AGENDA PACKET
November 15, 2018

Agenda Memos for Planning Process

Agenda Item 6a. Review of MAG Availability

An overview of the DB22 total MAG volumes will be presented, both by GMA and in terms of the most significant declines.

For decade 2020, the previous MAGs totaled 1,003,925 acre-feet per year (afy) for entire region. The current MAGs total 984,915 afy for 2020. Overall, there has been a decrease ranging from 19,010 afy for decade 2020 to a maximum decrease of 39,626 afy for decade 2040. The overall decrease can primarily be attributed to the Lipan, Ogallala, and Dockum Aquifers being reclassified as non-relevant in most counties within GMA-7.

The largest availability decrease in any one county in Region F during this planning cycle occurs in Glasscock County's Ogallala Aquifer MAG, which has decreased from 21,322 afy to 7,925 afy for the year 2020. The next largest decrease in total MAG volumes occurs in Ward County (6,387 afy) in the Dockum, Capitan, and Rustler Aquifers. The third largest decrease in available volume occurs in Reeves County (4,105 afy) in the Capitan, Dockum, Edwards-Trinity (Plateau) Aquifers.

A memo summarizing 2021 groundwater availability volumes was distributed to key members of the regional and joint planning groups on October 11, 2018 to: 1) inform stakeholders, planners and water users of the 2021 groundwater availability volumes and methodologies used to derive these volumes for Region F, 2) solicit feedback from stakeholders, planners, and water users regarding any specific availability volumes for which they may like to contribute input and/ or local knowledge that might revise the groundwater availability volumes, and 3) incorporate any revisions to volume changes into the Technical Memorandum prior to finalization. The updated memo, which incorporates stakeholder feedback, is attached.

Attachments:
1. Updated Groundwater Availability Volumes Memorandum
2. Updated Groundwater Availability Summary Tables

MEMO

TO: Simone Kiel, P.E., Freese and Nichols, and the Region F Water Planning Group

FROM: Kristie Laughlin, P.G. and James Beach, P.G., WSP USA

SUBJECT: **Region F Groundwater Availability Volumes**

DATE: **October 22, 2018**

Introduction

This memo summarizes 2021 MAG volumes, non-relevant aquifer groundwater availability volumes, and other (undifferentiated) aquifer availability volumes. The methodology used to derive the non-relevant and other aquifer volumes are noted or described either within this memo or the associated tables.

This memo was distributed to key members of the regional and joint planning groups prior to finalization of the Region F Technical Memorandum. This memo was distributed on October 11, 2018 to: 1) inform stakeholders, planners and water users of the 2021 groundwater availability volumes and methodologies used to derive these volumes for Region F, 2) solicit feedback from stakeholders, planners, and water users regarding any specific availability volumes for which they may like to contribute input and/ or local knowledge that might revise the groundwater availability volumes, and 3) incorporate any revisions to volume changes into the Technical Memorandum prior to finalization.

Subsequently, both Irion and Sterling County Other Aquifer availability volumes were removed from Table 5. Irion County has no aquifers besides the Lipan, Edwards-Trinity (Plateau), and Dockum. Sterling County Other has been assigned to the Lipan Aquifer, and now pumping for Sterling City public supply is captured under Sterling County non-relevant (Lipan Aquifer).

Region F MAGs

Region F includes portions of Groundwater Management Areas (GMAs) 2, 3, 7 and 8. The MAG estimates that were developed during the latest round of joint planning are summarized in Table 1. This table compares the total of all MAG estimates for each county in Region F for the current and previous joint planning cycles. All units are acre-feet per year (afy). The difference in volumes between joint planning cycles 1 and 2 is color-coded to indicate an increase in the MAG volume (with black numbers) or a decrease in the MAG (shown with red numbers and parentheses). For decade 2020, the previous MAGs totaled 1,003,925 acre-feet per year (afy) for entire region. The current MAGs total 984,915 afy for 2020. Overall, there has been a decrease ranging from 19,010 afy for decade 2020 to a maximum decrease of 39,626 afy for decade 2040. Some of the anticipated decreases in MAG volumes were discussed by Bill Hutchison at a previous meeting of the RWPG.

Nomenclature Changes

The three major aquifer MAGs have been lumped since the last planning cycle. The Edwards-Trinity (Plateau), Pecos Valley, and Trinity Aquifers (ETPPVT) have been combined into one MAG volume where applicable in GMA7. Also, with the introduction of regions to the North Trinity Woodbine GAM, the Trinity Aquifer formation / member nomenclature in GMA8 has expanded since the last planning cycle to include the Antlers, the Travis Peak and the Twin Mountains formations. This only affects Brown County in Region F.

MAG change to Non-MAG

The three seemingly largest MAG decreases for individual counties appear to be in Tom Green (decrease of 39,787 afy in 2020), Midland (decrease of 31,343 afy in 2020), and Mitchell (decrease of 14,018 afy in 2020) Counties. However, these are not real decreases in availability but are a result of the aquifers being declared as non-relevant. For aquifers that were designated to be non-relevant in this joint planning cycle, the previous MAG volume estimates were transferred over to the non-relevant availability volume without revision. There are comments in Table 1 indicating if the aquifer was determined to be non-relevant. These are discussed in greater detail in the Non-MAG portion of this memo.

Maps of the relevant and non-relevant portions of major and minor aquifers are included as Figures 1 through 4. Figure 5 is a map of the GCDs within Region F.

MAG Availability Volume Changes

The Ogallala is relevant only in Glasscock County, however, this is the largest real decrease in MAG volume estimates summarized in Table 1. The total MAG decrease in Glasscock County ranges from 13,424 to 8,092 afy. To help determine which aquifer this decrease can be attributed to, the current MAG volumes by aquifer are detailed in Table 2, and the 2016 MAG volumes are detailed in Table 3. A comparison of the MAGs listed for Glasscock County in Tables 2 and 3, indicates that the MAG volume for the Edwards-Trinity (Plateau) and Pecos Valley and Trinity Aquifers remains relatively unchanged at 65,186 afy (give or take). However, the previous Ogallala Aquifer MAG has decreased from 21,322 afy to 7,925 afy for the year 2020, which accounts for the largest availability decrease in any one county in Region F during this planning cycle.

The next largest decrease in total MAG volumes occurs in Ward County (6,387 afy). These decreases can be attributed to the Dockum, Capitan, and Rustler Aquifers, which have decreased available volume 4,850 afy, 948 afy, and 555 afy, respectively. The third largest decrease in available volume occurs in Reeves County, which can be attributed to the Dockum (2,431 afy), Capitan (1,007 afy), and the ETPPVT (667 afy). This is slightly offset by an increase for the Rustler Aquifer of 411 afy. All other total MAG volume decreases per county range from 1,913 afy (Crane County) to 1 afy (Coke County).

Martin, Howard, and McCulloch Counties had the largest increases in MAG volumes, which can be attributed solely to the Ogallala Aquifer for Martin and Howard Counties and primarily to the Hickory Aquifer in McCulloch County.

Partial MAGs

Note that there are two districts located within the Edwards-Trinity (Plateau) Aquifer that have declared this aquifer to be non-relevant for planning purposes, Therefore, both the Lipan-Kickapoo WCD and the Hickory UWCD1 counties may have both a partial MAG (for the portions of counties outside of the district) and a non-MAG (for portions of applicable counties located within the districts).

Region F Non-MAGs

Non-MAGs encompass both the aquifers designated as non-relevant and other aquifers. The total non-relevant availability volume for this planning cycle is 120,143 afy and the total availability from other aquifers is 29,130 afy. This totals 149,273 afy. In the previous plan, total non-relevant aquifer volume was 31,684 afy, and total other aquifer volume was 29,881 afy. Combined, these sources totaled 61,565 afy. The addition of over 87,000 afy to non-relevant and other aquifers can primarily be attributed to the Lipan, Ogallala, and Dockum Aquifers being reclassified as non-relevant in most counties within GMA7, and the addition of the San Andres Formation (10,000 afy) to Pecos County - Other Aquifer.

