



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

by
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Texas Alliance of Groundwater Districts

August 27, 2014

Texas Water Development Board

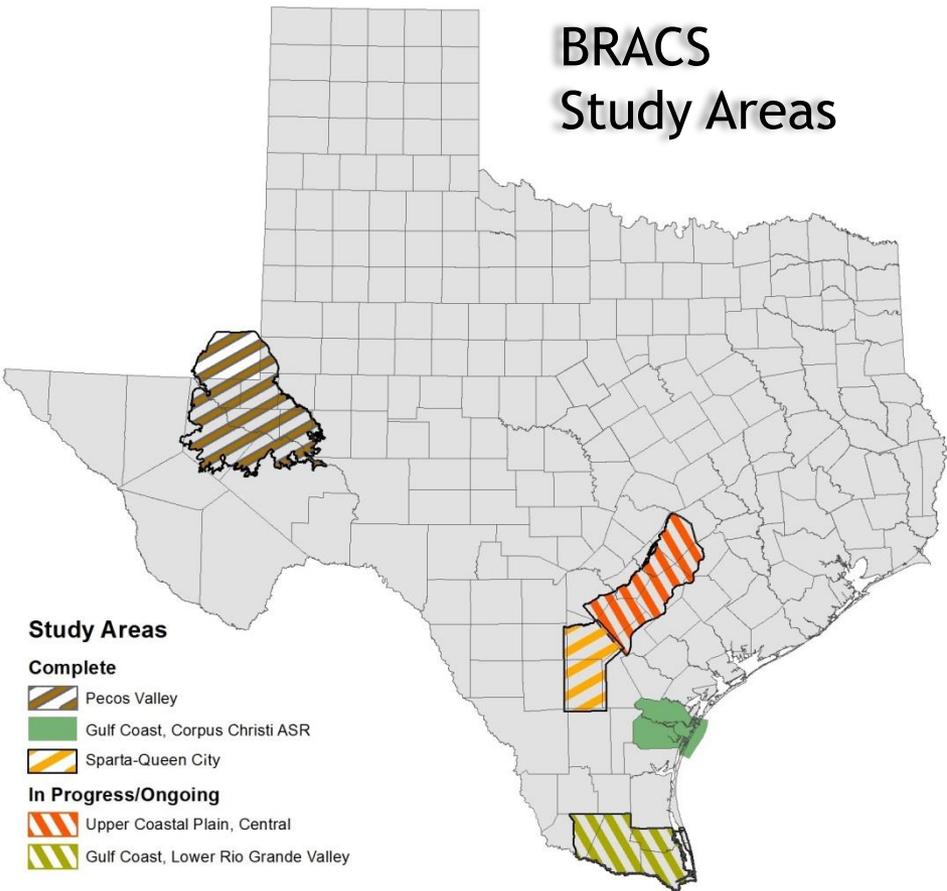
The following presentation is based upon professional research and analysis within the scope of the Texas Water Development Board's statutory responsibilities and priorities but, unless specifically noted, does not necessarily reflect official Board positions or decisions.

Source: TWDB General Counsel

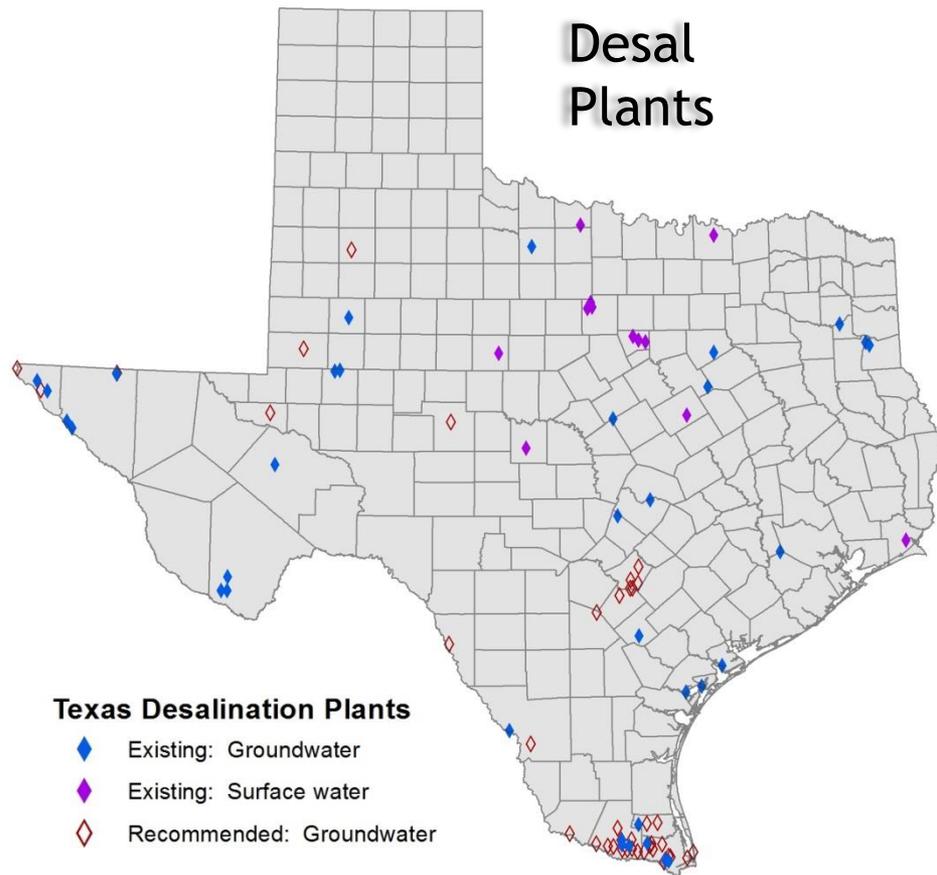


BRACS Studies and Existing/Recommended Desal Plants

BRACS Study Areas



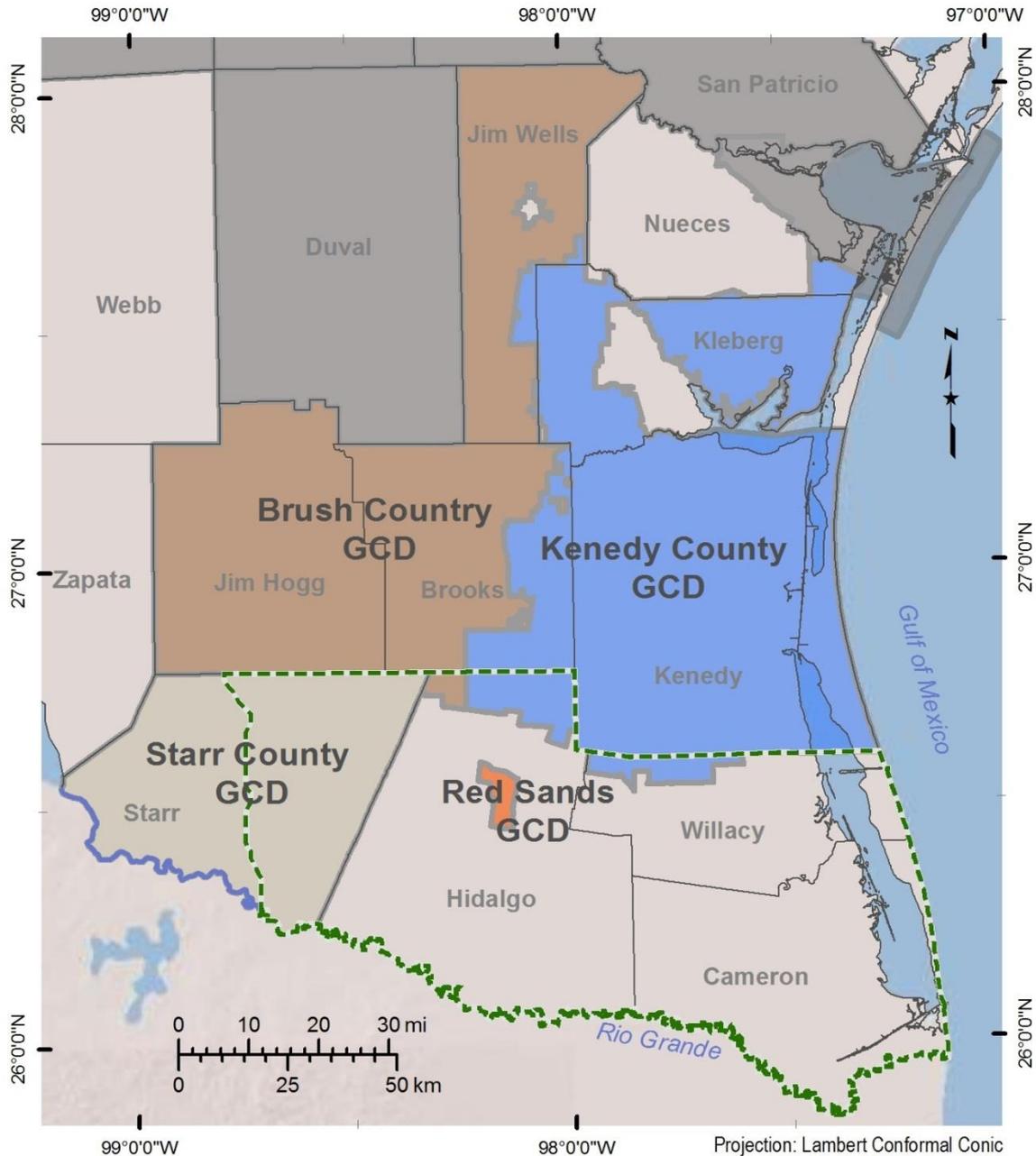
Desal Plants



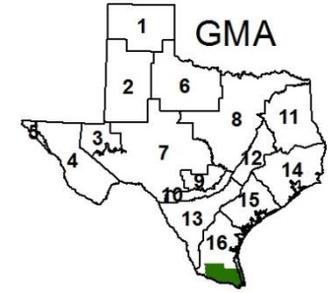
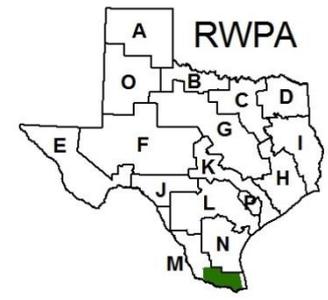
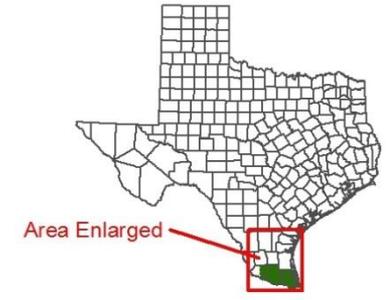
Lower Rio Grande Valley

