Technical Memo

2026 Desired Future Condition Recommendations Based on Water Level Decline Analysis of the Igneous and West Texas Bolsons Aquifers

Prepared for:

GMA 4

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May 6, 2026

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Introduction

Groundwater Management Area 4 (GMA 4) is tasked with setting the Desired Future Conditions (DFCs) for the aquifers in the area using the best available science. Accepted practice is to use a model that has been developed with existing structural and pumping data calibrated to historical water level data to predict possible future outcomes for the aquifers. The GMA must also determine whether each aquifer in the area is relevant or non-relevant. If districts determine that aquifer characteristics, projected groundwater demands, and current groundwater uses do not warrant adoption of a DFC, they may propose that an aquifer is non-relevant for the purposes of joint planning.

After many delays in the release of the new models and much discussion with the Texas Water Development Board (TWDB) regarding existing and newly developed models for the Igneous and Bolsons aquifers, a meeting on March 2, 2026, confirmed that neither of the existing models were the best available science to use for this round of planning. Currently, the best available science in GMA 4 is the historical water levels. Therefore, Districts of GMA 4 submitted their most recent water level analysis to be used to propose DFCs in the Igneous and West Texas Bolsons aquifers. The technical memos summarizing those water level analyses are incorporated here by reference. (Appendix A)

Description and Methods of Calculating Proposed DFCs

Igneous Aquifer

In the 2021 round of joint planning, the DFCs for the Igneous Aquifer based on the old model were 10 feet Decline for Brewster County, 20 feet for Jeff Davis County, 14 feet for Presidio County, and 66 feet for Culberson County.

Using a rate of decline linear water level analysis for Jeff Davis County was straightforward and resulted in a rate of decline of 0.48 feet per year. That rate for 50 years results in a proposed DFC of 24 feet' in Jeff Davis County.

Using that same method of linear water level decline analysis showed a trend that would only allow a DFC of 8 feet in Presidio County, which may not leave enough room for growth. In order to give a more reasonable DFC, the data was examined for several worst-case scenario options. The most robust spatial coverage uses the three wells with the highest rate of decline. The average rate of decline of those three wells is 0.38 feet per year, which calculates a DFC of 19 feet decline in 50 years.

The water level averages in Brewster County indicate a water level decline of 71 feet in 50 years, but that average is somewhat skewed by the City of Alpine's well field. Due to this small area skewing the average, using the median of water level declines better represents this county with a DFC of 52 feet decline in 50 years.

In Culberson County, there is a very small area of the aquifer which the county proposes to declare non-relevant this round. They have no measurement wells in that small area, and the state database only shows one well with that aquifer code in that county.

	Average Trend	Trend x 50 = DFC	Alternate Method Trend	District Proposed DFC	2021 DFC Trend	2021 DFC
Igneous	**-0.98**	**49**		**36**		
Brewster	**-1.42**	**71**	**-1.03**	**52**	**-0.20**	**10**
Jeff Davis	**-0.69**	**35**	**-0.48**	**24**	**-0.40**	**20**
Presidio	**-0.16**	**8**	**-0.38**	**19**	**-0.28**	**14**
Culberson	**non-relevant, no data**				**-1.32**	**66**

Table 1. Igneous Aquifer Proposed DFCs

West Texas Bolsons Aquifer

In the 2021 round of joint planning, the DFCs based on the old model were 72 feet decline in Presidio and Jeff Davis counties and 78 feet decline in Culberson County. The Bolsons in Hudspeth County were not included in the DFC resolutions, nor were they described in the non-relevant portion of the explanatory report. The Bolsons are not in the portion of the county covered by the District in Hudspeth County, so this round they will be added to the non-relevant portion. The West Texas Bolsons do not include the Presidio Bolson that is geographically separate and exists only in Presidio County. That Bolson will also be non-relevant for the purposes of joint planning this round, because it is contained wholly within Presidio County Underground Water Conservation District and production in that aquifer does not affect any other aquifer.

The water level data in this aquifer presented some challenges because Presidio and Jeff Davis counties show the long-term water level increasing. This is great news, but since we cannot set an increase in water levels as a DFC, several other datasets analysis were considered.

Using only the most recent data trends (6 years in Presidio and 10 years in Jeff Davis) shows a slight decline in water levels, but would still only results in very small DFCs (1 foot decline in Presidio County and 7 feet decline in Jeff Davis County). The development of any single project in those counties could drastically affect their ability to achieve a DFC of that magnitude. Presidio County measures 4 wells and Jeff Davis County measures 5 wells. In both cases, all wells showed an increase in long-term water levels, with the exception of one per county. If that single well worst-case scenario is used as the basis for the DFC, that gives a DFC of 20 feet decline in 50 years for Presidio County and 31 feet decline in 50 years for Jeff Davis County.

For Culberson County, the long-term trend data shows an average decline of 57 feet in 50 years, but Culberson County has some historical use permits that they must plan for in the future. They request that their DFC remain 78 feet decline in 50 years to allow room for their historical use permits to be developed. There is statutorily less justification needed for them to keep their current DFC than for other Districts to change their DFCs.

	Average Trend	Trend x 50 = DFC	Worst Case Well Trend	District Proposed DFC	2021 DFC Trend	2021 DFC
West Texas	-0.77	39				
Culberson	-1.13	57		78	-1.56	78
Jeff Davis	0.11	6 increase	-0.62	31	-1.44	72
Presidio	0.03	2 increase	-0.40	20	-1.44	72
Hudspeth	non-relevant, not in District					

Table 2. West Texas Bolsons Aquifer Proposed DFCs

Hudspeth County Underground Water Conservation District has requested to leave the DFC for the Bone Springs Victorio Peak Aquifer the same as it was in the 2021 round of planning. The DFC statement for this aquifer is "0-ft drawdown for the period from 2010-2060, averaged across the portion of the aquifer within the boundaries of the district."

The final recommendations for proposed DFCs are in Table 3 below.

Aquifer	County	DFC feet decline from 2030 - 2080
Bone Springs Victorio Peak	Hudspeth	0
Bolsons	Culberson	78
	Jeff Davis	31
	Presidio	20
Igneous	Brewster	52
	Jeff Davis	24
	Presidio	19

Table 3. GMA 4 2026 Proposed DFCs

The proposed DFCs above leave the following aquifers to be proposed as non-relevant for the purposes of joint planning. The GMA4 must use one of the justifications outlined in Chapter 356 rules of the TWDB. Further explanation of these non-relevant aquifers will be provided in the explanatory report, as well as the justifications as required. Table 4 below lists each of these non-relevant aquifers, as well as a brief justification. The justifications in Table 4 below that are colored in blue were not addressed with DFCs or non-relevance in the

2021 round. The purple color indicates a newly proposed non-relevant aquifer, and the gray color indicates an aquifer that was non-relevant during the 2021 round of joint planning.

Aquifer	County	Justification
Bolsons	Hudspeth	(not addressed last time)
Edwards-Trinity	Brewster	Limited Areal Extent, Lack of Use
	Culberson	Limited Areal Extent, Lack of Use
	Jeff Davis	Limited Areal Extent, Lack of Use
Marathon	Brewster	Limited Areal Extent, Lack of Use
Capitan Reef Complex	Brewster	Limited Areal Extent, Lack of Use
	Culberson	Limited Areal Extent, Lack of Use
	Hudspeth	Limited Areal Extent, Lack of Use
	Jeff Davis	Limited Areal Extent, Lack of Use
Presidio-Redford Bolson	Presidio	Limited Areal Extent, Lack of Use
Pecos Valley	Culberson	(not addressed last time)
	Jeff Davis	Limited Areal Extent, Lack of Use
Rustler	Brewster	Limited Areal Extent, Lack of Use
	Culberson	Limited Areal Extent, Lack of Use
	Jeff Davis	Limited Areal Extent, Lack of Use
Igneous	Culberson	Limited Areal Extent, Lack of Use

Table 4. Proposed Non-Relevant Aquifers

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STEVEN T. FINCH, JR.
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TECHNICAL MEMORANDUM

To: Sydney Bauer, General Manager
Brewster County GCD GeneralManager@BrewsterCountyGCD.com

From: Steven T. Finch, CPG, PG, Principal Hydrogeologist

Date: April 14, 2026

Subject: Brewster County GCD Water Level Trend Analysis

Within the boundaries of Brewster County Groundwater Conservation District (Brewster County GCD) there are three Texas Water Development Board (TWDB) designated minor aquifers and one TWDB designated major aquifer:

Minor Aquifers

1. Capitan Reef Complex
2. Igneous
3. Marathon

Major Aquifer

1. Edwards-Trinity (Plateau)

A map showing the distribution of these designated aquifers in Brewster County GCD is presented as Figure 1. Most of the designated aquifers cover large areas of rural undeveloped portions of Brewster County GCD, populated with exempt wells and limited water level data.

The primary water use in Brewster County GCD is ranching and public water supply for communities (Alpine and Marathon), and resort areas (Lajitas, Terlingua, Study Butte).

The purpose of the water-level trend analysis is to support GMA-4 planning cycle Desire Future Conditions (DFC) and subsequent updates to Brewster County GCD management plan. The water level trend analysis was performed for each designated aquifer except Capitan Reef Complex (due to lack of data).

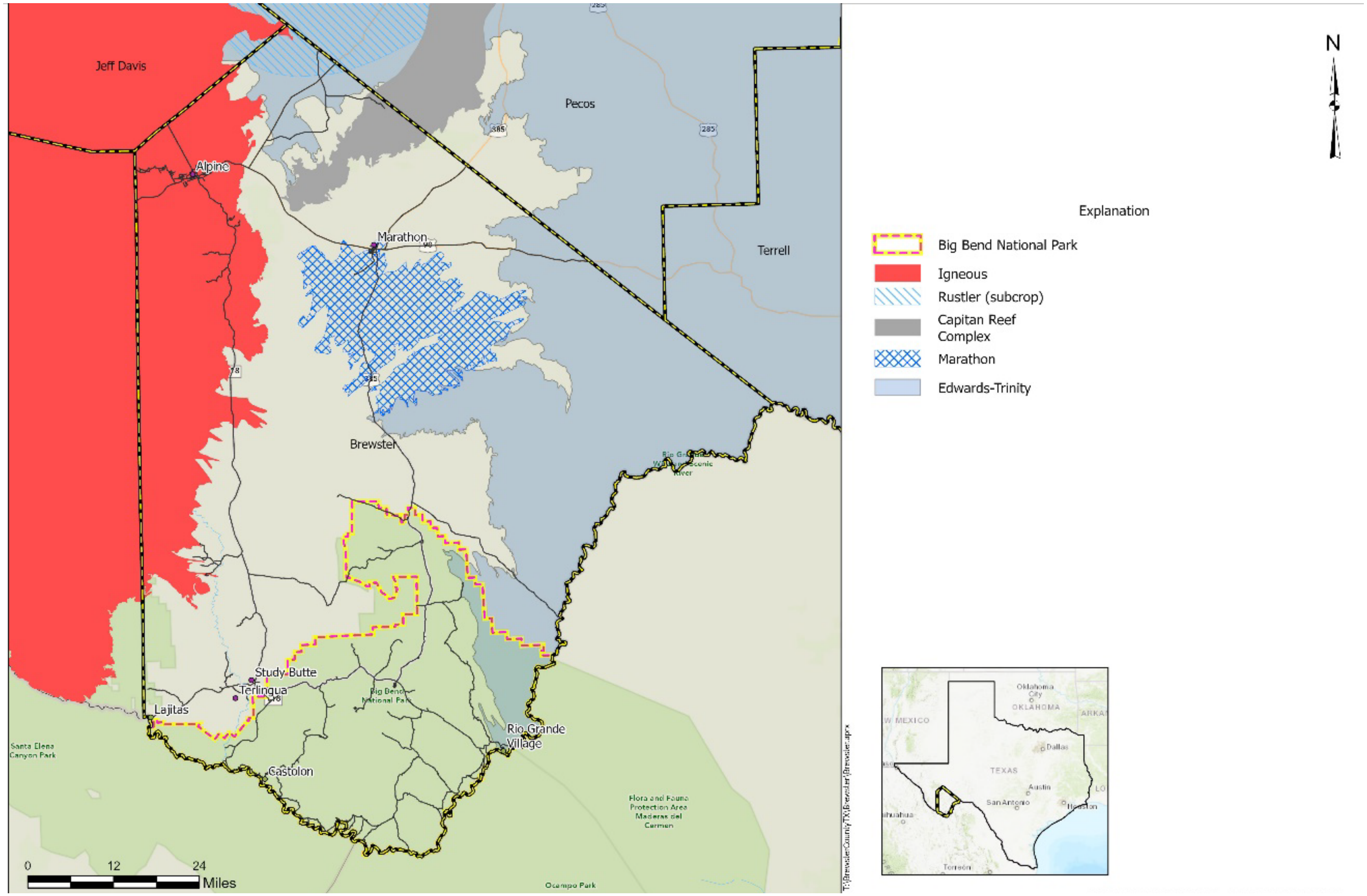


Figure 1. Map showing Brewster County GCD and designated aquifers.

Previous GMA-4 planning cycle (Hutchison, 2021) the following Brewster County GCD DFCs were proposed and adopted for the period from 2010-2060:

- 0-ft drawdown for the Capitan Reef Complex
- 10-ft drawdown for Igneous Aquifer
- 0-ft drawdown for the Marathon Aquifer
- 3 ft drawdown for the Edwards Trinity (Plateau).

Igneous Aquifer Drawdown Analysis

Brewster County GCD performs continuous water level monitoring on several wells in the Igneous Aquifer, and the TWDB performed monitoring on 32 wells completed in the Igneous Aquifer within Brewster County GCD. The most current water level database was obtained from TWDB. All wells with at least three data points over a five year period were considered for the evaluation. Figure 2 is a map showing the locations of identified water-level monitoring points for the Igneous aquifer in Brewster County. Most of the water level data comes from wells located in three areas: 1) City of Alpine (52-35-7, 52-43-3), 2) subdivision areas south of Alpine (52-44-7), and 3) Elephant Mountain Wildlife Management Area (52-60-8).

A water level trend analysis was performed on the wells with current and historical water level data. Attached Table 1 is a summary of the trend analysis. Hydrographs IG-1 through IG-13 used for trend analysis are appended. Water-level data were plotted by 2.5 minute quadrangle areas.

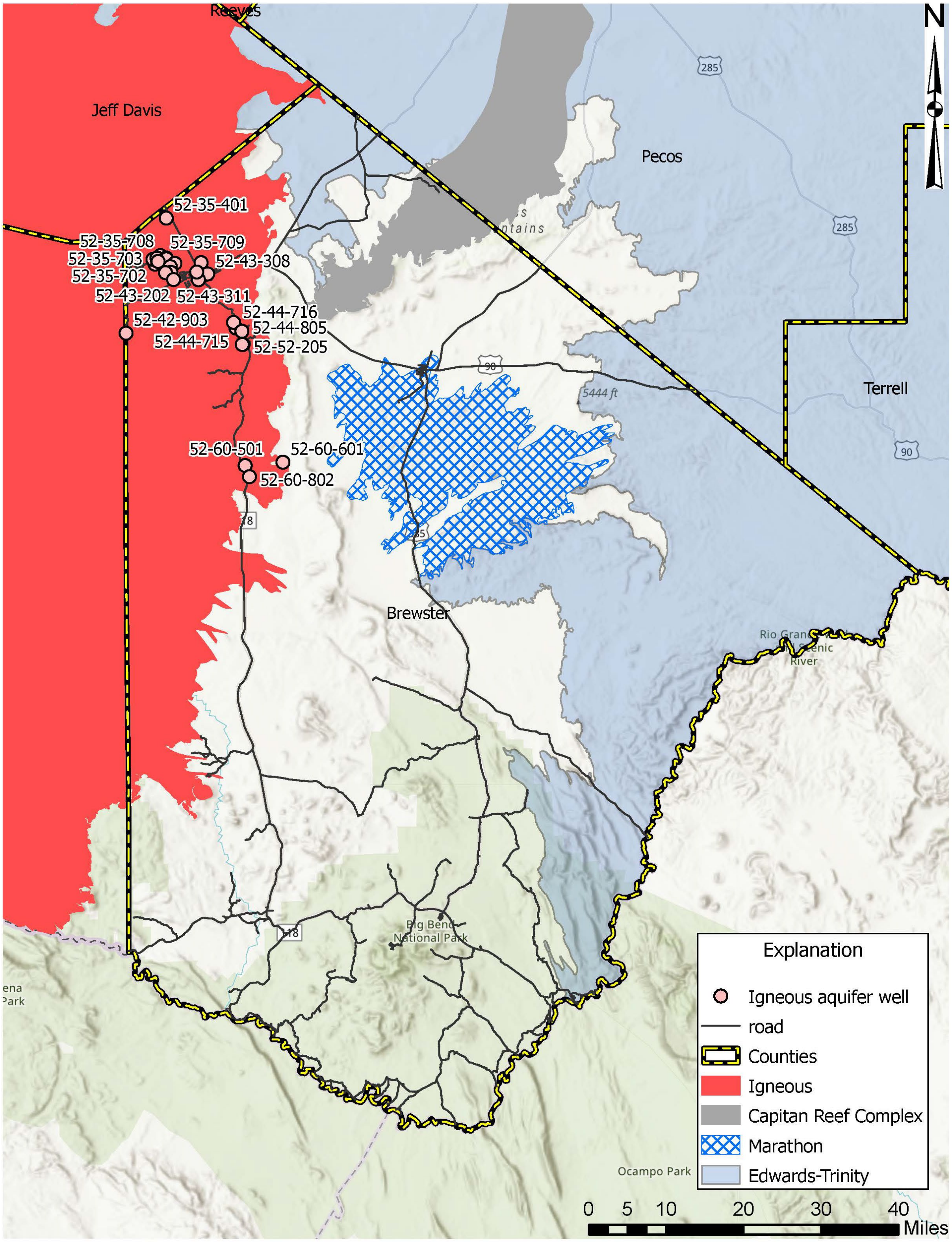


Figure 2. Map showing location of hydrograph wells for Igneous Aquifer, Brewster County GCD.

Marathon Aquifer Drawdown Analysis

The TWDB performed monitoring on 16 wells completed in the Marathon Aquifer. The most current water level database was obtained from TWDB. All wells with at least two data points over a two year period were considered for the evaluation. Figure 3 is a map showing the locations of identified water-level monitoring points for the Marathon aquifer in Brewster County. Wells to the northeast of Marathon, and outside of the Marathon Aquifer boundary were considered as part of this analysis, due to the fact that they are likely hydraulically connected to the Marathon Aquifer. Most all of the hydrograph wells are located in the northern portion of the Marathon aquifer, with no representative data for the southern portion of the Marathon Aquifer.

A water level trend analysis was performed on the wells with current and historical water level data. Hydrographs M1 through M8 used for trend analysis are appended. Water-level data were plotted by 2.5 minute quadrangle areas. Attached Table 2 is a summary of the trend analysis.

Edwards Trinity Plateau Aquifer Drawdown Analysis

The TWDB performed monitoring on eight wells completed in the Edwards-Trinity Plateau Aquifer within Brewster County GCD. The most current water level database was obtained from TWDB. All wells with at least two data points over a two year period were considered for the evaluation. Figure 4 is a map showing the locations of identified water-level monitoring points for the Edwards-Trinity Plateau aquifer in Brewster County. The distribution of hydrograph wells covers three general areas, 1) Hovey Channel in northern Brewster County, 2) northeast of Marathon Aquifer, and 3) Back Gap Wildlife Management Area in southeastern Brewster County.

A water level trend analysis was performed on the wells with current and historical water level data. Hydrographs E1 through E6 used for trend analysis are appended. Water-level data were plotted by 2.5 minute quadrangle areas. Attached Table 3 is a summary of the trend analysis.

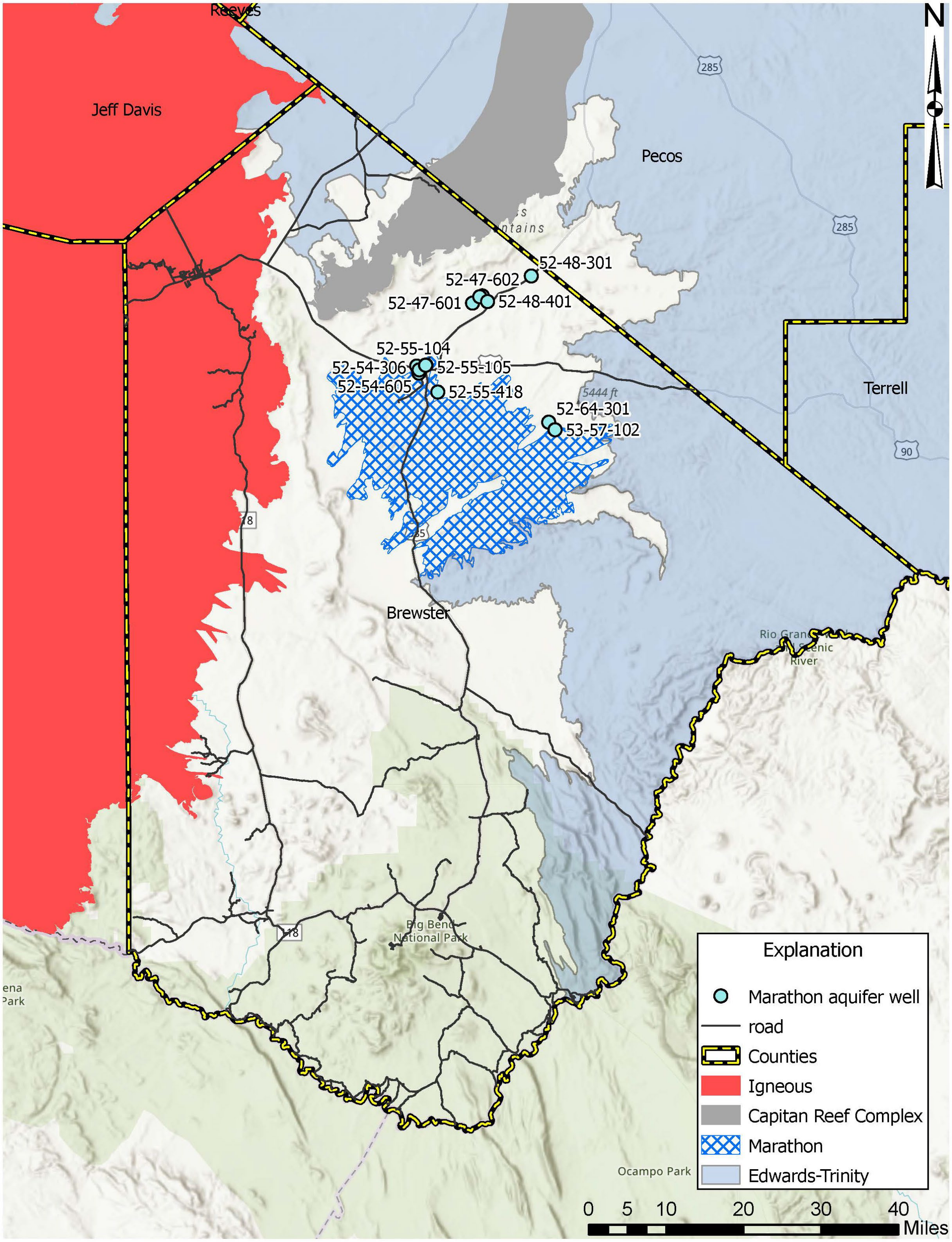


Figure 3. Map showing location of hydrograph wells for Marathon Aquifer, Brewster County GCD.

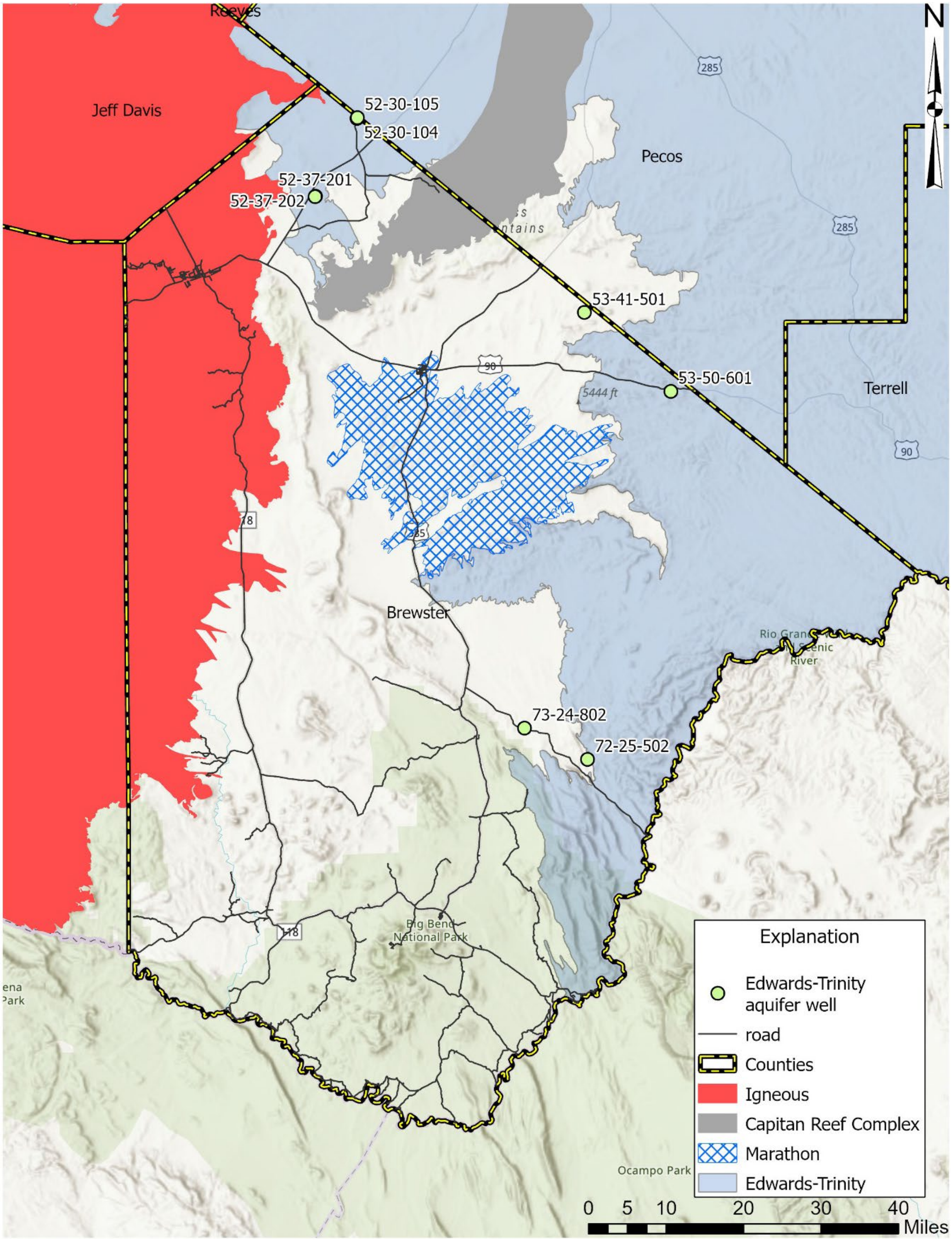


Figure 4. Map showing location of hydrograph wells for Edwards Trinity Plateau Aquifer, Brewster County GCD.

Summary

The water level trend analysis for Igneous aquifer is weighted toward the data from municipal wells for City of Alpine, such as Roberts Well Field (Hydrograph IG-1a). The average drawdown rate is higher than the median drawdown rate indicating the dataset is skewed to the high side. Therefore, the median drawdown rate best represents the water level datasets evaluated.

Aquifer	average drawdown rate (ft/yr)	median drawdown rate (ft/yr)
Igneous	1.42	1.03
Marathon	0.50	0.52
Edwards-Trinity Plateau	0.92	0.77

The water level trend analysis for the Marathon Aquifer resulted in the average drawdown rate near equal to the median drawdown rate indicating the data are normally distributed, however the data are limited to the northern portion of the Marathon aquifer.

The water level trend analysis for the Edwards Trinity Plateau aquifer was based on a very limited dataset spreadout over three different areas, with a large part of the aquifer in the southeastern part of the County absent of water level data for trend analysis.

References

HB-2078, House Bill relating to the joint planning of desired future conditions in groundwater management areas.

Hutchison, 2021, Explanatory report for desired future conditions (Final) Groundwater Management Area 4: consultants report prepared for GMA-4, June24, 2021, 148 p.

TWDB database, twdb.texas.gov

Attachments:

- Table 1. Summary of water level trend analysis for Igneous Aquifer in Brewster County
- Hydrographs IG1 through IG13
- Table 2. Summary of water level trend analysis for Marathon Aquifer in Brewster County
- Hydrographs M1 through M9
- Table 3. Summary of water level trend analysis for Edwards Trinity Plateau Aquifer in Brewster County
- Hydrographs E1 through E6

ATTACHMENT 1.

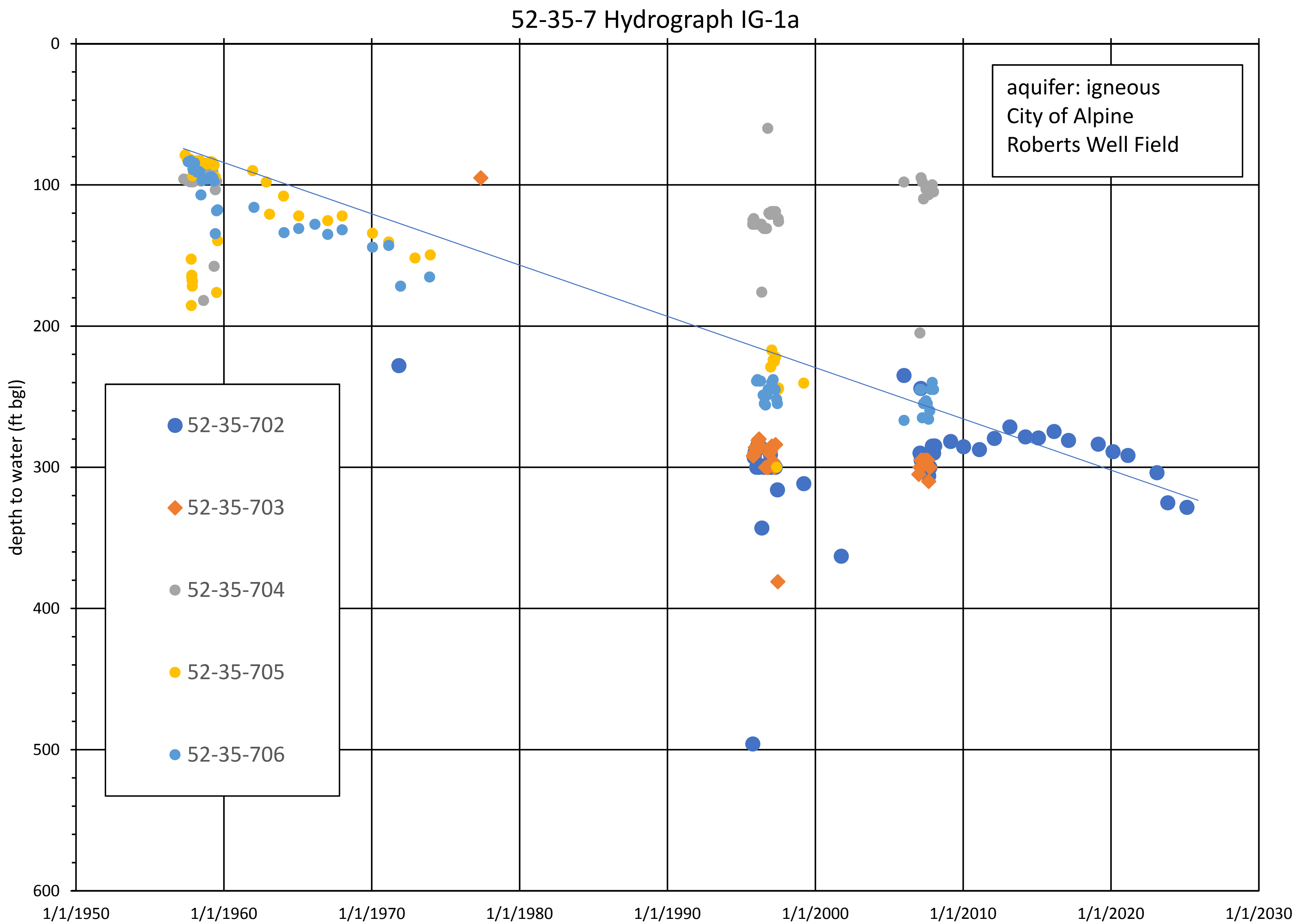
Table 1. Summary of water level trend analysis for Igneous Aquifer in Brewster County

Table 1. Summary of water-level trend analysis for Igneous Aquifer in Brewster County

Hydrograph #	State Well Number	Aquifer	Aquifer Code	ObsCode	Well Depth	Latitude DD	Longitude DD	comment	# measurements	time span (years)	trend (ft/yr)
none	52-35-401	Igneous	120VLCC	M	372	30.4505560	-103.722222	City of Alpine Meriweather #2	5	29	-0.38
IG-1a	52-35-702	Igneous	120VLCC	C	798	30.3765917	-103.743269	City of Alpine Roberts #4	49	53	1.89
IG-1a	52-35-703	Igneous	120VLCC	M	850	30.3841670	-103.746945	City of Alpine Roberts #5	26	30	6.75
IG-1a	52-35-704	Igneous	120VLCC	H	435	30.3830550	-103.728889	City of Alpine Roberts #1	58	51	0.18
IG-1a	52-35-705	Igneous	120VLCC	H	800	30.3805550	-103.734445	City of Alpine Roberts #2	62	42	3.86
IG-1a	52-35-706	Igneous	120VLCC	H	400	30.3819440	-103.738611	City of Alpine Roberts #3	69	50	3.20
IG-1b	52-35-707	Igneous	120VLCC	H	212	30.3825000	-103.734167		42	52	3.28
IG-1c	52-35-708	Igneous	120VLCC	H	390	30.3902780	-103.733334	City of Alpine Gardner Well	15	49	2.47
IG-1c	52-35-709	Igneous	120VLCC	C	400	30.3862111	-103.722167	City of Alpine Cartwright well	89	67	1.14
IG-1c	52-35-711	Igneous	120VLCC	H	265	30.3861110	-103.739445	City of Alpine Gardner Well #3	1221	46	4.15
IG-1c	52-35-713	Igneous	120VLCC	C	361	30.3849833	-103.721936		120	70	1.44
IG-1c	52-35-714	Igneous	120VLCC	H	300	30.3808330	-103.737500		66	54	1.49
IG-2	52-35-803	Igneous	120VLCC	H	504	30.3777780	-103.706112		117	69	0.91
IG-3	52-35-901	Igneous	120VLCC	H	276	30.3788890	-103.657223	06 Ranch Kokernot #2	91	55	-0.10
IG-4	52-42-903	Igneous	120IGNS	M	550	30.2653333	-103.797236		4	70	0.37
IG-5	52-43-109	Igneous	120VLCC	H	592	30.3725000	-103.714723	Terry #1	65	49	1.39
IG-5	52-43-110	Igneous	120VLCC	M	540	30.3633340	-103.713612	City of Alpine Terry #2	4	51	1.86
IG-5	52-43-112	Igneous		B	370	30.3627778	-103.723611		696	2	0.04
IG-6	52-43-202	Igneous	120VLCC	H	320	30.3516670	-103.708612		51	29	0.04
IG-7	52-43-307	Igneous	120VLCC	H	320	30.3597222	-103.650000	City of Alpine Railroad Well	13	62	-0.48
IG-7	52-43-308	Igneous	120IGNS	M	580	30.3608340	-103.645000	City of Alpine East Well	4	67	-0.39
IG-7	52-43-310	Igneous	120VLCC	C	443	30.3516806	-103.662394	City of Alpine South Hill Lower	19	23	4.00
IG-7	52-43-311	Igneous	120VLCC	M	700	30.3513890	-103.662223	City of Alpine South Hill Upper	3	58	-1.57
IG-7	52-43-318	Igneous	110AVTV	C	104	30.3638889	-103.665439		4	35	-0.18
IG-8	52-44-715	Igneous		B	385	30.2736111	-103.592222		723	2	7.03
IG-8	52-44-716	Igneous		B	230	30.2827778	-103.596667		716	2	-0.13
IG-9	52-44-805	Igneous		B	340	30.2683333	-103.581111		726	2	2.41
IG-10	52-52-205	Igneous		C	600	30.2471222	-103.579375		3	2	3.73
IG-10	52-52-206	Igneous		C	672	30.2471833	-103.580492		5	18	-4.03
IG-11	52-60-501	Igneous	120VLCC	C		30.0519444	-103.575000		12	11	0.28
IG-12	52-60-601	Igneous	120IGNS	C		30.0572222	-103.504444		11	10	0.20
IG-13	52-60-802	Igneous	120VLCC	C		30.0338889	-103.566944		14	12	0.55
										AVG DDN=	1.42
										MED DDN=	1.03

ATTACHMENT 2.

Hydrographs IG1 through IG13


52-35-7 Hydrograph IG-1a
aquifer: igneous
City of Alpine
Roberts Well Field
depth to water (ft bgl)
0
100
200
300
400
500
600
1/1/1950
1/1/1960
1/1/1970
1/1/1980
1/1/1990
1/1/2000
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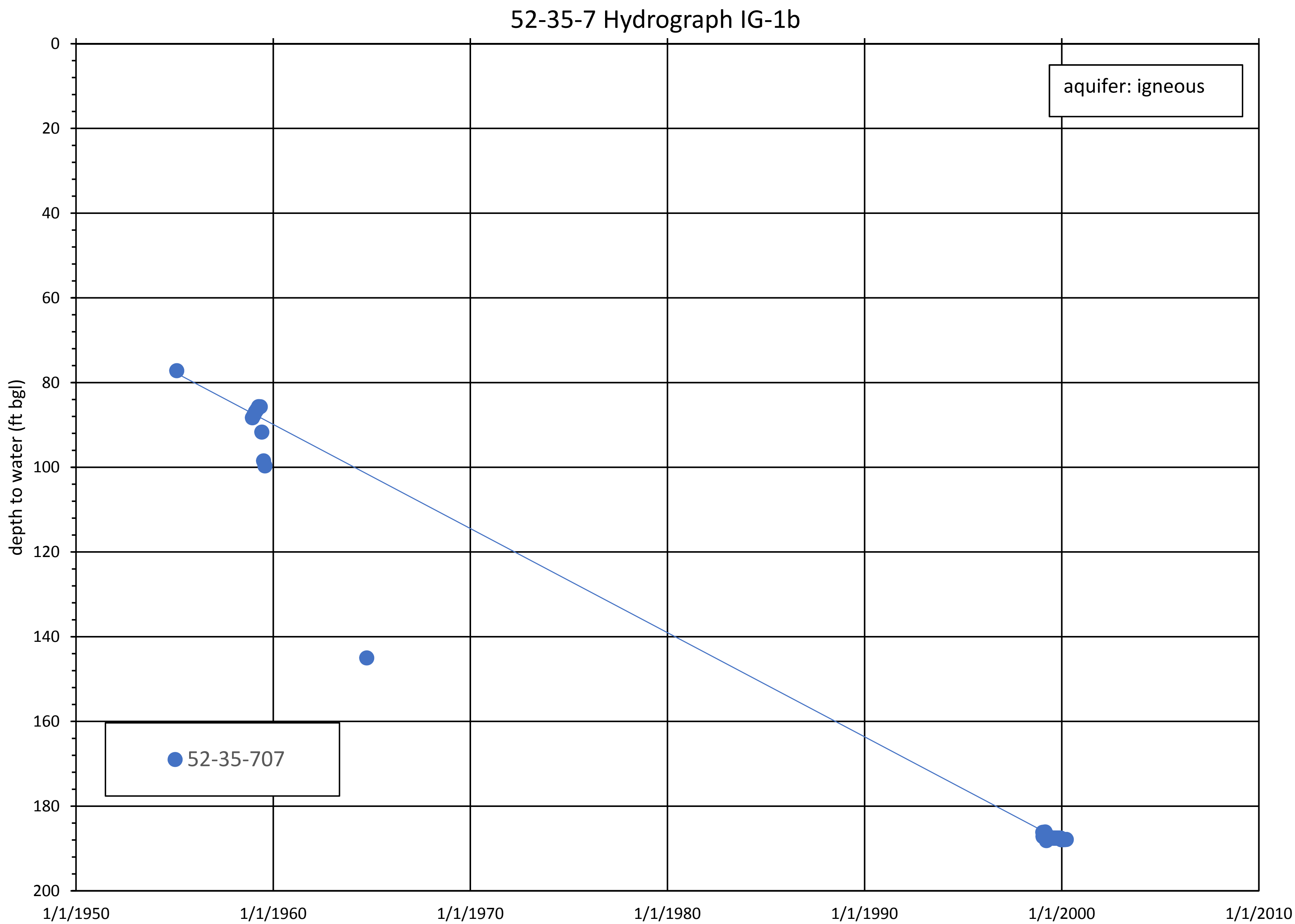
52-35-704
52-35-705
52-35-706


52-35-7 Hydrograph IG-1b
aquifer: igneous
depth to water (ft bgl)
0
20
40
60
80
100
120
140
160
180
200
1/1/1950
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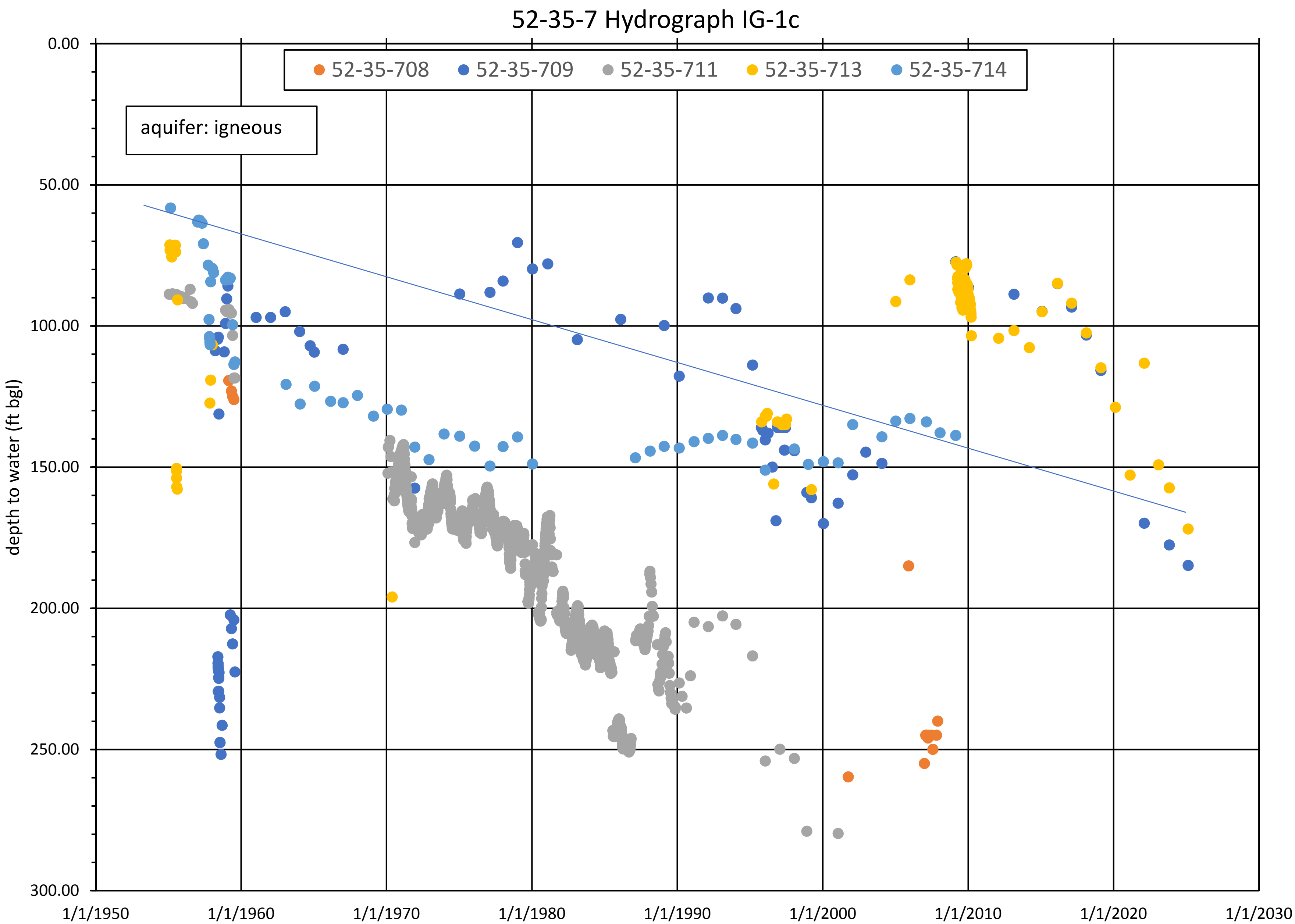
1/1/1970
1/1/1980
1/1/1990
1/1/2000
1/1/2010
52-35-707



