Deep Well Injection in Texas (Another Tool in the Concentrate Management Tool Shed)

Multi-State Salinity Coalition
Las Vegas, Nevada

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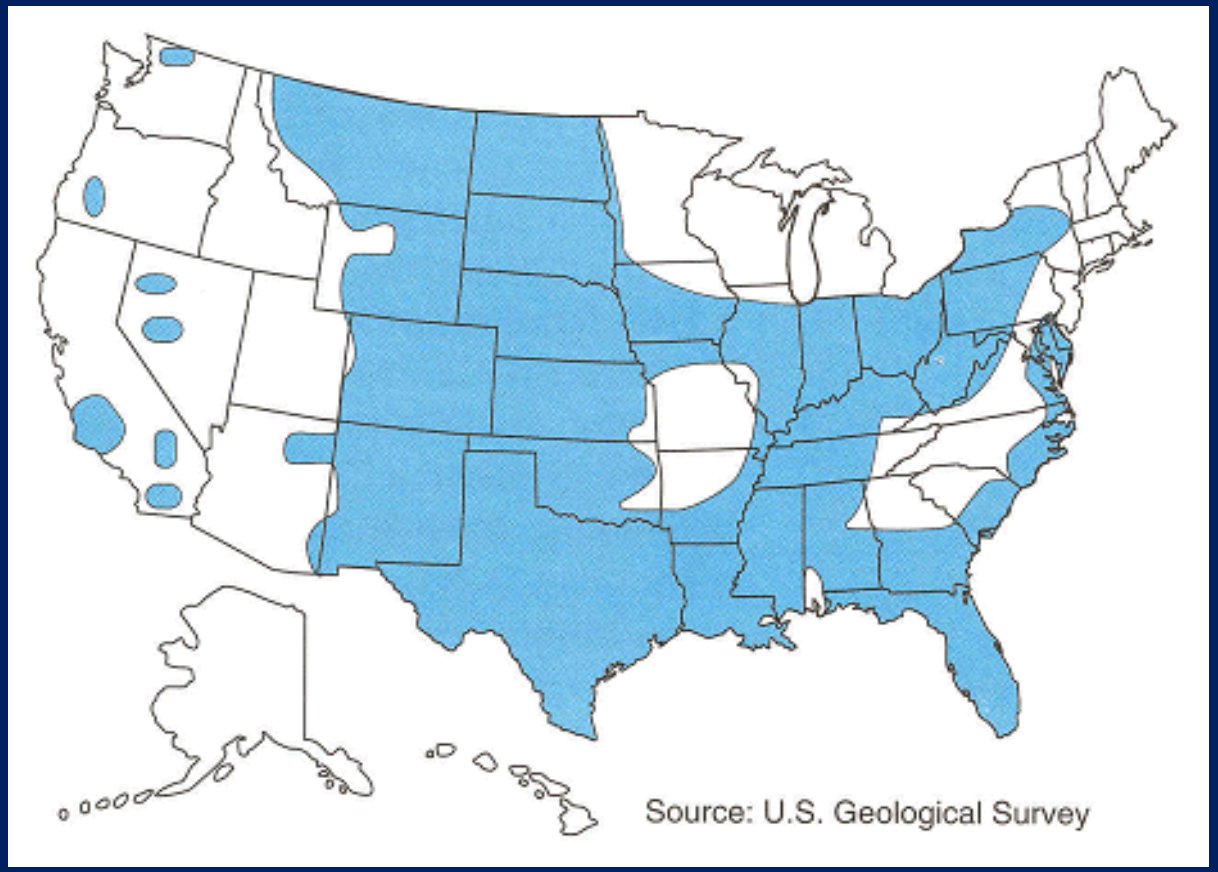
Austin, Texas

Brackish Groundwater in the United States

Opportunity: Availability of brackish groundwater resources in the United States (TDS < 3,000 mg/L)



Examples of Inland Concentrate Management

- Surface water discharge (Big Spring and Brownsville, TX)
- Wastewater treatment plant (El Paso, TX)
- Enhanced evaporation (Boise, ID)
- Evaporation ponds (Fort Hancock, TX)
- Deep well injection (El Paso and San Antonio, TX)
- High recovery (El Paso, TX)

Big Spring Raw Water Production Facility

Concentrate disposal-transition from pipe to surface flow. Treatment facility in background.