- Groundwater in the study area is mostly brackish
- 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
23 recommended brackish groundwater desalination projects

Study Area Administrative Boundaries



- Study Area Outline
- Rio Grande
- Texas Counties
- Brush Country GCD
- Kenedy County GCD
- Red Sands GCD
- Starr County GCD
- GCD Outside the Study Ar
- Study Area



Study Objectives

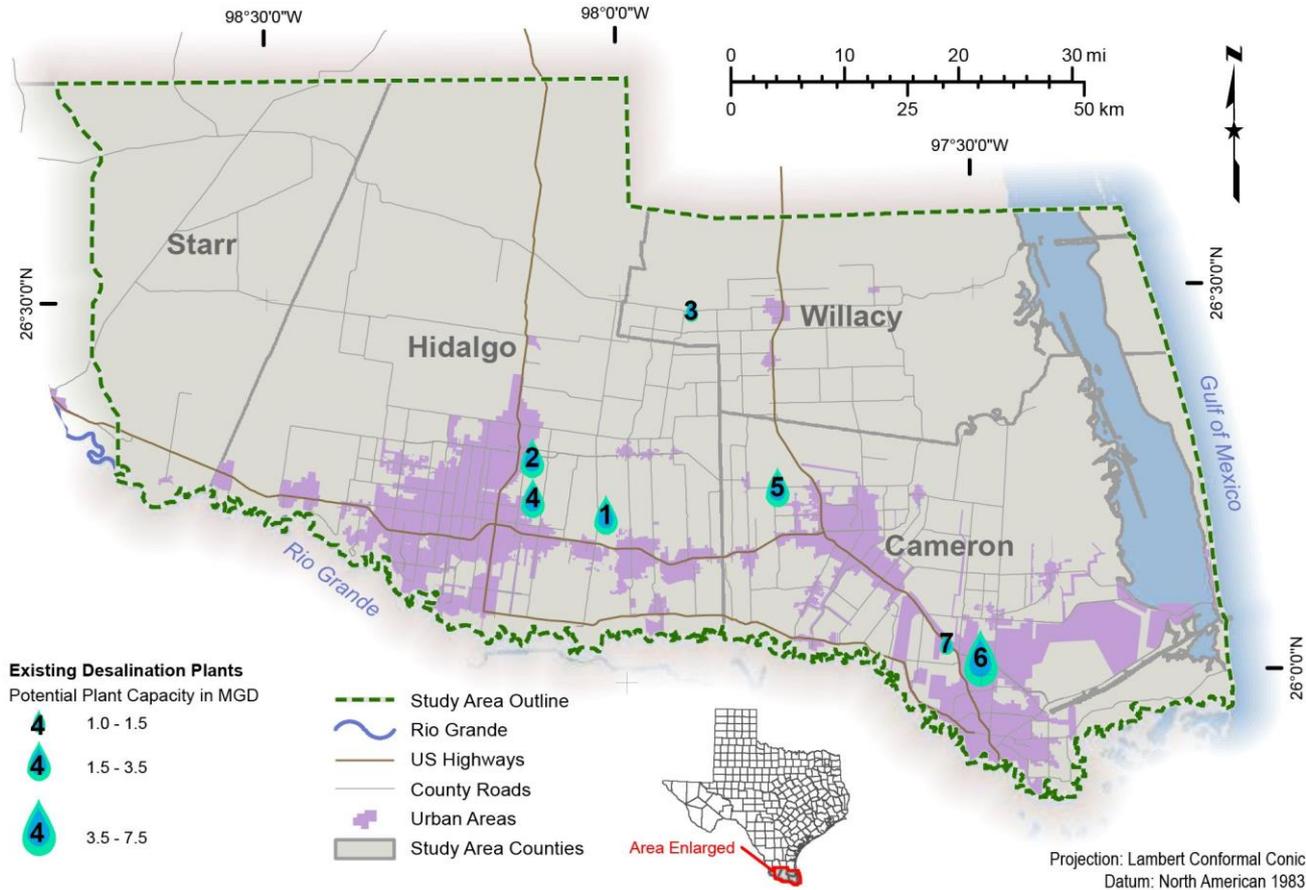
- Map salinity areas (2-dimensional) with a unique vertical salinity profile
- Create 3-dimensional salinity zone GIS datasets
- Determine volumes of brackish groundwater
- Map sand and clay layers within the Gulf Coast Aquifer
- Map water quality parameters
- Map aquifer tests
- Collect water well reports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

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

Source: modified from Winslow and Kister, 1956

Existing Desalination Plants



Existing Desalination Plants
Potential Plant Capacity in MGD

-  1.0 - 1.5
-  1.5 - 3.5
-  3.5 - 7.5

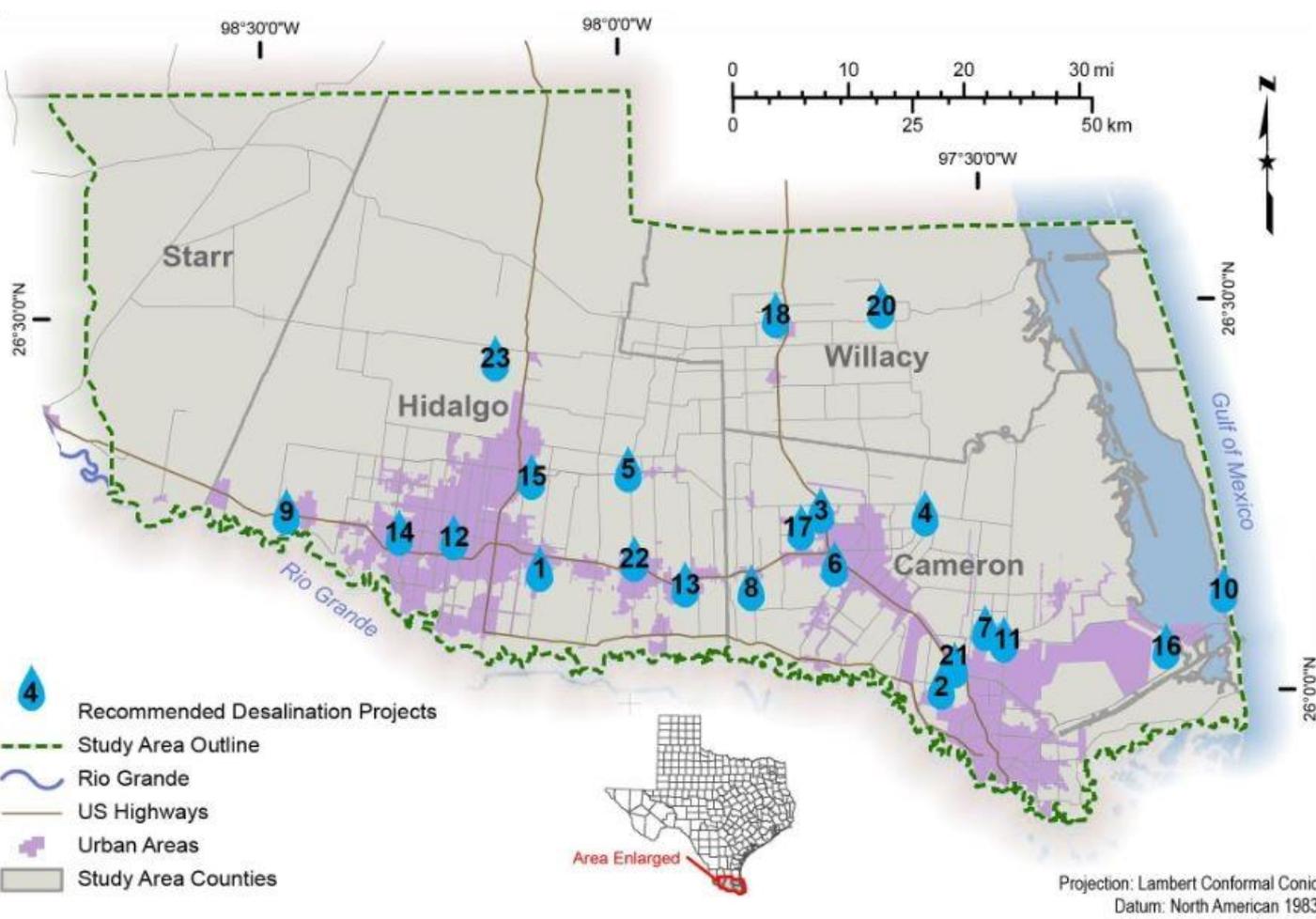
-  Study Area Outline
-  Rio Grande
-  US Highways
-  County Roads
-  Urban Areas
-  Study Area Counties



