Predictive Simulations to Support GMA-8 Runs 5 and 6

Presented to:

Groundwater Management Area-8

GMA – 8

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GEOSCIENCE & ENGINEERING SOLUTIONS

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Introduction and Runs

- Several predictive simulations were performed as part of the Northern Trinity and Woodbine GAM update
- These were presented to GMA-8 on November 4th, 2014 in a public meeting in Cleburne
  - Run 4 is a forward simulation from 2011 to 2070
  - Used the 2010 pumping as defined in the updated GAM
  - Purpose of Run 4 was to characterize future conditions if pumping was held at status quo
- GMA-8 approved the simulation of additional runs
  - Run 5 – Equivalent to Run 4 but allowing Districts to modify 2010 (baseline) pumping
  - Run 6 – A series of runs meant to evaluate aquifer conditions assuming a pro rata increase or decrease in pumping
    - Simulated factors of 0.7, 1.3, 1.6 and 1.9
    - Also reported average drawdown for a factor of 1.1 and 1.2

Baseline Pumping Changes (Acre-feet)

Baseline Pumping Changes (Positive is an increase, negative is a decrease)

County	Woodbine	Fred/Washita	Paluxy	Glenrose	Hensell	Pearsall	Hosston	Total
Bell	-	(4,877)	(2)	(118)	163	(308)	(807)	(5,949)
Burnet	-	-	-	-	1,123	-	(1,607)	(484)
Coryell	-	-	-	100	-	-	-	100
Hood	-	-	(69)	124	(1,811)	(8)	(268)	(2,033)
Johnson	-	-	(1,000)	-	-	-	-	(1,000)
McLennan	-	(866)	(64)	(2,461)	836	(204)	5,308	2,549
Montague	-	-	8	13	119	136	1,264	1,540
Parker	-	-	(887)	(1,733)	(362)	(865)	(1,958)	(5,804)
Red River	-	-	-	-	-	-	-	-
Wise	-	(696)	(1,166)	(827)	(862)	(279)	(2,573)	(6,402)
Total	-	(6,439)	(3,179)	(4,902)	(794)	(1,527)	(640)	(17,483)

Run Nomenclature

Run 5	**Revised Baseline Pumping after District Review**
Run 6	**Sensitivity to Pumping Simulations**
Run 6.1	Baseline Pumping X 0.7
Run 6.2	Baseline Pumping X 1.3
Run 6.3	Baseline Pumping X 1.6
Run 6.4	Baseline Pumping X 1.9
Run 6.5	Baseline Pumping X 1.1
Run 6.6	Baseline Pumping X 1.2

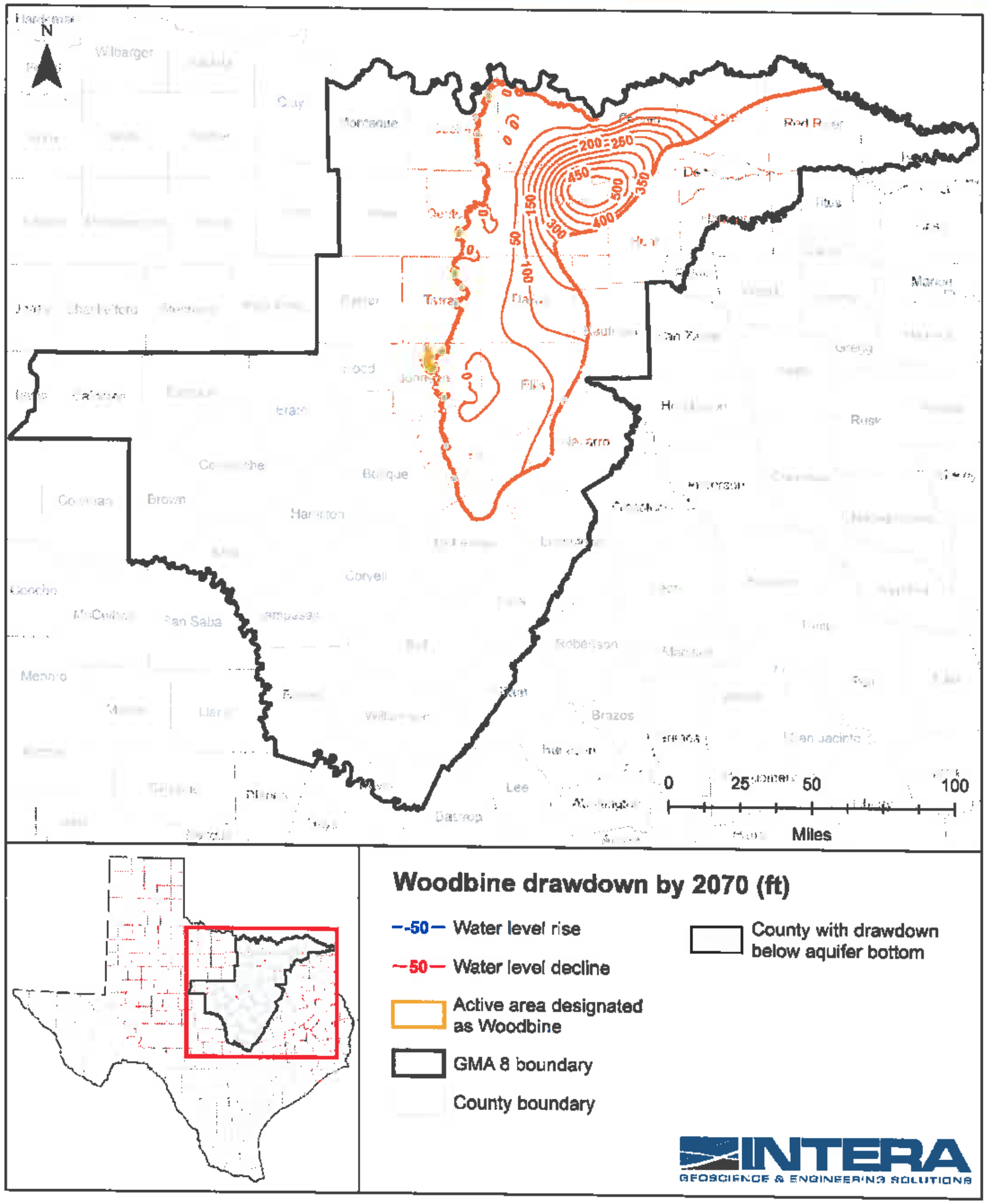
Key Assumptions

- The model was run using MODFLOW-NWT and in areas below the outcrop starting at a depth of approximately 200 feet below ground, aquifers were treated as confined aquifer conditions
  - This assumption was necessary to maintain the pumping rates stipulated in Run 6 simulations.
  - A result of this assumption is that water levels can fall below the bottom of an aquifer (i.e., non physical).
  - We have denoted counties and aquifers where this occurred. In these areas the pumping assumed would not be sustainable.

