Proposed Desired Future Condition(s) for Aquifer(s) in GMA 12

Environmental Stewardship

Comments on Hydrological Conditions Presentation

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Contact Information

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Proposed Desired Future Condition(s)

Please be as detailed as possible in describing your proposed DFC. Include the quantifiable value and a description of the method for measuring or calculating the value. Attach additional pages as needed.

Aquifer	Proposed DFC and Measuring/Calculating Method

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Consideration of Proposed Desired Future Condition(s)

The Texas Water code requires that the GMA develop DFCs that "provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area." In the space below, or on additional attached pages, please provide your considerations with regard to the nine items that must be considered, per the Texas Water Code, for the proposed DFC(s).

Consideration 1 – "Aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another:" ____

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Consideration 2 – "The water supply needs and water management strategies included in the state water plan:" ____

Consideration 3 – "Hydrological conditions, including for each aquifer in the management area the total estimated recoverable storage as provided by the executive administrator, and the average annual recharge, inflows, and discharge:" ____

Environmental Stewardship appreciates that the discussion at the May 28 meeting was presented for the PS-4 scenario in the context of a full water budget for the current planning period through 2070 and included the 1975-1999 calibration period.

The following comments are based on the GMA Consultant Team's slide set.

1) As noted in slide 8, the faults in the GAM are mostly "sealing" faults and are being re-evaluated by an INTERA study since the empirical data seems to indicate that many of these are "non-sealing" faults. We believe this is important as it relates to flows between aquifers, sections of aquifers, districts and counties as reflected in the water budgets presented later in the presentation. This is a consideration that will run throughout many of the comments on the water budgets.
2) As noted in slide 21, the Carrizo formation is hydrologically connected to the Wilcox formation, and in slide 25, the Simsboro is defined as a separate unit in most of the GMA. These two statements are significant "assumptions" that echo throughout the evaluation and decision process and, in many cases, conflict with the GAM out-put data. <u>Environmental Stewardship contends that the assumption for the Simsboro aquifer needs to be tempered to recognize that, over the long-term 50+ year planning horizon of the DFC process, it is likely that the Simsboro aquifer communicates with the other associated aquifers (Calvert Bluff, Hooper, and Carrizo).</u> To the extent that the hydrological dynamics of heavy pumping of the Simsboro Aquifer will cause inflows to the aquifer from these other formations, the likely impact over time will be to lower the levels of the Carrizo, Calvert Bluff and Hooper aquifers which will have impacts on

both exempt and non-exempt wells in those formations. These impacts need to be examined in considerations 4, 6 and 7.

3) As noted in slide 32, total estimated recoverable storage (TERS) *does not* account for impacts on surface waters. Since the districts must consider the impact of desired future conditions on surface waters before adopting DFCs, it will be prudent to develop an understanding of TERS levels of pumping (25% recovery for example) on surface waters through such hydrological functions as de-watering unconfined regions of the aquifers or reducing the artesian head pressure in the confined regions of the aquifers. As stated in slide 33, TERS uses a one-size-fits-all definition of "recovery" and the amount of water that is actually recoverable will likely vary from aquifer to aquifer. To make sound decisions we will need to have a better understanding of these relationships for *each* of our aquifers.
4) Regarding slide 33, please provide a more quantitative explanation of the statement that the "vast majority of water is in unconfined storage".
5) Annual Recharge, Inflows, and Discharges (Slide 46): What is the modeling periods used for each of the TWDB GAM Run's? Taken out of the context of a water budget, the values for recharge, inflows, and discharges can be very misleading. To be meaningful, these data need to be considered in the context of the pumping and other factors. At a minimum, this information should be presented as a sequence of GAM runs progressing from the earliest done for each district, through to the most current, so that changes in these values can be viewed and trends detected. The water budget information that follows is much more informative.
6) Water Budgets Observations: Environmental Stewardship analyzed the water budgets for the Simsboro aquifer in the five districts and consolidated for the GMA (See Attachment 1). The following observations are from the analysis:
   a) Outflows to surface waters: Surface water is the single most significant contributor of water for pumping. Outflows to surface waters are modeled to have decreased by a total of 100,000 ac-ft/yr since 1975 with the greatest declines occurring in Post Oak Savannah, Lost Pines, and Mid-East Texas respectively.
   b) Storage changes: Storage is the least significant contributor of water for pumping since 1975. Storage increased during the calibration period and decreases during the DFC period but is net neutral for the period. It is misleading to state that most of the groundwater pumped is contributed from storage.
   c) Vertical leakage: Vertical leakage from other aquifers into the Simsboro is the second most significant contributor of groundwater for pumping since 1975 (modeled to contribute 83,300 ac-ft/yr) and is the most significant contributor during the DFC period (modeled to contribute 69,800 ac-ft/yr by 2070). Vertical inflow to the Simsboro is most significant in Post Oak Savannah, Brazos Valley, and Lost Pines respectively during the DFC period.
   d) Lateral leakage: Lateral flow of groundwater from other districts into the Simsboro in Brazos Valley is significant during the DFC period. Lateral flows out of Lost Pines and Mid-East Texas are the most significant with moderate outflows from Post Oak Savannah.