52-35-7 Hydrograph IG-1c
52-35-708
52-35-709
52-35-711
52-35-713
52-35-714
aquifer: igneous
depth to water (ft bgl)
0.00
50.00
100.00
150.00
200.00
250.00
300.00
1/1/1950
1/1/1960
1/1/1970
1/1/1980
1/1/1990
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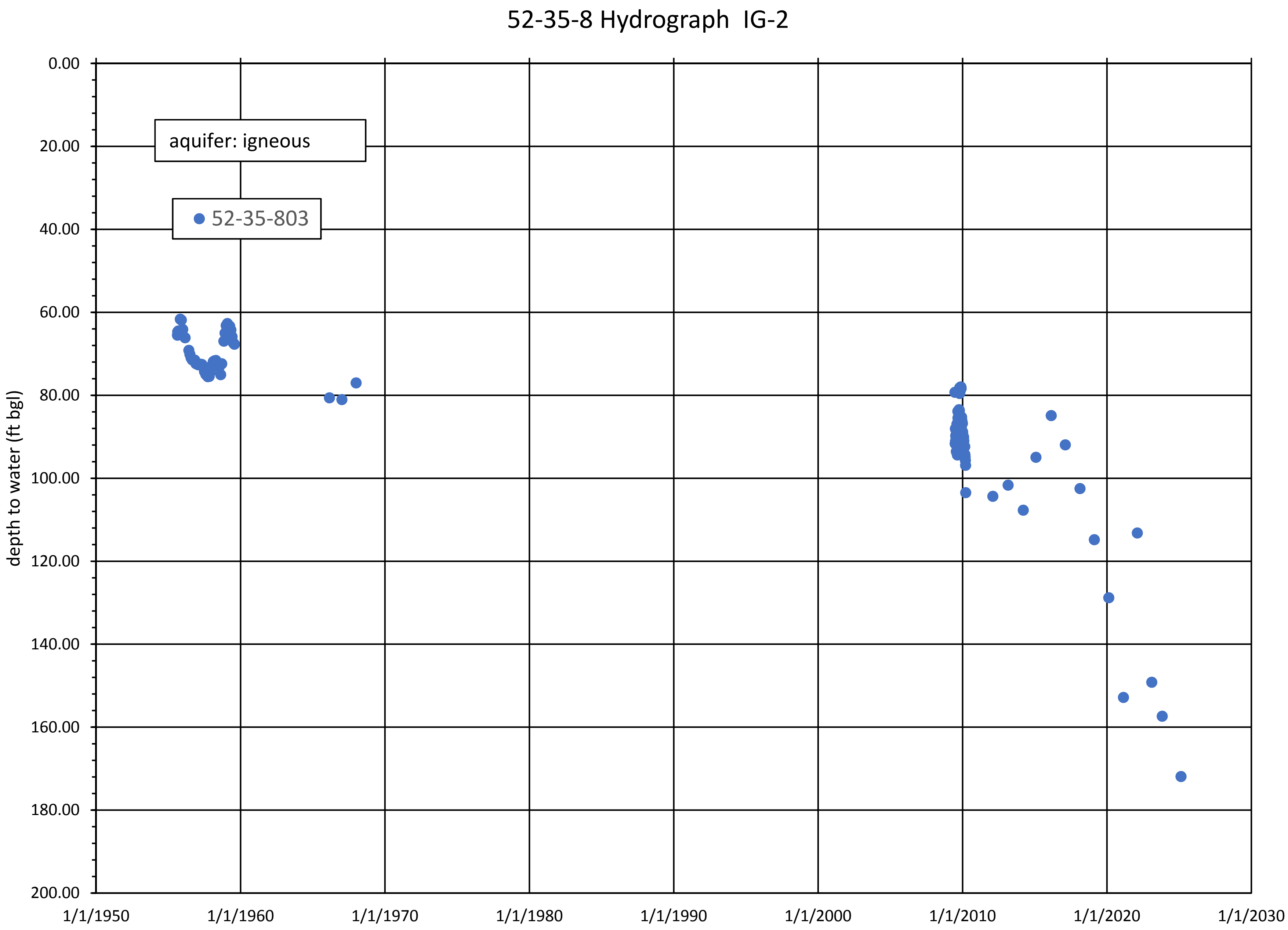
1/1/2020
1/1/2030



52-35-8 Hydrograph IG-2
aquifer: igneous
52-35-803
depth to water (ft bgl)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
1/1/1950
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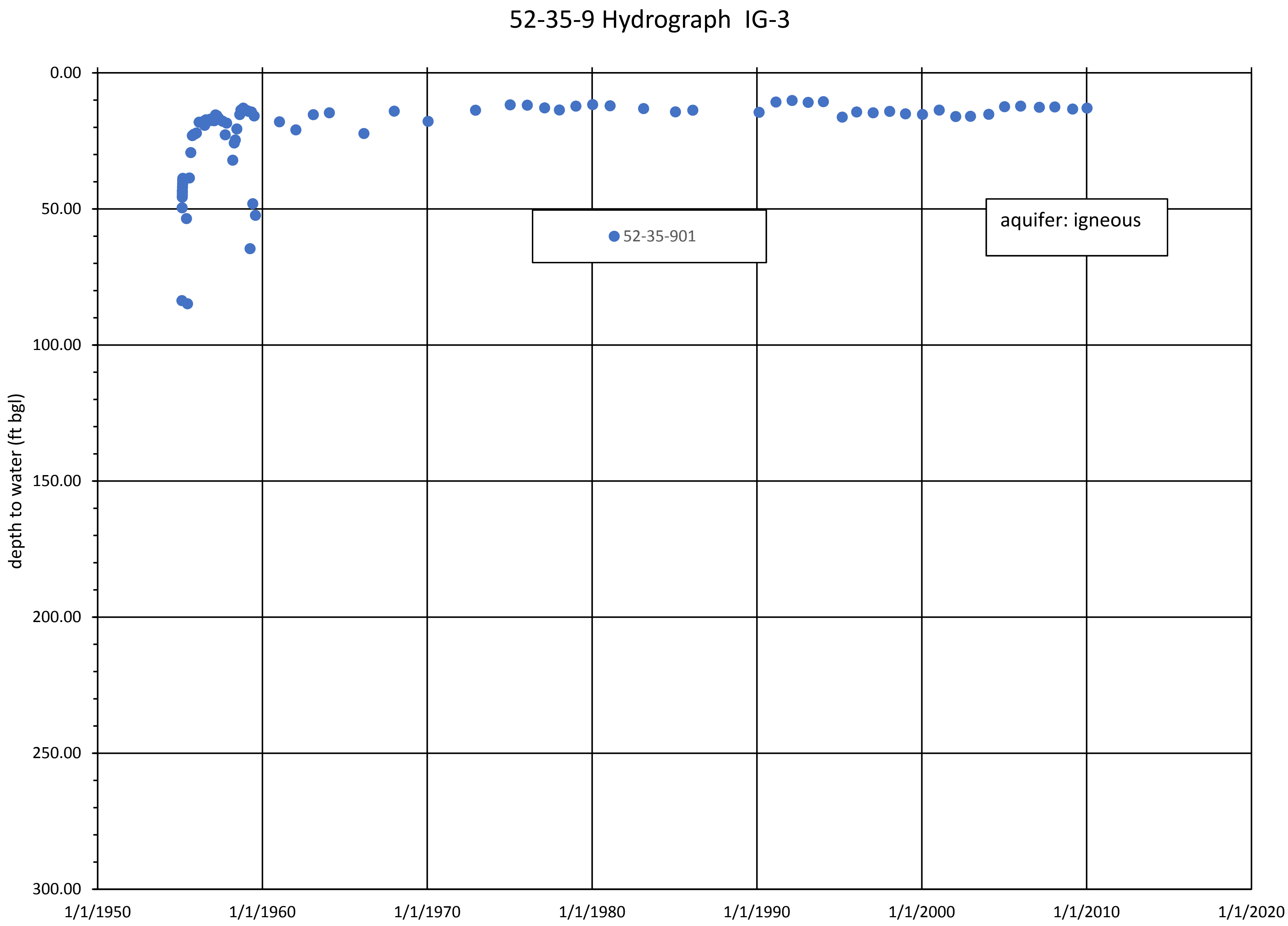
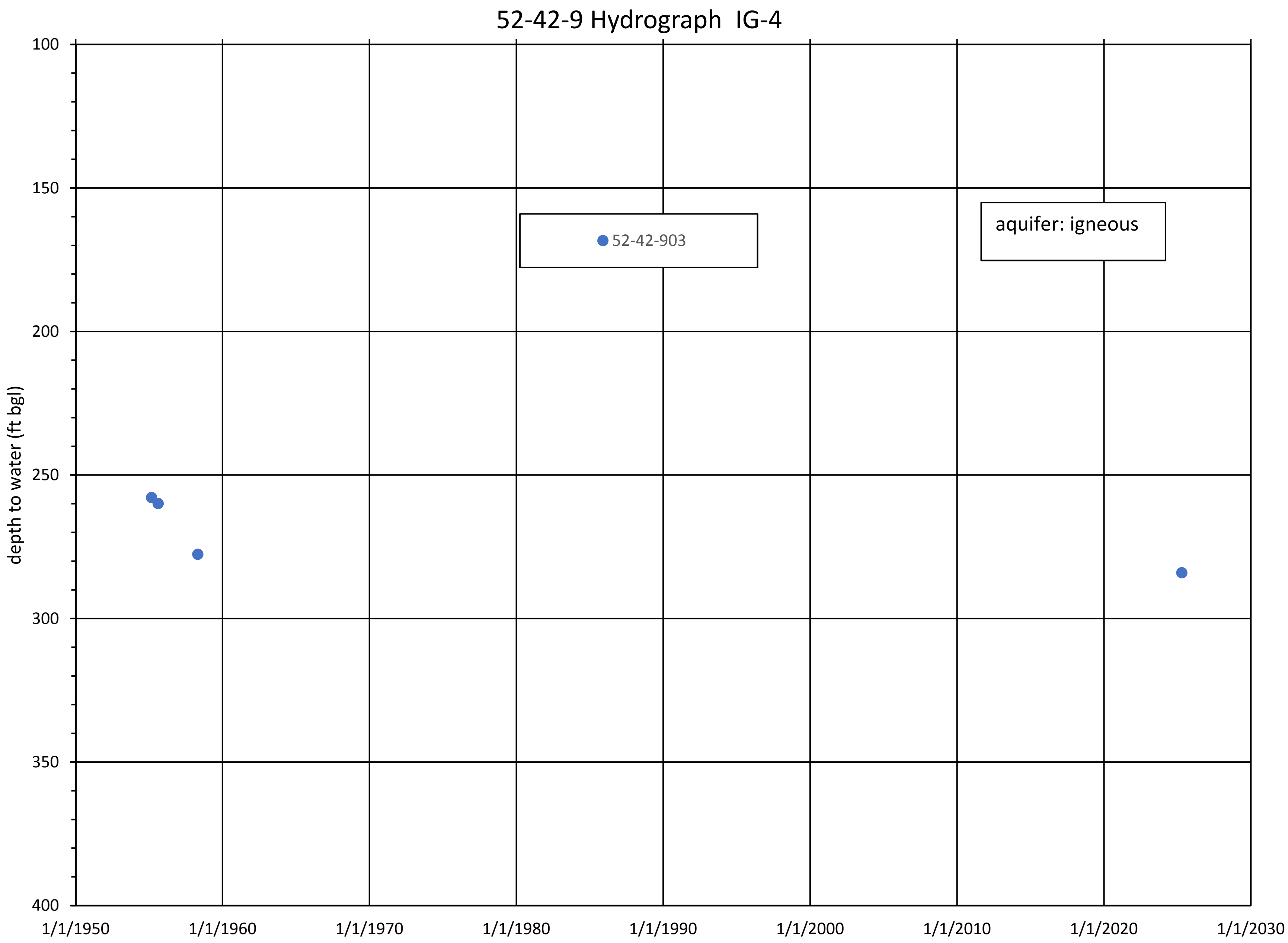
1/1/2020
1/1/2030



52-35-9 Hydrograph IG-3
depth to water (ft bgl)
0.00
50.00
100.00
150.00
200.00
250.00
300.00
1/1/1950
1/1/1960
1/1/1970
1/1/1980
1/1/1990
1/1/2000
1/1/2010
1/1/2020
52-35-901
aquifer: igneous



52-42-9 Hydrograph IG-4
depth to water (ft bgl)
100
150
200
250
300
350
400
1/1/1950
1/1/1960
1/1/1970
1/1/1980
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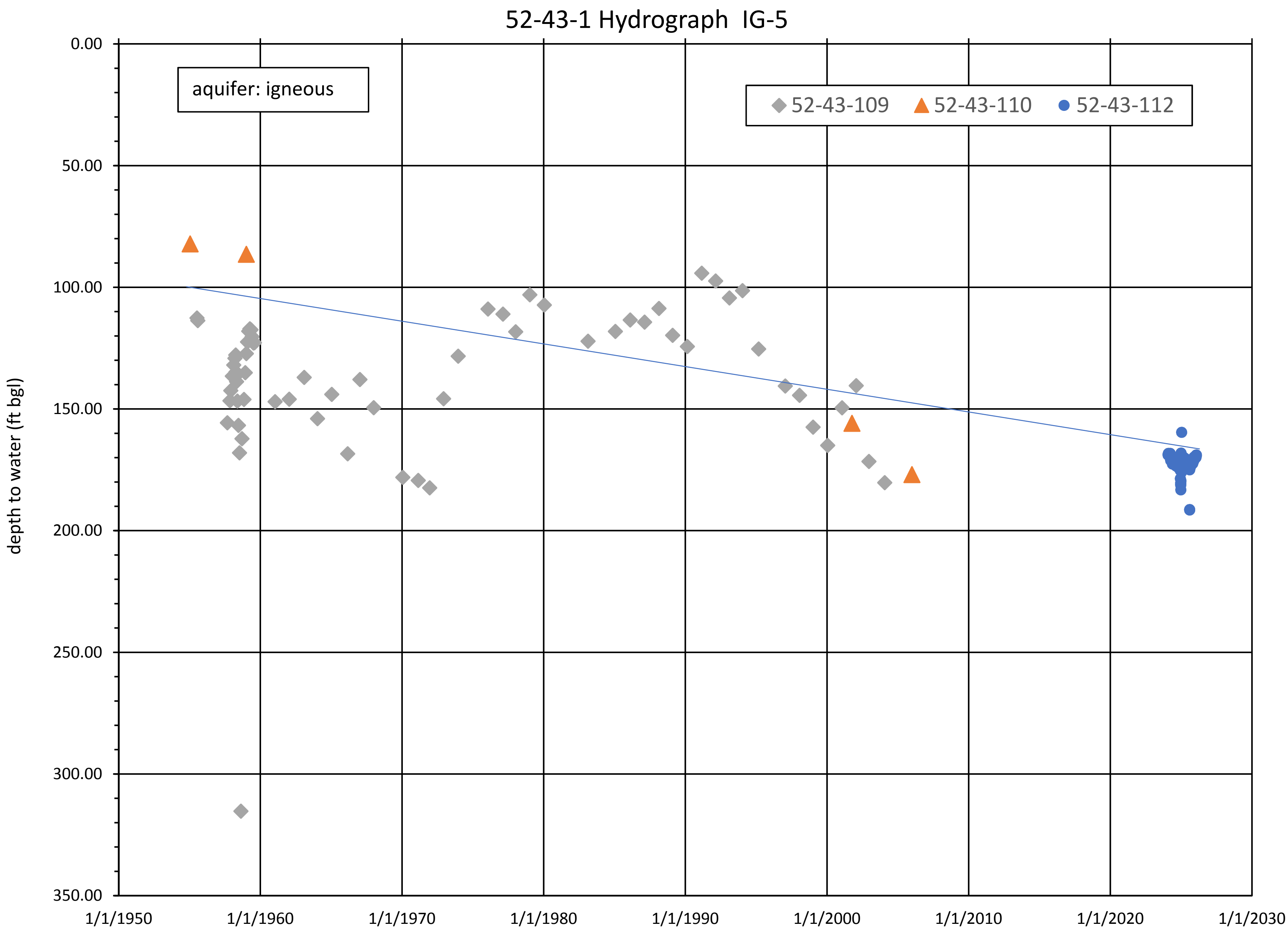
52-42-903
aquifer: igneous


52-43-1 Hydrograph IG-5
aquifer: igneous
52-43-109
52-43-110
52-43-112
depth to water (ft bgl)
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
1/1/1950
1/1/1960
1/1/1970
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1/1/1990
1/1/2000
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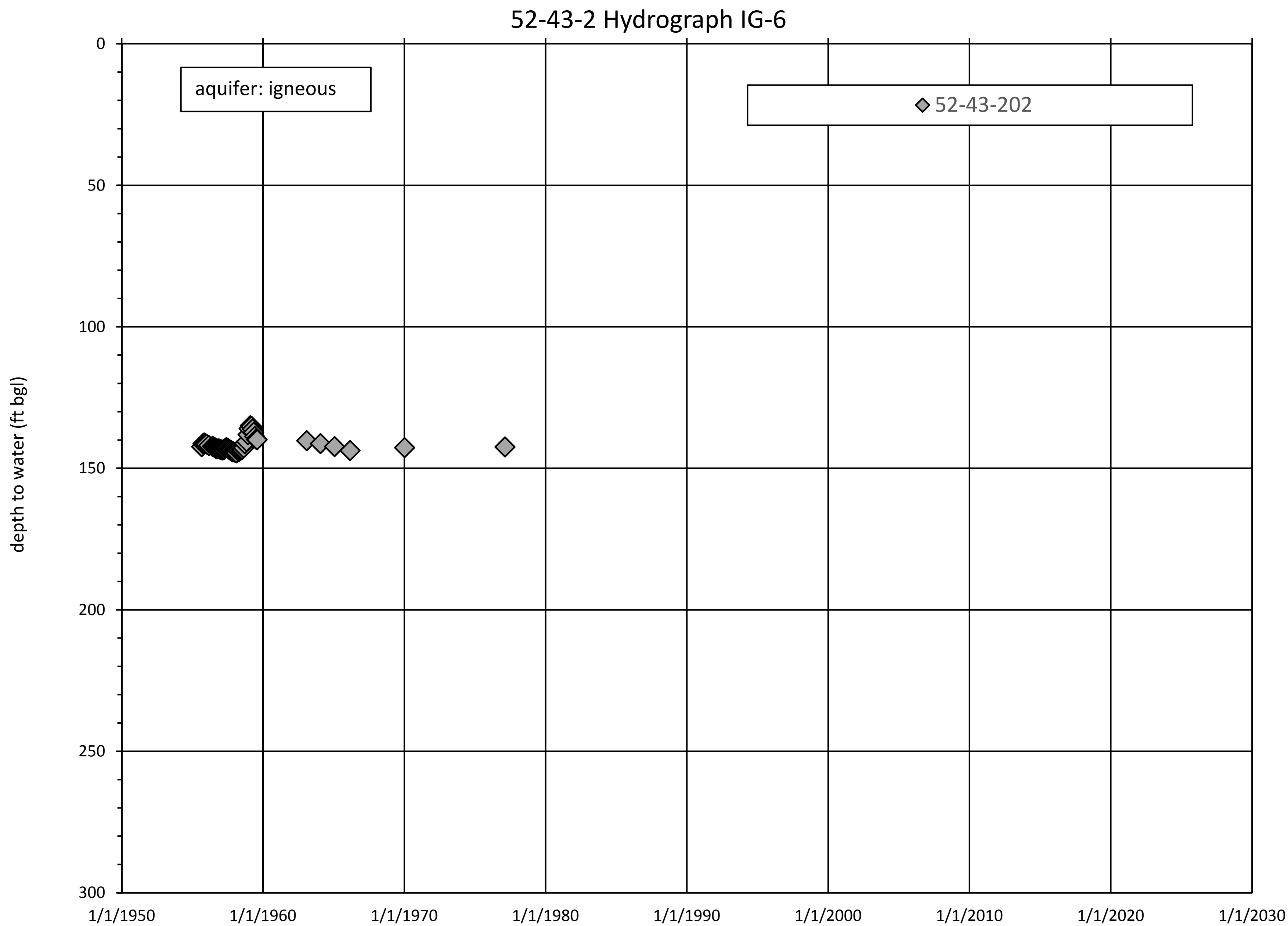
1/1/2020
1/1/2030


52-43-2 Hydrograph IG-6
aquifer: igneous
52-43-202
depth to water (ft bgl)
0
50
100
150
200
250
300
1/1/1950
1/1/1960
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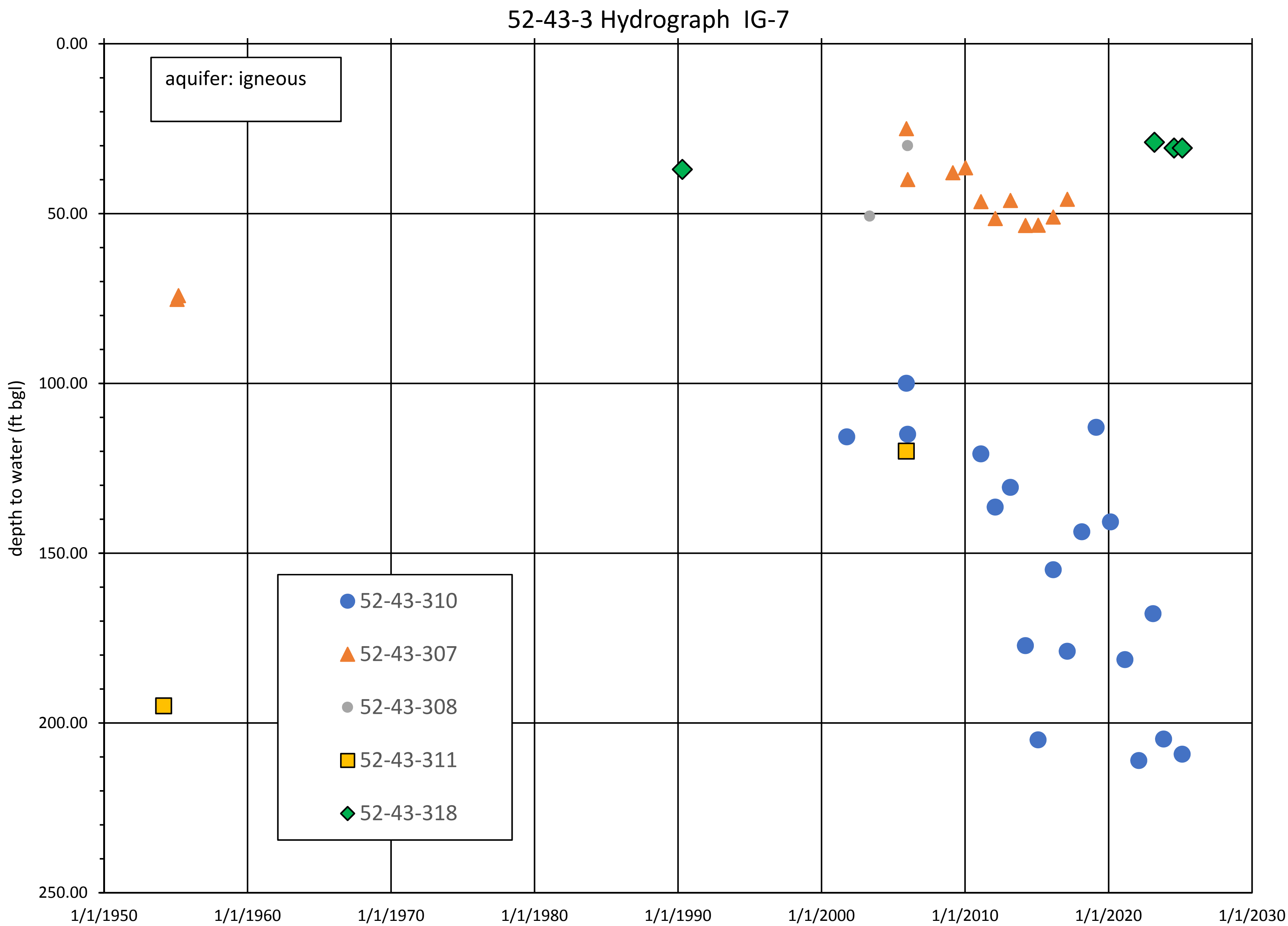
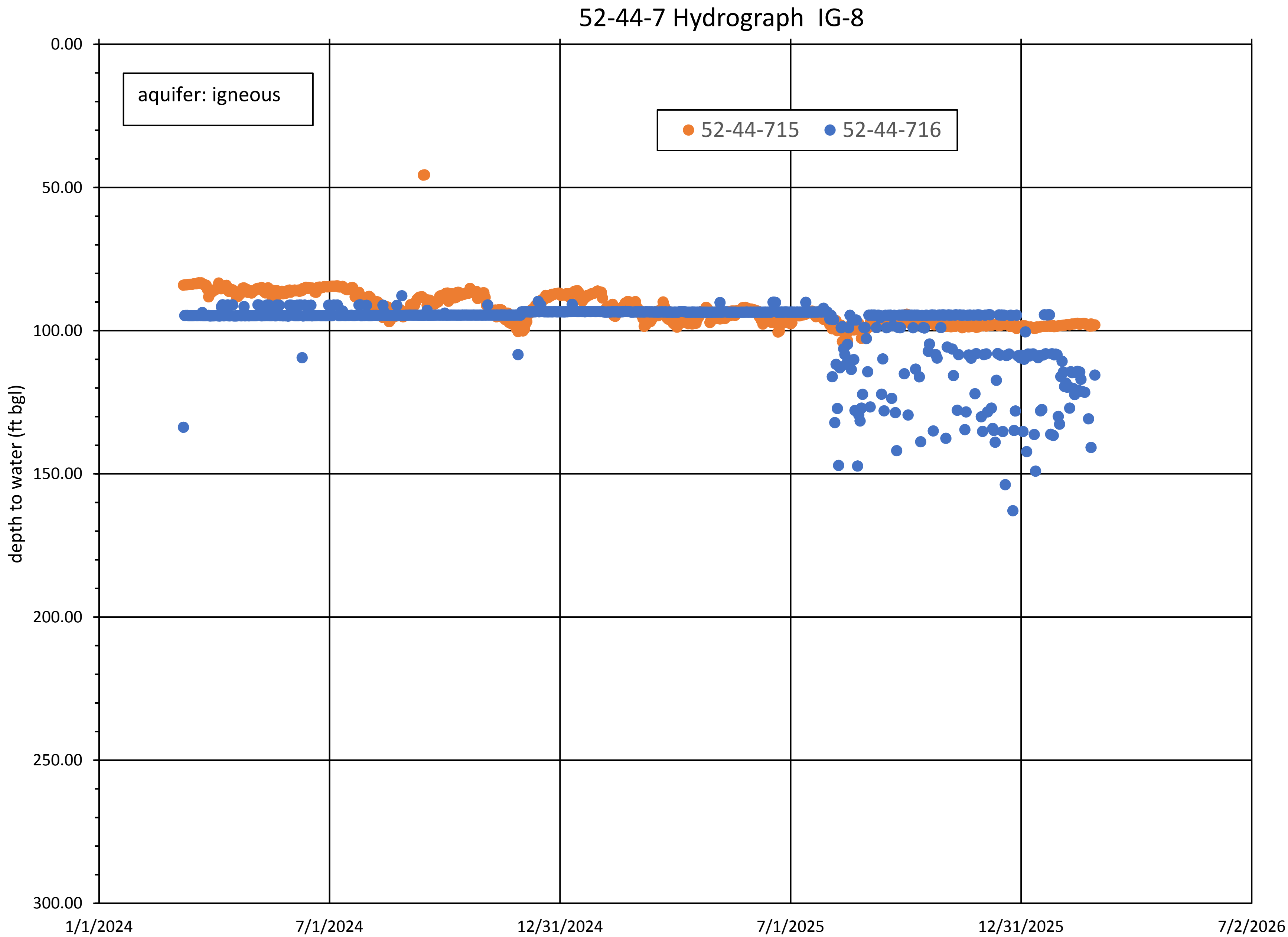
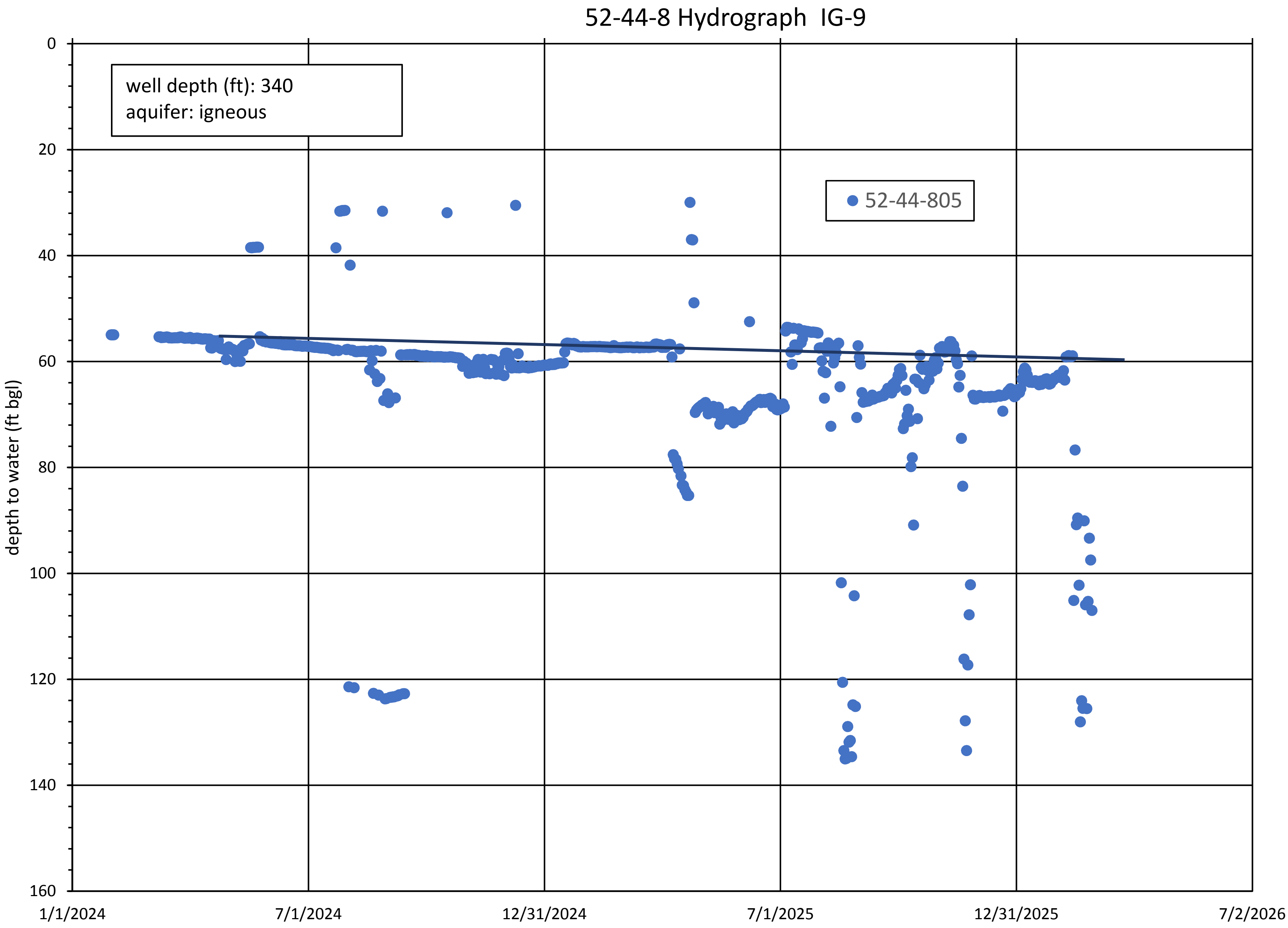
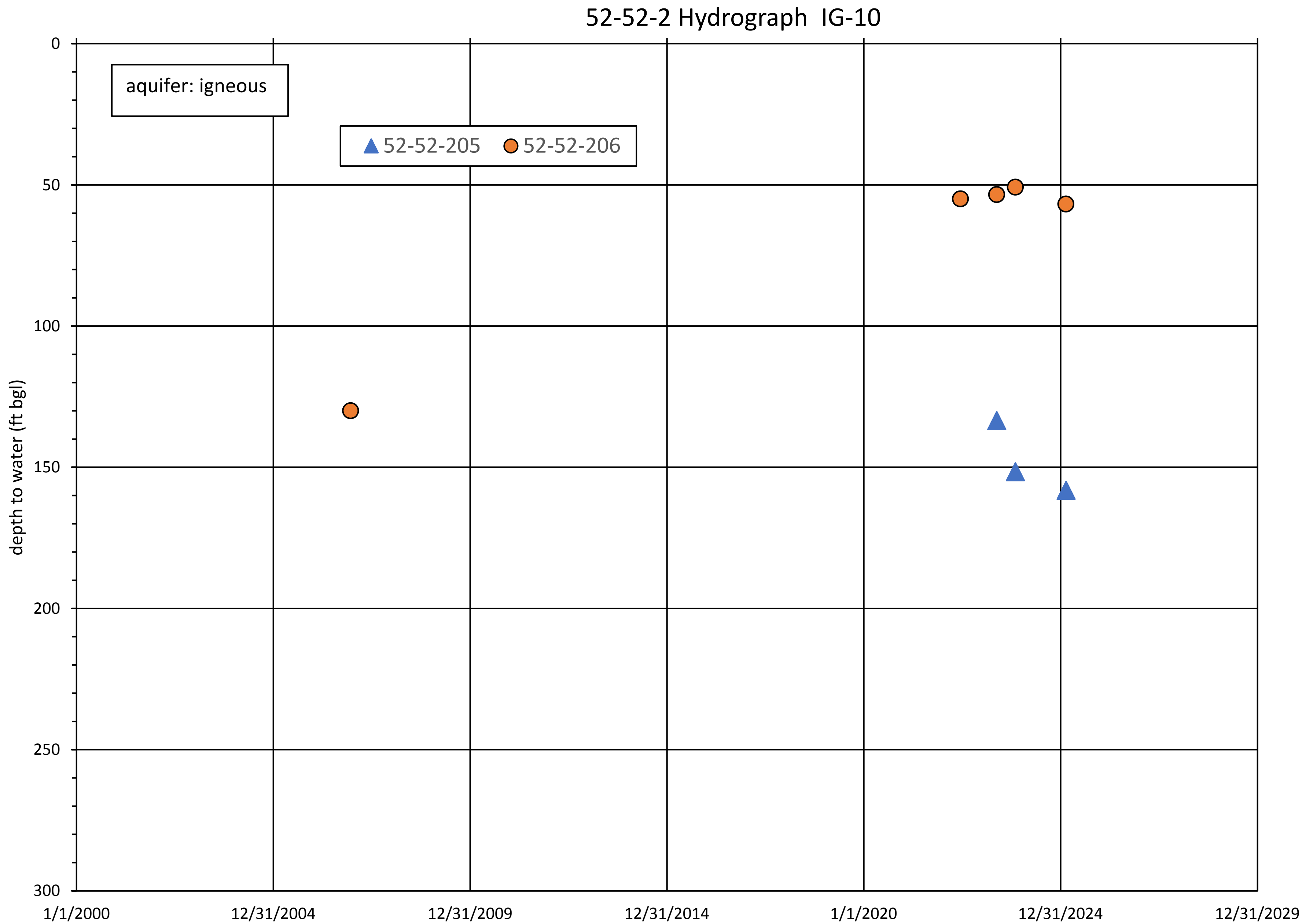
1/1/2020
1/1/2030



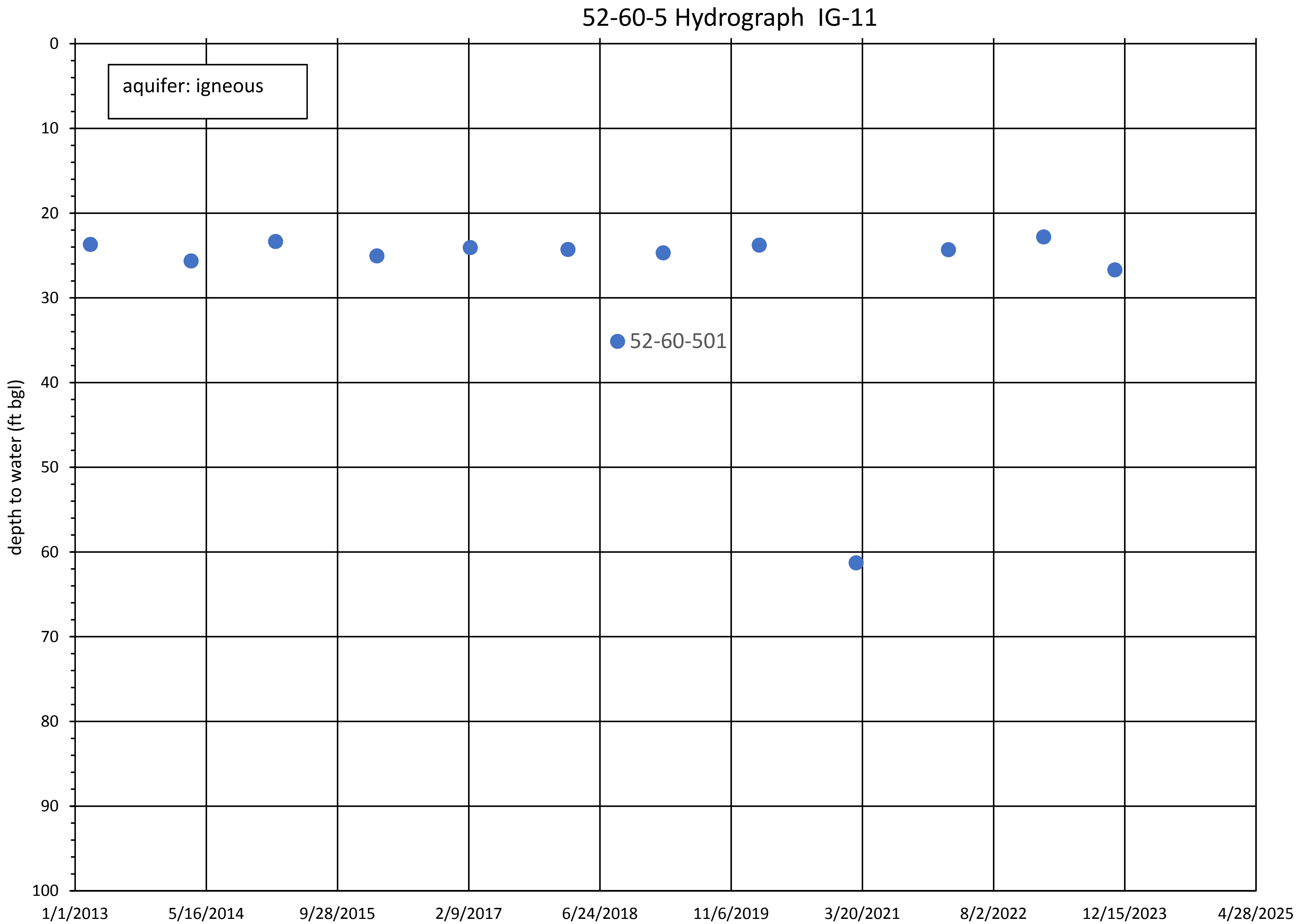
52-43-3 Hydrograph IG-7
aquifer: igneous
depth to water (ft bgl)
0.00
50.00
100.00
150.00
200.00
250.00
1/1/1950
1/1/1960
1/1/1970
1/1/1980
1/1/1990
1/1/2000
1/1/2010
1/1/2020
1/1/2030
52-43-310
52-43-307
52-43-308
52-43-311
52-43-318

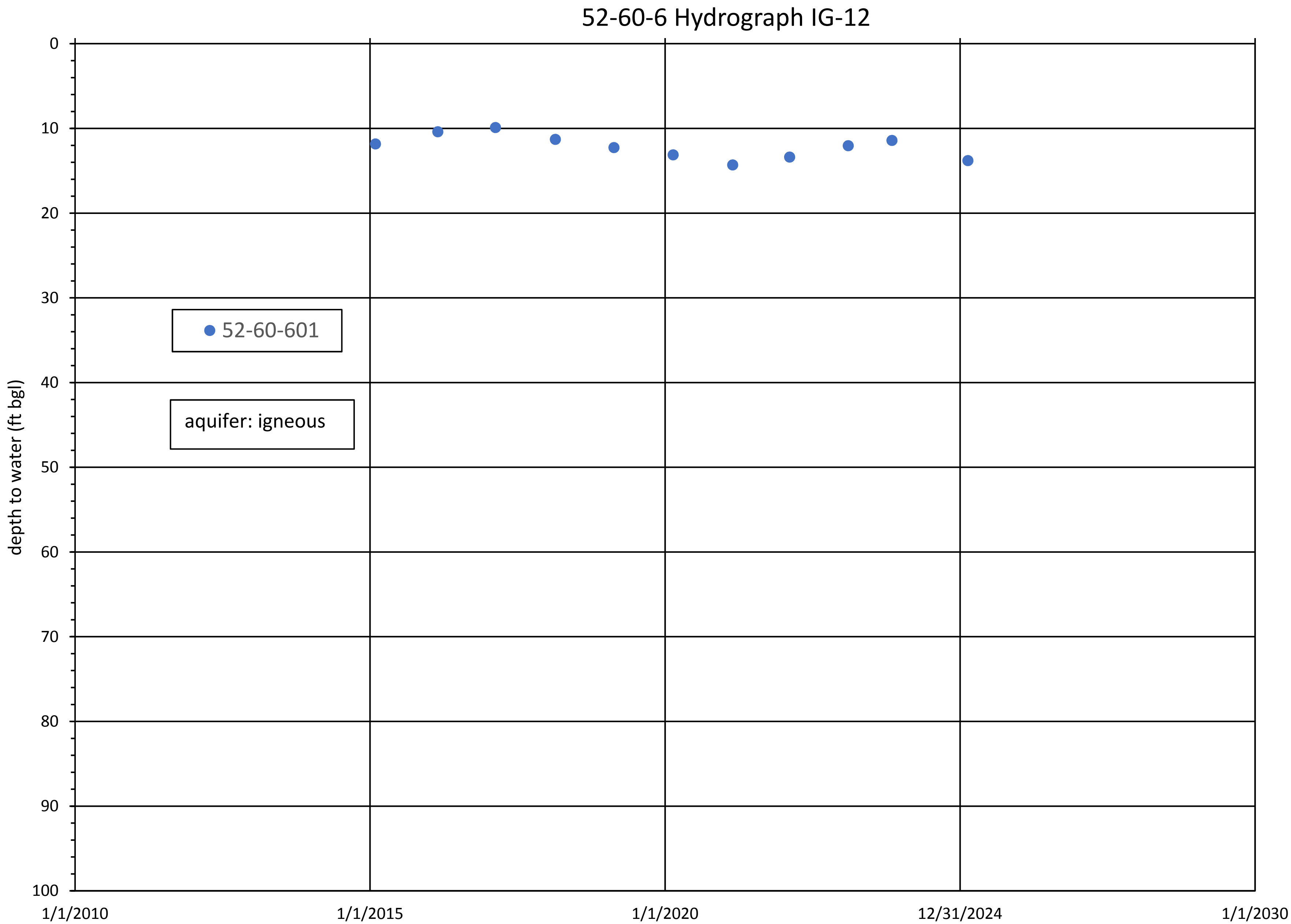

52-44-7 Hydrograph IG-8
aquifer: igneous
52-44-715
52-44-716
depth to water (ft bgl)
0.00
50.00
100.00
150.00
200.00
250.00
300.00
1/1/2024
7/1/2024
12/31/2024
7/1/2025
12/31/2025
7/2/2026


52-44-8 Hydrograph IG-9
well depth (ft): 340
aquifer: igneous
52-44-805
depth to water (ft bgl)
0
20
40
60
80
100
120
140
160
1/1/2024
7/1/2024
12/31/2024
7/1/2025
12/31/2025
7/2/2026

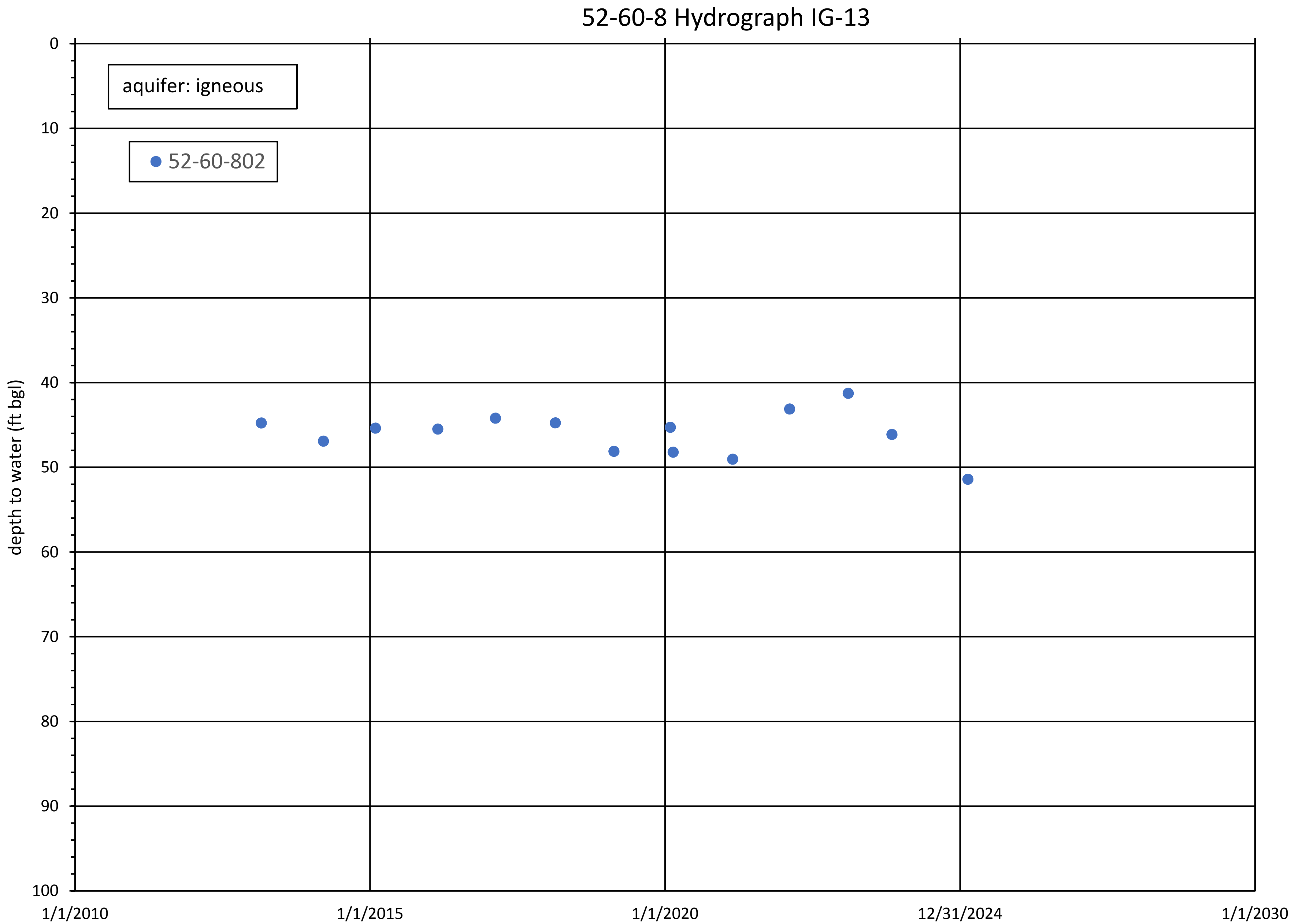


52-52-2 Hydrograph IG-10
aquifer: igneous
52-52-205
52-52-206
depth to water (ft bgl)
0
50
100
150
200
250
300
1/1/2000
12/31/2004
12/31/2009
12/31/2014
1/1/2020
12/31/2024
12/31/2029


52-60-5 Hydrograph IG-11
aquifer: igneous
52-60-501
depth to water (ft bgl)
0
10
20
30
40
50
60
70
80
90
100
1/1/2013
5/16/2014
9/28/2015
2/9/2017
6/24/2018
11/6/2019
3/20/2021
8/2/2022
12/15/2023
4/28/2025



52-60-6 Hydrograph IG-12
depth to water (ft bgl)
0
10
20
30
40
50
60
70
80
90
100
1/1/2010
1/1/2015
1/1/2020
12/31/2024
1/1/2030
52-60-601
aquifer: igneous


52-60-8 Hydrograph IG-13
aquifer: igneous
52-60-802
depth to water (ft bgl)
0
10
20
30
40
50
60
70
80
90
100
1/1/2010
1/1/2015
1/1/2020
12/31/2024
1/1/2030

ATTACHMENT 3.

