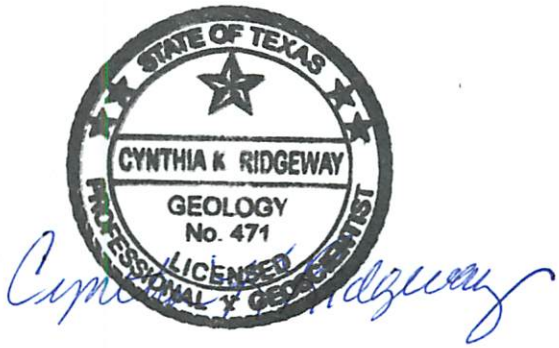
GAM Run 10-019 MAG Version 2

by Mr. Wade Oliver

Texas Water Development Board
Groundwater Availability Modeling Section
(512) 463-3132
August 30, 2011



Cynthia K. Ridgeway is the Manager of the Groundwater Availability Modeling Section and is responsible for oversight of work performed by employees under her direct supervision. The seal appearing on this document was authorized by Cynthia K. Ridgeway, P.G. 471 on August 30, 2011.

This page is intentionally blank.

EXECUTIVE SUMMARY:

The estimated total pumping from the Dockum Aquifer that achieves the desired future condition adopted by the members of Groundwater Management Area 1 is approximately 21,200 acre-feet per year and is summarized by county, regional water planning area, and river basin as shown in Table 1. The estimated managed available groundwater for the groundwater conservation districts within Groundwater Management Area 1 for the aquifer declines from approximately 13,900 acre-feet per year to 12,900 acre-feet per year between 2010 and 2060 and is shown in Table 6. The pumping estimates were extracted from the addendum to Groundwater Availability Model Run 09-014, which Groundwater Management Area 1 used as the basis for developing a desired future condition of an average decline in water levels of "no more than 30 feet over the next 50 years." This second version of the report contains updated estimates of pumping that is exempt from permitting by High Plains Underground Water Conservation District.

REQUESTOR:

Mr. Kyle Ingham of the Panhandle Regional Planning Commission on behalf of Groundwater Management Area 1

DESCRIPTION OF REQUEST:

In a letter received June 14, 2010, Mr. Kyle Ingham provided the Texas Water Development Board (TWDB) with the desired future condition of the Dockum Aquifer adopted by the members of Groundwater Management Area 1. The desired future condition for the Dockum Aquifer, as described in Resolution No. 2010-01 and adopted June 3, 2010 by the groundwater conservation districts within Groundwater Management Area 1, is described below:

> *The Joint Planning Committee adopts the Desired Future Condition of the Dockum Aquifer contained within* [Groundwater Management Area] *1 whereby the average decline in water levels will decline no more than 30 feet over the next 50 years.*

In response to receiving the adopted desired future condition, TWDB has estimated the managed available groundwater that achieves the above desired future condition for each of the groundwater conservation districts within Groundwater Management Area 1.

METHODS:

Groundwater Management Area 1, located in the northern portion of the Texas Panhandle, contains a portion of the Dockum Aquifer, a minor aquifer as defined in the 2007 State Water Plan (TWDB, 2007). The location of Groundwater Management Area 1, the Dockum Aquifer, and the groundwater availability model cells that represent the aquifer are shown in Figure 1. The TWDB previously completed several predictive groundwater availability model simulations for the Dockum Aquifer, documented in GAM Run 09-014 (Oliver, 2010a) and its addendum (Oliver, 2010b). The "30-foot drawdown scenario" in Oliver (2010b) achieves the desired future condition specified by Groundwater Management Area 1. The pumping results for Groundwater Management Area 1 presented here, taken directly from the above scenario, have been divided

by county, regional water planning area, river basin, and groundwater conservation district. These areas are shown in Figure 2.

PARAMETERS AND ASSUMPTIONS:

The parameters and assumptions for the model run using the modified groundwater model for the Dockum Aquifer are described below:

- The results presented in this report are based on the "30-foot drawdown scenario" in the addendum to GAM Run 09-014 (Oliver, 2010b). See GAM Run 09-014 (Oliver, 2010a) and its addendum (Oliver, 2010b) for a full description of the methods, assumptions, and results for the groundwater availability model run.

