Central Valley Salinity Management Program

Dr. Karl Longley, PE

Professor Emeritus, California State University, Fresno

Member, Central Valley Regional Water Quality Control Board

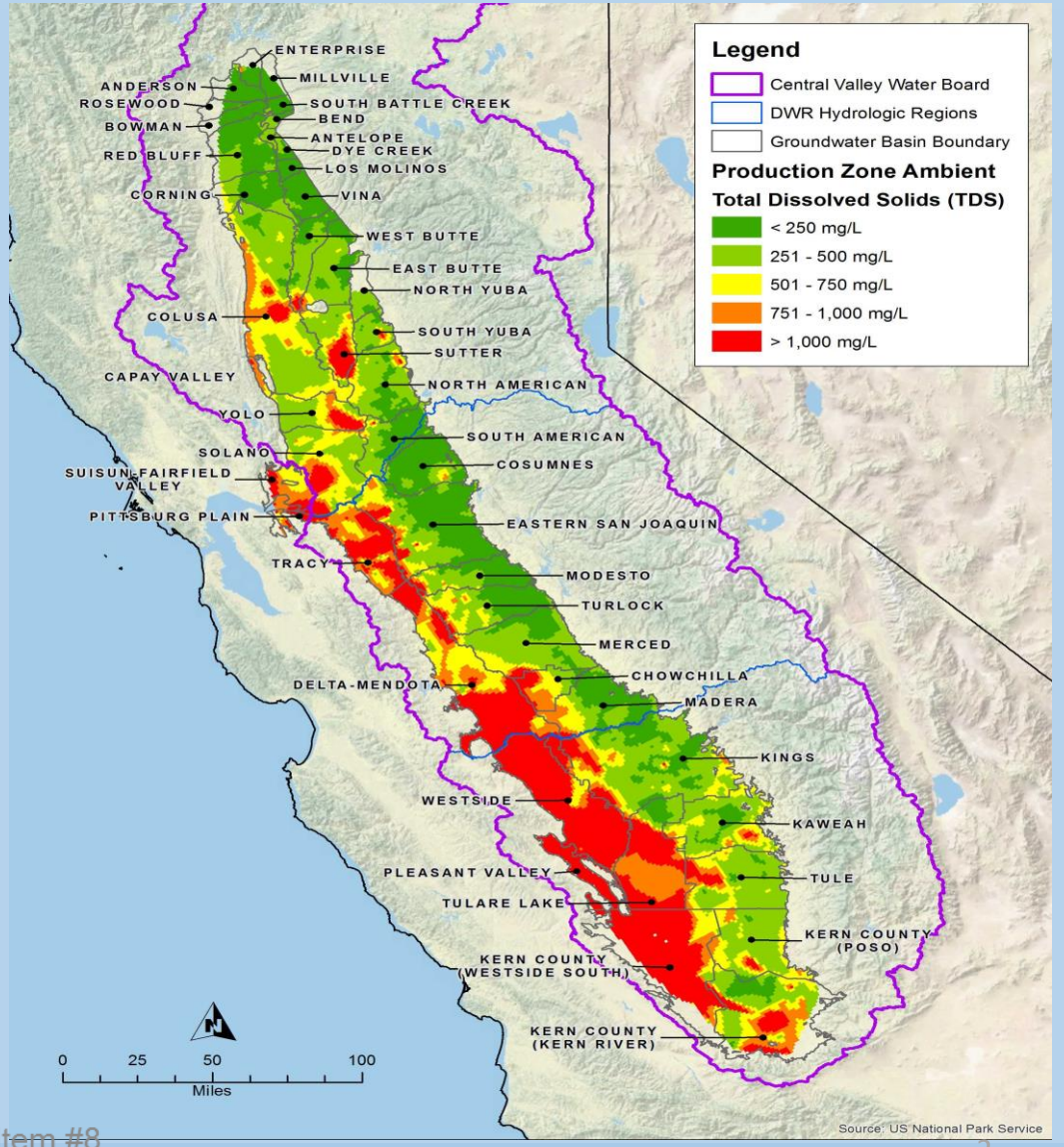
Salinity is a world problem. The world map shows countries which are investigating salinity. There are currently 77 million hectares of salinized land caused by human activities.

