Texas Water Development Board

Brackish Groundwater in the Gulf Coast Aquifer, Lower Rio Grande Valley, Texas

by
John Meyer, P.G.

Rio Grande Regional Water Authority

December 3, 2014

Texas Water Development Board

The following presentation is based upon professional research and analysis within the scope of the Texas Water Development Board's statutory responsibilities and priorities but, unless specifically noted, does not necessarily reflect official Board positions or decisions.

Source: TWDB General Counsel

Why did we study the Lower Rio Grande Valley?

- Population will more than double in the next 50 years
  1.7 to 3.9 million people

- Municipal water demand will more than double in the next 50 years
  260,000 to 581,000 acre-feet per year

- Brackish groundwater use will more than quadruple in next 50 years
  20,000 to 92,000 acre-feet per year

- Highest density of desalination plants in Texas
  7 existing brackish groundwater desalination plants

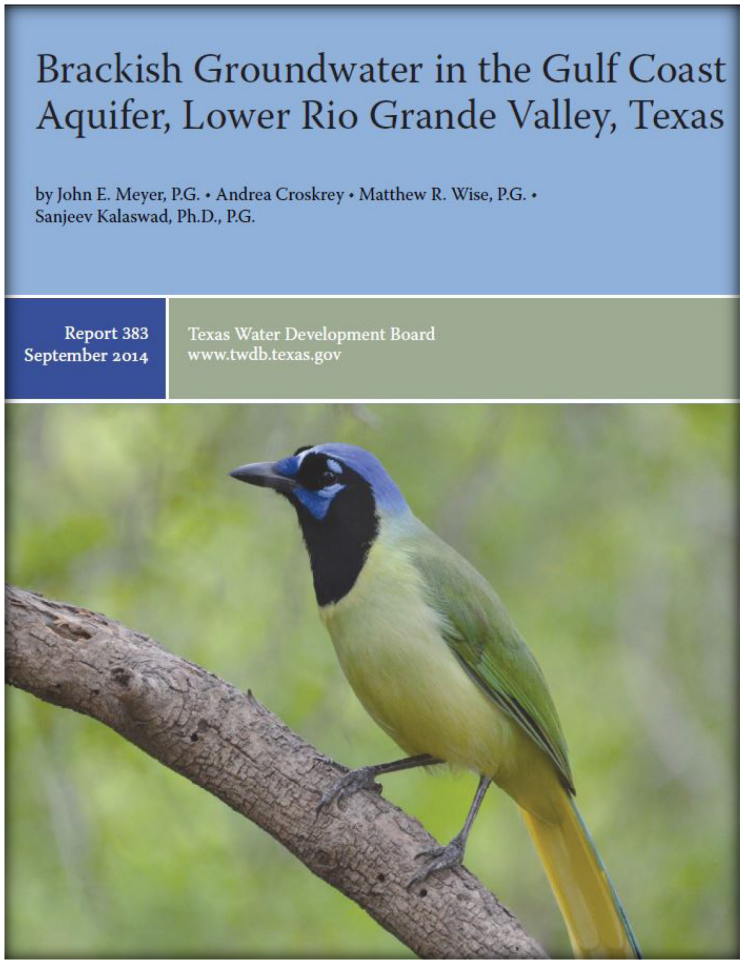
  Plans for additional 23 brackish groundwater desalination projects

Source: Region M statistics from 2012 State Water Plan

Texas Water Development Board

What did we produce?

- Published report



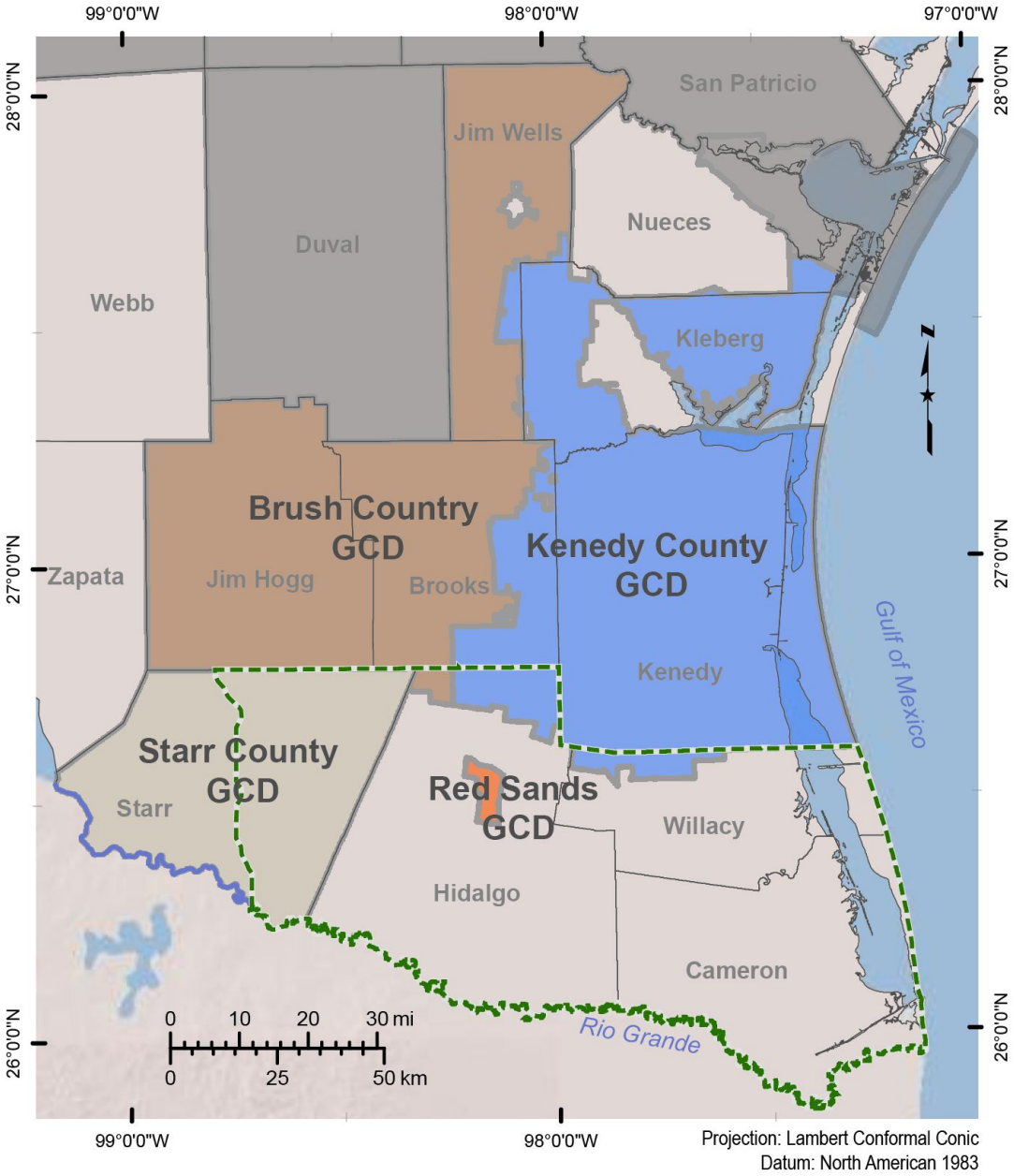
- GIS Datasets
- BRACS Database
- Well logs

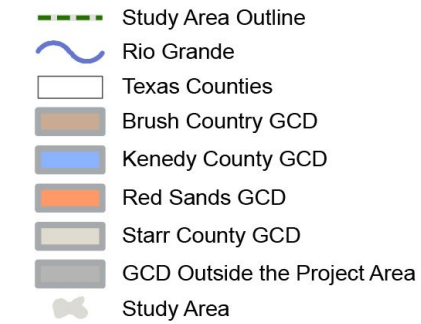
The real value is in the data:

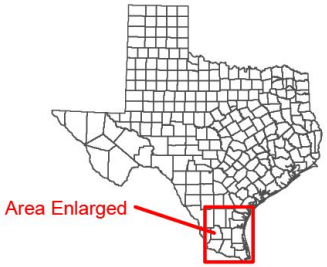
Stakeholders can use this to evaluate potential groundwater exploration areas.

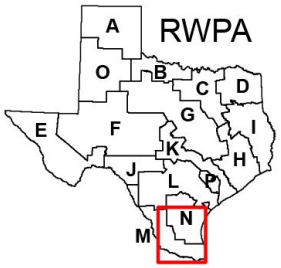
Texas Water Development Board

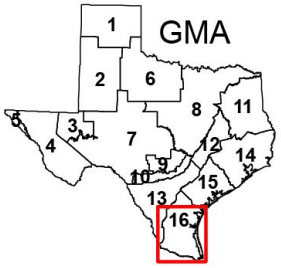
Where is the study?











Source: Lower Rio Grande Valley BRACS Study

Texas Water Development Board

What were the study objectives?

- Collect water well reports and oil/gas geophysical well logs
- Compile all data into BRACS Database
- Map salinity areas (2-dimensional) with a unique vertical salinity profile
- Create 3-dimensional salinity zone GIS datasets
- Map sand and clay layers within the Gulf Coast Aquifer
- Determine volumes of brackish groundwater
- Water quality parameter maps
- Aquifer property maps
- Study deliverables: Report, Database, GIS Datasets, and well logs

Groundwater Salinity Classification

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

← Drinking Water Limit

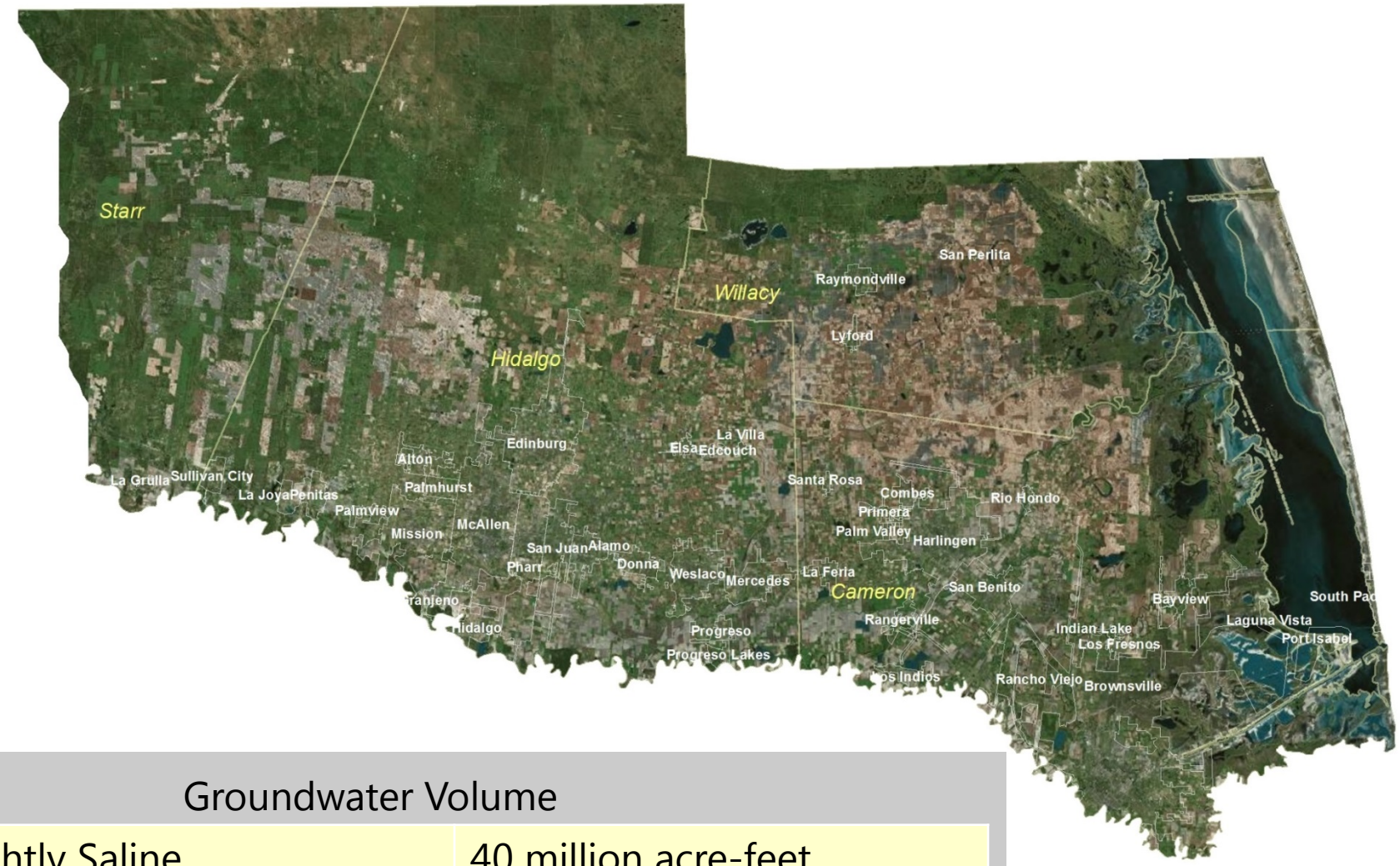
← Major/Minor Aquifer Mapped Limit

← Seawater

Source: modified from Winslow and Kister, 1956

Texas Water Development Board

How much groundwater is there?

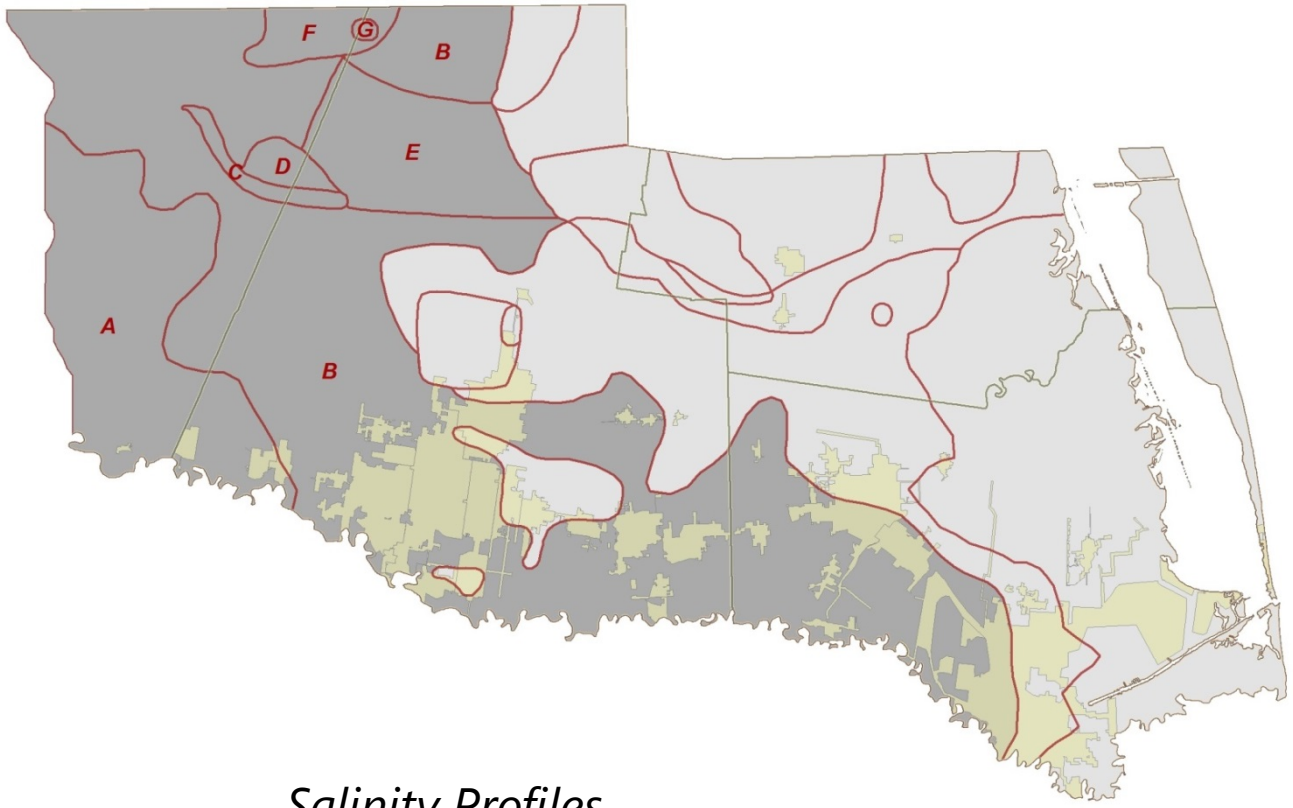


Groundwater Volume	
Slightly Saline	40 million acre-feet
Moderately Saline	112 million acre-feet
Very Saline	123 million acre-feet

