Idah Department of Water Resources

GRAND VIEW-BRUNEAU GWMA WATER LEVEL MONITORING UPDATE, 2024

OWYHEE COUNTY, IDAHO

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2024 Update of Groundwater Conditions in the Grand View-Bruneau Groundwater Management Area

The Idaho Department of Water Resources designates Critical Ground Water Areas (CGWAs) and Ground Water Management Areas (GWMAs) under Idaho Code §42-233a and §42-233b, respectively. A CGWA is all or part of a groundwater basin that does not have sufficient ground water to provide a reasonably-safe supply for irrigation or other uses at the current or projected rates of withdrawal. A GWMA is all or part of a groundwater basin that may be approaching the conditions of a CGWA. The Grand View-Bruneau GWMA was designated on October 29, 1982, based on increased and projected increases in groundwater withdrawal and declining spring flows. This report describes the status and trends of aquifer levels in the Grand View-Bruneau GWMA located primarily in Oneida County.

Introduction

The Idaho Department of Water Resources (IDWR) manages a groundwater-level monitoring network in the area encompassing the communities of Grand View and Bruneau, in southwestern Idaho (Figure 1). The monitoring network currently consists of 29 wells within the Grand View-Bruneau Groundwater Management Area (GV-B GWMA).

The GV-B GWMA is approximately 38 miles south of Boise, ID, and encompasses 640 square-miles in northern Owyhee County (Figure 1). Land surface elevations in the GWMA range from 2,330 to 6,060 feet (ft) with an average elevation of 3,140 ft. The 30-year (1991-2020) average annual precipitation at the Grand View 4 NW National Weather Service Climate station (NWS USC00103760) is 6.68 inches (NOAA, 2023). The region is classified as a "Dry Climate" using the Koppen-Geiger Climate Classification, where potential evapotranspiration exceeds precipitation. The GWMA encompasses two sub-climates classified as "cold arid desert" and "cold semi-arid," where the "cold" classification indicates the average annual temperature is below 64.4 ^{O}F (Kottek, 2006).

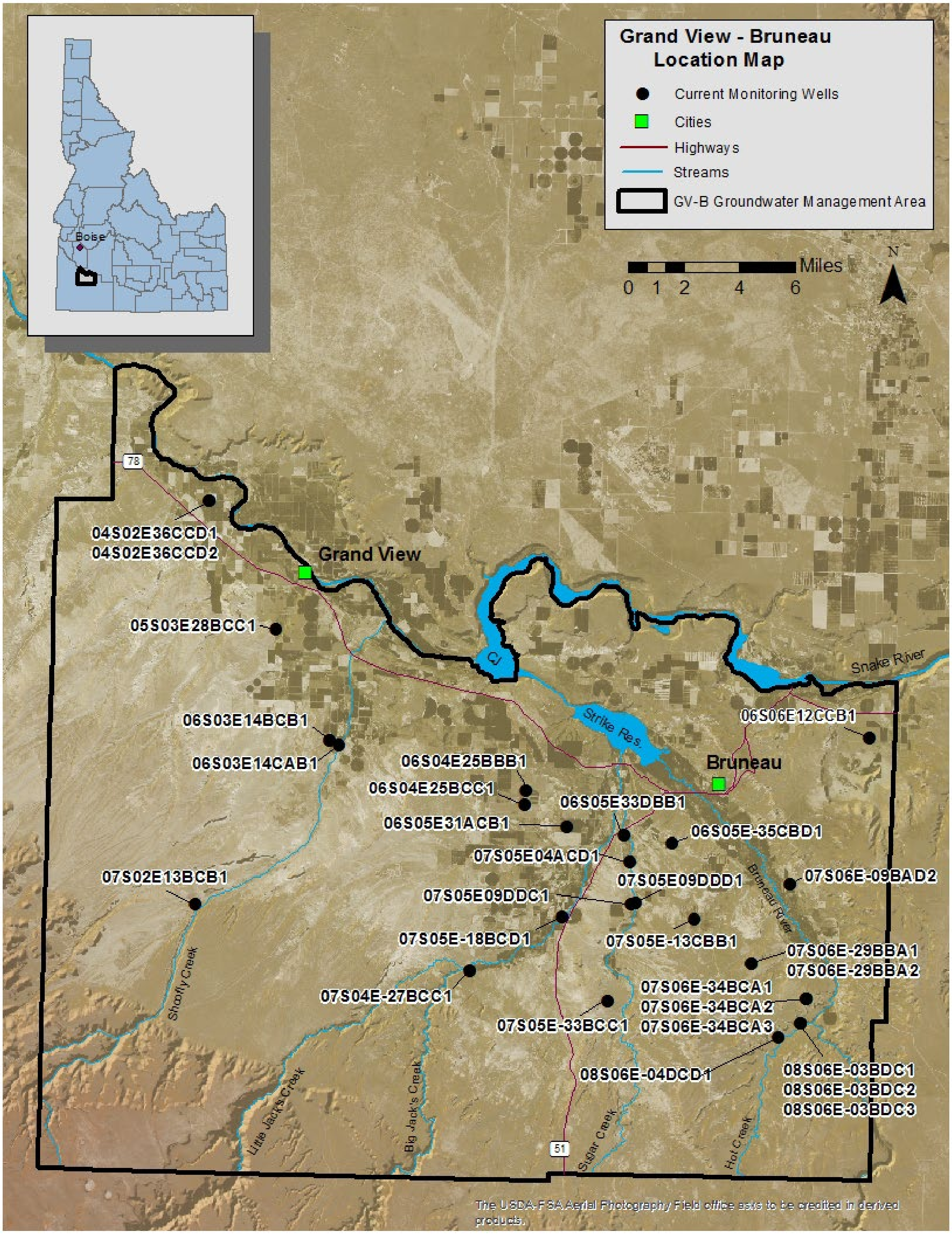

Figure 1. The GV-B GWMA Groundwater Monitoring Network.

The hydrogeology and groundwater conditions in the GV-B GWMA are summarized in several reports (Piper, 1924; Littleton and Crosthwaite, 1957; Ralston and Chapman, 1969; Young and Whitehead, 1975; Rightmire, Young and Whitehead, 1976; Young and Lewis, 1982; Berenbrock, 1993; Mink and Lockwood, 1995; Harrington and Bendixsen, 1999).

This report provides an update to the status of the groundwater monitoring network and presents water-level data collected over the network's history.

Precipitation and Drought

Precipitation

Precipitation data for the GV-B GWMA were obtained from the Grand View AgriMet station (USBR, 2023). The natural variation in annual precipitation tends to obscure the long-term precipitation signature; therefore, precipitation has been smoothed using a 3-year averaging window. Precipitation during the years 1945 through 2022 ranged from 4.3 to 9.8 inches/year with an average of 7.1 inches/year. Both the annual and 3-year average precipitation depths on the GWMA are illustrated in Figure 2.

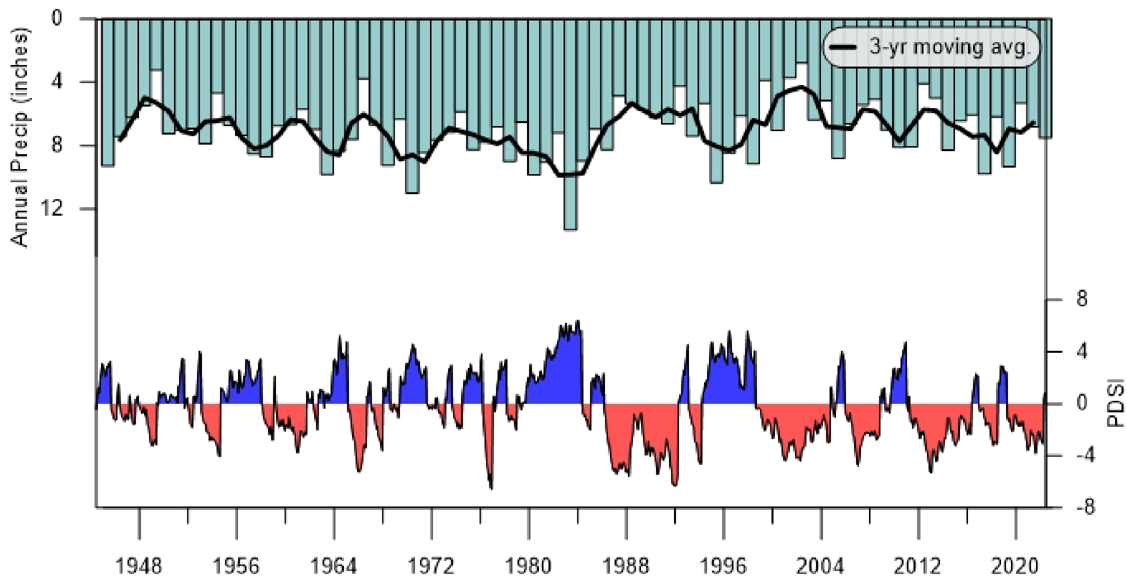

Figure 2. Grand View precipitation and Palmer Drought Severity Index in the GV-B GWMA.

Palmer Drought Severity Index

The Palmer Drought Severity Index (PDSI) is the most prominent index of regional drought severity (Dai, 2023). The index considers precipitation, potential evapotranspiration, and soil moisture to determine drought severity using a physical water balance model, and it has proven to be most effective in determining long-term (several months to years) drought (Alley, 1984).

The PDSI is a standardized measure of aridity, and ranges from -10 to 10, with zero considered as normal. Drought is indicated by values of -2 or less, normal conditions are indicated by values between -2 and 2, and values of 2 or greater are indicative of wet periods (Figure 2 and Table 1).

Table 1. PDSI for the GV-B GWMA[1]

PDSI Classification	PDSI Value	1945-2023	1984-2003	2004-2023	2014-2023
Extremely Wet	$x \geq 4$	6%	10%	2%	0%
Very Wet	$3 \leq x < 4$	8%	11%	2%	0%
Moderately Wet	$2 \leq x < 3$	9%	4%	8%	8%
Near Normal	$-2 < x < 2$	49%	30%	48%	51%
Moderate Drought	$-2 \geq x > -3$	13%	11%	25%	24%
Severe Drought	$-3 \geq x > -4$	9%	14%	13%	16%
Extreme Drought	$x \leq -4$	7%	19%	4%	2%

[1]The GV-B GWMA is within the Idaho Western Valleys climate zone (NOAA, 2023).

The PDSI indicates that for the period from 1945 to 2023, the GV-B GWMA experienced somewhat balanced climate conditions with relatively wet conditions occurring 23% of the time, near normal conditions 49% of the time, and relatively dry conditions 29% of the time (Table 2).

Viewing PDSI over discrete time periods allows for the assessment of climate conditions over time; therefore, the PDSI has been grouped into the most recent 40-, 20-, and 10-year periods.

The PDSI for the period from 1984 to 2003 indicates that the area experienced drier conditions than the long-term climate, with fewer normal years and more frequent dry years. Conditions of wet, normal, and dry conditions occurred 25%, 30%, and 44% of the time, respectively (Table 2).

The PDSI for the period from 2004 to 2023 indicates that the area experienced drier conditions than the 40-year and long-term periods, with conditions of wet, normal, and dry conditions occurring 11%, 48%, and 41% of the time, respectively (Table 2).

The PDSI for the period from 2004 to 2023 indicates that the area experienced fewer wet conditions than the other analyzed periods, with conditions of wet, normal, and dry conditions occurring 8%, 51%, and 42% of the time, respectively (Table 2).

Table 2. General climate conditions based on PDSI values.

General Conditions	1945-2023	1984-2003	2004-2023	2014-2023
Wet	23%	25%	11%	8%
Near Normal	49%	30%	48%	51%
Drought	29%	44%	41%	42%

Water Use

The overwhelming majority of water used in the GV-B GWMA originates as precipitation that falls outside of the GV-B GWMA boundaries. Surface water and groundwater provide water for irrigation, stock, municipal, commercial, industrial, and domestic water uses in the GV-B GWMA; however, irrigation is the predominant use in the basin based on listed water rights (Figure 3).

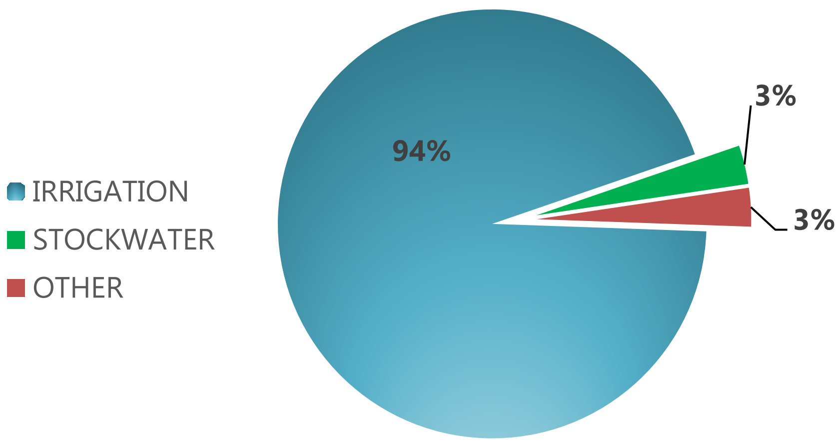

Figure 3. Percent of total allowable diversions by water use. The Other Uses category comprises municipal, commercial, industrial, and domestic uses.

There are approximately 15,700 acres of groundwater irrigated land, approximately 34,500 acres of surface water irrigated land, and approximately 7,900 acres of land irrigated with a combination of groundwater and surface water (Figure 4).

