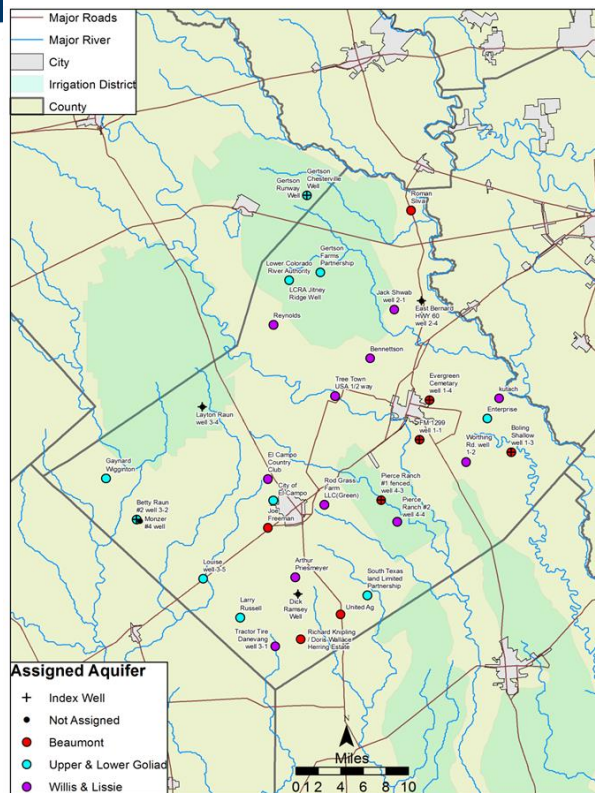


Identification of Potential Issues of Concern Regarding Monitoring and Desired Future Conditions



**Presentation to
Coastal Bend, GCD
Wharton, Texas**

By Steven Young, Ph.D., PE. PG.



April 21, 2015

Presentation Outline

- **Potential Issues of Concern Associated with GMA 15 DFC**
- **Potential Issues of Concern Associated with Demonstration of Compliance to DFC**
- **Suggestions for moving Forward**

Current GMA 15 DFC

An average drawdown of the Gulf Coast Aquifer within the GMA 15 boundary of 12 feet relative to year 1999 starting conditions in *accordance with Table 7 of GAM Run 10-008 Addendum*.

Pumping (AF/yr) 12 feet scenario							Overall
County	Chicot	Evangeline	Chicot+ Evangeline	Burkeville	Jasper	Overall	(without Burkeville)
Aransas	1,863	--	1,863	--	--	1,863	1,863
Bee	3,707	5,480	9,187	17	289	9,493	9,476
Calhoun	2,939	63	3,002	--	--	3,002	3,002
Colorado	24,937	23,102	48,039	--	918	48,957	48,957
DeWitt	1,019	7,071	8,090	128	6,408	14,626	14,498
Fayette (GMA 15)	--	906	906	157	7,408	8,490	8,314
Fayette (GMA 12)	--	--	--	--	339	339	339
Goliad	714	10,582	11,296	306	102	11,704	11,398
Jackson	55,772	20,615	76,387	--	--	76,387	76,387
Karnes	--	105	105	261	2,865	3,231	2,970
Lavaca	3,095	12,647	15,742	151	4,496	20,389	20,238
Matagorda	36,386	9,513	45,899	--	--	45,899	45,899
Refugio	6,379	22,951	29,330	--	--	29,330	29,330
Victoria	8,159	27,539	35,698	--	--	35,698	35,698
Wharton	110,822	67,676	178,498	--	--	178,498	178,498
Overall (GMA 15)	255,792	208,250	464,042	1,039	22,486	487,567	486,528

Drawdown after 60 years (in feet, 1999 Starting Conditions)							Overall
County	Chicot	Evangeline	Chicot+ Evangeline	Burkeville	Jasper	Overall	(without Burkeville)
Aransas	0.0	25.6	0.6	--	--	0.6	0.6
Bee	3.3	14.2	10.5	9.7	5.1	8.9	8.5
Calhoun	-0.9	9.7	2.1	2.6	--	2.1	2.1
Colorado	5.9	9.8	8.1	14.7	21.3	13.3	12.8
DeWitt	0.3	5.6	4.8	15.0	23.0	15.3	15.4
Fayette	--	14.2	14.2	42.4	49.3	42.2	42.1
Goliad	-1.2	3.7	2.6	7.4	9.3	6.0	5.4
Jackson	13.4	17.1	15.2	12.1	19.6	15.1	16.1
Karnes	--	-0.2	-0.2	16.1	15.7	14.3	13.7
Lavaca	5.3	5.6	5.5	14.7	29.4	16.1	16.7
Matagorda	3.3	19.0	8.1	14.8	--	8.7	8.1
Refugio	0.6	32.2	15.1	12.8	--	14.7	15.1
Victoria	-9.2	4.1	-2.3	3.5	7.8	1.0	0.0
Wharton	12.7	5.8	9.3	19.3	21.6	14.7	13.1
Overall	3.7	10.8	7.4	13.5	21.1	12.0	11.5

