GONZALES COUNTY
UNDERGROUND WATER CONSERVATION DISTRICT

MANAGEMENT PLAN

Original: February 10, 1998

Revision 1.0: July 8, 2003

Revision 2.0: May 14, 2009

Revision 3.0: February 18, 2014

Revision 4.0: November 13, 2018

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1.0 DISTRICT MISSION

The mission of the Gonzales County Underground Water Conservation District ("GCUWCD" or "District") is to conserve, preserve, protect, and prevent waste of groundwater resources. It shall be the policy of the Board of Directors that the most efficient use of groundwater in the District is to provide for the needs of the citizens and ensure growth for future generations. The Board of Directors, with the cooperation of the citizens of the District, shall implement this management plan and its accompanying rules to achieve this goal. GCUWCD shall also establish, as part of this plan, the policies of water conservation, public information and technical research by cooperation and coordination with the citizens of the District and equitable enforcement of this plan and its accompanying rules.

2.0 PURPOSE OF THE MANAGEMENT PLAN

Senate Bill 1, enacted in 1997, and Senate Bill 2, enacted in 2001, established a comprehensive statewide planning process, including requirements for groundwater conservation districts ("GCDs") under the Texas Water Code Chapter 36 to manage and conserve the groundwater resources of the State of Texas. Section 36.1071, Water Code, requires that each groundwater conservation district develop a management plan that addresses the following management goals, as applicable: (1) providing the most efficient use of groundwater, (2) controlling and preventing waste of groundwater, (3) controlling and preventing subsidence, (4) addressing conjunctive surface water management issues, (5) addressing natural resource issues, (6) addressing drought conditions, (7) addressing conservation, recharge enhancement, rainwater, precipitation enhancement, or brush control, where appropriate and cost-effective, and (8) addressing the desired future conditions adopted by the district under Section 36.108.

House Bill 1763, enacted in 2005, requires joint planning among GCDs within the same Groundwater Management Area ("GMA"). These Districts must establish the Desired Future Conditions ("DFCs") of the aquifers within their respective GMAs. Through this process, the GCDs will submit the DFCs of the aquifer to the executive administrator of the Texas Water Development Board ("TWDB"). The TWDB will calculate the modeled available groundwater ("MAG") in each District within the management area based upon the submitted DFCs of the aquifer within the GMA. Technical information, such as the DFCs of the aquifers within the District's jurisdiction and the amount of MAG from such aquifers is required by statute to be included in the District's management plan and will guide the District's regulatory and management policies.

3.0 DISTRICT INFORMATION

3.1 Creation

The GCUWCD was created on an order of the Texas Commission on Environmental Quality (TCEQ), formerly the Texas Natural Resource Conservation Commission (TNRCC), on November 19, 1993. A copy of TNRCC order number 101692-DO4, approving the petition for creation of the GCUWCD, is available on the District's website at: http://www.gcuwcd.org/documentsandforms.html. .

3.2 Directors

The GCUWCD Board of Directors is comprised of five (5) members elected from single member districts. The Board of Directors meets in regular sessions on the second Tuesday each month in the City of Gonzales, Texas. All meetings of the Board of Directors are open to the public as set forth in the Texas Open Meetings Act, Title 5, Chapter 551 of the Texas Government Code, and advanced written notices of such meetings are posted as required.

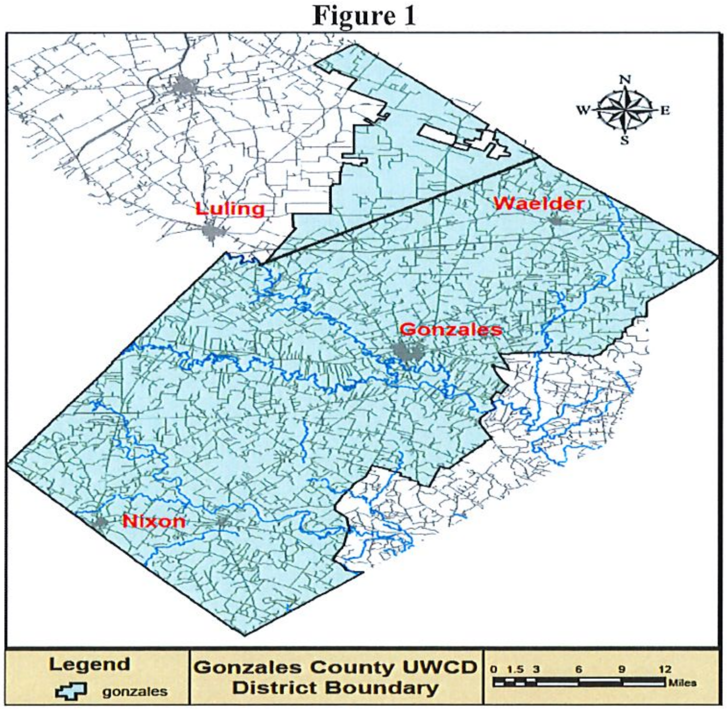
3.3 Authority of the District

As stated in TNRCC order number 101692-DO4, the GCUWCD has all the rights, powers, privileges, authority, and functions conferred by, and subject to all duties imposed by, the TCEQ and the general laws of the State of Texas relating to groundwater conservation districts. The District is governed by the provisions of Texas Water Code (TWC) Chapter 36 and 31 Texas Administrative Code (TAC) Chapter 356.

3.4 District Boundaries

GCUWCD serves the areas of Gonzales County and the southeast portion of Caldwell County (**Figure 1**). Gonzales County is bounded by Guadalupe, Wilson, Karnes, DeWitt, Lavaca, Fayette and Caldwell counties. There are approximately 677,000 acres in Gonzales County, of which 101,000 acres are excluded from the District leaving 576,000 acres within the boundaries of the county. Incorporated towns within Gonzales County include Gonzales, Waelder, Nixon, and Smiley. In December 2007, GCUWCD approved a resolution to annex the southeastern portion of Caldwell County into the District. An election was held in Caldwell County on May 10, 2008, with voters approving the annexation. The Board approved the canvass of the proposition election to ratify the annexation on May 13, 2008. The annexed area of Caldwell County encompassed approximately 77,440 acres. A dispute with the Plum Creek Conservation District over portions of this annexed territory was settled through the passage of Senate Bill No. 1225 (2011) leaving approximately 72,767 acres within the GCUWCD. Delhi and Taylorsville are the principal communities in the area. The District's economy is primarily agricultural, with poultry production being the primary income producer, followed by beef cattle and farming. Oil and gas production also contributes to the local economy.

Figure 1



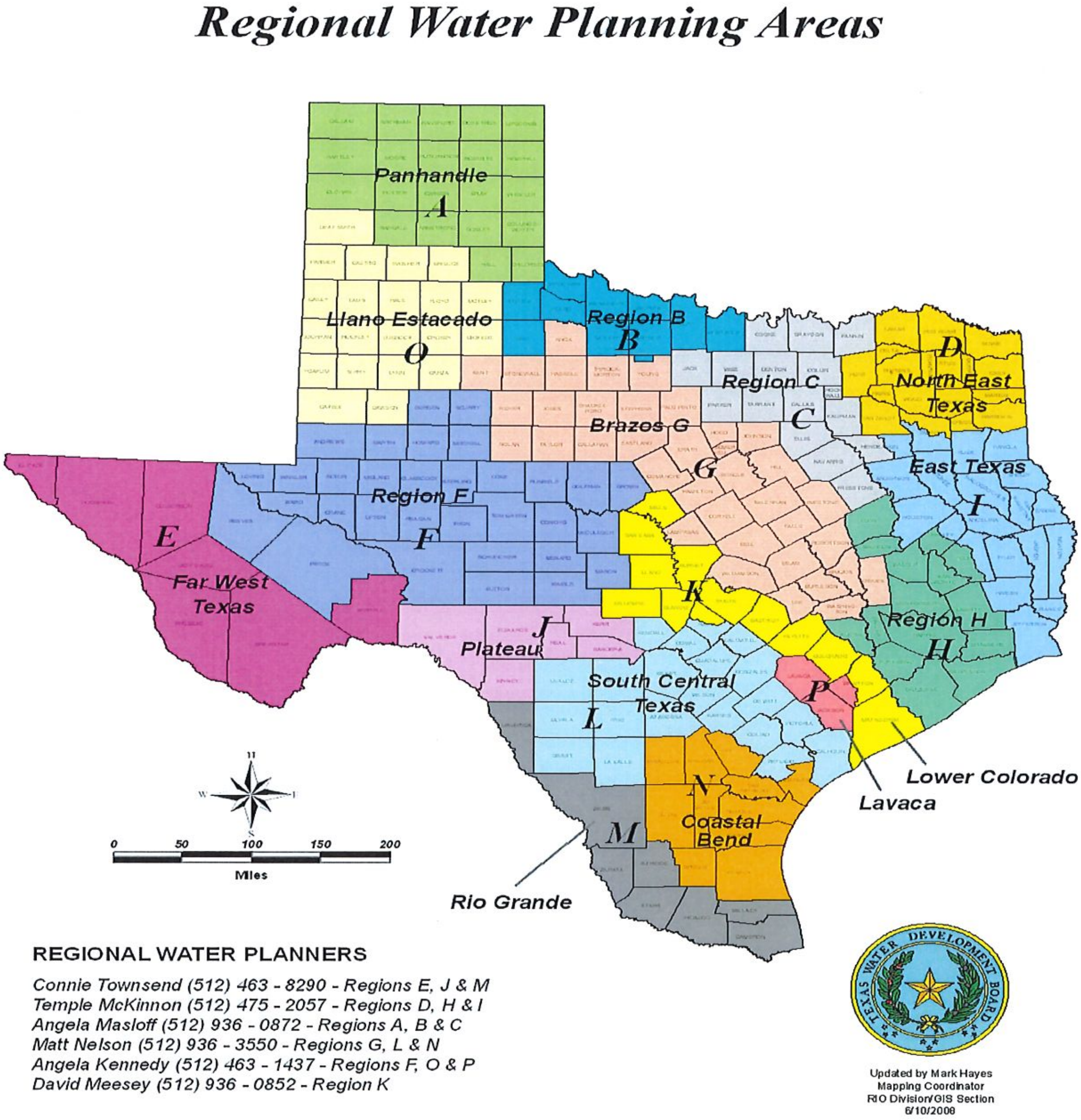
The GCUWCD is located within Groundwater Management Area 13 ("GMA 13"). GMA 13 includes seventeen counties and nine GCDs (**Figure 2**). Section 36.108, Water Code, requires joint planning among the GCDs within GMA 13. The District is actively engaged in the joint planning process and provides input to GMA 13. The District has a joint management agreement with Evergreen Underground Water Conservation District, Guadalupe County Underground Water Conservation District, Medina

County Groundwater Conservation District, and Wintergarden Groundwater Conservation District. This agreement, signed on August 8, 2000, states that the GCDs will cooperate in managing the groundwater resources of the Carrizo aquifer. The District has provided and will continue to provide the other GCDs in the aquifer management area with copies of its management plan and rules when changes are made.

Figure 2

The GCUWCD is located within planning Region L (South Central Texas Regional Planning Group). Region L includes all or parts of 21 counties, portions of nine river and coastal basins, the Guadalupe Estuary, and San Antonio Bay (**Figure 3**). The Board of Directors unanimously supports the concept of a grassroots planning effort. The District will actively provide input to the regional plan and participate in the planning effort.

Figure 3



3.5 Topography and Drainage

The GCUWCD lies within south-central Texas on the Gulf Coastal Plain. In most of the District the topography ranges from flat to rolling. However, two prominent lines of hills extend across parts of Gonzales County – one along the northwestern boundary from Ottine to about seven (7) miles northwest of Dewville and the other along the boundary with Lavaca County. In Caldwell County, the minimum elevation, about 295 feet, is at the southern tip of the County where Plum Creek joins the San Marcos River. The maximum elevation is in the area of the so-called "Iron Mountains" peaks southeast and south of McMahan.

Most of the District lies in the drainage basin of the Guadalupe River. Two small areas in the eastern and southeastern parts of the District are drained by the Colorado River. Most of the southern and southwestern parts of Gonzales County are drained by Sandies Creek, which flows southeastward and enters the Guadalupe River near Cuero in Dewitt County. Most of the northern and northeastern parts of Gonzales County are drained by Peach Creek, which flows southward, entering the Guadalupe River about ten (10) miles southeast of Gonzales. Plum Creek, the major tributary to the San Marcos River in Caldwell County, drains about 310 square miles (about 60 percent) of the County.

3.6 Groundwater Resources
The Wilcox Group yields small to moderate quantities of fresh to slightly saline water to a few wells in and near the outcrop in the northwestern part of Gonzales County. In Caldwell County, the Wilcox yields small to large quantities of water to many wells for domestic and stock purposes, public supply, and some irrigation. The Wilcox Group crops out in a small area in the GCUWCD near Ottine. The Wilcox is composed of clay, silt, fine to medium-grained sand and sandstone, sandy shale, and thin beds of lignite. The thickness of the Wilcox ranges from about 1,300 to 3,200 feet, with a maximum thickness of 2,000 feet occurring in an erosional channel in the southeastern part of the District. This erosional channel is filled largely with silty shale.

The principal water-bearing formation in the GCUWCD is the Carrizo Aquifer, which yields moderate to large quantities of fresh to slightly saline water throughout a large part of its subsurface extent. Most of the Carrizo in the GCUWCD has at least 80 percent sand. Portions of the Carrizo in the eastern half of the GCUWCD have 60 to 80 percent sand, generally corresponding to the area of the Yoakum Channel. Geologic thickness maps produced for the GCUWCD indicate that the Carrizo varies from less than 200 feet over the San Marcos Arch in the central portion of the county to more than 600 feet in the western portion of the GCUWCD and about 800 feet in the Yoakum Channel in the eastern portion of the GCUWCD. The Carrizo crops out in a small area along the western edge of Gonzales County and across the southeast portion of Caldwell County in a belt 1.5 to 3.5 miles wide. The Carrizo consists of beds of massive, commonly cross-bedded coarse sand and some minor amounts of sandstone and clay.

The Queen City aquifer yields small to moderate quantities of fresh to slightly saline water to wells in the area of the outcrop and downdip for a distance of about 5 to 8 miles. The Queen City aquifer crops out in a northeastward trending belt across Gonzales and Caldwell Counties about 2 to 4 miles wide and is composed of massive to thin bedded medium to fine sand and clay. The thickness of the Queen City ranges from about 400 to 825 feet where the entire section is present.

The Sparta aquifer yields small to moderate quantities of fresh to slightly saline water in the outcrop and for a few miles downdip. The Sparta aquifer crops out in a belt about 1 mile wide trending northeastward across Gonzales County and consists of fine to medium grained sand with some shale. The thickness of the Sparta aquifer averages about 100 feet.

The Yegua-Jackson aquifer runs approximately parallel to the Gulf of Mexico coastline and is aligned across the south-central portion of the GCUWCD in a narrow band approximately 7 to 10 miles wide. In Gonzales County, the Yegua Formation yields small quantities of slightly to moderately saline water for domestic use and for livestock. At some places in the County, sands in the Jackson also yield small quantities of fresh to slightly saline water for domestic use and for livestock. The Yegua Formation is composed of medium to fine sand, clay, silt, small amounts of gypsum, and beds of lignite. The Yegua has a maximum thickness of about 1,000 feet. The Jackson Group conformably overlies the Yegua Formation and consists of clay, silt, tuffaceous sand, sandstone, bentonitic clay, and some volcanic ash, and has a maximum thickness of at least 950 feet and possibly as much as 1,200 feet.

4.0 CRITERIA FOR PLAN APPROVAL

4.1 Planning Horizon

This plan shall be used for the ten (10) year period following approval as administratively complete by the Texas Water Development Board (TWDB) as required by *31 TAC §356.52(a).* The GCUWCD shall implement these goals and policies for a planning period of ten (10) years and will review the plan in five (5) years or sooner as circumstances warrant.

4.2 Board Resolution

A certified copy of the GCUWCD's resolution adopting this plan as required by *31 TAC §356.53(a)(2)* is included in **Appendix 1**.

4.3 Plan Adoption

Public notices documenting that this plan was adopted following appropriate public meetings and hearings, as required by *31 TAC §356.53(a)(3)*, are included in **Appendix 2**.

4.4 Coordination with Surface Water Management Entities

Letters transmitting copies of this plan to the Guadalupe Blanco River Authority and Region L are included in **Appendix 3** as required by *31 TAC §356.51.*

5.0 DESIRED FUTURE CONDITIONS AND MODELED AVAILABLE GROUNDWATER

Section 36.108, Texas Water Code, requires joint planning among the groundwater conservation districts within GMA 13. A key part of joint planning is determining "desired future conditions" (DFCs) that are used to calculate "modeled available groundwater" (MAG). These conditions and volumes are used for regional water plans, groundwater management plans, and permitting. DFCs are the desired, quantified conditions of groundwater resources (such as water levels, water quality, spring flows, or volumes) at a specified time or times in the future or in perpetuity.

Due to limitations with the model as described in Technical Memorandum 16-08, two proposed desired future conditions were selected for the Carrizo-Wilcox, Queen City, and Sparta aquifers as described below.

- The first proposed desired future condition for the Carrizo-Wilcox, Queen City and Sparta aquifers in Groundwater Management Area 13 is that 75 percent of the saturated thickness in the outcrop at the end of 2012 remains in 2070. This desired future condition is considered feasible as detailed in GMA 13 Technical Memorandum 16-08.

- A secondary proposed desired future condition for the Carrizo-Wilcox, Queen City, and Sparta aquifers in Groundwater Management Area 13 is an average drawdown of 48 feet for all of GMA 13. The drawdown is calculated from the end of 2012 conditions to the year 2070. This desired future condition is consistent with Scenario 9 as detailed in GMA 13 Technical Memorandum 16-01 and GMA 13 Technical Memorandum 16-08.

The desired future conditions for the Yegua-Jackson Aquifer in Groundwater Management Area 13 are summarized in GMA 13 Technical Memorandum 16-04:

- For Gonzales County, the average drawdown from 2010 to 2070 is 3 feet

For each aquifer, the DFC average drawdowns encompass the full extent of the aquifers within the District, from the outcrop to the downdip limit of the aquifer within the District boundary. The GMA13 wide DFCs for the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers equate to drawdowns in the District's aquifers as shown in **Table 1** below.

Table 1
Desired Future Conditions
Appendix 4: GMA 13 Technical Memorandums 16-01 and 16-04
Gonzales County Underground Water Conservation District

Aquifer	Average Drawdown (feet)
Wilcox (Upper)	139
Wilcox (Middle)	137
Wilcox (Lower)	216
Carrizo	140
Queen City	42
Sparta	28
Yegua-Jackson	3

Modeled Available Groundwater (MAG) is defined in the Texas Water Code, Section 36.001, Subsection (25) as "the amount of water that the executive administrator determines may be produced on an average annual basis to achieve a desired future condition established under Section 36.108." MAG estimates for the Wilcox, Carrizo, Queen City, Sparta and Yegua-Jackson Aquifers were received from the TWDB in October 2017. Presentation of this data in the management plan is required by *31 TAC §356.52 (a)(5)(A)*.

Table 2
Modeled Available Groundwater
Gonzales County Underground Water Conservation District
Appendix 5: GAM Run 10-017-027 MAG

Aquifer	Year						
	2012 (ac-ft/yr)	2020 (ac-ft/yr)	2030 (ac-ft/yr)	2040 (ac-ft/yr)	2050 (ac-ft/yr)	2060 (ac-ft/yr)	2070 (ac-ft/yr)
Upper Wilcox	0	0	0	0	0	0	0
Middle Wilcox	12,187	12,187	12,187	12,187	12,187	12,187	12,187
Lower Wilcox	25,836	25,836	25,836	25,836	25,836	25,836	25,836
Carrizo	83,284	83,284	83,284	84,026	84,390	81,607	81,615
Queen City	5,351	5,351	5,351	5,351	5,351	5,351	5,351
Sparta	3,554	3,554	3,554	3,554	3,554	3,554	3,554
Yegua Jackson	4,140	4,140	4,140	4,140	4,140	4,140	4,140

The GAM run used to determine the MAG included all groundwater from the outcrop to the downdip extent within the GCUWCD for all of the aquifers. The quality of the water was not taken into account so the MAG volumes include water with total dissolved solids concentrations (TDS) up to and possibly exceeding 3,000 ppm.

According to information included in the Final Reports of Groundwater Availability Models for the Carrizo-Wilcox. Queen City and Sparta Aquifers, prepared for the TWDB, limitations are intrinsic to models. Model limitations can be grouped into several categories including: (1) limitations in the data supporting a model, (2) limitations in the implementation of a model which may include assumptions inherent to the model application, and (3) limitations regarding model applicability. The report also states that the GAMs were developed on a regional scale and are applicable for assessing regional aquifer conditions resulting from groundwater development over a fifty-year time period. At this scale, the models are not capable of precisely predicting aquifer responses at specific points such as a particular well. Thus, the estimation of available groundwater calculated by the Southern Carrizo-Wilcox Queen City and Sparta (SCWQCS) GAM should be considered as a tool to assist the District in managing the aquifers to comply with the District's adopted DFCs.

6.0 Estimated Historical Groundwater Use and 2017 State Water Plan Datasets

The TWDB provides a package of data reports (Parts 1 and 2) to groundwater conservation districts to assist them in meeting the requirements for approval of their five-year groundwater Management Plan. Each report in the package addresses a specific numbered requirement in the TWDB's groundwater Management Plan checklist. The five reports in Part 1 are:

1. **Estimated Historical Groundwater Use** - the TWDB Uses Unit operates an annual survey of ground and surface water use by municipal and industrial entities within the state of Texas. This survey collects the volume of both ground and surface water used, the source of the water, water sales and other pertinent data from the users. The data provides an important source of information in helping guide water supply studies and regional and state water planning. Presentation of this data in the management plan is required by *§36.1071(e)(3)(B), Texas Water Code.*
2. **Projected Surface Water Supplies** - estimates of projected water supplies represent the estimated capacity of water systems to deliver water to meet user needs on an annual basis. Estimates of projected water supplies are compared with estimates of projected water demand to determine if the existing infrastructure is capable of meeting the expected needs of the water user group. Presentation of this data in the management plan is required by *§36.1071(e)(3)(F), Texas Water Code.*
3. **Projected Water Demands** - the projected water demand estimates are derived from the TWDB 2012 State Water Plan. These water demand projections are separated into the following designated uses: municipal, manufacturing, steam electric, irrigation, mining, and livestock. Water demand is the total volume of water required to meet the needs of the specified user groups located within the District's planning area. Presentation of this data in the management plan is required by *§36.1071(e)(3)(G), Texas Water Code.*
4. **Projected Water Supply Needs** - the projected water supply needs estimates are derived from the 2012 State Water Plan. Estimates of Projected Water Supplies are compared with estimates of Projected Water Demand to determine if the existing infrastructure is capable of meeting the expected Water Supply Needs of the water user group. Presentation of Water Supply Needs in the management plan is required by *§36.1071(e)(4), Texas Water Code.*
5. **Projected Water Management Strategies** - water management strategies are specific plans to increase water supply or maximize existing supply to meet a specific need. Municipal water conservation strategies focus on reducing residential, commercial, and institutional water use through a variety of social or technological approaches. Local Carrizo-Wilcox temporary overdraft strategies involve temporarily over-drafting the aquifer during drought conditions to

supplement water supplies. Presentation of water management strategies in the management plan is required by *§36.1071(e)(4), Texas Water Code.*

The Part 1 data package reports are included in **Appendix 6**.

7.0 Groundwater Availability Model Report

Part 2 of the TWDB data package is the Groundwater Availability Model report. Texas Water Code, Section 36.1071, Subsection (h) states that, in developing a groundwater management plan, GCDs shall use groundwater availability modeling provided by the TWDB. Information derived from the groundwater availability models that shall be included in the management plan includes:

1. the annual amount of recharge from precipitation, if any, to the groundwater resources within the District – required by *§36.1071(e)(3)(E), Texas Water Code.*
2. for each aquifer within the District, the annual volume of water that discharges from the aquifer to springs and any surface water bodies, including lakes, streams, and rivers – required by *§36.1071(e)(3)(E), Texas Water Code.*
3. the annual volume of flow into and out of the District within each aquifer and between aquifers in the District – required by *§36.1071(e)(3)(E), Texas Water Code.*

The TWDB ran a groundwater availability model (GAM Run 18-006) for the central and southern Carrizo-Wilcox, Queen City, and Sparta aquifers, the Yegua-Jackson Aquifer, and the central portion of the Gulf Coast Aquifer to create a groundwater budget. A groundwater budget summarizes water entering and leaving the aquifer according to input parameters assigned in the models to simulate the groundwater flow system. The components of the water budgets include:

1. **Precipitation Recharge** – this is the aerially distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at the land surface) within the District.
2. **Surface Water Outflow** – this is the total water exiting the aquifer (outflow) to surface water features such as streams, reservoirs, and drains (springs).
3. **Flow Into and Out of District** – this component describes lateral flow within the aquifer between the District and adjacent counties.
4. **Flow Between Aquifers** – this describes the vertical flow, or leakage, between aquifers or confining units. Inflow to an aquifer from an overlying aquifer will always equal the outflow from the other aquifer.

The Part 2 data package is included in **Appendix 7**.

8.0 MANAGEMENT OF GROUNDWATER RESOURCES

The GCUWCD will manage groundwater resources consistent with the intent and purpose of the District to conserve, preserve, protect and prevent waste of groundwater resources so that the economy of the areas within the District will be ensured of growth for future generations. Details of how the District will manage groundwater supplies, as required by *31 TAC 356.52(a)(4)*, as well as the actions, procedures, performance and avoidance necessary to effectuate the management plan, including specifications and the proposed rules, as required by *§36.1071(e)(2), Texas Water Code* are presented below.

8.1 Regulatory Action Plan

Pursuant to Chapter 36 of the Texas Water Code, the District has adopted rules limiting groundwater production based on tract size and the spacing of wells, to provide for conserving, preserving, protecting, preventing degradation of water quality and to prevent the waste of groundwater. This District will enforce the rules of the District to meet the goals of regulating the production of groundwater within the District. These rules will govern the permitting of wells to be drilled and the production of water from permitted wells. The rules shall be adhered to and shall be based on the best technical evidence available. Copies of the District's Rules and the Management Plan shall be available at the District's office at no charge to residents of the District.

The District will monitor water levels in selected observation wells and evaluate whether the annual change in water levels is in conformance with the DFCs adopted by GMA 13 for each aquifer. The District will use information readily available (Groundwater Availability Models, TWDB reports, etc.) or install observation wells to assess the saturated thickness of the outcrops for the Carrizo-Wilcox, Queen City, and Sparta aquifers. The District will use the saturated thickness of the approximate center of the outcrop as the monitoring location for the DFC. Water levels will be collected from nearby observation wells to monitor the saturated thickness levels of the aquifers.

For the Yegua-Jackson aquifer the starting water level date for the District's DFC is January 2010. The District will measure water levels in designated observation wells during the winter months (November through February). Water level measurements will be obtained by automatic or manual water level monitoring equipment. The District will calculate the average yearly change in water level based on all of the wells in the observation well network. These changes will be summed each year over the DFC planning period. The average water level declines over time will be compared to production amounts to assist in predicting future water level declines.

The District will estimate total annual groundwater production for each aquifer based on water use reports, estimated exempt use, and other relevant information and compare these production estimates to the MAGs. The District will base future permitting decisions on the amount of existing water permitted, amount existing water being produced, and the condition of the aquifer (water level drawdowns) at the time the permit application is filed in order to achieve the DFC.

8.2 Permits and Enforcement

The District may deny permits or limit groundwater withdrawals following the guidelines stated in the rules of the District and this plan. In determining whether to issue a permit or limit groundwater withdrawal, the District will consider the public benefit against individual hardship after considering all relevant evidence, appropriate testimony and all relevant factors.

In carrying out its purpose, the District may require the reduction of groundwater withdrawal to amounts that will not cause the water table or artesian pressure to drop to a level that would cause harm to the aquifer or exceed the specified drawdown limitations under the adopted Desired Future Conditions. To achieve this purpose the District may, at its discretion and based on information obtained through its groundwater monitoring procedures, amend or revoke any permits after notice and hearing. The monitoring procedures include calculation of yearly average drawdowns which will ensure that the District and permit holders are fully aware of the condition of the aquifers and corrective action measures can be reasonably implemented over appropriate intervals without causing harm to human health.

The District will enforce the terms and conditions of permits and its rules by enjoining the permittee in a court of competent jurisdiction as provided for in Section 36.102 of the Texas Water Code.

8.3 Exempt Use Wells

This plan and its accompanying rules shall exempt certain uses from the permit requirement as provided for in Section 36.117 of the Texas Water Code. The District, by rule, also provides exemptions for other categories of groundwater use including agricultural use, fracking use, and monitoring wells.

8.4 Permit Fees

The District will assess reasonable fees for processing a permit application to drill a test hole, for processing drilling and production permit applications, for processing export permit applications, and for processing permit applications to rework, re-equip, or alter a water well. No application fees are required for registering and recording the location of an existing well with the District.

8.5 Equity and Discretion

The District shall treat all citizens and entities of the District equally. Upon applying for a permit to drill a water well or a permit to increase the capacity of an existing well, the Board of Directors shall take into consideration all circumstances concerning the applicant's situation. The Board may grant an exception to the rules of the District when granting permits to prevent hardship or economic loss, also taking into consideration hydrological, physical or geophysical characteristics. Therefore, temporary exceptions to the general rule for a specific area may be necessary if an economic hardship will be created that is significantly greater for one person than for others in the District. In considering a request for an exception, the Board will also consider any potential adverse impacts on adjacent landowners. The exercising of discretion by the Board may not be construed to limit the power of the Board.

8.6 Spacing Requirements

Spacing of wells from the property line shall be in accordance with the rules of the District.

8.7 Production Ratios

The District may adopt rules to regulate groundwater withdrawals by means of production limits. The District may deny a well permit or limit groundwater withdrawals in accordance with guidelines stated in the rules of the District. In making a determination to deny a permit or reduce the amount of groundwater withdrawals authorized in an existing permit, the District may weigh the public benefit in managing the aquifer to be derived from denial of a groundwater withdrawal permit or the reduction of the amount of authorized groundwater withdrawals against the individual hardship imposed by the permit denial or authorization reduction.

8.8 Cooperation and Coordination

Public cooperation is essential for this plan to accomplish its objectives. The District will work with the public and local and state governments to achieve the goals set forth in this plan. The District will coordinate activities with all public water suppliers, private water suppliers, industrial users and agricultural users to help them conserve groundwater. The Guadalupe Blanco River Authority is the local entity regulating all surface water in the District and the District will work closely with this agency to achieve our mutual water related goals. The TCEQ is the agency charged with protecting the state's water resources, and the TWDB is the agency responsible for water resources planning and promotion of water conservation practices. The District will continue to work with both of these agencies to conserve, preserve and protect water resources and to prevent waste as outlined in this plan.

8.9 Subsidence

Subsidence is not a relevant factor with the aquifers managed by this District; the District includes a portion of the Gulf Coast Aquifer, which is known for its susceptibility to subsidence, but the District's creation order does not give the District any jurisdiction over the Gulf Coast Aquifer.

8.10 Transportation of Water from the District
In accordance with Section 36.122 of the Texas Water Code, if the proposed use of a water well or wells is for transportation of water outside the District additional information shall be required and an export permit must be obtained from the Board before operating a transportation facility. The District may, in considering renewal of an export permit, review the amount of water that may be transferred out of the District. At any time during the term of an export permit, the District may revise or revoke a permit if the use of water unreasonably affects existing groundwater and surface water resources or existing Permit Holders.

8.11 Groundwater Protection
Section 26.401 of the Texas Water Code states that: "In order to safeguard present and future groundwater supplies, usable and potential usable groundwater must be protected and maintained."

Groundwater contamination may result from many sources, including current and past oil and gas production, agricultural activities, industrial and manufacturing processes, commercial and business endeavors, domestic activities and natural sources that may be influenced by or may result from human activities. The District will take appropriate measures to monitor activities that are either causing, or have the potential threat to cause groundwater contamination. Due to permeability of aquifer outcrops and recharge zones, there is a greater threat of groundwater contamination from surface pollution in recharge and outcrop regions, and the District will monitor those areas more closely.

