

Criteria for mapping brackish groundwater

Texas Desal 2018

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Innovative Water Technologies
Texas Water Development Board

Unless specifically noted, this presentation does not necessarily reflect official Board positions or decisions

Groundwater Salinity Classification and Color Scheme

Groundwater Salinity Classification	Salinity Zone Code	Total Dissolved Solids Concentration (units: milligrams per liter)
Fresh	FR	0 to 1,000
Slightly Saline	SS	1,000 to 3,000
Moderately Saline	MS	3,000 to 10,000
Very Saline	VS	10,000 to 35,000
Brine	BR	Greater than 35,000



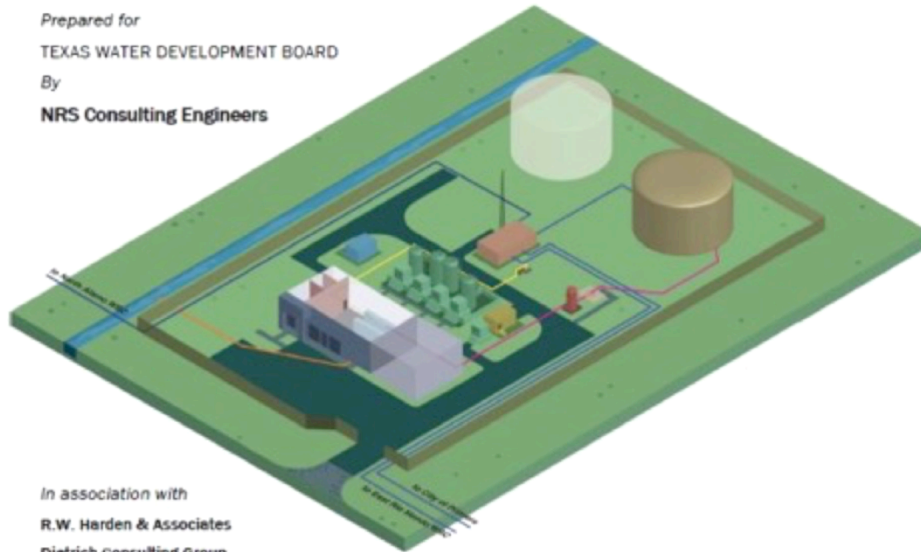
PWS: Public Water System threshold for fresh water
 BUQ: Base Useable Quality water, RRC
 USDW: Underground Source Drinking Water, US EPA

Source: modified from Winslow and Kister (1956) USGS WSP 1365

Resources for brackish groundwater development

GUIDANCE MANUAL For Brackish Groundwater Desalination in Texas

Prepared for
TEXAS WATER DEVELOPMENT BOARD
By
NRS Consulting Engineers



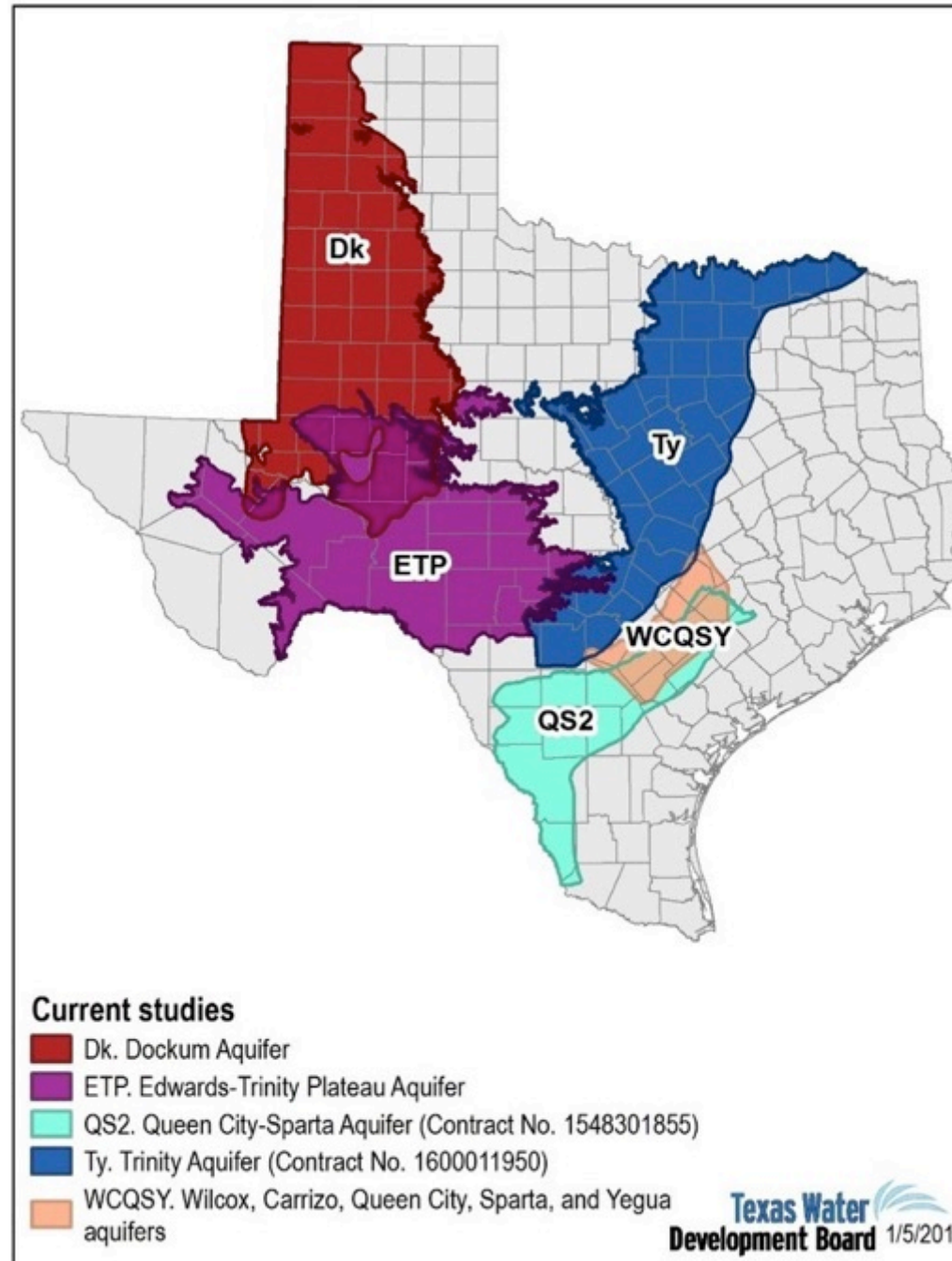
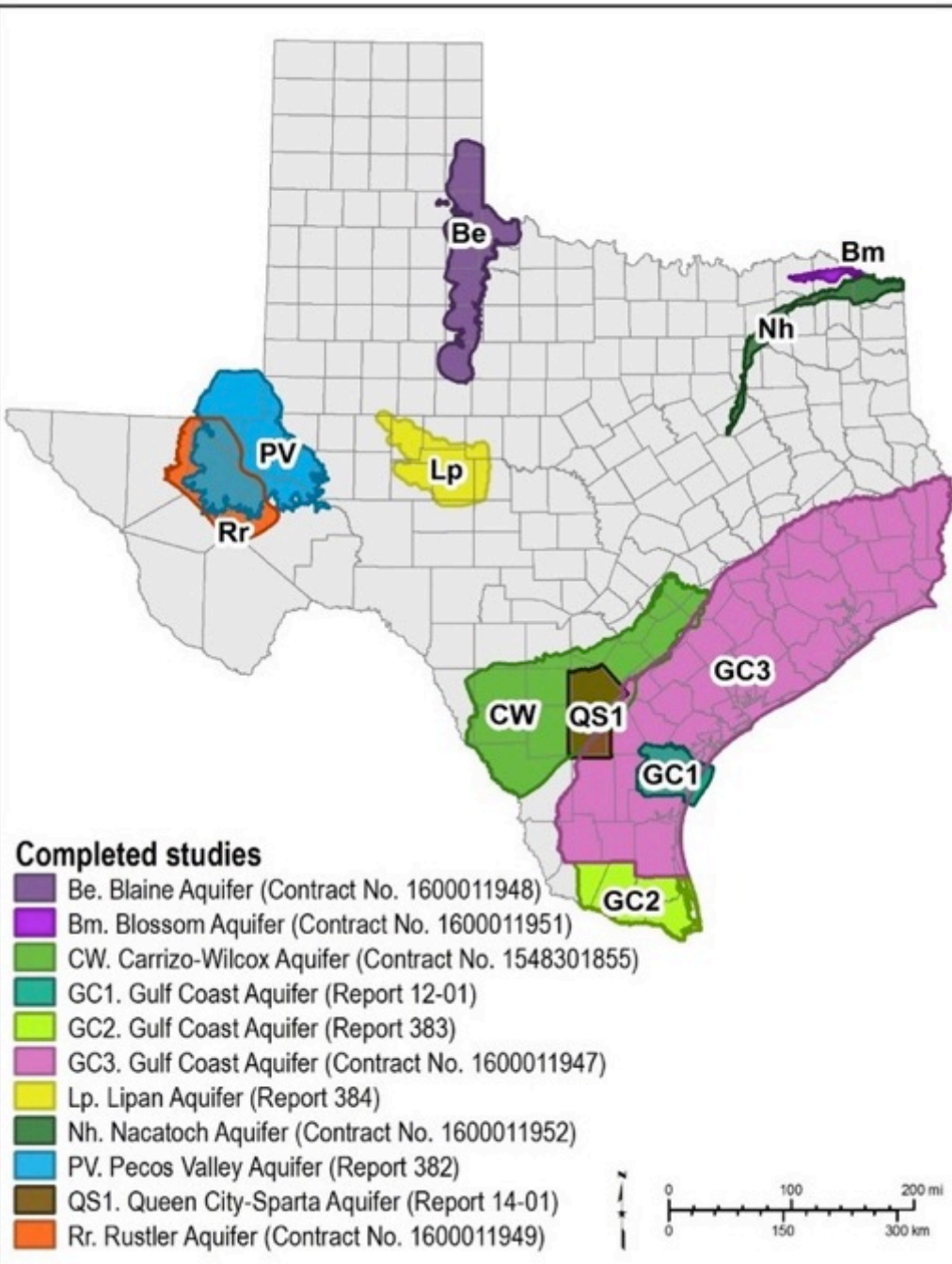
In association with
R.W. Harden & Associates
Dietrich Consulting Group
TRC
Electrical Expertise, Inc.
WaterPR

