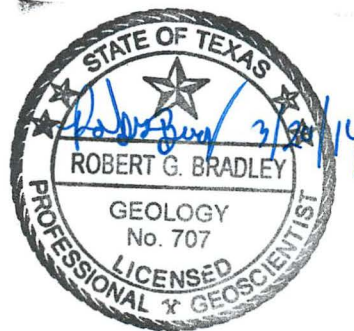

AQUIFER ASSESSMENT 14-01: TOTAL ESTIMATED RECOVERABLE STORAGE FOR THE LEONA GRAVEL IN MEDINA COUNTY FOR GROUNDWATER MANAGEMENT AREAS 10 AND 13

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March 20, 2014



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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 (24) 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.

The Leona Gravel in Medina County was declared relevant for joint planning purposes by Groundwater Management Area 10 on May 17, 2010 and by Groundwater Management Area 13 on July 13, 2011. This report is a supplement to GAM Task 13-033 (Jones and others, 2013) and GAM Task 13-036 (revised) (Wade and Bradley, 2013) issued to Groundwater Management Area 10 and Groundwater Management Area 13, respectively, covering each area's major and minor aquifers. This report only covers Medina County and the Medina County Groundwater Conservation District.

This report discusses the methods, assumptions, and results of an analysis to estimate the total recoverable storage for the Leona Gravel within Groundwater Management Areas 10 and 13 for Medina County. Tables 1 through 4 summarize the total estimated recoverable storage required by statute. Figure 1 shows the extent used to estimate the total recoverable storage.

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. The assumption is that between 25 and 75 percent of groundwater held within an aquifer can be removed by pumping.

Total estimated recoverable storage values may include a mixture of water quality types, including fresh, brackish, and saline groundwater, because the available data does not permit the differentiation of different water quality types. These 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 result from extracting groundwater from the aquifer.

METHODS, PARAMETERS, AND ASSUMPTIONS:

The total storage is the volume of groundwater that can be removed by completely draining the aquifer. The delineation by Lowery and Couch (2002) was used to estimate the total recoverable storage of the Leona Gravel.

A well screened in an unconfined aquifer will have a water level equal to the water level in the aquifer outside the well. Consequently, unconfined aquifers have water levels less than the top of the aquifers. The equation used to calculate total storage is:

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

where:

- $V_{drained}$ = storage volume due to water draining from the formation (acre-feet)
- $Area$ = area of aquifer (acre)
- $Water\ Level$ = groundwater elevation (feet above mean sea level)
- $Bottom$ = elevation of aquifer bottom (feet above mean sea level)
- S_y = specific yield (no units)

As presented in the equation, calculation of the total storage requires data, including aquifer base, aquifer storage properties, and water level. The total recoverable storage was calculated as the product of the total storage and an estimated factor ranging from 25 percent to 75 percent of the total storage.

Because there is no groundwater availability model for this aquifer, the total storage was calculated using the approach described below.

- The Leona Gravel in Medina County consists of three units; the Leona Formation (Qle), fluvial terrace deposits (Qt), and Quaternary alluvium (Qal) as delineated by Lowery and Couch (2002) and further described by George (2010) (Figure 1).
- The aquifer outline was created from the 1:250,000 Digital Geological Atlas of Texas (USGS and TWDB, 2006).
- Areas in acres for each unit of the aquifer, after being subdivided by Groundwater Management Area and river basin boundaries, were calculated in Esri® ArcMap™ 10.1 using the aquifer outline.
- Water levels and well depth information are from TWDB groundwater database downloads <http://www.twdb.texas.gov/groundwater/data/gwdbbrpt.asp> and from the Texas Department of Licensing and Regulation (TDLR) Well Reports <https://texaswellreports.twdb.state.tx.us/drillers-new/index.asp> , both accessed December 2013.
- The available water level data are not spatially and temporally extensive at any one period in the database record. Clusters of water levels occurs in the 1950s (drought years) and in the 1990s (wet years). Therefore, additional water level measurements were obtained from the TDLR Well Report The Surfer™ Filter Data Average tool averaged this dataset and an average water level surface raster was created in Surfer™.
- The base of the Leona Gravel was calculated using TWDB and TDLR well data. These data were used to create a base of the Leona Gravel raster in Surfer™.
- The two surfaces were used to calculate a saturated thickness raster using Surfer™ grid math.
- The saturated thickness raster was used to calculate total storage by using zonal statistics from Esri® ArcMap™ 10.1 and multiplying by an assumed specific yield of 0.15 (Johnson, 1967; George, 2010).