Projection: Lambert Conformal Conic
Datum: North American 1983

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

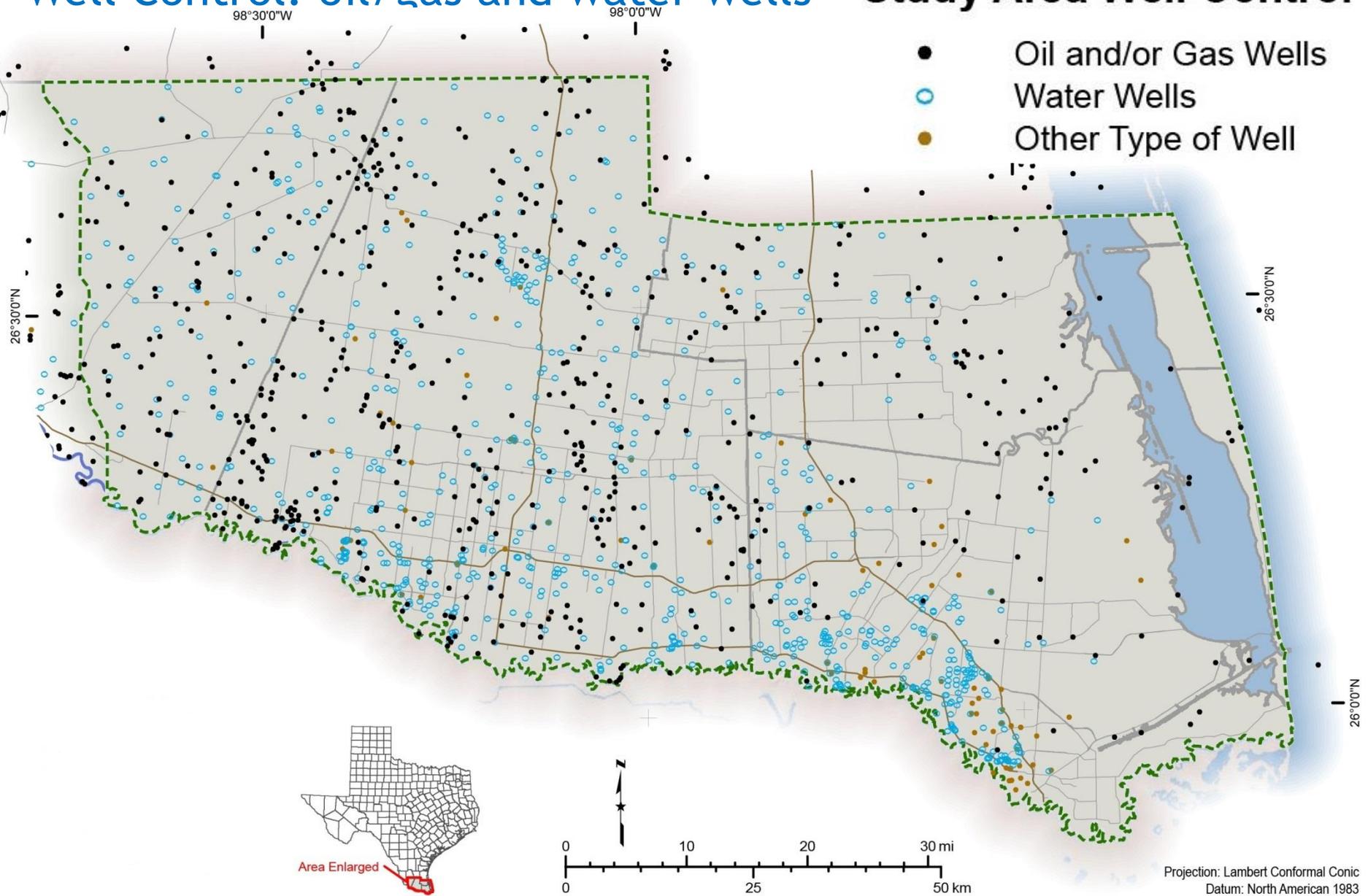
Recommended Desalination Plants



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

Study Area Well Control



Area Enlarged

Source: Lower Rio Grande Valley BRACS Study

Water Well Logs

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

ATTENTION OWNER: Confidentiality STATE OF TEXAS
 Privilege Notice on Reverse Side 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 TWRC?

6) WELL LOG: 28276 DIAMETER OF HOLE 7) DRILLING METHOD: 8) BOREHOLE COMPLETION:
 DATE DRILLING: DIAMETER FROM TO MUD ROTARY GRAVEL PACKED
 STARTED: 05/06/96 40 0 48 IF GRAVEL... FROM 180 FT. TO 400 FT.
 COMPLETED: 05/30/96 30 48 400 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 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 PLUM: 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

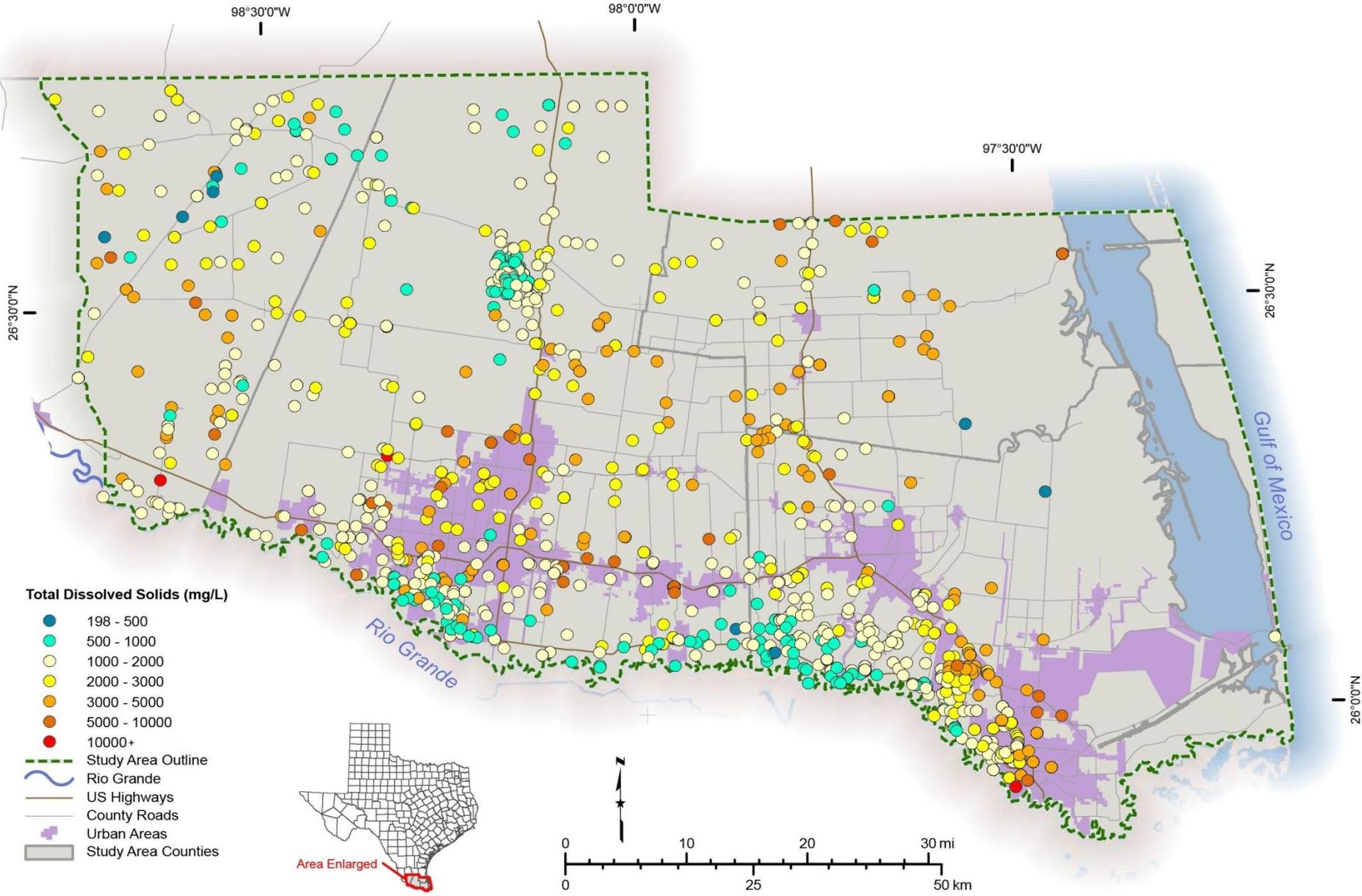
15) WATER QUALITY:
 TYPE OF WATER: GOOD DEPTH OF STRATA: CHEMICAL ANALYSIS MADE
 NO STRATA OF UNDESIRABLE WATER PENETRATED

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

Total Dissolved Solids



Source: Lower Rio Grande Valley BRACS Study

Aquifer Test Data

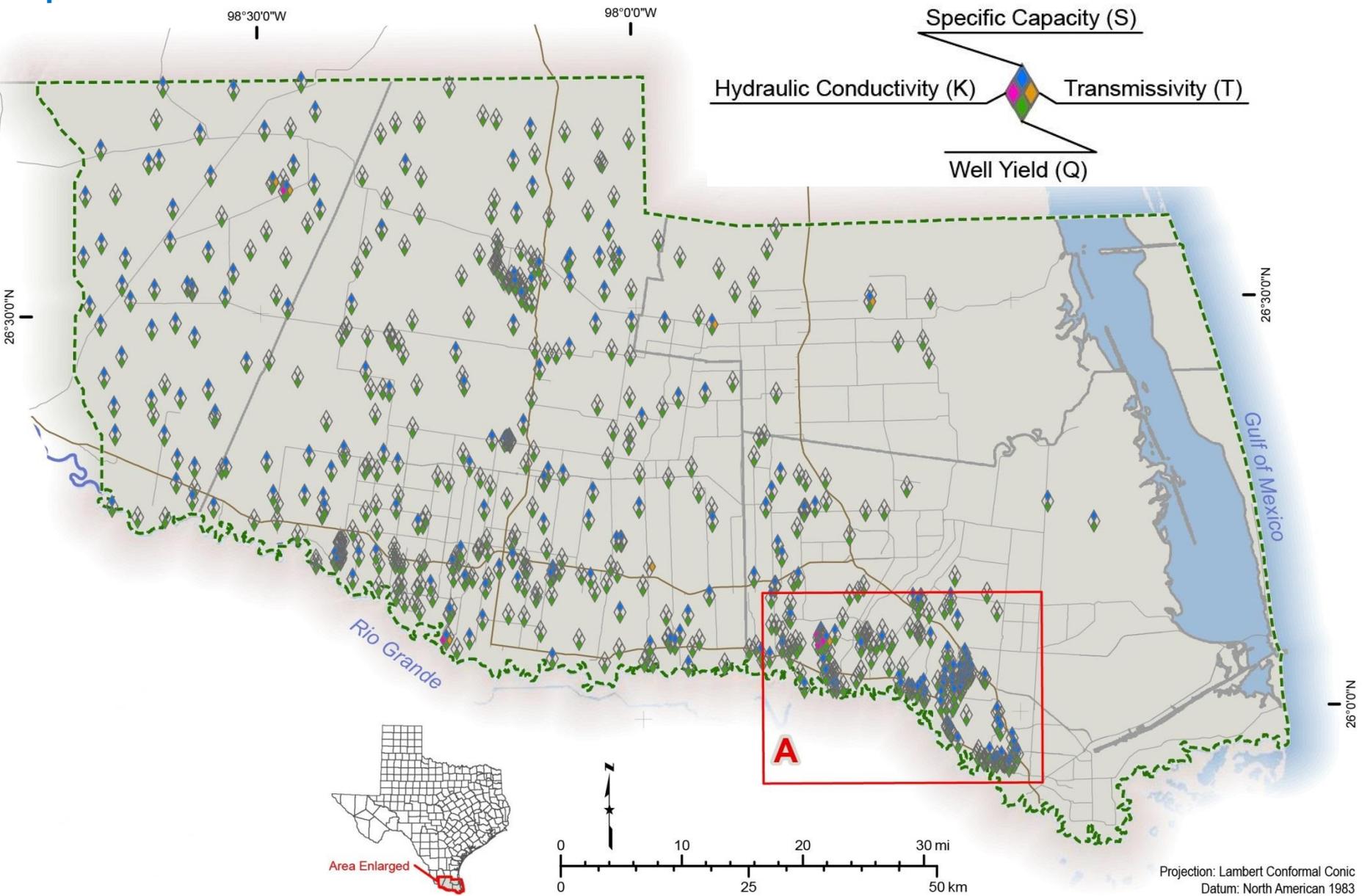
Aquifer Tests

Specific Capacity (S)