Source: Riverina Environmental Education Centre (Australia) website

Salinity Control Program Overview

- Basin-Wide Problem
- Long-term Sustainability Goal
  - Maintain good water quality while improving poor water quality

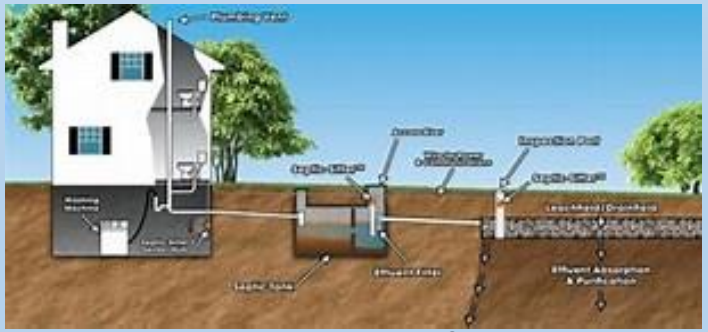
✓ This Salinity Problem Resulted in CV-SALTS



EXAMPLES OF SALT SOURCES

Delivered S. Delta Water

Wastewater (WW) Treatment Plants



Septic Tanks

Food Processing WW

Manufacturing Process WW

Produced Water

Dairy & Feed Lot WW

Irrigation Water & Runoff

Different Expressions of Salinity During Drought in Australia's Murray-Darling Basin

