

# The Paradox Valley Unit: 20 Years – 2.2 Million Tons

Don Barnett, P.E., P.G.  
Colorado River Basin Salinity Control Forum

Multi-State Salinity Coalition  
March 2-3, 2017  
Las Vegas, NV



# PVU Injection Well

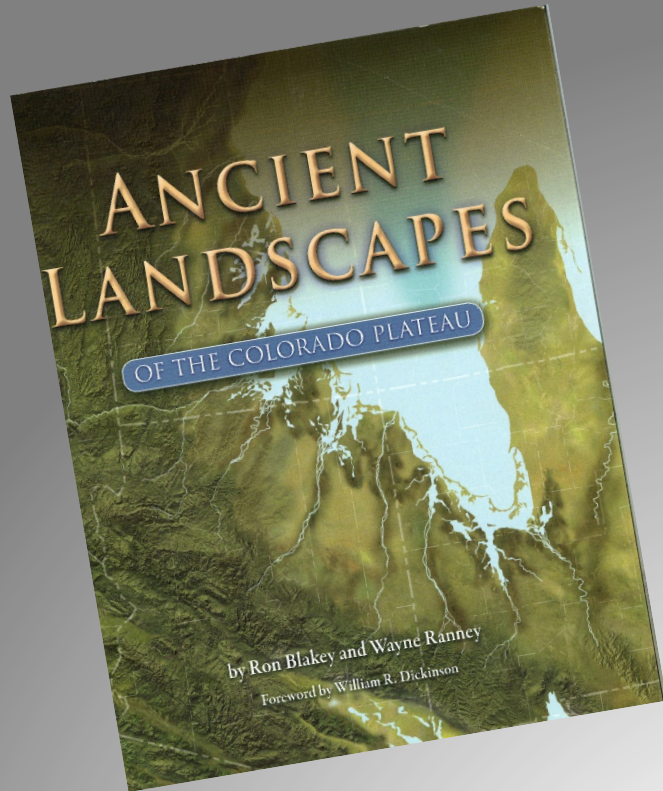
20 Years!

2.2 Million  
Tons!





# Rodinia

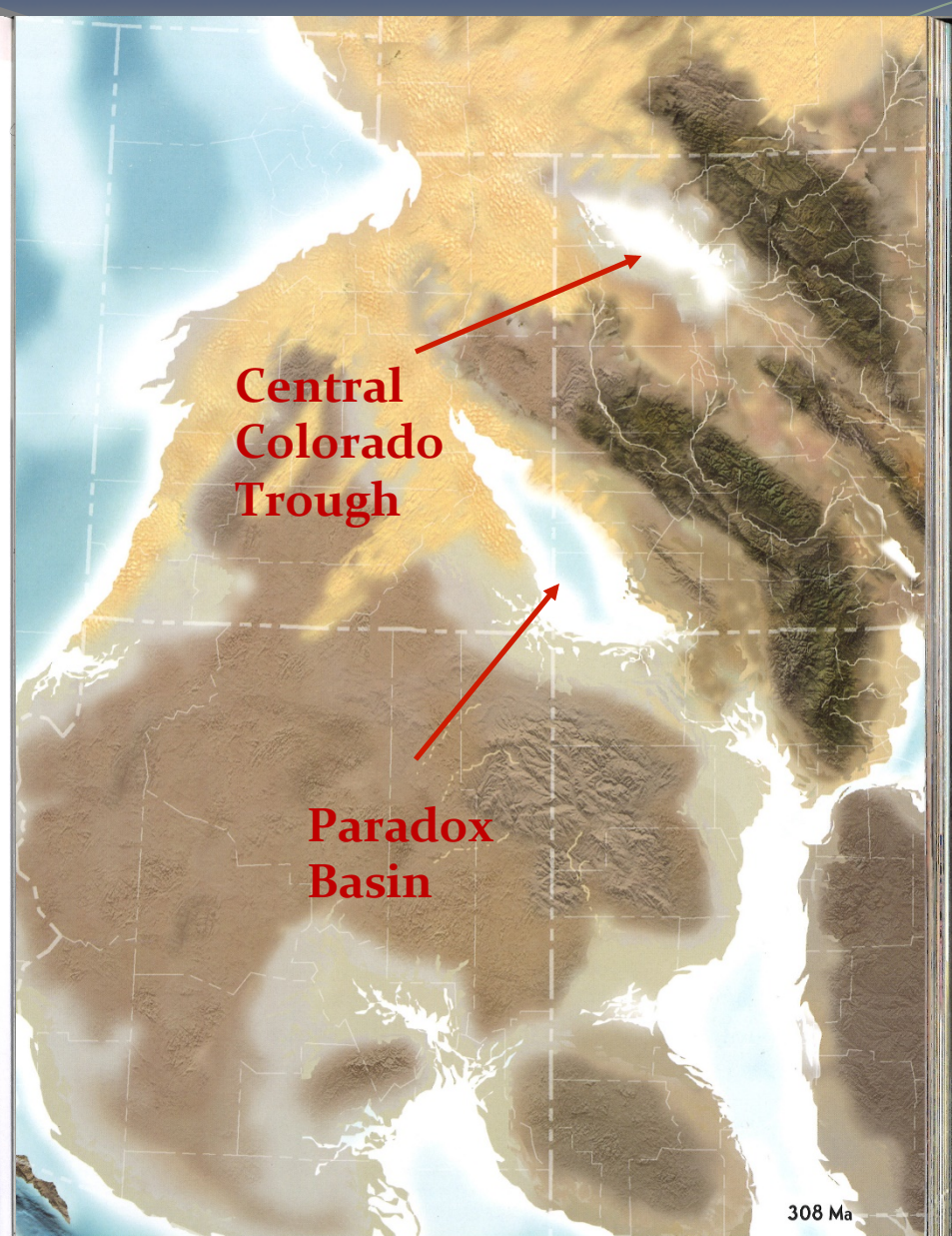






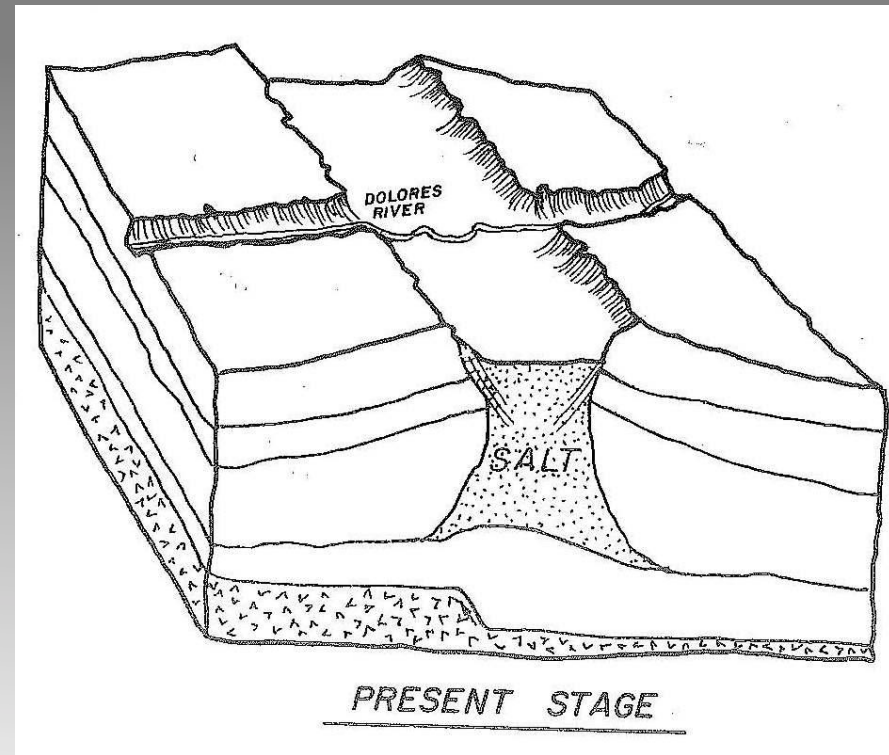
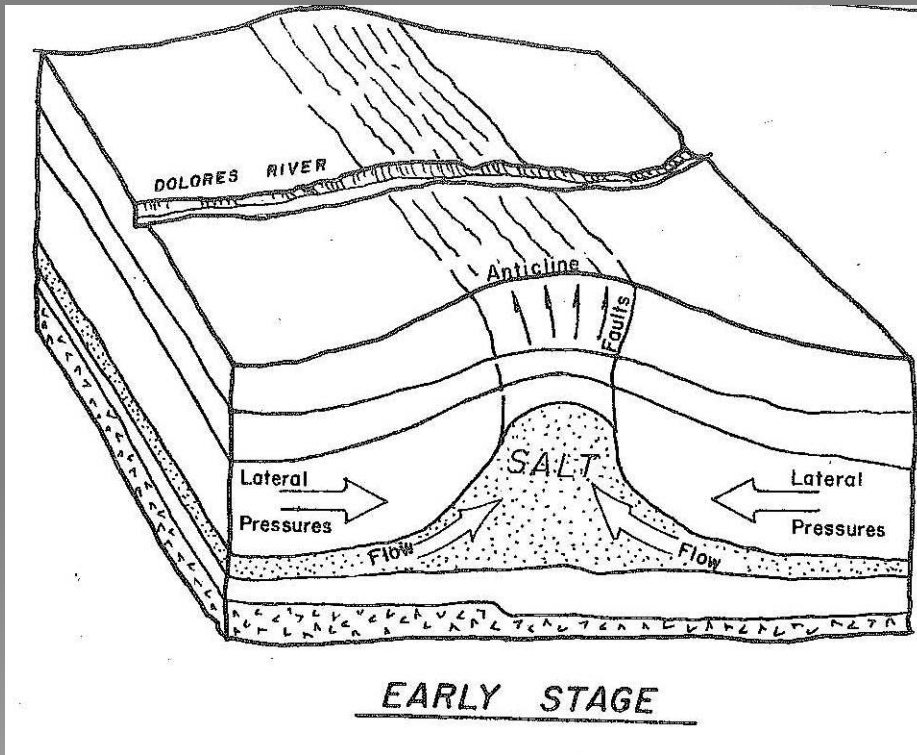
Above: Middle Pennsylvanian paleogeography (308 Ma). This map shows deposition during a sea level high. In southwestern Colorado and southeast Utah, normal marine deposits of the Paradox Formation were preserved.