8.12 Drought Management
Periodic drought is a condition that plagues the GCUWCD. The Board of Directors of the District is very concerned that water will be available for the needs of the citizens during times of drought. The General Manager of the District will update the Board at every monthly meeting on drought conditions in the District. The General Manager will report the Palmer Drought Severity Index to the Board during the manager's report for the month. The Board of Directors will instruct the General Manager of the appropriate actions to be taken upon notification of moderate to severe drought. The possible actions to be taken may include public service announcements on the radio, newspaper articles on conditions of the aquifer, water conservation information, and/or notices to municipal suppliers to implement their drought plan.

8.13 Technical Research and Studies
The District, in cooperation with the TWDB and the TCEQ, will conduct studies to monitor the water level in the Yegua Jackson, Sparta, Queen City, Carrizo, and Wilcox aquifers to determine if there is any danger of damaging these aquifers due to over production. The District will also establish water quality monitoring wells through out the District to determine if any degradation of water quality is occurring. The District is currently cooperating with the Texas Water Development Board with its monitoring of the Wilcox, Carrizo, Queen City, Sparta and Yegua Jackson aquifers.

8.14 Groundwater Recharge
The GCUWCD is prohibited from financing any groundwater recharge enhancement projects by order of the Texas Natural Resource Conservation Commission number 101692-DO4. The District has adopted rules to regulate Managed Aquifer Recharge projects.

8.15 Public Information
A well informed public is vital to the proper operation of a groundwater conservation district. The District will keep the citizens of the District informed by means of a website, timely newspaper articles and/or public service radio announcements. As part of the public information program the directors of the District and the District manager will make presentations to public gatherings, as requested, in order to

keep the citizens informed about District activities and to promote proper use of available groundwater. The District has an ongoing program to assist teachers at public schools with the education of children on issues of groundwater conservation and the hydrology of our area.

8.16 Conservation and Natural Resource Issues

Water is the most precious natural resource on Earth. The District will promote conservation as a way of life in order to conserve fresh water for future generations. The District will require wells in areas that are in danger of over producing groundwater and damaging the aquifers to restrict production by means of production permits and metering of the amount of water produced. The District will work with water utilities, agricultural and industrial users to promote the efficient use of water so that we may conserve water. The District will keep abreast of developments in water conservation and update requirements as needed. The District will, upon request, provide information on wells and water levels to the Natural Resources Conservation Service to develop waste management plans for the poultry producers.

Abandoned oil wells pose the greatest threat to the aquifers of the District. District personnel will monitor oilfield activity and notify the public that they may report abandoned oil wells and other problems associated with oil production to the District.

9.0 METHODOLOGY FOR TRACKING DISTRICT PROGRESS IN ACHIEVING MANAGEMENT GOALS

The District manager will prepare and present an Annual Report to the Board of Directors on District performance in regards to achieving management goals and objectives. The Annual Report will be presented to the Board on or before March 31st of each new year. The Board will maintain the report on file for public inspection at the District's offices upon adoption.

10.0 GOALS, MANAGEMENT OBJECTIVES, PERFORMANCE STANDARDS AND METHODOLOGY FOR TRACKING PROGRESS

The District's management goals, objectives, performance standards, and methodology for tracking progress, as specified in *36.1071(e)(2), Texas Water Code* are addressed below.

10.1 Plan Elements Required by State Law and Rule

Providing the Most Efficient Use of Groundwater *31 TAC 356.52(a)(1)(A)*

The District's goal is to provide for the most efficient use of the groundwater resources of the GCUWCD.

Management Objective 1: The District will register at least 20 exempt use wells and will compile the data into a database.

> **Performance:** Record the date and number of exempt use wells registered in a database and include the information in the District's Annual Report.

Management Objective 2: The District will measure water levels in at least 40 observation wells to provide coverage across the Wilcox, Carrizo, Queen City, Sparta, and Yegua-Jackson Aquifers three times a year and will compile the water level data into a database.

Performance: Record the number of wells and water level measurements measured for each aquifer annually in a database and include this information in the District's Annual Report.

Management Objective 3: The District will meet with the cities of Gonzales, Nixon, Smiley, and Waelder, and the Gonzales Area Development Corporation at least once a year to inform them on water availability for economic development.

Performance: Record the date and number of meetings annually and include a copy of the meeting attendee's sheet and information on the topics of discussion with each entity in the District's Annual Report.

Management Objective 4: The District will gather water production data from local public water suppliers including the Gonzales County Water Supply Corporation, City of Gonzales, City of Nixon, City of Smiley, and City of Waelder, ten permitted or registered irrigation wells, and two livestock production facilities annually and compile the data into a database.

Performance: Record the amount of water used by each public water supplier, irrigation well, and livestock production facility and include the information into the District's Annual Report.

Controlling and Preventing Waste of Groundwater
31 TAC 356.52(a)(1)(B)

Management Objective 1: The District will provide educational resources to citizens within the District on controlling and preventing waste of groundwater. The District will, at least annually, submit an information article on controlling and preventing waste of groundwater within the District for publication in a newspaper of general circulation in the District or may publish the article on the District's website. The District may also make a presentation to the public through local service organizations or public schools describing measures that can be taken by water users within the District.

Performance: Record the dates of each control and prevention of waste article submitted for publication, published on the District's website, or presentation made to the public and include this information in the District's Annual Report.

Controlling and Preventing Subsidence
31 TAC 356.52(a)(1)(C)

Because of the rigid geologic framework of the aquifers regulated by the District subsidence is not a relevant issue within the GCUWCD. The District includes a portion of the Gulf Coast Aquifer, which is known for its susceptibility to subsidence, but the District's creation order does not give the District any jurisdiction over the Gulf Coast Aquifer. Therefore, the management goal is not relevant or applicable.

Conjunctive Surface Water Management
31 TAC 356.52(a)(1)(D)

The District's goal is to maximize the efficient use of groundwater and surface water for the benefit of the residents of the District.

Management Objective 1: The District will meet with the staff of the Guadalupe Blanco River Authority ("GBRA"), at least once a year, to share information updates about conjunctive use potential.

Performance: Record the number of GBRA meetings attended annually and include a copy of the meeting attendee's sheet and information on the topics of discussion in the District's Annual Report.

Management Objective 2: The District will attend at least one Regional Water Planning Group ("RWPG") meeting annually to share information updates about conjunctive use potential.

Performance: Record the number of RWPG meetings attended annually and include a copy of each RWPG meeting agenda and a copy of the meeting minutes in the District's Annual Report.

Addressing Natural Resource Issues
31 TAC 356.52(a)(1)(E)

The District's goal is to protect the Natural Resources of the GCUWCD. The District believes that preventing the contamination of groundwater is the single most important waste prevention activity it can undertake.

Management Objective 1: The District will collect water quality data in at least 20 wells annually at locations throughout the District and will compile the data into a database. In selecting wells the District will emphasize the wells at or near the zone of bad water or potential pollution sources based on best available data. The District may conduct field measurements using hand held meters and/or collect samples for laboratory analysis from each well.

Performance: Record the number of wells in which water quality measurements were collected and the water quality results for each well and include this information in the District's Annual Report.

Management Objective 2: The District will monitor new facilities and activities on the recharge zones of the Carrizo/Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers on at least an annual basis for point source and non-point source pollution and compile this data into a database.

Performance: Record the date and results of the visual survey of all recharge zones for point source and nonpoint source activities and facilities and include the information in the District's Annual Report.

Management Objective 3: The District will meet with the local Texas Railroad Commission ("TRC") engineering technician at least once annually to review oil well permits and oil related activity that could endanger the aquifers and coordinate its efforts with this agency in locating abandoned or deteriorated oil wells.

Performance: Record the date and number of meetings with the TRC, the number of oil related activities that endangered the aquifers, the number of abandoned or deteriorated wells filed with the District and include the information in the District's Annual Report.

Management Objective 4: The District will meet with Natural Resources Conservation Service representatives to exchange information on irrigation demands, NRCS programs, and wells and water levels at least once annually.

Performance: Record the date and number of meetings with the Natural Resources Conservation Service representatives and include the information in the District's Annual Report.

Addressing Drought Conditions
31 TAC 356.52(a)(1)(F)

The District's goal is to provide information and coordinate an appropriate response with local water users and water managers regarding the existence of extreme drought events in the District.

Management Objective 1: The General Manager will access the National Weather Service – Climate Prediction Center website (http://www.cpc.ncep.noaa.gov/products/monitoring_and_data/drought.shtml) to determine the Palmer Drought Severity Index and will submit a report to the Board of Directors monthly. The District will provide information to and coordinate with local water users and water managers regarding drought response activities.

Performance: Record the number of monthly reports made to the District Board of Directors and the date and number of times when the District was under extreme drought conditions and the number of times letters were sent to public water suppliers. Include this information in the District's Annual Report.

Addressing Conservation, Recharge Enhancement, Rainwater Harvesting, Precipitation Enhancement, Brush Control
31 TAC 356.52(a)(1)(G)

The District believes that the most efficient and effective ways to facilitate conservation within the District are through sound data collection, dissemination, and the distribution of public information about the groundwater resources in the GCUWCD, its current use and more effective ways to use it.

Management Objective 1: The District will, at least annually, submit an information article describing conservation measures that can be taken by water users within the District for publication in a newspaper of general circulation in the District or may publish the article on the District's website.

Performance: Record the dates of each conservation article submitted for publication or published on the District's website and include this information in the District's Annual Report.

Management Objective 2: The District will, at least annually, submit an information article describing recharge enhancement measures for publication in a newspaper of general circulation in the District or may publish the article on the District's website.

Performance: Record the dates of each recharge enhancement article submitted for publication or published on the District's website and include this information in the District's Annual Report.

Management Objective 3: The District will, at least annually, submit an information article describing rainwater harvesting measures that can be taken by water users within the District for publication in a newspaper of general circulation in the District or may publish the article on the District's website.

Performance: Record the dates of each rainwater harvesting article submitted for publication or published on the District's website and include this information in the District's Annual Report.

Management Objective 4: The District will publish an information article in a publication of wide circulation in the District or on its website, at least annually, describing brush control measures that can be used by landowners within the District

Performance: Record the date and number of brush control articles published and include this information in the Annual Report.

Addressing the Desired Future Conditions of the Groundwater Resources
31 TAC 356.52(a)(1)(H)

Management Objective 1: A District representative will attend all Groundwater Management Area 13 meetings annually.

Performance: Record the number of GMA13 meetings attended annually and include a copy of each GMA13 meeting agenda and a copy of the meeting minutes in the District's Annual Report.

Management Objective 2: The District will monitor water levels and evaluate whether the change in water levels is in conformance with the DFCs adopted by the District. The District will estimate total annual groundwater production for each aquifer based on water use reports, estimated exempt use, and other relevant information and compare these production estimates to the MAGs.

Performance: Record the water level data and annual change in water levels for each aquifer and compare to the DFCs. Include this information in the District's Annual Report.

Performance: Record the total estimated annual production for each aquifer and compare these amounts to the MAG. Include this information in the District's Annual Report.

10.2 Plan Elements Developed at the Discretion of the District

Transportation of Water from the District

The District will seek an accurate accounting of water transported from the District to users outside its boundaries.

Management Objective: The District will obtain monthly usage reports from individuals or entities that transport groundwater out of the District and will compile this data into a database.

Performance: Record the monthly transporter usage reports and present the results in the District's Annual Report.

This Management Plan is approved by the undersigned on November 13, 2018. This Management Plan takes effect on approval by the Texas Water Development Board.

Gonzales County Underground Water Conservation District
Board of Directors

Bruce Tieken, President

Kermit Thiele, Vice President

Barry Miller, Secretary

Bruce Patteson, Director

Mark Ainsworth, Director

Location of District Office:

Gonzales County UWCD
522 Saint Matthew Street
P.O. Box 1919
Gonzales, TX 78629

Telephone: 830.672.1047
Fax: 830.672.1387

Email: greg.sengelmann@gcuwcd.org
Website: www.gcuwcd.org

APPENDIX 1

Certified Copy of GCUWCD Resolution Adopting Management Plan

Gonzales County Underground
Water Conservation District

Board Resolution 11-13-2018

Resolution Adopting the 2018 Management Plan

WHEREAS, §§36.1071 and 36.1073, Water Code, require the Gonzales County Underground Water Conservation District to develop and adopt a Management Plan that addresses the following management goals, as applicable:

(1) providing the most efficient use of groundwater;
(2) controlling and preventing waste of groundwater;
(3) controlling and preventing subsidence;
(4) addressing conjunctive surface water management issues;
(5) addressing natural resource issues;
(6) addressing drought conditions;
(7) addressing conservation, recharge enhancement, rainwater harvesting, precipitation enhancement, or brush control, where appropriate and cost-effective; and
(8) addressing the desired future conditions adopted by the district;

WHEREAS, §36.1072(e), Water Code, requires each groundwater conservation district to review and re-adopt the Management Plan at least every five years; and

WHEREAS, after providing notice and holding a public hearing, the Board of Directors of the Gonzales County Underground Water Conservation District has developed a Management Plan in accordance with the statutory requirements and utilizing the best available science, attached hereto and incorporated herein for purposes.

NOW THEREFORE, BE IT RESOLVED:

1) The Board of Directors of the Gonzales County Underground Water Conservation District do hereby adopt the attached 2018 Management Plan pursuant to §36.1071, Water Code.

2) The General Manager is hereby ordered to file the adopted Management Plan with the Texas Water Development Board for certification as administratively complete.

3) The General Manager is hereby authorized to take any and all reasonable action necessary [for the] implementation of this resolution.

GCUWCD
I hereby certify the attached document is a true and correct copy of the identical document as it appears in the records of the district.
Date: 11/13/2018
By: Laura Martin
Its Authorized Custodian
GCUWCD

This Resolution shall become effective on 11-13-2018.

Adopted this 13th day of November, 2018.

Bruce Tieken
Bruce Tieken, President
Gonzales County Underground
Water Conservation District

Barry Miller
Barry Miller, Secretary
Gonzales County Underground
Water Conservation District

APPENDIX 2

Public Notices For Adoption of Management Plan

THE ORIGINAL WAS

NOTICE OF PUBLIC HEARING
OF
GONZALES COUNTY UNDERGROUND WATER CONSERVATION DISTRICT
On Proposed Additions and Amendments to the District's Management Plan

The Gonzales County Underground Water Conservation District ("the District) will hold a public hearing for the purpose of receiving comments on proposed additions and amendments to the Management Plan of the District.

The Board of Directors will take public comments on the proposed amendments to the Management Plan on Thursday, October 11, 2018, at the District office located at 522 Saint Matthew Street, Gonzales, Texas. The public hearing will begin at 9:00 a.m. Agenda is as follows:

1. Call to order.
2. President of the Board to make comments.
3. Receive comments from the public on the District's proposed Management Plan.
4. Discussion of other items of interest by the Board and direction to management.
5. Adjourn.

Copies of the proposed additions and amendments to the Management Plan of the District are available at the offices of the Gonzales County Underground Water Conservation District, 522 Saint Matthew Street, Gonzales, Texas, from 8:00 a.m. to 5:00 p.m., Monday through Friday.

Written comments should be submitted to the General Manager, PO Box 1919, Gonzales, Texas 78629 or presented at the hearing.

POSTED

SEP 12 2018
9:30A

SYLVIA SHEFFIELD
COUNTY CLERK, GONZALES COUNTY TEXAS
BY Maria Macias DEPUTY

Gonzales County Underground Water Conservation District

Minutes of the Board of Directors
October 11, 2018
Public Hearing Management Plan

The public hearing of the Board of Directors of the Gonzales County Underground Water Conservation District (the District) was called to order. Present for the meeting were directors: Bruce Tieken, Barry Miller, and Kermit Thiele. Mr. Bruce Patteson and Mr. Mark Ainsworth were not in attendance. Also present for the meeting were GCUWCD General Manager, Greg Sengelmann, and Administrative Assistant, Laura Martin. Other Attendees included: (See Attached List)

Call to Order.
President of the Board to Make Comments.
The Board and General Manager discussed the changes to the Management Plan and the DFC's.

Public Comments. Limit to 3 minutes per person. Mr. Graham Moore, Alliance Regional Water Authority, made a public comment. A recording of the board meeting and comments received are filed at the District office.

Discussion of other items by the Board and direction to management.
None.

Adjourn:
A motion was made by Mr. Barry Miller to adjourn the meeting and Mr. Kermit Thiele seconded the motion. The motion passed unanimously. The meeting adjourned at 9:28 a.m.

Approved By:

November 13, 2018

GS:lm

APPENDIX 3

Certified Mail Receipts From Surface Water Management Entities

RECEIVED NOV 26 2018

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Mr. Kevin Patteson, CEO-General Manager
Guadalupe-Blanco River Authority
933 East Court Street
Seguin, TX 78155

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X [signature] ☑ Agent ☐ Addressee

B. Received by (Printed Name) Annlee Drazkowski

C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

933 E. Court

3. Service Type
☑ Certified Mail® ☐ Priority Mail Express™
☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ Collect on Delivery

4. Restricted Delivery? (Extra Fee) ☐ Yes

2. Article Number (Transfer from service label) 7014 2870 0001 4238 3594

PS Form 3811, July 2013 Domestic Return Receipt

7014 2870 0001 4238 3594

U.S. Postal Service™
CERTIFIED MAIL® RECEIPT
Domestic Mail Only

For delivery information, visit our website at *www.usps.com®*.

SEGUIN, TX 78155 OFFICIAL USE

Postage	$3.45 / $2.75	0030 09
Certified Fee	$0.00	Postmark Here
Return Receipt Fee (Endorsement Required)	$0.00	
Restricted Delivery Fee (Endorsement Required)	$0.00 / $0.00	
Total Postage & Fees	$6.70 $ $12.90	11/19/2018

Sent To: Mr. Kevin Patteson, CEO-General Manager
Guadalupe-Blanco River Authority
Street & Apt. No., or PO Box No.: 933 East Court Street
City, State, ZIP+4: Seguin, TX 78155

PS Form 3800, J

GONZALES
920 N SAINT JOSEPH ST STE 105
GONZALES
TX
78629-9998
4836250030
11/19/2018 (800)275-8777 11:49 AM

Product Description	Sale Qty	Final Price
PM 3-Day (Domestic) (SEGUIN, TX 78155) (Weight:0 Lb 13.10 Oz) (Expected Delivery Date) (Friday 11/23/2018)	1	$6.70
Certified (@@USPS Certified Mail #) (70142870000142383594)	1	$3.45
Return Receipt (@@USPS Return Receipt #) (9590940242128121673676)	1	$2.75
Total		$12.90

Debit Card Remit'd $12.90
(Card Name:VISA)
(Account #:XXXXXXXXXXXX6143)
(Approval #:)
(Transaction #:647)
(Receipt #:010443)
(Debit Card Purchase:$12.90)
(Cash Back:$0.00)
(AID:A0000000980840 Chip)
(AL:US DEBIT)
(PIN:Verified)

Includes up to $50 insurance

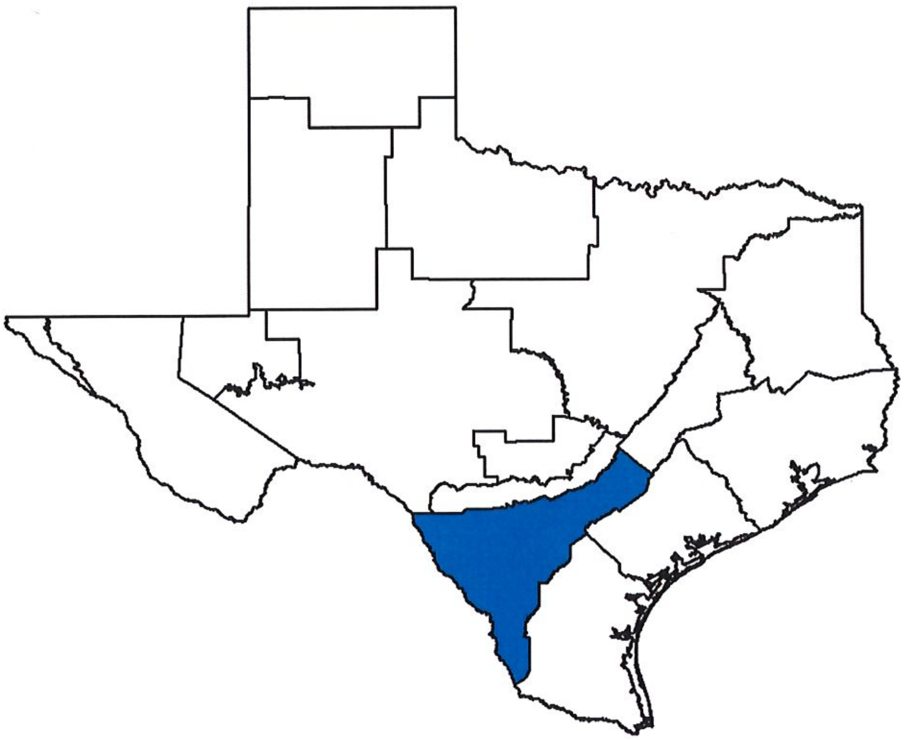
Text your tracking number to 28777 (2USPS) to get the latest status. Standard Message and Data rates may apply. You may also visit www.usps.com USPS Tracking or call 1-800-222-1811.

APPENDIX 4

Technical Memorandums 16-01/16-04/16-08

GMA 13 Technical Memorandum 16-01
Final

Sparta, Queen City, and Carrizo-Wilcox Aquifers GAM Predictive Scenarios 9 to 12 Region L Strategies



Prepared for:
Groundwater Management Area 13

Prepared by:
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February 22, 2017

GMA 13 Technical Memorandum 16-01 (Final)
Sparta, Queen City, and Carrizo-Wilcox Aquifers:
GAM Predictive Scenarios 9 to 12
Region L Strategies

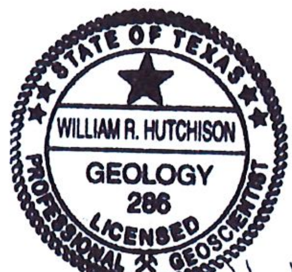
Geoscientist and Engineering Seal

This report documents the work and supervision of work of the following licensed Texas Professional Geoscientist and licensed Texas Professional Engineers:

William R. Hutchison, Ph.D., P.E. (96287), P.G. (286)

Dr. Hutchison completed the analyses and model simulations described in this report, and was the principal author of the final report.

2/22/2017



2/22/2017

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Appendices

1.0 Introduction and Objective

1.1 Review of Scenarios 1 to 8

As part of this round of joint planning, GMA 13 has been reviewing GAM predictive simulations. Scenarios 1 to 7 were completed and reviewed at the GMA 13 meeting on October 13, 2013. A base case (Scenario 4) was developed based on input from the groundwater conservation districts in GMA 13 as follows:

- Pumping in the Carrizo Aquifer in Bexar County was increased as compared to the MAG that was developed from the DFC that was adopted in 2010 in response to a request from SAWS
- Pumping in the Carrizo Aquifer in Gonzales County was increased as compared to the MAG that was developed from the DFC that was adopted in 2010 in response to a request from Gonzales County UWCD
- Pumping the Wilcox Aquifer in Gonzales County was decreased as compared to the MAG that was developed from the DFC that was adopted in 2010 in response to a request from Gonzales County UWCD
- Pumping in the Carrizo Aquifer in McMullen County was increased as compared to the MAG that was developed from the DFC that was adopted in 2010 in response to a request from McMullen GCD

Scenarios 1 to 3 represented incremental reductions of Scenario 4, and Scenarios 4 to 7 represented incremental increases of Scenario 4.

After reviewing the results, Scenario 8 was completed which represented the following changes to Scenario 4:

- Gonzales County UWCD requested that pumping be revised to match the current MAG
- Guadalupe County GCD requested increases in both the Carrizo and Wilcox aquifers

Results of Scenario 8 were completed and reviewed at the GMA 13 meeting of March 13, 2014. As a result of the comments received at the March 13, 2014 meeting, additional pumping was to be included in the next simulation that reflected additional pumping by SAWS. However, due to changes in the administration in GMA 13, the work was left pending.

1.2 Regional Planning Strategies

In considering the request of SAWS to simulate additional pumping, and the potential incremental effect of each entity in GMA 13 requesting similar simulations in the future, a more comprehensive approach was taken to consider all recommended and alternative water management strategies from the Region L plan. Sam Vaugh of HDR provided the initial data on August 22, 2014. However, due to the imminent release of the Region L IPP, it was decided to wait until the IPP was released to ensure that all strategies were current.

A meeting with HDR was held on May 27, 2015 to clarify the strategies and the data contained in the IPP. The IPP contained 12 strategies that were relevant to GMA 13. One of these was a collective strategy called "Local Carrizo Wells" that covered several areas in GMA 13. The pumping for all other strategies totaled 116,000 AF/yr in 2020, and 222,000 AF/yr in 2070.

The IPP distinguished between recommended and alternative strategies in areas where future pumping exceeded the MAG that was set in 2010 on the basis of the DFC that was established by GMA 13. Water management strategies are developed to meet deficits between current supply and future demand as part of the regional planning process. TWDB considers the MAG to be a hard limit, and recommended water management strategies cannot result in pumping that exceeds the MAG. Thus, Region L has included strategies that exceed the MAG as alternative strategies.

The heavy-handed approach of TWDB to the interaction between the joint planning process and the regional planning discounts the fact that DFCs and MAGs are updated every five years. If a strategy is identified that requires groundwater in excess of the MAG in 30 to 50 years, it should be a recommended strategy, which would then provide a signal to the joint planning process to consider revising the DFC to accommodate such a strategy in the next round of joint planning.

This technical memorandum documents four simulations that focus on simulating the recommended and alternative water management strategies in the 2015 Region L plan. Scenario 9 includes all pumping from Scenario 8 described above, and all recommended and alternative water management strategies. Scenarios 10 to 12 simulate reductions in all Wilcox Aquifer strategies in order to understand the interaction between the Wilcox and the overlying Carrizo Aquifer.

2.0 Description of Simulations

Appendix A includes maps of the locations of the 12 strategies that were taken from the Region L IPP. Table 1 summarizes the pumping amounts for all strategies except the Local Carrizo strategy. Please note that nearly all require the same amount of pumping in 2020 and in 2070. Only a few require increases in pumping during the planning period.

Table 1. Summary of Pumping for Strategies

Strategy	Project	2020	2030	2040	2050	2060	2070
2	SSLGC Brackish Wilcox	5,556	5,556	5,556	5,556	5,556	5,556
3	SSLGC Expanded Carrizo Project	6,500	6,500	6,500	6,500	6,500	6,500
4	Brackish Wilcox for SS WSC	1,244	1,244	1,244	1,244	1,244	1,244
5	CVLGC Carrizo Project	10,000	10,000	10,000	10,000	10,000	10,000
6	CRWA Wells Ranch - Phase 2	10,629	10,629	10,629	10,629	10,629	10,629
7	Brackish Wilcox Groundwater for CRWA	0	16,333	16,333	16,333	16,333	16,333
8	Brackish Wilcox Groundwater for SAWS	37,334	37,334	37,334	37,334	37,334	37,334
9	SAWS Expanded Brackish Project	0	53,853	53,853	53,853	53,853	53,853
10	SAWS Expanded Local Carrizo	30,000	30,000	30,000	30,000	30,000	30,000
11	Hays/Caldwell PUA Project	10,300	15,000	15,000	35,690	35,690	35,690
12	TWA Carrizo Project	5,000	15,000	15,000	15,000	15,000	15,000

Table 2 summarizes a comparison of Region L strategies, the calibrated GAM (1999 pumping), the current MAG (GAM Run 09-34), and Scenario 8 described above.

Table 2. Comparison of Strategies, 1999 Pumping, Current MAG, and Scenario 8

Strategy	Project	Region L IPP		Calibrated GAM	GAM Run 09-34		Scenario 8	
		2020	2070	1999	2000	2060	2012	2070
1	Local Carrizo		9,151	25,039	31,679	28,443	31,677	28,360
2	SSLGC Brackish Wilcox	5,556	5,556	0	235	235	235	235
3	SSLGC Expanded Carrizo Project	6,500	6,500	49	64	2,071	232	2,730
4	Brackish Wilcox for SS WSC	1,244	1,244	0	0	0	0	0
5	CVLGC Carrizo Project	10,000	10,000	37	143	174	143	160
6	CRWA Wells Ranch - Phase 2	10,629	10,629	20	3,108	5,106	3,364	6,153
7	Brackish Wilcox Groundwater for CRWA	0	16,333	35	35	35	37	117
8	Brackish Wilcox Groundwater for SAWS	37,334	37,334	87	16,989	16,989	33,601	33,601
9	SAWS Expanded Brackish Project	0	53,853	0	0	0	0	0
10	SAWS Expanded Local Carrizo	30,000	30,000	422	6,615	6,615	19,613	20,350
11	Hays/Caldwell PUA Project	10,300	35,690	101	22,646	22,646	22,647	22,647
12	TWA Carrizo Project	5,000	15,000	47	38	16,390	38	16,389
13	Other Pumping Areas	N/A	N/A	263,119	361,783	340,706	382,993	362,069

Please note that within many of the areas of these strategies, Scenario 8 included substantial pumping. These areas simply required adjustment to pumping input. Two strategy areas had no pumping in Scenario 8: Brackish Wilcox for SSWSC and SAWS Expanded Brackish Project (Strategies 4 and 9). New wells were included in these areas based on the locations as shown in Appendix A. Please note that Table 2 includes "Strategy 13" which is simply all the pumping in the model that is not within the boundaries of the 12 strategies as noted in Appendix A.

For purposes of these simulations, strategy pumping was assumed to be equal for the entire simulation period (2012 to 2070) and set based on the 2070 numbers in Table 2 (i.e. scheduled increases were not simulated to avoid problems in MAG caps in future regional planning sessions if there are changes in the timing of strategy implementation).

Scenarios 9 to 12 were developed as follows:

- Scenario 9 includes all of Scenario 8 pumping plus all strategy pumping as presented in Table 2 and discussed above.
- Scenario 10 includes all of Scenario 8 pumping, all Carrizo Aquifer strategy pumping, and 67 percent of Wilcox Aquifer strategy pumping.
- Scenario 11 includes all of Scenario 8 pumping, all Carrizo Aquifer strategy pumping, and 33 percent of Wilcox Aquifer strategy pumping.
- Scenario 12 includes all of Scenario 8 pumping, all Carrizo Aquifer strategy pumping, and no Wilcox Aquifer strategies.

Scenarios 10 to 12 were designed to understand the drawdown and water budget impacts of Wilcox Aquifer pumping on the overlying Carrizo Aquifer.

A summary of the pumping in Scenarios 9 to 12 by strategy is presented in Table 3. Please note that pumping in a strategy area in Table 3 may be higher than listed in Table 2 to account for other pumping that had already been included in Scenario 8.

Table 3. Summary of Pumping in Scenarios 9 to 12

Strategy Number	Project	Scenario 9		Scenario 10		Scenario 11		Scenario 12	
		2012	2070	2012	2070	2012	2070	2012	2070
1	Local Carrizo	40,222	40,222	40,222	40,222	40,222	40,222	40,222	40,222
2	SSLGC Brackish Wilcox	6,122	6,122	4,096	4,096	2,020	2,020	0	0
3	SSLGC Expanded Carrizo Project	7,140	7,140	7,140	7,140	7,140	7,140	7,140	7,140
4	Brackish Wilcox for SS WSC	1,243	1,243	835	835	409	409	0	0
5	CVLGC Carrizo Project	10,960	10,960	10,960	10,960	10,960	10,960	10,960	10,960
6	CRWA Wells Ranch - Phase 2	11,697	11,697	11,697	11,697	11,697	11,697	11,697	11,697
7	Brackish Wilcox Groundwater for CRWA	17,954	17,954	12,034	12,034	5,929	5,929	0	0
8	Brackish Wilcox Groundwater for SAWS	41,067	41,067	27,476	27,476	13,558	13,558	0	0
9	SAWS Expanded Brackish Project	53,879	53,879	36,115	36,115	17,764	17,764	0	0
10	SAWS Expanded Local Carrizo	32,987	32,987	32,987	32,987	32,987	32,987	32,987	32,987
11	Hays/Caldwell PUA Project	39,262	39,262	39,262	39,262	39,262	39,262	39,262	39,262
12	TWA Carrizo Project	16,487	16,487	16,487	16,487	16,487	16,487	16,487	16,487
13	Other Pumping Areas	383,001	362,021	383,001	362,021	383,001	362,021	383,001	362,021

3.0 Predictive Simulation Results

3.1 Overall Pumping and Drawdown Results

Summary drawdown and pumping results on a county scale and at the GMA 13 scale were extracted from the simulation output files. Additional detailed results for outcrop, downdip, and GCD areas were not extracted for this draft, but will be included once a proposed DFC is agreed upon.

