

# North Texas GCD Vision Workshop

LBG-Guyton Associates  
November 10, 2015



# Session Outline

- Review Pumping: 2011 through June 2015
- State Water Plan Strategies for North Texas GCD
- Review Water Demands
- Water Level Changes and DFCs
- Assessment Of Available Drawdown In 2070 For Public Water Supply Wells



# Pumping by County Graphs

- Total Metered Pumping Compared to Total MAGs
- Total Metered plus Exempt Pumping Compared to MAGs
- Total Metered Pumping by Aquifer Compared to MAG
- Total Metered plus Exempt Pumping by Aquifer



# Notes on Pumping Estimates

- TWDB Historical Groundwater Pumping Estimates Used for Years 2011 and 2012
- Exempt Pumping Volumes from North Trinity GAM Tables
- Meter Data Used for Years 2012, 2013, 2014, and January through June of 2015
- For Year 2015, MAG and Exempt Pumping Volumes were divided by 2



# Unassigned Pumping

- For some of the meter data, no screen information was available, so pumping volumes were unassigned.
- These volumes are not included in any of the county graphs.

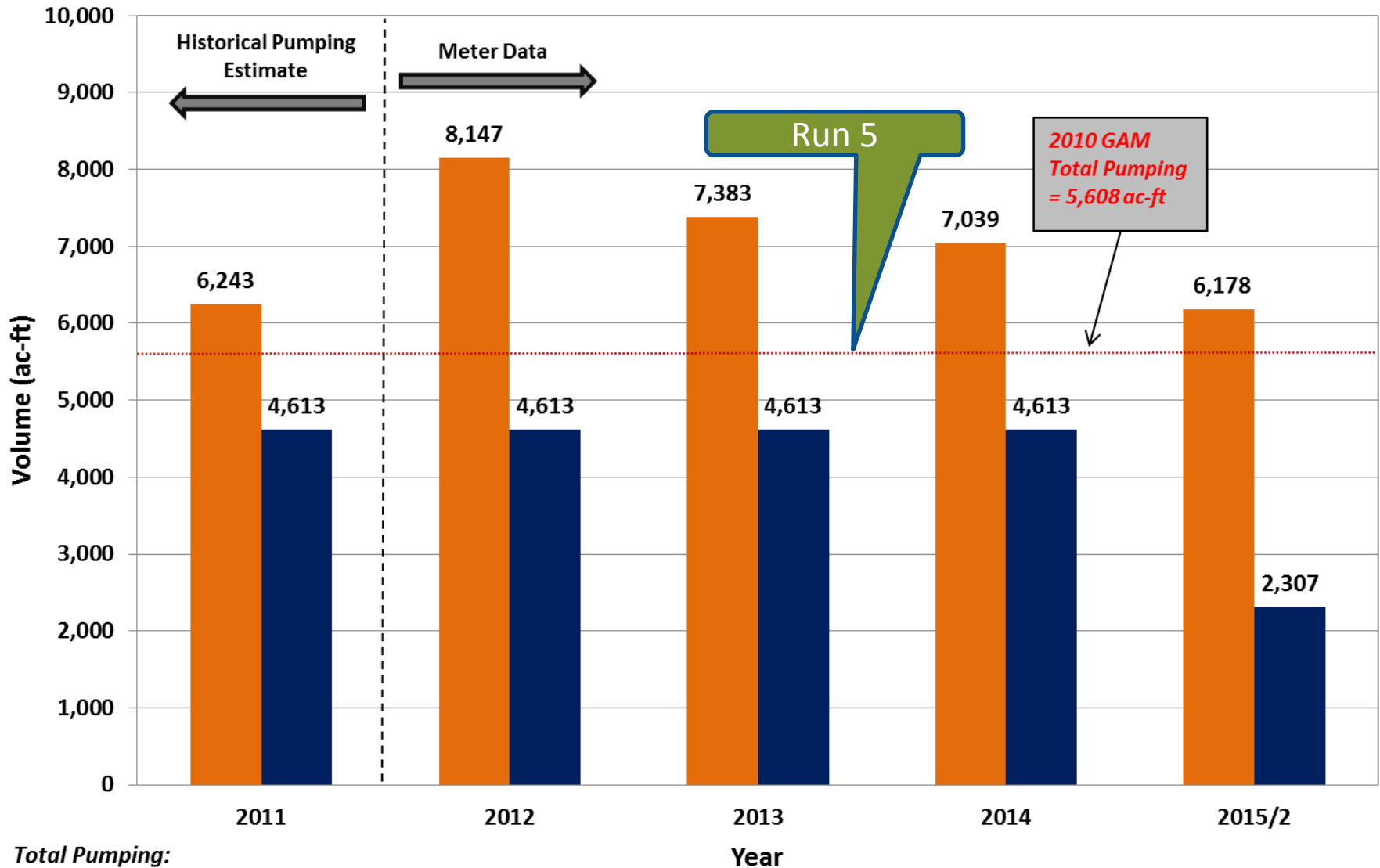
Unassigned Pumping (acre-feet)				
County	2012	2013	2014	2015 (1/2)
<b>Collin</b>	251	224	213	981
<b>Cooke</b>	92	74	93	48
<b>Denton</b>	372	553	573	139
Total Unassigned	715	851	879	1,168
% of Total Meters	2.01	2.26	2.25	4.44



# Collin County



# Collin County Total Metered Pumping



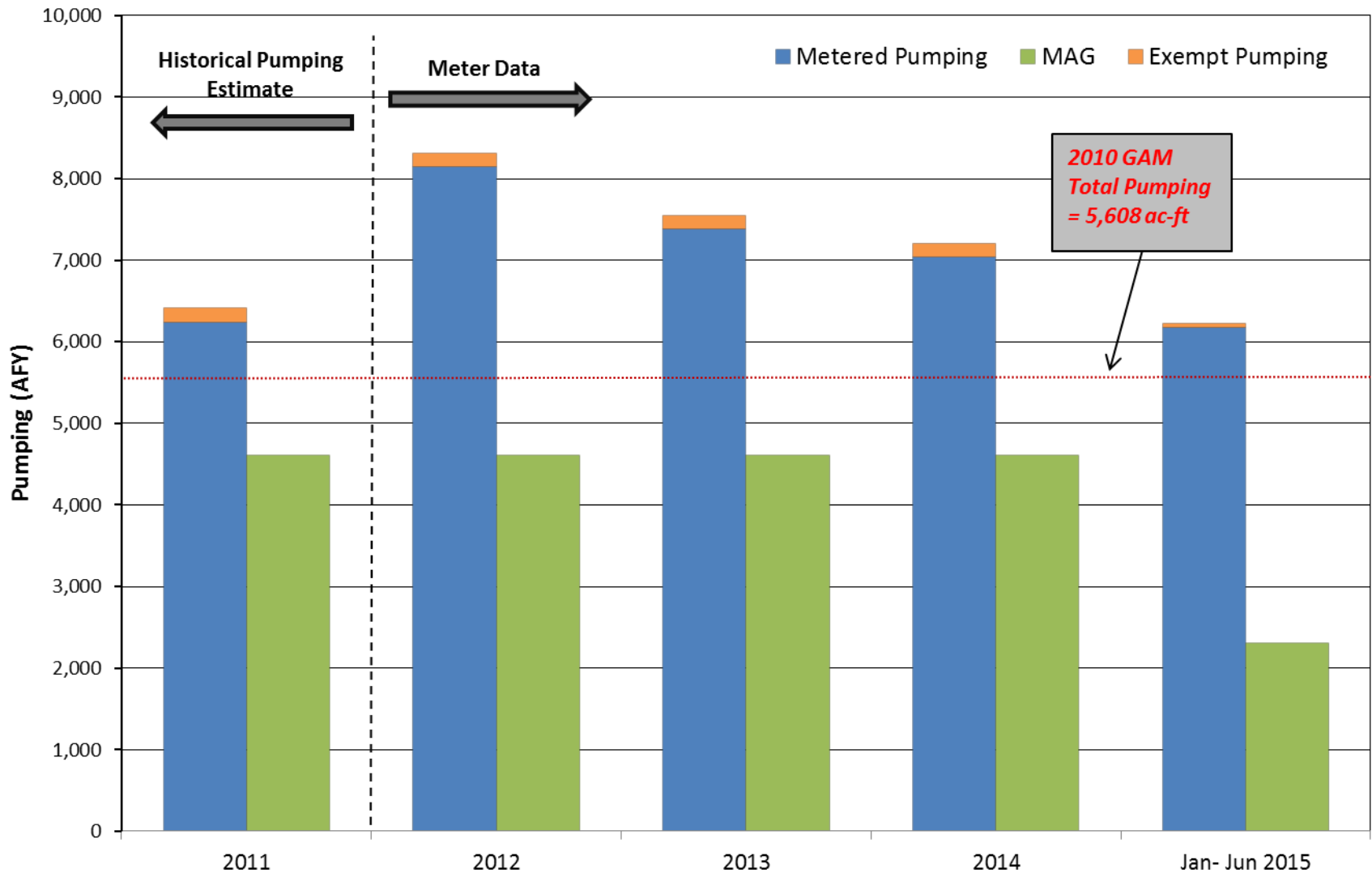
**Total Pumping:**

2011 source: TWDB historical pumping estimates.

2012, 2013, 2014 and first half of 2015: NTGCD meter data.

■ Total Pumping ■ MAGs

## Collin County Total Pumping Comparisons



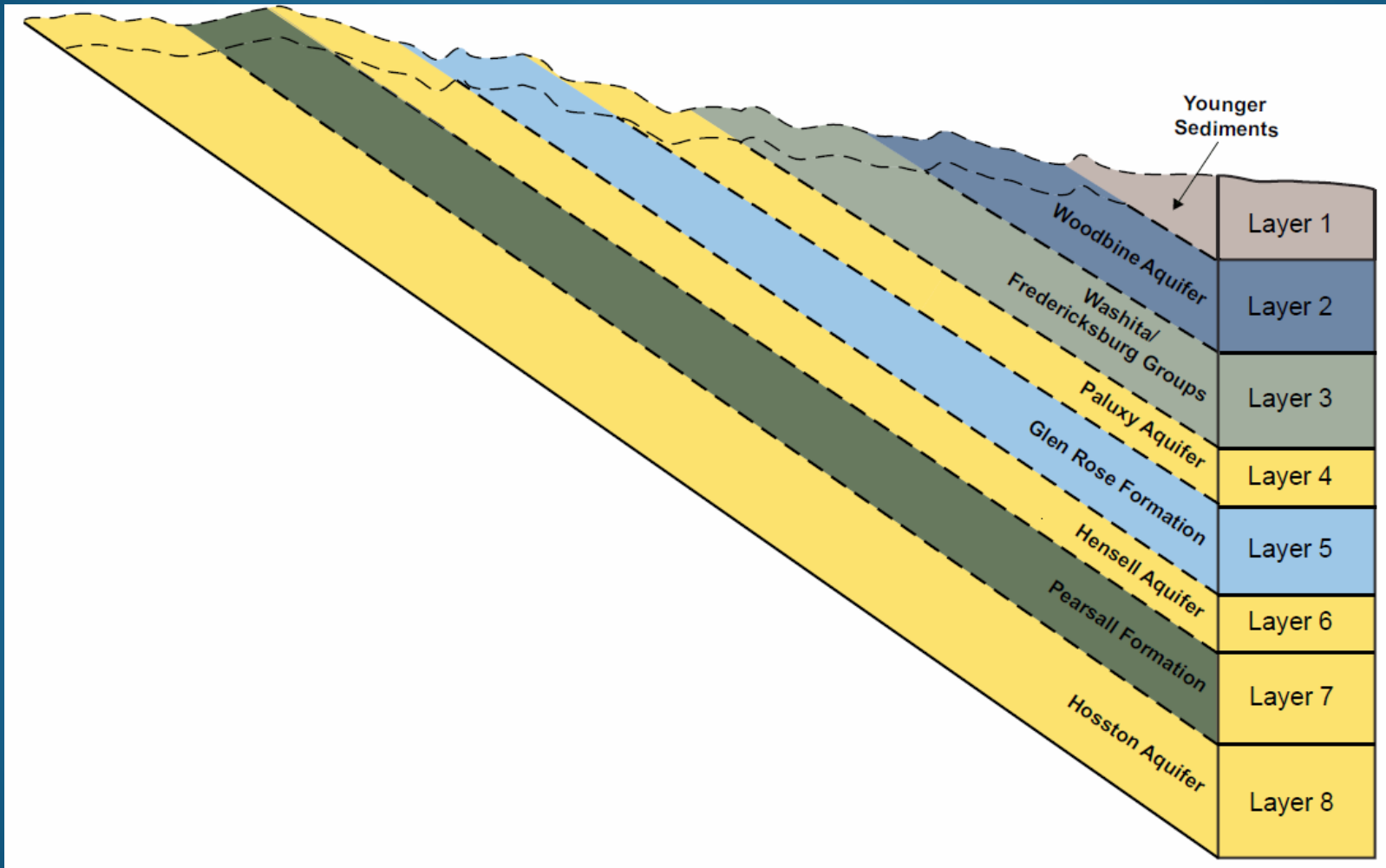
*TWDB Historical estimates used for Year 2011 pumping.*

*Exempt Pumping Estimates from North Trinity GAM (year 2010) were used for all years.*

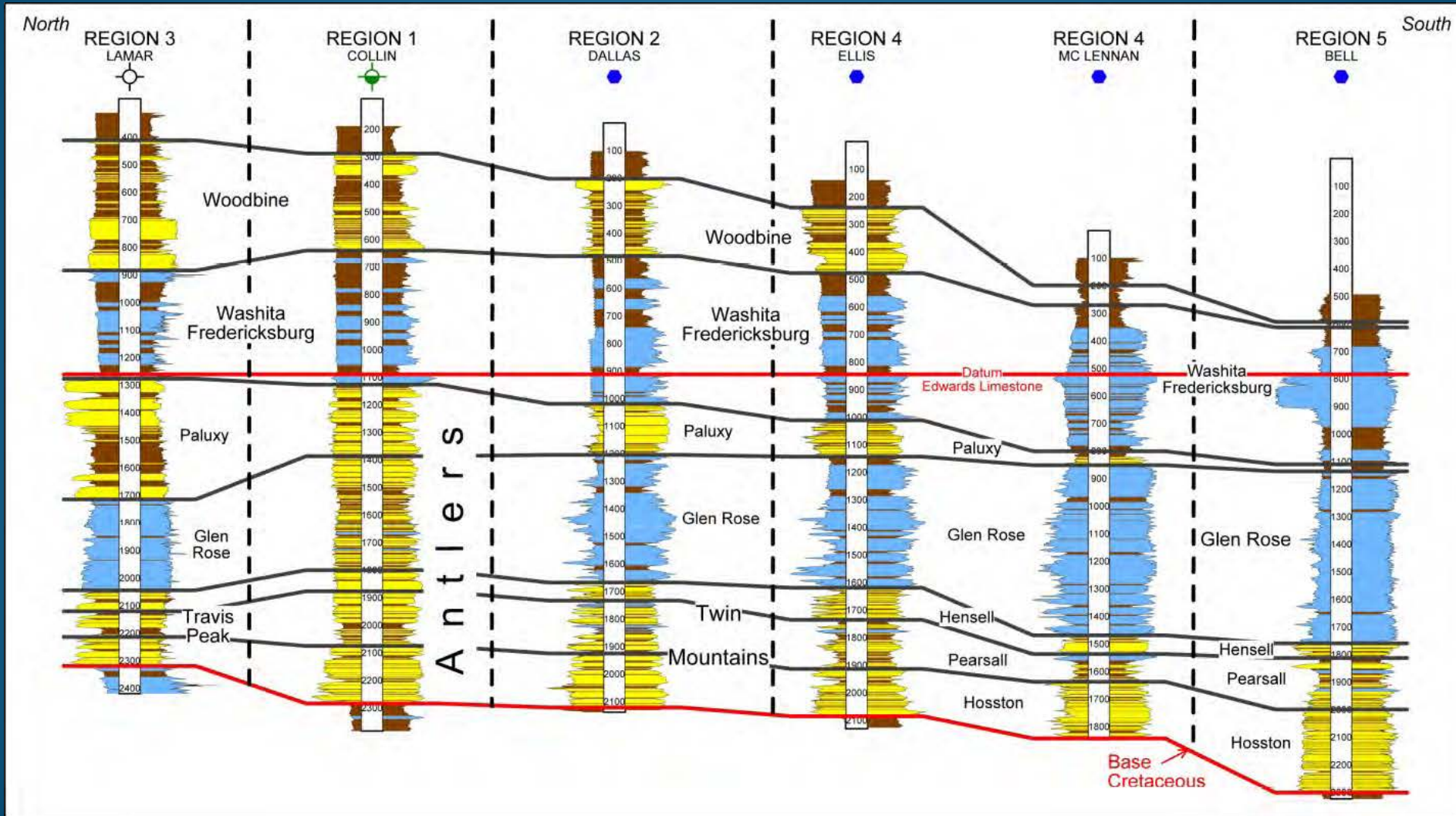
*MAG and exempt pumping for Year 2015 divided by 2 for comparison to 6 months of meter data.*