   e) Pumping: By 2070 the annual pumping of the Simsboro aquifer in the GMA is estimated at 244,000 ac-ft per year with the highest pumping in Brazos Valley, Post Oak Savannah, and Lost Pines respectively.

7) **SUMMARY OBSERVATION:** The GAM results indicate that the most significant contributors of groundwater for pumping of the Simsboro aquifer are from 1) a reduction in outflows to surface waters, and 2) the flow of groundwater out of other aquifers within the district (without consideration of the limitations noted in items 1 and 2 above). Considerable technical analysis of existing empirical data and observations need to be undertaken by the technical team in order to provide the GMA-12 districts a better understanding of the implications of these factors as they relate to 1) the desired future conditions, 2) impacts on the surface water and terrestrial environments, and 3) exempt groundwater wells in aquifers contributing to vertical flows. To a lesser extent the impacts of lateral flows between districts needs to be investigated.

8) **REQUESTS**:
   a) To better understand the environmental implications related to the decrease of outflows to surface waters and the terrestrial environment the GMA-12 technical team should be authorized to seek assistance from the Texas Parks and Wildlife Department.
   b) To model and manage the interaction between groundwater pumping and surface water impacts the INTERA improvements to the GAM need to include adequate scope and funding to ensure the needed tools are available to the GMA-12 districts.
   c) To better understand and manage the potential impact of vertical flows on exempt well owners the information requested by Environmental Stewardship in its March 27, 2015 letter needs to be collected and organized by aquifer, district and county.
   d) MODFLOW analyses for the Colorado and Brazos rivers and associated tributaries needs to be run for use in future discussions on the environmental and surface water impacts of permitted and proposed pumping.

Consideration 4 – "Other environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water:" __________

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Consideration 5 – "The impact on subsidence:" ______________________________

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Consideration 6 – "Socioeconomic impacts reasonably expected to occur:" ______

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Consideration 7 – "The impact on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater:" ____

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Consideration 8 – "The feasibility of achieving the desired future condition:" ____

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Consideration 9 – "Any other information relevant to the specific desired future conditions:" ____

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Attachment 1.

Analysis of GMA-12 Water Budgets
Planning Scenario 4 (PS-4)
Prepared by Environmental Stewardship

Simsboro Aquifer	Lost Pines GCD	Acre-feet per Year*				Net Change over period		
Description		**Calibration Period**		**DFC Period**				
Technical	**Layman**	**1975**	**1999**	**2000**	**2070**	**Calibration**	**DFC**	**Total**
Recharge	To(+) aquifer	5,000	25,000	5,000	5,000	20,000	0	20,000
Et	From(-) Evapotranspiration	0	0	0	-2,500	0	-2,500	-2,500
Storage Change	To(-)/from(+) storage	18,000	8,000	8,000	25,000	-10,000	17,000	7,000
Stream leakage	To(-)/from(+) surface waters	-15,000	-4,000	-2,000	12,000	11,000	14,000	25,000
Drains	To(-)/from(+) springs	-2,500	0	0	0	2,500	0	2,500
Verticle Leakage	To(-)/from(+) other aquifers	1,000	3,000	3,000	20,000	2,000	17,000	19,000
Lateral Leakage	To(-)/from(+) POS	-2,000	0	-4,000	-17,000	2,000	-13,000	-11,000
Wells	Pumping	-2,500	-13,000	-22,000	-58,000	-10,500	-36,000	-46,500
Slide # 79	**Net:**	2,000	19,000	-12,000	-15,500	17,000	-3,500	13,500

* All values are extrapolated from graph and are estimates of the actual GAM values