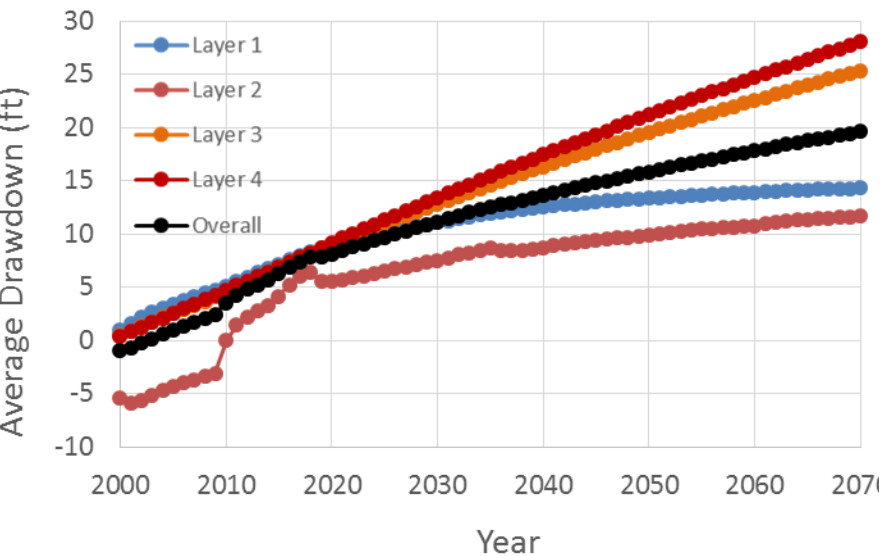
Comparison of 2010 DFC Run and 2014 DFC Basecase Run

Difference between 2014 Baseline Pumping and the 2010 DFC run Pumping for 2070. Positive numbers indicate the 2014 Baseline Pumping is higher

County	Chicot	Evangeline	Chicot + Evangeline	Burkeville	Jasper	Overall	Overall without Burkeville
Aransas	0	0	0	0	0	0	0
Bee	0	0	0	0	0	0	0
Calhoun	5,012	4	5,016	0	0	5,016	5,016
Colorado	6,121	5,147	11,268	0	-22	11,246	11,246
DeWitt	5	5	10	0	0	10	10
Fayette	0	0	0	0	0	0	0
Goliad	107	363	471	5	5	480	475
Jackson	10,374	15,931	26,305	0	0	26,305	26,305
Karnes	0	0	0	0	0	0	0
Lavaca	0	0	0	0	0	0	0
Matagorda	-2,489	-2,393	-4,881	0	0	-4,881	-4,881
Refugio	-2,996	-19,853	-22,849	0	0	-22,849	-22,849
Victoria	28,373	3,334	31,706	0	0	31,706	31,706
Wharton	4,052	-1,104	2,949	0	0	2,949	2,949
Overall	48,559	1,434	49,993	1,368	23,247	74,609	73,241

