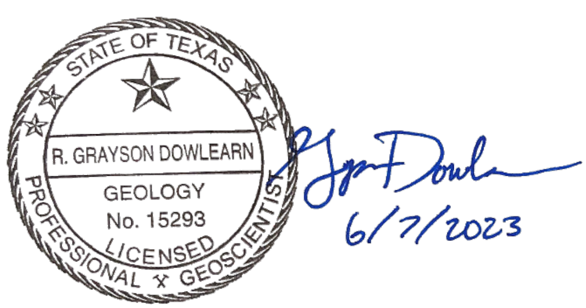
GAM RUN 23-010: JEFF DAVIS COUNTY UNDERGROUND WATER CONSERVATION DISTRICT MANAGEMENT PLAN

Micaela Pedrazas, GIT and Grayson Dowlearn, P.G.
Texas Water Development Board
Groundwater Division
Groundwater Modeling Department
512-463-3075

June 7, 2023



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EXECUTIVE SUMMARY:

Texas Water Code § 36.1071(h), states that, in developing its groundwater management plan, a groundwater conservation district shall use groundwater availability modeling information provided by the Executive Administrator of the Texas Water Development Board (TWDB) in conjunction with any available site-specific information provided by the district for review and comment to the Executive Administrator.

The TWDB provides data and information to the Jeff Davis County Underground Water Conservation District in two parts. Part 1 is the Estimated Historical Water Use/State Water Plan dataset report, which will be provided to you separately by the TWDB Groundwater Technical Assistance Department. Please direct questions about the water data report to Mr. Stephen Allen at 512-463-7317 or stephen.allen@twdb.texas.gov. Part 2 is the required groundwater availability modeling information, which includes:

1. the annual amount of recharge from precipitation, if any, to the groundwater resources within the district;
2. the annual volume of water that discharges from the aquifer to springs and any surface-water bodies, including lakes, streams, and rivers, for each aquifer within the district; and
3. the annual volume of flow into and out of the district within each aquifer and between aquifers in the district.

The groundwater management plan for the Jeff Davis County Underground Water Conservation District should be adopted by the district on or before September 13, 2023 and submitted to the TWDB Executive Administrator on or before October 13, 2023. The current management plan for the Jeff Davis County Underground Water Conservation District expires on December 12, 2023.

We used four groundwater availability models for the Jeff Davis County Underground Water Conservation District. Information for the Rustler Aquifer is from version 1.01 of the groundwater availability model for the Rustler Aquifer (Ewing and others, 2012). Information for the Edwards-Trinity (Plateau) and Pecos Valley aquifers is from version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers (Anaya and Jones, 2009). Information for the Igneous Aquifer is from version 1.01 of the groundwater availability model for the Igneous Aquifer and parts of the West Texas Bolsons Aquifer (Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat) (Beach and others, 2004). Information for the West Texas Bolsons Aquifer (Michigan Flat, Ryan Flat, Lobo Flat, and Green River Valley) is from two models: 1) version 1.01 of the groundwater availability model for the Igneous Aquifer and parts of the West Texas Bolsons Aquifer (Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat) (Beach and others, 2004) and 2) version 1.01 of the groundwater availability model for the West Texas Bolsons Aquifer (Red Light Draw, Green River Valley, and Eagle Flat) (Beach and others, 2008).

While a small portion of the Capitan Reef Complex Aquifer underlies the district in northern Jeff Davis County, the current model for the Capitan Reef Complex Aquifer does not extend into Jeff Davis County. For more information concerning this aquifer, please contact Mr. Stephen Allen at 512-463-7317 or stephen.allen@twdb.texas.gov.

This report replaces the results of GAM Run 12-023 (Jigmond, 2012). Values may differ from the previous report as a result of routine updates to the spatial grid file used to define county, groundwater conservation district, and aquifer boundaries, which can impact the calculated water budget values. Additionally, the approach used for analyzing model results is reviewed during each update and may have been refined to better delineate groundwater flows. Tables 1 through 5 summarize the groundwater availability model data required by statute. Figures 1, 3, 5, 7 and 9 show the areas of the respective models from which the values in Tables 1 through 5 were extracted. Figures 2, 4, 6, 8 and 10 provide a generalized diagram of the groundwater flow components provided in Tables 1 through 5. If, after review of the figures, the Jeff Davis County Underground Water Conservation District determines that the district boundaries used in the assessment do not reflect current conditions, please notify the TWDB at your earliest convenience.

The flow components presented in this report do not represent the full groundwater budget. If additional inflow and outflow information would be helpful for planning purposes, the district may submit a request in writing to the TWDB Groundwater Modeling Department for the full groundwater budget.

METHODS:

In accordance with Texas Water Code § 36.1071(h), the groundwater availability model mentioned above was used to estimate information for the Jeff Davis County Underground Water Conservation District management plan. Water budgets were extracted for the historical model periods for the Rustler Aquifer (1980 through 2008), Edwards-Trinity (Plateau) and Pecos Valley aquifers (1981 through 2000), Igneous and parts of the West Texas Bolsons (Michigan Flat, Ryan Flat, and Lobo Flat) aquifers (1980 through 2000) using ZONEBUDGET Version 3.01 (Harbaugh, 2009). A water budget for the West Texas Bolsons (Green River Valley) Aquifer was extracted from the steady state model using ZONEBUDGET Version 3.01 (Harbaugh, 2009). The average annual water budget values for recharge, surface-water outflow, inflow to the district, outflow from the district, and the flow between aquifers within the district are summarized in this report.

PARAMETERS AND ASSUMPTIONS:

Rustler Aquifer

- We used version 1.01 of the groundwater availability model for the Rustler Aquifer (Ewing and others, 2012) to analyze the Rustler Aquifer. See Ewing and others (2012) for assumptions and limitations of the model.
- The groundwater availability model for Rustler Aquifer contains the following two layers:
    - Layer 1 represents the Dewey Lake Formation and Dockum Group.
    - Layer 2 represents the Rustler Aquifer.
- A water budget was not extracted for the Dockum Aquifer since it does not occur within Jeff Davis County Underground Water Conservation District.
- The MODFLOW WEL package was used to simulate cross-formational flow from overlying units along the Davis Mountains.
- Water budget terms were averaged for the period 1980 through 2008 (stress periods 63 through 91).
- The model was run with MODFLOW-NWT (Niswonger and others, 2011).