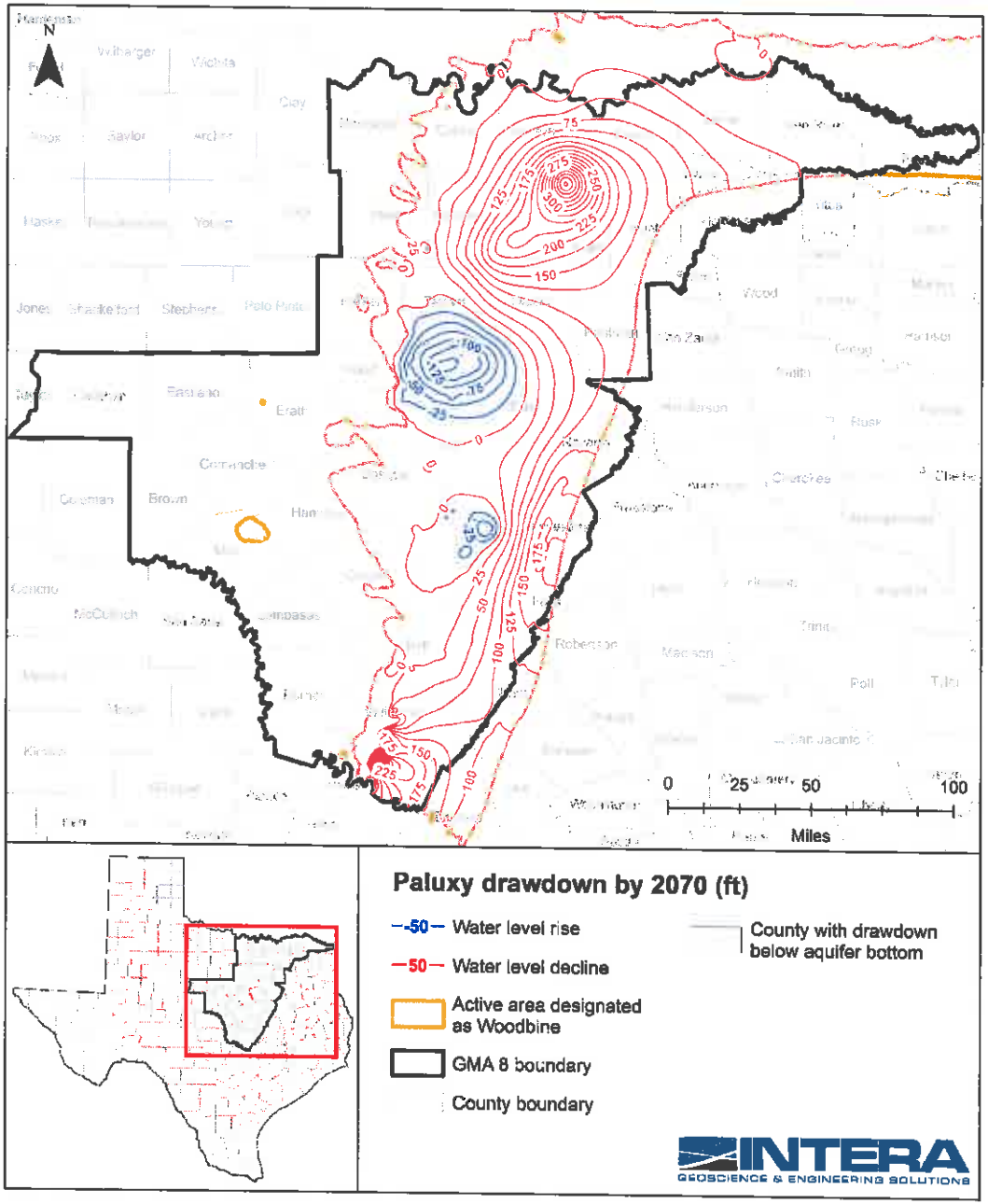
Performance Metrics

- Performance Metrics were discussed in meetings with GMA-8 representatives and were defined in a GMA-8 RFQ
- There are three types:
  - Drawdown - drawdown is equal to the simulated 2010 head (water level expressed as an elevation) minus the 2070 head
    - Contour maps of drawdown (in feet)
    - Average drawdown calculated by County and Aquifer
  - Well Impacts
    - Evaluated as reduction in available drawdown
  - Water Budget – an accounting of inflow, outflows and change in storage by county and aquifer (Trinity – Woodbine).
    - Evaluated at 2011, 2020, 2030, 2040, 2050, 2060, 2070
    - Presented in tables and in time-series plots

