

# LONE STAR GROUNDWATER CONSERVATION DISTRICT

May 9, 2017

## MINUTES OF SPECIAL MEETING

The Board of Directors of the Lone Star Groundwater Conservation District (“District”) held a “Special Meeting,” open to the public, in the Lone Star GCD – James B. “Jim” Wesley Board Room located at 655 Conroe Park North Drive, Conroe, Texas, within the boundaries of the District on May 9, 2017.

President Moffatt called the meeting to order at 9:02 a.m., announcing that it was now open to the public.

The roll was called of the members of the Board of Directors, to wit:

John D. Bleyl, PE  
Gregg Hope  
Jace Houston  
Roy McCoy, Jr.  
Webb Melder  
Rick J. Moffatt  
Jim Stinson, PE  
M. Scott Weisinger, PG  
W. B. Wood

All members of the Board were present, with the exceptions of Director(s) McCoy, Stinson and Weisinger, thus constituting a quorum of the Board of Directors. Also, in attendance at said meeting were Kathy Turner Jones, District General Manager; Paul R. Nelson, Assistant General Manager; Brian L. Sledge, General Counsel; District staff; and members of the public. *Copies of the public sign-in sheets are attached hereto as Exhibit “A”.*

After a proper and legally sufficient announcement to the public by President Moffatt, the Board of Directors went into a Closed Executive Session at 9:03 AM pursuant to Texas Government Code, Sections 551.071 and 551.074, to consult with the District’s attorney regarding pending or contemplated litigation, settlement offers, personnel matters, or on matters in which the duty of the attorney to the governmental body under the Texas Disciplinary Rules of Professional Conduct of the State Bar of Texas clearly conflicts with the Texas Open Meetings Act, Chapter 551, Government Code.

Following Executive Session, the Board reconvened in Open Session and President Moffatt declared it open to the public at 10:07 AM.

No additional action was taken on matters discussed in Executive Session and President Moffatt adjourned the meeting at 10:07 AM.

**PASSED, APPROVED, AND ADOPTED THIS 13th DAY OF JUNE, 2017.**

  
Gregg Hopp, Board Secretary

# LONE STAR GROUNDWATER CONSERVATION DISTRICT

May 9, 2017

## MINUTES OF PUBLIC HEARING ON PERMIT APPLICATIONS

The Board of Directors of the Lone Star Groundwater Conservation District (“District”) met in regular session, open to the public, in the Lone Star GCD – James B. “Jim” Wesley Board Room located at 655 Conroe Park North Drive, Conroe, Texas, within the boundaries of the District on May 9, 2017.

### CALL TO ORDER:

President Moffatt called to order the Public Hearing on Permit Applications at 9:53 a.m. announcing the meeting open to the public.

### ROLL CALL:

The roll was called of the members of the Board of Directors, to wit:

John D. Bleyl, PE  
Gregg Hope  
Jace Houston  
Roy McCoy, Jr.  
Webb Melder  
Rick J. Moffatt  
Jim Stinson, PE  
M. Scott Weisinger, PG  
W. B. Wood

All members of the Board were present with the exceptions of Director(s) McCoy, Stinson and Weisinger, thus constituting a quorum of the Board of Directors. Also, in attendance at said meeting were Kathy Turner Jones, General Manager; Paul R. Nelson, Assistant General Manager; Brian L. Sledge, District Counsel; District staff; and members of the public. *Copies of the public sign-in sheets are attached hereto as Exhibit “A”.*

### PRAYER AND PLEDGES OF ALLEGIANCE:

Director Melder gave the opening prayer. President Moffatt led the Pledge of Allegiance.

Permitting Director Samantha Reiter informed the Board that there were three permit applications received in May. Ms. Reiter noted that item #2 and item #3 received reduced recommendations and would be taken separately. Item #1 was requesting authorization to drill a new well, with no request for allocation at this time. She then stated that it was the General Manager's recommendation that item #1 be approved as requested. Lastly, Ms. Reiter stated that it was the General Manager's recommendation to approve the registration and construction of the wells as requested and further authorize reduced recommendations.

**Item #1, Aqua Texas, Inc. (Deerwood Sub.)**

Applicant is requesting an amendment to an Operating Permit for drilling authorization for a new well. No additional production authorization is being requested at this time. Based on technical review of the information supplied, it is the General Manager's recommendation to approve that which is being requested.

**Item #2, Hil & Don Properties, LP (32430 Dobbin Huffsmith Rd)**

Applicant is requesting registration of a new well and production authorization in the amount of 450,000 gallons for 2017 and 600,000 gallons for 2018 and annually thereafter. Based on technical review of the information supplied, it is the General Manager's recommendation to approve the registration and construction of the new well as well as authorize a **reduced** amount of 365,740 gallons for 2017 and annually thereafter.

**Item #3, PTT Properties, LLC**

Applicant is requesting registration of a new well and production authorization in the amount of 2,040,000 gallons for 2017 and 3,000,000 gallons for 2018 and annually thereafter. Based on technical review of the information supplied, it is the General Manager's recommendation to approve the registration and construction of the new well as well as authorize a **reduced** amount of 500,000 gallons for 2017 and annually thereafter.

Following Ms. Reiter's report, a motion was made by Director Houston, seconded by Director Wood to approve item #1 in accordance with the General Manager's recommendations. Director Wood then made a motion to approve Items#2 and #3 in accordance with the General Manager's recommendations. Director Houston seconded, and the motion was approved unanimously.

President Moffatt adjourned the public hearing on permit applications at 9:55 a.m.

**PASSED, APPROVED, AND ADOPTED THIS 13<sup>th</sup> DAY OF JUNE, 2017.**

  
Gregg Hope, Board Secretary

# LONE STAR GROUNDWATER CONSERVATION DISTRICT

May 9, 2017

## MINUTES OF SHOW CAUSE HEARING

The Board of Directors of the Lone Star Groundwater Conservation District (“District”) met in regular session, open to the public, in the Lone Star GCD – Board Room located at 655 Conroe Park North Drive, Conroe, Texas, within the boundaries of the District on May 9, 2017.

President Moffatt called to order the Show Cause Hearing at 10:08 a.m.

The roll was called of the members of the Board of Directors, to wit:

John D. Bleyl, PE  
Greg Hope  
Jace Houston  
Roy McCoy, Jr.  
Webb Melder  
Rick J. Moffatt  
Jim Stinson, PE  
M. Scott Weisinger, PG  
W. B. Wood

All members of the Board were present with the exceptions of Director(s) McCoy, Stinson and Weisinger thus constituting a quorum of the Board of Directors. Also, in attendance at said meeting were Kathy Turner Jones, District General Manager; Paul R. Nelson, Assistant General Manager; Brian L. Sledge, General Counsel; District staff; and members of the public. *Copies of the public sign-in sheets are attached hereto as Exhibit “A” on the Regular Board of Directors Meeting minutes.*

President Moffatt stated this was a Show Cause Hearing pursuant to District Rule 2.5, directing Respondents to appear before the Lone Star Groundwater Conservation District Board of Directors and show cause why the District should not issue a cease and desist order, file a civil suit against Respondent in State District Court seeking enforcement of District rules and the collection of all due and owing water use fees, late payment penalties, other civil penalties and attorneys’ fees and court costs incurred by the District and take all other enforcement action that is necessary and appropriate under the laws of the State of Texas.

Ms. Kathy Turner Jones, District General Manager, reviewed the persons and/or entities listed for Show Cause Hearing as follows: LCBGH15, LLC – Failure to remit 2016 production report

and/or fines associated with timely submission; and failure to remit 2017 annual water use fees and/or fines associated with timely submission.

President Moffatt asked if anyone was in attendance for the Show Cause Hearing. President Moffatt asked that the record show there was no one in attendance. Additionally, he clarified that agenda items #3 and #4 were to be considered jointly.

Ms. Jones noted that each of the remaining persons and entities on the agenda had been previously ordered to appear for the show cause hearing, and that notice had been provided to them by the District staff in accordance with the requirements in the District Rules. Because the persons and entities on the agenda had failed to appear for the hearing, Ms. Jones recommended to the board that it proceed with the recommended enforcement actions against them, including turning the matter over to local counsel as has been done in the past.

Director Wood made a motion that the board take action consistent with the recommended enforcement actions in the agenda for each of the remaining persons and entities for the violations associated with each on the agenda, which included issuance of a cease and desist order, authorization of filing of a civil suit, and other actions against each such person or entity as specifically set forth in the agenda. Director Hope seconded the motion. It passed unanimously.

President Moffatt adjourned the Show Cause Hearing at 10:09 a.m.

**PASSED, APPROVED, AND ADOPTED THIS 13<sup>th</sup> DAY OF JUNE 2017.**

  
Gregg Hope, Board Secretary

# LONE STAR GROUNDWATER CONSERVATION DISTRICT

May 9, 2017

## MINUTES OF REGULAR MEETING

The Board of Directors of the Lone Star Groundwater Conservation District ("District") met in regular session, open to the public, in the Lone Star GCD - James B. "Jim" Wesley Board Room located at 655 Conroe Park North Drive, Conroe, Texas, within the boundaries of the District on May 9, 2017.

### CALL TO ORDER:

President Moffatt presided and called to order the regular Board of Directors meeting at 10:10 AM, announcing that it was open to the public.

### ROLL CALL:

The roll was called of the members of the Board of Directors, to wit:

John D. Bleyl, PE  
Gregg Hope  
Jace Houston  
Roy McCoy, Jr.  
Webb Melder  
Rick J. Moffatt  
Jim Stinson, PE  
M. Scott Weisinger, PG  
W. B. Wood

All members of the Board were present, with the exceptions of Director(s) McCoy, Stinson and Weisinger, thus constituting a quorum of the Board of Directors. Also in attendance at said meeting were Kathy Turner Jones, General Manager; Paul R. Nelson, Assistant General Manager; Brian L. Sledge, General Counsel; District staff; and members of the public. *Copies of the public sign-in sheets are attached hereto as Exhibit "A".*

### APPROVAL OF THE MINUTES:

President Moffatt stated the Board would consider all meeting minutes as listed for approval on the day's agenda as one item. A motion was made to approve the meeting minutes by Director Houston, seconded by Director Bleyl. The motion was approved unanimously.

- a) April 11, 2017, Special Board Meeting
- b) April 11, 2017, Public Hearing on Permit Applications

c) April 11, 2017, Regular Board of Directors Meeting

### **USGS PRESENTATION:**

Mr. Sachin D. Shah, Chief of Hydrologic Studies and Research for U.S. Geological Survey, provided an overview of the “Water-Level Altitudes and Changes in the Chicot, Evangeline, and Jasper Aquifers, Houston-Galveston Region, Texas, 2017”. Mr. Mark Kasmarek, Groundwater Hydrologist, followed with a presentation on the findings of the study and discussed the water level altitude changes over both the past year and long term. Mr. Kasmarek also provided an explanation of the borehole-extensometer system located throughout the region and the soil compaction levels measured by that system. Mr. Kasmarek and Mr. Shah then responded to questions from both the Board members and the public. Director Melder asked for clarification regarding borehole-extensometers in Montgomery County. Mr. Kasmarek stated that Montgomery County did not have any extensometers though they did have eight Port-A-Measure (PAM) units in the county, which are cheaper and perform a similar function as the extensometers. In response to a question, Mr. Kasmarek clarified that this task does not monitor the recharge rate, rather they measure the water levels in the county. Director Houston requested that the map with the PAM and extensometer sites be included in the final report. There was a question from the public on whether the rises in water levels in 2016 could be linked to the conversion from groundwater to surface water in parts of the county. It was noted that the rises could not necessarily be attributed solely to the surface water conversion a, but rather a combination of the conversion coupled with a wet 2016. It was further stated that because recharge flows slowly through the aquifers, recharge itself, is not what is driving the rises on the maps but rather less demand on the aquifers. Director Wood clarified that a wet year doesn’t really have an effect on the water levels, to which Mr. Shah agreed, adding that it does play a part in the long-term rises. Director Melder commented that in 2011, the City of Conroe’s Water Conservation Manager prepared a report that stated that the city had a substantial conservation push during the drought and the water levels in 16 of the city’s 18 wells showed water level rises. He encouraged Mr. Kasmarek to review the report and ensure he was reporting correctly. Mr. Kasmarek stated that he would look at the report but advised that type of a response in water levels is not to be expected. He added that they saw tremendous withdrawals and spoke to a large number of operators who were worried about the water levels in their wells dropping so low that it would damage the wells during that time. It was noted that USGS would be accepting comments on the report for the next week, with the printed copy of the report being made available the first week in June. Ms. Jones stated that the presentation would be posted on the LSGCD website for the public to have access to. *(A copy of the PowerPoint presentation is attached hereto as Exhibit "B".)*

### **COMMITTEE REPORTS:**

#### **A. Executive Committee – Rick Moffatt, President**

- 1) Brief the Board on the Committee’s activities since the last regular Board meeting – President Moffatt reported that the committee had not met since the last regular board meeting. He stated that the Texas Legislature had twenty days remaining in the



present session. President Moffatt then asked Mr. Brian Sledge to update the Board on pending legal matters.

- 2) Defense of the following lawsuit: City of Conroe et al. v. Lone Star Groundwater Conservation District (and the District's directors and general manager in their official capacities) – Mr. Sledge said that the plaintiffs elected not to appeal the 9<sup>th</sup> Court of Appeals decision. Instead they filed a partial summary judgment with the District Court. The directors' attorney filed an amended answer to conform to the original answer in the decision from the Court of Appeals and requested the attorney's fees be recovered.
- 3) Defense of Appeal of Desired Future Conditions Adopted by the District: Cities of Conroe/Magnolia and Quadvest – Mr. Sledge stated that with respect to the DFC Appeal, the District had a preliminary conference with the administrative law judge last month. Mr. Sledge added that a preliminary hearing is scheduled May 12, 2017. He stated that the purpose of the hearing is to establish scheduling, deadlines, etc. The meeting will be in the District board room. He said the final hearing is proposed for November 6, 2017.

