Brackish Groundwater Characterization (BRACS)

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Texas Ground Water Association

Annual Convention

January 22, 2020

Outline

A. What is the Texas Water Development Board?

B. Why do we study brackish groundwater?

C. How do we study brackish groundwater?

D. What are some study results?

E. What data is available to me?

What is the Texas Water Development Board (TWDB)?

What is the Texas Water Development Board (TWDB)?

Mission: to provide leadership, information, education, and support for planning, financial assistance, and outreach for the conservation and responsible development of water for Texas

- Created in 1957 in response to the “drought of record”
- Supports development of regional water plans, culminates in State Water Plan
- Provides financial assistance for various water supply projects
- Researches water resources and collects data

State Water Plan

- Issued every 5 years
- Predicts the population and water needs of Texas for the next 50 years
- Summarizes projects from regional water planning
- Identifies potential water deficits
- https://www.twdb.texas.gov/waterplanning/swp/index.asp

TWDB Water Science and Conservation

- Research and data gathering wing
  - Innovative Water Technologies
    - Aquifer Storage and Recovery
    - Brackish Resources Aquifer Characterization System (BRACS)
    - Desalination
    - Water Reuse
  - We look at unconventional sources of water as a potential new water supply

A
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Why do we study brackish groundwater?

What is brackish groundwater?

Saltier than fresh water, less saline than seawater

Groundwater salinity classification	Salinity class code	Total Dissolved Solids (TDS) concentration, mg/L
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

brackish

Drinking water limit

Major/minor aquifer mapped limit

USDW limit

Seawater

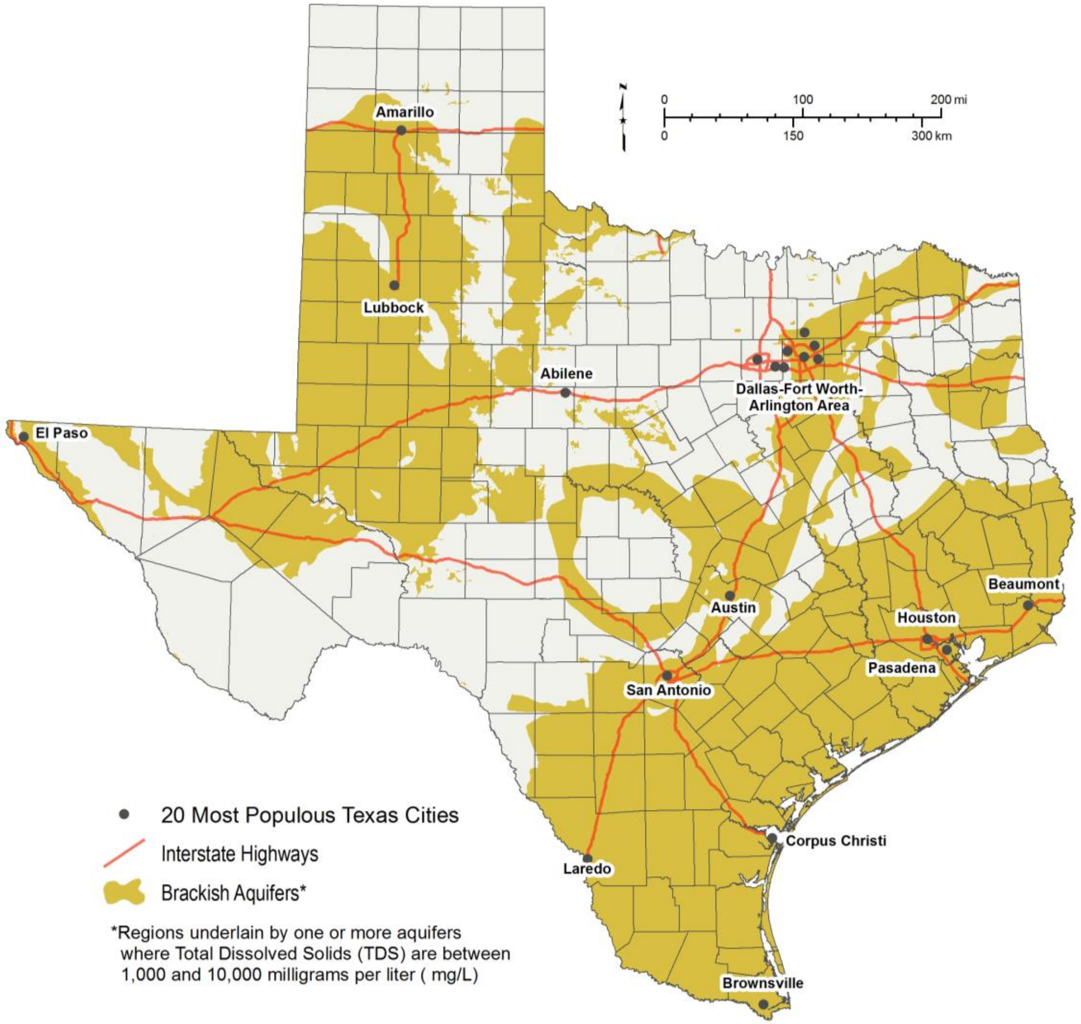
Modified from Winslow and Kister, 1956

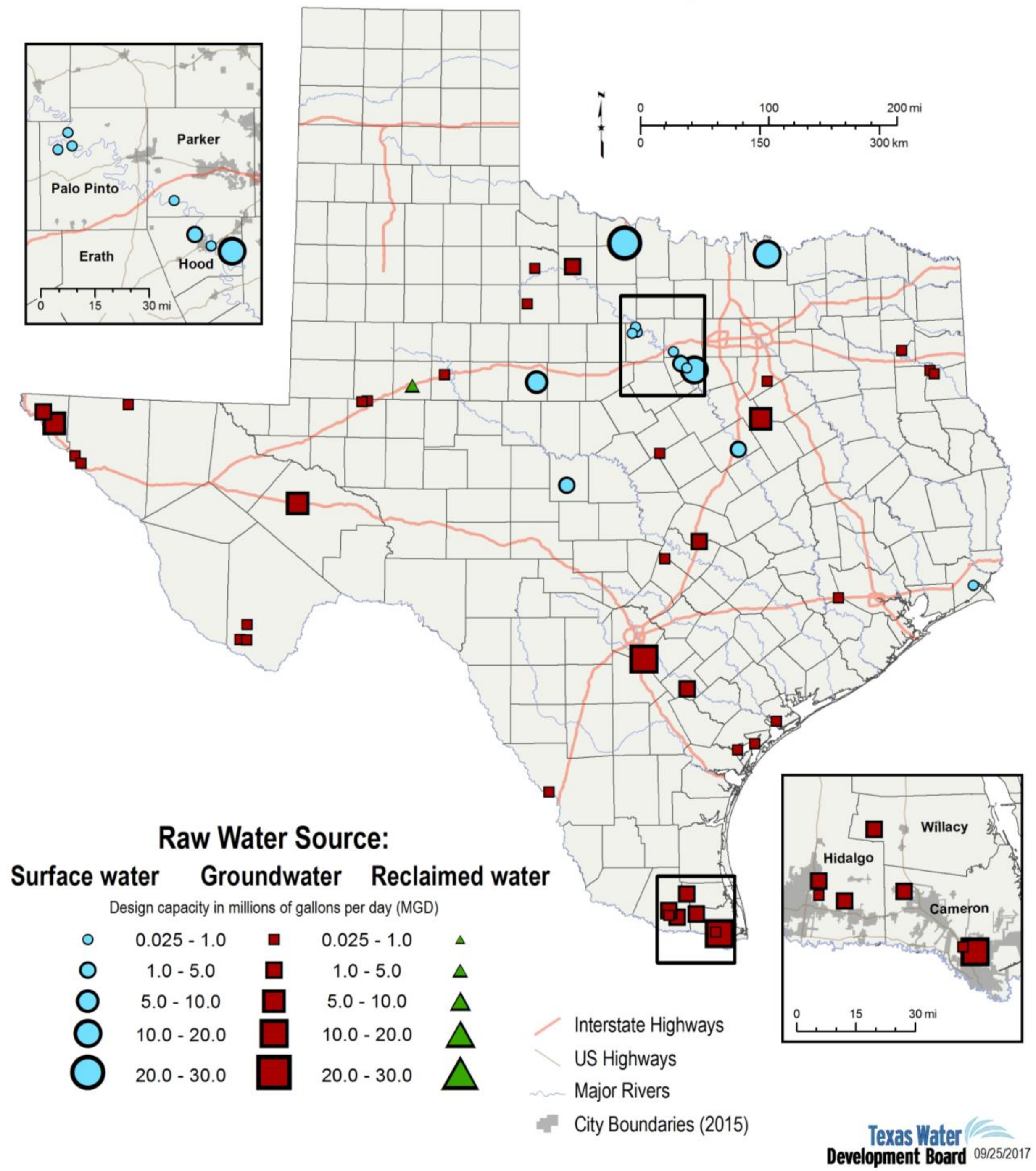
Why study brackish groundwater?

- Fresh water supplies are decreasing
  - Significant depletion in some aquifers
  - Sedimentation of reservoirs
- “Easy” reservoirs already built in 60s, new ones unlikely
  - expensive
  - unfeasible
- 2017 State Water Plan identified 3.1 million acre-feet of unmet water supply needs by 2070

How much brackish groundwater is available?

- Estimated 2.7 billion acre-feet of brackish groundwater in Texas (LBG-Guyton, 2003)
- Available throughout the state
- Less expensive than seawater
- “drought-proof”
- However, less data and knowledge exists for brackish aquifers



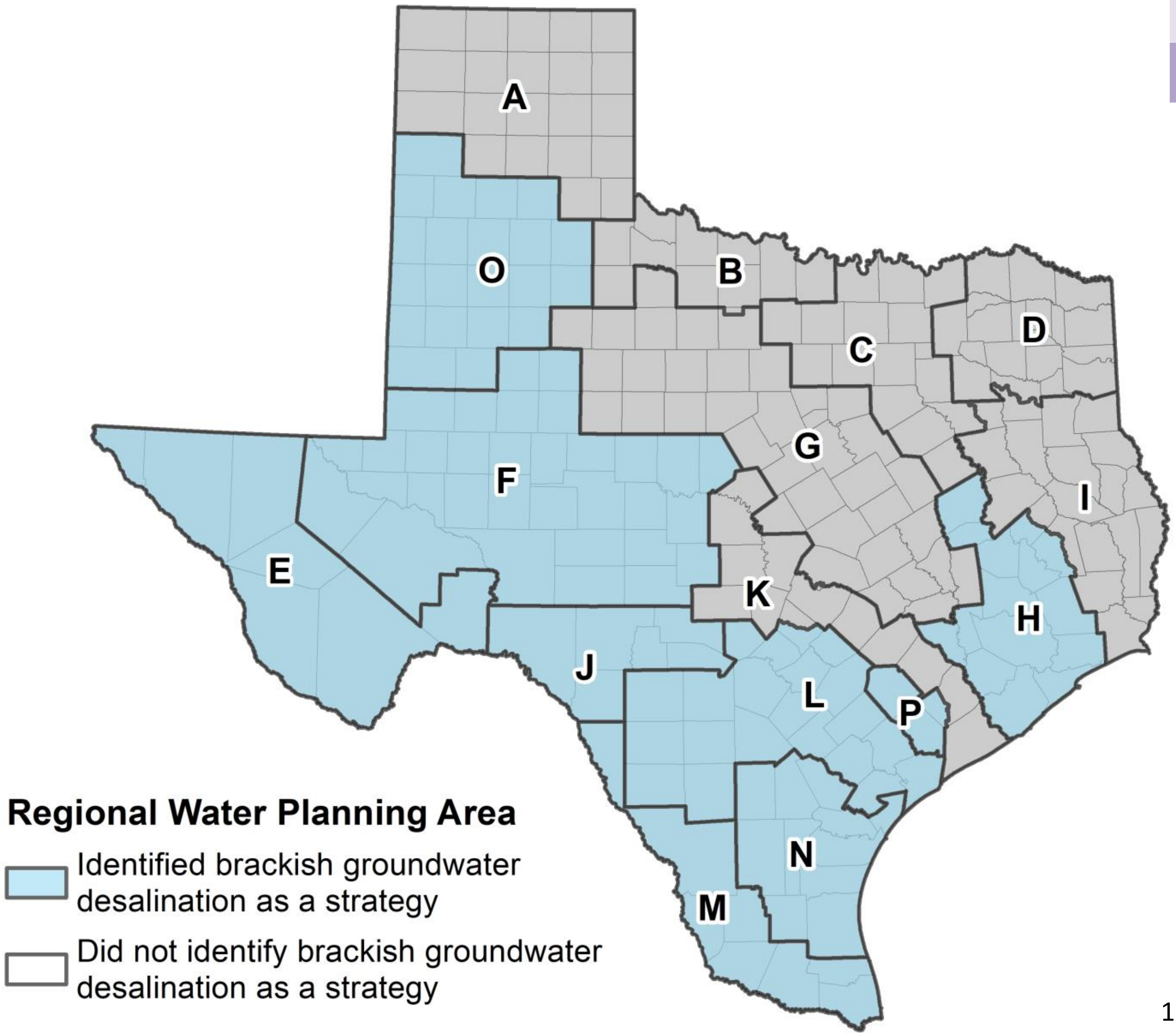


Existing brackish groundwater desalination

- Current municipal capacity = 85 million gallons per day (95,212 acre-feet per year)
- Largest capacity plant is Kay Bailey Hutchison in El Paso (27.5 MGD)
- 35 of 49 plants in desalination database

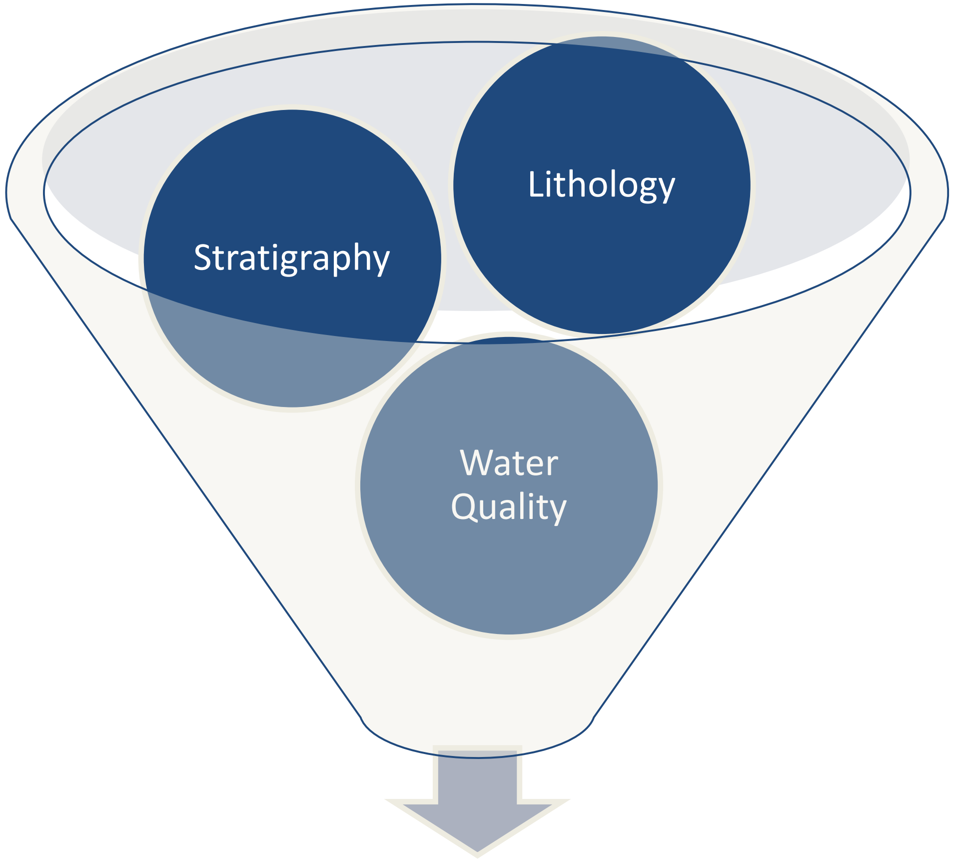
Why study brackish groundwater?