Source: Lower Rio Grande Valley BRACS Study

Texas Water Development Board

Where is the brackish groundwater? Salinity Areas A through G



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

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

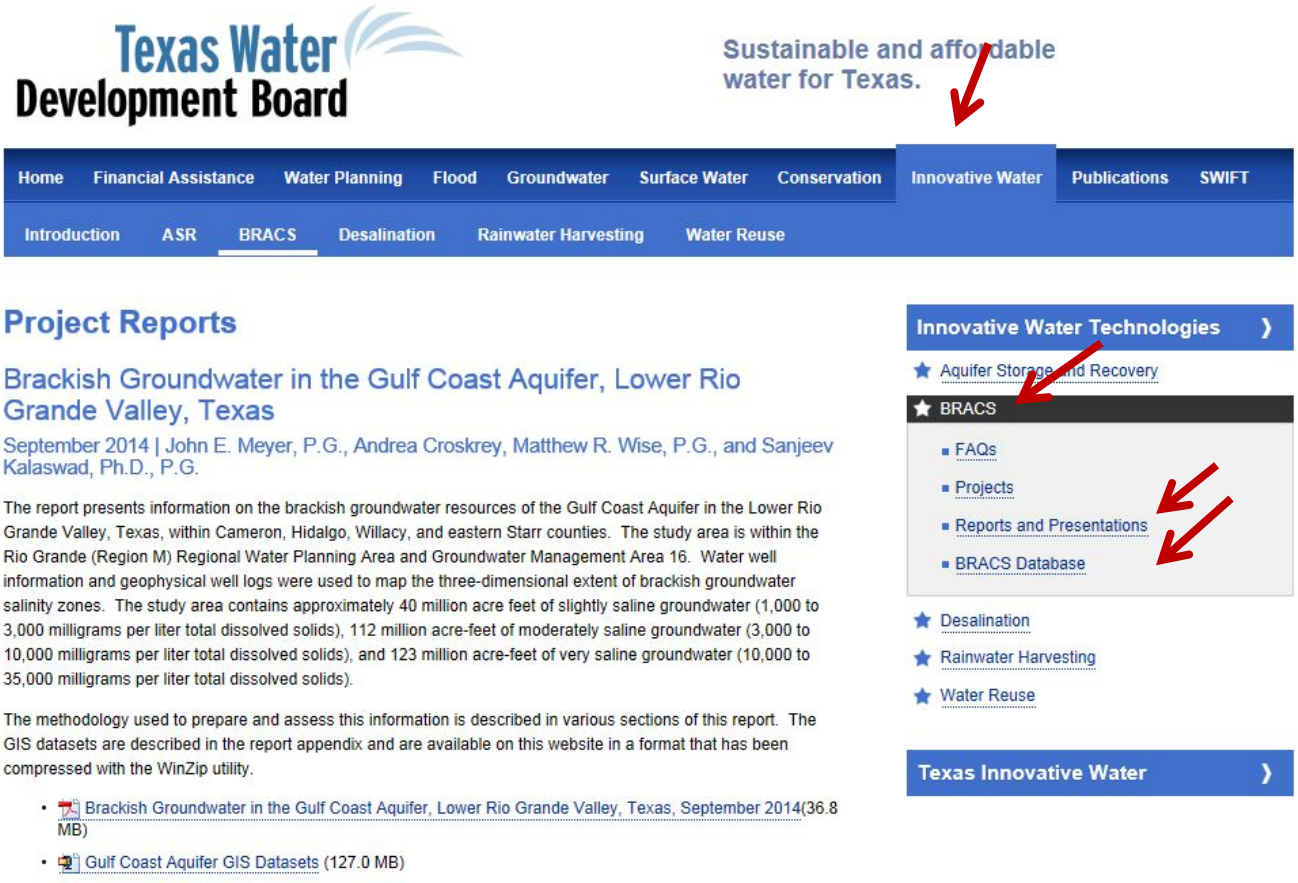
Source: Lower Rio Grande Valley BRACS Study

Texas Water Development Board

How do we obtain the study report and data?

Download the study at www.twdb.texas.gov

- Report 383
- GIS Files
- BRACS Database and Data Dictionary (OF 12-02)
- Obtain digital well logs *(email us for this data)*



Texas Water Development Board

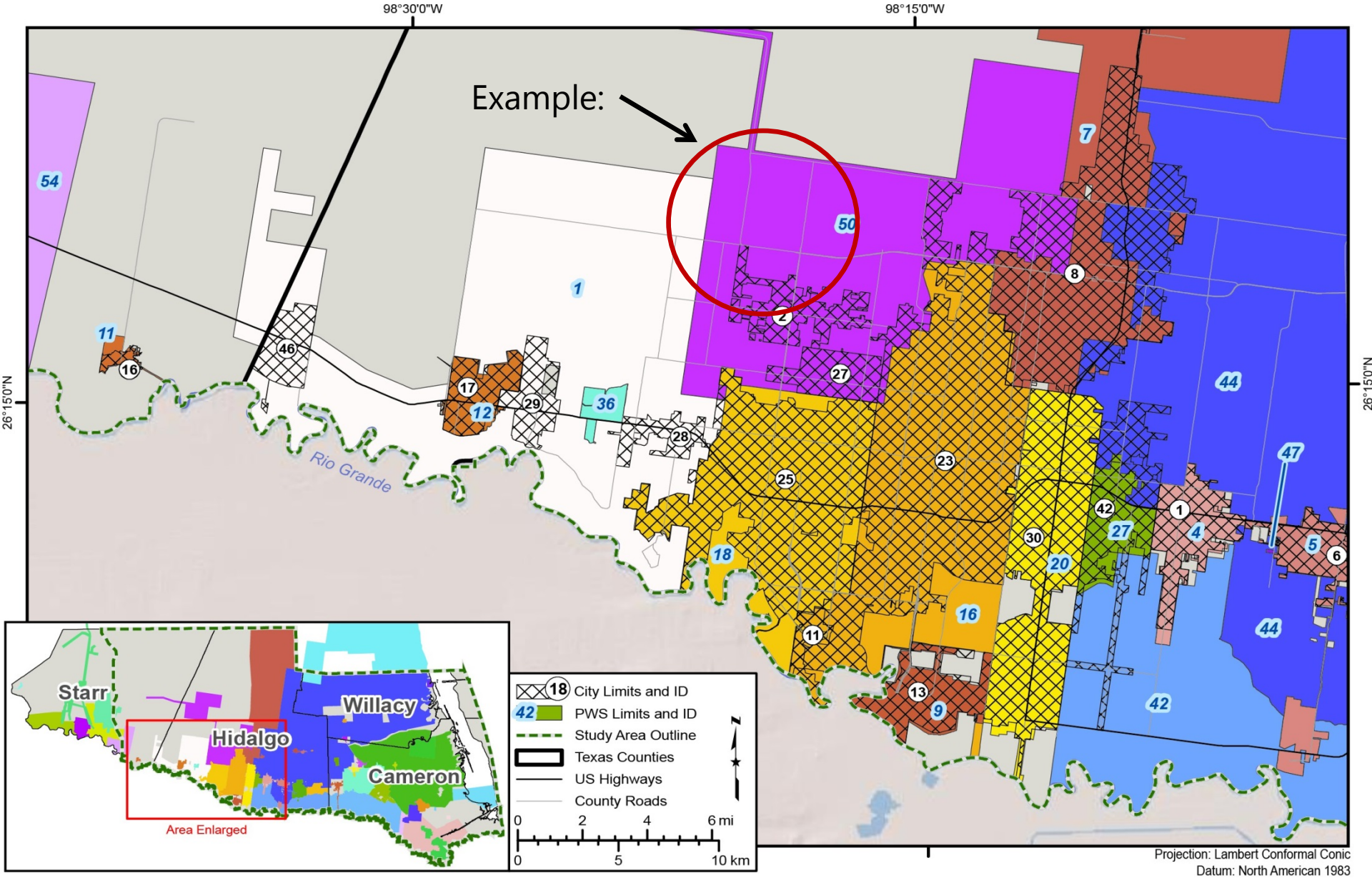
Decide what do you need?

- Regional plant with many wells? *for example, Southmost*
- Small plant with one or two wells? *for example, North Alamo WSC*

Lots of information to evaluate:

- cost and financing
- project partners
- water needs
- distance to existing infrastructure
- land acquisition
- hydrogeology
- existing water well production in the area
- existing injection well disposal in the area
- concentrate disposal options
- *and so on*

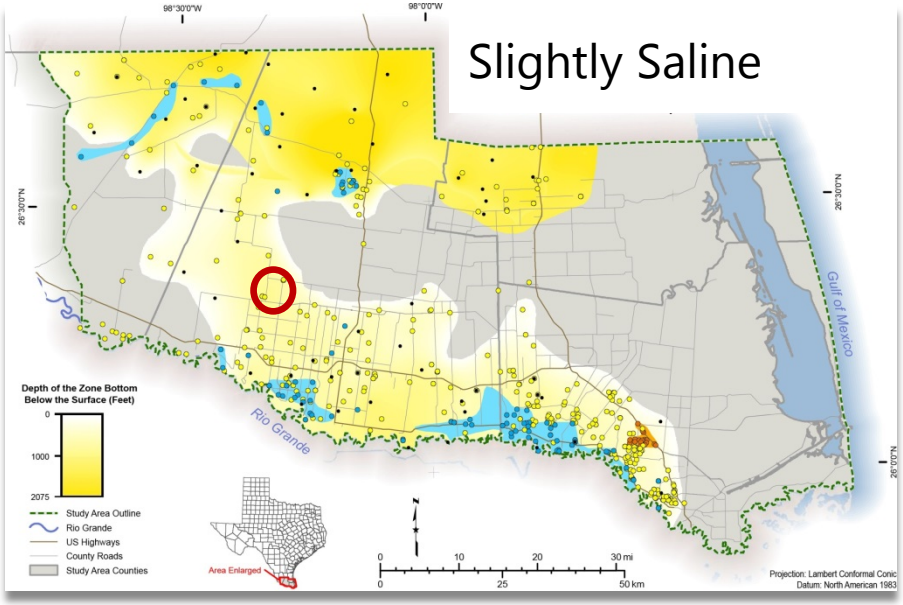
Where do you need it? Draw a circle on the map.

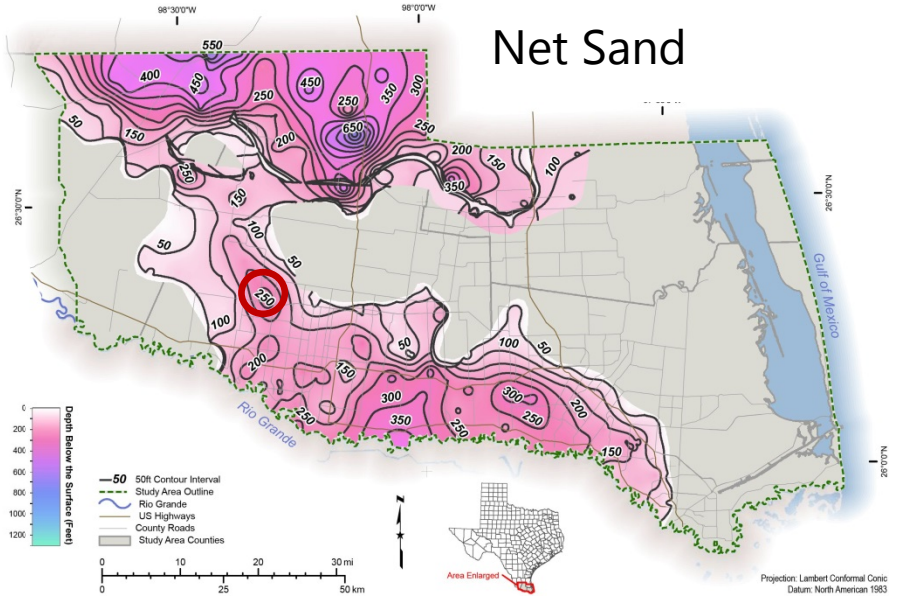


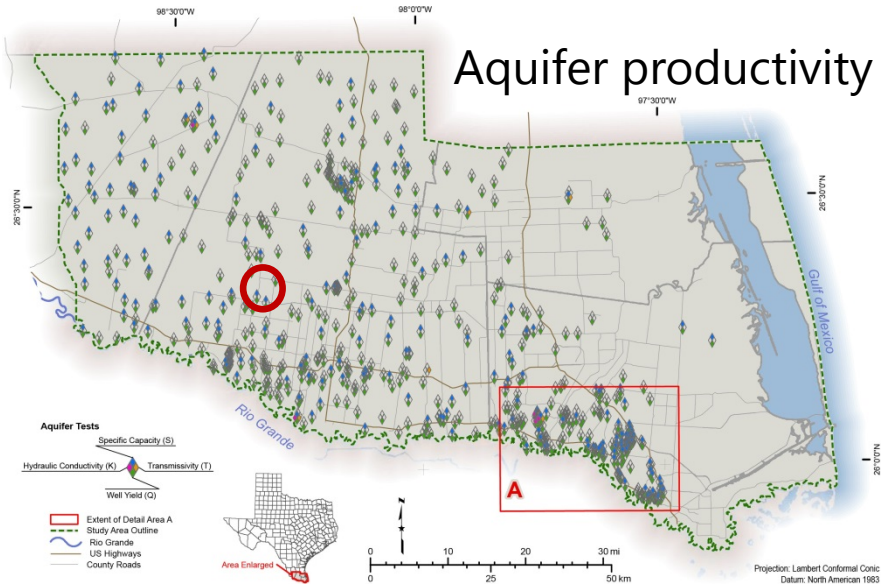
Source: Lower Rio Grande Valley BRACS Study

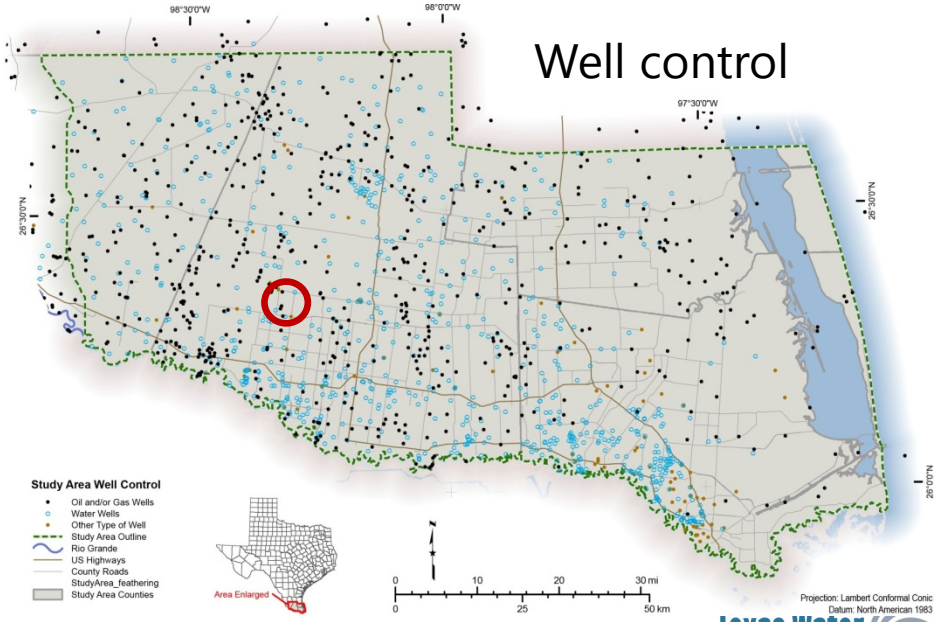
Texas Water Development Board

Qualitative review of data, using the report.