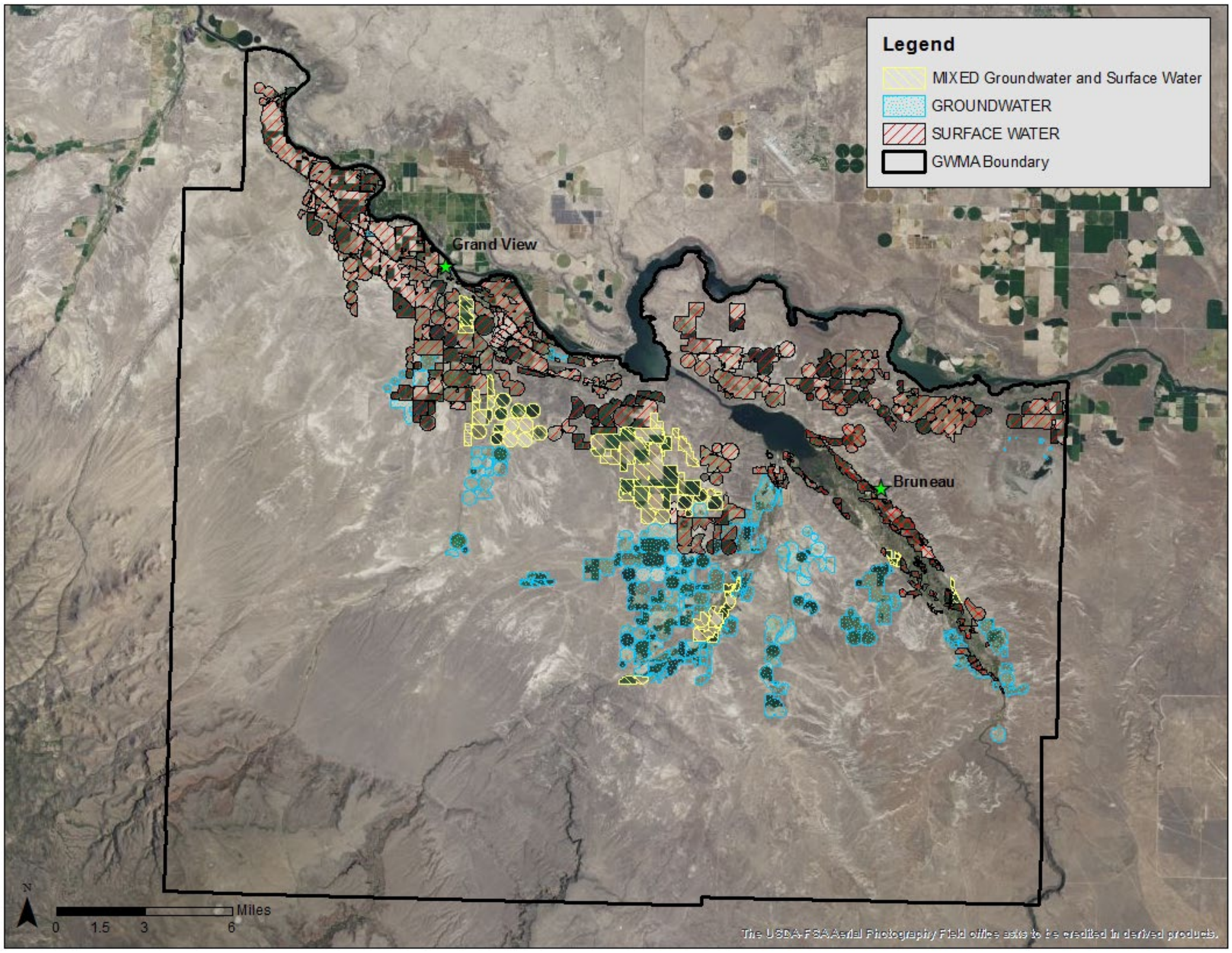

Figure 4. Water source for irrigated lands within the GV-B GWMA.

Consumptive use has been evaluated by analysis of crop irrigation requirement data. The total consumptive use of irrigation water within the GV-B GWMA, calculated for the 2010, 2012, 2017, and 2020 irrigation seasons, ranges from 142,000 to 184,000 acre-feet (AF) per season with an average of approximately 165,000 AF per season. Consumptive use of irrigation water for lands irrigated wholly or partially with groundwater ranges from 59,000 to 69,000 AF per season with an average of approximately 66,000 AF per season.

Crop irrigation requirement (CIR) represents the amount of water (in addition to precipitation) that must be applied to meet the evapotranspiration needs for a crop; CIR has been calculated as evapotranspiration minus precipitation for this report (Allen and Robison, 2017; PRISM, 2014). CIR on groundwater irrigated lands ranges from 2.4 to 3.4 feet per season.

Status of the Monitoring Network

The 29 wells currently in the network are measured at least monthly; however, equipment issues, pumping, or temporary access restrictions can result in short-term data gaps. Transducers with data loggers (transducers) have been installed in 14 of the wells, which provide hourly water-level measurements. Table 3 summarizes the active network and identifies the wells equipped with transducers. Water-level hydrographs for the current monitoring network are displayed in Appendix A.

Table 3. Active Grand View-Bruneau GWMA monitoring network.

Well Number	Total Depth (ft)	Production Depth (ft)	Start Year	Data Logger
04S 02E 36CCD1	202	42-202	2019	Yes
04S 02E 36CCD2	39	29-39	2019	Yes
05S 03E 28BCC1	2540	1860-2540	2024	No
06S 03E 14BCB1	1342	373-1340	1953	Yes
06S 03E 14CAB1	271	180-260	2023	No
06S 04E 25BBB1[1]	1750	938	2021	No
06S 04E 25BCC1	2042	1759-2042	2021	No
06S 05E 31ACB1	UNK	UNK	2021	No
06S 05E 33DBB1	142	UNK	1953	No
06S 05E 35CBD1	476	230-350	1980	No
06S 06E 12CCB1	990	920-990	2017	No
07S 02E 13BCB1	UNK	UNK	2020	No
07S 04E 27BCC1	1390	19-1390	1978	No
07S 05E 04ACD1[2,3]	1100	700-1100	2018	No
07S 05E 09DDC1	2100	96-2100	2015	Yes
07S 05E 09DDD1	1600	550-984, 1034-1337, 1432-1463	2015	No
07S 05E 13CBB1	1954	180-710, 1070-1180, 1560-1680	1978	No
07S 05E 18BCD1	517	254-517	1954	No
07S 05E 33BCC1	409	382-402	1994	Yes
07S 06E 09BAD2	960	80-960	1953	Yes
07S 06E 29BBA1	760	415-760	1990	Yes
07S 06E 29BBA2	384	250-384	1990	Yes
07S 06E 34BCA1	681	322-681	1990	Yes
07S 06E 34BCA2	323	302-322	1990	Yes
07S 06E 34BCA3	679	659-679	1990	Yes
08S 06E 03BDC1	480	194-480	1990	Yes
08S 06E 03BDC2	90	80-90	1990	No
08S 06E 03BDC3	140	120-140	1990	Yes
08S 06E 04DCD1	600	170-600	1990	Yes

[1]Well collapsed and a liner was installed to 938 ft. It is unclear where or how many openings there are.
[2]Well also has limited number of historical measurements from 1989-1990.
[3]Well is not currently monitored due to access difficulties.

Analyses of Water-Level Data

Historic (period of record), long-term (20-year), and recent (10-year) water levels have been analyzed to summarize conditions in the GV-B GWMA.

General Groundwater Flow

The Grand View-Bruneau area is underlain by a regional low-temperature geothermal aquifer system. This aquifer system is characterized by multiple confined and partially confined flow zones that exhibit increasing hydraulic head with depth (Berenbrock, 1993). The construction of many wells in the network allows for mixing (hydraulic communication) between multiple flow zones (Mink and Lockwood, 1995). Additionally, it is unclear which flow zone(s) some of the wells represent because some completion depths are unknown, and some wells have experienced partially collapsed boreholes. Because the observed water levels represent unknown flow zone(s) or combinations of flow zones, a reliable groundwater flow map cannot be constructed using the monitoring network data. However, previous research in the area indicates that groundwater flow is generally south to north within the Grand View-Bruneau GWMA, and locally can vary from northeastward to northwestward (Littleton and Crosthwaite, 1957; Young and Lewis, 1982; Berenbrock, 1993).

Water-Level Changes

Recent Water-Level Changes

To evaluate recent water-level behavior, springtime, non-pumping water-level differences for the period 2015 - 2024 have been calculated for 15 of the 29 wells in the network; 14 wells were excluded due to insufficient data. Water levels in the 15 wells analyzed were lower in the spring of 2024 than in the spring of 2015. Water-level changes in the Grand View-Bruneau GWMA over the last 10 years range from -0.89 to -9.75 feet (Table 4).

Long-Water-Level Changes

To evaluate long-term water-level behavior, non-pumping water-level differences for the period 2005 - 2024 have been calculated for 15 of the 29 wells in the network; 14 wells were excluded due to insufficient data. Water levels in 14 of the 15 wells analyzed were lower in the spring of 2024 than in the spring of 2005. Water-level changes in the Grand View-Bruneau GWMA over the last 20 years range from -17.33 to 5.55 feet (Table 4). One well (07S06E09BAD2) exhibits a long-term water-level rise over the most recent 20-year period; however, during this period, data collection changed, well usage was reduced, and leaks at the well head were repaired, all of which may have influenced water-level behavior.

Overall Water-Level Changes

To evaluate the overall changes at each well, non-pumping water-level differences between the historic and current water levels have been calculated for 16 of the 29 wells in the network; however, water-level data for each well span different time periods and the changes may not be directly comparable between wells. No matter the length of record, water levels in each of the

16 wells were lower in the spring of 2024 than they were when the wells were added to the network (Table 4).

Table 4. Spring-season water-level changes for wells in the Grand View-Bruneau GWMA monitoring network with sufficient data.

Well Number	10-YR Water Level Change Period	10-YR Water Level Change (feet)	20-YR Water Level Change Period	20-Year Water Level Change (feet)	Overall Water Level Change Period	Overall Water Level Change (feet)
06S 03 E14BCB1	2015-2024	-7.87	2005-2024	-16.39	1954-2024	-70.04
06S 05E 33DBB1	2015-2024	-9.75	2005-2024	-17.33	1967-2024	-22.80
06S 05E 35CBD1	2015-2024	-6.10	2005-2024	-5.47	1980-2024	-16.44
07S 04E 27BCC1	2015-2024	-6.05	2005-2024	-14.47	1978-2024	-30.27
07S 05E 13CBB1	2015-2024	-8.11	2005-2024	-17.30	1979-2024	-31.91
07S 05E 18BCD1	2015-2024	-5.12	2005-2024	-13.52	1954-2024	-50.64
07S 05E 33BCC1[1]	2015-2024	-6.10	NA	NA	2008-2024	-11.80
07S 06E 09BAD2[2]	NA	NA	2005-2024	5.55	1954-2024	-12.05
07S 06E 29BBA1	2015-2024	-4.41	2005-2024	-14.87	1990-2024	-21.02
07S 06E 29BBA2	2015-2024	-3.92	2005-2024	-7.56	1990-2024	-12.87
07S 06E3 4BCA1	2015-2024	-5.74	2005-2024	-15.13	1990-2024	-22.03
07S 06E 34BCA2	2015-2024	-5.45	2005-2024	-13.18	1990-2024	-20.79
07S 06E 34BCA3	2015-2024	-6.26	2005-2024	-14.31	1990-2024	-22.62
08S 06E 03BCD1	2015-2024	-5.74	2005-2024	-12.96	1990-2024	-22.98
08S 06E 03BCD2[3]	NA	NA	NA	NA	NA	NA
08S 06E 03BCD3	2015-2024	-0.89	2005-2024	-3.13	1990-2024	-8.33
08S 06E 04DCD1	2015-2024	-5.73	2005-2024	-13.75	1990-2024	-22.41
Regional[4]	--	-5.74	--	-13.52	--	--

[1]The 20-year water-level change was not calculated because the well was added to the network in 2008.
[2]No access from November 2014 through March 2017.
[3]Well intermittently dry since 2007; continuously dry since 2012.
[4]The regional water-level changes have been calculated as the median change.
NA indicates the calculation is not applicable due to insufficient data.

Water-level Trends

Calculating a linear trend for a set of water-level data is a simple way to describe long-term water-level changes. However, a calculated trend is not always representative of the behavior if there are frequent and/or large water-level fluctuations, and/or if the calculated trend is small. Therefore, a statistical assessment of the calculated trend is an important step in determining the general water-level behavior over time. A statistically significant trend indicates that there is a non-zero trend in the data (at the chosen confidence interval), and the calculated trend is the best linear representation of changes over time. Lack of statistical significance indicates that the trend cannot be considered different than zero, and the calculated trend does not adequately represent changes over time. The significance in water-level trends has been set to 95% probability; therefore, any trend with a p-value less than 0.05 is statistically significant.

Trends in water-level changes have been calculated using the Mann-Kendall (MK) test (Hirsch and Slack, 1984). The MK test was developed by the U.S. Geological Survey (USGS) and is the most frequently used test for trend in environmental sciences (Helsel and others, 2006). Trends in 15 wells were calculated for 10-year and 20-year periods, and trends in 16 wells were calculated for the respective periods of record.

Results from the MK analyses indicate that all 16 wells exhibit downward water-level trends for the respective periods of record, 15 of which are statistically significant (Table 3; Appendix B). Fourteen of the 15 wells that were evaluated for the most recent 20-year period exhibit downward trends, all of which are statistically significant. One well (07S06E09BAD2) exhibits an upward trend over the most recent 20-year period; however, data collection and well usage changed, and leaks at the well head were repaired during this period, all of which may have influenced water-level behavior (Table 5; Appendix B). Fifteen wells were evaluated for the most recent 10-year period and all exhibit downward trends, 14 of which are statistically significant (Table 5).

Table 5. Water-level trends in the Grand View-Bruneau GWMA monitoring network with sufficient data.

Well Number	10-yr Trend (feet/year)[1]	10-yr Trend p-value[2]	20-yr Trend (feet/year)	20-yr Trend p-value[6]	Overall Trend (feet/year)[6]	Overall Trend p-value
06S 03E 14BCB1	-0.61	0.10	**-0.55**	0.00	**-0.70**	0.00
06S 05E 33DBB1	**-0.84**	0.00	**-0.76**	0.00	-0.14	0.06
06S 05E 35CBD1	**-0.64**	0.00	**-0.84**	0.00	**-0.86**	0.00
07S 04E 27BCC1	**-0.72**	0.00	**-0.84**	0.00	**-0.71**	0.00
07S 05E 13CBB1	**-0.84**	0.01	**-0.91**	0.00	**-0.82**	0.00
07S 05E 18BCD1	**-0.57**	0.01	**-0.78**	0.00	**-0.66**	0.00
07S 05E 33BCC1[3]	**-0.59**	0.00	NA	NA	**-0.72**	0.00
07S 06E 09BAD2[4]	NA	NA	**0.28**	0.04	**-0.11**	0.00
07S 06E 29BBA1[5]	**-0.55**	0.00	**-0.77**	0.00	**-0.68**	0.00
07S 06E 29BBA2	**-0.44**	0.00	**-0.41**	0.00	**-0.37**	0.00
07S 06E 34BCA1[5]	**-0.65**	0.00	**-0.83**	0.00	**-0.73**	0.00
07S 06E 34BCA2	**-0.63**	0.00	**-0.75**	0.00	**-0.69**	0.00
07S 06E 34BCA3	**-0.75**	0.00	**-0.83**	0.00	**-0.69**	0.00
08S 06E 03BCD1	**-0.70**	0.00	**-0.80**	0.00	**-0.74**	0.00
08S 06E 03BCD3[5]	**-0.09**	0.00	**-0.11**	0.00	**-0.30**	0.00
08S 06E 04DCD1	**-0.67**	0.00	**-0.83**	0.00	**-0.71**	0.00

[1]Bold indicates the trend is statistically significant.
[2]A p-value less than 0.05 indicates the trend is significant at the 95% confidence interval.
[3]The 20-year trend was not calculated because the well was added to the network in 2008.
[4]The 10-year water-level trend was not calculated due to lack of data.
[5]The 20-year water-level trend has been calculated using the years 2004 through 2024 due to missing data in 2005.
[6]The overall water-level trend has been calculated for the same period as the overall water level change (Table 2).
NA indicates the calculation is not applicable due to insufficient data.