- We need more refined estimates of
  - Quantity
  - Quality
  - Location
- 8 of the 16 Regional Water Planning Areas identified brackish desalination as a strategy
- Estimated 111,000 acre-feet per year by 2070
- Study results can help identify
  - Where brackish groundwater is
  - Areas for site specific studies to develop desalination well fields



How do we study brackish groundwater?

General methodology



Volume and Quality of Brackish Groundwater

Area (Extent)
X
Thickness (Net Sand)
X
Porosity (Specific Yield)
=
Volume (acre-feet)

BRACS Study outline

- Collect well logs (water, oil/gas)
- Build geologic datasets (database, GIS)
- Compile aquifer properties (chemistry; productivity)
- Map aquifer extent from outcrop to 10,000+ mg/L TDS
- Estimate volumes of groundwater by salinity
- Provide data to stakeholders
- *Each aquifer will require unique analysis based on data availability and local hydrogeology*

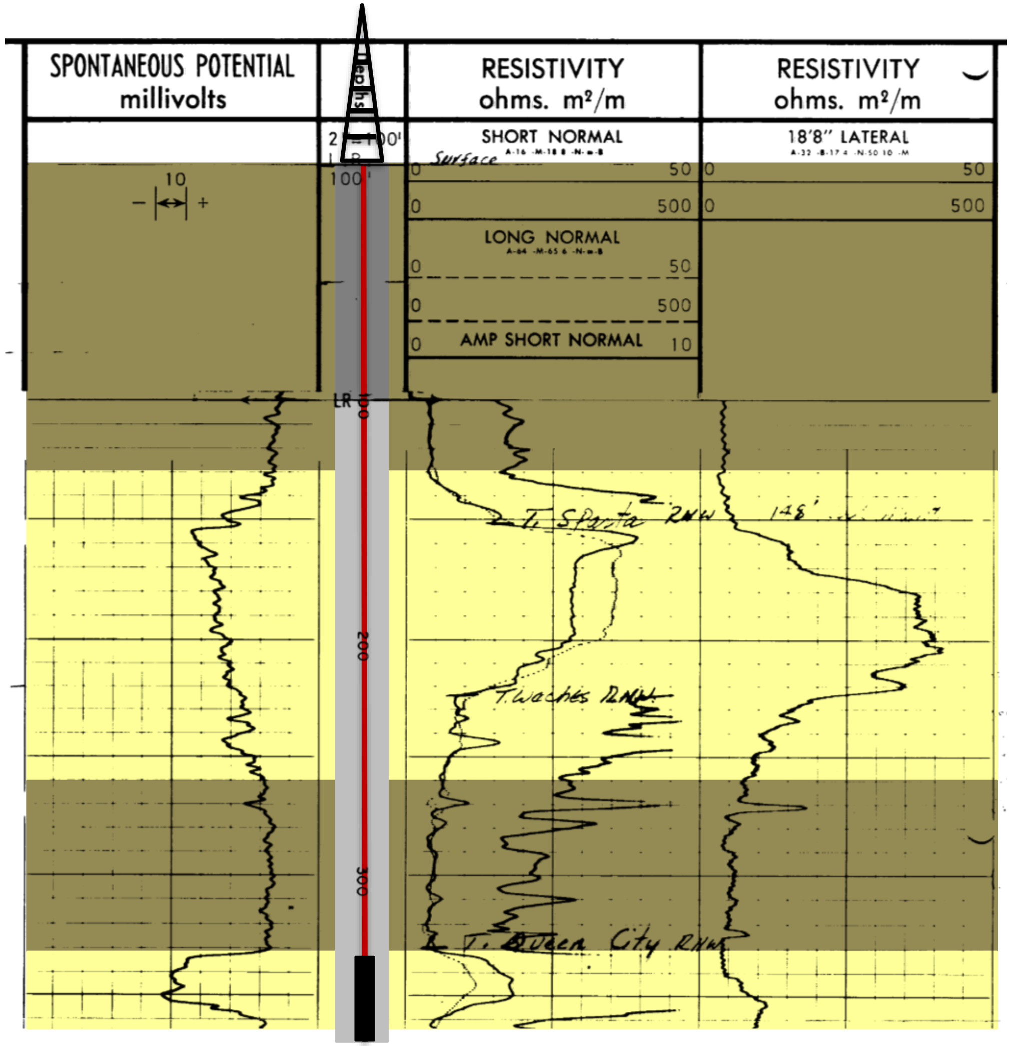
BRACS Database

- MS Access database
- Information saved in BRACS database
  - Geophysical well logs and well locations
  - Aquifer top and bottom depths
  - Interpreted lithology
  - Well test data
  - Lab analyzed water quality
- Available to download

http://www.twdb.texas.gov/innovativewater/bracs/database.asp

Brackish groundwater mapping source data

What is a geophysical well log?



BRACS 39472

- Tool or combination of tools lowered into a borehole on a wireline
- Measurements of the surrounding rock are made as the tools are retrieved to the surface
- Tools designed to read specific parameters
- Tool response recorded in left and right tracks
- Logs must be corrected for a number of parameters
- Complete and accurate header information vital to performing corrections

More examples of data sources

Submitted Driller's Report (1996)

...nd original copy by certified mail to: TNRCC, P.O. Box 13087, Austin, TX 78711-3087 G0890006D

Please use black ink.

ATTENTION OWNER: *Confidentiality Privilege Notice on Reverse Side*
Gonzales County Water Supply Corp.

State of Texas
WELL REPORT

Texas Water Well Drillers Advisory Council
P.O. Box 13087
Austin, TX 78711-3087
512-239-0530

1) OWNER Gonzales County Water Supply Corp (Name) ADDRESS 1903 Sarah DeWitt Dr., Gonzales, Texas 78629 (Street or RFD) (City) (State) (Zip)

2) ADDRESS OF WELL: County Gonzales 8 miles N. of Gonzales (F.M. 794 well) (Street, RFD or other) (City) (State) (Zip) GRID # 67-20-9

3) TYPE OF WORK (Check): [X] New Well [ ] Deepening [ ] Reconditioning [ ] Plugging

4) PROPOSED USE (Check): [ ] Monitor [ ] Environmental Soil Boring [ ] Domestic [ ] Industrial [ ] Irrigation [ ] Injection [X] Public Supply [ ] De-watering [ ] Testwell
If Public Supply well, were plans submitted to the TNRCC? [X] Yes [ ] No

5)

6) WELL LOG:
Date Drilling:
Started 10-24- 19 96
Completed 11-10- 19 96

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
18 1/2	Surface	748
11 1/2	748	830

7) DRILLING METHOD (Check): [ ] Driven [ ] Air Rotary [X] Mud Rotary [ ] Bored [ ] Air Hammer [ ] Cable Tool [ ] Jetted [ ] Other

From (ft.)		To (ft.)	Description and color of formation material
0	–	5	Top Soil
5	–	68	Clay (Yellow)
68	–	150	Sand & Shale
150	–	184	Sand
184	–	266	Shale
266	–	270	Sand
270	–	296	Shale
296	–	302	Sand
302	–	306	Sand & Shale
306	–	353	Sand
353	–	386	Shale
386	–	513	Sand & Shale
513	–	672	Sand
672	–	675	Shale
675	–	700	Sand

(Use reverse side if necessary)

8) Borehole Completion (Check): [ ] Open Hole [X] Straight Wall [ ] Underreamed [ ] Gravel Packed [ ] Other
If Gravel Packed give interval ... from ft. to ft.

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	Setting (ft.) To	Gage Casting Screen
122/4	New	Steel	4	748	
8 5/8	New	Steel	702	750	
8 5/8	New	Screen Mfg.	750	820	

9) CEMENTING DATA [Rule 338.44(1)]
Cemented from 0 ft. to 748 ft. No. of sacks used 420
ft. to ft. No. of sacks used
Method used Pressure
Cemented by International Services, Inc.
Distance to septic system field lines or other concentrated contamination 200 ft.
Method of verification of above distance measured

13) TYPE PUMP: N/A
[ ] Turbine [ ] Jet [ ] Submersible [ ] Cylinder
[ ] Other
Depth to pump bowls, cylinder, jet, etc., ft.

10) SURFACE COMPLETION
[X] Specified Surface Slab Installed [Rule 338.44(2)(A)]
[ ] Specified Steel Sleeve Installed [Rule 338.44(3)(A)]
[ ] Pitless Adapter Used [Rule 338.44(3)(b)]
[ ] Approved Alternative Procedure Used [Rule 338.71]

14) WELL TESTS:
Type test: [X] Pump [ ] Bailer [ ] Jetted [ ] Estimated
Yield: 1471 gpm with 252 ft. drawdown after 36 hrs.

11) WATER LEVEL:
Static level 65 ft. below land surface Date 12-23-96
Artesian flow gpm. Date

15) WATER QUALITY:
Did you knowingly penetrate any strata which contained undesirable constituents?
[ ] Yes [X] No If yes, submit "REPORT OF UNDESIRABLE WATER"
Type of water? Good Depth of strata 750-820
Was a chemical analysis made? [X] Yes [ ] No

12) PACKERS: Type Depth
N/A

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. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME Cude Drilling, Inc. (Type or print) WELL DRILLER'S LICENSE NO. 2738W

ADDRESS P. O. Box 8 (Street or RFD) Pleasanton (City) Texas (State) 78064 (Zip)

(Signed) Richard R. Barton (Licensed Well Driller) (Signed) (Registered Driller Trainee)

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

TNRCC-0199 (Rev. 11-01-94) TNRCC COPY

BRACS 39367

From (ft.)		To (ft.)	Description and color of formation material
0	–	5	Top Soil
5	–	68	Clay (Yellow)
68	–	150	Sand & Shale
150	–	184	Sand
184	–	266	Shale
266	–	270	Sand
270	–	296	Shale
296	–	302	Sand
302	–	306	Sand & Shale
306	–	353	Sand
353	–	386	Shale
386			
513			
672			
675			

14) WELL TESTS:
Type test: [X] Pump [ ] Bailer [ ] Jetted [ ] Estimated

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	Setting (ft.) To	Gage Casting Screen
122/4	New	Steel	4	748	
8 5/8	New	Steel	702	750	
8 5/8	New	Screen Mfg.	750	820	

More examples of data sources

Environmental Laboratory Services
The Solution Lab

FINAL ANALYSIS REPORT

LAB ID: 9901841 SAMPLE DESCRIPTION: Groundwater
COMPANY: TX Water Dev. Board SAMPLE DATE: 08/28/98
ACCT NO: SAMPLE TIME: 0905
REQUISITION No.: R08511 DATE RECEIVED: 08/31/98
LOCATION ID: 68-28-911 REPORT DATE: 10/06/98

PARAMETER	RESULTS	UNITS	STORET #	PQL in WATER	DATE ANALYZED
Bromide	0.11	mg/L	71870	0.02	09/01/98
Chloride	16.1	mg/L	00941	1.5	09/01/98
Fluoride	0.16	mg/L	00950	0.01	09/01/98
Nit.,Nitrate/Nitrite	1.600	mg/L	00630	0.020	09/09/98
Nitrogen, Kjeldahl	0.110	mg/L	00623	0.070	10/01/98
Nitrogen, ammonia	0.060	mg/L	00608	0.050	09/15/98
Phosphorus, Total	<0.070	mg/L	00665	0.070	09/09/98
Silica	12.70	mg/L	00955	1.00	09/01/98
Sulfate	28.50	mg/L	00946	1.50	09/01/98
Alkalinity, Total	246	mg/L	00410	1	09/01/98
Alkalinity, Phenol.	0	mg/L	00415	0	09/01/98
Boron, Dissolved	42.00	ug/L	01020	-----	09/15/98
Cobalt, Diss. ICPMS	<1.0	ug/L	01035	1.0	09/02/98
Iron, Dissolved	10.00	ug/L	01046	-----	09/15/98
Lithium, Diss. ICPMS	3.5	ug/L	01130	2.0	09/03/98
Molybdenum Dis ICPMS	<1.0	ug/L	01060	1.0	09/02/98
Potassium, Dissolved	1.21	mg/L	00935	1.00	09/15/98
Strontium, Dis ICPMS	475.0	ug/L	01080	1.0	09/02/98
Vanadium, Diss ICPMS	5.0	ug/L	01085	1.0	09/02/98
Aluminum, Dis. ICPMS	<4.0	ug/L	01106	4.0	09/02/98
Arsenic, Diss. ICPMS	<2.0	ug/L	01000	2.0	09/02/98

BRACS 48793

Brackish groundwater mapping

Aquifer framework

- Map extent of the aquifer, i.e. aquifer top and bottom depths
- Primary data source is geophysical well logs
  – Mostly oil and gas logs
- Interpret logs to get aquifer top pick, a.k.a. stratigraphic pick
- Record interpretations in the BRACS database
- Interpolate picks to generate aquifer top and bottom GIS surfaces
- Stratigraphic surfaces make study framework

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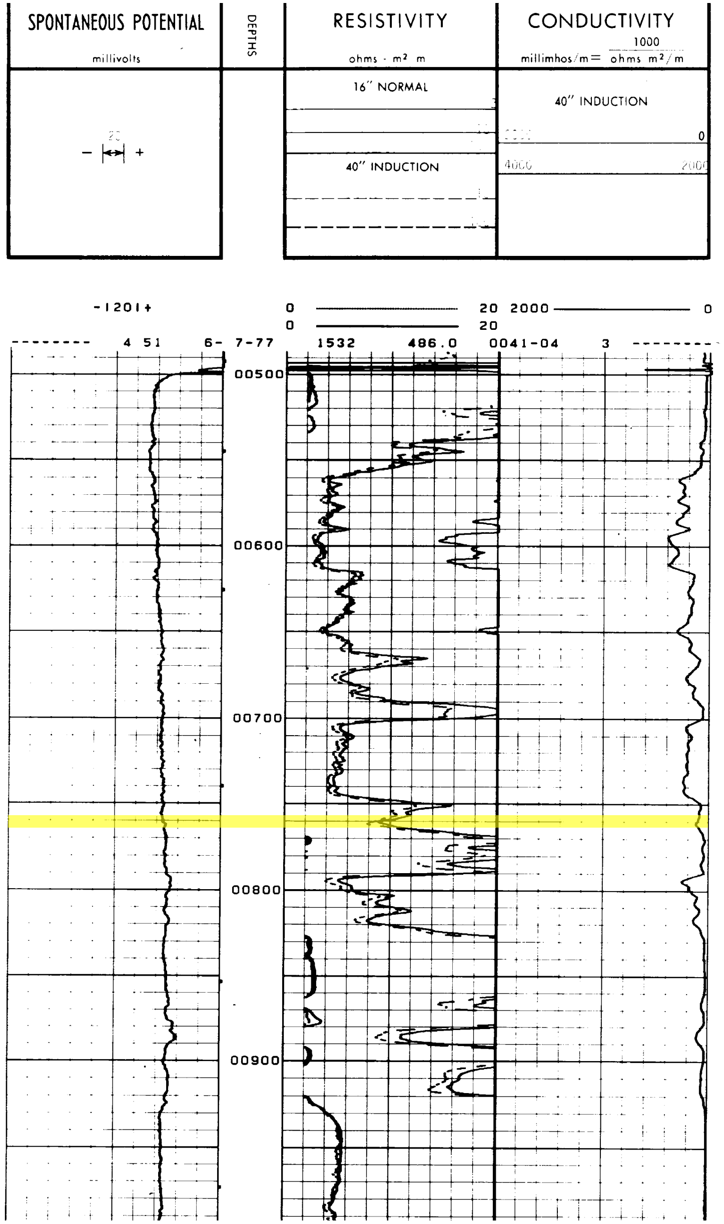
Geophysical Well Log