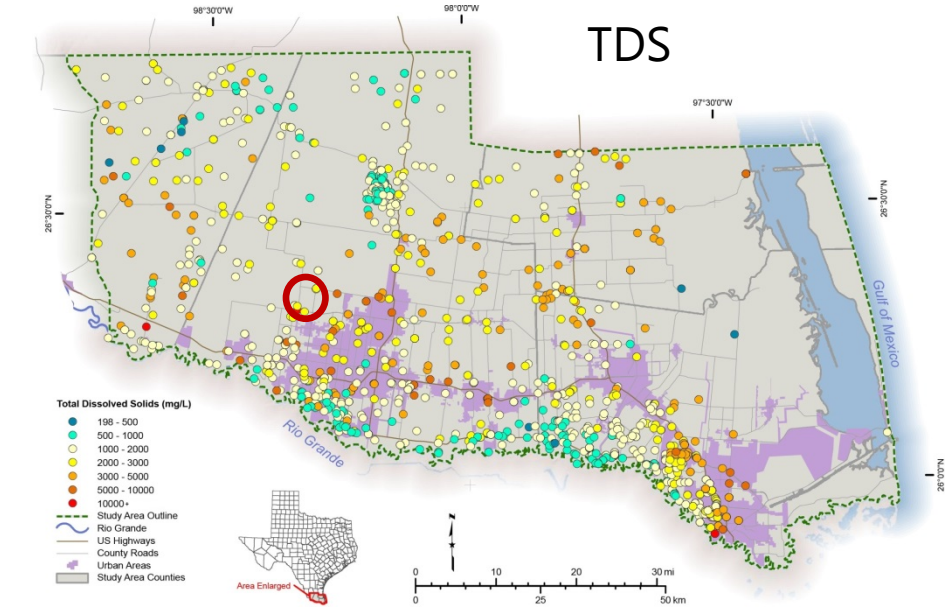




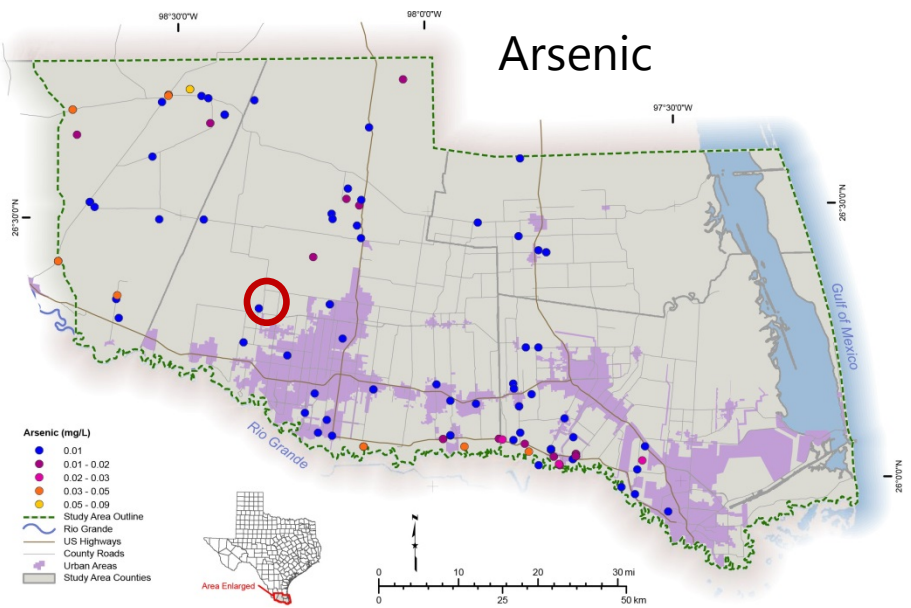
Source: Lower Rio Grande Valley BRACS Study

Texas Water Development Board

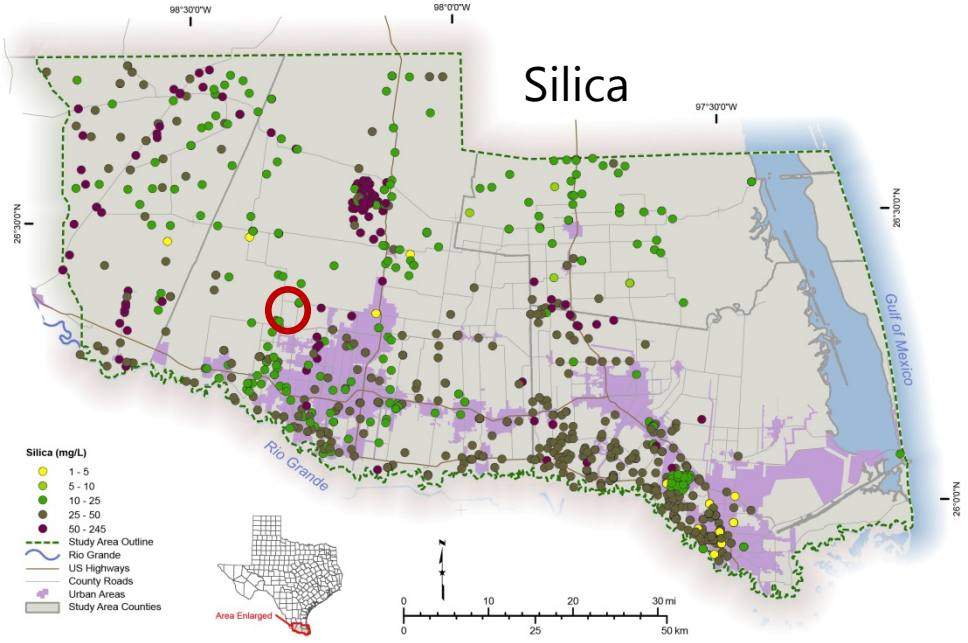
TDS



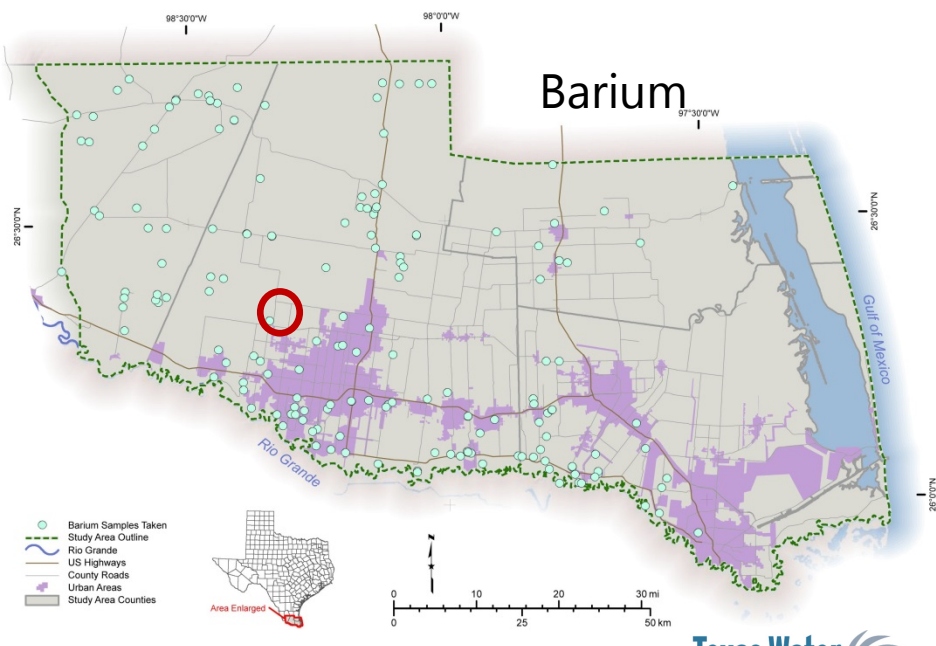
Arsenic



Silica



Barium



Source: Lower Rio Grande Valley BRACS Study

Texas Water Development Board

Quantitative review of data using database and GIS files.

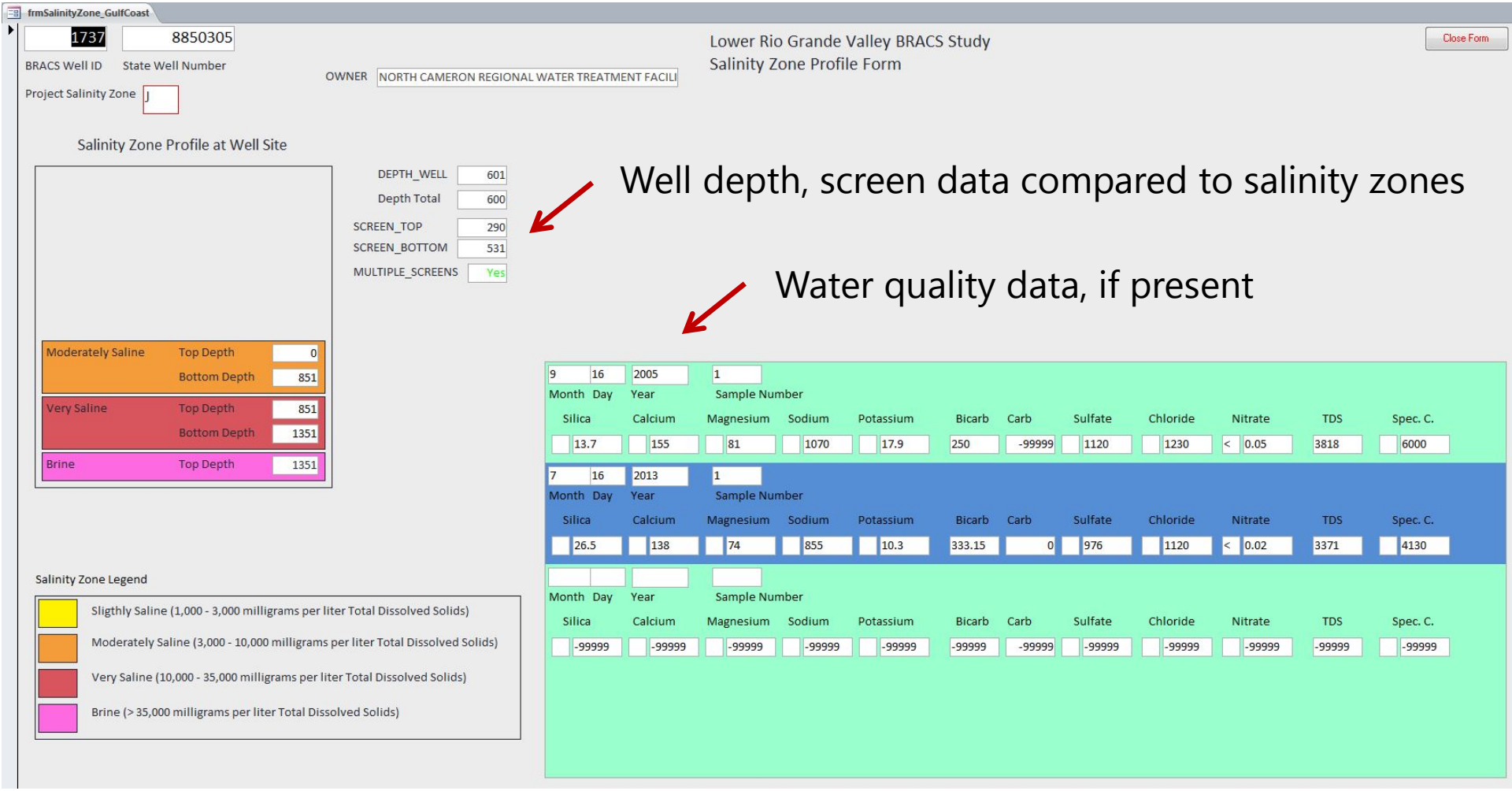
- Database
  - Review well control in database
  - Use the salinity zone database form
  - Use the net sand database form
  - Review water quality data
  - Review aquifer property data
  - Build custom queries and display data in GIS

- GIS
  - Three-dimensional salinity zone surfaces
  - Additional well control in area
  - Class II injection wells
  - Map / air photo overlays

BRACS Database: Project salinity zone table

Every project well (>2,900 wells) can be reviewed on this form

Well ID Numbers for BRACS and Groundwater Databases



Well depth, screen data compared to salinity zones

Water quality data, if present

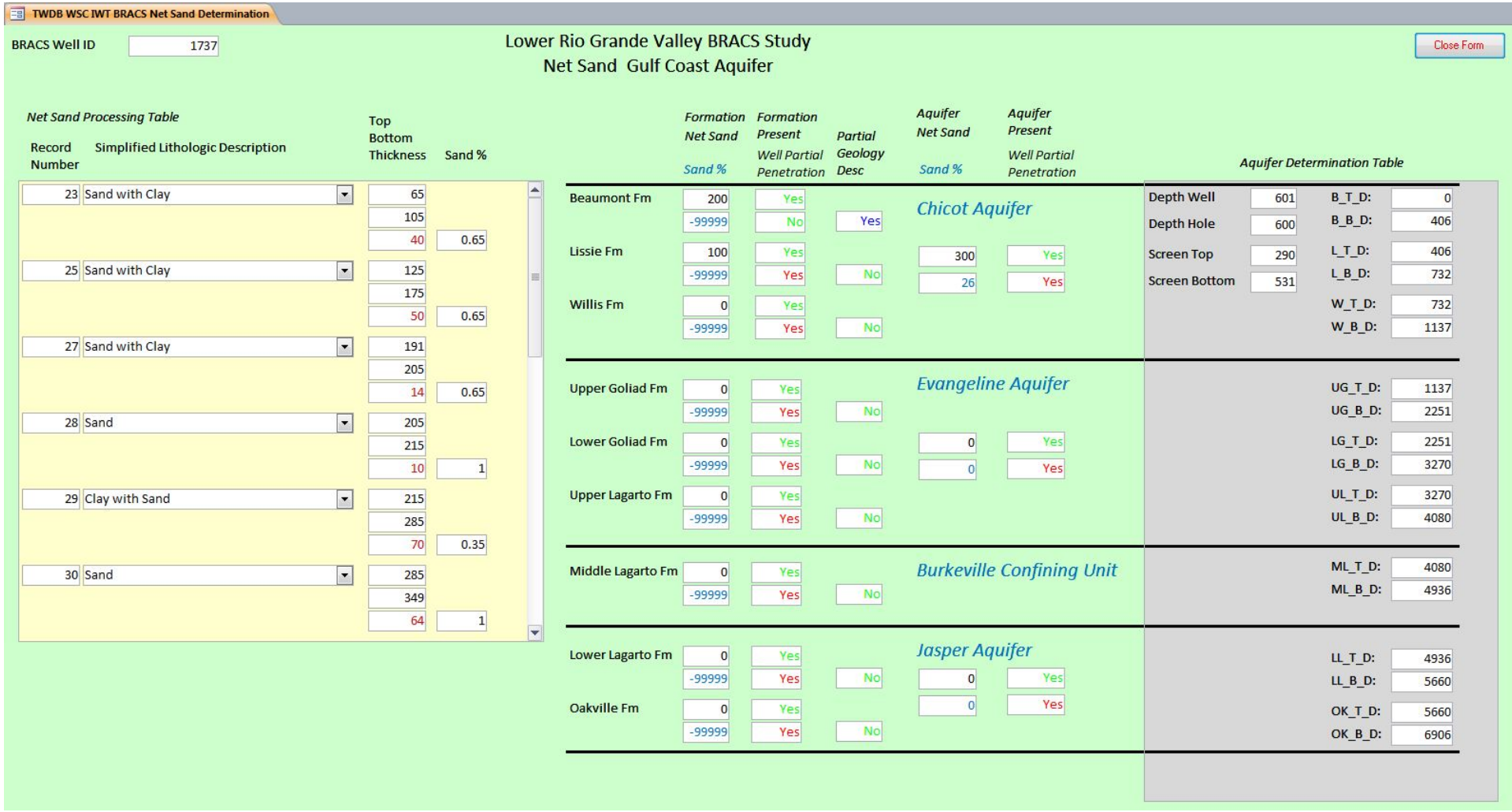
Source: BRACS program

Texas Water Development Board

BRACS Database: Project net sand determination tables

Every well used for sand analysis (593 wells) can be reviewed on this form

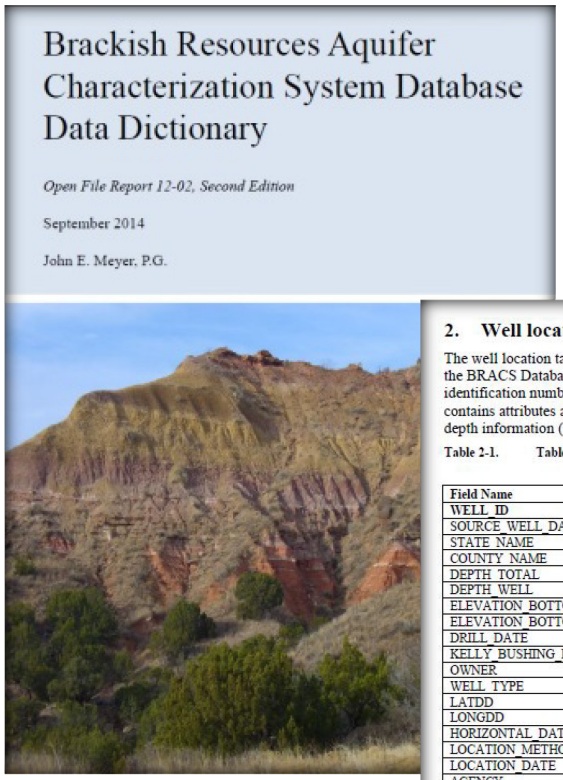
Wells are in a separate table processed for salinity zones



Source: BRACS program

Texas Water Development Board

BRACS Database Data Dictionary



All database tables are available for advanced queries.