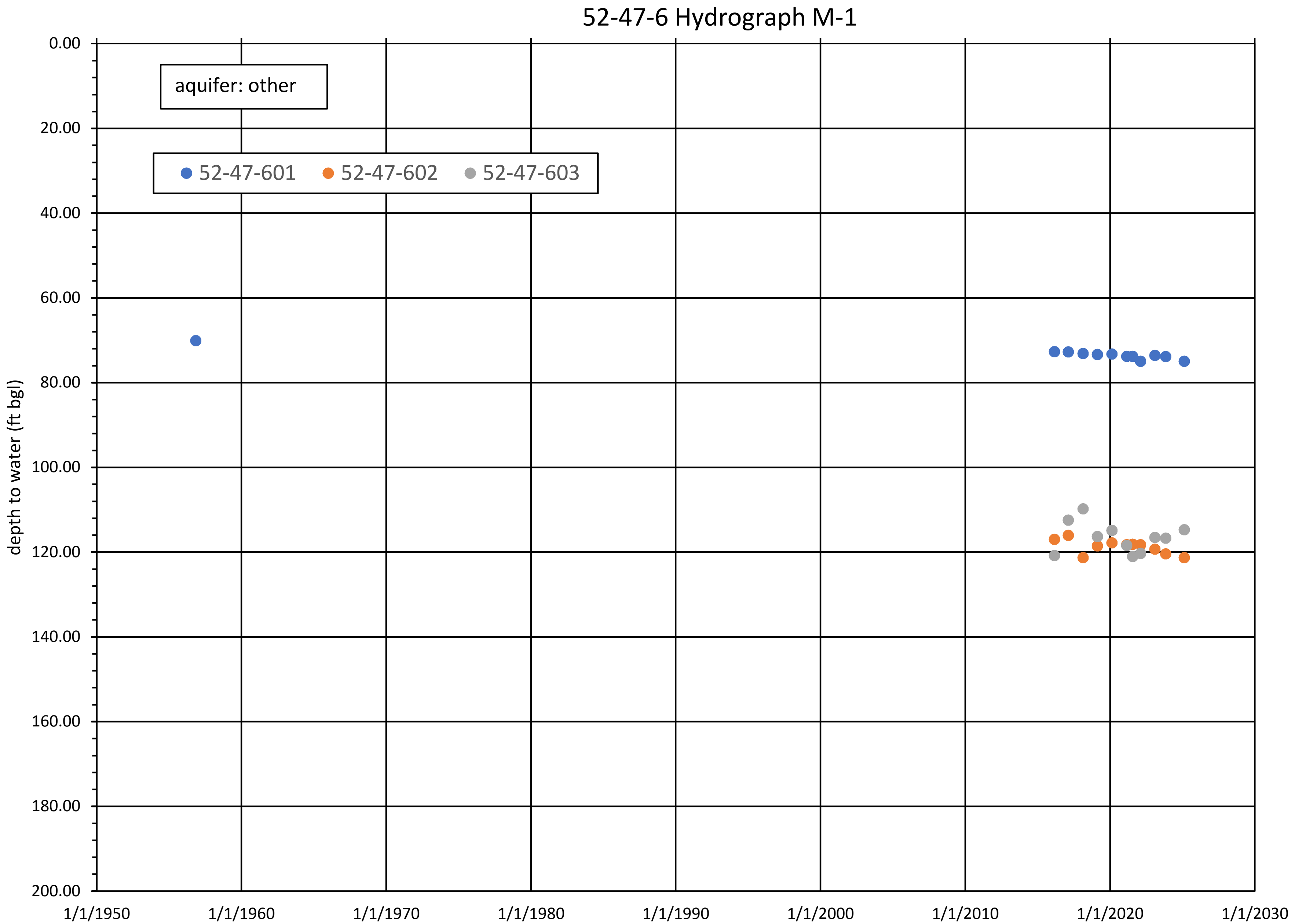
Table 2. Summary of water level trend analysis for Marathon Aquifer in Brewster County

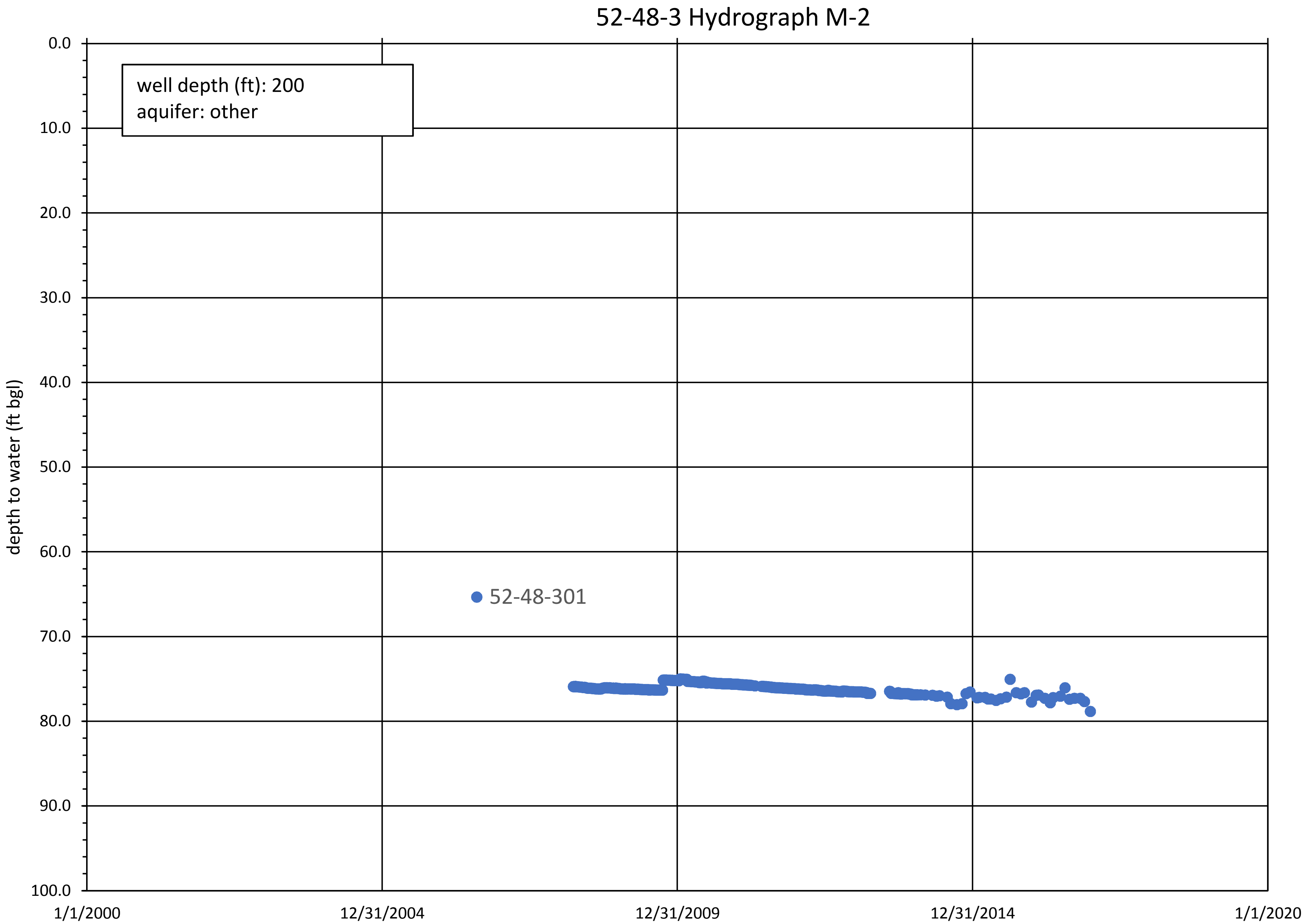
Table 2. Summary of water level trend analysis for Marathon Aquifer, Brewster County

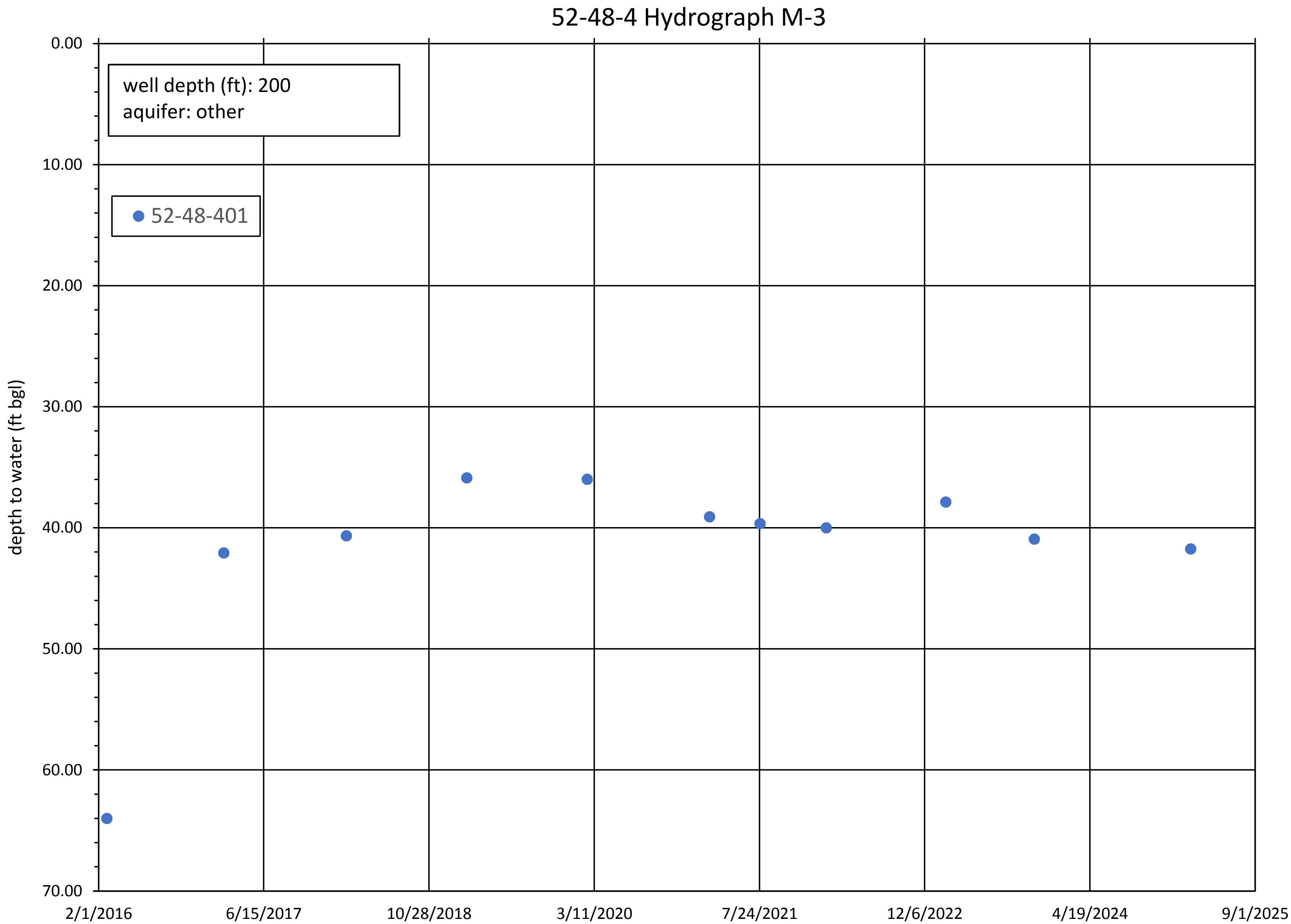
Hydrograph #	State Well Number	Aquifer	Aquifer Code	ObsCode	Well Depth	Latitude DD	Longitude DD	comment	# measurements	time span (years)	decline (ft/yr)
M-1	52-47-601	Other		C	104	30.3132806	-103.1507	Combs-Kincaid Ranch	12	68.3	0.07
M-1	52-47-602	Other	100ALVM	C		30.3249417	-103.1324		11	9.0	0.48
M-1	52-47-603	Other	100ALVM	C		30.3236111	-103.1372		11	9.0	-0.68
M-2	52-48-301	Other	323DMPL	D	142	30.3569450	-103.0411	MPGCD Obs well	431	8.8	0.34
M-3	52-48-401	Other		C	200	30.3157889	-103.1227	Combs-Kincaid Ranch	12	68.3	-0.29
M-4	52-54-301	Marathon	367MRTN	C	229	30.2102778	-103.2536		2	19.9	1.70
M-4	52-54-306	Marathon		C	350	30.2118833	-103.2549		2	2.3	0.67
M-5	52-54-605	Marathon	369MTDF	C	515	30.2005556	-103.2508		7	19.0	1.45
M-5	52-54-606	Marathon		C	247	30.2057778	-103.2502		5	3.6	0.88
M-6	52-55-104	Marathon	367MRTN	C	468	30.2133806	-103.2386	City of Marathon Well #1	27	56.0	0.55
M-6	52-55-105	Marathon	367MRTN	C	346	30.2133333	-103.2375	City of Marathon Well #2	3	50.4	1.03
M-6	52-55-112	Marathon		C	450	30.2131806	-103.2382		10	9.0	0.68
M-7	52-55-418	Marathon	327TSNS	M	100	30.1700000	-103.2156	Catto-Gage Ranch	3	54.5	0.03
M-8	52-64-301	Marathon		M	183	30.1214250	-103.0086		3	3.0	
M-9	53-57-101	Marathon	367MRTN	M		30.1091667	-102.9969		3	66.0	0.10
M-9	53-57-102	Marathon		M	243	30.1091139	-102.9966		3	2.3	0.52
										AVG DDN=	0.50
										MEDIAN DDN	0.52

ATTACHMENT 4.

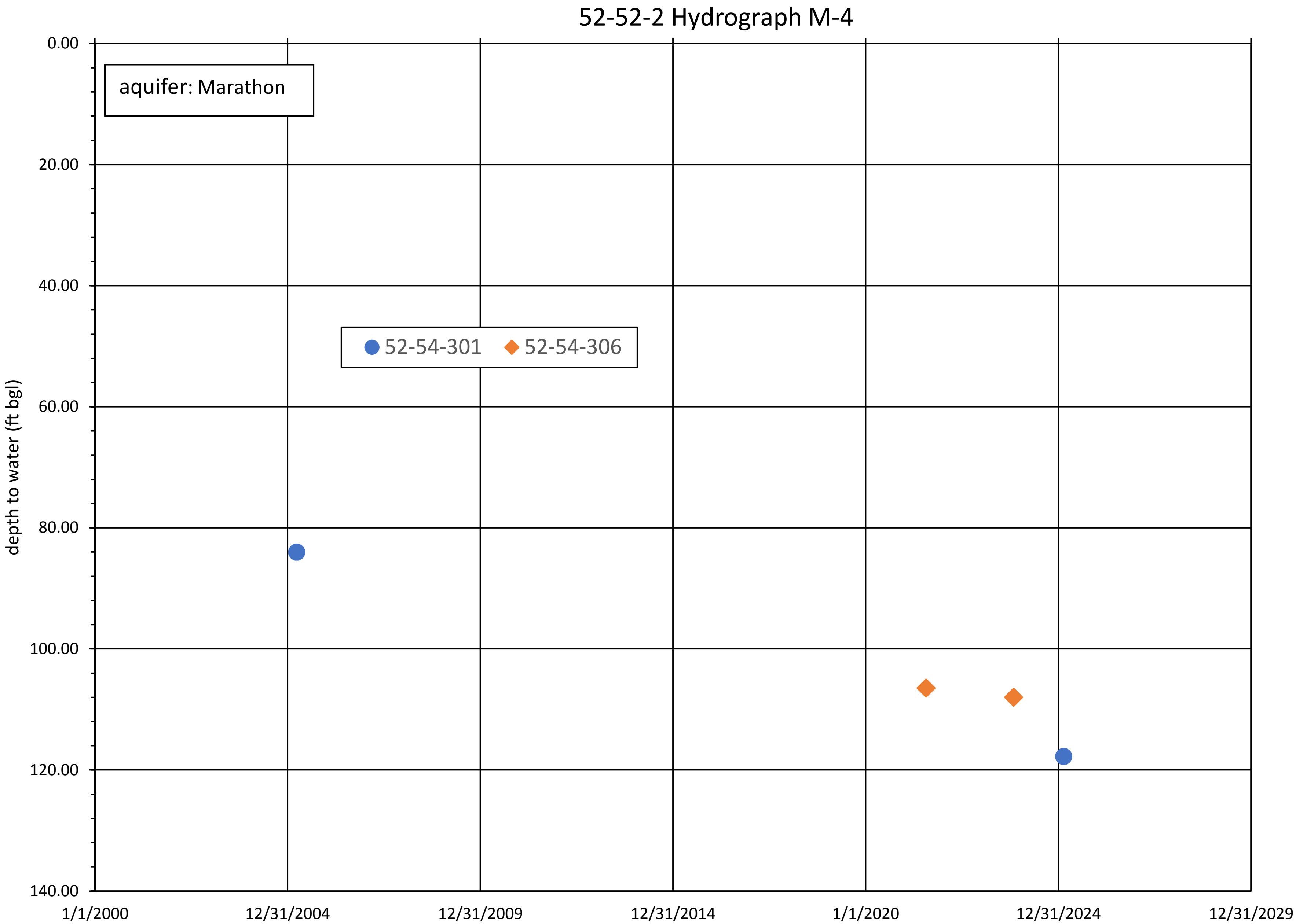
Hydrographs M1 through M9


52-47-6 Hydrograph M-1
aquifer: other
52-47-601
52-47-602
52-47-603
depth to water (ft bgl)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
1/1/1950
1/1/1960
1/1/1970
1/1/1980
1/1/1990
1/1/2000
1/1/2010
1/1/2020
1/1/2030

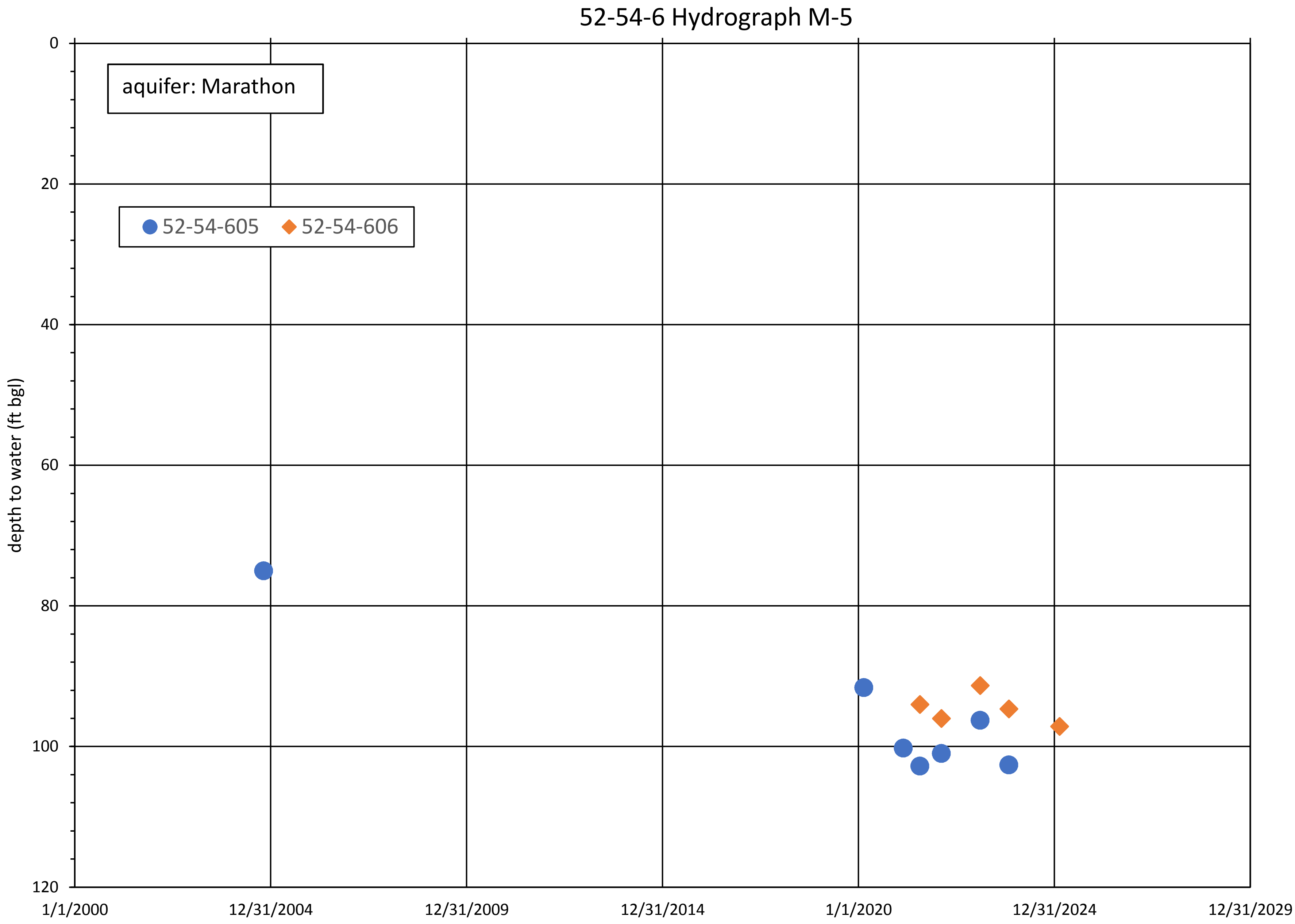

52-48-3 Hydrograph M-2
well depth (ft): 200
aquifer: other
depth to water (ft bgl)
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
1/1/2000
12/31/2004
12/31/2009
12/31/2014
1/1/2020
52-48-301

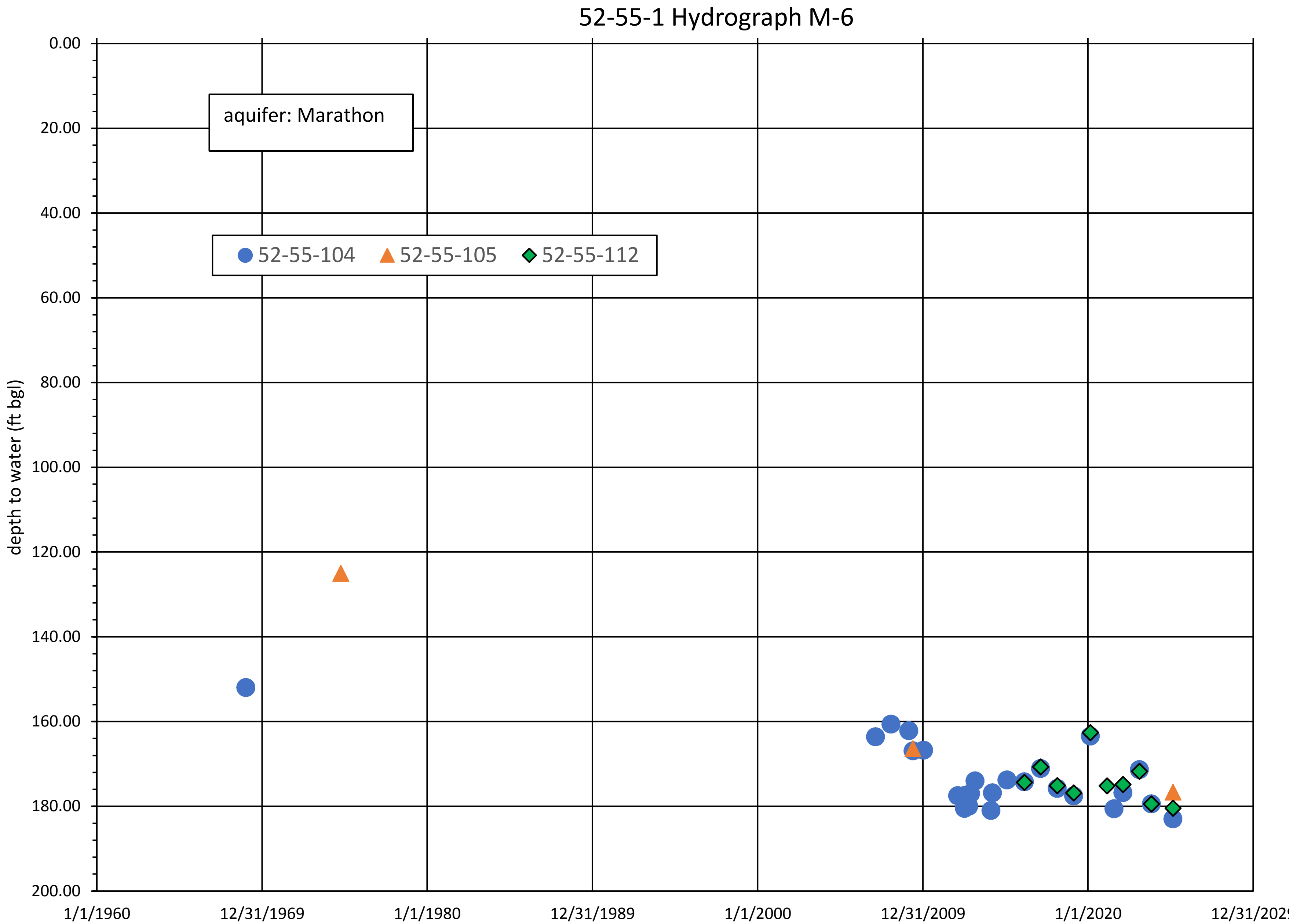


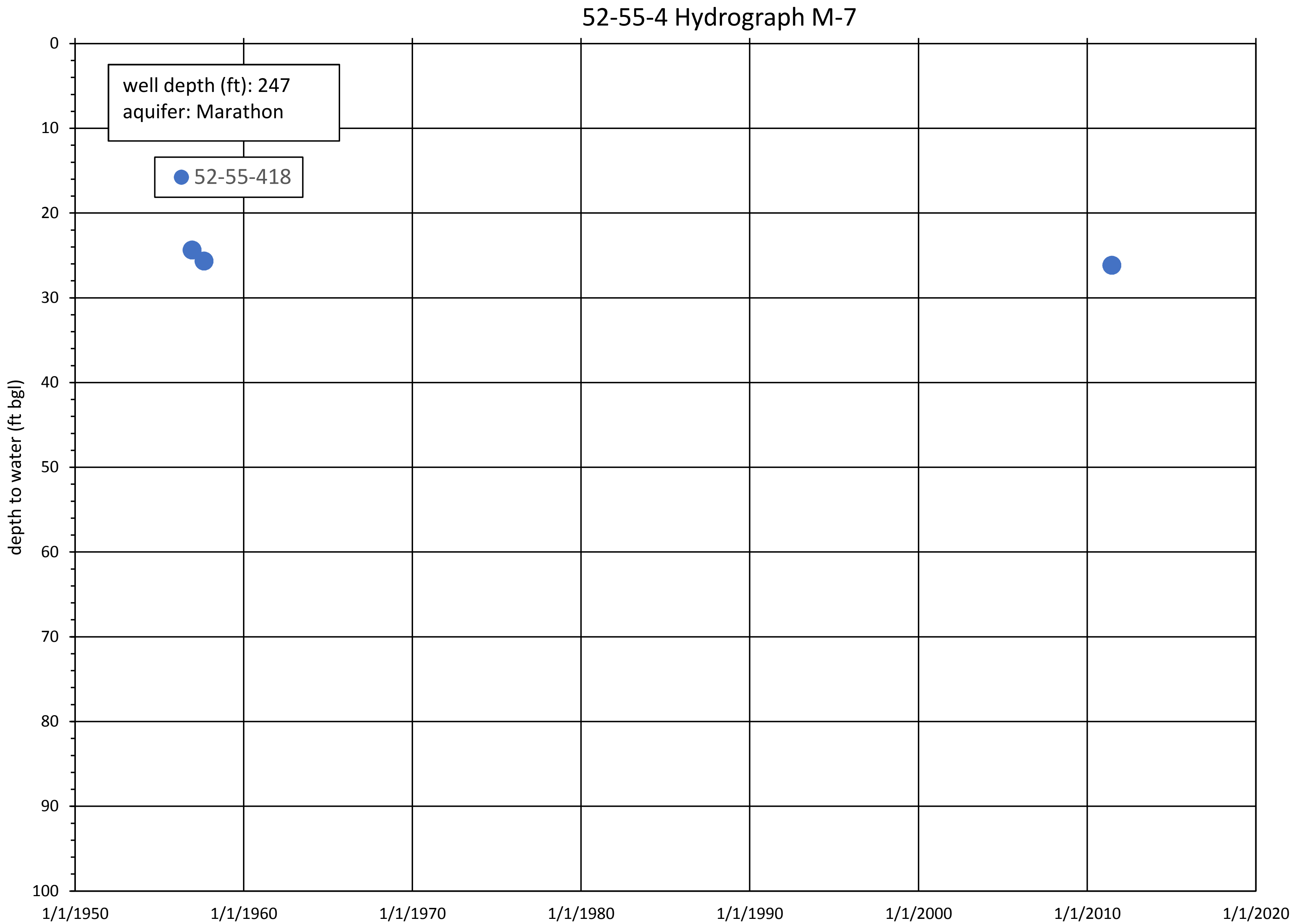
52-48-4 Hydrograph M-3
well depth (ft): 200
aquifer: other
52-48-401
depth to water (ft bgl)
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
2/1/2016
6/15/2017
10/28/2018
3/11/2020
7/24/2021
12/6/2022
4/19/2024
9/1/2025

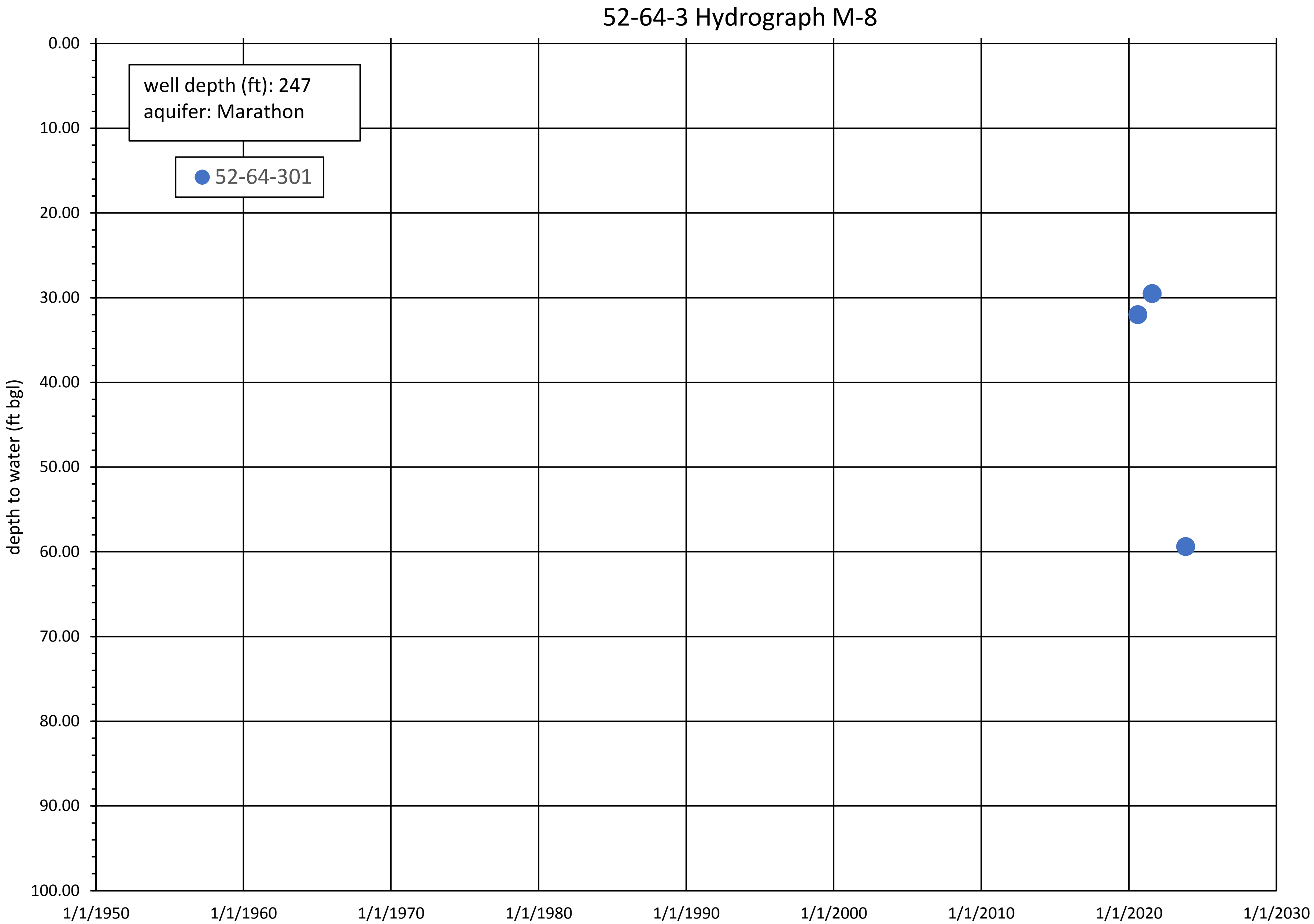


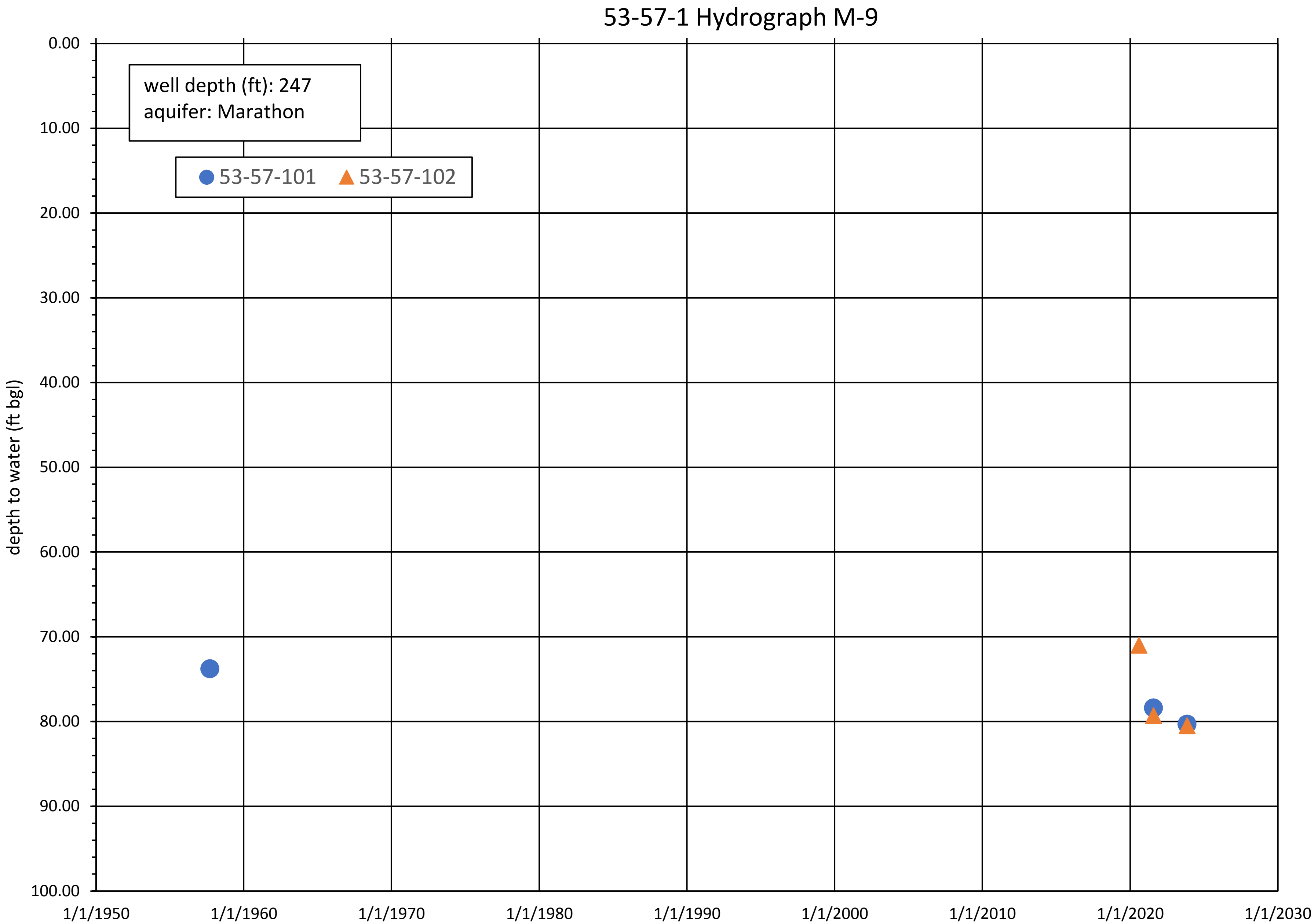
52-52-2 Hydrograph M-4
aquifer: Marathon
52-54-301
52-54-306
depth to water (ft bgl)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
1/1/2000
12/31/2004
12/31/2009
12/31/2014
1/1/2020
12/31/2024
12/31/2029


52-54-6 Hydrograph M-5
aquifer: Marathon
52-54-605
52-54-606
depth to water (ft bgl)
0
20
40
60
80
100
120
1/1/2000
12/31/2004
12/31/2009
12/31/2014
1/1/2020
12/31/2024
12/31/2029


52-55-1 Hydrograph M-6
aquifer: Marathon
52-55-104
52-55-105
52-55-112
depth to water (ft bgl)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
1/1/1960
12/31/1969
1/1/1980
12/31/1989
1/1/2000
12/31/2009
1/1/2020
12/31/2029


52-55-4 Hydrograph M-7
well depth (ft): 247
aquifer: Marathon
52-55-418
depth to water (ft bgl)
0
10
20
30
40
50
60
70
80
90
100
1/1/1950
1/1/1960
1/1/1970
1/1/1980
1/1/1990
1/1/2000
1/1/2010
1/1/2020


52-64-3 Hydrograph M-8
well depth (ft): 247
aquifer: Marathon
52-64-301
depth to water (ft bgl)
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
1/1/1950
1/1/1960
1/1/1970
1/1/1980
1/1/1990
1/1/2000
1/1/2010
1/1/2020
1/1/2030


53-57-1 Hydrograph M-9
well depth (ft): 247
aquifer: Marathon
53-57-101
53-57-102
depth to water (ft bgl)
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
1/1/1950
1/1/1960
1/1/1970
1/1/1980
1/1/1990
1/1/2000
1/1/2010
1/1/2020
1/1/2030

ATTACHMENT 5.

