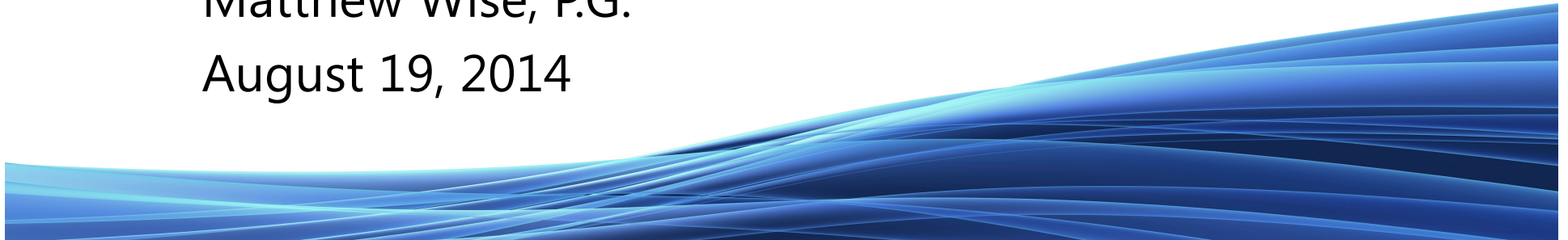




# Queen City and Sparta Aquifers, Atascosa and McMullen Counties, Texas: Structure and Brackish Groundwater

Matthew Wise, P.G.

August 19, 2014



# Texas Water Development Board

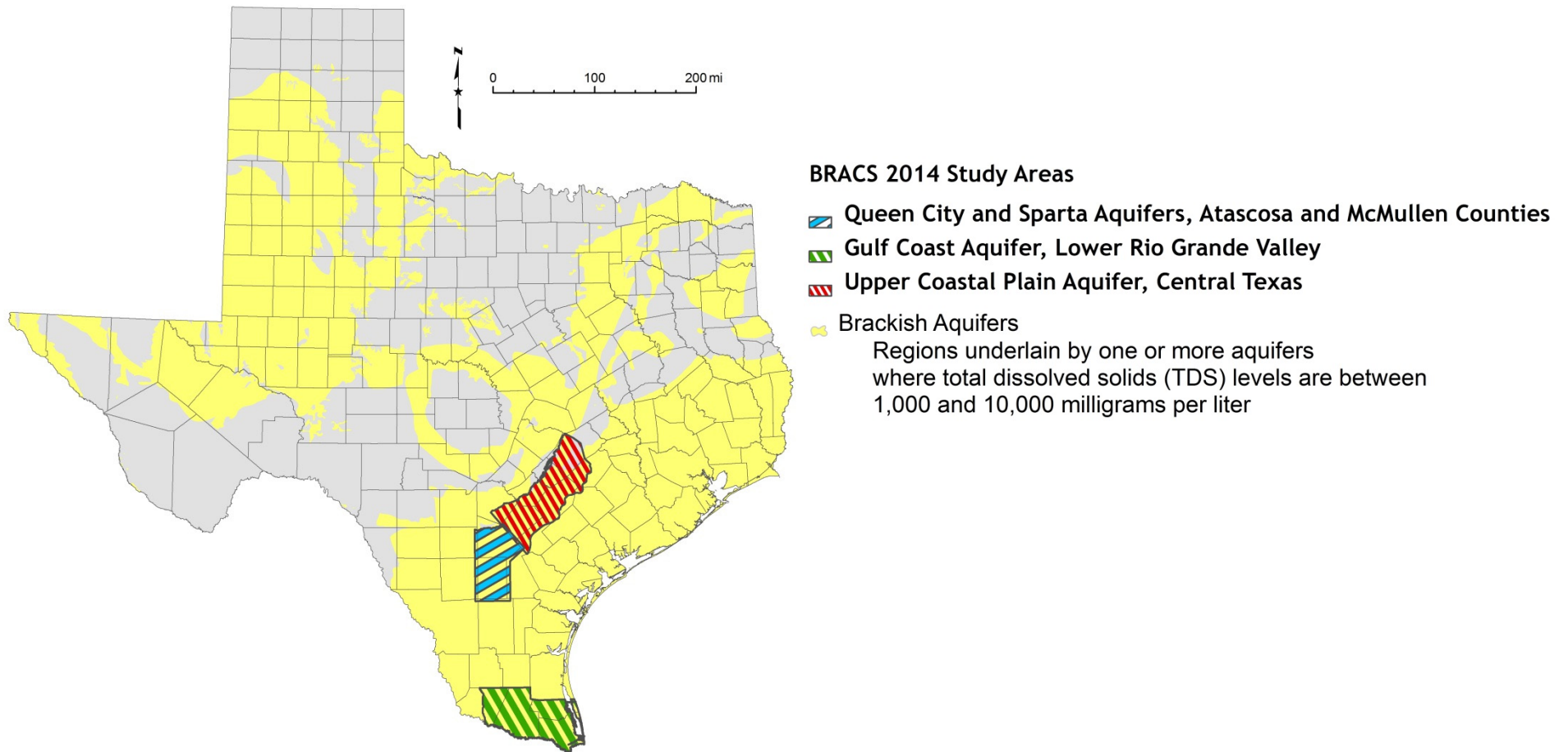
The logo for the Texas Water Development Board features the text "Texas Water" in a blue, sans-serif font and "Development Board" in a black, sans-serif font. To the right of the text is a stylized graphic of three curved, overlapping lines in shades of blue, resembling a wave or a fan.

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*

A decorative graphic at the bottom of the slide consists of several overlapping, wavy lines in various shades of blue, creating a sense of movement and depth. The lines are more densely packed on the right side and spread out towards the left.

# 81<sup>st</sup> Texas Legislature (2009) provided funding to implement the TWDB Brackish Resources Aquifer Characterization System (BRACS) program



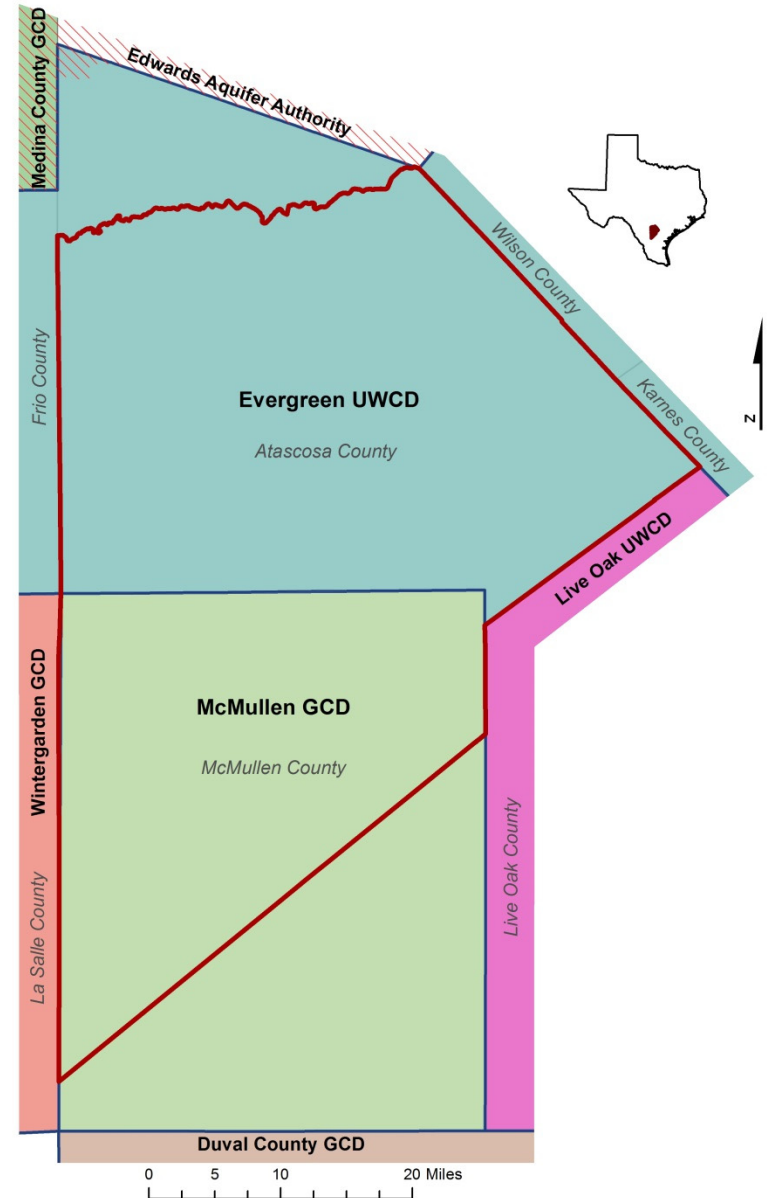
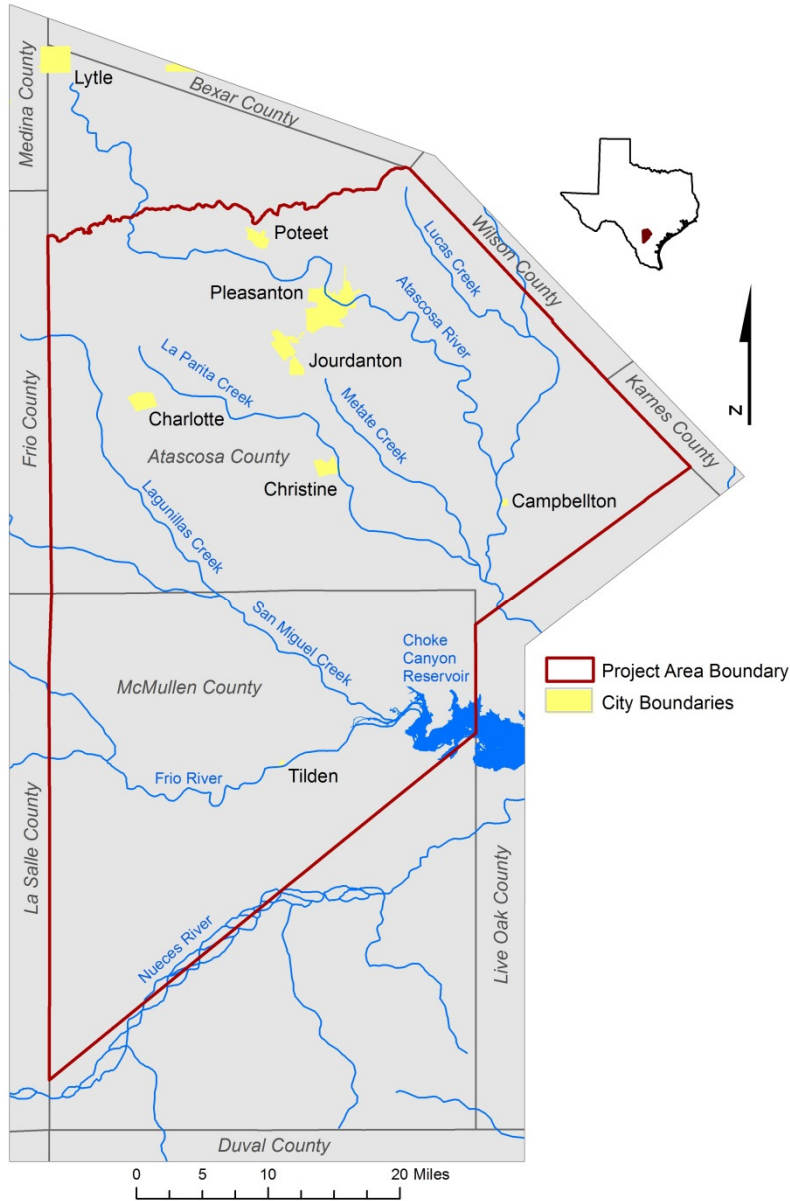
Sources: TWDB, Innovative Water Technologies and modified from LBG-Guyton, 2003