Regional Water-level Trend

It is helpful to determine if the trends found in individual wells are consistent across the area when evaluating regional aquifer conditions. The Regional Mann-Kendall (RMK) test calculates the regional water-level trend as the median trend for all wells. Because the wells have different periods of record, the RMK has only been applied to the most recent 10- and 20-year periods (Table 6).

Table 6. Regional water-level trends in the Grand View-Bruneau GWMA monitoring network.

Period	Trend (feet/year)	p-value
Regional 10-yr Trend	-0.63	0.00
Regional 20-yr Trend	-0.76	0.00

The RMK analyses indicate statistically significant regional trends of -0.63 feet/year and -0.76 feet/year for the most recent 10- and 20-year periods, respectively.

Discussion

Summary

The water-level monitoring network consists of 29 wells within the Grand View – Bruneau GWMA, 16 of which were analyzed for water-level changes. Water levels in all 16 wells decreased over the respective periods of record. Water-level changes in 15 wells were calculated for the most recent 10- and 20-year periods. The data indicate that water levels in all 15 wells declined during the last 10 years, and that water levels in 14 of the 15 wells declined over the most recent 20 years. Well 07S 06E0 9BAD2 is the only well with increased water levels over the most recent 20 years; however the changes may not be representative of aquifer conditions due to monitoring, well-head, and well-use changes that occurred in 2017.

Trend analyses indicate that all 16 wells evaluated for trends exhibit downward trends for the respective periods of record, 15 of which are statistically significant. The 15 wells that were evaluated for the most recent 10-year period all exhibit downward trends, 14 of which are statistically significant. Fourteen of the 15 wells that were evaluated for the most recent 20-year period exhibit statistically significant downward trends. Well 07S 06E 09BAD2 exhibits an upward trend over the most recent 20-year period; however, the trend may not be representative of aquifer conditions due to monitoring, well-head, and well-use changes.

Recommendations

Ten wells have been added to the network since 2017, which improved the spatial distribution of water-level data across the GWMA. However, there are important areas within the GWMA without monitoring wells and it is recommended that the monitoring network be expanded to provide better coverage in these areas. The following recommendations would provide basic information that is neededacross the management area:

1. Begin monitoring one or more low-temperature geothermal wells northeast of the Bruneau River (06S05E, 07S06E) to replace discontinued well 07S06E-26BDA1 (Figure 5).
2. Make improvements to well 07S 05E 18BCD1. Degradation of the well-head conditions have resulted in unreliable measurements. This is an important well because it is still flowing, has a long period of record, and is in an area without other monitoring wells (Figure 5).
3. Install or begin monitoring one or more additional wells in Township/Range 06S04E and 07S04E in the middle of the GWMA (Figure 5).
4. Install or begin monitoring one or more additional wells in the northwestern portion of the GWMA between Grand View and the northwest boundary (05S02E, 05S03E). The existing monitoring wells are completed in the upper aquifer, and water levels do not represent regional aquifer conditions (Figure 5).
5. Install or begin monitoring additional wells in the north-northeastern portion of the GWMA (05S05E) between CJ Strike and the Snake River (Figure 5).

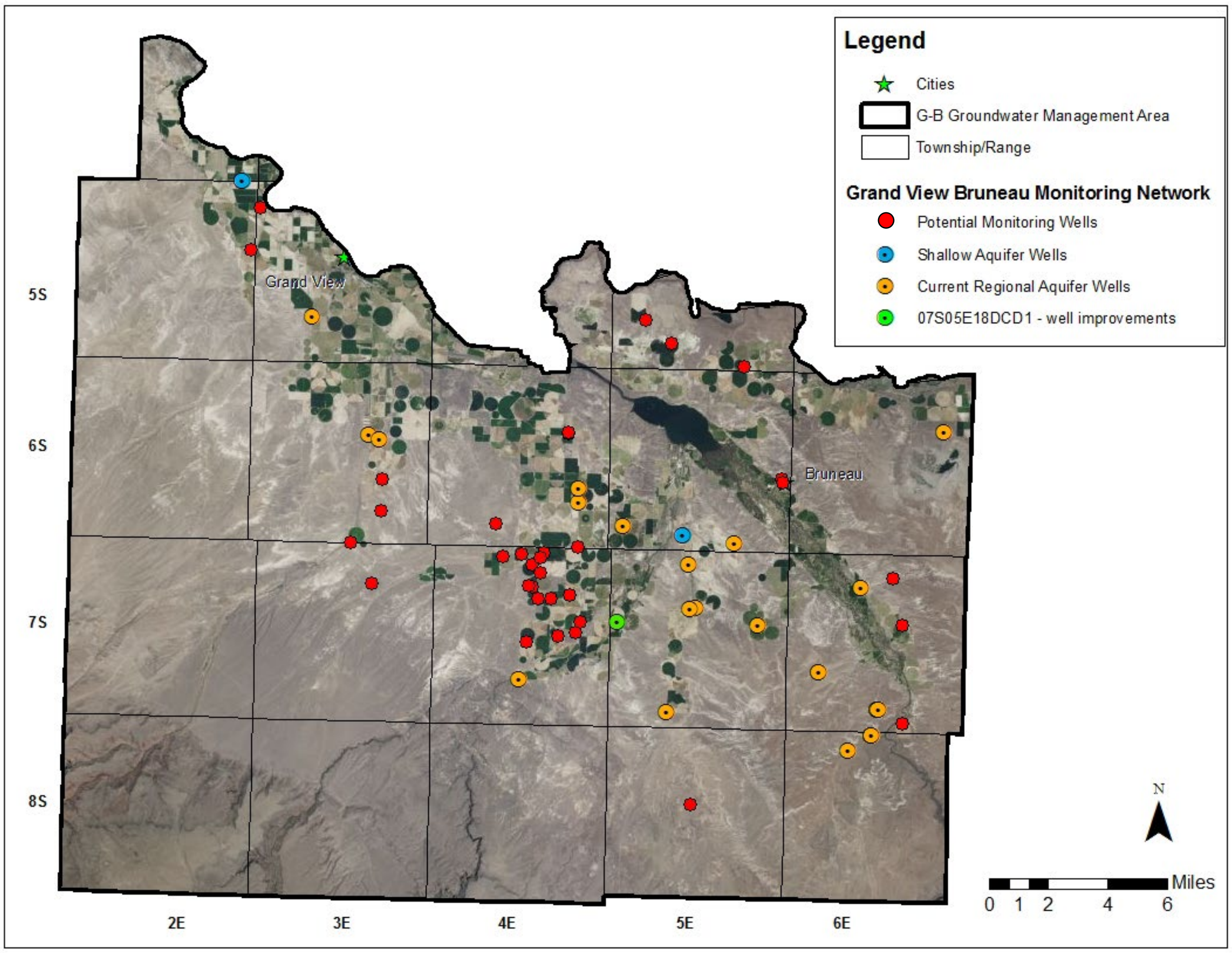

Figure 5. Blue, green, and orange locations are current monitoring locations. Red points represent potential future monitoring locations with well logs indicating the wells are completed in the deep aquifer.

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APPENDIX A

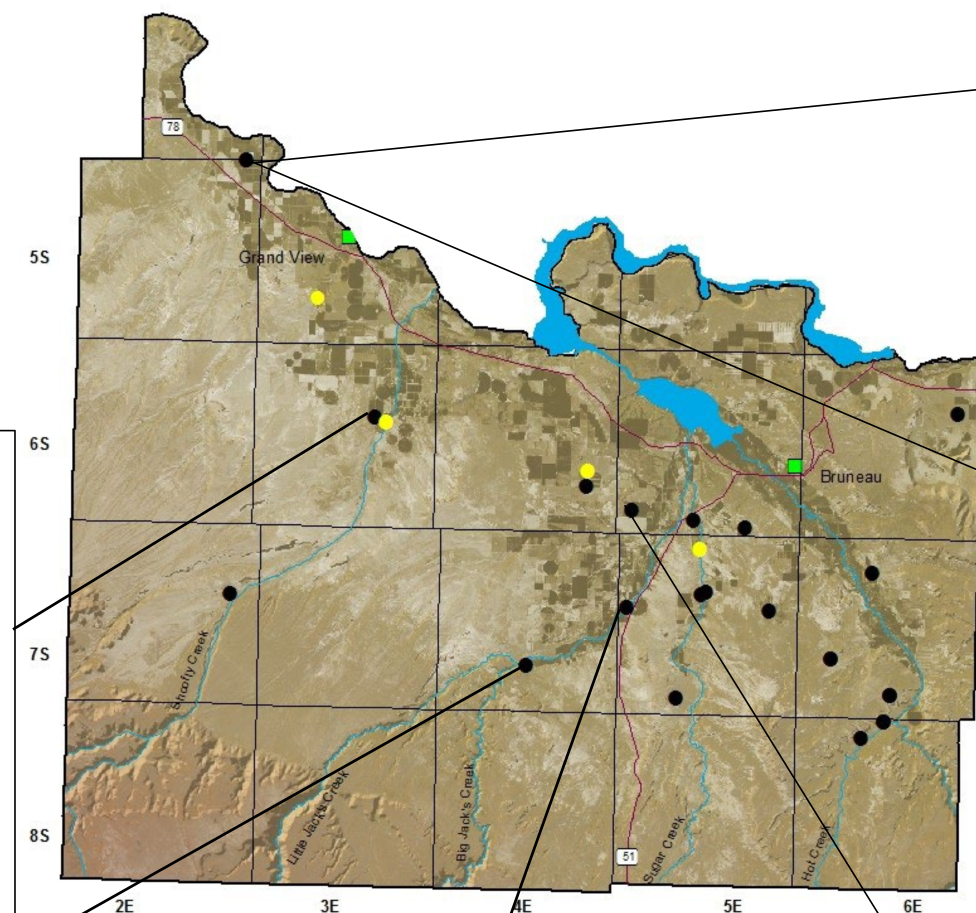
HYDROGRAPHS OF THE GRAND VIEW – BRUNEAU MONITORING NETWORK

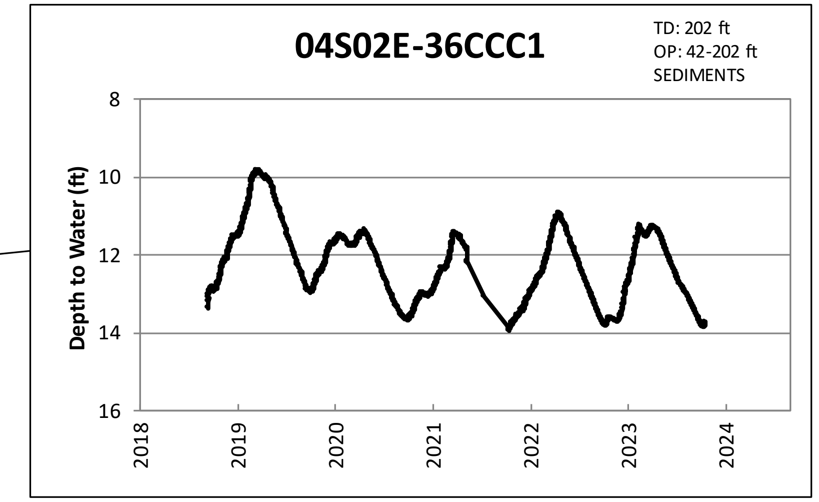
Grandview-Bruneau Hydrographs – West Area

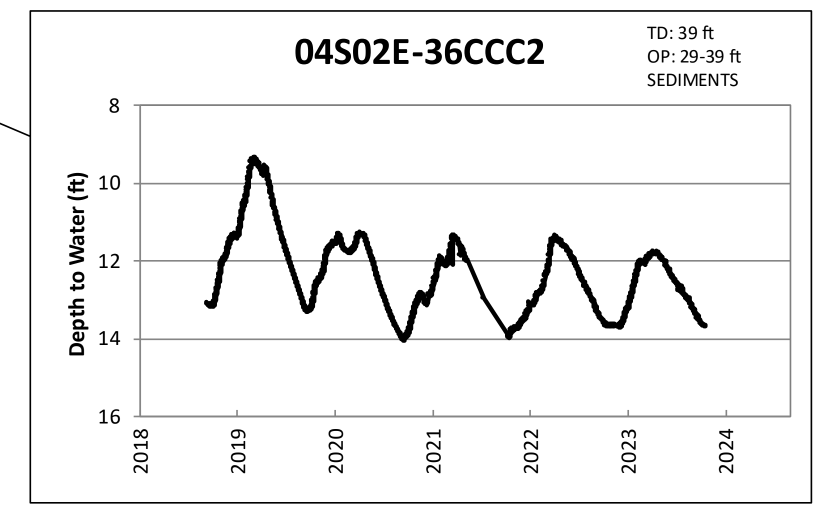
HYDROGRAPH LEGEND

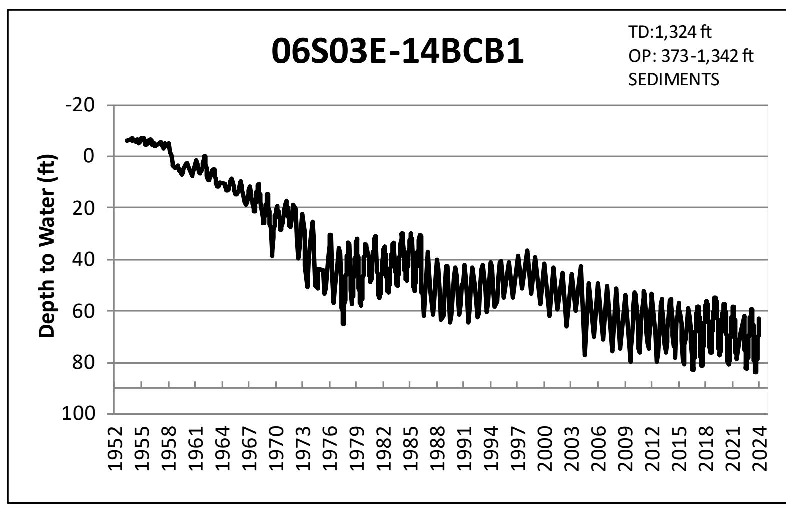
- ● Well
- ● Well (no hydrograph)

