Geologic salinity sources and management options for the Rio Grande

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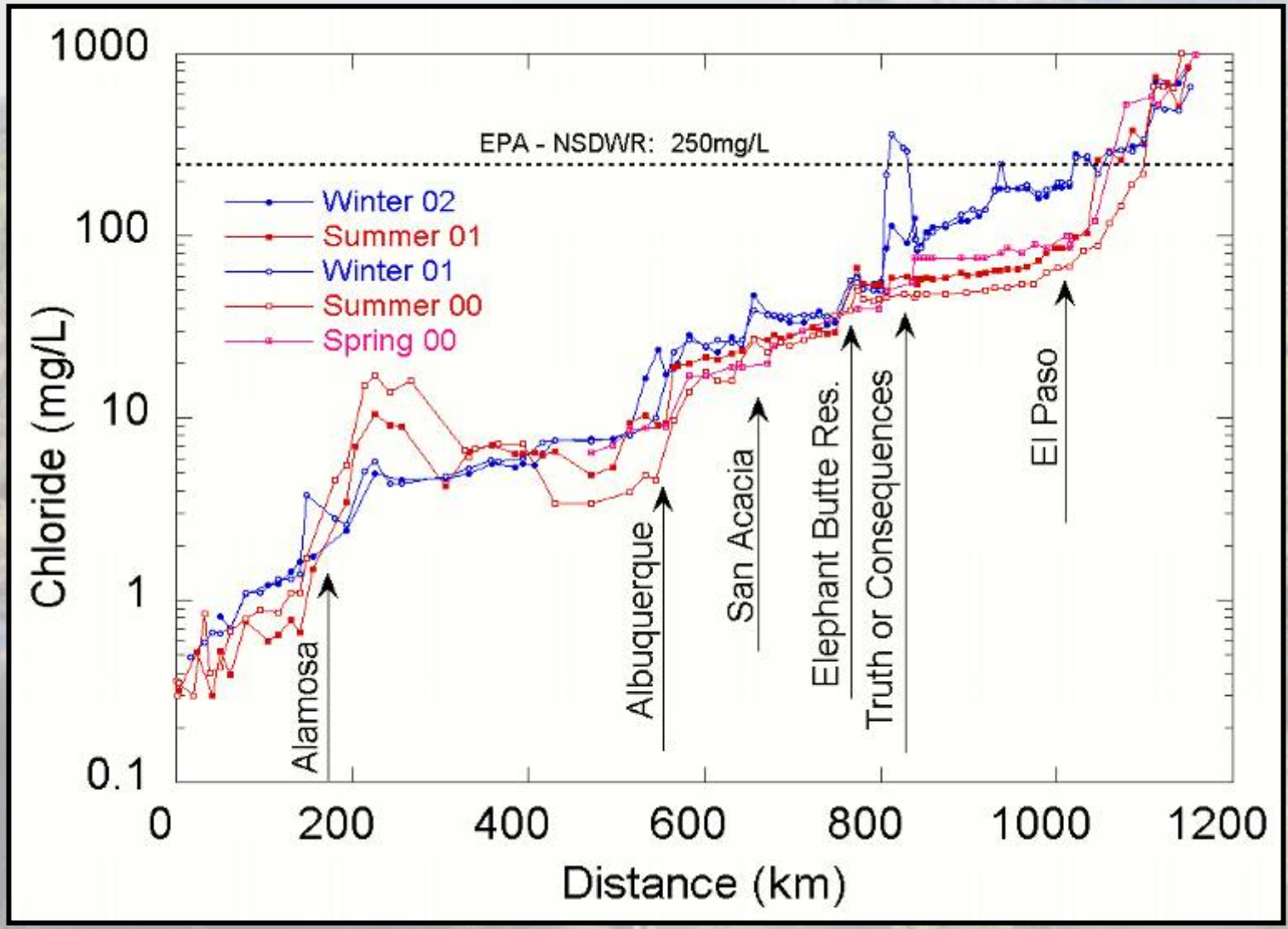
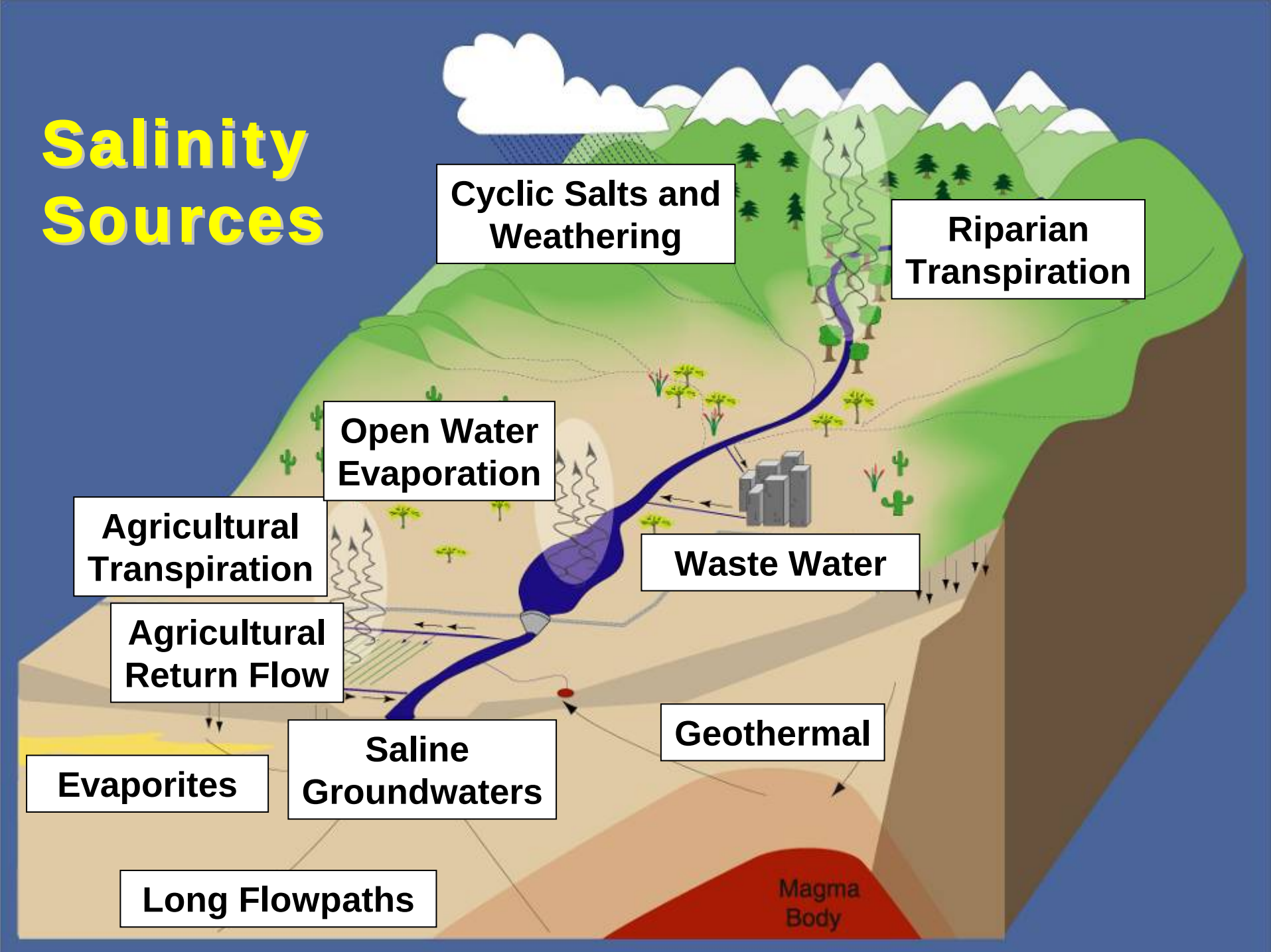
Rio Grande Salinity Increases