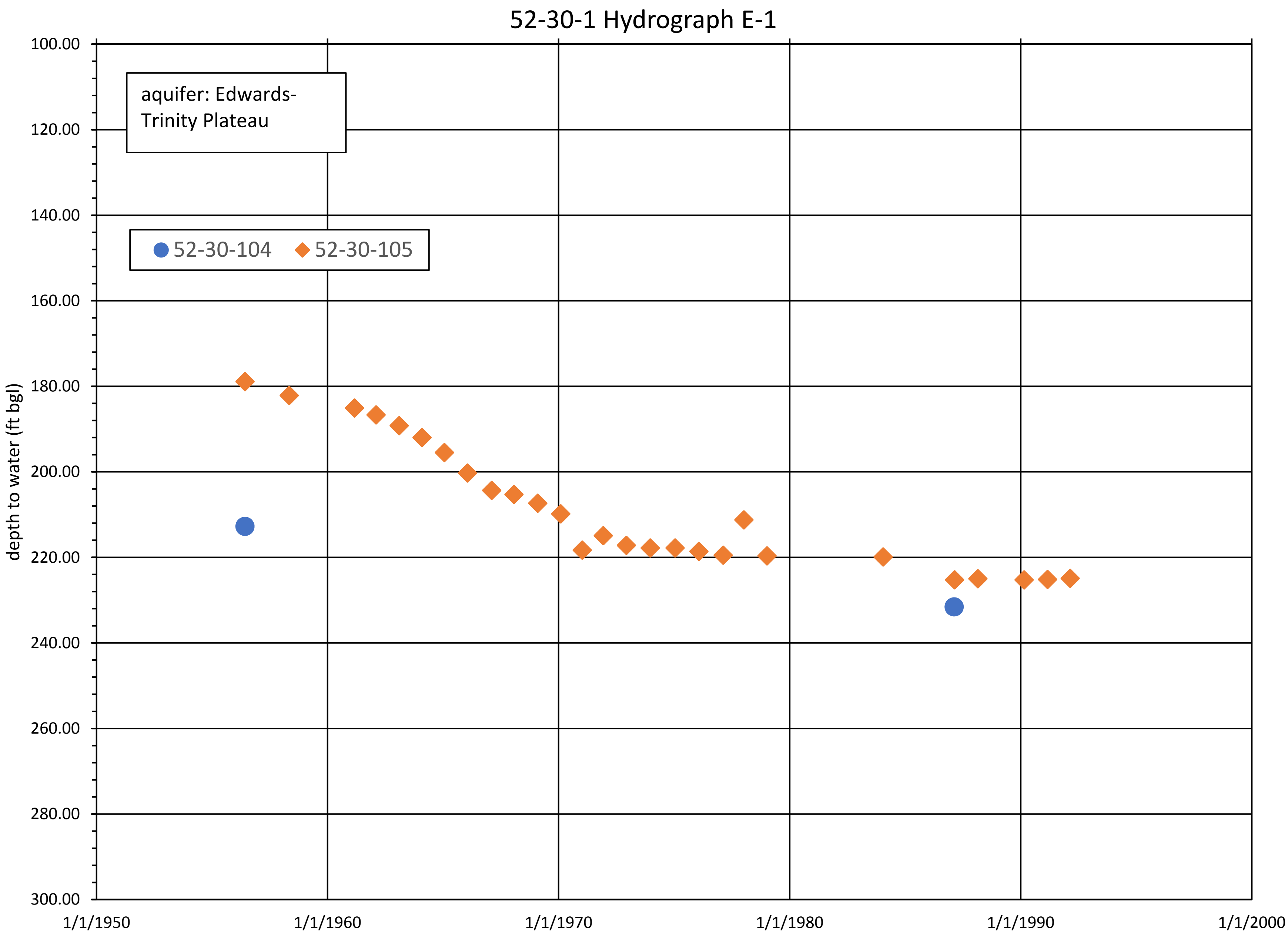
Table 3. Summary of water level trend analysis for Edwards Trinity Plateau Aquifer in Brewster County

Table 3. Water level trend analysis for Edwards Trinity Plateau Aquifer in Brewster County

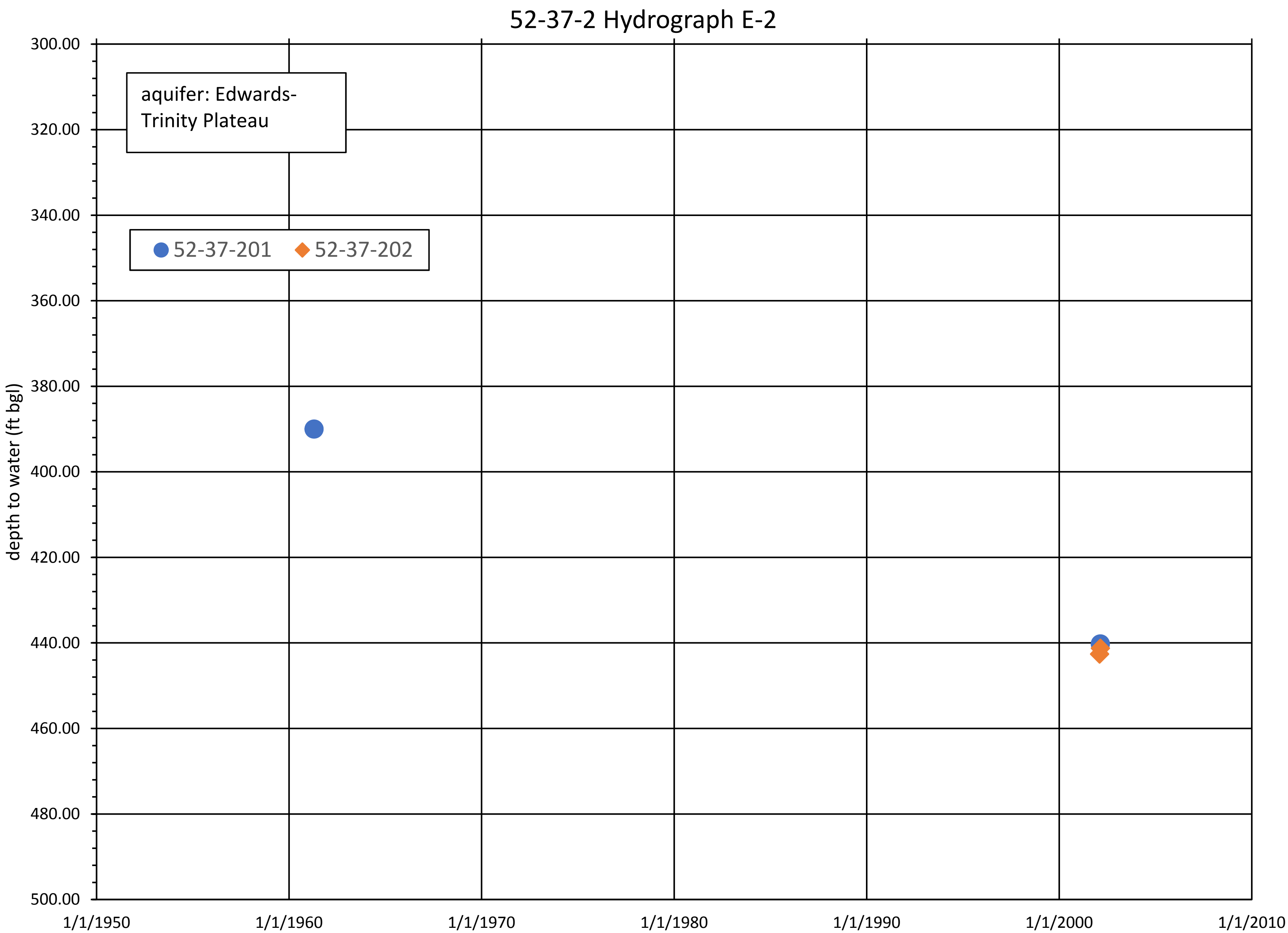
Hydrograph #	State Well Number	Aquifer	Aquifer Code	ObsCode	Well Depth	Latitude DD	Longitude DD	comment	# measurements	time span (years)	water level trend (ft/yr)
E1	52-30-104	Edwards-Trinity	218EDDT	M	313	30.610556	-103.3661	McGill house at Hovey	2	30.7	0.61
E1	52-30-105	Edwards-Trinity	218EDDT	H	300	30.612223	-103.3658	McGill house at Hovey	28	35.7	1.29
E2	52-37-201	Edwards-Trinity	210CRCS	M	510	30.485834	-103.4436	Four S Ranch	2	40.8	1.23
E2	52-37-202	Edwards-Trinity	210CRCS	M	600	30.4853028	-103.4442	Four S Ranch	2		
E3	53-41-501	Edwards-Trinity	100ALVM	H	121	30.2983333	-102.9417		54	4.7	1.72
E4	53-50-601	Edwards-Trinity	218EDRDA	D	312	30.1713889	-102.7808	MPGCD Obs well	110	9.4	0.77
E5	72-25-502	Edwards-Trinity		C	428	29.5753389	-102.9362	Black Gap Wildlife Management Area	14	12	0.11
E6	73-24-802	other	110AVCC	C	86	29.6261111	-103.0533	Black Gap Wildlife Management Area	9	2.8	0.73
										AVG DDN=	0.92
										MEDIAN DDN	0.77

ATTACHMENT 6.

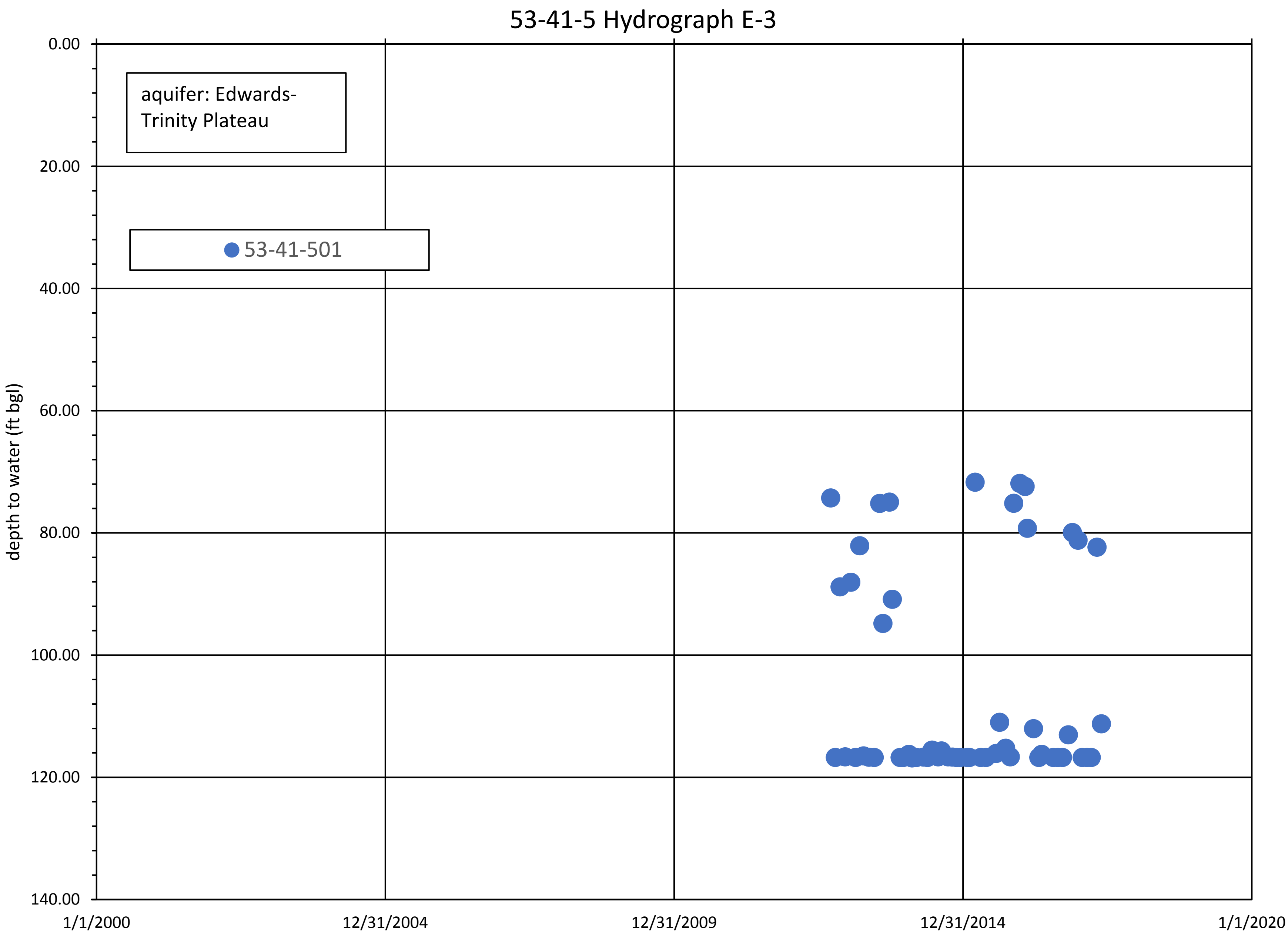
Hydrographs E1 through E6

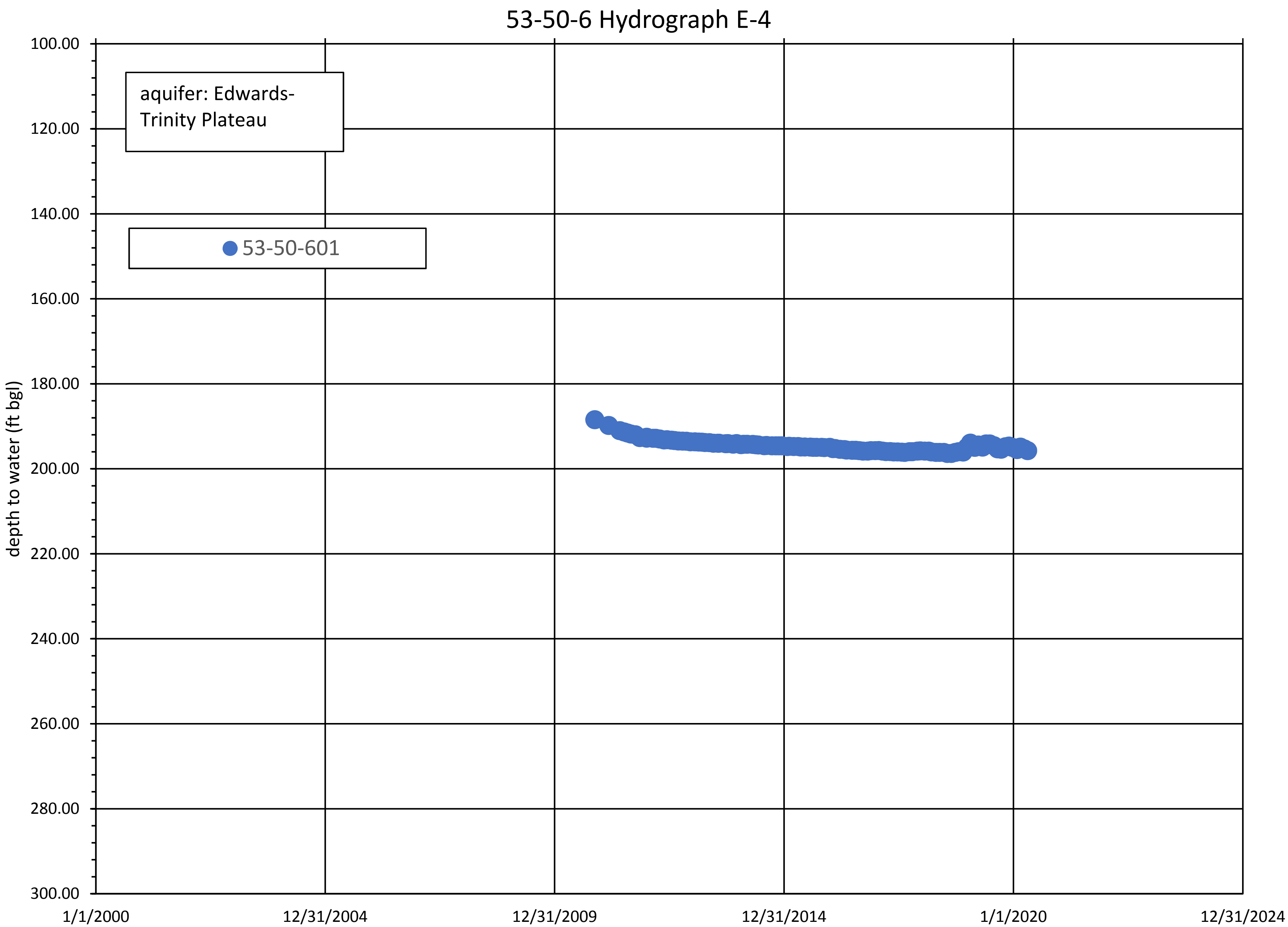


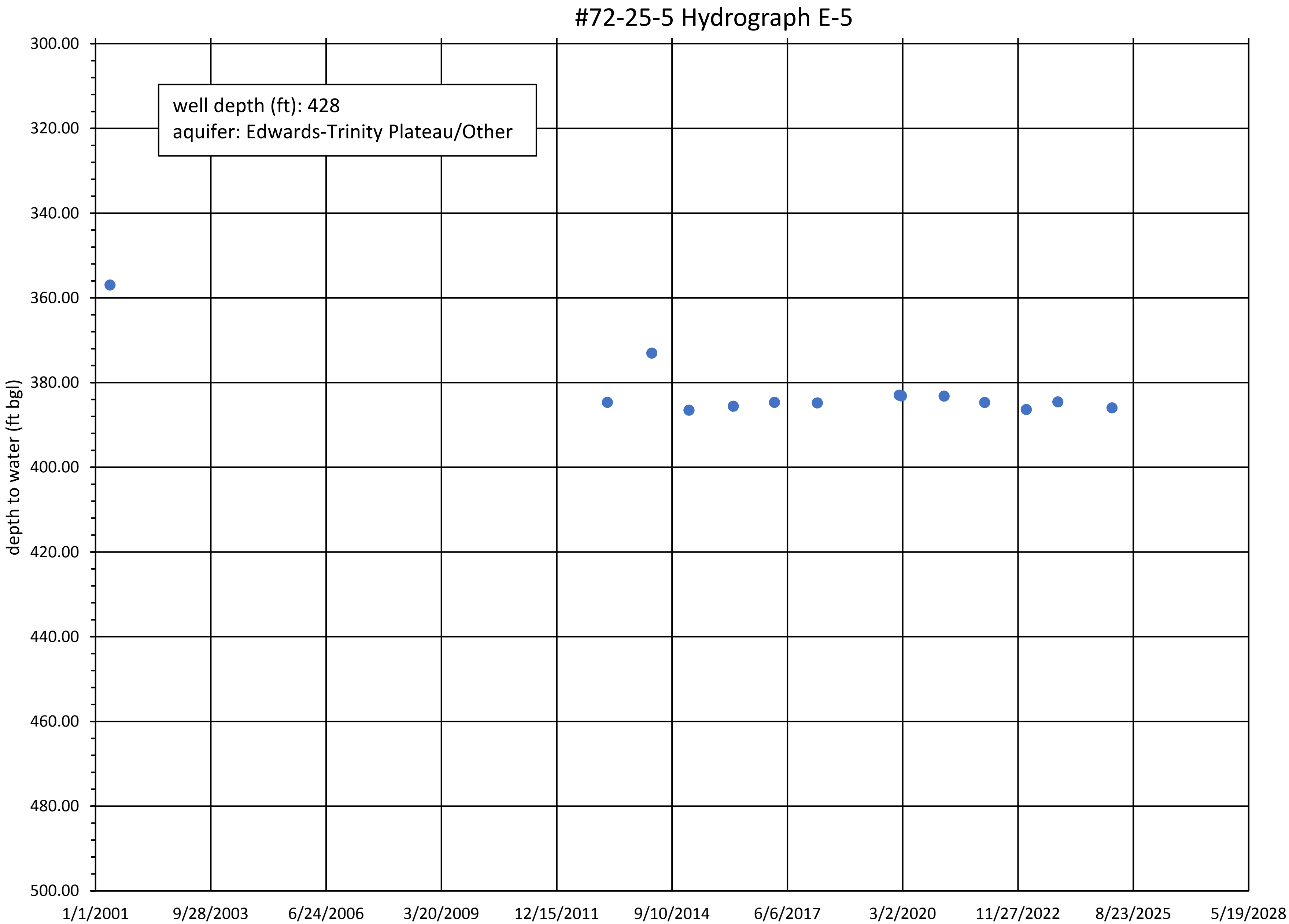
52-30-1 Hydrograph E-1
aquifer: Edwards-Trinity Plateau
52-30-104
52-30-105
depth to water (ft bgl)
100.00
120.00
140.00
160.00
180.00
200.00
220.00
240.00
260.00
280.00
300.00
1/1/1950
1/1/1960
1/1/1970
1/1/1980
1/1/1990
1/1/2000



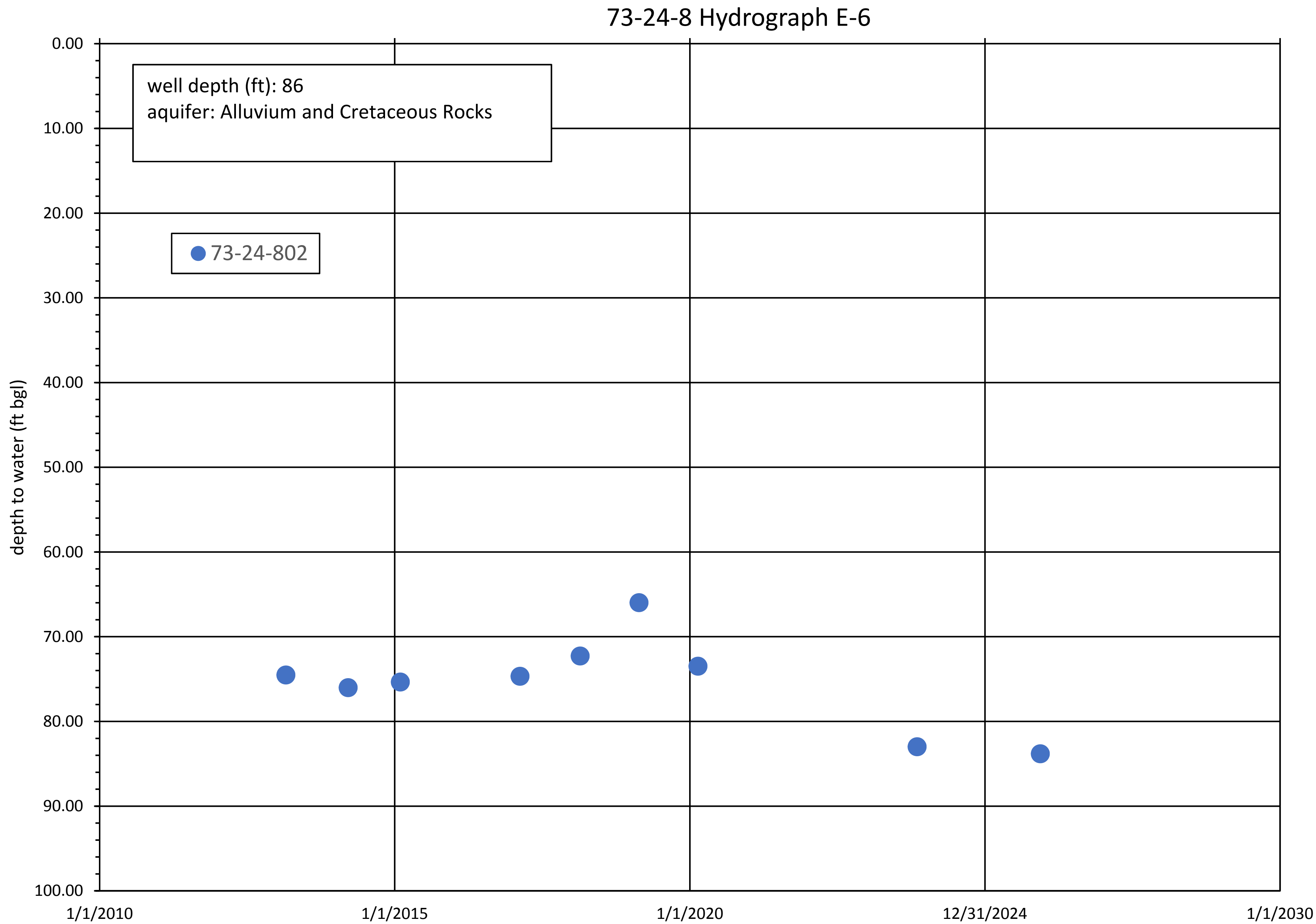
52-37-2 Hydrograph E-2
aquifer: Edwards-Trinity Plateau
52-37-201
52-37-202
depth to water (ft bgl)
300.00
320.00
340.00
360.00
380.00
400.00
420.00
440.00
460.00
480.00
500.00
1/1/1950
1/1/1960
1/1/1970
1/1/1980
1/1/1990
1/1/2000
1/1/2010


53-41-5 Hydrograph E-3
aquifer: Edwards-
Trinity Plateau
53-41-501
depth to water (ft bgl)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
1/1/2000
12/31/2004
12/31/2009
12/31/2014
1/1/2020


53-50-6 Hydrograph E-4
aquifer: Edwards-Trinity Plateau
53-50-601
depth to water (ft bgl)
100.00
120.00
140.00
160.00
180.00
200.00
220.00
240.00
260.00
280.00
300.00
1/1/2000
12/31/2004
12/31/2009
12/31/2014
1/1/2020
12/31/2024



#72-25-5 Hydrograph E-5
well depth (ft): 428
aquifer: Edwards-Trinity Plateau/Other
depth to water (ft bgl)
300.00
320.00
340.00
360.00
380.00
400.00
420.00
440.00
460.00
480.00
500.00
1/1/2001
9/28/2003
6/24/2006
3/20/2009
12/15/2011
9/10/2014
6/6/2017
3/2/2020
11/27/2022
8/23/2025
5/19/2028



73-24-8 Hydrograph E-6
well depth (ft): 86
aquifer: Alluvium and Cretaceous Rocks
73-24-802
depth to water (ft bgl)
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
1/1/2010
1/1/2015
1/1/2020
12/31/2024
1/1/2030

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Texas Firm Registration 50308

STATE OF TEXAS
STEVEN T. FINCH, JR.
GEOLOGY
5302
LICENSED
PROFESSIONAL GEOSCIENTIST

TECHNICAL MEMORANDUM

To: Haley Davis, General Manager
Culberson County GCD generalmanager@ccgwcd.com

From: Steven T. Finch, CPG, PG, Principal Hydrogeologist

Date: April 14, 2026

Subject: Culberson County GCD Drawdown Analysis and MAG

Within the boundaries of Culberson County Groundwater Conservation District (Culberson County GCD) there are three Texas Water Development Board (TWDB) designated minor aquifers and one TWDB designated major aquifer:

Minor Aquifers

1. Capitan Reef Complex
2. Igneous
3. West Texas Bolsons

Major Aquifer

1. Edwards-Trinity (Plateau)

A map showing the distribution of these designated aquifers in Culberson County GCD is presented as Figure 1. The fringes of the Igneous and Edwards –Trinity (Plateau) aquifers appear in the rural undeveloped portions of Culberson County GCD, populated with very few exempt wells and extremely limited water level data.

The primary aquifer in Culberson County GCD with production permits is the West Texas Bolsons, in particular the portions referred to as Lobo, Wildhorse, and Michigan Bolsons. The Capitan Reef Complex aquifer is primarily used to support ranching, with the exception of one irrigation farm the straddles the Hudspeth-Culberson County line.

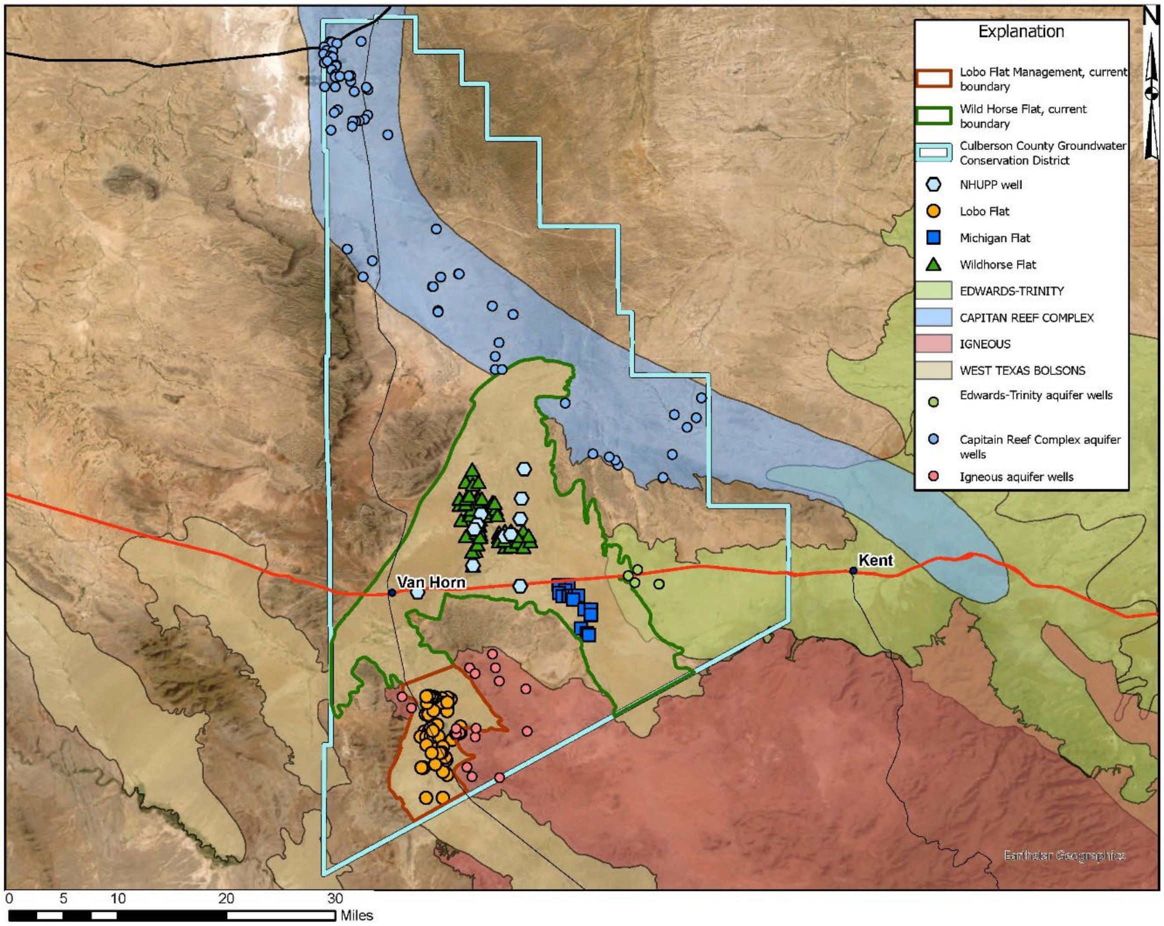

Figure 1. Map showing Culberson County GCD boundary, designated aquifers, HUPP wells, and wells with water level data.

Previous GMA-4 planning cycle (Hutchison, 2021) the following Culberson County GCD DFCs were proposed and adopted for the period from 2010-2060:

- 50-ft drawdown for the Capitan Reef Complex
- 78-ft drawdown for the Salt Basin portion of the West Texas Bolsons
- 66-ft drawdown for the Igneous Aquifer
- The Edwards Trinity (Plateau) and Upper Salt Basin were classified as non-relevant for joint planning purposes.

For the current planning cycle (2030-2080), Culberson County GCD proposes to retain the DFC of 78 ft for West Texas Bolsons, and proposes the remaining designated aquifers to be considered non-relevant, for the reasons described above.

Aquifer Drawdown Analysis

Culberson County GCD performs monthly water level monitoring on four wells in the West Texas Bolsons, and the TWDB performs monitoring on 21 wells completed in the West Texas Bolsons within Culberson County GCD. Figure 2 is a map showing the locations of water level monitoring points for the West Texas Bolsons aquifer.

A drawdown trend analysis was performed on the wells with current and historical water level data. Table 1 is a summary of the trend analysis.

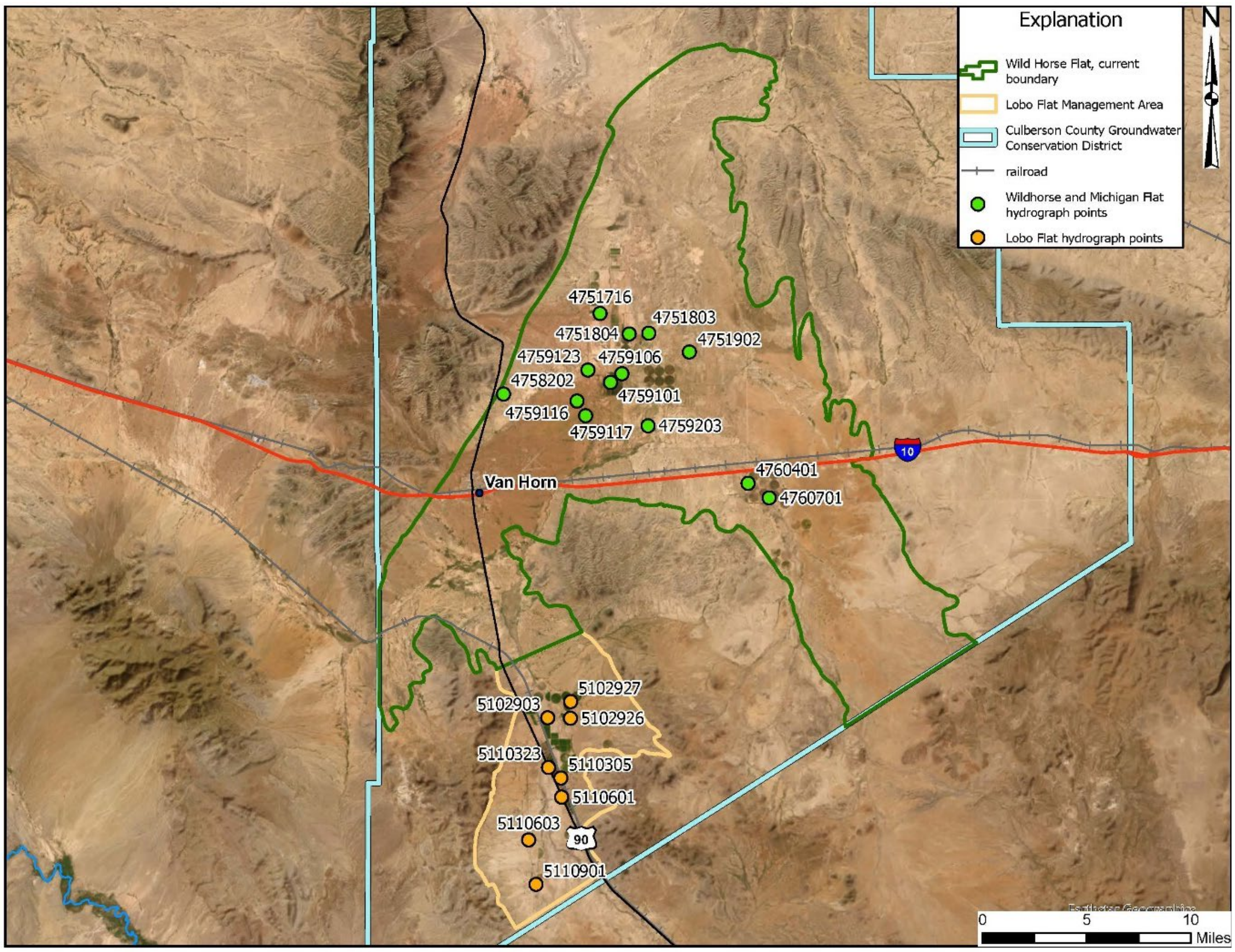

Figure 2. Map of West Texas Bolsons in Culberson County GCD and wells with data used for water level trend analysis.

Table 1. Summary of water level trend analysis for West Texas Bolsons in Culberson County GCD

TWDB #	bolson	Number of points	timeframe	Current water-level trend (ft), positive = decline; negative = rise	drawdown rate (ft/yr)	50 year Projected drawdown (FT)
4751803	Wildhorse	76	1953-2026	50.81	0.70	35
4759123	Wildhorse	3223	1994-2025	14.99	0.48	24
4759203	Wildhorse	81	1950-2025	49.80	0.66	33
4751716	Wildhorse	58	1953-2025	50.60	0.70	35
4751804	Wildhorse	54	1953-2020	21.45	0.32	16
4751902	Wildhorse	58	1953-2025	45.22	0.63	32
4758202	Wildhorse	19	1980-2023	14.97	0.35	18
4759101	Wildhorse	57	1953-2021	46.89	0.69	35
4759106	Wildhorse	60	1953-2023	22.28	0.32	16
4759116	Wildhorse	23	1993-2024	39.47	1.27	64
4759117	Wildhorse	34	1993-2025	20.34	0.64	32
4760701	Michigan	42	1970-2024	30.51	0.55	28
4760401	Michigan	51	2021-2026	1.51	0.30	15
5110901	Lobo	54	1953-2014	67.60	1.11	56
5110603	Lobo	65	1951-2025	86.43	1.17	59
5102926	Lobo	55	1957-2025	162.38	2.39	120
5102927	Lobo	68	1958-2026	162.01	2.38	119
5110305	Lobo	478	1960-2026	87.85	1.33	67
5102903	Lobo	62	1950-2025	168.16	2.24	112
5110323	Lobo	59	1954-2020	142.13	4.30	215
5110601	Lobo	163	1949-2006	72.88	1.28	64
			average =	**64.7**	**1.1**	**57**
			median =	**49.8**	**0.7**	**35**
					proposed DFC =	**78**

Proposed Method for Calculating the MAG

For the current GMA-4 planning cycle, there is not an available representative and calibrated Groundwater Availability Model (GAM) for the Igneous-Bolsons aquifers. For the West Texas Bolsons in Culberson County GCD, a groundwater storage calculation is proposed for calculating the fresh groundwater storage and Modeled Available Groundwater (MAG). The storage calculation method is described as follows:

1. Using available GIS datasets from Beach et al. (2006), define the total depth of the unconsolidated fill for the WTB area
2. Using recent water-level data, calculate the saturated thickness of the WTB aquifer in Culberson County GCD (Fig. 3).
3. Calculate the area for each saturated thickness interval of 200 ft.
4. Use a storage coefficient of 0.08 for calculating the groundwater volume
5. Calculate the available groundwater storage (Table 2)
6. Use the area for 0 to 200 ft saturated thickness and DFC of 78 to calculate the MAG [MAG=((78 ft*area ft^2*0.08)/(43,560 ft/acre))/50 years = ac-ft/yr]

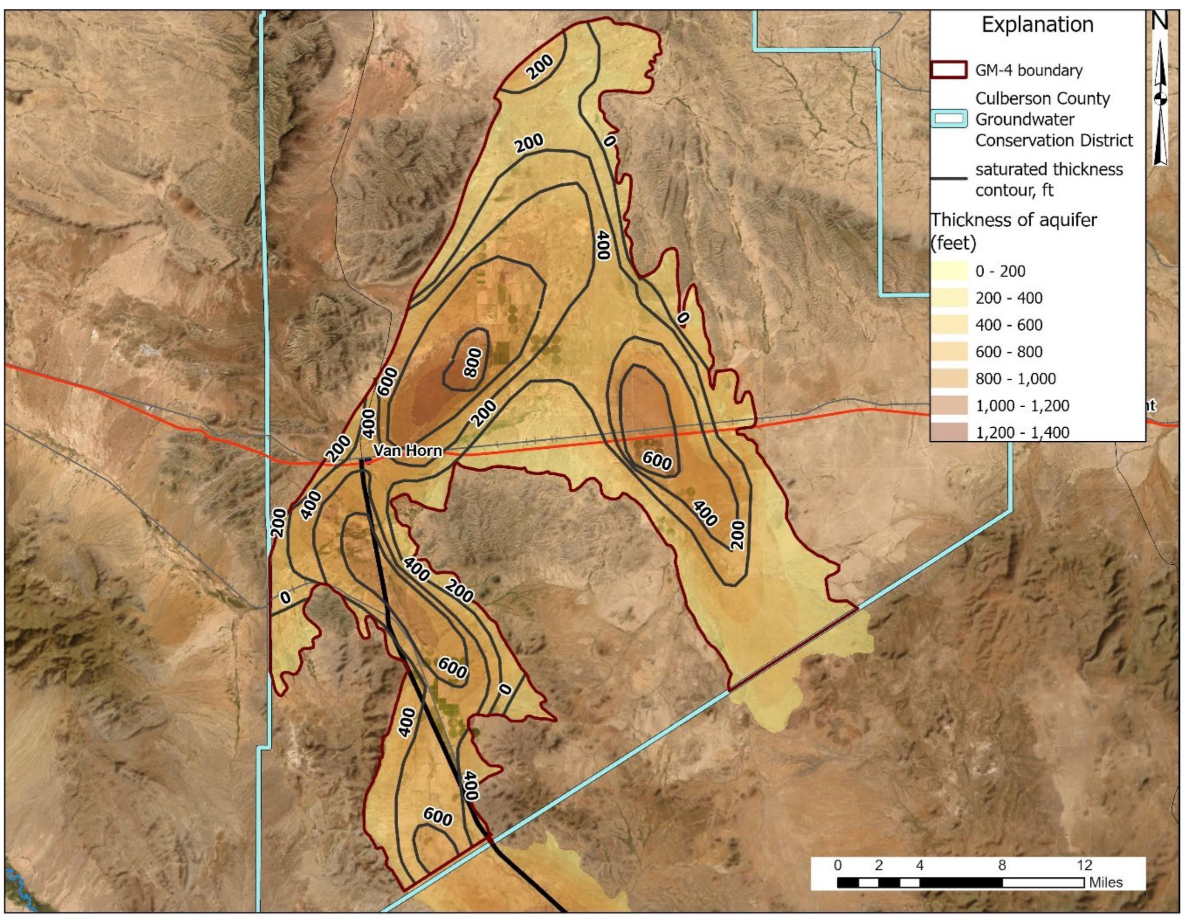

Figure 3. Saturated thickness of West Texas Bolson auifer in Culberson County GCD.