Texas Water Development Board
P.O. Box 13231, Capitol Station
Austin, Texas 78711-3231
April 2008



<https://www.twdb.texas.gov/innovativewater/desal/projects/northcameron/index.asp>

Source: NRS Engineers and others (2008) TWDB contract 0604830581



BRACS study reports and GIS data:

<https://www.twdb.texas.gov/innovativewater/bracs/studies.asp>

BRACS Database: <https://www.twdb.texas.gov/innovativewater/bracs/database.asp>

TWDB Reports and Contract data:

https://www.twdb.texas.gov/publications/reports/numbered_reports/index.asp

Groundwater Availability Models:

<https://www.twdb.texas.gov/groundwater/models/index.asp>

Water Data Interactive: <https://www.twdb.texas.gov/mapping/index.asp>

Groundwater and contract reports:

https://www.twdb.texas.gov/publications/reports/numbered_reports/index.asp

Groundwater Database: <https://www.twdb.texas.gov/groundwater/data/gwdbbrpt.asp>

Submitted Driller Report Database:

<https://www.twdb.texas.gov/groundwater/data/drillersdb.asp>

2017 State Water Plan: <https://2017.texasstatewaterplan.org/statewide>

Recommendations to emphasize and augment guidance manual

- ✓ Evaluate regional/local geology
- ✓ Critically review all existing well control (water, oil/gas, injection)
- ✓ Evaluate sand and clay character (log shape, continuity between wells, ...)
- ✓ Site visit: verify well locations, source water assessment, obtain local history, ...
- ✓ Drill test and monitor wells.
 - comprehensive geophysical logging
 - pumping tests
 - water quality samples
 - changes in data over time?
 - drill deeper than target depth to evaluate underlying lithology and water quality
- ✓ Construct groundwater model
- ✓ *Share data with TWDB?*