Urban

Dryland

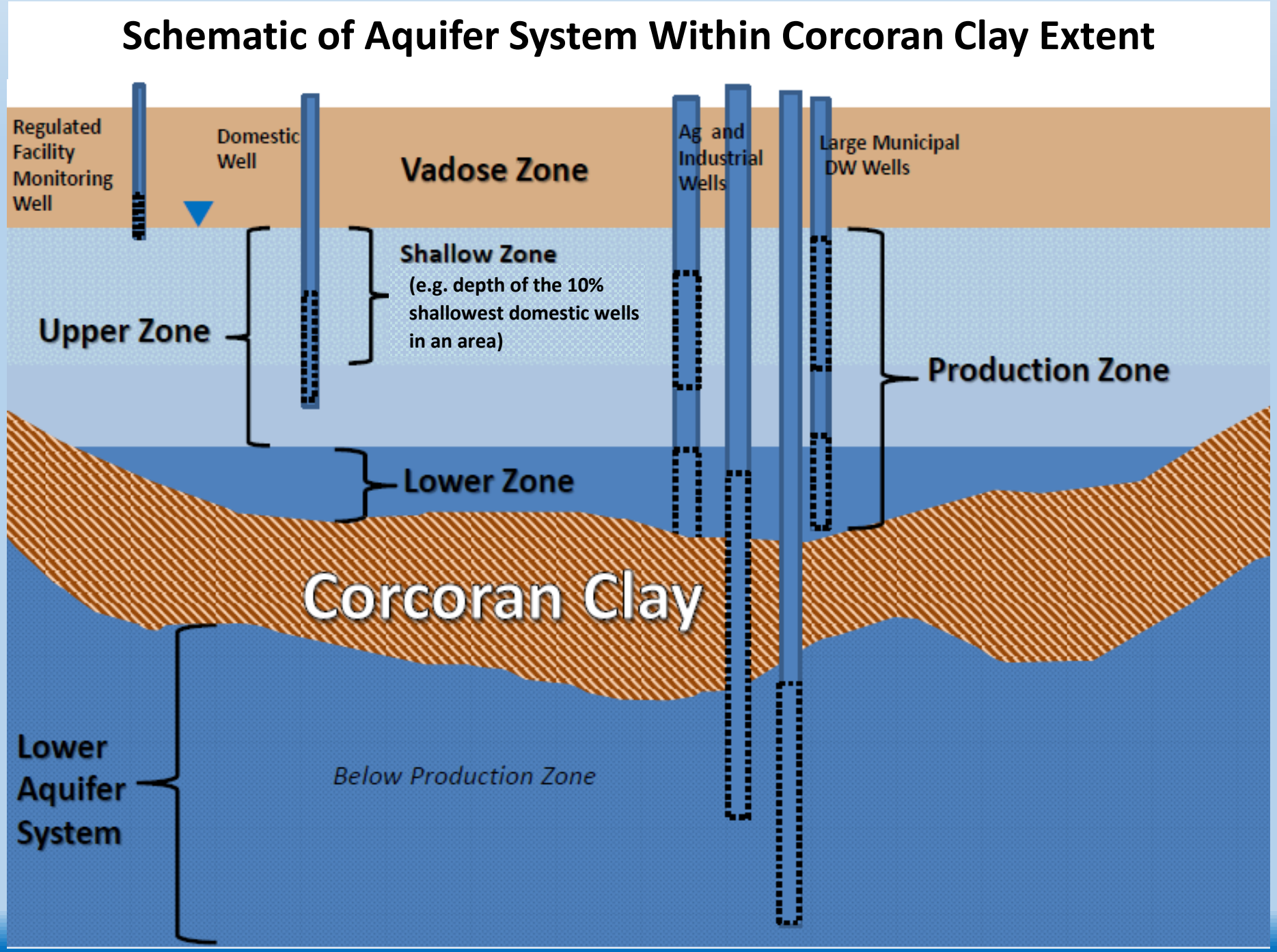
Dryland

Irrigation

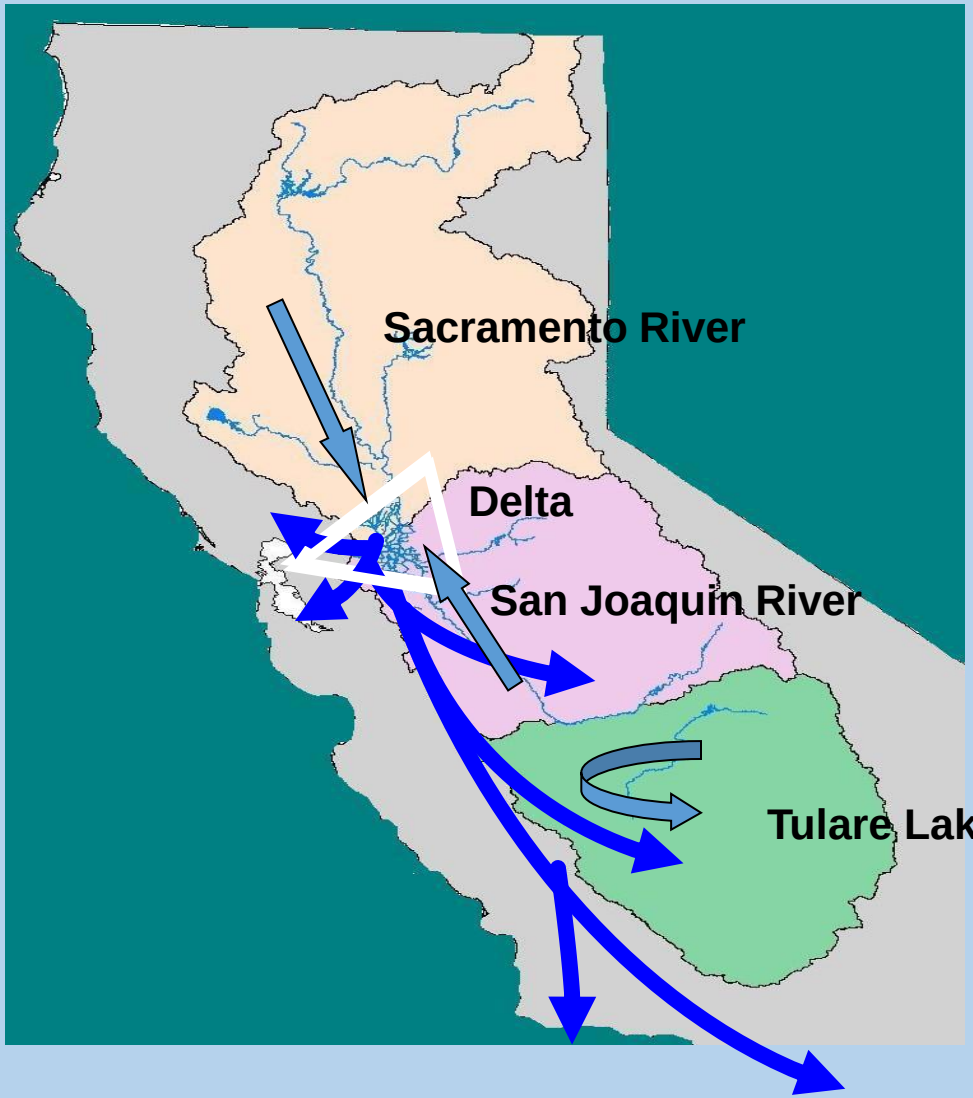
A town near the Glory River was abandoned after reductions in the Tigris flow shrank the canal and parched the surrounding wetlands. Photo by Julia Harte.
https://blog.nationalgeographic.org/2013/04/24/in-cradle-of-civilization-shrinking-rivers-endanger-unique-marsh-arab-culture/