Figure 1 is a time-series plot of average drawdown from 2012 to 2070 for GMA 13. This plot shows that after 59 years of pumping, drawdown is not flattening in any of the scenarios, which suggests that storage depletion is a dominant supply of the pumped water (i.e. pumping induced inflows and decreased outflows are not sufficient to supply the increased pumping).

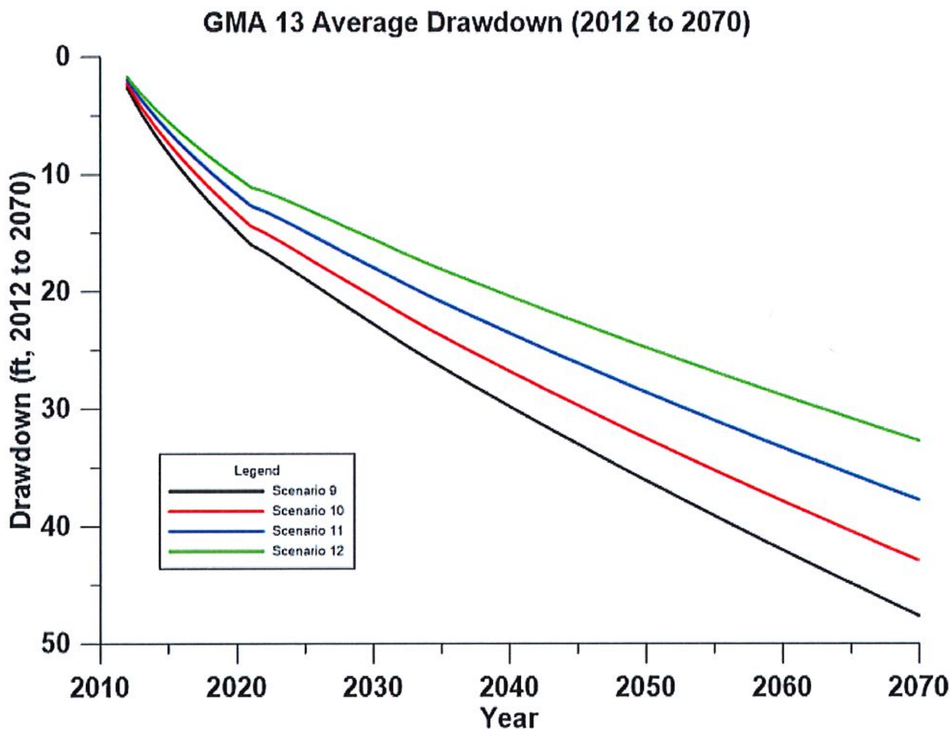


Figure 1. GMA 13 Average Drawdown Time Series

Figure 2 is an update of the pumping versus drawdown relationship of the current DFC and MAG and all 12 scenarios completed to date at the scale of GMA 13. Pumping is for all of GMA 13 (all layers), and the drawdown is the average drawdown for all layers over the entirety of GMA 13. This is a summary graph intended to provide regional perspective.

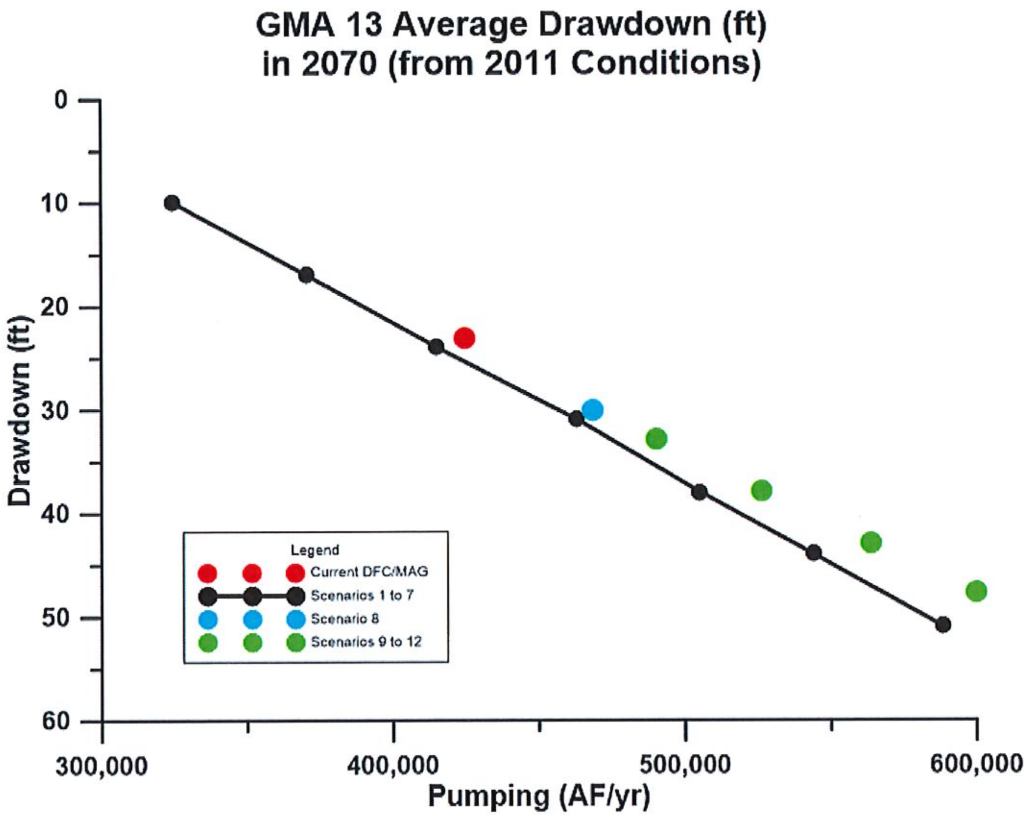


Figure 2. GMA 13 Pumping versus Drawdown for all Scenarios

3.2 County Level Pumping and Drawdown Results

Summary tables of pumping and drawdown for each county are presented in Appendix B.

Of note is the drawdown impact in the Carrizo Aquifer (Layer 5) as a result of changes in Wilcox Aquifer pumping. Recall that Scenario 9 included all Wilcox Aquifer strategies, and Scenarios 10 and 11 represented reductions in Wilcox Aquifer strategy pumping, and Scenario 12 included no Wilcox Aquifer strategies.

Bexar, Gonzales, Guadalupe, and Wilson counties are the locations of these Wilcox Aquifer strategies, and Figures 3 to 6 summarize the drawdown in the Carrizo Aquifer (Layer 5) and the Wilcox Aquifer (Layer 8). Please note that in each case, Wilcox Aquifer drawdown is highest in Scenario 9 and lowest in Scenario 12 as a result of differences in pumping. However, the changes in Carrizo Aquifer drawdown are minimal across all scenarios in each of these counties. This suggests that, according to this GAM, the Wilcox is relatively isolated from the Carrizo, and pumping in the Wilcox will result in minimal drawdown in the Carrizo Aquifer.

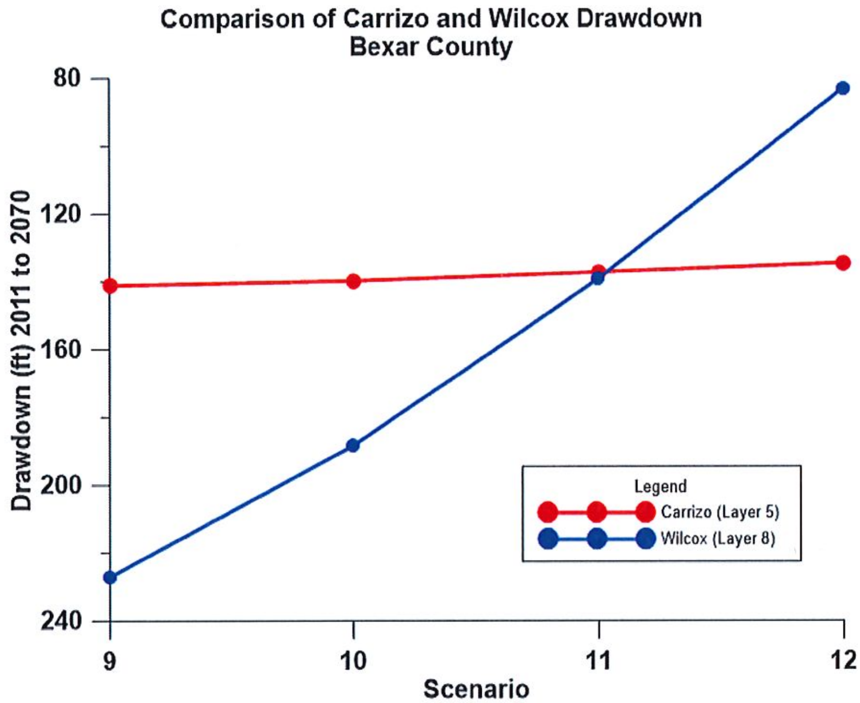


Figure 3. Bexar County Drawdown in Carrizo and Wilcox

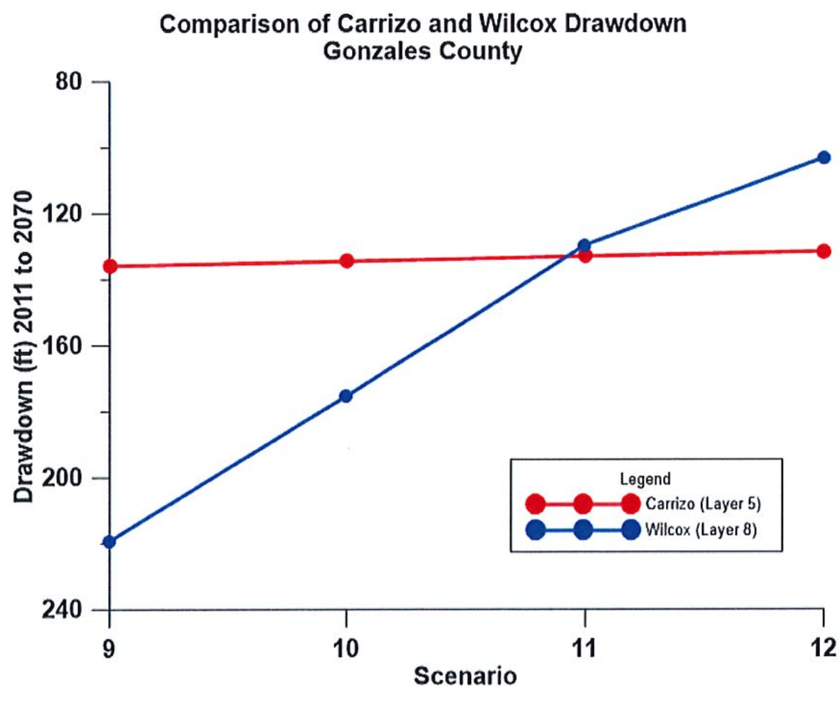


Figure 4. Gonzales County Drawdown in Carrizo and Wilcox

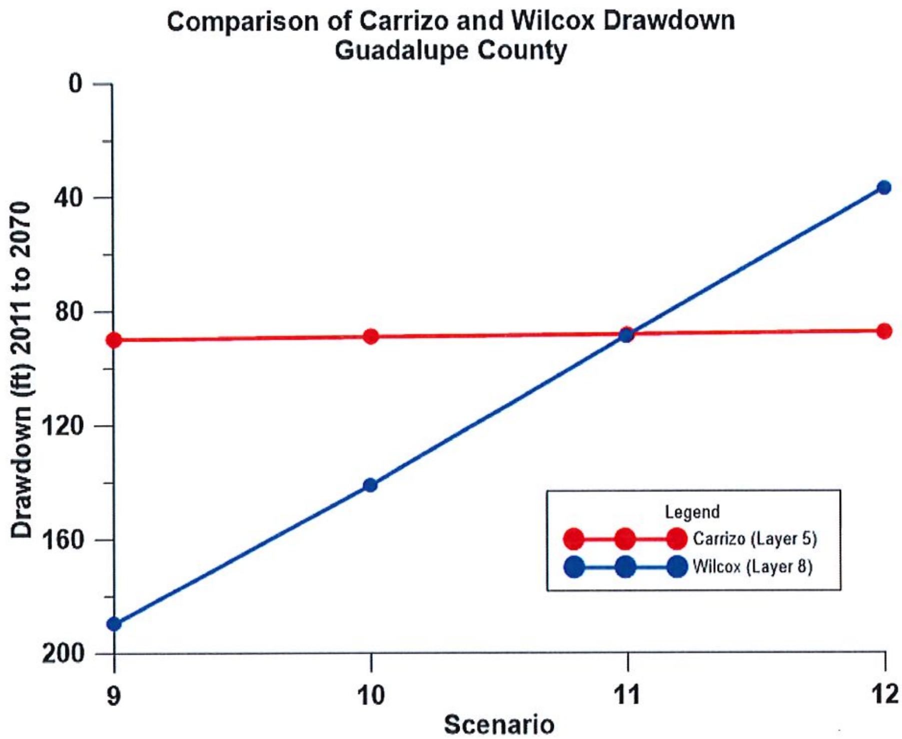


Figure 5. Guadalupe County Drawdown in Carrizo and Wilcox

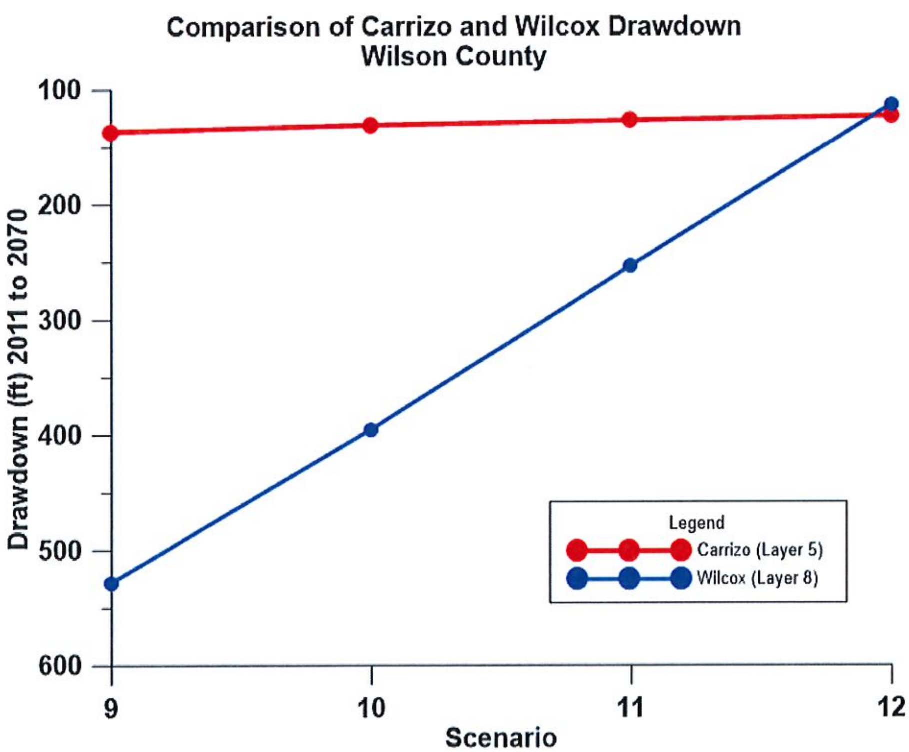


Figure 6. Wilson County Drawdown in Carrizo and Wilcox

3.3 Wilcox Aquifer Water Budget

Increases in pumping will result in three impacts: 1) reduction in storage, 2) increased or induced inflow, and 3) decreased outflow. A water budget is an accounting of all inflows, outflows and storage changes in an area, and can be useful to evaluate the impacts of pumping increases.

Water budgets for the Wilcox Aquifer (Layers 6, 7 and 8) for the updated calibration period (2000 to 2011) and for Scenario 9 are presented to understand the impacts of increasing Wilcox pumping. These water budgets are presented in Table 4. The water budget comparison for Scenario 12 is presented in Table 5.

Please note that Scenario 9 represents an increase in Wilcox Aquifer pumping of about 164,000 AF/yr. In response, storage declines increase about 95,000 AF/yr. Thus, after 59 years of pumping (2012 to 2070), storage declines supply only about 58 percent of the pumping.

Induced inflow and decreased outflow account for the other 42 percent of the pumping. Significant among these components is the induced inflow from GMA 12 and GMA 15, which, together, supply over 20 percent of the pumping. Induced flow from rivers and stream supply about 21 percent of the pumping.

From 2000 to 2011, groundwater flowed from the Wilcox upward to the Carrizo at a rate of 1,380 AF/yr. Note that in Scenario 9, the rate increased to 6,437 AF/yr, which suggests that increased pumping in the Carrizo associated with Scenario 9 is inducing additional flow from the Wilcox to the Carrizo. As presented in Table 5, Scenario 12 (no Wilcox strategy pumping) has a flow rate from the Wilcox to the Carrizo of about 19,000 AF/yr, which appears to be a primary factor in the relatively flat drawdown curves in the Carrizo Aquifer, previously presented in Figures 3 through 6.

Table 4. Groundwater Budgets for the Wilcox Aquifer in GMA 13 – Scenario 9

All Values in AF/yr

	Calibrated Model (Average 2000 to 2011)	Scenario 9 (2070)	Difference
Inflow			
River and Stream	1,950	36,405	34,455
Recharge	39,200	41,715	2,515
From Mexico	20	15	-5
From GMA 10	1,208	1,238	29
From GMA 12	189	10,454	10,265
From GMA 15	0	22,641	22,641
From GMA 16	0	2,559	2,559
Total Inflow	42,568	115,027	72,459
Outflow			
Wells	67,097	231,543	164,446
Drains	244	380	136
ET	1,009	1,468	460
To Overlying Carizzo	1,380	6,437	5,057
To GMA 15	2,725	0	-2,725
To GAM 16	298	0	-298
Total Outflow	72,752	239,828	167,076
Inflow-Outflow	-30,184	-124,801	-94,617
Storage	-30,169	-124,789	-94,620
Model Error	-14	-12	2

Table 5. Groundwater Budgets for the Wilcox Aquifer in GMA 13 – Scenario 13

All Values in AF/yr

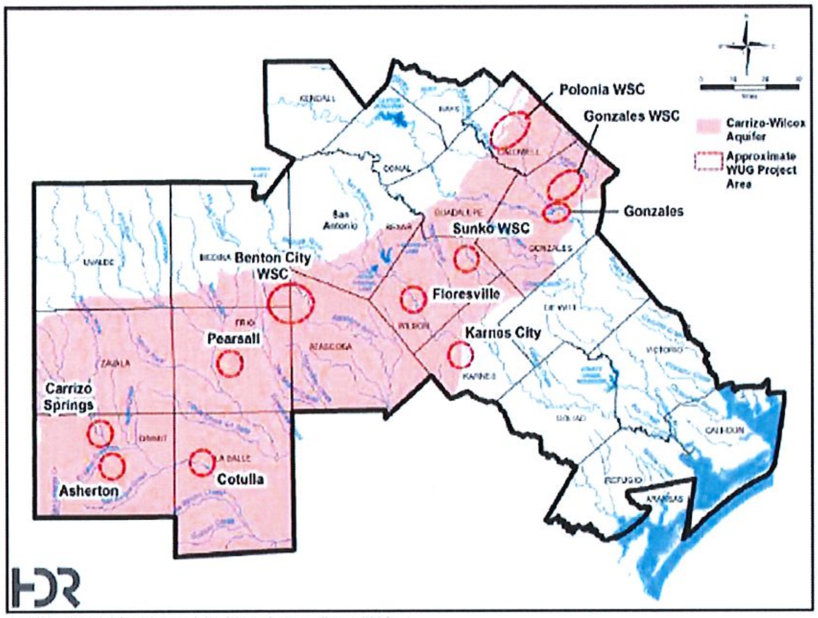
	Calibrated Model (Average 2000 to 2011)	Scenario 12 (2070)	Difference
Inflow			
River and Stream	1,950	25,100	23,150
Recharge	39,200	41,642	2,442
From Mexico	20	15	-5
From GMA 10	1,208	1,225	16
From GMA 12	189	9,167	8,978
From GMA 15	0	7,920	7,920
From GMA 16	0	1,169	1,169
Total Inflow	42,568	86,239	43,671
Outflow			
Wells	67,097	111,709	44,612
Drains	244	436	192
ET	1,009	1,475	466
To Overlying Carizzo	1,380	19,967	18,587
To GMA 15	2,725	0	-2,725
To GAM 16	298	0	-298
Total Outflow	72,752	133,587	60,835
Inflow-Outflow	-30,184	-47,348	-17,164
Storage	-30,169	-47,336	-17,167
Model Error	-14	-12	2

Appendix A

Location Maps of 12 Water Management Strategies Contained in Region L IPP

1. Local Carrizo

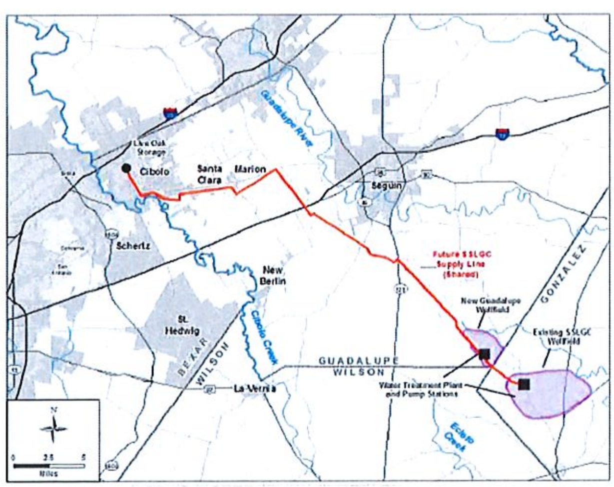
Figure 5.2.7-1. Local Carrizo-Wilcox Aquifer Projects



2. SSLGC Brackish Wilcox (Gonzales County)

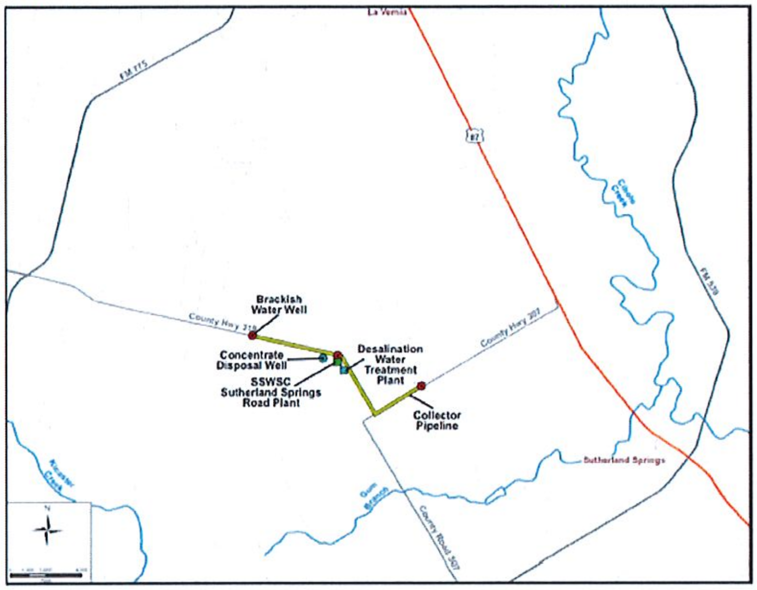
3. SSLGC Expanded Carrizo Project (Guadalupe County)

Figure 5.2.11-1 Schertz-Seguin Water Supply Project



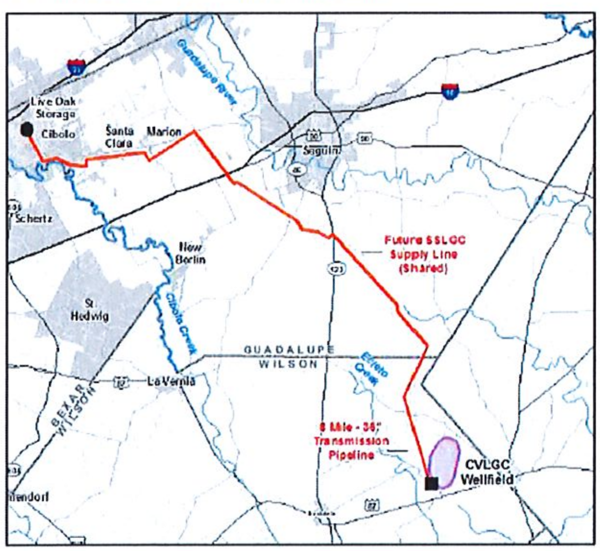
4. Brackish Wilcox for SS WSC

Figure 5.2.13-2 Brackish Wilcox Groundwater for SSWSC Project Location



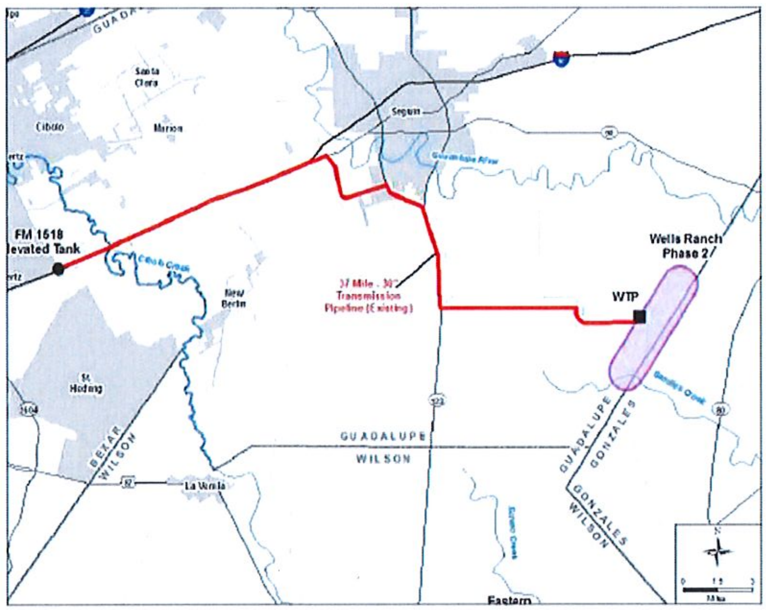
5. CVLGC Carrizo Project

Figure 14-1 Carrizo for Cibolo Valley Location Map



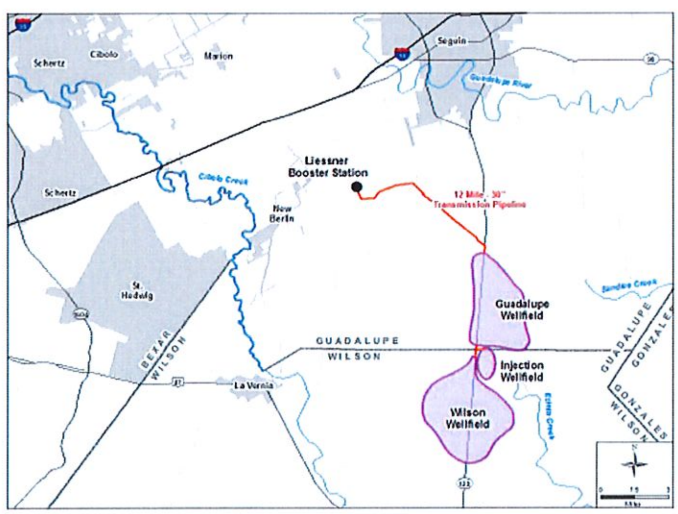
6. CRWA Wells Ranch - Phase 2

Figure 5.2.16-1 Wells Ranch Project Location Map



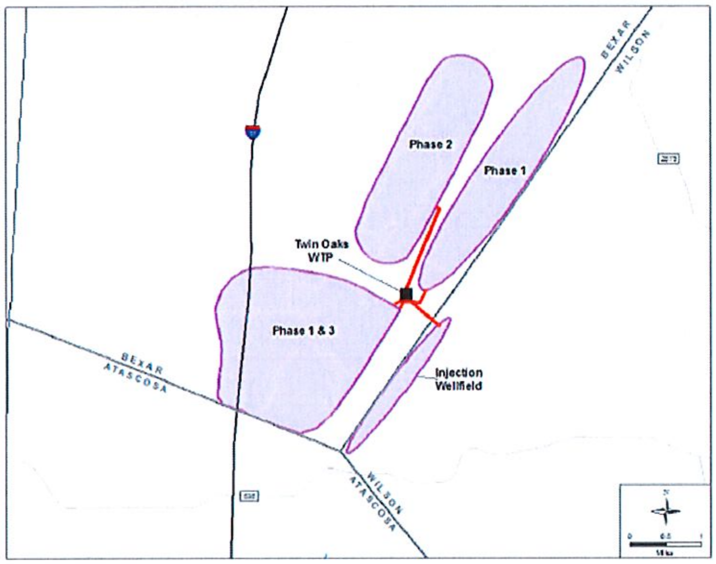
7. Brackish Wilcox Groundwater for CRWA

Figure 5.2.18-1 Project Location



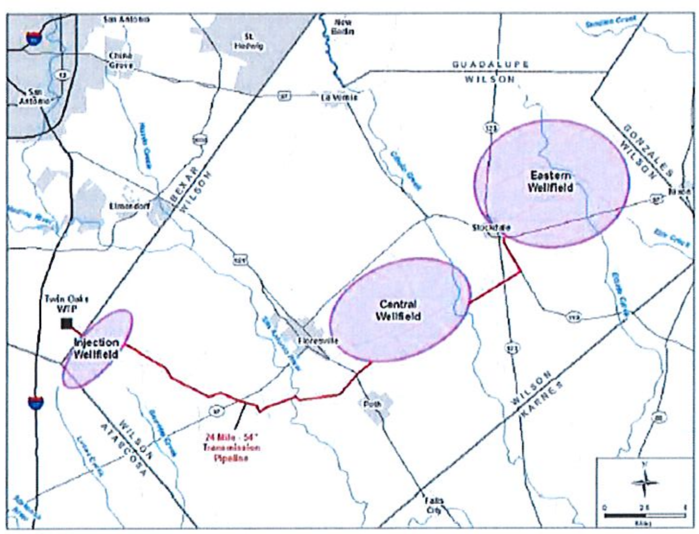
8. Brackish Wilcox Groundwater for SAWS

Figure 5.2.19-1 Brackish Wilcox Groundwater Desalination Project for SAWS



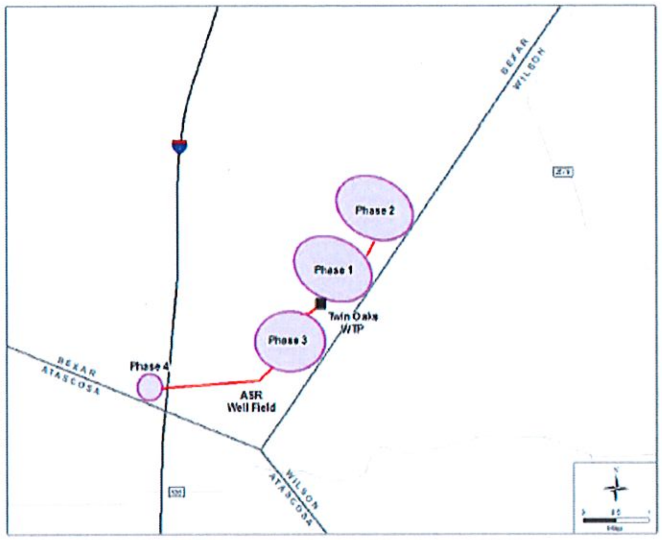
9. SAWS Expanded Brackish Project

Figure 5.2.20-1 Brackish Wilcox Groundwater Desalination Project for SAWS



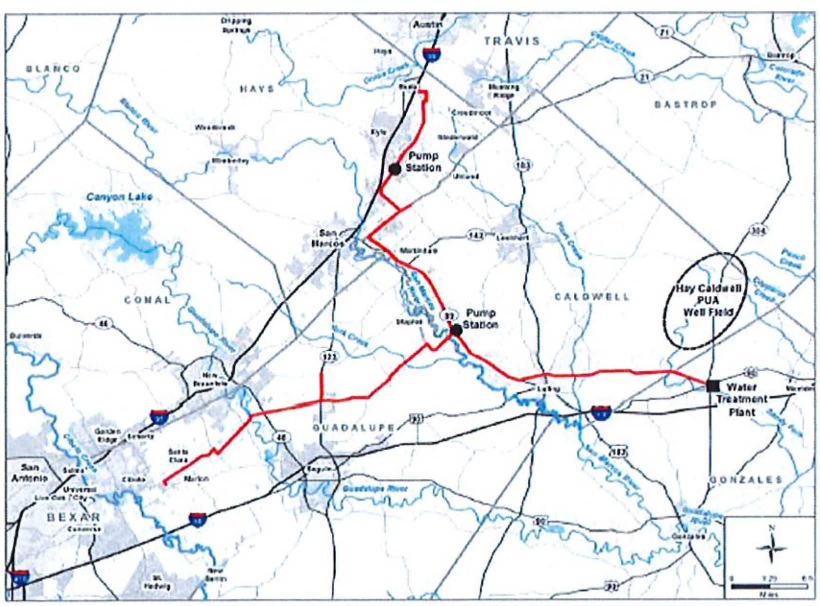
10. SAWS Expanded Local Carrizo

Figure 5.2.21-1 Local Carrizo Groundwater Project Location



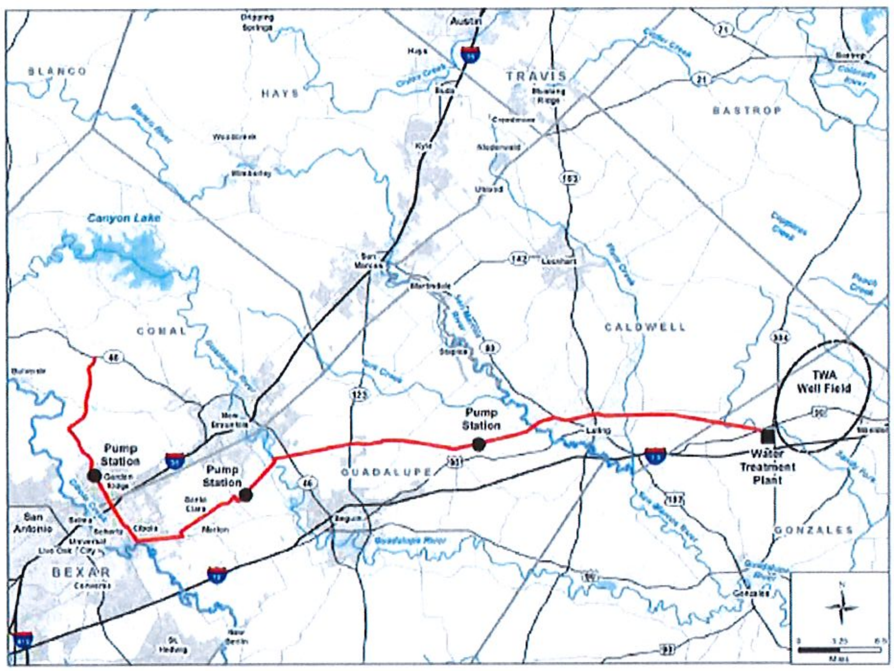
11. Hays/Caldwell PUA Project

Figure 5.2.25-1 HCPUA Project Conceptual Layout



12. TWA Carrizo Project

Figure 5.2.26-1 TWA Regional Carrizo Conceptual Layout



Appendix B

Tabluar Summaries of Pumping and Drawdown for Scenarios 9 to 12

Scenario 9 Pumping (AF/yr)