Recent DFC Run Performed by GMA 15

Base Case



Wharton	2030				2050			
	Chicot	Evangeline	Burkeville	Jasper	Chicot	Evangeline	Burkeville	Jasper
Inflow								
River Leakage	537	0	0	0	537	0	0	0
Recharge	21,818	0	0	0	21,818	0	0	0
Net Stream Leakage	113,092	0	0	0	116,033	0	0	0
Net Vertical Leakage Upper	-	41,010	-	-	-	40,991	-	-
Net Vertical Leakage Lower	-	3,124	1,205	-	-	2,785	1,118	-
Net Lateral Flow From Austin	1,597	1,169	1	13	1,676	1,190	1	15
Net Lateral Flow From Brazoria	-	92	-	-	-	108	-	-
Net Lateral Flow From Colorado	19,602	13,976	44	164	20,188	14,799	46	168
Net Lateral Flow From Fort Bend	-	1,128	-	-	-	521	-	-
Net Lateral Flow From Jackson	1,687	3,518	1	-	1,884	3,539	2	-
Net Lateral Flow From Matagorda	-	2,309	-	-	-	2,490	-	-
Total Inflow	158,133	66,326	1,251	177	161,936	66,423	1,167	183
Outflow								
Wells	114,787	66,501	0	0	114,787	66,501	0	0
Drains	8	0	0	0	8	0	0	0
Evapotranspiration	193	0	0	0	190	0	0	0
Net Vertical Leakage Upper	-	-	3,124	1,205	-	-	2,785	1,118
Net Vertical Leakage Lower	41,010	-	-	-	40,991	-	-	-
Net Lateral Flow To Brazoria	647	-	2	7	643	-	2	6
Net Lateral Flow To Fort Bend	5,690	-	3	111	5,993	-	3	98
Net Lateral Flow To Jackson	-	-	-	7	-	-	-	2
Net Lateral Flow To Matagorda	2,313	-	4	-	1,701	-	2	-
Total Outflow	164,648	66,501	3,133	1,330	164,313	66,501	2,792	1,224
Inflow - Outflow	-6,515	-175	-1,882	-1,153	-2,377	-78	-1,625	-1,041
Storage Change	-6,518	-160	-1,883	-1,155	-2,378	-73	-1,625	-1,043
Model Error	3	-15	1	2	1	-5	0	2
Model Error (percent)	0.00%	0.02%	0.03%	0.15%	0.00%	0.01%	0.00%	0.16%

Questions Regarding the Current DFC

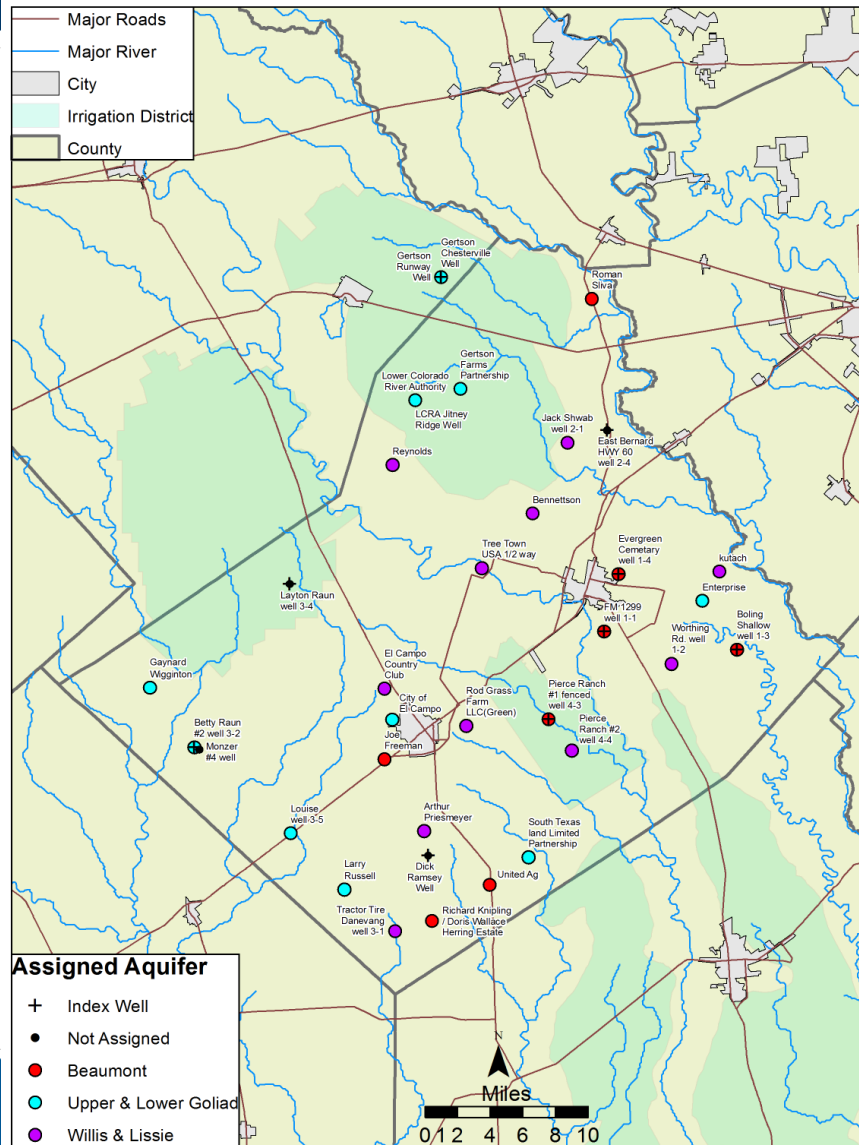
An average drawdown of the Gulf Coast Aquifer within the GMA 15 boundary of 12 feet relative to year 1999 starting conditions in *accordance with Table 7 of GAM Run 10-008 Addendum*.

