

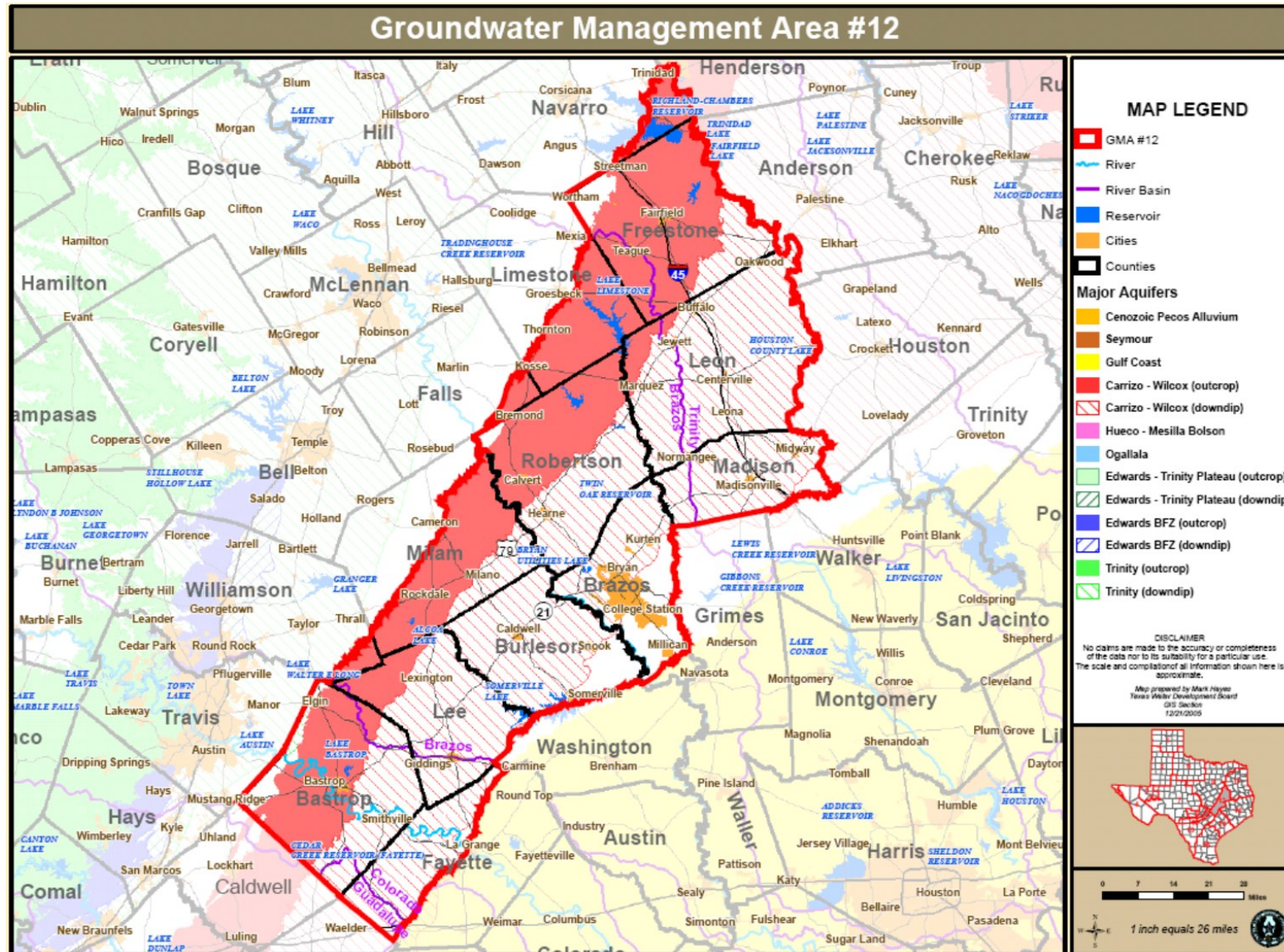
# **Brazos Valley Groundwater Conservation District**

Status of Water  
Levels compared  
to Desired Future  
Conditions

2023

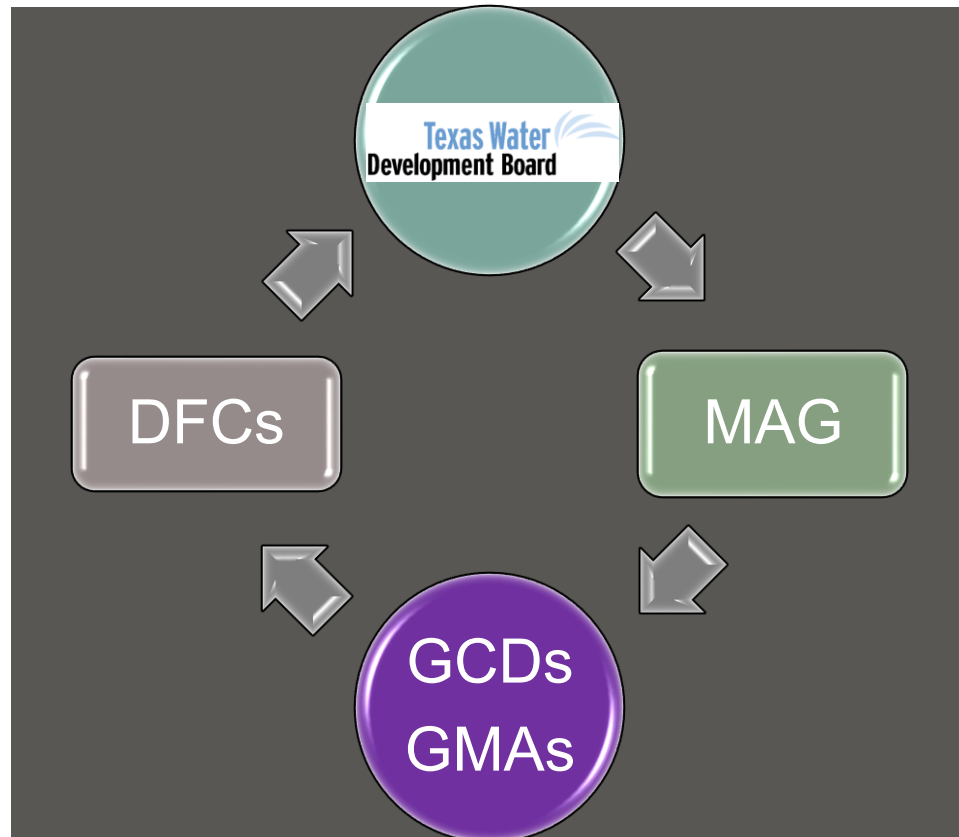
May 11, 2023

# Groundwater Management Area 12

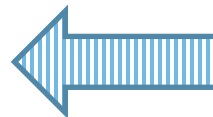
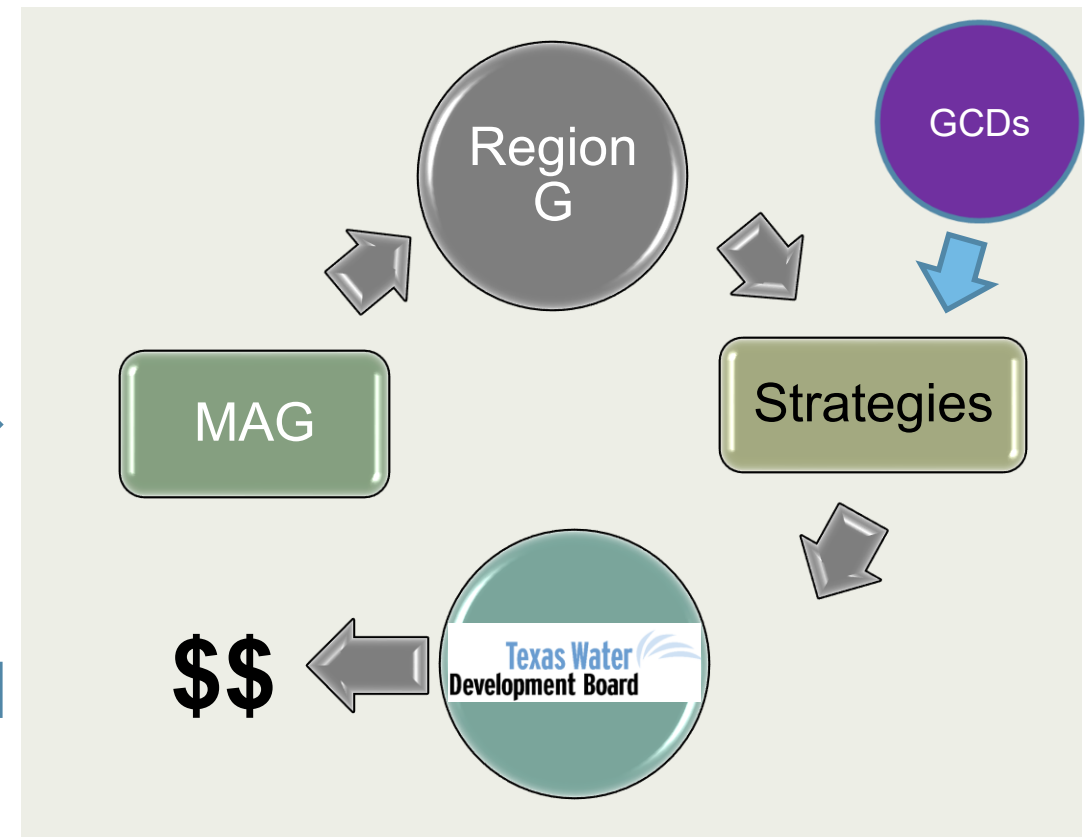


# The Groundwater Planning Cycle

## Joint Groundwater Planning



## Regional Water Planning



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**Desired future condition** means a quantitative description, adopted in accordance with Section 36.108, of the desired condition of the groundwater resources in a management area at one or more specified future times.

Water level decline  
Volume remaining  
Available drawdown remaining  
Spring discharge  
Water quality  
Subsidence

## Why track DFCs?

- Sec. 36.3011 (b) An affected person may file a petition with the commission requesting an inquiry for any of the following reasons:
  - (6) a district fails to update its rules to implement the applicable desired future conditions.....
  - (7) the rules adopted by a district are not designed to achieve the adopted desired future conditions;
  - (9) the groundwater in the management area is not adequately protected due to the failure of a district to enforce substantial compliance with its rules.

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## Some Potential Monitoring Challenges

- Sufficient monitoring locations in each aquifer
- Good geographic well distribution
- Access to wells
- Identifying screened intervals in wells
- Collecting consistent measurements (pump downtime)
- Even “static” measurements in confined aquifers are sensitive
- Incorporating changes in monitoring network
- Maintaining monitoring wells for long periods
- Back-estimating water levels to starting time

## Desired Future Conditions

- BVGCD worked with 4 other GCDs in GMA-12 to establish DFCs for 2070
- DFCs adopted by GMA 12 on November 30, 2021.
- TWDB published MAGs on November 1, 2022. (GAM RUN 21-017 MAG)
- Sparta, Queen City, Carrizo, Calvert Bluff, Simsboro, Hooper, Yegua, Jackson and Brazos River Alluvium aquifers
- All DFCs changed from 2016 cycle except for Brazos River Alluvium Aquifer
- DFCs result from both science and policy factors/decisions
- DFCs are generally long-term goals for larger areas
- Are DFCs planning or regulatory? Yes.

# DFC Development versus DFC Tracking

## ■ DFC Development

- As a part of Joint Planning Process, water level declines are evaluated by simulating the effects of pumping in GMA 12 with the GAM
- DFCs are decided in part by this modeling and other policy decisions

## ■ DFC Tracking

- Actual water level measurements are used to compare aquifer conditions to DFCs
- Use static artesian head declines in wells taken at generally the same time each year to estimate aquifer conditions for comparison to the DFC
- For Brazos River Alluvium – convert water level measurements to percent aquifer saturation



---

## Current BVGCD DFC Tracking Methods

1. Arithmetic average of data
2. Spatially weighted average
  - Use interpolation method to estimate data onto a regularly-spaced grid
  - Average the grid values

## DFC Goals Established During GMA 12 2021 Planning Cycle

| Aquifer       | BVGCD-DFC, ft | Planning Period  |
|---------------|---------------|------------------|
| Sparta        | 53            | 2000 - Dec. 2069 |
| Queen City    | 44            | 2000 - Dec. 2069 |
| Carrizo       | 84            | 2000 - Dec. 2069 |
| Calvert Bluff | 111           | 2000 - Dec. 2069 |
| Simsboro      | 262           | 2000 - Dec. 2069 |
| Hooper        | 167           | 2000 - Dec. 2069 |
| Yegua-Jackson | 67            | 2010 – Dec. 2069 |

- Monitoring of groundwater pumping essential in understanding changes in artesian head and the status of aquifer conditions compared to DFCs

**DFC Well Map – Aquifer Key**

- Brazos River Alluvium
- ⊙ Sparta Aquifer
- ⊙ Queen City Aquifer
- ◆ Carrizo Aquifer
- Calvert Bluff Formation
- ⊕ Simsboro Aquifer
- ▲ Hooper Formation
- ⊙ Yegua-Jackson Aquifer

**Sparta Aquifer Example:**

- 59-22-509 State Well Number
- 27 Artesian Head Change in Well Between about 1999 and 2023, ft
- + = Increase in Artesian Head
- = Decline in Artesian Head
- BVGCD Sparta Observation Well