Table 2. Summary of groundwater volume calcuations for West Texas Bolsons in Culberson County GCD

saturated thickness Contour interval (ft)	area (mi^2)	area (acres)	average saturated thickness (ft)	S=0.08 interval volume (ac-ft)
0	33.60	21,501	0	0
0-200	438.59	280,698	100	2,245,581
200-400	294.41	188,422	200	3,014,758
400-600	187.27	119,853	200	1,917,645
600-800	71.72	45,901	200	734,413
>800	4.52	2,895	100	23,163
			TOTAL =	**7,935,560**

The Modeled Available Groundwater (MAG) was calculated as follows

DFC = 78 ft over 50 years

= 1.56 avg rate (ft/yr)

DFC_vol (MAG) = 78 ft *280,698 acres * 0.08 = 1,751,553 acre feet for 50 years

DFC_MAG = 1,751,553 acre feet / 50 years = 35,031 ac-ft/yr

Summary

The water level trend analysis supports a DFC of 78 ft for the West Texas Bolsons in Culberson County GCD. The calculated average rate of drawdown has been 1.1 ft per year, which projects to a total drawdown of 57 ft for the next 50 years. A DFC of 78 ft should accommodate the exercise of all permitted Historical Use Production Permits in Culberson County GCD.

Using the DFC, current water level data, and groundwater storage calculations results in a calculated MAG that allows for reasonable management of permitted Historical Use Production Permits in Culberson County GCD. The calculated MAG of 35,031 ac-ft/yr is similar to the last planning cycle, and represents the West Texas Bolson aquifer system in Culberson County GCD.

References

Beach, J.A., Ashworth, J.B., Finch, S.T., Chastain-Howley, A., Calhoun, K., Urbanczyk, K.M., Sharp, J.M., and Olson, J., 2004, Groundwater availability model for the igneous and parts of the west Texas Bolsons (Wild Horse Flat, Michigan Flat, Ryan Flat and Lobo Flat) aquifers: Contract report to the Texas Water Development Board, 407 p., http://www.twdb.texas.gov/gam/bol_ig/IGBL_GAM_Full_Report.pdf

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Gates J. S., White, D. E., Stanley, W. D., and Ackermann, H. D., 1978, Availability of fresh and slightly saline ground water in the basins of westernmost Texas: U. S. Geological Survey, Open-File Report 78-663, 115 p.

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TWDB database, twdb.texas.gov

Technical Memo

2026 Water Level Decline Analysis in Jeff Davis County for GMA 4 Desired Future Condition Recommendations

Prepared for:

Jeff Davis County Underground Water Conservation District

Prepared by:

RMBJ Geo

Texas Geoscience Firm #50024

Amy Bush, P.G. #15289

Contents

Introduction

Jeff Davis County Underground Water Conservation District (District) has been analyzing their water level decline to track achievement of their Desired Future Conditions (DFC) since 2017. They have been an active participant in their Groundwater Management Area (GMA) since inception. This round of GMA planning revealed some issues with the existing and developing groundwater models in the region, which left water level analysis as the best available science. This 2026 update to the District's water level analysis serves a twofold purpose. First, the data shows the District is still on track to meet the previously set DFCs. In Jeff Davis County, the DFCs for the last cycle were stated as "20 feet drawdown from 2010 to 2060" for the Igneous Aquifer, and "72' from 2010 to 2060" in the West Texas Bolsons Aquifer. This is the fifth time this type of analysis has been performed in the District since 2017. The District's Board remains committed to tracking their achievement of the DFCs, especially in light of the new statutory requirements in HB 2078. Secondly, the water level data will inform the decisions to set the GMA 4 DFCs this planning round. This same data shows the District can achieve the DFCs, which is one of the elements required to be considered when setting a DFC.

Description and Results of Analysis

Texas Water Development Board measures 29 wells in Jeff Davis County. These wells are located in the Igneous, West Texas Bolsons, Alluvium, and Cretaceous aquifers. The Igneous and West Texas Bolsons aquifers are the subject of this analysis, since those are the aquifers that require a DFC to be set. During 2026, there were 20 wells measured in the Igneous Aquifer, and 5 wells measured in the West Texas Bolsons Aquifer within the county.

A hydrograph was created for each of these wells and analyzed for static change, 5-year change, 10-year change, 5-year trend rate, 10-year trend rate, and the period of record trend rate. The table showing these calculated numbers is below in Tables 1 and 2. All hydrographs are attached in Appendix A. The average for these metrics for all wells in each aquifer was then compared to the DFC from the last planning cycle. In the Igneous Aquifer, there were a few wells that had a very short period of record that were skewing the long-term trend; therefore, that dataset was analyzed within several time periods. The results of those analyses are shown below in Tables 3 and 4 and Figures 1 and 2.

State Well Number	Aquifer	Year	Depth	Static Change	5 Year Change	10 Year Change	5 Year Trend	10 Year Trend	Total Trend	Total Years
5225327	120IGNS	2026	-63.56	2.98					-1.29	4
5235104	120IGNS	2026	-144.1	5.53					-2.79	4
5119801	120VLCC	2026	-165.2	3.88					-2.2	4
5127201	120VLCC	2026	-294	-0.33					-0.44	4
5209501	120VLCC	2026	-213.9	0.45					-0.06	4
5225209	120VLCC	2026	-139.9	1.22	-1.11	-2.15	-0.29	-0.34	-0.28	28
5132403	120VLCC	2026	-147.6	8.83					-0.94	31
5225604	120VLCC	2026	-67.37	2.56	-1.29	-3.2	-0.56	-0.43	-0.02	31
5226704	120VLCC	2026	-43.16	1.31	-2.14	50.59	-0.9	4.8	0.03	31
5226706	120VLCC	2026	-151.7	-0.8		-4.54	-0.65	-0.59	-0.44	31
5225501	120IGNS	2026	-170.1	-0.79	-4.61	-26.19	-1.17	-3.84	-0.61	32
5122701	120VLCC	2026	-95.61	-2.16	-13.49	-29.61	-3.43	-3.28	-1.77	32
5122801	120VLCC	2026	-157.6	-2.06	-10.72	-29.32	-2.83	-3.22	-1.69	33
5225603	120VLCC	2026	-49.73	1.17	-0.72	-3.88	-0.32	-0.44	-0.33	33
5225612	120VLCC	2026	-129.1	2.44	-0.23	-2.78	-0.31	-0.38	-0.07	43
5226802	120VLCC	2026	-155.4	-6.62		33.5	6.96	5.68	-0.69	45
5225305	120IGNS	2026	-61.32	2.96	-3.54	-10.07	-1.29	-1.12	-0.27	48
5225801	120VLCC	2026	-120.3	-0.45		-3.15	-0.54	-0.35	-0.16	49
5225308	120VLCC	2026	-11.23	1.6	0.93	0.12	0.06	-0.04	-0.02	60
5127302	120VLCC	2026	-71.8	-0.45	-2.25	-6.15	-0.58	-0.78	0.24	72

Table 1. Igneous Aquifer Wells Analysis Data

State Well Number	Aquifer	Year	Depth	Static Change	5 Year Change	10 Year Change	5 Year Trend	10 Year Trend	Total Trend	Total Years
5119101	112SLBL	2026	-144.49	-3.19	-1.4	-2.19	-0.06	-0.12	0.19	77
5119203	112SLBL	2026	-226.69	-0.62	-2.43	-4.57	-0.63	-0.5	-0.62	76
5119902	112SLBL	2026	-111.42	0.21	0.1	-0.57	0.01	-0.08	0.04	72
5128303	112SLBL	2026	-333.29	0.26	2.26	1.01	0.74	-0.05	0.48	48
5128607	112SLBL	2026	-231.03	0.1	0.56	0.37	0.19	0.02	0.46	47

Table 2. West Texas Bolsons Aquifer Wells Analysis Data

	Static Change	5 Year Change	10 Year Change	5 Year Trend	10 Year Trend	Total Trend	Total Years
Igneous Aquifer Averages	**0.96**	**-3.56**	**-2.06**	**-0.35**	**-0.25**	**-0.71**	**30**
Igneous 30 Yr + Averages	**0.54**	**-3.81**	**-2.67**	**-0.43**	**-0.31**	**-0.48**	**41**
Igneous 40 Yr + Averages	**-0.09**	**-1.27**	**1.91**	**0.72**	**0.50**	**-0.16**	**53**
Igneous Aquifer 2021 DFC	**20' from 2010 - 2060**					**-0.4**	**50**

Table 3. Igneous Aquifer Averages and 2021 DFC

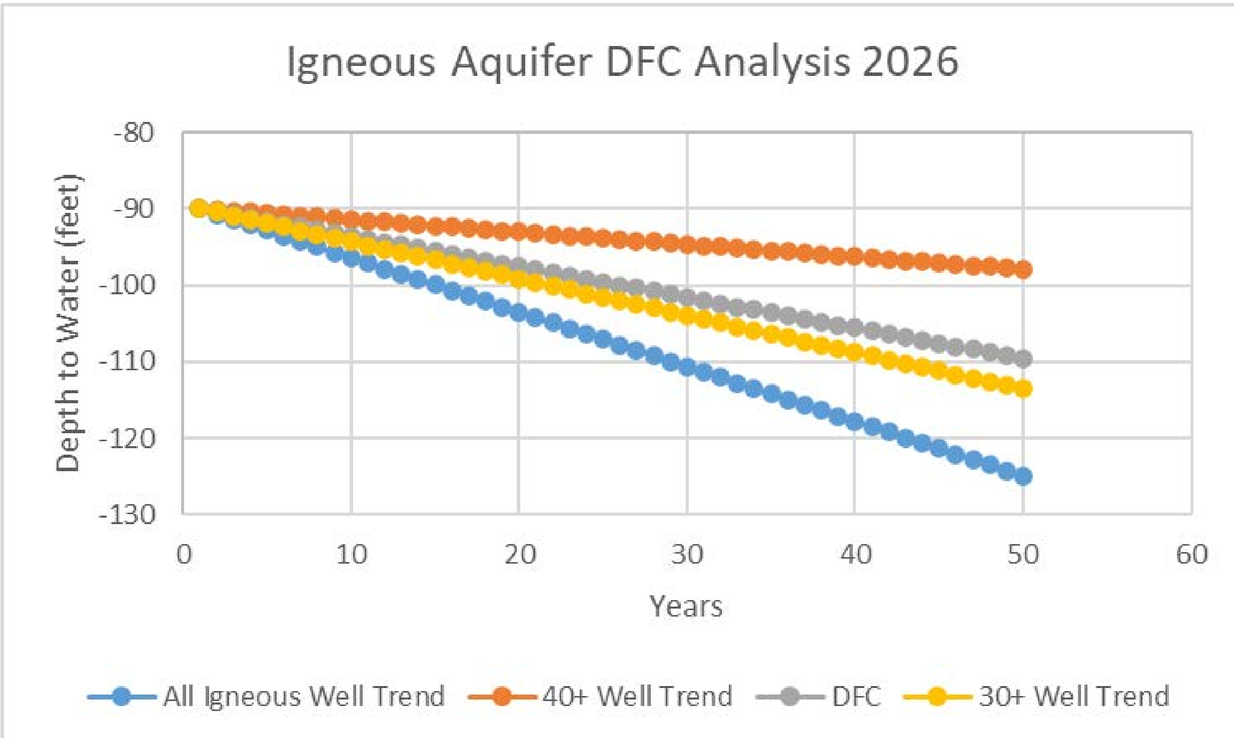


Figure 1. Igneous Aquifer 2021 DFC vs Water Level Decline Analysis

	Static Change	5 Year Change	10 Year Change	5 Year Trend	10 Year Trend	Total Trend	Total Years
West Texas Bolson AVG	-0.65	-0.18	-1.19	0.05	-0.15	0.11	64
West Texas Bolson 2021 DFC	72' from 2010 - 2080					-1.44	50

Table 4. West Texas Bolsons Aquifer Averages and 2021 DFC

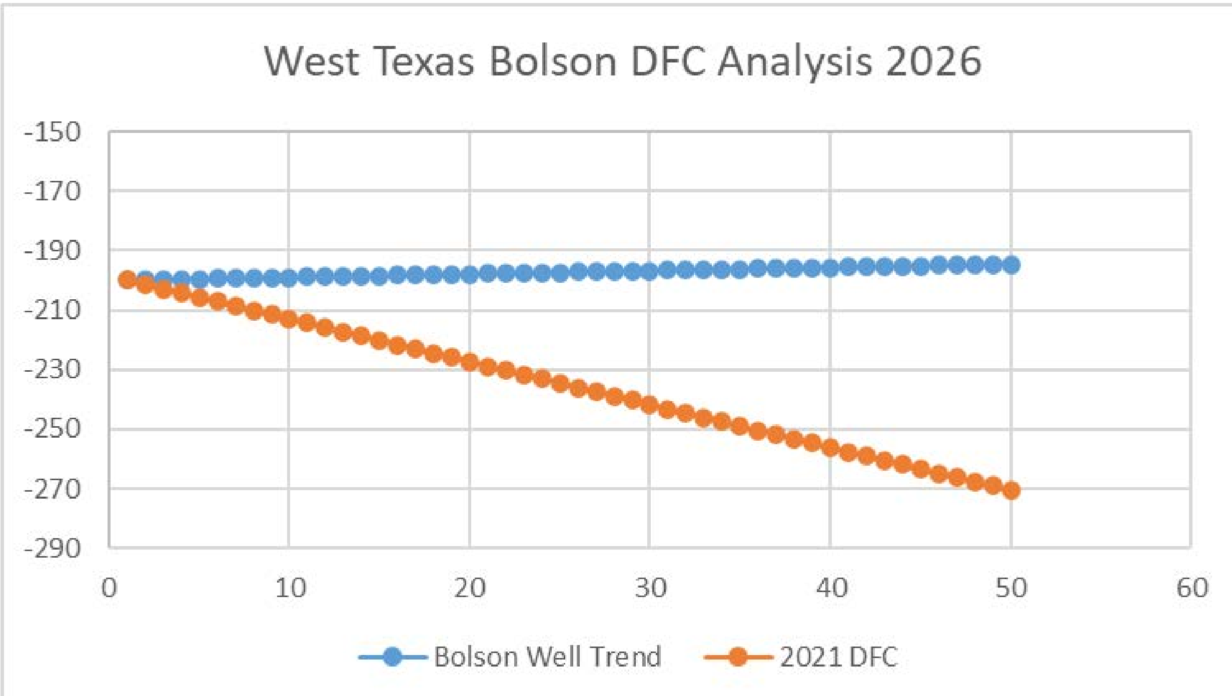


Figure 2. West Texas Bolsons Aquifer 2021 DFC vs Water Level Decline Analysis

Recommendations

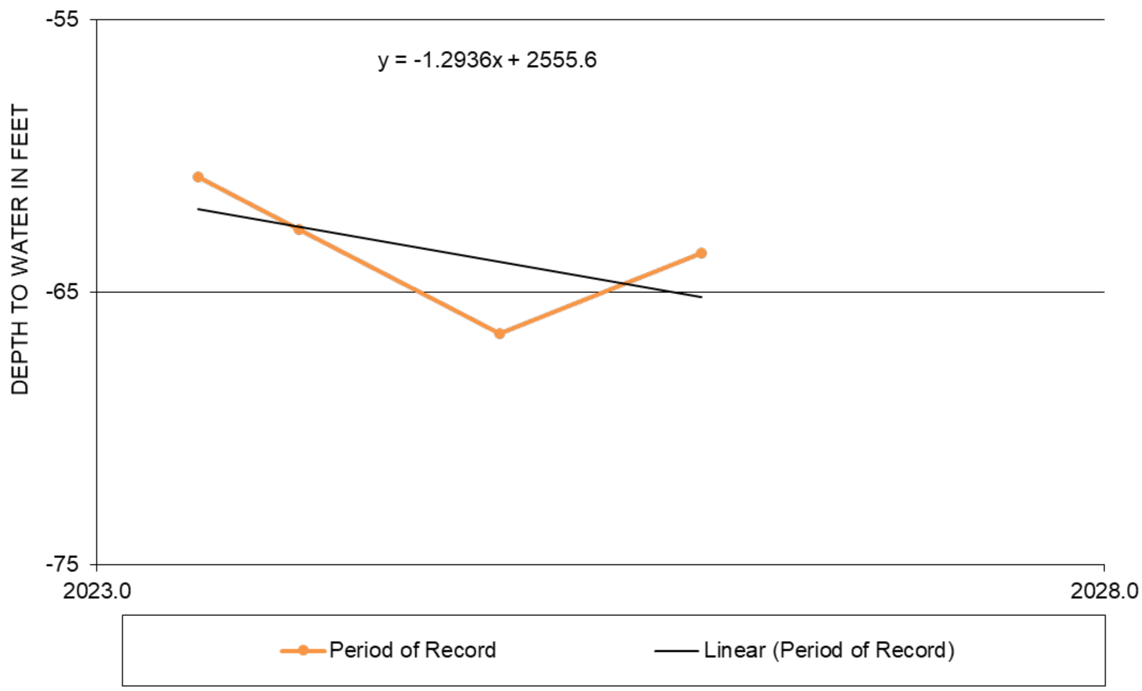
The District recommends using the long-term trend numbers for each aquifer to set the 2026 DFCs in this District. HB 2078 requires the DFC to cover the time period of 2030 to 2080, and GMA 4 has elected to use those years to set the DFC. Using the long-term trend multiplied by 50 years gives a reasonable assumption of possible decline in the aquifers for that 50-year period.

However, in the West Texas Bolsons Aquifer, the long-term trend indicates the water level is, on average, rising 0.11 feet per year. It is not feasible for the District to set a goal of a rising water level. Examination of the data shows four out of the five wells measured indicate a rising water level. These wells have all been measured for a very long period of time, and even the shorter-term trends show minimal decline. For this reason, the District recommends using the long-term trend of well number 51-19-203, which shows a worst-case scenario of water level decline. That well is declining on average 0.62 feet per year, so extrapolating that average decline over 50 years would be a decline of 31 feet in 50 years. The District recommends the DFC be set as 31 feet of decline from 2030 – 2080. This is significantly less than the previous DFC despite using the worst-case scenario of measured data.

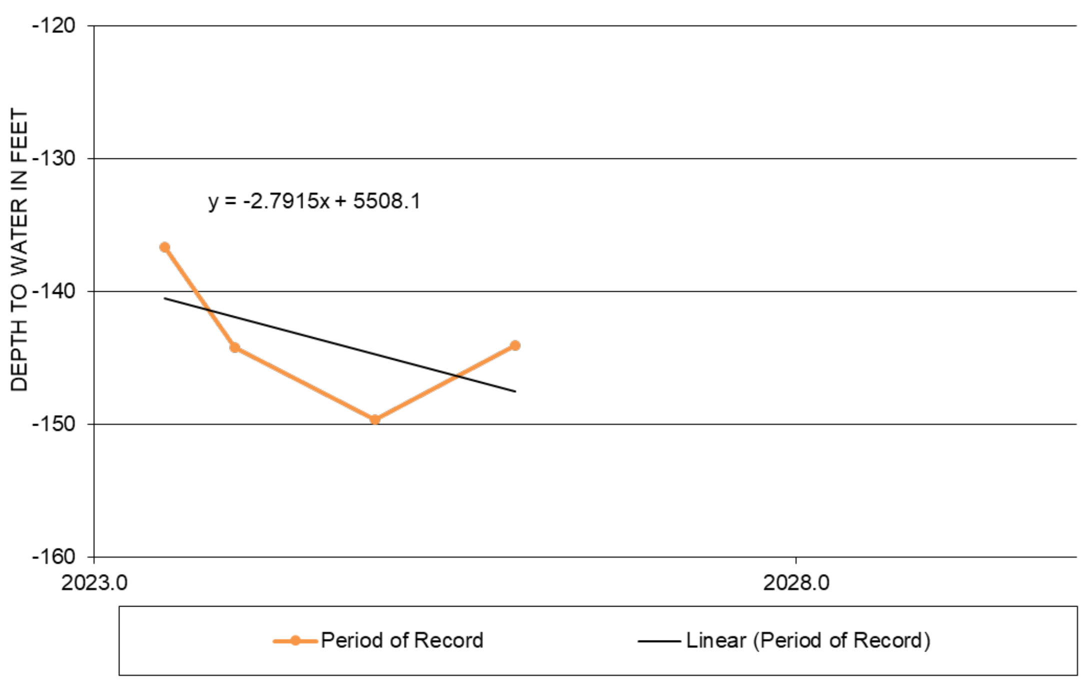
In the Igneous Aquifer, the District looked at datasets spanning several time periods to fully understand the aquifer trends. The first dataset included every measured well (20 wells), the second dataset included all wells measured for at least 30 years (14 wells), and the third dataset included all wells measured for at least 40 years (6 wells). After examining the data, it is clear there are three wells, with only four years of measurements, that show a much higher decline rate than the rest of the data. Wells completed in fractured rock frequently show variable water levels; therefore, wells with a short measurement history may not represent the long-term behavior of the aquifer. The dataset including wells with 40 or more years of measurements only contains six wells, which may not be representative of the whole dataset. Using the dataset that includes wells measured 30 years or more statistically increases the amount of data (70%) used, and better represents the aquifer water level trends. The long-term trend of the 30-year dataset is a decline of 0.48 feet per year, so extrapolating that average decline over 50 years would be a decline of 24 feet in 50 years. The District recommends the DFC be set as 24 feet of decline from 2030 – 2080 which is comparable to the previous DFC.

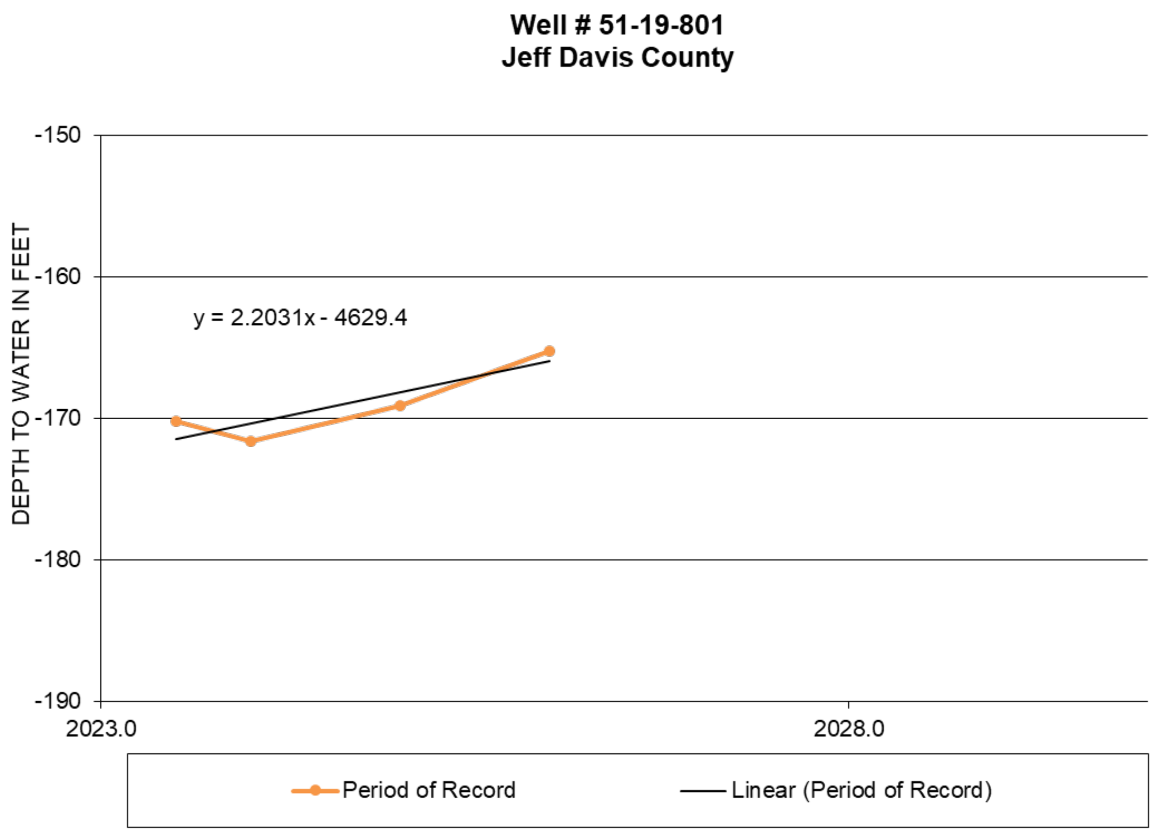
Appendix A – Hydrographs, Igneous Aquifer

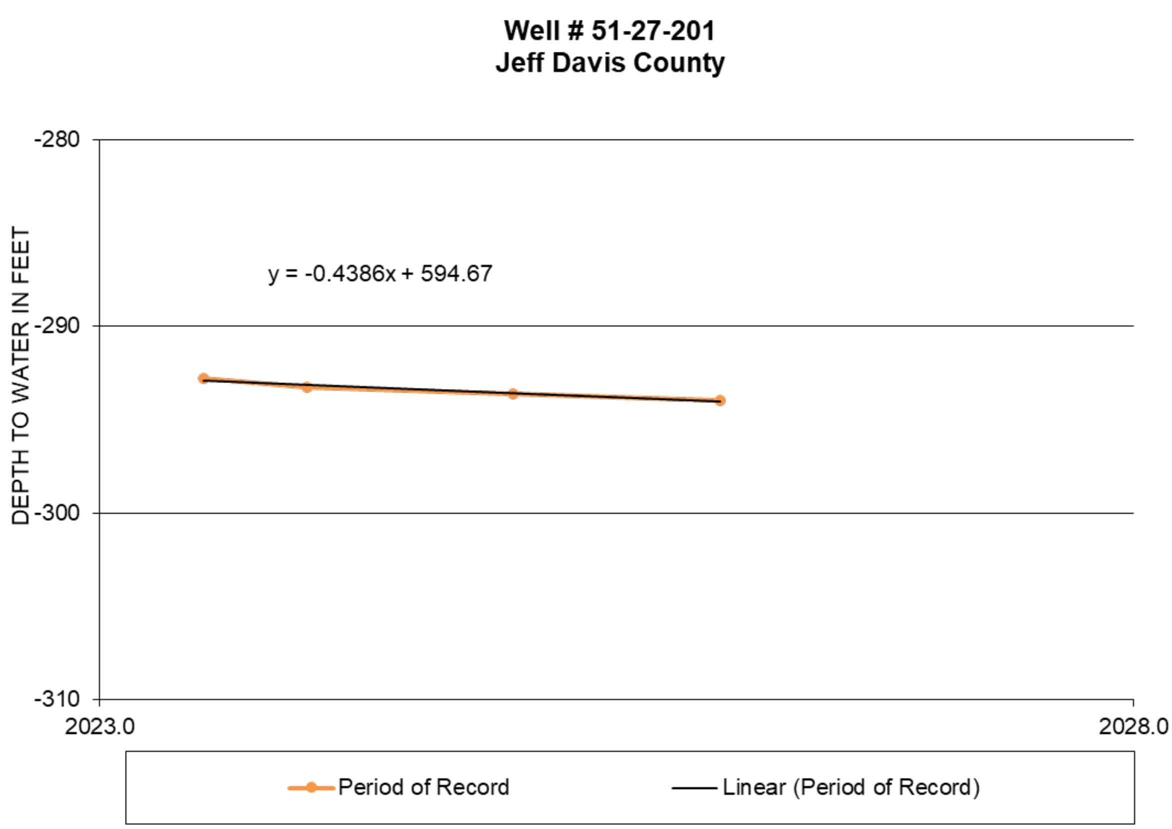
Well # 52-25-327
Jeff Davis County

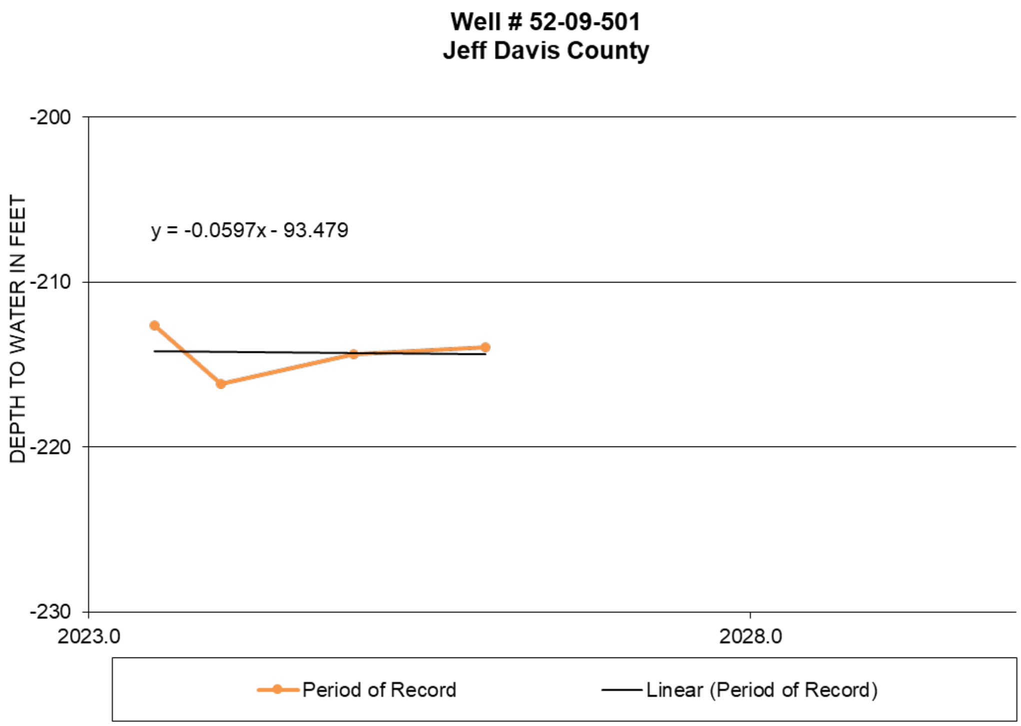


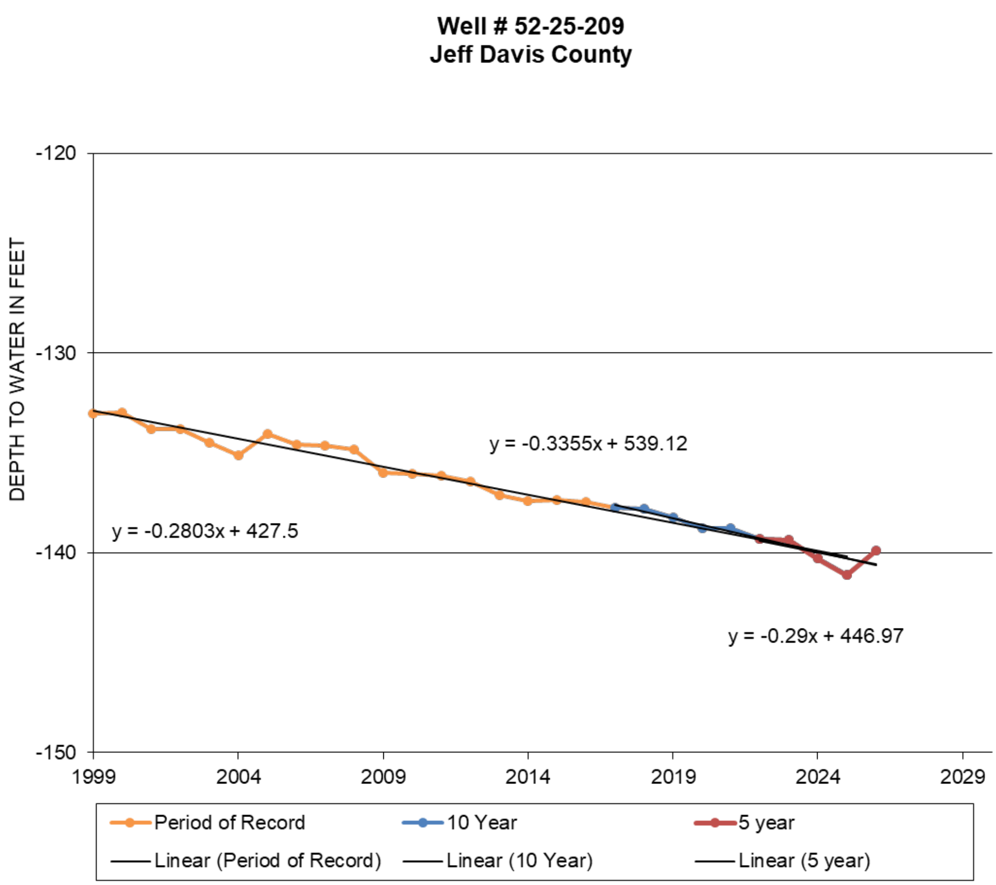
Well # 52-35-104
Jeff Davis County

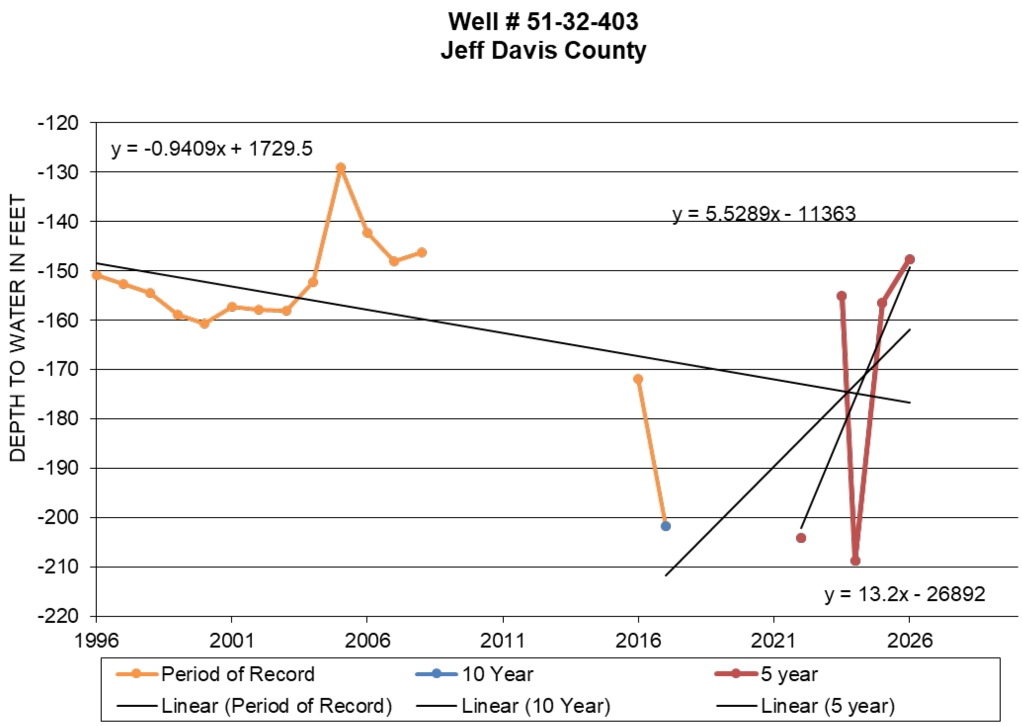


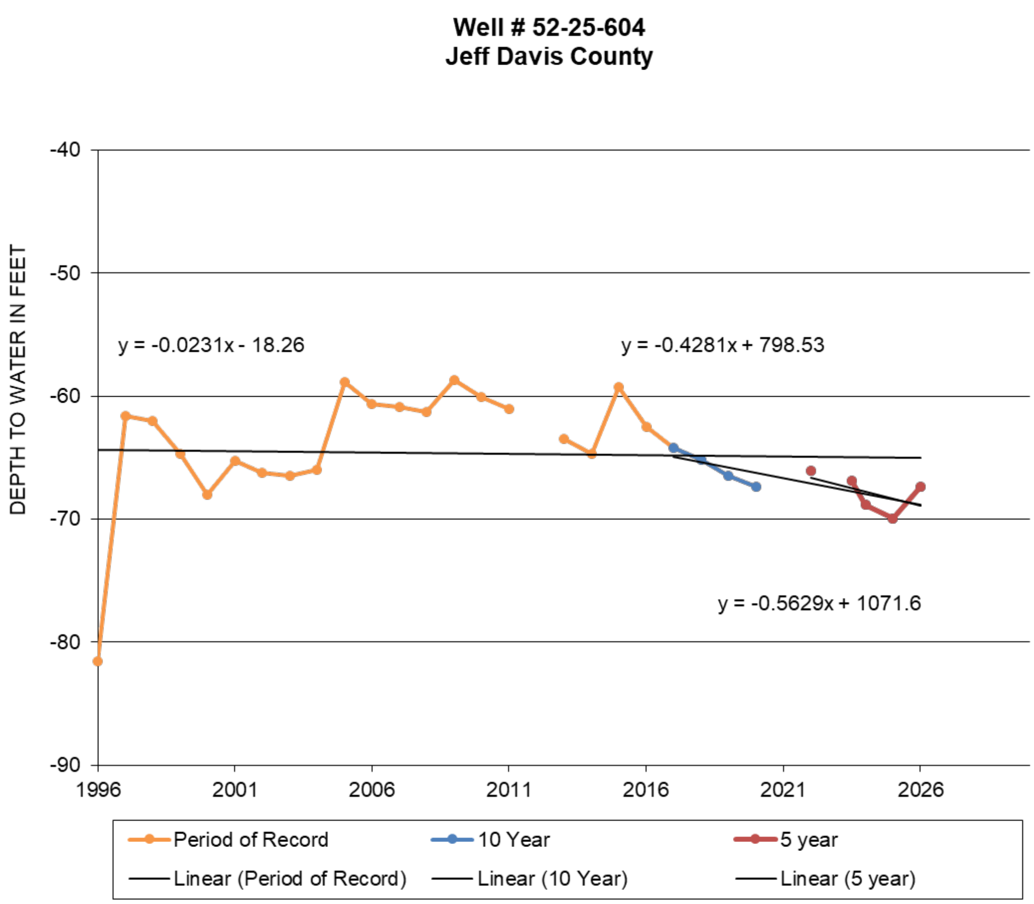

Well # 51-19-801
Jeff Davis County
DEPTH TO WATER IN FEET
-150
-160
-170
-180
-190
2023.0
2028.0
y = 2.2031x - 4629.4
Period of Record
Linear (Period of Record)

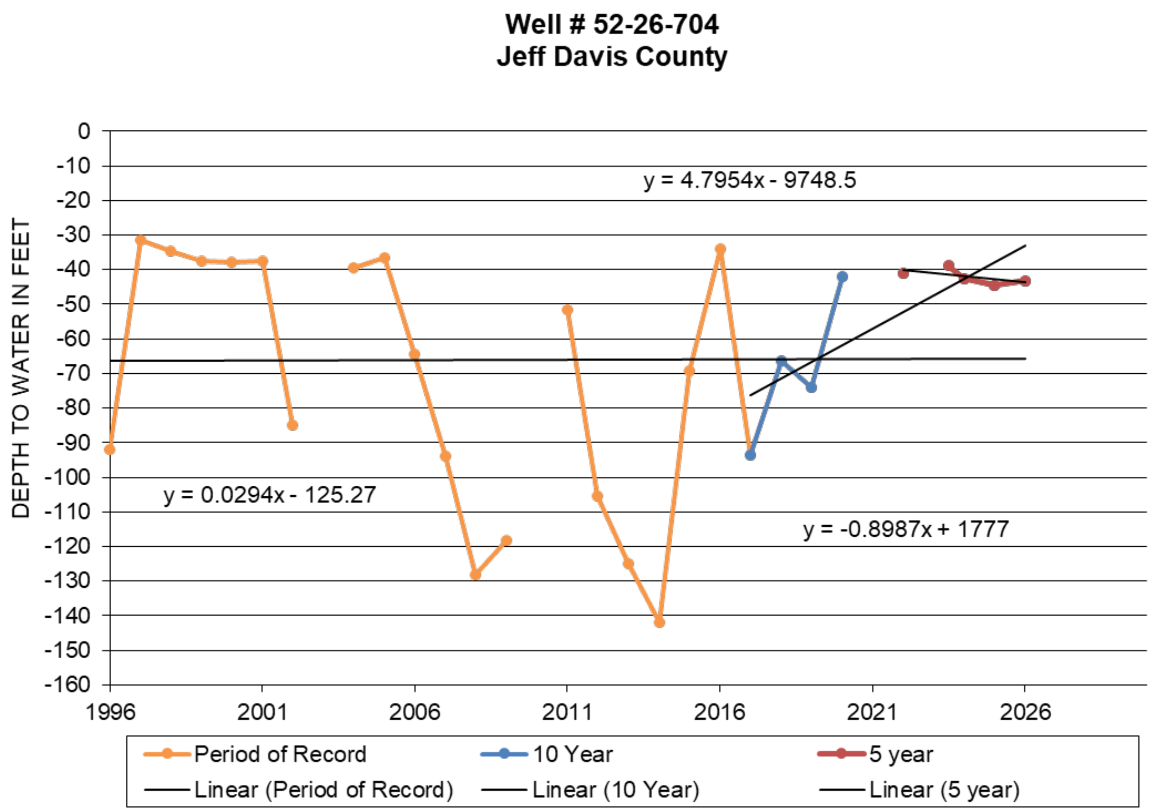

Well # 51-27-201
Jeff Davis County
DEPTH TO WATER IN FEET
-280
-290
-300
-310
2023.0
2028.0
y = -0.4386x + 594.67
Period of Record
Linear (Period of Record)

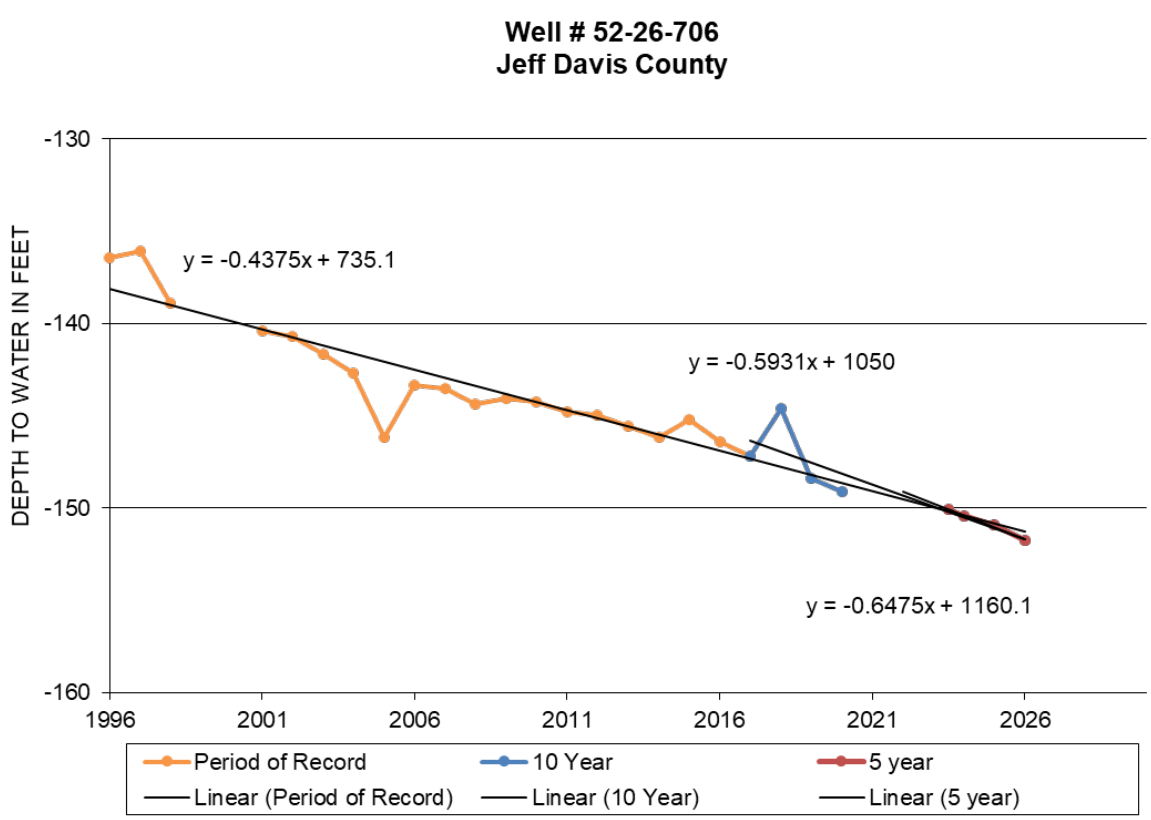

Well # 52-09-501
Jeff Davis County
DEPTH TO WATER IN FEET
-200
-210
-220
-230
2023.0
2028.0
y = -0.0597x - 93.479
Period of Record
Linear (Period of Record)