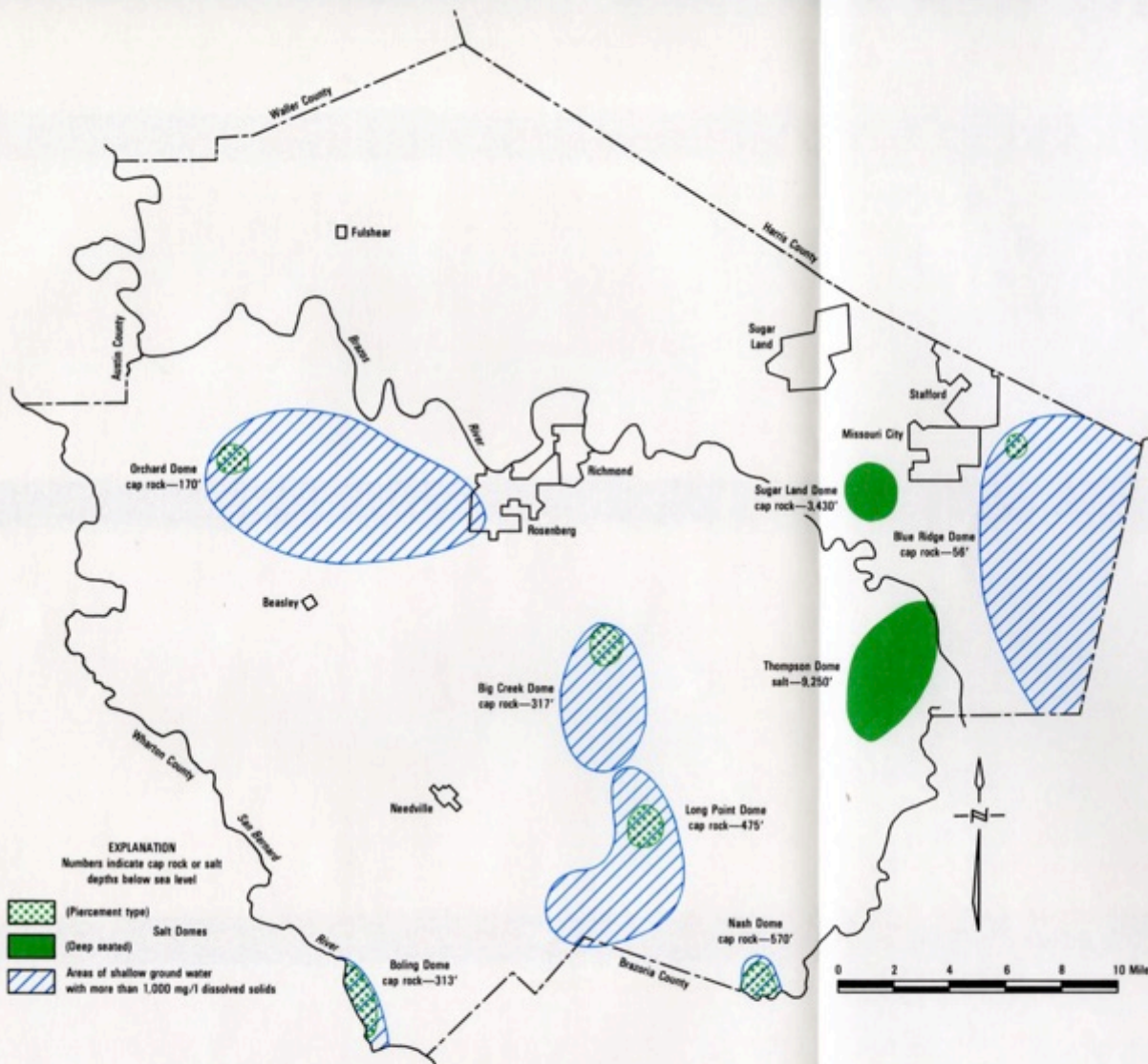
Regional Geology: Salt Domes

Source of elevated salinity in
adjacent formations

Associated with oil/gas
deposits

Class II injection in and
surrounding salt domes

Affect regional groundwater
flow paths



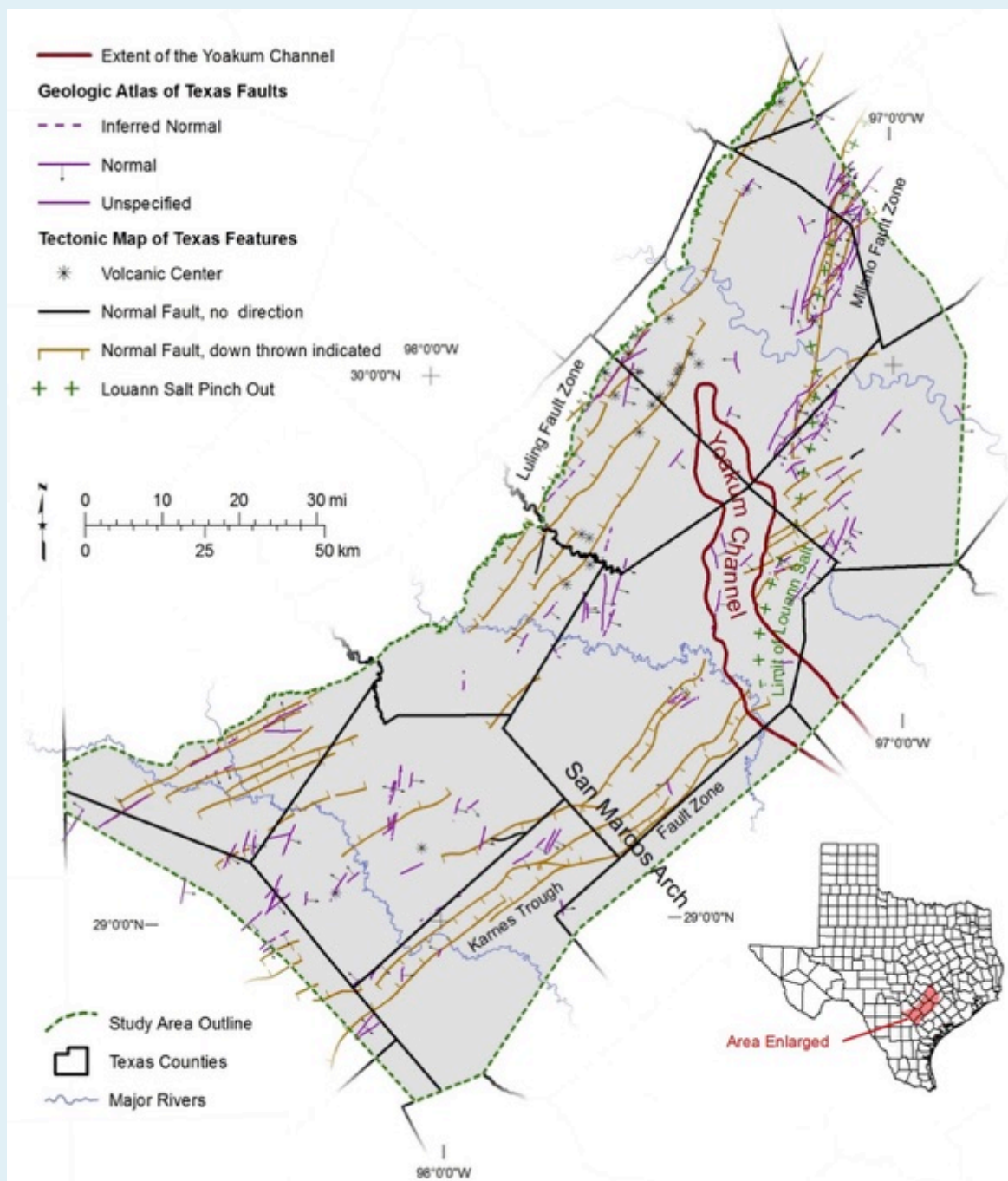
Regional Geology: Faulting

Major faults mapped in studies

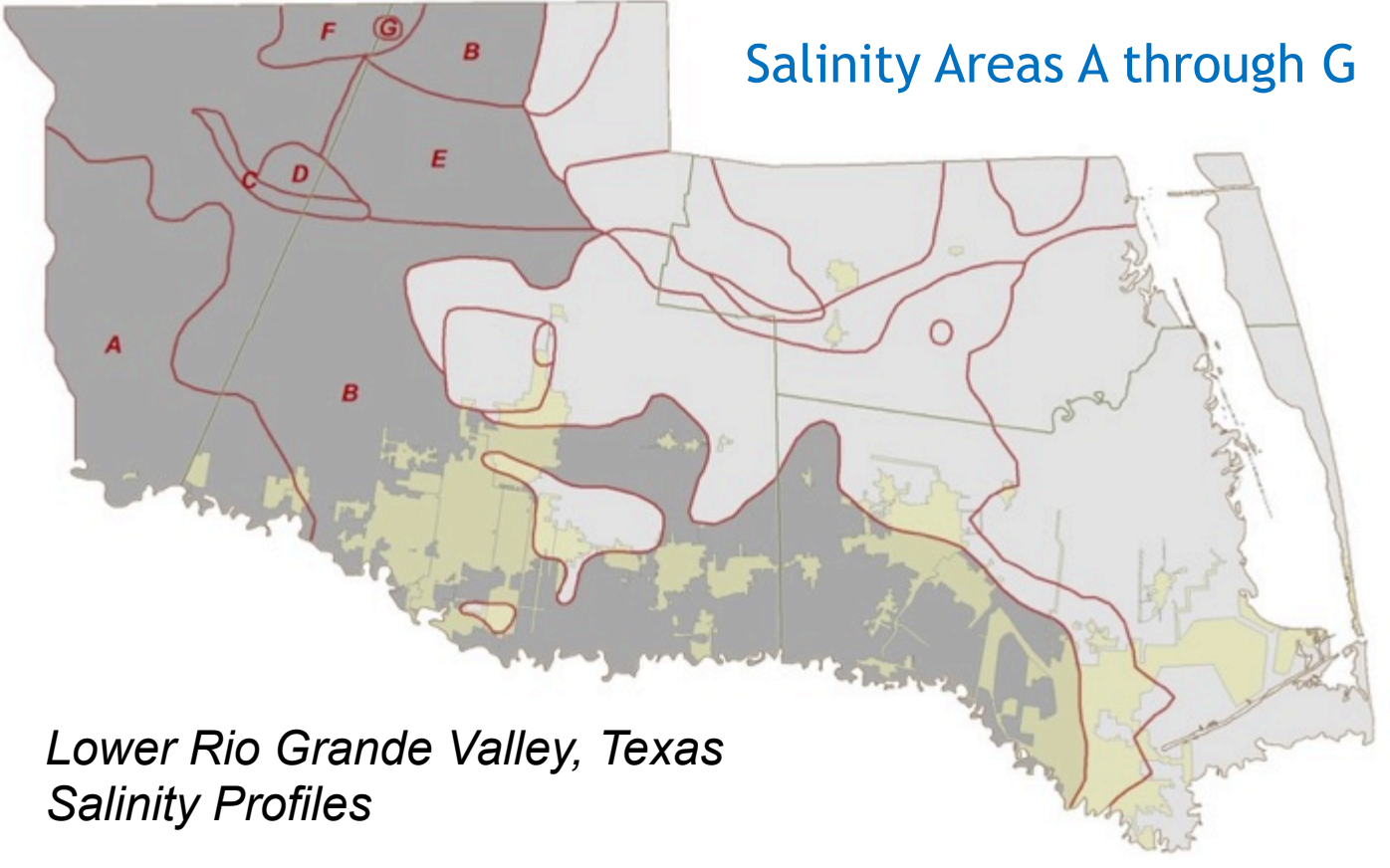
Mapping not sufficient for well field development