# Project Objectives

- Map top and bottom depths of the Queen City and Sparta aquifers
- Map sand content of the aquifers
- Compile aquifer hydraulic properties
- Map distribution of silica, iron, sulfate, and chloride in the aquifers
  - chemical parameters important to desalination
- Map ranges of total dissolved solids concentrations (salinity) in the aquifers
  - Fresh = 0 – 999 mg/L TDS
  - Slightly saline = 1,000 – 2,999 mg/L TDS
  - Moderately saline = 3,000 – 9,999 mg/L TDS
  - Very saline and brine = 10,000 – 35,000+ mg/L TDS
- Estimate brackish groundwater volumes in the aquifers

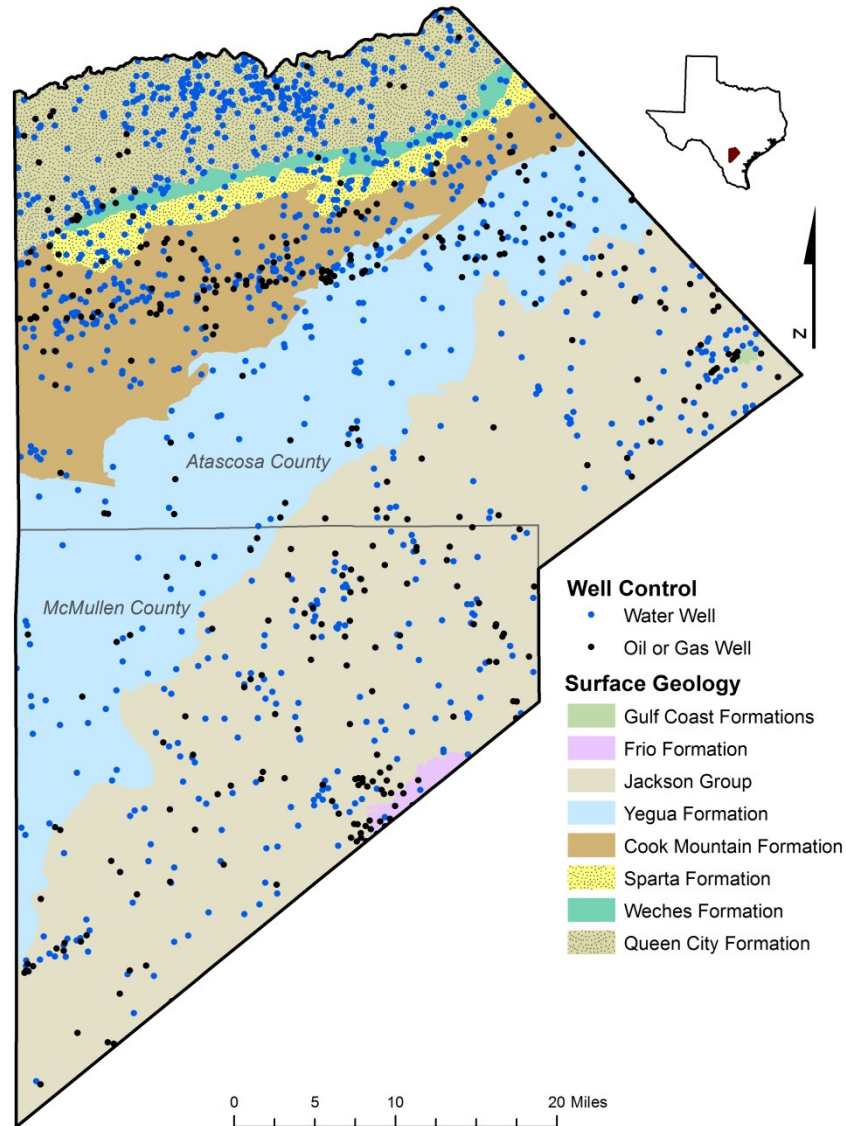
} Brackish groundwater

# Project Area Administrative Boundaries



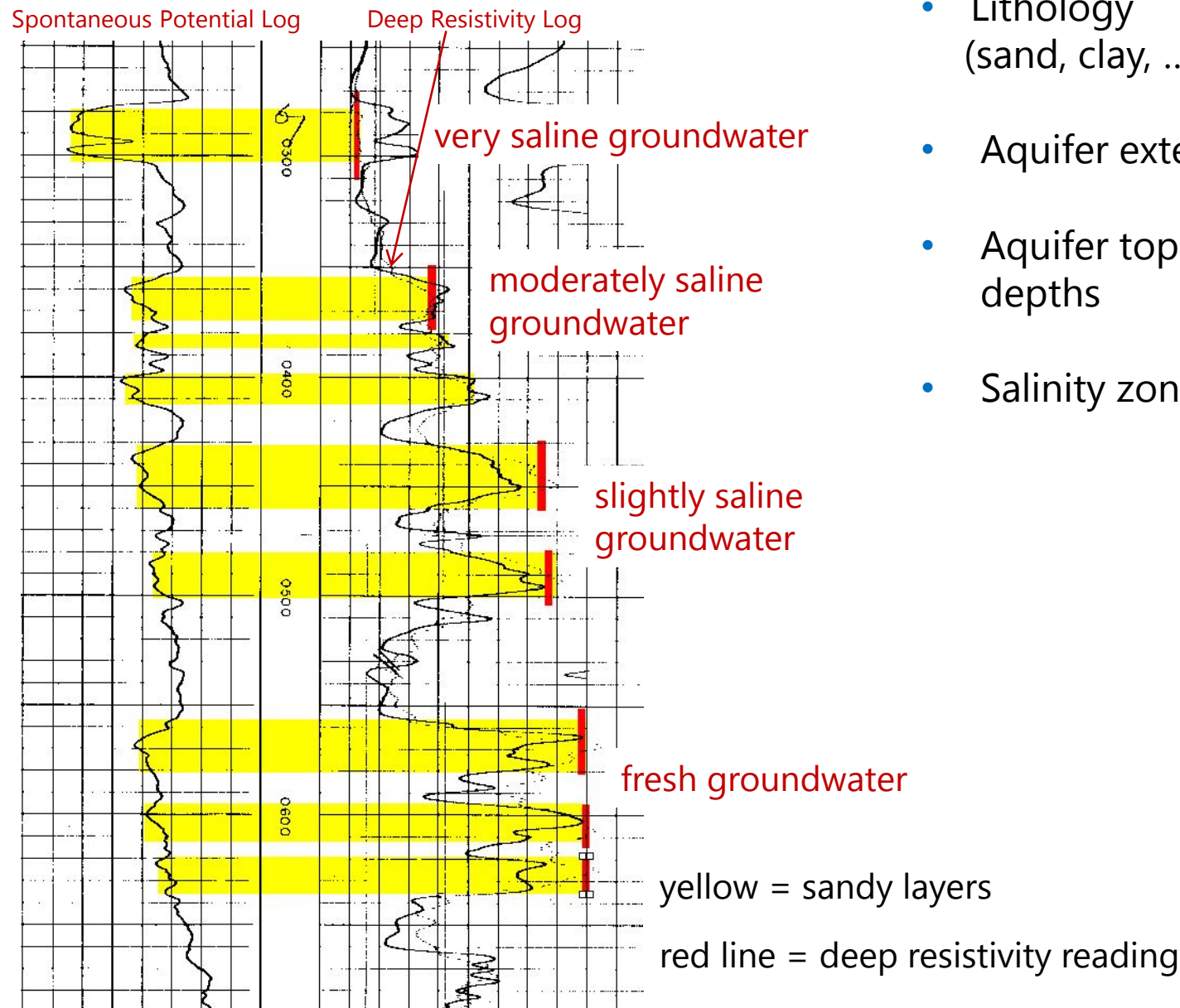
Source: TWDB Technical Note 14-01

# Project Well Control



Sources: TWDB Groundwater Database, BRACS Database, BEG 1974, and BEG 1976

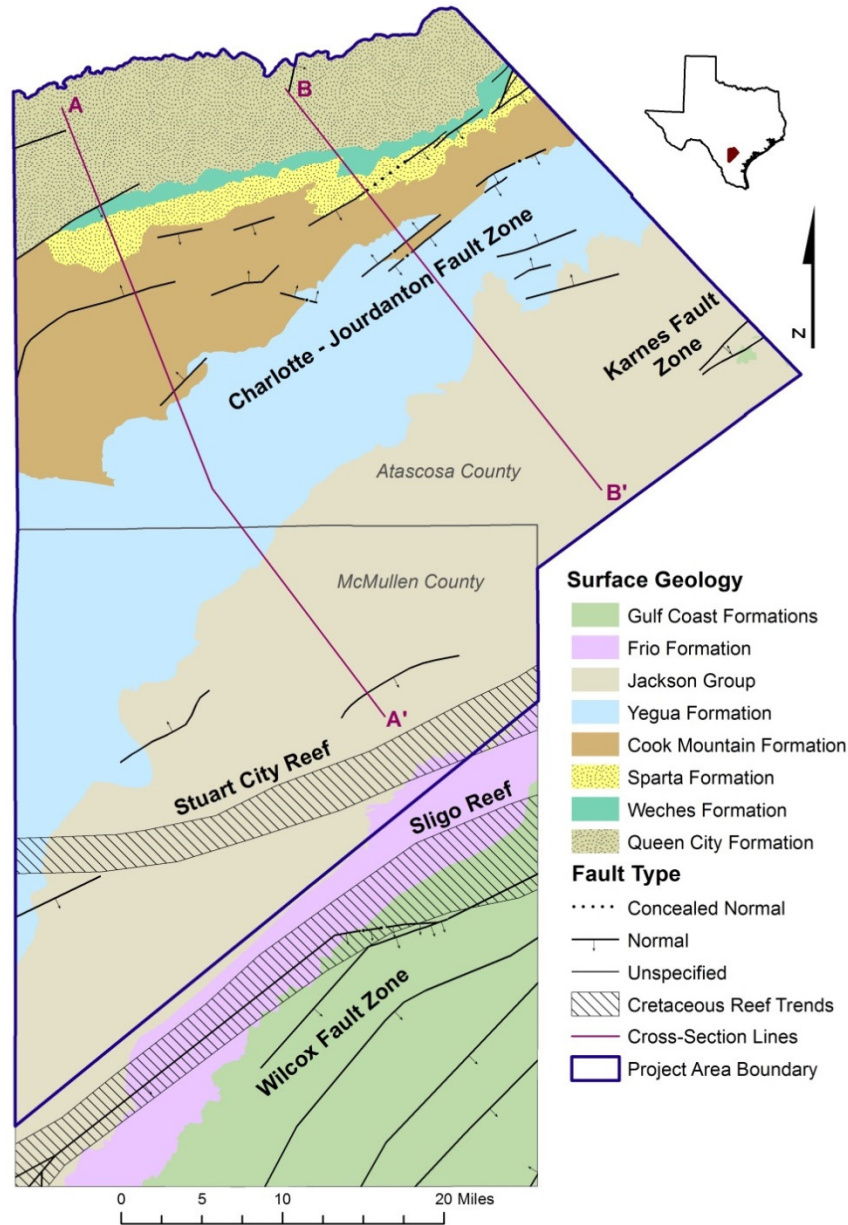
# Geophysical Well Logs



- Lithology (sand, clay, ...)
- Aquifer extent
- Aquifer top and bottom depths
- Salinity zones

Source: Lower Rio Grande Valley BRACS Study

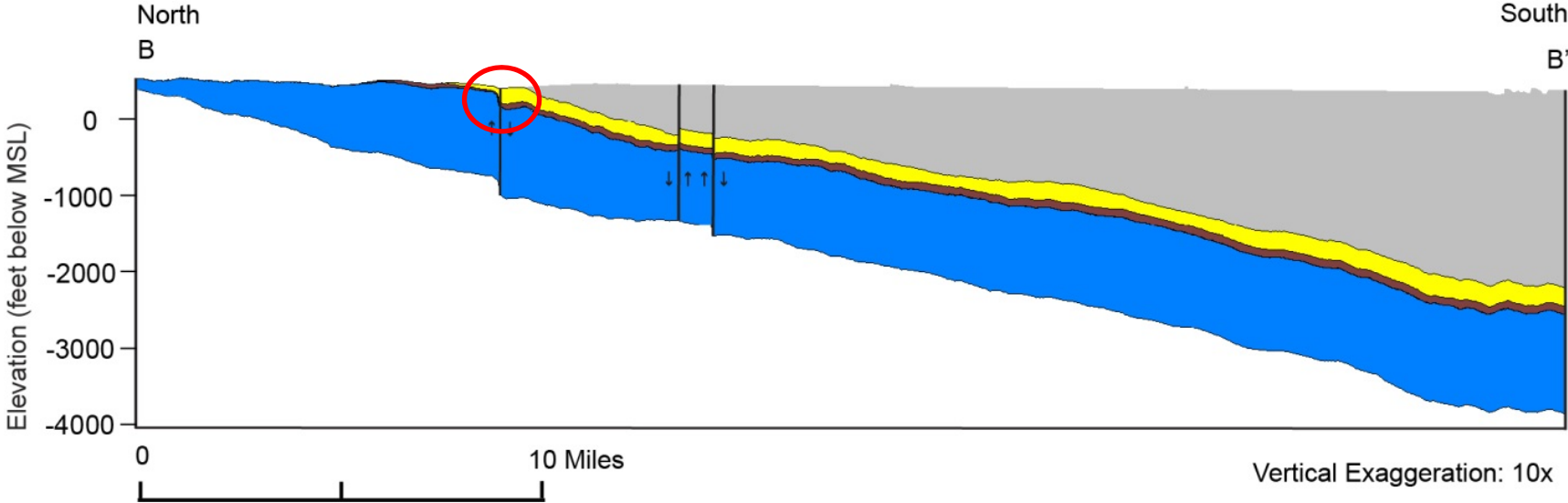
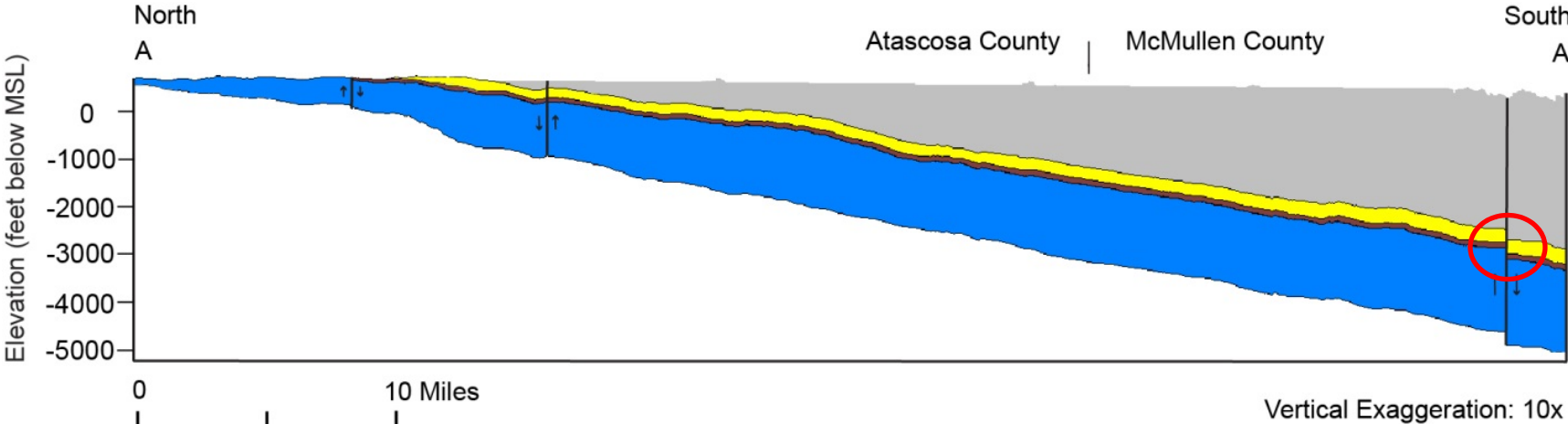
# Project Area General Geology and Geologic Structures