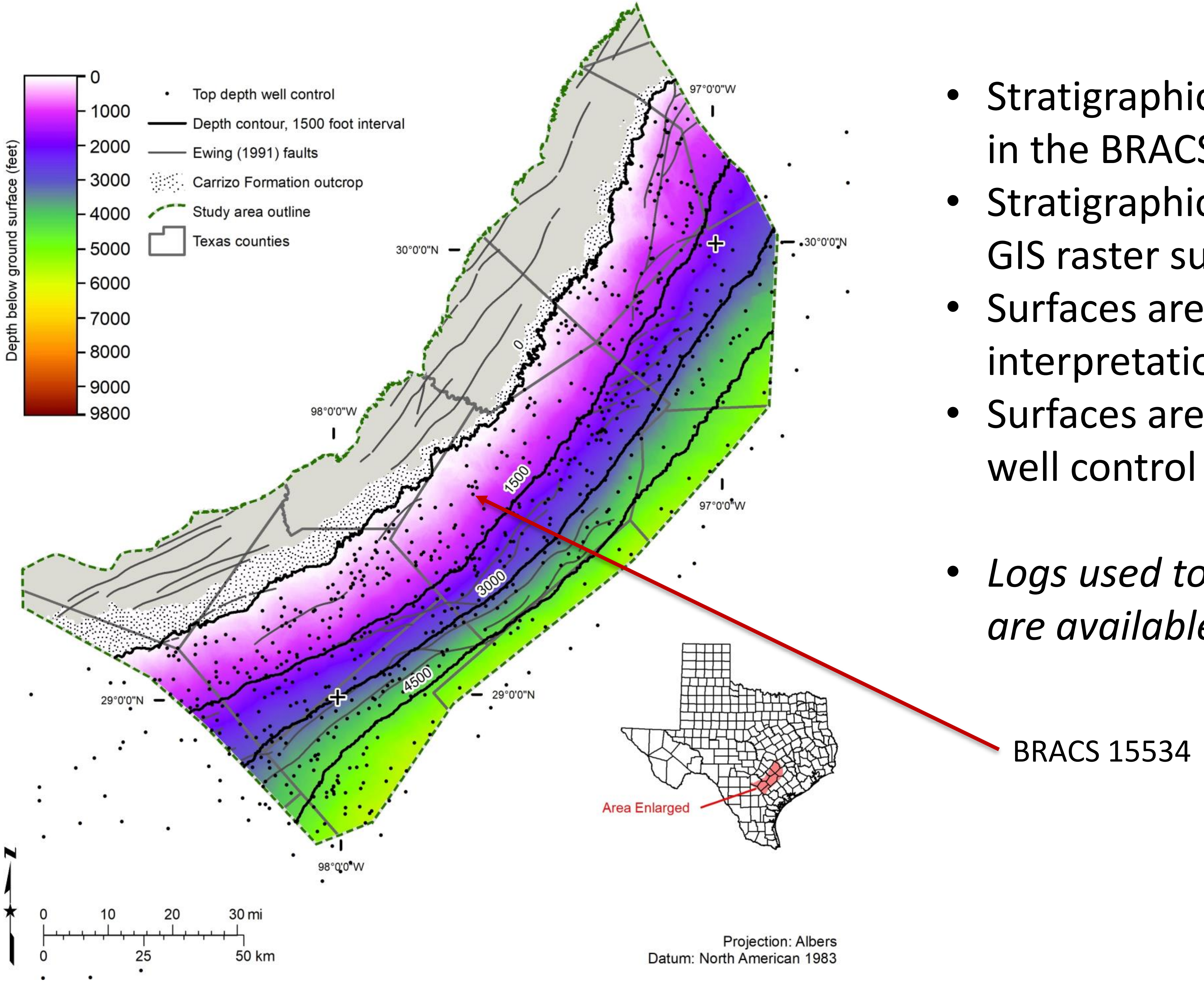


BRACS 15534

BRACS Database geology table

Stratigraphic Description

Record Number	Geologic Pick	Top Depth / Bottom Depth / Thickness	Stratigraphic Description / Source of Data	Initials	Last Change
1	Stratigraphic; Unit > Well Depth ?	0 / /	Weches Formation / Geophysical Well Log		10/2/2012
2	Stratigraphic; Unit > Well Depth ?	/ 560 /	Queen City Formation / Geophysical Well Log		10/2/2012
3	Stratigraphic; Unit > Well Depth ?	560 / 760 / 200	Reklaw Formation / Geophysical Well Log		10/2/2012
4	Stratigraphic; Unit > Well Depth ?	760 / 1450 / 690	Carrizo Formation / Geophysical Well Log		10/2/2012
5	Stratigraphic; Unit > Well Depth ?	1450 / 2940 / 1490	Wilcox Group / Geophysical Well Log		2/6/2015
6	Stratigraphic; Unit > Well Depth ?	2940 / /	Midway Group / Geophysical Well Log		2/6/2015
*	Unit > Well Depth ?				



- Stratigraphic interpretations saved in the BRACS database
- Stratigraphic picks used to make GIS raster surfaces
- Surfaces are reviewed and more interpretations are made
- Surfaces are regenerated with new well control

- *Logs used to make interpretations are available for download*

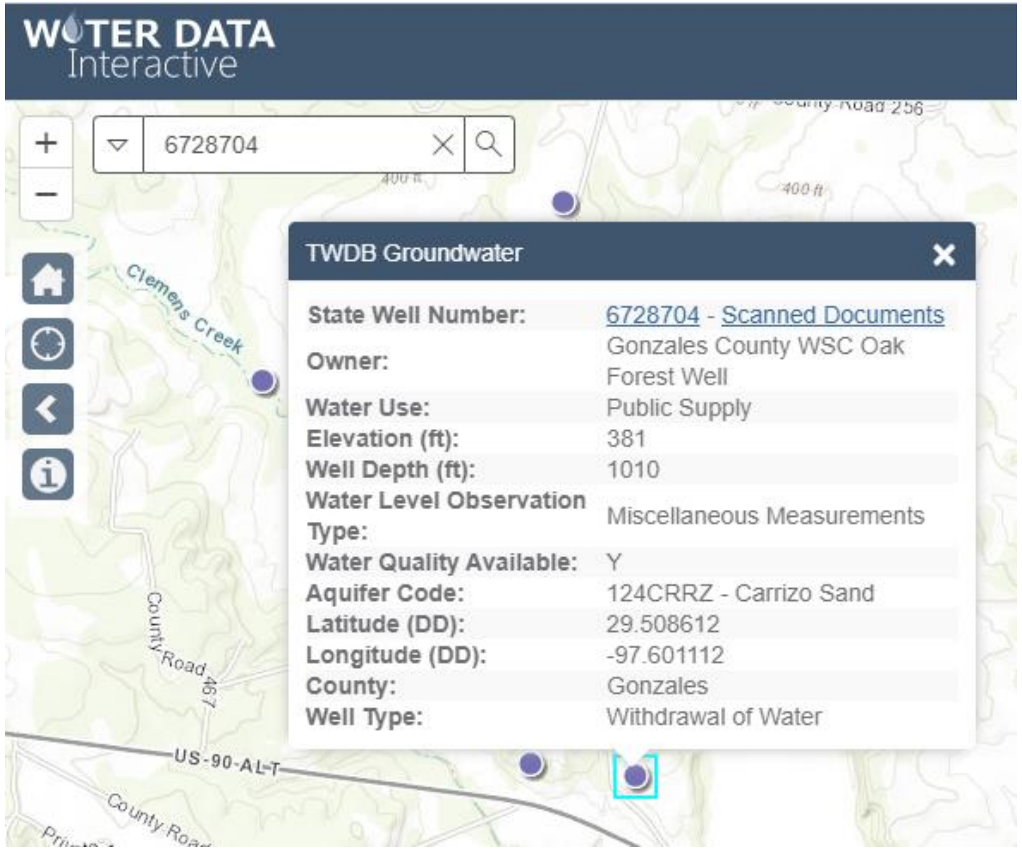
Aquifer Determination

- Assign aquifer(s) to each well in the project area
- Use screen top/bottom *or* well depth *or* total depth of hole
- Use the GIS-derived 3-D formation surfaces as vertical control

Why?

- Compare wells completed in same aquifer
- Consistent evaluation of aquifer water quality and properties
- Many new wells do not have TWDB aquifer code
- Some TWDB wells have incorrect aquifer code

Aquifer determination example



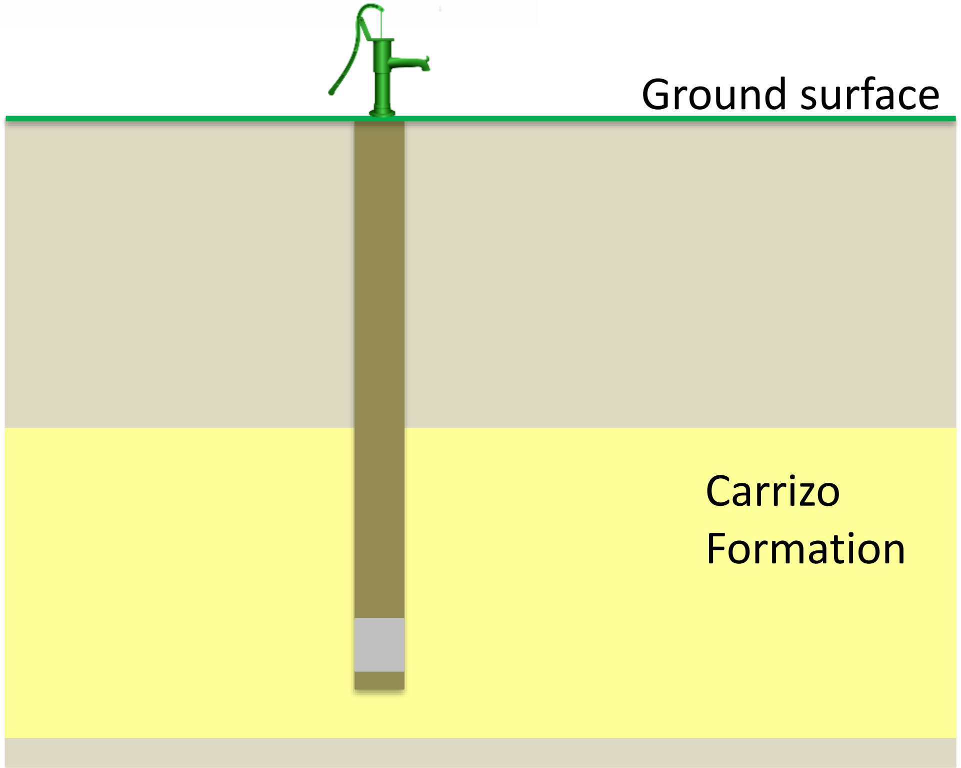
https://www3.twdb.texas.gov/apps/waterdatainteractive/groundwaterdataviewer

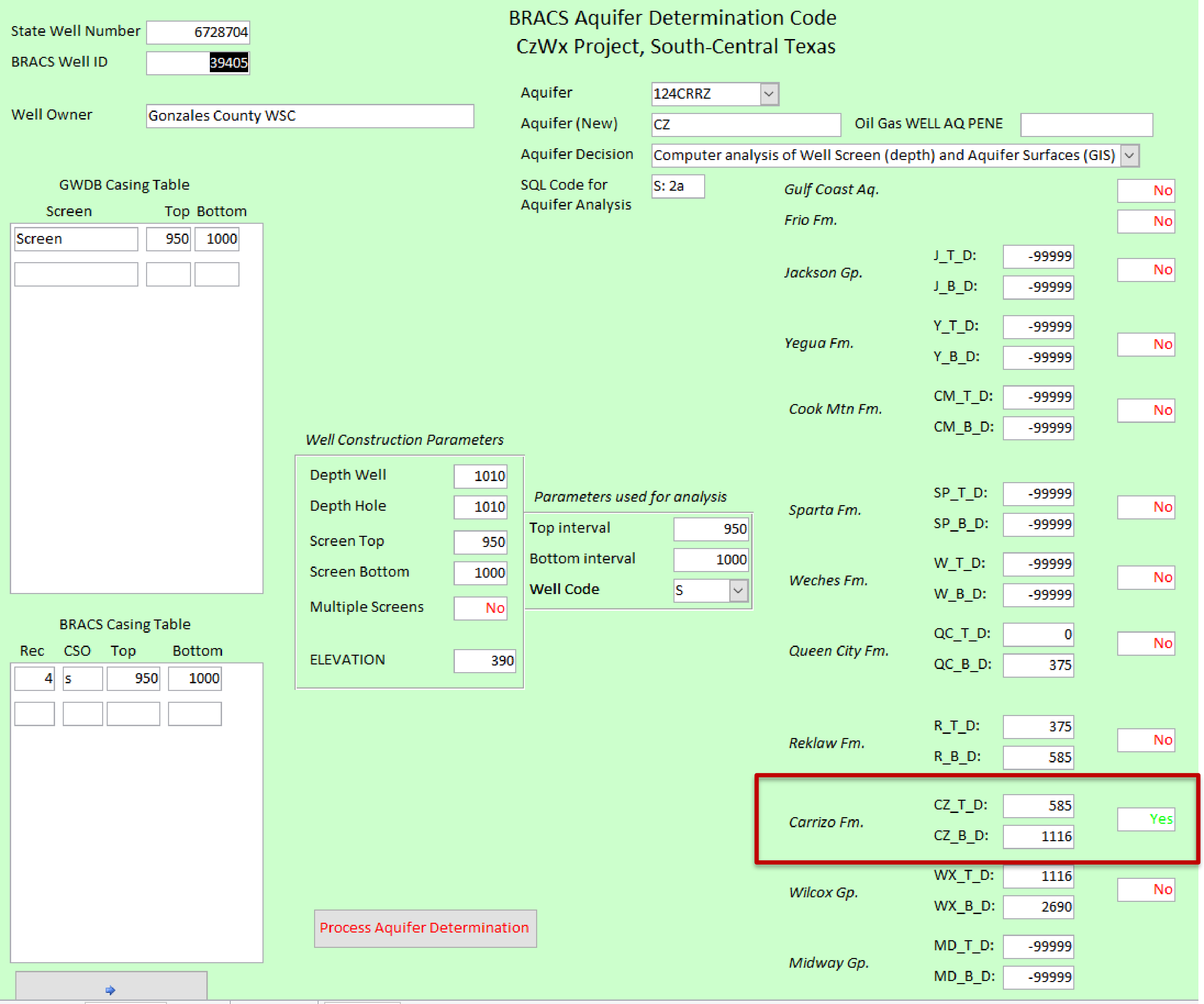
BRACS 39405/SWN 6728704

CASING, BLANK PIPE, AND WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To	Gage
8	New	Steel GR B	1010-1000	.322
8	New	Pipe Base SS Wire Wrap Screen	1000- 950	.40
8	New	Steel GR B	950- 777	.322
14	New	Steel GR B	935- +2	.375
24	New	Steel BR B	34- 0	.250

Carrizo Top Depth
585 ft
Carrizo Bottom Depth
1116 ft





BRACS Aquifer Determination Code
CzWx Project, South-Central Texas

State Well Number: 6728704

BRACS Well ID: 39405

Well Owner: Gonzales County WSC

Aquifer: 124CRRZ

Aquifer (New): CZ

Oil Gas WELL AQ PENE:

Aquifer Decision: Computer analysis of Well Screen (depth) and Aquifer Surfaces (GIS)

SQL Code for Aquifer Analysis: S: 2a

GWDB Casing Table

Screen	Top	Bottom
Screen	950	1000

BRACS Casing Table

Rec	CSO	Top	Bottom
4	s	950	1000

Well Construction Parameters

Depth Well	1010
Depth Hole	1010
Screen Top	950
Screen Bottom	1000
Multiple Screens	No
ELEVATION	390

Parameters used for analysis

Top interval	950
Bottom interval	1000
Well Code	S

Gulf Coast Aq.			No
Frio Fm.			No
Jackson Gp.	J_T_D:	-99999	No
	J_B_D:	-99999	
Yegua Fm.	Y_T_D:	-99999	No
	Y_B_D:	-99999	
Cook Mtn Fm.	CM_T_D:	-99999	No
	CM_B_D:	-99999	
Sparta Fm.	SP_T_D:	-99999	No
	SP_B_D:	-99999	
Weches Fm.	W_T_D:	-99999	No
	W_B_D:	-99999	
Queen City Fm.	QC_T_D:	0	No
	QC_B_D:	375	
Reklaw Fm.	R_T_D:	375	No
	R_B_D:	585	
Carrizo Fm.	CZ_T_D:	585	Yes
	CZ_B_D:	1116	
Wilcox Gp.	WX_T_D:	1116	No
	WX_B_D:	2690	
Midway Gp.	MD_T_D:	-99999	
	MD_B_D:	-99999	