Well # 52-25-209
Jeff Davis County
DEPTH TO WATER IN FEET
-120
-130
-140
-150
1999
2004
2009
2014
2019
2024
2029
y = -0.3355x + 539.12
y = -0.2803x + 427.5
y = -0.29x + 446.97
Period of Record
10 Year
5 year
Linear (Period of Record)
Linear (10 Year)
Linear (5 year)

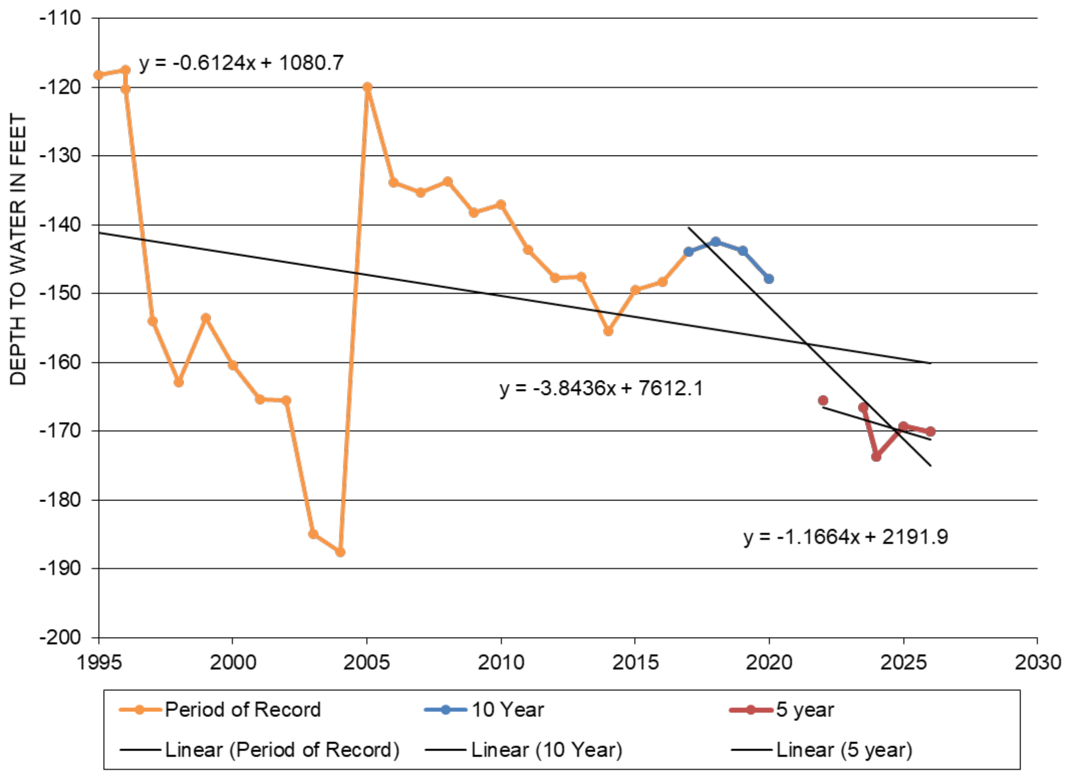

Well # 51-32-403
Jeff Davis County
DEPTH TO WATER IN FEET
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
-220
1996
2001
2006
2011
2016
2021
2026
y = -0.9409x + 1729.5
y = 5.5289x - 11363
y = 13.2x - 26892
Period of Record
10 Year
5 year
Linear (Period of Record)
Linear (10 Year)
Linear (5 year)


Well # 52-25-604
Jeff Davis County
DEPTH TO WATER IN FEET
-40
-50
-60
-70
-80
-90
1996
2001
2006
2011
2016
2021
2026
y = -0.0231x - 18.26
y = -0.4281x + 798.53
y = -0.5629x + 1071.6
Period of Record
10 Year
5 year
Linear (Period of Record)
Linear (10 Year)
Linear (5 year)

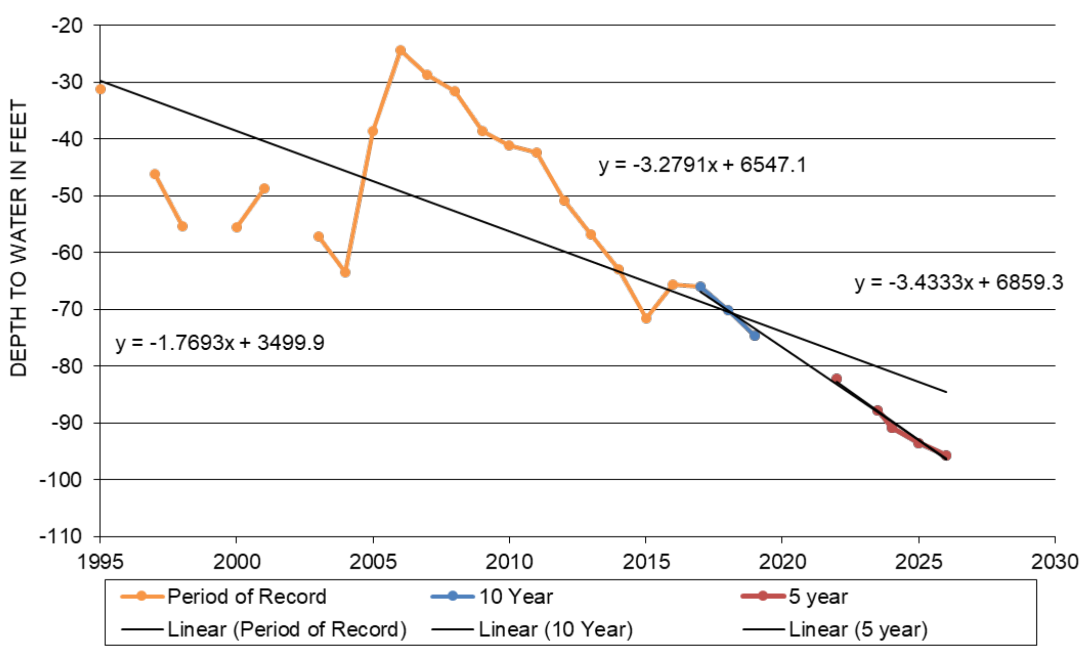

Well # 52-26-704
Jeff Davis County
DEPTH TO WATER IN FEET
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
1996
2001
2006
2011
2016
2021
2026
y = 4.7954x - 9748.5
y = 0.0294x - 125.27
y = -0.8987x + 1777
Period of Record
10 Year
5 year
Linear (Period of Record)
Linear (10 Year)
Linear (5 year)


Well # 52-26-706
Jeff Davis County
DEPTH TO WATER IN FEET
-130
-140
-150
-160
1996
2001
2006
2011
2016
2021
2026
y = -0.4375x + 735.1
y = -0.5931x + 1050
y = -0.6475x + 1160.1
Period of Record
10 Year
5 year
Linear (Period of Record)
Linear (10 Year)
Linear (5 year)

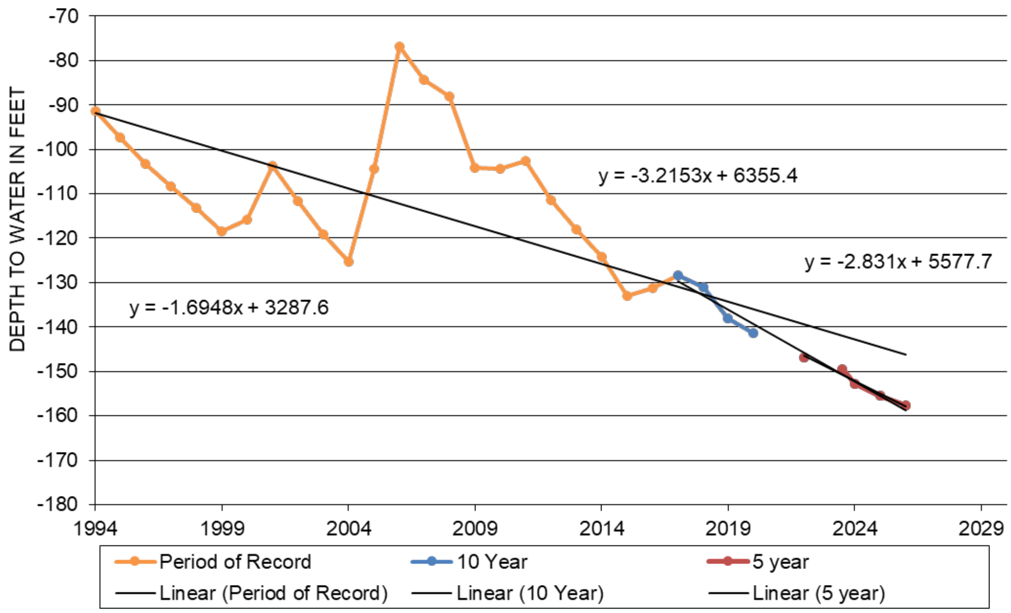
Well # 52-25-501
Jeff Davis County



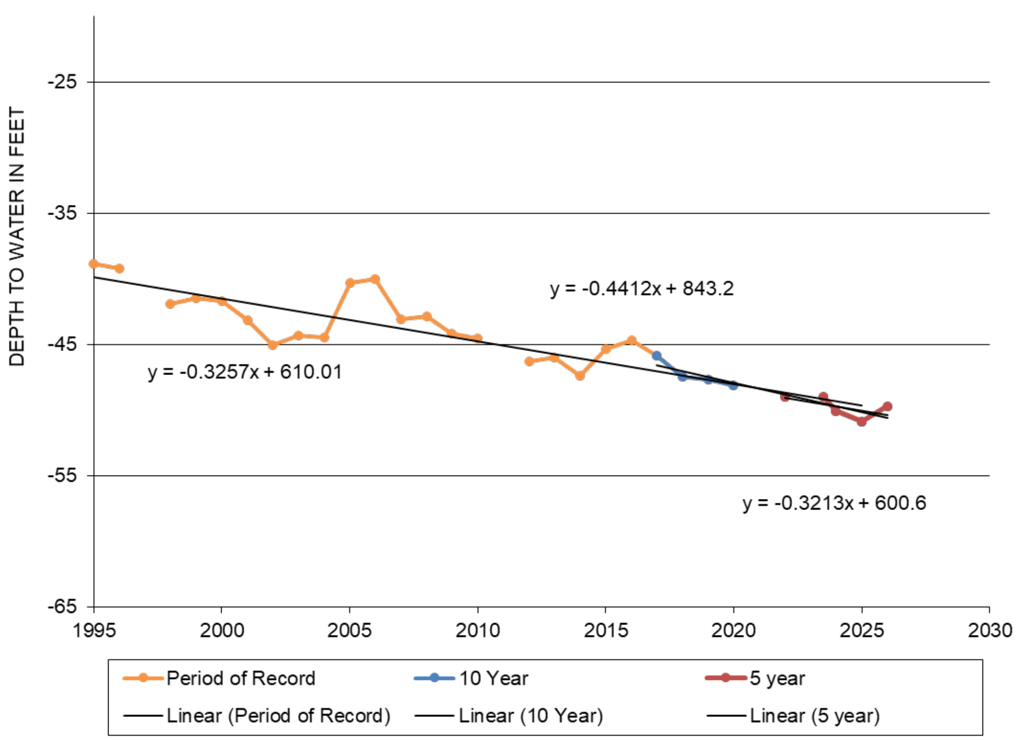
Well # 51-22-701
Jeff Davis County

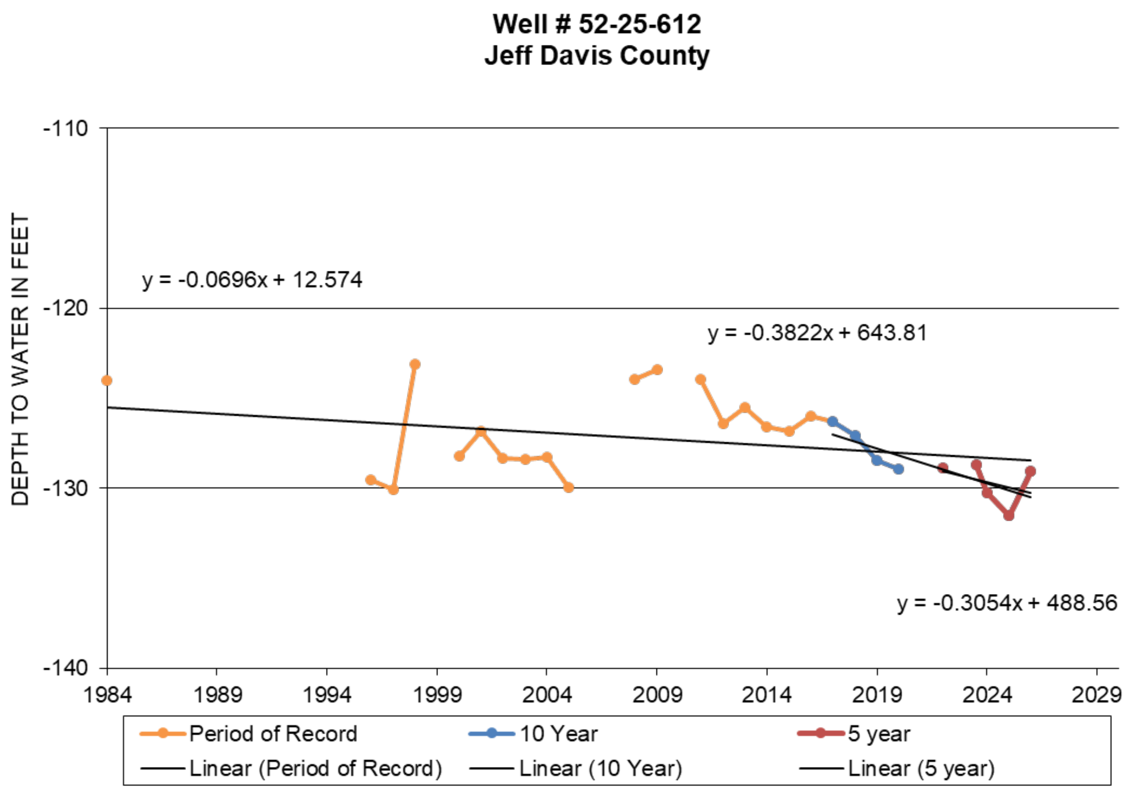


Well # 51-22-801
Jeff Davis County

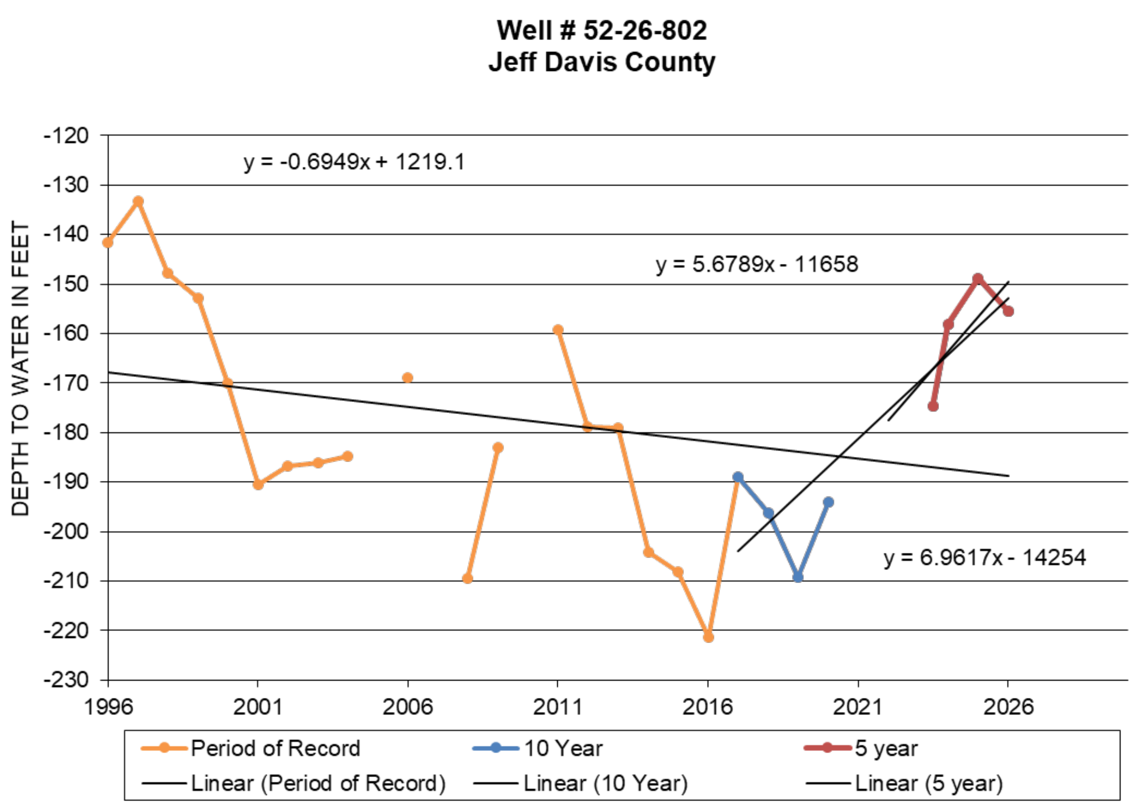


Well # 52-25-603
Jeff Davis County

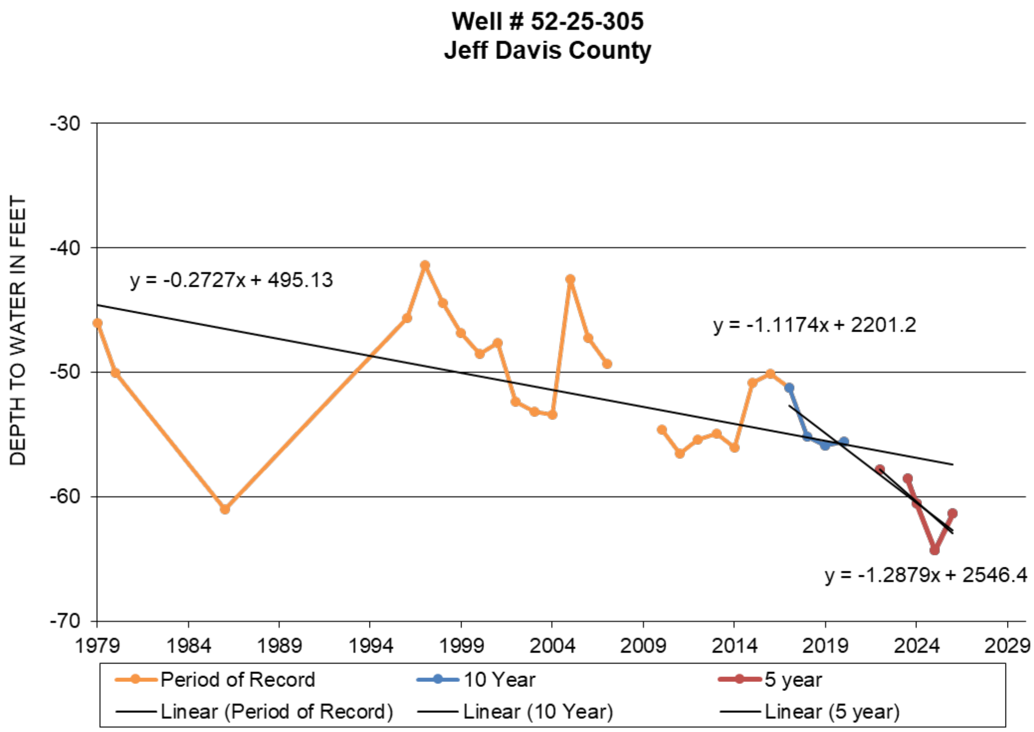


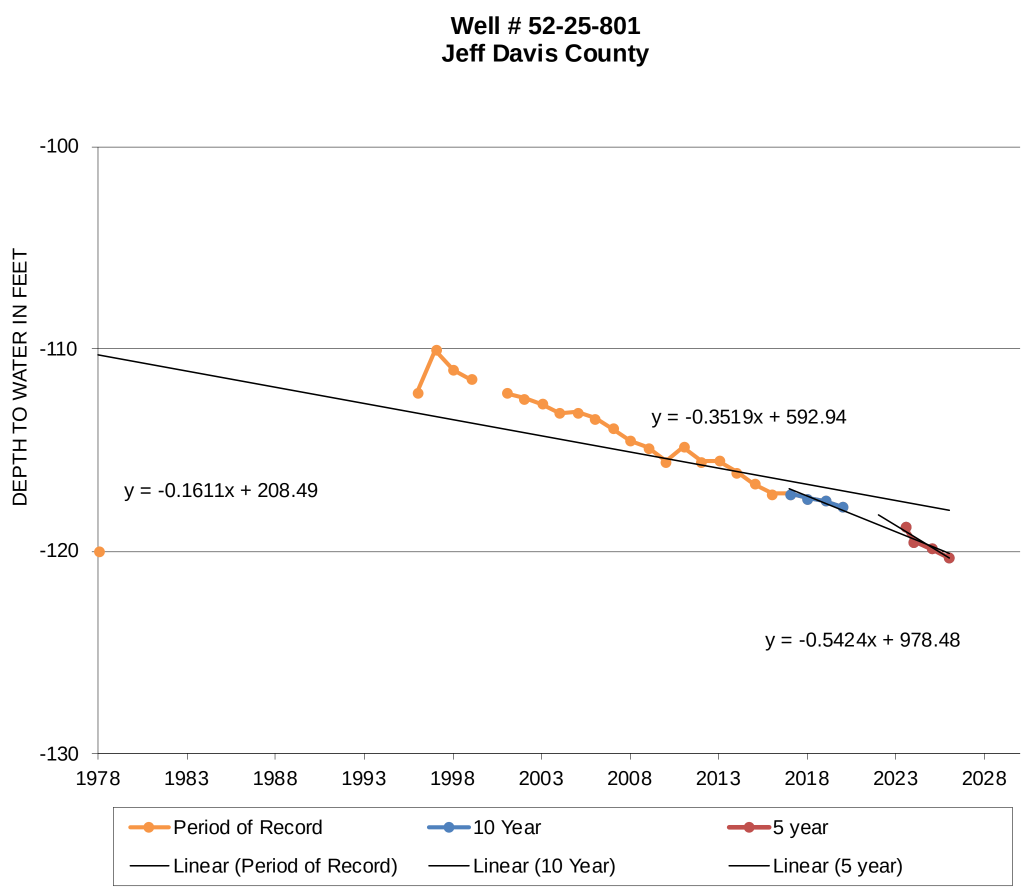


Well # 52-25-612
Jeff Davis County
DEPTH TO WATER IN FEET
-110
-120
-130
-140
y = -0.0696x + 12.574
y = -0.3822x + 643.81
y = -0.3054x + 488.56
1984
1989
1994
1999
2004
2009
2014
2019
2024
2029
Period of Record
10 Year
5 year
Linear (Period of Record)
Linear (10 Year)
Linear (5 year)

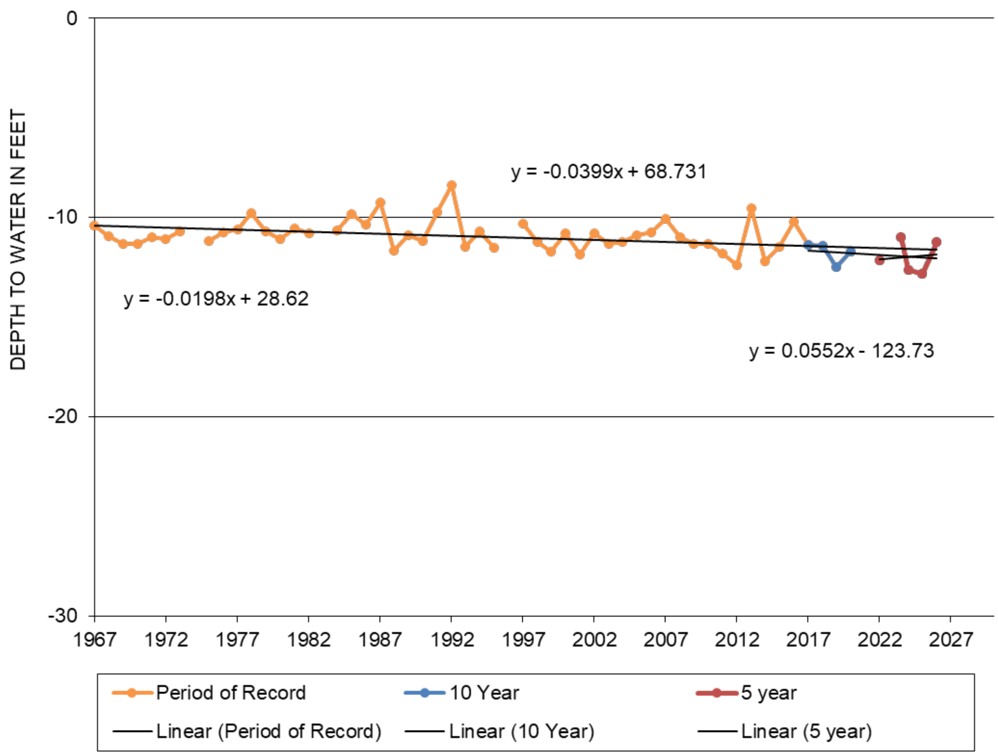


Well # 52-26-802
Jeff Davis County
DEPTH TO WATER IN FEET
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
-220
-230
y = -0.6949x + 1219.1
y = 5.6789x - 11658
y = 6.9617x - 14254
1996
2001
2006
2011
2016
2021
2026
Period of Record
10 Year
5 year
Linear (Period of Record)
Linear (10 Year)
Linear (5 year)

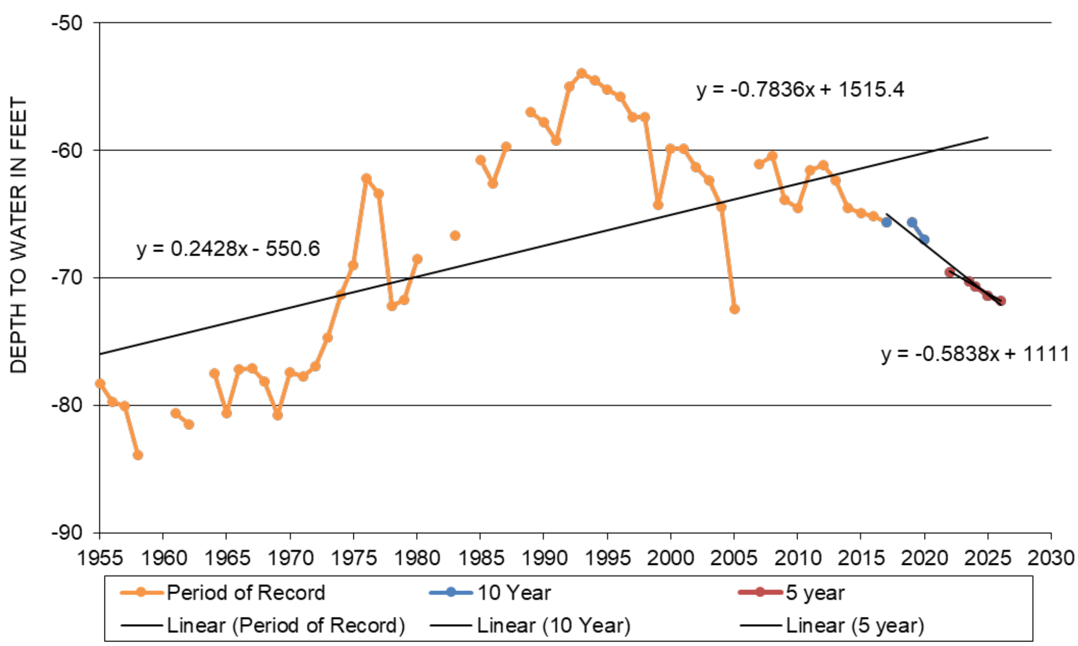

Well # 52-25-305
Jeff Davis County
DEPTH TO WATER IN FEET
-30
-40
-50
-60
-70
y = -0.2727x + 495.13
y = -1.1174x + 2201.2
y = -1.2879x + 2546.4
1979
1984
1989
1994
1999
2004
2009
2014
2019
2024
2029
Period of Record
10 Year
5 year
Linear (Period of Record)
Linear (10 Year)
Linear (5 year)


Well # 52-25-801
Jeff Davis County
DEPTH TO WATER IN FEET
-100
-110
-120
-130
y = -0.3519x + 592.94
y = -0.1611x + 208.49
y = -0.5424x + 978.48
1978
1983
1988
1993
1998
2003
2008
2013
2018
2023
2028
Period of Record
10 Year
5 year
Linear (Period of Record)
Linear (10 Year)
Linear (5 year)

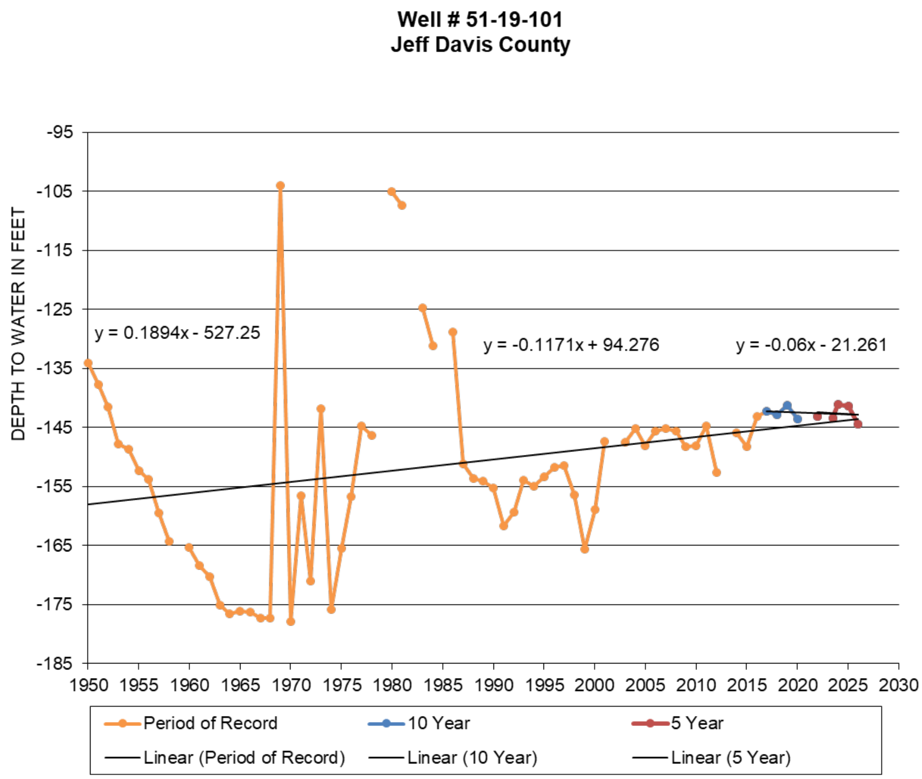
Well # 52-25-308
Jeff Davis County

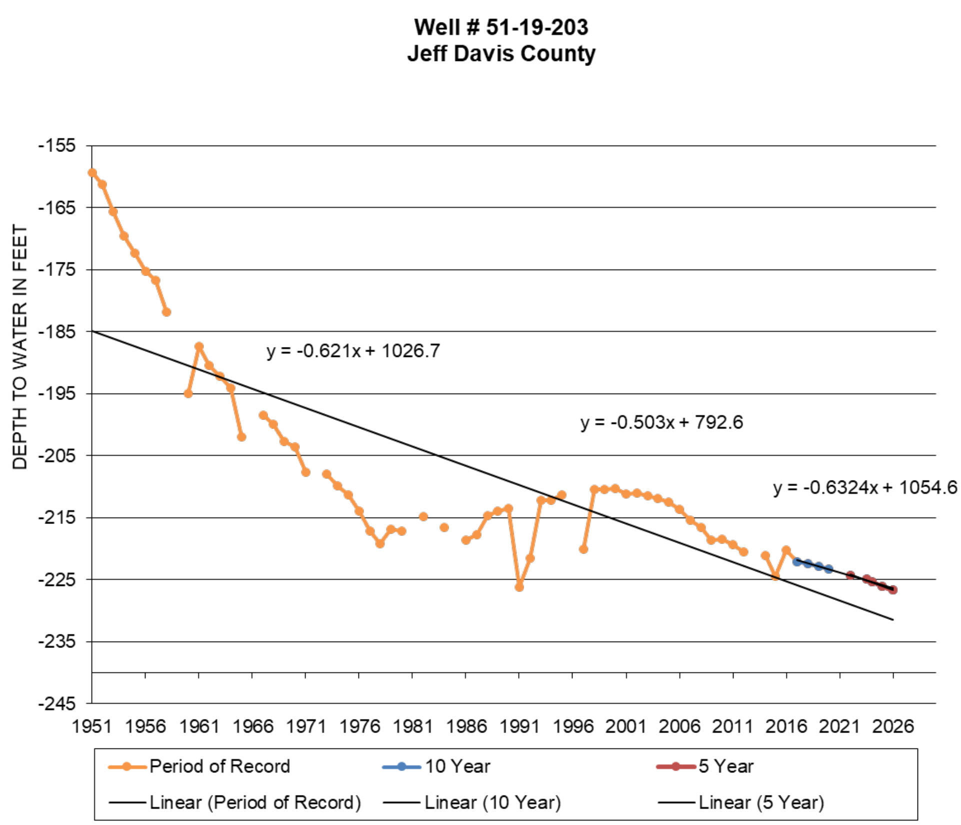


Well # 51-27-302
Jeff Davis County

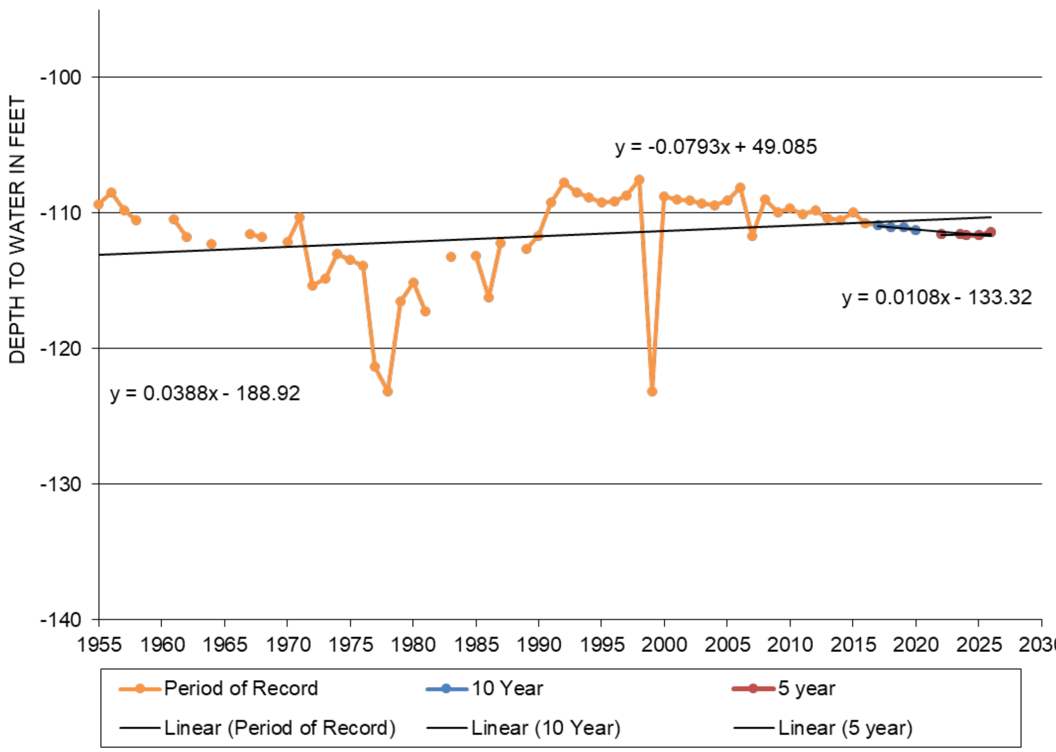


Hydrographs, West Texas Bolsons Aquifer

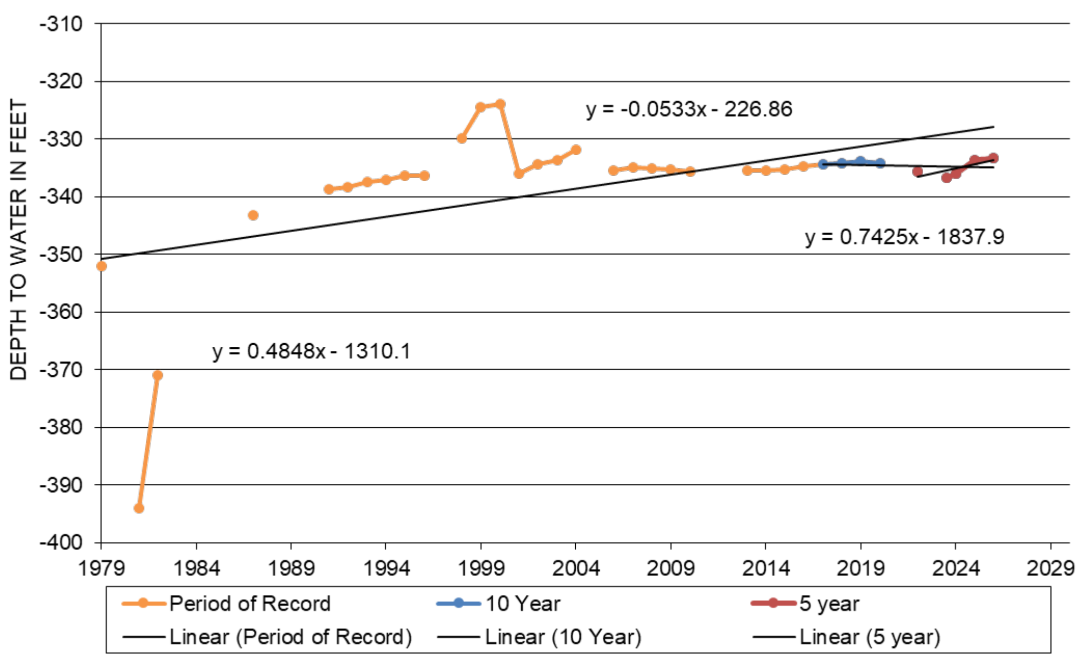


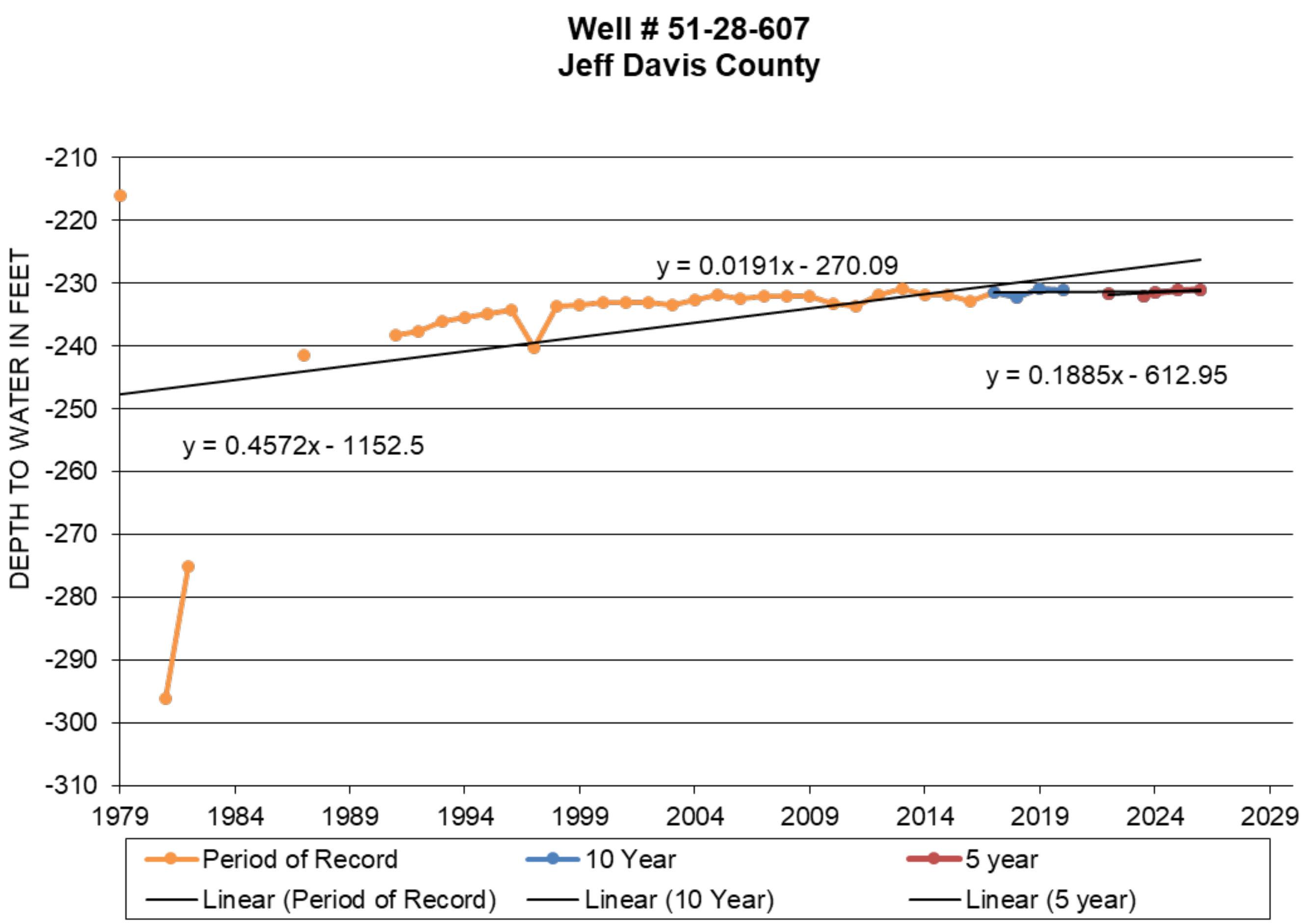


Well # 51-19-902
Jeff Davis County



Well # 51-28-303
Jeff Davis County





Well # 51-28-607
Jeff Davis County
DEPTH TO WATER IN FEET
-210
-220
-230
-240
-250
-260
-270
-280
-290
-300
-310
1979
1984
1989
1994
1999
2004
2009
2014
2019
2024
2029
y = 0.0191x - 270.09
y = 0.1885x - 612.95
y = 0.4572x - 1152.5
Period of Record
10 Year
5 year
Linear (Period of Record)
Linear (10 Year)
Linear (5 year)

Trend Analysis for Presidio County Underground Water Conservation District

Kevin Urbanzyk, Meadows Research Institute for West Texas Water

4/3/2026

This report is a summary of the trend analysis for the county water levels.

The first step of this analysis was to complete an overall assessment of all available data using a filtering technique that included criteria pertaining to number of records and number of wells and statistical parameters including R^2 and p-value. This is described in Appendix 1.

Igneous Aquifer

After updating the data with recent Presidio County Underground Water Conservation District (PCUWCD) data and data from the Texas Water Development Board (TWDB; 'Water Levels by County"), an analysis of the full period of record and all wells was performed. This section discusses the results for the Igneous and Igneous/Other aquifer values. There were 283 total wells with water level measurements and 10,247 individual measurements from September of 1929 to March of 2026. Table 1 includes the results of an analysis of all of these wells and criteria described in Appendix 1. Appendix 2 includes a breakdown of the Date Ranges.