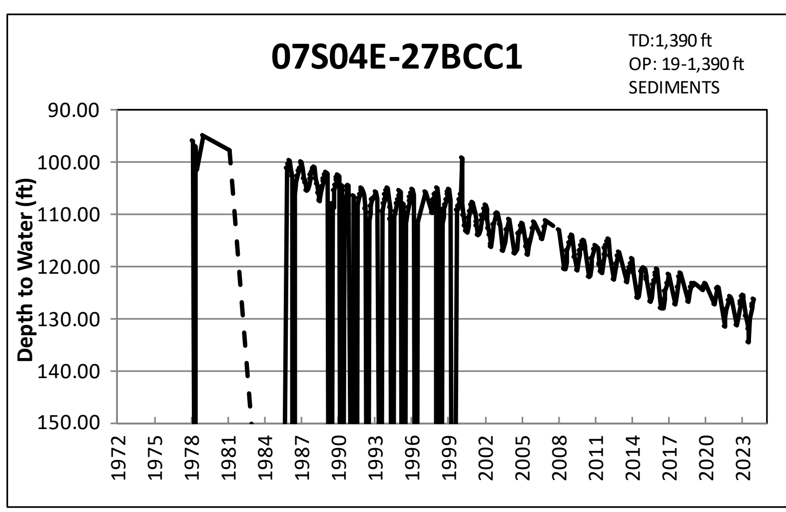
TD: Total Depth
OP: Interval that well is open to aquifer
VOLCANICS: Water Bearing Lithology
NA: Information is unknown
- - Indicates more than one month between measurements

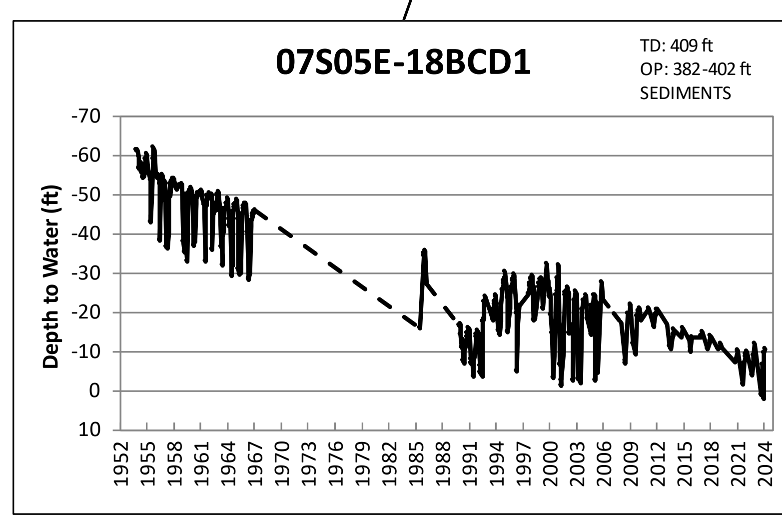


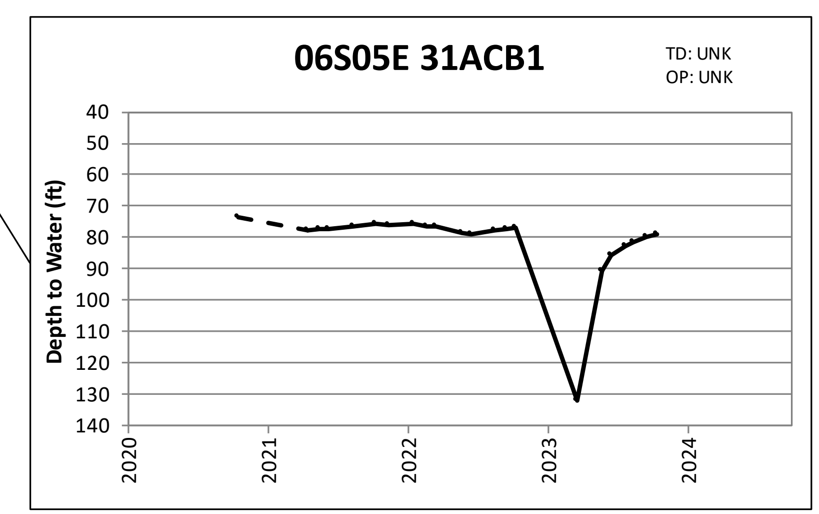




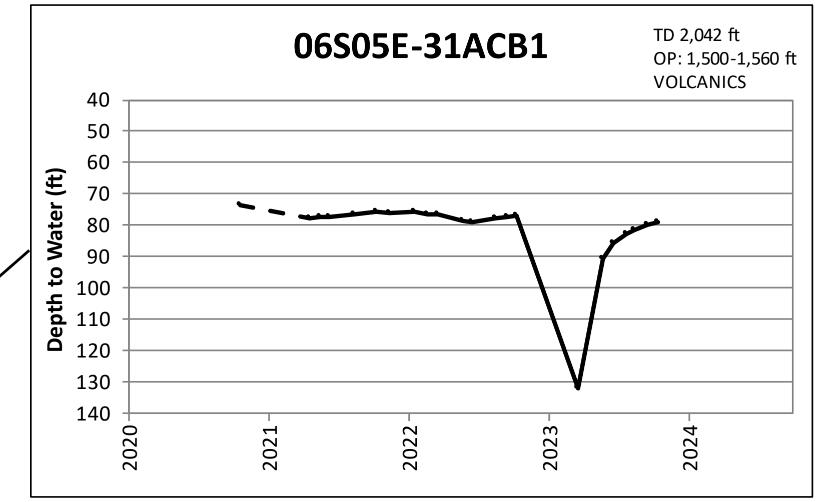








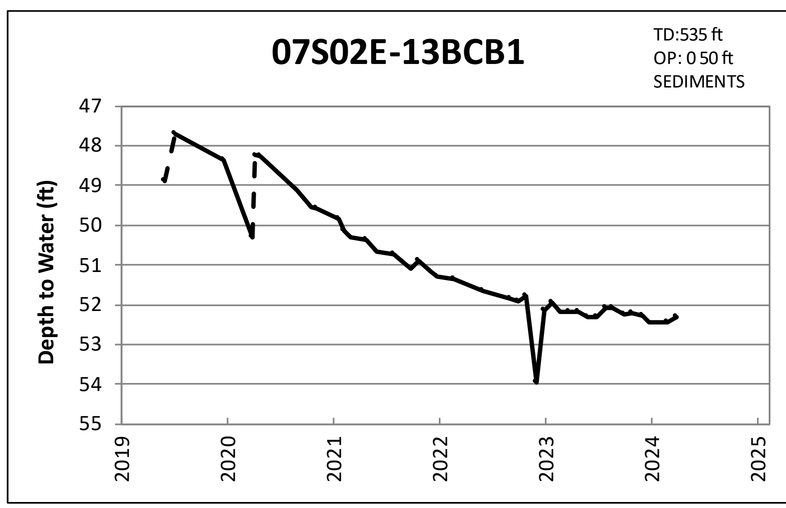
Grandview-Bruneau Hydrographs – Central Area

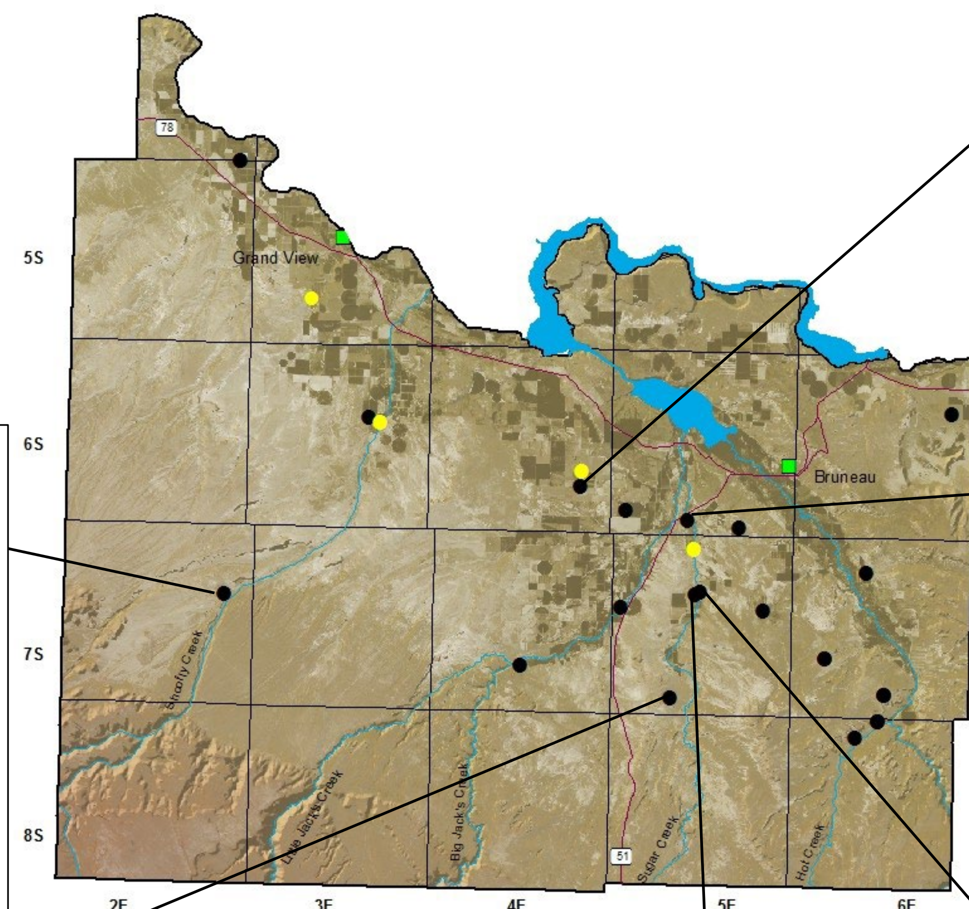


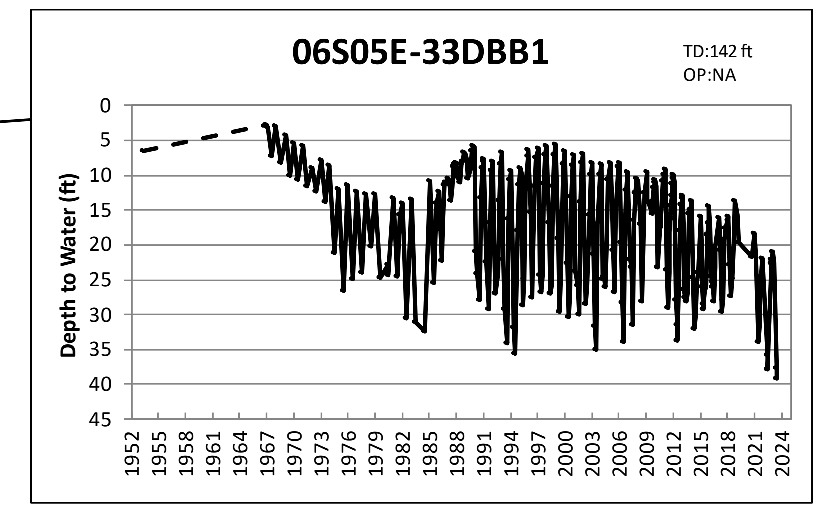
HYDROGRAPH LEGEND

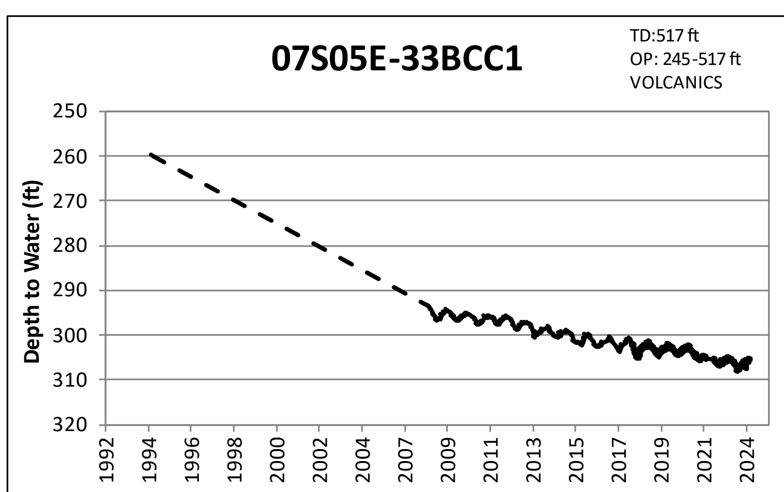
- ● Well
- ● Well (no hydrograph)

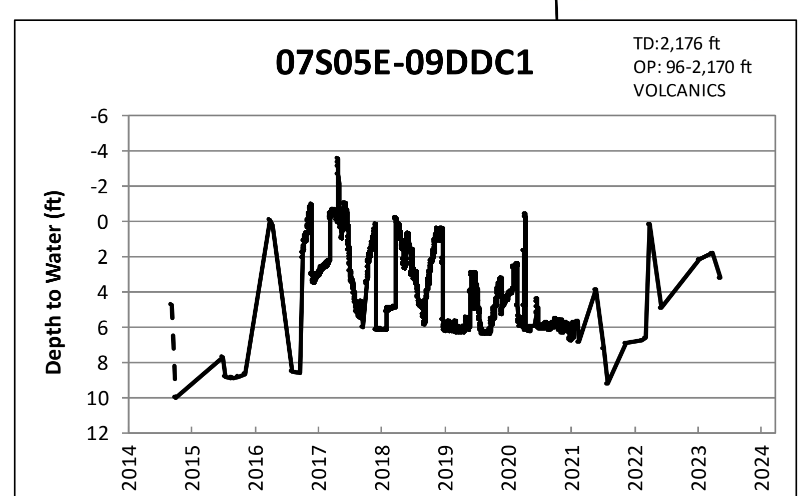
TD: Total Depth
OP: Interval that well is open to aquifer
VOLCANICS: Water Bearing Lithology
NA: Information is unknown
-- Indicates more than one month between measurements

