SLEDGE LAW GROUP PLLC
919 Congress Ave., Suite 460, Austin, Texas 78701 • Ph: 512-579-3600 • www.sledgelaw.com

B. Sledge Direct: 512-579-3601
Fax: 512-579-3611
Email: bsledge@sledgelaw.com

December 14, 2016

Mr. Jeff Walker
Executive Administrator
Texas Water Development Board
1700 North Congress Avenue
P.O. Box 13231
Austin, TX 78711-3231

Via Hand Delivery

Re: Petition Appealing Desired Future Conditions Adopted by Lone Star GCD

Dear Mr. Walker,

Please find attached a petition from Quadvest, L.P., which was received by the Lone Star Groundwater Conservation District ("District") on December 6, 2016, appealing the desired future conditions adopted by the District. As required by Section 36.1083, Water Code, the District hereby submits this copy of the petition not later than the 10th day after its receipt to the Texas Water Development Board to conduct its review and study as prescribed by the statute.

If you have any questions related to this submission, please do not hesitate to contact me at your convenience.

Sincerely,

Brian L. Sledge
Legal Counsel for the District

Attachment

CC: Ms. Kathy Turner Jones, General Manager
Mr. Richard Tramm, Board President

SPROUSE SHRADER SMITH P.C.
ATTORNEYS AT LAW

MARVIN W. JONES
(806) 468-3344

December 5, 2016

Via Federal Express

Kathy Turner Jones
General Manager
LONE STAR GROUNDWATER CONSERVATION DISTRICT
655 Conroe Park North Drive
Conroe, Texas 77303

RE: Petition of Quadvest, L.P. Appealing Desired Future Conditions Adopted by Lone Star Groundwater Conservation District

Dear Ms. Jones:

Enclosed please find the Petition of Quadvest, L.P. Appealing the Desired Future Conditions of GMA 14 Adopted by Lone Star Groundwater Conservation District. The petition has been enclosed in both paper and electronic format.

If you have any questions or concerns, please feel free to contact me at (806) 468-3344.

Respectfully,

Marvin W. Jones

Enclosure

cc: Brian Sledge – *via email* bsledge@sledgelaw.com
Simon Sequeira – *via email* simon@quadvest.com
Michael Stoecker – *via email* mike@stoe3ckercorp.com
Michael Powell – *via email* mpowell@lockelord.com

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PETITION OF QUADVEST, L.P.	§	
	§	
APPEALING DESIRED FUTURE	§	
CONDITIONS ADOPTED BY	§	**PURSUANT TO TEX. WATER**
	§	**CODE SEC. 36.1083**
LONE STAR GROUNDWATER	§	
CONSERVATION DISTRICT	§	

PETITION OF QUADVEST, L.P. APPEALING DESIRED FUTURE CONDITIONS OF GMA 14 ADOPTED BY LONE STAR GROUNDWATER CONSERVATION DISTRICT

To the Lone Star Groundwater Conservation District, by and through its Board of Directors, Richard J. Tramm, Sam W. Baker, M. Scott Weisinger P.G., Jim Stinson, P.E., John D Bleyl, P.E., Jace Houston, Roy McCoy, Jr., Rick Moffatt, and W. B. Wood, and General Manager, Kathy Turner Jones, 655 Conroe Park North Drive, Conroe, Texas 77303:

1. Every owner of groundwater rights in the same aquifer is entitled to be treated equally.[1] *Marrs v. Railroad Commission,* 177 S.W.2d 941 (Tex. 1944); *Coyote Lake Ranch, LLC v. City of Lubbock*, ___S.W.3d __, 59 Tex. Sup. J. 967, 2016 Tex. Lexis 415 (May 27, 2016). The groundwater conservation districts of Groundwater Management Area 14 ("GMA 14") have failed to ensure this basic right. For this and other reasons, the Desired Future Conditions ("DFCs") adopted by GMA 14 and Lone Star Groundwater Conservation District ("LSGCD" or "District") are unreasonable.

[1] "Every owner … is entitled to a fair chance to recover the [groundwater] in or under his land … and any denial of such fair chance amounts to confiscation." *Marrs* at 948.

2. Quadvest, L.P. is the owner of groundwater rights within GMA 14 from which it produces groundwater used to serve the consuming public under certificates of convenience and necessity issued by the Public Utility Commission of Texas (PUC). These properties are located within the boundaries of LSGCD.

3. Quadvest, L.P. files this Petition pursuant to Texas Water Code Section 36.1083, requiring LSGCD to contract with the State Office of Administrative Hearings ("SOAH") to conduct a hearing appealing the reasonableness of the DFCs of the groundwater resources established pursuant to Texas Water Code Section 36.108(d-4) by the groundwater conservation districts comprising GMA 14.

I.
BACKGROUND

4. GMA 14 is a groundwater management area designated by the Texas Water Development Board ("TWDB") pursuant to Texas Water Code § 35.004. GMA 14 is comprised of LSGCD, Bluebonnet Groundwater Conservation District, Brazoria County Groundwater Conservation District, Lower Trinity Groundwater Conservation District, and Southeast Texas Groundwater Conservation District. These districts are collectively referred to herein as "the Districts."

5. Quadvest, L.P. is an affected person within the meaning of Texas Water Code Section 36.1083(a)(1) and 31 T.A.C. § 356.10(1) because it is a privately owned utility company and owner of land used to produce water for sale to the public which holds permits issued by LSGCD in the groundwater management area encompassed in GMA 14, and owns groundwater rights in the groundwater management area encompassed in GMA 14.

6. On April 29, 2016, the Districts of GMA 14 officially approved Resolution 2016-01 (Appendix A, Exhibit 1), and LSGCD then adopted the DFCs described therein for Montgomery County on August 9, 2016 (Appendix A, Exhibit 2). This Petition is filed not later than the 120th day after the date on which LSGCD actually adopted such DFCs.

7. Appendix A lists technical and scientific evidence upon which Quadvest, L.P. relies to demonstrate that the DFCs adopted by LSGCD are not reasonable. Appendix A outlines the undisputed fact that none of the aquifers underlying GMA 14 are encompassed by county lines; all the aquifers extend over most, if not all, of the area of GMA 14, without regard to the political subdivisions lines of cities or counties.

8. The Districts of GMA 14 issued their Explanatory Report (Appendix A, Exhibit 10) as required by Texas Water Code Section

36.108(d-3). In the Explanatory Report, the Districts admit that the basis for the adopted DFCs was the protection of existing well owners from having to lower their pumps or drill new wells. (Explanatory Report at Section 4.1, pages 27-28). But that action prohibits other groundwater owners from accessing and enjoying that which is their constitutionally protected property. The Explanatory Report further admits that the second—and only other—justification for the GMA 14 DFCs is to prevent subsidence. But the Explanatory Report lumps all aquifers in all counties into its subsidence rationale; the undisputed scientific evidence shows that (a) there is relatively little to no subsidence in Montgomery County, and (b) there is not and will never be subsidence in the Jasper aquifer.

9. In other words, the Explanatory Report fails to justify the Montgomery County DFCs, which are based entirely on LSGCD's predetermined notions of how much groundwater it will "give" the owners of groundwater in its territory. This violation of private property rights compels the conclusion that the DFCs are unreasonable.

10. For these and other reasons, the DFCs adopted by LSGCD are not reasonable.

II.
LEGAL PRINCIPLES

11. Groundwater rights are a valuable and fundamental attribute of private property ownership in Texas. *Edwards Aquifer Authority v. Day*, 369 S.W.3d 814 (Tex. 2012); TEX. WATER CODE § 36.002. An unbroken line of Texas Supreme Court opinions has recognized the significant value of those groundwater rights, acknowledged Texas landowners' reliance on those valuable rights, and vigorously enforced statutory and constitutional protections of those rights. *Day*, 369 S.W.3d at 814; *Houston and Texas Central Railroad Co. v. East*, 81 S.W. 279 (Tex. 1904); *Texas Co. v. Burkett*, 296 S.W. 273, 278 (Tex. 1927); *City of Corpus Christi v. City of Pleasanton*, 276 S. W.2d 798 (Tex. 1955); *Sun Oil Co. v. Whitaker*, 483 S.W.2d 808, 811 (Tex. 1972); *Friendswood Dev. Co. v. Smith-Southwest Indus., Inc.*, 576 S.W.2d 21, 25-27 (Tex. 1978); *City of Sherman v. PUC*, 643 S.W.2d 681, 686 (Tex. 1983); *Moser v. United States Steel*, 676 S.W.2d 99, 102 (Tex. 1984); *Gifford-Hill & Co. v. Wise County Appraisal Dist.*, 827 S.W.2d 811, 815n.6 (Tex. 1992); *Sipriano v. Great Spring Waters of America*, 1 S.W.3d 75, 79 (Tex. 1999). *See also Edwards Aquifer Authority v. Bragg*, 421 S.W.3d 118 (Tex. App.—San Antonio 2013, pet. denied); *Pecos County WCID No. I v. Williams*, 271 S.W.2d 503 (Tex. Civ. App.—El

Paso 1954, writ ref'd n.r.e.); *Bartley v. Sone*, 527 S.W.2d 754, 759-60 (Tex. Civ. App.—San Antonio 1975, writ ref'd n.r.e.); *City of Del Rio v. Clayton Sam Colt Hamilton Trust*, 269 S.W.3d 613, 617-618 (Tex. App.—San Antonio 2008, pet. denied); S*ee also* U.S. Const. Amend. V, XIV; TEX. CONST. ART. I, §17; TEX. WATER CODE § 36.002.; S*ee generally* W. HUTCHINS, THE TEXAS LAW OF WATER RIGHTS, 556-572 (1961); Drummond, Sherman & McCarthy, *The Rule of Capture in Texas-Still Misunderstood After All of These Years*, 37 Tex. Tech. L. Rev. 1 (2004); Jones & Little, *The Ownership of Groundwater in Texas: A Contrived Battle For State Control of Groundwater*, 61 Baylor Law Rev. 578 (2009).

12. Chapter 36 of the Texas Water Code, from which the Districts derive their existence and authority, expressly recognizes and adopts the common law rule vesting ownership of groundwater in landowners. TEX. WATER CODE § 36.002. Section 36.002 states in pertinent part that a landowner, including lessees and assigns, "owns the groundwater below the surface of the landowner's land as real property'' and that "[n]othing in this code shall be construed as granting the authority to deprive or divest a landowner, including a landowner's lessees, heirs, or assigns, of the groundwater ownership and rights described by this section." TEX. WATER CODE § 36.002(a), (c), (emphasis added).

13. In analyzing the propriety of the actions of a groundwater conservation district, the Supreme Court has expressly held that analogous legal principles developed in oil and gas cases may provide direction in matters involving groundwater. *Day* at 831; *Coyote Lake Ranch, LLC,* No. 14-0572,___S.W.3d __, 59 Tex. Sup. J. 967, 2016 Tex. Lexis 415 *27-28 (May 27, 2016). ("Analogizing groundwater to minerals in determining the applicability of the accommodation doctrine is no less valid than it is in determining ownership. Common law rules governing mineral and groundwater estates are not merely similar; they are drawn from each other or from the same source.")

14. Under the Texas Constitution, a groundwater conservation district like LSGCD has only powers as "may be conferred by law." TEX. CONST. Art. XVI, §59(b). Accordingly, the power of LSGCD is limited to the terms of its applicable statutes; LSGCD can exercise no authority the Legislature has not clearly granted. *See, e.g., Tri-City Fresh Water Supply Dist. No. 2 v. Mann*, 142 S.W.2d 945, 948 (Tex. 1941) ("The powers of such districts are measured by the terms of the statutes which authorized their creation, and they can exercise no authority that has not been clearly granted by the legislature."); *South Plains Lamesa RR, Ltd. v. High Plains*

Underground Water Conservation Dist. No. 1, 52 S.W.3d 770, 776 (Tex. App.—Amarillo 2001, no pet.).

III.
THE ADOPTED DFCS FAIL TO PROTECT PRIVATE PROPERTY RIGHTS

15. By statute, the districts in GMA 14 are required to consider the impact of proposed DFCs on private property, including ownership and the rights of management area landowners and their lessee and assigns in groundwater. Texas Water Code §36.108(d)(7). The District failed to consider the impact of proposed DFCs on private property, including ownership and the rights of management area landowners and their lessee and assigns in groundwater. The adopted DFCs will damage or destroy private property, including ownership and the rights of management area landowners and their lessee and assigns in groundwater.

16. The Explanatory Report notes at page 27 that "the two overriding policy justifications for the DFCs adopted by GMA 14 are socioeconomic considerations and impacts on private property rights."

17. At page 28 of the Explanatory Report, the Districts admit:

> "[t]he primary economic and private property impact analyses that were considered by the GMA 14 District Representatives that justify the adoption of the DFCs were the impacts of those DFCs on **the economic costs to landowners of producing groundwater**. The

> evidence clearly indicates that economic considerations, and their inseparability from protection of private property rights, are the controlling factor behind the selection of the adopted DFCs." (Emphasis in original).

18. The Explanatory Report then attempts to tie this supposed economic harm incurred by the favored few to a secondary concern for "subsidence" that might be caused by increased production. The analysis is flawed and fails for several reasons.

19. First, and perhaps of the greatest constitutional concern, is the explicit decision that those who are currently accessing their private property should be protected from production that exceeds the current recharge[2] so that these current producers will not have to lower their pumps. The correlative rights of those who are not currently producing groundwater are disregarded by the Districts. The GMA 14 approach, then, is to implement a de facto historic use regime that disadvantages groundwater rights owners except those who currently produce groundwater. This approach to regulation was examined in *Bragg v. Edwards Aquifer Authority,* 421 S.W.3d 118 (Tex. App.--San Antonio, writ den'd) and found to result in a taking of private property for public purposes without compensation, in derogation of the constitutional protections afforded to private property

[2] As noted more fully below, Quadvest does not agree that current recharge is 64,000 acre feet per year. That estimate is scientifically flawed, or put another way, is not based on the best available science.

owners. The District's approach is actually worse than *Bragg* because it amounts to a taking of private property for private purposes, which is not allowed in Texas.[3] DFCs that result in unconstitutional takings are unreasonable as a matter of law.

20. Second, the LSGCD DFCs have and will result in rules that deprive groundwater rights owners in Montgomery County of their fair opportunity to produce a fair share of the groundwater beneath the county. This happens because groundwater owners who are not producing today lose their right to equal access to their private property so that the current producers won't be required to lower their pumps or drill new wells. The Texas Supreme Court has explicitly stated that groundwater rights owners are entitled to produce a fair share of the groundwater in an aquifer. *Day* at 830. This is in accord with well-settled law in the oil and gas area. *See Railroad Commission v. Shell Oil*, 380 S.W.2d 556 (Tex. 1964); *Railroad Commission v. Williams*, 356 S.W.2d 131 (Tex. 1961). *See also, Elliff v. Texon Drilling Co.*, 210 S.W.2d 558, 562 (1948) ("[O]ur courts, in decisions involving well-spacing regulations of our Railroad Commission, have frequently announced the sound view that each landowner should be

[3] *See* Texas Gov't Code Section 2206.001,*et seq.*

afforded the opportunity to produce his fair share of the recoverable oil and gas beneath his land....").

21. Third, the Explanatory Report fails to quantify the cost to the current producers to lower pumps or drill deeper wells. Further, the Explanatory Report fails to analyze or quantify the market value of the groundwater in storage put "off limits" by the LSGCD DFCs. Every owner of groundwater rights is damaged by LSGCD's actions because all groundwater in storage—as much as 180 million acre feet[4]—has been condemned and becomes valueless. If that groundwater is valued at the cost of surface water from San Jacinto River Authority, then the DFCs and resulting regulatory rules effectively condemn billions of dollars of groundwater. Given the magnitude of this harm, it is hard to imagine that the cost to current producers of lowering pumps or drilling new wells outweighs the economic loss to all other groundwater rights owners. But again, the Explanatory Report fails to quantify either cost.

22. In an attempt to achieve its DFCs, LSGCD has adopted (and will be required to continue to enforce) rules regarding production of groundwater that are more restrictive than those of neighboring districts. The

[4] Exhibit 7: Shirley Wade, Ph.D., P.G., David Thorkildsen, P.G., and Roberto Anaya, P.G., *GAM Task 13-037: Total Estimated Recoverable Storage for Aquifers in Groundwater Management Area 14*, Texas Water Development Board (June 09, 2014)("TERS Report").

DFCs and rules adopted by LSGCD explicitly prevent any use of groundwater in storage under Montgomery County, a resource that belongs to the landowners and groundwater rights owners. As a result, groundwater in storage in Montgomery County will be captured by production from wells outside the County's boundaries. This drainage of privately owned real property will be the result of the actions of Defendants, a governmental entity and its officials, without compensation to Plaintiffs. Moreover, the lack of ability to offset drainage and the lower production limits, together and separately, have caused and will cause a diminution in the fair market value of all groundwater rights in Montgomery County. None of these factors are considered in the superficial analysis set forth in the Explanatory Report.

23. As a second justification for the LSGCD DFCs, the Explanatory Report relies on the "economic costs" caused by subsidence in GMA 14. However, the Report wholly fails to acknowledge that the greatest amount of groundwater in storage in Montgomery County is found in the Jasper Aquifer, where the greatest current pumping takes place. The attached affidavit of Michael Thornhill (Appendix A, Exhibit 8) demonstrates that no subsidence has ever occurred or will ever occur from pumping in the Jasper

aquifer. Thus, from a factual standpoint, the rationale for LSGCD's DFCs is fundamentally wrong.

24. The Explanatory Report boils its DFC justifications down to two premises, both of which are demonstrably wrong. Because the LSGCD DFCs result in a prohibited taking of private property, they are unreasonable as a matter of law.

IV.
LSGCD ESTABLISHED MULTIPLE DFCs FOR THE SAME AQUIFERS

25. Contrary to Tex. Water Code Section 36.108(d) and contrary to GMA 14's own administrative rules, the groundwater conservation districts of GMA 14 (including LSGCD) adopted multiple DFC's for the same aquifers within GMA 14, based on political subdivision lines rather than aquifer subdivisions or conditions. Such DFCs are unreasonable because (1) DFCs that vary from county to county over the same aquifer violate the statutory directives for establishing DFCs; (2) TWDB staff has previously issued a memorandum discouraging DFCs based solely on political subdivisions; and (3) the DFCs violate GMA 14's own administrative rules. (Appendix A, Exhibit 11). As noted above, multiple DFCs for a single aquifer will ultimately result in disparate and unequal rules and regulatory requirements that deprive groundwater rights owners of their right to a fair

opportunity to produce a fair share of the groundwater in the relevant aquifers.

26. GMA 14 includes several different aquifers of the Gulf Coast aquifer system. These aquifers are not confined to the area encompassed by the boundaries of LSGCD, and the boundaries of LSGCD (the political lines outlining Montgomery County) are not coterminous with the boundaries of any of such aquifers. (Affidavit of Thornhill, Appendix A, Exhibit 8). None of the groundwater conservation districts of GMA 14 completely encompass any of the aquifers in the management area of GMA 14, and no groundwater conservation district in GMA 14 has boundaries coterminous with the boundaries of any such aquifers. *Id.*

27. Withdrawals of groundwater from the aquifers of the Gulf Coast aquifer system outside the boundaries of LSGCD can and will affect the groundwater resources inside the boundaries of LSGCD. *Id.* Therefore, production from any of the Gulf Coast aquifers under Montgomery County will affect groundwater in adjacent counties, and production from any of those aquifers under any adjacent counties will impact groundwater in Montgomery County. *Id.* LSGCD cannot change that hydrological fact.

28. On April 29, 2016, the groundwater conservation districts of GMA 14 adopted the DFCs reflected in Resolution 2016-01-01, a copy of

which is attached as Exhibit 2 to Appendix A. In that resolution, the groundwater conservation districts of GMA 14 claimed to adopt a single DFC for each relevant aquifer across the entire breadth of GMA 14, but also adopted different and separate DFCs for each relevant aquifer in each separate county encompassed in GMA 14. Thus, as an example, the Jasper Aquifer in Montgomery County and Liberty County has two DFCs, described in terms of "average draw down" from estimated 2009 conditions after 61 years:

County	County DFC	GMA-Wide DFC
Montgomery	34	66.2
Liberty	120	66.2

29. Montgomery and Liberty Counties are adjacent to one another. There is no aquifer subdivision or other hydrological barrier in the Jasper Aquifer as it exists between Montgomery and Liberty counties. *Id.* Production of groundwater on one side of the county line will affect groundwater on the other side. *Id.* There is no groundwater conservation district in Liberty County, and there are no production limits or spacing and density rules that apply to that county.

The GMA 14 DFCs are Contrary to the Intent of Water Code § 36.108

30. The differing county-specific DFCs adopted by the Districts violate the statutory direction for DFCs. Section 36.108(d-1) of the TEXAS WATER CODE, provides:

> (d-1) The districts may establish different desired future conditions for:
>
> (1) each aquifer, subdivision of an aquifer, or geologic strata located in whole or in part within the boundaries of the management area; or
>
> (2) each geographic area overlying an aquifer in whole or in part or subdivision of an aquifer within the boundaries of the management area.

31. The groundwater conservation districts of GMA 14, including LSGCD, have violated the provisions of Texas Water Code § 36.108(d-1) by adopting different DFCs for each of the aquifers in each of the counties in GMA 14. There are no identified aquifer subdivisions in any of the aquifers of the Gulf Coast aquifer system. Specifically, there are no identified subdivisions in the Jasper Aquifer, no identified subdivisions in the Evangeline Aquifer, and no identified subdivisions in the Chicot Aquifer. *Id.* There are no identified geographical areas overlying the aquifer as they relate to unique or specific natural conditions that would affect groundwater. The DFCs established for GMA 14 are tied strictly to political subdivision

lines which do not delineate substantial and discernible differences in uses or conditions of these aquifers, either coincidentally or otherwise. *Id.* The DFCs adopted by the districts of GMA 14 are based entirely on political subdivision lines, and the aquifers do not "see" those political lines. LSGCD is not authorized by the Texas Water Code to adopt DFCs based only on political subdivision lines.

32. The DFCs for LSGCD's Montgomery County are not based on substantial and discernible differences in uses or conditions as between the two counties, but on the stated objective of LSGCD to limit groundwater production to what it mistakenly claims to be a "sustainable" amount equal to just the recharge to the portions of aquifers within Montgomery County. *See, e.g.,* Lone Star Groundwater Conservation District Groundwater Management Plan adopted October 14, 2003 at p. 8 ("The estimated annual amount of recharge to the groundwater resources of the District is 64,000 acre-feet per year."); [5] Lone Star Groundwater Conservation District Groundwater Management Plan adopted October 14, 2008 at p. 7 ("However, in 2003, the District adopted in its Management Plan an

[5] Available at http://lonestargcd.org/wp-content/uploads/2014/09/031014-Final-Adopted-Management-Plan-BS.pdf (last visited September 22, 2016).

available useable groundwater amount of 64,000 acre-feet per year."); [6] Lone Star Groundwater Conservation District Groundwater Management Plan adopted November 12, 2013 at p. 6 ("Pursuant to the District Rules and this management plan, the District shall seek to limit production of groundwater from the resources within its boundaries to a sustainable level, so that the groundwater resources of Montgomery County are not depleted for future generations. For purposes of this plan, the word sustainable" means limiting total groundwater production in the District or in a management zone designated by the District to an amount that does not exceed the amount of effective deep aquifer recharge available in the District or the management zone, as applicable when averaged over a term of years to be determined by the District.") [7]

33. This "sustainable amount" of 64,000 acre-feet per year has been in the LSGCD management plan (and implementing rules) since well before any DFCs were ever mandated by the Legislature or adopted by LSGCD. The 2016 DFC for the Jasper Aquifer of no more than 34 feet of drawdown over the next 60 years is based solely on LGGCD's desire to limit groundwater production in Montgomery County to an amount equal to the

[6] Available at http://lonestargcd.org/wp-content/uploads/2014/09/031014-Final-Adopted-Management-Plan-BS.pdf (last visited September 22, 2016).

[7] Available at http://lonestargcd.org/wp-content/uploads/2014/09/Lone-Star-Mgmt-Plan-Update-2013-FINAL.pdf (last visited September 22, 2016).

recharge, i.e., 64,000 acre-feet per year. *Id.* The Jasper DFC is therefore not based on the factors set forth in Section 36.108(d-1), but on a decision made long ago, before the Legislature created the requirement for DFCs. Basing DFCs on political or non-scientific feelings rather than the factors set forth in Texas Water Code Section 36.108(d) is pure pretense, and unreasonable as a matter of law.

34. Not only is the recharge calculation arbitrary and wrong,[8] it is not based on and does not equate to "substantial and discernible difference in uses or conditions" of the aquifers. The resulting DFC for each aquifer is simply "reverse-engineered" to meet the above-stated political objective of LSGCD. *Id.* Basing DFCs on political subdivision lines is unreasonable where political subdivision lines do not reflect substantial and discernible differences in uses or conditions of an aquifer.

The GMA 14 DFCs Are Contrary to TWDB Opinions

35. On March 10, 2010, TWDB staff prepared a memo to its board discussing the use of "geographic areas" in establishing DFCs. (Appendix A, Exhibit 9). In that Memorandum, TWDB Director of Groundwater Resources William R. "Bill" Hutchison and General Counsel Kenneth L.

[8] LSGCD has struggled to explain the origin of the 64,000 acre feet number, but it appears to be based on a simplistic calculation of rainfall that makes its way to each acre of surface over of the aquifers multiplied by the acres in the county, without regard for the size of the recharge zones of the separate aquifers or inflows from other counties.

Petersen presented the issue whether districts in a GMA may delineate different "geographic areas" within the GMA by use of political subdivision boundaries. Hutchison and Petersen advised the TWDB that such practice was defensible only if the political subdivision boundaries happened to coincide with "substantial and discernible differences in uses or conditions" within the GMA. TWDB's Memorandum continues: "It should be emphasized that employing geographic areas that are not based on clear and substantial differences in uses or aquifer conditions is not supportable, regardless of how those geographic areas are drawn." The Memorandum concludes:

> The argument that the omission of "political subdivision boundaries" from Section 36.108(d) is not persuasive, as long as the groundwater conservation districts do not appear to be using county or other political subdivision lines to gerrymander DFCs for purposes other than accommodating discernible, substantial differences in uses or aquifer conditions within the GMA.

36. Accordingly, the DFCs adopted by the Districts of GMA 14, including LSGCD, are unreasonable because they fail to adhere to TWDB's guidance; Texas Water Code Section 36.108(d-1); and *Marrs v. Railroad Commission*, 177 S.W.2d 941 (Tex. 1944).

37. Section 4.3 of the Explanatory Report relies on Texas Water Code §36.108(d-1) to justify its disparate DFCs for the same aquifer, claiming that the Legislature intended to allow GCDs to establish different DFCs based on political subdivision boundaries. To the extent that Section 36.108(d-1) is construed to allow arbitrary lines to be drawn across an aquifer for regulatory purposes, that legislation would be unconstitutional. *See Marrs,* 177 S.W.2d 941. Texas courts are instructed to avoid construction of a statute that would render the statute unconstitutional. *City of Houston v. Clark*, 197 S.W.3d 314, 320 (Tex. 2006); *Brady v. Fourteenth Court of Appeals*, 795 S.W.2d 712, 715 (Tex. 1990); Texas Gov't Code § 311.021.

The GMA 14 DFCs are Contrary to GMA 14's Administrative Rules

38. The groundwater conservation districts of GMA 14 adopted certain administrative procedures for the consideration, proposal, and adoption of desired future conditions for GMA 14 ("GMA 14 Administrative Procedures," Appendix A, Exhibit 11) Included in the administrative procedures are the following sections:

a. "Section 2.04 The GMA 14 Member Districts, as a group to engage in joint planning activities, shall have only the power granted by Chapter 36, Water Code, that relates to joint planning activities."

b. "Section 3.05 Only after consideration of the nine statutory factors as stated in Section 3.04 may a DFC option become eligible for approval as the proposed DFC. **For each relevant aquifer** in GMA 14, the Member District Representatives shall approve by two-thirds vote of the total Member District Representatives **one DFC option** to serve as the proposed DFC as required by Sections 36.108(d) and (d-2), Water Code. The proposed DFC must provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in GMA 14. (Emphasis added).

39. In undertaking to define different DFCs for each aquifer in each county of GMA14 as noted above, the districts, including LSGCD, have violated Section 2.04 of the GMA 14 Administrative Procedures specifying that the Districts have only the power granted by Chapter 36 of the Texas Water Code that relates to joint planning activities.

40. The groundwater conservation districts of GMA 14, including LSGCD, have violated Section 3.04 of the GMA 14 Administrative Procedures by adopting more than one DFC for each relevant aquifer within GMA 14.

41. Adopting two DFCs for each relevant aquifer in each county prevents each groundwater conservation district from complying with the requirements of Texas Water Code Sections 36.1085 and 36.1132, which requires each district to achieve the DFC of each aquifer. Adopting two

DFCs for each relevant aquifer also prevents TWDB from designating the "modeled available groundwater" for each relevant aquifer pursuant to Texas Water Code Section 36.1084.[9]

42. Section 4.3 of the Explanatory Report attempts to disguise the reality that GMA 14 adopted different DFCs based on county lines. That section states that only one DFC was adopted for each relevant aquifer in GMA14, and the average drawdown for each county was then calculated. The Explanatory Report claims that the DFCs adopted for each aquifer in each GCD were not DFCs at all, but just a calculated average of GMA-wide DFCs. However, the Explanatory Report at Section 3.0 sets forth the adopted DFCs for both GMA 14 and for the individual counties in GMA 14, expressing all DFCs in identical language, and states that the county DFCs are "...to better facilitate the management and conservation of groundwater resources at the individual GCD level..." If only one DFC has been adopted by GMA 14 for the Jasper aquifer, then LSGCD must amend its rules to allow groundwater owners in Montgomery County to produce an amount of groundwater up to the point that the total volume of exempt and permitted

[9] In calculating the Modeled Available Groundwater for LSGCD, for example, will the TWDB use the adopted DFC for the Jasper Aquifer as stated for Montgomery County, or will the TWDB calculate one MAG number for the Jasper Aquifer on a GMA-wide level? Or will it calculate two MAG numbers for each aquifer for each county? Will each GCD have separate rules designed to implement the individual county DFCs, or will all the GCDs have a single set of rules designed to achieve the GMA-wide DFC for each aquifer?

groundwater production could cause 66.2 feet of drawdown in the Jasper aquifer over the next 61 years. Texas Water Code § 36.1132. The District has not done so, but has persisted in imposing restrictions that would allow only 34 feet of drawdown in that aquifer over that period.

43. Because all the GCDs in GMA 14 have different rules, and because the county level DFCs were reversed engineered to reflect local political decisions, the statement in the Explanatory Report is disingenuous, designed to disguise the fact that GMA 14 adopted a different DFC for each aquifer in each county. The existence of the statement in Section 3.1 indicates that the Districts were aware of the requirements of the statute, and were simply glossing over their failure to follow the command of the Legislature.

V.
THE GMA 14 DFCS FAIL TO MEET STATUTORY CRITERIA

44. The Explanatory Report provided by GMA 14 reveals that the Districts failed to meet several statutory criteria that must be considered as part of the DFC process. Further, the Explanatory Report is not based on the type of analytical process contemplated or required under Texas Water Code § 36.108.

45. By statute, the districts in GMA 14 are required to consider the total estimated recoverable storage ("TERS") in an aquifer before voting on DFCs. Texas Water Code Section 36.108(d)(3). Although TWDB issued a TERS Report for GMA 14 (Appendix A, Exhibit 7), the District failed to actually consider the total estimated recoverable storage of the aquifers in question. In fact, Section 5.3 of the Explanatory Report admits that the Districts ignored the TERS report because of "the negative socioeconomic impacts of subsidence." But subsidence is not relevant to the Jasper Aquifer, so ignoring the TERS is not reasonable as to that aquifer.

46. The adopted DFCs are artificially and adversely impacted by the failure to consider total estimated recoverable storage. Because the DFCs do not address aquifer storage, the rights of groundwater owners in the District's boundaries are adversely impacted.

47. The Districts of GMA 14 failed to provide an explanatory report for each DFC for each aquifer in each groundwater conservation district of GMA 14 as required by statute. The alleged justifications for the adopted DFCs wholly fail to address each aquifer separately, and the justifications set forth in the Explanatory Report either do not apply to all aquifers, or do not apply in the same manner to all aquifers.

VI.
INCORPORATION BY REFERENCE OF PETITION OF CITIES OF CONROE AND MAGNOLIA, TEXAS

48. The Cities of Conroe and Magnolia, Texas have filed their petition challenging the DFCs adopted by LSGCD. Quadvest, L.P. hereby incorporates by reference all of the matters set forth in the Petition of The Cities of Conroe and Magnolia, Texas Appealing Desired Future Conditions of GMA 14 Adopted By Lone Star Groundwater Conservation District, together with all attachments and exhibits to that Petition.

VII.
REQUESTS FOR LSGCD ACTION

49. Quadvest, L.P. respectfully requests that this Board contract with SOAH to conduct a hearing with respect to the reasonableness of the DFCs adopted by LSGCD, and to perform the other duties required of it pursuant to Texas Water Code Section 36.1083.

50. Texas Water Code § 36.1083(e) requires this Board to forward a copy of this Petition to TWDB to conduct a study containing scientific and technical analysis of the DFCs. However, Quadvest respectfully submits that this procedure would place TWDB in an irreconcilable conflict of interest because TWDB holds more than $400,000,000 in bonds issued by San Jacinto River Authority, which bonds explicitly state that a risk of bond

purchase is that SJRA has based its System (as defined in the bond issuance) and budget on the requirements set forth in the LSGCD regulations. Accordingly, TWDB's substantial investment in SJRA bonds could be at risk if LSGCD must alter its regulations as a result of its DFCs being struck down as unreasonable. At the least, TWDB should be requested to direct its members, employees, and staff to refrain from communicating with the parties, their agents, attorneys, witnesses, and representatives, including the Mr. Mullican and the consultants involved in preparing the questioned DFCs or the Explanatory Report.

51. Quadvest, L.P. requests SOAH to conduct all pre-hearing conferences, discovery matters, and contested case hearing pursuant to Texas Water Code Section 36.1083 and consistent with the procedural rules of the office and all other applicable laws.

52. Quadvest, L.P. prays that upon final hearing hereof, the duly appointed administrative law judge for SOAH find that Lone Star Groundwater Conservation District's Desired Future Conditions adopted on August 9, 2016 are unreasonable and grant all other relief to which Quadvest, L.P. is entitled under Texas Water Code Section 36.1083 and other applicable laws, together with its reasonable attorneys' fees and costs of this proceeding.

Respectfully submitted,

Marvin W. Jones
Texas Bar No. 10929100
marty.jones@sprouselaw.com
C. Brantley Jones
Texas Bar No. 24079808
brantley.jones@sprouselaw.com
SPROUSE SHRADER SMITH PLLC
701 S. Taylor, Suite 500
Amarillo, Texas 79101
Tel: 806-468-3300
Fax: 806-373-3454

Attorneys for Quadvest, LP

APPENDIX A

1. Exhibit 1: GMA 14 Resolution 2016-01-01;
2. Exhibit 2: Minutes of August 9, 2016 Meeting of Board of Directors of LSGCD (highlighting in original);
3. Exhibit 3: HAGM Run Rev20140610; [10]
4. Exhibit 4: Map of the DFCs for the Chicot aquifer as it exists in GMA 14 as adopted by the Districts;
5. Exhibit 5: Map of the DFCs for the Evangeline aquifer as it exists in GMA 14 as adopted by the Districts;
6. Exhibit 6: Map of the DFCs for the Jasper aquifer as it exists in GMA 14 as adopted by the Districts;
7. Exhibit 7: TERS Report
8. Exhibit 8: Affidavit of Michael Thornhill;
9. Exhibit 9: TWDB Memorandum dated March 10, 2010;
10. Exhibit 10: GMA 14 Explanatory Report; [11]
11. Exhibit 11: Administrative Rules of GMA 14.

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[10] HAGM Run Rev20140610 is not attached to this Petition because (a) it is a publicly available document and (b) a printout of the document would be voluminous at an estimated 60,000 pages. However, Petitioners refer to HAGM Run Rev20140610 in its entirety because GMA 14 and LSGCD appear to have adopted hundreds of thousands of individual DFCs described in that model. An electronic version of Exhibit 3 will be made available at or before the hearing or on request.

[11] Produced here without appendices, which will be produced at or before the hearing or on request.

RESOLUTION FOR THE APPROVAL OF DESIRED FUTURE CONDITIONS FOR ALL AQUIFERS IN GROUNDWATER MANAGEMENT AREA 14

Whereas, pursuant to Section 35.004 of the Texas Water Code, the Texas Water Development Board ("TWDB") has designated groundwater management areas that, together, cover all major and minor aquifers in the state; and

Whereas, each groundwater management area was designated with the objective of providing the most suitable area for the management of groundwater resources; and

Whereas, through Title 31, Section 356.21 of the Texas Administrative Code, the TWDB has designated the area encompassing all of Austin, Brazoria, Chambers, Fort Bend, Galveston, Grimes, Hardin, Harris, Jasper, Jefferson, Liberty, Montgomery, Newton, Orange, Polk, San Jacinto, Tyler, Walker, Waller, and Washington counties as Groundwater Management Area No. 14 ("GMA 14"); and

Whereas, GMA 14 includes all or portions of areas subject to groundwater regulation by Bluebonnet Groundwater Conservation District (Austin, Grimes, Walker, and Waller counties), Brazoria County Groundwater Conservation District (Brazoria County), Lone Star Groundwater Conservation District (Montgomery County), Lower Trinity Groundwater Conservation District (Polk and San Jacinto counties), and Southeast Texas Groundwater Conservation District (Hardin, Jasper, Newton, and Tyler counties) (the "Member Districts"); and

Whereas, the Member Districts are authorized by Chapter 36, Texas Water Code, to engage in joint planning activities for the coordinated management of the aquifers located in GMA 14, and in that regard, shall establish desired future conditions ("DFCs") for the relevant aquifers within GMA 14; and

Whereas Fort Bend Subsidence District (Fort Bend County), Harris-Galveston Subsidence District (Galveston and Harris counties), and other stakeholders within GMA 14 from Chambers County, and Washington County also contributed to the development of DFCs for GMA 14; and

Whereas, Section 36.108 of the Texas Water Code requires the Member Districts in GMA 14 to consider groundwater availability models and other data or information for the management area and vote on a proposal for the adoption of DFCs for each relevant aquifer within GMA 14 by May 1, 2016; and

Whereas, the Member Districts within GMA 14 secured hydrogeologic and engineering consulting services to provide technical support in their efforts to establish requisite DFCs; and

Whereas, in developing the proposed DFCs for the relevant aquifers within GMA 14, the Member Districts in GMA 14 considered the nine statutory factors set forth in Section 36.108(d) of the Texas Water Code:

- aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another,
- the water supply needs and water management strategies included in the state water plan,
- hydrological conditions, including for each aquifer in the management area the total estimated recoverable storage as provided by the executive administrator, and the average annual recharge, inflows, and discharge,
- other environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water,
- the impact on subsidence,
- socioeconomic impacts reasonably expected to occur,
- the impact on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater as recognized under Section 36.002,
- the feasibility of achieving the desired future condition, and
- any other information relevant to the specific desired future conditions; and

Whereas, pursuant to Section 36.108(d-2), the Member Districts also considered in their development of proposed DFCs the balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area; and

Whereas, the Member Districts used this information to developed proposed DFCs for the portions of the northern segment of the Gulf Coast Aquifer that occurs within the bounds of GMA 14; and

Whereas, TWDB conducted an evaluation of the Houston Area Groundwater Model ("HAGM") and adopted it as the updated Northern Gulf Coast Groundwater Availability Model ("GAM"); and

Whereas, the Members Districts conducted a model run of the updated Northern Gulf Coast GAM specifically identified as GAM Run 2 for the purpose of evaluating drawdown in the Northern Gulf Coast Aquifer; and

Whereas, the TWDB has prepared a report for GAM Task 10-052 MAG for the Carrizo-Wilcox Aquifer; and

Whereas, the TWDB has prepared a report for GAM Task 10-053 MAG for the Queen City Aquifer; and

Whereas, the TWDB has prepared a report for GAM Task 10-054 MAG for the Sparta Aquifer; and

Whereas, the TWDB has prepared a report for GAM Task 10-055 MAG for the Yegua-Jackson Aquifer; and

Whereas, the TWDB has prepared a report for Aquifer Assessment Task 10-30 MAG for the Brazos River Alluvium Aquifer; and

Whereas, the TWDB has prepared a report for Aquifer Assessment Task 10-31 MAG for the Navasota River Alluvium Aquifer; and

Whereas, the TWDB has prepared a report for Aquifer Assessment Task 10-32 MAG for the San Bernard River Alluvium Aquifer; and

Whereas, the TWDB has prepared a report for Aquifer Assessment Task 10-33 MAG for the San Jacinto River Alluvium Aquifer; and

Whereas, the TWDB has prepared a report for Aquifer Assessment Task 10-34 MAG for the Trinity River Alluvium Aquifer; and

Whereas, during joint meetings noticed and conducted pursuant to Section 36.108(e) of the Texas Water Code, the Member Districts considered GAMs and other data and information relevant to the development of DFCs for GMA 14, including input and comments from stakeholders within GMA 14; and

Whereas, the Member Districts find that all notice requirements for a meeting, held this day, to take up and consider the approval of the proposed DFCs as described herein for GMA 14 have been, and are, satisfied; and

Whereas, Texas Water Code Section 36.0015(b), as amended by House Bill 200 during the 84th Texas Legislature states that "(b) In order to provide for the conservation, preservation, protection, recharging, and prevention of waste of groundwater, and of groundwater reservoirs or their subdivisions, and to control subsidence caused by withdrawal of water from those groundwater reservoirs or their subdivisions, consistent with the objectives of Section 59, Article XVI, Texas Constitution, groundwater conservation districts may be created as provided by this chapter. Groundwater conservation districts created as provided by this chapter are the state's preferred method of groundwater management in order to protect property rights, balance the conservation and development of groundwater to meet the needs of this state, and use the best available science in the conservation and development of groundwater through rules developed, adopted, and promulgated by a district in accordance with the provisions of this chapter"; and

Whereas, the Member Districts find that the proposed DFCs provided herein for establishment are each merited and necessary for the effective and prudent management of groundwater resources within GMA 14, and have otherwise been developed in accordance with, and do satisfy the obligations imposed by, Chapter 36 of the Texas Water Code and all other applicable laws of the State of Texas.

Now, therefore, be it resolved by the Member Districts of GMA 14 that the following DFCs are each hereby established:

Formations of the Gulf Coast Aquifer

DFCs for the Gulf Coast Aquifer are hereby adopted, as documented by and incorporating herein GAM Run 2, at two scales, which do not differ substantively in their application; the first being for GMA 14 in its entirety, and also, to better facilitate the management and conservation of groundwater resources at the individual groundwater conservation district level after considering the statutory criteria set forth under Section 36.108(d), Water Code, on a county-by-county basis. DFCs for GMA 14 for the Gulf Coast Aquifer are as follows:

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 28.3 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 23.6 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 18.5 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 66.2 feet after 61 years.

Austin County (BGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 39 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 23 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 23 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 76 feet after 61 years.
- From estimated year 1890 conditions, the maximum subsidence in Austin County should not exceed approximately 2.83 feet by the year 2070.

Brazoria County (BCGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 23 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 27 feet after 61 years.

Chambers County

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 32 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 30 feet after 61 years.

Grimes County (BGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 5 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 5 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 6 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 52 feet after 61 years.
- From estimated year 1890 conditions, the maximum subsidence in Grimes County should not exceed approximately 0.12 feet by the year 2070.

Hardin County (STGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 21 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 27 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 29 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 89 feet after 61 years.

Jasper County (STGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 23 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 41 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 46 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 40 feet after 61 years.

Jefferson County

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 15 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 17 feet after 61 years.

Liberty County

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 27 feet after 61 years.

- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 29 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 25 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 120 feet after 61 years.

Montgomery County (LSGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 26 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately -4 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately -4 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 34 feet after 61 years.

Newton County (STGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 35 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 45 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 44 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 37 feet after 61 years.

Orange County

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 14 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 16 feet after 61 years.

Polk County (LTGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 26 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 10 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 15 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 73 feet after 61 years.

San Jacinto County (LTGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 22 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 19 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 19 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 108 feet after 61 years.

Tyler County (STGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 42 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 35 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 30 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 62 feet after 61 years.

Walker County (BGCD)

- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 9 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 4 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 42 feet after 61 years.
- From estimated year 1890 conditions, the maximum subsidence in Walker County should not exceed approximately 0.04 feet by the year 2070.

Waller County (BGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 39 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 39 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 40 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 101 feet after 61 years.
- From estimated year 1890 conditions, the maximum subsidence in Waller County should not exceed approximately 4.73 feet by the year 2070.

Washington County

- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 1 foot after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 16 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 48 feet after 61 years.

Formations in Fort Bend, Galveston, and Harris counties

Groundwater Management Area 14 (GMA 14) efforts to determine DFCs is primarily an aquifer water-level based approach to describe the regional and local desires for the aquifer beneath them. The GMA process requires Groundwater Conservation Districts (GCDs) to determine the DFCs for the entire GMA, regardless of whether each county is included within a GCD. The Fort Bend Subsidence District (FBSD) and the Harris-Galveston Subsidence District (HGSD), operating in Fort Bend County and Harris and Galveston counties, respectively, regulate groundwater for the purpose of ending land surface subsidence within their jurisdiction. They are not GCDs and operate considerably different from the typical GCD. Therefore, in an official context these three counties are "unrepresented" but the GCDs within GMA-14 must still determine the DFC for these counties.

Both FBSD and HGSD have participated in an unofficial role to aid the GCDs within GMA-14 with their evaluation of Fort Bend, Galveston and Harris County information. The groundwater pumpage within these three counties even though regulated is still greater than the sum of all other counties within GMA-14. FBSD and HGSD recognize that the projected groundwater pumpage from these three counties will impact the decisions of GMA-14 throughout a large portion of the area. FBSD and HGSD have provided considerable historical and projected groundwater pumpage data and details of regulations to assist GMA-14 in incorporating these counties in the overall GMA-14 DFCs. FBSD and HGSD cannot however, present DFCs for these three counties in terms of aquifer water-level changes over time. The FBSD and HGSD regulations do not specifically address water-levels nor do they designate a specific pumping limit, rather the regulations are based on limitations of groundwater as a percentage of total water demand. The percentage of groundwater to total water demand is decreased over time, as total water demand increases.

The goal of both FBSD and HGSD is to end land surface subsidence that is caused by man's pumpage of groundwater. There is a clearly established link between the over-pumpage of groundwater and land surface subsidence. The DFCs within the aquifer beneath Fort Bend, Galveston, and Harris counties has no easily defined relationship to water-levels. The DFC for FBSD and HGSD is the reduction and halting of the compaction of clay layers within the aquifer caused by the over-pumpage of groundwater. Stated more simply, the DFC for these three counties is that future land surface subsidence be avoided. That stated, HGSD and FBSD have adopted regulations, most recently in 2013, that require the reduction of

groundwater pumpage and the conversion to alternate water sources, while balancing with the realistic ability of the permittees to achieve compliance with these regulations. This effort was accomplished with the aid of computer models and information specific to the missions of FBSD and HGSD and outside of the revised Northern Gulf Coast GAM (NGCGAM) adopted by the TWDB.

Within HGSD, from central to southeastern Harris County and all of Galveston County (Regulatory Areas 1 and 2), virtually all permittees have achieved compliance with previous and current HGSD regulations. Subsidence has been halted and water-levels within the aquifer have risen dramatically in these areas. However, in northern and western areas of Harris County (Regulatory Area 3), the HGSD regulations have allowed groundwater pumpage to continue until the required reductions in 2010, 2025, and 2035. With these scheduled reductions in groundwater pumpage, subsidence will slow dramatically and even be halted with water-levels stabilizing and in later years rising.

Within FBSD, from central to northern and eastern Fort Bend County (Regulatory Area A), the regulations call for reductions of groundwater pumpage in 2014/2016, and 2025. Similar to HGSD's Regulatory Area 3, subsidence within FBSD Regulatory Area A will slow dramatically and even be halted with water-levels stabilizing and in later years rising.

In both HGSD and FBSD, because of the percentage based approach to regulations, groundwater pumpage will increase until scheduled reductions in milestone years (ex: 2010, 2014/2016, 2025, and 2035). In between milestone years, groundwater pumpage will increase with the assumed increase in total water demand from an assumed increase in population. In order to demonstrate the DFC of these three counties using water-level changes, the area of previous groundwater-to-alternative water conversions must be separated from future conversions AND each annual time step must be depicted.

The HGSD and FBSD have submitted to GMA-14 their current regulations and projected groundwater pumpage projections through the year 2070. This data has been divided into the grid cells/layers relative to the NGCGAM and utilized by the GCDs in development of their DFCs.

Groundwater pumpage within GMA-14 from Fort Bend, Galveston, and Harris counties is regulated by FBSD and HGSD, non GCD governmental agencies (the only GMA in Texas with this occurrence) and the missions of HGSD and FBSD are vastly different from GCDs and do not fit well with a water-level designed DFC process). The groundwater pumpage projections developed in recognition of the HGSD and FBSD regulatory plans have been utilized without adjustment by GMA14 in the DFC process. Therefore, the DFCs adopted by GMA-14 are consistent with the HGSD and FBSD regulatory plans.

Carrizo Sand Aquifer

Grimes County (BGCD)

- The portion of the Carrizo Sand Aquifer occurring in Grimes County is declared non-relevant.

Walker County (BGCD)

- The portion of the Carrizo Sand Aquifer occurring in Walker County is declared non-relevant.

Queen City Aquifer

Grimes County (BGCD)

- The portion of the Queen City Aquifer occurring in Grimes County is declared non-relevant..

Walker County (BGCD)

- The portion of the Queen City Aquifer occurring in Walker County is declared non-relevant..

Sparta Aquifer

Grimes County (BGCD)

- The portion of the Sparta Aquifer occurring in Grimes County is declared non-relevant..

Walker County (BGCD)

- The portion of the Sparta Aquifer occurring in Walker County is declared non-relevant.

Yegua-Jackson Aquifer

Grimes County (BGCD)

- The portion of the Yegua Jackson Aquifer occurring in Grimes County is declared non-relevant..
-

Jasper County (STGCD)

- The portion of the Yegua-Jackson occurring in Jasper County is declared non-relevant.

Newton County (STGCD)

- The portion of the Yegua-Jackson occurring in Newton County is declared non-relevant.

Polk County (LTGCD)

- The portion of the Yegua-Jackson occurring in Polk County is declared non-relevant.

Tyler County (STGCD)

- The portion of the Yegua-Jackson occurring in Tyler County is declared non-relevant.

Walker County (BGCD)

- The portion of the Yegua Jackson Aquifer occurring in Walker County is declared non-relevant..

Washington County

- The portion of the Yegua Jackson Aquifer occurring in Washington County is declared non-relevant..

River Alluvium Aquifers

Austin County (BGCD)

- The portion of the Brazos River Alluvium occurring in Austin County is declared non-relevant.
- The portion of the San Bernard River Alluvium occurring in Austin County is declared non-relevant.

Grimes County (BGCD)

- The portion of the Brazos River Alluvium occurring in Grimes County is declared non-relevant.
- The portion of the Navasota River Alluvium occurring in Grimes County is declared non-relevant.

Walker County (BGCD)

- The portion of the San Jacinto River Alluvium occurring in Walker County is declared non-relevant.
- The portion of the Trinity River Alluvium occurring in Walker County is declared non-relevant.

Waller County (BGCD)

- The portion of the Brazos River Alluvium occurring in Walker County is declared non-relevant.

Washington County

- The portion of the Brazos River Alluvium occurring in Washington County is declared non-relevant.

And it is so ordered and passed this 29th day of April, 2016.

Signed _____

Mr. Zach Holland Bluebonnet Groundwater Conservation District

Signed _____

Mr. Kent Burkett Brazoria County Groundwater Conservation District

Signed _____

Ms. Kathy Turner Jones Lone Star Groundwater Conservation District

Signed _____

Mr. Gary Ashmore Lower Trinity Groundwater Conservation District

Signed _____

Mr. John Martin Southeast Texas Groundwater Conservation District

LONE STAR
GROUNDWATER CONSERVATION DISTRICT

August 9, 2016

MINUTES OF PUBLIC MEETING TO ADOPT DESIRED FUTURE CONDITIONS ("DFCs") FOR THE GULF COAST AQUIFER THAT APPLY TO THE LONE STAR GROUNDWATER CONSERVATION DISTRICT

The Board of Directors of the Lone Star Groundwater Conservation District ("District") met in regular session, open to the public, in the Lone Star GCD - James B. "Jim" Wesley Board Room located at 655 Conroe Park North Drive, Conroe, Texas, within the boundaries of the District on August 9, 2016.

CALL TO ORDER:

President Tramm presided and reconvened the special-called Board of Directors meeting at 10:25 AM, announcing that it was open to the public.

ROLL CALL:

The roll was called of the members of the Board of Directors, to wit:

John D. Bleyl, PE
Gregg Hope
Jace Houston
Roy McCoy, Jr.
Rick J. Moffatt
Jim Stinson, PE
Richard J. Tramm
M. Scott Weisinger, PG
W. B. Wood

All members of the Board were present with the exception of Director McCoy thus constituting a quorum of the Board of Directors. Also in attendance at said meeting were Kathy Turner Jones, General Manager; Paul R. Nelson, Assistant General Manager; Brian L. Sledge, General Counsel; Mark Lowry, P.E., District Engineer; District staff; and members of the public. *Copies of the public sign-in sheets are attached hereto as Exhibit "A".*

President Tramm stated that Mr. Bill Mullican would be discussing the Desired Future Conditions (DFCs) adopted by the district representatives of Groundwater Management Area 14 (GMA 14) at the GMA 14 joint planning meeting held on April 29, 2015.

Mr. Mullican opened by briefing members of the board and the public detailing the purpose and legal requirements of the hearing, providing an overview of what GMA 14 is, what the proposed desired future conditions are, and what steps are left in the current joint planning process. Mr. Mullican stated the purpose of the meeting was to comply with Chapter 36.108 (d-4) of the Texas Water Code which requires that, after submission of the DFC's and the explanatory report to the Texas Water Development Board, that the District will adopt the DFCs contained in the resolution adopted by GMA 14. Mr. Mullican followed with a presentation on the desired future conditions adopted for GMA 14 and the desired future conditions proposed for Montgomery County, as well as a summary of the steps and procedures that had been taken by GMA 14 and District to date, and detailed the DFC's adopted for the four major units of the Gulf Coast Aquifer system for the planning period for both GMA14 and for Montgomery County specifically. He then reported that a letter was received from the Executive Administrator of the Texas Water Development Board sent to the District on July 12, 2016, stating that the explanatory report and the accompanying materials met all the requirements of the statutes and rules and were determined to be administratively complete, and that from the date of the letter the Water Development Board will be calculating and providing to GMA 14 estimates of Modeled Available Groundwater for the aquifers for which the Desired Future Conditions were adopted.

Director Weisinger asked that copies of the presentation be sent to the board. He also asked if the Board had to act on the matter today, or could there be a delay to see if there might be additional information provided by the Strategic Plan Study that might have an effect on the Board's decision. Mr. Mullican advised that the District had already voted to support the proposed desired future conditions adopted by GMA 14 this past April, and at this point, the process is complete. Action today is a statutory requirement to formulize the DFCs adopted by GMA 14. He commented that the strategic study is ongoing, and that when the study is complete a year from now, the Board will consider those results, not for this round of planning, but for the next report that is due by September 1, 2020. Director Bleyl then asked Mr. Mullican if he was saying that there was no way to revise or amend the DFC's until 2022. Mr. Mullican responded that yes, the GMA 14 could, during the next four years, consider amending the adopted DFC's, but that they would have to go through the entire GMA 14 process of the nine considerations and develop an explanatory report in order to do so.

Director Houston commented on Director Weisinger's question, stating that the District was in the last stage of this round of DFC planning, which started in September of 2010, and that the board will immediately began addressing this issue upon completion of the strategic summary study, which could very likely result in the District agreeing to a different goal or different number. That will enable the District to amend the DFC and get that information into the regional planning process in time for the next round.

A discussion of the timing and requirements of the law as to the ramifications of not approving the DFC resolution today ensued, with comments made by Mr. Mullican and Mr. Sledge who reiterated the laws and regulations pertaining to approval.

Director Bleyl then stated that he agreed with Director Houston's remarks and wanted to state for the record that Conroe Mayor Powell is supportive of taking a look as quickly as possible at the DFCs. He further stated that these DFCs are based on the 64,000 acre-foot number and that number can change. He too is supportive of looking at the DFCs again soon and thinks the Mayor agrees with that position.

Following the discussion, upon a motion by Director Houston, seconded by Director Stinson, with Directors Bleyl, and Weisinger voting nay, the Board approved the desired future conditions as presented. *Copy of the approved resolution is attached hereto as Exhibit "B".*

The Public Meeting was adjourned at 10:49 AM.

PASSED, APPROVED, AND ADOPTED THIS 13th DAY OF SEPTEMBER 2016.

Rick Moffatt, Board Secretary

RESOLUTION #16-006

RESOLUTION FOR THE ADOPTION OF THE DESIRED FUTURE CONDITIONS FOR THE GULF COAST AQUIFER THAT APPLY TO THE LONE STAR GROUDNWATER CONSERVATION DISTRICT

LONE STAR GROUNDWATER CONSERVATION DISTRICT

THE STATE OF TEXAS §

COUNTY OF MONTGOMERY §

WHEREAS, the Lone Star Groundwater Conservation District ("Lone Star") was created by the Legislature of the State of Texas by the Act of May 17, 2001, 77th Leg., R.S., ch. 1321, 2001 Tex. Gen. Laws 3246, as amended (the "Enabling Act"), as a groundwater conservation district operating under Chapter 36, Texas Water Code, and the Enabling Act; and

WHEREAS, pursuant to § 35.151 of the Texas Water Code, the Texas Water Development Board ("TWDB") has designated groundwater management areas that, together, cover all major and minor aquifers in the state, and, through Title 31 Texas Administrative Code §356.21, the TWDB has designated the area encompassing all of Austin, Brazoria, Chambers, Fort Bend, Galveston, Grimes, Hardin, Harris, Jasper, Jefferson, Liberty, Montgomery, Newton, Orange, Polk, San Jacinto, Tyler, Walker, Waller, and Washington counties as Groundwater Management Area No. 14 ("GMA 14"); and

WHEREAS, Lone Star and four other groundwater conservation districts, Bluebonnet Groundwater Conservation District, Brazoria Groundwater Conservation District, Lower Trinity Groundwater Conservation District, and Southeast Texas Groundwater Conservation District, (collectively referred to herein as the "Districts") are located wholly or partially within GMA 14; and

WHEREAS, the Districts are authorized by Chapter 36, Texas Water Code, to engage in joint planning activities for the coordinated management of the aquifers located in GMA 14, and in that regard, the Districts are required to establish desired future conditions ("DFCs") for the relevant aquifers within GMA 14; and

WHEREAS, Section 36.108 of the Texas Water Code requires representatives from the Districts to hold joint planning meetings for the consideration of DFC options, the proposal of DFCs for adoption, and after the contemplation of comments and suggested revisions provided by the public and Districts, the adoption of DFCs for each relevant aquifer in GMA 14 and the submission of an explanatory report to the TWDB for approval of the DFCs adopted; and

WHEREAS, as set forth in the attached Resolution for the Approval of Desired Future Conditions for All Aquifers in Groundwater Management Area 14 (the "Resolution"), attached hereto as Attachment A and incorporated by reference for all intents and purposes, the District representatives for GMA 14 have complied with the requirements provided by statute in Section 36.108, Texas Water Code, and on April 29, 2016, the District representatives for GMA 14 took final action to adopt the DFCs for the relevant aquifers in GMA 14 by approving the attached Resolution and the submission of the Desired Future Conditions Explanatory Report to the TWDB and the Districts as required by Section 36.108(d-3) of the Texas Water Code; and

WHEREAS, the DFCs adopted by the District representatives of GMA 14 are described in terms of acceptable drawdown levels for each subdivision of the Gulf Coast Aquifer, including the Chicot, Evangeline, Burkeville, and Jasper, for each county located within GMA 14, or in land surface subsidence, as applicable, and the DFCs were also adopted on aquifer-wide scales within GMA 14 for each of those aquifer subdivisions, which do not differ substantively in their application from the county-scale numbers; and

WHEREAS, the acceptable levels of drawdown for each subdivision of the aquifer underlying Montgomery County are measured in terms of water level drawdowns over the proposed current planning cycle measured in feet from 2009 estimated water levels; and

WHEREAS, Section 36.108(d-4) of the Texas Water Code provides that as soon as possible after a district receives the DFCs resolution and explanatory report under Subsection (d-3), the district shall adopt the DFCs in the resolution and report that apply to the district; and

WHEREAS, TWDB rules at Title 31, Texas Administrative Code §356.34 provide that as soon as possible after a district receives notice from the Executive Administrator of the TWDB that the DFC Submission Package submitted to the TWDB has been determined to be administratively complete, the district shall adopt the DFCs that apply to the district; and

WHEREAS, at this time, Lone Star has received a copy of the Resolution, as provided herein as Attachment A, and the Desired Future Conditions Explanatory Report prepared by GMA 14, and the Lone Star Board seeks to adopt the DFCs in the Resolution and the Explanatory Report that apply to Lone Star; and

WHEREAS, Lone Star received a letter from the TWDB, dated July 12, 2016, notifying Lone Star that the DFC Submission Package provided to the TWDB by the GMA 14 Districts has been determined to be administratively complete by the Executive Administrator of the TWDB, and therefore it is now appropriate for Lone Star to proceed with the adoption of the DFCs that apply to Lone Star in compliance with TWDB rules as set forth in Title 31, Texas Administrative Code §356.34; and

WHEREAS, the Board finds that the DFCs provided herein for adoption are reasonable and necessary for the effective and prudent management of groundwater resources within Montgomery County, and have otherwise been developed in accordance with, and do satisfy the obligations imposed by Chapter 36 of the Texas Water Code and all other applicable laws of the State of Texas; and

WHEREAS, the Board also finds that all notice requirements for a meeting, held this day, to take up and consider the adoption of the DFCs described herein that apply to Lone Star have been, and are, satisfied;

NOW, THEREFORE, be it resolved by the Board of Directors of the Lone Star Groundwater Conservation District that the following DFCs are hereby established for the Gulf Coast Aquifer as the DFCs that apply to Lone Star:

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer in Montgomery County should not exceed approximately 26 feet after 61 years;
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer in Montgomery County should not exceed approximately -4 feet after 61 years;
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit in Montgomery County should not exceed approximately -4 feet after 61 years;
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer in Montgomery County should not exceed approximately 34 feet after 61 years; and
- The Board also adopts as applicable to Lone Star the aquifer-wide scale average draw down numbers within GMA 14 for the Chicot Aquifer, Evangeline Aquifer, Burkeville confining unit, and the Jasper Aquifer as specifically set forth in the attached Resolution for the Approval of Desired Future Conditions for All Aquifers in Groundwater Management Area 14 (Attachment A).