Non-Relevant Aquifers

Table 4 summarize the non-relevant aquifer availability volume estimates for this planning cycle and contains notes regarding the methodology or source of the availability volume estimates. Aquifers declared non-relevant for this planning cycle are as follows:

GMA2 (Gam Run 16-028 MAG):

- Pecos Valley Aquifer in Andrews County
- Edwards-Trinity (Plateau) Aquifer in Andrews, Martin and Howard Counties

GMA3 (Gam Run 16-027 MAG Final):

- Capitan Reef in Crane, Loving, and Reeves Counties
- Rustler in Crane County

GMA7 (Gam Run 16-026 MAG Version 2):

- Blaine, Igneous, Lipan, Marble Falls, and Seymour Aquifers
- Edwards-Trinity (Plateau) Aquifer in Hickory UWCD1, Lipan-Kickapoo WCD, Lone Wolf GCD, and Wes-Tex GCD
- Ellenburger-San Saba Aquifer in Llano County
- Dockum Aquifer outside of Santa Rita GCD and Middle Pecos GCD
- Ogallala Aquifer outside of Glasscock County

GMA8 (Gam Run 17-029 MAG):

- No aquifers that are within Region F

Other Aquifers

Table 5 details the Other (undifferentiated) Aquifer volume estimates. The total availability from other aquifers is 29,130 afy. The methodology for these volume estimates is derived from the maximum four-year historical annual pumping that occurred in years 2012 through 2015. Historical pumping data are based upon TWDB water use surveys. An exception to this methodology is Borden County, which kept the 2,598 acre-feet maximum historical use (year 2009) that was used in the previous planning cycle. Another exception is the Pecos County volume of 10,000 afy for water from the San Andres Formation.

The Cross Timbers Aquifer was designated as a minor aquifer in 2017. This aquifer encompasses all of Coleman County and portions of Brown, Concho, McCulloch and Runnels Counties in Region F. The aquifer is comprised of Paleozoic-age formations in the Wichita Group (Permian System) and the Cisco, Canyon and Strawn Groups (Pennsylvanian System). The Cross Timbers Aquifer was designated as a minor aquifer in 2017. This aquifer encompasses all of Coleman County and portions of Brown, Concho, McCulloch and Runnels Counties in Region F.

San Andres Formation Estimated Groundwater Availability

In 1957, there were at least 27 groundwater wells completed in the San Andres Formation in northern Pecos County near Imperial, Texas. The wells were flowing at the surface when they were drilled but due to continuous discharge and decreasing formation pressure, only about eight of these wells currently flow. In 1957, the withdrawals were estimated to have been 10,000 acre-feet. An additional quantity of over 3,000 acre-feet was estimated to be available from this source. Uses included irrigation, secondary recovery via waterflooding, and livestock. Water quality was characterized by total dissolved solid concentrations that exceed 5,000 milligrams per liter, hydrogen sulfide gas presence in the groundwater, and sulphur that precipitates out upon oxidation at the surface (Armstrong and McMillion, 1961).

The Capitan Reef Complex is located about four miles to the west of the flowing San Andres Formation wells. The underlying San Andres Formation is structurally high in the area west of Imperial, functions as the base of the backreef sequence, and has good hydrogeological communication with the Capitan Reef Complex (Standen and others, 2009). However, the source of water to the flowing wells is the San Andres Formation (Standen, 2018).

Measurement of discharge from two flowing wells (C-83 and C-88) using weirs was performed in 2015.

- Measured flow from C-83 was 215 gallons per minute (gpm) in November, 2015. Historically, measured flow from this well varied from 1,330 to 900 gpm between April and August, 1957.
- Measured flow from C-88 was 900 to 1,200 gpm in 2015. In 1957 the flow from this well was measured at 900 gpm.

In 2015, total flow from the two wells was over 2 million gallons per day (mgd), which is equivalent to 2,280 acre-feet per year (afy) (LBG-Guyton, 2015). If this average is applied to the eight flowing wells, it

gives an estimate of nearly 9,000 afy. The Middle Pecos district recently indicated that several of the eight flowing wells produce between one to 2.5 mgd. Assuming this applies to four wells, this indicates groundwater availability estimates ranging between 4,480 afy and 11,200 afy for the more productive wells.

For the purposes of regional water planning, WSP believes that an availability estimate of 10,000 afy is reasonable for this planning cycle. This estimate only includes discharge from flowing wells and does not consider impacts from groundwater pumping, subsidence, or water quality. The various environmental issues associated with San Andres Formation water will be discussed in further detail in the regional water plan.

REFERENCES

Armstrong, C.A., and McMillion, L.G., 1961. Geology and Groundwater Resources of Pecos County, Texas, Bulletin 6106 prepared by the U.S. Geological Survey and the Texas Board of Water Engineers in cooperation with Pecos County, 2 volumes.

LBG-Guyton Associates, 2015. Preliminary Compilation of Hydrogeologic Information Collected on the MRK Wells, Pecos County, Texas, 38 p.

Standen, 2018. Personal communication.

Standen and others, 2009. Capitan Reef Complex Structure and Stratigraphy, prepared for Texas Water Development Board Contract No. 0804830794, 63 p.