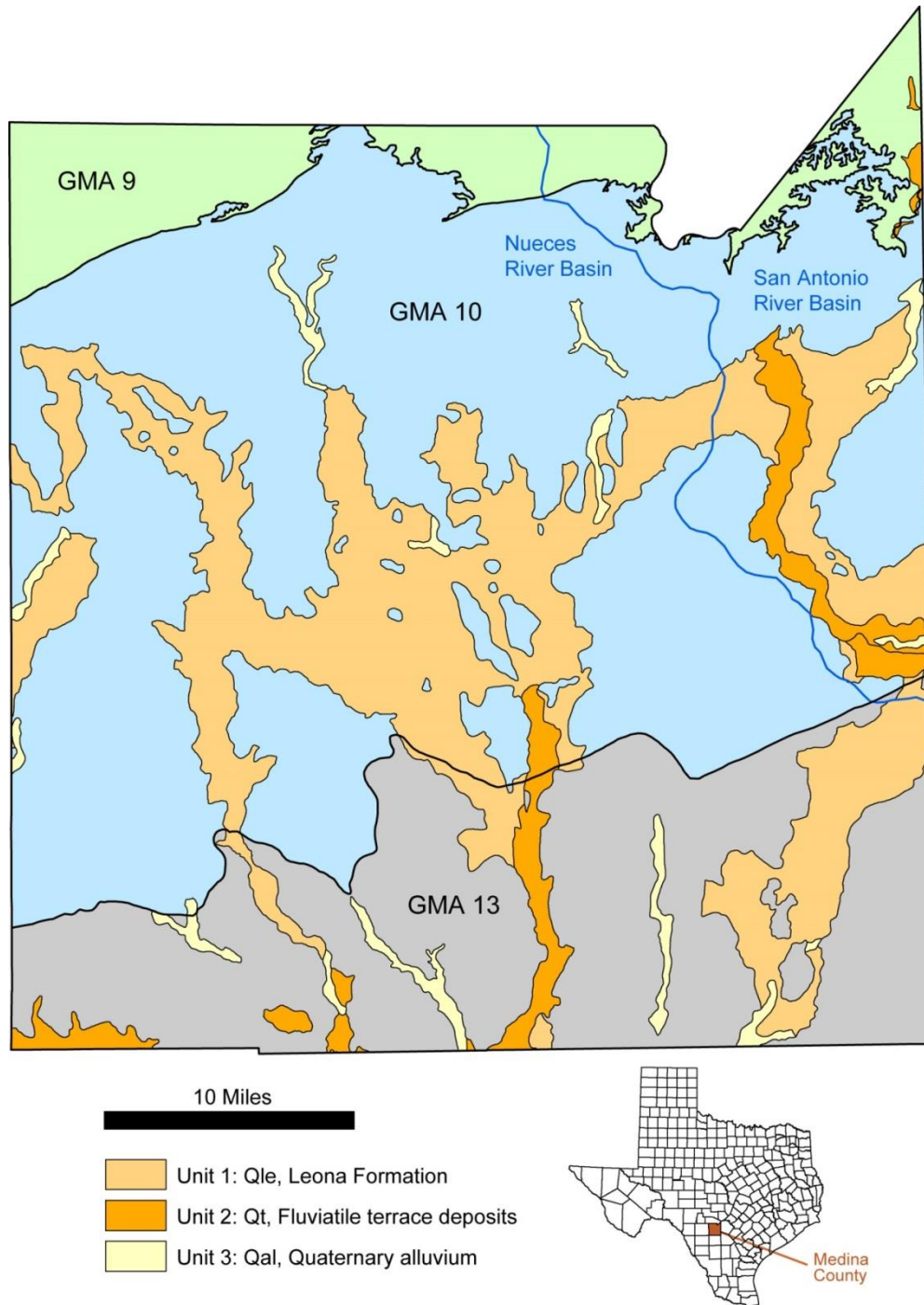


FIGURE 1. EXTENT OF THE LEONA GRAVEL IN MEDINA COUNTY USED TO ESTIMATE TOTAL RECOVERABLE STORAGE (TABLES 1 THROUGH 4) WITHIN GROUNDWATER MANAGEMENT AREAS (GMA) 10 AND 13 (FROM GEORGE, 2010).

The recoverable storage was estimated from the product of the total storage and an estimated factor ranging from 25 percent to 75 percent.

RESULTS:

Tables 1 through 4 summarize the total estimated recoverable storage in the Leona Gravel required by statute. The estimates are rounded to two significant figures.

TABLE 1. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE LEONA GRAVEL WITHIN GROUNDWATER MANAGEMENT AREA 10. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

<i>County</i>	<i>Total Storage (acre-feet)</i>	<i>25 percent of Total Storage (acre-feet)</i>	<i>75 percent of Total Storage (acre-feet)</i>
Medina	710,000	177,500	532,500

TABLE 2. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT FOR THE LEONA GRAVEL WITHIN GROUNDWATER MANAGEMENT AREA 10. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

<i>Groundwater Conservation District (GCD)</i>	<i>Total Storage (acre-feet)</i>	<i>25 percent of Total Storage (acre-feet)</i>	<i>75 percent of Total Storage (acre-feet)</i>
Medina County GCD	710,000	177,500	532,500

TABLE 3. TOTAL ESTIMATED RECOVERABLE STORAGE BY COUNTY FOR THE LEONA GRAVEL WITHIN GROUNDWATER MANAGEMENT AREA 13. COUNTY TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

<i>County</i>	<i>Total Storage (acre-feet)</i>	<i>25 percent of Total Storage (acre-feet)</i>	<i>75 percent of Total Storage (acre-feet)</i>
Medina	280,000	70,000	210,000

TABLE 4. TOTAL ESTIMATED RECOVERABLE STORAGE BY GROUNDWATER CONSERVATION DISTRICT FOR THE LEONA GRAVEL WITHIN GROUNDWATER MANAGEMENT AREA 13. GROUNDWATER CONSERVATION DISTRICT TOTAL ESTIMATES ARE ROUNDED TO TWO SIGNIFICANT FIGURES.

<i>Groundwater Conservation District (GCD)</i>	<i>Total Storage (acre-feet)</i>	<i>25 percent of Total Storage (acre-feet)</i>	<i>75 percent of Total Storage (acre-feet)</i>
Medina County GCD	280,000	70,000	210,00

LIMITATIONS

This analysis assumes a homogeneous and isotropic aquifer; however, these conditions may not be satisfied for the Leona Gravel. There is also uncertainty with respect to the distribution of the sand and gravel in the aquifer. This analysis was determined to be the best method available to develop a total estimated recoverable storage for the aquifer.

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