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

Environmental Stewardship

comments on new pumping file, recharge file,

water budgets, and impact of pumping on other formations.

Consideration 3

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Proposed Desired Future Condition(s): Environmental Stewardship has but one interest in this GMA-12 DFC review process; to protect the integrity and functioning of the ecological systems that form the basis of the Colorado and Brazos river basins and the Carrizo-Wilcox and associated aquifers for current and future generations. **In conformance with the Conservation Amendment of the Texas Constitution, it is the duty of the Texas Legislature and Groundwater Conservation Districts to conserve and preserve the natural resources of the state -- our groundwater, our rivers, our springs, and our ecosystems -- by passing laws, rules, and for the purposes of this effort, adopting desired future conditions, that achieve a balance between conservation and development of those resources *in perpetuity*. To protect our aquifers as we found them while respecting the ownership rights of landowners. Though the ability to preserve an aquifer for future generations is not totally in our control -- its rate of replenishment, and its hydrologic characteristics, are largely a function of Mother Nature and must be accepted and respected -- development of an aquifer, and ultimate depletion of an aquifer and/or the surface water and ecosystems which depend on groundwater, *is the voluntary human action in which we are currently engaged.***

The essence of conservation and preservation of an aquifer resource is that the rate at which we deplete our aquifers must be in balance with the conservation of the aquifer. That the depletion not be driven only by the desire for development, against which we simply wait for damage to the aquifer's sustainability before attempting to bring it back "in balance". Only as a bright "conservation standard" describing a sustainable aquifer is established -- an aquifer that is preserved in perpetuity -- can we then determine how much of that aquifer we can develop in balance with the conservation standard. Conservation and protection of an existing aquifer for the *common good of future generations* must be the priority, not the *development* of an aquifer to satisfy every current and speculated human demand on it. Civilizations that have disappeared have failed to realize this distinction when they exploited natural resources.

ES recommends that the GMA-12 districts debate and adopt its own version of this conservation standard to guide in adopting desired future conditions during this cycle.

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
Carrizo Aquifer	
Calvert Bluff Aquifer	
Simsboro Aquifer	
Hooper Aquifer	
Queen City Aquifer	
Sparta Aquifer	
Yegua-Jackson Aquifer	
Brazos Alluvium Aquifer	
Colorado Alluvium Aquifer	

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[1], 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 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 consultants attempted to run the New GAM with several new pumping files and against several scenarios that are attempting to investigate the impact of drought on GMA-12 aquifers' responses to proposed groundwater pumping.

New Pumping file: We are disappointed that the "new pumping file" has not yet been released as anticipated in the January, May and August meetings. We also note " Some review and minor adjustments will be needed before proceeding with DFC run" (page 4 of presentation).

Recharge file: We are also disappointed that the "recharge" files did not, in ES' view, adequately represent drought of record (DOR) conditions for the 1950's nor the more recent DOR for lakes Travis and Buchanan that extends from October 2007 through April 2015[2]. In our view 75% of average historic recharge is only a 25% reduction in recharge and does not represent a full-blown drought. Our recollection was that the recharge file was to represent the two DOR periods of 1950's and 2007-15 (per January, May and August minutes).

In support of our contention that the recharge files did not adequately represent the DOR's we call your attention to new information on the predictions of the New GAM as presented by Dr. William R. Hutchison[3] as follows:

> Also, Section 3.2 of the Hutchison Report provides that the New GAM showed that historic pumping has been relatively low in the sense that historic pumping has not

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[2] On Feb. 28, 2019, LCRA staff submitted the application to amend the plan to the Texas Commission on E[2]On Feb. 28, 2019, LCRA staff submitted the application to amend the plan to the Texas Commission on Environmental Quality for approval. The application can be found on LCRA's website at: https://www.lcra.org/water/water-supply-planning/water-management-plan-for-lower-colorado-river-basin/Pages/water-management-plan-amendment-application.aspx

Chapter 3, Section 3.2, page 3-2: "The model results indicate that the recent drought, specifically the period from October 2007 through April 2015, is the new Drought of Record for lakes Buchanan and Travis. The Combined Firm Yield as calculated in this WMP revision is 418,848 acre-feet per year. This replaces the value of 434,154 acre-feet per year calculated in the 2015 WMP.[6] A more detailed explanation of the Combined Firm Yield calculation can be found in Appendix A, Technical Paper A-5."