**B. Water Awareness and Conservation Committee- Billy Wood, Chair**

- 1) Brief the Board on the Committee's activities since the last regular Board meeting – Director Wood said the committee had not met since the last board meeting.
- 2) Update on water efficiency, conservation efforts – Paul R. Nelson – Mr. Nelson reported that the Water Efficiency Network meeting with Dr. Kevin Wagner on April 20th was well attended and that the discussion focused on ongoing innovations in water treatment and conservation at the Texas Water Resources Institute. Mr. Nelson promoted the May 13<sup>th</sup> "2017 Smarter About Water Seminar" to be held in The Woodlands. He stated that he would be the moderator for the seminar, talk about LSGCD's conservation efforts and listed the scheduled presenters. He then announced that May 18th is the next Water Efficiency Network meeting. The scheduled guest speaker is Jonathan Kleinman, President of AIQUEOUS who is to give a presentation on data-driven water conservation software that helps utilities and districts operate more efficiently.
- 3) Briefing on public outreach activities – James Ridgway – Mr. Ridgway reported that on April 29<sup>th</sup> the Mobile Lab was on display at KidzFest with approximately 15,000 in attendance. He stated that on Earth Day, the rainwater harvest demo went to Home Depot in both the Woodlands and Conroe. Mr. Ridgway informed the group of Rice University's student project; a special water exhibit. Mr. Ridgway plans to display the exhibit at next month's meeting.
  - (a) 2017-2018 Texas 4-H Water Ambassador Program – Mr. Ridgway discussed the Texas 4-H Water Ambassador Program. This program provides 4-H members, 14 years old and up, an opportunity to gain knowledge and leadership in skills related

to the science, technology, engineering and management of water in Texas. The District has committed a \$500 sponsorship in support of this program.

**C. Rules and Regulatory Planning Committee – Jim Stinson, Chair**

- 1) Brief the Board on the Committee’s activities since the last regular board meeting – Director Stinson was not present. President Moffatt stated that the committee had not met since the last regular Board meeting.

**D. Policy and Personnel Development Committee – Jace Houston, Chair**

- 1) Brief the Board on the Committee’s activities since the last regular Board meeting – Director Houston said there had not been any activity to report since last month.

**E. Budget and Finance Development Committee – Billy Wood, Chair**

- 1) Brief the Board on the Committee’s Activities – Director Wood stated that the committee had not met this month. He stated that the staff would be scheduling a meeting of the Budget Committee to begin discussions of projected water use fees for 2018. A public board budget workshop is tentatively scheduled for June 6, 2017.
- 2) Review of monthly financial reports – Director Wood reported that, for the month of April, revenue was budgeted at \$138,887—actual was \$141,457. He said April expenses were budgeted at \$283,740—actual expenses were \$278,335. Year-to-date net income, he said, was a net loss of \$136,878.

**F. Findings and Review Committee – Rick Moffatt, Chair**

- 1) Brief the Board on the Committee’s activities since the last regular Board meeting – President Moffatt reported that there had been a meeting on April 25<sup>th</sup> in which LBG-Guyton discussed the findings of Runs A and B of the Strategic Planning Study.
- 2) Status Update: update regarding development of a strategic plan evaluating opportunities for additional development of water resources in the District while ensuring long-term viability of the aquifers within the District – President Moffatt provided an update on Task #3 of the Strategic Planning Study stating that LBG-Guyton reviewed the preliminary results of Runs A and B. He stated that within the next thirty days the District will have results incorporating the survey data into the findings. Ms. Reiter reported that surveys for 245 wells had been returned, approximately one-third of the total number of survey responses anticipated. President Moffatt said that another meeting this month is anticipated. The goal of finishing the study is still set for June or July.
- 3) Groundwater Management Area 14 – Update the board on the status of the current desired future conditions development process in GMA 14 – Ms. Jones stated that there had been no action from the GMA 14 this month.

**ENGINEERING REPORT:**

Mark Lowry was not present. His report was included in the board's packet.

**GENERAL MANAGER'S REPORT:**

Ms. Jones said the 2016 Annual Report is now available. The final product is a professional booklet that required team effort providing an unique story of Montgomery County. Ms. Jones reported that the 2016 Water Use Fee Rebate Program requests had a March 15<sup>th</sup> deadline and resulted in total rebates of \$90,000. This is in excess of the budget by \$40,000+. Ms. Jones stated that the unexpected rebate total was due to the volume of rainfall and decline of demand for water in 2016. She further explained that the annual number of requests averaged 20-30 but last year there were only six requests. She announced an upcoming meeting date of June 7<sup>th</sup> for the Region H Planning Group at the SJRA facilities.

**GENERAL COUNSEL'S REPORT:**

Mr. Sledge said that in Executive Session he had briefed the board on the DFC Appeal litigation and legislation. He said the legislation was proceeding and the process was working as designed.

**PUBLIC COMMENTS:**

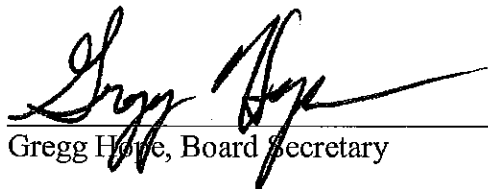
There was no public comment.

**NEW BUSINESS:**

There were no new business items.

There being no further business, upon a motion made by Director Wood and seconded by Director Houston, the meeting was adjourned at 11:14 AM.

**PASSED, APPROVED, AND ADOPTED THIS 13<sup>th</sup> DAY OF JUNE 2017.**

  
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Gregg Howe, Board Secretary



# Water-Level Altitudes and Changes in the Chicot, Evangeline, and Jasper Aquifers, Houston-Galveston Region, Texas, 2017

The Scientific Story of Water-Levels, Long-term Changes, and Compaction

Sachin D. Shah, Chief of Hydrologic Studies and Research  
Mark C. Kasmarek, Groundwater Hydrologist  
Jason K. Ramage, Hydrologist

U.S. Department of the Interior  
U.S. Geological Survey



# Introduction to U.S. Geological Survey

- Department of Interior - Founded in 1879
- Six Science Mission Areas
  - **Water Resources**
  - Ecosystems
  - Energy, Minerals, and Environmental Health
  - Core Science Systems
  - Climate and Land-Use Change
  - Natural Hazards
- **Scientific Mission**
- **Non-Regulatory**
- 8,300 employees nationwide
- Conduct interdisciplinary scientific monitoring, assessment, and research... distribute that information to the public

# Overview

- **Gulf Coast Aquifer System**

# Overview

- **Approach and Methodology**
  - Order of Operations
  - Monitoring Network

# Overview

- **Aquifer Map Interpretations**
  - Annual water-level altitude
  - 1-year water-level change
  - Long-term water-level change
  - Measured cumulative compaction



# Approach and Methodology

Initial planning: Field maps, Equipment, Logistics

Measure static water-levels (data management; QA/QC)

Analysis and Interpretation

- Altitude maps
- 1-year changes
- 5-year changes
- Long term changes

Final Publication



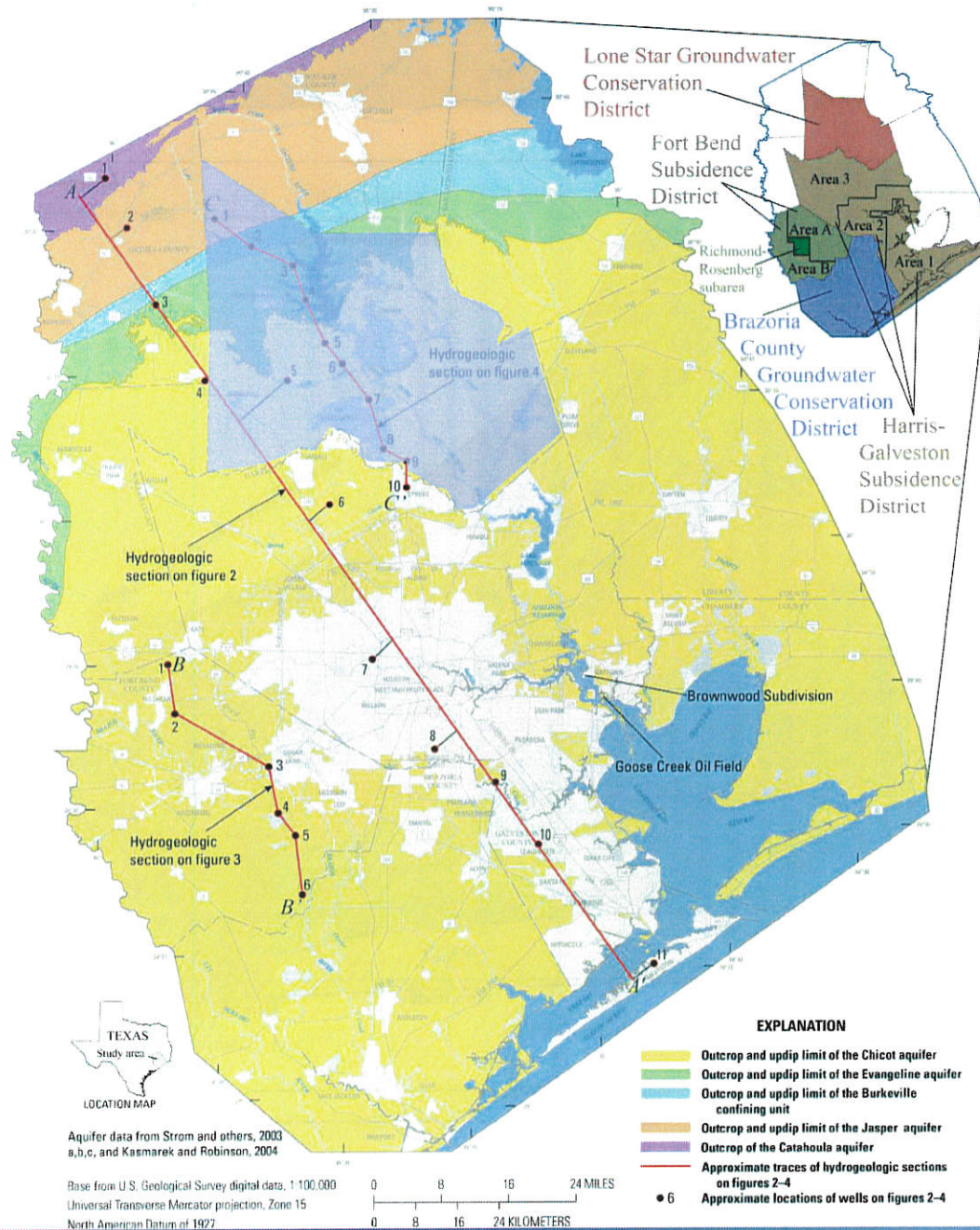
Approximately 700 wells measured between December and March in accordance with approved and documented USGS field procedures:

- public supply
- Irrigation
- industrial wells

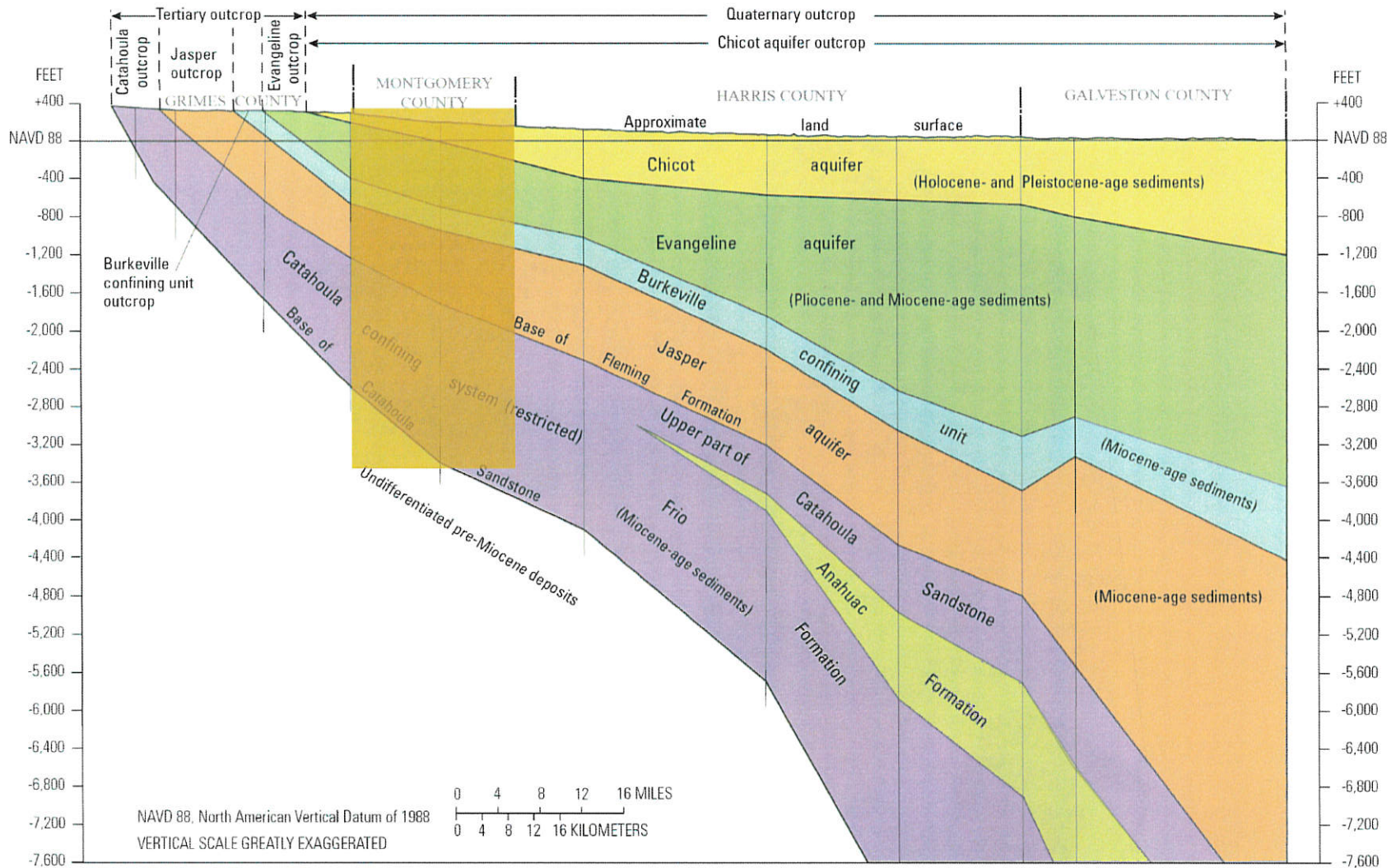
Peer reviewed by USGS prior to data delivery and presentation.

