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DRAFT MEMORANDUM

To: Bill Mullican, P.G., Contract Manager for the Northern Trinity and Woodbine aquifers GAM Overhaul Project

From: Van Kelley, P.G., INTERA

Date: June 18, 2014

RE: Northern Trinity and Woodbine MAG Run Draft Results

As the first predictive run with the draft model, INTERA was directed to create a simulation where pumping was equal to the current Modeled Available Groundwater (MAG) for Groundwater Management Area 8 (GMA-8) for the northern Trinity and Woodbine aquifers. The MAGs and the Desired Future Condition (DFC) for the northern Trinity and the Woodbine aquifers are documented for GMA-8 in GAM Run 08-84mag and GAM Run 08-14mag, respectively. The most recent modeled available groundwater reports, GAM Run 10-063 MAG and GAM Run 10-064 MAG, contain identical information to these previous GAM runs except for in Comanche and Erath counties where a non-GAM approach was used

In these previous simulations the DFC was estimated as an average decline in simulated water level (drawdown) from the year 2000 to 2050 assuming a constant pumping rate equal to the MAG. The MAGs, calculated per aquifer (Woodbine, Paluxy, Glen Rose, Hensell and Hosston) by county, are shown in Table 1.

To provide a comparison between the draft updated northern Trinity and Woodbine aquifers GAM and the existing TWDB GAM (Bené and others, 2004), INTERA performed this predictive simulation applying the MAG per aquifer and per county as pumping in the draft model and calculating average drawdown per aquifer and per county from 2000 to 2050. While the current GAM is calibrated through 2012, the DFC and MAG are based upon drawdown from 2000 to 2050. The MAG was therefore used to set pumping in the draft revised GAM predictive simulation from 2000 to 2050 consistent with the original MAG runs.

The simulation was run such that all model layers could convert to unconfined conditions once the water level in the aquifer falls below the elevation of the top of the aquifer. The specific yield applied to all units was set equal to 0.1. We also implemented the MODFLOW-NWT Well Package option to reduce pumping if the water level within a cell in an aquifer falls below the bottom one quarter of the aquifer thickness. This prevents cells from going dry and reflects the likely reduction in well yields and pumping that would occur under these conditions.

Table 2 summarizes the average simulated drawdown (feet) calculated from year 2000 to 2050 for the MAG simulation. The draft revised GAM predicts different drawdowns in many areas – both higher and lower. In general, average drawdowns in the updated GAM are greater than in the previous model in the Woodbine, Paluxy, and Hensell and less in the Glenn Rose and

Hosston, though responses vary by county. Area-wide, the updated model predicts approximately 7 feet more drawdown between 2000 and 2050 than the original GAM.

The overall reduction in pumping in the simulations, due to the Well Package option, was very small and occurred only in a few areas of significantly reduced saturated thickness. The reduction in pumping in the northern Trinity aquifer by 2050 represents approximately 0.5% of the total MAG, with the greatest reduction occurring in Johnson County (approximately 5%). Pumping was decreased by greater than 1% by 2050 in six counties. Woodbine pumping was not reduced.

Draft conclusions that can be made from this simulation are:

- The draft revised GAM and the current GAM predict different drawdowns at the local and regional scales. This is to be expected as the new model has completely updated structure and hydrogeologic properties. The revised hydraulic conductivities are based on aquifer lithology and depth of burial and exhibit much more variability than in the existing GAM. Another possible source of the different drawdowns is the differing distribution of historical pumping.
- The MODFLOW-NWT Package reduced overall pumping (the MAG) by approximately 0.5% as a result of conversion of confined aquifers to unconfined conditions in the down dip portions of the aquifers. Simulating a deeply buried aquifer converting to unconfined conditions requires an assumption of a specific yield (in this case a value of 0.1). This value greatly impacts drawdown when the simulated water level gets below the top of the aquifer. The correct specific yield for these conditions is highly uncertain.
- The current model is draft. These simulations will be repeated in final form once the final modeling report is submitted on at the end of August.