Hydraulic Conductivity (K)

Transmissivity (T)

Well Yield (Q)

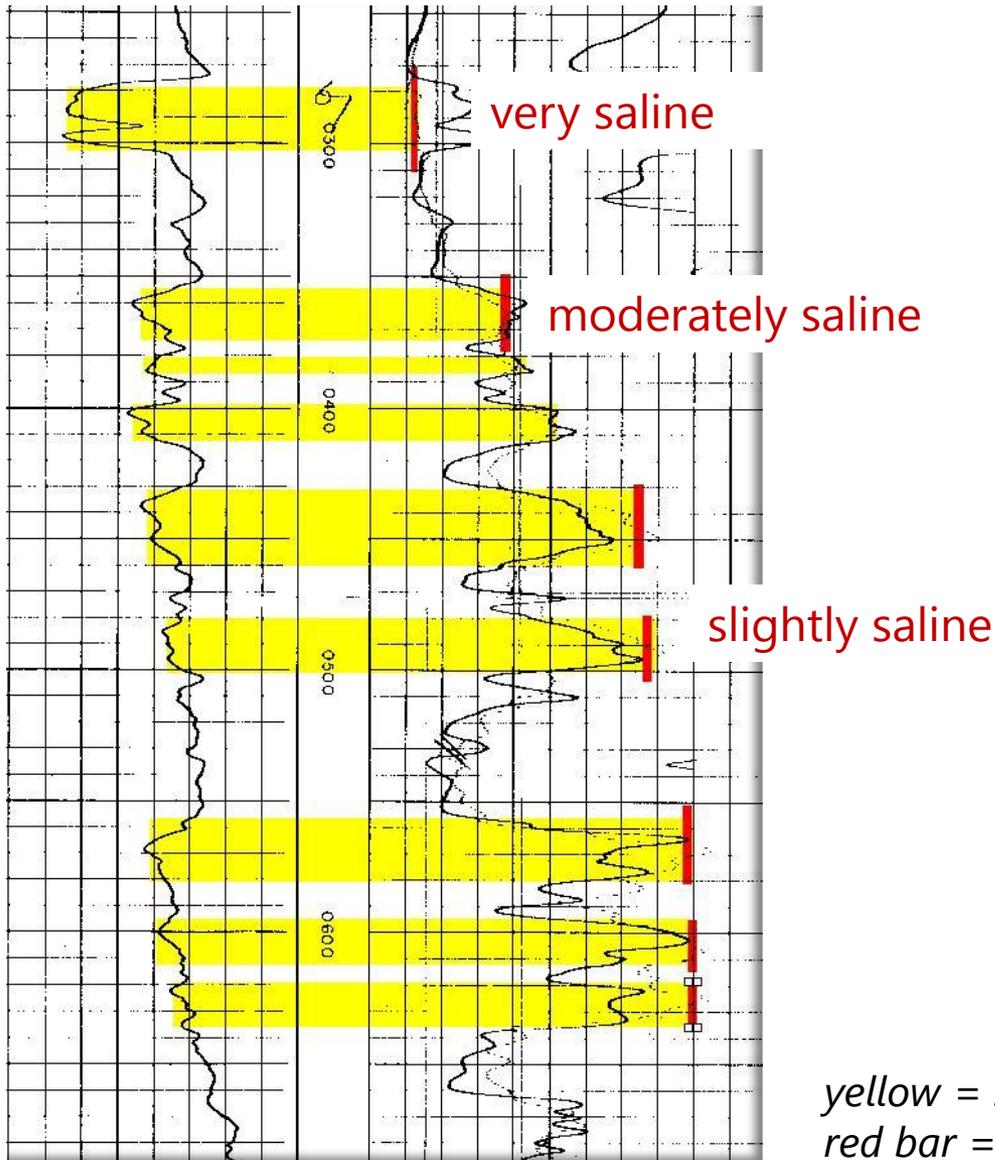


Source: Lower Rio Grande Valley BRACS Study

Projection: Lambert Conformal Conic
Datum: North American 1983



Geophysical Well Logs

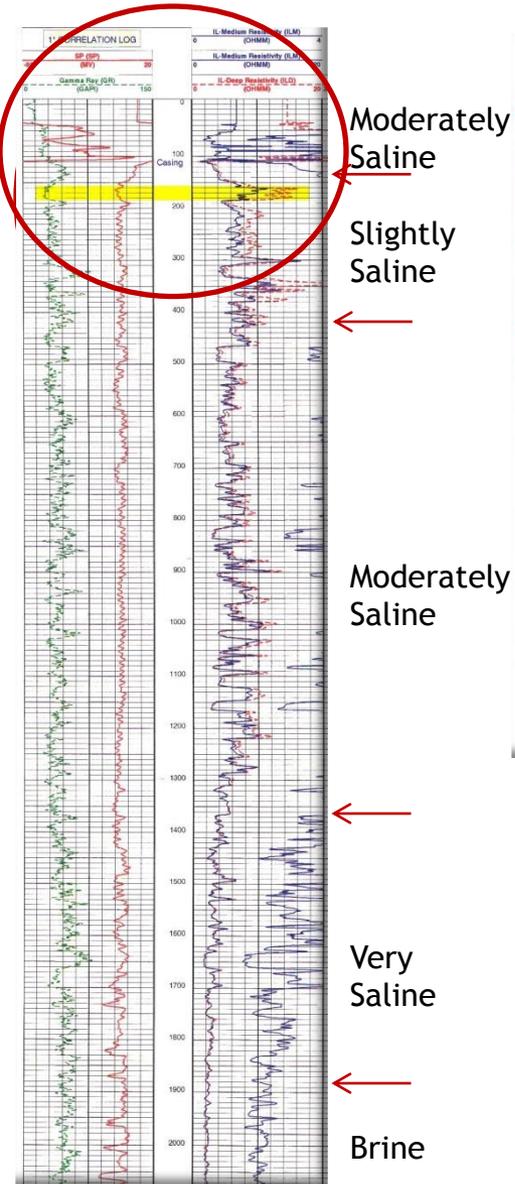


- Geology
(sand, clay, ...
depositional environment)
- Aquifer extent
top and bottom depths
- Fault identification
- 3-D Salinity zone
top and bottom depths

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

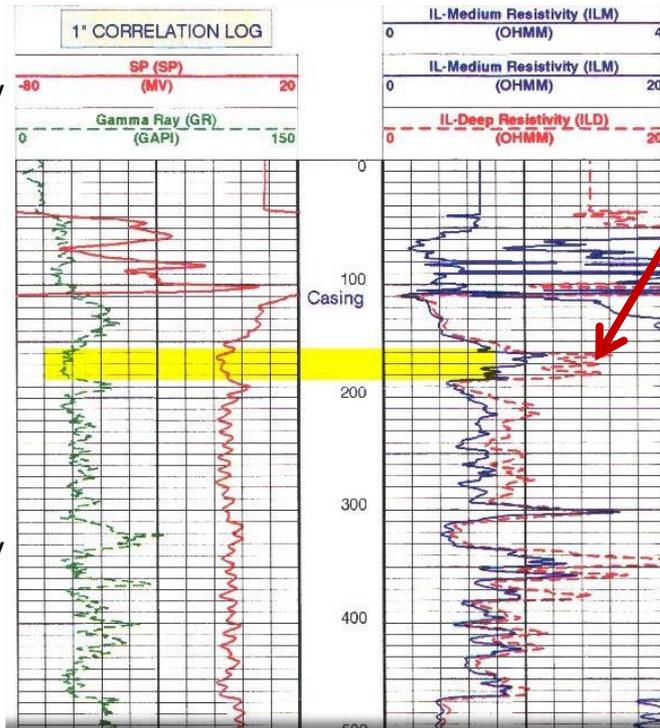
*yellow = sands
red bar = maximum deep resistivity
BRACS well 4161*

Log Analysis



BRACS Well ID 42889

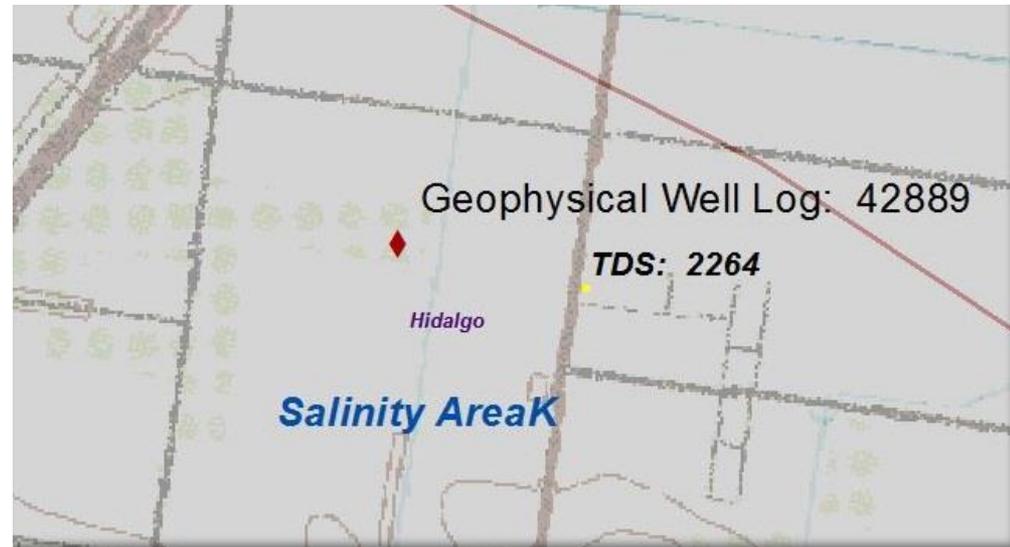
Source: Lower Rio Grande Valley BRACS Study



