
Las Vegas Wash Pitman		3,800
Grand Valley		122,300
Paradox Valley	2/	100,700
Lower Gunnison Winter Water (USBR)		41,400
Dolores		23,000
Reclamation Subtotal		**570,000**
MEASURES IN PLACE BY NRCS/BSP	3/	
Grand Valley		143,500
Price-San Rafael		80,100
Uinta Basin		157,200
Big Sandy River		58,200
Lower Gunnison		119,100
McElmo Creek		29,500
Mancos		4,400
Muddy Creek		100
Manila		10,400
Silt		2,300
Green River		700
Tier 2	4/	6,800
NRCS/BSP Subtotal		**612,000**
MEASURES IN PLACE BY BLM		
Nonpoint Sources	5/	111,600
Well-Plugging		14,600
BLM Subtotal		**126,000**
Measures in Place Total		**1,308,000**
GOALS TO REACH TARGET		
Reclamation Basinwide Program		222,000
NRCS Program		150,000
Goals Subtotal		**372,000**
Target Total (Measures in Place + Goals)		1,680,000
Target by 2035		**1,680,000**

1/ Off-farm projects funded by the BSP

2/ Paradox injection well capacity estimated to decline beginning in 2020; assumed continuation of well or alternative control methods after 2020

3/ May include off-farm controls that were not goaled.
4/ Measures in areas outside approved projects.
5/ BLM non-point source are estimates.

Table 10 – Summary of Colorado River Basin Salinity Control Program Appropriations and Cost Share from the Basin Funds (2005 thru 2015)

TOTAL PROGRAM ($1,000)

Unit	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	**Subtotal**
Grand Valley O&M	863	1,223	1,340	1,125	1,757	1,021	1,373	1,289	1,515	1,885	2,247	15,638
Paradox Valley O&M	2,536	2,423	2,633	3,621	3,121	3,764	3,660	3,236	3,124	3,501	3,575	35,194
Lower Gunnison O&M	0	0	0	0	0	0	0	0	0	0	0	0
McElmo Creek (Dolores) O&M	623	739	419	559	603	676	491	480	563	479	576	6,208
USBR Basinwide Program	11,776	12,103	12,770	11,406	24,686	9,577	12,104	11,854	12,399	10,021	10,419	139,115
Subtotal (USBR Program)	15,797	16,487	17,162	16,711	30,167	15,038	17,629	16,860	17,600	15,887	16,816	196,155
NRCS Program	28,039	28,194	26,466	22,803	23,346	20,833	23,403	22,121	19,077	20,697	21,751	256,730
BLM (no Basin Funds)	800	751	800	800	800	800	800	800	800	800	800	8,751
Total	44,636	45,432	44,428	40,314	54,313	36,671	41,832	39,781	37,477	37,384	39,367	461,636

Appropriations Expended ($1,000)

Unit	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	**Subtotal**
Grand Valley O&M	647	917	1,005	844	1,318	766	1,030	967	1,133	1,414	1,685	11,726
Paradox Valley O&M	1,902	1,817	1,975	2,716	2,341	2,823	2,745	2,427	2,343	2,626	2,681	26,396
Lower Gunnison O&M	(2)	0	0	0	0	0	0	0	0	0	0	(2)
McElmo Creek (Dolores) O&M	436	517	293	391	422	473	344	336	394	335	403	4,344
USBR Basinwide Program	8,243	8,472	8,939	7,984	17,280	6,704	8,473	8,298	8,679	7,015	7,293	97,380
Subtotal (USBR Program)	11,226	11,723	12,212	11,935	21,361	10,766	12,592	12,028	12,549	11,390	12,062	139,844
NRCS Program	19,627	19,736	18,526	15,962	16,342	14,583	16,382	15,485	13,354	14,488	15,226	179,711
Total	30,853	31,459	30,738	27,897	37,703	25,349	28,974	27,513	25,903	25,878	27,288	319,555

UPPER BASIN FUND COST SHARE PAYMENTS ($1,000)

Unit	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	**Subtotal**
Grand Valley O&M	32	46	50	42	66	38	52	48	57	71	84	586
Paradox Valley O&M	95	91	99	136	117	141	137	121	117	131	134	1,319
Lower Gunnison O&M	0	0	0	0	0	0	0	0	0	0	0	0
McElmo Creek (Dolores) O&M	28	33	19	25	27	30	22	22	25	22	26	279
USBR Basinwide Program	530	545	575	513	1,111	431	545	533	558	451	469	5,981
Subtotal (USBR Program)	685	715	742	716	1,321	641	756	725	757	675	713	8,165
NRCS Projects	1,262	1,269	1,191	1,026	1,051	937	1,053	995	858	931	979	11,552
Total Payment	1,947	1,983	1,934	1,743	2,371	1,578	1,809	1,720	1,616	1,606	1,692	19,717

LOWER BASIN FUND COST SHARE PAYMENTS ($1,000)

Unit	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	**Subtotal**
Grand Valley O&M	183	260	285	239	373	217	292	274	325	401	477	3,326
Paradox Valley O&M	539	515	560	770	663	800	778	688	664	744	760	7,481
Lower Gunnison O&M	0	0	0	0	0	0	0	0	0	0	0	0
McElmo Creek (Dolores) O&M	159	188	107	142	154	172	125	122	144	122	147	1,582
USBR Basinwide Program	3,003	3,086	3,256	2,908	6,295	2,442	3,087	3,023	3,162	2,555	2,657	35,474
Subtotal (USBR Program)	3,884	4,049	4,207	4,060	7,485	3,631	4,281	4,107	4,294	3,822	4,041	47,863
NRCS Projects	7,150	7,190	6,749	5,815	5,953	5,312	5,968	5,641	4,865	5,278	5,547	65,468
Total	11,034	11,239	10,956	9,874	13,438	8,944	10,249	9,748	9,159	9,100	9,587	113,331

Table 11 - UCRB Agriculture Salinity Control Summary (tons) - 2015

Project Area	Total Salt Load	Total Ag. Load	Total Controls	Remaining Ag. Load
Big Sandy	157,500	124,900	70,480	54,400
Grand Valley	580,000	535,500	275,624	259,876
Green River	15,700	15,700	657	15,043
Lower Gunnison	1,440,000	840,000	114,476	725,524
Mancos	43,000	26,000	25,331	669
Manila	49,000	40,000	9,643	30,357
McElmo	164,075	99,960	38,713	61,247
Muddy Creek	90,000	14,980	71	14,909
Price-San Rafael	430,000	244,000	77,695	166,305
Rifle - Silt	NA	24,700	56,793	-32,093
Uinta	500,000	328,120	196,153	131,967
Total	3,469,275	2,293,860	865,636	1,428,224

1. Off-farm load shown only. On-farm loads have not been estimated for the San Juan and Paria areas
2. Agricultural load for Paria only represents the conveyance systems which were piped as part of the Tropic Project
3. Areas outside existing project boundaries.

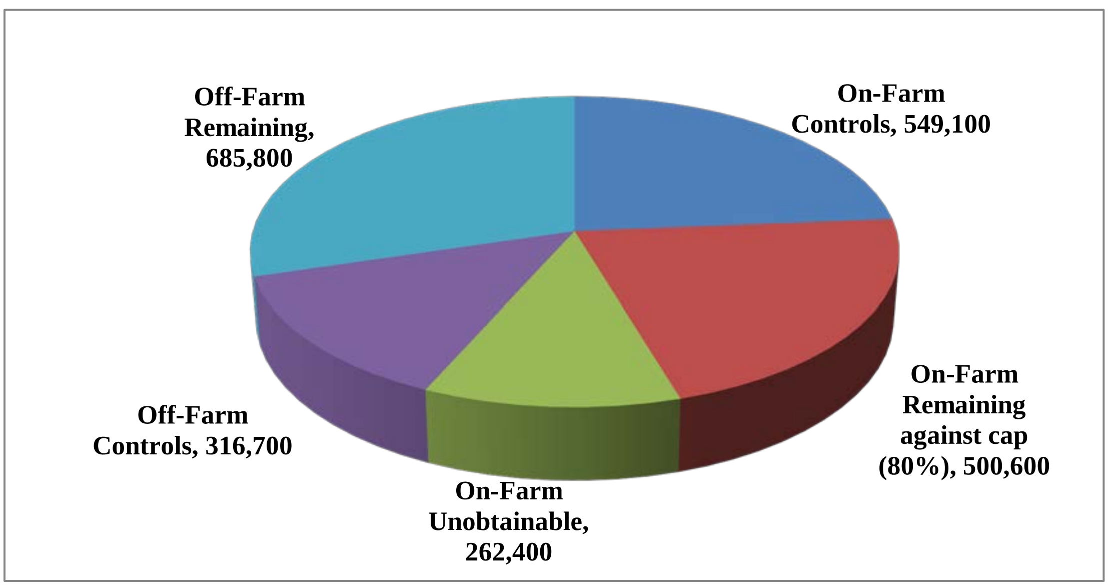

Figure 33 – Salt Load

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CHAPTER 5 - OTHER WATER QUALITY RELATED ISSUES

Gold King Mine Spill

On August 5, 2015, EPA was conducting an investigation of the Gold King Mine (GKM) near Silverton, Colorado. While excavating above the old adit, pressurized water began leaking above the mine tunnel, spilling about three million gallons of water stored behind the collapsed material into Cement Creek, a tributary of the Animas River. (EPA) On August 8, the USGS measured increased flows for several hours using a stream gauge. This measurement resulted in a provisional calculated flow volume of 3,043,067 gallons or 9.34 acre feet (af) discharged from the Gold King Mine. This flow went down Cement Creek into the Animas River and then into the San Juan River headed to Lake Powell and the Colorado River.

Mine River Waste
Flows Down the Animas River

Figure 34- Animas River

The major concern of this unintended discharge was the metals (lead, chromium, cadmium, mercury, arsenic, zinc, copper, iron, manganese and aluminum) which were in the mine wastewater and their potential impact to water users downstream. The acid mine drainage (AMD) plume was being monitored in real time primarily by the color of the water and its pH or acidity. Other samples were taken for metal content but could not be used to monitor the AMD in real time since those samples had to be sent to a lab for analysis. The pH of the AMD near the mine was less than 5, which is fairly acidic, and kept most of the metals in a dissolved state within the AMD. Once the AMD plume reached and mixed with the Animas and especially the San Juan Rivers the buffering capacity of those alkaline waters, > 7 pH, increased the pH of the AMD water. When the AMD plume reached the San Juan River it could no longer be tracked by the color of the water, since the San Juan River is very high in suspended sediments and thus has a high turbidity. The pH was also not useable as an indicator of the spill plume once it reached the lower Animas River and entered the San Juan River since all water testing showing pH levels of 8 – 8.1, which is the normal pH of those rivers, so tracking the AMD plume down the San Juan River became almost impossible using the color and pH of the water. The base flow out of Navajo Reservoir, upstream on the San Juan River from the confluence with the Animas River, during this time was 650 cfs (1,288 af/day) and Reclamation increased the flow out of Navajo Reservoir for 2 days to 1,300 cfs (2,577

af/day) to help dilute the AMD. The 9.3 af of the AMD plume was less than 2% of the daily flow in the San Juan River which also made tracking the AMD plume even harder to follow once it reached the San Juan River, due to the dilution effect.
According to the EPA, as the dissolved metals in the acidic waters of the mine entered into the alkaline water of the Animas and San Juan rivers naturally occurring chemical reactions changed the soluble metals into an insoluble or solid form which would then precipitate or drop out of the water column and mix with the river sediment. It was estimated by the EPA that 2/3 of the metals precipitated out over 200 km of the Animas River streambed and 1/3 reached the San Juan River.

Monitoring of the water and sediment will continue to verify there is no long term impact along the lower Animas and San Juan Rivers or into Lake Powell.

Dreissenid Mussels in the Upper Colorado River Basin

A fairly recent problem, which has the potential to affect the water quality in the Colorado River basin, is the introduction of dreissenid mussels. The dreissenid mussels (quagga and zebra) were first found in the Great Lakes area in 1988. The quagga mussels travel either downstream with the water current or via watercraft movement and were first found in the Colorado River basin at Lake Mead in 2007. The quagga mussels found in 2007 were adults and well established, so they probably were introduced into Lake Mead around 2005. Since 2007, quagga mussels in the lower Colorado River basin have become well established.


Figure 35 – Mussel encrusted chair from Lake Powell

Prior to quagga mussels being found in Lake Mead, scientists originally thought that Lake Powell would be the first western water body to become infested. In order to keep this from happening the National Park Service (NPS) Glen Canyon National Recreation Area (GLCA) started a campaign to keep the mussels out of Lake Powell beginning around 2000 with education and boat inspections being the primary activity. However, the Reclamation lab in Denver was getting random and inconclusive results of mussels in water samples after 2007. Since there was no conclusive positive results (both positive microscopy and PCR), NPS didn't accept the Denver lab results and established their own mussel sampling and lab using both microscopy and DNA at Lake Powell.

Mussel larvae, or veligers, were first confirmed in Lake Powell in late 2012, by NPS after routine water monitoring tests discovered mussel DNA in water samples taken just upstream from Glen Canyon Dam. Adult mussels were first reported in March 2013 when a local marine services business discovered 4 adult mussels on a boat that had been pulled for service. Adult mussels continued to be found on moored boats and marina structures at Wahweap and Antelope Point Marinas. Adult mussels have also been found attached to submerged canyon walls in and around Wahweap Bay and on fixed wheel gates on the Glen Canyon Dam penstocks, when they have been pulled for maintenance in the last couple of years. The majority of mussels are found in the southern end of the reservoir but veligers and adults are now being found farther up reservoir.

The impacts that the mussels will have at Lake Powell are yet to be seen as their overall population is still fairly low, but with increasing populations increased problems will be encountered. At the lower end of the reservoir, near the dam, when the female mussels are spawning concentrations of veligers in the water have been found to be greater than 100,000 per liter. Problems caused by high numbers of mussels include; plugging of the infrastructure and piping of Glen Canyon Dam, the water intake for the Navajo Power Plant, City of Page water delivery, and the yet to be built Lake Powell Pipeline to St. George. Other impacts could negatively impact the recreational activities on the beaches with the sharp mussel shells and smell when the mussels die as the water level fluctuates, boat engine overheating and increased fuel consumption from mussels on the boat hulls. As the mussels filter the water they will also reduce the amount of phytoplankton in the water column which is the base food source for the reservoir fishery, and potentially shift the algal community into a blue green algae base, which has the potential for releasing toxic byproducts.

Figure 36- Wheel gate from Glen Canyon Dam and rock wall with mussels.

Since Lake Powell is popular with boaters and surveys have shown that when boaters leave Lake Powell that they like to boat at other waters in and out of the Colorado River Basin, another concern is the potential for the spread of these mussels into new waters. The NPS and State of Utah are working hard to educate boaters and decontaminate boats, if necessary, to reduce the chance of moving quagga mussels to other non-infested waters in the area.

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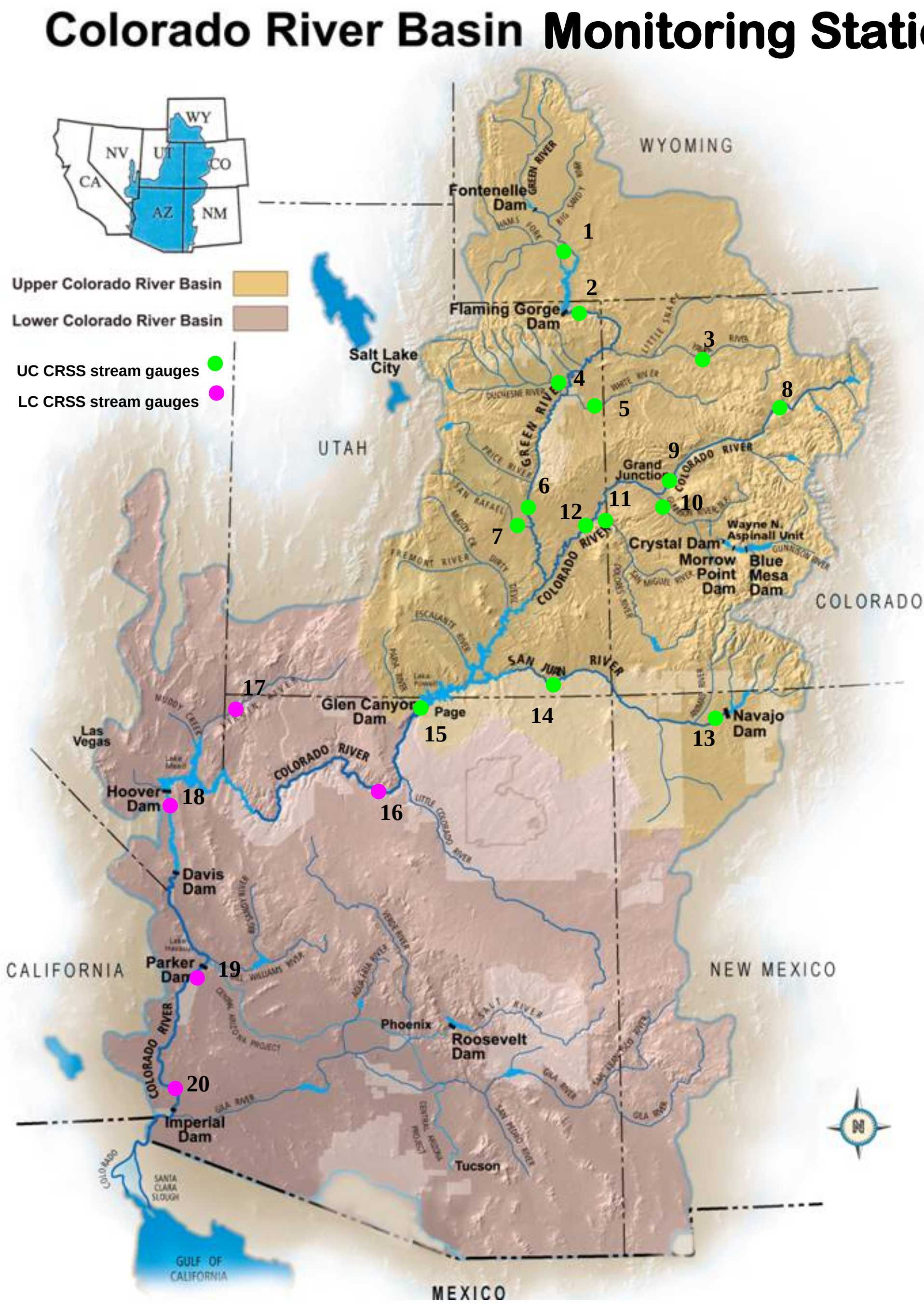
APPENDIX A

SALINITY MONITORING STATION INFORMATION



1. Green River nr Green River, WY
2. Green River nr Greendale, UT
3. Yampa River nr Maybell, CO
4. Duchesne River nr Randlett, UT
5. White River nr Watson, UT
6. Green River nr Green River, UT
7. San Rafael River nr Green River, UT
8. Colorado River nr Glenwood Springs, CO
9. Colorado River nr Cameo, CO
10. Gunnison River nr Grand Junction, CO
11. Dolores River nr Cisco, UT
12. Colorado River nr Cisco, UT
13. San Juan River nr Archuleta, NM
14. San Juan River nr Bluff, UT
15. Colorado River @ Lees Ferry, AZ
16. Colorado River nr Grand Canyon, AZ
17. Virgin River @ Littlefield, AZ

Numeric Criteria Stations

18. Colorado River below Hoover Dam
19. Colorado River below Parker Dam
20. Colorado River @ Imperial Dam

Figure A1 - Colorado River Basin 20 Stream Gage Locations

Table A1. Characteristics of the 20 Salinity Streamflow-gaging Stations in the Colorado River Basin.
[NA, indicates not applicable; Latitude and Longitude datum: NAD83; Elevation datum: NGVD29.]

