Idaho Department of Water Resources

Twin Falls Low-Temperature Geothermal Moratorium Area Monitoring Update, 2023

TWIN FALLS COUNTY, IDAHO

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2023 Update of Groundwater Conditions in the Twin Falls Low-Temperature Geothermal Moratorium Area

IDAHO DEPARTMENT OF WATER RESOURCES

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 Twin Falls GWMA was designated on January 11, 1984, based on concern that the thermal system was approaching a critical condition due to declining artesian pressures. A moratorium on new geothermal development was established on July 24, 1987, for a limited area within the GWMA. The moratorium on new geothermal development was extended in 1992, 1997, 2002, 2008, 2013, and 2018. This report describes the status and trends of aquifer levels and geothermal production in the moratorium area.

Introduction

The Idaho Department of Water Resources (IDWR) manages a monitoring network in the Twin Falls Low-Temperature Geothermal Moratorium Area (Twin Falls GTMA) which is located within the Twin Falls Groundwater Management Area (Twin Falls GWMA; Figure 1).

The IDWR monitoring network consists of five low-temperature (between 85 °F and 212 °F) geothermal wells in the Twin Falls GTMA, plus the Filer Test well which has a reported water temperature of 79 °F (Figure 1). Idaho Department of Water Resources staff from the Southern Regional office (IDWR) collect monthly operating pressure, temperature, flow rate, and totalizer readings at the Pristine Springs, Canyon Springs, and Twin Falls High School wells. IDWR also monitors pressure/water levels in the Filer Test well using manual measurements and twice-daily readings recorded by a pressure transducer and data logger. The College of Southern Idaho (CSI) collects monthly operating pressure, shut-in pressure/water levels, temperature, flow rate, and totalizer readings at both CSI production wells.