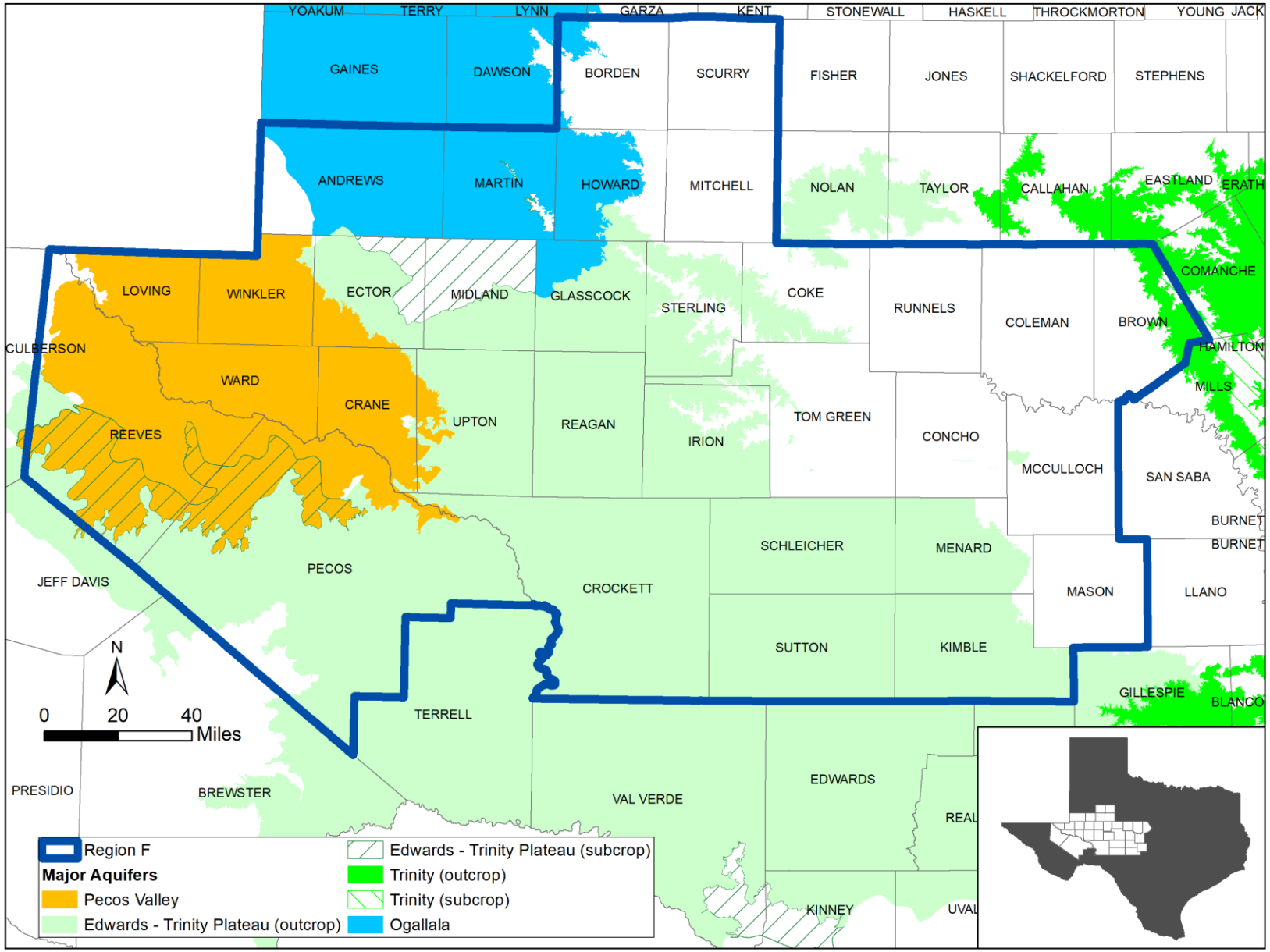

Figure 1. Relevant Major Aquifers

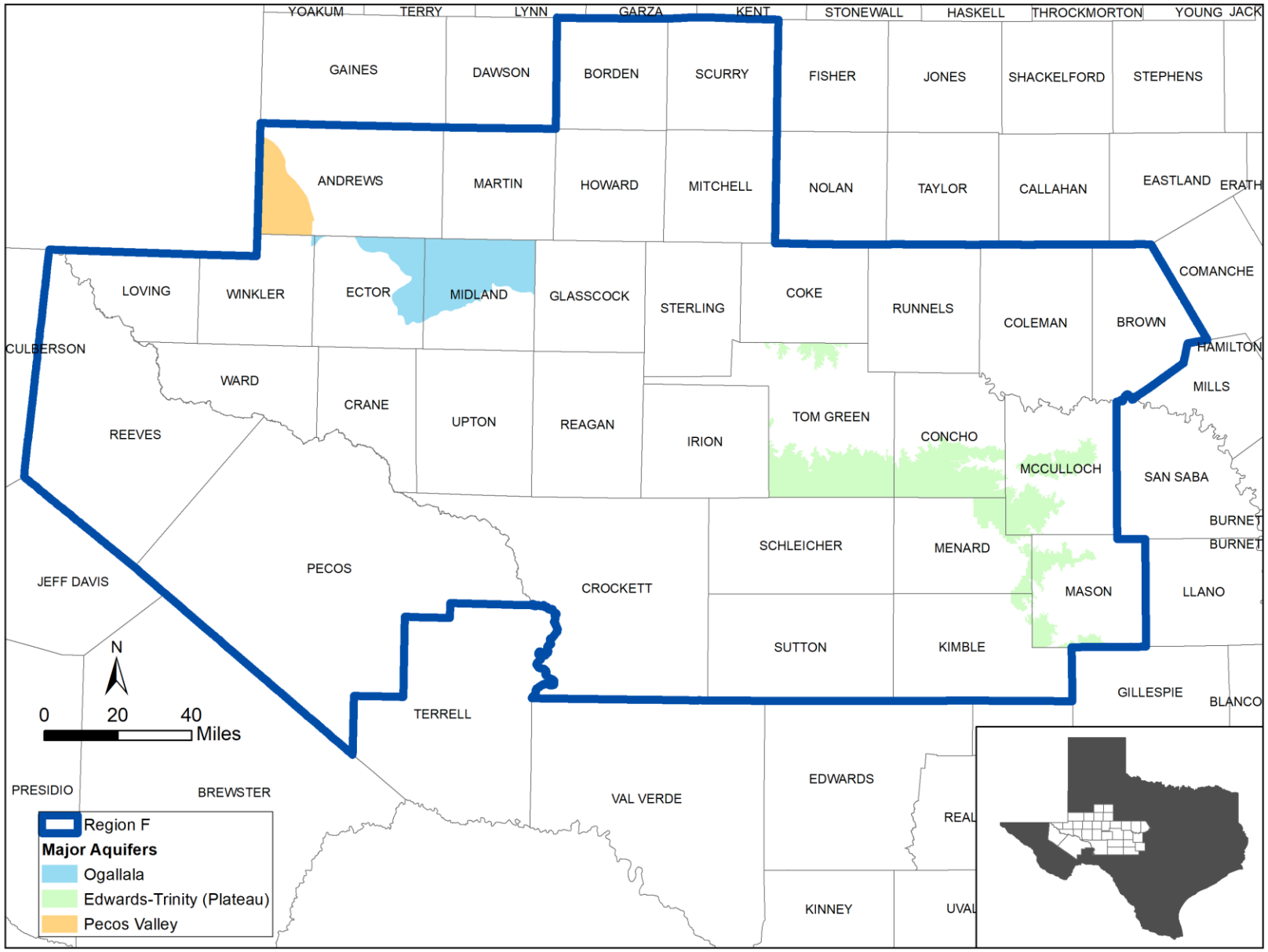

Figure 2. Non-relevant Major Aquifers

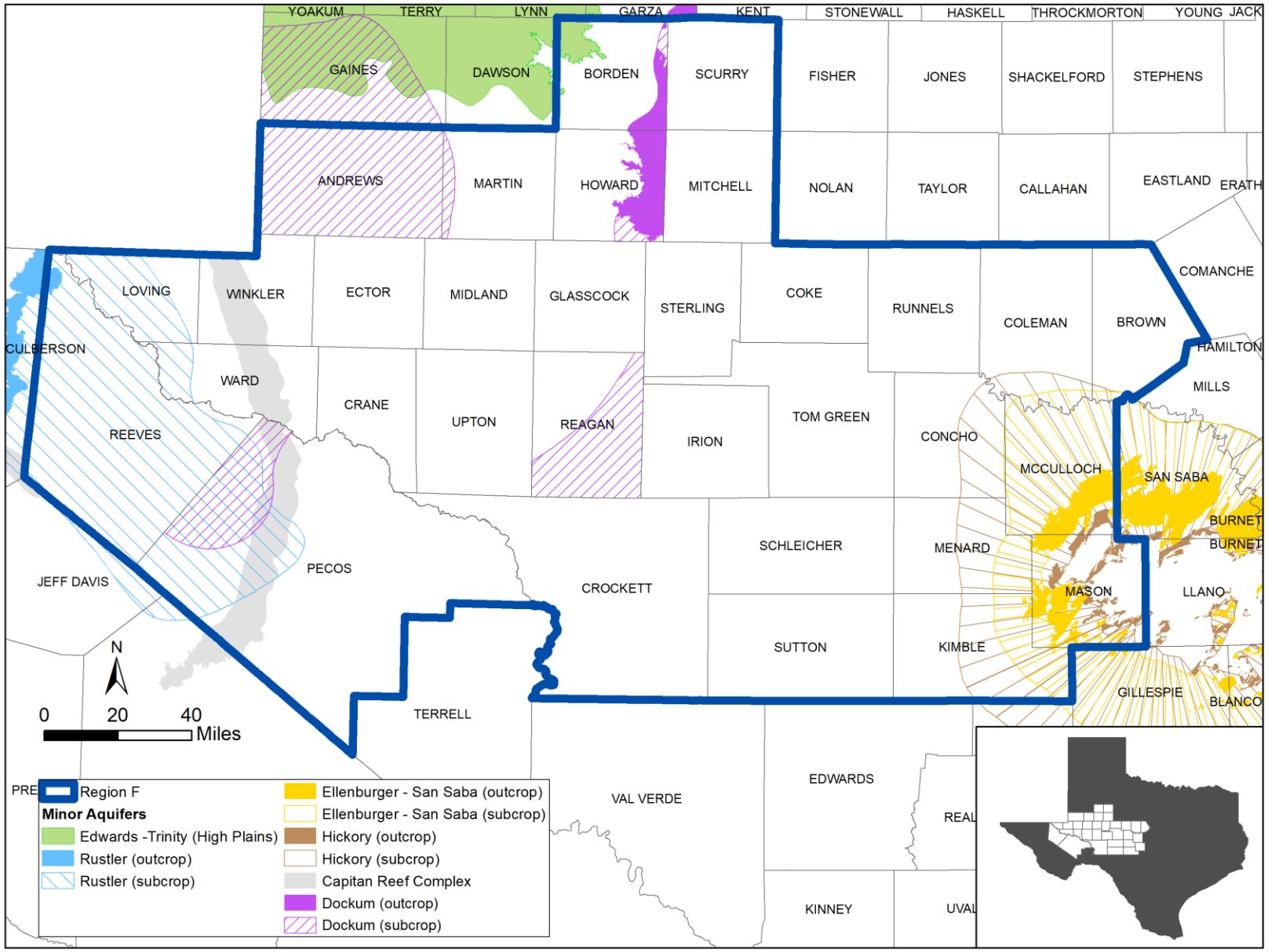

Figure 3. Relevant Minor Aquifers

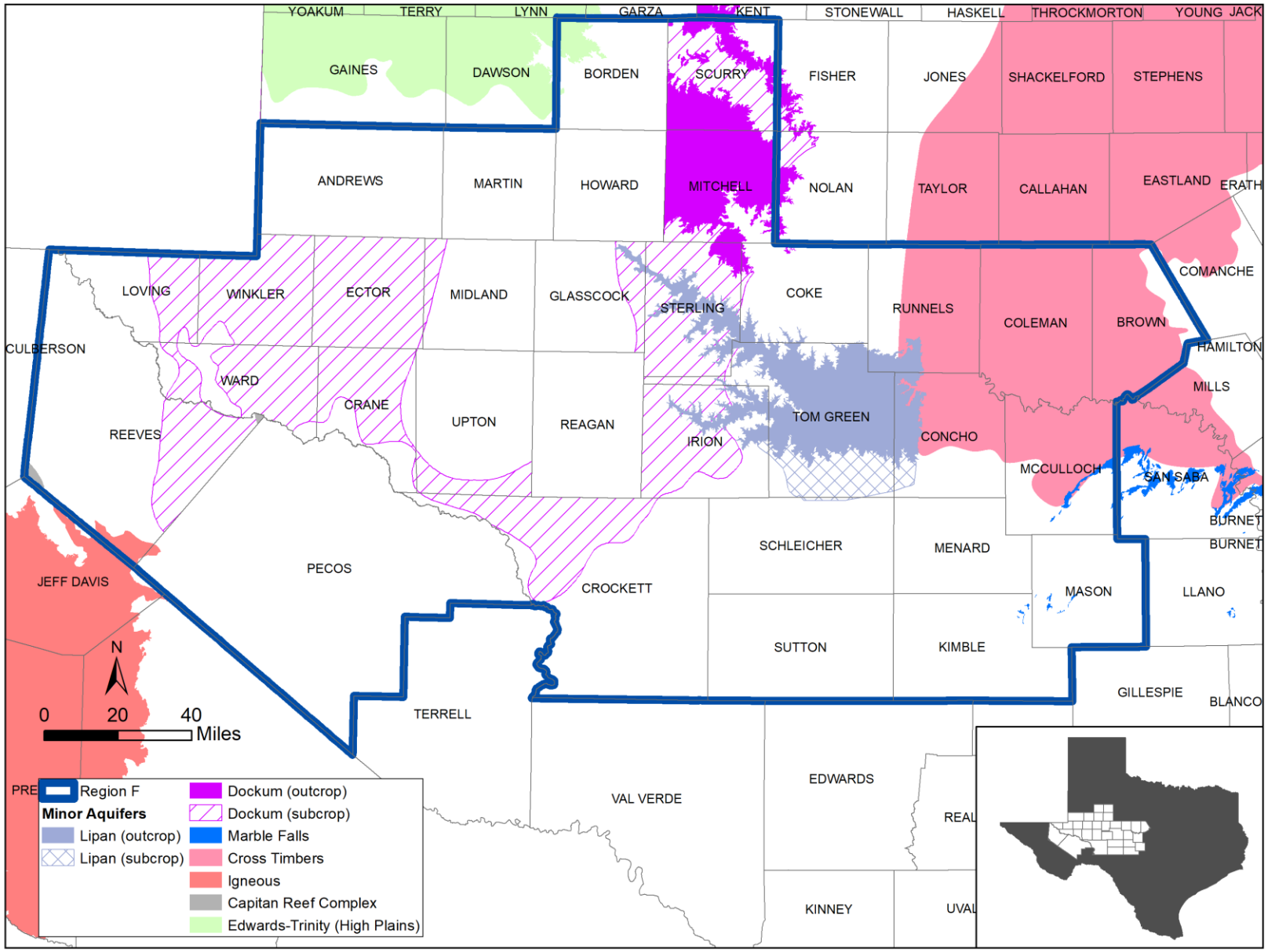