Process Aquifer Determination

A
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Aquifer determination form

Lithologic analysis

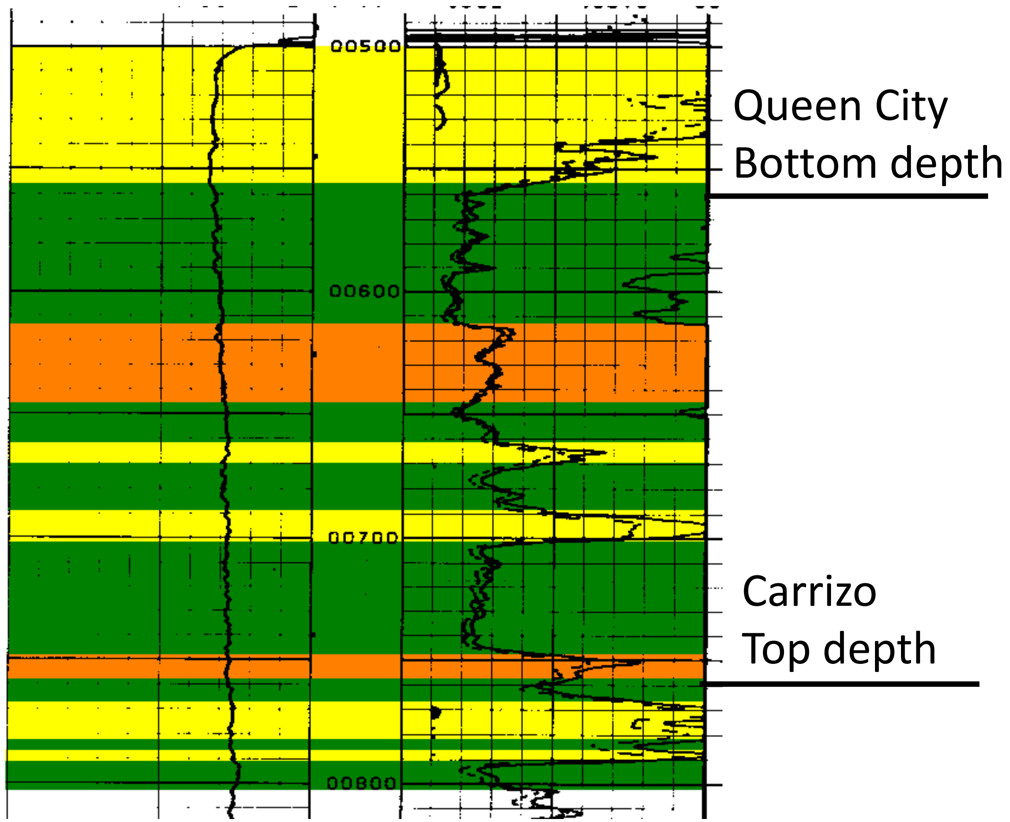
- Interpret geophysical well logs for lithology picks
- Summarize Submitted Driller's Reports into "Simplified Lithologic Descriptions"
- Build net sand data sets by formation
- Used to help get groundwater volume numbers

- Why use both geophysical well logs and Submitted Driller's Reports?

Net sands example: geophysical well log

Pick	Color	Sand%
Sand		100
Sand w/clay		65
Clay w/sand		35
Clay		0

Geophysical well log



BRACS 15534

- Interpret logs for sand, clay, and mixtures of sand and clay
- Geophysical tools cannot read through surface casing
- Surface casing in this well from ground surface to 500 feet below ground surface

A
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Net sands example continued

Submitted Driller's Report

DESCRIPTION AND COLOR OF FORMATION MATERIAL

From (ft.) To (ft.) Description

0-8 sand
8-16 red & tan clay w/carrizo
16-45 lignite/gray shale & sand
45-91 dark gray shale w/small sand strk.
91-92 rock
92-131 gray shale w/sand & rock streaks
131-165 fine - medium gray sand (carrizo)
165-412 large carrizo w/coal
412-413 rock
413-445 blue shale
445-460 gray shale w/rock streaks
460-520 fine-medium sharp multi color sand w/some shale
520-525 brown & gray shale
525-555 fine-medium sand

BRACS 14270 Carrizo Top: 138 ft
Carrizo Bottom: 419 ft

From	Simplified lithologic description	% sand	Lithologic pick thickness (ft)	Net sand thickness (ft)
91-92	Unknown	0	1	0
92-131	Sand and clay	50	39	19.5
131-165	Sand	100	34	34
165-412	Sand and coal	50	247	123.5
412-413	Unknown	0	1	0
413-445	Clay	0	32	0
445-460	Clay	0	15	0

151 ft of net sand for the Carrizo

Example of a project net sands form

Net Sand Processing Table

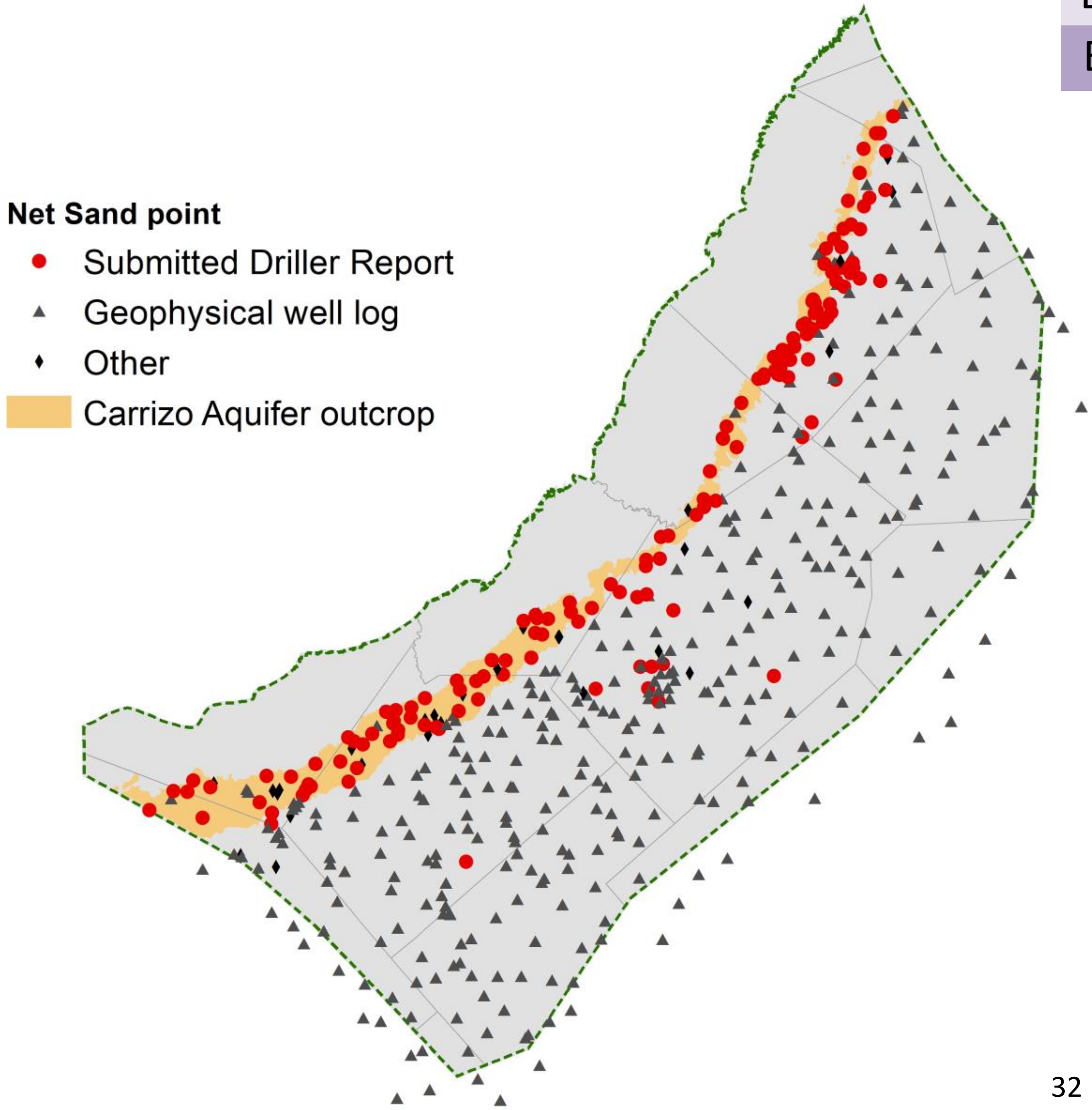
Record Number	Simplified Lithologic Description	Top / Bottom / Thickness	Sand %
1	Sand	0	
		8	
		8	1
2	Sand and Clay	8	
		16	
		8	0.5
3	Sand and Clay	16	
		45	
		29	0.5
4	Sand and Clay	45	
		91	
		46	0.5
6	Sand and Clay	92	
		131	
		39	0.5
7	Sand	131	
		165	
		34	1

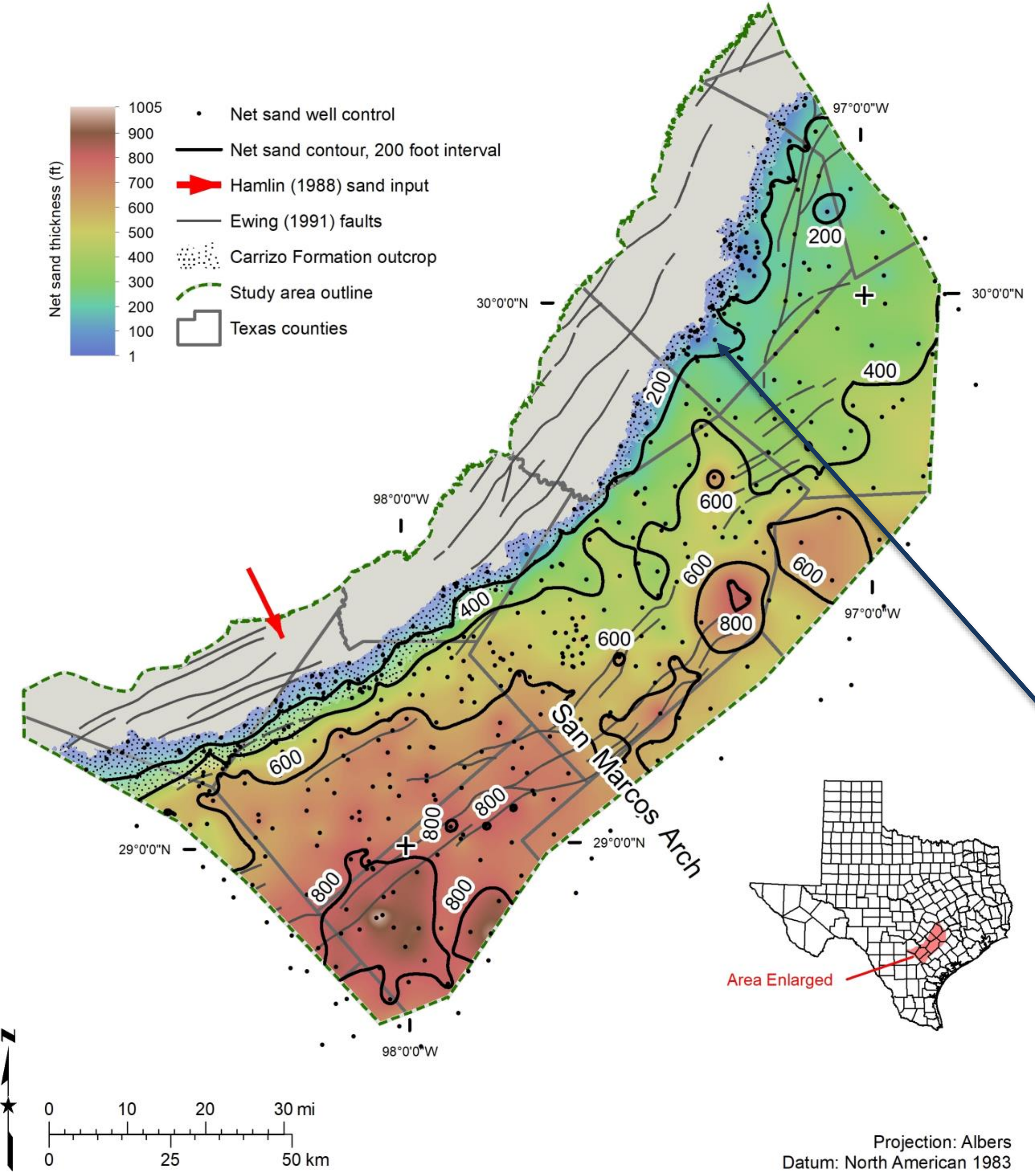
	Formation Net Sand / *Sand %*	*Formation Present* / *Well Partial Penetration*	*%*	*Partial Geol. Description* *Y/N*	*NR %*	*GNP %*
Jackson Gp	0	No				
	0	No		No		
Yegua Fm	0	No				
	0	No		No		
Cook Mtn Fm	0	No				
	0	No		No		
Sparta Fm	0	No				
	0	No		No		
Weches Fm	0	No				
	0	No		No		
Queen City Fm	0	No				
	0	No		No		
Reklaw Fm	76	Yes				
	55	No		No		
Carrizo Fm	151	Yes				
	54	No		No		
Wilcox Gp	117	Yes				
	-99999	Yes	18	No		

Geophysical well logs and Submitted Driller's Reports

- Oil and Gas surface casing installed to protect shallow groundwater

- We rely on Submitted Driller Report sediment descriptions in and near the outcrop!