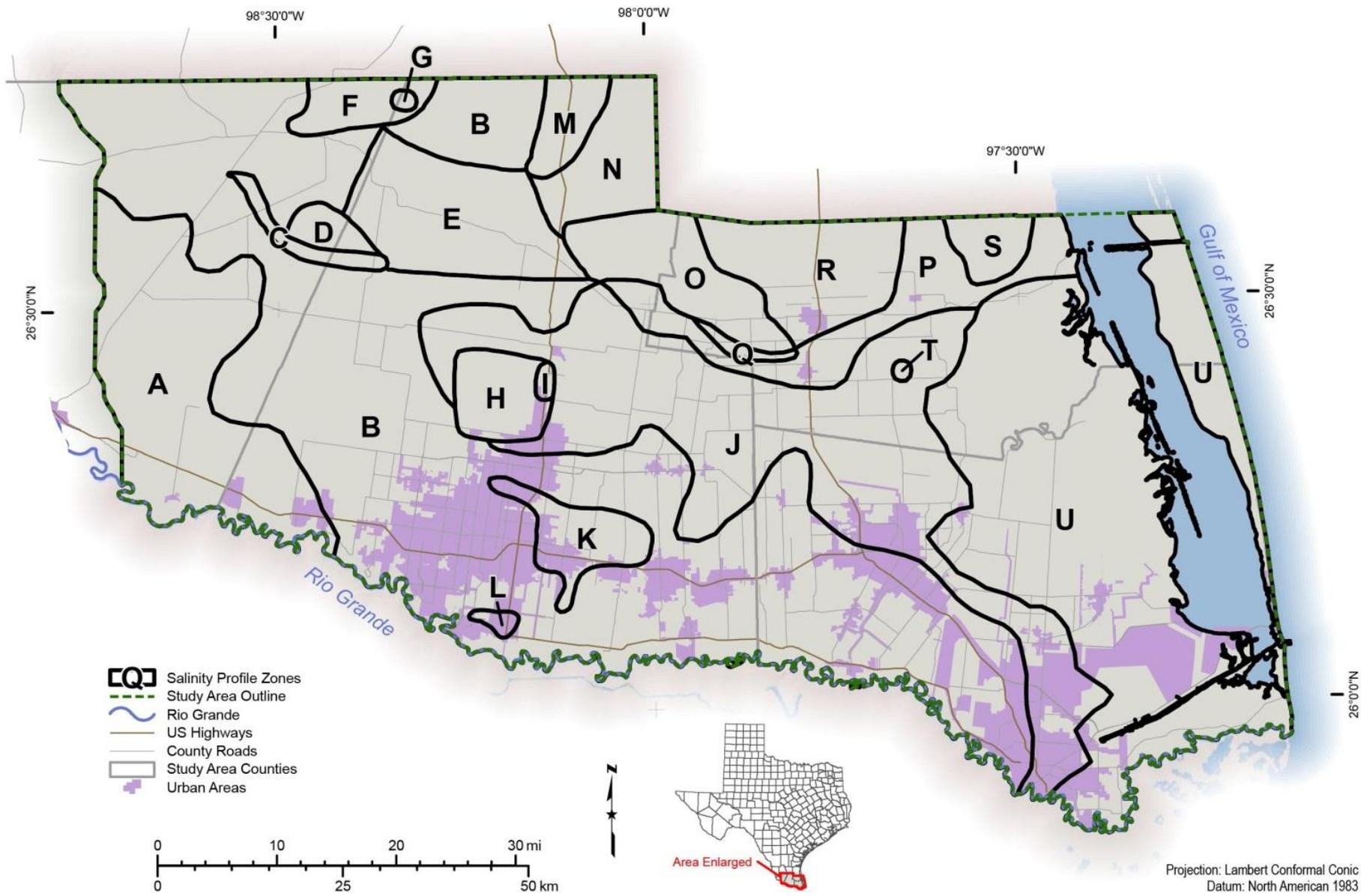
At 160 ft = 15 ohm-meter

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

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



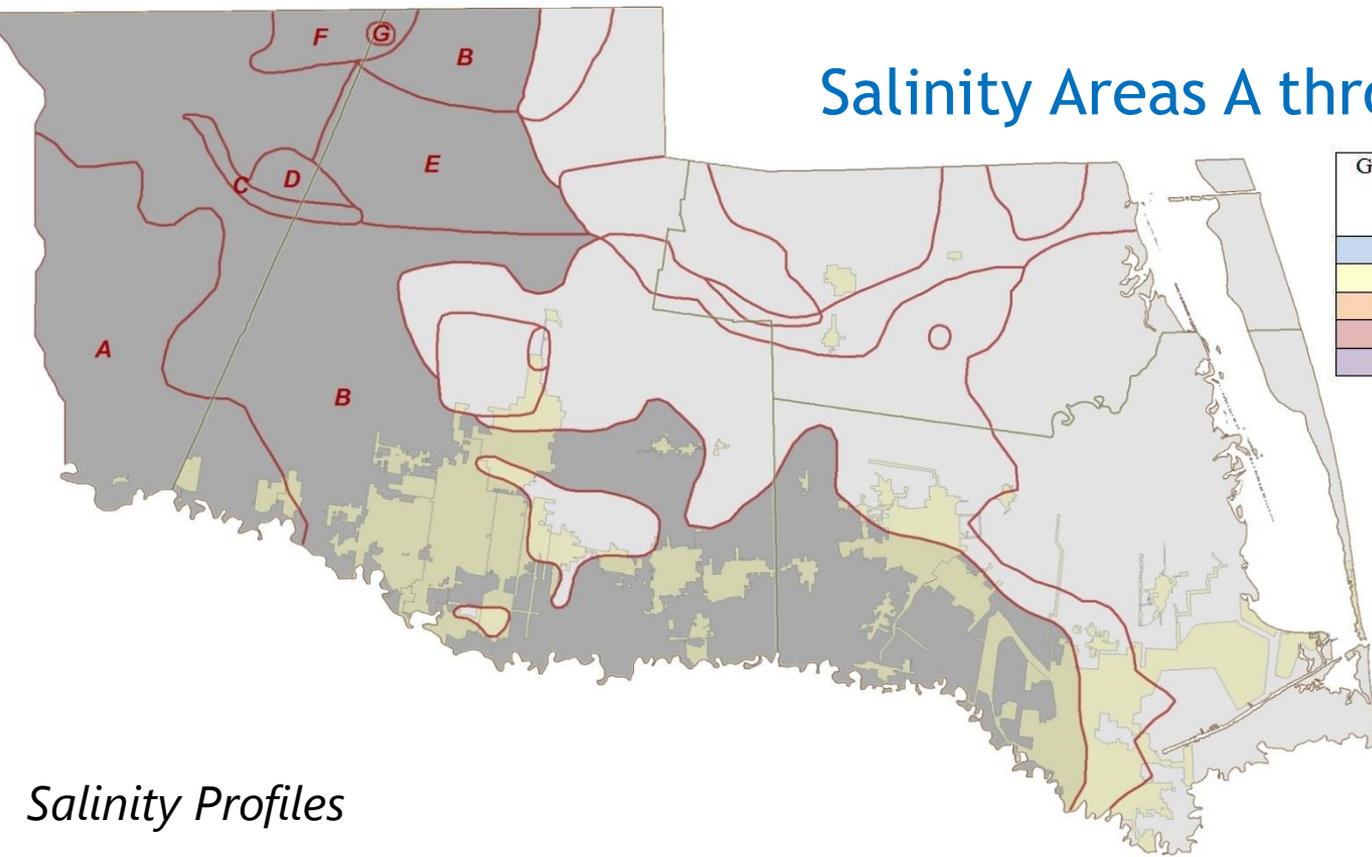
21 Salinity Areas Labeled A - U



Source: Lower Rio Grande Valley BRACS Study

Salinity Areas A through G

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

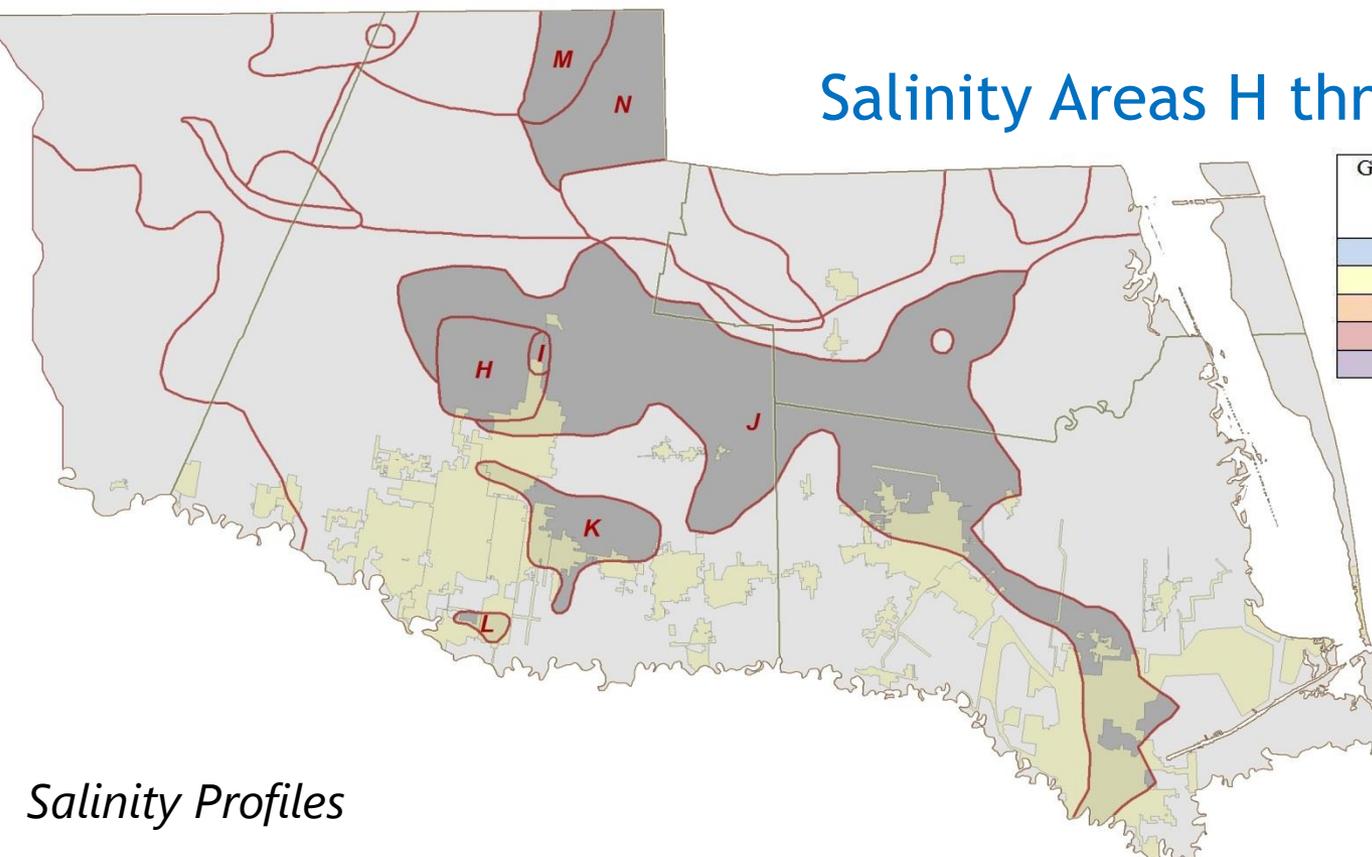