U.S. Geological Survey streamflow-gaging station number	U.S. Geological Survey streamflow-gaging station name	Site short name	Latitude, in decimal degrees	Longitude, in decimal degrees	Elevation, in feet above sea level	Drainage area, in square miles
09217000	Green River near Green River WY	GRWY	39.5589	-107.2909	5,760	4,556
09234500	Green River near Greendale, UT	GDALE	39.2391	-108.2662	4,814	7,986
09251000	Yampa River near Maybell, CO	YAMPA	38.9833	-108.4506	4,628	7,923
09302000	Duchesne River near Randlett, UT	DUCH	38.7972	-109.1951	4,165	4,580
09306500	White River near Watson, UT	WHITE	38.8105	-109.2934	4,090	24,100
09315000	Green River at Green River, UT	GRUT	41.5164	-109.4490	6,060	14,000
09328500	San Rafael River near Green River, UT	SANRAF	40.9083	-109.4229	5,594	19,350
09071750	Colorado River above Glenwood Springs, CO	GLEN	40.5027	-108.0334	5,900	3,383
09095500	Colorado River near Cameo, CO	CAMEO	40.2103	-109.7814	4,756	3,790
09152500	Gunnison River near Grand Junction, CO	GUNN	39.9789	-109.1787	4,947	4,020
09180000	Dolores River near Cisco, UT	DOLOR	38.9861	-110.1512	4,040	44,850
09180500	Colorado River near Cisco, UT	CISCO	38.8583	-110.3701	4,190	1,628
09355500	San Juan River near Archuleta, NM	ARCH	36.8019	-107.6986	5,653	3,260
09379500	San Juan River near Bluff, UT	BLUFF	37.1469	-109.8648	4,048	23,000
09380000	Colorado River at Lees Ferry, AZ	LEES	36.8647	-111.5882	3,106	111,800
09402500	Colorado River near Grand Canyon, AZ	GRCAN	36.1014	-112.0863	2,419	141,600
09415000	Virgin River at Littlefield, AZ	VIRGIN	36.8916	-113.9244	1,764	5,090
09421500	Colorado River below Hoover Dam, AZ-NV	HOOVER	36.0153	-114.7386	675	171,700
09427520	Colorado River below Parker Dam, AZ-CA	PARKER	34.2956	-114.1402	301	182,700
09429490	Colorado River above Imperial Dam, AZ-CA	IMPER	32.8837	-114.4674	183	188,500

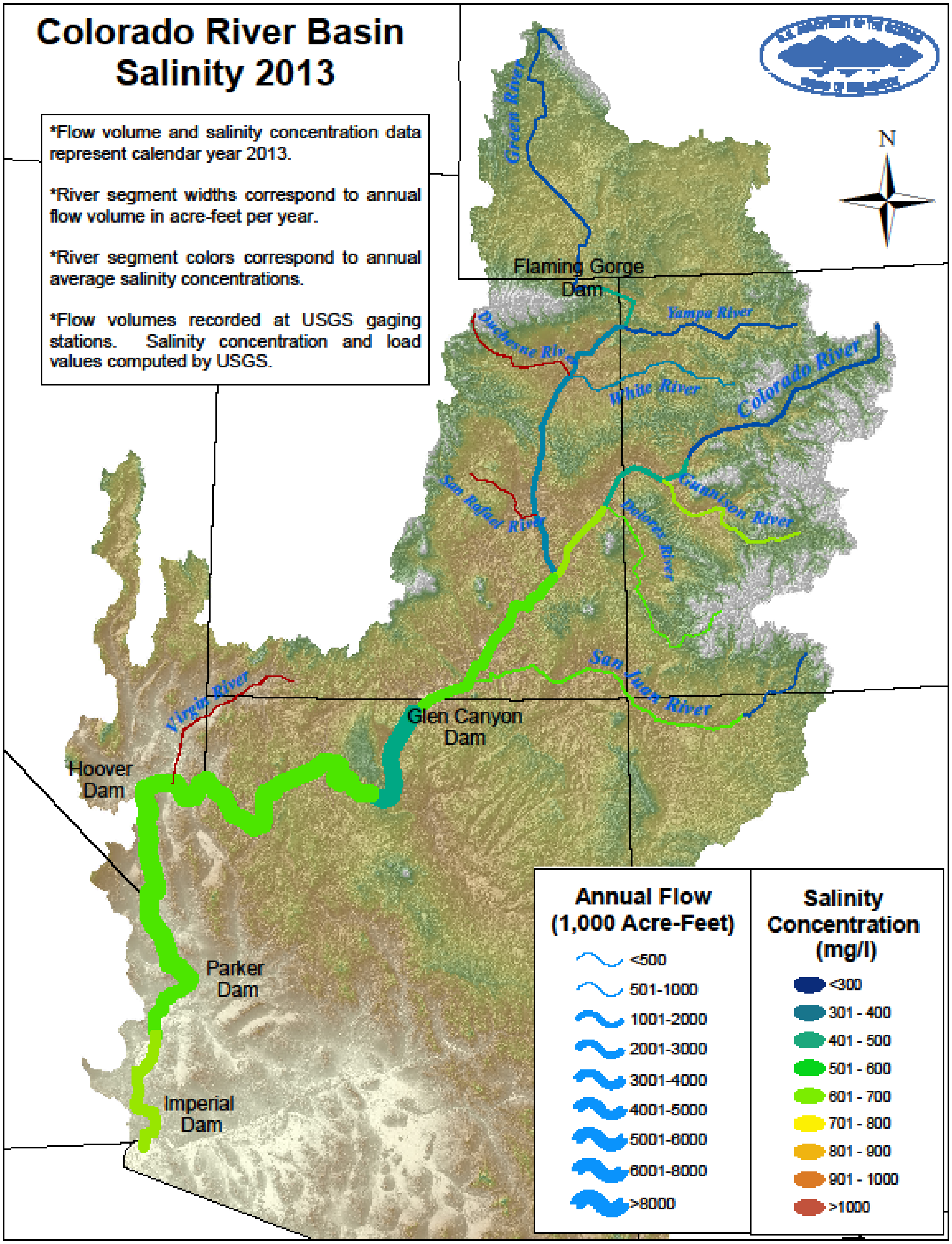


Figure A2 - Colorado River Basin Flows and Salinity

APPENDIX B

SALT LOAD 2014 UPDATE FOR THE 20 STATIONS

(Updates calendar years 2010 through 2013)

STATION CLASSIFICATIONS

U.S. Geological Survey
Colorado Water Science Center
Western Colorado Office

September 3, 2014

INTRODUCTION

Methodology

Three Statistical Analyses System (SAS) computer programs, FLAGIT, DVCOND, and SLOAD are used to estimate dissolved-solids concentrations and loads from existing data. The program FLAGIT retrieves data from the daily-values (DV) file and water-quality file (QW) of the U.S. Geological Survey's National Water Data Storage and Retrieval System (WATSTORE) (Hutchinson, 1975), examines the data, deletes incomplete observations, and flags possible errors in the remaining observations. FLAGIT also produces the data base used by the programs DVCOND and SLOAD. The program DVCOND fills in missing values in the daily specific-conductance record by linear interpolation. DVCOND needs to be used only when the flow at a streamflow-gaging station is extensively regulated.

The program SLOAD derives regression relations from water-quality data, modeling dissolved solids and six major ions as functions of specific conductance and discharge (Q). SLOAD then applies these relations to the daily specific conductance and discharge data and computes daily loads of dissolved solids and the other six major ions. The computed daily loads are summed by month and by year. Monthly and annual dissolved-solids and major ion concentrations are computed from the monthly and annual loads and streamflows. Monthly, annual, and seasonal concentrations and loads, in addition to regression statistics, are printed and saved on SAS data sets. Separate versions of SLOAD enable annual summation either by water year (WY) or calendar year (CY) (Lieberman and others, 1987).

The computerized method can be used for streamflow-gaging stations that have a complete record of DV Q and periodic QW analyses. The reliability of the estimate is considerably increased if DV specific conductance (SC) also is available. Water-quality analysis that includes total dissolved solids (TDS) with major ion analysis (also referred to as sum of constituents or SOC/SUM; herein referred to as SOC) is preferred over residue on evaporation at 180 degrees Celsius (ROE). SOC enables SLOAD calculations of the 8 major constituents normally present in natural streams: Calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}), potassium (K^{+}), silica (Si), chloride (Cl^{-}), sulfate (SO_4^{2-}), and carbon, expressed as carbonate equivalent (Liebermann and others, 1987).

Classification Criteria

The 20 stations are classified A, B, or C, according to the quantity and quality of available data for the salt-load computations. Optimal data collection at each station includes daily mean streamflow, daily mean SC, and at least 6 water quality samples per WY which include TDS. SC may be monitored continuously with an instrument (daily mean) or sampled once per day by an observer (instantaneous). Continuous monitoring for daily mean SC by instrument is the preferred method.

Types of Specific Conductivity

Specific Conductivity at the sites is classified into several types:

- Daily – mean daily SC collected by instrumentation. To be considered “daily”, the record may have up to 60 missing days of SC per water year which are spread out in small groups over the year.
- Intermittent – mean daily SC which has more than 60 missing days per water year spread out over the water year.
- Seasonal – mean daily SC has been continuously shut off during the winter (November through March typically), with more than 60 missing days.
- Instantaneous – single SC values which have been manually collected by an observer. Usually spaced several days apart, and may be missing during winter months.

CLASS A

For Class A, adequate data must be available for salt-load computation using SLOAD. Site data includes:

- 6 or more QW samples per WY which include some type of TDS (ROE, SOC, or Calculated). SLOAD automatically discards QW records without any type of TDS.
- Daily Q (SLOAD allows no days with missing Q).
- Mean daily SC from instrumentation. The SC record must be "daily", and must have no more than 60 total days of missing values for the WY.

CLASS B

Salt-load computation is possible using SLOAD, but limited data availability could be contributing to error in salt load estimate. Even though the site has daily Q and daily SC, if there are fewer than 6 QW observations, the site will be Class B. Site data includes:

- There are fewer than 6 QW samples per WY which include some type of TDS.
- Daily Q (SLOAD allows no days with missing Q). Missing Q values may be interpolated from surrounding values.
- SC may be mean daily (with up to 60 missing days), seasonal, intermittent (more than 60 missing days), instantaneous from observers, or non-existant.

CLASS C

Inadequate data exists for SLOAD salt-load computation. Site data includes:

- Some QW records may exist, but none have TDS, hence they are not usable.
- SC may or may not exist, but is not used.
- Salt concentration and load are calculated from regression analysis of old data (Q and TDS).

Improvements and Declines in Class

The classification is shown by year for each site in the tables. This is helpful to see the trend in classifications.

A judgment call must be made for the final year classification. The final year has incomplete data, and the data have not been finalized by USGS. The final year classification will be shown as "provisional" if the criteria for the class are being met as of the cutoff date for the data. For example, if sufficient QW records exist to suggest that 6 observations will be made by the end of the WY, and if daily SC is being recorded, then A (provisional) will be given. The pattern of QW observations for the previous years is taken to project the QW for the final year. The final year will not be shown as provisional if no daily SC is being recorded, (the class is clearly B), or, if no QW records are available, (the class is clearly C).

#1 GRWY - STATION 09217000, Green River near Green River, WY

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	12	12	12	12	8 (thru 5-08)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	None	None	None	None	None
ROE TDS samples	12	12	12	12	8
SOC TDS samples	12	11	12	12	8
Class by Year	**B**	**B**	**B**	**B**	**B (provisional)**
Classify Notes	No SC	No SC	No SC	No SC	No SC

Operation is by USGS for daily Q, daily SC, and periodic QW.

#2 GDALE - STATION 09234500, Green River near Greendale, UT

Daily Q only, no SC until WY 2013, no QW with TDS until WY 2012. Due to insufficient data, SLOAD computations cannot be run for this station. Salt loads were calculated using a linear regression equation derived from old Q and TDS data (1/1990 through 8/2000.) SLOAD analysis should be possible in 2016 if current data collection is continued.

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	9	12	12	13	7 (thru 5-15)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	None	None	Starts 8/10 (314 missing)	Daily (8 missing)	Daily (5 missing)
ROE TDS samples	0	0	1	9	5
SOC TDS samples	0	0	1	9	5
Class by Year	**C**	**C**	**B**	**A**	**A (provisional)**
Classify Notes	No SC or TDS	No SC or TDS	TDS < 6 / yr		

Operation is by USGS for daily Q.

#3 YAMPA – STATION 09251000, Yampa River near Maybell, CO

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	6	6	6	6	3 (thru 5-19)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Daily (44 missing)	Daily (34 missing)	Daily (16 missing)	Daily (23 missing)	Daily (33 missing)
ROE TDS samples	0	0	0	0	0
SOC TDS samples	6	6	6	6	3
Class by Year	**A**	**A**	**A**	**A**	**A (provisional)**
Classify Notes	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr

Operation is by USGS for daily Q, daily SC, and periodic QW.

#4 DUCH – STATION 09302000, Duchesne River near Randlett, UT

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	8	18	8	11	9
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (56 missing)
SC	Daily (5 missing)	Daily (59 missing)	Daily (0 missing)	Daily (18 missing)	Daily (21 missing)
ROE TDS samples	6	8	8	9	5
SOC TDS samples	8	8	8	9	5
Class by Year	**A**	**A**	**A**	**A**	**A (provisional)**
Classify Notes	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr

Operation is by USGS for daily Q, daily SC, and periodic QW.

#5 WHITE – STATION 09306500, White River near Watson, Utah

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	10	9	9	12	8
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (84 missing)
SC	None	None	None	None	None
ROE TDS samples	9	8	8	9	5
SOC TDS samples	9	8	8	9	5
Class by Year	**B**	**B**	**B**	**B**	**B (provisional)**
Classify Notes	No SC	No SC	No SC	No SC	No SC

Operation is by USGS for daily Q and periodic QW.

#6 GRUT – STATION 09315000, Green River at Green River, UT

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	8	9	13	8	3
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	None	None	None	None	None
ROE TDS samples	8	9	9	8	3
SOC TDS samples	8	9	9	8	3
Class by Year	**B**	**B**	**B**	**B**	**B (provisional)**
Classify Notes	No SC	No SC	No SC	No SC	No SC

Operation is by USGS for daily Q and periodic QW.

#7 SANRAF – STATION 09328500, San Rafael River near Green River, UT

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	8	11	10	9	4
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	None	None	None	None	None
ROE TDS samples	8	9	9	8	3
SOC TDS samples	7	9	9	8	3
Class by Year	**B**	**B**	**B**	**B**	**B (provisional)**
Classify Notes	No SC	No SC	No SC	No SC	No SC

Operation is by USGS for daily Q, daily SC, and periodic QW.

#8 GLEN – STATION 09071750, Colorado River above Glenwood Springs, CO

This station has an SC monitor but no stream gage. Flow is computed as the difference between station 09085100 (Colorado River below Glenwood Springs, CO) and station 09085000 (Roaring Fork River at Glenwood Springs, CO).

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	6	6	6	6	3
Daily Q	Estimated (0 missing)	Estimated (0 missing)	Estimated (0 missing)	Estimated (0 missing)	Estimated (0 missing)
SC	Daily (32 missing)	Daily (15 missing)	Daily (2 missing)	Daily (0 missing)	Daily (0 missing)
ROE TDS samples	0	0	0	0	0
SOC TDS samples	6	6	6	6	3
Class by Year	**A**	**A**	**A**	**A**	**A (provisional)**
Classify Notes	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr

Operation is by USGS for estimated Q, daily SC and periodic QW.

#9 CAMEO - STATION 09095500, Colorado River near Cameo, CO

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	5	5	7	5	4
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Daily (34 missing)	Daily (38 missing)	Daily (59 missing)	Daily (46 missing)	Daily (2 missing)
ROE TDS samples	0	0	0	0	0
SOC TDS samples	4	5	6	5	3
Class by Year	**B**	**B**	**A**	**B**	**B (provisional)**
Classify Notes	QW observations < 6	QW observations < 6	QW observations > 6	QW observations < 6	

Operation is by USGS for daily Q, daily SC, and periodic QW.