- Additional Observation Well in BVGCD Monitoring Program

# Sparta Aquifer DFC Wells

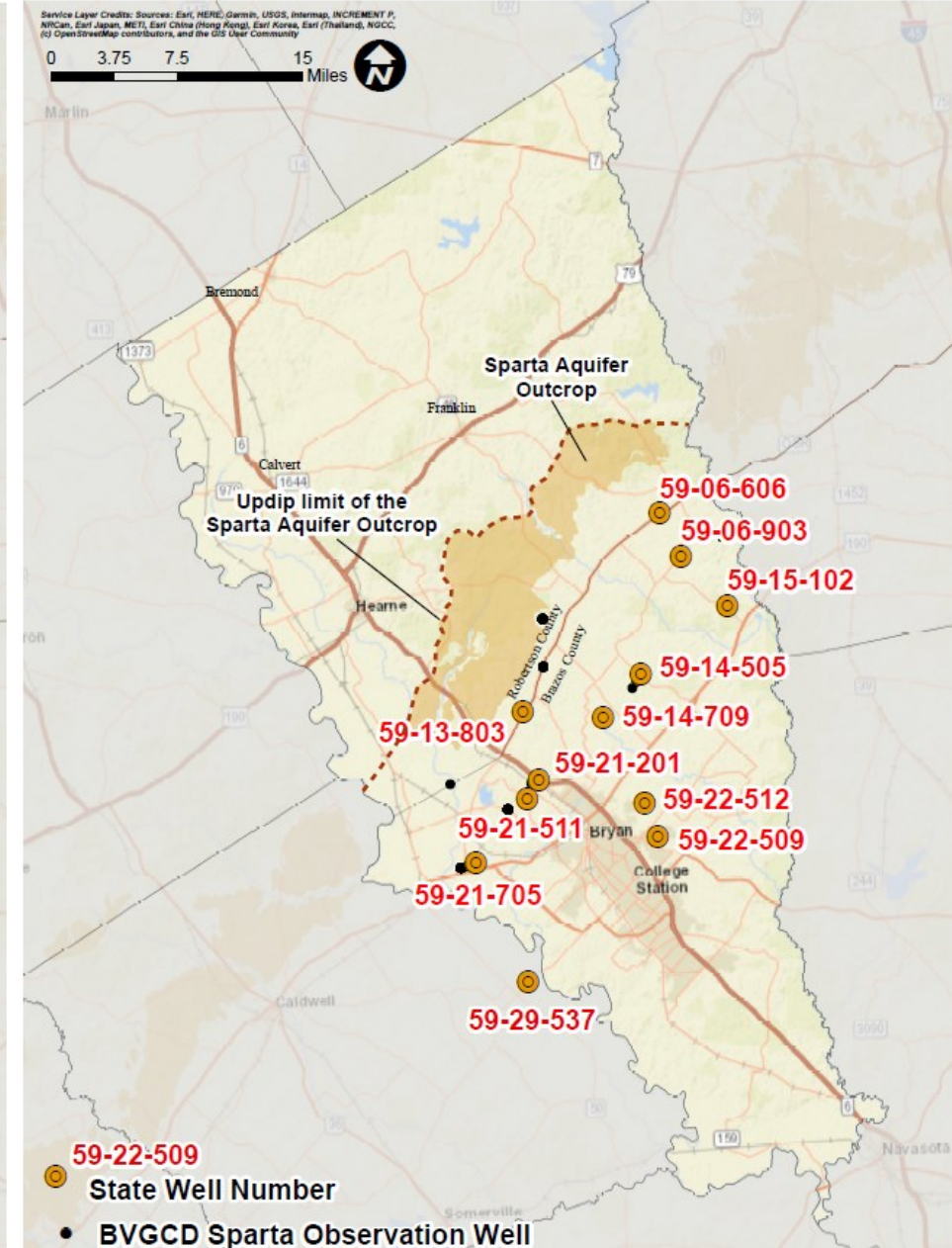
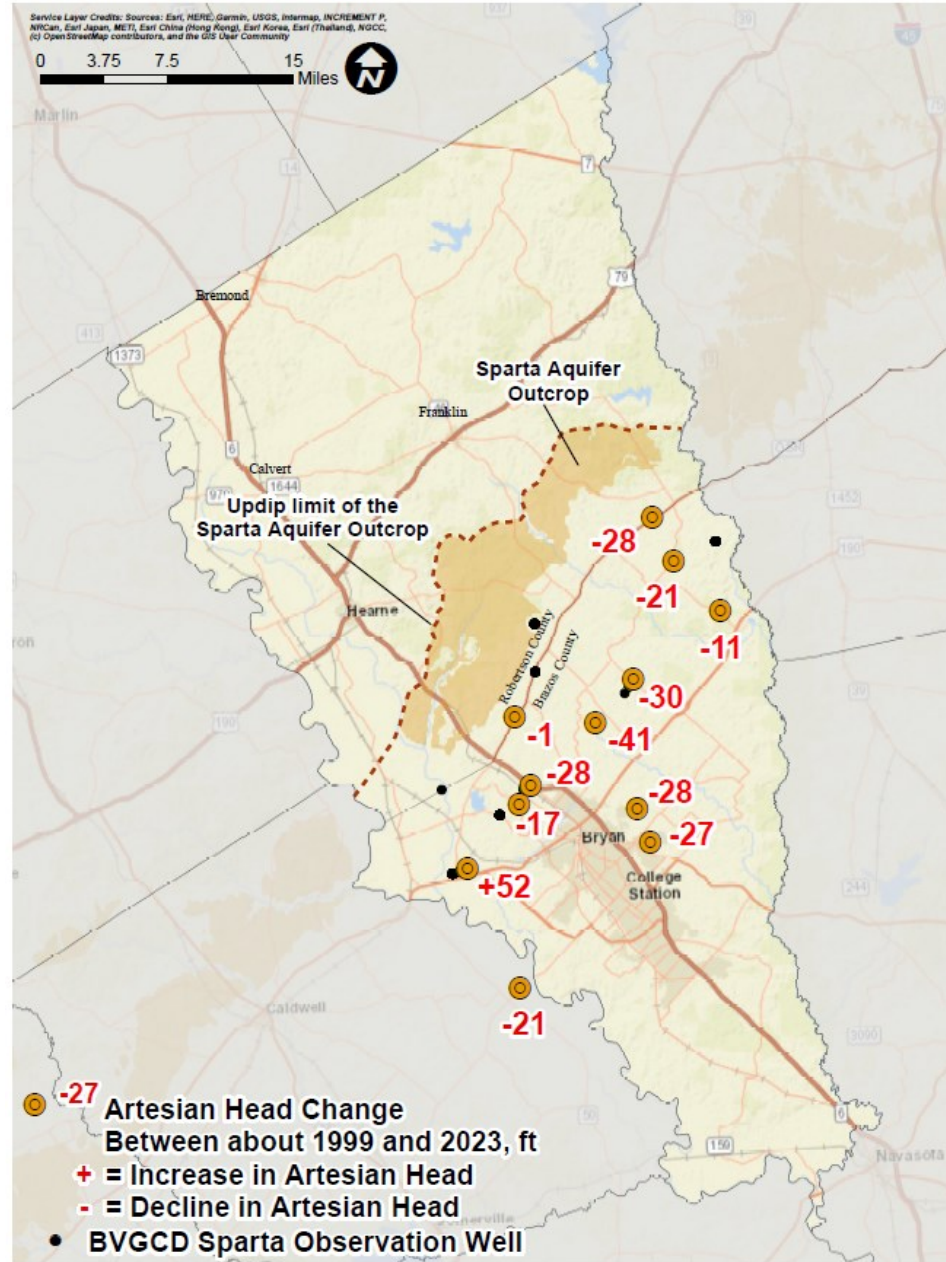
| State Well Number | Owner                |
|-------------------|----------------------|
| 59-06-606         | Private              |
| 59-06-903         | Private              |
| 59-13-803         | Private              |
| 59-14-505         | Private              |
| 59-14-709         | Private              |
| 59-15-102         | Private              |
| 59-21-201         | City of Bryan Well 6 |
| 59-21-511         | Private              |
| 59-21-705         | TAMU Well 2          |
| 59-22-509         | Private              |
| 59-22-512         | Private              |

# Sparta Aquifer

Arithmetic Average  
Artesian Head Change  
2000-2023:  
16 feet decline

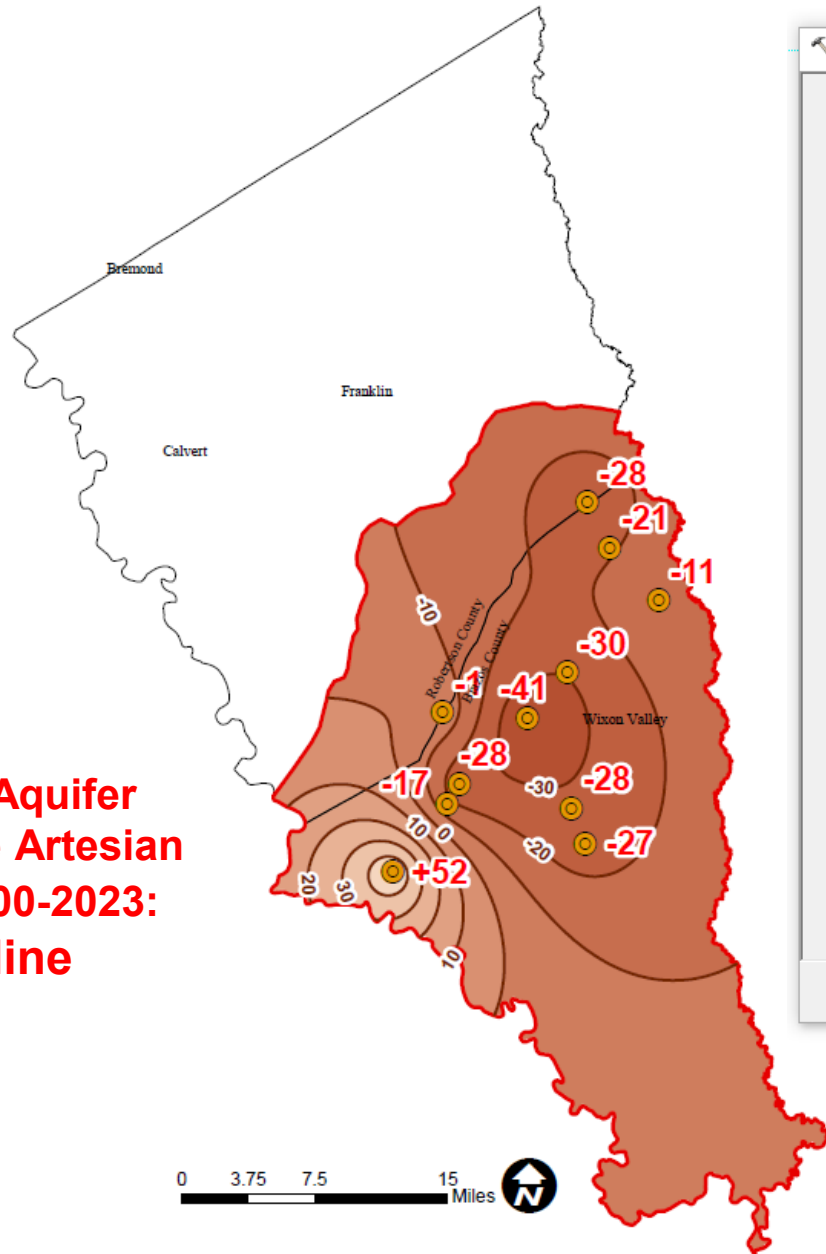
Spatially Weighted Average  
Artesian Head Change  
2000-2023:  
11 feet decline

2070 DFC  
Average Artesian Head  
53 feet decline



# Spatially Weighted Sparta Aquifer Head Change Estimate

**BVGCD Sparta Aquifer Weighted Average Artesian Head Change 2000-2023: 11 feet decline**



The screenshot shows the ArcGIS Kriging dialog box with the following settings:

- Input point features:** 23\_DFC
- Z value field:** DTW\_Diff\_f
- Output surface raster:** C:\\_AGS\Projects\BVGCD\2023\DFC\_Update\_2023\Esb\_Weighted\_Avg\GIS\_2023\SpBV
- Semivariogram properties:**
  - Kriging method:  Ordinary  Universal
  - Semivariogram model: Exponential
  - Advanced Parameters... button
- Output cell size (optional):** 661.083439583395
- Search radius (optional):** Variable
- Search Radius Settings:**
  - Number of points: 24
  - Maximum distance: [empty]
- Output variance of prediction raster (optional):** [empty]

Two sub-dialogs are also visible:

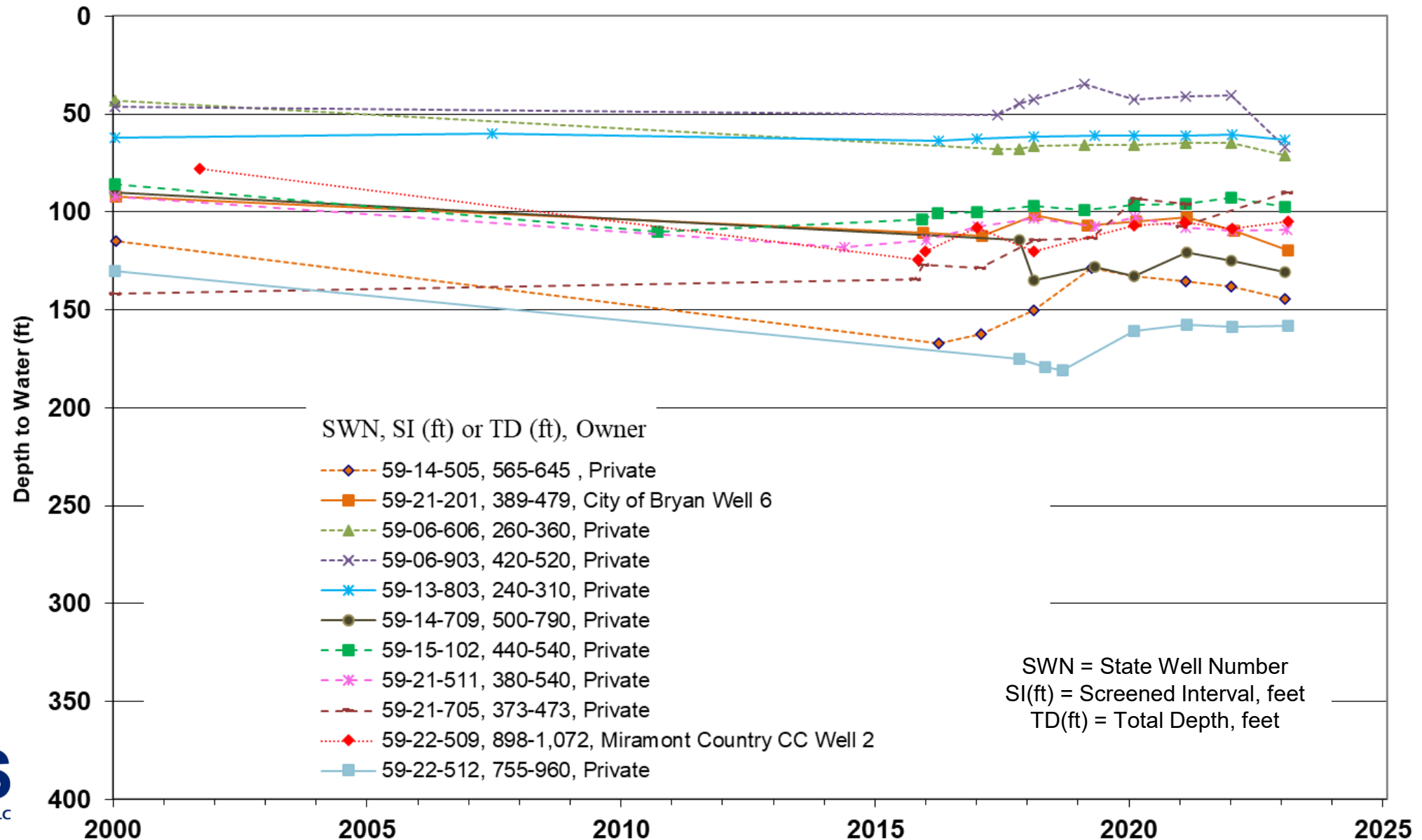
- Search radius (optional):** Defines which of the input points will be used to interpolate the value for each cell in the output raster.
- Advanced Parameters:**
  - Lag size: 661.083440
  - Variogram Parameters:
    - Major range: 100000
    - Partial sill: 1000
    - Nugget: 0

Buttons at the bottom include OK, Cancel, Environments..., << Hide Help, and Tool Help.

integer value specifying the number of nearest input sample points to be used to perform interpolation. The default is 12 points.