Salinity Profiles

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

Salinity Areas H through N

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

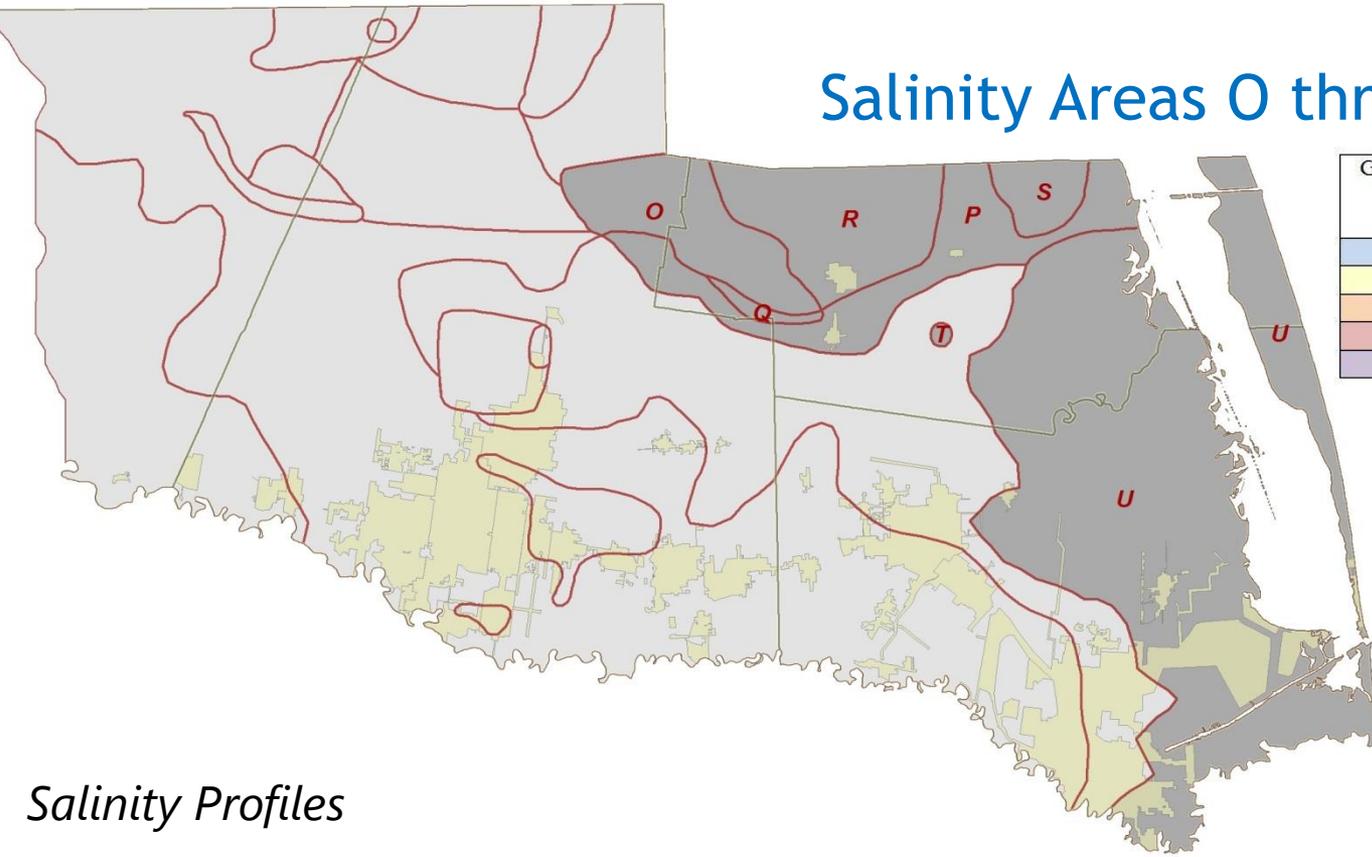


Salinity Profiles

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

Salinity Areas O through U

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

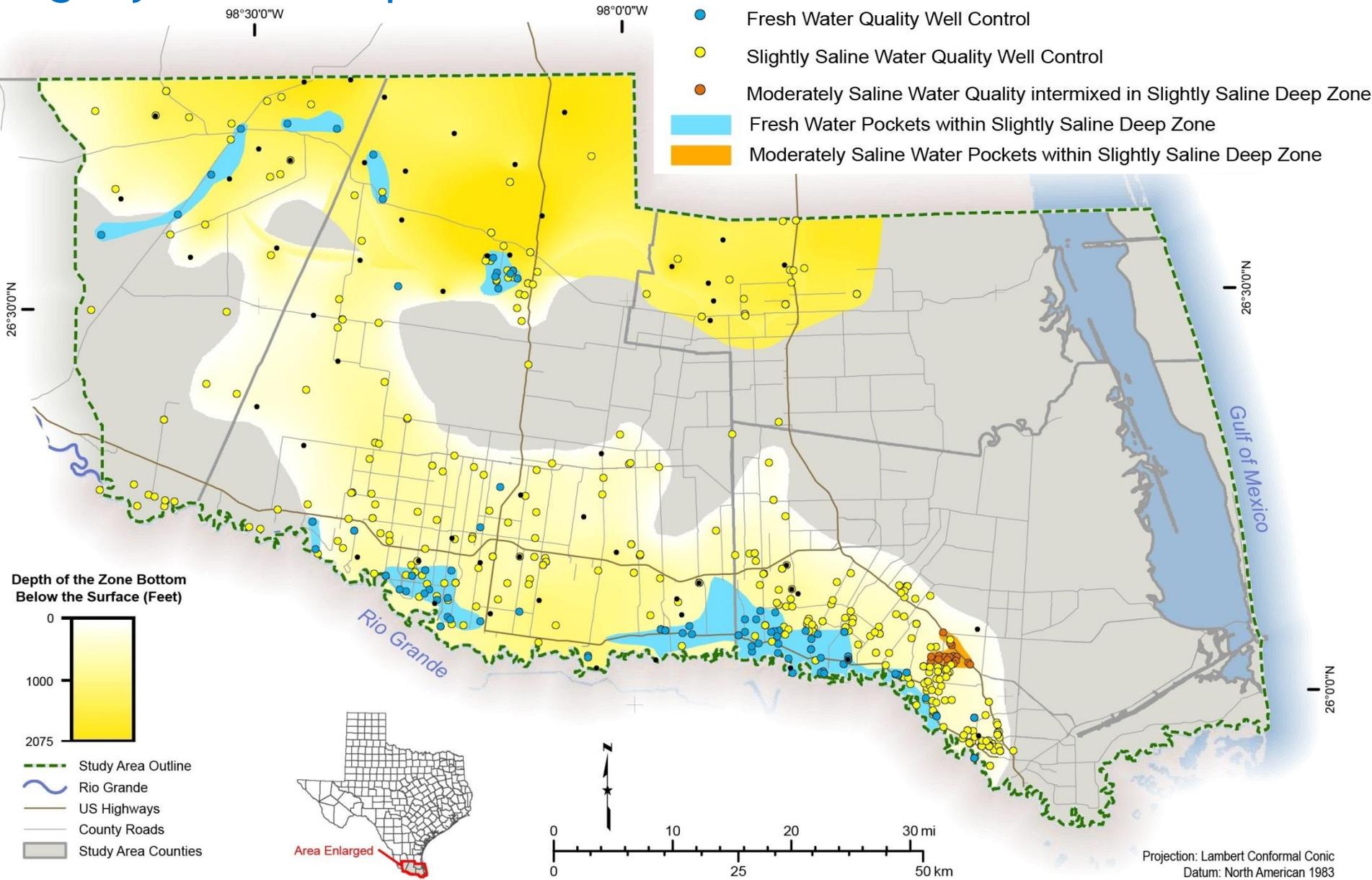


