

# GAM run 07-10

by **Roberto Anaya, P.G.**

Texas Water Development Board  
Groundwater Availability Modeling Section  
(512) 936-2415  
March 23, 2007

## **REQUESTOR:**

Mr. Duke Meek, president of the Kinney County Groundwater Conservation District.

## **EXECUTIVE SUMMARY:**

On behalf of the Kinney County Groundwater Conservation District, Mr. Meek requested that we calculate the total amount of annual recharge to the Edwards (Balcones Fault Zone) Aquifer occurring within their jurisdiction. Diffuse recharge over the aquifer recharge area was calculated as being 15,800 acre-feet per year and direct recharge to the aquifer from the West Nueces River losses was calculated as being 4,000 acre-feet per year. Therefore, the total amount of annual recharge to the Edwards (Balcones Fault Zone) Aquifer occurring within Kinney County is 19,800 acre-feet per year.

Our analysis revealed an over estimate of 23 square miles of recharge area for the Edwards Group aquifer units within Kinney County from our previous recharge study (Mace and Anaya, 2004). For future reference, we also calculated the total annual recharge for the Edwards-Trinity (Plateau) aquifer occurring as diffuse recharge within Kinney County to be 46,900 acre-feet per year based on the corrected recharge area.

## **DESCRIPTION OF REQUEST:**

Determine the total amount of annual recharge for the Edwards (Balcones Fault Zone) Aquifer occurring within the jurisdiction of the Kinney County Groundwater Conservation District in order to assist them with permitting and compliance with Section 36.108 of the Texas Water Code.

## **METHODS:**

To address the request, we:

- reviewed our previous study (Mace and Anaya, 2004),
- calculated the recharge area for the Edwards (Balcones Fault Zone) Aquifer within Kinney County,
- calculated the recharge area for the Edwards-Trinity (Plateau) aquifer within Kinney County,
- used a recharge rate of 134 acre-feet per square mile (Mace and Anaya, 2004) to calculate diffuse recharge,

- used a recharge value of 4,000 acre-feet per year of direct recharge to the Edwards (Balcones Fault Zone) Aquifer within Kinney County (Mace and Anaya, 2004).

## **PARAMETERS AND ASSUMPTIONS:**

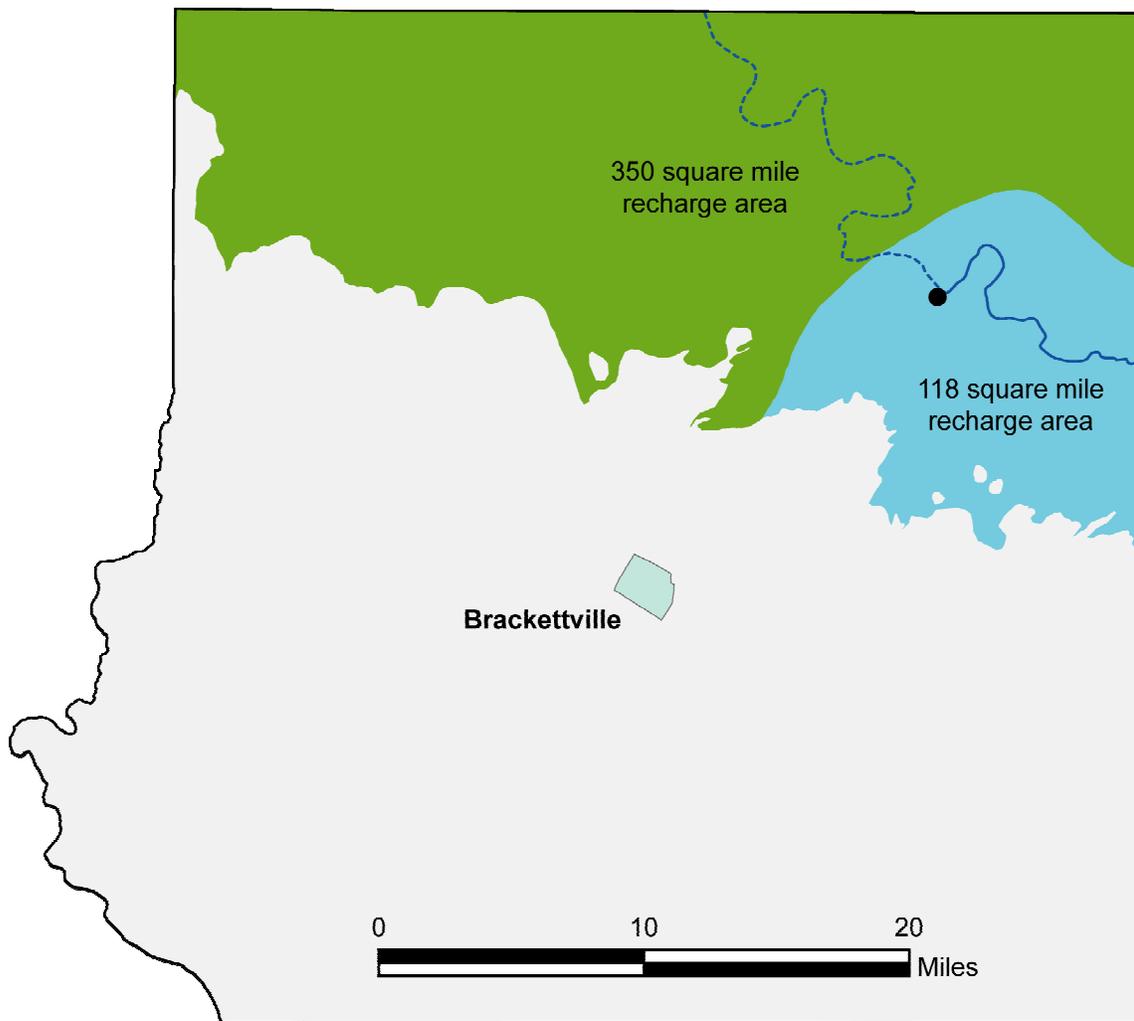
- 'Recharge' is generally defined as the amount of water that reaches the water table from the unsaturated zone above (for example, see Freeze and Cherry, 1979; Domenico and Schwartz, 1990; Jackson, 1997; Wilson and Moore, 1998; Fitts, 2002). TWDB rules concerning groundwater management plan certification define recharge as "The addition of water from precipitation or runoff by seepage or infiltration to an aquifer from the land surface, streams, or lakes directly into a formation or indirectly by way of leakage from another formation." Recharge generally does not consider underflow (flow into the county from outside of the county within the same formation). In karstic aquifers such as the Edwards (Balcones Fault Zone) Aquifer, recharge is sometimes split into 'direct recharge' and 'diffuse recharge'. 'Direct recharge' is defined as seepage or infiltration along specific discrete features such as streams while 'diffuse recharge' is defined as relatively slow and uniform infiltration over large areas. Combined, 'Direct recharge' and 'diffuse recharge' equal total recharge.
- We used a methodology from Bennett and Sayre (1962) modified to account for stream losses from the West Nueces River reach below the US Geological Survey stream gage near Brackettville to calculate recharge in Kinney County (Mace and Anaya, 2004).
- Direct recharge from the West Nueces River reach above the U.S. Geological Survey stream gage near Brackettville was not calculated due to insufficient data. However, because most of that reach occurs over much less permeable Trinity Group sediments, the actual amount of direct recharge above the gage is assumed to be insignificant.