Salt accumulation in an evaporation ponding basin for agricultural drainage water located on the western side of the San Joaquin Valley.

Schematic of Aquifer System Within Corcoran Clay Extent



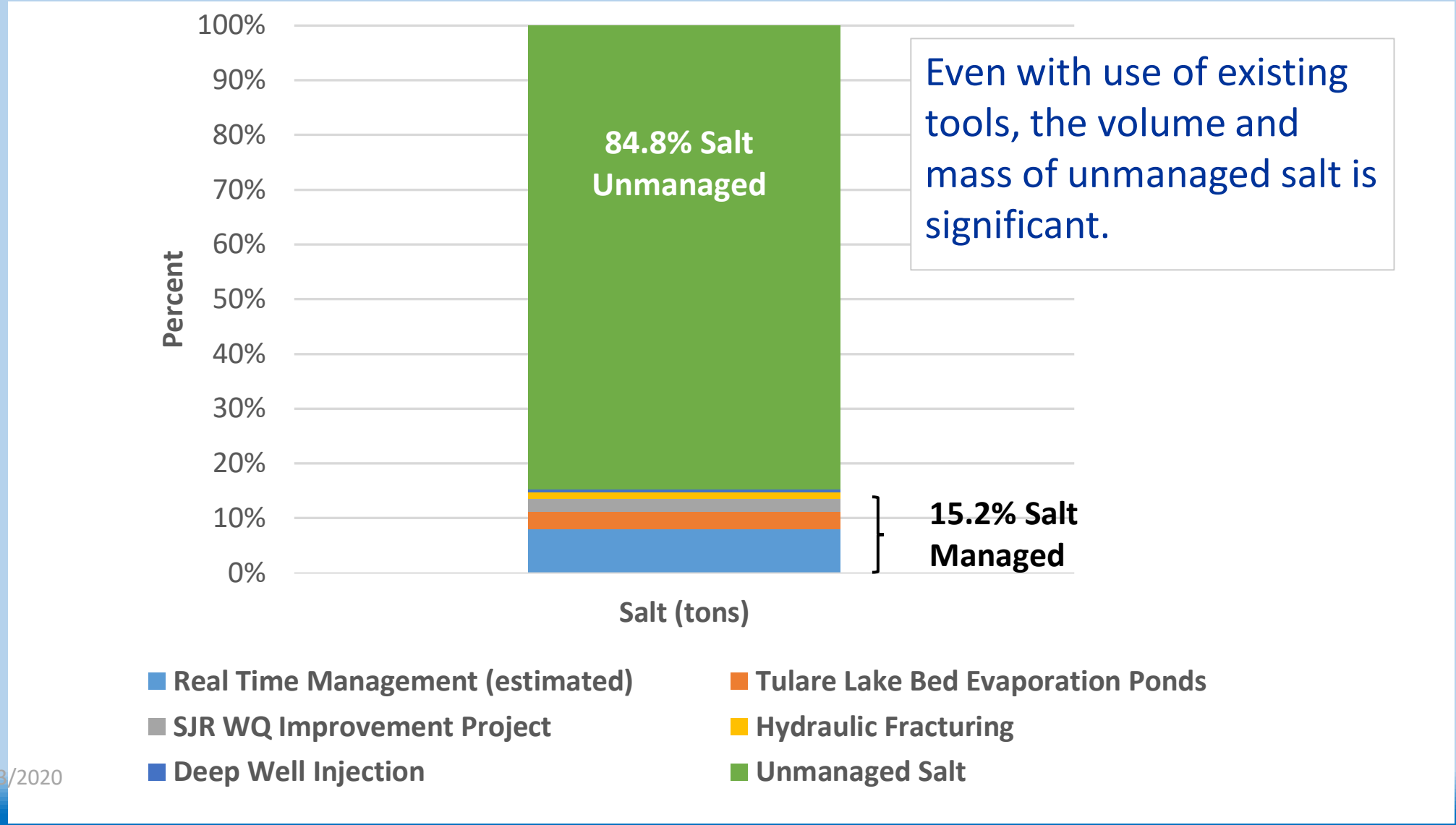
Central Valley Salt Issues



More salt enters the Central Valley Region than leaves

- Impacts (current/legacy)
  - Agricultural Production
  - Drinking Water Supplies
- Economic Cost
  - Direct Annual: $1.5 Billion
  - Statewide annual income impact: $3.0 Billion
- Diverse Sources of Salt