- **Gulf Coast Aquifer**
 - What portion of Chicot, Evangeline, Burkeville, Jasper?
 - What portion of Catahoula?
- **Average drawdown**
 - Calculated according to volume or area?
 - Based on what set of monitoring wells?
 - Interpolate between wells or use well as indicator measurements?
 - What interpolation to be used?
- **1999 starting conditions**
 - What is the starting condition for the average water levels?
 - What is used for regions with no measured or modeled values
- **Accordance with Table 7**
 - What set of drawdowns in Table 7 did the resolution mandate as DFCs for each District?
 - What constitutes a DFC exceedence (by district, by layer, or by entire aquifer)?
- **Time Period**
 - Is there a DFC besides the 12 ft at 2070?
 - What considerations are there seasonal fluctuations and variations for drought conditions?
 - Are seasonal variations in CBGCD a violation if Table 7 violated?
- **Enforcement**
 - What constitutes a violation that needs enforcement?
 - Who determines when a violation has occurred ?
 - What is the penalty(if any) for a violation ?
 - Since DFCs are set every 5 years, can they be violated?
- **Winners and Losers**
 - Who benefits from the grey area with DFCs?
 - Are DFCs process a net gain or loss to your District?

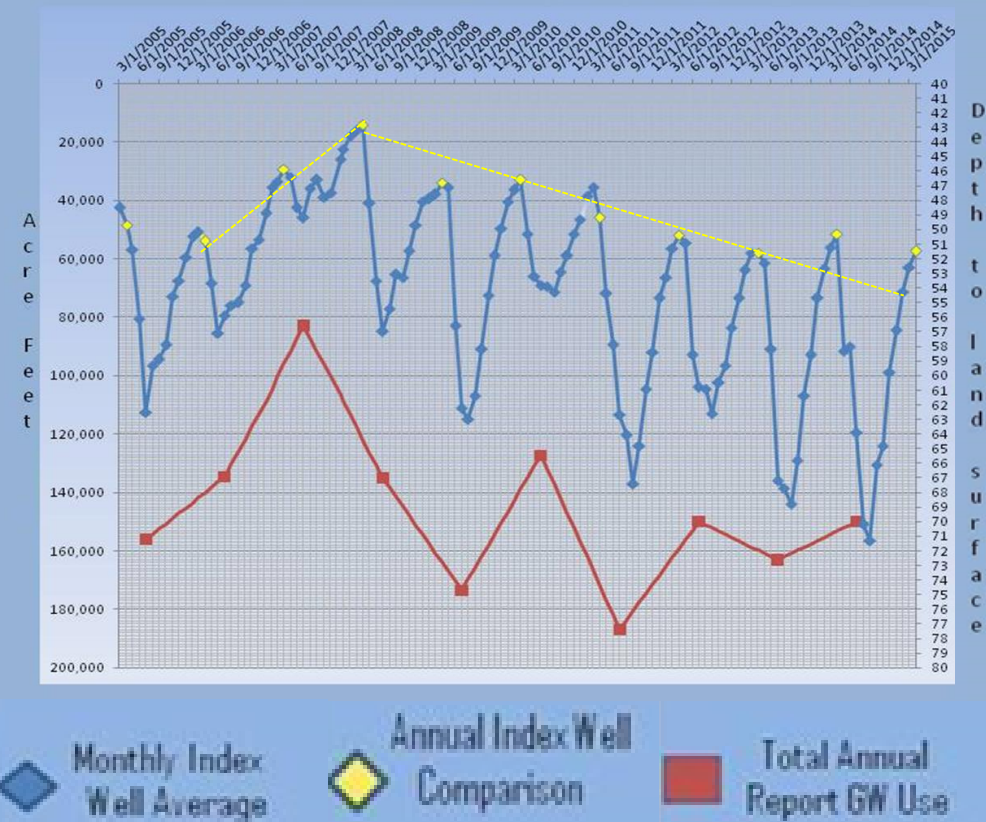
Additional DFC Questions of Concern to Wharton County

