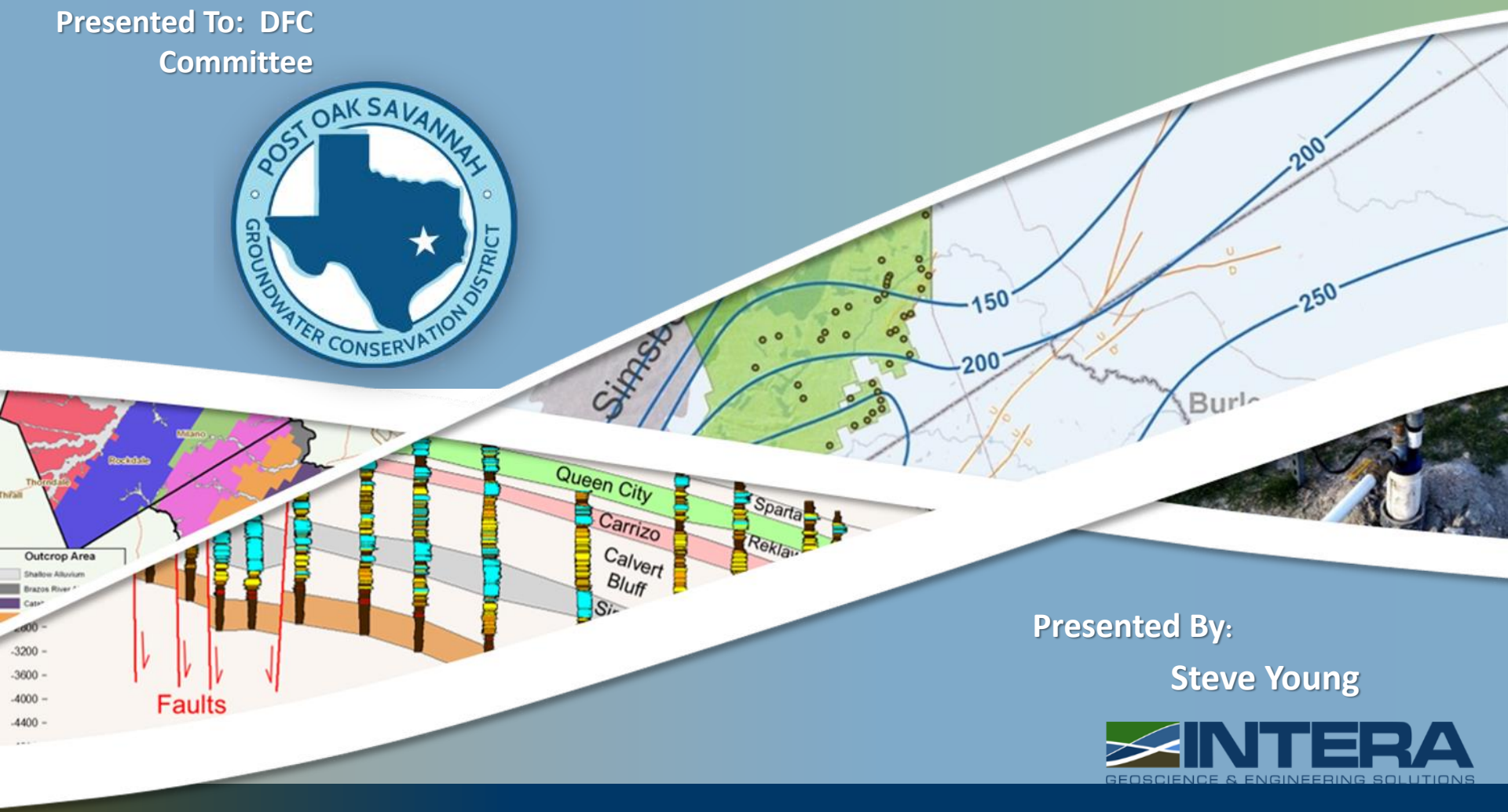
POSGCD Desired Future Committee Update

Presented To: DFC Committee



Presented By:

Steve Young

INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

November 8, 2021

Outline

- GMA 12
- GANA Report 2021
- Compliance Report 2021
- Guidance Document Report 2021
- Management Strategies Report 2021
- POSGCD Operational Model
- Well Spacing Study

GMA 12 Update

Summary of DFCs and Production Rates

Aquifer	Average Drawdown		
	2010 Adopted	2015 Adopted	2021 Proposed
	Jan 2000 to Dec 2059	Jan 2000 to Dec 2069	Jan 2010 to Dec 2069
Sparta	30	28	32
Queen City	30	30	31
Carrizo	65	67	172
Calvert Bluff	140	149	179
Simsboro	300	318	336
Hooper	180	205	214

Aquifer	Production[1] Associated with DFC Run			Permitted Amounts[2] (AFY)
	2010 Adopted	2015 Adopted	2021 Proposed	
	2059 Production	2069 Production	2069 Production	
Sparta	6,734	6,735	4,105	4,115
Queen City	502	504	7,838	1,637
Carrizo	7,059	7,058	18,206	21,641
Calvert Bluff	1,038	1,036	4,761	2,285
Simsboro	48,501	48,503	79,433	104,147
Hooper	4,422	4,422	3,126	2,080
Total	68,256	68,258	117,469	135,905

[1] production in acre-ft/year

[2] Permitted amount in Halff database in January 2021

Proposed 2021 DFC are associated with GAM Run S12

Summary of Comments Received by POSGCD on DFCs and DFC Process

- Requirement under TWC Section 36.108(d-2)

  "After the close of the public comment period, the district shall compile for consideration at the next joint planning meeting a summary of relevant comments received, any suggested revisions to the proposed desired future conditions, and the basis for the revisions."

- Summary of Comment Provided in Handouts
  - during comment period (April 23 to July 23)
  - outside of the comment period

Additional GAM Runs Proposed by GMA 12 During October 13 Meeting

- LPGCD Presented DFC Run S-15
  - Desire to reduce Simsboro DFC from 313 ft to 240 ft or less
  - Modified Run S-12 by removing:
    - Pumping associated with Gatehouse permit
    - Reducing Simsboro production across the board by 15% (resulting Simsboro pumpage = 82,830 ac-ft/yr)

	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper
LPGCD	22	26	126	129	239	137
POSGCD	32	30	161	155	277	178
BVGCD	47	40	72	89	195	136
METGCD	25	21	48	57	76	69
FCGCD	39	63	115	NA	NA	NA

Comparison of DFCs Produced by GAM Runs S12 and S15

DFC Generated by GAM Run S15

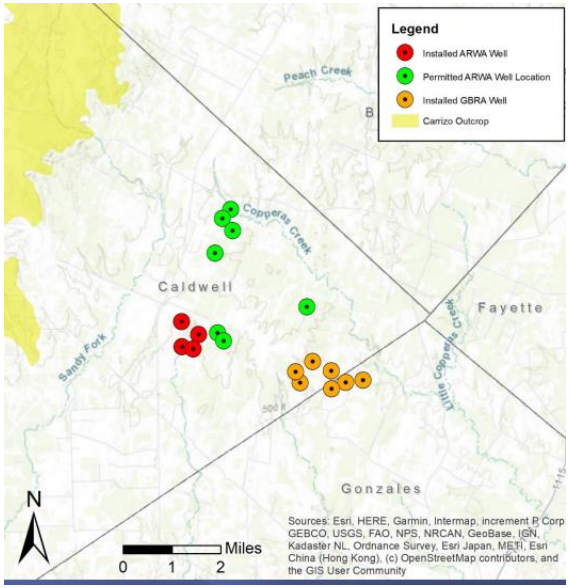
	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper
LPGCD	22	26	126	129	239	137
POSGCD	32	30	161	155	277	178
BVGCD	47	40	72	89	195	136
METGCD	25	21	48	57	76	69
FCGCD	39	63	115	NA	NA	NA

Amount that Run S15 Decreased DFCs from Run S12*

	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper
LPGCD	<1	2	12	27	74	37
POSGCD	<1	<1	11	25	61	39
BVGCD	1	1	4	9	21	17
METGCD	<1	<1	2	3	6	5
FCGCD	1	3	8	0	0	0

GMA 12 Request that Modification of Run S15 be Completed and Submitted in Nov 12 Meeting

- Include Pumpage for GBRA and ARWA projects in Gonzales and Caldwell Counties
- 31,320 ac-ft/yr of Carrizo pumping between the two projects



- New GAM Run is S19

Aquifer	Sparta	Queen City	Carrizo	Calvert Bluff	Simsboro	Hooper
LostPines	22	28	133	131	238	137
PostOak	32	30	162	155	275	176
BrazosValley	46	39	71	88	192	135
Mid-East	25	20	47	56	75	69
Fayette	42	72	139	140	206	118

For POSGCD, the change in Carrizo-Wilcox S15 DFCs is less than 2 feet

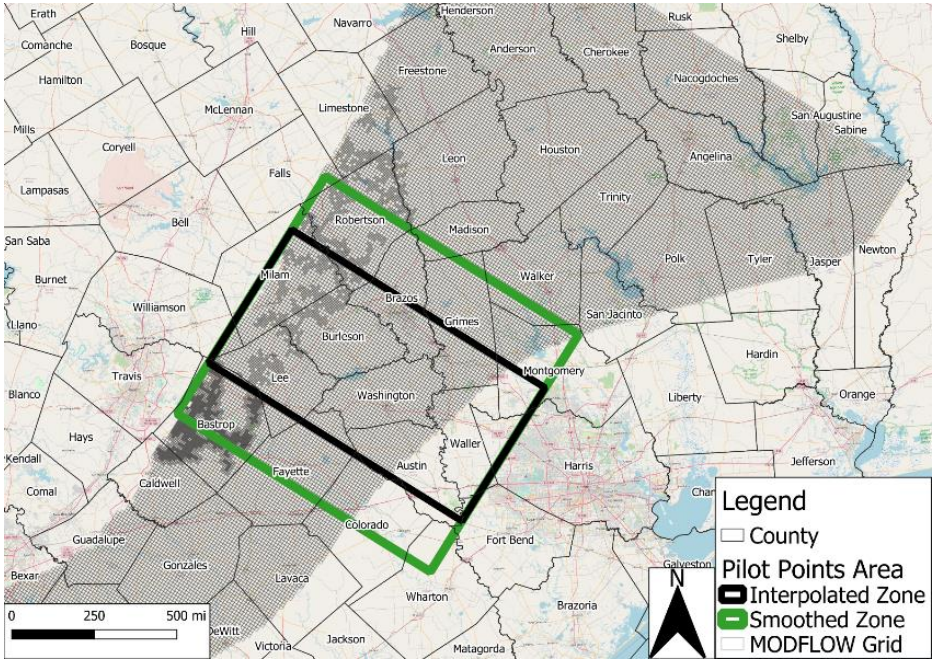
Discussion DFC Issues

- Lost Pines Board Meeting on November 8
  - Approved DFC for SimAboro of about 183 feet
  - Simsboro DFC to be based on 2017 MAG for Simsboro Aquifer (~33,000 ac-ft/yr)
- GMA 12 Meeting on November 12
  - Comments Received on DFC and DFC process
    - GMA 12 meeting
    - Explanatory report
  - Suggestions for POSGCD Board Meeting
  - Suggestions for GMA 12 Meeting