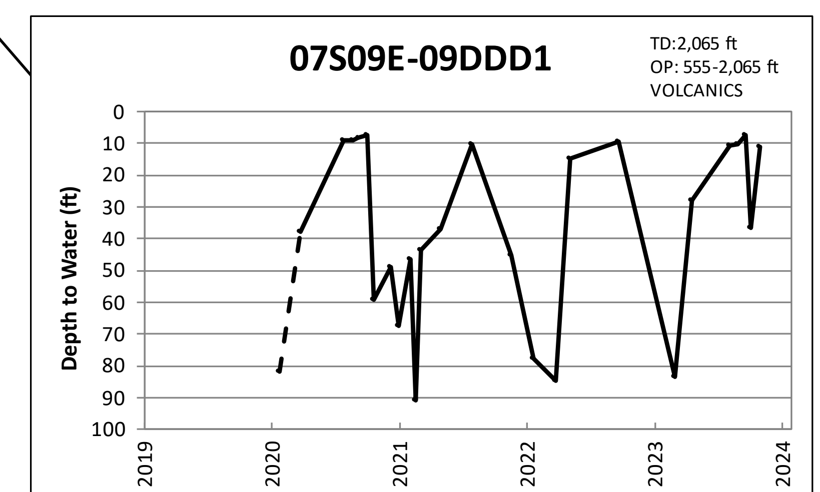










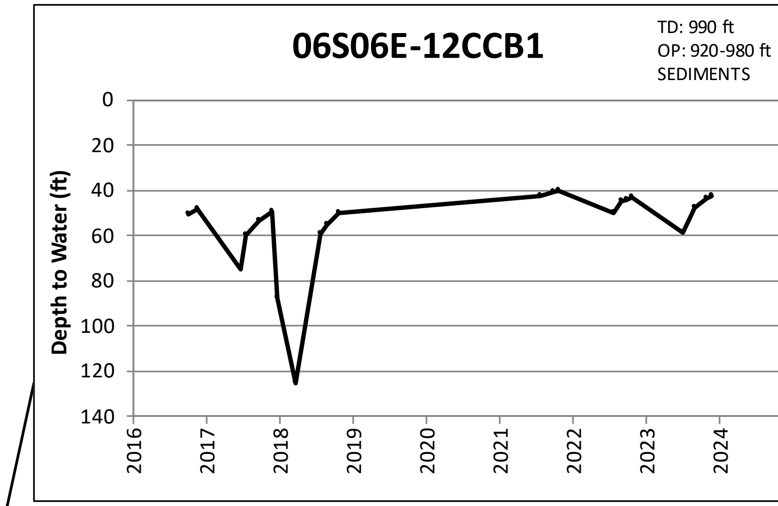


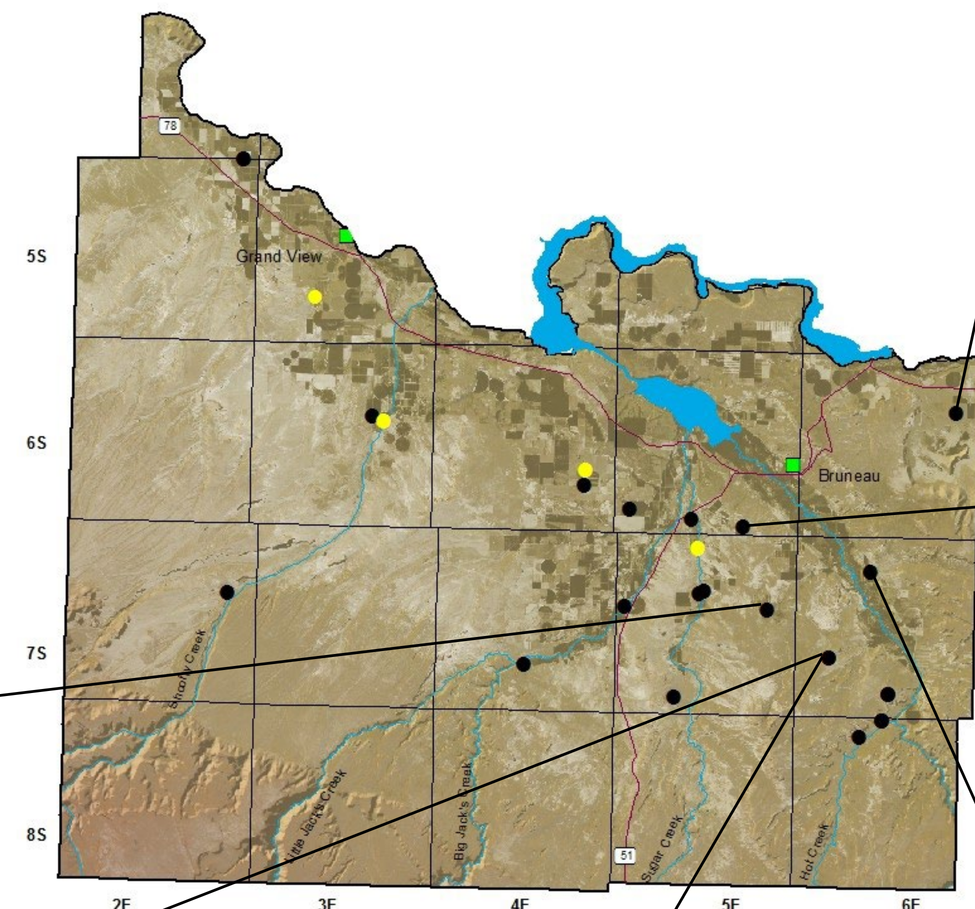
Grandview-Bruneau Hydrographs – East Area

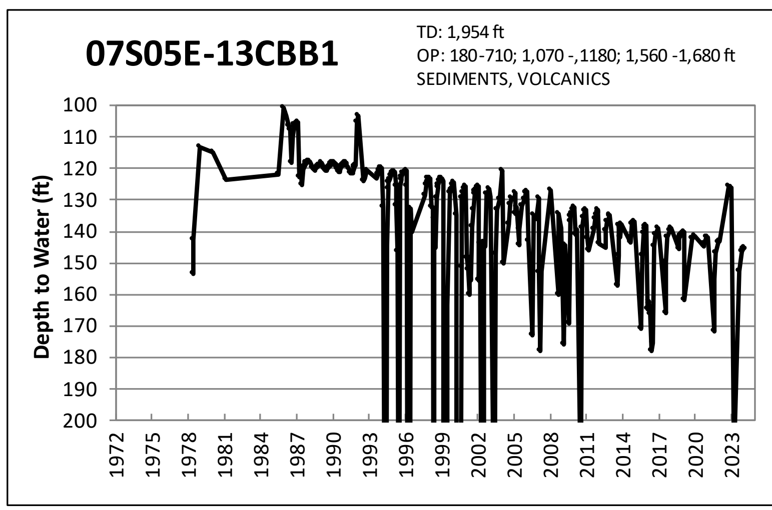
HYDROGRAPH LEGEND

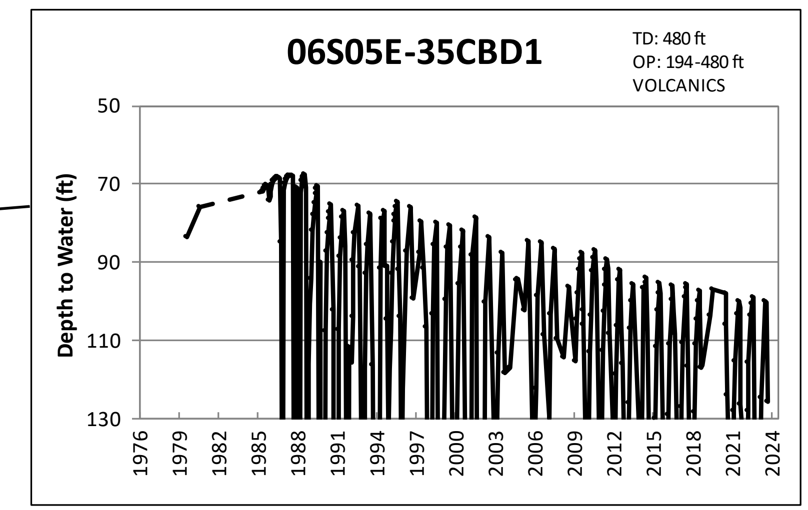
- ● Well
- ● Well (no hydrograph)

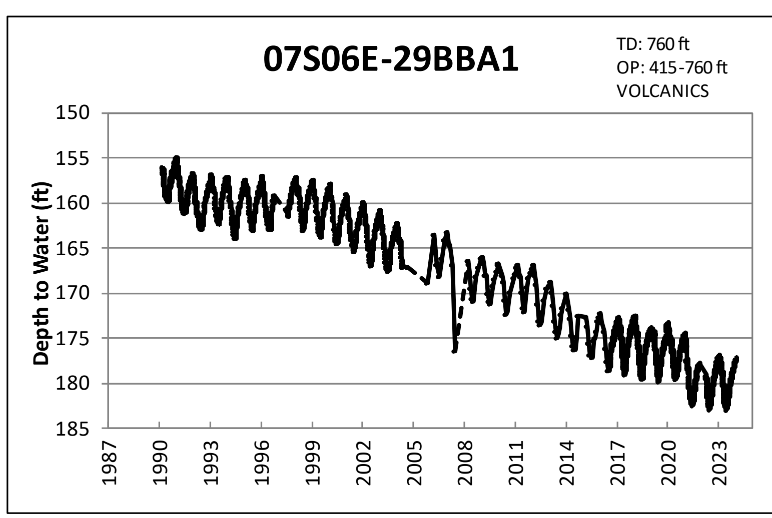
TD: Total Depth
OP: Interval that well is open to aquifer
VOLCANICS: Water Bearing Lithology
NA: Information is unknown
– – Indicates more than one month between measurements

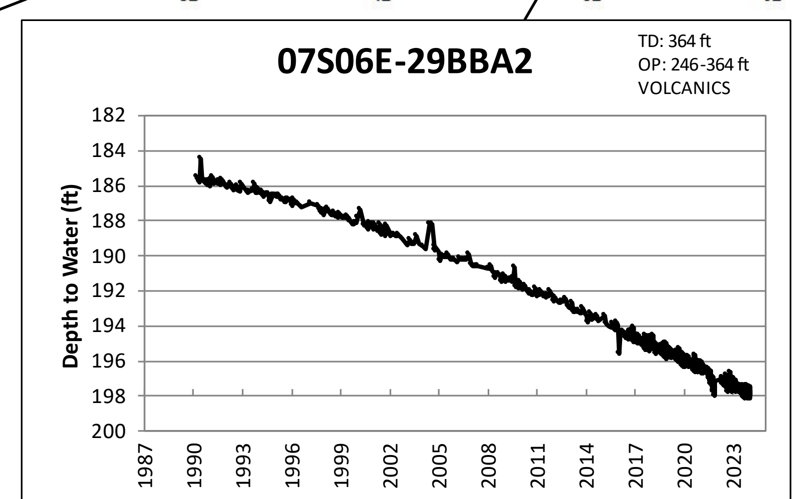


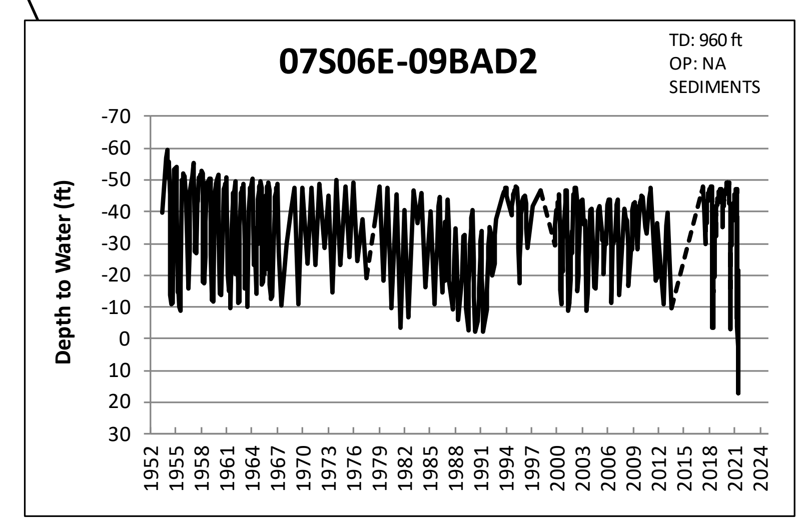










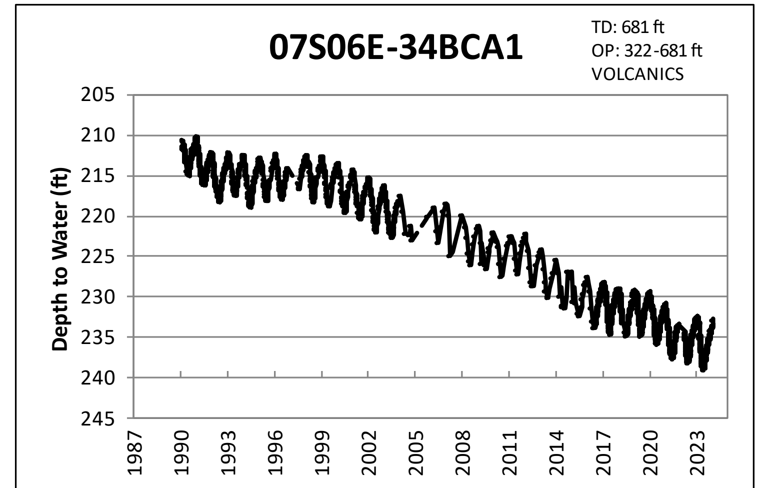


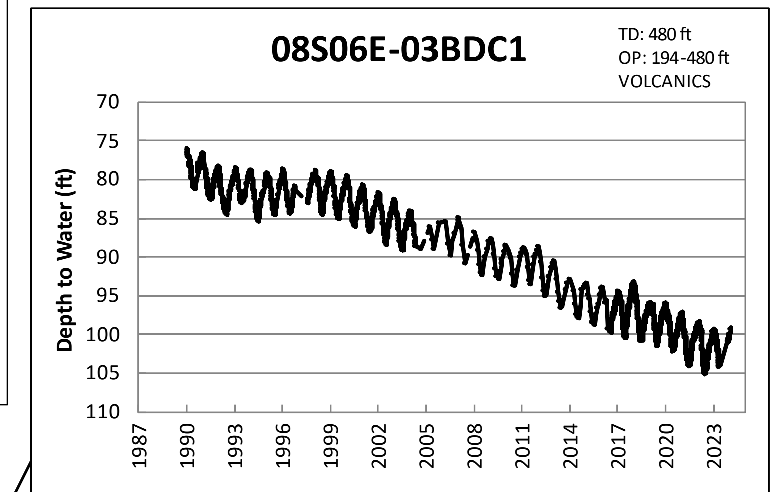
Grandview-Bruneau Hydrographs – Bathtub Area