Figure 4. Non-relevant Minor and Other Aquifers

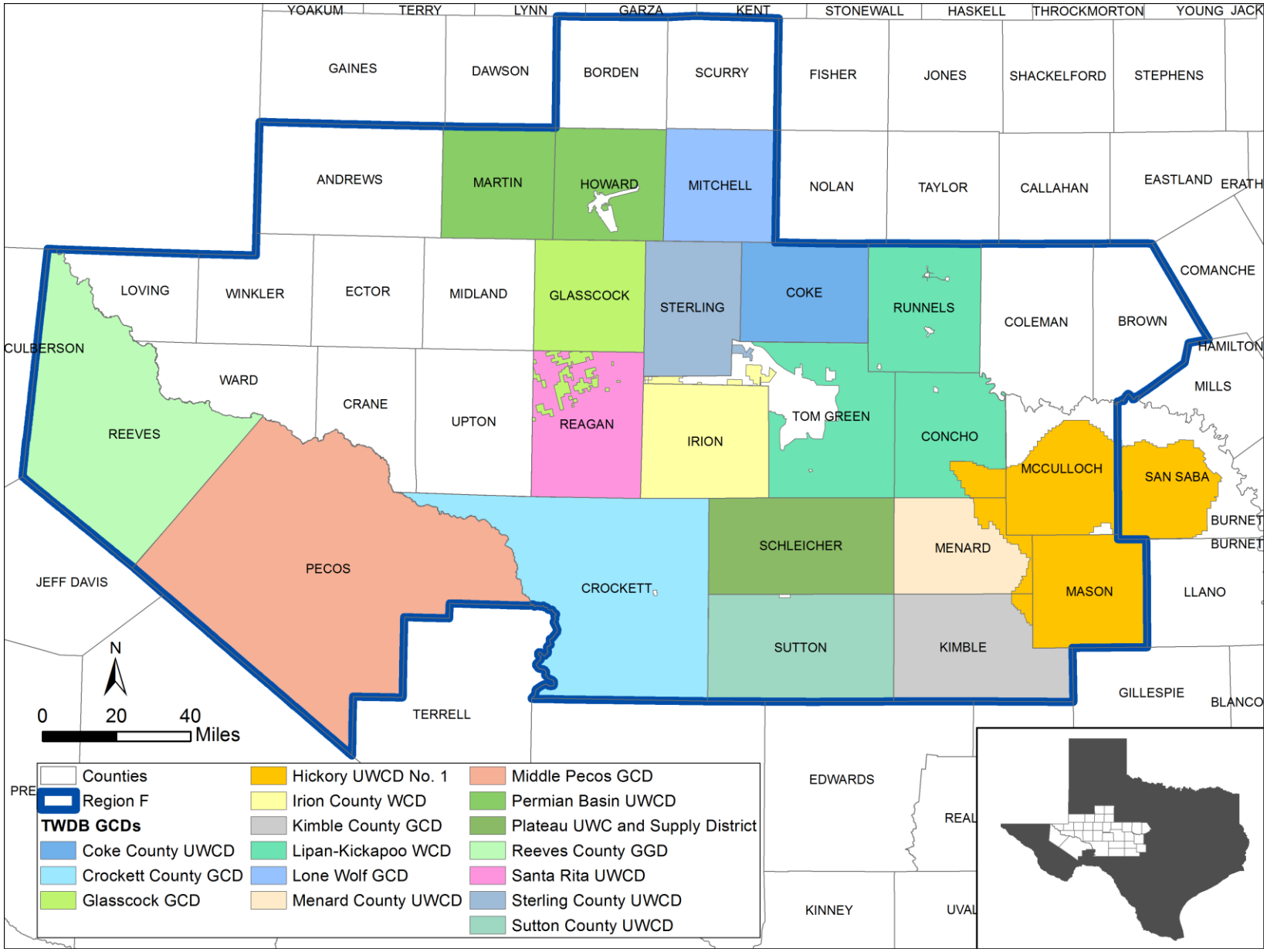

Figure 5. GCDs within Region F

Table 1

Region F Comparison of MAG Volumes

Previous and Current Joint Planning Cycles

(all values are in acre-feet per year)