This data dictionary will help you understand the data.

2. Well location table: tblWell_Location

The well location table contains one record per well. When a new well record is appended into the BRACS Database, the record is first added to this table, which assigns its unique identification number using an autonumber data type in the field [WELL_ID]. The table contains attributes about the well, such as owner, location, source of well information, and well depth information (Table 2-1).

Table 2-1. Table tblWell_Location field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
SOURCE_WELL_DATA	Text	250	tblLkSourceWellData
STATE_NAME	Text	50	tblLkState
COUNTY_NAME	Text	13	tblLkCounty
DEPTH_TOTAL	Long Integer	2	
DEPTH_WELL	Long Integer	2	
ELEVATION_BOTTOM_WELL	Long Integer	2	
ELEVATION_BOTTOM_HOLE	Long Integer	2	
DRILL_DATE	Text	10	
KELLY_BUSHING_HEIGHT	Integer	2	
OWNER	Text	100	
WELL_TYPE	Text	50	tblLkWellType
LATDD	Double	8	
LONGDD	Double	8	
HORIZONTAL_DATUM	Text	2	tblLkHorizontalDatum
LOCATION_METHOD	Text	10	tblLkLocationMethod
LOCATION_DATE	Date/Time	8	
AGENCY	Text	5	tblLkAgency
GRID_25MIN	Text	15	
ELEVATION	Long Integer	4	
VERTICAL_DATUM	Text	2	tblLkVerticalDatum
ELEVATION_METHOD	Text	1	tblLkElevationMethod
ELEVATION_AGENCY	Text	5	tblLkAgency
ELEVATION_DATE	Date/Time	8	
REMARKS	Text	250	
INITIALS	Text	3	tblLkIntial
ADDRESS	Text	100	
CITY	Text	50	
SITE_DIRECTIONS	Text	255	

Field Descriptions

WELL_ID Each well record in the database is assigned a unique well ID in this table using the Microsoft® Access® autonumber data type, which is a long integer. This is the key field in the table and serves as the primary key field linking every BRACS Database table.

SOURCE_WELL_DATA Each well record is assigned the source of the well information. In some cases multiple sources exist; in this case, the source of the geophysical well log or water well driller report takes precedence. These field values are listed in the lookup table

tblLkSourceWellData (Table 2-2). This lookup table also contains a description of the data source, a web address if applicable, and a published report reference if applicable. The table will continue to grow with time as new sources of information are acquired, and Table 2-2 contains only a partial list of these values.

Table 2-2. Lookup table tblLkSourceWellData. A partial list of these values is presented in this table.

SOURCE_WELL_DATA	AGENCY
BAER Yegua Jackson Study	Baer Engineering and Environmental Consulting, Inc., with Intera, Inc.
BEG Paper/Digital Geophysical Logs	Bureau of Economic Geology, University of Texas at Austin
DBSA Capitan Reef Study	Daniel B. Stephens Assoc. et al
DBSA Llano Aquifers Study	Daniel B. Stephens Assoc. et al
GLO Paper/Digital Geophysical Logs	General Land Office
Intera Gulf Coast Aquifer Study	Intera, Inc.
Intera Rustler Aquifer Study	Intera, Inc.
NM EMNRD Geophysical Logs	New Mexico Energy, Minerals and Natural Resources Department
NM OSE Aquifer Test Information	New Mexico Office of State Engineers
NM OSE Digital Water Well Reports	New Mexico Office of State Engineers
NM OSE Paper Water Well Reports	New Mexico Office of State Engineers
RRC Digital Geophysical Logs	Railroad Commission of Texas
SL Digital Geophysical Logs	Subsurface Library
TCEQ PWS Water Wells	Texas Commission on Environmental Quality
TCEQ SC Q Paper/Digital Geophysical Logs	Texas Commission on Environmental Quality
TCEQ Water Well Images	Texas Commission on Environmental Quality
TDLR Digital Water Well Reports	Texas Department of Licensing and Regulation
TDLR Paper Water Well Reports	Texas Department of Licensing and Regulation
TWDB Aquifer Test Information	Texas Water Development Board
TWDB Geophysical Logs	Texas Water Development Board
TWDB Groundwater Database	Texas Water Development Board
TWDB Published Reports	Texas Water Development Board (and all predecessor agency names)
ULUTS Digital Geophysical Logs	University Lands, University of Texas System
USGS Brazos River Alluvium Study	U.S. Geological Survey
USGS Edwards-Trinity (Plateau) Study, Pecos Co.	U.S. Geological Survey
USGS Geophysical Logs	U.S. Geological Survey

STATE_NAME The state name based on the well location. This lookup table contains state and codes for Texas and adjacent states. These field values are listed in the lookup table tblLkState.

COUNTY_NAME The county name based on the well location. This lookup table contains state and county names for Texas and adjacent states. These field values are listed in the lookup table tblLkCounty.

DEPTH_TOTAL The total depth of the hole in units of feet below ground surface. This is reported on the water well driller report or header page on a geophysical well log. A value of -99999 is used if the value is not known.

Texas Water Development Board

Source: BRACS program

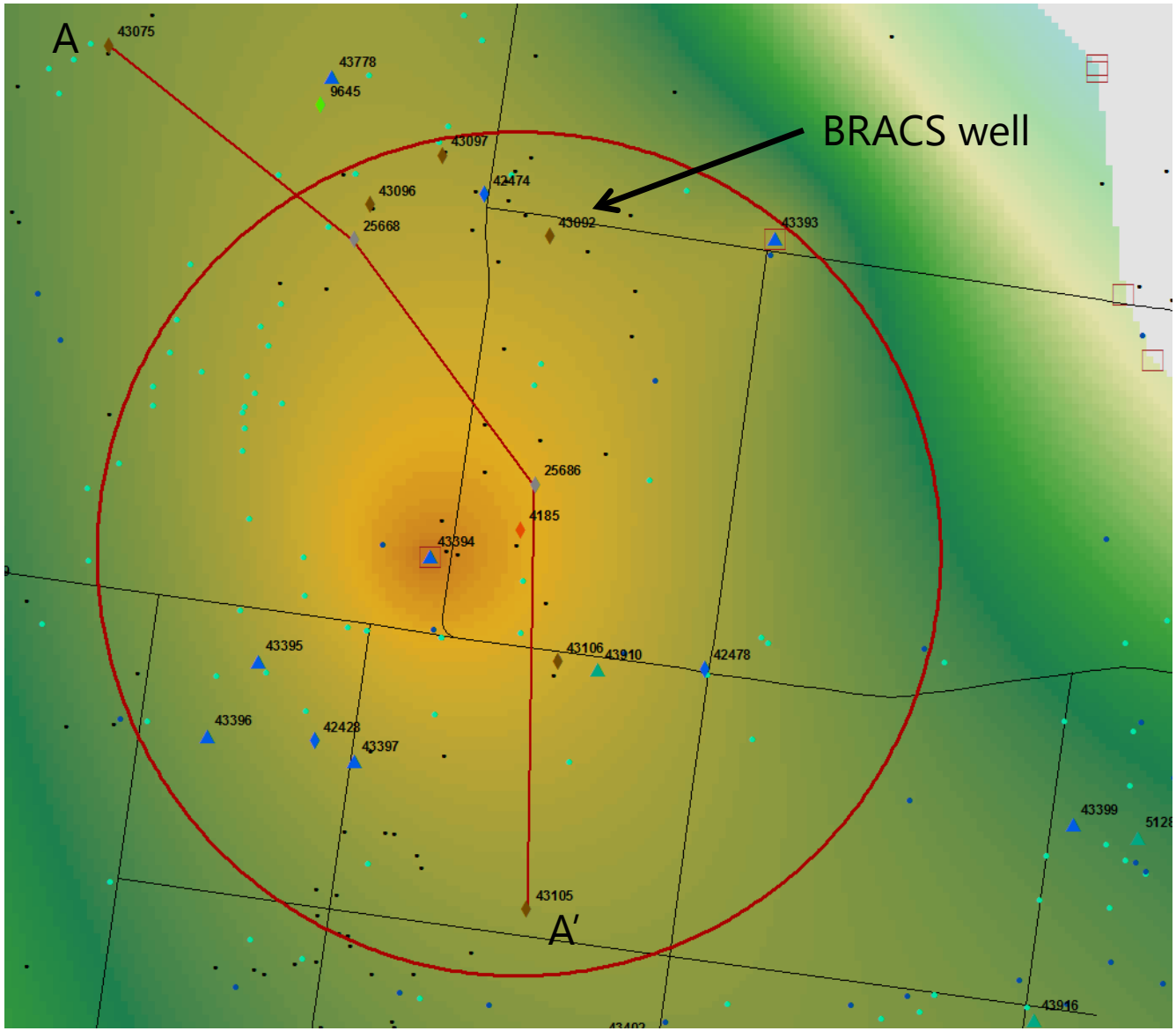
GIS analysis

- ✓ All GIS data is available on the web
- ✓ Fully documented with metadata
- ✓ Data is described in Report 383 appendices

Example tasks:

- Critically review existing well control
- Review additional well control
- Overlay maps / air photos
- Review three-dimensional salinity zones
- Build cross-sections to better understand three-dimensional sands
- Review distances to existing infrastructure

Additional well control in area.



Slightly saline zone bottom depth

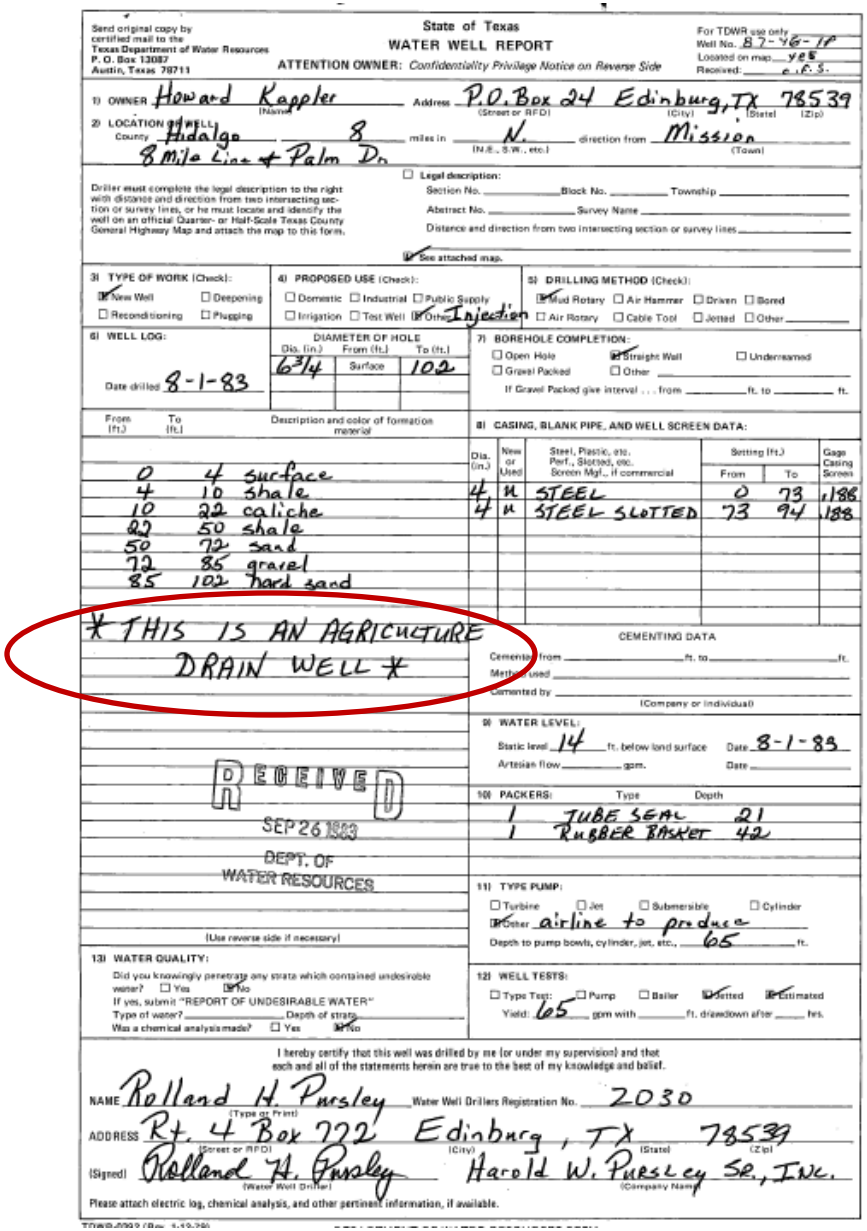
0 2,500

Water wells:
green dots
blue dots
no dots (TCEQ)

Oil / gas wells:
black dots

Texas Water Development Board

Due diligence: no surprises!



State of Texas
WATER WELL REPORT
ATTENTION OWNER: Confidentiality Privilege Notice on Reverse Side

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

For TDWR use only: Well No. B7-96-1P; Located on map yes; Received: e.f.s.

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

2) LOCATION OF WELL: County Hidalgo; 8 miles in N. (N.E., S.W., etc.) direction from Mission (Town); 8 Mile Line & Palm Dr.

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-Scale Texas County General Highway Map and attach the map to this form.