Reference:

Bené, J., Harden, B., O'Rourke, D., Donnelly, A., and Yelderman, J., 2004, Northern Trinity/Woodbine groundwater availability model: Prepared for the TWDB by R.W. Harden & Associates, Inc., with Freese and Nichols, Inc, HDR Engineering, Inc., LBG Guyton Associates, USGS, and Dr. Joe Yelderman, Jr.

Table 1. Desired future conditions adopted June 23, 2011 for the Trinity and Woodbine Aquifers in GMA-8. Values are shown as drawdown (in feet) between 2000 and 2050.

County	Average water level decline (feet)				
	Woodbine	Paluxy	Glen Rose	Hensell	Hosston
Bell	n/a	134	155	286	319
Bosque	n/a	26	33	201	220
Brown	n/a	0	0	1	1
Burnet	n/a	1	1	11	29
Callahan	n/a	n/a	n/a	0	2
Collin	154	298	247	224	236
Comanche	n/a	0	0	2	11
Cooke	0	26	42	60	78
Coryell	n/a	15	15	156	179
Dallas	112	240	224	263	290
Delta	n/a	175	162	162	159
Denton	16	98	134	180	214
Eastland	n/a	0	0	0	0
Ellis	102	265	283	336	362
Erath	n/a	1	1	11	27
Falls	n/a	279	354	459	480
Fannin	186	212	196	182	181
Grayson	28	175	161	160	165
Hamilton	n/a	0	2	39	51
Hill	87	209	253	381	406
Hood	n/a	1	2	16	56
Hunt	353	286	245	215	223
Johnson	4	37	83	208	234
Kaufman	211	303	286	295	312
Lamar	297	132	130	136	134
Lampasas	n/a	0	1	12	23
Limestone	n/a	328	392	475	492
McLennan	n/a	251	291	489	527
Milam	n/a	252	294	337	344
Mills	n/a	0	0	3	12
Montague	n/a	0	1	3	12
Navarro	177	344	353	399	413
Parker	n/a	5	6	16	40
Red River	202	82	77	78	78
Rockwall	241	346	272	248	265
Somervell	n/a	1	4	53	113
Tarrant	2	33	75	160	173
Taylor	n/a	n/a	n/a	n/a	3
Travis	n/a	124	61	98	116
Williamson	n/a	108	88	142	166
Wise	n/a	4	14	23	53

Table 2. Average drawdown between 2000 and 2050 using current MAG pumping rates in the updated model

County	Average water level decline (feet)				
	Woodbine	Paluxy	Glen Rose	Hensell	Hosston
Bell	n/a	38	53	178	219
Bosque	n/a	8	30	93	160
Brown	n/a	n/a	3	2	2
Burnet	n/a	n/a	1	3	10
Callahan	n/a	n/a	n/a	1	2
Collin	390	652	141	297	343
Comanche	n/a	n/a	2	3	11
Cooke	1	70	12	2	47
Coryell	n/a	5	8	47	97
Dallas	241	315	131	525	270
Delta	n/a	174	185	194	191
Denton	18	162	36	131	315
Eastland	n/a	n/a	n/a	3	2
Ellis	328	285	153	521	200
Erath	n/a	1	4	9	36
Falls	n/a	192	203	398	352
Fannin	172	272	168	273	273
Grayson	72	385	73	171	262
Hamilton	n/a	2	2	7	33
Hill	172	140	112	302	207
Hood	n/a	4	4	11	63
Hunt	400	373	273	297	298
Johnson	3	65	8	174	111
Kaufman	351	312	253	361	276
Lamar	340	71	112	153	169
Lampasas	n/a	n/a	2	2	10
Limestone	n/a	269	253	375	288
McLennan	30	59	73	420	484
Milam	n/a	189	200	250	223
Mills	n/a	1	1	3	13
Montague	n/a	2	1	0	12
Navarro	286	369	221	383	250
Parker	n/a	3	3	20	24
Red River	84	49	56	64	76
Rockwall	470	583	230	376	303
Somervell	n/a	3	2	11	91
Tarrant	1	41	55	275	174
Taylor	n/a	n/a	n/a	n/a	2
Travis	n/a	51	162	47	62
Williamson	n/a	48	86	109	86
Wise	n/a	3	0	10	50