



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

by  
John Meyer, P.G.

*3<sup>rd</sup> Rio Grande Valley Water Awareness Summit  
December 5, 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*

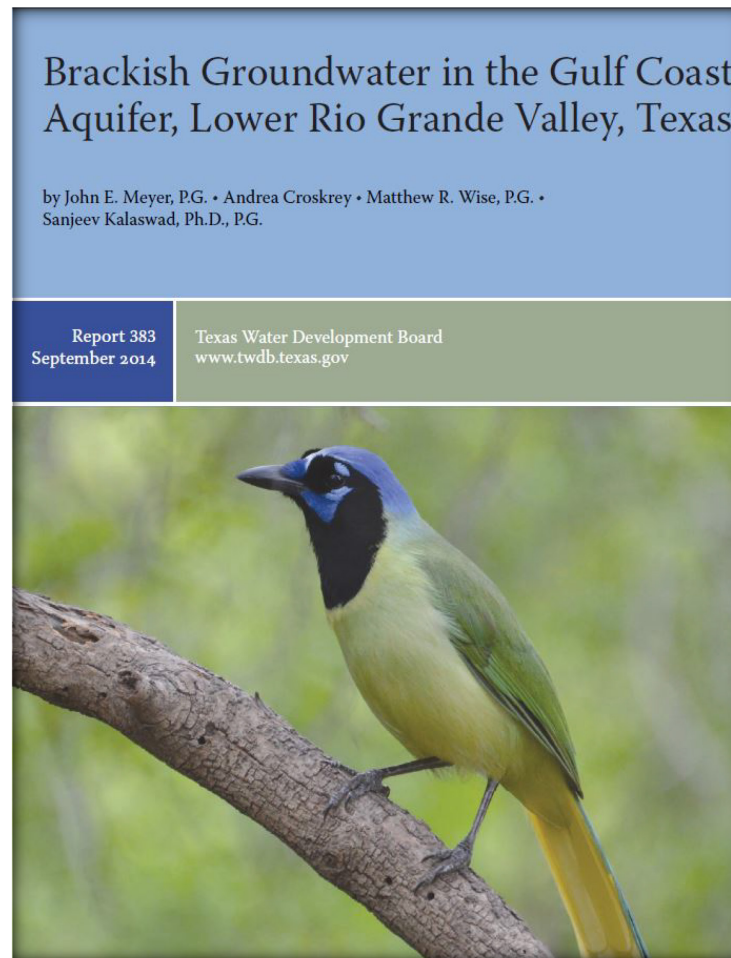


# Why did we study the Lower Rio Grande Valley?

- 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*

# 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.*



Sustainable and affordable water for Texas.

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Introduction ASR BRACS Desalination Rainwater Harvesting Water Reuse

## Project Reports

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

September 2014 | John E. Meyer, P.G., Andrea Croskrey, Matthew R. Wise, P.G., and Sanjeev Kalaswad, Ph.D., P.G.

The report presents information on the brackish groundwater resources of the Gulf Coast Aquifer in the Lower Rio Grande Valley, Texas, within Cameron, Hidalgo, Willacy, and eastern Starr counties. The study area is within the Rio Grande (Region M) Regional Water Planning Area and Groundwater Management Area 16. Water well information and geophysical well logs were used to map the three-dimensional extent of brackish groundwater salinity zones. The study area contains approximately 40 million acre feet of slightly saline groundwater (1,000 to 3,000 milligrams per liter total dissolved solids), 112 million acre-feet of moderately saline groundwater (3,000 to 10,000 milligrams per liter total dissolved solids), and 123 million acre-feet of very saline groundwater (10,000 to 35,000 milligrams per liter total dissolved solids).

The methodology used to prepare and assess this information is described in various sections of this report. The GIS datasets are described in the report appendix and are available on this website in a format that has been compressed with the WinZip utility.

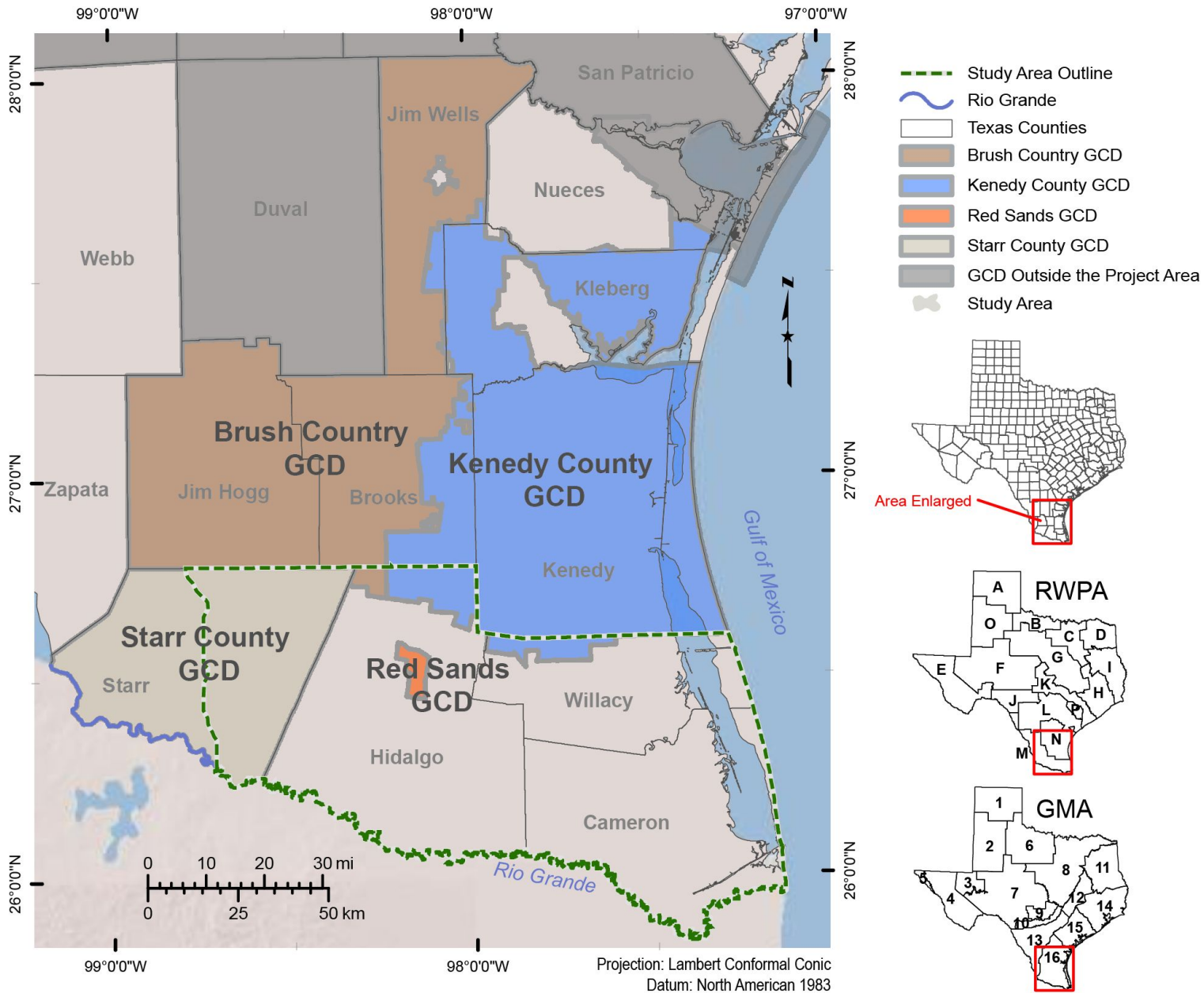
- [Brackish Groundwater in the Gulf Coast Aquifer, Lower Rio Grande Valley, Texas, September 2014](#)(36.8 MB)
- [Gulf Coast Aquifer GIS Datasets](#) (127.0 MB)

