

**LSGCD STRATEGIC PLANNING FOR  
GROUNDWATER MANAGEMENT AND  
DEVELOPMENT**  
PUBLIC STAKEHOLDER MEETING

Prepared by  
**LBG-Guyton Associates**  
May 24, 2016



# PLANNING STUDY OUTLINE

- Task 0 Project Communications
- Task 1 Groundwater Production and Water Level Monitoring Program Review (completed)
- **Task 2 Total Estimated Recoverable Storage Review and Evaluation**
- Task 3 Future Groundwater Availability

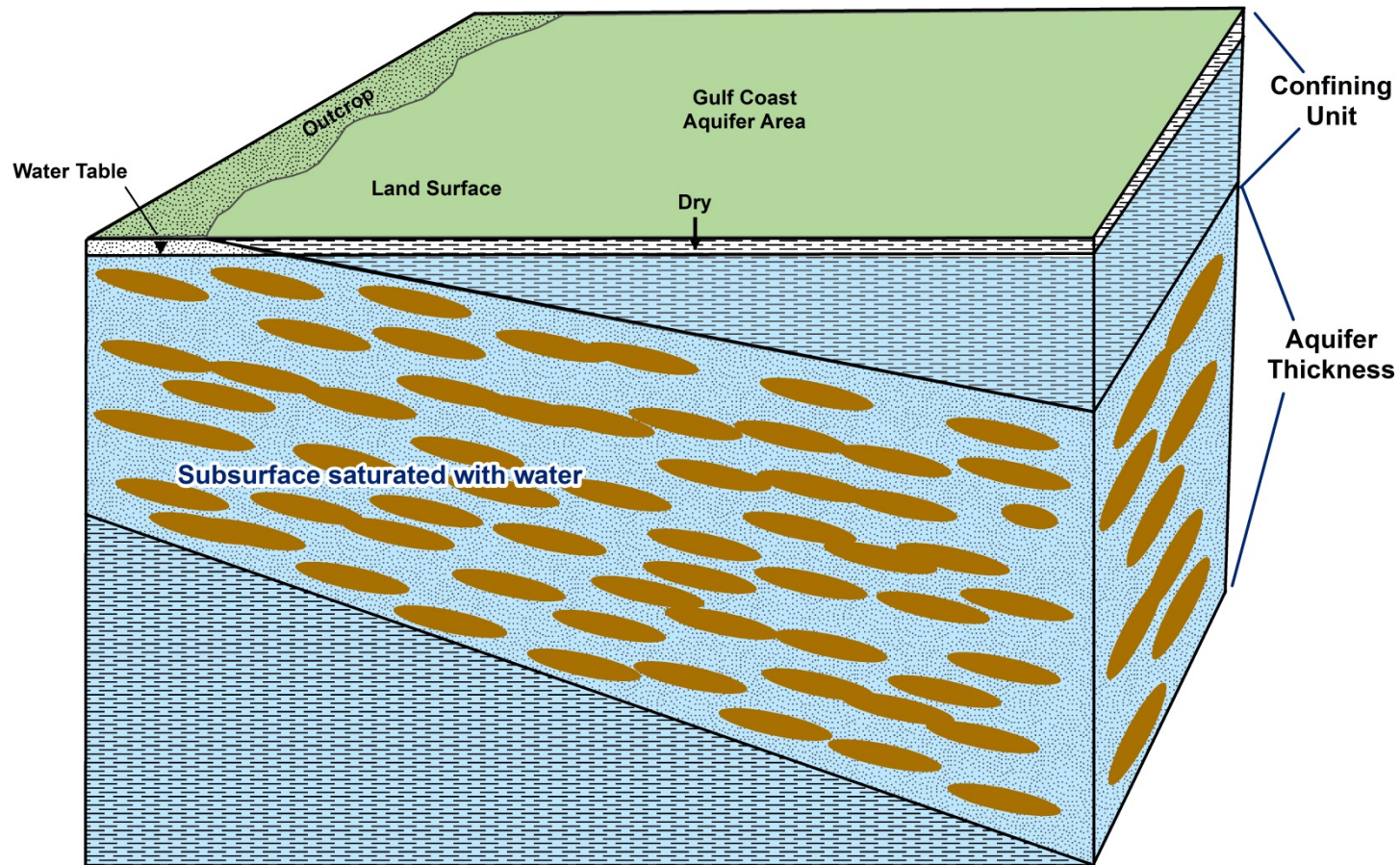
# PRESENTATION OUTLINE

- Review of the total estimated recoverable storage (TERS) estimates released by the TWDB and their possible implications to groundwater management in the District.
- Assess potential volumes of fresh and brackish groundwater in the TERS volume within the District.

## PRESENTATION OUTLINE(CONT'D)

- Explore options for estimating amount of water removed from storage by pumping in the District.
- Develop estimates of subsidence in the District through 2009.

# Generic Block Diagram of an Aquifer

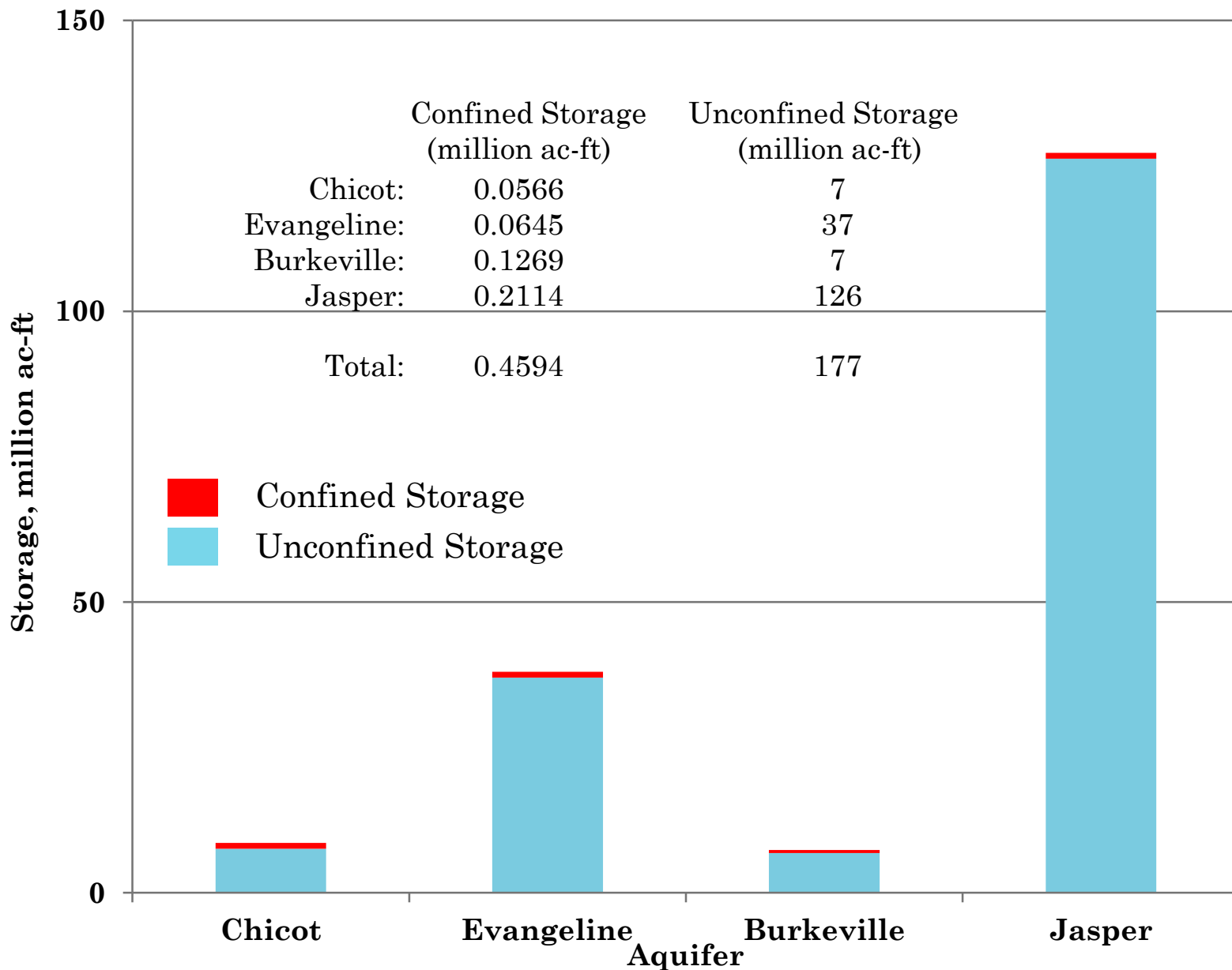


5/24/2016

Confined Storage = Water removed from storage until water level in aquifer declines to the top of the aquifer