[3] Hutchison, William R. July 26, 2019. DIRECT TESTIMONY OF WILLIAM R. HUTCHISON, Ph.D., P.E., P.G. on behalf of THE GENERAL MANAGER OF LOST PINES GROUNDWATER CONSERVATION DISTRICT SUBMITTED ON JULY 26, 2019, Testimony page 16, Expert Report pages 14 and 16.

been a major factor in changes in groundwater levels in Bastrop County. Analysis of the historic model results show that 94 percent of the variation in groundwater levels in Bastrop County can be explained by the variation in recharge. (Recharge to aquifers results primarily from precipitation on the outcrop areas of the aquifer, The outcrop is the surface extent of an aquifer -- Le, the area in which the aquifer formations are exposed at the land surface.) [emphasis added]

The results highlight the fact that groundwater pumping results in three impacts: 1) reduced storage (manifested by reduced groundwater levels), 2) induced inflow from surrounding areas and from surface water, and 3) reduced natural outflow to surface water and/or subsurface outflow to surrounding area. [emphasis added]

Figure 5 plots the annual recharge and the annual groundwater storage change from 1930 to 2010 in Bastrop County. Please note that the regression line is also plotted along with the regression equation and r2 value of the regression that is a quantitative expression of how well the line fits the data (perfect fit = 140) The r2 value of 094 can be interpreted as 94 percent of the variation in groundwater storage change can be explained by the variation in recharge. This suggests that, historically, groundwater pumping has had a relatively minor impact on changes in regional groundwater storage (ire. groundwater levels). [emphasis added].

Figure 6 presents the annual surface water-groundwater interaction graph and includes the calibrated model results and the two predictive scenario results. Please note that negative values represent a flow from groundwater to surface water (groundwater discharge to rivers that forms baseflow), and positive values represent a flow from surface water to groundwater (surface water providing recharge water to groundwater).