All data, interpretations, depictions, and documents are:

1. Archived
2. Published
3. made available to the public.



# Hydrogeologic Section of the Gulf Coast Aquifer System



Geologic units						Hydrogeologic units (Baker, 1979)	
Erathem	System	Series	Years before present	Group	Stratigraphic units	Aquifers and confining units	
Cenozoic	Quaternary	Holocene	11,000	Houston	Alluvium	Chicot aquifer	
		Pleistocene			Beaumont Clay		
					Lissie Formation		Montgomery Formation
							Bentley Formation
					Willis Sand		
	Tertiary	Pliocene	1.8 million	Citronelle	Goliad Sand	Evangeline aquifer	
		Miocene	5.0 million	Fleming	Fleming Formation	Burkeville Confining Unit	
					Lagarto Clay		
				Vicksburg	Oakville Sandstone	Jasper aquifer	
					<sup>1</sup> Catahoula Tuff or Catahoula Sandstone <sup>2</sup> Upper part of Catahoula Tuff <sup>2</sup> Anahuac Formation <sup>2</sup> Frio Formation	Catahoula Confining System	
Pre-Miocene-age sediments							

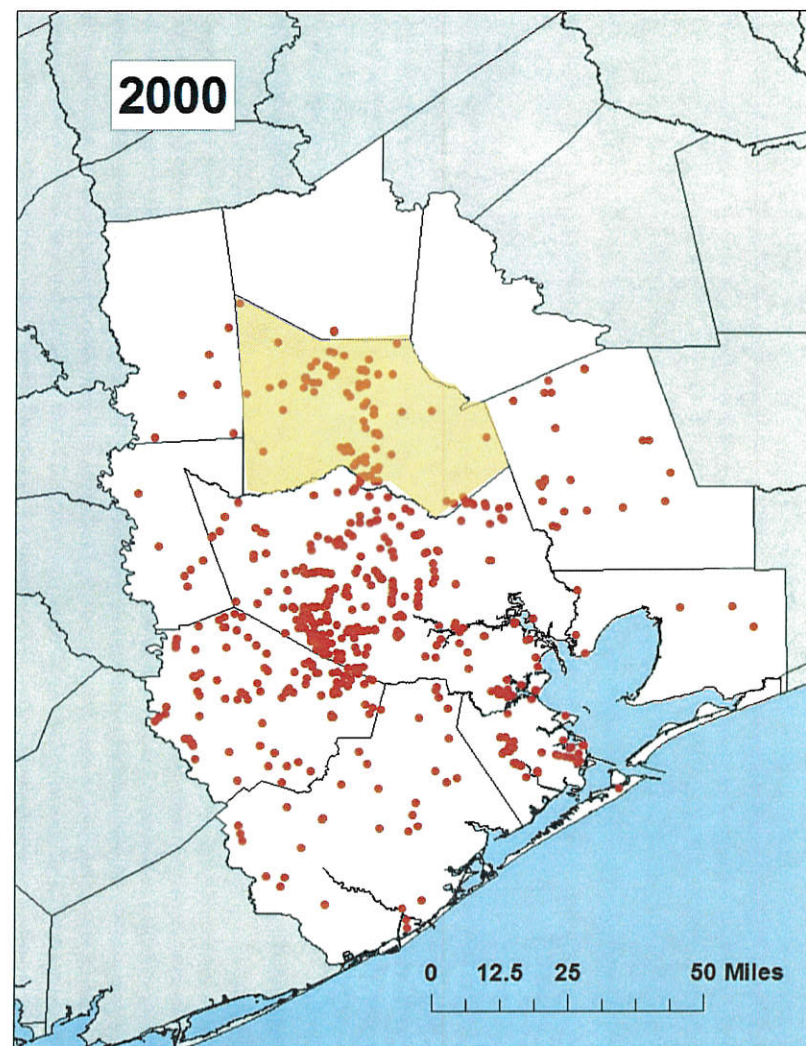
# Monitoring Network

- Collaboration with local well owners, municipalities, MUDs, PUDs, SUDs, and other entities.
- Chicot and Evangeline aquifers are hydraulically connected: *Withdrawals from one aquifer can affect water-levels in the other.*
- USGS measuring water-level information in the Catahoula aquifer.
- Number of wells used for constructing 2017 maps:
  - Chicot (164)
  - Evangeline (307)
  - Jasper (102)

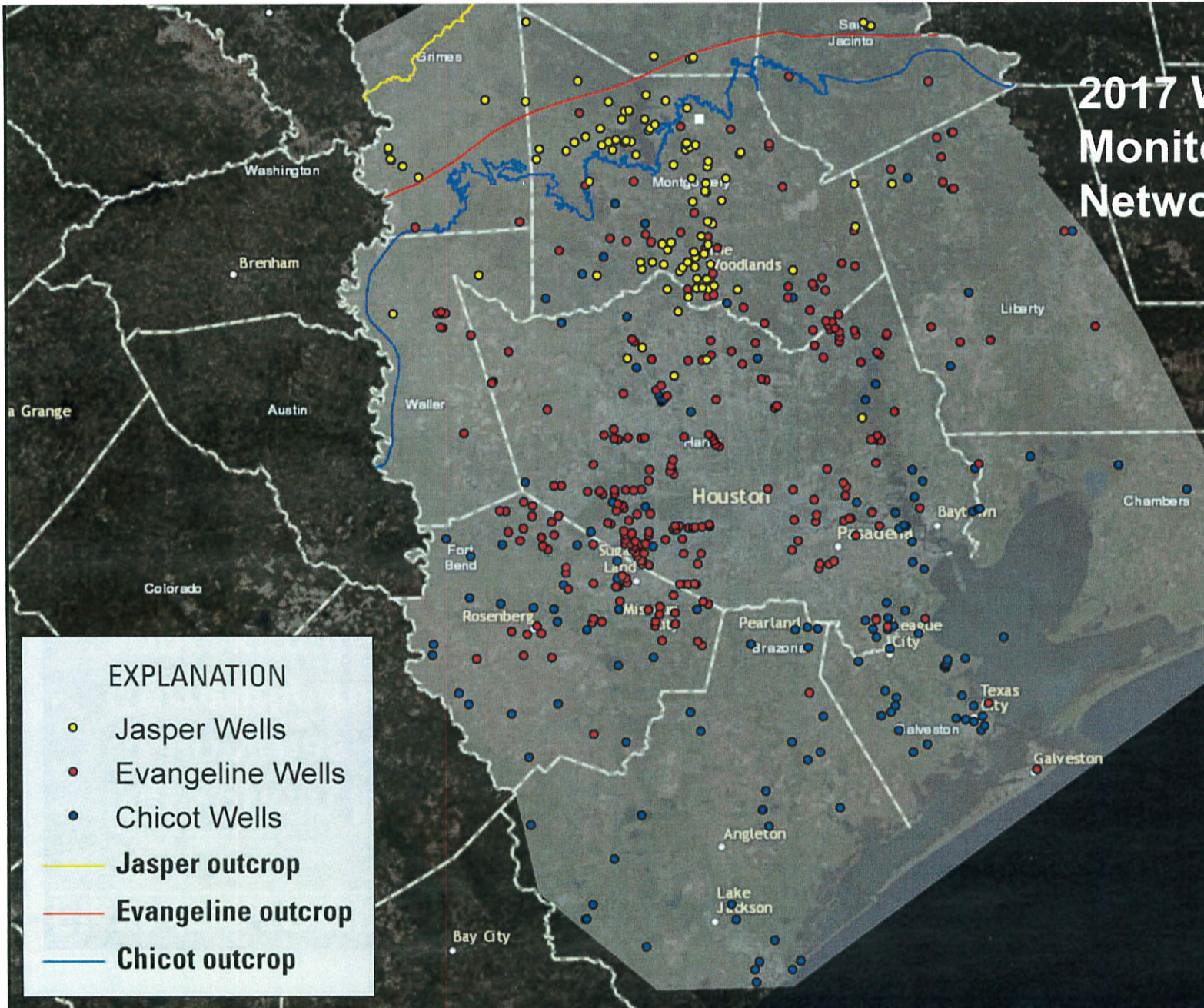
## Field Data Collection

- Network in Montgomery County has grown over time
- Currently measuring data at approximately 700 wells