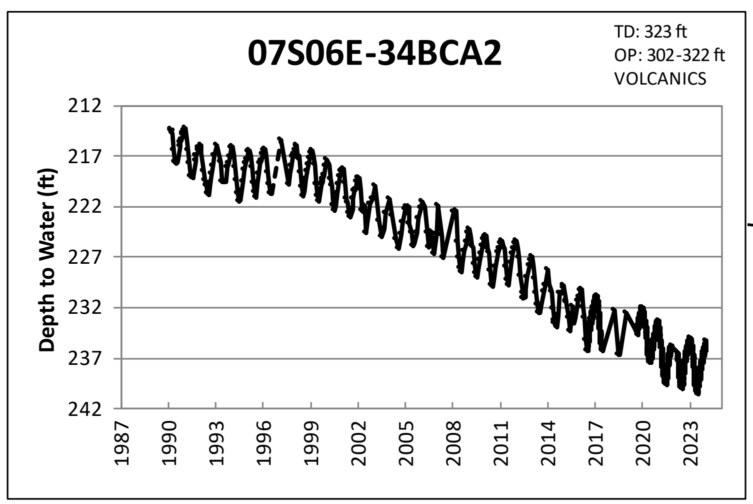
HYDROGRAPH LEGEND

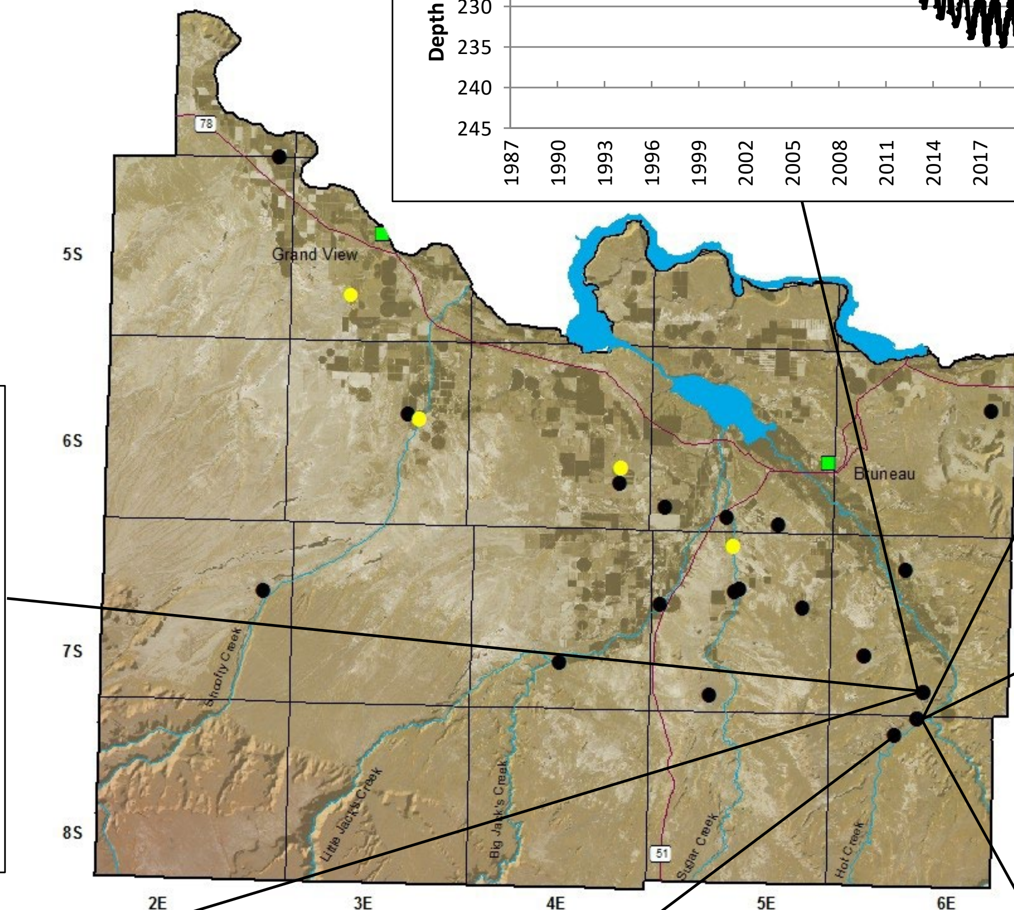
- ● Well
- ● Well (no hydrograph)

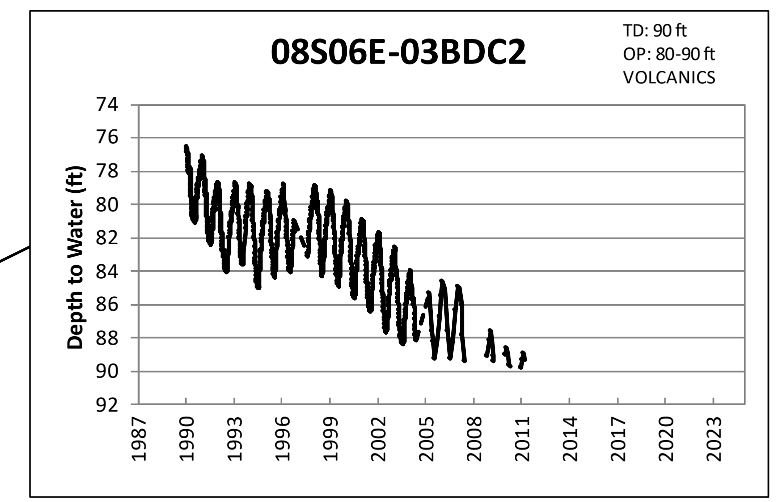
TD: Total Depth
OP: Interval that well is open to aquifer
VOLCANICS: Water Bearing Lithology
NA: Information is unknown
- - Indicates more than one month between measurements