- The modified version the groundwater model for the Dockum Aquifer described in Oliver and Hutchison (2010) was used for this analysis. This model is an update to the previously developed groundwater availability model for the Dockum Aquifer described in Ewing and others (2008) in order to more effectively simulate predictive conditions. See Oliver and Hutchison (2010) and Ewing and others (2008) for assumptions and limitations of the model.

- The model includes two active layers which represent the upper and lower portions of the Dockum Aquifer. Layer 2 represents the upper portion of the Dockum Aquifer. Layer 3 represents the lower portion of the Dockum Aquifer. Layer 1, which is active in version 1.01 of the model documented in Ewing and others (2008), was inactivated in the modified model as described in Oliver and Hutchison (2010).

- The mean absolute error (a measure of the difference between simulated and measured water levels during model calibration) for the lower portion of the Dockum Aquifer between 1980 and 1997 is 53 feet.

- Cells were assigned to individual counties, river basins, regional water planning areas, and groundwater conservation districts as shown in the August 3, 2010 version of file that associates the model grid to political and natural boundaries for the Dockum Aquifer. Note that some minor corrections were made to the file to correct river basin cell assignments.

- The recharge used for the model run represents average recharge as described in Ewing and others (2008).

Determining Managed Available Groundwater

As defined in Chapter 36 of the Texas Water Code, "managed available groundwater" is the amount of water that may be permitted. The pumping output from groundwater models, however, represents the total amount of pumping from the aquifer. The total pumping includes uses of water both subject to permitting and exempt from permitting. Examples of exempt uses include domestic, livestock, and oil and gas exploration. Each district may also exempt additional uses as defined by its rules or enabling legislation.

Since exempt uses are not available for permitting, it is necessary to account for them when determining managed available groundwater. To do this the Texas Water Development Board developed a standardized method for estimating exempt use for domestic and livestock purposes based on projected changes in population and the distribution of domestic and livestock wells in the area. Because other exempt uses can vary significantly from district to district, and there is much higher uncertainty associated with estimating use due to oil and gas exploration, estimates of exempt pumping outside domestic and livestock uses were not been included. The districts were also encouraged to evaluate the estimates of exempt pumping and, if desired, provide updated estimates. Once established, the estimates of exempt pumping were subtracted from the total pumping output from the groundwater model to yield the estimated managed available groundwater for permitting purposes.

RESULTS:

The estimated total pumping from the Dockum Aquifer in Groundwater Management Area 1 that achieves the above desired future condition is approximately 21,200 acre-feet per year. This pumping has been divided by county, regional water planning area, and river basin for each decade between 2010 and 2060 for use in the regional water planning process (Table 1). Note that Groundwater Management Area 1 is located entirely within the Panhandle Regional Water Planning Area (Region A).

The total pumping estimates are also summarized by county, river basin, and groundwater conservation district as shown in tables 2, 3, and 4, respectively. In Table 4, the total pumping both excluding and including areas outside of a groundwater conservation district is shown. Table 5 contains the estimates of exempt pumping in the groundwater conservation districts within Groundwater Management Area 1 either estimated by the TWDB or provided by the districts. The managed available groundwater for each groundwater conservation district, the difference between the total pumping in the district (Table 4) and the estimated exempt use (Table 5) is shown in Table 6.

Notice in Table 6 that the estimated managed available groundwater for Panhandle Groundwater Conservation District is zero beginning in 2030. This is because the estimated exempt use for the district in Table 5 is higher than the total pumping for the district in Table 4.

LIMITATIONS:

Managed available groundwater numbers included in this report are the result of subtracting the estimated future exempt use from the estimated total pumping that would achieve the desired future condition adopted by the groundwater conservation districts in the groundwater management area. These numbers, therefore, are the result of (1) running the groundwater model to estimate the total pumping required to achieve the desired future condition and (2) estimating the future exempt use in the area.