**Measured 143 wells in  
Montgomery County in 2017**



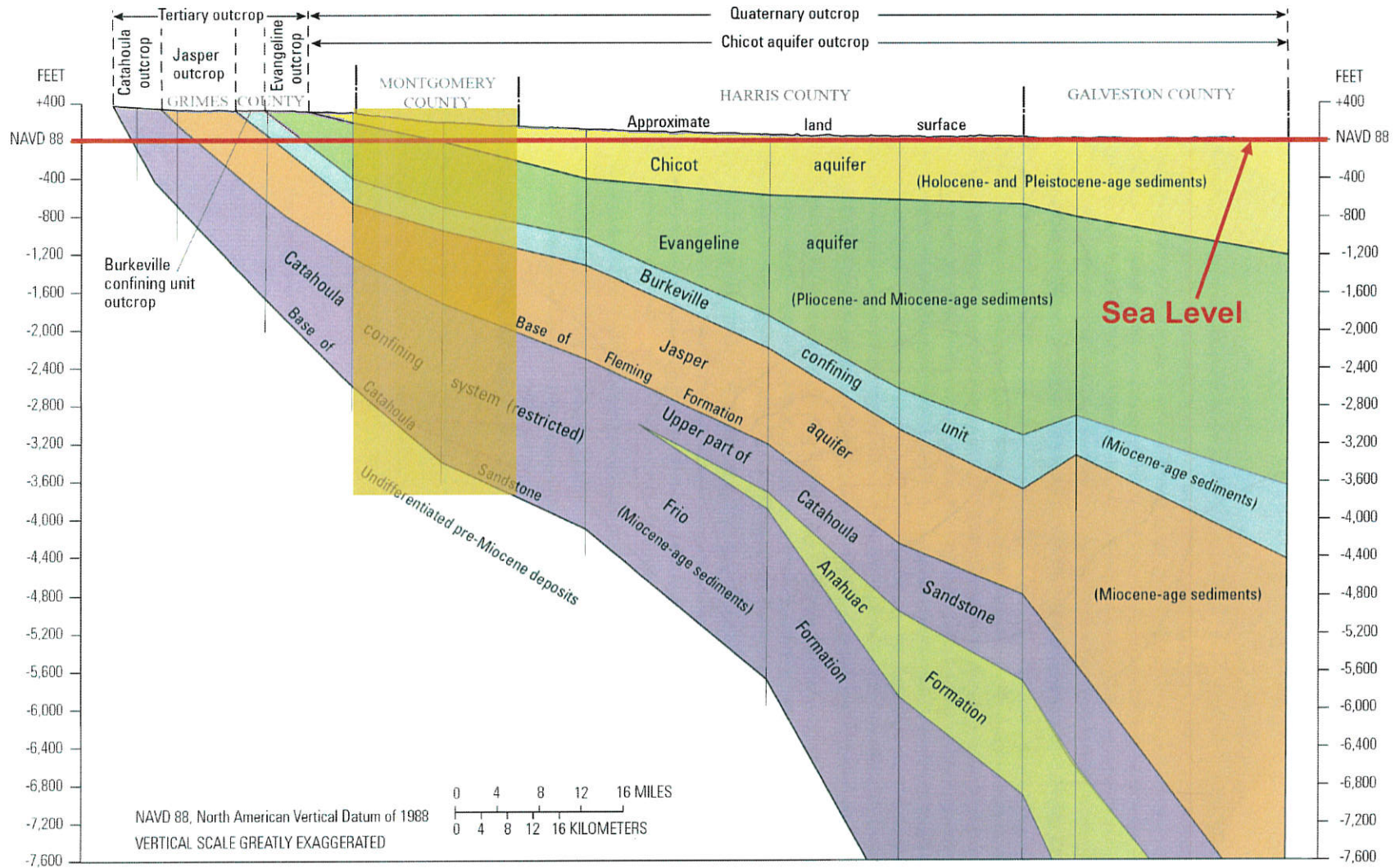
# 2017 Water-Level Monitoring Network



## EXPLANATION

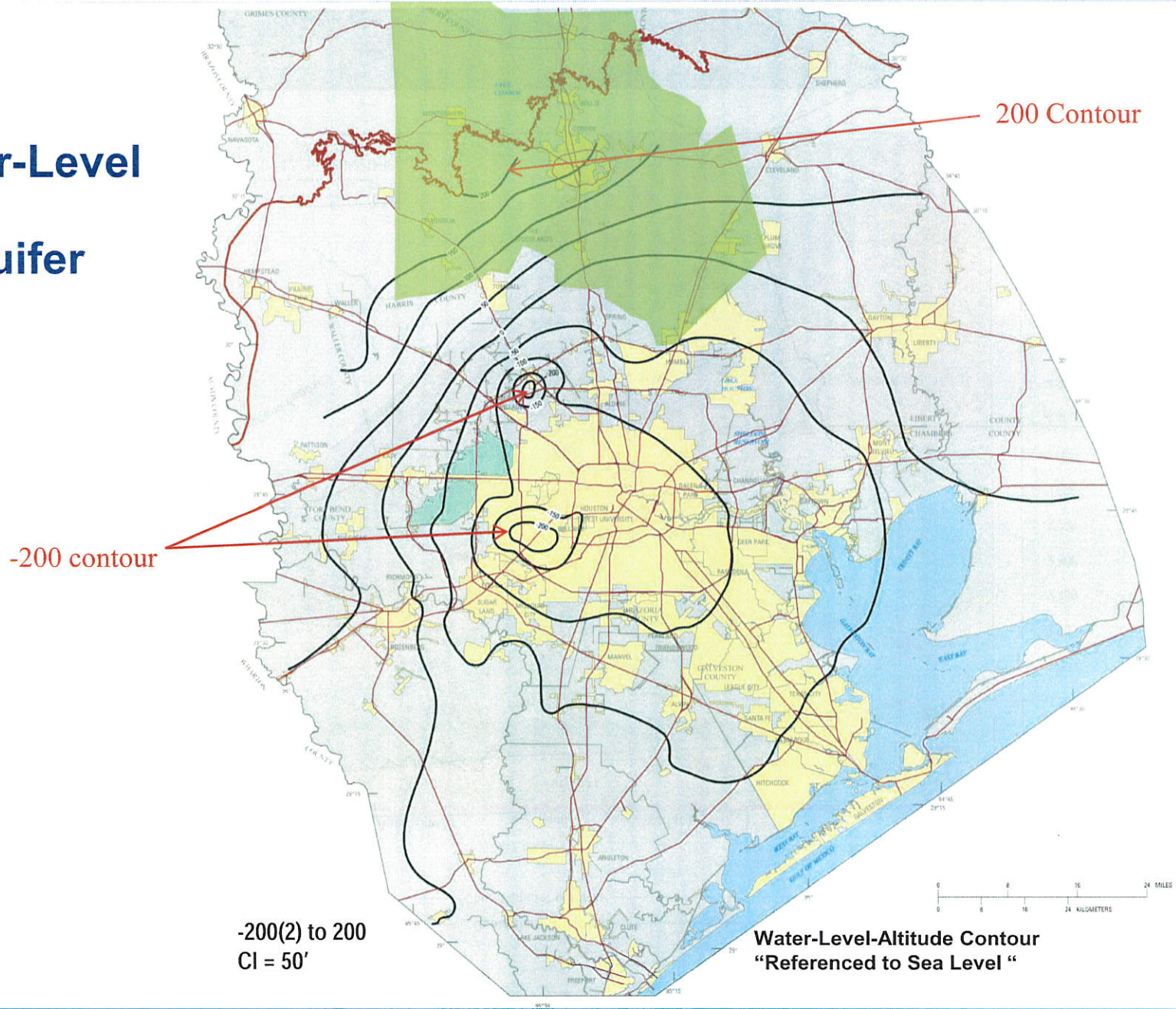
- Jasper Wells
- Evangeline Wells
- Chicot Wells
- Jasper outcrop
- Evangeline outcrop
- Chicot outcrop

# Hydrogeologic Section of the Gulf Coast Aquifer System





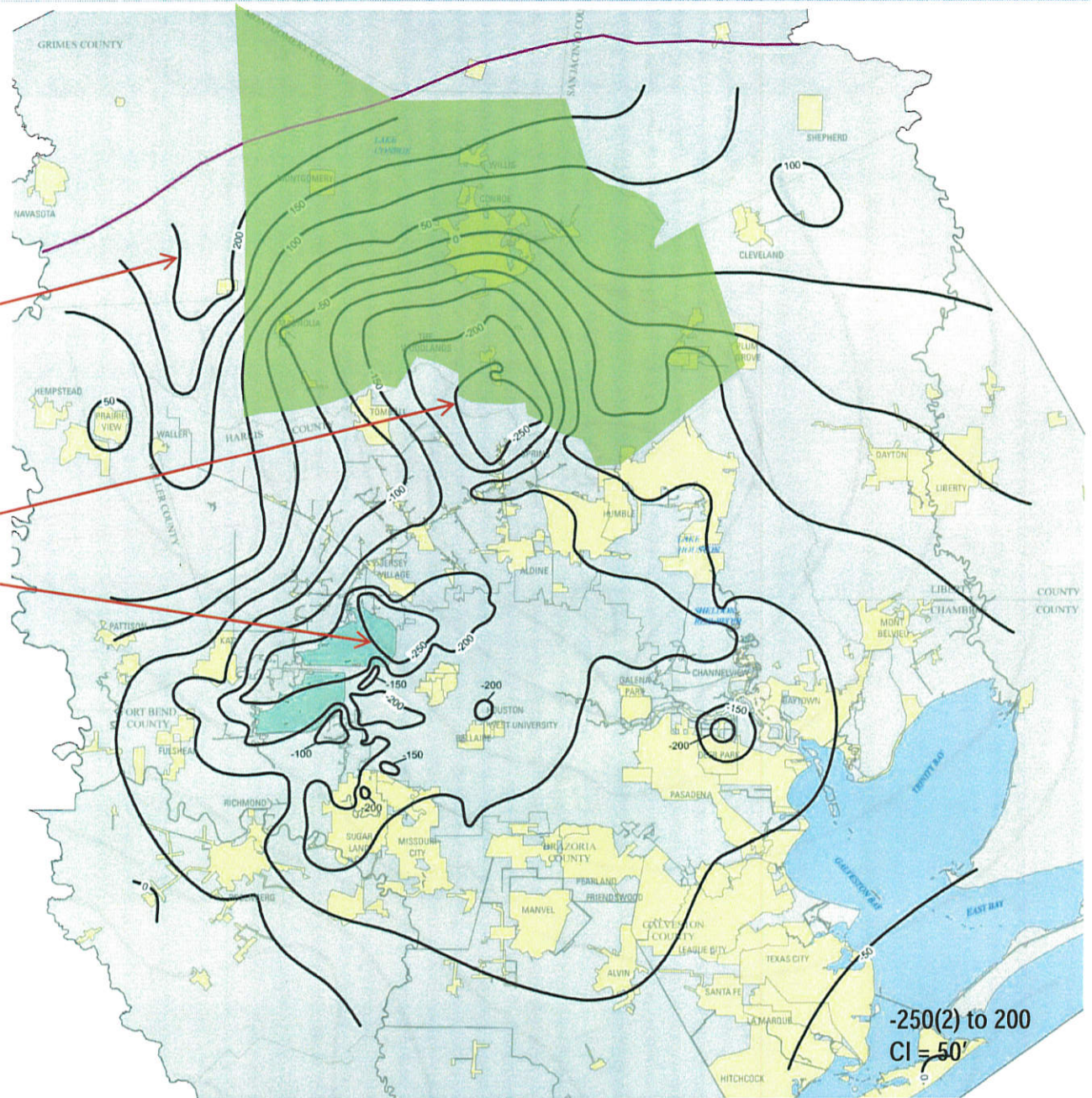
# 2017 Water-Level Altitude: Chicot Aquifer



# 2017 Water-Level Altitude: Evangeline Aquifer

200 contour

-250 contour



Water-Level-Altitude Contour  
"Referenced to Sea Level "

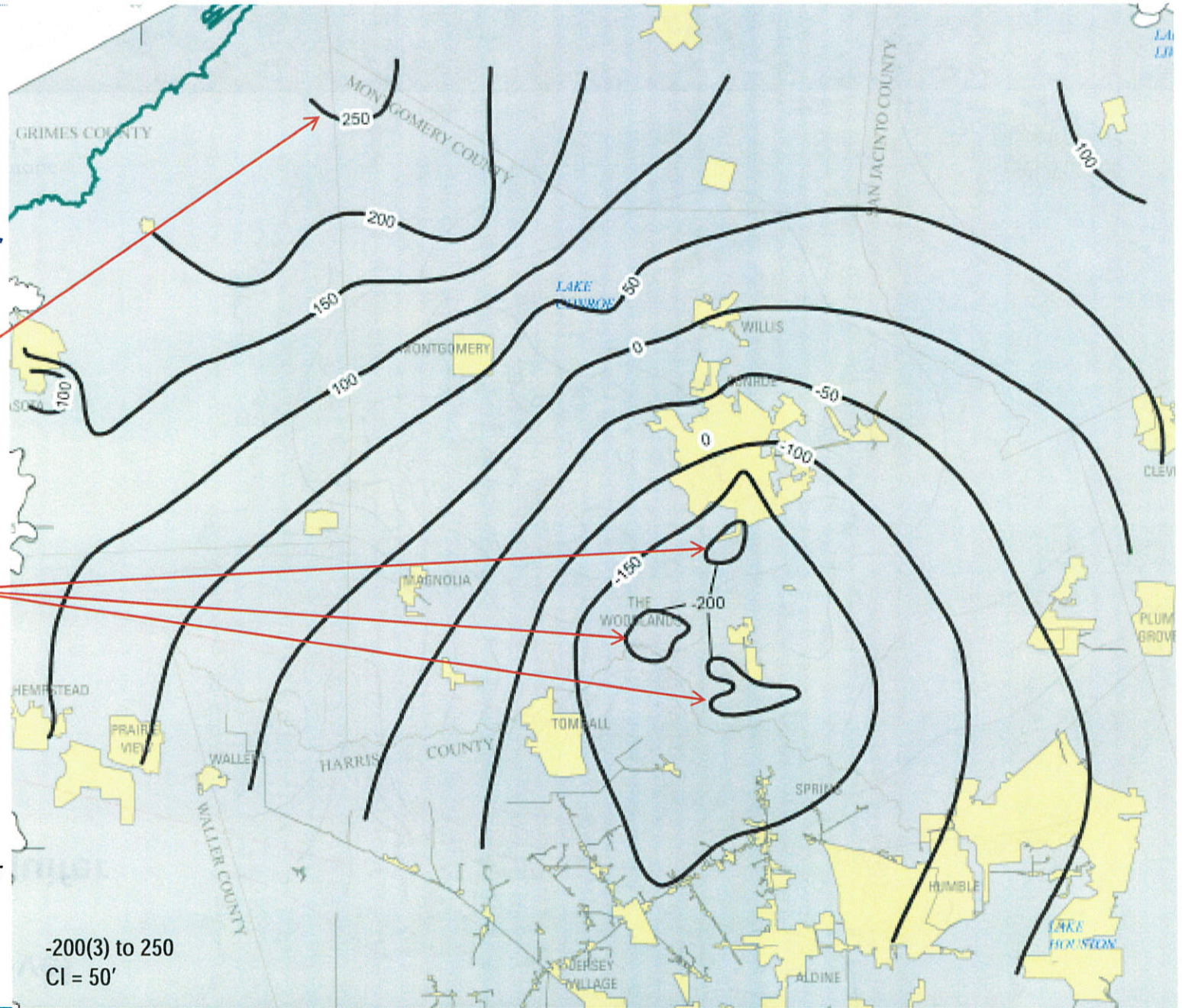
# 2017 Water-Level Altitude: Jasper Aquifer

250 contour

-200 contour

Water-Level-Altitude Contour  
"Referenced to Sea Level "

-200(3) to 250  
CI = 50'



## Drivers for Short vs. Long-Term Water-Level Change

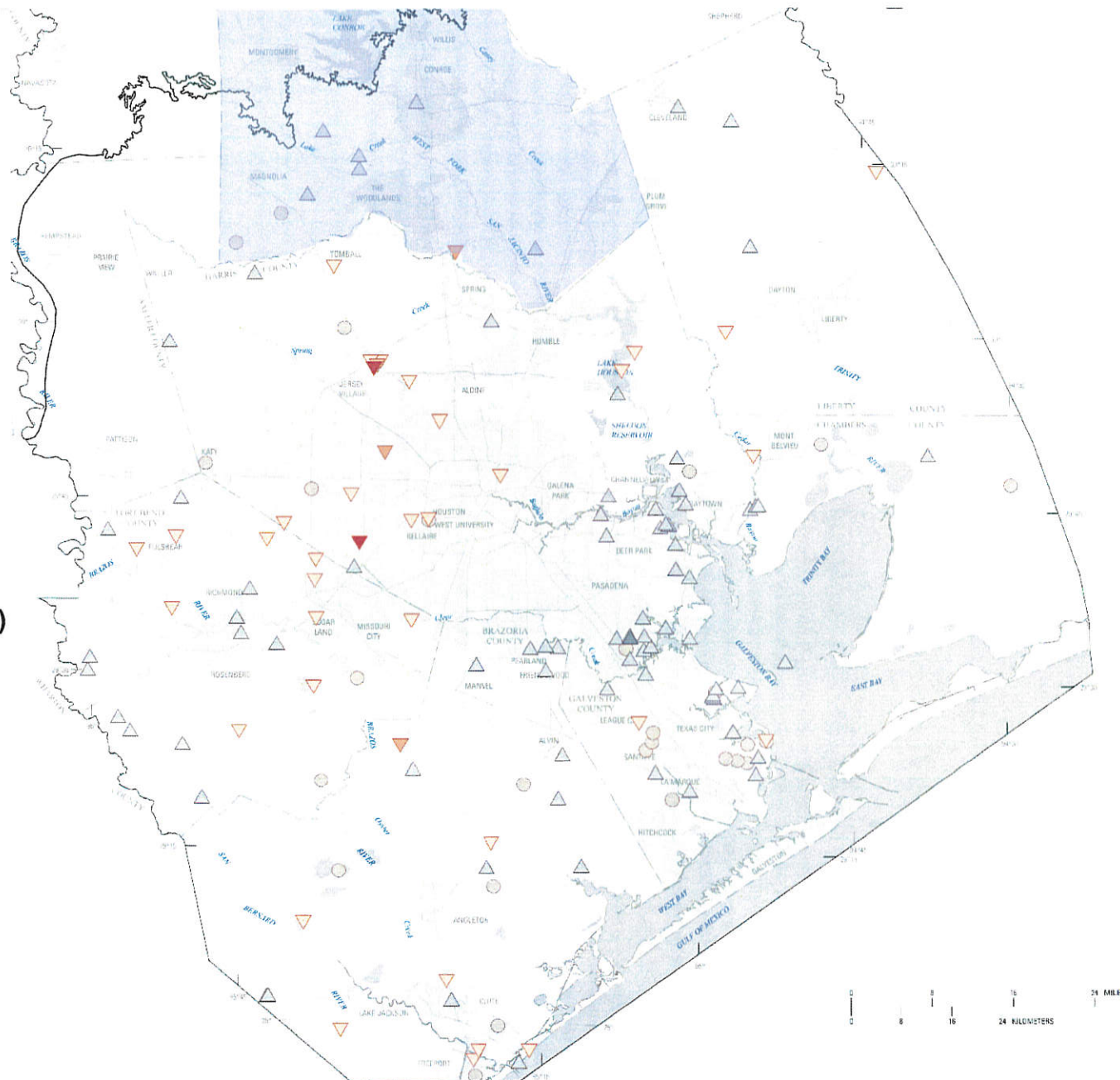
- **Short-term Change (one-year)**
    - Groundwater Demand
    - Groundwater Use
  - **Long-term Change (decades)**
    - Policy
    - Shifts in Water Supply
- } Precipitation

