Deep Well Injection for Concentrate Disposal – An Overview

Multi State Salinity Coalition
Las Vegas, Nevada

Scott Reinert P.E., P.G.,

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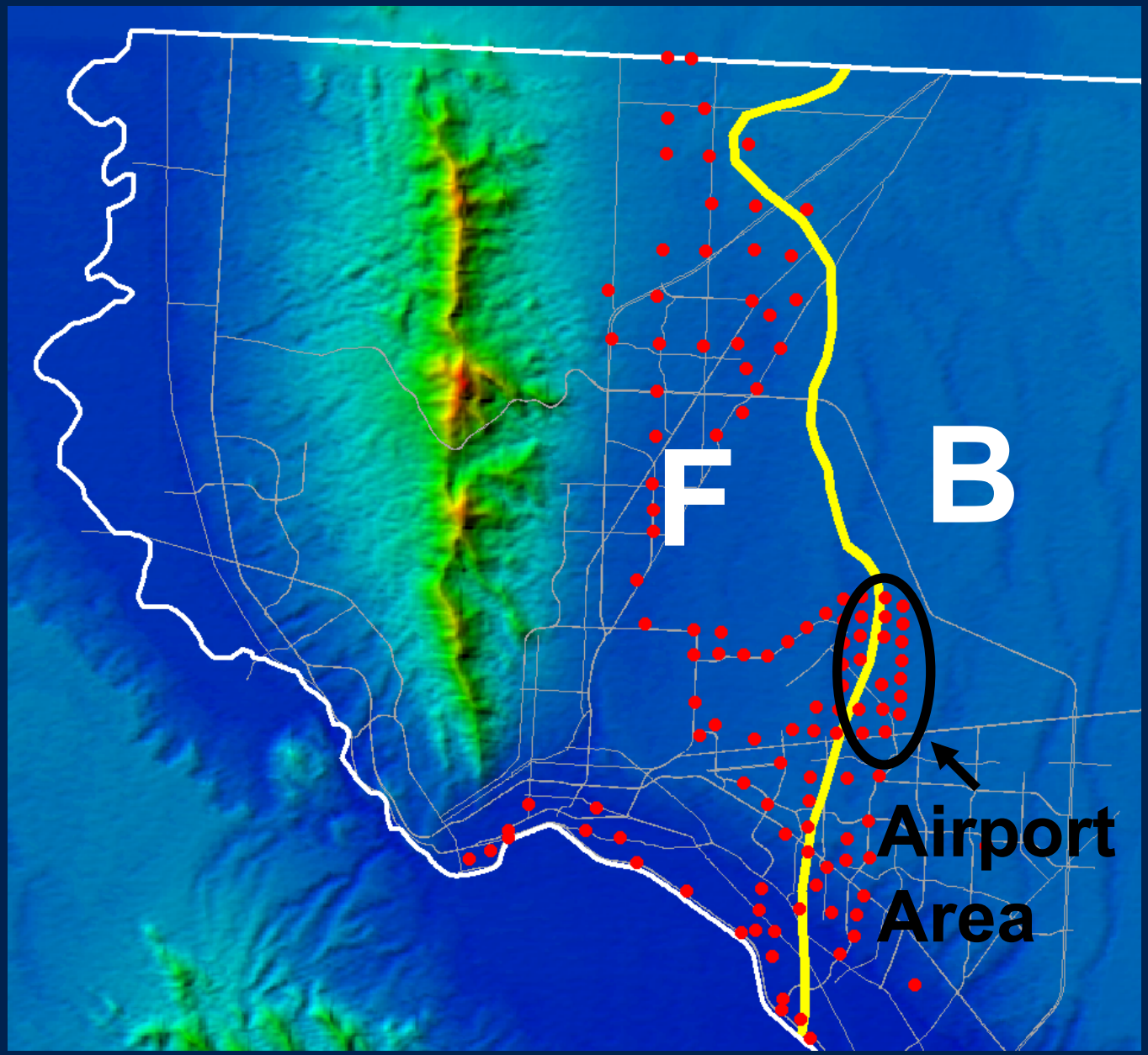
Topics