Innovative Water Technologies >

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Texas Innovative Water >

# Where is the study area?



Source: Lower Rio Grande Valley BRACS Study

# 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

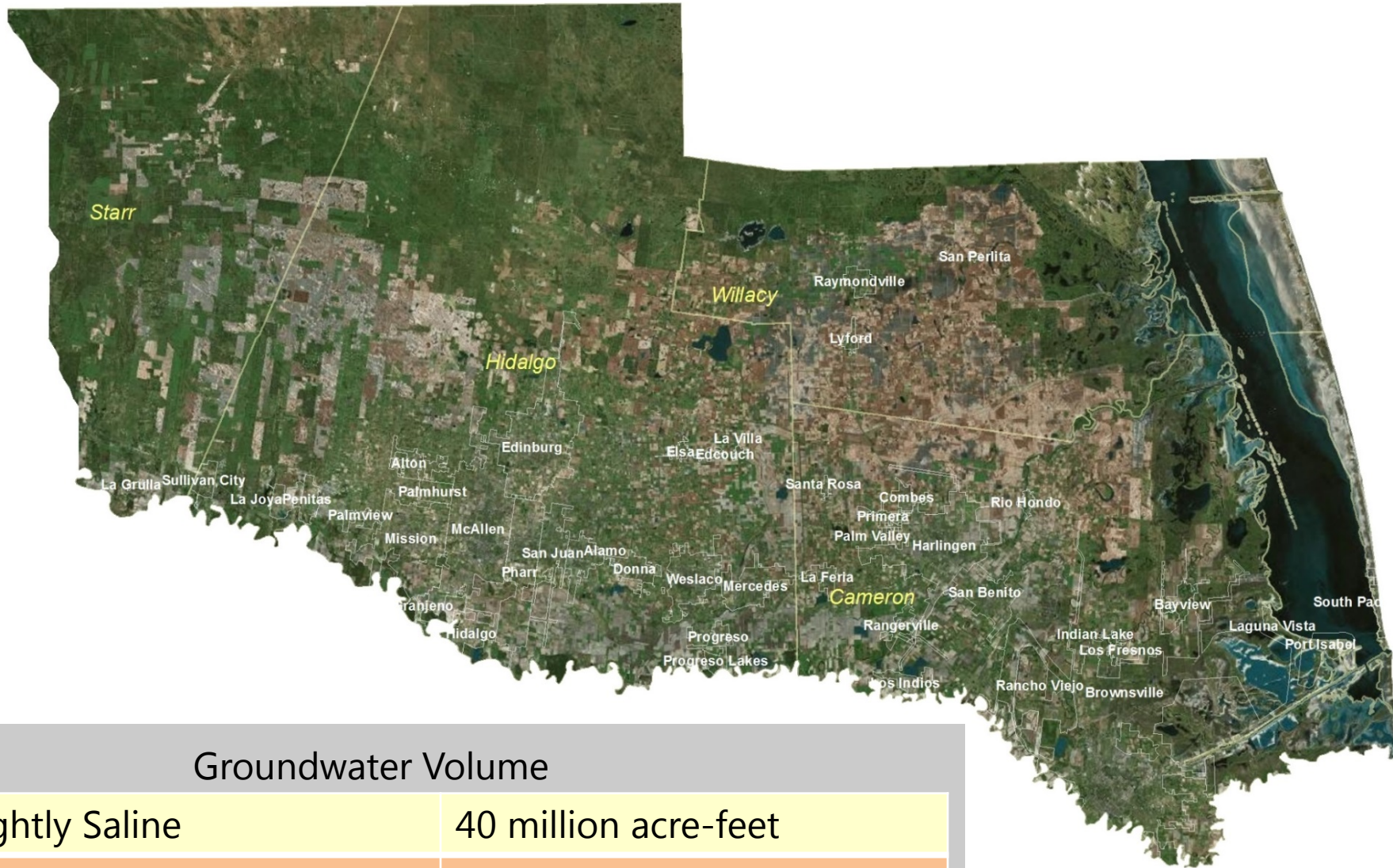
← Major/Minor Aquifer Mapped Limit

← Seawater

Source: modified from Winslow and Kister, 1956



# How much groundwater is there?

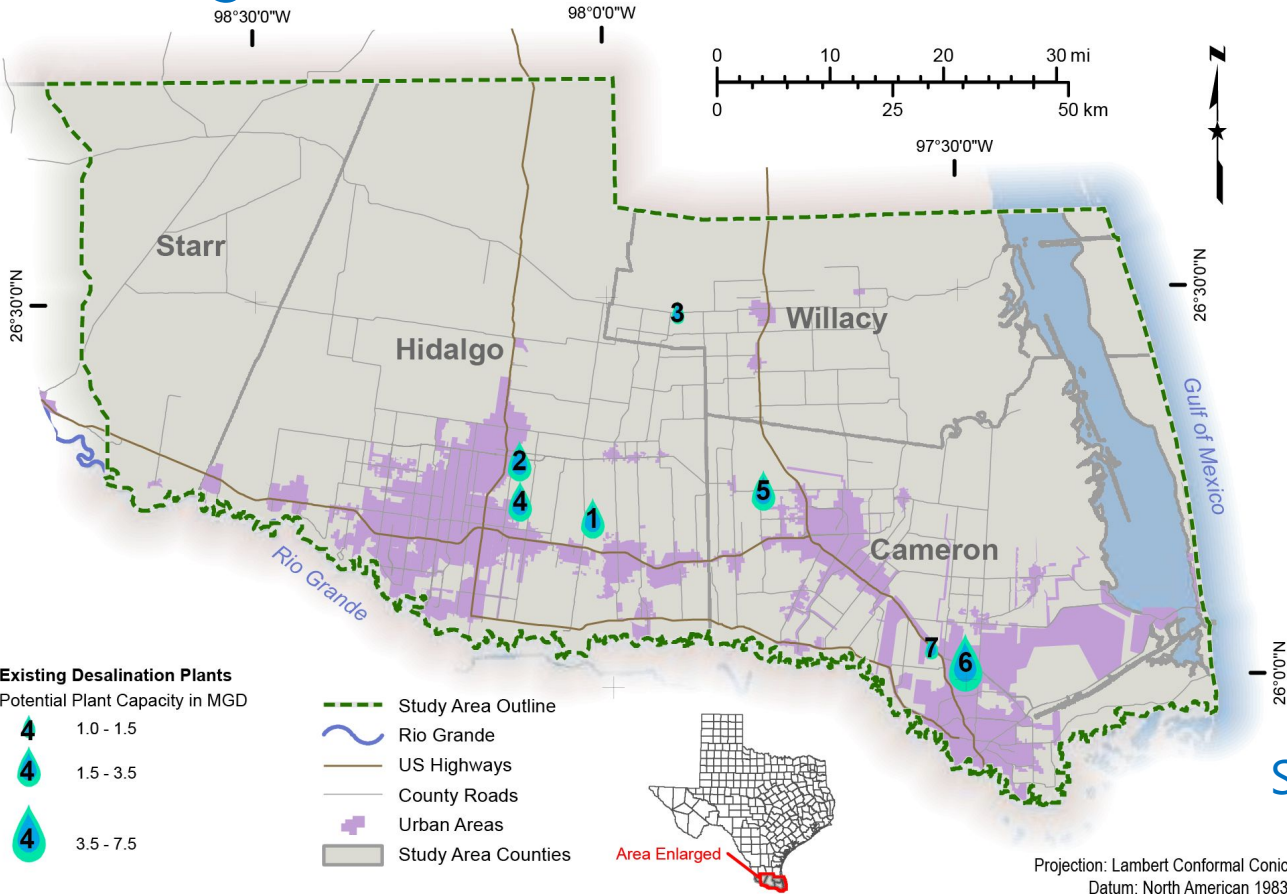


## Groundwater Volume

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

# Existing Desalination Plants



## Salinity zones used by plants

*SS = Slightly Saline*

*MS = Moderately Saline*

*MS Deep*

*SS Deep and MS Deep*

*SS Deep*

*SS Deep*

*MS Deep*

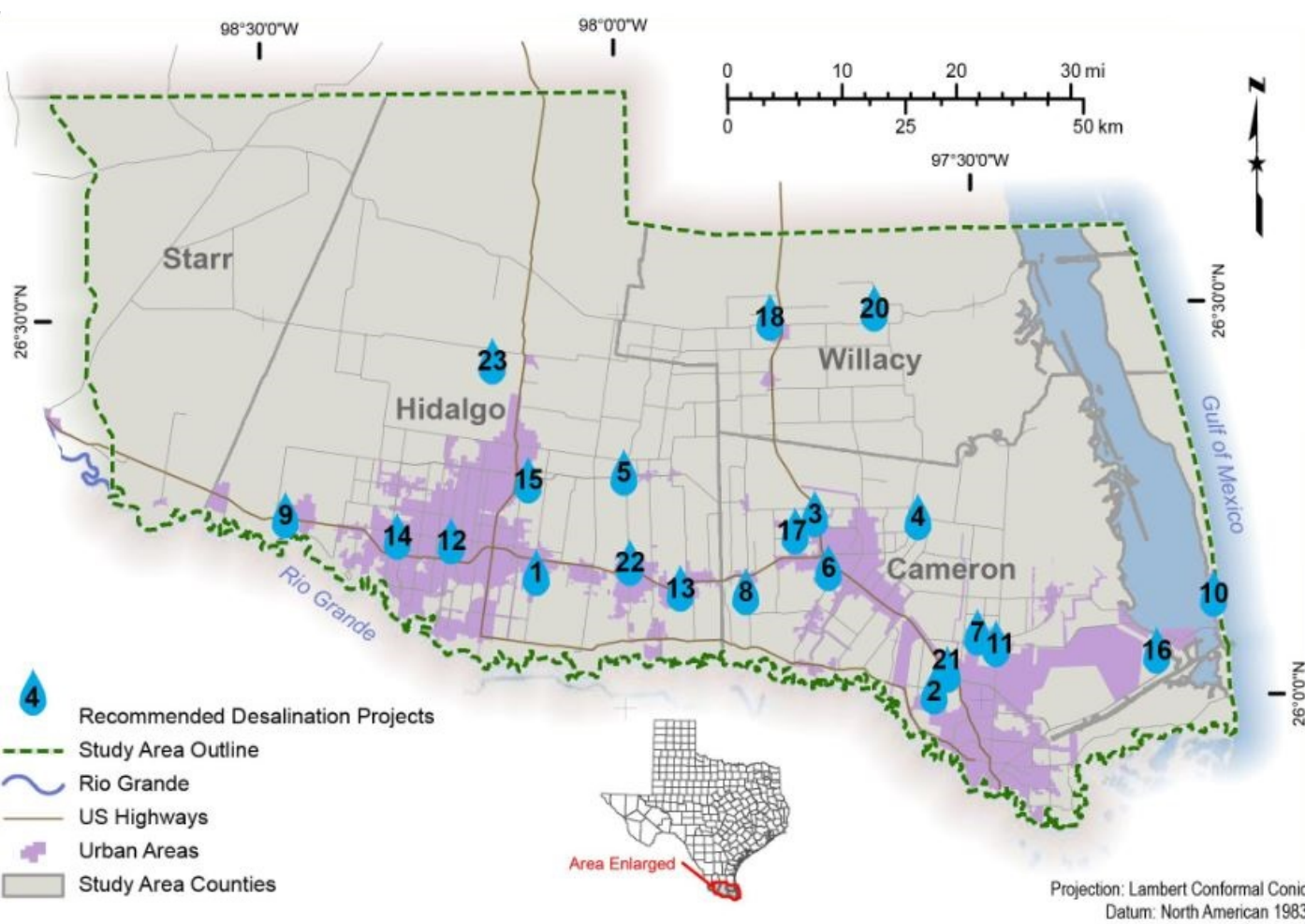
*SS Deep*

*MS Deep*

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

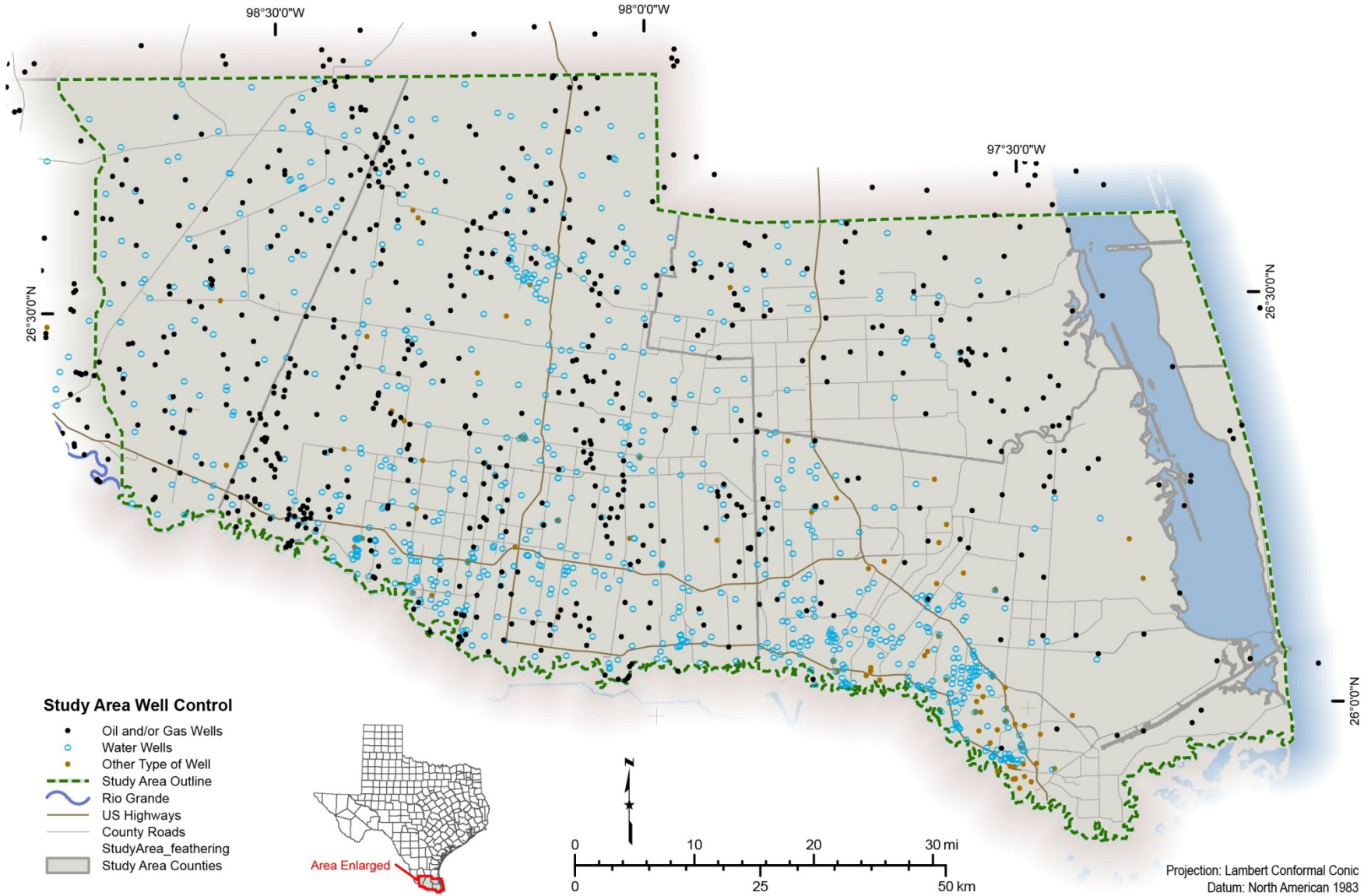
Source: Lower Rio Grande Valley BRACS Study