Table 1. Summary table for all of the Igneous aquifer wells.

Summary (Good + Weak Mean & Median Trends)

Date Range	Mean Trend (ft/year)	Median Trend (ft/year)
1929 to 1979	0.189	0.159
1929 to 2026	-0.252	-0.060
1980 to 1999	-1.414	-1.414
2000 to 2026	-0.456	-0.296
2020 to 2026	0.034	-0.184
2023 to 2026	0.155	-0.176

These results are highly variable and are hampered by the lack of long term continuous data but the recent data ranges do show some consistent patterns of water level decline. PCUWCD might want to later revisit this analysis technique to vary the time ranges and the statistical thresholds using the code that was developed for the analysis. But, for this report we chose to focus primarily on the 2000 to 2026 time span for which there were 176 wells and 9,767 water level measurements. After applying the thresholds, and with visual assessments, we reduced the number of wells for the trend analysis to 10. These are included in Table 2.

Table 2. Wells from the Igneous and Igneous/other chosen for use in the trend analysis.

District ID	SWN	Name	Count	MinDate	MaxDate	Trend ft/yr
PR-000935	5148305	Mimms	2416	3/21/2022	3/26/2026	-0.10
PR-000169	5148604	Marfa5	775	4/5/2006	3/6/2026	-0.01
PR-000934	5148616	Section House	533	4/13/2023	3/12/2025	-0.33
Unknown	5148617	Christina	37	10/14/2022	3/19/2026	-0.10
PR-000243	5156902	X-4	803	2/28/1958	3/27/2026	-0.16
PR-000947	5164401	Williams	1076	3/21/2022	3/27/2026	-0.60
PR-000350	5249402	Tinaja Station	760	1/21/2000	3/27/2026	-0.04
PR-000923	7333201	Sauceda	1348	11/4/2016	4/22/2025	-0.22
PR-000930	7333801	Javelin	181	9/28/2025	3/27/2026	0.11
PR-000451	7406901	Dyer	289	1/21/2000	3/18/2026	-0.13

The mean and median values are -0.16 feet and -0.12 feet respectively which equate to -8.0 and -5.9 feet over 50 years.

Figure 1 is a map that shows the locations of the wells used for the analysis.

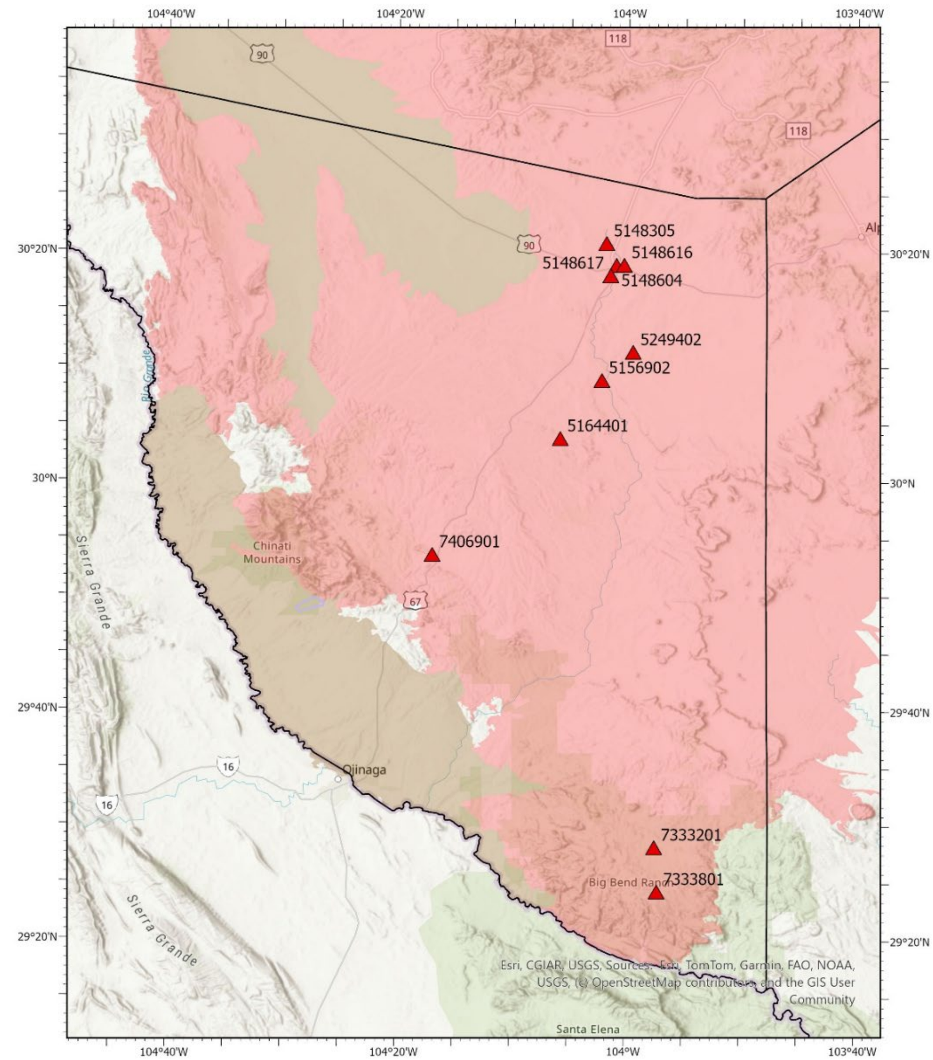
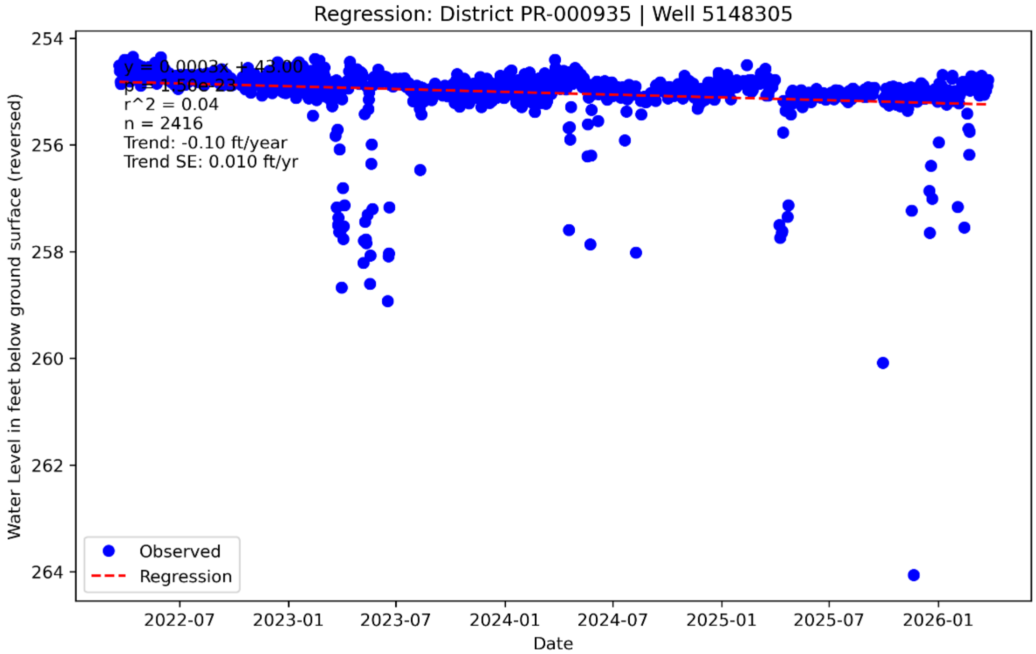


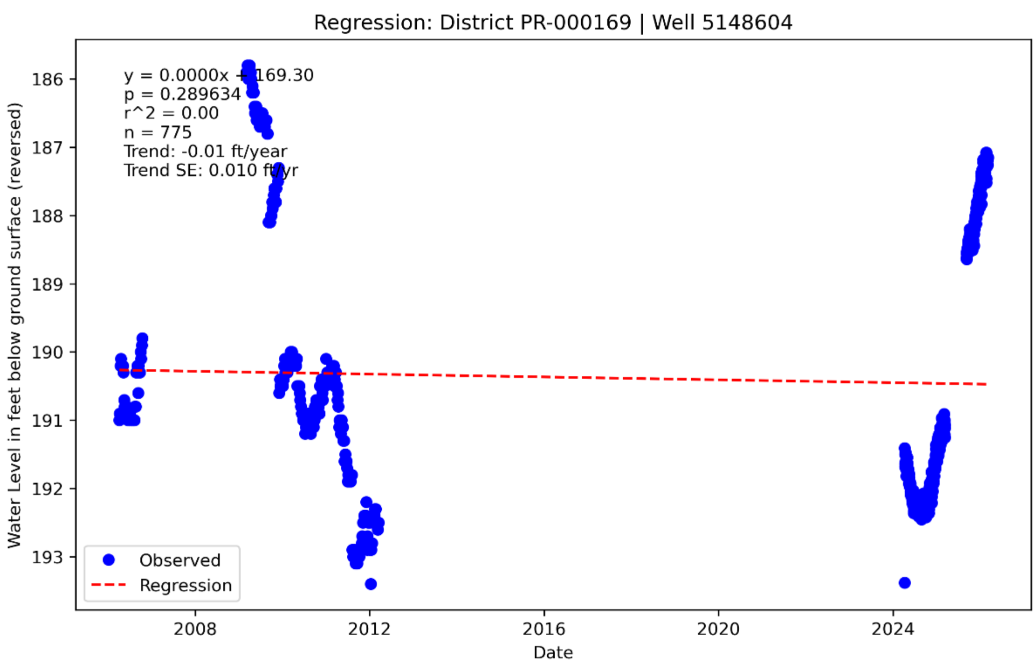
Figure 1. Location of wells in the Igneous and Igneous/other that were used in the analysis.

The following section includes XY plots of these wells. Each plot includes the formula for the regression line (all linear), the p-value, the r^2 value, the number of points, the Trend and the Trend standard error.

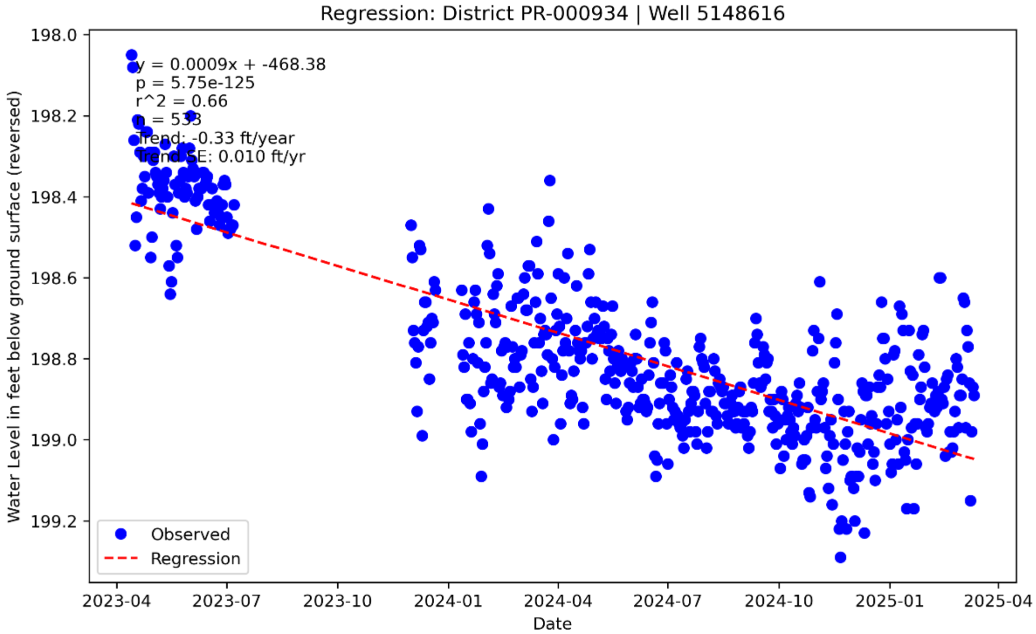
5148305 – Mimms; -0.1 ft/yr



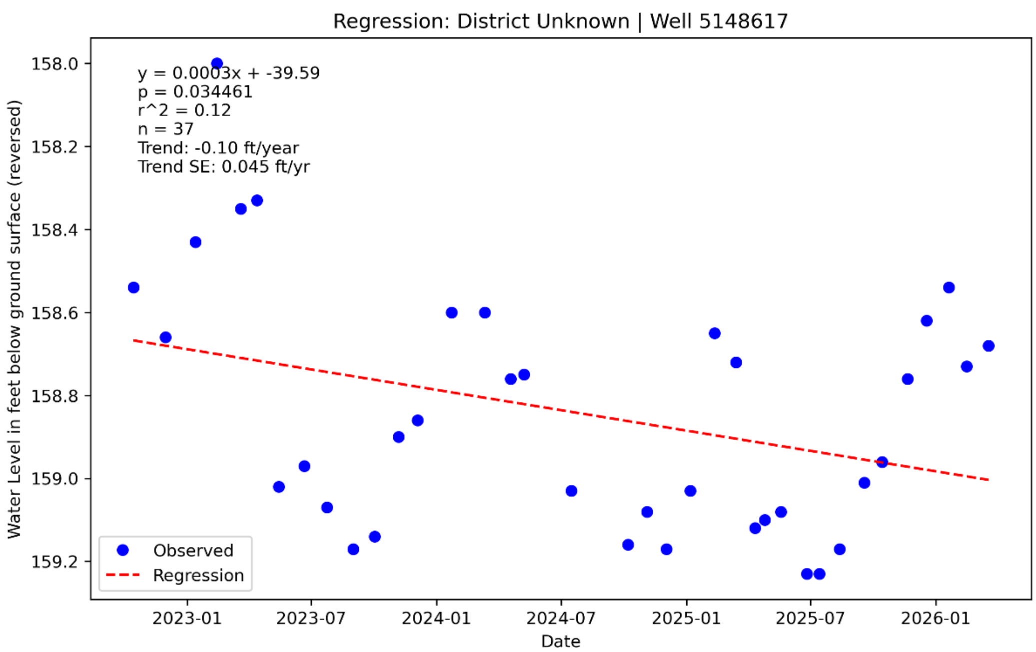
5148604 Marfa #5; -0.01 ft/yr



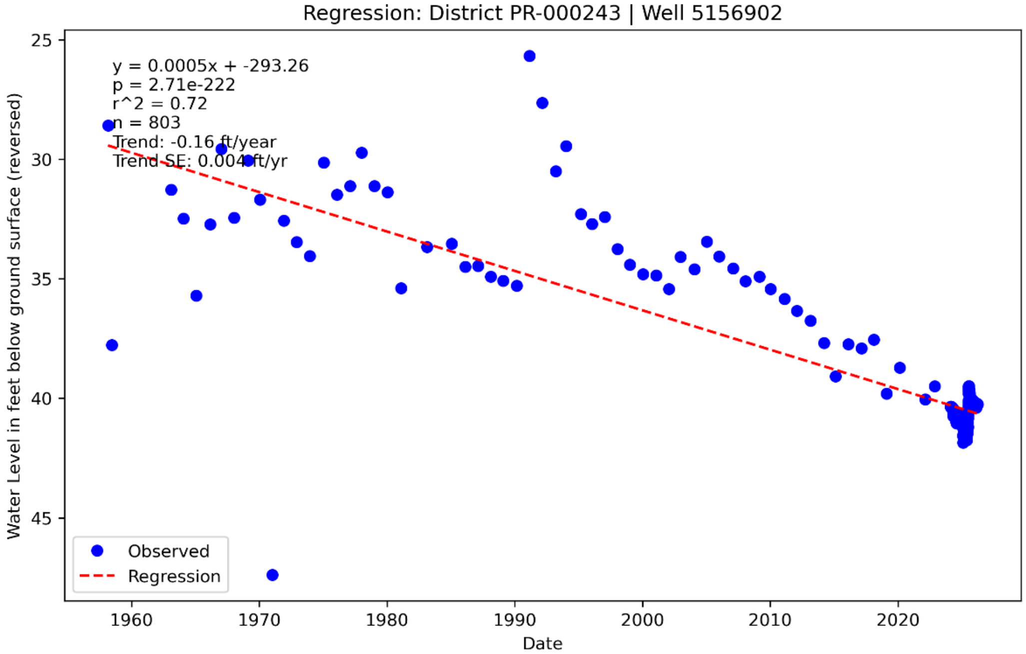
5148616 Section House; -.33 ft/yr



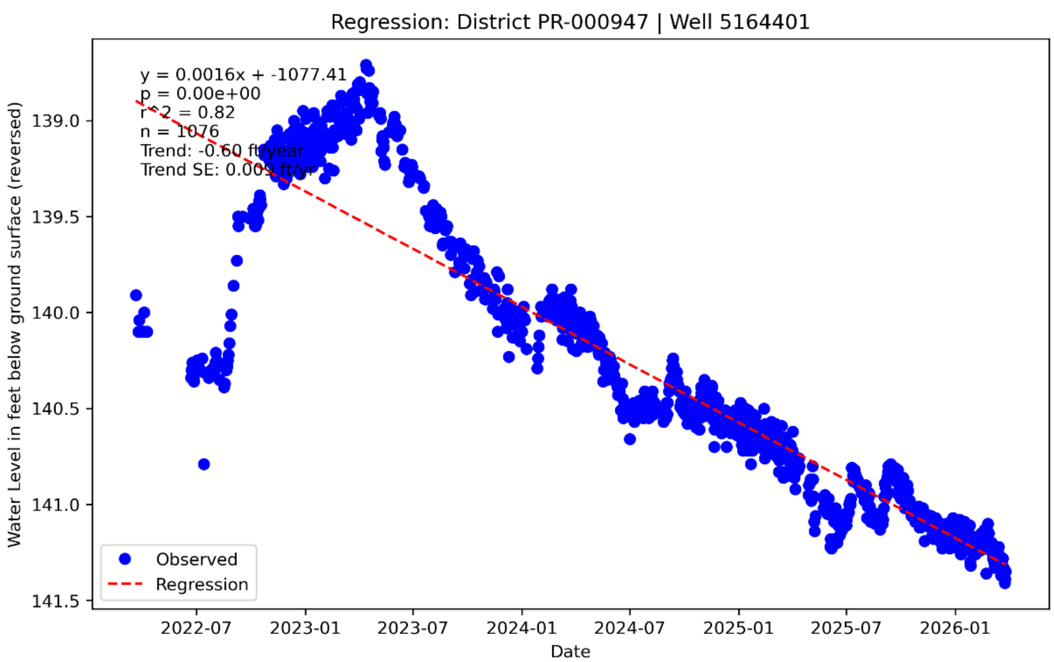
5148617 Christina; -0.1 ft/yr



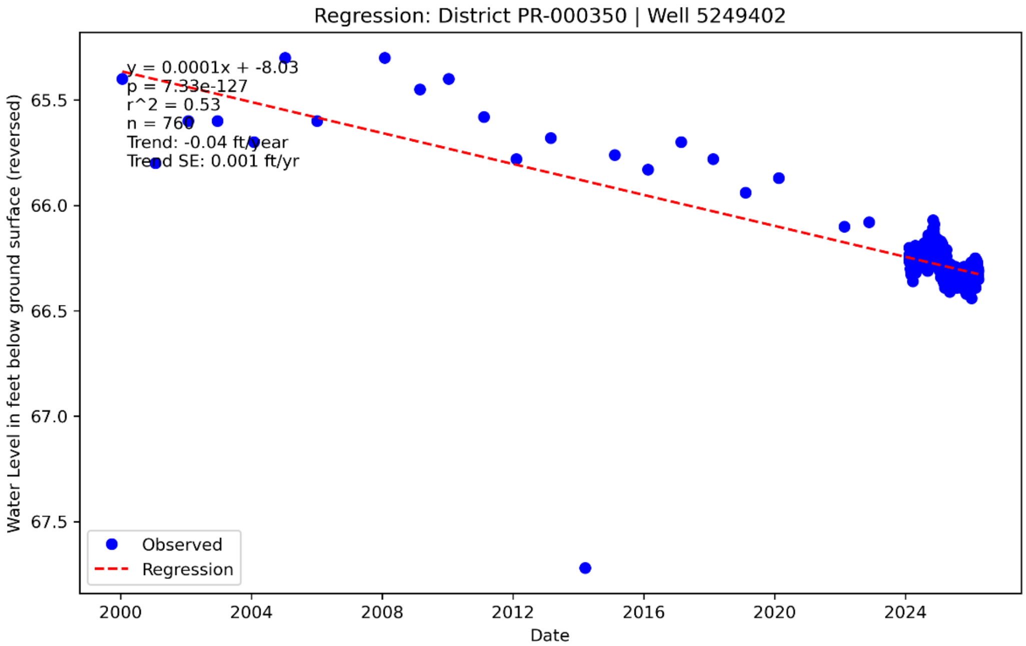
5156902 X-4;



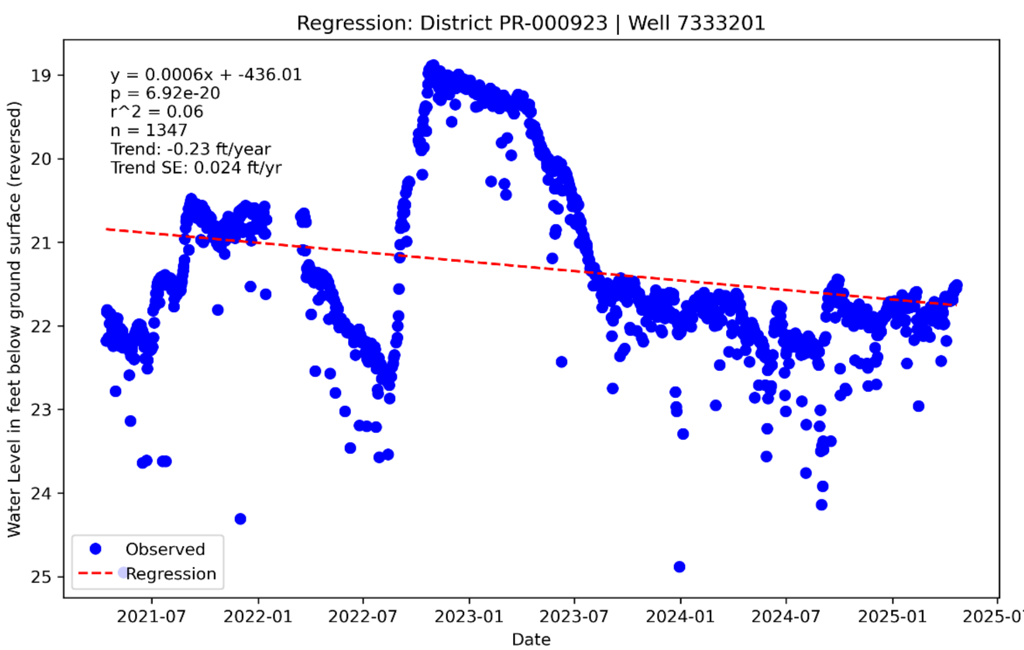
5164401 Williams;



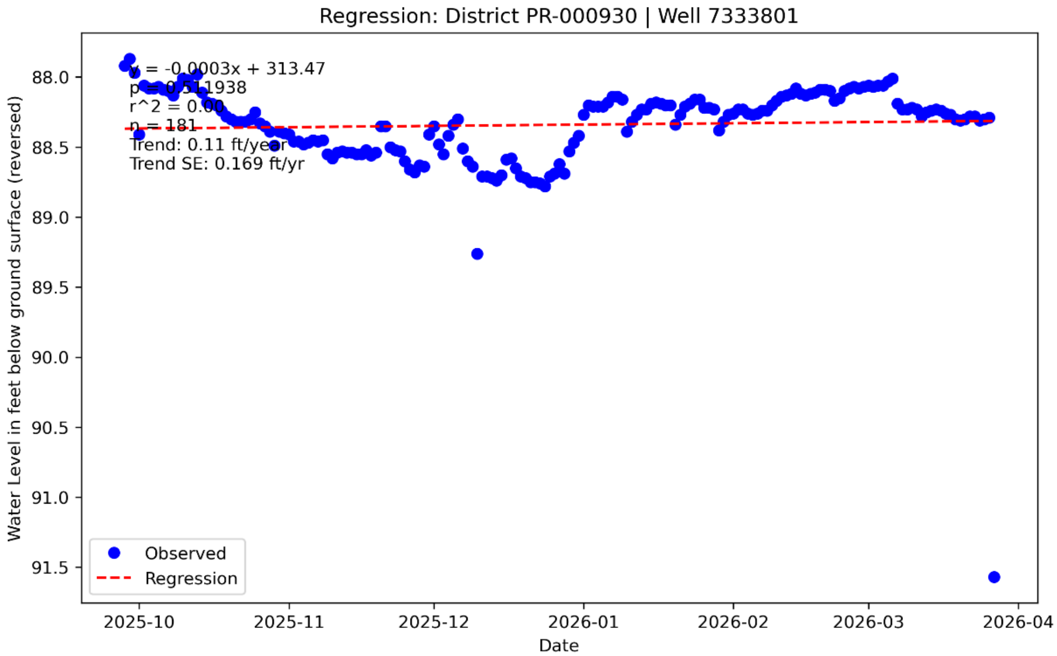
5249402 Tinaja Station ;



7333201 Sauceda BBRSP;



7333801 Javelin camp BBRSP:



7406901 Dyer

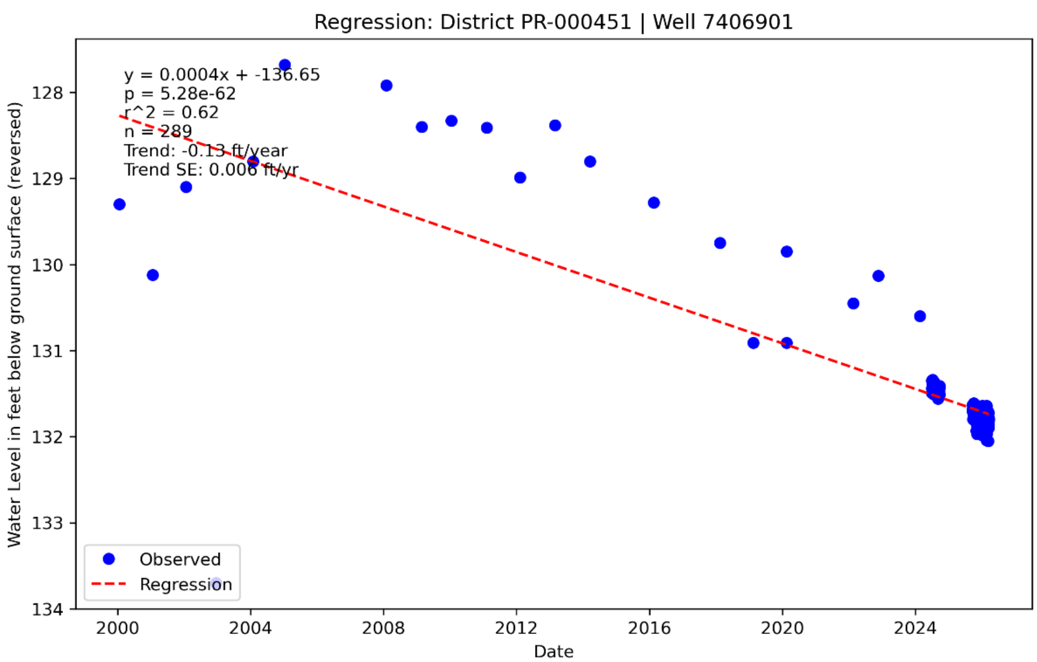


Figure 2. Hydrographs for the Igneous Aquifer wells.

West Texas Bolsons Aquifer

This section includes a discussion of the trends in the West Texas Bolsons Aquifer. There are two separate components of the West Texas Bolsons Aquifer in Presidio county, the Presidio Bolson and the Ryan Flat. We chose to treat these separately.

Presidio Bolson Aquifer

There were 360 wells with water level measurements and 15,917 individual water level records. Table 3 includes a summary of all of the wells that met the threshold criteria as described in Appendix 1.

Table 3. Summary table for all of the West Texas Bolsons wells.

Summary (Good + Weak Mean & Median Trends)

Date Range	Mean Trend (ft/year)	Median Trend (ft/year)
1929 to 1979	0.140	0.114
1929 to 2026	-0.060	0.111
2000 to 2026	-1.417	-0.462
2020 to 2026	-1.398	-0.348
2023 to 2026	-0.538	0.170

As was the case with the Igneous Aquifer wells, the results are highly variable and hampered by the lack of long term continuous data. There are some consistent patterns and we chose to mostly focus on the 2000 to 2026 time period. We had to modify the thresholds to include wells with poor R^2 values (0.01 for the 'weak' category) in order to have wells to use for the final analysis. Table 4 includes the wells that we selected for the trend analysis.

Table 4. Wells from the Presidio Bolson Aquifer chosen for use in the trend analysis.

District-ID	SWN	Name	Count	MinDate	MaxDate	Trend ft/yr
PR-000435	7404201	Benavidez	4	8/19/2004	1/28/2026	-0.93
PR-000444	7404801	CMSNA2	182	8/12/2004	3/27/2026	-0.11
PR-000472	7413402	CMSNA1	298	6/3/2025	3/27/2026	-0.35
PR-000636	7430605	City of Presidio	10	7/14/2004	1/28/2026	-0.57
PR-000666	7430813	Loma Paloma	2062	10/6/2004	3/18/2026	-0.05

The mean and median values are -0.40 and -0.46 respectively which equate to -20.2 and -23.1 feet over 50 years.

Figure 3 is a map that shows the locations of the wells used for the analysis.

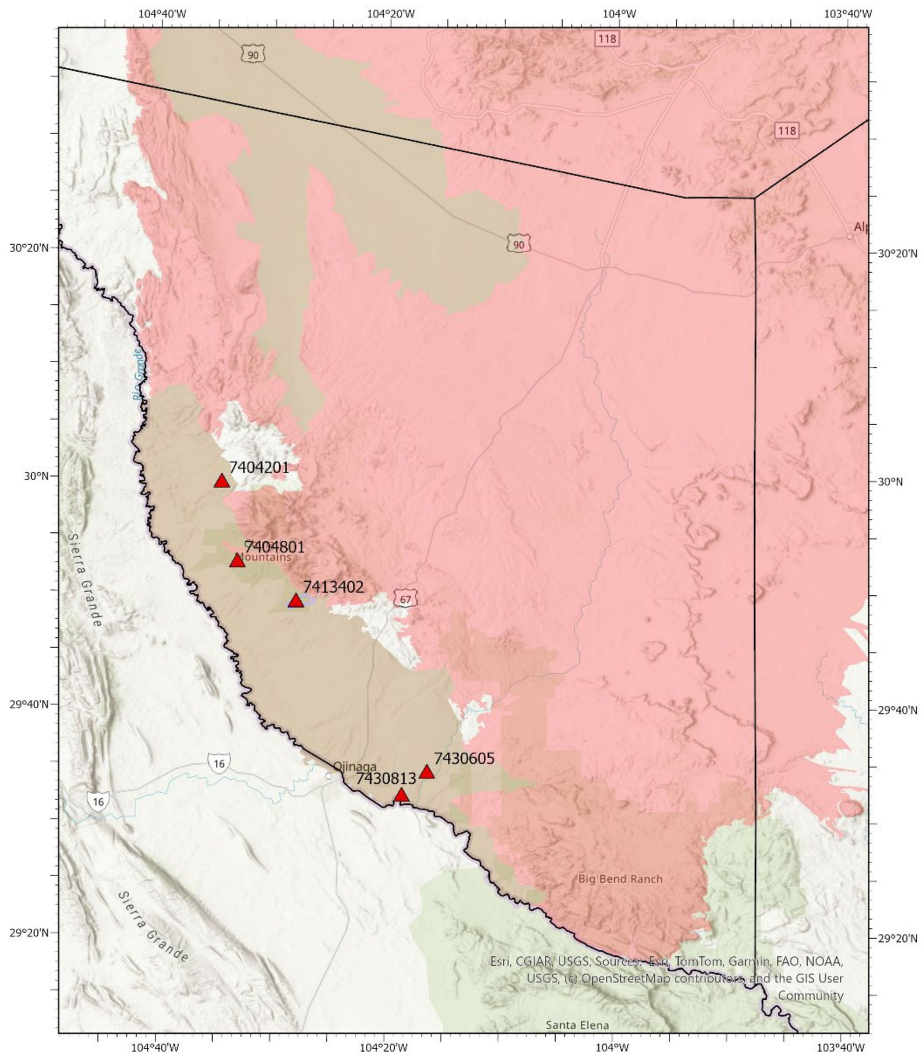
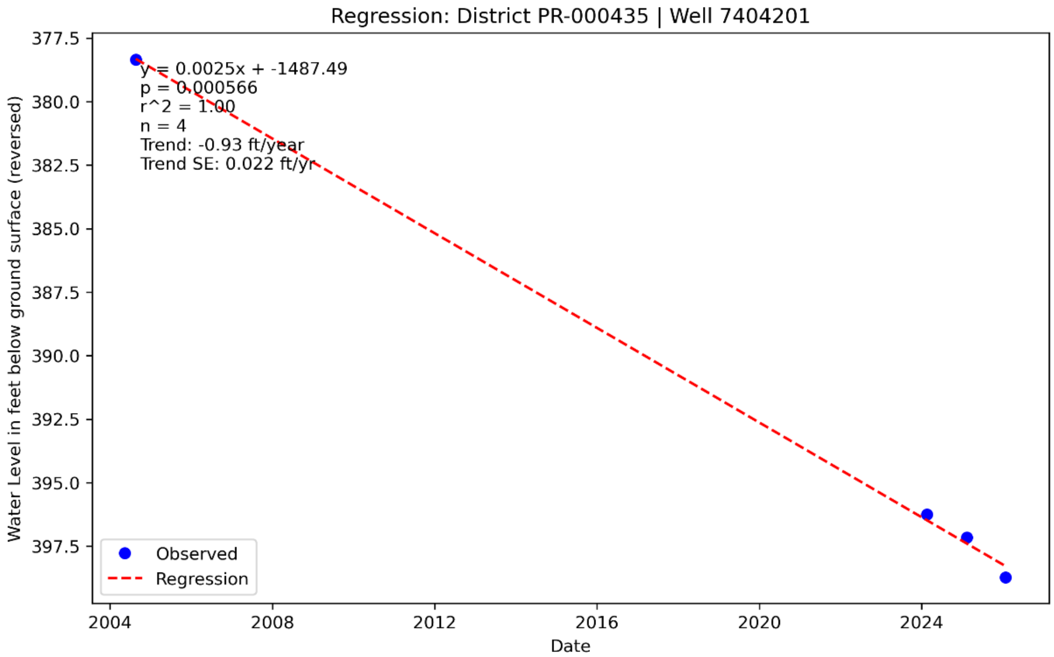


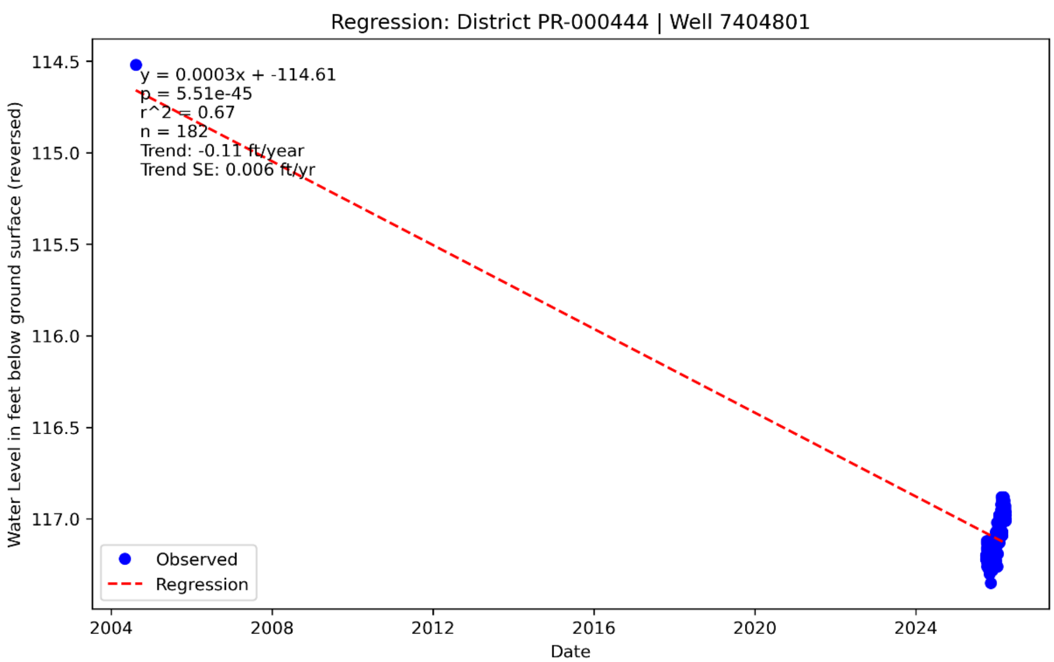
Figure 3. Map of the wells used for the Presidio Bolson area of the West Texas Bolsons Aquifer.

The following section includes XY plots of these wells. Each plot includes the formula for the regression line (all linear), the p-value, the r^2 value, the number of points, the Trend and the Trend standard error.

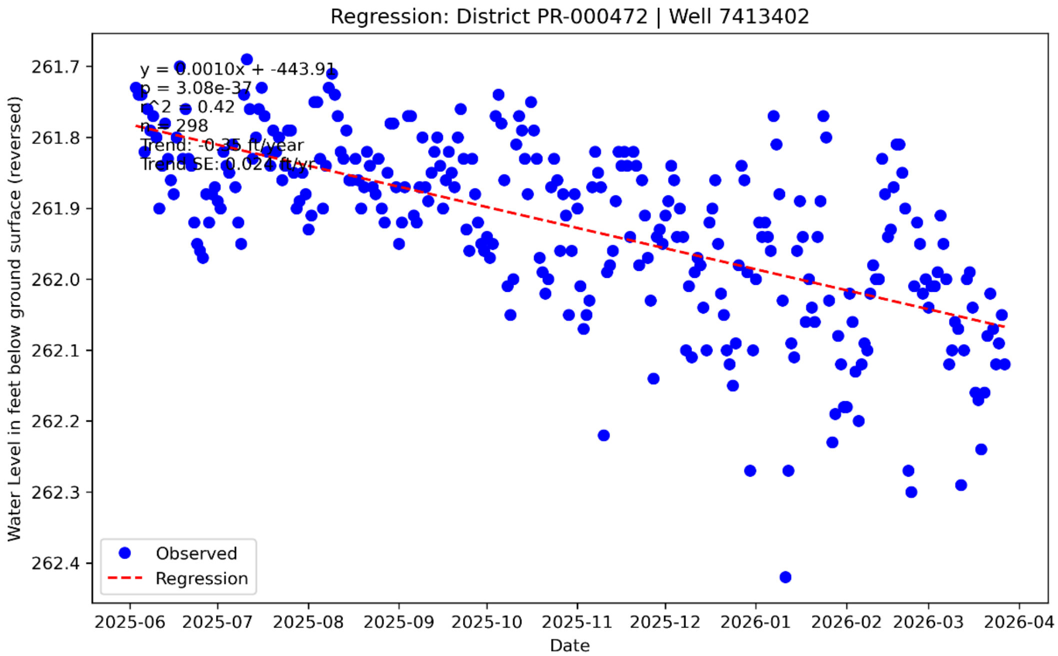
7404201 – Benavidez



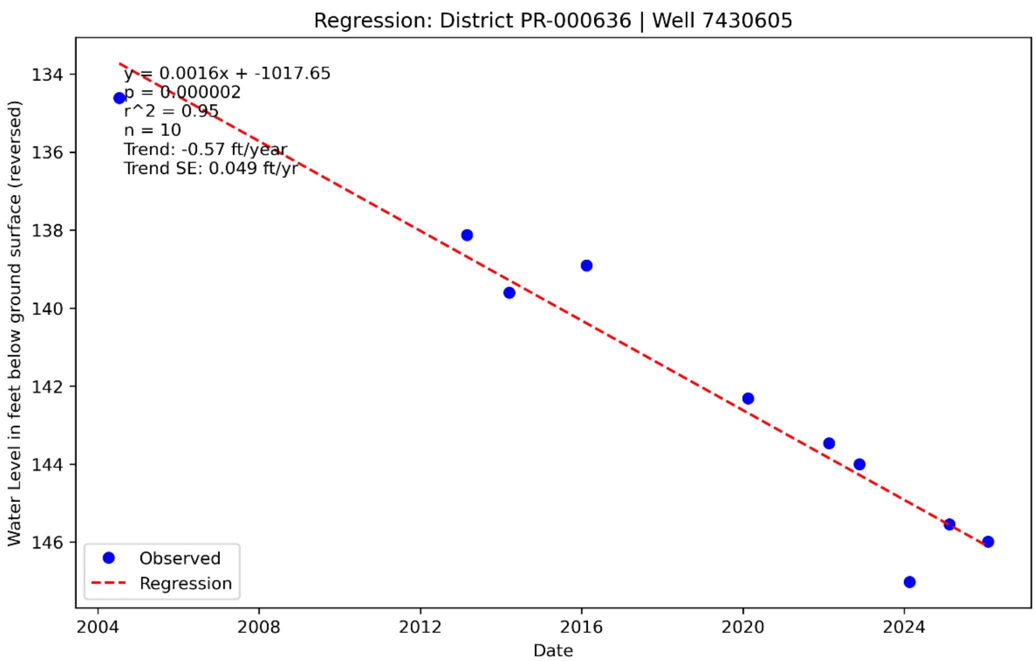
7404801 – CMSNA2



7413402 – CMSNA1



7430605 – City of Presidio



7430813 – Loma Paloma

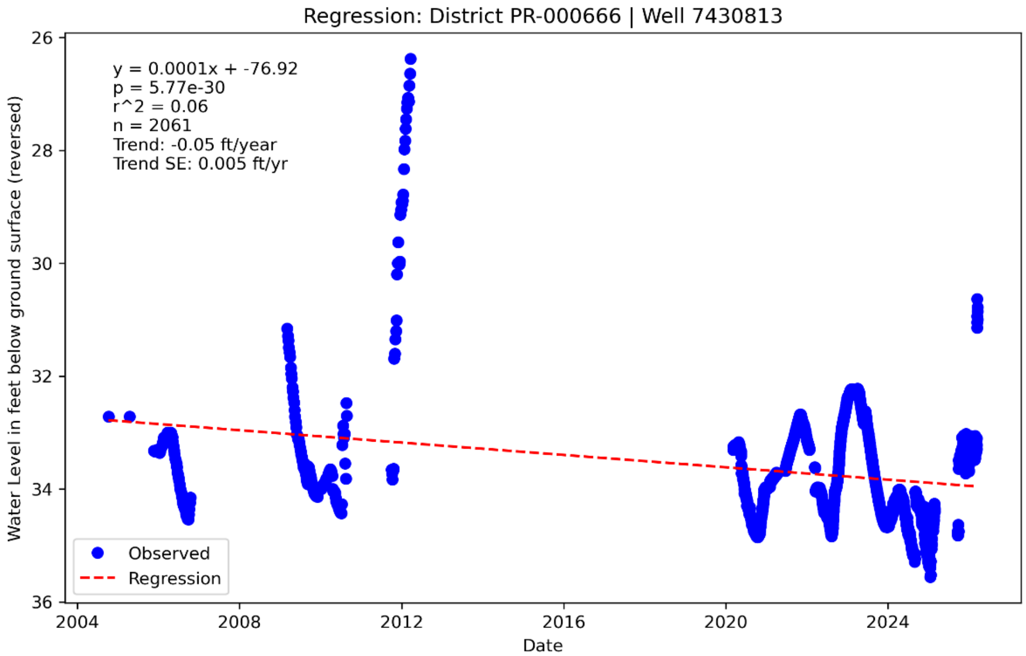


Figure 4. Hydrographs for the Presidio Bolsons wells.