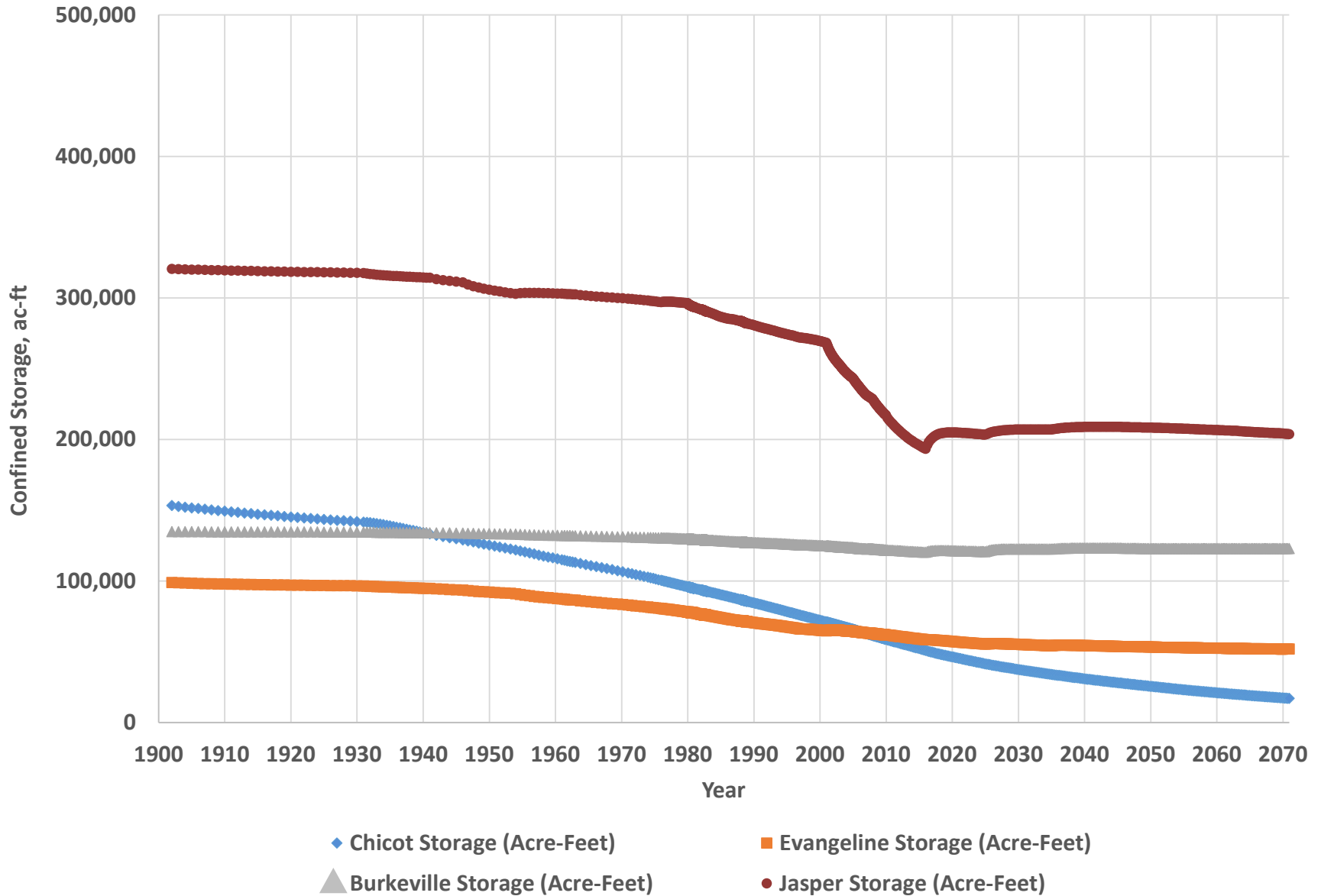
Unconfined Storage = Water removed from the aquifer as the water level declines through the aquifer

# Total Estimated Recoverable Storage In Montgomery County as of 2010 Based on Data from Texas Water Development Board



5/24/2016

# Estimates of Aquifer Confined Storage Changes Resulting in Montgomery County from GMA 14 DFC GAM Run 2



# ESTIMATED CONFINED STORAGE CHANGES IN AQUIFERS IN MONTGOMERY COUNTY 1900 THROUGH 2009

5/24/2016

Aquifer	Storage Change, ac-ft
Chicot	93,276
Evangeline	35,550
Burkeville	7,144
Jasper	<u>103,572</u>
<b>Total</b>	<b>239,542</b>

Estimated remaining confined storage as of 2010 is 459,467 ac-ft.

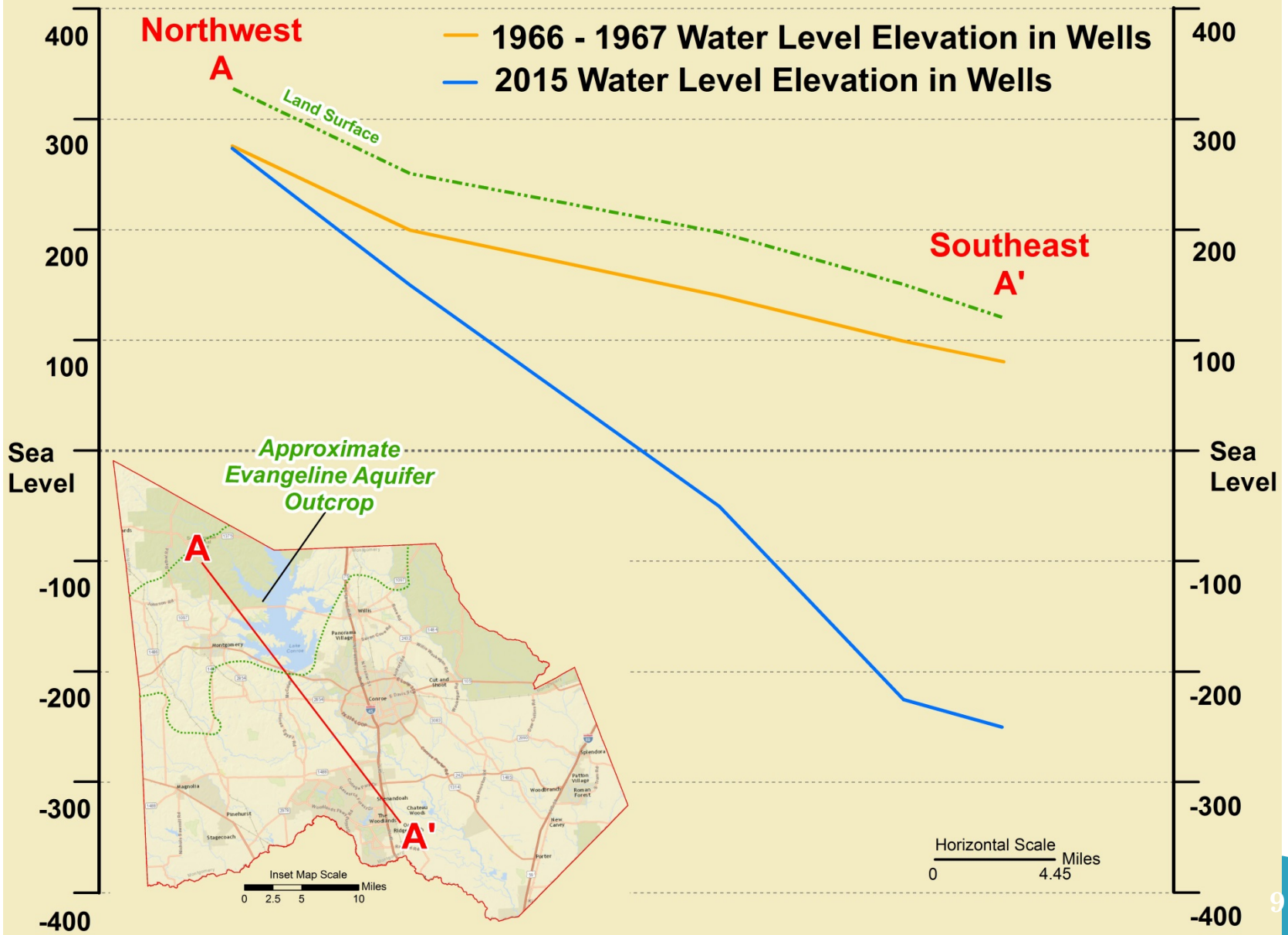
Estimates of confined storage remaining developed by TWDB

Estimates of confined storage change from 1990 through 2009 developed by LSGCD

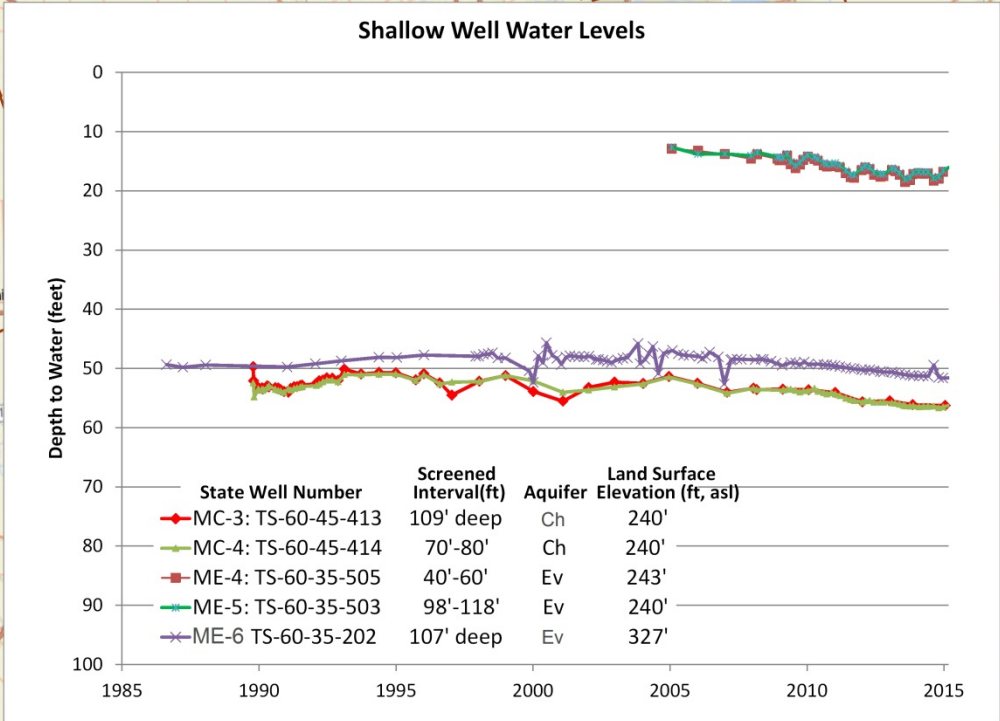
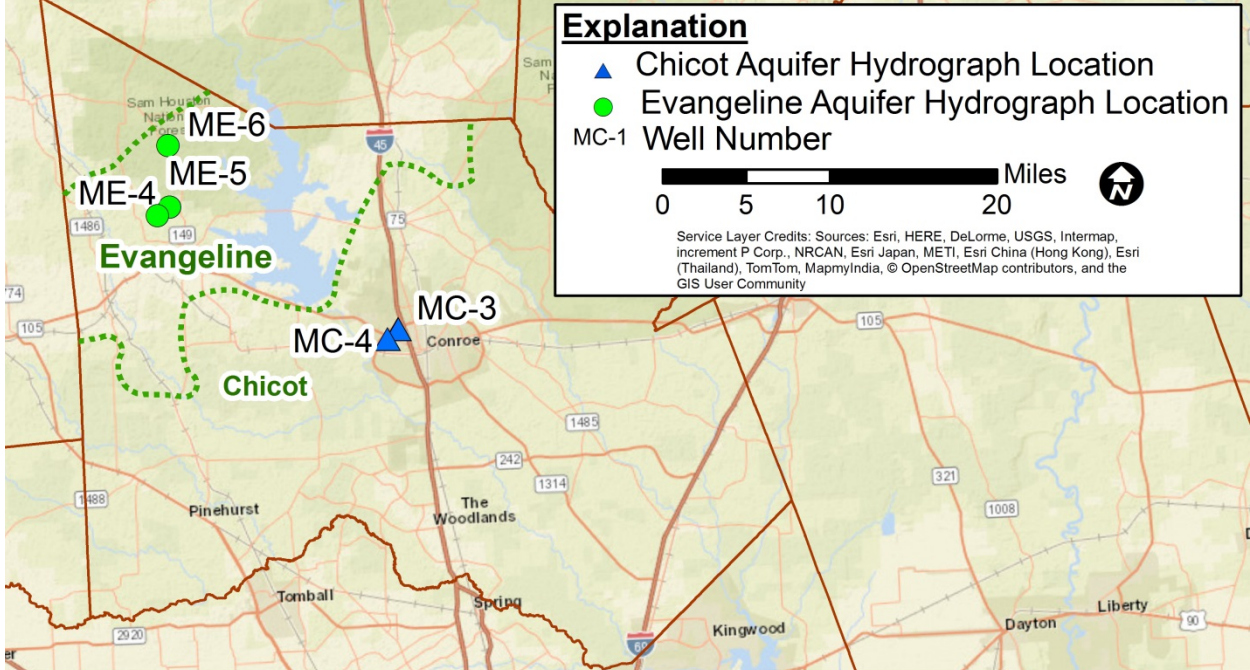