Edwards-Trinity (Plateau) and Pecos Valley Aquifers

- We used version 1.01 of the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers (Anaya and Jones, 2009) to analyze the Edwards-Trinity (Plateau) and Pecos Valley aquifers. See Anaya and Jones (2009) for assumptions and limitations of the model.
- The groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers in Jeff Davis County Underground Water Conservation District is represented by one layer:
    - Layer 1 represents the Pecos Valley Aquifer, Edwards Group and equivalent limestone hydrostratigraphic units of the Edwards-Trinity (Plateau) Aquifer, and undifferentiated Trinity Group hydrostratigraphic units or equivalent units of the Edwards-Trinity (Plateau) Aquifer.
- Water budget terms were averaged for the period 1981 through 2000 (stress periods 2 through 21).
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

Igneous Aquifer and parts of the West Texas Bolsons Aquifer (Michigan Flat, Ryan Flat, Lobo Flat, and Green River Valley)

- We used version 1.01 of the groundwater availability model for the Igneous Aquifer and parts of the West Texas Bolsons Aquifer (Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat) (Beach and others, 2004) to analyze the Igneous and West Texas Bolsons (Michigan Flat, Ryan Flat, and Lobo Flat) aquifers. See Beach and others (2004) for assumptions and limitations of the model.
- The groundwater availability model for the Igneous Aquifer and parts of the West Texas Bolsons Aquifer (Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat) contains the following three layers:
    - Layer 1 represents the West Texas Bolsons Aquifer.
    - Layer 2 represents the Igneous Aquifer.
    - Layer 3 represents the Cretaceous and Permian units.
- Water budgets for the district have been determined individually for the West Texas Bolsons Aquifer and the Igneous Aquifer.
- Water budget terms were averaged for the period 1980 through 2000 (stress periods 32 through 52).
- The model was run with MODFLOW-96 (Harbaugh and McDonald, 1996).

- We used version 1.01 of the groundwater availability model of the West Texas Bolsons (Red Light Draw, Green River Valley, and Eagle Flat) aquifer (Beach and others, 2008) to analyze the West Texas Bolsons (Green River Valley) Aquifer. See Beach and others (2008) for assumptions and limitations of the groundwater availability model.
- The groundwater availability model for West Texas Bolsons Aquifer contains the following three layers:
    - Layer 1 represents the West Texas Bolsons Aquifer.
    - Layer 2 represents the Cretaceous and Permian units.
    - Layer 3 represents the Cretaceous and Paleozoic units.
- The groundwater availability model does not contain a transient simulation due to lack of data when the model was built.
- Water budget terms were extracted for the steady state period (stress period 1).
- The model was run with MODFLOW-2000 (Harbaugh and Others, 2000).

RESULTS:

A groundwater budget summarizes the amount of water entering and leaving an aquifer according to the groundwater availability model. Selected groundwater budget components listed below were extracted from the groundwater availability model results for the Rustler, Edwards-Trinity (Plateau), Pecos Valley, Igneous and West Texas Bolsons aquifers located within the Jeff Davis County Underground Water Conservation District and averaged over the historical calibration period, as shown in Tables 1 through 5.

1. Precipitation recharge—the areally distributed recharge sourced from precipitation falling on the outcrop areas of the aquifers (where the aquifer is exposed at land surface) within the district.
2. Surface-water outflow—the total water discharging from the aquifer (outflow) to surface-water features such as streams, reservoirs, and springs.
3. Flow into and out of district—the lateral flow within the aquifer between the district and adjacent counties.
4. Flow between aquifers—the net vertical flow between the aquifer and adjacent aquifers or confining units. This flow is controlled by the relative water levels in each aquifer and aquifer properties of each aquifer or confining unit that define the amount of leakage that occurs.

The information needed for the district's management plan is summarized in Tables 1 through 5. Figures 1, 3, 5, 7 and 9 show the areas of the respective models from which the values in Tables 1 through 5 were extracted. Figures 2, 4, 6, 8 and 10 provide a generalized diagram of the groundwater flow components provided in Tables 1 through 5. It is important to note that sub-regional water budgets are not exact. This is due to the size of the model cells and the approach used to extract data from the model. To avoid double accounting, a model cell that straddles a political boundary, such as a district or county boundary, is assigned to one side of the boundary based on the location of the centroid of the model cell. For example, if a cell contains two counties, the cell is assigned to the county where the centroid of the cell is located.

Table 1: Summarized information for the Rustler Aquifer that is needed for the Jeff Davis County Underground Water Conservation District groundwater management plan. All values are reported in acre-feet per year and rounded to the nearest 1 acre-foot.

Management plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Rustler Aquifer	0
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Rustler Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Rustler Aquifer	7
Estimated annual volume of flow out of the district within each aquifer in the district	Rustler Aquifer	532
Estimated net annual volume of flow between each aquifer in the district	To Rustler Aquifer from overlying stratigraphic units	462
	To Rustler Aquifer from Rustler equivalent units	58