AND IT IS SO ORDERED.

PASSED AND ADOPTED on this 9th day of August, 2016.

LONE STAR GROUNDWATER CONSERVATION DISTRICT

By: _____
Richard J. Tramm, Board President

ATTEST:

_____
Rick Moffatt, Secretary

ATTACHMENT A

RESOLUTION FOR THE APPROVAL OF DESIRED FUTURE CONDITIONS FOR ALL AQUIFERS IN GROUNDWATER MANAGEMENT AREA 14

Whereas, pursuant to Section 35.004 of the Texas Water Code, the Texas Water Development Board ("TWDB") has designated groundwater management areas that, together, cover all major and minor aquifers in the state; and

Whereas, each groundwater management area was designated with the objective of providing the most suitable area for the management of groundwater resources; and

Whereas, through Title 31, Section 356.21 of the Texas Administrative Code, the TWDB has designated the area encompassing all of Austin, Brazoria, Chambers, Fort Bend, Galveston, Grimes, Hardin, Harris, Jasper, Jefferson, Liberty, Montgomery, Newton, Orange, Polk, San Jacinto, Tyler, Walker, Waller, and Washington counties as Groundwater Management Area No. 14 ("GMA 14"); and

Whereas, GMA 14 includes all or portions of areas subject to groundwater regulation by Bluebonnet Groundwater Conservation District (Austin, Grimes, Walker, and Waller counties), Brazoria County Groundwater Conservation District (Brazoria County), Lone Star Groundwater Conservation District (Montgomery County), Lower Trinity Groundwater Conservation District (Polk and San Jacinto counties), and Southeast Texas Groundwater Conservation District (Hardin, Jasper, Newton, and Tyler counties) (the "Member Districts"); and

Whereas, the Member Districts are authorized by Chapter 36, Texas Water Code, to engage in joint planning activities for the coordinated management of the aquifers located in GMA 14, and in that regard, shall establish desired future conditions ("DFCs") for the relevant aquifers within GMA 14; and

Whereas Fort Bend Subsidence District (Fort Bend County), Harris-Galveston Subsidence District (Galveston and Harris counties), and other stakeholders within GMA 14 from Chambers County, and Washington County also contributed to the development of DFCs for GMA 14; and

Whereas, Section 36.108 of the Texas Water Code requires the Member Districts in GMA 14 to consider groundwater availability models and other data or information for the management area and vote on a proposal for the adoption of DFCs for each relevant aquifer within GMA 14 by May 1, 2016; and

Whereas, the Member Districts within GMA 14 secured hydrogeologic and engineering consulting services to provide technical support in their efforts to establish requisite DFCs; and

Whereas, in developing the proposed DFCs for the relevant aquifers within GMA 14, the Member Districts in GMA 14 considered the nine statutory factors set forth in Section 36.108(d) of the Texas Water Code:

- aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another,
- the water supply needs and water management strategies included in the state water plan,
- hydrological conditions, including for each aquifer in the management area the total estimated recoverable storage as provided by the executive administrator, and the average annual recharge, inflows, and discharge,
- other environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water,
- the impact on subsidence,
- socioeconomic impacts reasonably expected to occur,
- the impact on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater as recognized under Section 36.002,
- the feasibility of achieving the desired future condition, and
- any other information relevant to the specific desired future conditions; and

Whereas, pursuant to Section 36.108(d-2), the Member Districts also considered in their development of proposed DFCs the balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area; and

Whereas, the Member Districts used this information to developed proposed DFCs for the portions of the northern segment of the Gulf Coast Aquifer that occurs within the bounds of GMA 14; and

Whereas, TWDB conducted an evaluation of the Houston Area Groundwater Model ("HAGM") and adopted it as the updated Northern Gulf Coast Groundwater Availability Model ("GAM"); and

Whereas, the Members Districts conducted a model run of the updated Northern Gulf Coast GAM specifically identified as GAM Run 2 for the purpose of evaluating drawdown in the Northern Gulf Coast Aquifer; and

Whereas, the TWDB has prepared a report for GAM Task 10-052 MAG for the Carrizo-Wilcox Aquifer; and

Whereas, the TWDB has prepared a report for GAM Task 10-053 MAG for the Queen City Aquifer; and

Whereas, the TWDB has prepared a report for GAM Task 10-054 MAG for the Sparta Aquifer; and

Whereas, the TWDB has prepared a report for GAM Task 10-055 MAG for the Yegua-Jackson Aquifer; and

Whereas, the TWDB has prepared a report for Aquifer Assessment Task 10-30 MAG for the Brazos River Alluvium Aquifer; and

Whereas, the TWDB has prepared a report for Aquifer Assessment Task 10-31 MAG for the Navasota River Alluvium Aquifer; and

Whereas, the TWDB has prepared a report for Aquifer Assessment Task 10-32 MAG for the San Bernard River Alluvium Aquifer; and

Whereas, the TWDB has prepared a report for Aquifer Assessment Task 10-33 MAG for the San Jacinto River Alluvium Aquifer; and

Whereas, the TWDB has prepared a report for Aquifer Assessment Task 10-34 MAG for the Trinity River Alluvium Aquifer; and

Whereas, during joint meetings noticed and conducted pursuant to Section 36.108(e) of the Texas Water Code, the Member Districts considered GAMs and other data and information relevant to the development of DFCs for GMA 14, including input and comments from stakeholders within GMA 14; and

Whereas, the Member Districts find that all notice requirements for a meeting, held this day, to take up and consider the approval of the proposed DFCs as described herein for GMA 14 have been, and are, satisfied; and

Whereas, Texas Water Code Section 36.0015(b), as amended by House Bill 200 during the 84th Texas Legislature states that "(b) In order to provide for the conservation, preservation, protection, recharging, and prevention of waste of groundwater, and of groundwater reservoirs or their subdivisions, and to control subsidence caused by withdrawal of water from those groundwater reservoirs or their subdivisions, consistent with the objectives of Section 59, Article XVI, Texas Constitution, groundwater conservation districts may be created as provided by this chapter. Groundwater conservation districts created as provided by this chapter are the state's preferred method of groundwater management in order to protect property rights, balance the conservation and development of groundwater to meet the needs of this state, and use the best available science in the conservation and development of groundwater through rules developed, adopted, and promulgated by a district in accordance with the provisions of this chapter"; and

Whereas, the Member Districts find that the proposed DFCs provided herein for establishment are each merited and necessary for the effective and prudent management of groundwater resources within GMA 14, and have otherwise been developed in accordance with, and do satisfy the obligations imposed by, Chapter 36 of the Texas Water Code and all other applicable laws of the State of Texas.

Now, therefore, be it resolved by the Member Districts of GMA 14 that the following DFCs are each hereby established:

Formations of the Gulf Coast Aquifer

DFCs for the Gulf Coast Aquifer are hereby adopted, as documented by and incorporating herein GAM Run 2, at two scales, which do not differ substantively in their application; the first being for GMA 14 in its entirety, and also, to better facilitate the management and conservation of groundwater resources at the individual groundwater conservation district level after considering the statutory criteria set forth under Section 36.108(d), Water Code, on a county-by-county basis. DFCs for GMA 14 for the Gulf Coast Aquifer are as follows:

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 28.3 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 23.6 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 18.5 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 66.2 feet after 61 years.

Austin County (BGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 39 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 23 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 23 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 76 feet after 61 years.
- From estimated year 1890 conditions, the maximum subsidence in Austin County should not exceed approximately 2.83 feet by the year 2070.

Brazoria County (BCGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 23 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 27 feet after 61 years.

Chambers County

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 32 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 30 feet after 61 years.

Grimes County (BGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 5 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 5 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 6 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 52 feet after 61 years.
- From estimated year 1890 conditions, the maximum subsidence in Grimes County should not exceed approximately 0.12 feet by the year 2070.

Hardin County (STGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 21 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 27 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 29 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 89 feet after 61 years.

Jasper County (STGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 23 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 41 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 46 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 40 feet after 61 years.

Jefferson County

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 15 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 17 feet after 61 years.

Liberty County

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 27 feet after 61 years.

- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 29 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 25 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 120 feet after 61 years.

Montgomery County (LSGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 26 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately -4 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately -4 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 34 feet after 61 years.

Newton County (STGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 35 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 45 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 44 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 37 feet after 61 years.

Orange County

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 14 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 16 feet after 61 years.

Polk County (LTGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 26 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 10 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 15 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 73 feet after 61 years.

San Jacinto County (LTGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 22 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 19 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 19 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 108 feet after 61 years.

Tyler County (STGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 42 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 35 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 30 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 62 feet after 61 years.

Walker County (BGCD)

- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 9 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 4 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 42 feet after 61 years.
- From estimated year 1890 conditions, the maximum subsidence in Walker County should not exceed approximately 0.04 feet by the year 2070.

Waller County (BGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 39 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 39 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 40 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 101 feet after 61 years.
- From estimated year 1890 conditions, the maximum subsidence in Waller County should not exceed approximately 4.73 feet by the year 2070.

Washington County

- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 1 foot after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 16 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 48 feet after 61 years.

Formations in Fort Bend, Galveston, and Harris counties

Groundwater Management Area 14 (GMA 14) efforts to determine DFCs is primarily an aquifer water-level based approach to describe the regional and local desires for the aquifer beneath them. The GMA process requires Groundwater Conservation Districts (GCDs) to determine the DFCs for the entire GMA, regardless of whether each county is included within a GCD. The Fort Bend Subsidence District (FBSD) and the Harris-Galveston Subsidence District (HGSD), operating in Fort Bend County and Harris and Galveston counties, respectively, regulate groundwater for the purpose of ending land surface subsidence within their jurisdiction. They are not GCDs and operate considerably different from the typical GCD. Therefore, in an official context these three counties are "unrepresented" but the GCDs within GMA-14 must still determine the DFC for these counties.

Both FBSD and HGSD have participated in an unofficial role to aid the GCDs within GMA-14 with their evaluation of Fort Bend, Galveston and Harris County information. The groundwater pumpage within these three counties even though regulated is still greater than the sum of all other counties within GMA-14. FBSD and HGSD recognize that the projected groundwater pumpage from these three counties will impact the decisions of GMA-14 throughout a large portion of the area. FBSD and HGSD have provided considerable historical and projected groundwater pumpage data and details of regulations to assist GMA-14 in incorporating these counties in the overall GMA-14 DFCs. FBSD and HGSD cannot however, present DFCs for these three counties in terms of aquifer water-level changes over time. The FBSD and HGSD regulations do not specifically address water-levels nor do they designate a specific pumping limit, rather the regulations are based on limitations of groundwater as a percentage of total water demand. The percentage of groundwater to total water demand is decreased over time, as total water demand increases.

The goal of both FBSD and HGSD is to end land surface subsidence that is caused by man's pumpage of groundwater. There is a clearly established link between the over-pumpage of groundwater and land surface subsidence. The DFCs within the aquifer beneath Fort Bend, Galveston, and Harris counties has no easily defined relationship to water-levels. The DFC for FBSD and HGSD is the reduction and halting of the compaction of clay layers within the aquifer caused by the over-pumpage of groundwater. Stated more simply, the DFC for these three counties is that future land surface subsidence be avoided. That stated, HGSD and FBSD have adopted regulations, most recently in 2013, that require the reduction of

groundwater pumpage and the conversion to alternate water sources, while balancing with the realistic ability of the permittees to achieve compliance with these regulations. This effort was accomplished with the aid of computer models and information specific to the missions of FBSD and HGSD and outside of the revised Northern Gulf Coast GAM (NGCGAM) adopted by the TWDB.

Within HGSD, from central to southeastern Harris County and all of Galveston County (Regulatory Areas 1 and 2), virtually all permittees have achieved compliance with previous and current HGSD regulations. Subsidence has been halted and water-levels within the aquifer have risen dramatically in these areas. However, in northern and western areas of Harris County (Regulatory Area 3), the HGSD regulations have allowed groundwater pumpage to continue until the required reductions in 2010, 2025, and 2035. With these scheduled reductions in groundwater pumpage, subsidence will slow dramatically and even be halted with water-levels stabilizing and in later years rising.

Within FBSD, from central to northern and eastern Fort Bend County (Regulatory Area A), the regulations call for reductions of groundwater pumpage in 2014/2016, and 2025. Similar to HGSD's Regulatory Area 3, subsidence within FBSD Regulatory Area A will slow dramatically and even be halted with water-levels stabilizing and in later years rising.

In both HGSD and FBSD, because of the percentage based approach to regulations, groundwater pumpage will increase until scheduled reductions in milestone years (ex: 2010, 2014/2016, 2025, and 2035). In between milestone years, groundwater pumpage will increase with the assumed increase in total water demand from an assumed increase in population. In order to demonstrate the DFC of these three counties using water-level changes, the area of previous groundwater-to-alternative water conversions must be separated from future conversions AND each annual time step must be depicted.

The HGSD and FBSD have submitted to GMA-14 their current regulations and projected groundwater pumpage projections through the year 2070. This data has been divided into the grid cells/layers relative to the NGCGAM and utilized by the GCDs in development of their DFCs.

Groundwater pumpage within GMA-14 from Fort Bend, Galveston, and Harris counties is regulated by FBSD and HGSD, non GCD governmental agencies (the only GMA in Texas with this occurrence) and the missions of HGSD and FBSD are vastly different from GCDs and do not fit well with a water-level designed DFC process). The groundwater pumpage projections developed in recognition of the HGSD and FBSD regulatory plans have been utilized without adjustment by GMA14 in the DFC process. Therefore, the DFCs adopted by GMA-14 are consistent with the HGSD and FBSD regulatory plans.

Carrizo Sand Aquifer

Grimes County (BGCD)

- The portion of the Carrizo Sand Aquifer occurring in Grimes County is declared non-relevant.

Walker County (BGCD)

- The portion of the Carrizo Sand Aquifer occurring in Walker County is declared non-relevant.

Queen City Aquifer

Grimes County (BGCD)

- The portion of the Queen City Aquifer occurring in Grimes County is declared non-relevant..

Walker County (BGCD)

- The portion of the Queen City Aquifer occurring in Walker County is declared non-relevant..

Sparta Aquifer

Grimes County (BGCD)

- The portion of the Sparta Aquifer occurring in Grimes County is declared non-relevant..

Walker County (BGCD)

- The portion of the Sparta Aquifer occurring in Walker County is declared non-relevant.

Yegua-Jackson Aquifer

Grimes County (BGCD)

- The portion of the Yegua Jackson Aquifer occurring in Grimes County is declared non-relevant..
-

Jasper County (STGCD)

- The portion of the Yegua-Jackson occurring in Jasper County is declared non-relevant.

Newton County (STGCD)

- The portion of the Yegua-Jackson occurring in Newton County is declared non-relevant.

Polk County (LTGCD)

- The portion of the Yegua-Jackson occurring in Polk County is declared non-relevant.

Tyler County (STGCD)

- The portion of the Yegua-Jackson occurring in Tyler County is declared non-relevant.

Walker County (BGCD)

- The portion of the Yegua Jackson Aquifer occurring in Walker County is declared non-relevant..

Washington County

- The portion of the Yegua Jackson Aquifer occurring in Washington County is declared non-relevant..

River Alluvium Aquifers

Austin County (BGCD)

- The portion of the Brazos River Alluvium occurring in Austin County is declared non-relevant.
- The portion of the San Bernard River Alluvium occurring in Austin County is declared non-relevant.

Grimes County (BGCD)

- The portion of the Brazos River Alluvium occurring in Grimes County is declared non-relevant.
- The portion of the Navasota River Alluvium occurring in Grimes County is declared non-relevant.

Walker County (BGCD)

- The portion of the San Jacinto River Alluvium occurring in Walker County is declared non-relevant.
- The portion of the Trinity River Alluvium occurring in Walker County is declared non-relevant.

Waller County (BGCD)

- The portion of the Brazos River Alluvium occurring in Walker County is declared non-relevant.

Washington County

- The portion of the Brazos River Alluvium occurring in Washington County is declared non-relevant.

And it is so ordered and passed this 29th day of April, 2016.

Signed _____

Mr. Zach Holland Bluebonnet Groundwater Conservation District

Signed _____

Mr. Kent Burkett Brazoria County Groundwater Conservation District

Signed _____

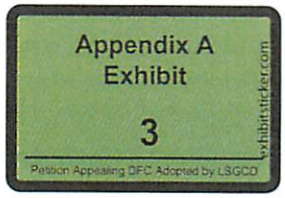
Ms. Kathy Turner Jones Lone Star Groundwater Conservation District

Signed _____

Mr. Gary Ashmore Lower Trinity Groundwater Conservation District

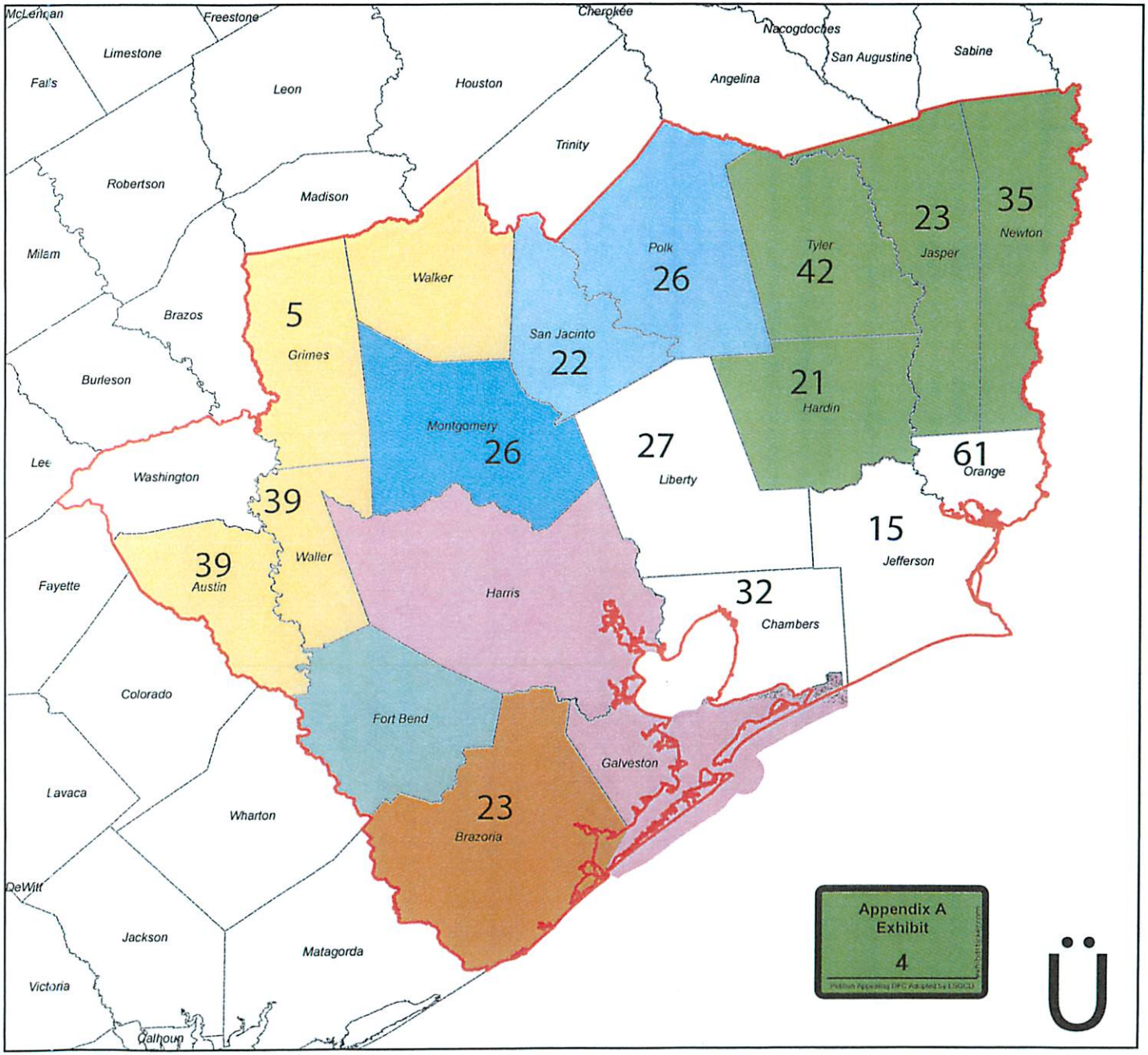
Signed _____

Mr. John Martin Southeast Texas Groundwater Conservation District



HAGM Run Rev20140610 is not attached to this Petition because (a) it is a publicly available document and (b) a printout of the document would be voluminous at an estimated 60,000 pages. However, Petitioners refer to HAGM Run Rev20140610 in its entirety because GMA 14 and LSGCD appear to have adopted hundreds of thousands of individual DFCs described in that model. An electronic version of Exhibit 3 will be made available at or before the hearing or on request.

DFCS FOR CHICOT AQUIFER IN GMA 14*



MAP LEGEND

- GMA 14
- Counties

Groundwater Conservation Districts

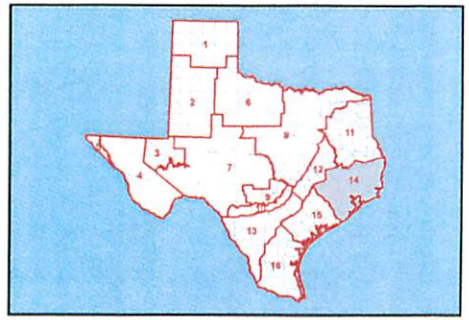
- Bluebonnet GCD
- Brazoria County GCD
- Lone Star GCD
- Lower Trinity GCD
- Southeast Texas GCD

Subsidence Districts

- Harris-Galveston Subsidence District
- Fort Bend Subsidence District

DISCLAIMER
This map was generated by the Texas Water Development Board. No claims are made to the accuracy or completeness of the information shown herein nor to its suitability for a particular use. The scale and location of all mapped data are approximate. Boundaries for groundwater conservation districts are approximate and may not accurately depict legal descriptions.

Updated 1/27/2014

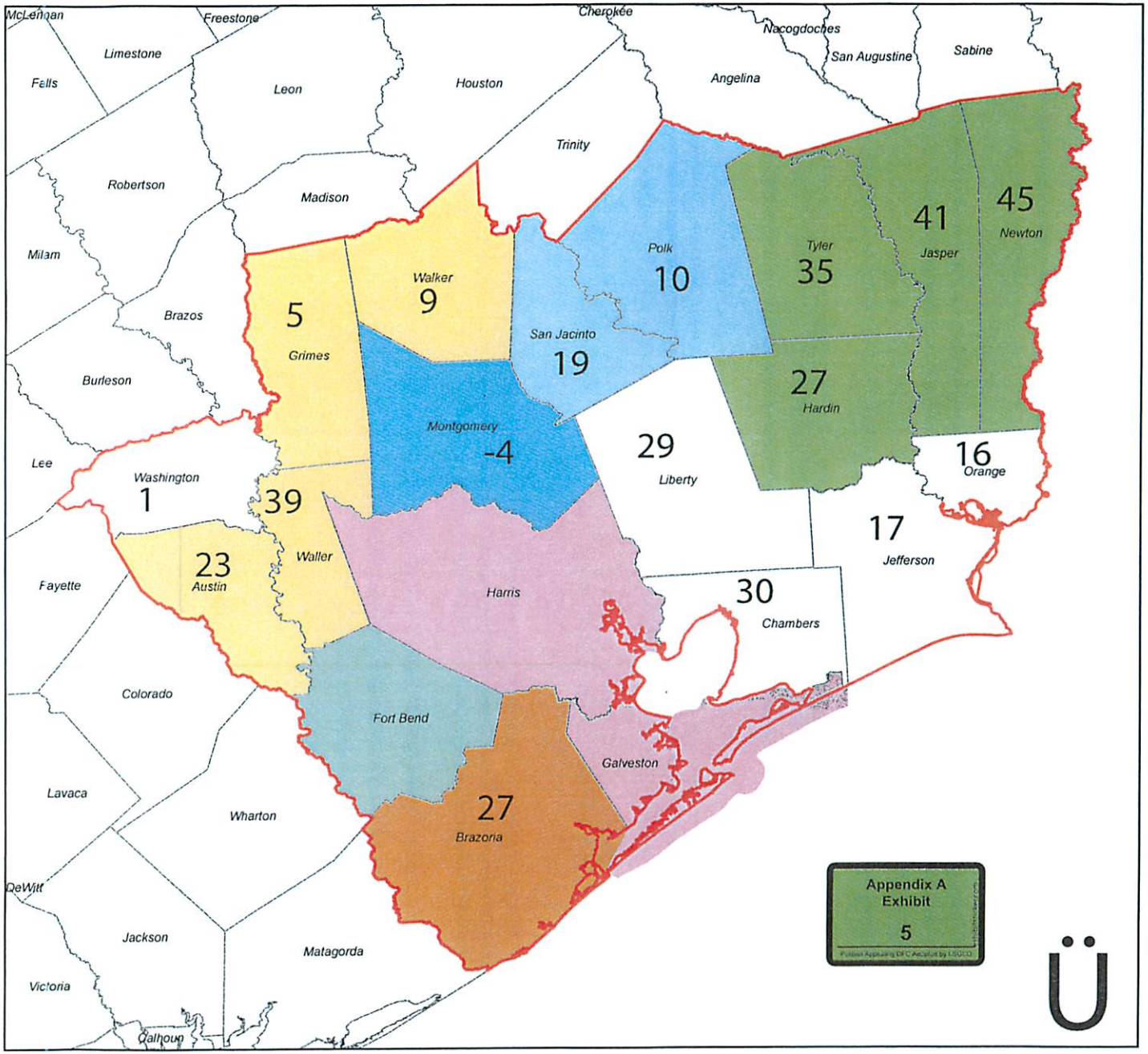


0 5 10 20 30 40 Miles

1 in = 14 miles

* expressed in feet of drawdown after 61 years as compared to 2009 levels

DFCS FOR EVANGELINE AQUIFER IN GMA 14*



MAP LEGEND

- GMA 14
- Counties

Groundwater Conservation Districts

- Bluebonnet GCD
- Brazoria County GCD
- Lone Star GCD
- Lower Trinity GCD
- Southeast Texas GCD

Subsidence Districts

- Harris-Galveston Subsidence District
- Fort Bend Subsidence District

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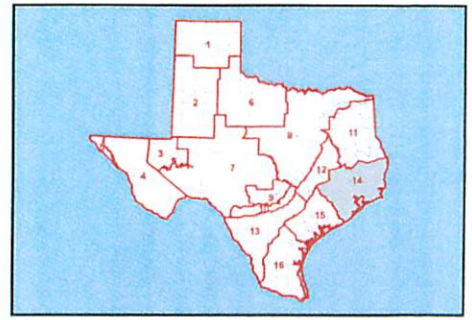
Updated 1/27/2014

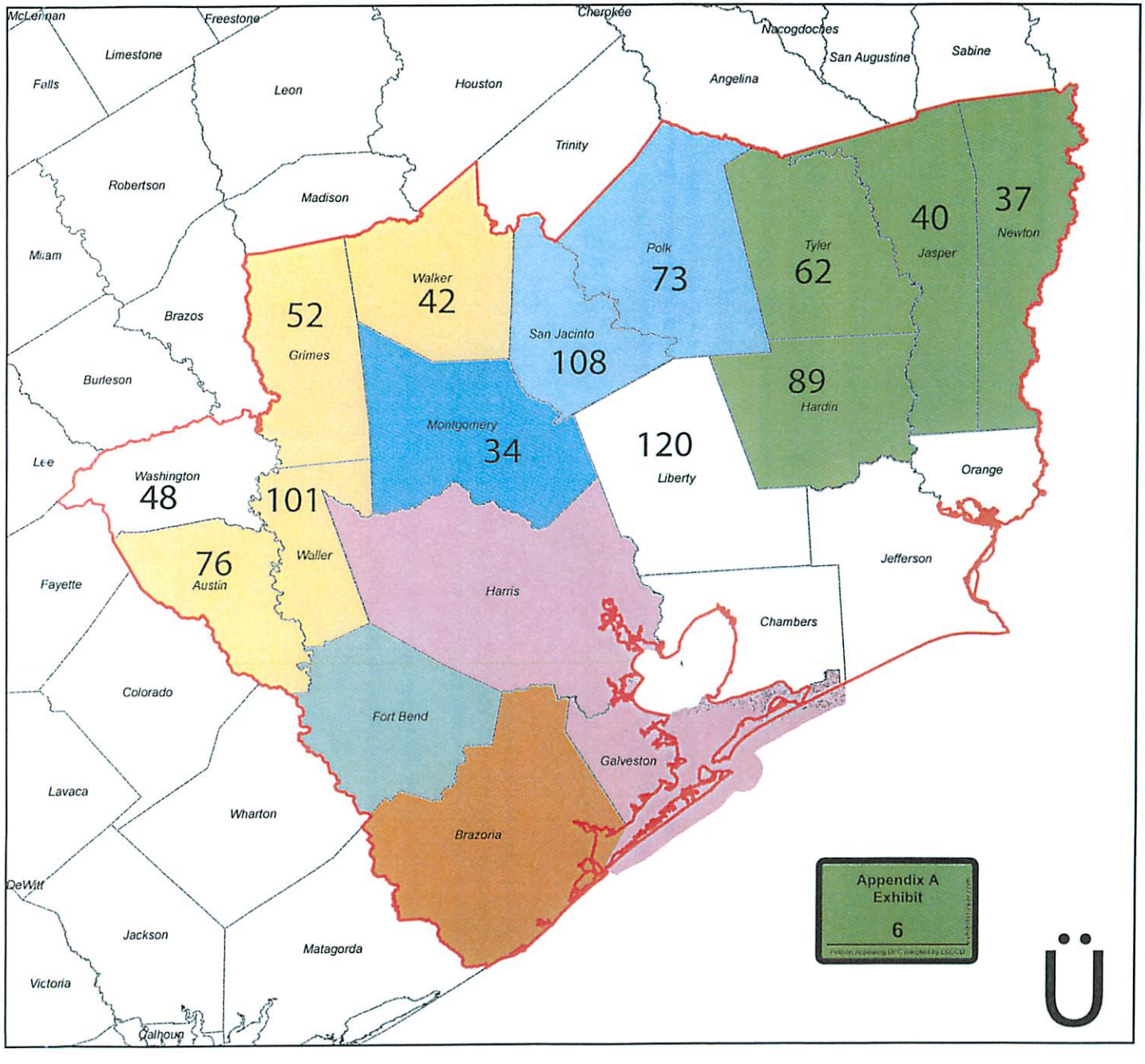


0 5 10 20 30 40 Miles

1 in = 14 miles

* expressed in feet of drawdown after 61 years as compared to 2009 levels

DFCS FOR JASPER AQUIFER IN GMA 14*



MAP LEGEND

- GMA 14
- Counties

Groundwater Conservation Districts

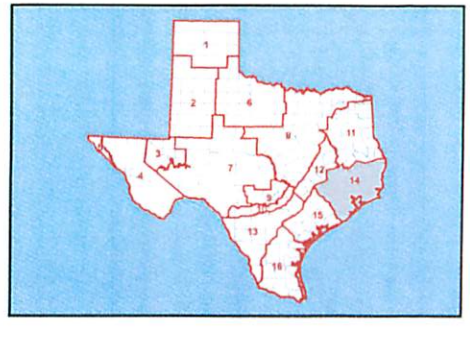
- Bluebonnet GCD
- Brazoria County GCD
- Lone Star GCD
- Lower Trinity GCD
- Southeast Texas GCD

Subsidence Districts

- Harris-Galveston Subsidence District
- Fort Bend Subsidence District

DISCLAIMER
This map was generated by the Texas Water Development Board. No claims are made to the accuracy or completeness of the information shown herein nor to its suitability for a particular use. The scale and location of all mapped data are approximate. Boundaries for groundwater conservation districts are approximate and may not accurately depict legal descriptions.

Updated 1/27/2014



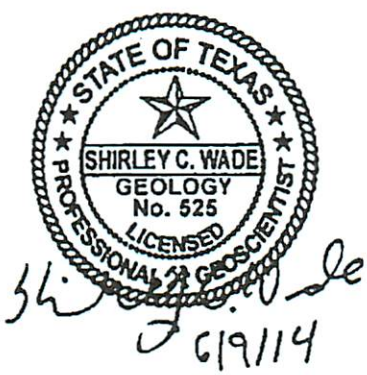
0 5 10 20 30 40 Miles

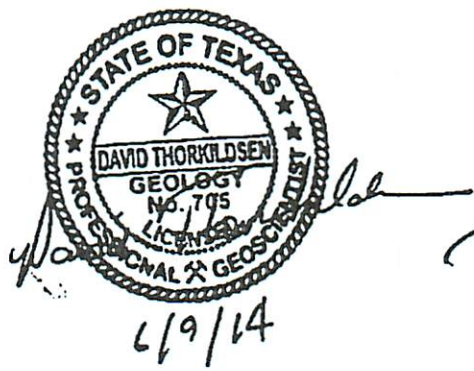
1 in = 14 miles

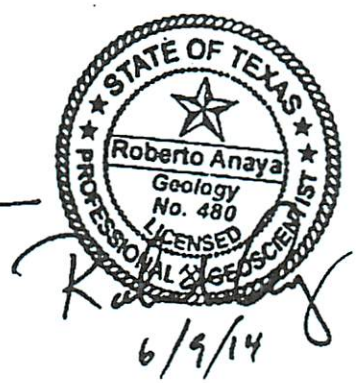
* expressed in feet of drawdown after 61 years as compared to 2009 levels

GAM Task 13-037: Total Estimated Recoverable Storage for Aquifers in Groundwater Management Area 14

by Shirley Wade, Ph.D., P.G., David Thorkildsen, P.G., and Roberto Anaya, P.G.
Texas Water Development Board
Groundwater Resources Division
(512) 463-6115[1]
June 09, 2014







The seal appearing on this document were authorized by Shirley C. Wade, P.G. 525, and David Thorkildsen, P.G. 705, and Roberto Anaya, P.G. 480 on June 09, 2014.

The total estimated recoverable storage in this report was calculated as follows: the Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson aquifers, the Gulf Coast Aquifer System and the Brazos River Alluvium Aquifer (Shirley Wade); and the San Bernard, Navasota, San Jacinto, and Trinity river alluviums determined as relevant (David Thorkildsen), quality assurance and report preparation (Roberto Anaya).

[1] Contact information is for Roberto Anaya

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GAM TASK 13-037: TOTAL ESTIMATED RECOVERABLE STORAGE FOR AQUIFERS IN GROUNDWATER MANAGEMENT AREA 14

by Shirley Wade, Ph.D., P.G., David Thorkildsen, P.G., and Roberto Anaya, P.G.
Texas Water Development Board
Groundwater Resources Division
(512) 463-6115[1]
June 09, 2014

EXECUTIVE SUMMARY:

Texas Water Code, §36.108 (d) (Texas Water Code, 2011) states that, before voting on the proposed desired future conditions for a relevant aquifer within a groundwater management area, the groundwater conservation districts shall consider the total estimated recoverable storage as provided by the executive administrator of the Texas Water Development Board (TWDB) along with other factors listed in §36.108 (d). Texas Administrative Code Rule §356.10 (Texas Administrative Code, 2011) defines the total estimated recoverable storage as the estimated amount of groundwater within an aquifer that accounts for recovery scenarios that range between 25 percent and 75 percent of the porosity-adjusted aquifer volume.

This report discusses the methods, assumptions, and results of an analysis to estimate the total recoverable storage for the Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, Gulf Coast, and Brazos River Alluvium aquifers in addition to water-bearing alluvial sediments determined as relevant by Groundwater Management Area 14 groundwater conservation districts for the San Bernard, Navasota, San Jacinto, and Trinity rivers within Groundwater Management Area 14. Tables 1 through 20 summarize the total estimated recoverable storage required by the statute. The total estimated recoverable storage values are for areas within the official extent of the aquifers (and other portions deemed relevant by the groundwater conservation districts) in Groundwater Management Area 14. In addition, areas that currently have adopted desired future conditions but may be declared to be non-relevant are included

[1] Contact information is for Roberto Anaya

as the total estimated recoverable storage values are needed for the associated explanatory report per Texas Administrative Code Rule §356.31 (b) (Texas Administrative Code, 2011).

DEFINITION OF TOTAL ESTIMATED RECOVERABLE STORAGE:

The total estimated recoverable storage is defined as the estimated amount of groundwater within an aquifer that accounts for recovery scenarios that range between 25 percent and 75 percent of the porosity-adjusted aquifer volume. In other words, we assume that only 25 to 75 percent of groundwater held within an aquifer can be removed by pumping.

The total recoverable storage was estimated for the portion of the aquifers within Groundwater Management Area 14 that lie within the official lateral aquifer boundaries as delineated by George and others (2011). If portions of aquifers outside these boundaries were defined as relevant in the resolution dated August 25, 2010, that adopted the current desired future conditions, then estimates of total recoverable storage reported here include these specific areas. Total estimated recoverable storage values may include a mixture of water quality types, including fresh, brackish, and saline groundwater, because the available data and the existing groundwater availability models do not permit the differentiation between different water quality types. The total estimated recoverable storage values do not take into account the effects of land surface subsidence, degradation of water quality, or any changes to surface water-groundwater interaction that may occur as the result of extracting groundwater from the aquifer.

METHODS:

To estimate the total recoverable storage of an aquifer, we first calculated the total storage in an aquifer within the official and/or relevant aquifer boundary. The total storage is the volume of groundwater removed by pumping that completely drains the aquifer.

Aquifers can be either unconfined or confined (Figure 1). A well screened in an unconfined aquifer will have a water level equal to the water level outside the well or in the aquifer. Thus, unconfined aquifers have water levels within the aquifers. A confined aquifer is bounded by low permeable geologic units at the top and bottom, and the aquifer is under hydraulic pressure above the ambient atmospheric pressure. The water level at a well screened in a confined aquifer will be above the top of the aquifer. As a result, calculation of

total storage is also different between unconfined and confined aquifers. For an unconfined aquifer, the total storage is equal to the volume of groundwater removed by pumping that makes the water level fall to the aquifer bottom. For a confined aquifer, the total storage contains two parts. The first part is the groundwater released from the aquifer when the water level falls from above the top of the aquifer to the top of the aquifer. The reduction of hydraulic pressure in the aquifer by pumping causes expansion of groundwater and deformation of aquifer solids. The aquifer is still fully saturated to this point. The second part, just like unconfined aquifer, is the groundwater released from the aquifer when the water level falls from the top to the bottom of the aquifer. Given the same aquifer area and water level drop, the amount of water released in the second part is much greater than the first part. The difference is quantified by two parameters: storativity related to confined aquifers and specific yield related to unconfined aquifers. For example, storativity values range from 10^{-5} to 10^{-3} for most confined aquifers, while the specific yield values can be 0.01 to 0.3 for most unconfined aquifers. The equations for calculating the total storage are presented below:

- for unconfined aquifers

$$Total\ Storage\ = V_{drained} = Area \times S_y \times (Water\ Level - Bottom)$$

- for confined aquifers

$$Total\ Storage\ = V_{confined} + V_{drained}$$

  - confined part

$$V_{confined} = Area \times [S \times (Water\ Level - Top)]$$

or

$$V_{confined} = Area \times [S_s \times (\text{Top} - \text{Bottom}) \times (Water\ Level - Top)]$$

  - unconfined part

$$V_{drained} = Area \times [S_y \times (Top - Bottom)]$$

where:

- $V_{drained}$ = storage volume due to water draining from the formation (acre-feet)
- $V_{confined}$ = storage volume due to elastic properties of the aquifer and water(acre-feet)
- *Area* = area of aquifer (acre)
- *Water Level* = groundwater elevation (feet above mean sea level)

- *Top* = elevation of aquifer top (feet above mean sea level)
- *Bottom* = elevation of aquifer bottom (feet above mean sea level)
- S_y = specific yield (no units)
- S_s = specific storage (1/feet)
- S = storativity or storage coefficient (no units)

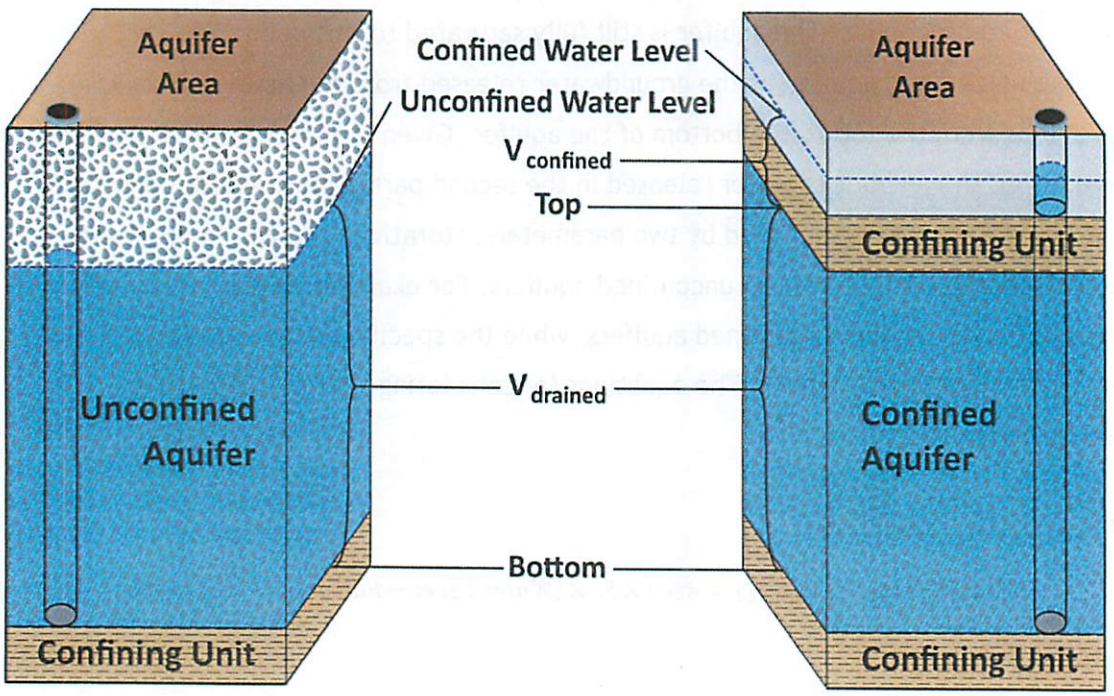

FIGURE 1. SCHEMATIC GRAPH SHOWING THE DIFFERENCE BETWEEN UNCONFINED AND CONFINED AQUIFERS.

As presented in the equations, calculation of the total storage requires data, such as aquifer top, aquifer bottom, aquifer storage properties, and water level. For the Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, and Gulf Coast aquifers we extracted this information from existing groundwater availability model input and output files on a cell-by-cell basis.

For the Brazos River Alluvium Aquifer which does not have a groundwater availability model, we used an analytical approach. For each county, ArcMAP™ was used to estimate the Brazos River Alluvium Aquifer thickness (assuming base of the alluvium and land surface) and average water table depth (Shah and others, 2007; TWDB, 2013). Average Brazos River Alluvium Aquifer saturated thickness for each county was then calculated from average thickness minus average water table depth. Finally we estimated the total storage of the Brazos River

Alluvium Aquifer from average saturated thickness multiplied with area and an assumed specific yield value.

For the water bearing alluvial sediments determined as relevant for the San Bernard, Navasota, San Jacinto, and Trinity rivers, which do not have a groundwater availability model, we used an analytical approach. For each county, ArcMAP™ was used to calculate the acreage area for the delineated spatial extents of each of the river alluvia. The saturated thickness was then estimated based on water well and water-level data from the TWDB groundwater database for each of the acreage areas of the water bearing alluvial sediments determined as relevant (TWDB, 2011). Finally, we estimated the total storage for each of the river alluvia using average saturated thicknesses multiplied with associated areas and an assumed uniformly distributed specific yield values reported in the literature (Baker and others, 1974; Bradley, 2011; Cronin and Wilson, 1967; Johnson, 1967; Wilson, 1967).

The recoverable storage for each of the aquifers listed above was the product of its total storage and an estimated factor ranging from 25 percent to 75 percent.

PARAMETERS AND ASSUMPTIONS:

Carrizo-Wilcox, Queen City, and Sparta aquifers

- We used version 2.02 of the groundwater availability model for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers to estimate the total recoverable storage for the Carrizo-Wilcox, Queen City, and Sparta aquifers. See Dutton and others (2003) and Kelley and others (2004) for assumptions and limitations of the groundwater availability model.
- 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 Formation (Layer 5), the Upper Wilcox Formation or Calvert Bluff Formation (Layer 6), the Middle Wilcox Formation or Simsboro Formation (Layer 7), and the Lower Wilcox Formation or Hooper Formation (Layer 8). To develop the estimates for the total estimated recoverable storage, we used Layer 1 (Sparta Aquifer), Layer 3 (Queen City Aquifer), and Layers 5 through 8 (Carrizo-Wilcox Aquifer system).

- The down-dip boundary of the model is based on the location of the Wilcox Growth Fault Zone, which is considered to be a barrier to flow (Kelley and others, 2004). This boundary is relatively deep and in the portion of the aquifer that is characterized as brackish to saline; consequently, the model includes parts of the formation beyond potable portions of the aquifer (Dutton and others, 2003). The groundwater in the official extent of the Carrizo-Wilcox, Queen City, and Sparta aquifers ranges from fresh to brackish in composition (Kelley and others, 2004).
- The groundwater availability model for the northern part of the Carrizo-Wilcox, Queen City, and Sparta aquifers was not considered for analysis because the active model area was more adequately covered by the overlap of the active model area for the central part of the Carrizo-Wilcox, Queen City, and Sparta aquifers.

Yegua-Jackson Aquifer and the Catahoula Formation portion of the Gulf Coast Aquifer System

- We used version 1.01 of the groundwater availability model for the Yegua-Jackson Aquifer to estimate the total recoverable storages of 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 section for the Yegua-Jackson Aquifer and the Catahoula Formation and other younger overlying units (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). To develop the estimates for the total estimated recoverable storage in the Yegua-Jackson Aquifer, we used layers 1 through 5; however, we only used model cells in Layer 1 that represent the outcrop area of the Yegua-Jackson Aquifer.
- The down-dip boundary for the Yegua-Jackson Aquifer in this model was set to approximately coincide with the extent of the available geologic data, well beyond any active portion (groundwater use) of the aquifer (Deeds and others, 2010). Consequently, the model extends into zones of brackish and saline groundwater. The groundwater in the official extent of the Yegua-Jackson Aquifer ranges from fresh to brackish in composition (Deeds and others, 2010).

- For Jasper, Newton, Polk, Tyler, and Washington counties we used the official active areas of the groundwater availability model to estimate the total recoverable storage for the Yegua-Jackson Aquifer. However, for Grimes and Walker counties the desired future condition statement adopted on August 25, 2010,o included confined and brackish confined areas outside of the official aquifer area. Geographic information for those areas was submitted with the desired future condition statement. We used that information in this assessment to estimate the total recoverable storage for Grimes and Walker counties for layers 2 through 5 which represent the confined parts of the Yegua-Jackson units.

Gulf Coast Aquifer System

- We used version 3.01 of the groundwater availability model for the northern portion of the Gulf Coast Aquifer system for this analysis. See Kasmarek (2013) for assumptions and limitations of the 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).
- The southeastern boundary of flow in each hydrogeologic unit of the model was set at the down-dip limit of freshwater (defined in this case to be up to 10,000 milligrams per liter of total dissolved solids; Kasmarek, 2013).

Brazos River Alluvium Aquifer

- The Brazos River Alluvium Aquifer is under water table conditions in most places (George and others, 2011).
- The thickness of the Brazos River Alluvium Aquifer is based on a U.S. Geological Survey electromagnetic and resistivity imaging project (Shah and others, 2007).
- Water levels are from the TWDB groundwater database http://www.twdb.texas.gov/groundwater/data/gwdbrpt.asp accessed in July 2013. The three latest years of water level data were used to estimate the average water table depth for each county.
- We used a specific yield value of 0.15 from Cronin and others (1967).

San Bernard River Alluvium

- The areal extent of the San Bernard River Alluvium within Austin County was calculated to be 2,792 acres (USGS and TWDB, 2006).
- Average saturated thickness of the water bearing alluvium determined as relevant was calculated to be 20 feet (Thorkildsen and Backhouse, 2011).
- We used a specific yield value of 0.15 (Wilson, 1967).

Navasota River Alluvium

- The areal extent of the Navasota River Alluvium within Grimes County was calculated to be 12,004 acres (USGS and TWDB, 2006).
- Based on water well and water-level data from the TWDB groundwater database near the confluence of the Navasota and Brazos Rivers the water bearing alluvium determined as relevant has an average saturated thickness of 32 feet (TWDB, 2011).
- We used a specific yield value of 0.15 (Baker and others, 1974; Bradley, 2011; Johnson, 1967).

San Jacinto River Alluvium

- The areal extent of the San Jacinto River Alluvium within Walker County was calculated to be 7,399 acres (USGS and TWDB, 2006).
- Based on water well and water-level data from the TWDB groundwater database the water bearing alluvium determined as relevant has an average saturated thickness of 20 feet (TWDB, 2011).
- We used a specific yield value of 0.15 (Cronin and Wilson, 1967; Johnson, 1967).

Trinity River Alluvium

- The areal extent of the Trinity River Alluvium within Walker County was calculated to be 19,873 acres (USGS and TWDB, 2006).
- Based on water well and water-level data from the TWDB groundwater database the water bearing alluvium determined as relevant has an average saturated thickness of 23 feet (TWDB, 2011).

- We used a specific yield value of 0.15 (Cronin and Wilson, 1967; Johnson, 1967).

RESULTS:

Tables 1 through 20 summarize the total estimated recoverable storage required by statute. The county and groundwater conservation district total storage estimates are rounded to two or three significant digits. Figures 2 through 11 indicate the extent of the groundwater availability models or aquifer boundaries deemed relevant by the groundwater conservation districts in Groundwater Management Area 14 for the Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson, Gulf Coast, and Brazos River Alluvium aquifers as well as the water bearing alluvial sediments determined as relevant by Groundwater Management Area 14 groundwater conservation districts for the San Bernard, Navasota, San Jacinto, and Trinity rivers.

TABLE 1. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE CARRIZO-WILCOX AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 14. COUNTY TOTAL ESTIMATES ARE ROUNDED TO THREE SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Grimes	14,500,000	3,625,000	10,875,000
Walker	5,040,000	1,260,000	3,780,000
Washington	264,000	66,000	198,000
Total	19,804,000	4,951,000	14,853,000

TABLE 2. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[2] FOR THE CARRIZO-WILCOX AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 14. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO THREE SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	264,000	66,000	198,000
Bluebonnet GCD	19,500,000	4,875,000	14,625,000
Total	19,764,000	4,941,000	14,823,000

[2] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to three significant digits.

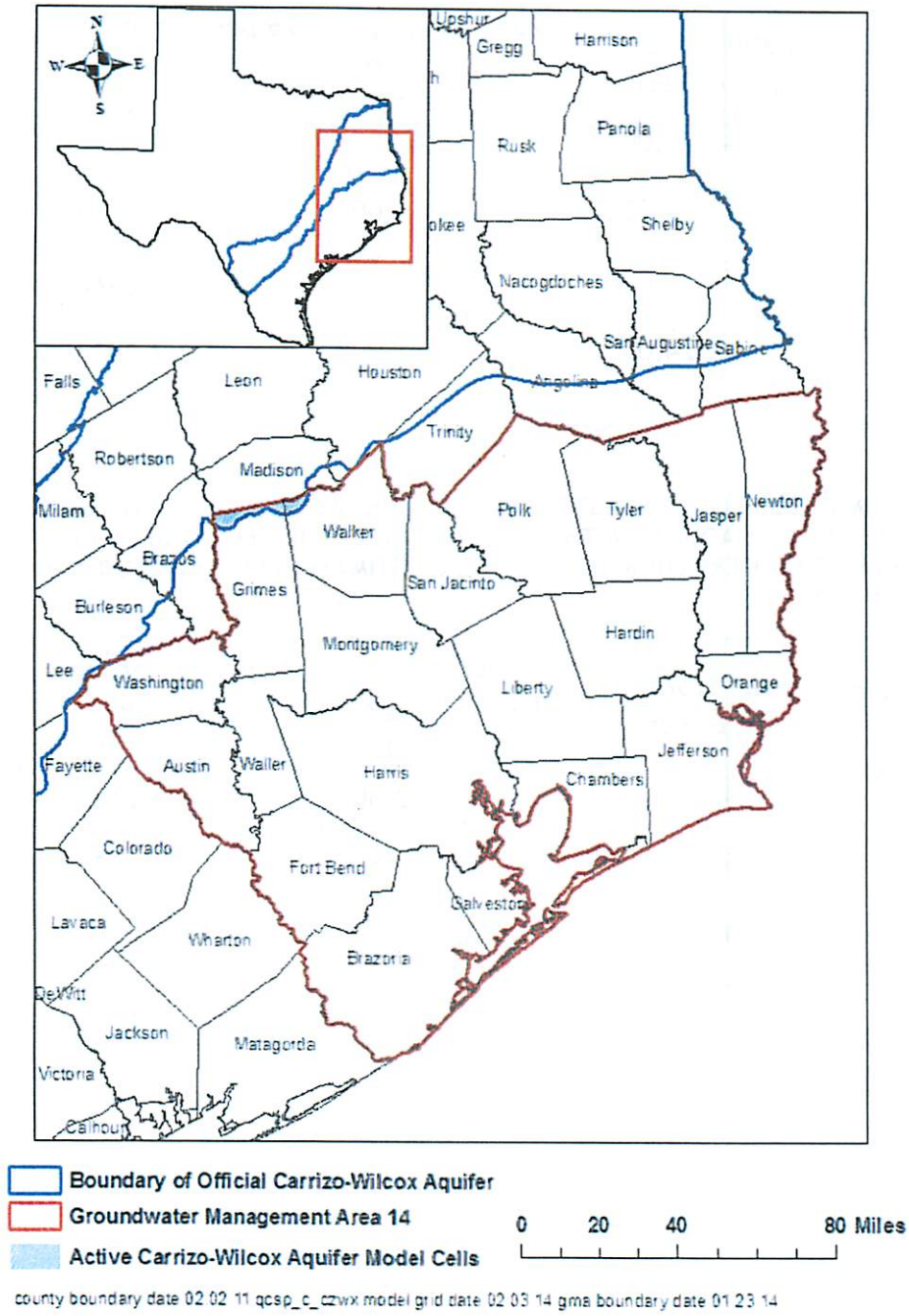

FIGURE 2. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE CENTRAL PART OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE CARRIZO-WILCOX AQUIFER (TABLES 1 AND 2) WITHIN GROUNDWATER MANAGEMENT AREA 14.

TABLE 3. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE QUEEN CITY AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 14. COUNTY TOTAL ESTIMATES ARE ROUNDED TO THREE SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Grimes	4,970,000	1,242,500	3,727,500
Walker	624,000	156,000	468,000
Washington	4,330,000	1,082,500	3,247,500
Total	9,924,000	2,481,000	7,443,000

TABLE 4. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[3] FOR THE QUEEN CITY AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 14. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO THREE SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	4,330,000	1,082,500	3,247,500
Bluebonnet GCD	5,590,000	1,397,500	4,192,500
Total	9,920,000	2,480,000	7,440,000

[3] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to three significant digits.

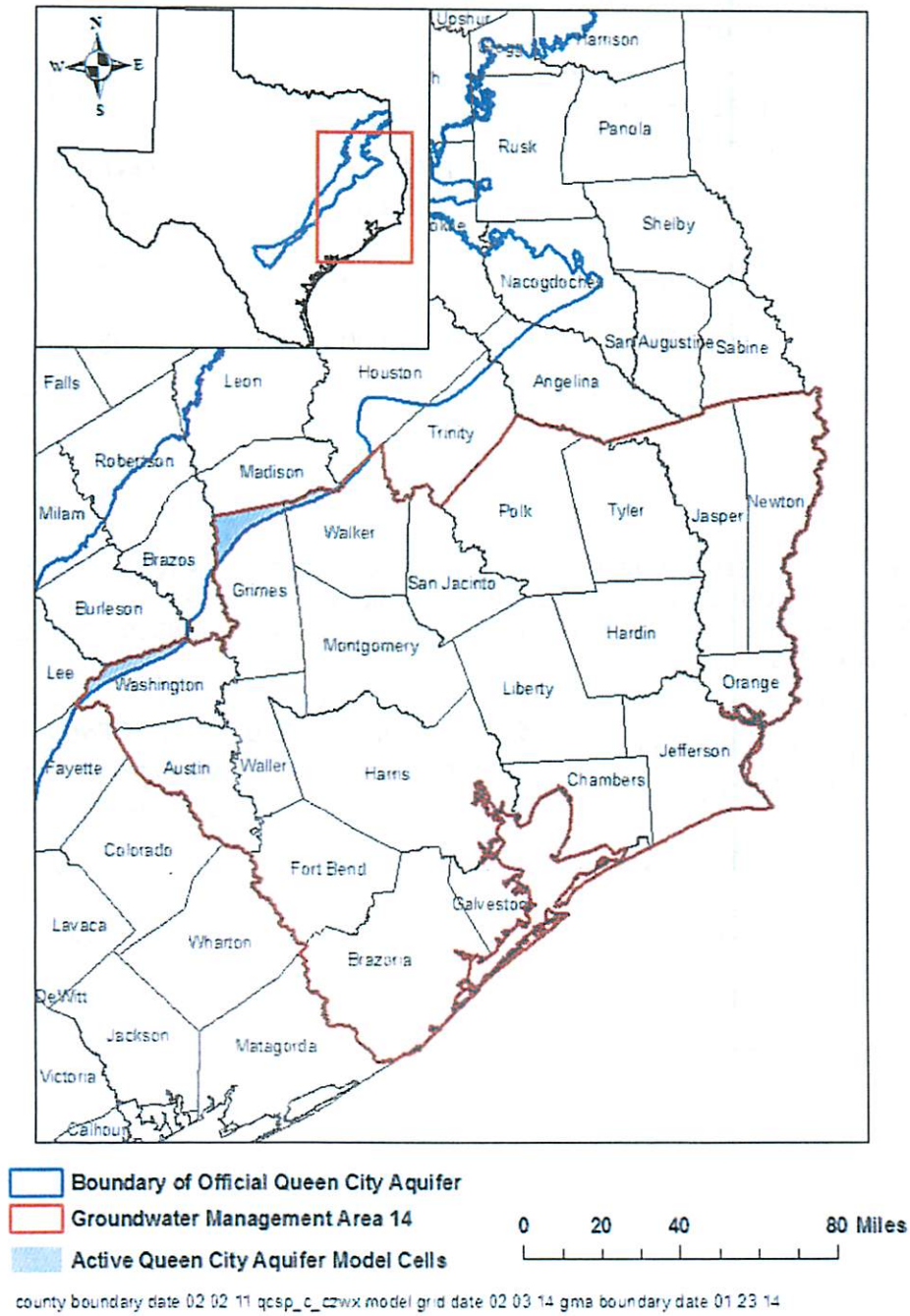

FIGURE 3. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE CENTRAL PART OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE QUEEN CITY AQUIFER (TABLES 3 AND 4) WITHIN GROUNDWATER MANAGEMENT AREA 14.