More detailed work needed including well drilling, logging, and pumping tests

Affect regional/local groundwater flow paths



Source: Meyer and others Upper Coastal Plain – Central study, in progress



Salinity Areas A through G

Lower Rio Grande Valley, Texas
Salinity Profiles

A	B	C	D	E	F	G
				SS Shallow 2		VS Shallow 1
		MS Shallow 5		MS Intermediate 1	MS Shallow 4	MS Shallow 4
	SS Deep	SS Deep		SS Deep	SS Deep	SS Deep
MS Deep	MS Deep	MS Deep	MS Deep	MS Deep	MS Deep	MS Deep
VS Deep	VS Deep	VS Deep	VS Deep	VS Deep	VS Deep	VS Deep
BR Deep	BR Deep	BR Deep	BR Deep	BR Deep	BR Deep	BR Deep

Some areas have higher salinity groundwater above lower salinity groundwater

This will affect well completion practices

Groundwater Salinity Classification	Total Dissolved Solids Concentration (units: milligrams per liter)
Fresh	0 to 1,000
Slightly Saline	1,000 to 3,000
Moderately Saline	3,000 to 10,000
Very Saline	10,000 to 35,000
Brine	Greater than 35,000

Source: Meyer and others (2014) TWDB Report 383

State of Texas
WATER WELL REPORT

Send original copy by certified mail to the Texas Department of Water Resources, P. O. Box 13087, Austin, Texas 78711

ATTENTION OWNER: Confidentiality/Privacy Notice on Reverse Side

For TDWR use only
Well No. 87-46-1P
Located on map Y88
Received 6-16-83

1) OWNER Howard Kappeler Address P.O. Box 24 Edinburg, TX 78539
(Name) (Street or RFD) (City) (State) (Zip)

2) LOCATION OF WELL
County Hidalgo 8 miles in N. direction from Mission
(County) (Mileage) (Direction) (Town)

Driller must complete the legal description to the right with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Section Texas County General Highway Map and attach the map to this form.

☐ Legal description: Section No. _____ Block No. _____ Township _____
Acreage No. _____ Survey Name _____
Distance and direction from two intersecting section or survey lines _____
☒ See attached map.

3) TYPE OF WORK (Check):
☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):
☐ Domestic ☐ Industrial ☐ Public Supply
☐ Irrigation ☐ Test Well ☒ Other Injection

5) DRILLING METHOD (Check):
☒ Mud Rotary ☐ Air Hammer ☐ Driven ☐ Bored
☐ Air Rotary ☐ Cable Tool ☐ Jetted ☐ Other _____

6) WELL LOG:
Date drilled 8-1-83

From (ft.)	To (ft.)	Description and color of formation material
0	4	surface
4	10	shale
10	22	caliche
22	50	shale
50	72	sand
72	85	gravel
85	102	hard sand

7) BOREHOLE COMPLETION:
☐ Open Hole ☒ Straight Wall ☐ Underreamed
☐ Gravel Packed ☐ Other _____
If Gravel Packed give interval ... from _____ ft. to _____ ft.

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., slotted, etc. Screen Mfg., if commercial	Setting (ft.) From	To	Gage Casing Screens
4	N	STEEL	0	73	188
4	N	STEEL SLOTTED	73	94	188

9) CEMENTING DATA:
Cemented from _____ ft. to _____ ft.
Method used _____
Cemented by _____ (Company or individual)

10) WATER LEVEL:
Static level 14 ft. below land surface Date 8-1-83
Artesian flow _____ gpm. Date _____

10a) PACKERS: Type Depth
1 TUBE SEAL 21
1 RUBBER BASKET 42

11) TYPE PUMP:
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☒ Other airline to produce
Depth to pump bowl, cylinder, jet, etc., 65 ft.

12) WELL TESTS:
☐ Type Test ☐ Pump ☐ Bailor ☒ Sealed ☒ Estimated
Yield 65 gpm with _____ ft. drawdown after _____ hrs.

13) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable water? ☐ Yes ☒ No
If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? _____ Depth of strata _____
Was a chemical analysis made? ☐ Yes ☒ No

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief.

NAME Roland H. Pursley Water Well Driller's Registration No. 2030
(Type or Print)
ADDRESS Rt. 4 Box 722 Edinburg, TX 78539
(Street or RFD) (City) (State) (Zip)
(Signed) Roland H. Pursley Harold W. Pursley Sr., Inc.
(Water Well Driller) (Company Name)

Please attach electric log, chemical analysis, and other pertinent information, if available.

Review all existing well control: Water wells

Pre-2000: TCEQ scanned water well reports

- > 500,000 paper well logs were scanned as pdf files.

- Difficult to use (locations, ...)

- Valuable information

- <https://gisweb.tceq.texas.gov/waterwellpublic/>

Post-2000: TDLR Submitted Driller Reports

- <http://www2.twdb.texas.gov/apps/waterdatainteractive/groundwaterdataviewer>

Review all existing well control: Oil/Gas wells

- Log Libraries
- Railroad Commission of Texas:
<http://www.gisp.rrc.texas.gov/GISViewer2/>
- Bureau of Economic Geology:
<http://igor.beg.utexas.edu/crc2/>
- TWDB BRACS Program:
<http://www2.twdb.texas.gov/apps/waterdatainteractive/groundwaterdataviewer>
- TWDB has additional logs not in the database!
Contact us for questions
- Historical surface casing linen maps at RRC GAU and TWDB BRACS (50+ years of info on these proprietary maps!)