# Chicot Aquifer 2016–2017 Water-Level Changes

- ~ 27% Declines
- ~ 19% No change
- ~ 54% Rises

## EXPLANATION

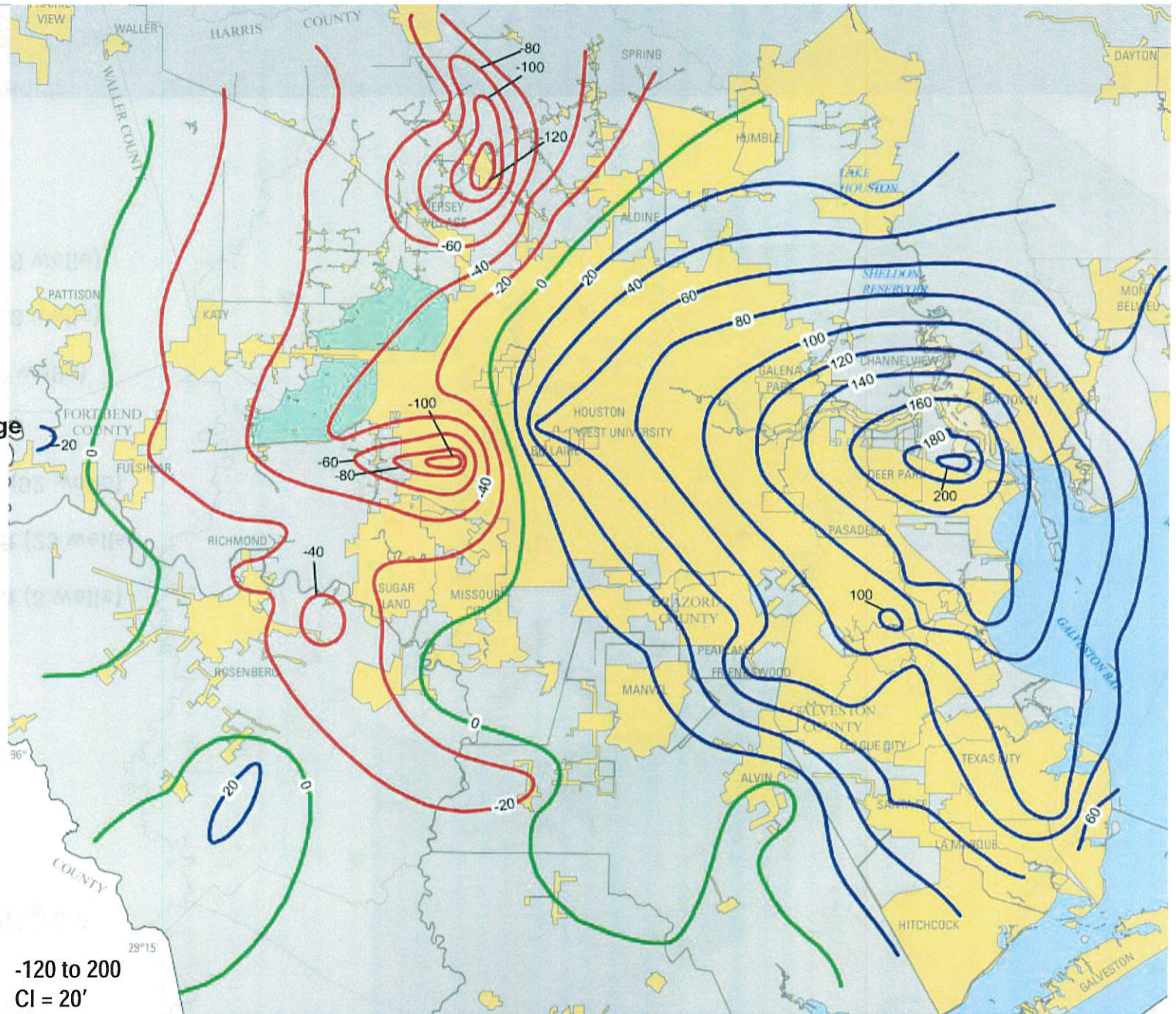
- ▼ Decline of 21 to 50 feet (2 wells)
- ▾ Decline of 11 to 20 feet (4 wells)
- ▽ Decline of 1 to 10 feet (36 wells)
- No change (29 wells)
- △ Rise of 1 to 10 feet (82 wells)
- ▲ Rise of 11 to 20 feet (1 well)



# Chicot Aquifer 1977–2017 Water-Level Change

## EXPLANATION

- Water-Level Decline
- No Water Level Change
- Water-Level Rise



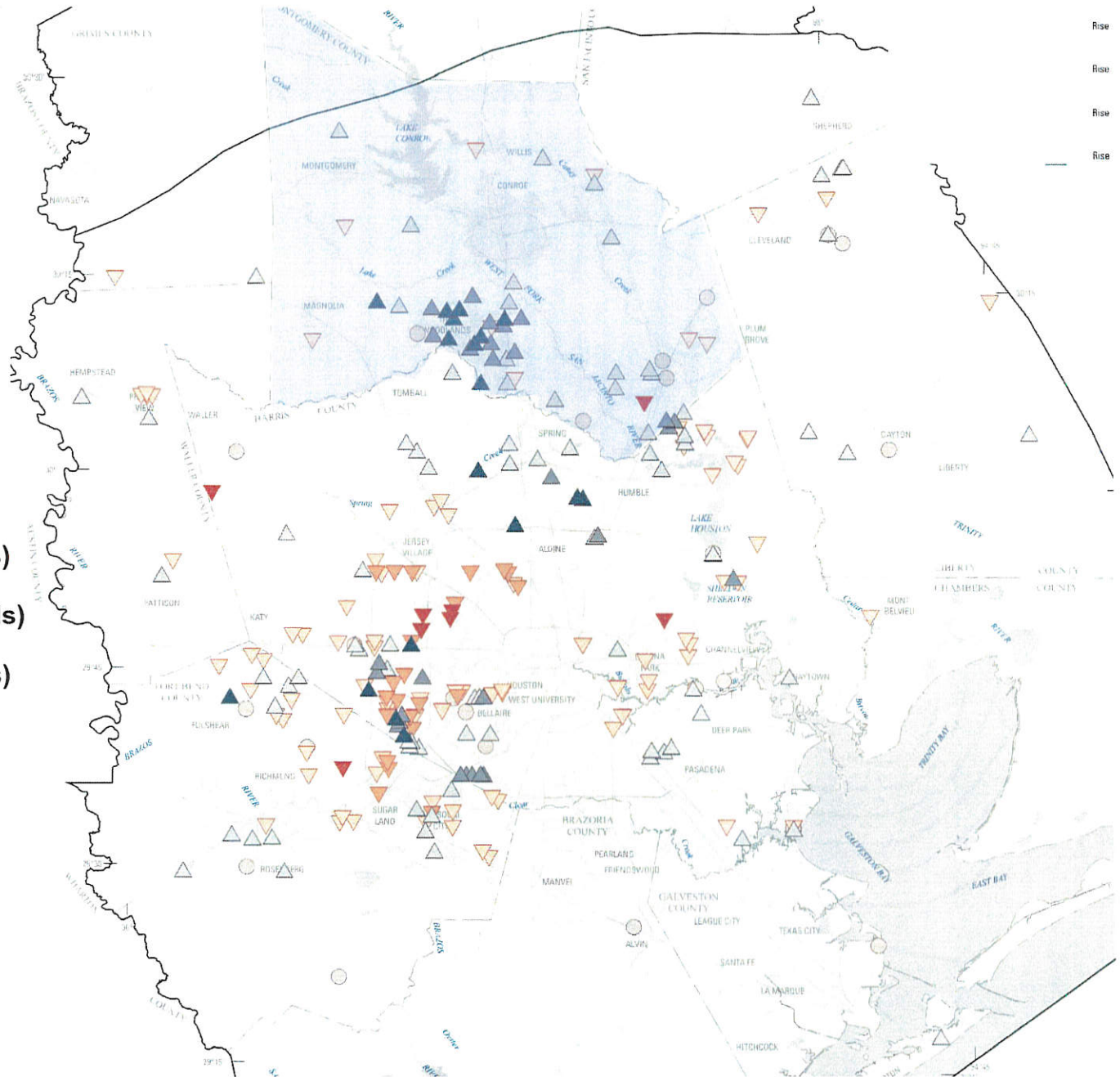
-120 to 200  
CI = 20'

# Evangeline Aquifer 2016–2017 Water-Level Changes

- ~ 43% Declines
- ~ 8% No change
- ~ 48% Rises

## EXPLANATION

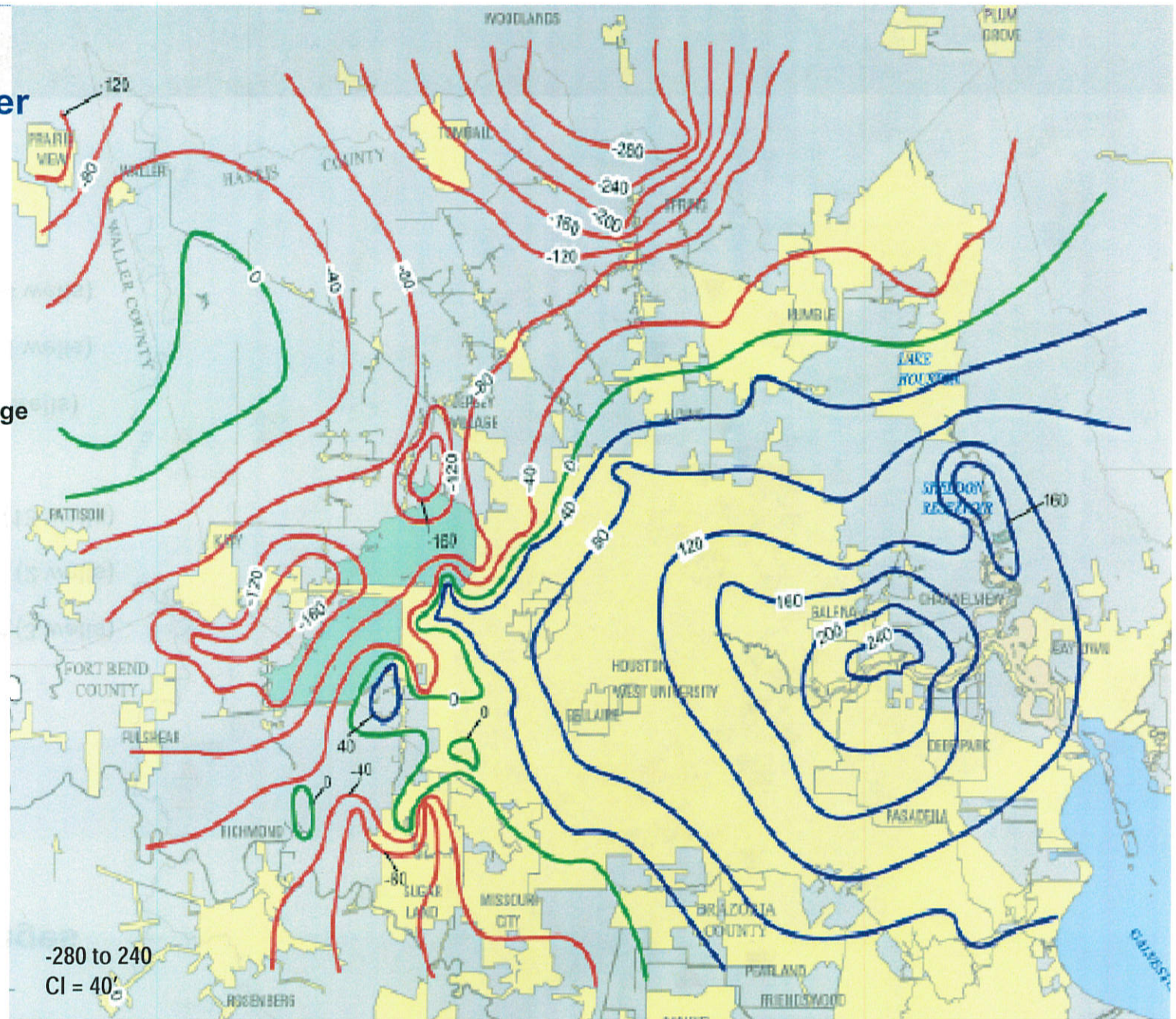
- ▼ Decline of 21 to 50 ft (8 wells)
- ▾ Decline of 11 to 20 ft (23 wells)
- ▽ Decline of 1 to 10 ft (92 wells)
- No change (24 wells)
- △ Rise of 1 to 10 ft (90 wells)
- ▲ Rise of 11 to 20 ft (28 wells)
- ▲ Rise of 21 to 50 ft (18 wells)