Opposite: Middle Pennsylvanian time (308 Ma) during low sea level. The Paradox and Eagle basins became the sites of isolated seas (like the modern Caspian Sea), and large amounts of salt precipitated in the warm, restricted water. Calculations suggest a 400–600-foot difference between high and low sea levels, and the changes may have occurred rapidly in less than 200,000 years. As many as sixty cycles have been documented and resulted from fluctuating glaciations in the Southern Hemisphere.

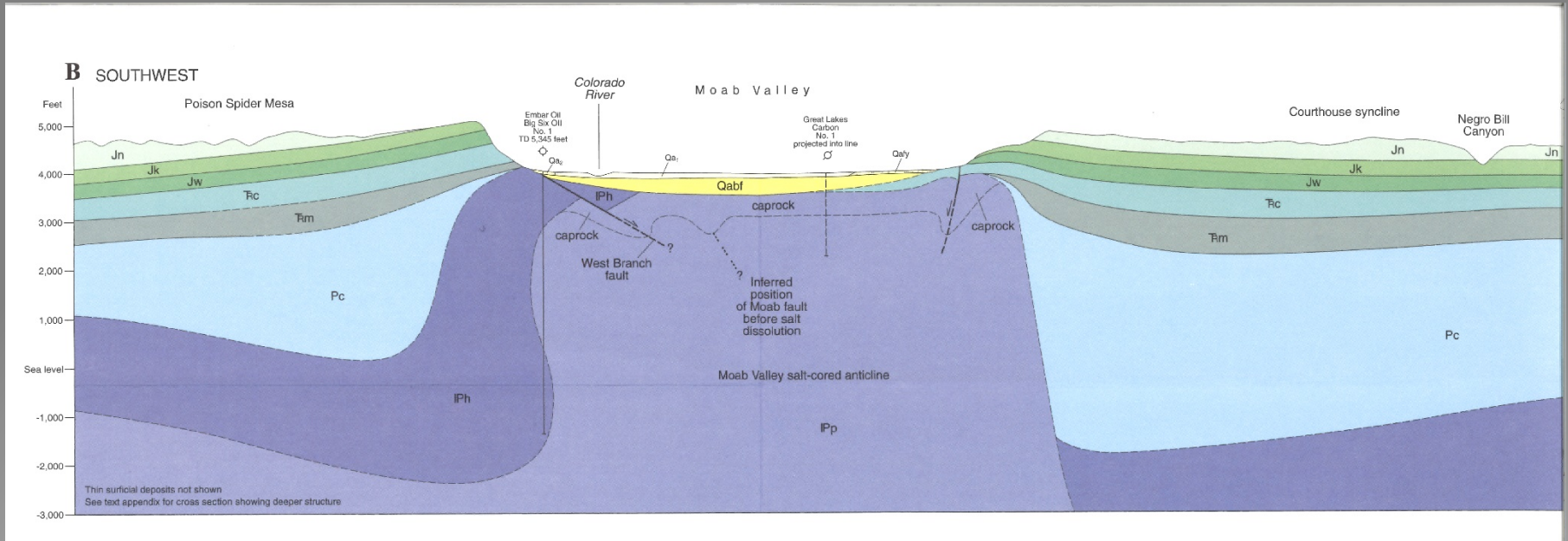




# Paradox Valley









# Paradox Valley, CO

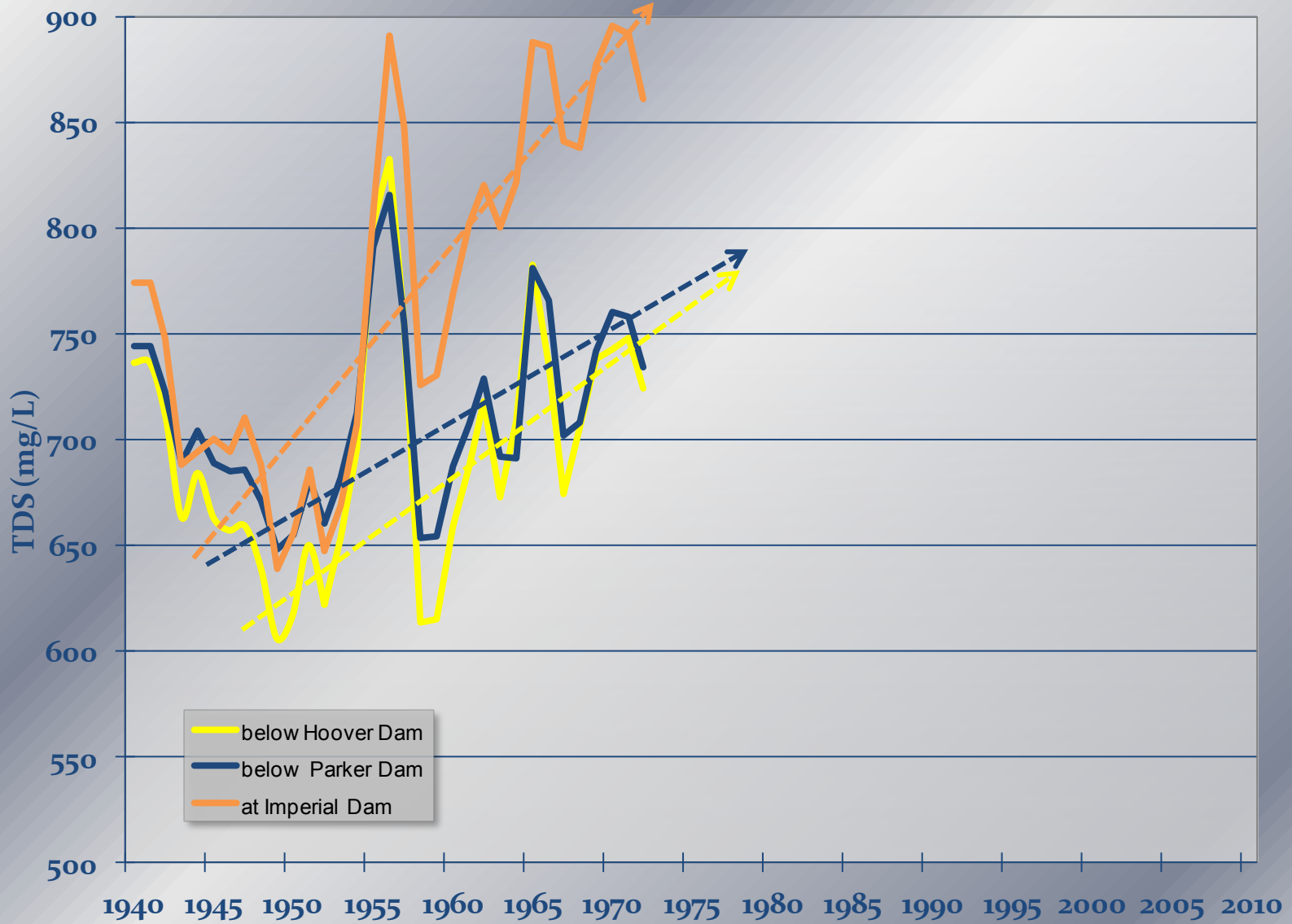


La Sal Mountains (recharge)

Dolores River



# Colorado River Salinity Concentrations at Numeric Criteria Sites



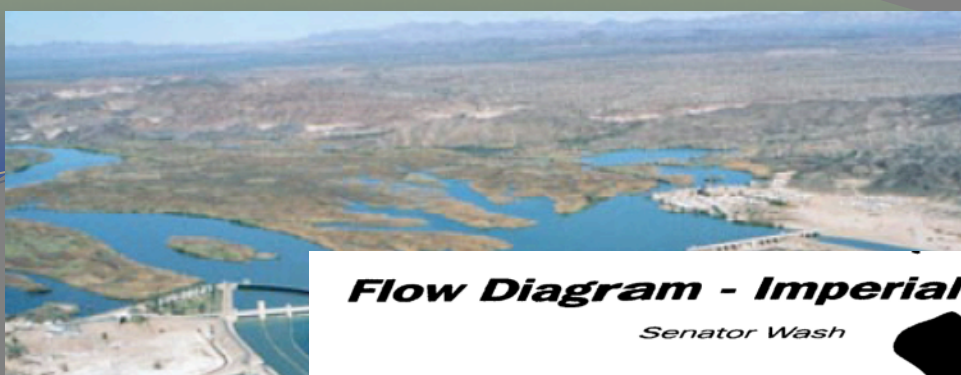


# Salinity Control Program History

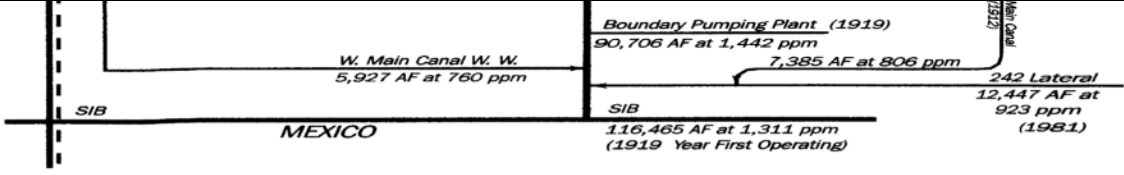
- Early 1970's
  - Salinity of the Colorado River was rising
  - Significant concerns by Mexico







