GAM run 06-15

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Groundwater Availability Modeling Section
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REQUESTOR:

Mr. Allan Lange, General Manager for the Lipan-Kickapoo Water Conservation District.

DESCRIPTION OF REQUEST:

Mr. Lange requested the following information for his district from the groundwater availability model (GAM) for the Lipan Aquifer for his management plan:

1) estimated annual amount of recharge from precipitation to the district;
2) estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers;
3) estimated annual volume of flow into and out of the district within each aquifer and between each aquifer in the district; and
4) estimated annual amount of groundwater being used in the district on an annual basis.

METHODS:

To address the request, we ran the Lipan Aquifer GAM for 1980 to1998 and averaged the results for each layer in the model to obtain values.

PARAMETERS AND ASSUMPTIONS:

The Lipan Aquifer GAM has a root mean square of the errors of 40 feet. In the Lipan Aquifer model, each model cell is ½ mile by ½ mile with a resulting cell area of ¼ square mile or 160 acres. The model is one layer which is 400 feet thick. Pumpage for the model is based on a yearly time step and is from the centroid of each ¼ square mile grid cell. The springs, lakes, and rivers included in the model are shown in Figure 1.0.

We used the following assumptions in this analysis:

- see Beach and others (2004) for assumptions and limitations of the GAM;
- recharge represents long-term average climatic conditions for 1980 through 1998;

RESULTS:

Recharge and water budget

A groundwater budget summarizes how the model estimates water entering and leaving the aquifer. The groundwater budget for the average values from the transient model (1980 to 1998) is shown in Table 1. The components of the budgets shown in Table 1 include:

- Precipitation recharge—This is the areally distributed recharge due to precipitation falling on the outcrop areas of the aquifers within the district.

- Surface water inflow and outflow—This is the total surface water entering the aquifer (inflow) through streams or reservoirs, or total surface water exiting the aquifer (outflow) to streams, reservoirs, drains, or through evapotranspiration.

- Net inter-aquifer flow—This describes the vertical flow, or leakage, between two aquifers. This flow is controlled by the relative water levels in each aquifer and aquifer properties of each aquifer. "Inflow" to an aquifer from an overlying or underlying aquifer will always equal the "Outflow" from the other aquifer. In the case of the Lipan, the aquifer is modeled as a single layer and is underlain by a no-flow boundary.

- Lateral flow into and out of district—This component describes lateral flow within the aquifer between the district and adjacent counties.

Table 2 shows the pumpage, in acre-feet per year, used in the GAM for cells overlain by the Lipan-Kickapoo Water Conservation District.

REFERENCES:

Beach, James A., Burton, Stuart, and Kolarik, Barry, 2004, Groundwater availability model for the Lipan Aquifer in Texas: final report prepared for the Texas Water Development Board by LBG-Guyton Associates, 157 pages.

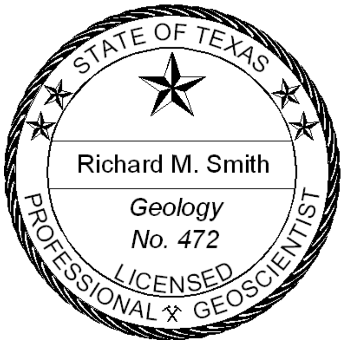

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Table 1: Groundwater flow budget for each aquifer layer, into and out of the Lipan-Kickapoo Water Conservation District, averaged for the years 1980 through 1998 from the GAM of the Lipan Aquifer. Flows are reported in acre-feet per year.

Aquifer	Recharge from precipitation	Surface water inflow	Surface water outflow	Inflow into district	Outflow from district	Net Inter-aquifer flow (upper)	Net Inter-aquifer flow (lower)
Lipan	52,175	6,476	15,798	15,937	14,623	0	0

Table 2: Groundwater demands from the Lipan –Kickapoo for the years 1980 through 1998. All demands are in acre-feet per year
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Year	Well Demand
1980	10,788
1981	13,936
1982	17,101
1983	20,230
1984	23,384
1985	20,271
1986	18,090
1987	15,388
1988	23,459
1989	25,270
1990	26,581
1991	22,452
1992	15,844
1993	65,905
1994	62,365
1995	78,096
1996	37,293
1997	68,304
1998	51,133

Note: All numbers are rounded to the nearest one acre-foot and are probably only accurate to two significant figures.

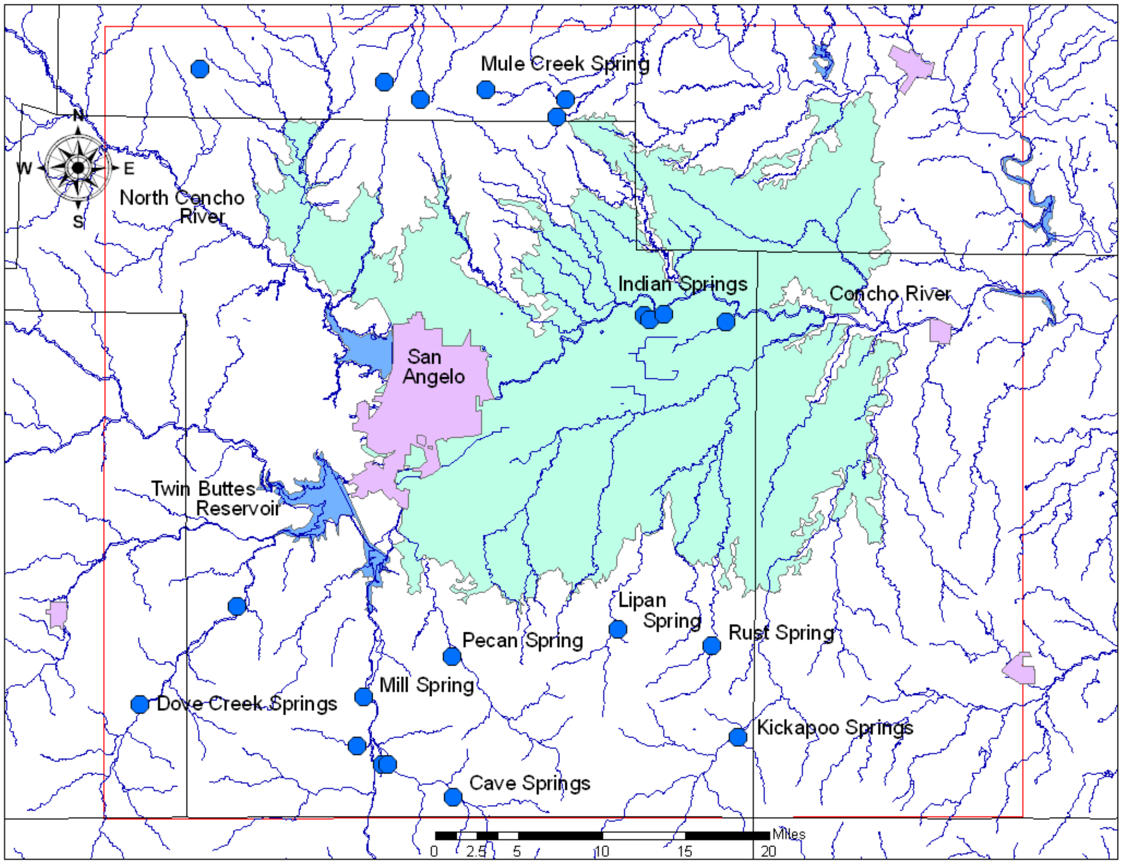

Figure 1.0: Location map of the Lipan Aquifer with springs shown as blue dots, streams and rivers are in blue. The model boundary is indicated by the red line.