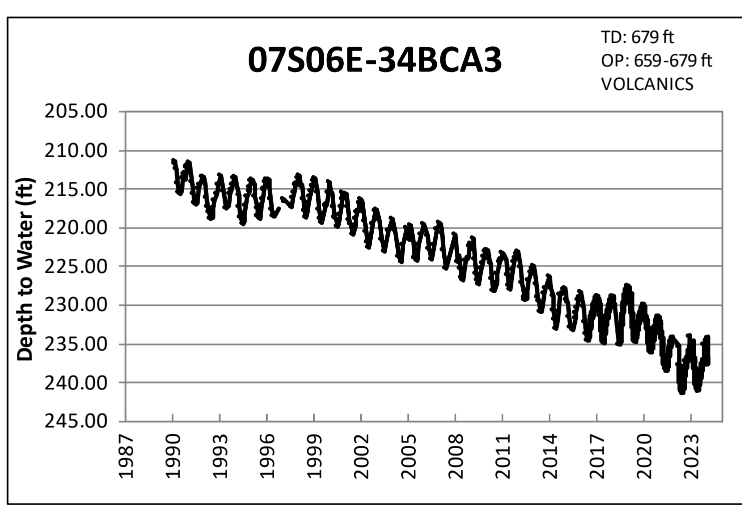


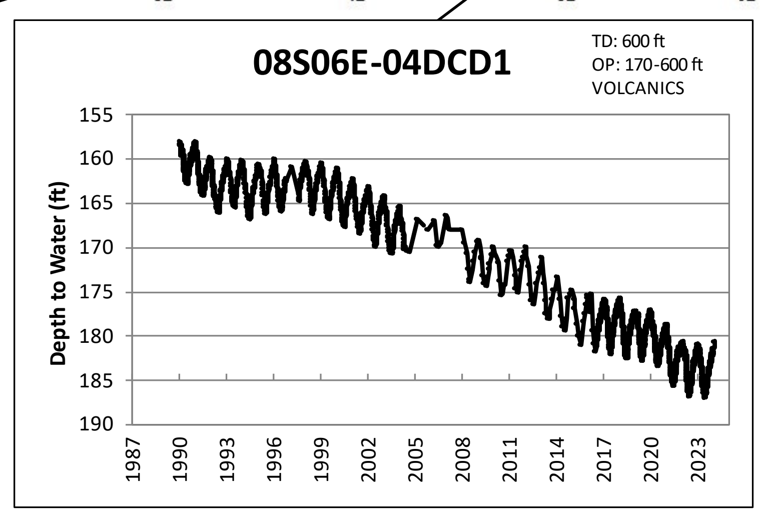


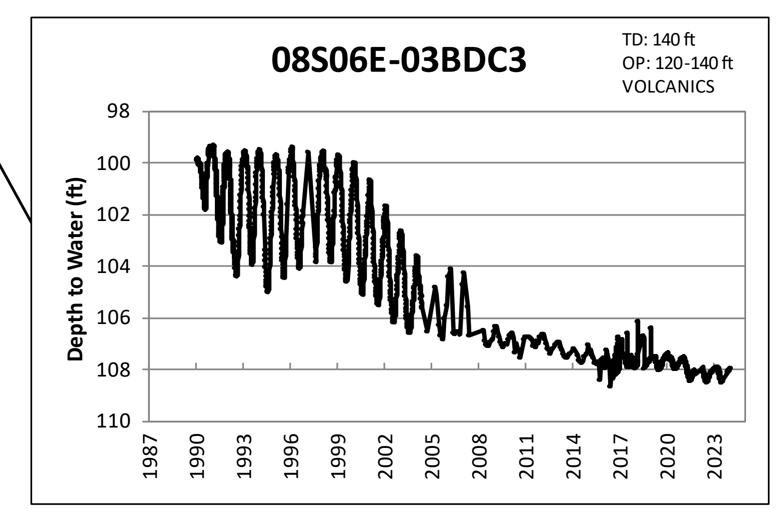








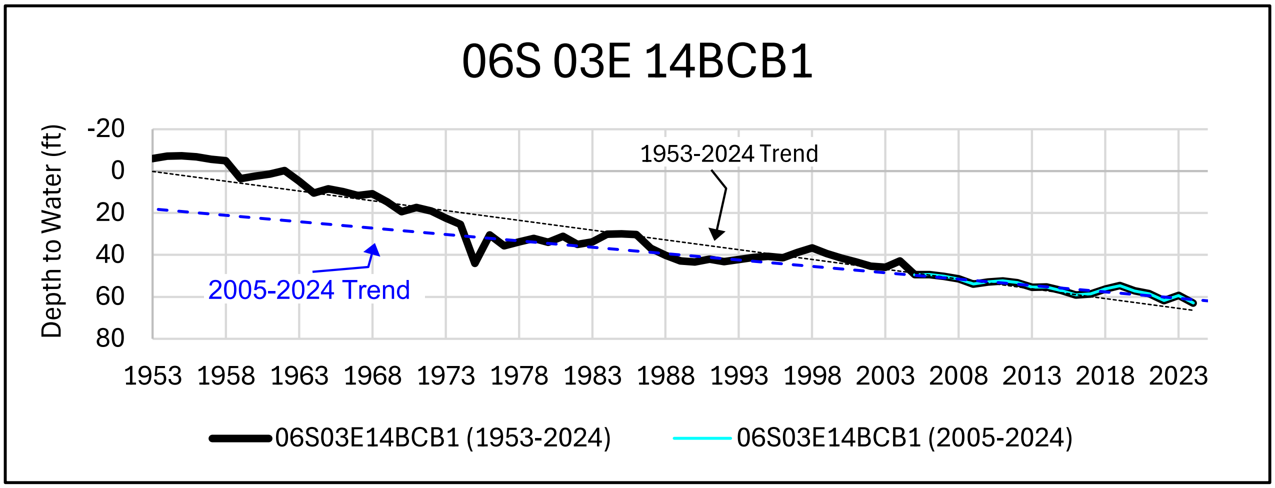


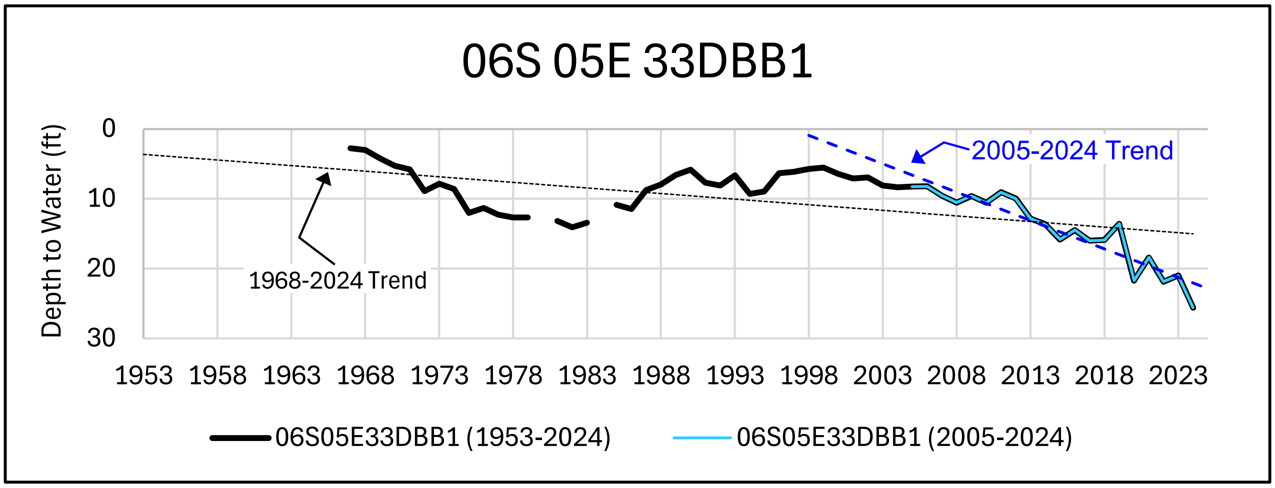


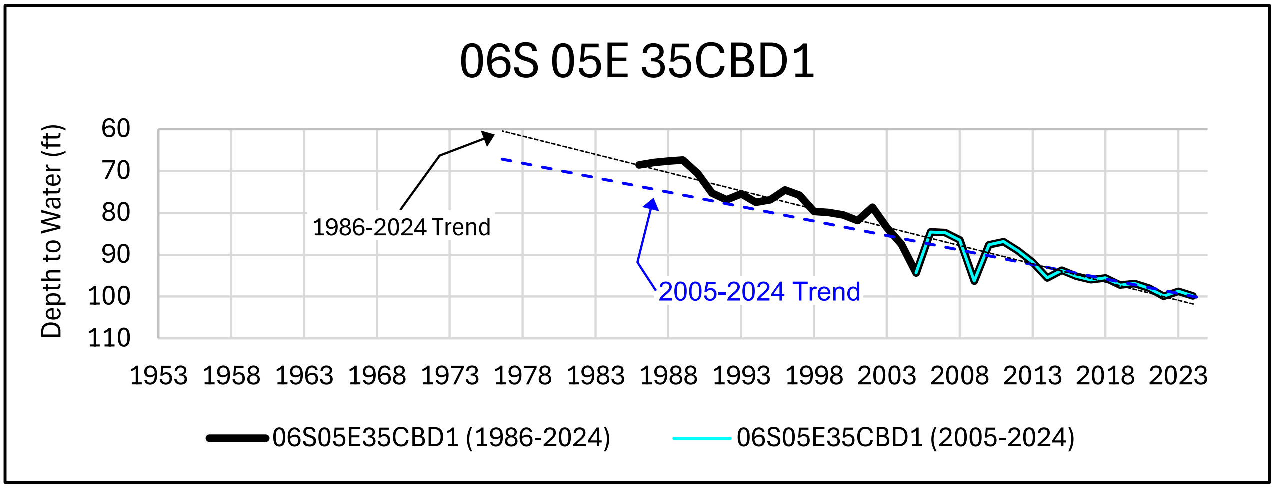
APPENDIX B

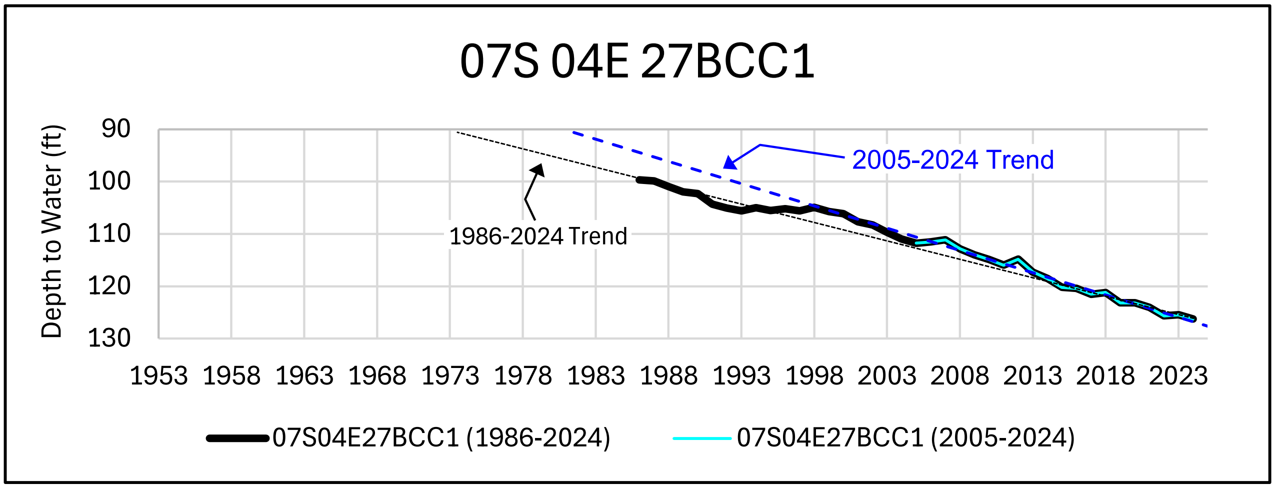
WATER-LEVEL TRENDS

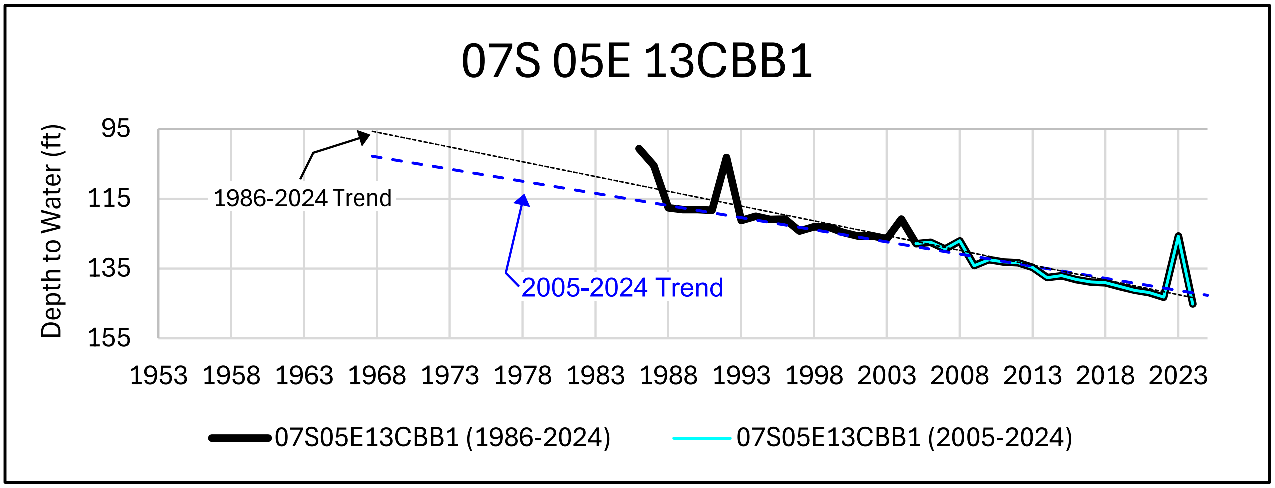
The following figures illustrate spring-season water levels plotted with linear trends for the period-of-record, and the most recent 20-years. Trends for the most recent 10 years have not been plotted for readability.

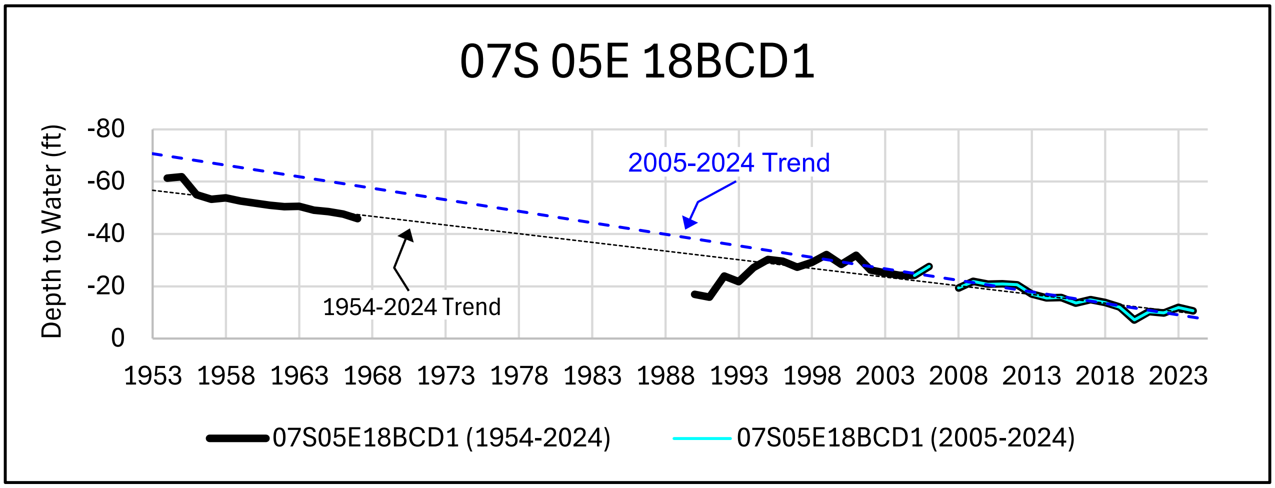


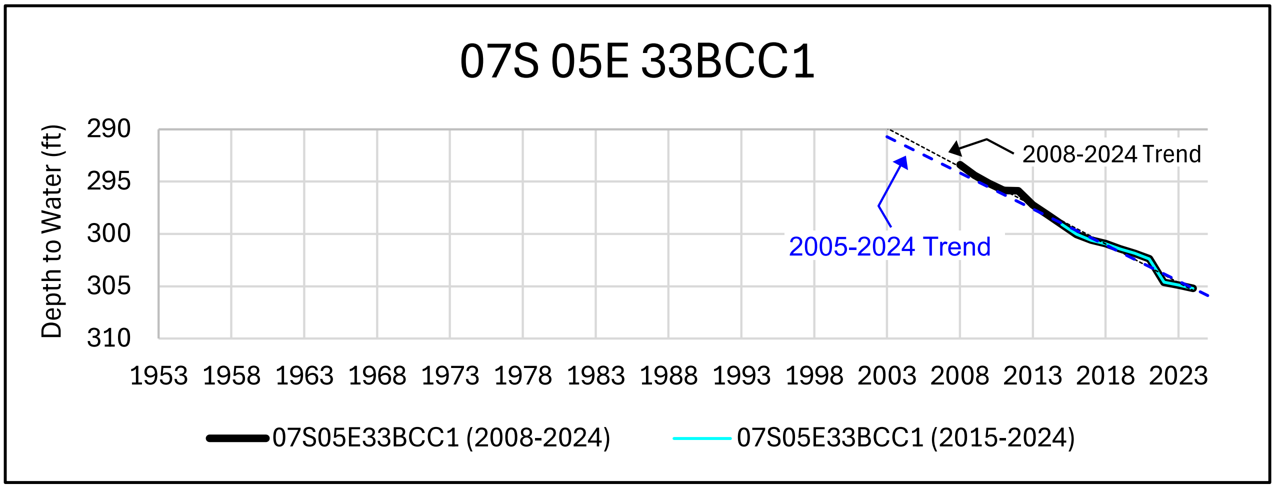


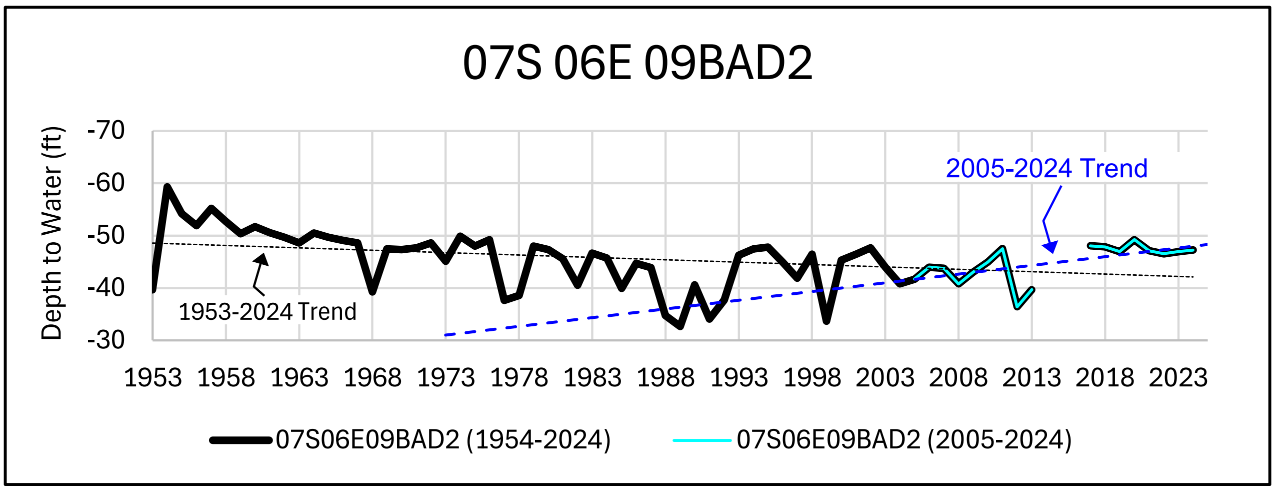


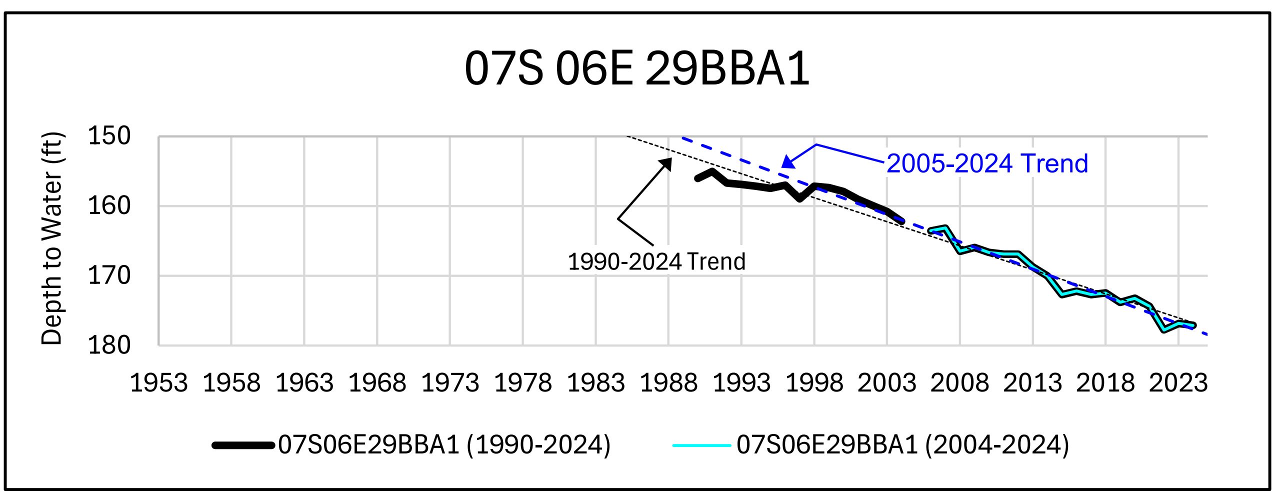

07S 04E 27BCC1
Depth to Water (ft)
90
100
110
120
130
1953 1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018 2023
2005-2024 Trend
1986-2024 Trend
07S04E27BCC1 (1986-2024)
07S04E27BCC1 (2005-2024)

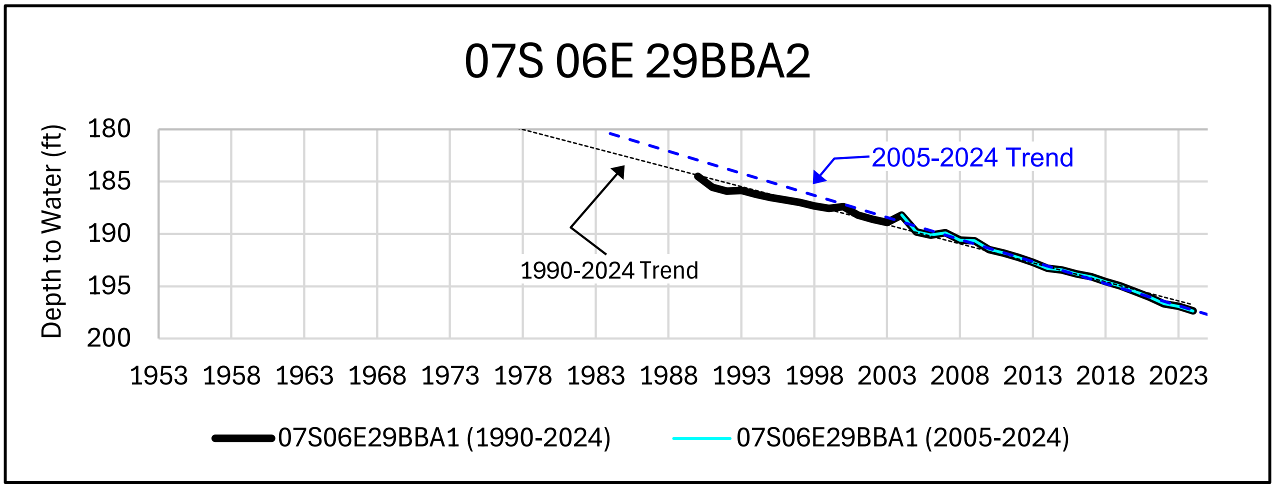

07S 05E 13CBB1
Depth to Water (ft)
95
115
135
155
1953 1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018 2023
1986-2024 Trend
2005-2024 Trend
07S05E13CBB1 (1986-2024)
07S05E13CBB1 (2005-2024)