Salinity Increases

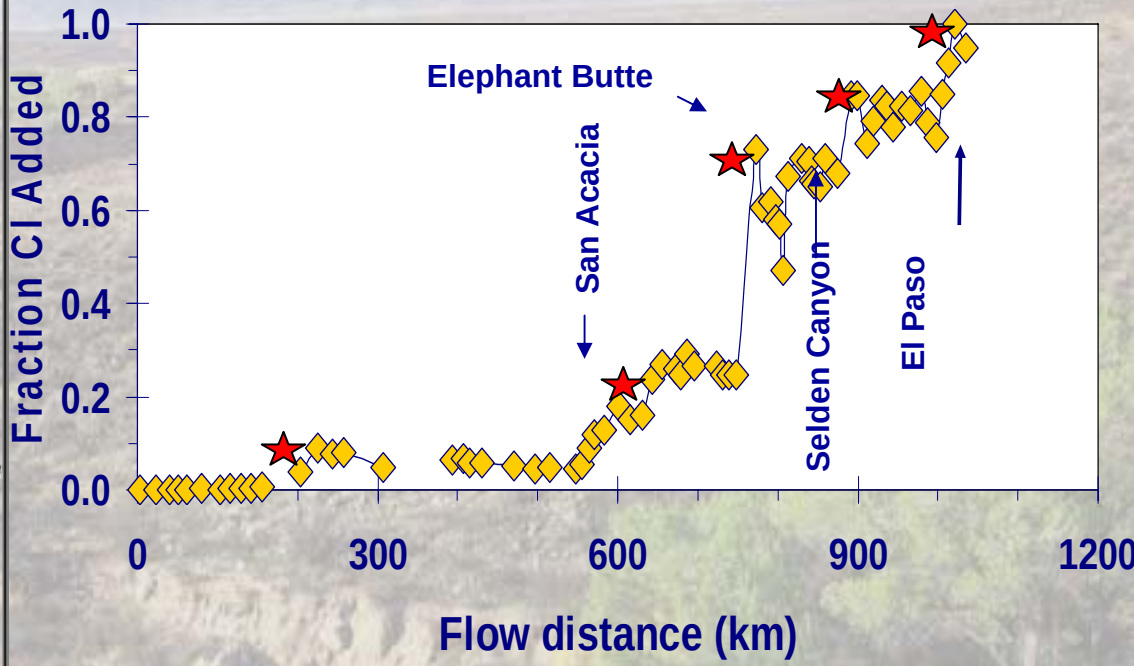
- Cl in the Rio Grande increases from ~1 mg/L to ~100 mg/L at El Paso
- Headwaters contain chloride mainly derived from atmospheric deposition
- ET losses remove ~75%
- Concentration would be ~ 4 mg/L if no additional sources
- About 24 mg of chloride are added to each original liter of water