# ogram History



Unmeasured Return Flows: 60,357 af at 1,859 ppm

( ) = Date facility put in operation

--- = MOD, MODE, Bypass Drain

/adams/don's stuff/Don@.cd



and has 20 river gates and 12 intake



# Salinity Control Program History

- Early 1970's

- Salinity of the Colorado River was rising
- Significant concerns by Mexico
- The Basin States were concerned about the implications of the newly passed Federal Water Pollution Control Act amendments





# Salinity Control Program History

- 1973 – created the Colorado River Basin Salinity Control Forum (Forum)
  - Conference on the Matter of the Pollution of the Interstate Waters of the Colorado River and its Tributaries (concl'd 1972)
- 1974 – passed the Colorado River Basin Salinity Control Act (Act)
  - Title I and Title II
- 1975 – adopted salinity standards for the Colorado River





UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VIII  
1860 LINCOLN STREET  
DENVER, COLORADO 80203

JUL 17 1978  
Re: 8W-EE

Mr. Joe D. Hall  
Regional Director  
U.S. Bureau of Reclamation  
Upper Colorado Regional Office  
P.O. Box 11568  
125 S. State Street  
Salt Lake City, Utah 84147

Dear Mr. Hall:

The Region VIII Office of the Environmental Protection Agency has reviewed the draft environmental impact statement for Paradox Valley Unit, part of the Colorado River Basin Salinity Control Program. EPA strongly supports your agency's efforts to reduce the salt load in the Colorado River Basin in order that State adopted and EPA approved salinity standards might be maintained. Such efforts are supported particularly where there are few conflicts with aesthetic, recreational or environmental values as is the situation with the Paradox Valley saline seeps. However, EPA does have severe environmental problems regarding the proposed method of brine disposal.

Surface disposal of brine at the Radium Evaporation Site has the following potential environmental problems:

1. possible contamination of underlying aquifers,
2. possible fugitive dust problems regarding salt dispersion to surrounding areas,
3. erosion of the proposed salt flat over geologic time,
4. conflicts with the existing land uses of ranching, wildlife habitat, and uranium exploration,
5. possible hazard to waterfowl.

EPA believes that disposal by deep well injection is the environmentally preferred solution and therefore should be seriously investigated for brine disposal. Deep well injection will not require large tracts of land for surface disposal with its attendant environmental problems. To be environmentally acceptable, brine injection must be below possible interference with potable or potentially potable aquifers and the risk of seismic changes should be minimal.

# Preferred A

- Capture up to
- Dispose of in evaporation p
- Reduce salt lo or 180,000 ton
- Reduced down concentration





# Permanent Facility

- » Capture up to 5 cfs of brine
- » Dispose of brine in a 3,636 af deep injection well
- » Reduce salt loading by 64.8% or 180,000 tons per year
- » Reduce annual downstream damages by \$43M

CRBSCF 11.4.16  
USBR-PROJ-PVU-1  
1997-05

Colorado River Basin  
Salinity Control Project

Paradox Valley Unit  
Final Supplemental  
Definite Plan Report and  
Environmental Assessment

May 1997

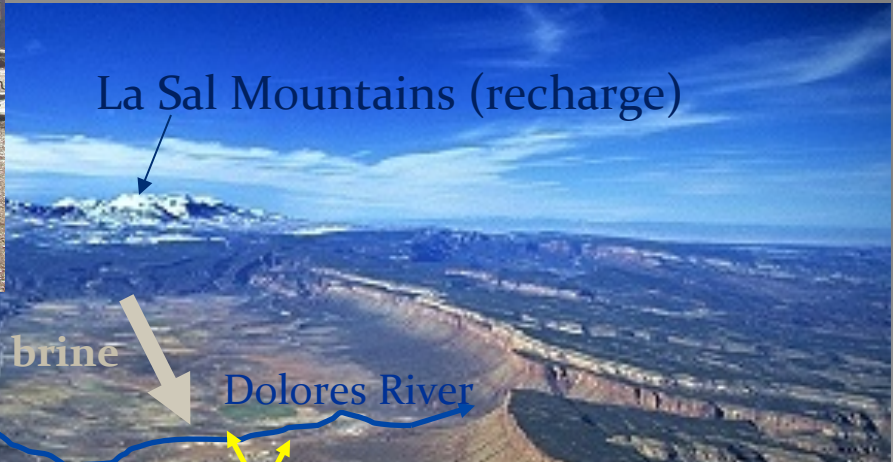
United States  
Department of the Interior

Bureau of Reclamation





# Paradox Valley Unit (PVU)



La Sal Mountains (recharge)

