Groundwater Management Area 3

Desired Future Conditions

Adopted August 9, 2010

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Groundwater Management Area 3
Desired Future Conditions
August 31, 2010

Section 1: Groundwater Management Area map
Map showing monitor wells in Pecos County

Section 2: Dockum Aquifer DFC Resolution

Section 3: Capitan Reef Aquifer DFC Resolution
Capitan Reef Aquifer memo

Section 4: Edwards/Trinity and Pecos Valley Aquifer DFC Resolution

Section 5: Rustler Aquifer DFC Resolution
Rustler Aquifer memo

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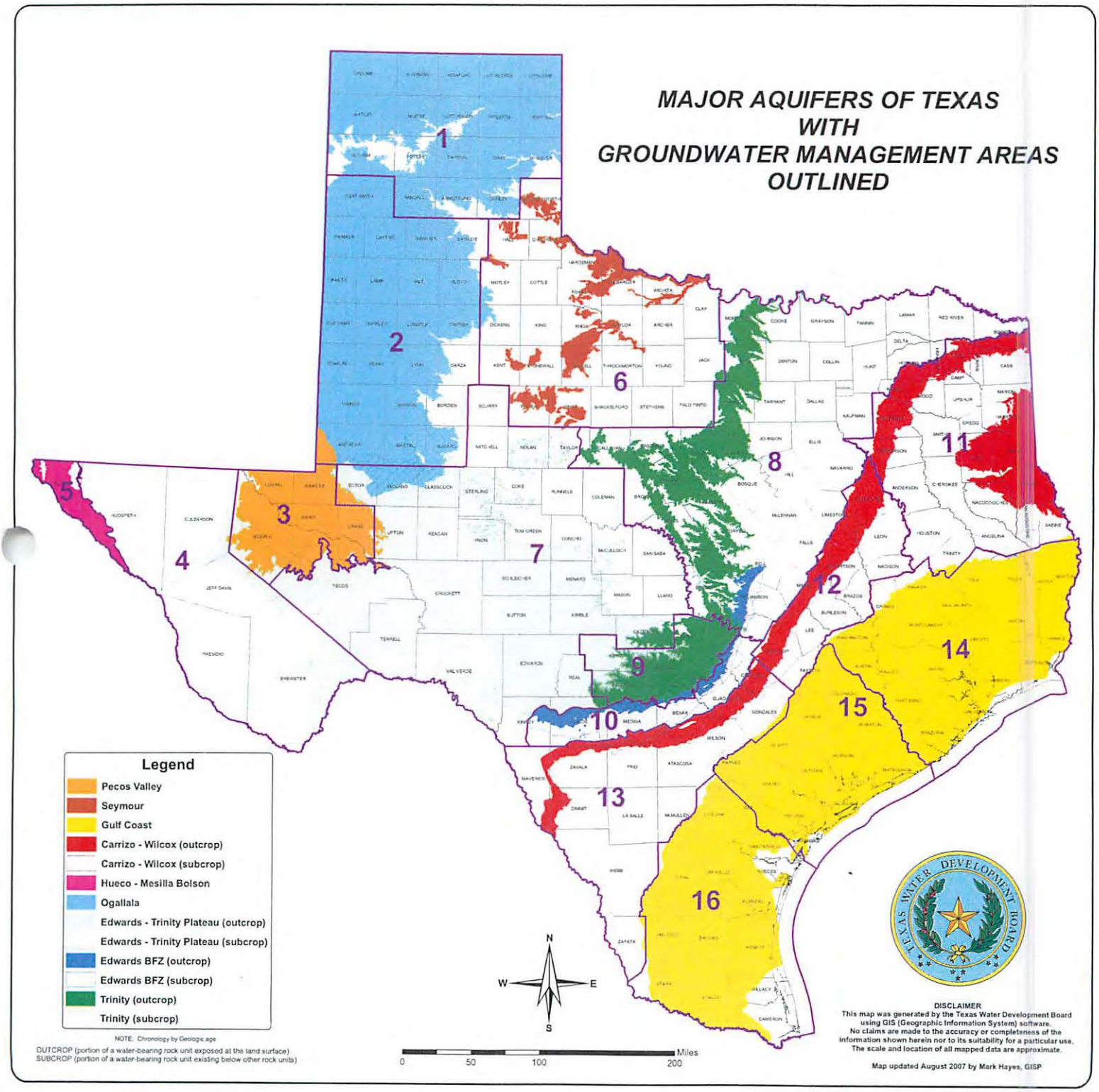
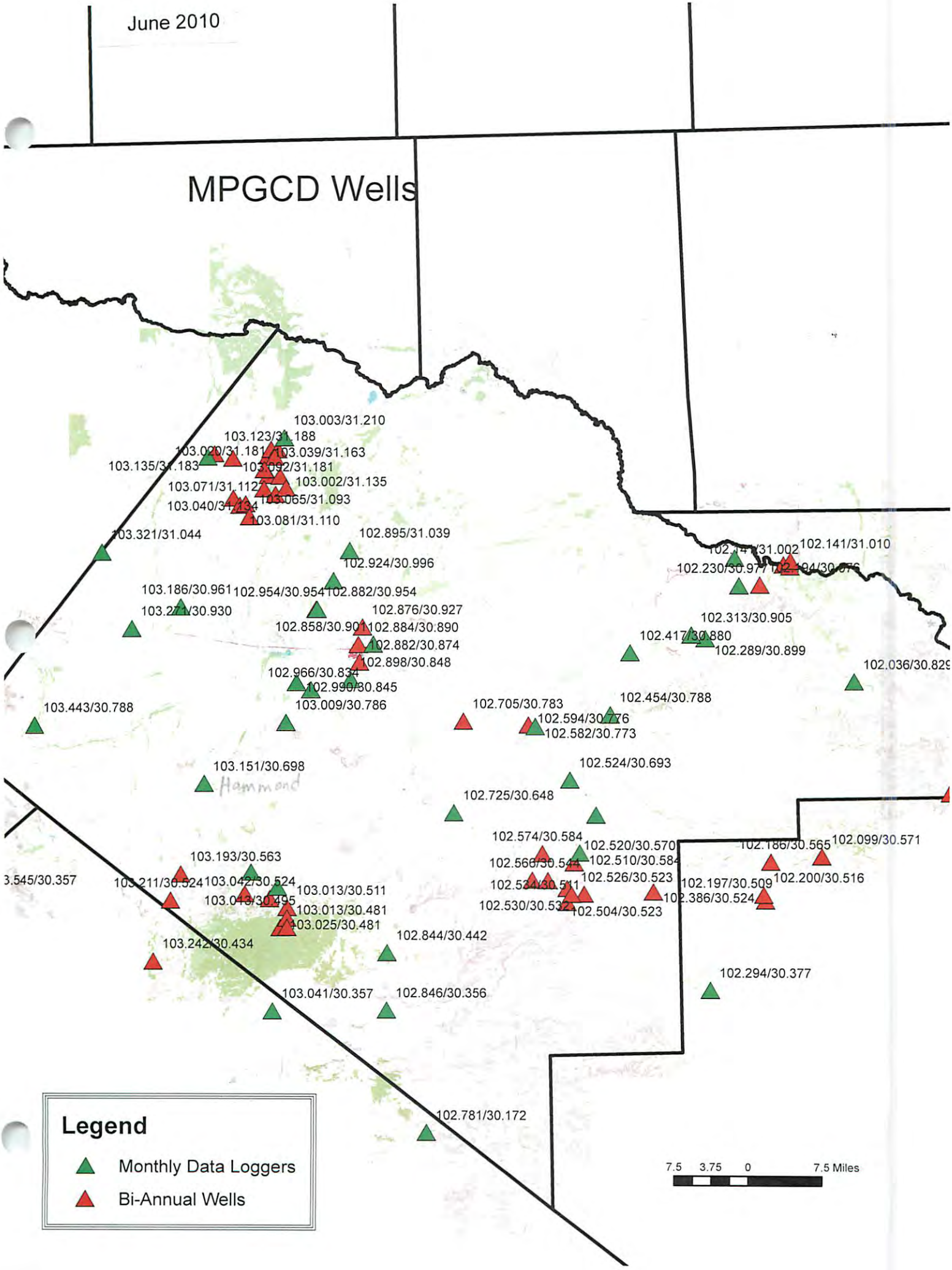
Section 16: 2-D Model Minor Aquifers

Middle Pecos Groundwater Conservation District
103 W. Callaghan 3rd Floor Pecos County Court House
P. O. Box 1644 Fort Stockton, TX 79735

Paul Weatherby, General Manager
Office (432) 336-0698 Cell (432) 940-1996
Fax (432) 336-3407 email: mpgcd@sbcglobal.net
Website: middlepecosgcd.org

Section 1
Groundwater Mgmt Area Map
Map: Monitor Wells in Pecos County


MAJOR AQUIFERS OF TEXAS
WITH
GROUNDWATER MANAGEMENT AREAS
OUTLINED
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Legend
Pecos Valley
Seymour
Gulf Coast
Carrizo - Wilcox (outcrop)
Carrizo - Wilcox (subcrop)
Hueco - Mesilla Bolson
Ogallala
Edwards - Trinity Plateau (outcrop)
Edwards - Trinity Plateau (subcrop)
Edwards BFZ (outcrop)
Edwards BFZ (subcrop)
Trinity (outcrop)
Trinity (subcrop)
NOTE: Chronology by Geologic age
OUTCROP (portion of a water-bearing rock unit exposed at the land surface)
SUBCROP (portion of a water-bearing rock unit existing below other rock units)
N
W
E
S
0
50
100
200
Miles
TEXAS WATER DEVELOPMENT BOARD
DISCLAIMER
This map was generated by the Texas Water Development Board using GIS (Geographic Information System) software.
No claims are made to the accuracy or completeness of the information shown herein nor to its suitability for a particular use.
The scale and location of all mapped data are approximate.
Map updated August 2007 by Mark Hayes, GISP


June 2010
MPGCD Wells
103.003/31.210
103.123/31.188
103.020/31.181
103.039/31.163
103.135/31.183
103.092/31.181
103.071/31.112
103.002/31.135
103.040/31.134
103.065/31.093
103.081/31.110
103.321/31.044
102.895/31.039
102.924/30.996
102.141/31.010
102.230/30.977
103.186/30.961
102.954/30.954
102.882/30.954
103.271/30.930
102.876/30.927
102.858/30.901
102.884/30.890
102.882/30.874
102.898/30.848
102.313/30.905
102.417/30.880
102.289/30.899
102.966/30.834
102.990/30.845
102.036/30.829
103.443/30.788
103.009/30.786
102.705/30.783
102.454/30.788
102.594/30.776
102.582/30.773
103.151/30.698
Hammond
102.524/30.693
102.725/30.648
102.574/30.584
102.520/30.570
102.186/30.565
102.099/30.571
102.566/30.544
102.510/30.584
102.526/30.523
102.524/30.511
102.197/30.509
102.200/30.516
102.530/30.532
102.504/30.523
102.386/30.524
103.193/30.563
3.545/30.357
103.211/30.524
103.042/30.524
103.013/30.511
103.013/30.495
103.013/30.481
103.025/30.481
102.844/30.442
103.242/30.434
102.294/30.377
103.041/30.357
102.846/30.356
102.781/30.172
Legend
Monthly Data Loggers
Bi-Annual Wells
7.5 3.75 0 7.5 Miles

Section 2
Dockum Aquifer DFC Resolution

Resolution # 08-09-2010-1

Designation of Desired Future Conditions
Dockum Aquifer
GMA 3

Whereas, the Middle Pecos Groundwater Conservation District (MPGCD) is the only GCD located within the boundary of GMA 3 and is required under 36.108, Texas Water Code to conduct planning and designate the Desired Future Conditions of aquifers within GMA 3,

Whereas, the MPGCD Designated Representative in GMA 3 have met in various meetings and conducted planning in accordance with Section 36.108, Texas Water Code since January 22, 2010;

Whereas, the GMA 3 designated representative has received and considered technical advice regarding local aquifers, hydrology, geology, recharge characteristics, local groundwater demands and usage, population projections, groundwater and surface water inter-relationships, and other considerations that affect groundwater conditions, and

Whereas, GMA 3, having given proper notice, held an open meeting on August 9, 2010, at the Ward County Convention Center, Monahans, Texas, to accept public comment on the proposed DFC for the Dockum Aquifer within the boundary of GMA 3:

Whereas, following public discussion, due consideration has been given the current and future needs and geology and current conditions of the aquifers in question, the current and projected groundwater demands, total water supply and quality of water

supply available from all aquifers, and the potential effects on springs, surface water, and habitat of water-dependant species through the year 2060, and

Whereas, the GMA 3 Middle Pecos Groundwater Conservation District has on August 9, 2010, considered the results of the revised Base Case scenario of the Texas Water Development Board GAM-Task 10-025 as presented by Dr. Bill Hutchison on August 9, 2010, voted, upon motion made and seconded to designate the following DFC for Dockum Aquifer;

1. The average total net decline in water levels within GMA 3, taken as a whole, at the end of the fifty-year period in 2060, shall not exceed twenty seven (27) feet below water levels in the aquifer in the year 2010, and;
2. The results of the revised Base Case of the Texas Water Development Board GAM-Task 10-025 as presented by Dr. Bill Hutchison on August 9, 2010, used to develop the DFC for the Dockum Aquifer in GMA 3 are adopted in their entirety.

Now therefore be it resolved, that GMA 3 does hereby confirm, document, and record, the above described designation of the Desired Future Condition for the Dockum Aquifer which was approved by the following vote of the Designated Representative of the GCD present and voting on August 9, 2010;

Paul Weatherby

Paul Weatherby, General Manager
Designated Representative– Middle Pecos GCD

County	Drawdown in 2060 (feet)
Crane	8
Loving	24
Pecos (GMA 3 portion only)	47
Reeves	17
Ward	31
Winkler	32
GMA 3 Average	**27**

Table 1, Results of Revised Base Case of TWDB GAM-Task 10-025

Section 3
Capitan Reef Aquifer
DFC Resolution & Memo

Resolution # 08-09-2010-2

Designation of Desired Future Conditions
Capitan Aquifer
GMA 3

Whereas, the Middle Pecos Groundwater Conservation District (MPGCD) is the only GCD located within the boundary of GMA 3 and is required under 36.108, Texas Water Code to conduct planning and designate the Desired Future Conditions of aquifers within GMA 3,

Whereas, the MPGCD Designated Representative in GMA 3 have met in various meetings and conducted planning in accordance with Section 36.108, Texas Water Code since January 22, 2010;

Whereas, the GMA 3 designated representative has received and considered technical advice regarding local aquifers, hydrology, geology, recharge characteristics, local groundwater demands and usage, population projections, groundwater and surface water inter-relationships, and other considerations that affect groundwater conditions, and

Whereas, GMA 3, having given proper notice, held an open meeting on August 9, 2010, at the Ward County Convention Center, Monahans, Texas, to accept public comment on the proposed DFC for the Capitan Aquifer within the boundary of GMA 3:

Whereas, following public discussion, due consideration has been given the current and future needs and geology and current conditions of the aquifers in question, the current and projected groundwater demands, total water supply and quality of water

supply available from all aquifers, and the potential effects on springs, surface water, and habitat of water-dependant species through the year 2060, and

Whereas, the GMA 3 Middle Pecos Groundwater Conservation District has on August 9, 2010, considered the results of the 2-D Model for the Capitan Aquifer in GMA-3 developed by Bar-W Groundwater Exploration as presented on August 9, 2010, voted, upon motion made and seconded to designate the following DFC for Capitan Aquifer;

1. Total net decline in water levels within GMA 3 at the end of the fifty-year period in 2060 shall not exceed two hundred (200) feet below water levels in the aquifer in the year 2010, and;
2. The results of the 2-D Model for the Capitan Aquifer in Pecos, Reeves, Ward and Winkler Counties within GMA-3 developed by Bar-W Groundwater Exploration and as presented on August 9, 2010, used to develop the DFC for the Capitan Aquifer are adopted in their entirety, and;
3. The Capitan Aquifer is not considered a relevant aquifer for joint planning purposes in Crane and Loving Counties within GMA-3, at this time.

Now therefore be it resolved, that GMA 3 does hereby confirm, document, and record, the above described designation of the Desired Future Condition for the Capitan Aquifer which was approved by the following vote of the Designated Representative of the GCD present and voting on August 9, 2010;

Paul Weatherby

Paul Weatherby, General Manager
Designated Representative– Middle Pecos GCD

Bar-W GROUNDWATER EXPLORATION

Memorandum

To: Paul Weatherby,
General Manager
Middle Pecos Groundwater Conservation District

From: Charles R. Williams, P.G. No. 526

Date: August 27, 2010

Re: Desired Future Condition of the Capitan Reef Aquifer in GMA-3

STATE OF TEXAS
CHARLES R. WILLIAMS
GEOLOGY
No. 526
LICENSED
PROFESSIONAL GEOSCIENTIST

Introduction

Groundwater Management Area 3 (GMA-3) is a groundwater management area of the State of Texas as defined by Statute with responsibility for developing a desired future condition (DFC) for aquifers within an approximately 6-County area. (Fig. 1) Membership of the GMA is composed of the groundwater conservation districts (GCDs) that occur all or in part within the GMA boundary. However, Middle Pecos Groundwater Conservation District (MPGCD) is currently the only GCD located within GMA-3. The Capitan Reef aquifer occurrence within GMA-3, as it is currently recognized by Texas Water Development Board (TWDB), is limited to Pecos, Ward and Winkler Counties. The area of occurrence of the Rustler aquifer in GMA-3 is entirely within the Rio Grande River Basin. The Rustler aquifer is not considered a relevant aquifer for joint planning purposes at this time in Crane, Loving and Reeves Counties. At the request of MPGCD, Bar-W Groundwater Exploration LLC (Bar-W) developed a 2-D model projections and statements describing DFCs for the portions of the Capitan Reef aquifer recognized by TWDB to occur within Pecos, Ward and Winkler Counties of GMA-3. (Fig. 2)

Methodology

To predict the effects of pumping in the Capitan Reef aquifer a 2-D spreadsheet model was developed. The model uses estimates of: the area of the aquifer recharge (unconfined) and the artesian (confined) zones; the annual amount of aquifer use (pumping); and the coefficient of storage of the aquifer in the confined and unconfined zones to predict the annual volume of water that could be produced from the aquifer and result in a specified amount of aquifer draw-down after 50 years. Predictions of estimated draw down are made for each of the sub-zones of the Capitan Reef aquifer established in the unconfined and confined zones of the aquifer within Pecos County where the aquifer occurs in GMA-3. Predictions of the estimated annual amount of groundwater that could be produced for the several sub-zones in the unconfined zone and confined zone of the aquifer in Pecos County are presented. Aquifer-zone area estimates are from the TWDB geographic information system (GIS) coverages, where available. Estimates of the annual aquifer use are from MPGCD site-specific data. The storage coefficients used in the projections are reasonable assumptive values.

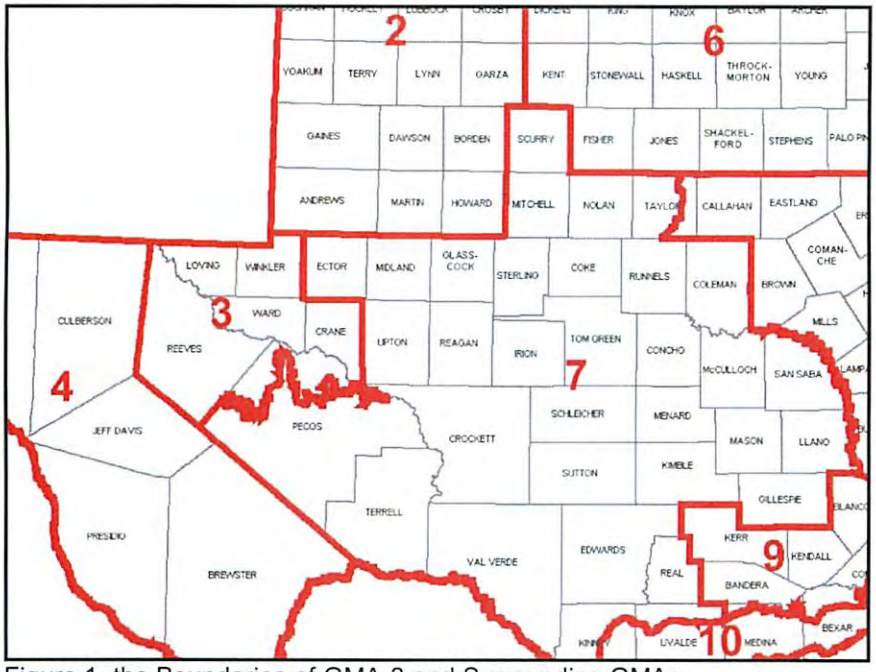


Figure 1, the Boundaries of GMA-3 and Surrounding GMAs

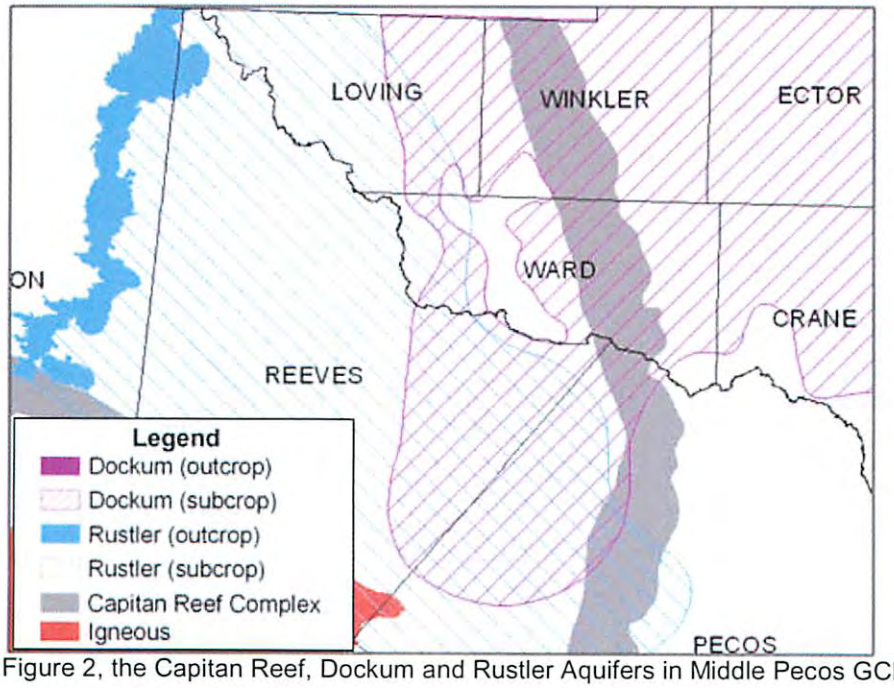


Figure 2, the Capitan Reef, Dockum and Rustler Aquifers in Middle Pecos GCD of GMA-3

Discussion

In GMA-3, the Capitan Reef aquifer has a limited area of occurrence. As delineated by the TWDB GIS coverage, the Capitan Reef aquifer occurs within GMA-3, in Pecos, Ward and Winkler Counties. The area of occurrence of the Capitan Reef aquifer in GMA-3 is entirely within the Rio Grande River Basin. The Capitan Reef aquifer is not considered a relevant aquifer for joint planning purposes at this time in Crane, Loving and Reeves Counties. The GMA-3 approach to DFC development for the Capitan Reef aquifer is to describe a DFC in terms of the average draw down (in feet) for the confined zone of the aquifer with an equivalent amount of draw down as used in the Capitan Reef aquifer confined-zone of Pecos County in GMA-7. The additional GMA-3 intent is to describe a DFC for the Capitan Reef aquifer that will result in a MAG that allows for reasonable growth in groundwater use in the Capitan Reef aquifer above the 2008 MPGCD estimates of the sum of issued permits and groundwater use in the aquifer (approximately 10,315 acre-feet per year) or TWDB estimates of groundwater use (< 700 acre-feet per year total for all other Counties).

Only the confined zone of the Capitan Reef aquifer occurs within GMA-3. Few data are available on the aquifer parameters of the Capitan Reef aquifer in GMA-3. The assessment was unable to locate a published value for the Capitan Reef storage coefficient. In attempting to arrive at a reasonable assumptive value the Lohman method was employed. (Kasenow, 2000) The thickness of the Capitan Reef aquifer may be variable but an average thickness of approximately 2,000 feet may be assumed. (Ashworth, 1990) Multiplying 1 $x10^{-6}$ x 2,000 feet gives an estimated storage coefficient value of approximately 0.02 (dimensionless). However, this value is greater than the general range of storage coefficient values for confined aquifers and was considered potentially unreasonable. (Driscoll, 1986) Employing a storage coefficient value of approximately 1 $x10^{-6}$ (dimensionless) gave trial draw down results that appeared unreasonably large for relatively modest demands in a limited comparison to water-level change over time. The assessment then employed a storage coefficient of approximately 1 $x10^{-4}$ (dimensionless), use of this value gave trial draw down results considered conservatively reasonable and was applied to the confined-aquifer portion of the model. The assessment assumes that the approximate thickness of the water bearing zones of the Rustler aquifer Pecos County is reasonable similar to the approximate thickness of the aquifer in Ward and Winkler Counties.

DFC Development Approach

The purpose of the spreadsheet model is to conveniently predict the estimated amount of water that could be produced annually for 50 years without exceeding a specified level of draw down. The model is used to aid in the DFC development process for aquifers where a TWDB GAM is not available. Iterative trials of a range of draw down values were made until the desired result was achieved for each aquifer sub-zone in each County. (Table 1) The spreadsheet model project the effects of pumping using the following relationships:

$Q(t) = R(t) - D(t) + dS/dt$

Where:
Q(t) = the total rate of groundwater withdrawal (ac-ft/yr)
R(t) = the total rate of groundwater recharge to the basin (aquifer) (ac-ft/yr)
D(t) = the total rate of groundwater discharge from the basin (aquifer) (ac-ft/yr)
dS/dt = change in aquifer storage of groundwater over time (draw down in feet)
(Freeze and Cherry, 1979)

The results of water-level monitoring of the Capitan Reef aquifer appear to show relatively little change over time and suggest that annual aquifer use (pumping) may be approximately equal to or less than annual aquifer recharge. If annual pumping is approximately equal to annual recharge; the factors for recharge and discharge in the aquifer will cancel each other and the relationship may be simplified to:

Q(t) = dS/dt

If it is assumed that the annual amount of recharge to the aquifer is approximately equal to the most recent (2008) MPGCD estimates for groundwater use from the aquifer in Pecos County (or reasonable projections) for groundwater use from the aquifer in each other County. The step-by-step description of the process to develop the DFC for each county is as follows:

1. The total area occupied by the aquifer in each county is subdivided by river basin and then by aquifer zone (confined or unconfined).
2. Within each County; the area of each aquifer sub-zone is divided by the total area occupied by the aquifer in the County to give the percentage of the total aquifer area in the County represented by each sub-zone.
3. The estimate of annual recharge (assumed to be equal to the estimate annual aquifer pumping) for each County is divided by the percentage value of the total aquifer area in the County represented by each aquifer sub-zone in the County to give an estimate of recharge to each aquifer sub-zone (in acre-feet per year).
4. The area (in acres) of each aquifer sub-zone in each County is multiplied by an estimated amount of aquifer draw-down (in feet) $_1$ and then multiplied by the storage coefficient of the aquifer sub-zone (expressed as a decimal fraction) $_2$ to give an estimate of the amount of water (in acre-feet) that could be removed from the aquifer if the estimated amount of aquifer draw-down occurred.
5. The estimated volume of water that could be produced from each aquifer sub-zone with the specified estimate of aquifer draw-down is divided by 50 (years) to estimate the amount of water that could be produced each year from the aquifer sub-zone over a 50-year period to result in the estimated amount of aquifer draw-down at the end to the 50-year time period.
6. The estimated annual amount of water that could be produced from each aquifer sub-zone in each County (in acre-feet per year) is added to the estimate of annual recharge for the sub-zone (in acre-feet per year) to give the estimated MAG value for the aquifer sub-zone (in acre-feet per year).

Notes:

1. The estimated average aquifer draw-down values were kept constant for the several sub-zones of the confined and unconfined zones of the aquifer within each County.
2. The storage coefficient values for the confined and unconfined zones were kept constant for all sub-zones in the aquifer zone in all Counties.

County	Aquifer	Aquifer zone	Sub-divsion Area (acres)	Total Aquifer Area in County (acres)	Sub-division Percent of Total Area	Estimated Total County Pumping (ac-ft per year)	Assigned Annual Recharge Volume (ac-ft)	Estimated Average Aquifer Draw-down (ft)	Storage Co-efficient (dimen-sionless)	Total With-drawal Volume (ac-ft)	Annual With-drawal Volume (ac-ft)	MAG Estimate (ac-ft)
Pecos	Capitan	Un-confined GMA 7	22,279	369,708	6%	10,315	619	15	0.1	33419	668	1287
Pecos	Capitan	Confined GMA 7	298,622	369,708	81%	10,315	8355	200	0.0001	5972	119	8474
Pecos	Capitan	Confined GMA 3	48,807	369,708	13%	10,315	1341	200	0.0001	976	20	1361
Reeves	Capitan	Confined GMA 3	16,847	16,847	100%	1,000	1000	200	0.0001	337	7	1007
Ward	Capitan	Confined GMA 3	126,768	126,768	100%	1,000	1000	200	0.0001	2535	51	1051
Winkler	Capitan	Confined GMA 3	151,462	151,462	100%	1,000	1000	200	0.0001	3029	61	1061
Totals			**664,785**				**13,315**			**46,268**	**926**	**14,241**

Table 1, Identification of Capitan Reef Aquifer Sub-zones in Pecos County, Sub-zone Area, Percentage of Each Sub-zone of the Total Aquifer Area in the County, Estimated Annual Aquifer Use, Estimated Annual Recharge by Aquifer Sub-zone, Estimated Average Aquifer Draw Down in Each Sub-zone, Estimated Total Water Withdrawal by Sub-zone, Estimated Annual Water Withdrawal by Sub-zone and Estimated MAG by Sub-zone

GMA-3 Desired Future Conditions for the Capitan Reef Aquifer

Confined Zone

- From estimated water-level conditions in 2010, the average draw down of the confined zone of the Capitan Reef aquifer should not exceed approximately 200 feet after 50 years.

Areas Where Aquifer is Not Relevant for Joint Planning

- The Capitan Reef aquifer is not relevant for joint planning purposes at this time in Crane, Loving and Reeves Counties.

Note: The observations and assessments made in this report were based on data supplied by MPGCD, other GMA-3 stakeholders, TWDB, or available from referenced published sources available at the time of the report preparation. The conclusions drawn in the report are based on the available data and reasonable methods of assessment. The Desired Future Conditions presented in this report reflect policy decisions made by GMA-3. If new or different data is made available, the conclusions of this report may change.

Bibliography

Ashworth, John B., 1990; Evaluation of Ground-Water Resources in Parts of Loving, Pecos, Reeves, Ward and Winkler Counties, Texas; Texas Water Development Board Report 317

Driscoll, Fletcher, 1986; Groundwater and Wells, Second Edition; Johnson Division; ISBN 0-9616456-0-1

Freeze, R. Allan and Cherry, John A., 1979; Groundwater; Prentice-Hall Inc; ISBN 0-13-365312-9

Kasenow, Michael, 2001, Applied Ground-Water Hydrology and Well Hydraulics, 2nd Edition, Water Resources Publications, LLC

Section 4
Edwards/Trinity & Pecos Valley
DFC Resolution

Resolution # 08-09-2010-3

Designation of Desired Future Conditions Edwards-Trinity (Plateau)/Pecos Valley Aquifers GMA 3

Whereas, the Middle Pecos Groundwater Conservation District (MPGCD) is the only GCD located within the boundary of GMA 3 and is required under 36.108, Texas Water Code to conduct planning and designate the Desired Future Conditions of aquifers within GMA 3,

Whereas, the MPGCD Designated Representative in GMA 3 have met in various meetings and conducted planning in accordance with Section 36.108, Texas Water Code since January 22, 2010;

Whereas, the GMA 3 designated representative has received and considered technical advice regarding local aquifers, hydrology, geology, recharge characteristics, local groundwater demands and usage, population projections, groundwater and surface water inter-relationships, and other considerations that affect groundwater conditions, and

Whereas, GMA 3, having given proper notice, held an open meeting on August 9, 2010, at the Ward County Convention Center, Monahans, Texas, to accept public comment on the proposed DFC for the Edwards-Trinity (Plateau)/Pecos Valley Aquifers within the boundary of GMA 3:

Whereas, following public discussion, due consideration has been given the current and future needs and geology and current conditions of the aquifers in question, the current and projected groundwater demands, total water supply and quality of water

supply available from all aquifers, and the potential effects on springs, surface water, and habitat of water-dependant species through the year 2060, and

Whereas, the GMA 3 Middle Pecos Groundwater Conservation District has on August 9, 2010, considered the results of Scenario 11 of the Texas Water Development Board GAM-Run 09-35 version-3 (single-layer model), voted, upon motion made and seconded to designate the following DFC for the Edwards-Trinity (Plateau)/Pecos Valley Aquifers;

1. The average total net decline in water levels within GMA 3, taken as a whole, at the end of the fifty-year period in 2060, shall not exceed twenty eight (28) feet below water levels in the aquifers in the year 2010, and;
2. The results of Scenario 11 of the Texas Water Development Board GAM-Run 09-35 version-3 (single-layer model) used to develop the DFC for the Edwards-Trinity (Plateau)/Pecos Valley Aquifers within GMA 3 are adopted in their entirety.

Now therefore be it resolved, that GMA 3 does hereby confirm, document, and record, the above described designation of the Desired Future Condition for the Edwards-Trinity (Plateau)/Pecos Valley Aquifers which was approved by the following vote of the Designated Representative of the GCD present and voting on August 9, 2010;

Paul Weatherby

Paul Weatherby, General Manager
Designated Representative– Middle Pecos GCD

County	Drawdown in 2060 (feet)
Crane	50
Loving	5
Pecos (GMA 3 portion only)	12
Reeves	6
Ward	56
Winkler	113
GMA 3 Average	**28**

Table 1, Results of Scenario 11 of TWDB GAM-Run 09-35 version-3 (single layer model)

Section 5
Rustler Aquifer
DFC Resolution & Memo

Resolution # 08-09-2010-4

Designation of Desired Future Conditions
Rustler Aquifer
GMA 3

Whereas, the Middle Pecos Groundwater Conservation District (MPGCD) is the only GCD located within the boundary of GMA 3 and is required under 36.108, Texas Water Code to conduct planning and designate the Desired Future Conditions of aquifers within GMA 3,

Whereas, the MPGCD Designated Representative in GMA 3 have met in various meetings and conducted planning in accordance with Section 36.108, Texas Water Code since January 22, 2010;

Whereas, the GMA 3 designated representative has received and considered technical advice regarding local aquifers, hydrology, geology, recharge characteristics, local groundwater demands and usage, population projections, groundwater and surface water inter-relationships, and other considerations that affect groundwater conditions, and

Whereas, GMA 3, having given proper notice, held an open meeting on August 9, 2010, at the Ward County Convention Center, Monahans, Texas, to accept public comment on the proposed DFC for the Rustler Aquifer within the boundary of GMA 3:

Whereas, following public discussion, due consideration has been given the current and future needs and geology and current conditions of the aquifers in question, the current and projected groundwater demands, total water supply and quality of water supply available from all aquifers, and the potential effects on springs, surface water, and habitat of water-dependant species through the year 2060, and

Whereas, the GMA 3 Middle Pecos Groundwater Conservation District has on August 9, 2010, considered the results of the 2-D Model for the Rustler Aquifer in GMA-3 developed by Bar-W Groundwater Exploration as presented on August 9, 2010,voted, upon motion made and seconded to designate the following DFC for Rustler Aquifer;

1. The average total net decline in water levels within the unconfined portion of the Rustler Aquifer in Reeves County within GMA 3 at the end of the fifty-year period in 2060 shall not exceed fifteen (15) feet below water levels in the aquifer in the year 2010, and;
2. The average total net decline in water levels within the confined portion of the Rustler Aquifer in Pecos, Loving, Reeves and Ward Counties within GMA 3 at the end of the fifty-year period in 2060 shall not exceed three hundred (300) feet below water levels in the aquifer in the year 2010, and;
3. The results of the 2-D Model for the Rustler Aquifer in Pecos, Loving, Reeves, and Ward Counties within GMA-3 developed by Bar-W Groundwater Exploration and as presented on August 9, 2010, used to develop the DFC for the Rustler Aquifer are adopted in their entirety, and;
4. The Rustler Aquifer is not considered a relevant aquifer for joint planning purposes in Crane and Winkler Counties within GMA-3, at this time.

Now therefore be it resolved, that GMA 3 does hereby confirm, document, and record, the above described designation of the Desired Future Condition for the Rustler Aquifer which was approved by the following vote of the Designated Representative of the GCD present and voting on August 9, 2010;

Paul Weatherby

Paul Weatherby, General Manager
Designated Representative– Middle Pecos GCD

Bar-W GROUNDWATER EXPLORATION

Memorandum

To: Paul Weatherby,
General Manager
Middle Pecos Groundwater Conservation District

From: Charles R. Williams, P.G. No. 526

Date: August 27, 2010

Re: Desired Future Condition of the Rustler Aquifer in GMA-3

STATE OF TEXAS
CHARLES R. WILLIAMS
GEOLOGY
No. 526
LICENSED
PROFESSIONAL GEOSCIENTIST

Introduction

Groundwater Management Area 3 (GMA-3) is a groundwater management area of the State of Texas as defined by Statute with responsibility for developing a desired future condition (DFC) for aquifers within an approximately 6-County area. (Fig. 1) Membership of the GMA is composed of the groundwater conservation districts (GCDs) that occur all or in part within the GMA boundary. However, Middle Pecos Groundwater Conservation District (MPGCD) is currently the only GCD located within GMA-3. The Rustler aquifer occurrence within GMA-3, as it is currently recognized by Texas Water Development Board (TWDB), is limited to Loving, Pecos, Reeves and Ward Counties. The area of occurrence of the Rustler aquifer in GMA-3 is entirely within the Rio Grande River Basin. The Rustler aquifer is not considered a relevant aquifer for joint planning purposes at this time in Crane and Winkler Counties. At the request of MPGCD, Bar-W Groundwater Exploration LLC (Bar-W) developed a 2-D model projections and statements describing DFCs for the portions of the Rustler aquifer recognized by TWDB to occur within Loving, Pecos, Reeves and Ward Counties of GMA-3. (Fig. 2)

Methodology

To predict the effects of pumping in the Rustler aquifer a 2-D spreadsheet model was developed. The model uses estimates of: the area of the aquifer recharge (unconfined) and the artesian (confined) zones; the annual amount of aquifer use or a projected use value (pumping); and the coefficient of storage of the aquifer in the confined and unconfined zones to predict the annual volume of water that could be produced from the aquifer and result in a specified amount of aquifer draw-down after 50 years. Predictions of estimated draw down are made for each of the sub-zones of the Rustler aquifer established in the unconfined and confined zones of the aquifer in each County in which the aquifer occurs in GMA-3. Predictions of the estimated annual amount of groundwater that could be produced for the several sub-zones in the unconfined zone and confined zone of the aquifer in each County are presented. Aquifer-zone area estimates in each County are from the TWDB geographic information system (GIS) coverages. Estimates of the annual aquifer use are from MPGCD site-specific data and reasonable projections in other Counties. The storage coefficients used in the projections are reasonable assumptive values.

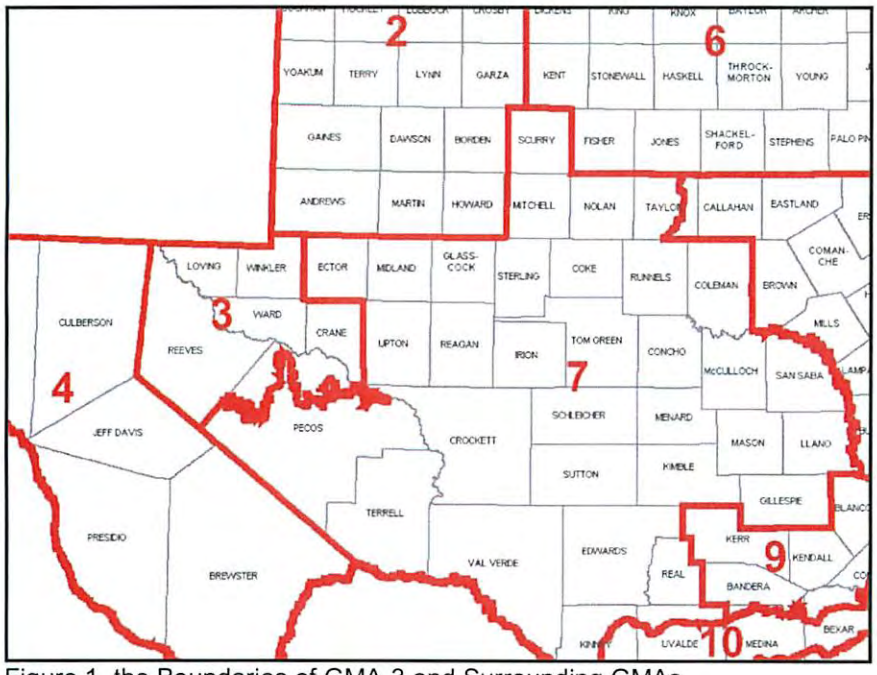


Figure 1, the Boundaries of GMA-3 and Surrounding GMAs

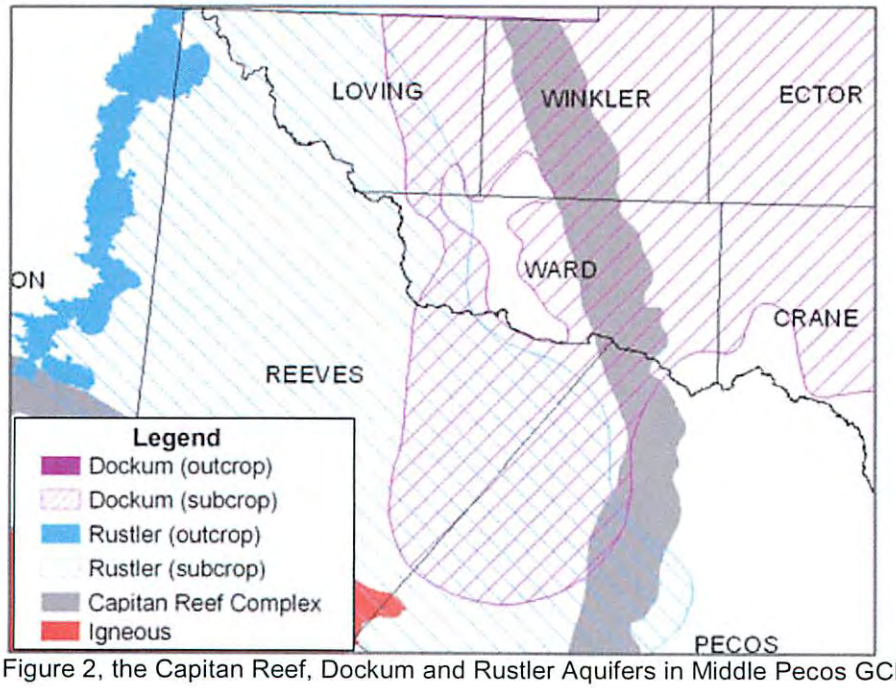


Figure 2, the Capitan Reef, Dockum and Rustler Aquifers in Middle Pecos GCD of GMA-3

Discussion

In GMA-3, the Rustler aquifer has a limited area of occurrence. As delineated by the TWDB GIS coverage, the Rustler aquifer occurs within GMA-3, in Loving, Pecos, Reeves and Ward Counties. The Rustler aquifer is not considered a relevant aquifer for joint planning purposes at this time in Crane and Winkler Counties. The entire are of occurrence of the Rustler aquifer in GMA-3 is the Rio Grande River basin. The GMA-3 approach to DFC development for the Rustler aquifer is to describe a DFC in terms of the average draw down (in feet) for the confined zone of the aquifer with an equivalent amount of draw down as used in the Rustler aquifer confined zone of Pecos County in GMA-7. The additional GMA-3 intent is also to describe a DFC for the Rustler aquifer that results in a MAG that allows for reasonable growth in Rustler aquifer use above 2008 MPGCD estimates of the sum of issued permits and groundwater use in the aquifer (approximately 10,063 acre-feet per year) or TWDB estimates of groundwater use (< 400 acre-feet per year total for all other Counties).

Few data are available on the aquifer parameters of the Rustler aquifer in GMA-3. The assessment was unable to locate a published value for the Rustler storage coefficient. In attempting to arrive at a reasonable assumptive value, the Lohman method was employed. (Kasenow, 2000) The thickness of the Rustler aquifer in Pecos County varies from approximately 0 to 450 feet. The average thickness of Rustler aquifer in Pecos County appears to be approximately 200 feet. (Armstrong and McMillion, 1961) To conservatively account for potential error in the apparent average thickness of the aquifer and to account for the potential that the entire thickness of the aquifer may not be water-bearing, the assessment assumes a water-bearing zone thickness of approximately 100 feet. Multiplying 1 $x10^{-6}$ x 100 feet gives an estimated storage coefficient value of approximately 0.0001 (dimensionless). The assessment assumes that the approximate thickness of the water bearing zones of the Rustler aquifer Pecos County is reasonable similar to the approximate thickness of the aquifer in Loving , Reeves and Ward Counties. A storage coefficient value of approximately 0.1 (dimensionless) was applied to the unconfined-aquifer portion of the model.

DFC Development Approach

The purpose of the spreadsheet model is to conveniently predict the estimated amount of water that could be produced annually for 50 years without exceeding a specified level of draw down. The model is used to aid in the DFC development process for aquifers where a TWDB GAM is not available. Iterative trials of a range of draw down values were made until the desired result was achieved for each aquifer sub-zone in each County. (Table 1) The spreadsheet model project the effects of pumping using the following relationships:

Q(t) = R(t) – D(t) + dS/dt

Where:
Q(t) = the total rate of groundwater withdrawal (ac-ft/yr)
R(t) = the total rate of groundwater recharge to the basin (aquifer) (ac-ft/yr)
D(t) = the total rate of groundwater discharge from the basin (aquifer) (ac-ft/yr)
dS/dt = change in aquifer storage of groundwater over time (draw down in feet)
(Freeze and Cherry, 1979)

The results of water-level monitoring of the Rustler aquifer appear to show relatively little change over time and suggest that annual aquifer use (pumping) may be approximately equal to or less than annual aquifer recharge. If annual pumping is approximately equal to annual recharge; the factors for recharge and discharge in the aquifer will cancel each other and the relationship may be simplified to:

Q(t) = dS/dt

If it is assumed that the annual amount of recharge to the aquifer is approximately equal to the most recent (2008) MPGCD estimates (or reasonable projections) for groundwater use from the aquifer in each other County. The step-by-step description of the process to develop the DFC for each county is as follows:

1. The total area occupied by the aquifer in each county is subdivided by river basin and then by aquifer zone (confined or unconfined).
2. Within each County; the area of each aquifer sub-zone is divided by the total area occupied by the aquifer in the County to give the percentage of the total aquifer area in the County represented by each sub-zone.
3. The estimate of annual recharge (assumed to be equal to the estimate annual aquifer pumping) for each County is divided by the percentage value of the total aquifer area in the County represented by each aquifer sub-zone in the County to give an estimate of recharge to each aquifer sub-zone (in acre-feet per year).
4. The area (in acres) of each aquifer sub-zone in each County is multiplied by an estimated amount of aquifer draw-down (in feet) $_1$ and then multiplied by the storage coefficient of the aquifer sub-zone (expressed as a decimal fraction) $_2$ to give an estimate of the amount of water (in acre-feet) that could be removed from the aquifer if the estimated amount of aquifer draw-down occurred.
5. The estimated volume of water that could be produced from each aquifer sub-zone with the specified estimate of aquifer draw-down is divided by 50 (years) to estimate the amount of water that could be produced each year from the aquifer sub-zone over a 50-year period to result in the estimated amount of aquifer draw-down at the end to the 50-year time period.
6. The estimated annual amount of water that could be produced from each aquifer sub-zone in each County (in acre-feet per year) is added to the estimate of annual recharge for the sub-zone (in acre-feet per year) to give the estimated MAG value for the aquifer sub-zone (in acre-feet per year).