County	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Total
Atascosa	1,012	0	4,299	0	58,331	249	249	16,993	81,135
Bexar	0	0	0	0	37,686	0	0	41,067	78,753
Caldwell	0	0	307	0	33,353	0	7,389	13,409	54,458
Dimmit	0	0	0	0	2,810	1,073	205	38	4,126
Frio	623	0	4,110	0	77,299	0	0	0	82,032
Gonzales	3,551	0	5,063	0	54,319	0	9,545	22,132	94,610
Guadalupe	0	0	0	0	16,851	0	8,218	22,723	47,792
Karnes	0	0	0	0	1,295	0	0	0	1,295
LaSalle	983	0	2	0	4,669	1,952	188	50	7,843
Maverick	0	0	0	0	143	136	259	1,004	1,543
McMullen	89	0	134	0	4,402	0	0	0	4,626
Medina	0	0	0	0	534	0	1,247	863	2,644
Uvalde	0	0	0	0	828	0	0	0	828
Webb	0	0	0	0	895	13	6	1	915
Wilson	156	0	944	0	38,639	125	121	62,434	102,417
Zavala	0	0	0	0	24,504	6,230	3,610	328	34,672
GMA 13	6,415	0	14,859	0	356,554	9,777	31,036	181,039	599,702

Scenario 9 Drawdown (ft, 2012 to 2070)

County	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Total
Atascosa	14.45	19.61	22.14	70.92	121.98	122.27	139.88	254.59	104.51
Bexar	0	0	0	11.76	141.15	72.66	64.46	227.09	154.53
Caldwell	0	0	8.53	25.51	133.76	130.48	56.45	85.47	82.28
Dimmit	-1.39	2.79	-4.06	-4.06	-3.39	-2.61	-5.65	-4.77	-3.87
Frio	4.26	3.98	-0.93	31.23	51.71	50.35	49.32	55.86	36.14
Gonzales	28.76	36.74	46.07	87.77	135.67	135.6	136.92	219.14	108.68
Guadalupe	0	0	-10.05	5.46	89.9	88.83	79.47	189.7	128.05
Karnes	28.29	44.59	57.39	102.53	145.08	145.54	185.01	393.45	137.74
LaSalle	7.9	10.1	12.53	21.98	29.13	29.93	8.6	1.79	15.25
Maverick	0	0	0	0.36	-7.39	-10.11	-9.92	-2.1	-5.93
McMullen	32.79	38.57	44.02	63.37	80.32	77.97	24.58	26.96	48.57
Medina	0	0	0	-0.84	25.93	26.54	28.91	31.09	28.81
Uvalde	0	0	0	0	0.59	3.74	11.12	26.41	17.13
Webb	-5.71	-4.01	-8.58	-4.13	-1.87	-1.12	-0.88	-3.42	-3.55
Wilson	10.16	20.38	22.6	74.33	135.08	136.69	210.35	527.56	172.25
Zavala	-5.79	-5.01	-12.01	-3.98	10.26	9.85	11.73	14.26	5.46
GMA 13	12.32	16.21	11.65	32.59	54.64	54.32	53.85	101.97	47.59

Scenario 10 Pumping (AF/yr)

County	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Total
Atascosa	1,012	0	4,299	0	58,331	249	249	16,993	81,135
Bexar	0	0	0	0	37,950	0	0	27,476	65,425
Caldwell	0	0	307	0	33,353	0	7,389	13,409	54,458
Dimmit	0	0	0	0	2,810	1,073	205	38	4,126
Frio	623	0	4,110	0	77,299	0	0	0	82,032
Gonzales	3,551	0	5,063	0	54,319	0	9,545	20,106	92,583
Guadalupe	0	0	0	0	16,851	0	8,429	16,803	42,083
Karnes	0	0	0	0	1,295	0	0	0	1,295
LaSalle	983	0	2	0	4,669	1,952	188	50	7,843
Maverick	0	0	0	0	143	136	259	1,004	1,543
McMullen	89	0	134	0	4,402	0	0	0	4,626
Medina	0	0	0	0	534	0	1,247	863	2,644
Uvalde	0	0	0	0	828	0	0	0	828
Webb	0	0	0	0	895	13	6	1	915
Wilson	156	0	944	0	38,639	125	121	47,458	87,442
Zavala	0	0	0	0	24,504	6,230	3,610	328	34,672
GMA13	6,415	0	14,859	0	356,817	9,777	31,247	144,527	563,660

Scenario 10 Drawdown (ft, 2012 to 2070)

County	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Total
Atascosa	14.2	19.25	21.73	69.4	119.11	119.23	124.72	210.58	95.02
Bexar	0	0	0	11.68	139.86	74.39	55.3	188.46	132.13
Caldwell	0	0	8.52	25.48	133.57	130.28	55.59	79.99	79.76
Dimmit	-1.39	2.79	-4.06	-4.1	-3.45	-2.67	-5.73	-4.89	-3.93
Frio	4.23	3.93	-0.97	30.87	50.9	49.51	47.13	51.47	34.83
Gonzales	28.6	36.49	45.71	86.91	134.28	134.16	125.97	175.27	100.69
Guadalupe	0	0	-10.05	5.46	89.11	87.85	68.78	141.09	103.15
Karnes	27.64	43.52	55.99	99.75	140.85	140.88	149.88	289.62	118.52
LaSalle	7.85	10.03	12.44	21.76	28.76	29.56	8.13	0.49	14.88
Maverick	0	0	0	0.36	-7.39	-10.11	-9.92	-2.1	-5.93
McMullen	32.5	38.2	43.59	62.56	79.19	76.84	22.94	20.81	47.08
Medina	0	0	0	-0.84	25.74	26.28	28.15	29.58	27.95
Uvalde	0	0	0	0	0.59	3.74	11.11	26.39	17.13
Webb	-5.71	-4.01	-8.58	-4.14	-1.89	-1.14	-0.89	-3.45	-3.56
Wilson	9.97	19.95	22.09	72.43	131.28	132.13	172.25	394.94	143.63
Zavala	-5.79	-5.01	-12.02	-4.02	10.18	9.77	11.64	14.14	5.39
GMA13	12.19	16.01	11.46	32.03	53.65	53.26	47.65	81.01	42.9

Scenario 11 Pumping (AF/yr)

County	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Total
Atascosa	1,012	0	4,299	0	58,331	249	249	16,993	81,135
Bexar	0	0	0	0	37,950	0	0	13,558	51,507
Caldwell	0	0	307	0	33,353	0	7,389	13,409	54,458
Dimmit	0	0	0	0	2,810	1,073	205	38	4,126
Frio	623	0	4,110	0	77,299	0	0	0	82,032
Gonzales	3,551	0	5,063	0	54,319	0	9,545	18,030	90,507
Guadalupe	0	0	0	0	16,851	0	8,465	10,698	36,014
Karnes	0	0	0	0	1,295	0	0	0	1,295
LaSalle	983	0	2	0	4,669	1,952	188	50	7,843
Maverick	0	0	0	0	143	136	259	1,004	1,543
McMullen	89	0	134	0	4,402	0	0	0	4,626
Medina	0	0	0	0	534	0	1,247	863	2,644
Uvalde	0	0	0	0	828	0	0	0	828
Webb	0	0	0	0	895	13	6	1	915
Wilson	156	0	944	0	38,639	125	121	31,985	71,969
Zavala	0	0	0	0	24,504	6,230	3,610	328	34,672
GMA 13	6,415	0	14,859	0	356,817	9,777	31,283	106,954	526,096

Scenario 11 Drawdown (ft, 2012 to 2070)

County	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Total
Atascosa	13.93	18.86	21.28	67.74	115.97	115.9	108.02	162.33	84.6
Bexar	0	0	0	11.6	137.32	71.45	42.94	139.12	102.71
Caldwell	0	0	8.52	25.45	133.36	130.07	54.67	74.17	77.09
Dimmit	-1.39	2.78	-4.06	-4.13	-3.52	-2.74	-5.82	-5.03	-4
Frio	4.2	3.88	-1.02	30.48	50	48.59	44.7	46.6	33.39
Gonzales	28.43	36.23	45.34	86	132.81	132.63	114.42	129.49	92.32
Guadalupe	0	0	-10.06	5.45	88.24	86.75	55.27	88.71	75.88
Karnes	26.93	42.37	54.49	96.77	136.32	135.9	112.75	180.13	98.21
LaSalle	7.8	9.95	12.33	21.51	28.34	29.15	7.62	-0.92	14.47
Maverick	0	0	0	0.36	-7.39	-10.11	-9.92	-2.1	-5.93
McMullen	32.18	37.8	43.11	61.69	77.94	75.61	21.18	14.15	45.46
Medina	0	0	0	-0.84	25.53	25.99	27.3	27.87	26.96
Uvalde	0	0	0	0	0.59	3.74	11.11	26.38	17.12
Webb	-5.72	-4.02	-8.59	-4.15	-1.92	-1.17	-0.9	-3.48	-3.58
Wilson	9.78	19.49	21.54	70.37	127.17	127.19	130.68	253.12	112.87
Zavala	-5.79	-5.01	-12.02	-4.06	10.09	9.67	11.53	14.02	5.32
GMA 13	12.04	15.79	11.25	31.43	52.56	52.08	40.85	58.35	37.81

Scenario 12 Pumping (AF/yr)

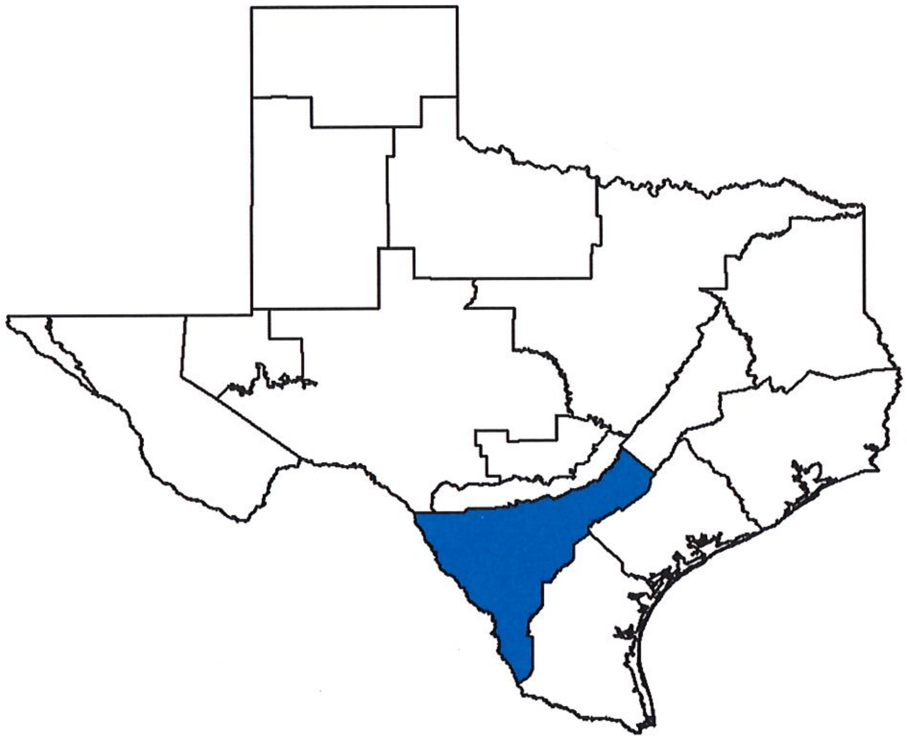
County	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Total
Atascosa	1,012	0	4,299	0	58,331	249	249	16,993	81,135
Bexar	0	0	0	0	37,950	0	0	0	37,950
Caldwell	0	0	307	0	33,353	0	7,389	13,409	54,458
Dimmit	0	0	0	0	2,810	1,073	205	38	4,126
Frio	623	0	4,110	0	77,299	0	0	0	82,032
Gonzales	3,551	0	5,063	0	54,319	0	9,545	16,011	88,488
Guadalupe	0	0	0	0	16,851	0	8,649	4,769	30,269
Karnes	0	0	0	0	1,295	0	0	0	1,295
LaSalle	983	0	2	0	4,669	1,952	188	50	7,843
Maverick	0	0	0	0	143	136	259	1,004	1,543
McMullen	89	0	134	0	4,402	0	0	0	4,626
Medina	0	0	0	0	534	0	1,247	863	2,644
Uvalde	0	0	0	0	828	0	0	0	828
Webb	0	0	0	0	895	13	6	1	915
Wilson	156	0	944	0	38,639	125	121	17,010	56,995
Zavala	0	0	0	0	24,504	6,230	3,610	328	34,672
GMA13	6,415	0	14,859	0	356,817	9,777	31,468	70,472	489,793

Scenario 12 Drawdown (ft, 2012 to 2070)

County	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Total
Atascosa	13.66	18.46	20.83	66.06	112.77	112.5	91	113.53	74.04
Bexar	0	0	0	11.52	134.62	67.84	27.59	83.11	68.94
Caldwell	0	0	8.51	25.41	133.16	129.87	53.79	68.59	74.53
Dimmit	-1.39	2.78	-4.06	-4.17	-3.59	-2.81	-5.9	-5.16	-4.06
Frio	4.17	3.83	-1.07	30.07	49.07	47.64	42.22	41.64	31.92
Gonzales	28.26	35.97	44.96	85.1	131.35	131.12	103.14	85.02	84.17
Guadalupe	0	0	-10.06	5.44	87.34	85.6	40.86	37.02	48.66
Karnes	26.23	41.22	52.99	93.8	131.8	130.95	76.24	72.69	78.24
LaSalle	7.74	9.88	12.23	21.26	27.92	28.73	7.11	-2.36	14.06
Maverick	0	0	0	0.36	-7.39	-10.11	-9.92	-2.1	-5.93
McMullen	31.85	37.4	42.63	60.8	76.68	74.37	19.4	7.45	43.82
Medina	0	0	0	-0.84	25.31	25.69	26.4	26.07	25.92
Uvalde	0	0	0	0	0.59	3.74	11.11	26.36	17.11
Webb	-5.72	-4.03	-8.59	-4.17	-1.94	-1.19	-0.91	-3.51	-3.59
Wilson	9.58	19.02	20.99	68.3	123.05	122.24	89.55	113.28	82.49
Zavala	-5.79	-5.01	-12.02	-4.1	10	9.58	11.42	13.89	5.24
GMA13	11.89	15.58	11.04	30.83	51.46	50.88	34.01	35.74	32.72

GMA 13 Technical Memorandum 16-04
Final

Yegua-Jackson Aquifer: GAM Predictive Simulations



Prepared for:
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February 22, 2017

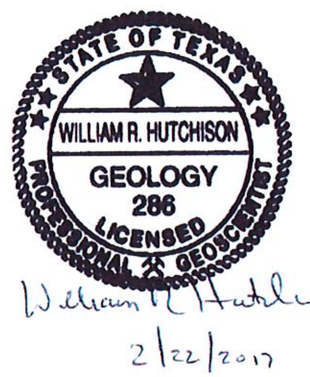
GMA 13 Technical Memorandum 16-04 (Final)
Yegua-Jackson Aquifer: GAM Predictive Simulations

Geoscientist and Engineering Seal

This report documents the work and supervision of work of the following licensed Texas Professional Geoscientist and licensed Texas Professional Engineers:

William R. Hutchison, Ph.D., P.E. (96287), P.G. (286)

Dr. Hutchison completed the analyses and model simulations described in this report, and was the principal author of the final report.



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1.0 Introduction

The Yegua-Jackson Aquifer is a minor aquifer within the boundaries of eight counties of GMA 13. In 2010, GMA 13 adopted desired future conditions for the Yegua-Jackson after considering the results of ten alternative GAM simulations using the Groundwater Availability Model (GAM) for the Yegua-Jackson Aquifer. The GAM is documented in Deeds and others (2010), and the ten alternative simulations are documented in Oliver (2010).

As part of its process to consider updated proposed desired future conditions, this technical memorandum supplements the analysis of Oliver (2010) by modifying the pumping in Gonzales and Karnes counties to account for increased use by the oil and gas industry, and extending the time period of the simulations to 2070.

Table 1 presents the 2012 estimated pumping (from the TWDB pumping data base) organized by county, and the simulated pumping for each county used in Scenario 4.0 of Oliver (2010). The simulated pumping became the basis for the modeled available groundwater (MAG) for the Yegua-Jackson Aquifer in GMA 13. It should be noted that TWDB's estimated pumping in 2012 assumed no pumping in the mining category (i.e. no groundwater pumping associated with oil and gas). Evergreen UWCD and Gonzales UWCD provided updated oil and gas pumping estimates for 2012, 2013 and 2014.

Table 1. Estimates of Historic Pumping and Simulated Pumping from Oliver (2010)

County	2012 Estimated Pumping (TWDB)	Simulated Pumping in 2060 (Oliver, 2010)
Atascosa	396	856
Gonzales	687	975
Karnes	271	776
La Salle	54	92
McMullen	29	180
Webb	4	19,999
Wilson	177	840
Zapata	159	8,000

In Gonzales County, groundwater pumping from the Yegua-Jackson Aquifer for oil and gas activities peaked at 2,500 AF/yr. Oil and gas related groundwater pumping in Karnes County peaked at 1,741 AF/yr according to data provided by the UWCD.

After reviewing monitoring well data and initial model runs, Gonzales County UWCD requested that pumping be increased to achieve a drawdown of 3 feet. This required adding an additional 1,500 AF/yr of pumping in Gonzales County (above the 2,500 AF/yr historic oil and gas related pumping). These amounts were added to the TWDB estimated historic use pumping estimates to update the simulation in Oliver (2010).

Table 2 summarizes the pumping that was used for the simulation described in this technical memorandum.

Table 2. Assumed Pumping for Updated Simulation

County	Assumed Pumping for Updated Simulation (AF/yr)
Atascosa	856
Gonzales	4,687
Karnes	2,012
La Salle	92
McMullen	180
Webb	19,999
Wilson	840
Zapata	8,000

The model input file from Oliver (2010) for his Scenario 4.0 was used to develop the pumping input file for this simulation by increasing pumping in Gonzales County by a factor of 4.81, and increasing pumping in Karnes County by a factor of 2.59. In addition, an additional 10 years was added to the simulation to extend it to 2070.

2.0 Simulation Results

The simulation results were processed and average drawdown was calculated for each county, and total pumping was obtained from the model output file (i.e. the cbb file). The Yegua-Jackson GAM is somewhat unique in that the assignment of aquifer does not necessarily conform to specific model layers like most GAM's in Texas. The model's grid file was used to define area used in the drawdown calculations.

The model grid file includes a specification labeled "ib", which designates the aquifer unit for a particular model cell (designated by its layer, row, column) as follows:

- 0 = Inactive cell
- 1 = Catahoula
- 2 = Upper Jackson
- 3 = Lower Jackson
- 4 = Upper Yegua
- 5 = Lower Yegua
- 6 = Conduit cells

The conduit cells (and the inactive cells) were not included in the calculation of drawdown. Drawdowns in all cells labeled 1 to 5 in the ib array were summed for each county and divided by the total number of cells labeled 1 to 5 in the ib array for each county. Pumping was also summed in a similar fashion (i.e. summation of all calls labeled 1 to 5 in the ib array for each county).

The results are summarized in Table 3. The current DFC is also shown in Table 3.

Table 3. Summary of Average Drawdown and Output Pumping

County	Current DFC (from 2010 to 2060)	Average Drawdown (ft) from 2010 to 2070	Pumping (AF/yr)
Atascosa	0	0	856
Gonzales	1	3	4,710
Karnes	1	1	2,057
La Salle	0	0	92
McMullen	0	0	179
Webb	3	4	19,986
Wilson	1	1	827
Zapata	3	3	7,982

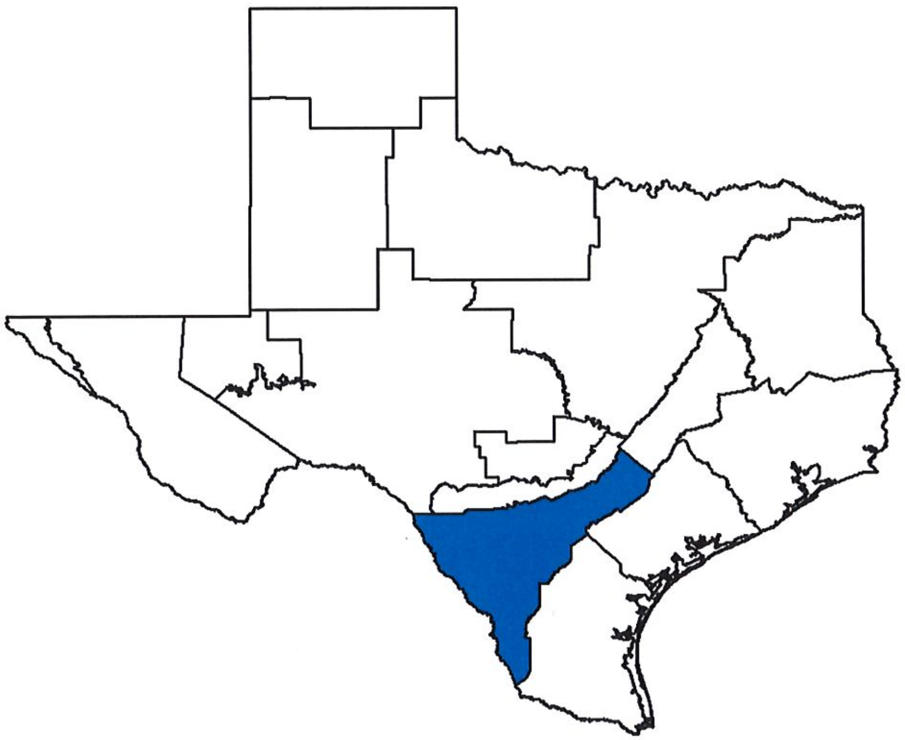
3.0 References

Deeds, N.E., Yan, T., Singh, A., Jones, T., Kelley, V.A., Knox, P.R., and Young, S.C., 2010. Final Report, Groundwater Availability Model for the Yegua-Jackson Aquifer. Prepared for the Texas Water Development Board, March 2010, 582p.

Oliver, W., 2010, GAM Task 10-012 Model Run Report. Texas Water Development Board, Groundwater Availability Modeling Section, August 9, 2010, 48p.

GMA 13 Technical Memorandum 16-08
Final

Sparta, Queen City, and Carrizo-Wilcox Aquifers: Summary of Scenario 9 Drawdown and Outcrop Results



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GMA 13 Technical Memorandum 16-08 (Final)
Sparta, Queen City, and Carrizo-Wilcox Aquifers:
Summary of Scenario 9 Drawdown and Outcrop Results

Geoscientist and Engineering Seal

This report documents the work and supervision of work of the following licensed Texas Professional Geoscientist and licensed Texas Professional Engineers:

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Dr. Hutchison completed the analyses and model simulations described in this report, and was the principal author of the final report.

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1.0 Introduction and Objective

As a follow-up to the GMA 13 meeting of March 30, 2016, this technical memorandum summarizes the results of Scenario 9 that are covered in Technical Memoranda 16-01, 16-02, and 16-03. Technical Memorandum 16-01 included drawdown results of Scenarios 9 to 12, Technical Memorandum 16-02 covered an analysis of the outcrop area of Scenarios 9 to 12, and Technical Memorandum 16-03 covered a more detailed analysis of the outcrop areas of Scenarios 9, 13 and 14. Thus, the results of Scenario 9 are covered in three separate tech memos. Because GMA 13 is considering proposed DFCs based on Scenario 9, it seemed reasonable to summarize all the results in a single document to assist the districts during the public comment period. For more details, please refer to the original tech memos.

Scenario 9 was developed from Scenario 8, which was based on input from the groundwater conservation districts, and added all recommended and alternative water management strategies in the 2015 Region L plan.

2.0 Description of Simulations

Appendix A of Technical Memorandum 16-01 includes maps of the locations of the 12 strategies that were taken from the Region L IPP. Table 1 summarizes the pumping amounts for all strategies except the Local Carrizo strategy. Please note that nearly all require the same amount of pumping in 2020 and in 2070. Only a few require increases in pumping during the planning period.

Table 1. Summary of Pumping for Strategies

Strategy	Project	2020	2030	2040	2050	2060	2070
2	SSLGC Brackish Wilcox	5,556	5,556	5,556	5,556	5,556	5,556
3	SSLGC Expanded Carrizo Project	6,500	6,500	6,500	6,500	6,500	6,500
4	Brackish Wilcox for SS WSC	1,244	1,244	1,244	1,244	1,244	1,244
5	CVLGC Carrizo Project	10,000	10,000	10,000	10,000	10,000	10,000
6	CRWA Wells Ranch - Phase 2	10,629	10,629	10,629	10,629	10,629	10,629
7	Brackish Wilcox Groundwater for CRWA	0	16,333	16,333	16,333	16,333	16,333
8	Brackish Wilcox Groundwater for SAWS	37,334	37,334	37,334	37,334	37,334	37,334
9	SAWS Expanded Brackish Project	0	53,853	53,853	53,853	53,853	53,853
10	SAWS Expanded Local Carrizo	30,000	30,000	30,000	30,000	30,000	30,000
11	Hays/Caldwell PUA Project	10,300	15,000	15,000	35,690	35,690	35,690
12	TWA Carrizo Project	5,000	15,000	15,000	15,000	15,000	15,000

Table 2 summarizes a comparison of groundwater pumping for Region L strategies, the calibrated GAM (1999 pumping), the current MAG (GAM Run 09-34), and Scenarios 8 and 9.

Table 2. Comparison of Strategies, 1999 Pumping, Current MAG, and Scenario 8

Strategy	Project	Region L IPP		Calibrated GAM	GAM Run 09-34		Scenario 8		Scenario 9	
		2020	2070	1999	2000	2060	2012	2070	2012	2070
1	Local Carrizo		9,151	25,039	31,679	28,443	31,677	28,360	40,222	40,222
2	SSLGC Brackish Wilcox	5,556	5,556	0	235	235	235	235	6,122	6,122
3	SSLGC Expanded Carrizo Project	6,500	6,500	49	64	2,071	232	2,730	7,140	7,140
4	Brackish Wilcox for SS WSC	1,244	1,244	0	0	0	0	0	1,243	1,243
5	CVLGC Carrizo Project	10,000	10,000	37	143	174	143	160	10,960	10,960
6	CRWA Wells Ranch - Phase 2	10,629	10,629	20	3,108	5,106	3,364	6,153	11,697	11,697
7	Brackish Wilcox Groundwater for CRWA	0	16,333	35	35	35	37	117	17,954	17,954
8	Brackish Wilcox Groundwater for SAWS	37,334	37,334	87	16,989	16,989	33,601	33,601	41,067	41,067
9	SAWS Expanded Brackish Project	0	53,853	0	0	0	0	0	53,879	53,879
10	SAWS Expanded Local Carrizo	30,000	30,000	422	6,615	6,615	19,613	20,350	32,987	32,987
11	Hays/Caldwell PUA Project	10,300	35,690	101	22,646	22,646	22,647	22,647	39,262	39,262
12	TWA Carrizo Project	5,000	15,000	47	38	16,390	38	16,389	16,487	16,487
13	Other Pumping Areas	N/A	N/A	263,119	361,783	340,706	382,993	362,069	383,001	383,001

Please note that within many of the areas of these strategies, Scenario 8 included substantial pumping. These areas simply required adjustment to pumping input. Two strategy areas had no pumping in Scenario 8: Brackish Wilcox for SSWSC and SAWS Expanded Brackish Project (Strategies 4 and 9). New wells were included in these areas based on the locations as shown in Appendix A. Please note that Table 2 includes "Strategy 13" which is simply all the pumping in the model that is not within the boundaries of the 12 strategies as noted in Appendix A.

For purposes of these simulations, strategy pumping was assumed to be equal for the entire simulation period (2012 to 2070) and set based on the 2070 numbers in Table 2 (i.e. scheduled increases were not simulated to avoid problems in MAG caps in future regional planning sessions if there are changes in the timing of strategy implementation).

Scenario 9 includes all of Scenario 8 pumping plus all strategy pumping as presented in Table 2 and discussed above. A summary of the pumping in Scenario 9 is also presented in Table 2. Please note that pumping in Scenario 9 may be higher than listed by Region L to account for other pumping that had already been included in Scenario 8.

3.0 Predictive Simulation Results

3.1 Pumping and Drawdown Results

Summary tables of pumping and average drawdown for each county and model layer for Scenario 9 are presented in Tables 3 and 4, respectively.