Salinity Profiles

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

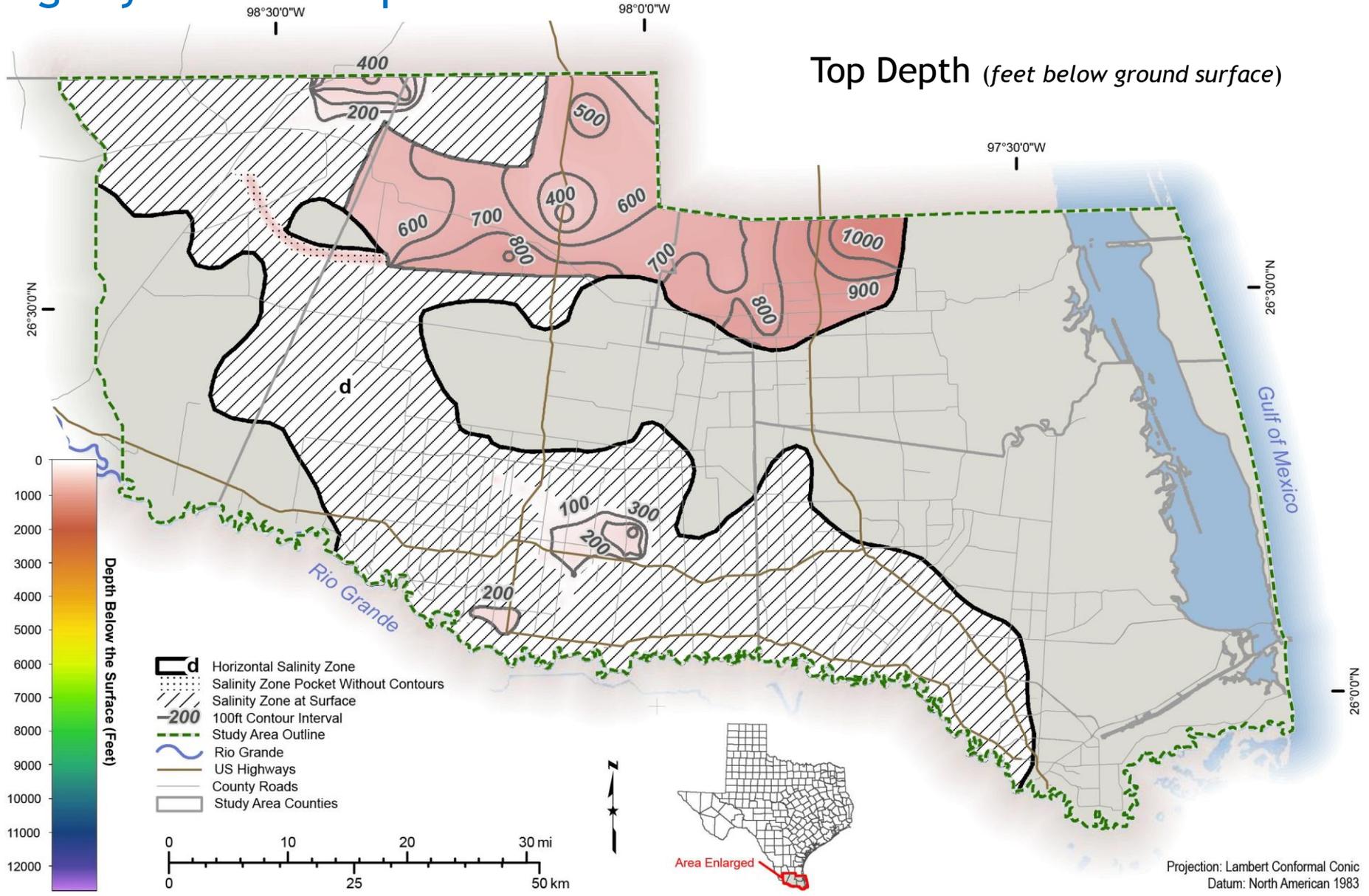
Source: Lower Rio Grande Valley BRACS Study

Slightly Saline Deep Zone



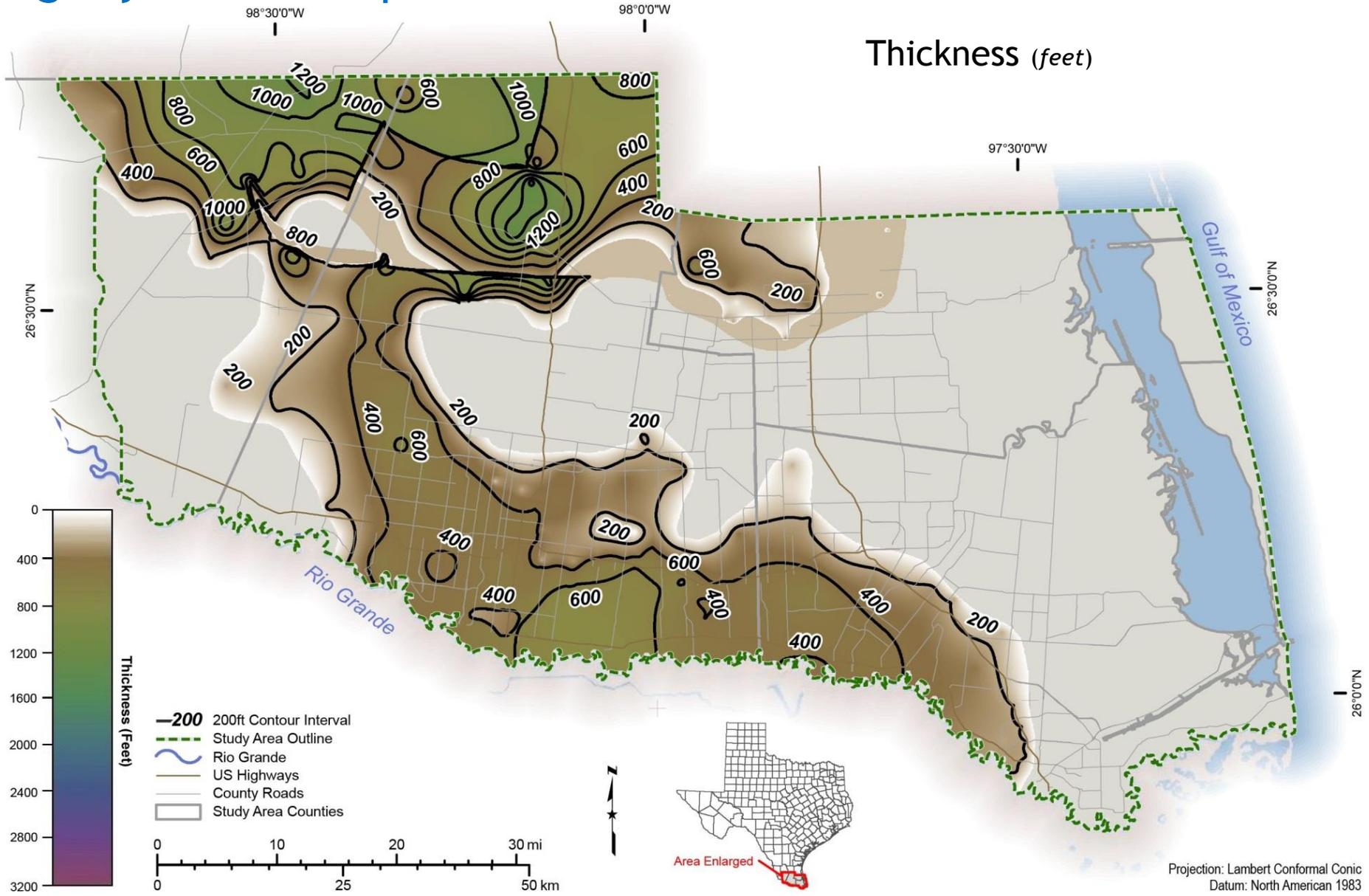
Source: Lower Rio Grande Valley BRACS Study

Slightly Saline Deep Zone



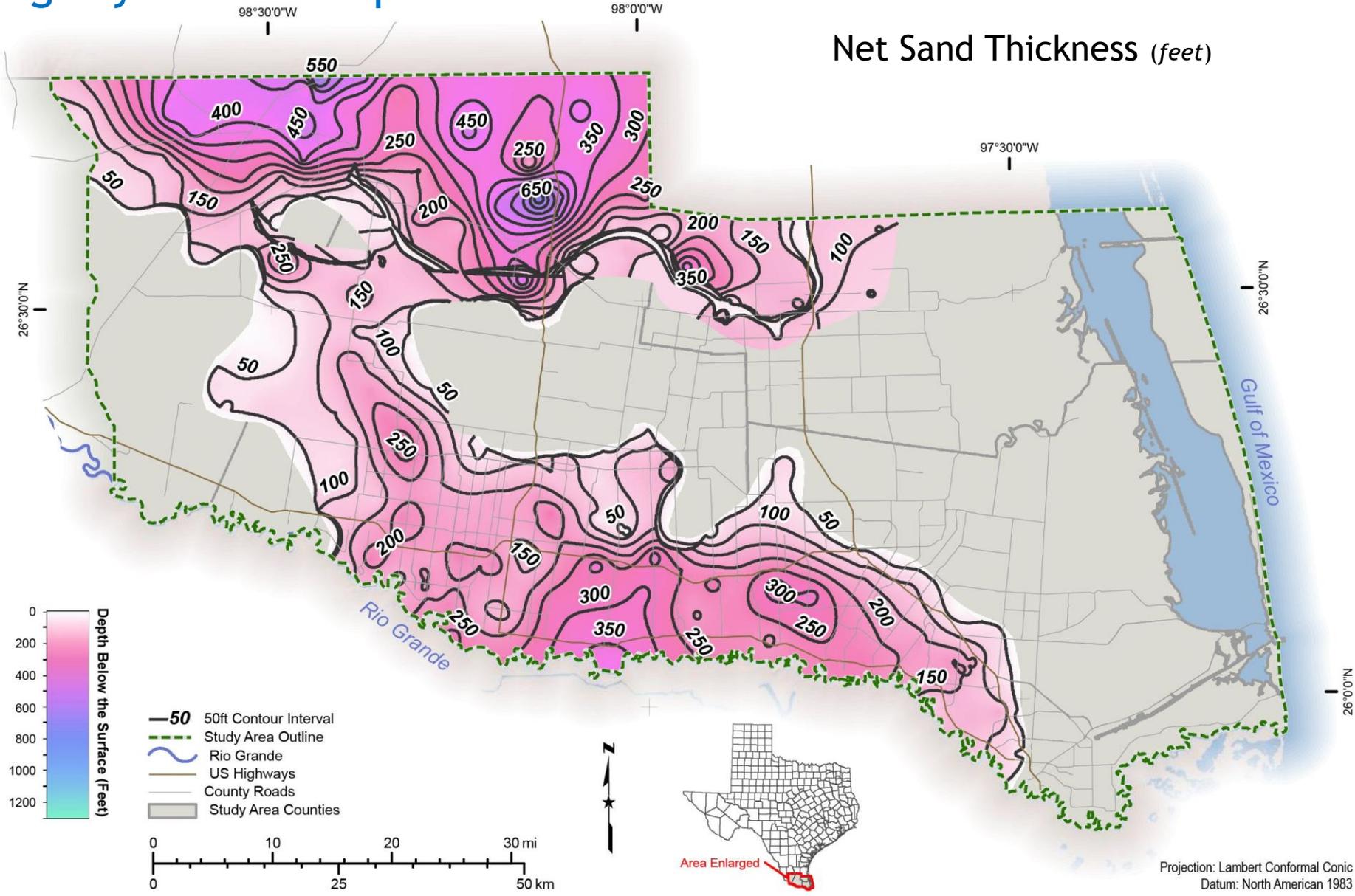
Source: Lower Rio Grande Valley BRACS Study