TABLE 5. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE SPARTA AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 14. COUNTY TOTAL ESTIMATES ARE ROUNDED TO THREE SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Grimes	11,600,000	2,900,000	8,700,000
Walker	8,550,000	2,137,500	6,412,500
Washington	1,860,000	465,000	1,395,000
Total	22,010,000	5,502,500	16,507,500

TABLE 6. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[4] FOR THE SPARTA AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 14. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO THREE SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	1,860,000	465,000	1,395,000
Bluebonnet GCD	20,100,000	5,025,000	15,075,000
Total	21,960,000	5,490,000	16,470,000

[4] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to three significant digits.

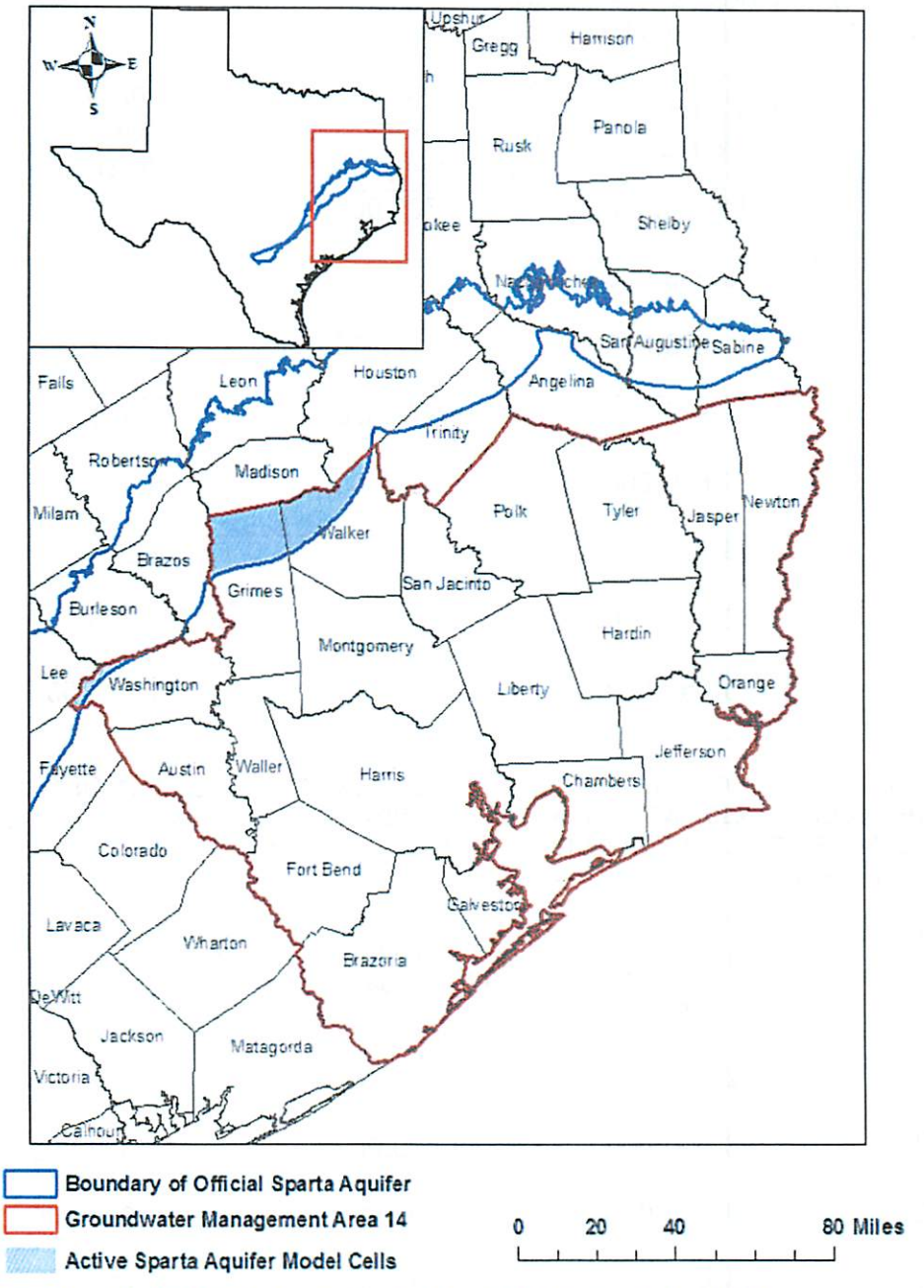

FIGURE 4. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE CENTRAL PART OF THE CARRIZO-WILCOX, QUEEN CITY, AND SPARTA AQUIFERS USED TO ESTIMATE TOTAL RECOVERABLE STORAGE FOR THE SPARTA AQUIFER (TABLES 5 AND 6) WITHIN GROUNDWATER MANAGEMENT AREA 14.

TABLE 7. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE YEGUA-JACKSON AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 14. COUNTY TOTAL ESTIMATES ARE ROUNDED TO THREE SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Grimes	94,900,000	23,725,000	71,175,000
Jasper	6,930,000	1,732,500	5,197,500
Newton	1,270,000	317,500	952,500
Polk	27,900,000	6,975,000	20,925,000
Tyler	8,650,000	2,162,500	6,487,500
Walker	103,000,000	25,750,000	77,250,000
Washington	12,400,000	3,100,000	9,300,000
Total	255,050,000	63,762,500	191,287,500

TABLE 8. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[5] FOR THE YEGUA-JACKSON AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 14. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO THREE SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	12,400,000	3,100,000	9,300,000
Bluebonnet GCD	198,000,000	49,500,000	148,500,000
Lower Trinity GCD	28,000,000	7,000,000	21,000,000
Southeast Texas GCD	16,900,000	4,225,000	12,675,000
Total	255,300,000	63,825,000	191,475,000

[5] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to three significant digits.

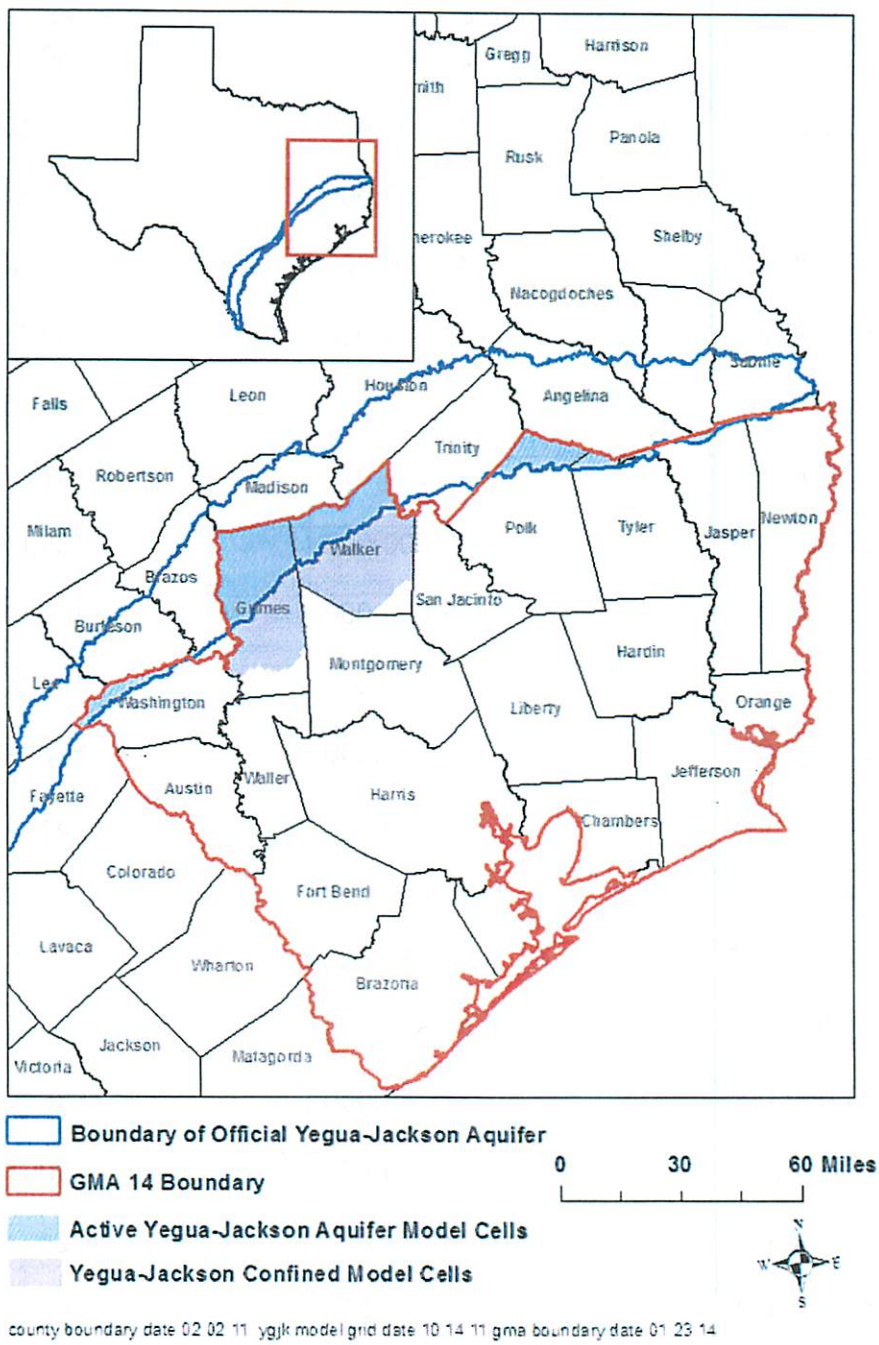

FIGURE 5. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE YEGUA-JACKSON AQUIFER USED TO ESTIMATE TOTAL RECOVERABLE STORAGE (TABLES 7 AND 8) FOR THE YEGUA-JACKSON AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 14.

TABLE 9. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE GULF COAST AQUIFER SYSTEM WITHIN GROUNDWATER MANAGEMENT AREA 14. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Austin	80,000,000	20,000,000	60,000,000
Brazoria	330,000,000	82,500,000	247,500,000
Chambers	130,000,000	32,500,000	97,500,000
Fort Bend	170,000,000	42,500,000	127,500,000
Galveston	81,000,000	20,250,000	60,750,000
Grimes	35,000,000	8,750,000	26,250,000
Hardin	190,000,000	47,500,000	142,500,000
Harris	380,000,000	95,000,000	285,000,000
Jasper	140,000,000	35,000,000	105,000,000
Jefferson	170,000,000	42,500,000	127,500,000
Liberty	250,000,000	62,500,000	187,500,000
Montgomery	180,000,000	45,000,000	135,000,000
Newton	120,000,000	30,000,000	90,000,000
Orange	61,000,000	15,250,000	45,750,000
Polk	110,000,000	27,500,000	82,500,000
San Jacinto	95,000,000	23,750,000	71,250,000
Tyler	120,000,000	30,000,000	90,000,000
Walker	32,000,000	8,000,000	24,000,000
Waller	80,000,000	20,000,000	60,000,000
Washington	22,000,000	5,500,000	16,500,000
Total	2,776,000,000	694,000,000	2,082,000,000

TABLE 10. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[6] FOR THE GULF COAST AQUIFER SYSTEM WITHIN GROUNDWATER MANAGEMENT AREA 14. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	640,000,000	160,000,000	480,000,000
Bluebonnet GCD	230,000,000	57,500,000	172,500,000
Brazoria County GCD	330,000,000	82,500,000	247,500,000
Fort Bend Subsidence District	170,000,000	42,500,000	127,500,000
Harris-Galveston Coastal Subsidence District	460,000,000	115,000,000	345,000,000
Lone Star GCD	180,000,000	45,000,000	135,000,000
Lower Trinity GCD	200,000,000	50,000,000	150,000,000
Southeast Texas GCD	570,000,000	142,500,000	427,500,000
Total	2,780,000,000	695,000,000	2,085,000,000

[6] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to two significant digits.

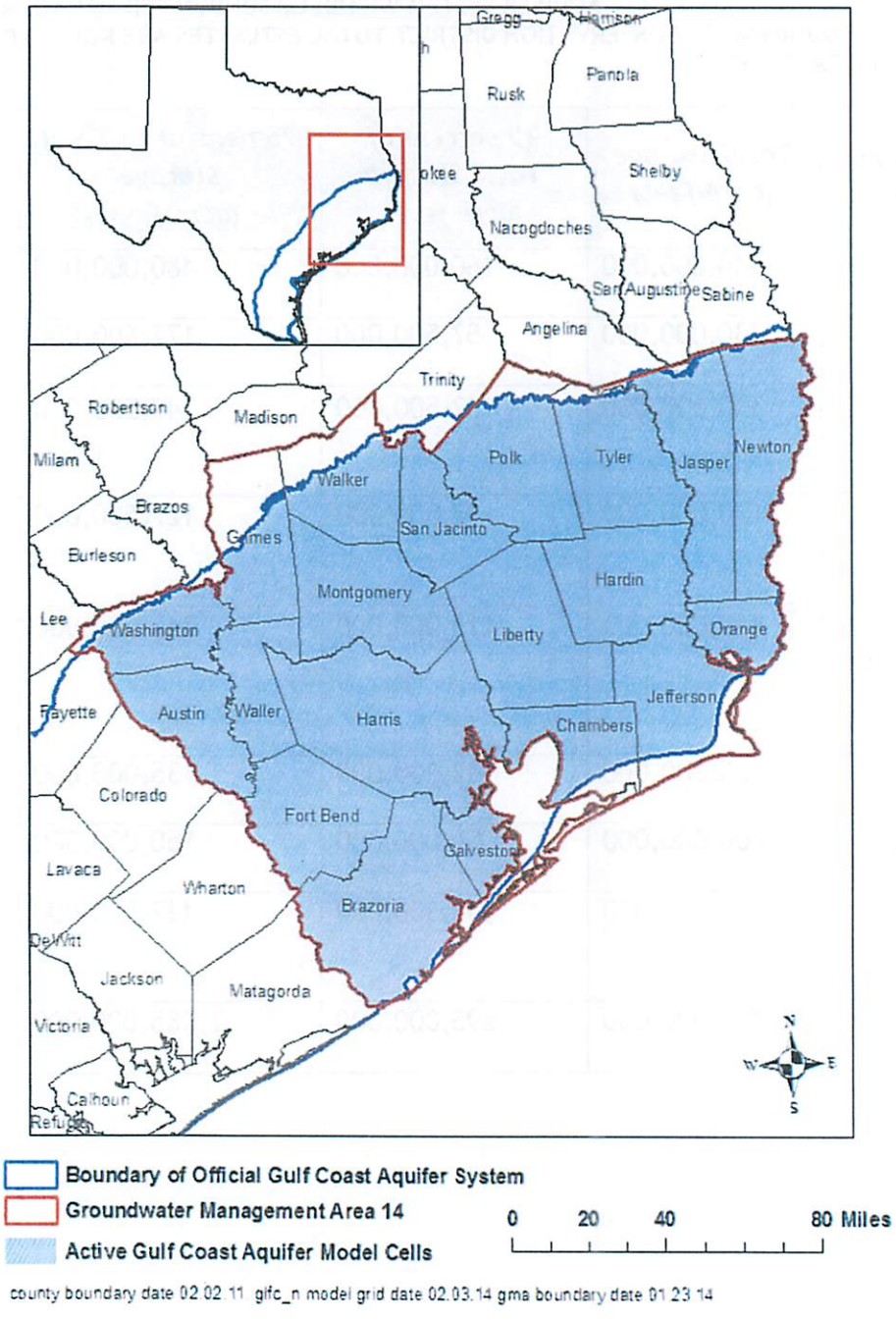

FIGURE 6. EXTENT OF THE GROUNDWATER AVAILABILITY MODEL FOR THE NORTHERN PART OF THE GULF COAST AQUIFER SYSTEM USED TO ESTIMATE TOTAL RECOVERABLE STORAGE (TABLES 9 AND 10) FOR THE GULF COAST AQUIFER SYSTEM WITHIN GROUNDWATER MANAGEMENT AREA 14.

TABLE 11. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE BRAZOS RIVER ALLUVIUM AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 14. COUNTY TOTAL ESTIMATES ARE ROUNDED TO THREE SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Austin	220,000	55,000	165,000
Fort Bend	1,010,000	252,500	757,500
Grimes	74,700	18,675	56,025
Waller	412,000	103,000	309,000
Washington	179,000	44,750	134,250
Total	1,895,700	473,925	1,421,775

TABLE 12. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT[7] FOR THE BRAZOS RIVER ALLUVIUM AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 14. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO THREE SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
No District	179,140	179,000	44,750
Bluebonnet GCD	707,000	176,750	530,250
Fort Bend Subsidence District	1,010,000	252,500	757,500
Total	1,896,000	474,000	1,422,000

[7] The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to three significant digits.

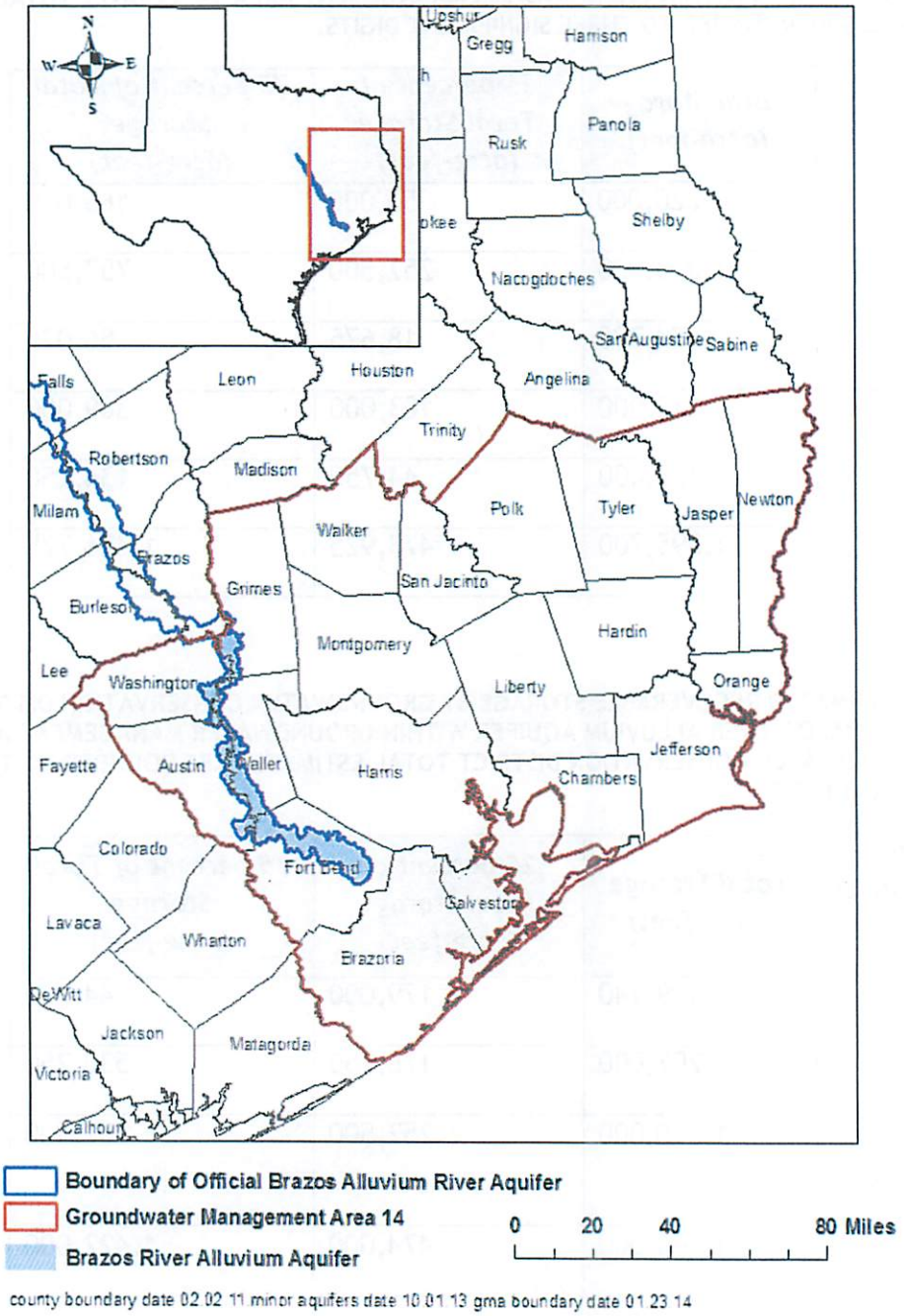

FIGURE 7. EXTENT OF THE BRAZOS RIVER ALLUVIUM AQUIFER USED TO ESTIMATE TOTAL RECOVERABLE STORAGE (TABLES 11 AND 12) FOR THE BRAZOS RIVER ALLUVIUM AQUIFER WITHIN GROUNDWATER MANAGEMENT AREA 14.

TABLE 13. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE SAN BERNARD RIVER ALLUVIUM DETERMINED AS RELEVANT WITHIN GROUNDWATER MANAGEMENT AREA 14. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Austin	8,400	2,100	6,300
Total	8,400	2,100	6,300

TABLE 14. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT FOR THE SAN BERNARD RIVER ALLUVIUM DETERMINED AS RELEVANT WITHIN GROUNDWATER MANAGEMENT AREA 14. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Bluebonnet GCD	8,400	2,100	6,300
Total	8,400	2,100	6,300

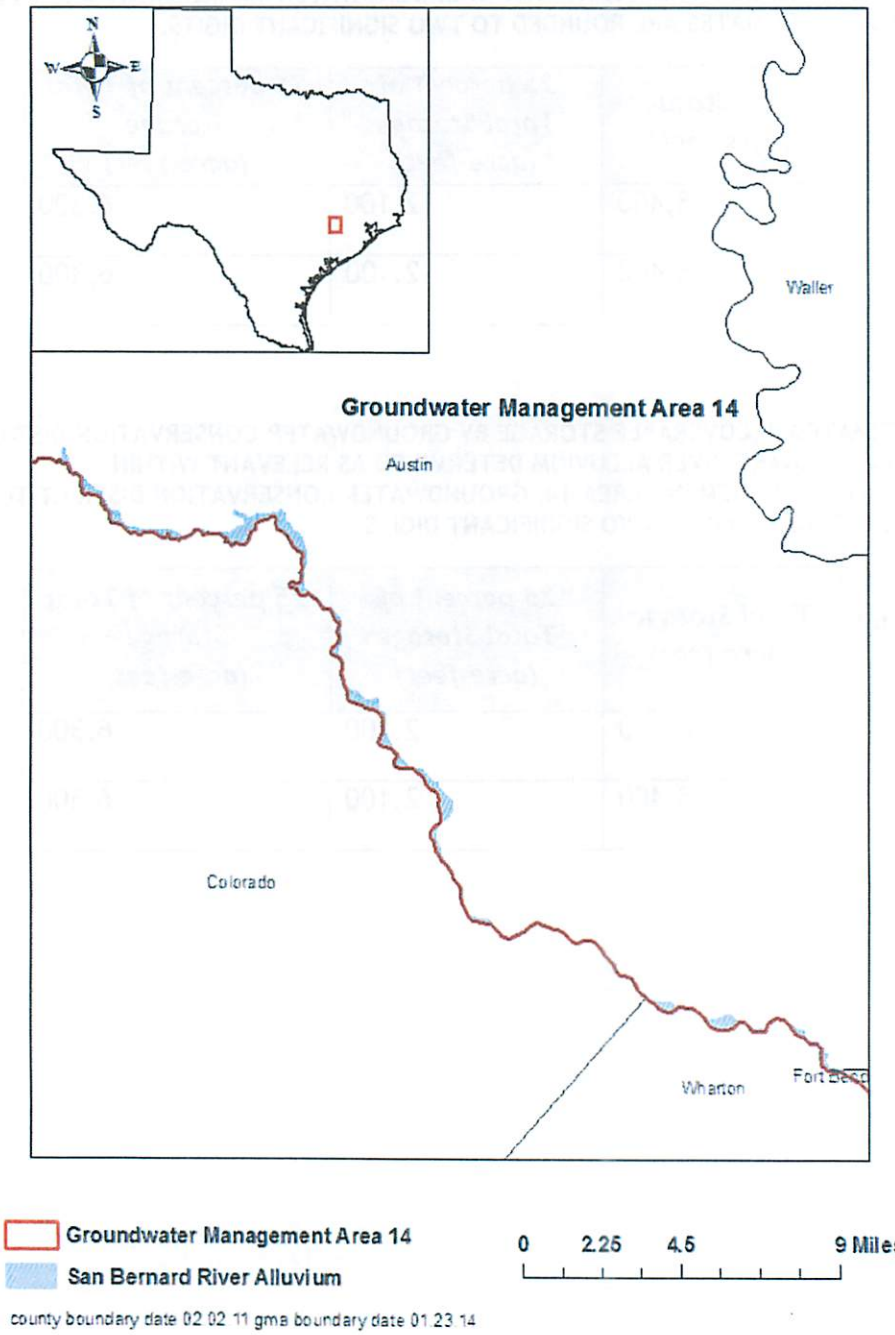

FIGURE 8. EXTENT OF THE SAN BERNARD RIVER ALLUVIUM DETERMINED AS RELEVANT IN AUSTIN COUNTY USED TO ESTIMATE TOTAL RECOVERABLE STORAGE (TABLES 13 AND 14) FOR THE SAN BERNARD RIVER ALLUVIUM DETERMINED AS RELEVANT WITHIN GROUNDWATER MANAGEMENT AREA 14.

TABLE 15. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE NAVASOTA RIVER ALLUVIUM DETERMINED AS RELEVANT WITHIN GROUNDWATER MANAGEMENT AREA 14. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Grimes	58,000	14,500	43,500
Total	58,000	14,500	43,500

TABLE 16. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT FOR THE NAVASOTA RIVER ALLUVIUM DETERMINED AS RELEVANT WITHIN GROUNDWATER MANAGEMENT AREA 14. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Bluebonnet GCD	58,000	14,500	43,500
Total	58,000	14,500	43,500

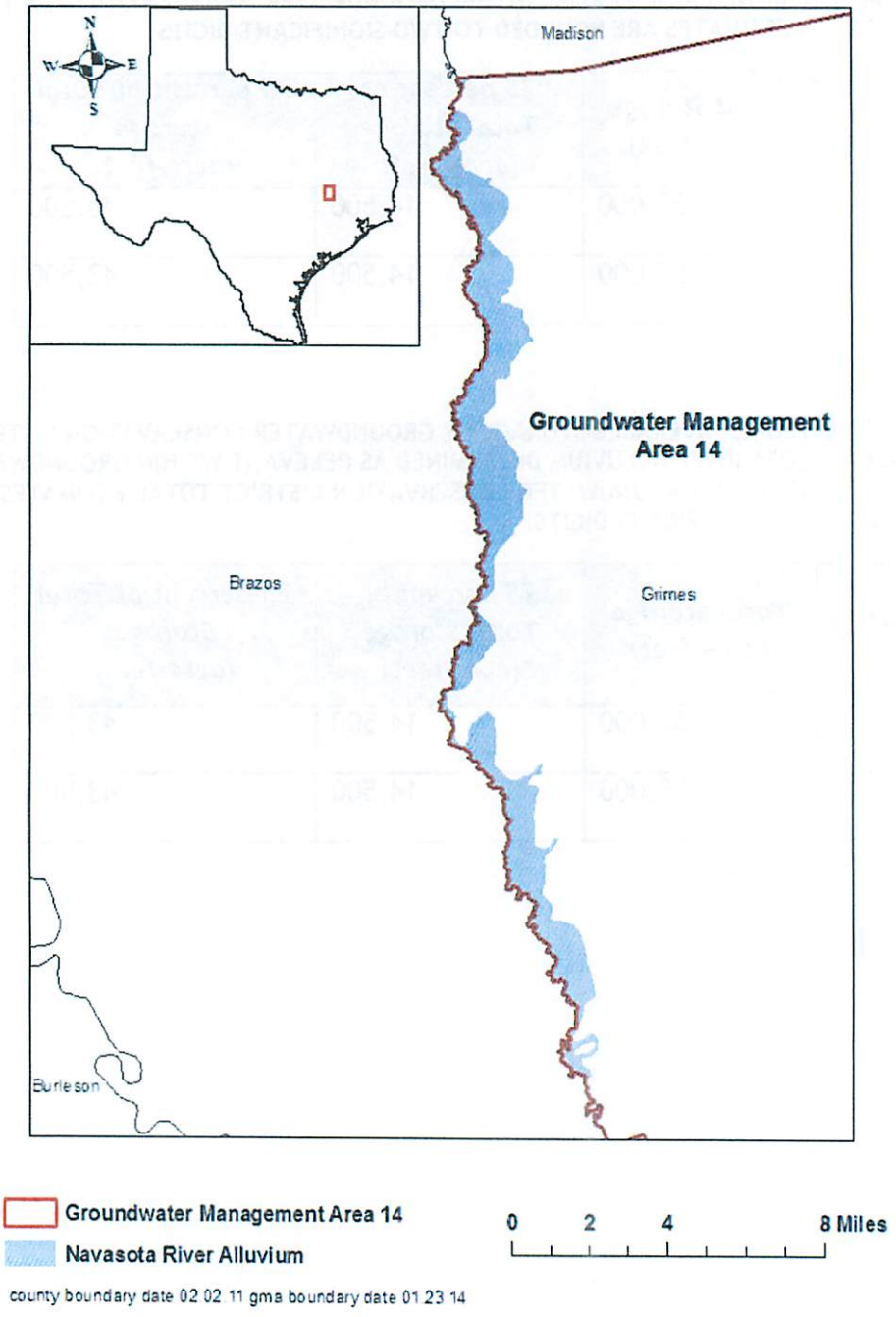

FIGURE 9. EXTENT OF THE NAVASOTA RIVER ALLUVIUM DETERMINED AS RELEVANT IN GRIMES COUNTY USED TO ESTIMATE TOTAL RECOVERABLE STORAGE (TABLES 15 AND 16) FOR NAVASOTA RIVER ALLUVIUM DETERMINED AS RELEVANT WITHIN GROUNDWATER MANAGEMENT AREA 14.

TABLE 17. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE SAN JACINTO RIVER ALLUVIUM DETERMINED AS RELEVANT WITHIN GROUNDWATER MANAGEMENT AREA 14. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Walker	22,000	5,500	16,500
Total	22,000	5,500	16,500

TABLE 18. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT FOR THE SAN JACINTO RIVER ALLUVIUM DETERMINED AS RELEVANT WITHIN GROUNDWATER MANAGEMENT AREA 14. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Bluebonnet GCD	22,000	5,500	16,500
Total	22,000	5,500	16,500

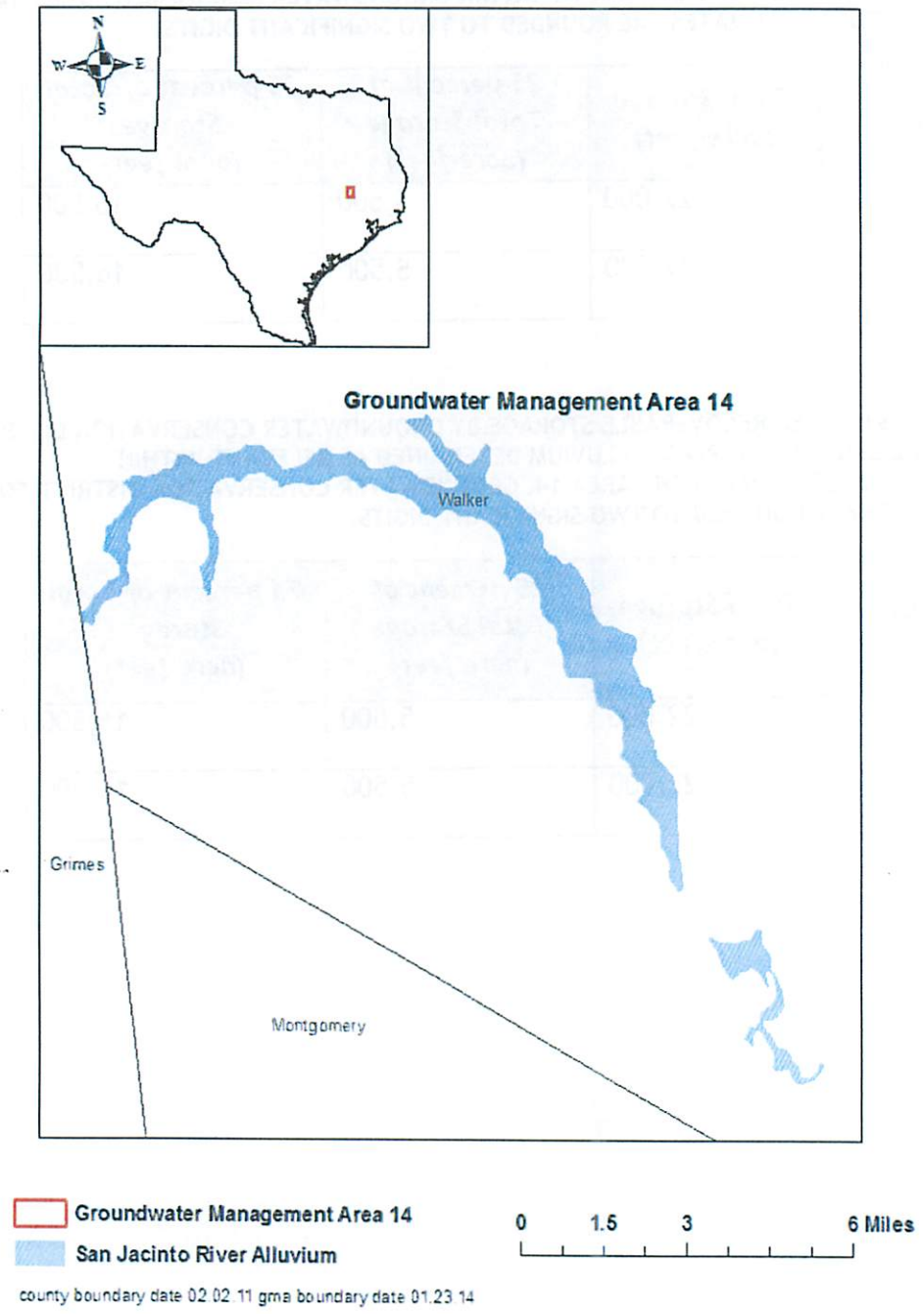

FIGURE 10. EXTENT OF THE SAN JACINTO RIVER ALLUVIUM DETERMINED AS RELEVANT IN WALKER COUNTY USED TO ESTIMATE TOTAL RECOVERABLE STORAGE (TABLES 17 AND 18) FOR THE SAN JACINTO RIVER ALLUVIUM DETERMINED AS RELEVANT WITHIN GROUNDWATER MANAGEMENT AREA 14.

TABLE 19. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE TRINITY RIVER ALLUVIUM DETERMINED AS RELEVANT WITHIN GROUNDWATER MANAGEMENT AREA 14. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

County	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Walker	69,000	17,250	51,750
Total	69,000	17,250	51,750

TABLE 20. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT FOR THE TRINTY RIVER ALLUVIUM DETERMINED AS RELEVANT WITHIN GROUNDWATER MANAGEMENT AREA 14. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT DIGITS.

Groundwater Conservation District (GCD)	*Total Storage (acre-feet)*	*25 percent of Total Storage (acre-feet)*	*75 percent of Total Storage (acre-feet)*
Bluebonnet GCD	69,000	17,250	51,750
Total	69,000	17,250	51,750

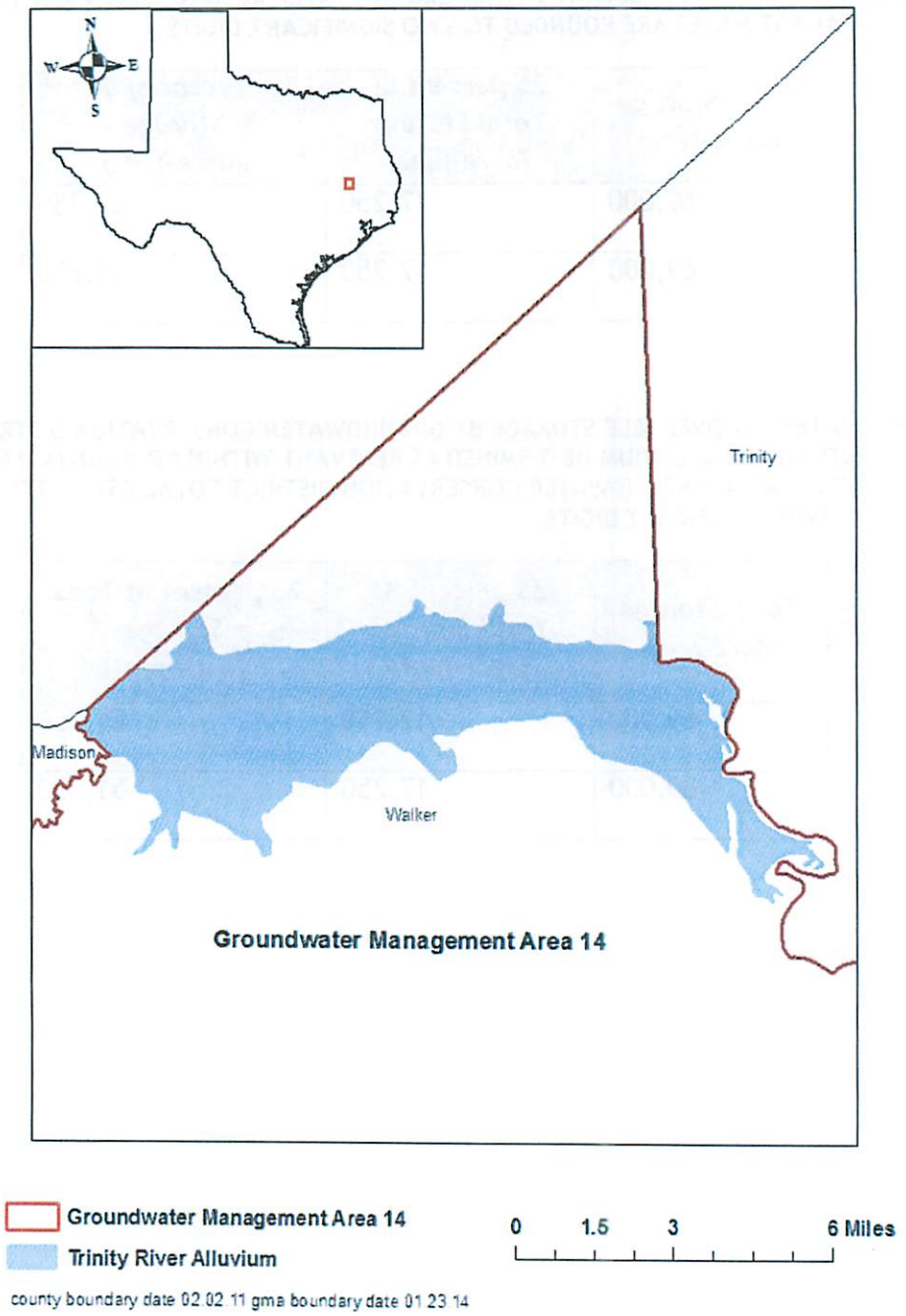

FIGURE 11. EXTENT OF THE TRINITY RIVER ALLUVIUM DETERMINED AS RELEVANT IN WALKER COUNTY USED TO ESTIMATE TOTAL RECOVERABLE STORAGE (TABLES 19 AND 20) FOR THE TRINITY RIVER ALLUVIUM DETERMINED AS RELEVANT WITHIN GROUNDWATER MANAGEMENT AREA 14.

LIMITATIONS

The groundwater models used in completing this analysis are the best available scientific tools that can be used to meet the stated objective(s). 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."*

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.

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AFFIDAVIT OF MICHAEL R. THORNHILL, P.G., CPG

STATE OF TEXAS §
§
COUNTY OF TRAVIS §

BEFORE ME, the undersigned Notary Public on this day personally appeared, MICHAEL R. THORNHILL, P.G., CPG, and being by me duly sworn according to law upon his oath, states:

1. "I am over 21 years of age, have never been convicted of a crime involving moral turpitude and am competent to make this Affidavit. I have personal knowledge of the facts stated herein, and they are true and correct.
2. I am the president and founder Thornhill Group, Inc. I have a Bachelor of Science of degree in Geology, and a Master of Science degree in Geology, both from Oklahoma State University, and with both with emphases in hydrogeology and groundwater resources. I am a licensed geologist in Texas, and a Certified Professional Geologist with the American Institute for Professional Geologists.
3. I have reviewed the resolution of the Districts of Groundwater Management Area 14 ("GMA 14")[1] approving the desired future conditions ("DFCs") for GMA 14,[2] and the Explanatory Report issued by GMA 14 pursuant to Texas Water Code Section 36.108(d-3).[3] I have also reviewed the minutes of the meeting of the Board of Directors of Lone Star Groundwater Conservation District ("LSGCD") reflecting the adoption of DFCs for

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[1] GMA 14 is comprised of Lone Star Groundwater Conservation District ("LSGCD"), Bluebonnet Groundwater Conservation District, Brazoria County Groundwater Conservation District, Lower Trinity Groundwater Conservation District, and Southeast Texas Groundwater Conservation District. These districts are collectively referred to herein as "the Districts."

[2] Resolution 2016-01 (Appendix A, Exhibit 1).

[3] Explanatory Report (Appendix A, Exhibit 10).

Montgomery County.[4] Additionally, I personally attended many of the meetings of the LSGCD board of directors concerning the DFCs.

4. I have more than 27 years' experience in conducting aquifer and groundwater resources investigations across all of the Major Aquifers of Texas, and most of the Minor Aquifers of Texas.

5. I am familiar with the Chicot, Evangeline and Jasper aquifers as they exist in GMA 14, and I have reviewed numerous hydrogeological reports regarding those aquifers. Additionally, I have conducted and supervised numerous hydrogeologic investigations and well-siting studies involving the Chicot, Evangeline and Jasper aquifers within GMA 14.

6. In their consideration of DFCs for GMA 14, the Districts failed to delineate the common aquifers before assigning DFCs. In my opinion, the Districts should have delineated such common aquifers before considering DFCs because:

    a. GMA 14 includes several different aquifers of the Gulf Coast aquifer system, including the Chicot, Evangeline and Jasper aquifers.

    b. These aquifers are not confined to the area encompassed by the boundaries of LSGCD, and the boundaries of LSGCD (the political lines outlining Montgomery County) are not coterminous with the boundaries of any of such aquifers.

    c. There are no identified aquifer subdivisions in the Chicot aquifer within GMA 14

    d. There are no identified aquifer subdivisions in the Evangeline aquifer within GMA 14.

    e. There are no identified aquifer subdivisions in the Jasper aquifer within GMA 14

[4] Minutes of Meeting of Board of Directors of LSGCD, June 14, 2016 (Appendix A, Exhibit 2).

f. The political boundaries of the various counties within GMA 14 do not identify or delineate substantial or discernible differences in uses or conditions of the Chicot aquifer.

g. The political boundaries of the various counties within GMA 14 do not identify or delineate substantial or discernible differences in uses or conditions of the Evangeline aquifer.

h. The political boundaries of the various counties within GMA 14 do not identify or delineate substantial or discernible differences in uses or conditions of the Jasper aquifer.

i. Withdrawals of groundwater from the aquifers of the Gulf Coast aquifer system outside the boundaries of LSGCD can and will affect the groundwater resources inside the boundaries of LSGCD.

j. Montgomery and Liberty Counties are adjacent to one another. There is no aquifer subdivision or other hydrological barrier in the Jasper Aquifer as it exists between Montgomery and Liberty counties. Yet, the DFC approved by GMA 14 for the Jasper aquifer in Liberty County (average drawdown of no more than 120 feet after 61 years) is very different from the DFC adopted by LSGCD for Montgomery County (average drawdown of no more than 34 feet after 61 years).

k. Because Liberty County has no GCD and therefore no production limits or other rules, groundwater rights owners in Liberty County can produce groundwater from that county in a way that will adversely impact groundwater rights owners in adjacent counties, including Montgomery County.

7. The DFCs adopted by LSGCD make no distinction between the Chicot, Evangeline and Jasper aquifers in terms of susceptibility to causing subsidence. No subsidence has ever been documented to have occurred or will ever occur from pumping groundwater from the Jasper aquifer within Montgomery County or the other counties of GMA 14. This is because the Jasper aquifer is a confined aquifer that that is considerably deeper than the Chicot and Evangeline aquifers, and is bounded by and contains clay layers that are not substantially susceptible to compaction due to groundwater withdrawal or diminution in artesian pressure.

8. Based on the Explanatory Report, it is my opinion that GMA 14 did not equally apply a management standard based on subsidence. This is true because:

   a. The areas of greatest subsidence within the Gulf Coast aquifer system are in Harris and Fort Bend Counties, neither of which is within the jurisdiction of any GCD in GMA 14, but both of which are within the jurisdiction of subsidence districts.

   b. The subsidence districts have given producers within Harris and Fort Bend Counties a greater right to produce groundwater than LSGCD allows in adjacent Montgomery County. Thus, producers in Harris and Fort Bend Counties have the greatest right and ability to induce subsidence than anywhere else in GMA 14. This is unfair and arbitrary.

   c. Only one district, the Bluebonnet Groundwater Conservation District (BGCD), specified subsidence DFCs within its three-county area. However, the subsidence DFCs established by BGCD are not physically measurable or verifiable.

9. LSGCD has adopted management criteria for the Chicot, Evangeline and Jasper aquifers in Montgomery County that restricts production to an amount equal to annual recharge only. This restriction is not based on the best available science, and results in effectively condemning essentially all of the groundwater in storage under Montgomery County, and is based on a hydrogeologic fallacy.

    a. The DFCs for the Chicot, Evangeline and Jasper aquifers underlying Montgomery County are reverse-engineered to produce only 64,000 acre-feet of groundwater per year, based on LSGCD's calculations of "annual recharge" of those aquifers, and the claim that recharge is the "sustainable yield" of the aquifers.

    b. LSGCD has used 64,000 acre-feet per year as its estimated annual recharge since its inception as a GCD, well before the Legislature mandated the adoption of DFCs. The estimated recharge of 64,000 acre feet per year is not now, and has never been, based on the best available science, as mandated by the Water Code.

10. Texas Water Code Section 36.108(d)(3) requires the Districts to consider the "Total Estimated Recoverable Storage" or "TERS" for each aquifer in the management area. The Districts and LSGCD failed to properly consider the TERS in the Jasper aquifer in adopting the DFCs.

    a. Based on TWDB estimates, there is 180,000,000 acre feet of in storage under Montgomery County.[5] Note that the Texas Water Code defines total aquifer storage as "...the total calculated volume of groundwater that an aquifer is capable of producing" (Texas Water Code, §36.001(24)). The TERS is defined by the TWDB as the "...estimated amount of groundwater within an aquifer that

[5] *See* "GAM Task 13-037: Total Estimated Recoverable Storage for Aquifers in Groundwater Management Area 14," Texas Water Development Board, June 9, 2014, Tables 10 and

accounts for recovery scenarios that range between 25% and 75% of the porosity-adjusted aquifer volume" (Texas Administrative Code Rule §356.10 (24)). Therefore, the TERS for the Gulf Coast Aquifer system within Montgomery County alone is between 45,000,000 and 135,000,000 acre-feet.

b. The DFCs and resulting rules of LSGCD prevent groundwater rights owners from accessing essentially any of this groundwater in storage under Montgomery County.

c. All of the groundwater withdrawals in Montgomery County since 1900 have resulted in a diminution of groundwater in storage of less than 0.5%.

d. Continued production of groundwater in Montgomery County at a rate twice the current limit of 64,000 acre-feet per year over the next 60 years would result in diminution of groundwater in storage of less than 2%.

e. By way of contrast, the groundwater rights owners in the Ogallala aquifer in North and West Texas will be allowed to produce 50% of today's available groundwater over the next 50 years.

f. Production of groundwater in storage under Montgomery County at a rate equal to 128,000 acre-feet per year will not cause the aquifers to "go dry", will not harm wells, and will not induce significant subsidence.

11. The rules of LSGCD allow certain groundwater producers to produce groundwater in amounts that exceed the amounts allowed to other similarly situated owners. Additionally, the rules regarding production limitations do not take into consideration the relative amounts of groundwater rights owned by different owners or producers. This creates a situation where some groundwater rights owners are treated more favorably than

other similarly situation owners, based merely on regulatory constraints and not on either aquifer characteristics or relative amounts of groundwater ownership. The rules of LSGCD effectively prevent groundwater owners from exercising a right of offset with respect to nearby production, and arbitrarily either increase or diminish the value of groundwater rights because of production limitations that are not correlative.

12. The aquifers underlying GMA 14 and Montgomery County each have different characteristics, capacities and storage amounts, but the Explanatory Report treats them as though they were one aquifer. The districts of GMA 14, including LSGCD, did not provide an Explanatory Report for each of the DFCs for each of the relevant aquifers in Montgomery County or in GMA 14.

13. The GMA 14 Explanatory Report does not adequately address nine (9) factors required in Texas Water Code §36.108(d), nor the considerations required under Texas Water Code §36.108(d-1) and (d-2). Additionally, the GMA 14 Explanatory Report did not adequately address the alternative DFCs provided by Quadvest and other stakeholders.

FURTHER AFFIANT SAYETH NOT.

MICHAEL R. THORNHILL

SUBSCRIBED AND SWORN TO BEFORE ME, by MICHAEL R. THORNHILL on this the 30th day of November, 2016, to certify which witness my hand and seal of office.

HANNAH LEIGH THORNHILL
Notary Public, State of Texas
My Commission Expires
June 24, 2017

Hannah Thornhill

NOTARY PUBLIC

STATE OF TEXAS

My Commission Expires:

June 24, 2017

TO: Board Members

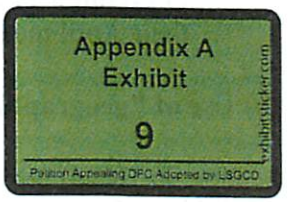
THROUGH: Robert E. Mace, Deputy Executive Administrator, Water Science and Conservation

FROM: William R. Hutchison, Director, Groundwater Resources Division
Kenneth L. Petersen, General Counsel

DATE: March 10, 2010

SUBJECT: Briefing and discussion on: (a) status of joint planning in groundwater management areas; and (b) use of "geographic areas" in establishing desired future conditions.

ACTION REQUESTED



No action requested; this is a discussion item.

BACKGROUND

Key background points are:

- Groundwater management areas are required to submit desired future conditions to the Texas Water Development Board (TWDB) by September 1, 2010.
- Once desired future conditions are submitted, Groundwater Resources Division staff develops values of managed available groundwater based on the desired future condition.
- Groundwater conservation districts are required to include the desired future condition and managed available groundwater number in their groundwater management plans and permitting.
- Regional water planning groups are required to use the managed available groundwater values in their regional water plans if they are received in a timely manner.
- Once adopted, desired future conditions can be challenged by petitioning the TWDB.
- If the Board finds that the desired future condition is reasonable, the petition process ends.
- If the Board finds that the desired future condition is not reasonable, TWDB staff issues written findings to the petitioner and the groundwater conservation districts which include a list of findings and recommended changes to the desired future condition.
- The groundwater conservation districts are then required to prepare a revised desired future condition, to hold a public hearing, and to submit the revised future condition to the Board.
- TWDB will then provide public notice of the revised desired future condition and may provide a public response to the districts' revised conditions, at which point the petition process is concluded.

KEY ISSUES

(a) Status of joint planning in groundwater management areas

The status of desired future conditions, managed available groundwater determinations, and active petitions is shown in the attachment. Progress during the first two months of 2010 includes:

- The groundwater conservation districts in Groundwater Management Area 11 adopted a set of preliminary desired future conditions that will generally result in managed available groundwater values that are about the same as the 2007 State Water Plan groundwater availability estimates. It is expected that formal adoption will occur at their April meeting after a series of public meetings being organized by individual groundwater conservation districts
- The groundwater conservation districts in Groundwater Management Area 12 adopted a set of preliminary desired future conditions. It is expected that formal adoption will occur at their April meeting.

(b) Use of "geographic areas" in establishing desired future conditions

Section 36.108(d) provides that groundwater conservation districts "shall consider uses or conditions of an aquifer within the management area that differ substantially from one geographic area to another" when establishing desired future conditions. However, the law does not define "geographic area" and there is no guidance to the districts either on how to delineate a geographic area or on how to measure "substantial" differences between geographic areas in either uses or conditions. Under Section 36.108(d)(2), districts may establish different desired future conditions within a management area for "each geographic area overlying an aquifer in whole or in part ... within the boundaries of the management area."

The question has been presented whether groundwater conservation districts within a groundwater management area (GMA) may delineate different "geographic areas" within the GMA by use of county (or other political subdivision) boundaries. Staff believes this approach is legally defensible provided the districts are using the political subdivision boundaries to locate discernible and substantial differences in uses or conditions within the GMA and not for any other purposes. It should be emphasized that employing geographic areas that are not based on clear and substantial differences in uses or aquifer conditions is not supportable, regardless of how those geographic areas are drawn.

As noted, there is no definition of "geographic" or "geographic area" in Chapter 36, Water Code, nor are there any such definitions in the Code Construction Act which is generally applicable to statutory schemes. Webster's Third New International Dictionary (Unabridged, 1993) recognizes "political geography" as one form of geography (in addition to "mathematical geography," "physical geography," "economic geography," "commercial geography" and "bio-geography"). The argument that the omission of "political subdivision boundaries" from Section 36.108(d) is not

persuasive, as long as the groundwater conservation districts do not appear to be using county or other political subdivision lines to gerrymander DFCs for purposes other than accommodating discernible, substantial differences in uses or aquifer conditions within the GMA. (Known as the doctrine of expressio unius est exclusion alterius, the courts have stated that this approach to statutory construction is simply an aid to determine legislative intent and that it should not be mechanically applied. Mid-Century Insurance Co. of Texas v. Kidd, 1999 WL 450908 (Tex. 1999).

Attachment

Attachment

Status of Desired Future Conditions, Managed Available Groundwater Determinations, and Active Petitions

Status of Desired Future Condition Adoptions

Statute requires that groundwater conservation districts submit desired future conditions to the TWDB by September 1, 2010. To date, districts in four groundwater management areas have adopted desired future conditions. Districts in one area (Groundwater Management Area 8) have submitted conditions for all of its aquifers. Desired future conditions adopted thus far are:

Groundwater Management Area 1

- Ogallala Aquifer
- Rita Blanca Aquifer

Groundwater Management Area 8

- Blossom Aquifer
- Brazos River Alluvium Aquifer
- Edwards (Balcones Fault Zone) Aquifer
- Ellenberger-San Saba Aquifer
- Hickory Aquifer
- Marble Falls Aquifer
- Nacatoch Aquifer
- Trinity Aquifer
- Woodbine Aquifer

Groundwater Management Area 9

- Edwards Group of the Edwards-Trinity (Plateau) Aquifer
- Ellenberger Aquifer
- Hickory Aquifer
- Marble Falls Aquifer

Groundwater Management Area 10

- San Antonio Segment (excluding Kinney County) of the Edwards (Balcones Fault Zone) Aquifer

Status of Managed Available Groundwater Determinations

Statute requires that the TWDB provide managed available groundwater numbers based on the adopted desired future conditions to groundwater conservation districts and regional water planning groups. Final managed available groundwater numbers provided thus far are:

Groundwater Management Area 8

- Blossom Aquifer
- Brazos River Alluvium Aquifer
- Edwards (Balcones Fault Zone) Aquifer
- Ellenburger-San Saba Aquifer
- Hickory Aquifer
- Marble Falls Aquifer
- Trinity Aquifer
- Woodbine Aquifer

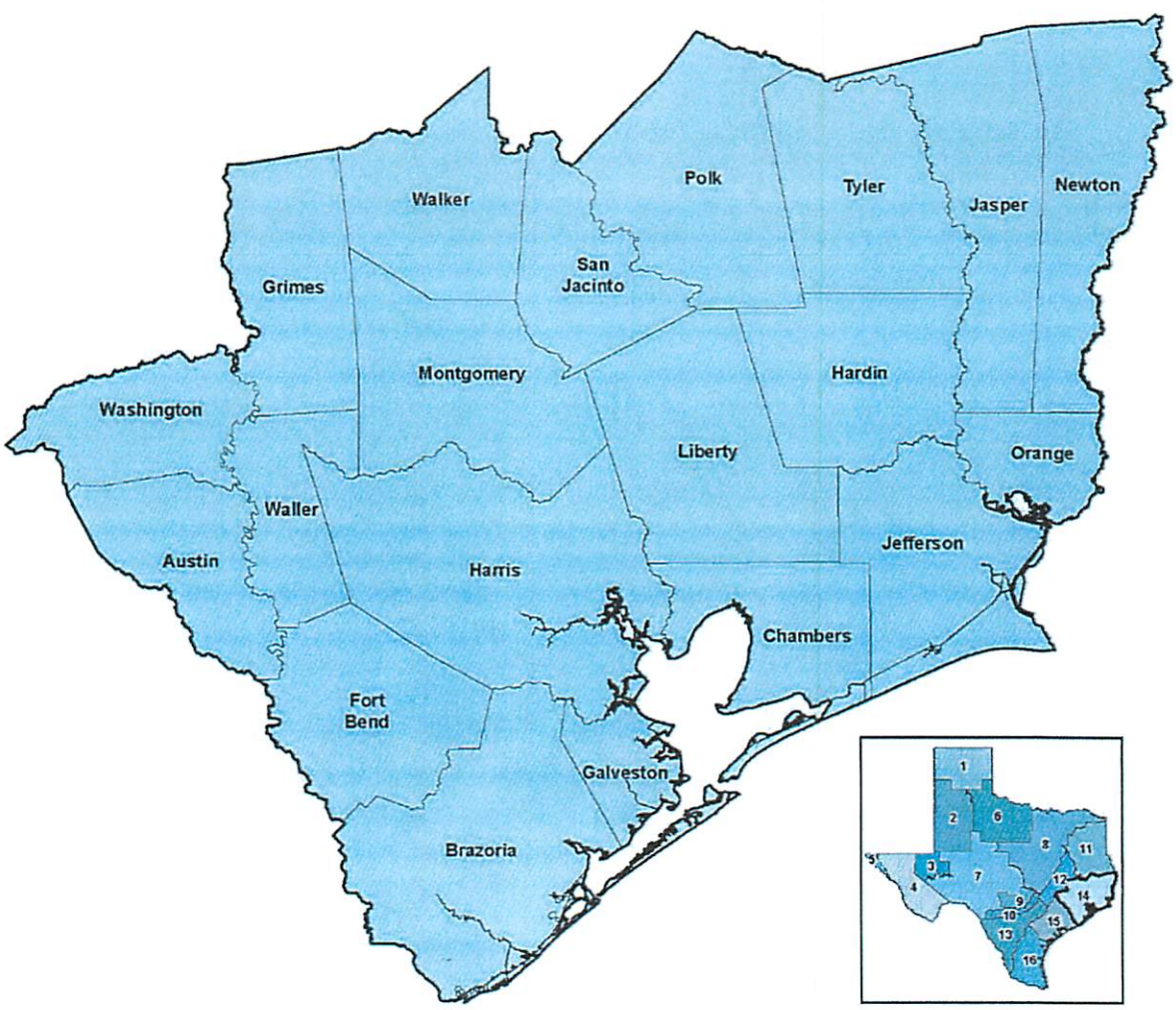
Groundwater Management Area 9

- Edwards Group of the Edwards-Trinity (Plateau) Aquifer

Groundwater Resources Division staff sends draft managed available groundwater numbers to the districts in the groundwater management area for review. Once comments are addressed and received from the districts, Groundwater Resources Division staff brings the numbers to the Board for review. As requested by the Board, this review will include a side-by-side comparison of managed available groundwater numbers with current state water plan and water use numbers as well as estimates of drainable water in place and a maximum sustained pumping level.