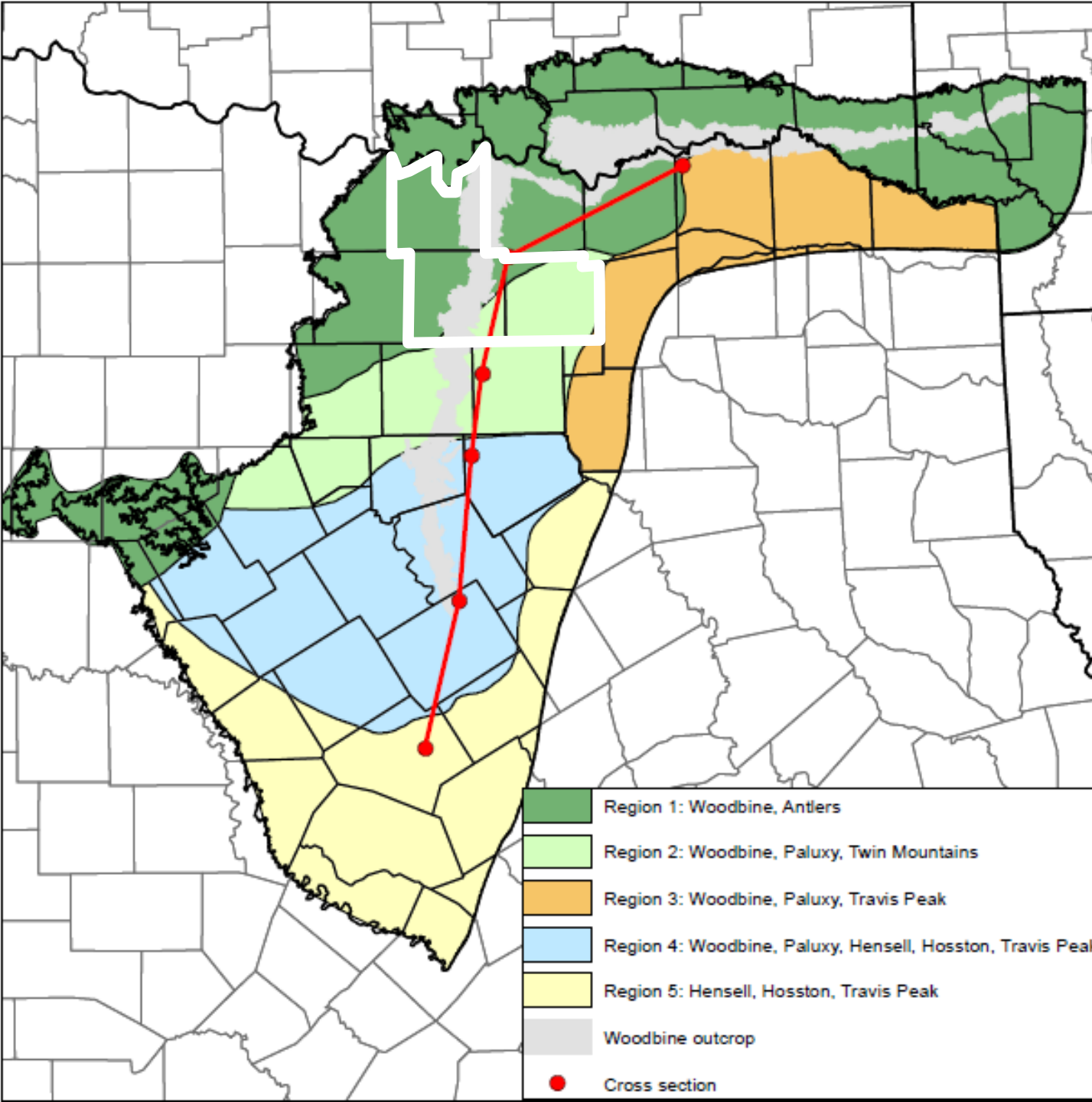
# NTWGAM Layers



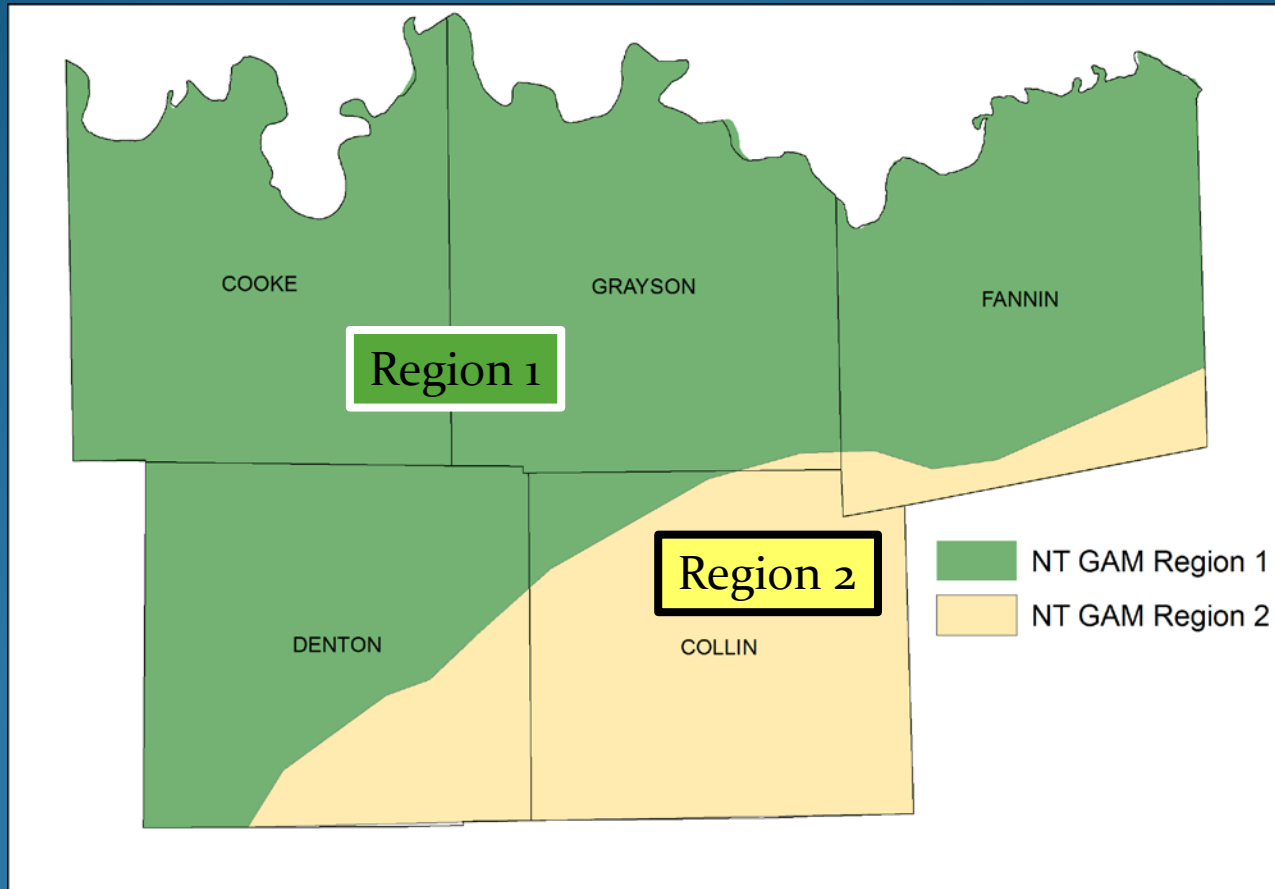
# Northern Trinity Aquifer



# Northern Trinity and Woodbine Aquifers



# North Trinity GAM Stratigraphic Regions



Region 1: Woodbine, Antlers

Region 2: Woodbine, Paluxy, Twin Mountains



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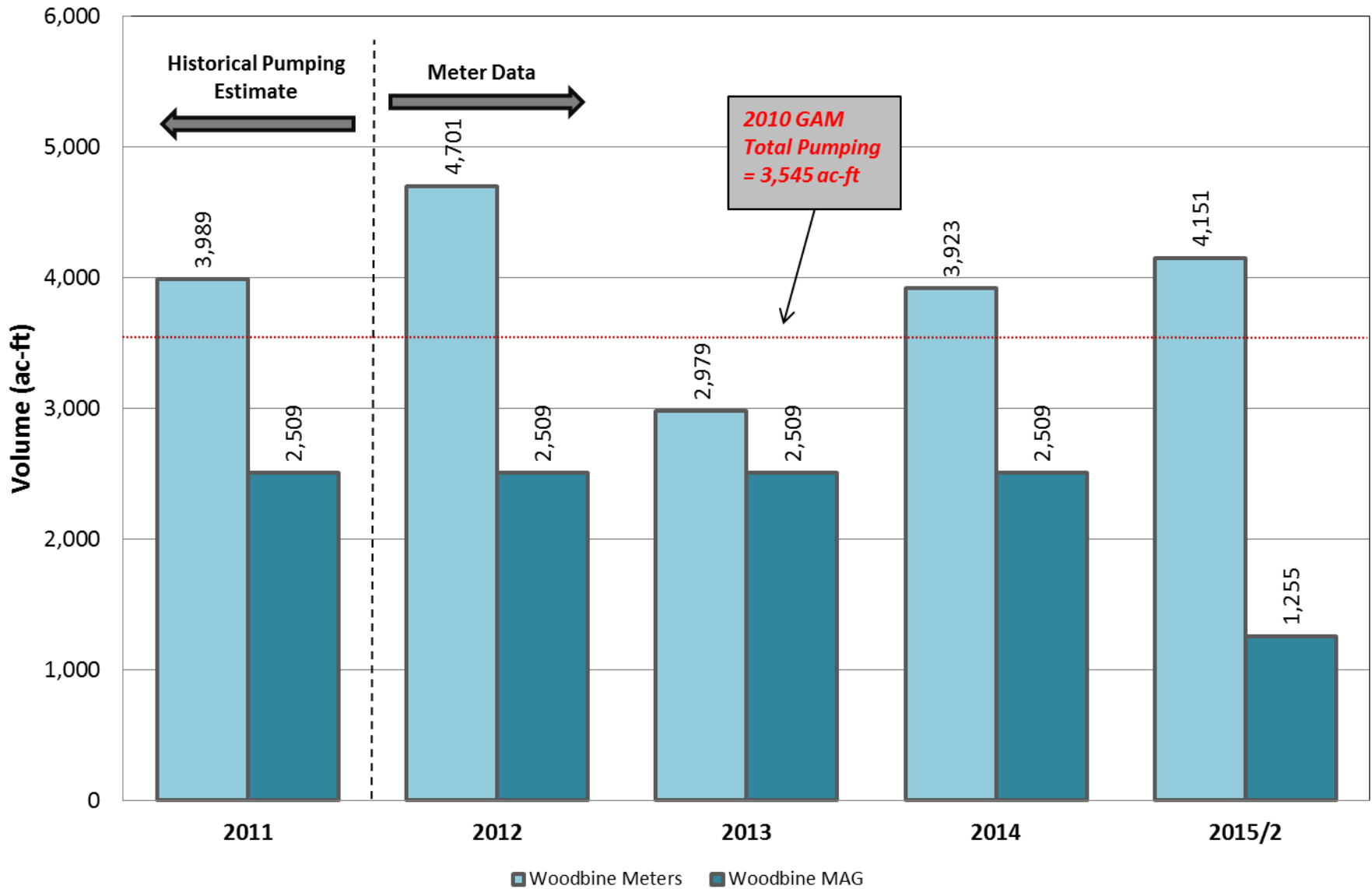
8

Model Terminology	Region 1	Region 2	Region 3	Region 4	Region 5
Woodbine Aquifer	Woodbine	Woodbine	Woodbine	Woodbine	Woodbine (no sand)
Washita/ Fredericksburg Groups	Washita/ Fredericksburg	Washita/ Fredericksburg	Washita/ Fredericksburg	Washita/ Fredericksburg	Washita/ Fredericksburg
Paluxy Aquifer	Antlers	Paluxy	Paluxy	Paluxy	Paluxy (no sand)
Glen Rose Formation	Antlers	Glen Rose	Glen Rose	Glen Rose	Glen Rose
Hensell Aquifer	Antlers	Twin Mountains	Travis Peak	Hensell/ Travis Peak	Hensell/ Travis Peak
Pearsall Formation	Antlers	Twin Mountains	Travis Peak	Pearsall/ Sligo	Pearsall/ Sligo
Hosston Aquifer	Antlers	Twin Mountains	Travis Peak	Hosston/ Travis Peak	Hosston/ Travis Peak

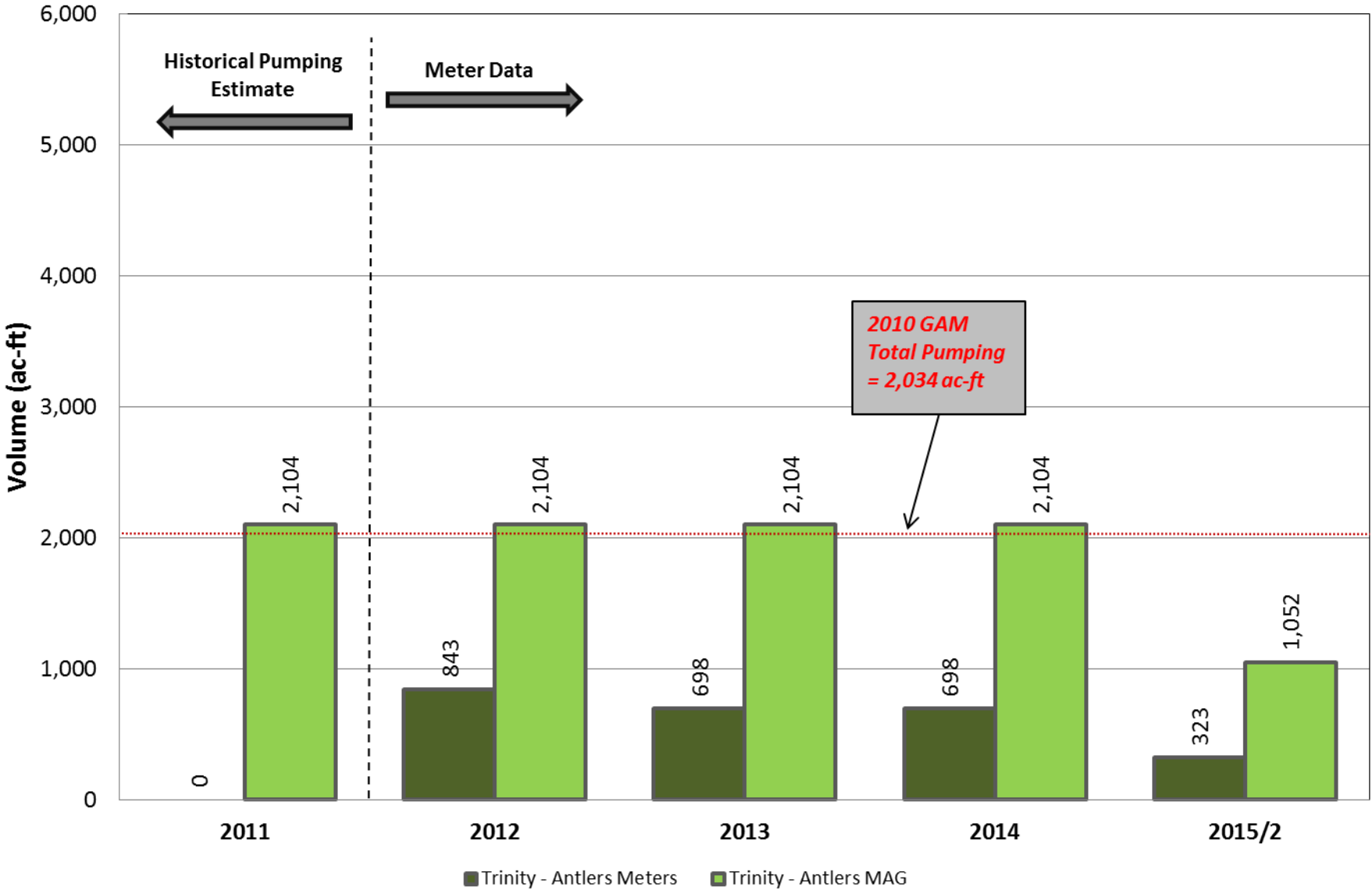
yellow = sandstone aquifers

**Figure 4.1.6** Chart showing model terminology and corresponding formation names and aquifer names common to each region.

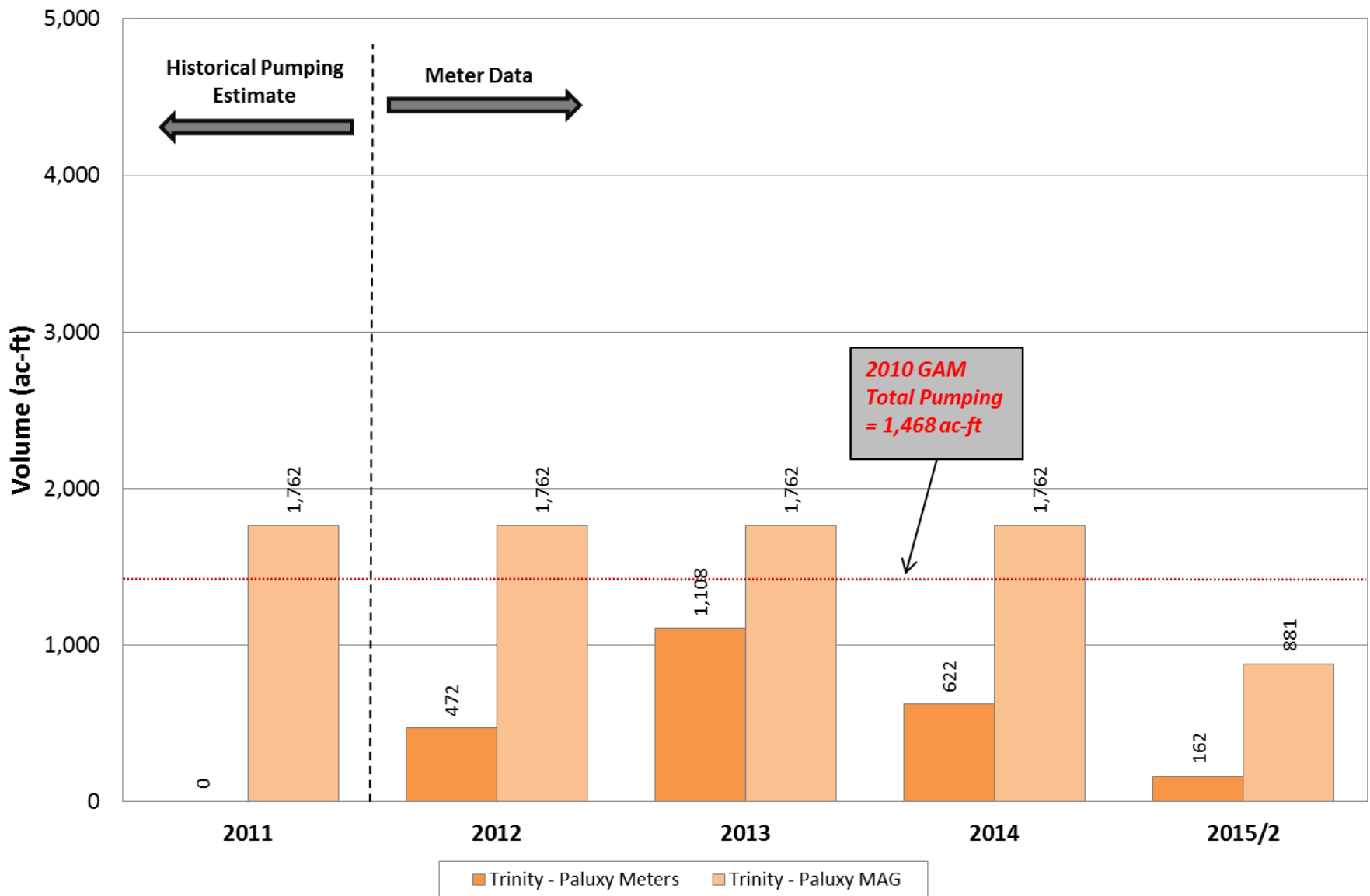
## Collin County Region 1 (Woodbine) Metered Pumping and MAG



# Collin County Region 1 (Antlers) Metered Pumping and MAG

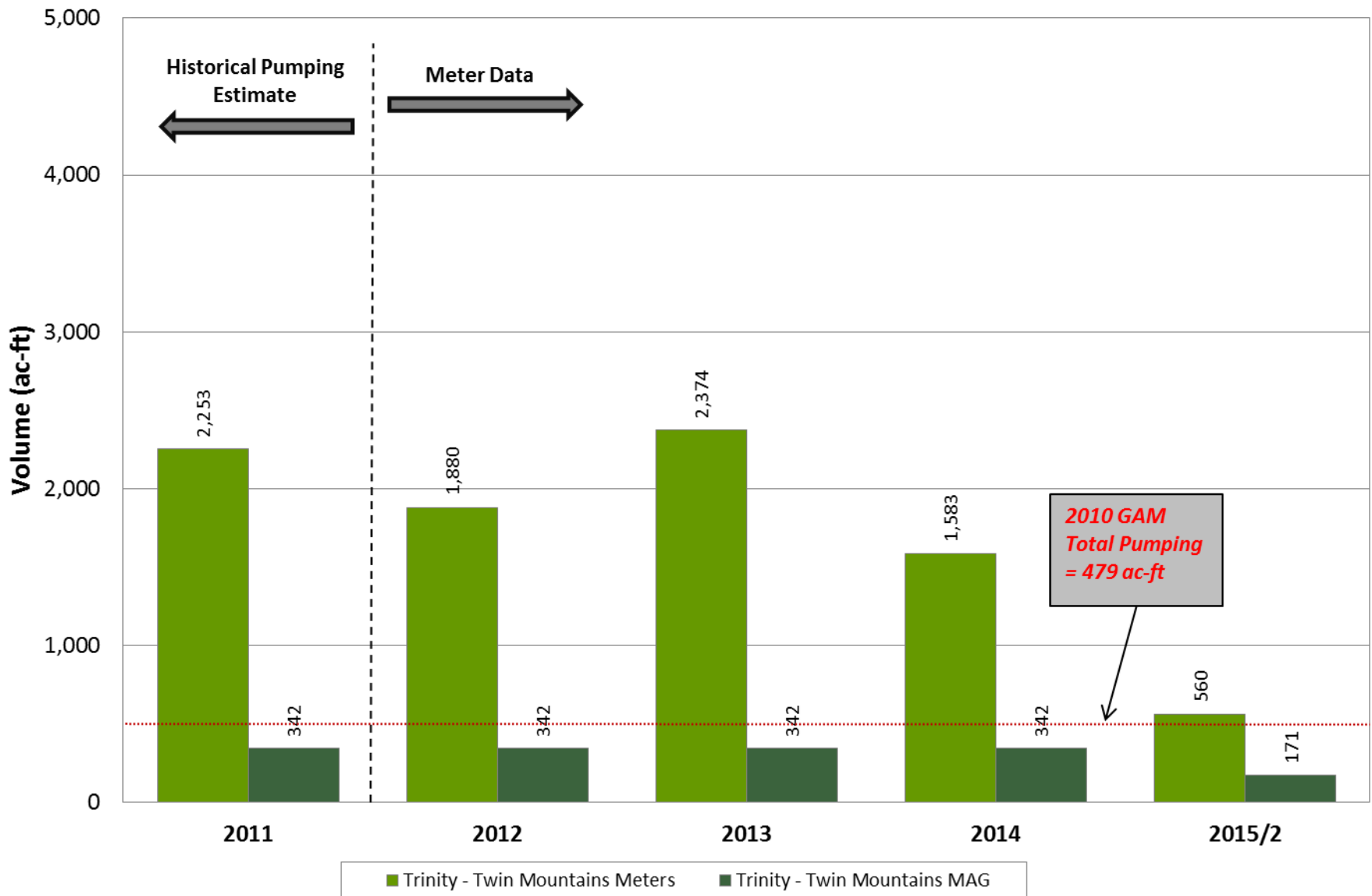


## Collin County Region 2 (Paluxy) Metered Pumping and MAG





## Collin County Region 2 (Twin Mountains) Metered Pumping and MAG



# Big Picture Comparison Collin County

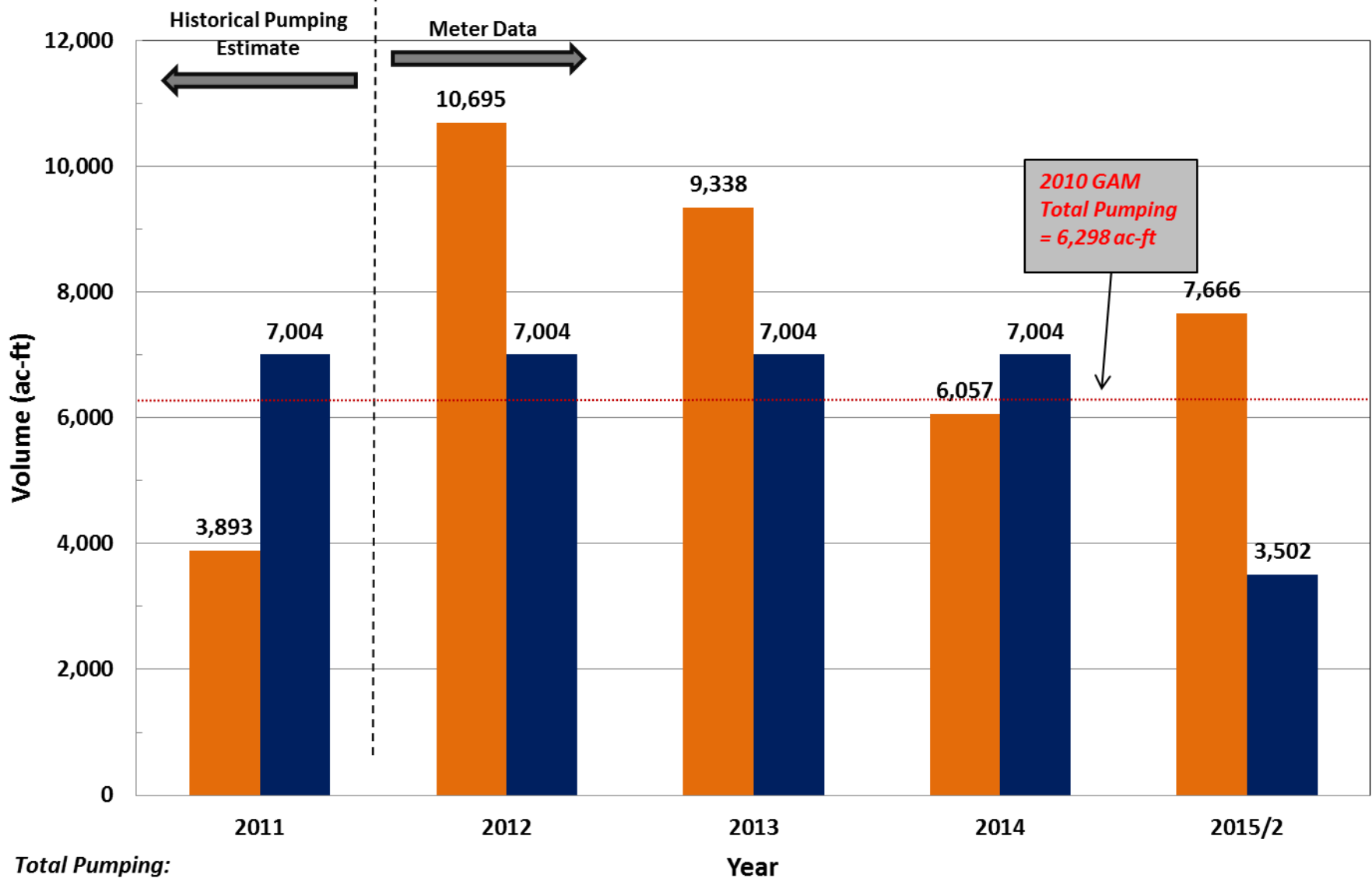
- Recent Woodbine pumping exceeds annual MAG
- Trinity - Twin Mountains pumping exceeds MAG in 2012 and 2013 (Region 2)
- Trinity – Antlers (Region 1) and Trinity – Paluxy (Region 2) pumping consistently less than MAG volumes



# Cooke County



# Cooke County Total Metered Pumping



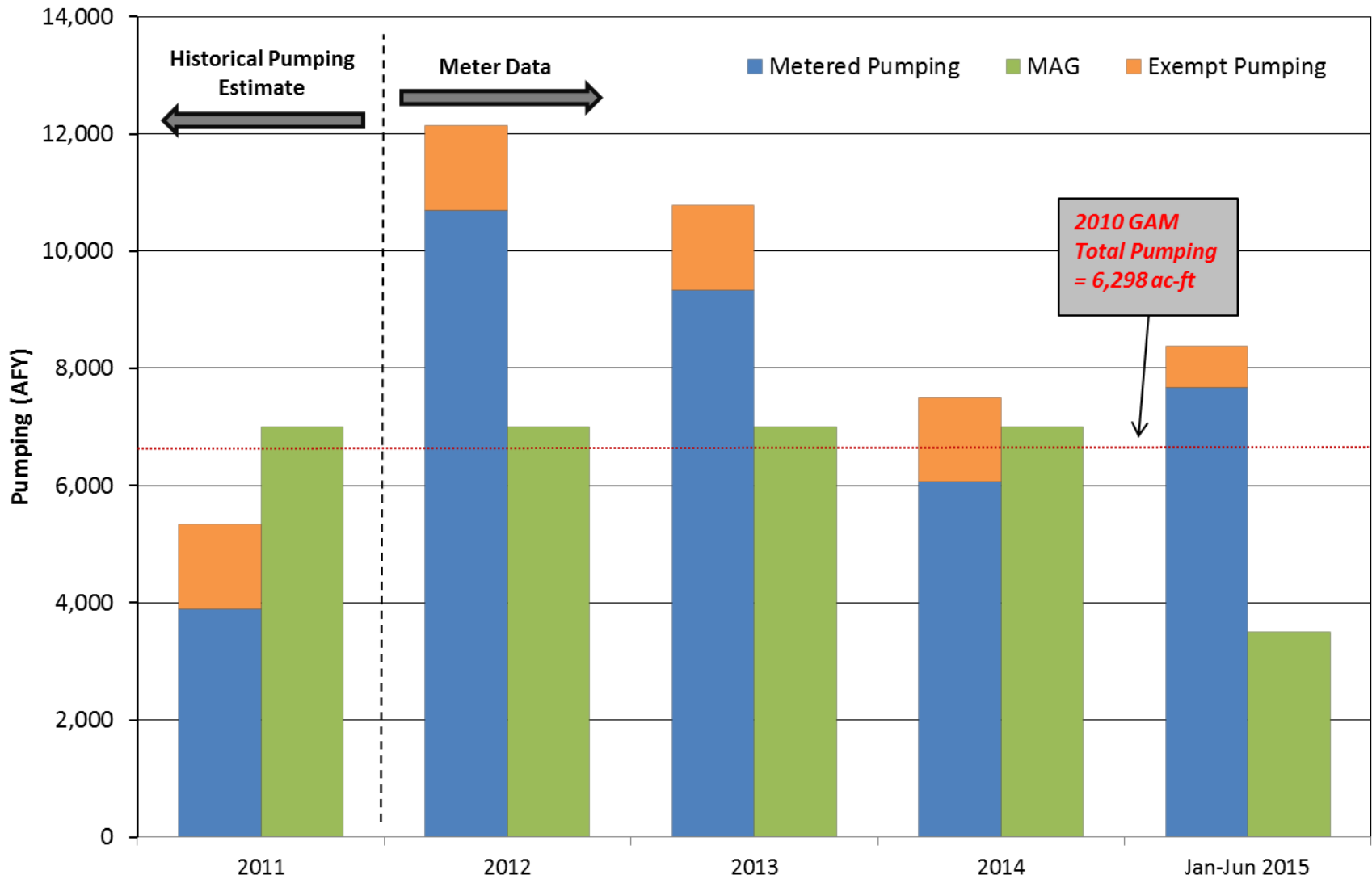
**Total Pumping:**

2011 source: TWDB historical pumping estimates.