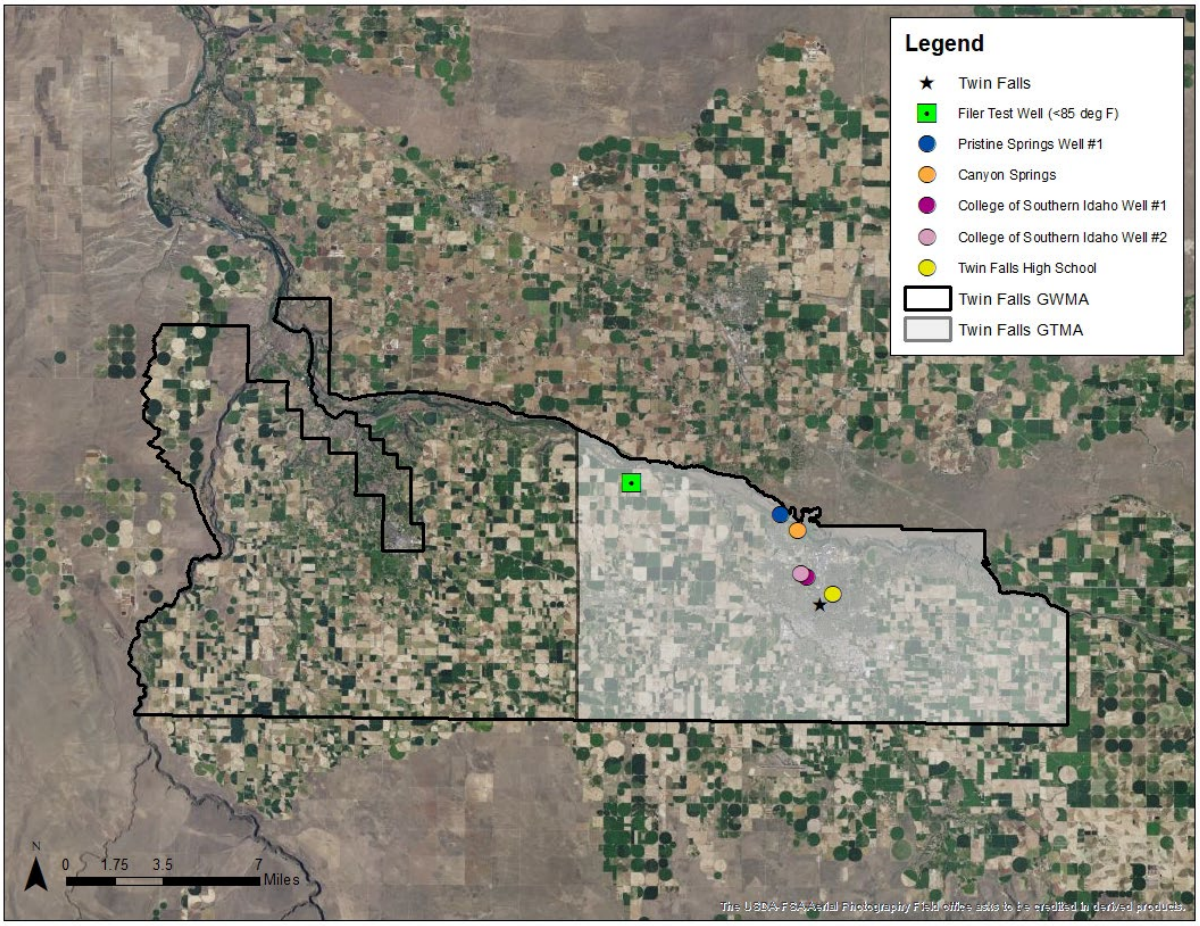

Figure 1. The IDWR low-temperature geothermal monitoring network within the Twin Falls GWMA and GTMA.

Withdrawals

Low-temperature geothermal water is used for space heating, power generation, and aquaculture. CSI and Twin Falls High School withdrew a combined 1,097 acre-feet for space heating in 2023 (Figures 2 and 3; Table 1). Pristine Springs and Canyon springs withdrew a combined 10,804 acre-feet for power generation and aquaculture in 2023 (Figures 2 and 3; Table 1). Combined withdrawals in the Twin Falls GTMA in 2023 totaled 11,901 acre-feet, which is 424 acre-feet more (4%) than in 2022 (Figure 2; Table 1).

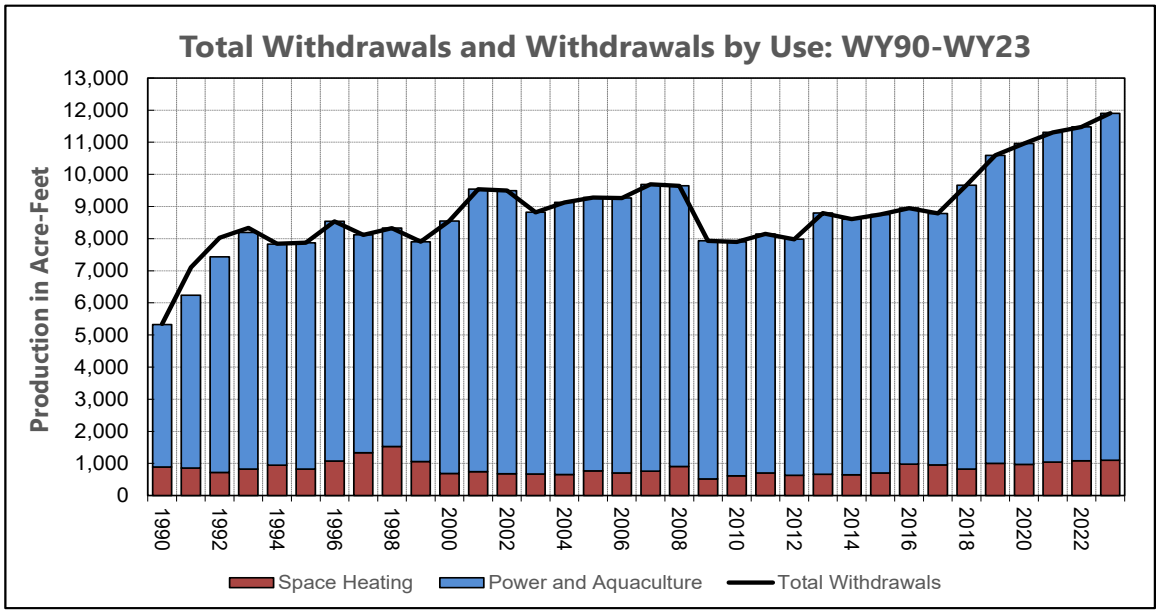

Figure 2. Total withdrawals and withdrawals by use in the Twin Falls GTMA.

A significant change in total withdrawals occurred in 2009 when the State of Idaho purchased Pristine Springs, and withdrawals were reduced by approximately 30% (Figure 3). Total withdrawals remained stable at a lower rate until 2013 when Canyon Springs increased withdrawals by 20%, and withdrawals increased noticeably again in 2018 and 2019 when Canyon Springs increased withdrawals by 39% over 2017. Withdrawals at Pristine Springs remained stable from 2010 through 2019 when withdrawals started to increase. Withdrawals at Pristine Springs have increased 36% since 2019 (Figure 3). Total system withdrawals have continued to increase since 2018. However, it is important to note that the meter at Canyon Springs failed in 2020, and 2019 values have been used to estimate withdrawals from 2020 through 2023.