	JP1						JP2						Difference (Red value in parentheses is a decrease, black is an increase.)					Comments
County	**2020**	**2030**	**2040**	**2050**	**2060**	**GMA**	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2020**	**2030**	**2040**	**2050**	**2060**	
ANDREWS	15,985	14,569	12,905	10,907	8,268	**2**	26,256	22,694	21,114	20,093	19,359	18,793	10,271	8,125	8,209	9,186	11,091	
BORDEN	1,020	1,020	1,020	1,020	1,020	**2**	6,823	5,540	4,970	4,638	4,322	4,113	5,803	4,520	3,950	3,618	3,302	
BROWN	2,188	2,188	2,188	2,188	2,188	**8**	1,618	1,614	1,618	1,614	1,618	1,614	(570)	(574)	(570)	(574)	(570)	Trinity
COKE	998	998	998	998	998	**7**	997	997	997	997	997	997	(1)	(1)	(1)	(1)	(1)	
COLEMAN	500	500	500	500	500	**7**	-	-	-	-	-	-	(500)	(500)	(500)	(500)	(500)	Hickory
CONCHO	1,835	1,835	1,835	1,835	1,835	**7**	27	27	27	27	27	27	(1,808)	(1,808)	(1,808)	(1,808)	(1,808)	Lipan Non-relevant
CRANE	6,998	6,998	6,998	6,998	6,998	**3**	5,085	5,085	5,085	5,085	5,085	5,085	(1,913)	(1,913)	(1,913)	(1,913)	(1,913)	Dockum
CROCKETT	5,457	5,457	5,457	5,457	5,457	**7**	5,447	5,447	5,447	5,447	5,447	5,447	(10)	(10)	(10)	(10)	(10)	
ECTOR	14,089	13,793	13,234	13,198	12,790	**7**	5,542	5,542	5,542	5,542	5,542	5,542	(8,547)	(8,251)	(7,692)	(7,656)	(7,248)	Ogallala Non-relevant
GLASSCOCK	86,535	86,088	84,904	82,502	80,081	**7**	73,111	72,859	72,558	72,244	71,989	71,756	(13,424)	(13,229)	(12,346)	(10,258)	(8,092)	Ogallala relevant but much smaller MAG
HOWARD	3,075	2,731	2,731	2,731	2,703	**2**	21,424	18,980	17,853	17,227	16,870	16,655	18,349	16,249	15,122	14,496	14,167	
IRION	2,293	2,293	2,293	2,293	2,293	**7**	3,289	3,289	3,289	3,289	3,289	3,289	996	996	996	996	996	
KIMBLE	1,593	1,593	1,593	1,593	1,593	**7**	1,968	1,968	1,968	1,968	1,968	1,968	375	375	375	375	375	
LOVING	5,167	5,167	5,167	5,167	5,167	**3**	3,635	3,635	3,635	3,635	3,635	3,635	(1,532)	(1,532)	(1,532)	(1,532)	(1,532)	Rustler, Dockum
MCCULLOCH	12,525	12,525	12,525	12,525	12,525	**7**	28,741	28,741	28,741	28,741	28,741	28,741	16,216	16,216	16,216	16,216	16,216	
MARTIN	13,570	13,570	13,140	12,299	12,277	**2**	63,471	51,134	43,869	39,801	37,218	35,433	49,901	37,564	30,729	27,502	24,941	
MASON	18,095	18,095	18,095	18,095	18,095	**7**	16,449	16,449	16,449	16,449	16,449	16,449	(1,646)	(1,646)	(1,646)	(1,646)	(1,646)	Ellenburger-San Saba smaller MAG
MENARD	4,001	4,001	4,001	4,001	4,001	**7**	5,251	5,251	5,251	5,251	5,251	5,251	1,250	1,250	1,250	1,250	1,250	
MIDLAND	61,639	60,075	57,874	55,944	54,576	**7**	23,233	23,233	23,233	23,233	23,233	23,233	(38,406)	(36,842)	(34,641)	(32,711)	(31,343)	Ogallala Non-relevant
MITCHELL	14,018	14,018	14,018	14,018	14,018	**7**	-	-	-	-	-	-	(14,018)	(14,018)	(14,018)	(14,018)	(14,018)	Dockum Non-relevant
PECOS	275,715	275,715	275,715	275,715	275,715	**3&7**	281,583	281,583	281,583	281,583	281,583	281,583	5,868	5,868	5,868	5,868	5,868	
REAGAN	68,278	68,278	68,278	68,278	68,278	**7**	68,535	68,535	68,535	68,535	68,535	68,233	257	257	257	257	257	
REEVES	198,094	198,094	198,094	198,094	198,094	**3**	194,670	194,670	194,670	194,670	194,670	194,670	(3,424)	(3,424)	(3,424)	(3,424)	(3,424)	Dockum, Capitan
RUNNELS	15	15	15	15	15	**7**	-	-	-	-	-	-	(15)	(15)	(15)	(15)	(15)	Lipan Non-relevant
SCHLEICHER	8,050	8,050	8,050	8,050	8,050	**7**	8,034	8,034	8,034	8,034	8,034	8,034	(16)	(16)	(16)	(16)	(16)	
SCURRY	1,209	1,209	1,209	1,209	1,209	**7**	-	-	-	-	-	-	(1,209)	(1,209)	(1,209)	(1,209)	(1,209)	Dockum Non-relevant
STERLING	2,497	2,497	2,497	2,497	2,497	**7**	2,495	2,495	2,495	2,495	2,495	2,495	(2)	(2)	(2)	(2)	(2)	
SUTTON	6,438	6,438	6,438	6,438	6,438	**7**	6,410	6,410	6,410	6,410	6,410	6,410	(28)	(28)	(28)	(28)	(28)	
TOM GREEN	39,787	39,787	39,787	39,787	39,787	**7**	-	-	-	-	-	-	(39,787)	(39,787)	(39,787)	(39,787)	(39,787)	Lipan Non-relevant
UPTON	22,600	22,600	22,600	22,600	22,600	**7**	22,369	22,369	22,369	22,369	22,369	22,369	(231)	(231)	(231)	(231)	(231)	Dockum Non-relevant
WARD	58,616	58,616	58,616	58,616	58,616	**3**	52,229	52,229	52,229	52,229	52,229	52,229	(6,387)	(6,387)	(6,387)	(6,387)	(6,387)	Dockum, Capitan, Rustler
WINKLER	51,045	51,045	51,045	51,045	51,045	**3**	56,223	56,223	56,223	56,223	56,223	56,223	5,178	5,178	5,178	5,178	5,178	
	1,003,925	**999,858**	**993,820**	**986,613**	**979,727**		**984,915**	**965,033**	**954,194**	**947,829**	**943,588**	**940,274**	**(19,010)**	**(34,825)**	**(39,626)**	**(38,784)**	**(36,139)**	

2021 Plan - Table 2. Modeled Available Groundwater in Region F
(Values in Acre-Feet per Year)

Largest amount of water that can be withdrawn from a given source without violating the most restrictive physical, regulatory, or policy conditions limiting withdrawals, under drought-of-record conditions.