2012, 2013, 2014 and first half of 2015: NTGCD meter data.

■ Total Pumping ■ MAGs

## Cooke County Total Pumping Comparisons

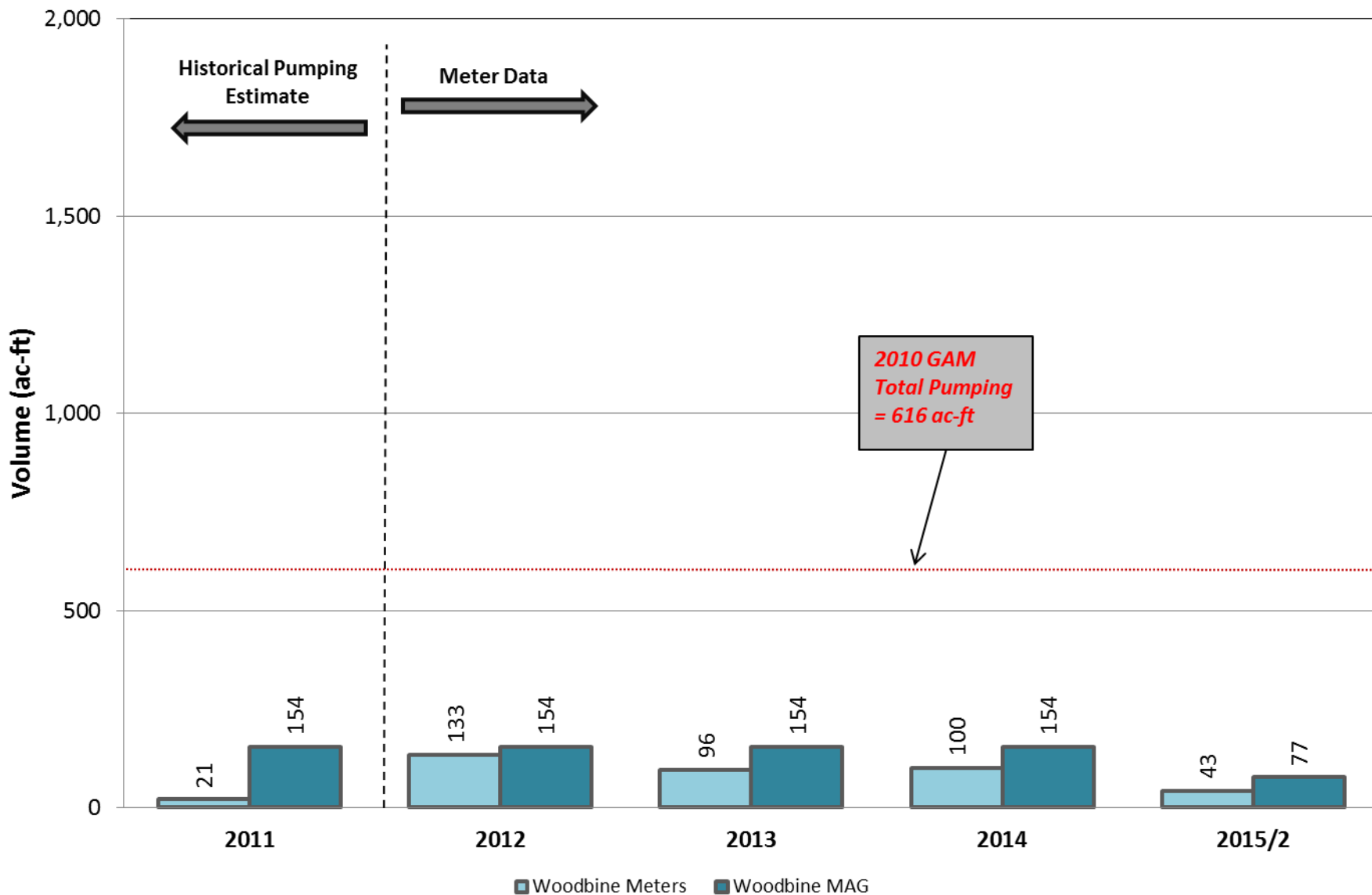


*TWDB Historical estimates used for Year 2011 pumping.*

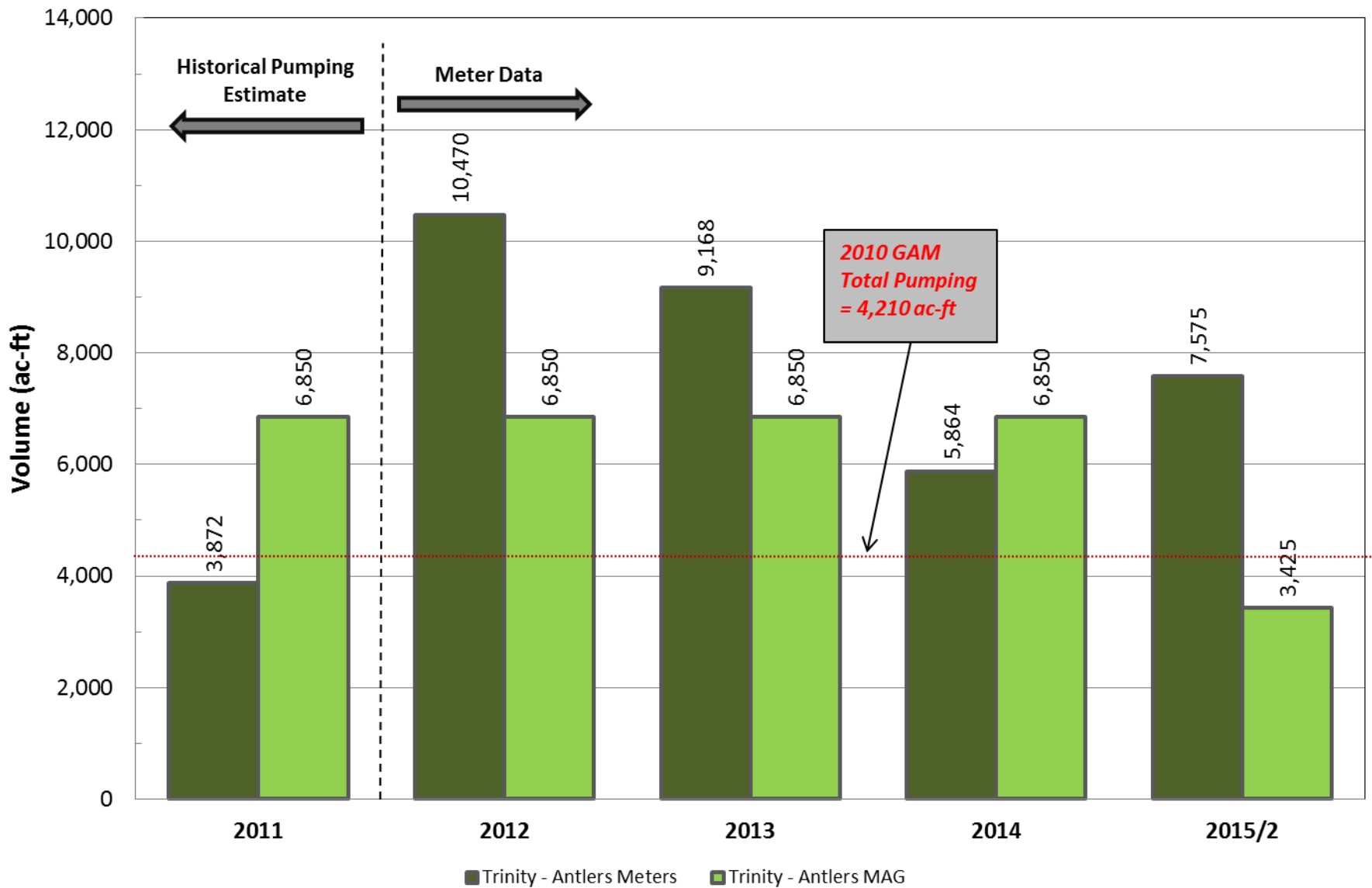
*Exempt Pumping Estimates from North Trinity GAM (year 2010) were used for all years.*

*MAG and exempt pumping for Year 2015 divided by 2 for comparison to 6 months of meter data.*

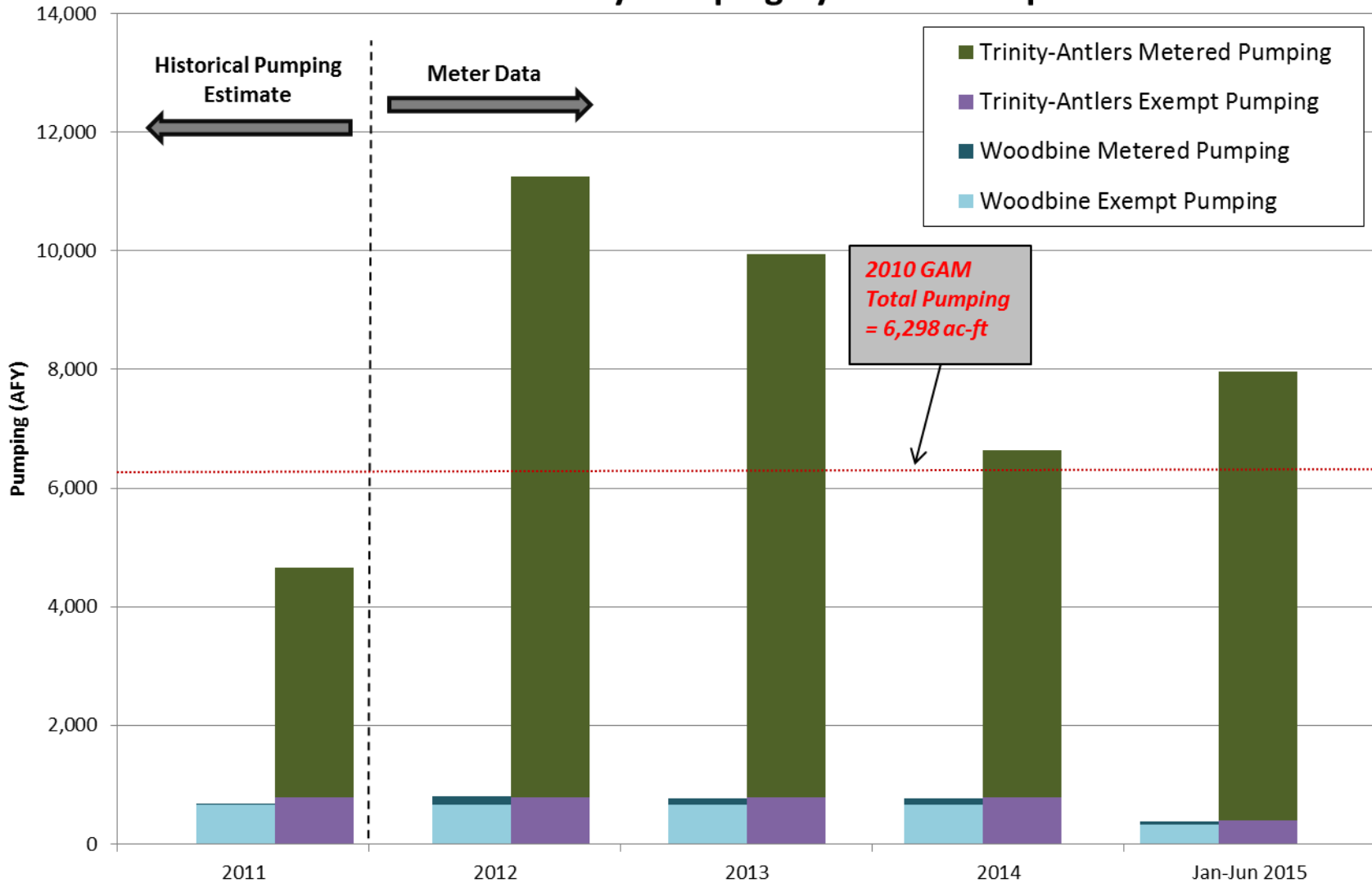
## Cooke County Region 1 (Woodbine) Metered Pumping and MAG



## Cooke County Region 1 (Antlers) Metered Pumping and MAG



## Cooke County Pumping by Year and Aquifer



*TWDB Historical estimates used for Year 2011 pumping.*

*Exempt Pumping Estimates from North Trinity GAM (year 2010) were used for all years.*

*MAG and exempt pumping for Year 2015 divided by 2 for comparison to 6 months of meter data.*



# Big Picture Comparison Cooke County

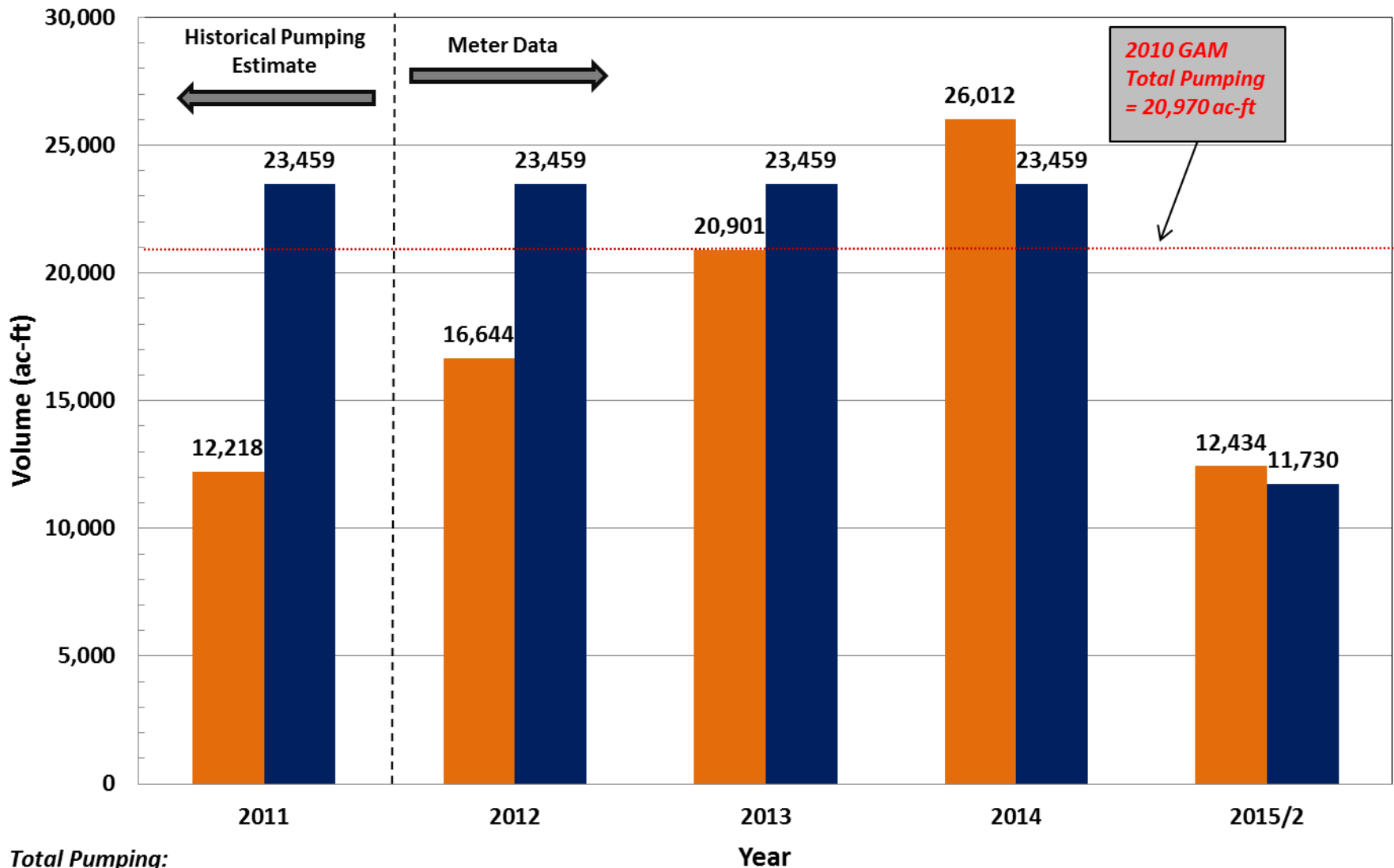
- Trinity – Antlers pumping significantly exceeds MAG in 2012 and 2013 and first half of 2015
- Recent Woodbine pumping less than MAG volumes



# Denton County



# Denton County Total Metered Pumping



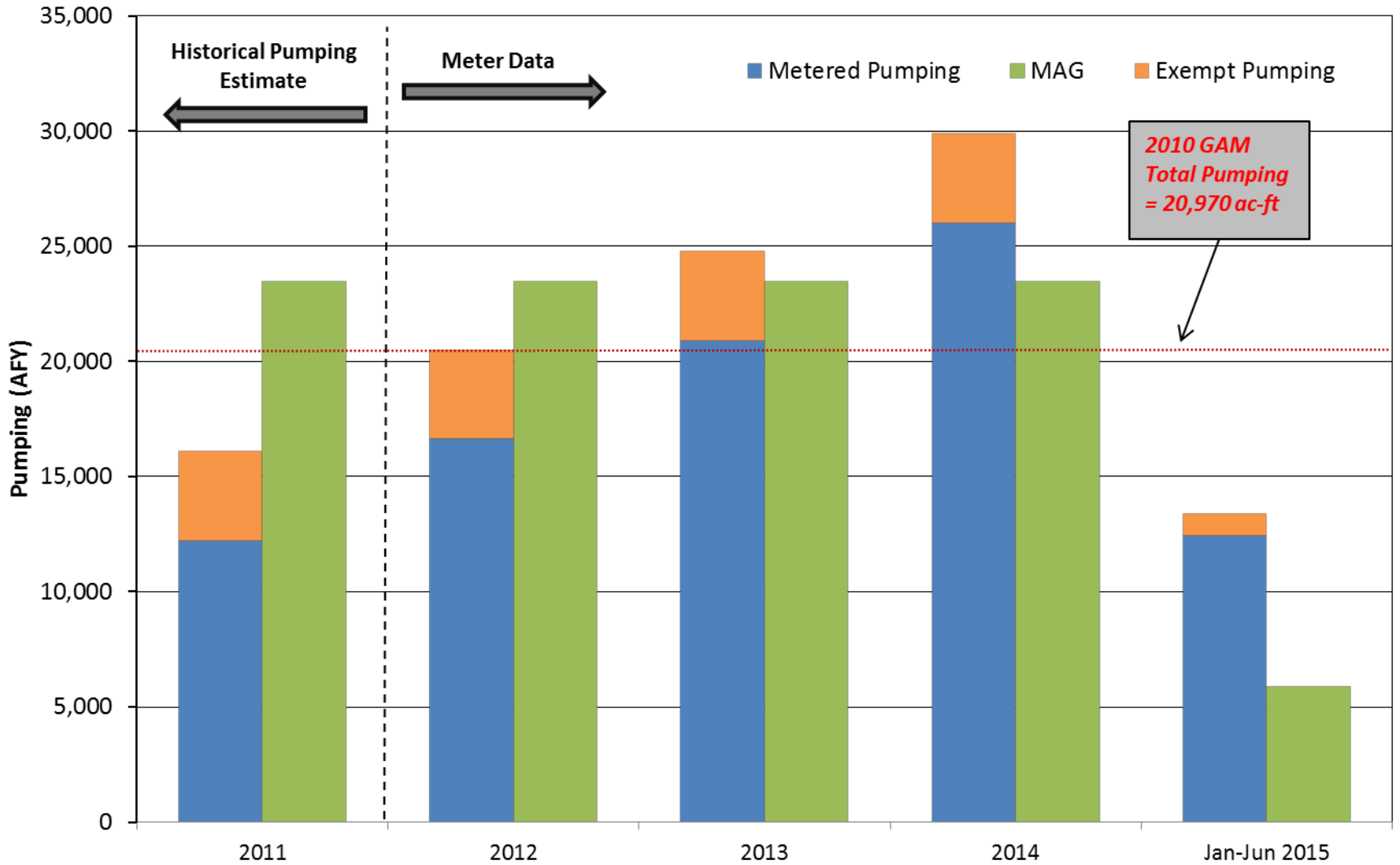
**Total Pumping:**

2011 source: TWDB historical pumping estimates.

2012, 2013, 2014 and first half of 2015: NTGCD meter data.