The groundwater model used in developing estimates of total pumping is the best available scientific tool that can be used to estimate the pumping that will achieve the desired future condition. Although the groundwater model used in this analysis is the best available scientific

tool for this purpose, it, like all models, has limitations. In reviewing the use of models in environmental regulatory decision making, the National Research Council (2007) noted:

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

A key aspect of using the groundwater model to develop estimates of total pumping is the need to make assumptions about the location in the aquifer where future pumping will occur. As actual pumping changes in the future, it will be necessary to evaluate the amount of that pumping as well as its location in the context of the assumptions associated with this analysis. Evaluating the amount and location of future pumping is as important as evaluating the changes in groundwater levels, spring flows, and other metrics that describe the condition of the groundwater resources in the area that relate to the adopted desired future condition.

In addition, certain assumptions have been made regarding future precipitation, recharge, and streamflow in developing these total pumping estimates. Those assumptions also need to be considered and compared to actual future data when evaluating compliance with the desired future condition.

In the case of TWDB's estimates of future exempt use, key assumptions were made as to the pattern of population growth relative to the need for domestic wells or supplied water, per capita use from domestic wells, and livestock uses of water. In the case of district estimates of future exempt use, including exempt use associated with the exploration of oil and gas, the assumptions are specific to that district. In either case, these assumptions need to be considered when reviewing future data related to exempt use.

Given these limitations, users of this information are cautioned that the total pumping numbers should not be considered a definitive, permanent description of the amount of groundwater that can be pumped to meet the adopted desired future condition. Because the application of the groundwater model was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations relating to the actual conditions of any aquifer at a particular location or at a particular time.

It is important for groundwater conservation districts to monitor future groundwater pumping as well as whether or not they are achieving their desired future conditions. Because of the limitations of the groundwater model and the assumptions in this analysis, it is important that the groundwater conservation districts work with the TWDB to refine these managed available groundwater numbers given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future.

REFERENCES AND ASSOCIATED MODEL RUNS:

Ewing, J.E., Jones, T.L., Yan, T., Vreugdenhil, A.M., Fryar, D.G., Pickens, J.F., Gordon, K., Nicot, J.P., Scanlon, B.R., Ashworth, J.B., Beach, J., 2008, Groundwater Availability Model for the Dockum Aquifer – Final Report: contract report to the Texas Water Development Board, 510 p.

National Research Council, 2007. Models in Environmental Regulatory Decision Making. Committee on Models in the Regulatory Decision Process, National Academies Press, Washington D.C., 287 p.

Oliver, W., Hutchison, W.R., 2010, Modification and recalibration of the Groundwater Availability Model of the Dockum Aquifer: Texas Water Development Board, 114 p.

Oliver, W., 2010a, GAM Run 09-014: Texas Water Development Board, GAM Run 09-014 Report, 44 p.

Oliver, W., 2010b, GAM Run 09-014 Addendum: Texas Water Development Board, GAM Run 09-014 Addendum Report, 7 p.

Texas Water Development Board, 2007, Water for Texas – 2007—Volumes I-III; Texas Water Development Board Document No. GP-8-1, 392 p.

Table 1. Estimated total annual pumping for the Dockum Aquifer in Groundwater Management Area 1. Results are in acre-feet per year and are divided by county, regional water planning area, and river basin.

County	Region	Basin	Year					
			2010	2020	2030	2040	2050	2060
Armstrong	A	Red	582	582	582	582	582	582
Carson	A	Canadian	20	20	20	20	20	20
		Red	263	263	263	263	263	263
Dallam	A	Canadian	4,034	4,034	4,034	4,034	4,034	4,034
Hartley	A	Canadian	3,567	3,567	3,567	3,567	3,567	3,567
Moore	A	Canadian	5,395	5,395	5,395	5,395	5,395	5,395
Oldham	A	Canadian	2,868	2,868	2,868	2,868	2,868	2,868
		Red	104	104	104	104	104	104
Potter	A	Canadian	1,525	1,525	1,525	1,525	1,525	1,525
		Red	155	155	155	155	155	155
Randall	A	Red	2,119	2,119	2,119	2,119	2,119	2,119
Sherman	A	Canadian	591	591	591	591	591	591
Total			**21,223**	**21,223**	**21,223**	**21,223**	**21,223**	**21,223**

Table 2. Estimated total annual pumping for the Dockum Aquifer summarized by county in Groundwater Management Area 1 for each decade between 2010 and 2060. Results are in acre-feet per year.