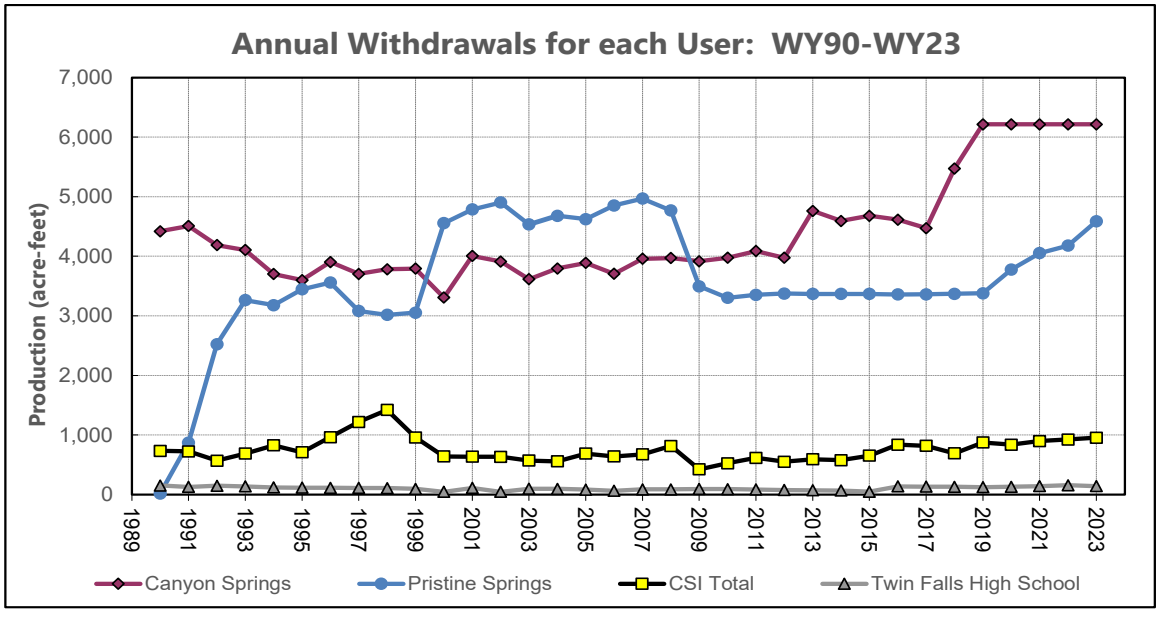

Figure 3. Annual withdrawals by individual geothermal users in the Twin Falls GTMA.

As shown in Table 1, Pristine Springs increased withdrawals from 2022 to 2023 by 410 acre-feet (10%), CSI increased withdrawals by 29 acre-feet (3%), and Twin Falls High School reduced withdrawals by 15 acre-feet (-10%).

Table 1. Total 2023 withdrawals and change from 2022.

Water User	2023 Total Withdrawals (acre-feet)	2022-2023 Change (acre-feet)	2022-2023 Change (percent)
Pristine Springs	4,589	410	10%
Canyon Springs[1]	6,215	NA	NA
CSI	955	29	3%
Twin Falls High School	142	-15	-10%
Combined	11,901	424	4%

[1]The meter at Canyon Springs has not worked since 2019, and the 2019 volume has been carried forward to estimate 2020-2023 withdrawals.

Withdrawal Trends

Calculating a linear trend for a set of withdrawals data is a simple way to describe the long-term changes in water use. 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. Furthermore, short-term data variability often results in changes that may not represent the long-term trend in withdrawals, and it is possible to calculate trends that may be misleading as to the nature of the changes over time. Therefore, withdrawal trends have been calculated for the periods 1995 – 2023 and 2009 – 2023 using a statistical approach known as the Mann-Kendall (MK) test.

A statistical assessment of the calculated trend is an important step in determining the general changes in withdrawals 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 assumed to be 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. A confidence interval of 95% has been used to determine statistical significance for all water-level trends.