brine

Dolores River

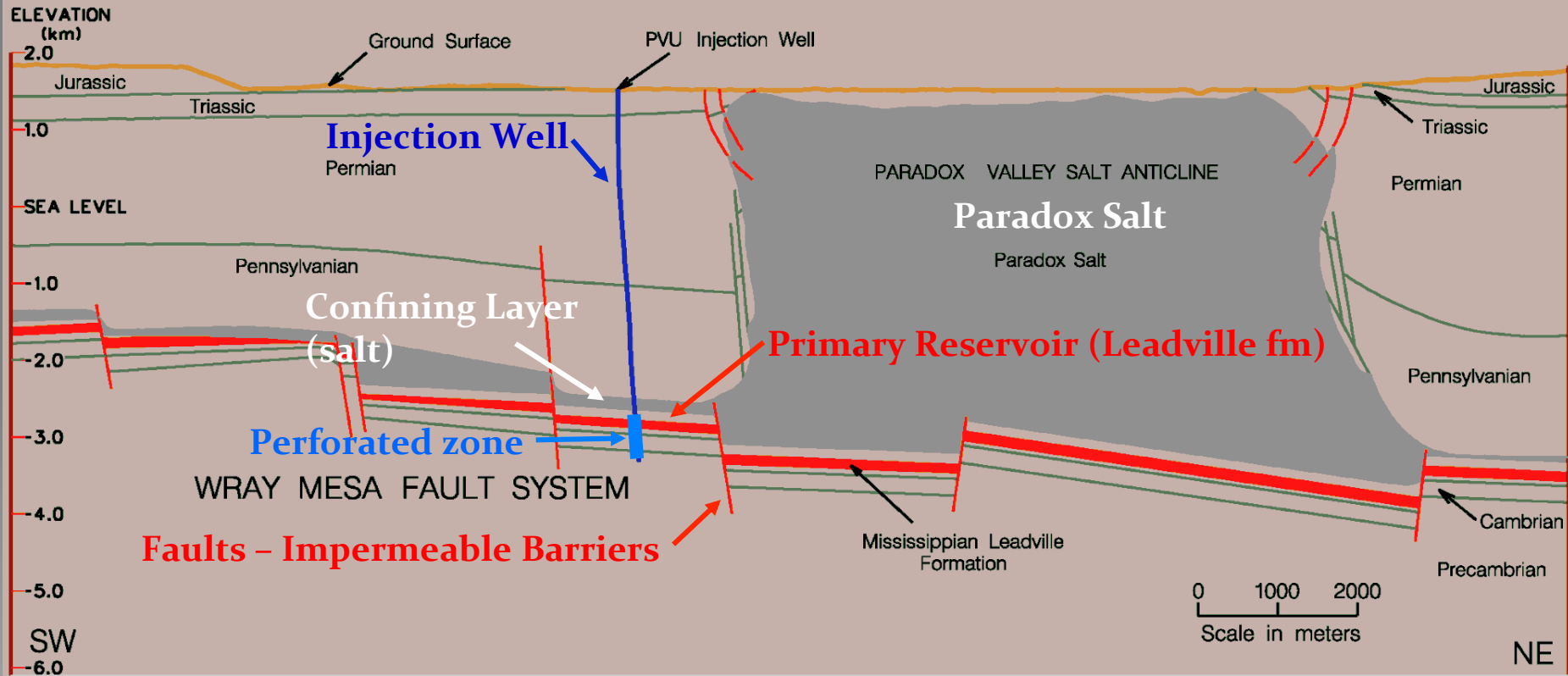
deep injection well

shallow collection wells





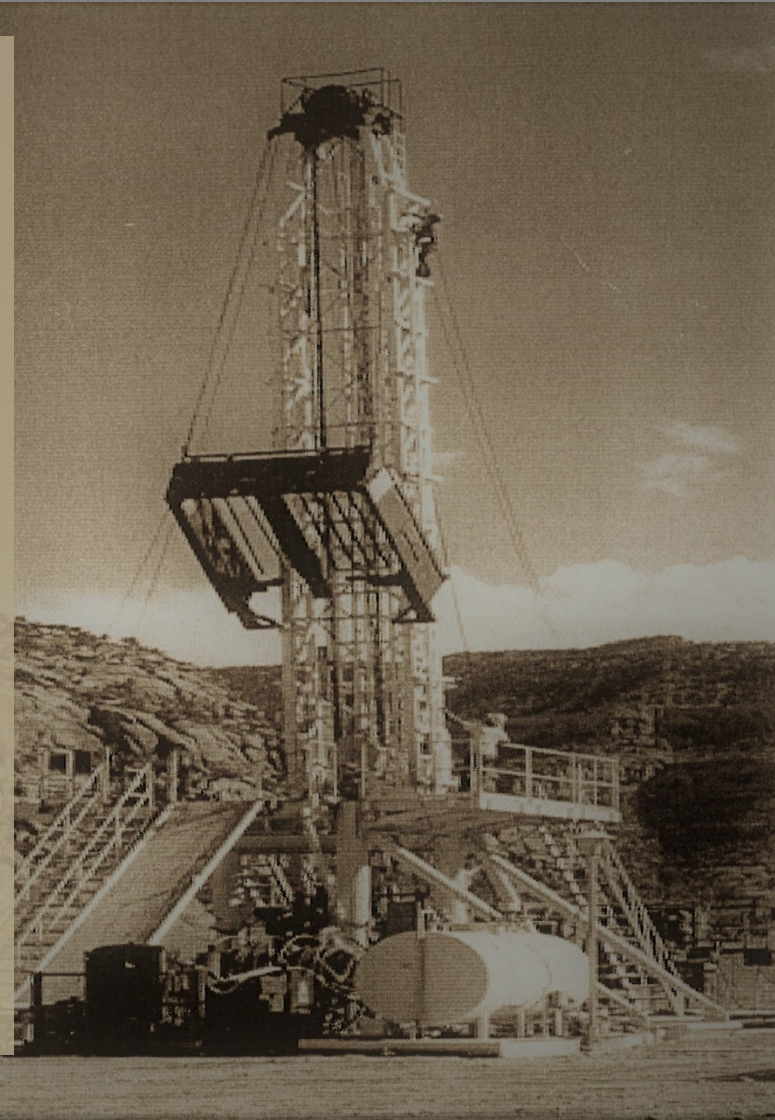
# PVU Injection Well System



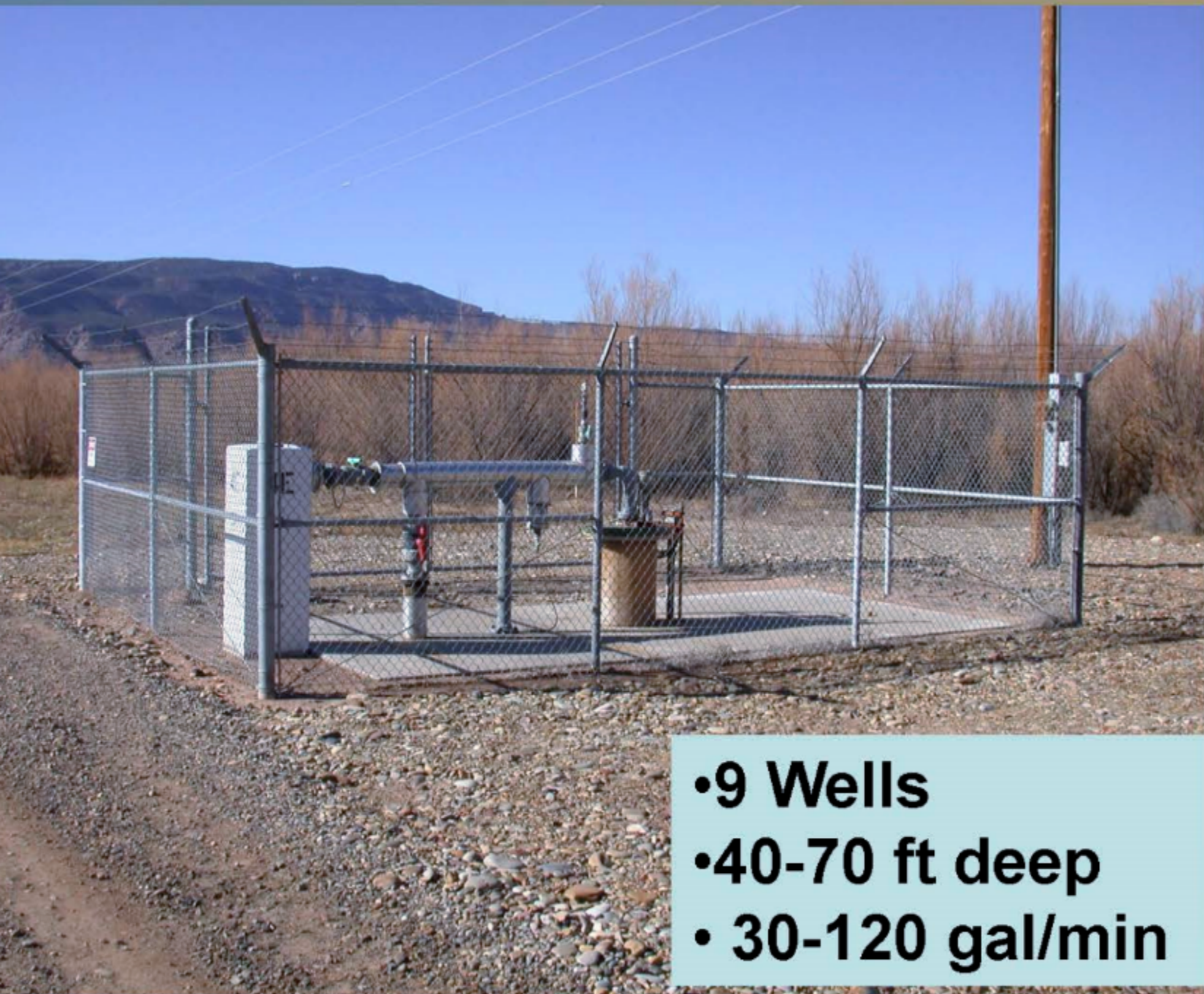
X-Section B-B' from Harr & Bremkamp (1988)

# Paradox Injection Well

- $\cong$  16,000' deep
- Main injection zone  
Mississippian Leadville Fm  
(limestone) at approx. 14,000'
- Continued into Precambrian
- $\cong$  500' salt above injection zone
- 9-5/8" casing
- Interior 5-1/2 Hastelloy C-276  
injection liner
- WAMS (annulus pressurized  
system)







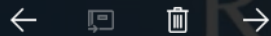
- **9 Wells**
- **40-70 ft deep**
- **30-120 gal/min**



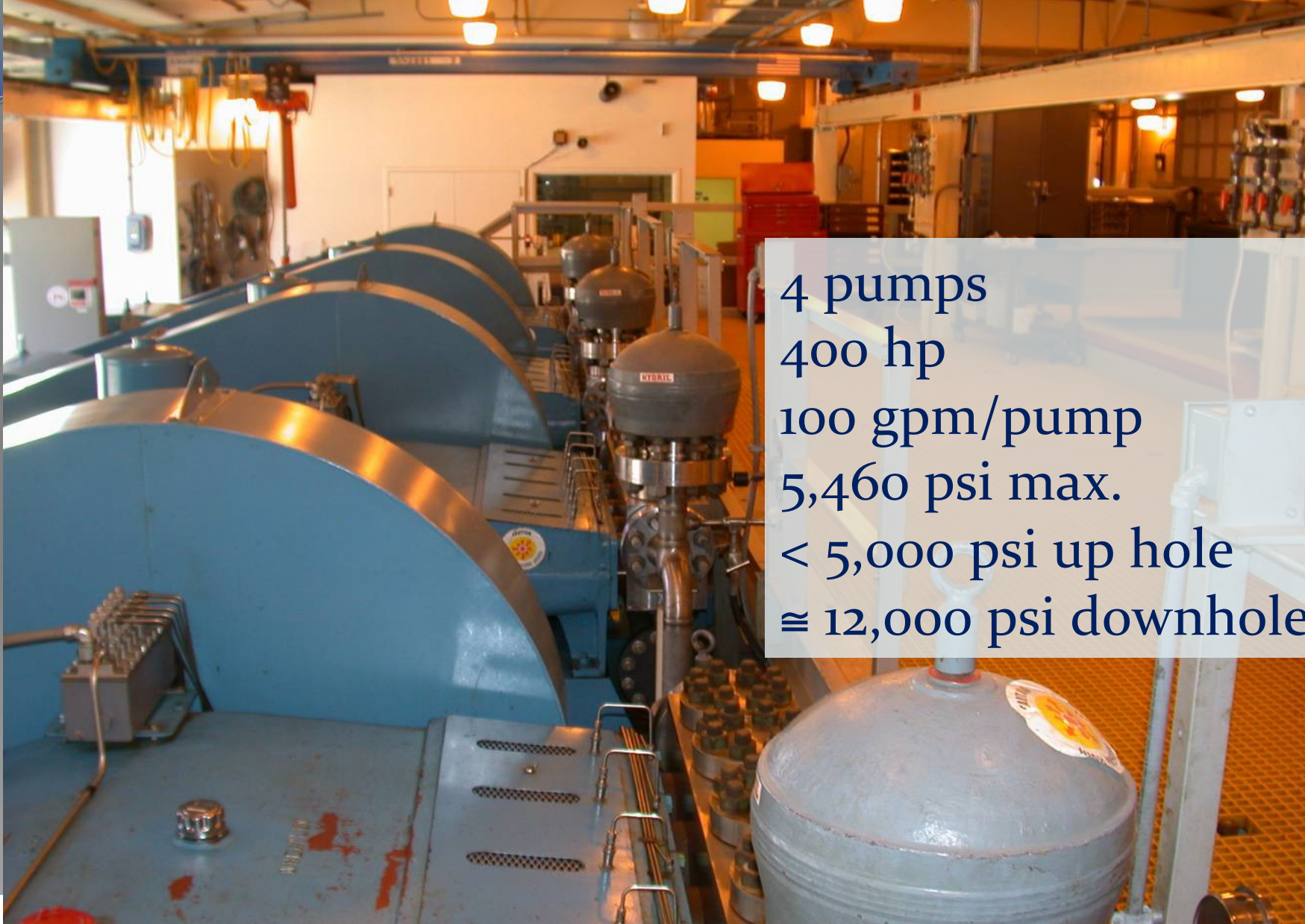
# Surface Treatment Facility



RECLAMATION







4 pumps  
400 hp  
100 gpm/pump  
5,460 psi max.  
< 5,000 psi up hole  
≅ 12,000 psi downhole