County	Year					
	2010	2020	2030	2040	2050	2060
Armstrong	582	582	582	582	582	582
Carson	283	283	283	283	283	283
Dallam	4,034	4,034	4,034	4,034	4,034	4,034
Hartley	3,567	3,567	3,567	3,567	3,567	3,567
Moore	5,395	5,395	5,395	5,395	5,395	5,395
Oldham	2,972	2,972	2,972	2,972	2,972	2,972
Potter	1,680	1,680	1,680	1,680	1,680	1,680
Randall	2,119	2,119	2,119	2,119	2,119	2,119
Sherman	591	591	591	591	591	591
Total	**21,223**	**21,223**	**21,223**	**21,223**	**21,223**	**21,223**

Table 3. Estimated total annual pumping for the Dockum Aquifer summarized by river basin in Groundwater Management Area 1 for each decade between 2010 and 2060. Results are in acre-feet per year.

Basin	Year					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Canadian	18,000	18,000	18,000	18,000	18,000	18,000
Red	3,223	3,223	3,223	3,223	3,223	3,223
Total	**21,223**	**21,223**	**21,223**	**21,223**	**21,223**	**21,223**

Table 4. Estimated total annual pumping for the Dockum Aquifer summarized by groundwater conservation district (GCD) in Groundwater Management Area 1 for each decade between 2010 and 2060. Results are in acre-feet per year. UWCD refers to Underground Water Conservation District.

Groundwater Conservation District	Year					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
High Plains UWCD No. 1	1,296	1,296	1,296	1,296	1,296	1,296
North Plains GCD	12,118	12,118	12,118	12,118	12,118	12,118
Panhandle GCD	2,237	2,237	2,237	2,237	2,237	2,237
Total (excluding non-district areas)	**15,651**	**15,651**	**15,651**	**15,651**	**15,651**	**15,651**
No District	5,572	5,572	5,572	5,572	5,572	5,572
Total (including non-district areas)	**21,223**	**21,223**	**21,223**	**21,223**	**21,223**	**21,223**

Table 5. Estimates of exempt use for the Dockum Aquifer in Groundwater Management Area 1 by groundwater conservation district (GCD) for each decade between 2010 and 2060. Results are in acre-feet per year. UWCD refers to Underground Water Conservation District.

Groundwater Conservation District	Source	Year					
		2010	**2020**	**2030**	**2040**	**2050**	**2060**
High Plains UWCD No.1	D	0	0	0	0	0	0
North Plains GCD	TA	350	395	442	476	494	493
Panhandle GCD	TA	1,423	1,875	2,290	2,763	3,281	3,703
Total		**1,773**	**2,270**	**2,732**	**3,239**	**3,775**	**4,196**

TA = Estimated exempt use calculated by TWDB and accepted by the district

D = Estimated exempt use provided by the district

Table 6. Estimates of managed available groundwater for the Dockum Aquifer in Groundwater Management Area 1 by groundwater conservation district (GCD) for each decade between 2010 and 2060. Results are in acre-feet per year. UWCD refers to Underground Water Conservation District.