■ Total Pumping ■ MAGs

## Denton County Total Pumping Comparisons

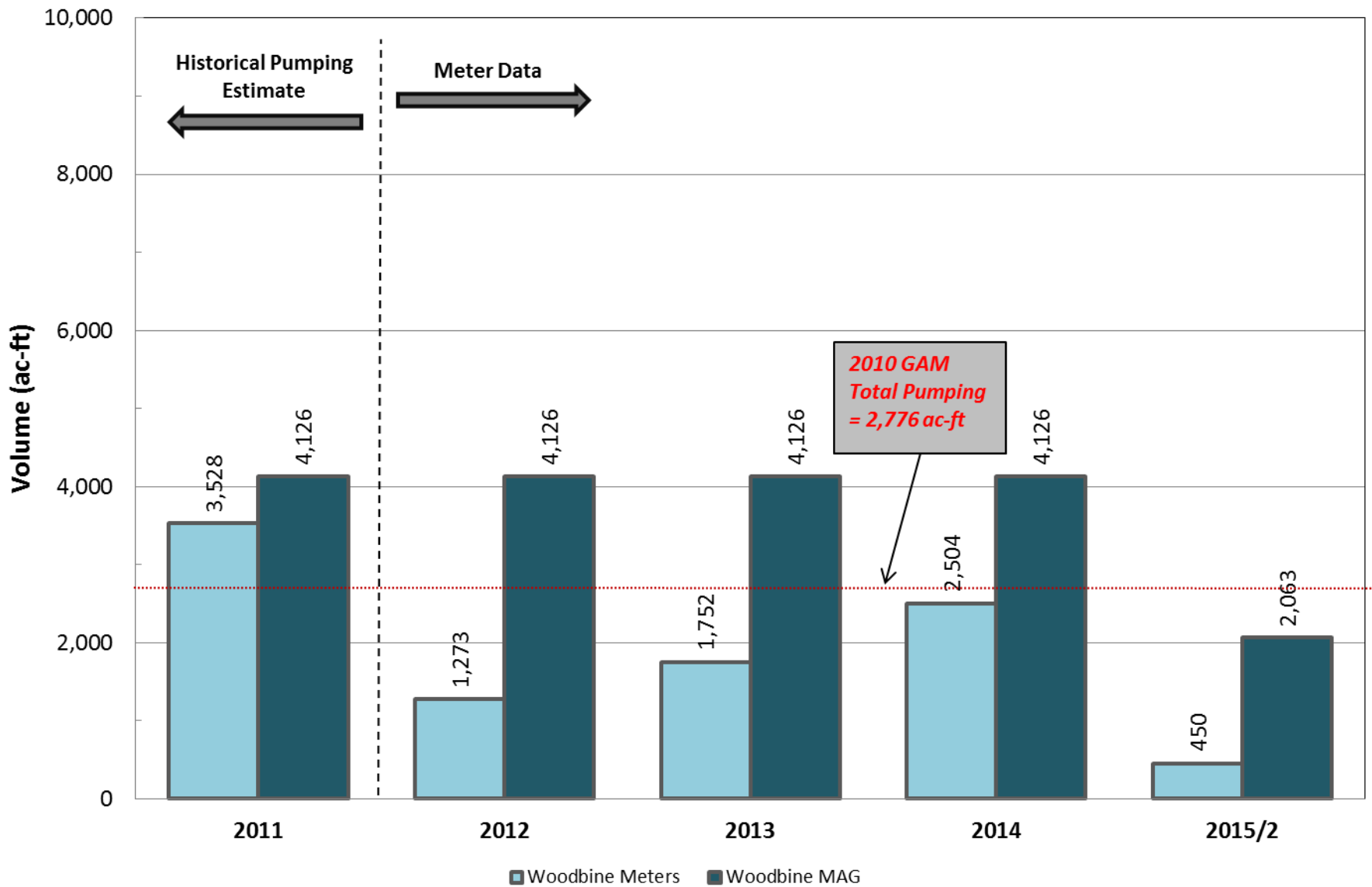


*TWDB Historical estimates used for Year 2011 pumping.*

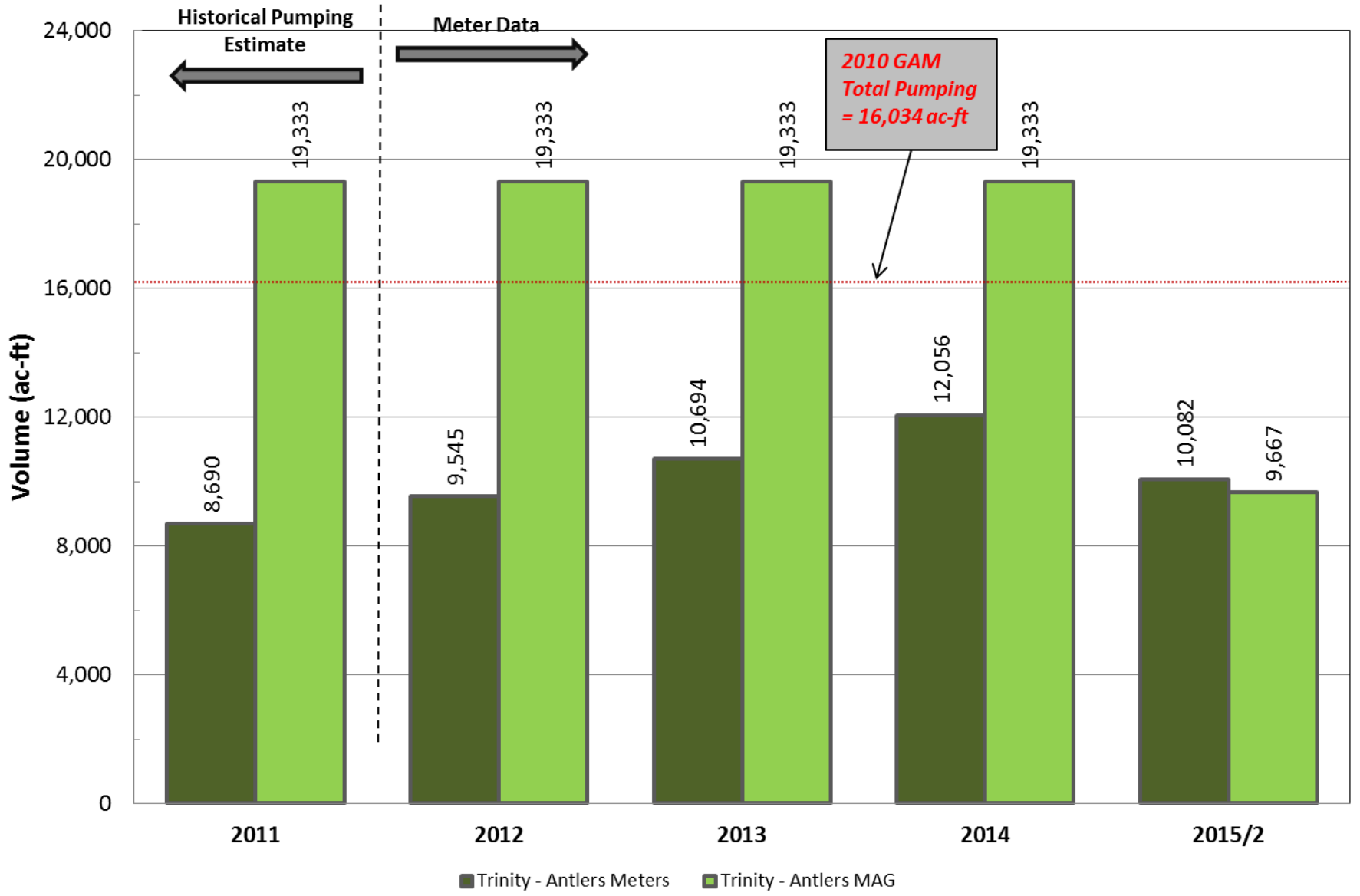
*Exempt Pumping Estimates from North Trinity GAM (year 2010) were used for all years.*

*MAG and exempt pumping for Year 2015 divided by 2 for comparison to 6 months of meter data.*

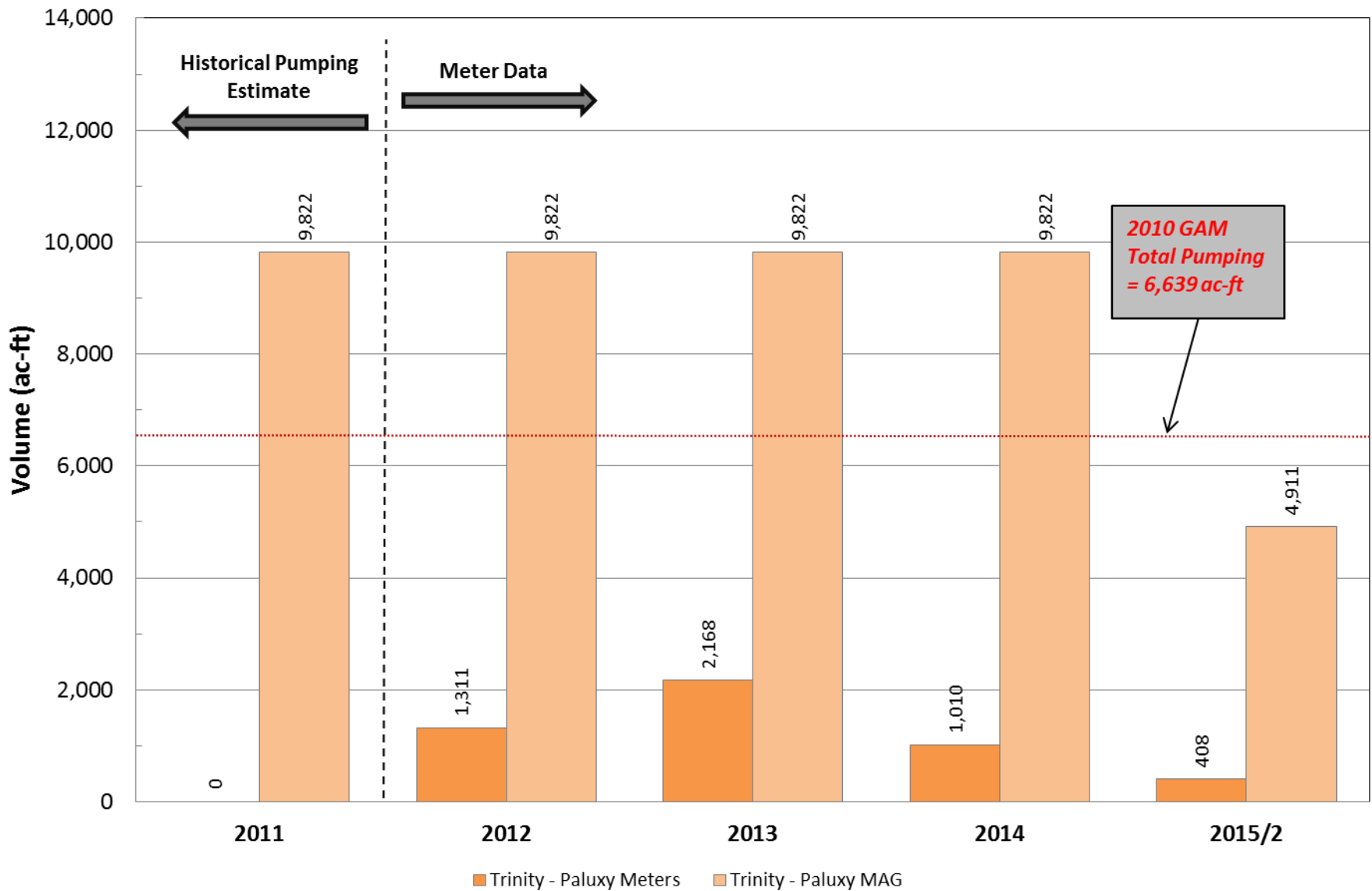
# Denton County Region 1 (Woodbine) Metered Pumping and MAG



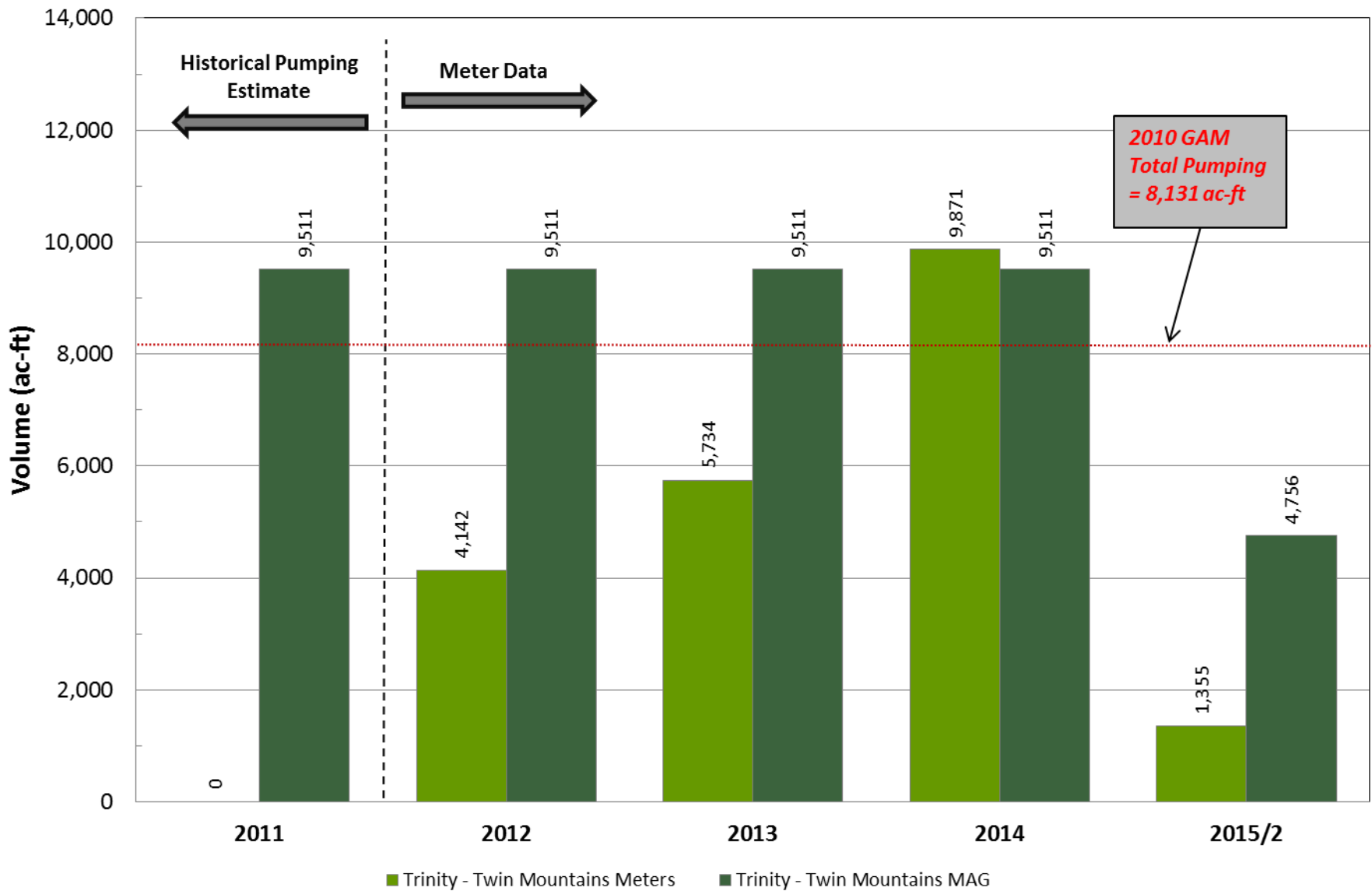
## Denton County Region 1 (Antlers) Metered Pumping and MAG



## Denton County Region 2 (Paluxy) Metered Pumping and MAG

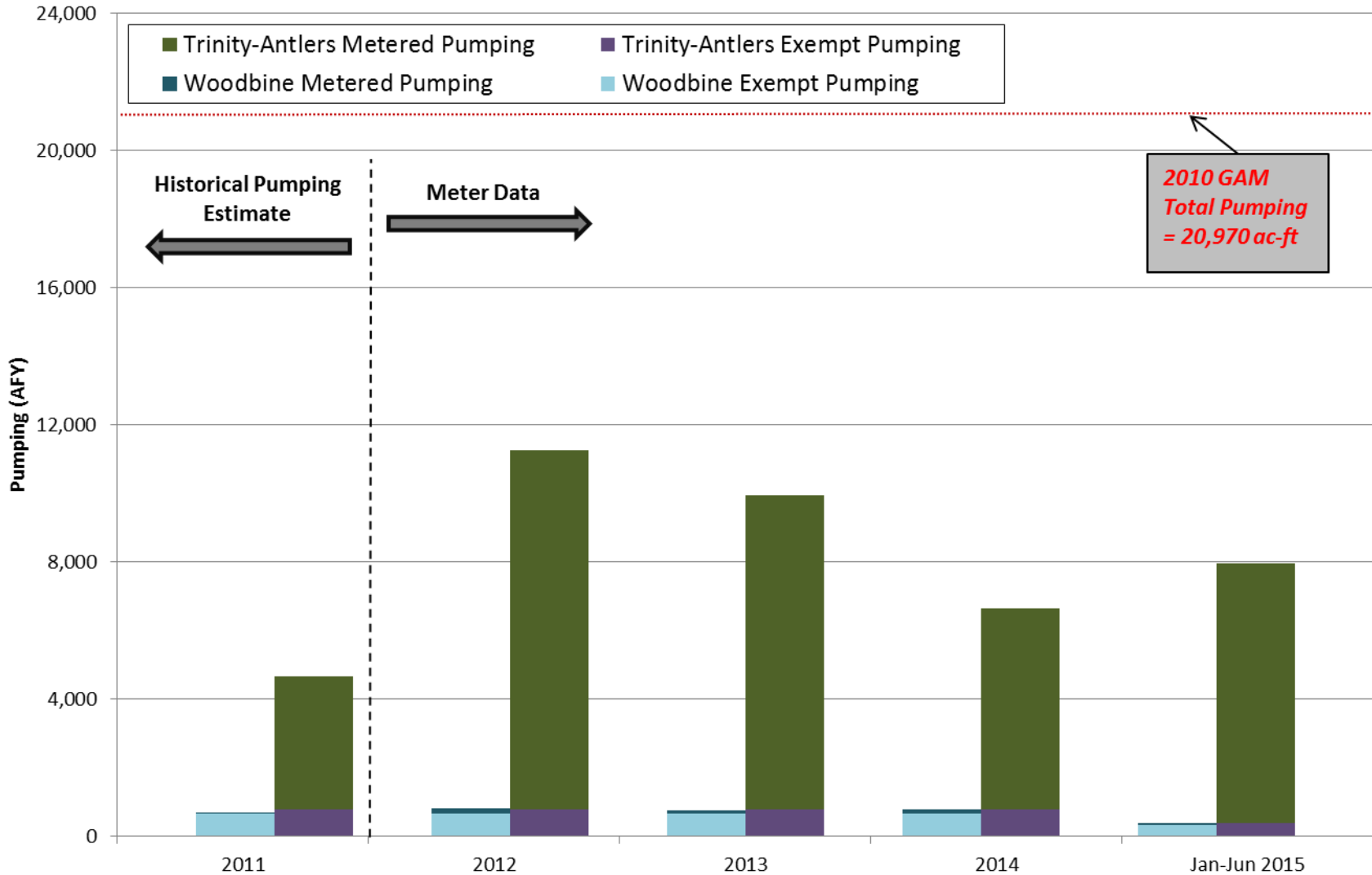


## Denton County Region 2 (Twin Mountains) Metered Pumping and MAG





## Denton County Pumping by Year and Aquifer



*TWDB Historical estimates used for Year 2011 pumping.*

*Exempt Pumping Estimates from North Trinity GAM (year 2010) were used for all years.*

*MAG and exempt pumping for Year 2015 divided by 2 for comparison to 6 months of meter data.*

# Big Picture Comparison Denton County

- Meter data currently similar to MAG estimates
- Woodbine, Trinity – Antlers and Trinity – Paluxy pumping less than MAG volumes
- Trinity – Twin Mountains pumping barely exceeds MAG in 2014 only



# Review of Water Supply Strategies for North Texas GCD

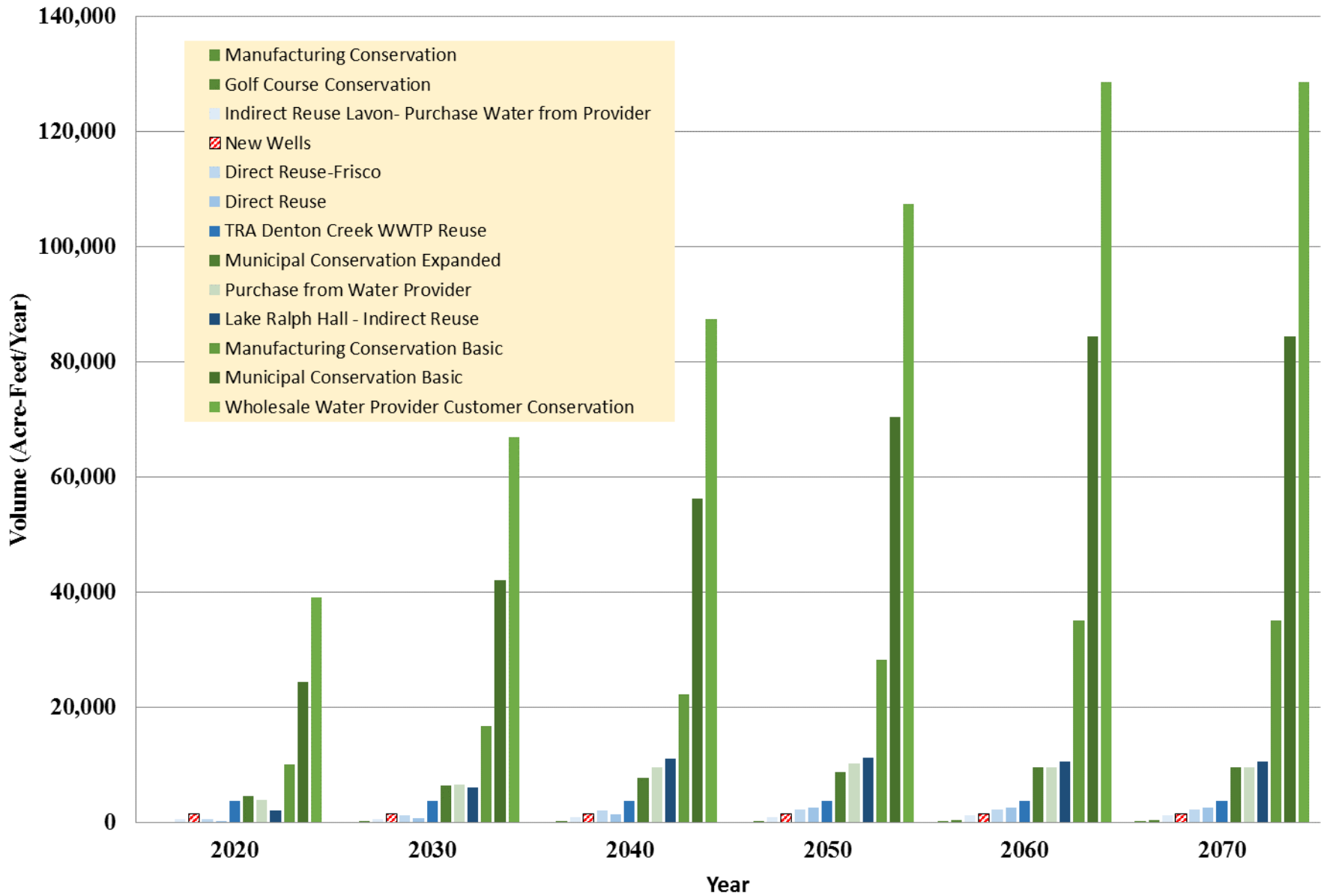


# Water Management Strategy Graphs

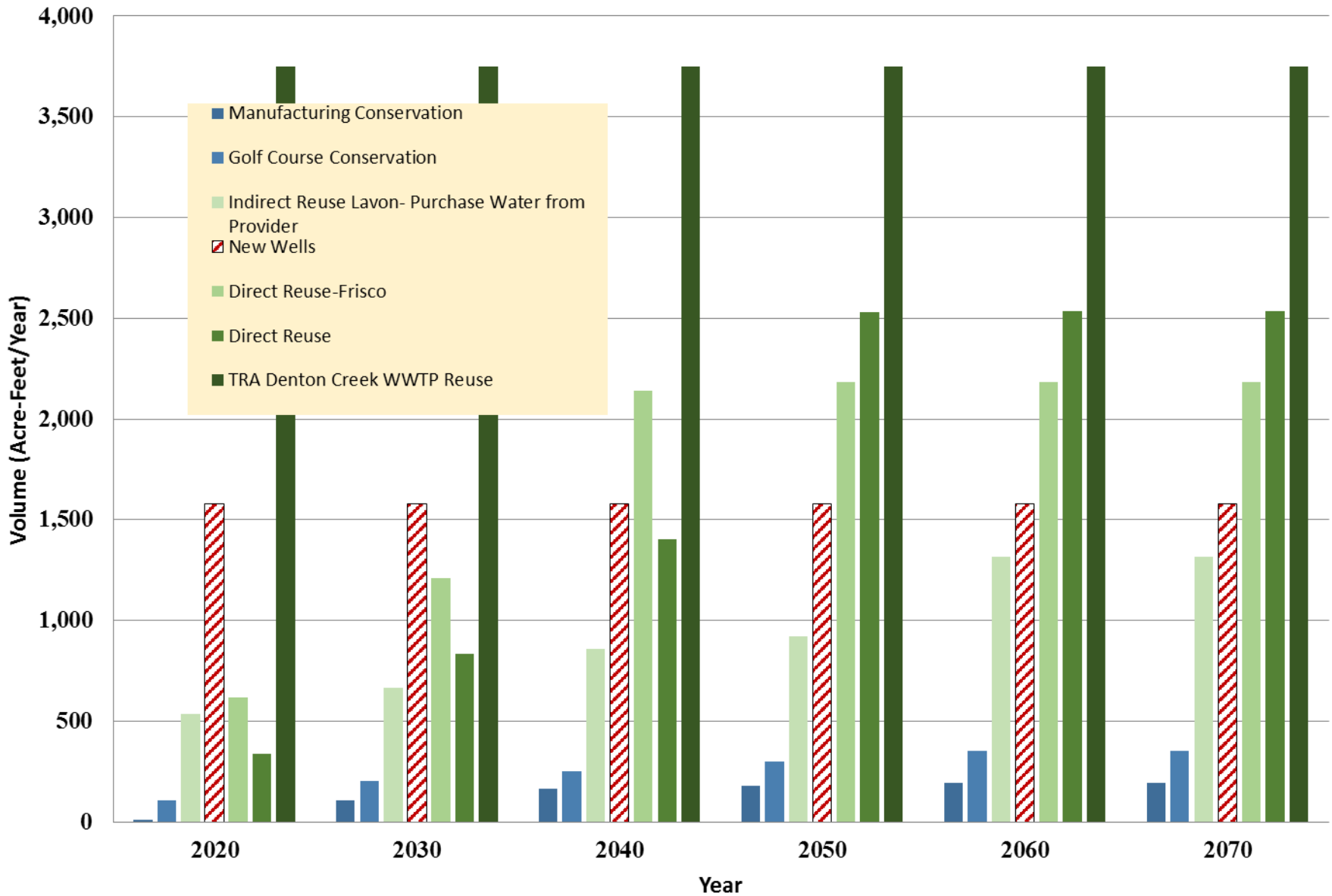
- Water Supplies by Type
- Water Supplies by Type: By County and Year
- Water Source Type: Percentage by County and Year
- Total Strategy Volumes by County
- Denton County: Groundwater vs. All Other Sources