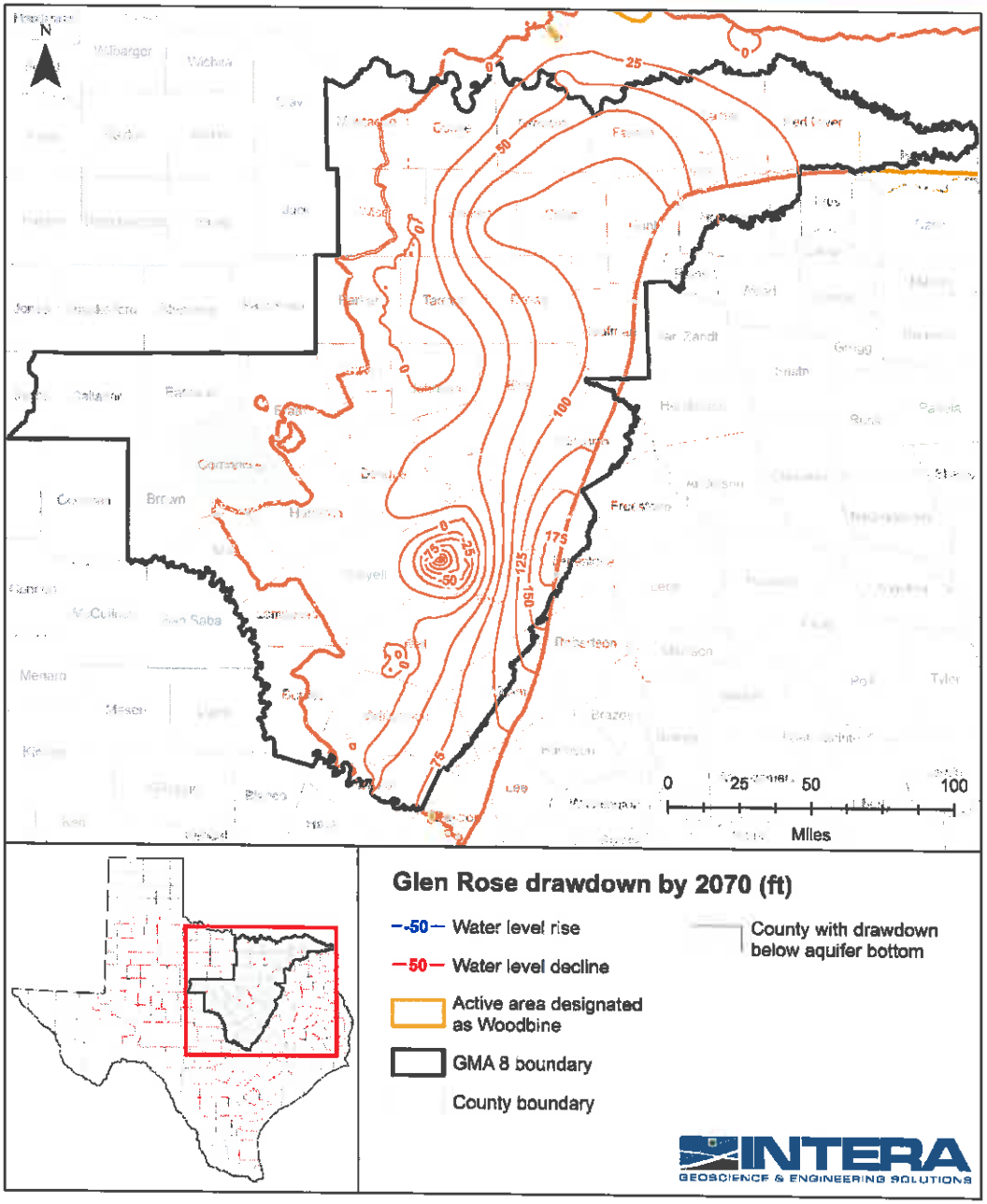
Woodbine Drawdown – Baseline



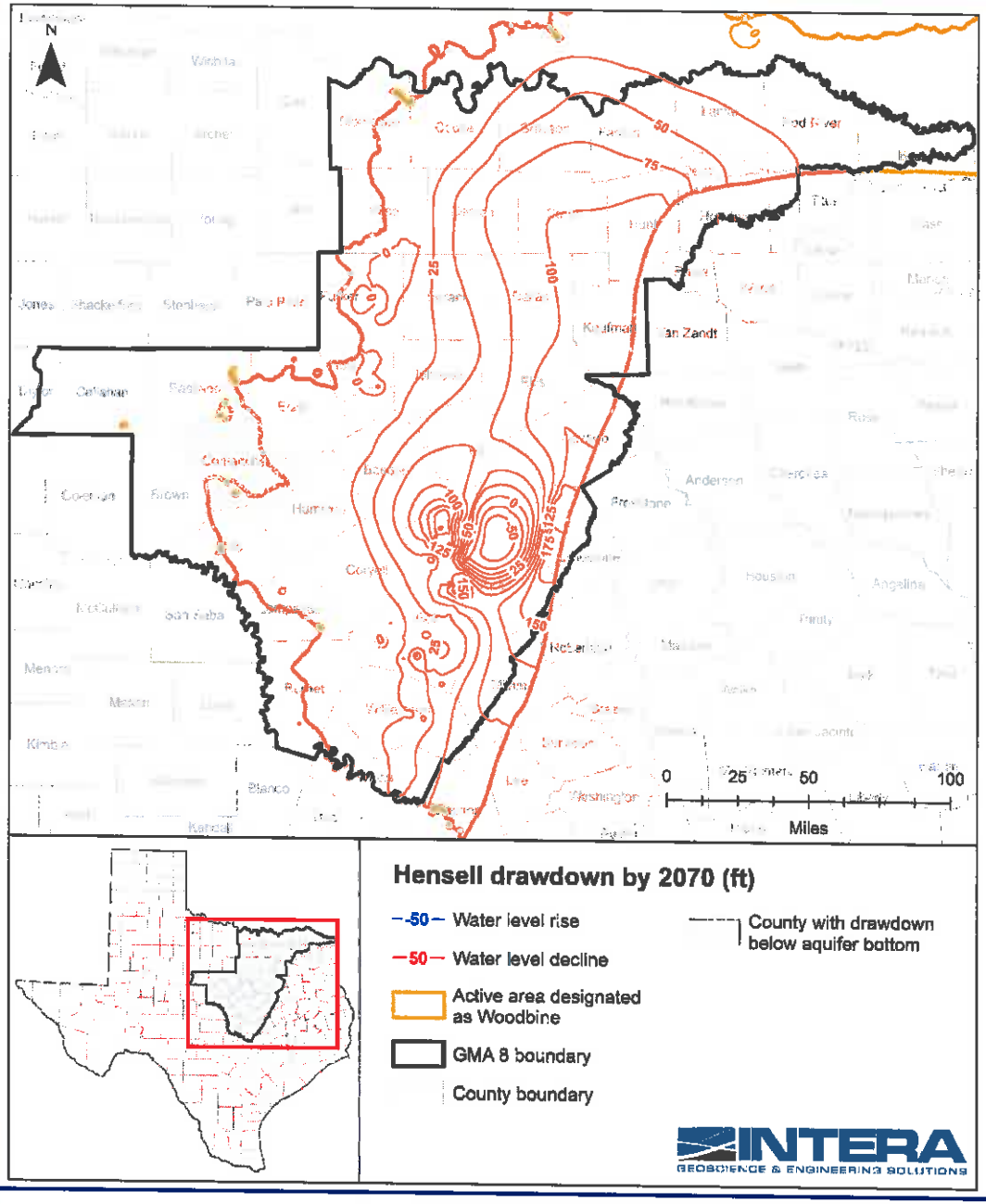
Paluxy Drawdown – Baseline



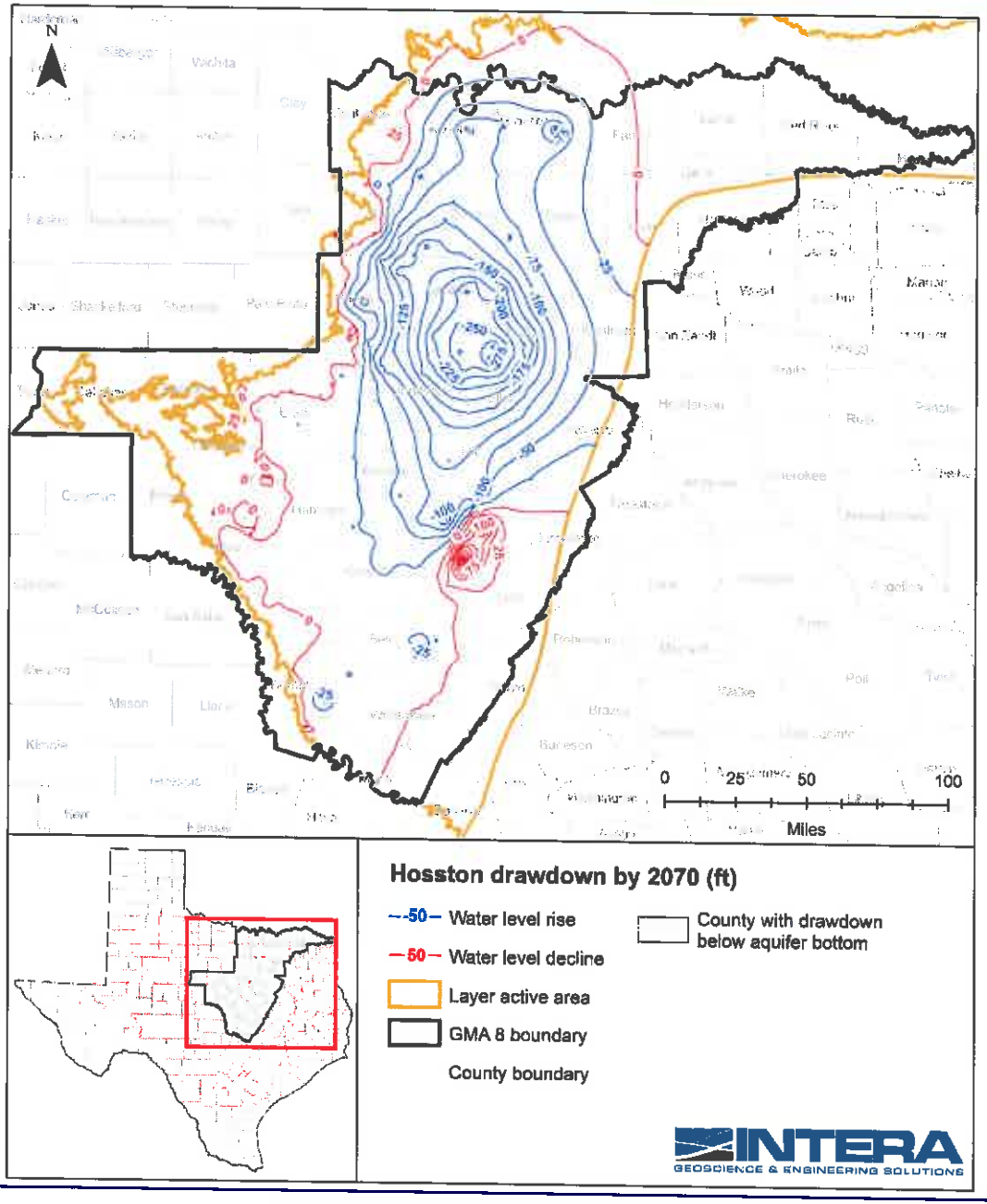
Glen Rose Drawdown – Baseline



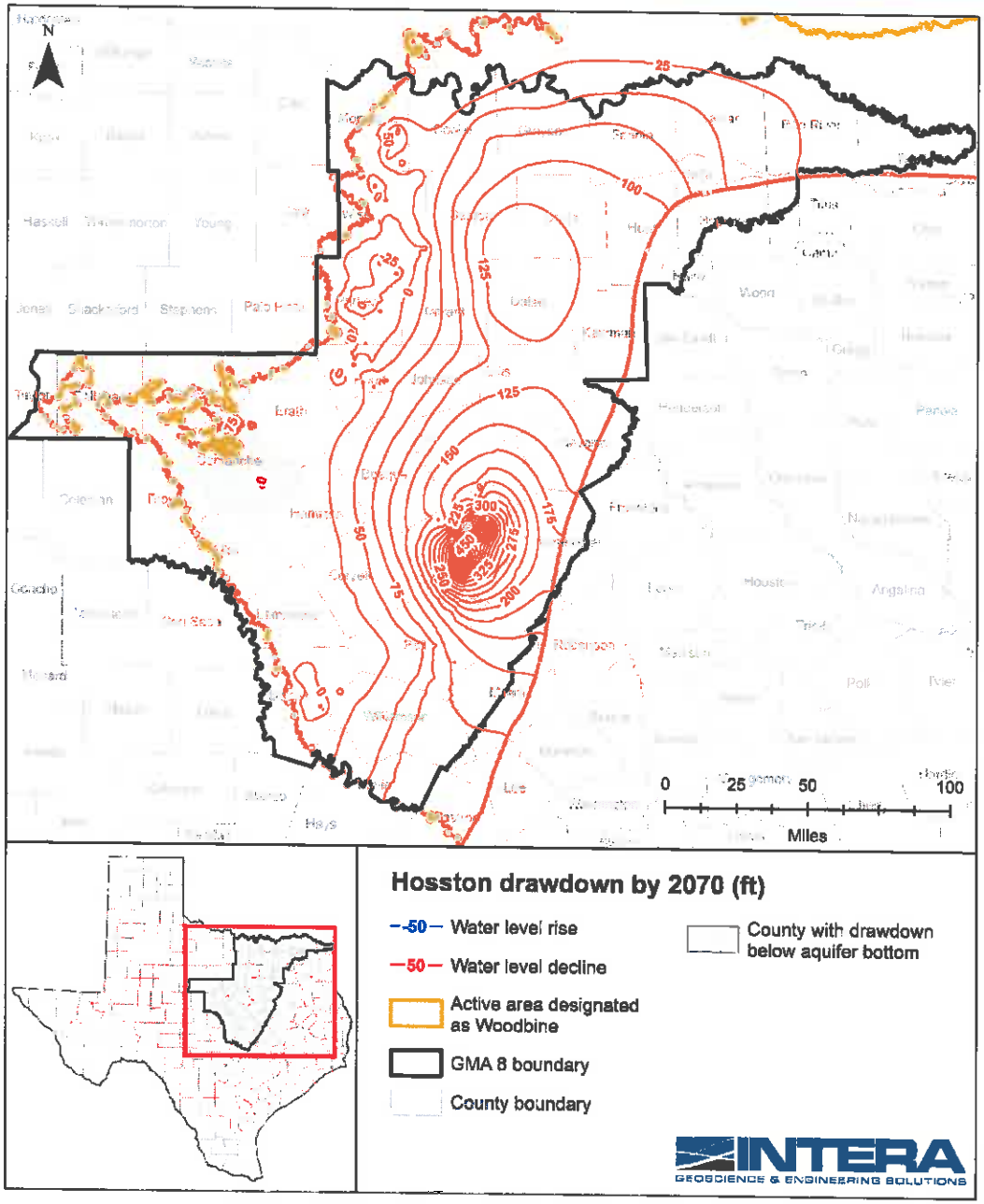