- Use net sands analysis to determine groundwater volumes

BRACS 14270

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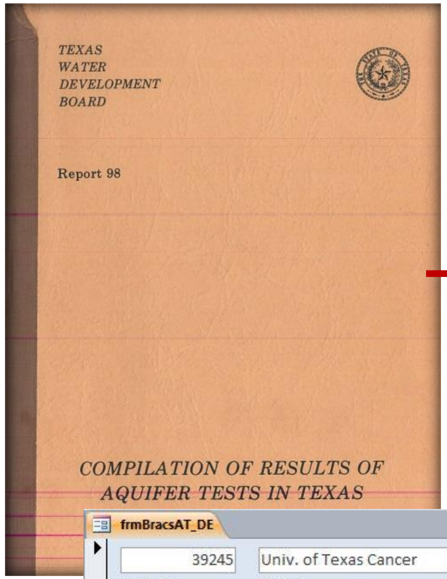
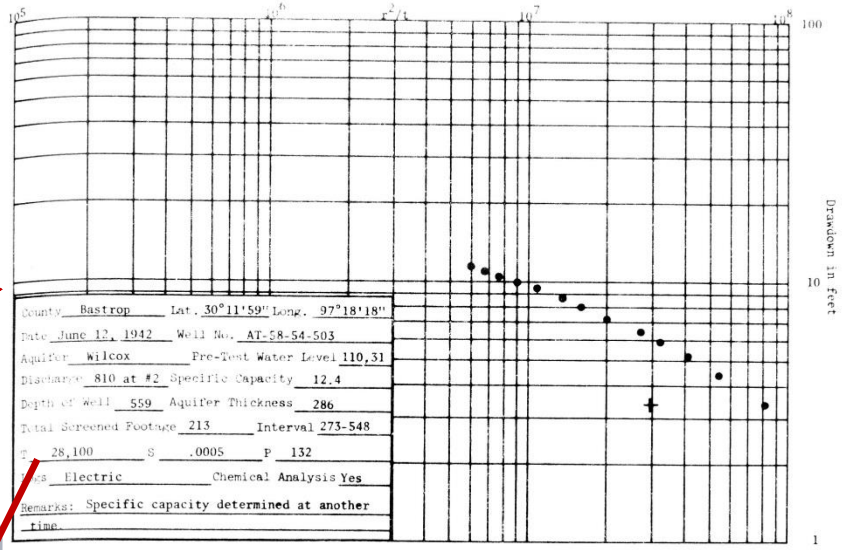
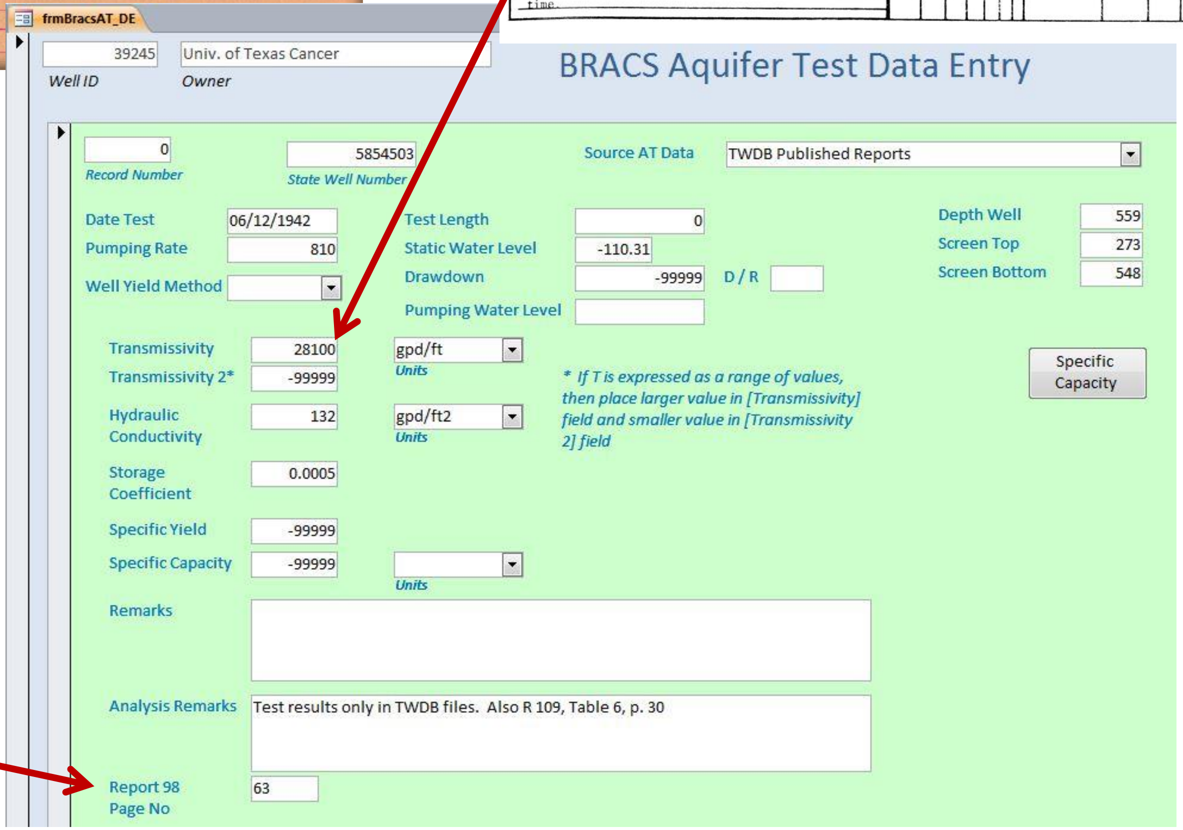
Aquifer properties

- Pump tests, specific yield, etc
- Harvested from GWDB, Submitted Driller's reports, published reports
- Recorded in BRACS database

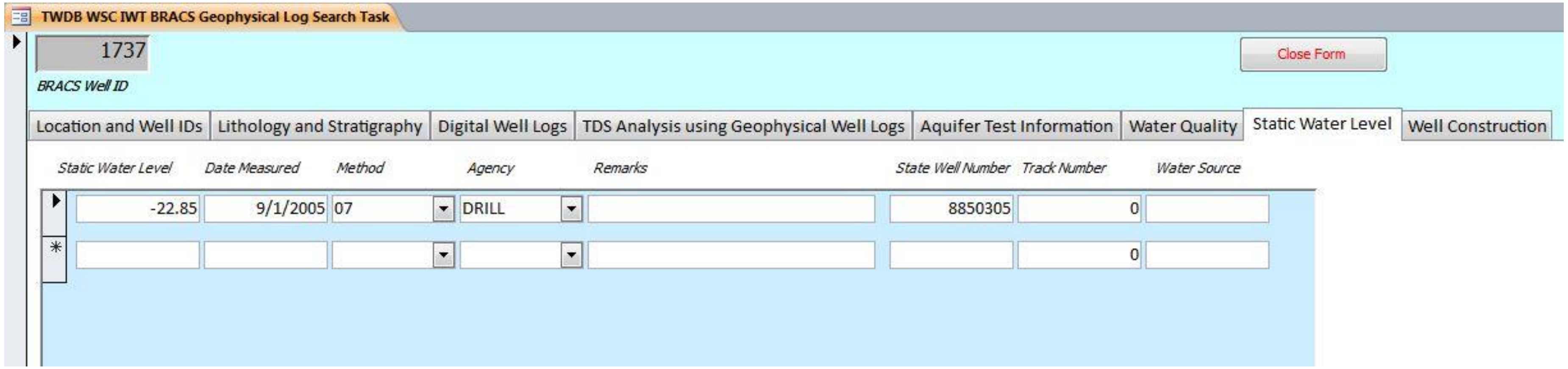






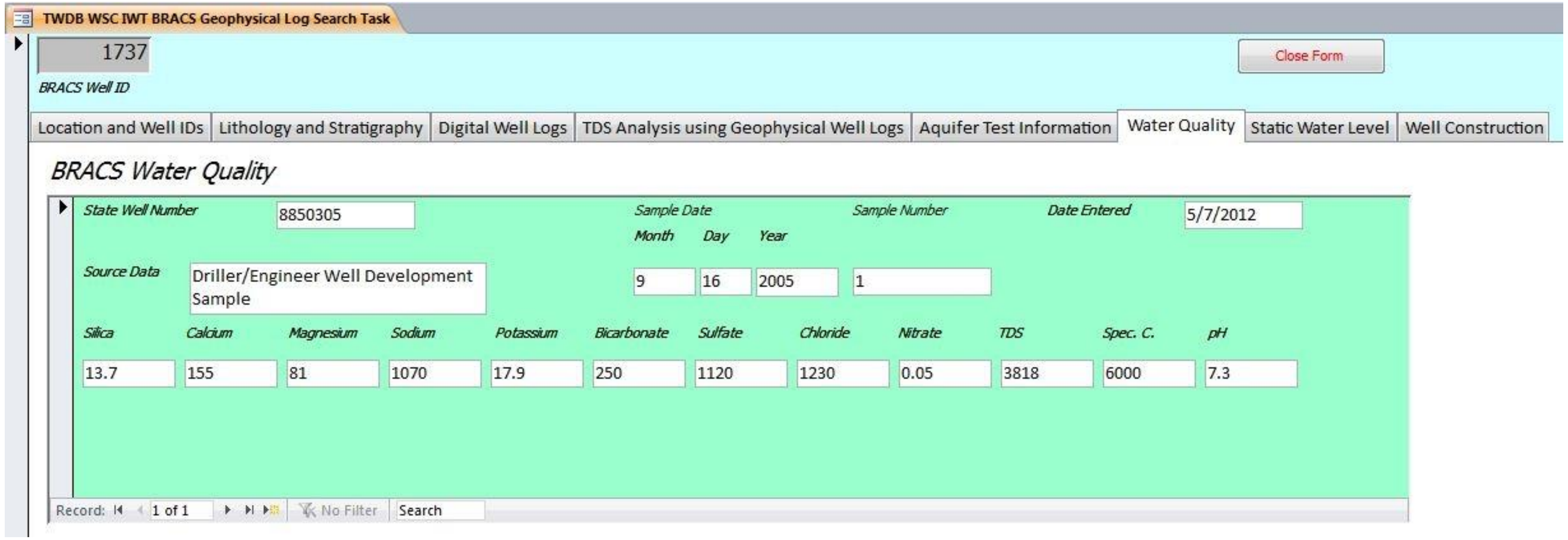
Static water level

- Static water level is used in the outcrop to modify the saturated thickness (i.e. water is unlikely to be at the ground surface)
- Data harvested primarily from GWDB and Submitted Driller's Records



Water chemistry data

- Use water quality measurements from the GWDB
  - Use aquifer code from the “aquifer determination” process
- Use water quality measurements not in the GWDB, saved in BRACS water quality tables


TWDB WSC IWT BRACS Geophysical Log Search Task

1737
BRACS Well ID

Close Form

Location and Well IDs | Lithology and Stratigraphy | Digital Well Logs | TDS Analysis using Geophysical Well Logs | Aquifer Test Information | Water Quality | Static Water Level | Well Construction

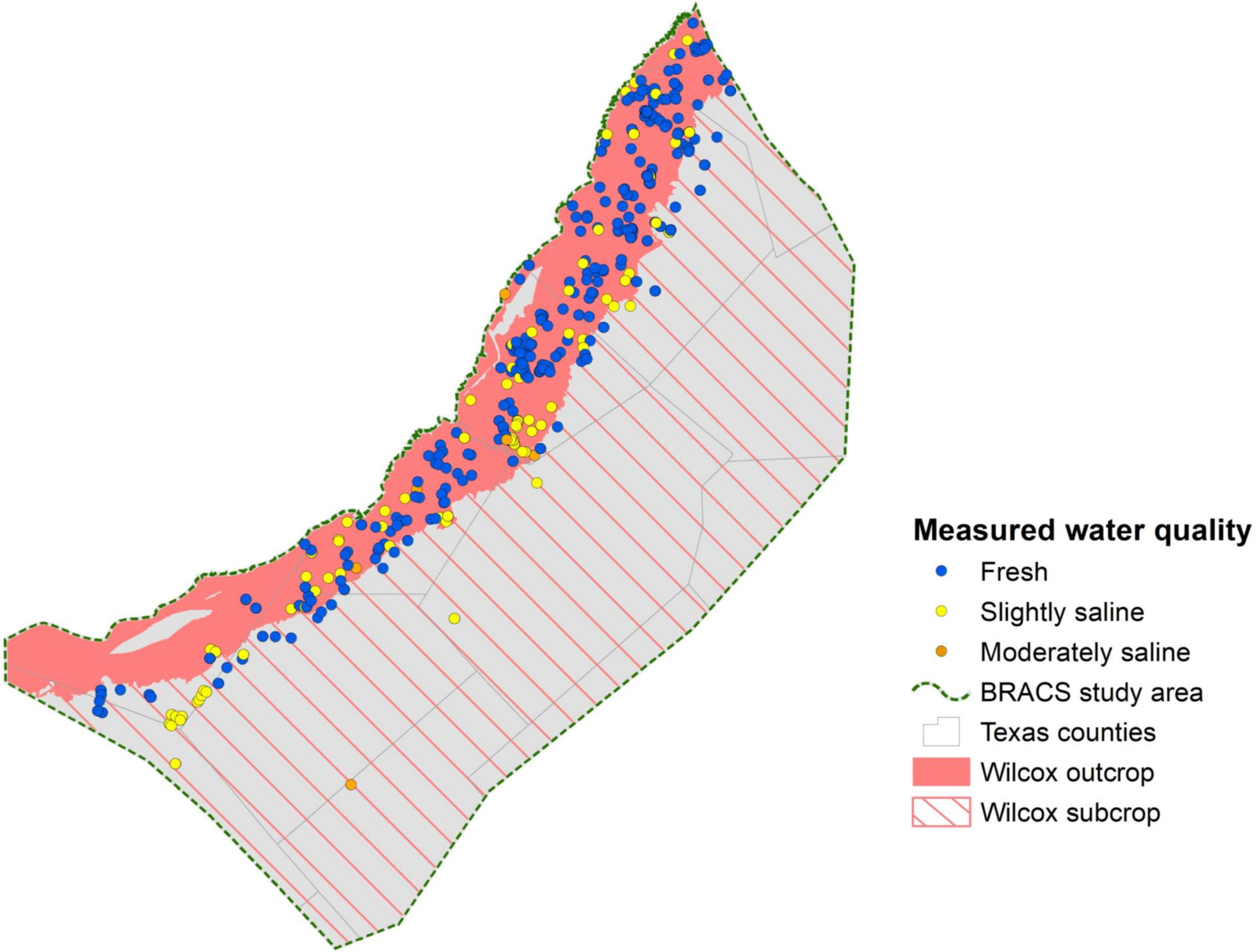
BRACS Water Quality

State Well Number: 8850305
Sample Date — Month: 9, Day: 16, Year: 2005
Sample Number: 1
Date Entered: 5/7/2012
Source Data: Driller/Engineer Well Development Sample

Silica	Calcium	Magnesium	Sodium	Potassium	Bicarbonate	Sulfate	Chloride	Nitrate	TDS	Spec. C.	pH
13.7	155	81	1070	17.9	250	1120	1230	0.05	3818	6000	7.3

Record: 1 of 1 No Filter Search

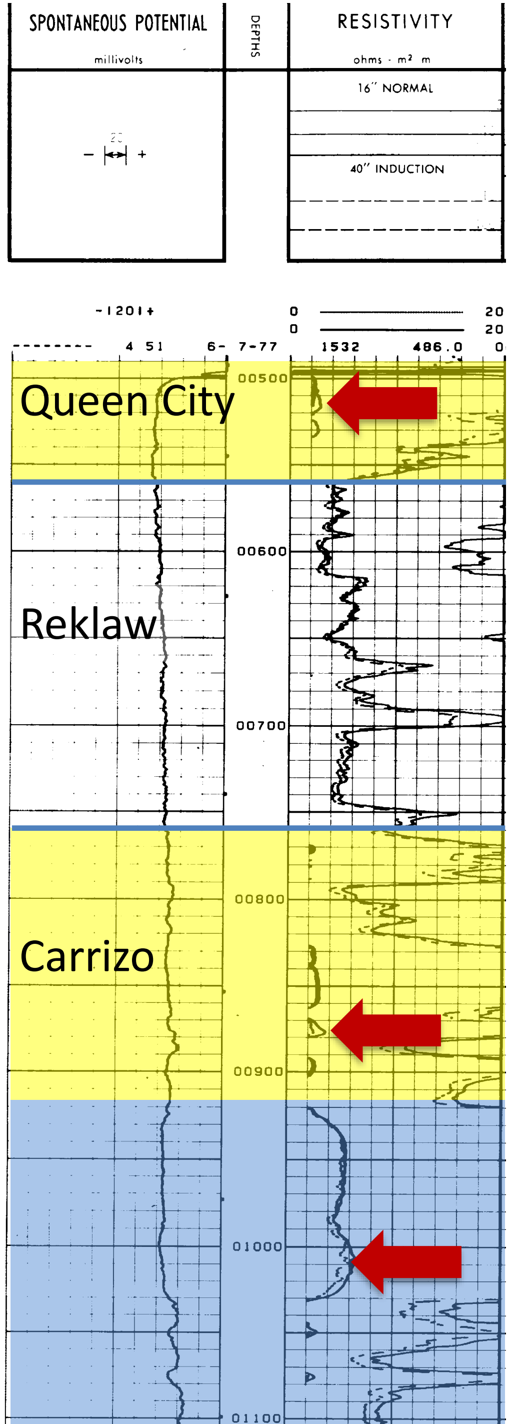
A
B
C
D
E


Measured water quality
Fresh
Slightly saline
Moderately saline
BRACS study area
Texas counties
Wilcox outcrop
Wilcox subcrop

Estimate TDS from well logs

- Handful of methods to estimate water quality from geophysical well logs
- Complete well headers necessary
  - Mud resistivity
  - Type of mud in the borehole
  - Temperature of bottom hole
  - Tool scales
- Need measured water quality data to calibrate calculations

1. Select method
2. Read log header
3. Select appropriate interval for analysis
4. Perform calculations
5. Record information in BRACS database



Estimating TDS from well logs

- Rwa Minimum Method for these examples
- Calculated TDS of 1751 mg/L
  - At 514 ft (QC), Ro = 22 ohm-meter
- Calculated TDS of 1603 mg/L
  - At 877 ft (CZ), Ro = 24 ohm-meter
- Calculated TDS of 639 mg/L
  - At 1010 ft (CZ), Ro = 60 ohm-meter