# Evangeline Aquifer 1977–2017 Water-Level Change

## EXPLANATION

- Water-Level Decline
- No Water Level Change
- Water-Level Rise










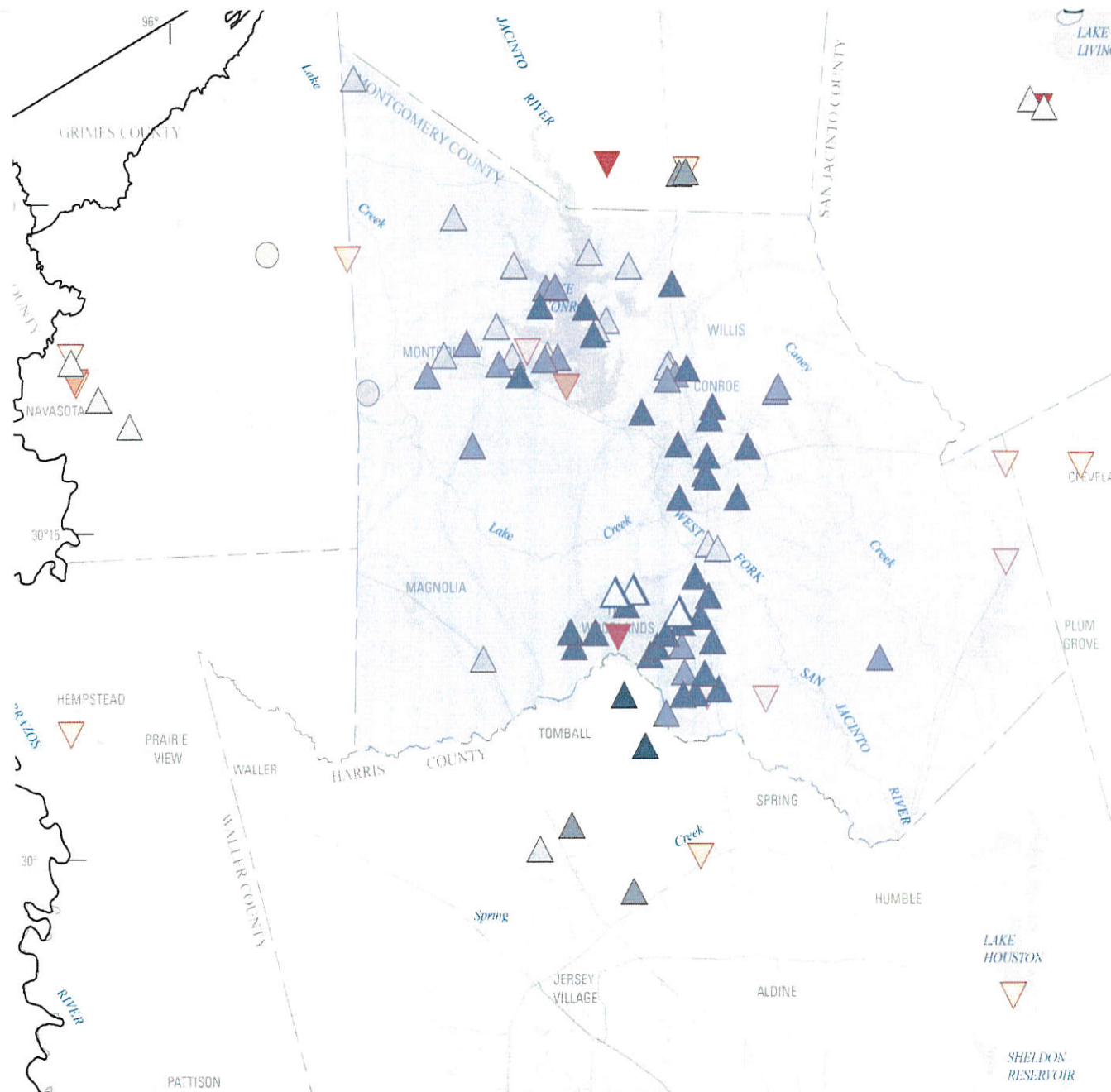


# Jasper Aquifer 2016–2017 Water-Level Changes

~18% Declines  
~2% No change  
~80% Rises

## EXPLANATION

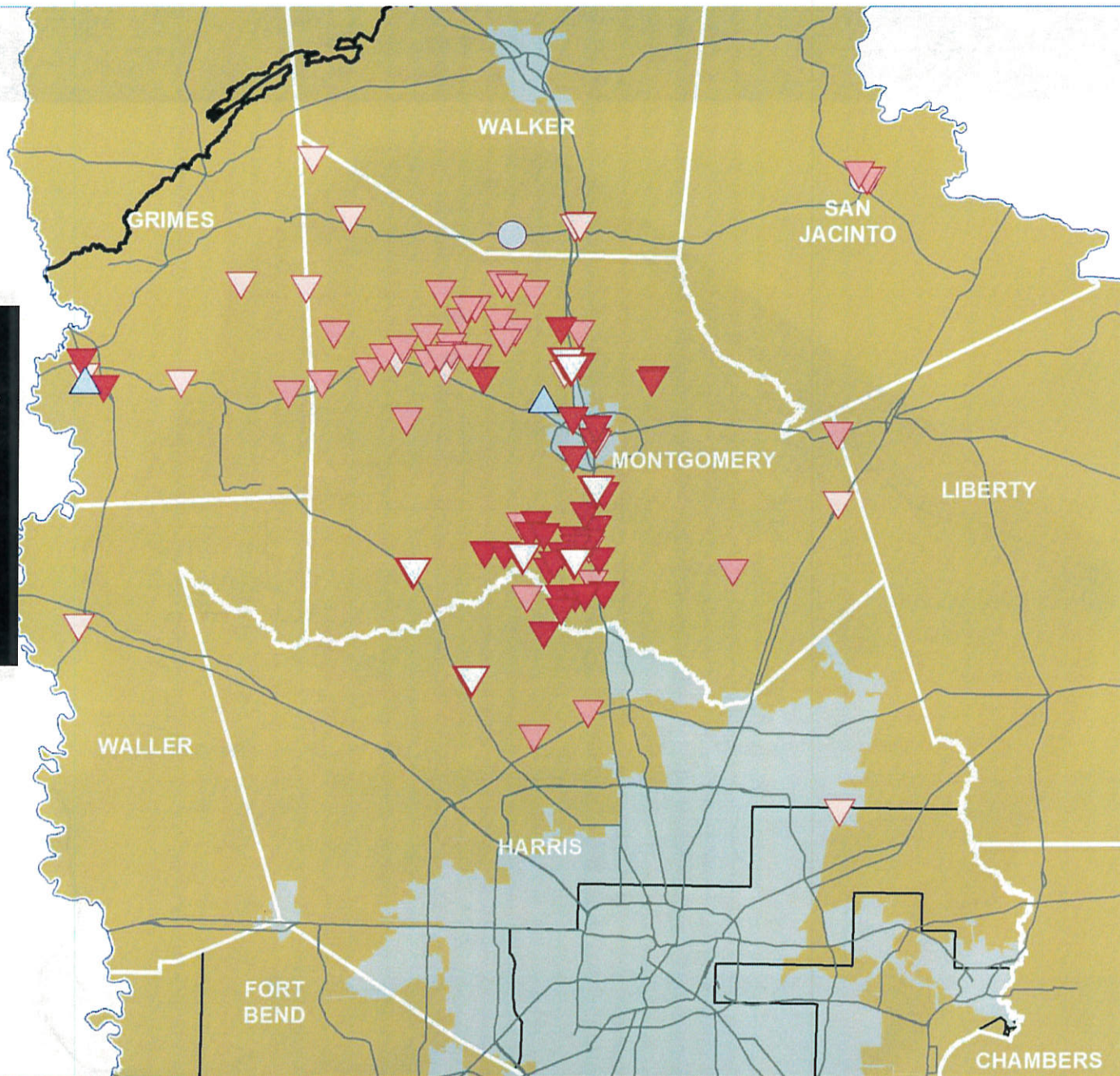
-  Decline of 21 to 50 ft (3 wells)
-  Decline of 11 to 20 ft (2 wells)
-  Decline of 1 to 10 ft (13 wells)
-  No change (4 wells)
-  Rise of 1 to 10 ft (22 wells)
-  Rise of 11 to 20 ft (21 wells)
-  Rise of 21 to 50 ft (34 wells)



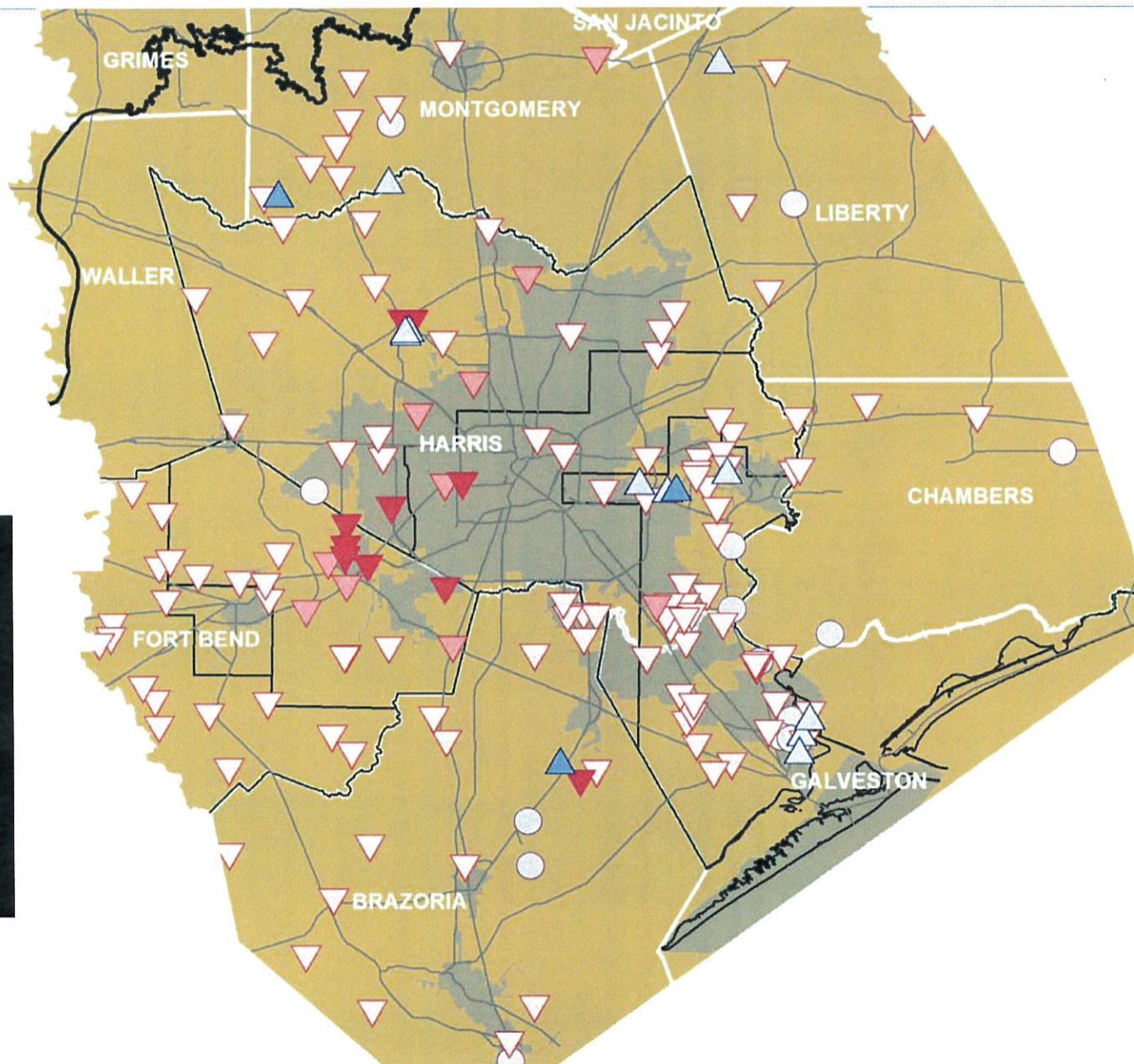
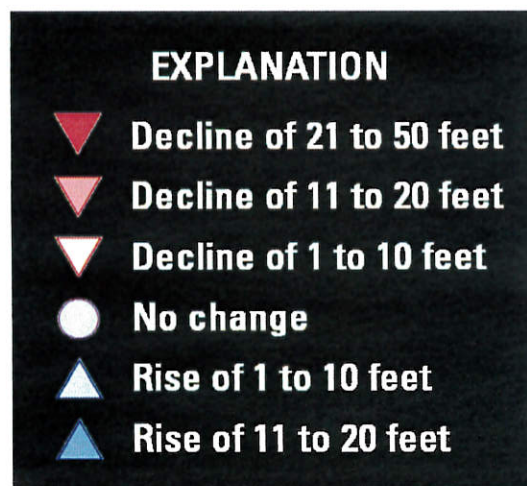
# Jasper Aquifer 2011–2012 Water-Level Changes (Drought Year)