Hensell Drawdown – Baseline



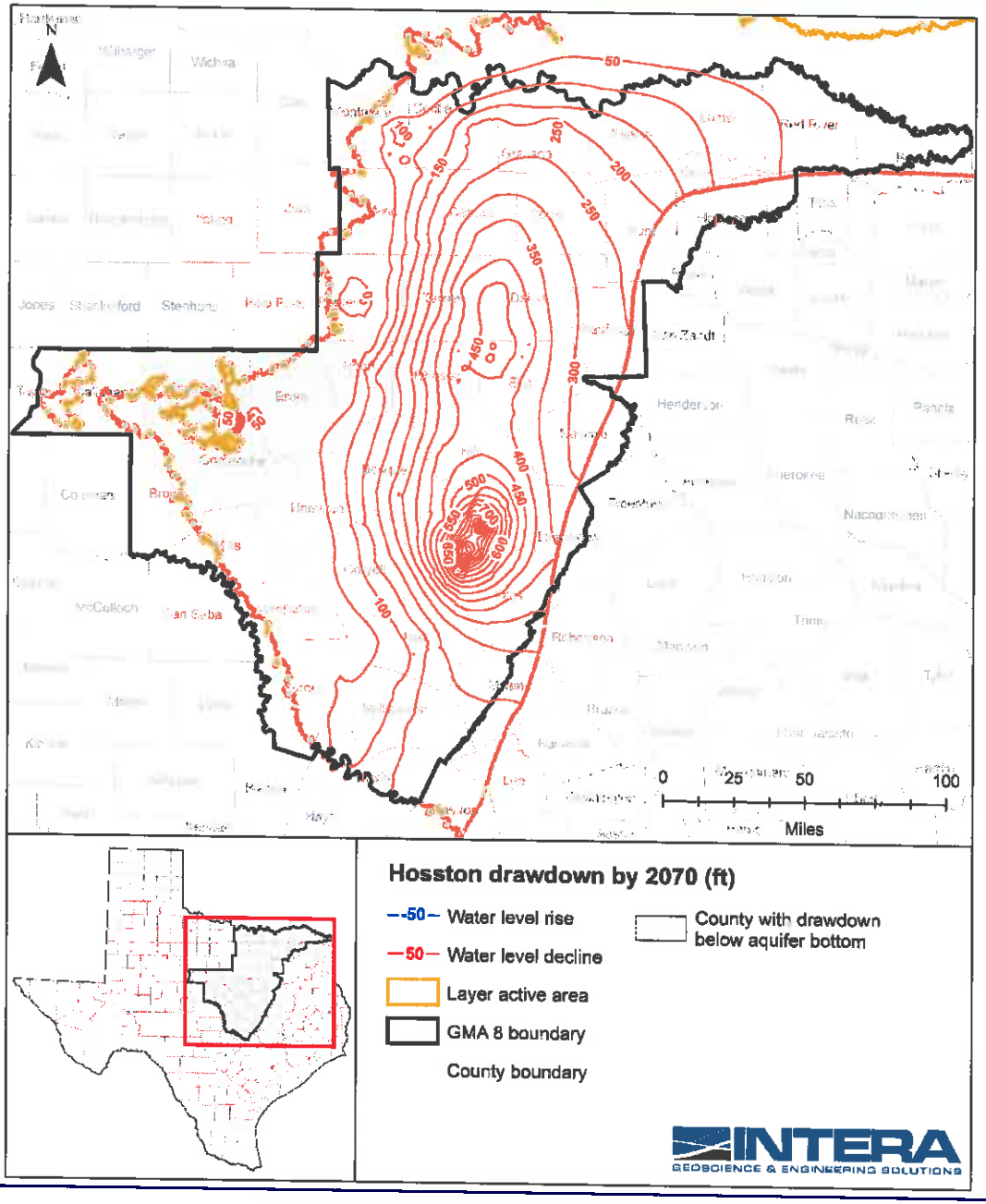
Hosston Drawdown – Baseline X 0.7



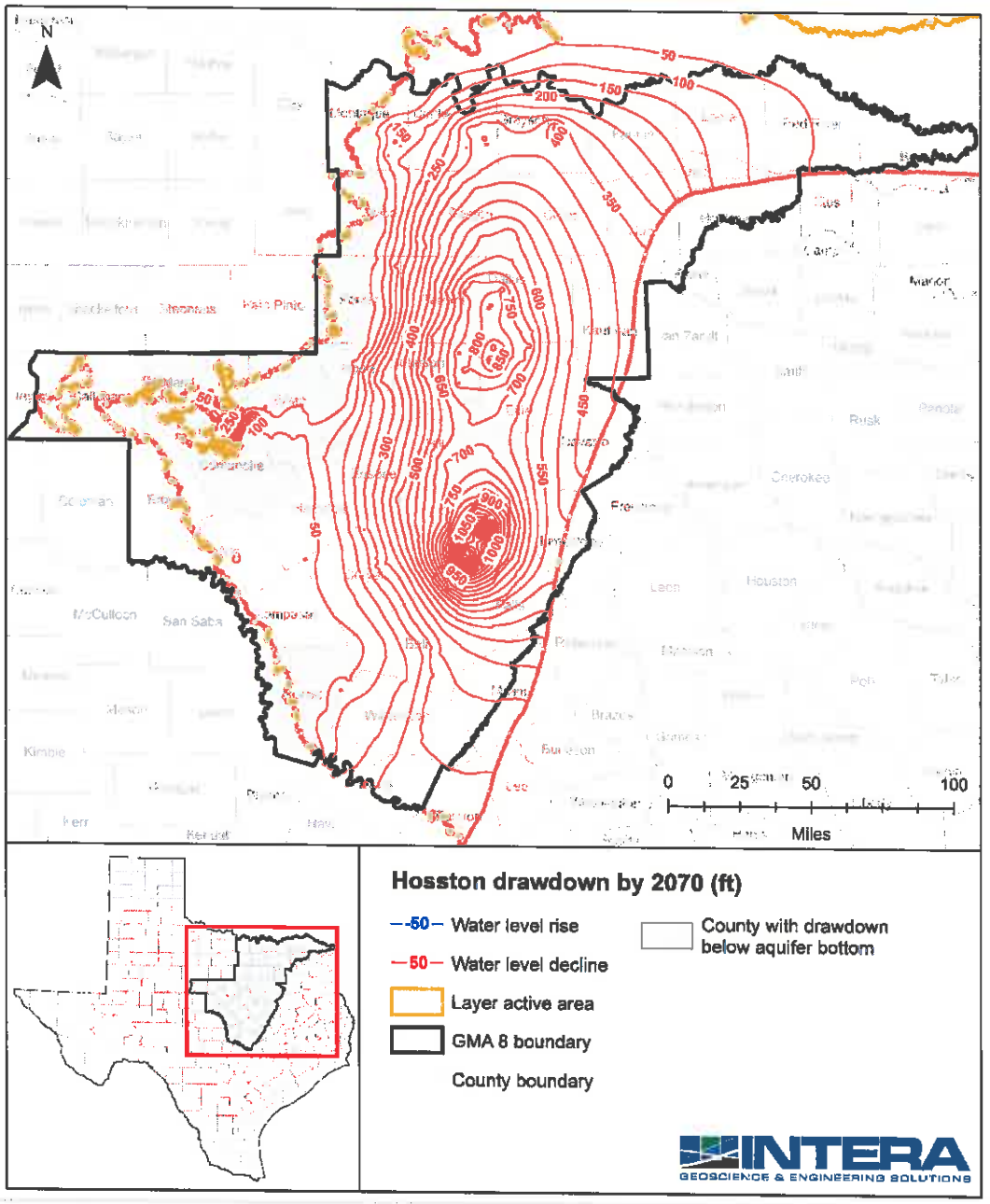
Hosston Drawdown - Baseline



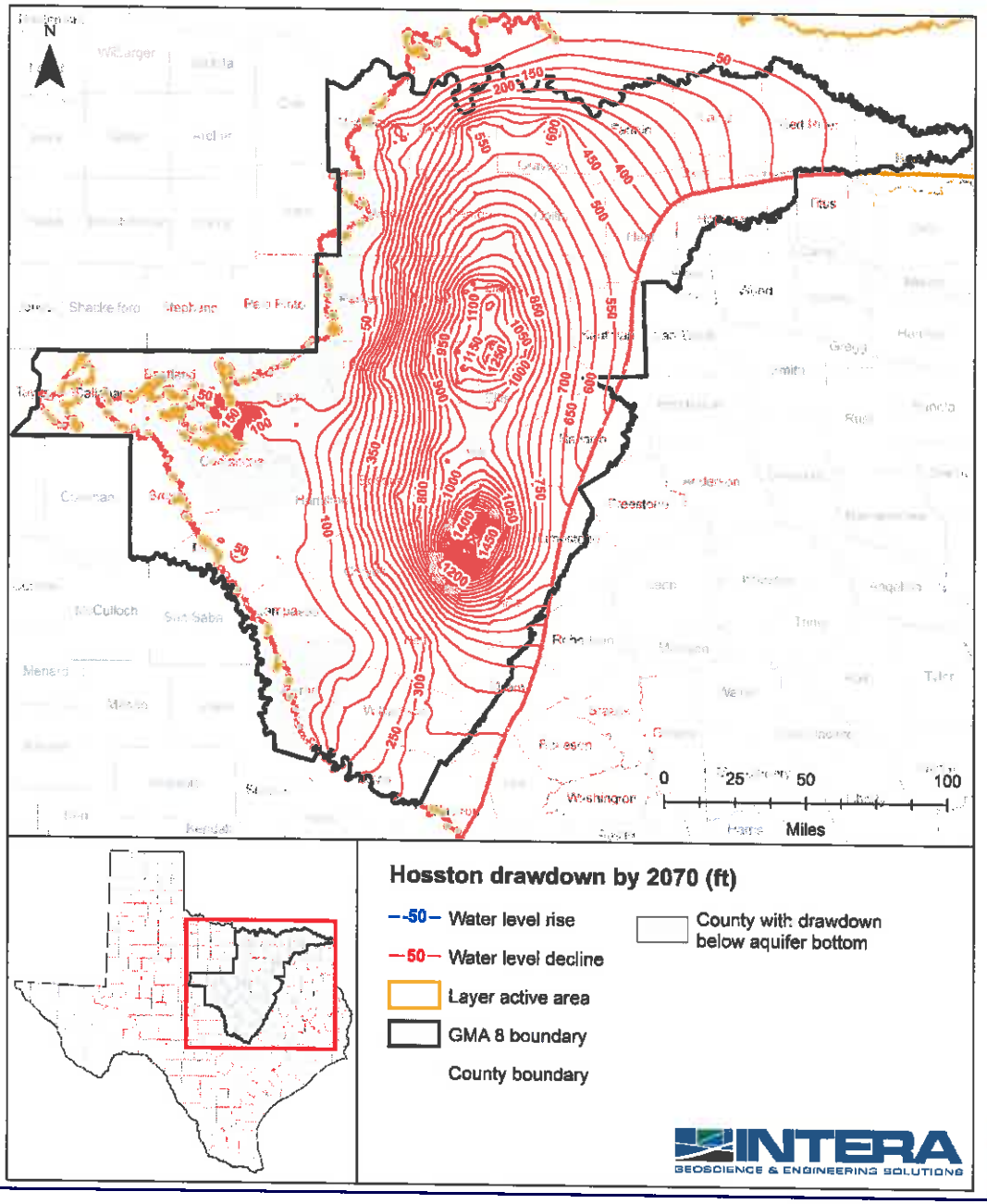
Hosston Drawdown – Baseline X 1.3



Hosston Drawdown – Baseline X 1.6