#10 GUNN - STATION 09152500, Gunnison River near Grand Junction, CO

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	5	7	9	9	5
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Daily (9 missing)	Daily (37 missing)	Daily (7 missing)	Daily (60 missing)	Daily (9 missing)
ROE TDS samples	0	0	0	0	0
SOC TDS samples	5	7	8	9	**2**
Class by Year	**B**	**A**	**A**	**B**	**A (provisional)**
Classify Notes				Missing SC >59 / yr	

Operation is by USGS for daily Q, daily SC, and periodic QW.

#11 DOLOR - STATION 09180000, Dolores River near Cisco, UT

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	8	8	11	8	5
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Daily (12 missing)	Daily (29 missing)	Daily (0 missing)	Daily (26 missing)	Daily (7 missing)
ROE TDS samples	8	8	9	8	4
SOC TDS samples	7	8	9	8	4
Class by Year	**A**	**A**	**A**	**A**	**A (provisional)**
Classify Notes	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr

Operation is by USGS for daily Q, daily SC, and periodic QW.

#12 CISCO - STATION 09180500, Colorado River near Cisco, UT

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	8	8	12	8	4
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Daily (13 missing)	Daily (2 missing)	Daily (13 missing)	Daily (11 missing)	Daily (6 missing)
ROE TDS samples	7	8	9	8	2
SOC TDS samples	8	8	9	8	2
Class by Year	**A**	**A**	**A**	**A**	**A (provisional)**
Classify Notes	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr

Operation is by USGS for daily Q, daily SC, and periodic QW.

#13 ARCH - STATION 09355500, San Juan River near Archuleta, NM

Due to improvements in QW observations starting in 2009, it was possible to use SLOAD for the update in 2014.

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	3	4	5	4	1
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	None	None	None	None	None
ROE TDS samples	3	4	4	3	1
SOC TDS samples	1	3	3	3	1
Class by Year	**B**	**B**	**B**	**B**	**B (provisional)**
Classify Notes					

Operation is by USGS for daily Q and periodic QW.

#14 BLUFF - STATION 09379500, San Juan River near Bluff, UT

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	9	9	9	9	3
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Daily (9 missing)	Daily (6 missing)	Daily (1 missing)	Daily (30 missing)	Daily (9 missing)
ROE TDS samples	9	9	8	9	2
SOC TDS samples	9	9	8	9	2
Class by Year	**A**	**A**	**A**	**A**	**A (provisional)**
Classify Notes	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr	Missing SC < 60 / yr

Operation is by USGS for daily Q, daily SC, and periodic QW.

#15 LEES - STATION 09380000, Colorado River at Lees Ferry, AZ

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	4	4	5	14	10
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Daily (16 missing)	Daily (0 missing)	Daily (2 missing)	Daily (0 missing)	Daily (0 missing)
ROE TDS samples	4	4	4	14	9
SOC TDS samples	4	4	5	14	9
Class by Year	**B**	**B**	**B**	**A**	**A (provisional)**
Classify Notes	TDS samples < 6	TDS samples < 6	TDS samples < 6		

Operation is by USGS for daily Q, daily SC, and periodic QW.

#16 GRCAN - STATION 09402500, Colorado River near Grand Canyon, AZ

Daily Q only, no SC or QW. There has been no water quality sampling since late 1980's. Salt loads are computed with a special version of SLOAD by using the load at station 09380000 (Colorado River at Lees Ferry, AZ) and the flow difference between the 2 stations.

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	None	None	None	None	None
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	None	None	None	None	None
ROE TDS samples	0	0	0	0	0
SOC TDS samples	0	0	0	0	0
Class by Year	**C**	**C**	**C**	**C**	**C**
Classify Notes	No SC or QW	No SC or QW	No SC or QW	No SC or QW	No SC or QW

Operation is by USGS for daily Q.

#17 VIRGIN - STATION 09415000, Virgin River at Littlefield, AZ

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	4	4	4	4	2
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	None	None	None	None	None
ROE TDS samples	2	4	4	4	2
SOC TDS samples	2	4	4	4	2
Class by Year	**B**	**B**	**B**	**B**	**B (provisional)**
Classify Notes	No SC, TDS samples < 6	No SC, TDS samples < 6	No SC, TDS samples < 6	No SC, TDS samples < 6	No SC, TDS samples < 6

Operation is by USGS for daily Q and periodic QW.

#18 HOOVER – STATION 09421500, Colorado River below Hoover Dam, AZ-NV

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	11	11	11	11	6
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Daily (1 missing)	Daily (0 missing)	Daily (3 missing)	Daily (11 missing)	Daily (51 missing)
ROE TDS samples	11	11	11	11	6
SOC TDS samples	11	11	11	11	6
Class by Year	**A**	**A**	**A**	**A**	**A (provisional)**
Classify Notes	Includes USBR data	Includes USBR data	Includes USBR data	Includes USBR data	Includes USBR data

Operation is by USGS for daily Q and periodic QW and by Reclamation for daily SC and periodic QW.

#19 PARKER - STATION 09427520, Colorado River below Parker Dam, AZ-CA

Daily SC data provided by Reclamation was available for the first time for the 2014 update.

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	29	28	31	37	24 (thru 5/21)
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (2 missing)	Yes (0 missing)
ROE TDS samples	29	28	31	37	23
SOC TDS samples	29	28	31	37	23
Class by Year	**A**	**A**	**A**	**A**	**A**
Classify Notes	Includes USBR data	Includes USBR data	Includes USBR data	Includes USBR data	Includes USBR data

Operation is by USGS for daily Q and periodic QW and by Reclamation for daily SC and periodic QW.

#20 IMPER - STATION 09429490, Colorado River above Imperial Dam, AZ-CA

Water Year	2010	2011	2012	2013	2014 (thru 5-31)
QW Observations	30	27	26	27	17
Daily Q	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)	Yes (0 missing)
SC	Daily (0 missing)	Daily (0 missing)	Daily (0 missing)	Daily (0 missing)	Daily (0 missing)
ROE TDS samples	30	27	26	27	16
SOC TDS samples	4	4	10	27	16
Class by Year	**A**	**A**	**A**	**A**	**A (provisional)**
Classify Notes	Includes USBR data	Includes USBR data	Includes USBR data	Includes USBR data	Includes USBR data

Operation is by USGS for daily Q and quarterly QW, and by BOR for daily SC and additional periodic QW.

APPENDIX C

REGRESSION STATISTICS FOR 2014 SLOAD

Updates CY 2010-2013

1. STATION 09217000 (GRWY) Green River near Green River, WY

STATION 09217000 Green River near Green River, UT UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	36	2.8	0.0
2	2011	36	2.8	0.0
3	2012	36	2.8	0.0
4	2013	32	0.0	0.0
5	2014	32	0.0	0.0

STATION 09217000 Green River near Green River, UT UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	36	0.78425	0.16147	1.17013	0.79566	35	0.99398	0.02779	-6.70133	0.96864	1.08661
2	Calcium	35	0.04699	0.16402	4.51269	-0.09299	34	0.89891	0.05508	-3.10829	0.07752	1.04790
3	Magnesium	35	0.15118	0.14546	3.90034	-0.15674	34	0.94655	0.03765	-3.01949	-0.00206	0.95171
4	Chloride	35	0.15812	0.26883	3.59769	-0.29748	34	0.87079	0.10842	-8.48670	-0.02928	1.66499
5	Sulfate	35	0.36880	0.22813	7.66155	-0.44527	34	0.95446	0.06322	-3.12322	-0.20500	1.48452
6	Carbonate	35	0.01276	0.12104	4.71130	-0.03514	34	0.85332	0.04804	-0.77306	0.08783	0.75372
7	Sodium +K	35	0.45037	0.18611	6.42602	-0.43018	34	0.84514	0.10134	-1.14891	-0.26330	1.04559

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	36	0.78425	0.16147	1.17013	0.79566	35	0.99398	0.02779	-6.70133	0.96864	1.08661
9	Calcium	35	0.04699	0.16402	4.51269	-0.09299	34	0.89891	0.05508	-3.10829	0.07752	1.04790
10	Magnesium	35	0.15118	0.14546	3.90034	-0.15674	34	0.94655	0.03765	-3.01949	-0.00206	0.95171
11	Chloride	35	0.15812	0.26883	3.59769	-0.29748	34	0.87079	0.10842	-8.48670	-0.02928	1.66499
12	Sulfate	35	0.36880	0.22813	7.66155	-0.44527	34	0.95446	0.06322	-3.12322	-0.20500	1.48452
13	Carbonate	35	0.01276	0.12104	4.71130	-0.03514	34	0.85332	0.04804	-0.77306	0.08783	0.75372
14	Sodium +K	35	0.45037	0.18611	6.42602	-0.43018	34	0.84514	0.10134	-1.14891	-0.26330	1.04559

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	36	0.85861	0.14919	0.59168	0.87741	36	0.99573	0.02633	-6.81492	0.98229	1.08946
16	Calcium	35	0.00027	0.15896	3.89778	-0.00614	35	0.88938	0.05370	-3.58966	0.10098	1.09975
17	Magnesium	35	0.05876	0.13644	3.35825	-0.08021	35	0.93607	0.03611	-3.22095	0.01392	0.96635
18	Chloride	35	0.07972	0.25476	2.73525	-0.17642	35	0.81714	0.11532	-8.65506	-0.01347	1.67300
19	Sulfate	35	0.28603	0.21921	6.81453	-0.32645	35	0.92314	0.07304	-3.52812	-0.17849	1.51912
20	Carbonate	35	0.00102	0.11360	4.40280	0.00853	35	0.81362	0.04983	-0.71469	0.08174	0.75165
21	Sodium +K	35	0.41100	0.17753	5.85872	-0.34892	35	0.79389	0.10664	-1.29045	-0.24665	1.05006

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	32	0.81897	0.11376	0.04654	0.95683	31	0.82824	0.11414	-0.90112	1.05703	0.04376
23	Calcium	32	0.05132	0.12479	3.06838	0.11478	31	0.12035	0.12429	1.92540	0.23530	0.05310
24	Magnesium	32	0.00009	0.10274	2.77827	0.00389	31	0.05116	0.10340	2.01162	0.08400	0.03629
25	Chloride	32	0.00021	0.15073	1.56809	-0.00864	31	0.04453	0.15237	0.51796	0.10131	0.04950
26	Sulfate	32	0.06829	0.16188	5.76621	-0.17331	31	0.13065	0.16122	4.28457	-0.01536	0.06720
27	Carbonate	32	0.01730	0.09181	4.13016	0.04818	31	0.02058	0.09369	3.90781	0.06979	0.01205
28	Sodium +K	32	0.20091	0.13475	5.29398	-0.26719	31	0.22743	0.13693	4.42363	-0.17509	0.04012

2. STATION 09234500 (GDALE) Green River near Greendale, UT, NO REGRESSION STATS

This site has daily Q, no daily SC, and periodic QW observations. There are no TDS measurements included in the QW records prior to 2012, therefore there is insufficient data for SLOAD computations. Salt loads were calculated using a linear regression equation derived from old data (01/1990 through 08/2000.) See spreadsheet gdale_regression_2014.xlsx. If current QW sampling continues with TDS, there should be possible an SLOAD calculation in 2016.

3. STATION 09251000 (YAMPA) Yampa River near Maybell, CO

STATION 09251000 Yampa River near Maybell, CO UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	17	0.0	0.0
2	2011	17	0.0	0.0
3	2012	17	0.0	0.0
4	2013	15	0.0	0.0
5	2014	15	0.0	0.0

STATION 09251000 Yampa River near Maybell, CO UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	17	0.92766	0.32294	0.56887	0.87050	17	0.99928	0.03334	-7.45796	1.02395	1.14446
2	Calcium	17	0.15501	0.23837	4.12354	-0.07685	17	0.90085	0.08452	-1.47070	0.03009	0.79762
3	Magnesium	17	0.12689	0.35907	3.65154	-0.10304	17	0.97388	0.06429	-5.18290	0.06585	1.25960
4	Chloride	17	0.79302	0.28465	5.12268	-0.41942	17	0.96487	0.12138	-1.35649	-0.29555	0.92379
5	Sulfate	17	0.07684	0.46778	5.25035	-0.10159	17	0.97970	0.07180	-6.30568	0.11933	1.64765
6	Carbonate	17	0.40007	0.21064	5.09804	-0.12948	17	0.80251	0.12509	0.78851	-0.04709	0.61445
7	Sodium +K	17	0.52397	0.34288	5.24684	-0.27080	17	0.96312	0.09879	-2.98003	-0.11352	1.17298

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	17	0.92766	0.32294	0.56887	0.87050	17	0.99928	0.03334	-7.45796	1.02395	1.14446
9	Calcium	17	0.15501	0.23837	4.12354	-0.07685	17	0.90085	0.08452	-1.47070	0.03009	0.79762
10	Magnesium	17	0.12689	0.35907	3.65154	-0.10304	17	0.97388	0.06429	-5.18290	0.06585	1.25960
11	Chloride	17	0.79302	0.28465	5.12268	-0.41942	17	0.96487	0.12138	-1.35649	-0.29555	0.92379
12	Sulfate	17	0.07684	0.46778	5.25035	-0.10159	17	0.97970	0.07180	-6.30568	0.11933	1.64765
13	Carbonate	17	0.40007	0.21064	5.09804	-0.12948	17	0.80251	0.12509	0.78851	-0.04709	0.61445
14	Sodium +K	17	0.52397	0.34288	5.24684	-0.27080	17	0.96312	0.09879	-2.98003	-0.11352	1.17298

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	17	0.91611	0.35691	0.75361	0.83104	17	0.99919	0.03624	-7.23087	1.03361	1.09955
16	Calcium	17	0.25034	0.28521	4.31660	-0.11613	17	0.95124	0.07529	-1.88273	0.04115	0.85371
17	Magnesium	17	0.20943	0.42179	3.87190	-0.15296	17	0.98820	0.05335	-5.53874	0.08579	1.29595
18	Chloride	17	0.84266	0.30494	5.56992	-0.49723	17	0.98209	0.10648	-0.88308	-0.33352	0.88865
19	Sulfate	17	0.15165	0.52418	5.49289	-0.15615	17	0.97743	0.08851	-6.13265	0.13879	1.60096
20	Carbonate	17	0.47600	0.23683	5.23939	-0.15904	17	0.84854	0.13179	0.75049	-0.04516	0.61817
21	Sodium +K	17	0.59829	0.38449	5.57181	-0.33062	17	0.97374	0.10176	-2.78402	-0.11863	1.15069

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	15	0.88596	0.40327	0.93593	0.79919	15	0.99938	0.03087	-7.36973	1.04341	1.11376
23	Calcium	15	0.28999	0.31995	4.48693	-0.14538	15	0.95938	0.07965	-1.92875	0.04326	0.86032
24	Magnesium	15	0.26563	0.47075	4.12982	-0.20130	15	0.99191	0.05143	-5.53828	0.08297	1.29646
25	Chloride	15	0.83084	0.35236	5.89115	-0.55522	15	0.98043	0.12473	-0.95189	-0.35401	0.91763
26	Sulfate	15	0.17276	0.59705	5.70166	-0.19399	15	0.98963	0.06959	-6.55071	0.16627	1.64300
27	Carbonate	15	0.52162	0.25848	5.43198	-0.19191	15	0.89828	0.12406	0.69536	-0.05263	0.63517
28	Sodium +K	15	0.59520	0.43897	5.86364	-0.37846	15	0.98376	0.09153	-3.01801	-0.11731	1.19100

4. STATION 09302000 (DUCH) Duchesne River near Randlett, UT

STATION 09302000 Duchesne River near Randlett, UT UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	24	0.0	0.0
2	2011	24	0.0	0.0
3	2012	25	0.0	4.0
4	2013	22	0.0	4.5
5	2014	22	0.0	4.5

STATION 09302000 Duchesne River near Randlett, UT UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	24	0.92729	0.24232	2.41805	0.64737	23	0.99908	0.02695	-6.97015	1.00366	1.08730
2	Calcium	24	0.65932	0.21762	5.45805	-0.22648	23	0.94163	0.09339	-2.27285	0.06680	0.89548
3	Magnesium	24	0.68090	0.27950	5.32165	-0.30543	23	0.98892	0.05373	-5.48914	0.10732	1.24948
4	Chloride	24	0.85083	0.26502	6.12180	-0.47350	23	0.97982	0.10032	-3.35476	-0.11664	1.10043
5	Sulfate	24	0.81953	0.29598	8.00317	-0.47183	23	0.98071	0.09954	-2.87334	-0.05999	1.26064
6	Carbonate	24	0.54949	0.22841	5.93173	-0.18871	23	0.90604	0.10812	-2.09513	0.11796	0.92751
7	Sodium +K	24	0.84772	0.25810	6.93225	-0.45556	23	0.99112	0.06402	-2.77578	-0.08836	1.12563

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	24	0.92729	0.24232	2.41805	0.64737	23	0.99908	0.02695	-6.97015	1.00366	1.08730
9	Calcium	24	0.65932	0.21762	5.45805	-0.22648	23	0.94163	0.09339	-2.27285	0.06680	0.89548
10	Magnesium	24	0.68090	0.27950	5.32165	-0.30543	23	0.98892	0.05373	-5.48914	0.10732	1.24948
11	Chloride	24	0.85083	0.26502	6.12180	-0.47350	23	0.97982	0.10032	-3.35476	-0.11664	1.10043
12	Sulfate	24	0.81953	0.29598	8.00317	-0.47183	23	0.98071	0.09954	-2.87334	-0.05999	1.26064
13	Carbonate	24	0.54949	0.22841	5.93173	-0.18871	23	0.90604	0.10812	-2.09513	0.11796	0.92751
14	Sodium +K	24	0.84772	0.25810	6.93225	-0.45556	23	0.99112	0.06402	-2.77578	-0.08836	1.12563