☐ Legal description: Section No. ____ Block No. ____ Township ____; Abstract 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

DIAMETER OF HOLE Dia. (in.)	From (ft.)	To (ft.)
6 3/4	Surface	102

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

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

* THIS IS AN AGRICULTURE DRAIN WELL *

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

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mgf., if commercial	Setting (ft.) From	Setting (ft.) To	Gage Casing Screen
4	N	STEEL	0	73	.186
4	N	STEEL SLOTTED	73	94	.188

CEMENTING DATA: Cemented from ____ ft. to ____ ft.; Method used ____; Cemented by ____ (Company or Individual)

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

10) PACKERS:

	Type	Depth
1	TUBE SEAL	21
1	RUBBER BASKET	42

RECEIVED SEP 26 1983 DEPT. OF WATER RESOURCES

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

12) WELL TESTS: ☐ Type Test: ☐ Pump ☐ Bailer ✓ Jetted ✓ 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

(Use reverse side if necessary)

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 Rolland H. Pursley (Type or Print) Water Well Drillers Registration No. 2030

ADDRESS Rt. 4 Box 722 (Street or RFD) Edinburg (City) TX (State) 78539 (Zip)

(Signed) Rolland H. Pursley (Water Well Driller) Harold W. Pursley Sr., Inc. (Company Name)

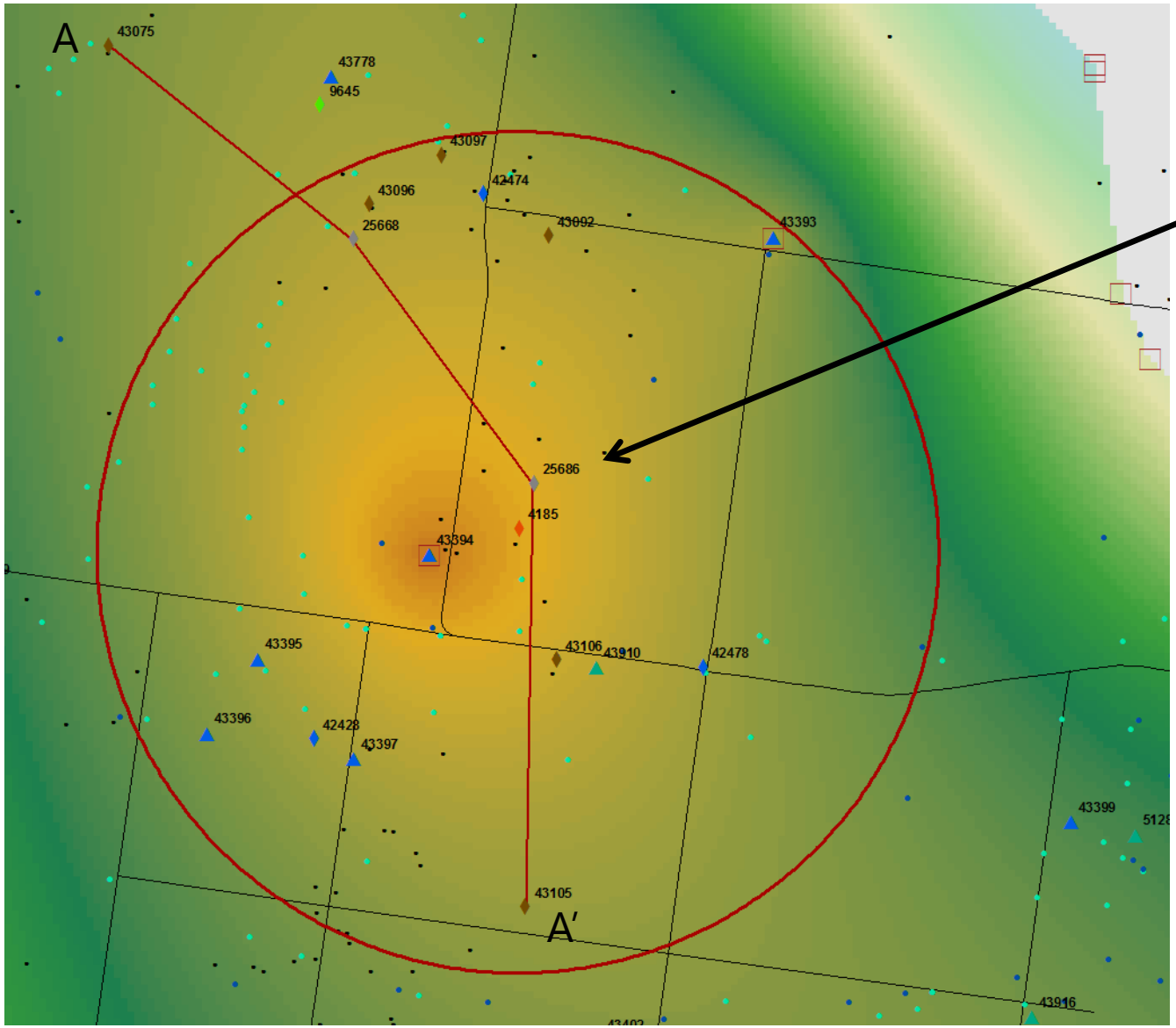
Please attach electric log, chemical analysis, and other pertinent information, if available.

This log was downloaded from the Texas Commission on Environmental Quality website.

- ✓ > 500,000 paper well logs were scanned as pdf files.
- ✓ Difficult to use (locations ?)
- ✓ However, lots of information

Texas Water Development Board

Review spatial distribution of wells using cross-sections.



Wells used in cross-section

Slightly saline zone bottom depth

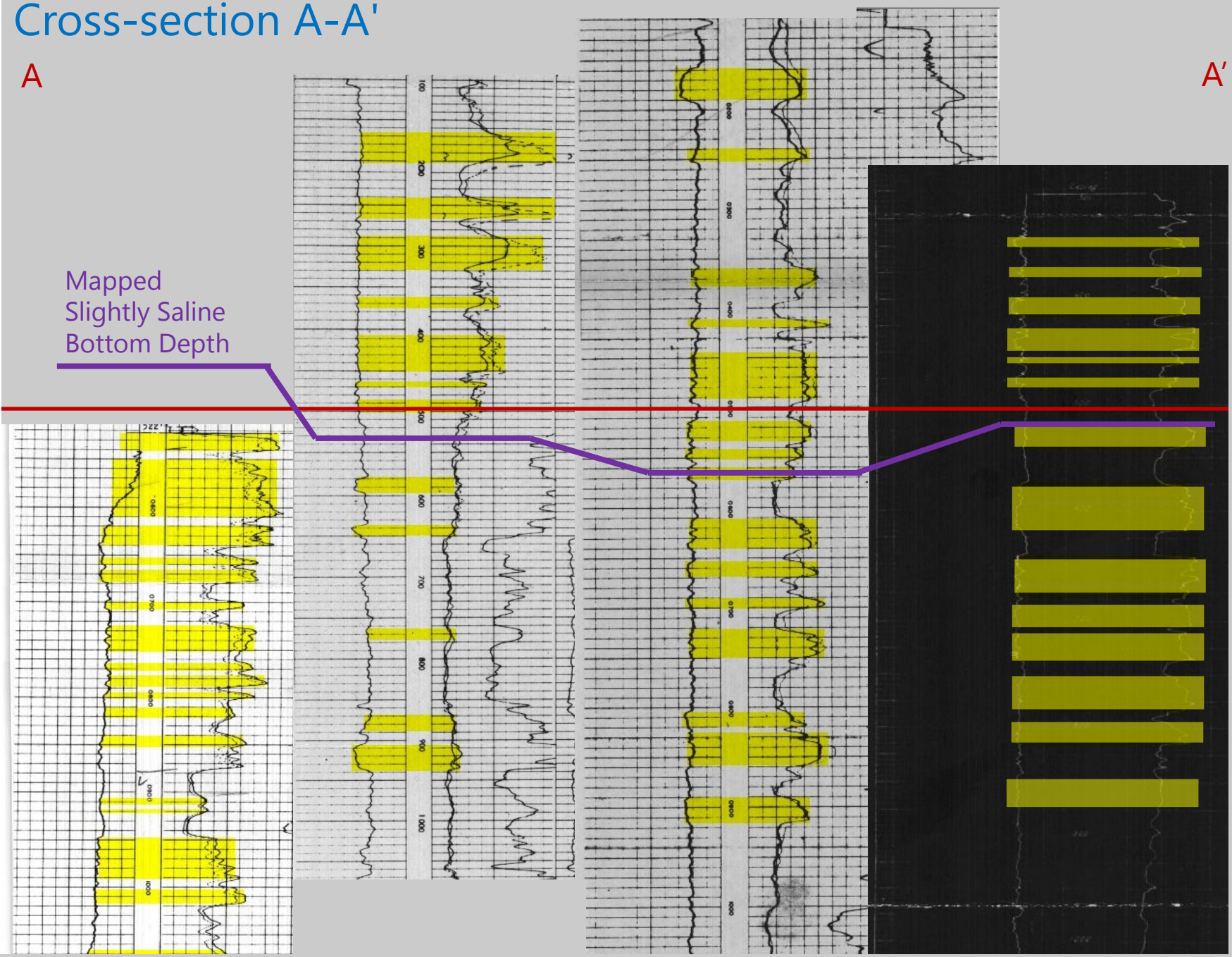
0 2,500

Texas Water Development Board

Cross-section A-A'

A

A'



Hire a consultant?

- ✓ Critically review existing well control
- ✓ Evaluate sand character (log shape, continuity between wells, …)
- ✓ Site visit: verify well locations, sample more wells, …
- ✓ Class II well location and history of injection
- ✓ Class V well location and history of injection
- ✓ Drill test and monitor wells.
  - pumping test
  - evaluate sand character
  - water quality samples
- ✓ Construct groundwater model
- ✓ *Share well data with TWDB ???*

Summary

- There is substantial brackish groundwater for development
- This study can support the identification of favorable exploration sites
- Well field drilling and testing is required to provide site-specific details that this study cannot provide
- BRACS study deliverables available on TWDB website
- Geophysical well log files available upon request
- Additional contract reports and deliverables available on TWDB website
- Future efforts:
  - TWDB will solicit contractor to build a new groundwater model in study area to evaluate effect of brackish groundwater pumping on freshwater aquifers and land subsidence
  - TWDB is very interested in obtaining new well data in study area

Texas Water Development Board

Texas Water Development Board

www.twdb.texas.gov

Conservation and Innovative Water Technologies Division

Sanjeev Kalaswad, Ph.D., P.G. Director
sanjeev.kalaswad@twdb.texas.gov (512) 936-0838

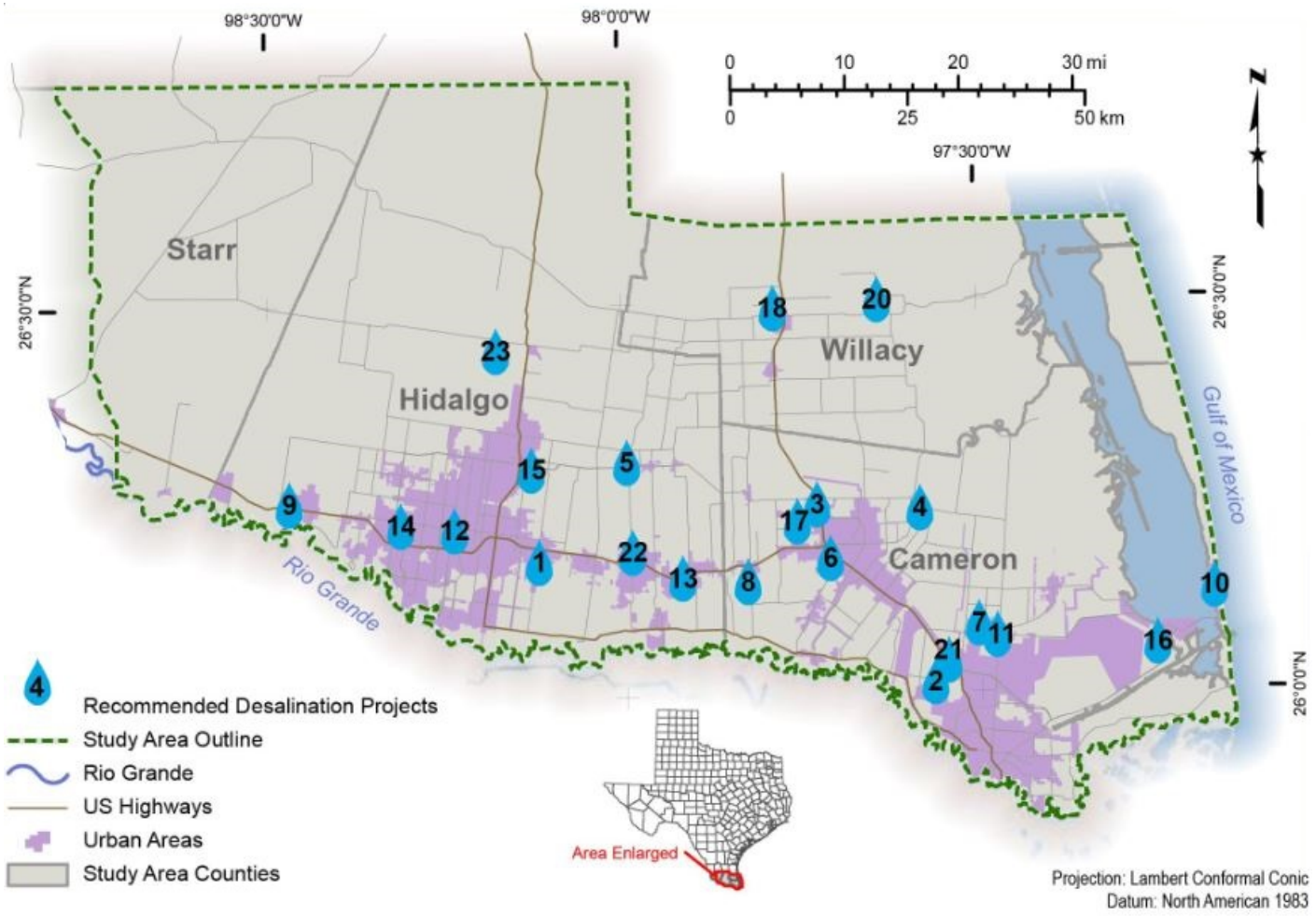
Andrea Croskrey
andrea.croskrey@twdb.texas.gov (512) 463-2865

John E. Meyer, P.G.
john.meyer@twdb.texas.gov (512) 463-8010

Matthew Webb
matthew.webb@twdb.texas.gov (512) 463-6929

Additional slides to answer questions

Recommended Desalination Plants

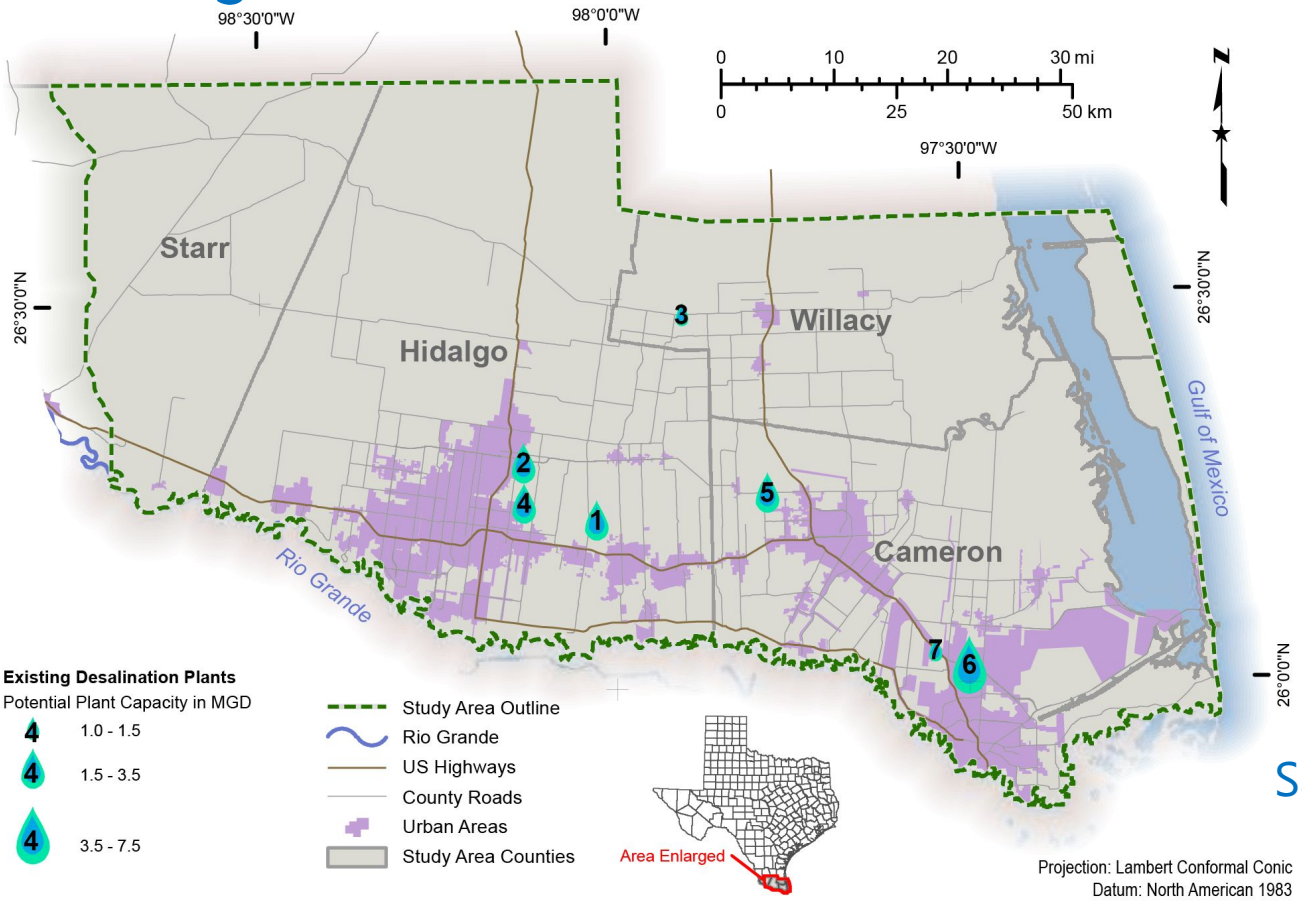


ID	Proposed Area or Name
1	Alamo
2	Brownsville
3	Combes
4	East Rio Honda WSC
5	Elsa
6	Harlingen
7	Indian Lake
8	La Feria
9	La Joya
10	Laguna Madre WD
11	Los Fresnos
12	McAllen
13	Mercedes
14	Mission
15	North Alamo WSC
16	Port Isabel
17	Primera
18	Raymondville
19	Rio Grande City
20	San Perlita
21	Valley MUD 2
22	Weslaco
23	County - Other