Table 3. Scenario 9 Pumping (AF/yr)

County	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Total
Atascosa	1,012	0	4,299	0	58,331	249	249	16,993	81,135
Bexar	0	0	0	0	37,686	0	0	41,067	78,753
Caldwell	0	0	307	0	33,353	0	7,389	13,409	54,458
Dimmit	0	0	0	0	2,810	1,073	205	38	4,126
Frio	623	0	4,110	0	77,299	0	0	0	82,032
Gonzales	3,551	0	5,063	0	54,319	0	9,545	22,132	94,610
Guadalupe	0	0	0	0	16,851	0	8,218	22,723	47,792
Karnes	0	0	0	0	1,295	0	0	0	1,295
LaSalle	983	0	2	0	4,669	1,952	188	50	7,843
Maverick	0	0	0	0	143	136	259	1,004	1,543
McMullen	89	0	134	0	4,402	0	0	0	4,626
Medina	0	0	0	0	534	0	1,247	863	2,644
Uvalde	0	0	0	0	828	0	0	0	828
Webb	0	0	0	0	895	13	6	1	915
Wilson	156	0	944	0	38,639	125	121	62,434	102,417
Zavala	0	0	0	0	24,504	6,230	3,610	328	34,672
GMA13	6,415	0	14,859	0	356,554	9,777	31,036	181,039	599,702

Table 4. Scenario 9 Average Drawdown (ft) from 2011 to 2070

County	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Total
Atascosa	14	20	22	71	122	122	140	255	105
Bexar	0	0	0	12	141	73	64	227	155
Caldwell	0	0	9	26	134	130	56	85	82
Dimmit	-1	3	-4	-4	-3	-3	-6	-5	-4
Frio	4	4	-1	31	52	50	49	56	36
Gonzales	29	37	46	88	136	136	137	219	109
Guadalupe	0	0	-10	5	90	89	79	190	128
Karnes	28	45	57	103	145	146	185	393	138
LaSalle	8	10	13	22	29	30	9	2	15
Maverick	0	0	0	0	-7	-10	-10	-2	-6
McMullen	33	39	44	63	80	78	25	27	49
Medina	0	0	0	-1	26	27	29	31	29
Uvalde	0	0	0	0	1	4	11	26	17
Webb	-6	-4	-9	-4	-2	-1	-1	-3	-4
Wilson	10	20	23	74	135	137	210	528	172
Zavala	-6	-5	-12	-4	10	10	12	14	5
GMA13	12	16	12	33	55	54	54	102	48

3.2 Outcrop Area Saturated Thickness

Figure 1 presents the saturated thickness in 2011 of the outcrop area of the Carrizo Aquifer in 2011. Figure 2 presents the simulated saturated thickness of 2070 of the outcrop area of the Carrizo Aquifer in 2070 under Scenario.

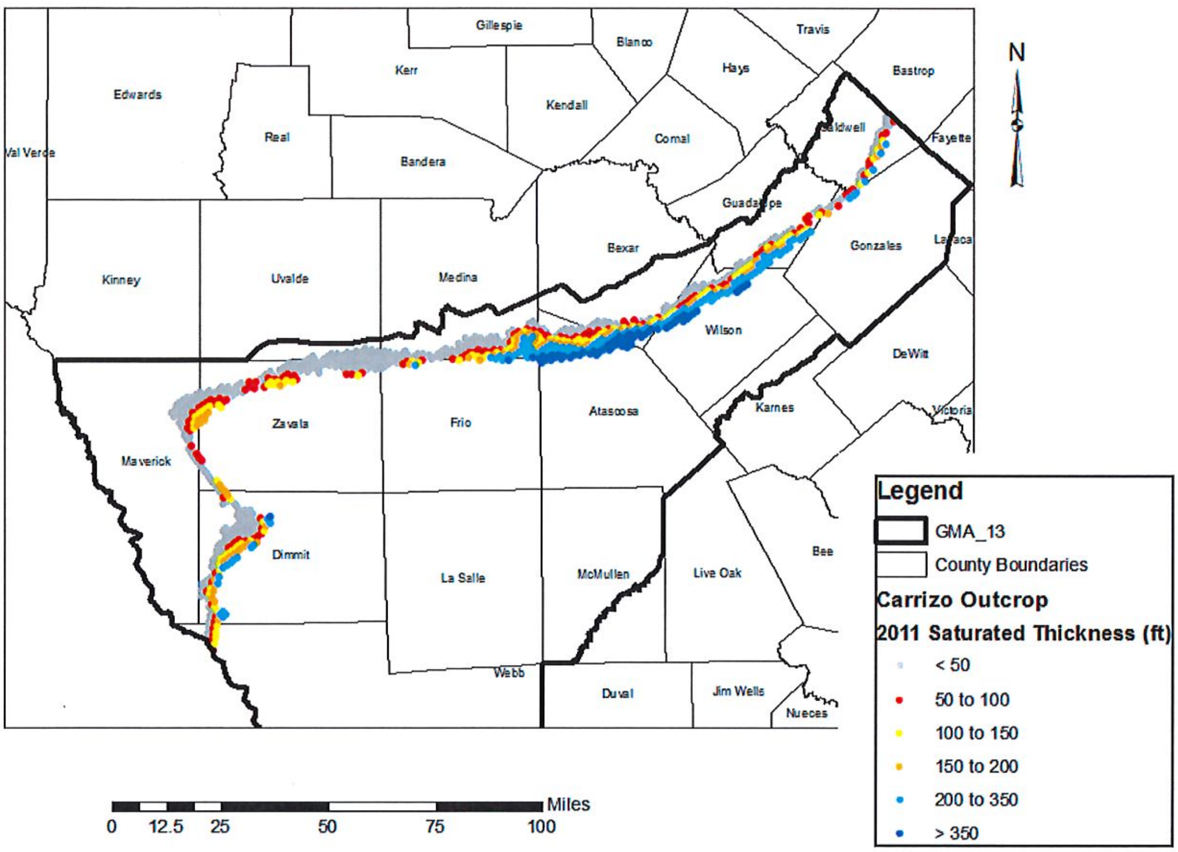

Figure 1. 2011 Saturated Thickness of the Outcrop Area of the Carrizo Aquifer

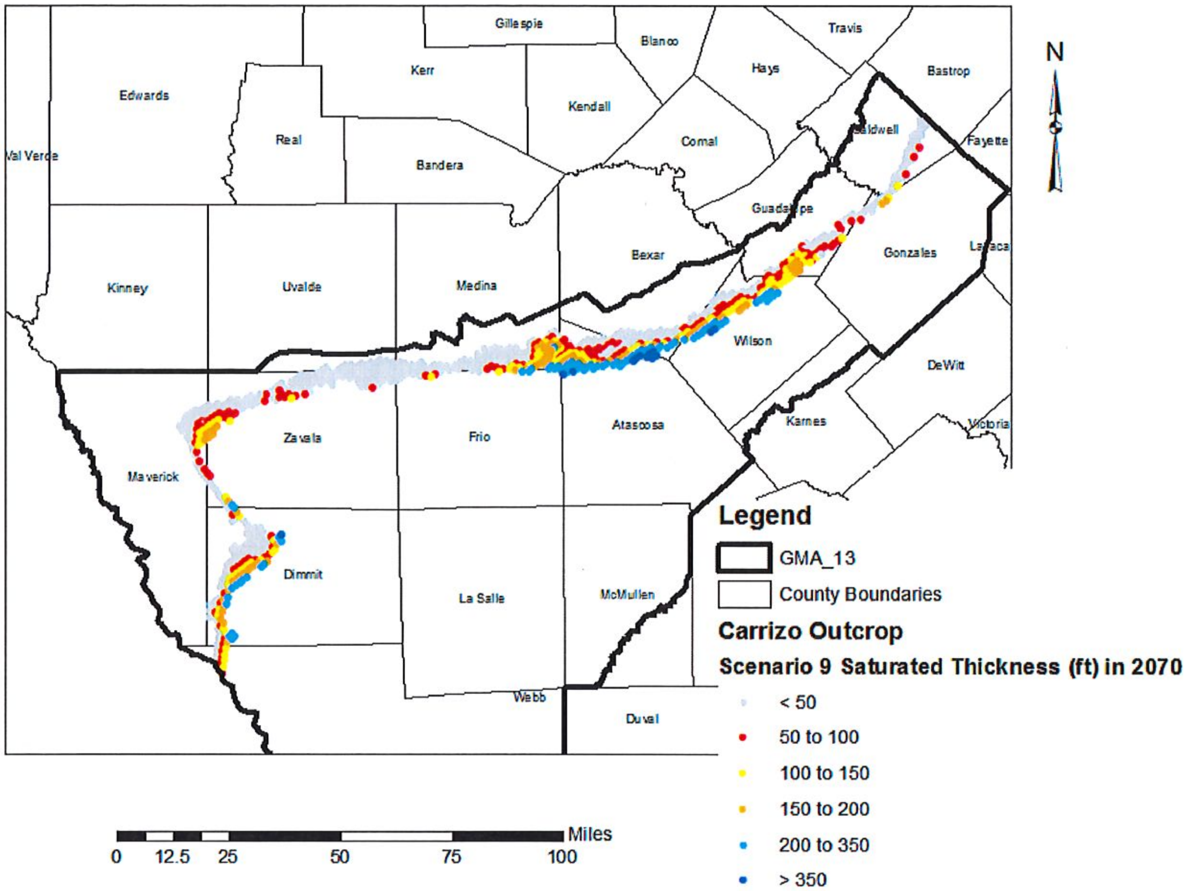

Figure 2. Simulated Saturated Thickness of the Outcrop Area of the Carrizo Aquifer in 2070 (Scenario 9)

Figure 3 presents the saturated thickness in 2011 of the outcrop area of the Wilcox Aquifer in 2011. Figure 4 presents the simulated saturated thickness of 2070 of the outcrop area of the Wilcox Aquifer in 2070 under Scenario 9.

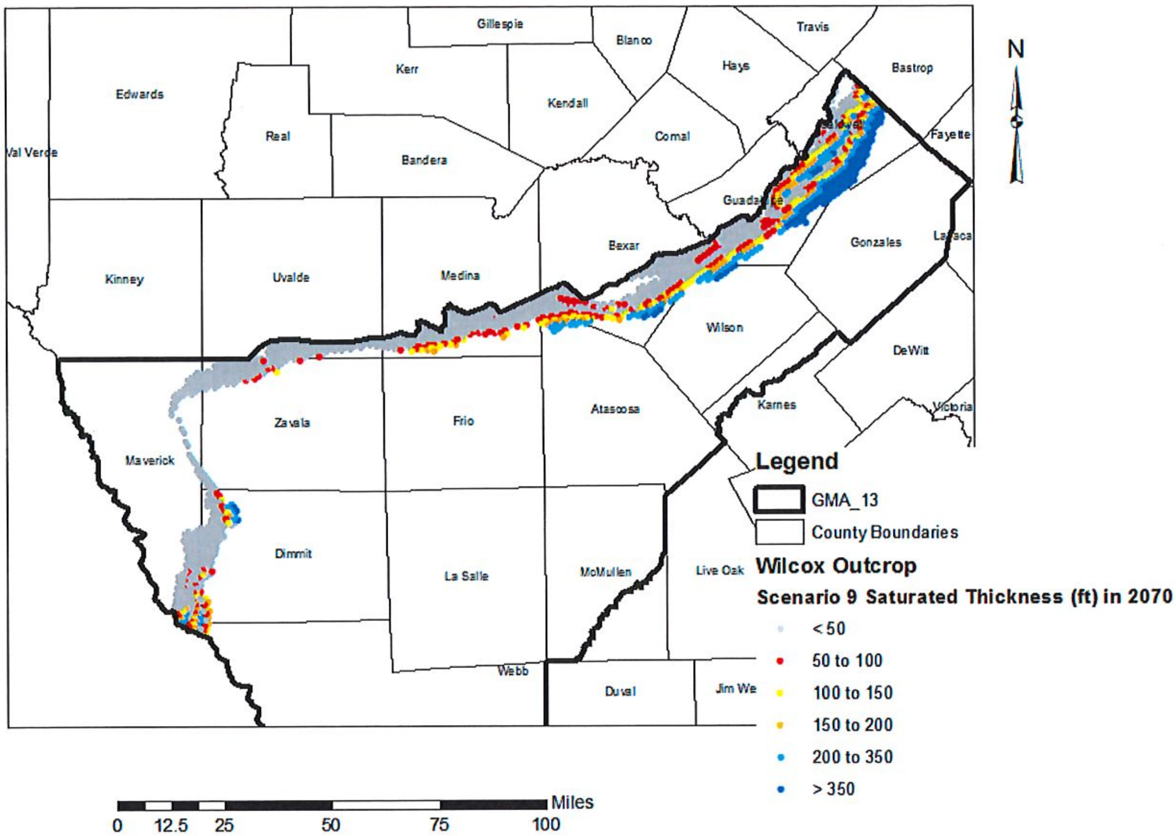

Figure 3. 2011 Saturated Thickness of the Outcrop Area of the Wilcox Aquifer

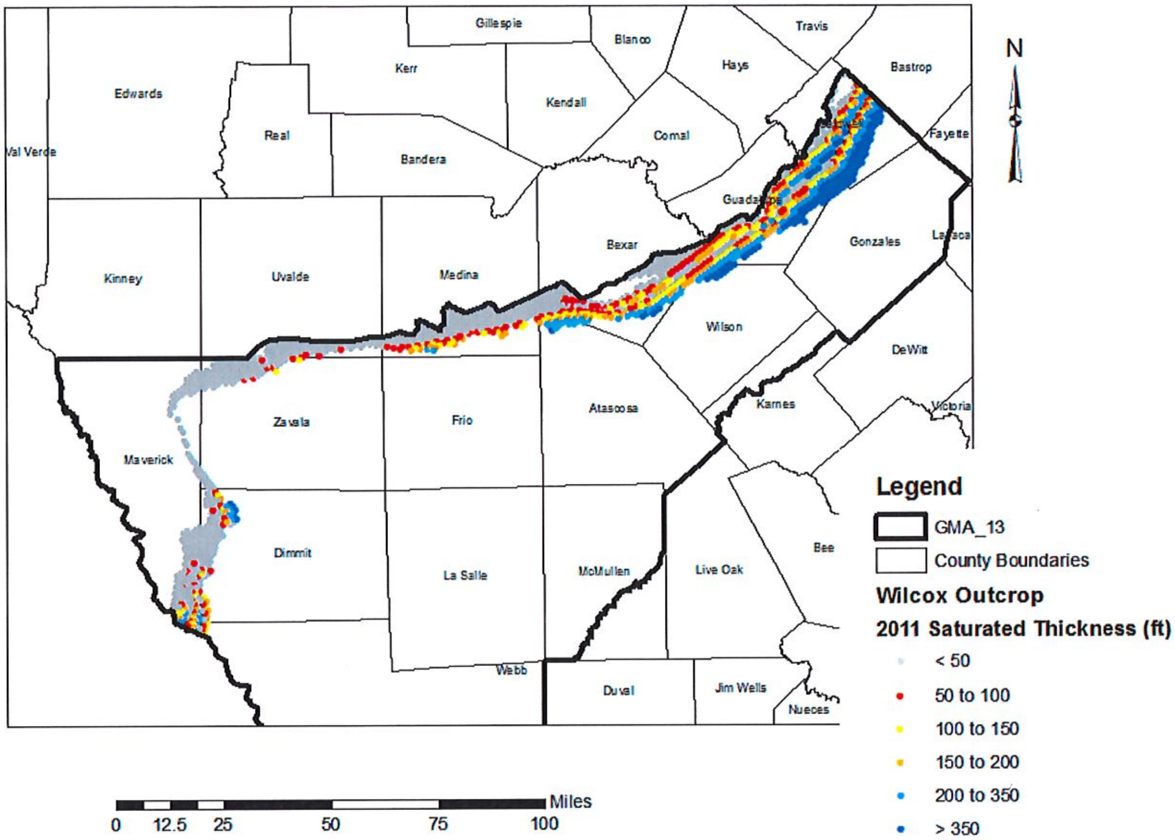

Figure 4. Simulated Saturated Thickness of the Outcrop Area of the Wilcox Aquifer in 2070 (Scenario 9)

3.3 Outcrop Area Classification

The outcrop area of the Carrizo and Wilcox aquifers was subdivided based on estimated 2011 saturated thickness. Table 5 summarizes the classification and the number of cells within each class.

Table 5. Summary of Outcrop Area Classification

Aquifer	2011 Saturated Thickness (ft)	Number of Model Cells in GMA 13
Carrizo	0 to 50	475
Carrizo	50 to 100	131
Carrizo	100 to 250	260
Carrizo	250 to 500	121
Carrizo	> 500	12
Wilcox	0 to 50	860
Wilcox	50 to 100	168
Wilcox	100 to 250	291
Wilcox	250 to 500	177
Wilcox	> 500	62

Model output was processed to calculate the saturated thickness in 2070 for each of these classes. The 2070 saturated thickness was then divided by the saturated thickness in 2011 (Table 5) and multiplied by 100 to develop an estimate of the saturated thickness remaining in 2070 as a percentage of the saturated thickness in 2011 for each class.

Table 6 presents the saturated thickness in 2070 for Scenario 9, and compares these results to Scenario 15 (a scenario where 2011 pumping is assumed from 2012 to 2070). Please note that in some western areas of GMA 13 (Dimmit, Maverick, Webb, and Zavala counties), Scenario 9 assumes pumping decreases that result in groundwater level recoveries. Thus, some of the results for saturated thickness in Scenario 9 are greater than in Scenario 15.

Table 6. Summary of Outcrop Saturated Thickness Remaining in 2070

		Scenario 9	Scenario 15
Outcrop Area of Carrizo Aquifer Saturated Thickness in 2070 (% of 2011 Saturated Thickness)	0 to 50 ft	116.59	131.76
	50 to 100 ft	72.80	80.87
	100 to 250 ft	66.03	78.92
	250 to 500 ft	61.31	77.27
	> 500 ft	65.25	84.09
Outcrop Area of Wilcox Aquifer Saturated Thickness in 2070 (% of 2011 Saturated Thickness)	0 to 50 ft	100.48	93.55
	50 to 100 ft	66.22	85.31
	100 to 250 ft	75.22	98.05
	250 to 500 ft	87.34	97.97
	> 500 ft	95.72	99.54

Please note that due to model limitations that have been documented in the Task 0 report and discussed by consultants for various stakeholders at previous GMA 13 meetings, the model predicts drawdown in the outcrop area that is not always consistent with actual data. Note that under Scenario 15, the model predicts that saturated thickness in 2070 would drop below 80 percent even if pumping remained at 2011 rates. This is not consistent with actual monitoring data, and highlights the limitations of the model.

Therefore, a desired future condition of maintaining 75 percent of saturated thickness in the outcrop areas under Scenario 9 is considered feasible despite model predictions to the contrary. Improvements in the monitoring program in the outcrop area is needed. Also, the upcoming model update needs to focus more attention on model calibration for the outcrop area. Presumably, this update will be completed and the model will be available when the next proposed DFC is due in 2021.

APPENDIX 5

GAM Run 10-017-027 MAG

GAM RUN 17-027 MAG:
MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, SPARTA, AND YEGUA-JACKSON AQUIFERS IN GROUNDWATER MANAGEMENT AREA 13

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October 27, 2017

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10/27/17

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GAM RUN 17-027 MAG:
MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, SPARTA, AND YEGUA-JACKSON AQUIFERS IN GROUNDWATER MANAGEMENT AREA 13

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October 27, 2017

EXECUTIVE SUMMARY:

The modeled available groundwater for Groundwater Management Area 13 for the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers is summarized by decade for the groundwater conservation districts (Tables 1 through 4 respectively) and for use in the regional water planning process (Tables 5 through 8 respectively). The modeled available groundwater estimates for the Carrizo-Wilcox Aquifer range from approximately 626,000 acre-feet per year in 2012 to approximately 589,000 acre-feet per year in 2070 (Table 1). The modeled available groundwater estimates for the Queen City Aquifer range from approximately 19,000 acre-feet per year in 2012 to approximately 15,000 acre-feet per year in 2070 (Table 2). The modeled available groundwater estimates for the Sparta Aquifer range from approximately 7,000 acre-feet per year in 2012 to approximately 6,000 acre-feet per year in 2070 (Table 3). The estimates were extracted from results of a model run using the groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers (version 2.01). The model run files, which meet the secondary desired future condition adopted by district representatives of Groundwater Management Area 13 for the Carrizo-Wilcox, Queen City, and Sparta Aquifers, were submitted to the Texas Water Development Board (TWDB) on February 28, 2017, as part of the Desired Future Conditions Explanatory Report for Groundwater Management Area 13. The modeled available groundwater estimates for the Yegua-Jackson Aquifer are approximately 7,000 acre-feet per year from 2010 to 2070 (Table 4). The estimates were extracted from results of a model run using the groundwater availability model for the

Yegua-Jackson Aquifer version 1.01. The model run files, which meet the desired future conditions adopted by district representatives of Groundwater Management Area 13 for the Yegua-Jackson Aquifer, were submitted to the TWDB on March 29, 2017 as supplemental information for the original February 28, 2017 submittal. The explanatory reports and other materials submitted to the TWDB were determined to be administratively complete on September 8, 2017.

REQUESTOR:

Mr. Greg Sengelmann, coordinator of Groundwater Management Area 13.

DESCRIPTION OF REQUEST:

In a letter dated February 24, 2017, Dr. William R. Hutchison, on behalf of Groundwater Management Area 13, provided the TWDB with the desired future conditions of the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers adopted by the groundwater conservation districts in Groundwater Management Area 13. The desired future conditions for the Carrizo-Wilcox, Queen City, and Sparta aquifers described in Resolution 16-01 from Groundwater Management Area 13, adopted November 21, 2016 are:

- *"The first proposed desired future condition for the Carrizo-Wilcox, Queen City and Sparta aquifers in Groundwater Management Area 13 is that 75 percent of the saturated thickness in the outcrop at the end of 2012 remains in 2070. This desired future condition is considered feasible despite model predictions to the contrary as detailed in GMA 13 Technical Memorandum 16-08", and*
- *"In addition, a secondary proposed desired future condition for the Carrizo-Wilcox, Queen City, and Sparta aquifers in Groundwater Management Area 13 is an average drawdown of 48 feet for all of GMA 13. The drawdown is calculated from the end of 2012 conditions to the year 2070. This desired future condition is consistent with Scenario 9 as detailed in GMA 13 Technical Memorandum 16-01 and GMA 13 Technical Memorandum 16-08."*

The desired future conditions for the Yegua-Jackson Aquifer described in Resolution 16-02 from Groundwater Management Area 13, adopted November 21, 2016 are:

- *"For Gonzales County, the average drawdown from 2010 to 2070 is 3 feet*
- *For Karnes County, the average drawdown from 2010 to 2070 is 1 foot*
- *For all other counties in GMA 13, the Yegua-Jackson is classified as not relevant for purposes of joint planning."*

TWDB staff reviewed the model files associated with the desired future conditions and received clarification on procedures and assumptions from the Groundwater Management Area 13 Technical Coordinator on April 4, 2017, and on September 21, 2017. Groundwater Management Area 13 adopted two desired future conditions for the Carrizo-Wilcox, Queen City, and Sparta Aquifers and they were not mutually compatible in the groundwater availability model. The technical coordinator for the groundwater management area confirmed that their intention was for the modeled available groundwater values to be based on the secondary desired future condition and Pumping Scenario 9 (Hutchison, 2017a). The first proposed desired future condition was not intended for the calculation of modeled available groundwater. Other questions included whether drawdown averages and modeled available groundwater values were based on official aquifer extent or model extent, whether to include dry cells in drawdown averaging, which stress periods to use for drawdown calculation, and whether to provide modeled available groundwater separately for the Carrizo-Wilcox, Queen City, and Sparta aquifers or as a combined value for all three aquifers .

In addition, TWDB staff requested and received supplemental model files for the Yegua-Jackson Aquifer on March 29, 2017, and supplemental documentation (Hutchison, 2017d) related to initial conditions for modeling the Carrizo-Wilcox, Queen City, and Sparta aquifers from Dr. William R. Hutchison on August 25, 2017, on behalf of Groundwater Management Area 13. All clarifications are included in the Parameters and Assumptions Section of this report.

METHODS:

The groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers (Figures 1 through 4) was run using the model files submitted with the explanatory reports (Hutchison, 2017c). Model-calculated drawdowns were extracted for the year 2070. An overall drawdown average was calculated for the entire Groundwater Management Area 13 using all aquifer layers in the average. Based on clarifications, the reference year for drawdown calculations was the end of 2011 (or the beginning of 2012). As specified in the clarifications, drawdowns for cells that became dry during the simulation (water level dropped below the base of the cell) were excluded from the averaging. The calculated drawdown average was compared with the desired future condition of 48 feet to verify that the pumping scenario (Hutchison, 2017a) achieved the desired future conditions within one foot.

The groundwater availability model for the Yegua-Jackson Aquifer (Figures 5 and 6) was run using the model files submitted on March 29, 2017, as supplemental information and drawdowns were calculated for the year 2070. County-wide average drawdowns were calculated for Gonzales and Karnes counties within Groundwater Management Area 13 using all model layers in the average. Based on clarifications, the reference year for drawdown calculation was the end of 2009 (or the beginning of 2010). As specified in the clarifications, drawdowns for cells that became dry during the simulation (water level dropped below the base of the cell) were excluded from the averaging. The calculated drawdown averages were compared with the desired future conditions for Gonzales and Karnes counties to verify that the pumping scenario (Hutchison, 2017b) achieved the desired future conditions within one foot.

The modeled available groundwater values were determined by extracting pumping rates by decade from the model results using ZONEBUDGET Version 3.01 (Harbaugh, 2009). Annual pumping rates by aquifer are presented by county and groundwater conservation district, subtotaled by groundwater conservation district, and then summed for Groundwater Management Area 13 (Tables 1 through 4). Annual pumping rates by aquifer are also presented by county, river basin, and regional water planning area within Groundwater Management Area 13 (Tables 5 through 8). Additional tables are provided in Appendix A which summarize the total modeled available groundwater for the Carrizo-Wilcox, Queen City, and Sparta aquifers by regional water planning area, county, river basin, and groundwater conservation district. Tables are provided in Appendix B which split the Carrizo-Wilcox, Queen City, and Sparta aquifers modeled pumping by model layer for each groundwater conservation district.

Modeled Available Groundwater and Permitting

As defined in Chapter 36 of the Texas Water Code (2011), "modeled available groundwater" is the estimated average amount of water that may be produced annually to achieve a desired future condition. Groundwater conservation districts are required to consider modeled available groundwater, along with several other factors, when issuing permits in order to manage groundwater production to achieve the desired future condition(s). The other factors districts must consider include annual precipitation and production patterns, the estimated amount of pumping exempt from permitting, existing permits, and a reasonable estimate of actual groundwater production under existing permits.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the modeled available groundwater estimates are described below:

Carrizo-Wilcox, Queen City, and Sparta aquifers

- We used Version 2.01 of the groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers. See Deeds and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers.
- This groundwater availability model includes eight layers, which generally represent the Sparta Aquifer (Layer 1), the Weches Confining Unit (Layer 2), the Queen City Aquifer (Layer 3), the Reklaw Confining Unit (Layer 4), the Carrizo (Layer 5), the Upper Wilcox (Layer 6), the Middle Wilcox (Layer 7), and the Lower Wilcox (Layer 8). Parts of the Upper Wilcox do not exist in Groundwater Management Area 13 and the official extent of the Queen City and Sparta aquifers end around the Frio River. Layers represent equivalent geologic units outside of the official aquifer extents.
- The model was run with MODFLOW-96 (Harbaugh and others, 1996).
- The end of the calibration period was extended from 1999 to 2011 (Hutchison, 2017e) and the reference year for drawdown calculations was the end of 2011.
- Drawdown averages and modeled available groundwater values were based on the extent of the model area rather than the official aquifer boundaries.
- Drawdowns for cells where water levels dropped below the base elevation of the cell causing the cell to become inactive (dry cells) were excluded from the averaging.
- A tolerance of one foot was assumed when comparing desired future conditions (Table 1, average drawdown values per county) to model drawdown results.
- Estimates of modeled available groundwater from the model simulation were rounded to whole numbers.
- Although the desired future condition for the Carrizo-Wilcox, Queen City, and Sparta aquifers is a combined value for all three aquifers, the modeled available groundwater values will be provided individually for each aquifer per clarification from the Groundwater Management Area 13 Technical Coordinator on September 21, 2017.

Yegua-Jackson Aquifer

- We used version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer. See Deeds and others (2010) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes five layers which represent the outcrop of the Yegua-Jackson Aquifer and younger overlying units—the Catahoula Formation (Layer 1), the upper portion of the Jackson Group (Layer 2), the lower portion of the Jackson Group (Layer 3), the upper portion of the Yegua Group (Layer 4), and the lower portion of the Yegua Group (Layer 5).
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).
- The end of the calibration period was extended from 1997 to 2009 (Oliver, 2010) and the reference year for drawdown calculations was the end of 2009.
- Drawdown averages and modeled available groundwater values were based on the extent of the model area rather than the official aquifer boundaries.
- Drawdown for cells where water levels dropped below the base elevation of the cell causing the cell to become inactive (dry cells) were excluded from the averaging.
- A tolerance of one foot was assumed when comparing desired future conditions (Table 1, average drawdown values per county) to model drawdown results.
- Estimates of modeled available groundwater from the model simulation were rounded to whole numbers.

RESULTS:

The modeled available groundwater estimates for the Carrizo-Wilcox Aquifer range from approximately 626,000 acre-feet per year in 2012 to approximately 589,000 acre-feet per year in 2070 (Table 1). The modeled available groundwater estimates for the Queen City Aquifer range from approximately 19,000 acre-feet per year in 2012 to approximately 15,000 acre-feet per year in 2070 (Table 2). The modeled available groundwater estimate for the Sparta Aquifer ranges from approximately 7,000 acre-feet per year in 2012 to approximately 6,000 acre-feet per year in 2070 (Table 3). The modeled available groundwater is summarized by groundwater conservation district and county for the Carrizo-Wilcox, Queen City, and Sparta aquifers (Tables 1, 2, and 3 respectively). The modeled available groundwater has also been summarized by county, river basin, and regional water planning area for use in the regional water planning process for the Carrizo-Wilcox, Queen City, and Sparta aquifers (Tables 5, 6, and 7 respectively). Small differences in values between table summaries are due to rounding. Additional tables are provided in Appendix A which summarize the total modeled available groundwater for all three aquifers by regional water planning area, county, river basin, and groundwater conservation district. Tables are provided in Appendix B which split the modeled pumping by each model aquifer layer for each groundwater conservation district.

The modeled available groundwater estimate for the Yegua-Jackson Aquifer is approximately 7,000 acre-feet per year from 2010 to 2070 (Table 4). The modeled available groundwater for the Yegua-Jackson Aquifer is summarized by groundwater conservation district and county (Table 4) and by county, river basin, and regional water planning area for use in the regional water planning process (Table 8). Small differences of values between table summaries are due to rounding.