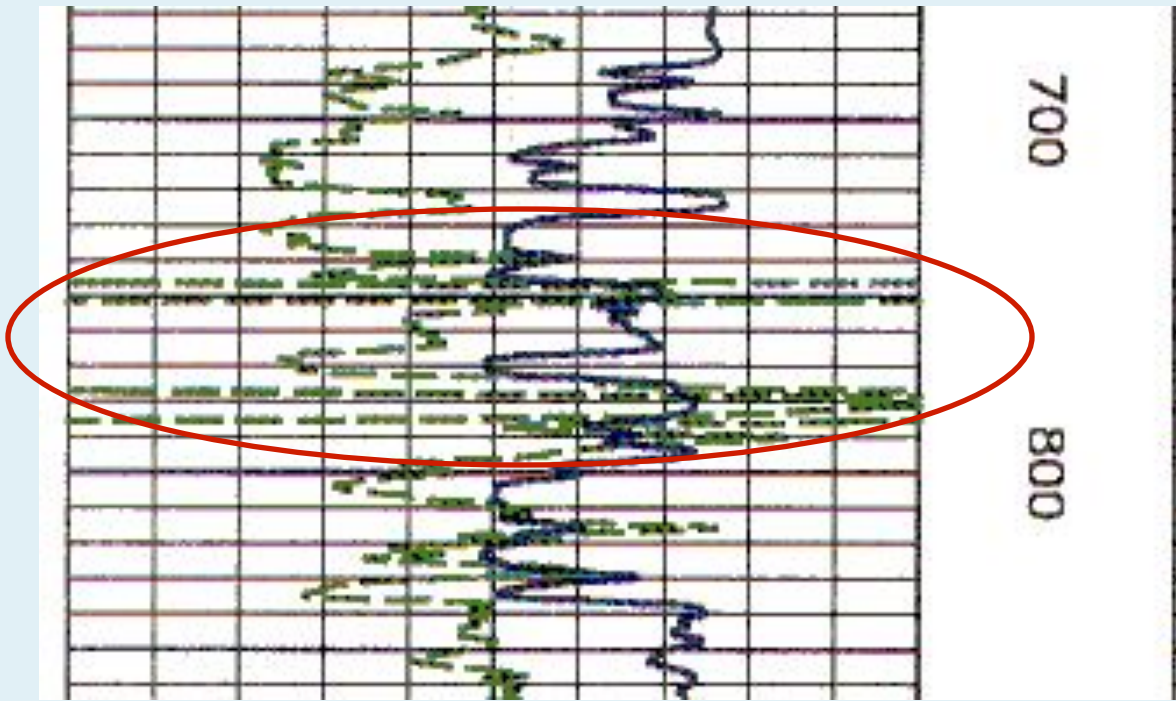
→ Verify locations!

Review all existing well control

Elevated radionuclide concentrations

Gamma ray spikes, > background

Gulf Coast, Dockum, Hickory, ... aquifers



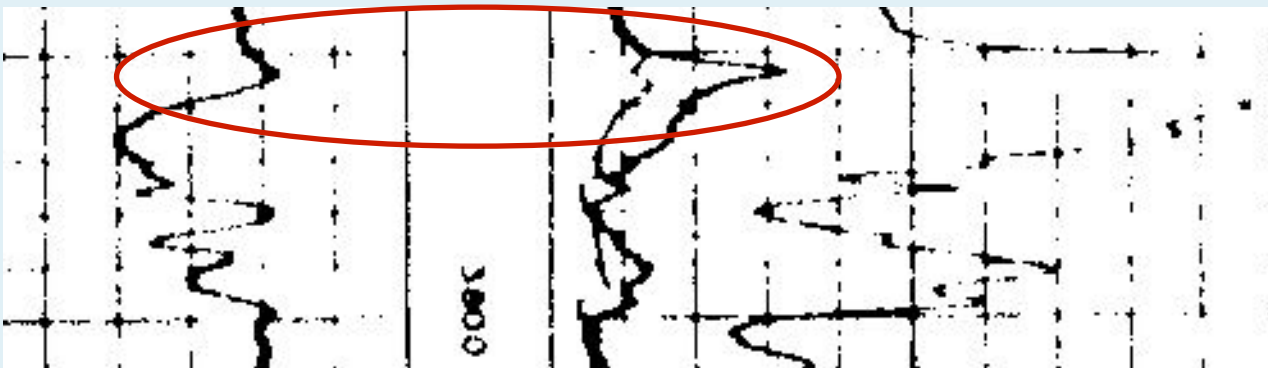
gamma ray tool

Hydrocarbon presence in sands

suppressed SP, increased resistivity

many aquifers

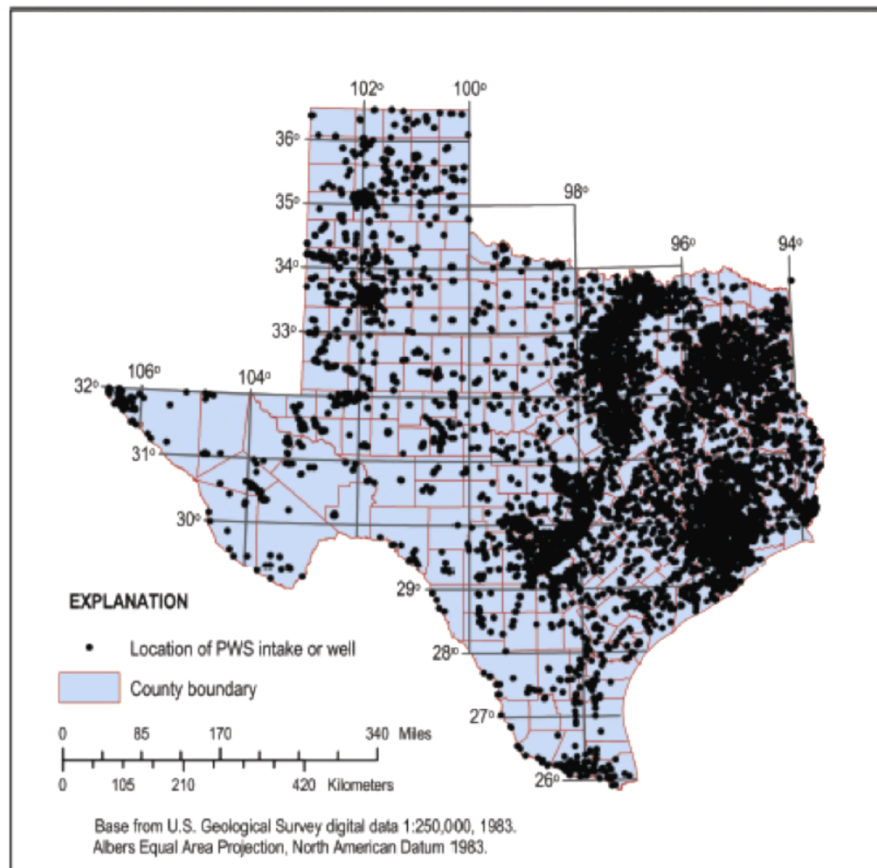
not all deposits are economic, but
smaller ones may affect desal



SP tool

resistivity tools

Source-Water Susceptibility Assessment in Texas: Approach and Methodology



Scientific Investigations Report 2011–5197

U.S. Department of the Interior
U.S. Geological Survey

Source: Ulery and others (2011) USGS SIR 2011-5197

Source water assessment

TCEQ program for public water systems

GIS datasets of sites

Landfills

Petroleum storage tanks

Injection wells

...

