

Addendum to Final Report for TWDB Contract #0903580958

TWDB Comments on Economic Impacts of Groundwater Management Standards in the  
Panhandle Groundwater Conservation District of Texas

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1. Please provide an electronic copy of the datasets, computer programs, and models developed under the terms of this contract (as outlined in Section II. Article III. Item III.)

Response: No datasets, computer programs, or models were developed utilizing the granting funds.

2. Please include a table of contents, list of figures, and list of tables. Also include a glossary or index of terms *I* acronym definitions (IMPLAN, GAMs, DFCs, etc.). Distinguish throughout the report the two different "GAMs" - Groundwater Availability Models vs. General Algebraic Modeling System.

Response: A table of contents, list of figures, list of tables, and glossary have been provided. Groundwater Availability Model is referenced as GAM. General Algebraic Modeling System is referenced as GAMS. An explanation of the differentiation is noted on page 8.

3. All TWDB Agricultural Water Conservation Grants are required to report actual water savings.
  - Please include an estimation of actual water savings resulting through implementation of this project, and an explanation of the methodology used for calculation.

Response: This number is not easy to estimate over a long period of time. Water savings early in a planning horizon is available for use later in time and thus the “net” over fifty years can be very insignificant.

For the “High Drawdown Farm” the numbers are as follows:

Total Water savings the first 20 years on the high drawdown farm as a result of the policy evaluated – 3097 acre-feet or 2.75 acre-feet/irrigated acre or 0.16 acre-feet/irrigated acre/year

Total Water savings over the 50 year planning horizon on the high drawdown farm - 1399 acre-feet or 1.25 acre-feet/irrigated acre or 0.025 acre-feet/irrigated acre/year.

These numbers can be scaled but it is important to note that this will only be realized on acres with characteristics that match the hydrology of the “high drawdown farm”.

4. In the Executive Summary, Senate Bill One is explained as being the underlying reason for the 50/50 management standard. Additional explanation about the subsequent HB 1763 desired future conditions process is also relevant to this project and should be explained.

Response: The explanation of several pieces of applicable legislation, including Senate Bill One and HB1763, is now in Paragraph 2 of the Introduction.

5. Page 2. Paragraph 1. Please revise this sentence, "... as required by the TWDB, the PGCD implemented a 50 year management goal to ensure that at least 50% of supply will be available in 50 years."
  - While TWDB does require the DFCs to match the planning horizon (e.g., 50-year management goals), this statement incorrectly infers that TWDB required that 50% of supply be available in 50 years. Clarify that the PGCD 50/50 management standard was determined through working with the other districts in the Groundwater Management Area (GMA 1).

Response: The statement was corrected.

6. Page 2. Paragraph 3. "... the analysis did indicate a decline in the present value of net returns of \$350 over a ten year period."
  - Please clarify whether the \$350 figure is a 'per-acre' figure or the sum-total economic impact of the 50/50 management standard over the period on the Donley County High Drawdown Farm.
  - Please also correct this to correlate with the '20-year period' used in the farm-level analyses instead of the 'ten-year period' as stated here; or, to correlate with the 50-year planning horizon.

Response: The \$350 figure was clarified as net returns per acre over the 50-year planning horizon.

7. Page 2. Paragraph 4. "Further research should be conducted to better understand high impact areas and the associated irrigated operations."
  - Please explain why the "High Drawdown" farms are not representative of these "high impact areas". Include a map showing the proximity of potential high impact areas to the study areas and representative farms.

Response: The sentence referencing "Further research...high impact areas" has been deleted.

8. Page 3. Paragraph 7. "Minnesota IMPLAN Group" is now "MIG, Inc."
  - Please change references throughout text to MIG, Inc.

- First occurrence here (and on Page 6 where the explanation of the model is given) should mention that Minnesota IMPLAN Group is now MIG, Inc.

Response: MIG, Inc. references have been changed.

9. Page 5. Methodology - general suggestions:

- Please clarify which model inputs are random variables.

Response: “Validation was used to insure that the random variables being simulated were correct and demonstrated characteristics of the parent distribution. In the case of the simulation model, the variables being simulated were stochastic yield and price.” as referenced on page 13.

- Please provide additional detail including error bounds, confidence intervals, and sensitivity analysis.