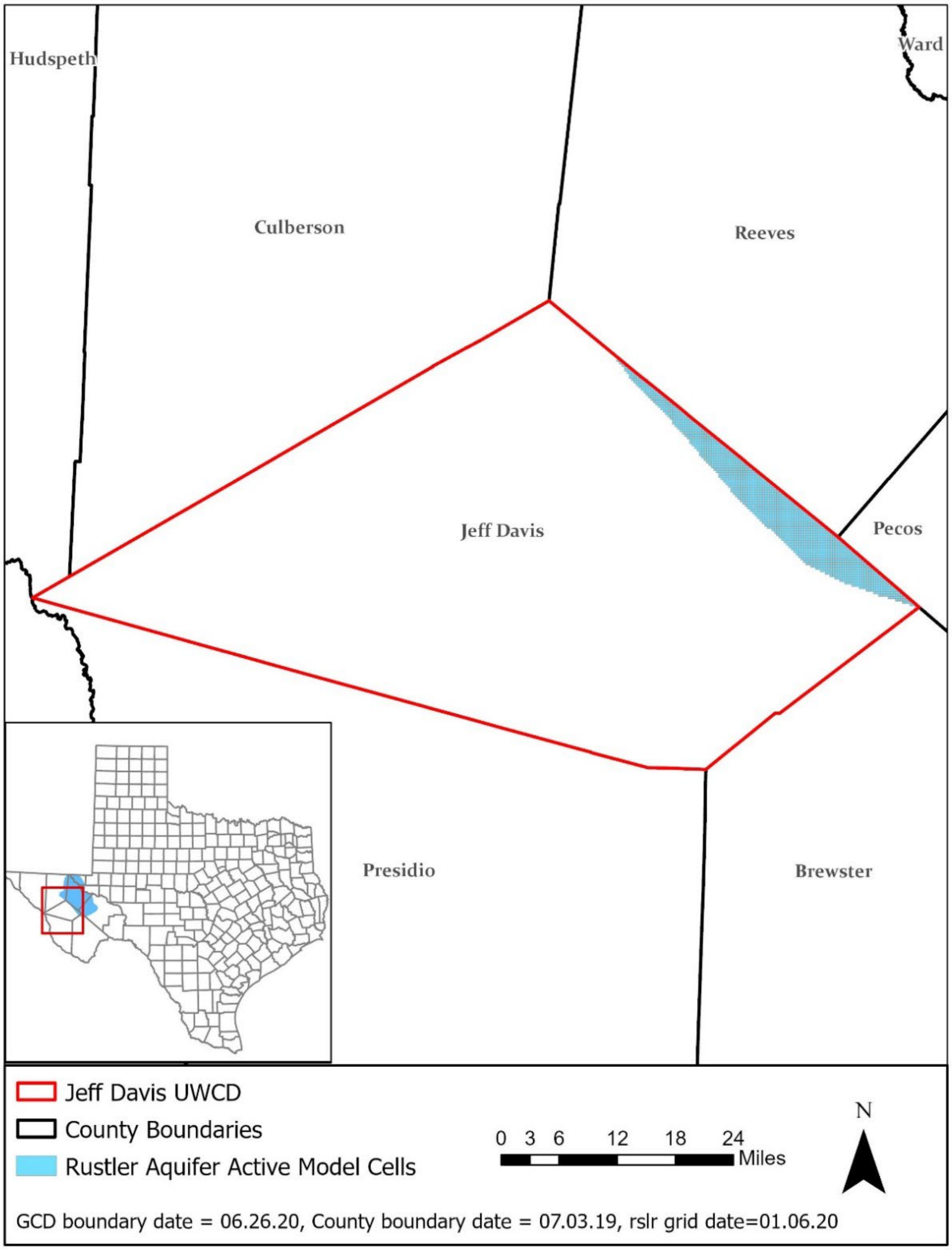
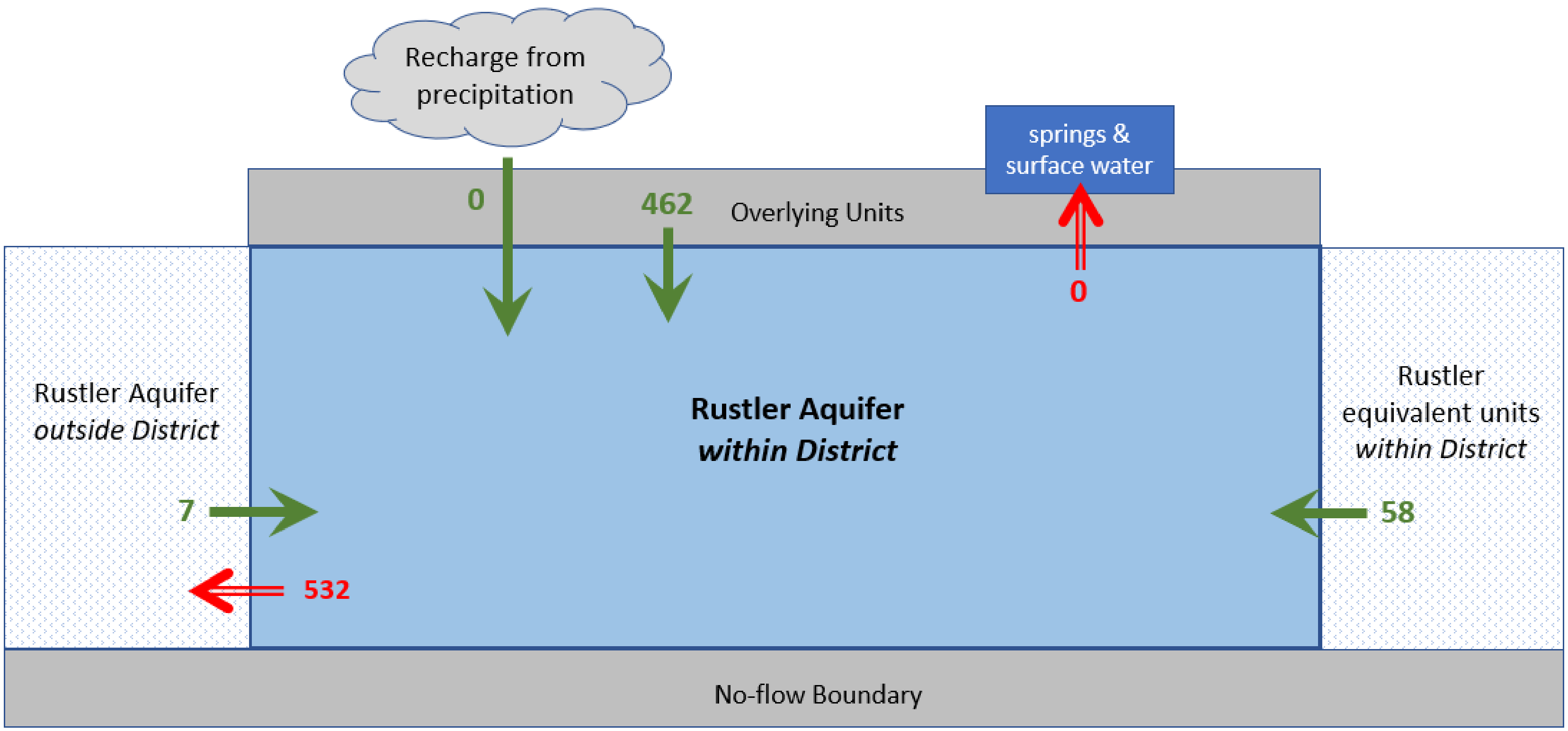


Figure 1: Area of the Rustler Aquifer groundwater availability model from which the information in Table 1 was extracted (the Rustler Aquifer extent within the district boundary).



Caveat: This diagram only includes the water budget items provided in Table 1. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 2: Generalized diagram of the summarized budget information from Table 1, representing directions of flow for Rustler Aquifer within Jeff Davis County Underground Water Conservation District. Flow values are expressed in acre-feet per year.

Table 2: Summarized information for the Edwards-Trinity (Plateau) Aquifer for the Jeff Davis County Underground Water Conservation District groundwater management plan. All values are reported in acre-feet per year and rounded to the nearest 1 acre-foot.

Management plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Edwards-Trinity (Plateau) Aquifer	14,861
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Edwards-Trinity (Plateau) Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	5,902
Estimated annual volume of flow out of the district within each aquifer in the district	Edwards-Trinity (Plateau) Aquifer	20,070
Estimated net annual volume of flow between each aquifer in the district	From Edwards-Trinity (Plateau) Aquifer to Pecos Valley Aquifer	1,748