Sources: BEG 1974, BEG 1976, Hamlin 1988, and Ewing 1991



# Project Cross-Sections

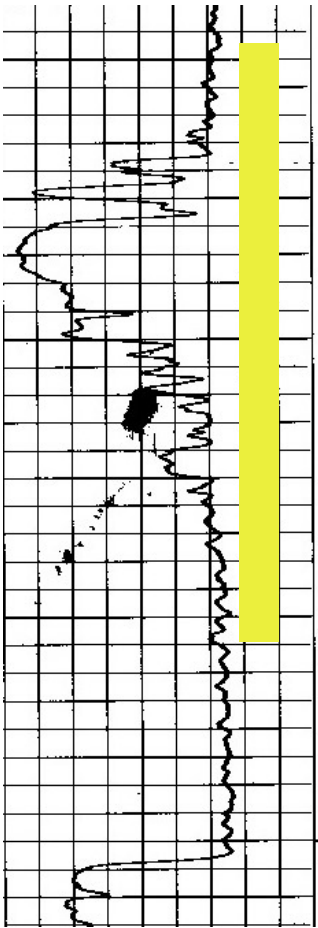


- Sparta Formation
- Weches Formation
- Queen City Formation
- Post-Sparta formations
- Pre-Queen City formations
- ↑  
|  
↓ Fault showing relative movement