# EVANGELINE AQUIFER WATER LEVEL ELEVATION

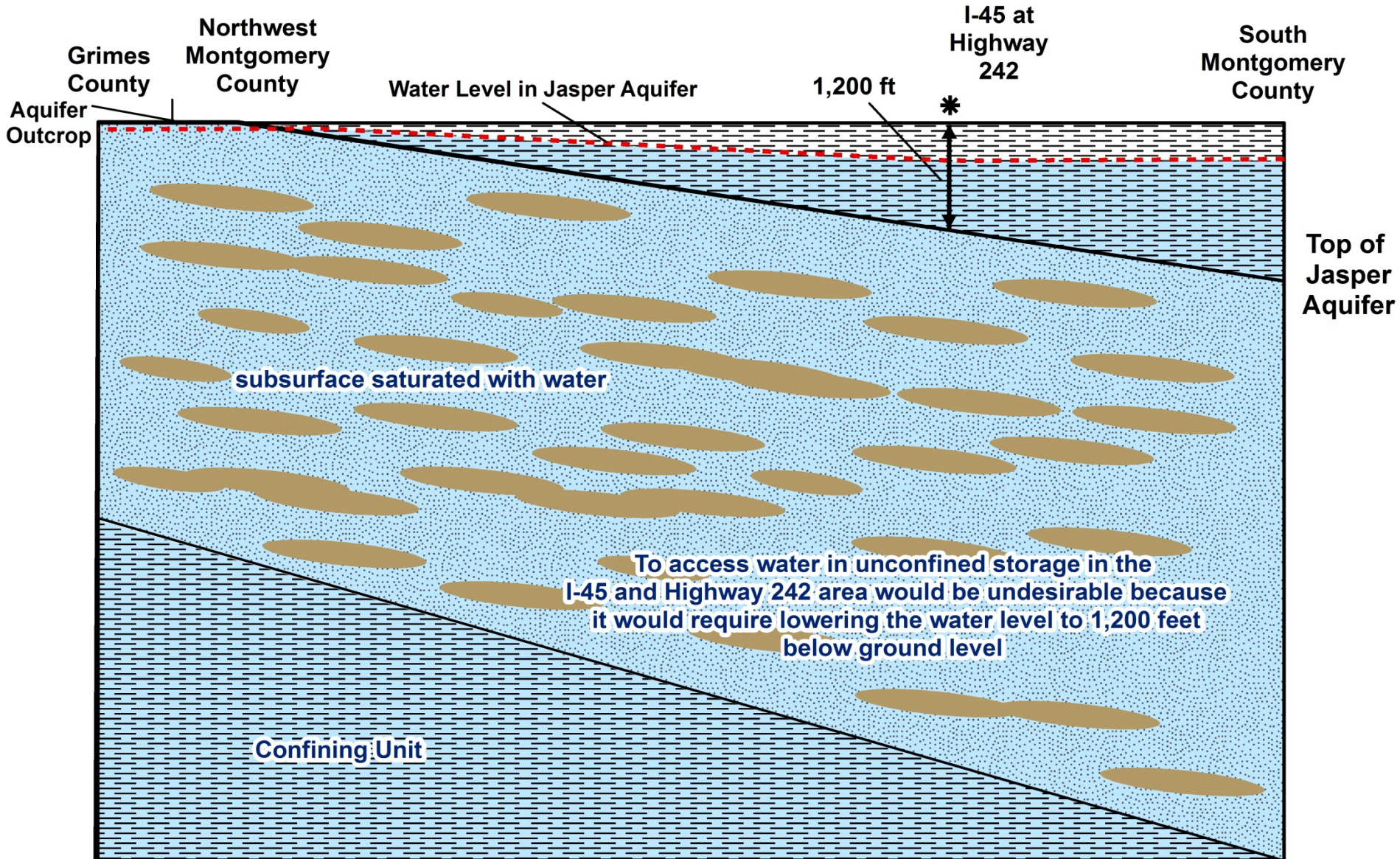
Water Level Elevation, ft rsl



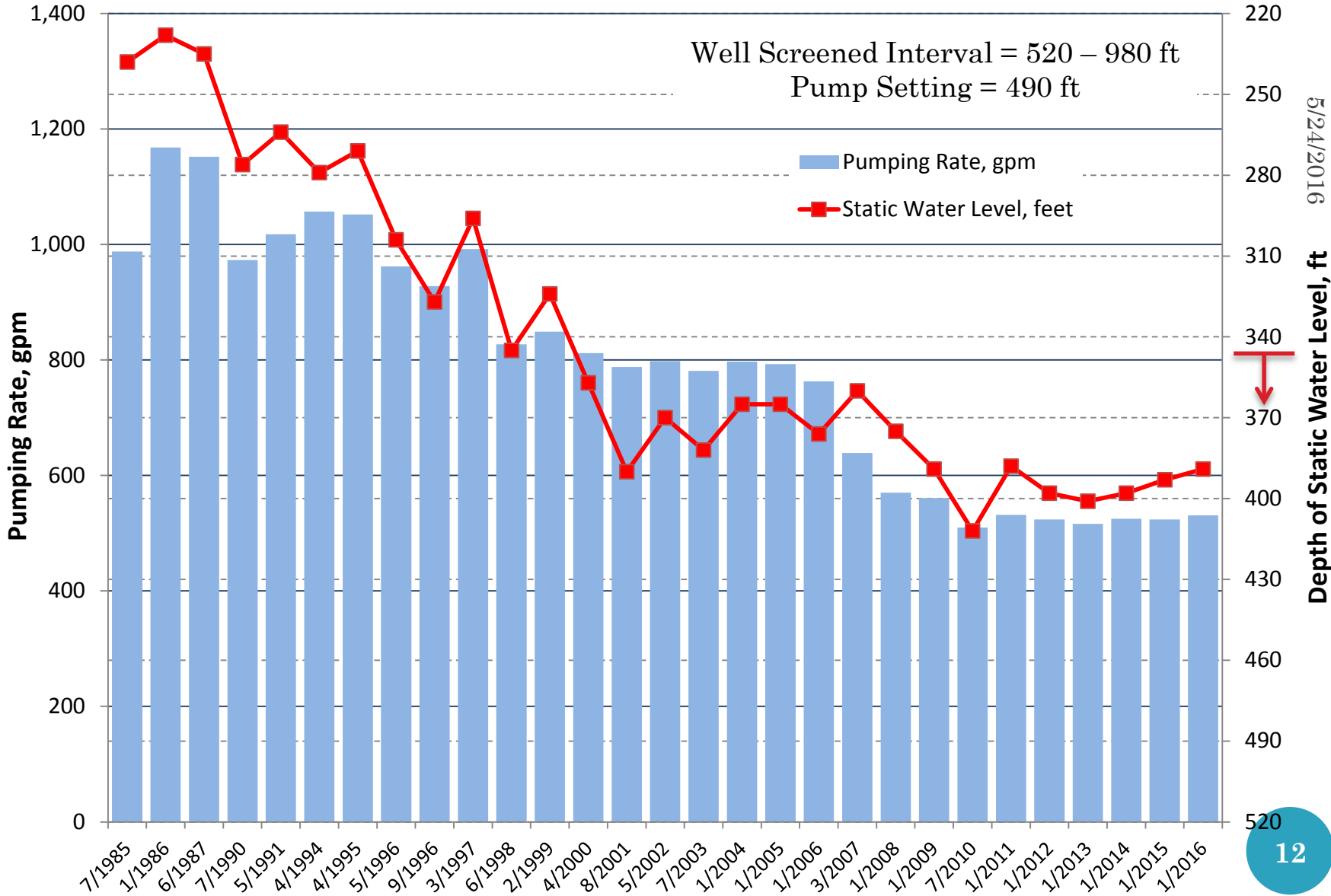
# Shallow Monitoring Wells Located in Aquifer Outcrops



# Montgomery County Jasper Aquifer Example



# Southern Montgomery County Public Supply Well Screening the Evangeline Aquifer



# FINDINGS

- Large amount of artesian head decline in a major area of pumping in central and south Montgomery County can occur with very limited head decline and removal of water from storage evident in the outcrop area.
- To obtain a substantial amount of water from the outcrop requires:
  - Lowering the water level in the outcrop
  - Reducing pumping rates in existing wells in the outcrop
  - Constructing many low pumping rate wells in the outcrop
  - Pumping effects will spread outside the District in aquifer outcrop areas

## FINDINGS

- Large amounts of static water-level decline can result in wells with limited available drawdown and lower pumping rates.