- Maximum distance

# Sparta Aquifer Observation Wells



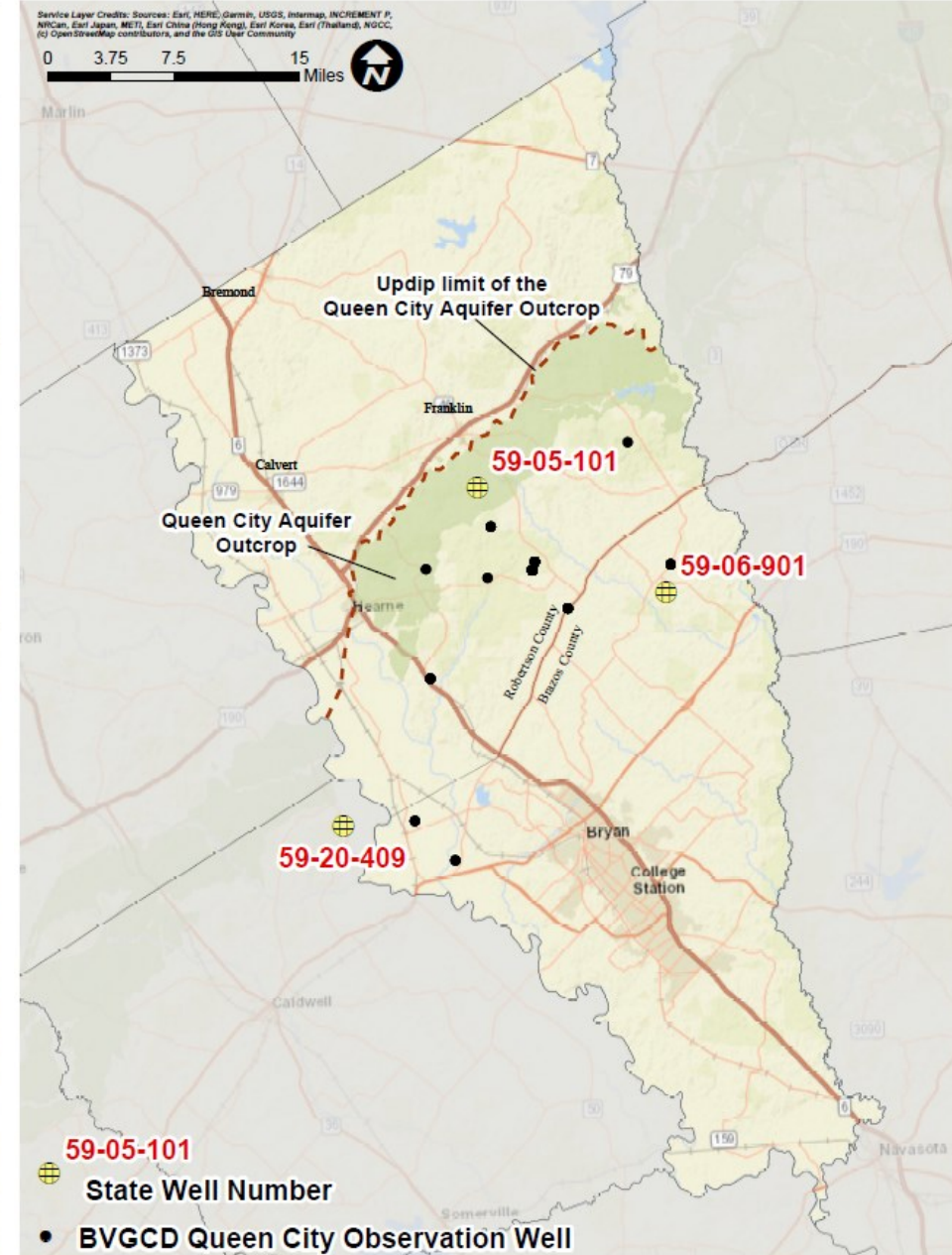
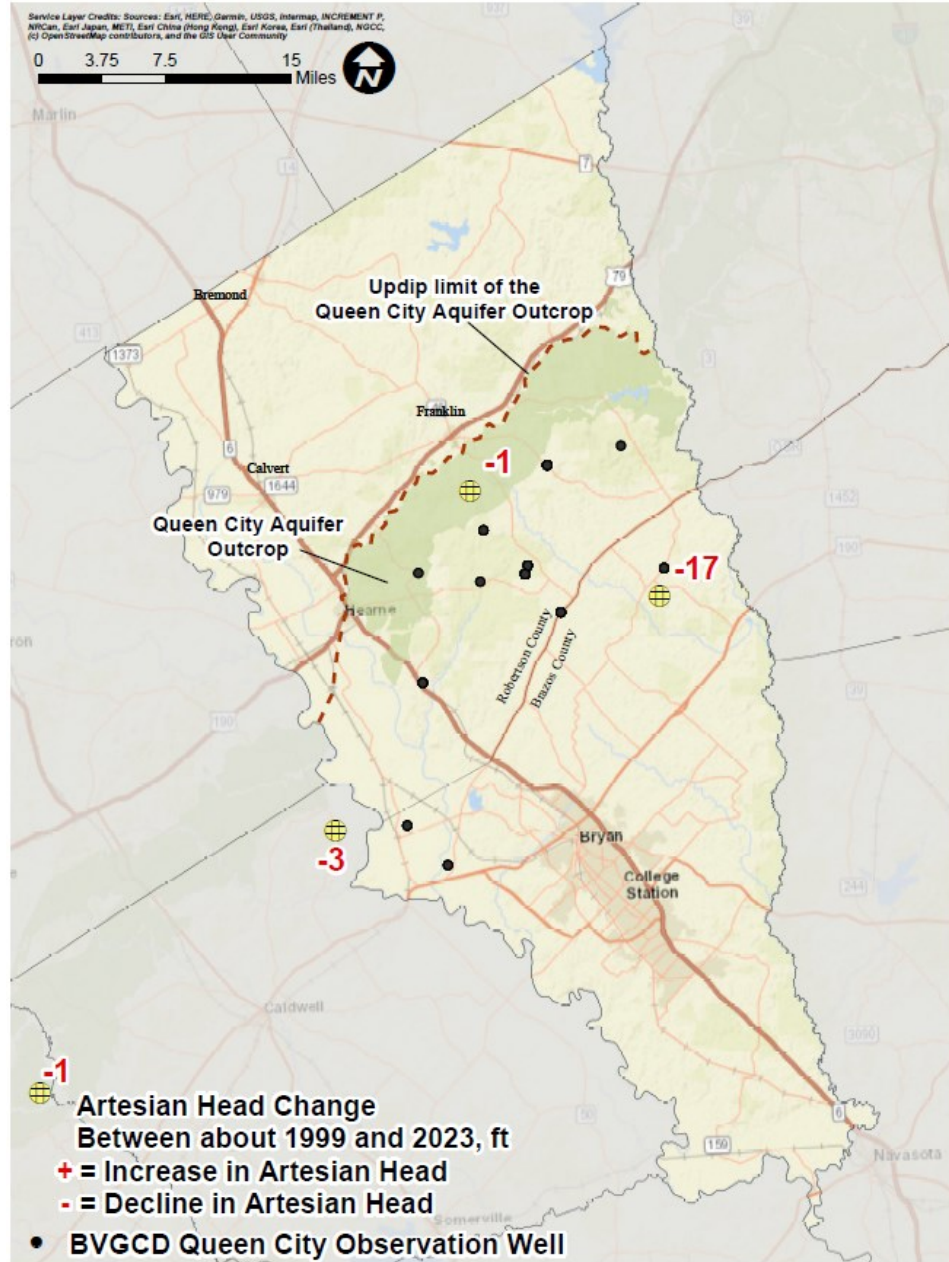
# Queen City Aquifer DFC Wells

| State Well Number | Well Owner |
|-------------------|------------|
| 59-05-101         | Private    |
| 59-06-901         | Private    |

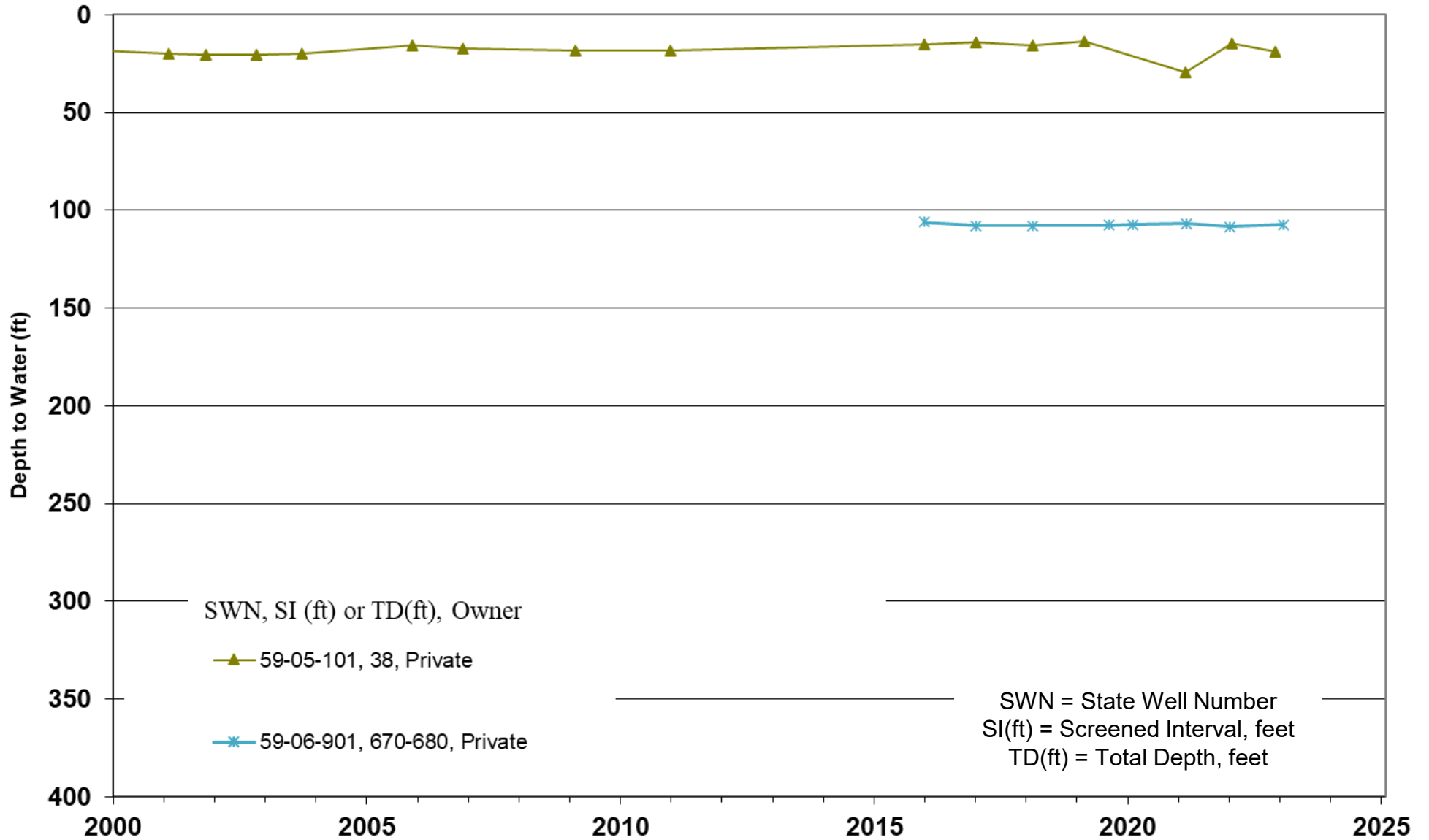


# Queen City Aquifer

2070 DFC  
Average Artesian Head  
44 feet decline



# Queen City Aquifer Observation Wells



# Carrizo Aquifer DFC Wells

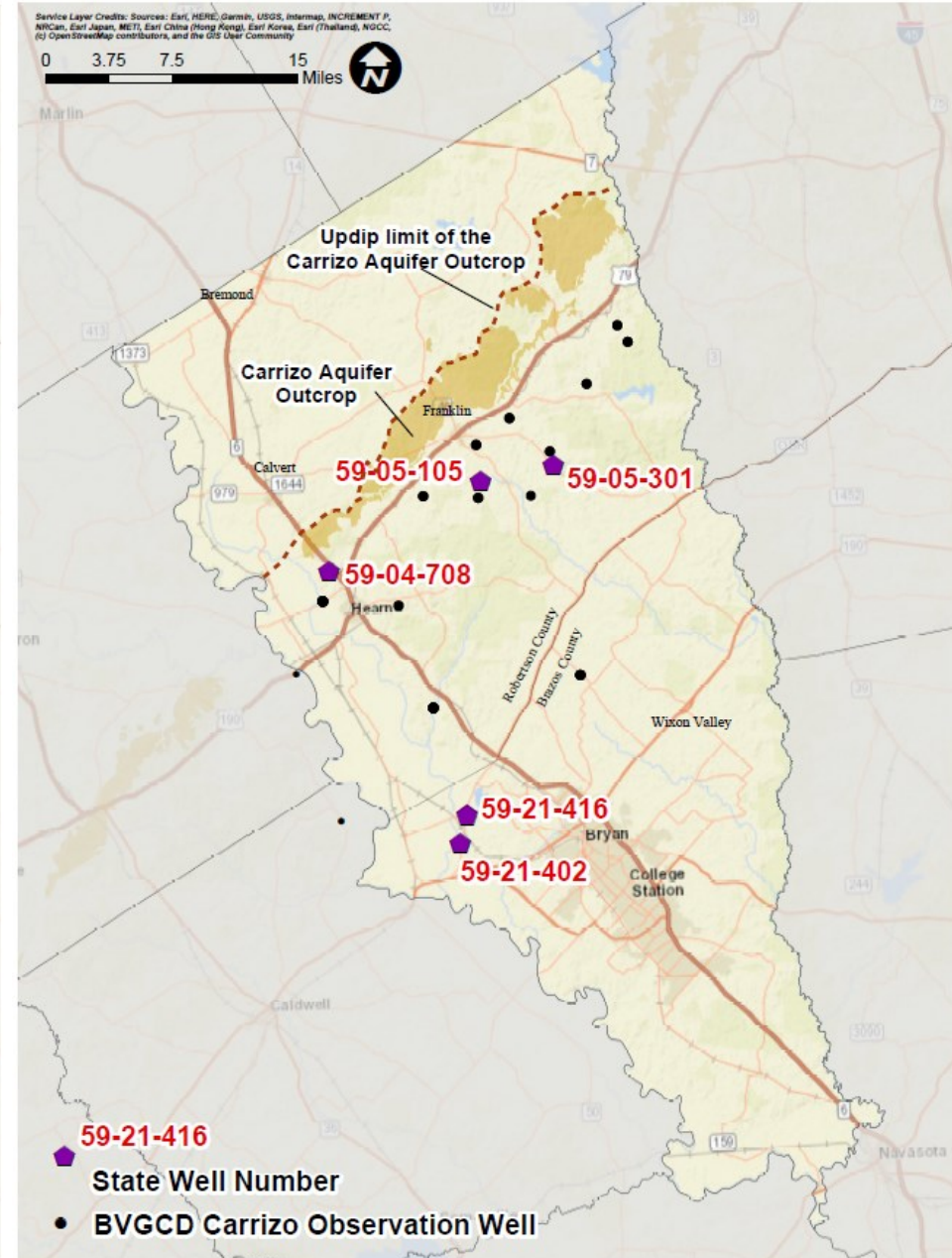
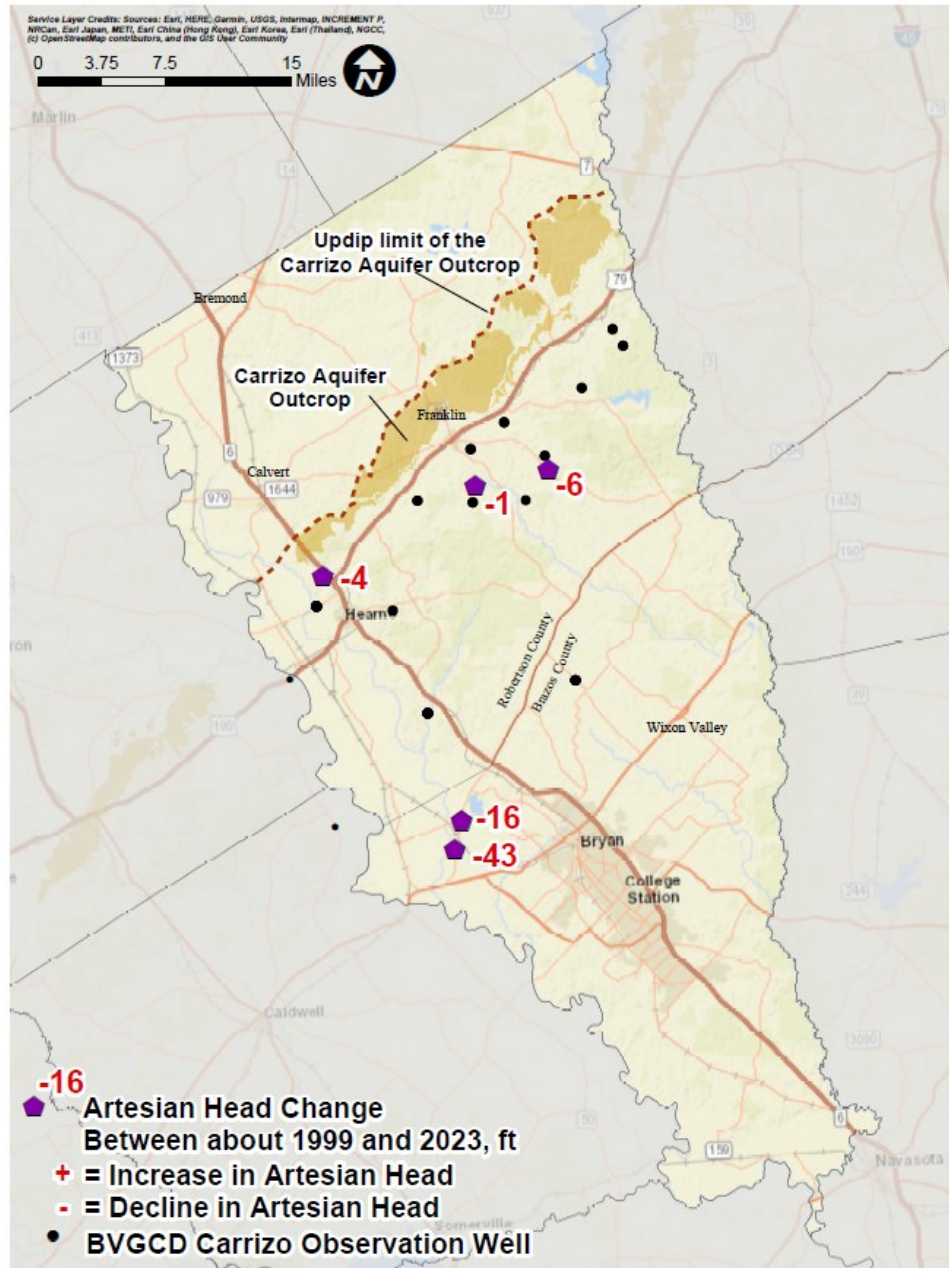
| State Well Number | Well Owner                         |
|-------------------|------------------------------------|
| 59-04-708         | Private                            |
| 59-05-105         | Private                            |
| 59-05-301         | Private                            |
| 59-21-402         | TAMU Well 5                        |
| 59-21-416         | City of College Station Carrizo #1 |