Simsboro Aquifer	Post Oak Savannah GCD	Acre-feet per Year*				Net Change over period		
Description		**Calibration Period**		**DFC Period**				
Technical	**Layman**	**1975**	**1999**	**2000**	**2070**	**Calibration**	**DFC**	**Total**
Recharge	To(+) aquifer	13,000	10,000	12,000	12,000	-3,000	0	-3,000
Et	From(-) Evapotranspiration	0	0	0	0	0	0	0
Storage Change	To(-)/from(+) storage	22,000	28,000	30,000	30,000	6,000	0	6,000
Stream leakage	To(-)/from(+) surface waters	-30,000	-12,000	-8,000	10,000	18,000	18,000	36,000
Drains	To(-)/from(+) springs	0	0	0	0	0	0	0
Verticle Leakage	To(-)/from(+) other aquifers	2,000	4,500	4,500	27,000	2,500	22,500	25,000
Lateral Leakage	To(-)/from(+) other districts	-7,000	-11,000	-18,000	-25,000	-4,000	-7,000	-11,000
Wells	Pumping	-2,000	-22,000	-25,000	-71,000	-20,000	-46,000	-66,000
	Net:	-2,000	-2,500	-4,500	-17,000	-500	-12,500	-13,000

* All values are extrapolated from graph and are estimates of the actual GAM values

Simsboro Aquifer	Brazos Valley GCD	Acre-feet per Year*				Net Change over period		
Description		**Calibration Period**		**DFC Period**				
Technical	**Layman**	**1975**	**1999**	**2000**	**2070**	**Calibration**	**DFC**	**Total**
Recharge	To(+) aquifer	7,500	4,000	5,000	5,000	-3,500	0	-3,500
Et	From(-) Evapotranspiration	2,000	3,000	0	0	1,000	0	1,000
Storage Change	To(-)/from(+) storage	17,000	17,000	10,000	12,000	0	2,000	2,000
Stream leakage	To(-)/from(+) surface waters	-18,000	-6,000	-6,000	-2,000	12,000	4,000	16,000
Drains	To(-)/from(+) springs	0	0	0	0	0	0	0
Verticle Leakage	To(-)/from(+) other aquifers	6,000	13,000	13,000	33,000	7,000	20,000	27,000
Lateral Leakage	To(-)/from(+) other districts	2,000	7,000	7,000	41,000	5,000	34,000	39,000
Wells	Pumping			-45,000	-111,000	0	-66,000	-66,000
	Net:	16,500	38,000	-16,000	-22,000	21,500	-6,000	15,500

* All values are extrapolated from graph and are estimates of the actual GAM values

Simsboro Aquifer	Fayette County GCD	Acre-feet per Year*				Net Change over period		
Description		**Calibration Period**		**DFC Period**				
Technical	**Layman**	**1975**	**1999**	**2000**	**2070**	**Calibration**	**DFC**	**Total**
Recharge	To(+) aquifer	0	0	0	0	0	0	0
Et	From(-) Evapotranspiration	-50	-50	0	0	0	0	0
Storage Change	To(-)/from(+) storage	0	50	50	50	50	0	50
Stream leakage	To(-)/from(+) surface waters	0	0	0	0	0	0	0
Drains	To(-)/from(+) springs	0	0	0	0	0	0	0
Verticle Leakage	To(-)/from(+) other aquifers	200	700	400	4,200	500	3,800	4,300
Lateral Leakage	To(-)/from(+) other districts	-300	-500	-700	-4,500	-200	-3,800	-4,000
Wells	Pumping	0	0	0	0	0	0	0
	Net:	-150	200	-250	-250	350	0	350

* All values are extrapolated from graph and are estimates of the actual GAM values

Simsboro Aquifer	Mid-East Texas GCD	Acre-feet per Year*					Net Change over period		
Description		Calibration Period		DFC Period					
Technical	Layman	1,975	1,999	2,000	2,070		Calibration	DFC	Total
Recharge	To(+) aquifer	12,000	6,000	10,000	10,000		-6,000	0	-6,000
Et	From(-) Evapotranspiration	-1,000	-1,000	-1,000	-1,000		0	0	0
Storage Change	To(-)/from(+) storage	21,000	4,000	2,500	1,000		-17,000	-1,500	-18,500
Stream leakage	To(-)/from(+) surface waters	-30,000	-8,000	-8,000	-7,000		22,000	1,000	23,000
Drains	To(-)/from(+) springs	0	0	0	0		0	0	0
Verticle Leakage	To(-)/from(+) other aquifers	2,500	4,000	5,500	12,000		1,500	6,500	8,000
Lateral Leakage	To(-)/from(+) other districts	0	1,000	2,000	-11,000		1,000	-13,000	-12,000
Wells	Pumping	-2,000	-3,000	-9,000	-4,000		-1,000	5,000	4,000
	Net:	2,500	3,000	2,000	0		500	-2,000	-1,500

* All values are extrapolated from graph and are estimates of the actual GAM values