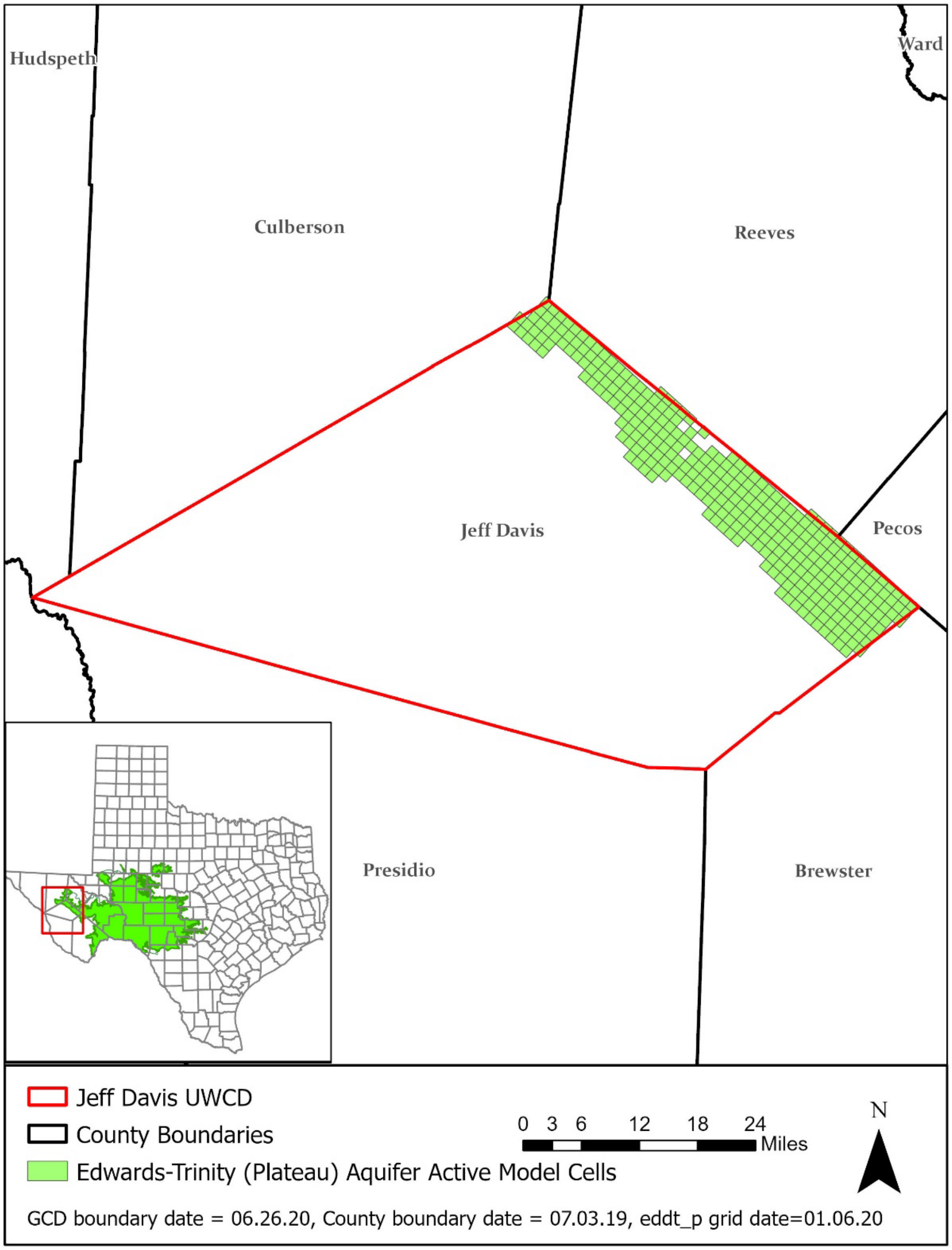
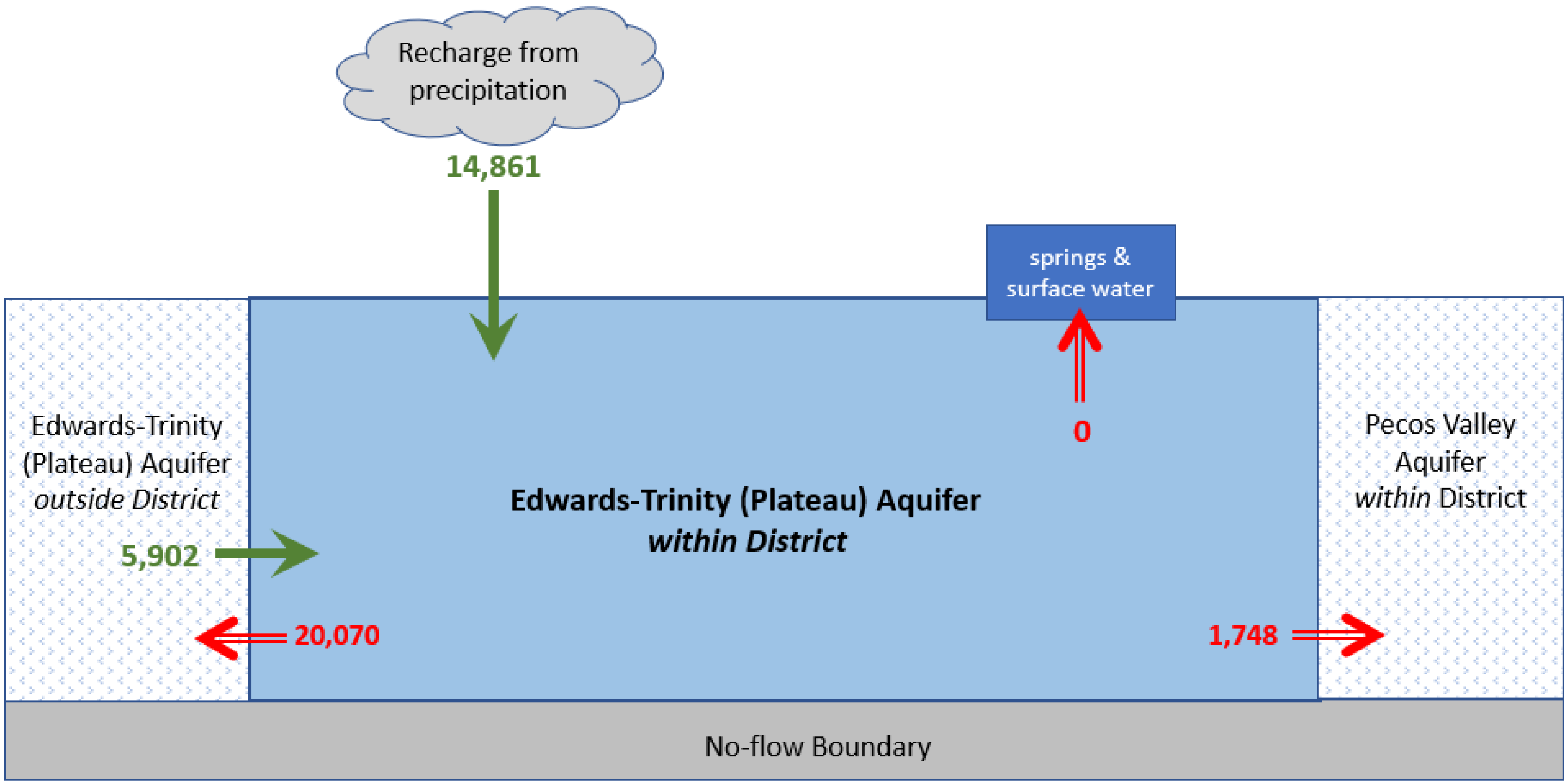


Figure 3: Area of the Edwards-Trinity (Plateau) and Pecos Valley aquifers groundwater availability model from which the information in Table 2 was extracted (the Edwards-Trinity [Plateau] Aquifer extent within the district boundary).



Caveat: This diagram only includes the water budget items provided in Table 2. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 4: Generalized diagram of the summarized budget information from Table 2, representing directions of flow for the Edwards-Trinity (Plateau) Aquifer within Jeff Davis County Underground Water Conservation District. Flow values are expressed in acre-feet per year.