Status of Active Petitions

To date, TWDB has received two administratively complete petitions challenging the desired future conditions for the Ogallala Aquifer adopted by the districts in Groundwater Management Area 1. TWDB has also received three administratively complete petitions concerning desired future conditions in Groundwater Management Area 9. The process for Groundwater Management Area 1 is complete because the Board found the desired future conditions to be reasonable. The process for Groundwater Management Area 9 is ongoing after the Board's finding that the desired future conditions were not reasonable. The Board's recommended desired future condition has been discussed at a Groundwater Management Area 9 meeting, and a public hearing has been held. No action on the recommendation has been taken to date.



Desired Future Conditions Explanatory Report

Prepared by Groundwater Management Area 14

With assistance from

Mullican & Associates
Freese and Nichols, Inc.

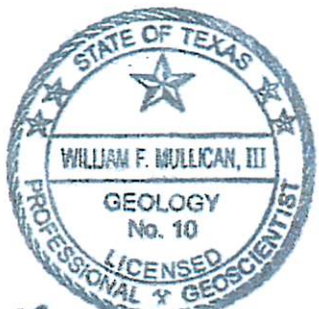
Desired Future Conditions Explanatory Report

Prepared by Groundwater Management Area 14

With assistance from

Mullican and Associates

Freese and Nichols, Inc.
TBPE Reg. No. F-2144



William F. Mullican III, PG
Principal, Mullican & Associates

Jason D. Afinowicz, PE
Project Manager, Freese and Nichols, Inc.

April 2016

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1.0 EXECUTIVE SUMMARY

District Representatives in Groundwater Management Area 14 ("GMA 14") developed this Explanatory Report as part of the requirements included in Texas Water Code Section 36.108, as part of the joint-planning process for the current round of joint planning (September 1, 2010 – May 1, 2016). This GMA 14 Explanatory Report contains two main elements required in statute for the joint-planning process: the desired future conditions ("DFCs") statement for all relevant aquifers that was adopted by District Representatives for GMA 14 during a regularly scheduled meeting on April 29, 2016, and documentation of all data, analyses, and supporting materials including policy and technical issues considered by the District Representatives of GMA 14 from July 26, 2013, through April 29, 2016 All required considerations included in Texas Water Code Section 36.108 (d)(1-9) are included in this GMA 14 Explanatory Report.

The Texas Water Development Board ("TWDB") has made available an "Explanatory Report Checklist," which it uses to determine administrative completeness with respect to the requirements of statute and administrative rules. To facilitate this review by the TWDB, a populated Explanatory Report Checklist is included in *Appendix A*.

Groundwater conservation districts ("GCDs") located within a groundwater management area are required to meet at least annually to jointly review each other's management plans and consider proposals to adopt new or amended DFCs (Texas Water Code Section 36.108(c)). A DFC is "the desired, quantified condition of groundwater resources (such as water levels, spring flows, or volume) within a management area at one or more specific future times as defined by participating groundwater conservation districts within a groundwater management area as part of a joint-planning process." (31 Texas Administrative Code Section 356.10(6))

The TWDB designated the Northern Gulf Coast Aquifer System, made up of the Chicot Aquifer, the Evangeline Aquifer, the Burkeville Confining Unit, and the Jasper Aquifer, along with small portions of other major and minor aquifers, as GMA 14 (Figure 2-1). Included within GMA 14 are the following counties and GCDs:

Districts	Counties
Bluebonnet GCD	Austin
	Grimes
	Walker
	Waller
Brazoria County GCD	Brazoria
Lone Star GCD	Montgomery
Lower Trinity GCD	Polk
	San Jacinto
Southeast Texas GCD	Hardin
	Jasper
	Newton
	Tyler
Other	
Fort Bend Subsidence District	Fort Bend
Harris-Galveston Subsidence District	Galveston
	Harris
No district	
	Chambers
	Jefferson
	Liberty
	Orange
	Washington

GMA 14 District Representatives first adopted DFCs in 2009. The GCDs in GMA 14 are required to adopt proposed 2016 DFCs before May 1, 2016. The District Representatives began joint-planning meetings focused on the review and adoption of updated DFCs in April of 2013, and held an additional ten meetings to develop proposed DFCs for each relevant aquifer in GMA 14. At their June 24, 2015, meeting, the District Representatives unanimously adopted the "RESOLUTION FOR THE APPROVAL OF PROPOSED DESIRED FUTURE CONDITIONS FOR ALL AQUIFERS IN GROUNDWATER MANAGEMENT AREA 14." The Resolution, along with supporting materials considered prior to adoption of the Resolution, was submitted to the individual GCDs on July 6, 2015. All of the Districts subsequently posted the public notices for individual GCD public hearings on the proposed DFCs as required by Texas Government Code Chapter 551 and by Texas Water Code Section 36.108(e). Copies of the public notices given for all required public hearings are contained in *Appendix B*. Subsequently, at their April 29, 2016, meeting, the District Representatives adopted the "RESOLUTION FOR THE APPROVAL OF DESIRED FUTURE CONDITIONS FOR ALL AQUIFERS IN GROUNDWATER MANAGEMENT AREA 14."

This Explanatory Report documents that the District Representatives in GMA 14 have considered all of the elements required by Texas Water Code Section 36.108(d-3) in establishing the 2016 DFCs by:

(1) identifying each desired future condition;

(2) providing the policy and technical justifications for each desired future condition;

(3) documenting that the factors under Texas Water Code Section 36.108(d) were considered by the districts along with how the adopted desired future conditions impact each factor;

(4) listing other desired future condition options considered, if any, and the reasons why those options were not adopted; and

(5) discussing reasons why recommendations made by any advisory committee and relevant public comments received by the districts were or were not incorporated into the desired future conditions.

The primary tools for analyzing groundwater conditions and for groundwater management are computer simulations or models. Computer models are the preferred means of assessing the effects of past, current, and future pumping and droughts on groundwater availability. Modeling involves developing and using computer programs to estimate future trends in the amount of water available in an aquifer and is based on hydrogeologic principles, actual aquifer measurements, and stakeholder guidance. In correspondence dated February 18, 2014, the TWDB formally approved the updated Houston Area Groundwater Model[1] ("HAGM") as the official Groundwater Availability Model ("GAM") for the Northern Segment of the Gulf Coast Aquifer System[2] ("Northern Gulf Coast Aquifer GAM") (*Appendix C*). The 2016 DFCs adopted are the result, in part, of the modeling prepared by the GMA's consultants using the updated Northern Gulf Coast Aquifer GAM.

Texas Water Code Section 36.108(d) requires GCDs to consider eight factors and other relevant information before adopting proposed DFCs and to prepare a report documenting that the factors were considered. The eight factors are discussed below.

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[1] Kasmarek, M.C., 2012, Hydrogeology and simulation of groundwater flow and land-surface subsidence in the northern part of the Gulf Coast Aquifer System, Texas, 1891–2009 (ver. 1.1, December 2013): U.S. Geological Survey Scientific Investigations Report 2012–5154, 55 p., http://dx.doi.org/sir20125154; and Freese and Nichols, 2013, "Regional Groundwater Update Project – Final Report," *for* Harris-Galveston Subsidence District, Fort Bend Subsidence District, and Lone Star Groundwater Conservation District, http://hgsubsidence.org/wp-content/uploads/2013/07/Regional_Groundwater_Update_Project-Report-6-2013.pdf, 24 p.

[2] https://www.twdb.texas.gov/groundwater/models/gam/glfc_n/glfc_n.asp

1. AQUIFER USES AND CONDITIONS

The Gulf Coast Aquifer System is a predominant source of water for all of GMA 14. Groundwater data was obtained from the TWDB, which maintains records and reports of groundwater use, water wells, and other relevant data. The District Representatives received presentations from its technical consultants of the modeled effects of the adopted DFCs on existing aquifer uses and conditions.

2. WATER SUPPLY NEEDS AND WATER MANAGEMENT STRATEGIES

The District Representatives considered the water supply needs (the amount of projected water demand beyond existing supplies) and water management strategies (new water supplies to meet water supply needs) for GMA 14. Specifically, information on water supply needs and water management strategies from the 2011 Regional Water Plans and the 2012 State Water Plan was considered. GMA 14 includes parts of Regional Water Planning Areas G (Brazos), H, and I (East Texas). The reports show most future water supplies will be from sources other than groundwater.

3. HYDROLOGIC CONDITIONS

The District Representatives considered presentations and reports on the total estimated recoverable storage ("TERS"), average annual recharge, inflows and discharge. After the District Representatives began the work for the 2016 DFCs, the TWDB provided the TERS numbers for GMA 14, a required consideration in establishing the DFCs. TERS is the estimated amount of groundwater within an aquifer that accounts for recoverable storage scenarios that range between 25 percent and 75 percent of the porosity-adjusted aquifer volume. The District Representatives also considered potentiometric surface contour maps showing the current aquifer/hydrologic conditions. All of this information was used to set the adopted DFCs.

4. ENVIRONMENTAL FACTORS

The District Representatives considered the potential impacts by the DFC options on environmental factors such as spring flow and other interactions between groundwater and surface water. Available information from the models and other technical resources were presented. The District Representatives determined there are limited interactions between the aquifer systems as a whole and surface water within the region encompassing GMA 14.

5. SUBSIDENCE

Subsidence is a major factor in GMA 14. The GMA 14 consultants spent considerable time and effort to evaluate potential impacts by the DFCs on subsidence. The only means of preventing subsidence is stabilizing groundwater levels throughout the Gulf Coast Aquifer

System. The District Representatives concluded that the only means of stabilizing groundwater levels is to limit groundwater production.

6. SOCIOECONOMIC IMPACTS

The District Representatives considered the socioeconomic impact analysis provided by the TWDB to Water Planning Regions G, H, and I, for the 2011 Regional Water Plans. In addition, GMA 14 reviewed the socioeconomic impact data used by the Subsidence Districts in formulating their Regulatory Plans. While there are economic impacts to limiting groundwater production, the negative socioeconomic impacts of lower water quality, higher groundwater production costs and subsidence support the adopted DFCs.

7. PRIVATE PROPERTY RIGHTS

The District Representatives in GMA 14 extensively considered the potential effects of the DFCs on the interests and rights in private property. It was recognized that there are many property owners competing to pump groundwater and that excessive withdrawals can cause land subsidence, increased pumpage costs, and the lowering of water tables. District representatives reported individually on the impacts of the DFCs on private property rights and how GCD Management Plans and Rules have been developed to protect private property rights.

8. FEASIBILITY OF ACHIEVING THE DFCs

The District Representatives considered groundwater modeling and information about historic use, current and projected supplies, projected water demands, and applicable rules, regulations, and laws to determine that the DFCs are feasible. The GCDs and Subsidence Districts have adequate authority to implement regulations necessary to achieve the adopted DFCs.

9. OTHER RELEVANT INFORMATION

The GMA 14 District Representatives considered other material and relevant information as reflected in the materials contained in this Explanatory Report.

CONCLUSION

The District Representatives in GMA 14 have extensively reviewed and evaluated the adopted 2016 DFCs and determined that they are reasonable.

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2.0 INTRODUCTION AND FUNDAMENTALS OF THE JOINT-PLANNING PROCESS

In Texas, the legislature has declared groundwater conservation districts ("GCDs") as the preferred method of groundwater management.[3] Local GCDs are required to manage, preserve, and protect the groundwater resources within their jurisdiction pursuant to their statutory powers and duties as set forth in Chapter 36 of the Texas Water Code and their respective enabling legislation. In 2005, the Texas Legislature passed legislation that created a joint-planning process by which GCDs located within a groundwater management area must conduct joint planning to develop Desired Future Conditions ("DFCs"). These DFCs describe how the GCDs in the management area want the groundwater resources of the region to look in the future. GCDs are statutorily obligated to regulate the production of groundwater on a long-term basis to achieve the DFCs for the applicable aquifer so that water is available for future generations of existing and new users.[4]

A groundwater management area ("GMA") is a geographic area designated and delineated by the Texas Water Development Board ("TWDB") under Chapter 35 of the Texas Water Code as an area suitable for management of groundwater resources.[5] The TWDB designated a total of sixteen (16) GMAs, which together cover the entire State of Texas. The TWDB designated the area encompassing all of Austin, Brazoria, Chambers, Fort Bend, Galveston, Grimes, Hardin, Harris, Jasper, Jefferson, Liberty, Montgomery, Newton, Orange, Polk, San Jacinto, Tyler, Walker, Waller, and Washington counties as Groundwater Management Area No. 14 ("GMA 14").[6] GMA 14 is located along the Upper Texas Gulf Coast, and groundwater management efforts for GMA 14 are primarily focused on the Gulf Coast Aquifer System.

The Bluebonnet Groundwater Conservation District (Austin, Grimes, Walker, and Waller counties), Brazoria County Groundwater Conservation District (Brazoria County), Lone Star Groundwater Conservation District (Montgomery County), Lower Trinity Groundwater Conservation District (Polk and San Jacinto counties), and Southeast Texas Groundwater Conservation District (Hardin, Jasper, Newton, and Tyler counties) are GCDs located wholly in

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[3] TEX. WATER CODE § 35.0015 (West 2015).

[4] TEX. WATER CODE § 36.1132. *Compare* Act of May 30, 1993, 73rd Leg., R.S., ch. 626, 1993 Tex. Gen. Laws 2350, as amended, and TEX. WATER CODE Ch. 36.

[5] TEX. WATER CODE § 35.004(a), Act of May 23, 2005, 79th Leg., R.S., ch. 970, 2005 Tex. Gen. Laws 3247.

[6] One small change to the GMA 12 and GMA 14 boundaries was made by the TWDB during the current round of joint-planning in that the small portion of Brazos County originally assigned to GMA 14 was moved to GMA 12, so that all of Brazos Valley GCD is now located in GMA 12. *See* TWDB correspondence from Kevin Patteson, Executive Administrator to Alan Day, General Manager, Brazos Valley GCD, dated November 25, 2013.

the boundaries of GMA 14 (see Figure 2.1). As required by Chapter 36 of the Texas Water Code, and further described herein, these GCDs have engaged in joint planning and, in that regard, have adopted DFCs for the groundwater resources underlying GMA 14. The Fort Bend Subsidence District (Fort Bend County) and Harris-Galveston Subsidence District (Harris and Galveston counties), special districts created by the Texas Legislature to regulate groundwater withdrawals for the purpose of preventing land subsidence, and other stakeholders within GMA 14 from Chambers and Washington counties also contributed to the joint-planning process. These stakeholders participated in an unofficial role to aid in the development of the DFCs by providing the District Representatives in GMA 14 important information and data relevant to their respective counties that are otherwise not represented by the GCDs in the GMA joint-planning process.

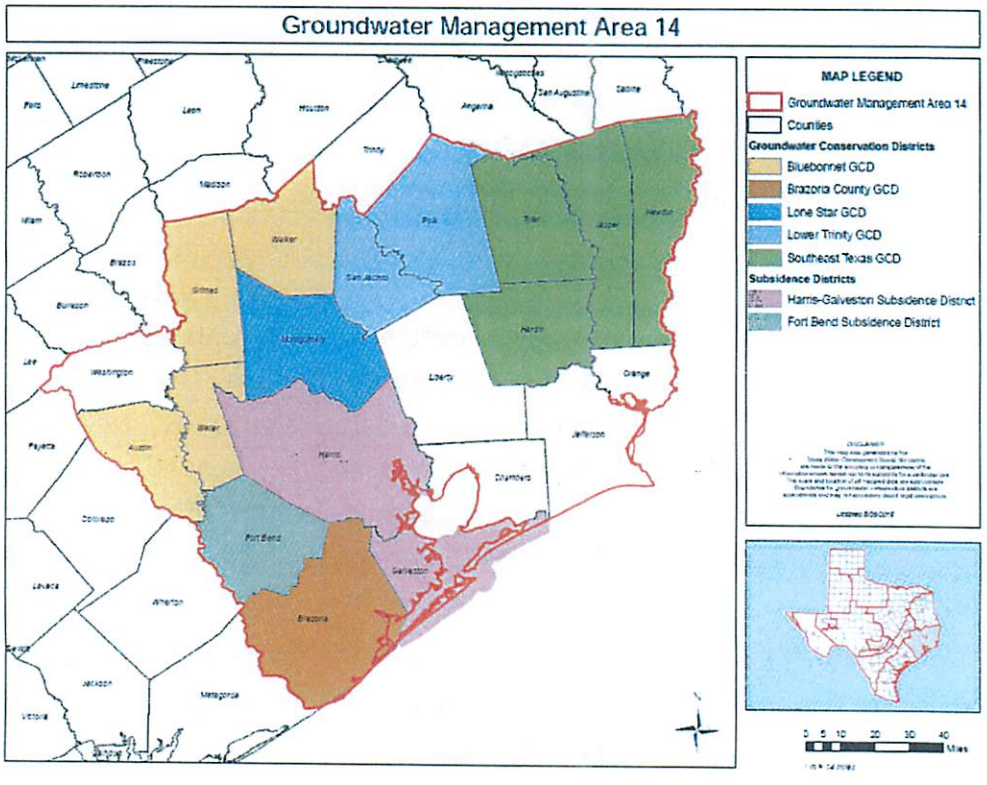

Figure 2-1 – Map illustrating GMA 14 boundary, counties, groundwater conservation districts, and subsidence districts[7]

The joint-planning process for coordination of groundwater management activities by GCDs was first amended by the Texas Legislature to include the requirement to establish DFCs with the passage of House Bill ("HB") 1763 in 2005.[8] HB 1763 amended Chapter 36, Texas

[7] Source TWDB: See http://www.twdb.texas.gov/groundwater/management_areas/maps/GMA14_GCD.pdf.
[8] Act of May 24, 2005, 79th Leg., R.S., ch. 970, 2005 Tex. Gen. Laws 3247.

Water Code, to require representatives of GCDs located within a GMA to meet and adopt DFCs for the aquifers underlying the GMA no later than September 1, 2010, and every five years thereafter.[9] After the first round of DFCs were adopted by the initial 2010 deadline, the joint-planning process was significantly expanded with the passage of Senate Bill ("SB") 660 in 2011.[10] In order to allow GCDs more time to meet the new statutory requirements established by SB 660, and to allow for the completion of several major GAM updates, the deadline for adopting proposed DFCs for the second round of joint-planning was extended to May 1, 2016, by the passage of Senate Bill 1282 in 2013.[11]

Texas Water Code Section 36.108 provides the current requirements applicable to this second round of joint planning and DFC development. As set forth in the statute, representatives from each GCD within the same GMA are required to meet as a committee, at least annually, to consider each other's groundwater management plans, accomplishments in the GMA, and proposals to adopt new or amend existing DFCs. At least every five years, the GCD representatives must meet to consider groundwater availability models and other data and information for the GMA and propose for adoption DFCs for the relevant aquifers within the GMA.[12]

In developing proposed DFCs, the GCDs must consider nine statutory factors: (1) the aquifer's uses or conditions within the management area, including conditions that differ substantially from one geographic area to another; (2) the water supply needs and water management strategies included in the state water plan; (3) hydrogeological conditions; (4) other environmental impacts such as spring flow and other interactions between groundwater and surface water; (5) the impact on subsidence; (6) socioeconomic impacts reasonably expected to occur; (7) the impact on the interests and rights in private property; (8) the feasibility of achieving the DFC; and (9) any other relevant information.[13] After consideration of these factors, the representatives of the GCDs in the GMA ("District Representatives") must approve by a two-thirds vote proposed DFCs.[14]. The proposed DFCs must provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and preventing of waste of groundwater and control of subsidence in the GMA.[15]

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[9] TEX. WATER CODE ANN. § 36.108(c)–(d-1) (West 2010).
[10] Act of May 29, 2011, 82nd Leg., R.S., ch. 1233, 2011 Tex. Gen. Laws 3287
[11] Act of May 20, 2013, 83rd Leg., R.S., ch. 786, § 1, 2013 Tex. Gen. Laws 2001 (codified at TEX. WATER CODE § 36.108(d-5)).
[12] TEX. WATER CODE ANN. § 36.108(c),(d) (West 2015).
[13] § 36.108(d)(1-9).
[14] § 36.108(d-5).
[15] § 36.108(d-2).

Once approved by the District Representatives in the joint-planning committee, the proposed DFCs are sent to the individual GCDs within the GMA, and a 90-day public comment period begins.[16] During the 90-day public comment period, each GCD is required to hold a public hearing on any proposed DFCs relevant to that GCD.[17] After the public hearing, each GCD is required to compile for consideration at the next joint-planning meeting a summary of the relevant comments received, suggested revisions to the proposed DFCs, and the basis for the suggested revisions.[18] The joint-planning committee is required to reconvene to review the summary reports prepared by the GCDs, consider proposed changes to the DFCs, and finally adopt DFCs by a two-thirds vote of all the District Representatives in the GMA.[19] Upon final adoption, the joint-planning committee is required to prepare and submit an Explanatory Report to the TWDB and the individual GCDs. [20]

This joint-planning process established by HB 1763 in 2005 and amended by SB 660 in 2011 is a public, transparent process, where all planning decisions are made in open, publicly noticed meetings in accordance with provisions of Texas Water Code Chapter 36. GMA 14 began this joint-planning process in 2010. Over the course of several years, the District Representatives in GMA 14 held multiple joint-planning meetings, and in a coordinated effort to manage the groundwater resources, adopted DFCs for the relevant aquifers in GMA 14. A timeline of the GMA 14 joint-planning process and significant events, including but not limited to the development of the updated groundwater availability model, the consideration of model run results, the consideration of information applicable to each of the statutory factors, the approval of proposed DFCs, the public comment period, and the adoption of DFCs, is provided in *Appendix D*.

This Explanatory Report provides an official record demonstrating compliance with all statutory requirements applicable to the joint-planning process and the adoption of DFCs. As part of this Explanatory Report, documentation of all meetings conducted by the joint-planning committee and the individual GCDs in GMA 14, including duly posted GMA 14 meeting agendas, approved GMA 14 meeting minutes, individual GCD public hearing notices, and individual GCD meeting minutes documenting individual public hearings, is included in *Appendix B*. This documentation establishes that through appointed District Representatives, the GCDs in GMA 14 participated in joint planning and held multiple joint-planning committee meetings over the course of several years to develop DFCs as required by statute. As described in the agendas and meeting minutes, the GCDs considered the statutory criteria required prior

[16] § 36.108(d-2).
[17] § 36.108(d-2).
[18] § 36.108(d-2).
[19] § 36.108(d-3).
[20] § 36.108(d-3).

to the adoption of proposed DFCs, and properly adopted proposed DFCs in accordance with procedural requirements.[21] Upon receipt of the proposed DFCs, the individual GCDs properly provided a 90-day public comment period and held hearings as evidenced by the public hearing notices and minutes.

Also, as part of the record included in this Explanatory Report by reference, are the five individual GCD Summary Reports prepared and presented at the October 28, 2015, GMA 14 joint-planning meeting. These Summary Reports contain documentation of all public comments received by the individual GCDs at each of the five public hearings on the proposed DFCs, along with any recommendations for changes to the proposed DFCs offered by the individual GCDs that were considered by the GMA 14 joint-planning committee.[22] On April 29, 2016, the District Representatives adopted DFCs for the groundwater resources in GMA 14, as further described in Section 3.0 of this Explanatory Report.

[21] The District Representatives also adopted an administrative procedural process consistent with Chapter 36, Texas Water Code, including the procedural requirements currently in place under Section 36.108, for the consideration, proposal, and adoption of DFCs to ensure the development of a clear administrative record that not only supports the DFCs ultimately adopted, but also addresses any DFCs considered but not adopted, in a manner that is sufficient for inclusion in this Explanatory Report as required by Texas Water Code Section 36.108(d-3). See *Appendix T* for administrative procedures adopted by GMA 14 District Representatives.

[22] These Summary Reports are available by request from each of the GCDs in GMA 14, but are not physically included in this Explanatory Report due to the combined length of each report (in excess of 1,000 pages). To request a specific Summary Report, please request from the individual GCD General Manager.

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3.0 GMA 14 DESIRED FUTURE CONDITIONS

The following Statements of Desired Future Conditions is excerpted from GMA 14 Resolution2016-01-01. The resolution in its entirety is presented in *Appendix E*. This resolution was adopted by GMA 14 District Representatives, after providing notice as required, on April 29, 2016. GMA 14 DFCs are based on model results utilizing the updated Northern Gulf Coast Aquifer Groundwater Availability Model (Northern Gulf Coast GAM), which was designated by TWDB as the official model of record for GMA 14 (Appendix C). GMA 14 utilized predictions of pumping contained in a predictive simulation referred to as Northern Gulf Coast GAM Run 2. All technical guidance necessary to review and reproduce the Northern Gulf Coast GAM Run 2 is included in Appendix F.

3.1 FORMATIONS OF THE GULF COAST AQUIFER

DFCs for the Gulf Coast Aquifer System adopted by GMA 14, as documented by and incorporating herein Northern Gulf Coast GAM Run 2, at two scales, which do not differ substantively in their application: the first being for GMA 14 in its entirety; the second being to better facilitate the management and conservation of groundwater resources at the individual GCD level, after considering the statutory criteria set forth under Texas Water Code Section 36.108(d), on a county-by-county basis. DFCs for GMA 14 for the Gulf Coast Aquifer System are as follows:

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 28.3 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 23.6 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 18.5 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 66.2 feet after 61 years.

3.1.1 Austin County (BGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 39 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 23 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 23 feet after 61 years.

- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 76 feet after 61 years.
- From estimated year 1890 conditions, the maximum subsidence in Austin County should not exceed approximately 2.83 feet by the year 2070.

3.1.2 Brazoria County (BCGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 23 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 27 feet after 61 years.

3.1.3 Chambers County

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 32 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 30 feet after 61 years.

3.1.4 Grimes County

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 5 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 5 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 6 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 52 feet after 61 years.
- From estimated year 1890 conditions, the maximum subsidence in Grimes County should not exceed approximately 0.12 feet by the year 2070.

3.1.5 Hardin County (STGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 21 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 27 feet after 61 years.

- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 29 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 89 feet after 61 years.

3.1.6 Jasper County (STGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 23 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 41 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 46 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 40 feet after 61 years.

3.1.7 Jefferson County

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 15 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 17 feet after 61 years.

3.1.8 Liberty County

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 27 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 29 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 25 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 120 feet after 61 years.

3.1.9 Montgomery County (LSGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 26 feet after 61 years.

- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately -4 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately -4 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 34 feet after 61 years.

3.1.10 Newton County (STGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 35 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 45 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 44 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 37 feet after 61 years.

3.1.11 Orange County

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 14 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 16 feet after 61 years.

3.1.12 Polk County (LTGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 26 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 10 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 15 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 73 feet after 61 years.

3.1.13 San Jacinto County (LTGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 22 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 19 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 19 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 108 feet after 61 years.

3.1.14 Tyler County (STGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 42 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 35 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 30 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 62 feet after 61 years.

3.1.15 Walker County (BGCD)

- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 9 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 4 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 42 feet after 61 years.
- From estimated year 1890 conditions, the maximum subsidence in Walker County should not exceed approximately 0.04 feet by the year 2070.

3.1.16 Waller County (BGCD)

- From estimated year 2009 conditions, the average draw down of the Chicot Aquifer should not exceed approximately 39 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 39 feet after 61 years.

- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 40 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 101 feet after 61 years.
- From estimated year 1890 conditions, the maximum subsidence in Waller County should not exceed approximately 4.73 feet by the year 2070.

3.1.17 Washington County

- From estimated year 2009 conditions, the average draw down of the Evangeline Aquifer should not exceed approximately 1 foot after 61 years.
- From estimated year 2009 conditions, the average draw down of the Burkeville confining unit should not exceed approximately 16 feet after 61 years.
- From estimated year 2009 conditions, the average draw down of the Jasper Aquifer should not exceed approximately 48 feet after 61 years.

3.1.18 Formations in Fort bend, Galveston, and Harris Counties

GMA 14 efforts to determine DFCs are primarily an aquifer water-level-based approach to describe the regional and local desires for the aquifer beneath them. The GMA process requires GCDs to determine the DFCs for the entire GMA, regardless of whether each county is included within a GCD. The Fort Bend Subsidence District ("FBSD") and the Harris-Galveston Subsidence District ("HGSD"), operating in Fort Bend County and Harris and Galveston counties, respectively, regulate groundwater for the purpose of ending land surface subsidence within their jurisdiction. The two Subsidence Districts are not subject to Chapter 36, are not GCDs, and operate under separate enabling legislation that is different from the typical GCD. Therefore, in an official context these three counties are "unrepresented" but the GCDs within GMA 14 must still determine the DFC for these counties.

Both FBSD and HGSD have participated in an unofficial role to aid the GCDs within GMA 14 with their evaluation of Fort Bend, Galveston and Harris County information. The groundwater pumpage within these three counties even though regulated is still greater than the sum of all other counties within GMA 14.

FBSD and HGSD recognize that the projected groundwater pumpage from these three counties will impact the decisions of GMA 14 throughout a large portion of the area. FBSD and HGSD have provided considerable historical and projected groundwater pumpage data and details of regulations to assist GMA 14 in incorporating these counties in the overall GMA 14 DFCs. FBSD and HGSD cannot, however, present DFCs for these three counties in terms of aquifer water-level changes over time. The FBSD and HGSD regulations do not specifically

address water levels nor do they designate a specific pumping limit. Rather, the regulations are based on limitations of groundwater as a percentage of total water demand. The percentage of groundwater to total water demand is decreased over time, as total water demand increases.

The goal of both FBSD and HGSD is to end land surface subsidence, which is caused by humankind's pumpage of groundwater. There is a clearly established link between the over-pumpage of groundwater and land surface subsidence. The DFCs within the aquifer beneath Fort Bend, Galveston, and Harris counties has no easily defined relationship to water levels. The DFC for FBSD and HGSD is the reduction and halting of the compaction of clay layers within the aquifer caused by the over-pumpage of groundwater. Stated more simply, the DFC for these three counties is that future land surface subsidence be avoided. That stated, HGSD and FBSD have adopted regulations, updated most recently in 2013[23], that require the reduction of groundwater pumpage and the conversion to alternate source waters balanced against the realistic ability of the permittees to achieve compliance with these regulations. This effort was accomplished with the aid of the HAGM and information specific to the population projections and future water demands within FBSD and HGSD.

Within HGSD, from central to southeastern Harris County and all of Galveston County (Regulatory Areas 1 and 2), virtually all permittees have achieved compliance with previous and current HGSD regulations. Subsidence has been halted and water levels within the aquifer have risen dramatically in these areas. However, in northern and western areas of Harris County (Regulatory Area 3), the HGSD regulations have allowed groundwater pumpage to continue until the required reductions in 2010, 2025, and 2035. With these scheduled reductions in groundwater pumpage, subsidence will slow dramatically and even be halted with water levels stabilizing and in later years rising.

Within FBSD, from central to northern and eastern Fort Bend County (Regulatory Area A), the regulations call for reductions of groundwater pumpage in 2014/2016, and 2025. Similar to HGSD's Regulatory Area 3, subsidence within FBSD Regulatory Area A will slow dramatically and even be halted with water levels stabilizing and in later years rising.

In both HGSD and FBSD, because of the percentage based approach to regulations, groundwater pumpage will increase until scheduled reductions in milestone years (ex: 2010, 2014/2016, 2025, and 2035). In between milestone years, groundwater pumpage will increase with the assumed increase in total water demand from a predicted increase in population. In

[23] The HGSD District Regulatory Plan is *available at* http://hgsubsidence.org/wp-content/uploads/2013/07/HGSD-2013-Regulatory-Plan-with-Amendment.pdf; the FBSD District Regulatory Plan is *available at* http://www.fbsubsidence.org/docs_reports/2015/20130828_FBSD_Regulatory_Plan_ADOPTED_(FINAL).pdf

order to demonstrate the DFC of these three counties using water-level changes, the area of previous groundwater-to-alternative water conversions must be separated from future conversions and each annual time step must be depicted.

The HGSD and FBSD have submitted to GMA 14 their current regulations and projected groundwater pumpage projections through the year 2070. This data has been divided into the grid cells/layers relative to the NGCGAM and utilized by the GCDs in development of their DFCs.

Groundwater pumpage within GMA 14 from Fort Bend, Galveston, and Harris counties is regulated by FBSD and HGSD, non-GCD governmental agencies (the only GMA in Texas with this occurrence), and the missions of HGSD and FBSD are very different from GCDs and do not fit well with a water-level designed DFC process). The groundwater pumpage projections developed in recognition of the HGSD and FBSD regulatory plans have been utilized without adjustment by GMA 14 in the DFC process. Therefore, the DFCs adopted by GMA 14 are consistent with the HGSD and FBSD regulatory plans.

3.2 NON-RELEVANT AQUIFERS

TWDB rules[24] allow for portions of major or minor aquifers to be classified as non-relevant if their aquifer characteristics, groundwater demands, and current groundwater uses do not warrant adoption of a desired future condition. After review, District Representatives in GMA 14 have classified all portions of the following aquifers located within GMA 14 boundaries as non-relevant aquifers for the purposes of Joint-planning; (1) Carrizo Sand Aquifer, (2) Queen City Aquifer, (3) Sparta Aquifer, (4) Yegua-Jackson Aquifer, and (5) all river alluvium aquifers.

[24] Title 31, Texas Administrative Code Section 356.31 (b) see http://texreg.sos.state.tx.us/public/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=31&pt=10&ch=356&rl=31

4.0 POLICY AND TECHNICAL JUSTIFICATIONS

The "policy and technical justifications for each DFC"[25] are embodied by, and not differentiable from, the careful consideration and balancing by the GMA 14 District Representatives of all of the technical and policy information that was considered in working through the statutory criteria as set forth in Section 5 of this report. There is no stand-alone policy justification or technical justification that can be easily identified and presented as the sole policy or technical reason that the GMA 14 District Representatives ultimately decided on the DFCs that were adopted. The balancing of all the various information required to be considered by statute and the balancing of competing interests and the exercise of discretion in performing that balancing act is the justification for the adopted DFCs. Nonetheless, set forth below are some of the policy and technical justifications that can be gleaned from the information considered by GMA 14 in its evaluation and adoption of the DFCs.

4.1 POLICY JUSTIFICATIONS

The most important task for GMA 14 District Representatives in developing and adopting DFCs is to carefully consider all available information related to the aquifers and their past, present, and future use—including, without limitation, all information related to the statutory considerations set forth in Section 5 of this report—and to achieve an appropriate balance of those criteria using their best judgment and discretion. From a policy perspective, a number of key considerations emerge from that balancing act that justify the adopted DFCs.

Heavy growth in population and water demand in GMA 14 have outstripped the ability of the aquifers to keep pace—they are being slowly depleted. Depleting the aquifers harms the property rights of those currently pumping groundwater, those who hope to pump groundwater in the future, and those whose property may be damaged by subsidence. The task for the GMA 14 District Representatives therefore becomes determining how much of that depletion, if any, should occur in each layer of the aquifer and in each geographic area of the region between now and 2070, and how to best avoid damaging any private property rights.

The two overriding policy justifications for the DFCs adopted by GMA 14 are socioeconomic considerations and impacts on private property rights. All of the other technical information and policy issues feed into these two essential considerations, which themselves are inextricably tied to one another.

[25] TEX. WATER CODE § 36.108 (d-3)(2) (West 2015).

The primary economic and private property impact analyses that were considered by the GMA 14 District Representatives that justify the adoption of the DFCs were the impacts of those DFCs on **the economic costs to landowners of producing groundwater**. The evidence clearly indicates that economic considerations, and their inseparability from protection of private property rights, are the controlling factor behind the selection of the adopted DFCs. The amount of groundwater located under the geographic area defined by GMA 14 is ultimately not a controlling consideration. It is indisputable that it is impossible to physically produce all of the groundwater in the aquifers, even if the GMA 14 District Representatives desired to allow it to be produced. It is also indisputable that if water levels continue to drop the economic costs associated with producing groundwater and, in some instances, treating it for beneficial use, will ultimately control whether it can actually be produced long before the question of how much can be physically produced comes into play. Thus, the economic costs associated with groundwater production and use dictate how much groundwater should be produced during the planning horizon. Those economic costs fall into two primary areas in GMA 14: (1) the economic cost to the individual landowner to drill a well and produce groundwater of a sufficient quality and in sufficient quantities as to be beneficial to the landowner; and (2) the economic cost to the individual landowner of the preservation of the value of their surface estates as that value is impacted by groundwater production from the common groundwater reservoir, especially in terms of land subsidence.

When considering the economic cost to individual landowners to drill a well and produce groundwater, a number of factors were considered. How much an individual landowner has to pay to drill a producing water well is largely driven by how deep the well must be drilled to reach the groundwater. How much an individual landowner has to pay to lift the water from the pump to the land surface is also a consideration, not only in terms of the cost to properly equip the well with the appropriate pump and the wiring to go all the way down the well bore, but also in terms of the ongoing cost of energy to lift the water. Also, the water needs to be of a sufficient quality that it can be either used for its beneficial purpose without treatment or with economically affordable treatment, and water quality tends to diminish as water levels decline in the aquifer and landowners are forced to produce ever-deepening groundwater resources. And, finally, the amount of groundwater that the water well will yield at the land surface, when weighed along with the other considerations, is almost always an important consideration, if not the controlling consideration, for a landowner in determining whether drilling a well is economically feasible for the intended purpose.

The vast majority of groundwater produced in GMA 14 comes from the subcrop areas of the various layers of the Gulf Coast Aquifer where confining conditions create artesian pressure and push groundwater into and up water well bores and to water well pumps. That fact is what makes the Gulf Coast Aquifer in GMA 14 such a beneficial water supply resource

to the overlying landowners. Without preservation of that artesian pressure, the costs of drilling a well, equipping the well, lifting the water to the surface, the huge impacts to well yields, and in some cases water quality degradation would simply render the option of a water well economically infeasible to most landowners as a source of water supply. And for large numbers of landowners throughout GMA 14, it is the only water supply option available to their properties. Without water being economically available on their properties, the negative impacts to the landowners' property values in most situations are enormous and devastating.

Individual landowners have differing needs for groundwater and widely differing abilities to produce it. Some landowners, such as large municipal water suppliers and industrial users, have the financial wherewithal to drill the deep multi-million-dollar water wells necessary to chase falling water levels, to lift that water to the surface and to treat it, if necessary. Other landowners, such as individual homeowners, small businesses, and farmers who must irrigate crops, do not have the financial resources to drill deep wells and treat lower quality water, and must necessarily rely on the preservation of artesian conditions and the ability to drill water wells that are affordable to drill, equip, and produce in order to realize the benefits of their private property investments. Even landowners who do not drill their own water wells but rather rely upon a public water system count on their monthly water bills from the supplier to be affordable.

Existing water-well owners have made investments in their water wells and the economic activities that those wells support, and have reasonable expectations that those investments will continue to be recovered in the foreseeable future. Many of those investments have been made in reliance on the preservation of artesian conditions. If water levels fall too low, they may have to endeavor to re-equip their wells and lower their pumps to chase falling water columns. In many instances, the pumps simply cannot be lowered any further and the well will have to be drilled deeper or abandoned altogether, resulting in huge negative economic losses for the well owners.

Future well owners and landowners also have an expectation of being able to drill affordable water wells on their properties. The same considerations set forth above apply to this class of property owners, whether they be individual homeowners in a rural area with limited financial resources or huge regional water authorities who must answer to their ratepayers. Virtually all of them, both existing and future, both large and small, count upon the availability of quality water in sufficient quantities at a reasonable depth from the land surface. In GMA 14, by and large, this means preservation of artesian conditions in the subcrop of the Gulf Coast Aquifer and preservation of an adequate amount of saturated thickness in its outcrop throughout the joint-planning period.

Another major economic consideration of the DFCs, especially in the coastal regions of GMA 14, is the impact of groundwater production on land subsidence. For the better part of

the last half-century, the coastal areas of GMA 14 have been working diligently to address the issues associated with land subsidence and the devastating economic losses to landowners and their private property investments from the periodic widespread flooding associated with that land subsidence. Groundwater production has clearly been demonstrated to be the primary cause of land subsidence, and millions upon millions of dollars have been invested in researching the amount of groundwater that can be produced in the region as weighed against the correlating subsidence of the land surface and its disastrous economic consequences. The GMA 14 District Representatives carefully considered this important factor and the research and data supporting it in developing and adopting the DFCs.

The DFCs adopted by GMA 14 strikes the appropriate balance of preservation of those artesian conditions, and of the preservation of the saturated thickness of the water levels in the outcrop areas of the aquifer layers. This balance allows for the economically feasible production of groundwater and the prevention of land subsidence. These DFCs, in light of the economic and private property impacts to all landowners in the region, are therefore justifiable adoptions.

4.2 TECHNICAL JUSTIFICATIONS

It is impossible to articulate the technical justifications for the adopted DFCs in terms that are not intricately connected to the policy justifications set forth above. Rather, the technical information considered by the GMA 14 District Representatives in balancing the competing interests associated with the establishment of the DFCs and evaluating the various interests and economic costs to landowners associated with groundwater production both drive and support those policy justifications.

As set forth in Section 4.1, the adopted DFCs are primarily focused on achieving the appropriate balance of all of the statutory criteria required to be considered by maintaining appropriate water levels in all areas of GMA 14, whether in terms of maintaining appropriate artesian levels in the subcrop areas of the aquifer's layers or water table levels and saturated thickness in the outcrop areas. In that regard, while this section will highlight a number of the technical justifications for the adopted DFCs, all of the technical information set forth under Section 5 of this report was considered by the GMA 14 District Representatives in their development and adoption of the DFCs and will not be restated in its entirety in this section.

The GMA 14 District Representatives relied heavily upon the use of the HAGM (Northern Gulf Coast GAM), which was developed by the U. S. Geological Survey (USGS) in cooperation with the Harris-Galveston Subsidence District, the Fort Bend Subsidence District, and the Lone Star Groundwater Conservation District, in the development and adoption of the

DFCs.[26] The Northern Gulf Coast GAM simulates groundwater flow and potentiometric surface declines in the northern Gulf Coast Aquifer in the GMA 14 region, and (in conjunction with the Subsidence Module) land-surface subsidence. It is presently the best available technical tool for modeling different groundwater-production scenarios in GMA 14 and the resulting impacts to the various layers of the Gulf Coast Aquifer in terms of water level declines in both the subcrop and outcrop areas of the aquifer, and impacts to the land surface from the resulting subsidence. The utilization of this tool by the GMA 14 District Representatives, which represents the best available science at the present time, to consider the impacts of pumping throughout the GMA 14 region and the extensive review by the GMA 14 District Representatives of contour maps of the potentiometric surfaces of the various aquifers within GMA 14 and of the predicted impacts on land subsidence provides technical justification for the adopted DFCs.

The GMA 14 District Representatives also considered both the current and planned future uses of the Gulf Coast Aquifer in the region, projected population and water demand growth over the joint planning horizon, and identified water supply needs and water management strategies from the approved regional and state water plans. The information considered represents the best available information on these topics. By and large, the adopted DFCs are consistent with the recommended water management strategies in the approved regional and state water plans that rely on groundwater from the Gulf Coast Aquifer, which strategies were formulated after consideration of the current and planned future uses of the aquifer and the projected population growth, water demand growth, and identified water supply needs over the ensuing 50-year planning period. Therefore, the DFCs adopted by the GMA 14 District Representatives are technically justified.

The GMA 14 District Representatives also considered the environmental impacts of the adopted DFCs in terms of impacts to spring flows and interaction with surface water resources. Because it was determined that there is negligible interaction between the northern Gulf Coast Aquifer System and spring flows and surface water resources, the water level declines associated with the adopted DFCs are technically justified.

The GMA 14 District Representatives also carefully considered the total estimated recoverable storage (TERS) estimates for the Gulf Coast Aquifer that were provided by the executive administrator of the TWDB. As set forth in greater detail later in this report, because the GMA 14 District Representatives determined the maintenance of artesian conditions in the subcrop was a primary consideration for the protection of private property rights and

[26] Kasmarek, M.C., 2012, Hydrogeology and simulation of groundwater flow and land-surface subsidence in the northern part of the Gulf Coast Aquifer System, Texas, 1891–2009 (ver. 1.1, December 2013): U.S. Geological Survey Scientific Investigations Report 2012–5154, 55 p., http://dx.doi.org/sir20125154.

mitigation of economic impacts to landowners in being able to affordably access groundwater in the establishment of the DFCs, and because artesian conditions are largely eliminated long before a question of how much total recoverable storage is actually in the aquifer if economic costs to produce were of no consideration, the adopted DFCs are technically justified.

4.3 RESPONSE TO COMMENTS

As part of the joint-planning process in GMA 14, five issues were discussed on numerous occasions that warrant documentation in this Explanatory Report. The issues are:

(1) the establishment of DFCs on the basis of geographic area;

(2) the failure to factor economic and hydrologic constraints into the calculation of TERS;

(3) the evaluation of socioeconomic impacts of proposed DFCs;

(4) historical water use estimates for the Gulf Coast Aquifer System by formation, i.e., Chicot, Evangeline, and Jasper; and

(5) the development of DFCs for unprotected counties (counties not incorporated into a GCD).

Another issue discussed early in this round of joint planning is the need to potentially revisit the use of general head boundary conditions in the Northern Gulf Coast Aquifer GAM.

On June 24, 2015, GMA 14 District Representatives approved the adoption of proposed DFCs for the Gulf Coast Aquifer System in GMA 14. The proposed DFCs provided acceptable drawdown levels for each subdivision of the Gulf Coast Aquifer (the Chicot, Evangeline, Burkeville, and Jasper formations/aquifers) throughout the GMA and for each county located within GMA 14, as well as acceptable land subsidence levels. The acceptable levels of drawdown for each subdivision of the Gulf Coast Aquifer were measured in terms of water level drawdowns over the current planning cycle measured in feet from 2009 estimated water levels. As required by Texas Water Code Section 36.108(d-2), the proposed DFCs were subsequently distributed to the individual GCDs in GMA 14. A period of not less than 90 days was provided to allow for public comments on the proposed DFCs, and during this comment period, each GCD held a public hearing on the proposed DFCs.[27]

The GCDs in GMA 14 evaluated all comments received, including a claim that the adoption of different DFCs for different geographic areas over the same aquifer—along the boundaries of political subdivisions—was not authorized by law, and as such the proposed DFCs were legally and hydrogeologically insufficient. The comments suggested that the proposed DFCs would cause GCDs to adopt different regulatory schemes, including different production limits, allowing landowners producing groundwater in GCDs with less restrictive

[27] See TEX. WATER CODE ANN. § 36.108(d-2) (West 2015)

regulations to unfairly drain groundwater from landowners in adjacent GCDs with more restrictive regulations potentially causing a regulatory taking of property by the GCDs.

First, the selected DFCs cover the entirety of each aquifer subdivision throughout GMA 14. Once the aquifer-wide DFC is selected, the average drawdown for each county and each GCD is then calculated. The commenters mistakenly interpreted these calculations as separate DFCs for each county instead of the calculated average of the GMA-wide DFCs.

The adoption of DFCs by GCDs, pursuant to the requirements and procedures set forth in Texas Water Code Chapter 36, is an important policy-making function. DFCs are planning goals that state a desired condition of the groundwater resources in a GMA in the future in order to promote better management of those resources on a long-term basis. GCDs are authorized to utilize different approaches in developing and adopting DFCs based on local conditions and the consideration of other statutory criteria as set forth in Texas Water Code Section 36.108.

Second, Texas Water Code Section 36.108(d)(1) contemplates and authorizes the adoption of different DFCs for different geographic areas over the same aquifer, and that area may be based on the boundaries of political subdivisions. The statute expressly and specifically *directs* GCDs "to consider uses or conditions of an *aquifer* within the management area, including conditions that differ substantially from one geographic area to another" when developing and adopting DFCs.[28] The use of the singular "aquifer" in this context clearly demonstrates that the Legislature intended that the uses and conditions in different geographic areas *over the same aquifer* were to be considered when adopting DFCs.

Third, Texas Water Code Section 36.108(d-1) provides that GCDs may establish different DFCs for:

1) each aquifer, subdivision of an aquifer, or geologic strata located in whole or in part within the boundaries of the management area; *or*
2) *each geographic area overlying an aquifer in whole or in part* or subdivision of an aquifer within the boundaries of the management area.[29]

The Legislature's addition of the phrase "in whole or in part" makes it clear that GCDs may establish a "different" DFC for a geographic area that does not cover a whole aquifer but only part of that aquifer. Moreover, the plain meaning of the term "geographic area" in this context clearly includes an area defined by political boundaries such as those of a GCD or a

[28] Id. § 36.108(d)(1) (emphasis added).
[29] Id. § 36.108(d-1) (emphasis added).

county.[30] Any other reading of "geographic area" in Texas Water Code Section 36.108(d-1) would be highly strained and contrary to the obvious intent of the larger statute.[31]

Such statutory authorization has also been recognized by the Texas Water Development Board (TWDB). In 2009, after GMA 1 adopted different DFCs for different geographic areas over the same aquifer (the Ogallala Aquifer) along the boundaries of political subdivisions, Mesa Water, LP and G&J Ranch (collectively the "Petitioners") filed a petition with the TWDB to appeal the reasonableness of the adopted DFCs.[32] Petitioners made the same complaints in opposition of the DFCs adopted by GMA 1 raised in the comments received in GMA 14. In their appeal of the DFCs adopted by GMA 1, Petitioners argued that, overall, the DFCs had no scientific basis and that the DFCs should be uniform on an aquifer-wide basis to ensure all areas and landowners receive "equal treatment." However, on February 17, 2010, the TWDB considered and approved its staff's recommendation that the DFCs adopted by GMA 1 were reasonable.[33] The TWDB staff's analysis concluded that political boundaries, such as county lines, can be used to define geographic areas for different DFCs provided that aquifer uses and conditions support the designation of the areas. In reaching this conclusion, TWDB staff addressed private property rights, stating that "[t]o one degree or another, all DFCs adopted by groundwater conservation districts potentially impact the exercise of private property rights."[34] The TWDB staff explained that "beyond outright prohibition, the impact on private property rights involves the balancing of competing interest."[35]

During the joint planning process for GMA 14, District Representatives considered uses and conditions of the Gulf Coast Aquifer System, as required by Texas Water Code Section 36.108(d)(1). District Representatives studied uses and conditions for each subdivision of the Gulf Coast Aquifer System, including the Chicot, Evangeline, Burkeville, and Jasper, for each county located within GMA 14. Evidence was provided and considered that demonstrated different types of uses of groundwater, differences in historic pumping, and different

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[30] See Morales v. Liberty Mutual Insurance Co., 241 S.W.3d 514, 517-18 (Tex. 2007) (stating that a particular term is to be considered and interpreted in the context of the entire statutory provision).

[31] See McIntyre v. Ramirez, 109 S.W.3d 741, 745 (Tex. 2003) (stating that it is improper to give an undefined statutory term a meaning that is out of harmony or inconsistent with other provisions in the statute).

[32] See TEX. WATER CODE ANN. § 36.108(l) (West 2009).

[33] See Texas Water Development Board, Report on Appeal of the Reasonableness of the Desired Future Conditions Adopted by Groundwater Management Area 1 for the Ogallala and Rita Blanca Aquifers (February 10, 2010) available at http://www.twdb.texas.gov/groundwater/petitions/doc/GMA1/2009_Petitions/Mesa_G&J_Ranch/TWDB_Staff_Report_GMA1_Petitions_02-10.pdf.

[34] Id. at 4 (citing TEX. WATER CODE ANN. § 36.002 (West 2009) ("Ownership and rights of the owners of the land. . . in groundwater are hereby recognized, and nothing in this code shall be constituted as depriving or divesting the owners . . . of the ownership or rights, except as those rights may be limited or altered by rules promulgated by a district.") (Emphasis added).

[35] Id.

environmental conditions that were distinguishable in the various geographic areas of GMA 14 and described conveniently by reference to the counties (a more detailed discussion of these considerations is included below in the discussion of aquifer uses and conditions in *Section 5.1*). For these reasons, in developing proposed DFCs, District Representatives in GMA 14 found it reasonable to adopt GMA-wide DFCs, then calculate the effective DFC for each geographic area over each subdivision of the Gulf Coast Aquifer System using the political boundaries of the counties. This finding was further supported by other relevant factors considered by District Representatives in GMA 14, including:

(1) the heavy utilization by the TWDB and the regional water planning groups in the state and regional water planning processes of information and data related to water supply and demand and other demographic information on a county-by-county basis;

(2) the ability of the public to identify the boundaries of the geographic areas delineated; and

(3) the ability of the GCDs—the responsible planning and regulatory entities created along county boundaries by the Texas Legislature—to achieve the DFCs, as mandated by law.

Also, as part of the joint planning process, District Representatives in GMA 14 considered impacts to private property rights and interests in groundwater, as required by Texas Water Code Section 36.108(d)(7). The Gulf Coast Aquifer System is a finite resource that replenishes at a lower rate than is required to meet all current and projected water demands. Accordingly, the consideration of impacts to private property rights necessitated the careful balancing of competing interests, such as the protection of the property rights of existing well owners (and their ability to realize their reasonable investment-backed expectations from their wells) with the protection of the property rights of other landowners (who have yet to drill water wells on their properties). The potential future harm to landowners along adjacent county lines were weighed against the real and present economic harm to existing groundwater users in certain areas of GMA 14 where groundwater levels continue to decline as demands exceed available, sustainable supplies, such as is the case in Montgomery County. In balancing all sectors, District Representatives found that the proposed DFCs were reasonable, as was establishing the average aquifer decline based on political boundaries of the counties.

Finally, the comments that suggested the proposed DFCs will result in a taking of property are not only speculative but counter to the fundamental principles in support of local groundwater management and regulation by GCDs. In Texas, the Legislature has declared GCDs as the preferred method of groundwater management.[36] Unlike the statewide regulation of oil and gas, local GCDs are required to manage and protect the groundwater resources within their jurisdiction pursuant to their statutory powers and duties as set forth in Texas

[36] See TEX. WATER CODE ANN. § 36.0015 (b)

Water Code Chapter 36 and their respective enabling legislation. The adoption of DFCs, whether GMA-wide or county-by-county, does not prevent individual GCDs from adopting different regulatory plans based on local conditions, level of demand, type of demand, frequency of demand, and communities in each GCD.

The GCDs in GMA 14 each prepared a Summary Report inclusive of all relevant comments received during the 90-day public comment period regarding the proposed DFCs, any suggested revisions to the proposed DFCS, and the basis for the revisions. The GCDs' Summary Reports were submitted to GMA 14 for further review by the District Representatives at a joint-planning meeting held October 28, 2015. At this meeting, District Representatives of GMA 14 considered and approved non-substantive changes to the proposed DFCs. The DFCs that were considered and proposed for final adoption, inclusive of all non-substantive changes, provided acceptable drawdown levels for each hydrogeologic subdivision of the Gulf Coast Aquifer System, including the Chicot, Evangeline, Burkeville, and Jasper, on two different scales—on an aquifer-wide basis for the entire geographic extent of the aquifer subdivisions in GMA 14 and on a county-by-county geographic basis, in light of the various considerations set forth above—and acceptable land subsidence levels, as applicable, for certain counties located within GMA 14. These proposed DFCs, inclusive of acceptable drawdown levels on an aquifer-wide scale and a county-by-county basis, were finally adopted by the District Representatives in GMA 14 on April 29, 2016, at a properly noticed joint-planning meeting.

In June of 2014, as required by amendments to Texas Water Code Chapter 36 resulting from passage of Senate Bill 660 in 2011, the executive administrator of the TWDB submitted the initial report on total estimated recoverable storage (TERS) to GMA 14 District Representatives. While GMA 14 District Representatives were cognizant of the enormity of this new responsibility assigned to the TWDB, significant concerns were raised during public comments and by GMA 14 District Representatives regarding the lack of usefulness of this information for two primary reasons. First, in the TWDB analysis, there were no constraints placed on the recoverability analysis due to the obvious and inevitable negative economic impacts that will result with the reduction and elimination of artesian pressures in systems like the Gulf Coast Aquifer. Based on input from GMA 14 District Representatives and technical presentations received during the 90-day public comment period, the negative economic impacts resulting from the elimination of artesian pressures from the Gulf Coast Aquifer System, a dynamic projected to occur with less than one percent of the TERS volume being produced, will clearly result in the elimination of the Gulf Coast Aquifer System as a viable water resource for almost all water use sectors. These economic impacts are, in part, driven by the negative impacts on well yields that will result with the inevitable conversion from confined to unconfined conditions as water levels are lowered due to over-pumping. The

analysis provided in the TERS report to GMA 14 by the TWDB shows the calculations did not factor in either economics or hydrology. GMA 14 District Representatives strongly encourage the TWDB to conduct necessary science to better constrain future estimates of TERS, taking into consideration the negative impacts of economics and hydrology on the volumes of water that can reasonably be expected to be recovered from storage.

Another technical issue discussed by GMA 14 District Representatives was the lack of available socioeconomic impacts information directly appropriate for the joint-planning process (see *Section 5.6* below for results of GMA 14's consideration of socioeconomic impacts). It was noted that the only consistently available quantitative socioeconomic impact analysis for water planning in Texas is the analysis of socioeconomic impacts on cities and other major water use sectors resulting from not meeting current and future water supply needs. This analysis is an outgrowth of the regional water planning process created by the passage of Senate Bill 1 in 1997[37] and codified in Texas Water Code Sections 16.051 and 16.053. More importantly, this analysis is performed on an ongoing basis by the TWDB and updates are provided to the 16 regional water planning groups at the conclusion of each five-year planning cycle.

This analysis executed and provided by the TWDB to the regional water planning groups is designed to answer a somewhat different question than the factor to be considered in the joint-planning process by Texas Water Code Section 36.108 (d)(6), which requires District Representatives in a GMA to consider the socioeconomic impacts reasonably expected to occur for a proposed DFC. No uniform quantitative analysis has been performed by the TWDB or any other entity to answer this specific question. There are multiple reasons for the absence of quantitative socioeconomic impact analysis. The most important being that, as GMA 14 District Representatives determined during the joint-planning process, any potential socioeconomic impacts that may occur, either positive or negative impacts, will be the result of the specifics of an individual GCD's regulatory approach to achieve the DFC, not the DFC itself. Therefore, the requirements of this element of the joint-planning process should be revisited to better clarify what is practicable with respect to the socioeconomic impacts of proposed and adopted DFCs.

Throughout the joint-planning process in GMA 14, consistent historical water use data by the primary units of the Gulf Coast Aquifer System (Chicot, Evangeline, and Jasper) was not well established. Within individual GCDs significant progress has been made in the recent past to improve the quality of water use data by aquifer. However, especially in counties without GCDs, water use data is often simply reported as "Gulf Coast Aquifer," "local aquifer" or "other" if the respondent to the TWDB's Water Use Survey is not informed as to the

[37] Act of June 2, 1997, 75th Leg., R.S., ch. 1010, 1997 Tex. Gen. Laws 3610.

hydrostratigraphic unit being produced by the individual well. In future joint-planning efforts, and as the Northern Gulf Coast Aquifer GAM is updated, it will be increasingly important that better resolution on pumping volumes from the discrete hydrostratigraphic units is available for model calibration.

Finally, District Representatives in GMA 14 spent considerable time and effort to encourage the participation of all counties that do not have a GCD (unprotected counties) in the joint-planning effort. Individual District Representatives contacted leaders in each of the unprotected counties to encourage their participation in the joint-planning process. While it is recognized that Chambers and Washington counties did participate throughout this round of joint planning and provided valuable insight into local issues in their respective counties, the reality is that the joint-planning process, as currently designed, suffers from the lack of any participation in the GMA 14 efforts by Jefferson, Liberty, and Orange counties. Especially with the new incentives for water project financing now available from the TWDB, the ramifications of DFCs adopted for these unprotected counties may have significant consequences in the future on municipalities in these unprotected counties. In addition, the lack of financial participation by these unprotected counties does not relieve the GMA from the responsibility of planning for the areas, thus creating a financial hardship on the GCDs in GMA 14 to meet statutory requirements for the joint-planning process in the unprotected areas. GMA 14 District Representatives support another look at this issue by future Texas Legislatures to ensure that all water users in Texas are fairly and adequately considered during future joint-planning efforts.