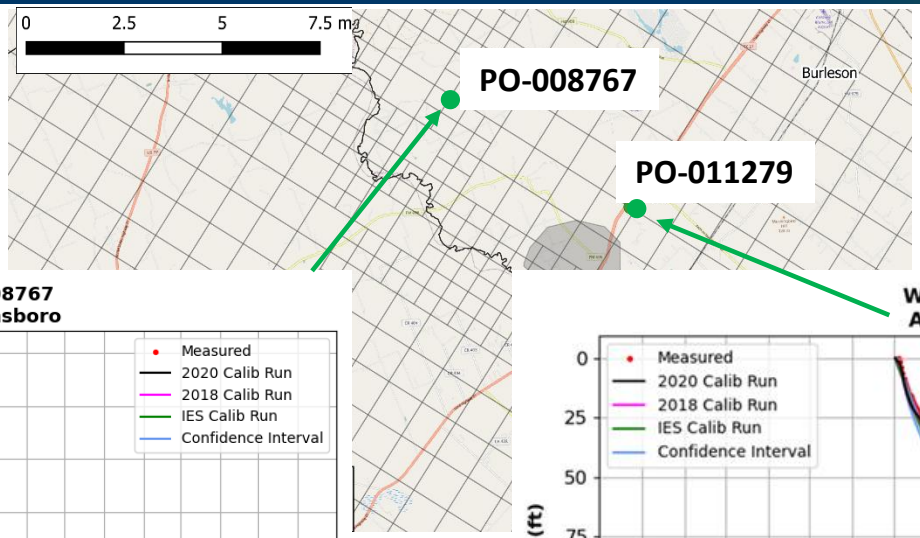
GANA Report 2021

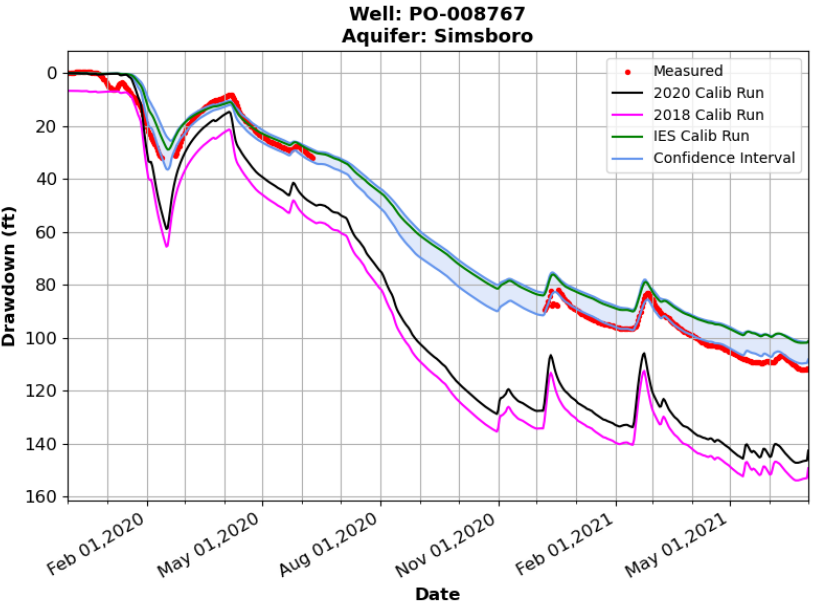
GANA Report 2021

- Model
  - POSGCD Operational Model
  - GMA 12 DFC Run 19
- Revised Well Database
  - HALFF Well Inventory
  - Well Aquifer assignments based on GAM layers
- Schedule
  - Draft November 19th

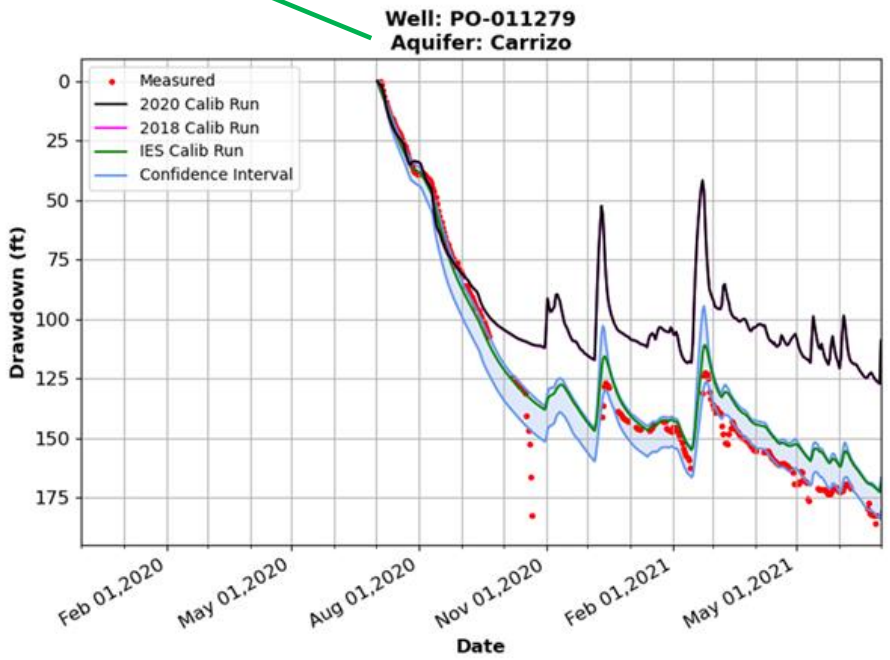


POSGCD Operational Model and GMA 12 GAM





GAM overpredict Simsboro Drawdowns



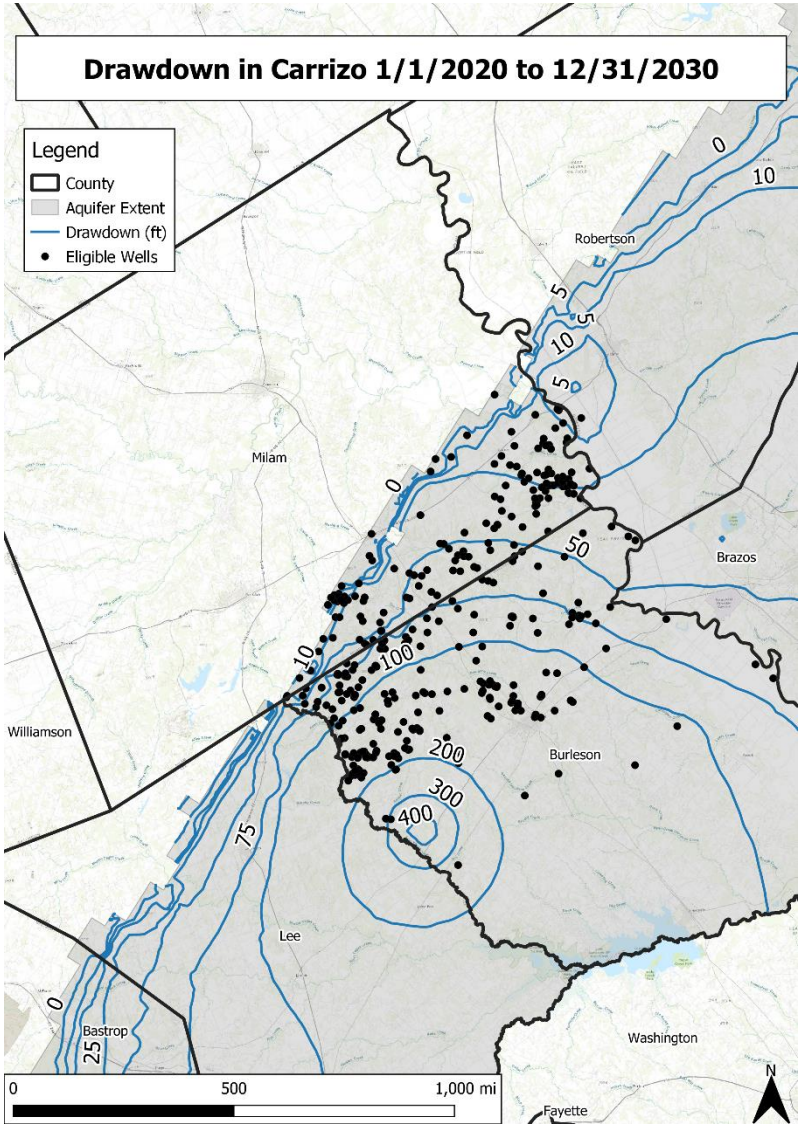
GAM underpredict Carrizo Drawdowns

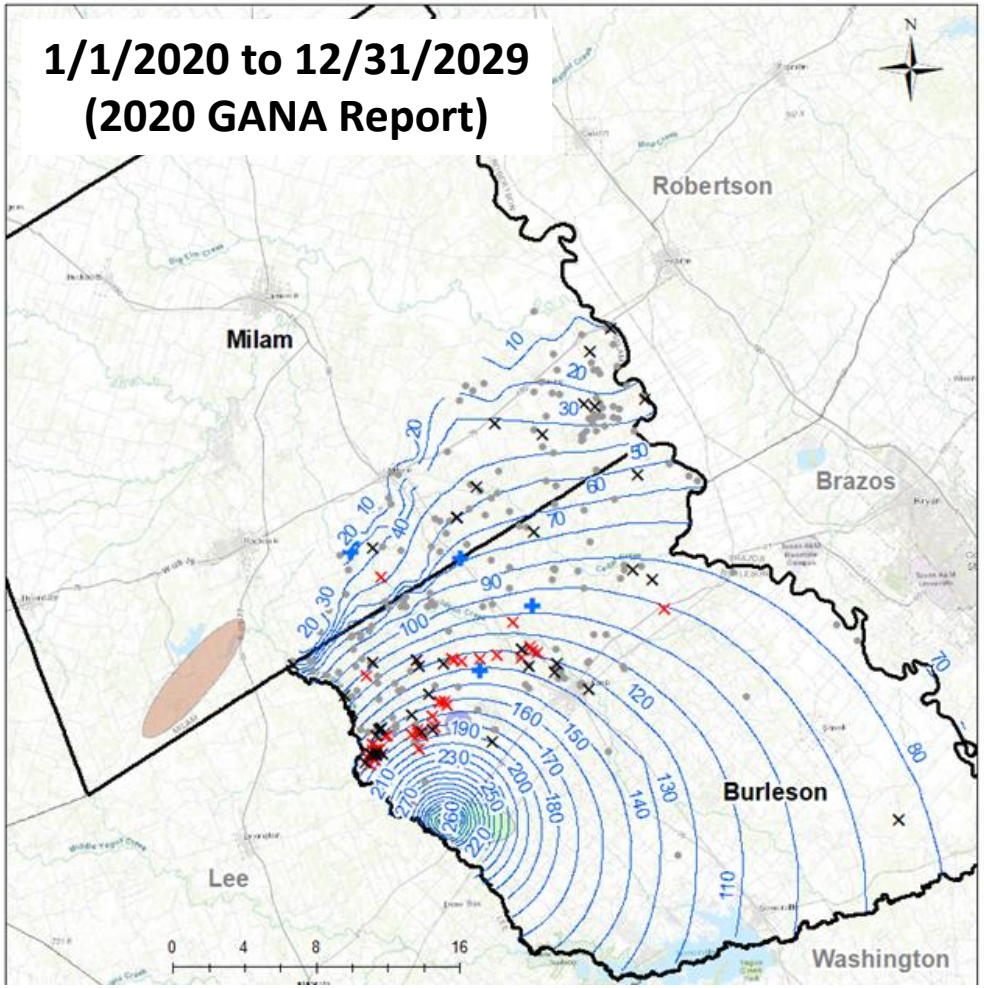
Eligible Wells

Formation	2021			2020
	Exempt	Low Capacity	Total Eligible	Total Eligible
Sparta	1,162	33	1,195	974
Queen City	1,176	22	1,198	898
Carrizo	375	10	385	325
Calvert Bluff	746	43	789	670
Simsboro	439	46	485	411
Hooper	703	14	717	806
TOTAL	4,601	168	4,769	4084