Simsboro Aquifer	GCD's Consolidated	Acre-feet per Year*					Net Change over period		
Description		Calibration Period		DFC Period					
Technical	Layman	1975	1999	2000	2070		Calibration	DFC	Total
Recharge	To(+) aquifer	37,500	45,000	32,000	32,000		7,500	0	7,500
Et	From(-) Evapotranspiration	950	1,950	-1,000	-3,500		1,000	-2,500	-1,500
Storage Change	To(-)/from(+) storage	78,000	57,050	50,550	68,050		-20,950	17,500	-3,450
Stream leakage	To(-)/from(+) surface waters	-93,000	-30,000	-24,000	13,000		63,000	37,000	100,000
Drains	To(-)/from(+) springs	-2,500	0	0	0		2,500	0	2,500
Verticle Leakage	To(-)/from(+) other aquifers	11,700	25,200	26,400	96,200		13,500	69,800	83,300
Lateral Leakage	To(-)/from(+) other districts	-7,300	-3,500	-13,700	-16,500		3,800	-2,800	1,000
Wells	Pumping	-6,500	-38,000	-101,000	-244,000		-31,500	-143,000	-174,500
	Net:	18,850	57,700	-30,750	-54,750		38,850	-24,000	14,850

* All values are extrapolated from graph and are estimates of the actual GAM values

OBSERVATIONS: Lost Pines GCD

1 Outflow to surface water decreased by 11,000 ac-ft/yr during calibration and another 14,000 during DFC; a total of 25,000 ac-ft/yr
2. Outflow to surface water ceases about 2060
3. Storage increased during calibration period and decreases during DFC (drawdown)
4. Verticle leakage into Simsbor increases significantly during DFC period
5. Lateral flow out of Districtt decreased slightly during calibration but increases significantly during DFC period (net outflow from District).
6. Pumping increased during calibration and increases significantly during DFC period (total 2070 pumping is 58,000 ac-ft/yr).

OBSERVATIONS: Post Oak Savannah GCD

1 Outflow to surface water decreased by 18,000 ac-ft/yr during calibration and another 18,000 during DFC; a total of 36,000 ac-ft/yr
2. Outflow to surface water ceases about 2020
3. Storage decreased during calibration period and is neutral during DFC (drawdown)
4. Verticle leakage into Simsbor increases significantly during DFC period
5. Lateral flow out of the District increases during calibration and continues increase significantly during DFC period (net outflow from District).
6. Pumping increased sginificantly during calibration and increases significantly during DFC period (total 2070 pumping is 71,000 ac-ft/yr).

OBSERVATIONS: Brazos Valley GCD

1 Outflow to surface water decreased by 12,000 ac-ft/yr during calibration and another 4,000 during DFC; a total of 16,000 ac-ft/yr
2. Outflow to surface water remains near neutral
3. Storage is neutral during calibration period and decreases slightly during DFC (drawdown)
4. Verticle leakage into Simsbor increases significantly during DFC period
5. Lateral flow into District increases increased during calibration and increases very significantly during DFC period (net inflow to District).
6. Pumping is not recorded during calibration but increases very significantly during DFC period (total 2070 pumping is 111,000 ac-ft/yr).

OBSERVATIONS: Fayette County GCD

1 Outflow to surface water decrease is insignificant
2. Outflow to surface water does not change significantly
3. Storage is neutra during both periods.
4. Verticle leakage into Simsbor increases during DFC period
5. Lateral flow out of District is slight during calibration and increases moderately during DFC period (net outflow from District).
6. Pumping does not occur in Simsboro aquifer.

OBSERVATIONS: **Mid-East Texas GCD**

1 Outflow to surface water decreased by 22,000 ac-ft/yr during calibration and another 1,000 during DFC; a total of 23,000 ac-ft/yr
2. Outflow to surface water continues through both periods
3. Storage increased significantly during calibration period and only slightly during DFC (net increase)
4. Verticle leakage into Simsbor increases during DFC period
5. Lateral flow into District increased slightly during calibration but reverses during DFC period (net outflow from District).
6. Pumping increased slightly during calibration and DFC period (total 2070 pumping is 4,000 ac-ft/yr).

OBSERVATIONS: **GCD's Consolidated**

1 Outflow to surface water decreased by 63,000 ac-ft/yr during calibration and another37,000 during DFC; a total of 100,000 ac-ft/yr
2. Outflow to surface water ceases between 2020 (Post Oak) and 2060 (Lost Pines).
3. Storage increased during calibration period and decreases more significantly during DFC (drawdown)
4. Verticle leakage into Simsbor increases very significantly during DFC period
5. Lateral flow out of districts decreased slightly during calibration and increases slightly during DFC period (net outflow from District).
6. Pumping increased significanly during calibration and DFC period (total 2070 pumping is 244,000 ac-ft/yr).