Salinity Sources



Points of Salt Addition

Fraction Cl Added vs. flow distance



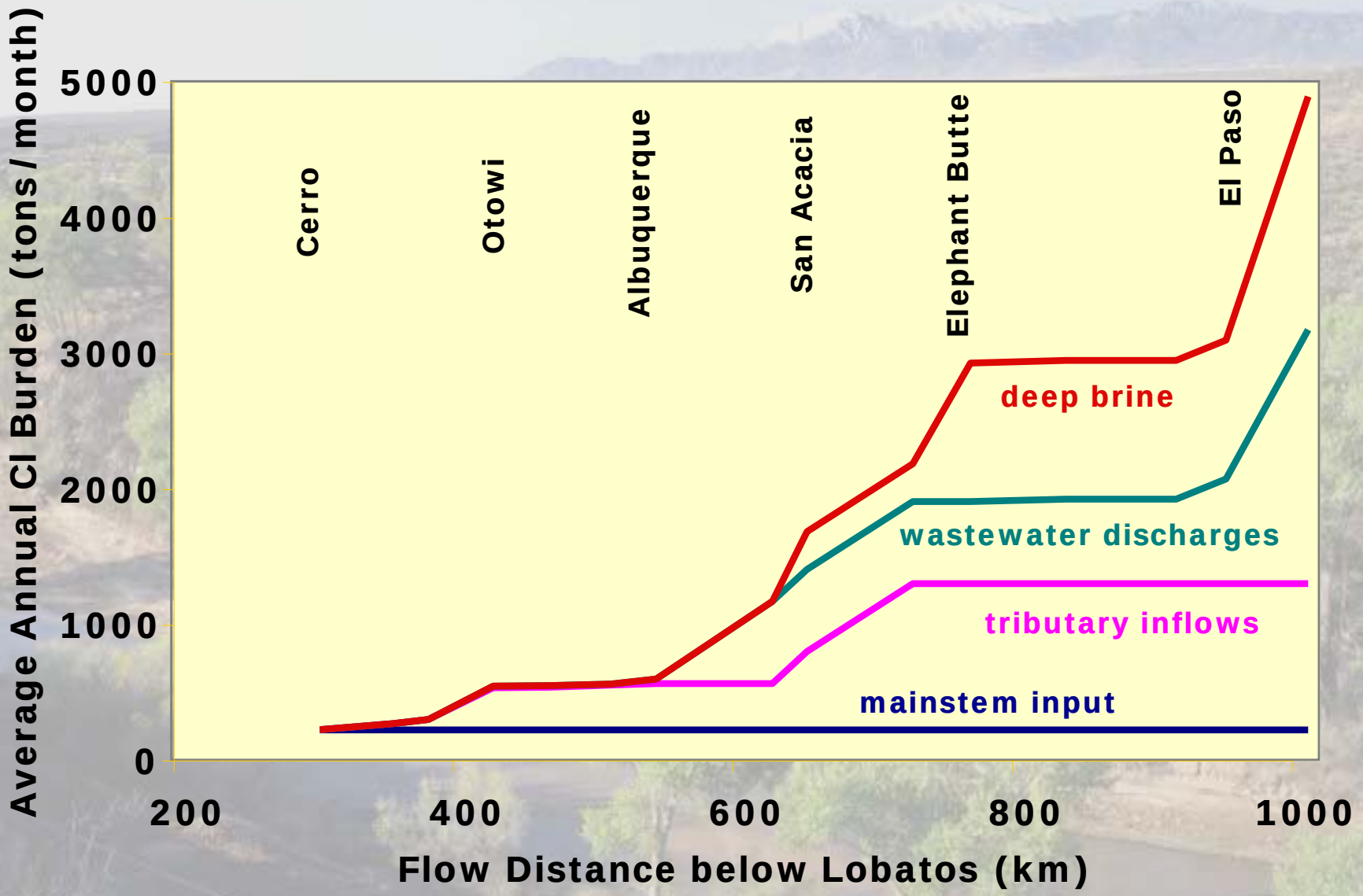
- Simple Mass Balance of Cl and Br
- Account for Evaporation

★ = basin terminus

San Acacia Saline Pool

salt-encrusted tree stumps

Cumulative Chloride Sources



Implications

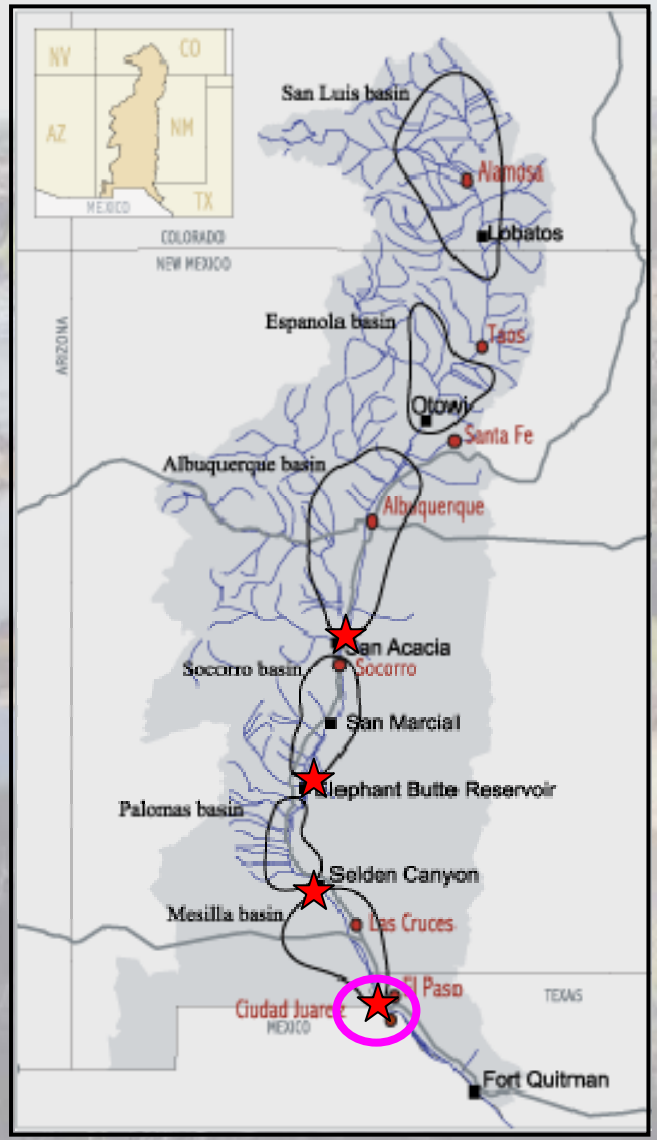
- Concentrated saline subsurface discharges account for at least one-third of solute additions to the Rio Grande