Note: Low Capacity is less than 50 gpm

Comparison of Drawdown in Carrizo





Compliance Report 2021

Compliance Report

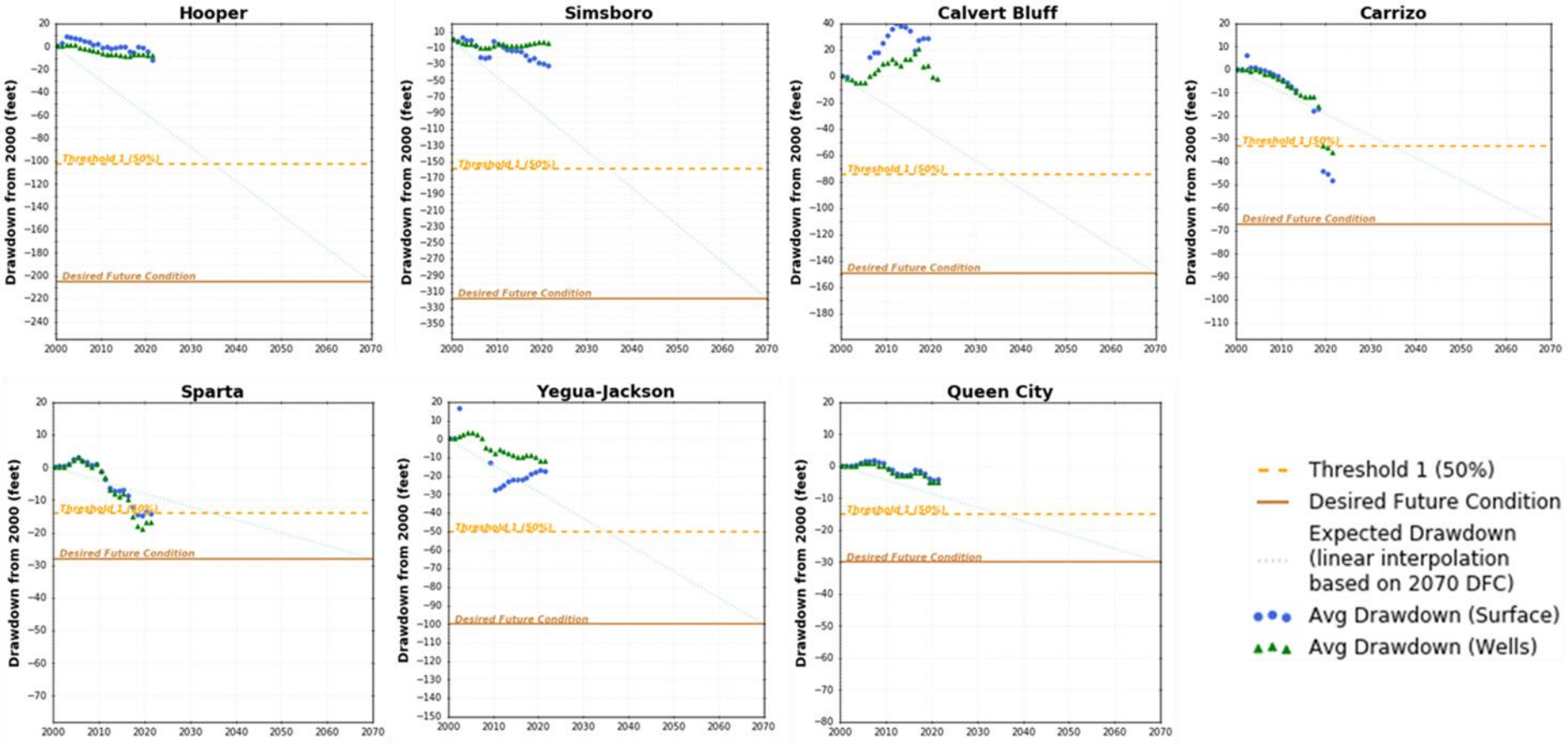
- Results
  - Presented at POSGCD Summit in August
  - A few minor corrections
- Schedule
  - Late November/Early December

Desired Future Condition (DFC) Assessment

Management Zone	DFC	Drawdown from 2000 to 2010	Drawdown from 2000 to 2015	Drawdown from 2000 to 2016	Drawdown from 2000 to 2017	Drawdown from 2000 to 2018	Drawdown from 2000 to 2019	Drawdown from 2000 to 2020	Drawdown from 2000 to 2021
		Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)
Yegua Jackson	100	27.5	22.3	22.2	21.0	19.2	18.1	17.1	17.8
		27.5%	22.3%	22.2%	21.0%	19.2%	18.1%	17.1%	17.80%
Sparta	28	1.4	6.9	8.6	12.3	14.5	15.0	13.8	14.3
		5.0%	24.8%	30.6%	43.8%	51.8%	53.4%	49.3%	51.20%
Queen City	30	0.9	2.7	1.3	1.6	2.4	3.9	4.4	4.2
		3.0%	8.9%	4.4%	5.5%	8.0%	13.0%	14.6%	14.10%
Carrizo	67	-11.1	-4.3	-3.8	18.1	17.3	44.1	45.5	48.2
		-16.6%	-6.4%	-5.7%	27.0%	25.8%	65.9%	67.9%	71.90%
Calvert Bluff (Upper Wilcox)	149	-29.9	-34.6	-19.0	-27.0	-28.3	-28.4	-57.8	-56.5
		-20.1%	-23.2%	-12.7%	-18.1%	-19.0%	-19.1%	-38.8%	-37.90%
Simsboro (Middle Wilcox)	318	5.0	14.9	19.0	24.7	22.4	28.3	30.3	32
		1.6%	4.7%	6.0%	7.8%	7.0%	8.9%	9.5%	10.10%
Hooper (Lower Wilcox)	205	5.4	-1.3	2.2	3.6	-0.7	-0.5	3.0	10.7
		2.6%	-0.6%	1.0%	1.8%	-0.3%	-0.2%	1.5%	5.20%

Threshold 1 = 50% of PDL Threshold 2 = 60% of PDL Threshold 3 = 75% of PDL

Calculated Compliance with DFCs: Graphs

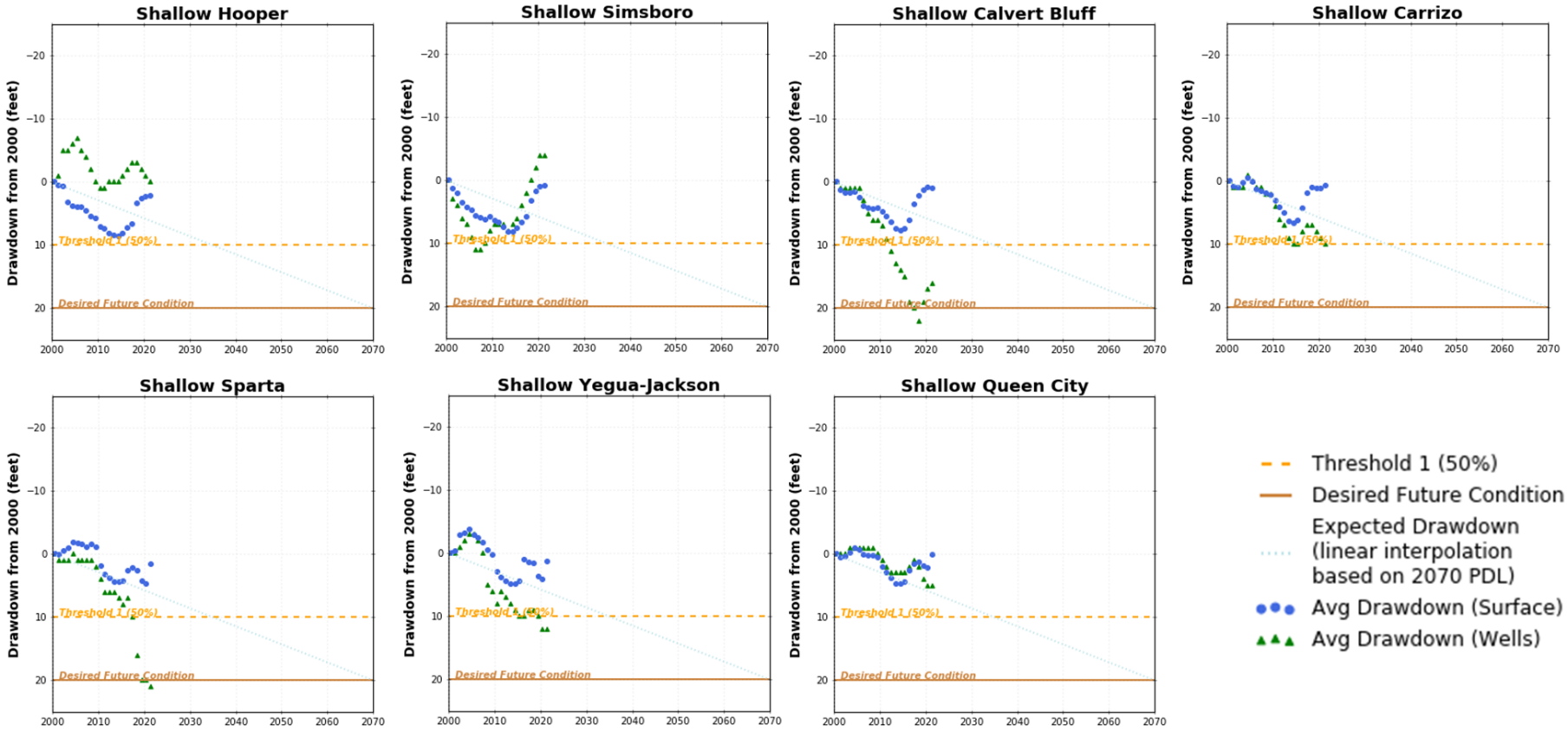


Protective Drawdown Limit (PDL) Assessment

Management Zone	PDL	Drawdown from 2000 to 2015	Drawdown from 2000 to 2016	Drawdown from 2000 to 2017	Drawdown from 2000 to 2018	Drawdown from 2000 to 2019	Drawdown from 2001 to 2020	Drawdown from 2000 to 2021
		Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)
Yegua Jackson	20	4.40	0.93	1.46	1.60	3.63	4.07	1.2
		22%	5%	7%	8%	18%	20%	6%
Sparta	20	4.3	2.6	2.1	2.7	4.2	4.7	1.6
		21%	13%	11%	13%	21%	24%	8%
Queen City	20	4.4	2.6	1.6	1.2	1.9	2.2	0.03
		22%	13%	8%	6%	10%	11%	0%
Carrizo	20	6.1	4.3	1.9	1.0	1.1	1.1	0.66
		31%	21%	10%	5%	6%	6%	3%
Calvert Bluff (Upper Wilcox)	20	7.3	6.1	3.5	2.3	1.4	0.8	0.96
		37%	30%	18%	11%	7%	4%	5%
Simsboro (Middle Wilcox)	20	7.6	6.6	5.8	3.2	1.8	1.0	0.87
		38%	33%	29%	16%	9%	5%	4%
Hooper (Lower Wilcox)	20	8.1	7.3	6.7	3.3	2.6	2.3	2.2
		40%	37%	33%	17%	13%	12%	11%

Threshold 1 = 50% of PDL Threshold 2 = 60% of PDL Threshold 3 = 75% of PDL

Calculated Compliance with PDLs: Graphs



Guidance Document 2021

Guidance Document Overview

- Management Zones
- Aquifer Assignment Methodology for Wells
- Monitoring Well Network
- Monitoring Protocols
- Data Filtering and Quality Checks
- Methodology for Calculating
  - Drawdown
  - Water Levels

Post Oak Savannah Guidance Document for Evaluating Compliance with Desired Future Conditions and Protective Drawdown Limits

Prepared for:

Post Oak Savannah Groundwater Conservation District
310 E Ave C
Milano, TX 76556

Prepared by:

INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

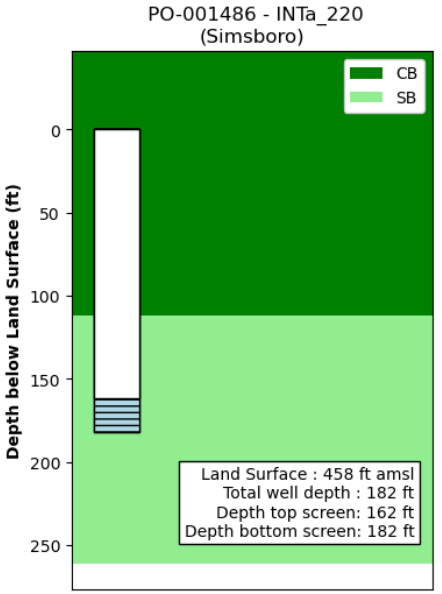
9600 Great Hills Trail
Suite 300W
Austin, TX 78759