Obtain site history

Review state permit or site investigation reports

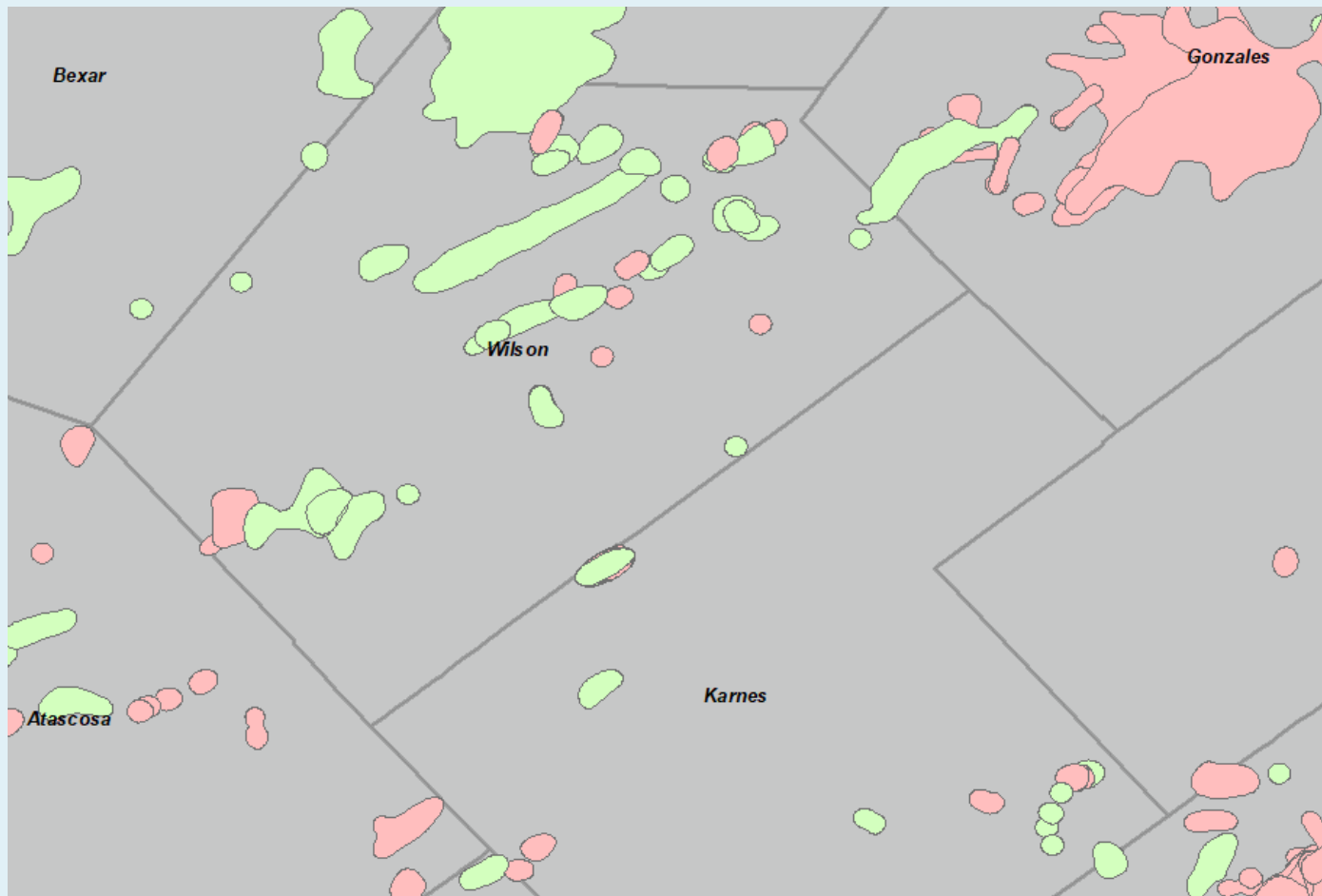
Class II injection wells

RRC buffered field boundaries

Draft map ... revisions in progress

Includes pre-primacy (April 1982)
oil/gas fields that are above the
county maximum USDW* depth

USDW = underground source of
drinking water, < 10,000 mg/L TDS



Contains wells (Type 2, 3) permitted for injection

Does not contain wells (Type 2, 3)

NOTE: mapping does not address Type 1 wells

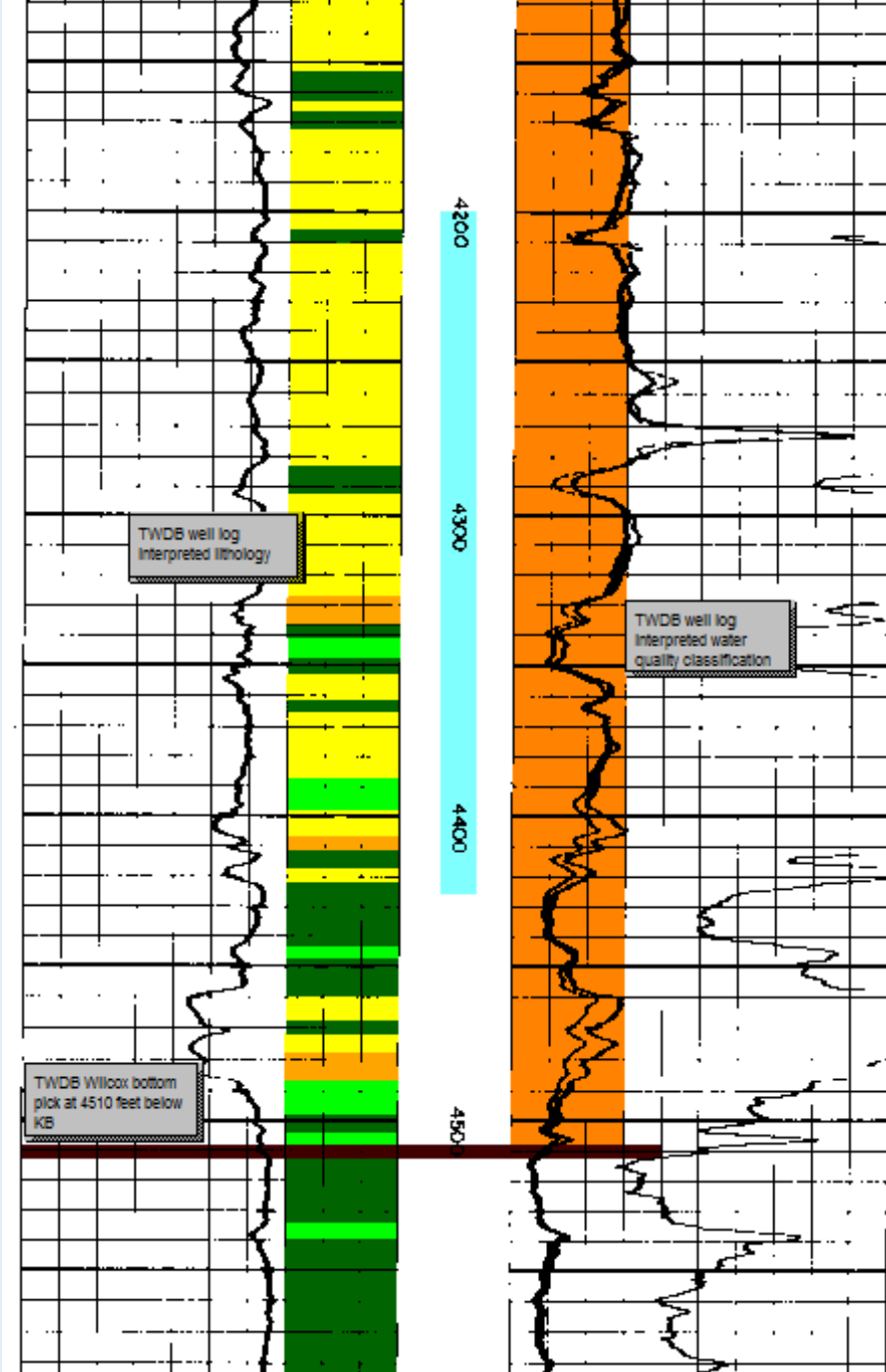
Source: Meyer and others Upper Coastal Plain – Central study, in progress

Class II injection wells

Class II, Type 1 injection disposal into Wilcox Group sands.

Geologic separation between injection zone and overlying sands?