BRACS 15534

TDS calculations and inputs recorded in BRACS

BRACS 15534

Depth Formation (Df): 514

TDS Interpreted: 0

Consensus TDS Method: N/A

Thickness Lithologic Unit: 0

Tf: 77

Rmf Tf: 0

Stratigraphic Name: Queen City Formation

Remarks: N/A

TDS Method: Rwa Method

Rwe: 4.43 | Rw: 3.54 | Rw75: 3.54 | Cw: 2824.86 | TDS: 1751

Geophysical Log Used: Resistivity

SP	0
Rxo	0
Ro	22
Rxo / Ro	0
m	1.75
Source m	UCPC study fixed m value
Porosity:	0.4
Source Porosity:	UCPC study formation porosity, regression

Correction Factors

0	K (Temperature): SP Method
1.25	Rwe Rw: Sp, Alger Harrison, and Rwa Minimum Methods
0	Rmf: SP and Alger Harrision Methods
0.62	ct: Many Methods
99	Invasion Zone: Alger Harrison Method
1	m correction factor: Estepp Method high anion waters
1	Ro: Mean Ro Method

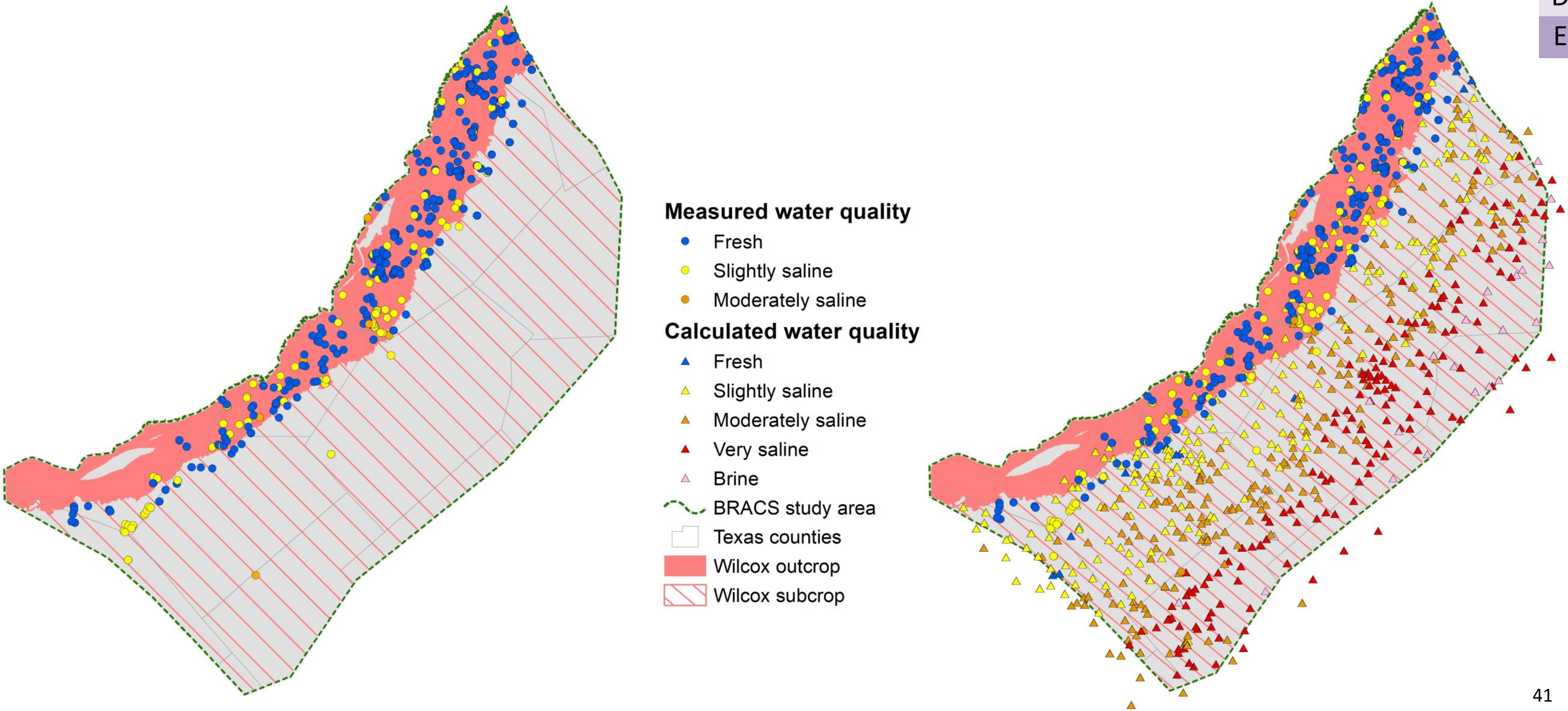
Chart: N/A

Remarks: N/A

Record: 1 of 1 No Filter Search

Record: 1 of 8 No Filter Search

Map water quality data



Calculate groundwater volumes by salinity class

Extent of salinity class (area)

X

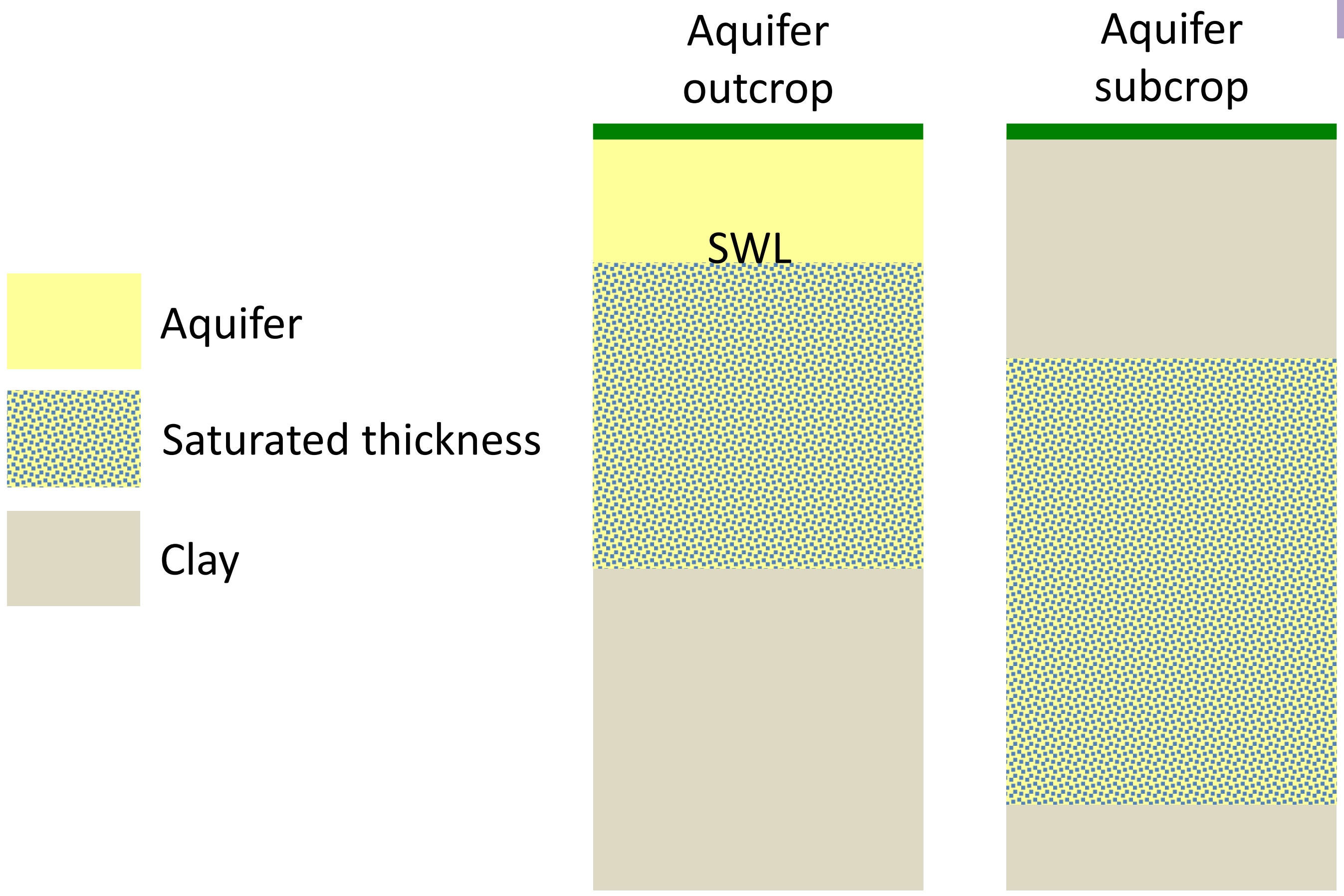
Saturated thickness (net sands)

X

Specific yield

=

Groundwater volume by salinity class

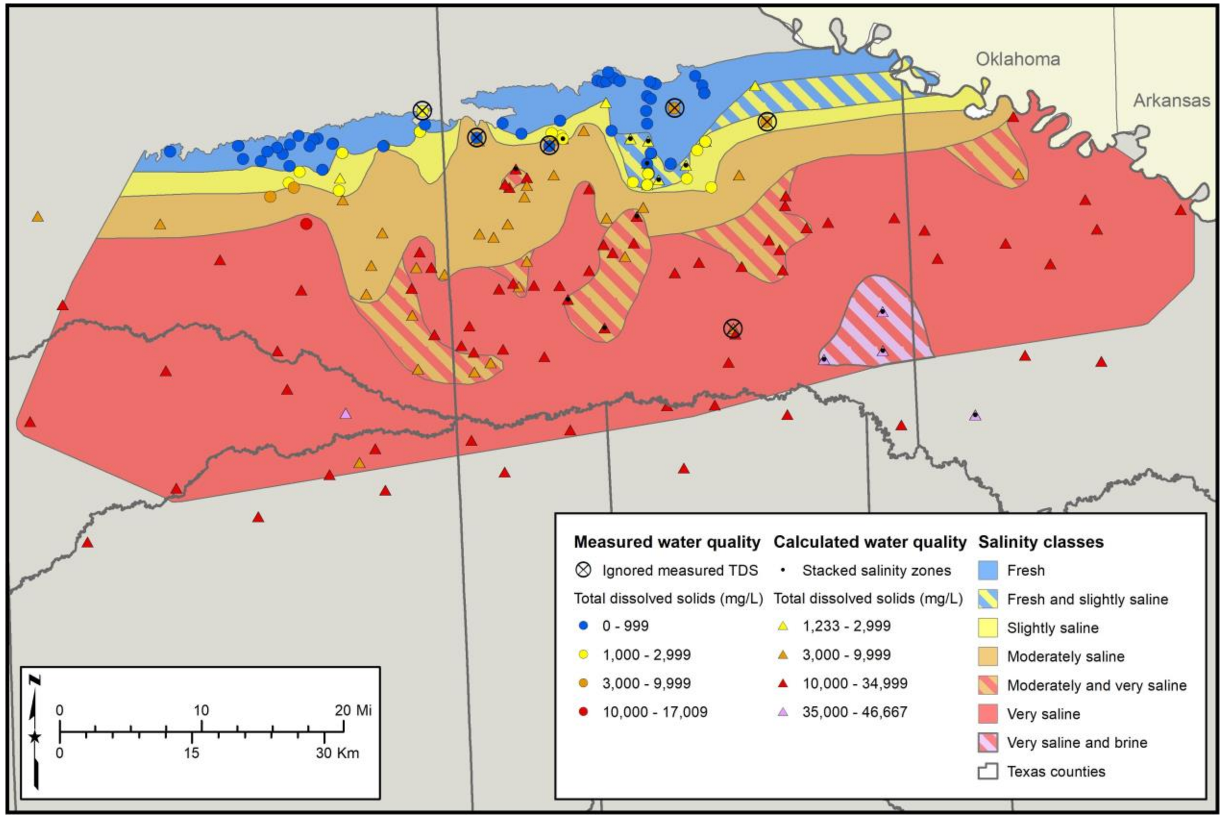


What are some study results?

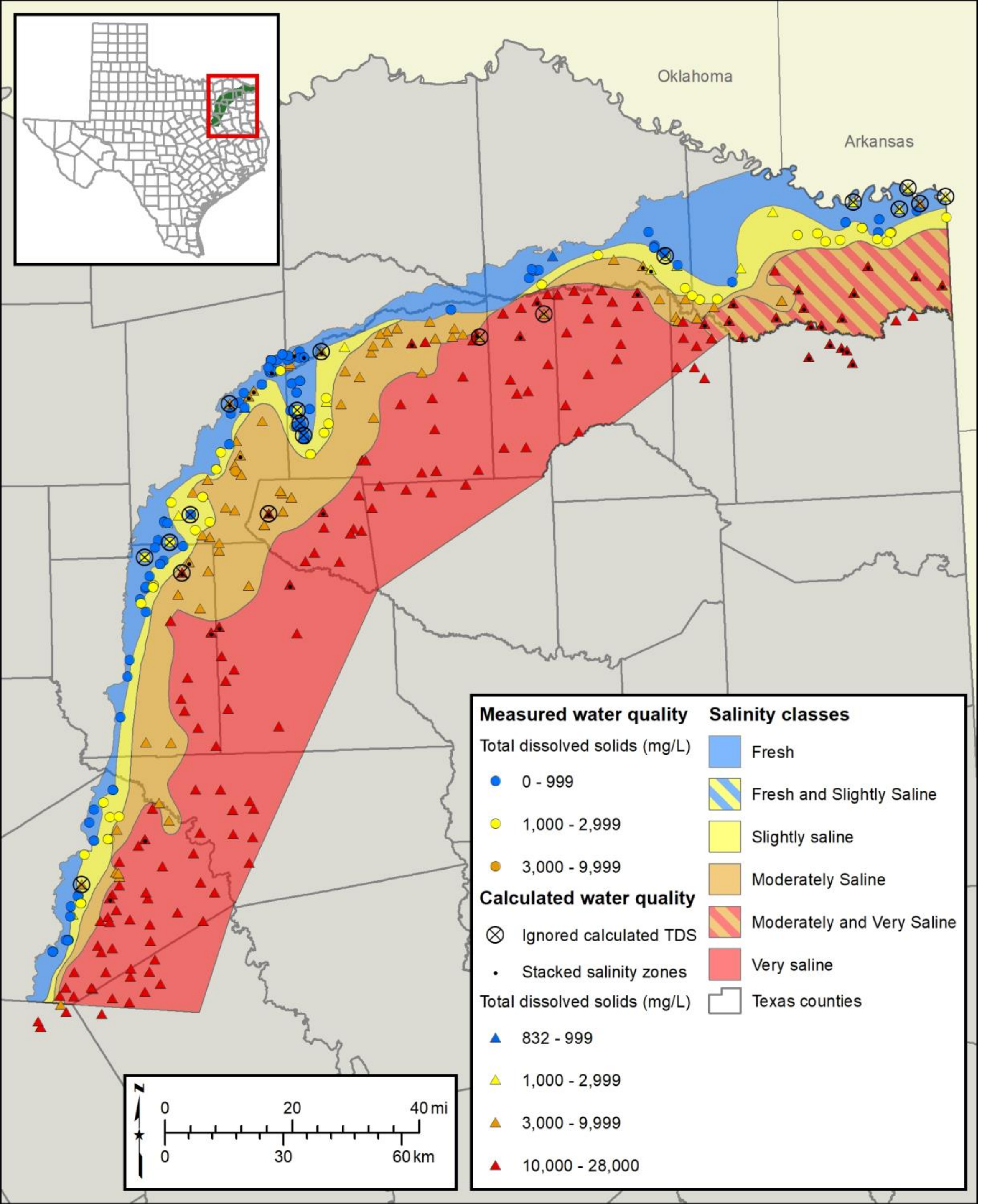
Examples from recently published studies