# CONSIDERATIONS IN TERS ANALYSIS BY LONE STAR GCD

- Water quality (whether it is fresh, brackish or saline)
- Technical practicability
- Economic feasibility
- Environmental consequences (esp. base-flows to surface water)
- Land surface subsidence
- Well yield declines
- Impacts to existing wells
- Interplay with board policy of sustainable production

# DETERMINING GROUNDWATER AVAILABILITY IN TEXAS

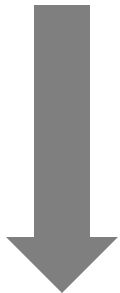
**Groundwater  
Model or Other  
Appropriate Tool**



**Desired  
Future  
Condition  
(DFC)**



**Modeled  
Available  
Groundwater  
(MAG)**



**Science**



**Policy**



**Groundwater  
Availability**

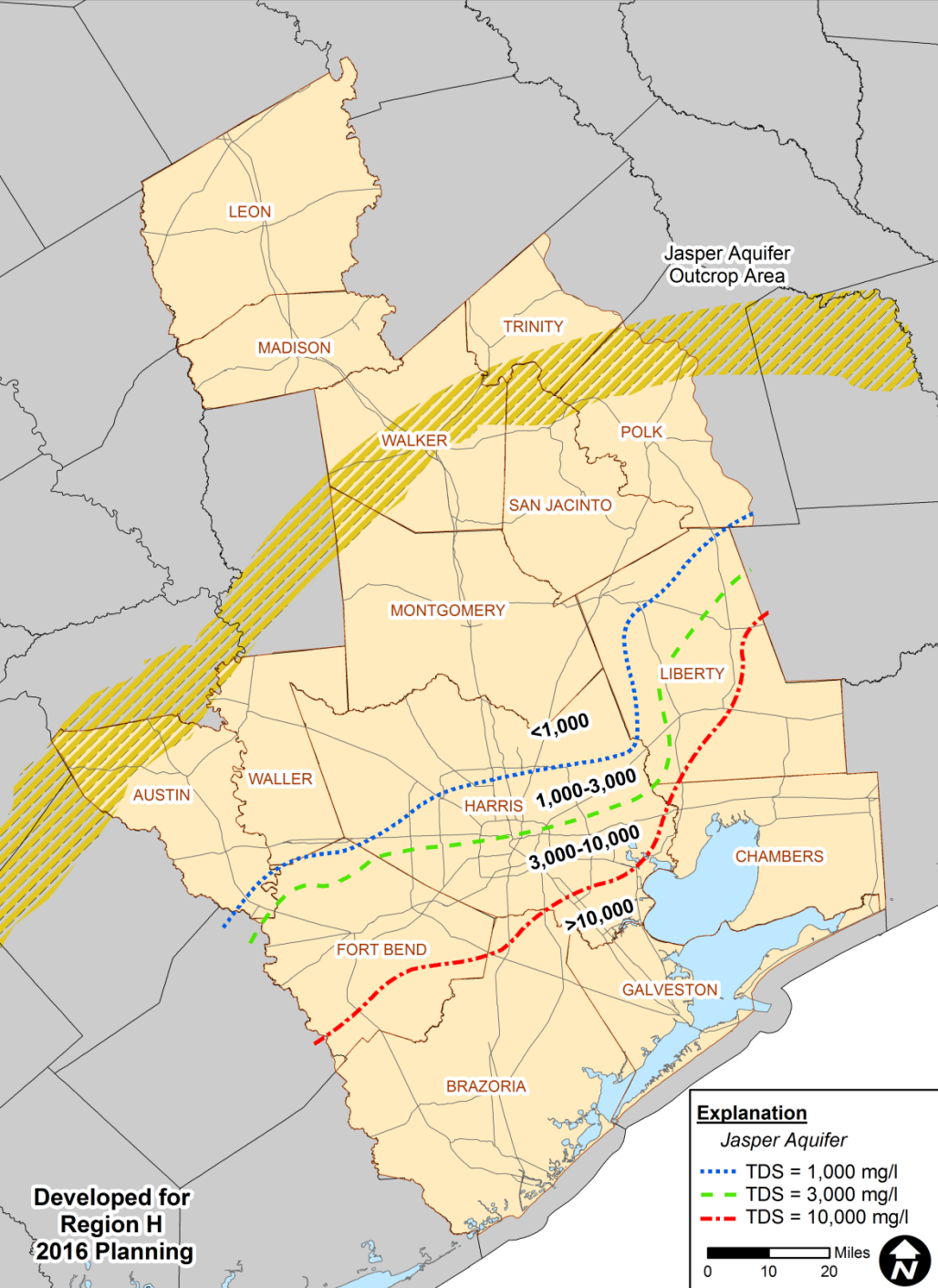


5/24/2016



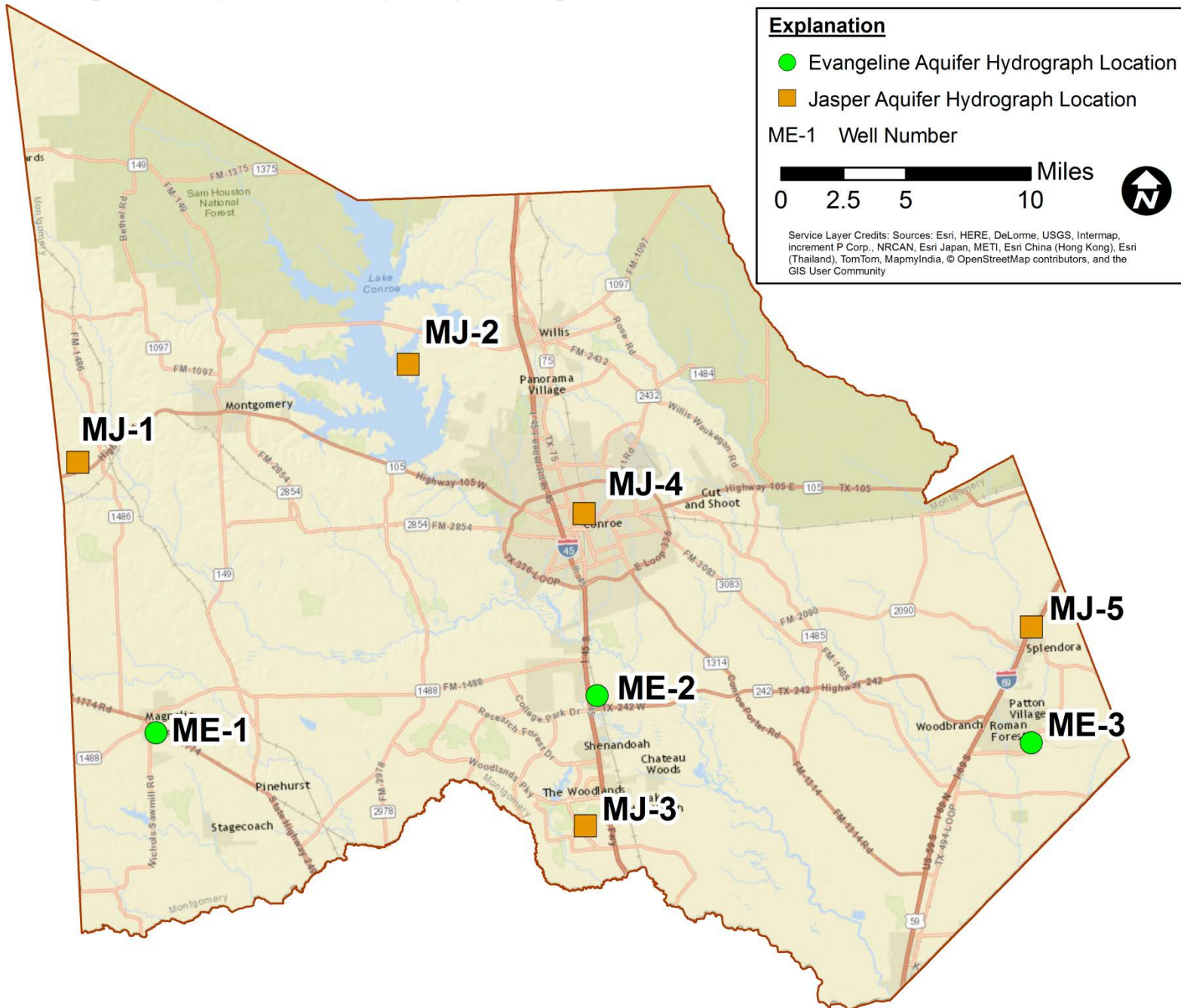
# Delineation of Brackish Groundwater, Jasper Aquifer

Chicot, Evangeline and Jasper aquifers contain water with less than 1,000 mg/l TDS in Montgomery County