Injection well API 4249330824 (BRACS 42221)

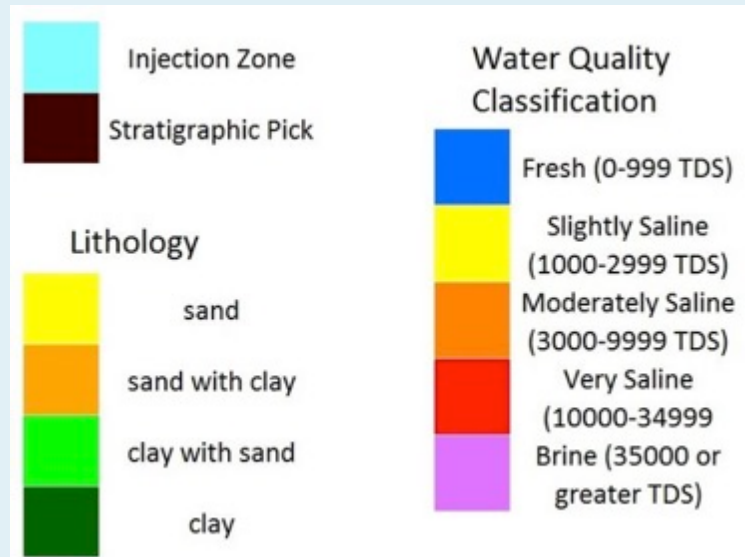
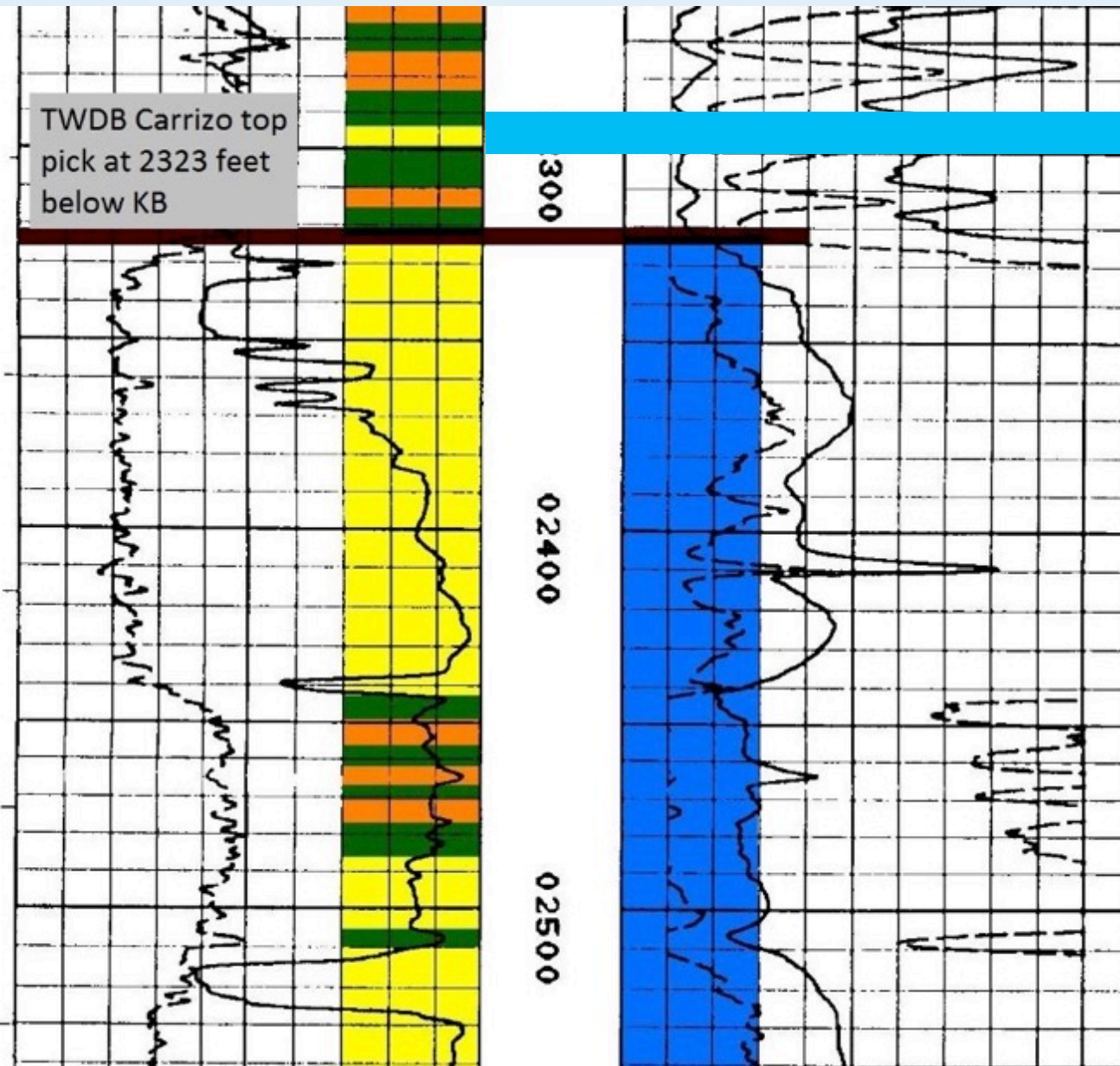


Class II injection wells

Class II, Type 3 injection into Reklaw Formation sand directly above freshwater Carrizo Aquifer.

Injection well API 4214931848

Surrogate well API 4214931742,
2,500 feet away (BRACS 42802)