Notes:

1. The estimated average aquifer draw-down values were kept constant for the several sub-zones of the confined and unconfined zones of the aquifer within each County.
2. The storage coefficient values for the confined and unconfined zones were kept constant for all sub-zones in the aquifer zone in all Counties.

County	Aquifer	Aquifer zone	Sub-divsion Area (acres)	Total Aquifer Area in County (acres)	Sub-division Percent of Total Area	Estimated Total County Pumping (ac-ft per year)	Assigned Annual Recharge Volume (ac-ft)	Estimated Average Aquifer Draw-down (ft)	Storage Co-efficient (dimen-sionless)	Total With-drawal Volume (ac-ft)	Annual With-drawal Volume (ac-ft)	MAG Estimate (ac-ft)
Pecos	Rustler	Confined GMA 3	241,707	741,398	33%	10,063	3321	300	0.0001	7251	145	3466
Pecos	Rustler	Confined GMA 7	499,691	741,398	67%	10,063	6742	300	0.0001	14991	300	7042
Reeves	Rustler	Recharge un-confined	15,306	1,659,076	1%	1,000	10	15	0.1	22959	459	469
Reeves	Rustler	Confined GMA 3	1,643,770	1,659,076	99%	1,000	990	300	0.0001	49313	986	1976
Loving	Rustler	Confined GMA 3	305,663	305,663	100%	1,000	1000	300	0.0001	9170	183	1183
Ward	Rustler	Confined GMA 3	92,462	92,462	100%	500	500	300	0.0001	2774	55	555
Totals			**2,798,599**				**12,563**			**106,458**	**2,128**	**14,691**

Table 1, Identification of Rustler Aquifer Sub-zones in Pecos County, Sub-zone Area, Percentage of Each Sub-zone of the Total Aquifer Area in the County, Estimated Annual Aquifer Use, Estimated Annual Recharge by Aquifer Sub-zone, Estimated Average Aquifer Draw Down in Each Sub-zone, Estimated Total Water Withdrawal by Sub-zone, Estimated Annual Water Withdrawal by Sub-zone and Estimated MAG by Sub-zone

GMA-3 Desired Future Conditions for the Rustler Aquifer

Un-Confined Zone

- From estimated water-level conditions in 2010, the average draw down of the un-confined zone of the Rustler aquifer should not exceed approximately 15 feet after 50 years.

Confined Zone

From estimated water-level conditions in 2010, the average draw down of the confined zone of the Rustler aquifer should not exceed approximately 300 feet after 50 years.

Areas Where Aquifer is Not Relevant for Joint Planning

- The Rustler aquifer is not relevant for joint planning purposes at this time in Crane and Winkler Counties.

Note: The observations and assessments made in this report were based on data supplied by MPGCD, GMA-3 stakeholders, TWDB, or available from referenced published sources available at the time of the report preparation. The conclusions drawn in the report are based on the available data and reasonable methods of assessment. The Desired Future Conditions presented in this report reflect policy decisions made by GMA-3. If new or different data is made available, the conclusions of this report may change.

Bibliography

Armstrong, C. A. and McMillion, L.G., 1961; Geology and Ground-Water Resources of Loving, Pecos County, Texas; Texas Board of Water Engineers, Bulletin 6106

Freeze, R. Allan and Cherry, John A., 1979; Groundwater; Prentice-Hall Inc; ISBN 0-13-365312-9

Kasenow, Michael, 2001, Applied Ground-Water Hydrology and Well Hydraulics, 2nd Edition, Water Resources Publications, LLC

Section 6
TWDB Submission Instructions

TEXAS WATER DEVELOPMENT BOARD

P.O. Box 13231, Capitol Station Austin, TX 78711-3231

Phone: 512.463.7847
FAX: 512.475.2053

URL Address:
http://www.twdb.state.tx.us

Email Address:
info@twdb.state.tx.us

Texas Natural Resources Information System (TNRIS)
http://www.tnris.state.tx.us

StratMap
http://www.stratmap.org

Borderlands Information Center (BIC)
http://www.bic.state.tx.us

Water Information Integration and Dissemination (TWDB WIID System)
http://wiid.twdb.state.tx.us/

Texas Water Information Network (TxWIN)
http://www.txwin.net

Water IQ
http://www.water-iq.org

How to Submit Desired Future Conditions to the Texas Water Development Board

Texas Water Code § 36.1072 requires groundwater conservation districts to submit desired future conditions of the groundwater resources in their groundwater management area to the Executive Administrator of the Texas Water Development Board (TWDB) before September 1, 2010. The TWDB expects to receive the following in a submission packet:

(1) The desired future conditions of each aquifer in the groundwater management area (see notes below for more details).
(2) The groundwater management area meeting posting and minutes, with the complete voting record by member, from the groundwater management area public meeting in which the desired future conditions were adopted.
(3) A resolution signed by the groundwater management area member districts adopting the desired future conditions.
(4) The name of a member from the groundwater management area for TWDB staff to contact if necessary.

The TWDB expects to receive desired future conditions for the entirety of each aquifer in the groundwater management area in the submission packet. A completed packet needs to be sent by certified mail (or other traceable methods) to:

Mr. J. Kevin Ward, Executive Administrator
Texas Water Development Board
P.O. Box 13231
Austin, Texas 78711-3231

If sending by private carrier, please send to:

Mr. J. Kevin Ward, Executive Administrator
Texas Water Development Board
1700 North Congress Avenue
Austin, Texas 78701
(512) 463-7847

(OVER)

The desired future conditions have to be physically possible. For example, a desired future condition limiting water level declines to 100 feet in an unconfined (water table) aquifer with only 50 feet of water would be physically impossible. Second, if there are multiple desired future conditions in the same aquifer in a groundwater management area, they need to be compatible. For example, it would be difficult to estimate managed available groundwater if one area with a desired future condition of maintaining spring flow was located next to another area with a desired future condition to drain the aquifer.

If questions arise about this process, please do not hesitate to contact Robert Bradley at (512) 936-0870 or Rima Petrossian at (512) 936-2420.

Our Mission
Provide leadership, planning, financial assistance, information, and education for the conservation and responsible development of water for Texas.

EQUAL OPPORTUNITY EMPLOYER
The Texas Water Development Board does not discriminate on the basis of race, color, national origin, sex, religion, age or disability in employment or the provision of services, programs or activities.
1-800-RELAY TX (for the hearing impaired)

TWDB Adopts Amended Groundwater Rules on Desired Future Conditions

By: Dr. Robert Mace

On December 4, 2007, the TWDB adopted amendments to the agency's rules in Texas Administrative Code, Chapter 356, related to groundwater management. This adoption culminated a nearly six-month long process to revise the rules. Agency staff approached the TWDB in June with a plan to amend the agency's rules. After several Board meetings, stakeholder meetings, a posting in the *Texas Register*, and the receipt of over 200 comments, the amended rules will become effective on January 23, 2008.

Garnering the most interest were the proposed rules to clarify the petition process, a process through which a qualified entity can petition the TWDB that a desired future condition is not reasonable. The petition process in the final amended rules is as follows:

1. A person with a legally defined interest files a petition with the TWDB appealing the approval of the desired future condition, including evidence that the groundwater conservation districts did not establish a reasonable desired future condition. The petitioner is required to send the petition to the groundwater conservation districts in the groundwater management area at least 30 days before he or she submits the petition to the TWDB.
2. Agency staff determines if the petition is reviewable. If the petition is not reviewable, the executive administrator may dismiss the petition.
3. Groundwater conservation districts in the groundwater management area have 10 days to request a 60-day period to try and resolve the petition.
4. The executive administrator, or his designee, holds at least one public hearing at a central location in the groundwater management area.
5. Agency staff reviews the petition, testimony, and any relevant evidence and provides a summary analysis, which may include a recommendation, to the TWDB. The summary analysis may include information on whether or not the adopted desired future conditions are physically possible, groundwater use, any socioeconomic impact reasonably expected to occur, any environmental impacts, including but not limited to, impacts to spring flow or other interaction between groundwater and surface water, the impact on private property rights, the reasonable and prudent development of the state's groundwater resources, state policy and legislative directives, and any other information relevant to the specific condition.
6. The TWDB reviews the summary analysis and decides whether or not the desired future condition is reasonable. The TWDB may table the decision for further consideration at another meeting.
7. If the TWDB decides that the desired future condition is reasonable, the TWDB issues written findings to the petitioner and the groundwater conservation districts and the petition process ends.
8. If the TWDB decides that the desired future condition is not reasonable, the TWDB issues written findings to the petitioner and the groundwater conservation districts, including recommended changes to the desired future condition.
9. The groundwater conservation districts revise their desired future condition in accordance with the TWDB's findings and recommendations.
10. The groundwater conservation districts submit the revised desired future condition to the TWDB and may request TWDB opinion regarding whether the revisions are in accordance with the TWDB's recommendations.
11. The groundwater conservation districts hold at least one public hearing at a central location in the groundwater management area.

(OVER)

12. The groundwater conservation districts revise the desired future condition after considering public comments and the TWDB's findings and recommendations.
13. The groundwater conservation districts submit the revised desired future condition to the TWDB for review. If the districts changed the desired future condition from the TWDB's recommendations, then the districts have to provide a rationale, based on comments received at their public hearing, for the changes.
14. The TWDB will provide public notice of the district's revisions and may provide a response to the revisions.
15. The TWDB provides managed available groundwater numbers to the groundwater conservation districts and regional water planning groups according to the revised future condition.

The amended rules also clarify language in other parts of Chapter 356 that affect desired future conditions and groundwater management plans. For example, Chapter 356 now requires that desired future conditions be applicable at least through the next regional water planning horizon.

Section 7
Public Letters

May 18, 2010

Ms. Caroline Runge, Manager
Menard County Underground Water District
P.O. Box 1225
Menard, Texas 76859-1225

Mr. Allan Lange, Manager
Lipan-Kickapoo Water Conservation District
P.O. Box 67
Vancourt, Texas 76857

Re: GMA 7 – Determination of Desired Future Conditions

Dear Ms. Runge and Mr. Lange,

I am writing to provide you with Texas Parks and Wildlife Department's comments regarding the determination of desired future conditions (DFCs) for Groundwater Management Area 7 (GMA 7). As you are aware, Texas Water Code § 36.1072 requires groundwater conservation districts to define and submit DFCs of the groundwater resources in their GMA to the Executive Administrator of the Texas Water Development Board (TWDB) before September 1, 2010. The quantifiable groundwater conditions that are identified by the DFCs will be used to determine the amount of managed available groundwater (MAG) for future withdrawal, which will in turn become the permitting targets for the groundwater districts. These availability volumes will also be used in the state's regional water planning process.

The decisions made through the DFC process will set the stage for the future of groundwater resources across the state. Considering the interconnected nature of groundwater and surface water, the DFCs may also have serious, long term implications on surface water supplies and habitats such as spring systems that are dependent upon continued groundwater interactions. As the state agency charged with the primary responsibility for protecting the state's fish and wildlife resources (Texas Parks and Wildlife Code § 12.001), the Texas Parks and Wildlife Department (TPWD), in a letter mailed to all GMA Chairs in March 2007,

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recommended that GMAs consider aquifer contributions to streamflows as a metric in determining their DFCs.

Identifying the potential consequences of groundwater development and defining undesirable impacts is difficult as knowledge of the relationship between groundwater and surface water interactions is generally limited. This relationship is often clouded due to the fact that different stakeholders may have different opinions on preferred outcomes, and because the effects of development may not be fully realized for many years. The DFC process provides the GMAs and member Groundwater Conservation Districts (GCD) with the opportunity to define undesirable impacts and protect what they deem important. Because the DFC will be reviewed every five years and can be amended at any time, it also provides the GMAs with the opportunity to be conservative in defining DFCs while gaining knowledge on the potential impacts of future pumping.

The GMAs have until September 2010 to define their respective DFCs. As a result, water availability projections have yet to be determined under this process for many GMAs, leading some GCDs (e.g. Cow Creek GCD) to declare a moratorium on issuing groundwater withdrawal permits until the DFC process is complete and water availability is calculated using the accepted DFC criteria. However, many GCDs are using groundwater availability data that was defined in the Regional Water Planning process, while other GCDs are finding that currently permitted volumes exceed the MAG identified under their preferred DFC scenario. Once DFCs are defined it is possible that groundwater availability figures will change from those identified in the Regional Water Planning process.

Given the uncertainty in quantifiable groundwater conditions and the effect of DFCs on managed available groundwater and future withdrawals, TPWD encourages GMAs and their respective GCDs to carefully consider the interactions between groundwater and surface water in any new large-scale use permits, permit amendments, or export requests. If the potential impacts of such large-scale groundwater withdrawal projects are unclear, GCDs may require the applicant to provide a quantifiable analysis of the potential impact their actions may have on groundwater/surface water interactions. Alternatively, GCDs could include special conditions in permits that limit the volume of water that can be pumped in relation to an identified metric (e.g. streamflows or springflows). While the information may not currently exist to define a metric that relates to an identified DFC, studies may be undertaken (such as those initiated by the USGS and others

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in the San Antonio and Nueces river basins) to better understand the groundwater and surface water relationship. The results of these studies can then be used to modify the DFC as needed.

Groundwater is an important resource for maintaining springs and base flows throughout Texas. This is especially true in the arid and semi-arid regions of west Texas, but groundwater is important to maintaining surface water habitats during drought throughout the state of Texas. As such, TPWD staff encourages GMAs to protect the groundwater/surface water interactions that occur in their area by using springflows or streamflows as a metric in the DFC defined for their respective aquifer systems.

Thank you. Should you have any questions or wish to discuss this matter in more detail, please do not hesitate to contact me at 512/389-8715.

Sincerely,

Cindy Loeffler, Chief
Water Resources Branch

Cc: Coke County Underground Water Conservation District

Crockett County Groundwater Conservation District

Edwards Aquifer Authority

Glasscock Groundwater Conservation District

Hickory Underground Water Conservation District No. 1

Hill Country Underground Water Conservation District

Irion County Water Conservation District

Kimble County Groundwater Conservation District

Kinney County Groundwater Conservation District

Lipan-Kickapoo Water Conservation District

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Lone Wolf Groundwater Conservation District

Menard County Underground Water District

Middle Pecos Groundwater Conservation District

Plateau Underground Water Conservation And Supply District

Real-Edwards Conservation And Reclamation District

Santa Rita Underground Water Conservation District

Sterling County Underground Water Conservation District

Sutton County Underground Water Conservation District

Uvalde County Underground Water Conservation District

Wes-Tex Groundwater Conservation District

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Paul Weatherby

From: Randy Williams [barw.groundwater@gmail.com]
Sent: Monday, June 14, 2010 4:33 PM
To: Paul Weatherby
Subject: Re: GMA 3

The main agenda item should be presentation of the TWDB Dockum GAM results. We'll need to check if they'll be ready. The agenda could also include asking if anyone has any additional input regarding the pumping amounts/distribution for Pecos Valley, Capitan and Rustler outside of Pecos County that would modify what was proposed at the last meeting.

That should cover things for this meeting. I'll review the materials from last meeting and emails to confirm.

Sent from my iPhone

On Jun 14, 2010, at 10:13 PM, "Paul Weatherby" <mpgcd@sbcglobal.net> wrote:

> Refresh my memory pertaining to what I need for the GMA 3 Agenda the 21st.
>
> Paul

CITY OF KERMIT

110 SOUTH TORNILLO ST.
KERMIT TEXAS, 79745
(432) 586-3460

DATE: 6-16-10
NUMBER OF PAGES
INCLUDING COVER PAGE: 5

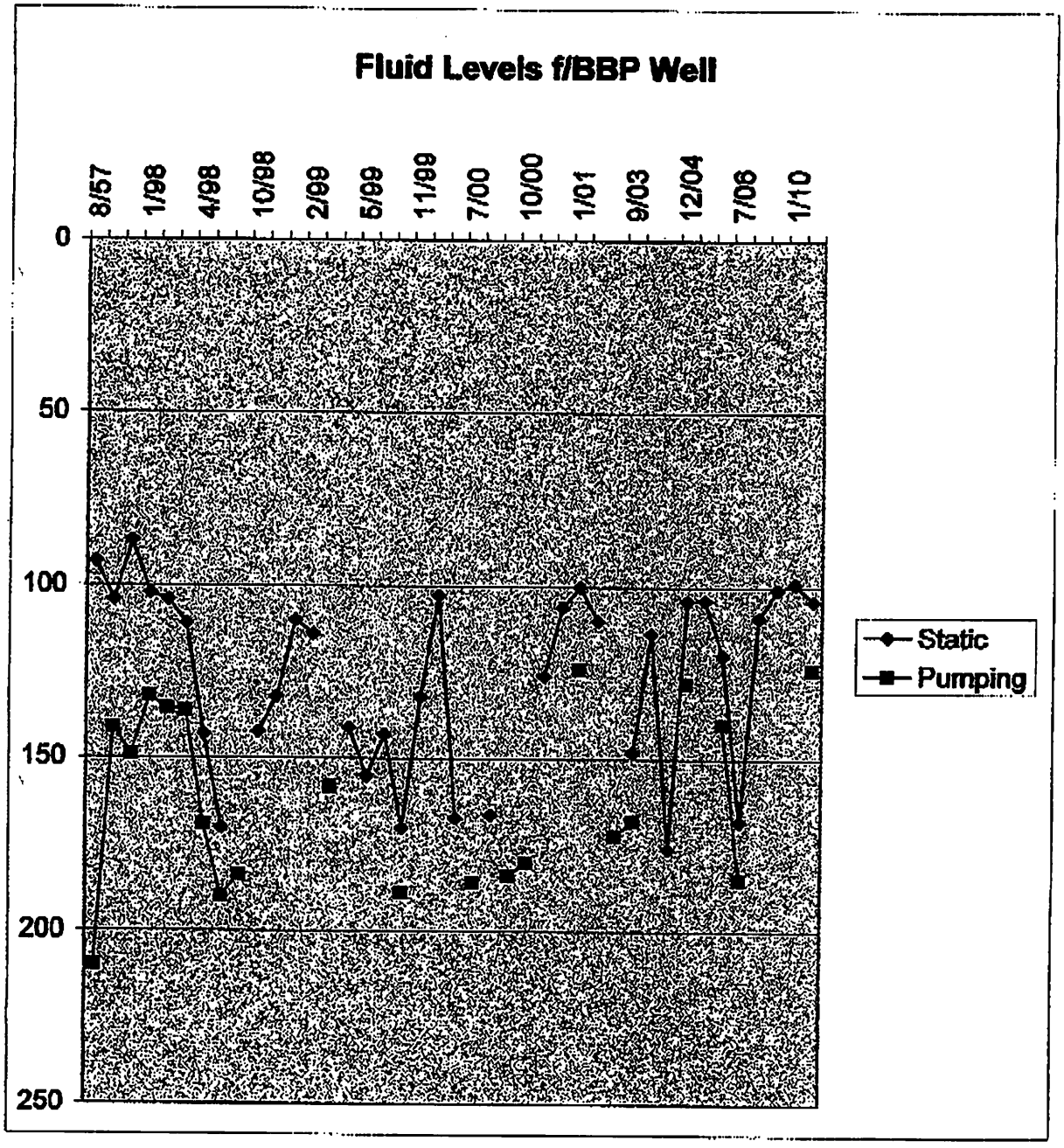
TO: MPGWCD
(Paul Weatherby)
PHONE: 432/336-0698
FAX: 432/336-3407

FROM: John C. Shepard
PHONE: 432/586-3468
FAX: 432/586-2220

REMARKS: __URGENT ✓FOR YOUR REVIEW __REPLY ASAP __PLEASE COMMENT

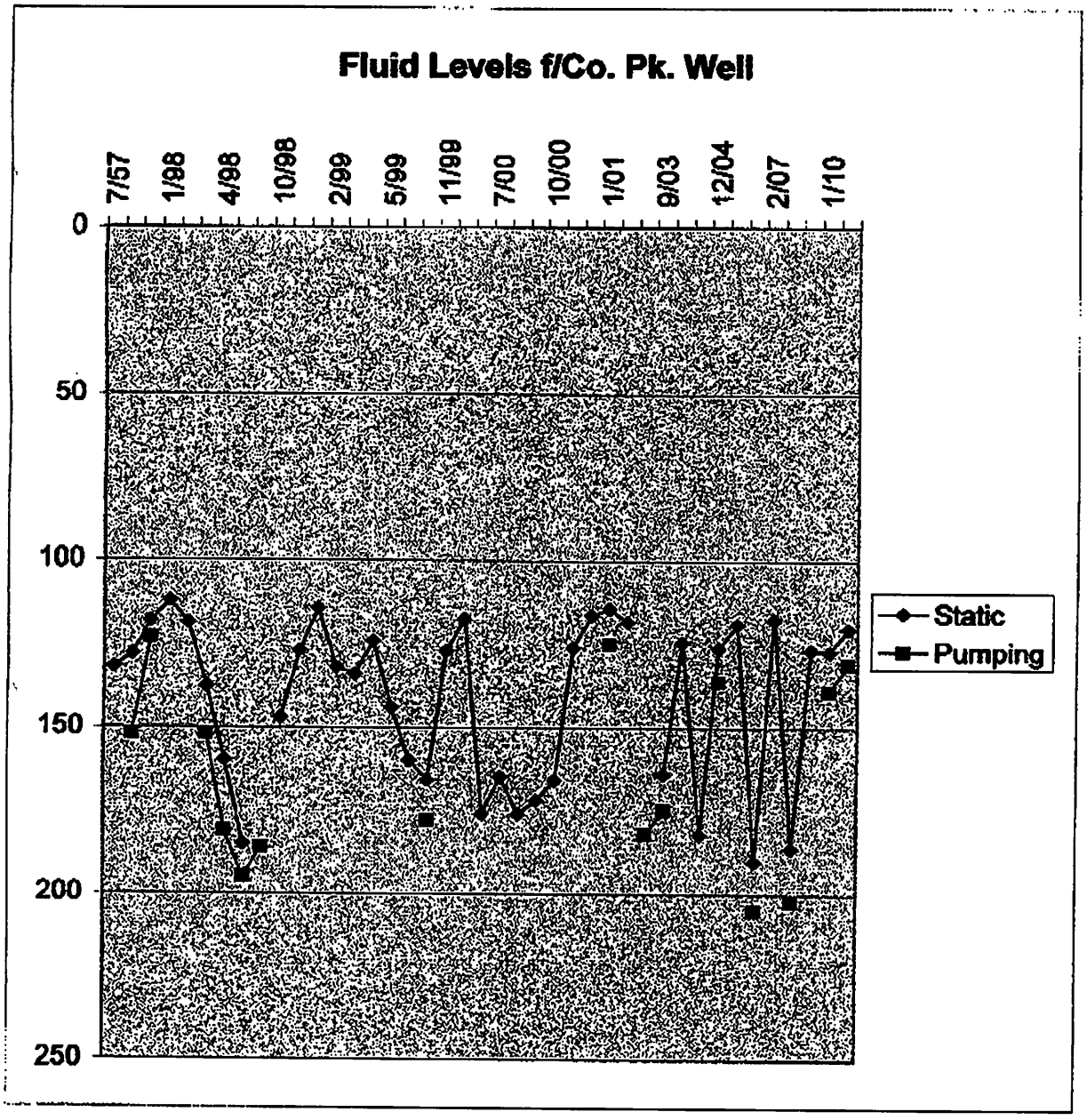
Here are some historical F.L.'s for 2 of our municipal water wells. I compiled data for our far eastern and far western wells. When I get the data compiled for our other 8 active wells, between these 2 wells, I will forward the info to you. Will see you Monday the 21st @ Monahans.

Have a good one,
JCS


Fluid Levels f/BBP Well
8/57
1/98
4/98
10/98
2/99
5/99
11/99
7/00
10/00
1/01
9/03
12/04
7/06
1/10
0
50
100
150
200
250
Static
Pumping

Fluid Levels @ Big Ball Park Well - S.R. #3
(far Western side of City Wellfield)
(pump set >240')

Month/Year	*Static*	*Pumping*
8/57	93	210
7/60	104	141
4/81	87	149
1/98	102	132
2/98	104	135.5
3/98	111	136
4/98	143	169
8/98	170	190
9/98		184
10/98	142.25	
11/98	132	
1/99	110	
2/99	114	
3/99		158
4/99	141	
5/99	155	
7/99	143	
8/99	170	189
11/99	132	
1/00	102.65	
6/00	167	
7/00		186
8/00	166	
9/00		184
10/00		180
11/00	126	
12/00	106	
1/01	100	124
2/03	110	
5/03		172
9/03	148	168
1/04	113.8	
6/04	176	
12/04	104	128
1/05	103.84	
5/05	120	140
7/06	168	185
2/07	109.07	
1/08	100.82	
1/10	99	
2/10	104	124


Fluid Levels f/Co. Pk. Well
7/57
1/98
4/98
10/98
2/99
5/99
11/99
7/00
10/00
1/01
9/03
12/04
2/07
1/10
0
50
100
150
200
250
Static
Pumping

Fluid Levels @ County Park Well - S.R. #2
(far Eastern side of City Wellfield)
(pump set >265')

	(feet)	
Month/Year	*Static*	*Pumping*
7/57	132	
4/81	128	152
12/87	118	123
1/98	112	
2/98	118.5	
3/98	137.75	152
4/98	160	181
8/98	185	195
9/98		186
10/98	147	
11/98	127	
1/99	114	
2/99	132	
3/99	134	
4/99	124	
5/99	144	
7/99	160	
8/99	166	178
11/99	127	
1/00	117.29	
6/00	176	
7/00	165	
8/00	176	
9/00	172	
10/00	166	
11/00	126	
12/00	116	
1/01	114	125
2/03	118	
5/03		182
9/03	164	175
1/04	124.3	
6/04	182	
12/04	126	136
1/05	118.64	
6/06	190	205
2/07	117.19	
7/08	186	202
1/09	126.49	
1/10	127	139
2/10	120	131

CRMWD Colorado River Municipal Water District

January 27, 2010

Mr. Paul Weatherby
General Manager
Middle Pecos Groundwater Conservation District
P.O. Box 1644
Fort Stockton, Texas 79735

CERTIFIED MAIL: 7008 2810 0001 4844 4692

Re: Texas Water Development Board
Groundwater Management Area 3

Dear Mr. Weatherby:

As we have discussed the Colorado River Municipal Water District has a vested interest in Groundwater Management Area 3 (GMA 3). The District owns property in Winkler County which was acquired for future groundwater development and we also have a groundwater lease in Ward County with an active major well field. Given the unique nature of GMA 3, with only one groundwater district, we are requesting to have a "seat at the table" during the development and adoption of the desired future conditions.

Since our offices are not physically located in GMA 3 we would appreciate it if you could send us copies of all meeting notices that apply to GMA 3 such as the GMA 3 planning group, work groups, or the Middle Pecos Groundwater Conservation District where either discussion or action will be taken on the desired future conditions for GMA 3. You can either e-mail or fax me a copy of the notice. I've included my business card with my contact information. If you have prepared a schedule for developing and adopting the DFCs that would help us schedule those meeting dates in advance. Also if you have had any past meetings where discussion or action has occurred regarding GMA 3 we would like to get a copy of those meeting minutes.

We appreciate you including the Colorado River Municipal Water District in the process to develop and adopt the desired future conditions for GMA 3 and if you have any questions please don't hesitate to give me a call.

Sincerely,

John W. Grant
General Manager

xc: Robert Bradley, TWDB

F:\GroupWise Files\Admin General\Letter to Paul Weatherby 1-27-10.docx

Melissa Mills

From: John Grant [jgrant@crmwd.org]
Sent: Saturday, April 03, 2010 11:02 AM
To: Paul Weatherby
Subject: FW: Pecos County irrig pumping from Pecos Valley ac
Attachments: Pecos Alluvium Irrig Use.pdf

Paul

Attached is the information from the Edwards Trinity / Pecos Valley GAM on water use in northern Pecos County. Can you take a look at this and give me a call? I'd like to discuss what we've found out about the Pecos Valley portion of the model.

Thanks, John

John W. Grant, General Manager
Colorado River Municipal Water District
P.O. Box 869 (400 E. 24th Street)
Big Spring, Texas 79721-0869
Phone: 432-267-6341
Fax: 432-267-3121
www.crmwd.org

From: Blandford, Neil [mailto:nblandford@dbstephens.com]
Sent: Friday, April 02, 2010 9:21 AM
To: John Grant
Cc: Kuchanur, Muthu; Donnelly, Andrew; Blandford, Neil
Subject: Pecos County irrig pumping from Pecos Valley aquifer

John,

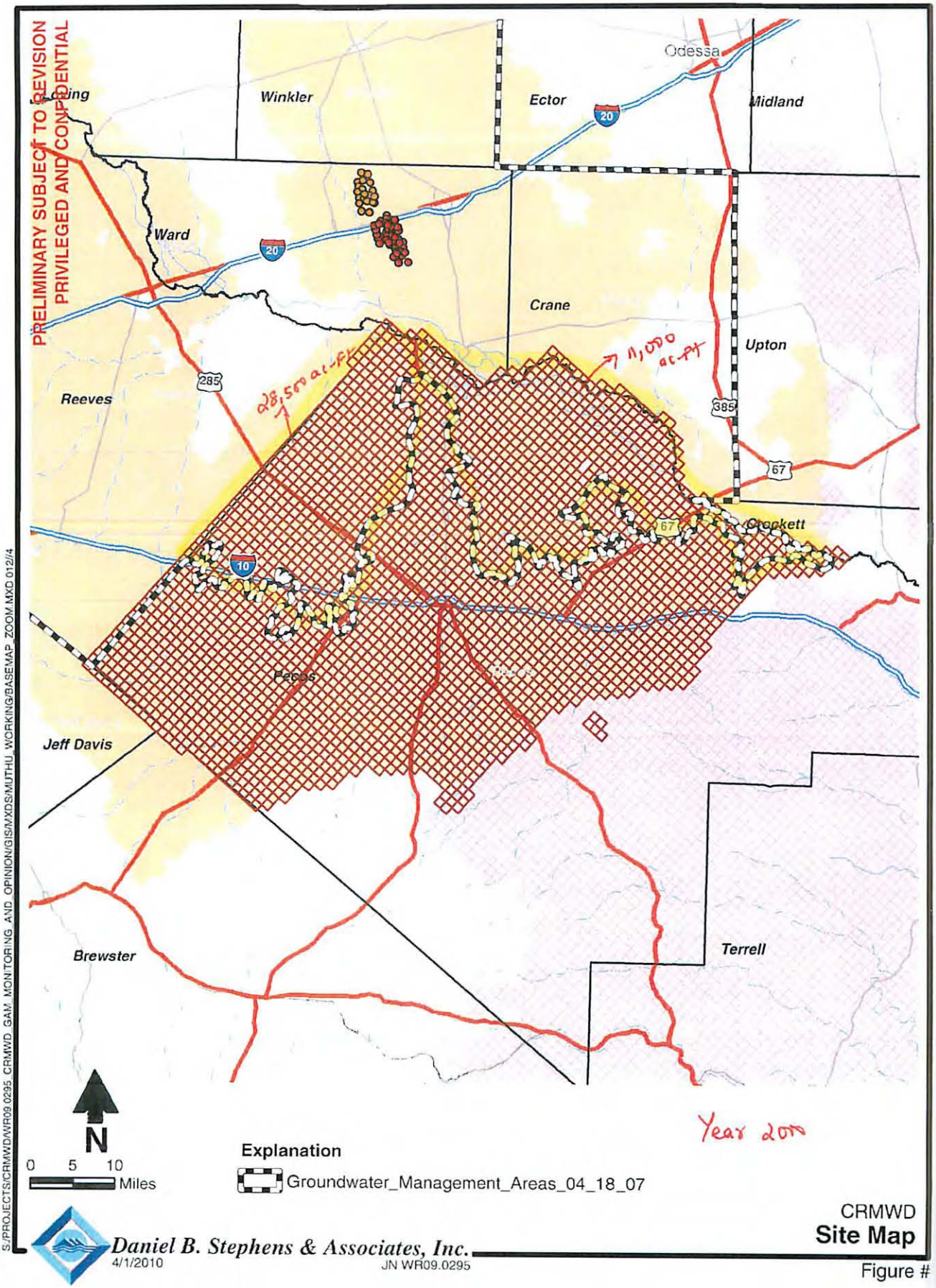
Attached is a working figure illustrating the irrigation pumping in the GAM in the Pecos Valley aquifer for northern Pecos County. The values are actually for all pumping, but the vast majority is agriculture. You will see it is 28,500 ac-ft for the northwest portion of the county, and 11,000 ac-ft for the north-central portion, the dividing line being made along the "tongue" of Edwards-Trinity aquifer that extends to the north from Ft. Stockton (Edwards-Trinity aquifer extent is marked by the thick white dashed line). Total for Pecos County is = 39,500 ac-ft.

This is for the year 2000; there is significant variation in past years. I selected this year because it is most likely what would be carried forward for predictive runs.

Let me know if you have any questions or need anything else on this.

Thanks

Neil Blandford
Vice President/Principal Hydrologist
Daniel B. Stephens & Associates, Inc.
(505) 822-9400 office
(505) 239-9446 cell
www.dbstephens.com



CRMWD
Site Map

Daniel B. Stephens & Associates, Inc.
4/1/2010
JN WR09.0295

Figure #

CRMWD Colorado River Municipal Water District

May 11, 2010

Mr. Paul Weatherby
General Manager
Middle Pecos Groundwater Conservation District
PO Box 1644
Fort Stockton, Texas 79735

Re: Baseline Pecos Valley Aquifer groundwater availability numbers for Ward and Winkler Counties to be used in the development of DFCs

Dear Paul:

Thank you for the opportunity for CRMWD to have our consultants present some potential approaches to determining desired future conditions (DFCs) in the portions of Groundwater Management Area 3 (GMA 3) that are not included in the Middle Pecos Groundwater Conservation District (MPGCD). When researching that presentation, we felt that it would be of value to you to have some information on all of the aquifers in GMA 3, and so our presentation was a fairly comprehensive evaluation of the entire GMA. However, as a stakeholder in GMA 3, our main interest is in the DFCs that are established for the Pecos Valley Aquifer in Ward and Winkler counties. This letter provides a follow up to our presentation and outlines what we would like to see for these two counties with respect to the DFCs that are established, and the rationale behind this request.

The current availabilities for the Pecos Valley Aquifer in Ward and Winkler counties are 17,288 and 51,994 acre-feet/year, respectively. The methodology used to develop these numbers in the regional planning process was "Recharge + 75% of recoverable storage depletion over 50 years" for both counties. We are unsure of the rationale behind the development of these availabilities beyond this generic methodology statement. However, the availabilities that resulted are not logical when compared to each other. Recharge rates are similar in both counties, and since the two counties are virtually identical in size, the recharge component of the availability should be approximately the same. When the amount of groundwater in storage is evaluated, we see that Ward

County actually has more groundwater in storage in the Pecos Valley Aquifer than does Winkler County. Consequently, these two factors should have resulted in a larger groundwater availability for Ward County than for Winkler County in the regional water planning process, rather than an availability for Ward County of about one-third that of Winkler County. We believe strongly that this discrepancy should be corrected, and that the GMA process is the time to correct issues such as this.

What CRMWD would like to see is an availability that is similar between these two counties. We understand that there is little time left before the September 1, 2010 deadline for DFC submittals, and that this means that GMA 3 will be relying on the "spread analyses" that will be done by the Texas Water Development Board (TWDB) using a series of GAM runs. We feel that it is critical that the baseline pumpage totals that are used for Ward and Winkler Counties in these GAM runs reflect the fact that there is, in fact, at least as much groundwater present in storage in the Pecos Valley Aquifer in Ward County as there is in Winkler County. We therefore propose that the pumpage totals for Ward and Winkler counties both be set at 50,000 acre-ft/yr for the baseline pumpage data set for the TWDB model runs. This should ensure that the resulting DFCs ultimately selected by the GMA will result in appropriate and internally consistent MAGs for Ward and Winkler Counties. Finally, we have posed the question of altering the baseline groundwater availability numbers to the TWDB (as a general matter), and they are open to such requests.

Please call me at (432) 267-6341 if you have any questions or concerns.

Sincerely,

John W. Grant
General Manager

xc: Bill Hutchinson – TWDB
Robert Bradley – TWDB

News and Information

From CRMWD

WATER FOR THE FUTURE OF WEST TEXAS. THINK BEFORE YOU WASTE!

For Immediate Release

CRMWD TAKES STEPS TO PROVIDE ADDITIONAL WATER FOR THE REGION

(June 3, 2010) The Colorado River Municipal Water District has taken steps to provide additional long-term water supplies for its member cities and municipal customers by acquiring additional groundwater and moving forward with the construction of a water reclamation plant.

CRMWD has acquired a groundwater well field from Luminant Generation Company in Ward County, Texas. This well field supplies the Permian Basin Power Plant west of Monahans. Under terms of the agreement Luminant has retained enough water for their current operational plans for the power plant. The remaining groundwater reserves and existing well field infrastructure (wells, pipelines and pump stations) were purchased by the District. The District anticipates that this new source of water will be connected to its existing water transmission system sometime during the summer of 2011.

Based on CRMWD's current use of groundwater and the estimated groundwater reserves in the well field, this new groundwater source will last the District for over 100 years. This was a win-win situation for everyone involved; Luminant can continue the operation of their power plant and the District has acquired addition supplies to meet the long-term municipal needs of the region.

Also, as a part of CRMWD's efforts to seek new water sources, the District's Board of Directors have taken steps to construct a water reclamation plant in Big Spring, Texas. This plant will take the treated water discharged from Big Spring's Wastewater Treatment Plant and process the water through a membrane water treatment system, remove the salts using a reverse osmosis process and then disinfection. This water will be blended into the District's raw water transmission system before being treated again at the water treatment plants of the District's member cities and municipal customers. Many entities are turning to "wetlands water recovery systems" which clean the water through a natural process before blending it back with raw water supplies, however with the higher evaporation rates that exist in west Texas, the District has elected to substitute a mechanical treatment process for the natural process.

Bids were recently received for the water treatment equipment for the Big Spring project and it is anticipate that construction of the water reclamation plant will be underway by

December 2010 with start-up of the plant in early 2012. This plant will produce approximately 2.0 million gallons of treated water per day with substantially reduced levels of chlorides or salt in the water.

The estimated cost of these two projects is just over $72,000,000. The District was able to obtain financing from the Texas Water Development Board at reduced interest rates and with a favorable financing structure to help offset the cost. However the District anticipates that it may need to increase its cost of water by 5 to 10 cents per 1,000 gallons over the next two to three years to help offset the cost of these new water supplies and to continue its capital improvements program for upgrading existing water supply facilities.

Both projects, the acquisition groundwater and the construction of the water reclamation plant, will help the District meet municipal demands during drought conditions because these new water supply sources are consider "drought proof" in arid west Texas.

CRMWD member cities are Odessa, Big Spring and Snyder; municipal customers include Midland, San Angelo, Abilene, Stanton, Robert Lee, Grandfalls, Pyote and the Millersview-Doole Water Supply Corporation.

For additional information contact John W. Grant, General Manager at 432-267-6341.

Section 8
Meeting Notices

NOTICE OF
GROUNDWATER MANAGEMENT AREA 3
STAKEHOLDER MEETING

The Middle Pecos Groundwater Conservation District will be hosting a meeting Monday, February 22, 2010, 1:30 PM at the Ward County Convention Center in Monahans, Texas. This will be an informative meeting regarding setting the Desired Future Conditions of our Aquifers in Groundwater Management Area 3 which includes all of Loving, Winkler, Reeves, Ward, and Crane Counties along with the northern portion of Pecos County. Portions of Upton, Ector, and Andrews Counties are also included.

Representatives from the Texas Water Development Board will make a presentation on what a Groundwater Management Area is, Desired Future Conditions, their purpose, and to answer questions.

Meeting Information:

February 22, 2010, 1:30 PM
Ward County Convention Center
400 East 4th Street
Monahans, Tx

Contact/Questions:

Paul Weatherby
General Manager
Middle Pecos Groundwater Conservation District
432-336-0698

FILED FOR RECORD

APR 2 3 2010

TRISH KING
County Clerk, Pecos County, Texas
By _____ Deputy

PRELIMINARY NOTICE OF MEETING

Groundwater Management Area # 3
Joint Planning Meeting

Notice is hereby given that on **Monday, May 3 at 1:30 P.M.**. one or more members of the Board of Directors and/or the designated representatives of the Groundwater Conservation District located within Texas Water Development Board-designated **Groundwater Management Area # 3** of the State of Texas will meet at **Ward County Convention Center, Monahans, Texas, located at 400 E 4th St.** for purposes of conducting joint planning in compliance with the requirements of Section 36.108 of the Texas Water Code.

Agenda

1. Call to Order

2. Introduction of Member District – Middle Pecos Groundwater Conservation District

3. Approval of the Minutes of the meeting on February 22, 2010

4. Report by Texas Parks and Wildlife, Water Resource Branch

5. Report by Daniel B Stephens & Associates regarding the general approach to developing Desired Future Conditions for aquifers in GMA 3

6. Report by Randy Williams, Bar-W Exploration LLC, on approach to trial MAG/DFC development for the Capitan and Rustler aquifer and development of groundwater use estimates for the Pecos Valley aquifer in the Pecos County area of GMA 3.

7. Discussion reference Stakeholders groups on additional comments and additional information needs in the Pecos Valley Aquifer

8. Public comment period

9. Set next meeting date and preliminary agenda

10. Adjournment

I herby certify that the above and foregoing notice was posted and delivered/mailed on April 23, 2010 to Representatives/Stakeholders within Groundwater Management Area 3, and to other interested parties.

Paul Weatherby
Middle Pecos Groundwater Conservation District
P.O. Box 1644
Ft. Stockton, Texas 79735
432-336-0698
432-940-1996
mpgcd@sbcglobal.net

PRELIMINARY NOTICE OF MEETING

Groundwater Management Area # 3
Joint Planning Meeting

Notice is hereby given that on **Monday, June 21 at 1:30 P.M.**. one or more members of the Board of Directors and/or the designated representatives of the Groundwater Conservation District located within Texas Water Development Board-designated **Groundwater Management Area # 3** of the State of Texas will meet at **Ward County Convention Center, Monahans, Texas, located at 400 E 4th St.** for purposes of conducting joint planning in compliance with the requirements of Section 36.108 of the Texas Water Code.

Agenda

1. Call to Order

2. Introduction of Member District – Middle Pecos Groundwater Conservation District

3. Approval of the Minutes of the meeting on February 22, 2010

4. Report by Texas Parks and Wildlife, Water Resource Branch

5. Report by Daniel B Stephens & Associates regarding the general approach to developing Desired Future Conditions for aquifers in GMA 3

6. Report by Randy Williams, Bar-W Exploration LLC, on approach to trial MAG/DFC development for the Capitan and Rustler aquifer and development of groundwater use estimates for the Pecos Valley aquifer in the Pecos County area of GMA 3.

7. Presentation of the TWDB Dockum GAM (Groundwater Available Model) results.

8. Discussion reference Stakeholders groups on additional comments and additional information needs in the Pecos Valley Aquifer

9. Public comment period

10. Set next meeting date and preliminary agenda

11. Adjournment

I herby certify that the above and foregoing notice was posted and delivered/mailed on June 17, 2010 to Representatives/Stakeholders within Groundwater Management Area 3, and to other interested parties.

Paul Weatherby
Middle Pecos Groundwater Conservation District
P.O. Box 1644
Ft. Stockton, Texas 79735
432-336-0698 432-940-1996 mpgcd@sbcglobal.net

Groundwater Management Area 3
Joint Planning / Stakeholders Meeting

Please be advised that one or more members of the Board of Directors and/or the designated representatives of said Board of the Groundwater Conservation Districts within the TWDB-designated Groundwater Management Area 7 of the State of Texas will meet for purposes of discussing and conducting joint planning in compliance with the requirements of Section 36.108 of the Texas Water Code at **1:30 PM on Monday August 9, 2010 at the Ward County Convention Center in Monahans, Texas**

AGENDA

1. Call to order
2. Introduction of Member District – Middle Pecos Groundwater Conservation District
3. Approval of June 21, 2010 Minutes
4. Presentation by Dr. Bill Hutchinson on the Edwards-Trinity (Plateau)/ Pecos Valley groundwater availability model and status update on GAM run requests, discussion on specific pumpage projections and draw downs.
5. Presentation by Dr. Bill Hutchinson on the Dockum groundwater availability model and status update on GAM run requests, discussion on specific pumpage projections and draw downs.
6. Presentation by Randy Williams, Bar-W Exploration LLC, on the Capitan and Rustler 2-D model and status update on DFC development

RECESS OF GMA 3 JOINT PLANNING MEETING FOR GMA 3 PUBLIC HEARING TO RECEIVE COMMENTS ON DRAFT DESIRED FUTURE CONDITIONS

PUBLIC HEARING AGENDA

1. Present Draft Resolutions for DFC for the Capitan and Rustler Aquifers and receive public comments.
2. Present Draft Resolution for DFC for the Edwards-Trinity (Plateau)/ Pecos Valley Aquifers and receive public comment
3. Present Draft Resolution for DFC for the Dockum Aquifer and receive public comment.
4. Adjourn Public Hearing

FILED

AUG 4 2010

TRISH KING
County Clerk, Pecos County, Texas
Deputy

(Cont)

RECONVENE GMA 3 JOINT PLANNING MEETING

7. Discussion and possible action on adoption of resolutions for adoption of DFCs for the following aquifers within the boundaries of GMA 3:

    Dockum Aquifer
    Capitan Aquifer
    Edwards-Trinity (Plateau)/Pecos Valley Aquifers
    Rustler Aquifer

8. Public Comment Period

9. Set next meeting date and preliminary agenda

10. Adjournment

Paul Weatherby
General Manager
Middle Pecos Groundwater Conservation District
432-336-0698

Groundwater Management Area 3
Joint Planning / Stakeholders Meeting

Please be advised that one or more members of the Board of Directors and/or the designated representatives of said Board of the Groundwater Conservation Districts within the TWDB-designated Groundwater Management Area 7 of the State of Texas will meet for purposes of discussing and conducting joint planning in compliance with the requirements of Section 36.108 of the Texas Water Code at **4:00 PM on Monday August 9, 2010 at the Ward County Convention Center in Monahans, Texas**

AGENDA

1. Call to Order
2. Approval of Minutes of August 9, 2010, 1:30 PM Hearing
3. Any other business to come before the District
4. Adjournment

Paul Weatherby
General Manager
Middle Pecos Groundwater Conservation District
432-336-0698

FILED

AUG 4 2010

TRISH KING
County Clerk, Pecos County, Texas
Deputy

NOTICE OF
GROUNDWATER MANAGEMENT AREA 3
JOINT PLANNING/STAKEHOLDER MEETING/DRAFT RESOLUTIONS

The Middle Pecos Groundwater Conservation District will be hosting two (2) meetings on Monday, August 9, 2010, beginning at 1:30 PM at the Ward County Convention Center in Monahans Texas.

First will be a Joint Planning / Stakeholder Meeting regarding setting the Desired Future Conditions of our Aquifers in Groundwater Management Area 3 (Capitan, Rustler, Edwards-Trinity/ Pecos Valley, and Dockum) aquifers. Groundwater Management Area 3 includes Loving, Winkler, Reeves, Ward, Crane, and the northern portion of Pecos County.

The Joint Planning / Stakeholder Meeting will be recessed to hold a Public Hearing to receive public comments on draft Resolutions giving the Desired Future Conditions for each aquifer. Immediately following the Public hearing, the Joint Planning / Stakeholder Meeting will re-convene to consider adopting the Resolutions for the Desired Future Conditions of the aquifers of GMA 3.

The second Joint Planning / Stakeholder Meeting will convene at 4:00 PM at the Ward County Convention Center in Monahans, Texas to adopt the minutes of the first Stakeholders Meeting.