- **Central Gulf Coast GAM**
 - Is the GAM a reliable tool for representing the groundwater flow system?
 - How accurate is historical and future pumping represented in DFC Runs
- **DFC Simulations**
 - Is predictive uncertainty important?
 - Should predictive uncertainty be included in setting the DFC?
- **Jasper and Burkeville DFCs**
 - Should CBGCD have a DFC for Jasper and Burkeville if CBGCD has not pumping in those aquifers?
 - Should Jasper and Burkeville DFC (is about double Chicot and Evangeline DFC) be treated as separate from Chicot Evangeline for the entire Gulf Coast Aquifer?
- **Sustainability**
 - What is the importance of the GAM predicted drawdown not leveling off (aka stabilizing) before 2070
 - What does sustainability mean to CBGCD
- **Impact of Other Counties on Wharton's groundwater levels**
 - What impact does pumping in other counties have on the DFC for Wharton County?
 - What assumptions should be used for regions with no measured or modeled values?
- **Management Plans**
 - What should be the criteria to evaluate whether or not a District Management Plan supports the GAM DFCs?
 - Should there be uniformity in how the Districts use the DFCs and MAGs as management objectives?
- **Monitoring Network**
 - How many wells are needed in a monitoring network to provide reliable measurements of average water levels/drawdowns?
 - How should monitoring wells be evaluated?
 - What agencies should determine GCD or GMA compliance?
- **DFC Compliance**
 - How are predictive and measurement error accounted for in determining compliance?
 - Should the method for evaluating compliance be established by a GMA or by a GCD?
- **Average Values**
 - Can aquifers be effectively managed using average values over entire aquifers
 - Is there benefits for a District to have a more specific DFCs ?