Response: Sensitivity or distribution analysis was not conducted due to the length of the planning horizon and the ad hoc approach that would be necessary to include additional projected or random data. – See Limitations on page 31

- Please explain the level of model prediction error for 2010 saturated thickness and the certainty of projections.

Response: “Assuming that saturated thickness and the GAM values for acre-feet of water in storage are synonymous, percentage changes from 2010 to 2060 were compared for the optimization model and the most recent baseline GAM run for the Panhandle Water Planning Group (PWPG) prepared by INTERA. These percentage changes (2010 to 2060) in water storage/saturated thickness indicated that the optimization models used in this study were within 3% of the baseline GAM projections made for the PWPG.” – page 13

10. Page 5. Paragraph 3. Please explain in greater detail what comes out of the GAMS model and what goes into the IMPLAN model.

Response: The results of the model include changes in crop acres, irrigated acres, and farm profitability over the planning horizon. The model also estimates the value of gross receipts from agricultural production for each irrigated and dryland crop by year.

11. Page 5. Paragraph 4. "The production functions were estimated with the aid of Leon New ... "

- Please explain that Leon New is a local crop consultant and agricultural engineer with exceptional knowledge and familiarity of the area, having \_ years of experience working in the region.

Response: “Dr. New is a local crop consultant and agricultural engineer with exceptional knowledge and familiarity of the area, having 40 years of experience working in the region.” – page 9

12. Page 6. Paragraph 2. Please explain what is meant by the "baseline scenario."

Response: “The baseline scenario projects the economic, agronomic, and hydrologic variables under the assumption that no management techniques are employed and farmers irrigate under an environment with no pumping restrictions.” – page 8

13. Page 7. Paragraph 4. "20 year time horizon"

- Please explain whether or not the twenty-year horizon used for the representative farms creates limitations on the applicability of this analysis over the 50-year planning horizon in determining the economic impacts of the PGCD 50/50 management standard. Include a brief mention of the level of uncertainty in the subsequent 30 years by those not being included in the scope of work for this project and how that ultimately may affect the accuracy and usability of this study in determining 50-year economic [and water resource] impacts to the region.

Response: Explanation of analysis for two separate time horizons is offered on pages 10-11.

14. Page 7. Paragraph 4. "High Drawdown"

- Please explain how rates of drawdown were determined. Include tables, figures, and discussion of correlation between groundwater withdrawals and the effects on saturated thickness. Include an explanation of how the irrigation water use demand projections were created.

Response: “ Each rate of drawdown was provided by PGCD.” – page 10.

Explanation of groundwater withdrawal effects on saturated thickness is on page 11.

15. Page 9. Paragraph 1. " ... the optimization models used in this study estimate water demand through an economic process which differs from the methods reported in the regional water plans GAM runs."

- Please explain how the economic process used in the optimization models differs from the methods used in regional plans/GAM runs. Give a brief analysis and

comparison between the two. Add a table or figure showing how the water storage, saturated thickness, and groundwater withdrawals correlate over the study horizon with the projected irrigation demands developed by the Panhandle Regional Planning Group.

Response: Explanation and comparative analysis of optimization models and GAM runs is presented under the Validation section on page 13.

16. Page 9. Paragraph 1. " ... comparisons were made between the saturated thickness estimates ... and GAM runs completed by the TWDB (Intera 2010)."

- Please explain what comparisons were made to the Intera models. Also consider including comparative analysis with the Region A 2007 water plan, work by Freese and Nichols Inc., and/or Dutton, Reedy, and Mace (2000).

Response: "Assuming that saturated thickness and the GAM values for acre-feet of water in storage are synonymous, percentage changes from 2010 to 2060 were compared for the optimization model and the most recent baseline GAM run for the Panhandle Water Planning Group (PWPG) prepared by INTERA. These percentage changes (2010 to 2060) in water storage/saturated thickness indicated that the optimization models used in this study were within 3% of the baseline GAM projections made for the PWPG." – page 13

17. Page 9. Although the GAM model was used in the 50/50 scenario at the regional level and in this report's analysis, it might be more relevant to look at the GAM model results from the Groundwater Management Area 1 runs from the desired future condition process.