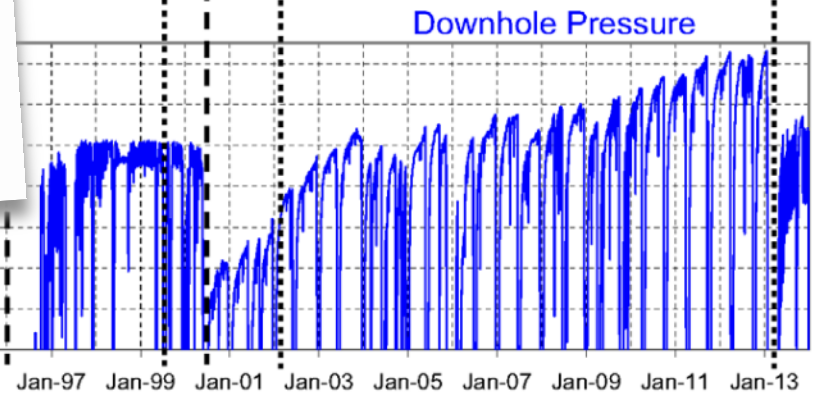
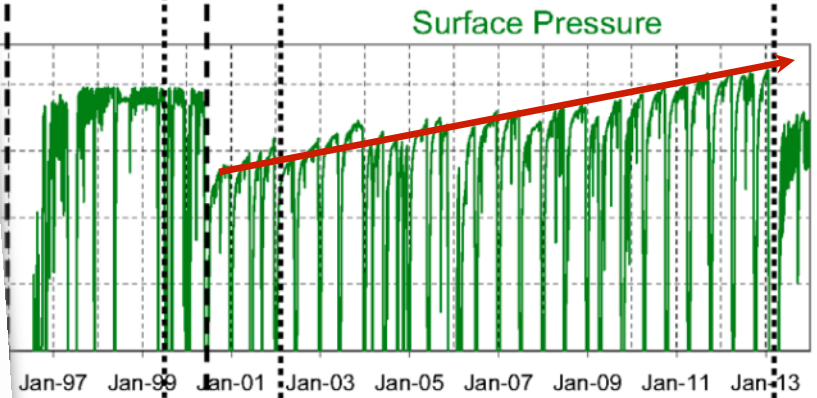
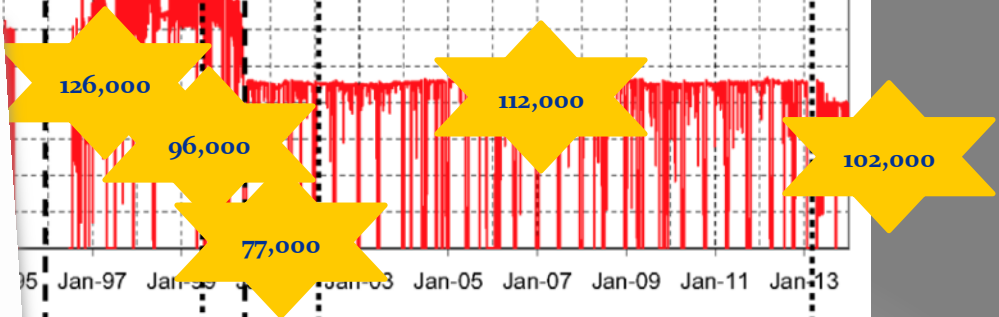
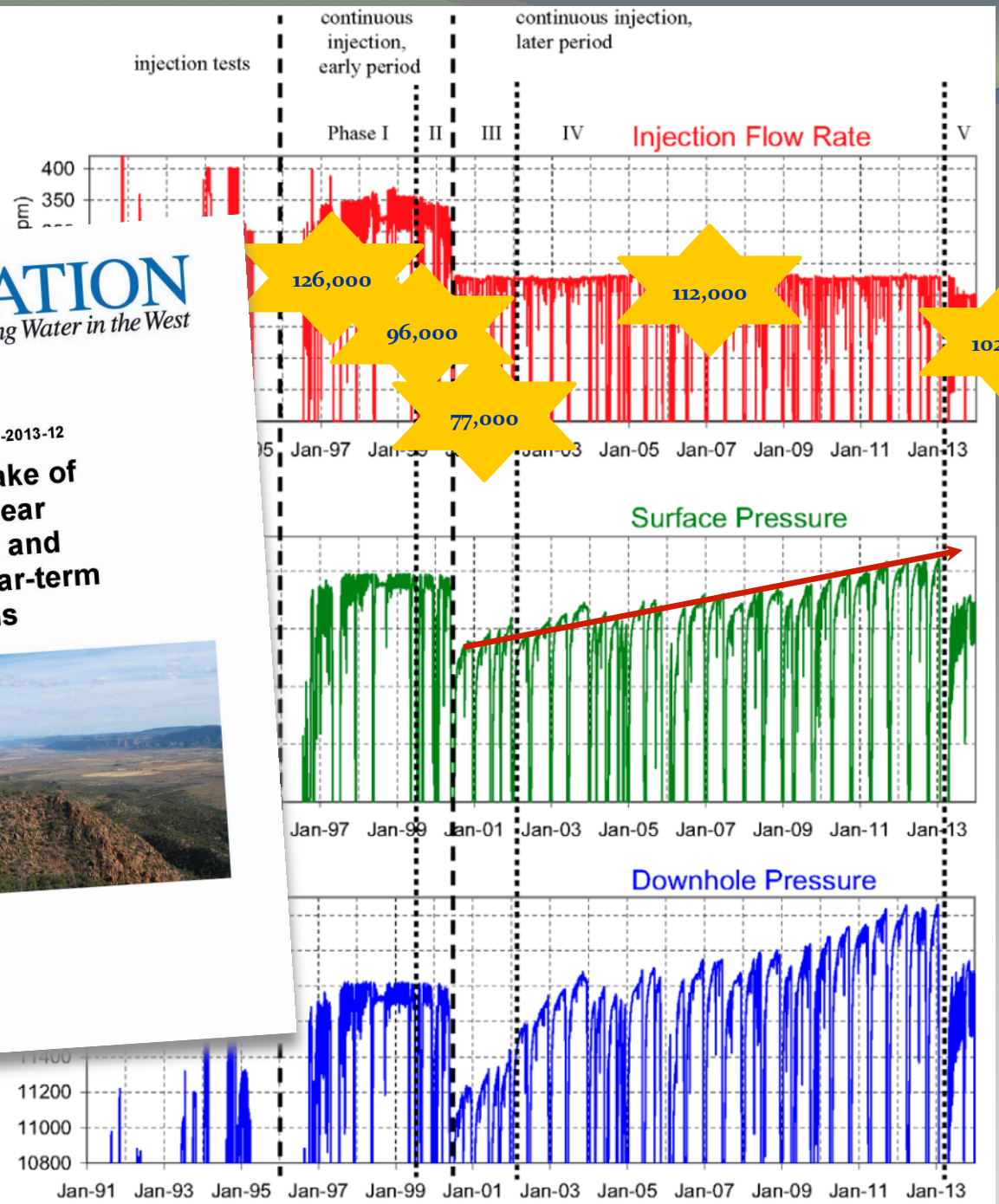
# RECLAMATION

Managing Water in the West

Technical Memorandum TM-86-68330-2013-12

## The *M<sub>L</sub>* 4.4 Earthquake of January 24, 2013, Near Paradox, Colorado, and Implications for Near-term Injection Operations

Colorado Basin Salinity Control Project, Paradox Valley Unit, Colorado Upper Colorado Region