# 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

# Well Control: oil/gas and water wells



# 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	DIAMETER OF HOLE		7) DRILLING METHOD: 8) BOREHOLE COMPLETION:
DATE DRILLING:	DIAMETER	FROM	TO
STARTED: 05/06/96	40	0	48
COMPLETED: 05/30/96	30	48	400
			MUD ROTARY
			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
9) CEMENTING DATA:			
Cemented from		No. of Sacks Used	
0 FT. TO 180 FT.		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. DRILL:			
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:	
NO STRATA OF UNDESIRABLE WATER PENETRATED			
CHEMICAL ANALYSIS MADE			
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) _____		(signed) _____	
(LICENSED WATER WELL DRILLER)		(REGISTERED DRILLER TRAINEE)	

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

# What is a Geophysical Well Log?

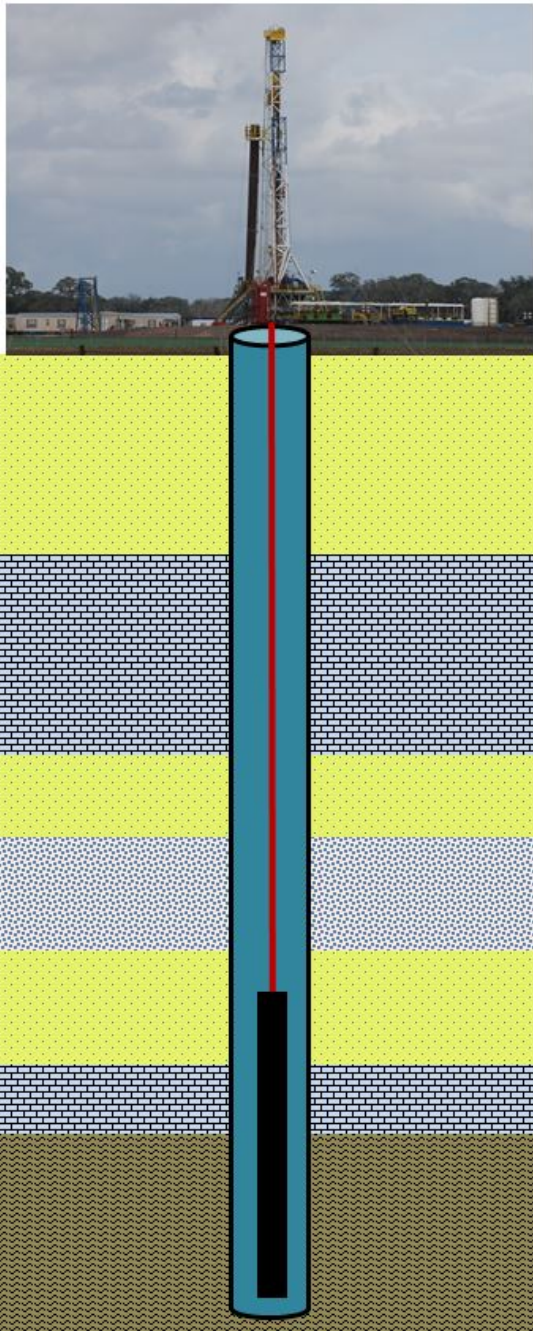
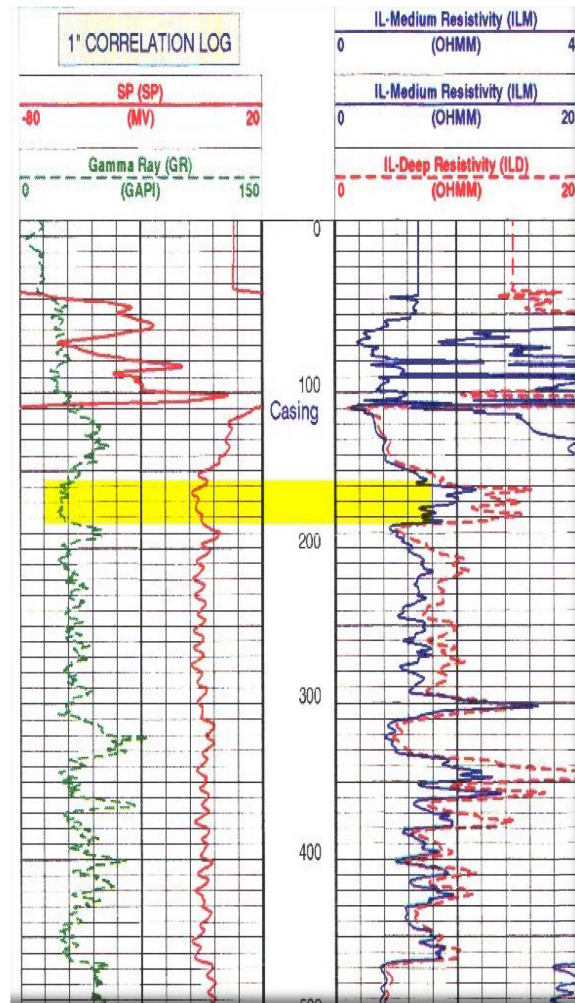
A tool or combination of tools lowered into a borehole on a wireline and retrieved to the surface.

Also known as: electrical logging; wireline logging.