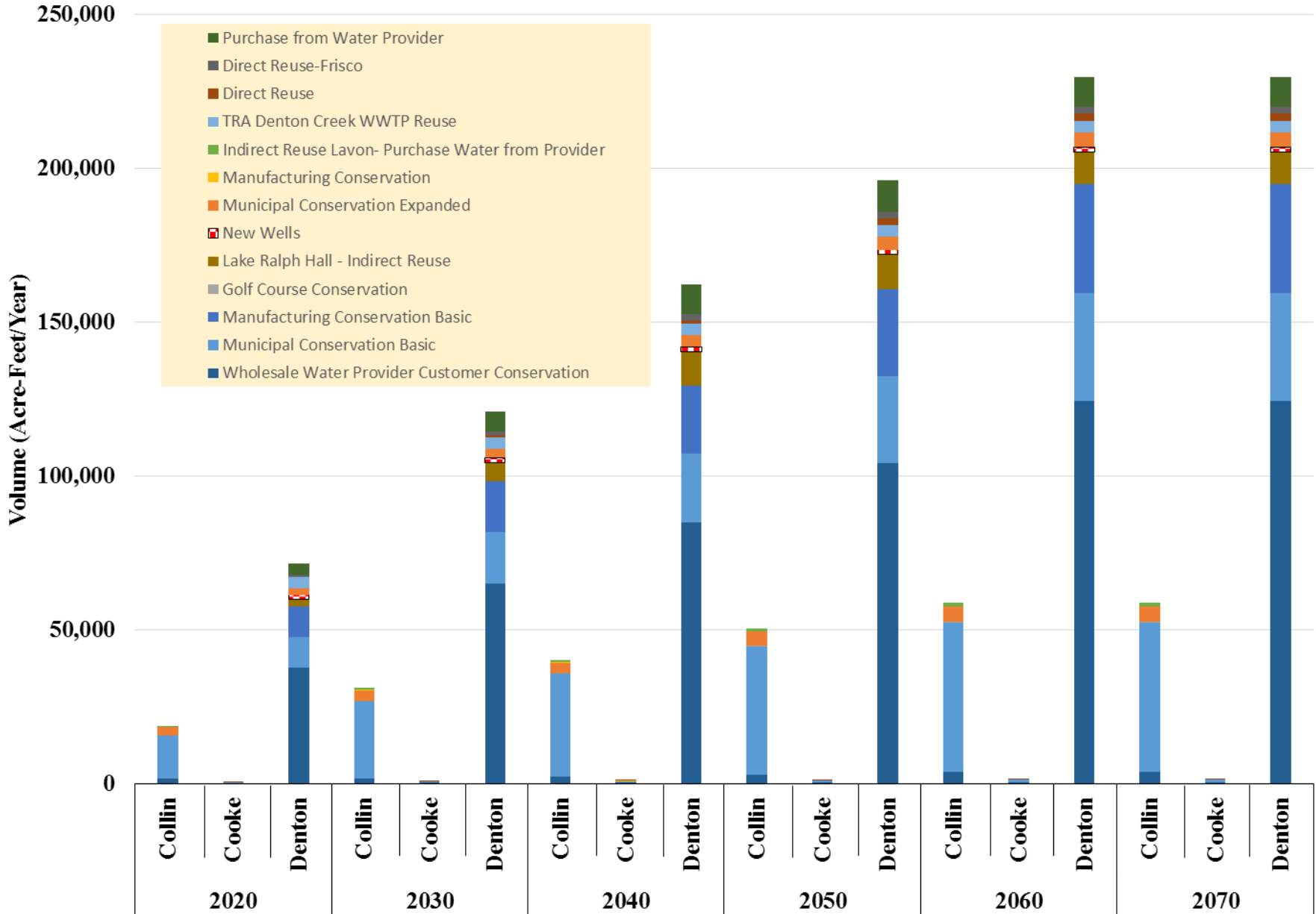
# N. TX GCD Water Supplies by Type



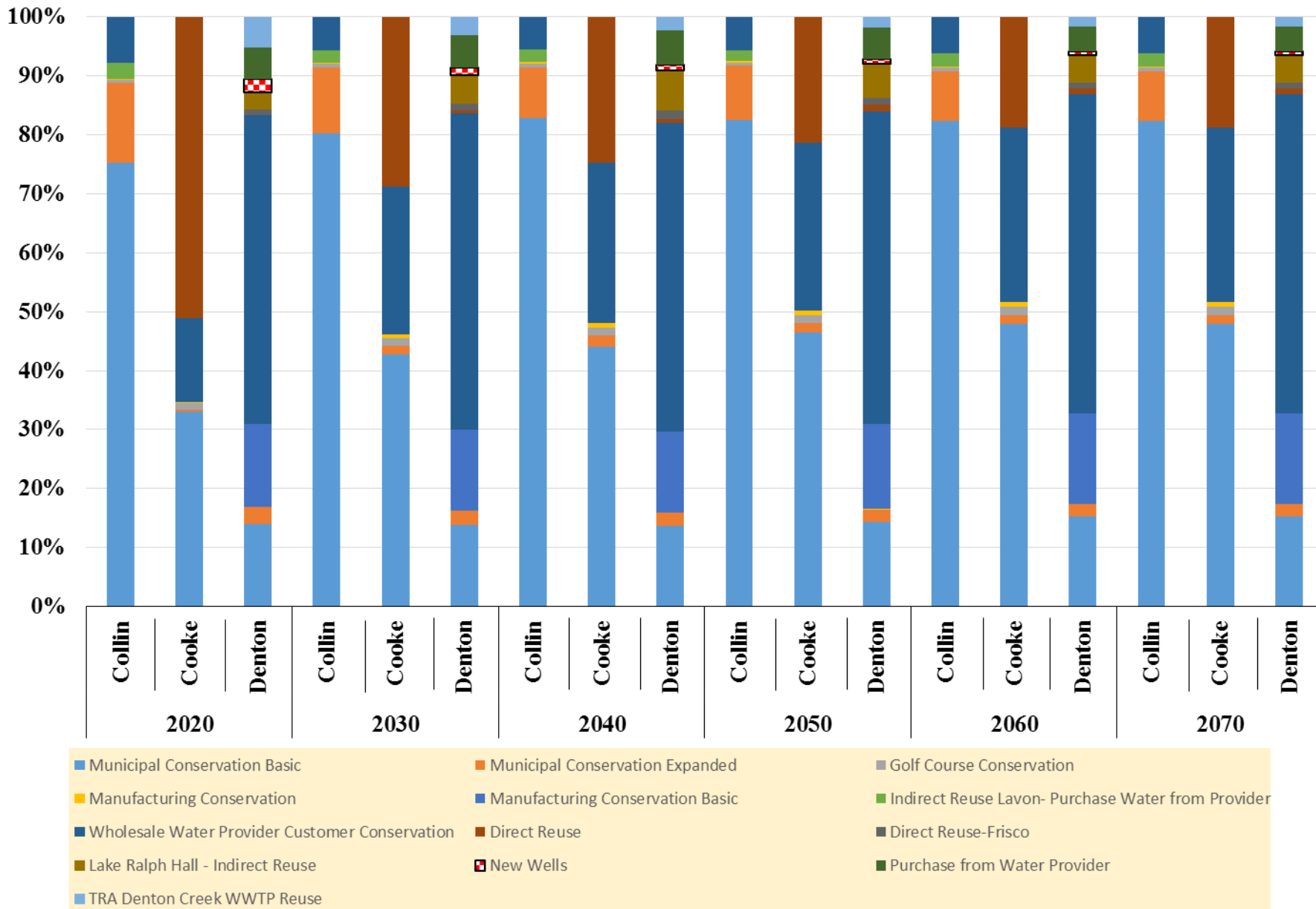
# N. TX GCD Water Supplies by Type



## N. TX GCD Water Supplies by Type, County, and Year

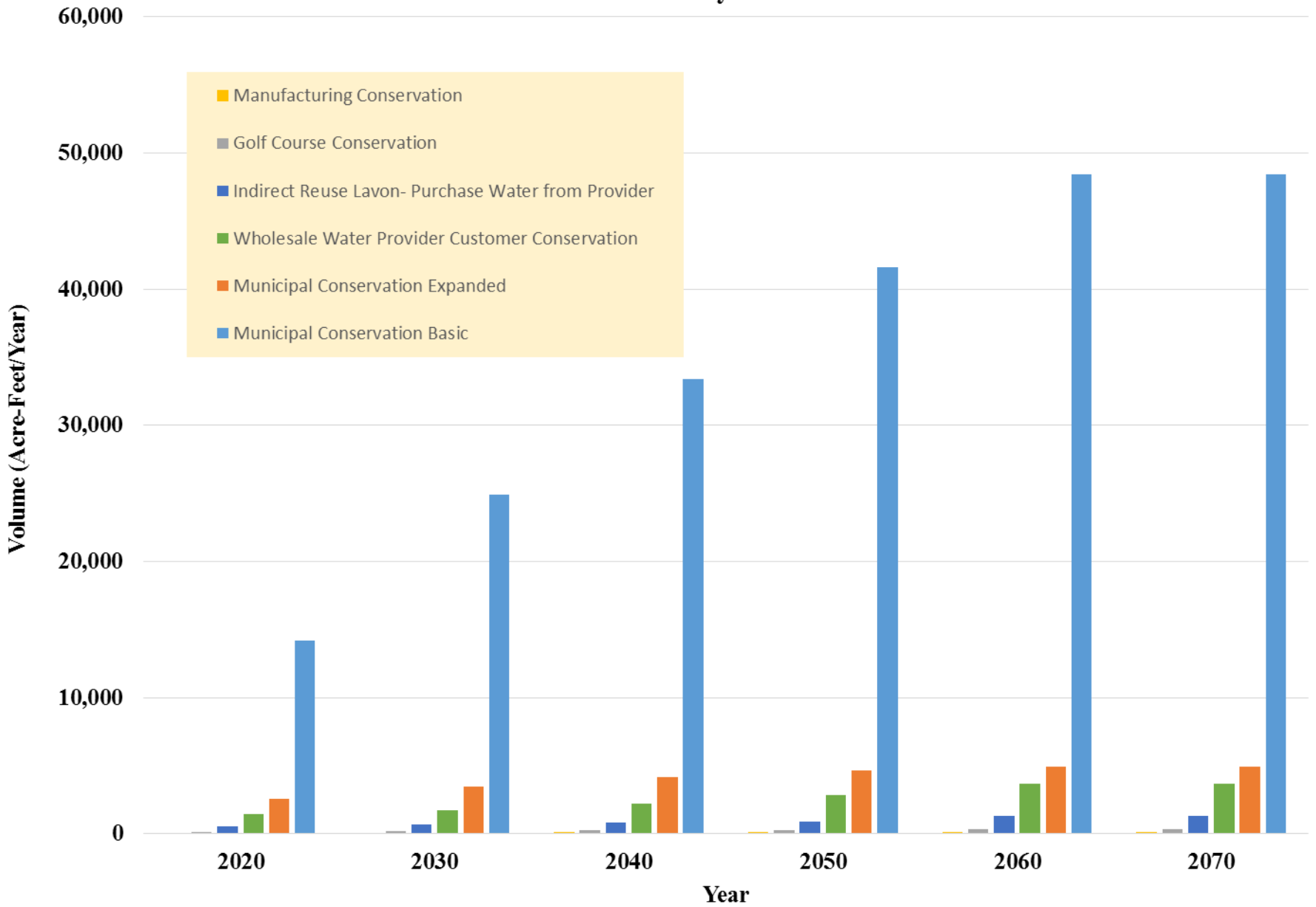


## N. TX GCD Water Source Type Percentage by County and Year

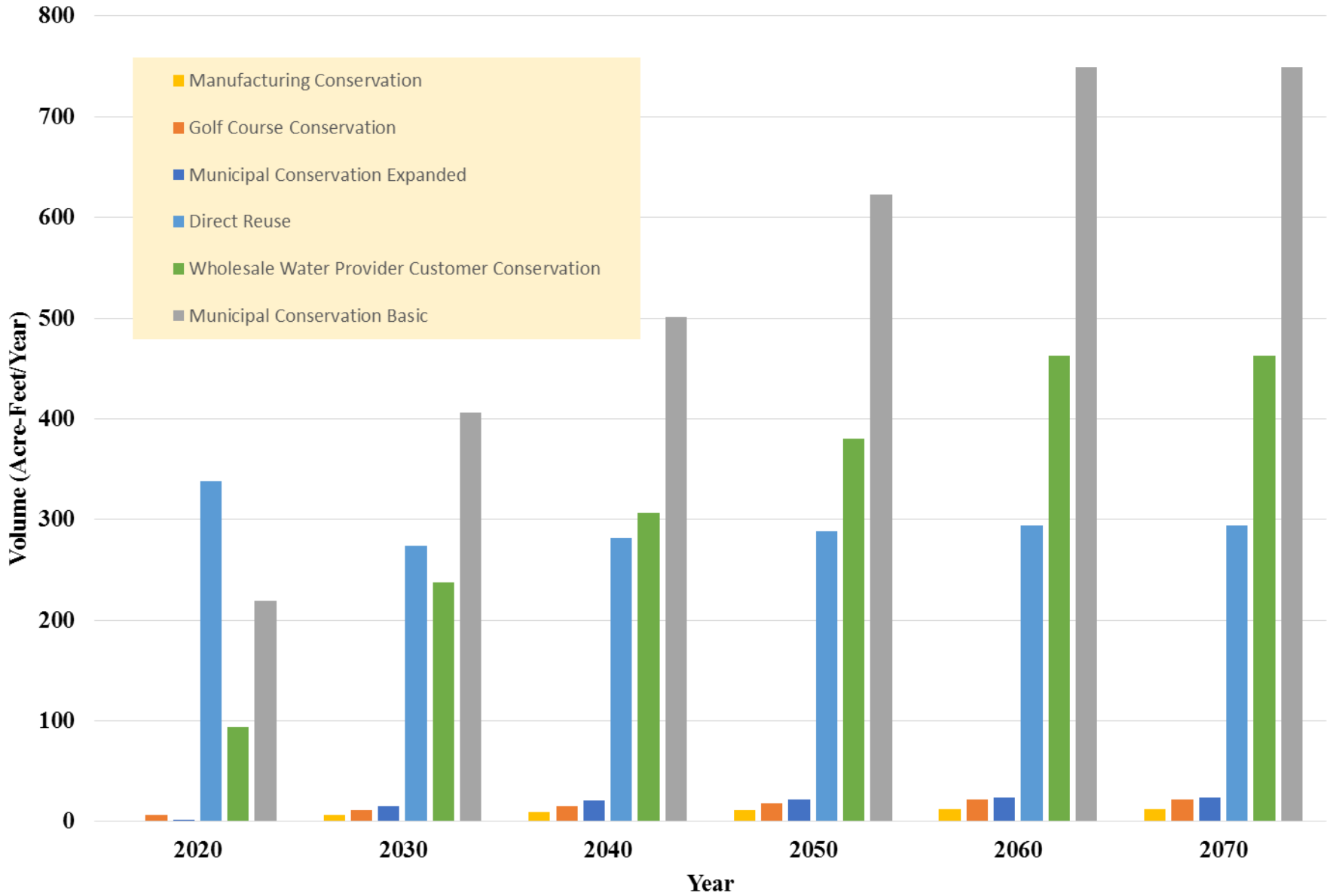




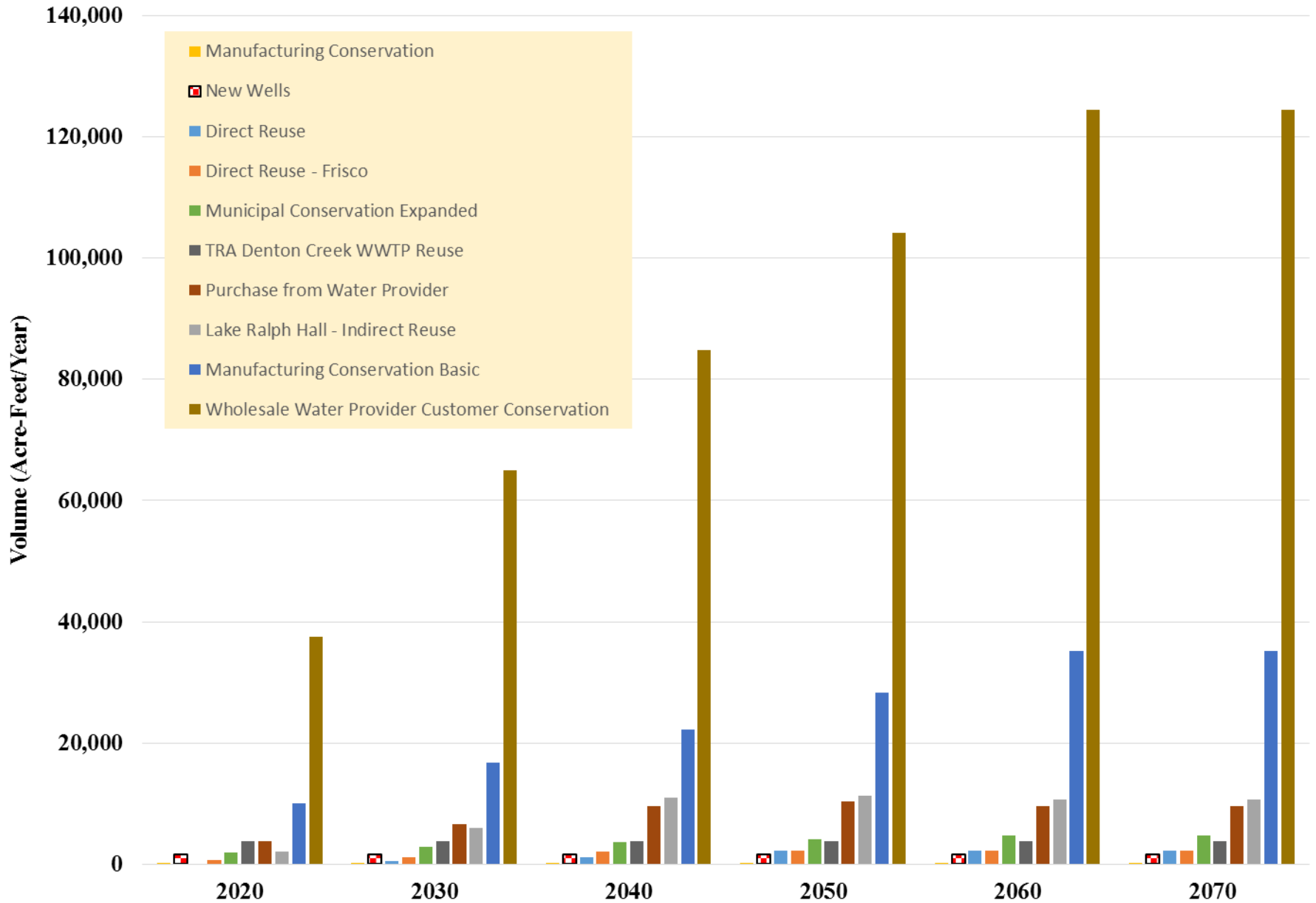
# Collin County



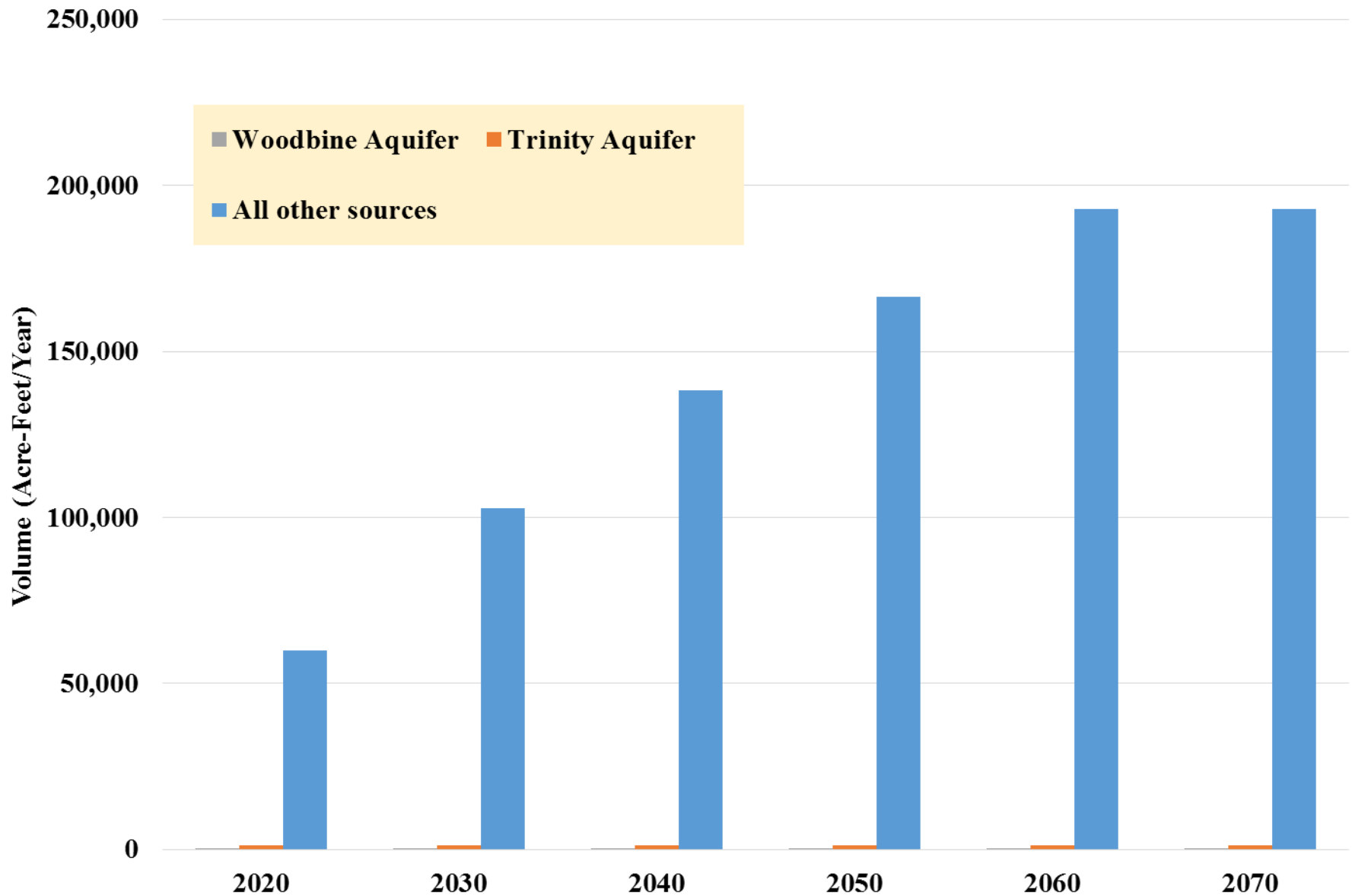
# Cooke County



# Denton County



## Denton County Groundwater Supply vs. All Other Sources



# Summary of Strategies

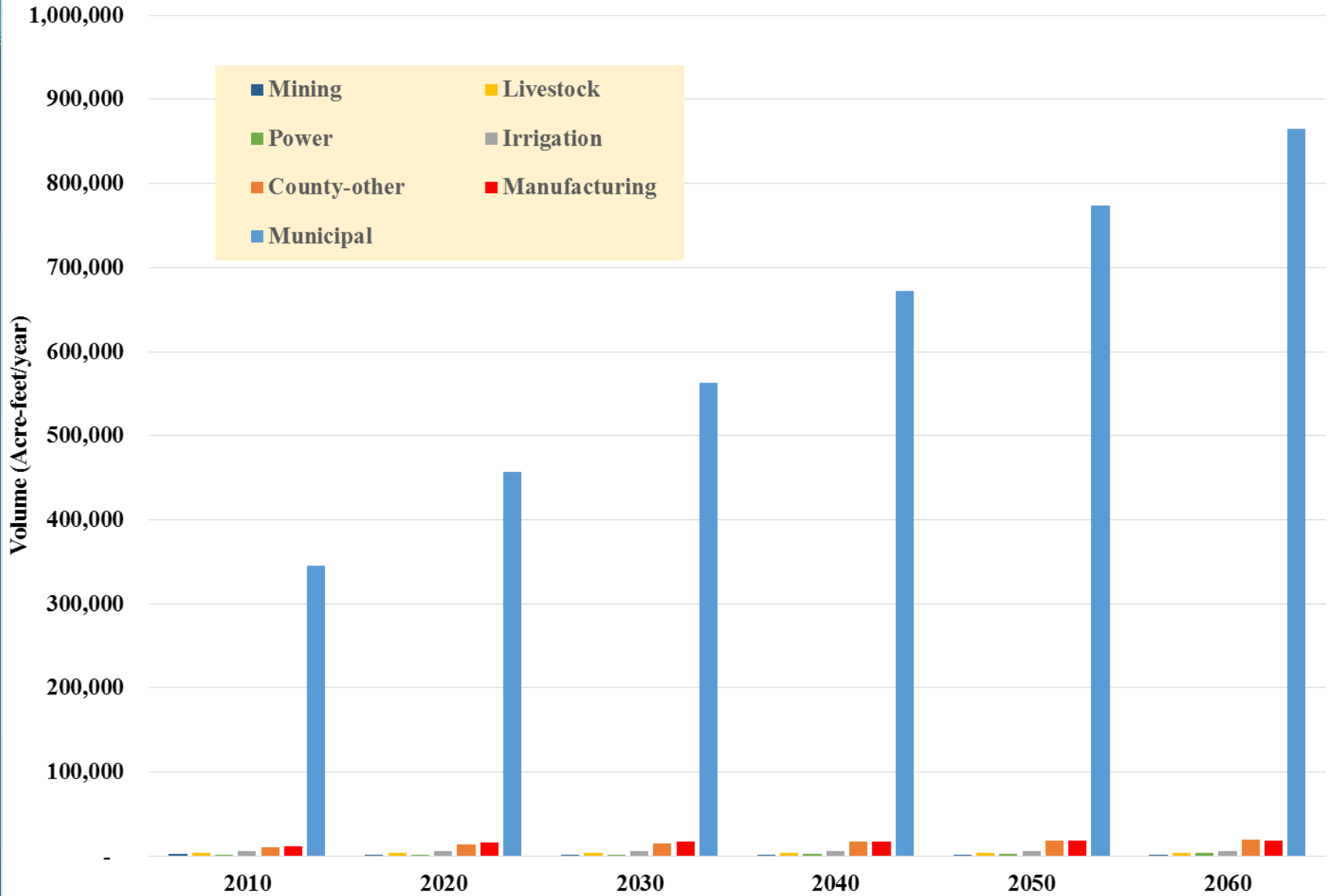
- Reuse (~1,500 ac-ft in 2020 to ~6,000 ac-ft in 2070)
- New Wells (~1,500 ac-ft, 2020 through 2070)
- Conservation (~75,000 ac-ft in 2020 to 250,000 ac-ft in 2070)



# Review of Water Demand



# North Texas GCD Water Demand by Type

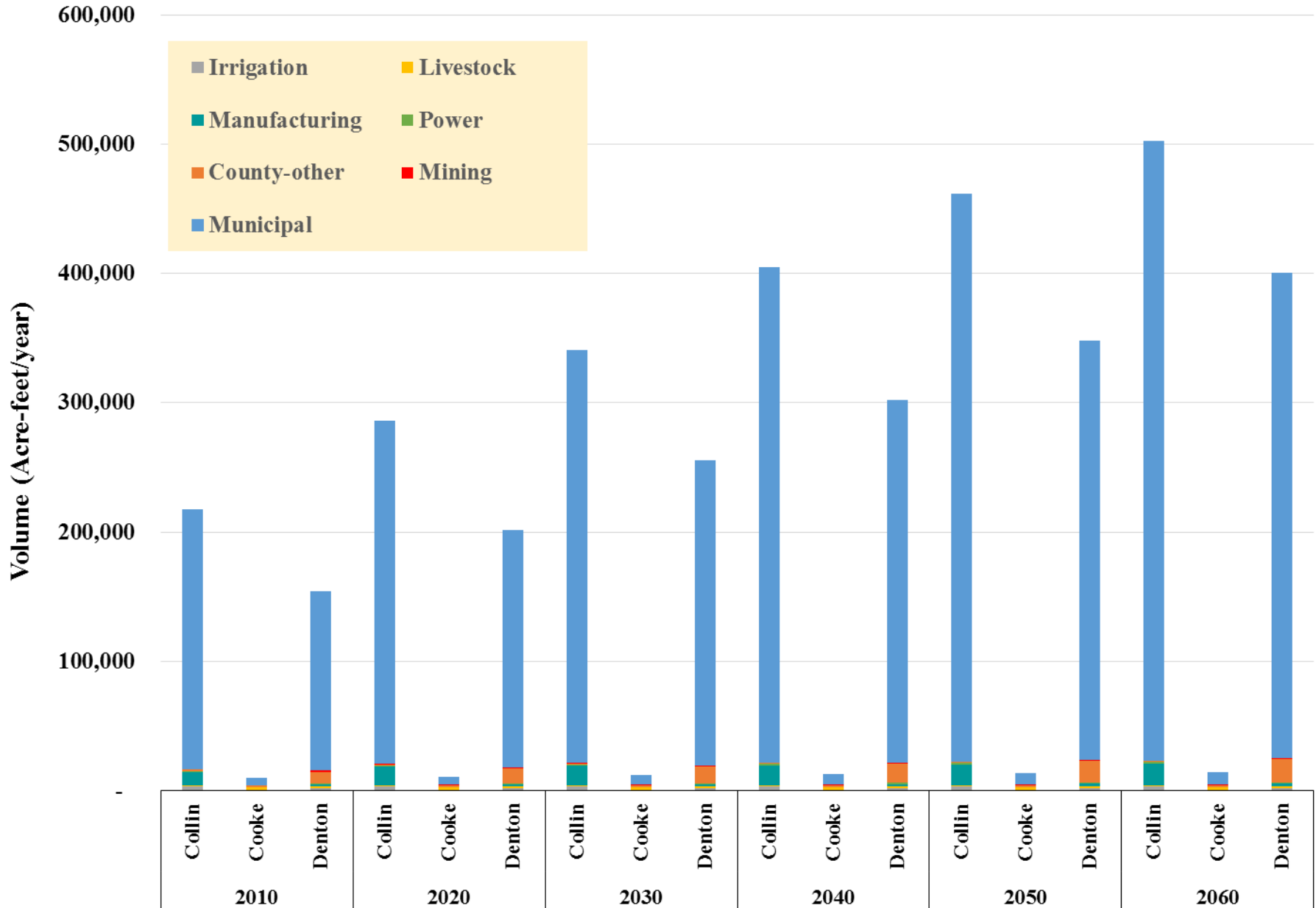


## North Texas GCD Water Demand by Type (Non-Municipal)





## North Texas GCD Water Demand by Type, County, and Year



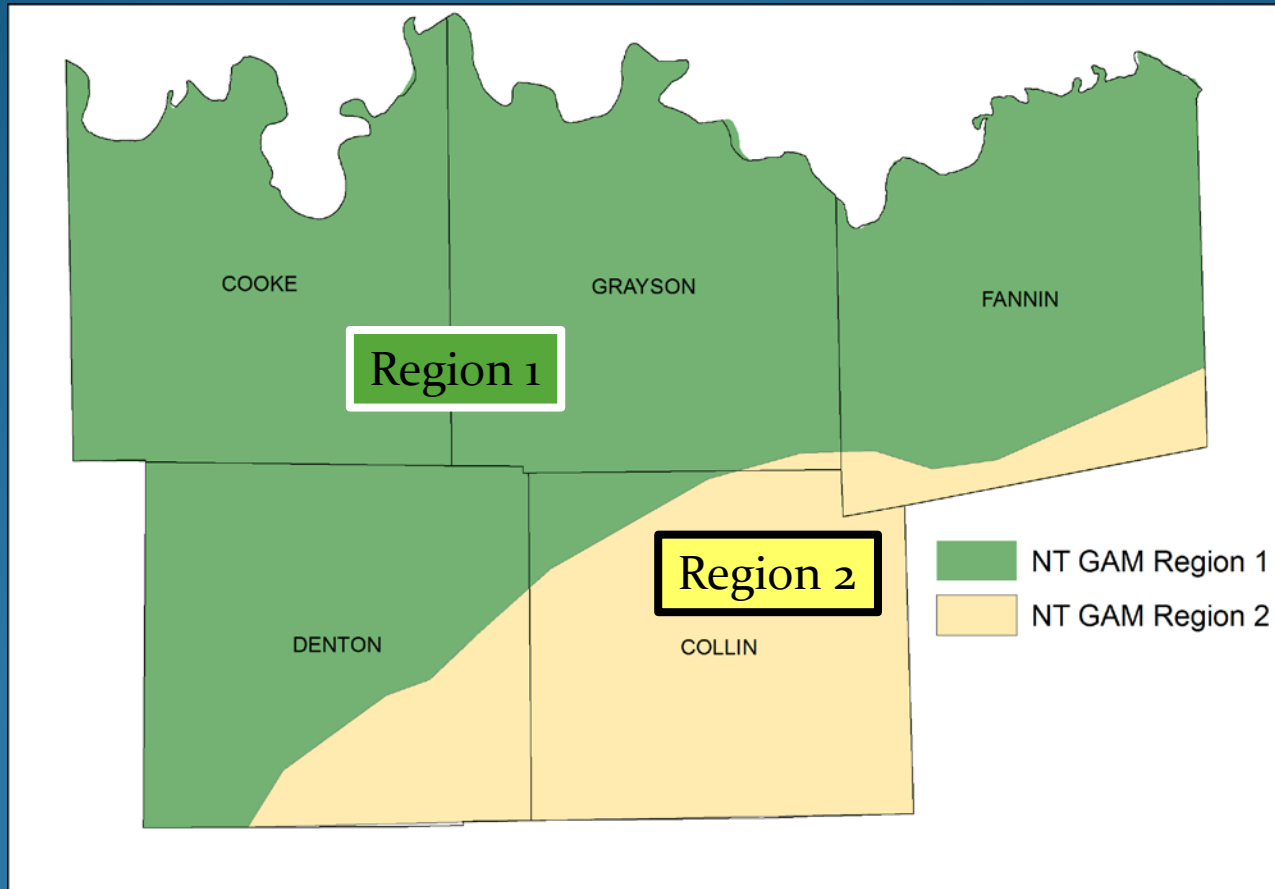
# Demand Summary

- Non-Municipal Demand: ~35,000 ac-ft in 2010 to over 50,000 ac-ft in 2060
- Municipal Demand: ~350,000 ac-ft in 2010 to over 850,000 ac-ft in 2060
- County other?

# DFCs and Water Level Changes



# North Trinity GAM Stratigraphic Regions



Region 1: Woodbine, Antlers

Region 2: Woodbine, Paluxy, Twin Mountains



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Model Terminology	Region 1	Region 2	Region 3	Region 4	Region 5
Woodbine Aquifer	Woodbine	Woodbine	Woodbine	Woodbine	Woodbine (no sand)
Washita/ Fredericksburg Groups	Washita/ Fredericksburg	Washita/ Fredericksburg	Washita/ Fredericksburg	Washita/ Fredericksburg	Washita/ Fredericksburg
Paluxy Aquifer	Antlers	Paluxy	Paluxy	Paluxy	Paluxy (no sand)
Glen Rose Formation	Antlers	Glen Rose	Glen Rose	Glen Rose	Glen Rose
Hensell Aquifer	Antlers	Twin Mountains	Travis Peak	Hensell/ Travis Peak	Hensell/ Travis Peak
Pearsall Formation	Antlers	Twin Mountains	Travis Peak	Pearsall/ Sligo	Pearsall/ Sligo
Hosston Aquifer	Antlers	Twin Mountains	Travis Peak	Hosston/ Travis Peak	Hosston/ Travis Peak

yellow = sandstone aquifers

**Figure 4.1.6** Chart showing model terminology and corresponding formation names and aquifer names common to each region.



# Converting Trinity DFCs

## Region 1

## Region 2

North Texas GCD Desired Future Conditions (50-year DFC)

	Woodbine	Antlers	Paluxy	Glen Rose	Hensel	Hosston	Twin Mountains
Collin	154	251	298	247	224	236	230
Cooke	0.0	52	26	42	60	78	n/a
Denton	16	157	98	134	180	214	197

All values are in feet of drawdown over a 50-year period.

North Texas GCD Desired Future Conditions (One-year DFC)

	Woodbine	Antlers	Paluxy	Glen Rose	Hensel	Hosston	Twin Mountains
Collin	3.1	5.0	6.0	4.9	4.5	4.7	4.6
Cooke	0.0	1.0	0.5	0.8	1.2	1.6	n/a
Denton	0.3	3.1	2.0	2.7	3.6	4.3	3.9

All values are in feet of drawdown over a one-year period.

= calculated DFC

To derive DFCs for Region 1 Trinity - Antlers, the DFCs for the Paluxy, Glen Rose, Hensell and Hosston were averaged.

For Region 2 Trinity – Twin Mountains, the DFCs for the Hensell and Hosston were averaged.



# Calculation of Water Level Change

- Used TWDB water level data for wells with at least five measurements between January 2000 and June 2015