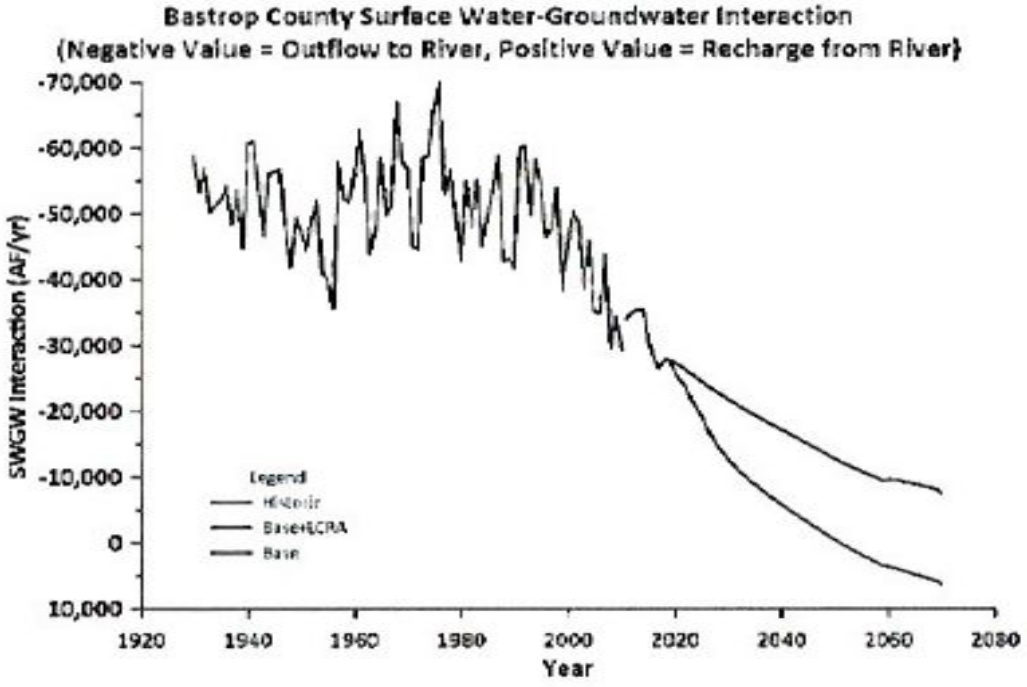

Figure 6. Bastrop County Surface Water-Groundwater Interaction

Figure 6. Bastrop County Surface Water-Groundwater Interaction. Please note that prior to about 1990, groundwater discharge to surface water varied without a discernible trend. Beginning in about 1990 a trend begins to be observed where the rate of discharge to surface water declines (from about 60,000 AF/yr to about 30,000 AF/yr in 2010). [Emphasis added]

ES concludes that the impact of precipitation on recharge is and important factor to be considered as a part of the hydrological conditions that should be thoroughly and completely represented in the recharge file and that the file data for the period of 1930-2010 should be replicated for the period 2011-2070 in order to fully understand the impact of variable precipitation on GMA-12's evaluation of pumping scenarios. As such, ES questions whether the "Drought Impact" table for Lost Pines GCD Results on page 28 of the August 2, 2019 presentation accurately and adequately represents the impact of either or both DOR's.

ES Questions to GMA-12:

1. Does the recharge file contain data on precipitation for the period of 1930 - 2010 (80 years) that would have influenced the surface water-groundwater interaction during that period as represented in Figure 6?
2. Could such data, if present in the recharge file, be used to populate the years 2011-2070?
3. Since the new drought of record (DOR) extends past 2010, the period represented in Hutchison's graph and presumably in the recharge file, could climatological data for the recharge area of the Simsboro, Carrizo, Calvert Bluff and Hooper formations in GMA-12 be updated to fully represent the new DOR?

Water Budgets: After looking more closely at the water budgets resulting from the S1-S6 runs, we find that there are some inconsistencies in these results that do not make sense. Perhaps a more thorough discussion and explanation would be helpful.

Dr. Hutchison[4] states that:

> The groundwater budget comparison suggests that about 46 percent of the pumping will be sourced from reduced baseflow to the surface water system in Bastrop County, About 35 percent of the pumping will be sourced from reduced groundwater storage, and about 16 percent will be sourced from decreased subsurface outflow to Lee County, [Emphasis added]

Looking at the Budget Evaluations for Lost Pines GCD- run S-2 (pages 67) for the Carrizo and Simsboro formations, it appears that:

- + numbers are inflows to formation; - numbers are outflows from formation. An "increase" is a greater quantity, and a "decrease" is a lesser quantity.
- Storage - amount in storage in each formation.
    - o inflows increase in the Carrizo (unexpected)
    - o inflows increases then flattens out in the Simsboro (unexpected - we have repeatedly been told that the groundwater pumped comes primarily from storage).
- Wells - Outflow from each formation.
    - o outflows increase with pumping in the Carrizo (expected. How much is pumped form this formation in Lost Pines?)
    - o outflows increase with pumping in the Simsboro (expected)

[4] Hutchison, William R. July 26, 2019. DIRECT TESTIMONY OF WILLIAM R. HUTCHISON, Ph.D., P.E., P.G. on behalf of THE GENERAL MANAGER OF LOST PINES GROUNDWATER CONSERVATION DISTRICT SUBMITTED ON JULY 26, 2019, Expert Report page15.