Groundwater Conservation District	**Year**					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
High Plains UWCD No. 1	1,296	1,296	1,296	1,296	1,296	1,296
North Plains GCD	11,768	11,723	11,676	11,642	11,624	11,625
Panhandle GCD	814	362	0	0	0	0
Total	**13,878**	**13,381**	**12,972**	**12,938**	**12,920**	**12,921**

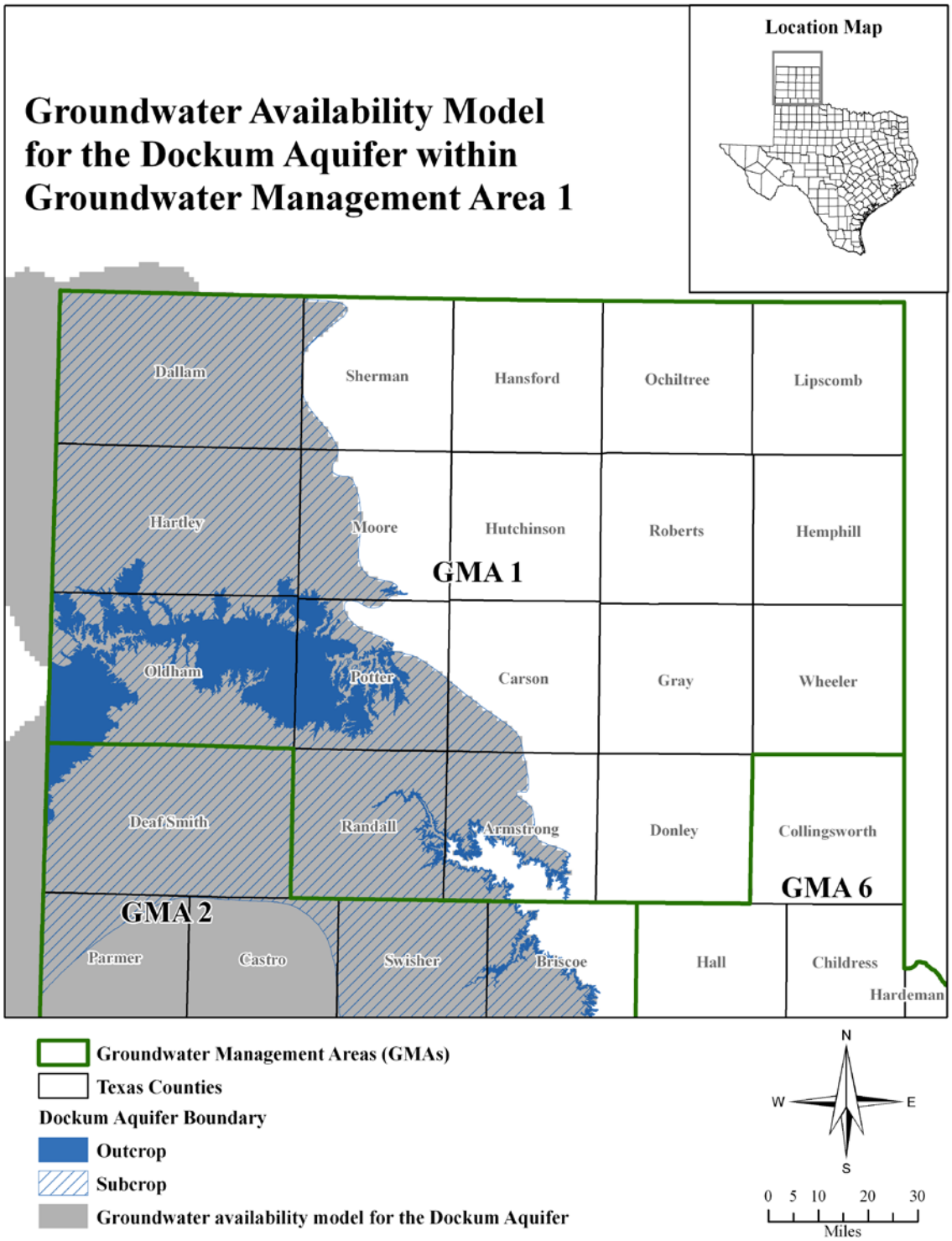


Figure 1. Map showing the areas covered by the groundwater availability model for the Dockum Aquifer and the boundary of Groundwater Management Area 1.