5.0 FACTORS CONSIDERED FOR DESIRED FUTURE CONDITIONS

Texas Water Code Section 36.108 (d)(1 – 8), require GCDs to consider the impacts of proposed DFCs on the following eight factors. The results of GMA 14 District Representatives' considerations required by Section 36.108 (d)(1– 8) have been summarized below. *Table 5-1* provides a chronology for GMA 14 meetings during which each of the eight factors were formally considered. Posted meeting agendas and minutes are included in *Appendix B*.

Table 5-1 – GMA 14 schedule for discussing relevant factors related to selection of Desired Future Conditions

Factor	Meeting Date								
	4/13	5/13	6/13	9/13	4/14	6/14	9/14	11/14	6/15
(1) Aquifer Uses and Conditions				✓					✓
(2) Water Supply Needs and Strategies				✓					✓
(3) Hydrological Conditions						✓			✓
(4) Other Environmental Impacts						✓			✓
(5) Impacts on Subsidence						✓			✓
(6) Socioeconomic Impacts							✓		✓
(7) Impacts on Private Property							✓		✓
(8) Feasibility of Achieving DFC								✓	✓
(9) Other Relevant Factors				o		o	o	o	o

5.1 AQUIFER USES OR CONDITIONS

Texas Water Code Section 36.108(d)(1) requires District Representatives in a GMA to consider "aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another." District Representatives in GMA 14

first examined this factor on September 18, 2013 and then again on June 24, 2015. During this consideration, GMA 14 District Representatives considered aquifer uses, both historical and projected, along with historical, current, and projected aquifer conditions.

Groundwater represents a significant source of supply within GMA 14, due to its historical abundance relative to demand, easy accessibility and high quality. Access to reliable groundwater supplies has, in the past, allowed many parts of GMA 14 to avoid the development of other, more costly, alternative supplies. However, this pattern has changed over time for the more populous counties where the need for water supplies exceeded sustainable levels of groundwater production, as recognized by local GCDs and Subsidence Districts. In Harris County and the rapidly growing suburban counties like Fort Bend and Montgomery counties, municipal growth has largely driven the conversion from historically utilized groundwater supplies to alternative water supplies, primarily through the conversion to surface water sources. In other locations, such as Brazoria and Jefferson counties, non-municipal demands such as manufacturing have converted from groundwater to alternatives such as surface water and saline water supplies.

This section of the Explanatory Report focuses on historical and current use or production of groundwater for meeting demands within GMA 14. For the purposes of this analysis, data was obtained from the TWDB through their Water Use Survey[38] and Groundwater Database, and other sources of estimates, in order to depict the current status of groundwater pumpage in GMA 14 for the purpose of considering the balance of resource use and protection when considering proposed DFCs. Data was summarized from the years 2001 through 2011 to illustrate average conditions, absent of temporary trends in water use brought about by short-term climate effects (both droughts and above normal precipitation).

Groundwater use in GMA 14 is from a variety of aquifers that are recognized by the TWDB but are primarily related to pumpage from the Gulf Coast Aquifer System. Due to the fact that historical water use data for the Gulf Coast Aquifer System has not been consistently discretized to the individual aquifers (sometimes also referred to as formations) that make up the Gulf Coast Aquifer System, those being the Chicot Aquifer, Evangeline Aquifer, Burkeville Confining Unit, and Jasper Aquifer, for the purposes of this discussion on aquifer use, pumping estimates will be reported at the broader "Gulf Coast Aquifer System" level. As demonstrated in *Figure 5-1* and *Table 5-2* and *Table 5-3*, the Gulf Coast Aquifer System is the most significant source of groundwater supply within each county in GMA 14. In total, the Gulf Coast Aquifer System has provided 85.44 percent of the total volume of groundwater pumped in GMA 14 for the reporting period of 2007 – 2011 (*Table 5-3*). However, it should be noted that the second most significant source is reported by the TWDB as "Other/Unknown Aquifer," with

[38] See http://www.twdb.texas.gov/ to access TWDB Historical Groundwater Pumping Database.

13.81 percent of the total groundwater pumped for the same reporting period. This is due to the reality that historically, entities, when submitting their water use surveys to the TWDB, often do not know the specific hydrogeologic unit from which their groundwater is being produced. Alternatively, in some cases a well may be screened over multiple aquifers. As a result, the water use survey respondent will enter in "Other" as the source when not specifically known. It is generally accepted that a large share of this "Other" supply is actually Gulf Coast Aquifer System water. All of the other aquifers for which groundwater pumped is recorded in the TWDB's Water Use Survey and Groundwater Database individually represent less than one percent of the total groundwater pumped in GMA 14 for the 2007 – 2011 reporting period.

Groundwater use within GMA 14 is also dominated largely by municipal pumpage. In some counties, this is driven by the overall nature of water demands. From 2007 – 2011, average municipal groundwater pumpage accounted for 79.6 percent of total groundwater pumpage. Of this groundwater pumpage, Harris County accounts for 41.06 percent, followed by 11.40 percent in Fort Bend County and 11.36 percent in Montgomery County (*Figure 5-2* and *Table 5-4*). However, in most counties where other demands such as manufacturing or steam-electric power generation represent a sizable portion of the overall water demand, groundwater use continues to be dominated by municipal production because of the way that these communities have evolved over time. The expansion of municipal demands throughout much of GMA 14 has been accomplished through the development of local, non-regional infrastructure including wells and small wastewater facilities. In contrast, the development of large, industrial centers has often been done in conjunction with the development of significant surface water facilities. This is an important distinction in that the historical groundwater use estimates included in this section do not include water use for the large industrial centers and steam-electric power generation facilities. Two exceptions to this trend are Jasper and Waller counties, which demonstrate manufacturing and irrigation as their primary groundwater uses, respectively. *Figure 5-2* and *Table 5-4* summarizes this trend throughout GMA 14.

This Explanatory Report will combine the reported "Gulf Coast Aquifer" and "Aquifer-Other" amounts as all having been produced from the Gulf Coast Aquifer.

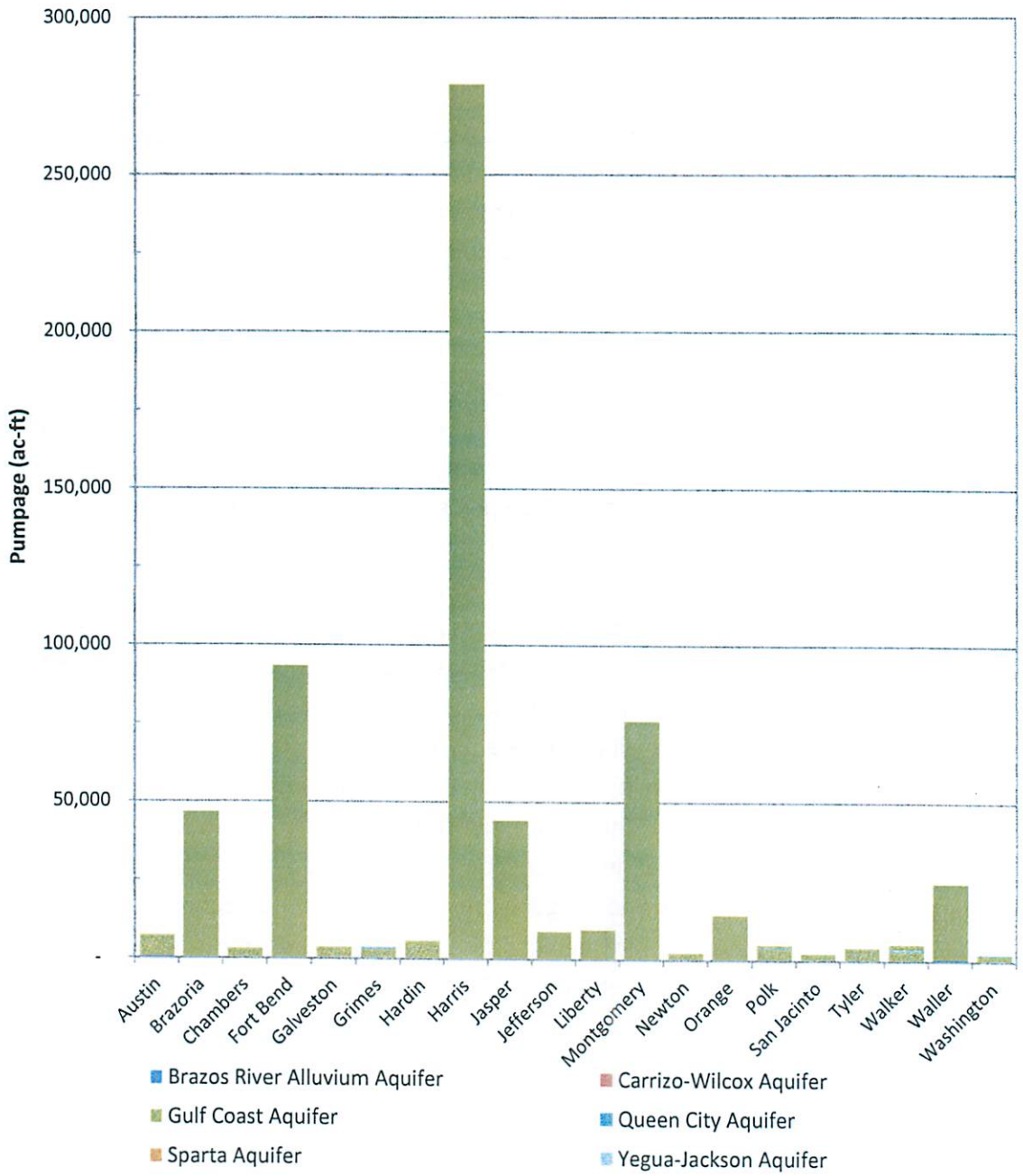

Figure 5-1 – GMA 14 groundwater reported pumpage by aquifer: 2007-2011 annual average. Gulf Coast Aquifer is combined with "other" aquifers in this graphic, as discussed above.

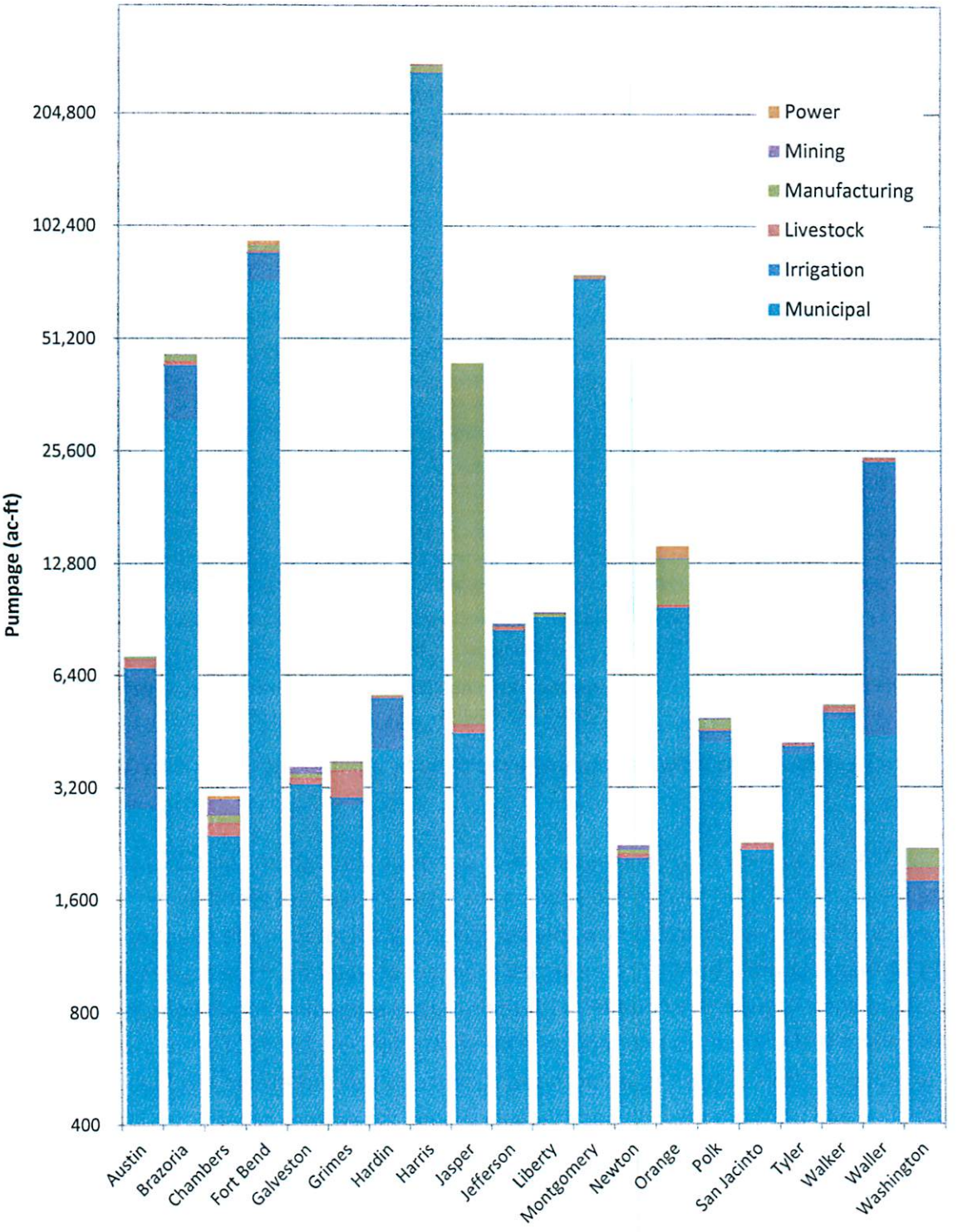

Figure 5-2 – GMA 14 groundwater pumpage by county: 2007-2011 averages.

Similarly, the same trend in municipal use from the Gulf Coast Aquifer System can be recognized throughout the extent of GMA 14. *Figure 5-3* demonstrates the portion of groundwater production originating from each aquifer by water use category.

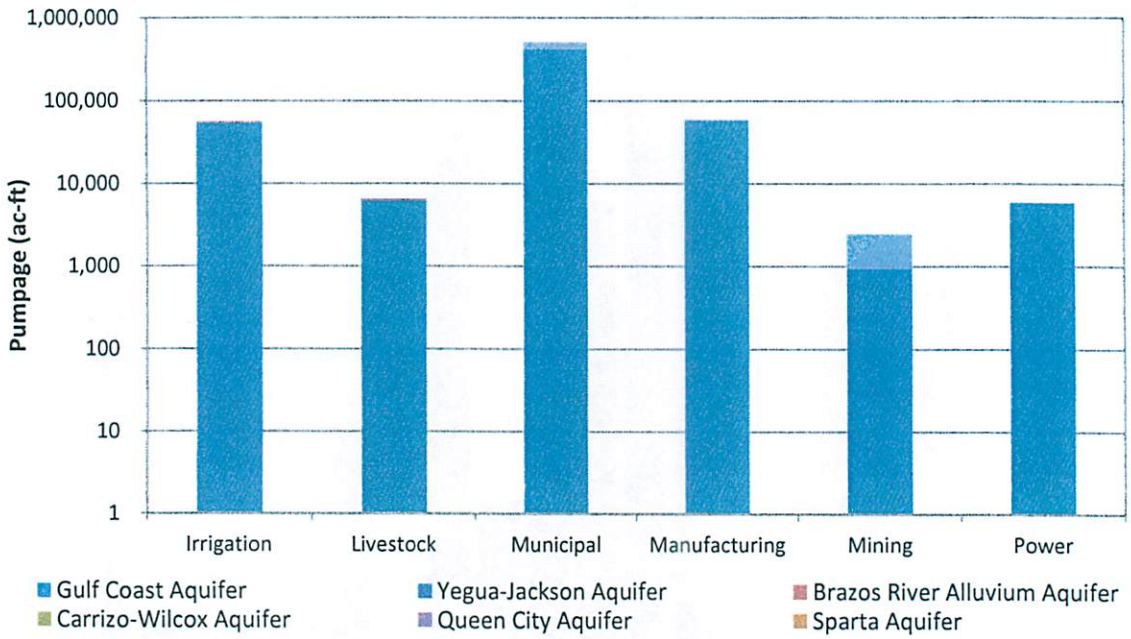

Figure 5-3 – GMA 14 groundwater pumpage reported by aquifer and use: 2007-2011 annual average

The distribution of groundwater use or pumpage throughout the Gulf Coast Aquifer System within GMA 14 is heavily centered on the historical users of groundwater throughout the region. *Figure 5-4* illustrates how this pumpage is distributed in the counties making up GMA 14. Harris County represents the largest producer of water from the aquifer, followed by Fort Bend and Montgomery counties with their rapidly expanding populations. Neighboring Brazoria and Waller counties also represent significant concentrations of groundwater usage. An exception to this pattern is within Jasper County, which represents the highest level of production and use from the Gulf Coast Aquifer among the eastern counties of GMA 14.

In establishing DFCs, GMA 14 District Representatives had discussions specific to the question of how to balance the needs of meeting current and projected water use needs with the GCD purpose statement included in Texas Water Code Section 36.001 which states, in part, "In order to provide for the conservation, preservation, protection, recharging and prevention of waste of groundwater, and of groundwater reservoirs or their subdivisions and to control subsidence caused by withdrawal of water from those groundwater resources or their

subdivisions ... groundwater conservation districts may be created as provided by this chapter." Detailed descriptions of groundwater use were included in the supporting materials presented to GMA 14 during the course of the development of DFCs. This information is presented in *Appendix G*.

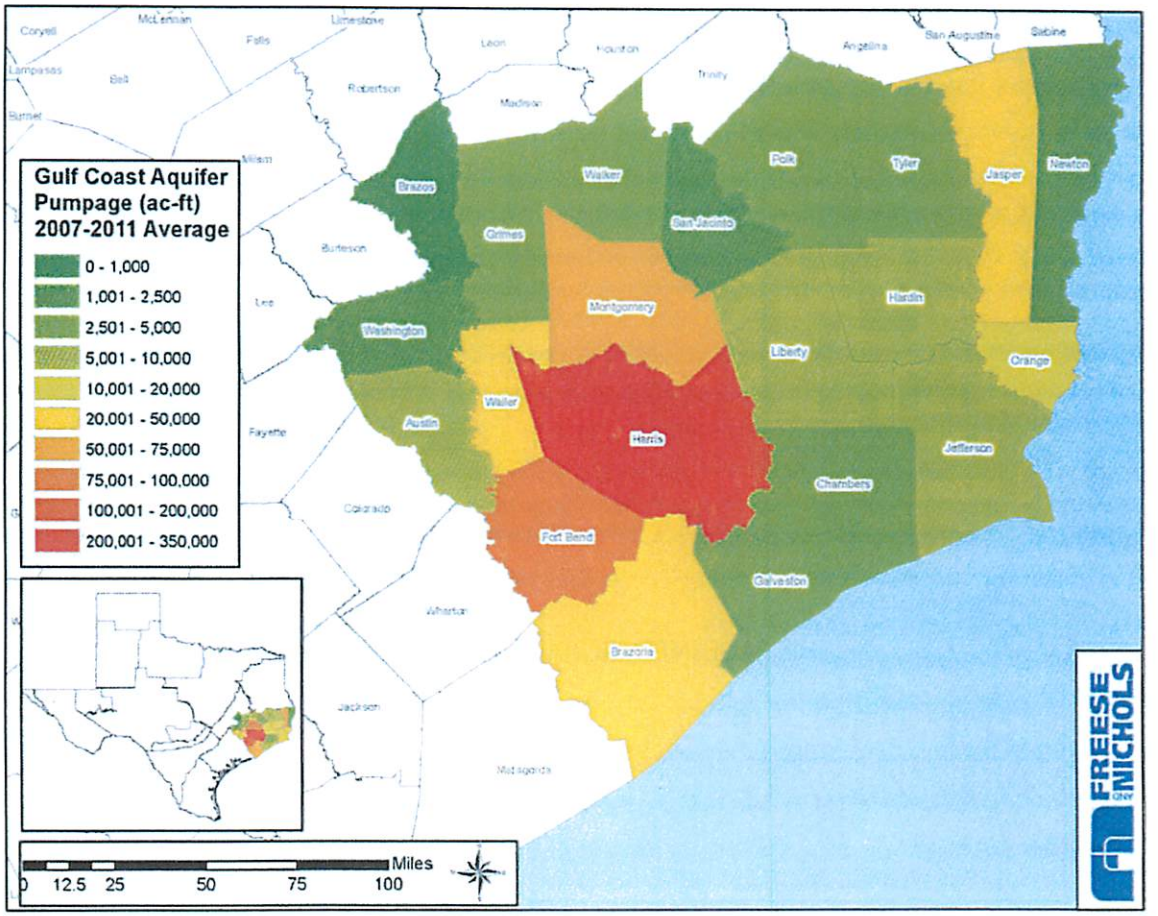

Figure 5-4 – Gulf Coast Aquifer pumpage reported by County within GMA 14: 2007-2011 annual average

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Table 5-2 – Historical groundwater pumpage by aquifer for counties in GMA 14 (in acre-feet per year)

County	Aquifer	Groundwater Pumpage by County and Formation (ac-ft)											
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Austin	Brazos River Alluvium	971	872	455	620	878	709	368	395	407	357	465	684
	Gulf Coast	12,770	11,597	7,721	9,290	9,589	8,962	6,696	6,514	6,935	7,210	5,825	6,611
	Other	193	173	90	123	175	137	74	78	84	76	99	112
	Unknown	-	-	-	-	-	-	-	-	-	4	8	6
	Subtotal	*13,934*	*12,643*	*8,266*	*10,032*	*10,642*	*9,808*	*7,138*	*6,987*	*7,426*	*7,647*	*6,398*	*7,413*
Brazoria	Gulf Coast	35,807	31,125	31,166	31,462	26,573	26,332	36,061	38,202	54,980	48,202	43,763	27,687
	Other	-	-	-	-	40	-	-	-	-	66	6,779	11,944
	Unknown	-	-	-	-	-	-	-	-	143	167	190	147
	Subtotal	*35,807*	*31,125*	*31,166*	*31,462*	*26,612*	*26,332*	*36,061*	*38,202*	*55,123*	*48,435*	*50,732*	*39,778*
Chambers	Gulf Coast	5,253	4,155	4,245	4,594	3,774	2,714	2,657	3,447	3,595	1,782	3,042	1,490
	Other	-	-	-	-	-	-	-	-	-	-	895	913
	Unknown	-	-	-	-	-	-	-	-	-	-	9	4
	Subtotal	*5,253*	*4,155*	*4,245*	*4,594*	*3,774*	*2,714*	*2,657*	*3,447*	*3,595*	*1,782*	*3,946*	*2,407*
Fort Bend	Brazos River Alluvium	5,043	3,208	2,932	3,110	-	-	-	-	-	-	-	-
	Gulf Coast	94,619	79,702	78,921	82,152	70,461	79,944	95,207	82,870	92,369	107,244	74,283	73,165
	Other	-	-	-	-	-	-	-	42	-	-	10,463	25,904
	Unknown	-	-	-	-	-	-	-	-	24	33	43	31
	Subtotal	*99,662*	*82,910*	*81,853*	*85,262*	*70,461*	*79,944*	*95,207*	*82,913*	*92,393*	*107,277*	*84,789*	*99,101*
Galveston	Gulf Coast	8,231	7,612	7,243	6,780	2,850	2,886	2,032	1,552	1,944	2,913	3,400	7,715
	Other	-	-	-	-	-	-	-	-	-	-	101	228
	Unknown	-	-	-	-	-	-	-	-	70	78	86	71
	Subtotal	*8,231*	*7,612*	*7,243*	*6,780*	*2,850*	*2,886*	*2,032*	*1,552*	*2,014*	*2,991*	*3,587*	*8,014*
Grimes	Brazos River Alluvium	96	91	73	40	40	71	200	139	126	61	72	67
	Gulf Coast	3,605	3,510	3,537	3,451	2,914	3,460	3,926	3,523	3,822	3,687	2,449	969
	Other	486	412	410	379	29	51	228	166	124	67	205	134
	Sparta	5	5	4	4	-	-	-	-	-	-	-	-
	Unknown	-	-	-	-	-	-	-	-	-	-	17	106
	Yegua-Jackson	134	75	78	71	66	130	280	277	297	300	382	1,779
	Subtotal	*4,327*	*4,092*	*4,102*	*3,945*	*3,049*	*3,712*	*4,635*	*4,105*	*4,369*	*4,114*	*3,125*	*3,054*
Hardin	Gulf Coast	19,074	18,576	18,715	17,283	15,451	17,046	17,512	7,499	7,811	6,645	4,490	1,783
	Other	-	-	-	-	-	-	7	6	6	8	9	-
	Unknown	-	-	-	-	-	-	-	-	35	23	12	5
	Subtotal	*19,074*	*18,576*	*18,715*	*17,283*	*15,451*	*17,046*	*17,519*	*7,505*	*7,853*	*6,676*	*4,512*	*1,788*

County	Aquifer	Groundwater Pumpage by County and Formation (ac-ft)											
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Harris	Gulf Coast	385,584	332,616	302,190	313,866	260,515	317,231	267,003	243,928	287,891	308,138	138,199	157,277
	Other	-	-	-	-	2,858	10,627	12,535	11,301	708	2,696	116,900	123,620
	Unknown	-	-	-	-	-	-	-	-	693	762	832	697
	Subtotal	*385,584*	*332,616*	*302,190*	*313,866*	*263,373*	*327,859*	*279,538*	*255,229*	*289,293*	*311,596*	*255,930*	*281,593*
Jasper	Gulf Coast	52,381	52,024	52,505	51,110	38,678	54,671	50,897	49,485	47,327	44,642	39,796	34,766
	Other	-	-	-	-	-	-	19	3	4	56	1,131	2,914
	Unknown	-	-	-	-	-	-	-	-	-	-	13	80
	Subtotal	*52,381*	*52,024*	*52,505*	*51,110*	*38,678*	*54,671*	*50,915*	*49,489*	*47,332*	*44,698*	*40,940*	*37,760*
Jefferson	Gulf Coast	2,051	3,270	3,242	3,276	1,177	1,037	1,957	1,685	1,769	12,608	12,691	14,299
	Other	-	-	-	-	-	-	-	-	-	-	360	411
	Unknown	-	-	-	-	-	-	-	-	58	60	63	51
	Subtotal	*2,051*	*3,270*	*3,242*	*3,276*	*1,177*	*1,037*	*1,957*	*1,685*	*1,827*	*12,668*	*13,113*	*14,761*
Liberty	Gulf Coast	13,388	14,165	13,749	13,087	9,128	7,374	11,321	10,342	10,807	10,865	4,509	3,480
	Other	2	-	-	-	-	-	-	-	-	-	4,345	2,437
	Unknown	-	-	-	-	-	-	-	-	117	121	125	114
	Subtotal	*13,389*	*14,165*	*13,749*	*13,087*	*9,128*	*7,374*	*11,321*	*10,342*	*10,924*	*10,986*	*8,979*	*6,031*
Montgomery	Gulf Coast	55,699	52,494	55,514	54,925	46,006	57,259	65,626	63,211	70,002	72,629	41,307	40,364
	Other	-	-	-	-	-	-	1,635	204	-	505	39,944	49,495
	Unknown	-	-	-	-	-	-	-	-	380	386	392	388
	Subtotal	*55,699*	*52,494*	*55,514*	*54,925*	*46,006*	*57,259*	*67,260*	*63,414*	*70,382*	*73,520*	*81,643*	*90,247*
Newton	Gulf Coast	2,814	2,573	2,576	2,612	1,678	3,717	2,727	2,379	2,231	2,199	2,075	818
	Other	-	-	-	-	-	-	140	-	-	-	478	655
	Unknown	-	-	-	-	-	-	-	-	69	73	77	125
	Subtotal	*2,814*	*2,573*	*2,576*	*2,612*	*1,678*	*3,717*	*2,867*	*2,379*	*2,300*	*2,272*	*2,630*	*1,598*
Orange	Gulf Coast	17,530	17,658	17,818	16,300	12,675	13,033	16,900	15,552	15,461	15,225	8,466	7,500
	Other	-	-	-	-	-	-	-	-	-	-	4,321	4,467
	Unknown	-	-	-	-	-	-	-	-	68	74	79	70
	Subtotal	*17,530*	*17,658*	*17,818*	*16,300*	*12,675*	*13,033*	*16,900*	*15,552*	*15,529*	*15,299*	*12,865*	*12,037*
Polk	Gulf Coast	4,006	4,081	4,233	4,257	3,077	3,421	4,734	4,347	4,232	4,372	3,153	2,708
	Other	1,115	1,117	1,089	1,332	623	791	871	774	726	612	808	706
	Unknown	-	-	-	-	-	-	-	-	23	20	16	132
	Yegua-Jackson	9	5	4	4	4	3	411	339	374	380	558	212
	Subtotal	*5,130*	*5,202*	*5,326*	*5,593*	*3,704*	*4,215*	*6,016*	*5,460*	*5,355*	*5,384*	*4,536*	*3,758*
San Jacinto	Gulf Coast	3,294	2,922	2,981	2,938	3,433	2,186	3,257	2,913	3,020	2,912	1,521	943
	Other	-	-	-	-	-	-	6	5	6	6	6	-
	Unknown	-	-	-	-	-	-	-	-	-	-	4	1
	Subtotal	*3,294*	*2,922*	*2,981*	*2,938*	*3,433*	*2,186*	*3,263*	*2,918*	*3,025*	*2,918*	*1,531*	*944*

County	Aquifer	Groundwater Pumpage by County and Formation (ac-ft)											
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Tyler	Gulf Coast	3,704	3,793	3,848	3,805	3,011	3,223	4,440	3,975	3,839	4,110	3,372	2,062
	Other	-	-	-	-	-	-	6	252	-	-	1,713	1,509
	Unknown	-	-	-	-	-	-	-	-	22	18	14	78
	Yegua-Jackson	-	-	-	-	-	-	10	8	9	11	13	-
	Subtotal	*3,704*	*3,793*	*3,848*	*3,805*	*3,011*	*3,223*	*4,456*	*4,235*	*3,870*	*4,139*	*5,113*	*3,649*
Walker	Carrizo-Wilcox	-	-	2	1	-	-	-	-	-	-	-	-
	Gulf Coast	4,726	4,171	4,156	4,448	4,652	3,664	4,247	3,854	3,387	4,041	2,273	1,685
	Other	989	727	1,036	1,027	924	1,081	960	970	1,087	1,073	2,533	2,457
	Queen City	26	13	13	13	13	19	23	21	37	36	26	26
	Unknown	-	-	-	-	-	-	-	-	-	-	7	3
	Yegua-Jackson	26	13	13	13	13	19	218	108	105	479	1,873	497
	Subtotal	*5,766*	*4,925*	*5,219*	*5,501*	*5,602*	*4,784*	*5,448*	*4,952*	*4,616*	*5,628*	*6,712*	*4,668*
Waller	Brazos River Alluvium	808	915	936	827	871	780	692	501	699	716	825	865
	Gulf Coast	28,298	31,542	31,736	28,077	26,888	24,392	22,113	16,130	23,679	24,378	26,289	27,705
	Other	208	215	218	204	212	213	238	185	193	204	270	227
	Unknown	-	-	-	-	-	-	-	-	-	2	4	2
	Subtotal	*29,314*	*32,673*	*32,890*	*29,108*	*27,970*	*25,385*	*23,043*	*16,815*	*24,571*	*25,299*	*27,388*	*28,799*
Washington	Brazos River Alluvium	250	182	183	112	114	96	78	58	57	48	66	104
	Gulf Coast	3,337	2,896	3,099	2,721	1,747	1,742	2,376	2,032	2,073	2,112	1,698	1,301
	Other	97	106	119	72	-	-	-	-	-	-	-	-
	Unknown	-	-	-	-	-	-	-	-	4	7	10	14
	Yegua-Jackson	12	12	12	15	14	14	163	137	151	168	870	52
	Subtotal	*3,696*	*3,197*	*3,413*	*2,920*	*1,876*	*1,852*	*2,617*	*2,227*	*2,285*	*2,335*	*2,644*	*1,471*

County	Aquifer	Groundwater Pumpage by County and Formation (ac-ft)											
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
GMA 14	Gulf Coast	756,172	680,482	649,196	656,434	544,276	634,295	621,688	563,440	647,176	685,914	422,602	414,328
	Yegua-Jackson	181	105	107	104	98	166	1,082	870	935	1,338	3,696	2,540
	Brazos River Alluvium	7,169	5,269	4,579	4,708	1,903	1,655	1,338	1,093	1,289	1,181	1,429	1,720
	Carrizo-Wilcox	-	-	2	1	-	-	-	-	-	-	-	-
	Queen City	26	13	13	13	13	19	23	21	37	36	26	26
	Sparta	5	5	4	4	-	-	-	-	-	-	-	-
	Other	3,091	2,751	2,961	3,138	4,860	12,901	16,719	13,986	2,940	5,369	191,360	228,132
	Unknown	-	-	-	-	-	-	-	-	1,706	1,828	2,001	2,125
	Total	766,643	688,624	656,862	664,400	551,150	649,036	640,849	579,409	654,083	695,666	621,114	648,870

Table 5-3 – Historical groundwater pumpage statistics for 2007-2011 by aquifer for counties in GMA 14 (in acre-feet per year)

County	Aquifer	2007-2011 Summary Statistics (ac-ft.)			
		Average	Median	Maximum	% of Total Average
Austin	Brazos River Alluvium	462	407	684	0.07%
	Gulf Coast	6,619	6,611	7,210	1.03%
	Other	90	84	112	0.01%
	Unknown	4	4	8	0.00%
	Subtotal Austin	7,174	7,413	7,647	1.12%
Brazoria	Gulf Coast	42,567	43,763	54,980	6.65%
	Other	3,758	66	11,944	0.59%
	Unknown	129	147	190	0.02%
	Subtotal Brazoria	46,454	48,435	55,123	7.26%
Chambers	Gulf Coast	2,671	3,042	3,595	0.42%
	Other	362	-	913	0.06%
	Unknown	3	-	9	0.00%
	Subtotal Chambers	3,036	3,447	3,946	0.47%
Fort Bend	Brazos River Alluvium	-	-	-	0.00%
	Gulf Coast	85,986	82,870	107,244	13.44%
	Other	7,282	42	25,904	1.14%
	Unknown	26	31	43	0.00%
	Subtotal Fort Bend	93,295	92,393	107,277	14.58%
Galveston	Gulf Coast	3,505	2,913	7,715	0.55%
	Other	66	-	228	0.01%
	Unknown	61	71	86	0.01%
	Subtotal Galveston	3,632	2,991	8,014	0.57%
Grimes	Brazos River Alluvium	93	72	139	0.01%
	Gulf Coast	2,890	3,523	3,822	0.45%
	Other	139	134	205	0.02%
	Sparta	-	-	-	0.00%
	Unknown	25	-	106	0.00%
	Yegua-Jackson	607	300	1,779	0.09%
	Subtotal Grimes	3,754	4,105	4,369	0.59%
Hardin	Gulf Coast	5,646	6,645	7,811	0.88%
	Other	6	6	9	0.00%
	Unknown	15	12	35	0.00%
	Subtotal Hardin	5,667	6,676	7,853	0.89%
Harris	Gulf Coast	227,087	243,928	308,138	35.49%
	Other	51,045	11,301	123,620	7.98%
	Unknown	597	697	832	0.09%
	Subtotal Harris	278,728	281,593	311,596	43.56%
Jasper	Gulf Coast	43,203	44,642	49,485	6.75%
	Other	822	56	2,914	0.13%
	Unknown	19	-	80	0.00%
	Subtotal Jasper	44,044	44,698	49,489	6.88%

County	Aquifer	2007-2011 Summary Statistics (ac-ft.)			
		Average	Median	Maximum	% of Total Average
Jefferson	Gulf Coast	8,610	12,608	14,299	1.35%
	Other	154	-	411	0.02%
	Unknown	46	58	63	0.01%
	Subtotal Jefferson	8,811	12,668	14,761	1.38%
Liberty	Gulf Coast	8,001	10,342	10,865	1.25%
	Other	1,356	-	4,345	0.21%
	Unknown	95	117	125	0.01%
	Subtotal Liberty	9,452	10,342	10,986	1.48%
Montgomery	Gulf Coast	57,503	63,211	72,629	8.99%
	Other	18,030	505	49,495	2.82%
	Unknown	309	386	392	0.05%
	Subtotal Montgomery	75,841	73,520	90,247	11.85%
Newton	Gulf Coast	1,940	2,199	2,379	0.30%
	Other	227	-	655	0.04%
	Unknown	69	73	125	0.01%
	Subtotal Newton	2,236	2,300	2,630	0.35%
Orange	Gulf Coast	12,441	15,225	15,552	1.94%
	Other	1,758	-	4,467	0.27%
	Unknown	58	70	79	0.01%
	Subtotal Orange	14,256	15,299	15,552	2.23%
Polk	Gulf Coast	3,762	4,232	4,372	0.59%
	Other	725	726	808	0.11%
	Unknown	38	20	132	0.01%
	Yegua-Jackson	373	374	558	0.06%
	Subtotal Polk	4,899	5,355	5,460	0.77%
San Jacinto	Gulf Coast	2,262	2,912	3,020	0.35%
	Other	5	6	6	0.00%
	Unknown	1	-	4	0.00%
	Subtotal San Jacinto	2,267	2,918	3,025	0.35%
Tyler	Gulf Coast	3,472	3,839	4,110	0.54%
	Other	695	252	1,713	0.11%
	Unknown	26	18	78	0.00%
	Yegua-Jackson	8	9	13	0.00%
	Subtotal Tyler	4,201	4,139	5,113	0.66%
Walker	Carrizo-Wilcox	-	-	-	0.00%
	Gulf Coast	3,048	3,387	4,041	0.48%
	Other	1,624	1,087	2,533	0.25%
	Queen City	29	26	37	0.00%
	Unknown	2	-	7	0.00%
	Yegua-Jackson	612	479	1,873	0.10%
	Subtotal Walker	5,315	4,952	6,712	0.83%
Waller	Brazos River Alluvium	721	716	865	0.11%
	Gulf Coast	23,636	24,378	27,705	3.69%
	Other	216	204	270	0.03%
	Unknown	2	2	4	0.00%
	Subtotal Waller	24,574	25,299	28,799	3.84%

County	Aquifer	2007-2011 Summary Statistics (ac-ft.)			
		Average	Median	Maximum	% of Total Average
Washington	Brazos River Alluvium	67	58	104	0.01%
	Gulf Coast	1,843	2,032	2,112	0.29%
	Other	-	-	-	0.00%
	Unknown	7	7	14	0.00%
	Yegua-Jackson	276	151	870	0.04%
	Subtotal Washington	2,192	2,285	2,644	0.34%
GMA 14	Gulf Coast	546,692	563,440	685,914	85.44%
	Yegua-Jackson	1,876	1,338	3,696	0.29%
	Brazos River Alluvium	1,342	1,289	1,720	0.21%
	Carrizo-Wilcox	-	-	-	0.00%
	Queen City	29	26	37	0.00%
	Sparta	-	-	-	0.00%
	Other	88,357	13,986	228,132	13.81%
	Unknown	1,532	1,828	2,125	0.24%
	Total	639,828	648,870	695,666	100.00%

Table 5-4 – Historical groundwater pumpage statistics by water use sector for 2007-2011 for counties in GMA 14 (in acre-feet per year)

County	Use	2007-2011 Groundwater Pumpage Summary (ac-ft)			
		Average	Median	Maximum	% of Total Average
Austin	Irrigation	3,874	3,634	5,303	0.61%
	Livestock	405	379	521	0.06%
	Municipal	2,808	3,031	4,013	0.44%
	Manufacturing	84	84	110	0.01%
	Mining	4	4	8	0.00%
	Power				0.00%
	Subtotal Austin	*7,174*	*7,413*	*7,647*	1.12%
Brazoria	Irrigation	12,465	14,508	20,827	1.95%
	Livestock	1,200	1,210	1,241	0.19%
	Municipal	30,969	31,468	33,143	4.84%
	Manufacturing	1,691	1,475	2,816	0.26%
	Mining	130	147	190	0.02%
	Power				0.00%
	Subtotal Brazoria	*46,454*	*48,435*	*55,123*	7.26%
Chambers	Irrigation				0.00%
	Livestock	207	212	219	0.03%
	Municipal	2,372	2,332	3,534	0.37%
	Manufacturing	112	107	156	0.02%
	Mining	289	9	729	0.05%
	Power	56	37	120	0.01%
	Subtotal Chambers	*3,036*	*3,447*	*3,946*	0.47%
Fort Bend	Irrigation	13,928	14,940	18,600	2.18%
	Livestock	824	829	924	0.13%
	Municipal	72,932	73,523	84,407	11.40%
	Manufacturing	2,928	2,934	3,286	0.46%
	Mining	66	50	113	0.01%
	Power	2,616	2,587	2,821	0.41%
	Subtotal Fort Bend	*93,295*	*92,393*	*107,277*	14.58%
Galveston	Irrigation	47		208	0.01%
	Livestock	127	122	150	0.02%
	Municipal	3,221	2,549	7,711	0.50%
	Manufacturing	81	91	112	0.01%
	Mining	154	214	241	0.02%
	Power	2	2	4	0.00%
	Subtotal Galveston	*3,632*	*2,991*	*8,014*	0.57%
Grimes	Irrigation	146	75	333	0.02%
	Livestock	553	502	698	0.09%
	Municipal	2,865	3,087	3,544	0.45%
	Manufacturing	164	182	207	0.03%
	Mining	25		106	0.00%
	Power	1	1	2	0.00%
	Subtotal Grimes	*3,754*	*4,105*	*4,369*	0.59%

County	Use	2007-2011 Groundwater Pumpage Summary (ac-ft)			
		Average	Median	Maximum	% of Total Average
Hardin	Irrigation	1,520	1,436	2,245	0.24%
	Livestock	46	44	53	0.01%
	Municipal	4,042	5,487	5,712	0.63%
	Manufacturing	43	35	75	0.01%
	Mining	15	12	35	0.00%
	Power				0.00%
	Subtotal Hardin	*5,667*	*6,676*	*7,853*	0.89%
Harris	Irrigation	1,628	1,411	2,511	0.25%
	Livestock	841	804	955	0.13%
	Municipal	262,729	264,181	297,272	41.06%
	Manufacturing	10,612	10,245	11,855	1.66%
	Mining	992	835	1,760	0.15%
	Power	1,925	1,893	2,092	0.30%
	Subtotal Harris	*278,728*	*281,593*	*311,596*	43.56%
Jasper	Irrigation	12		30	0.00%
	Livestock	264	197	437	0.04%
	Municipal	4,462	4,509	4,892	0.70%
	Manufacturing	39,287	39,389	44,446	6.14%
	Mining	19		80	0.00%
	Power				0.00%
	Subtotal Jasper	*44,044*	*44,698*	*49,489*	6.88%
Jefferson	Irrigation	155		650	0.02%
	Livestock	183	190	203	0.03%
	Municipal	8,305	12,261	13,840	1.30%
	Manufacturing	25	33	55	0.00%
	Mining	143	136	215	0.02%
	Power				0.00%
	Subtotal Jefferson	*8,811*	*12,668*	*14,761*	1.38%
Liberty	Irrigation				0.00%
	Livestock				0.00%
	Municipal	9,179	10,087	10,653	1.43%
	Manufacturing	178	212	255	0.03%
	Mining	95	117	125	0.01%
	Power				0.00%
	Subtotal Liberty	*9,452*	*10,342*	*10,986*	1.48%
Montgomery	Irrigation	1,356	244	5,753	0.21%
	Livestock	552	546	614	0.09%
	Municipal	72,668	71,816	82,805	11.36%
	Manufacturing	579	687	726	0.09%
	Mining	311	387	392	0.05%
	Power	376	597	657	0.06%
	Subtotal Montgomery	*75,841*	*73,520*	*90,247*	11.85%

County	Use	2007-2011 Groundwater Pumpage Summary (ac-ft)			
		Average	Median	Maximum	% of Total Average
Newton	Irrigation	47	50	137	0.01%
	Livestock	58	49	84	0.01%
	Municipal	2,020	2,142	2,280	0.32%
	Manufacturing	42	52	52	0.01%
	Mining	69	73	125	0.01%
	Power				0.00%
	Subtotal Newton	*2,236*	*2,300*	*2,630*	0.35%
Orange	Irrigation				0.00%
	Livestock	152	156	182	0.02%
	Municipal	9,724	10,323	10,992	1.52%
	Manufacturing	3,260	3,157	4,055	0.51%
	Mining	58	70	79	0.01%
	Power	1,062	1,062	1,142	0.17%
	Subtotal Orange	*14,256*	*15,299*	*15,552*	2.23%
Polk	Irrigation	324	342	595	0.05%
	Livestock	37	35	44	0.01%
	Municipal	4,211	4,767	4,995	0.66%
	Manufacturing	289	282	426	0.05%
	Mining	38	20	132	0.01%
	Power				0.00%
	Subtotal Polk	*4,899*	*5,355*	*5,460*	0.77%
San Jacinto	Irrigation				0.00%
	Livestock	90	83	116	0.01%
	Municipal	2,169	2,825	2,948	0.34%
	Manufacturing	8	9	10	0.00%
	Mining	1		4	0.00%
	Power				0.00%
	Subtotal San Jacinto	*2,267*	*2,918*	*3,025*	0.35%
Tyler	Irrigation	205	175	437	0.03%
	Livestock	61	60	80	0.01%
	Municipal	3,905	3,999	4,644	0.61%
	Manufacturing	4	2	11	0.00%
	Mining	26	18	78	0.00%
	Power				0.00%
	Subtotal Tyler	*4,201*	*4,139*	*5,113*	0.66%
Walker	Irrigation	220	117	570	0.03%
	Livestock	202	199	221	0.03%
	Municipal	4,858	4,652	5,882	0.76%
	Manufacturing	33	32	67	0.01%
	Mining	2		7	0.00%
	Power				0.00%
	Subtotal Walker	*5,315*	*4,952*	*6,712*	0.83%

County	Use	2007-2011 Groundwater Pumpage Summary (ac-ft)			
		Average	Median	Maximum	% of Total Average
Waller	Irrigation	19,553	20,070	23,599	3.06%
	Livestock	593	538	753	0.09%
	Municipal	4,381	4,429	4,748	0.68%
	Manufacturing	25	22	34	0.00%
	Mining	24	2	110	0.00%
	Power				0.00%
	Subtotal Waller	*24,574*	*25,299*	*28,799*	3.84%
Washington	Irrigation	301	250	509	0.05%
	Livestock	154	152	160	0.02%
	Municipal	1,493	1,742	1,888	0.23%
	Manufacturing	238	254	369	0.04%
	Mining	7	7	14	0.00%
	Power				0.00%
	Subtotal Washington	*2,192*	*2,285*	*2,644*	0.34%
GMA 14	Irrigation	55,781	57,634	62,500	8.72%
	Livestock	6,547	6,595	7,000	1.02%
	Municipal	509,312	514,953	566,088	79.60%
	Manufacturing	59,682	58,224	66,363	9.33%
	Mining	2,468	2,289	3,214	0.39%
	Power	6,038	5,998	6,576	0.94%
	Total	**639,828**	**648,870**	**695,666**	**100.00%**

The current or historic condition of an aquifer may be evaluated in a number of ways. In regions with regional-dipping, predominantly confined aquifers such as the Gulf Coast Aquifer System, the relative measurements of artesian pressures in the aquifer (measurements of artesian pressure as expressed in static water levels below land surface or above mean sea level in a well) have been determined by many GMAs in Texas to be the most effective metric for long-range planning purposes. For joint planning in GMA 14, the District Representatives reviewed contour maps of the potentiometric surface of the various aquifers within GMA 14 as a representation of current aquifer conditions. Historical pumpage, along with the natural geology of the formations, resulted in patterns of potentiometric groundwater surface elevations throughout the aquifers that vary from county to county across the GMA. The pattern of these contours was used by GMA 14 District Representatives to evaluate aquifer conditions as part of the joint-planning process.

As the primary groundwater-bearing unit within GMA 14, the Gulf Coast Aquifer System has experienced significant declines in local and regional water levels that correspond to the high levels of pumpage discussed above. In general, this is within and surrounding Harris County in the more urbanized areas of GMA 14, including Fort Bend, Galveston, and Montgomery counties. Local and regional depressions mapped on the potentiometric surfaces across the four primary formations (Chicot, Evangeline, Burkeville, and Jasper aquifers) within the Gulf Coast Aquifer System generally track the location of greatest pumpage within each

formation; the center of the cones of depression in the lower-lying layers like the Jasper Formation (Aquifer) occur north of the cones for the overlying layers like the Chicot Formation. *Figure 5-5*, *Figure 5-6*, and *Figure 5-7* represent both measured and simulated contours of the potentiometric surface across the Chicot, Evangeline, and Jasper formations, respectively. Contours are presented to extend the geographic extent of measured data across the entirety of the northern Gulf Coast Aquifer System and GMA 14. This data is adapted from Kasmarek, 2012[39]. Presentation materials considered by GMA 14 District Representatives and inter-local partners are included in its entirety in *Appendix H*.

39 Kasmarek, M.C., 2012, Hydrogeology and simulation of groundwater flow and land-surface subsidence in the northern part of the Gulf Coast Aquifer System, Texas, 1891–2009 (ver. 1.1, December 2013): U.S. Geological Survey Scientific Investigations Report 2012–5154, 55 p., http://dx.doi.org/sir20125154.

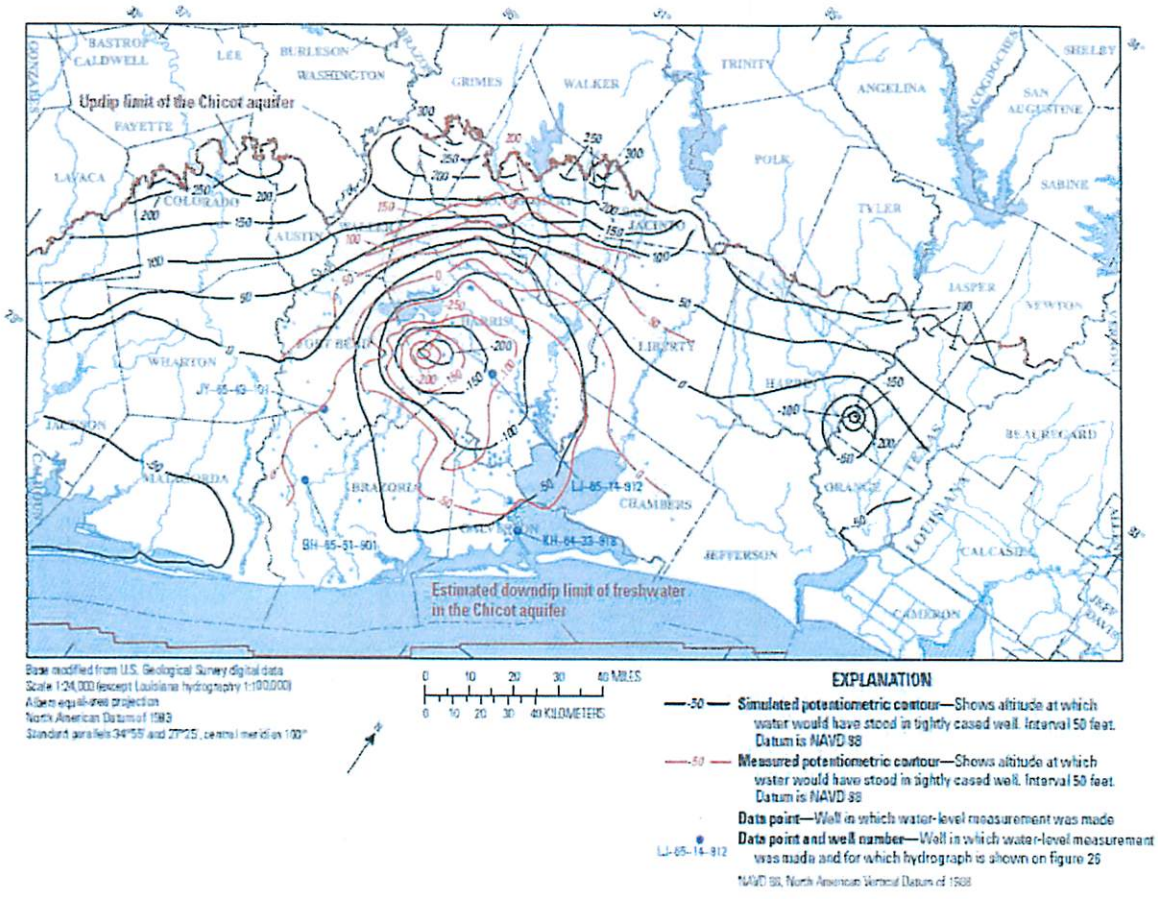

Figure 5-5 – Simulated and measured water level elevation contours in the Chicot Formation, 2009.

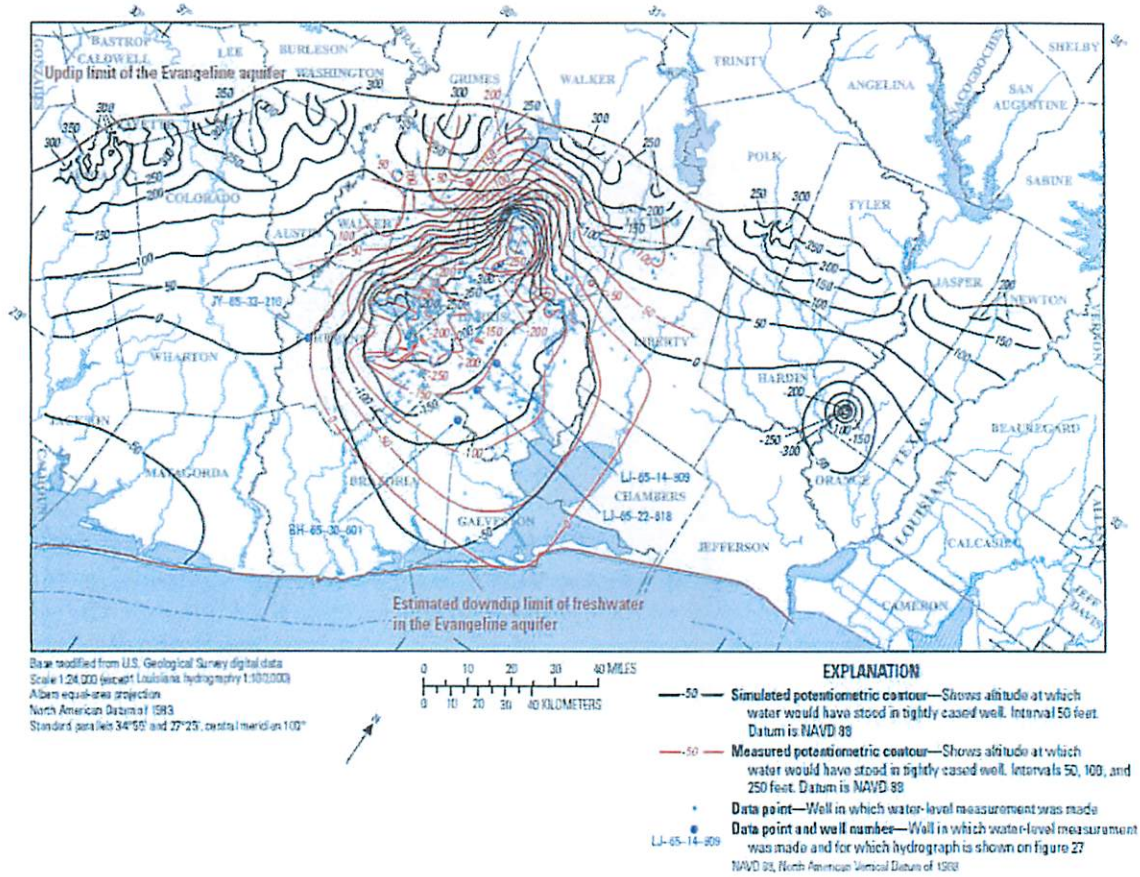

Figure 5-6 – Simulated and measured water level elevation contours in the Evangeline Formation, 2009.

In areas of high historical groundwater use, subsidence has been a significant factor related to aquifer conditions. *Figure 5-8* represents available measured and simulated data of subsidence for the Northern Gulf Coast Aquifer System. Note the high levels of historical subsidence centered in the vicinity of Harris and Galveston counties with impacts extending into neighboring areas.

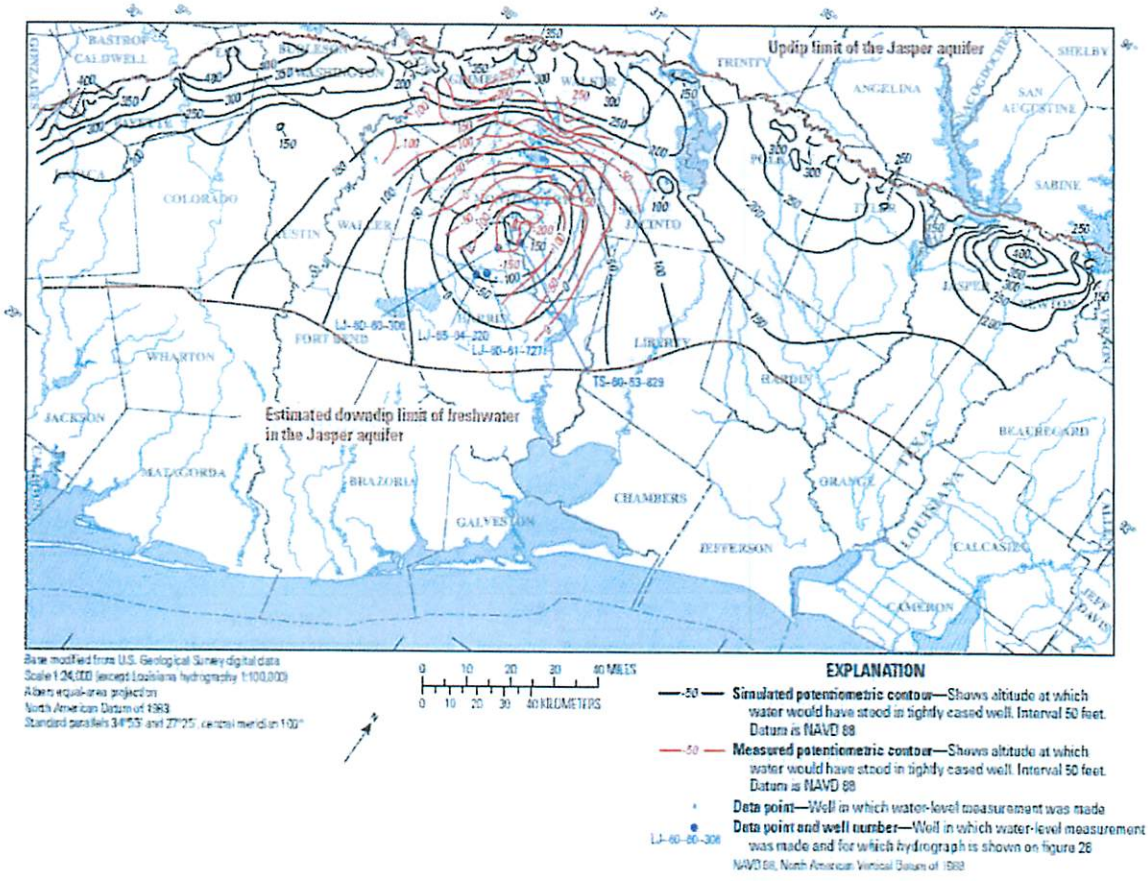

Figure 5-7 – Simulated and measured water level elevation contours in the Jasper Formation, 2009.