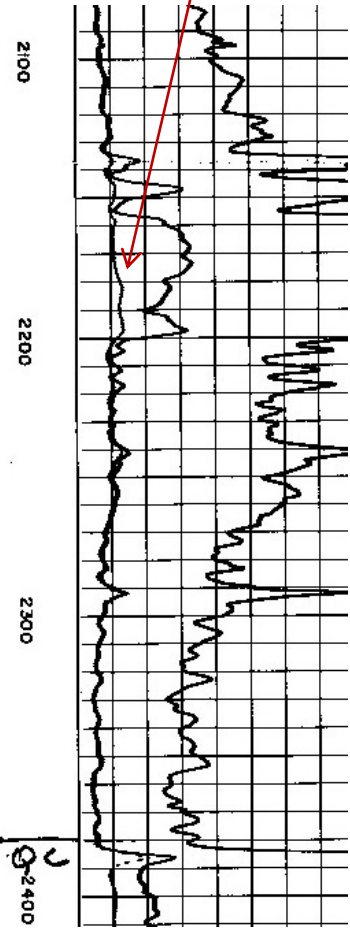
Source: TWDB Technical Note 14-01

# Sparta Aquifer Stratigraphic Interpretation and Top Depth Surface

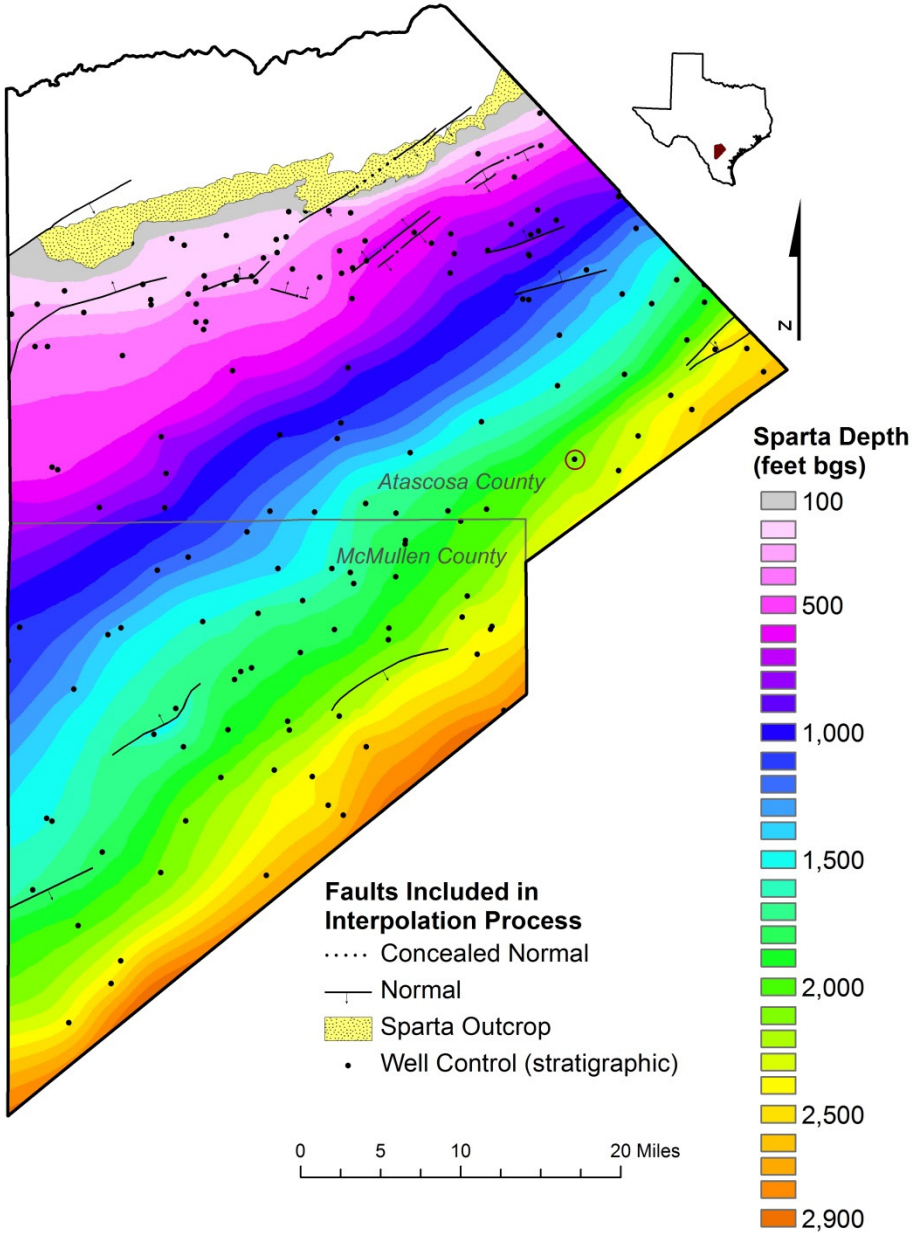
Spontaneous Potential Log



Deep Resistivity Log



Log location is circled on map

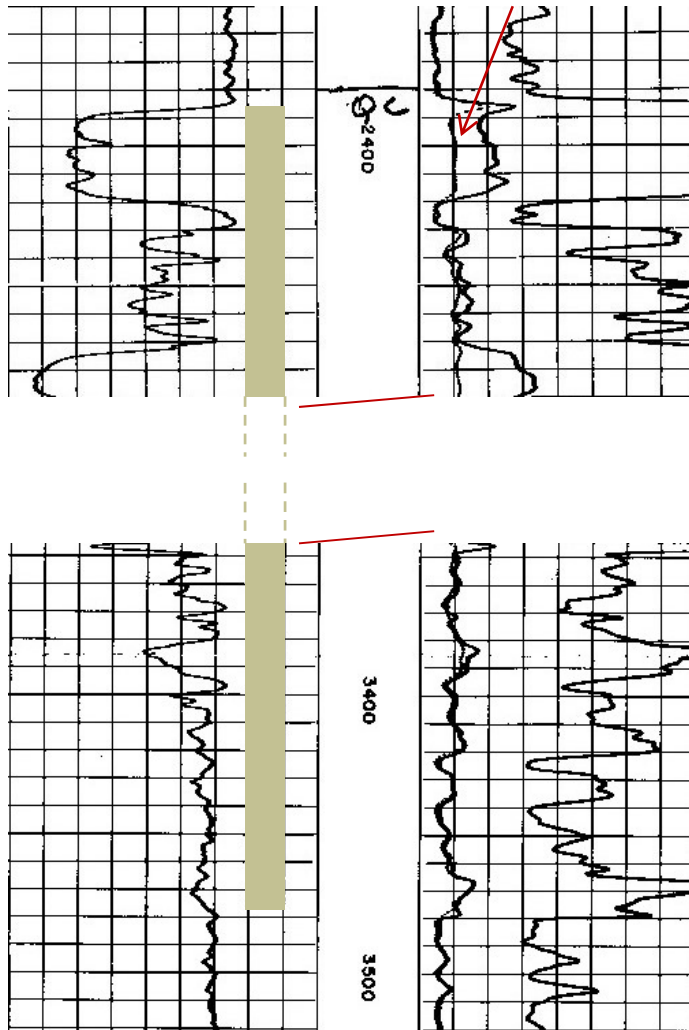


Source: TWDB Technical Note 14-01

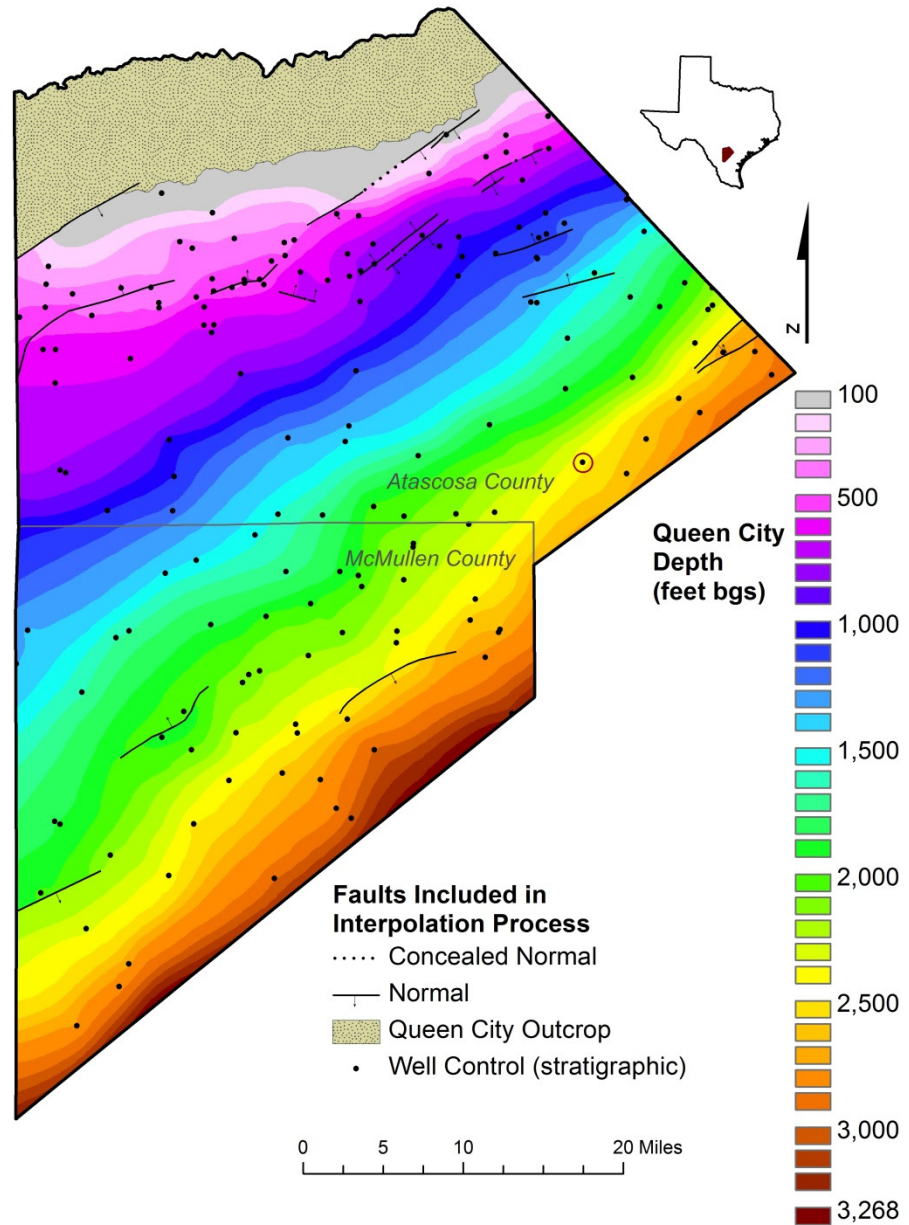
# Queen City Aquifer Stratigraphic Interpretation and Top Depth Surface

Spontaneous Potential Log