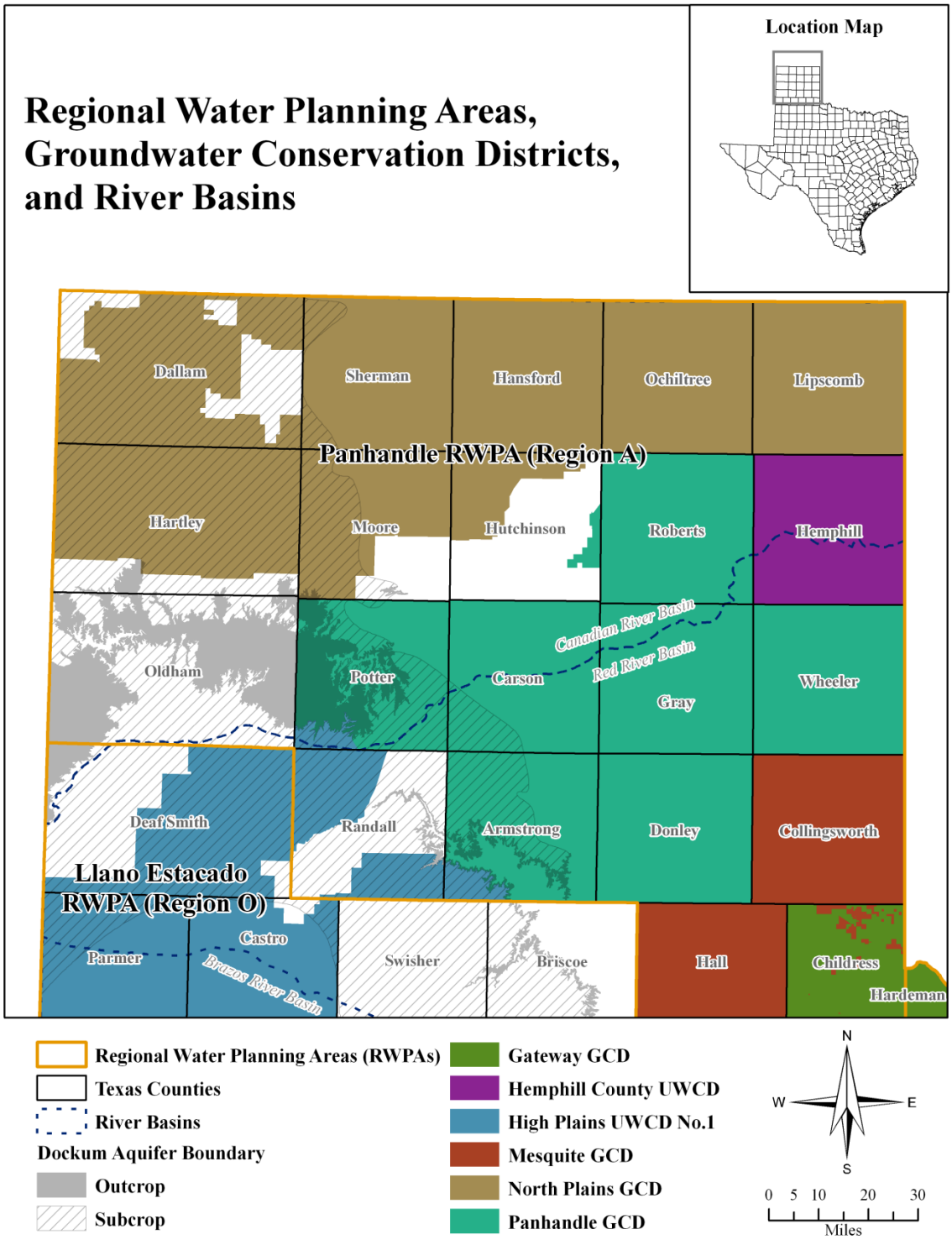


Figure 2. Map showing regional water planning areas (RWPAs), groundwater conservation districts (GCDs), counties, and river basins in and neighboring Groundwater Management Area 1. UWCD refers to Underground Water Conservation District.