  - Ag Drainage
  - Soil Amendments (gypsum, etc.)
  - Industry (Produced Water, Food Processing, etc.)
  - Brackish Groundwater
  - Water Reclamation
  - Other

Achieving Salt Sustainability – Example Scenario from Southern Part of Central Valley



Even with use of existing tools, the volume and mass of unmanaged salt is significant.

CV-SALTS: THREE PHASE PROGRAM

Phase 1: Prioritization/Optimization Study

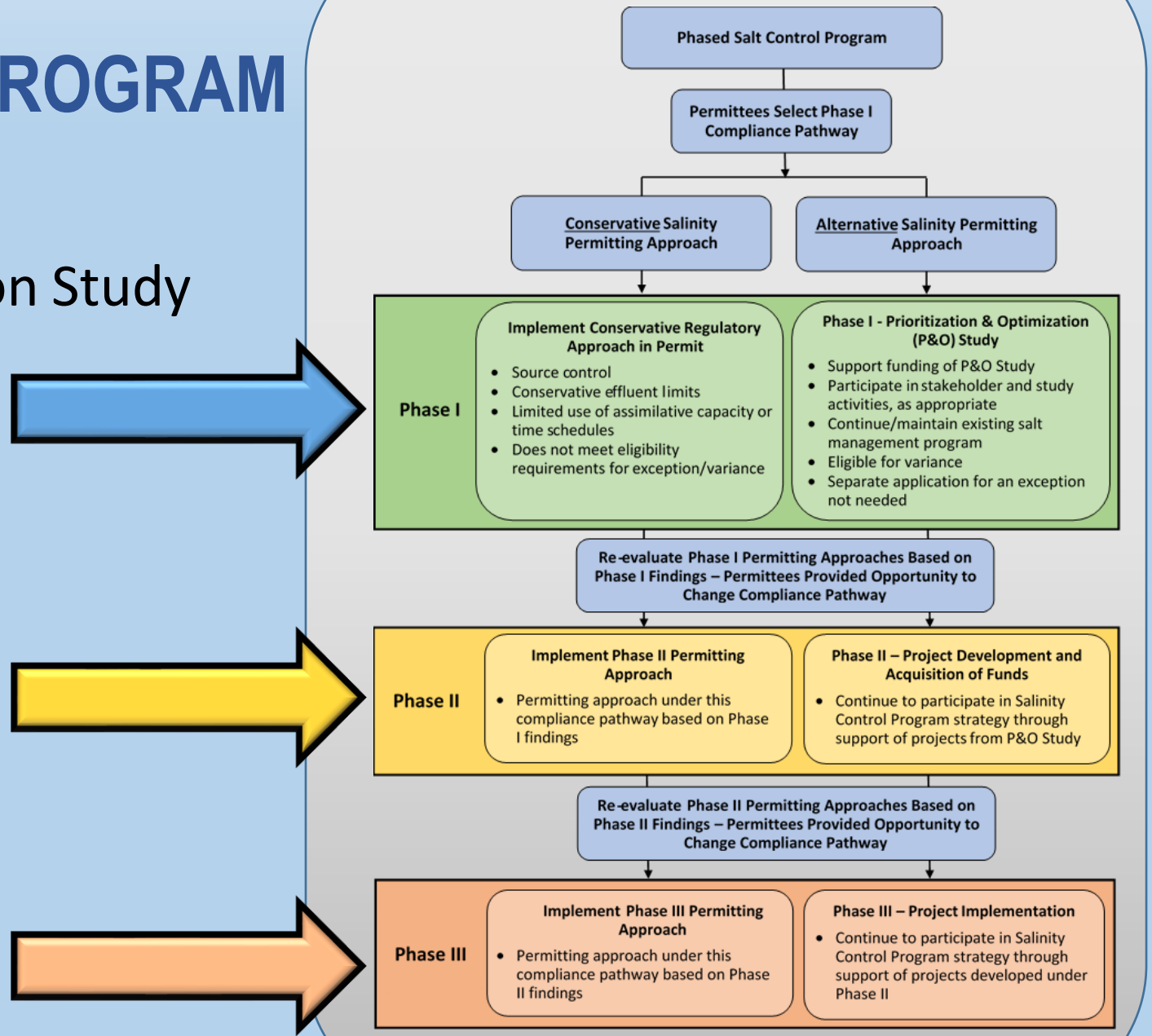
- *Expanded Evaluations*
- *Physical/Non-Physical Projects*
- *Governance/Funding*