Hosston Drawdown – Baseline X 1.9



County Average Drawdown – Baseline X 1.3

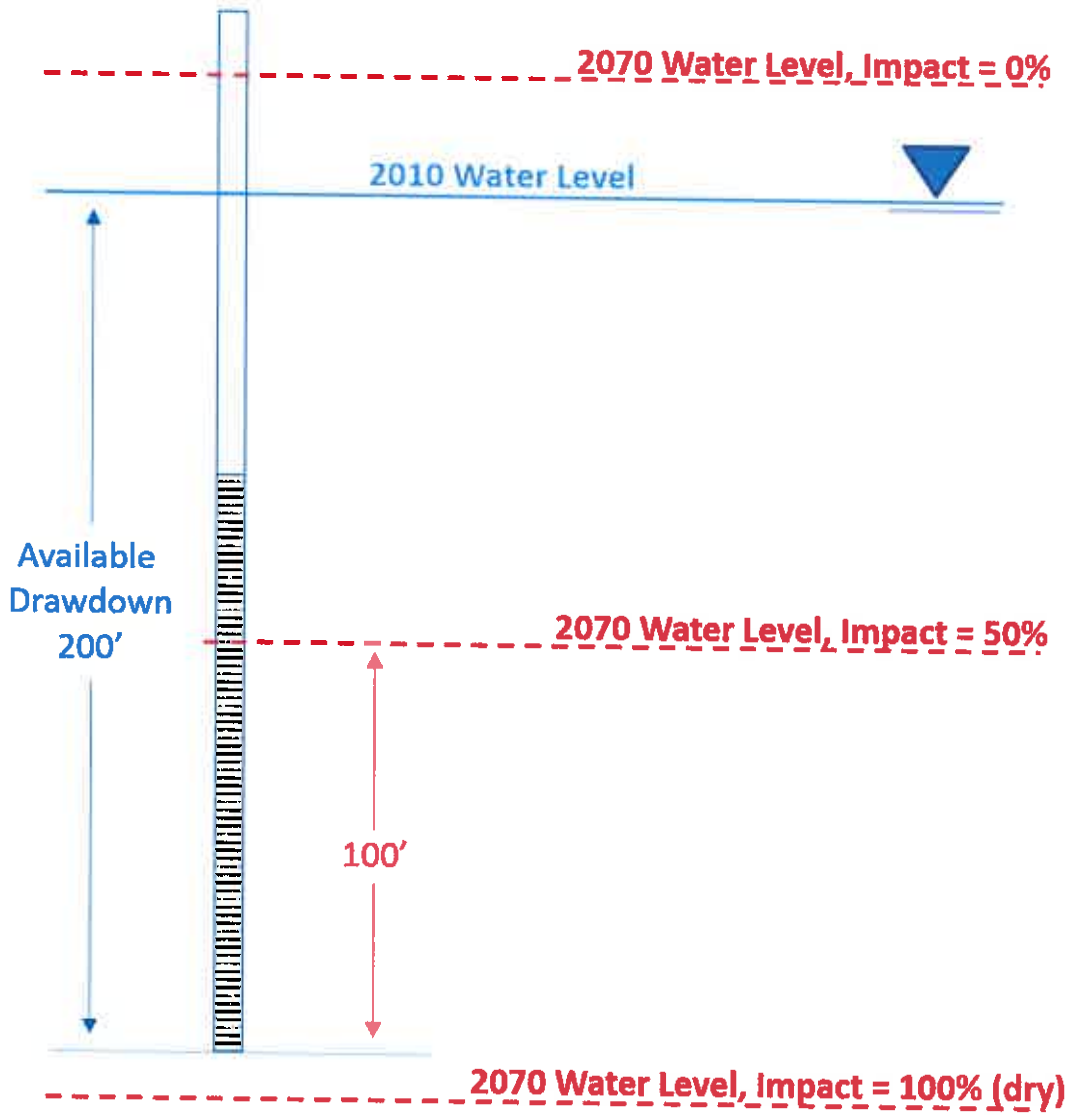
County	Average water level decline between 2010 and 2070 (feet)						
	Woodbine	Fredericksburg/ Washita	Paluxy	Glen Rose	Hensell	Pearsall	Hosston
Falls	n/a	190	143	175	231	374	414
Fannin	313	75	169	145	136	142	154
Grayson	166	46	232	151	196	170	195
Hamilton	n/a	2	3	4	15	31	41
Hill	36	40	55	149	216	371	419
Hood	n/a	n/a	5	10	21	52	*55*
Hunt	682	203	282	197	195	187	204
Johnson	12	4	-7	91	151	270	*323*