# Carrizo Aquifer

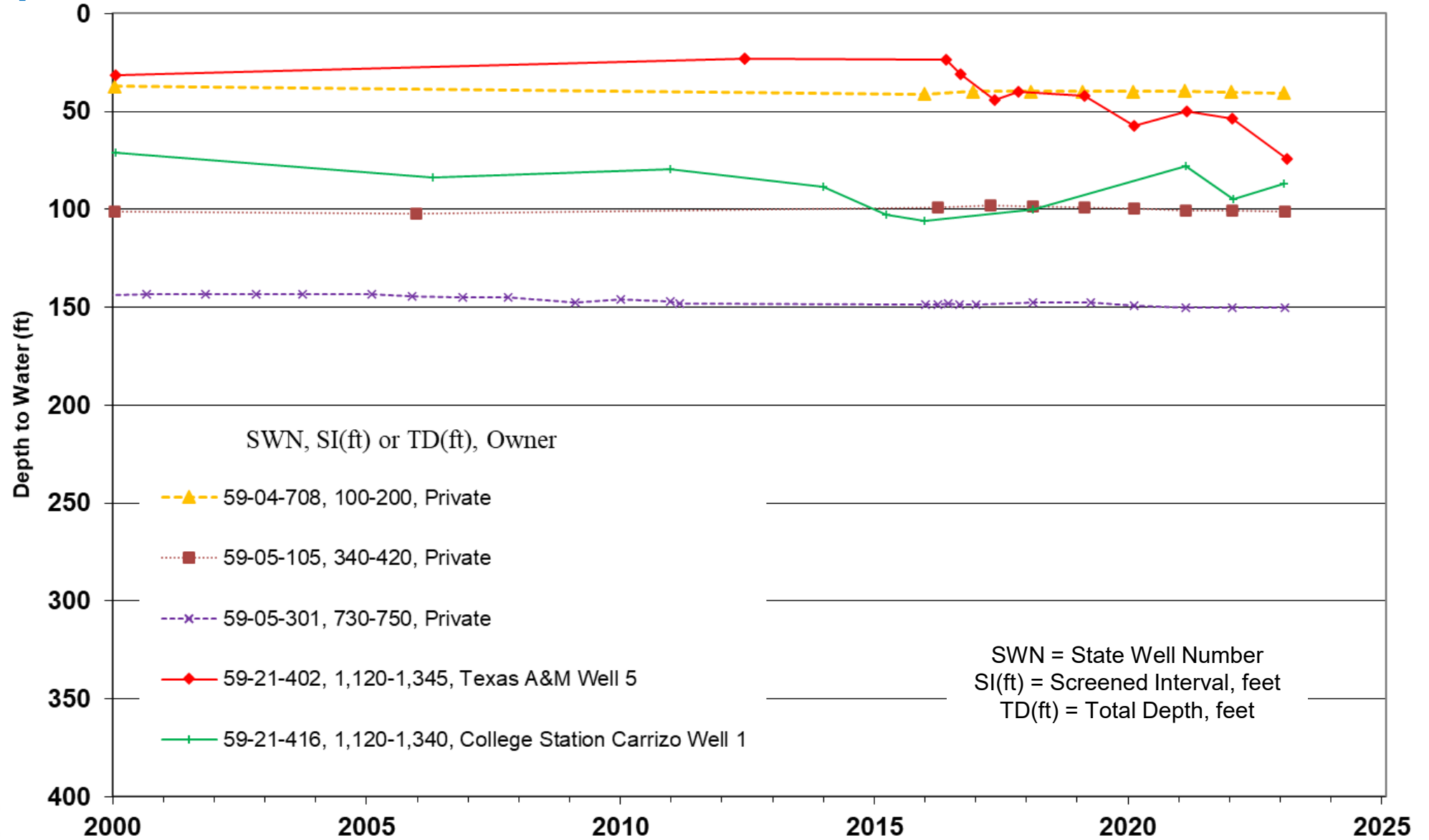
**Arithmetic Average  
Artesian Head Change  
2000-2023:  
14 feet decline**

**Spatially Weighted Average  
Artesian Head Change  
2000-2023:  
13 feet decline**

**2070 DFC  
Average Artesian Head  
84 feet decline**



# Carrizo Aquifer Observation Wells

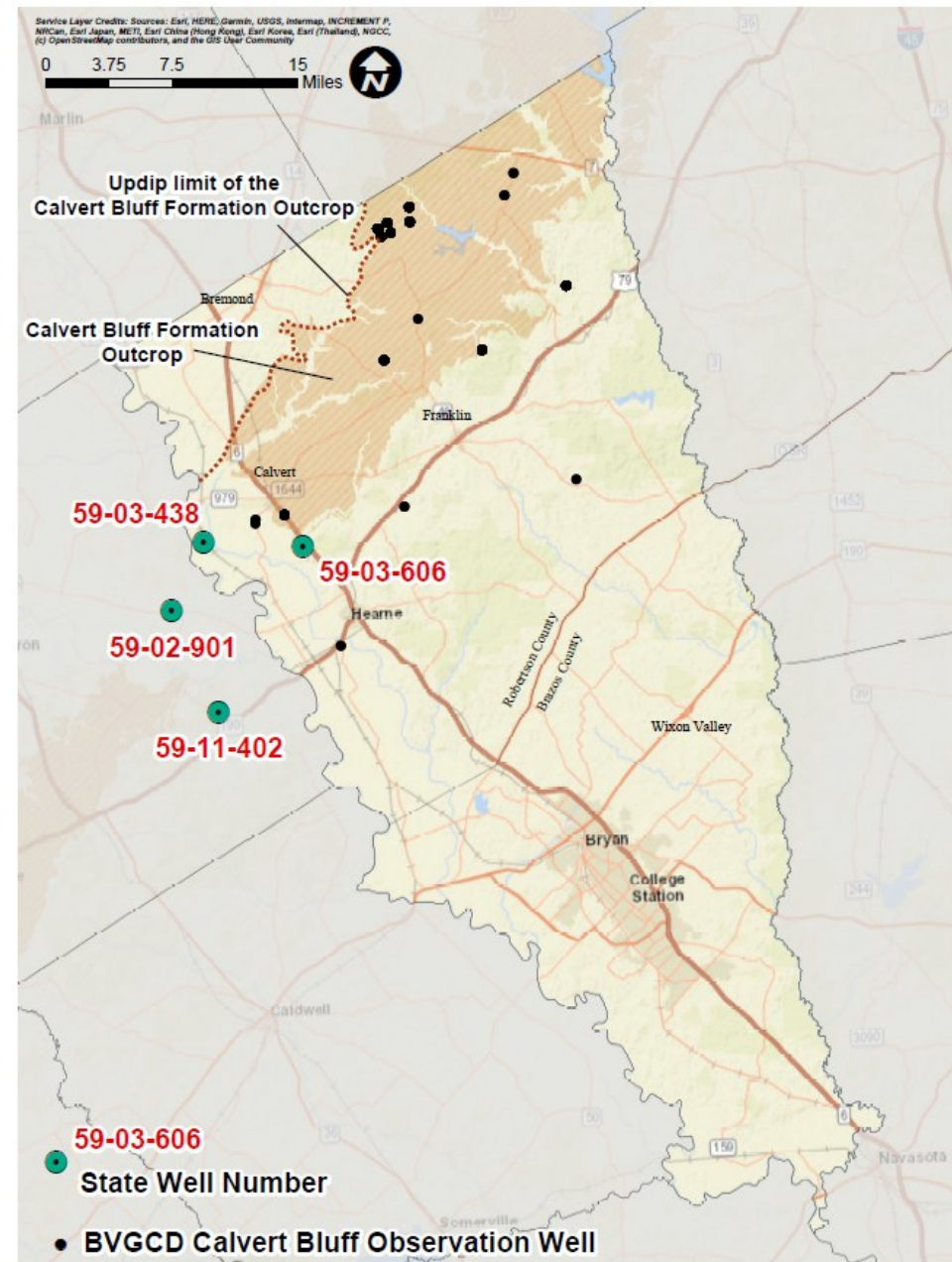
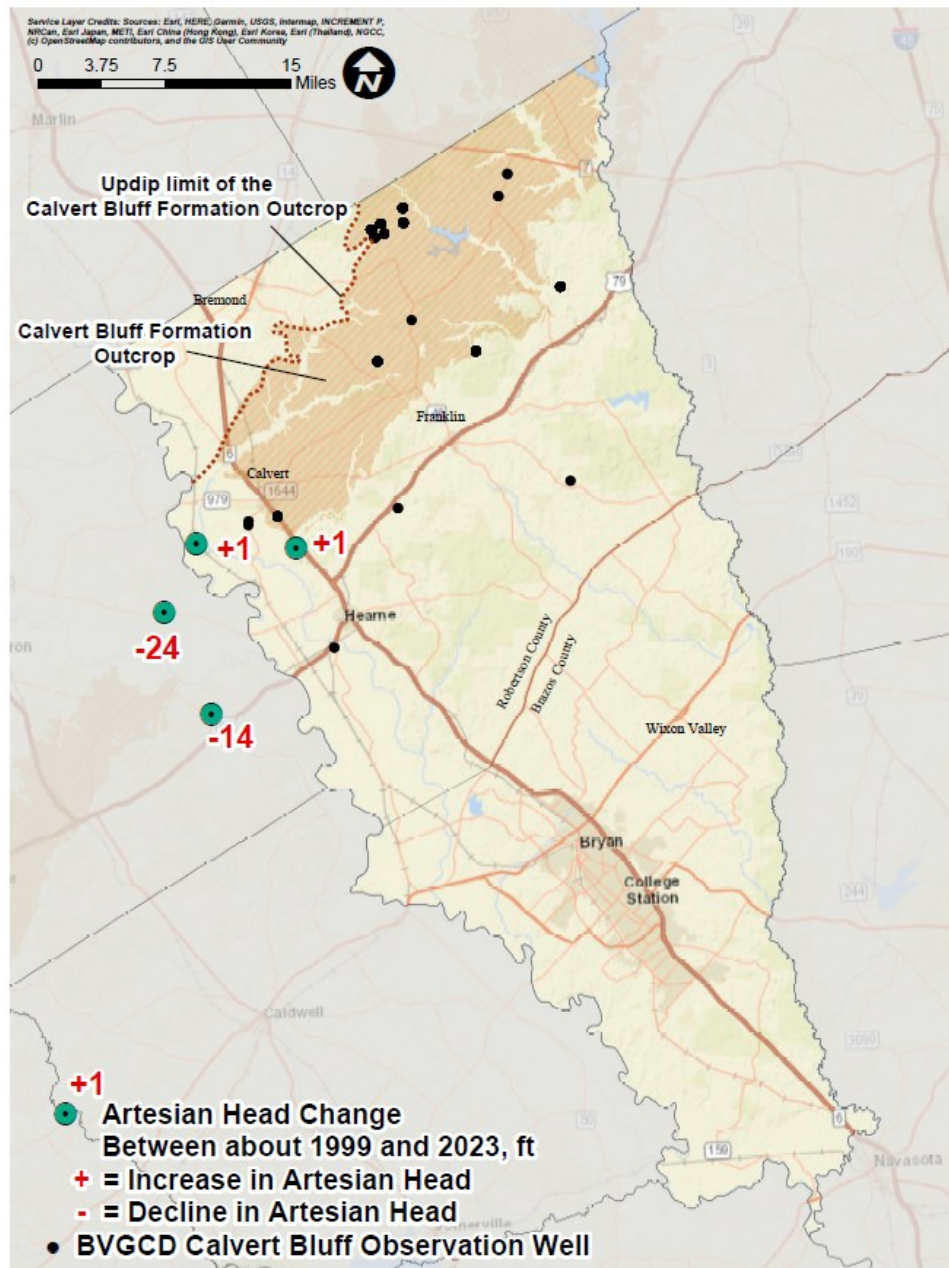


# Calvert Bluff Formation DFC Wells

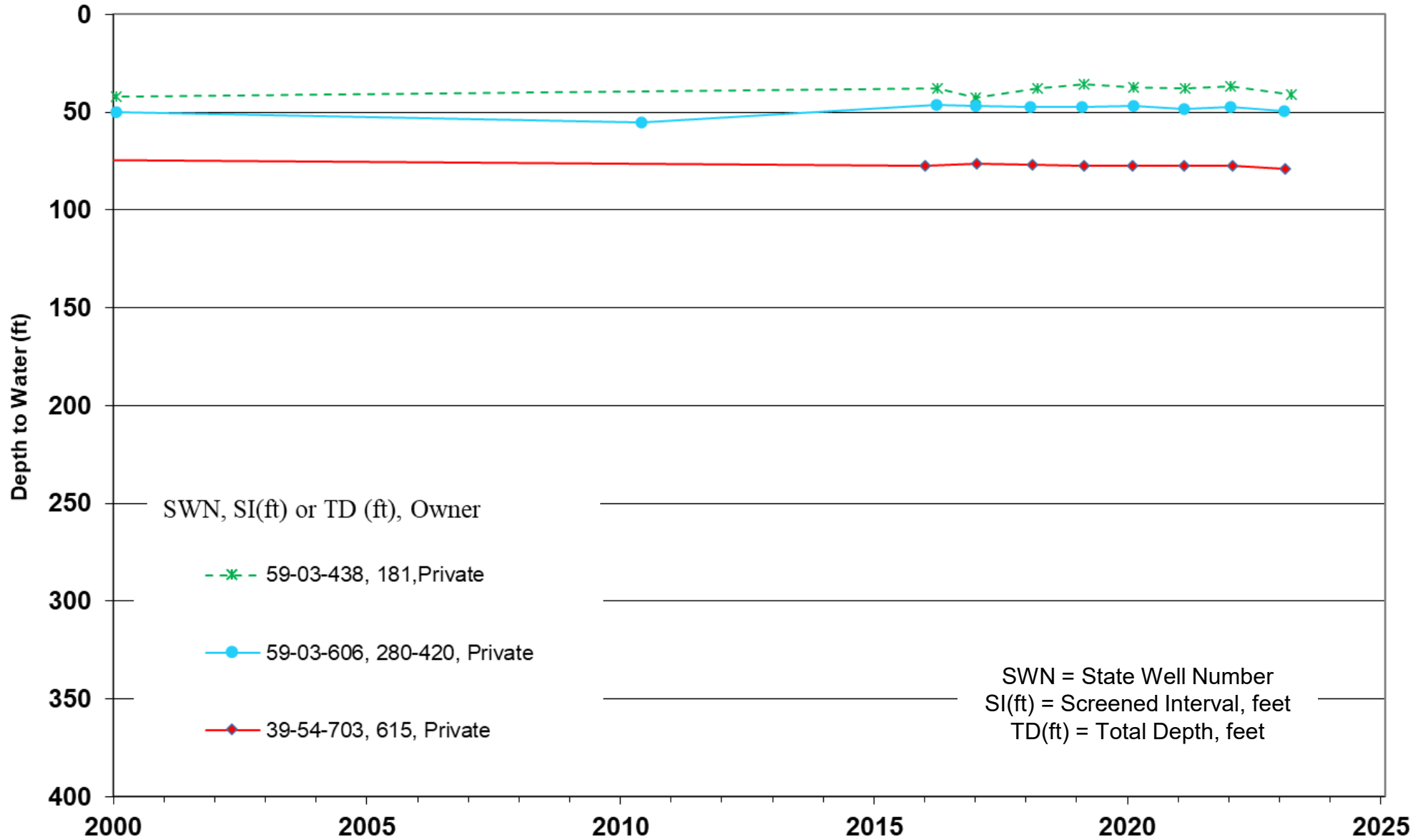
| State Well Number | Well Owner |
|-------------------|------------|
| 59-03-438         | Private    |
| 59-03-606         | Private    |