# SUMMARY REPORT

for

## PARADOX VALLEY SALINITY CONTROL UNIT



by

**Franson Civil Engineers Team**

Franson Civil Engineers

Malcolm Pirnie

# RECLAMATION

*Managing Water in the West*

## Scoping Report- Paradox Valley Unit EIS

January 2013

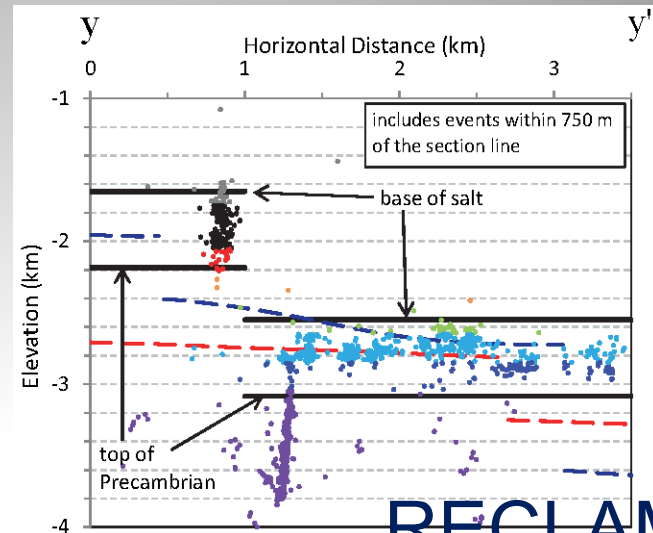
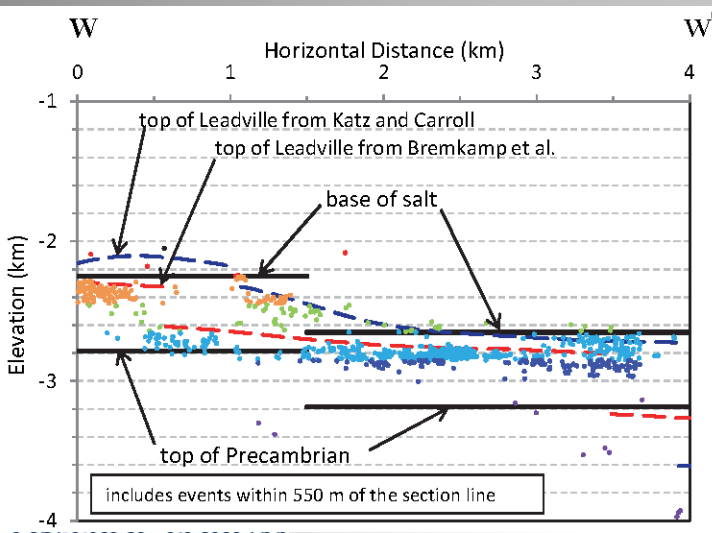
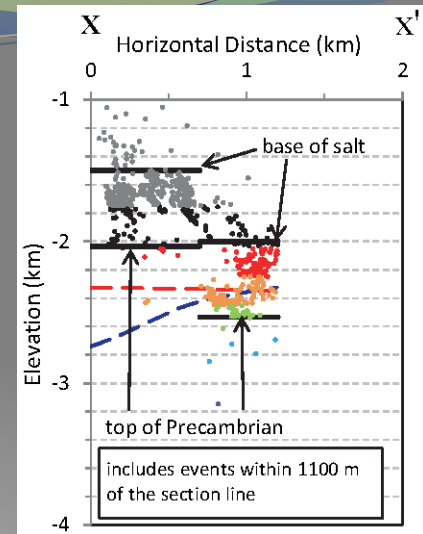
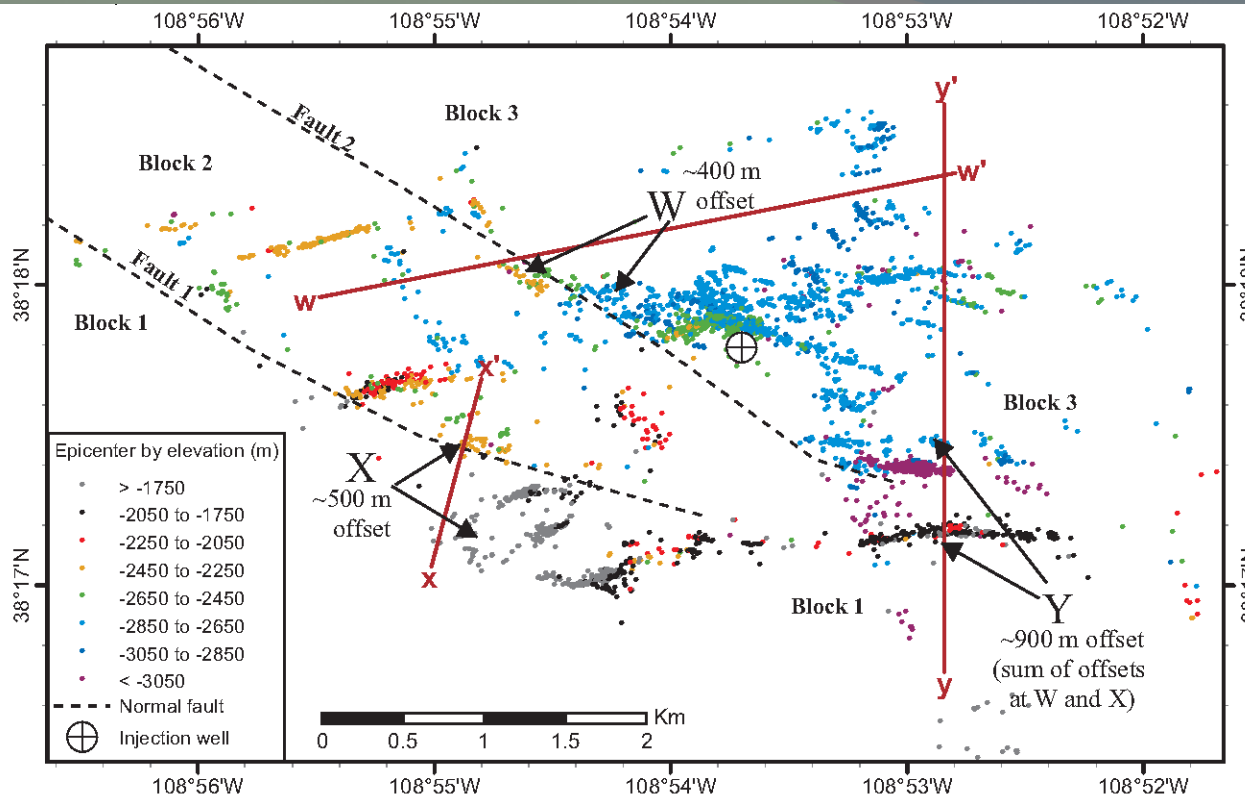


Paradox Valley

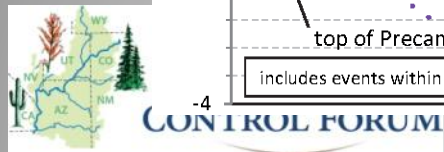
Bureau of Reclamation  
Western Colorado Area Office  
2764 Compass Drive  
Suite 106  
Grand Junction CO 81506  
(Contact: ParadoxEIS@usbr.gov)