Table 3: Summarized information for the Pecos Valley Aquifer that is needed for the Jeff Davis County Underground Water Conservation District groundwater management plan. All values are reported in acre-feet per year and rounded to the nearest 1 acre-foot.

Management plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Pecos Valley Aquifer	361
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Pecos Valley Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	Pecos Valley Aquifer	0
Estimated annual volume of flow out of the district within each aquifer in the district	Pecos Valley Aquifer	2,780
Estimated net annual volume of flow between each aquifer in the district	To Pecos Valley Aquifer from Edwards-Trinity (Plateau) Aquifer	1,748

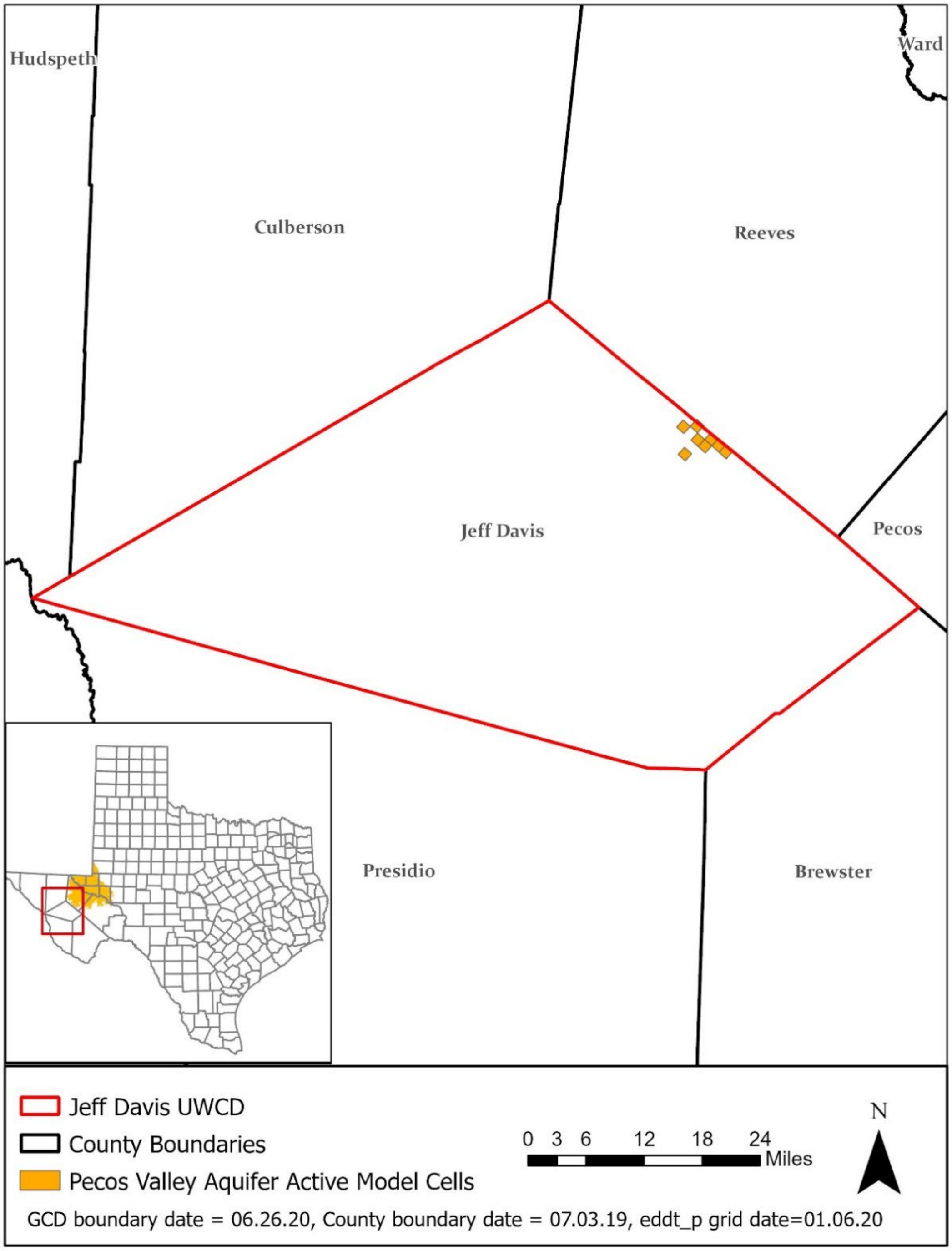
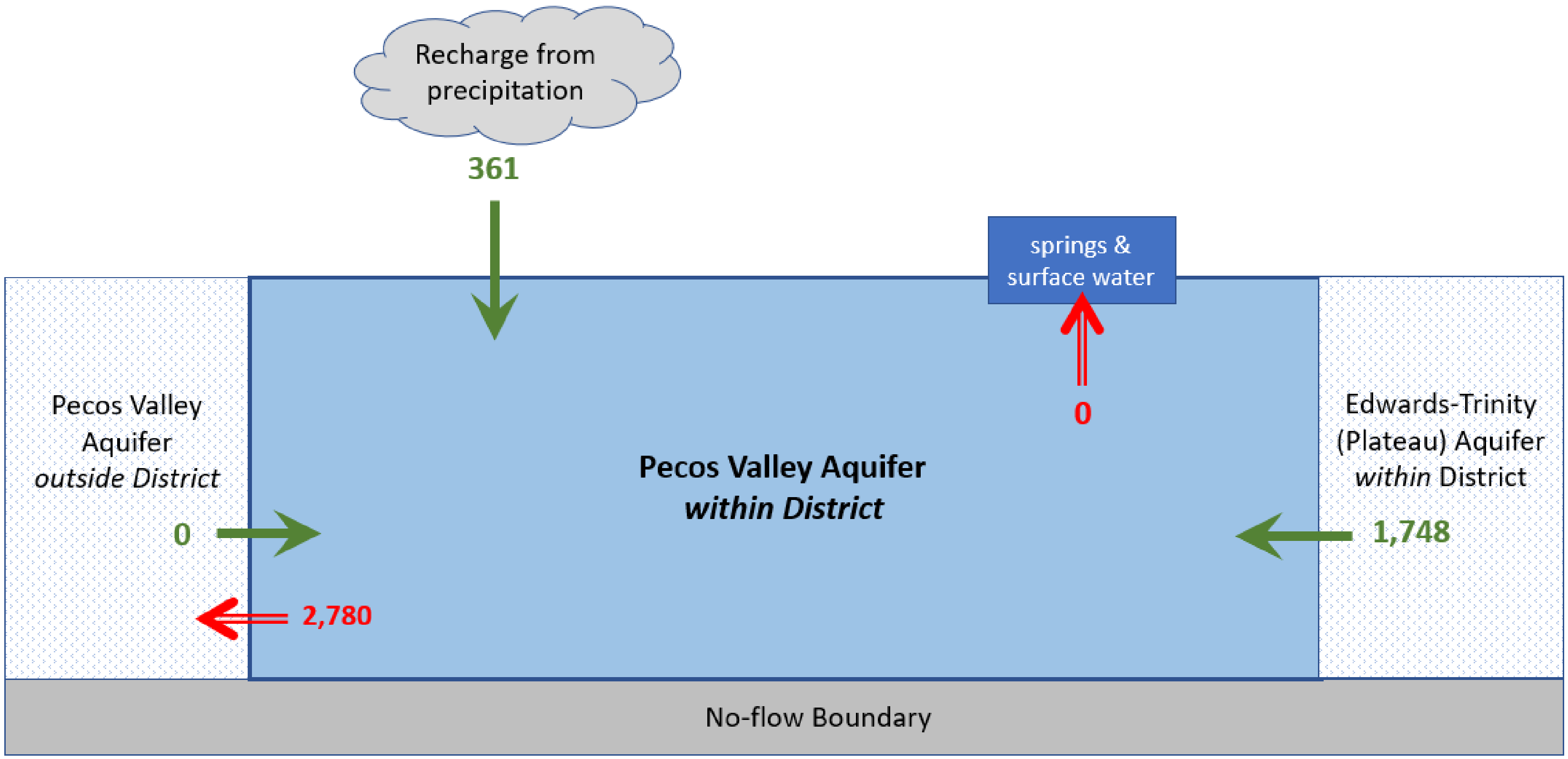