- Approximately one-half of such discharges occur between Bernardo and Elephant Butte Dam

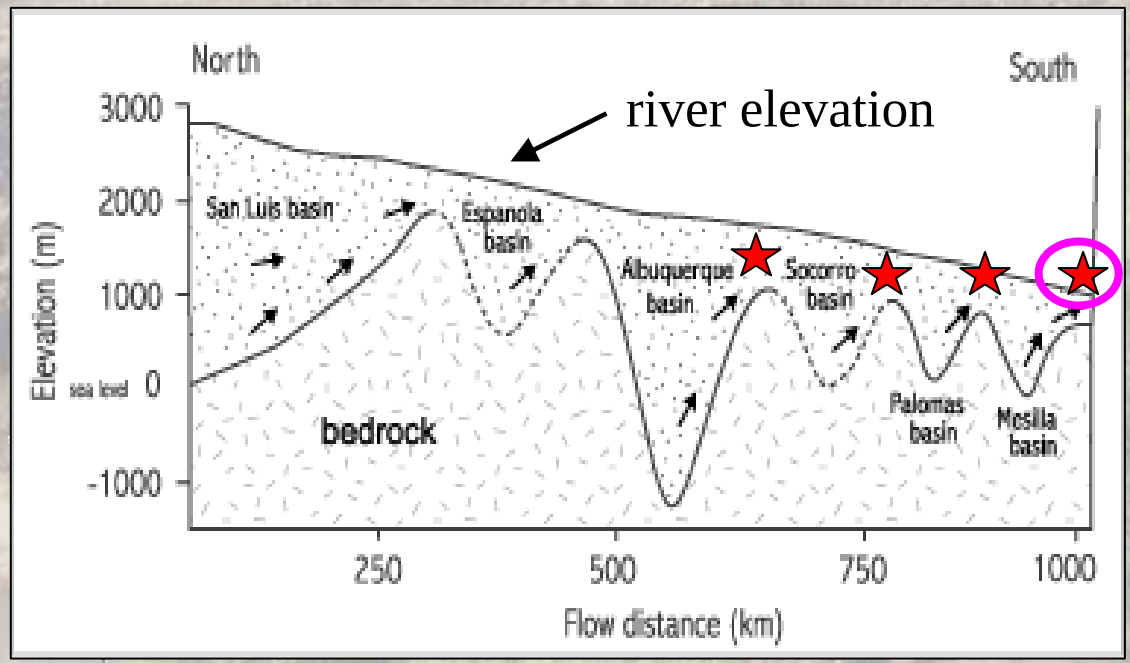
Basic point to keep in mind

- We would like to get out as much salt as possible
- We want to remove as little water as possible
- Implication: for any salt mitigation effort to be successful, we must be able to locate and pump out concentrated brine