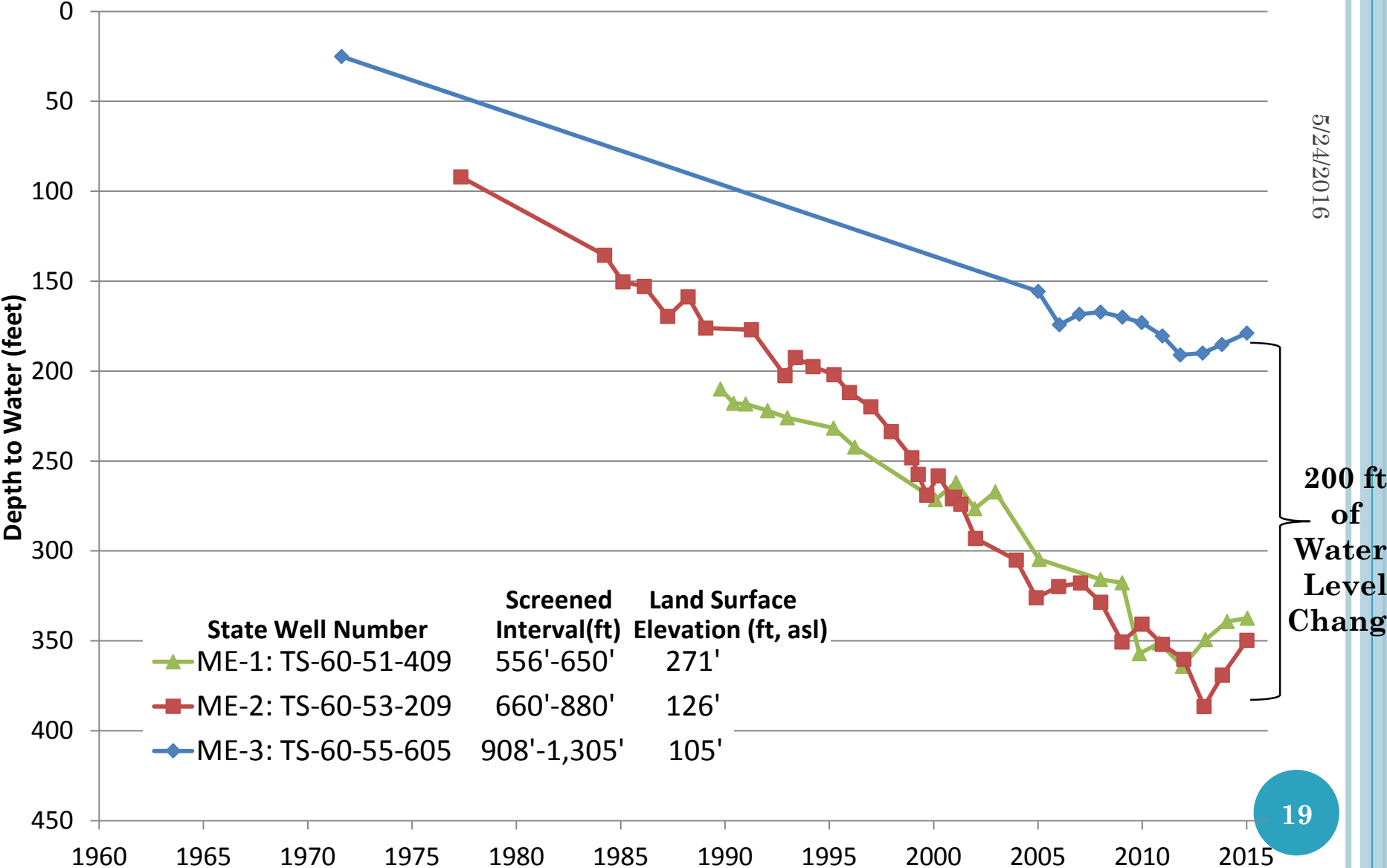
Developed for  
Region H  
2016 Planning

# Montgomery County Hydrograph Locations for Deeper Wells



5/24/2016

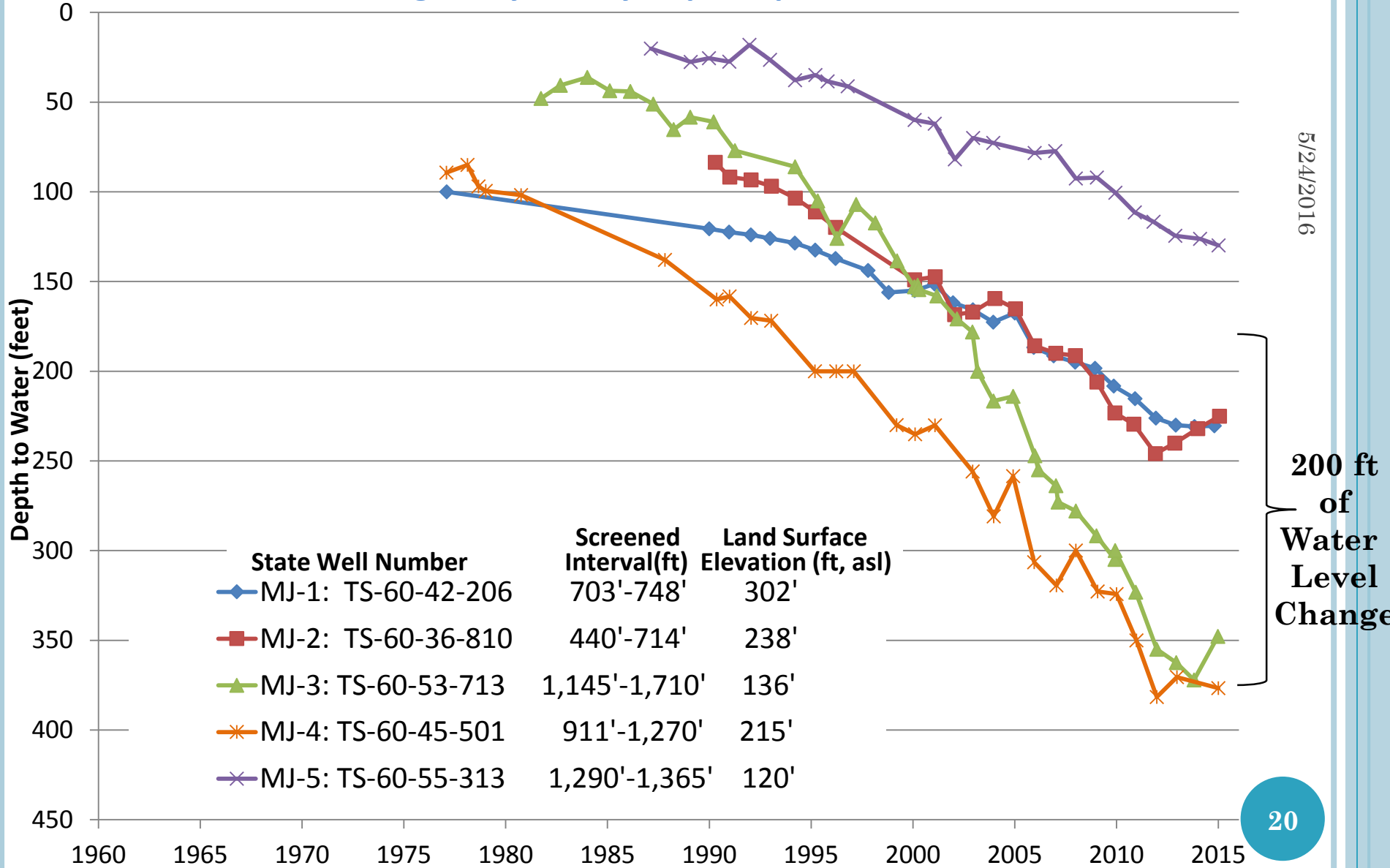
# Montgomery County Evangeline Aquifer Water Levels