Figure 5: Area of the Edwards-Trinity (Plateau) and Pecos Valley aquifers groundwater availability model from which the information in Table 3 was extracted (the Pecos Valley Aquifer extent within the district boundary).



Caveat: This diagram only includes the water budget items provided in Table 3. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 6: Generalized diagram of the summarized budget information from Table 3, representing directions of flow for Pecos Valley Aquifer within Jeff Davis County Underground Water Conservation District. Flow values are expressed in acre-feet per year.

Table 4: Summarized information for the West Texas Bolsons Aquifer that is needed for the Jeff Davis County Underground Water Conservation District groundwater management plan. All values are reported in acre-feet per year and rounded to the nearest 1 acre-foot.

Management plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district[1]	West Texas Bolsons Aquifer	153
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	West Texas Bolsons Aquifer	0
Estimated annual volume of flow into the district within each aquifer in the district	West Texas Bolsons Aquifer	4,188
Estimated annual volume of flow out of the district within each aquifer in the district	West Texas Bolsons Aquifer	7,422
Estimated net annual volume of flow between each aquifer in the district	To West Texas Bolsons Aquifer from Igneous Aquifer	1,726
	To West Texas Bolsons Aquifer from Cretaceous and Permian units	11

[1] It is assumed that the West Texas Bolsons Aquifer does not receive any direct recharge from precipitation. However, the model estimate presented above includes indirect recharge estimates from alluvial fan and stream bed infiltration during precipitation events.

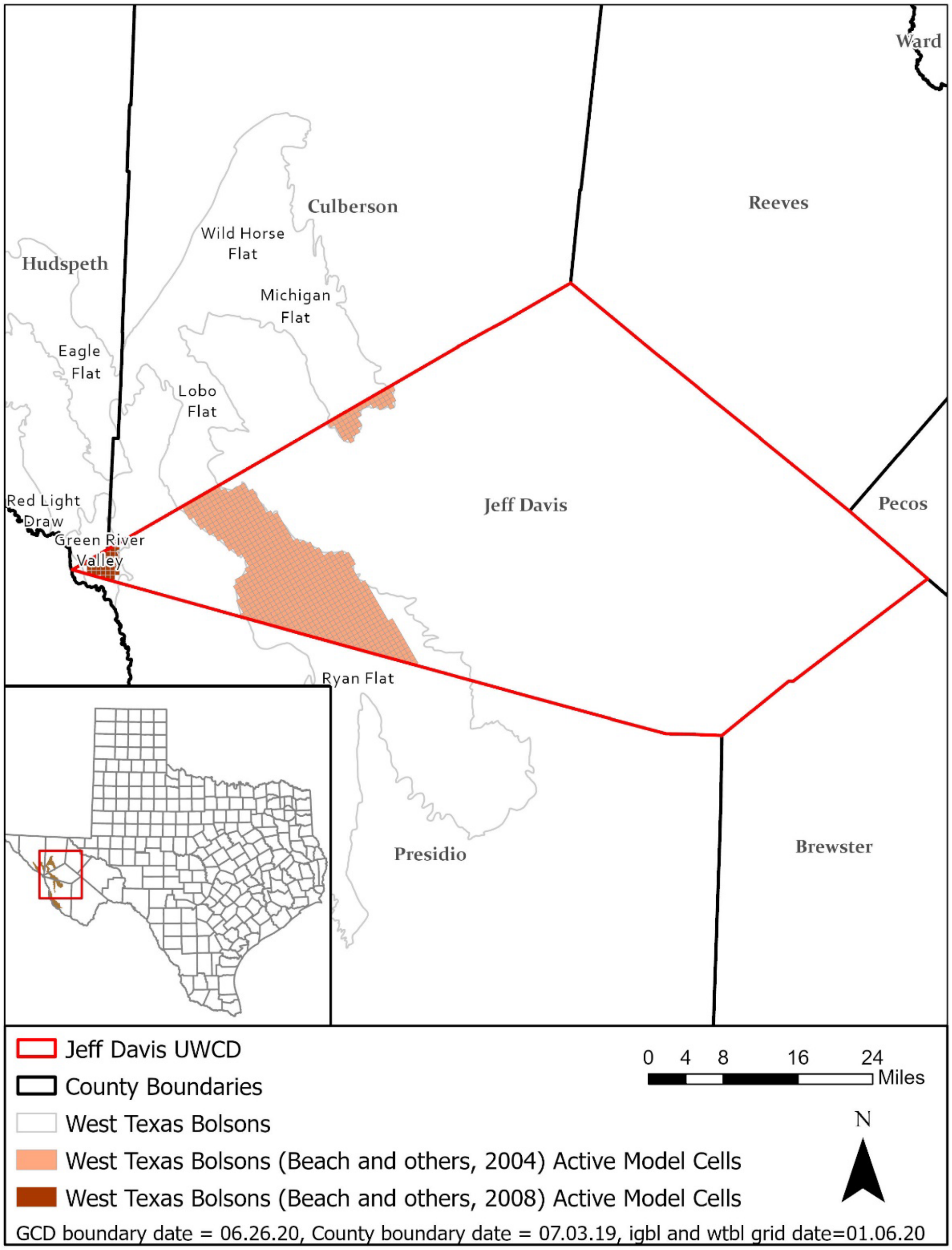
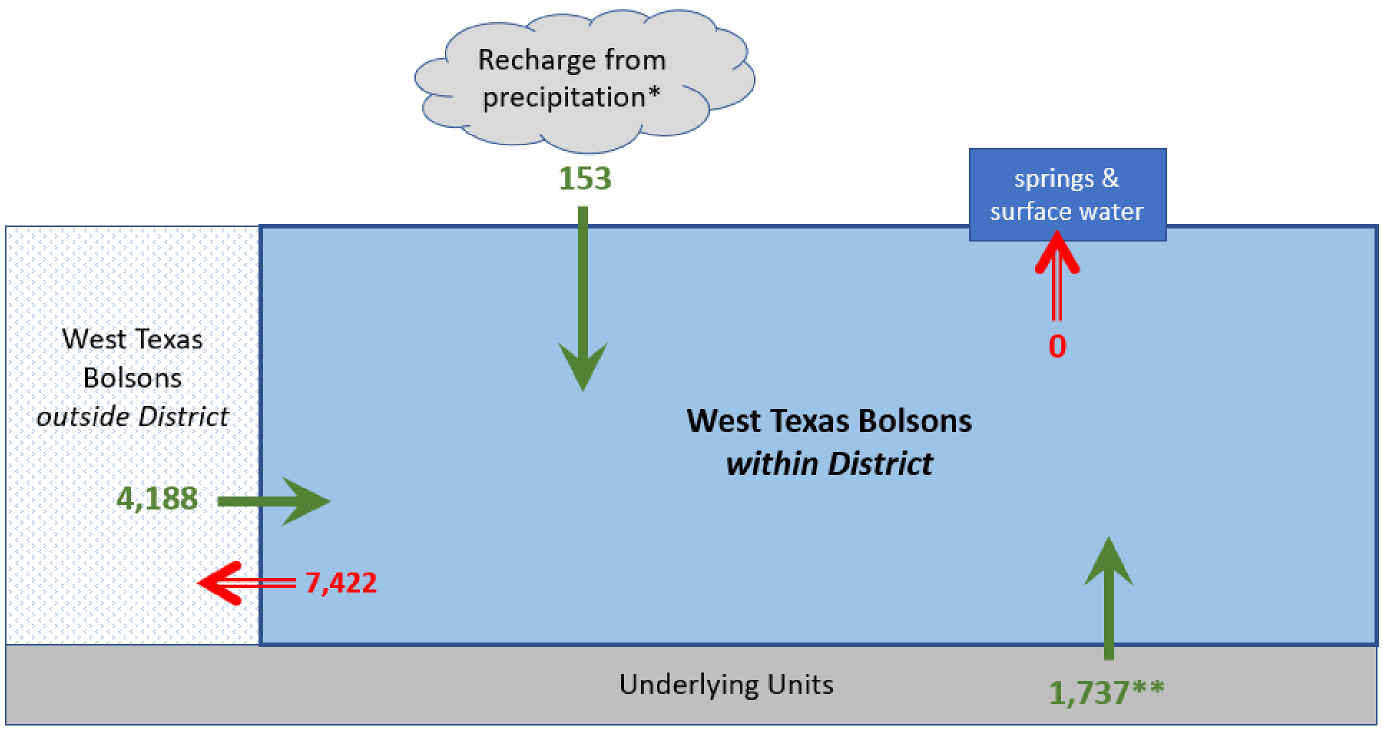