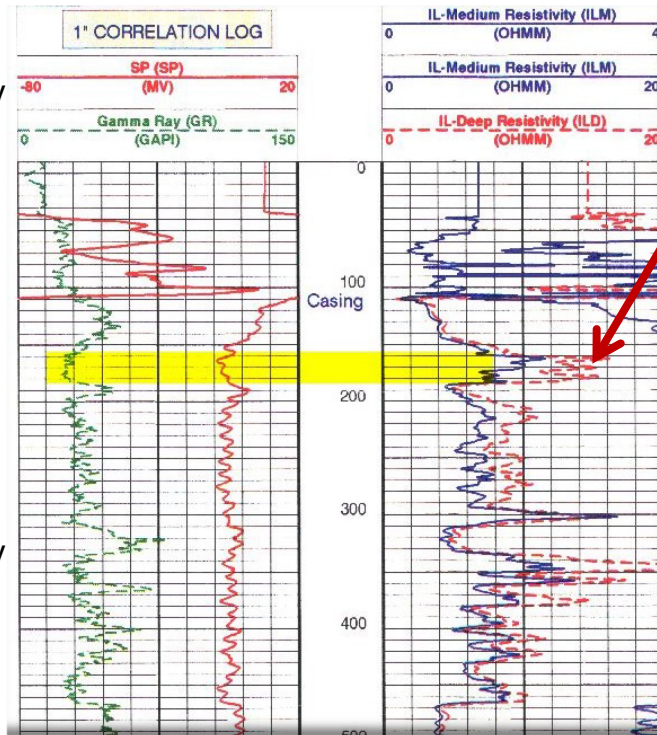
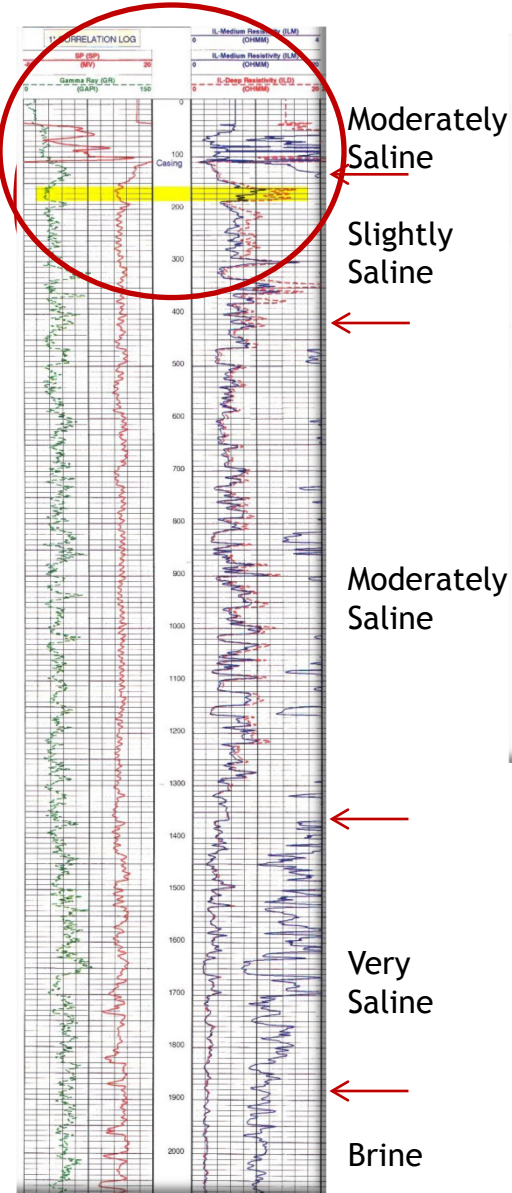
Logs must be corrected for a number of parameters.

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*



# Log Analysis



At 160 ft = 15 ohm-meter

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

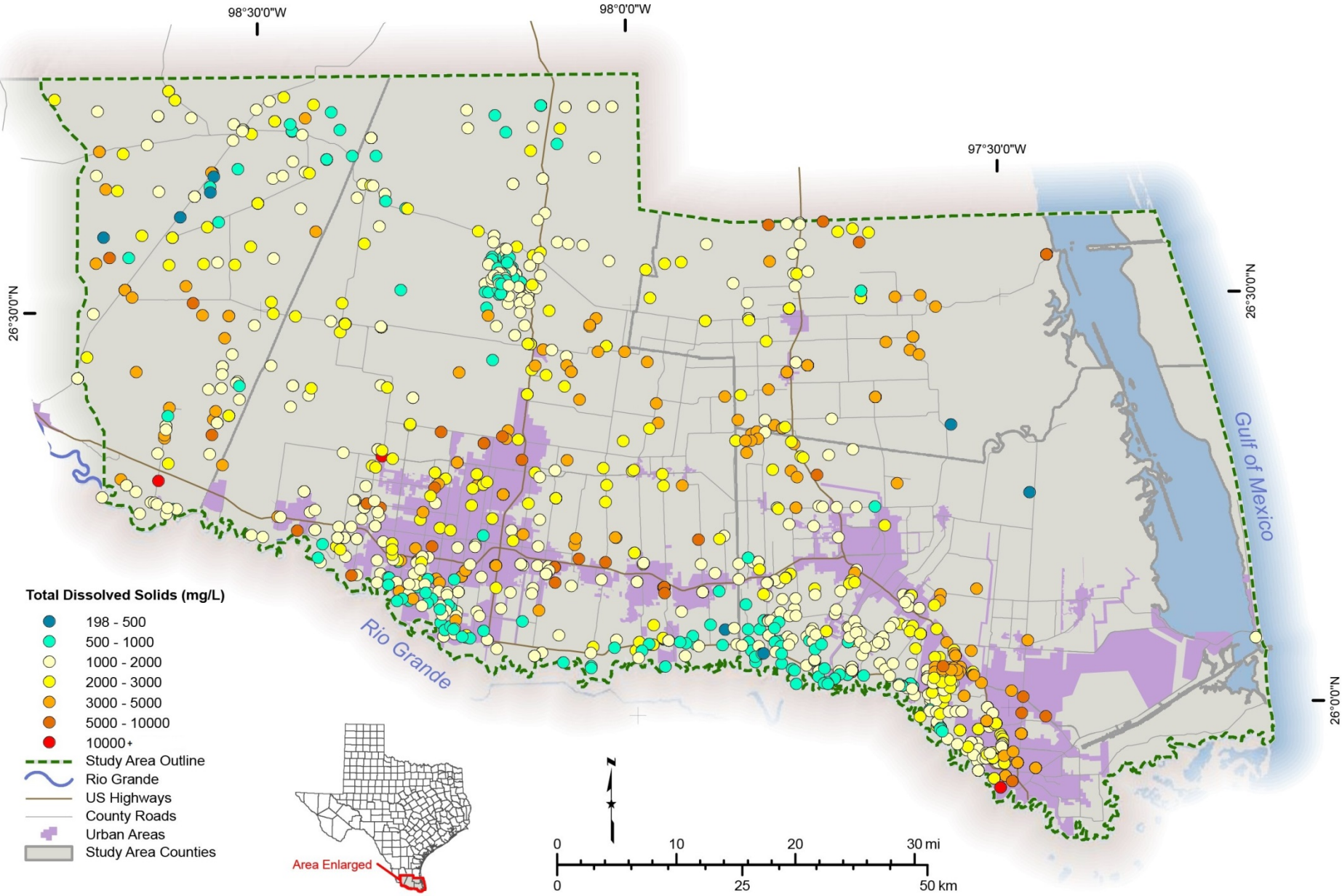
Water Well  
 TDS concentration = 2,264 mg/L  
*(well screen 170-349 ft)*