## **RESULTS:**

A review of the geographic information systems data from a previous analysis (Mace and Anaya, 2004) indicated that it had included an additional 23 square miles of recharge area for the Edwards Group aquifer units within Kinney County. We corrected the total recharge area from 491 square miles to 468 square miles for the Edwards Group aquifer units within Kinney County.

The results show that the total amount of annual recharge to the Edwards (Balcones Fault Zone) Aquifer occurring within Kinney County is 15,800 acre-feet per year as diffuse recharge and 4,000 acre-feet per year as direct recharge for a total of 19,800 acre-feet per year (Figure 1).

In addition, the total amount of annual recharge to the Edwards-Trinity (Plateau) Aquifer occurring within Kinney County is 46,900 acre-feet per year as diffuse recharge and zero recharge occurring as direct recharge (Figure 1).



- US Geological Survey stream gage near Brackettville
- Direct recharge for West Nueces River reach above stream gage = zero recharge
- Direct recharge for West Nueces River reach below stream gage = 4,000 acre feet
- Diffuse recharge for Edwards-Trinity (Plateau) = 46,900 acre-feet
- Diffuse recharge for Edwards (Balcones Fault Zone) = 15,800 acre-feet

Figure 1. Average annual recharge to the Edwards (Balcones Fault Zone) and Edwards-Trinity (Plateau) aquifers.

## REFERENCES:

Bennett, R.R., and Sayre, A.N., 1962, Geology and ground water resources of Kinney County, Texas: Texas Water Commission, Bulletin 6216, 163 p.

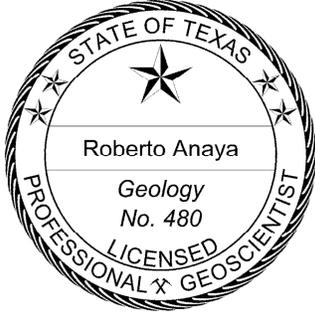
Domenico, P.A., and Schwartz, F.W., 1990, Physical and chemical hydrology: John Wiley & Sons, New York, 824 p.

Fitts, C.R., 2002, Groundwater science: Academic Press, San Diego, California, 450 p.

Freeze, R.A., and Cherry, J.A., 1979, Groundwater: Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 604 p.

Mace, R.E. and Anaya, R., 2004, Estimate of recharge to the Edwards (Balcones Fault Zone) and Edwards-Trinity (Plateau) aquifers in Kinney County, Texas: *in* Mace, R. M., Angle, E. S., and Mullican, W. F., III, editors, Aquifers of the Edwards Plateau: Texas Water Development Board, Report 360, p. 345–366.

Wilson, W.E., and Moore, J.E., 1998, Glossary of hydrology: American Geological Institute, Alexandria, Virginia, 248 p.



The seal appearing on this document was authorized by Roberto Anaya, P.G. on March 23, 2007.