# EIS/Alternatives Study

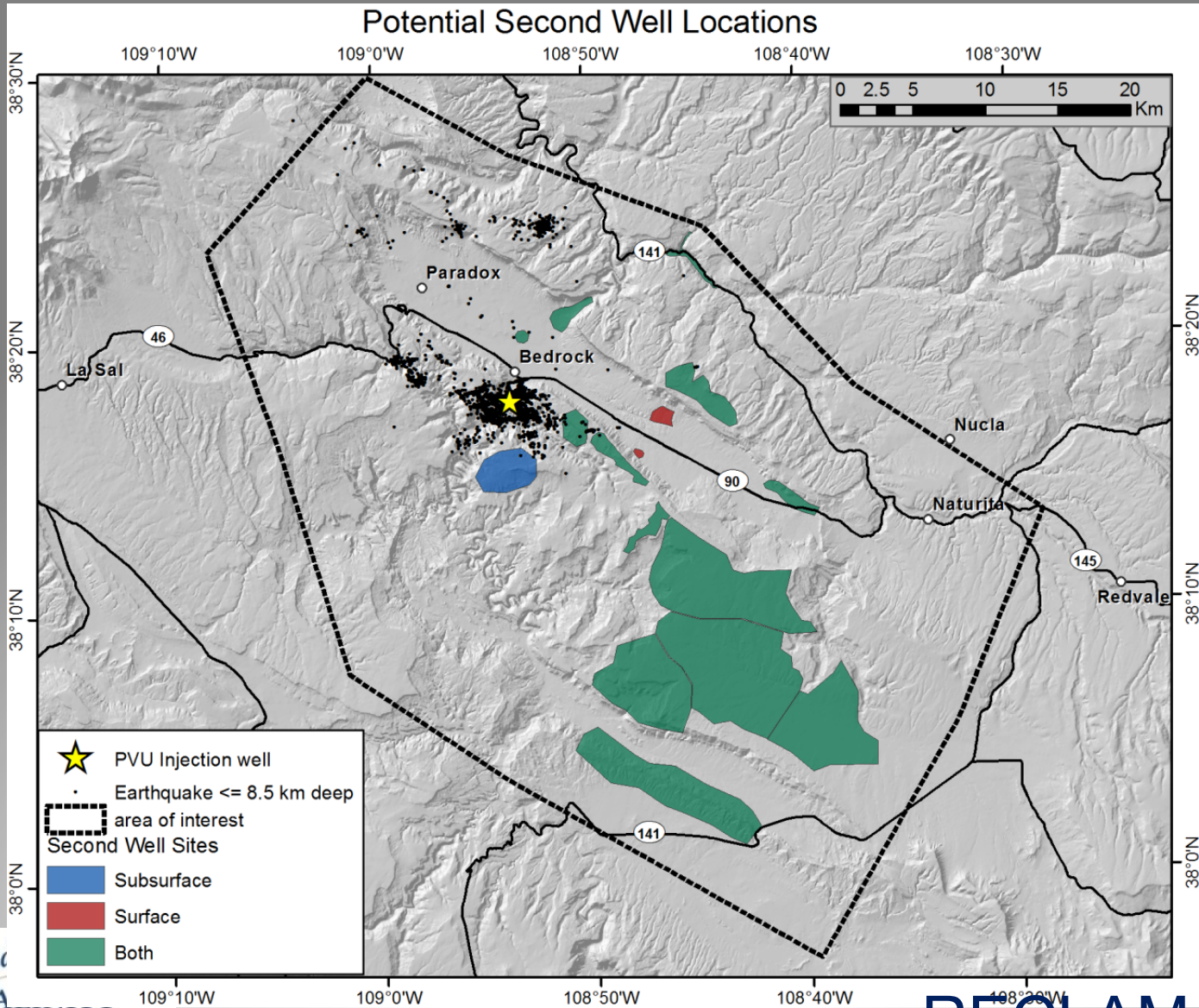


RECLAMATION



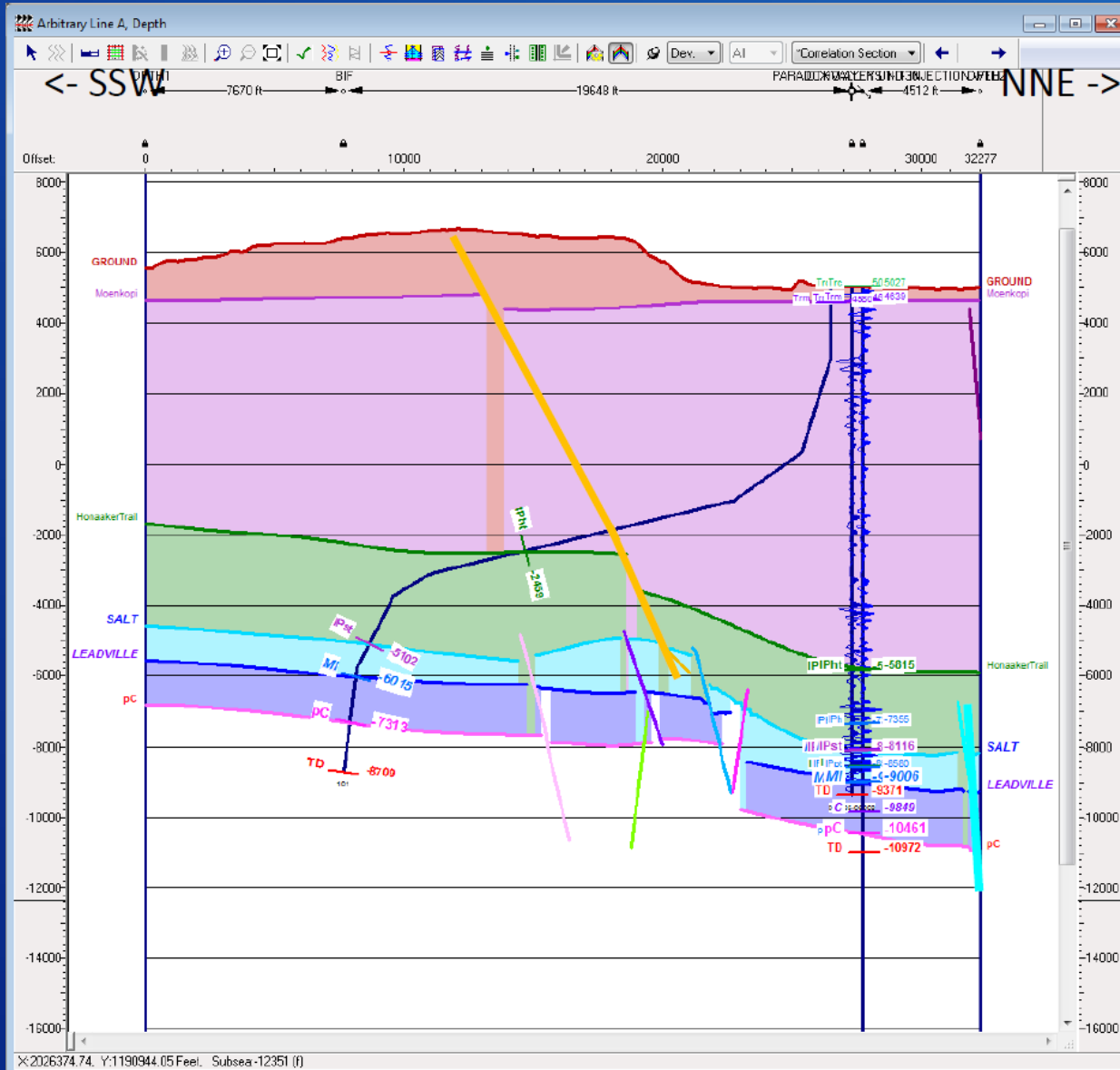


# Preliminary Locations for Additional Well(s)



RECLAMATION

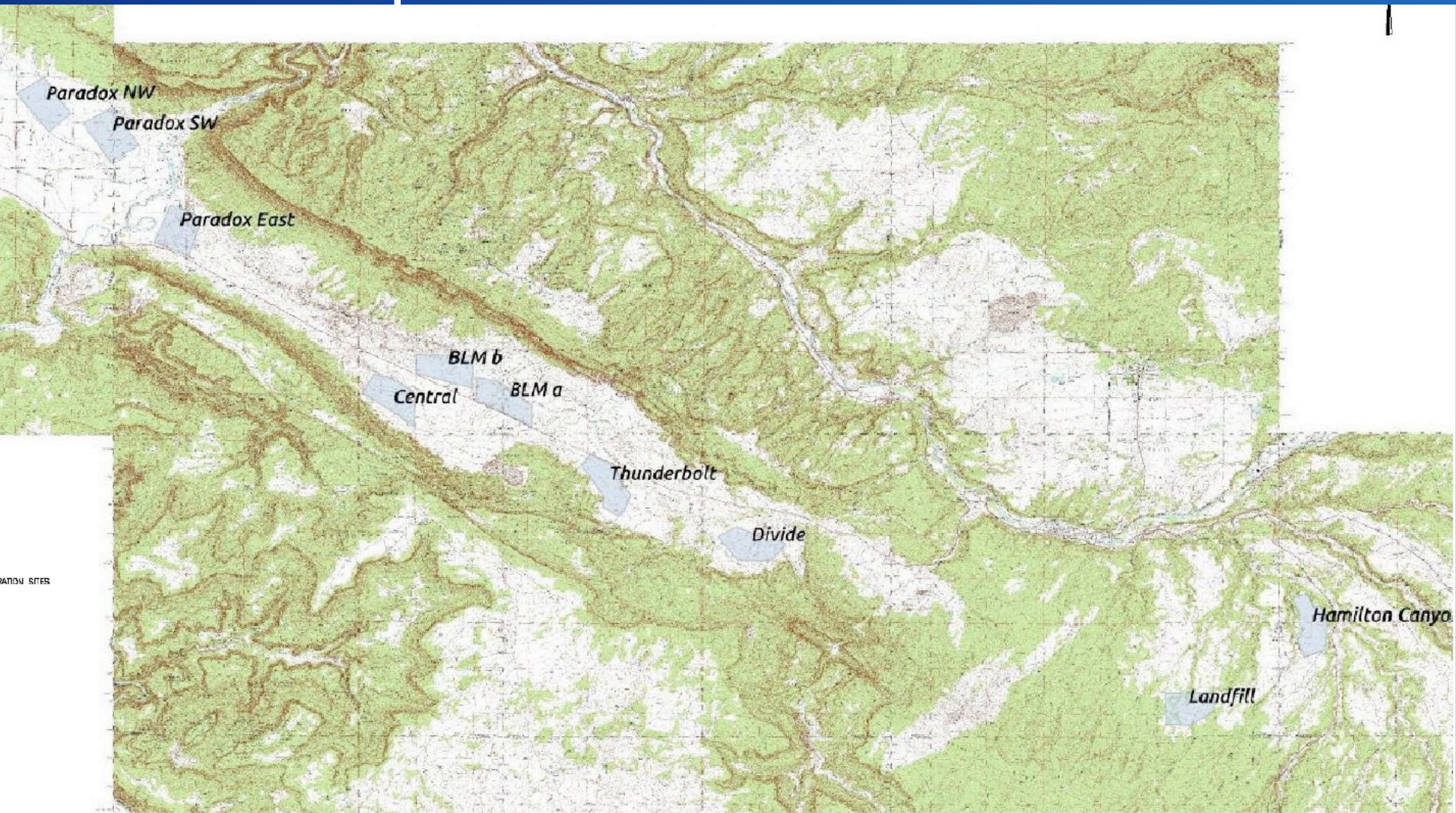
# Well Deviated South from BIF (Schematic)