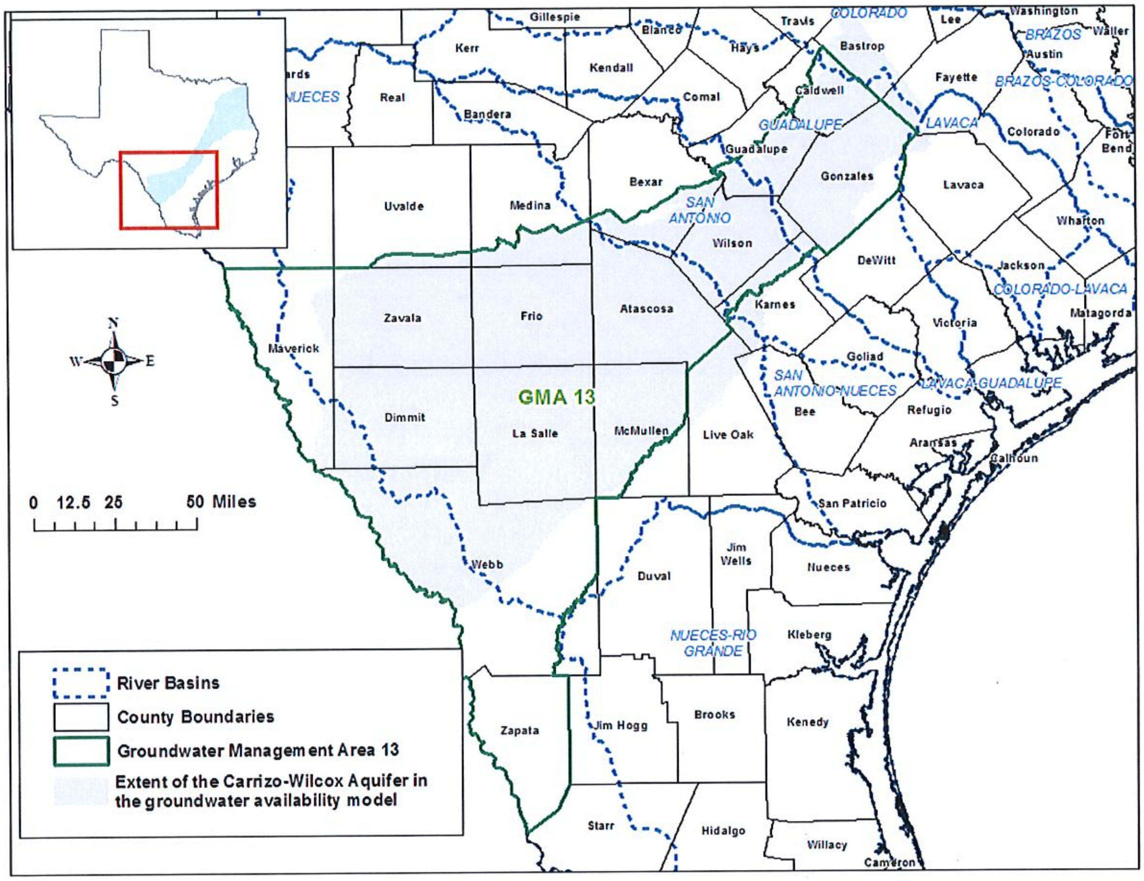

FIGURE 1. GROUNDWATER MANAGEMENT AREA (GMA) 13 BOUNDARY, RIVER BASINS, AND COUNTIES OVERLAIN ON THE EXTENT OF THE CARRIZO-WILCOX AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE SOUTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.

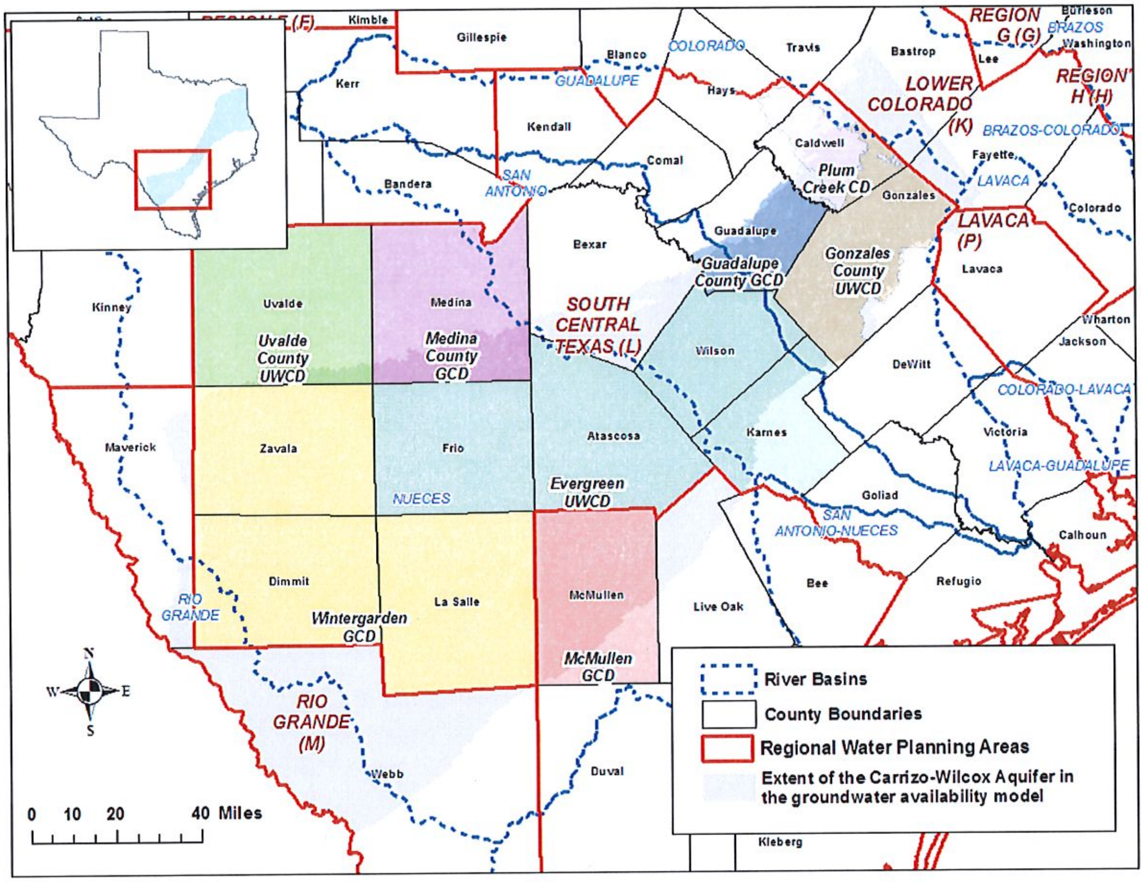

FIGURE 2. **REGIONAL WATER PLANNING AREAS (RWPAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE CARRIZO-WILCOX AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE SOUTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.**

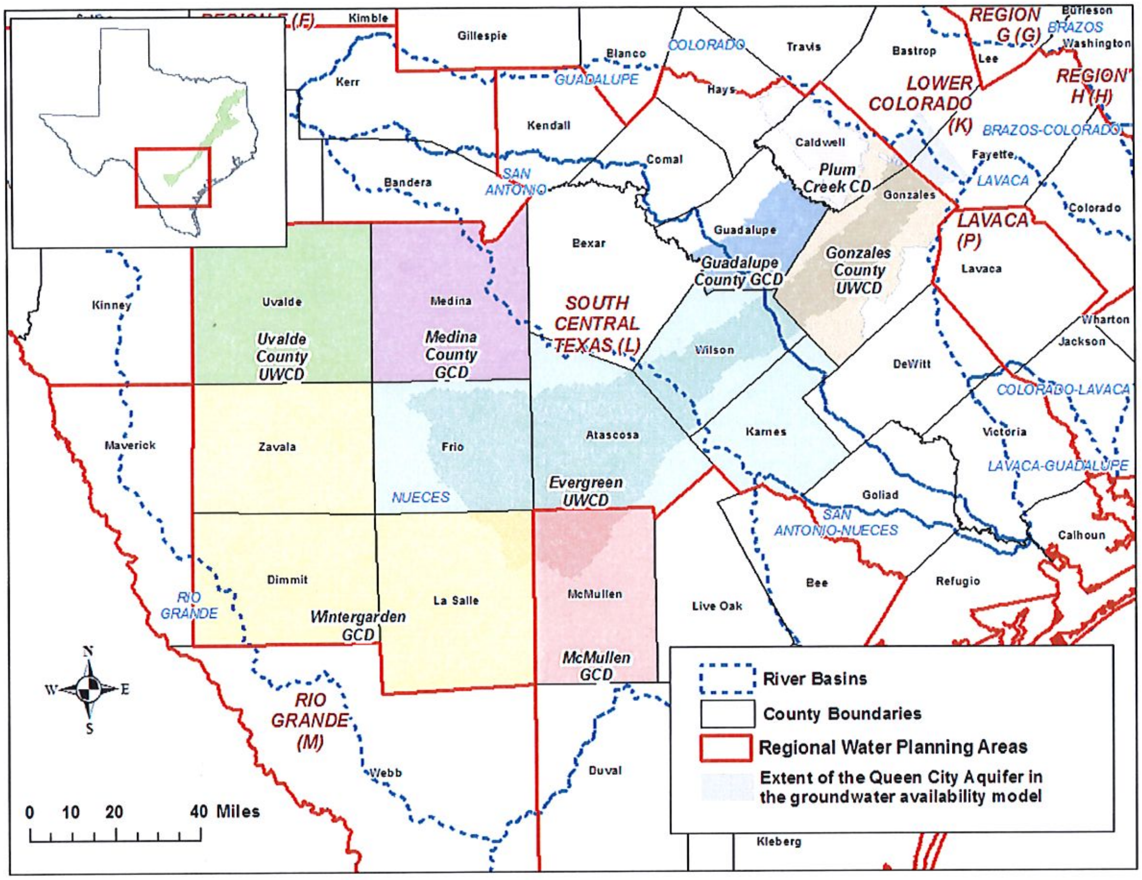

FIGURE 3. **REGIONAL WATER PLANNING AREAS (RWPAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE QUEEN CITY AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE SOUTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.**

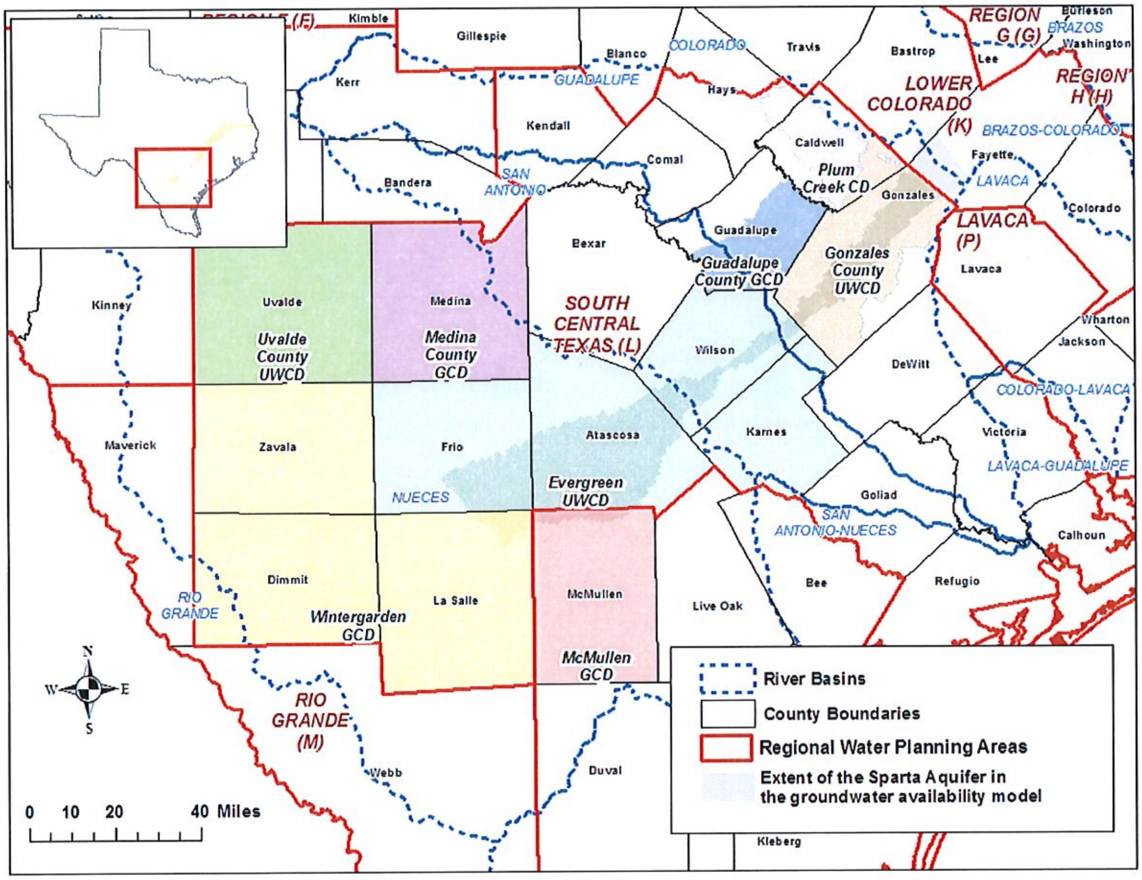

FIGURE 4. **REGIONAL WATER PLANNING AREAS (RWPAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE SPARTA AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL FOR THE SOUTHERN PORTION OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS.**

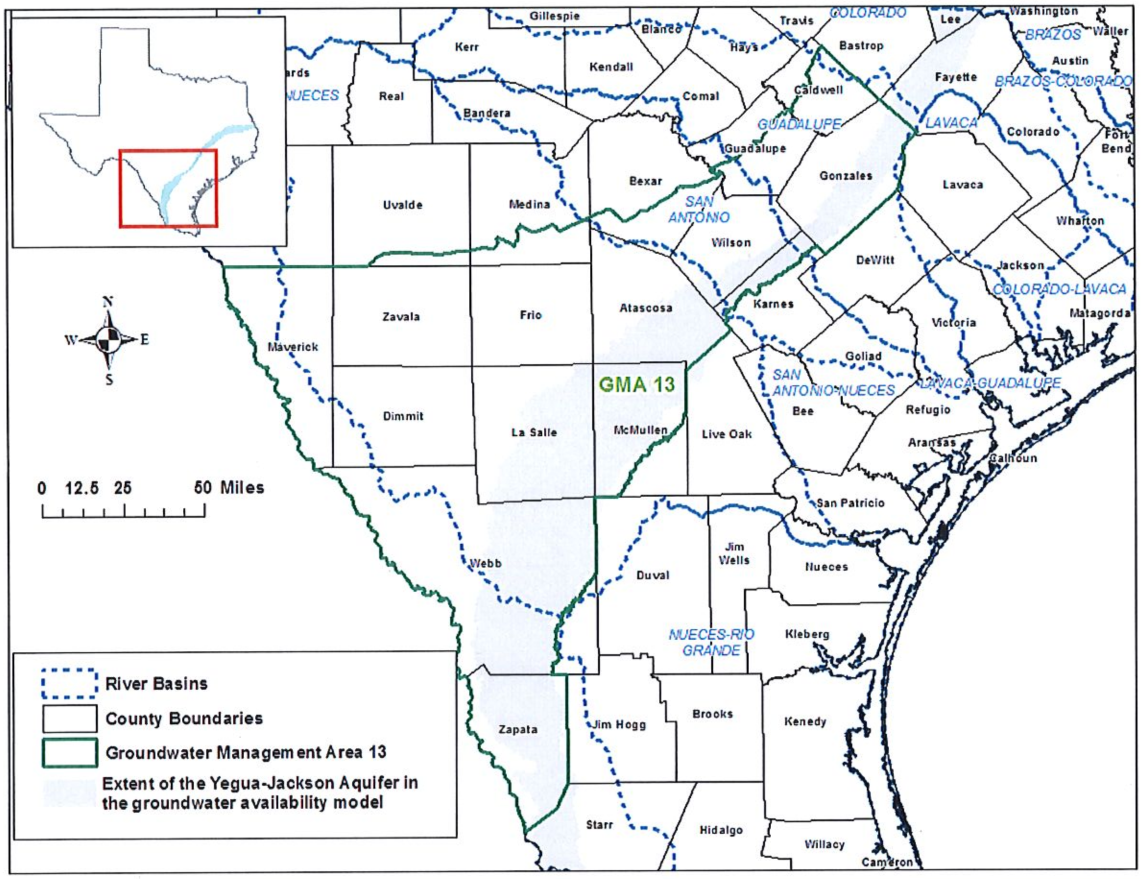

FIGURE 5. **GROUNDWATER MANAGEMENT AREA (GMA) 13 BOUNDARY, RIVER BASINS, AND COUNTIES OVERLAIN ON THE EXTENT OF THE YEGUA-JACKSON AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL.**

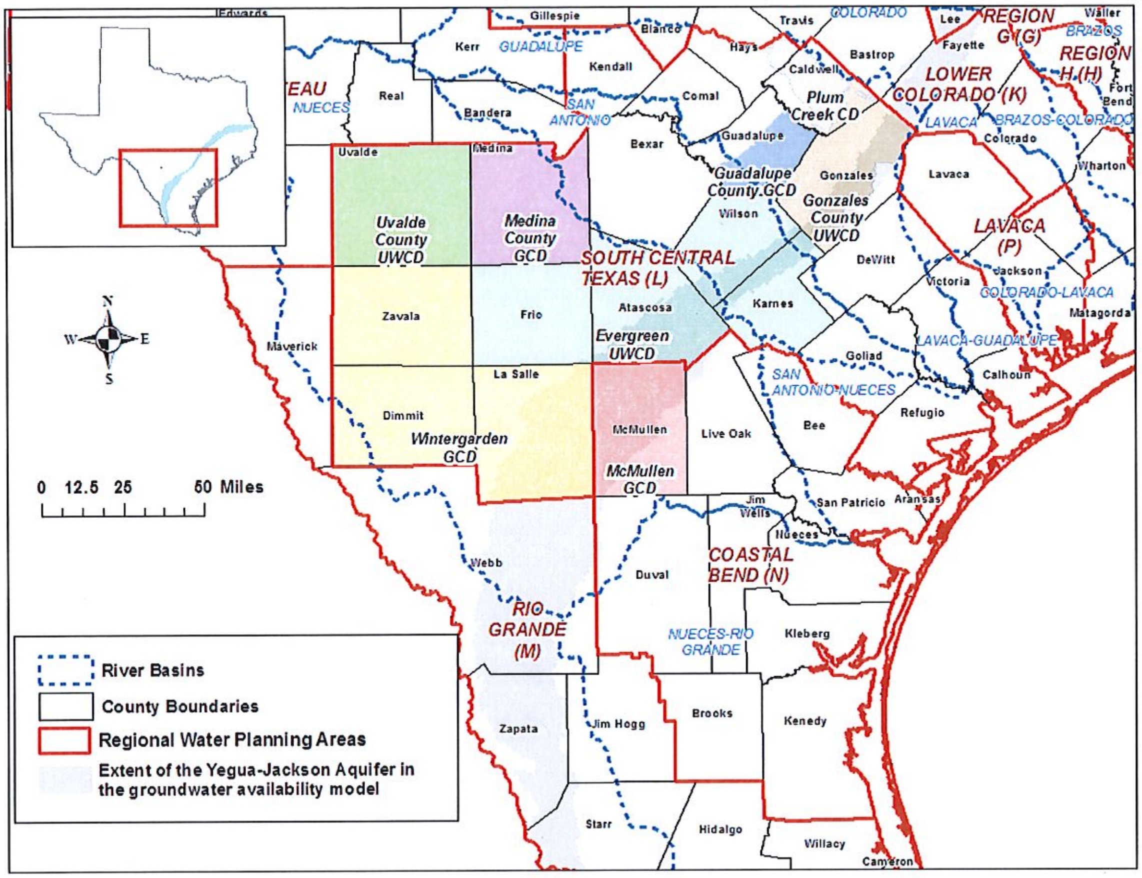

FIGURE 6. **REGIONAL WATER PLANNING AREAS (RWPAS), RIVER BASINS, GROUNDWATER CONSERVATION DISTRICTS (GCDS), AND COUNTIES OVERLAIN ON THE EXTENT OF THE YEGUA-JACKSON AQUIFER IN THE GROUNDWATER AVAILABILITY MODEL.**

TABLE 1. MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX AQUIFER IN GROUNDWATER MANAGEMENT AREA 13 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2012 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2012	2020	2030	2040	2050	2060	2070
Evergreen UWCD	Atascosa	Carrizo-Wilcox	67,668	67,668	70,286	71,066	72,718	74,298	75,874
Evergreen UWCD	Frio	Carrizo-Wilcox	111,920	111,920	85,036	82,999	81,083	79,197	77,353
Evergreen UWCD	Karnes	Carrizo-Wilcox	1,042	1,042	1,085	1,146	1,212	1,264	1,296
Evergreen UWCD	Wilson	Carrizo-Wilcox	108,465	108,465	104,918	106,196	107,653	109,358	111,093
Evergreen UWCD Total		**Carrizo-Wilcox**	**289,096**	**289,096**	**261,325**	**261,406**	**262,666**	**264,116**	**265,616**
Gonzales County UWCD	Caldwell	Carrizo-Wilcox	39,713	39,713	39,713	36,678	36,678	33,643	33,643
Gonzales County UWCD	Gonzales	Carrizo-Wilcox	81,594	81,594	81,594	85,371	85,735	85,987	85,996
Gonzales County UWCD Total		**Carrizo-Wilcox**	**121,307**	**121,307**	**121,307**	**122,049**	**122,413**	**119,630**	**119,638**
Guadalupe County GCD	**Guadalupe**	**Carrizo-Wilcox**	**48,032**	**52,528**	**47,844**	**45,776**	**47,995**	**47,965**	**47,833**
McMullen GCD	**McMullen**	**Carrizo-Wilcox**	**7,002**	**7,056**	**7,056**	**4,405**	**4,405**	**4,405**	**4,405**
Medina County GCD	**Medina**	**Carrizo-Wilcox**	**2,657**	**2,657**	**2,648**	**2,647**	**2,647**	**2,646**	**2,646**
Plum Creek CD	**Caldwell**	**Carrizo-Wilcox**	**21,073**	**20,610**	**20,610**	**20,202**	**20,202**	**19,625**	**19,625**
Uvalde County UWCD	**Uvalde**	**Carrizo-Wilcox**	**4,451**	**2,975**	**1,231**	**828**	**828**	**828**	**828**

Groundwater Conservation District	County	Aquifer	2012	2020	2030	2040	2050	2060	2070
Wintergarden GCD	Dimmit	Carrizo-Wilcox	4,129	4,129	4,129	4,129	4,129	4,129	4,129
Wintergarden GCD	La Salle	Carrizo-Wilcox	6,863	6,863	6,863	6,863	6,863	6,863	6,863
Wintergarden GCD	Zavala	Carrizo-Wilcox	35,653	35,653	35,305	35,171	35,071	34,750	34,695
Wintergarden GCD Total		**Carrizo-Wilcox**	**46,645**	**46,645**	**46,297**	**46,163**	**46,063**	**45,742**	**45,687**
No District-County	Bexar	Carrizo-Wilcox	81,992	81,474	80,817	80,348	79,470	78,977	78,807
No District-County	Caldwell	Carrizo-Wilcox	921	921	921	921	921	921	921
No District-County	Gonzales	Carrizo-Wilcox	59	59	59	59	59	59	59
No District-County	Maverick	Carrizo-Wilcox	2,203	2,042	2,042	2,001	1,914	1,570	1,531
No District-County	Webb	Carrizo-Wilcox	916	916	916	916	916	916	916
No District-County Total		**Carrizo-Wilcox**	**86,091**	**85,412**	**84,755**	**84,245**	**83,280**	**82,443**	**82,235**
Total for GMA 13		**Carrizo-Wilcox**	**626,354**	**628,284**	**593,072**	**587,722**	**590,498**	**587,400**	**588,514**

TABLE 2. MODELED AVAILABLE GROUNDWATER FOR THE QUEEN CITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 13 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2012 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2012	2020	2030	2040	2050	2060	2070
Evergreen UWCD	Atascosa	Queen City	4,075	4,075	4,543	4,543	4,513	4,407	4,302
Evergreen UWCD	Frio	Queen City	6,759	6,759	4,745	4,573	4,429	4,257	4,113
Evergreen UWCD	Wilson	Queen City	2,780	2,780	1,508	1,339	1,191	1,059	945
Evergreen UWCD Total		**Queen City**	**13,614**	**13,614**	**10,797**	**10,455**	**10,133**	**9,723**	**9,359**
Gonzales County UWCD	**Caldwell**	**Queen City**	284	284	284	284	284	284	284
Gonzales County UWCD	**Gonzales**	**Queen City**	5,067	5,067	5,067	5,067	5,067	5,067	5,067
Gonzales County UWCD Total		**Queen City**	**5,351**	**5,351**	**5,351**	**5,351**	**5,351**	**5,351**	**5,351**
Guadalupe County GCD	**Guadalupe**	**Queen City**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
McMullen GCD	**McMullen**	**Queen City**	**134**	**134**	**134**	**134**	**134**	**134**	**134**
Plum Creek CD	**Caldwell**	**Queen City**	**22**	**22**	**22**	**22**	**22**	**22**	**22**
Wintergarden GCD	**La Salle**	**Queen City**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
Total for GMA 13		**Queen City**	**19,123**	**19,123**	**16,307**	**15,965**	**15,643**	**15,233**	**14,869**

TABLE 3. MODELED AVAILABLE GROUNDWATER FOR THE SPARTA AQUIFER IN GROUNDWATER MANAGEMENT AREA 13 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2012 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2012	2020	2030	2040	2050	2060	2070
Evergreen UWCD	Atascosa	Sparta	1,219	1,215	1,188	1,129	1,083	1,044	1,013
Evergreen UWCD	Frio	Sparta	1,045	1,045	728	702	674	651	624
Evergreen UWCD	Wilson	Sparta	462	462	251	224	198	176	156
Evergreen UWCD Total		**Sparta**	**2,726**	**2,723**	**2,166**	**2,056**	**1,955**	**1,870**	**1,792**
Gonzales County UWCD	**Gonzales**	**Sparta**	**3,554**	**3,554**	**3,554**	**3,554**	**3,554**	**3,554**	**3,554**
McMullen GCD	**McMullen**	**Sparta**	**89**	**89**	**89**	**89**	**89**	**89**	**89**
Wintergarden GCD	**La Salle**	**Sparta**	**983**	**983**	**983**	**983**	**983**	**983**	**983**
Total for GMA 13		**Sparta**	**7,353**	**7,349**	**6,793**	**6,682**	**6,582**	**6,497**	**6,419**

TABLE 4. MODELED AVAILABLE GROUNDWATER FOR THE YEGUA-JACKSON AQUIFER IN GROUNDWATER MANAGEMENT AREA 13 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD) AND COUNTY FOR EACH DECADE BETWEEN 2010 AND 2070. VALUES ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	County	Aquifer	2010	2020	2030	2040	2050	2060	2070
Evergreen UWCD	Karnes	Yegua-Jackson	2,059	2,059	2,059	2,059	2,059	2,059	2,059
Gonzales County UWCD	Gonzales	Yegua-Jackson	4,140	4,140	4,140	4,140	4,140	4,140	4,140
No District-County	Gonzales	Yegua-Jackson	573	573	573	573	573	573	573
Total for GMA 13		**Yegua-Jackson**	**6,771**	**6,771**	**6,771**	**6,771**	**6,771**	**6,771**	**6,771**

TABLE 5. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE CARRIZO-WILCOX AQUIFER IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Atascosa	L	Nueces	Carrizo-Wilcox	67,548	70,166	70,946	72,598	74,178	75,754
Atascosa	L	San Antonio	Carrizo-Wilcox	120	120	120	120	120	120
Bexar	L	Nueces	Carrizo-Wilcox	48,152	48,152	48,152	48,152	48,152	48,176
Bexar	L	San Antonio	Carrizo-Wilcox	33,322	32,665	32,196	31,318	30,825	30,631
Caldwell	L	Colorado	Carrizo-Wilcox	593	593	593	593	593	593
Caldwell	L	Guadalupe	Carrizo-Wilcox	60,652	60,652	57,208	57,208	53,596	53,596
Dimmit	L	Nueces	Carrizo-Wilcox	4,022	4,022	4,022	4,022	4,022	4,022
Dimmit	L	Rio Grande	Carrizo-Wilcox	107	107	107	107	107	107
Frio	L	Nueces	Carrizo-Wilcox	111,920	85,036	82,999	81,083	79,197	77,353
Gonzales	L	Guadalupe	Carrizo-Wilcox	81,438	81,438	85,216	85,579	85,832	85,840
Gonzales	L	Lavaca	Carrizo-Wilcox	215	215	215	215	215	215
Guadalupe	L	Guadalupe	Carrizo-Wilcox	36,180	32,150	29,767	31,569	31,793	31,744
Guadalupe	L	San Antonio	Carrizo-Wilcox	16,347	15,693	16,008	16,426	16,172	16,089
Karnes	L	Guadalupe	Carrizo-Wilcox	177	185	195	207	215	220
Karnes	L	Nueces	Carrizo-Wilcox	83	87	92	97	101	103
Karnes	L	San Antonio	Carrizo-Wilcox	783	813	859	909	948	972
La Salle	L	Nueces	Carrizo-Wilcox	6,863	6,863	6,863	6,863	6,863	6,863
Medina	L	Nueces	Carrizo-Wilcox	2,652	2,643	2,643	2,642	2,641	2,641
Medina	L	San Antonio	Carrizo-Wilcox	5	5	5	5	5	5
Uvalde	L	Nueces	Carrizo-Wilcox	2,975	1,231	828	828	828	828
Wilson	L	Guadalupe	Carrizo-Wilcox	20,287	20,186	20,340	20,452	20,783	20,923

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Wilson	L	Nueces	Carrizo-Wilcox	7,652	7,154	7,317	7,510	7,709	7,938
Wilson	L	San Antonio	Carrizo-Wilcox	80,526	77,577	78,538	79,691	80,865	82,232
Zavala	L	Nueces	Carrizo-Wilcox	35,653	35,305	35,171	35,071	34,750	34,695
Maverick	M	Nueces	Carrizo-Wilcox	777	777	777	777	472	472
Maverick	M	Rio Grande	Carrizo-Wilcox	1,265	1,265	1,224	1,137	1,097	1,059
Webb	M	Nueces	Carrizo-Wilcox	92	92	92	92	92	92
Webb	M	Rio Grande	Carrizo-Wilcox	824	824	824	824	824	824
McMullen	N	Nueces	Carrizo-Wilcox	7,056	7,056	4,405	4,405	4,405	4,405
GMA 13 Total			**Carrizo-Wilcox**	**628,284**	**593,072**	**587,722**	**590,498**	**587,400**	**588,514**

TABLE 6. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE QUEEN CITY AQUIFER IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Atascosa	L	Nueces	Queen City	4,075	4,543	4,543	4,513	4,407	4,302
Caldwell	L	Guadalupe	Queen City	307	307	307	307	307	307
Frio	L	Nueces	Queen City	6,759	4,745	4,573	4,429	4,257	4,113
Gonzales	L	Guadalupe	Queen City	5,032	5,032	5,032	5,032	5,032	5,032
Gonzales	L	Lavaca	Queen City	35	35	35	35	35	35
Guadalupe	L	Guadalupe	Queen City	0	0	0	0	0	0
La Salle	L	Nueces	Queen City	2	2	2	2	2	2
Wilson	L	Guadalupe	Queen City	236	128	114	101	90	80
Wilson	L	Nueces	Queen City	273	148	132	117	104	93
Wilson	L	San Antonio	Queen City	2,271	1,232	1,094	973	865	772
McMullen	N	Nueces	Queen City	134	134	134	134	134	134
GMA 13 Total			**Queen City**	**19,123**	**16,307**	**15,965**	**15,643**	**15,233**	**14,869**

TABLE 7. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE SPARTA AQUIFER IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Atascosa	L	Nueces	Sparta	1,215	1,188	1,129	1,083	1,044	1,013
Frio	L	Nueces	Sparta	1,045	728	702	674	651	624
Gonzales	L	Guadalupe	Sparta	3,531	3,531	3,531	3,531	3,531	3,531
Gonzales	L	Lavaca	Sparta	23	23	23	23	23	23
La Salle	L	Nueces	Sparta	983	983	983	983	983	983
Wilson	L	Guadalupe	Sparta	42	23	20	18	16	14
Wilson	L	Nueces	Sparta	102	55	49	44	39	34
Wilson	L	San Antonio	Sparta	319	173	154	137	121	108
McMullen	N	Nueces	Sparta	89	89	89	89	89	89
GMA 13 Total			**Sparta**	**7,349**	**6,793**	**6,682**	**6,582**	**6,497**	**6,419**

TABLE 8. MODELED AVAILABLE GROUNDWATER BY DECADE FOR THE YEGUA-JACKSON AQUIFER IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR AND ARE SUMMARIZED BY COUNTY, REGIONAL WATER PLANNING AREA (RWPA), RIVER BASIN, AND AQUIFER.

County	RWPA	River Basin	Aquifer	2020	2030	2040	2050	2060	2070
Atascosa	L	Nueces	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Frio	L	Nueces	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Gonzales	L	Guadalupe	Yegua-Jackson	4,694	4,694	4,694	4,694	4,694	4,694
Gonzales	L	Lavaca	Yegua-Jackson	19	19	19	19	19	19
Karnes	L	Guadalupe	Yegua-Jackson	327	327	327	327	327	327
Karnes	L	Nueces	Yegua-Jackson	91	91	91	91	91	91
Karnes	L	San Antonio	Yegua-Jackson	1,641	1,641	1,641	1,641	1,641	1,641
La Salle	L	Nueces	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Wilson	L	Guadalupe	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Wilson	L	Nueces	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Wilson	L	San Antonio	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Webb	M	Nueces	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Webb	M	Rio Grande	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
Zapata	M	Rio Grande	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
McMullen	N	Nueces	Yegua-Jackson	NULL	NULL	NULL	NULL	NULL	NULL
GMA 13 Total			**Yegua-Jackson**	**6,771**	**6,771**	**6,771**	**6,771**	**6,771**	**6,771**

NULL: Groundwater Management Area 13 declared the Yegua-Jackson Aquifer not relevant in these areas.