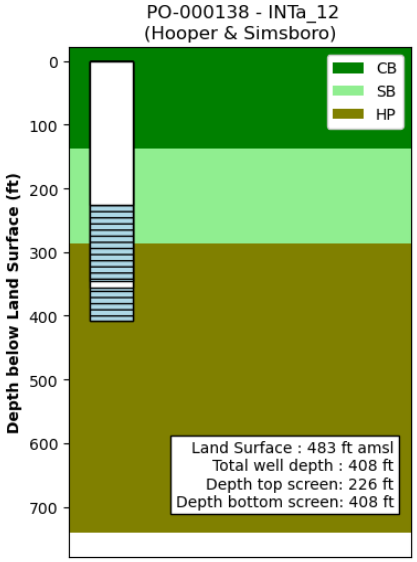
August 2018

Version 2.0

Wells Assignments

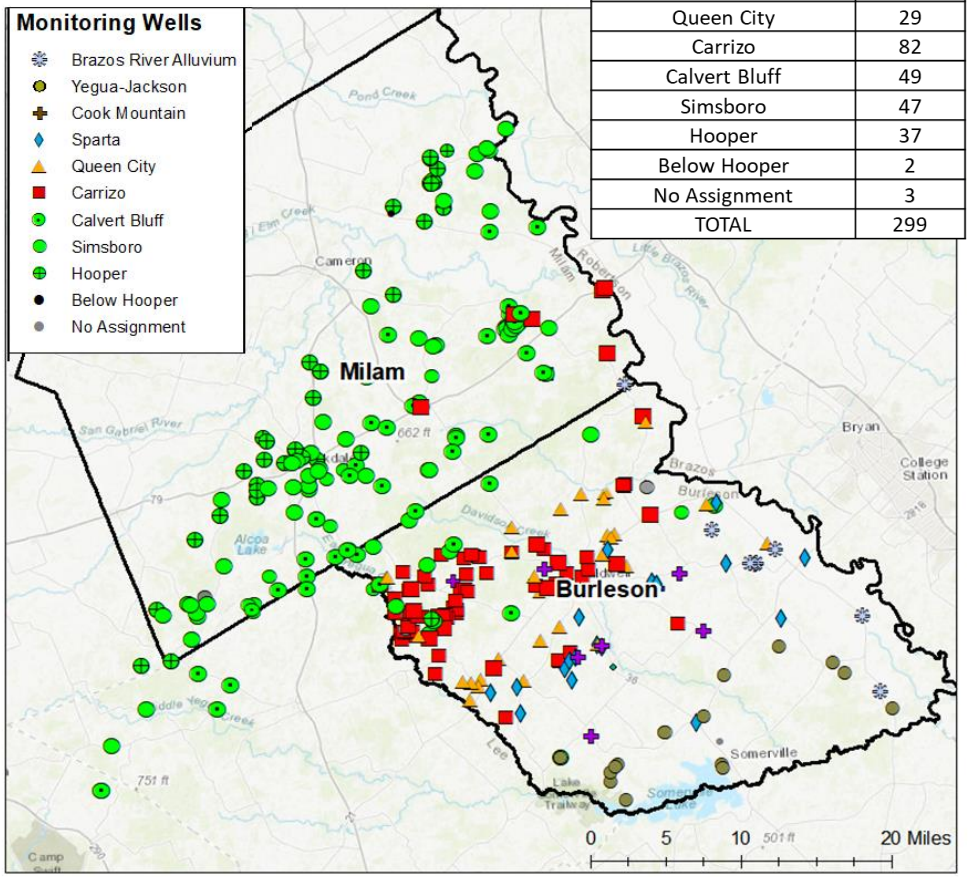
- Adjustments from GAM layers
  - continual process
  - includes TWDB review
- Criteria for Inclusion in Generating Water Level Surfaces
  - single aquifer
  - multiple aquifer



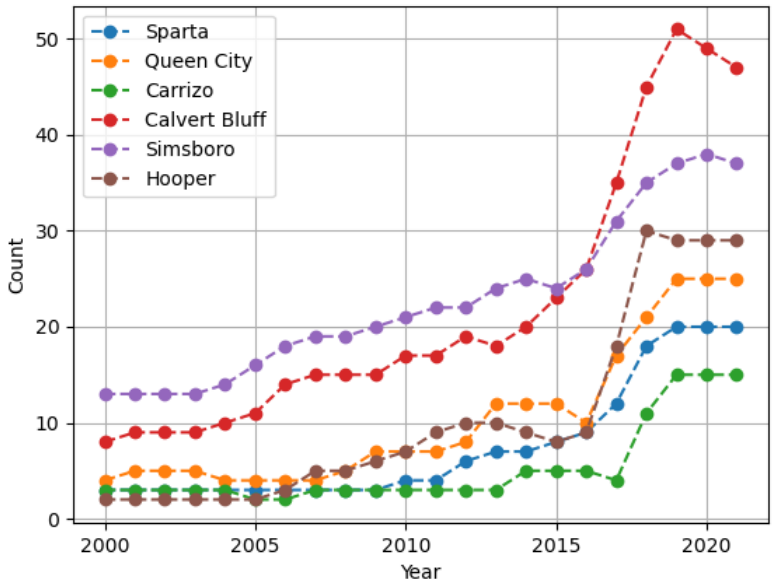


Monitoring Network

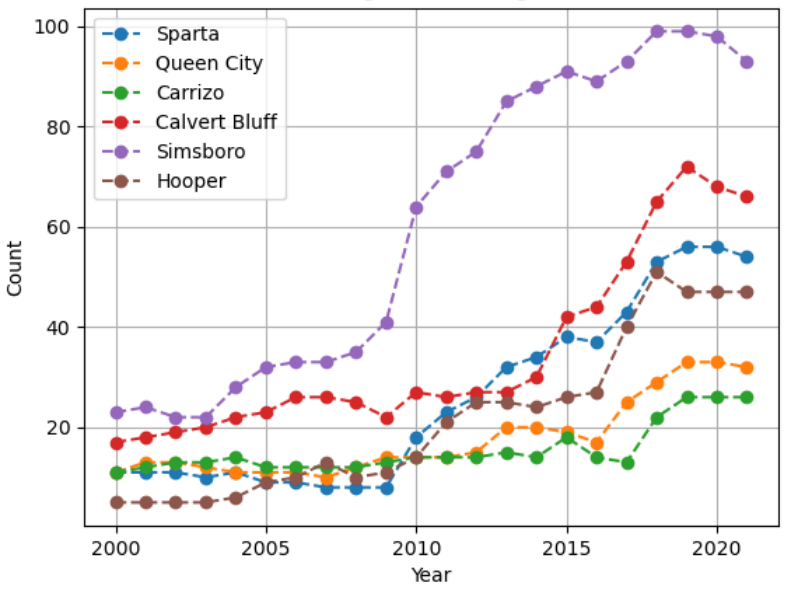
Aquifer	# of Wells
BRAA	7
Yegua-Jackson	15
Cook Mountain	8
Sparta	20
Queen City	29
Carrizo	82
Calvert Bluff	49
Simsboro	47
Hooper	37
Below Hooper	2
No Assignment	3
TOTAL	299



2021 POSGCD = 195

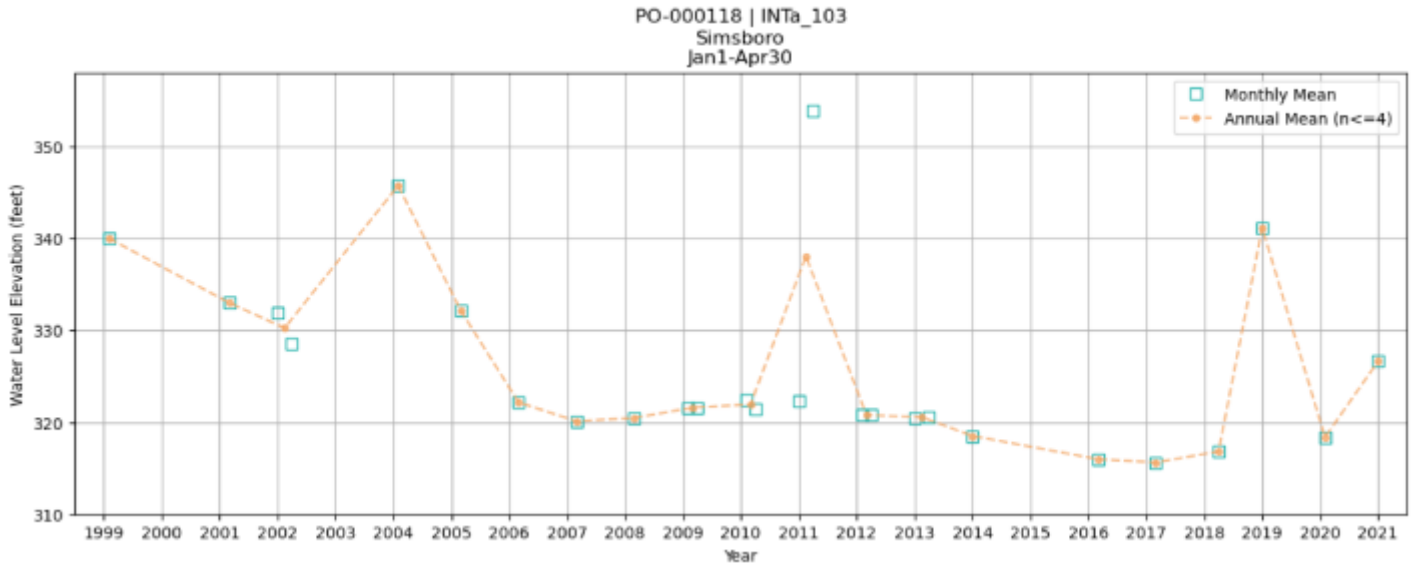


2021 POSGCD, LPGCD, BVGCD Total = 377



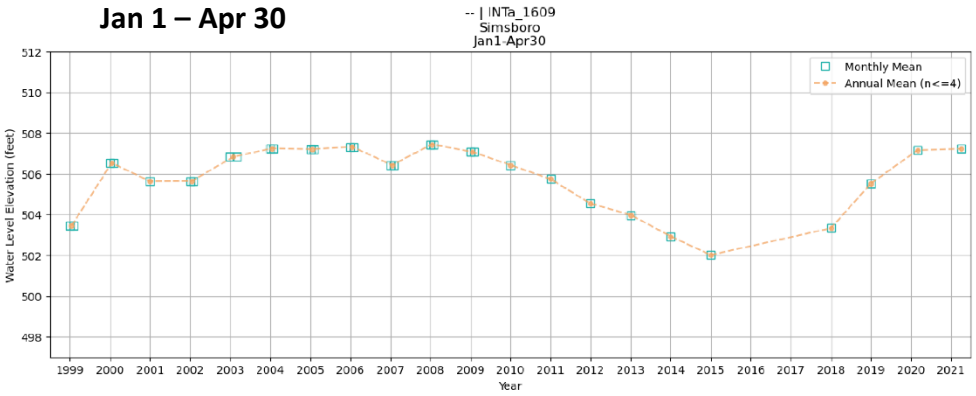
Water Level Data

- Updates Regarding 3-year averages
  - Incorporate continuous measurements from transducers
  - Clarify QA/QC of water level measurements
  - Change average period
    - from November 1 through March 1
    - to January 1 through April 30