El Paso Water Utility Well No. 412

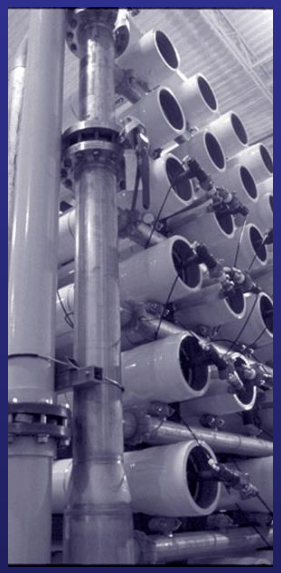
1 MGD Reverse Osmosis Facility producing 70 gallons per minute of concentrate discharged into sewer

Evaporation Ponds – Fort Hancock, Texas

Enhanced Evaporation – Boise, Idaho

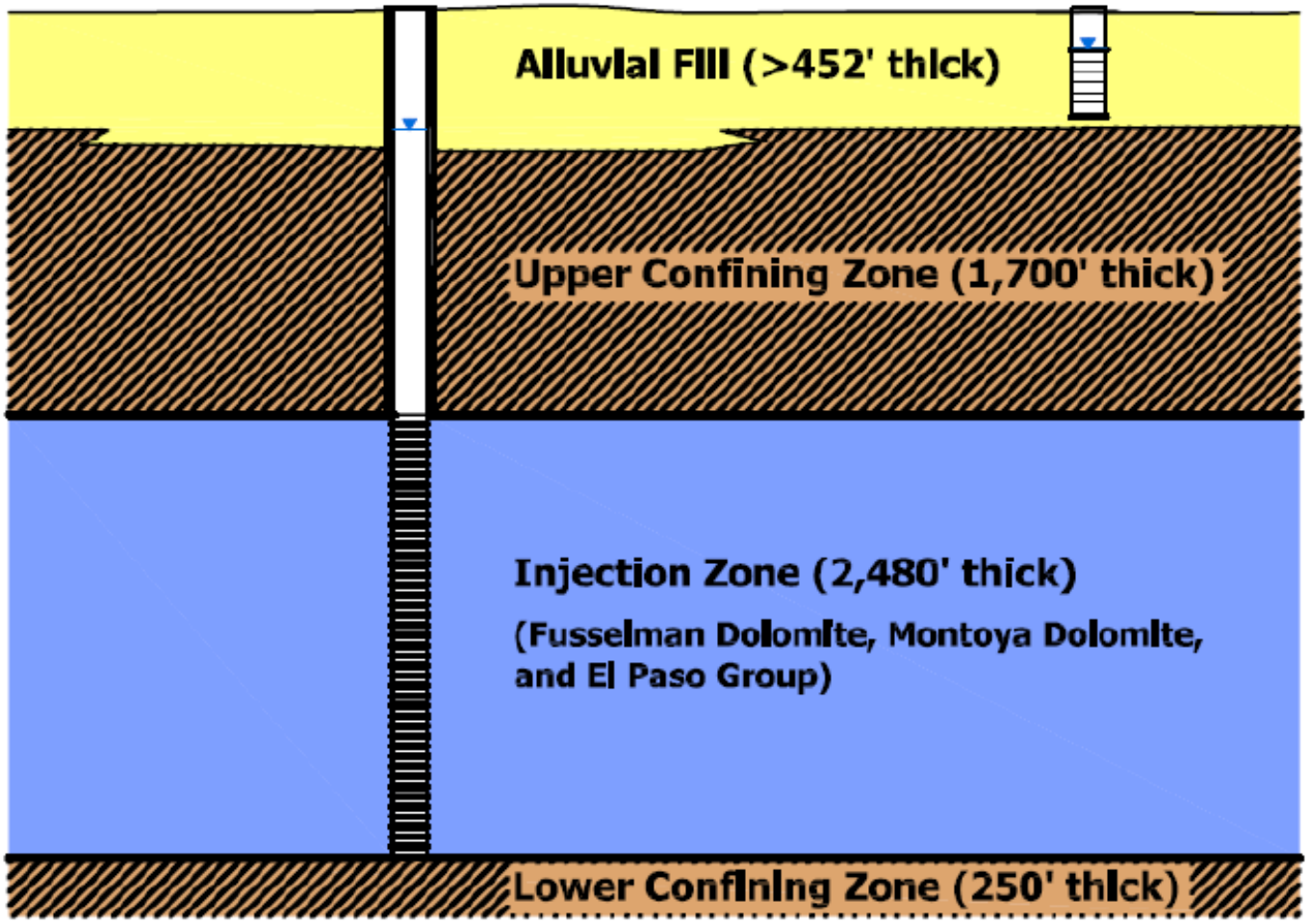
Deep Well Injection

El Paso Water Experience



- Hueco Bolson aquifer has 3 times more brackish groundwater than fresh water
- Deep well injection works because of ideal geologic conditions (reservoir storage, highly fractured, confinement, reservoir not a water supply source)
- 3 injection wells in use for 12 years
- Current injection about 1 MGD
- TDS of Concentrate is 15,000 – 20,000 mg/L TDS
- Native formation water > 8,800 mg/L TDS
- El Paso will continue to experience an increase in growth and brackish water volumes
- Excellent relationship with regulators