LIMITATIONS:

The groundwater model used in completing this analysis is the best available scientific tool that can be used to meet the stated objectives. To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

> "Models will always be constrained by computational limitations, assumptions, and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions. Scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or to prove that a given model is correct in all respects for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."

A key aspect of using the groundwater model to evaluate historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historic pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and streamflow are specific to a particular historic time period.

Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor groundwater pumping and groundwater levels in the aquifer. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine this analysis in the future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

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Appendix A

Modeled Available Groundwater for the Carrizo-Wilcox, Queen City, and Sparta Aquifers Summarized by County, River Basin, Regional Water Planning Area, and Groundwater Conservation District in Groundwater Management Area 13

TABLE A.1 MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS SUMMARIZED BY COUNTY IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR.

County	2020	2030	2040	2050	2060	2070
Atascosa	72,959	76,017	76,739	78,315	79,749	81,189
Bexar	81,474	80,817	80,348	79,470	78,977	78,807
Caldwell	61,551	61,551	58,108	58,108	54,495	54,495
Dimmit	4,129	4,129	4,129	4,129	4,129	4,129
Frio	119,724	90,509	88,274	86,185	84,104	82,089
Gonzales	90,273	90,273	94,051	94,415	94,667	94,675
Guadalupe	52,528	47,844	45,776	47,995	47,965	47,833
Karnes	1,042	1,085	1,146	1,212	1,264	1,296
La Salle	7,848	7,848	7,848	7,848	7,848	7,848
Maverick	2,042	2,042	2,001	1,914	1,570	1,531
McMullen	7,279	7,279	4,629	4,629	4,629	4,629
Medina	2,657	2,648	2,647	2,647	2,646	2,646
Uvalde	2,975	1,231	828	828	828	828
Webb	916	916	916	916	916	916
Wilson	111,707	106,677	107,759	109,041	110,593	112,193
Zavala	35,653	35,305	35,171	35,071	34,750	34,695
GMA 13 Total	**654,757**	**616,172**	**610,369**	**612,723**	**609,130**	**609,802**

TABLE A.2 MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS SUMMARIZED BY RIVER BASIN IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR.

River Basin	2020	2030	2040	2050	2060	2070
Colorado	593	593	593	593	593	593
Guadalupe	207,880	203,631	201,729	204,002	201,193	201,286
Lavaca	273	273	273	273	273	273
Nueces	310,122	281,200	276,645	276,208	275,121	274,730
Rio Grande	2,196	2,196	2,155	2,068	2,028	1,990
San Antonio	133,693	128,278	128,974	129,578	129,922	130,929
GMA 13 Total	**654,757**	**616,172**	**610,369**	**612,723**	**609,130**	**609,802**

TABLE A.3 MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS SUMMARIZED BY REGIONAL WATER PLANNING AREA IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR.

Regional Water Planning Area	2020	2030	2040	2050	2060	2070
L	644,520	605,934	602,823	605,264	602,016	602,726
M	2,958	2,958	2,917	2,829	2,485	2,447
N	7,279	7,279	4,629	4,629	4,629	4,629
GMA 13 Total	**654,757**	**616,172**	**610,369**	**612,723**	**609,130**	**609,802**

TABLE A.4 MODELED AVAILABLE GROUNDWATER FOR THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT IN GROUNDWATER MANAGEMENT AREA 13. RESULTS ARE IN ACRE-FEET PER YEAR.

Groundwater Conservation District	2020	2030	2040	2050	2060	2070
Evergreen UWCD	305,432	274,288	273,917	274,754	275,710	276,768
Gonzales County UWCD	130,212	130,212	130,954	131,318	128,535	128,543
Guadalupe County GCD	52,528	47,844	45,776	47,995	47,965	47,833
McMullen GCD	7,279	7,279	4,629	4,629	4,629	4,629
Medina County GCD	2,657	2,648	2,647	2,647	2,646	2,646
Plum Creek CD	20,633	20,633	20,224	20,224	19,647	19,647
Uvalde County UWCD	2,975	1,231	828	828	828	828
Wintergarden GCD	47,630	47,282	47,149	47,048	46,727	46,673
No District-Bexar County	81,474	80,817	80,348	79,470	78,977	78,807
No District-Caldwell County	921	921	921	921	921	921
No District-Gonzales County	59	59	59	59	59	59
No District-Maverick County	2,042	2,042	2,001	1,914	1,570	1,531
No District-Webb County	916	916	916	916	916	916
GMA 13 Total	**654,757**	**616,172**	**610,369**	**612,723**	**609,130**	**609,802**

Appendix B

Total Pumping Associated with Modeled Available Groundwater Run for the Carrizo-Wilcox, Queen City, and Sparta Aquifers Split by Model Layers for Groundwater Conservation Districts in Groundwater Management Area 13

TABLE B.1 TOTAL PUMPING BY MODEL LAYER ASSOCIATED WITH THE MODELED AVAILABLE GROUNDWATER RUN FOR THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS IN GROUNDWATER MANAGEMENT AREA 13 SUMMARIZED BY GROUNDWATER CONSERVATION DISTRICT (GCD).

Groundwater Conservation District	Model Layer (Aquifer)	2012	2020	2030	2040	2050	2060	2070
Evergreen UWCD	1 (Sparta)	2,726	2,723	2,166	2,056	1,955	1,870	1,792
Evergreen UWCD	3 (Queen City)	13,614	13,614	10,797	10,455	10,133	9,723	9,359
Evergreen UWCD	5 (Carrizo)	199,165	199,165	171,394	171,475	172,735	174,186	175,686
Evergreen UWCD	6 (Upper Wilcox)	374	374	374	374	374	374	374
Evergreen UWCD	7 (Middle Wilcox)	370	370	370	370	370	370	370
Evergreen UWCD	8 (Lower Wilcox)	89,186	89,186	89,186	89,186	89,186	89,186	89,186
Evergreen UWCD Total		**305,436**	**305,432**	**274,288**	**273,917**	**274,754**	**275,710**	**276,768**
Gonzales County UWCD	1 (Sparta)	3,554	3,554	3,554	3,554	3,554	3,554	3,554
Gonzales County UWCD	3 (Queen City)	5,351	5,351	5,351	5,351	5,351	5,351	5,351
Gonzales County UWCD	5 (Carrizo)	83,284	83,284	83,284	84,026	84,390	81,607	81,615
Gonzales County UWCD	6 (Upper Wilcox)	0	0	0	0	0	0	0
Gonzales County UWCD	7 (Middle Wilcox)	12,187	12,187	12,187	12,187	12,187	12,187	12,187
Gonzales County UWCD	8 (Lower Wilcox)	25,836	25,836	25,836	25,836	25,836	25,836	25,836
Gonzales County UWCD Total		**130,212**	**130,212**	**130,212**	**130,954**	**131,318**	**128,535**	**128,543**

Groundwater Conservation District	Model Layer (Aquifer)	2012	2020	2030	2040	2050	2060	2070
Guadalupe County GCD	5 (Carrizo)	25,143	25,143	20,771	16,367	16,470	16,783	16,862
Guadalupe County GCD	6 (Upper Wilcox)	0	0	0	0	0	0	0
Guadalupe County GCD	7 (Middle Wilcox)	3,299	6,290	5,978	7,377	8,700	8,435	8,224
Guadalupe County GCD	8 (Lower Wilcox)	19,590	21,094	21,094	22,031	22,825	22,747	22,747
Guadalupe County GCD Total		**48,032**	**52,528**	**47,844**	**45,776**	**47,995**	**47,965**	**47,833**
McMullen GCD	1 (Sparta)	89	89	89	89	89	89	89
McMullen GCD	3 (Queen City)	134	134	134	134	134	134	134
McMullen GCD	5 (Carrizo)	7,002	7,056	7,056	4,405	4,405	4,405	4,405
McMullen GCD	6 (Upper Wilcox)	0	0	0	0	0	0	0
McMullen GCD	7 (Middle Wilcox)	0	0	0	0	0	0	0
McMullen GCD	8 (Lower Wilcox)	0	0	0	0	0	0	0
McMullen GCD Total		**7,226**	**7,279**	**7,279**	**4,629**	**4,629**	**4,629**	**4,629**
Medina County GCD	5 (Carrizo)	545	545	537	536	535	535	534
Medina County GCD	6 (Upper Wilcox)	0	0	0	0	0	0	0
Medina County GCD	7 (Middle Wilcox)	1,248	1,248	1,248	1,248	1,248	1,248	1,248

Groundwater Conservation District	Model Layer (Aquifer)	2012	2020	2030	2040	2050	2060	2070
Medina County GCD	8 (Lower Wilcox)	864	864	864	864	864	864	864
Medina County GCD Total		**2,657**	**2,657**	**2,648**	**2,647**	**2,647**	**2,646**	**2,646**
Plum Creek CD	3 (Queen City)	22	22	22	22	22	22	22
Plum Creek CD	5 (Carrizo)	6,057	6,057	6,057	6,057	6,057	6,057	6,057
Plum Creek CD	6 (Upper Wilcox)	0	0	0	0	0	0	0
Plum Creek CD	7 (Middle Wilcox)	5,301	4,838	4,838	4,838	4,838	4,261	4,261
Plum Creek CD	8 (Lower Wilcox)	9,714	9,714	9,714	9,306	9,306	9,306	9,306
Plum Creek CD Total		**21,095**	**20,633**	**20,633**	**20,224**	**20,224**	**19,647**	**19,647**
Uvalde County UWCD	5 (Carrizo)	828	828	828	828	828	828	828
Uvalde County UWCD	6 (Upper Wilcox)	3,622	2,147	402	0	0	0	0
Uvalde County UWCD	7 (Middle Wilcox)	0	0	0	0	0	0	0
Uvalde County UWCD	8 (Lower Wilcox)	0	0	0	0	0	0	0
Uvalde County UWCD Total		**4,451**	**2,975**	**1,231**	**828**	**828**	**828**	**828**
Wintergarden GCD	1 (Sparta)	983	983	983	983	983	983	983
Wintergarden GCD	3 (Queen City)	2	2	2	2	2	2	2
Wintergarden GCD	5 (Carrizo)	32,962	32,962	32,615	32,481	32,381	32,060	32,005
Wintergarden GCD	6 (Upper Wilcox)	9,261	9,261	9,261	9,261	9,261	9,261	9,261

Groundwater Conservation District	Model Layer (Aquifer)	2012	2020	2030	2040	2050	2060	2070
Wintergarden GCD	7 (Middle Wilcox)	4,006	4,006	4,006	4,006	4,006	4,006	4,006
Wintergarden GCD	8 (Lower Wilcox)	416	416	416	416	416	416	416
Wintergarden GCD Total		**47,630**	**47,630**	**47,282**	**47,149**	**47,048**	**46,727**	**46,673**

APPENDIX 6

Part 1
Estimated Historical Groundwater Use
And
2017 State Water Plan Datasets

Estimated Historical Groundwater Use And 2017 State Water Plan Datasets:

Gonzales County Underground Water Conservation District

by Stephen Allen
Texas Water Development Board
Groundwater Division
Groundwater Technical Assistance Section
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(512) 463-7317
July 30, 2018

GROUNDWATER MANAGEMENT PLAN DATA:

This package of water data reports (part 1 of a 2-part package of information) is being provided to groundwater conservation districts to help them meet the requirements for approval of their five-year groundwater management plan. Each report in the package addresses a specific numbered requirement in the Texas Water Development Board's groundwater management plan checklist. The checklist can be viewed and downloaded from this web address:

http://www.twdb.texas.gov/groundwater/docs/GCD/GMPChecklist0113.pdf

The five reports included in this part are:

1. Estimated Historical Groundwater Use (checklist item 2)

   from the TWDB Historical Water Use Survey (WUS)

2. Projected Surface Water Supplies (checklist item 6)
3. Projected Water Demands (checklist item 7)
4. Projected Water Supply Needs (checklist item 8)
5. Projected Water Management Strategies (checklist item 9)

   from the 2017 Texas State Water Plan (SWP)

Part 2 of the 2-part package is the groundwater availability model (GAM) report for the District (checklist items 3 through 5). The District should have received, or will receive, this report from the Groundwater Availability Modeling Section. Questions about the GAM can be directed to Dr. Shirley Wade, shirley.wade@twdb.texas.gov, (512) 936-0883.

DISCLAIMER:

The data presented in this report represents the most up-to-date WUS and 2017 SWP data available as of 7/30/2018. Although it does not happen frequently, either of these datasets are subject to change pending the availability of more accurate WUS data or an amendment to the 2017 SWP. District personnel must review these datasets and correct any discrepancies in order to ensure approval of their groundwater management plan.

The WUS dataset can be verified at this web address:

http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/

The 2017 SWP dataset can be verified by contacting Sabrina Anderson (sabrina.anderson@twdb.texas.gov or 512-936-0886).

The values presented in the data tables of this report are county-based. In cases where groundwater conservation districts cover only a portion of one or more counties the data values are modified with an apportioning multiplier to create new values that more accurately represent conditions within district boundaries. The multiplier used in the following formula is a land area ratio: (data value * (land area of district in county / land area of county)). For two of the four SWP tables (Projected Surface Water Supplies and Projected Water Demands) only the county-wide water user group (WUG) data values (county other, manufacturing, steam electric power, irrigation, mining and livestock) are modified using the multiplier. WUG values for municipalities, water supply corporations, and utility districts are not apportioned; instead, their full values are retained when they are located within the district, and eliminated when they are located outside (we ask each district to identify these entity locations).

The remaining SWP tables (Projected Water Supply Needs and Projected Water Management Strategies) are not modified because district-specific values are not statutorily required. Each district needs only "consider" the county values in these tables.

In the WUS table every category of water use (including municipal) is apportioned. Staff determined that breaking down the annual municipal values into individual WUGs was too complex.

TWDB recognizes that the apportioning formula used is not perfect but it is the best available process with respect to time and staffing constraints. If a district believes it has data that is more accurate it can add those data to the plan with an explanation of how the data were derived. Apportioning percentages that the TWDB used are listed above each applicable table.

For additional questions regarding this data, please contact Stephen Allen (stephen.allen@twdb.texas.gov or 512-463-7317).

Estimated Historical Water Use
TWDB Historical Water Use Survey (WUS) Data

Groundwater and surface water historical use estimates are currently unavailable for calendar year 2017. TWDB staff anticipates the calculation and posting of these estimates at a later date.

CALDWELL COUNTY *21.83% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2016	GW	400	0	0	0	87	36	523
	SW	668	3	0	0	18	141	830
2015	GW	396	0	0	0	88	34	518
	SW	641	2	0	0	11	138	792
2014	GW	446	0	0	0	142	34	622
	SW	644	1	0	0	12	137	794
2013	GW	443	0	0	0	126	32	601
	SW	639	1	0	0	8	129	777
2012	GW	511	0	0	0	165	32	708
	SW	684	0	0	0	17	129	830
2011	GW	655	0	6	0	223	37	921
	SW	688	0	12	0	17	145	862
2010	GW	575	0	1	0	156	37	769
	SW	669	0	1	0	8	147	825
2009	GW	593	0	0	0	32	36	661
	SW	629	0	0	0	4	143	776
2008	GW	541	0	0	0	57	38	636
	SW	685	0	0	0	249	153	1,087
2007	GW	387	0	0	0	13	45	445
	SW	674	0	0	0	257	181	1,112
2006	GW	440	0	0	0	75	42	557
	SW	590	0	0	0	0	168	758
2005	GW	479	0	0	0	66	59	604
	SW	532	0	0	0	5	236	773
2004	GW	814	0	0	0	35	17	866
	SW	298	0	0	0	5	213	516
2003	GW	844	0	0	0	28	15	887
	SW	284	0	0	0	204	196	684
2002	GW	853	1	0	0	49	15	918
	SW	236	0	0	0	298	194	728
2001	GW	846	2	0	0	49	14	911
	SW	263	0	0	0	298	180	741

GONZALES COUNTY *84.64% (multiplier)* All values are in acre-feet

Year	Source	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock	Total
2016	GW	2,213	1,308	1,992	0	1,903	6,215	13,631
	SW	1,102	27	493	0	734	2,072	4,428
2015	GW	2,346	1,282	2,147	0	2,066	6,025	13,866
	SW	1,041	27	581	0	617	2,009	4,275
2014	GW	2,431	1,173	3,115	0	4,064	5,869	16,652
	SW	1,113	28	711	0	0	1,956	3,808
2013	GW	2,375	1,208	3,232	0	2,794	5,977	15,586
	SW	1,329	20	680	0	1,199	1,992	5,220
2012	GW	3,430	1,202	2,155	0	2,215	5,950	14,952
	SW	381	20	508	0	1,011	1,983	3,903
2011	GW	3,777	1,427	1,556	0	4,533	6,263	17,556
	SW	313	27	690	0	1,232	2,087	4,349
2010	GW	2,078	1,223	184	0	3,028	6,322	12,835
	SW	1,466	30	362	0	730	2,108	4,696
2009	GW	1,863	1,689	3	0	1,410	2,880	7,845
	SW	1,804	34	219	0	998	960	4,015
2008	GW	2,116	1,247	0	0	2,426	3,006	8,795
	SW	1,807	48	306	0	1,069	1,006	4,236
2007	GW	1,458	1,265	30	0	1,517	2,917	7,187
	SW	1,551	43	0	0	677	978	3,249
2006	GW	1,813	1,322	30	0	2,222	3,133	8,520
	SW	1,851	39	0	0	0	1,050	2,940
2005	GW	1,648	1,207	30	0	1,199	3,096	7,180
	SW	2,121	37	0	0	296	1,038	3,492
2004	GW	1,384	1,211	30	0	965	389	3,979
	SW	2,066	30	0	0	305	3,583	5,984
2003	GW	1,426	1,143	30	0	901	393	3,893
	SW	1,514	44	0	0	708	3,610	5,876
2002	GW	1,646	1,168	30	0	1,004	384	4,232
	SW	1,722	35	0	0	317	3,534	5,608
2001	GW	1,670	1,183	33	0	963	366	4,215
	SW	2,087	79	0	0	305	3,365	5,836

Projected Surface Water Supplies
TWDB 2017 State Water Plan Data

CALDWELL COUNTY

21.83% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
L	COUNTY LINE WSC	GUADALUPE	CANYON LAKE/RESERVOIR	103	83	61	39	18	0
L	COUNTY-OTHER, CALDWELL	GUADALUPE	GUADALUPE RUN-OF-RIVER	109	109	109	109	109	109
L	GONZALES COUNTY WSC	GUADALUPE	CANYON LAKE/RESERVOIR	19	21	22	23	25	25
L	LIVESTOCK, CALDWELL	COLORADO	COLORADO LIVESTOCK LOCAL SUPPLY	7	7	7	7	7	7
L	LIVESTOCK, CALDWELL	GUADALUPE	GUADALUPE LIVESTOCK LOCAL SUPPLY	103	103	103	103	103	103
L	MARTINDALE	GUADALUPE	CANYON LAKE/RESERVOIR	90	90	90	90	90	90
L	MARTINDALE	GUADALUPE	GUADALUPE RUN-OF-RIVER	100	100	100	100	100	100
L	MAXWELL WSC	GUADALUPE	CANYON LAKE/RESERVOIR	359	368	373	375	376	376
L	MAXWELL WSC	GUADALUPE	GUADALUPE RUN-OF-RIVER	543	557	565	568	569	569
L	SAN MARCOS	GUADALUPE	CANYON LAKE/RESERVOIR	2	2	2	3	3	3
L	UHLAND	GUADALUPE	CANYON LAKE/RESERVOIR	79	94	110	126	142	158
	Sum of Projected Surface Water Supplies (acre-feet)			**1,514**	**1,534**	**1,542**	**1,543**	**1,542**	**1,540**

GONZALES COUNTY

84.64% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	Source Name	2020	2030	2040	2050	2060	2070
L	GONZALES	GUADALUPE	GUADALUPE RUN-OF-RIVER	2,240	2,240	2,240	2,240	2,240	2,240
L	GONZALES COUNTY WSC	GUADALUPE	CANYON LAKE/RESERVOIR	635	634	634	634	634	635
L	IRRIGATION, GONZALES	GUADALUPE	CANYON LAKE/RESERVOIR	6	6	6	6	6	6
L	IRRIGATION, GONZALES	GUADALUPE	GUADALUPE RUN-OF-RIVER	1,524	1,524	1,524	1,524	1,524	1,524
	Sum of Projected Surface Water Supplies (acre-feet)			**4,405**	**4,404**	**4,404**	**4,404**	**4,404**	**4,405**

Projected Water Demands
TWDB 2017 State Water Plan Data

Please note that the demand numbers presented here include the plumbing code savings found in the Regional and State Water Plans.

CALDWELL COUNTY

21.83% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	AQUA WSC	COLORADO	43	51	60	68	77	86
L	AQUA WSC	GUADALUPE	242	289	336	385	435	484
L	COUNTY LINE WSC	GUADALUPE	82	97	114	132	149	166
L	COUNTY-OTHER, CALDWELL	COLORADO	11	13	15	17	20	22
L	COUNTY-OTHER, CALDWELL	GUADALUPE	147	174	201	229	259	288
L	CREEDMOOR-MAHA WSC	COLORADO	114	133	152	172	195	216
L	CREEDMOOR-MAHA WSC	GUADALUPE	29	34	39	45	50	56
L	GOFORTH SUD	GUADALUPE	41	49	56	64	73	81
L	GONZALES COUNTY WSC	GUADALUPE	58	70	83	95	91	102
L	IRRIGATION, CALDWELL	COLORADO	4	4	3	3	3	2
L	IRRIGATION, CALDWELL	GUADALUPE	131	116	103	92	81	74
L	LIVESTOCK, CALDWELL	COLORADO	15	15	15	15	15	15
L	LIVESTOCK, CALDWELL	GUADALUPE	205	205	205	205	205	205
L	LOCKHART	GUADALUPE	2,251	2,676	3,105	3,547	4,010	4,465
L	LULING	GUADALUPE	950	1,125	1,301	1,484	1,678	1,868
L	MANUFACTURING, CALDWELL	GUADALUPE	2	2	2	2	3	3
L	MARTINDALE	GUADALUPE	187	221	256	292	330	367
L	MAXWELL WSC	GUADALUPE	414	487	561	638	720	802
L	MINING, CALDWELL	COLORADO	2	2	1	1	0	0
L	MINING, CALDWELL	GUADALUPE	24	19	14	9	4	2
L	MUSTANG RIDGE	COLORADO	69	82	95	108	122	136
L	MUSTANG RIDGE	GUADALUPE	2	2	2	3	3	3
L	NIEDERWALD	GUADALUPE	16	19	22	25	28	31
L	POLONIA WSC	COLORADO	282	333	386	440	498	554
L	POLONIA WSC	GUADALUPE	596	707	819	935	1,055	1,175
L	SAN MARCOS	GUADALUPE	2	3	4	5	6	7
L	UHLAND	GUADALUPE	79	94	110	126	142	158
		Sum of Projected Water Demands (acre-feet)	**5,998**	**7,022**	**8,060**	**9,137**	**10,252**	**11,368**

Projected Water Demands
TWDB 2017 State Water Plan Data

Please note that the demand numbers presented here include the plumbing code savings found in the Regional and State Water Plans.

GONZALES COUNTY

84.64% (multiplier)

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	COUNTY-OTHER, GONZALES	GUADALUPE	340	355	384	418	392	425
L	COUNTY-OTHER, GONZALES	LAVACA	17	18	19	20	20	21
L	GONZALES	GUADALUPE	2,200	2,375	2,545	2,759	2,677	2,895
L	GONZALES COUNTY WSC	GUADALUPE	1,989	2,153	2,340	2,534	2,337	2,528
L	IRRIGATION, GONZALES	GUADALUPE	2,042	1,761	1,517	1,308	1,128	1,010
L	LIVESTOCK, GONZALES	GUADALUPE	3,918	3,918	3,918	3,918	3,918	3,918
L	LIVESTOCK, GONZALES	LAVACA	91	91	91	91	91	91
L	MANUFACTURING, GONZALES	GUADALUPE	1,414	1,518	1,620	1,710	1,831	1,960
L	MINING, GONZALES	GUADALUPE	1,354	1,022	688	354	20	1
L	NIXON	GUADALUPE	433	462	491	529	538	582
L	SMILEY	GUADALUPE	136	146	156	170	164	177
L	WAELDER	GUADALUPE	224	241	258	279	270	292
		Sum of Projected Water Demands (acre-feet)	**14,158**	**14,060**	**14,027**	**14,090**	**13,386**	**13,900**

Projected Water Supply Needs
TWDB 2017 State Water Plan Data

Negative values (in red) reflect a projected water supply need, positive values a surplus.

CALDWELL COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	AQUA WSC	COLORADO	43	35	26	18	9	0
L	AQUA WSC	GUADALUPE	242	195	148	99	49	0
L	COUNTY LINE WSC	GUADALUPE	56	19	-22	-64	-104	-141
L	COUNTY-OTHER, CALDWELL	COLORADO	182	173	163	154	143	133
L	COUNTY-OTHER, CALDWELL	GUADALUPE	1,108	986	862	732	596	462
L	CREEDMOOR-MAHA WSC	COLORADO	0	0	0	0	0	0
L	CREEDMOOR-MAHA WSC	GUADALUPE	0	0	0	0	0	0
L	GOFORTH SUD	GUADALUPE	0	0	0	0	0	0
L	GONZALES COUNTY WSC	GUADALUPE	14	11	4	-3	6	-3
L	IRRIGATION, CALDWELL	COLORADO	0	2	4	6	7	8
L	IRRIGATION, CALDWELL	GUADALUPE	34	101	160	213	261	294
L	LIVESTOCK, CALDWELL	COLORADO	0	0	0	0	0	0
L	LIVESTOCK, CALDWELL	GUADALUPE	0	0	0	0	0	0
L	LOCKHART	GUADALUPE	-188	-613	-1,042	-1,484	-1,947	-2,402
L	LULING	GUADALUPE	133	-41	-217	-400	-594	-784
L	MANUFACTURING, CALDWELL	GUADALUPE	5	4	3	2	1	0
L	MARTINDALE	GUADALUPE	3	-31	-66	-102	-140	-177
L	MAXWELL WSC	GUADALUPE	624	578	519	448	368	286
L	MINING, CALDWELL	COLORADO	0	0	0	0	0	0
L	MINING, CALDWELL	GUADALUPE	0	0	0	0	0	0
L	MUSTANG RIDGE	COLORADO	0	0	0	0	0	0
L	MUSTANG RIDGE	GUADALUPE	0	0	0	0	0	0
L	NIEDERWALD	GUADALUPE	-13	-16	-20	-23	-26	-29
L	POLONIA WSC	COLORADO	118	65	11	-45	-104	-164
L	POLONIA WSC	GUADALUPE	262	146	26	-101	-237	-377
L	SAN MARCOS	GUADALUPE	1	0	-1	-1	-2	-3
L	UHLAND	GUADALUPE	0	0	0	0	0	0
		Sum of Projected Water Supply Needs (acre-feet)	**-201**	**-701**	**-1,368**	**-2,223**	**-3,154**	**-4,080**

Projected Water Supply Needs
TWDB 2017 State Water Plan Data

Negative values (in red) reflect a projected water supply need, positive values a surplus.