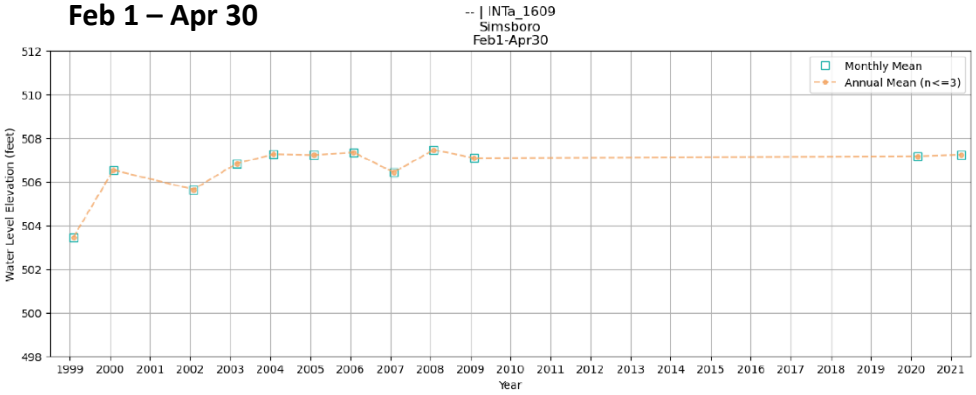


Sensitivity of Water Levels to Sampling Period

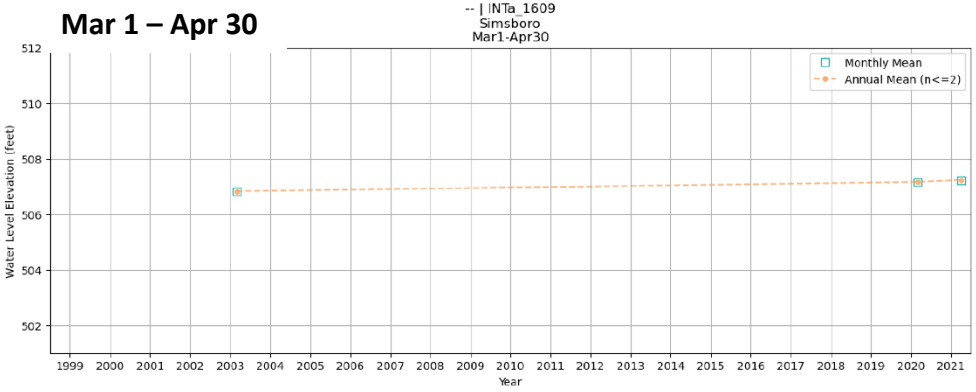
Jan 1 – Apr 30



Feb 1 – Apr 30

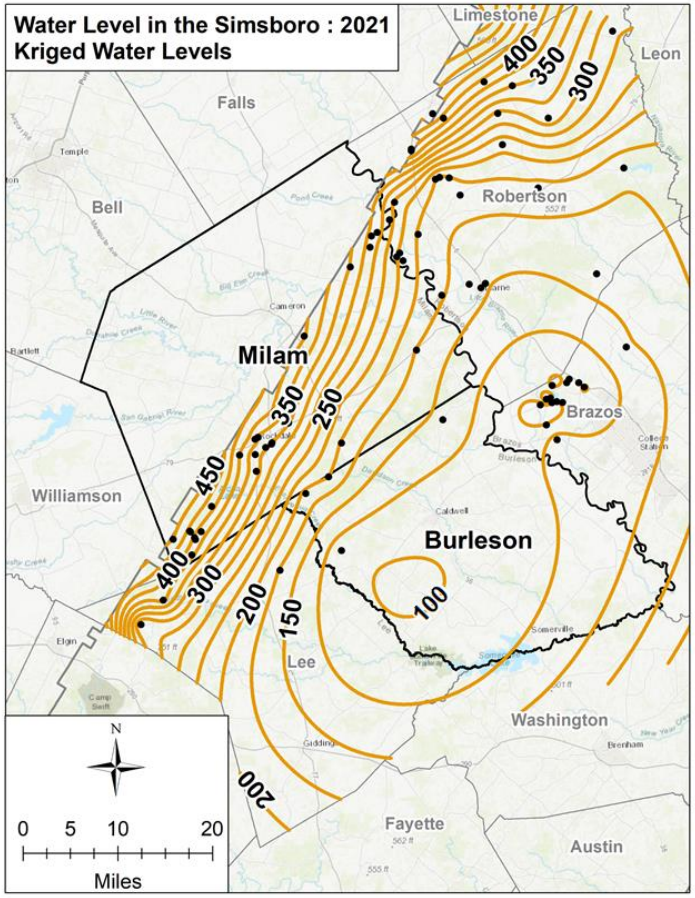


Mar 1 – Apr 30



Interpolation of Measured Water Levels to Generate Continuous Surfaces

- Data Selection
  - Only wells with measurements for both years
  - Use all available wells for each year
- Data Interpolation Options
  - Topo2Raster (method for land surface) [1]
  - Kriged Water Levels (method with no spatial trend)[2]
  - Kriged Residuals (method that accounts for spatial trend)[3]

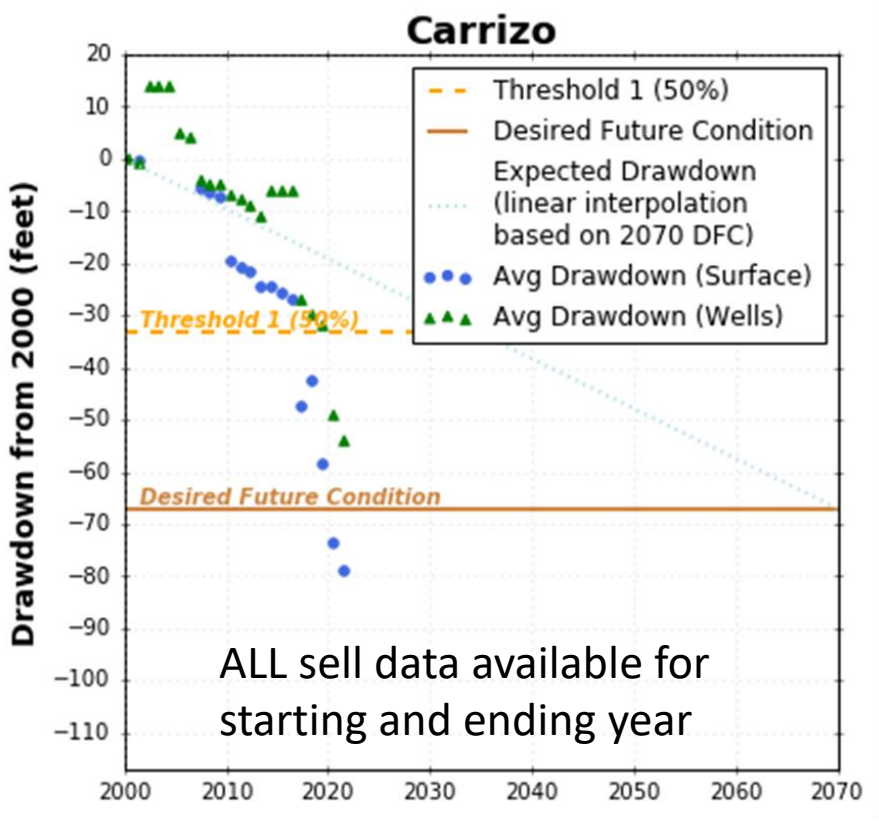


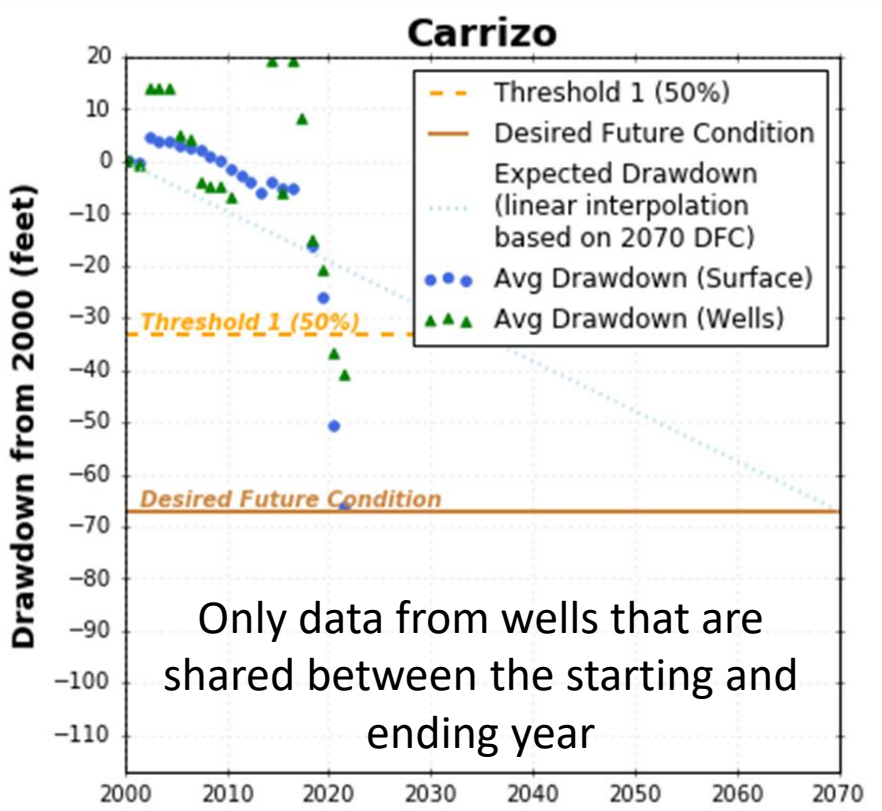
[1] Current method

[2] Kriged Water Levels are based on geostatistical analysis of data

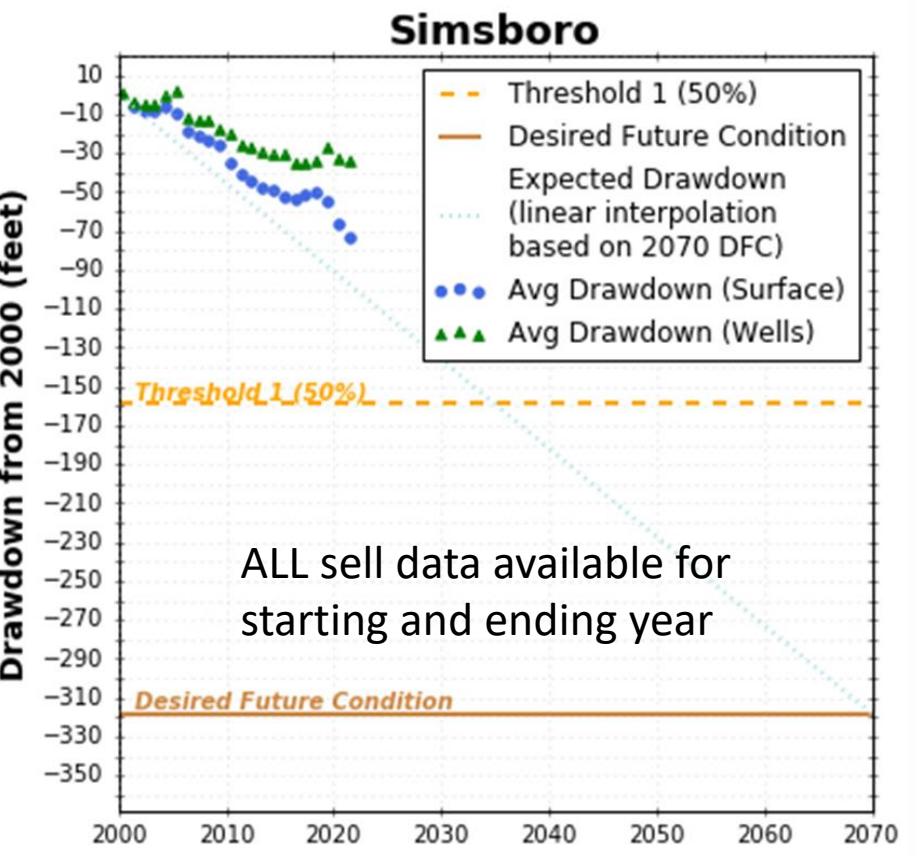
[3] Kriged Residuals is based on geostatistical analysis of data and groundwater modeling

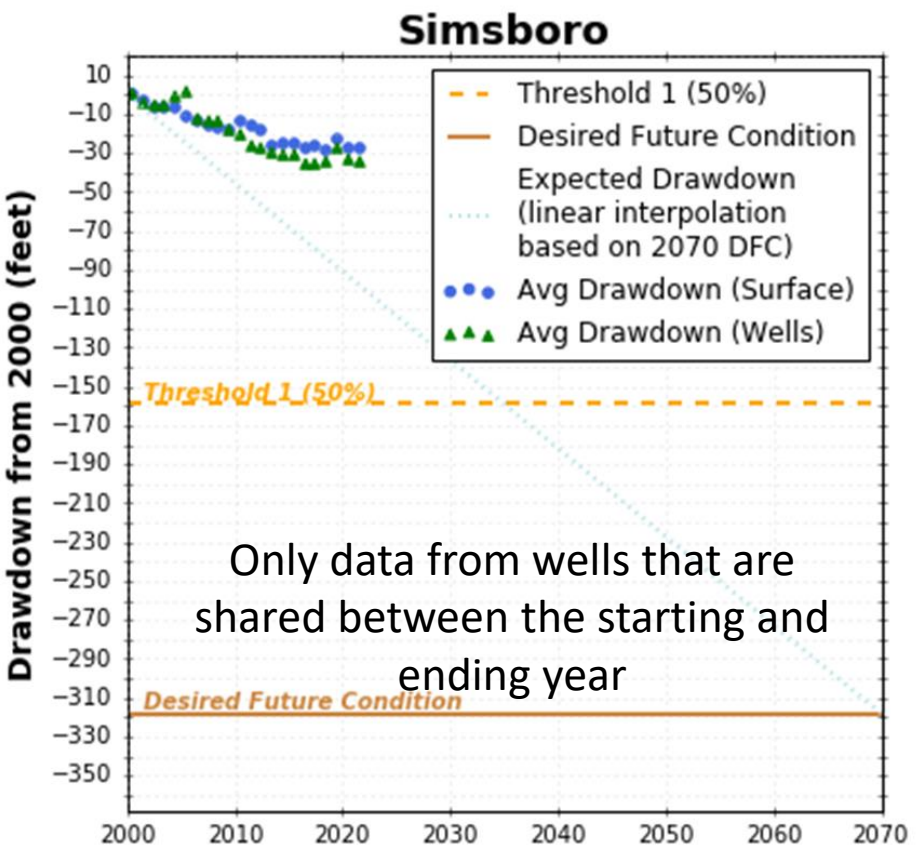
Comparison between Measurements for Common Wells and All Available Well Measurements: Topo2Raster