- Calculated the water level change from the first measurement to the last
- Divided by the number of years between first and last measurements to get an average annual water level change
- Mapped along with North Texas data to add continuity to the data set
- Negative change is drawdown (water level decline) and positive change is a rebound (increase in water level)



# Calculation of Water Level Change

SWN	County	LBG Aquifer	Strat Region	WL Change (ft)	Total Years	Average Change (ft)	+/-	1-yr DFC	Status
1842302	Collin	Antlers	1	217.0	12	-18.1	decline	-5.0	Exceeds DFC
1842604	Collin	Antlers	1	37.0	14	-2.6	decline	-5.0	Less than DFC
1850502	Collin	TwinMtns	2	2.0	6	-0.3	decline	-4.6	Less than DFC
1836803	Collin	Woodbine	1	-35.0	14	2.5	rebound	-3.1	Less than DFC
1842601	Collin	Woodbine	1	-23.0	14	1.6	rebound	-3.1	Less than DFC
1844803	Collin	Woodbine	2	129.0	9	-14.3	decline	-3.1	Exceeds DFC
1845604	Collin	Woodbine	2	0.0	14	0.0	rebound	-3.1	Less than DFC
1850301	Collin	Woodbine	2	150.0	8	-18.8	decline	-3.1	Exceeds DFC
1915701	Cooke	Antlers	1	24.4	14	-1.7	decline	-1.0	Exceeds DFC
1922704	Cooke	Antlers	1	23.0	14	-1.6	decline	-1.0	Exceeds DFC
1923502	Cooke	Antlers	1	7.0	10	-0.7	decline	-1.0	Less than DFC
1923503	Cooke	Antlers	1	-126.0	11	11.5	rebound	-1.0	Less than DFC
1923805	Cooke	Antlers	1	42.0	11	-3.9	decline	-1.0	Exceeds DFC
1923901	Cooke	Antlers	1	-7.0	11	0.6	rebound	-1.0	Less than DFC
1923906	Cooke	Antlers	1	193.0	11	-17.9	decline	-1.0	Exceeds DFC
1924702	Cooke	Antlers	1	15.9	14	-1.1	decline	-1.0	Exceeds DFC
1931302	Cooke	Antlers	1	284.0	14	-20.1	decline	-1.0	Exceeds DFC
1938301	Cooke	Antlers	1	44.0	14	-3.1	decline	-1.0	Exceeds DFC
1948501	Denton	Antlers	1	29.8	3	-9.9	decline	-3.1	Exceeds DFC
1954603	Denton	Antlers	1	205.0	14	-14.4	decline	-3.1	Exceeds DFC
1954605	Denton	Antlers	1	23.0	14	-1.6	decline	-3.1	Less than DFC
1956104	Denton	Antlers	1	-91.7	5	18.1	rebound	-3.1	Less than DFC
1961301	Denton	Antlers	1	2.2	14	-0.2	decline	-3.1	Less than DFC
1962203	Denton	Antlers	1	75.0	11	-6.8	decline	-3.1	Exceeds DFC
1963701	Denton	Antlers	1	1.0	14	-0.1	decline	-3.1	Less than DFC
1857802	Denton	Paluxy	2	208.0	4	-46.4	decline	-2.0	Exceeds DFC
1963601	Denton	Paluxy	2	101.0	13	-7.7	decline	-2.0	Exceeds DFC
1964505	Denton	TwinMtns	2	38.0	12	-3.2	decline	-3.9	Less than DFC
1964201	Denton	TwinMtns	2	82.0	11	-7.4	decline	-3.9	Exceeds DFC
1964308	Denton	TwinMtns	2	83.0	12	-6.9	decline	-3.9	Exceeds DFC
1964406	Denton	TwinMtns	2	41.0	9	-4.7	decline	-3.9	Exceeds DFC
1833811	Denton	Woodbine	1	10.8	14	-0.8	decline	-0.3	Exceeds DFC
1841201	Denton	Woodbine	1	10.2	14	-0.7	decline	-0.3	Exceeds DFC
1841708	Denton	Woodbine	1	38.7	7	-5.6	decline	-0.3	Exceeds DFC
1956602	Denton	Woodbine	1	-2.8	14	0.2	rebound	-0.3	Less than DFC
1964901	Denton	Woodbine	2	-5.9	3	2.0	rebound	-0.3	Less than DFC

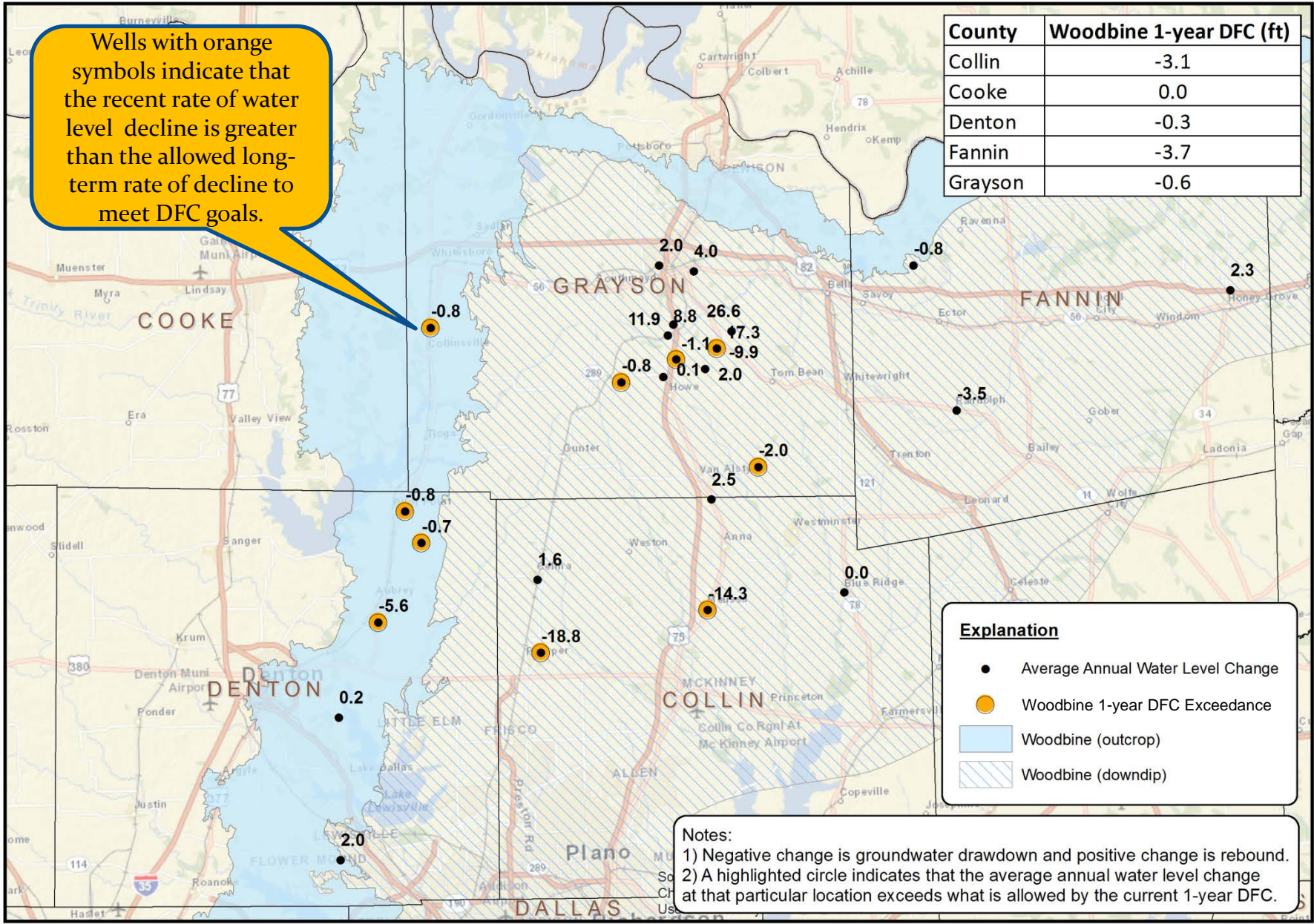
*These calculation compare a 1-year average using multiple years of measurements to assess recent status of DFCs based on recent rate of decline or rebound.*





Wells with orange symbols indicate that the recent rate of water level decline is greater than the allowed long-term rate of decline to meet DFC goals.