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	25	0.96022	0.19821	2.32122	0.67101	25	0.99945	0.02387	-7.13389	1.00409	1.11130
16	Calcium	25	0.67693	0.19583	5.31006	-0.19532	25	0.92588	0.09591	-2.94768	0.09558	0.97057
17	Magnesium	25	0.79120	0.20143	5.17066	-0.27017	25	0.98906	0.04715	-4.24840	0.06164	1.10707
18	Chloride	25	0.88994	0.23104	6.04367	-0.45268	25	0.98418	0.08955	-4.22618	-0.09089	1.20707
19	Sulfate	25	0.86774	0.25977	7.95932	-0.45847	25	0.99128	0.06821	-4.10068	-0.03362	1.41747
20	Carbonate	25	0.68727	0.13665	5.66843	-0.13958	25	0.89017	0.08280	0.38100	0.04668	0.62146
21	Sodium +K	25	0.88437	0.22513	6.82198	-0.42900	25	0.99017	0.06713	-3.52224	-0.06459	1.21581

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	22	0.92052	0.19805	2.34201	0.66884	22	0.99913	0.02122	-7.35038	1.01619	1.13492
23	Calcium	22	0.41509	0.19606	5.19693	-0.16390	22	0.87321	0.09365	-3.34146	0.14209	0.99979
24	Magnesium	22	0.63298	0.20043	5.14980	-0.26120	22	0.98039	0.04753	-4.44570	0.08268	1.12357
25	Chloride	22	0.83521	0.21885	6.19715	-0.48892	22	0.97839	0.08132	-3.84087	-0.12918	1.17539
26	Sulfate	22	0.75539	0.25799	7.93247	-0.44990	22	0.98976	0.05416	-4.49409	-0.00456	1.45507
27	Carbonate	22	0.50113	0.13226	5.64217	-0.13155	22	0.77151	0.09184	0.85072	0.04016	0.56105
28	Sodium +K	22	0.81154	0.22344	6.95768	-0.46012	22	0.98403	0.06674	-3.56109	-0.08315	1.23168

5. STATION 09306500 (WHITE) White River near Watson, UT

STATION 09306500 White River near Watson, UT UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	23	0.0	0.0
2	2011	23	0.0	0.0
3	2012	24	0.0	0.0
4	2013	21	0.0	0.0
5	2014	21	0.0	0.0

STATION 09306500 White River near Watson, UT UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	23	0.94429	0.15572	1.45052	0.77393	23	0.99498	0.04787	-7.60188	1.01580	1.17935
2	Calcium	23	0.58461	0.10935	5.10920	-0.15661	23	0.76637	0.08403	0.70089	-0.03882	0.57432
3	Magnesium	23	0.62456	0.15568	4.60898	-0.24240	23	0.92007	0.07360	-3.80815	-0.01750	1.09659
4	Chloride	23	0.74415	0.24795	5.45283	-0.51050	23	0.94071	0.12231	-7.79196	-0.15661	1.72554
5	Sulfate	23	0.59345	0.25141	7.19344	-0.36670	23	0.96367	0.07701	-7.42766	0.02397	1.90485
6	Carbonate	23	0.40020	0.10035	5.26197	-0.09896	23	0.69365	0.07349	0.98437	0.01534	0.55729
7	Sodium +K	23	0.52133	0.27688	5.76904	-0.34884	23	0.88975	0.13617	-9.03454	0.04670	1.92862

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	23	0.94429	0.15572	1.45052	0.77393	23	0.99498	0.04787	-7.60188	1.01580	1.17935
9	Calcium	23	0.58461	0.10935	5.10920	-0.15661	23	0.76637	0.08403	0.70089	-0.03882	0.57432
10	Magnesium	23	0.62456	0.15568	4.60898	-0.24240	23	0.92007	0.07360	-3.80815	-0.01750	1.09659
11	Chloride	23	0.74415	0.24795	5.45283	-0.51050	23	0.94071	0.12231	-7.79196	-0.15661	1.72554
12	Sulfate	23	0.59345	0.25141	7.19344	-0.36670	23	0.96367	0.07701	-7.42766	0.02397	1.90485
13	Carbonate	23	0.40020	0.10035	5.26197	-0.09896	23	0.69365	0.07349	0.98437	0.01534	0.55729
14	Sodium +K	23	0.52133	0.27688	5.76904	-0.34884	23	0.88975	0.13617	-9.03454	0.04670	1.92862

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	24	0.95088	0.14602	1.31237	0.80003	24	0.99872	0.02409	-6.94672	1.01728	1.07746
16	Calcium	24	0.45464	0.11840	4.99452	-0.13463	24	0.72846	0.08552	0.18608	-0.00815	0.62730
17	Magnesium	24	0.57682	0.14799	4.45968	-0.21516	24	0.92464	0.06392	-3.22968	-0.01290	1.00313
18	Chloride	24	0.78275	0.20035	5.25892	-0.47358	24	0.96259	0.08509	-5.18810	-0.19878	1.36289
19	Sulfate	24	0.59121	0.22104	7.01097	-0.33105	24	0.98230	0.04707	-5.38032	-0.00510	1.61654
20	Carbonate	24	0.28067	0.09396	5.10849	-0.07309	24	0.76914	0.05448	0.67087	0.04364	0.57892
21	Sodium +K	24	0.46812	0.25009	5.45176	-0.29219	24	0.90545	0.10793	-7.54531	0.04970	1.69556

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	21	0.93220	0.12670	1.15094	0.82710	21	0.99856	0.01898	-6.75544	1.01762	1.04854
23	Calcium	21	0.08706	0.09938	4.53971	-0.05402	21	0.52677	0.07351	0.18970	0.05080	0.57689
24	Magnesium	21	0.45722	0.12755	4.38998	-0.20608	21	0.88597	0.06006	-2.76004	-0.03378	0.94823
25	Chloride	21	0.60639	0.20055	5.04136	-0.43822	21	0.90501	0.10122	-5.97670	-0.17271	1.46121
26	Sulfate	21	0.39900	0.19031	6.66749	-0.27298	21	0.97542	0.03954	-5.08809	0.01031	1.55901
27	Carbonate	21	0.20094	0.07942	5.08258	-0.07011	21	0.71246	0.04895	1.07478	0.02647	0.53151
28	Sodium +K	21	0.33849	0.22867	5.41843	-0.28797	21	0.85791	0.10888	-7.36244	0.02003	1.69499

6. STATION 09315000 (GRUT) Green River at Green River, UT

STATION 09315000 Green River at Green River, UT UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	26	0.0	0.0
2	2011	26	0.0	0.0
3	2012	26	0.0	0.0
4	2013	20	0.0	0.0
5	2014	20	0.0	0.0

STATION 09315000 Green River at Green River, UT UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	26	0.94161	0.18777	2.11825	0.74956	26	0.99902	0.02481	-6.81928	1.00350	1.06202
2	Calcium	26	0.54175	0.16705	5.44243	-0.18056	26	0.95599	0.05288	-2.18152	0.03606	0.90594
3	Magnesium	26	0.49352	0.22634	4.90599	-0.22210	26	0.96488	0.06088	-5.57513	0.07571	1.24545
4	Chloride	26	0.79987	0.19916	6.15847	-0.39580	26	0.98115	0.06244	-2.94016	-0.13728	1.08117
5	Sulfate	26	0.62777	0.24860	7.62181	-0.32092	26	0.99047	0.04063	-4.15721	0.01376	1.39967
6	Carbonate	26	0.51793	0.16043	5.90192	-0.16530	26	0.77867	0.11105	0.23849	-0.00439	0.67297
7	Sodium +K	26	0.78039	0.18733	6.84291	-0.35103	26	0.98756	0.04554	-1.89068	-0.10288	1.03779

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	26	0.94161	0.18777	2.11825	0.74956	26	0.99902	0.02481	-6.81928	1.00350	1.06202
9	Calcium	26	0.54175	0.16705	5.44243	-0.18056	26	0.95599	0.05288	-2.18152	0.03606	0.90594
10	Magnesium	26	0.49352	0.22634	4.90599	-0.22210	26	0.96488	0.06088	-5.57513	0.07571	1.24545
11	Chloride	26	0.79987	0.19916	6.15847	-0.39580	26	0.98115	0.06244	-2.94016	-0.13728	1.08117
12	Sulfate	26	0.62777	0.24860	7.62181	-0.32092	26	0.99047	0.04063	-4.15721	0.01376	1.39967
13	Carbonate	26	0.51793	0.16043	5.90192	-0.16530	26	0.77867	0.11105	0.23849	-0.00439	0.67297
14	Sodium +K	26	0.78039	0.18733	6.84291	-0.35103	26	0.98756	0.04554	-1.89068	-0.10288	1.03779

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	26	0.93502	0.21406	2.12875	0.74857	26	0.99939	0.02123	-7.35604	1.01704	1.12960
16	Calcium	26	0.52170	0.19195	5.47892	-0.18480	26	0.95441	0.06053	-2.64919	0.04526	0.96803
17	Magnesium	26	0.49350	0.23726	4.85527	-0.21590	26	0.96968	0.05930	-5.38639	0.07400	1.21974
18	Chloride	26	0.77359	0.23298	6.16040	-0.39699	26	0.97734	0.07529	-3.67884	-0.11849	1.17182
19	Sulfate	26	0.60792	0.28033	7.63097	-0.32178	26	0.98255	0.06040	-4.56831	0.02352	1.45289
20	Carbonate	26	0.56375	0.15703	5.90080	-0.16456	26	0.95288	0.05272	-0.70166	0.02233	0.78633
21	Sodium +K	26	0.72251	0.23443	6.81354	-0.34871	26	0.97615	0.07021	-3.16445	-0.06628	1.18834

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	20	0.80563	0.22144	2.71636	0.66828	20	0.99883	0.01764	-7.67801	1.03869	1.15375
23	Calcium	20	0.43532	0.19156	5.94456	-0.24932	20	0.92747	0.07064	-2.47535	0.05072	0.93459
24	Magnesium	20	0.39267	0.24408	5.40813	-0.29092	20	0.97591	0.05002	-5.85325	0.11037	1.24999
25	Chloride	20	0.66284	0.23851	6.87493	-0.49572	20	0.97385	0.06835	-3.91016	-0.11139	1.19712
26	Sulfate	20	0.44165	0.29757	8.13402	-0.39230	20	0.98390	0.05199	-5.67259	0.09970	1.53250
27	Carbonate	20	0.56828	0.14873	6.55535	-0.25295	20	0.94370	0.05527	0.02544	-0.02025	0.72481
28	Sodium +K	20	0.63062	0.24056	7.68919	-0.46594	20	0.96955	0.07108	-3.15999	-0.07933	1.20424

7. STATION 09328500, San Rafael River near Green River, UT

STATION 09328500 San Rafael River near Green River, UT UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	26	3.8	0.0
2	2011	26	3.8	0.0
3	2012	26	0.0	0.0
4	2013	20	0.0	0.0
5	2014	20	0.0	0.0

STATION 09328500 San Rafael River near Green River, UT UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	26	0.91521	0.31389	2.94805	0.64393	26	0.99732	0.05704	-7.42052	1.00639	1.16111
2	Calcium	25	0.59706	0.35610	6.31706	-0.27023	25	0.70763	0.31015	0.10648	-0.05046	0.69350
3	Magnesium	25	0.68924	0.39353	6.00357	-0.36538	25	0.92101	0.20287	-5.31172	0.03504	1.26352
4	Chloride	25	0.70722	0.44425	5.51665	-0.43044	25	0.88936	0.27923	-6.14931	-0.01762	1.30268
5	Sulfate	25	0.72243	0.41180	8.53751	-0.41417	25	0.97409	0.12864	-4.51752	0.04781	1.45779
6	Carbonate	25	0.34566	0.31223	5.49690	-0.14148	25	0.34739	0.31883	4.96353	-0.12260	0.05956
7	Sodium +K	25	0.62684	0.51805	6.97731	-0.41859	25	0.85413	0.33117	-6.48382	0.05777	1.50314

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	26	0.91521	0.31389	2.94805	0.64393	26	0.99732	0.05704	-7.42052	1.00639	1.16111
9	Calcium	25	0.59706	0.35610	6.31706	-0.27023	25	0.70763	0.31015	0.10648	-0.05046	0.69350
10	Magnesium	25	0.68924	0.39353	6.00357	-0.36538	25	0.92101	0.20287	-5.31172	0.03504	1.26352
11	Chloride	25	0.70722	0.44425	5.51665	-0.43044	25	0.88936	0.27923	-6.14931	-0.01762	1.30268
12	Sulfate	25	0.72243	0.41180	8.53751	-0.41417	25	0.97409	0.12864	-4.51752	0.04781	1.45779
13	Carbonate	25	0.34566	0.31223	5.49690	-0.14148	25	0.34739	0.31883	4.96353	-0.12260	0.05956
14	Sodium +K	25	0.62684	0.51805	6.97731	-0.41859	25	0.85413	0.33117	-6.48382	0.05777	1.50314

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	26	0.92906	0.30209	2.81708	0.68273	26	0.99665	0.06703	-6.99319	0.99798	1.10942
16	Calcium	26	0.57713	0.30284	6.16910	-0.22095	26	0.67140	0.27270	1.41202	-0.06808	0.53797
17	Magnesium	26	0.62366	0.39892	5.80534	-0.32071	26	0.89385	0.21642	-5.43997	0.04065	1.27171
18	Chloride	26	0.64993	0.44787	5.32162	-0.38111	26	0.87342	0.27510	-6.58403	0.00147	1.34638
19	Sulfate	26	0.70535	0.37748	8.37447	-0.36473	26	0.96481	0.13326	-3.41013	0.01395	1.33269
20	Carbonate	26	0.36730	0.30981	5.52419	-0.14742	26	0.40887	0.30590	2.88223	-0.06252	0.29877
21	Sodium +K	26	0.57383	0.52339	6.81335	-0.37928	26	0.85085	0.31629	-7.22560	0.07184	1.58763

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	20	0.91112	0.26165	2.56526	0.77271	20	0.99445	0.06726	-6.17112	0.98415	1.01063
23	Calcium	20	0.27676	0.22169	5.92414	-0.12649	20	0.29322	0.22551	4.77094	-0.09858	0.13340
24	Magnesium	20	0.31314	0.44176	5.67251	-0.27513	20	0.90238	0.17137	-8.43656	0.06635	1.63215
25	Chloride	20	0.32479	0.48599	5.13054	-0.31090	20	0.82393	0.25537	-9.27780	0.03782	1.66677
26	Sulfate	20	0.47247	0.27243	8.01514	-0.23781	20	0.94643	0.08933	-0.88921	-0.02230	1.03006
27	Carbonate	20	0.25682	0.29133	5.54344	-0.15797	20	0.58914	0.22290	-1.17418	0.00461	0.77710
28	Sodium +K	20	0.25886	0.56721	6.61740	-0.30920	20	0.75524	0.33541	-9.38933	0.07821	1.85167

8. STATION 09071750 (GLEN) Colorado River above Glenwood Springs CO

STATION 09071750 Colorado River above Glenwood Springs, CO UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	18	0.0	0.0
2	2011	18	0.0	0.0
3	2012	18	0.0	0.0
4	2013	15	0.0	0.0
5	2014	15	0.0	0.0

STATION 09071750 Colorado River above Glenwood Springs, CO UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	18	0.90628	0.11032	3.8626	0.46251	18	0.99325	0.03057	-8.25824	1.10004	1.16234
2	Calcium	18	0.83199	0.11687	6.4882	-0.35061	18	0.96362	0.05617	-5.30957	0.26992	1.13136
3	Magnesium	18	0.82083	0.13705	5.2548	-0.39547	18	0.93542	0.08498	-7.24558	0.26203	1.19874
4	Chloride	18	0.97273	0.11609	11.2073	-0.93481	18	0.98700	0.08279	1.62949	-0.43104	0.91848
5	Sulfate	18	0.84667	0.16058	8.0158	-0.50870	18	0.95558	0.08926	-7.41909	0.30315	1.48015
6	Carbonate	18	0.82800	0.09130	6.0761	-0.27005	18	0.95548	0.04797	-2.88816	0.20145	0.85964
7	Sodium +K	18	0.96007	0.11917	9.7983	-0.78777	18	0.98974	0.06240	-1.91751	-0.17155	1.12350

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	18	0.90628	0.11032	3.8626	0.46251	18	0.99325	0.03057	-8.25824	1.10004	1.16234
9	Calcium	18	0.83199	0.11687	6.4882	-0.35061	18	0.96362	0.05617	-5.30957	0.26992	1.13136
10	Magnesium	18	0.82083	0.13705	5.2548	-0.39547	18	0.93542	0.08498	-7.24558	0.26203	1.19874
11	Chloride	18	0.97273	0.11609	11.2073	-0.93481	18	0.98700	0.08279	1.62949	-0.43104	0.91848
12	Sulfate	18	0.84667	0.16058	8.0158	-0.50870	18	0.95558	0.08926	-7.41909	0.30315	1.48015
13	Carbonate	18	0.82800	0.09130	6.0761	-0.27005	18	0.95548	0.04797	-2.88816	0.20145	0.85964
14	Sodium +K	18	0.96007	0.11917	9.7983	-0.78777	18	0.98974	0.06240	-1.91751	-0.17155	1.12350

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	18	0.89141	0.11833	3.9130	0.45219	18	0.99329	0.03038	-8.30693	1.10826	1.16165
16	Calcium	18	0.84175	0.11854	6.5679	-0.36463	18	0.96272	0.05943	-4.48162	0.22861	1.05039
17	Magnesium	18	0.83085	0.12809	5.1118	-0.37861	18	0.95538	0.06795	-6.60541	0.25048	1.11385
18	Chloride	18	0.96709	0.13152	11.2863	-0.95084	18	0.98619	0.08801	0.60547	-0.37740	1.01534
19	Sulfate	18	0.83103	0.17480	8.0344	-0.51703	18	0.96270	0.08483	-8.41678	0.36622	1.56387
20	Carbonate	18	0.83717	0.08914	6.0499	-0.26957	18	0.94634	0.05285	-1.73148	0.14821	0.73971
21	Sodium +K	18	0.95700	0.12971	9.9891	-0.81606	18	0.99294	0.05428	-2.65347	-0.13730	1.20182