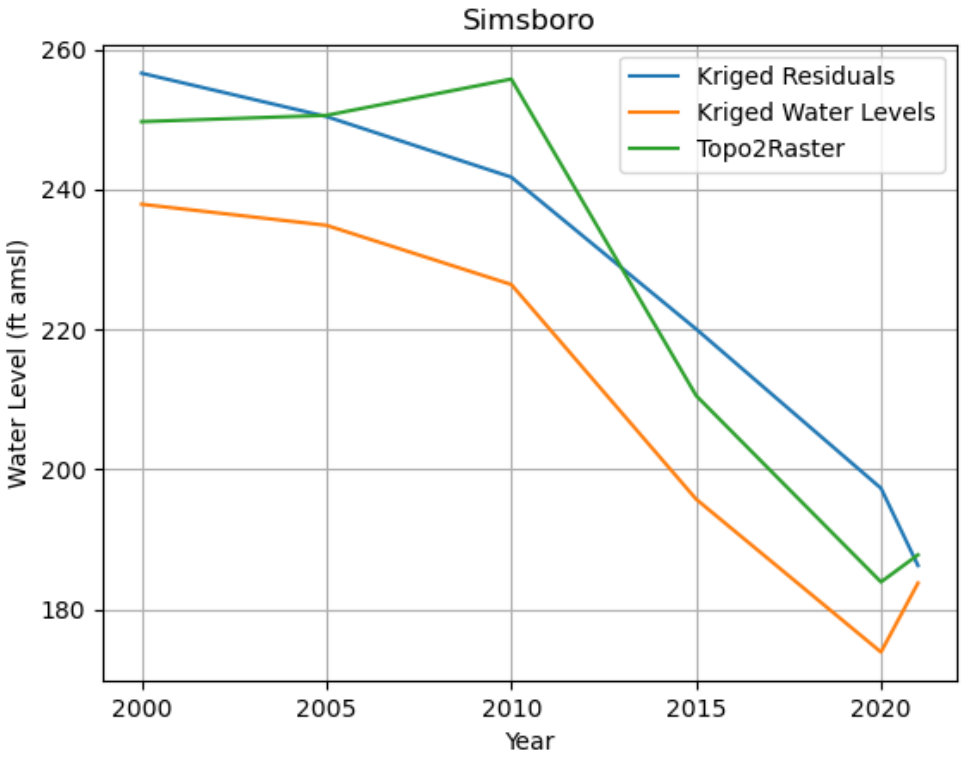
Comparison between Measurements for Common Wells and All Available Well Measurements: Topo2Raster





Comparison of Three Methods: Simsboro

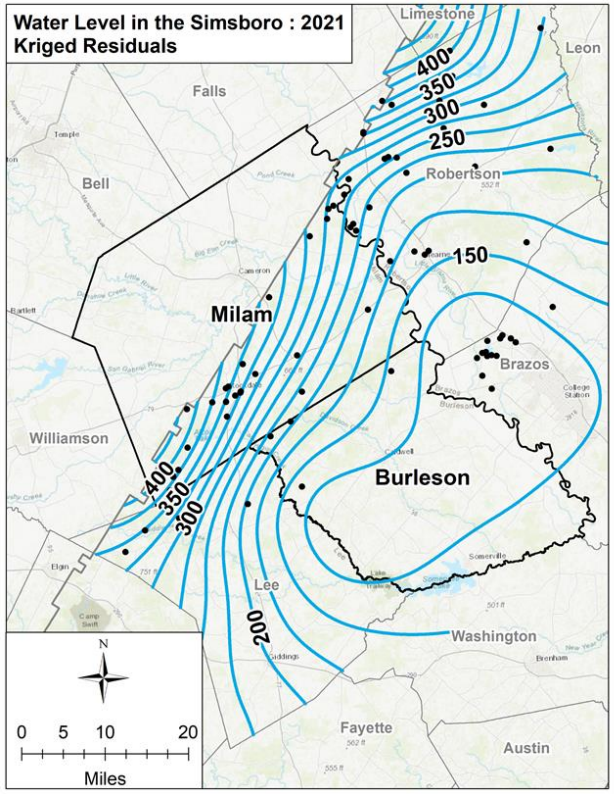
Simsboro			
Method	Year	Avg. Water Level (ft amsl)	Drawdown (ft) Since 2000
Kriged Residuals	2000	257	0
	2005	250	6
	2010	242	15
	2015	220	37
	2020	197	59
	2021	186	70
Kriged Water Levels	2000	238	0
	2005	235	3
	2010	226	11
	2015	196	42
	2020	174	64
	2021	184	54
Topo2Raster	2000	250	0
	2005	251	-1
	2010	256	-6
	2015	211	39
	2020	184	66
	2021	188	62



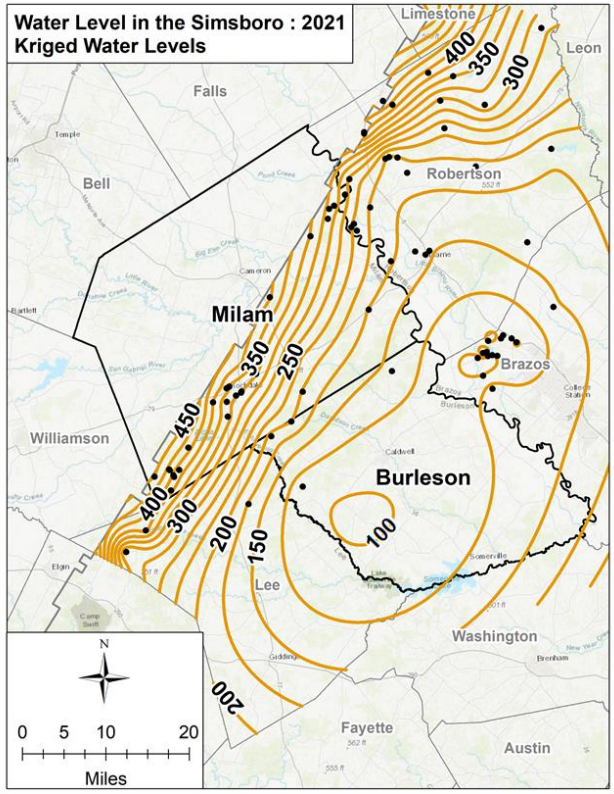
Kriged Residuals will be

Contours of Simsboro Water Level

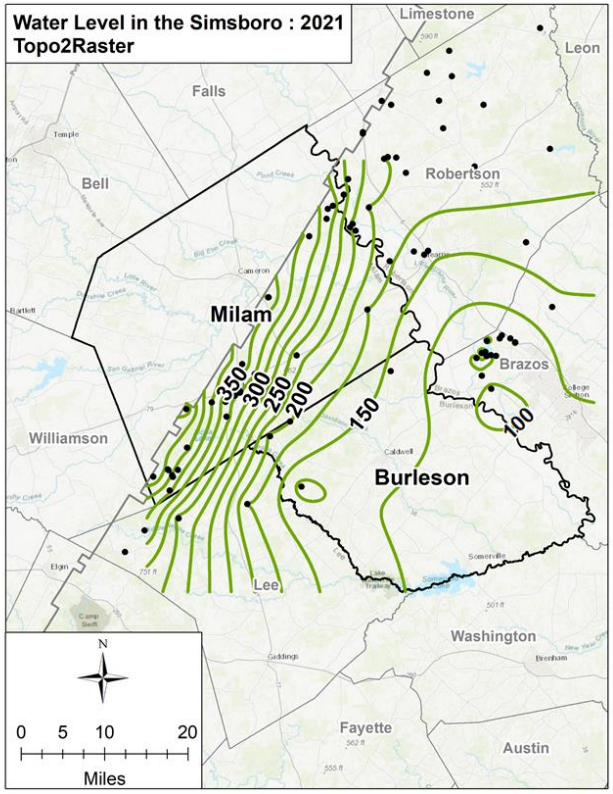
Average WL = 186 (ft, msl)



Average WL = 184 (ft, msl)



Average WL = 188 (ft, msl)



Guidance Document Objective

- Data Collection & Analysis
  - Effective
  - Cost Effective
  - Transparent
  - Driven by Best Available Science
  - Credible
- Reviewed
  - Discussions with TWDB and other state agencies
  - Presentations
  - Publications

Management Strategies Report 2021

Suggested Priority Issues

7.3 Management Issues Affecting the Monitoring and Enforcement of Production and Drawdown Thresholds

- Unreasonable Impacts to Groundwater and Surface Water
- Maximum Production Volumes Based on Permitted Acreage
- Compatibility of DFCs and PDLs
- Boundaries for Management Zones Associated with Desired Future Conditions
- Time Intervals Associated with Desired Future Conditions
- Enforcement and PDLs by Curtailment of Production
- Incentivize Conjunctive use of Groundwater and Surface Water

Suggested Tasks

- Unreasonable Impacts to Groundwater and Surface Water
  - Expand well spacing criteria to account for large well field impacts
  - Base analysis on observed drawdown impacts that either observed or predicted
- Maximum Production Volumes Based on Permitted Acreage
  - Explanation of benefits of adjusting maximum production to aquifer productivity
  - Options/criteria for implementing aquifer, management zone, aquifer thickness

Suggested Tasks

- Compatibility of DFCs and PDLs
  - Rationale for compatibility concern
  - Revisit depth of 400 feet
  - Investigate viable alternative

- Boundaries for Management Zones Associated with Desired Future Conditions
  - Consider logistics of demonstrating that DFC has been exceeded
  - Consider impact on enforcement of all rules and all district goals

Suggested Tasks

- Time Intervals Associated with Desired Future Conditions
  - Continuation of Permit Production in DFC simulations
  - DFCs that occur sooner that 50+ years
  - Clarify meaning of DFC exceedance
- Enforcement and PDLs by Curtailment of Production
  - Consider logistics of demonstrating that DFC has been exceeded
  - Consider impact on enforcement of all rules and all district goals

Suggested Tasks

- Incentivize Conjunctive use of Groundwater and Surface Water
  - Promote prudent management of groundwater resources
  - Reduce long-term demand on groundwater resources