BRACS Well ID 42889

Source: Lower Rio Grande Valley BRACS Study



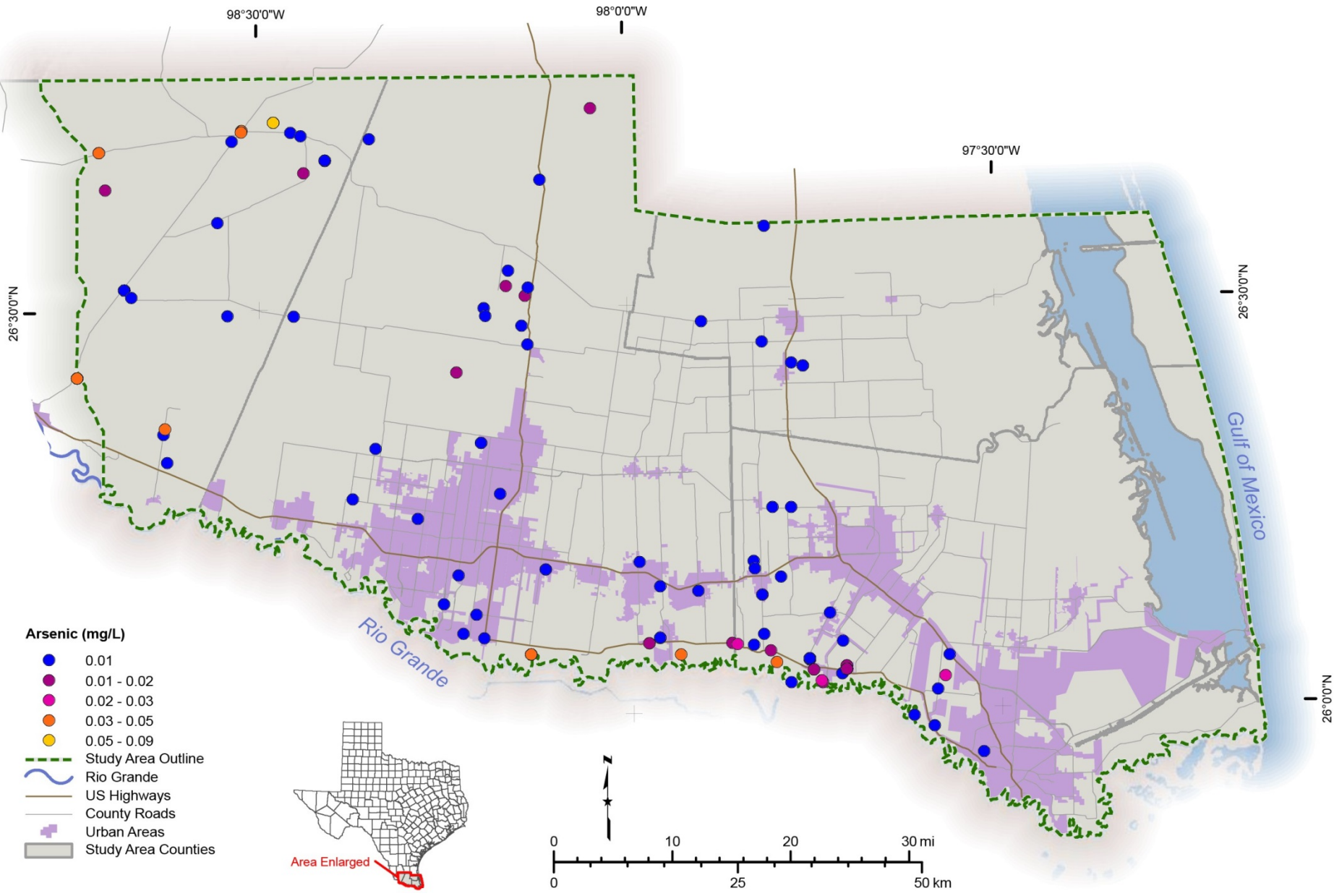
# Total Dissolved Solids



Source: Lower Rio Grande Valley BRACS Study

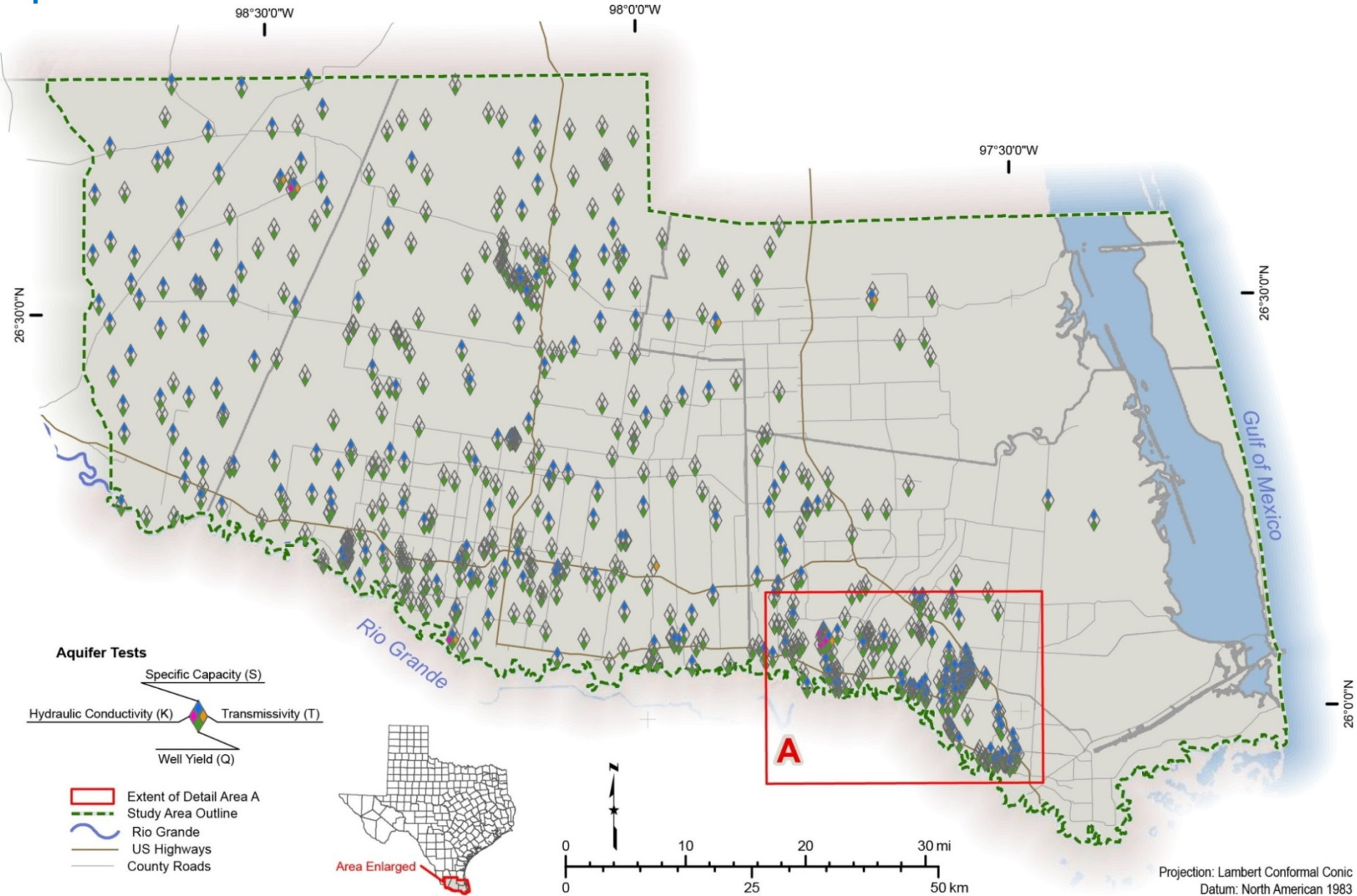


# Arsenic



Source: Lower Rio Grande Valley BRACS Study

# Aquifer Test Data

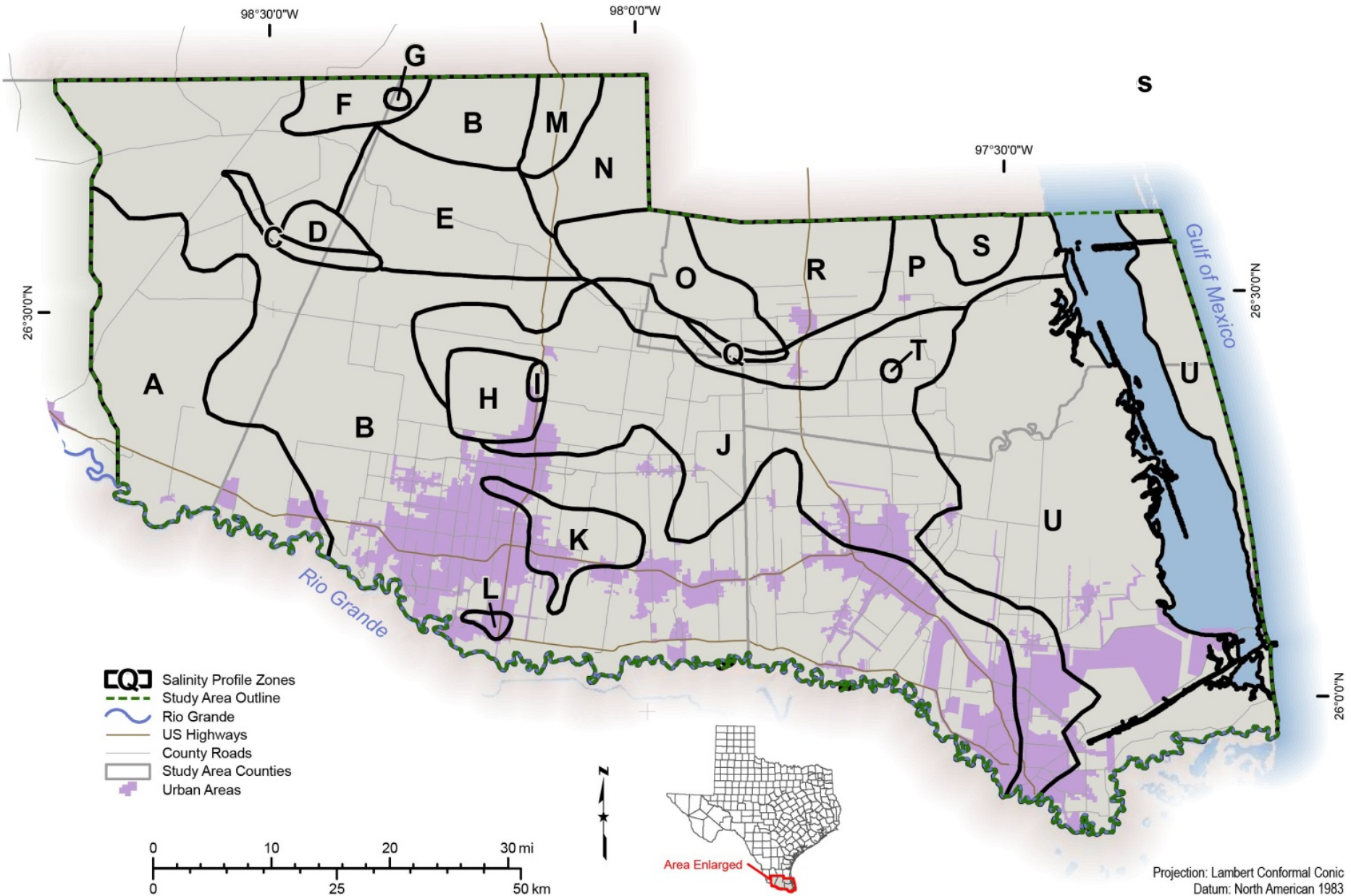


Source: Lower Rio Grande Valley BRACS Study

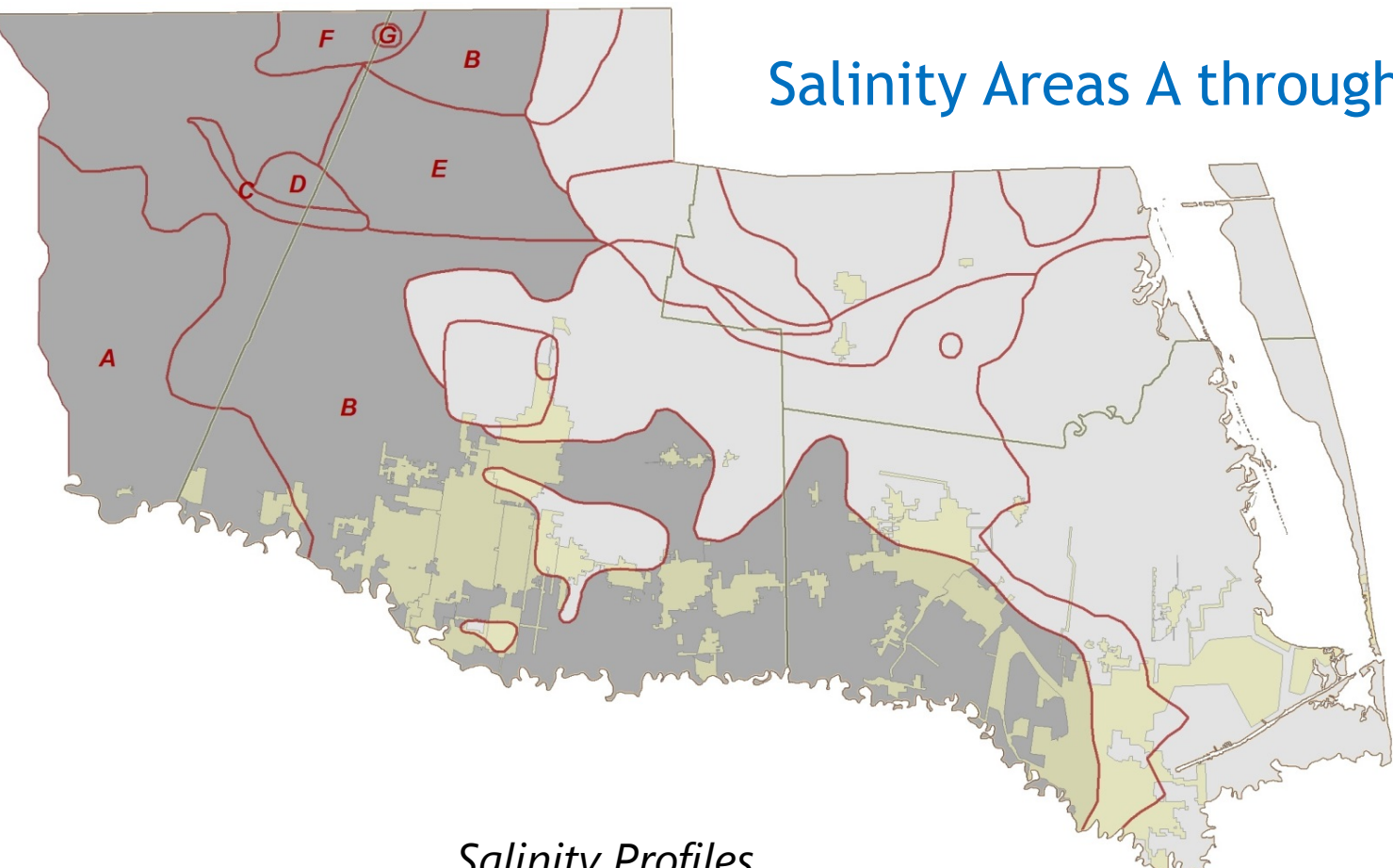
Projection: Lambert Conformal Conic  
Datum: North American 1983