5/24/2016

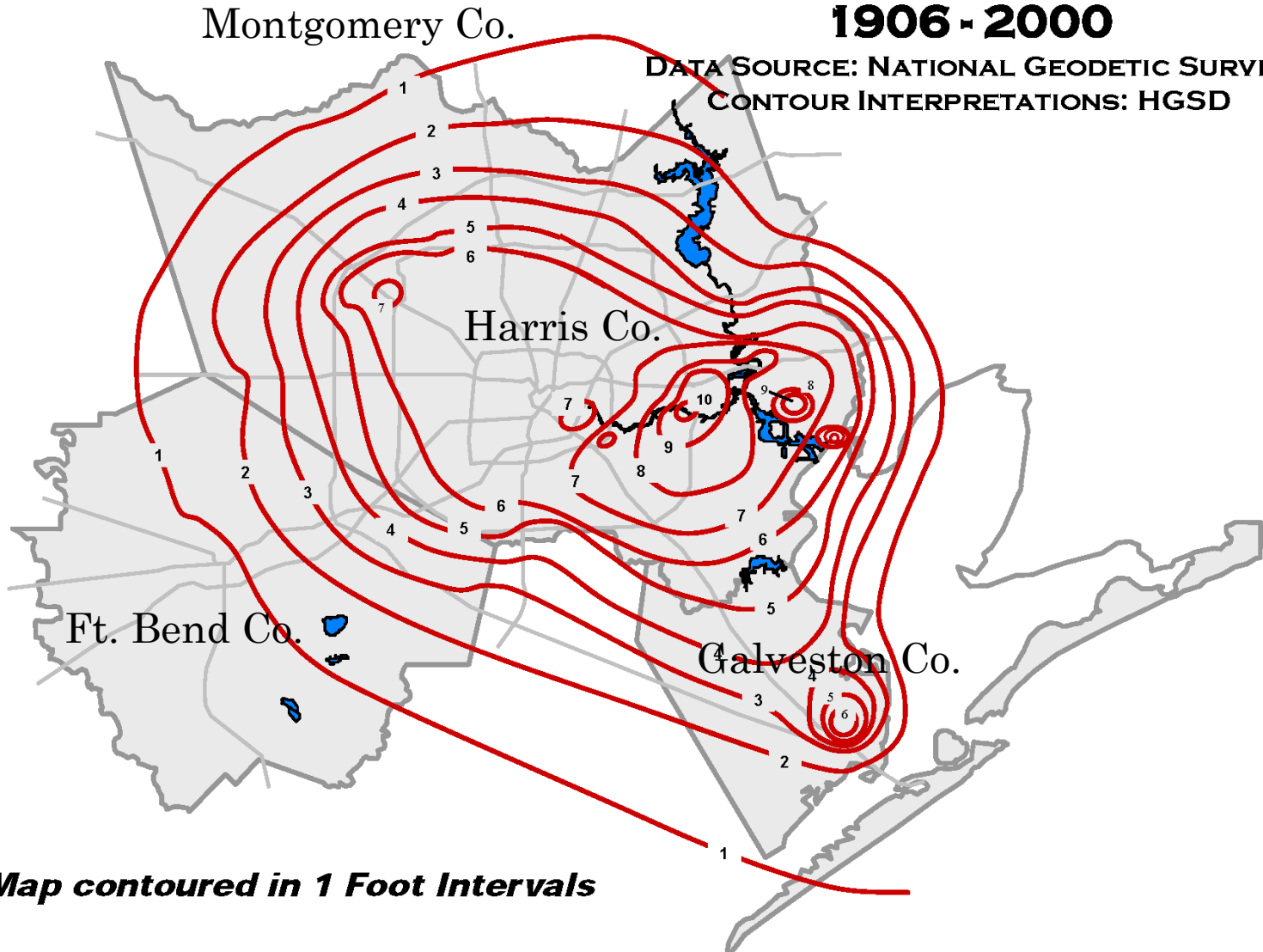
200 ft of Water Level Change

# Montgomery County Jasper Aquifer Water Levels



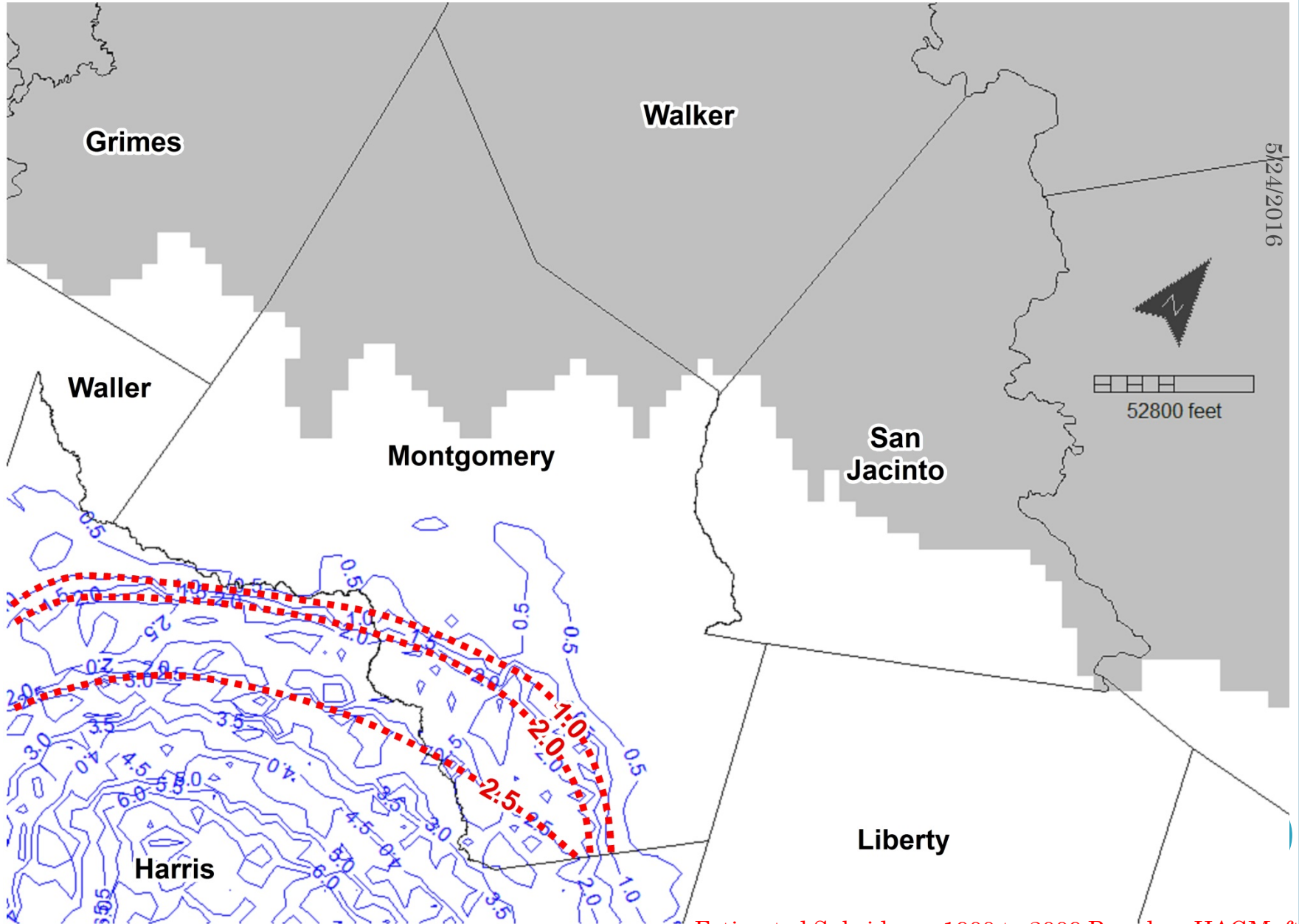
# SUBSIDENCE 1906 - 2000

DATA SOURCE: NATIONAL GEODETIC SURVEY  
CONTOUR INTERPRETATIONS: HGSD



**Map contoured in 1 Foot Intervals**

# GMA 14 DFC Pumping File Subsidence 12/31/1900 - 12/31/2009

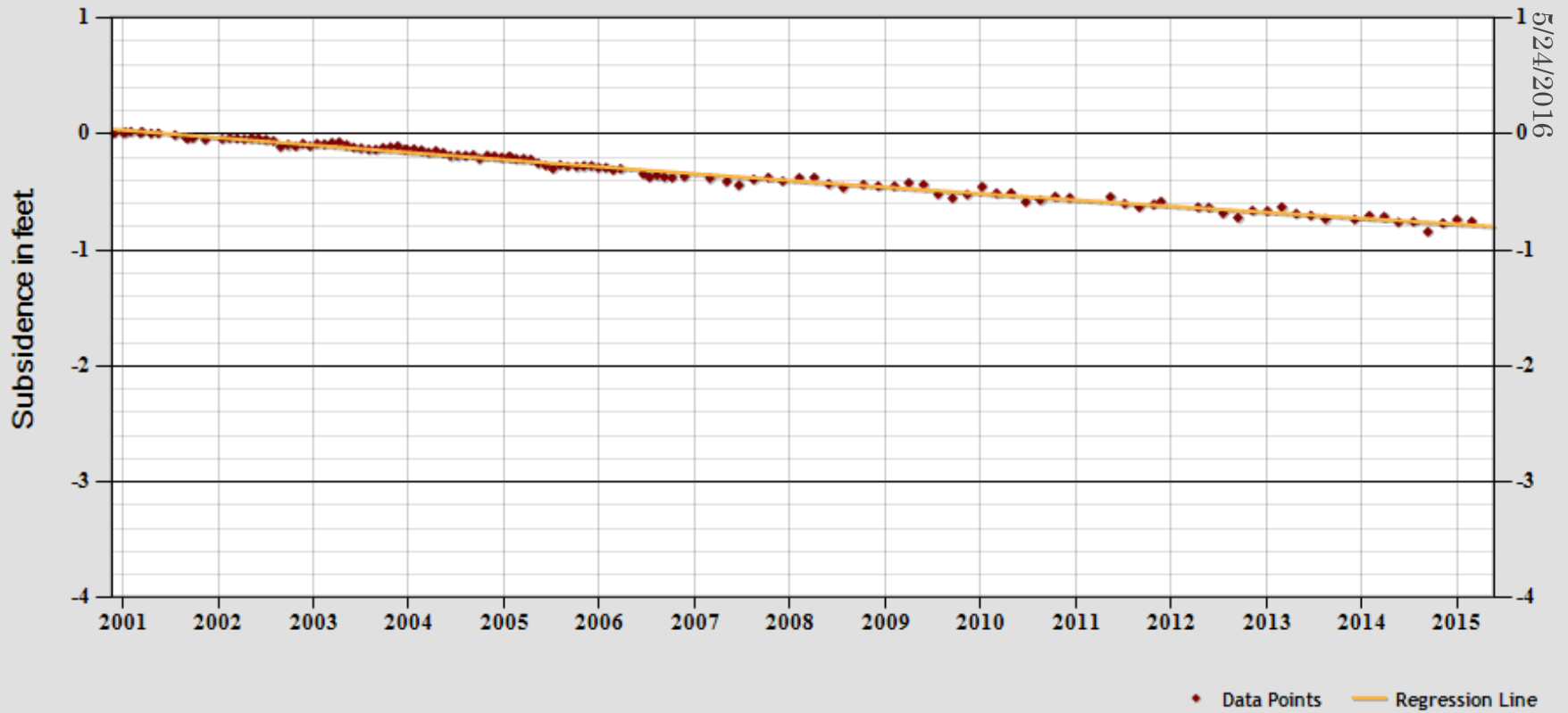


Estimated Subsidence 1900 to 2009 Based on HAGM, ft



# Lone Star Groundwater Conservation District - PAM 13

## *Subsidence Observations*

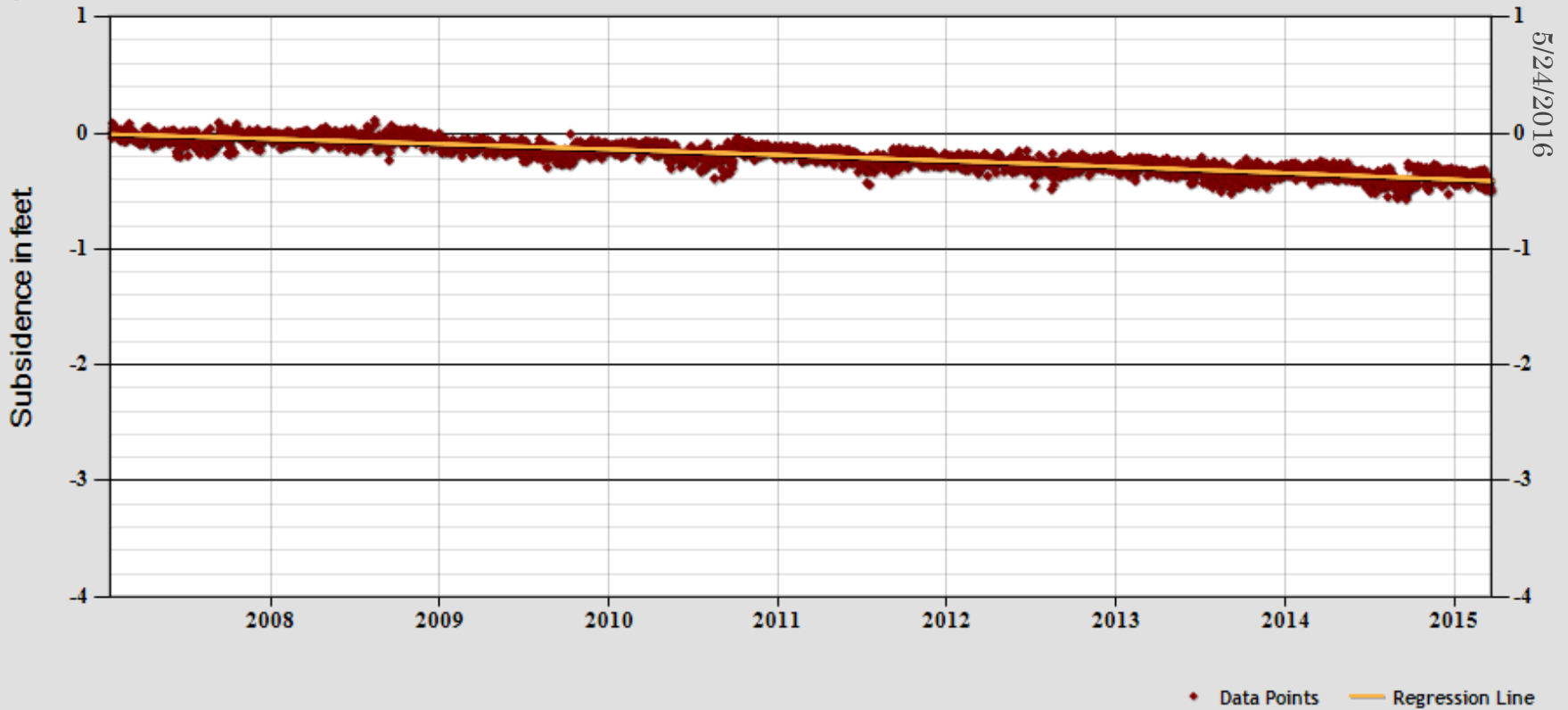


The Woodlands





*Subsidence Observations*



North of City of Conroe

## SUBSIDENCE 1900 - 2009

- Based on National Geodetic Survey and HAGM results, subsidence in the south-southeast part of Montgomery County ranges from less than one foot to about 2.5 feet.
- Based on subsidence data collected by the Harris-Galveston Subsidence District, current subsidence in Montgomery County is spread over the south and central parts with rates ranging from about 0.017- to 0.1-foot per year.

# TASK 2 – TOTAL ESTIMATED RECOVERABLE STORAGE SUMMARY

- TWDB methodology of estimating TERS
  - Meets statutory requirements
  - Does not consider longevity of supply, economics, subsidence, water quality, technical practicability, etc.