Phase 2: Project Development

- *Funding/Permits/Non-Physical Projects*

Phase 3: Project Implementation

- *Construction*



Key Salt Management Alternatives

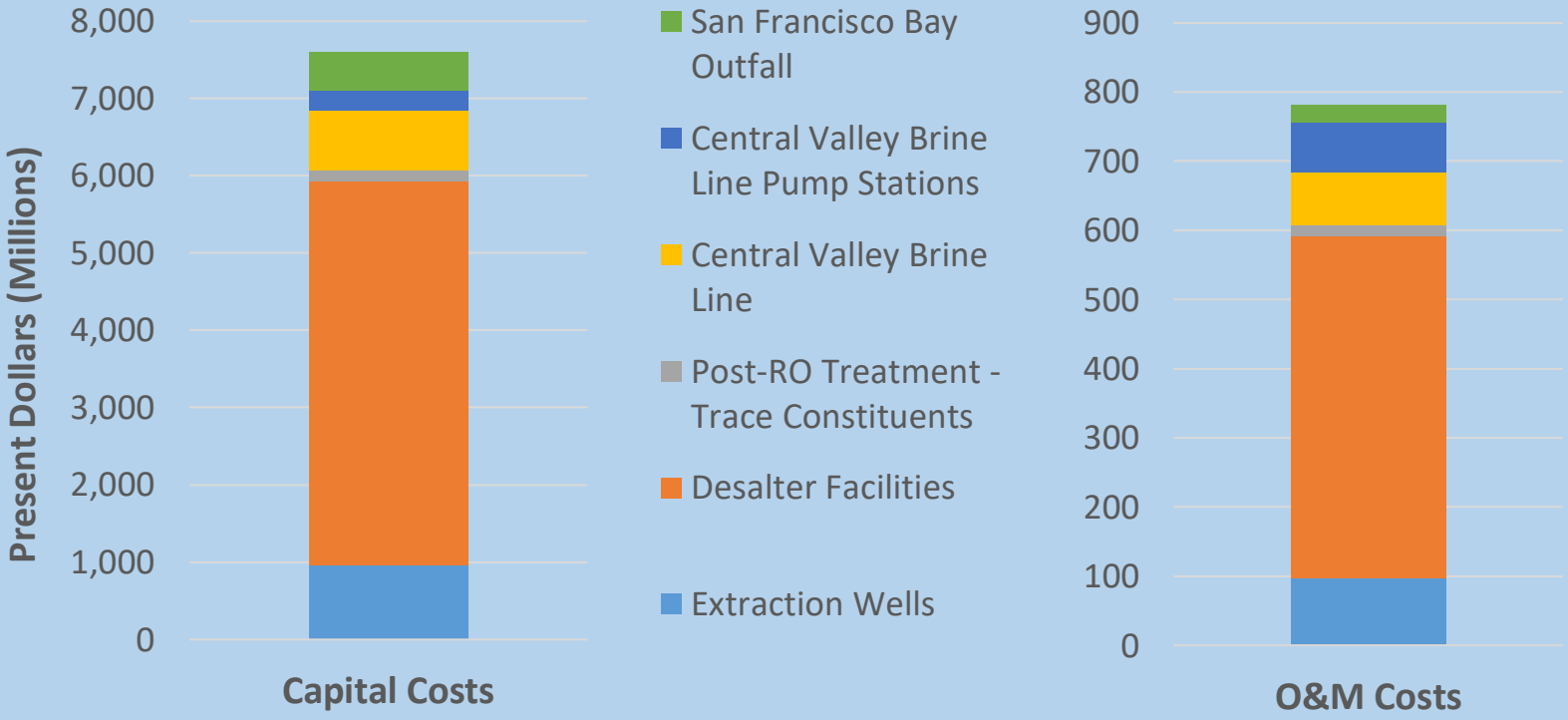
Treatment & Salt Recovery Technology	Brine Disposal and Storage