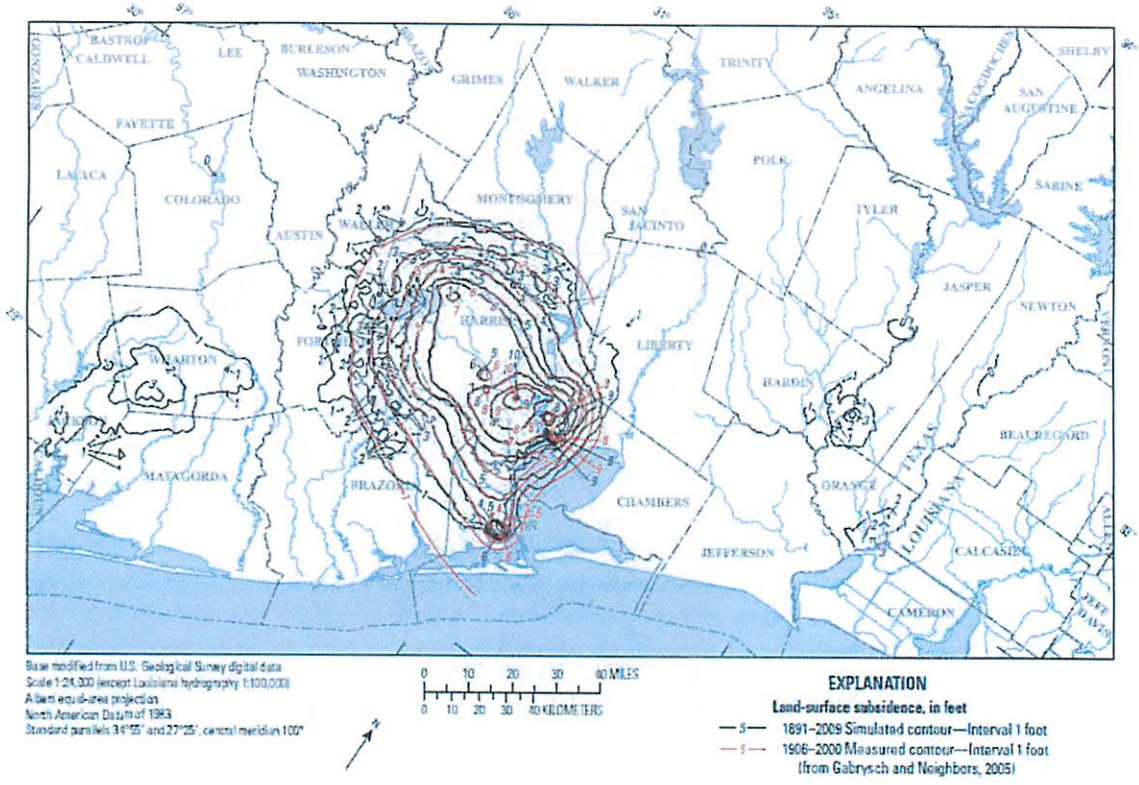

Figure 5-8 – Simulated and measured subsidence contours occurring in the Gulf Coast Aquifer System, 2009.

The dominating reliance on the Gulf Coast Aquifer System generally results in less significant patterns in conditions of other aquifers within GMA 14. *Figure 5-9* represents measured contours within the Carrizo Sand Aquifer, which crosses the northern portion of GMA 14. Significant declines in the formation are generally seen in the area north of GMA 14 where the aquifer is a more significant source of water supply. The water level elevations within GMA 14 are dictated more by geology than patterns of usage, as was demonstrated in the Gulf Coast Aquifer System. This data is taken from Dutton and others, 2003[40]. Similar trends are recognized in the Queen City and Sparta Aquifers as shown in *Figure 5-10* and *Figure 5-11*, which are taken from Kelley and others, 2004[41]. Water level elevation data was also available for the Upper and Lower Yegua and Jackson formations from Deeds and others, 2010[42] Water

[40] Dutton, A. R., Harden, B., Nicot, J. P., and O'Rourke, D., 2003, Groundwater Availability Model for the Central Part of the Carrizo-Wilcox Aquifer in Texas: The University of Texas at Austin, Bureau of Economic Geology, Final Technical Report prepared for the Texas Water Development Board, 405 p.

[41] Kelley, V. A.,, Deeds, N. E., Fryar, D.G., Nicot, J.P., Jones, T., Dutton, A. R., Bruehl, G., Unger-Holtz, T., and Machin, J.L., 2004, Groundwater availability models for the Queen City and Sparta Aquifers: INTERA, Inc., Final Technical Report prepared for the Texas Water Development Board, 867 p.

[42] Deeds, N. E., Singh, T. Y. A., Jones, T. L., Kelley, V. A., Knox, P. R., and Young. S. C., 2010, Final Report Groundwater availability model for the Yegua-Jackson Aquifer: Final Technical Report prepared for the Texas Water Development Board, 582 p.

level elevation data for the Upper Jackson, Lower Jackson, Upper Yegua, and Lower Yegua area shown below in *Figure 5-12* through *Figure 5-15*, respectively.

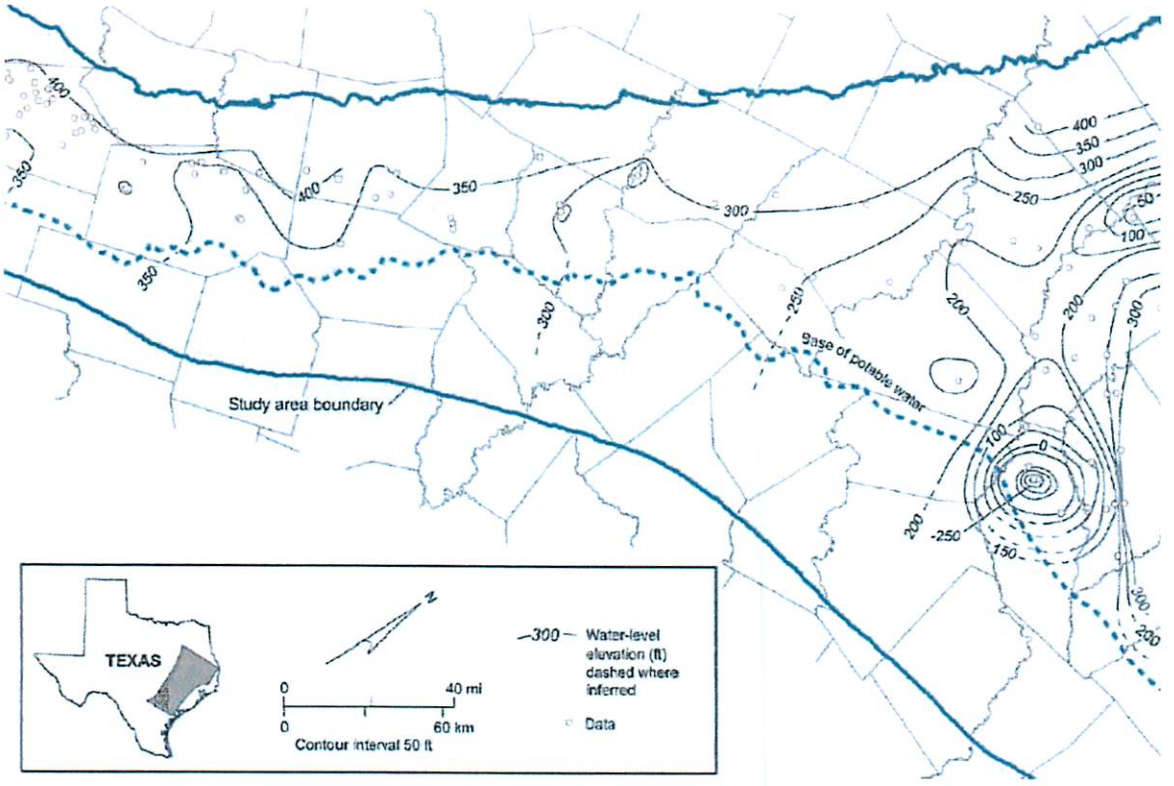

Figure 5-9 – Water level elevation contours in the Carrizo Sand Aquifer based on water level measurements from 1987 – 1990[43]

[43] Map reproduced from Dutton, A. R., Harden, B., Nicot, J. P., and O'Rourke, D., 2003, Groundwater Availability Model for the Central Part of the Carrizo-Wilcox Aquifer in Texas: The University of Texas at Austin, Bureau of Economic Geology, Final Technical Report prepared for the Texas Water Development Board, 405 p

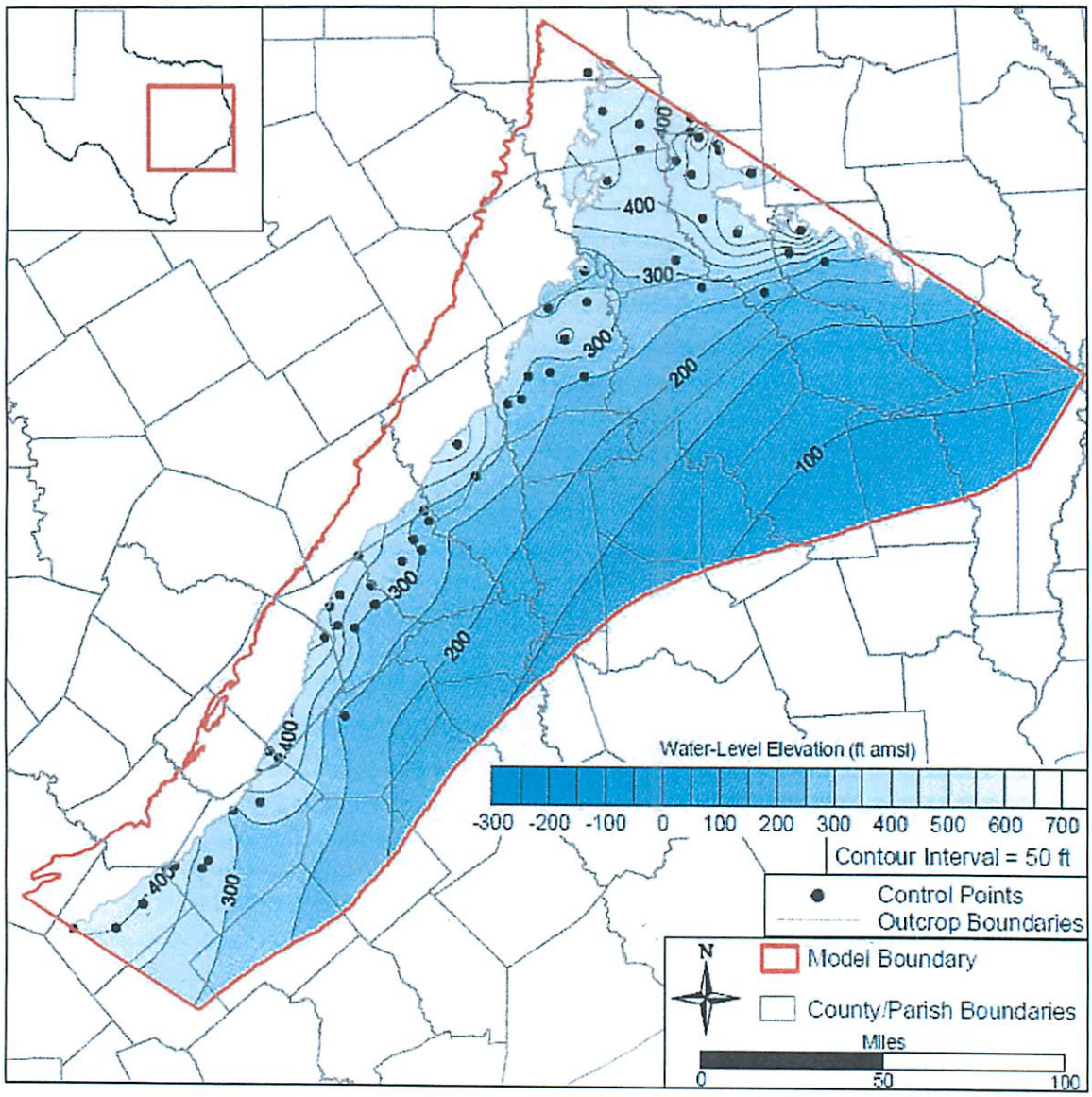

Figure 5-10 – 1999 estimated elevation contours in the Queen City Aquifer[44]

[44] Map from Kelley, V. A., Deeds, N. E., Fryar, D.G., Nicot, J.P., Jones, T., Dutton, A. R., Bruehl, G., Unger-Holtz, T., and Machin, J.L., 2004, Groundwater availability models for the Queen City and Sparta Aquifers: INTERA, Inc., Final Technical Report prepared for the Texas Water Development Board, 867 p.

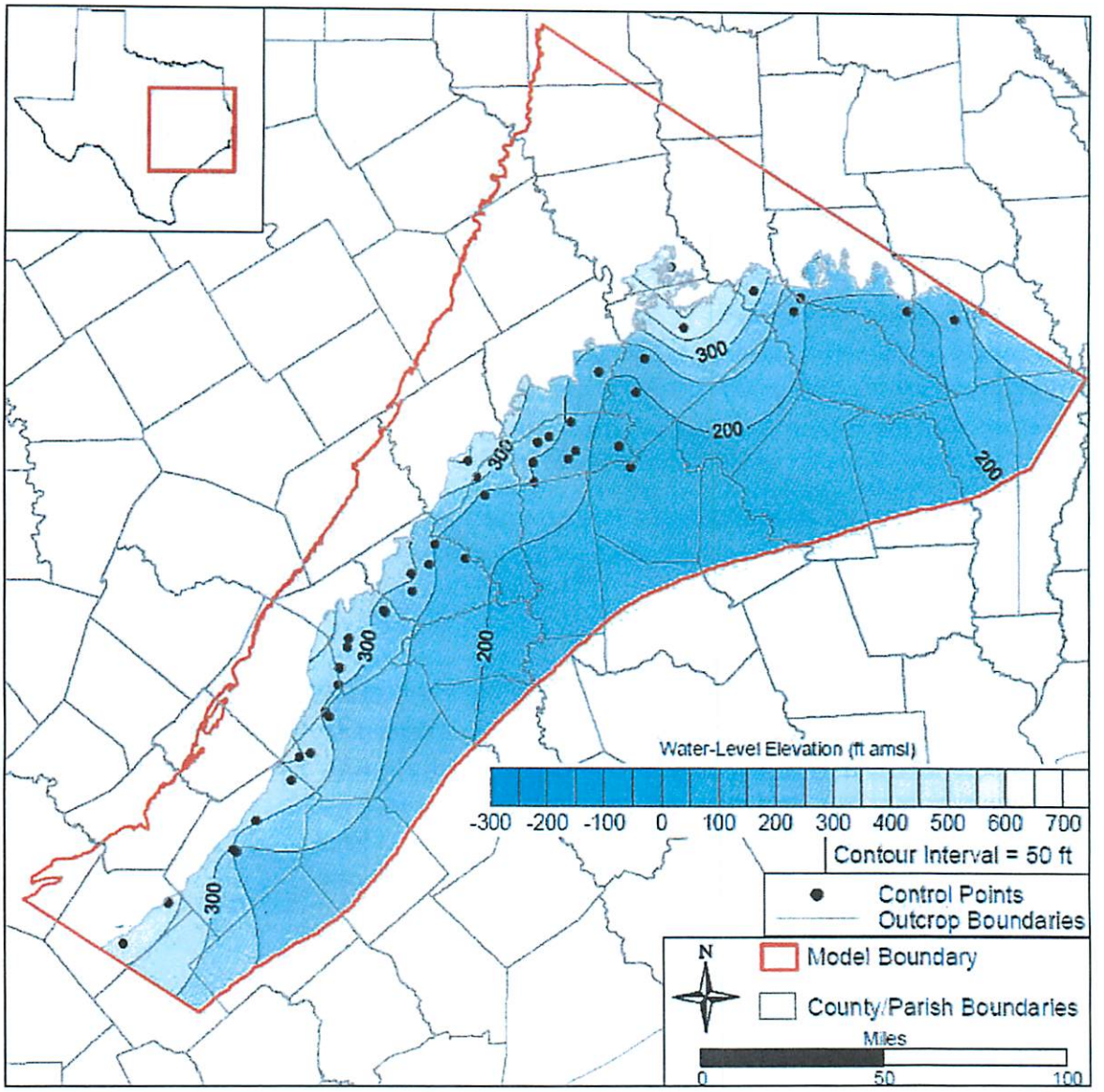

Figure 5-11 – 1999 estimated elevation contours in the Sparta Aquifer[45]

[45] Map from Kelley, V. A., Deeds, N. E., Fryar, D.G., Nicot, J.P., Jones, T., Dutton, A. R., Bruehl, G., Unger-Holtz, T., and Machin, J.L., 2004, Groundwater availability models for the Queen City and Sparta Aquifers: INTERA, Inc., Final Technical Report prepared for the Texas Water Development Board, 867 p.

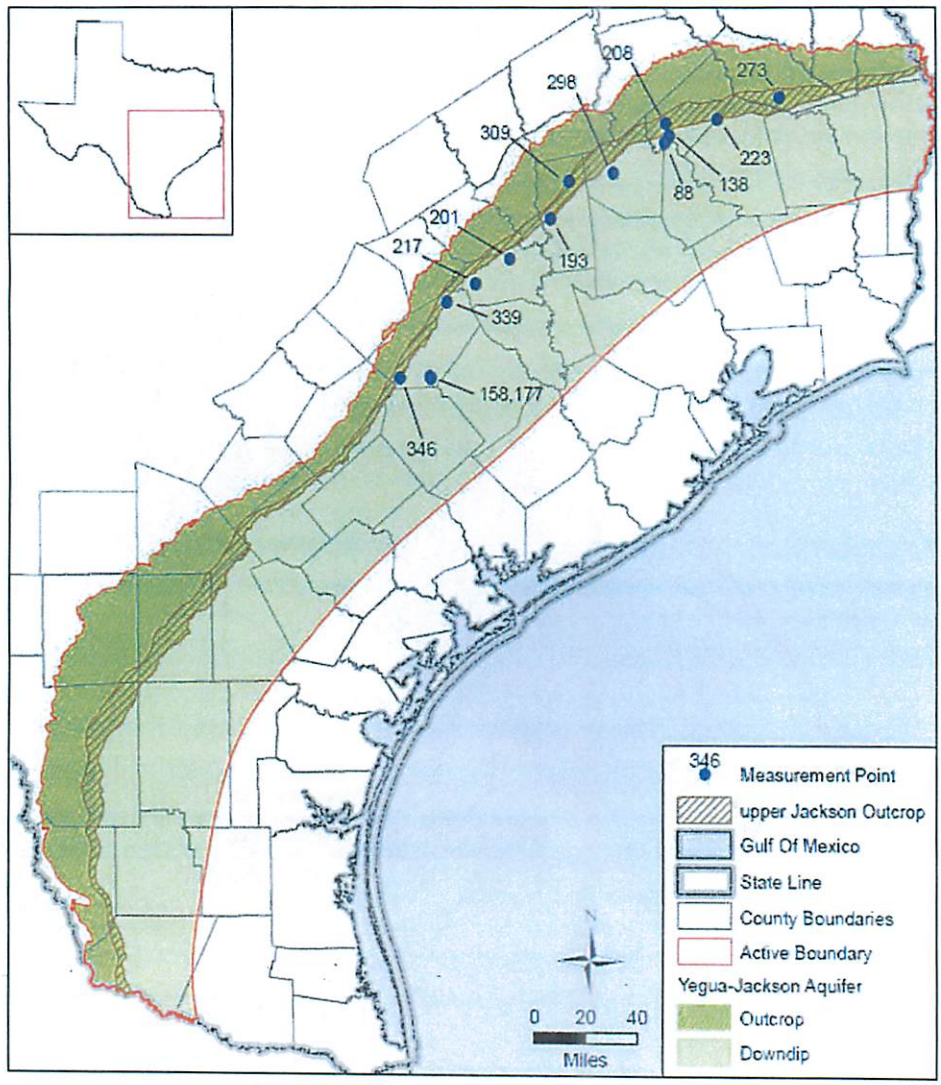

Figure 5-12 – 1997 estimated elevations in Upper Jackson Formation[46]

[46] Map from Deeds, N. E., Singh, T. Y. A., Jones, T. L., Kelley, V. A., Knox, P. R., and Young. S. C., 2010, Final Report Groundwater availability model for the Yegua-Jackson Aquifer: Final Technical Report prepared for the Texas Water Development Board, 582 p.

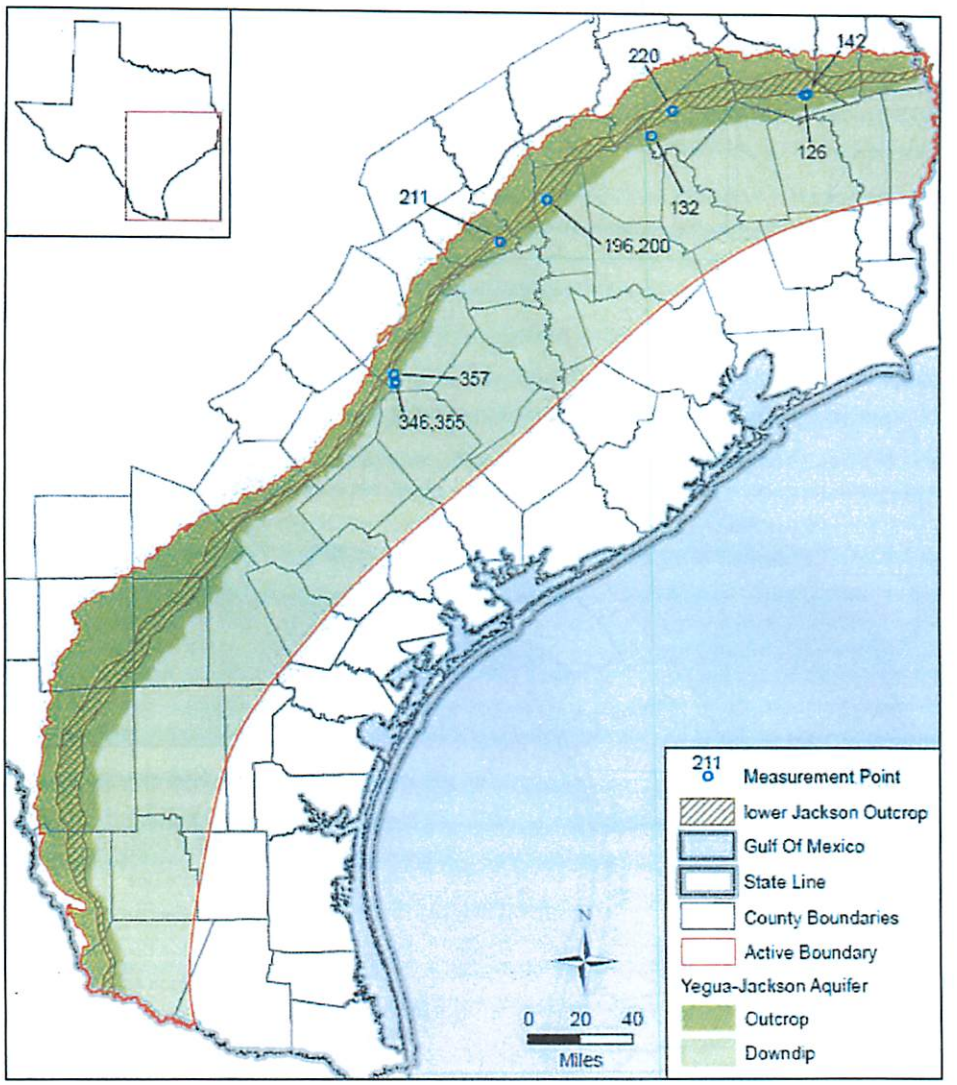

Figure 5-13 – 1997 estimated elevations in Lower Jackson Formation[47]

[47] Map from Deeds, N. E., Singh, T. Y. A., Jones, T. L., Kelley, V. A., Knox, P. R., and Young. S. C., 2010, Final Report Groundwater availability model for the Yegua-Jackson Aquifer: Final Technical Report prepared for the Texas Water Development Board, 582 p.

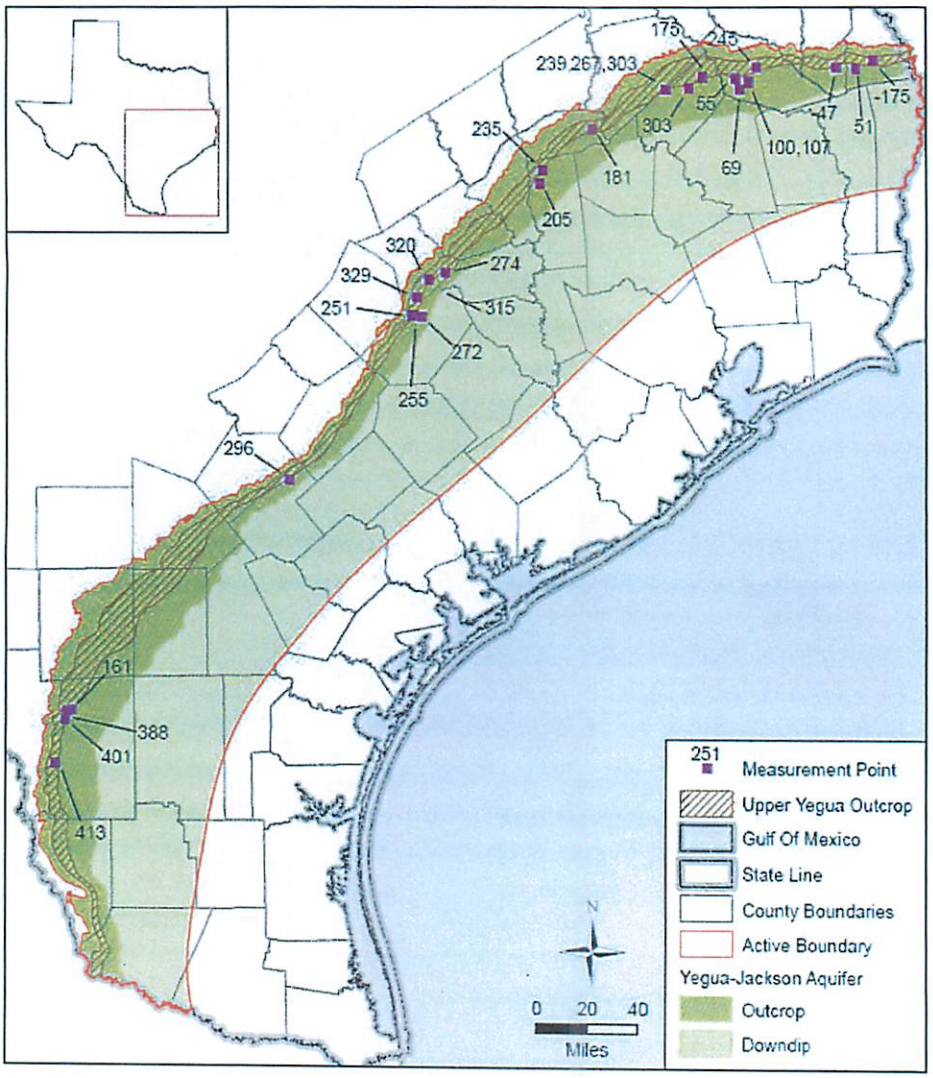

Figure 5-14 – 1997 estimated elevations in Upper Yegua Formation[48]

[48] Deeds, N. E., Singh, T. Y. A., Jones, T. L., Kelley, V. A., Knox, P. R., and Young. S. C., 2010, Final Report Groundwater availability model for the Yegua-Jackson Aquifer: Final Technical Report prepared for the Texas Water Development Board, 582 p.

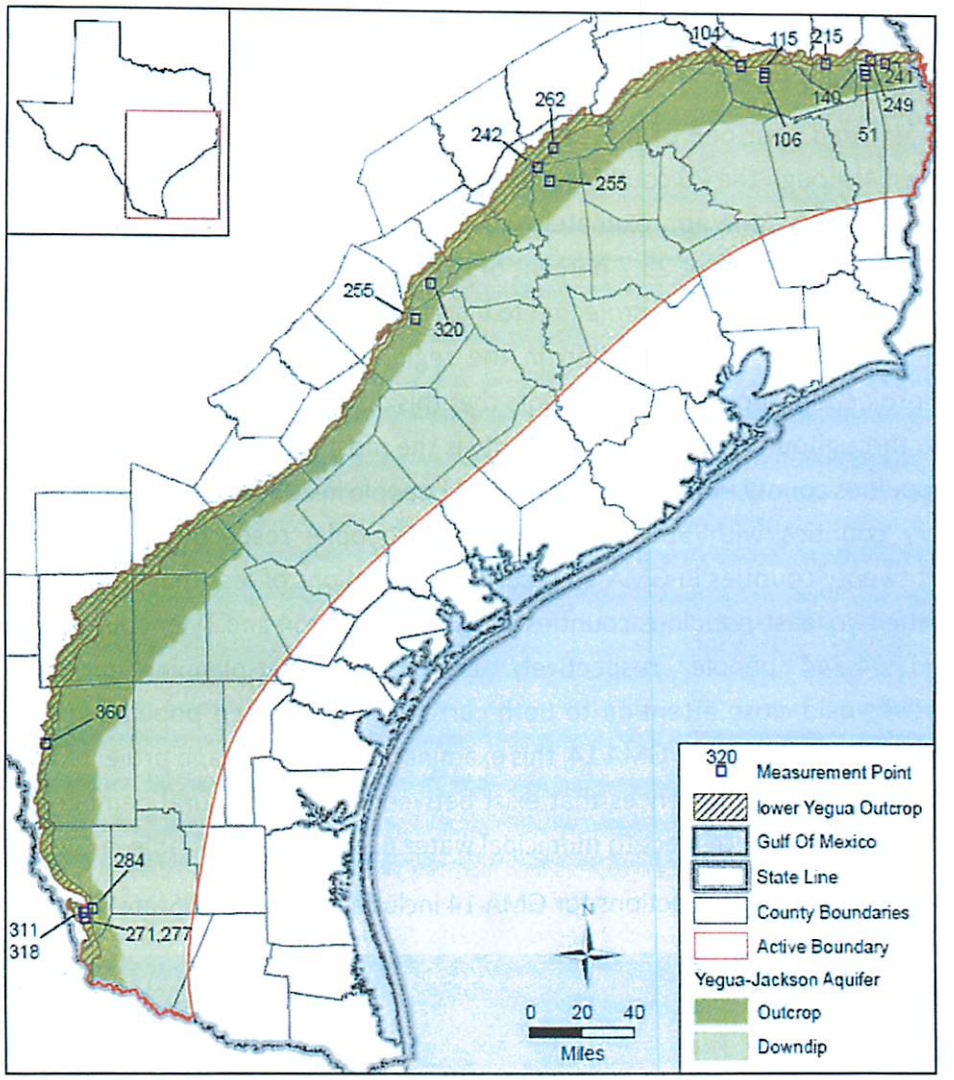

Figure 5-15 – 1997 estimated elevations in Lower Yegua Formation[49]

5.2 WATER SUPPLY NEEDS AND WATER MANAGEMENT STRATEGIES

Texas Water Code Section 36.108 (d)(2), requires District Representatives in a GMA to consider the water supply needs and water management strategies included in the state water plan. In order to meet this requirement, the District Representatives in GMA 14 considered the continued population growth in the area, all water supplies needs, and recommended water

[49] Deeds, N. E., Singh, T. Y. A., Jones, T. L., Kelley, V. A., Knox, P. R., and Young. S. C., 2010, Final Report Groundwater availability model for the Yegua-Jackson Aquifer: Final Technical Report prepared for the Texas Water Development Board, 582 p.

management strategies included in the 2011 regional water plans[50] and the 2012 State Water Plan.[51] Applicable information for this factor is included in its entirety in *Appendix I*.

GMA 14 is centered over one of the most diverse, demographically dynamic regions of the State of Texas. Although the 20 counties making up GMA 14 represent less than 10 percent of the land mass of Texas, the approximately 6,529,891 people living in the area of GMA 14 in 2010 (see Table 5.5) represent 25.7 percent of the State's total population, and over the 50-year planning horizon, GMA 14 is projected to increase to 11,958,683 people, representing an 83 percent increase in the population in the region. A review of the individual county population projections, however, documents that this distribution of population in GMA 14 is not uniform throughout the area. Harris County is the most populous county in GMA 14 (and the most populous county in Texas) with 4,078,231 people in 2010, followed by Fort Bend, and Montgomery counties with 550,121 and 453,369 people, respectively (see Table 5.5)). Fourteen of twenty counties in GMA 14 recorded populations of less than 100,000 people in 2010, with the two least-populous counties in GMA 14, Newton and Tyler counties, recording 16,008 and 24,744 people, respectively. During the joint-planning process District Representatives paid close attention to both current and projected population projections, both in urban and rural areas. In GMA 14, this examination of current and projected population highlights the significant differences that exist between urban and rural demographics. This difference, especially with respect to municipal water use, is widely variable in GMA 14.

Table 5-5 – Population projections for GMA 14 included in the 2012 State Water Plan[52]

County	2012 State Water Plan Projected Population					
	2010	2020	2030	2040	2050	2060
AUSTIN	27,173	30,574	32,946	34,355	35,031	35,958
BRAZORIA	305,649	354,708	401,684	444,981	490,875	538,795
CHAMBERS	34,282	40,786	46,838	52,083	57,402	62,850
FORT BEND	550,121	719,737	893,875	1,090,710	1,348,851	1,643,825
GALVESTON	268,714	284,731	294,218	298,057	300,915	302,774
GRIMES	26,635	30,073	32,785	34,670	36,176	37,657
HARDIN	54,504	59,115	61,211	63,381	65,627	67,954
HARRIS	4,078,231	4,629,335	5,180,439	5,731,543	6,282,647	6,833,751

[50] Brazos G Regional Water Planning Group, 2011, Brazos G Regional Water Plan, http://www.twdb.texas.gov/waterplanning/rwp/plans/2011/index.asp. Region H Regional Water Planning Group, 2011, Region H Regional Water Plan, http://www.twdb.texas.gov/waterplanning/rwp/plans/2011/index.asp. East Texas Regional Water Planning Group, 2011, East Texas Regional Water Plan, http://www.twdb.texas.gov/waterplanning/rwp/plans/2011/index.asp.

[51] Texas Water Development Board, Water for Texas – 2012: The State Water Plan, 299 p., http://www.twdb.texas.gov/waterplanning/swp/2012/index.asp.

[52] Texas Water Development Board, Water for Texas, 2012 Texas State Water Plan.

County	2012 State Water Plan Projected Population					
	2010	2020	2030	2040	2050	2060
JASPER	38,445	40,897	42,344	42,712	42,712	42,712
JEFFERSON	259,700	270,686	280,590	288,225	295,924	310,478
LIBERTY	81,930	94,898	107,335	119,519	132,875	147,845
MONTGOMERY	453,369	588,351	751,702	931,732	1,169,199	1,444,999
NEWTON	16,008	16,731	16,825	17,329	17,849	18,385
ORANGE	90,503	94,274	95,818	96,473	97,843	98,836
POLK	48,072	54,897	60,401	64,478	68,247	71,928
SAN JACINTO	27,443	32,541	36,617	39,159	40,630	41,299
TYLER	24,744	28,513	30,937	31,866	31,866	31,866
WALKER	70,672	77,915	81,402	80,547	80,737	80,737
WALLER	41,137	51,175	62,352	74,789	89,598	106,608
WASHINGTON	32,559	35,253	36,973	37,908	38,747	39,426
TOTAL	6,529,891	7,535,190	8,547,292	9,574,517	10,723,751	11,958,683
STATE TOTAL	25,388,403	29,650,388	33,712,020	37,734,422	41,924,167	46,323,725
GMA 14 PERCENT of STATE TOTAL	25.7%	25.4%	25.4%	25.4%	25.6%	25.8%

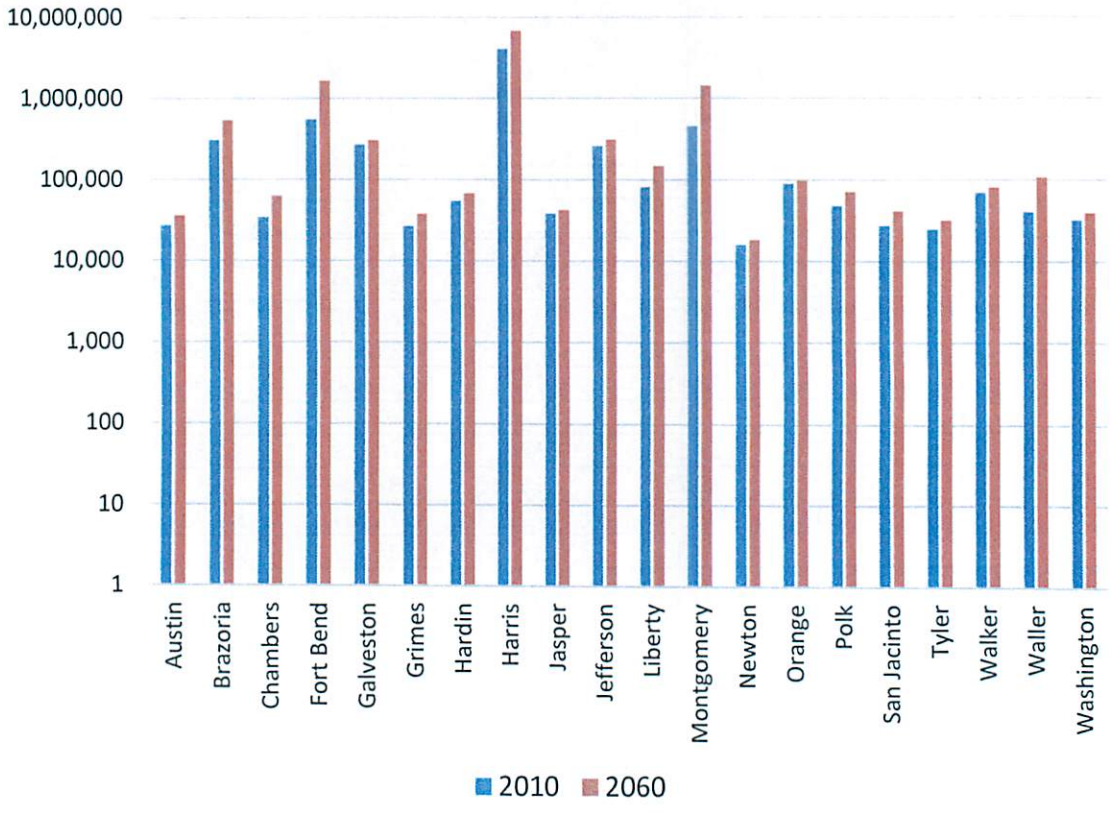

Figure 5-16 – Population projections by county for GMA 14. Population projections are for 2010 and 2060. Note, scale of this graphic is logarithmic in order to document populations in less populated counties.

In Texas, the overall "water needs" for a region, as defined within the Texas State Water Plan, are the demands (based on water demand projections developed during the water-planning process for 6 major water use sectors) that cannot be met with existing supplies. These existing supplies may be inadequate to satisfy demands because of natural conditions (e.g., sustainable supply of an aquifer or firm yield of a reservoir) or infrastructure limitations (e.g. inadequate diversion, treatment, or transmission capacity). A review of the future water management strategies within a region gives some insight into the potential future supply to meet an identified need. Therefore, future groundwater management strategies identified in the 2012 Texas State Water Plan indicate the potential future demand for groundwater in addition to currently utilized supplies.

GMA 14 comprises an area spanning Regional Water Planning Areas G (Brazos G), H, and I (East Texas). Data from the 2012 Texas State Water Plan for each of these regions was used to develop data summaries for consideration by the GMA 14 District Representatives and

interlocal agreement partners. *Figure 5-17* illustrates the growth of total demands and needs (demands not met by existing supplies) within GMA 14 for the three regional water planning areas (G, H, and I). The columns in this figure demonstrate the availability of existing groundwater and other water (surface water, reuse, conservation) supplies in dark and light blue colors, respectively. Future water management strategies based on groundwater and other water supplies are shown in dark and light red colors, respectively. Generally, it can be seen in this figure that the majority of future water supplies will originate from sources other than groundwater supplies and that this ratio of new groundwater supplies to other options will be far below that currently making up existing regional water supplies.

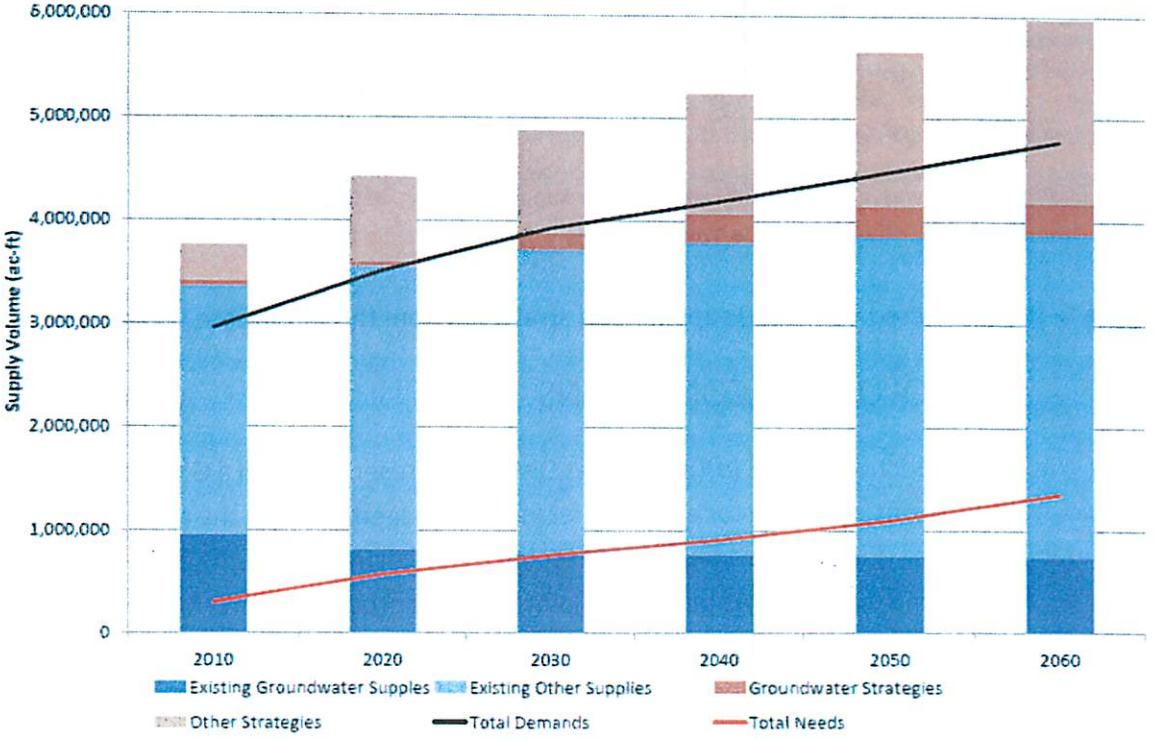

Figure 5-17 – Projected supplies and strategies from the 2012 Texas State Water Plan

The trend toward other water supplies in lieu of expanded groundwater continues at the county level of all counties anticipating significant need for additional water supplies over the course of the planning horizon (*Figure 5-18*).

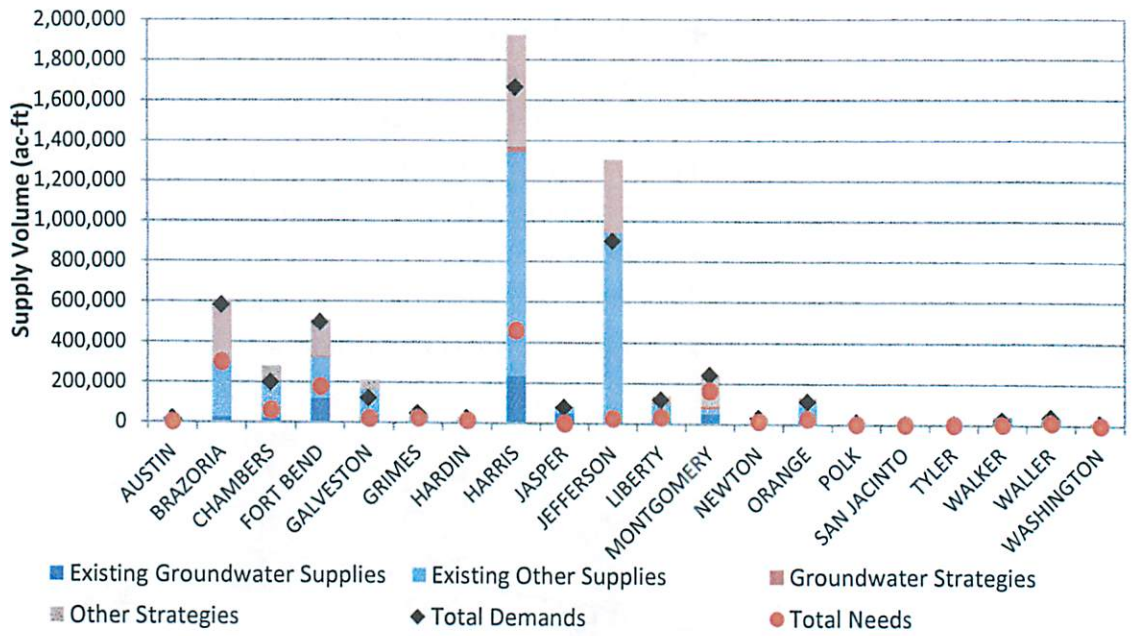

Figure 5-18 – Projected year 2060 supplies and strategies from the 2012 State Water Plan

5.3 HYDROLOGICAL CONDITIONS

Texas Water Code Section 36.108 (d)(3) requires District Representatives in a GMA to consider hydrological conditions, including for each aquifer in the management area the total estimated recoverable storage (TERS) as provided by the executive administrator, and the average annual recharge, inflows, and discharge. As part of the joint-planning process, District Representatives in GMA 14 reviewed and considered estimates of TERS, inflows, outflows, recharge, and discharge for all relevant aquifers based on results from the most recently adopted groundwater availability models (GAMs) and technical assessments from the TWDB. The principal GAM utilized in this analysis was the Northern Gulf Coast Groundwater Availability Model or Northern Gulf Coast GAM. Estimates of TERS were provided by the TWDB executive administrator for review and consideration during the joint-planning process, as required by statute. The technical materials focused on hydrological conditions, including estimates of TERS, inflows, outflows, recharge, and discharge for all relevant aquifers, presented and considered by the District Representatives in GMA 14, are included in their entirety in *Appendix J*.

The hydrostratigraphy utilized in the Northern Gulf Coast GAM for the Gulf Coast Aquifer System is documented in the following *Figure 5-19*. Of the five hydrostratigraphic units utilized in construction of the Northern Gulf Coast GAM, the Chicot, Evangeline, and Jasper aquifers are recognized as the primary water-bearing resources in GMA 14.

Although this section is focused on the consideration of hydrological conditions, it is noted, however, that there are no significant differences between this requirement in Texas Water Code Section 36.108 (d)(3) and the requirements contained in Texas Water Code Section 36.108 (d)(1) to consider "aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another," at least with respect to "hydrologic conditions." As discussed in *Section 5.1* above, there are several ways to express and evaluate hydrological conditions in an aquifer. As discussed in *Section 5.4*, hydrologic conditions may be evaluated based on spring flows, the volume of water remaining in storage in areas of unconfined conditions, the measurements of artesian pressures in the aquifer in regional-dipping and predominantly confined aquifers, and in certain coastal areas on levels of land-surface subsidence. As discussed in *Section 5.1* and in *Figure 5-5* through *Figure 5-15* above, GMA 14 District Representatives reviewed contour maps of the potentiometric surface of the various aquifers within GMA 14 as a representation of current aquifer/hydrologic conditions. Historical pumpage, along with the geology of the formations, have resulted in patterns of potentiometric (water) surface elevations throughout the aquifers that vary from county to county across the GMA. The pattern of these contours was used by GMA 14 District Representatives to evaluate aquifer/hydrologic conditions as part of the joint-planning process.

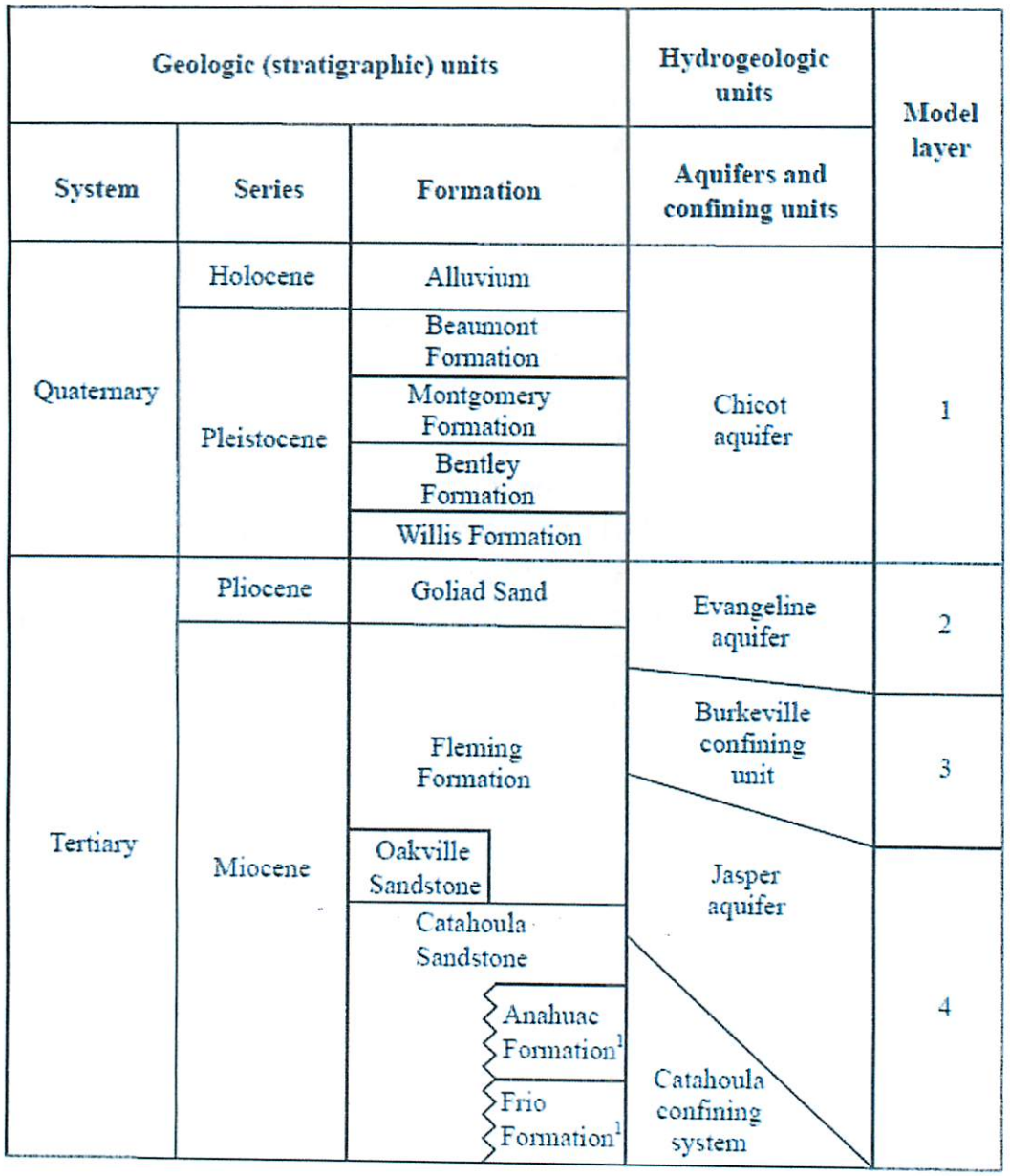

Figure 5-19 – Hydrostratigraphic column utilized in development of the Northern Gulf Coast GAM [53]

With the release of the initial report of TERS, as provided by the TWDB[54], GMA 14 District Representatives invested significant time in consideration of the TERS and the ramifications of

[53] Kasmarek, M.C., 2012, Hydrogeology and simulation of groundwater flow and land-surface subsidence in the northern part of the Gulf Coast Aquifer System, Texas, 1891–2009 (ver. 1.1, December 2013): U.S. Geological Survey Scientific Investigations Report 2012–5154, 55 p., http://dx.doi.org/sir20125154.

[54] Wade, S., Thorkildsen, D., and Anaya, R., 2014, GAM Task 13-037: Total estimated recoverable storage for aquifers in Groundwater Management Area 14: Texas Water Development Board, 35 p.

those estimates on proposed DFCs. For a more detailed reference to these discussions, the reader is referred to the meeting minutes included in *Appendix B*. The TERS report prepared and provided by the TWDB is reproduced in its' entirety in *Appendix K*. TERS volumes, in acre-feet, for GMA 14 for the Gulf Coast Aquifer System, based on this report is 2,776,000,000 acre-feet. *Figure 5-20* provides a county by county comparison of the TERS values included in Wade and others, 2014).

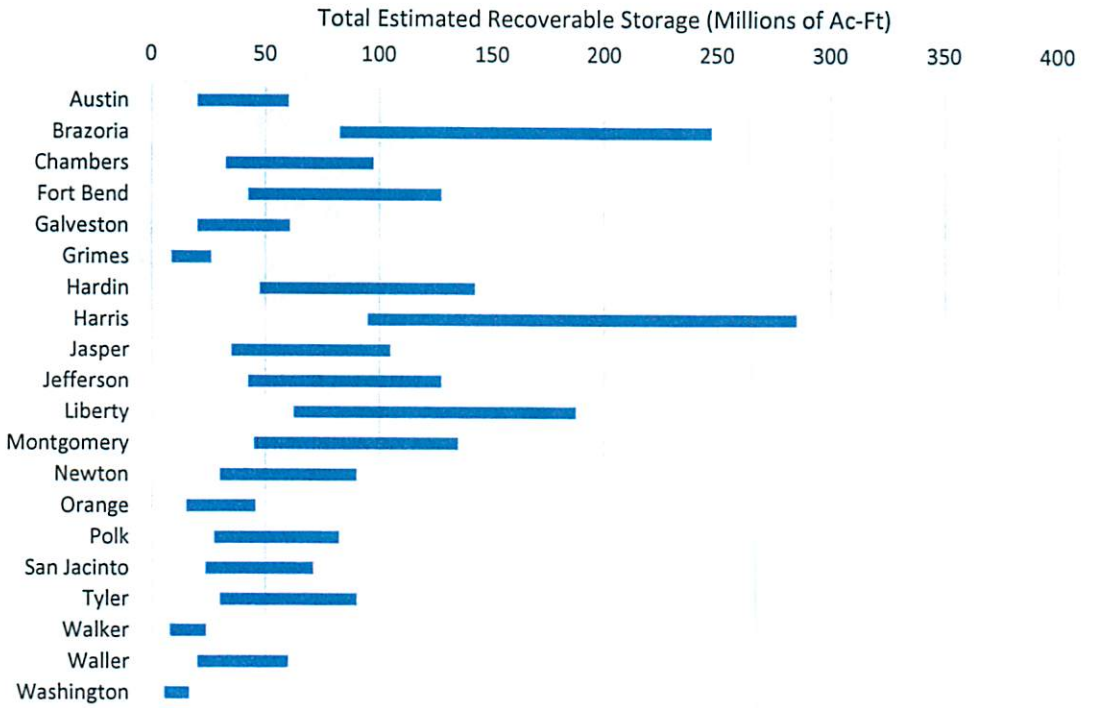

Figure 5-20 –Total Estimated Recoverable Storage by county

Following release of the initial TERS report by the TWDB, the estimates were again provided to GMA 14 by the TWDB in a slightly different format, wherein estimates are divided into unconfined and confined storage. The following graphic (*Figure 5-21*) is taken from Wade and others (2014) and is reproduced here to illustrate the differences in confined and unconfined storage. *Table 5-6* and *Table 5-7* include the additional breakdowns of TERS into confined and unconfined storage provided by the TWDB. One of the more notable conclusions that GMA 14 District Representatives made with regards to the TERS data was that while the Gulf Coast Aquifer System in GMA 14, as reported by the TWDB in Table 5.7, contains 2,776,000,000 acre-feet in total storage, only 10,952,354 acre-feet, equivalent to 0.39 percent, is in confined storage.

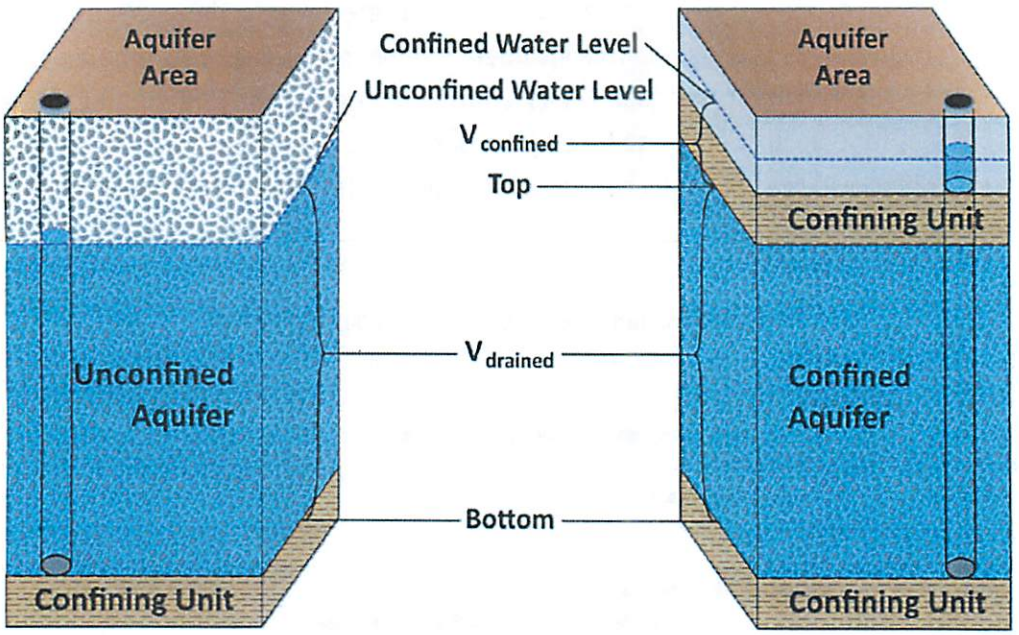

Figure 5-21 – Illustration of relevant hydrological features on which TERS analysis is based

Table 5-6 – Total estimated recoverable storage separated into unconfined and confined components by county for the Gulf Coast Aquifer System within GMA 14[55]

County	Unconfined Storage (acre-feet)	Confined Storage (acre-feet)	Total Storage (acre-feet)	25 percent of Total Storage (acre-feet)	75 percent of Total Storage (acre-feet)
Austin	79,623,694	271,616	80,000,000	20,000,000	60,000,000
Brazoria	331,167,468	353,328	330,000,000	82,500,000	247,500,000
Chambers	133,220,055	110,414	130,000,000	32,500,000	97,500,000
Fort Bend	169,317,122	278,931	170,000,000	42,500,000	127,500,000
Galveston	81,060,010	64,662	81,000,000	20,250,000	60,750,000
Grimes	34,519,292	349,720	35,000,000	8,750,000	26,250,000
Hardin	186,491,653	597,418	190,000,000	47,500,000	142,500,000
Harris	378,374,831	928,622	380,000,000	95,000,000	285,000,000
Jasper	134,045,649	1,477,803	140,000,000	35,000,000	105,000,000
Jefferson	167,257,677	176,416	170,000,000	42,500,000	127,500,000
Liberty	252,446,158	503,245	250,000,000	62,500,000	187,500,000
Montgomery	177,162,460	459,467	180,000,000	45,000,000	135,000,000
Newton	117,797,063	1,307,452	120,000,000	30,000,000	90,000,000
Orange	61,007,322	74,590	61,000,000	15,250,000	45,750,000
Polk	104,012,585	1,270,347	110,000,000	27,500,000	82,500,000

[55] Data provided via email communication from Cindy Ridgeway, TWDB, to Kathy Turner Jones, Lone Star GCD, dated August 19, 2015, regarding additional information pertaining to confined and unconfined TERS in GMA 14.

County	Unconfined Storage (acre-feet)	Confined Storage (acre-feet)	Total Storage (acre-feet)	25 percent of Total Storage (acre-feet)	75 percent of Total Storage (acre-feet)
San Jacinto	94,096,911	674,636	95,000,000	23,750,000	71,250,000
Tyler	122,555,582	1,084,621	120,000,000	30,000,000	90,000,000
Walker	31,581,118	369,472	32,000,000	8,000,000	24,000,000
Waller	79,788,799	197,751	80,000,000	20,000,000	60,000,000
Washington	21,389,164	401,842	22,000,000	5,500,000	16,500,000
Total	**2,756,914,613**	**10,952,354**	**2,776,000,000**	**694,000,000**	**2,082,000,000**

Table 5-7 – Total estimated recoverable storage separated into unconfined and confined components by groundwater conservation district for the Gulf Coast Aquifer System within GMA 14[56]

Groundwater Conservation District (GCD)	Unconfined Storage (acre-feet)	Confined Storage (acre-feet)	Total Storage (acre-feet)	25 percent of Total Storage (acre-feet)	75 percent of Total Storage (acre-feet)
No District	635,320,376	1,266,508	640,000,000	160,000,000	480,000,000
Bluebonnet GCD	225,512,903	1,188,558	230,000,000	57,500,000	172,500,000
Brazoria County GCD	331,167,468	353,328	330,000,000	82,500,000	247,500,000
Fort Bend Subsidence District	169,317,122	278,931	170,000,000	42,500,000	127,500,000
Harris-Galveston Coastal Subsidence District	459,434,842	993,283	460,000,000	115,000,000	345,000,000
Lone Star GCD	177,162,460	459,467	180,000,000	45,000,000	135,000,000
Lower Trinity GCD	198,109,496	1,944,983	200,000,000	50,000,000	150,000,000
Southeast Texas GCD	560,889,946	4,467,294	570,000,000	142,500,000	427,500,000
Total	**2,756,914,613**	**10,952,354**	**2,780,000,000**	**695,000,000**	**2,085,000,000**

Note: The total estimated recoverable storage values by groundwater conservation district and county for an aquifer may not be the same because the numbers have been rounded to two significant digits.