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	15	0.82628	0.14299	3.8366	0.46092	15	0.99612	0.02226	-8.15638	1.10201	1.14483
23	Calcium	15	0.74203	0.13906	6.4486	-0.34857	15	0.95297	0.06179	-4.21771	0.22160	1.01820
24	Magnesium	15	0.74660	0.14561	5.0359	-0.36942	15	0.96054	0.05981	-6.31347	0.23726	1.08340
25	Chloride	15	0.94982	0.15303	11.5048	-0.98404	15	0.97848	0.10432	1.69541	-0.45968	0.93639
26	Sulfate	15	0.69493	0.21355	7.7343	-0.47636	15	0.93961	0.09889	-8.48857	0.39084	1.54862
27	Carbonate	15	0.75635	0.09969	5.9617	-0.25961	15	0.93061	0.05538	-1.19006	0.12269	0.68270
28	Sodium +K	15	0.91747	0.16680	10.0129	-0.82198	15	0.98636	0.07057	-2.91457	-0.13094	1.23404

9. STATION 09095500 (CAMEO) Colorado River near Cameo, CO

STATION 09095500 Colorado River near Cameo, CO UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	15	0.0	0.0
2	2011	15	0.0	0.0
3	2012	16	0.0	0.0
4	2013	14	0.0	0.0
5	2014	14	0.0	0.0

STATION 09095500 Colorado River near Cameo, CO UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	15	0.69355	0.20719	5.4497	0.35552	15	0.99087	0.03723	-9.7008	1.15985	1.28917
2	Calcium	15	0.53831	0.35876	7.6834	-0.44186	15	0.92347	0.15203	-16.6433	0.84963	2.06998
3	Magnesium	15	0.97066	0.07130	6.3860	-0.46775	15	0.98268	0.05702	2.9976	-0.28786	0.28832
4	Chloride	15	0.98501	0.10667	12.6991	-0.98628	15	0.98852	0.09715	8.8654	-0.78275	0.32621
5	Sulfate	15	0.67720	0.42328	10.2562	-0.69928	15	0.97094	0.13218	-19.7201	0.89214	2.55071
6	Carbonate	15	0.94935	0.05726	6.5579	-0.28275	15	0.96268	0.05116	8.7390	-0.39855	-0.18559
7	Sodium +K	15	0.98784	0.08660	11.6184	-0.89036	15	0.99166	0.07466	8.0161	-0.69911	0.30652

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	15	0.69355	0.20719	5.4497	0.35552	15	0.99087	0.03723	-9.7008	1.15985	1.28917
9	Calcium	15	0.53831	0.35876	7.6834	-0.44186	15	0.92347	0.15203	-16.6433	0.84963	2.06998
10	Magnesium	15	0.97066	0.07130	6.3860	-0.46775	15	0.98268	0.05702	2.9976	-0.28786	0.28832
11	Chloride	15	0.98501	0.10667	12.6991	-0.98628	15	0.98852	0.09715	8.8654	-0.78275	0.32621
12	Sulfate	15	0.67720	0.42328	10.2562	-0.69928	15	0.97094	0.13218	-19.7201	0.89214	2.55071
13	Carbonate	15	0.94935	0.05726	6.5579	-0.28275	15	0.96268	0.05116	8.7390	-0.39855	-0.18559
14	Sodium +K	15	0.98784	0.08660	11.6184	-0.89036	15	0.99166	0.07466	8.0161	-0.69911	0.30652

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	16	0.64393	0.22372	5.1436	0.38825	16	0.99077	0.03739	-9.8711	1.16934	1.30316
16	Calcium	16	0.46220	0.35538	7.5203	-0.42516	16	0.91268	0.14860	-14.5966	0.72540	1.91959
17	Magnesium	16	0.90305	0.11830	6.3206	-0.46592	16	0.95168	0.08667	0.6233	-0.16954	0.49448
18	Chloride	16	0.97460	0.11503	12.1166	-0.91955	16	0.98443	0.09345	7.2494	-0.66635	0.42244
19	Sulfate	16	0.57217	0.42857	9.7279	-0.63959	16	0.94659	0.15714	-17.5348	0.77866	2.36620
20	Carbonate	16	0.89816	0.07271	6.4952	-0.27866	16	0.89837	0.07538	6.7157	-0.29013	-0.01914
21	Sodium +K	16	0.96363	0.12739	11.2169	-0.84617	16	0.97903	0.10038	5.5795	-0.55290	0.48929

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	14	0.52482	0.24140	5.2225	0.37616	14	0.99345	0.02960	-10.4777	1.21798	1.33804
23	Calcium	14	0.34296	0.38095	7.4078	-0.40808	14	0.95987	0.09834	-16.7670	0.88814	2.06029
24	Magnesium	14	0.87588	0.12134	6.3938	-0.47791	14	0.93935	0.08859	0.7116	-0.17324	0.48427
25	Chloride	14	0.97822	0.09691	12.4139	-0.96306	14	0.98811	0.07480	8.1375	-0.73376	0.36445
26	Sulfate	14	0.42070	0.46401	9.3243	-0.58630	14	0.96446	0.12004	-20.1167	0.99229	2.50910
27	Carbonate	14	0.80594	0.07831	6.1599	-0.23661	14	0.80726	0.08151	6.5837	-0.25933	-0.03612
28	Sodium +K	14	0.95943	0.11925	11.2831	-0.85990	14	0.97852	0.09064	5.9262	-0.57267	0.45654

10. STATION 09152500 (GUNN) Gunnison River near Grand Junction, CO

STATION 09152500 Gunnison River near Grand Junction, Co UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	21	0.0	0.0
2	2011	21	0.0	0.0
3	2012	25	0.0	0.0
4	2013	21	0.0	0.0
5	2014	21	0.0	0.0

STATION 09152500 Gunnison River near Grand Junction, Co UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	21	0.75515	0.18860	3.2308	0.61397	21	0.99146	0.03618	-6.67547	0.98558	1.07359
2	Calcium	21	0.41139	0.21899	7.0209	-0.33936	21	0.91791	0.08402	-3.83998	0.06805	1.17703
3	Magnesium	21	0.63531	0.17201	6.4570	-0.42085	21	0.91950	0.08303	-1.66142	-0.11631	0.87983
4	Chloride	21	0.80294	0.13262	5.6407	-0.49625	21	0.88934	0.10211	0.94576	-0.32013	0.50881
5	Sulfate	21	0.51136	0.23788	8.9302	-0.45109	21	0.98321	0.04531	-3.56743	0.01772	1.35442
6	Carbonate	21	0.68793	0.10560	6.5579	-0.29064	21	0.83715	0.07837	2.65375	-0.14418	0.42311
7	Sodium +K	21	0.64034	0.18331	7.2117	-0.45339	21	0.93655	0.07910	-1.68229	-0.11976	0.96388

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	21	0.75515	0.18860	3.2308	0.61397	21	0.99146	0.03618	-6.67547	0.98558	1.07359
9	Calcium	21	0.41139	0.21899	7.0209	-0.33936	21	0.91791	0.08402	-3.83998	0.06805	1.17703
10	Magnesium	21	0.63531	0.17201	6.4570	-0.42085	21	0.91950	0.08303	-1.66142	-0.11631	0.87983
11	Chloride	21	0.80294	0.13262	5.6407	-0.49625	21	0.88934	0.10211	0.94576	-0.32013	0.50881
12	Sulfate	21	0.51136	0.23788	8.9302	-0.45109	21	0.98321	0.04531	-3.56743	0.01772	1.35442
13	Carbonate	21	0.68793	0.10560	6.5579	-0.29064	21	0.83715	0.07837	2.65375	-0.14418	0.42311
14	Sodium +K	21	0.64034	0.18331	7.2117	-0.45339	21	0.93655	0.07910	-1.68229	-0.11976	0.96388

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	25	0.77282	0.18880	3.5705	0.57022	25	0.99299	0.03391	-6.68460	0.98410	1.07648
16	Calcium	25	0.52634	0.21939	7.3442	-0.37870	25	0.95286	0.07076	-4.14238	0.08488	1.20574
17	Magnesium	25	0.72350	0.16867	6.6487	-0.44678	25	0.94012	0.08026	-1.58840	-0.11434	0.86465
18	Chloride	25	0.87980	0.11563	5.7433	-0.51226	25	0.92582	0.09288	1.79594	-0.35295	0.41435
19	Sulfate	25	0.62645	0.23481	9.2891	-0.49793	25	0.98510	0.04795	-3.40534	0.01440	1.33253
20	Carbonate	25	0.73513	0.11613	6.7637	-0.31679	25	0.88050	0.07975	2.01700	-0.12522	0.49826
21	Sodium +K	25	0.74330	0.18009	7.5806	-0.50182	25	0.94140	0.08798	-1.14841	-0.14953	0.91629

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	21	0.54587	0.15494	4.7783	0.39469	21	0.98056	0.03294	-7.45124	1.02475	1.14713
23	Calcium	21	0.57480	0.21006	8.6362	-0.56748	21	0.96884	0.05842	-7.67838	0.27305	1.53032
24	Magnesium	21	0.76353	0.14573	7.7653	-0.60842	21	0.91897	0.08764	-1.76674	-0.11732	0.89411
25	Chloride	21	0.89710	0.09925	6.9134	-0.68089	21	0.91421	0.09311	3.64860	-0.51269	0.30624
26	Sulfate	21	0.74266	0.17413	10.5898	-0.68733	21	0.98212	0.04716	-2.96182	0.01085	1.27115
27	Carbonate	21	0.69600	0.11764	7.4314	-0.41358	21	0.92585	0.05969	-0.82100	0.01159	0.77408
28	Sodium +K	21	0.80890	0.14139	8.7895	-0.67588	21	0.92328	0.09204	-0.03520	-0.22123	0.82776

11. STATION 09180000 (DOLOR) Dolores River near Cisco, UT

STATION 09180000 Dolores River near Cisco, UT UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	25	4.0	0.0
2	2011	25	4.0	0.0
3	2012	24	0.0	0.0
4	2013	20	0.0	0.0
5	2014	20	0.0	0.0

STATION 09180000 Dolores River near Cisco, UT UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	25	0.73201	0.33233	3.09468	0.53432	25	0.99325	0.05394	-6.11243	0.97097	0.97772
2	Calcium	24	0.64619	0.25565	6.21452	-0.32936	24	0.78208	0.20536	1.55242	-0.11050	0.49871
3	Magnesium	24	0.75260	0.26548	5.56640	-0.44141	24	0.91647	0.15789	-0.79126	-0.14295	0.68009
4	Chloride	24	0.55728	0.66788	8.66663	-0.71434	24	0.86376	0.37922	-7.68448	0.05326	1.74911
5	Sulfate	24	0.69339	0.37441	8.17155	-0.53675	24	0.80949	0.30207	1.39229	-0.21850	0.72519
6	Carbonate	24	0.73592	0.12646	5.50512	-0.20126	24	0.82850	0.10431	3.30185	-0.09782	0.23569
7	Sodium +K	24	0.59210	0.51962	7.79399	-0.59682	24	0.92585	0.22675	-6.03636	0.05245	1.47946

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	25	0.73201	0.33233	3.09468	0.53432	25	0.99325	0.05394	-6.11243	0.97097	0.97772
9	Calcium	24	0.64619	0.25565	6.21452	-0.32936	24	0.78208	0.20536	1.55242	-0.11050	0.49871
10	Magnesium	24	0.75260	0.26548	5.56640	-0.44141	24	0.91647	0.15789	-0.79126	-0.14295	0.68009
11	Chloride	24	0.55728	0.66788	8.66663	-0.71434	24	0.86376	0.37922	-7.68448	0.05326	1.74911
12	Sulfate	24	0.69339	0.37441	8.17155	-0.53675	24	0.80949	0.30207	1.39229	-0.21850	0.72519
13	Carbonate	24	0.73592	0.12646	5.50512	-0.20126	24	0.82850	0.10431	3.30185	-0.09782	0.23569
14	Sodium +K	24	0.59210	0.51962	7.79399	-0.59682	24	0.92585	0.22675	-6.03636	0.05245	1.47946

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	24	0.78785	0.25997	2.86985	0.55173	24	0.98901	0.06057	-6.11259	0.97802	0.97324
16	Calcium	24	0.60790	0.23158	6.09818	-0.31755	24	0.71575	0.20181	1.78844	-0.11302	0.46695
17	Magnesium	24	0.68757	0.27198	5.50471	-0.44434	24	0.88211	0.17100	-2.11070	-0.08293	0.82512
18	Chloride	24	0.58465	0.58403	8.72886	-0.76309	24	0.87295	0.33060	-8.53670	0.05630	1.87070
19	Sulfate	24	0.70051	0.29956	7.94080	-0.50455	24	0.78219	0.26148	2.38974	-0.24111	0.60145
20	Carbonate	24	0.53764	0.15376	5.37385	-0.18261	24	0.81349	0.09996	1.15948	0.01740	0.45662
21	Sodium +K	24	0.60491	0.45283	7.72671	-0.61707	24	0.94180	0.17789	-7.11081	0.08709	1.60763

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	20	0.65787	0.29430	3.12049	0.49551	20	0.98516	0.06308	-6.19589	0.98908	0.97749
23	Calcium	20	0.61345	0.25381	6.45519	-0.38823	20	0.76579	0.20329	1.29825	-0.11503	0.54107
24	Magnesium	20	0.65042	0.32049	5.93625	-0.53080	20	0.89332	0.18218	-2.71037	-0.07272	0.90721
25	Chloride	20	0.52827	0.57742	8.51457	-0.74194	20	0.85983	0.32388	-7.15338	0.08811	1.64390
26	Sulfate	20	0.67933	0.34174	8.43313	-0.60395	20	0.81129	0.26976	1.33786	-0.22806	0.74444
27	Carbonate	20	0.48179	0.18386	5.54119	-0.21525	20	0.84638	0.10301	0.54992	0.04918	0.52369
28	Sodium +K	20	0.55229	0.46980	7.73818	-0.63357	20	0.94836	0.16418	-6.56362	0.12411	1.50056

12. STATION 09180500 (CISCO) Colorado River near Cisco, UT

STATION 09180500 Colorado River near Cisco, UT UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	25	0.0	0.0
2	2011	25	0.0	0.0
3	2012	25	0.0	0.0
4	2013	19	0.0	0.0
5	2014	19	0.0	0.0

STATION 09180500 Colorado River near Cisco, UT UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	25	0.76320	0.16459	5.6954	0.38446	25	0.98595	0.04100	-8.07891	1.05423	1.18027
2	Calcium	25	0.72294	0.25883	9.0757	-0.54400	25	0.89945	0.15943	-8.75107	0.32283	1.52751
3	Magnesium	25	0.92605	0.12556	8.0980	-0.57814	25	0.98222	0.06295	-1.34469	-0.11899	0.80911
4	Chloride	25	0.93496	0.17399	11.6219	-0.85832	25	0.93736	0.17458	8.73367	-0.71788	0.24748
5	Sulfate	25	0.82341	0.26111	11.6341	-0.73361	25	0.96770	0.11418	-8.73233	0.25671	1.74513
6	Carbonate	25	0.87257	0.07652	6.6515	-0.26052	25	0.91998	0.06200	2.62423	-0.06469	0.34508
7	Sodium +K	25	0.95684	0.12357	10.7727	-0.75704	25	0.96373	0.11583	6.51202	-0.54986	0.36508

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	25	0.76320	0.16459	5.6954	0.38446	25	0.98595	0.04100	-8.07891	1.05423	1.18027
9	Calcium	25	0.72294	0.25883	9.0757	-0.54400	25	0.89945	0.15943	-8.75107	0.32283	1.52751
10	Magnesium	25	0.92605	0.12556	8.0980	-0.57814	25	0.98222	0.06295	-1.34469	-0.11899	0.80911
11	Chloride	25	0.93496	0.17399	11.6219	-0.85832	25	0.93736	0.17458	8.73367	-0.71788	0.24748
12	Sulfate	25	0.82341	0.26111	11.6341	-0.73361	25	0.96770	0.11418	-8.73233	0.25671	1.74513
13	Carbonate	25	0.87257	0.07652	6.6515	-0.26052	25	0.91998	0.06200	2.62423	-0.06469	0.34508
14	Sodium +K	25	0.95684	0.12357	10.7727	-0.75704	25	0.96373	0.11583	6.51202	-0.54986	0.36508

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	25	0.74794	0.19699	5.2429	0.43488	25	0.99141	0.03719	-8.48088	1.07151	1.21825
16	Calcium	25	0.63223	0.29033	8.5649	-0.48785	25	0.91726	0.14080	-9.55332	0.35263	1.60834
17	Magnesium	25	0.87198	0.15713	7.6153	-0.52556	25	0.97670	0.06854	-2.45887	-0.05823	0.89428
18	Chloride	25	0.94724	0.15236	11.3184	-0.82735	25	0.95329	0.14658	7.66188	-0.65774	0.32458
19	Sulfate	25	0.75144	0.29849	11.0342	-0.66514	25	0.97001	0.10601	-8.80721	0.25528	1.76130
20	Carbonate	25	0.78836	0.09531	6.4243	-0.23574	25	0.89225	0.06953	1.69115	-0.01617	0.42016
21	Sodium +K	25	0.92962	0.15468	10.4240	-0.72048	25	0.95658	0.12423	3.63778	-0.40567	0.60241