- Overview of KBH Desalination Plant
- Concentrate Disposal Alternatives
- Site Characterization
- Injection Well Construction
- Regulatory Compliance
- Project and Permitting Costs
- Future Plans


NEW MEXICO
TEXAS
DEEP WELL
DISPOSAL SITE
CONCENTRATE LINE
BY DEEP WELL DISP.
BLEND WELLS &
COLLECTION LINE
LOOP STS
SOURCE WELLS
RO PLANT SITE
© 2003
© 2003


F
B
Airport
Area

Concentrate Disposal Alternatives

- Passive Evaporation
- Enhanced Evaporation
- Deep Well Injection

Injection Well Timeline

- McGregor Range Geothermal Study (1997)
- Initial Disposal Site Studies (2002)
- Test holes, pilot well, and geophysical studies (2003-4)
- Class V – Authorization by Rule Application Submitted (3/2005)
- Class V-Authorization Approved (up to 5 wells)(7/2005)
- Desalination Plant start-up (9/2007)
- Aquifer Exemption -2012

Site Characterization

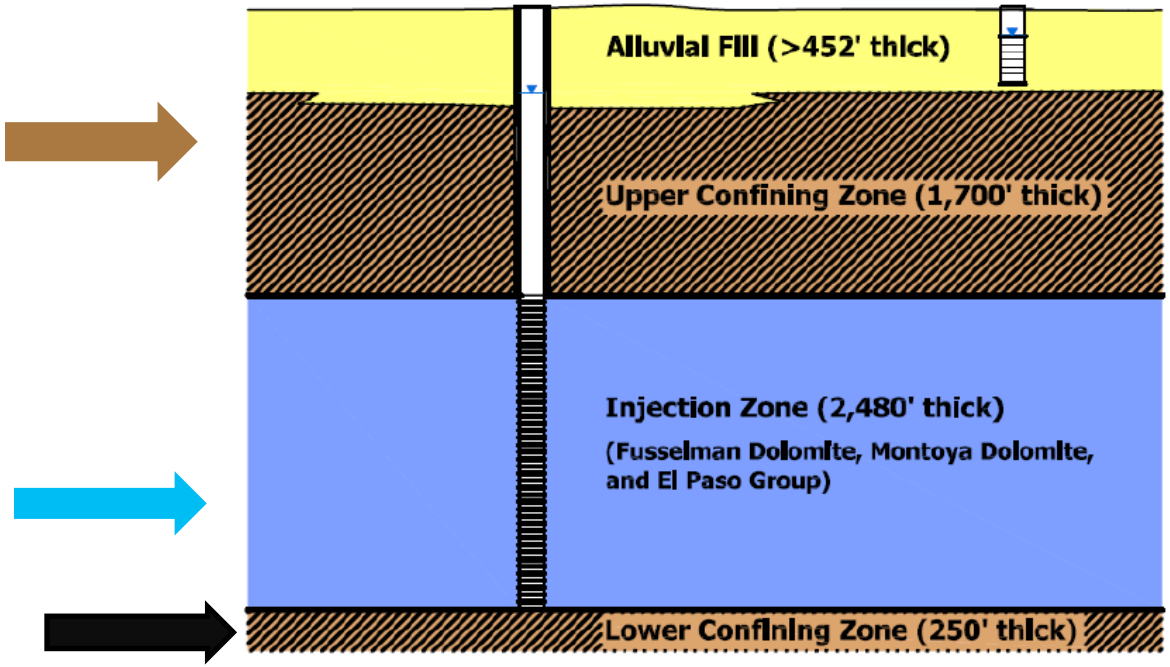
- Timeline of injection well activities.
- Identify suitable geologic conditions for deep well injection.
- Storage, containment, permeability, water quality


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


2336.2

Schematic Cross-Section of Units Overlying the Injection Zone

Groundwater in the injection zone is under artesian pressure. Static water level in the injection zone is 500 feet beneath ground surface.