Deep Resistivity Log



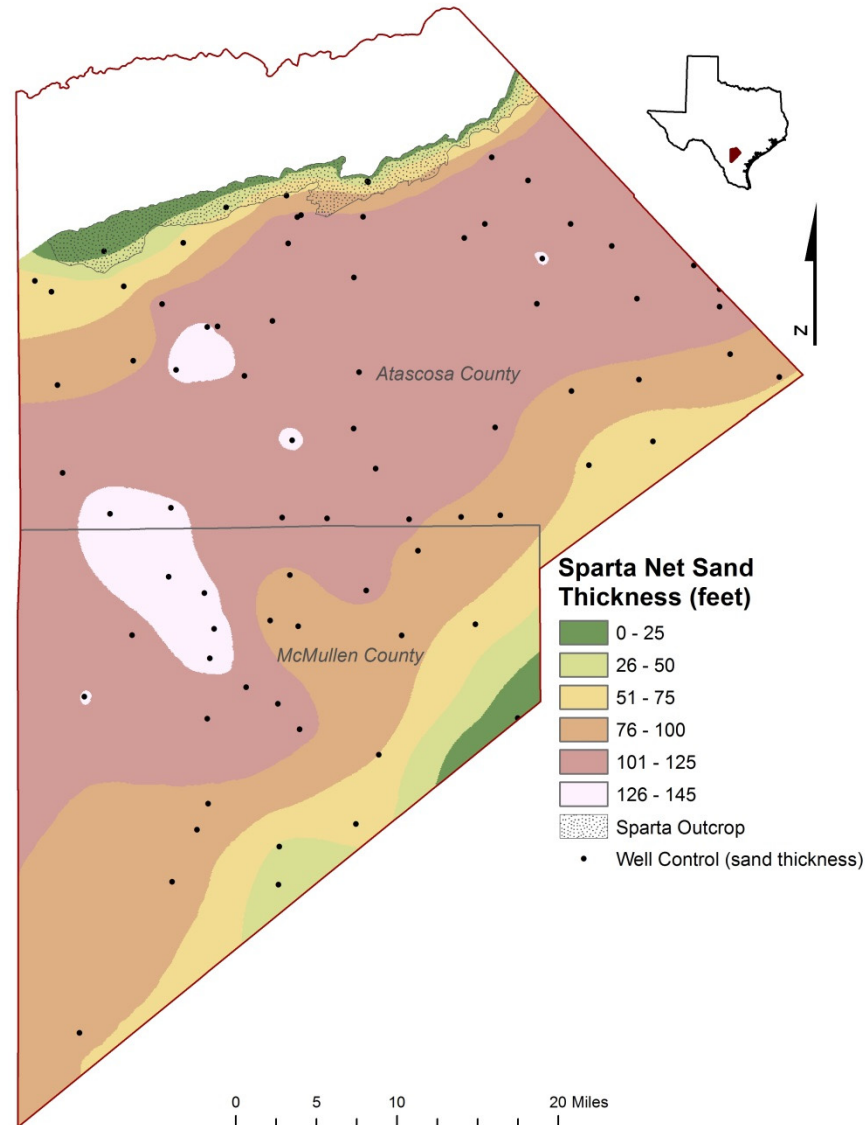
Log location is circled on map



Source: TWDB Technical Note 14-01

# Sparta Aquifer Net Sand Thickness

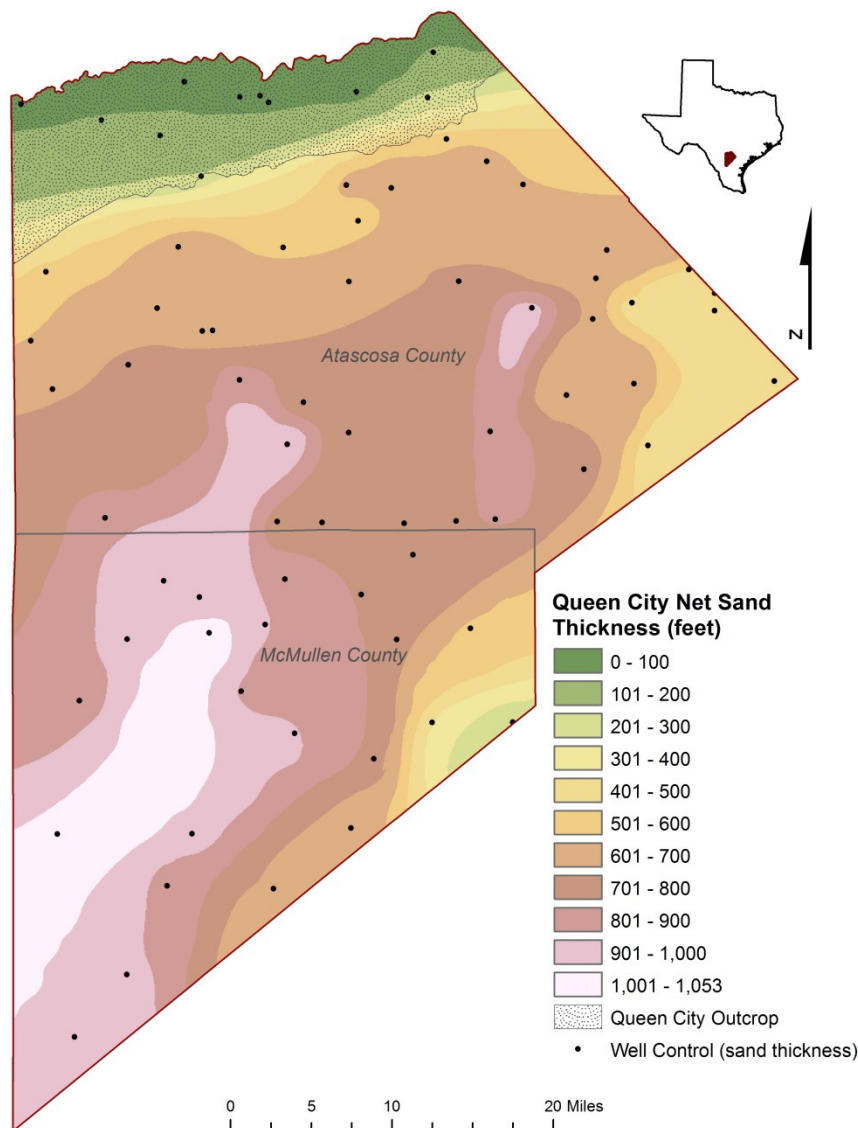
- Map created from 85 well records
- Thickest Sparta sand deposits extend along a northeast-southwest trending belt
- Maximum net sand value is 145 feet
- Sparta sand content decreases fairly steadily downdip