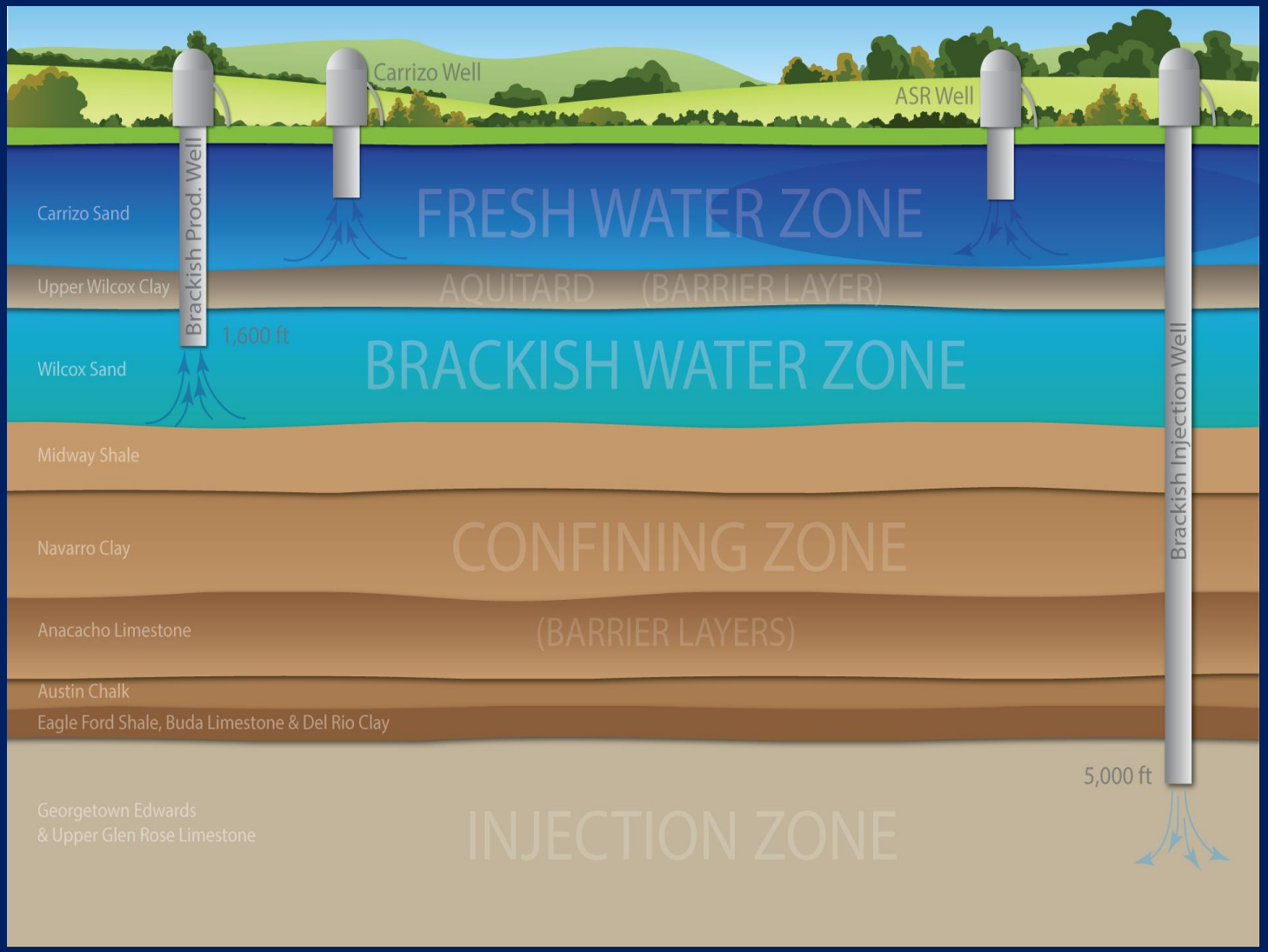
El Paso Water – 3 Injection Wells Utilized for Concentrate Management




Test Hole Φ3
7/16/03
BOX #50
2343-2357
2343
2346
2347
2349
2357
RATED SHEATHING

SAWS Program Summary

- H2Oaks Center opened in January 2017
- Three Phase Program – 12 MGD / 24 MGD / 30 MGD
- Uses an underutilized brackish water resource – Wilcox Aquifer
- Utilize 2 deep injection wells at 5,000 ft. deep
- Injection zone is Edwards Fm with a 90,000 mg/L TDS
- Concentrate currently has a TDS of 15,000 mg/L


Carrizo Well
ASR Well
Brackish Prod. Well
Brackish Injection Well
FRESH WATER ZONE
AQUITARD (BARRIER LAYER)
BRACKISH WATER ZONE
CONFINING ZONE
(BARRIER LAYERS)
INJECTION ZONE
Carrizo Sand
Upper Wilcox Clay
Wilcox Sand
1,600 ft
Midway Shale
Navarro Clay
Anacacho Limestone
Austin Chalk
Eagle Ford Shale, Buda Limestone & Del Rio Clay
5,000 ft
Georgetown Edwards
& Upper Glen Rose Limestone

Summary

- Texas is right for further desal operations!
- We've got available brackish groundwater and multiple concentrate management options.
- Deep injection wells work – and they're a cheaper option!! Don't overlook them. They're not a new concept and have been utilized for chemical waste disposal since the 1950s.
- With the right geology, injection can be one of the most valuable tools in your tool box.
- Develop and cultivate a positive, working relationship with State & Federal regulators.

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