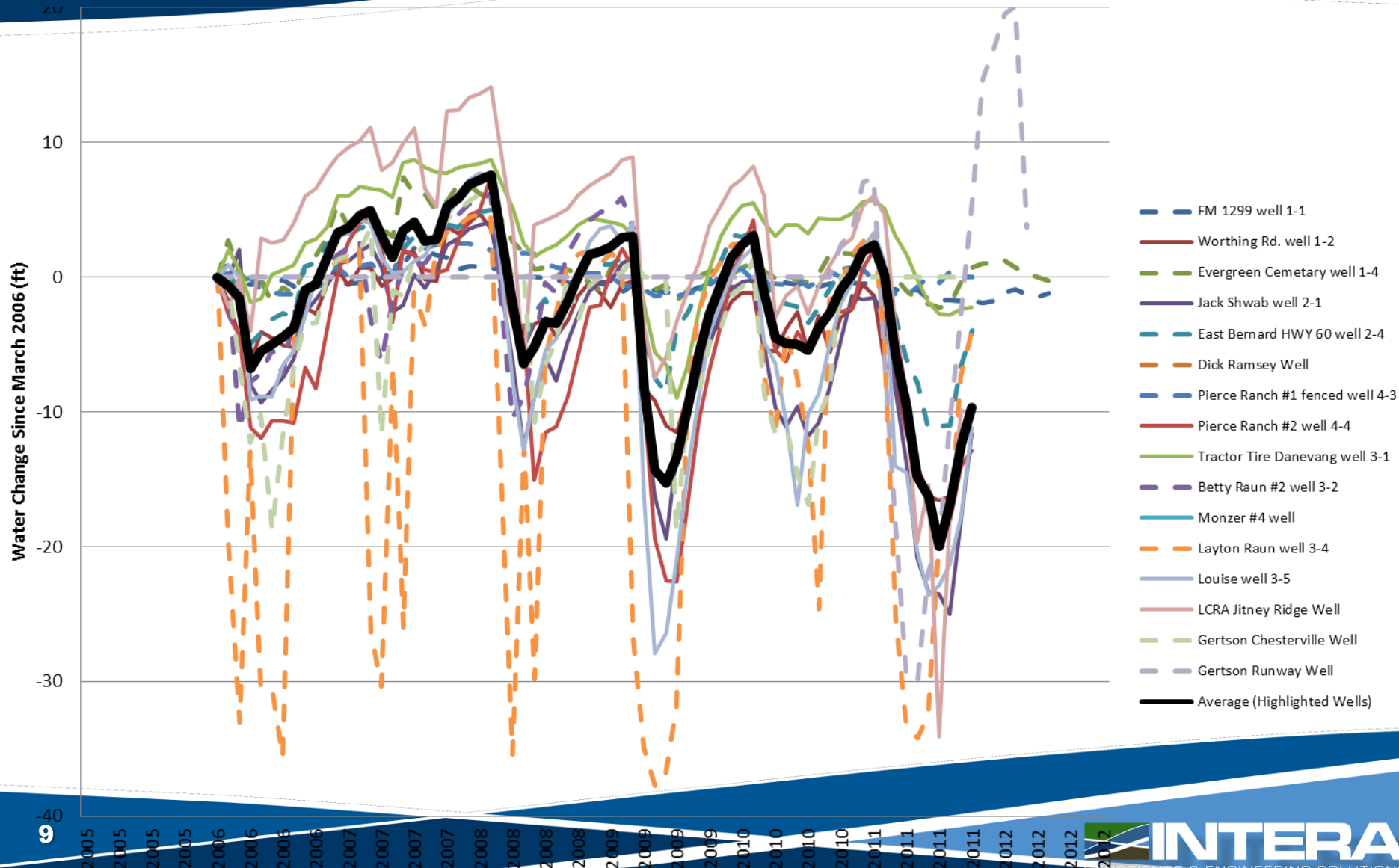
CBGCD Existing Monitoring Network



Coastal Bend GCD Index Well Graph

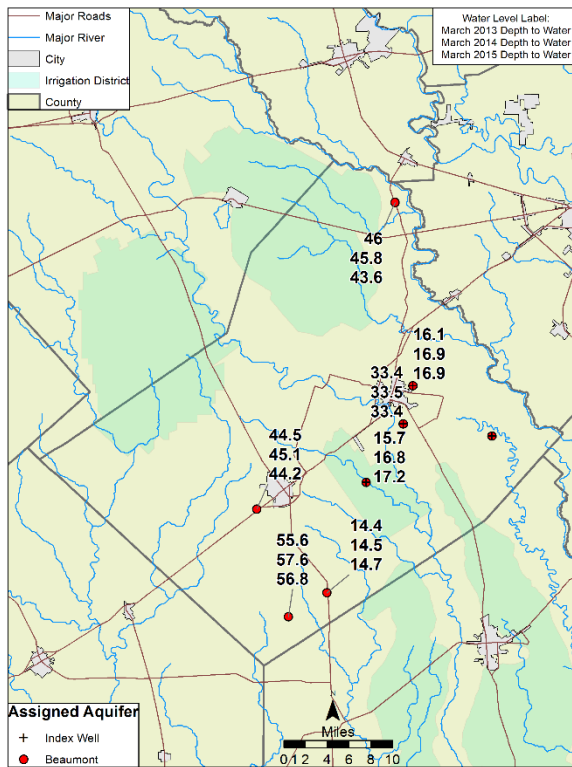


Drawdown from 2006 – 2012 from Individual Wells

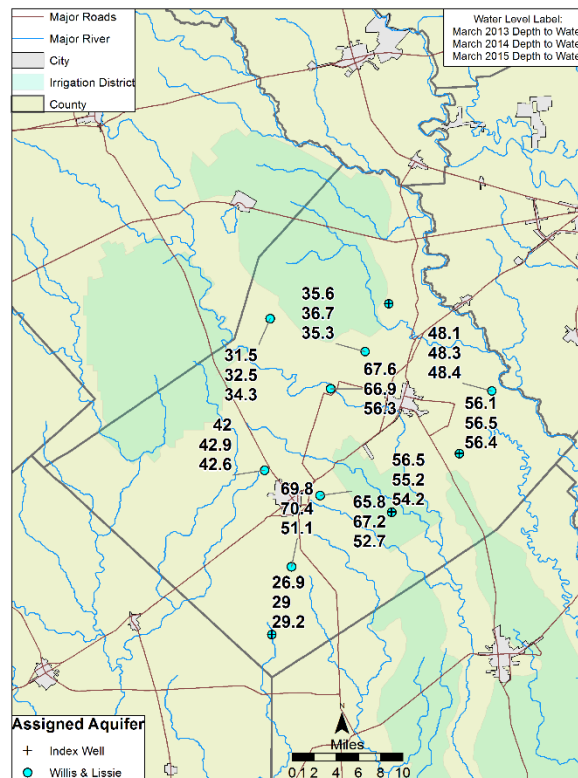


Existing Monitoring Network (Annual Measurements)