# What did we find?

# 21 Salinity Areas Labeled A - U



# Salinity Areas A through G



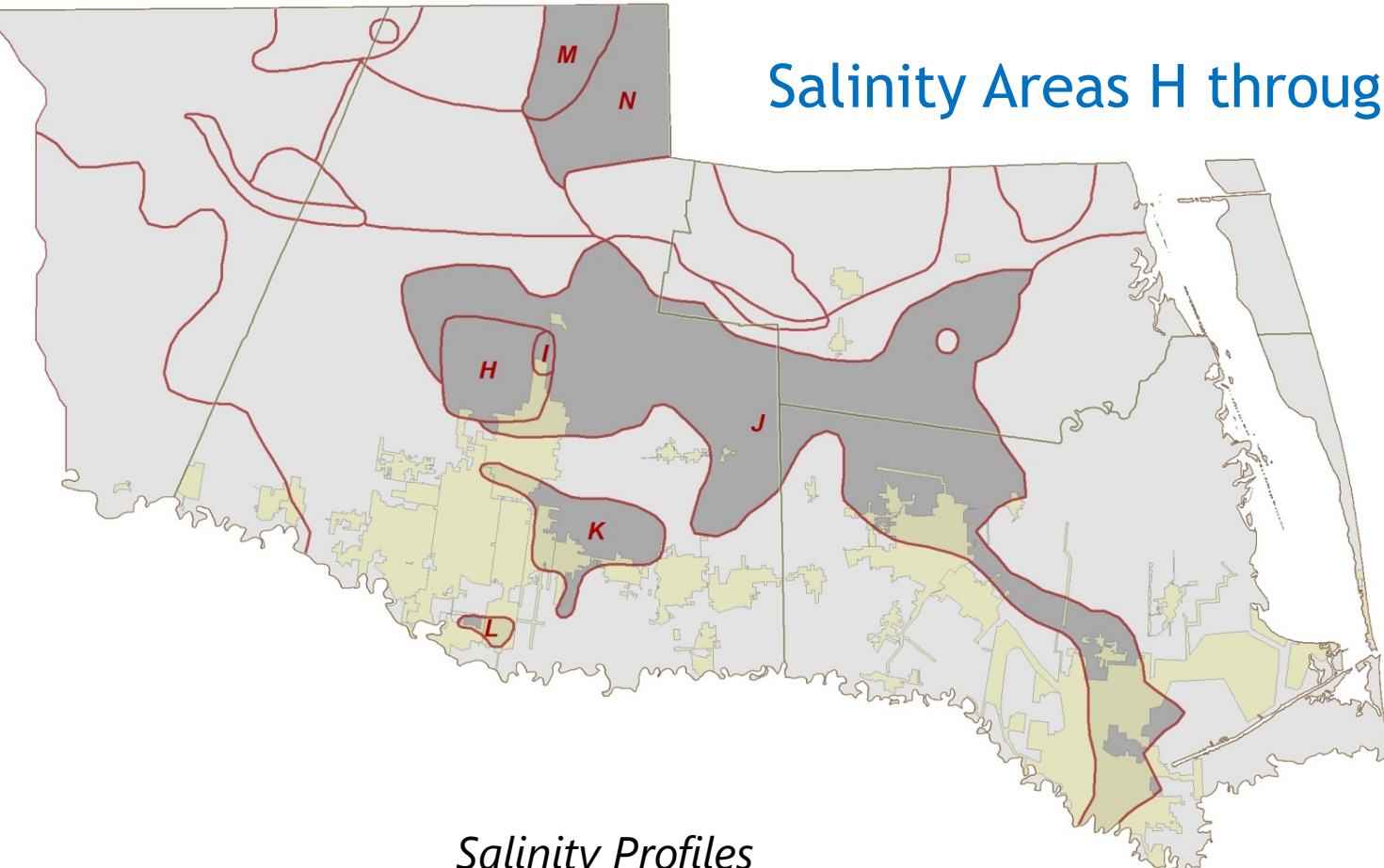
## Salinity Profiles

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

# Salinity Areas H through N



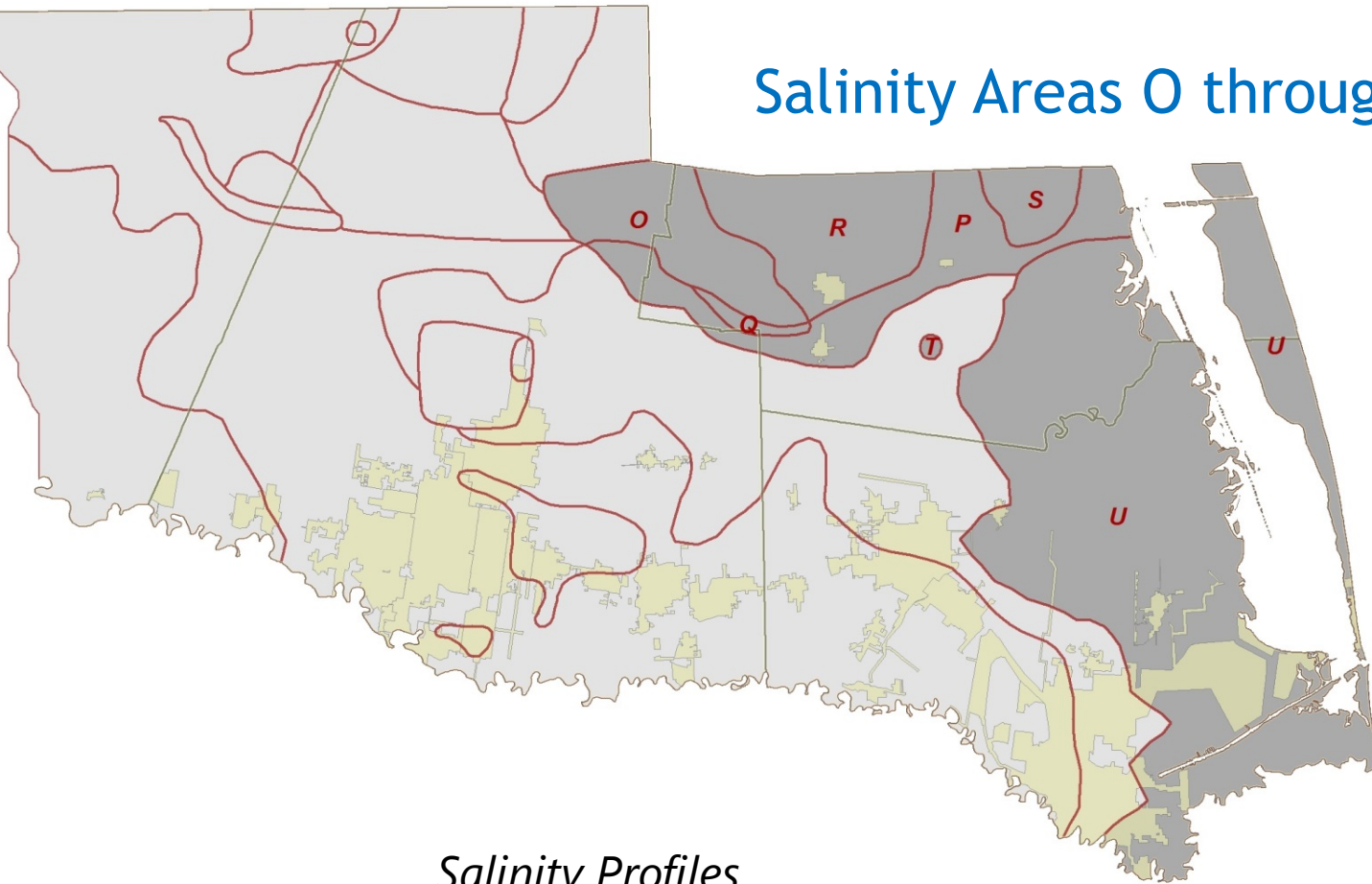
## Salinity Profiles

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