# Calvert Bluff Formation

2070 DFC  
Average Artesian Head  
111 feet decline



# Calvert Bluff Formation Observation Wells





# Simsboro Aquifer DFC Wells

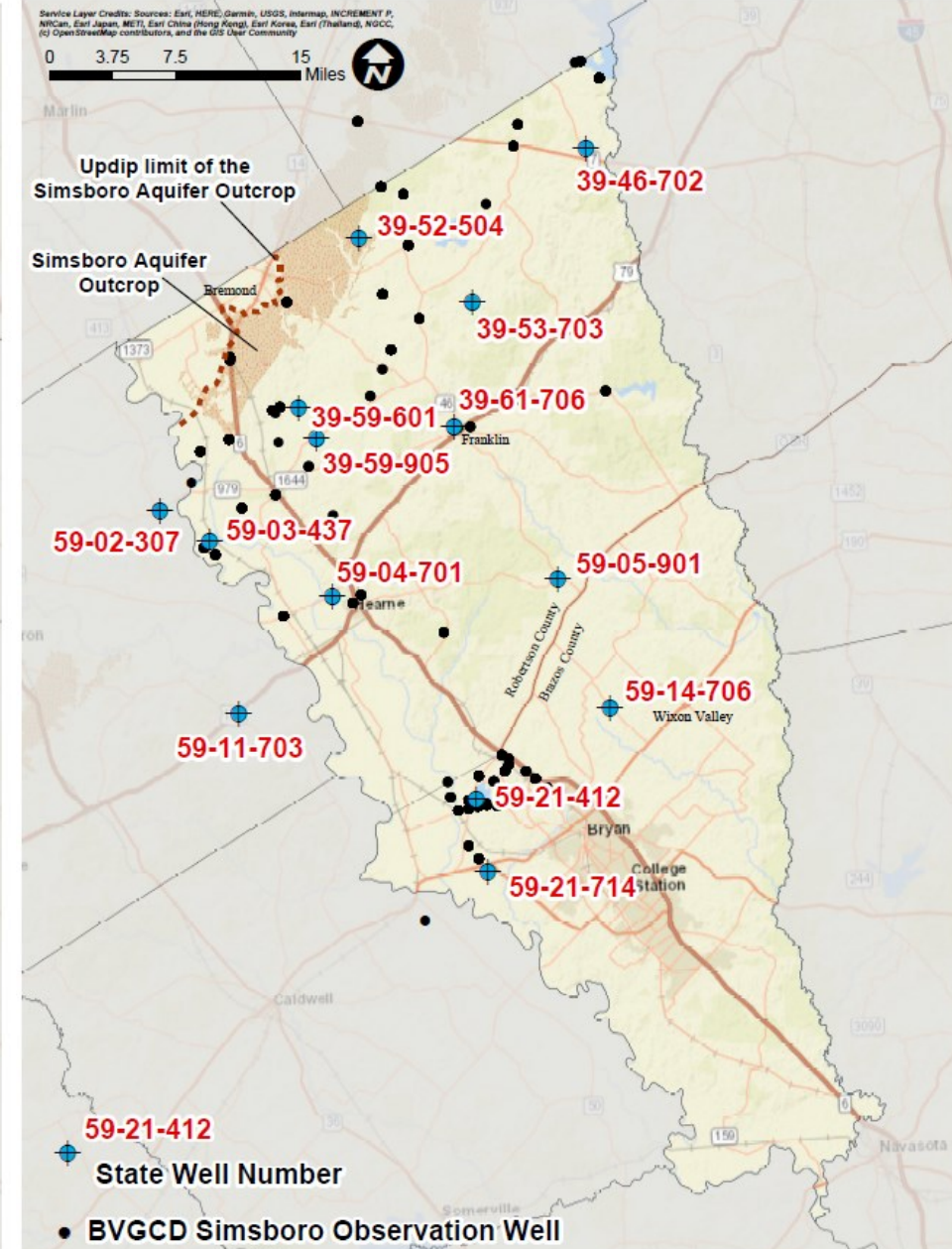
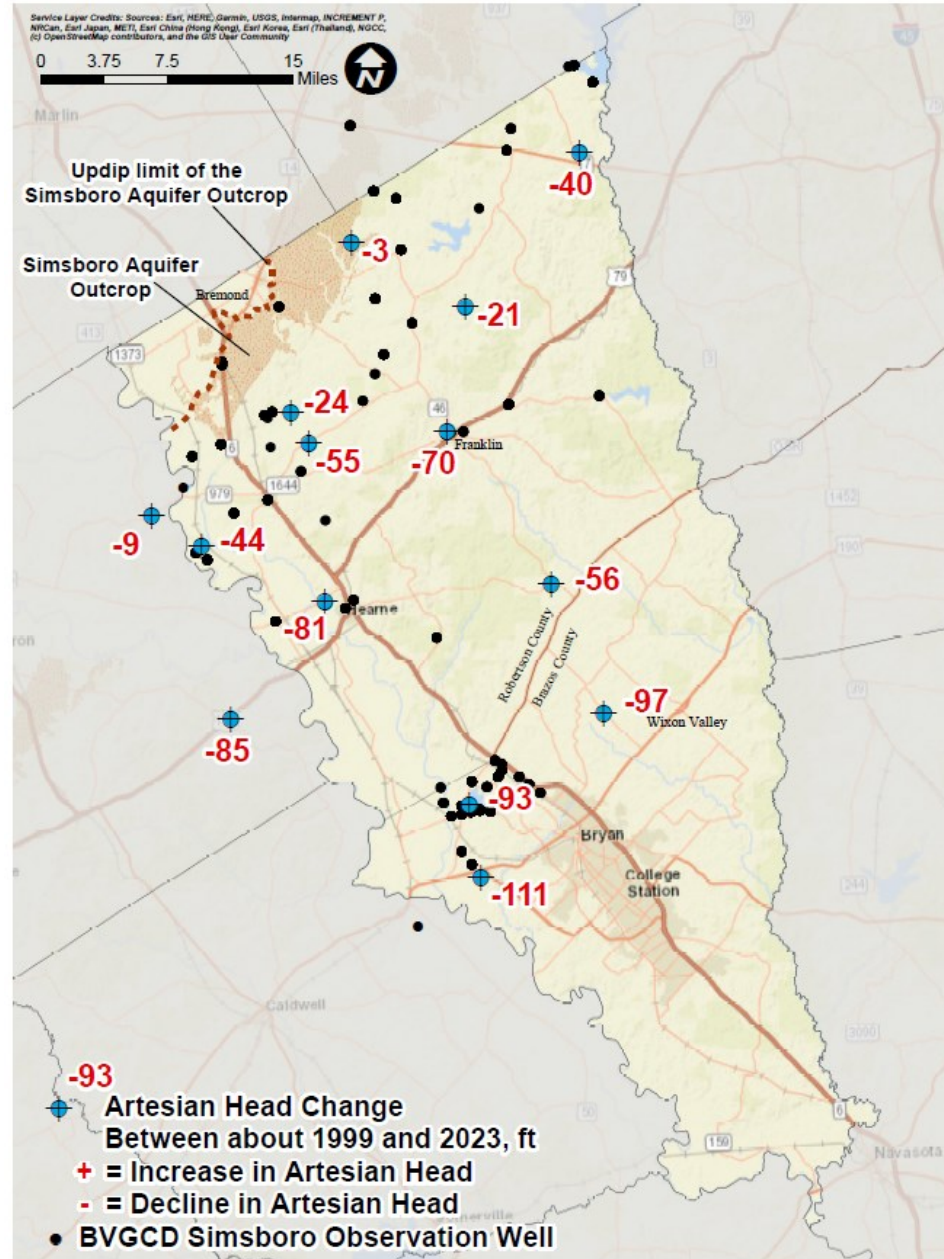
| State Well Number | Well Owner                      |
|-------------------|---------------------------------|
| 39-46-702         | Private                         |
| 39-52-504         | Private                         |
| 39-53-703         | Private                         |
| 39-59-601         | Private                         |
| 39-59-905         | Private                         |
| 39-61-706         | City of Franklin Well 4         |
| 59-03-437         | Private                         |
| 59-04-701         | City of Hearne Well 4           |
| 59-05-901         | Wickson Creek SUD Wheelock Well |
| 59-14-706         | Wickson Creek SUD Well 1        |
| 59-21-412         | City of Bryan Well 19           |
| 59-21-714         | TAMU Well 8                     |

# Simsboro Aquifer

**Arithmetic Average Artesian Head Change 2000-2023:**  
58 feet decline

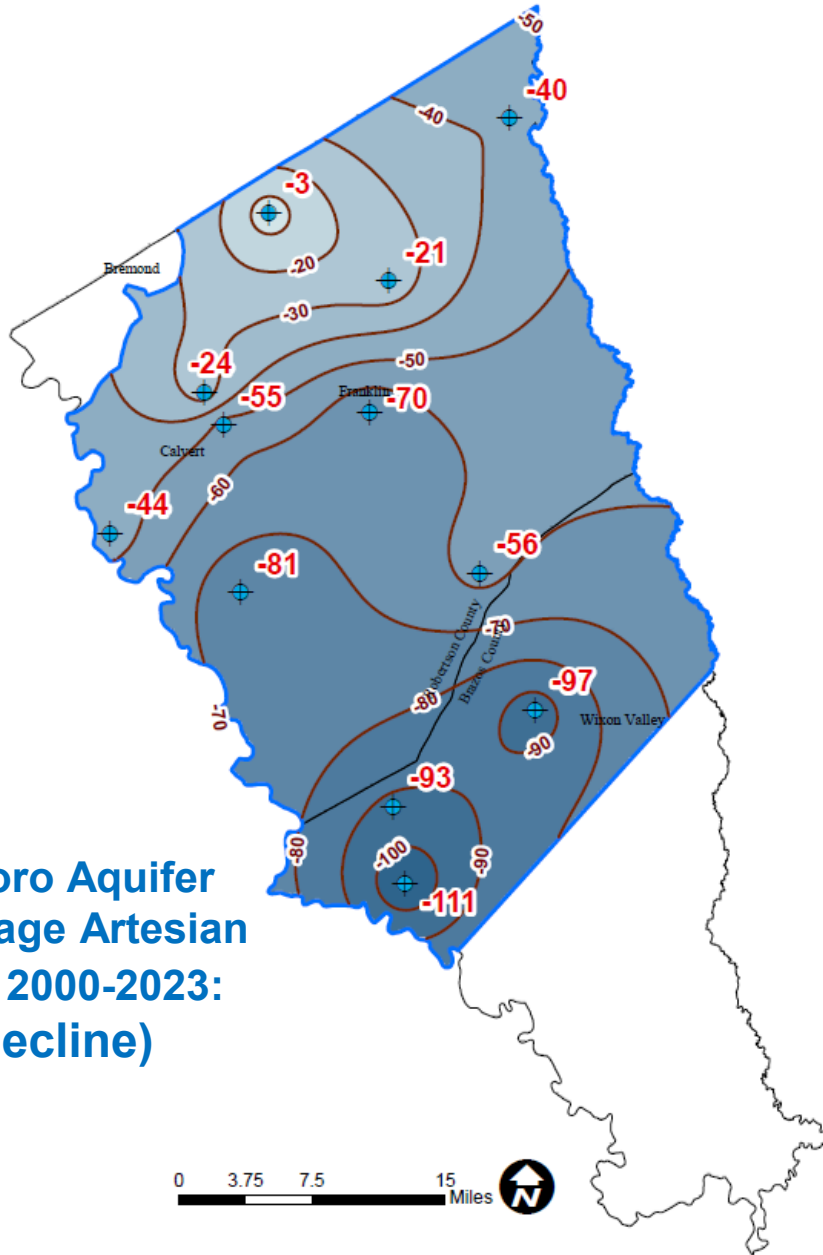
**Spatially Weighted Average Artesian Head Change 2000-2023:**  
59 or 61 feet decline