NOT TO SCALE

EPA Injection Well Classification

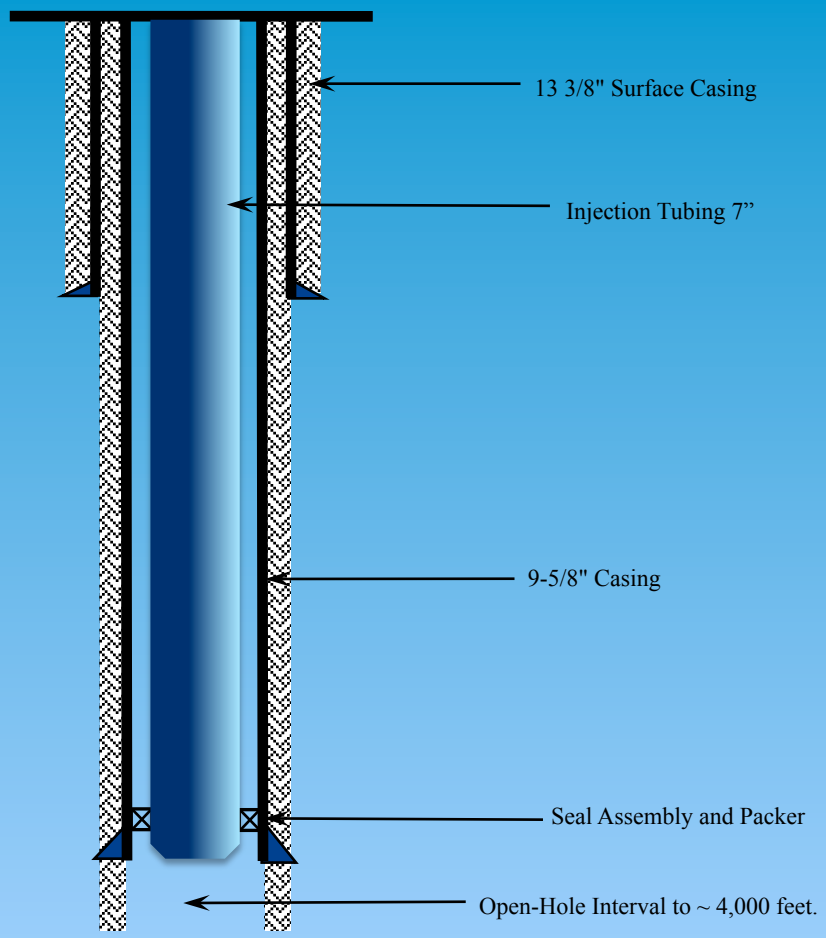
- **Class I** – Inject hazardous waste below an Underground Source of Drinking Water (USDW)
- **Class II** – Dispose of fluids associated with the production of oil and natural gas. Inject fluids for enhanced oil recovery.
- **Class III** – Inject fluids for the extraction of minerals
- **Class IV** – Inject waste above a USDW and radioactive waste (banned)
- **Class V** – Wells not included in the other classes.
  - Includes wells that inject non-hazardous fluids into a USDW
  - TDS less than 10,000 mg/l

Injection Well Construction

- Class I Standards
- Well 1 (2004)
  - 3,777 ft deep
- Well 3 (2006)
  - 4,030 ft deep
- Well 2 (2007)
  - 3,720 ft deep

Injection Well Construction

- Cementing technique
- Purpose
- Cement Bond Log
- Challenges


13 3/8" Surface Casing
Injection Tubing 7”
9-5/8" Casing
Seal Assembly and Packer
Open-Hole Interval to ~ 4,000 feet.

Injection Well Summary

- Depth to Water (Static) ~ 500 ft
- Injection Capacity 1,400 to 2,000 gpm
- Depth to Water (Injection) > 350 ft
- Formation Water TDS ~ 8,800 mg/l
- Bottom Hole Temperature ~ 160^{o}F

Regulatory Concepts

- Injection Zone considered an Underground Source of Drinking Water (USDW) <10,000 mg/l total dissolved solids
- Safe Drinking Water Act (SDWA) prohibits injection which endangers an underground source of drinking water.
- Aquifer Exemption

Compliance Testing Of Injection Wells

- Mechanical Integrity Test (MIT) verifies the wells containment of the fluid being injected and that the injection provides no path for contamination of underground source of drinking water (**USDW**)

  - Annulus Pressure Test (APT)
  - Radioactive Tracer Survey (RTS)
  - Differential Temperature Survey (DTS)