In addition to the consideration of TERS, GMA 14 District Representatives also considered the water budgets for each aquifer in GMA 14, including recharge from land surface (as quantified by General Head Boundary in the Northern Gulf Coast Aquifer GAM), pumpage, lateral inflows, leakage to an upper unit, leakage from an upper unit, leakage to a lower unit, leakage from a

[56] Data provided via email communication from Cindy Ridgeway, TWDB, to Kathy Turner Jones, Lone Star GCD, dated August 19, 2015, regarding additional information pertaining to confined and unconfined TERS in GMA 14.

lower unit, discharge to the surface (as quantified by General Head Boundary in the Northern Gulf Coast Aquifer GAM), and lateral outflows. An example of the county/aquifer specific water budgets for Austin County is included below in *Figure 5-22*. In Austin County, the volumetrically dominant aquifer is the Evangeline Aquifer. Other observations from this illustration of the water budgets in Austin County include (1) pumping from the Chicot Aquifer is a very small part of the water budget, (2) recharge to the Chicot Aquifer from land surface is almost equal to the amount of leakage from the Chicot Aquifer to the Evangeline Aquifer, and (3) lateral inflows in to the Chicot Aquifer in Austin County are almost twice the lateral inflows into the Evangeline Aquifer. Similarly prepared water budgets for the remaining 19 counties in GMA 14 are presented in *Appendix L*.

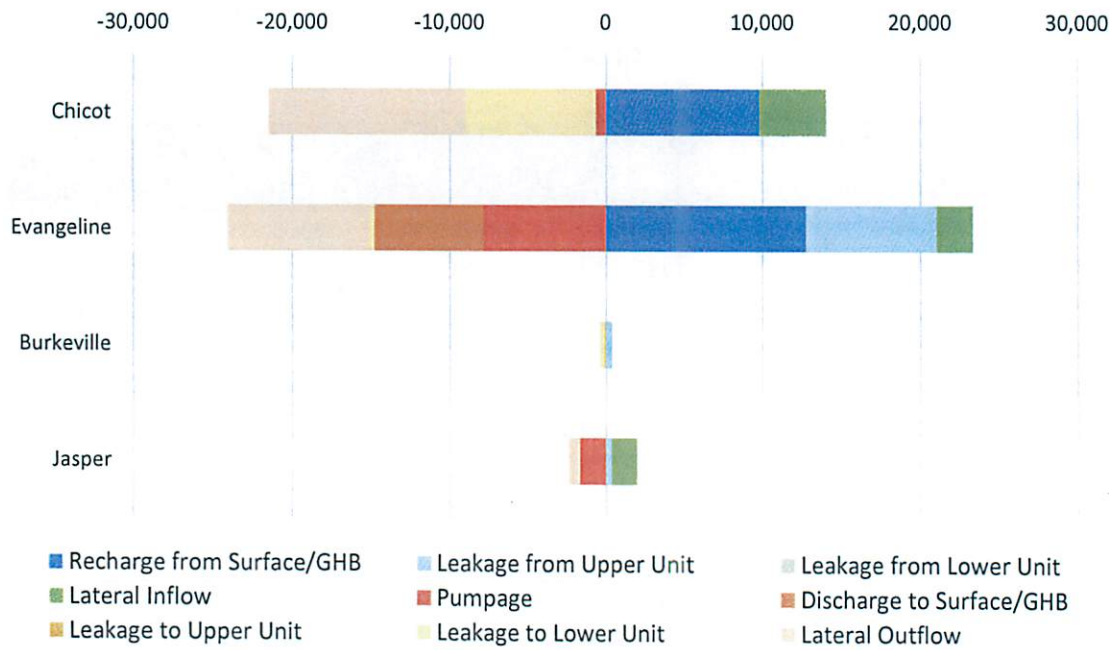

Figure 5-22 – Example water balance for Austin County

Estimates of TERS, water budgets, and aquifer conditions (based on potentiometric surface maps) for the minor aquifers in GMA 14 were also considered by the District Representatives. This information is included in *Appendix K* and *Appendix L*. However, since all minor aquifers in GMA 14 have been declared as non-relevant for joint-planning purposes (see *Section 0* below), no further discussion of these minor aquifers is included in this section focused on the consideration of hydrological conditions in GMA 14.

Throughout the later stages of the GMA 14 joint-planning efforts, significant comments were received from stakeholders with regards to the appropriate role that the estimates of TERS should have in establishing DFCs. A more detailed discussion on these comments is provided in Section 8.0 of this Explanatory Report. As stated therein, the GMA 14 District

Representatives carefully weighed all comments received on the issue of TERS and ultimately decided, for a number of reasons, that due to other considerations, in particular the negative socioeconomic impacts of subsidence, TERS has no practical application in the GMA 14 joint-planning process or in groundwater management of the Gulf Coast Aquifer System.

5.4 ENVIRONMENTAL FACTORS

Texas Water Code Section 36.108 (d)(4) requires District Representatives in a GMA to consider environmental impacts, including impacts on spring flow and other interactions between groundwater and surface water. This requirement was met by reviewing applicable scientific literature including information contained in scientific literature published for relevant aquifers in GMA 14. In addition, environmental issues presented in applicable 2011 regional water plans were also considered. Information presented and considered by GMA 14 District Representatives on this factor is included in its entirety in *Appendix M*.

The primary focus of this factor was on surface water – groundwater interaction. After a review of available literature, in particular Kasmarek (2012)[57], it was determined that there is insignificant interaction between surface water bodies (streams, rivers, and lakes) and aquifers in the Northern Gulf Coast Aquifer System. As a result, there is no significant surface water/groundwater interaction modeled in the Northern Gulf Coast GAM utilizing the MODFLOW "stream package." Consequently, there is no tool available to provide any quantitative analysis of the interaction between surface water and groundwater for the Gulf Coast Aquifer system. As part of the considerations made by GMA 14 District Representatives, however, it was noted that groundwater and surface water interaction occurs on a very limited basis, based on USGS and TWDB studies. In addition, Lower Colorado River Authority studies conducted to the southwest of GMA 14 have shown that surface water and groundwater interaction is limited to the shallow groundwater system and the Colorado River, and that similar conditions could occur in GMA 14.

5.5 SUBSIDENCE

Texas Water Code Section 36.108 (d)(5) requires District Representatives in a GMA to consider the impacts of proposed desired future conditions on subsidence. The impact of proposed DFCs on subsidence are clearly more significant in GMA 14 than in any other GMA in Texas. The importance of subsidence, and more importantly, the prevention of future subsidence, is illustrated in *Figure 5-8*, which illustrated actual measured subsidence in the Harris and Galveston areas greater than 10 feet from 1906 – 2000. District Representatives spent

[57] Kasmarek, M.C., 2012, Hydrogeology and simulation of groundwater flow and land-surface subsidence in the northern part of the Gulf Coast Aquifer System, Texas, 1891–2009 (ver. 1.1, December 2013): U.S. Geological Survey Scientific Investigations Report 2012–5154, 55 p., http://dx.doi.org/sir20125154.

considerable time reviewing scientific studies on subsidence in GMA 14, including results from the recently completed update to the Northern Gulf Coast GAM with a focus on the subsidence package developed as part of this model update (see Kasmarek, 2012[58], and Freese & Nichols and others, 2012[59]). Additional technical resources utilized by GMA 14 District Representatives during their consideration of potential impacts of proposed DFCs included Kasmarek and Robinson, (2004)[60], Coplin and Galloway, (1999)[61], Holzschuh, (1991)[62], Jones and Larson (1975)[63], Harris-Galveston Subsidence District (2014)[64], and Campbell and others (2014)[65]. The presentation on impacts of proposed DFCs on subsidence is included in its' entirety in *Appendix N*. This presentation on subsidence in GMA 14 generally focused on predictions of subsidence utilizing PRESS model results for Harris, Galveston, and Fort Bend counties, and utilizing the Northern Gulf Coast GAM Run 2 (SUB package) for the remainder of GMA 14.

Prediction of Effective Stress and Subsidence ("PRESS") model predictions of subsidence (Freese & Nichols and others, 2012), as illustrated in *Figure 5-23*, for the period of 2010 – 2070, indicate that more than 3.25 feet of future subsidence will occur in the Arcola area of Fort Bend County, followed by more than 2.25 feet and 1.75 feet of future subsidence in the Katy area and Laughlin Creek area in Harris County, respectively. It is noted that the PRESS model results were limited to areas where PRESS model sites exist, mostly within the Subsidence Districts. At this point in time, no areas other than the Subsidence Districts have PRESS models.

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[58] Kasmarek, M.C., 2012, Hydrogeology and Simulation of Groundwater Flow and Land-Surface Subsidence in the Northern Part of the Gulf Coast Aquifer System, Texas, 1891–2009: Scientific Investigations Report 2012–5154, Version 1.1, 55 p.

[59] Freese & Nichols, and others, 2012, Regional Groundwater Update Project: Final Report prepared for the Harris-Galveston Subsidence District, Fort Bend Subsidence District, and Lone Star Groundwater Conservation District, 24 p.

[60] Kasmarek, M. C., and Robinson, J. L., 2004, Hydrogeology and Simulation of Ground-Water Flow and Land-Surface Subsidence in the Northern Part of the Gulf Coast Aquifer System, Texas: U. S. Geological Survey Scientific Investigations Report 2004–5102, 111 p.

[61] Coplin, L.S., and Galloway, D.L., 1999, Houston-Galveston, Texas—Managing coastal subsidence: in Land Subsidence in the United States, Galloway, D.L., Jones, D.R., and Ingebritsen, S.E., eds., U.S. Geological Survey Circular 1182, p. 35-48, http://pubs.usgs.gov/circ/circ1182/, accessed Feb. 13, 2009.

[62] Holzschuh, J.C., 1991, Land Subsidence in Houston, Texas U.S.A.: Field-Trip Guidebook for the 4th International Symposium on Land Subsidence, May 12–17, 1991, Houston, Tex., 22 p.

[63] Jones, L. L., and Larson, J., 1975, Economic effects of land subsidence due to excessive groundwater withdrawal in the Texas Gulf Coast area: Texas Water Resources Institute, Texas A & M University, Technical Report No. 67, 33 p.

[64] Harris-Galveston Subsidence District 2015 Annual Groundwater Report, 146 p. See http://hgsubsidence.org/wp-content/uploads/2015/08/HG_GW_Report_2015-Approved.pdf

[65] Campbell, M. D., Wise, H. M., and Bost, R. C., 2014, Growth faulting and subsidence in the Houston, Texas Area: Guide to the origins, relationships, hazards, potential impacts and methods of investigation: Published for the Graduates and Members of The Institute of Environmental Technology, Houston, Texas, The Houston Geological Society, and, The American Institute of Professional Geologists, 102 p.

The SUB package in the Northern Gulf Coast GAM was utilized for the rest of the GMA 14. Based on results from the Northern Gulf Coast GAM Run 2 utilizing the SUB package, average predictions of subsidence on a county basis range from 0.0 feet for Grimes, Polk, Walker, and Washington counties to 0.5 feet for Austin, Liberty, and Montgomery counties and 0.7 feet in Brazoria County (*Figure 5-24* and *Figure 5-25*).

The economic impacts of subsidence are a priority public policy issue in the areas included in GMA 14, in large part due to the catastrophic economic impacts that result from significant land surface subsidence. During considerations of the impacts of proposed DFCs on subsidence, District Representatives and inter-local agreement partners discussed a number of factors impacting subsidence. Groundwater use resulting in groundwater-level declines in the Gulf Coast Aquifer System results in land surface subsidence and increased movement along growth faults in the Texas Gulf Coast. Groundwater-level decline, subsidence, and faulting are inter-related in the Gulf Coast Aquifer System, all having the potential for an adverse economic impact (Campbell and others, 2013[66]). Jones and Larson (1975[67]) estimated the cost associated with land subsidence in about a 900 mi^2 area including a small portion of Harris County and some shoreline in Galveston County to be about $32 million (about $150 million in 2015) annually. When looking at the financial impacts for repairing 165 homes along 3 fault zones, costs exceed $2.7 million dollars, not including damage to public infrastructure, which would have been far greater (Campbell and others, 2013). Coplin and Galloway (1999[68]) and Holzschuh (1991[69]) suggested that subsidence-damage estimates just along the Houston Ship Channel refineries were in the range of $340 million (1998 dollars) while damage requiring repairs and re-construction to industry-wide infrastructure likely amounted to billions of dollars (as of 1998) (Campbell and others, 2013). Considering the magnitude of population growth over the last decade and the associated increased water demand, public infrastructure, and new development, the economic impact of subsidence in the GMA 14 region is most certainly in the billions of dollars.

[66] Campbell, M. D., Wise, H. M., and Bost, R. C., 2014, Growth faulting and subsidence in the Houston, Texas Area: Guide to the origins, relationships, hazards, potential impacts and methods of investigation: Published for the Graduates and Members of The Institute of Environmental Technology, Houston, Texas, The Houston Geological Society, and, The American Institute of Professional Geologists, 102 p.

[67] Jones, L. L., and Larson, J., 1975, Economic effects of land subsidence due to excessive groundwater withdrawal in the Texas Gulf Coast area: Texas Water Resources Institute, Texas A & M University, Technical Report No. 67, 33 p.

[68] Coplin, L.S., and Galloway, D.L., 1999, Houston-Galveston, Texas—Managing coastal subsidence: in Land Subsidence in the United States, Galloway, D.L., Jones, D.R., and Ingebritsen, S.E., eds., U.S. Geological Survey Circular 1182, p. 35-48, http://pubs.usgs.gov/circ/circ1182/, accessed Feb. 13, 2009.

[69] Holzschuh, J.C., 1991, Land Subsidence in Houston, Texas U.S.A.: Field-Trip Guidebook for the 4th International Symposium on Land Subsidence, May 12–17, 1991, Houston, Tex., 22 p.

Based on these considerations, subsidence is clearly one of the most important factors to take into account when establishing DFCs. Unique to GMA 14, DFCs specific to land subsidence were adopted for 7 of the 20 counties making up the GMA. While DFCs specific to every county in GMA 14 were not adopted, clearly, the impact of projected groundwater use was considered in the adopted DFCs for the Gulf Coast Aquifer System in GMA 14.

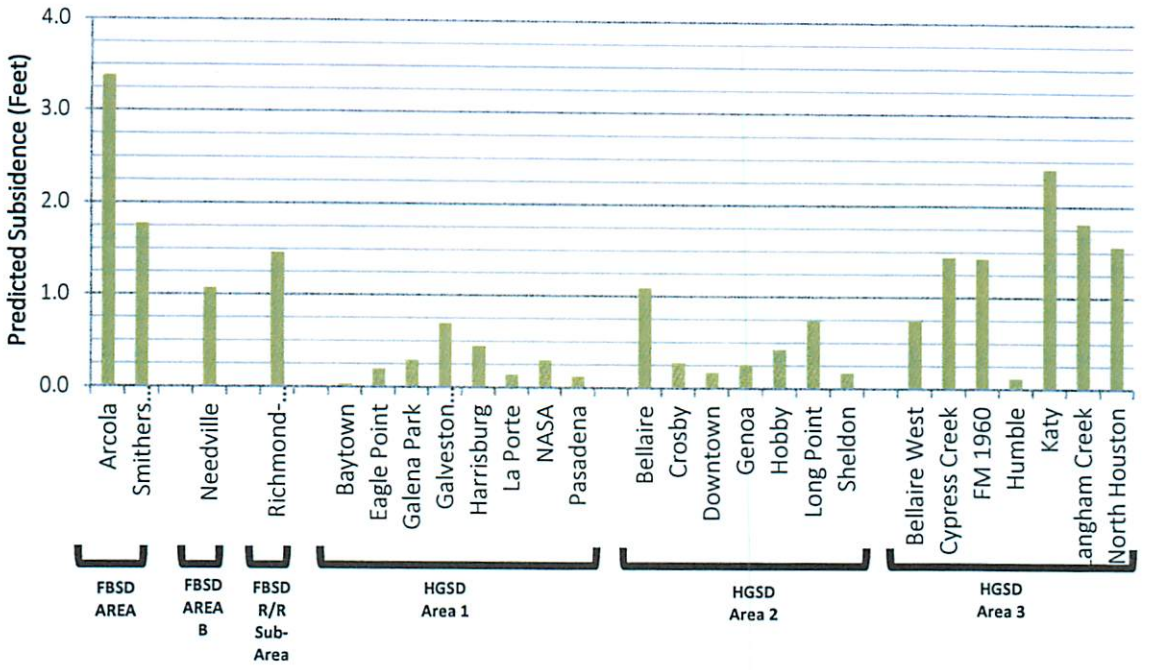

Figure 5-23 – Predictions of subsidence in locations throughout Fort Bend, Galveston, and Harris Counties utilizing the PRESS model[70]

[70]See http://hgsubsidence.org/wp-content/uploads/2013/07/Regional_Groundwater_Update_Project-Report-6-2013.pdf

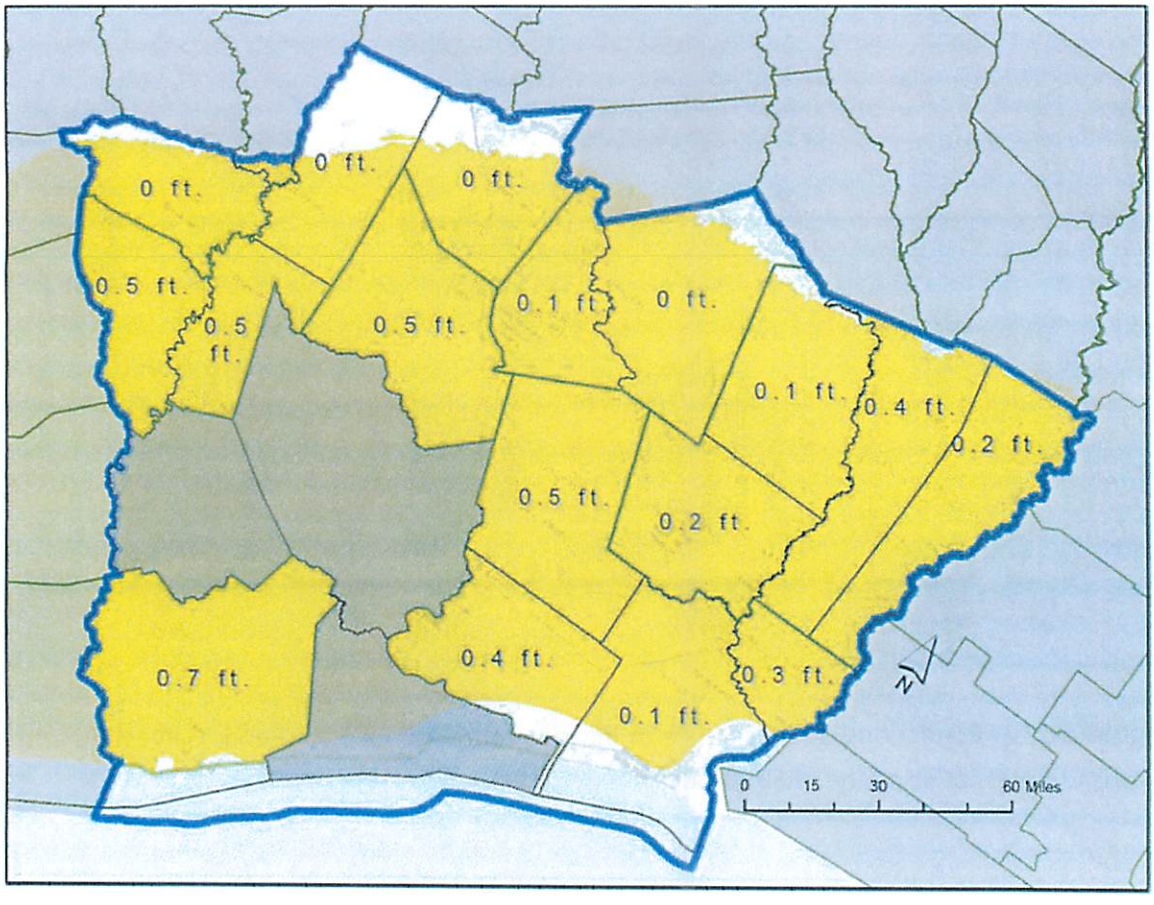

Figure 5-24 – County average subsidence results from Northern Gulf Coast GAM Run 2 using SUB package for predictive period of 2010-2070[71]

[71] Results from Northern Gulf Coast Aquifer GAM Run 2

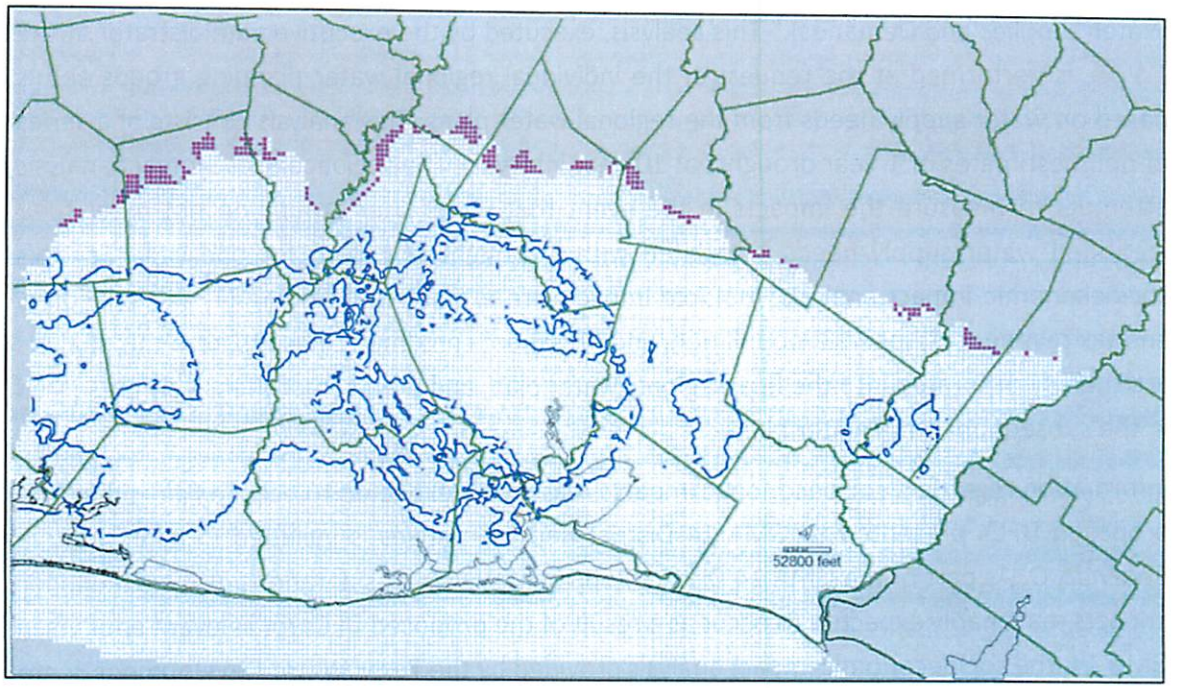

Figure 5-25 – Contours of subsidence from Northern Gulf Coast GAM Run 2 using SUB package for predictive period of 2010-2070.

5.6 SOCIOECONOMICS

Texas Water Code Section 36.108 (d)(6) requires District Representatives in a GMA to consider socioeconomic impacts reasonably expected to occur as a result of the proposed desired future conditions for relevant aquifers. Consideration of socioeconomic impacts as part of water planning in Texas, both at the regional and state level, has been a fundamental element of the planning process dating back to the 1990s. Texas Water Code Section 16.051 (a) states that the TWDB "shall prepare, develop, formulate, and adopt a comprehensive state water plan that . . . shall provide for . . . further economic development." A companion provision in Texas Water Code Section 16.053 (a) and (b) creates a similar requirement for regional water planning groups that regional water plans "further economic development." Title 31 of Texas Administrative Code, Section 357.7 (4)(A) states, "The executive administrator shall provide available technical assistance to the regional water planning groups, upon request, on water supply and demand analysis, including methods to evaluate the social and economic impacts of not meeting needs." This technical assistance and analysis provided by the executive administrator is the only consistent analysis of socioeconomic impacts available for joint-planning in regards to socioeconomic impacts, both at the local, regional, and state level. Title 31 of Texas Administrative Code, Section 357.40(a) states that regional water plans "shall include a quantitative description of the socioeconomic impacts of not meeting the identified water needs pursuant to §357.33(c) of this title (relating to Needs Analysis: Comparison of

Water Supplies and Demands)." This analysis, executed by the executive administrator at the TWDB, is performed at the request of the individual regional water planning groups and is based on water supply needs from the regional water plans. This analysis consists of a series of point estimates of 1-year droughts at 10-year intervals. The socioeconomic impact analysis attempts to measure the impacts in the event that water user groups do not meet their identified water supply needs associated with a drought of record for one year. For this socioeconomic impact analysis, multiple impacts are examined, including (1) sales, income, and tax revenue, (2) jobs, (3) population, and (4) school enrollment. Results from this analysis are then incorporated into the final regional water plan, and then comprehensively presented in the subsequent state water plan.

Information regarding socioeconomic impacts reasonably expected to occur as a result of the proposed DFCs presented to GMA 14 District Representatives is included in its entirety in *Appendix O*. As part of the GMA 14 District Representatives' considerations of socioeconomic impacts reasonably expected to occur as a result of the proposed DFCs for relevant aquifers in GMA 14, the socioeconomic impact analysis provided by the Texas Water Development Board to Brazos G[72], Region H[73], and East Texas[74] regional water planning groups for the 2011 regional water plans were considered. These technical memoranda are included in their entirety as *Appendix P*, *Appendix Q*, and *Appendix R*, respectively. To illustrate the regional impacts of not meeting water supply needs, examples for specific water user groups for each of the three regional water planning areas (G, H, and I) along with regional summaries for Region H were presented. *Figure 5-26* and *Figure 5-27* illustrate the socioeconomic impacts of not meeting water supply needs in Region H based on the 2011 Region H Regional Water Plan. An example of the significance of not meeting future water supply needs is illustrated in *Figure 5-26* in which lost income in 2060 will be almost $19 billion annually for Region H if water supply needs identified in the 2011 Region H Regional Water Plan are not met. Similarly, *Figure 5-27* illustrates that there will be a loss of more than 170,000 people in Region H if projected water supply needs are not met.

[72] Norvell, S. D., and Shaw, S. D. 2010, Socioeconomic Impacts of Projected Water Shortages for the Brazos G Regional Water Planning Area (Region G) Prepared in Support of the 2011 Brazos G Regional Water Plan: Texas Water Development Board, 60 p.

[73] Norvell, S. D., and Shaw, S. D. 2010, Socioeconomic Impacts of Projected Water Shortages for the Region H Regional Water Planning Area: Prepared in Support of the 2011 Region H Regional Water Plan: Texas Water Development Board, 73 p.

[74] Norvell, S. D., and Shaw, S. D., 2010, Socioeconomic Impacts of Projected Water Shortages for the East Texas Regional Water Planning Area (Region I), Prepared in Support of the 2011 East Texas Regional Water Plan: Texas Water Development Board, 45 P.

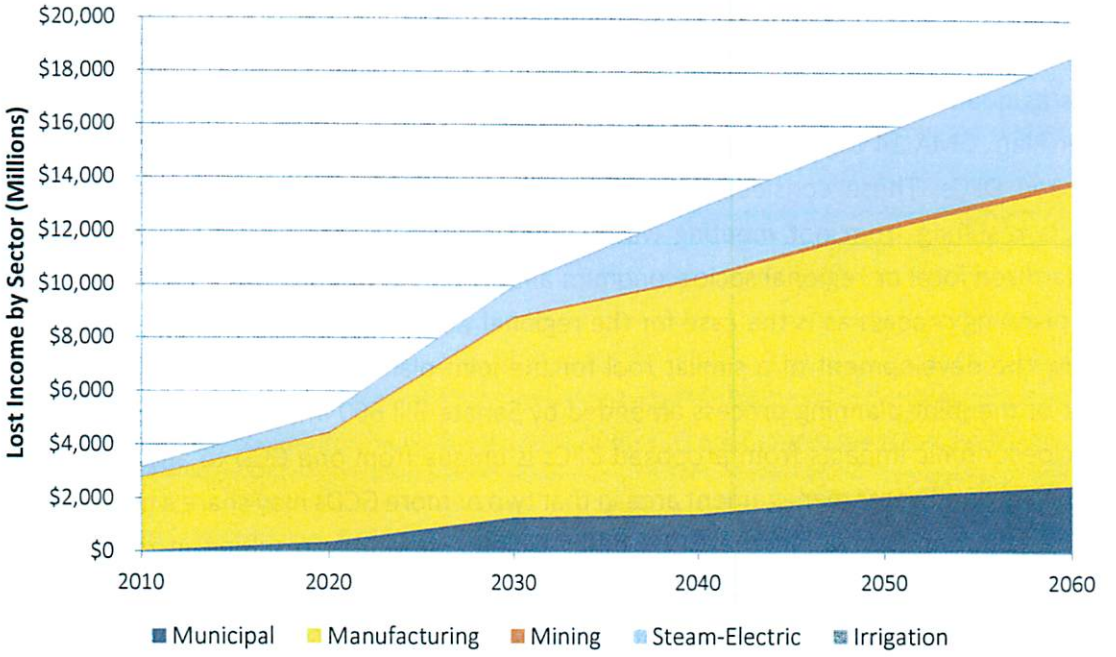

Figure 5-26 – Estimates of lost income due to not meeting water supply needs by water use sector over the 50-year planning horizon (2010-2060) for Region H based on analysis provided by TWDB

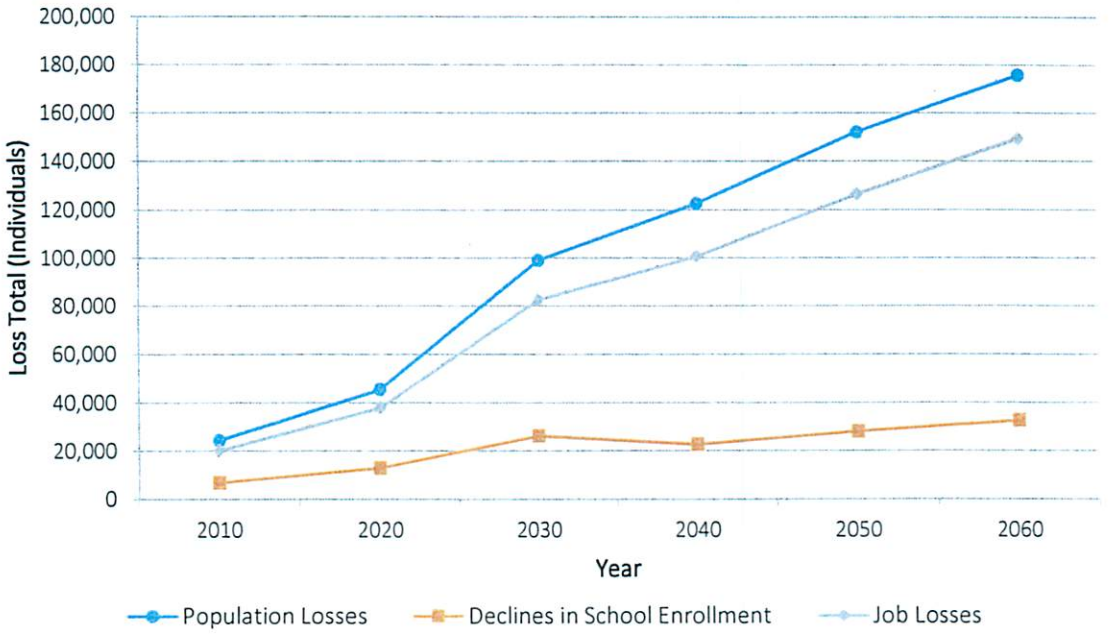

Figure 5-27 – Estimates of population losses, declines in school enrollment, and job losses over the 50-year planning horizon (2010-2060) due to not meeting water supply needs by water use sector for Region H based on analysis provided by TWDB

The primary source of quantitative information considered by GMA 14 as part of the joint-planning process was information on the socioeconomic impacts of not meeting water supply needs as quantified in the applicable 2011 Regional Water Plans and the 2012 Texas State Water Plan. GMA 14 District Representatives also considered the socioeconomic impacts of proposed DFCs. These considerations were somewhat different from the socioeconomic impacts resulting from not meeting water supply needs for two primary reasons. First, a standardized local or regional socioeconomics analytical tool has not been developed for the joint-planning process as is the case for the regional water supply planning process in Texas. Clearly, the development of a similar tool for the joint-planning process is well beyond the intent of the joint-planning process amended by Senate Bill 660 in 2011. Second, the nature of socioeconomic impacts from proposed DFCs is unique from one GCD to another within a common groundwater management area in that two or more GCDs may share a common DFC, but the communities within the GCDs differ widely—inevitably resulting in differences in socioeconomic impacts. The GCDs in GMA 14 vary from almost entirely urban to almost entirely rural farming areas. As such, a quantitative analysis of socioeconomic impacts for proposed DFCs in the joint-planning process is not practical.

Instead, GMA 14 District Representatives had discussions of qualitative socioeconomic impacts that may result from proposed DFCs. These impacts were both positive and negative, depending on the timing of the consideration. The following is a summary list of socioeconomic impacts considered by GMA 14 District Representatives.

- Proposed DFCs may require conversion to alternative water supply, which may have increased costs associated to infrastructure, operation, and maintenance.
- Proposed DFCs may reduce/eliminate the costs of lowering pumps and either drilling or deepening of wells.
- Proposed DFCs may reduce/eliminate the costs associated with subsidence (including legal costs assigned to parties determined to be liable).
- Proposed DFCs may serve to sustain/enhance economic growth due to assurances provided by diversified water portfolio.
- Alternatives to proposed DFCs may result in short-term reduction in utility rates due to reduction in cost of water management strategy implementation.
- Alternatives to proposed DFCs may result in significant but unquantified production costs due to transition from confined to unconfined conditions in local aquifers.
- Alternatives to proposed DFCs may result in either an increase or reduction of production costs due to positive or negative changes in water quality.

As part of the 90-day public comment period and public hearings held by the five GMA 14 GCDs, a comment was received highlighting one additional study of socioeconomic impacts related to changing water levels in Lake Conroe in Montgomery County. In this study (Rogers

and others, 2012[75]) the local socioeconomic impacts projected to result from fluctuating water levels in Lake Conroe are presented. This study was considered by the Lone Star GCD during their proposed DFC hearing on September 18, 2015 and by GMA 14 District Representatives at the October 28, 2015 joint-planning meeting.

Another technical issue discussed by GMA 14 District Representatives was the lack of available socioeconomic impacts information directly appropriate for the joint-planning process (see *Section 5.6* below for results of GMA 14's consideration of socioeconomic impacts). It was noted that the only consistently available quantitative socioeconomic impact analysis for water planning in Texas is the analysis of socioeconomic impacts on cities and other major water use sectors resulting from not meeting current and future water supply needs.

The analysis executed and provided by the TWDB to the regional water planning groups is designed to answer a somewhat different question than the factor to be considered in the joint-planning process by Texas Water Code Section 36.108 (d)(6), which requires District Representatives in a GMA to consider the socioeconomic impacts reasonably expected to occur for proposed DFCs. No uniform quantitative analysis has been performed by the TWDB or any other entity to answer this specific question. There are multiple reasons for this absence of quantitative socioeconomic impact analysis. The most important reason is that, as GMA 14 District Representatives determined during the joint-planning process, any potential socioeconomic impacts that may occur, either positive or negative impacts, will be the result of the specifics of an individual GCD's regulated community and the regulatory approach taken by that GCD to achieve the DFC, not the DFC itself. Therefore, the requirements of this element of the joint-planning process should be revisited to better clarify what is practicable with respect to the socioeconomic impacts of proposed and adopted DFCs.

5.7 PRIVATE PROPERTY RIGHTS

Texas Water Code Section 36.108(d)(7) requires that District Representatives in a GMA consider the impact of proposed DFCs on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater, as recognized under Texas Water Code Section 36.002. GMA 14 District Representatives formally considered this factor during joint-planning meetings on September 23, 2014, June 24, 2015, and October 28, 2015. The presentation materials utilized by GMA 14 District Representatives are included in their entirety in *Appendix S*. While GMA 14 District Representatives invested significant time during these three meetings on the impacts of

[75] Rogers, G. O., Moore, G. W., Saginor, J., Brody, S. D., Burns, G. R., Jithitikulch, T., and Young, T., 2012, Impact of Lake-Level Reductions on Lake Conroe Area, Lake Area Property Values, Property Tax Revenues and Sales Tax Revenues: Contract report prepared for Montgomery County by Texas A & M University, 54 p.

proposed DFCs on private property rights, it is understood that the impacts of proposed DFCs on private property rights has truly been an overarching consideration throughout the joint-planning process. Each District Representative provided input to GMA 14 on not only the impacts of proposed DFCs, but also how individual GCD management plans and rules have been developed to achieve current DFCs (adopted in August 2010) while protecting private property rights. GCDs must consider all private property rights when considering management plans, rules, and permit decisions. GCDs must balance the interests of historic groundwater users, landowners who desire to preserve the aquifer levels beneath their property, and property owners who may be damaged by either groundwater-level declines or subsidence. The DFCs attempt to strike a balance between all of these property interests.

For a more complete record of these discussions, see the approved GMA 14 meeting minutes for the April 29, 2016, GMA 14 meeting (included in *Appendix B*).While the approach to protecting private property rights varies somewhat from GCD to GCD in GMA 14, depending upon local conditions, it is recognized that in addition to the proposed DFCs, all GCDs in GMA 14 have developed management plans and rules that fundamentally work to protect private property rights.

For reference, Texas Water Code Section 36.002 reads as follows:

a) *The legislature recognizes that a landowner owns the groundwater below the surface of the landowner's land as real property.*
b) *The groundwater ownership and rights described by this section:*
    1) *entitle the landowner, including a landowner's lessees, heirs, or assigns, to drill for and produce the groundwater below the surface of real property, subject to Subsection (d), without causing waste or malicious drainage of other property or negligently causing subsidence, but does not entitle a landowner, including a landowner's lessees, heirs, or assigns, to the right to capture a specific amount of groundwater below the surface of that landowner's land; and*
    2) *do not affect the existence of common law defenses or other defenses to liability under the rule of capture.*
c) *Nothing in this code shall be construed as granting the authority to deprive or divest a landowner, including a landowner's lessees, heirs, or assigns, of the groundwater ownership and rights described by this section.*
d) *This section does not:*
    1) *prohibit a district from limiting or prohibiting the drilling of a well by a landowner for failure or inability to comply with minimum well spacing or tract size requirements adopted by the district;*

2) *affect the ability of a district to regulate groundwater production as authorized under Section 36.113, 36.116, or 36.122 or otherwise under this chapter or a special law governing a district; or*
3) *require that a rule adopted by a district allocate to each landowner a proportionate share of available groundwater for production from the aquifer based on the number of acres owned by the landowner.*

e) *This section does not affect the ability to regulate groundwater in any manner authorized under:*
1) *Chapter 626, Acts of the 73rd Legislature, Regular Session, 1993, for the Edwards Aquifer Authority;*
2) *Chapter 8801, Special District Local Laws Code, for the Harris-Galveston Subsidence District; and*
3) *Chapter 8834, Special District Local Laws Code, for the Fort Bend Subsidence District.*

While this provision of the Texas Water Code Section 36.002 was substantively amended to its current scope with the passage of Senate Bill 660 by the Texas Legislature in 2011[76], the spirit of this section has been at the core of groundwater laws since passage of House Bill 162 by the Texas Legislature in 1949[77]. GMA 14 District Representatives ultimately based the adopted DFCs on a balancing of private property rights, for both current and future users, as exemplified in each GCDs management plan and rules.

5.8 FEASIBILITY OF ACHIEVING THE PROPOSED DESIRED FUTURE CONDITIONS

Texas Water Code Section 36.108 (d)(8) requires District Representatives in a GMA to consider the feasibility of achieving the proposed desired future condition(s). This requirement was added to the joint-planning process with the passage in 2011 of Senate Bill 660 by the 82nd Texas Legislature[78]. However, this review concept actually dates back to the rules adopted by the Texas Water Development Board (TWDB) in 2007 to provide guidance as to what would be considered by the TWDB during a petition process regarding the reasonableness of an adopted DFC. In these rules, the TWDB required that an adopted DFC must be physically possible from a hydrological perspective. During the first round of joint planning, the TWDB definition for DFCs included in Title 31, Texas Administrative Code, Section 356.2 (8) was "The desired, quantified condition of groundwater resources (such as water levels, water quality, spring flows, or volumes) for a specified aquifer within a management area at a specified time

[76] Act of May 29, 2011, 82nd Leg., R.S., ch. 1233, 2011 Tex. Gen. Laws 3287.
[77] Act of May 23, 1949, 51st Leg., R.S., ch. 306, 1949 Tex. Gen. Laws 559.
[78] Act of May 29, 2011, 82nd Leg., R.S., ch. 1233, 2011 Tex. Gen. Laws 3287.

or times in the future, through at least the period that includes the current planning period for the development of regional water plans pursuant to §16.053, Texas Water Code, or in perpetuity, as defined by participating groundwater conservation districts within a groundwater management area as part of the joint-planning process. Desired future conditions have to be physically possible, individually and collectively, if different desired future conditions are stated for different geographic areas overlying an aquifer or subdivision of an aquifer."

In addition, in these original rules, Title 31, Texas Administrative Code Section 356.34 (1) stated the following: "Submission Package - Districts must include the following when submitting an adopted desired future condition to the board:(1) the desired future condition of the aquifer in the groundwater management area (multiple desired future conditions for the same aquifer in a groundwater management area need to be physically compatible)."

Upon passage of Senate Bill 660 in 2011, the TWDB made significant revisions to the rules contained in Title 31, Texas Administrative Code, Chapter 356 to be consistent with requirements and terminology added and revised by the new statutes. During this process, the reference to the need for a DFC to be physically possible or physically compatible was removed, under the rationale that the reference to consideration of feasibility of achieving a DFC included in Texas Water Code Section 36.108 (d) (8) equated to a DFC being physically possible or physically compatible.

During the TWDB's review of multiple petitions regarding the reasonableness of adopted DFCs in groundwater management areas from 2010 - 2011, the evaluation of whether or not an adopted DFC was physically possible was based on whether or not the DFC(s) could reasonably be simulated using the TWDBs adopted groundwater availability model for the aquifer(s) in question. This was a valid approach because if an adopted DFC was not physically possible, then under the physical laws of hydrology, as incorporated in the mathematical calculations executed during model simulations, the model would not execute the prescribed simulation successfully.

There have been and continue to be many potential DFC scenarios considered in GMAs across Texas that are not physically possible. One example is GMA 9, where petitions filed in 2009 challenged DFCs approved for the Edwards Group of the Edwards Trinity (Plateau) Aquifer. Following a hearing, the TWDB determined the DFC for Kerr County to be unreasonable because more than 100% of the available MAG would be produced through exempt-use wells making it unfeasible to achieve the adopted DFC.[79]

[79] http://www.twdb.texas.gov/groundwater/petitions/doc/GMA9/2009_Petitions/TWDB_Staff_Report_GMA9_Petitions_01-10.pdf

The DFCs and resulting estimates of modeled available groundwater initially presented during the June 24, 2014 GMA 14 meeting, referred to as the Northern Gulf Coast GAM Run 2, and utilized throughout the remainder of the joint-planning process in GMA 14, were successfully simulated and corresponding estimates of modeled available groundwater were produced. Therefore, utilizing the approach taken by the TWDB during the first round of joint planning that concluded on September 1, 2010, the proposed DFCs for the Northern Gulf Coast Aquifer System in GMA 14 are physically possible, and thus are feasible.

A common definition of feasibility is "capable of being accomplished or brought about; possible." Using this definition, it becomes important to consider the estimates of modeled available groundwater resulting from proposed DFCs with respect to both historic use, current and projected supplies, projected water demands, and available regulatory framework necessary to achieve proposed DFCs. All of these elements were considered by GMA 14 District Representatives to confirm this finding of feasibility.

5.9 OTHER SPECIFIC INFORMATION

Finally, Texas Water Code Section 36.108 (d)(8) requires District Representatives in a GMA to consider any other information relevant to the specific desired future condition. As GMA 14 District Representatives worked through the considerations process required in Texas Water Code Section 36.108(d)(1)–(8), no additional information was identified for inclusion in this explanatory report.

5.10 BALANCE BETWEEN THE HIGHEST PRACTICABLE LEVEL OF GROUNDWATER PRODUCTION AND THE CONSERVATION, PRESERVATION, PROTECTION, RECHARGING, AND PREVENTION OF WASTE OF GROUNDWATER

GMA 14 DFCs achieve balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area.

Texas Water Code Section 36.108(d-2) states, in part, that GCDs, while establishing DFCs during the joint-planning process in a GMA, "...must provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area."[80] This requirement does not prohibit the establishment of desired future

[80] Texas Water Code Section 36.108(d-2)

conditions that provide for the reasonable long-term management of groundwater resources consistent with the management goals under Section 36.1071(a).[81]

This requirement for a balance is a new requirement in the joint-planning process resulting from the passage of Senate Bill 660 by the Texas Legislature in 2011.[82] This requirement recognizes that the proposed DFCs may vary significantly from one area of the state to another. Texas Water Code Section 36.108(d-1) authorizes GCDs within a specific GMA to establish different DFCs for each aquifer, subdivision thereof, or geologic strata, as well as different DFCs for different geographic areas overlying those aquifers or subdivisions thereof. Such DFCs are only to be established after consideration by the GMA of the nine statutory criteria set forth in Texas Water Code Section 36.108(d), which includes consideration of "aquifer uses or conditions within the management area, including conditions that differ substantially from one geographic area to another." The proposed DFCs for GMA 14, both on the regional scale and by county, clearly document unique conditions in GMA 14 that exist in no other area of Texas that work collectively to influence the balance achieved by the proposed DFCs.

The primary groundwater resource in GMA 14 is the Gulf Coast Aquifer System. As a result, the primary emphasis during this, the second cycle of joint planning (2010 – 2016), has been on the Gulf Coast Aquifer System. All other minor or local aquifers in GMA 14 have been classified as non-relevant (see Section 7.0) for the current round of joint planning, as allowed by Title 31, Texas Administrative Code Section 356.31 (b). Overarching and disparate conditions in the Gulf Coast Aquifer System existing in GMA 14 are best illustrated by demographic dynamics, water demand projections documented in the 2012 State Water Plan[83], and the presence of and associated socioeconomic costs resulting from land subsidence. Current and future population projections for GMA 14 indicate that slightly more than 25 percent of Texas' population resides in GMA 14. Population projections for GMA 14 are projected to increase from 2010's 6,529,891 residents to 11,958,683 in 2060. That would equate to an 83 percent increase in population over the 50-year planning horizon. However, these significant increases in population are not uniformly distributed throughout GMA 14. For example, according to the 2012 Texas State Water Plan, increases in county population projections are expected to range from 9 percent, 11 percent, and 13 percent in Orange, Jasper, and Galveston counties, respectively, whereas in Montgomery, Fort Bend, and Waller counties, projected increases in population range from 219 percent, 199 percent, and 159 percent, respectively.

[81] Texas Water Code Section 36.1071(a)

[82] Act of May 29, 2011, 82nd Leg., R.S., ch. 1233, 2011 Tex. Gen. Laws 3287.

[83] Texas Water Development Board, 2012, Water For Texas – The Texas State Water Plan, 299 p. see http://www.twdb.texas.gov/waterplanning/swp/2012/index.asp.

This variability in demographic dynamics in GMA 14 translates strongly to the projections for GMA 14 water demands. As part of the regional water-planning process in Texas (Texas Water Code Section 16.053), water demand projections are developed for municipalities and utilities, manufacturing, mining, steam-electric power generation, irrigated agriculture, livestock, and rural areas within each county. For the regional and state water-planning process in Texas, water demand projections are based on an analysis of the volume of water necessary to meet projected needs during drought conditions (often referred to as drought-of-record conditions). Based on an analysis of all of these primary water use sectors in GMA 14, water demand projections range from 2,917,795 acre-feet per year in 2010 to 4,723,228 acre-feet per year in 2060, representing a 61.9 percent increase in water demands. An acre foot of water is equal to 325,851 gallons. It is noteworthy that the increase in water demands, on a percentile basis, is approximately 21.2 percent less than the increase in population, primarily a result of increased water conservation efforts throughout the region and the disconnect between population and certain demands such as irrigated agriculture.

An important element of the balance required in the joint-planning process is the consideration of how proposed DFCs may affect water supply needs and water management strategies in the current 2012 Texas State Water Plan. After consideration of water supply needs and water management strategies recommended in the 2012 Texas Water Plan and the 2011 Regions G, H, and I regional water plans[84],[85],[86], District Representatives in GMA 14 have determined that adoption and implementation of the proposed DFCs for GMA 14 will not negatively impact the implementation of any recommended water management strategies included in the 2012 Texas Water Plan. Furthermore, it is anticipated that these proposed DFCs will not negatively impact recommended water management strategies included in the Initially Prepared Plans for the 2016 round of regional water planning in the 2016 Region G, H, and I regional water plans.

Texas Water Code Section 36.108(d)(3) requires District Representatives in a GMA to consider hydrological conditions, including, for each aquifer in the GMA, the total estimated recoverable storage (TERS) as provided by the executive administrator of the Texas Water Development Board.

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[84] Brazos G Regional Water Planning Group, 2011, Brazos G Regional Water Plan, see http://www.twdb.texas.gov/waterplanning/rwp/plans/2011/index.asp#region-g.

[85] Region H Water Planning Group, 2011,Region H Water Plan, see http://www.twdb.texas.gov/waterplanning/rwp/plans/2011/index.asp#region-h

[86] East Texas Regional Water Planning Group, 2011, East Texas Regional Water Plan, see http://www.twdb.texas.gov/waterplanning/rwp/plans/2011/index.asp#region-i

The TERS estimates for GMA 14 were made available to GMA 14 in June of 2014[87] and, since that time, have been the subject of numerous formal discussions, both by District Representatives in GMA 14 as part of the joint-planning process, by individual GCDs in GMA 14, and during the 90-day public comment period on the proposed DFCs. These considerations of the TERS report have included a special workshop by Lone Star GCD to better understand the implications of the TERS report on future groundwater management. Specific considerations of the TERS report by GMA 14 occurred on June 24, 2014, June 24, 2015, and October 28, 2015. The TERS report for GMA 14 provides an estimate for the Gulf Coast Aquifer System that ranges from 694,000,000 to 2,082,000,000 acre-feet of water. Estimates of TERS for the other relevant aquifers in GMA 14 are also provided in this report.

While some observers of the joint-planning process have suggested that volumes of groundwater quantified in the TERS report should equate to the "highest practicable level of groundwater production" referenced in Texas Water Code Section 36.108 (d-2), District Representatives have determined that the TERS volumes for GMA 14, due to the potential impacts of excessive production on land-surface subsidence, the lowering of artesian water levels, and the resulting decreasing yields in water wells that would result from the production of even a very small fraction of the TERS volume reported by the TWDB is not even remotely practicable. Further, it was determined that adequate applied scientific research regarding the impacts for producing groundwater from storage in an artesian aquifer such as the Gulf Coast Aquifer System does not exist, and thus a conservative approach with respect to consideration of the TERS volumes is warranted.

GMA 14 is unique in that Texas Water Code Section 36.108(d)(5), requiring District Representatives to consider the impacts of proposed DFCs on subsidence, at least currently, only applies to GMA 14. In GMA 14, District Representatives clearly recognize that the socioeconomic impacts and public health and safety issues resulting from subsidence require that appropriate groundwater management policies take precedent over any other consideration. As previously described in section *5-5* on Subsidence, inaction would likely beget substantial financial consequences. Information considered by GMA 14 District Representatives included analysis that groundwater use resulting in groundwater-level declines in the Gulf Coast Aquifer System results in land surface subsidence and increased movement along growth faults in the Texas Gulf Coast.

Texas Water Code Section 36.108(d)(6) requires District Representatives in a GMA to consider the socioeconomic impacts reasonably expected to occur from the adoption of proposed DFCs. This consideration is a central element that any GMA must carefully evaluate in achieving a

[87] Wade, S., Thorkildsen, D., and Anaya, R., 2014, GAM Task 13-037: Total estimated recoverable storage for aquifers in Groundwater Management Area 14, 35 p.

balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in the management area. It is noteworthy that, in a similar planning process in Texas, the regional water-planning process, it is required that the socioeconomic impacts of not meeting water supply needs identified in the regional water-planning process is required according to guidelines adopted by the TWDB. All quantitative analysis performed to support this socioeconomic impact analysis in the regional water-planning process is performed by staff at the TWDB. This analysis is based on a straightforward valuation of water to the various water use sectors and subsectors present in any particular region. As part of the joint-planning process, all quantitative analysis performed regarding the socioeconomic impacts of not meeting future water supply needs identified in the 2011 regional water plans for Regions G, H, and I were considered by GMA 14 to, in part, meet this requirement to consider the socioeconomic impacts reasonably expected to occur from the implementation of the proposed DFCs. GMA 14 District Representatives, based both on this review and on the determination stated above that implementation of recommended water management strategies to meet water supply needs included in the 2011 regional water plans and the 2012 State Water Plan, and also in the draft 2016 regional water plans, will not be negatively impacted, have also determined that, on balance, since the proposed DFCs will not prevent implementation of recommended water management strategies, there will be no negative socioeconomic impacts utilizing the quantitative socioeconomic impact methodology utilized in the Texas regional water-planning process.

After significant consideration by GMA 14 District Representatives, however, there were a number of socioeconomic impacts identified that could be reasonably expected to occur from a qualitative perspective. As the reader will note, most, but not all, of the socioeconomic impacts identified fall on the positive side of the balancing consideration. An overview of these socioeconomic impacts includes:

- Proposed DFCs may require water users to convert to an alternative water supply, which may have increased costs associated with infrastructure, operation, and maintenance;
- Proposed DFCs may reduce/eliminate the costs of lowering pumps and either drilling or deepening of water wells;
- Proposed DFCs may reduce/eliminate the costs associated with subsidence (including legal costs assigned to parties determined to be liable);
- Proposed DFCs may serve to sustain/enhance economic growth due to assurances provided by a diversified water portfolio to new industry and development;

- Alternatives to the DFCs proposed by GMA 14 may result in short-term reduction in utility rates due to reduction in cost of water management strategy implementation; and
- Alternatives to the DFCs proposed by GMA 14 may result in significant but unquantified production costs due to transition from confined to unconfined conditions in local aquifers.

Texas Water Code Section 36.108(d)(7) requires District Representatives in a GMA to consider the impact of proposed DFCs on the interests and rights in private property, including ownership and the rights of management area landowners and their lessees and assigns in groundwater, as recognized under Texas Water Code Section 36.002. GMA 14 District Representatives formally considered this factor during meetings on September 23, 2014, June 24, 2015, and October 28, 2015. However, the impacts of proposed DFCs on private property rights has truly been an overarching consideration throughout the joint-planning process. Each District Representative provided input to GMA 14 on, not only the impacts of proposed DFCs, but also how individual District management plans and rules have been developed to achieve current DFCs (adopted in August 2010) while protecting private property rights. While the approach to protecting private property rights varies somewhat from District to District in GMA 14, depending upon local conditions, it is recognized that in addition to the proposed DFCs, all Districts in GMA 14 have developed management plans and rules that fundamentally work to protect private property rights.

After having considered each of the nine statutory criteria set forth in Texas Water Code Section 36.108(d) for the DFCs for the proposed DFCs for GMA 14, the GMA 14 District Representatives have concluded that the DFCs provide a reasonable balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence. Each of the eight required statutory criteria contributed in some way to this conclusion, including, without limitation, the following: (1) land subsidence is a serious problem in some geographic areas of GMA 14 and can have enormous economic consequences; (2) vast differences in aquifer uses and conditions in different parts of the GMA, including huge discrepancies in demands that will be placed on groundwater resources because of expected population growth patterns over the 50-year joint-planning horizon and corresponding increases in water demand projections; (3) the impacts, or lack thereof, on recommended water management strategies in the state and regional water plans; (4) other socioeconomic impacts unrelated to land subsidence or impacts on recommended water management strategies, such as the economic costs to current and future well owners to continue to chase falling artesian water levels in the aquifer and corresponding declining well yields, including

numerous existing wells completed at shallower depths that may go dry, as well as the socioeconomic risk to GMA 14's regional and local economies associated with reliance upon a single source of water supply versus the security of a diversified water supply portfolio; (5) hydrological conditions, such as total estimated recoverable storage, effective annual recharge, inflows, and discharge of the aquifer, and the relationship of those values to the current and projected groundwater pumping estimates over the joint-planning horizon, to existing well yields and groundwater-related investments, and to the long-term viability of the aquifer to serve the landowners and communities as an economically viable source of water supply; (6) the achievability of the DFCs; and (7) the impacts on the interests and rights in private property, including the ownership rights of GMA 14 landowners, which include the protection of investments by those landowners in existing wells and related infrastructure, as well as the ability of landowners to drill and produce groundwater at an economically feasible cost from new wells in the future.

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6.0 AQUIFERS DECLARED NON-RELEVANT FOR JOINT PLANNING

TWDB rules[88] allow for portions of major or minor aquifers to be classified as non-relevant if their aquifer characteristics, groundwater demands, and current groundwater uses do not warrant adoption of a desired future condition. In these cases, a desired future condition is not required. Instead, GCDs must submit documentation describing why the aquifer was considered non-relevant. This documentation includes:

1) A description, location, and/or map of the aquifer or portion of the aquifer;

2) A summary of aquifer characteristics, groundwater demands, and current groundwater uses, including the total estimated recoverable storage as provided by the executive administrator, that support the conclusion that desired future conditions in adjacent or hydraulically connected relevant aquifer(s) will not be affected; and

3) An explanation of why the aquifer or portion of the aquifer is non-relevant for joint-planning purposes.

This section is included in the Explanatory Report to serve as the documentation required to classify several aquifers in GMA 14 as non-relevant for joint planning and for development of a DFC. These aquifers include the Carrizo-Wilcox, Queen City, Sparta, Yegua-Jackson and several river alluviums (Brazos, San Bernard, Navasota, Trinity and San Jacinto river alluviums).

6.1 CARRIZO-WILCOX AQUIFER

Figure 6-1 shows the locations of major aquifers in GMA 14. As shown in *Figure 6-1*, the Gulf Coast Aquifer System is present throughout most of the management area. The Carrizo-Wilcox Aquifer is only present in subcrop in the far northern and western portions of Grimes and Walker counties. Outside of these areas, the Carrizo-Wilcox Aquifer is not recognized as an aquifer by the TWDB. It is wholly located within the Bluebonnet GCD.

All reported information on groundwater pumpage/use and current groundwater demands is included in *Table 5-2* and *Table 5-3*. Using data from the TWDB Water Use Survey program, groundwater use in Grimes and Walker counties averages 3,700 and 5,300 acre-feet per year, respectively. No groundwater production is reported from Grimes County for the Carrizo-

[88] Title 31, Texas Administrative Code Section 356.31 (b) see http://texreg.sos.state.tx.us/public/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=31&pt=10&ch=356&rl=31

Wilcox Aquifer and a maximum of 2 acre-feet per year has been reported in Walker County for the 10 years of data examined. Uses categorized as coming from "other" or "unknown" aquifers account for 165 and 1,600 acre-feet per year from Grimes and Walker counties, respectively.

Appendix K shows the TERS for the Carrizo-Wilcox Aquifer as defined and estimated by the TWDB.

Table 6-1 shows the water-budget values for the Carrizo-Wilcox Aquifer in Bluebonnet GCD from the District's 2013 management plan. As shown in *Table 6-1*, the aquifer receives no direct recharge from precipitation in the GCD. The primary inflow is lateral flow of approximately 2,700 acre-feet per year from the up-dip portions of the aquifer outside GMA 14. The vast majority of this discharges to deeper portions of the Carrizo and Wilcox formations. The Carrizo-Wilcox GAM indicates that, on average, only 17 acre-feet of water discharges vertically upward into the overlying Reklaw confining unit. GMA 14, therefore, expects very little impact on the Gulf Coast Aquifer System DFCs as a result of classifying the Carrizo-Wilcox Aquifer non-relevant.