County	Aquifer	Basin	2020	2030	2040	2050	2060	2070
Andrews	Dockum	Colorado	1,319	1,319	1,319	1,319	1,319	1,319
		Rio Grande	0	0	0	0	0	0
	Ogallala and Edwards-Trinity (High Plains)	Colorado	24,937	21,375	19,795	18,774	18,040	17,474
		Rio Grande	0	0	0	0	0	0
Borden	Dockum	Brazos	284	284	284	284	284	284
		Colorado	617	617	617	617	617	617
	Ogallala and Edwards-Trinity (High Plains)	Brazos	842	699	635	597	572	555
		Colorado	5,080	3,940	3,433	3,140	2,849	2,657
Brown	Ellenburger-San Saba	Colorado	131	131	131	131	131	131
	Hickory	Colorado	12	12	12	12	12	12
	Marble Falls	Colorado	25	25	25	25	25	25
	Trinity	Brazos	51	51	51	51	51	51
		Colorado	1,399	1,399	1,399	1,399	1,399	1,399
Coke	Edwards-Trinity (Plateau)	Colorado	997	997	997	997	997	997
Coleman	---	Colorado	---	---	---	---	---	---
Concho	Hickory	Colorado	27	27	27	27	27	27
Crane	Dockum	Rio Grande	94	94	94	94	94	94
	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Rio Grande	4,991	4,991	4,991	4,991	4,991	4,991
Crockett	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Colorado	20	20	20	20	20	20
		Rio Grande	5,427	5,427	5,427	5,427	5,427	5,427
Ector	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Colorado	4,925	4,925	4,925	4,925	4,925	4,925
		Rio Grande	617	617	617	617	617	617
Glasscock	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Colorado	65,186	65,186	65,186	65,186	65,186	65,186
	Ogallala	Colorado	7,925	7,673	7,372	7,058	6,803	6,570
Howard	Ogallala and Edwards-Trinity (High Plains)	Colorado	19,835	17,391	16,264	15,638	15,281	15,066
	Dockum	Colorado	1,589	1,589	1,589	1,589	1,589	1,589
Irion	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Colorado	3,289	3,289	3,289	3,289	3,289	3,289
Kimble	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Colorado	1,282	1,282	1,282	1,282	1,282	1,282
	Ellenburger-San Saba	Colorado	521	521	521	521	521	521
	Hickory	Colorado	165	165	165	165	165	165

2021 Plan - Table 2. Modeled Available Groundwater in Region F
(Values in Acre-Feet per Year)

Largest amount of water that can be withdrawn from a given source without violating the most restrictive physical, regulatory, or policy conditions limiting withdrawals, under drought-of-record conditions.

County	Aquifer	Basin	2020	2030	2040	2050	2060	2070
Loving	Dockum	Rio Grande	453	453	453	453	453	453
	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Rio Grande	2,982	2,982	2,982	2,982	2,982	2,982
	Rustler	Rio Grande	200	200	200	200	200	200
McCulloch	Ellenburger-San Saba	Colorado	4,364	4,364	4,364	4,364	4,364	4,364
	Hickory	Colorado	24,377	24,377	24,377	24,377	24,377	24,377
Martin	Ogallala	Colorado	63,463	51,126	43,861	39,793	37,210	35,425
	Dockum	Colorado	8	8	8	8	8	8
Mason	Ellenburger-San Saba	Colorado	3,237	3,237	3,237	3,237	3,237	3,237
	Hickory	Colorado	13,212	13,212	13,212	13,212	13,212	13,212
Menard	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Colorado	2,217	2,217	2,217	2,217	2,217	2,217
	Ellenburger-San Saba	Colorado	309	309	309	309	309	309
	Hickory	Colorado	2,725	2,725	2,725	2,725	2,725	2,725
Midland	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Colorado	23,233	23,233	23,233	23,233	23,233	23,233
Pecos	Capitan Reef	Rio Grande	26,168	26,168	26,168	26,168	26,168	26,168
	Dockum	Rio Grande	8,164	8,164	8,164	8,164	8,164	8,164
	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Rio Grande	240,208	240,208	240,208	240,208	240,208	240,208
	Rustler	Rio Grande	7,043	7,043	7,043	7,043	7,043	7,043
Reagan	Dockum	Colorado	302	302	302	302	302	302
	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Colorado	68,205	68,205	68,205	68,205	68,205	68,205
		Rio Grande	28	28	28	28	28	28
Reeves	Dockum	Rio Grande	2,539	2,539	2,539	2,539	2,539	2,539
	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Rio Grande	189,744	189,744	189,744	189,744	189,744	189,744
	Rustler	Rio Grande	2,387	2,387	2,387	2,387	2,387	2,387
Schleicher	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Colorado	6,403	6,403	6,403	6,403	6,403	6,403
		Rio Grande	1,631	1,631	1,631	1,631	1,631	1,631
Sterling	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Colorado	2,495	2,495	2,495	2,495	2,495	2,495
Sutton	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Colorado	388	388	388	388	388	388
		Rio Grande	6,022	6,022	6,022	6,022	6,022	6,022

2021 Plan - Table 2. Modeled Available Groundwater in Region F
(Values in Acre-Feet per Year)

Largest amount of water that can be withdrawn from a given source without violating the most restrictive physical, regulatory, or policy conditions limiting withdrawals, under drought-of-record conditions.

County	Aquifer	Basin	2020	2030	2040	2050	2060	2070
Upton	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Colorado	21,243	21,243	21,243	21,243	21,243	21,243
		Rio Grande	1,126	1,126	1,126	1,126	1,126	1,126
Ward	Capitan Reef	Rio Grande	103	103	103	103	103	103
	Dockum	Rio Grande	2,150	2,150	2,150	2,150	2,150	2,150
	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Rio Grande	49,976	49,976	49,976	49,976	49,976	49,976
	Rustler	Rio Grande	0	0	0	0	0	0
Winkler	Capitan Reef	Rio Grande	274	274	274	274	274	274
	Dockum	Colorado	13	13	13	13	13	13
		Rio Grande	5,987	5,987	5,987	5,987	5,987	5,987
	Edwards-Trinity (Plateau) and Pecos Valley and Trinity	Rio Grande	49,949	49,949	49,949	49,949	49,949	49,949

Table 3. 2016 Modeled Available Groundwater in Region F
(Values in Acre-Feet per Year)