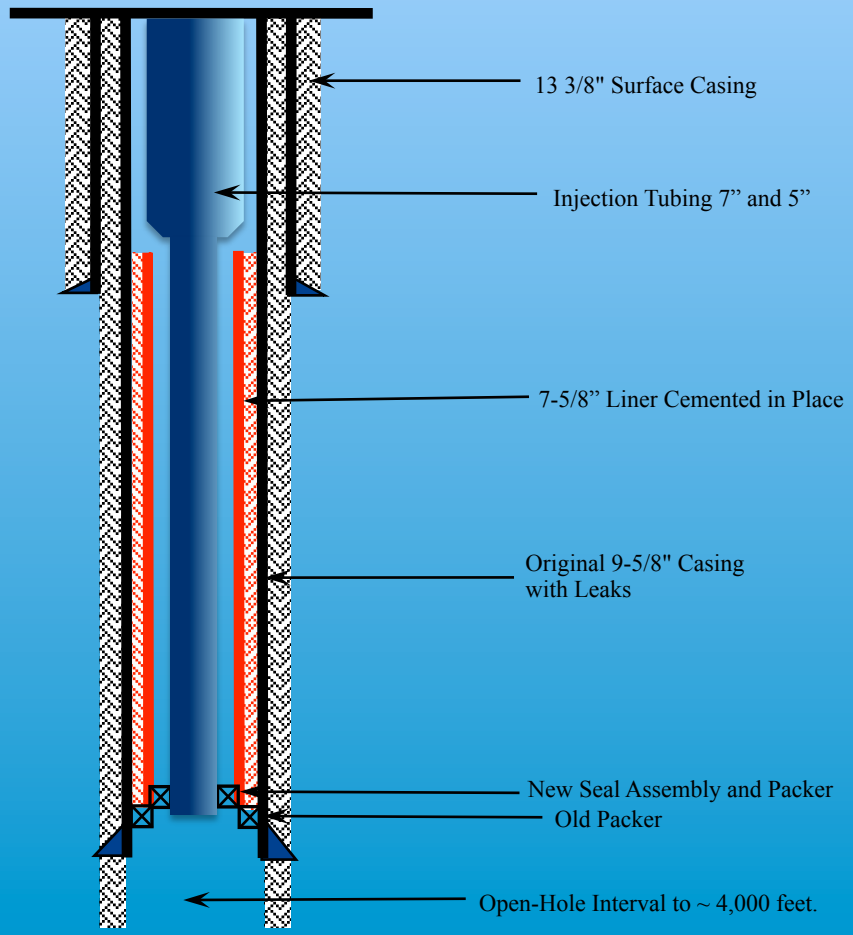
- Pressure Fall-Off Test

Injection Well Repair

- Both wells failed their MITs and required extensive testing and analysis to locate leaks.
- A micro-vertilog was performed to ascertain the casing condition and the resulting data sent out for analysis and interpretation.
- Both wells suffered failure at generally the same geologic zone and from corrosion of the exterior of the casing that was exposed to the naturally occurring groundwater.
- A plan was submitted to the TCEQ Executive Director for approval and guidance.

Injection Well Liner

- TCEQ Executive Director approved the use of a liner for repair of the injection well.
- A liner was installed and cemented from just below the identified leak to a point inside the surface casing.
- A MIT was performed to verify adequacy of repair
- TCEQ Executive Director specified a series of annual MITs to verify adequacy of repair.