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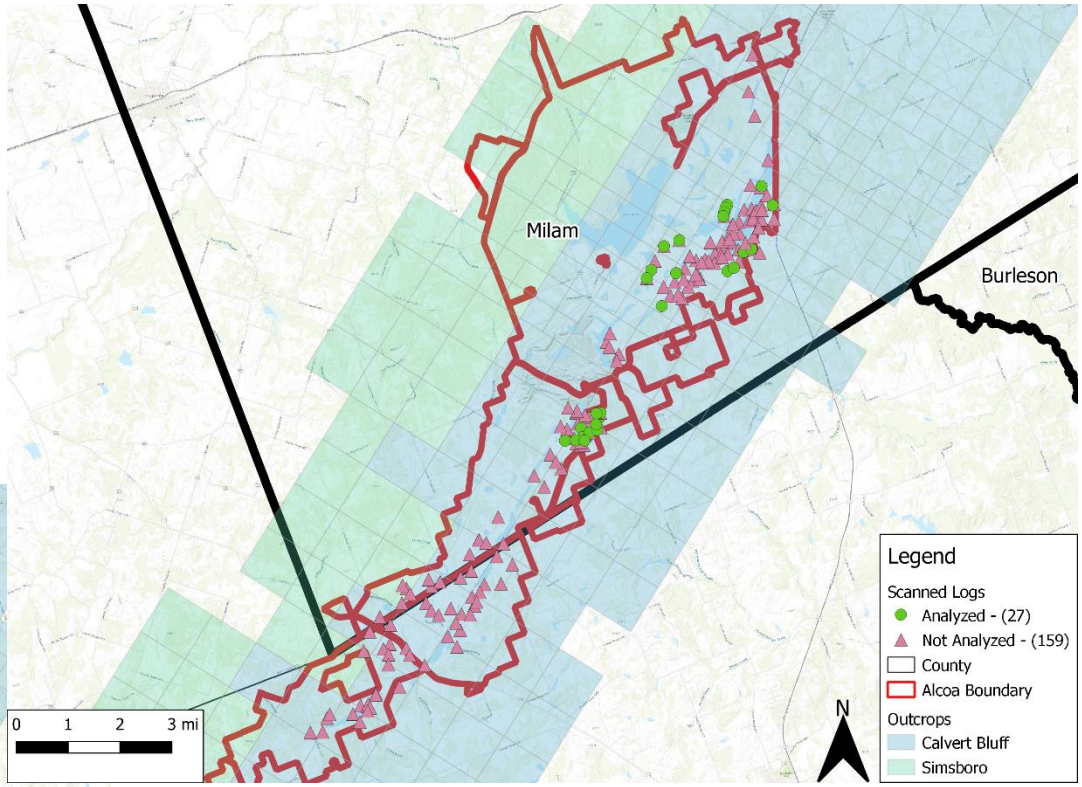
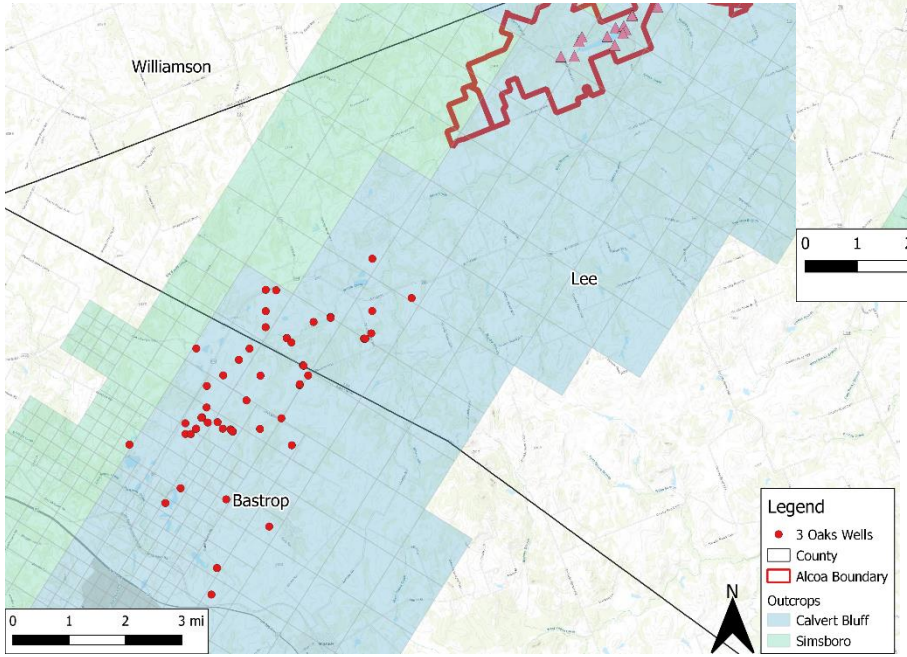
Operational POSGCD Model

Acquisition of Logs from ALCOA





Well Spacing Study

Well Spacing Study

- Estimate the Drawdown Impacts that are allowed by the well spacing rules
  - Assume two identical wells are impacting each other
  - Based on aquifer properties in the GAM

Baseline Pumping Scenario

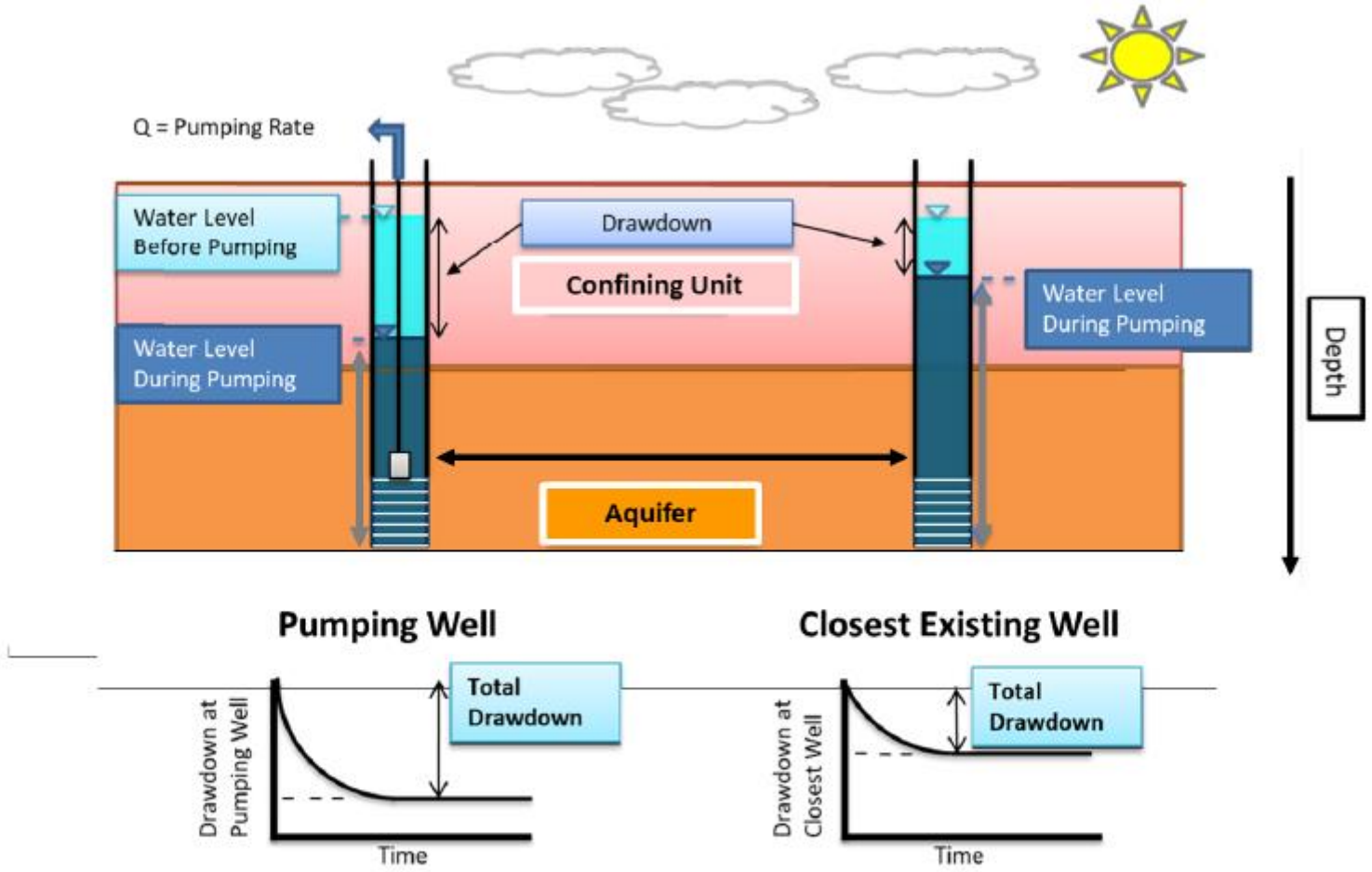
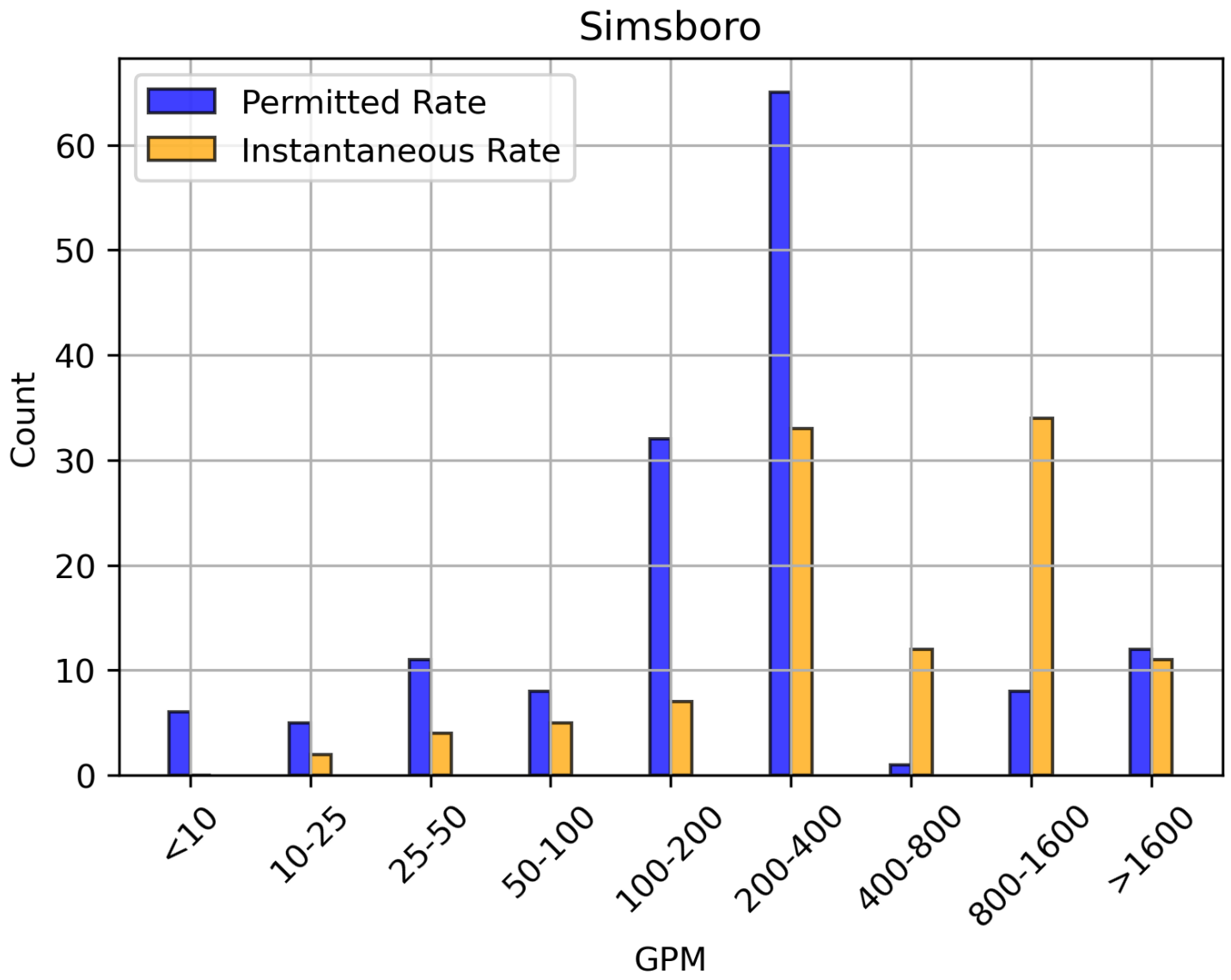
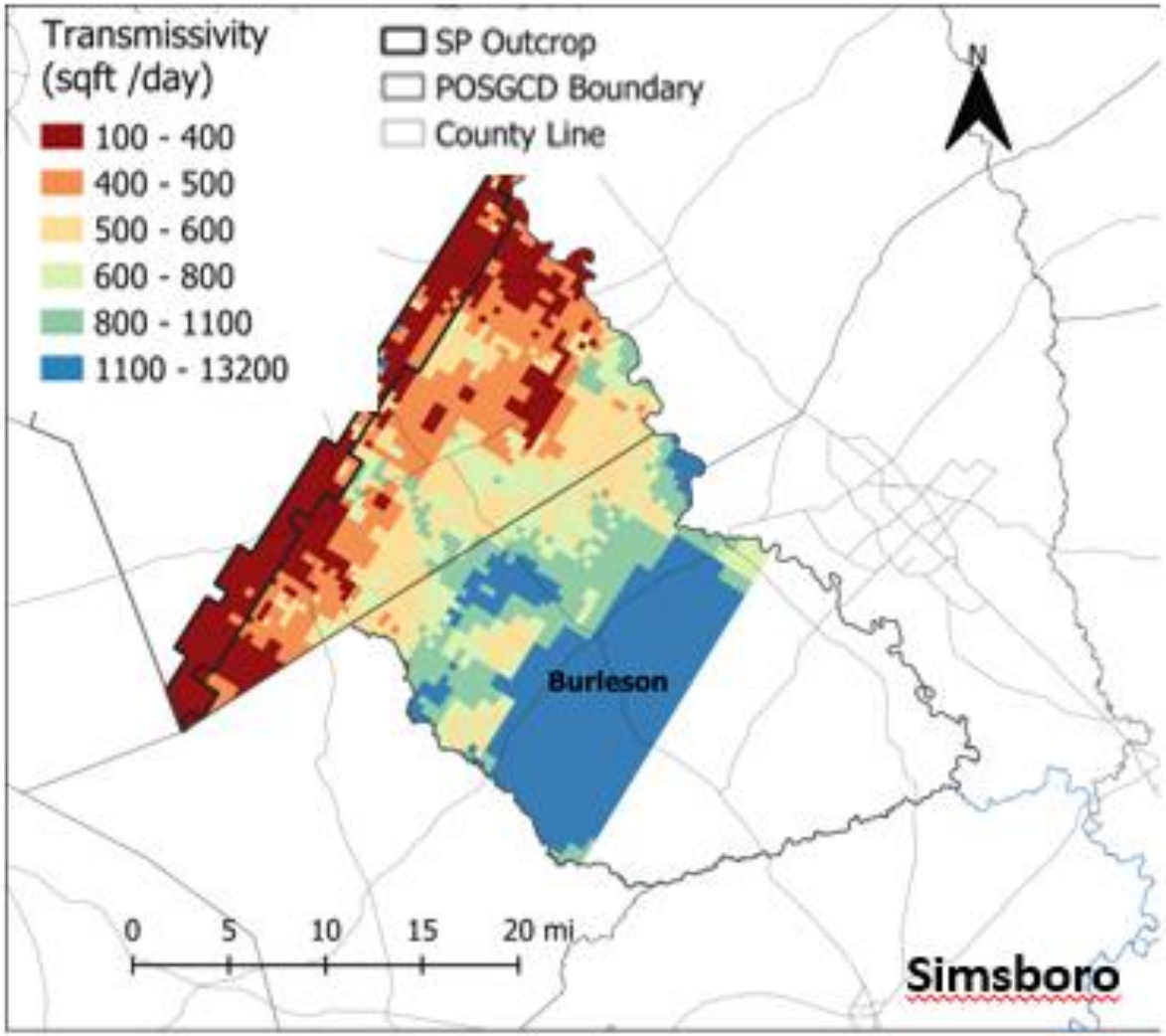