County	Aquifer	Basin	2020	2030	2040	2050	2060	2070
Andrews	Dockum	Colorado	715	715	715	715	715	715
		Rio Grande	135	135	135	135	135	135
	Ogallala	Colorado	15,085	13,678	12,014	10,016	7,377	7,377
		Rio Grande	50	41	41	41	41	41
Borden	Dockum	Brazos	33	33	33	33	33	33
		Colorado	482	482	482	482	482	482
	Edwards-Trinity (High Plains)	Brazos	65	65	65	65	65	65
		Colorado	41	41	41	41	41	41
	Ogallala	Brazos	292	292	292	292	292	292
		Colorado	107	107	107	107	107	107
Brown	Ellenburger-San Saba	Colorado	131	131	131	131	131	131
	Hickory	Colorado	12	12	12	12	12	12
	Trinity	Brazos	28	28	28	28	28	28
		Colorado	2,017	2,017	2,017	2,017	2,017	2,017
Coke	Edwards-Trinity (Plateau)	Colorado	998	998	998	998	998	998
Coleman	Hickory	Colorado	500	500	500	500	500	500
Concho	Hickory	Colorado	1	1	1	1	1	1
	Lipan	Colorado	1,834	1,834	1,834	1,834	1,834	1,834
Crane	Dockum	Rio Grande	2,000	2,000	2,000	2,000	2,000	2,000
	Edwards-Trinity (Plateau)	Rio Grande	26	26	26	26	26	26
	Pecos Valley	Rio Grande	4,972	4,972	4,972	4,972	4,972	4,972
Crockett	Edwards-Trinity (Plateau)	Colorado	19	19	19	19	19	19
		Rio Grande	5407	5407	5407	5407	5407	5407
	Pecos Valley	Rio Grande	31	31	31	31	31	31
Ector	Dockum	Colorado	13	13	13	13	13	13
		Rio Grande	515	515	515	515	515	515
	Edwards-Trinity (Plateau)	Colorado	4,918	4,918	4,918	4,918	4,918	4,918
		Rio Grande	504	504	504	504	504	504
	Pecos Valley	Rio Grande	113	113	113	113	113	113
	Ogallala	Colorado	8,026	7,730	7,171	7,135	6,727	6,727
Glasscock	Edwards-Trinity (Plateau)	Colorado	65,213	65,213	65,213	65,213	65,213	65,213
	Ogallala	Colorado	21,322	20,875	19,691	17,289	14,868	14,868
Howard	Ogallala	Colorado	3,075	2,731	2,731	2,731	2,703	2,703
Irion	Edwards-Trinity (Plateau)	Colorado	2,293	2,293	2,293	2,293	2,293	2,293
Kimble	Edwards-Trinity (Plateau)	Colorado	1,283	1,283	1,283	1,283	1,283	1,283
	Ellenburger-San Saba	Colorado	304	304	304	304	304	304
	Hickory	Colorado	6	6	6	6	6	6
Loving	Dockum	Rio Grande	1,000	1,000	1,000	1,000	1,000	1,000
	Edwards-Trinity (Plateau)	Rio Grande	0	0	0	0	0	0
	Pecos Valley	Rio Grande	2,984	2,984	2,984	2,984	2,984	2,984
	Rustler	Rio Grande	1,183	1,183	1,183	1,183	1,183	1,183
Martin	Ogallala	Colorado	13,570	13,570	13,140	12,299	12,277	12,277
Mason	Ellenburger-San Saba	Colorado	5,801	5,801	5,801	5,801	5,801	5,801
	Hickory	Colorado	12,294	12,294	12,294	12,294	12,294	12,294
McCulloch	Edwards-Trinity (Plateau)	Colorado	4	4	4	4	4	4
	Ellenburger-San Saba	Colorado	5,369	5,369	5,369	5,369	5,369	5,369
	Hickory	Colorado	7,152	7,152	7,152	7,152	7,152	7,152

Table 3. 2016 Modeled Available Groundwater in Region F
(Values in Acre-Feet per Year)

County	Aquifer	Basin	2020	2030	2040	2050	2060	2070
Menard	Edwards-Trinity (Plateau)	Colorado	2,194	2,194	2,194	2,194	2,194	2,194
	Ellenburger-San Saba	Colorado	791	791	791	791	791	791
	Hickory	Colorado	1,016	1,016	1,016	1,016	1,016	1,016
Midland	Dockum	Colorado	0	0	0	0	0	0
	Edwards-Trinity (Plateau)	Colorado	23,251	23,251	23,251	23,251	23,251	23,251
	Ogallala	Colorado	38,388	36,824	34,623	32,693	31,325	31,325
Mitchell	Dockum	Colorado	14,018	14,018	14,018	14,018	14,018	14,018
Pecos	Capitan Reef	Rio Grande	11,122	11,122	11,122	11,122	11,122	11,122
	Dockum	Rio Grande	13,965	13,965	13,965	13,965	13,965	13,965
	Edwards-Trinity (Plateau)	Rio Grande	115,938	115,938	115,938	115,938	115,938	115,938
	Pecos Valley	Rio Grande	124,182	124,182	124,182	124,182	124,182	124,182
	Rustler	Rio Grande	10,508	10,508	10,508	10,508	10,508	10,508
Reagan	Edwards-Trinity (Plateau)	Colorado	68,250	68,250	68,250	68,250	68,250	68,250
		Rio Grande	28	28	28	28	28	28
Reeves	Capitan Reef	Rio Grande	1,007	1,007	1,007	1,007	1,007	1,007
	Dockum	Rio Grande	5,000	5,000	5,000	5,000	5,000	5,000
	Edwards-Trinity (Plateau)	Rio Grande	3,389	3,389	3,389	3,389	3,389	3,389
	Pecos Valley	Rio Grande	186,722	186,722	186,722	186,722	186,722	186,722
	Rustler	Rio Grande	1,976	1,976	1,976	1,976	1,976	1,976
Runnels	Lipan	Colorado	15	15	15	15	15	15
Schleicher	Edwards-Trinity (Plateau)	Colorado	6,410	6,410	6,410	6,410	6,410	6,410
		Rio Grande	1,640	1,640	1,640	1,640	1,640	1,640
Scurry	Dockum	Brazos	306	306	306	306	306	306
		Colorado	903	903	903	903	903	903
Sterling	Edwards-Trinity (Plateau)	Colorado	2,497	2,497	2,497	2,497	2,497	2,497
Sutton	Edwards-Trinity (Plateau)	Colorado	386	386	386	386	386	386
		Rio Grande	6,052	6,052	6,052	6,052	6,052	6,052
Tom Green	Edwards-Trinity (Plateau)	Colorado	426	426	426	426	426	426
	Lipan	Colorado	39,361	39,361	39,361	39,361	39,361	39,361
Upton	Dockum	Colorado	0	0	0	0	0	0
		Rio Grande	219	219	219	219	219	219
	Edwards-Trinity (Plateau)	Colorado	21,257	21,257	21,257	21,257	21,257	21,257
		Rio Grande	1,122	1,122	1,122	1,122	1,122	1,122
	Pecos Valley	Rio Grande	2	2	2	2	2	2
Ward	Capitan Reef	Rio Grande	1,051	1,051	1,051	1,051	1,051	1,051
	Dockum	Rio Grande	7,000	7,000	7,000	7,000	7,000	7,000
	Edwards-Trinity (Plateau)	Rio Grande	0	0	0	0	0	0
	Pecos Valley	Rio Grande	50,010	50,010	50,010	50,010	50,010	50,010
	Rustler	Rio Grande	555	555	555	555	555	555
Winkler	Capitan Reef	Rio Grande	1,061	1,061	1,061	1,061	1,061	1,061
	Dockum	Colorado	33	33	33	33	33	33
		Rio Grande	9,967	9,967	9,967	9,967	9,967	9,967
	Pecos Valley	Rio Grande	39,984	39,984	39,984	39,984	39,984	39,984