- Streams/Seeps/Spring flow (drains) - Inflows (+) to the formation from streams, seeps and springs and outflows (-) from the formation to streams, seeps and springs.
    - flat in Carrizo (unexpected, is this being measured accurately?)
    - flat in Simsboro (unexpected, is this being measured accurately?)
- River-Groundwater Exchange (rivers package) - Inflows (+) to formation from rivers and outflow (-) from the formation to the river.
    - inflows increases in the Carrizo - (expected, there is greater drawdown due to induced flow into the Simsboro so would expect the inflows from rivers to increase)
    - inflows are flat in the Simsboro (unexpected, would expect that inflows would increase based on predicted declining ouftlows to the river that are predicted)
- Recharge - Inflows (+) to each formation from precipitation and surface waters.
    - inflows are flat in the Carrizo (expected due to limitations in construction of the file as discussed above)
    - inflows are flat in the Simsboro (expected due to limitations in the construction of the file recharge file as discussed above)
- Lateral Flows - inflows (+) to the formation from other counties and outflows (-) from the formation to other counties.
    - outflows increases in the Carrizo (perhaps expected due to probable outflows to Lee and Burleson counties)
    - inflows increases then flatten out in the Simsboro (expected)
- Vertical Flows - inflows (+) to the formation from other formations (above or below) and outflows (-) to other formations (above or below) from the formation.
    - outflows increase and then decline in the Carrizo (expected as it moves toward equilibrium)
    - inflows increase in the Simsboro (expected)

Impact of pumping on Carrizo Wilcox Group: Finally, ES wants to call to the attention of the GMA-12 representatives that the New GAM predicts a different drawdown response in the Simsboro formation (less drawdown) than in the Carrizo, Calvert Bluff and Hooper formations (greater drawdown) when compared to the Old GAM.

George Rice's evaluation[5] of the difference between the New GAM compared to the Old GAM are as follows:

> Simulations performed with the old and new GAMs give different results. The new GAM predicts a greater reduction in the flow of the Colorado River (Exhibit 102). The new GAM also predicts less of a decline (drawdown) in water levels in the Simsboro Aquifer (Exhibit 103). But, compared to the old GAM, the new GAM predicts greater water level declines in the Hooper, Calvert Bluff, and Carrizo aquifers. [emphasis added]
>
> Pumping files are still being developed for the new GAM. To date, I have used the pumping file provided by the LPGCD in 2018 (DBS, 2018b). An updated pumping file is due to be completed in July. Once available, I intend to use the updated file to produce new GAM predictions. I do not know whether the predictions produced with the updated file will differ significantly from those produced with the current file.

[5] Rice, George. June 28, 2019. PRE-FILED DIRECT TESTIMONY OF GEORGE RICE ON BEHALF OF ENVIRONMENTAL STEWARDSHIP, page 7.

The implication is that there is greater impact from Simsboro pumping on the formations above and below the Simsboro than were predicted by the Old GAM.

ES Questions to GMA-12:

1. Does the above-cited relationship indicate that it is likely that there is induced leakage into the Simsboro from the Carrizo, Calvert Bluff and Hooper formations due to pumping in the Simsboro formation?
2. Is it likely that the New GAM better predicts the recharge into the Simsboro from the induced leakage from the Carrizo, Calvert Bluff and Hooper formations, thereby predicting the reduced drawdown in the Simsboro than the Old GAM?
3. If the answers to 1 and 2 are in the affirmative, shouldn't the impacts of pumping in the Simsboro collectively involve the Simsboro, Carrizo, Calvert Bluff and Hooper formations for purposes of predicting and evaluating the impact of groundwater pumping in the Simsboro formation on DFCs in all four formations and outflows to surface waters from all four formations.
4. Should the GMA-12 Districts revise the DFCs for the Simsboro, Carrizo, Calvert Bluff and Hooper with these impacts included from the New GAM?