Meeting Information:

August 9, 2010, 1:30 PM
August 9, 2010, 4:00 PM
Ward County Convention Center
400 East 4th Street
Monahans, TX

Contact/Questions:

Paul Weatherby
General Manager
Middle Pecos Groundwater Conservation District
432-336-0698

FILED

AUG 4 2010

TRISH KING
County Clerk, Pecos County, Texas
Deputy

Section 9
Contact Lists

Skeet Jones
County Judge
Box 193
Mentone, Tx 79754

Sam Contreras
County Judge
100 E. 4th St.
Pecos, Tx 79772

City of Monahans
David Mills
112 W. 2nd St.
Monahans, Tx 79756

CRMWD
Box 869
Big Spring, Tx 79721

Michael McCulloch, DVM
P. O. Box 61410
Midland, TX 79711

Billy Hopper
P. O. Box 353
Mentone, TX 79754

Bonnie Leck
County Judge
Drawer Y
Kermit, Tx 79745

City of Pecos
Joseph Torres
Box 929
Pecos, Tx 79772

Luminant (TXU)
Tim Warren
3177 Hwy 163
Colorado City, Tx 79512

John Farmer
County Judge
Box 457
Crane, Tx 79731

UTL
Jim Buice
Box 553
Midland, Tx 79702

City of Kermit
City Manager
110 S. Tornillo
Kermit, Tx 79745

Greg Holly
County Judge
400 s. Allen
Monahans, Tx 79756

City of Midland
Director of Utilities
Box 1152
Midland, Tx 79702

City of Crane
City Manager
115 W 8th St.
Crane, Tx 79731

Greg Carasco
Box 15039
Las Cruces, NM 88004

*Copy of Notice is on back.
Mailed 4-23-2010

Alan Zeman
Box 810
Pecos, Tx 79772
445-2885
445-1847 (FAX)
448-3006 cell
AZzeman@hughes.net

Melissa Mills

From: Melissa Mills [mmills_mpgcd@sbcglobal.net]

Sent: Friday, April 23, 2010 11:30 AM

To: (adonnelly@dbstephens.com); (jbuice@utsystem.edu); Alan R. Zeman (arzeman@hughes.net); Arlan Gentry (a-gentry@tamu.edu); Bert Lopez (blopez@cityofandrews.org); Carol & Steve Hunt (huntcarol1@yahoo.com); Danny Griffin (dgriffin@cityofandrews.org); Darrell S. Peckham; Derek McGregor; Dru Gravens (durgravens@classicnet.net); Gary Bryant; gstanton@usgs.gov; J Grant; Joe Alexander (joe.alexander@texasagriculture.gov); Judge Bonnie Leck (bonnie.leck@co.winkler.tx.us); Judge Skeet Lee Jones; Nancy Carpenter; Neil Blandford (nblandford@dbstephens.com); Pap Roark (sroarks6@aol.com); Patel C; Permian Basin UWCD; Robert Bradley; S. B. Wight Jr. (yt.ranch@hotmail.com); Steve Sellepack (ssellepack@premiercorp-usa.com); Stuart Purvis (spurvis@midlandtexas.gov); Tom Brown (tom.brown@co.crane.tx.us); H McKenzie; Alvaro Mandujano Jr.; E Turpin; Glenn Honaker; Jack McIntyre; John Dorris; Lynn Holland; M. R. Gonzalez; Merrell Daggett; mpgcd@sbcglobal.net; Ronnie Cooper ; Vanessa Cardwell

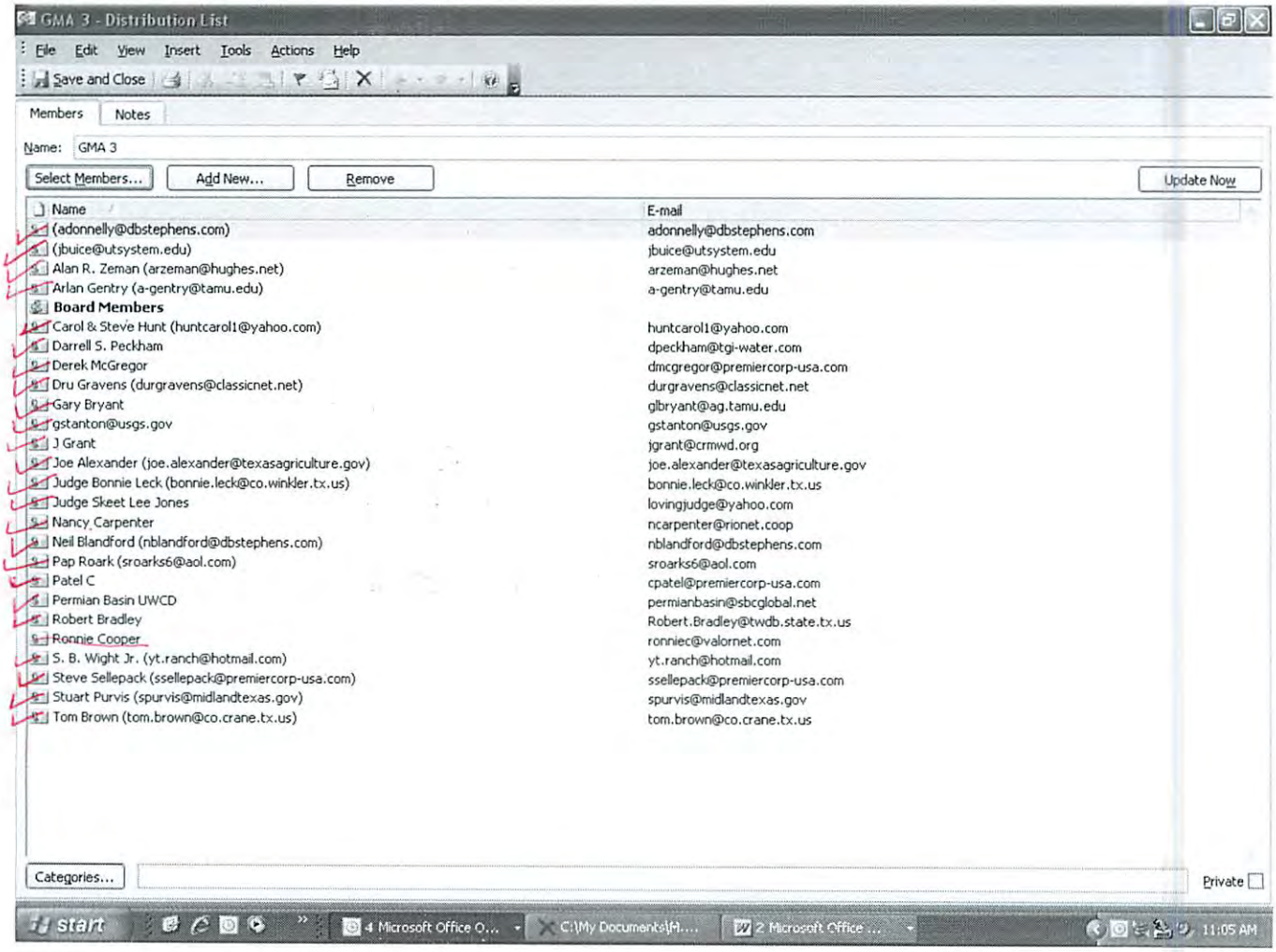
Cc: 'MPGCD'

Subject: GMA 3 Joint Planning Meeting

Attachments: GMA_3_Mtg_Notice 05-03-2010_.doc

Groundwater Management Area #3 Joint Planning Meeting. May 3, 2010. Monahans, TX @ Ward County Convention Center.

Melissa Mills
Office Manager
Middle Pecos Groundwater Conservation District
P. O. Box 1644 103 W. Callaghan
Fort Stockton, TX 79735
Phone#432-336-0698 Fax#432-336-3407
mmills_mpgcd@sbcglobal.net
Web: www.middlepecosgcd.org


GMA 3 - Distribution List
File Edit View Insert Tools Actions Help
Save and Close
Members Notes
Name: GMA 3
Select Members... Add New... Remove Update Now
Name E-mail
(adonnelly@dbstephens.com) adonnelly@dbstephens.com
(jbuice@utsystem.edu) jbuice@utsystem.edu
Alan R. Zeman (arzeman@hughes.net) arzeman@hughes.net
Arlan Gentry (a-gentry@tamu.edu) a-gentry@tamu.edu
Board Members
Carol & Steve Hunt (huntcarol1@yahoo.com) huntcarol1@yahoo.com
Darrell S. Peckham dpeckham@tgi-water.com
Derek McGregor dmcgregor@premiercorp-usa.com
Dru Gravens (durgravens@classicnet.net) durgravens@classicnet.net
Gary Bryant glbryant@ag.tamu.edu
gstanton@usgs.gov gstanton@usgs.gov
J Grant jgrant@crmwd.org
Joe Alexander (joe.alexander@texasagriculture.gov) joe.alexander@texasagriculture.gov
Judge Bonnie Leck (bonnie.leck@co.winkler.tx.us) bonnie.leck@co.winkler.tx.us
Judge Skeet Lee Jones lovingjudge@yahoo.com
Nancy Carpenter ncarpenter@rionet.coop
Neil Blandford (nblandford@dbstephens.com) nblandford@dbstephens.com
Pap Roark (sroarks6@aol.com) sroarks6@aol.com
Patel C cpatel@premiercorp-usa.com
Permian Basin UWCD permianbasin@sbcglobal.net
Robert Bradley Robert.Bradley@twdb.state.tx.us
Ronnie Cooper ronniec@valornet.com
S. B. Wight Jr. (yt.ranch@hotmail.com) yt.ranch@hotmail.com
Steve Sellepack (ssellepack@premiercorp-usa.com) ssellepack@premiercorp-usa.com
Stuart Purvis (spurvis@midlandtexas.gov) spurvis@midlandtexas.gov
Tom Brown (tom.brown@co.crane.tx.us) tom.brown@co.crane.tx.us
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Section 10
Minutes

GROUNDWATER MANAGEMENT AREA 3

Minutes of February 22, 2010 Meeting

Called to order at 1:30 PM

Middle Pecos Groundwater Conservation District Manager, Paul Weatherby, presented information as to GMA 3 boundaries, legislative mandated requirements of establishing Desired Future Conditions, and cooperative participation request from representatives in GMA 3 area.

Robert Bradley, Texas Water Development Board, Groundwater Specialist, presented purposes and goals of establishing Desired Future conditions.

Group discussion on general plan of action/participation on obtaining data/information to accomplish goals of submitting Desired Future conditions to the Texas Water Development Board by September 1, 2010.

Set next meeting for May 3rd, 2010, at 1:30 PM, at Ward County Convention Center

Adjourned at 3:30 PM

Paul Weatherby
5/3/10

Groundwater Management Area 3
Minutes of May 3, 2010

On May 3, 2010, a Stakeholder Meeting was held by the Middle Pecos Groundwater Conservation District in Monahans, Texas, at the Ward County convention Center with the following member present:

Paul Weatherby, General Manager, MPGCD

Others Present:

Neil Blandford, Andy Donnelly, John Shepard, Sam Watson, Alan Zeman, Jim Duke, Darrell Peckham, Bonnie Leck, Kyle Wright, Robin Hernandez, Leo Carrillo, Chris Wingert, Joe Alexander, Arlan Gentry, Billy Hopper, Gene Cowden, David Cutberth, Amy Porter, John Grant, Terry Gilchrest, Gary Bryant, J. Logoulau, Greg Huber, Michael McCullough, Stuart Purvis, John Dorris, Chad Norris, Randy Williams, Tom Brown, Derek McGregor, Bobby Sinclair, Bill Hutchinson, Rex Thoc

Called to order at 1:35 PM by Paul Weatherby

Sole member Groundwater District in GMA 3 introduced was the Middle Pecos Groundwater Conservation District

Minutes approved for February 22, 2010

Chad Norris with Texas Parks & Wildlife presented a letter supporting the protection of Streams, rivers, and springs in Texas

Andy Donnelly with Daniel B. Stephens & Associates presented a power point program reference the general approach to developing Desired Future Conditions for aquifers in GMA 3

Randy Williams, Bar-W Exploration LLC, repoted approach to trial MAG/DFC development for the Capitan and Rustler aquifers and development of groundwater use estimates for the Pecos Valley aquifer in the Pecos County area of GMA 3

There was Stakeholder comments and additional information provided as to the unknown amount of groundwater use in Agriculture and Industry due to no active monitoring of same

Public Comment was received reference the importance for the Middle Pecos Groundwater Conservation District to obtain as much information as possible before setting the DFCs for GMA 3 with the understanding that the process will be reviewed every 5 years or sooner if needed

The next meeting date was set for June 21, 2010 at same location and time.

Meeting adjourned at 3:15 P Approved June 21, 2010, Paul Weatherby

Groundwater Management Area 3
Minutes of June 21, 2010

On June 21, 2010, a Stakeholder Meeting was held by the Middle Pecos Groundwater Conservation District in Monahans, Texas, at the Ward County convention Center with the following member present:

Paul Weatherby, General Manager, MPGCD

Others Present:

Randy Williams, Arlan Gentry, Bill Hutchinson, Joe Alexander, Gary Bryant, Jim Duke, Darrell Peckham, John Grant, Steven Shuster, Chris Wingert, Neil Blandford, Stuart Purvis, Bobby Sinclair, Alan Zeman, and Michael McCulloch

Called to order at 1:20 PM by Paul Weatherby

Sole member Groundwater District in GMA 3 introduced was the Middle Pecos Groundwater Conservation District

Minutes approved for May 3, 2010

Randy Williams, Bar-W Exploration LLC, reported approach to trial MAG/DFC development for the Capitan and Rustler aquifers and development of groundwater use estimates for the Pecos Valley aquifer in the Pecos County area of GMA 3

There were Stakeholder comments and additional information provided as to the unknown amount of groundwater use in Agriculture, Industry, Domestic, and Municipal due to no active monitoring of same;

Bill Hutchinson, TWDB, discussed various models/layers to be used in determining GAMS to be used in the DFC process with the aquifers in GMA 3

Public Comment was received reference the importance for the Middle Pecos Groundwater Conservation District to obtain as much information as possible before setting the DFCs for GMA 3 with the understanding that the process will be reviewed every 5 years or sooner if needed. MPGCD Manager Paul Weatherby stated the importance of each County in GMA 3 to initiate some type of groundwater monitoring, and also advised statutory protection of groundwater was only available thru the establishment of a groundwater district in their respective area(s).

The next meeting date was set for August 9, 2010 at same location and time.

Meeting adjourned at 3:15 PM

Approved August 9, 2010, Paul Weatherby

Groundwater Management Area 3
Minutes of August 9, 2010

On August 9, 2010, a Stakeholder Meeting was held by the Middle Pecos Groundwater Conservation District in Monahans, Texas, at the Ward County Convention Center with the following member present:

Paul Weatherby, General Manager, MPGCD

Others Present:

Bill Hutchison, John Grant, Jim Duke, Darrell Peckham, Stuart Purvis, Chris Wingert, Stephan Schuster, Gary Bryant, Cary Carman, Neil Blandford, Randy Williams

Called to order at 1:35 PM

Sole member of Groundwater Management Area 3 introduced was the Middle Pecos Groundwater Conservation District

Minutes of June 21, 2010 was approved

Paul Weatherby reviewed drafts of Resolutions to be presented for adoption of Desired Future Conditions for the Edwards/Trinity(Plateau)/Pecos Valley (#3), Dockum (#1), Capitan (#2), and Rustler (#4) aquifers.

Presentation by Bill Hutchison, TWDB, on Groundwater Model Runs for E/T Plateau, Pecos Valley, and Dockum Aquifers

Presentation by Randy Williams, Bar-W Groundwater Exploration, on 2-D Models for Minor Aquifer DFC's

Discussion with group pertaining to relevant/irrelevant aquifers in each county of GMA 3, along with discussion reference confined/unconfined aquifers.

Received Public Comment on Draft DFC's on aquifers
Rustler – 15 ft in 60 years – unconfined portion in Reeves Co.
300 ft. – confined in Pecos, Loving, Ward
Not relevant in Crane and Winkler
Dockum – 27 ft.
Edwards/Trinity (Plateau)/Pecos Valley 28 ft. for portion in GMA 3
Note reference GAM run 09-35 version2 scenario 11 by Dr. Hutchison

Recessed Joint Planning Meeting on Public Hearing comment on draft resolutions at 2:15 PM

Resumed Joint Planning Meeting 2:15 PM

Adoption of Resolutions for DFCs for aquifers in GMA 3

There was no Public Comment received.

Motion was made, seconded, and approved by Paul Weatherby, sole representative of GMA 3 MPGCD to adopt the Resolutions for the Aquifers in GMA 3 as presented.
(See attached resolutions)
Note : All Stakeholders involved in this DFC process and results will receive same.

Meeting adjourned at 2:20 PM.

Paul Weatherby
8/9/10

Section 11
Sign-In Sheets

pg. 1 & 4.

Groundwater Management Area 3 Stakeholders Meeting
Hosted by Middle Pecos Groundwater Conservation District
Ward County Convention Center - Monahans, Texas
Attendance Sheet – February 22, 2010 @ 1:30 PM
(Include your email address if you would like)

Name	Mailing Address	Phone #(s)
CHAN PATEL	4200 SUGAR GROVE BLVD #390 SUGAR LAND TX 77477	713 201 5704
Steve Sellepack	4800 Sugar Grove Blvd. #390 Stafford, TX 77477	SSellepack@premiercorp-usa.com 713-305-1925
Robert Bradly TWDB	P.O. Box 13231 Austin, TX 78711	Robert.Bradley@twdb.state.tx.us
Bert Lopez	111 Logsdon Andrews TX	blopez@cityofandrews.org 432-523-5820
DAnny Griffin	"	dgriffin@cityofandrews.org "
DALTON Trowbridge	BOX 265 Balmorhea TX 79718	432-395-2922
Steve+Carol Hunt	//	// huntcarol1@yahoo.com
Beatrice Adams	PO BOX 1314 Stanton, TX	permianbasin@sbcglobal.net 432-756-2136
Donna Springer	" "	" "
Tom Brown	201 W. 6TH Crane, TX	tom.brown@co.crane.tx.us 432-558-1100 Crane County
Bill Sanders	115 W. 8TH Crane, TX 79731	No email 432-558-3563 City Hall

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Groundwater Management Area 3 Stakeholders Meeting
Hosted by Middle Pecos Groundwater Conservation District
Ward County Convention Center - Monahans, Texas
Attendance Sheet – February 22, 2010 @ 1:30 PM
(Include your email address if you would like)

Name	Mailing Address	Phone #(s)
Drew Beavers	115 W 8th Crane TX 79731	drugravens@classicnet.net 432-558-3565 cityhall
Billy Hopper	Rt. 353 Monahans TX 79756	432-377-2002
Michael McCulloch Orum	P.O Box 61410 Midland, TX 79711	432-559-7817
Ronnie Cooper	Box 147, Imperial TX 79743	432-940-4412
Jeff Vellan.	P.O. Box 1668 Fort Stockton 79735	432 290 3827
Elizabeth Ferry	TGI 1104 S. Main RR ITY Fort Stockton Holdings LP	512 8264630
Darrell Peckham	TGI - Midland Fresh Water District No. 1	512-658-0829
Derek McGregor	Premier Environ. Consulting Houston, TX	380-600-8332 432-249-1622
Greg Stanton	USGS 1505 Ferguson Ln Austin, TX 7875-7	512-927-3558
Arlan Gentry	3600 S. Stockton Monahans, TX. 79756	432-943-2682
Alan F. Zeman	Box 810 Pecos, Texas 79772	432-445-2785 Cell 448-3006 arzeman@hughes.net ~~hughes.net~~

pg. 3 of 4

Groundwater Management Area 3 Stakeholders Meeting
Hosted by Middle Pecos Groundwater Conservation District
Ward County Convention Center - Monahans, Texas
Attendance Sheet – February 22, 2010 @ 1:30 PM
(Include your email address if you would like)

Name	Mailing Address	Phone #(s)
Paul Weatherly	Box 1644 F. S.	432-336-0688
Houston Stokes	HC 73 Box 3 McCamey Tx 79752	(432) 353-6670
Jack W Mentzer	107 N Overland Ft Stockton	432 360 9424
S. B. Wright Jr.	Box D Kermit	yt.ranch@hotmail.com 432 924 0446
John Grant	P.O. Box 869 Big Spring TX 79720	432-267-6341
Stuart Purvis (City of Midland)	PO Box ~~1150~~ 1152 Midland TX 79702	spurvis@midlandtexas.gov 432-685-7262
Neil Blandford	6020 Academy NE DBS Albuquerque, NM 87109	nblandford@dbstephens.com 505-822-9400
Andy Donnelly	DBS+A 4030 W. Braker, #325 Austin, TX 78759	adonnelly@dbstephens.com 512-821-2765
Chris Wingert	CRMWD Box 869 Big Spring, TX	(432) 267-6341
Joe Alexander (Texas Dept. of Agriculture)	4502 Englewood Lubbock TX 79414	joe.alexander@texasagriculture.gov (806) 799-8555
Gary Bryant	P.O Box 1298 Ft Stockton TX 79735	432-336-8585

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Groundwater Management Area 3 Stakeholders Meeting
Hosted by Middle Pecos Groundwater Conservation District
Ward County Convention Center - Monahans, Texas
Attendance Sheet – February 22, 2010 @ 1:30 PM
(Include your email address if you would like)

Name	Mailing Address	Phone #(s)
Jim Bice UTL	PoB 553 MIDLAND TX 79702	jbuice@utsystem.edu 432 684 4404
Bonnie Leck	P.O. Drawer Y Kermit, Tx. 79745	432-586-6658 bonnie.leck@co.winkler.tx.us
Ray Roark	2629 Dame Brilen	432-559-7197
	Louisville, TX. 75067	SROARK56@AOL.COM
Skeet Jones	Box 213 Mentone, Tx. 79754	432-377-2362 432-940-5983

GMA 3 5-3-10, 2010

PRINT NAME	MAILING ADDRESS	EMAIL	PHONE
Neil Blandford	6020 Academy NE Albuquerque NM 87109	nblandford@dbstephens.com	505-822-9400
Andy Donnelly	4030 W. Braker #325 Austin 78759	adonnelly@dbstephens.com	512 821 2765
JOHN C SHEPARD	110 S. Tornillo St. Kermit 79745	jsc65@ygahoo.com	432 586-3468
Sam Watson	110 S Tornillo Kermit TX 79745	shwatson@sreaccess.net	432-586-3460
Alan R. Zeman	Box 810 Pecos, TX 79772	arzeman@hughes.net	432-448-3006
Jim Duke	5303 Pony Chase Austin, TX 78727	jim@waterduke.com	512-258-5749
Darrell S. Peckham	1104 South Mays Suite 208 Round Rock, TX 78644	dpeckham@TGI-water.com	512-244-2172
Bonnie Leck	P.O. Drawer Y Kermit, Tx. 79745	bonnie.leck@co.winkler.tx.us	432-586-6658

GMA 3 5-3, 2010

PRINT NAME	MAILING ADDRESS	EMAIL	PHONE
Kyle Wright	607 N. Missouri Fort Stockton TX	jkw1960@gmail.com	661-4875
Robin Hernandez	PO Box 2 Barstow TX 79711	wcid1@pecos.net	445-6834
LEO Carrillo	3600 Stockton Hwy Suit 6 Monahans. TX 79756	leo.carrillo@tx.usda.gov	943-4462
Chris Wingert	CRMWD Box 869 Big Spring, TX 79720	cwingert@crmwd.org	(432) 267-6341
Joe Alexander	4502 Englewood Lubbock 79414		806 799-8555
Adam Gentry		agentry@texas.edu	432-943-2682
Billy Hoppeit	P.O. Box 355 MENTONE TX 79754	hopp37@yahoo	432-377-2002
Gene Cowden	232 Robbie Rd Crane TX 79731	jecowden@AOL.com	432 558 2051 432 553 1392 cell
DAVID CUTBIRTH	P.O. Box 1552 Monahans, TX. 79756	dbcutbirth@yahoo.com	432-943-8400 432-940-5376 cell

GMA 3 May 3, 2010

PRINT NAME	MAILING ADDRESS	EMAIL	PHONE
Amy Porter	1415 W 3RD ST Pecos TX 79772	Amy.Porter@tx.nacdnet.net	432.445.3194
JOHN GRANT	CRMWD P.O. Box 869 Big Spring TX 79721-0869	JGRANT@CRMWD.ORG	432-267-6341
Terry Gilchrest	MVWSC POBox 9009 Verhalen, TX 79772	maderavalleywsc@yahoo.com	432-375-2556
Gary Bryant	PO Box 1298 Ft Stockton TX 79735	glbryant@ag.tamu.edu	432-336-8585
J. Logan Lair	POBox 2011 Pecos TX 79772	JLlair@ag.tamu.edu	432-448-2681
Greg Huber		greg.huber@tx.usda.gov	
Michael McCulloch DVM	P.O. Box 61410 Midland Texas 79711	permianseavet@cableone.net	

GMA 3 May 3, 2010

PRINT NAME	MAILING ADDRESS	EMAIL	PHONE
STUART T PURVIS	PO BOX ~~1000~~ 1152 MIDLAND TX 79702	SPURVIS@MIDLANDTEXAS.GOV	432-685-7262
John Dorris	P.O. Box 1027 ~~1027~~ Iraan, TX 79744	jdorris@bigbend.net	432-395-2308
Chad Norris	950 FM 2325 Ste A Wimberley, TX 78676	chad.norris@tpwd.state.tx.us	(512) 788-2423
Randy Williams	12 Rose Dr Sunset Valley TX 78745	barw.groundwaterregmail.com	(512) 899-8880
Tom Brown	201 W. 6TH CRANE, TX	tom.brown@co.crane.tx.us	(432)208-4230
Derek McGregor	333 SW 5th Ave, Ste. 410 Portland, OR 97241	dmcgregor@premiercorp-usa.com	360-600-8332
Bobby Sinclair	112 W 2nd Monahans TX 79756		432 943-4343
Bill Hutchison	TWDB PO Box 13231 Austin TX 78711	bill.hutchison@twdb.state.tx.us	512-463-5067
Rex Thee	112 W. 2nd Monahans 79756	pw.monahans@cebridge.net	432-943-~~8~~4343

GMA 3 June 21, 2010

PRINT NAME	MAILING ADDRESS	EMAIL	PHONE
Paul Weatherby	Box 1644 F.S.	mpgcd@sbcglobal.net	432-336-0698
Charles R. Williams	2 Reese Dr Sweetwater, Tx 79556	barw.groundwater@gmail.com	512 595-8880
Arlan Gentry	3600 S. Stockton Sterling Monahans 79756	a-gentry@tamu.edu	432-943-2682
Bill Hutchison	TWDB	bill.hutchison@twdb.state.tx.us	
Joe Alexander	4502 Englewood Lubbock TX 79414		
Gary Bryant	PO Box 1298 Ft Stockton	glbryant@ag.tamu.edu	432-336-8585
Jim Duke	5303 Pony Chase Austin, Texas 78727	jim@waterdoke.com	512-258-5749
Darrell Beckham	1104 S. Mays Suite 208 Round Rock, Tx 78664	dbeckham@tgt-water.com	512-244-2172
John Grant	P.O. Box 869 Big Spring Tx 79721-0869	JGRANT@CRMWD.ORG	432-267-6341

GMA 3 June 21, 2010

PRINT NAME	MAILING ADDRESS	EMAIL	PHONE
STEFAN SCHUSTER	4030 BRAKER LANE, STE 350 AUSTIN, TX 78759	SSCHUSTER@DBSTEPHENS.COM	512 651 6004
Chris Wingert	CRMWD Box 869 Big Spring, Tx 79720	cwingert@crmwd.org	(432) 267-6341
Neil Blandford	6020 Academy NE Albuquerque, NM 87109	nblandford@dbsa.com	505-822-9400
STUART PURVIS	PO Box 1152 MIDLAND, TX 79702	spurvis@midland-texas.gov	432-685-7262
Bobby Sinclair	112 W 2nd Monahans 79756		432 943-4343
Alan R. Zeman	P.O. Box 810, Pecos, Texas 79772	arzeman@hughes.net	432 448-3006 - C
Michael McCulloch MWM	P.O. BOX 61410 Midland, Texas 79711	permianseed@cableone.net	432-559-7517

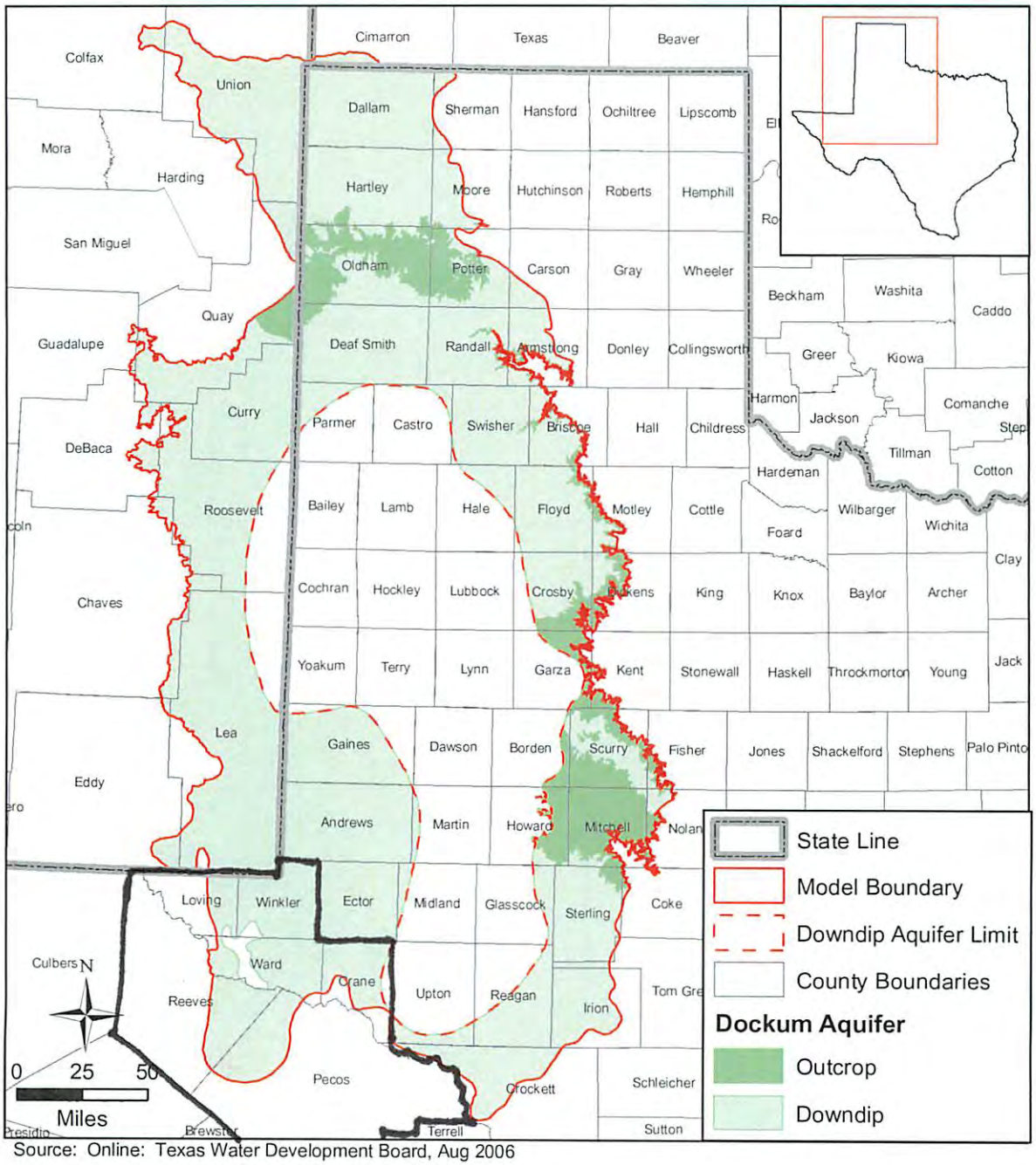
GMA 3 August 9, 2010

PRINT NAME	MAILING ADDRESS	EMAIL	PHONE
Paul Weatherby	Box 1644	MPgcd@sbc.global.net	432-336-0685
Bill Hutchison	TWDB	bill.hutchison@twdb.state.tx.us	512-463-5067
JOHN GRANT	CRMWD	JGRANT@CRMWD.ORG	432-267-6391
Jim Dunce	SAME AS USUAL	jim@waterdude.com	512-258-5749
Farrell S. Peckham	TGI - FSH	fpeckham@TGI-WATER.com	512-244-2172
STUART T. PURVIS	CITY of MIDLAND	SPURVIS@MIDLANDTEXAS.GOV	432-685-7262
Chris Wrape	CRMWD	CWRAPE@CRMWD.org	(432) 267-6341
STEFAN SCHUSTER	PBSA 4030 BRAKER LANE, STE 325 AUSTIN TX 78759	SSCHUSTER@DBSTEPHENS.COM	512 651 6004
Gary Bryant	Pobox 1298	g/bryant.wvg.texas.edu	432-556-8585

GMA 3 August 9, 2010

PRINT NAME	MAILING ADDRESS	EMAIL	PHONE
CARY D. CARMAN	944 ARROYO SAN ANGELO TX	cdcarman@usgs.gov	325-280-1357
Neil Blandford	6020 Academy NE Suite 100, Albuquerque NM, 87109	nblandford@dbstephens.com	505-822-9400
Charles R. Williams	12 Reese Dr Sunset Valley, Tx	[redacted] barw.groundwater.	512 565-6880

Section 12
Dockum Aquifer



Source: Online: Texas Water Development Board, Aug 2006

Figure 2.0.2 Active model boundary for the Dockum Aquifer groundwater availability model.

Groundwater Management Area 3

Appendix B contains detailed results for the predictive model runs for Groundwater Management Area 3. As described in the Methods section, the hydrographs shown in figures B-1 through B-4 do not indicate any trends in the water levels in the Dockum Aquifer that would require changing the pumping for the interim period from 1998 to 2009 from the level for the last year of the historical-calibration period.

Figure B-5 depicts the drawdown between 2010 and 2060 versus the constantly applied pumping rate for each of the pumping scenarios. Drawdown is based on the water levels in the model for the end of 2009. The average drawdown over Groundwater Management Area 3 is 27 feet for the base scenario with approximately 39,000 acre-feet of pumping per year. Among the scenarios, this ranges from a water level rise of 4 feet to a decline of 48 feet.

Figures B-6 through B-13 depict each of the water budget components described in the Results section above for the lower portion of the Dockum Aquifer in Groundwater Management Area 3 for the base scenario. Figure B-6 shows that no recharge from precipitation occurs to the Dockum Aquifer in Groundwater Management Area 3. This is because the portion of the Dockum Aquifer in the area is entirely subcrop, being overlain by other aquifers or units. Figure B-7 shows the pumping applied to the model each year between 1998 and 2060. At the beginning of the predictive period (2010), the pumping increases dramatically to meet the requests described in the Pumping section. This also includes a portion of the 15,000 acre-feet per year added in northern Pecos County (see Figure 2).

Figure B-8 shows that the volume of water removed from storage each year increases sharply during the first year of the predictive period before slowly declining. This increase is due to the much higher rate of pumping applied during the predictive model run as shown in Figure B-7 compared to the historical-calibration period.

Figure B-9 shows the net volume of flow to and from overlying aquifers in the Dockum Aquifer. Prior to 2010, a relatively small amount of water flowed upward from the Dockum Aquifer to the overlying aquifers (primarily the Pecos Valley Aquifer). Due to the increased pumping and subsequent decline in water levels, the direction of this flow is reversed beginning in 2010 with water flowing into the Dockum Aquifer from the overlying aquifers.

Figures B-10 and B-11 show that the model does not consider any interaction of the Dockum Aquifer with streams (Figure B-10) or discharge to springs or by evapotranspiration (Figure B-11). As with the recharge shown in Figure B-6, this is because the aquifer exists exclusively in subcrop in Groundwater Management Area 3.

Figure B-12 shows that, through the predictive period, there is a net inflow to Groundwater Management Area 3 from adjacent areas. At the beginning of the predictive period, the magnitude of flow decreases before slowly increasing. The initial decrease in the magnitude of inflow is counterintuitive with the increase in pumping in Groundwater Management Area 3. However, due to the increases in pumping in neighboring Groundwater Management Area 7, the net result is an initial decline in the lateral inflow before the gradual increase.

Tables B-1 through B-9 show the drawdown and pumping by decade for each county in Groundwater Management Area 3 for the Dockum Aquifer. The results for each groundwater management area is also shown. As shown in Table B-1, the pumping total for each county for the base scenario matches the requested pumping shown in Table 1. Note that the county and district results are not necessarily limited to Groundwater Management Area 3 (for example, Pecos County).

Appendix B

Spread Analysis Results for Groundwater Management Area 3

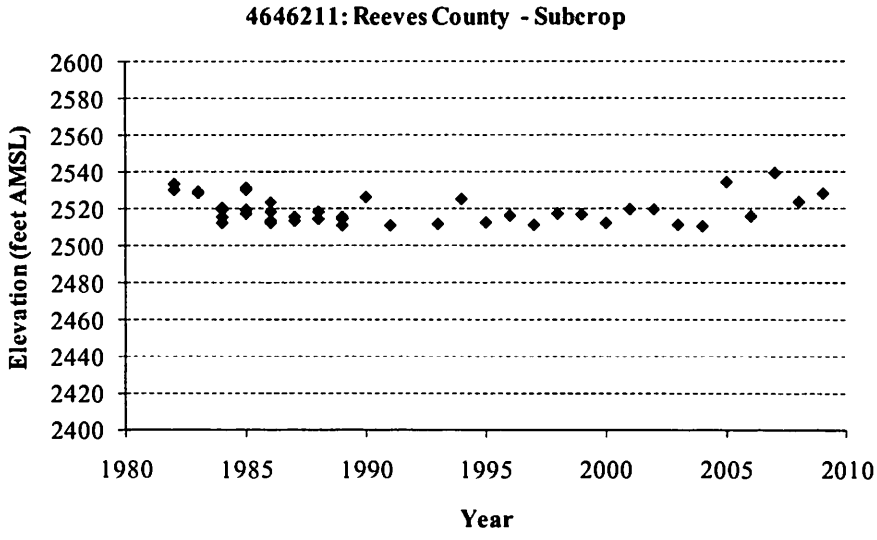


Figure B-1. Hydrograph of state well 4646211 located in the subcrop portion of the Dockum Aquifer in Reeves County.

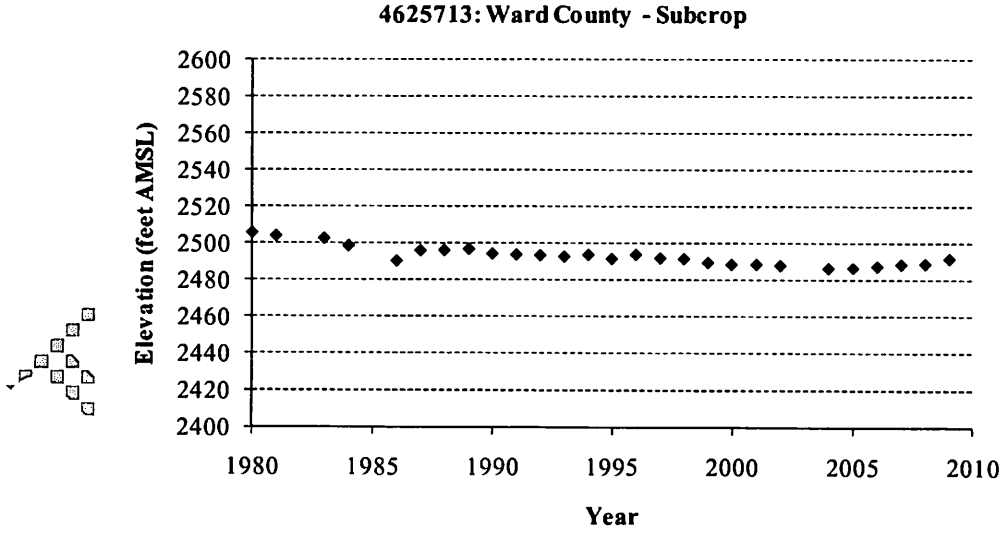


Figure B-2. Hydrograph of state well 4625713 located in the subcrop portion of the Dockum Aquifer in Ward County.

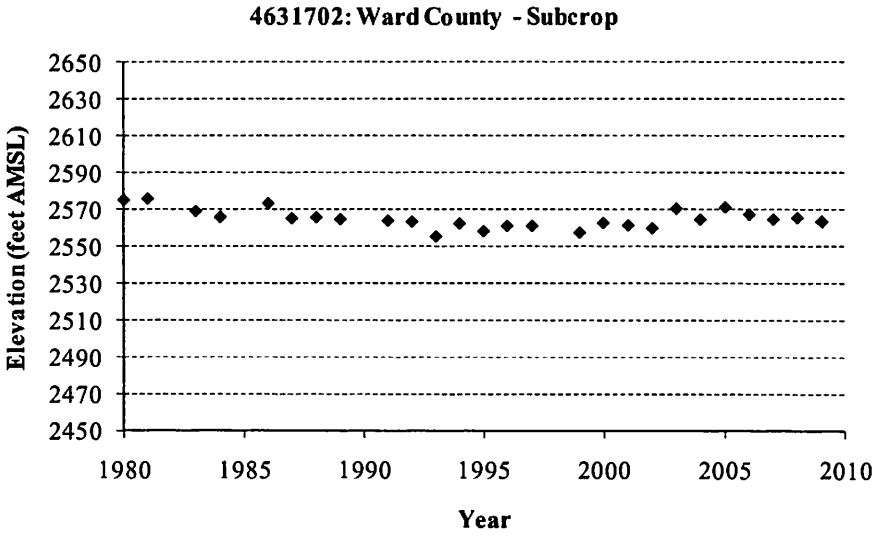


Figure B-3. Hydrograph of state well 4631702 located in the subcrop portion of the Dockum Aquifer in Ward County.

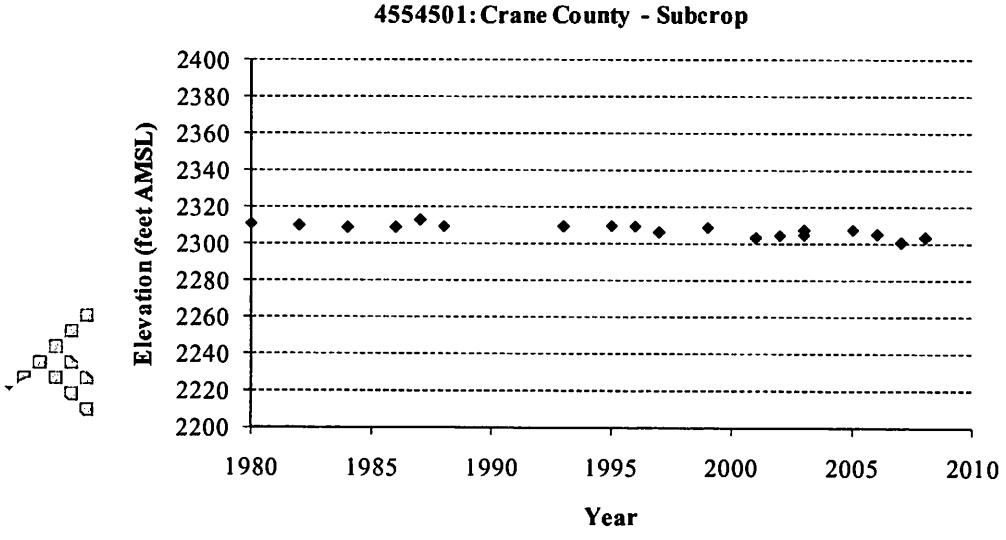


Figure B-4. Hydrograph of state well 4554501 located in the subcrop portion of the Dockum Aquifer in Crane County.

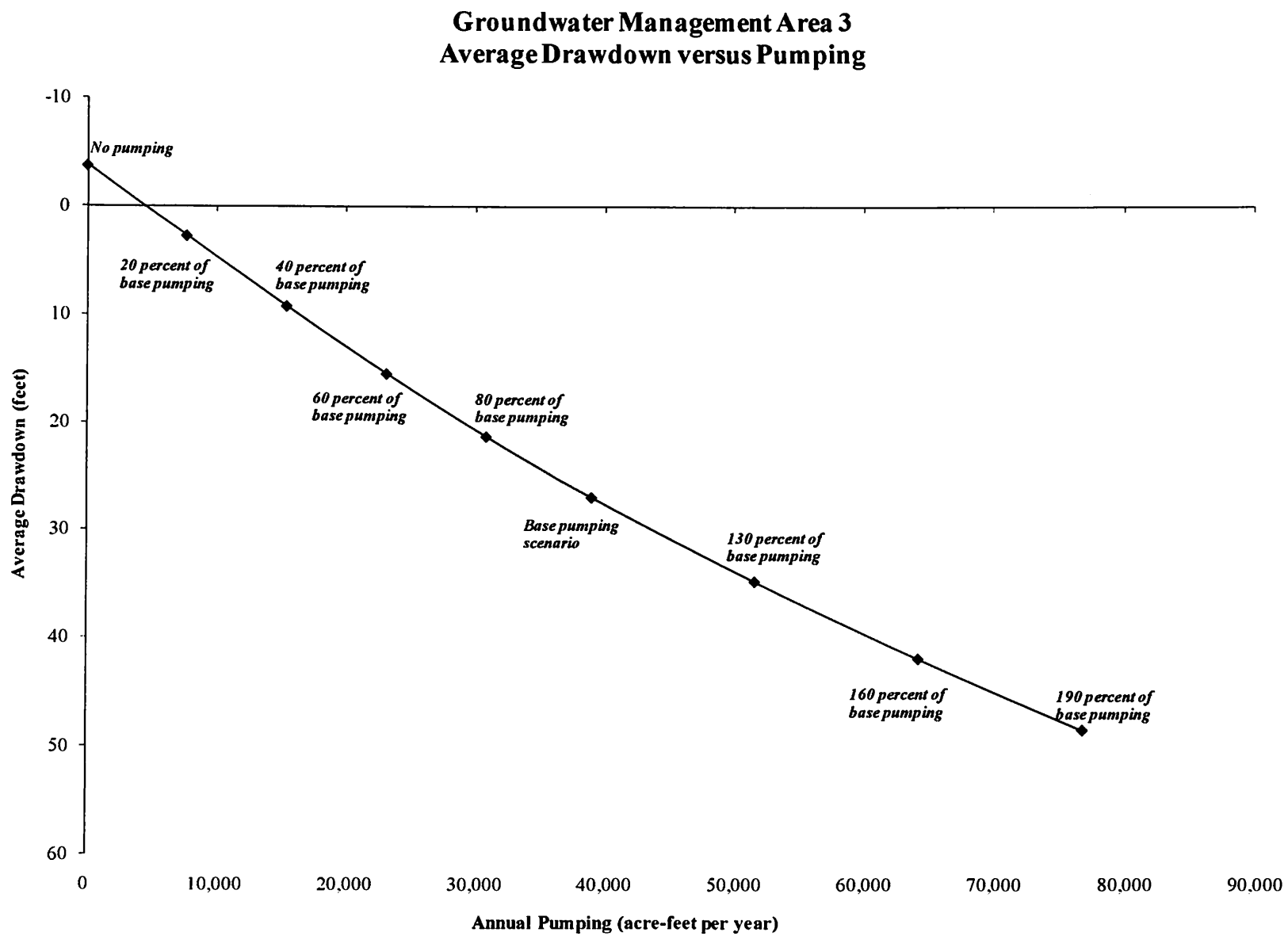


Figure B-5. Average drawdown through time for each of the pumping scenarios for Groundwater Management Area 3.