Slightly Saline Deep Zone



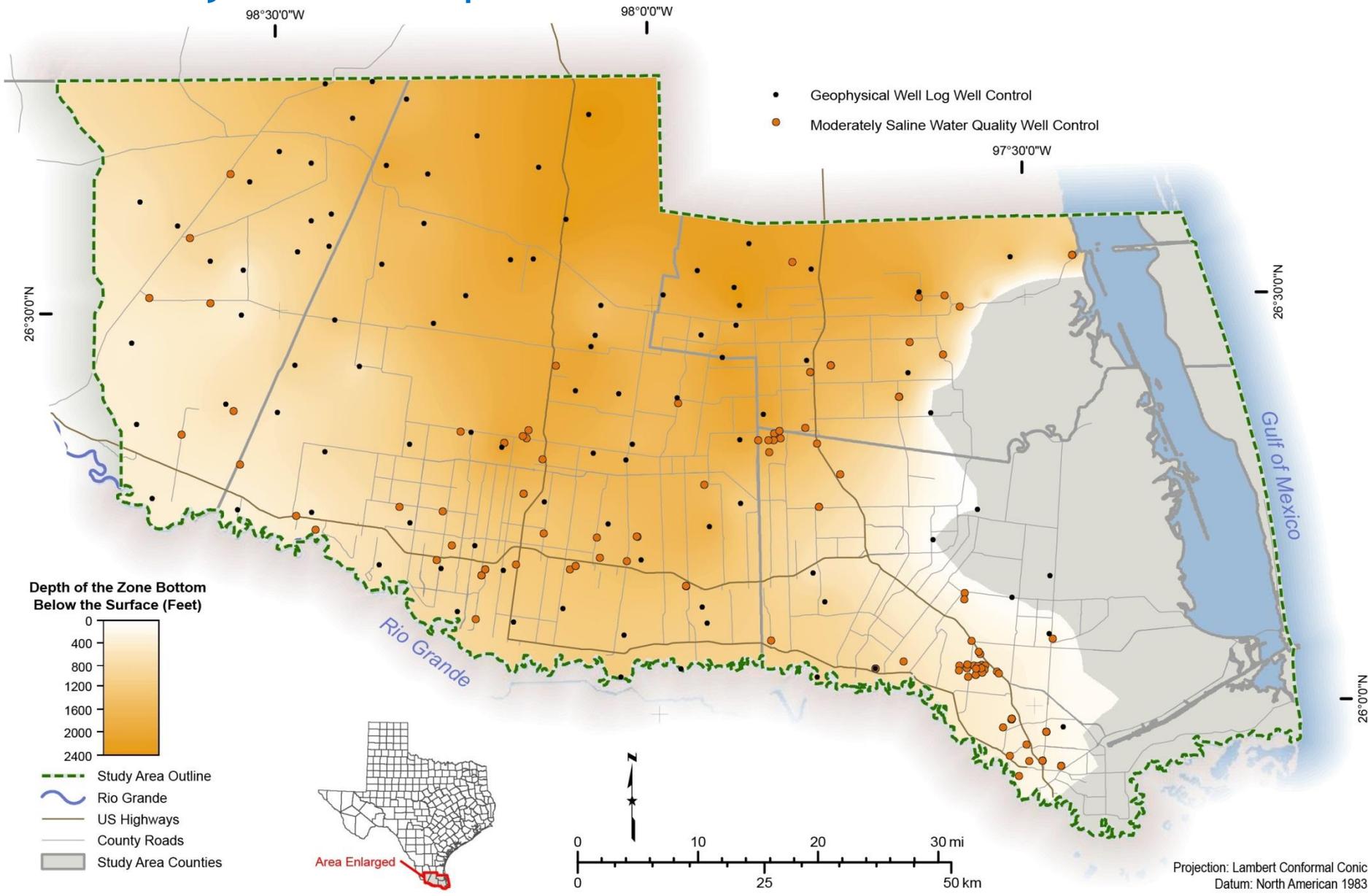
Source: Lower Rio Grande Valley BRACS Study

Slightly Saline Deep Zone

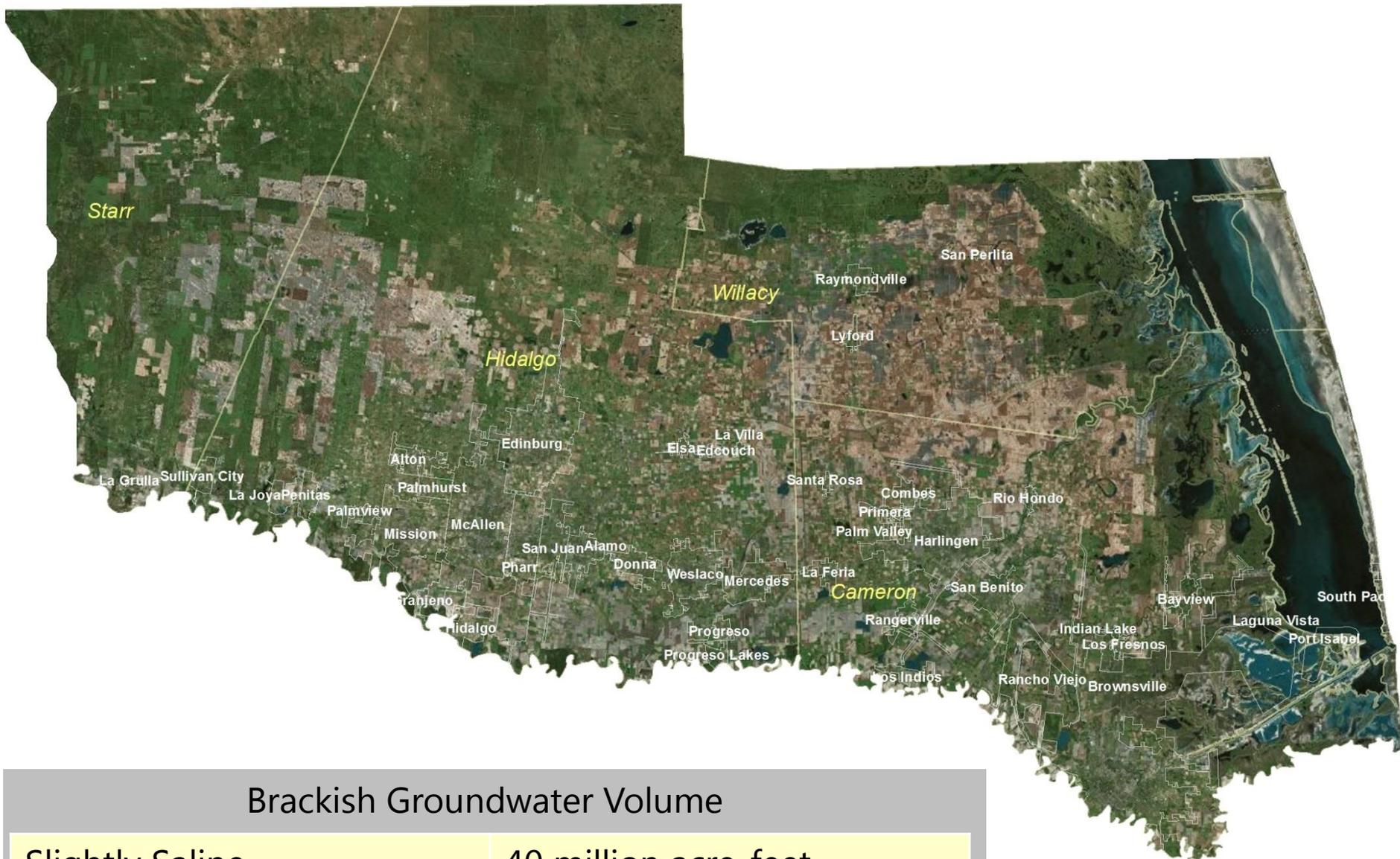


Source: Lower Rio Grande Valley BRACS Study

Moderately Saline Deep Zone



Source: Lower Rio Grande Valley BRACS Study



Brackish Groundwater Volume

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

BRACS Database

- Microsoft Access® relational design
- Contains all of the well data and interpretations
- Hyperlinks to thousands of digital geophysical well logs and water well reports
- Designed to process information (Visual Basic Code)
- Link to additional databases through key fields
- Available on our website
- Well locations on a GIS layer on the WIID website

Database Tables

TWDB Groundwater Database

(> 138,000 records)

- Well Data
- Remarks
- Water Levels
- Water Chemistry (2 tables)
- Casing

- (WIID: Digital Water Well Reports)

TWDB BRACS Database

(> 45,000 records)

- Well Data (location, depth, owner, ...)
- Water Levels
- Water Chemistry (2 tables)
- Casing

- Digital Water Well Reports

New
Tables

- Foreign Keys (well ids; links to other databases)
- Well Geology (lithology, stratigraphy, saline zones)
- Net Sand and Sand Percent
- Interpreted TDS from Geophysical Logs
- Aquifer Determination Analysis
- Digital Geophysical Well Logs
- Geophysical Well Log Suites
- Aquifer Test Information
- Study-specific data

Summary

- Study report is in final editing stage
- Mapped brackish groundwater resource evaluation – quantity, quality, distribution
- There is substantial brackish groundwater for development
- This 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 will be available on TWDB website
- Geophysical well log files available upon request
- Future efforts: modeling ?, collection of additional log and well data

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