Source: 2011 Recommended Innovative Strategies of the Regional Water Planning Groups

Texas Water Development Board

Existing Desalination Plants



Salinity zones used by plants

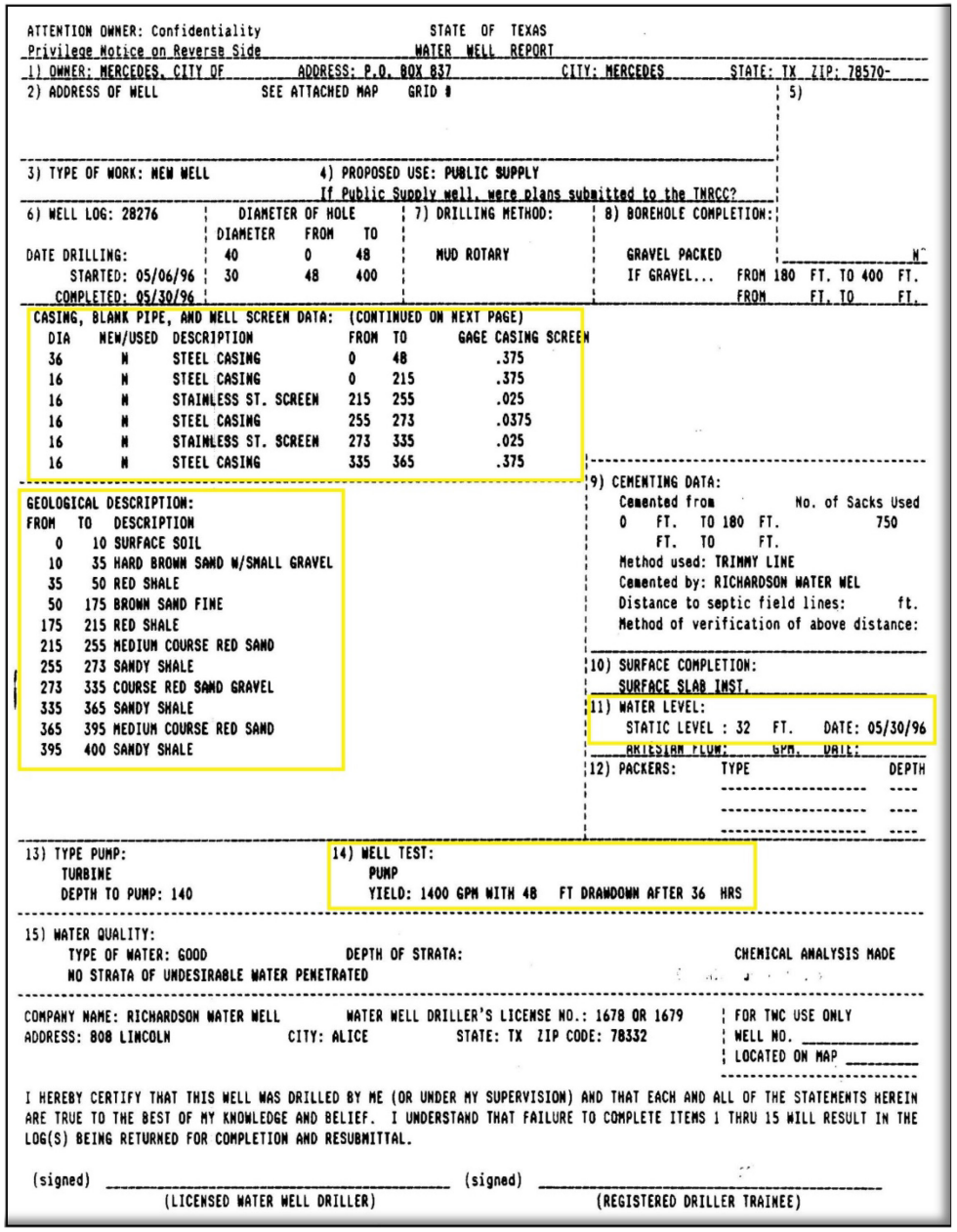
SS = Slightly Saline
MS = Moderately Saline

ID	Plant Name	Potential Plant Capacity (MGD)	
1	North Alamo Water Supply Corporation (Donna)	2.25	*MS Deep*
2	North Alamo Water Supply Corporation (Doolittle)	3.50	*SS Deep and MS Deep*
3	North Alamo Water Supply Corporation (Lasara)	1.20	*SS Deep*
4	North Alamo Water Supply Corporation (Owassa)	2.00	*SS Deep*
5	North Cameron/Hidalgo WA	2.50	*MS Deep*
6	Southmost Regional Water Authority	7.50	*SS Deep*
7	Valley MUD #2	1.00	*MS Deep*

Source: Lower Rio Grande Valley BRACS Study

Texas Water Development Board

Water Well Logs



ATTENTION OWNER: Confidentiality Privilege Notice on Reverse Side

STATE OF TEXAS
WATER WELL REPORT

1) OWNER: MERCEDES, CITY OF ADDRESS: P.O. BOX 837 CITY: MERCEDES STATE: TX ZIP: 78570-

2) ADDRESS OF WELL SEE ATTACHED MAP GRID #

5)

3) TYPE OF WORK: NEW WELL

4) PROPOSED USE: PUBLIC SUPPLY
If Public Supply well, were plans submitted to the TNRCC?

6) WELL LOG: 28276
DATE DRILLING:
STARTED: 05/06/96
COMPLETED: 05/30/96

DIAMETER OF HOLE

DIAMETER	FROM	TO
40	0	48
30	48	400

7) DRILLING METHOD: MUD ROTARY

8) BOREHOLE COMPLETION: GRAVEL PACKED
IF GRAVEL... FROM 180 FT. TO 400 FT.
FROM FT. TO FT.

CASING, BLANK PIPE, AND WELL SCREEN DATA: (CONTINUED ON NEXT PAGE)

DIA	NEW/USED	DESCRIPTION	FROM	TO	GAGE CASING SCREEN
36	N	STEEL CASING	0	48	.375
16	N	STEEL CASING	0	215	.375
16	N	STAINLESS ST. SCREEN	215	255	.025
16	N	STEEL CASING	255	273	.0375
16	N	STAINLESS ST. SCREEN	273	335	.025
16	N	STEEL CASING	335	365	.375

GEOLOGICAL DESCRIPTION:

FROM	TO	DESCRIPTION
0	10	SURFACE SOIL
10	35	HARD BROWN SAND W/SMALL GRAVEL
35	50	RED SHALE
50	175	BROWN SAND FINE
175	215	RED SHALE
215	255	MEDIUM COURSE RED SAND
255	273	SANDY SHALE
273	335	COURSE RED SAND GRAVEL
335	365	SANDY SHALE
365	395	MEDIUM COURSE RED SAND
395	400	SANDY SHALE

9) CEMENTING DATA:
Cemented from 0 FT. TO 180 FT. No. of Sacks Used 750
FT. TO FT.
Method used: TRIMMY LINE
Cemented by: RICHARDSON WATER WEL
Distance to septic field lines: ft.
Method of verification of above distance:

10) SURFACE COMPLETION:
SURFACE SLAB INST.

11) WATER LEVEL:
STATIC LEVEL : 32 FT. DATE: 05/30/96
ARTESIAN FLOW: GPM. DATE:

12) PACKERS: TYPE DEPTH

13) TYPE PUMP:
TURBINE
DEPTH TO PUMP: 140

14) WELL TEST:
PUMP
YIELD: 1400 GPM WITH 48 FT DRAWDOWN AFTER 36 HRS

15) WATER QUALITY:
TYPE OF WATER: GOOD DEPTH OF STRATA: CHEMICAL ANALYSIS MADE
NO STRATA OF UNDESIRABLE WATER PENETRATED

COMPANY NAME: RICHARDSON WATER WELL WATER WELL DRILLER'S LICENSE NO.: 1678 OR 1679
ADDRESS: 808 LINCOLN CITY: ALICE STATE: TX ZIP CODE: 78332

FOR TWC USE ONLY
WELL NO.
LOCATED ON MAP

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.

(signed) _____ (LICENSED WATER WELL DRILLER)

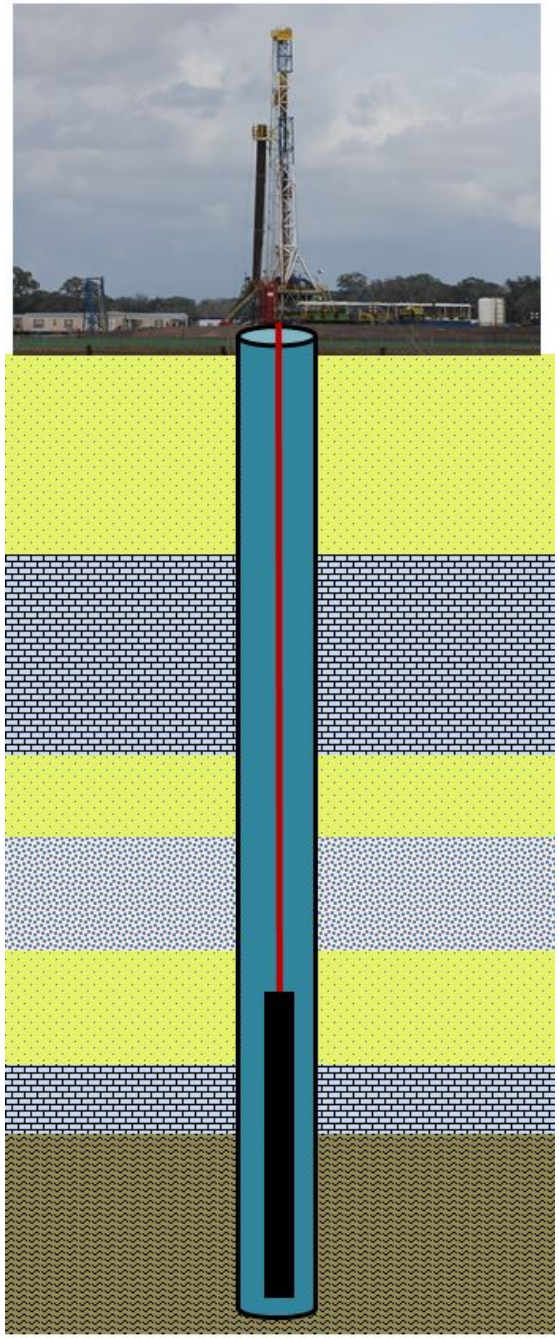
(signed) _____ (REGISTERED DRILLER TRAINEE)

- Geology (sand, clay, … depositional environment)
- Well screen
- Aquifer productivity
- Water quality
- Static water level

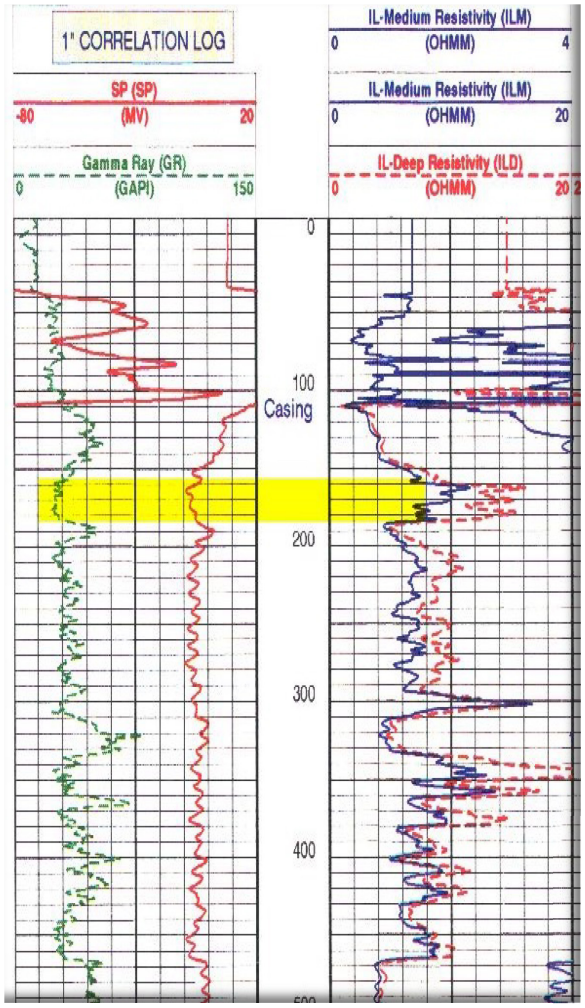
Source: Lower Rio Grande Valley BRACS Study

Texas Water Development Board

What is a Geophysical Well Log?



Source: BRACS program



A tool or combination of tools lowered into a borehole on a wireline and retrieved to the surface.

Also known as: electrical logging; wireline logging.

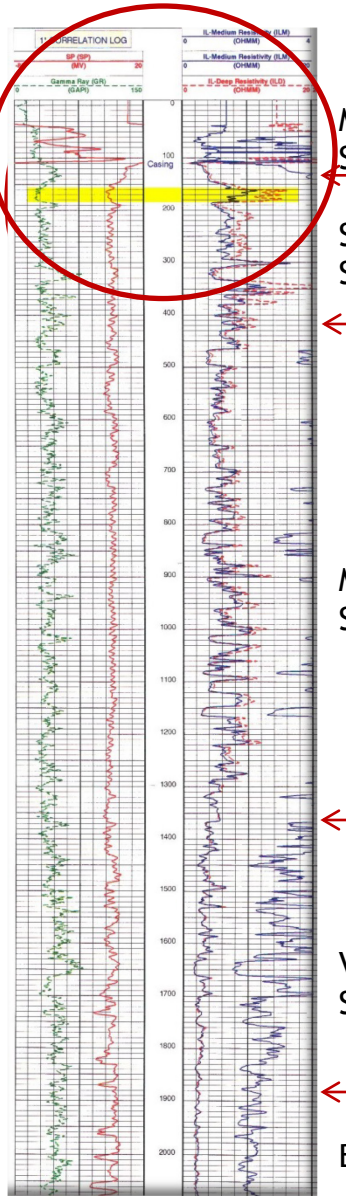
Logs must be corrected for a number of parameters.

Tool response recorded in left and right tracks.