**2070 DFC Average Artesian Head**  
262 feet decline

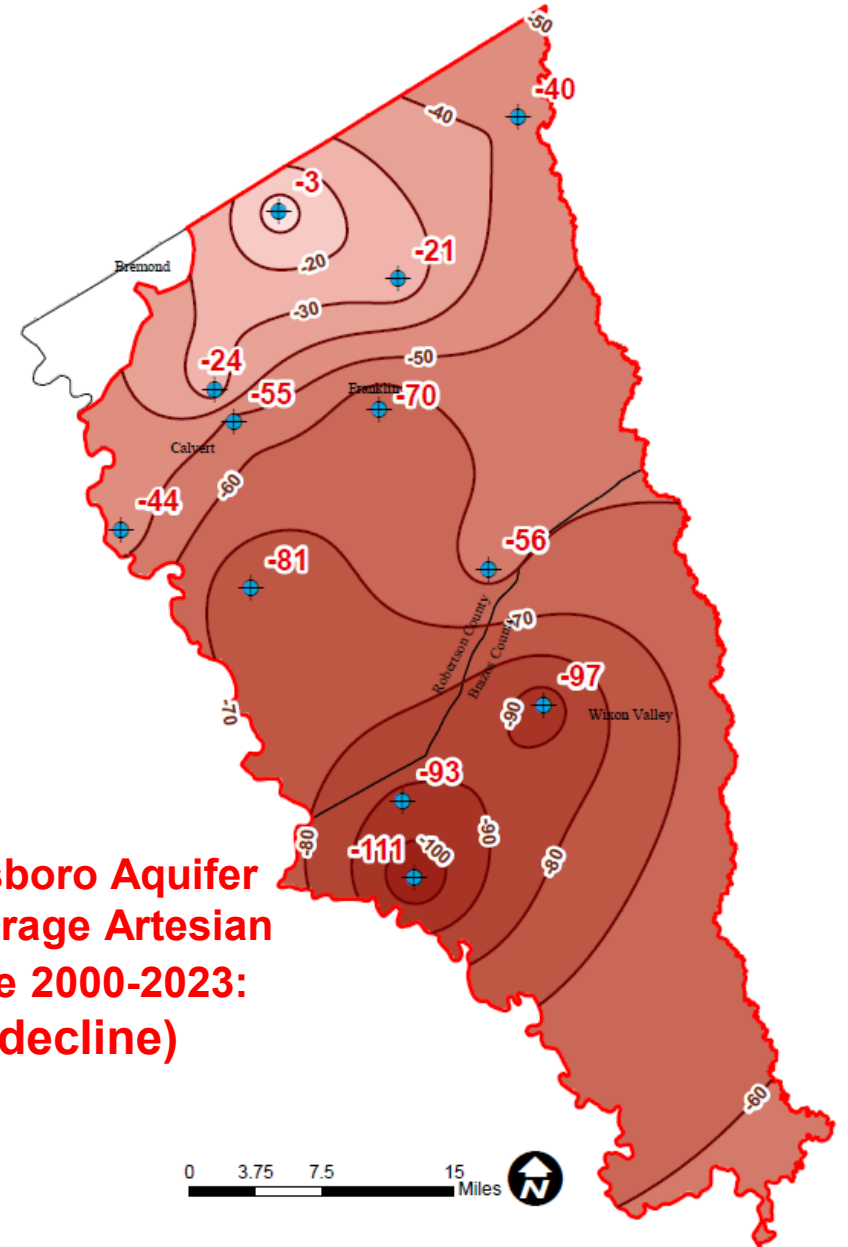


# Spatially Weighted Simsboro Aquifer Head Change Estimates

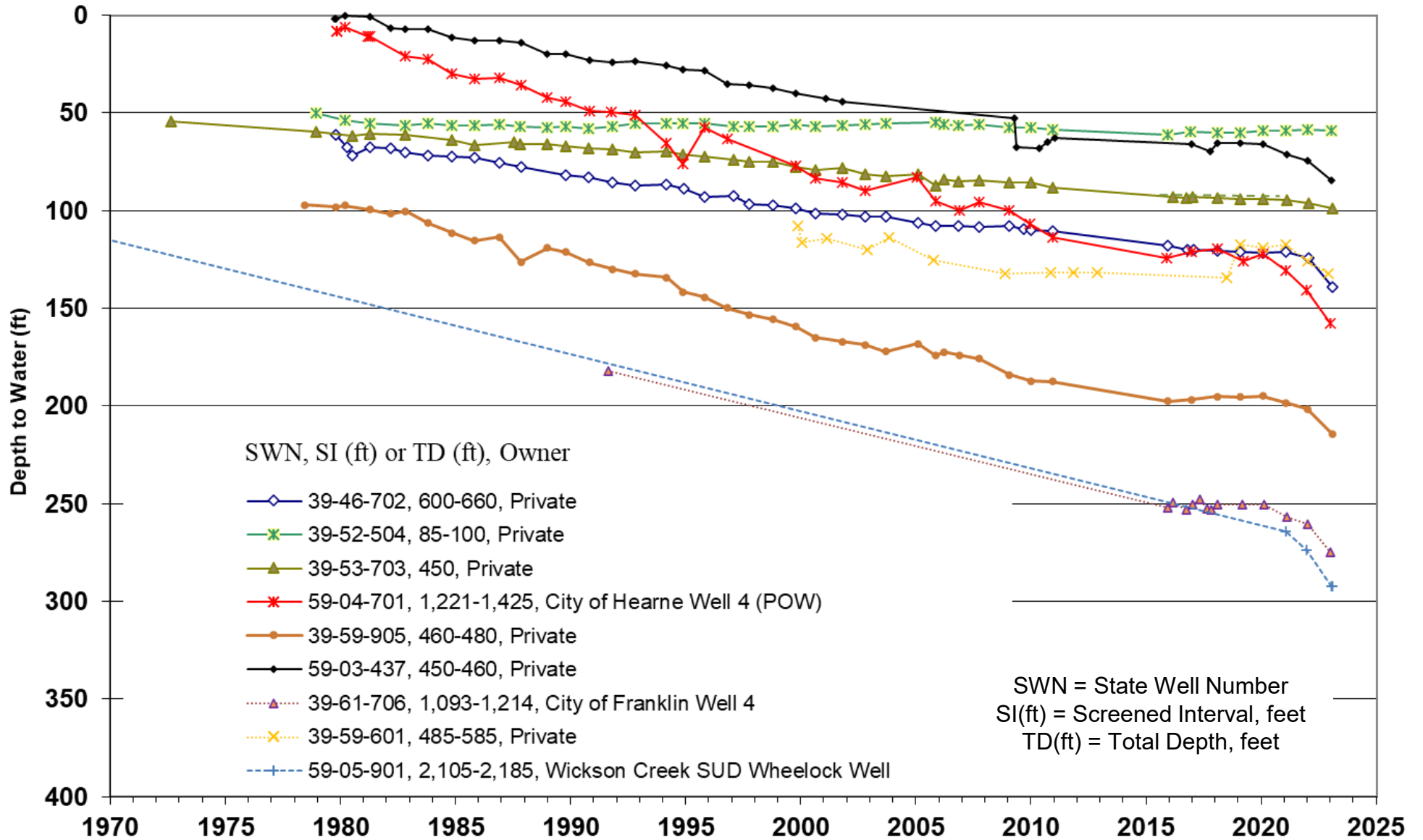
Fresh Simsboro Aquifer  
Weighted Average Artesian  
Head Change 2000-2023:  
59 feet (decline)



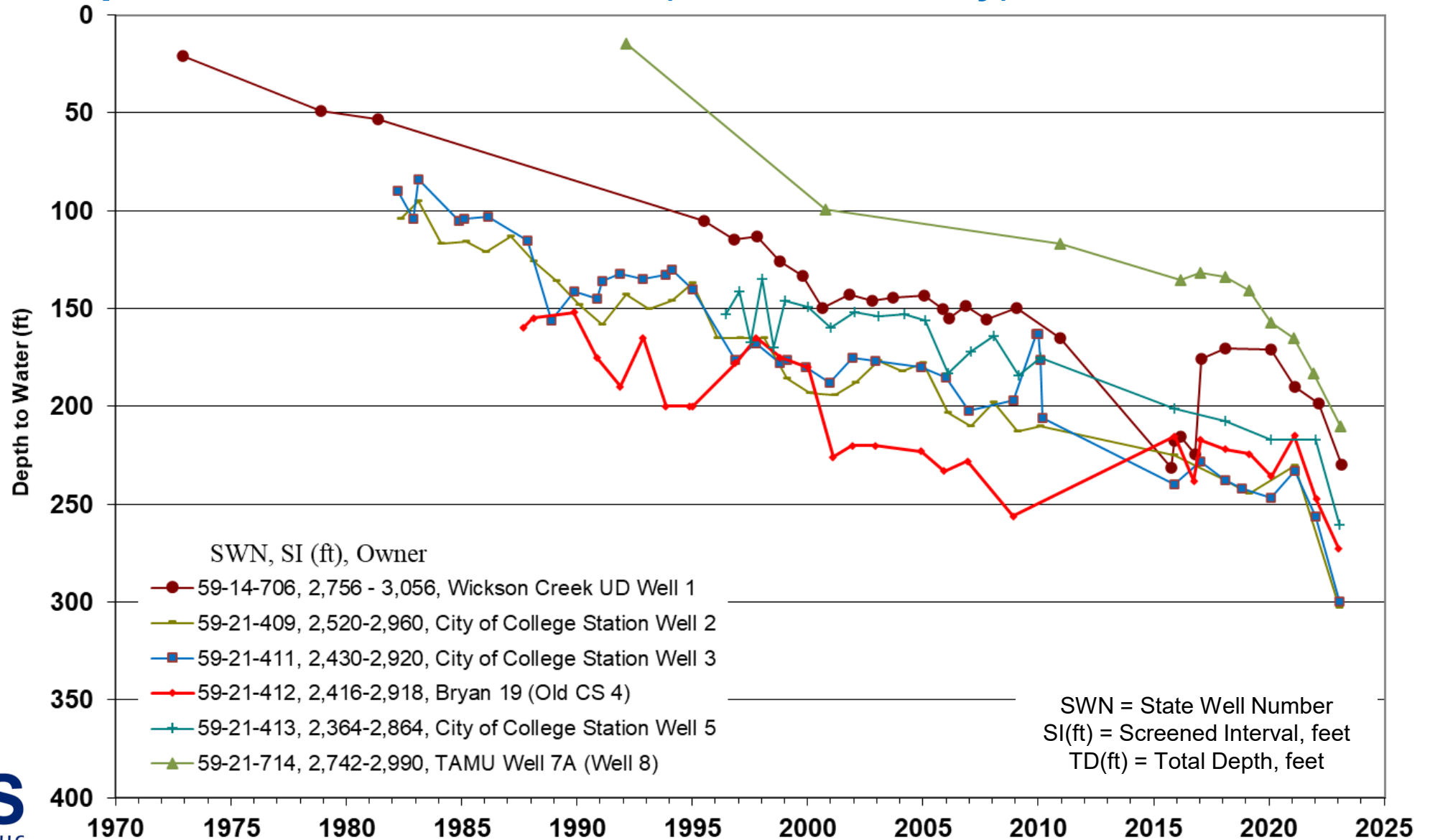
BVGCD Simsboro Aquifer  
Weighted Average Artesian  
Head Change 2000-2023:  
61 feet (decline)



# Simsboro Aquifer Observation Wells (Robertson County)



# Simsboro Aquifer Observation Wells (Brazos County)



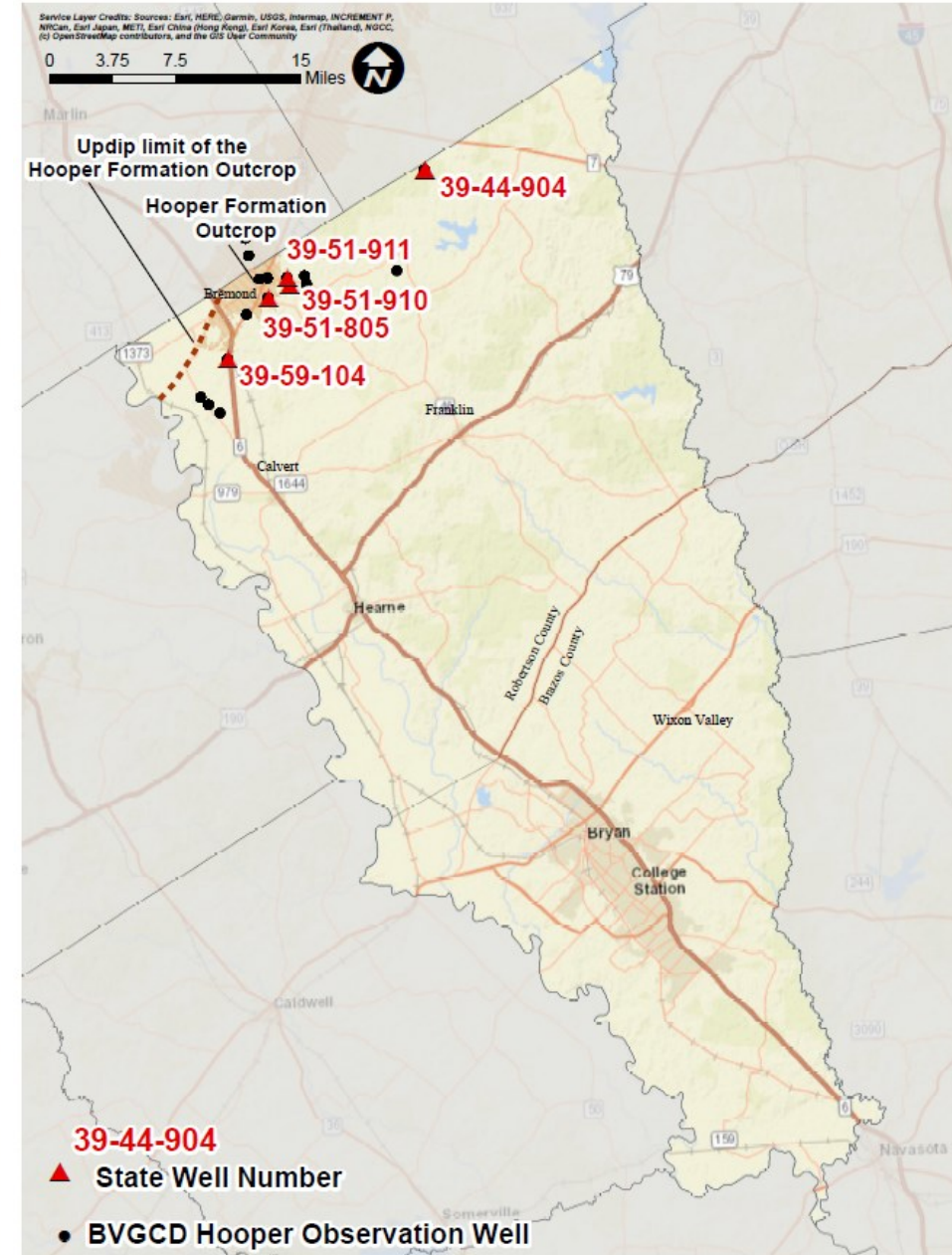
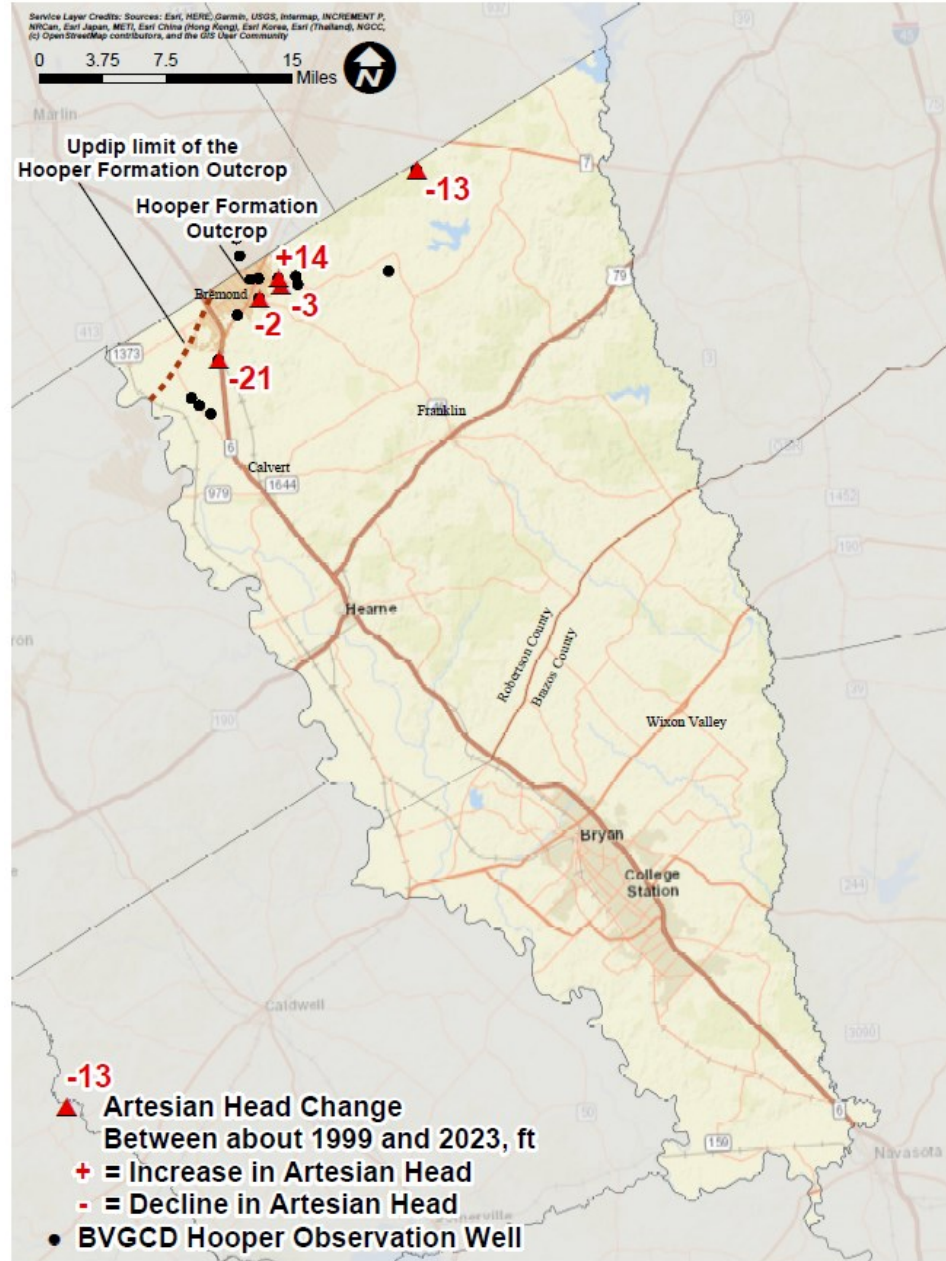
# Hooper Formation DFC Wells

| State Well Number | Well Owner             |
|-------------------|------------------------|
| 39-44-904         | Private                |
| 39-51-805         | Private                |
| 39-51-910         | City of Bremond Well 4 |
| 39-51-911         | City of Bremond Well 5 |
| 39-59-104         | Private                |