Ryan Flat Aquifer

There were 138 wells in the Ryan Flat Aquifer area with water level measurements and 20,516 individual water level records. Table 5 includes a summary of all of the wells that met the threshold criteria as described in Appendix 1.

Table 5. Summary table for all of the Ryan Flat Aquifer wells.

Summary (Good + Weak Mean & Median Trends)

Date Range	Mean Trend (ft/year)	Median Trend (ft/year)
1929 to 1979	-4.659	-4.659
1929 to 2026	0.275	0.246
1980 to 1999	3.499	2.847
2000 to 2026	0.031	0.133
2020 to 2026	-0.013	0.094
2023 to 2026	0.071	0.090

Again there were limited wells with adequate data and we had to again lower the R^2 threshold for the data in the table. This area shows an increase over time for most of the data ranges and we have chosen to focus on the 2000 to 2026 time frame and we selected only a few wells for the trend analysis (Table 6).

Table 6. Wells from the Ryan Flat Aquifer chosen for use in the tend analysis.

District ID	SWN	Name	Count	MinDate	MaxDate	Trend ft/yr
PR-000924	5127604	Miller	1454	10/13/2021	3/27/2026	-0.40
PR-000940	5128903	City El Paso	1166	1/12/2000	1/21/2026	0.26
PR-000029	5129805	City El Paso	2887	1/5/2000	2/28/2026	0.18
PR-000093	5137302	City El Paso	181	9/16/2025	3/15/2026	0.09

The mean and the median values are 0.03 and 0.03 respectively. Figure yy is a map that shows the wells used for the analysis.

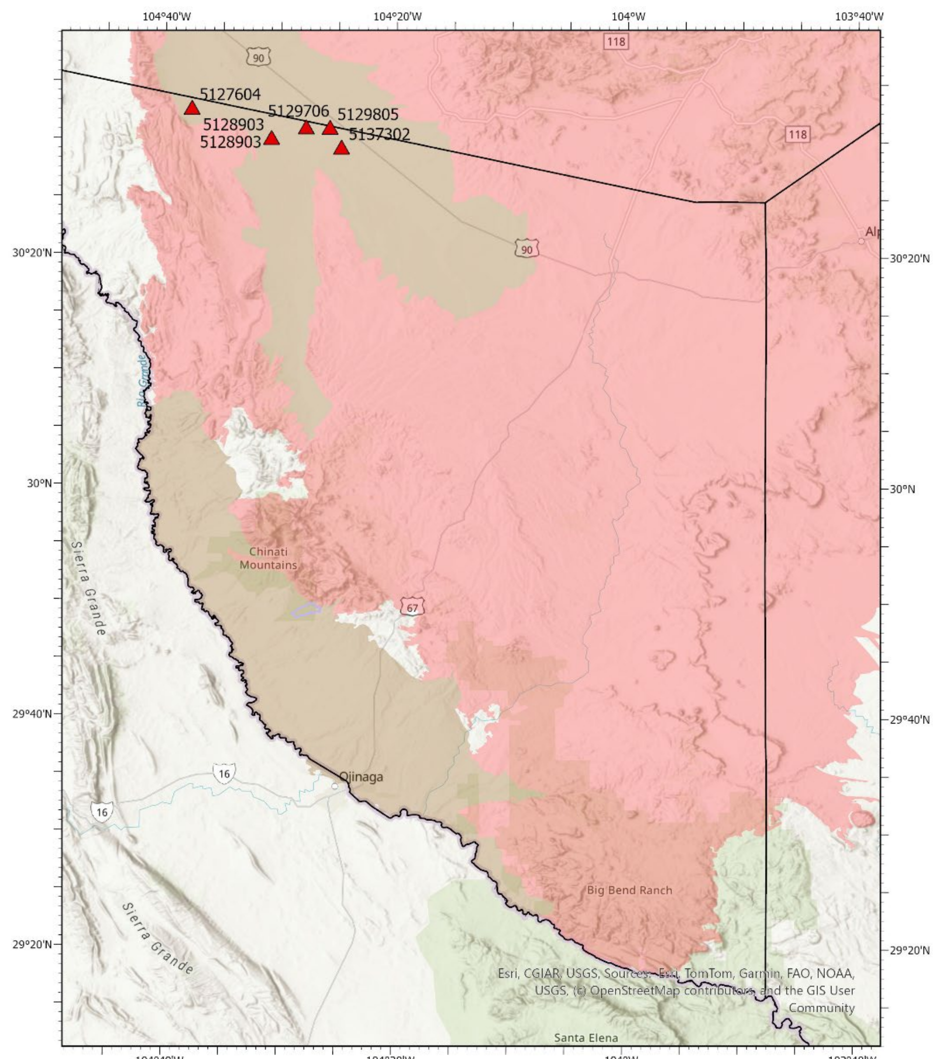
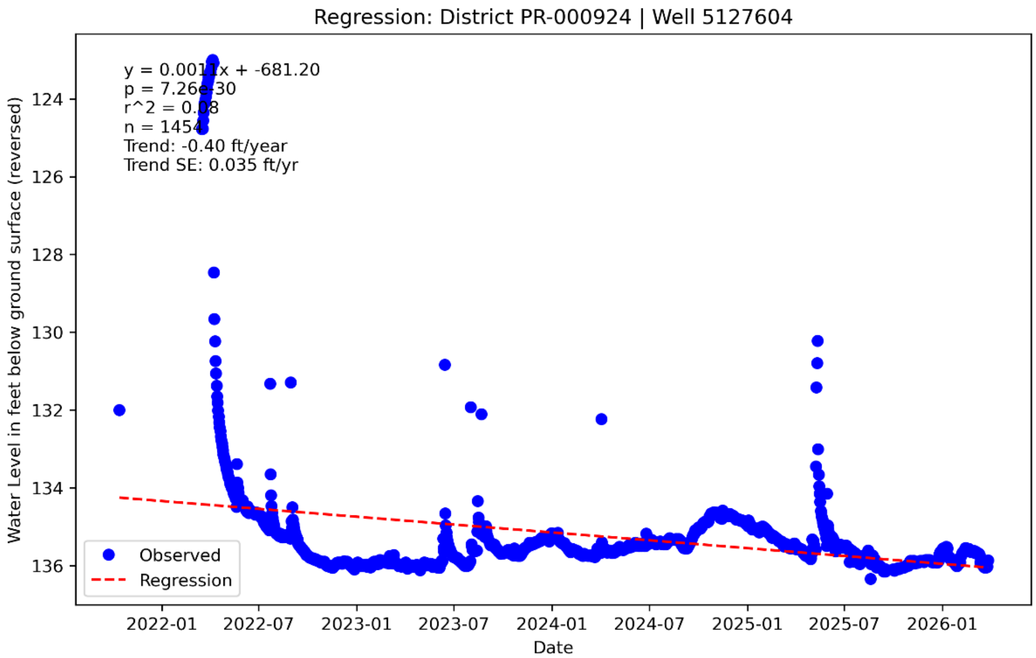


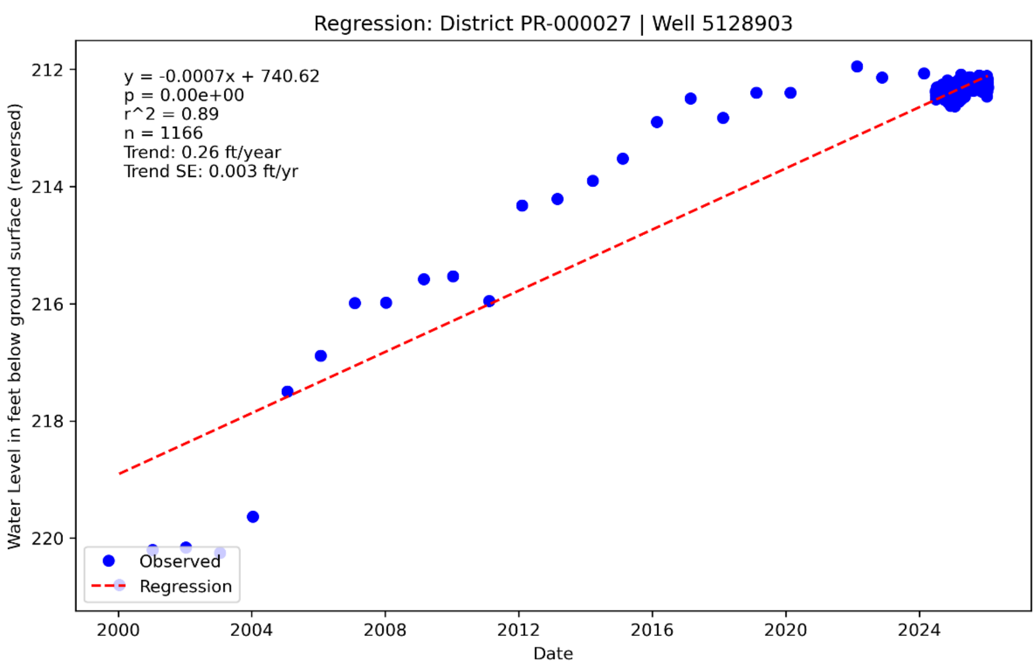
Figure 5. Location of wells in the Ryan Flat Aquifer that were used in the analysis.

The following section includes XY plots of these wells. Each plot includes the formula for the regression line (all linear), the p-value, the r^2 value, the number of points, the Trend and the Trend standard error.

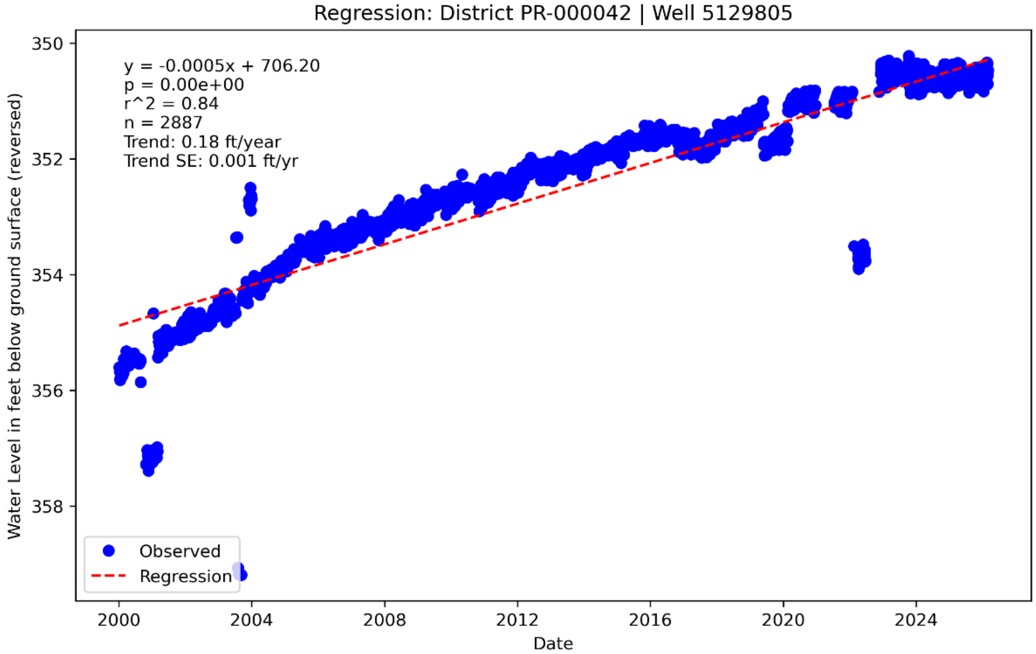
5127604 – Miller



5128903 – City El Paso



5129805 – City El Paso



5137302 – City El Paso

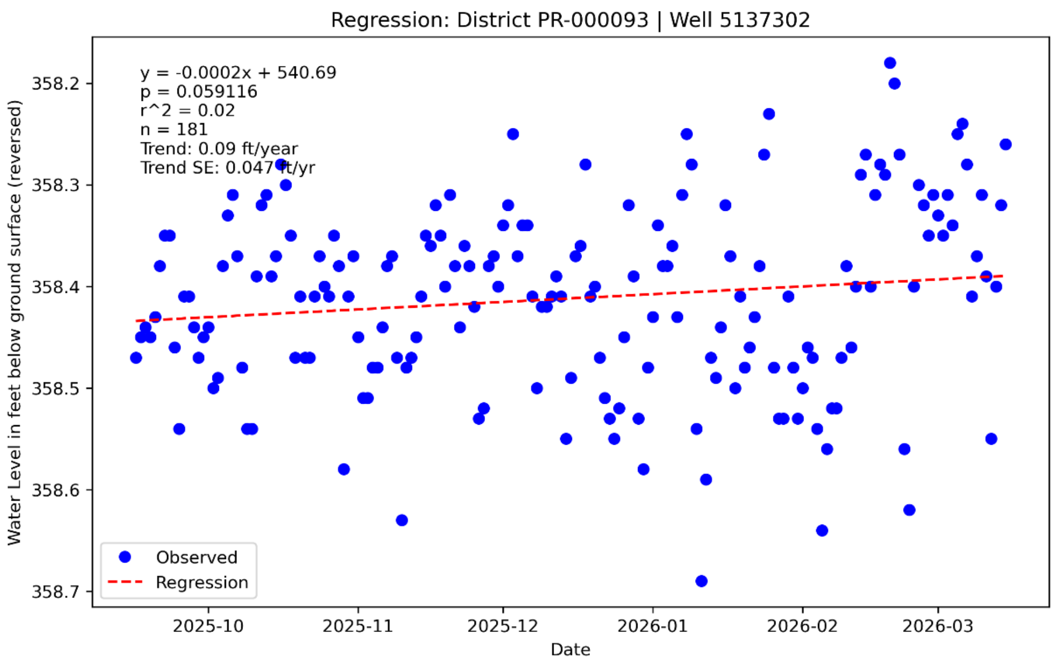


Figure 6. Hydrographs for the Ryan Flat Aquifer wells.

Summary

Table 7 in includes a summary for all aquifers.

Table 7. Summary for Presidio County.

Igneous Aquifer

District ID	SWN	Name	Count	MinDate	MaxDate	Trend ft/yr
PR-000935	5148305	Mimms	2416	3/21/2022	3/26/2026	-0.1
PR-000169	5148604	Marfa5	775	4/5/2006	3/6/2026	-0.01
PR-000934	5148616	Section House	533	4/13/2023	3/12/2025	-0.33
Unknown	5148617	Christina	37	10/14/2022	3/19/2026	-0.1
PR-000243	5156902	X-4	803	2/28/1958	3/27/2026	-0.16
PR-000947	5164401	Williams	1076	3/21/2022	3/27/2026	-0.6
PR-000350	5249402	Tinaja Station	760	1/21/2000	3/27/2026	-0.04
PR-000923	7333201	Sauceda	1348	11/4/2016	4/22/2025	-0.22
PR-000930	7333801	Javelin	181	9/28/2025	3/27/2026	0.11
PR-000451	7406901	Dyer	289	1/21/2000	3/18/2026	-0.13
					Mean	-0.158
					Median	-0.115

Presidio Bolson Aquifer

District-ID	SWN	Name	Count	MinDate	MaxDate	Trend ft/yr
PR-000435	7404201	Benavidez	4	8/19/2004	1/28/2026	-0.93
PR-000444	7404801	CMSNA2	182	8/12/2004	3/27/2026	-0.11
PR-000472	7413402	CMSNA1	298	6/3/2025	3/27/2026	-0.35
PR-000636	7430605	City of Presidio	10	7/14/2004	1/28/2026	-0.57
PR-000666	7430813	Loma Paloma	2062	10/6/2004	3/18/2026	-0.05
					Mean	-0.402
					Median	-0.35

Ryan Flat Aquifer

District ID	SWN	Name	Count	MinDate	MaxDate	Trend ft/yr
PR-000924	5127604	Miller	1454	10/13/2021	3/27/2026	-0.4
PR-000940	5128903	City El Paso	1166	1/12/2000	1/21/2026	0.26
PR-000029	5129805	City El Paso	2887	1/5/2000	2/28/2026	0.18
PR-000093	5137302	City El Paso	181	9/16/2025	3/15/2026	0.09
					Mean	0.0325
					Median	0.135

Appendix 1 Initial report

Presidio County Groundwater Levels Trend Analysis

Prepared for the Presidio County Underground Water Conservation District

Kevin Urbanczyk, West Texas Water Research Center, Sul Ross State University

kevinu@sulross.edu, 432-386-7492

This report is an analysis of groundwater level trends over time for the data available from the Texas Water Development Board and from data collected by the Presidio County Underground Water Conservation District (PCUWCD).

Tasks for the report:

- Survey all county wells in TWDB database, extract those with > 10 levels reported or > 10 years "period of record"
- Compile existing PCUWCD groundwater data
- Complete trend analysis on each – hydrograph with x-axis = date and y-axis = depth to water
- Complete regression analysis for 5, 10 and period of record time periods
- Create comparison to projected DFC of the same time periods
- Compile report of results

Discussion

The data for this section comes from the Texas Water Development Board Groundwater Database (TWDB; https://www.twdb.texas.gov/groundwater/data/gwdbrpt.asp). Two files were acquired: Record of Wells by County and Water Levels by County. The Record of Wells file has basic information about each well in the database included attributes such as date drilled, latitude/longitude, driller … The Water Levels file includes a single record for each water level that has been measured for each well.

There are 803 wells in the TWDB "Record of Wells" file. For comparison, there are 894 wells in the PCUWCD Halff data.

There are 626 wells represented in the TWDB "Water Levels" file with a total of 12,719 individual water level measurements. The PCUWCD Halff database contains 572 wells with water level measurements and a total of 13,483 individual measurements. See Table 1.

Table 1. Comparison of records in TWDB and PCUWCD Halff data.

File	Individual Wells	Total Records
TWDB Record of Wells	803	

Halff 'Record of Wells'	894	
TWDB Water Levels	626	12719
Halff 'Water Levels'	572	13483

There are 108 wells in the PCUWCD Halff data that do not have TWDB State Well Numbers and there are several gaps in the numbering scheme for the data. The missing State Well Numbers might be wells that were added from permit applications or from the TWDB Submitted Drillers Report (https://www.twdb.texas.gov/groundwater/data/drillersdb.asp).

An analysis was completed to extract specific water level records for wells that had one of the following criteria:

- >= 10 records and >= 10 years (many records, many years)
- Of the remaining records, find those with >= 2 records and >= 10 years
- Of the remaining, find those with >= 2 records and < 10 years

A summary of the results is included in Table 2.

Table 2. Summary of continuous water level data.

Criteria	# wells that meet criteria
1. ≥10 records and ≥10 years	37
2. ≥10 records and < 10 years	5
3. ≥2 records < 10 records and ≥10 years	165

A total of 207 wells meet one of the criteria. Most of these (165) fall in the third category where they have been measured only a few times but over a long time period. Of these, most (106) only have 2 water level measurements.

Only 5 wells fall in the second category. These are wells with numerous measurements but over a short period of time. These include MacGuire Ranch (PR-000885), Papalote Llano (PR-000389), and Sauceda (PR-000923). All of these were former PCUWCD monitor wells but Papalote Llano is the only current district monitor well.

The 37 wells that meet the first criteria will be the most valuable for trend analysis. Of these, 16 are current or past PCUWCD monitor wells (see Table 3).

Table 3. PCUWCD monitor wells that meet criteria 1.

Name	District ID	State Well Number	Record Count	Slope	R-squared	P-value	MinDate	MaxDate	YearSpan
Botella Camp	PR-000689	7431602	169	-0.0004	0.0224	0.0522	7/26/1969	6/30/2025	55.9
Casa Moreno	PR-000739	7448101	162	0.0001	0.8853	0	6/18/1974	6/30/2025	51.0
Chinati State Natural Area 1	PR-000472	7413402	29	-0.0005	0.9986	0	4/4/1974	6/30/2025	51.2
Chaa	PR-000475	7413502	28	0.0141	0.845	0	1/27/2005	6/30/2025	20.4
Williams	PR-000947	5164401	763	0.0126	0.5456	0	12/16/2008	6/30/2025	16.5
X-bull	PR-000243	5156902	497	0.0005	0.7499	0	2/28/1958	6/30/2025	67.3
Tinaja Station	PR-000350	5249402	344	-0.0001	0.2353	0	6/15/1930	5/31/2025	95.0
Loma Paloma	PR-000666	7430813	1683	0.0001	0.055	0	10/6/2004	8/12/2024	19.8
Burford Well / Miller	PR-000924	5127604	876	0.0046	0.5323	0	12/8/1993	8/12/2024	30.7
Mimms	PR-000935	5148305	1682	0.0017	0.0074	0.0004	4/22/1959	7/8/2025	66.2
Marfa #5	PR-000169	5148604	349	0.0002	0.101	0	3/9/1987	7/9/2024	37.3
Dyer	PR-000451	7406901	91	0	0.0544	0.026	8/11/1954	8/11/2024	70.0
Ft Leaton	PR-000941	7430503	110	-0.0002	0.0518	0.0168	11/8/1969	8/11/2024	54.8
Antelope Valley 2	PR-000940	5128903	146	-0.0013	0.611	0	4/30/1980	8/1/2024	44.3

Once the wells that fit the criteria were selected, a simple linear regression analysis was performed on each. This mathematical technique fits a straight line through the data with the formula y = mx + b. ‘y’ is the water level, ‘m’ is the slope of the line, ‘x’ is the date and ‘b’ is the y-intercept. Statistical information includes:

- R^2 (R-squared) – ‘Goodness of Fit’; this value varies from 0-1 where 1 is perfect ‘fit’; we prefer values closer to one where the linear regression line approximates the actual data well
- p-value – ‘Statistical Significance’; this measures the probability that the trends happened by random chance; the range is from 0-1; we prefer low values which represent statistically significant trends

See Figure 1 for an example. The figure shows the actual data (Observed) and the regression line (Regression). Also included on the figure is the formula for the line, the p-value (p), the R^2 rvalue (r^2), the number of water level measurements included on the graph and the overall linear trend in feet per year.

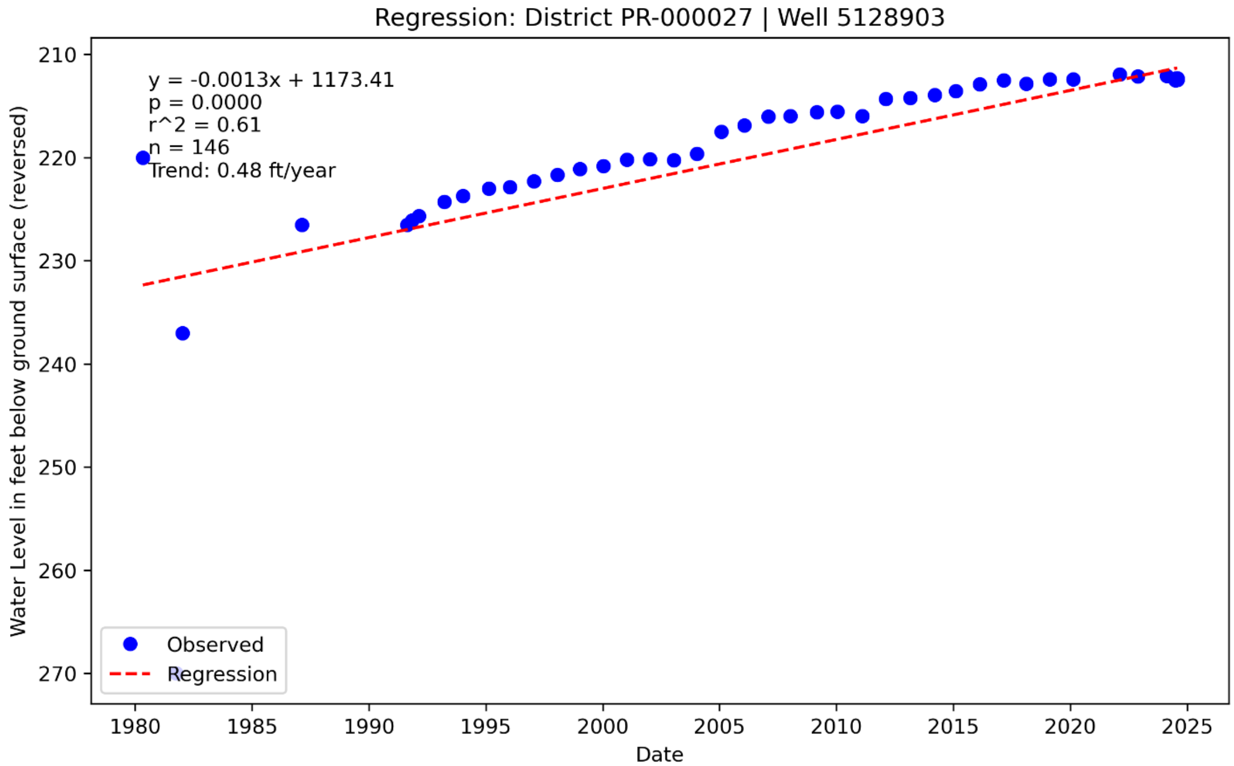


Figure 1. An example of a linear regression and statistical parameters

Once the wells were selected based upon the number of records and time span, they were classified based upon R2 and p-value in this way:

- 'Good' if R2 was >= to 0.5 and p-value was < 0.05
- 'Weak' if R2 was >= to 0.3 and p-value was < 0.1
- 'Unreliable' for all other wells

These are fairly low threshold values and I considered this to be necessary for the analysis. There are many variables involved in long term water level trends such as changing precipitation and pumping. The trends are often not linear but the basic premise of this report was to complete a *linear* analysis of the trends.

A python code script was developed to complete the analysis. This code read the input file and categorized the wells based on number of measurements and duration of measurements. The next step was to input time spans for analysis. The code was written in a way to allow for the analysis of various time spans. The total time span of all TWDB data covered the span from 1929 to 2025. For the first iteration of the project, I chose to run the code for these time spans:

- 1929 to 2025
- 1929 to 1979
- 1980 to 1999
- 2000 to 2025

The code is written in a way where I can change or add any time span if desired. Reducing the time span results in fewer water level records that satisfy the initial criteria. The code also allows for varying the statistical thresholds for R2 and p-value.

Table 4 shows the overall results for all aquifers. The table includes the ‘Good’ and the ‘Weak’ assessments of the data correlations. If we consider all of the wells that have either, the full time span shows a nearly equal trend of increases and decreases with 63 wells showing a decline and 63 wells showing an increase. The 1929 to 1979 time span has 7 wells with a decline and 22 with an increase. The 1980 to 1999 time span has 1 well with a decline and 8 wells with an increase and the 2000 to 2025 time span has 18 wells with a decline and 6 wells with an increase.

Table 4. Overall results for all aquifers.

Date Range	Assessment	Slope Type	Count	Average Slope	Trend in ft/year
1929 to 2025	Good	Positive	10	0.0013	-0.46
1929 to 2025	Good	Negative	11	-0.0039	1.42
1929 to 2025	Weak	Positive	53	0.0017	-0.61
1929 to 2025	Weak	Negative	52	-0.0009	0.34
1929 to 2025	Good + Weak	Positive	63	0.0016	-0.59
1929 to 2025	Good + Weak	Negative	63	-0.0014	0.53
1929 to 1979	Good	Positive	1	0.0019	-0.69
1929 to 1979	Good	Negative	1	-0.0003	0.11
1929 to 1979	Weak	Positive	6	0.0026	-0.94
1929 to 1979	Weak	Negative	21	-0.0008	0.28
1929 to 1979	Good + Weak	Positive	7	0.0025	-0.91
1929 to 1979	Good + Weak	Negative	22	-0.0008	0.28
1980 to 1999	Good	Positive	1	0.0087	-3.18
1980 to 1999	Good	Negative	3	-0.0106	3.87
1980 to 1999	Weak	Positive	0		
1980 to 1999	Weak	Negative	5	-0.0073	2.65
1980 to 1999	Good + Weak	Positive	1	0.0087	-3.18
1980 to 1999	Good + Weak	Negative	8	-0.0085	3.11
2000 to 2025	Good	Positive	11	0.0018	-0.65
2000 to 2025	Good	Negative	3	-0.0011	0.39
2000 to 2025	Weak	Positive	7	0.0009	-0.31
2000 to 2025	Weak	Negative	3	-0.0003	0.10
2000 to 2025	Good + Weak	Positive	18	0.0014	-0.52
2000 to 2025	Good + Weak	Negative	6	-0.0007	0.24

Table 5 shows the results for the West Texas Bolsons aquifer. It shows similar results but has fewer records because it is a subset of the values in Table 4. Note that for the 2000 to 2025 time span, there are 4 records showing an average decline of 1.02 feet per year and 3 records showing an increase of 0.39 feet per year.

Table 5. Model results for the West Texas Bolsons aquifer.

Date Range	Assessment	Slope Type	Count	Average Slope	Trend in ft/year
1929 to 2025	Good	Positive	2	0.0033	-1.21
1929 to 2025	Good	Negative	9	-0.0047	1.72
1929 to 2025	Weak	Positive	20	0.0020	-0.74
1929 to 2025	Weak	Negative	22	-0.0010	0.37
1929 to 2025	Good + Weak	Positive	22	0.0021	-0.78
1929 to 2025	Good + Weak	Negative	31	-0.0021	0.76
1929 to 1979	Good	Positive	0		
1929 to 1979	Good	Negative	0		
1929 to 1979	Weak	Positive	3	0.0045	-1.66
1929 to 1979	Weak	Negative	4	-0.0008	0.27
1929 to 1979	Good + Weak	Positive	3	0.0045	-1.66
1929 to 1979	Good + Weak	Negative	4	-0.0008	0.27
1980 to 1999	Good	Positive	0		
1980 to 1999	Good	Negative	3	-0.0106	3.87
1980 to 1999	Weak	Positive	0		
1980 to 1999	Weak	Negative	4	-0.0088	3.22
1980 to 1999	Good + Weak	Positive	0		
1980 to 1999	Good + Weak	Negative	7	-0.0096	3.50
2000 to 2025	Good	Positive	4	0.0028	-1.02
2000 to 2025	Good	Negative	3	-0.0011	0.39
2000 to 2025	Weak	Positive	0		
2000 to 2025	Weak	Negative	0		
2000 to 2025	Good + Weak	Positive	4	0.0028	-1.02
2000 to 2025	Good + Weak	Negative	3	-0.0011	0.39

Lastly, Table 6 shows the results for the Igneous / other (a category in the TWDB data, hereafter referred to as “Igneous”) aquifer. This table indicates a general decline of the full period of record and significantly shows a decline in the 2000 to 2025 time frame (14 records with an average decline of 0.37 feet per year and 2 with an average increase of 0.07 feet per year).

Summary

In order to summarize these results, I performed a weighted average for 4 different data subsets: all years, all aquifers; 2000-2025 all aquifers; 2000-2025 West Texas Bolson aquifer; and 2000-2025 Igneous aquifer. The weighted average technique took into account the number of wells per slope type (increase or decrease) and then applied that weight to the Trends in ft/year and then added them together. For example, the West Texas Bolsons aquifer had 4 wells with an average decrease of 1.02 ft/year and 3 wells with an average increase of 0.39 ft/year. The weight for the decreasing wells was 0.57 (57 %) which is 4/(4+3). The weight for the increasing wells was the complimentary 0.43 (43%). The final results were calculated in this way:

$$(\text{Weight}_{\text{pos slope}} * \text{Trend}_{\text{pos slope}}) + (\text{Weight}_{\text{neg slope}} * \text{Trend}_{\text{neg slope}})$$

$$(0.57*-1.02) + (0.43*0.39)$$

$$-0.42 \text{ ft/year}$$

Table 7 shows this calculation for 4 of the time frames and aquifer combinations of interest. The table shows a general decline over the full period of record (-0.33 ft/year) but shows a significant decline over the 2000-2025 time period (-0.42 ft/year for the West Texas Bolsons aquifer and -0.32 for the Igneous aquifer).

Category:	Count:	weight (+):	weight(-):	weighted trend:	50 yr condition
All years, all aquifers	126	0.50	0.50	-0.03	-1.49
2000 - 2025, all aquifers	24	0.75	0.25	-0.33	-16.36
2000 - 2025 W TX Bolson aquifer	7	0.57	0.43	-0.42	-20.87
2000-2025 Igneous and Other aquifer	16	0.88	0.13	-0.32	-15.87

This table also includes a column labeled '50 yr condition'. This is the weighted trend projected out to 50 years, created in order to compare the results to the Desired Future Condition (DFC).

Conclusion:

This analysis took into account all available well data for Presidio County. It selected a subset of wells based upon the number of water level measurements and on the time span of these measurements. It then performed a regression analysis and the results were subset based upon statistical quality parameters. Lastly, the results were subset by aquifer type.

The results show that water levels in Presidio cCounty are declining. The projected 50 year condition for the West Texas Bolsons aquifer is an average decline of -20.87 feet (-1.42 ft/yr) and for the Igneous and Other aquifer is an average decline of -15.87 feet (-0.32 ft/yr). The 2025 to 2030 Management Plan indicates a DFC of 72 feet for the West Texas Bolsons aquifer and 14 feet for the Igneous aquifer (Table 6). Therefore, at current production levels this model predicts that the DFC will not be reached for the West Texas Bolsons aquifer but will be exceeded in the Igneous aquifer.

Table 6. Desired Future Conditions from the 2025 to 2030 Management Plan for PCUWCD and model results from this study

Aquifer	Average drawdown should not exceed after 50 years (2020-2060), in feet	Modeled drawdown (this study)
Igneous	14	15.87
West Texas Bolson	72	20.87

Recommendation

It is recommended that the county continue the groundwater monitoring program and to periodically assess the trends as discussed in this report. Particular attention should be paid to the wells listed in Table 7? since they are the 17 wells that were selected by the model to best statistically represent the levels in the Igneous aquifer. I suspect that as we continue the monitoring program the new data will allow for more wells to satisfy the statistical criteria and make the prediction even more viable. The code is designed to take the TWDB water levels file which does not necessarily have all of the recent PCUWCD data. But, I should be able to merge it with our new data and run it at any interval that we choose. We could also come up with a simple metric that indicates the short term status of water levels in wells of concern.

Table 7. Wells used for the Igneous aquifer component of this study.

District ID	State Well Number	Records Used	Trend (ft/year)	MinDate	MaxDate	YearSpan	Assessment	Name
PR-000167	5148602	24	-1.0482	1/20/2000	2/6/2025	25.05	Good	City of Marfa
PR-000934	5148616	442	-0.4069	4/13/2023	12/11/2024	1.66	Good	Section House
PR-000243	5156902	460	-0.3069	1/21/2000	6/30/2025	25.44	Good	X-bull
PR-000947	5164401	860	-0.6759	12/16/2008	8/5/2025	16.64	Good	Williams
PR-000350	5249402	312	-0.0335	1/21/2000	5/31/2025	25.36	Good	Tinaja Station
PR-000389	7333501	121	-0.4643	4/23/2017	6/23/2025	8.17	Good	Papalote Llano
PR-000739	7448101	161	-0.0896	1/20/2005	6/30/2025	20.44	Good	Casa Moreno
Unknown	5148617	28	-0.2112	10/14/2022	6/26/2025	2.70	Weak	Christina
Unknown	5148622	2	-0.0263	12/31/2005	5/14/2025	19.37	Weak	West side Marfa
PR-000231	5156301	2	-0.0096	6/9/2001	4/22/2025	23.87	Weak	Mitchell
PR-000232	5156302	2	-0.3787	6/9/2001	5/2/2025	23.90	Weak	Mitchell
PR-000233	5156303	2	0.0599	6/9/2001	4/22/2025	23.87	Weak	Mitchell
Unknown	5241408	2	-0.0894	10/8/2011	1/28/2025	13.31	Weak	Culbertson
PR-000351	5249403	2	0.0825	8/31/2001	4/22/2025	23.64	Weak	Mitchell
PR-000451	7406901	64	-0.1124	1/21/2000	8/11/2024	24.56	Weak	Dyer
PR-000489	7415501	9	-1.2604	5/10/2005	2/12/2025	19.76	Weak	Cibolo
PR-000699	7432701	2	-0.1139	7/22/2004	11/4/2016	12.29	Weak	Rancho Viejo

Appendix 2 – Summary of the statistical analysis on the full period of record for the Igneous and Igneous/other

Summary (Good + Weak Mean & Median Trends)

Date Range	Mean Trend (ft/year)	Median Trend (ft/year)
1929 to 1979	0.189	0.159
1929 to 2026	-0.252	-0.060
1980 to 1999	-1.414	-1.414
2000 to 2026	-0.456	-0.296
2020 to 2026	0.034	-0.184
2023 to 2026	0.155	-0.176

Date Range	Assessment	Count	Mean Slope	Median Slope	Mean Trend (ft/year)	Median Trend (ft/year)	Percent Increasing	Percent Decreasing
1929 to 1979	Good	2	0.0007735	0.0007735	-0.2825	-0.2825	50	50
1929 to 1979	Weak	9	-0.0008032	-0.000479	0.2934	0.175	22.22	77.78
1929 to 1979	Good + Weak	11	-0.0005165	-0.000435	0.1887	0.1589	27.27	72.73
1929 to 2026	Good	11	0.0006537	0.000451	-0.2388	-0.1647	81.82	18.18
1929 to 2026	Weak	60	0.0006961	1.95e-05	-0.2543	-0.007122	51.67	48.33
1929 to 2026	Good + Weak	71	0.0006895	0.000165	-0.2519	-0.06027	56.34	43.66
1980 to 1999	Good	1	0.008703	0.008703	-3.179	-3.179	100	0
1980 to 1999	Weak	1	-0.000963	-0.000963	0.3517	0.3517	0	100

Date Range	Assessment	Count	Mean Slope	Median Slope	Mean Trend (ft/year)	Median Trend (ft/year)	Percent Increasing	Percent Decreasing
1980 to 1999	Good + Weak	2	0.00387	0.00387	-1.414	-1.414	50	50
2000 to 2026	Good	8	0.001156	0.000985	-0.4222	-0.3598	100	0
2000 to 2026	Weak	8	0.00134	0.0002785	-0.4894	-0.1017	75	25
2000 to 2026	Good + Weak	16	0.001248	0.00081	-0.4558	-0.2959	87.5	12.5
2020 to 2026	Good	4	-0.001265	0.000812	0.462	-0.2966	75	25
2020 to 2026	Weak	4	0.001077	0.0002315	-0.3934	-0.08456	75	25
2020 to 2026	Good + Weak	8	-9.4e-05	0.0005045	0.03433	-0.1843	75	25
2023 to 2026	Good	5	-0.0003324	0.000903	0.1214	-0.3298	80	20
2023 to 2026	Weak	3	-0.000579	0.00017	0.2115	-0.06209	66.67	33.33
2023 to 2026	Good + Weak	8	-0.0004249	0.000481	0.1552	-0.1757	75	25

Appendix 3 – Summary of the statistical analysis on the full period of record for the Presidio Bolson Aquifer.

Summary (Good + Weak Mean & Median Trends)

Date Range	Mean Trend (ft/year)	Median Trend (ft/year)
1929 to 1979	0.140	0.114
1929 to 2026	-0.060	0.111
2000 to 2026	-1.417	-0.462
2020 to 2026	-1.398	-0.348
2023 to 2026	-0.538	0.170

Date Range	Assessment	Count	Mean Slope	Median Slope	Mean Trend (ft/year)	Median Trend (ft/year)	Percent Increasing	Percent Decreasing
1929 to 1979	Good	0	nan	nan	nan	nan	nan	nan
1929 to 1979	Weak	6	-0.0003845	-0.0003125	0.1404	0.1141	33.33	66.67
1929 to 1979	Good + Weak	6	-0.0003845	-0.0003125	0.1404	0.1141	33.33	66.67
1929 to 2026	Good	4	0.002644	0.000702	-0.9658	-0.2564	50	50
1929 to 2026	Weak	33	-0.0001348	-0.000304	0.04924	0.111	36.36	63.64
1929 to 2026	Good + Weak	37	0.0001656	-0.000304	-0.06049	0.111	37.84	62.16
2000 to 2026	Good	5	0.005846	0.00255	-2.135	-0.9314	100	0
2000 to 2026	Weak	3	0.0006043	0.000865	-0.2207	-0.3159	66.67	33.33
2000 to 2026	Good + Weak	8	0.00388	0.001263	-1.417	-0.4615	87.5	12.5

Date Range	Assessment	Count	Mean Slope	Median Slope	Mean Trend (ft/year)	Median Trend (ft/year)	Percent Increasing	Percent Decreasing
2020 to 2026	Good	2	0.005266	0.005266	-1.923	-1.923	50	50
2020 to 2026	Weak	1	0.000954	0.000954	-0.3484	-0.3484	100	0
2020 to 2026	Good + Weak	3	0.003829	0.000954	-1.398	-0.3484	66.67	33.33
2023 to 2026	Good	2	0.005266	0.005266	-1.923	-1.923	50	50
2023 to 2026	Weak	2	-0.002319	-0.002319	0.847	0.847	50	50
2023 to 2026	Good + Weak	4	0.001473	-0.000464	-0.5382	0.1695	50	50

Appendix 3 – Summary of the statistical analysis on the full period of record for the Ryan Flat Aquifer.

Summary (Good + Weak Mean & Median Trends)

Date Range	Mean Trend (ft/year)	Median Trend (ft/year)
1929 to 1979	-4.659	-4.659
1929 to 2026	0.275	0.246
1980 to 1999	3.499	2.847
2000 to 2026	0.031	0.133
2020 to 2026	-0.013	0.094
2023 to 2026	0.071	0.090

Date Range	Assessment	Count	Mean Slope	Median Slope	Mean Trend (ft/year)	Median Trend (ft/year)	Percent Increasing	Percent Decreasing
1929 to 1979	Good	0	nan	nan	nan	nan	nan	nan
1929 to 1979	Weak	1	0.01276	0.01276	-4.659	-4.659	100	0
1929 to 1979	Good + Weak	1	0.01276	0.01276	-4.659	-4.659	100	0
1929 to 2026	Good	8	-0.005406	-0.005553	1.975	2.028	0	100
1929 to 2026	Weak	7	0.004565	0.001704	-1.667	-0.6224	100	0
1929 to 2026	Good + Weak	15	-0.000753	-0.000675	0.275	0.2465	46.67	53.33
1980 to 1999	Good	3	-0.0106	-0.007796	3.87	2.847	0	100
1980 to 1999	Weak	4	-0.008819	-0.006465	3.221	2.362	0	100

Date Range	Assessment	Count	Mean Slope	Median Slope	Mean Trend (ft/year)	Median Trend (ft/year)	Percent Increasing	Percent Decreasing
1980 to 1999	Good + Weak	7	-0.009581	-0.007796	3.499	2.847	0	100
2000 to 2026	Good	2	-0.000598	-0.000598	0.2184	0.2184	0	100
2000 to 2026	Weak	2	0.0004295	0.0004295	-0.1569	-0.1569	50	50
2000 to 2026	Good + Weak	4	-8.425e-05	-0.0003635	0.03077	0.1328	25	75
2020 to 2026	Good	0	nan	nan	nan	nan	nan	nan
2020 to 2026	Weak	4	3.5e-05	-0.0002565	-0.01278	0.09369	25	75
2020 to 2026	Good + Weak	4	3.5e-05	-0.0002565	-0.01278	0.09369	25	75
2023 to 2026	Good	0	nan	nan	nan	nan	nan	nan
2023 to 2026	Weak	3	-0.0001937	-0.000246	0.07074	0.08985	33.33	66.67
2023 to 2026	Good + Weak	3	-0.0001937	-0.000246	0.07074	0.08985	33.33	66.67