A
B
C
D
E

Blossom Aquifer



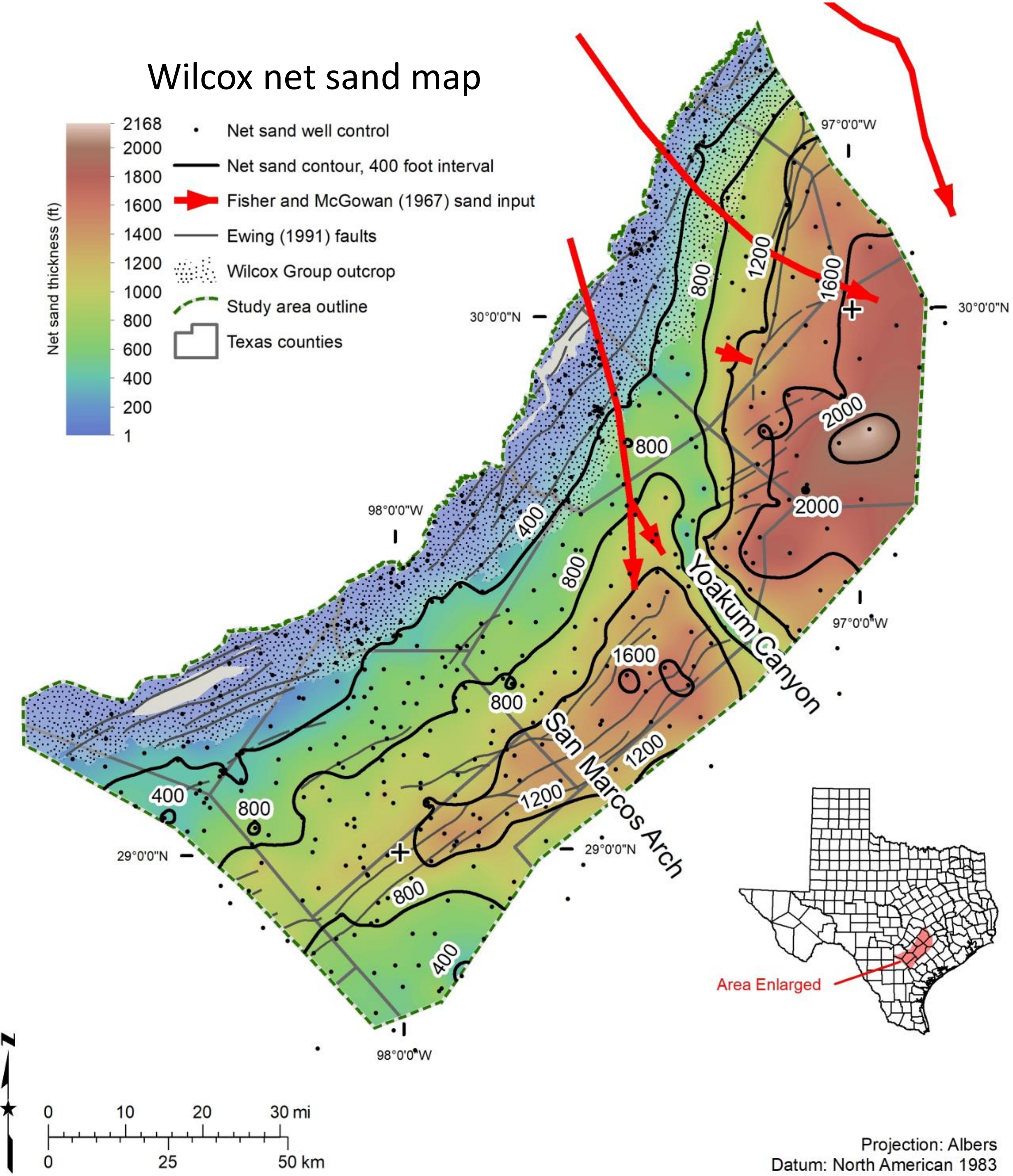
Salinity class	Volume (acre-feet)
Fresh	240,000
Fresh and slightly saline	190,000
Slightly saline	350,000
Moderately saline	1,530,000
Moderately and very saline	790,000
Very saline	6,840,000
Very saline and brine	320,000
Total	10,260,000



Examples from recently published studies

Salinity class	Volume (acre-feet)
Fresh	2,120,000
Fresh and slightly saline	30,000
Slightly saline	2,040,000
Moderately saline	3,720,000
Moderately and very saline	1,890,000
Very saline	8,190,000
Total	17,990,000

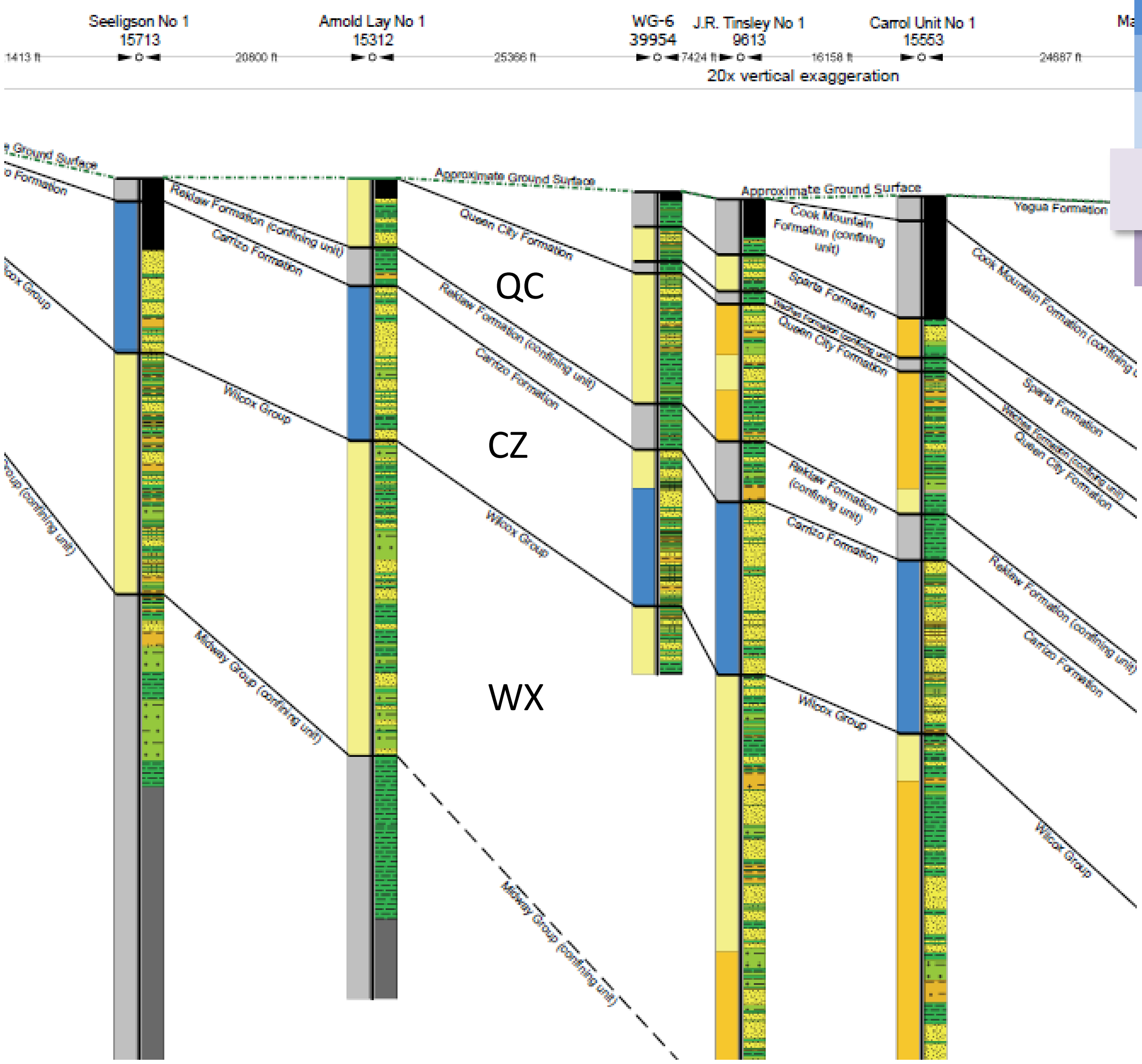
Examples from an upcoming study



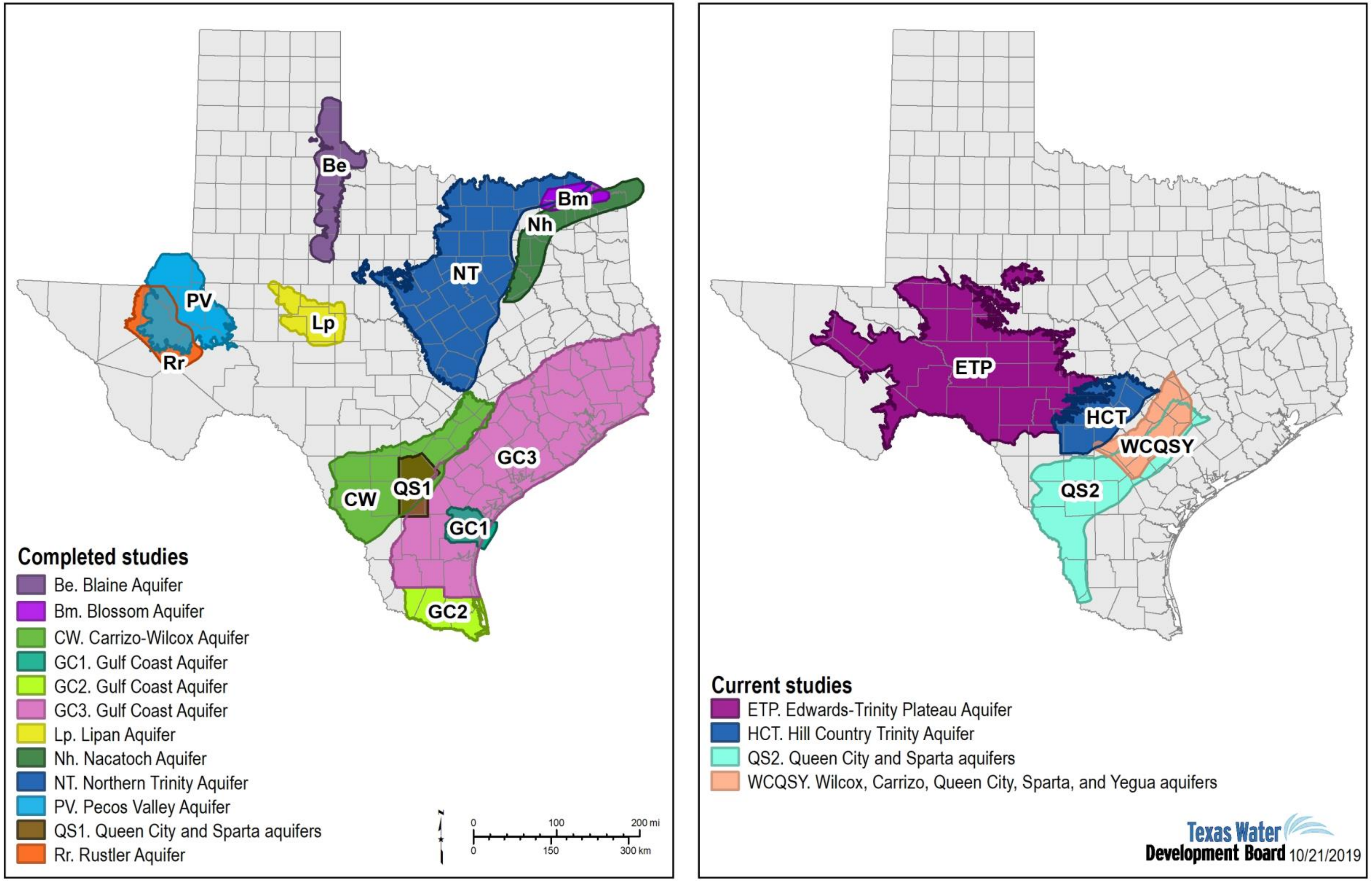
- Upper Coastal Plains – Central, mapped the Yegua, Sparta, Queen City, Carrizo, and Wilcox aquifers between the Guadalupe and Colorado rivers
- Stratigraphic maps
- Lithologic maps
- Mapped salinity classes
- Brackish groundwater volume estimates
- 9 regional cross-sections
- GIS data

Example of a regional cross-section

- Left hand side is water quality
- Right hand side is lithology
- Useful to illustrate vertical complexity in stacked aquifer systems



Brackish Resources Aquifer Characterization System (BRACS) Program - Study Status



Completed studies and current studies

A
B
C
D
E

What data is available to me?

Report deliverables

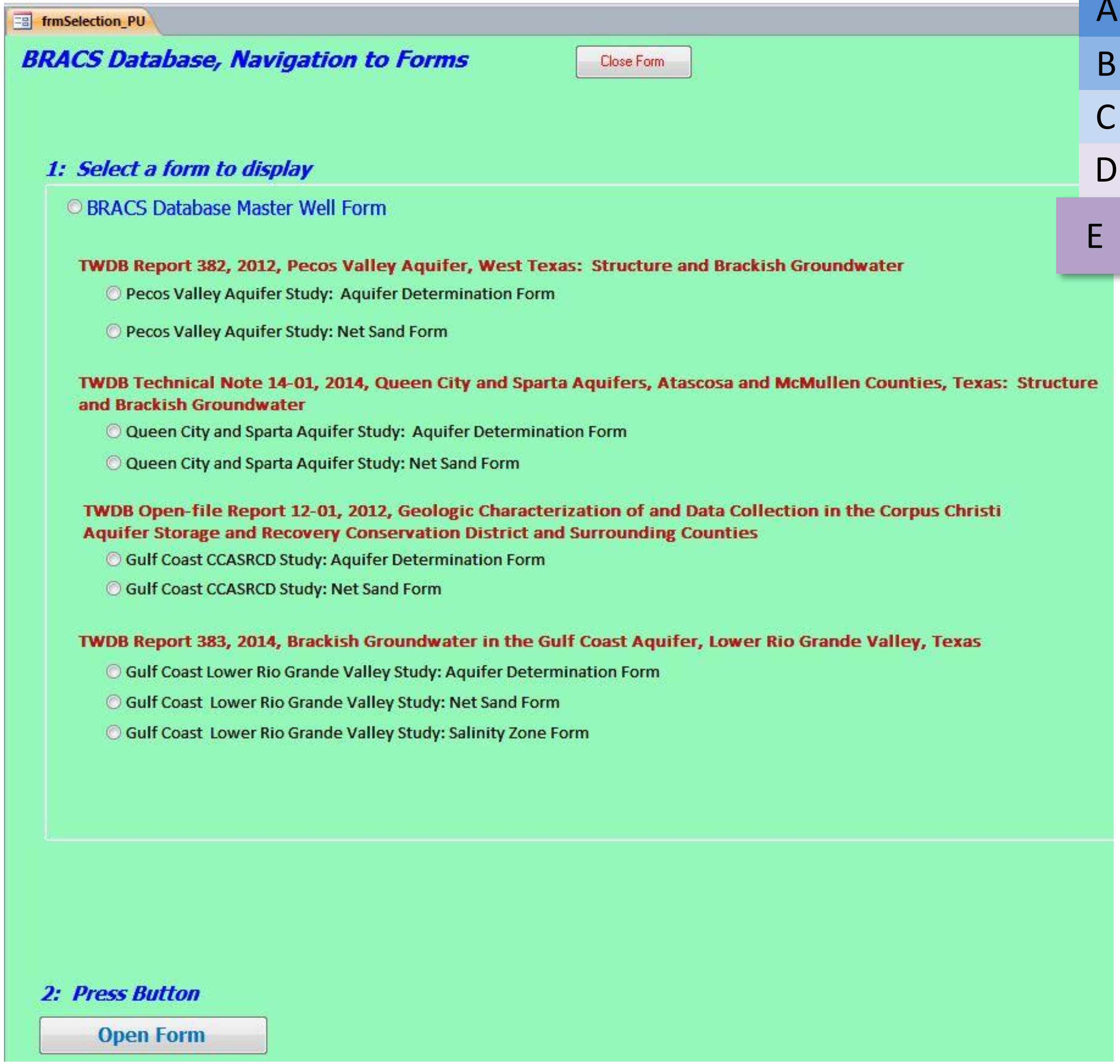
A
B
C
D
E

- Peer-reviewed study reports detailing methodologies
- GIS datasets used in analysis and to prepare report figures
- Source data, like geophysical well logs and scanned well reports
- BRACS database and study tables