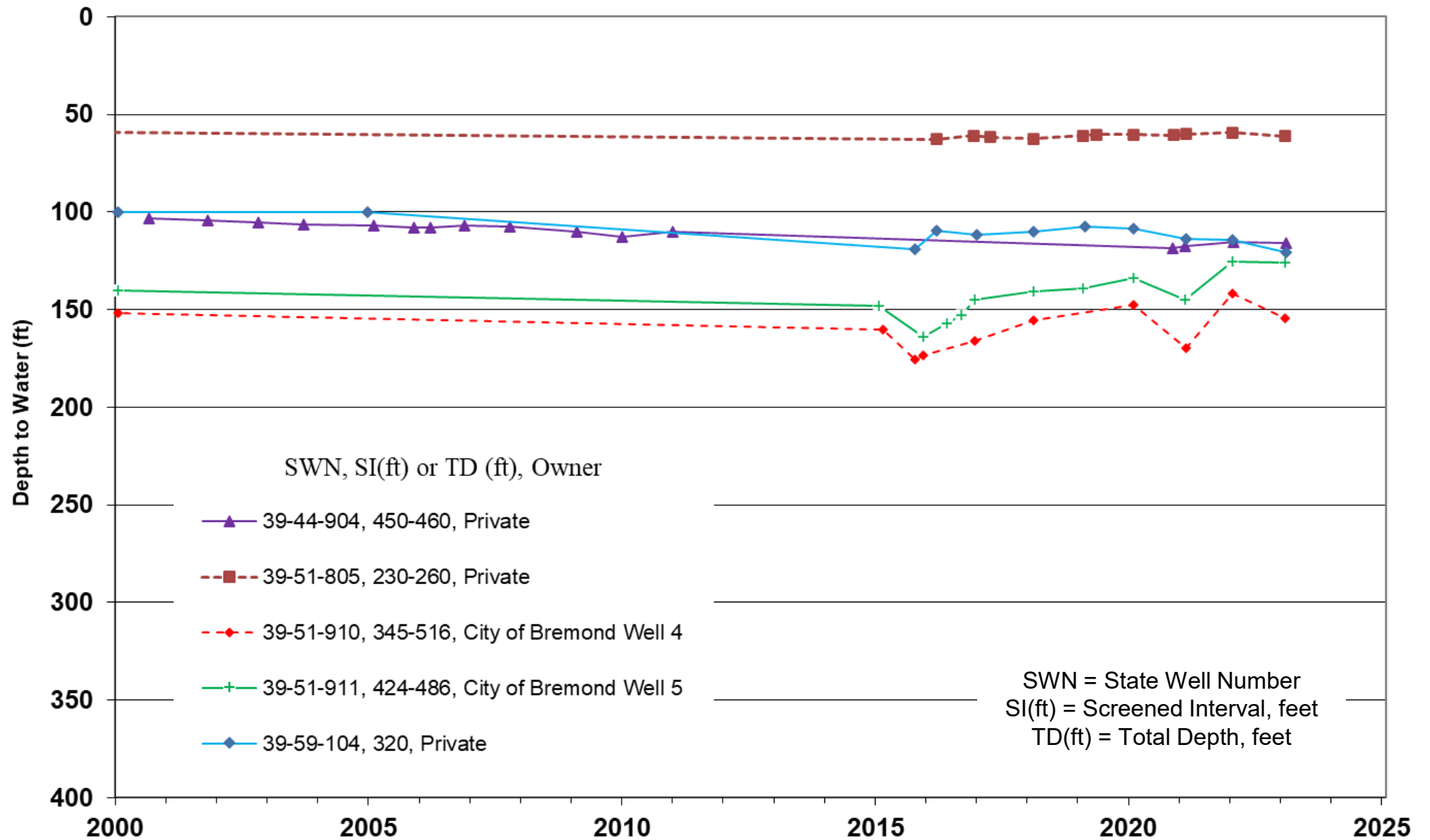
# Hooper Formation

Arithmetic Average  
Artesian Head Change  
2000-2023:  
5 feet decline

2070 DFC  
Average Artesian Head  
167 feet Decline



# Hooper Formation Observation Wells





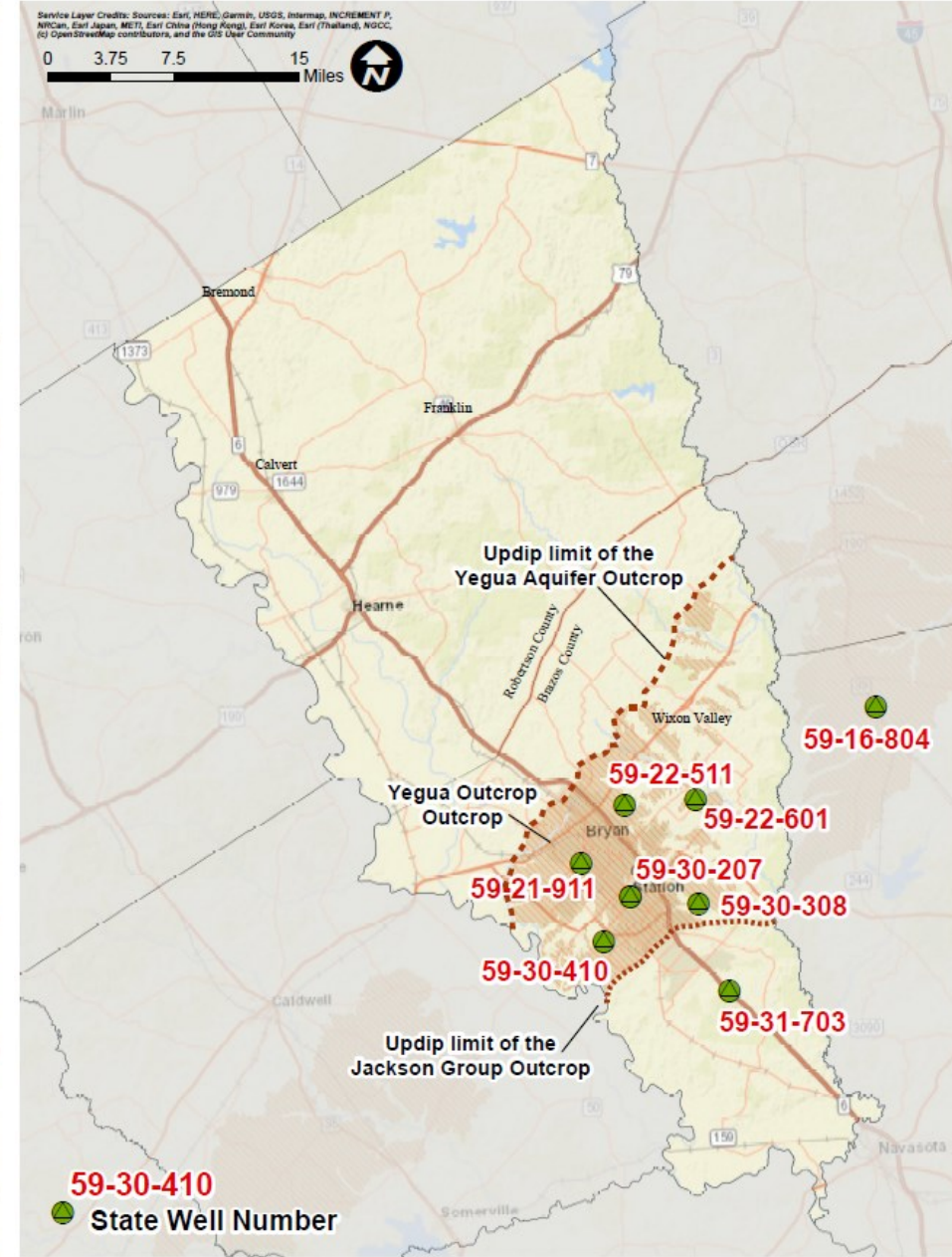
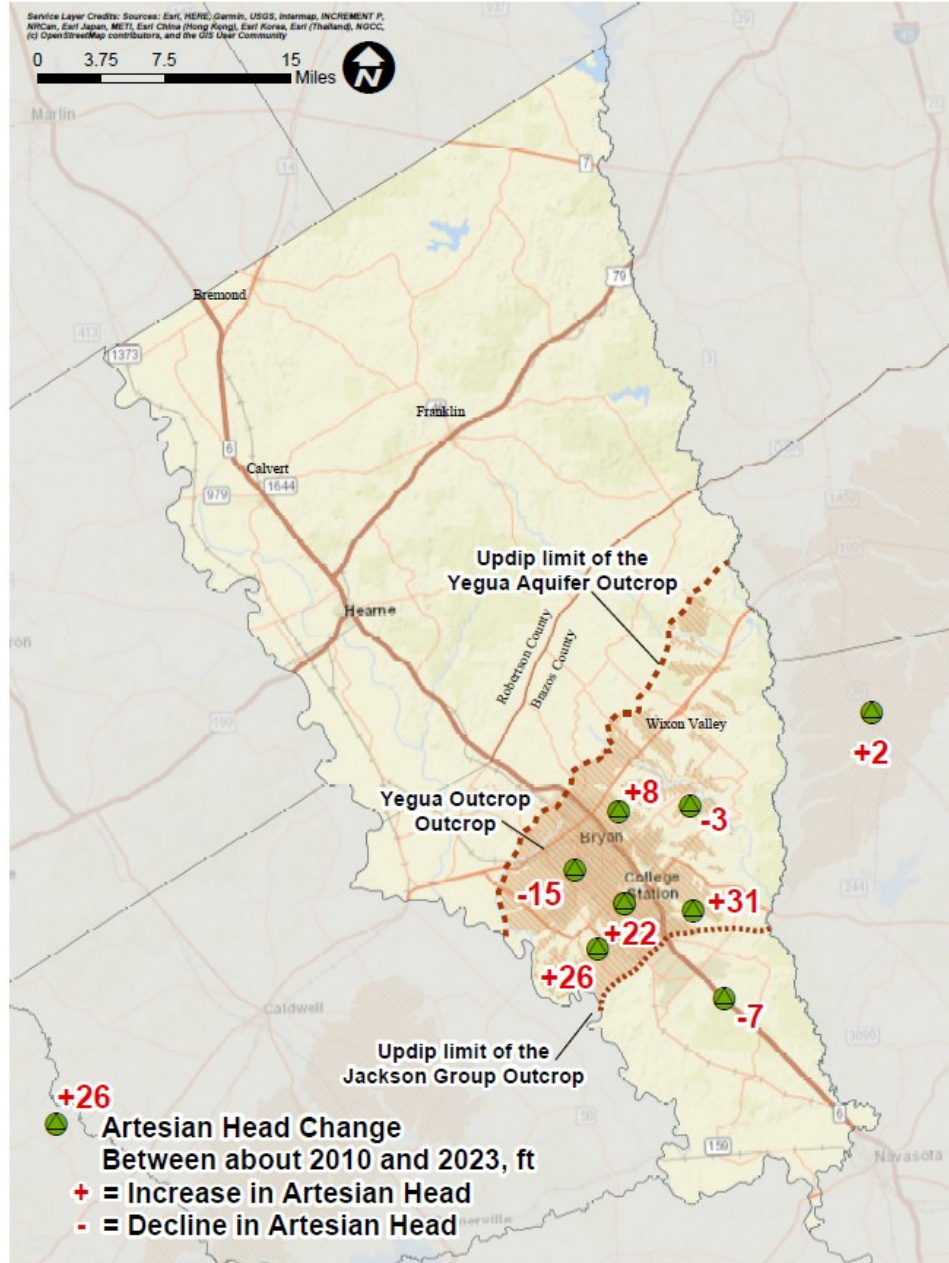
# Yegua-Jackson Aquifer DFC Wells

| State Well Number | Well Owner                  |
|-------------------|-----------------------------|
| 59-21-911         | Private                     |
| 59-22-511         | Private                     |
| 59-22-601         | Private                     |
| 59-30-207         | TAMU Golf Course            |
| 59-30-308         | Wellborn WSC Agnello Well 1 |
| 59-30-410         | TAMU Brayton Training Field |
| 59-31-703         | Private                     |

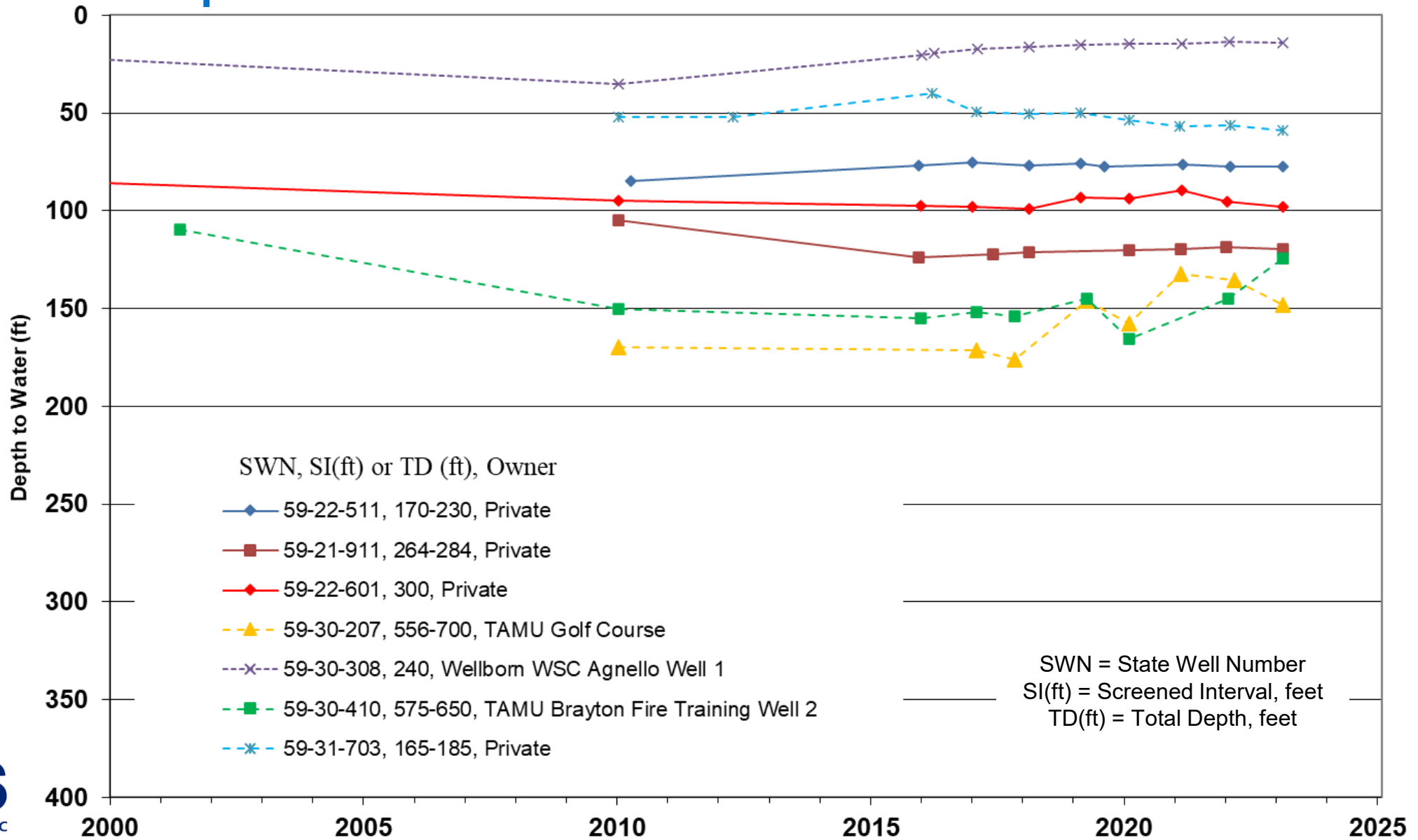
# Yegua-Jackson Aquifer

**Arithmetic Average  
Artesian Head Change  
2000-2023:  
9 feet increase**

**2070 DFC  
Average Artesian Head  
67 feet Decline**



# Yegua-Jackson Aquifer Observation Wells



## Comparison of DFCs Over Last Six Years, average feet of artesian head change

| Span of Years                       | Sparta     | Queen City | Carrizo    | Calvert Bluff | Simsboro    | Hooper      | Yegua-Jackson (2010) |
|-------------------------------------|------------|------------|------------|---------------|-------------|-------------|----------------------|
| 2000-2018                           | -7         | -          | -14        | -             | -31         | -6          | -6                   |
| 2000-2019                           | +1         | -          | -8         | -             | -32         | -1          | +6                   |
| 2000-2020                           | -7         | -          | -20        | -             | -33         | -8          | +6                   |
| 2000-2021                           | -9         | -          | -7         | -             | -34         | -14         | +11                  |
| 2000-2022                           | -12        | -          | -11        | -             | -43         | -6          | +8                   |
| 2000-2023                           | -16        | -          | -14        | -             | -58         | -5          | +9                   |
| DFC 2000-2070 (water level decline) | <b>-53</b> | <b>-44</b> | <b>-84</b> | <b>-111</b>   | <b>-262</b> | <b>-167</b> | <b>-67</b>           |