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	19	0.35911	0.23195	5.6016	0.38948	19	0.97722	0.04508	-8.26805	1.07847	1.18115
23	Calcium	19	0.32437	0.32751	8.7398	-0.50903	19	0.86743	0.14954	-9.13816	0.37908	1.52250
24	Magnesium	19	0.64514	0.18494	7.8795	-0.55936	19	0.95835	0.06531	-2.69962	-0.03383	0.90093
25	Chloride	19	0.81703	0.16392	10.8857	-0.77697	19	0.86667	0.14423	5.68740	-0.51874	0.44269
26	Sulfate	19	0.46857	0.33683	11.3865	-0.70946	19	0.93505	0.12138	-7.82766	0.24503	1.63629
27	Carbonate	19	0.59044	0.11345	6.9829	-0.30556	19	0.81407	0.07880	1.87854	-0.05199	0.43469
28	Sodium +K	19	0.74576	0.16989	9.8547	-0.65268	19	0.88921	0.11560	2.08457	-0.26669	0.66171

13. STATION 09355500 (ARCH) San Juan River near Archuleta, NM

STATION 09355500 San Juan River near Archuleta, NM UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	11	18.2	0.0
2	2011	11	18.2	0.0
3	2012	11	18.2	9.1
4	2013	8	12.5	12.5

STATION 09355500 San Juan River near Archuleta, NM UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	11	0.99838	0.03964	-0.82861	0.98791	11	0.99943	0.024975	-7.57890	1.01077	1.19937
2	Calcium	9	0.01478	0.03985	3.37951	-0.00470	9	0.30387	0.036177	-1.36735	0.00824	0.84804
3	Magnesium	9	0.13612	0.03464	1.59656	0.01325	9	0.38033	0.031693	-2.45451	0.02430	0.72373
4	Chloride	9	0.11845	0.05237	1.12096	-0.01850	9	0.57739	0.039166	-7.18936	0.00416	1.48466
5	Sulfate	9	0.34936	0.04856	3.85504	-0.03429	9	0.63152	0.039474	-3.17819	-0.01512	1.25650
6	Carbonate	9	0.00341	0.02452	3.88664	-0.00138	9	0.35082	0.021377	0.70247	0.00730	0.56886
7	Sodium +K	9	0.09811	0.05423	2.56832	0.01724	9	0.27226	0.052615	-2.67240	0.03152	0.93627

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	11	0.99838	0.03964	-0.82861	0.98791	11	0.99943	0.024975	-7.57890	1.01077	1.19937
9	Calcium	9	0.01478	0.03985	3.37951	-0.00470	9	0.30387	0.036177	-1.36735	0.00824	0.84804
10	Magnesium	9	0.13612	0.03464	1.59656	0.01325	9	0.38033	0.031693	-2.45451	0.02430	0.72373
11	Chloride	9	0.11845	0.05237	1.12096	-0.01850	9	0.57739	0.039166	-7.18936	0.00416	1.48466
12	Sulfate	9	0.34936	0.04856	3.85504	-0.03429	9	0.63152	0.039474	-3.17819	-0.01512	1.25650
13	Carbonate	9	0.00341	0.02452	3.88664	-0.00138	9	0.35082	0.021377	0.70247	0.00730	0.56886
14	Sodium +K	9	0.09811	0.05423	2.56832	0.01724	9	0.27226	0.052615	-2.67240	0.03152	0.93627

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	11	0.99689	0.05646	-0.66235	0.96753	11	0.99938	0.026826	-6.65145	1.00296	1.04049
16	Calcium	9	0.22128	0.05915	3.57276	-0.02826	9	0.75805	0.035613	-1.83905	0.00744	0.93500
17	Magnesium	9	0.08834	0.04068	1.79889	-0.01135	9	0.83946	0.018441	-2.27058	0.01549	0.70308
18	Chloride	9	0.38393	0.07008	1.36465	-0.04957	9	0.88699	0.032419	-5.61347	-0.00355	1.20561
19	Sulfate	9	0.43227	0.10861	4.26193	-0.08493	9	0.92955	0.041326	-6.93940	-0.01105	1.93525
20	Carbonate	9	0.16482	0.03535	3.98779	-0.01407	9	0.60731	0.026185	1.15196	0.00463	0.48995
21	Sodium +K	9	0.20648	0.10130	3.07983	-0.04630	9	0.72960	0.063871	-5.98378	0.01347	1.56592

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	8	0.99523	0.06709	-0.48319	0.94146	8	0.99936	0.027033	-7.36332	1.01001	1.16019
23	Calcium	7	0.51668	0.05165	3.72623	-0.04877	7	0.97396	0.013404	-2.46011	0.01981	1.03326
24	Magnesium	7	0.45254	0.04060	1.94714	-0.03371	7	0.98309	0.007978	-2.97453	0.02085	0.82204
25	Chloride	7	0.71228	0.06263	1.64154	-0.08999	7	0.92325	0.036162	-4.96185	-0.01678	1.10292
26	Sulfate	7	0.64785	0.11750	4.68876	-0.14555	7	0.94958	0.049708	-8.70456	0.00293	2.23700
27	Carbonate	7	0.52423	0.04058	4.15466	-0.03890	7	0.82100	0.027831	0.20782	0.00485	0.65922
28	Sodium +K	7	0.43870	0.09307	3.30101	-0.07515	7	0.75559	0.068666	-5.31035	0.02032	1.43830

14. STATION 09379500 (BLUFF) San Juan River near Bluff, UT

STATION 09379500 San Juan River near Bluff, UT UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	25	0.0	0.0
2	2011	25	0.0	0.0
3	2012	26	0.0	0.0
4	2013	19	0.0	0.0
5	2014	19	0.0	0.0

STATION 09379500 San Juan River near Bluff, UT UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	25	0.65567	0.24495	1.29613	0.83311	25	0.99458	0.03141	-7.18479	0.98945	1.14038
2	Calcium	25	0.00587	0.24648	4.57240	-0.04666	25	0.75066	0.12622	-2.87289	0.09059	1.00112
3	Magnesium	25	0.14421	0.30007	4.81187	-0.30360	25	0.36601	0.26408	-0.51931	-0.20532	0.71685
4	Chloride	25	0.32570	0.20565	5.05855	-0.35227	25	0.81375	0.11051	-1.04730	-0.23971	0.82102
5	Sulfate	25	0.04261	0.31306	6.41440	-0.16278	25	0.97758	0.04898	-4.38230	0.03625	1.45177
6	Carbonate	25	0.50799	0.12573	6.43751	-0.31489	25	0.75582	0.09057	3.32328	-0.25748	0.41875
7	Sodium +K	25	0.10224	0.33965	5.79613	-0.28250	25	0.65905	0.21401	-3.53868	-0.11041	1.25520

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	25	0.65567	0.24495	1.29613	0.83311	25	0.99458	0.03141	-7.18479	0.98945	1.14038
9	Calcium	25	0.00587	0.24648	4.57240	-0.04666	25	0.75066	0.12622	-2.87289	0.09059	1.00112
10	Magnesium	25	0.14421	0.30007	4.81187	-0.30360	25	0.36601	0.26408	-0.51931	-0.20532	0.71685
11	Chloride	25	0.32570	0.20565	5.05855	-0.35227	25	0.81375	0.11051	-1.04730	-0.23971	0.82102
12	Sulfate	25	0.04261	0.31306	6.41440	-0.16278	25	0.97758	0.04898	-4.38230	0.03625	1.45177
13	Carbonate	25	0.50799	0.12573	6.43751	-0.31489	25	0.75582	0.09057	3.32328	-0.25748	0.41875
14	Sodium +K	25	0.10224	0.33965	5.79613	-0.28250	25	0.65905	0.21401	-3.53868	-0.11041	1.25520

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	26	0.92782	0.21995	-1.33160	1.23257	26	0.99859	0.03135	-7.50197	1.00002	1.17769
16	Calcium	26	0.28700	0.28373	2.39650	0.28137	26	0.72328	0.18056	-3.89147	0.04439	1.20013
17	Magnesium	26	0.00209	0.42362	2.92739	-0.03028	26	0.26527	0.37131	-3.23600	-0.26256	1.17635
18	Chloride	26	0.34586	0.18292	4.10121	-0.20790	26	0.59710	0.14665	0.88947	-0.32895	0.61300
19	Sulfate	26	0.33696	0.27531	3.33471	0.30677	26	0.97890	0.05016	-4.33984	0.01753	1.46478
20	Carbonate	26	0.42385	0.11745	5.37351	-0.15746	26	0.42883	0.11946	5.06425	-0.16911	0.05903
21	Sodium +K	26	0.17776	0.27256	2.65689	0.19809	26	0.53318	0.20979	-2.42002	0.00675	0.96899

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	19	0.93217	0.24894	-1.26969	1.23026	19	0.99892	0.03232	-7.46200	1.00502	1.16558
23	Calcium	19	0.26739	0.34540	2.45697	0.27817	19	0.74558	0.20981	-4.54003	0.02366	1.31704
24	Magnesium	19	0.00110	0.48241	2.85655	-0.02135	19	0.33683	0.40517	-4.15602	-0.27643	1.31997
25	Chloride	19	0.37866	0.21669	4.24912	-0.22549	19	0.64599	0.16859	0.68533	-0.35512	0.67081
26	Sulfate	19	0.36238	0.30635	3.37953	0.30786	19	0.98430	0.04955	-4.20666	0.03192	1.42795
27	Carbonate	19	0.48172	0.13358	5.47356	-0.17167	19	0.49191	0.13633	5.00391	-0.18875	0.08840
28	Sodium +K	19	0.20837	0.27143	2.82272	0.18563	19	0.51080	0.21994	-1.38382	0.03262	0.79180

15. STATION 09380000 (LEES) Colorado River at Lees Ferry, AZ

STATION 09380000 Colorado River at Lees Ferry, AZ UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	13	0.0	0.0
2	2011	13	0.0	0.0
3	2012	22	0.0	0.0
4	2013	27	0.0	0.0
5	2014	27	0.0	0.0

STATION 09380000 Colorado River at Lees Ferry, AZ UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	13	0.93679	0.08677	-0.00704	1.01421	13	0.99723	0.019035	-6.28397	0.99733	0.98615
2	Calcium	13	0.00111	0.07689	4.19316	-0.00777	13	0.65935	0.047093	-0.42438	-0.02019	0.72544
3	Magnesium	13	0.01265	0.05507	3.17120	-0.01892	13	0.77142	0.027789	-0.40001	-0.02853	0.56106
4	Chloride	13	0.00894	0.17282	3.18667	0.04984	13	0.94827	0.041409	-9.26008	0.01636	1.95546
5	Sulfate	13	0.02106	0.10499	4.65077	0.04675	13	0.96926	0.019514	-2.99345	0.02619	1.20096
6	Carbonate	13	0.16475	0.03535	4.83442	-0.04766	13	0.80274	0.018015	2.54915	-0.05381	0.35903
7	Sodium +K	13	0.00404	0.11766	3.81575	0.02276	13	0.90738	0.037631	-4.47395	0.00046	1.30236

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	13	0.93679	0.08677	-0.00704	1.01421	13	0.99723	0.019035	-6.28397	0.99733	0.98615
9	Calcium	13	0.00111	0.07689	4.19316	-0.00777	13	0.65935	0.047093	-0.42438	-0.02019	0.72544
10	Magnesium	13	0.01265	0.05507	3.17120	-0.01892	13	0.77142	0.027789	-0.40001	-0.02853	0.56106
11	Chloride	13	0.00894	0.17282	3.18667	0.04984	13	0.94827	0.041409	-9.26008	0.01636	1.95546
12	Sulfate	13	0.02106	0.10499	4.65077	0.04675	13	0.96926	0.019514	-2.99345	0.02619	1.20096
13	Carbonate	13	0.16475	0.03535	4.83442	-0.04766	13	0.80274	0.018015	2.54915	-0.05381	0.35903
14	Sodium +K	13	0.00404	0.11766	3.81575	0.02276	13	0.90738	0.037631	-4.47395	0.00046	1.30236

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	22	0.93635	0.10328	0.55635	0.96015	22	0.99785	0.019495	-6.90662	1.00348	1.07543
16	Calcium	22	0.01022	0.06836	4.30645	-0.01684	22	0.86680	0.025730	-0.36874	0.01030	0.67371
17	Magnesium	22	0.05108	0.07919	3.45474	-0.04453	22	0.87742	0.029200	-1.97766	-0.01299	0.78282
18	Chloride	22	0.02235	0.19865	4.40606	-0.07280	22	0.96763	0.037084	-9.95377	0.01056	2.06929
19	Sulfate	22	0.01713	0.12197	5.51607	-0.03903	22	0.96936	0.022095	-3.30940	0.01221	1.27178
20	Carbonate	22	0.12023	0.04826	4.82209	-0.04324	22	0.77524	0.025026	1.76099	-0.02547	0.44111
21	Sodium +K	22	0.00081	0.12324	4.14818	-0.00850	22	0.88258	0.043345	-4.36273	0.04091	1.22645

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	27	0.85698	0.13101	1.26132	0.89143	27	0.99831	0.014524	-7.30450	1.02047	1.11251
23	Calcium	27	0.07372	0.09327	4.87881	-0.07314	27	0.93408	0.025394	-1.03331	0.01592	0.76785
24	Magnesium	27	0.09893	0.09539	3.90599	-0.08786	27	0.95739	0.021172	-2.21814	0.00439	0.79539
25	Chloride	27	0.10427	0.22755	5.83295	-0.21581	27	0.97853	0.035958	-8.95312	0.00693	1.92038
26	Sulfate	27	0.07901	0.15294	6.38597	-0.12451	27	0.98286	0.021295	-3.57937	0.02561	1.29428
27	Carbonate	27	0.10821	0.05356	4.92613	-0.05186	27	0.91182	0.017189	1.58220	-0.00148	0.43430
28	Sodium +K	27	0.06516	0.16534	5.28532	-0.12134	27	0.93476	0.044580	-5.20322	0.03667	1.36223

16. STATION 09402500 (GRCAN) Colorado River Near Grand Canyon, AZ - NO REGRESSION STATS

No QW since late 1980’s. Alternate method from Mueller calculates GRCAN load from Lees Ferry load and the flow difference between GRCAN and LEES. See no.15 STATION 09380000 (LEES) Colorado River at Lees Ferry, AZ

COLORADO RIVER NEAR GRAND CANYON-09402500- MONTHLY Q, LOAD, TDS DATA, JAN 2011-DECEMBER 2013

Obs	YEAR	MONTH	WMONTH	GCQ	GCLOAD	MTDS
16	2011	1	Jan	1,036,542	652,526	463
17	2011	2	Feb	1,009,377	662,880	483
18	2011	3	Mar	1,088,747	763,988	516
19	2011	4	Apr	1,006,243	732,415	535
20	2011	5	May	1,211,860	835,867	507
21	2011	6	Jun	1,415,469	939,378	488
22	2011	7	Jul	1,533,417	1,000,189	480
23	2011	8	Aug	1,537,255	965,285	462
24	2011	9	Sep	998,567	627,824	462
25	2011	10	Oct	1,014,408	622,860	452
26	2011	11	Nov	1,127,689	655,382	427
27	2011	12	Dec	1,257,872	652,818	382
28	2012	1	Jan	886,142	508,891	422
29	2012	2	Feb	673,226	449,683	491
30	2012	3	Mar	629,120	471,203	551
31	2012	4	Apr	628,225	458,955	537
32	2012	5	May	624,780	428,571	504
33	2012	6	Jun	735,191	488,483	489
34	2012	7	Jul	918,543	586,686	470
35	2012	8	Aug	878,874	563,738	472
36	2012	9	Sep	525,878	363,102	508
37	2012	10	Oct	524,754	347,336	487
38	2012	11	Nov	764,523	494,583	476
39	2012	12	Dec	822,664	519,035	464
40	2013	1	Jan	838,669	531,746	466
41	2013	2	Feb	634,136	443,985	515
42	2013	3	Mar	652,681	483,170	544
43	2013	4	Apr	575,938	458,212	585
44	2013	5	May	630,471	489,271	571
45	2013	6	Jun	831,642	610,947	540
46	2013	7	Jul	924,327	656,202	522
47	2013	8	Aug	882,252	623,741	520
48	2013	9	Sep	686,242	517,262	554
49	2013	10	Oct	502,480	387,771	568
50	2013	11	Nov	722,946	555,964	566
51	2013	12	Dec	620,157	470,795	558

17. STATION 09415000 (VIRGIN) Virgin River at Littlefield, AZ

STATION 09415000 Virgin River at Littlefield, AZ UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	10	0.0	0.0
2	2011	10	0.0	0.0
3	2012	12	0.0	0.0
4	2013	10	0.0	0.0
5	2014	10	0.0	0.0

STATION 09415000 Virgin River at Littlefield, AZ UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	10	0.91167	0.08503	3.69869	0.58475	10	0.99950	0.00686	-6.9362	0.99171	1.08882
2	Calcium	10	0.82043	0.08436	7.44489	-0.38600	10	0.90672	0.06500	0.1099	-0.10531	0.75097
3	Magnesium	10	0.88742	0.05538	6.03912	-0.33285	10	0.94814	0.04018	0.9376	-0.13763	0.52231
4	Chloride	10	0.79838	0.12318	8.39955	-0.52472	10	0.96302	0.05640	-5.5626	0.00957	1.42947
5	Sulfate	10	0.90493	0.07602	9.17721	-0.50208	10	0.99278	0.02240	0.0105	-0.15130	0.93850
6	Carbonate	10	0.01918	0.17422	4.73029	0.05216	10	0.46825	0.13713	-10.0565	0.61800	1.51389
7	Sodium +K	10	0.72445	0.11641	7.61629	-0.40406	10	0.98796	0.02601	-6.6630	0.14237	1.46193

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	10	0.91167	0.08503	3.69869	0.58475	10	0.99950	0.00686	-6.9362	0.99171	1.08882
9	Calcium	10	0.82043	0.08436	7.44489	-0.38600	10	0.90672	0.06500	0.1099	-0.10531	0.75097
10	Magnesium	10	0.88742	0.05538	6.03912	-0.33285	10	0.94814	0.04018	0.9376	-0.13763	0.52231
11	Chloride	10	0.79838	0.12318	8.39955	-0.52472	10	0.96302	0.05640	-5.5626	0.00957	1.42947
12	Sulfate	10	0.90493	0.07602	9.17721	-0.50208	10	0.99278	0.02240	0.0105	-0.15130	0.93850
13	Carbonate	10	0.01918	0.17422	4.73029	0.05216	10	0.46825	0.13713	-10.0565	0.61800	1.51389
14	Sodium +K	10	0.72445	0.11641	7.61629	-0.40406	10	0.98796	0.02601	-6.6630	0.14237	1.46193