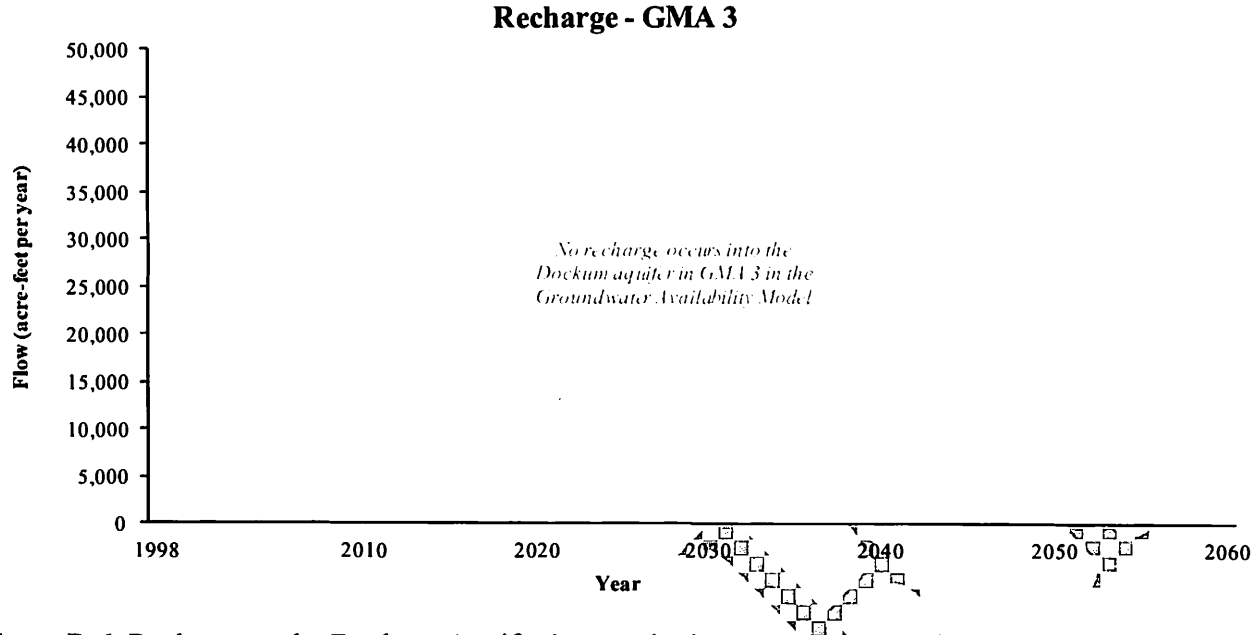


Figure B-6. Recharge to the Dockum Aquifer by year in the groundwater availability model for Groundwater Management Area 3. Note that no recharge from precipitation occurs to the Dockum Aquifer in the model because the aquifer is in subcrop in the management area.

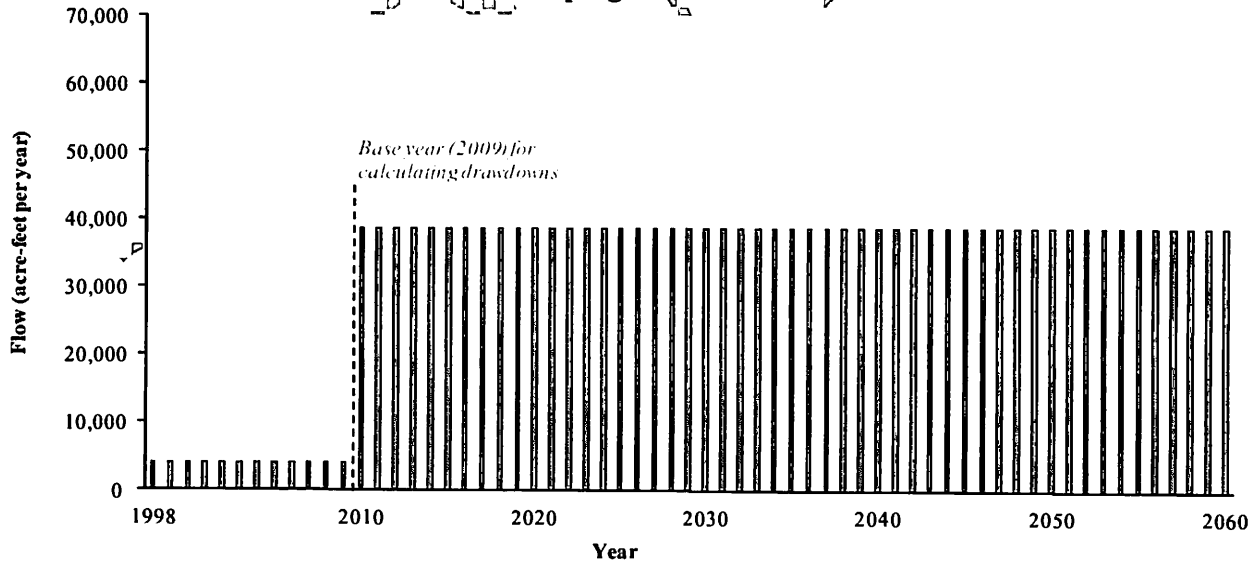


Figure B-7. Pumping output from the groundwater availability model in the Dockum Aquifer by year for Groundwater Management Area 3.

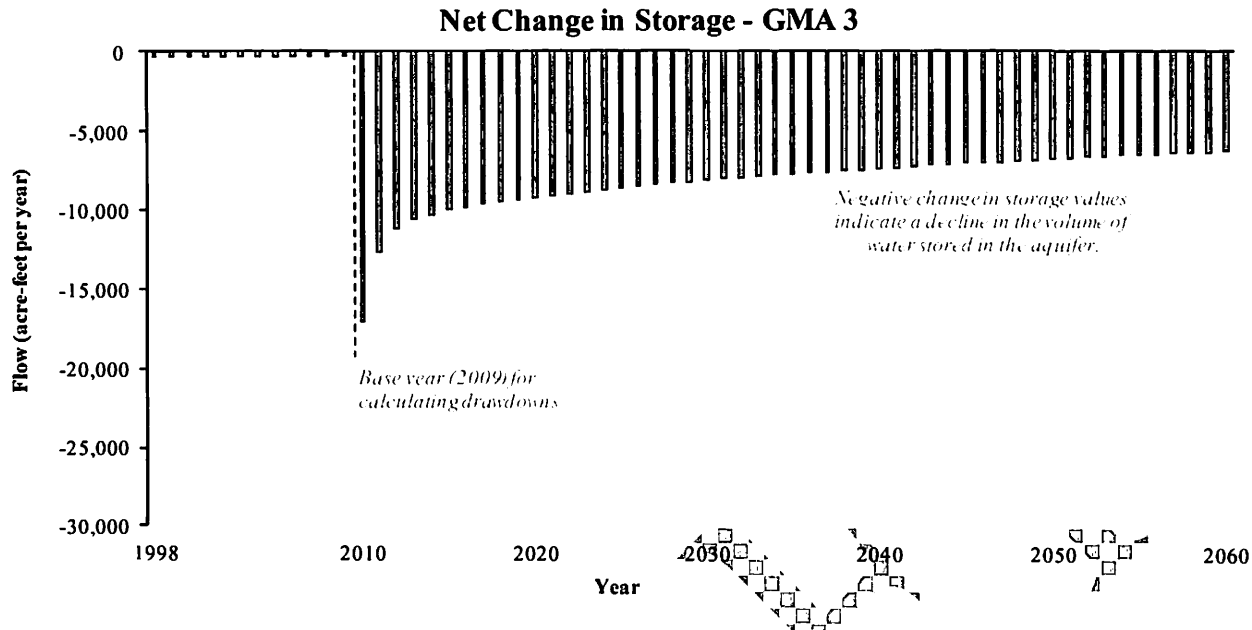


Figure B-8. Net change in storage (the volume of water stored in the aquifer) by year in the Dockum Aquifer for Groundwater Management Area 3.

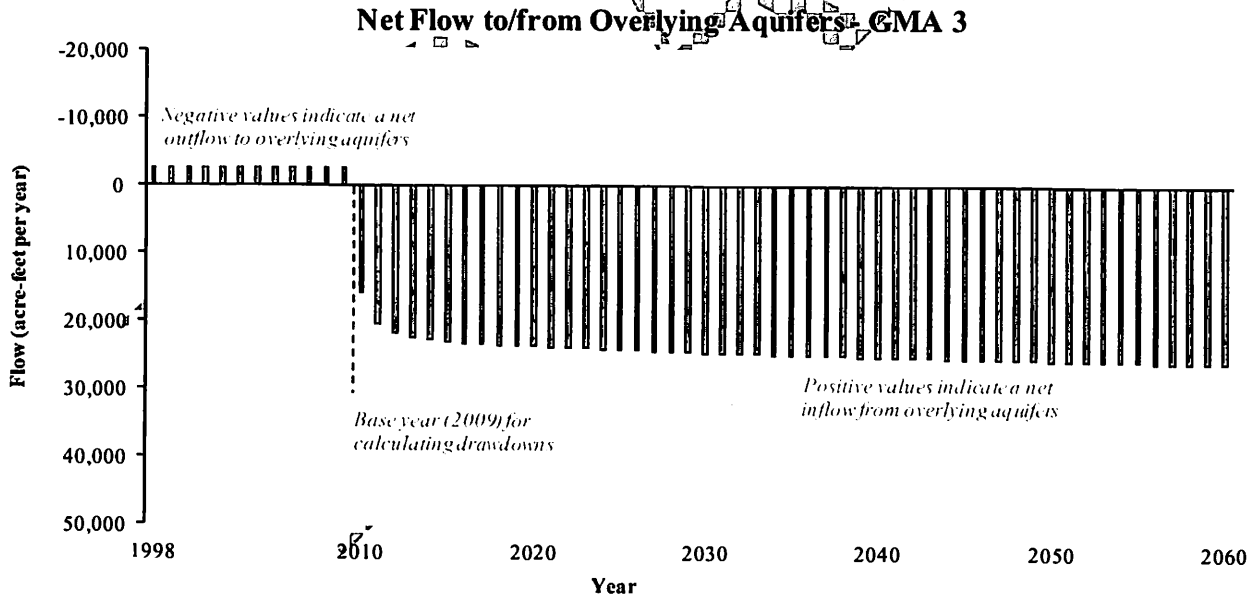


Figure B-9. Net flow between overlying aquifers and the Dockum Aquifer by year for Groundwater Management Area 3.

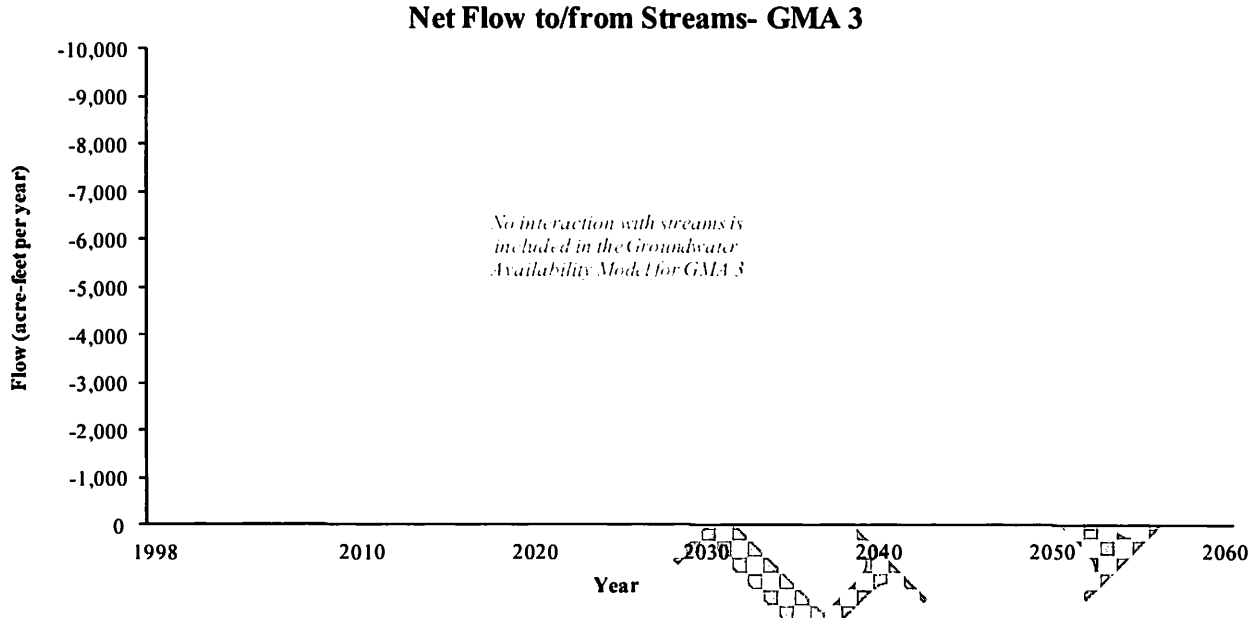


Figure B-10. Net flow to/from streams in the Dockum Aquifer by year for Groundwater Management Area 3. Note that no interaction with streams occurs to the Dockum Aquifer in the model because the aquifer is in subcrop in the management area.

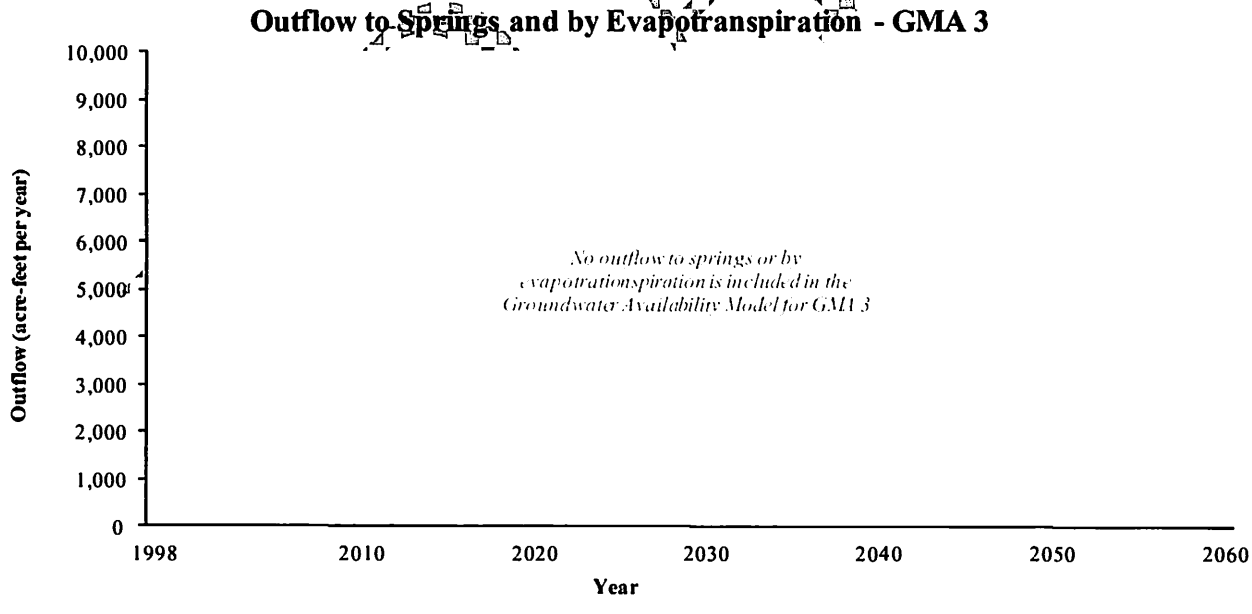


Figure B-11. Outflow from the Dockum Aquifer in Groundwater Management Area 3 to springs and by evapotranspiration. Note that no outflow to springs or by evaporation occurs to the Dockum Aquifer in the model because the aquifer is in subcrop in the management area.

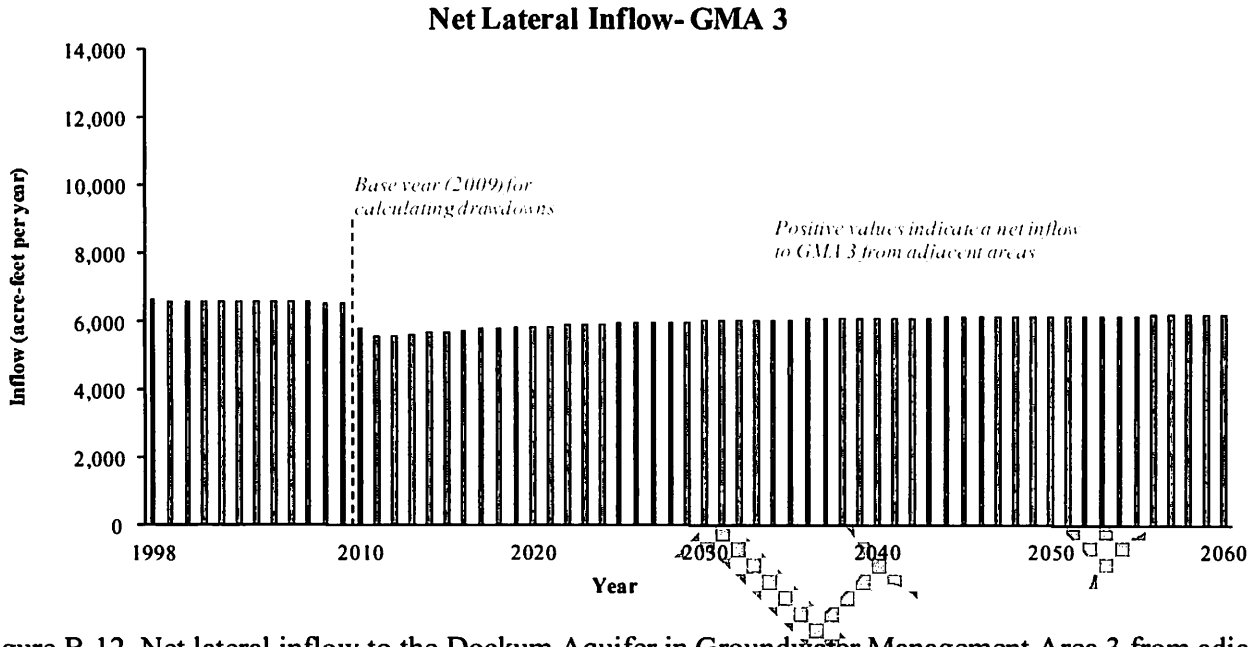


Figure B-12. Net lateral inflow to the Dockum Aquifer in Groundwater Management Area 3 from adjacent areas.

Table B-1. Pumping (in acre-feet per year) and average drawdown (in feet) in the Dockum Aquifer between 2010 and 2060 for each county, groundwater conservation district (GCD), and groundwater management area (GMA) for Groundwater Management Area 3 for the base scenario.

Base Scenario	Pumping						Average drawdown					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
County												
Crane	2,000	2,000	2,000	2,000	2,000	2,000	4	6	6	7	7	8
Loving	1,000	1,000	1,000	1,000	1,000	1,000	18	21	22	23	23	24
Pecos	18,000	18,000	18,000	18,000	18,000	18,000	33	46	46	46	47	47
Reeves	5,000	5,000	5,000	5,000	5,000	5,000	12	15	15	16	16	17
Ward	7,000	7,000	7,000	7,000	7,000	7,000	20	28	29	30	30	31
Winkler	10,000	10,000	10,000	10,000	10,000	10,000	17	28	29	30	31	32
District												
Middle Pecos GCD	18,000	18,000	18,000	18,000	18,000	18,000	33	46	46	46	47	47
Management Area												
Out-of-State	7,793	7,793	7,793	7,793	7,793	7,793	0	1	1	1	2	2
GMA 1	21,226	21,226	21,226	21,226	21,226	21,226	4	13	18	23	27	30
GMA 2	9,607	9,607	9,607	9,607	9,607	9,607	1	12	23	31	37	39
GMA 3	38,961	38,961	38,961	38,961	38,961	38,961	17	24	25	26	27	27
GMA 6	70	70	70	70	70	70	0	1	1	2	3	4
GMA 7	35,144	35,144	35,144	35,144	35,144	35,144	1	3	5	6	7	8

Table B-2. Pumping (in acre-feet per year) and average drawdown (in feet) in the Dockum Aquifer between 2010 and 2060 for each county, groundwater conservation district (GCD), and groundwater management area (GMA) for Groundwater Management Area 3 for the zero pumping scenario.

Zero Pumping Scenario	Pumping						Average drawdown					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
County												
Crane	0	0	0	0	0	0	0	0	0	0	0	0
Loving	0	0	0	0	0	0	0	-1	-1	-1	-1	-1
Pecos	0	0	0	0	0	0	-2	-3	-3	-3	-3	-3
Reeves	0	0	0	0	0	0	-1	-3	-4	-4	-4	-4
Ward	0	0	0	0	0	0	0	-1	-1	-1	-1	-1
Winkler	0	0	0	0	0	0	-1	-8	-9	-9	-9	-9
District												
Middle Pecos GCD	0	0	0	0	0	0	-2	-3	-3	-3	-3	-3
Management Area												
Out-of-State	7,793	7,793	7,793	7,793	7,793	7,793	0	1	1	1	1	2
GMA 1	21,226	21,226	21,226	21,226	21,226	21,226	4	13	18	23	27	30
GMA 2	0	0	0	0	0	0	1	11	21	29	34	36
GMA 3	0	0	0	0	0	0	-1	-3	-4	-4	-4	-4
GMA 6	0	0	0	0	0	0	-1	-1	0	0	1	1
GMA 7	0	0	0	0	0	0	-1	-5	-6	-6	-5	-5

Table B-3. Pumping (in acre-feet per year) and average drawdown (in feet) in the Dockum Aquifer between 2010 and 2060 for each county, groundwater conservation district (GCD), and groundwater management area (GMA) for Groundwater Management Area 3 for the 20 percent of base pumping scenario.

20 Percent of Base	Pumping						Average drawdown					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
County												
Crane	400	400	400	400	400	400	1	1	1	1	1	1
Loving	200	200	200	200	200	200	3	3	4	4	4	4
Pecos	3,600	3,600	3,600	3,600	3,600	3,600	5	7	7	7	7	7
Reeves	1,000	1,000	1,000	1,000	1,000	1,000	0	1	1	1	1	1
Ward	1,400	1,400	1,400	1,400	1,400	1,400	4	6	6	6	6	6
Winkler	2,000	2,000	2,000	2,000	2,000	2,000	0	0	0	0	0	0
District												
Middle Pecos GCD	3,600	3,600	3,600	3,600	3,600	3,600	5	7	7	7	7	7
Management Area												
Out-of-State	7,793	7,793	7,793	7,793	7,793	7,793	0	1	1	1	2	2
GMA 1	21,226	21,226	21,226	21,226	21,226	21,226	4	13	18	23	27	30
GMA 2	1,921	1,921	1,921	1,921	1,921	1,921	1	11	22	30	35	37
GMA 3	7,706	7,706	7,706	7,706	7,706	7,706	2	3	3	3	3	3
GMA 6	14	14	14	14	14	14	0	0	0	1	1	2
GMA 7	7,115	7,115	7,115	7,115	7,115	7,115	-1	-3	-4	-3	-3	-3

Table B-4. Pumping (in acre-feet per year) and average drawdown (in feet) in the Dockum Aquifer between 2010 and 2060 for each county, groundwater conservation district (GCD), and groundwater management area (GMA) for Groundwater Management Area 3 for the 40 percent of base pumping scenario.

40 Percent of Base	Pumping						Average drawdown					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
County												
Crane	800	800	800	800	800	800	2	2	2	3	3	3
Loving	400	400	400	400	400	400	7	8	9	9	9	10
Pecos	7,200	7,200	7,200	7,200	7,200	7,200	12	17	17	17	17	17
Reeves	2,000	2,000	2,000	2,000	2,000	2,000	3	4	4	5	5	5
Ward	2,800	2,800	2,800	2,800	2,800	2,800	9	12	13	13	13	13
Winkler	4,000	4,000	4,000	4,000	4,000	4,000	4	8	8	8	9	9
District												
Middle Pecos GCD	7,200	7,200	7,200	7,200	7,200	7,200	12	17	17	17	17	17
Management Area												
Out-of-State	7,793	7,793	7,793	7,793	7,793	7,793	0	1	1	1	2	2
GMA 1	21,226	21,226	21,226	21,226	21,226	21,226	4	13	19	23	27	30
GMA 2	3,843	3,843	3,843	3,843	3,843	3,843	1	12	22	30	35	37
GMA 3	15,412	15,412	15,412	15,412	15,412	15,412	6	8	9	9	9	9
GMA 6	28	28	28	28	28	28	0	0	0	1	2	2
GMA 7	14,230	14,230	14,230	14,230	14,230	14,230	0	-2	-1	-1	0	0

Table B-5. Pumping (in acre-feet per year) and average drawdown (in feet) in the Dockum Aquifer between 2010 and 2060 for each county, groundwater conservation district (GCD), and groundwater management area (GMA) for Groundwater Management Area 3 for the 60 percent of base pumping scenario.

60 Percent of Base	Pumping						Average drawdown					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
County												
Crane	1,200	1,200	1,200	1,200	1,200	1,200	2	3	4	4	4	5
Loving	600	600	600	600	600	600	11	13	14	14	14	15
Pecos	10,800	10,800	10,800	10,800	10,800	10,800	19	26	26	26	26	26
Reeves	3,000	3,000	3,000	3,000	3,000	3,000	6	8	8	8	9	9
Ward	4,200	4,200	4,200	4,200	4,200	4,200	13	18	19	19	19	20
Winkler	6,005	6,005	6,005	6,005	6,005	6,005	9	15	16	16	17	17
District												
Middle Pecos GCD	10,800	10,800	10,800	10,800	10,800	10,800	19	26	26	26	26	26
Management Area												
Out-of-State	7,793	7,793	7,793	7,793	7,793	7,793	0	1	1	1	2	2
GMA 1	21,226	21,226	21,226	21,226	21,226	21,226	4	13	19	23	27	30
GMA 2	5,764	5,764	5,764	5,764	5,764	5,764	1	12	22	31	36	38
GMA 3	23,124	23,124	23,124	23,124	23,124	23,124	10	14	15	15	15	15
GMA 6	42	42	42	42	42	42	0	0	1	1	2	3
GMA 7	22,041	22,041	22,041	22,041	22,041	22,041	0	0	1	2	3	3

Table B-6. Pumping (in acre-feet per year) and average drawdown (in feet) in the Dockum Aquifer between 2010 and 2060 for each county, groundwater conservation district (GCD), and groundwater management area (GMA) for Groundwater Management Area 3 for the 80 percent of base pumping scenario.

80 Percent of Base	Pumping						Average drawdown					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
County												
Crane	1,600	1,600	1,600	1,600	1,600	1,600	3	5	5	5	6	6
Loving	800	800	800	800	800	800	14	17	18	19	19	19
Pecos	14,400	14,400	14,400	14,400	14,400	14,400	26	35	36	36	36	36
Reeves	4,000	4,000	4,000	4,000	4,000	4,000	9	11	12	12	12	13
Ward	5,600	5,600	5,600	5,600	5,600	5,600	17	24	24	25	26	26
Winkler	8,000	8,000	8,000	8,000	8,000	8,000	13	22	23	24	24	25
District												
Middle Pecos GCD	14,400	14,400	14,400	14,400	14,400	14,400	26	35	36	36	36	36
Management Area												
Out-of-State	7,793	7,793	7,793	7,793	7,793	7,793	0	1	1	1	2	2
GMA 1	21,226	21,226	21,226	21,226	21,226	21,226	4	13	19	23	27	30
GMA 2	7,685	7,685	7,685	7,685	7,685	7,685	1	12	23	31	36	39
GMA 3	30,825	30,825	30,825	30,825	30,825	30,825	13	19	20	21	21	21
GMA 6	56	56	56	56	56	56	0	0	1	2	3	3
GMA 7	28,459	28,459	28,459	28,459	28,459	28,459	1	2	3	4	5	5

Table B-7. Pumping (in acre-feet per year) and average drawdown (in feet) in the Dockum Aquifer between 2010 and 2060 for each county, groundwater conservation district (GCD), and groundwater management area (GMA) for Groundwater Management Area 3 for the 130 percent of base pumping scenario.

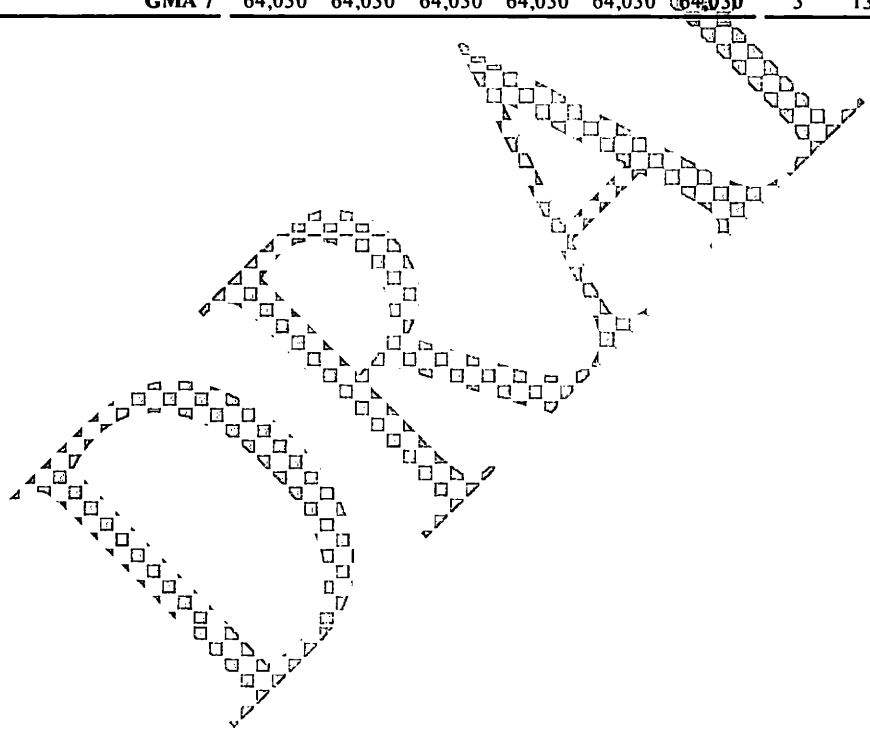
130 Percent of Base	Pumping						Average drawdown					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
County												
Crane	2,600	2,600	2,600	2,600	2,600	2,600	5	8	8	9	10	10
Loving	1,300	1,300	1,300	1,300	1,300	1,300	22	27	27	28	29	30
Pecos	23,399	23,399	23,399	23,399	23,399	23,399	45	61	62	63	63	63
Reeves	6,500	6,500	6,500	6,500	6,500	6,500	16	20	21	22	22	23
Ward	9,100	9,100	9,100	9,100	9,100	9,100	24	33	34	35	36	37
Winkler	13,000	13,000	13,000	13,000	13,000	13,000	23	36	38	39	40	41
District												
Middle Pecos GCD	23,399	23,399	23,399	23,399	23,399	23,399	45	61	62	63	63	63
Management Area												
Out-of-State	7,793	7,793	7,793	7,793	7,793	7,793	0	1	1	2	2	2
GMA 1	21,226	21,226	21,226	21,226	21,226	21,226	4	13	19	23	27	30
GMA 2	12,488	12,488	12,488	12,488	12,488	12,488	1	13	24	32	37	40
GMA 3	51,564	51,564	51,564	51,564	51,564	51,564	22	31	33	33	34	35
GMA 6	91	91	91	91	91	91	0	1	2	3	3	4
GMA 7	44,772	44,772	44,772	44,772	44,772	44,772	1	7	9	11	12	13

Table B-8. Pumping (in acre-feet per year) and average drawdown (in feet) in the Dockum Aquifer between 2010 and 2060 for each county, groundwater conservation district (GCD), and groundwater management area (GMA) for Groundwater Management Area 3 for the 160 percent of base pumping scenario.

160 Percent of Base	Pumping						Average drawdown					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
County												
Crane	3,200	3,200	3,200	3,200	3,200	3,200	6	9	10	11	12	12
Loving	1,600	1,600	1,600	1,600	1,600	1,600	26	31	32	33	33	34
Pecos	28,799	28,799	28,799	28,799	28,799	28,799	57	76	77	78	79	79
Reeves	8,000	8,000	8,000	8,000	8,000	8,000	20	25	26	27	28	28
Ward	11,200	11,200	11,200	11,200	11,200	11,200	28	38	39	40	41	42
Winkler	16,000	16,000	16,000	16,000	16,000	16,000	28	43	45	46	47	48
District												
Middle Pecos GCD	28,799	28,799	28,799	28,799	28,799	28,799	57	76	77	78	79	79
Management Area												
Out-of-State	7,793	7,793	7,793	7,793	7,793	7,793	0	1	1	2	2	2
GMA 1	21,226	21,226	21,226	21,226	21,226	21,226	4	13	19	23	27	30
GMA 2	15,370	15,370	15,370	15,370	15,370	15,370	1	13	24	32	38	40
GMA 3	64,167	64,167	64,167	64,167	64,167	64,167	27	38	39	40	41	42
GMA 6	112	112	112	112	112	112	0	1	2	3	4	4
GMA 7	54,401	54,401	54,401	54,401	54,401	54,401	2	10	14	16	18	19

Table B-9. Pumping (in acre-feet per year) and average drawdown (in feet) in the Dockum Aquifer between 2010 and 2060 for each county, groundwater conservation district (GCD), and groundwater management area (GMA) for Groundwater Management Area 3 for the 190 percent of base pumping scenario.

190 Percent of Base	Pumping						Average drawdown					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
County												
Crane	3,800	3,800	3,800	3,800	3,800	3,800	8	11	12	13	14	14
Loving	1,900	1,900	1,900	1,900	1,900	1,900	30	34	35	36	37	38
Pecos	34,199	34,199	34,199	34,199	34,199	34,199	67	90	91	92	93	94
Reeves	9,500	9,500	9,500	9,500	9,500	9,500	24	29	31	32	33	34
Ward	13,300	13,300	13,300	13,300	13,300	13,300	31	42	44	45	46	47
Winkler	18,999	18,999	18,999	18,999	18,999	18,999	32	48	51	52	53	55
District												
Middle Pecos GCD	34,199	34,199	34,199	34,199	34,199	34,199	67	90	91	92	93	94
Management Area												
Out-of-State	7,793	7,793	7,793	7,793	7,793	7,793	0	1	1	2	2	2
GMA 1	21,226	21,226	21,226	21,226	21,226	21,226	4	13	19	23	27	30
GMA 2	18,252	18,252	18,252	18,252	18,252	18,252	1	13	24	33	38	41
GMA 3	76,770	76,770	76,770	76,770	76,770	76,770	32	43	45	46	47	48
GMA 6	133	133	133	133	133	133	0	1	2	3	4	5
GMA 7	64,030	64,030	64,030	64,030	64,030	64,030	3	13	18	21	23	24



Section 13
DB Stephens Aquifer Summary

Review of Groundwater Management Area 3

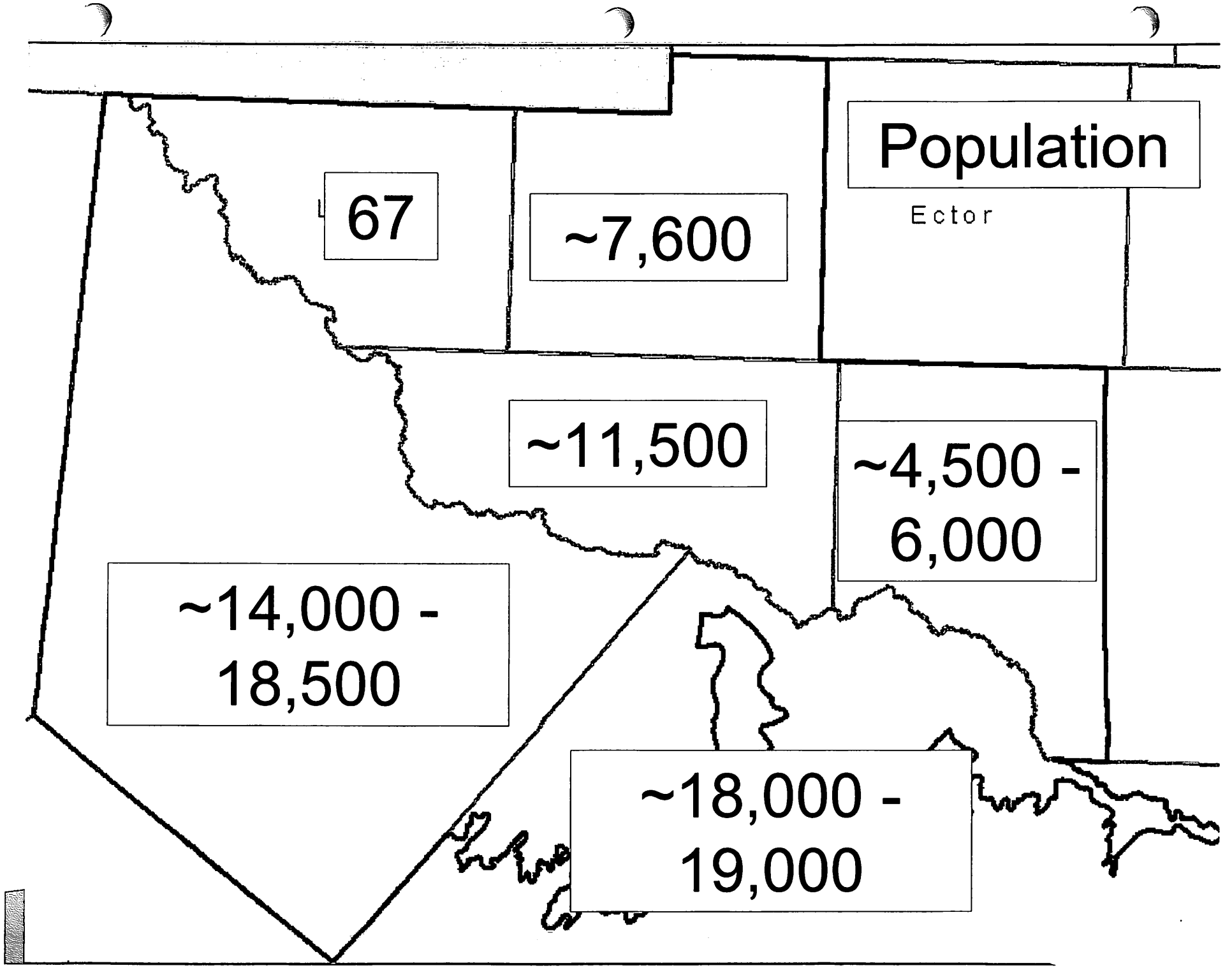
Daniel B. Stephens and Associates

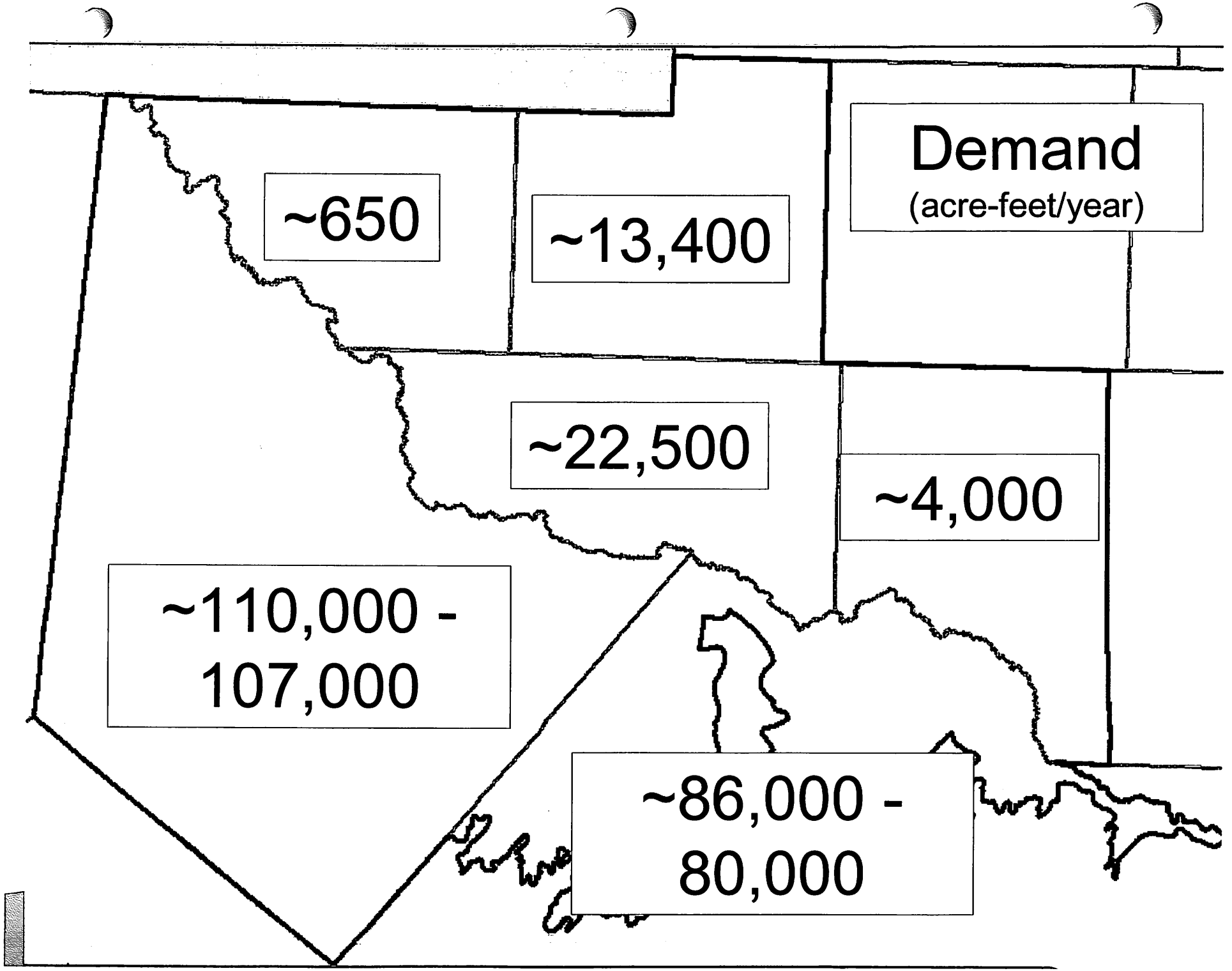
Purpose of Evaluation

- Provide the GMA 3 some input on five counties that are not part of a GCD
- Summarize nature, historic use, etc. of each aquifer present in GMA 3

GMA 3 Overview

- All or parts of six counties (Crane, Loving, Pecos, Reeves, Ward, Winkler)
- Major Aquifers
  - Pecos Valley Aquifer
  - Edwards-Trinity (Plateau) Aquifer
- Minor Aquifers
  - Igneous Aquifer
  - Capitan Reef Aquifer
  - Rustler Aquifer
  - Dockum Aquifer


Population
Ector
67
~7,600
~11,500
~4,500 -
6,000
~14,000 -
18,500
~18,000 -
19,000

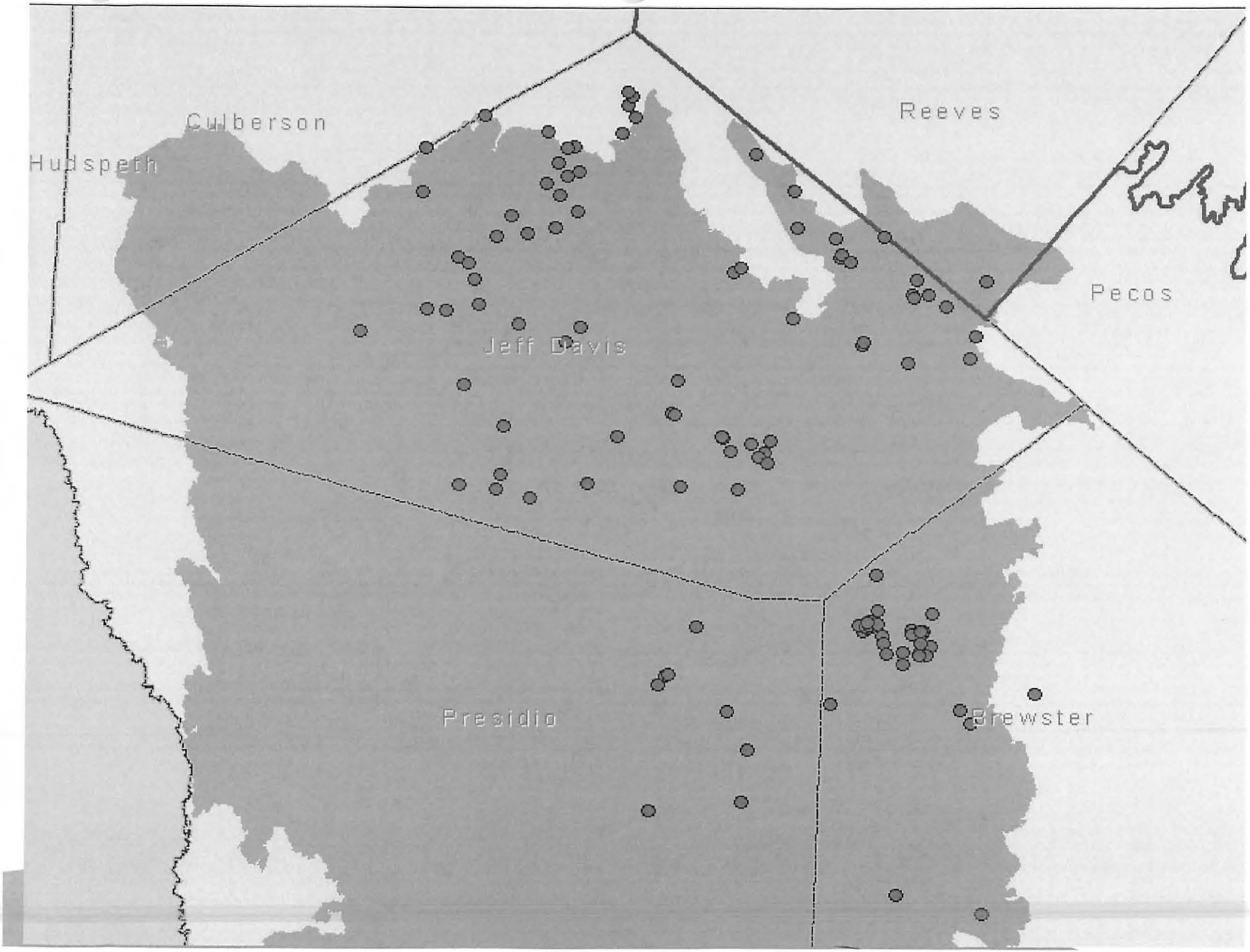

Demand
(acre-feet/year)
~650
~13,400
~22,500
~4,000
~110,000 -
107,000
~86,000 -
80,000