**EXPLANATION**

- Decline of more than 50 feet
- Decline of 21 to 50 feet
- Decline of 11 to 20 feet
- Decline of 1 to 10 feet
- No change
- Rise of 1 to 10 feet











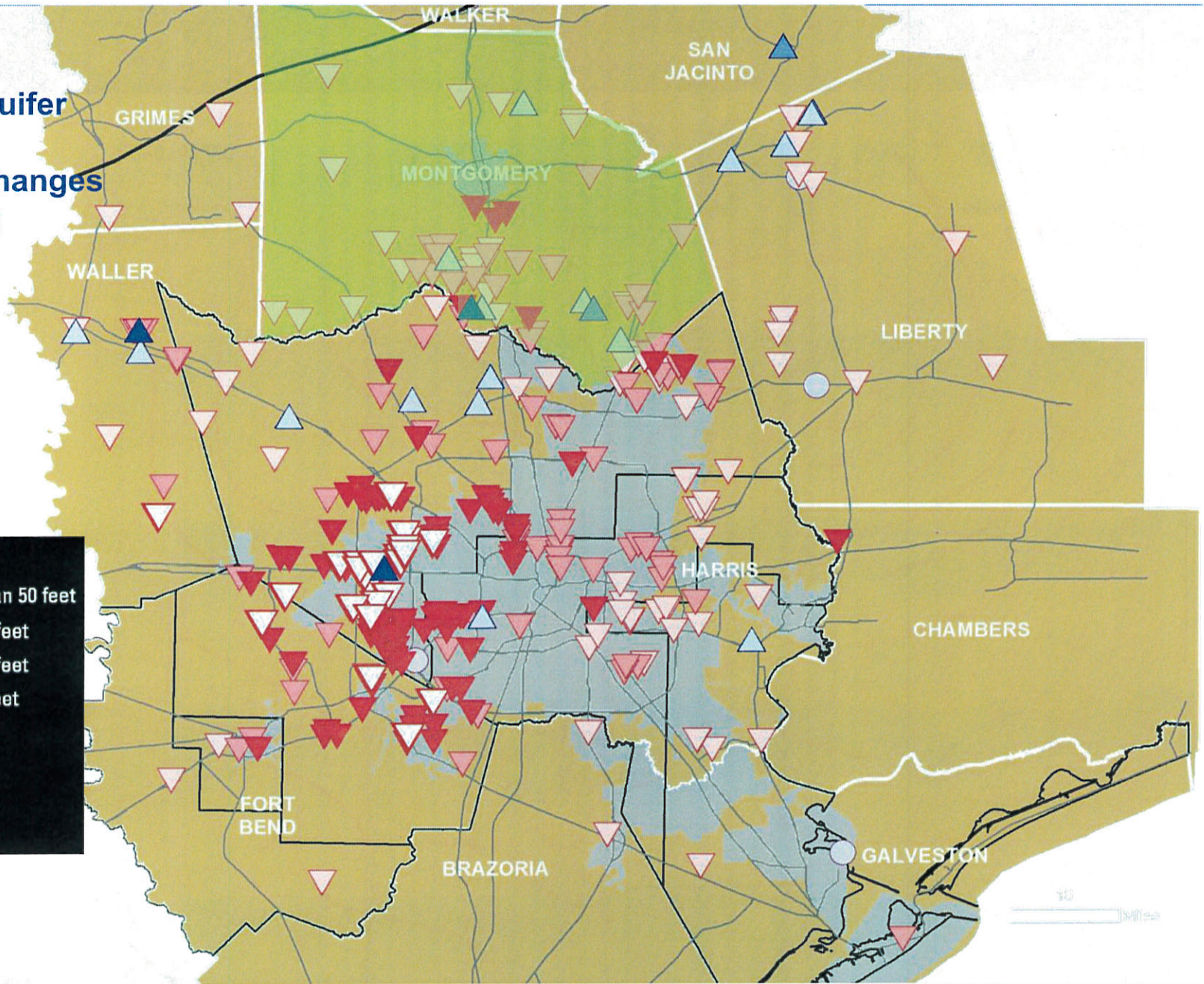
**Chicot Aquifer  
2011–2012  
Water-Level Changes  
(Drought Year)**



**Evangeline Aquifer  
2011–2012  
Water-Level Changes  
(Drought Year)**

**EXPLANATION**

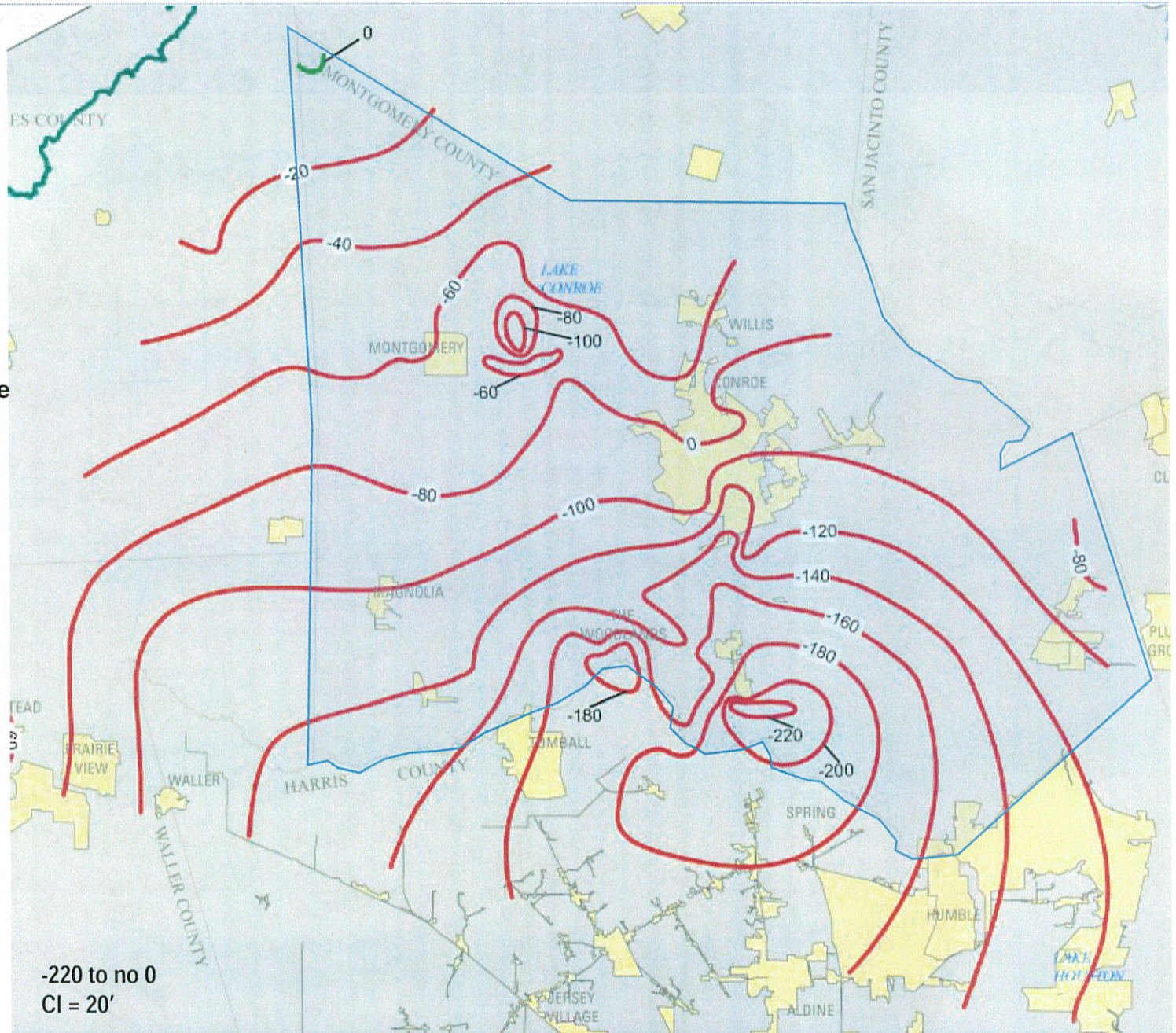
-  Decline of more than 50 feet
-  Decline of 21 to 50 feet
-  Decline of 11 to 20 feet
-  Decline of 1 to 10 feet
-  No change
-  Rise of 1 to 10 feet
-  Rise of 11 to 20 feet
-  Rise of 21 to 50 feet



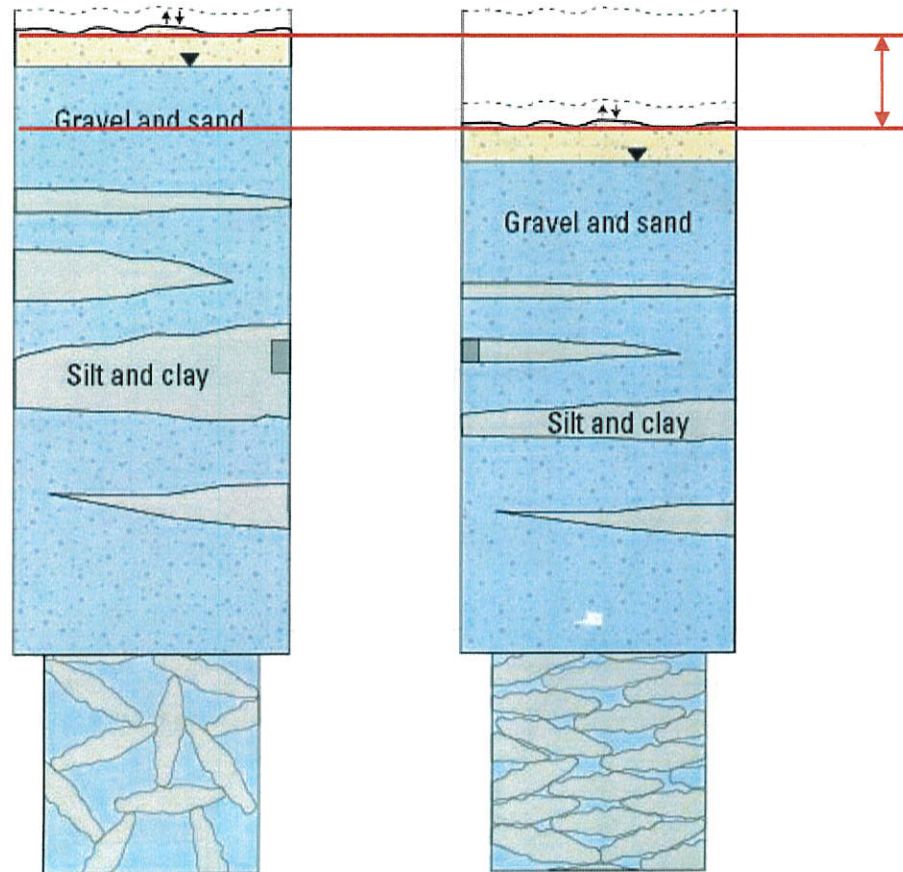
# Jasper Aquifer 2000–2017 Water-Level Change