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	12	0.91701	0.09530	3.33673	0.65739	12	0.99902	0.01093	-7.0746	1.00178	1.09998
16	Calcium	12	0.78618	0.09242	7.37308	-0.36775	12	0.88896	0.07021	0.3310	-0.13481	0.74401
17	Magnesium	12	0.88655	0.05408	5.94772	-0.31373	12	0.95979	0.03394	1.1722	-0.15576	0.50455
18	Chloride	12	0.58306	0.15120	7.62157	-0.37103	12	0.92736	0.06653	-7.4782	0.12845	1.59533
19	Sulfate	12	0.84808	0.09050	8.89159	-0.44369	12	0.99181	0.02216	-0.7820	-0.12371	1.02204
20	Carbonate	12	0.03859	0.14234	4.70108	0.05918	12	0.36366	0.12207	-4.3947	0.36005	0.96099
21	Sodium +K	12	0.42752	0.14048	6.83400	-0.25192	12	0.91856	0.05585	-7.4644	0.22105	1.51066

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	10	0.95597	0.06530	2.92979	0.74233	10	0.99752	0.01658	-6.4482	0.99102	1.02775
23	Calcium	10	0.87613	0.05508	7.35621	-0.35740	10	0.97812	0.02475	-0.0334	-0.16144	0.80984
24	Magnesium	10	0.90432	0.04138	5.93555	-0.31042	10	0.97189	0.02398	0.7939	-0.17407	0.56348
25	Chloride	10	0.35990	0.09663	6.67153	-0.17678	10	0.89883	0.04107	-6.4380	0.17087	1.43670
26	Sulfate	10	0.81232	0.07400	8.55658	-0.37562	10	0.97961	0.02608	-1.7730	-0.10170	1.13203
27	Carbonate	10	0.33832	0.05083	4.61224	0.08868	10	0.33976	0.05428	4.2617	0.09798	0.03842
28	Sodium +K	10	0.14400	0.08798	6.03935	-0.08804	10	0.81399	0.04385	-5.4693	0.21715	1.26125

18. STATION 09421500 (HOOVER) Colorado River below Hoover Dam, AZ-NV

STATION 09421500 Colorado River below Hoover Dam, AZ UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	33	0.0	0.0
2	2011	33	0.0	0.0
3	2012	33	0.0	0.0
4	2013	28	0.0	0.0
5	2014	28	0.0	0.0

STATION 09421500 Colorado River below Hoover Dam, AZ UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	33	0.99477	0.036527	0.51365	0.99202	33	0.99743	0.026007	-4.83370	0.99074	0.78408
2	Calcium	33	0.00261	0.050173	4.35525	-0.00505	33	0.06174	0.049467	1.84961	-0.00565	0.36740
3	Magnesium	33	0.00132	0.059810	3.24967	-0.00428	33	0.05244	0.059222	0.47404	-0.00495	0.40699
4	Chloride	33	0.00445	0.056333	4.42705	-0.00742	33	0.48911	0.041022	-3.63479	-0.00936	1.18210
5	Sulfate	33	0.00457	0.046893	5.44468	-0.00626	33	0.46571	0.034923	-1.10172	-0.00783	0.95989
6	Carbonate	33	0.00005	0.020899	4.41052	-0.00028	33	0.03425	0.020878	5.20324	-0.00009	-0.11624
7	Sodium +K	33	0.02789	0.068173	4.70594	-0.02274	33	0.48181	0.050596	-4.84897	-0.02503	1.40102

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	33	0.99477	0.036527	0.51365	0.99202	33	0.99743	0.026007	-4.83370	0.99074	0.78408
9	Calcium	33	0.00261	0.050173	4.35525	-0.00505	33	0.06174	0.049467	1.84961	-0.00565	0.36740
10	Magnesium	33	0.00132	0.059810	3.24967	-0.00428	33	0.05244	0.059222	0.47404	-0.00495	0.40699
11	Chloride	33	0.00445	0.056333	4.42705	-0.00742	33	0.48911	0.041022	-3.63479	-0.00936	1.18210
12	Sulfate	33	0.00457	0.046893	5.44468	-0.00626	33	0.46571	0.034923	-1.10172	-0.00783	0.95989
13	Carbonate	33	0.00005	0.020899	4.41052	-0.00028	33	0.03425	0.020878	5.20324	-0.00009	-0.11624
14	Sodium +K	33	0.02789	0.068173	4.70594	-0.02274	33	0.48181	0.050596	-4.84897	-0.02503	1.40102

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	33	0.99630	0.040401	0.46218	0.99525	33	0.99845	0.026615	-5.70943	0.99281	0.90924
16	Calcium	33	0.00000	0.046355	4.30377	-0.00008	33	0.09342	0.044867	1.46190	-0.00121	0.41868
17	Magnesium	33	0.00268	0.052747	3.24656	-0.00410	33	0.33104	0.043914	-2.82425	-0.00650	0.89439
18	Chloride	33	0.00642	0.064496	4.39770	-0.00778	33	0.62447	0.040306	-5.80536	-0.01181	1.50318
19	Sulfate	33	0.00025	0.053286	5.37028	-0.00126	33	0.48820	0.038756	-2.09677	-0.00421	1.10009
20	Carbonate	33	0.01256	0.025378	4.44787	-0.00429	33	0.01287	0.025794	4.35881	-0.00433	0.01312
21	Sodium +K	33	0.01683	0.070100	4.58337	-0.01376	33	0.40185	0.055581	-4.21563	-0.01724	1.29632

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	28	0.99830	0.029853	0.43532	0.99629	28	0.99864	0.027215	-3.44201	0.99450	0.57265
23	Calcium	28	0.01200	0.038581	4.34898	-0.00586	28	0.01206	0.039344	4.26689	-0.00590	0.01213
24	Magnesium	28	0.00482	0.047307	3.22913	-0.00454	28	0.01685	0.047952	1.72228	-0.00523	0.22255
25	Chloride	28	0.00413	0.045481	4.33530	-0.00404	28	0.37137	0.036850	-3.66758	-0.00773	1.18196
26	Sulfate	28	0.00088	0.037116	5.32415	0.00152	28	0.17818	0.034329	0.79363	-0.00058	0.66912
27	Carbonate	28	0.03604	0.025974	4.47461	-0.00692	28	0.04046	0.026428	3.96473	-0.00715	0.07530
28	Sodium +K	28	0.00975	0.064329	4.50939	-0.00879	28	0.11920	0.061871	-1.68770	-0.01166	0.91526

19. STATION 09427520 (PARKER) Colorado River below Parker Dam, AZ-CA

STATION 09427520 Colorado River below Parker Dam, AZ UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	88	0.0	0.0
2	2011	88	0.0	0.0
3	2012	96	0.0	0.0
4	2013	90	0.0	0.0
5	2014	90	0.0	0.0

STATION 09427520 Colorado River below Parker Dam, AZ UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	88	0.99135	0.037009	0.53468	0.99148	88	0.99562	0.026502	-6.24631	1.00584	0.96909
2	Calcium	88	0.04327	0.047797	4.05924	0.02543	88	0.07659	0.047233	1.73181	0.03036	0.33262
3	Magnesium	88	0.10423	0.065531	3.74044	-0.05593	88	0.31776	0.057525	-4.60735	-0.03825	1.19300
4	Chloride	88	0.00686	0.065623	4.53644	-0.01364	88	0.32532	0.054405	-5.15912	0.00689	1.38561
5	Sulfate	88	0.00496	0.051685	5.49372	-0.00913	88	0.36013	0.041690	-2.56290	0.00793	1.15139
6	Carbonate	88	0.06225	0.029503	4.22371	0.01902	88	0.07676	0.029445	5.18140	0.01699	-0.13687
7	Sodium +K	88	0.05851	0.063943	4.89743	-0.03989	88	0.45032	0.049145	-5.86510	-0.01709	1.53810

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	88	0.99135	0.037009	0.53468	0.99148	88	0.99562	0.026502	-6.24631	1.00584	0.96909
9	Calcium	88	0.04327	0.047797	4.05924	0.02543	88	0.07659	0.047233	1.73181	0.03036	0.33262
10	Magnesium	88	0.10423	0.065531	3.74044	-0.05593	88	0.31776	0.057525	-4.60735	-0.03825	1.19300
11	Chloride	88	0.00686	0.065623	4.53644	-0.01364	88	0.32532	0.054405	-5.15912	0.00689	1.38561
12	Sulfate	88	0.00496	0.051685	5.49372	-0.00913	88	0.36013	0.041690	-2.56290	0.00793	1.15139
13	Carbonate	88	0.06225	0.029503	4.22371	0.01902	88	0.07676	0.029445	5.18140	0.01699	-0.13687
14	Sodium +K	88	0.05851	0.063943	4.89743	-0.03989	88	0.45032	0.049145	-5.86510	-0.01709	1.53810

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	96	0.99428	0.027426	0.51925	0.99092	96	0.99574	0.023798	-3.21758	0.99757	0.53778
16	Calcium	96	0.00538	0.044856	4.20876	0.00904	96	0.01061	0.044978	3.33186	0.01060	0.12620
17	Magnesium	96	0.07085	0.049858	3.57241	-0.03773	96	0.10656	0.049152	0.93527	-0.03303	0.37952
18	Chloride	96	0.00676	0.061383	4.50725	-0.01388	96	0.36466	0.049356	-5.43362	0.00381	1.43063
19	Sulfate	96	0.01798	0.036114	5.50321	-0.01339	96	0.10482	0.034665	2.60591	-0.00824	0.41696
20	Carbonate	96	0.11842	0.026078	4.16056	0.02619	96	0.21969	0.024666	1.77602	0.03043	0.34317
21	Sodium +K	96	0.08570	0.043938	4.83417	-0.03686	96	0.22039	0.040790	0.28449	-0.02877	0.65476

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	90	0.99635	0.026470	0.54868	0.98662	90	0.99657	0.025811	-1.74425	0.98949	0.33204
23	Calcium	90	0.00197	0.037137	4.32353	-0.00372	90	0.03887	0.036652	1.79666	-0.00055	0.36592
24	Magnesium	90	0.02652	0.058896	3.41259	-0.02192	90	0.02754	0.059202	4.08871	-0.02276	-0.09791
25	Chloride	90	0.03637	0.050000	4.55562	-0.02190	90	0.13464	0.047653	-1.09438	-0.01482	0.81818
26	Sulfate	90	0.10300	0.035225	5.61735	-0.02691	90	0.10812	0.035325	4.67549	-0.02573	0.13639
27	Carbonate	90	0.19515	0.025362	4.14175	0.02816	90	0.27516	0.024206	1.31224	0.03170	0.40974
28	Sodium +K	90	0.04354	0.046491	4.68633	-0.02236	90	0.05203	0.046549	3.13664	-0.02042	0.22441

20. STATION 09429490 (IMPER) Colorado River above Imperial Dam, AZ-CA

STATION 09429490 Colorado River above Imperial Dam, AZ UPDATE 2014
SUMMARY OF QW OBSERVATIONS, BY 3-YEAR SLIDING GROUP

Obs	WATER YEAR	# OF QW OBSV.	% P70300 SUBST.	% P00060 SUBST.
1	2010	83	0.0	0.0
2	2011	83	0.0	0.0
3	2012	80	0.0	0.0
4	2013	69	0.0	0.0
5	2014	69	0.0	0.0

STATION 09429490 Colorado River above Imperial Dam, AZ UPDATE 2014
REGRESSION STATISTICS, BY 3-YEAR SLIDING GROUPS
REGRESSION #1: VARIABLE = e**A * DISCHARGE**B
REGRESSION #2: VARIABLE = e**C * DISCHARGE**D * COND**E
VARIABLE=(mg/L), except for SALT LOAD (tons/day)
DISCHARGE=(cfs) COND=(uMHOS/cm)

GROUP=2010

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
1	SALT LOAD	83	0.97037	0.039604	2.28118	0.81453	83	0.99468	0.016886	-7.77873	1.02775	1.16164
2	Calcium	83	0.25100	0.053067	5.38900	-0.11040	83	0.44218	0.046082	-2.12972	0.04895	0.86820
3	Magnesium	83	0.33384	0.060009	4.72249	-0.15267	83	0.58429	0.047700	-5.59614	0.06603	1.19152
4	Chloride	83	0.61045	0.055375	6.86562	-0.24913	83	0.83894	0.035827	-5.02775	0.00295	1.37335
5	Sulfate	83	0.57224	0.043945	7.20811	-0.18267	83	0.83535	0.027433	-2.45706	0.02218	1.11606
6	Carbonate	83	0.52188	0.035634	5.70451	-0.13380	83	0.78187	0.024219	-1.66452	0.02238	0.85092
7	Sodium +K	83	0.55810	0.059446	6.89525	-0.24010	83	0.77703	0.042489	-4.83874	0.00860	1.35495

GROUP=2011

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
8	SALT LOAD	83	0.97037	0.039604	2.28118	0.81453	83	0.99468	0.016886	-7.77873	1.02775	1.16164
9	Calcium	83	0.25100	0.053067	5.38900	-0.11040	83	0.44218	0.046082	-2.12972	0.04895	0.86820
10	Magnesium	83	0.33384	0.060009	4.72249	-0.15267	83	0.58429	0.047700	-5.59614	0.06603	1.19152
11	Chloride	83	0.61045	0.055375	6.86562	-0.24913	83	0.83894	0.035827	-5.02775	0.00295	1.37335
12	Sulfate	83	0.57224	0.043945	7.20811	-0.18267	83	0.83535	0.027433	-2.45706	0.02218	1.11606
13	Carbonate	83	0.52188	0.035634	5.70451	-0.13380	83	0.78187	0.024219	-1.66452	0.02238	0.85092
14	Sodium +K	83	0.55810	0.059446	6.89525	-0.24010	83	0.77703	0.042489	-4.83874	0.00860	1.35495

GROUP=2012

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
15	SALT LOAD	80	0.97540	0.033215	2.11056	0.83244	80	0.99469	0.015528	-6.66907	1.00220	1.03635
16	Calcium	80	0.22601	0.045066	5.27686	-0.09694	80	0.39350	0.040151	-0.98075	0.02406	0.73865
17	Magnesium	80	0.39795	0.043334	4.60951	-0.14024	80	0.68857	0.031368	-4.37724	0.03353	1.06079
18	Chloride	80	0.62728	0.044740	6.69556	-0.23104	80	0.87046	0.026547	-4.09123	-0.02246	1.27327
19	Sulfate	80	0.56464	0.036437	7.03570	-0.16517	80	0.80954	0.024256	-1.12150	-0.00745	0.96287
20	Carbonate	80	0.43449	0.034838	5.59351	-0.12155	80	0.69675	0.025677	-1.48806	0.01538	0.83591
21	Sodium +K	80	0.49728	0.052289	6.57144	-0.20701	80	0.76392	0.036064	-4.79525	0.01278	1.34172

GROUP=2013

Obs	VARIABLE	#1 obsv.	R-square #1	Std. Error	A	B	#2 obsv.	R-square #2	Std. Error	C	D	E
22	SALT LOAD	69	0.98281	0.027512	2.34901	0.80552	69	0.99745	0.010666	-5.88913	0.97874	0.95547
23	Calcium	69	0.55062	0.031278	5.61692	-0.13408	69	0.69409	0.026001	-0.11659	-0.01352	0.66498
24	Magnesium	69	0.60828	0.035540	4.88572	-0.17150	69	0.78917	0.026270	-2.94937	-0.00676	0.90872
25	Chloride	69	0.79047	0.035305	7.00230	-0.26555	69	0.96585	0.014360	-3.47638	-0.04522	1.21533
26	Sulfate	69	0.75487	0.028524	7.28668	-0.19383	69	0.90528	0.017865	0.03828	-0.04142	0.84068
27	Carbonate	69	0.44439	0.037976	5.68603	-0.13152	69	0.63897	0.030844	-1.60478	0.02178	0.84560
28	Sodium +K	69	0.65016	0.044411	6.80446	-0.23445	69	0.83577	0.030658	-3.68993	-0.01379	1.21715