Response: "...it must be noted that the optimization models used within this study estimate water demand through an economic process which differs from the methods reported in the regional water plans GAM runs. The economic process utilized within this model allocates water to land based upon if it is economical to irrigate or not. This "allocation" of water differs from projections made by groups such as INTERA, as their projections utilize only hydrologic parameters to estimate water in storage or pumping volumes." – As found in Validation on page 13

18. Page 9. Paragraph 4. Please explain the conditions of the "baseline scenario" for Carson and Donley counties.

Response: Please see paragraph 2 under III. Results – Task I Results – Carson and Donley Counties.

19. Page 10. In the conclusions, although this study did not address the value of water it might be helpful to explain briefly if someone chose not to irrigate and chose to sell their

water instead to a water market, how that might or might not change the outcome of the impacts. In addition, although the 50/50 management strategy is not strictly a binding restriction, it might be helpful to elaborate in much more detail on what it is from the regional planning standpoint and the groundwater conservation district standpoint. Another factor that might be worth mentioning and could be better explained in this report is how the water quality changes as the aquifer is being pumped down and how that affects the economic impacts.

Response: The “water market” scenario is mentioned in the Conclusions section of the study on page 30.

“No attempt was made to capture potential impacts of water quality issues, as this was beyond the scope of the project.” – Limitations on page 31

20. Page 23. Please include a map showing the location of the two "hydrologic study areas".

Response: “These blocks were not specific to any location but rather scaled up versions of the representative farms. As with Task I, the changes in each of these study areas were aggregated and projected through the region.” – As stated in Results – Hydrologic Study Areas on page 26

21. Page 23. Paragraph 6. Given that the standard was not a binding restriction, please explain the function of IMPLAN in this analysis.

Response: “While there is no change in the regional economy under the management standard, the IMPLAN results provide an estimate of the economic contribution of agricultural crop production over the planning horizon.” – pages 29-30

22. Page 26. Table 13. Consider moving the description of Table 13 from page 23.

Response: The description was moved to the paragraph preceding Table 13 – page 29

23. Page 27. Paragraph 1. "Regional economic projections were based on current economic linkages ... no attempt was made to project how the economy would change through time. In addition, no attempt was made to project changes in land value through time."

- According to Task 3, the scope involves analysis of changes in enterprise levels, irrigated acres, and farm net income. Please explain why certain variables were not included in the analysis; for example, changes in farm land values that have increased over time, especially in recent years (i.e., from 2002 to 2007 respectively, \$444 to \$816 per acre in Carson County and \$360 to \$642 per acre in Donley County, according to the 2007 USDA-NASS Ag Census).

Response: “In order to capture the impacts of the policy evaluated (50/50) certain variables had to be held constant. Sensitivity or distribution analysis was not conducted due to the length of the planning horizon and the ad hoc approach that would be necessary to include additional projected or random data.” – Limitations on page 31

- Please include a brief discussion/disclaimer of regional and farm-level economic impacts that could be caused by other factors not included for analysis in this study (changes in national farm policy, land-use changes due to dairies and ethanol industries entering the region, global food shortages, population growth, climate variability, etc.).

Response: “The procedure used in this study did not include any estimation of changes in farm land values.” – Limitations on page 31

24. Page 27. Paragraph 2. "Agricultural water use ... was based on average annual weather patterns."

- Please mention the potential economic impacts and uncertainty due to changing weather patterns, climate change, etc.

Response: “...estimates made did not include any projections of changes in climate, drought, population growth, or expansions in regional industries such as confined livestock operations. Changes in these parameters were beyond the evaluation focus of the study.” – Limitations on page 31

- Consider updating the analysis by incorporating 2011 drought conditions and 2011 pumping data from PGCD. (TWDB acknowledges this would likely require a no-cost, one-year, time-extension amendment to the contract.)

Response: Given the lengthy time horizon evaluated in this project (20 to 50 years) including a single outlying drought into a 50 year average weather pattern would not produce significantly different results or change long run pumping estimates for irrigation. To accurately estimate the long term impacts of drought the weather patterns within the modeling process must be adjusted in a manner which would represent a long term change in weather i.e. extreme drought expected 4 out of 5 years. Additionally, to conduct such a change in weather patterns under the current modeling process would require additional funds and was beyond the scope and objective of the original study.