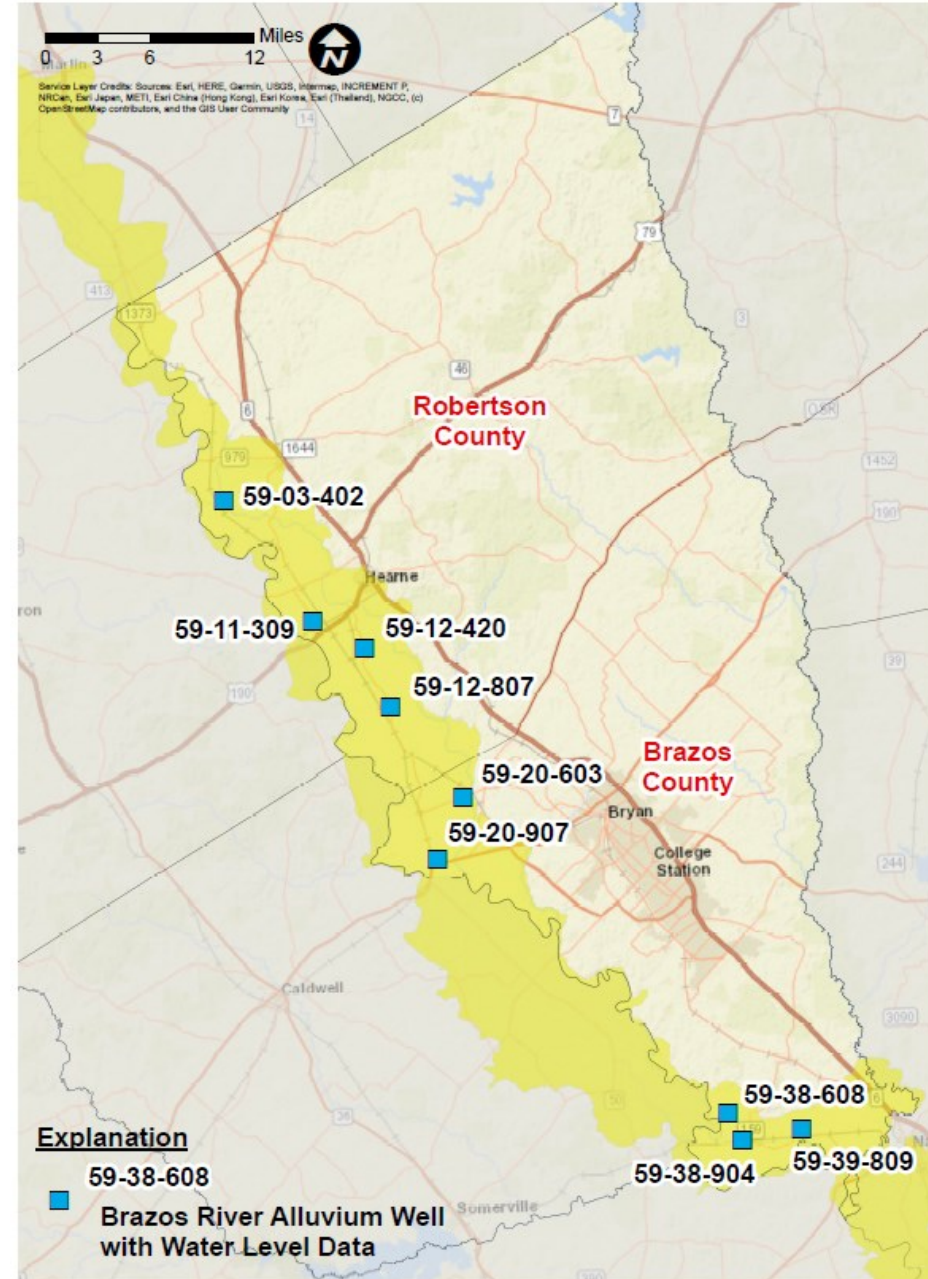
## Comparison of Simsboro DFCs and Rate of Decline Over Last Six Years

| Span of Years   | Simsboro Average Artesian Head Change, feet | Simsboro Rate of Decline, feet per year |
|-----------------|---|---|
| 2000-2018       | -31   | -                                       |
| 2000-2019       | -32   | 1                                       |
| 2000-2020       | -33   | 1                                       |
| 2000-2021       | -34   | 1                                       |
| 2000-2022       | -43   | 9                                       |
| 2000-2023       | -58   | 15                                      |
| DFC (2000-2070) | <b>-262</b>                                 |   |

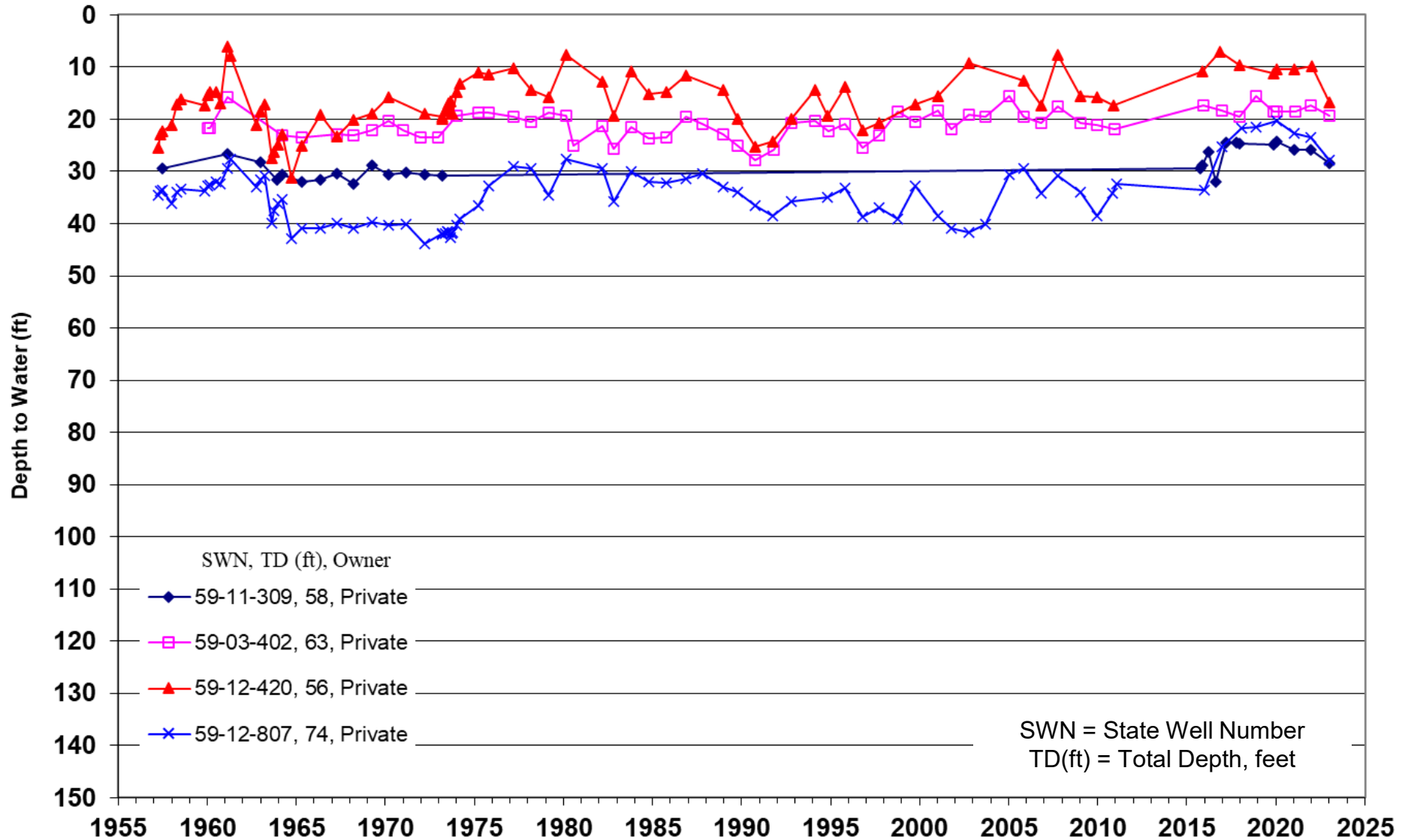
# Brazos River Alluvium Aquifer DFC Wells

| State Well Number | Well Owner |
|-------------------|------------|
| 59-03-402         | Private    |
| 59-11-309         | Private    |
| 59-12-420         | Private    |
| 59-12-807         | Private    |
| 59-20-603         | Private    |
| 59-20-907         | Private    |
| 59-38-608         | Private    |
| 59-38-904         | Private    |
| 59-39-809         | Private    |

# Location of Brazos River Alluvium Wells with Water Level Hydrographs

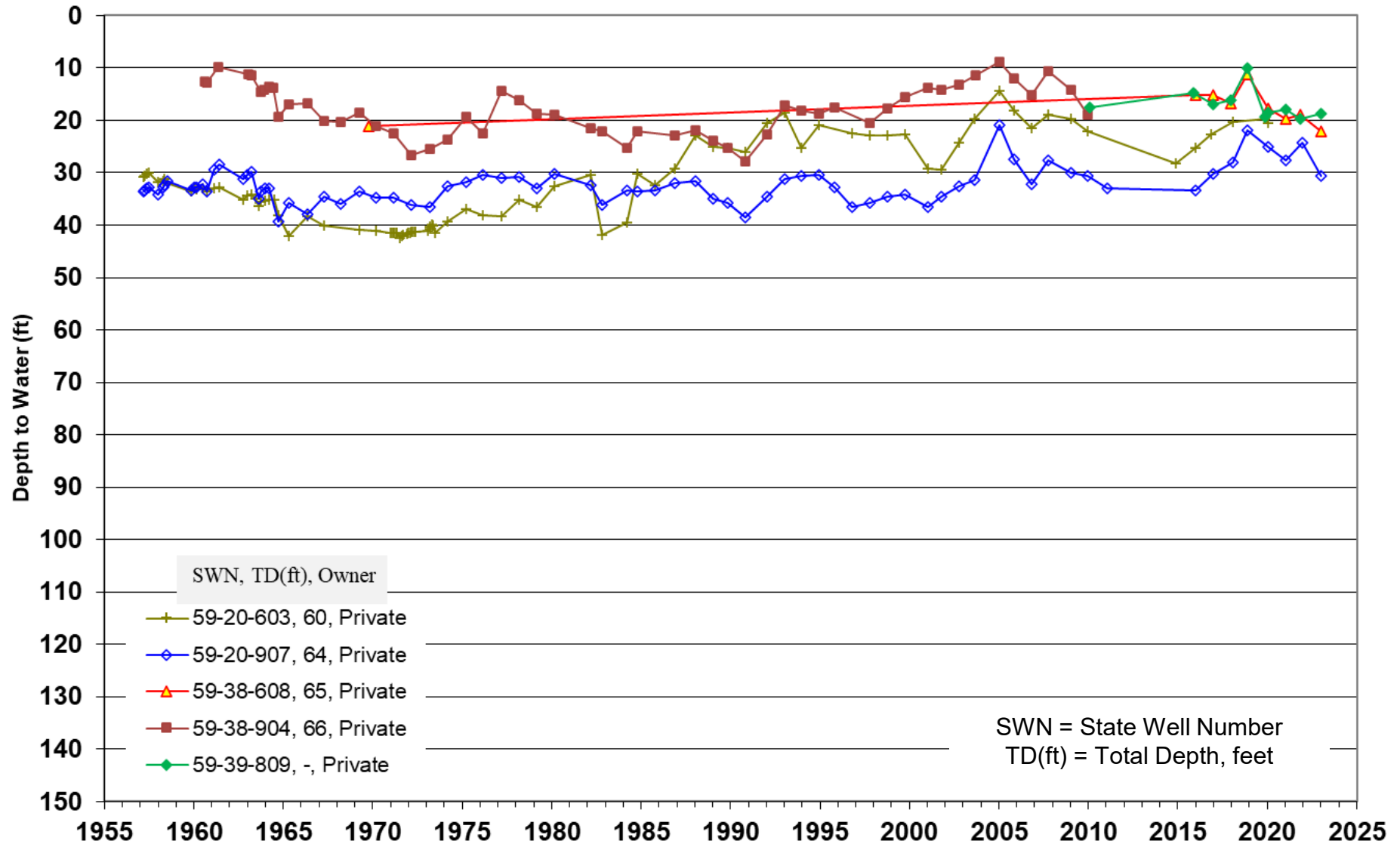


# Brazos River Alluvium Observation Wells (Robertson County)





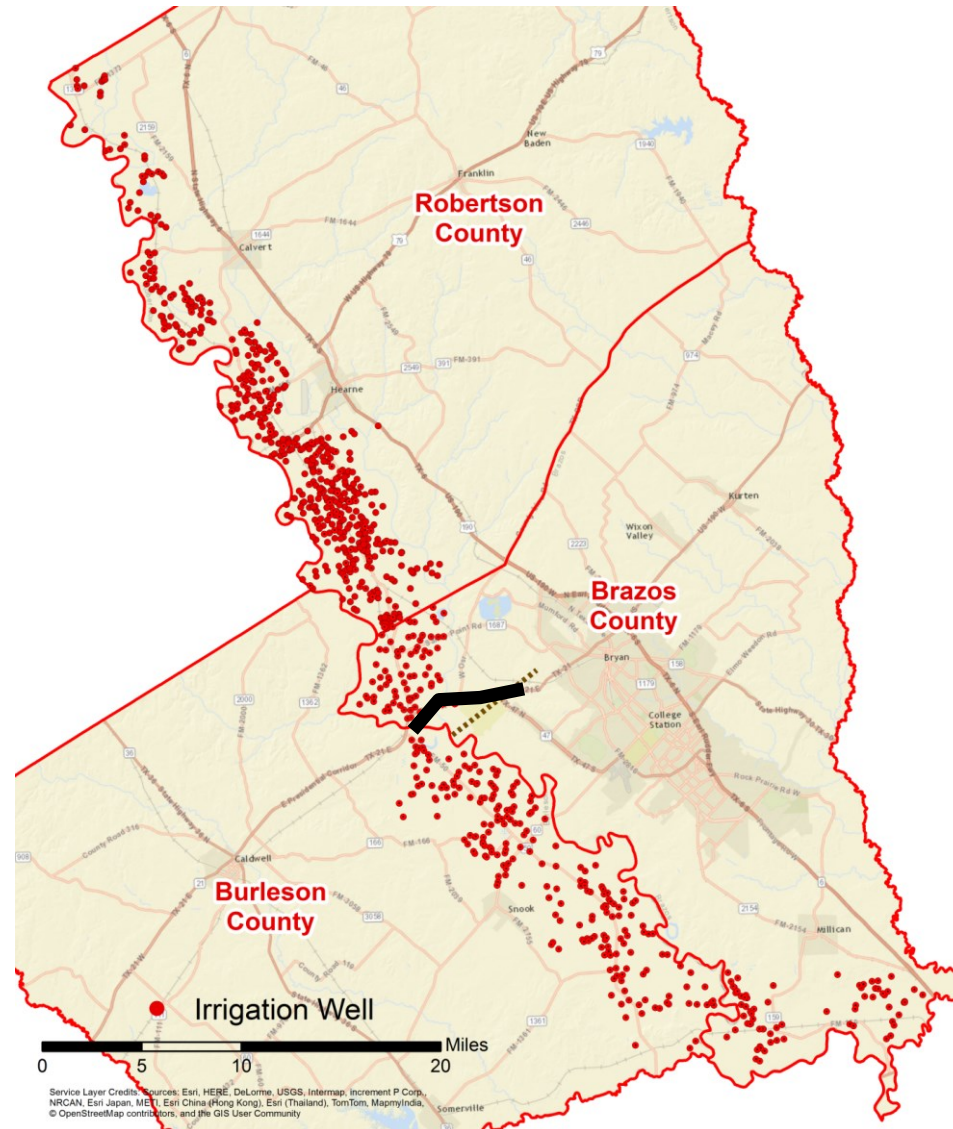
# Brazos River Alluvium Observation Wells (Brazos County)



# Brazos River Alluvium Well Data

Arithmetic Average Percent Saturation in 2023  
63%

2070 DFC  
Percent Saturation  
≥ 30% north of Hwy 21  
and  
≥ 40% South of Hwy 21



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## Summary

- At this time, there is no indication that the District cannot comply with the current DFCs
- The rate of average artesian head decline increased in the Simsboro in 2022 and 2023
- District staff continues to add wells to monitoring network

# Pumping estimates through 2022 (draft)