Due to its limited spatial extent, current uses and connection to other aquifers, GMA 14 finds that a DFC for the Carrizo-Wilcox Aquifer in GMA 14 is not warranted and declare it non-relevant for joint-planning purposes.

Table 6-1 – Inflows and outflows to/from the Carrizo-Wilcox Aquifer in the Bluebonnet GCD management plan (GAM Run 13-028: Kohlrenken, 2013)

Management Plan Requirement	Aquifer or Confining Unit	Results
Estimated annual amount of recharge from precipitation to the district	Carrizo-Wilcox Aquifer	0
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	0
Estimated annual volume of flow into the district within each aquifer in the district	Carrizo-Wilcox Aquifer	2,699
Estimated annual volume of flow out of the district within each aquifer in the district	Carrizo-Wilcox Aquifer	379
Estimated net annual volume of flow between each aquifer in the district	From the Carrizo-Wilcox Aquifer into the Reklaw Confining Unit	17
	From the Carrizo-Wilcox Aquifer to the downdip portions of the Carrizo and Wilcox formations	2,322

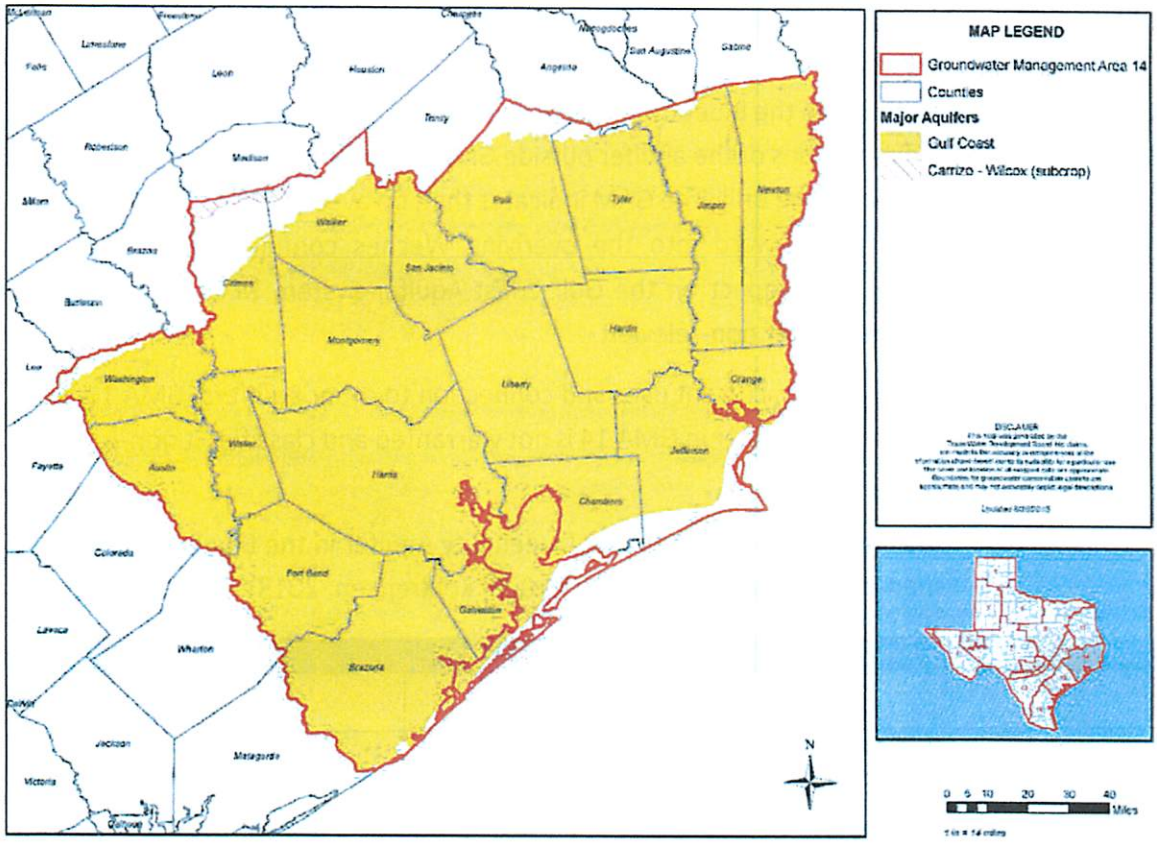

Figure 6-1 – Major Aquifers in GMA 14

6.2 QUEEN CITY AQUIFER

Figure 6-2 shows the locations of minor aquifers in GMA 14. The Queen City Aquifer is only present in subcrop in the far northern and western portions of Grimes, Walker and Washington counties. Outside of these areas, the Queen City is not recognized as an aquifer by the TWDB in GMA 14. Bluebonnet GCD encompasses Grimes and Walker counties while Washington County is not in a GCD.

All reported information on groundwater pumpage/use and current groundwater demands is included in *Table 5-2* and *Table 5-3*. Using data from the TWDB Water Use Survey program, groundwater use in Grimes, Walker, and Washington counties averages, respectively, 3,700 acre-feet per year, 5,300 acre-feet per year, and 2,200 acre-feet per year. Less than 30 acre-feet per year of this is specifically estimated to be from the Queen City Aquifer. Uses categorized as coming from "other" or "unknown" aquifers account for 165 acre-feet per year, 1,600 acre-feet per year, and 7 acre-feet per year from Grimes, Walker and Washington counties, respectively.

Appendix K shows the TERS for the Queen City Aquifer as defined and estimated by the TWDB.

Table 6-2 shows the water-budget values for the Queen City Aquifer in Bluebonnet GCD from the District's 2013 management plan. As shown in *Table 6-2*, the aquifer receives no direct recharge from precipitation in the Bluebonnet GCD. Flows in the aquifer consist of small lateral inflows from the up-dip portions of the aquifer outside GMA 14 and small vertical inflows from the underlying Reklaw confining unit. The GAM indicates that, on average, only 55 acre-feet of water discharges vertically upward into the overlying Weches confining unit. GMA 14, therefore, expects very little impact on the Gulf Coast Aquifer System DFCs as a result of declaring the Queen City Aquifer non-relevant.

Due to its limited spatial extent, current uses and connection to other aquifers, GMA 14 finds that a DFC for the Queen City Aquifer in GMA 14 is not warranted and classifies it non-relevant for joint-planning purposes.

Table 6-2 – Inflows and outflows to/from the Queen City Aquifer in the Bluebonnet GCD management plan (GAM Run 13-028: Kohlrenken, 2013)

Management Plan Requirement	Aquifer or Confining Unit	Results
Estimated annual amount of recharge from precipitation to the district	Queen City Aquifer	0
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	0
Estimated annual volume of flow into the district within each aquifer in the district	Queen City Aquifer	134
Estimated annual volume of flow out of the district within each aquifer in the district	Queen City Aquifer	98
Estimated net annual volume of flow between each aquifer in the district	From the Queen City Aquifer into the Weches Confining Unit	190
	From the Reklaw Confining Unit into the Queen City Aquifer	55
	From the downdip portion of the Queen City formation to the Queen City Aquifer	49

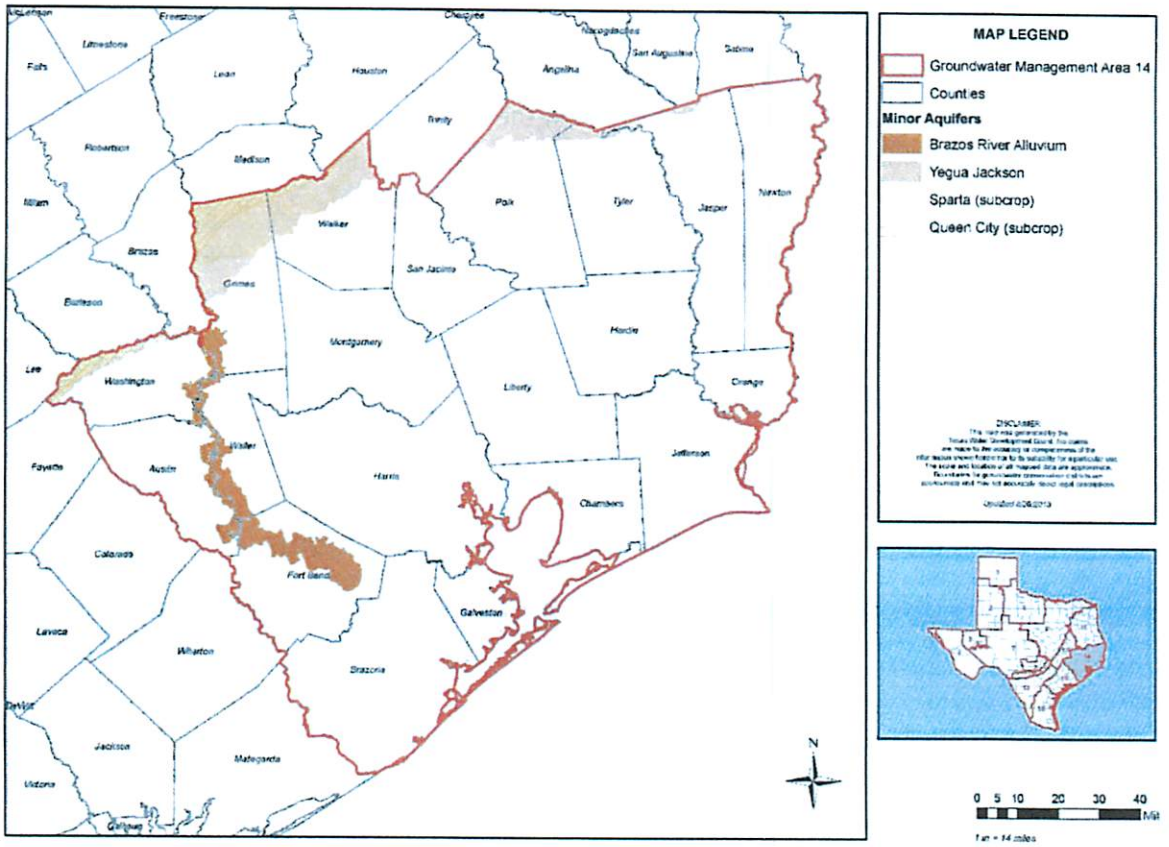

Figure 6-2 – Minor aquifers in GMA 14

6.3 SPARTA AQUIFER

Figure 6-2 shows the locations of minor aquifers in GMA 14. The Sparta Aquifer is only present in subcrop in the northern and western portions of Grimes, Walker, and Washington counties. Outside of these areas, the Sparta Aquifer is not recognized as an aquifer by the TWDB. Bluebonnet GCD encompasses Grimes and Walker counties while Washington County is not in a GCD.

All reported information on groundwater pumpage/use and current groundwater demands is included in *Table 5-2* and *Table 5-3*. Using data from the TWDB Water Use Survey program, groundwater use in Grimes, Walker, and Washington counties averages, respectively, 3,700 acre-feet per year, 5,300 acre-feet per year, and 2,200 acre-feet per year. Less than 5 acre-feet per year of this is specifically estimated to be from the Sparta Aquifer. Uses categorized as coming from "other" or "unknown" aquifers account for 165 acre-feet per year, 1,600 acre-feet per year, and 7 acre-feet per year from Grimes, Walker, and Washington counties, respectively.

Appendix K shows the TERS for the Sparta Aquifer as defined and estimated by the TWDB.

Table 6-3 shows the water-budget values for the Sparta Aquifer in Bluebonnet GCD from the District's 2013 management plan. As shown in *Table 6-3*, the aquifer receives no direct recharge from precipitation in the district. Flows in the aquifer consist of small lateral inflows from the up-dip portions of the aquifer outside GMA 14 and small vertical inflows from the Weches confining unit. The GAM indicates that, on average, only 31 acre-feet of water discharges vertically upward into the overlying units. GMA 14, therefore, expects very little impact on the Gulf Coast Aquifer DFCs as a result of classifying the Sparta Aquifer non-relevant.

Due to its limited spatial extent, current uses and connection to other aquifers, GMA 14 finds that a DFC for the Sparta Aquifer in GMA 14 is not warranted and classifies it non-relevant for joint-planning purposes.

Table 6-3 – Inflows and outflows to/from the Sparta Aquifer in the Bluebonnet GCD management plan (GAM Run 13-028: Kohlrenken, 2013)

Management Plan Requirement	Aquifer or Confining Unit	Results
Estimated annual amount of recharge from precipitation to the district	Sparta Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Sparta Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Sparta Aquifer	338
Estimated annual volume of flow out of the district within each aquifer in the district	Sparta Aquifer	482
Estimated net annual volume of flow between each aquifer in the district	From the Sparta Aquifer to overlying units	31
	From the Weches Confining Unit into the Sparta Aquifer	208
	From the Sparta Aquifer to the downdip portion of the Sparta Formation	49

6.4 YEGUA-JACKSON AQUIFER

Figure 6-2 shows the locations of minor aquifers in GMA 14. The Yegua-Jackson Aquifer is only present in the far northern and western portions of GMA 14 (Grimes, Walker, Washington, Polk, Tyler, Jasper, and Newton counties). Outside of these areas, the Yegua-Jackson is not recognized as an aquifer by the Texas Water Development Board in GMA 14. The Yegua-Jackson Aquifer is present in Bluebonnet GCD, Lower Trinity GCD, and Southeast Texas GCD.

All reported information on groundwater pumpage/use and current groundwater demands is included in *Table 5-2* and *Table 5-3*. Using data from the TWDB Water Use Survey program, the average groundwater pumping from the Yegua-Jackson Aquifer between 2000 and 2011

was approximately 1,900 acre-feet per year with a maximum annual use of 3,700 acre-feet per year. On average the Yegua-Jackson Aquifer accounts for approximately 3 percent of the groundwater use in the counties where it exists (*Figure 6-2*), with the maximum of 16 percent in Grimes County.

Appendix K shows the TERS for the Yegua-Jackson Aquifer as defined and estimated by the TWDB.

Table 6-4,

Table 6-5, and *Table 6-6* show the water-budget values for the Yegua-Jackson Aquifer in Bluebonnet, Lower Trinity, and Southeast Texas GCDs, respectively. In Bluebonnet GCD the Yegua-Jackson receives considerable recharge. However, more than 80 percent of this quickly discharges to lakes, streams, and rivers. Most of the water that does not discharge to surface water flows laterally out of the districts. The GAM indicates that, on average, 691 acre-feet of water flows vertically into the Yegua-Jackson Aquifer from the overlying Catahoula Formation (limited to Bluebonnet GCD). GMA 14 expects very little impact on the Gulf Coast Aquifer DFCs as a result of declaring the Yegua-Jackson Aquifer non-relevant.

Due to its limited spatial extent, current uses and connection to other aquifers, GMA 14 finds that a DFC for the Yegua-Jackson Aquifer in GMA 14 is not warranted and classify it non-relevant for joint-planning purposes.

Table 6-4 – Inflows and outflows to/from the Yegua-Jackson Aquifer in the Bluebonnet GCD management plan (GAM Run 13-028: Kohlrenken, 2013)

Management Plan Requirement	Aquifer or Confining Unit	Results
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	47.258
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	38,660
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	6,829
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	14,759
Estimated net annual volume of flow between each aquifer in the district	From the confined portion of the Yegua-Jackson units into the official Yegua-Jackson Aquifer	691
	From the Catahoula and overlying units into the Yegua-Jackson Aquifer	598

Table 6-5 – Inflows and outflows to/from the Yegua-Jackson Aquifer developed for the Lower Trinity GCD management plan (GAM Run 14-006: Kohlrenken, 2014)

Management Plan Requirement	Aquifer or Confining Unit	Results
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	4,114
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	3,879
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	1,950
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	2,826
Estimated net annual volume of flow between each aquifer in the district	To the Yegua-Jackson Aquifer from the confined portion of the Yegua and Jackson groups	434

Table 6-6 – Inflows and outflows to/from the Yegua-Jackson Aquifer developed for the Southeast Texas GCD management plan (GAM Run 11-019: Jones, 2012)

Management Plan Requirement	Aquifer or Confining Unit	Results
Estimated annual amount of recharge from precipitation to the district	Yegua-Jackson Aquifer	5
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	152
Estimated annual volume of flow into the district within each aquifer in the district	Yegua-Jackson Aquifer	751
Estimated annual volume of flow out of the district within each aquifer in the district	Yegua-Jackson Aquifer	798
Estimated net annual volume of flow between each aquifer in the district	From Yegua-Jackson Aquifer into overlying units	33

6.5 RIVER ALLUVIUM AQUIFERS

Figure 6-2 shows the location of minor aquifers in GMA 14. The Brazos River Alluvium Aquifer is present in portions of Grimes, Washington, Waller, Austin, and Fort Bend counties. Though not recognized as minor aquifers by the TWDB, several other alluvial aquifers are also present in GMA 14. These include the Navasota River Alluvium Aquifer (*Figure 6-3*), the San Bernard River Alluvium Aquifer (*Figure 6-4*), the San Jacinto River Alluvium Aquifer (*Figure 6-5*), and the Trinity River Alluvium Aquifer (*Figure 6-6*). All of the river alluvium aquifers are present in

Bluebonnet GCD. Washington County does not have a GCD. In Fort Bend County, groundwater is regulated by the Fort Bend Subsidence District.

All reported information on groundwater pumpage/use and current groundwater demands is included in *Table 5-2* and *Table 5-3*. Using data from the TWDB Water Use Survey program, groundwater production from the Brazos River Alluvium Aquifer between 2000 and 2011 averaged approximately 1,300 acre-feet per year with a maximum of 1,700 acre-feet per year. While estimates are not available for the other river alluvium aquifers, Bluebonnet GCD has indicated that the small amount of pumping that does occur from these aquifers is exempt from GCD permitting.

Appendix K shows the TERS for each of the river alluvium aquifers as defined and estimated by the TWDB.

At this time, a GAM is being developed for the Brazos River Alluvium Aquifer, but is not yet completed. TWDB does not have GAMs completed or in development for the remaining river alluvium aquifers. For this reason, water-budget inflows and outflows are not available for the river alluvium aquifers. GMA 14, however, expects very little impact on the Gulf Coast Aquifer DFCs as a result of classifying the river alluvium aquifers non-relevant. This is because 1) the alluvial aquifers are very shallow relative to pumping horizons of the Gulf Coast Aquifer, and 2) the magnitude of pumping in the alluvial aquifers is very small compared to that of the Gulf Coast Aquifer.

Due to their limited spatial extent, current uses and connection to other aquifers, GMA 14 finds that DFCs for the river alluvium aquifers in GMA 14 are not warranted and classifies them non-relevant for joint-planning purposes.

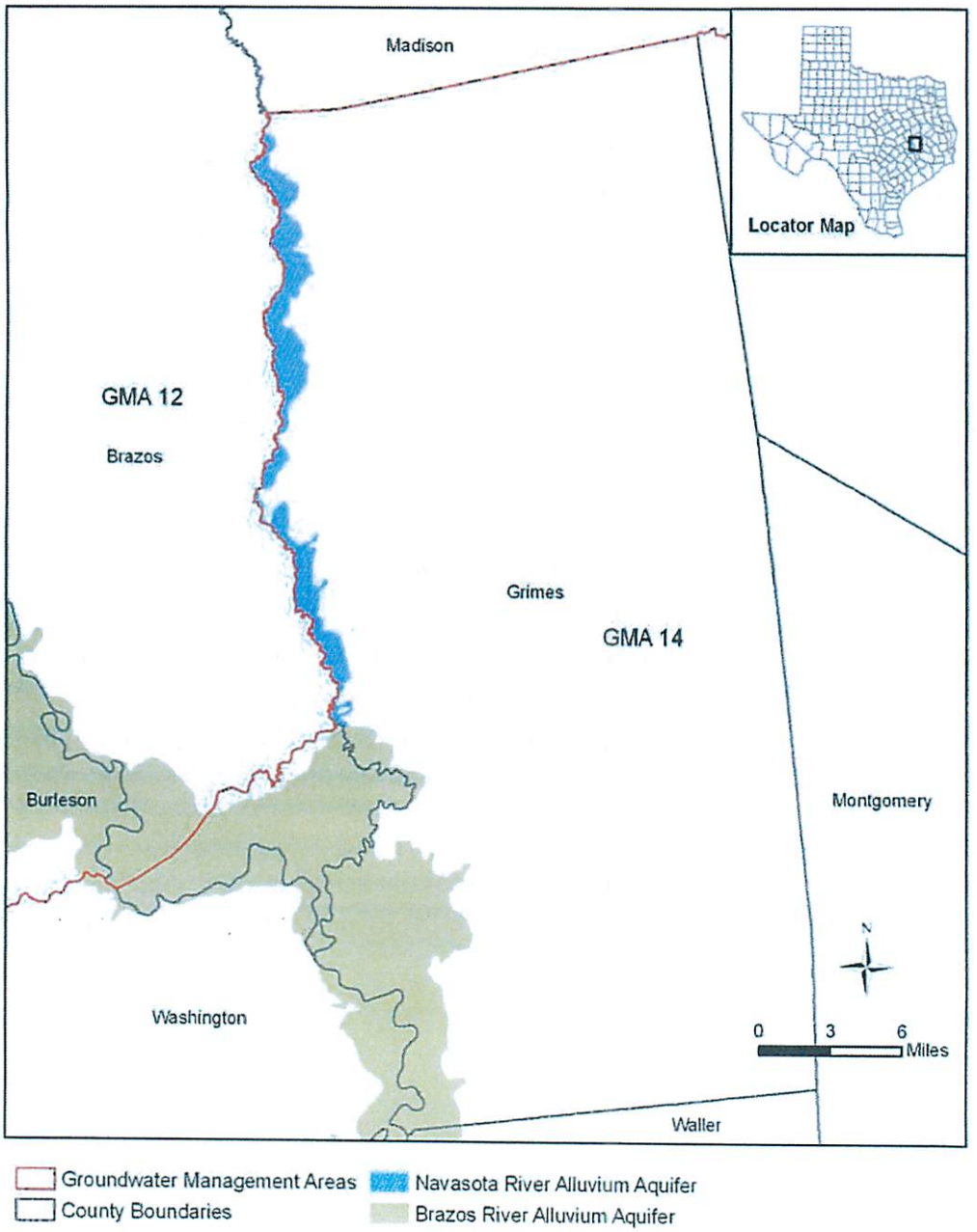

Figure 6-3 – Area of the Navasota and Brazos River Alluvium Aquifers in GMA 14

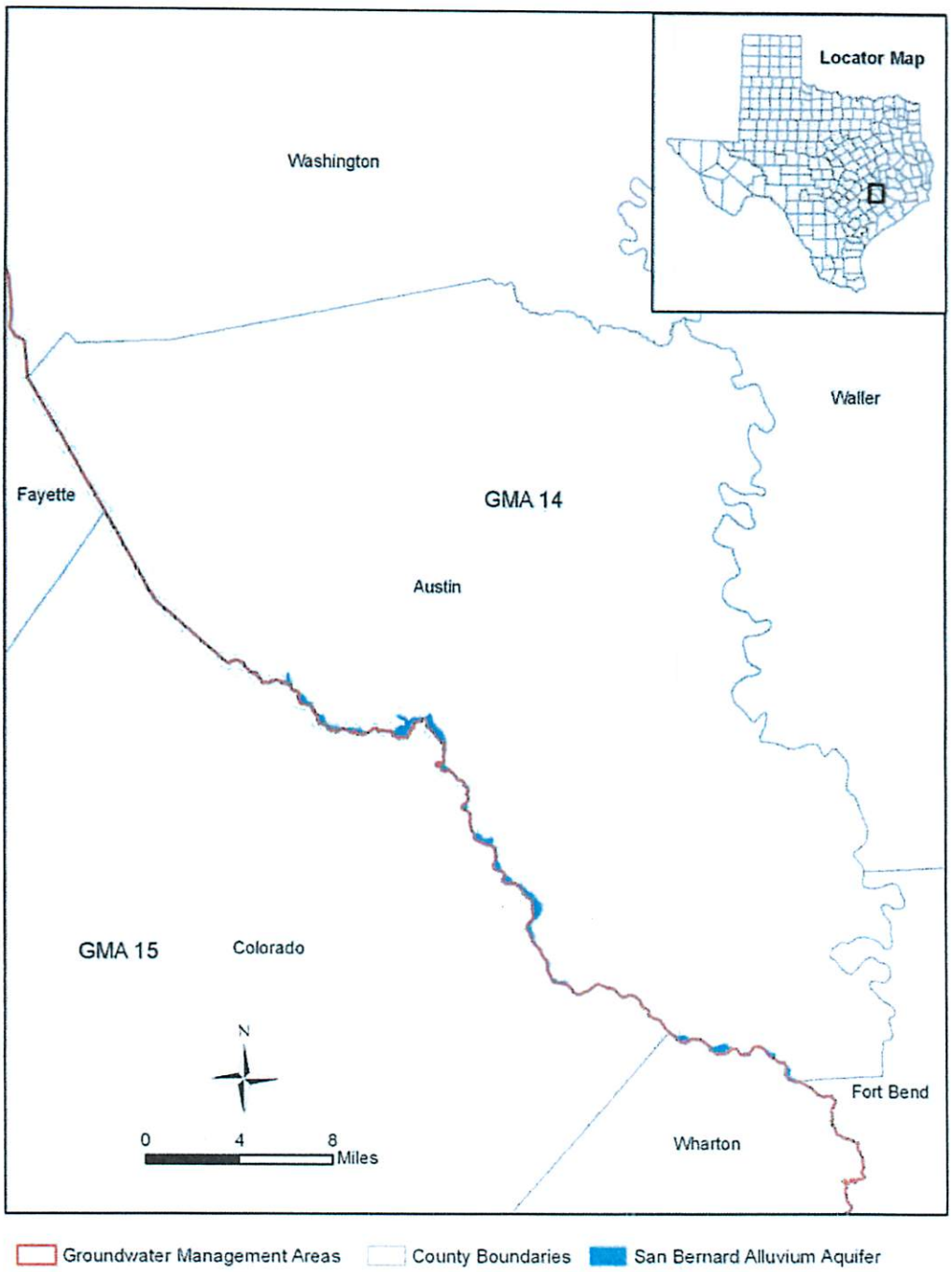

Figure 6-4 – Area of the San Bernard River Alluvium Aquifers in GMA 14

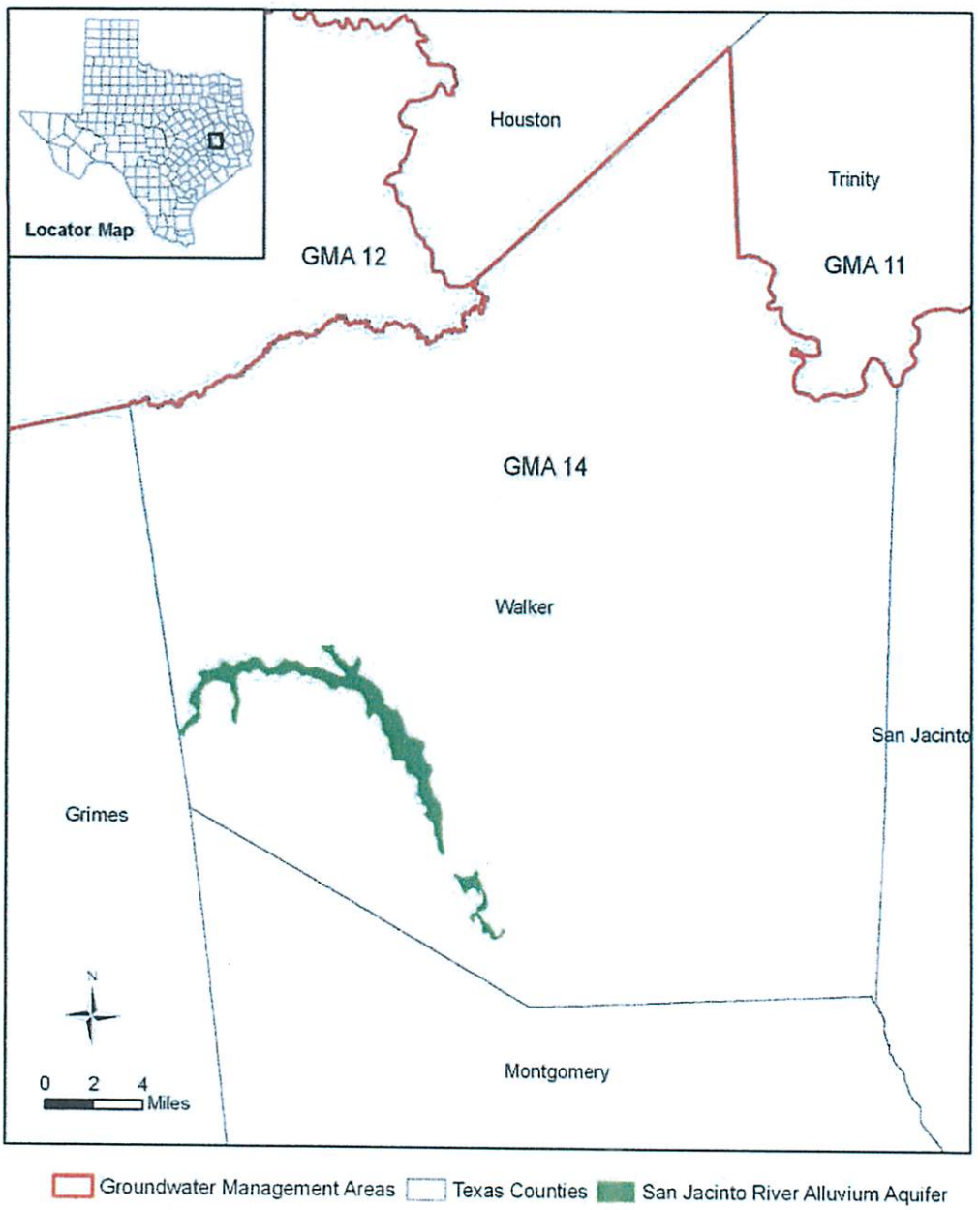

Figure 6-5 – Area of the San Jacinto River Alluvium Aquifers in GMA 14

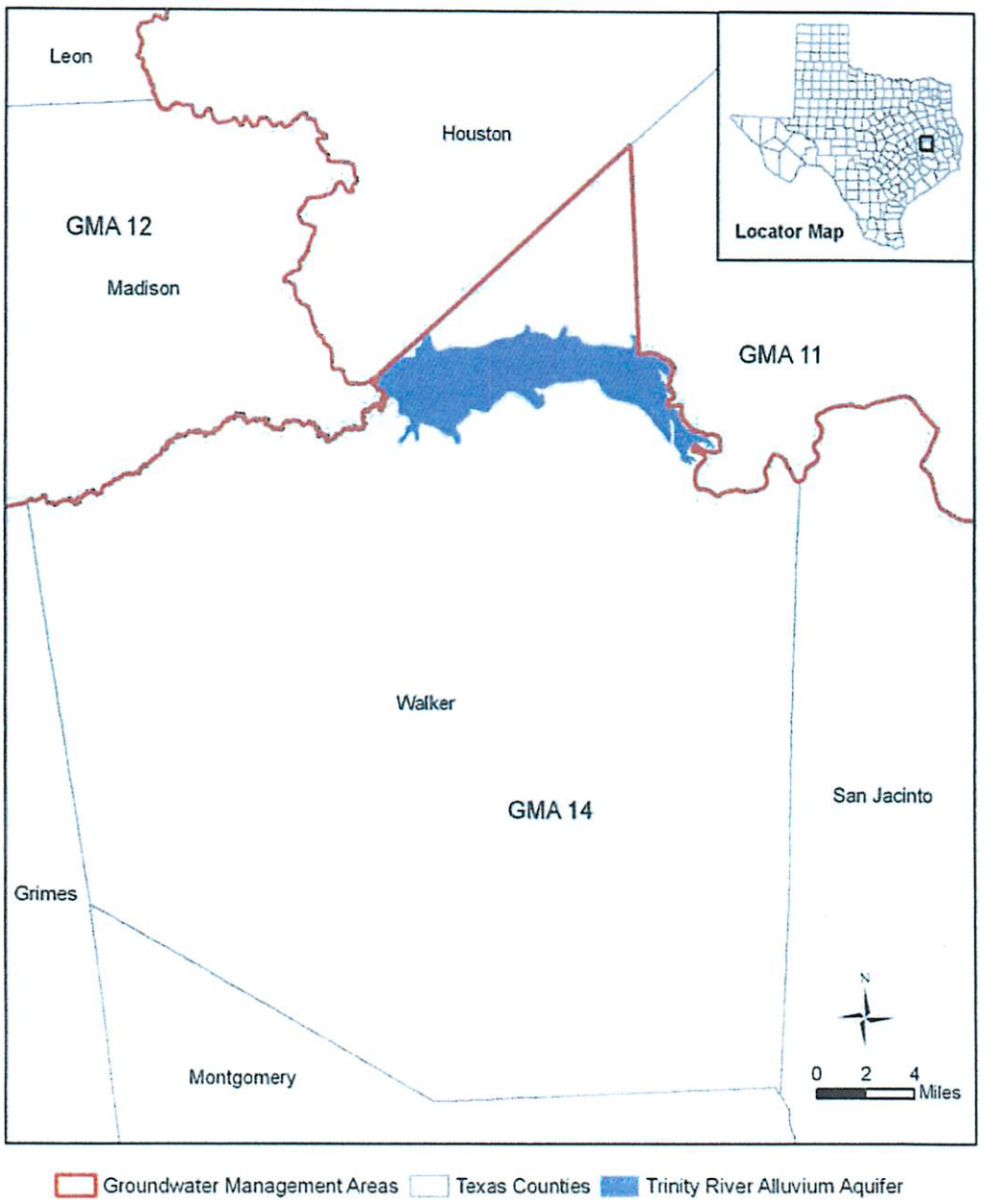

Figure 6-6 – Area of the Trinity River Alluvium Aquifers in GMA 14

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7.0 OTHER DFC OPTIONS CONSIDERED

During this round of joint planning in GMA 14, the new requirement for GMAs to address other DFC options that were considered but not adopted (Texas Water Code Section 36.108 (d – 3)(4)) led the District Representatives to develop and adopt, by resolution, administrative procedures that clearly prescribed the process for recognizing any suggested proposals for DFCs as official "options" that would then need to be addressed in the explanatory report. The administrative produces (see Appendix T) clearly articulate the procedures for any suggested proposals for DFCs to be designated as official options. Once designated as an official DFC option, then the District Representatives considered the nine factors included in Texas Water Code Section 36.108 (d) (1 – 9) with respect to the DFC option.

Following the process prescribed in the adopted administrative procedures, GMA 14 District Representatives only designated one DFC option for the four aquifers in the Gulf Coast Aquifer System. After consideration of the nine factors on the approved DFC option, this option was ultimately adopted as the Final DFC for the four aquifers in the Gulf Coast Aquifer System (see Appendix E). There were no other DFC options considered during this round of joint planning by GMA 14 District Representatives.

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8.0 RECOMMENDATIONS BY ADVISORY COMMITTEES AND RELEVANT PUBLIC COMMENTS

In accordance with Texas Water Code Section 36.108(d-3) and (d-4), this section of the Explanatory Report discusses reasons why recommendations made by advisory committees and relevant public comments received by the GCDs during the joint-planning process were or were not incorporated into the DFCs ultimately adopted on April 29, 2016.

The consideration, proposal, and adoption of DFCs in the joint-planning process, as described in Section 2.0 of this Explanatory Report, is necessarily a public, transparent process authorized only through open, publicly noticed meetings as required by the provisions of Chapter 36, Texas Water Code, and the Open Meetings Act, Texas Government Code. Over the course of several years, beginning in 2010, GMA 14 has held multiple joint-planning meetings to consider information in order to develop DFCs, including research applicable to the nine statutory factors and other relevant scientific and hydrogeological data. The Fort Bend Subsidence District and Harris-Galveston Subsidence District, special districts statutorily obligated to regulate groundwater withdrawals within their respective jurisdictions in GMA 14 for the purpose of preventing land subsidence, and other public stakeholders from Chambers and Washington counties sought participation early on in the joint-planning process to develop DFCs. As a result, these stakeholders were appointed to a nonvoting advisory committee to assist in the development of the DFCs pursuant to Texas Water Code Section 36.1081. With the exception of this advisory committee, GMA 14 received little to no public participation or comments throughout the majority of the joint-planning process. Only in the final months of the DFC process did GMA 14 receive comments from the public.

On October 28, 2015, the District Representatives in GMA 14 approved proposed DFCs for the purpose of drafting this Explanatory Report. The proposed DFCs provided acceptable drawdown levels for each subdivision of the Gulf Coast Aquifer System, including the Chicot, Evangeline, Burkeville, and Jasper (formations/aquifers), for each county located within GMA 14, as well as acceptable land subsidence levels, as applicable. The acceptable levels of drawdown for each subdivision of the Gulf Coast Aquifer System were measured in terms of water level drawdowns over the current planning cycle measured in feet from 2009 estimated water levels. These proposed DFCs were also supported by the advisory committee stakeholders.

The GCDs in GMA 14 each prepared a Summary Report inclusive of all relevant comments received during the 90-day public comment period regarding the proposed DFCs, any suggested revisions to the proposed DFCS, and the basis for the revisions. The GCDs'

Summary Reports were submitted to GMA 14 for further review by the District Representatives at a joint-planning meeting held October 28, 2015. In evaluating the comments received, GMA 14 District Representatives deemed certain comments relevant to the proposed DCFs. The remainder of this section identifies the relevant comments received and discusses why these comments were or were not incorporated into the DFCs.

As set forth in the public comments received, one commenter contended that the adoption of different DFCs for different geographic areas over the same aquifer—along the boundaries of political subdivisions—was not authorized by law, and as such the proposed DFCs were legally and hydrogeologically wrong. The commenter further stated that such proposed DFCs would cause GCDs to adopt different regulatory schemes, including different production limits, which would allow landowners producing groundwater in GCDs with less restrictive regulations to unfairly drain groundwater from landowners in adjacent GCDs with more restrictive regulations. The commenter claimed that this sort of activity constituted a regulatory taking of property by the GCDs as a result of the proposed DFCs.

The District Representatives to GMA 14 did not recommend any substantive changes to the proposed DFCs, but did recommend changes in the presentation and explanation of those DFCs. As originally proposed, it appeared the District Representatives proposed separate DFCs for each GCD and county in GMA 14; in actuality, the proposed DFCs applied throughout GMA 14, with a separate DFC for each of the four primary formations within the Gulf Coast Aquifer System. The presentation changes made it clear that GMA 14 was adopting four DFCs, but then also provided how the Northern Gulf Coast Aquifer GAM calculated the impact on each individual county within GMA 14.

To the extent the comments are directed at different DFCs for each aquifer formation they relate to policy issues GCDs face in considering, proposing, and adopting DFCs. As previously noted, the adoption of DFCs by GCDs, pursuant to the requirements and procedures set forth in Texas Water Code Chapter 36, is an important policy-making function. DFCs are planning goals that state a desired condition of the groundwater resources in a GMA in the future in order to promote better management of those resources on a long-term basis. GCDs are authorized to utilize different approaches in developing and adopting DFCs based on local conditions and the consideration of other statutory criteria as set forth in Texas Water Code Section 36.108. Contrary to the commenter's statements, the law authorizes GCDs in a GMA to adopt different DFCs for different geographic areas over the same aquifer based on political boundaries. However, whether this approach to setting DFCs should be utilized by the GCDs in GMA 14 is a policy decision the GCDs must make after careful consideration of local conditions and all other mandatory, statutory criteria as part of the joint-planning process.

Texas Water Code Section 36.108(d)(1) contemplates and authorizes the adoption of different DFCs for different geographic areas over the same aquifer based on the boundaries

of political subdivisions. First, the statute expressly and specifically *directs* GCDs "to consider uses or conditions of an *aquifer* within the management area, including conditions that differ substantially from one geographic area to another" when developing and adopting DFCs.[89] The use of the singular "aquifer" in this context clearly demonstrates that the Legislature intended that the uses and conditions in different geographic areas *over the same aquifer* were to be considered when adopting DFCs. Second, Texas Water Code Section 36.108(d-1) provides that districts may establish different DFCs for:

1) each aquifer, subdivision of an aquifer, or geologic strata located in whole or in part within the boundaries of the management area; *or*
2) *each geographic area overlying an aquifer in whole or in part* or subdivision of an aquifer within the boundaries of the management area.[90]

The Legislature's addition of the phrase "in whole or in part" makes it clear that GCDs may establish a "different" DFC for a geographic area that does not overlie a whole aquifer but only part of that aquifer. Moreover, the plain meaning of the term "geographic area" in this context clearly includes an area defined by political boundaries such as those of a GCD or a county.[91] Any other reading of "geographic area" in Texas Water Code Section 36.108(d-1) would be highly strained and contrary to the obvious intent of the larger statute.[92]

Such statutory authorization has also been recognized by the TWDB. In 2009, after GMA 1 adopted different DFCs for different geographic areas over the same aquifer (the Ogallala Aquifer) along the boundaries of political subdivisions, Mesa Water, LP and G&J Ranch (collectively the "Petitioners") filed a petition with the TWDB to appeal the reasonableness of the adopted DFCs.[93] The same complaints made in opposition of the DFCs adopted by GMA 1 are the same complaints made by the commenter to the GCDs in GMA 14 in opposition of the proposed DFCs. In their appeal of the DFCs adopted by GMA 1, Petitioners argued that, overall, the DFCs had no scientific basis and that the DFCs should be uniform on an aquifer-wide basis to ensure all areas and landowners receive "equal treatment." However, on February 17, 2010, the TWDB considered and approved its staff's recommendation that the DFCs adopted by GMA

[89] TEX. WATER CODE § 36.108(d)(1) (emphasis added).
[90] *Id.* § 36.108(d-1) (emphasis added).
[91] See *Morales v. Liberty Mutual Insurance Co.*, 241 S.W.3d 514, 517-18 (Tex. 2007) (stating that a particular term is to be considered and interpreted in the context of the entire statutory provision).
[92] See *McIntyre v. Ramirez*, 109 S.W.3d 741, 745 (Tex. 2003) (stating that it is improper to give an undefined statutory term a meaning that is out of harmony or inconsistent with other provisions in the statute).
[93] See TEX. WATER CODE ANN. § 36.108(l) (West 2009).

1 were reasonable.[94] The TWDB staff's analysis concluded that political boundaries, such as county lines, can be used to define geographic areas for different DFCs provided that aquifer uses and conditions support the designation of the areas. In reaching this conclusion, TWDB staff addressed private property rights, stating that "[t]o one degree or another, all DFCs adopted by groundwater conservation districts potentially impact the exercise of private property rights."[95] The TWDB staff explained that "beyond outright prohibition, the impact on private property rights involves the balancing of competing interest."[96]

During the joint-planning process for GMA 14, District Representatives considered uses and conditions of the Gulf Coast Aquifer System, as required by Texas Water Code Section 36.108(d)(1). District Representatives studied uses and conditions for each subdivision of the Gulf Coast Aquifer System, including the Chicot, Evangeline, Burkeville, and Jasper, for each county located within GMA 14. Evidence was provided and considered that demonstrated different types of uses of groundwater, differences in historic pumping, and different environmental conditions that were distinguishable in the various geographic areas of GMA 14 and described conveniently by reference to the counties (a more detailed discussion of these considerations is included below in the discussion of aquifer uses and conditions in *Section 5.1*).

For these reasons, in developing proposed DFCs, District Representatives in GMA 14 found it reasonable to divide the geographic area over each subdivision of the Gulf Coast Aquifer System for the different DFCs using the political boundaries of the counties. This finding was further supported by other relevant factors considered by District Representatives in GMA 14, including: (1) the heavy utilization by the TWDB and the regional water planning groups in the state and regional water-planning processes of information and data related to water supply and demand and other demographic information on a county-by-county basis, (2) the ability of the public to identify the boundaries of the geographic areas delineated, and (3) the ability of the GCDs—the responsible planning and regulatory entities created along county boundaries by the Texas Legislature—to achieve the DFCs, as mandated by law.

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[94] *See* Texas Water Development Board, Report on Appeal of the Reasonableness of the Desired Future Conditions Adopted by Groundwater Management Area 1 for the Ogallala and Rita Blanca Aquifers (February 10, 2010) *available at* http://www.twdb.texas.gov/groundwater/petitions/doc/GMA1/2009_Petitions/Mesa_G&J_Ranch/TWDB_Staff_Report_GMA1_Petitions_02-10.pdf.

[95] *Id.* at 4 (citing TEX. WATER CODE ANN. § 36.002 (West 2009) ("Ownership and rights of the owners of the land . . . in groundwater are hereby recognized, and nothing in this code shall be constituted as depriving or divesting the owners . . . of the ownership or rights, *except as those rights may be limited or altered by rules promulgated by a district.*") (Emphasis added).

[96] *Id.*

Also, as part of the joint-planning process, District Representatives in GMA 14 considered impacts to private property rights and interests in groundwater, as required by Texas Water Code Section 36.108(d)(7). The Gulf Coast Aquifer System is a finite resource that replenishes at a lower rate than is required to meet all current and projected water demands. Accordingly, the consideration of impacts to private property rights necessitated the careful balancing of competing interests. For instance, it is essential to protect the property rights of existing well owners and their abilities to realize their reasonable investment-backed expectations from their wells. It is also essential to protect the property rights of landowners who have yet to drill water wells on their properties. Protecting the property rights of landowners who may be impacted by subsidence is also critical. The concerns raised by commenters regarding future harm to landowners along adjacent county lines were weighed against the real and present economic harm to existing groundwater users in certain areas of GMA 14 where groundwater levels continue to decline as demands exceed available, sustainable supplies—such as is the case in Montgomery County. In balancing all sectors, District Representatives found that it was reasonable to divide the geographic area over each subdivision of the Gulf Coast Aquifer System for the different DFCs using the political boundaries of the counties in order to protect existing users in the more stressed areas of GMA 14, which were best delineated on a county-by-county basis.

As previously noted, the GCDs also received comments suggesting that the proposed DFCs will result in a taking of property. However, these assumptions are not only speculative, but also counterintuitive to the fundamental principles in support of local groundwater management and regulation by GCDs. In Texas, the legislature has declared GCDs as the preferred method of groundwater management.[97] Unlike the statewide regulation of oil and gas, local GCDs are required to manage and protect the groundwater resources within their jurisdiction pursuant to their statutory powers and duties as set forth in Texas Water Code Chapter 36 and their respective enabling legislation. While the GCDs in a GMA may adopt aquifer-wide DFCs, the adoption of such DFCs does not prevent the GCDs from adopting different regulatory plans based on local conditions and uses occurring in each GCD.

Nonetheless, after consideration of these comments, the District Representatives of GMA 14 approved non-substantive changes to the proposed DFCs. The DFCs that were considered and proposed for final adoption, inclusive of all non-substantive changes, provided acceptable drawdown levels for each hydrogeologic subdivision of the Gulf Coast Aquifer System, including the Chicot, Evangeline, Burkeville, and Jasper, on two different scales—on an aquifer-wide basis for the entire geographic extent of the aquifer subdivisions in GMA 14 and on a county-by-county geographic basis, in light of the various considerations set forth

[97] *See* TEX. WATER CODE § 36.0015 (b)

above—and acceptable land subsidence levels, as applicable, for certain counties located within GMA 14. These proposed DFCs, inclusive of acceptable drawdown levels on an aquifer-wide scale and a county-by-county basis, were finally adopted by the District Representatives in GMA 14 on April 29, 2016, at a properly noticed joint-planning meeting. These non-substantive changes were also supported by the advisory committee stakeholders. As a result, the policy issues raised by commenters as discussed above are now moot.

The GCDs also received various comments regarding the failure to factor economic and hydrologic constraints into the calculation of total estimated recoverable storage ("TERS"). In June of 2014, as required by amendments to Texas Water Code Chapter 36, resulting from the passage of Senate Bill 660 in 2011, the executive administrator of the TWDB submitted the initial report on total estimated recoverable storage to GMA 14 District Representatives. While GMA 14 District Representatives were cognizant of the enormity of this new responsibility assigned to the TWDB, significant concerns were raised both by GMA 14 District Representatives and also during public comments regarding the lack of usefulness of this information for two primary reasons. First, in the TWDB analysis, it was confirmed that there were no constraints placed on the recoverability analysis due to the obvious and inevitable negative economic impacts that will result with the reduction and elimination of artesian pressures in systems like the Gulf Coast Aquifer System. Second, sufficient information was provided to prove the far-reaching negative consequences of adopting DFCs based on a percentage of storage calculated from TERS, as proposed by commenters.

Based on input from GMA 14 District Representatives and technical presentations received during the 90-day public comment period, in particular two presentations by representatives from INTERA, Inc. on behalf of various stakeholders, including those stakeholders participating in the advisory committee, the negative economic impacts resulting from the elimination of artesian pressures from the Gulf Coast Aquifer System, a dynamic projected to occur with less than one percent of the TERS volume being produced, clearly resulted in the elimination of the Gulf Coast Aquifer System as a viable water resource for almost all water use sectors. These economic impacts are, in part, driven by the negative impacts on well yields that will result with the inevitable conversion from confined to unconfined conditions as water levels are lowered due to pumping. The analysis provided in the TERS report to GMA 14 by the TWDB does not factor in either economics or hydrology into the calculations. GMA 14 District Representatives strongly encourage the TWDB to conduct necessary science to better constrain future estimates of TERS, taking into consideration the negative impacts of economics and hydrology, on the volumes of water that can reasonably be expected to be recovered from storage.

GMA 14 District Representatives carefully weighed all comments received on this issue of TERS and ultimately decided, for the reasons provided above (as also discussed in Section

5.10 of this Explanatory Report) that, due to other considerations, in particular the negative socioeconomic impacts of subsidence, TERS has no practical application in the GMA 14 joint-planning process or in groundwater management of the Gulf Coast Aquifer System. Therefore, the public comments received on this issue did not result in any changes to the DFCs.

Finally, public comments were also received from both sides of the issue of the balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence. Some comments received suggested that there should be sustainable management of groundwater resources in GMA 14 through proactive conservation and management. These comments were predicated on the critical need for the long-term viability of the economy and environment in the region, both today and for future generations. Others have suggested that as much as 5 percent of the groundwater in storage in the Jasper Aquifer should be allocated for pumping over the next 50 years in order to sustain anticipated economic development. The balance achieved by GMA 14 with respect to the volume of groundwater quantified in the TERS report may be compartmentalized into two areas.

In the more rural areas of GMA 14, water demands will easily be met by proposed DFCs resulting from selected pumping projections. As such, the TERS estimates in these rural areas are functionally irrelevant in proposing DFCs. In the urban, fast-growing areas of GMA 14, District Representatives have balanced the TERS volumes with the need to mitigate the impacts of subsidence, the impacts of declining artesian water levels on existing and future well owners (in particular, the economic impacts on smaller utilities with limited customer base and individual landowners with limited economic means to drill for and produce groundwater), and the negative consequences of decreasing well yields that result when artesian water levels are lowered/eliminated and groundwater is produced form storage. Ultimately, for the reasons provided in Section 5.10, GMA 14 did not revise the DFCs in response to these comments.

RESOLUTION ESTABLISHING ADMINISTRATIVE PROCEDURES FOR THE CONSIDERATION, PROPOSAL, AND ADOPTION OF DESIRED FUTURE CONDITIONS FOR GROUNDWATER MANAGEMENT AREA 14

WHEREAS, pursuant to Section 35.004 of the Texas Water Code, the Texas Water Development Board ("TWDB") has designated groundwater management areas, which together cover all major and minor aquifers in the state, for the objective of providing the most suitable area for the management of the groundwater resources; and

WHEREAS, through Title 31, Section 356.21 of the Texas Administrative Code, the TWDB has designated the area encompassing all of Austin, Brazoria, Chambers, Fort Bend, Galveston, Grimes, Hardin, Harris, Jasper, Jefferson, Liberty, Montgomery, Newton, Orange, Polk, San Jacinto, Tyler, Walker, Waller, and Washington counties as Groundwater Management Area No. 14 ("GMA 14"); and

WHEREAS, the Bluebonnet Groundwater Conservation District, Brazoria County Groundwater Conservation District, Lone Star Groundwater Conservation District, Lower Trinity Groundwater Conservation District, and Southeast Texas Groundwater Conservation District (the "Member Districts") are located wholly or partially within GMA 14; and

WHEREAS, the Member Districts are authorized by Chapter 36, Texas Water Code, to engage in joint planning activities for the coordinated management of the aquifers located in GMA 14, and in that regard, shall establish desired future conditions ("DFCs") for the relevant aquifers within GMA 14; and

WHEREAS, Section 36.108 of the Texas Water Code requires the Member District Representatives to hold joint planning meetings for the consideration of DFC options, the proposal of DFCs for adoption, and, after the contemplation of comments and suggested revisions provided by the public and Member Districts, the adoption of DFCs for each relevant aquifer in GMA 14 and the submission of an explanatory report to the TWDB for approval of the DFCs adopted; and

WHEREAS, Section 36.108(d-3) of the Texas Water Code provides that the explanatory report must include the following: (1) identification of each DFC; (3) the policy and technical justification for each DFC; (3) documentation that the Member Districts considered the nine statutory factors listed in 36.108(d)(1)-(9), Water Code, and how the DFC adopted impacts each factor, (4) a list of the other DFC options considered, if any, and the reasons why those options were not adopted, and (5) the reasons why recommendations made by advisory committees and relevant public comments received by the districts were or were not incorporated into the DFCs; and

WHEREAS, the DFC explanatory report serves as the administrative record in the DFC adoption process, and for this reason, the Member Districts recognize the importance of establishing a procedural record from the beginning of the DFC consideration, proposal, and

adoption process that contemplates each of the items to be addressed and included in the explanatory report under Section 36.108(d-3), Water Code; and

WHEREAS, Section 36.108 of the Texas Water Code provides a clear procedural process for DFCs that have been approved by a two-thirds vote by the Member District Representatives as the proposed DFCs for distribution to the Member Districts for public hearings and subject to a public comment period, but the statute is less clear as to the procedure applicable to the consideration of one or more DFC option(s), DFC options that may be discussed, evaluated, or considered but not adopted, the extent to which those DFC options must be addressed in the explanatory report, and the consideration of the nine statutory factors prior to the Member District Representatives' vote to approve a DFC option as the proposed DFC; and

WHEREAS, the Member Districts desire to adopt an administrative procedural process that is consistent with Chapter 36, including the procedural requirements currently in place under Texas Water Code Section 36.108, for the consideration, proposal, and adoption of DFCs to ensure the development of a clear administrative record that not only supports the DFCs ultimately adopted, but also addresses any DFCs considered but not adopted, in a manner that is sufficient for inclusion in the explanatory report as required by Texas Water Code Section 36.108(d-3); and

NOW, THEREFORE, it is agreed and understood among the Member Districts as follows:

SECTION ONE
INTENT AND PURPOSES

1.01 It is the intent and purpose of the Member Districts to carry out and fulfill the joint planning activities and requirements of Chapter 36, Texas Water Code, to establish DFCs by adopting administrative procedures for the consideration, proposal, and adoption of DFCs that promote the consideration of various DFC options, as necessary, to be included in the explanatory report, while preventing the lack of procedural guidance provided in Texas Water Code Chapter 36 from hindering the development of a defensible administrative record or explanatory report. The Member Districts intend for the administrative procedures herein to promote the ability of the Member Districts to openly identify, evaluate, and discuss multiple ideas, proposals, technical information, and policy options regarding the establishment of DFCs while simultaneously establishing some procedures to identify when a particular discussion or evaluation rises to the level of it being formally considered for inclusion in the DFC explanatory report.

SECTION TWO
PARTICIPATION IN JOINT PLANNING PROCESS TO ESTABLISH DFCs

2.01 Each Member District shall be subject to these administrative procedures.

2.02 Only a Member District Representative may vote or take action on GMA 14 activities. For any action, only one representative from each Member District may vote.

2.03 Each Member District of GMA 14 shall endeavor to participate and contribute in good faith in joint planning activities and to satisfy the joint planning requirements of Chapter 36, Water Code.

2.04 The GMA 14 Member Districts, as a group to engage in joint planning activities, shall have only the power granted by Chapter 36, Water Code, that relates to joint planning activities.

2.05 GMA 14 joint planning meetings must be held in accordance with the Texas Open Meetings Act, Chapter 551, Government Code. The Member Districts agree that notice of meetings shall be provided in accordance with the requirements of Chapter 36, Texas Water Code.

2.06 Each Member District shall comply with the Texas Public Information Act, Chapter 552, Government Code, with regard to joint planning activities.

SECTION THREE
PROCEDURE FOR THE CONSIDERATION, PROPOSAL, AND ADOPTTION OF DFCs

3.01 For a DFC option to be formally considered as a potential candidate for proposal and adoption by the Member Districts to be included in the explanatory report as a DFC that was adopted or a DFC that was considered but not adopted pursuant to Section 36.108(d-3), Water Code, the DFC option must be requested in writing and approved by the Member District Representatives for formal consideration at a GMA 14 joint planning meeting.

3.02 A Member District Representative shall request a DFC option to be approved for formal consideration by submitting, no less than 14 days before a GMA 14 joint planning meeting, a written request to each Member District and the Contracted Consultant, as defined in Section 4 below, describing with sufficient specificity the DFC option requested to be approved for formal consideration. The sufficiency of the written request shall be reviewed by the Contracted Consultant and, no later than 7 days after receiving the written request, the Contract Consultant shall notify the requesting party of any possible deficiencies in the written request in preparation for discussion of the request at the GMA 14 joint planning meeting.

3.03 Based on the information provided in the written request, including any supplemental information provided in writing and accepted by the Member District Representatives at or before the GMA 14 joint planning meeting, the Member District Representatives shall vote to determine whether the requested DFC option shall be formally considered. To be formally considered, the requested DFC option must be approved by a two-thirds vote of the total Member District Representatives. If through discussions at the GMA 14 joint planning meeting, the DFC option originally requested in writing is amended, the DFC option, as amended, may nonetheless be approved for formal consideration by a two-thirds vote of the total Member District Representatives without the submission of an additional, amended

written request. A DFC option approved for formal consideration under this section shall be included in the explanatory report pursuant to Texas Water Code Section 36.108(d-3).

3.04 Of the DFC options formally considered, at least one of the DFC options shall be approved by two-thirds vote of the total Member District Representatives to be further reviewed in consideration of the nine statutory factors listed in Section 36.108(d)(1)-(9), Water Code. For a DFC option approved for further review, the Member District Representatives shall discuss and consider the nine statutory factors and how the DFC option impacts each of the nine factors at a joint planning meeting. A written report shall be prepared to document the consideration of the nine statutory factors and the discussions relevant to the DFC option's impact to each factor, to the extent necessary for purposes of the explanatory report as required by Section 36.108(d-3)(3), Water Code.

3.05 Only after consideration of the nine statutory factors as stated in Section 3.04 may a DFC option become eligible for approval as the proposed DFC. For each relevant aquifer in GMA 14, the Member District Representatives shall approve by two-thirds vote of the total Member District Representatives one DFC option to serve as the proposed DFC as required by Sections 36.108(d) and (d-2), Water Code. The proposed DFC must provide a balance between the highest practicable level of groundwater production and the conservation, preservation, protection, recharging, and prevention of waste of groundwater and control of subsidence in GMA 14.

3.06 The proposed DFC approved by two-thirds vote of the total Member District Representatives shall be distributed to the Member Districts. A period of not less than 90 days for public comment begins on the day the proposed DFC is mailed to the Member Districts.

3.07 During the public comment period and after posting proper notice as required by Section 36.063, Water Code, each Member District shall hold a public hearing on the proposed DFCs relevant to that Member District pursuant to the requirements set forth in Section 36.108(d-2), Water Code. After the public hearing, each Member District shall compile for consideration at the next joint planning meeting a summary report of relevant comments received and any suggested revisions to the proposed DFC and the basis for the revisions.

3.08 Pursuant to Texas Water Code Section 36.108(d-3), after the earlier of the date on which all the Member District have submitted their district summaries or the expiration of the public comment period, the Member District Representatives shall reconvene to review the reports, consider any Member District's suggested revisions to the proposed DFCs, and vote to adopt the proposed DFCs. The DFCs must be adopted as a resolution by a two-thirds vote of all the Member District Representatives.

3.09 A record shall be prepared to address each relevant comment received during the public comment period or at the public hearing and any suggested revisions included in the Member Districts' summary reports submitted to and considered by the Member District Representatives at the joint planning meeting, as well as any recommendations made by advisory committees. The record shall identify those comments and revisions incorporated into the DFC, as well as those comments and revisions not incorporated, and provide the reasoning behind the