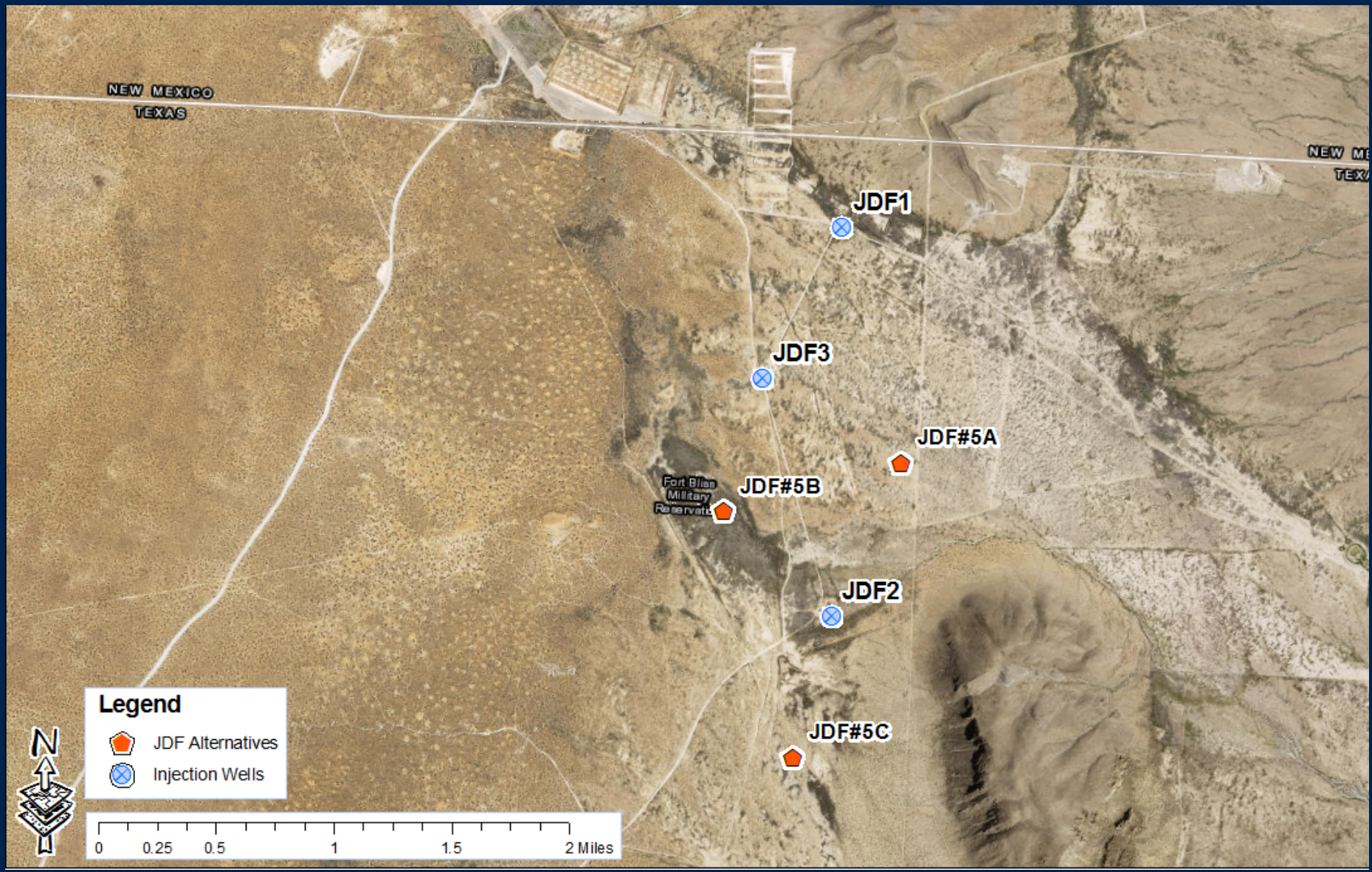

13 3/8" Surface Casing
Injection Tubing 7” and 5”
7-5/8” Liner Cemented in Place
Original 9-5/8" Casing
with Leaks
New Seal Assembly and Packer
Old Packer
Open-Hole Interval to ~ 4,000 feet.

Project Costs

Injection wells	$6.5 Million
Surface Injection Facilities	$4.9 Million
Downhole Equipping	$1.0 Million
Concentrate Pipeline	$7.0 Million
Total	**$18 Million**

Future Injection Wells

- Additional injection capacity needed for plant expansion.
- Injection well site selection will consider groundwater modeling, subsurface geology, and coordination with US Army.
- Evaluating options for well construction materials and construction techniques


NEW MEXICO
TEXAS
JDF1
JDF3
JDF#5A
Fort Bliss
Military
Reservation
JDF#5B
JDF2
JDF#5C
Legend
JDF Alternatives
Injection Wells
N
0
0.25
0.5
1
1.5
2 Miles

Questions?

Surface Injection Facilities