• Mature Technologies
  • Reverse Osmosis
  • Ion Exchange
  • Lime Softening
  • Evaporation Ponds
• Emerging Technologies
  • Smart Integrated Membrane System (SIMS)
  • WaterFX Aqua4 System – Multi-effect Distillation
  • Zero Discharge Distillation by Veolia – Electrodialysis Metathesis
  • New Sky Energy – Temperature Control and Electrodialysis
  • Element Renewal – addition of polymers to remove trace elements
	• Brine Supply for Hydraulic Fracturing
	• Deep Well Injection
	• Salt Management Disposal Areas
	  • Landfills
	  • Dedicated Disposal Sites
	  • San Joaquin River Improvement Project
	• San Joaquin River Real Time Management
	• Transport Brine Out of Valley
	  • Truck/Rail Brine
	  • Regulated Brine Line
	  • Bay Area WWTP
	  • Permitted Bay Area Outfall

Achieving Salt Sustainability – Export the Salt

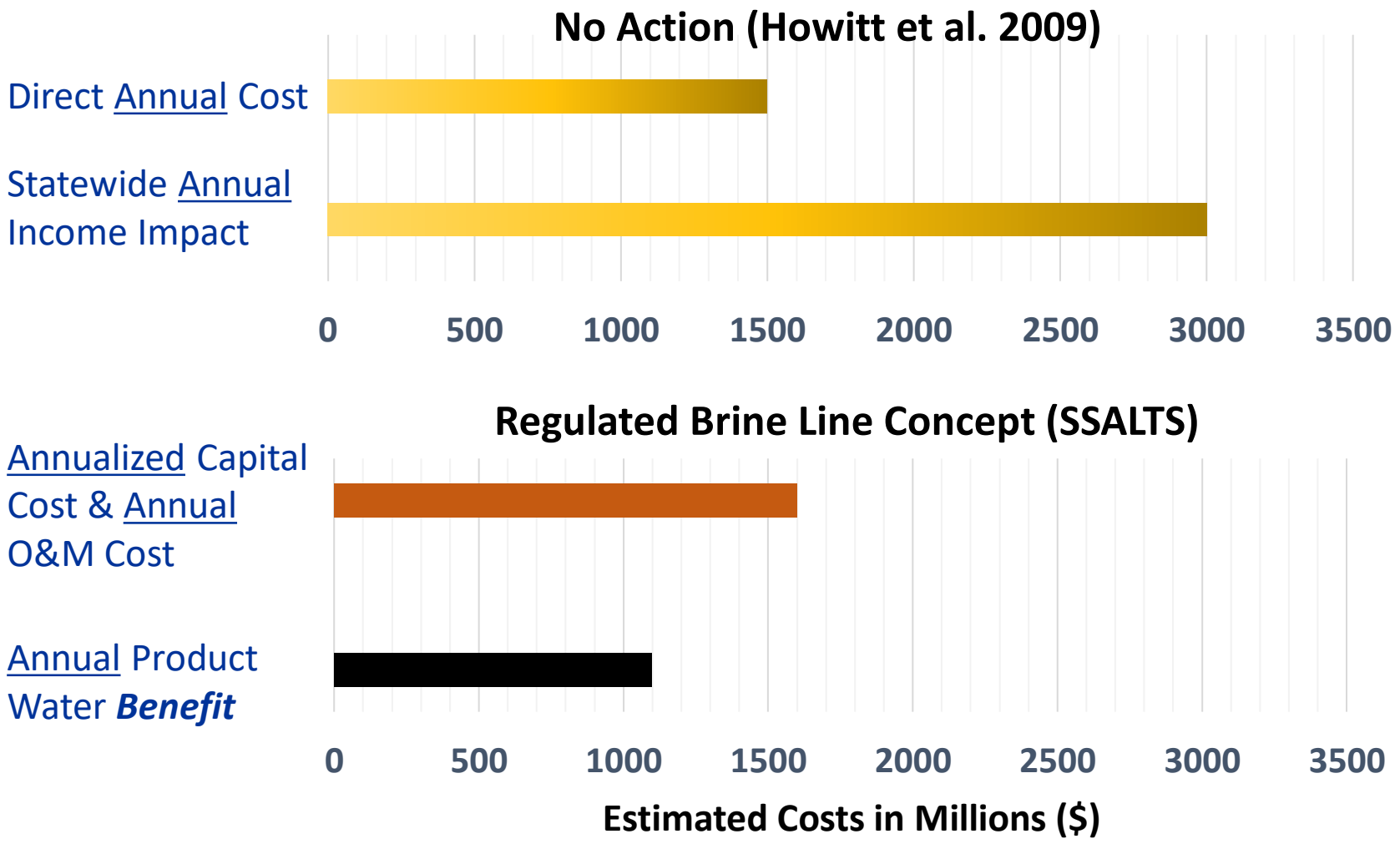
- Analysis shows that sustainability only achieved if the salt is exported out of the Central Valley **(True??)**
- Central to all evaluated salt management alternatives is a ***regulated Central Valley brine line***
- SSALTS completed a conceptual level analysis
  - Preliminary Brine Discharge Alternatives
    - Via existing East Bay Municipal Utility District outfall
    - Via an alternative outfall to San Francisco Bay
  - Alternative Central Valley routes
  - Cost estimate – Capital and O&M for Brine Line
    - Costs do not include development of local facilities to collect/transport brine to the Central Valley brine line