Logs can be used to evaluate the entire aquifer, whereas data from water wells typically ends at the base of fresh to slightly saline water zones

Texas Water Development Board

Log Analysis



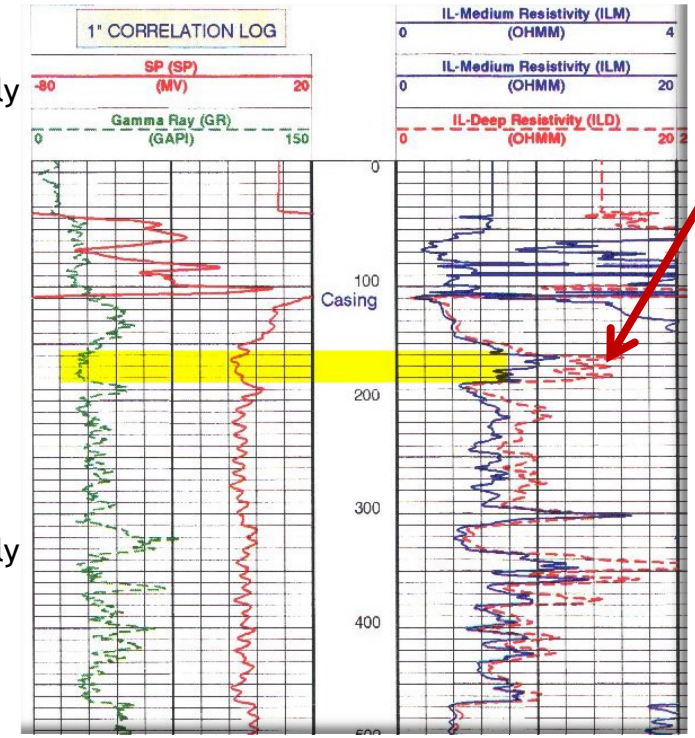
Moderately Saline

Slightly Saline

Moderately Saline

Very Saline

Brine



At 160 ft = 15 ohm-meter

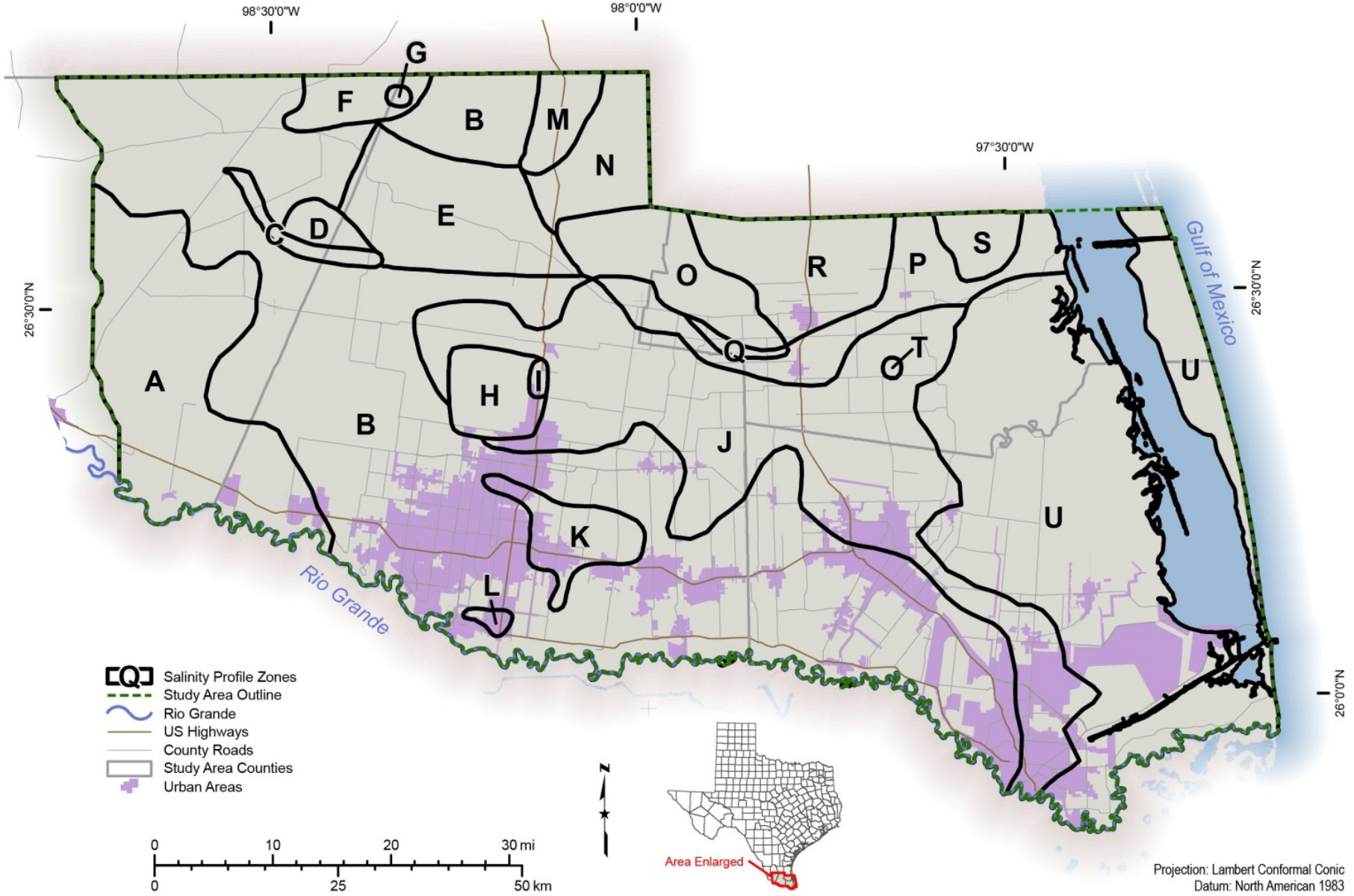
Rwa Minimum Method
interpreted TDS = 2,500 mg/L

Water Well
TDS concentration = 2,264 mg/L
(well screen 170-349 ft)

BRACS Well ID 42889

Source: Lower Rio Grande Valley BRACS Study

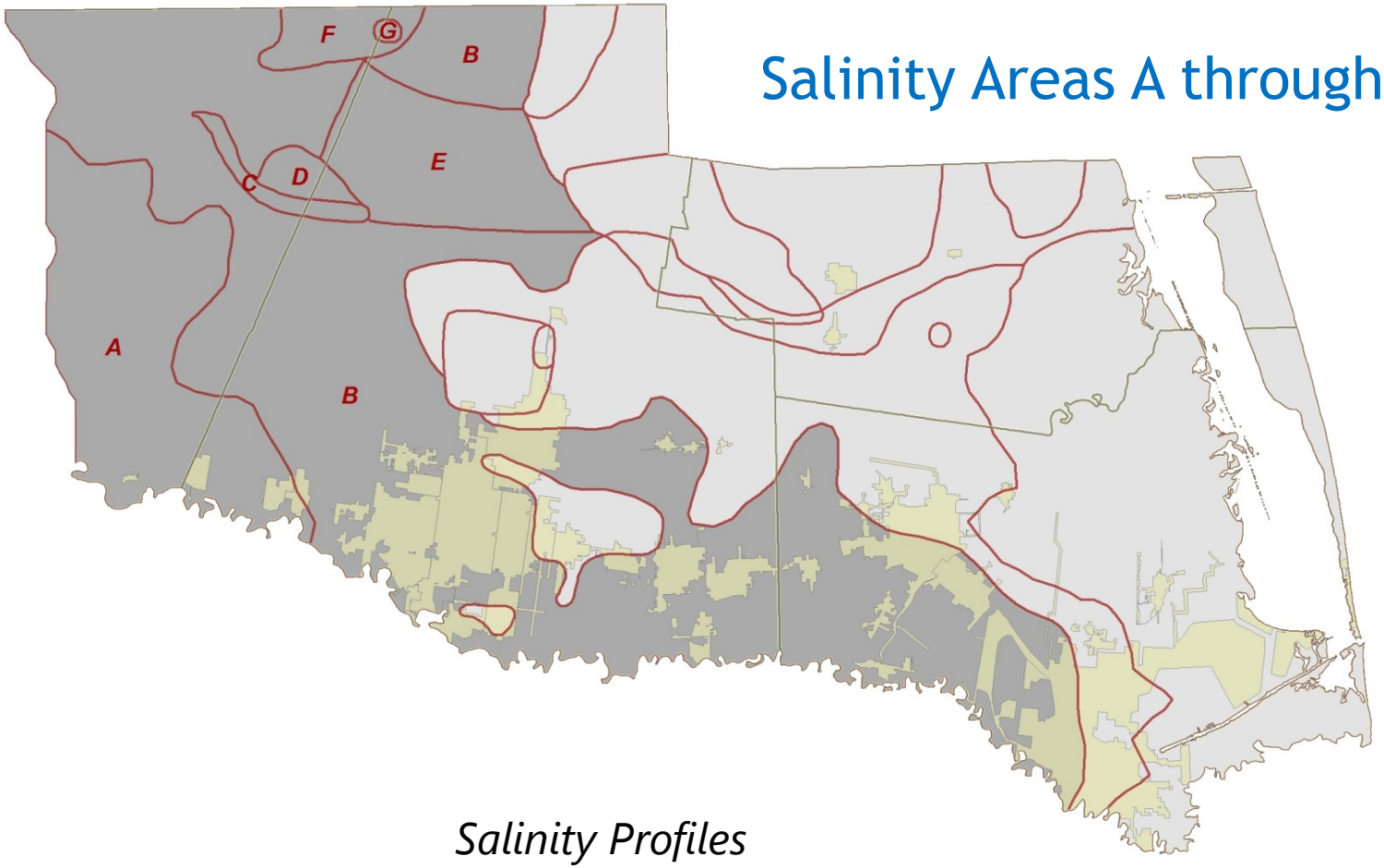
What did we find? 21 Salinity Areas Labeled A - U



Source: Lower Rio Grande Valley BRACS Study

Texas Water Development Board

Salinity Areas A through G



Salinity Profiles

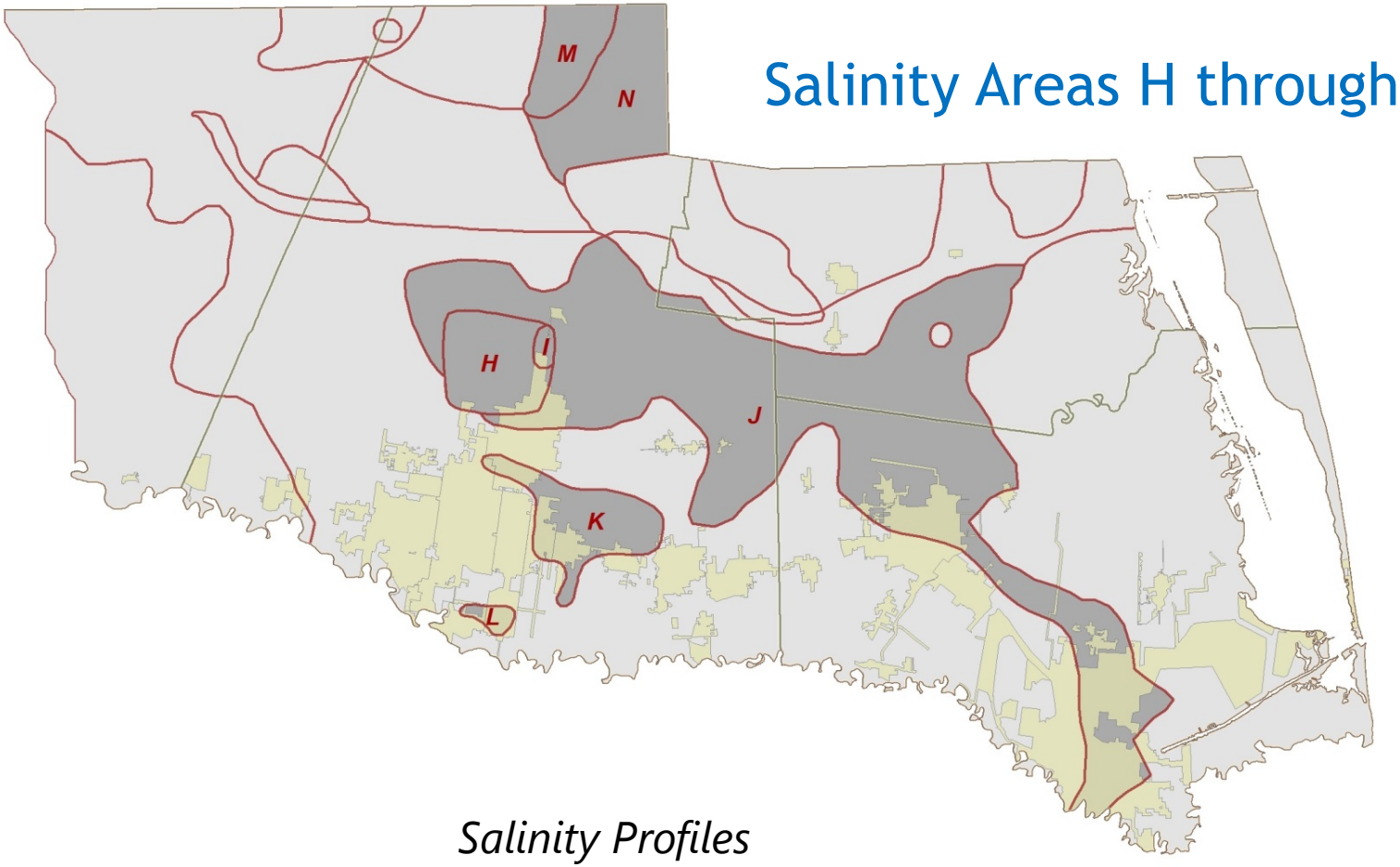
A	B	C	D	E	F	G
				SS Shallow 2		VS Shallow 1
		MS Shallow 5		MS Intermediate 1	MS Shallow 4	MS Shallow 4
	SS Deep	SS Deep		SS Deep	SS Deep	SS Deep
MS Deep	MS Deep	MS Deep	MS Deep	MS Deep	MS Deep	MS Deep
VS Deep	VS Deep	VS Deep	VS Deep	VS Deep	VS Deep	VS Deep
BR Deep	BR Deep	BR Deep	BR Deep	BR Deep	BR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

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: Lower Rio Grande Valley BRACS Study

Texas Water Development Board

Salinity Areas H through N



Salinity Profiles

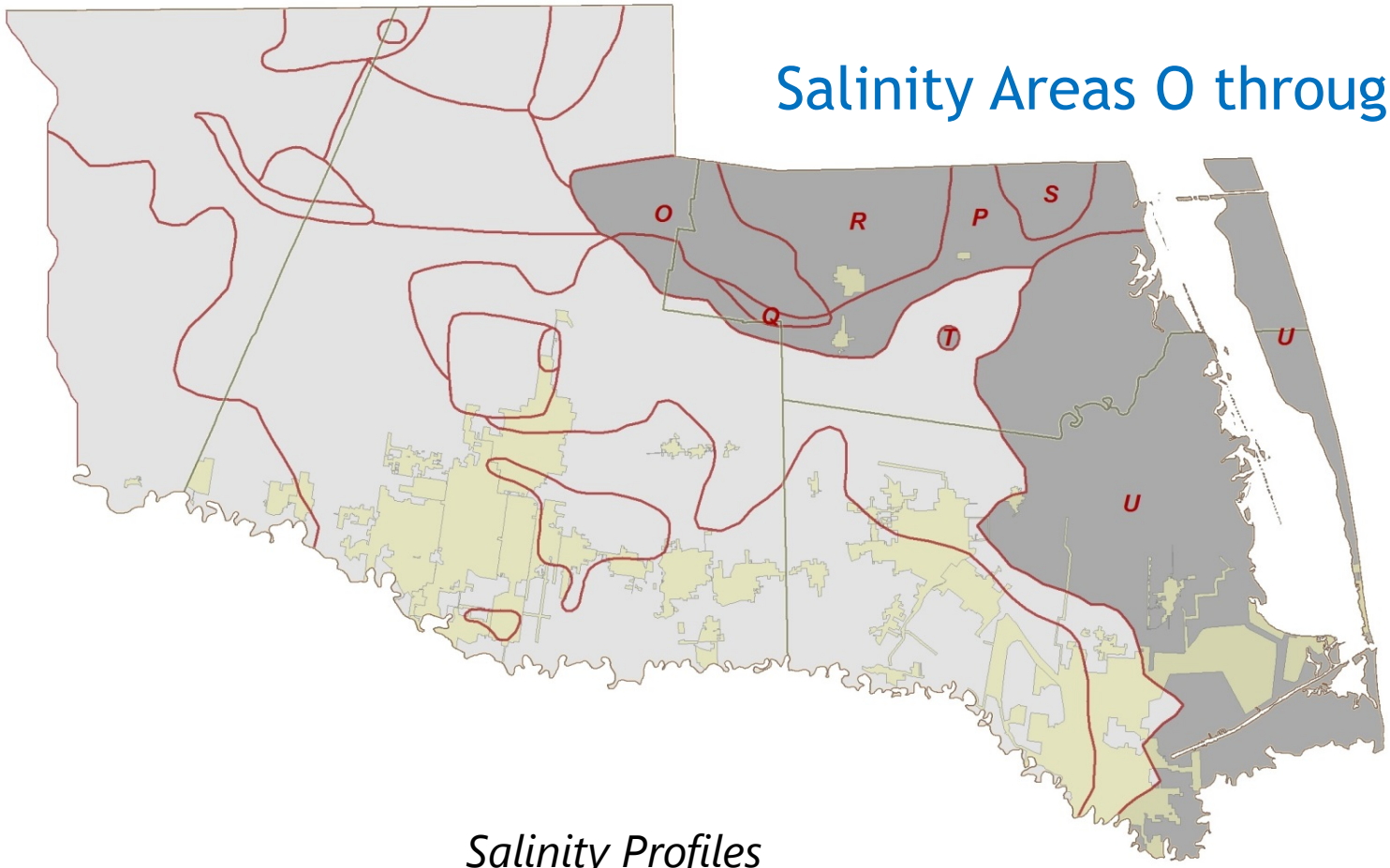
H	I	J	K	L	M	N
	VS Shallow 3			SS Shallow 1	VS Shallow 2	
MS Shallow 2	MS Shallow 2		MS Shallow 1	MS Intermediate 2	MS Intermediate 1	MS Intermediate 1
SS Intermediate	SS Intermediate		SS Deep	SS Deep	SS Deep	SS Deep
MS Deep	MS Deep	MS Deep	MS Deep	MS Deep	MS Deep	MS Deep
VS Deep	VS Deep	VS Deep	VS Deep	VS Deep	VS Deep	VS Deep
BR Deep	BR Deep	BR Deep	BR Deep	BR Deep	BR Deep	BR Deep