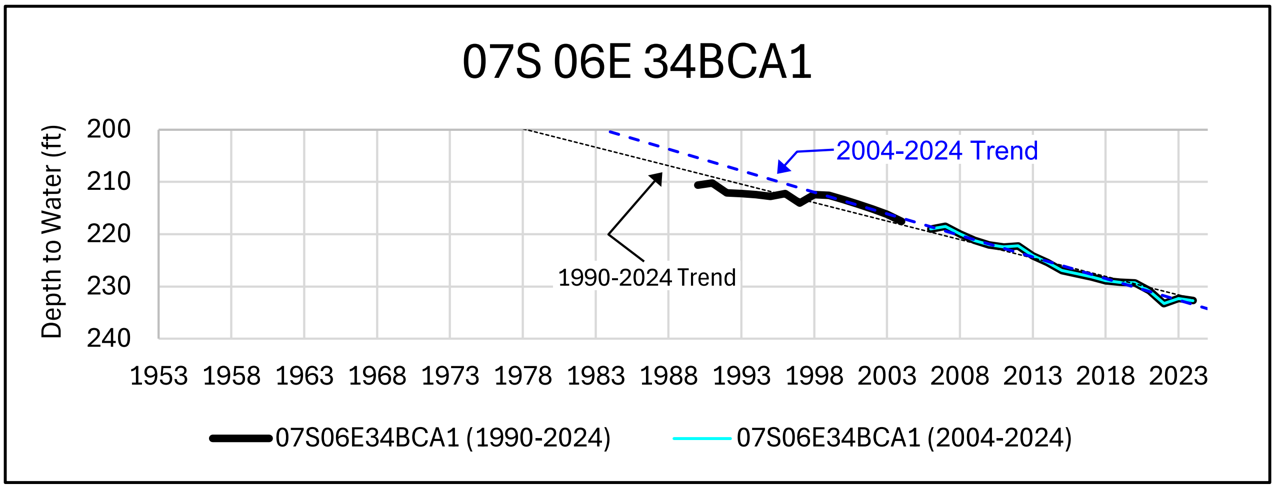

07S 05E 18BCD1
Depth to Water (ft)
-80
-60
-40
-20
0
1953 1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018 2023
2005-2024 Trend
1954-2024 Trend
07S05E18BCD1 (1954-2024)
07S05E18BCD1 (2005-2024)

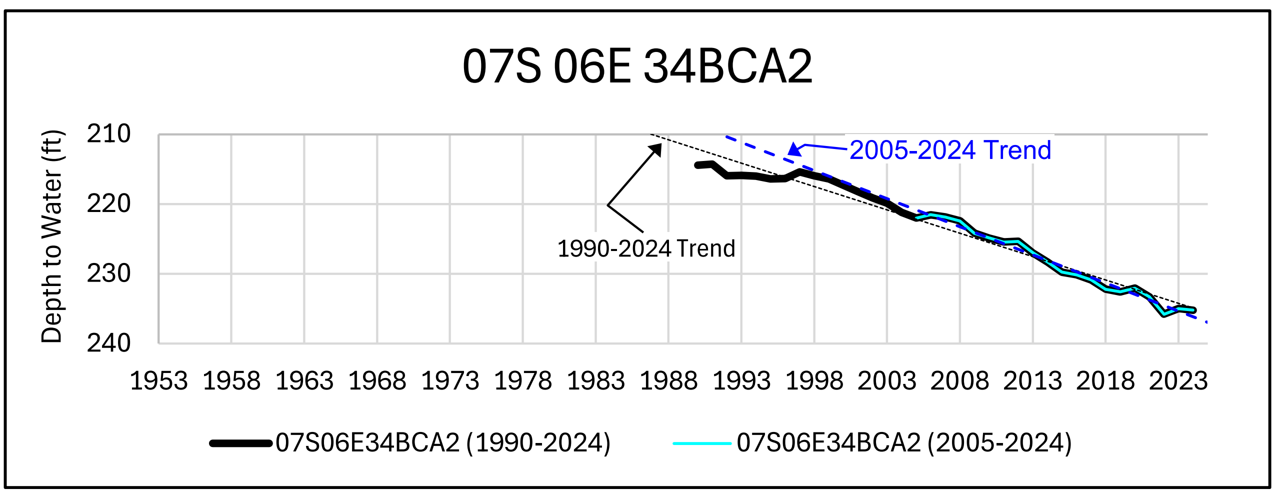

07S 05E 33BCC1
Depth to Water (ft)
290
295
300
305
310
1953 1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018 2023
2008-2024 Trend
2005-2024 Trend
07S05E33BCC1 (2008-2024)
07S05E33BCC1 (2015-2024)

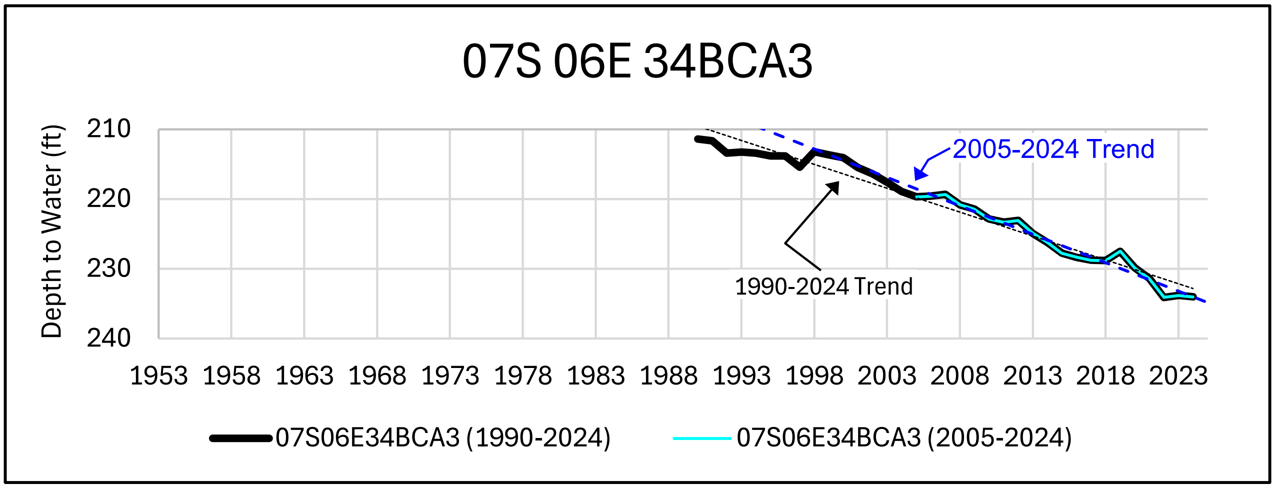

07S 06E 09BAD2
Depth to Water (ft)
-70
-60
-50
-40
-30
1953 1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018 2023
2005-2024 Trend
1953-2024 Trend
07S06E09BAD2 (1954-2024)
07S06E09BAD2 (2005-2024)

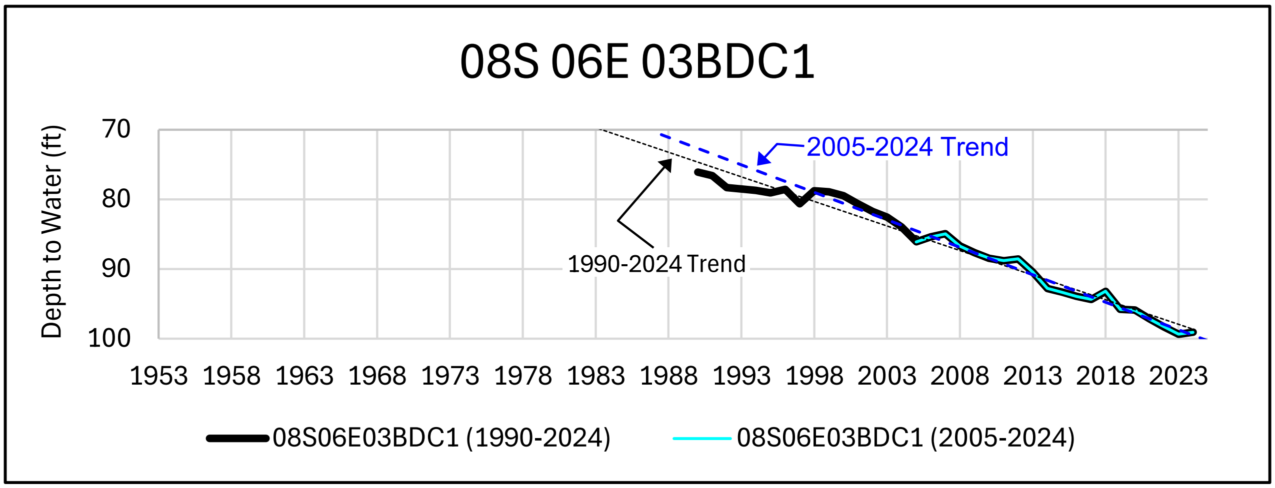

07S 06E 29BBA1
Depth to Water (ft)
150
160
170
180
1953 1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018 2023
2005-2024 Trend
1990-2024 Trend
07S06E29BBA1 (1990-2024)
07S06E29BBA1 (2004-2024)

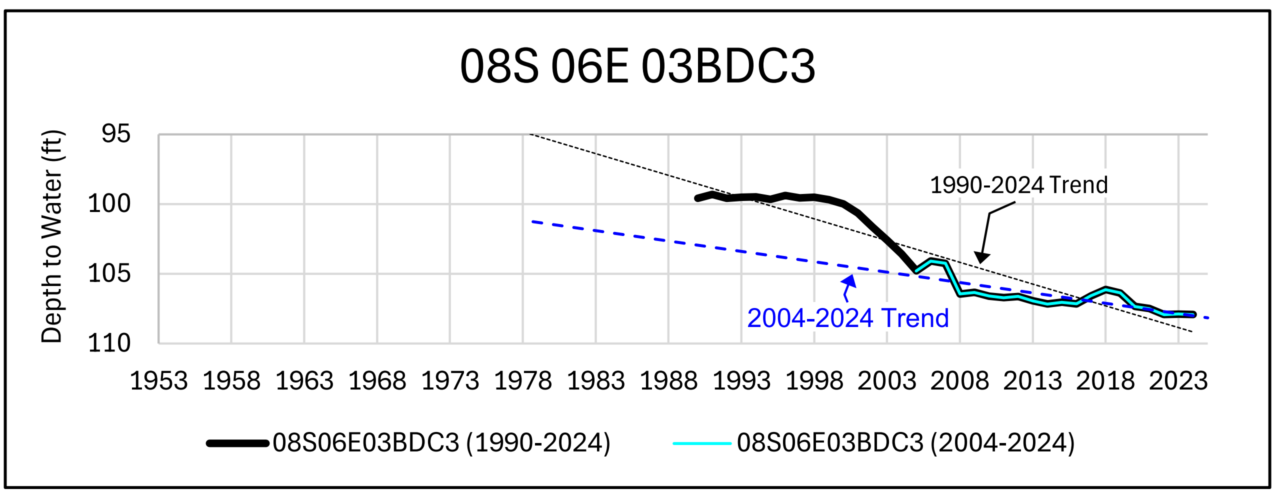

07S 06E 29BBA2
Depth to Water (ft)
180
185
190
195
200
1953 1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018 2023
2005-2024 Trend
1990-2024 Trend
07S06E29BBA1 (1990-2024)
07S06E29BBA1 (2005-2024)

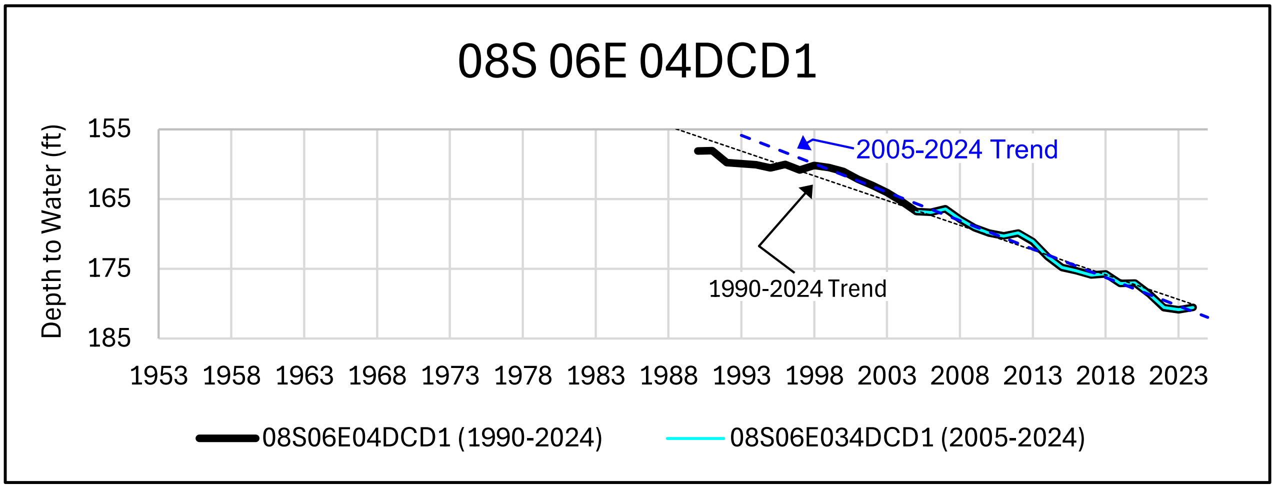

07S 06E 34BCA1
Depth to Water (ft)
200
210
220
230
240
1953 1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018 2023
2004-2024 Trend
1990-2024 Trend
07S06E34BCA1 (1990-2024)
07S06E34BCA1 (2004-2024)


07S 06E 34BCA2
Depth to Water (ft)
210
220
230
240
1953 1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018 2023
2005-2024 Trend
1990-2024 Trend
07S06E34BCA2 (1990-2024)
07S06E34BCA2 (2005-2024)


07S 06E 34BCA3
Depth to Water (ft)
210
220
230
240
1953 1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018 2023
2005-2024 Trend
1990-2024 Trend
07S06E34BCA3 (1990-2024)
07S06E34BCA3 (2005-2024)


08S 06E 03BDC1
Depth to Water (ft)
70
80
90
100
1953 1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018 2023
2005-2024 Trend
1990-2024 Trend
08S06E03BDC1 (1990-2024)
08S06E03BDC1 (2005-2024)


08S 06E 03BDC3
Depth to Water (ft)
95
100
105
110
1953 1958 1963 1968 1973 1978 1983 1988 1993 1998 2003 2008 2013 2018 2023
1990-2024 Trend
2004-2024 Trend
08S06E03BDC3 (1990-2024)
08S06E03BDC3 (2004-2024)



08S 06E 04DCD1
Depth to Water (ft)
155
165
175
185
1953
1958
1963
1968
1973
1978
1983
1988
1993
1998
2003
2008
2013
2018
2023
2005-2024 Trend
1990-2024 Trend
08S06E04DCD1 (1990-2024)
08S06E034DCD1 (2005-2024)