# RECLAMATION

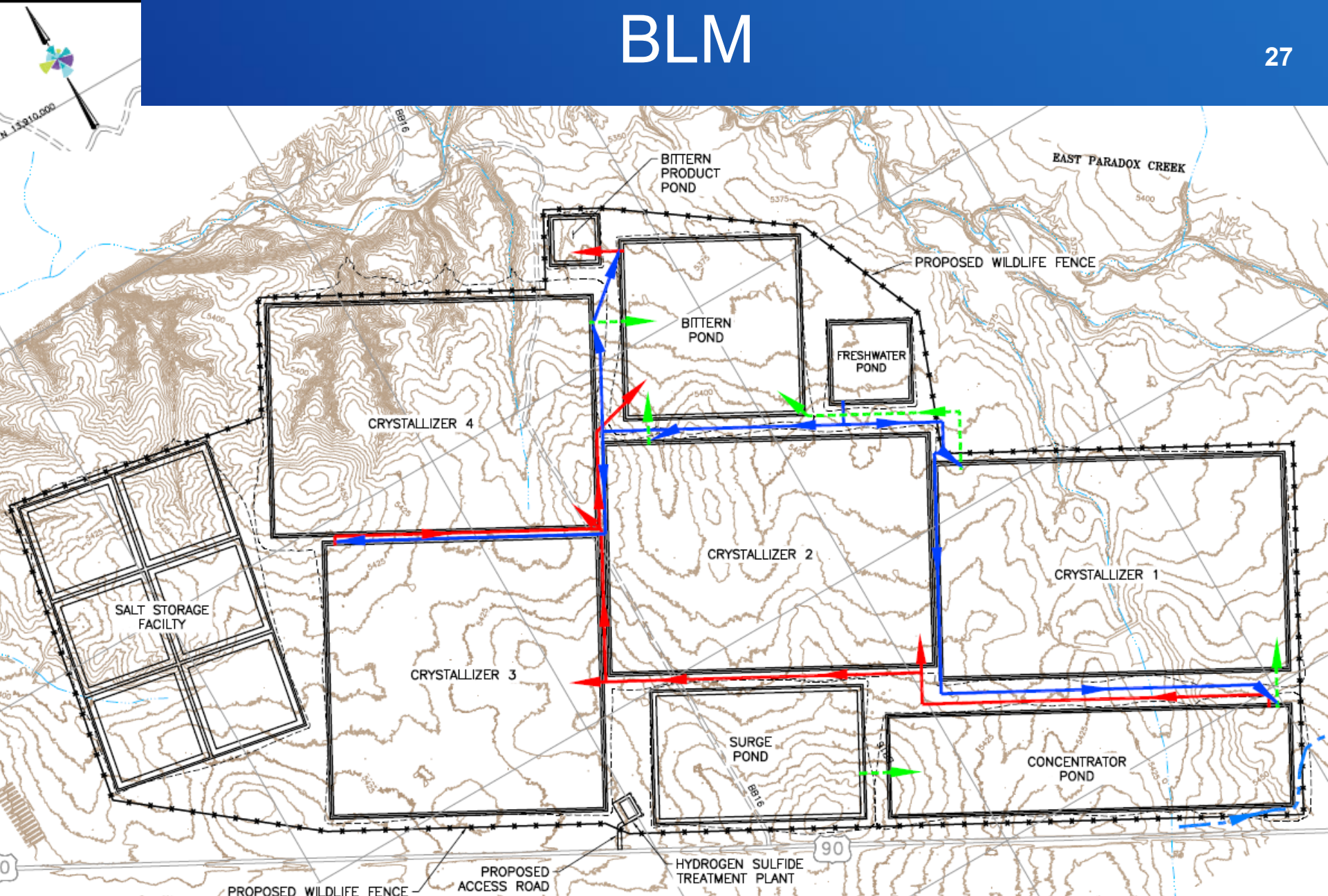


# Evaporation Ponds Alternative



RECLAMATION



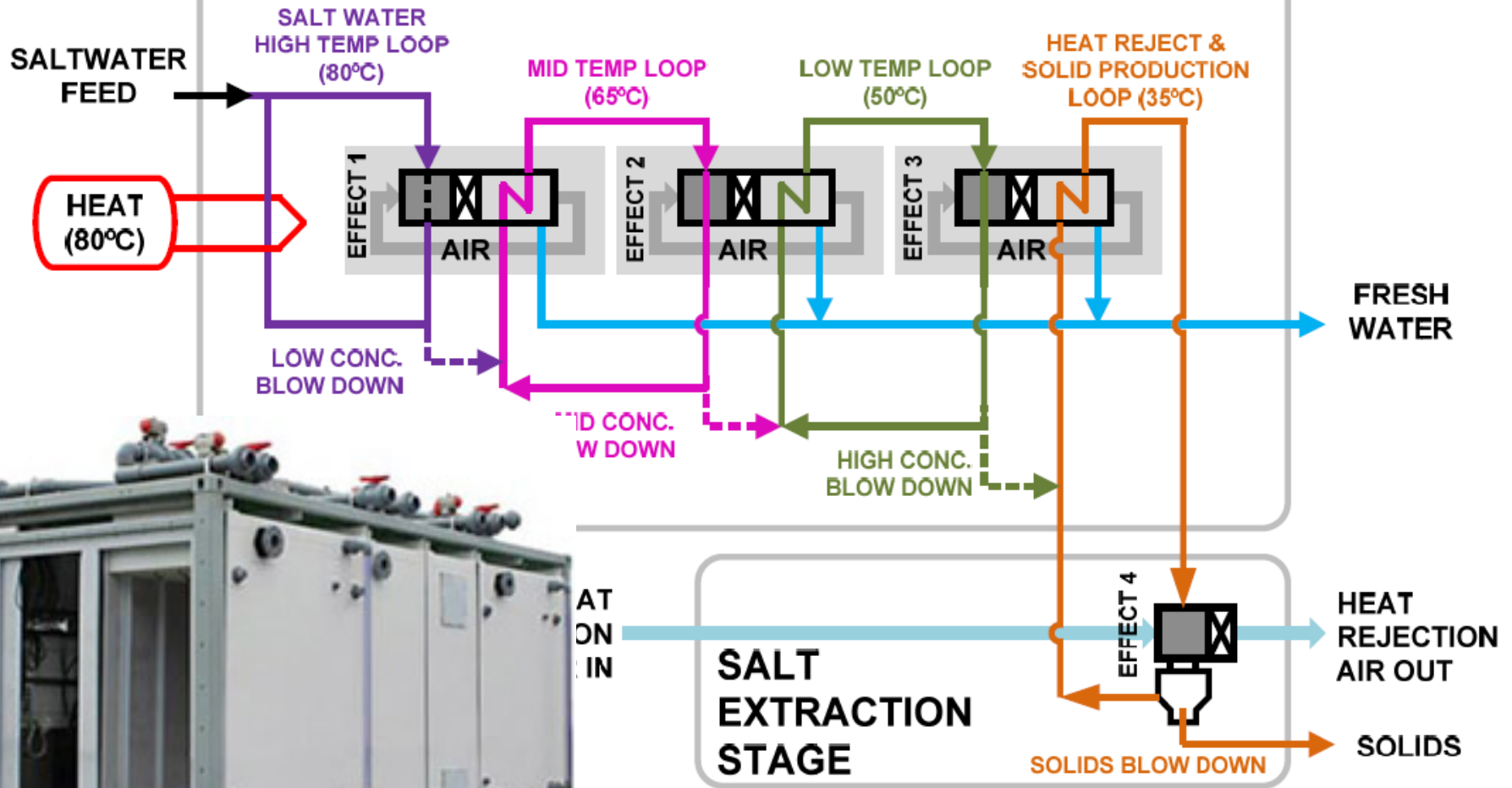


# RECLAMATION



# Brine Crystallization

## CONCENTRATING STAGES



# Alternatives Study/EIS Schedule

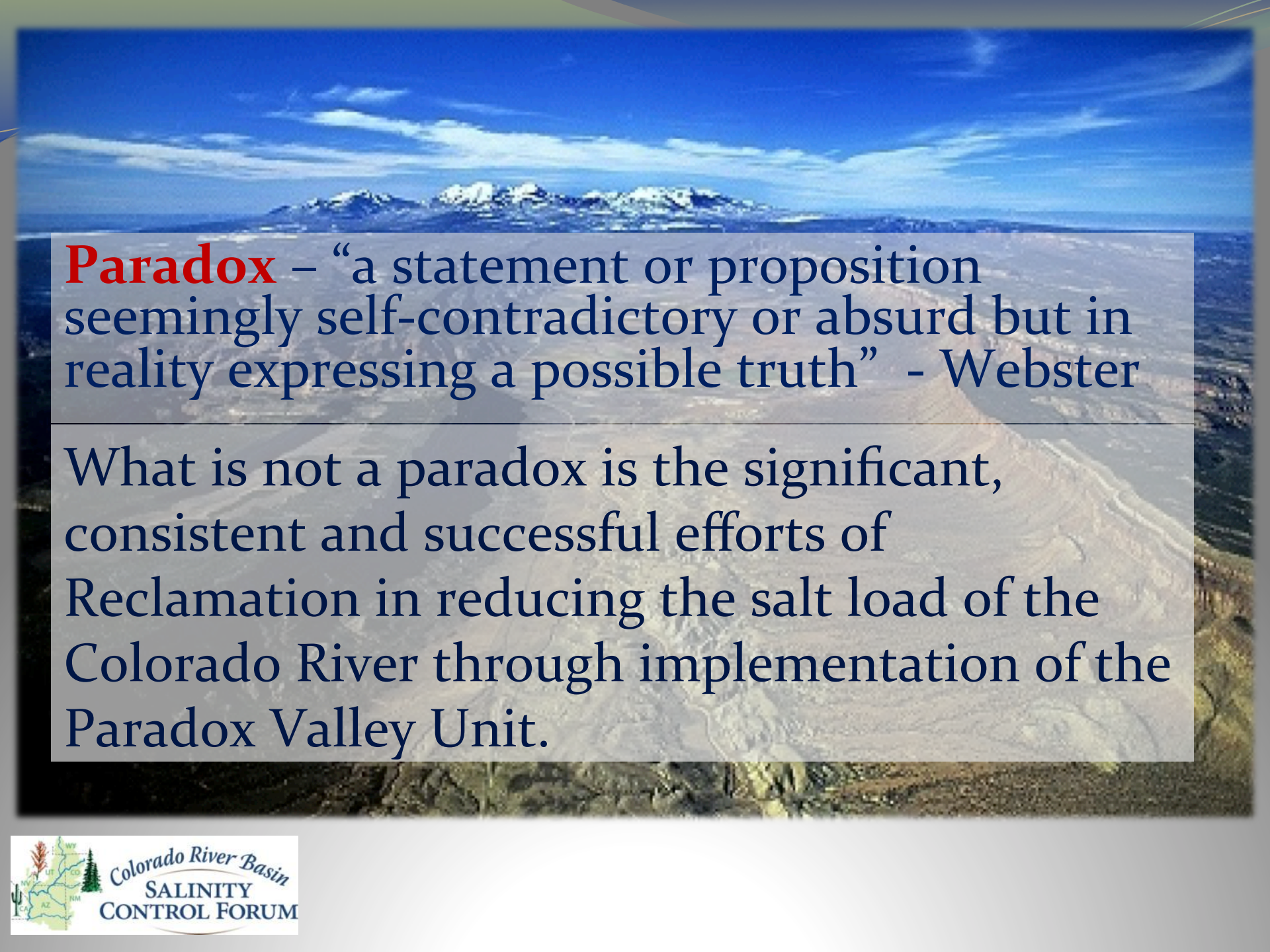
ACTIVITY	2012	2013	2014	2015		2016		2017		2018		2019	
				Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
Scoping													
Alternatives Development and Studies								Mar-17		Apr-18			
Value Planning Study (All Alternatives)									Jul-17		Jul-18		
Impact Analyses / Draft EIS Preparation									Oct-17		Sep-18		
Publish Draft EIS									Nov-17		Nov-18		
Comment Period and Public Meetings on Draft EIS									Nov-17	Feb-18	Nov-18	Feb-19	
Design, Estimating and Construction (DEC) Review									Dec-17		Dec-18		
Prepare and Publish Final EIS									Dec-17	Jul-18	Dec-18	Jul-19	
Issue ROD											Sep-18		Sep-19

Underway

Previous Schedule

Changes to Schedule





**Paradox** – “a statement or proposition seemingly self-contradictory or absurd but in reality expressing a possible truth” - Webster

What is not a paradox is the significant, consistent and successful efforts of Reclamation in reducing the salt load of the Colorado River through implementation of the Paradox Valley Unit.