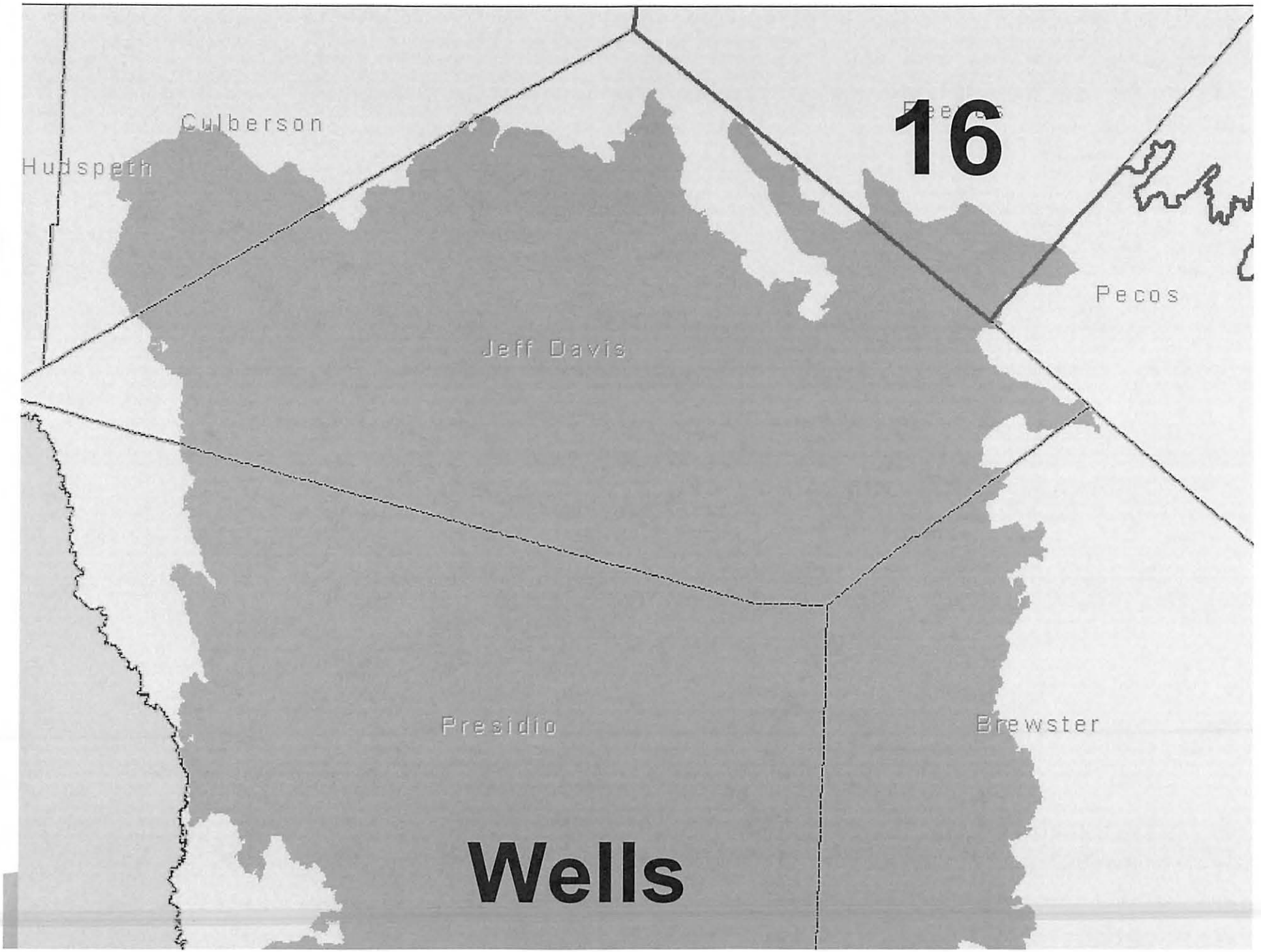
Strategies

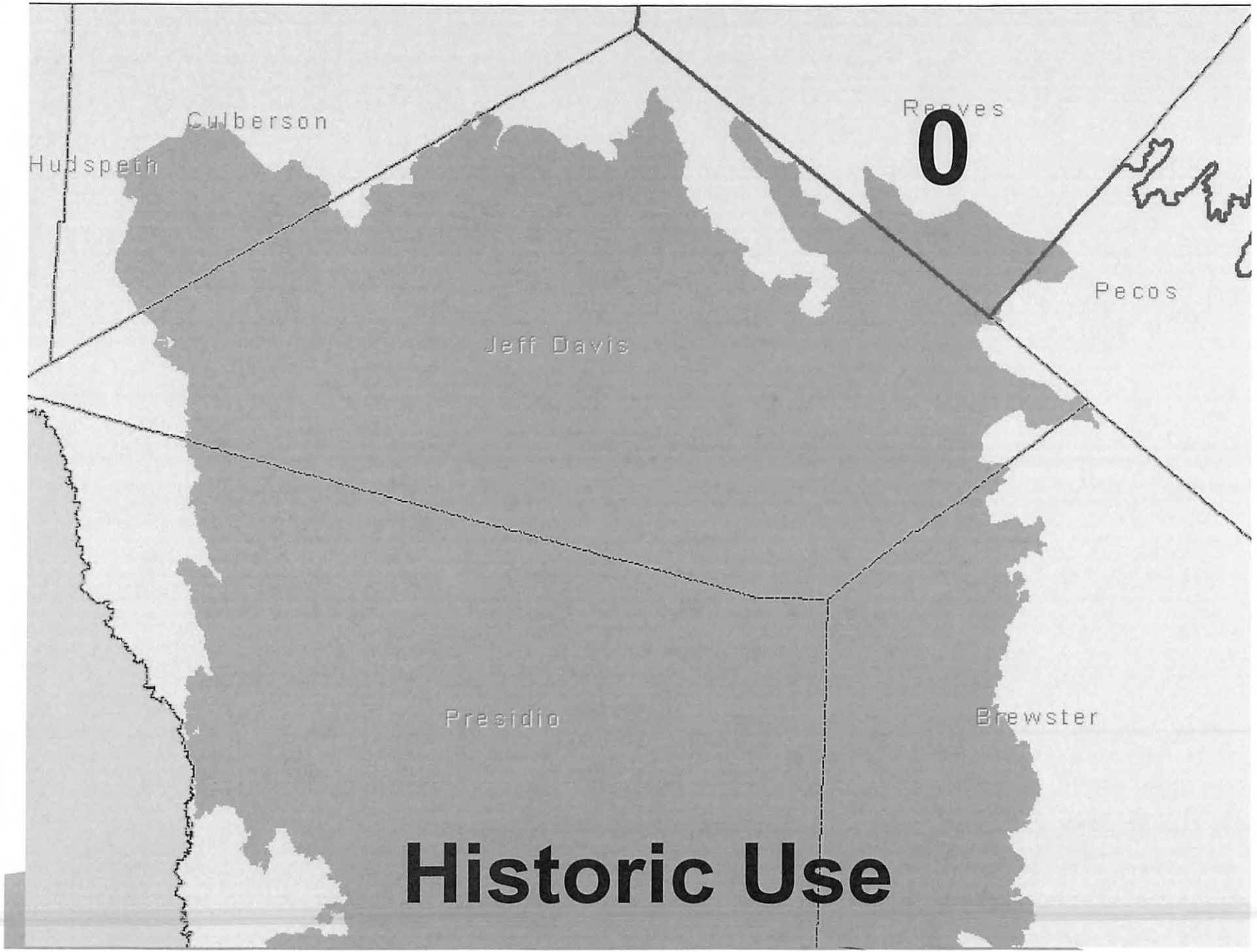
- Crane- No shortages, therefore no strategies
- Loving- No shortages, therefore no strategies
- Pecos- Irrigation conservation, not quantified
- Reeves- Irrigation conservation, not quantified
- Ward- Irrigation conservation, not quantified
- Winkler- Irrigation conservation, not quantified

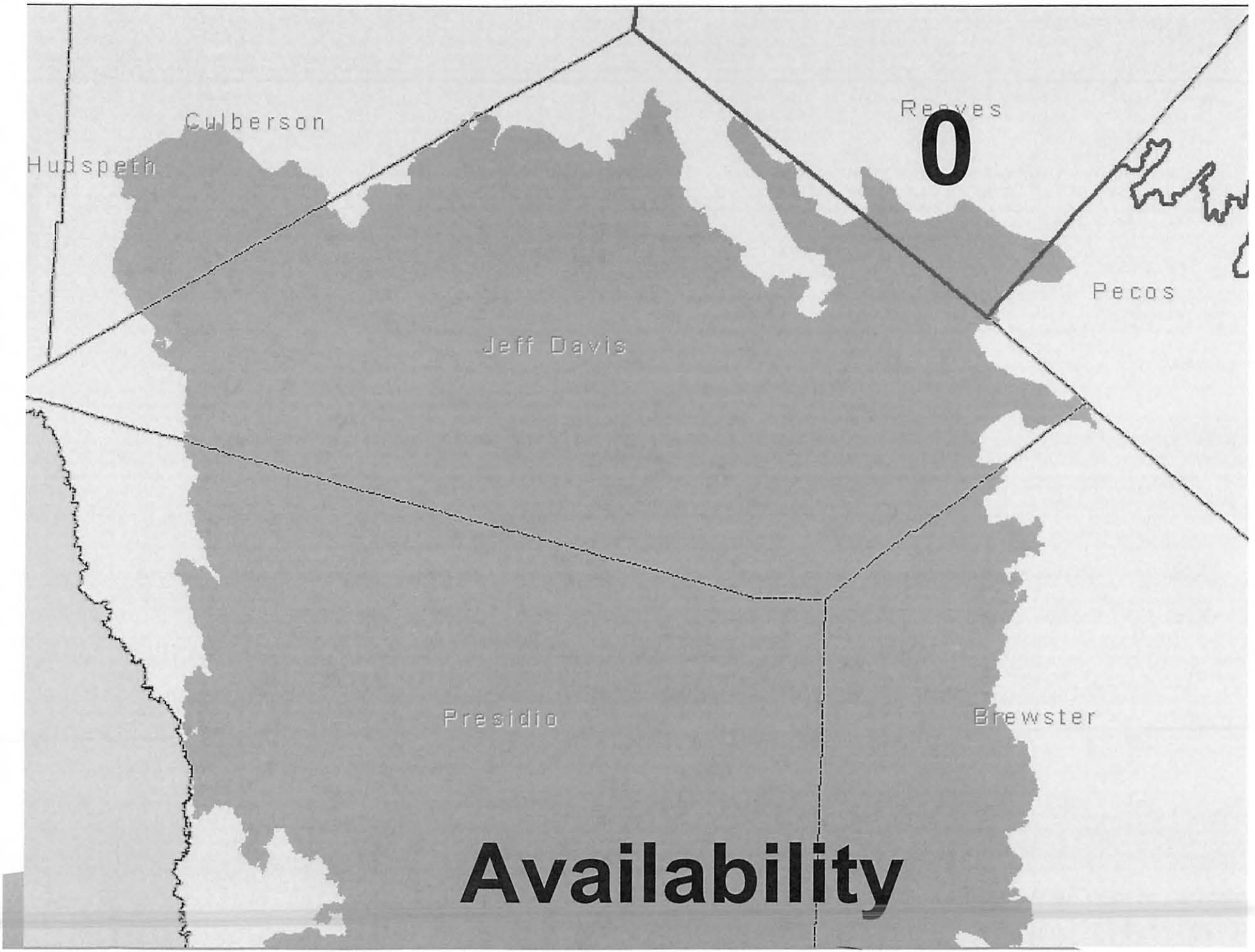
Igneous Aquifer

- Series of distinct water-bearing units occurring in Tertiary-aged volcanic rocks
- Primary occurrence is in GMA 4, where it is an important water source for multiple purposes
- Complex, variable hydrogeology
- GAM has been completed


Culberson
Hudspeth
Reeves
Pecos
Jeff Davis
Presidio
Brewster


16
Culberson
Hudspeth
Jeff Davis
Pecos
Presidio
Brewster
Wells


Culberson
Hudspeth
Reeves
0
Pecos
Jeff Davis
Presidio
Brewster
Historic Use


Culberson
Hudspeth
Reeves
0
Pecos
Jeff Davis
Presidio
Brewster
Availability

Igneous Aquifer

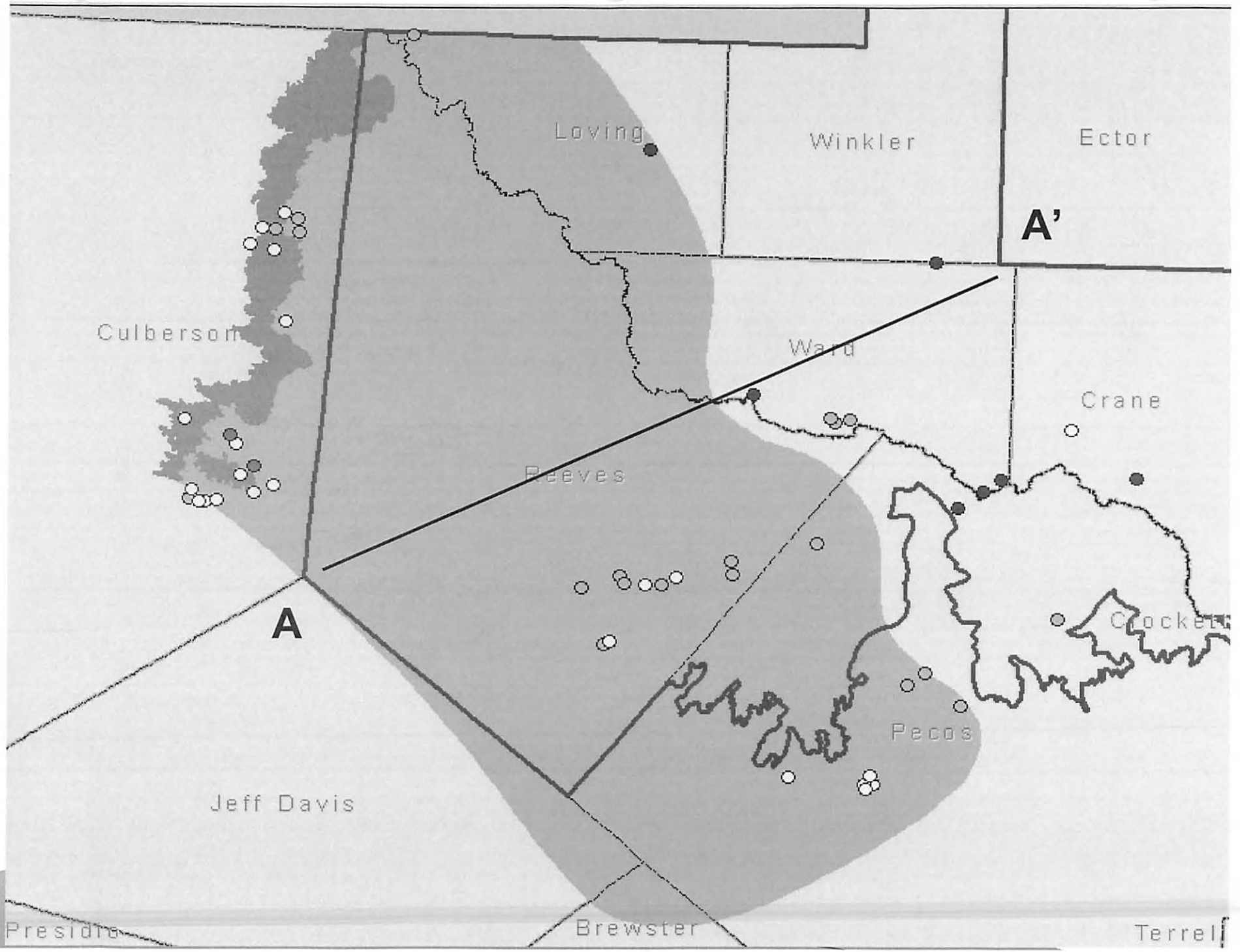
- Very limited extent in GMA 3
- No availability in DB07
- Very few wells in TWDB database, most of which are abandoned or unused

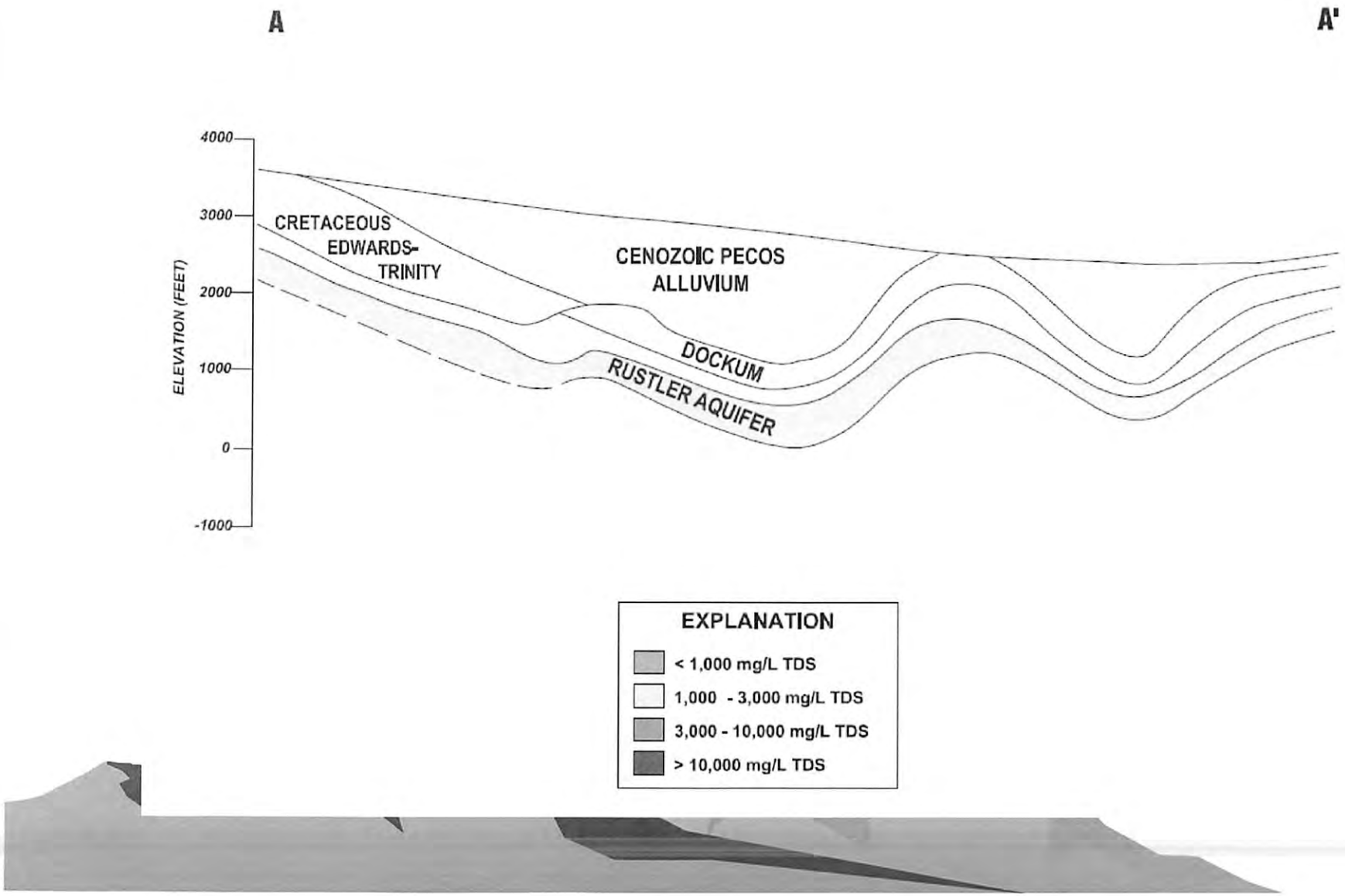
Recommendation

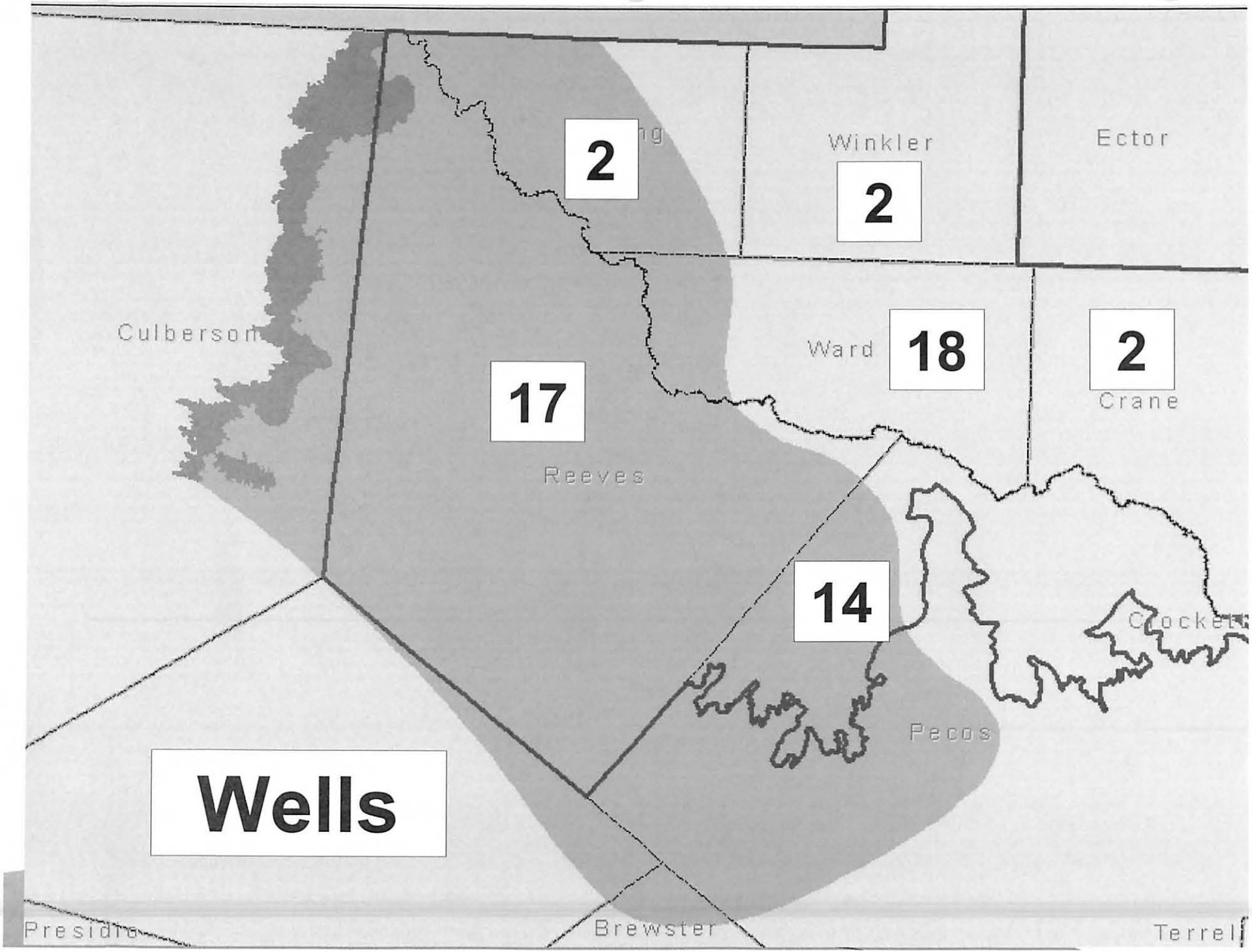
- Recommend that the Igneous Aquifer be considered “not relevant” for GMA 3

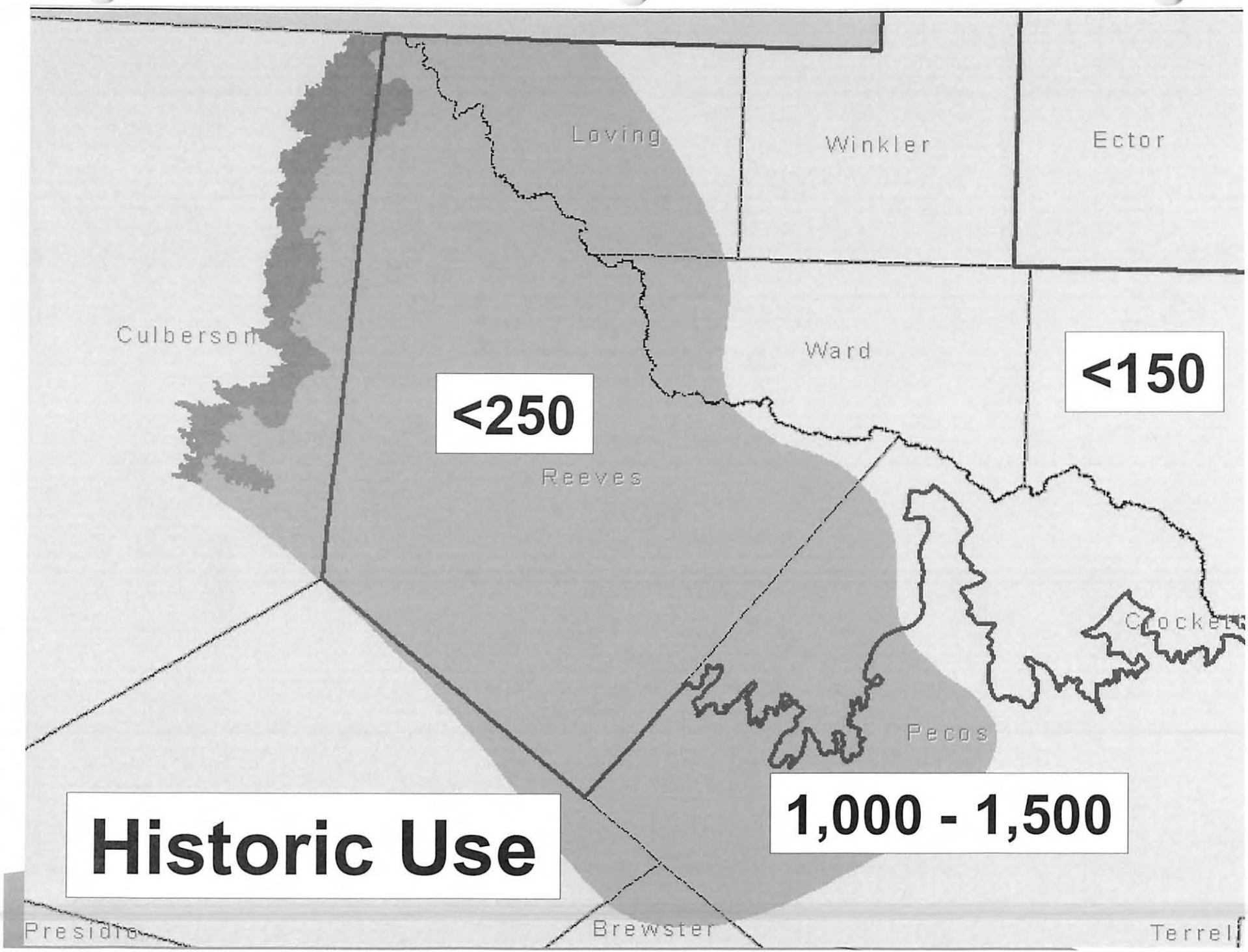
Rustler Aquifer

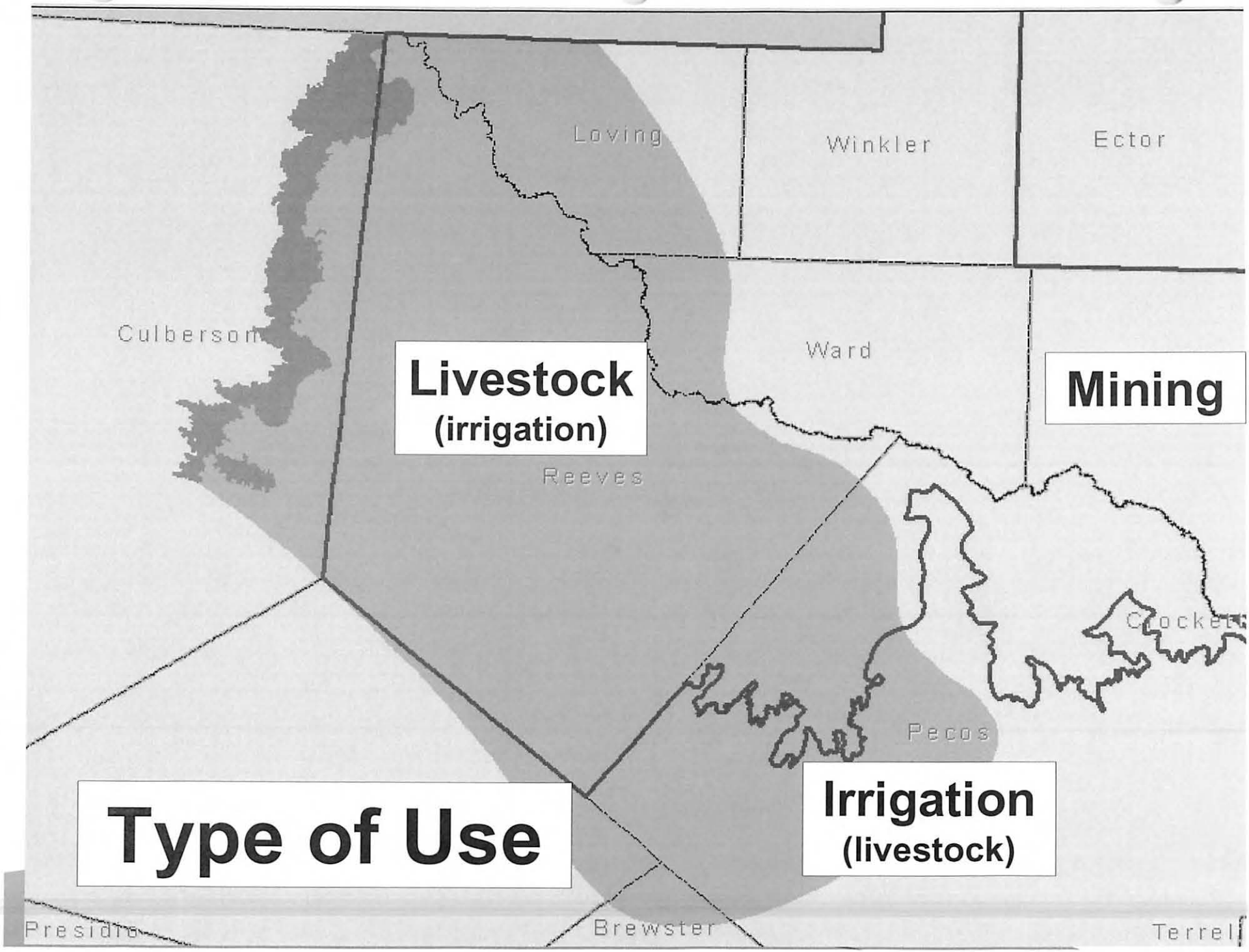
- Permian-aged dolomite/anhydrite aquifer with a basal sand/conglomerate. Some limestone and salt also found in it.
- Generally poor water quality, not producible where it occurs, highly variable well yields
- No GAM completed

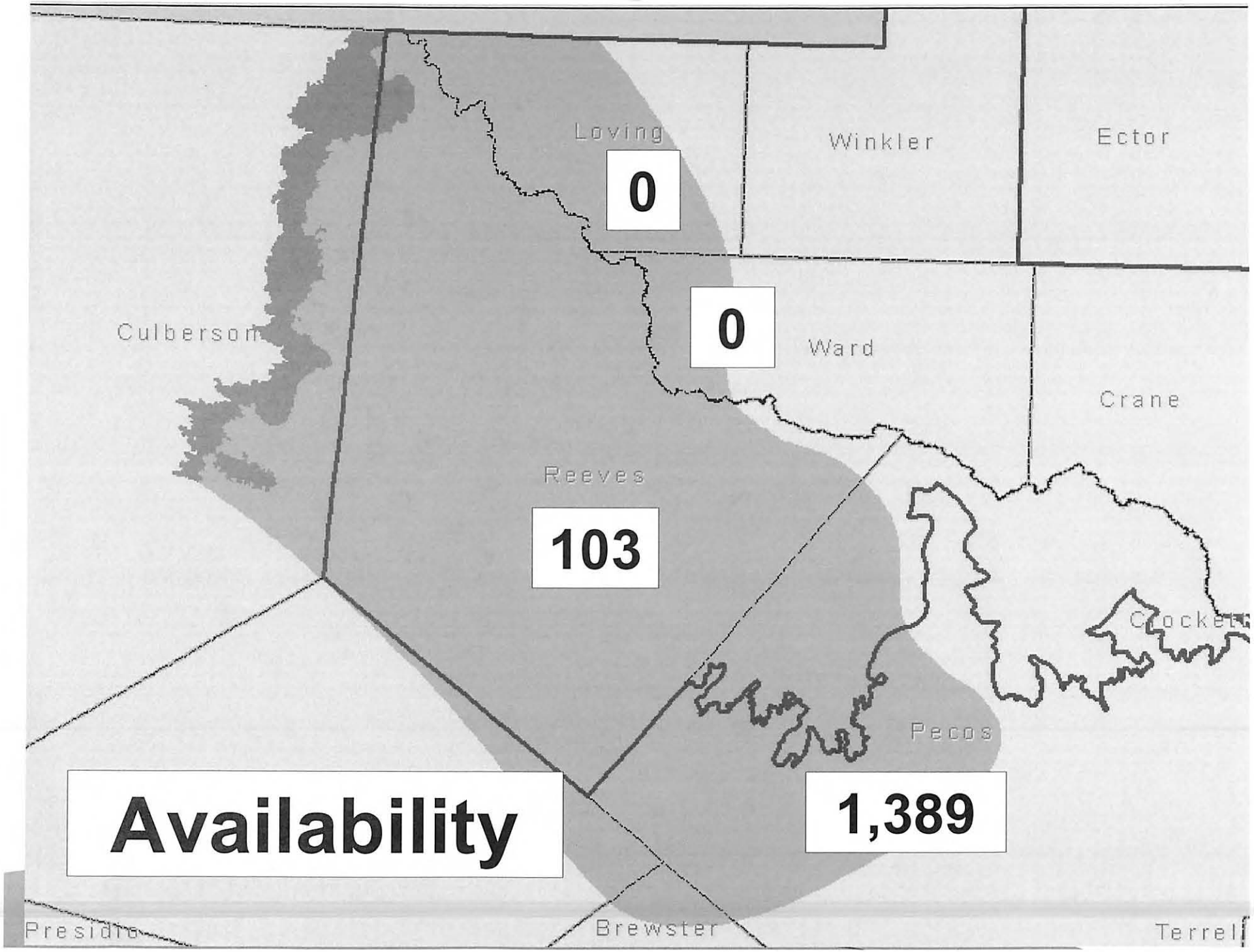

Loving
Winkler
Ector
A'
Culberson
Ward
Crane
Reeves
A
Crockett
Pecos
Jeff Davis
Presidio
Brewster
Terrell


A
A'
4000
3000
2000
1000
0
-1000
ELEVATION (FEET)
CRETACEOUS
EDWARDS-
TRINITY
CENOZOIC PECOS
ALLUVIUM
DOCKUM
RUSTLER AQUIFER
EXPLANATION
< 1,000 mg/L TDS
1,000 - 3,000 mg/L TDS
3,000 - 10,000 mg/L TDS
> 10,000 mg/L TDS


2
Winkler
2
Ector
Culberson
17
Reeves
Ward
18
2
Crane
14
Pecos
Wells
Presidio
Brewster
Terrell


Loving
Winkler
Ector
Culberson
Ward
<250
<150
Reeves
Pecos
1,000 - 1,500
Historic Use
Presidio
Brewster
Terrell


Loving
Winkler
Ector
Culberson
Ward
Livestock
(irrigation)
Mining
Reeves
Crockett
Pecos
Irrigation
(livestock)
Type of Use
Presidio
Brewster
Terrell


Loving
0
Winkler
Ector
Culberson
0
Ward
Crane
Reeves
103
Pecos
1,389
Availability
Presidio
Brewster
Terrell

Rustler Aquifer

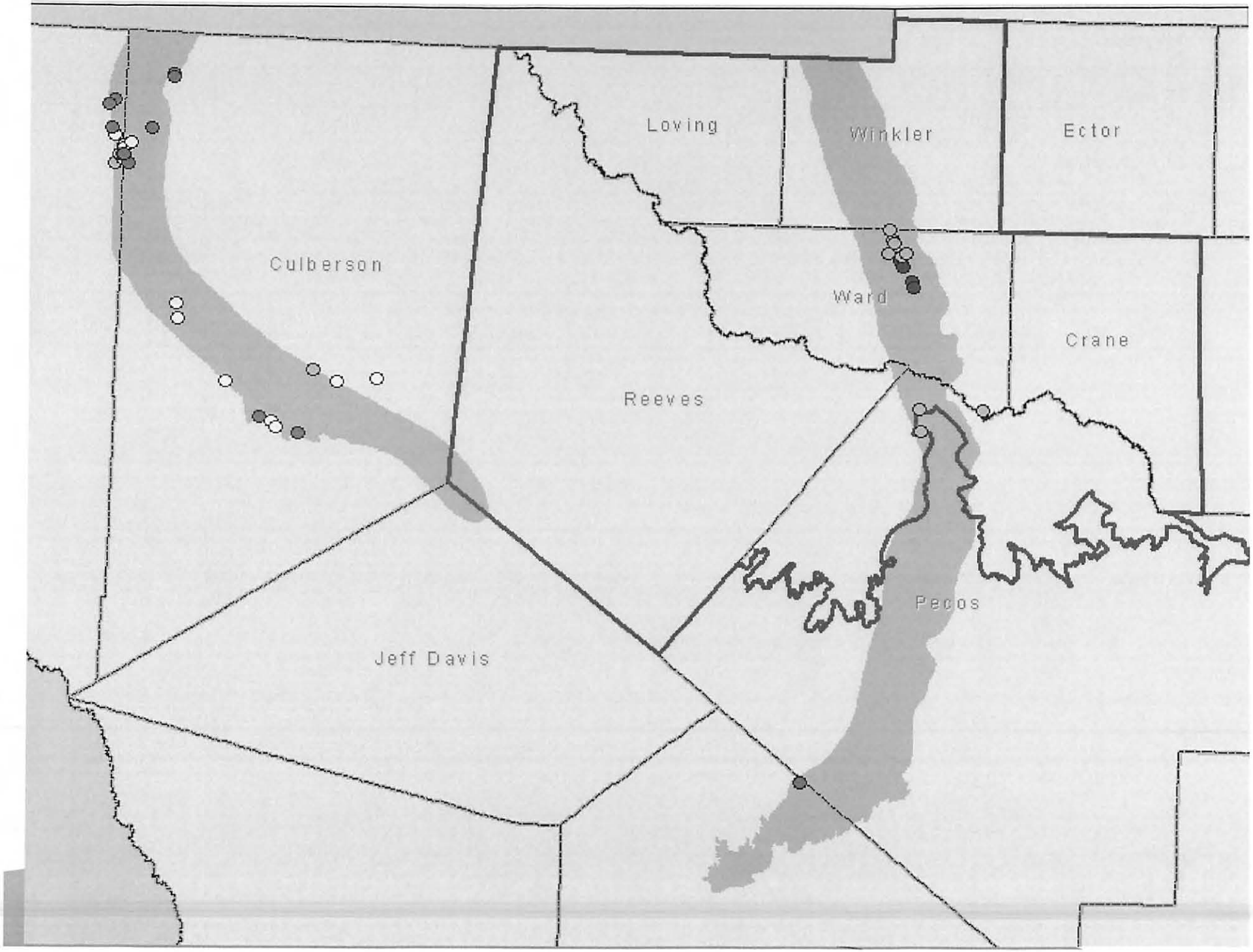
- Limited availability (set at historic use)
- Moderate to poor water quality
- Variable productivity

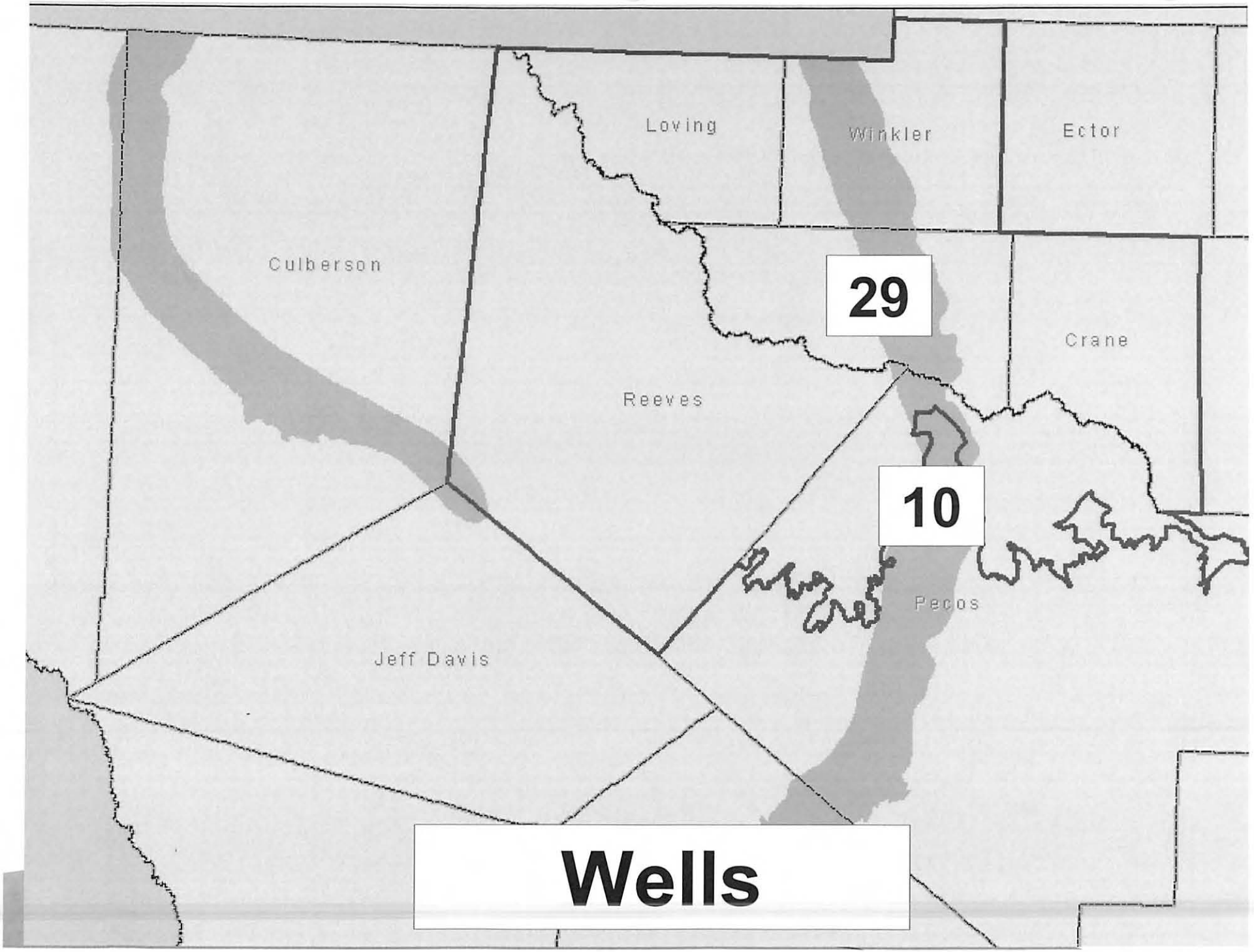
Recommendation

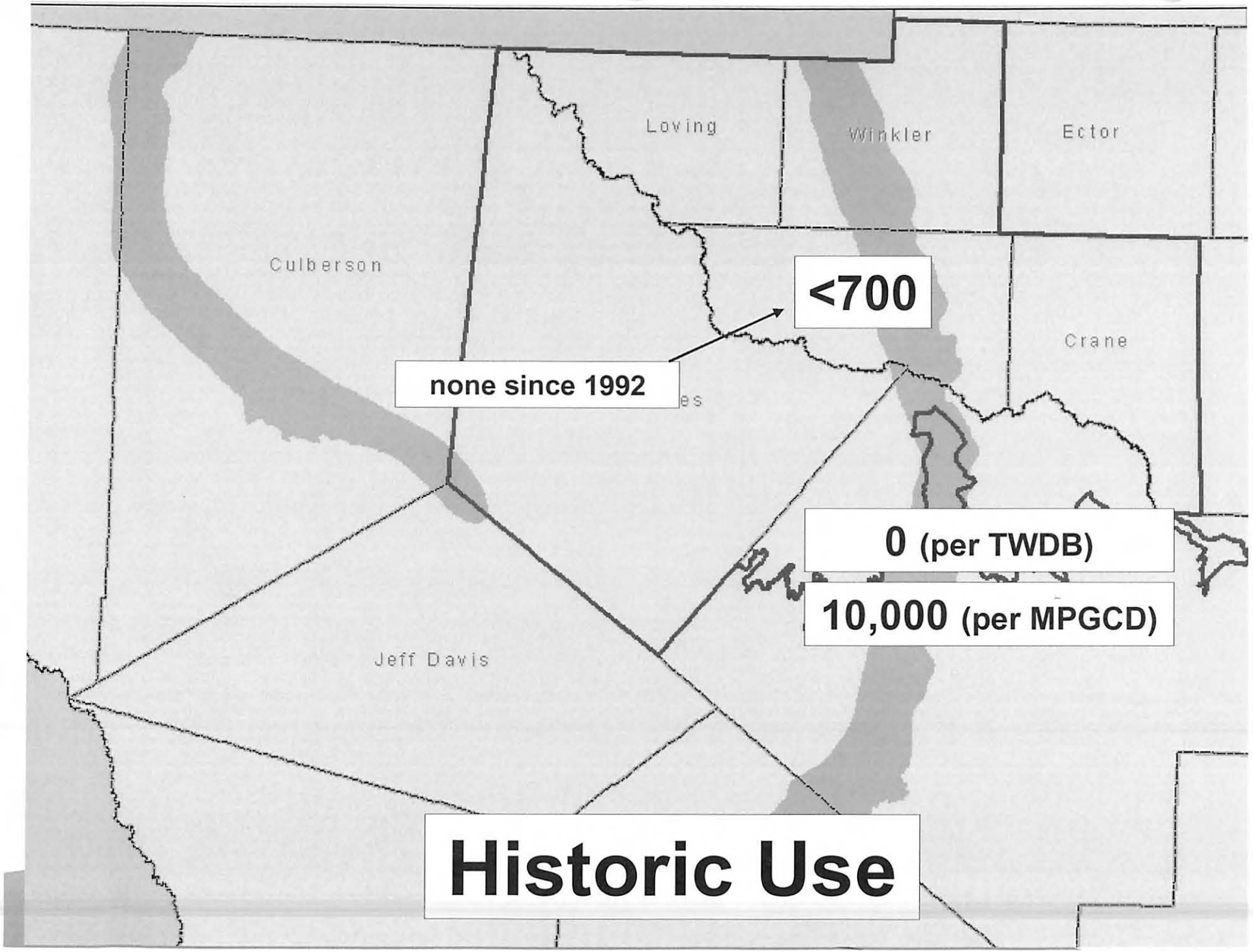
- Recommend the Rustler Aquifer be considered “not relevant” in Crane, Loving, Ward, and Winkler counties.
- The Middle-Pecos GCD should use the same DFC approach for both Pecos and Reeves counties.