## EXPLANATION

- Water-Level Decline
- No Water Level Change
- Water-Level Rise

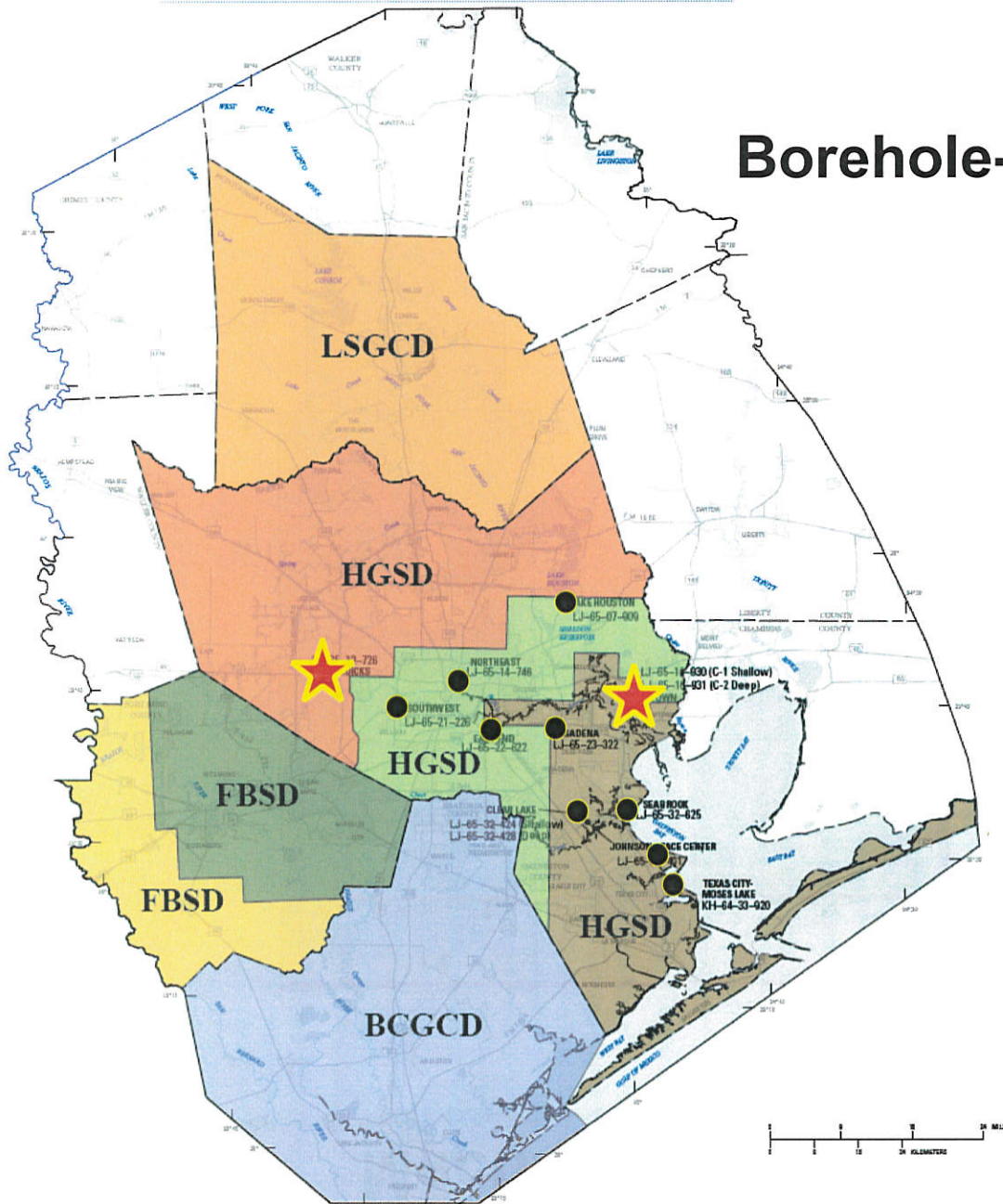


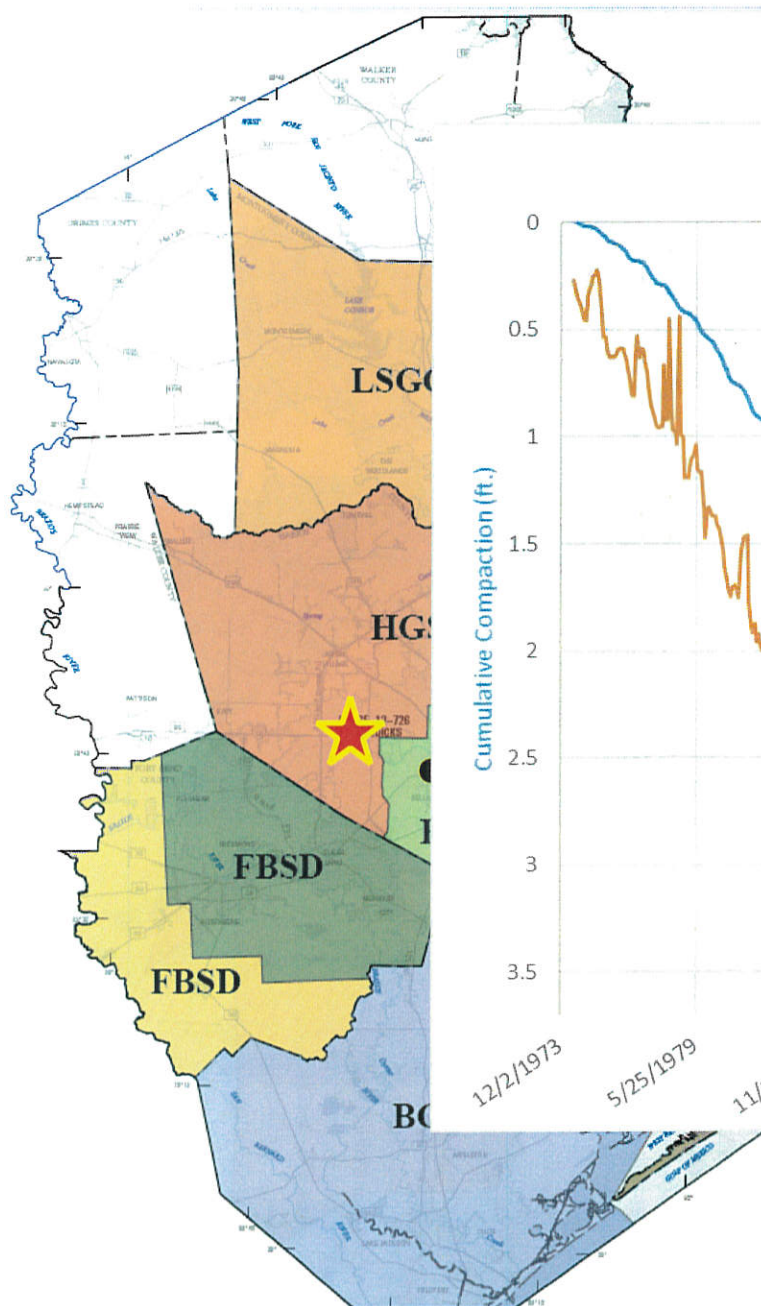
# Mechanism of Subsidence



- Withdrawal reduces inter-granular pore fluid pressure
- Supporting matrix collapses and grains re-align
- Reduction in initial volume
- Volume loss becomes significant and lowers land elevation

# Borehole-Extensometer Sites



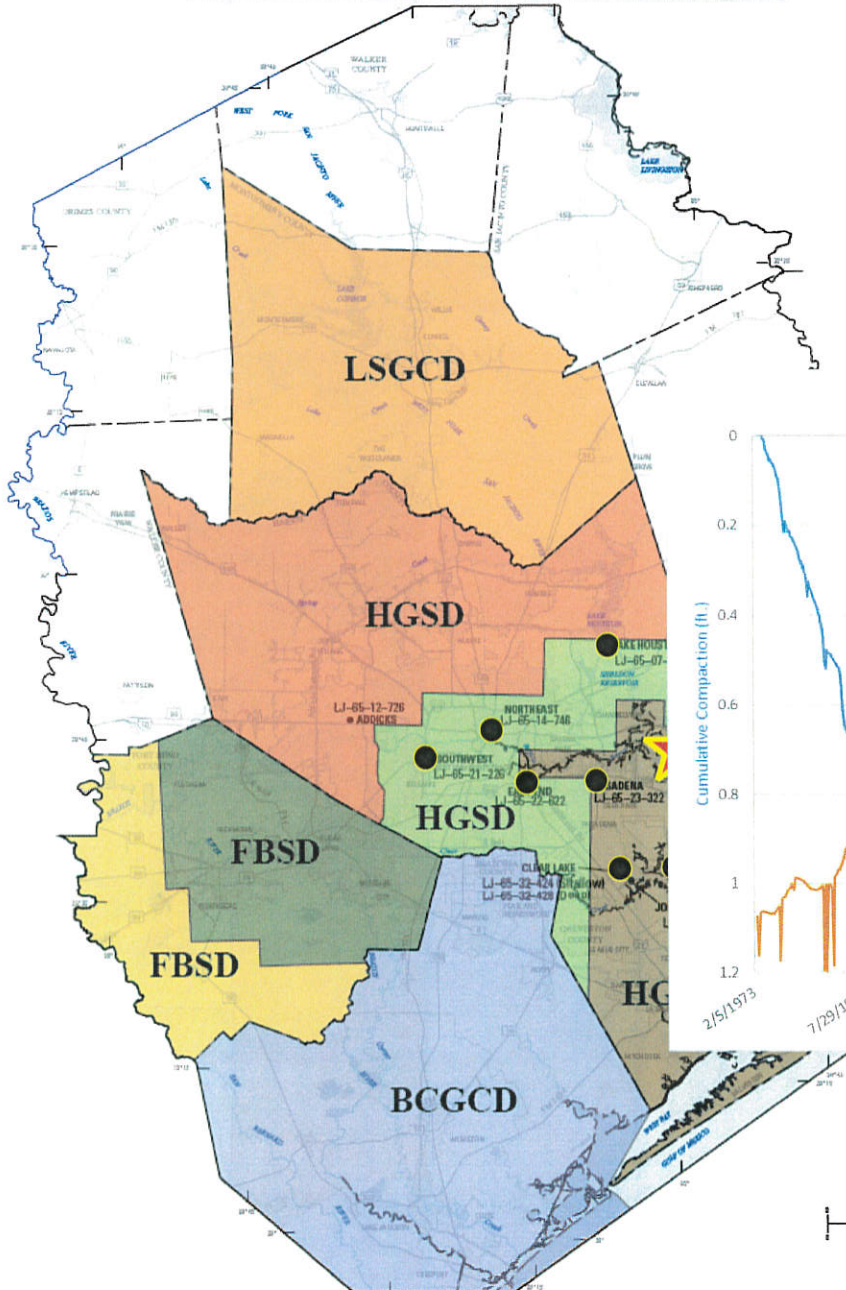


Katy-Addicks - Regulatory Area 3

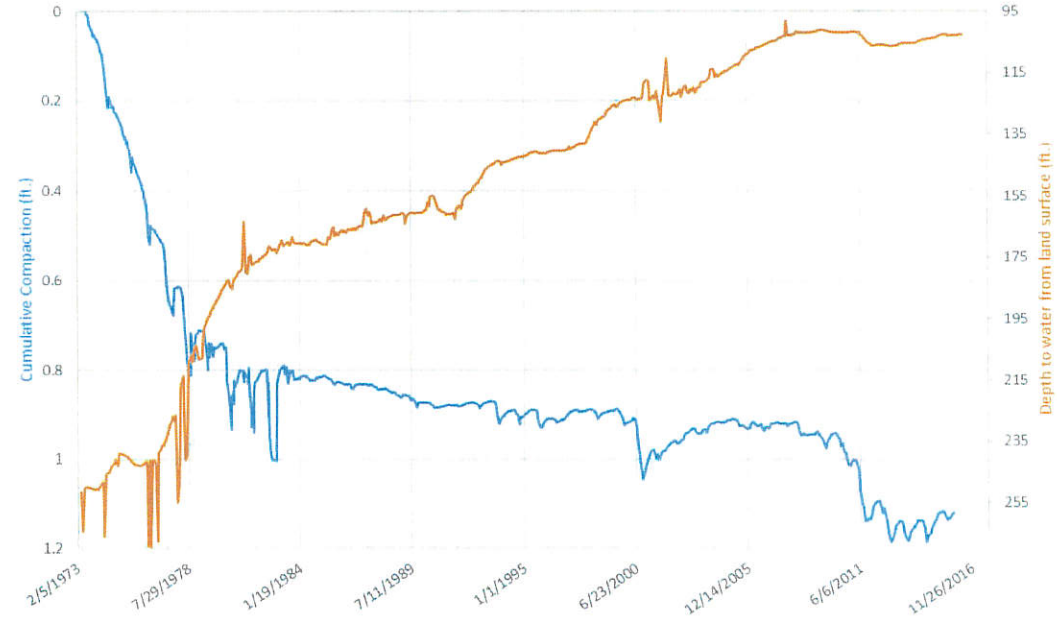




# Baytown-Extensometer



Baytown Deep - Regulatory Area 1



# Water-Level Trend Summary in Montgomery County

- Approximately **140 wells measured** in 2017
- **Well Statistics (2016-2017):**
  - Chicot
    - 67% showed rises
    - 11% showed declines
  - Evangeline
    - 74% of wells show rises
    - 17% showed declines
  - Jasper
    - 89% showed rises
    - 9% showed declines
- **Long-term trends: (2000-2017)**
  - Trends in **Jasper aquifer** show declines throughout Montgomery County extending into north-central Harris County.



Prepared in cooperation with the Harris-Galveston S

### Investigation of Land Subsidence



Prepared in cooperation with the Harris-Galveston Subsidence District, the Fort Bend Subsidence District, and the Lone Star Groundwater Conservation District

### Hydrogeology and Simulated Land-Surface Subsidence in the Gulf Coast Aquifer System

# Thank You

## U.S. Geological Survey Gulf Coast Program (936) 271-5300

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Scientific Investigations Report 2012-5154  
Version 1.1, December 2013

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### Water-Level and Land-Compaction in the Chicot, Evangeline, and Houston-Galveston Aquifers



Prepared in cooperation with the Harris-Galveston Subsidence District, Fort Bend Subsidence District, Lone Star Groundwater Conservation District, and Brazoria County Groundwater Conservation District

### Water-Level and Land-Compaction in the Chicot, Evangeline, and Houston-Galveston Aquifers



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### Water-Level and Land-Compaction in the Chicot, Evangeline, and Houston-Galveston Aquifers



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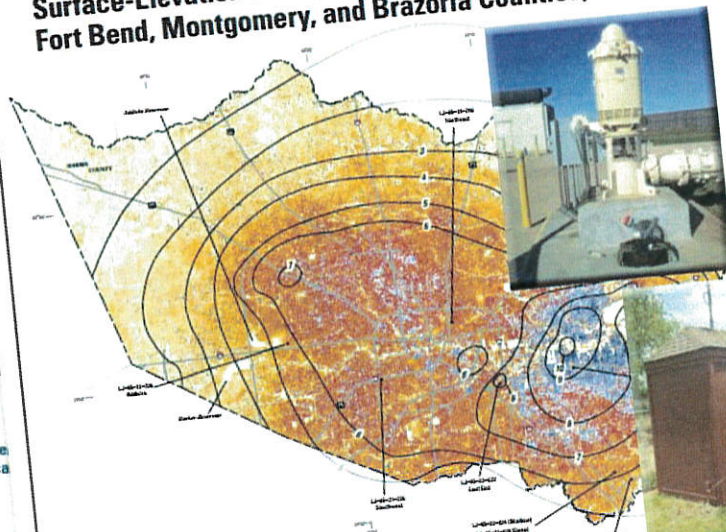
Prepared in cooperation with the Harris-Galveston Subsidence District, City of Houston, Fort Bend Subsidence District, Lone Star Groundwater Conservation District, and Brazoria County Groundwater Conservation District

### Water-Level Altitudes 2014 and Water-Level Changes 1973-2013 in the Chicot, Evangeline, and Houston-Galveston Aquifers



Prepared in cooperation with the Harris-Galveston Subsidence District

### Groundwater Withdrawals 1976, 1990, and 2000-10 and Land-Surface-Elevation Changes 2000-10 in Harris, Galveston, Fort Bend, Montgomery, and Brazoria Counties, Texas



Scientific Investigations Report 2013-5034

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