# Salinity Areas O through U

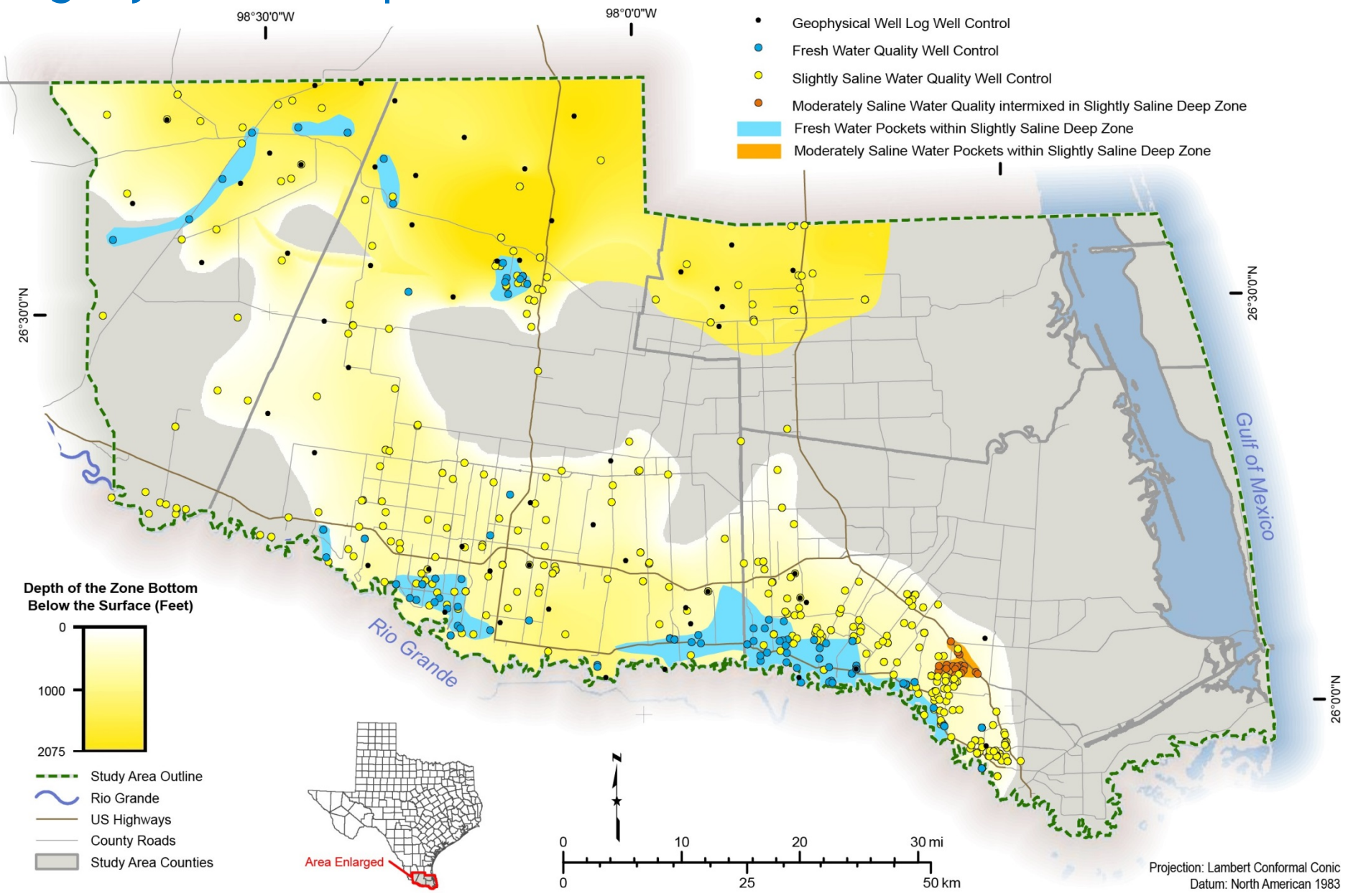


## Salinity Profiles

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

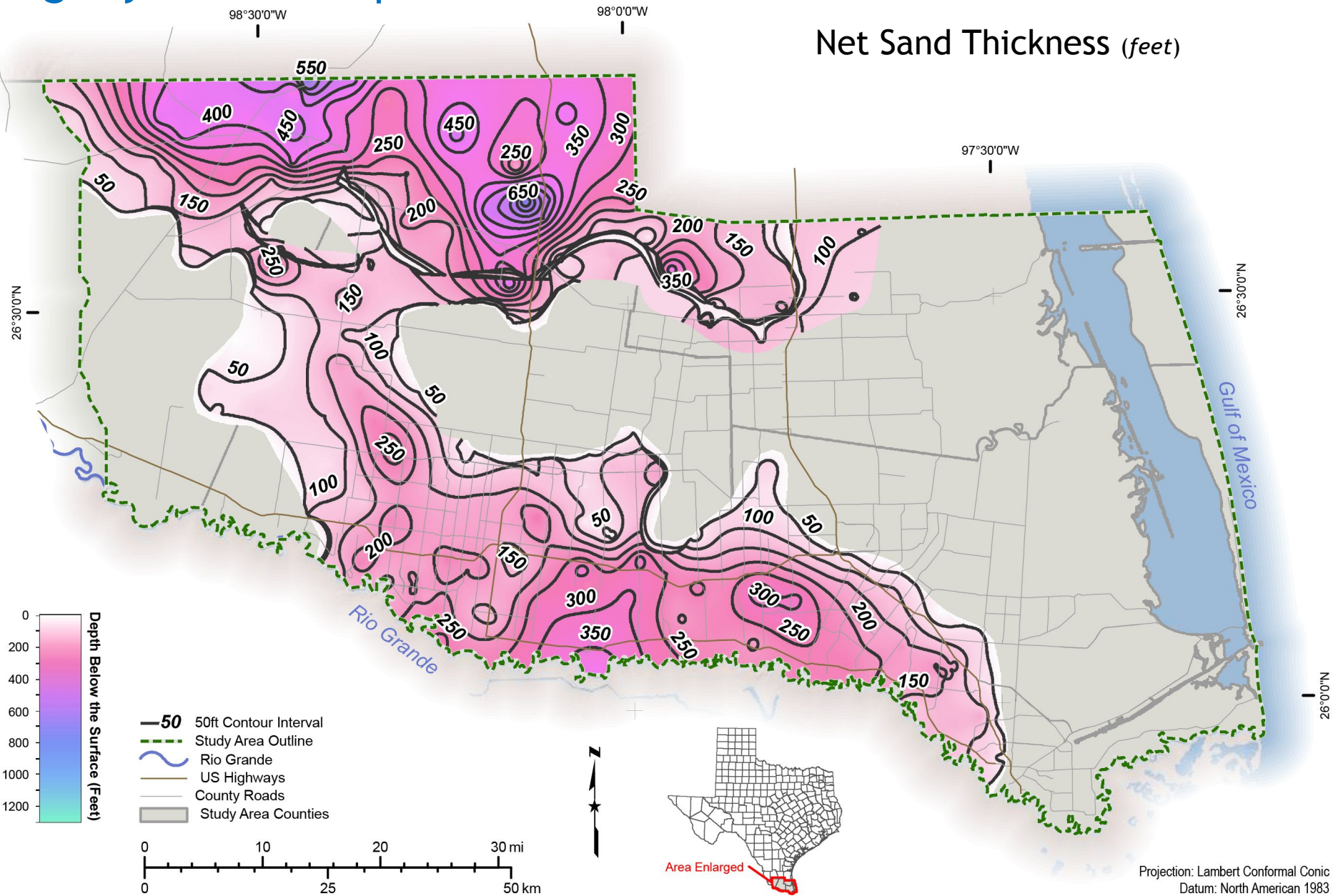
# Slightly Saline Deep Zone



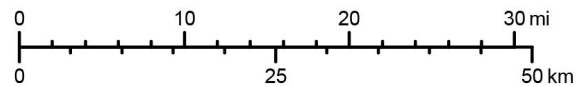
Source: Lower Rio Grande Valley BRACS Study

# Slightly Saline Deep Zone

Net Sand Thickness (feet)