GONZALES COUNTY

All values are in acre-feet

RWPG	WUG	WUG Basin	2020	2030	2040	2050	2060	2070
L	COUNTY-OTHER, GONZALES	GUADALUPE	137	119	85	45	76	37
L	COUNTY-OTHER, GONZALES	LAVACA	13	12	10	9	9	8
L	GONZALES	GUADALUPE	385	210	40	-174	-92	-310
L	GONZALES COUNTY WSC	GUADALUPE	482	314	125	-68	130	-57
L	IRRIGATION, GONZALES	GUADALUPE	1,190	1,523	1,811	2,058	2,270	2,410
L	LIVESTOCK, GONZALES	GUADALUPE	0	0	0	0	0	0
L	LIVESTOCK, GONZALES	LAVACA	0	0	0	0	0	0
L	MANUFACTURING, GONZALES	GUADALUPE	716	593	473	367	224	71
L	MINING, GONZALES	GUADALUPE	0	0	0	0	0	0
L	NIXON	GUADALUPE	2,199	2,171	2,142	2,100	2,091	2,048
L	SMILEY	GUADALUPE	89	79	69	55	61	48
L	WAELDER	GUADALUPE	373	356	339	318	327	305
	Sum of Projected Water Supply Needs (acre-feet)		**0**	**0**	**0**	**-242**	**-92**	**-367**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

CALDWELL COUNTY

WUG, Basin (RWPG) All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
COUNTY LINE WSC, GUADALUPE (L)							
BRACKISH WILCOX GROUNDWATER FOR CRWA	CARRIZO-WILCOX AQUIFER [WILSON]	0	0	0	64	105	141
CRWA SIESTA PROJECT	DIRECT REUSE [BEXAR]	0	0	10	0	0	0
CRWA SIESTA PROJECT	SAN ANTONIO RUN-OF-RIVER [WILSON]	0	0	12	0	0	0
REUSE - KYLE/COUNTY LINE WSC	DIRECT REUSE [HAYS]	16	15	14	13	12	11
		16	**15**	**36**	**77**	**117**	**152**
COUNTY-OTHER, CALDWELL, COLORADO (L)							
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [CALDWELL]	0	0	0	0	0	0
		0	**0**	**0**	**0**	**0**	**0**
COUNTY-OTHER, CALDWELL, GUADALUPE (L)							
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [CALDWELL]	0	0	0	0	0	2
		0	**0**	**0**	**0**	**0**	**2**
GOFORTH SUD, GUADALUPE (L)							
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [CALDWELL]	0	0	0	0	0	0
		0	**0**	**0**	**0**	**0**	**0**
GONZALES COUNTY WSC, GUADALUPE (L)							
LOCAL CARRIZO AQUIFER DEVELOPMENT	CARRIZO-WILCOX AQUIFER [GONZALES]	0	0	0	3	3	3
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [CALDWELL]	8	12	20	29	32	42
		8	**12**	**20**	**32**	**35**	**45**
LOCKHART, GUADALUPE (L)							
DROUGHT MANAGEMENT - LOCKHART	DEMAND REDUCTION [CALDWELL]	113	0	0	0	0	0
GBRA - MBWSP - CONJUNCTIVE USE (OPTION 3A) - CARRIZO DEVELOPMENT	CARRIZO-WILCOX AQUIFER [GONZALES]	1,120	1,120	1,120	1,484	760	0
GBRA - MBWSP - CONJUNCTIVE USE W/ASR (OPTION 3A)	CARRIZO-WILCOX AQUIFER ASR [GONZALES]	0	0	0	0	1,187	2,402
MUNICIPAL WATER CONSERVATION (SUBURBAN)	DEMAND REDUCTION [CALDWELL]	0	0	0	0	0	72
		1,233	**1,120**	**1,120**	**1,484**	**1,947**	**2,474**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

WUG, Basin (RWPG) All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
LULING, GUADALUPE (L)							
GBRA - MBWSP - CONJUNCTIVE USE (OPTION 3A) - CARRIZO DEVELOPMENT	CARRIZO-WILCOX AQUIFER [GONZALES]	1,673	1,674	1,674	1,673	0	0
GBRA - MBWSP - CONJUNCTIVE USE W/ASR (OPTION 3A)	CARRIZO-WILCOX AQUIFER ASR [GONZALES]	0	0	0	0	1,678	1,868
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [CALDWELL]	0	0	0	0	0	3
		1,673	**1,674**	**1,674**	**1,673**	**1,678**	**1,871**
MARTINDALE, GUADALUPE (L)							
DROUGHT MANAGEMENT - MARTINDALE	DEMAND REDUCTION [CALDWELL]	9	0	0	0	0	0
HAYS/CALDWELL PUA PROJECT	CARRIZO-WILCOX AQUIFER [CALDWELL]	0	31	66	102	140	177
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [CALDWELL]	0	0	0	0	0	1
		9	**31**	**66**	**102**	**140**	**178**
MUSTANG RIDGE, COLORADO (L)							
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [CALDWELL]	0	0	0	0	0	1
		0	**0**	**0**	**0**	**0**	**1**
MUSTANG RIDGE, GUADALUPE (L)							
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [CALDWELL]	0	0	0	0	0	0
		0	**0**	**0**	**0**	**0**	**0**
NIEDERWALD, GUADALUPE (L)							
DROUGHT MANAGEMENT - NIEDERWALD	DEMAND REDUCTION [CALDWELL]	1	0	0	0	0	0
GBRA - MBWSP - CONJUNCTIVE USE (OPTION 3A) - CARRIZO DEVELOPMENT	CARRIZO-WILCOX AQUIFER [GONZALES]	13	16	20	23	0	0
GBRA - MBWSP - CONJUNCTIVE USE W/ASR (OPTION 3A)	CARRIZO-WILCOX AQUIFER ASR [GONZALES]	0	0	0	0	26	29
		14	**16**	**20**	**23**	**26**	**29**
POLONIA WSC, COLORADO (L)							
LOCAL CARRIZO AQUIFER WITH CONVERSION	CARRIZO-WILCOX AQUIFER [CALDWELL]	0	0	0	45	104	164
		0	**0**	**0**	**45**	**104**	**164**

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

WUG, Basin (RWPG) — All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
POLONIA WSC, GUADALUPE (L)							
LOCAL CARRIZO AQUIFER WITH CONVERSION	CARRIZO-WILCOX AQUIFER [CALDWELL]	0	0	0	101	237	377
		0	**0**	**0**	**101**	**237**	**377**
SAN MARCOS, GUADALUPE (L)							
GBRA - MBWSP - CONJUNCTIVE USE (OPTION 3A) - CARRIZO DEVELOPMENT	CARRIZO-WILCOX AQUIFER [GONZALES]	0	0	1	1	0	0
GBRA - MBWSP - CONJUNCTIVE USE W/ASR (OPTION 3A)	CARRIZO-WILCOX AQUIFER ASR [GONZALES]	0	0	0	0	1	1
HAYS/CALDWELL PUA PROJECT	CARRIZO-WILCOX AQUIFER [CALDWELL]	0	0	0	1	1	2
MUNICIPAL WATER CONSERVATION (SUBURBAN)	DEMAND REDUCTION [CALDWELL]	0	0	0	0	1	1
REUSE - SAN MARCOS	DIRECT REUSE [HAYS]	0	1	1	1	2	2
		0	**1**	**2**	**3**	**5**	**6**
UHLAND, GUADALUPE (L)							
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [CALDWELL]	0	0	0	0	2	6
		0	**0**	**0**	**0**	**2**	**6**
Sum of Projected Water Management Strategies (acre-feet)		**2,953**	**2,869**	**2,938**	**3,540**	**4,291**	**5,305**

GONZALES COUNTY

WUG, Basin (RWPG) — All values are in acre-feet

Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
GONZALES, GUADALUPE (L)							
LOCAL CARRIZO AQUIFER DEVELOPMENT	CARRIZO-WILCOX AQUIFER [GONZALES]	0	0	0	310	310	310
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [GONZALES]	183	318	475	695	901	1,035
		183	**318**	**475**	**1,005**	**1,211**	**1,345**
GONZALES COUNTY WSC, GUADALUPE (L)							
LOCAL CARRIZO AQUIFER DEVELOPMENT	CARRIZO-WILCOX AQUIFER [GONZALES]	0	0	0	68	68	68
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [GONZALES]	255	385	561	760	811	1,034

Projected Water Management Strategies
TWDB 2017 State Water Plan Data

WUG, Basin (RWPG)							All values are in acre-feet
Water Management Strategy	Source Name [Origin]	2020	2030	2040	2050	2060	2070
		255	**385**	**561**	**828**	**879**	**1,102**
NIXON, GUADALUPE (L)							
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [GONZALES]	0	0	0	0	21	37
		0	**0**	**0**	**0**	**21**	**37**
SMILEY, GUADALUPE (L)							
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [GONZALES]	11	18	27	33	37	43
		11	**18**	**27**	**33**	**37**	**43**
WAELDER, GUADALUPE (L)							
MUNICIPAL WATER CONSERVATION (RURAL)	DEMAND REDUCTION [GONZALES]	16	22	20	24	33	42
		16	**22**	**20**	**24**	**33**	**42**
Sum of Projected Water Management Strategies (acre-feet)		**465**	**743**	**1,083**	**1,890**	**2,181**	**2,569**

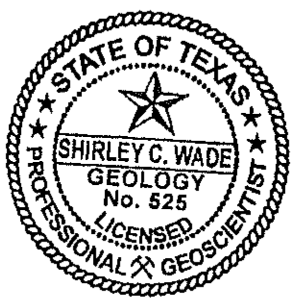
APPENDIX 7

Part 2
Groundwater Availability Model Report
GAM Run 18-006

GAM Run 18-006: Gonzales County Underground Water Conservation District Groundwater Management Plan

Shirley C. Wade, Ph.D., P.G.
Texas Water Development Board
Groundwater Division
Groundwater Availability Modeling Department
512-936-0883

April 6, 2018



Shirley C. Wade
4/6/2018

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GAM Run 18-006: Gonzales County Underground Water Conservation District Groundwater Management Plan

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April 6, 2018

EXECUTIVE SUMMARY:

Texas State Water Code, Section 36.1071, Subsection (h) (Texas Water Code, 2015), states that, in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the Executive Administrator of the Texas Water Development Board (TWDB) in conjunction with any available site-specific information provided by the district for review and comment to the Executive Administrator.

The TWDB provides data and information to the Gonzales County Underground Water Conservation District in two parts. Part 1 is the Estimated Historical Water Use/State Water Plan dataset report, which will be provided to you separately by the TWDB Groundwater Technical Assistance Department. Please direct questions about the water data report to Mr. Stephen Allen at 512-463-7317 or stephen.allen@twdb.texas.gov. Part 2 is the required groundwater availability modeling information and this information includes:

1. the annual amount of recharge from precipitation, if any, to the groundwater resources within the district;
2. for each aquifer within the district, the annual volume of water that discharges from the aquifer to springs and any surface-water bodies, including lakes, streams, and rivers; and
3. the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

The groundwater management plan for the Gonzales County Underground Water Conservation District should be adopted by the district on or before November 20, 2018, and submitted to the Executive Administrator of the TWDB on or before December 20, 2018. The current management plan for the Gonzales County Underground Water Conservation District expires on February 18, 2019.

We used three groundwater availability models to estimate the management plan information for the aquifers within the Gonzales County Underground Water Conservation District. Information for the Carrizo-Wilcox, Queen City, and Sparta aquifers is from version 2.01 of the groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers (Kelley and others, 2004). Information for the Yegua-Jackson Aquifer is from version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer (Deeds and others, 2010). Information for the Gulf Coast Aquifer System is from version 1.01 of the groundwater availability model for the central portion of the Gulf Coast Aquifer System (Chowdhury and others, 2004).

This report replaces the results of GAM Run 13-014 (Wade, 2013), as the approach used for analyzing model results has been since refined. Tables 1 through 5 summarize the groundwater availability model data required by statute and Figures 1 through 5 show the area of the models from which the values in the tables were extracted. If, after review of the figures, the Gonzales County Underground Water Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB at your earliest convenience.

METHODS:

In accordance with the provisions of the Texas State Water Code, Section 36.1071, Subsection (h), the three groundwater availability models mentioned above were used to estimate information for the Gonzales County Underground Water Conservation District management plan. Water budgets were extracted for the historical model periods for the Carrizo-Wilcox, Queen City, and Sparta aquifers (1980 through 1999), Yegua-Jackson Aquifer (1980 through 1997) and Gulf Coast Aquifer System (1980 through 1999) using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface-water outflow, inflow to the district, and outflow from the district for the aquifers within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Carrizo-Wilcox, Queen City, and Sparta aquifers

- We used version 2.01 of the groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers. See Deeds and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model for the southern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers.

- This groundwater availability model includes eight layers, which generally represent the Sparta Aquifer (Layer 1), the Weches Formation confining unit (Layer 2), the Queen City Aquifer (Layer 3), the Reklaw Formation confining unit (Layer 4), the Carrizo Formation (Layer 5), the Upper Wilcox Unit (Layer 6), the Middle Wilcox Unit (Layer 7), and the Lower Wilcox Unit (Layer 8).
- Water budgets for the district were determined for the Sparta Aquifer (Layer 1), the Queen City Aquifer (Layer 3), and the Carrizo-Wilcox Aquifer (Layers 5 through 8, collectively).
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

Yegua-Jackson Aquifer

- We used version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer. See Deeds and others (2010) for assumptions and limitations of the groundwater availability model.
- This groundwater availability model includes five layers that represent the outcrop of the Yegua-Jackson Aquifer and younger overlying units—the Catahoula Formation (Layer 1), the upper portion of the Jackson Group (Layer 2), the lower portion of the Jackson Group (Layer 3), the upper portion of the Yegua Group (Layer 4), and the lower portion of the Yegua Group (Layer 5).
- An overall water budget for the district was determined for the Yegua-Jackson Aquifer (Layer 1 through Layer 5, collectively, for the portions of the model that represent the Yegua-Jackson Aquifer).
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

Gulf Coast Aquifer System

- We used version 1.01 of the groundwater availability model for the central part of the Gulf Coast Aquifer System for this analysis. See Chowdhury and others (2004) and Waterstone and others (2003) for assumptions and limitations of the groundwater availability model.

- The model has four layers which represent the Chicot Aquifer (Layer 1), the Evangeline Aquifer (Layer 2), the Burkeville Confining Unit (Layer 3), and the Jasper Aquifer and parts of the Catahoula Formation in direct hydrologic communication with the Jasper Aquifer (Layer 4).
- Water budgets for the district were determined for the Gulf Coast Aquifer System (Layers 1 through 4, collectively).
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).
- Because this model assumes a no-flow boundary condition at the base we used version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer to investigate groundwater flows between the Catahoula Formation and the base of the Gulf Coast Aquifer System. See Deeds and others (2010) for assumptions and limitations of the groundwater availability model for the Yegua-Jackson Aquifer.

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving the aquifers according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the groundwater availability model results for the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers and the Gulf Coast Aquifer System, located within Gonzales County Underground Water Conservation District and averaged over the historical calibration periods, as shown in Tables 1 through 5.

1. Precipitation recharge—the areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.
2. Surface-water outflow—the total water discharging from the aquifer (outflow) to surface-water features such as streams, reservoirs, and springs.
3. Flow into and out of district—the lateral flow within the aquifer between the district and adjacent counties.
4. Flow between aquifers—the net vertical flow between the aquifer and adjacent aquifers or confining units. This flow is controlled by the relative water levels in each aquifer and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs.

The information needed for the district's management plan is summarized in Tables 1 through 5. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as a district or county boundary, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located.

TABLE 1. SUMMARIZED INFORMATION FOR THE CARRIZO-WILCOX AQUIFER FOR GONZALES COUNTY UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Carrizo-Wilcox Aquifer	7,767
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Carrizo-Wilcox Aquifer	8,493
Estimated annual volume of flow into the district within each aquifer in the district	Carrizo-Wilcox Aquifer	17,738
Estimated annual volume of flow out of the district within each aquifer in the district	Carrizo-Wilcox Aquifer	10,838
Estimated net annual volume of flow between each aquifer in the district	Flow from Carrizo-Wilcox Aquifer into the overlying Reklaw Confining Unit	1,774
	Flow from Carrizo-Wilcox Aquifer to brackish Carrizo-Wilcox units	2,403

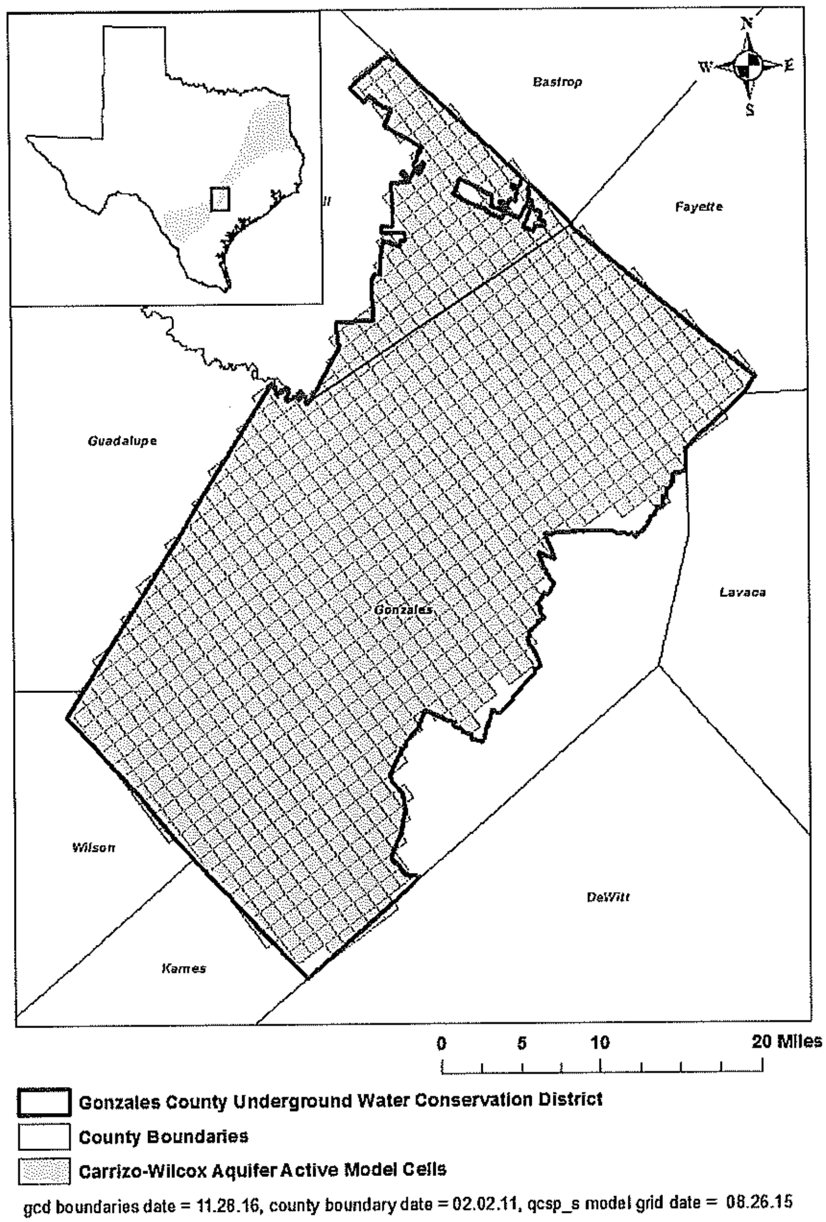

FIGURE 1. AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE CARRIZO-WILCOX AQUIFER FROM WHICH THE INFORMATION IN TABLE 1 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 2. SUMMARIZED INFORMATION FOR THE QUEEN CITY AQUIFER FOR GONZALES COUNTY UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Queen City Aquifer	7,025
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Queen City Aquifer	3,534
Estimated annual volume of flow into the district within each aquifer in the district	Queen City Aquifer	1,215
Estimated annual volume of flow out of the district within each aquifer in the district	Queen City Aquifer	60
Estimated net annual volume of flow between each aquifer in the district	Flow into Queen City Aquifer from the underlying Reklaw Confining Unit	1,631
	Flow from Queen City Aquifer into the overlying Weches Confining Unit	1,785
	Flow from Queen City Aquifer into brackish Queen City units	992

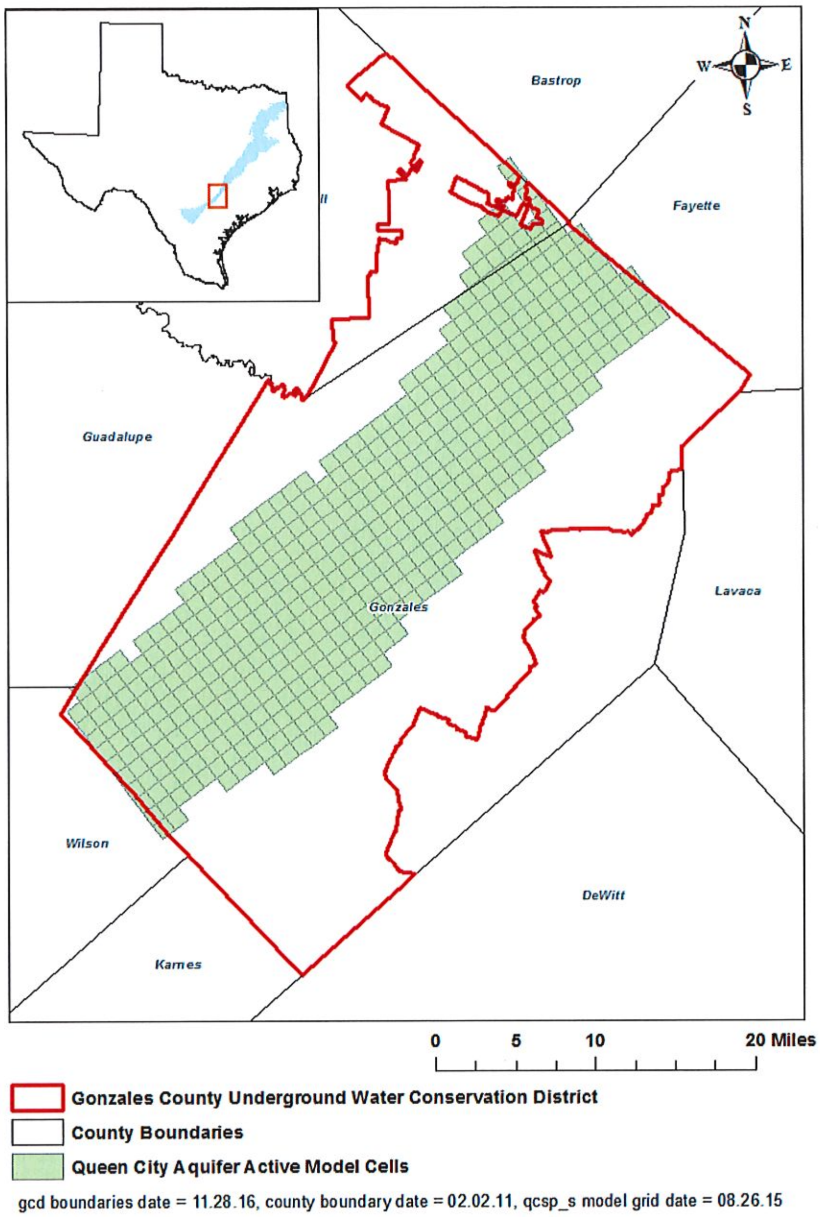

FIGURE 2. AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE QUEEN CITY AQUIFER FROM WHICH THE INFORMATION IN TABLE 2 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 3. SUMMARIZED INFORMATION FOR THE SPARTA AQUIFER FOR GONZALES COUNTY UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Sparta Aquifer	3,021
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Sparta Aquifer	2,012
Estimated annual volume of flow into the district within each aquifer in the district	Sparta Aquifer	197
Estimated annual volume of flow out of the district within each aquifer in the district	Sparta Aquifer	0
Estimated net annual volume of flow between each aquifer in the district	Flow from Sparta Aquifer into the overlying units	2,330
	Flow into Sparta Aquifer from the underlying Weches Confining Unit	2,034
	Flow from Sparta Aquifer to brackish Sparta units	579

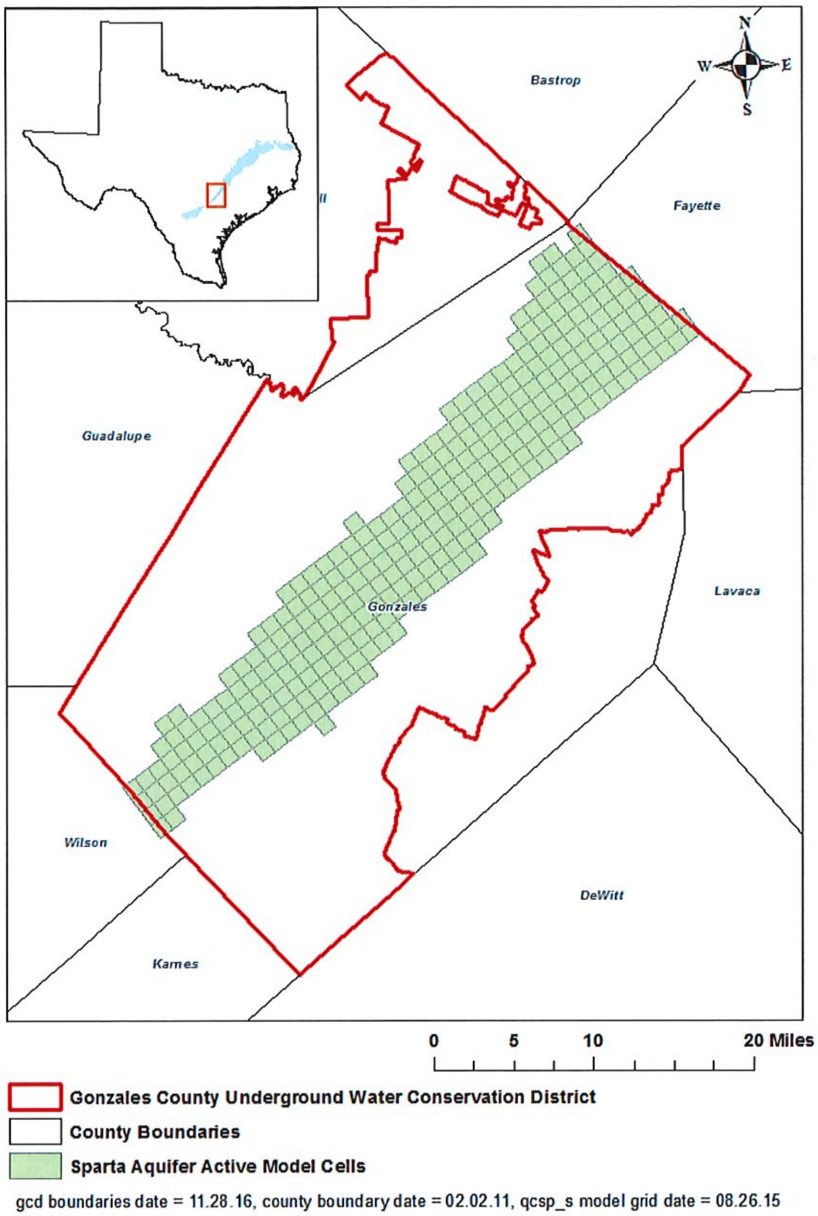

FIGURE 3. AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE SPARTA AQUIFER FROM WHICH THE INFORMATION IN TABLE 3 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 4. SUMMARIZED INFORMATION FOR THE YEGUA-JACKSON AQUIFER FOR GONZALES COUNTY UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	25,756
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Yegua-Jackson Aquifer	41,092
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	10,698
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	3,221
Estimated net annual volume of flow between each aquifer in the district	Flow to Yegua-Jackson Aquifer from the Catahoula and younger units	14
	Flow from the confined portion of the Yegua-Jackson units into the Yegua-Jackson Aquifer	247

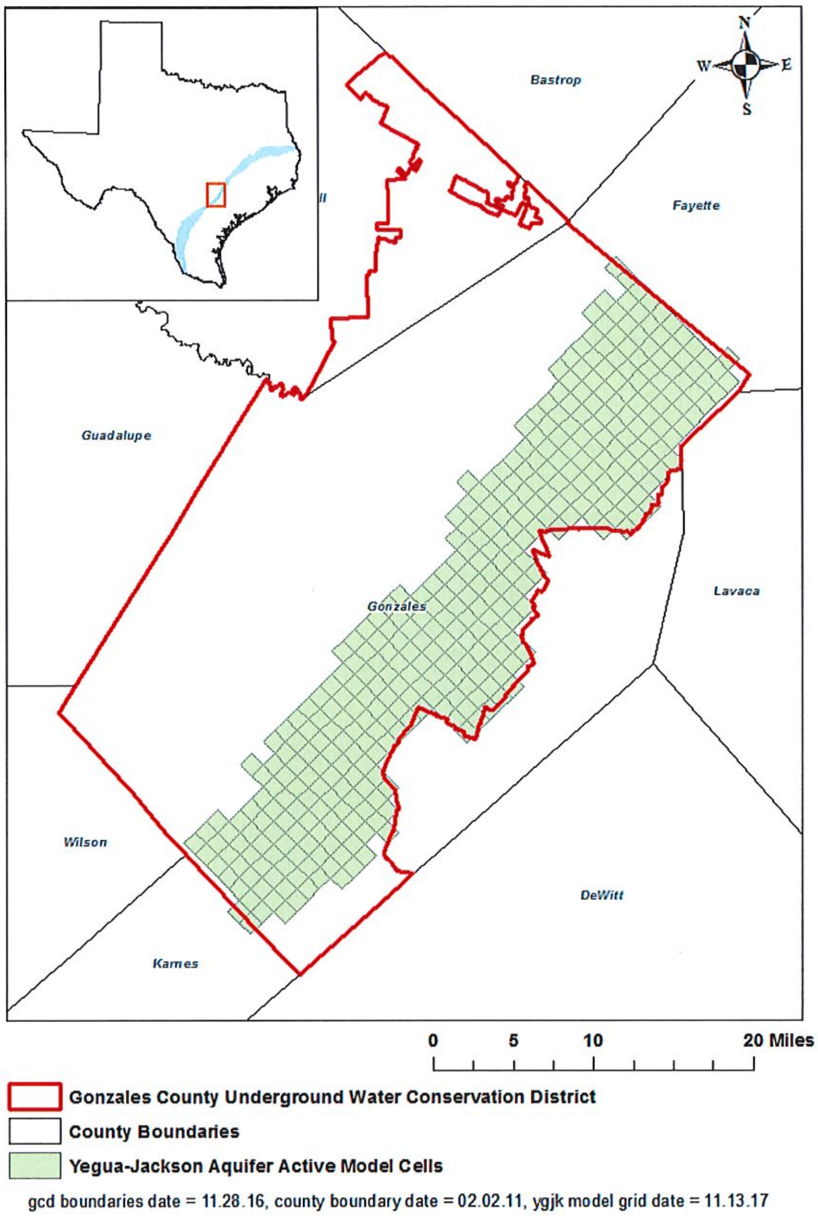

FIGURE 4. AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE YEGUA-JACKSON AQUIFER FROM WHICH THE INFORMATION IN TABLE 4 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

TABLE 5. SUMMARIZED INFORMATION FOR THE GULF COAST AQUIFER SYSTEM FOR GONZALES COUNTY UNDERGROUND WATER CONSERVATION DISTRICT'S GROUNDWATER MANAGEMENT PLAN. ALL VALUES ARE REPORTED IN ACRE-FEET PER YEAR AND ROUNDED TO THE NEAREST 1 ACRE-FOOT.

Management Plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Gulf Coast Aquifer System	29
Estimated annual volume of water that discharges from the aquifer to springs and any surface-water body including lakes, streams, and rivers	Gulf Coast Aquifer System	57
Estimated annual volume of flow into the district within each aquifer in the district	Gulf Coast Aquifer System	46
Estimated annual volume of flow out of the district within each aquifer in the district	Gulf Coast Aquifer System	67
Estimated net annual volume of flow between each aquifer in the district	Flow into the Catahoula unit from the Jasper Aquifer[1]	50
	Flow from the Catahoula unit into underlying formations[2]	23

[1] Based on the general head boundary flux from the groundwater availability model for the Yegua-Jackson Aquifer. A part of the flow from the Catahoula confining system to the Jasper Aquifer represents flow to the Gulf Coast Aquifer System from deeper units and part represents flow within the Gulf Coast Aquifer System.
[2] Based on flux between layers 1 and 2 in the groundwater availability model for the Yegua-Jackson Aquifer.

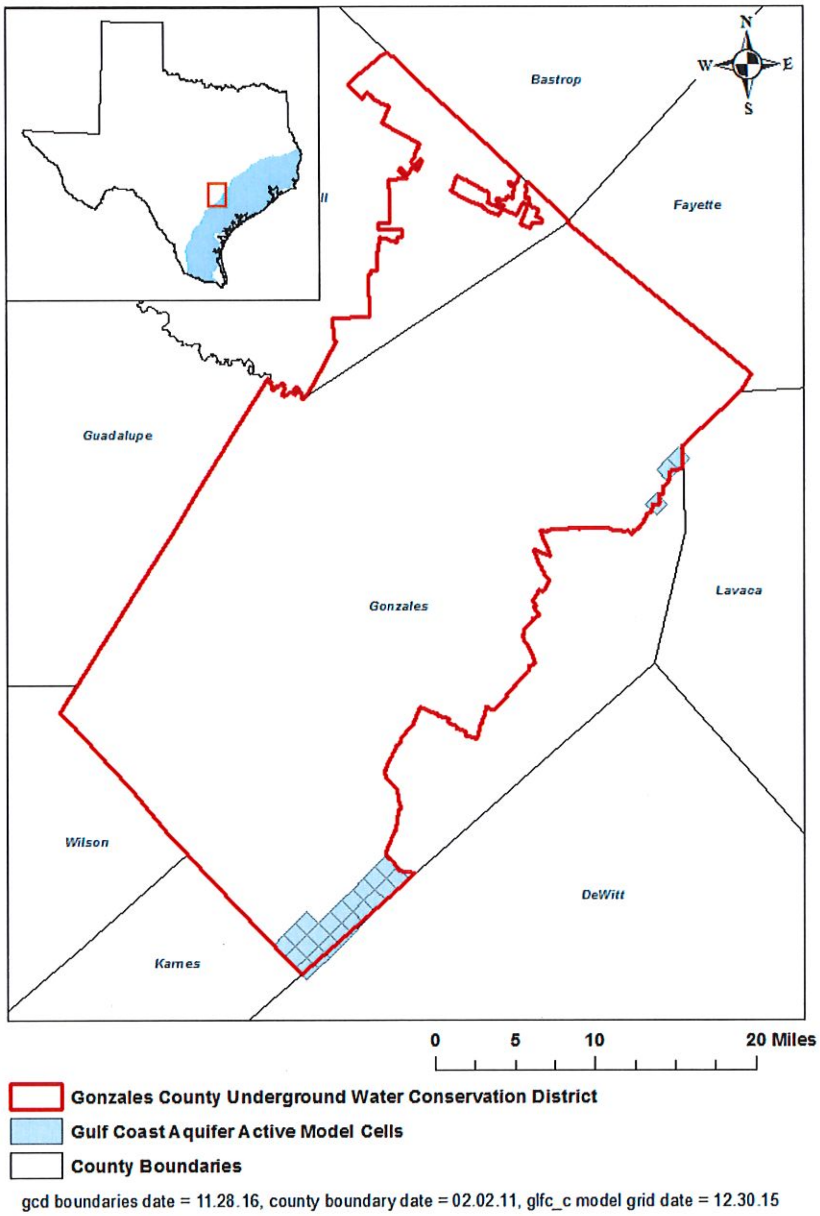

FIGURE 5. AREA OF THE GROUNDWATER AVAILABILITY MODEL FOR THE GULF COAST AQUIFER SYSTEM FROM WHICH THE INFORMATION IN TABLE 5 WAS EXTRACTED (THE AQUIFER SYSTEM EXTENT WITHIN THE DISTRICT BOUNDARY).

LIMITATIONS:

The groundwater models used in completing this analysis are the best available scientific tools that can be used to meet the stated objectives. To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

> *"Models will always be constrained by computational limitations, assumptions, and knowledge gaps. They can best be viewed as tools to help inform decisions rather than as machines to generate truth or make decisions. Scientific advances will never make it possible to build a perfect model that accounts for every aspect of reality or to prove that a given model is correct in all respects for a particular regulatory application. These characteristics make evaluation of a regulatory model more complex than solely a comparison of measurement data with model results."*

A key aspect of using the groundwater model to evaluate historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historic pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and interaction with streams are specific to particular historic time periods.

Because the application of the groundwater models was designed to address regional-scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations related to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor groundwater pumping and overall conditions of the aquifer. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine this analysis in the future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

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APPENDIX 8

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