- *Well logs may be downloaded from TWDB or requested in bulk by county!* http://www.twdb.texas.gov/innovativewater/bracs/WellLogs.asp

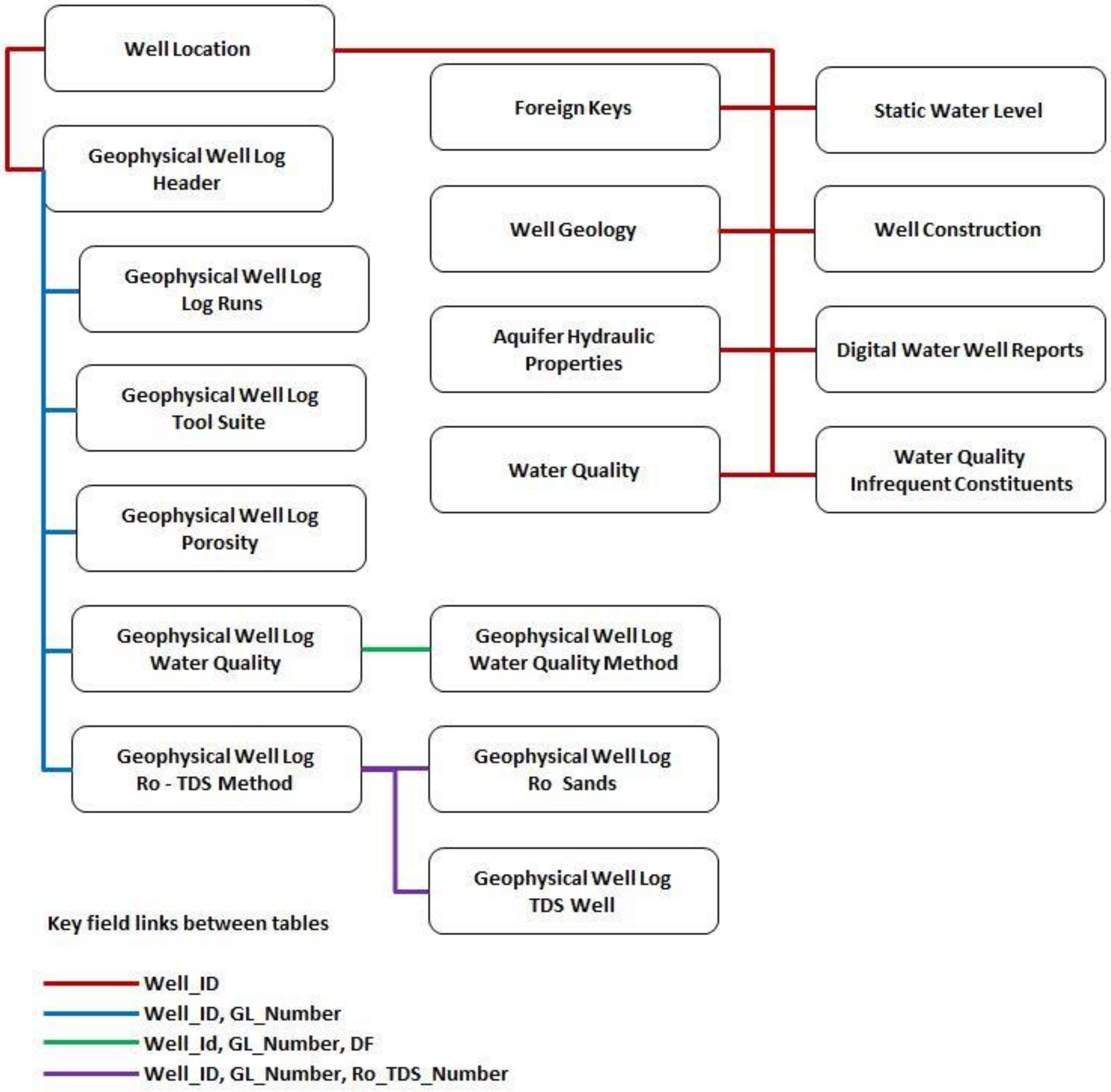
BRACS database

- MS Access
- Data dictionary available
- Relational table design
- Wells assigned unique well id (a.k.a. BRACS ID)
- Tracks other ids (foreign keys) to link to supporting databases
- Primarily oil and gas wells and water wells



BRACS Data Dictionary

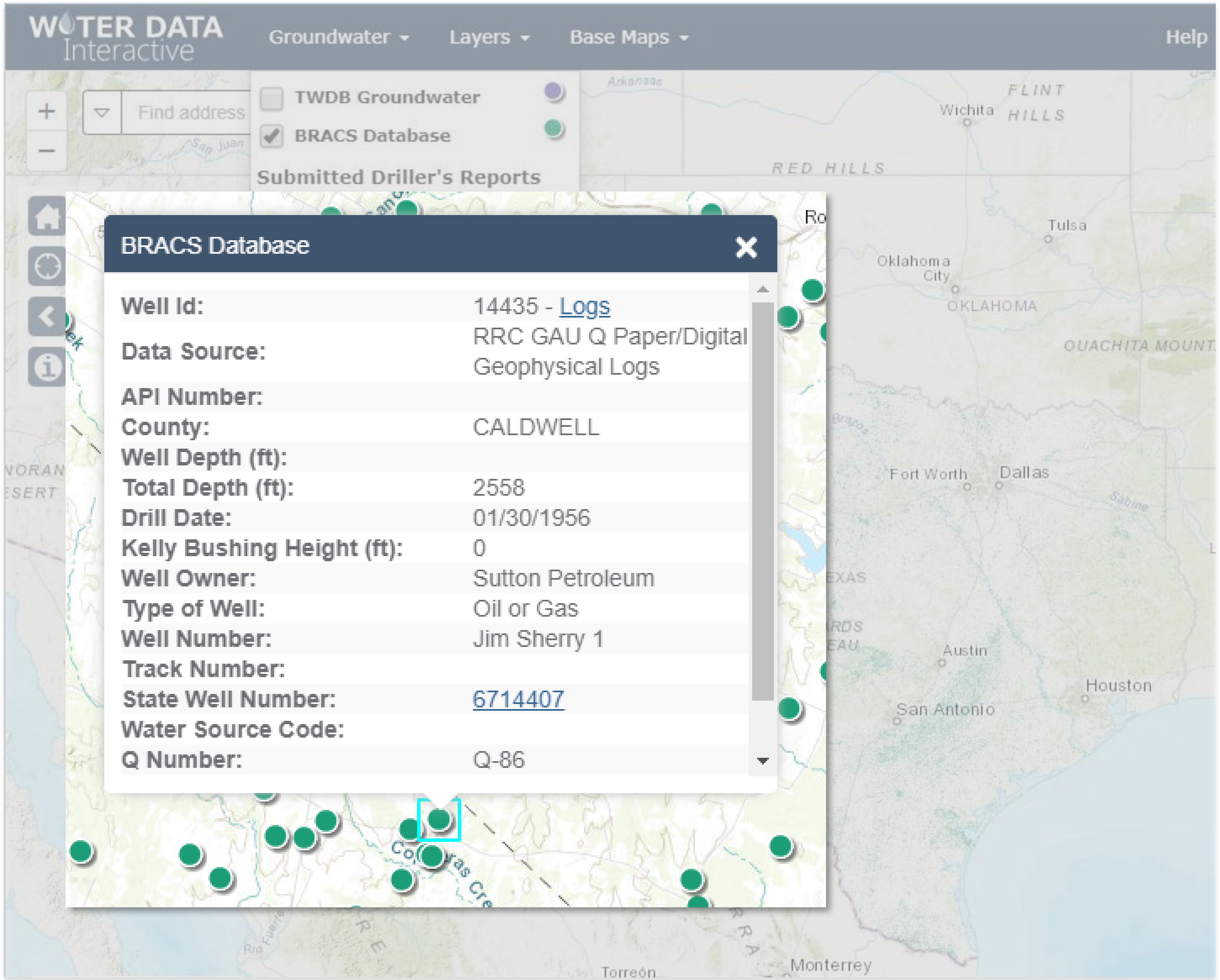
- Describes tables in the BRACS database
- Defines and describes fields in the tables



A
B
C
D
E

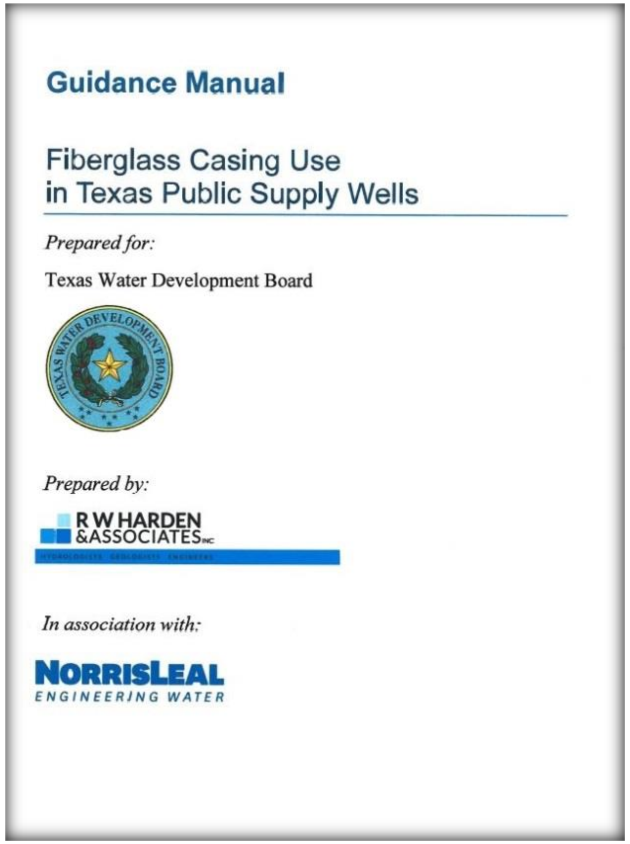
Water Data Interactive

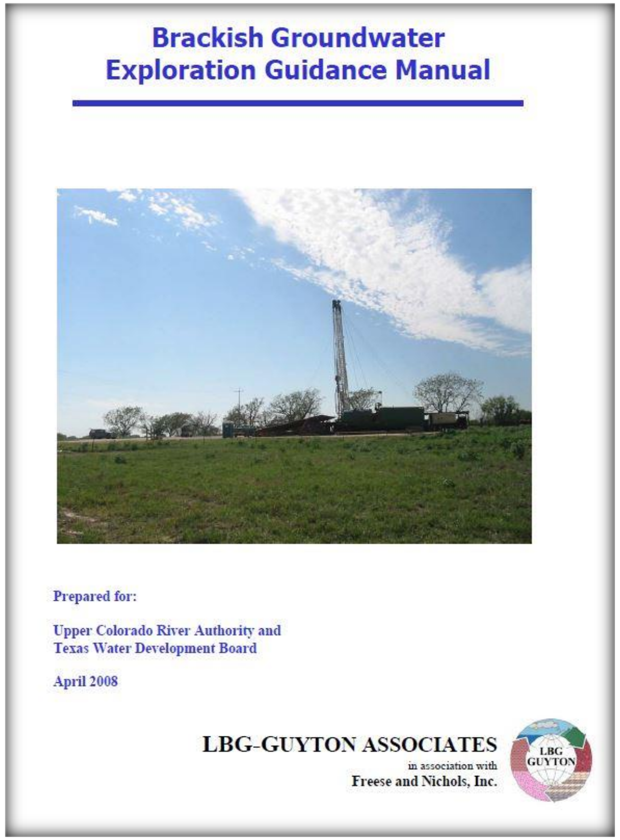
- https://www3.twdb.texas.gov/apps/WaterDataInteractive/GroundwaterDataViewer/?map=bracs
- See BRACS well coverage
- Download individual logs

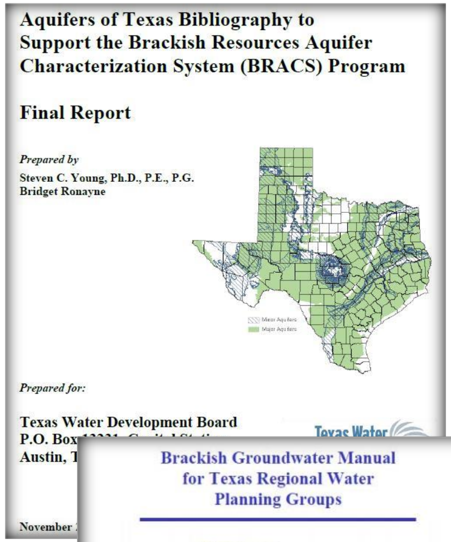


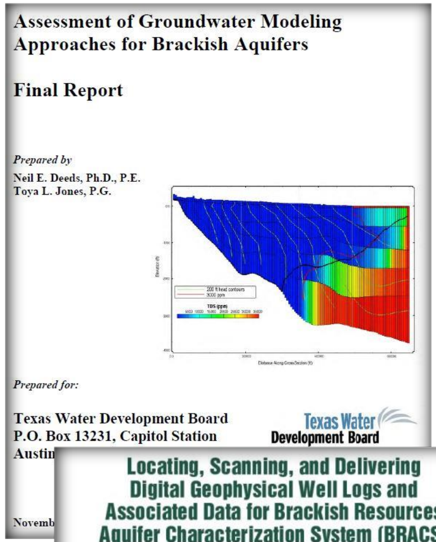
A
B
C
D
E

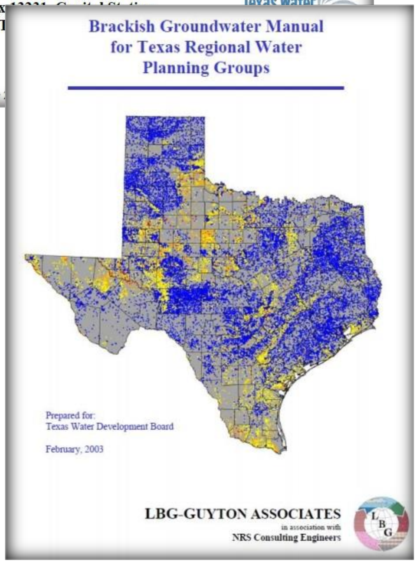
Other Contracted Reports

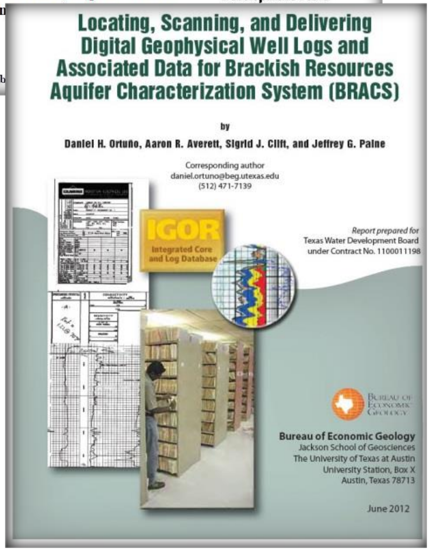












- http://www.twdb.texas.gov/innovativewater/desal/docs.asp
- http://www.twdb.texas.gov/innovativewater/bracs/docs.asp

Conclusions

- Brackish groundwater desalination is part of the State Water Plan
- Detailed information about the brackish portions of aquifers is necessary
- BRACS studies can be used to find appropriate areas to do site-specific desalination well field studies
  - Also to support Aquifer Storage and Recovery evaluations
- BRACS study deliverables available on the TWDB website
  - Well logs
  - GIS data
  - BRACS database
- Bulk geophysical well log files available by county upon request

Thank you for your data!

Questions?

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www.twdb.texas.gov/innovativewater/index.asp

References and useful links

Completed BRACS studies

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

BRACS Database and documentation

- https://www.twdb.texas.gov/innovativewater/bracs/database.asp

TWDB Water Data Interactive

- https://www2.twdb.texas.gov/apps/waterdatainteractive/groundwaterdataviewer

BRACS reports, maps, and presentations

- https://www.twdb.texas.gov/innovativewater/bracs/docs.asp

Additional TWDB publications

- https://www.twdb.texas.gov/publications/index.asp