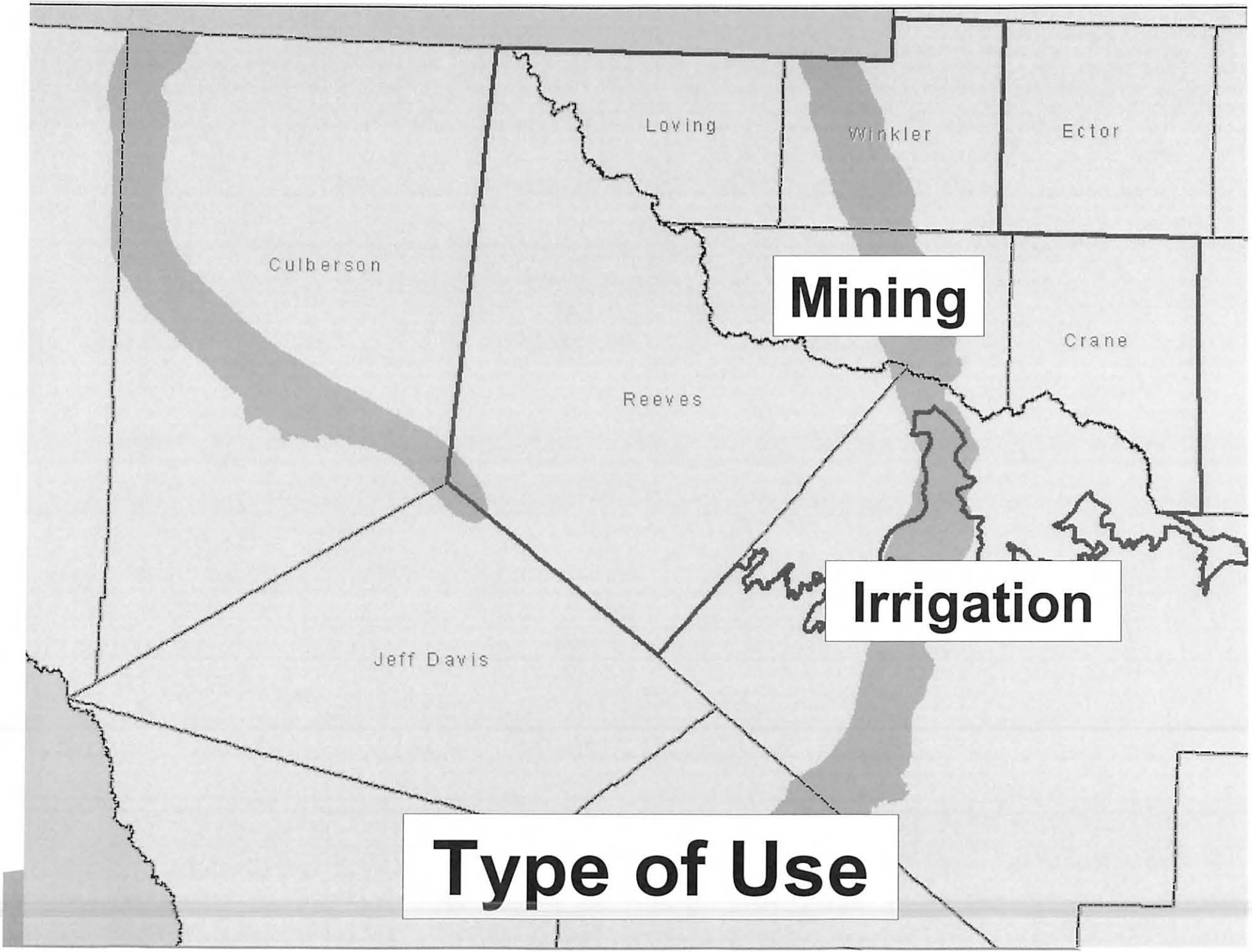
Capitan Reef Complex

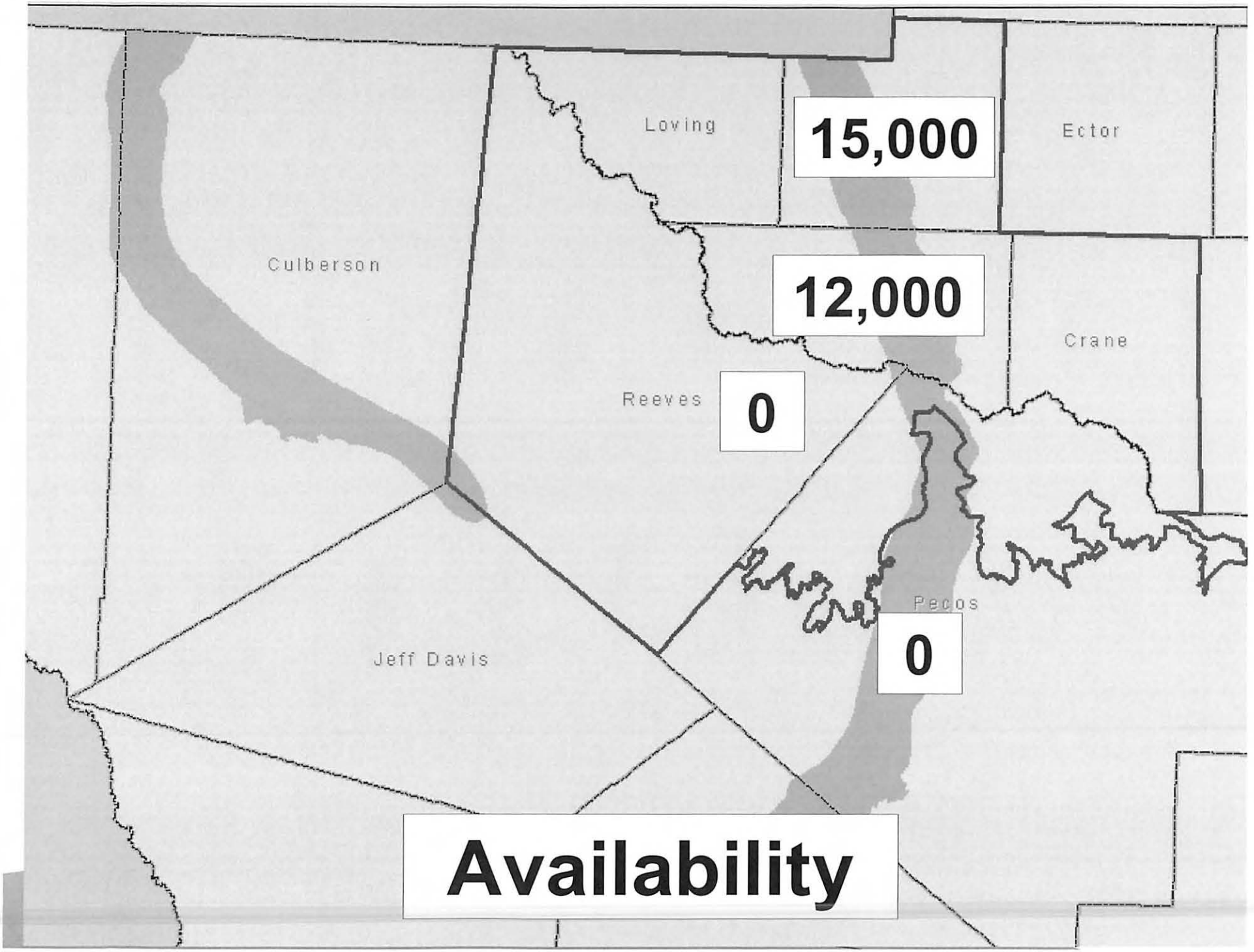
- Permian-age reef structure
- Up to 2,000 feet thick consisting of massive, cavernous limestone, dolomite, and reef material.
- Highly variable well yields
- No GAM completed


Loving
Winkler
Ector
Culberson
Ward
Crane
Reeves
Pecos
Jeff Davis


Loving
Winkler
Ector
Culberson
29
Crane
Reeves
10
Pecos
Jeff Davis
Wells


Loving
Winkler
Ector
Culberson
<700
Crane
none since 1992
es
0 (per TWDB)
10,000 (per MPGCD)
Jeff Davis
Historic Use


Loving
Winkler
Ector
Culberson
Mining
Crane
Reeves
Irrigation
Jeff Davis
Type of Use


Loving
15,000
Ector
Culberson
12,000
Crane
Reeves
0
Pecos
0
Jeff Davis
Availability

Capitan Reef Complex

- Present in Ward, Winkler, and Pecos counties, very small portion in Reeves County
- Substantial availability in Ward and Winkler counties. Substantial amount permitted in Pecos County.
- Occurs at great depth in Ward and Winkler counties (thousands of feet)
- Poor water quality in Ward and Winkler counties (moderately saline to saline)

Capitan Reef Complex

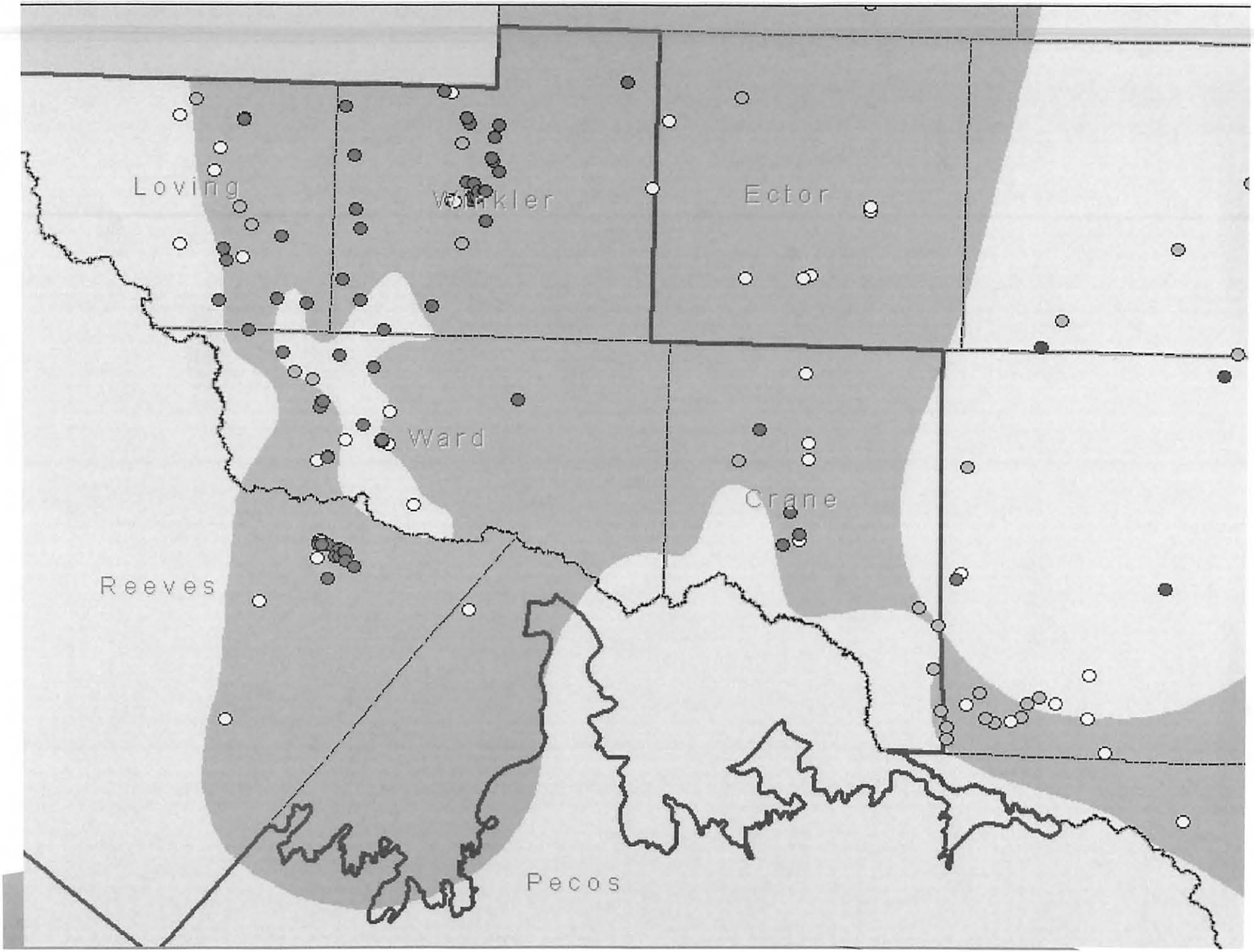
- No historic use since early 1990s, all use was “mining” (oil and gas) according to TWDB.
- MPGCD indicates ~10,000 acre-feet/year in use. Almost all of this is permitted use, very little estimated exempt use.

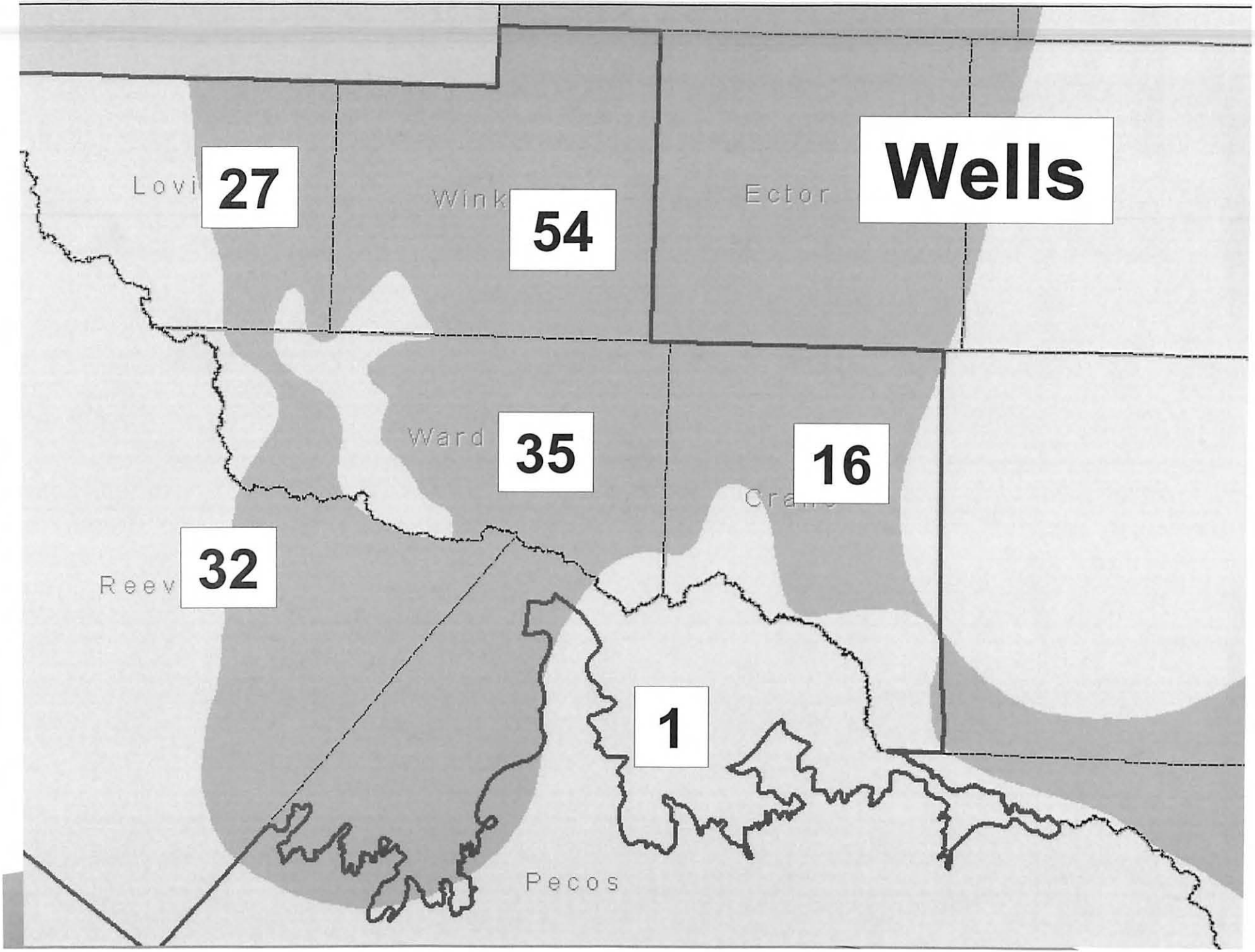
Recommendation

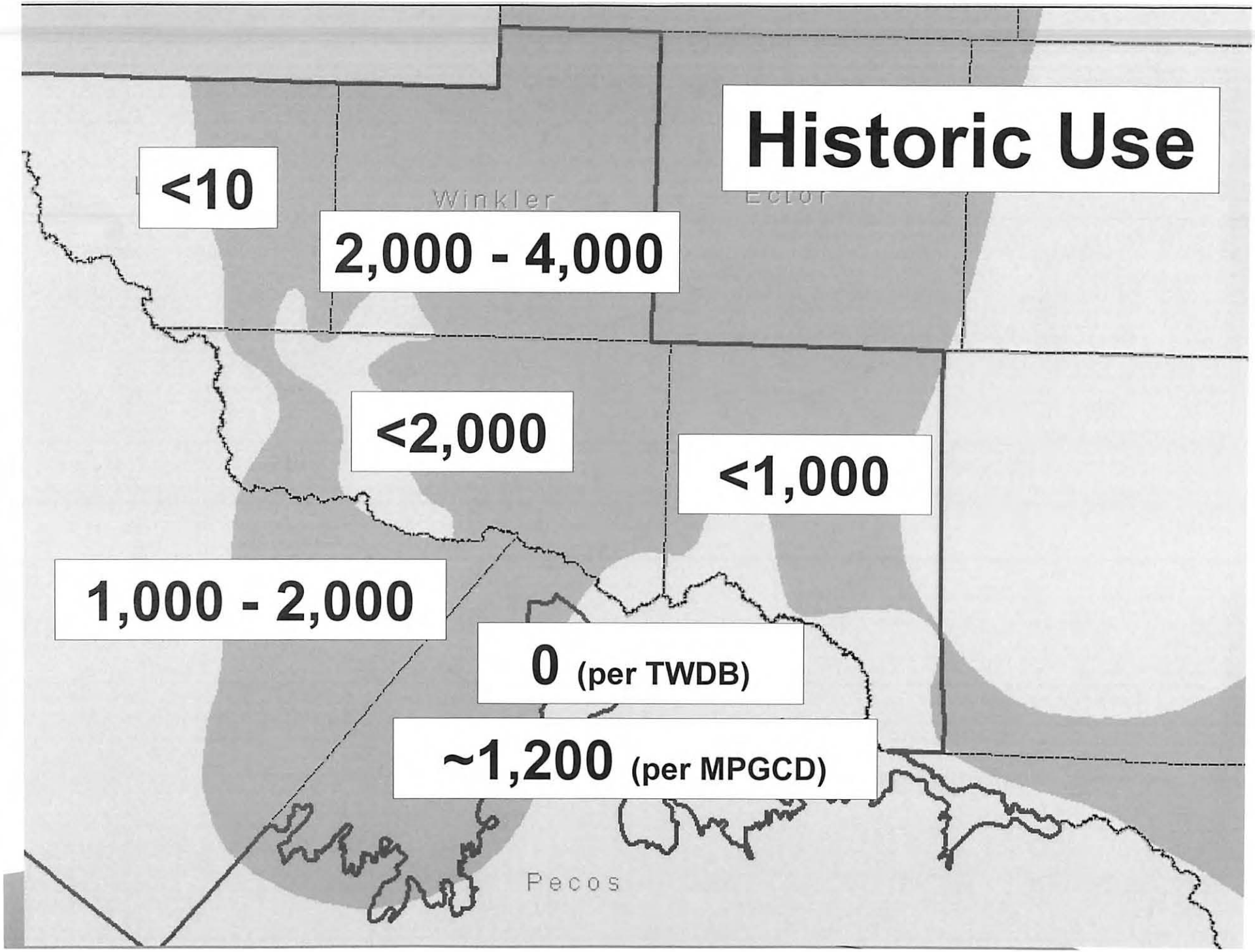
- Recommend that the Capitan Reef Complex Aquifer be considered “not relevant” Rustler County
- Recommend that MPGCD use the same approach for Ward and Winkler counties as Pecos County.

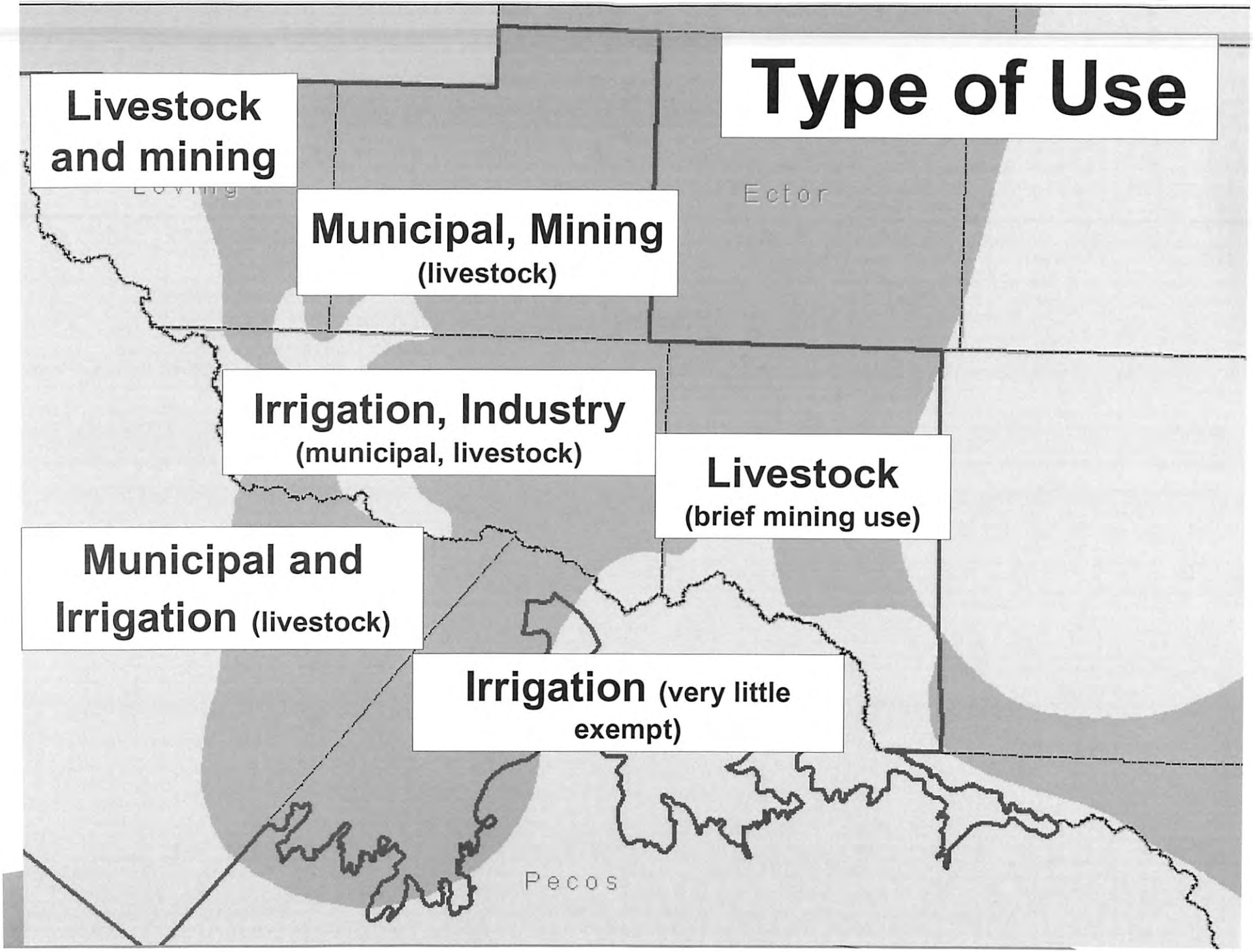
Dockum Aquifer

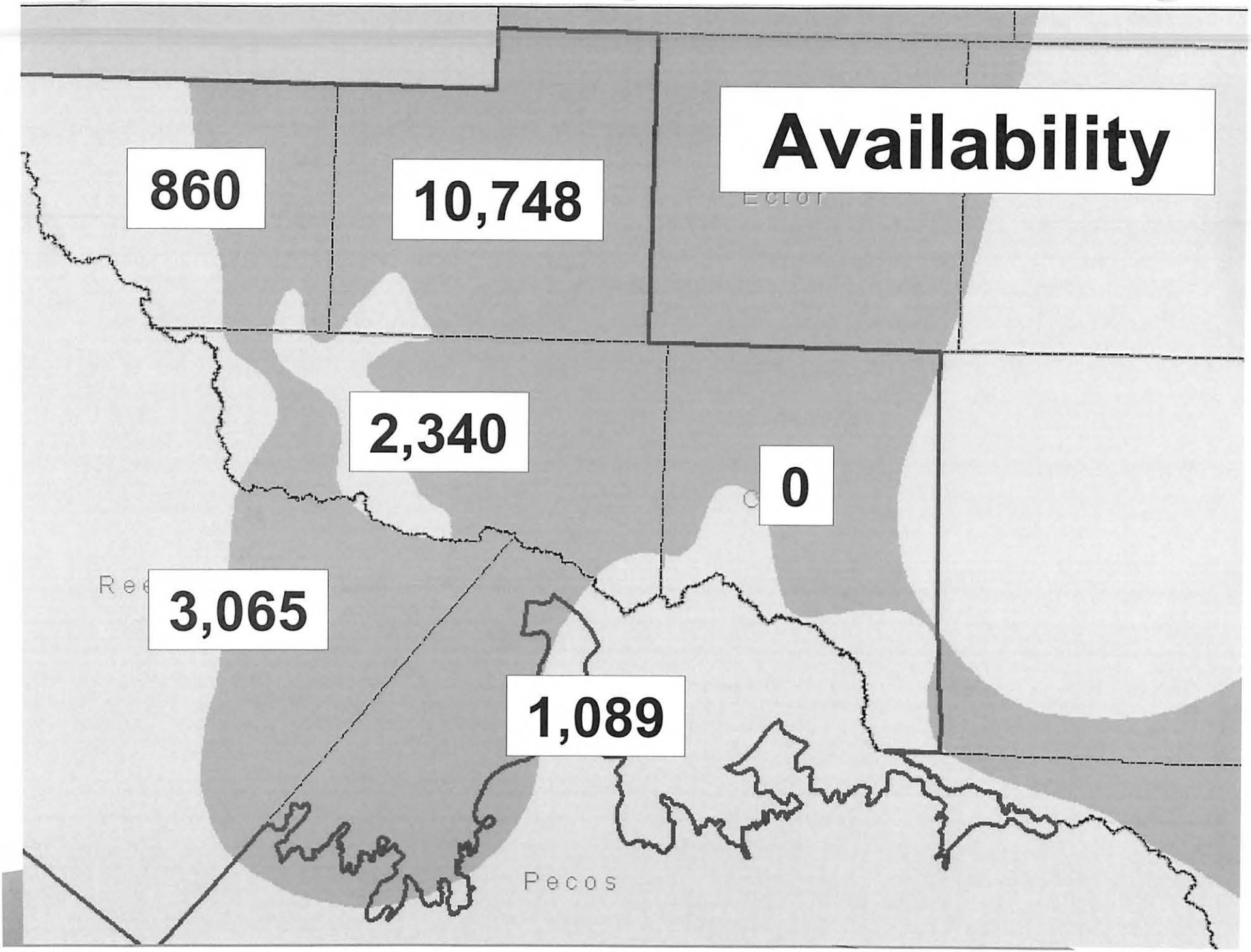
- Triassic-age sandy to silty aquifer
- Extensive, occurs from the Panhandle to the GMA 3 area
- Up to 2,000 feet thick
- GAM completed and being used for other GMAs


Loving
Winkler
Ector
Ward
Crane
Reeves
Pecos


Lovi
27
Wink
54
Ector
Wells
Ward
35
16
Reev
32
1
Pecos


Historic Use
<10
2,000 - 4,000
<2,000
<1,000
1,000 - 2,000
0 (per TWDB)
~1,200 (per MPGCD)
Winkler
Ector
Pecos


Type of Use
Livestock and mining
Municipal, Mining (livestock)
Irrigation, Industry (municipal, livestock)
Livestock (brief mining use)
Municipal and Irrigation (livestock)
Irrigation (very little exempt)
Ector
Pecos


Availability
860
10,748
2,340
0
3,065
1,089
Pecos

Availability Estimates

- Crane County = 0 acre-feet/year (no recharge so zero supply)
- Loving County = 860 acre-feet/year (recharge + 75% of recoverable storage depletion over 50 years)
- Pecos County = 1,089 acre-feet/year (recharge + 75% of recoverable storage depletion over 100 years)
- Reeves County = 3,065 acre-feet/year (recharge + 75% of recoverable storage depletion over 50 years)
- Ward County = 2,340 acre-feet/year (recharge + 75% of recoverable storage depletion over 50 years)
- Winkler County = 10,746 acre-feet/year (recharge + 75% of recoverable storage depletion over 50 years)

Dockum Aquifer

- Occurs throughout GMA 3
- Fair amount of fresh water
- Significant historic use and availability
- Wells often completed in the Pecos and Dockum

Recommendation

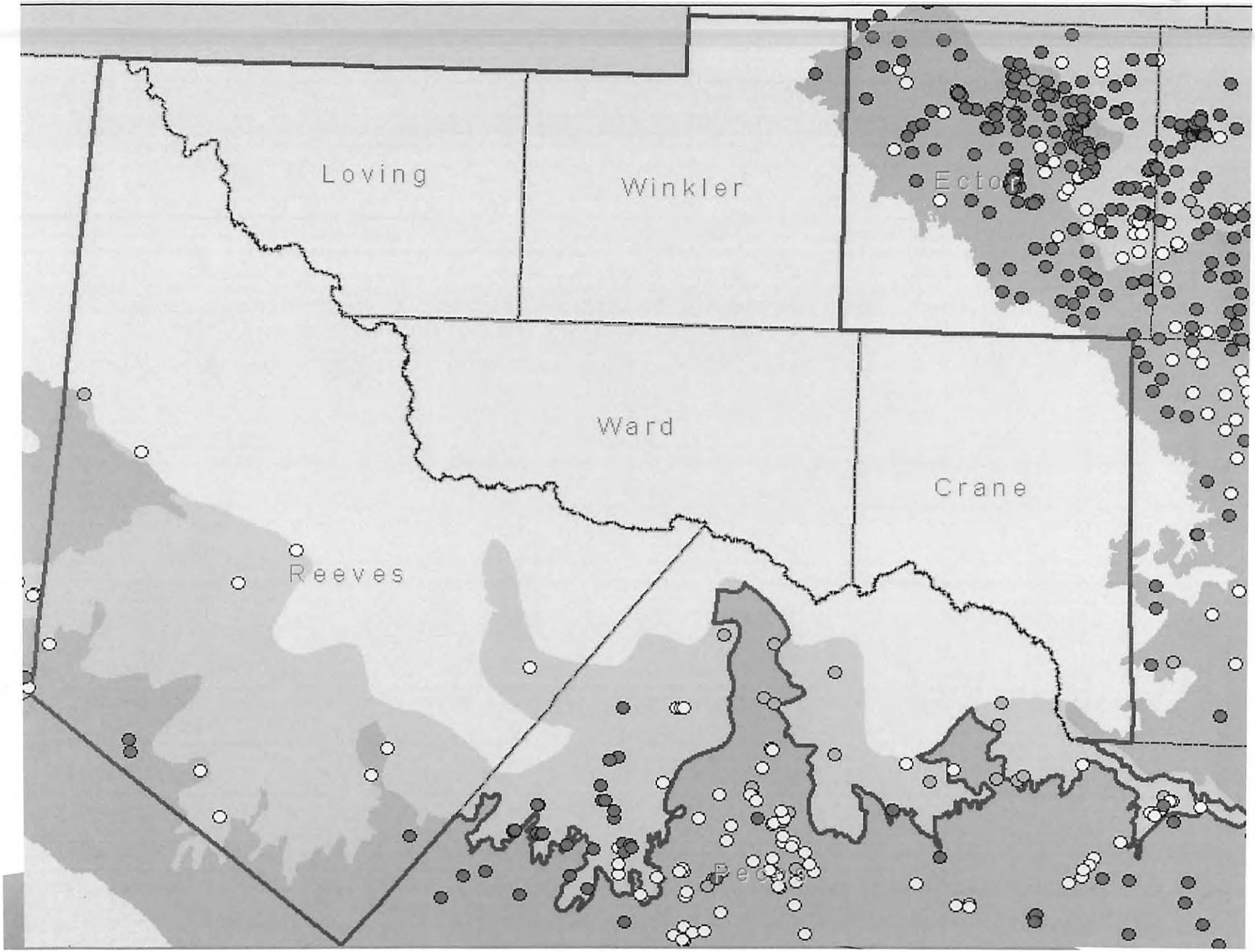
- Recommend that a GAM run be requested from the TWDB for the Dockum Aquifer with the following pumpage totals:
  - Crane County = 2,000 acre-feet/year
  - Loving County = 1,000 acre-feet/year
  - Pecos County = 3,000 acre-feet/year
  - Reeves County = 5,000 acre-feet/year
  - Ward County = 7,000 acre-feet/year
  - Winkler County = 10,000 acre-feet/year

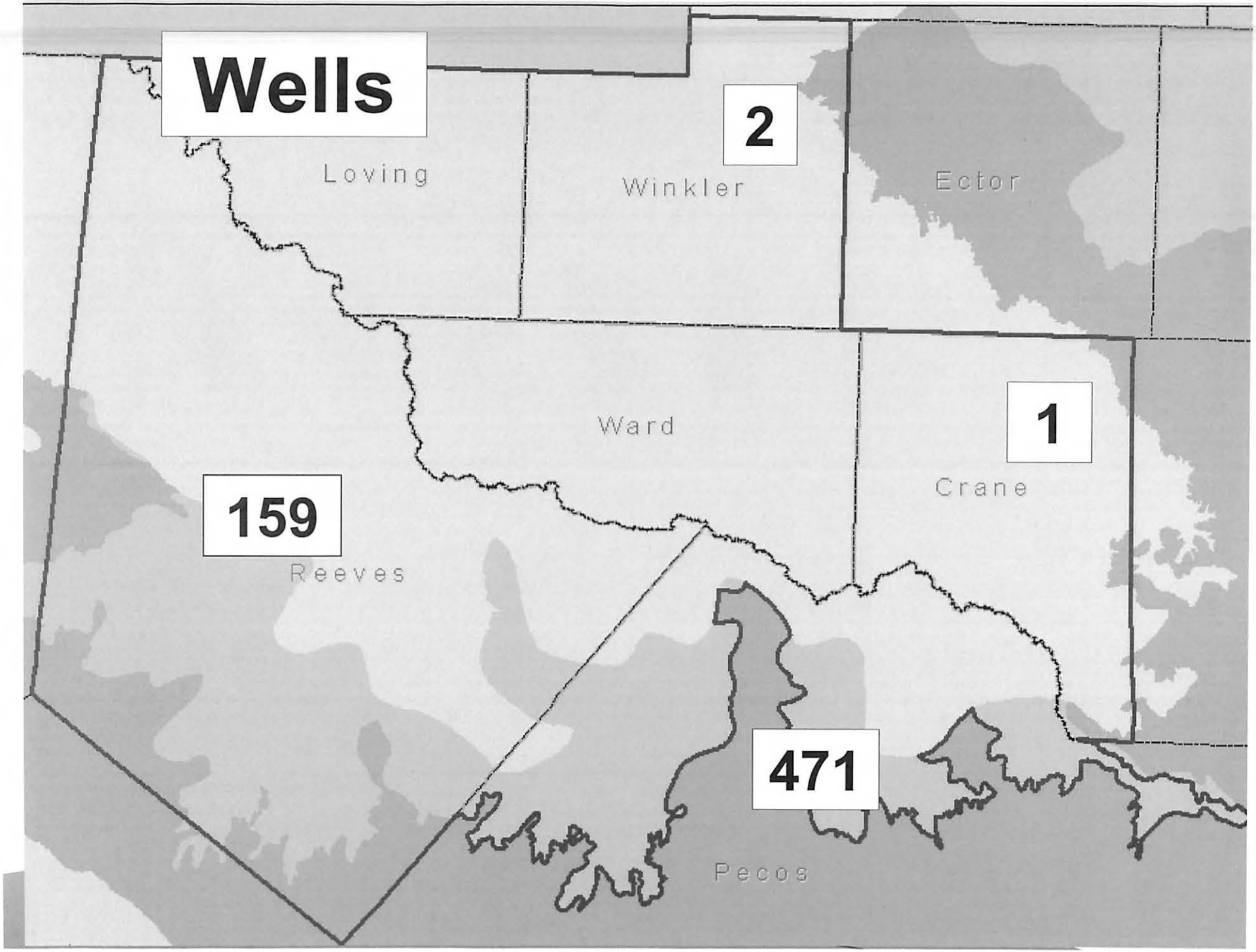
Edwards-Trinity (Plateau) Aquifer

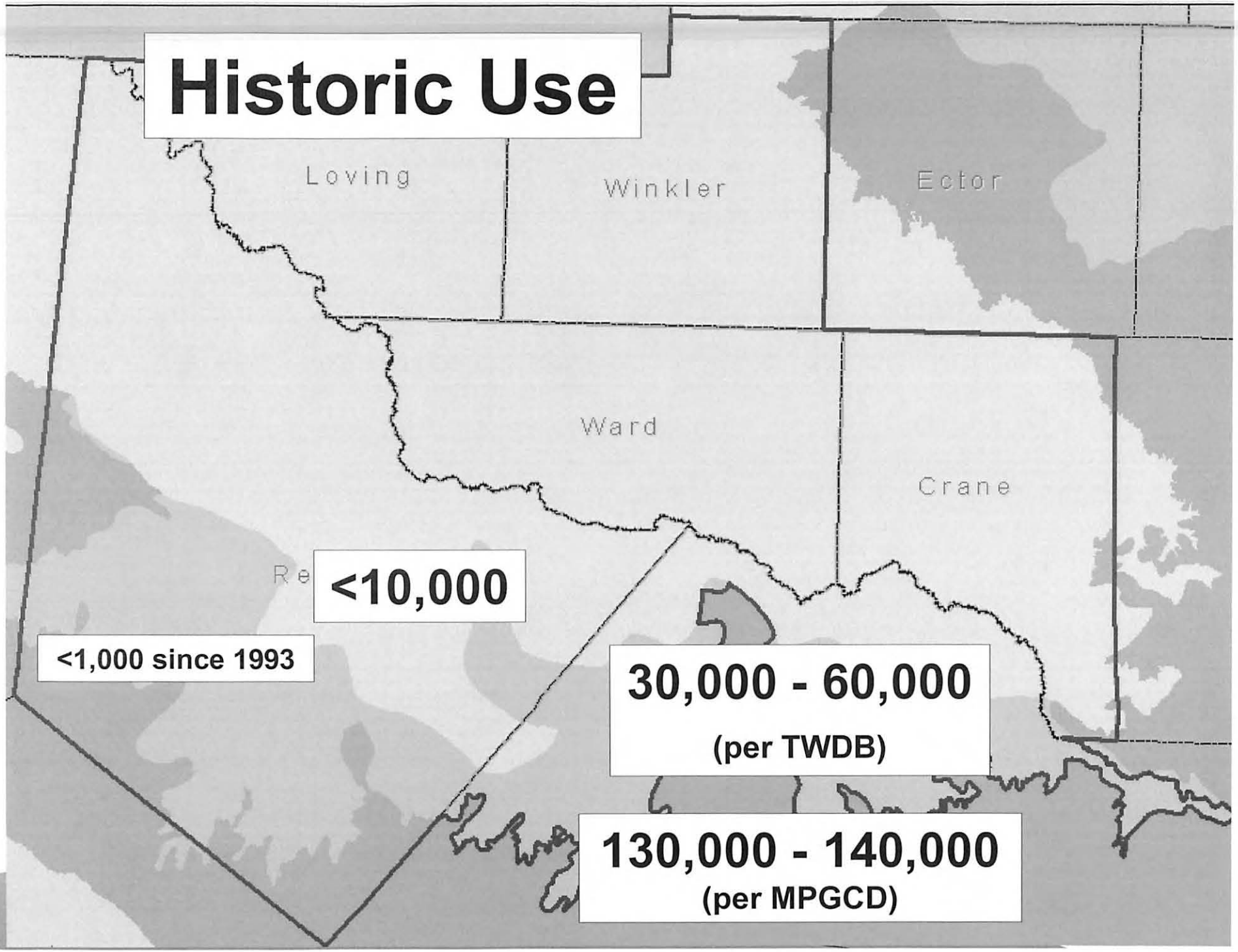
- Cretaceous-aged limestones, sandstones, and dolomites
- In many areas of the state, the formations are divided up into the Edwards Aquifer and the Trinity Group Aquifer. Here they are considered a single aquifer.
- Saturated thickness of aquifer typically hundreds of feet, although it can be greater.

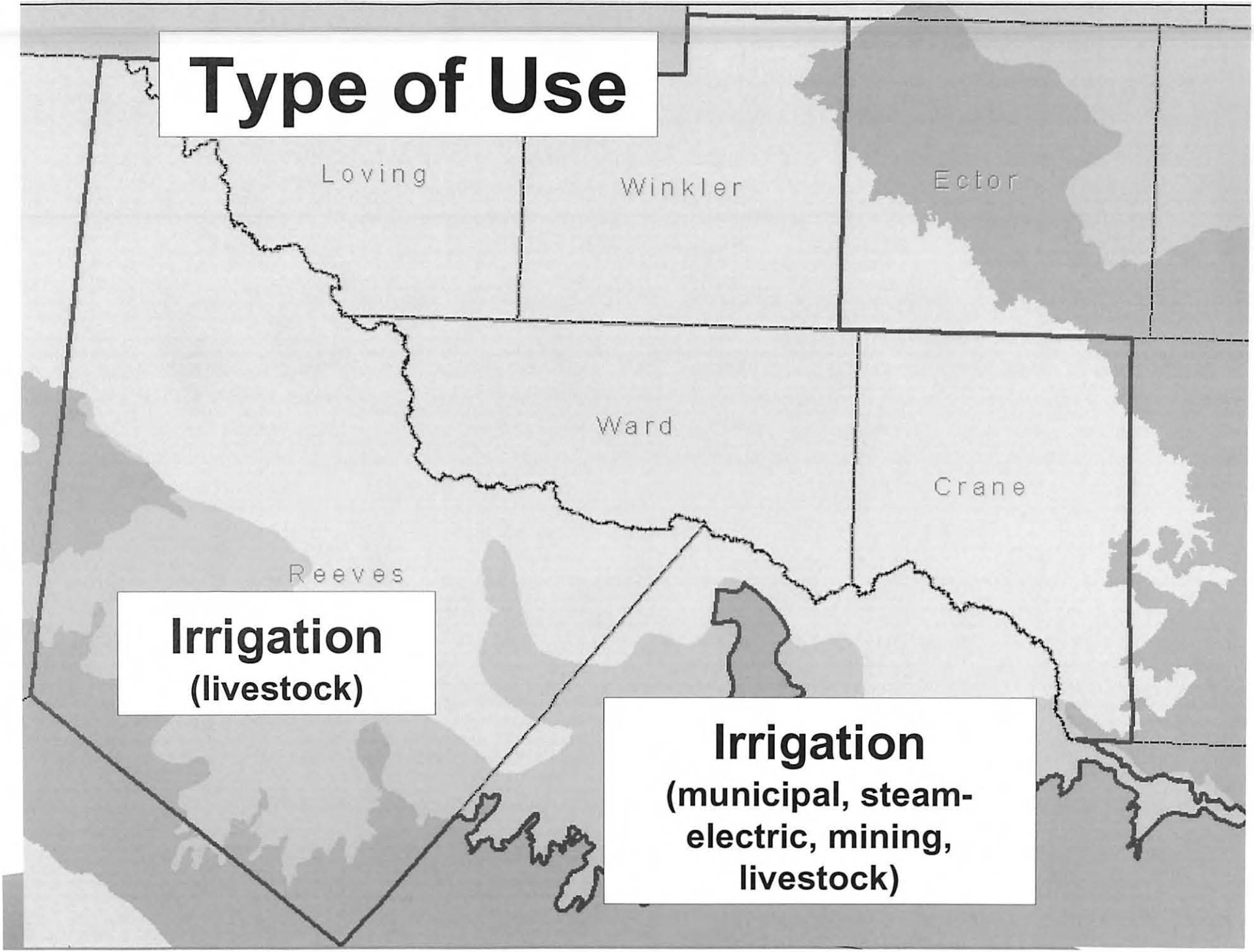
Edwards-Trinity (Plateau) Aquifer

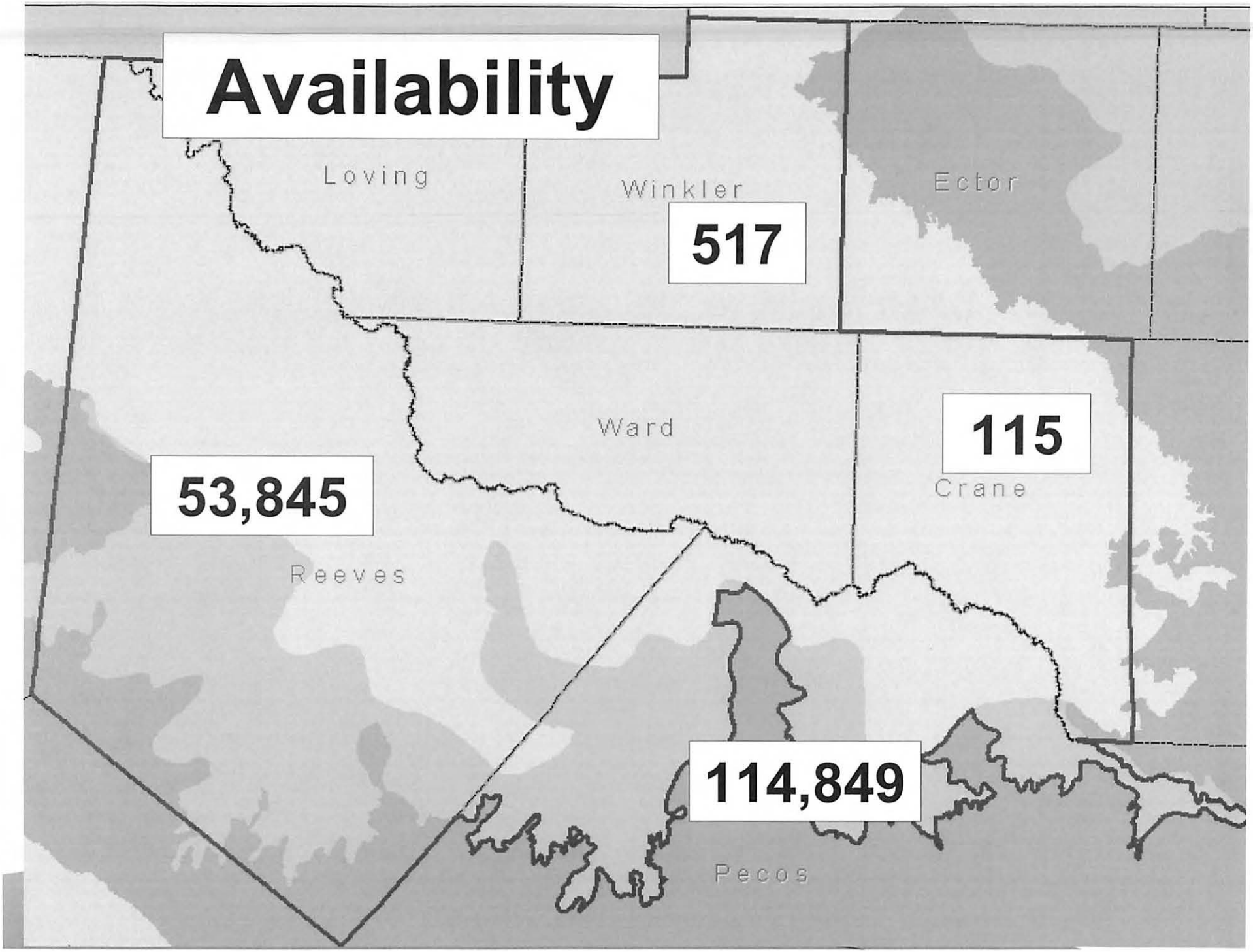
- Aquifer properties can be difficult to estimate.
- GAM completed. Recalibrated once. Being revised by TWDB. Another revision planned in the future.