Figure 7: Area of the Igneous and parts of the West Texas Bolsons (Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat) Aquifer groundwater availability model and the West Texas Bolsons (Red Light Draw, Green River Valley, and Eagle Flat) Aquifer groundwater availability model from which the information in Table 4 was extracted (the West Texas Bolsons Aquifer extent within the district boundary).



* It is assumed that precipitation recharge directly to the West Texas Bolsons Aquifer is zero. The recharge package suggests, on average, 153 acre-feet per year from alluvial fan/stream bed infiltration enters the aquifer in the district.
** Flow from underlying units includes an inflow of 1,726 acre-feet per year from the Igneous Aquifer and an inflow of 11 acre-feet from the Cretaceous and Permian Units.

Caveat: This diagram only includes the water budget items provided in Table 4. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 8: Generalized diagram of the summarized budget information from Table 4, representing directions of flow for the West Texas Bolsons Aquifer within Jeff Davis County Underground Water Conservation District. Flow values are expressed in acre-feet per year.

Table 5: Summarized information for the Igneous Aquifer that is needed for the Jeff Davis County Underground Water Conservation District groundwater management plan. All values are reported in acre-feet per year and rounded to the nearest 1 acre-foot.

Management plan requirement	Aquifer or confining unit	Results
Estimated annual amount of recharge from precipitation to the district	Igneous Aquifer	26,032
Estimated annual volume of water that discharges from the aquifer to springs and any surface water body including lakes, streams, and rivers	Igneous Aquifer	2,566
Estimated annual volume of flow into the district within each aquifer in the district	Igneous Aquifer	610
Estimated annual volume of flow out of the district within each aquifer in the district	Igneous Aquifer	4,318
Estimated net annual volume of flow between each aquifer in the district	From Igneous Aquifer to West Texas Bolsons Aquifer	1,726
	From Igneous Aquifer to Cretaceous and Permian units	14,350