- Average drawdown by aquifer and county have been tabulated for all runs
- Example table shows a portion of the table for Run 6.2 (baseline X 1.3)
  - "n/a" indicated that aquifer/formation is not in the county
  - Positive sign, black entries are declining average water level drawdown
  - Positive sign, ***red italics*** entries are declining average water level drawdown which includes drawdown values that are below the aquifer bottom.
  - Negative sign, black entries are increasing average water levels "drawdown"

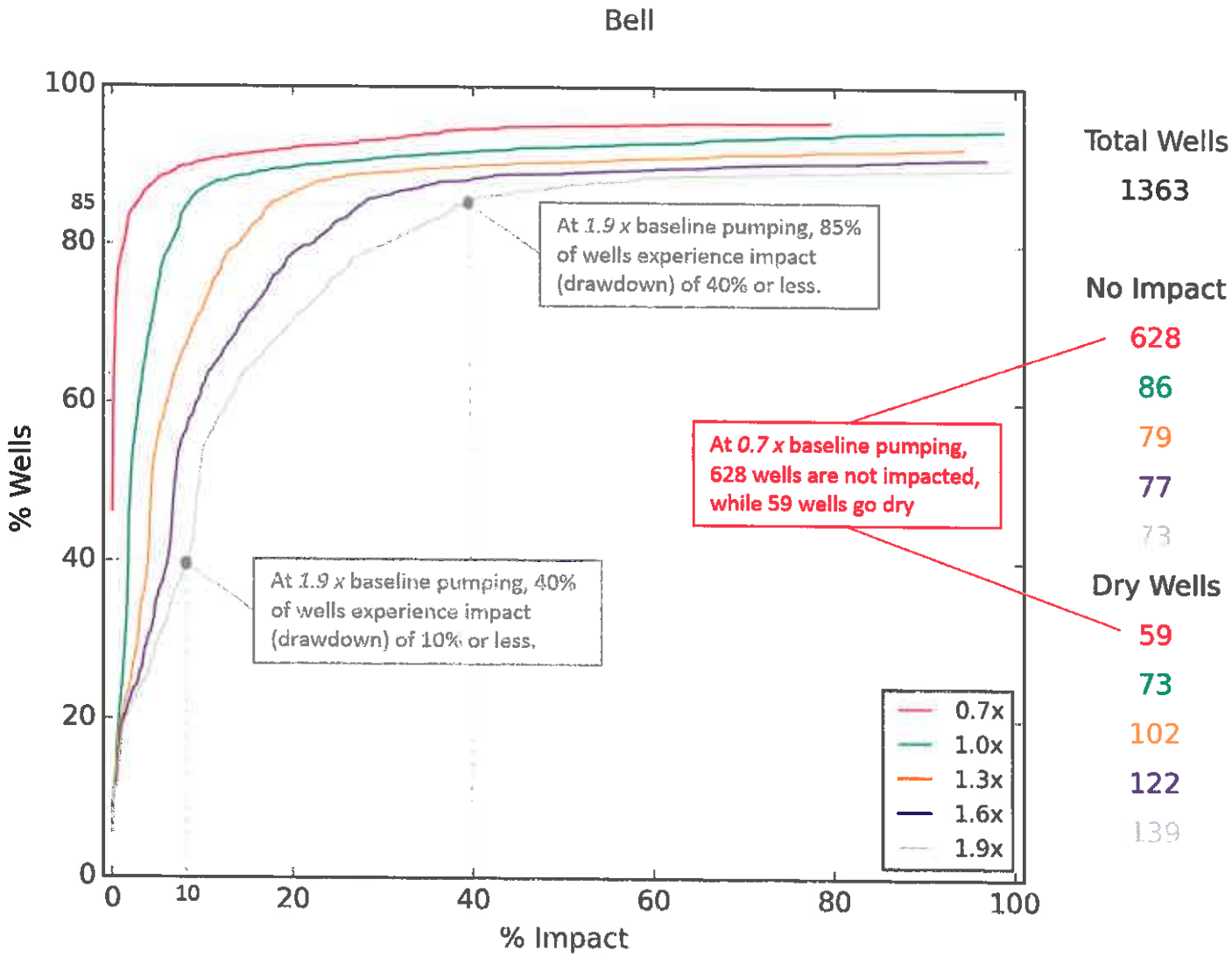
Key Assumptions – Well Impacts

- Well impacts have been defined in terms of the fraction of 2010 available drawdown evaluated at 2070 and expressed as a percent
  - Available drawdown is the distance between the 2010 water level and the bottom of the well in feet.
  - We chose the bottom of the well because water levels are currently within screened intervals of wells in the Trinity Aquifer in many areas
- We used a wells database that is comprised of 83,090 wells but is not comprehensive. We believe this number of wells provides a representative analysis for most counties.

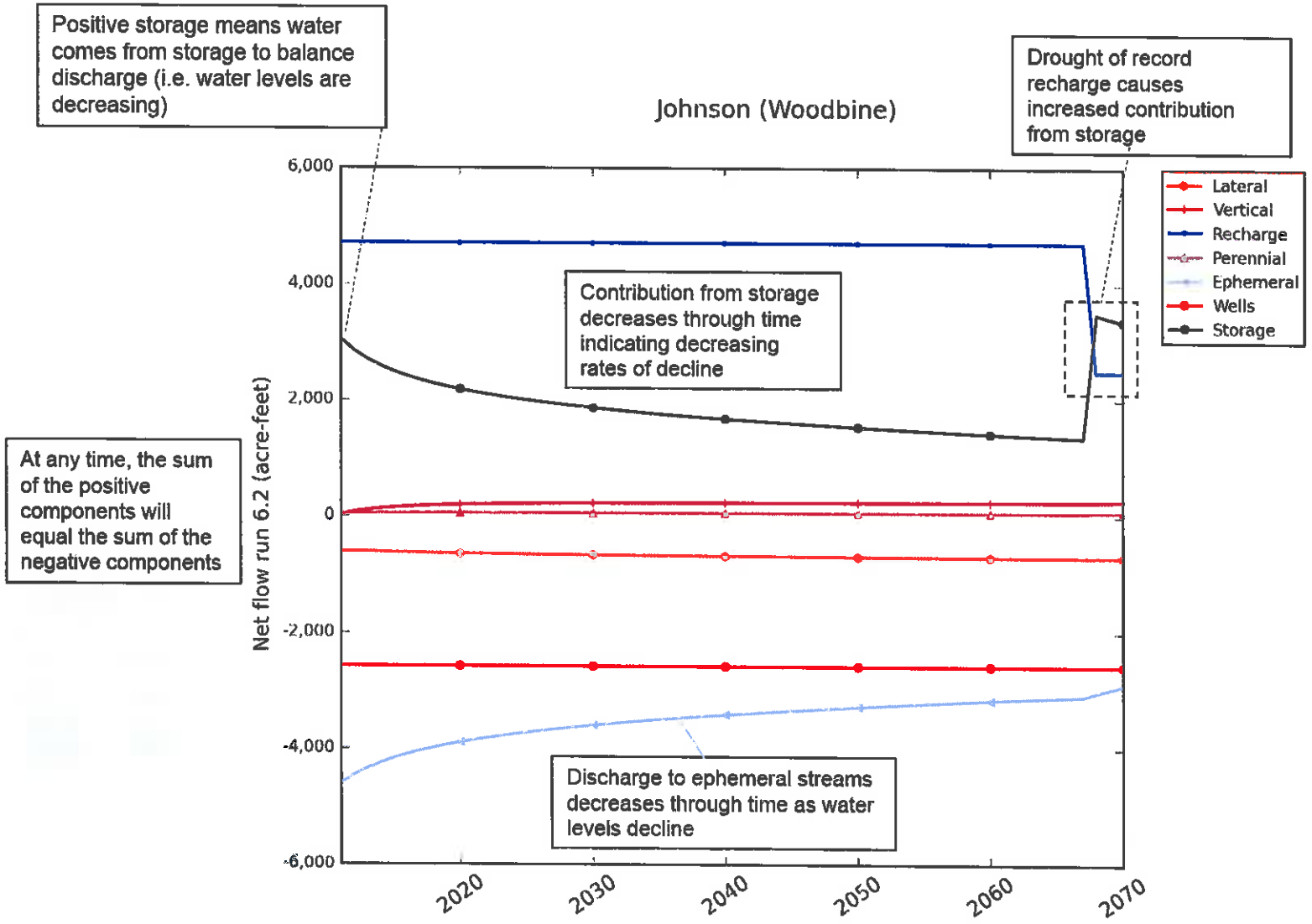
Available Drawdown for Well Impacts Analysis