County	Woodbine 1-year DFC (ft)
Collin	-3.1
Cooke	0.0
Denton	-0.3
Fannin	-3.7
Grayson	-0.6



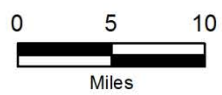
**Explanation**

- Average Annual Water Level Change
- Woodbine 1-year DFC Exceedance
- Woodbine (outcrop)
- Woodbine (downdip)

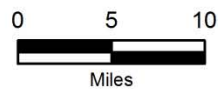
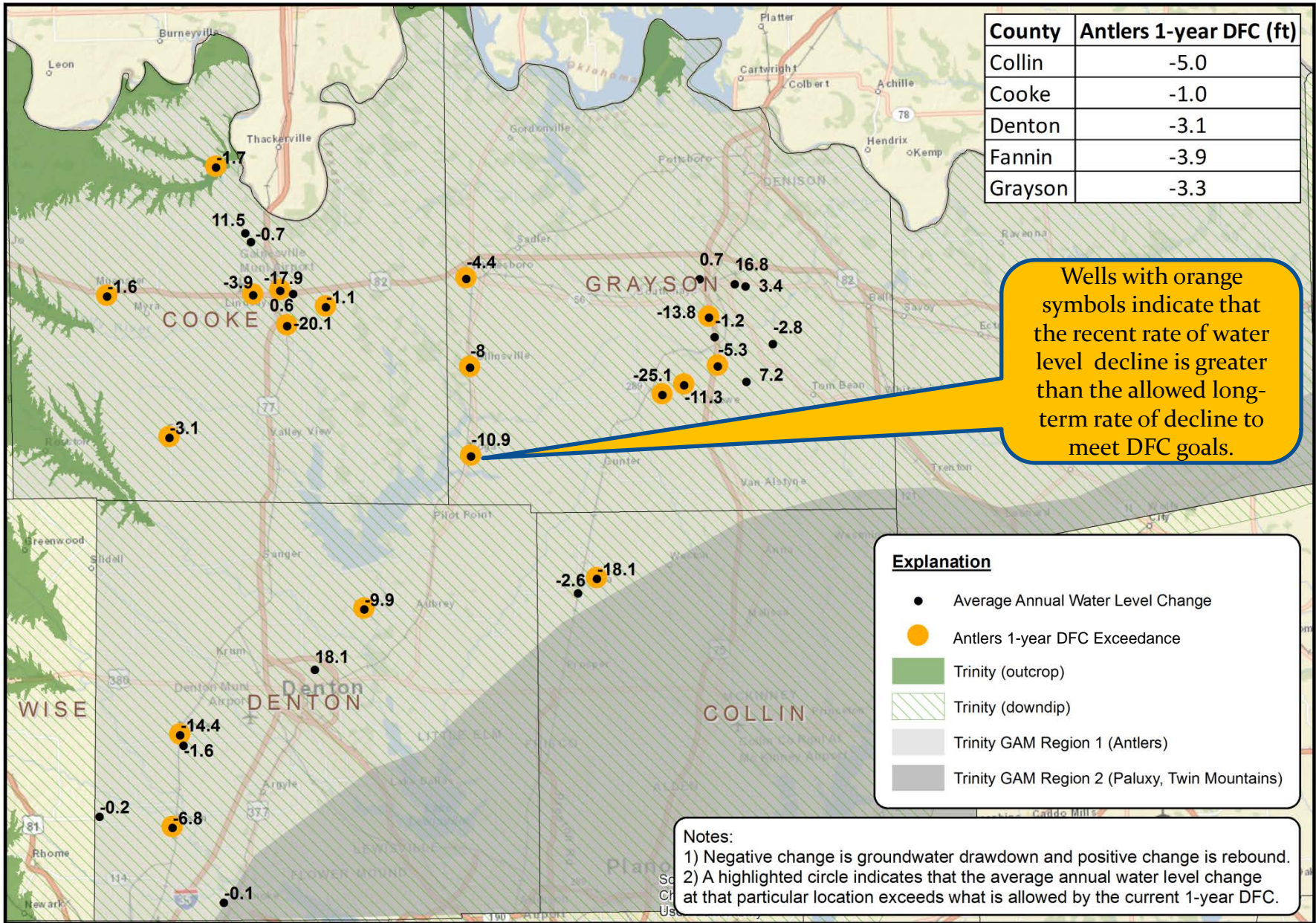
**Notes:**  
 1) Negative change is groundwater drawdown and positive change is rebound.  
 2) A highlighted circle indicates that the average annual water level change at that particular location exceeds what is allowed by the current 1-year DFC.



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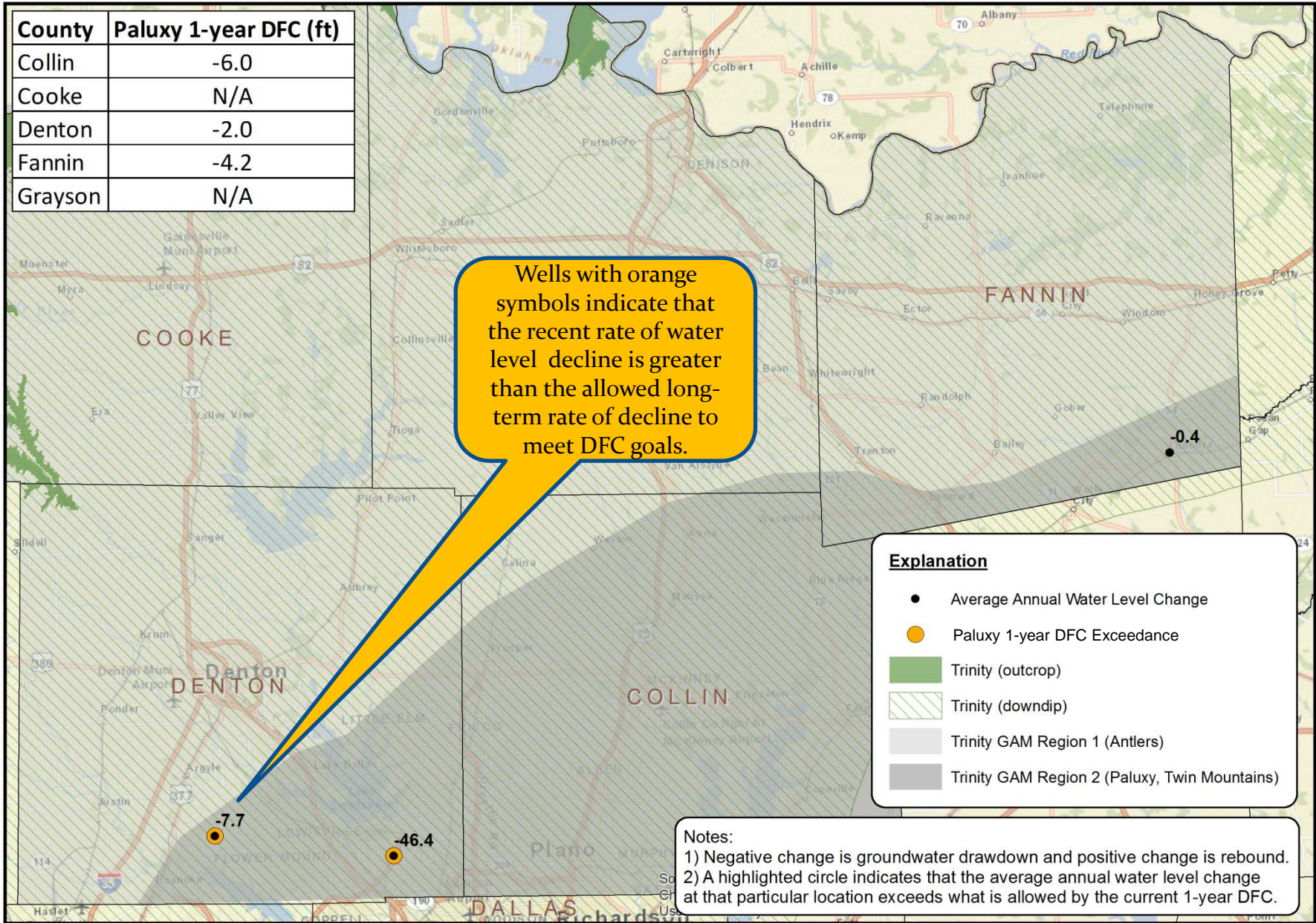


**WOODBINE AQUIFER  
 AVERAGE ANNUAL WATER LEVEL CHANGE**



County	Paluxy 1-year DFC (ft)
Collin	-6.0
Cooke	N/A
Denton	-2.0
Fannin	-4.2
Grayson	N/A

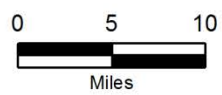
Wells with orange symbols indicate that the recent rate of water level decline is greater than the allowed long-term rate of decline to meet DFC goals.

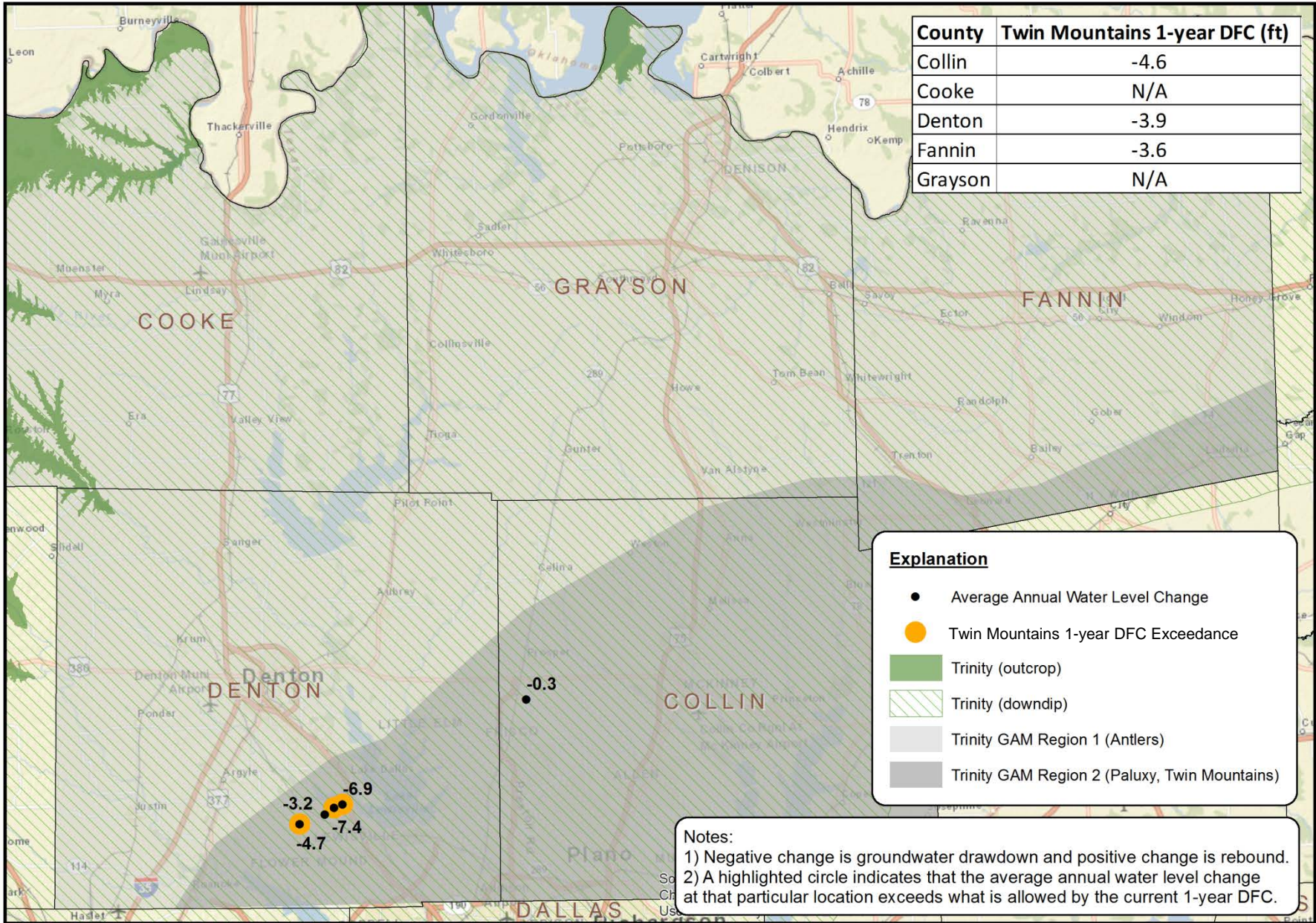


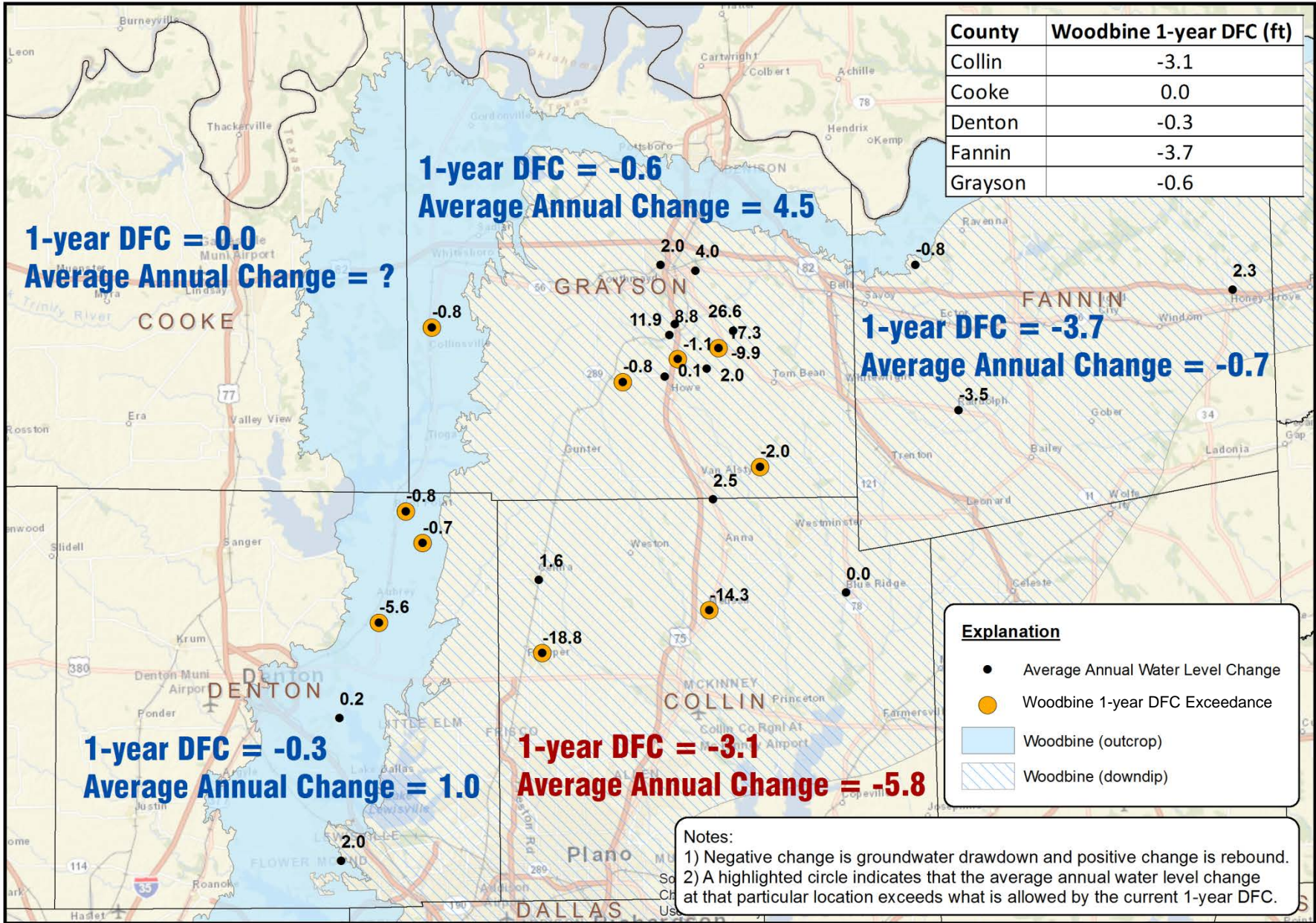
**Explanation**

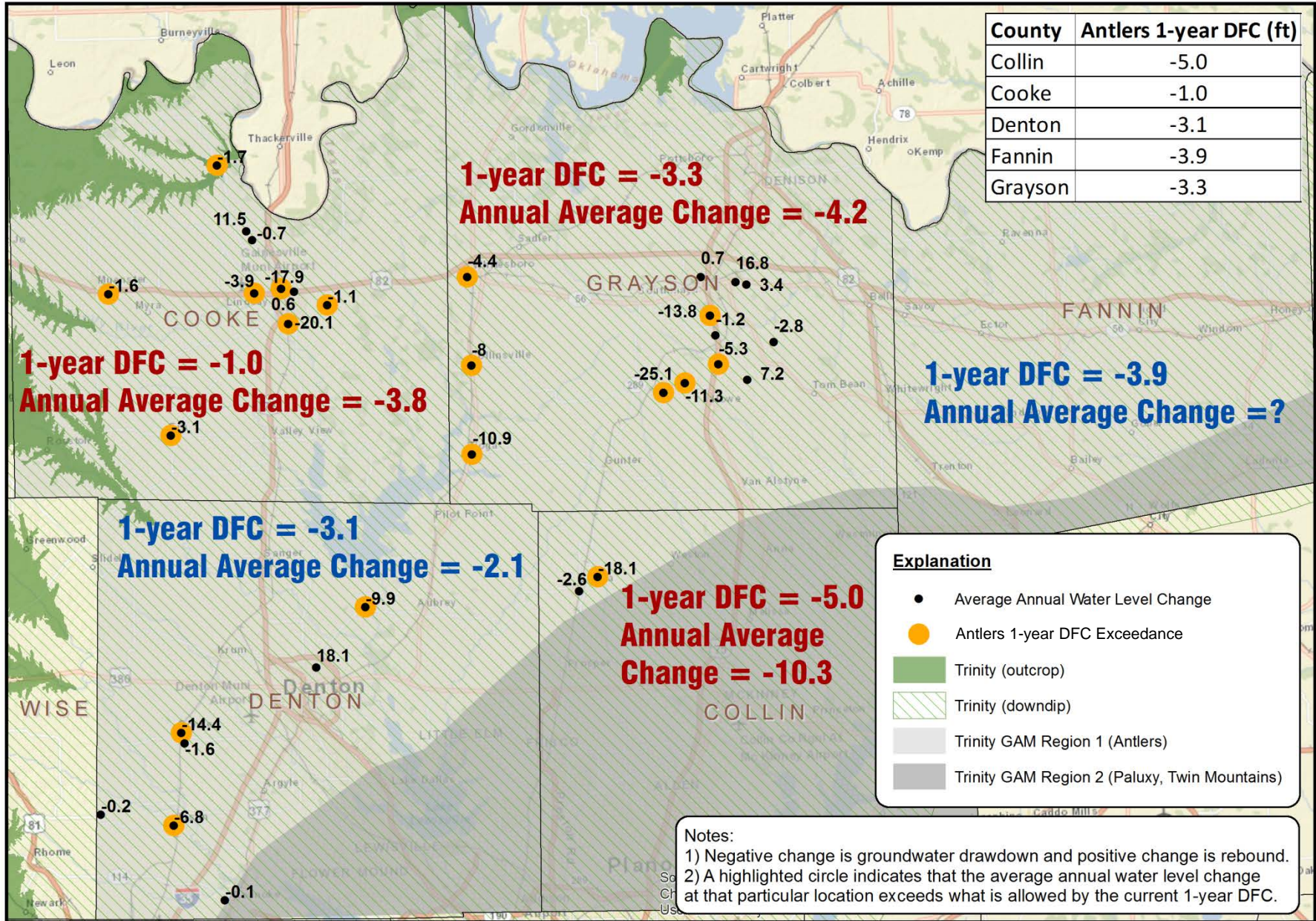
- Average Annual Water Level Change
- Paluxy 1-year DFC Exceedance
- Trinity (outcrop)
- ▨ Trinity (downdip)
- Trinity GAM Region 1 (Antlers)
- Trinity GAM Region 2 (Paluxy, Twin Mountains)

**Notes:**  
 1) Negative change is groundwater drawdown and positive change is rebound.  
 2) A highlighted circle indicates that the average annual water level change at that particular location exceeds what is allowed by the current 1-year DFC.