Conceptual Level Costs for Regulated Brine Line Alternative – Outfall to San Francisco Bay



- Implementation of this alternative would yield product water with an estimated value of $909M/year

Regulated Brine Line Concept vs. No Action



ALTERNATIVES

- If a marine disposal option is not available, OR
- If the cost is not sustainable, OR
- A marine disposal option takes too much recoverable water out of the Valley –
- Then, what are <u>other</u> alternatives?

- There are many alternatives and all may be implemented even if disposal to a marine environment is finally determined to be the best solution.

Managed Groundwater Recharge (MGWR) & Its Importance

1. Large amount of aquifer volume available for storage as result of over pumping.
2. Significant amounts of groundwater recharge historically occurred as a result of flooding during wet years.
3. Past development of surface water management included dams that reduced flooding but also very significantly reduced groundwater recharge in the San Joaquin Valley.
4. An effective MGWR program utilizing water from periods of high surface water flows will –
    i. Provide a pathway to groundwater resource recovery, and
    ii. Provide dilution to existing contaminants in the groundwater.

Brine Disposal – Does It Have To Be A **Money Sink** On The Red Site Of the Ledger?

Think **Recycling** – It May Provide **Economic Opportunity** And **Save Water** In the Process.

Brine Treatment Produces Revenue Sources

1. Safe, Usable Water Result of Effective Recycling
2. Product Recovery
    - 2.1 Market for product should be early consideration
    - 2.2 Agricultural Drain & Tail Water
    - 2.3 Resource recovery opportunity is site dependent
    - 2.4 Possible products
        - Acids
        - Bases
        - Pure Salts (gypsum, sodium bicarbonate, etc.)
        - Arsenic (Challenge: RCRA)
        - Selenium (Challenge: RCRA)

Some Parting Thoughts

1. Sustainability is the “Name of the Game” Both in Terms Of:
    i. Providing A Water Supply, Particularly In Areas Of Limited Useable Water Availability, And
    ii. Providing Both Efficient Water Reclamation (Water Recovery & Energy Requirement) & Resource Recovery.
2. Consider Water Recharge Particularly Where High Quality Water Is Available
3. Agricultural Water Uses Are the Major Water Uses In Some Areas
    i. Agricultural Drain & Tail Water Can Be Important Resource
    ii. Use Of Salt Tolerant Plants May Provide Important Treatment Process That Also Provides Revenue.