Loving
Winkler
Ward
Crane
Reeves


Wells
Loving
2
Winkler
Ector
Ward
1
Crane
159
Reeves
471
Pecos


Historic Use
Loving
Winkler
Ector
Ward
Crane
Re
<10,000
<1,000 since 1993
30,000 - 60,000
(per TWDB)
130,000 - 140,000
(per MPGCD)


Type of Use
Loving
Winkler
Ector
Ward
Crane
Reeves
Irrigation
(livestock)
Irrigation
(municipal, steam-electric, mining, livestock)


Availability
Loving
Winkler
517
Ector
Ward
115
Crane
53,845
Reeves
114,849
Pecos

Edwards-Trinity (Plateau) Aquifer

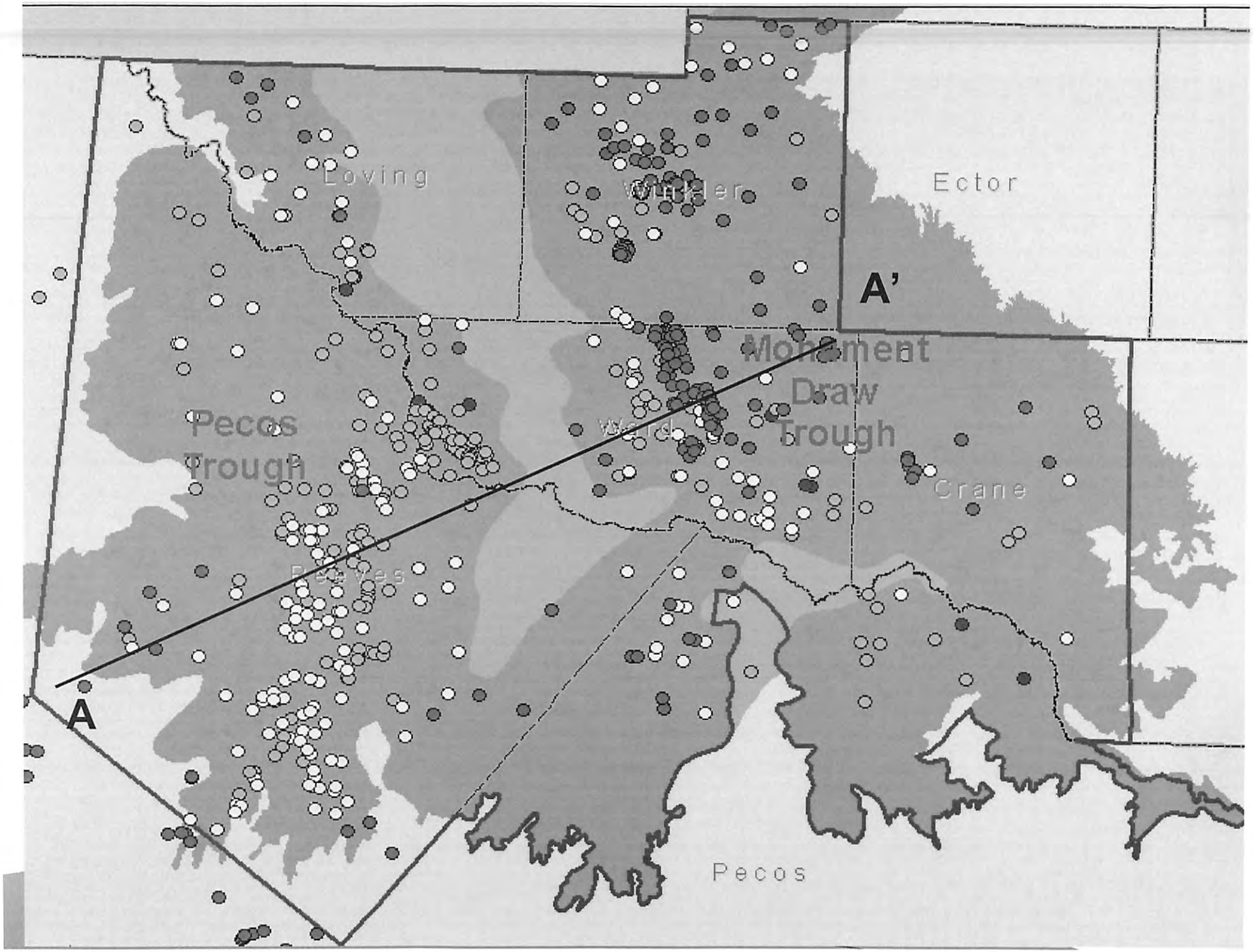
- Significant extent in Pecos and Reeves counties, limited extent in Crane and Winkler counties
- Significant availability in DB07 for Pecos and Reeves counties, small availability in Crane and Winkler counties.

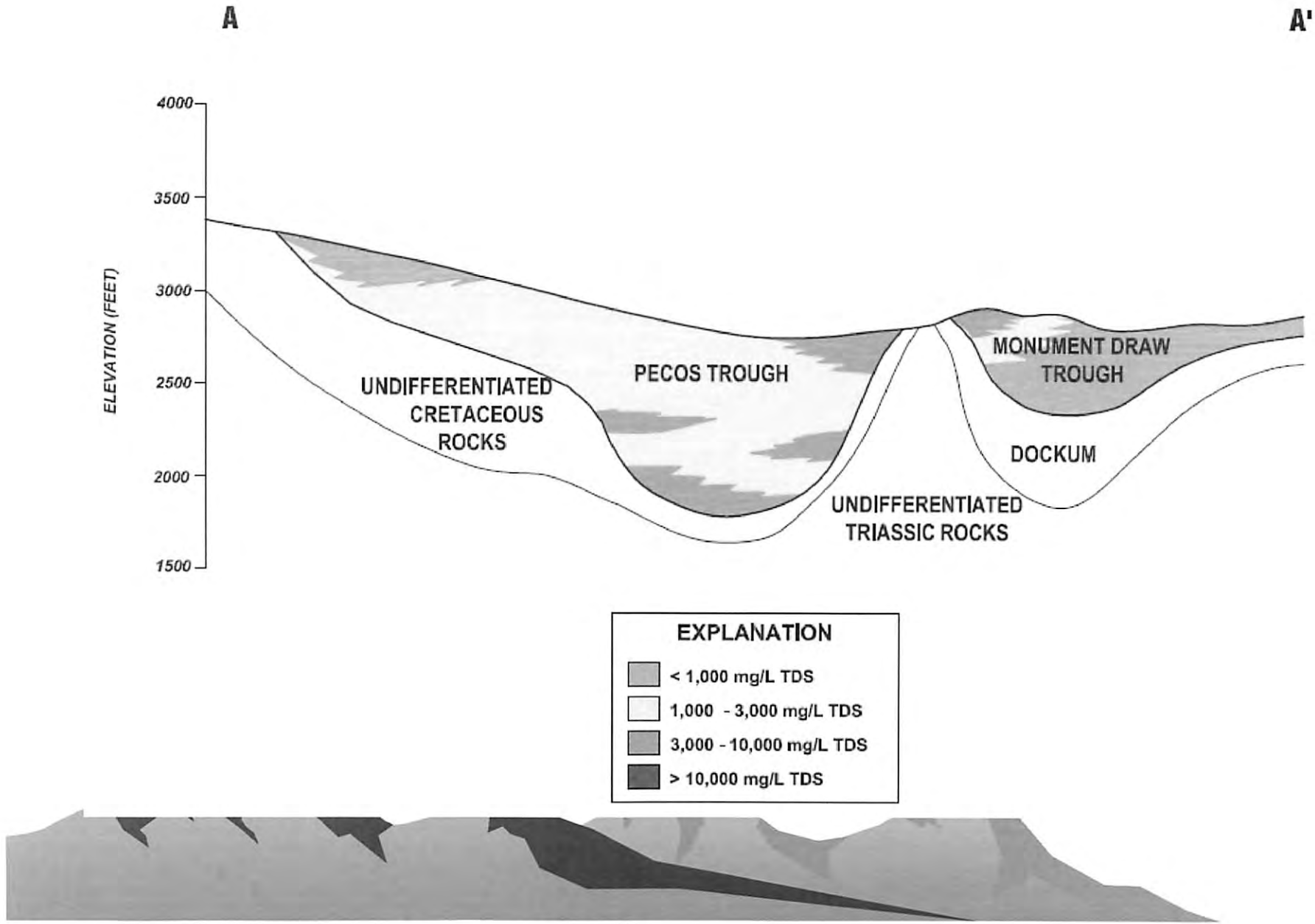
Recommendation

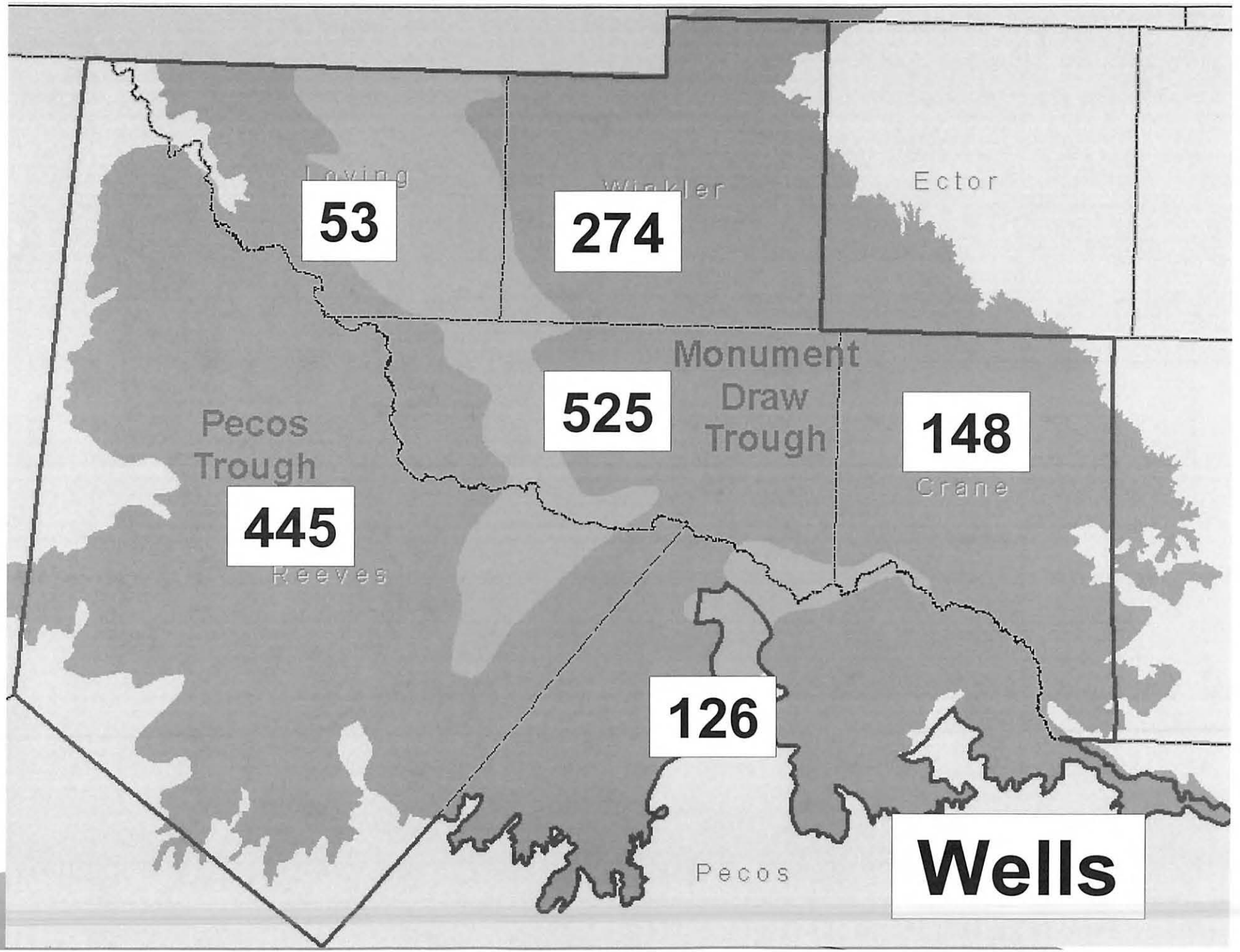
- Recommend that the Edwards-Trinity (Plateau) Aquifer be considered “not relevant” in Crane and Winkler counties
- Recommend that work being done with GMA 7 dictate DFCs for Pecos and Reeves counties

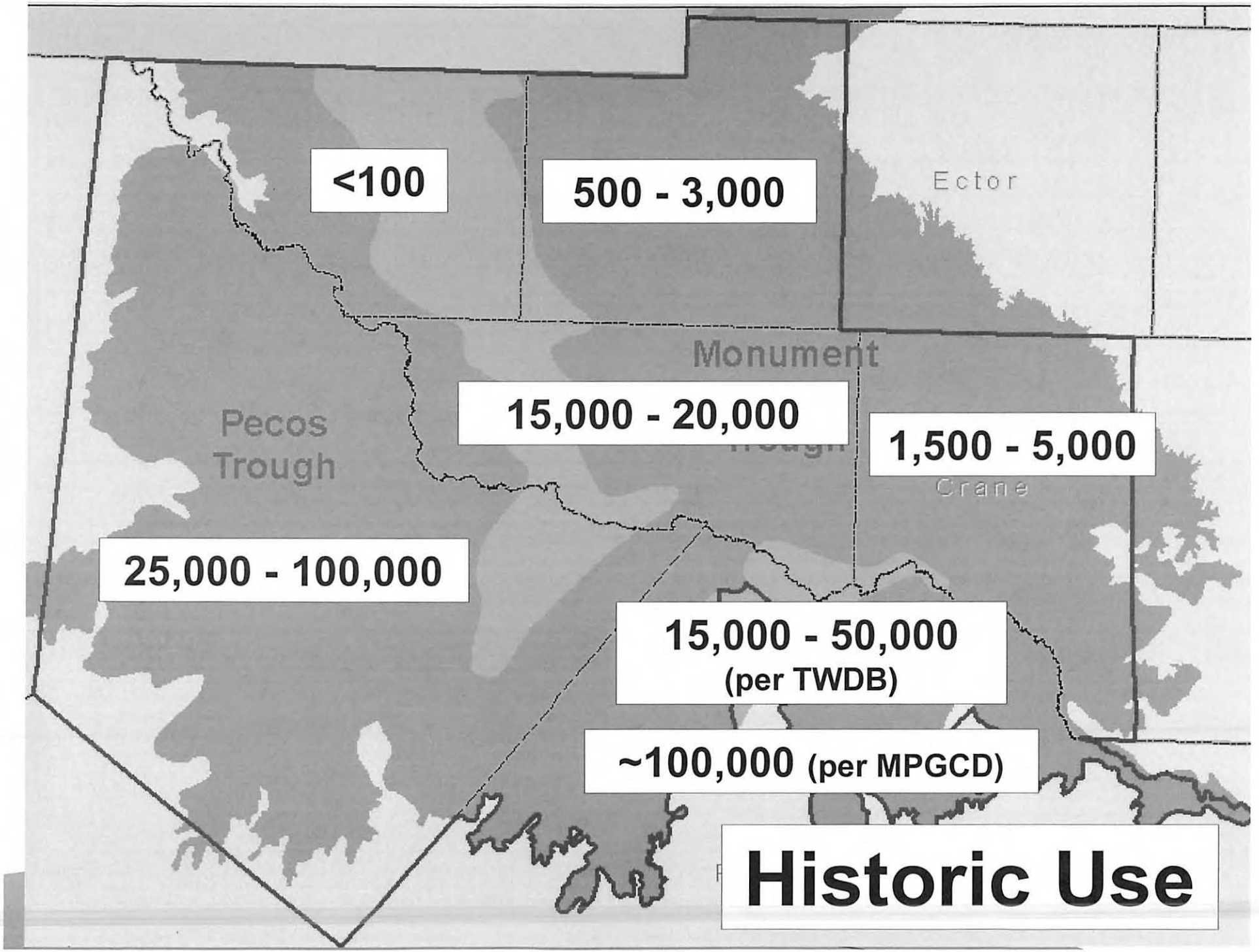
Pecos Valley Aquifer

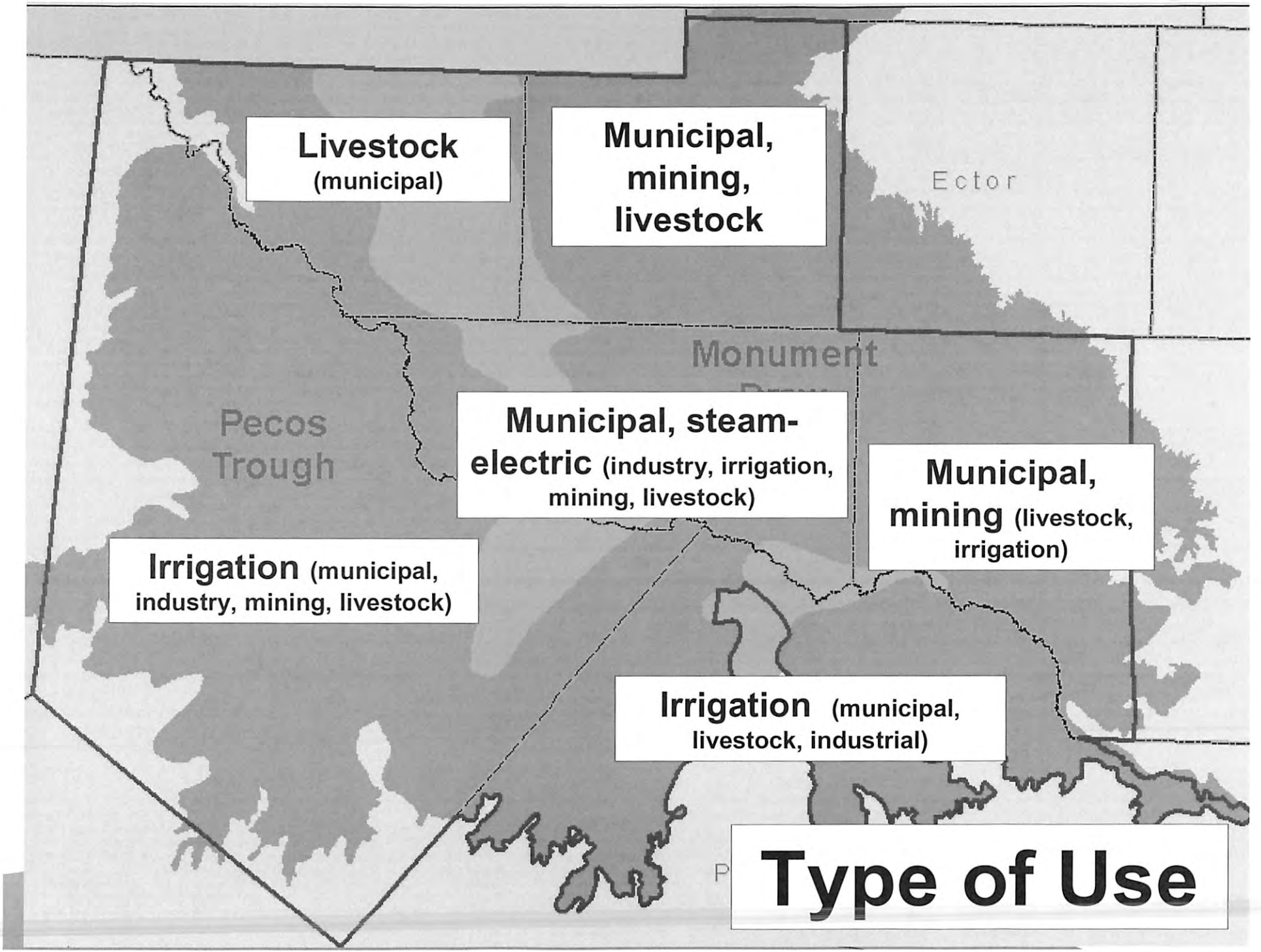
- Formerly known as Cenozoic Pecos Alluvium
- Tertiary age basin fill aquifer
- Main production is from two troughs--the Pecos Trough to the west, and the Monument Draw Trough to the east
- Included in the Edwards-Trinity (Plateau) GAM

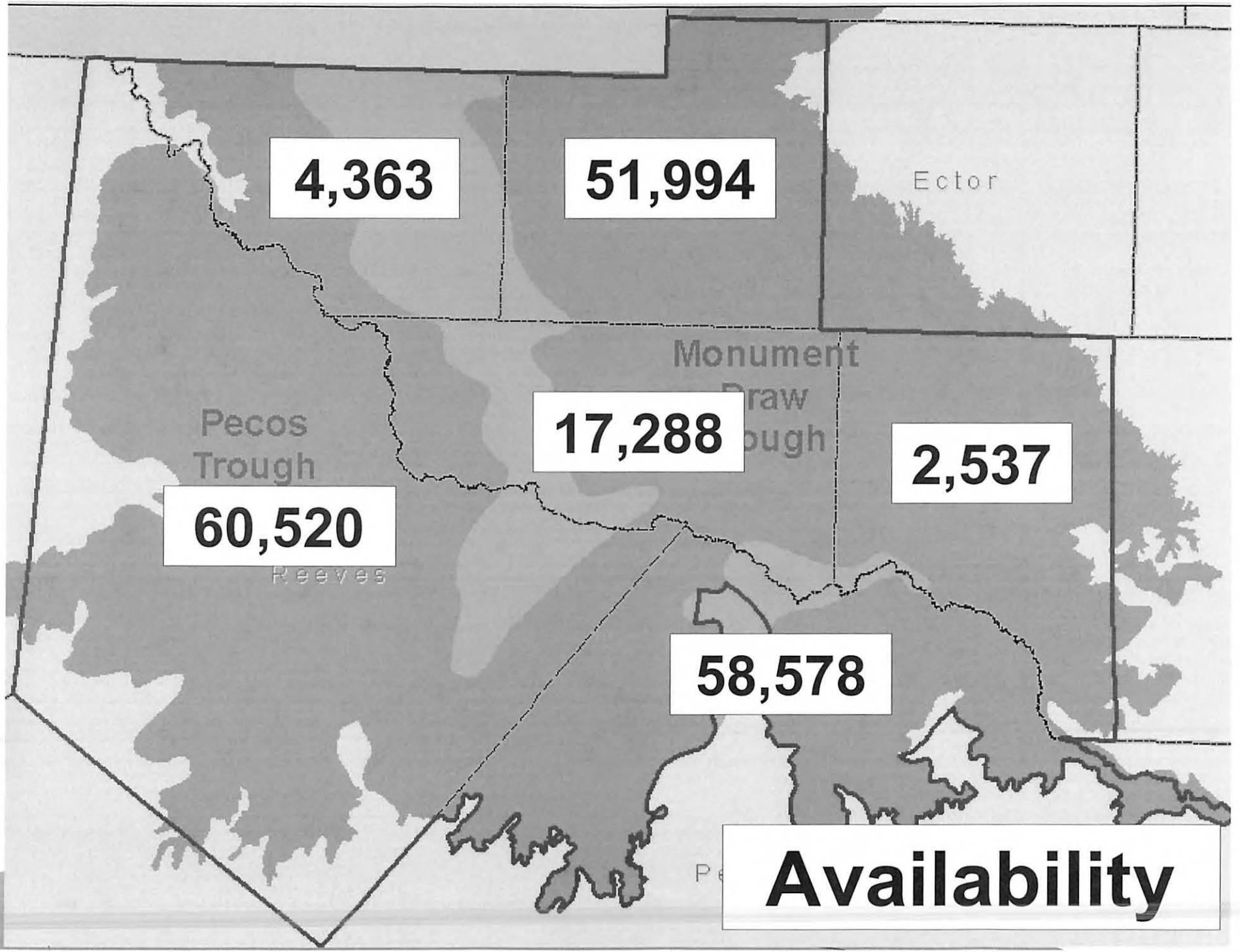

Loving
Winkler
Ector
A'
Monument
Draw
Trough
Pecos
Trough
Ward
Crane
Reeves
A
Pecos


A
A'
4000
3500
3000
2500
2000
1500
ELEVATION (FEET)
UNDIFFERENTIATED CRETACEOUS ROCKS
PECOS TROUGH
MONUMENT DRAW TROUGH
DOCKUM
UNDIFFERENTIATED TRIASSIC ROCKS
EXPLANATION
< 1,000 mg/L TDS
1,000 - 3,000 mg/L TDS
3,000 - 10,000 mg/L TDS
> 10,000 mg/L TDS


Loving
Winkler
Ector
53
274
Monument
Draw
Trough
525
148
Crane
Pecos
Trough
445
Reeves
126
Pecos
Wells

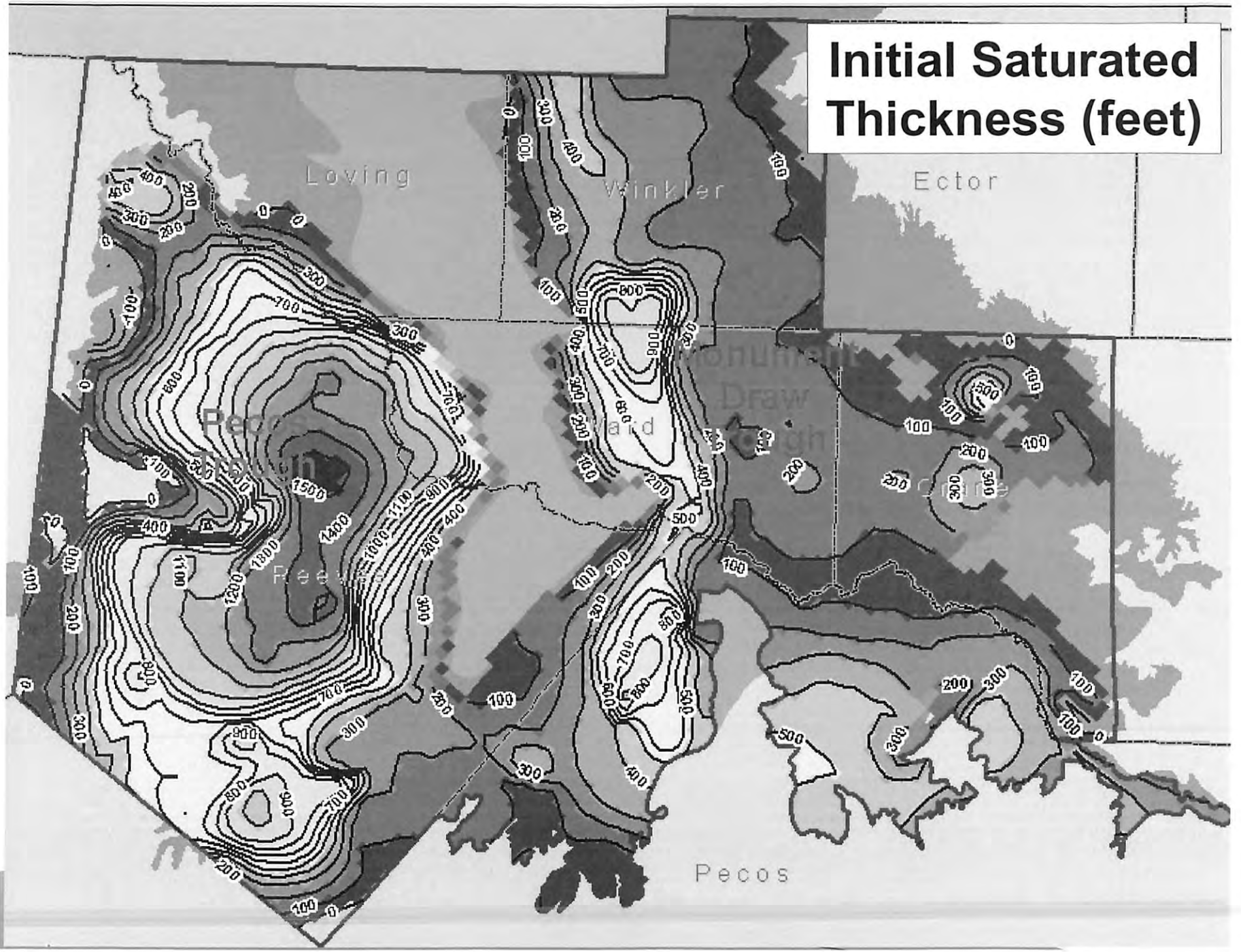

<100
500 - 3,000
Ector
Monument
15,000 - 20,000
Pecos
Trough
1,500 - 5,000
Crane
25,000 - 100,000
15,000 - 50,000
(per TWDB)
~100,000 (per MPGCD)
Historic Use


Livestock (municipal)
Municipal, mining, livestock
Ector
Monument
Pecos Trough
Municipal, steam-electric (industry, irrigation, mining, livestock)
Municipal, mining (livestock, irrigation)
Irrigation (municipal, industry, mining, livestock)
Irrigation (municipal, livestock, industrial)
Type of Use


4,363
51,994
Ector
Monument
Draw
Pecos
Trough
17,288
2,537
60,520
Reeves
58,578
Availability

Availability Estimates

- Crane County = 2,537 acre-feet/year (50% of recharge)
- Loving County = 4,363 acre-feet/year (recharge + 75% of recoverable storage depletion over 50 years)
- Pecos County = 58,578 acre-feet/year (recharge + 75% of recoverable storage depletion over 100 years)
- Reeves County = 60,520 acre-feet/year (recharge + 75% of recoverable storage depletion over 50 years)
- Ward County = 17,288 acre-feet/year (recharge + 75% of recoverable storage depletion over 50 years)
- Winkler County = 51,994 acre-feet/year (recharge + 75% of recoverable storage depletion over 50 years)


Initial Saturated Thickness (feet)
Loving
Winkler
Ector
Pecos

Recommendation

- Recommend that a GAM run be requested from the TWDB for the Pecos Valley Aquifer. Starting pumpage totals for each county should be the following:
  - Crane - 5,000 acre-feet/year
  - Loving - 3,000 acre-feet/year
  - Pecos - 100,000 acre-feet/year
  - Reeves - 125,000 acre-feet/year
  - Ward - 50,000 acre-feet/year
  - Winkler - 50,000 acre-feet/year

Section 14
Draft GAM Model #09-035 v2

Draft GAM Run 09-035 (version 2)

by William R. Hutchison, Ph.D, P.E., P.G.
Texas Water Development Board
Groundwater Resources Division
(512) 463-5067
August 7, 2010

This document is released for the purpose of interim review under the authority of William R. Hutchison, P.E. 96287, P.G. 286 on August 7, 2010

EXECUTIVE SUMMARY:

Eleven simulations of groundwater pumping were run using the modified and recalibrated groundwater availability model of the Edwards-Trinity (Plateau) and Pecos Valley aquifers. Scenario 1 represents pumping that is consistent with the requested pumping by the groundwater conservation districts in both Groundwater Management Areas 3 and 7. Scenario 2 represents an increase of ten percent in pumping in each county of Groundwater Management Area 7 as compared to Scenario 1. Scenarios 3, 4 and 5 represent 20, 30, and 40 percent pumping increases in each county in Groundwater Management Area 7 as compared to Scenario 1, respectively. The results from Scenario 1 to 5 were summarized and distributed at the July 29, 2010 meeting of Groundwater Management Area 7. At the meeting, representatives of the groundwater conservation districts provided updates to their requested pumping on a county by county basis, pumping was adjusted in the model, and the results discussed. Scenarios 6 to 10 were run during the meeting, and were based on input from the groundwater conservation districts.

In Groundwater Management Area 7, the average drawdown in Scenario 1 is 6 feet. Scenarios 2 to 5 (run prior to the July 29 meeting of Groundwater Management Area 7) resulted in a foot of additional drawdown for each ten percent increase in pumping. Scenarios 6 to 10 resulted in average drawdown of seven feet in Groundwater Management Area 7.

Subsequent to the Groundwater Management Area 7 meeting, representative of interested parties in Groundwater Management Area 3 reviewed the model calibration and the model runs, including the first draft version of this report. As a result of that review and subsequent conversations, Scenario 11 was run for use in the establishing desired future conditions in Groundwater Management Area 3. Average drawdown in Groundwater Management Area 3 in Scenario 11 is estimated to be 28 feet.

REQUESTOR:

Ms Caroline Runge, General Manager of the Menard County Underground Water Conservation District, on behalf of Groundwater Management Area 7 requested a series of runs that involved running the groundwater availability model for the Edwards-Trinity (Plateau) and Pecos Valley aquifers under a variety of pumping scenarios to estimate drawdown in each county in Groundwater Management Area 7. As a result of limitations with the existing groundwater availability model, the existing model was modified and recalibrated subsequent to the initial requests.

During the work associated with the modification and recalibration, presentations to the groundwater conservation districts in Groundwater Management Area 7 were made at the April, May and June meetings of Groundwater Management Area 7. As a result of those presentations, the scope of the request runs was simplified. Prior to the July 29, 2010 meeting of Groundwater Management Area 7, a summary table with the results of one

simulation were transmitted to the groundwater conservation districts in Groundwater Management Area 7.

On the basis of the results of the initial simulation, Mr. Scott Holland and Mr. Allan Lange requested additional scenarios. At the July 29, 2010 meeting of Groundwater Management Area 7, the results of five scenarios were presented. During the meeting, an additional five scenarios were run based on input from the groundwater conservation districts. This report summarizes the results of the ten scenarios.

Because the modified and recalibrated model also covers all of Groundwater Management Area 3, the model runs also provide results that can be used in the consideration of desired future condition adoption in Groundwater Management Area 3. The initial requests for Groundwater Management Area 3 were developed through public meetings held by the Middle Pecos Groundwater Conservation District (the only groundwater conservation district in Groundwater Management Area 3) in May and June of 2010.

Subsequent to the Groundwater Management Area 7 meeting, representative of interested parties in Groundwater Management Area 3 reviewed the model calibration and the model runs, including the first draft version of this report. As a result of that review and subsequent conversations, Scenario 11 was run for use in the establishing desired future conditions in Groundwater Management Area 3.

DESCRIPTION OF REQUEST:

Eleven simulations of groundwater pumping were run using the modified and recalibrated groundwater availability model of the Edwards-Trinity (Plateau) and Pecos Valley Alluvium aquifers. Each scenario was completed under the assumption of average groundwater recharge conditions. Scenarios 1 to 5 were run prior to the July 29, 2010 meeting of Groundwater Management Area 7. Scenarios 6 to 10 were run during the meeting, and were based on input from the groundwater conservation districts. The objective of running the model at the meeting was to provide an opportunity for the groundwater conservation districts to evaluate the effects of changes in pumping on their own district and neighboring districts and facilitate communication among the districts on these impacts. Scenario 11 was run as a result of discussions with interested parties in Groundwater Management Area 3.

A county-by-county summary of pumping for the Groundwater Management Area 7 portion of the model area is presented in Table 1. Please note that pumping in Pecos County in Table 1 represents pumping for the entire county, even though part of Pecos County is located in Groundwater Management Area 3. Pumping in the rest of Groundwater Management Area 3 did not change in these ten scenarios, and is summarized in Table 2. Pumping in Winkler County for Scenarios 1 to 10 was 50,000 acre-feet per year for Scenarios 1 to 10, and 40,000 acre-feet per year in Scenario 11.

Table 1. Summary of pumping in GMA 7 counties.
Note that Pecos County pumping includes all pumping in GMA 3 and GMA 7

County	Pumping (AF/yr)									
	1	2	3	4	5	6	7	8	9	10
Coke	300	330	360	390	420	300	1,000	1,000	1,000	1,000
Concho	350	385	420	455	490	490	490	490	490	490
Crockett	5,475	6,023	6,570	7,118	7,665	5,475	5,475	5,475	5,475	5,475
Ector	5,534	6,087	6,641	7,194	7,748	5,534	5,534	5,534	5,534	5,534
Edwards	7,782	8,560	9,338	10,117	10,895	4,000	4,000	4,000	5,659	5,659
Gillespie	5,000	5,500	6,000	6,500	7,000	5,000	5,000	5,000	5,000	5,000
Glasscock	59,252	65,177	71,102	77,028	82,953	59,252	59,252	65,177	65,177	65,177
Irion	2,300	2,530	2,760	2,990	3,220	2,300	2,300	2,300	2,300	2,300
Kimble	1,000	1,100	1,200	1,300	1,400	1,400	1,400	1,400	1,400	1,400
Kinney	65,000	71,500	78,000	84,500	91,000	65,000	65,000	65,000	65,000	65,000
McCulloch	150	165	180	195	210	150	150	150	150	150
Mason	20	22	24	26	28	20	20	20	20	20
Menard	1,843	2,027	2,212	2,396	2,580	2,580	2,580	2,580	2,580	2,580
Midland	21,130	23,243	25,356	27,469	29,582	21,130	21,130	23,243	23,243	23,243
Nolan	500	550	600	650	700	700	700	700	700	700
Pecos	220,000	242,000	264,000	286,000	308,000	240,000	240,000	240,000	240,000	240,000
Reagan	62,039	68,243	74,447	80,651	86,855	62,039	62,039	68,243	68,243	68,243
Real	11,468	12,615	13,762	14,908	16,055	4,000	4,000	4,000	7,533	7,533
Schelicher	6,200	6,820	7,440	8,060	8,680	8,060	8,680	8,680	8,680	8,060
Sterling	2,500	2,750	3,000	3,250	3,500	2,500	2,500	2,500	2,500	2,500
Sutton	4,000	4,400	4,800	5,200	5,600	6,450	6,450	6,450	6,450	6,450
Taylor	350	385	420	455	490	490	490	490	490	490
Terrell	1,031	1,134	1,237	1,340	1,443	1,443	1,443	1,443	1,443	1,443
TomGreen	2,000	2,200	2,400	2,600	2,800	2,800	2,800	2,800	2,800	2,800
Upton	20,341	22,375	24,409	26,443	28,477	20,341	20,341	22,375	22,375	22,375
Uvalde	2,000	2,200	2,400	2,600	2,800	2,000	2,000	2,000	2,000	2,000
ValVerde	25,000	27,500	30,000	32,500	35,000	25,000	25,000	25,000	25,000	25,000

Table 2. Simulated pumping in Groundwater Management Area (GMA) 3 counties (except for Pecos County) for all ten scenarios.

GMA 3 counties	Simulated pumping (AF/yr) Scenarios 1 to 10	Simulated pumping (AF/yr) Scenario 11
Crane	5,000	5,000
Loving	3,000	3,000
Reeves	190,000	190,000
Ward	50,000	50,000
Winkler	50,000	40,000

Pumping in counties outside of Groundwater Management Area 3 and Groundwater Management Area 7 did not change in these ten scenarios, and is summarized in Table 3.

Table 3. Simulated pumping in counties outside of Groundwater Management Area 3 and Groundwater Management Area 7 for all eleven scenarios.

Counties outside of GMA 3 and GMA 7	Simulated pumping (AF/yr)
Andrews	1,200
Bandera	2,600
Bexar	11,000
Blanco	744
Brewster	1,200
Burnet	700
Comal	3,058
Culberson	37
Hays	7,000
Howard	700
Jeff Davis	140
Kendall	4,500
Kerr	6,000
Martin	250
Medina	1,843
Travis	3,000
Outside of Texas	20

METHODS:

Scenarios 1 to 10 were developed in response to various model run requests by the groundwater conservation districts in Groundwater Management Area 7 as later modified in discussions during Groundwater Management Area 7 meetings in April, May and June 2010. These requests revolved around certain county by county future pumping scenarios and general management goals regarding the amount of drawdown in various portions of Groundwater Management Area 7. In summary, relatively high drawdown was anticipated in the western portion of Groundwater Management Area 7, and essentially no drawdown was anticipated in the eastern portion of Groundwater Management Area 7 in order to maintain groundwater discharge to surface water.

Scenario 1 represents pumping that is consistent with the requested pumping by the groundwater conservation districts in both Groundwater Management Areas 3 and 7. Scenario 2 represents an increase of ten percent in pumping for each county located in Groundwater Management Area 7 as compared to Scenario 1. Scenarios 3, 4 and 5 represent 20, 30, and 40 percent pumping increases in each county in Groundwater Management Area 7 as compared to Scenario 1, respectively. The results from Scenario 1 to 5 were summarized and distributed at the July 29, 2010 meeting of Groundwater Management Area 7. At the meeting, representatives of the groundwater conservation districts provided updates to their requested pumping on a county by county basis, pumping was adjusted in the model, and the results discussed. Scenarios 6 to 10 were run during the meeting, and were based on input from the groundwater conservation districts.

Scenario 11 was developed after discussions with Mr. Neil Blandford of Daniel B. Stephens & Associates, Inc., representing the Colorado River Municipal Water District. Mr. Blandford had reviewed the model subsequent to the July 29, 2010 Groundwater Management Area 7 meeting, and reviewed the first draft of this report. Mr. Blandford expressed concerns regarding the specific storage parameter in Crane, Ward, and Winkler counties. He had prepared hydrographs that demonstrated the sensitivity of this parameter to drawdown in these counties.

As a result of Mr. Blandford's comments, a detailed sensitivity analysis was completed on specific storage in those counties. Increases in specific storage up to ten times the values specified in the model used in Scenarios 1 to 10 in Crane, Ward, and Winkler counties resulted in some minor changes to the model calibration statistics. Although increasing specific storage generally resulted in a worse calibration based on the statistics, they were generally deemed insignificant. However, analysis of hydrographs based on the results of the sensitivity analysis suggested that drawdown in some wells was better simulated when specific storage was slightly increaased as compared to the model used in Scenarios 1 to 10. The resulting changes in specific storage are summarized below in terms of storativity (specific storage times saturated thickness).

County	Average storativity used in Scenarios 1 to 10 (dimensionless)	Average storativity used in Scenario 11 (dimensionless)
Crane	0.00234	0.01420
Ward	0.01359	0.05919
Winkler	0.00669	0.03254

Because field data on specific storage (or storativity) is sparse, all the values listed above are considered reasonable given the uncertainty in this parameter. Because the historic pumping in these counties is substantially less than that requested in the predictive runs, the increased pumping will undoubtedly cause substantial drawdown in these area. However, there is considerable uncertainty associated with estimating the drawdown as evidenced by the sensitivity analysis which demonstrated that small changes in storativity can result in differences in drawdown in the tens of feet.

Scenario 11 was run with the alternative specific storage values listed above as input into the process of establishing desired future conditions in Groundwater Management Area 3. These changes did not affect the results of adjacent areas of Groundwater Management Area 7.

PARAMETERS AND ASSUMPTIONS:

- The recently modified and calibrated groundwater flow model of the Edwards Trinity (Plateau) and Pecos Valley aquifers (Hutchison and Jones, 2010) was used for these simulations. The model was calibrated based on groundwater elevation data from 1930 to 2005. Scenarios 1 to 10 used the calibrated model. As discussed above, specific storage values were modified in Crane, Ward, and Winkler counties for Scenario 11.

- The model has one layer which represents the Pecos Valley Aquifer in the northwest portion of the model area, the Edwards-Trinity (Plateau) Aquifer in the southeast portion of the model area, and a lumped representation of both aquifers in the relatively narrow area where the Pecos Valley Aquifer overlies the Edwards-Trinity (Plateau) Aquifer.

- As further detailed in the model report (Hutchison and Jones, 2010), model calibration statistics for the entire model domain for groundwater elevation is summarized below. Note that the calibrated model statistics are presented as well as the statistics for the modified model used in Scenario 11.

Statistic	Calibrated Model Used in Scenarios 1 to 10	Modified Model Used in Scenario 11
Average residual	-1.3 feet	-2.9 feet
Standard deviation	70 feet	70 feet
Range of measurements	3058 feet	3058 feet
Standard deviation divided by range	0.02	0.02

- Eleven different pumping scenarios were used as described above
- Each simulation consisted of 55 annual stress periods. Pumping for the first five stress periods (2006 to 2010) was set equal to pumping estimated during model calibration for 2005. Pumping in stress periods 6 to 55 (2011 to 2060) was set equal to the values previously presented in Tables 1, 2 and 3, based on the scenario.
- Drawdown was calculated based on the difference between an initial condition at the end of 2010 (stress period 5) and the end of stress period 55 (2060).
- Recharge in each stress period was assumed to be equal to average recharge during the calibration period (1930 to 2005).
- Other model inputs were based on average recharge conditions, and did not vary during the simulations.
- The model was run with MODFLOW-2000 (Harbaugh and others, 2000).

RESULTS:

Groundwater Management Area 7 Results

Estimated drawdown in 2060 for the ten scenarios on a county basis is presented in Table 4. Note that the drawdown estimate for Pecos County is limited to the portion of Pecos County that is in Groundwater Management Area 7. Also listed is the average drawdown for each scenario averaged over all of Groundwater Management Area 7. Note that the average drawdown in Scenario 1 is 6 feet. Scenarios 2 to 5 (run prior to the July 29 meeting of Groundwater Management Area 7) resulted in a foot of additional drawdown for each ten percent increase in pumping. Scenarios 6 to 10 resulted in average drawdown of seven feet, and the differences between scenarios can be seen in individual county drawdown estimates due to changes in pumping in individual counties.

Table 4. Estimated drawdown in feet from 2010 conditions for ten scenarios. Groundwater Management Area 7

County	Drawdown in 2060 (ft)									
	1	2	3	4	5	6	7	8	9	10
Coke	0	0	0	0	0	0	0	0	0	0
Concho	0	0	0	0	0	0	0	0	0	0
Crockett	8	9	10	12	13	8	9	9	9	9
Ector	7	7	7	8	8	7	7	7	7	7
Edwards	2	2	3	3	3	1	1	1	2	2
Gillespie	5	5	6	6	6	5	5	5	5	5
Glasscock	31	34	38	42	45	31	31	34	34	34
Irion	8	9	11	12	14	8	9	10	10	10
Kimble	1	1	1	1	1	1	1	1	1	1
Kinney	0	1	1	1	1	0	0	0	0	0
McCulloch	0	0	0	0	0	0	0	0	0	0
Mason	0	0	0	0	0	0	0	0	0	0
Menard	0	1	1	1	1	1	1	1	1	1
Midland	9	10	10	11	12	9	9	10	10	10
Nolan	0	0	0	0	0	0	0	0	0	0
Pecos (GMA 7 portion)	9	11	12	14	15	11	11	11	11	11
Reagan	32	37	42	47	51	33	33	37	37	37
Real	6	7	8	9	10	1	1	1	4	4
Schelicher	6	7	8	9	10	7	7	8	8	8
Sterling	5	6	7	8	9	5	5	6	6	6
Sutton	5	6	7	7	8	6	6	6	6	6
Taylor	0	0	0	0	0	0	0	0	0	0
Terrell	2	2	3	3	3	2	2	2	2	2
TomGreen	2	2	2	3	3	2	2	2	2	2
Upton	12	13	15	16	18	12	12	13	13	13
Uvalde	3	4	4	5	5	1	1	1	2	2
ValVerde	1	1	1	2	2	1	1	1	1	1
GMA 7 Average	6	7	8	9	10	7	7	7	7	7

Groundwater Management Area 3 Results

Estimated drawdown in 2060 for the counties in Groundwater Management Area 3 for Scenario 11 is presented in Table 5. Please note that the overall average drawdown in Groundwater Management Area 3 shown in Table 5 only includes the Groundwater Management Area 3 portion of Pecos County.

Table 5. Estimated drawdown in Groundwater Management Area (GMA) 3 based on Scenario 11

County	Drawdown in 2060 (feet)
Crane	50
Loving	5
Pecos (GMA 3 portion only)	12
Reeves	6
Ward	56
Winkler	113
GMA 3 Average	**28**

REFERENCES:

Harbaugh, A.W., Banta, E.R., Hill, M.C., and McDonald, M.G., 2000, MODFLOW-2000, The U.S. Geological Survey modular ground-water model-user guide to modularization concepts and the ground-water flow process: U.S. Geological Survey Open-File Report 00-92, 121 p.

Hutchison, William R., and Jones, Ian, 2010 (in preparation). Evaluation of Groundwater Flow in Groundwater Management Areas 3 and 7 Using a MODFLOW-2000 Model. Texas Water Development Board Unpublished Report.