Example Well Impacts Analysis



Example Water Budget



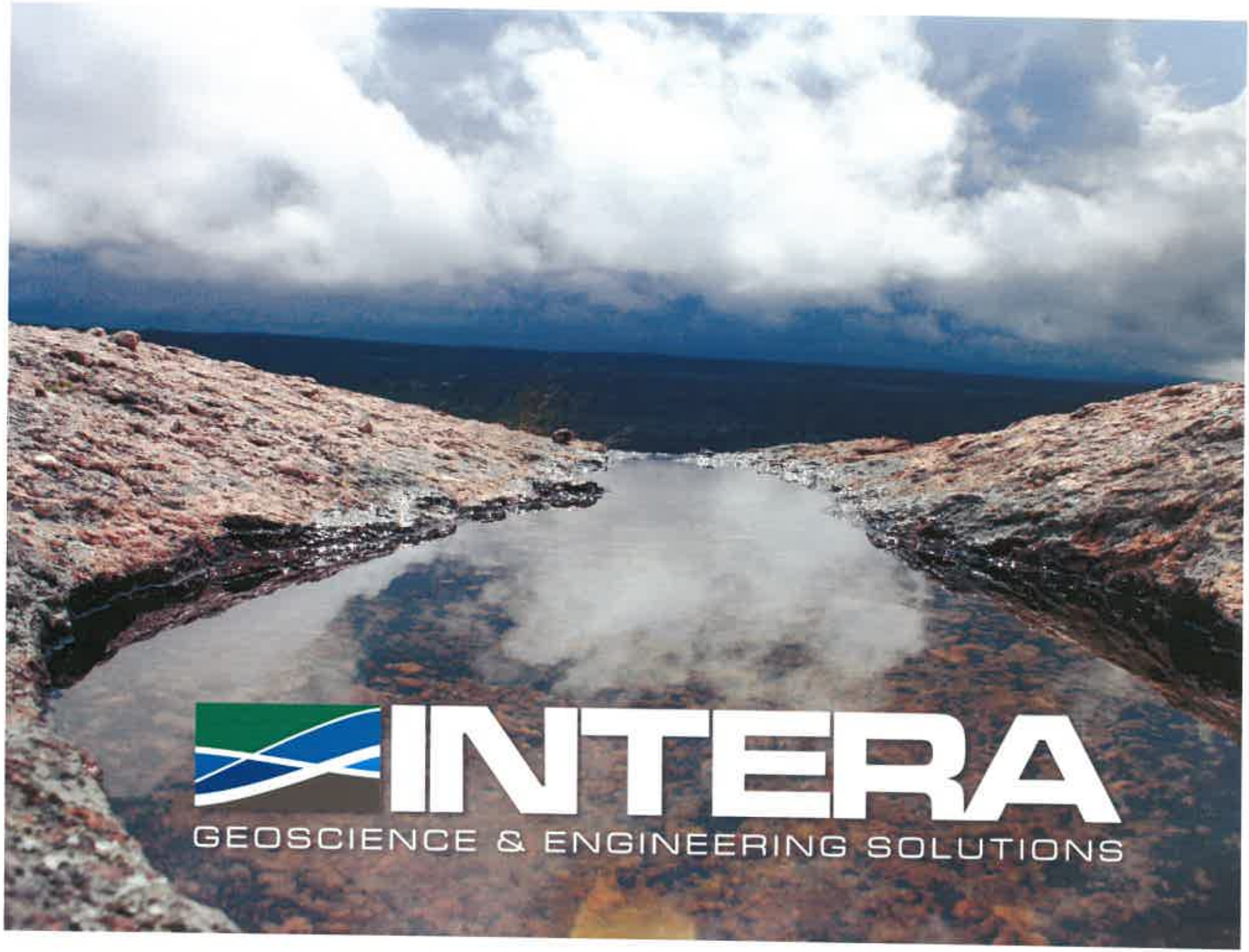
Example Water Budget – Tabulated Acre-feet

Johnson County

WOODBINE							
COMPONENT	2011	2020	2030	2040	2050	2060	2070
Lateral	-618	-648	-668	-681	-689	-696	-696
Vertical	14	187	218	228	235	243	259
Recharge	4,709	4,709	4,709	4,709	4,709	4,709	2,485
Perennial	33	48	52	55	58	60	74
Ephemeral	-4,608	-3,901	-3,604	-3,418	-3,279	-3,163	-2,911
ET	0	0	0	0	0	0	0
Spring	0	0	0	0	0	0	0
Younger	0	0	0	0	0	0	0
Reservoir	0	0	0	0	0	0	0
Wells	-2,575	-2,575	-2,575	-2,575	-2,575	-2,575	-2,575
Flowing	0	0	0	0	0	0	0
Storage	3,045	2,181	1,868	1,681	1,541	1,423	3,365

Next Steps

- Each of you have all the information developed to support these runs including:
  - The model files;
  - The codes we used to develop each table or map.
- These results plus the model files and codes provide a good framework for Districts to develop an understanding of how the aquifer may respond to a range of future pumping conditions
- In almost all areas drawdown is relatively linear to pumping by aquifer and county. As a result, Districts can consider alternate pumping scenarios for first order analysis
- Districts should combine model results with their local experience to base decisions.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