Figure 6-1 Schematic showning drawdown impacts at pumping well and closest existing well

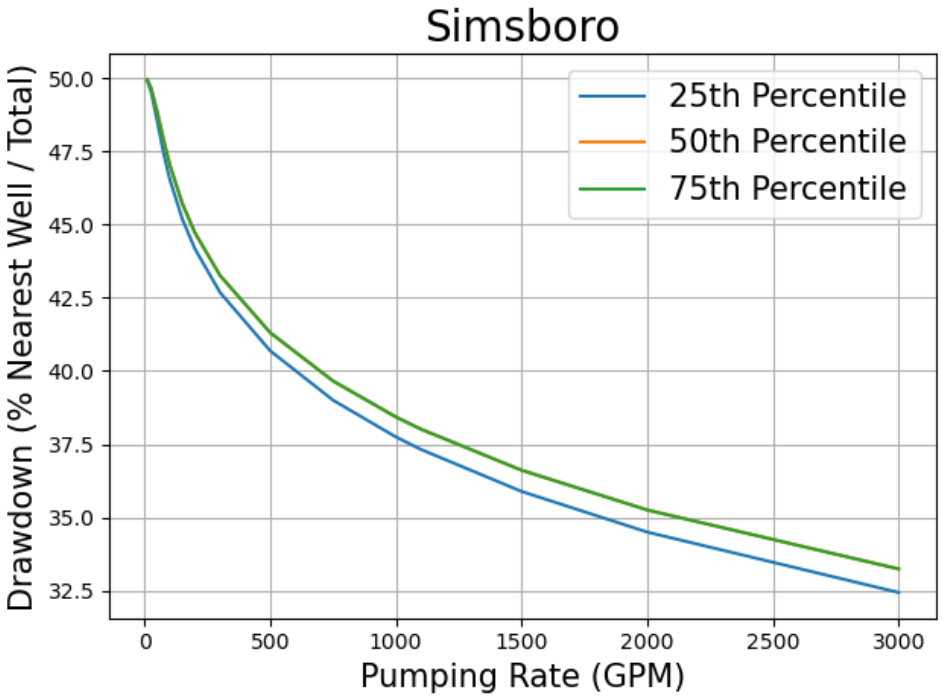
Distribution Pumping Rates Associated with Permits: Simsboro

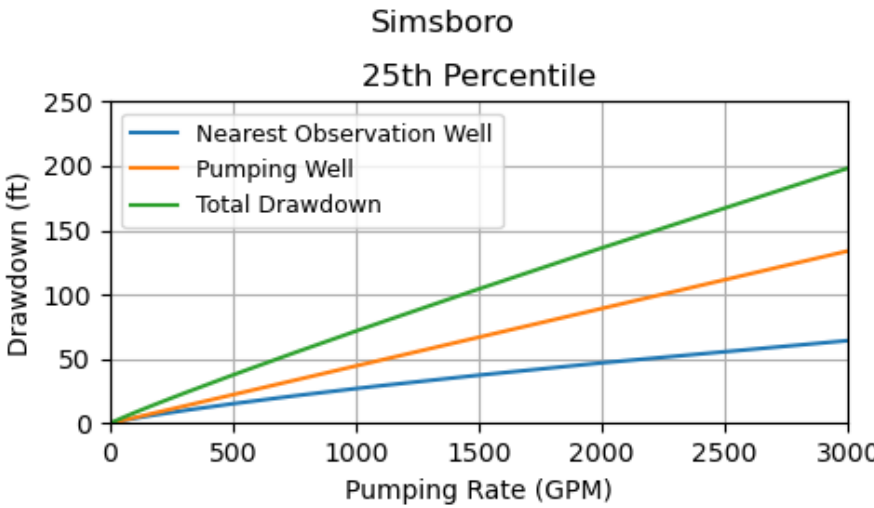


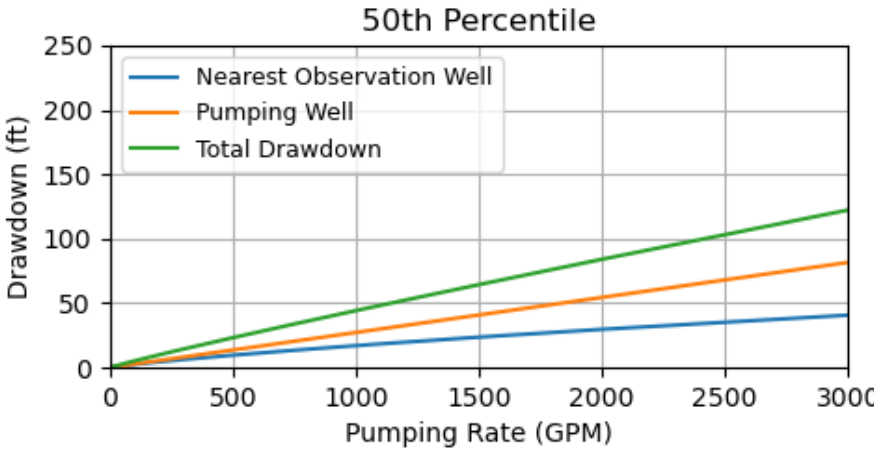
Transmissivity Spatial Distribution: Simsboro

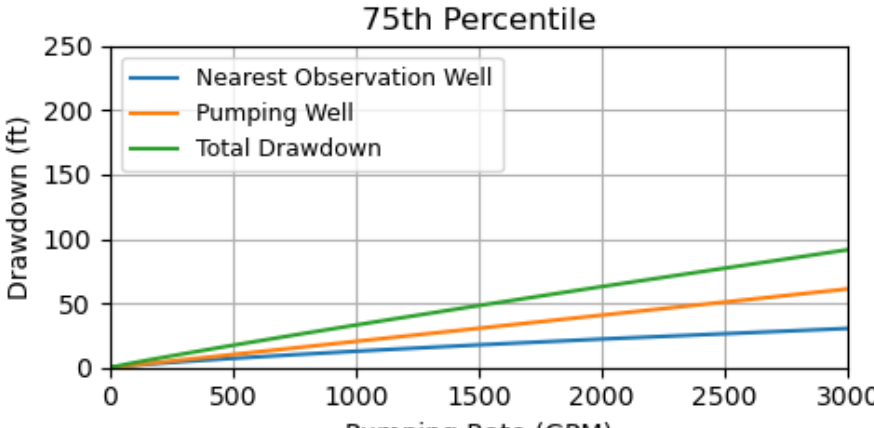


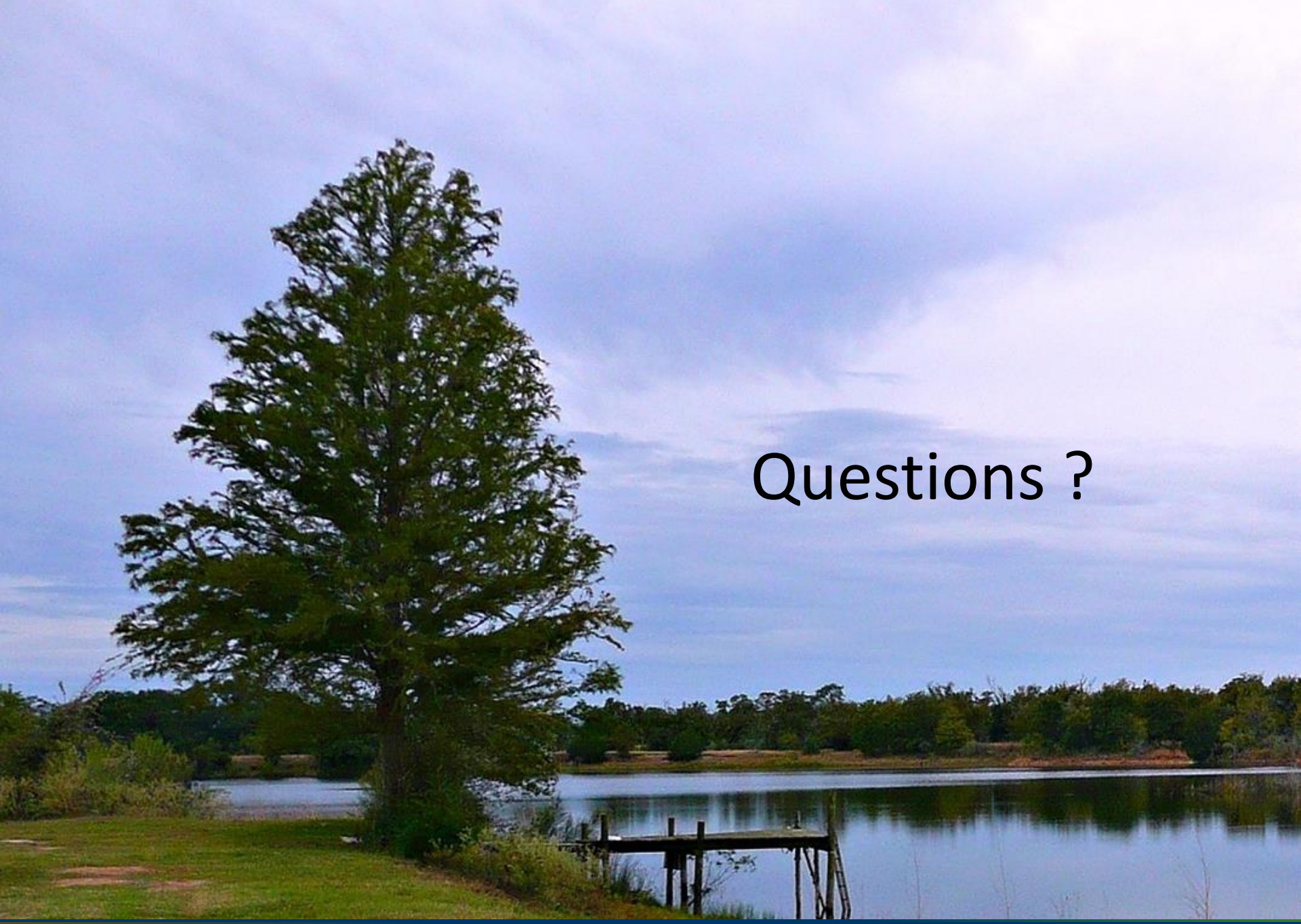
Simulated Drawdown Impacts from Well Spacing










Questions ?