APPENDIX D

20 Station Flow and Salt over Time

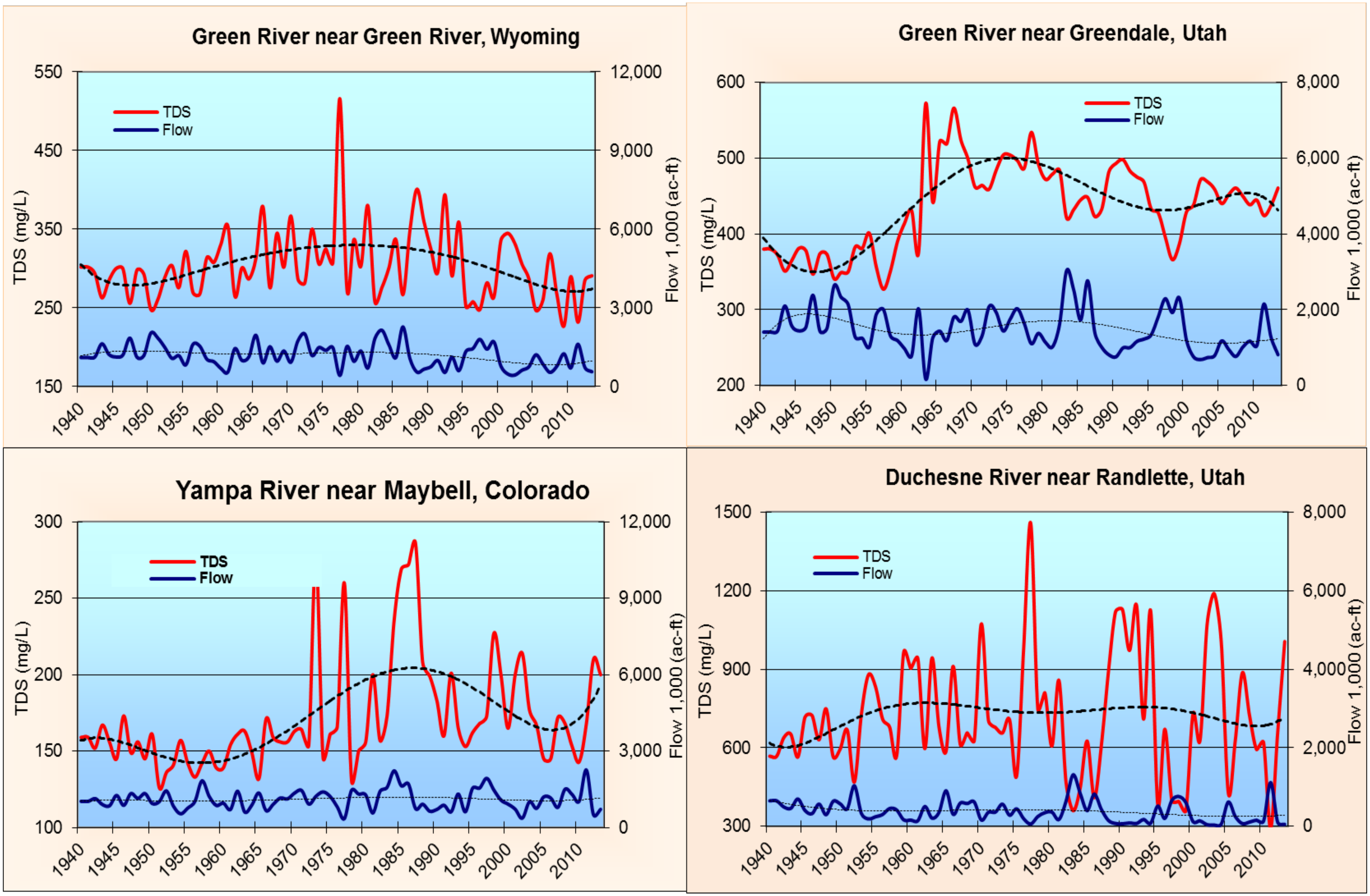


Figure D1 – Flow and TDS over Time for Sites 1-4

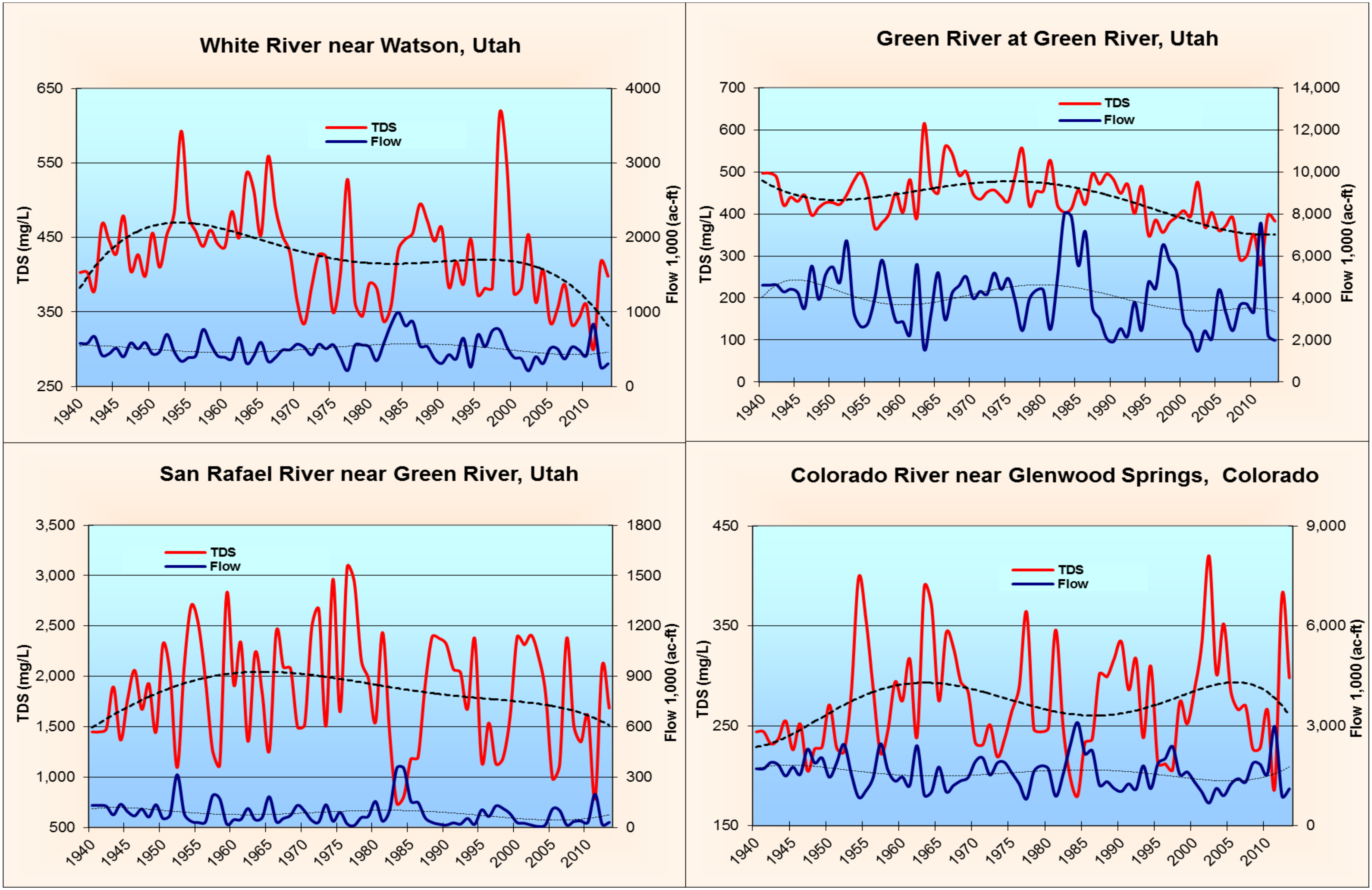


Figure D2 – Flow and TDS over Time for Sites 5 - 8

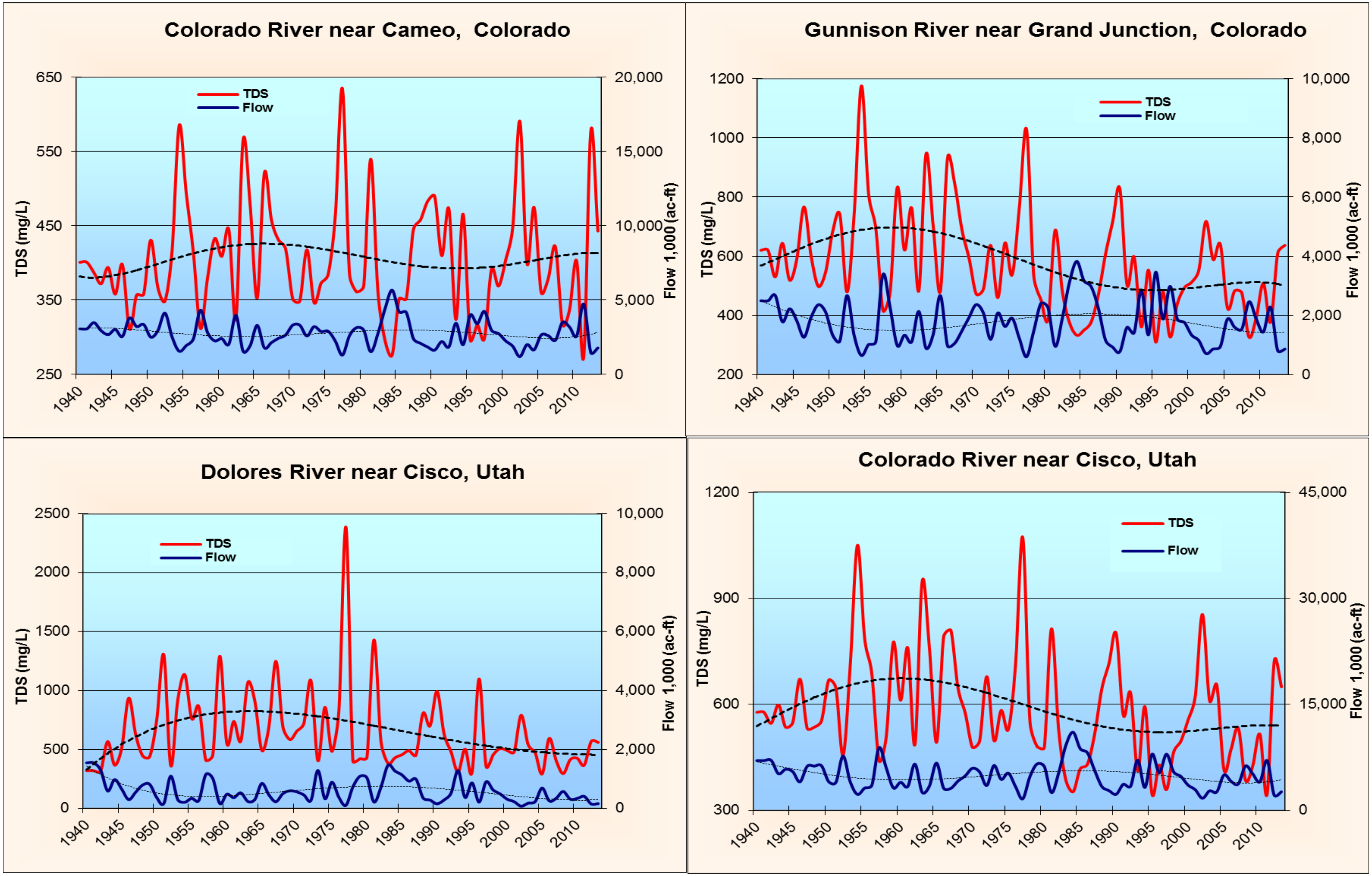


Figure D3 – Flow and TDS over Time for Sites 9 - 12

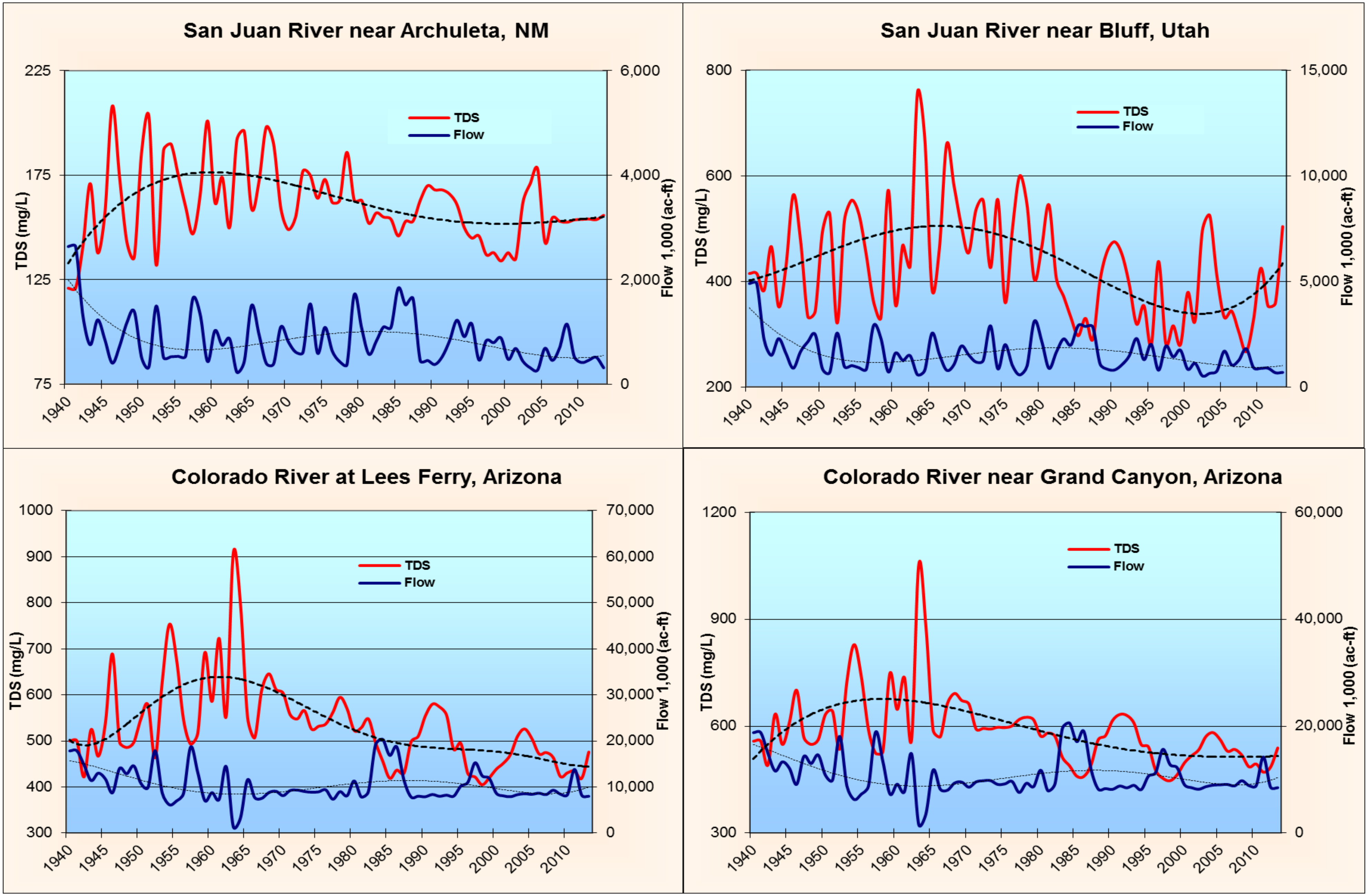


Figure D4 – Flow and TDS over Time for Sites 13 - 16

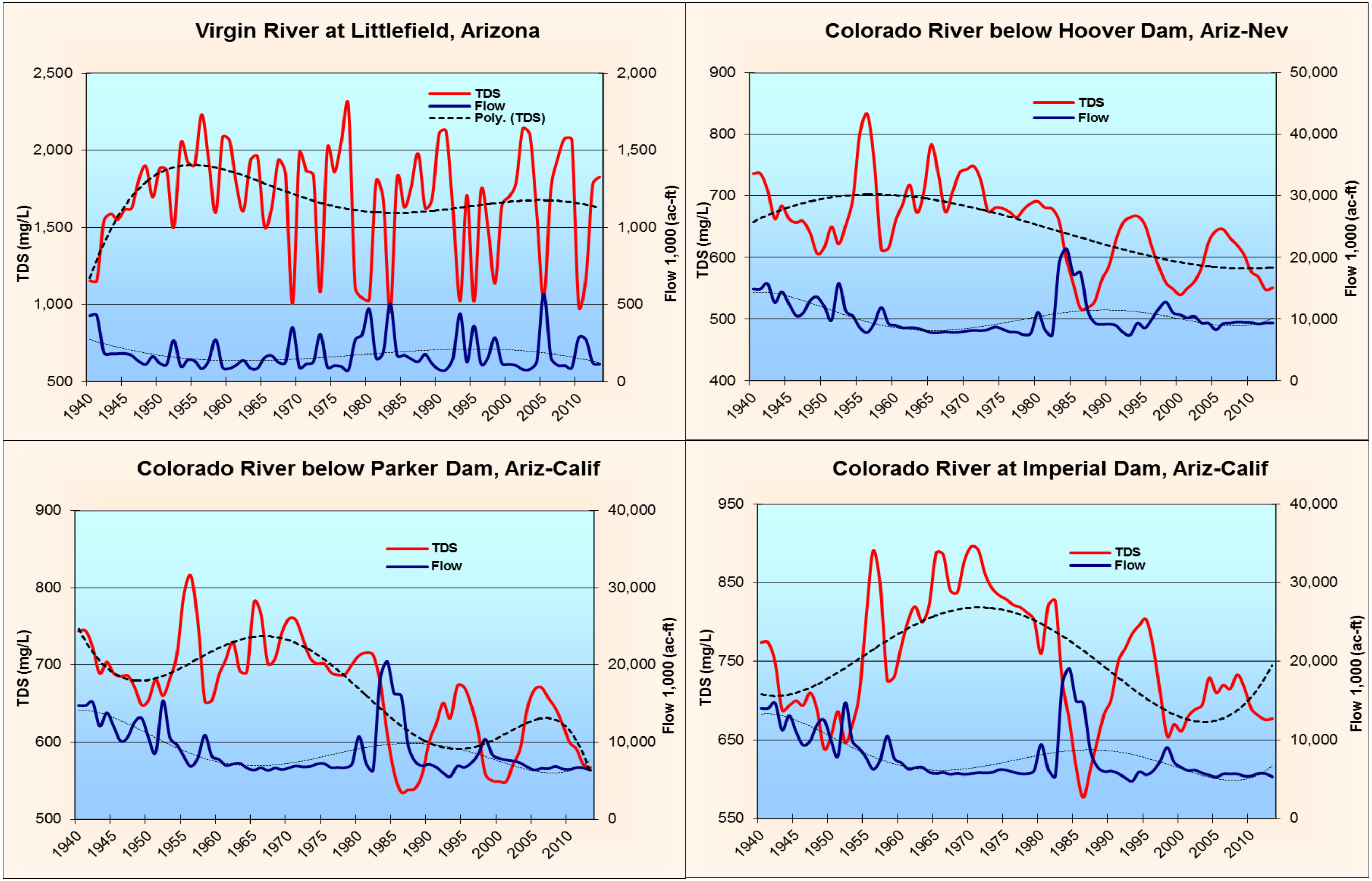


Figure D5 – Flow and TDS over Time for Sites 17 - 20