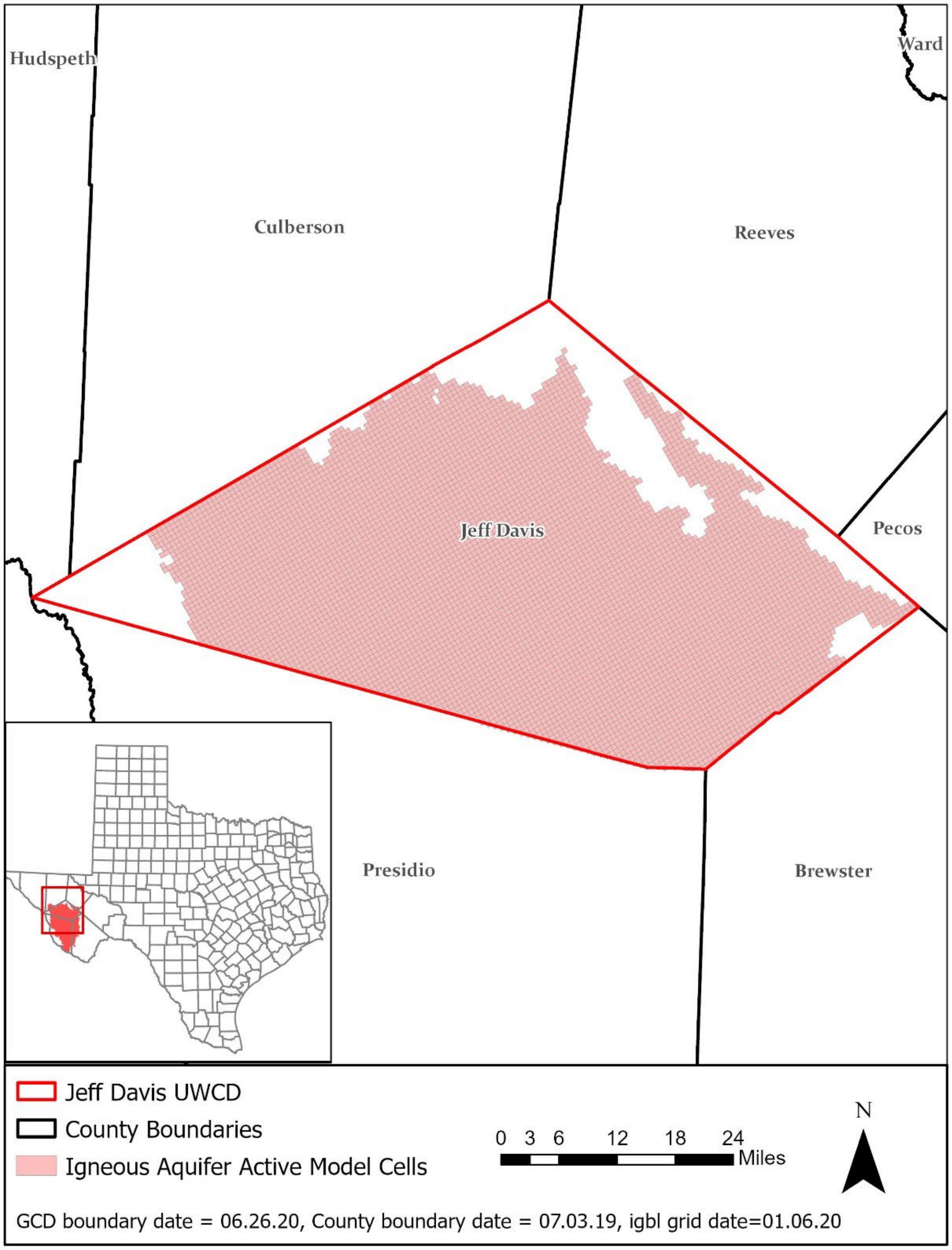
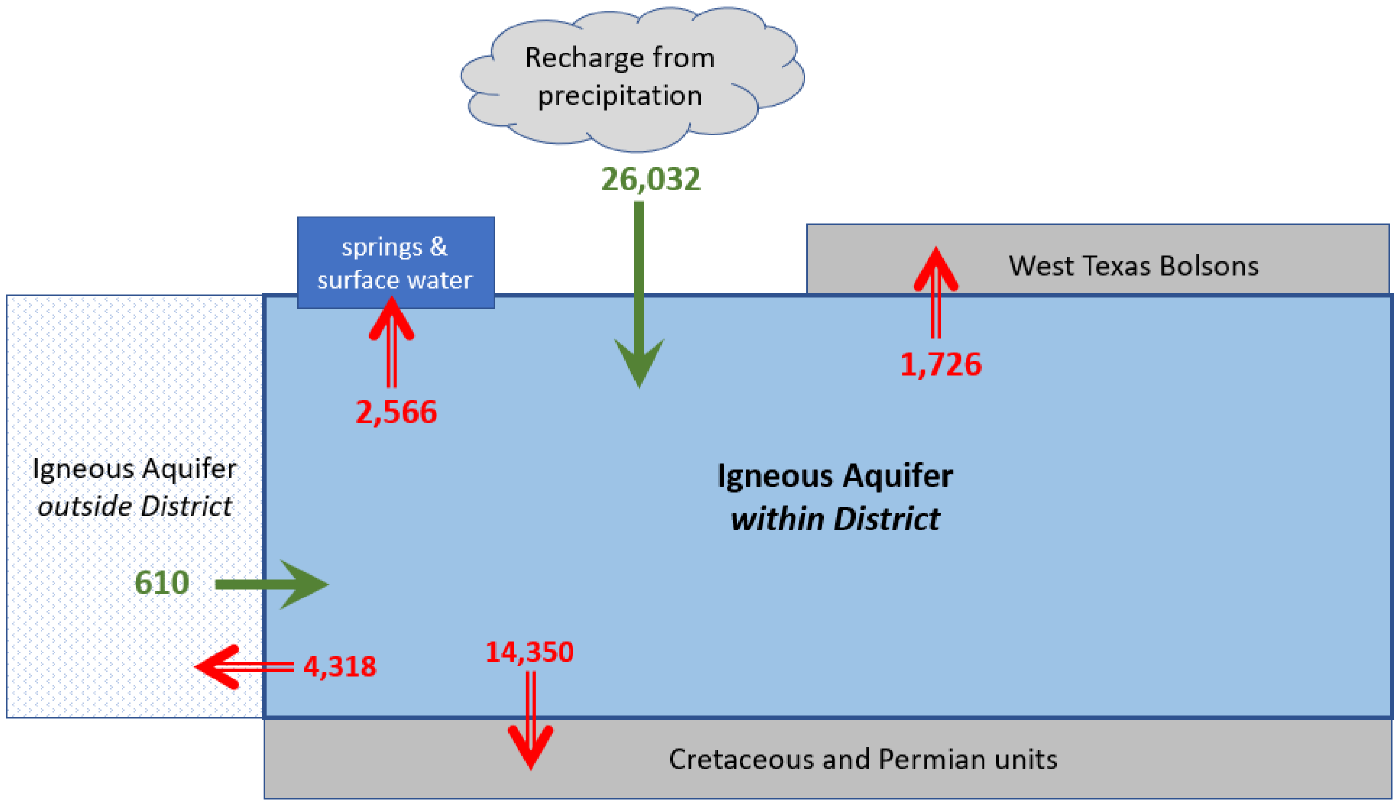


Figure 9: Area of the Igneous and West Texas Bolsons aquifers groundwater availability model from which the information in Table 5 was extracted (the Igneous Aquifer extent within the district boundary).



Caveat: This diagram only includes the water budget items provided in Table 5. A complete water budget would include additional inflows and outflows. For a full groundwater budget, please submit a request in writing to the Groundwater Modeling Department.

Figure 10: Generalized diagram of the summarized budget information from Table 5, representing directions of flow for Igneous Aquifer within Jeff Davis County Underground Water Conservation District. Flow values are expressed in acre-feet per year.

LIMITATIONS:

The groundwater models used in completing this analysis are the best available scientific tools that can be used to meet the stated objectives. To the extent that this analysis will be used for planning purposes and/or regulatory purposes related to pumping in the past and into the future, it is important to recognize the assumptions and limitations associated with the use of the results. 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 evaluate historic groundwater flow conditions includes the assumptions about the location in the aquifer where historic pumping was placed. Understanding the amount and location of historical pumping is as important as evaluating the volume of groundwater flow into and out of the district, between aquifers within the district (as applicable), interactions with surface water (as applicable), recharge to the aquifer system (as applicable), and other metrics that describe the impacts of that pumping. In addition, assumptions regarding precipitation, recharge, and interaction with streams are specific to particular historic time periods.

Because the application of the groundwater models was designed to address regional scale questions, the results are most effective on a regional scale. The TWDB makes no warranties or representations related 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 groundwater pumping and overall conditions of the aquifer. 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 this analysis in the future given the reality of how the aquifer responds to the actual amount and location of pumping now and in the future. Historic precipitation patterns also need to be placed in context as future climatic conditions, such as dry and wet year precipitation patterns, may differ and affect groundwater flow conditions.

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Texas Water Code § 36.1071