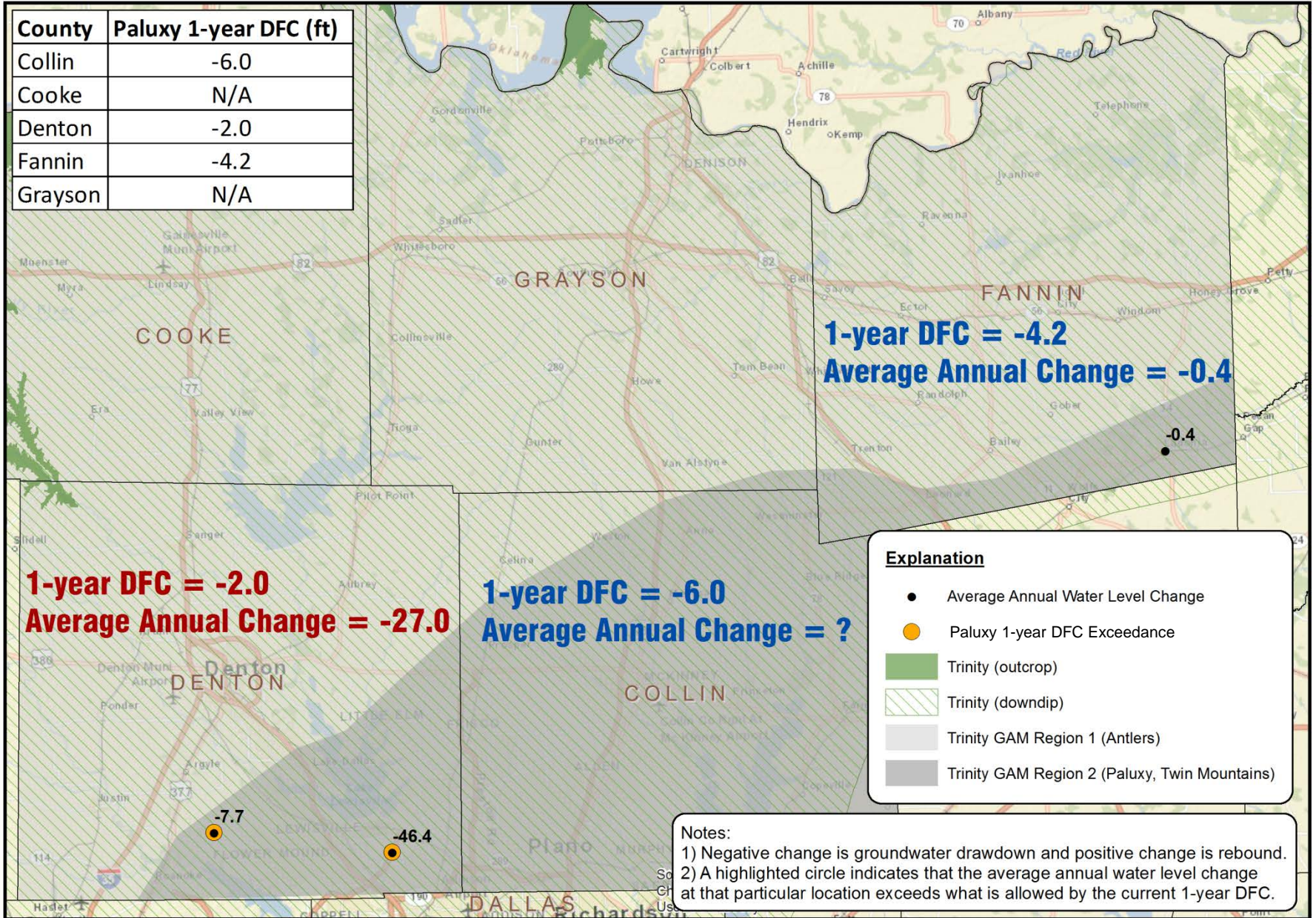








County	Paluxy 1-year DFC (ft)
Collin	-6.0
Cooke	N/A
Denton	-2.0
Fannin	-4.2
Grayson	N/A



**1-year DFC = -2.0**  
**Average Annual Change = -27.0**

**1-year DFC = -6.0**  
**Average Annual Change = ?**

**1-year DFC = -4.2**  
**Average Annual Change = -0.4**

**Explanation**

- Average Annual Water Level Change
- Paluxy 1-year DFC Exceedance
- Trinity (outcrop)
- ▨ Trinity (downdip)
- Trinity GAM Region 1 (Antlers)
- Trinity GAM Region 2 (Paluxy, Twin Mountains)

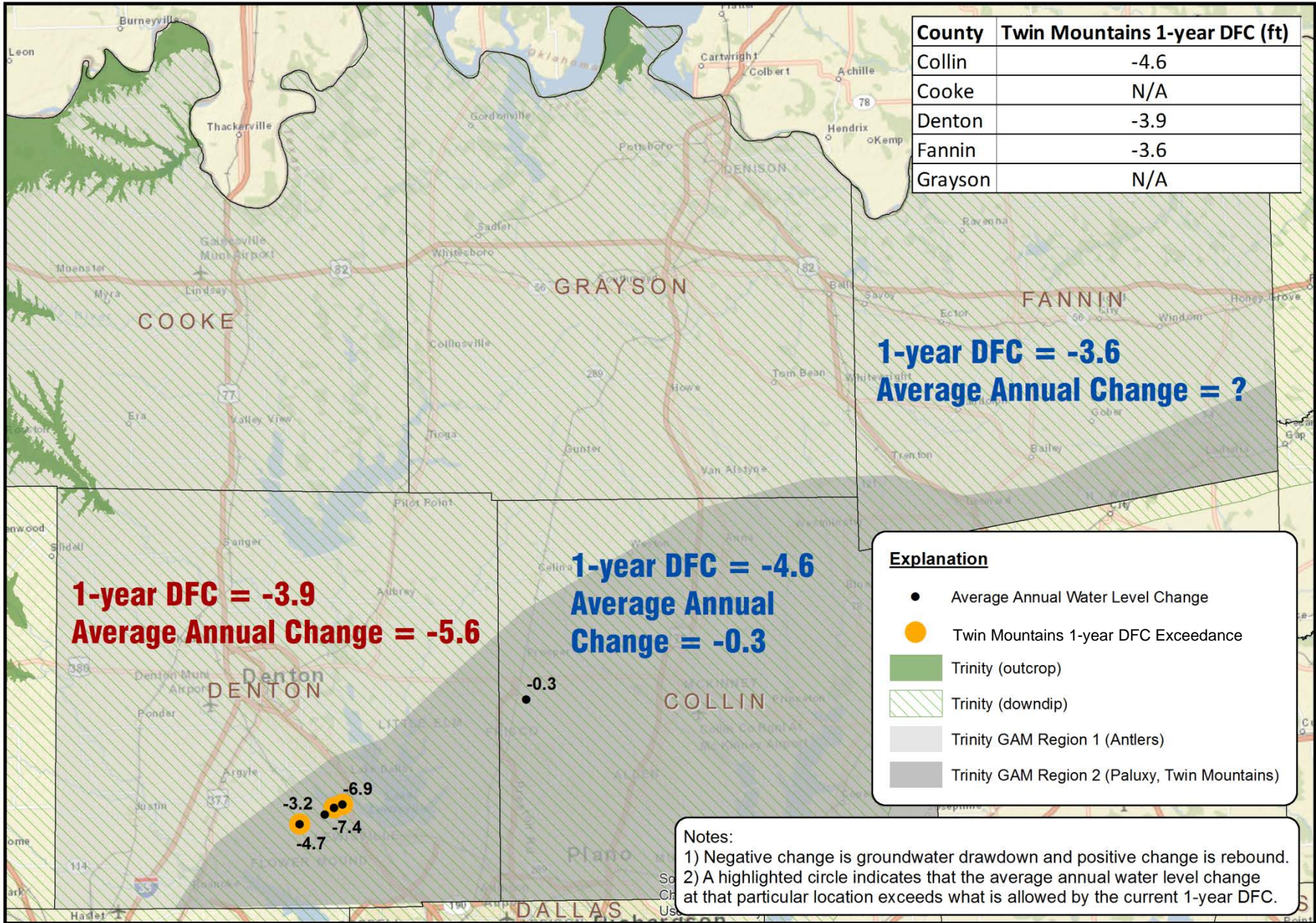
**Notes:**  
 1) Negative change is groundwater drawdown and positive change is rebound.  
 2) A highlighted circle indicates that the average annual water level change at that particular location exceeds what is allowed by the current 1-year DFC.



LBG-GUYTON ASSOCIATES



**TRINITY PALUXY AQUIFER**  
**AVERAGE ANNUAL WATER LEVEL CHANGE**  
**2000-2015**





# Summary of Water Levels /DFCs

- Woodbine:
  - Good monitoring well coverage except in Cooke County outcrop
  - Recent Collin County average rate of decline exceeds DFC
- Antlers:
  - Good monitoring well coverage
  - Recent Cooke and Collin Counties average rate of decline exceeds DFC
- Paluxy:
  - Need monitoring wells in Collin County
  - Recent Denton County average rate of decline exceeds DFC
- Twin Mountain:
  - Need monitoring wells in Collin County
  - Recent Denton County average rate of decline exceeds DFC



# Summary of Water Levels /DFCs

	Woodbine	Antlers	Paluxy	Twin Mountains
Collin	Exceeds DFC	Exceeds DFC	No Data	Less than DFC
Cooke	No Data	Exceeds DFC	N/A	N/A
Denton	Less than DFC	Less than DFC	Exceeds DFC	Less than DFC

## FINE PRINT

- Preliminary data and analysis
- Based on arithmetic averages of wells by county
- Evaluation not meant to imply any regulatory response



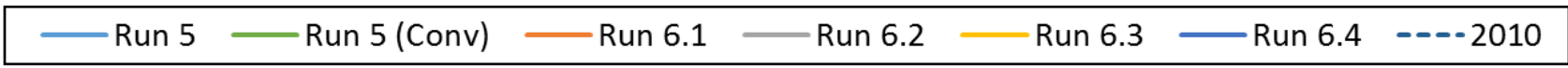
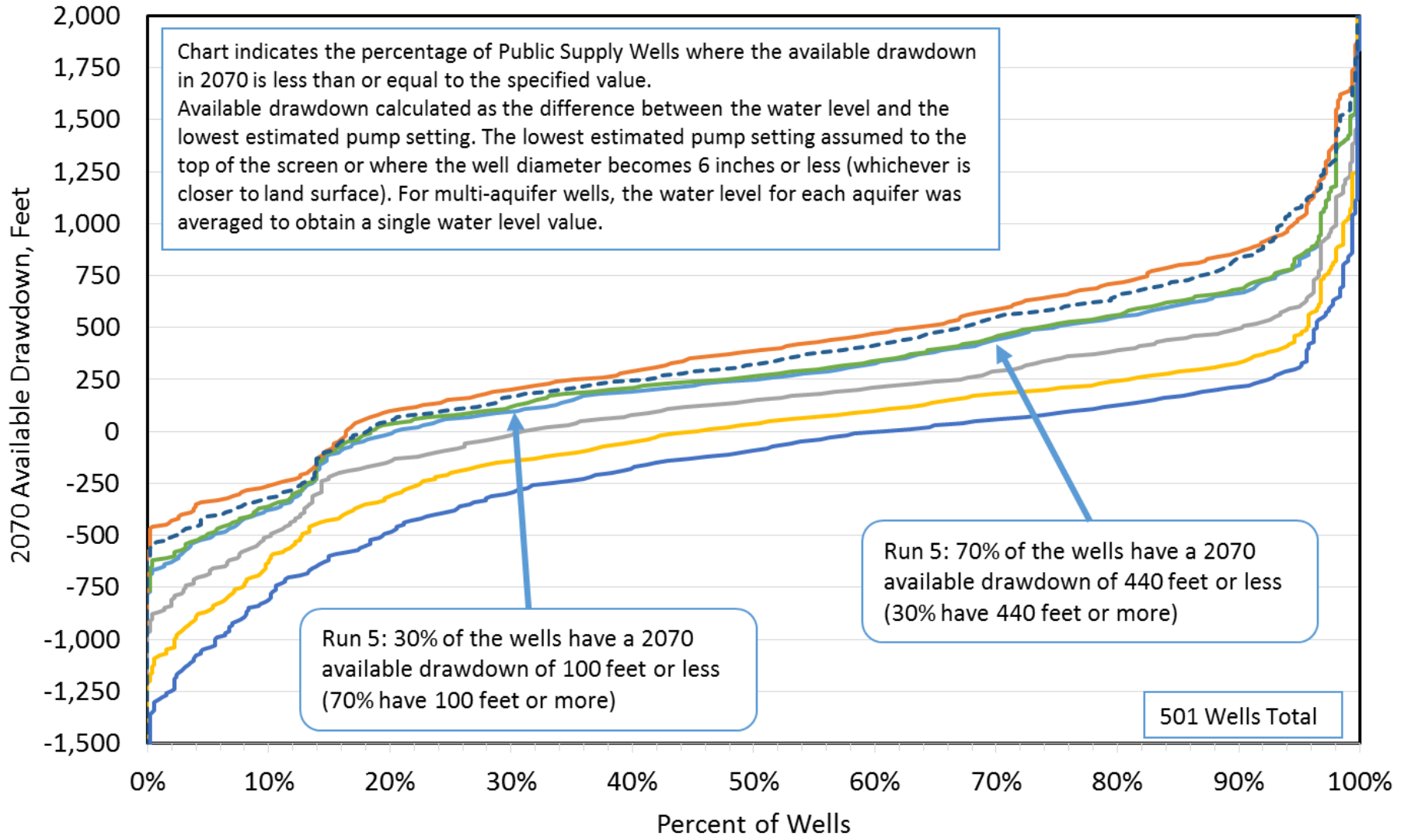
# Available Drawdown in 2070

- Public Water Supply wells
- 2070 available drawdown calculated above the “lowest” possible pump setting
  - Top of the screen
  - 6” casing or screen
- Water levels were averaged across multiple layers as appropriate in Hydrogeologic Regions 1 and 2
- Simulated water levels represent regional condition – therefore, 24-hour drawdown in each well needs to be accounted for when assessing well impacts – these impacts are not included in this analysis

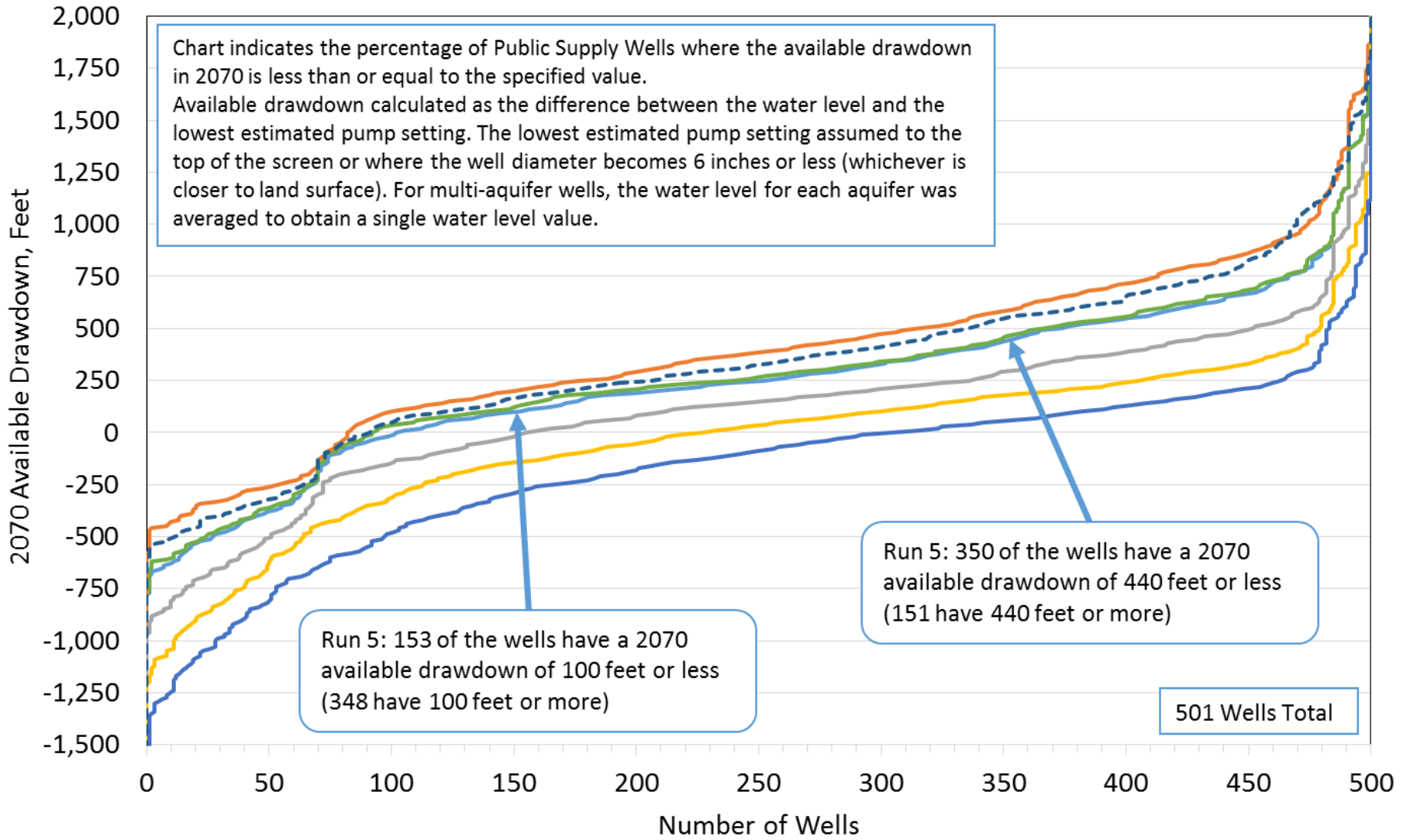
# North Texas Groundwater Conservation District

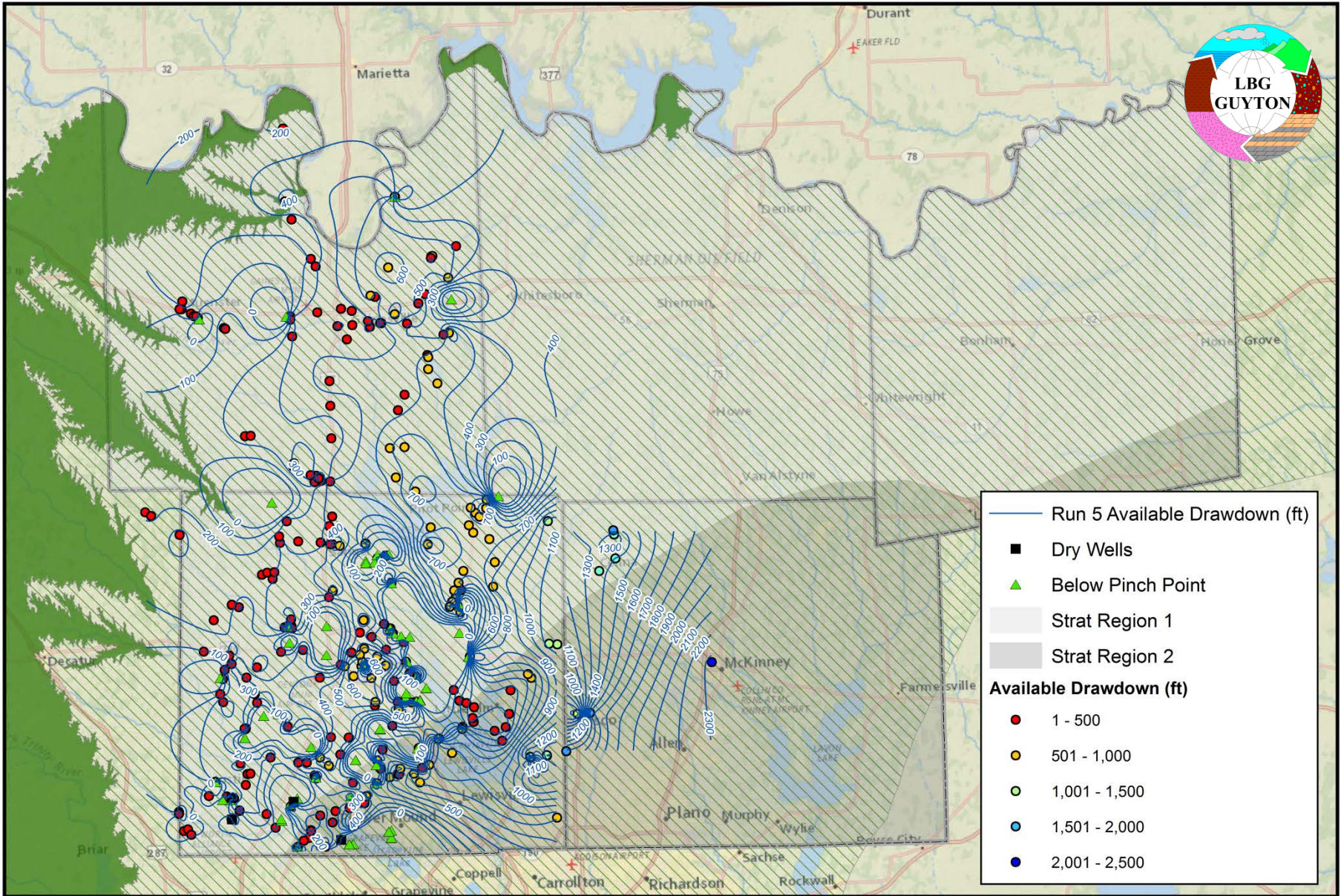


## NTWGAM Run Results - Available Drawdown in Public Water Supply Wells



# North Texas Groundwater Conservation District NTWGAM Run Results - Available Drawdown in Public Water Supply Wells



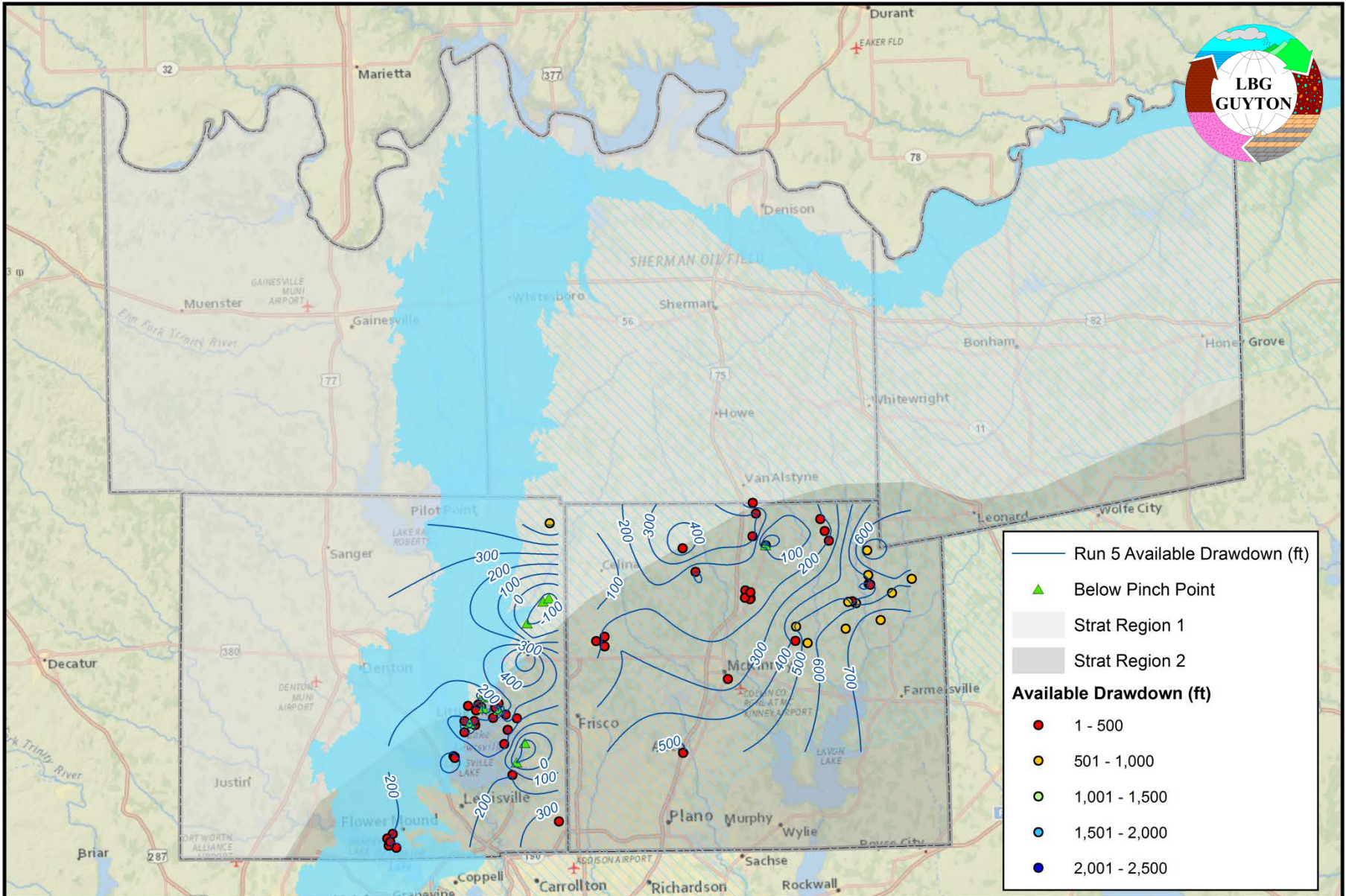


- Run 5 Available Drawdown (ft)
- Dry Wells
- ▲ Below Pinch Point
- ◻ Strat Region 1
- ◻ Strat Region 2
- Available Drawdown (ft)**
- 1 - 500
- 501 - 1,000
- 1,001 - 1,500
- 1,501 - 2,000
- 2,001 - 2,500



**2070 Available Drawdown Map**  
**Trinity - Antlers**  
 Collin, Cooke and Denton Counties  
 NTGAM Run 5

**Explanation**  
 Available drawdown calculated as the difference between water level and the lowest estimated pump setting.  
 For multi-aquifer wells, the Run 5 water level for each aquifer was averaged to obtain a single water level value.



**2070 Available Drawdown Map  
Woodbine**  
Collin, Cooke and Denton Counties  
NTGAM Run 5



Explanation  
Available drawdown calculated as the difference between water level and the lowest estimated pump setting.  
For multi-aquifer wells, the Run 5 water level for each aquifer was averaged to obtain a single water level value.

# Issues.....

- How to state DFCs ?
  - Drawdown in 2070
  - Available drawdown in 2070
  - With the modeling approach and results - Each of these is possible
- Scale of DFC ?
  - GMA wide
  - County and aquifer
  - Dwindip (confined) and Outcrop (unconfined)
  - Impact on Monitoring, Implementation, Petitions, Rules, Management Plans



# What's next?

- Most districts are currently assessing the modeling results
- GMA-8 meeting on November 18
- Next Step: Based on everything you have learned
  - Discuss facts and develop a direction for GMA-8
  - Consider percent remaining available drawdown in 2070 as a DFC
  - Additional runs based on input from GCDs