Source: TWDB Technical Note 14-01

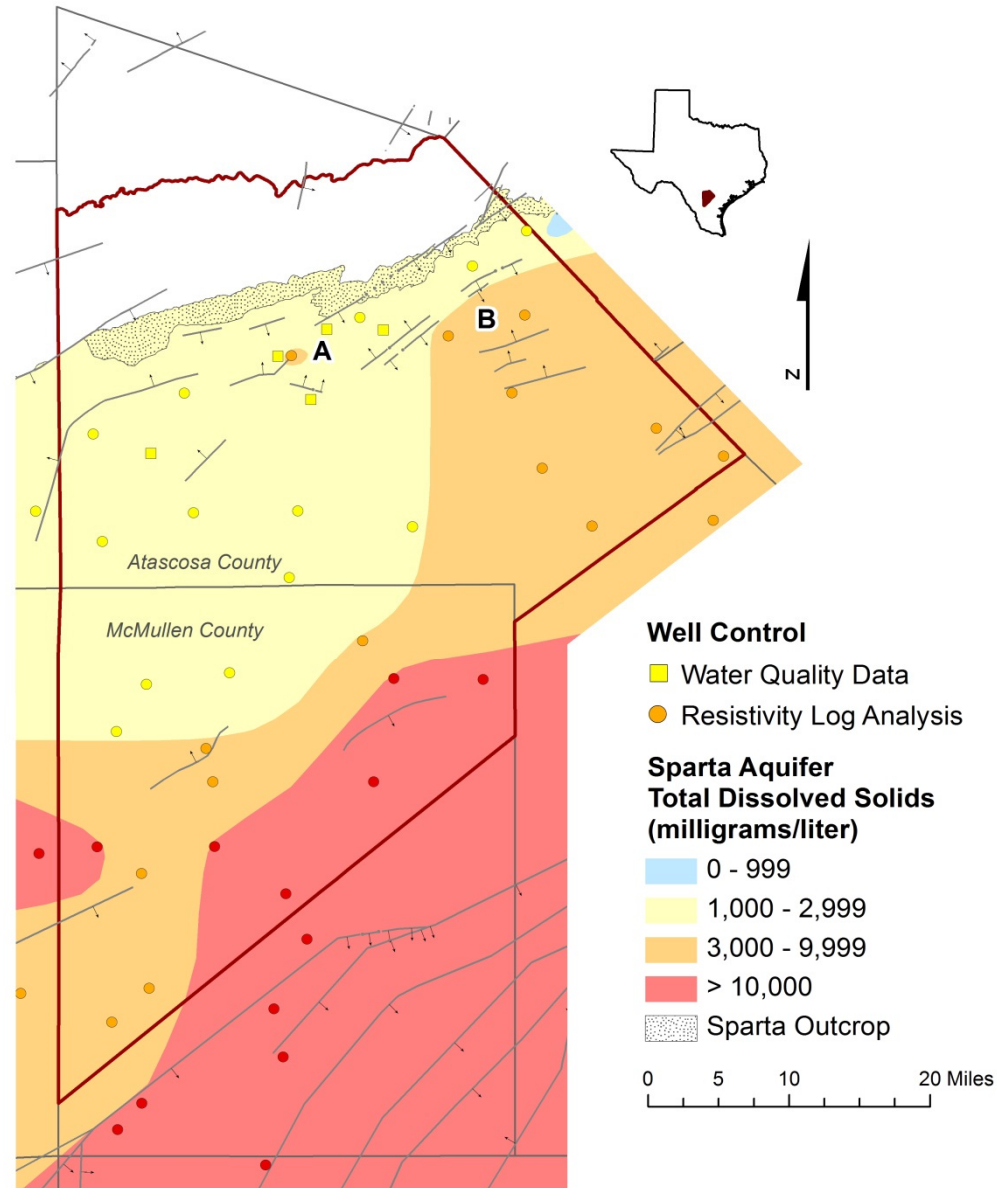
# Queen City Aquifer Net Sand Thickness

- Map generated from 86 well records
- Queen City sand content increases in southwesterly direction as the aquifer thickens
- Net sand values exceeding 1,000 feet occur in McMullen County
- Relatively lower net sand values present along southern boundary