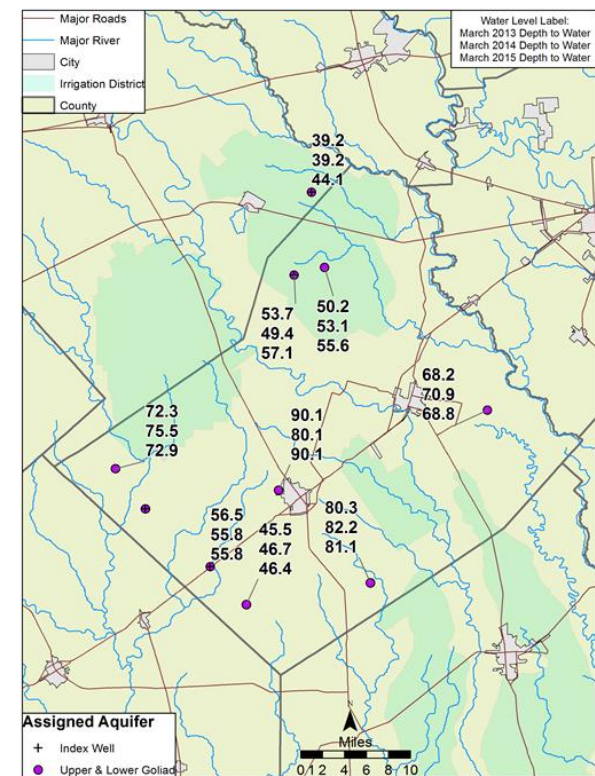
Beaumont



Willis and Lissie



Upper & Lower Goliad



Issues Associated with Demonstration of DFC Compliance

- No Guidelines from GMA, TWDB, or TCEQ regarding Demonstration of Compliance

From Slide #6

- **Average drawdown**
 - Calculated according to volume or area?
 - Based on what set of monitoring wells?
 - Interpolate between wells or use well as indicator measurements?
 - What interpolation to be used?
- **1999 starting conditions**
 - What is the starting condition for the average water levels?
 - What is used for regions with not measured or modeled values
- **Accordance with Table 7**
 - What set of drawdowns in Table 7 did the resolution mandate as DFCs for each District?
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From Slide #7

- **Jasper and Burkeville DFCs**
 - Should CBGCD have a DFC for Jasper and Burkeville if CBGCD has not pumping in those aquifers?
 - Should Jasper and Burkeville DFC (is about double Chicot and Evangeline DFC) be treated as separate from Chicot Evangeline for the entire Gulf Coast Aquifer?
- **Impact of Other Counties on Wharton's groundwater levels**
 - What impact does pumping in other counties have on the DFC for Wharton County?
 - What is used for regions with not measured or modeled values
- **DFC Compliance**
 - How are predictive and measurement error accounted for in determining compliance?
 - Should the method for evaluating compliance be established by a GMA or by a GCD?
-

Suggested Options for CBGCD Related to Demonstrating DFC Compliance

- Adopt DFCs only for portion of Gulf Coast Aquifer that includes Chicot and Evangeline Aquifer
- Set DFC independent of GAM 15 final DFC simulation -- use GAM 15 final DFC simulation as confirmation that CGCD DFC is compatible with other District DFCs
- Evaluate using multiple DFCs (across time and space) than a single DFC
- Adopt an average water level(s) to represent 1999 conditions(needs to be consistent with GAM calibration)
- Use a multi-year averaging period for drawdown instead of a single year
- Develop multiple approaches for calculating an “average” water level
 - Unweighted averages of point measurements
 - Weighted averages of point measurements
 - Integration of contour lines generated by an specific tool or equation for interpolation among water level measurements
 - Options for considering the effects of well pumping or aquifer properties in the calculation of an “average” water level
- Evaluate multiple approaches to calculate average water levels on modeled and monitored data and select one or more approaches for determining compliance
- Develop a DFC compliance process that includes incremental actions that include notification, public comment, studies, and a plan for reducing pumping