Class III injection wells

Uranium discovered in 1954 in Karnes County

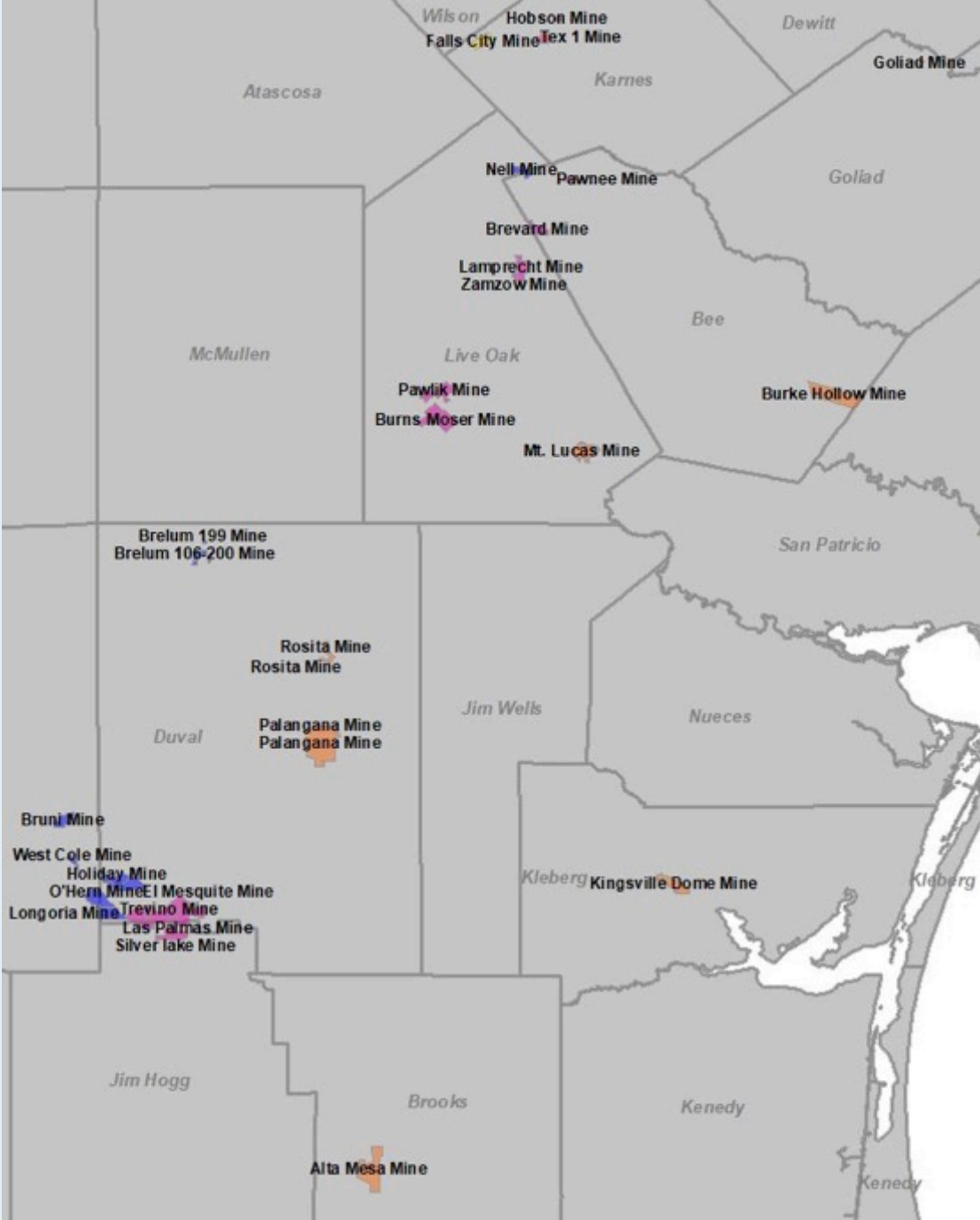
Open-pit mining began in late 1950's

In-situ solution mining began in 1975

In-situ uranium plants have aquifer exemptions

→ Many unplugged exploration holes still exist

Uranium-bearing mineral deposits occur in:
Jackson,
Catahoula,
Oakville, and
Goliad formations.



Source: TCEQ (2016) Class III UIC Program GIS files

Class V Injection Wells

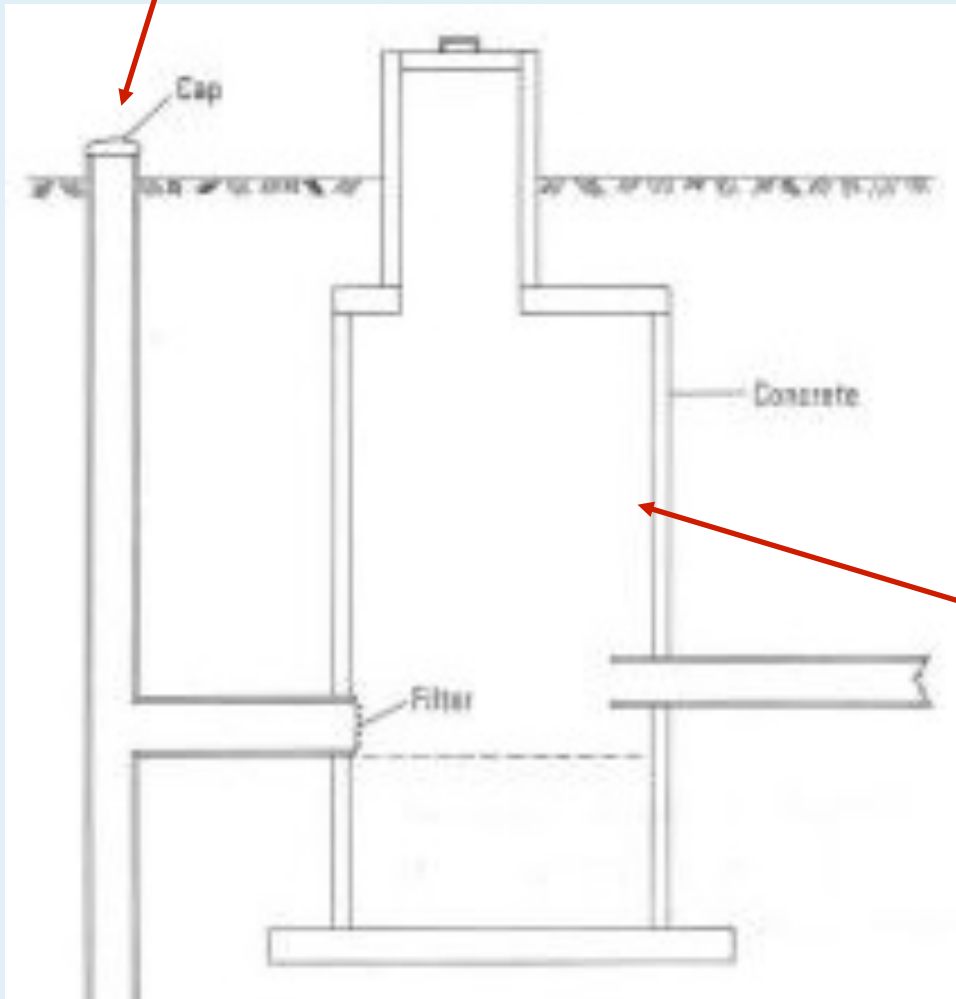
Very little, if any, information at state offices

Most wells are not a problem (heat pump wells, ...)

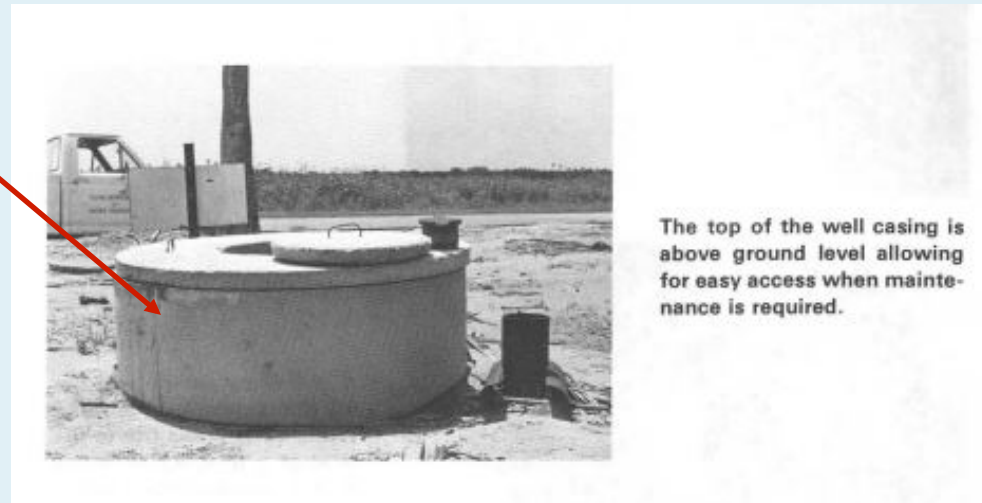
Office research plus field investigations and interviews are warranted for some types

These diagrams and photos are in a state report, but most wells never mapped.

Agricultural drainage well



Cistern



Salt Water Disposal Pits

Active until 1969 no-pit rule

Some published studies exist

Check TWDB groundwater quality data for anomalies

Historic air photo analysis can be used

Significant volumes of produced water were deposited in unlined, earthen pits.



Source: TWDB TNRIS historical air photo imagery, 1950, San Patricio County, Texas

Summary

- There is substantial brackish groundwater for development
- BRACS studies can support the identification of favorable exploration sites
- Well field drilling and testing is required to provide site-specific details that regional studies cannot provide
- Reduce project risk by performing due diligence
- Contact TWDB if you have any questions about data

Questions ?

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