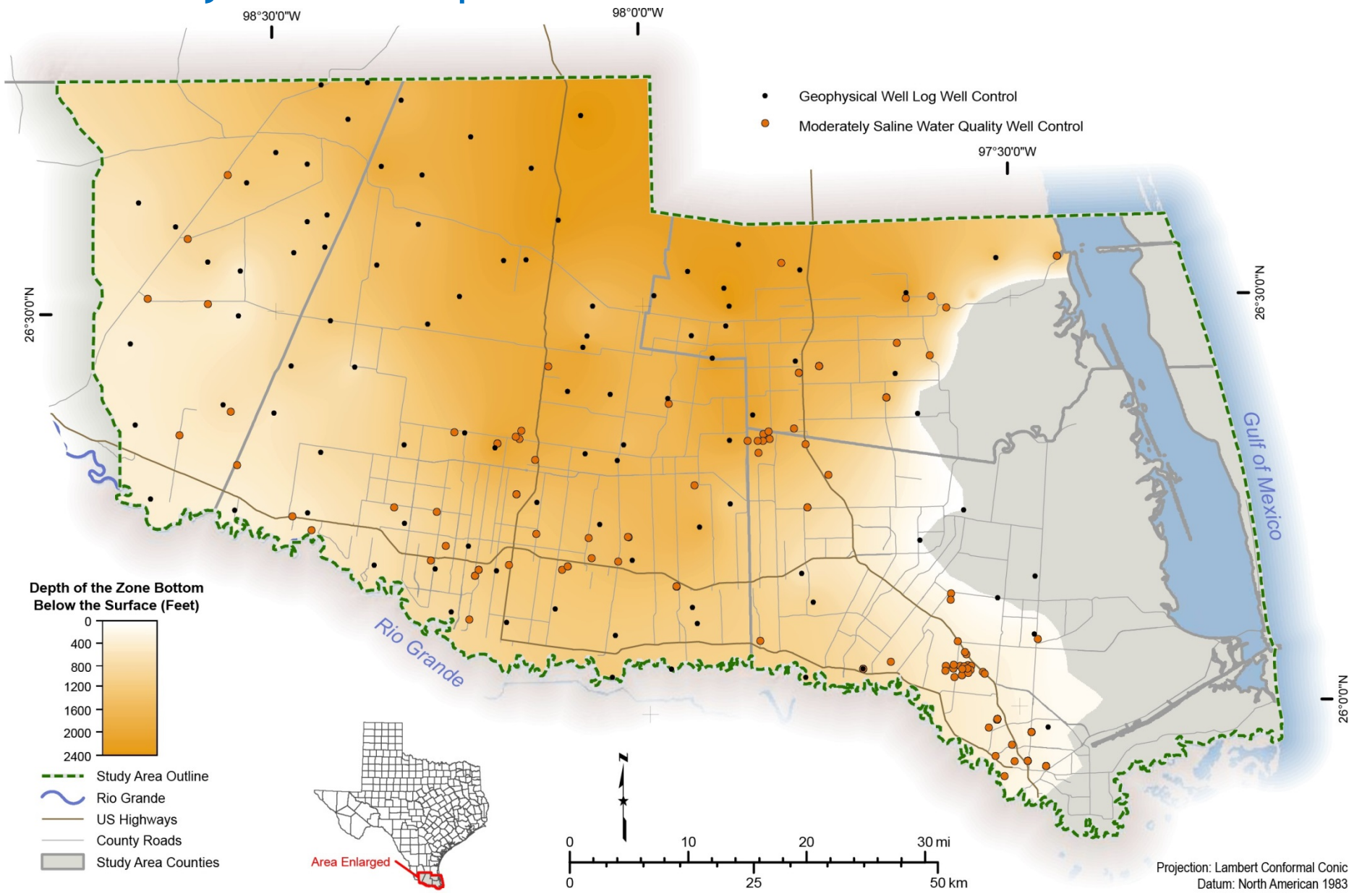
- 50** 50ft Contour Interval
- - -** Study Area Outline
- Rio Grande
- US Highways
- County Roads
- Study Area Counties



Source: Lower Rio Grande Valley BRACS Study



# Moderately Saline Deep Zone



Source: Lower Rio Grande Valley BRACS Study

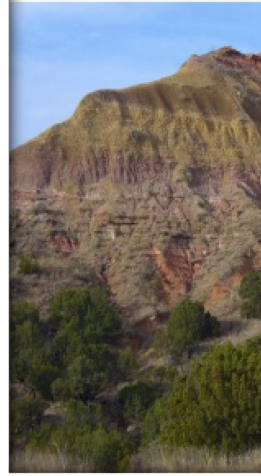
# BRACS Database Data Dictionary

## Brackish Resources Aquifer Characterization System Database Data Dictionary

Open File Report 12-02, Second Edition

September 2014

John E. Meyer, P.G.



### 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	tblLkInitial
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 -999999 is used if the value is not known.

# BRACS Database: Project salinity zone table

frmSalinityZone\_GulfCoast

BRACS Well ID:  State Well Number:

Project Salinity Zone:

OWNER:

Lower Rio Grande Valley BRACS Study  
Salinity Zone Profile Form

[Close Form](#)

Salinity Zone Profile at Well Site

Moderately Saline	Top Depth	<input type="text" value="0"/>
	Bottom Depth	<input type="text" value="851"/>
Very Saline	Top Depth	<input type="text" value="851"/>
	Bottom Depth	<input type="text" value="1351"/>
Brine	Top Depth	<input type="text" value="1351"/>

DEPTH\_WELL:


Depth Total:

SCREEN\_TOP:

SCREEN\_BOTTOM:

MULTIPLE\_SCREEN:

Salinity Zone Legend

	Slightly Saline (1,000 - 3,000 milligrams per liter Total Dissolved Solids)
	Moderately Saline (3,000 - 10,000 milligrams per liter Total Dissolved Solids)
	Very Saline (10,000 - 35,000 milligrams per liter Total Dissolved Solids)
	Brine (> 35,000 milligrams per liter Total Dissolved Solids)

9	16	2005	1										
Month	Day	Year	Sample Number										
Silica	Calcium	Magnesium	Sodium	Potassium	Bicarb	Carb	Sulfate	Chloride	Nitrate	TDS	Spec. C.		
<input type="text" value="13.7"/>	<input type="text" value="155"/>	<input type="text" value="81"/>	<input type="text" value="1070"/>	<input type="text" value="17.9"/>	<input type="text" value="250"/>	<input type="text" value="-99999"/>	<input type="text" value="1120"/>	<input type="text" value="1230"/>	<input type="text" value="&lt; 0.05"/>	<input type="text" value="3818"/>	<input type="text" value="6000"/>		
7	16	2013	1										
Month	Day	Year	Sample Number										
Silica	Calcium	Magnesium	Sodium	Potassium	Bicarb	Carb	Sulfate	Chloride	Nitrate	TDS	Spec. C.		
<input type="text" value="26.5"/>	<input type="text" value="138"/>	<input type="text" value="74"/>	<input type="text" value="855"/>	<input type="text" value="10.3"/>	<input type="text" value="333.15"/>	<input type="text" value="0"/>	<input type="text" value="976"/>	<input type="text" value="1120"/>	<input type="text" value="&lt; 0.02"/>	<input type="text" value="3371"/>	<input type="text" value="4130"/>		
Month	Day	Year	Sample Number										
Silica	Calcium	Magnesium	Sodium	Potassium	Bicarb	Carb	Sulfate	Chloride	Nitrate	TDS	Spec. C.		
<input type="text" value="-99999"/>	<input type="text" value="-99999"/>	<input type="text" value="-99999"/>	<input type="text" value="-99999"/>	<input type="text" value="-99999"/>	<input type="text" value="-99999"/>	<input type="text" value="-99999"/>	<input type="text" value="-99999"/>	<input type="text" value="-99999"/>	<input type="text" value="-99999"/>	<input type="text" value="-99999"/>	<input type="text" value="-99999"/>		

Source: BRACS program



# BRACS Database: Project net sand determination tables

BRACS Well ID

## Lower Rio Grande Valley BRACS Study Net Sand Gulf Coast Aquifer

Net Sand Processing Table		Top	Bottom	Sand %
Record Number	Simplified Lithologic Description	Thickness		
23	Sand with Clay	65	105	0.65
		40		
25	Sand with Clay	125	175	0.65
		50		
27	Sand with Clay	191	205	0.65
		14		
28	Sand	205	215	1
		10		
29	Clay with Sand	215	285	0.35
		70		
30	Sand	285	349	1
		64		

Formation	Formation Net Sand	Formation Present	Partial Geology Desc	Aquifer Net Sand	Aquifer Present	Aquifer Determination Table									
	Sand %	Well Partial Penetration		Sand %	Well Partial Penetration	Depth Well	B_T_D:	Depth Hole	B_B_D:	Screen Top	L_T_D:	Screen Bottom	L_B_D:	W_T_D:	W_B_D:
<b>Chicot Aquifer</b>															
Beaumont Fm	200	Yes	Yes												
	-99999	No													
Lissie Fm	100	Yes	No	300	Yes										
	-99999	Yes		26	Yes										
Willis Fm	0	Yes	No												
	-99999	Yes													
<b>Evangeline Aquifer</b>															
Upper Goliad Fm	0	Yes	No												
	-99999	Yes													
Lower Goliad Fm	0	Yes	No	0	Yes										
	-99999	Yes		0	Yes										
Upper Lagarto Fm	0	Yes	No												
	-99999	Yes													
<b>Burkeville Confining Unit</b>															
Middle Lagarto Fm	0	Yes	No												
	-99999	Yes													
<b>Jasper Aquifer</b>															
Lower Lagarto Fm	0	Yes	No	0	Yes										
	-99999	Yes													
Oakville Fm	0	Yes	No	0	Yes										
	-99999	Yes													

# Summary

- Substantial brackish groundwater for development
- Study can support the location 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
- Future efforts:

TWDB will contract a Lower Rio Grande Valley groundwater salinity model

Collect new well data as brackish groundwater is developed

# Texas Water Development Board



[www.twdb.texas.gov](http://www.twdb.texas.gov)

## Conservation and Innovative Water Technologies Division

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