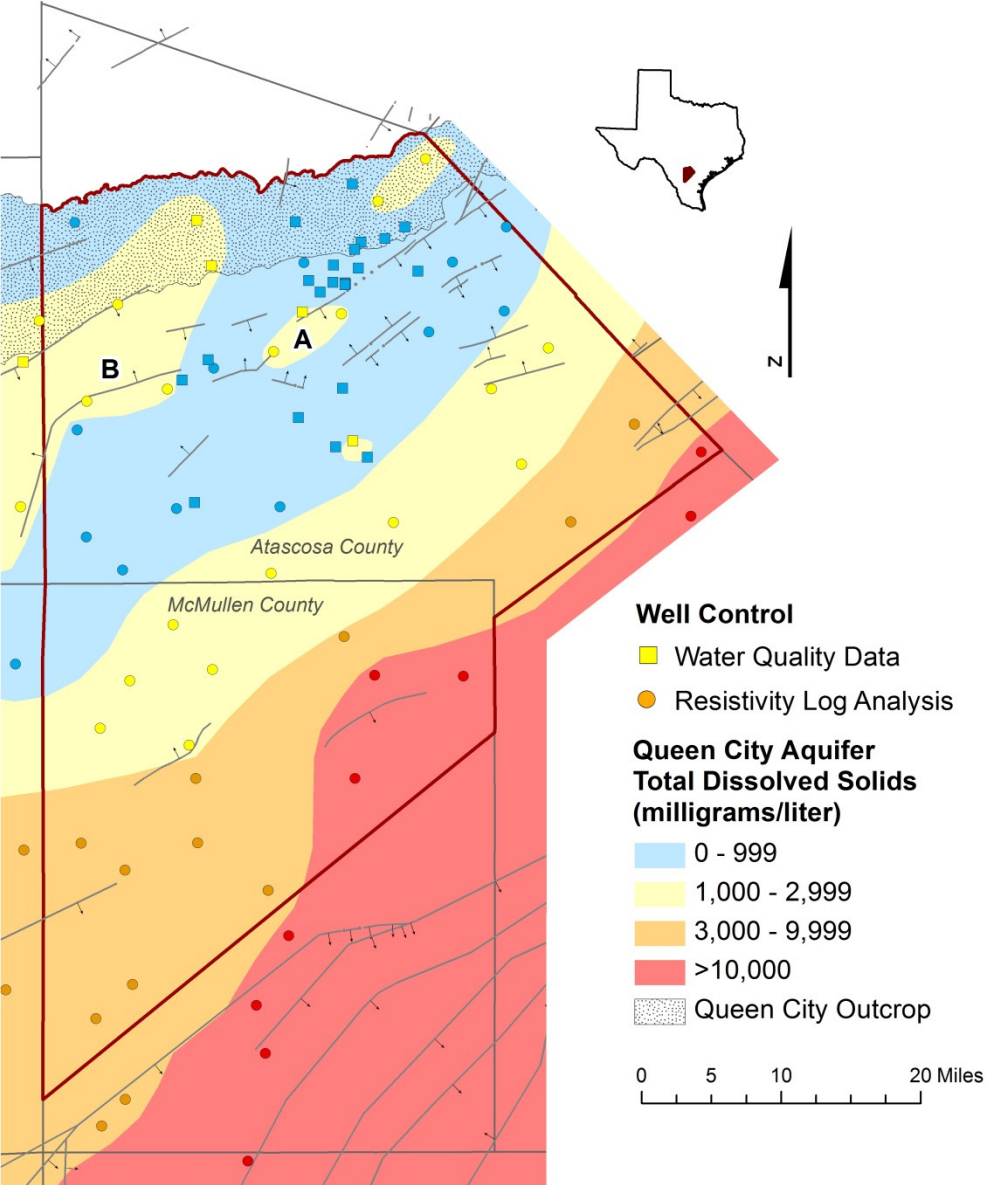
Source: TWDB Technical Note 14-01

# Sparta Aquifer Total Dissolved Solids Distribution



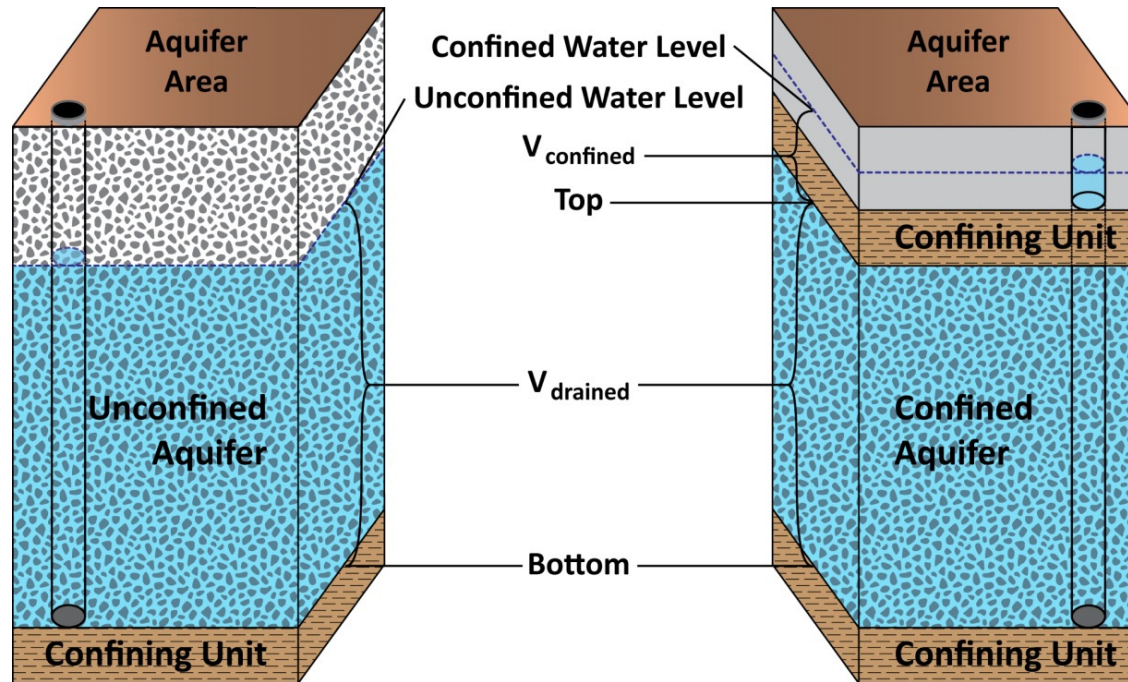
Source: TWDB Technical Note 14-01

# Queen City Aquifer Total Dissolved Solids Distribution



Source: TWDB Technical Note 14-01

# Groundwater Volume Estimate Methodology



- Drainable volumes in unconfined areas =  $V_{\text{drained}}$
- In confined areas, sum of compressive and drainable volumes =  $V_{\text{confined}} + V_{\text{drained}}$
- Estimating drainable volumes of water contained within the interpreted sand content of the aquifers
- Sparta and Queen City specific yield = 0.10 and storativity = 0.0005
- Used simulated hydraulic heads for 1999 from the Sparta and Queen City calibrated GAM to estimate unconfined and confined water levels



# BRACS Sparta Aquifer Groundwater Volume Estimates

<b>Atascosa County</b>	
TDS range (milligrams per liter)	Volume (millions of acre-feet)
Fresh (0-999)	0
Slightly saline (1,000-2,999)	3.32
Moderately saline (3,000-9,999)	2.15
Very saline (>10,000)	0

<b>McMullen County Within Project Area</b>	
TDS range (milligrams per liter)	Volume (millions of acre-feet)
Fresh (0-999)	0
Slightly saline (1,000-2,999)	1.50
Moderately saline (3,000-9,999)	1.91
Very saline (>10,000)	0.994

Source: TWDB Technical Note 14-01

# BRACS Queen City Aquifer Groundwater Volume Estimates

<b>Atascosa County</b>	
TDS range (milligrams per liter)	Volume (millions of acre-feet)
Fresh (0-999)	19.3
Slightly saline (1,000-2,999)	14.0
Moderately saline (3,000-9,999)	4.48
Very saline (>10,000)	0.18


<b>McMullen County Within Project Area</b>	
TDS range (milligrams per liter)	Volume (millions of acre-feet)
Fresh (0-999)	1.80
Slightly saline (1,000-2,999)	10.4
Moderately saline (3,000-9,999)	20.5
Very saline (>10,000)	4.52

Source: TWDB Technical Note 14-01

## Summary

- Brackish groundwater volume is about 58,260,000 acre-feet for both aquifers
- Faulting appears to influence spatial variation of water quality in both aquifers to a significant degree
- Queen City Aquifer is the more productive of the two within the project area although hydraulic property information is limited
- Drilling boreholes and performing additional testing is required to provide site-specific details on the salinity profile with depth and aquifer productivity
- Project related data and information is available on the Board's website:
  - Technical Note 14-01 report, GIS datasets, and BRACS Database
- Our statewide collection of geophysical well log files are publicly available upon request
- TWDB is interested in obtaining non-confidential data in this region to support future work on these and other aquifers



Source: Photo courtesy Peter George – Sparta Aquifer along State Highway 39, Leon County, Texas 

# Texas Water Development Board



## Conservation and Innovative Water Technologies Division

Sanjeev Kalaswad, Ph.D., P.G., Director

[sanjeev.kalaswad@twdb.texas.gov](mailto:sanjeev.kalaswad@twdb.texas.gov)

(512) 936-0838

Erika Mancha, IWT Team Leader

[erika.mancha@twdb.texas.gov](mailto:erika.mancha@twdb.texas.gov)

(512) 463-7932

Andrea Croskrey

[andrea.croskrey@twdb.texas.gov](mailto:andrea.croskrey@twdb.texas.gov)

(512) 463-2865

John E. Meyer, P.G.

[john.meyer@twdb.texas.gov](mailto:john.meyer@twdb.texas.gov)

(512) 463-8010

Matthew Webb

[matthew.webb@twdb.texas.gov](mailto:matthew.webb@twdb.texas.gov)

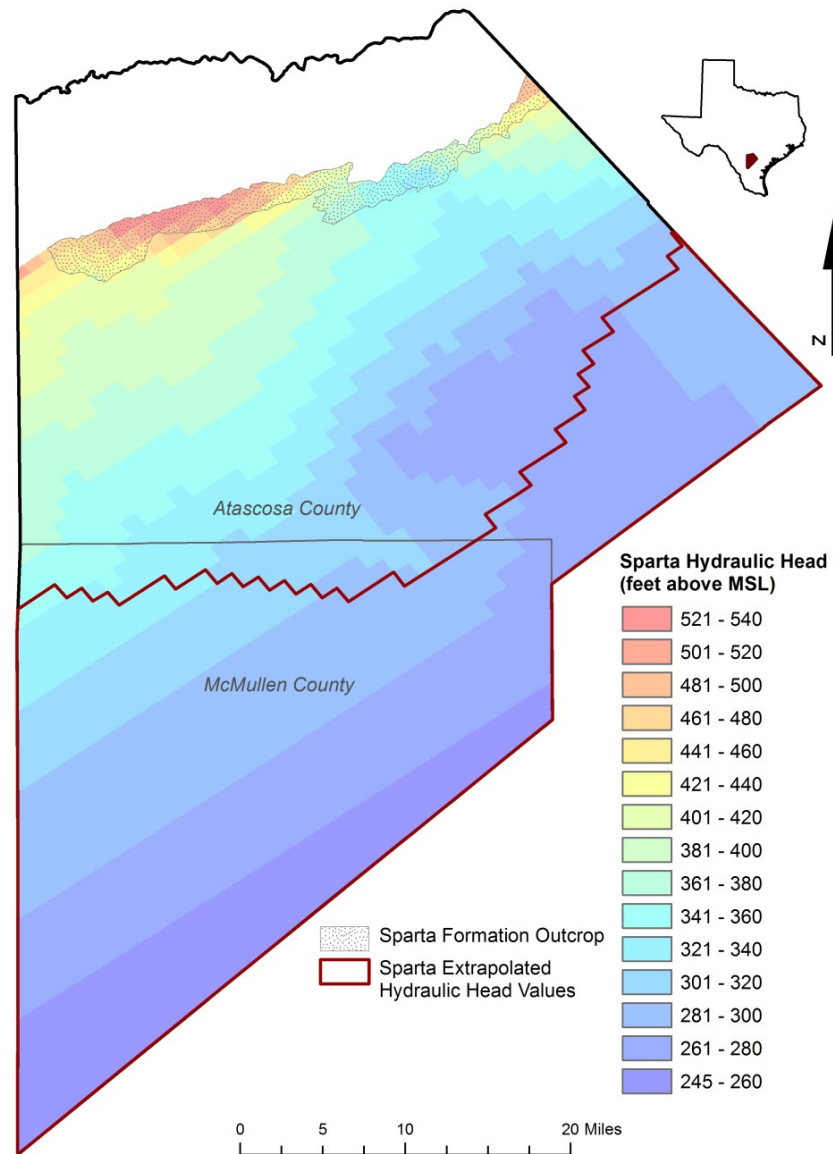
(512) 463-6929

Matthew Wise, P.G.