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: Lower Rio Grande Valley BRACS Study

Texas Water Development Board

Salinity Areas O through U



Salinity Profiles

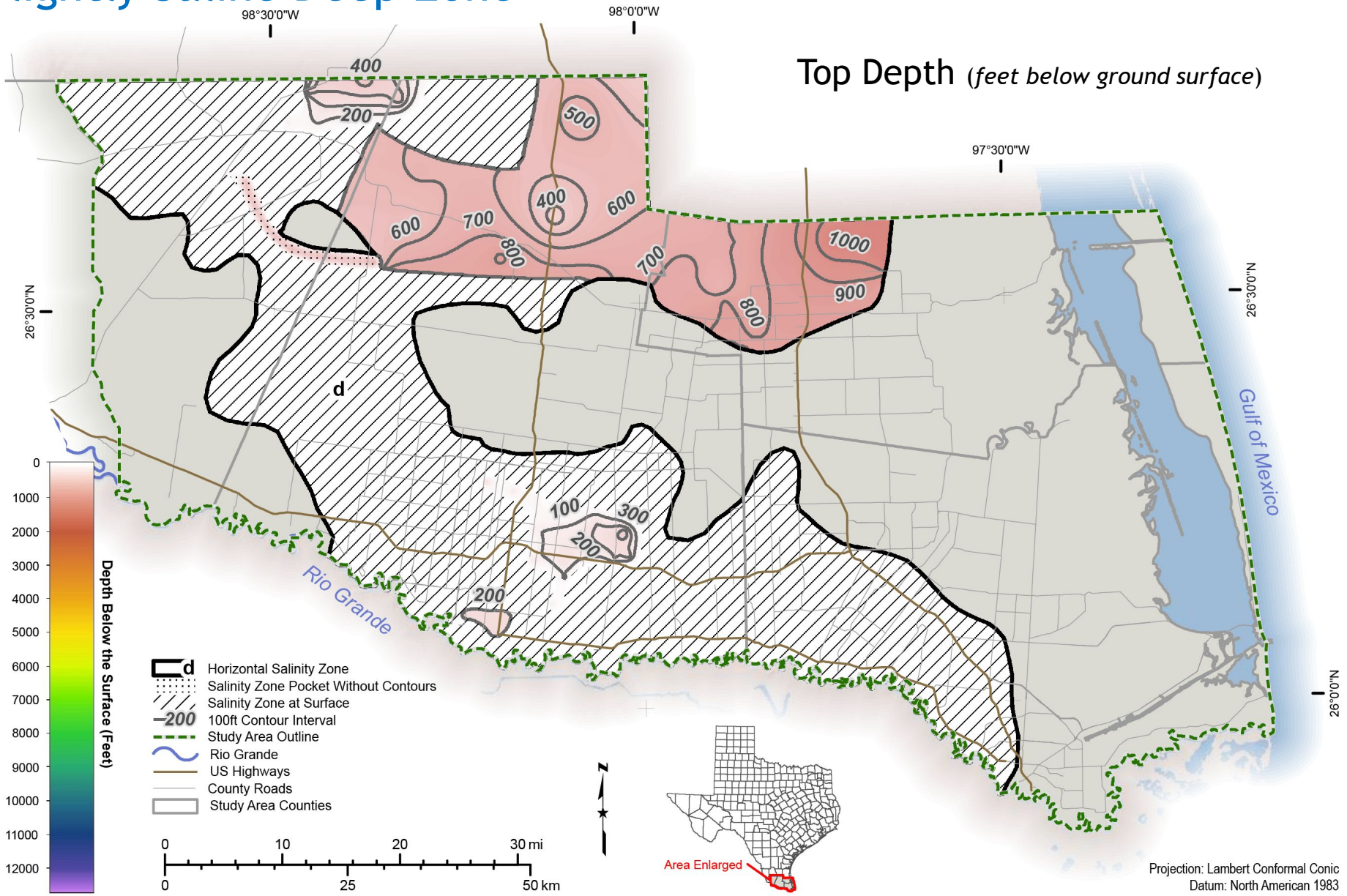
O	P	Q	R	S	T	U
VS Shallow 4			VS Shallow 4			
MS Intermediate 1			MS Intermediate 1	MS Shallow 3	Brine Shallow	
SS Deep	VS Shallow 4		SS Deep	VS Shallow 4	VS Intermediate	
MS Deep	MS Deep	MS Deep	MS Deep	MS Deep	MS Deep	
VS Deep	VS Deep	VS Deep	VS Deep	VS Deep	VS Deep	VS Deep
BR Deep	BR Deep	BR Deep	BR Deep	BR Deep	BR Deep	BR Deep

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: Lower Rio Grande Valley BRACS Study

Texas Water Development Board

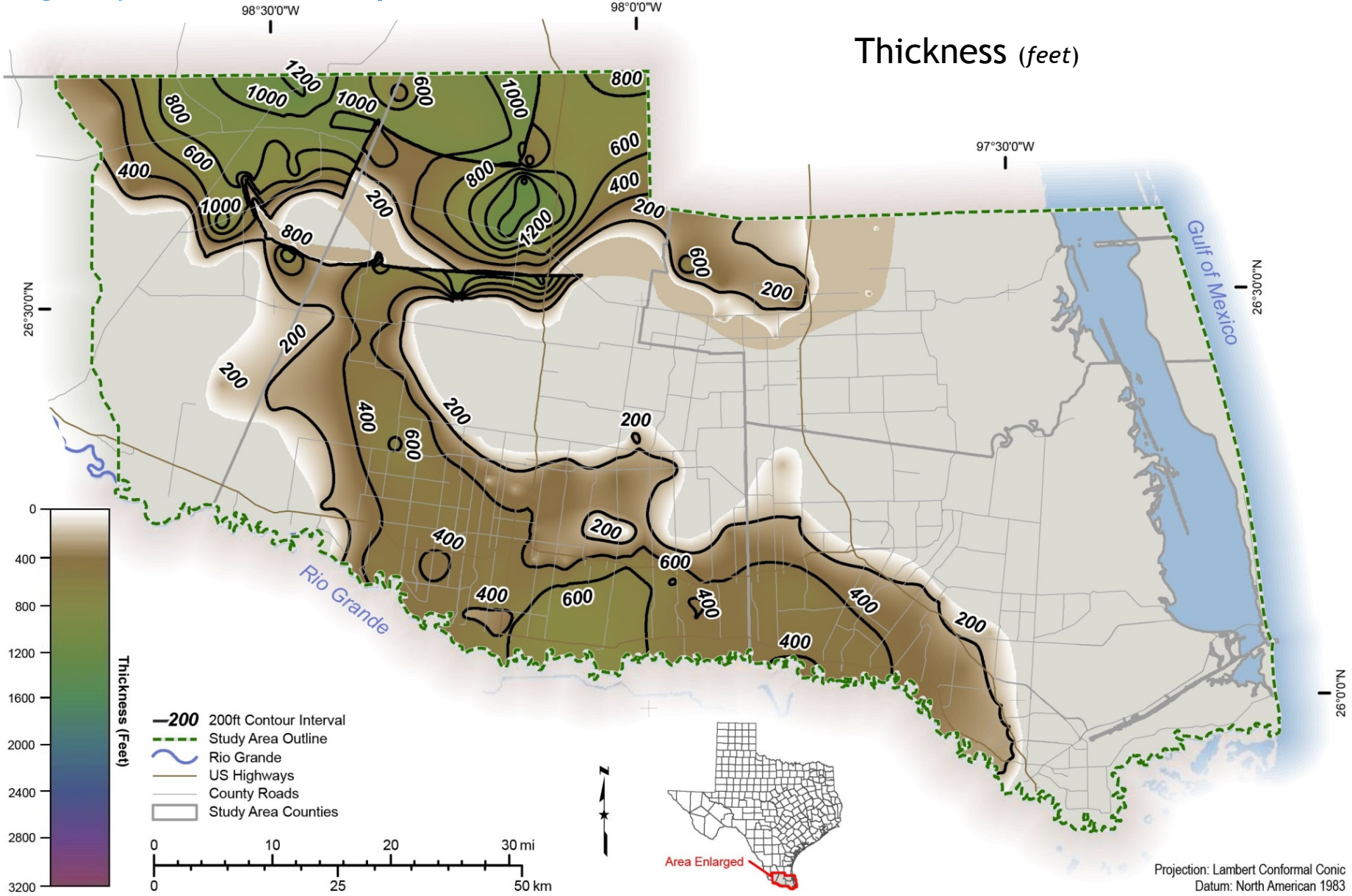
Slightly Saline Deep Zone



Source: Lower Rio Grande Valley BRACS Study

Texas Water Development Board

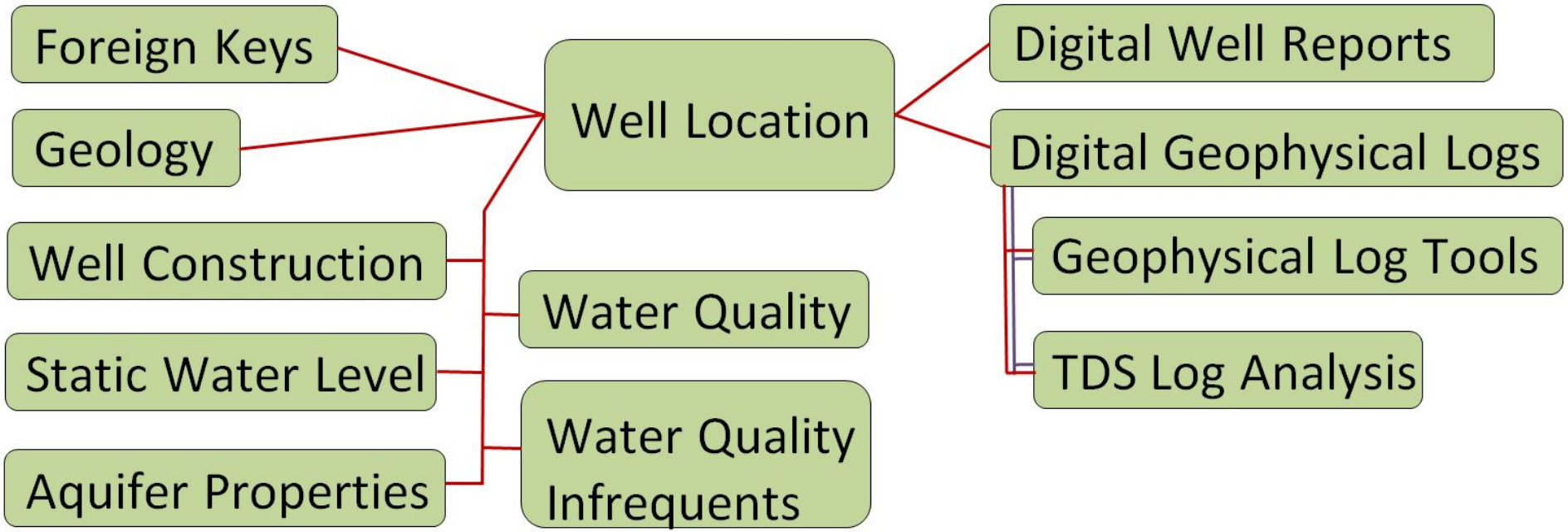
Slightly Saline Deep Zone



Source: Lower Rio Grande Valley BRACS Study

Texas Water Development Board

BRACS Database Tables

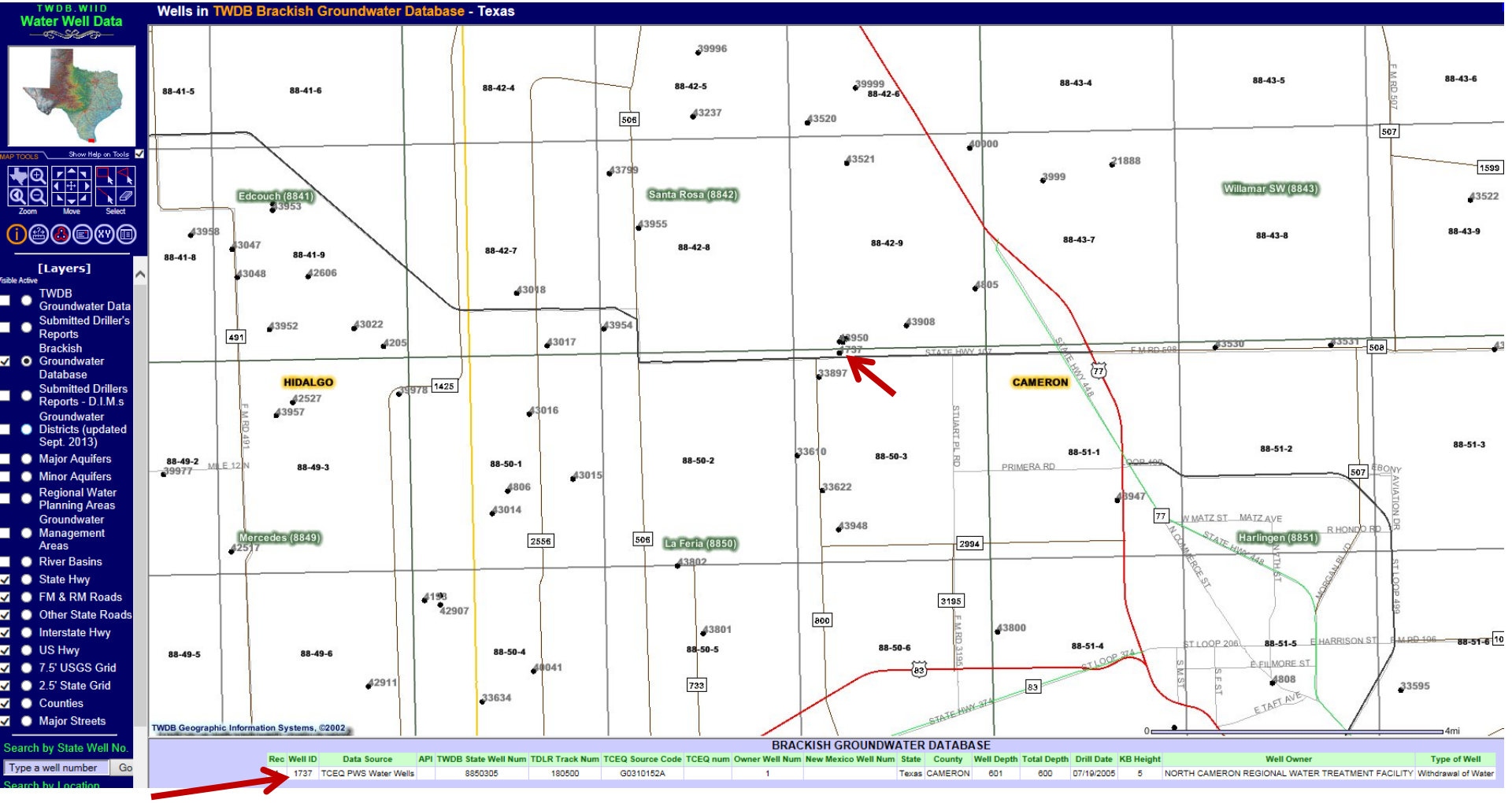


- Microsoft Access Database
- Available on the TWDB web site (with data dictionary)
- Relational table design
- All wells are assigned a unique well id, linking (red line) records together

Texas Water Development Board

Source: BRACS program

TWDB WIID website: http://wiid.twdb.texas.gov/



WIID: Water Information Integration and Dissemination

Can use this site see / query well locations in an area.
Other data is also available by checking the *Visible box*.

Texas Water Development Board