- Water resources planning and development considerations
  - Water in storage
  - Pumping effects on other users
  - Water chemistry
  - Pumping lifts
  - Longevity of supply
  - General water development policy, etc.
- Essentially all of the groundwater in the Gulf Coast Aquifer in Montgomery County contains less than 1,000 mg/l of TDS.

## TASK 2 – TOTAL ESTIMATED RECOVERABLE STORAGE SUMMARY (CONT'D)

- The amount of groundwater removed from confined storage is:
  - Estimated by HAGM at 239,542 ac-ft from 1900 to 2009
  - Confined storage provided a small percentage of the estimated pumping volume from 1900 through 2009 of 1.79 million ac-ft, based on the HAGM
  - Remaining confined storage estimated at 459,467 ac-ft
- Removing large quantities of groundwater from unconfined storage substantially lowers well water levels in outcrop inside and outside Montgomery County.

## TASK 2 – TOTAL ESTIMATED RECOVERABLE STORAGE SUMMARY (CONT'D)

5/24/2016

- Large amounts of static water-level decline can result in wells with limited available drawdown and lower pumping rates.
- Past subsidence from 1900 to 2009 less than 1 to 2.5 feet in south part of District
- Current subsidence rate 0.017 to 0.10 feet per year

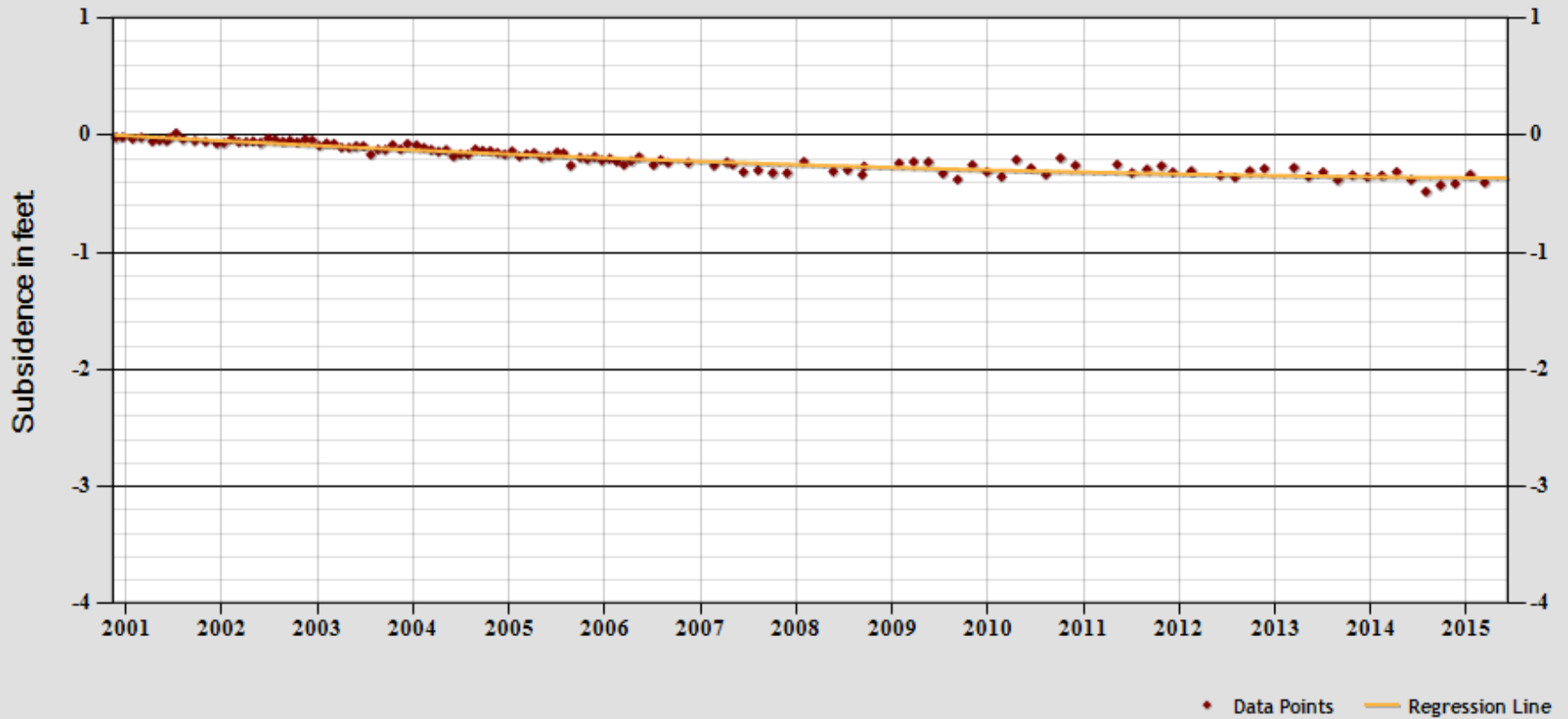


Thank you.

Questions?