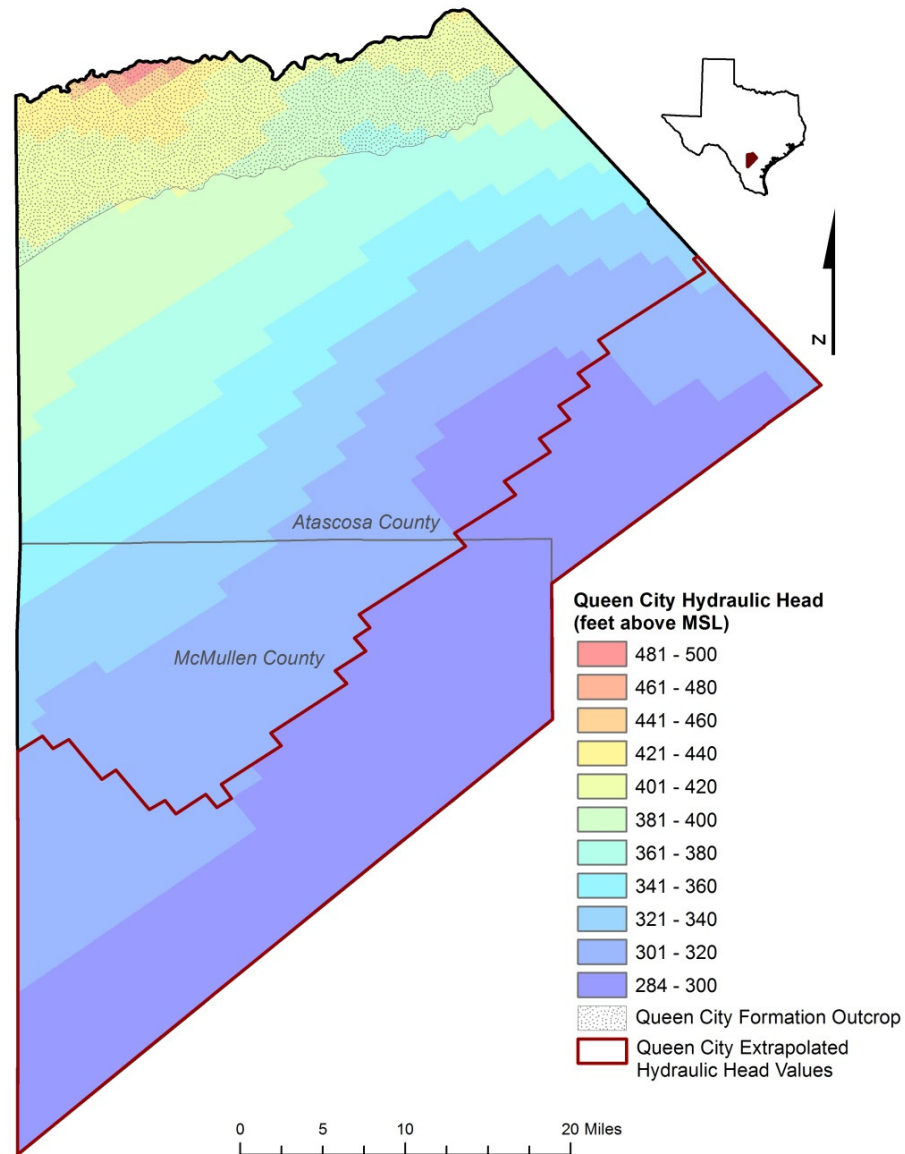
[matthew.wise@twdb.texas.gov](mailto:matthew.wise@twdb.texas.gov)

(512) 936-9488

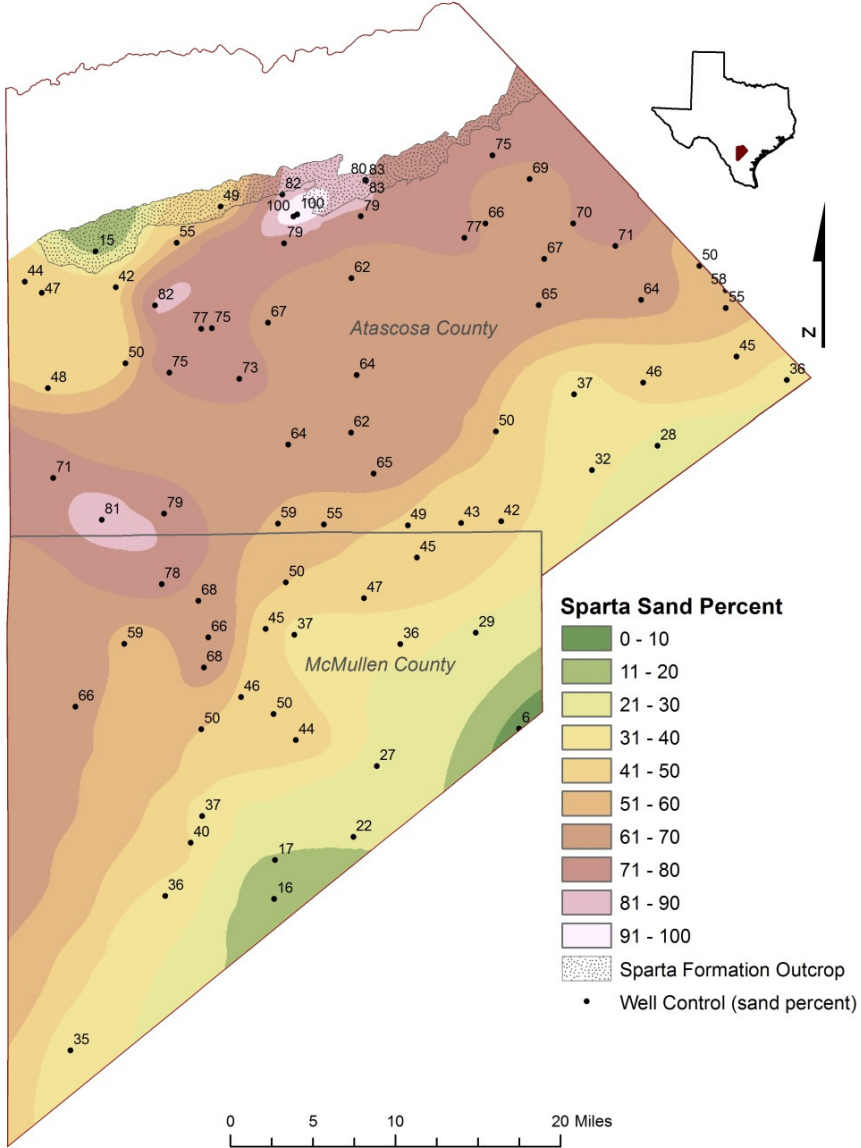
# Sparta Aquifer Simulated Hydraulic Head Values



# Queen City Aquifer Simulated Hydraulic Head Values

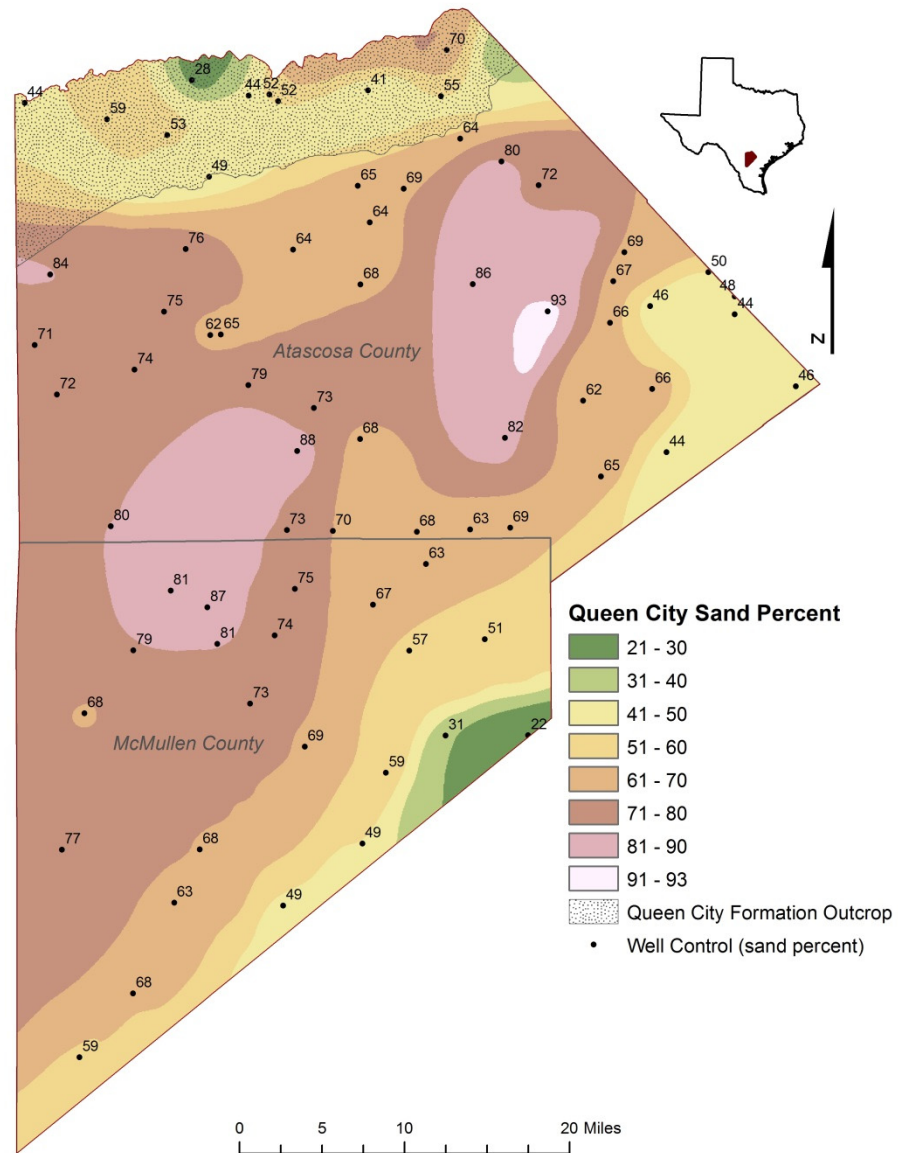


# Sparta Aquifer Sand Percentage





# Queen City Aquifer Sand Percentage



# 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

(> 43,000 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