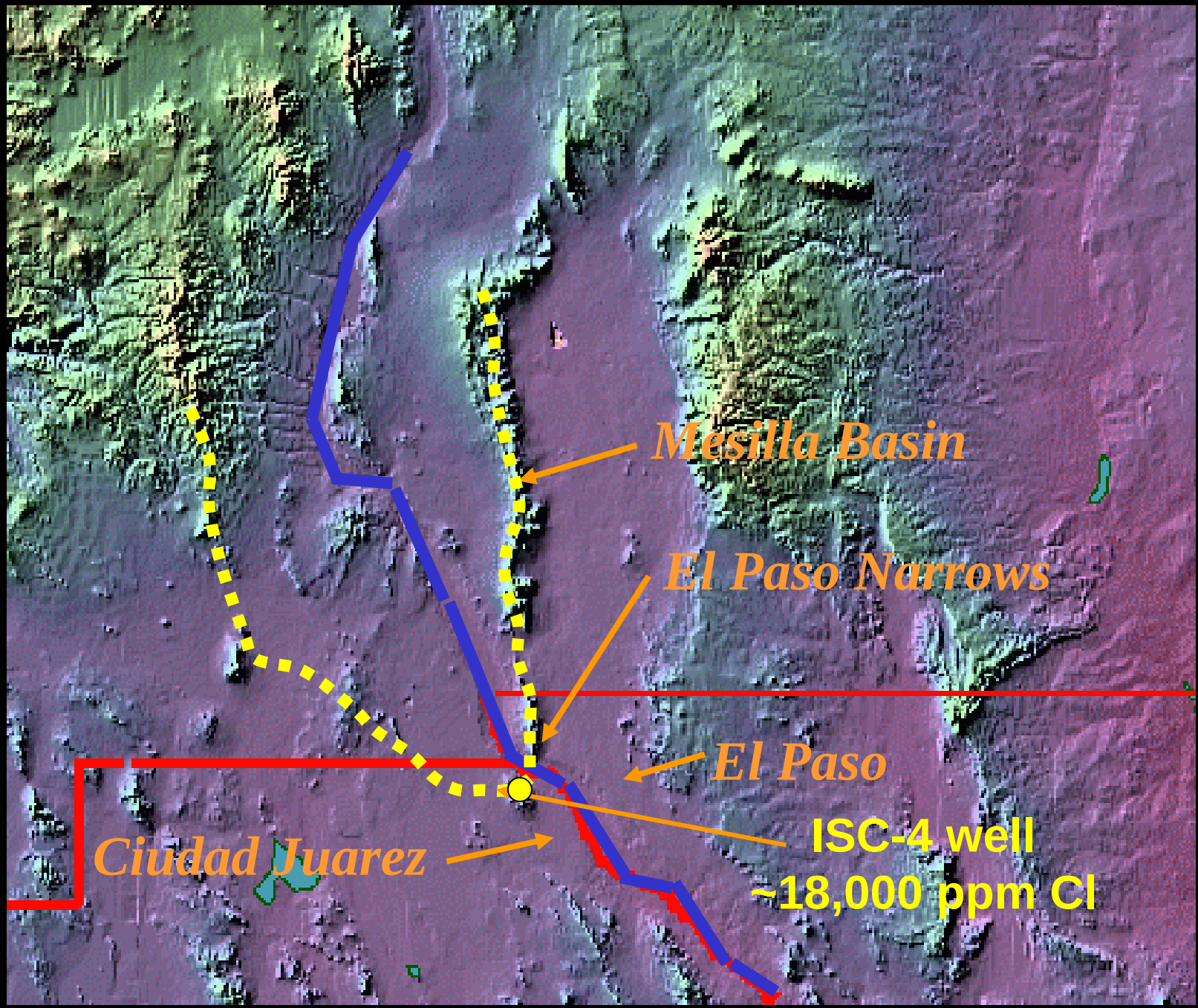
Basin Groundwater Systems



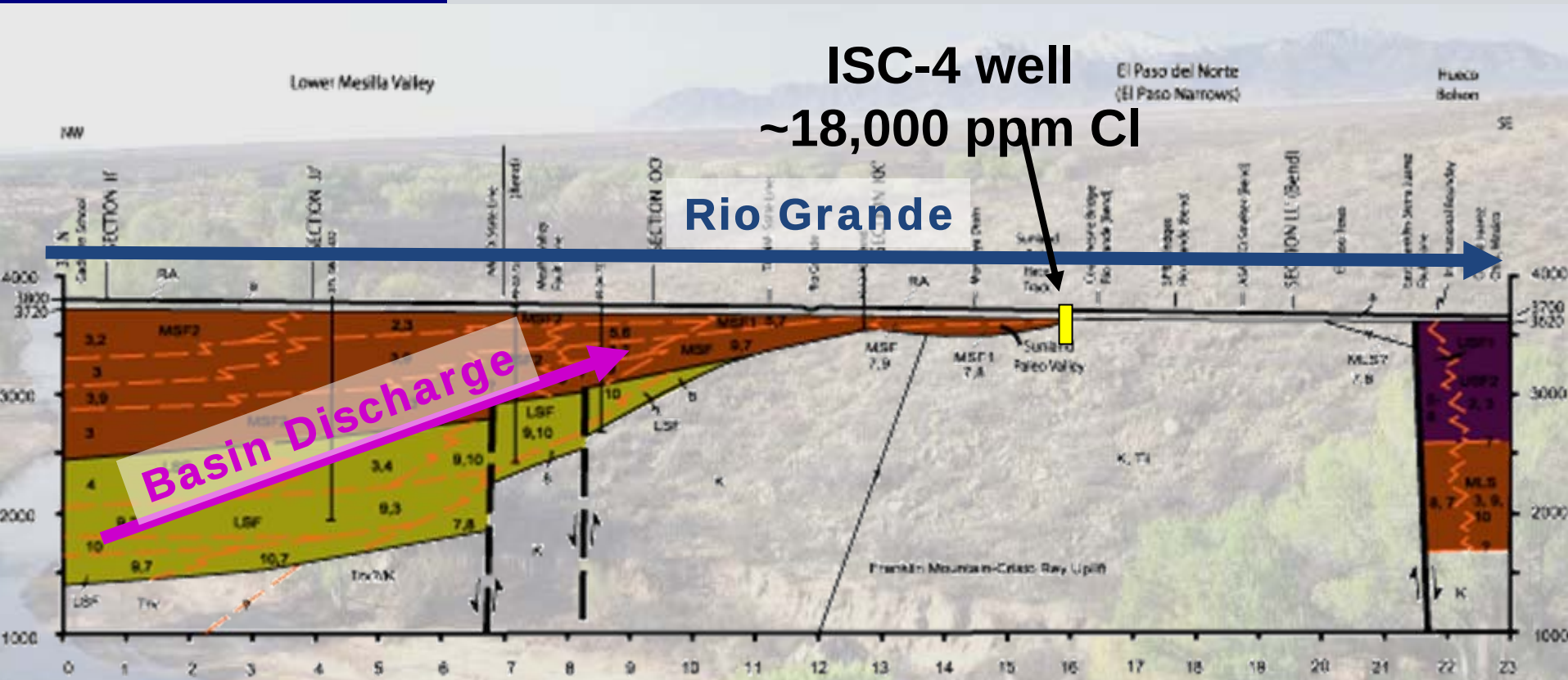
Schematic Hydrogeologic Cross-Section, Parallel to River Path



★ = basin terminus


Mesilla Basin
El Paso Narrows
El Paso
Ciudad Juarez
ISC-4 well
~18,000 ppm Cl

El Paso del Norte



- Cross section through Paso del Norte along Rio Grande
- Basin flow from Mesilla basin forced up
- Saline groundwater discharge

Implications

- The likelihood of success in pumping out and sequestering subsurface brines is far from being a “slam dunk”
- Focused geochemical studies above at, above, and below suspected discharge localities are needed
- Additional methods of investigation are needed:
  - Structural geology, Basin analysis, Aeromagnetic surveys, Well-to-well electromagnetic tomography

Summary

- **Salinity of Rio Grande**
  - ~15 mg/L to ~1500 mg/L in 1200 km
  - Increases occur in a stepwise fashion
- **Solutes are added to the system**
  - At least 1/3 of salts originate from points of sedimentary basin discharge
  - ~50% of inputs are from Abq. to El. Butte.
- **Points of focused salinity addition**
  - Potential for brine interception
  - Feasibility studies are needed