# Lone Star Groundwater Conservation District - PAM 12

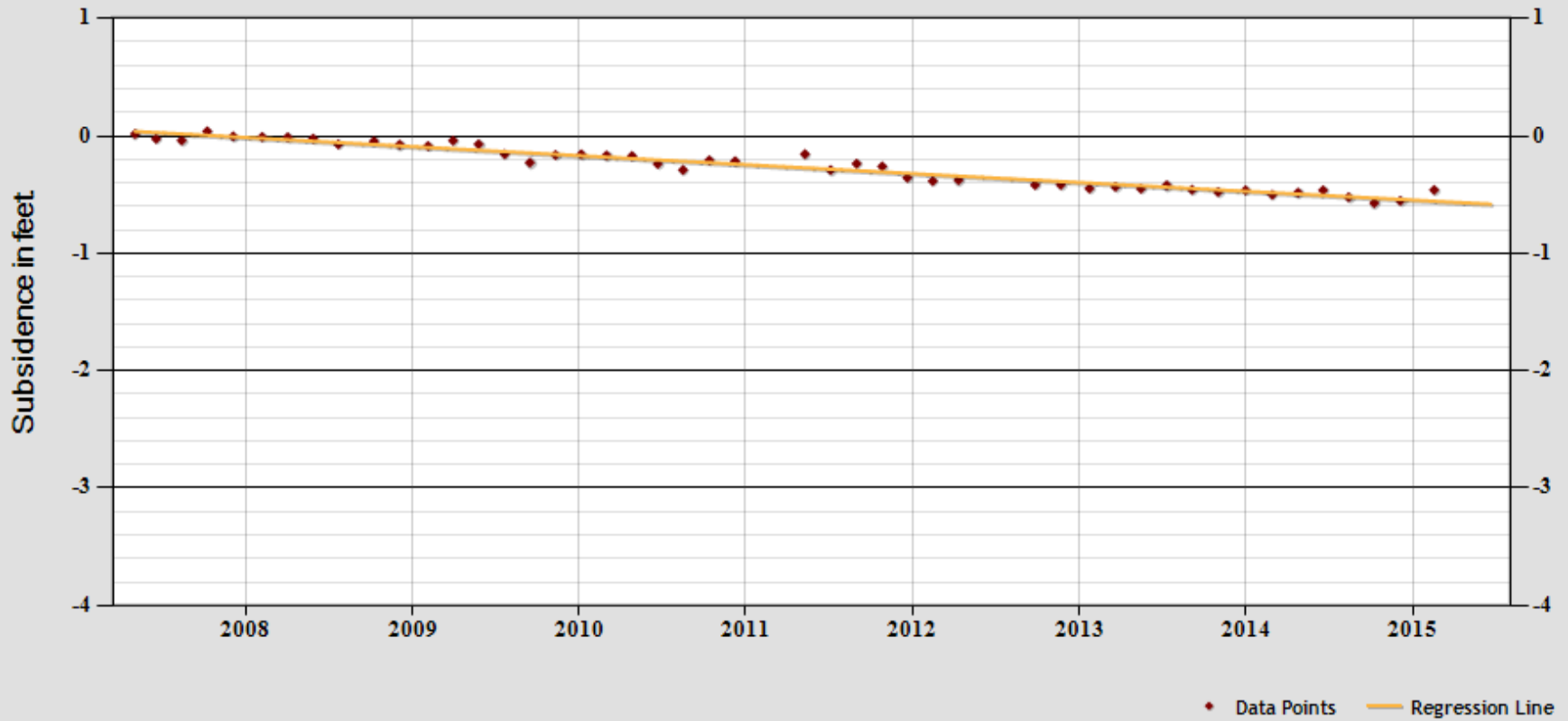
## *Subsidence Observations*



Near Kingwood

## Harris Galveston Subsidence District - PAM 47

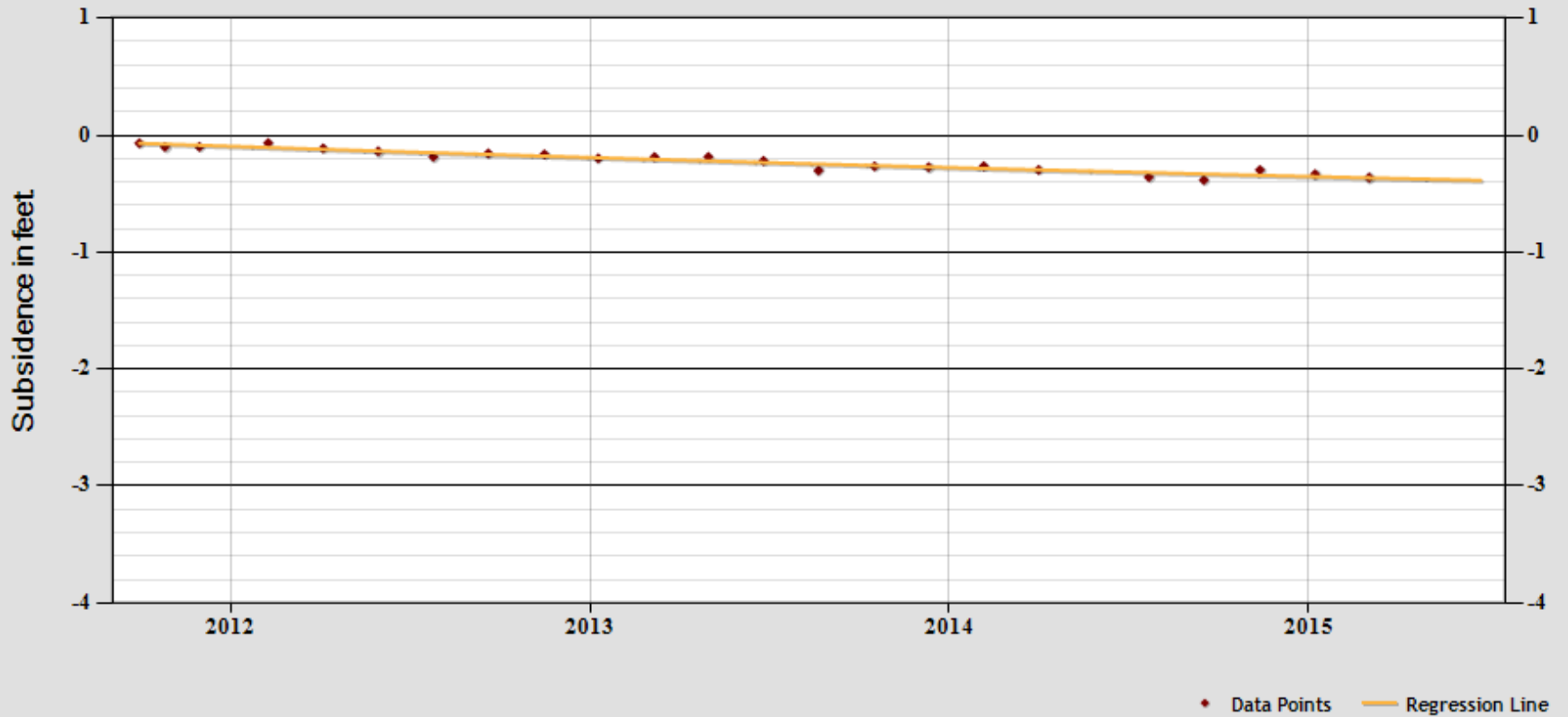
### *Subsidence Observations*



North Harris County



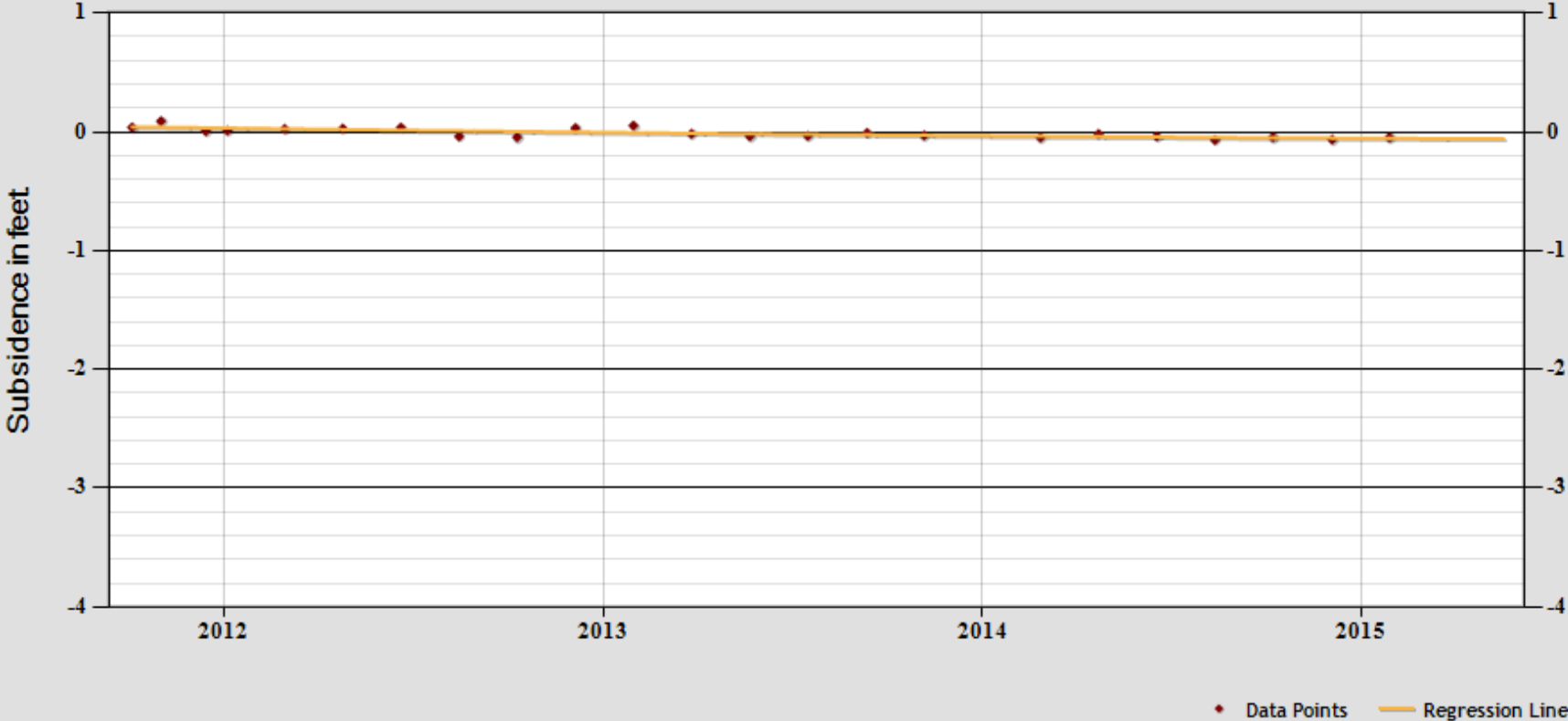
*Subsidence Observations*



Near Hwy 242 & IH-45

Lone Star Groundwater Conservation District - PAM 70

*Subsidence Observations*



Southeast of City of Conroe

*Subsidence Observations*