Section 15
Model Runs for
E/T, P/V and Dockum

Groundwater Model Runs: Edwards-Trinity (Plateau) and Pecos Valley Aquifers; Dockum Aquifer

Bill Hutchison, Ph.D., P.E., P.G.
Director, Groundwater Resources
Texas Water Development Board

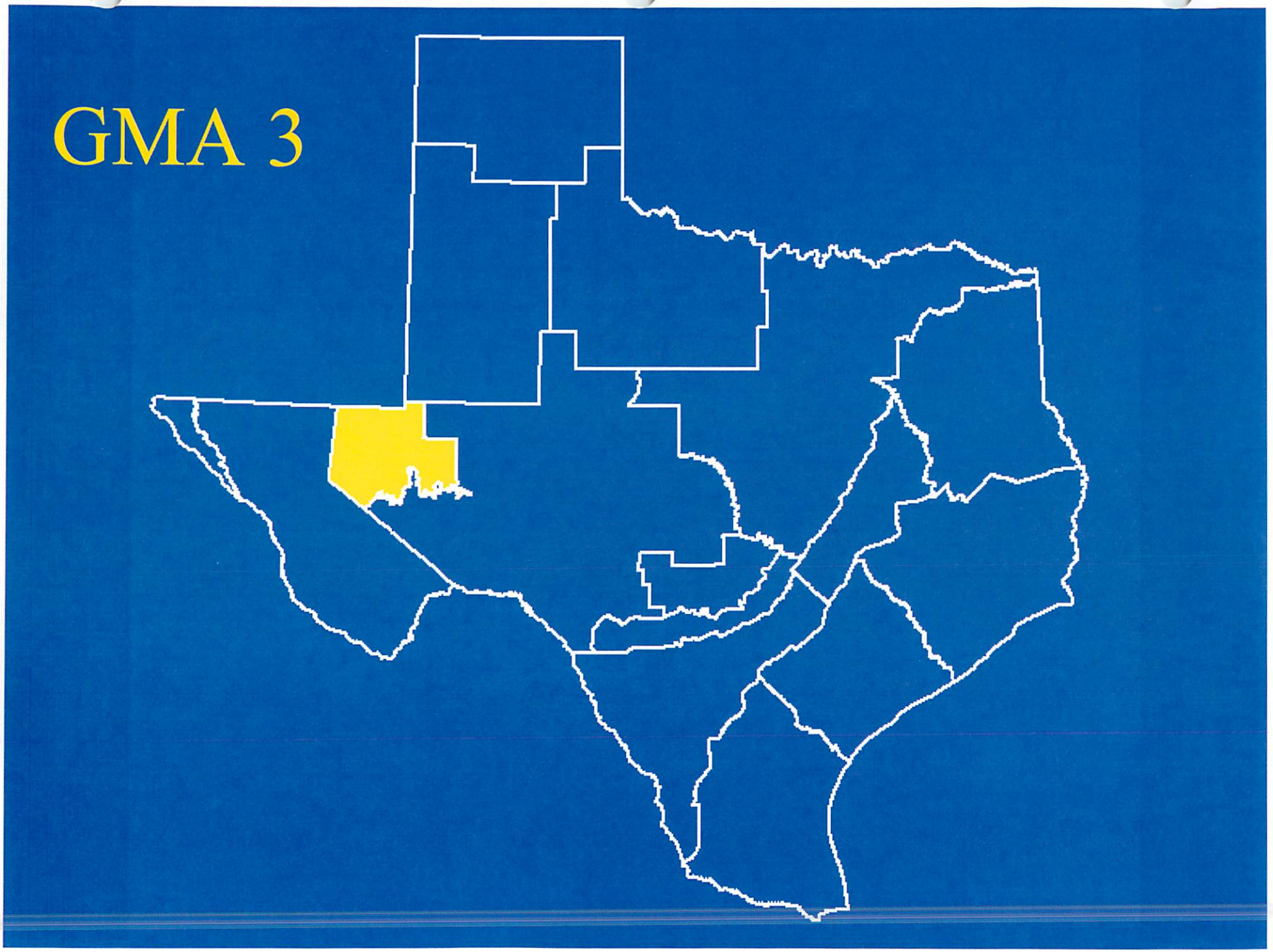
GMA 3 Meeting
August 9, 2010

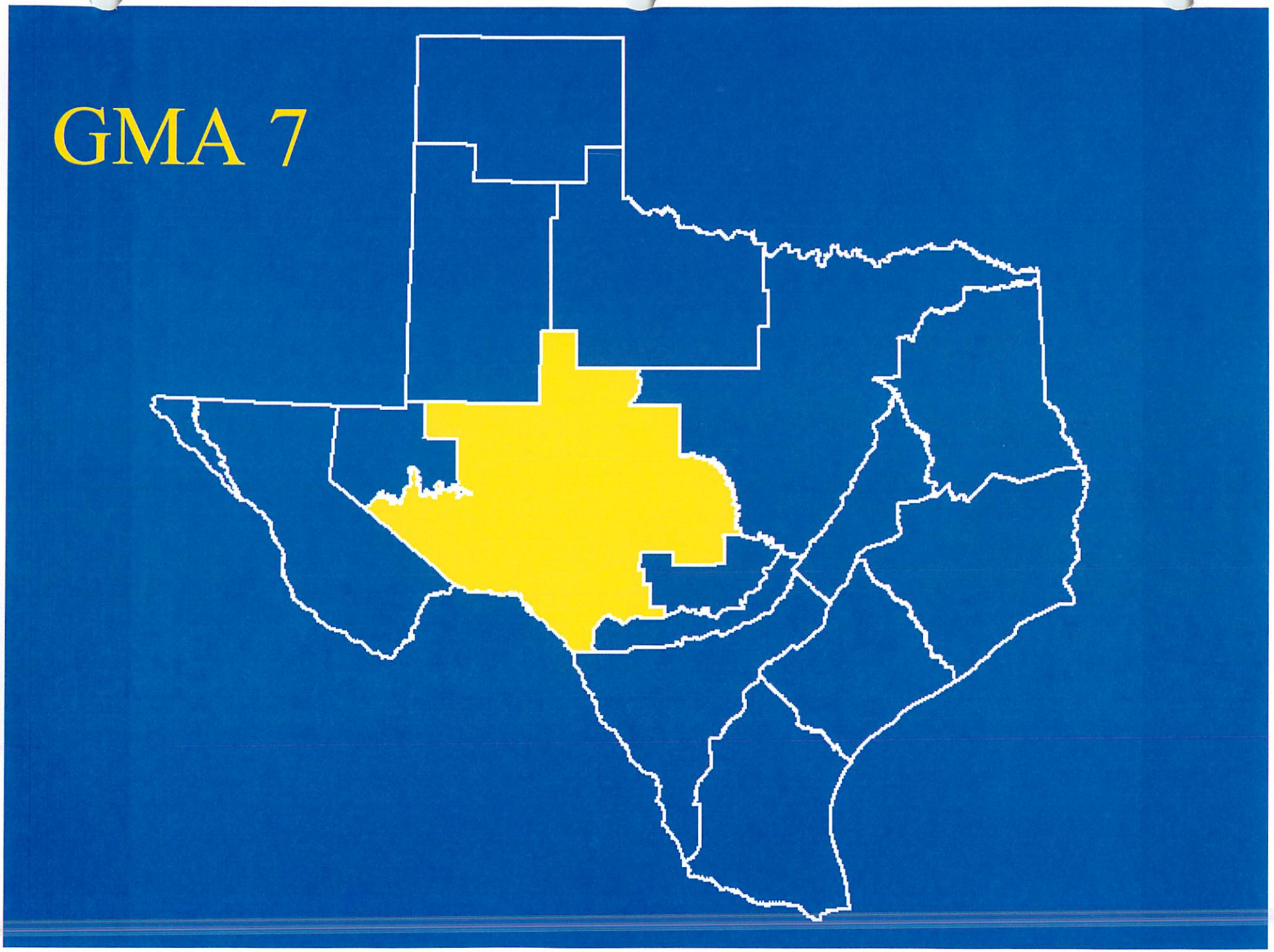
Edwards Trinity (Plateau) and Pecos Valley Groundwater Model

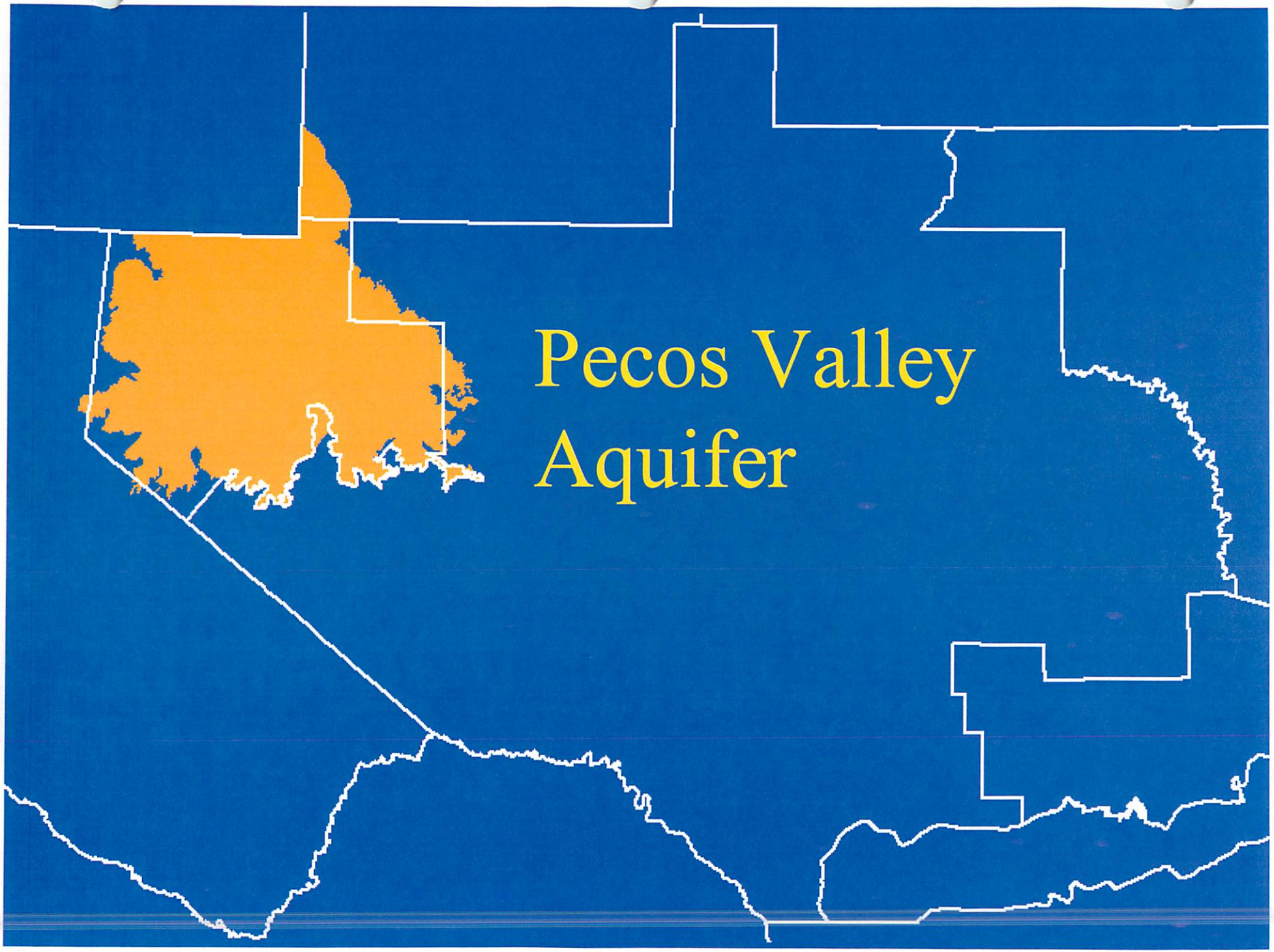
- Revisions to model
- Ten Scenarios for GMA 7
- Scenario 11 for GMA 3

Model History

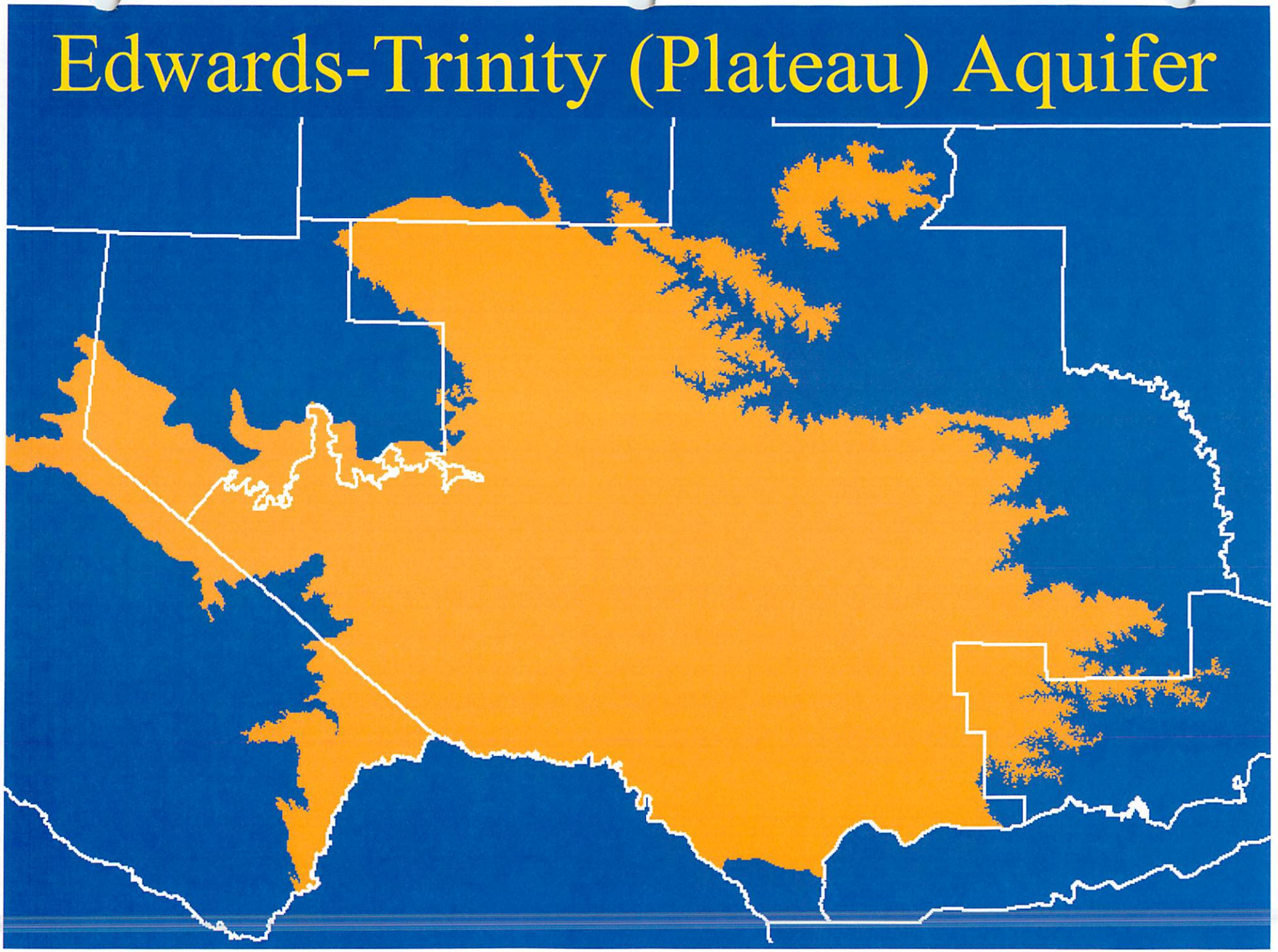
- Version 1 – Two-layer model
- Version 2 – Recalibration of Version 1
- Version 3
  - One layer model
  - Updated/corrected historic pumping


GMA 3


GMA 7


Pecos Valley
Aquifer

Edwards-Trinity (Plateau) Aquifer

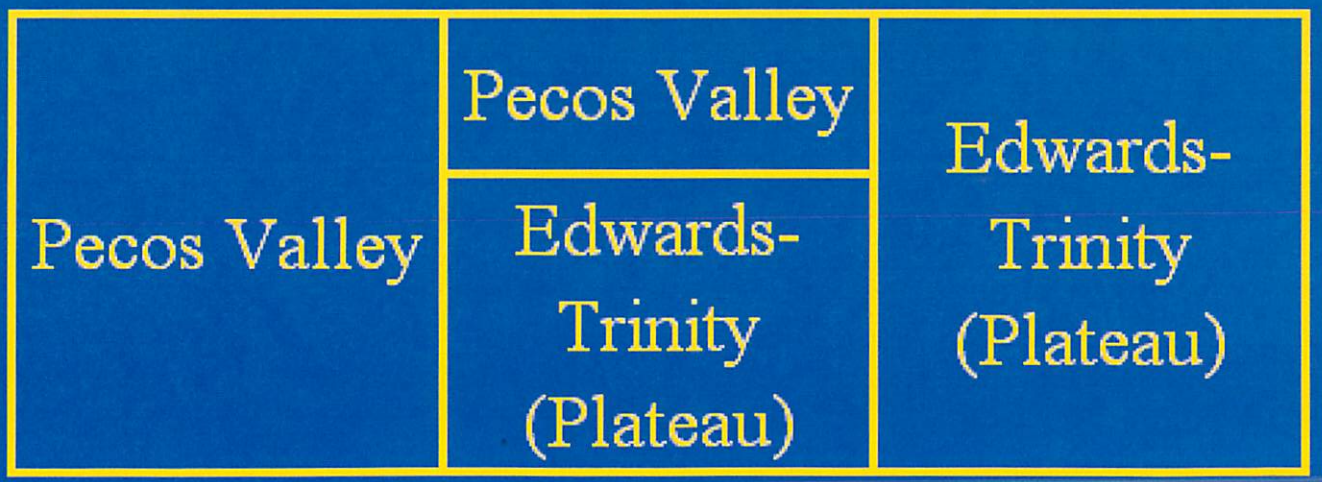


Conceptual Cross-Section

Northwest → Southeast

Pecos Valley

Edward-Trinity (Plateau)



Calibration Issues

- Versions 1&2 – 1980 to 2000 calibration period
  - Highest pumping occurred before 1980

Calibration Data

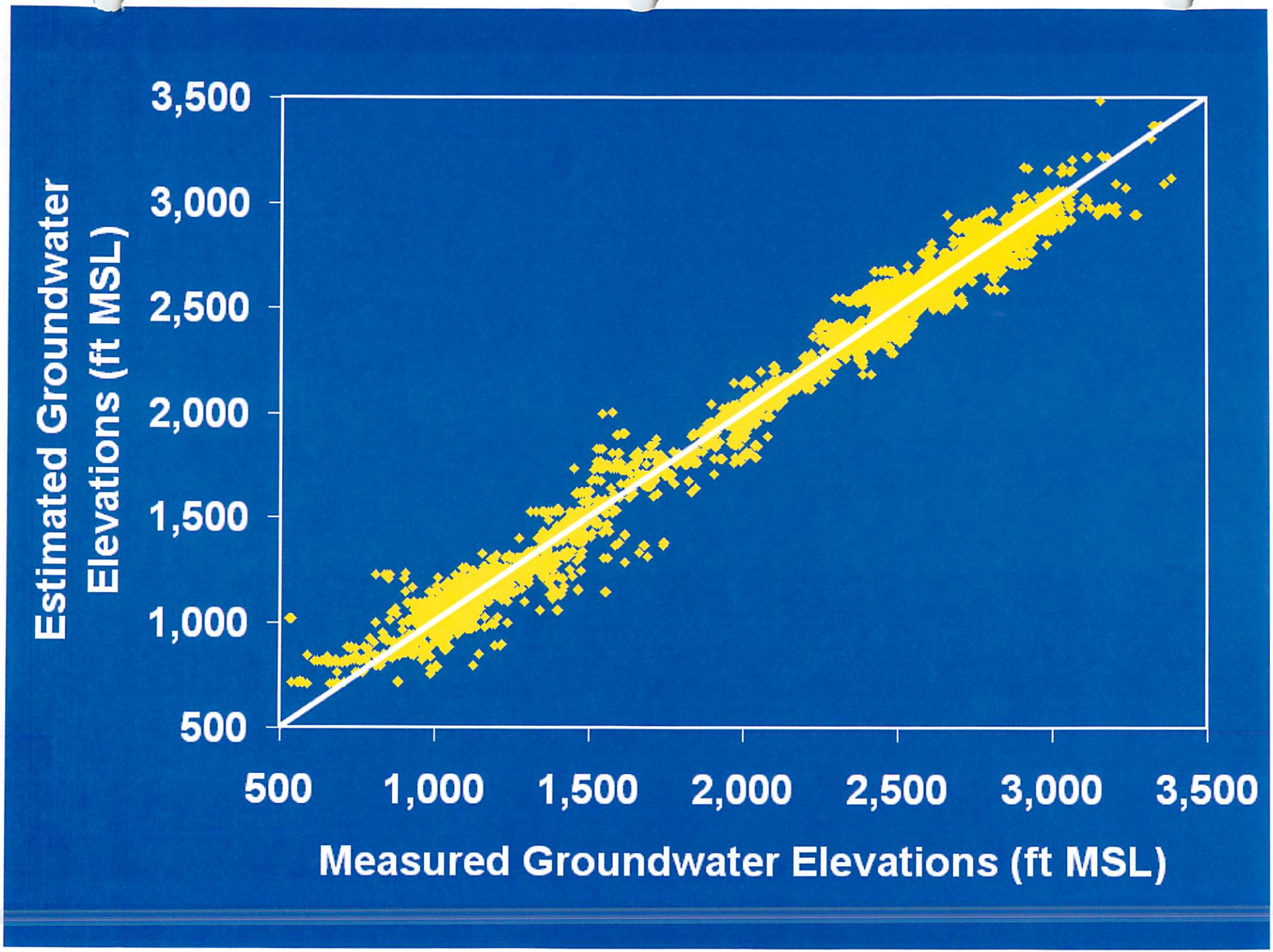
- Version 1
  - 677 groundwater elevation measurements
- Version 2
  - 4,751 groundwater elevation measurements
  - Includes “non-winter” measurements

Key Features of Version 3

- Extended calibration period
  - 1931 to 2005
  - One initial steady state stress period
  - 75 transient stress periods (annual)
- Extends boundaries into Mexico and to Colorado River
  - 300 Rows
  - 400 Columns

One-Layer Model Calibration

- Calibrated
- 10,272 groundwater elevation measurements
  - Includes Texas, New Mexico and Mexico


Estimated Groundwater Elevations (ft MSL)
3,500
3,000
2,500
2,000
1,500
1,000
500
500
1,000
1,500
2,000
2,500
3,000
3,500
Measured Groundwater Elevations (ft MSL)

Calibration Statistics

Average Residual (ft)	-1.33
Average Absolute Residual (ft)	48.45
Sum of Squared Residuals	4.93E+07
Maximum Measured Head (ft)	3504
Minimum Measured Head (ft)	446
Range of Heads	3058
Standard Deviation of Residuals (ft)	70.33
Standard Deviation/Range	0.02

Simulations

- 2006 to 2010 (2005 pumping)
- 2011 to 2060 (predicted pumping)
- Single layer model so all drawdown estimates are lumped estimates (Pecos Valley and Edwards Trinity Plateau)

Scenarios 1 to 10

- Completed for GMA 7
- Scenario 1
  - Base case: requested pumping
- Scenarios 2 to 5
  - 10% to 40% pumping increase from base case
- Scenarios 6 to 10
  - County by county changes at GMA 7 meeting

GMA 7 Desired Future Condition

- Adopted GMA-wide average drawdown of 7 feet based on Scenario 10
- GMA 3 pumping held constant at request values for all ten scenarios

Model Review (GMA 3)

- Concerns raised regarding specific storage values in Crane, Ward and Winkler counties
- Completed sensitivity analysis
  - Increased specific storage up to 10x
  - Calibration not significantly affected
  - Drawdown match in some wells improved with slight increase

Comparison

Statistic	"Calibrated" Model	"Modified" Model
Average Residual (ft)	-1.33	-2.92
Average Absolute Residual (ft)	48.45	48.68
Sum of Squared Residuals	4.93E+07	4.95E+07
Maximum Measured Head (ft)	3,504	3,504
Minimum Measured Head (ft)	446	446
Range of Heads	3,058	3,058
Standard Deviation of Residuals (ft)	70.33	70.42
Standard Deviation/Range	0.02	0.02

Scenario 11

- Run at request of CRMWD consultants
  - Slight increase in specific storage in Crane, Ward and Winkler counties
  - Reduced pumping in Winkler County to 40,000 AF/yr

Storativity Values

County	Average storativity used in Scenarios 1 to 10 (dimensionless)	Average storativity used in Scenario 11 (dimensionless)
Crane	0.00234	0.01420
Ward	0.01359	0.05919
Winkler	0.00669	0.03254

GMA 3 Pumping

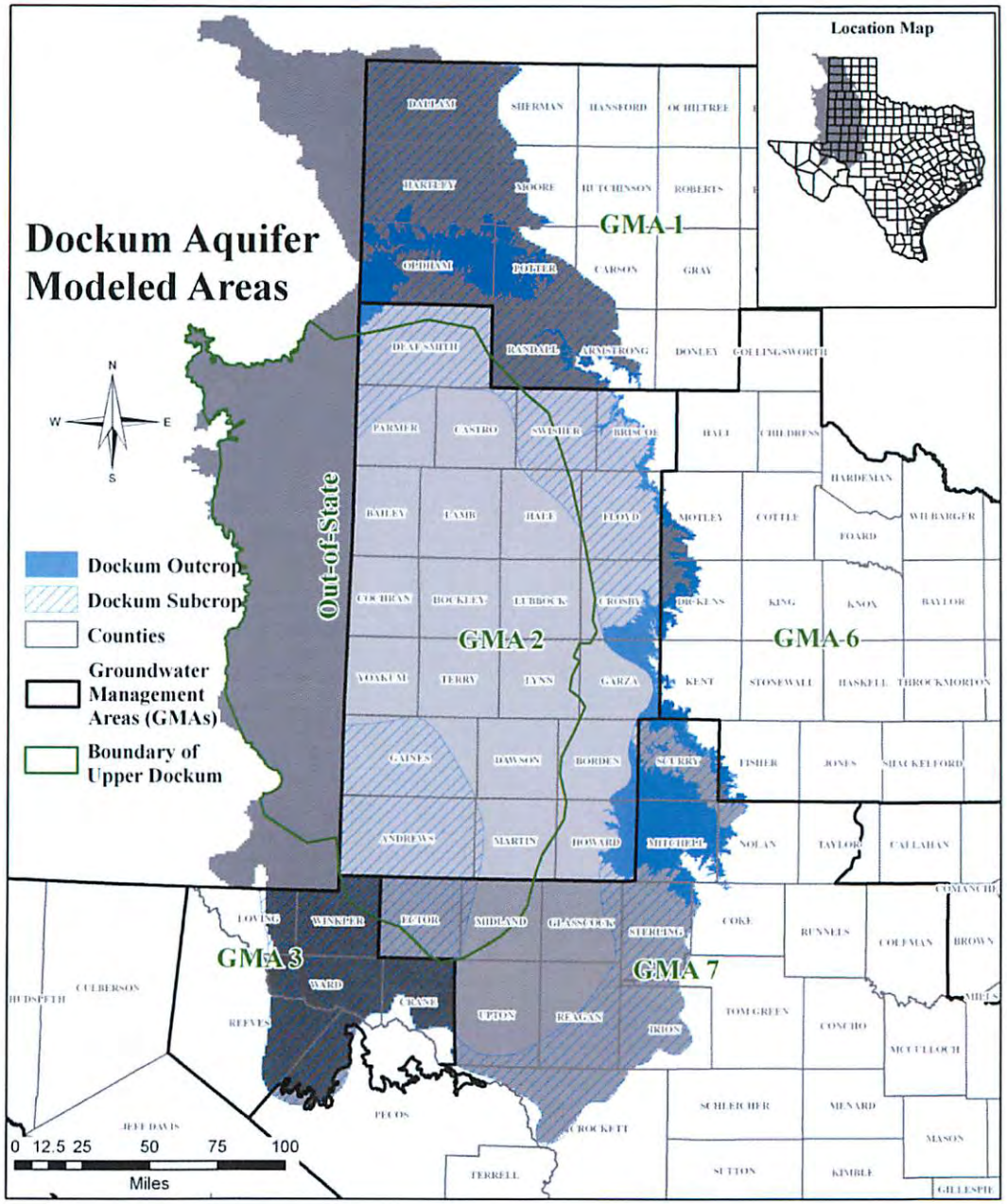
GMA 3 counties	Simulated pumping (AF/yr) Scenarios 1 to 10	Simulated pumping (AF/yr) Scenario 11
Crane	5,000	5,000
Loving	3,000	3,000
Reeves	190,000	190,000
Ward	50,000	50,000
Winkler	50,000	40,000

Scenario 11 Results (GMA 3)

County	Drawdown in 2060 (feet)
Crane	50
Loving	5
Pecos (GMA 3 portion only)	12
Reeves	6
Ward	56
Winkler	113
GMA 3 Average	**28**

Dockum Aquifer

- GAM Task 10-025
- Report for GMAs 2, 3, and 7
- Summary of GMA 3 portion


Location Map
Dockum Aquifer
Modeled Areas
N
W
E
S
Dockum Outcrop
Dockum Subcrop
Counties
Groundwater Management Areas (GMAs)
Boundary of Upper Dockum
Out-of-State
GMA-1
GMA-2
GMA-6
GMA 3
GMA 7
0 12.5 25 50 75 100
Miles

Pumping Request

- GMA 3 Total = 43,000 AF/yr
- 2007 SWP Availability = 17,558 AF/yr

County	Annual Pumping	Additional Well Field	Base Scenario Total
Crane	2,000		2,000
Loving	1,000		1,000
Pecos*	3,000	15,000	18,000
Reeves	5,000		5,000
Ward	7,000		7,000
Winkler	10,000		10,000

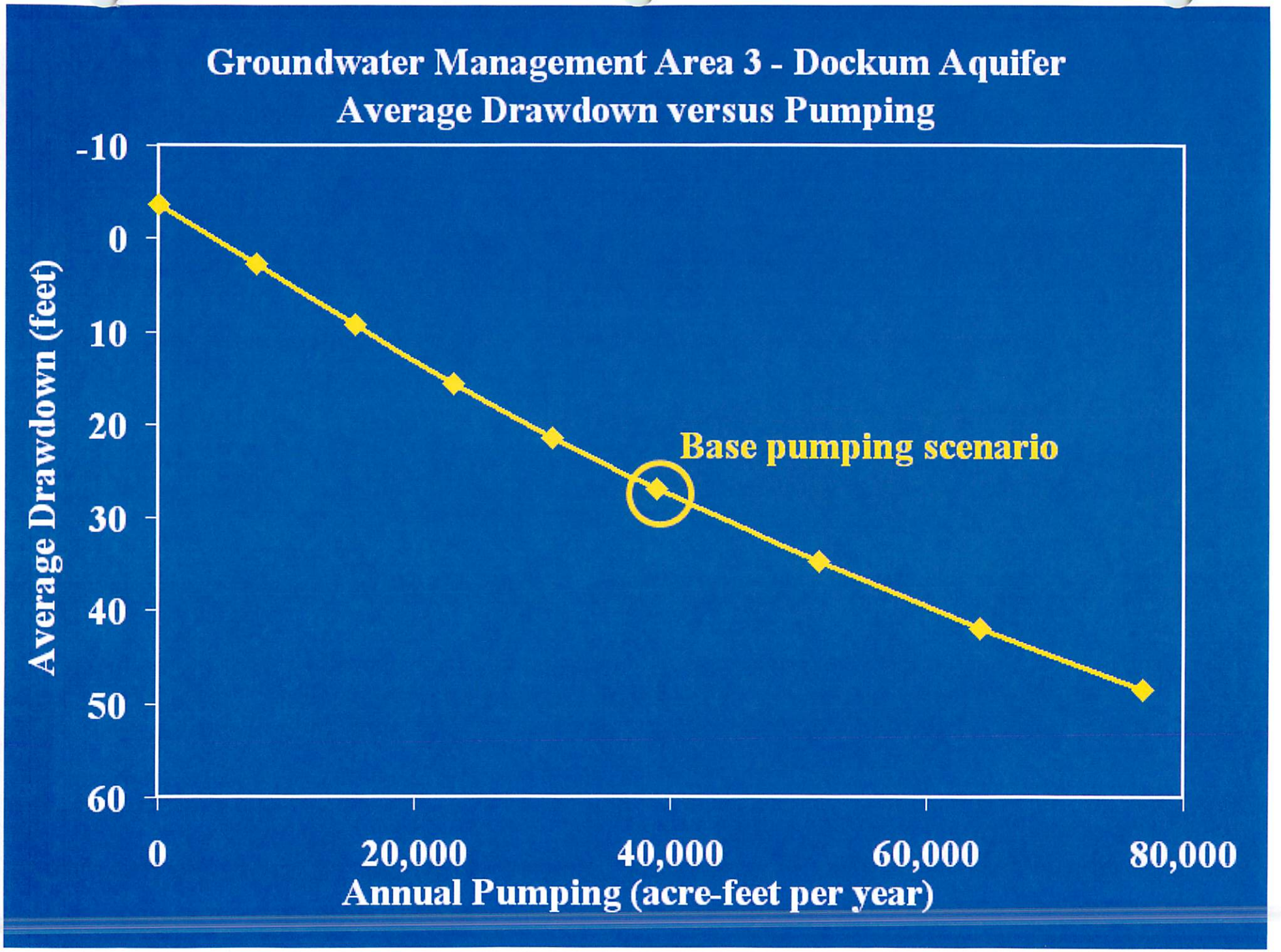
*Note that Pecos County pumping applies to the entire county, not just the portion within Groundwater Management Area 3.

Assumptions

- All pumping is in the lower portion of the Dockum Aquifer
- Ran 51 year simulation from 2010 through 2060

Base Case Results

County	Pumping (AF/yr)	Average Drawdown in 2060 (ft)
Crane	2,000	8
Loving	1,000	24
Pecos	18,000	47
Reeves	5,000	17
Ward	7,000	31
Winkler	10,000	32
GMA 3	43,000	27


Groundwater Management Area 3 - Dockum Aquifer
Average Drawdown versus Pumping
Average Drawdown (feet)
-10
0
10
20
30
40
50
60
Base pumping scenario
0
20,000
40,000
60,000
80,000
Annual Pumping (acre-feet per year)

Questions?

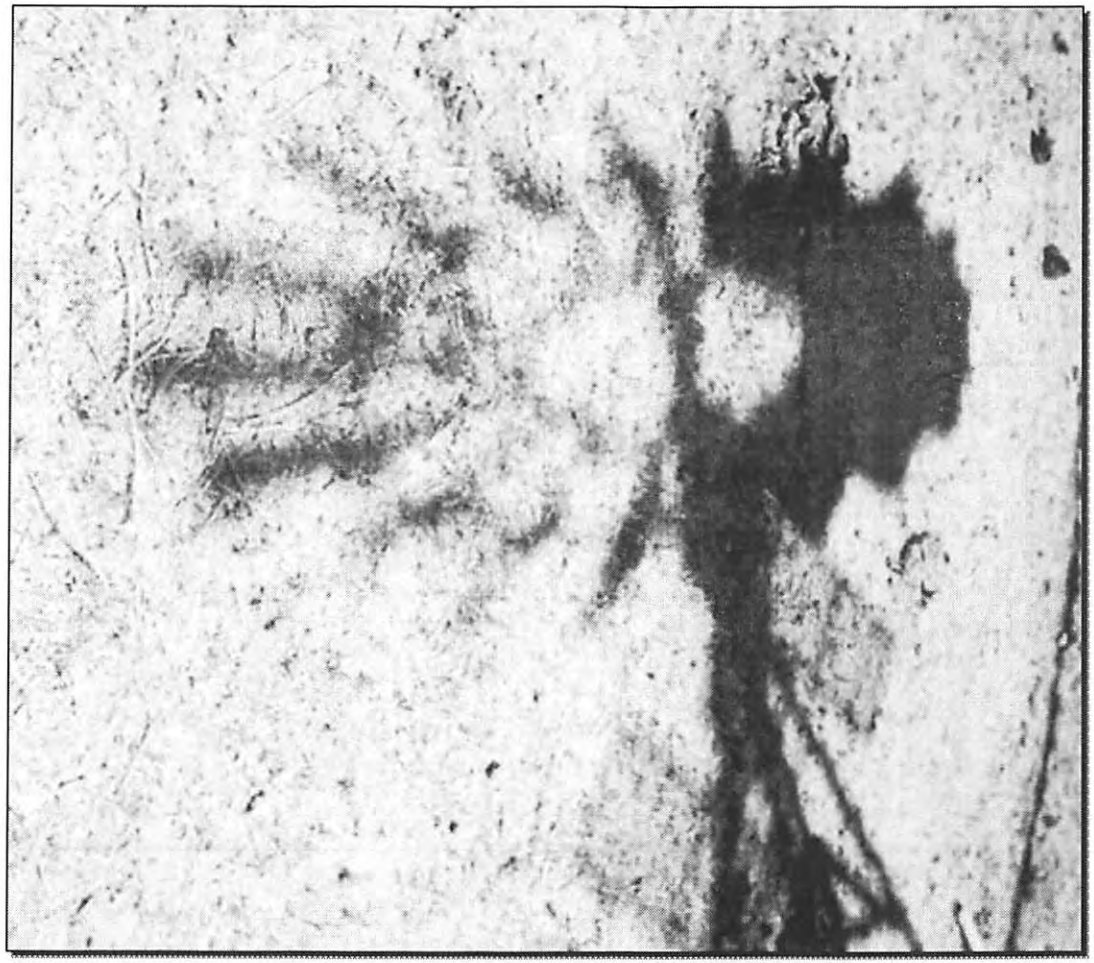
Bill Hutchison

512-463-5067

bill.hutchison@twdb.state.tx.us

Section 16
2-D Model Minor Aquifers

2-D Models for Minor Aquifer DFCs in GMA-3

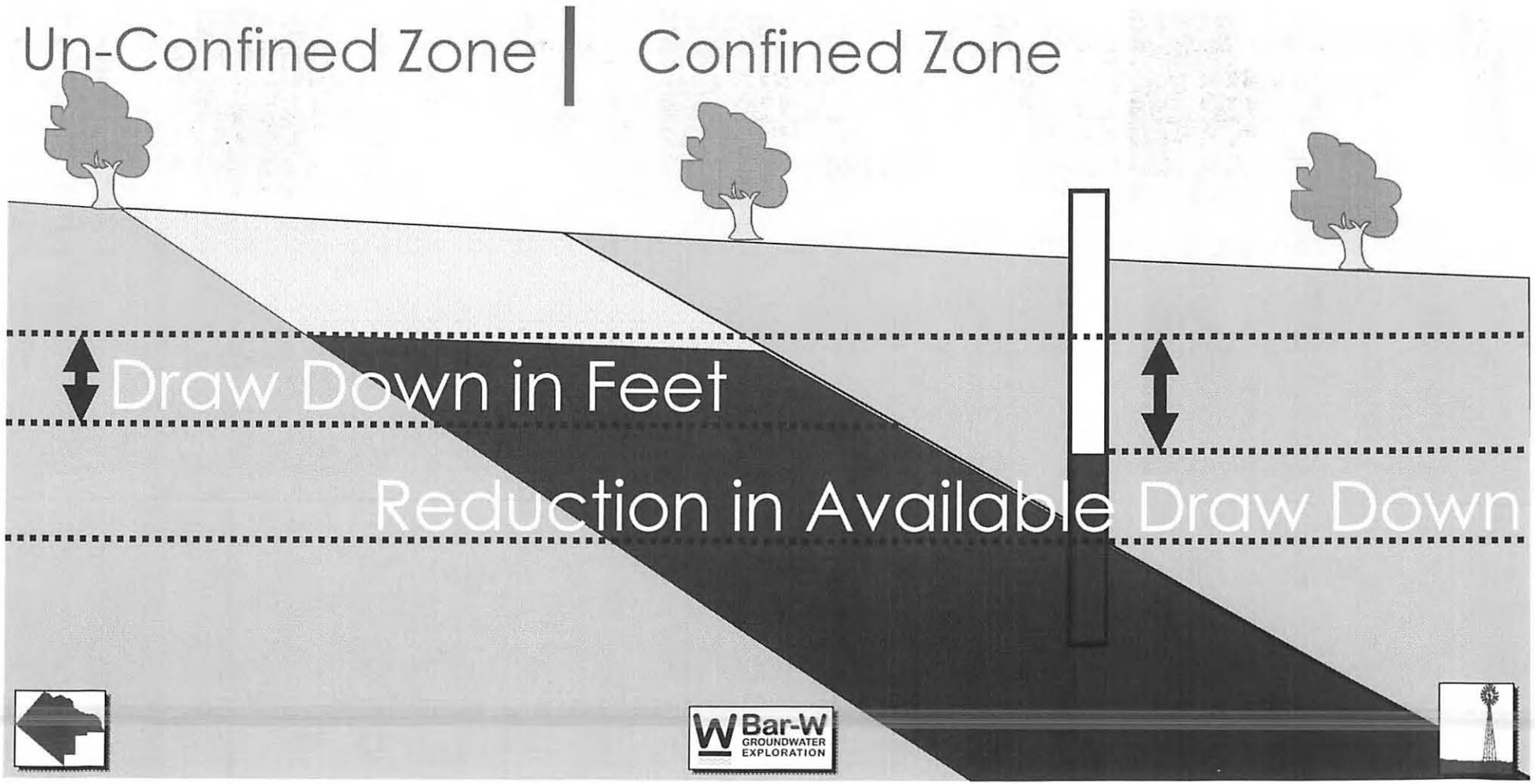


Charles R. (Randy) Williams, PG August 9, 2010

Bar-W GROUNDWATER EXPLORATION

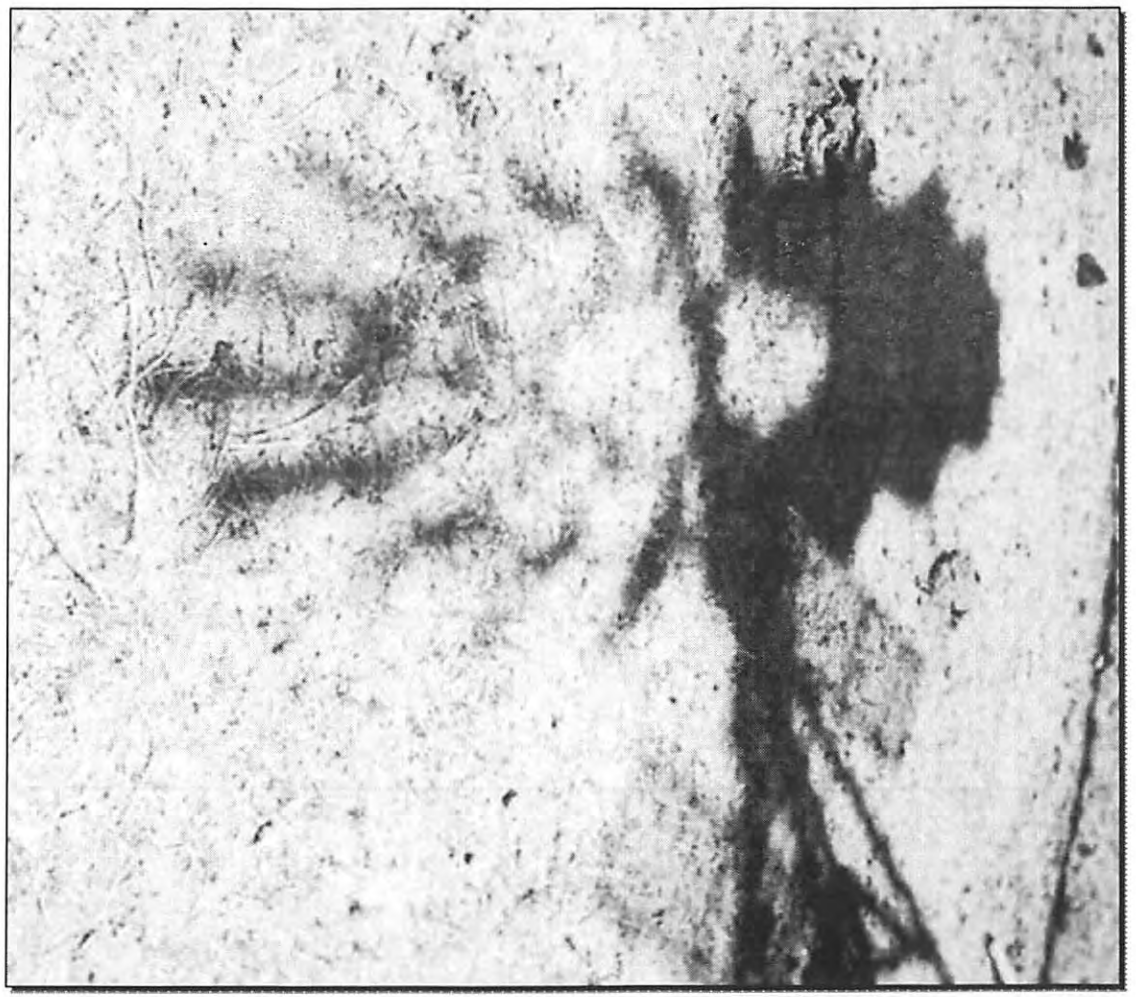
Aquifer DFCs from 2-D Models

Un-Confined & Confined aquifer



GMA-3 Minor Aquifer DFC Development for Capitan and Rustler Aquifers

- Estimates of Confined and Unconfined Zone Areas
- Estimates of Groundwater Use
- Storage Coefficient Estimates
- Trial Draw Downs
- Estimated MAG Results



Bar-W GROUNDWATER EXPLORATION

2-D Model - Aquifer w/Unconfined and Confined Zones

- **Q(t) = R(t) – D(t) + dS/dt**
  - Where:
    - **Q(t)** = the total rate of groundwater withdrawal (ac-ft/yr)
    - **R(t)** = the total rate of groundwater recharge to the basin (aquifer) (ac-ft/yr)
    - **D(t)** = the total rate of groundwater discharge from the basin (aquifer) (ac-ft/yr)
    - **dS/dt** = change in aquifer storage of groundwater over time (draw down in feet) **(Freeze and Cherry, 1979)**
- **Q(t) = dS/dt**

2-D Model - Aquifer w/Unconfined and Confined Zones

Capitan Reef Aquifer

County	Aquifer	Aquifer zone	Sub-divsion Area (acres)	Total Aquifer Area in County (acres)	Sub-division Percent of Total Area	Estimated Total County Pumping (ac-ft per year)	Assigned Annual Recharge Volume (ac-ft)	Estimated Average Aquifer Draw-down (ft)	Storage Co-efficient (dimen-sionless)	Total With-drawal Volume (ac-ft)	Annual With-drawal Volume (ac-ft)	MAG Estimate (ac-ft)
Brewster	Capitan	Recharge un-confined	50,000	73,628	68%	3,000	2040	15	0.1	75000	1500	3540
Brewster	Capitan	Confined	23,628	73,628	32%	3,000	960	20	0.0001	47	1	961
Pecos	Capitan	Recharge un-confined	22,279	369,708	6%	10,315	619	15	0.1	33419	668	1287
Pecos	Capitan	Confined GMA 7	298,622	369,708	81%	10,315	8355	200	0.0001	5972	119	8474
Pecos	Capitan	Confined GMA 3	48,807	369,708	13%	10,315	1341	200	0.0001	976	20	1361
Reeves	Capitan	Confined GMA 3	16,847	16,847	100%	1,000	1000	200	0.0001	337	7	1007
Ward	Capitan	Confined GMA 3	126,768	126,768	100%	1,000	1000	200	0.0001	2535	51	1051
Winkler	Capitan	Confined GMA 3	151,462	151,462	100%	1,000	1000	200	0.0001	3029	61	1061
Totals			**738,413**				**16,315**			**121,315**	**2,427**	**18,742**

Bar-W GROUNDWATER EXPLORATION

2-D Model - Aquifer w/Unconfined and Confined Zones

Rustler Aquifer

County	Aquifer	Aquifer zone	Sub-divsion Area (acres)	Total Aquifer Area in County (acres)	Sub-division Percent of Total Area	Estimated Total County Pumping (ac-ft per year)	Assigned Annual Recharge Volume (ac-ft)	Estimated Average Aquifer Draw-down (ft)	Storage Co-efficient (dimen-sionless)	Total With-drawal Volume (ac-ft)	Annual With-drawal Volume (ac-ft)	MAG Estimate (ac-ft)
Pecos	Rustler	Confined GMA 3	241,707	741,398	33%	10,063	3321	300	0.0001	7251	145	3466
Pecos	Rustler	Confined GMA 7	499,691	741,398	67%	10,063	6742	300	0.0001	14991	300	7042
Reeves	Rustler	Recharge un-confined	15,306	1,659,076	1%	1,000	10	15	0.1	22959	459	469
Reeves	Rustler	Confined GMA 3	1,643,770	1,659,076	99%	1,000	990	300	0.0001	49313	986	1976
Loving	Rustler	Confined GMA 3	305,663	305,663	100%	1,000	1000	300	0.0001	9170	183	1183
Ward	Rustler	Confined GMA 3	92,462	92,462	100%	500	500	300	0.0001	2774	55	555
Totals			**2,798,599**				**12,563**			**106,458**	**2,128**	**14,691**

Bar-W GROUNDWATER EXPLORATION