Table 4
Region F
Non-relevant Aquifer Availability Volumes

Still non-relevant?	County	Aquifer	Basin	2011 Plan Availibility	2016 Plan Availability	DFC Compatible Availability	DFC Compatible Availibility Source/Method	Comments
Y	Andrews	Edwards-Trinity (Plateau)	Colorado	4,640	3,000	1,198	Current: 2016 TWDB DFC Compatible Availability Value; 2016 plan estimate based on GMA7 GTA 08-05 GAM run, Ector Co area 7 numbers and assumption that approximate areas are equivalent; area 7 is most similar and closest to Andrews	2011 pumpage (livestock) = 3 2016 pumpage for livestock ~2.4 af (no other reported user)
Y		Pecos Valley Alluvium	Rio Grande	1,189	1,000	150	Current estimate based on existing well reports compiled (2000-2018) plus historical pumping; 2016 plan estimate based on Ector Co DFC compatible availability, both areas on outer edge of basin	2011 pumpage (livestock) = 34 2016 municipal and livestock pumping = 138 af
Y	Coke	Dockum	Colorado	12	0	100	Current estimate: Lots of rig supply wells; previous estimate was TWDB value	
Y		Lipan	Colorado	0	0	160	Current estimate: sum of yield for existing wells; previous estimate was TWDB value	
Y	Coleman	Hickory	Colorado	0	500	500	estimate equivalent to Concho Co	no TWDB wells; no known historical use
Y	Concho	Edwards-Trinity (Plateau)	Colorado	12,278	487	459	TWDB DFC Compatible Availability Value	2011 pumpage (livestock) = 184
Y, adding area inside LKGCD		Lipan	Colorado	6,513	59	1,893	Current: 2016 MAG plus NR volume from 2016 plan	outside Lipan-Kickapoo GAM area = 59; relevant portion (in GCD) MAG=1834 - summed partials (all NR)
Y, Brackish	Crane	Rustler	Rio Grande	0	1,000	1,000	Current: Rustler brackish study indicates slightly to moderately saline water in Crane County) 2016 plan estimate based on GMA3 AA-10-37 MAG numbers	1 well TDS=111,000; 1 well TDS=2,595 (unused) (brackish - outside of fw aquifer boundary)
Y	Crockett	Dockum	Colorado	0	80	2	Current estimate revised to account for basin is very small portion of county; 2016 plan estimate based on 25% total inflow for Crockett Co - GAM run 10-001; assume relevant area 25% area of entire county	2011 pumpage (livestock) = 1 2016 pumping ~1.8 af
Y		Dockum	Rio Grande	0	2	2	TWDB DFC Compatible Availability Value	
NEW	Ector	Dockum	Colorado			13	2016 MAG	
NEW	Ector	Dockum	Rio Grande			515	2016 MAG	
NEW	Ector	Ogallala	Colorado			8,026	2016 MAG	
Y	Glasscock	Dockum	Colorado	140	900	900	Estimate based on GMA7 GAM run 10-001 Glasscock Co total inflow and assumes that the non-rel portion area ~ 10% of entire county, TWDB MAG = 0 ??	brackish - outside of fw aquifer boundary; 2018 - lots of rig supply wells, but not Dockum
Y		Lipan	Colorado	0	10	10		
Y	Howard	Edwards-Trinity (Plateau)	Colorado	1,700	1,650	672	2016 TWDB DFC Compatible Availability Value	2011 pumpage (irr, stk, mun) = 3853 2016 pumping = 1485 af
Y	Irion	Dockum	Colorado	0	150	150	estimate based on GMA7 GAM run 17-013 Irion Co total Lipan inflow	2011 pumpage (livestock) = 1; O&G activity high 2016 pumping ~1.1 af
Y		Lipan	Colorado	0	13	13	TWDB DFC Compatible Availability Value	
Y	Kimble	Edwards-Trinity (Plateau)	Colorado	23,965	104	104	2.55% of Kimble CO ETP recharge	
Y		Marble Falls	Colorado	0	100	100		no wells on WIID
Y	McCulloch	Edwards-Trinity (Plateau)	Colorado	8,249	144	148	TWDB DFC Compatible Availability Value	144 for area within Hickory UWCD; relevant portion MAG=4
Y		Marble Falls	Colorado	15	50	50		a few exempt wells; avg. historical use 2007-2011=36
Y	Martin	Edwards-Trinity (Plateau)	Colorado	3,398	1,500	242	Current = 2016 TWDB DFC Compatible Availability Value; previous estimate based on GMA7 GTA 08-05 (p. 7) Midland Co area 9 numbers and assumes non-rel area ~ 33% of Midland Co area 9	
Y	Mason	Edwards-Trinity (Plateau)	Colorado	3,828	18	18	TWDB DFC Compatible Availability Value	2011 pumpage (livestock) = 12
Y		Marble Falls	Colorado	134	100	100		no wells on WIID
Y	Menard	Edwards-Trinity (Plateau)	Colorado	19,000	377	377	TWDB DFC Compatible Availability Value	377 for area within Hickory UWCD; relevant portion MAG=2194
NEW	Midland	Dockum	Colorado			400	well reports for fracking 7 wells - assume Santa Rosa 35 gpm	BRACKISH TDS ~8000 from 1 well
NEW	Midland	Ogallala	Colorado			38,388	2016 MAG	
NEW	Mitchell	Dockum	Colorado			14,018	2016 MAG	
NEW	Mitchell	PV, ETP, T	Colorado			0	2016 MAG	
NEW	Pecos	Igneous	Rio Grande			80	assume 4-5 stock wells @5-10 gpm	assume 4-5 stock wells @5-10 gpm

Table 4
Region F
Non-relevant Aquifer Availability Volumes

Still non-relevant?	County	Aquifer	Basin	2011 Plan Availibility	2016 Plan Availability	DFC Compatible Availability	DFC Compatible Availibility Source/Method	Comments
NEW	Reeves	Igneous	Rio Grande			300	TWDB 2016 groundwater pumpage = 372 afy (non-surveyed estimates) x 0.8	
NEW	Reeves	Capitan Reef Complex	Rio Grande			1,007	2016 MAG	NO WELLS; NO DATA
Y, adding area inside LKGCD	Runnels	Lipan	Colorado	4,536	30	45	2016 MAG	outside Lipan-Kickapoo GAM area=30; relevant portion (in GCD) MAG=15 summed partials (all NR)
Y	Schleicher	Lipan	Colorado	0	0	0	TWDB DFC Compatible Availability Value	furthest downdip portion, zero is fine
NEW	Scurry	Dockum	Brazos			306	2016 MAG	
NEW	Scurry	Dockum	Colorado			903	2016 MAG	
NEW	Scurry	Seymour	Brazos			10	no wells no data no recharge numbers (no district)	
Y	Sterling	Dockum	Colorado	0	10	10	TWDB DFC Compatible Availability Value	2011 pumpage (livestock) = 6
Y		Lipan	Colorado	0	50	850	Sterling City system capacity = 2,580 afy pumping 24/7, assume 6 hours pumping/day = 645 afy; average daily consumption = 200 afy	2013 historical pumping for municipal livestock irrigation and mining = 872 afy
Y	Tom Green	Dockum	Colorado	54	0	200	2 rig supply wells have been drilled, very small area	2 rig supply wells have been drilled, very small area
Y		PV, ETP, T	Colorado	15,037	2,372	2,797	2016 MAG	outside Lipan-Kickapoo GAM area=2372; relevant portion (in GCD) MAG=426 this is a sum of partial MAGs from 2016
Y, adding area inside LKGCD		Lipan	Colorado	37,486	4,207	43,568	2016 MAG	outside Lipan-Kickapoo GAM area=4207; relevant portion (in GCD) MAG=39361 - summed partials (all NR)
NEW	Upton	Dockum				1,000	well reports for fracking 17 wells - assume Santa Rosa 35 gpm	
Y, Brackish	Winkler	Rustler	Rio Grande	0	500	500	based on GMA3 AA-10-37 MAG numbers(four Rustler county MAGs total 7180, Ward Co MAG is 555 and is closest in proximity) 2018: revised downward	2 Shell wells: one plugged/destroyed, one TDS=44,000; very brackish for mining or desal only
NEW	Winkler	Ogallala	Rio Grande			40	The nearest well drilled in 2011 (4 miles to northeast) pumps about 25 gpm. About 25 feet of saturated thickness. 40 afy assumes 2 similar wells could be sustained in Winkler.	
					Total:	**121,324**		

Color key

	WSP estimate
	TWDB 'DFC-compatible' spreadsheet MAG from previous cycle
	MAG from previous cycle

Table 5
Groundwater Supplies from Other Undifferentiated Aquifers
(Acre-Feet per Year)

County	Aquifer Name	Basin	2021 Availability
Borden	Other Aquifer	Colorado	2,598
Brown	Other Aquifer | Cross Timbers	Colorado	993
Coke	Other Aquifer	Colorado	2,100
Coleman	Other Aquifer	Colorado	109
	Other Aquifer | Cross Timbers	Colorado	108
Concho	Other Aquifer	Colorado	5,964
Mason	Other Aquifer	Colorado	873
McCulloch	Other Aquifer	Colorado	103
	Other Aquifer | Cross Timbers	Colorado	103
Mitchell	Other Aquifer	Colorado	789
Pecos	Other Aquifer |San Andres	Rio Grande	10,000
Runnels	Other Aquifer	Colorado	5,001
Scurry	Other Aquifer	Brazos	74
		Colorado	315

Total: 29,130 afy