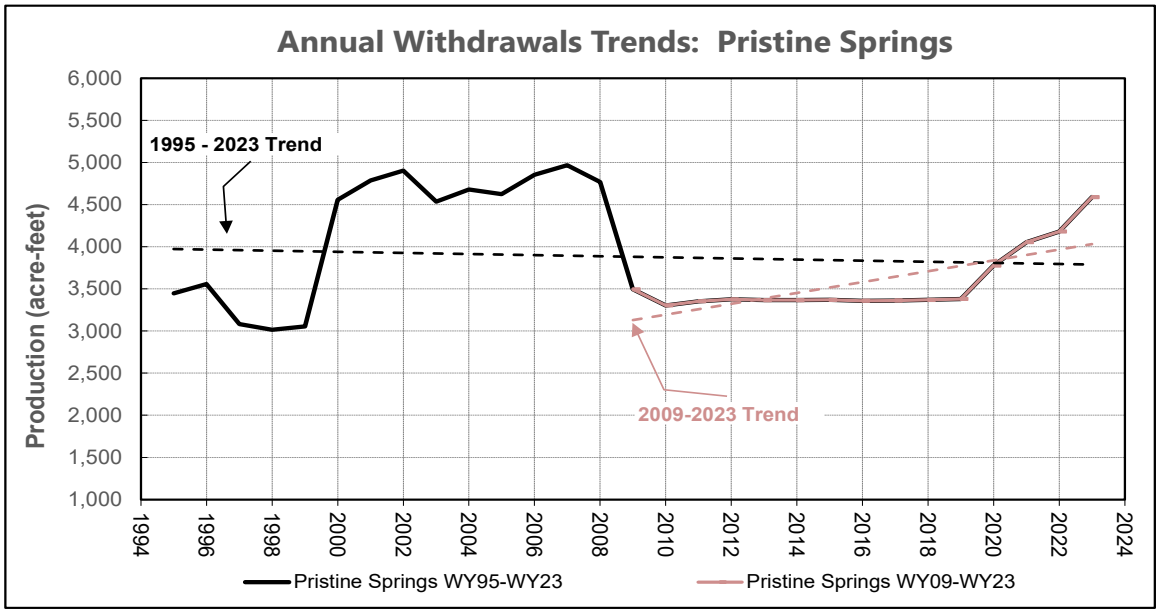

Figure 4. Pristine Springs withdrawals trends for 1995 – 2023.

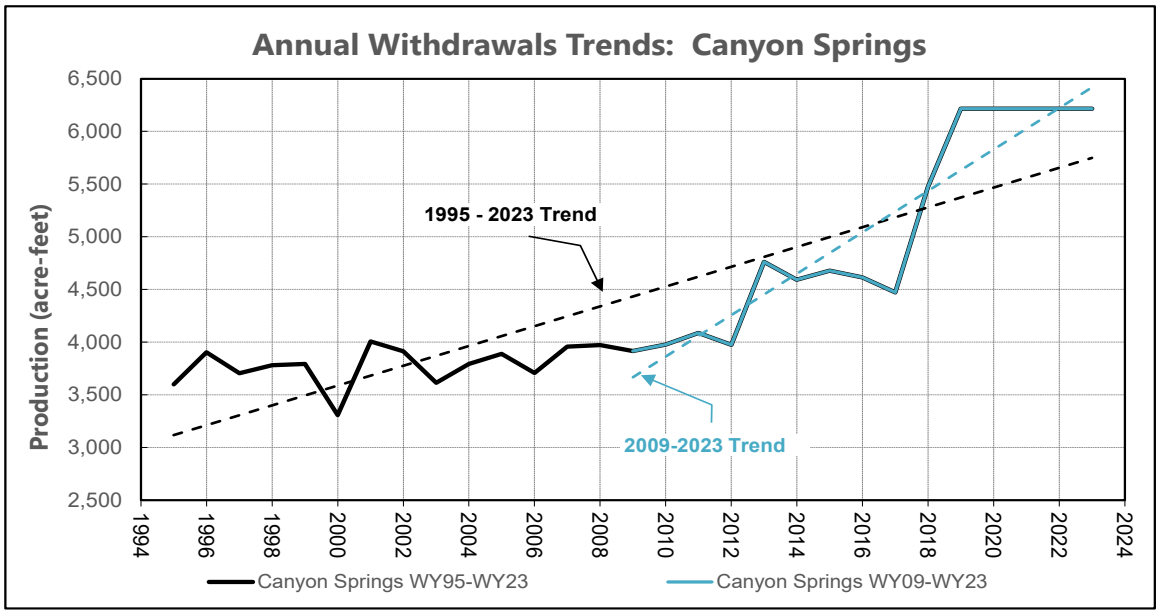

Figure 5. Canyon Springs withdrawals trends for 1995 – 2023.

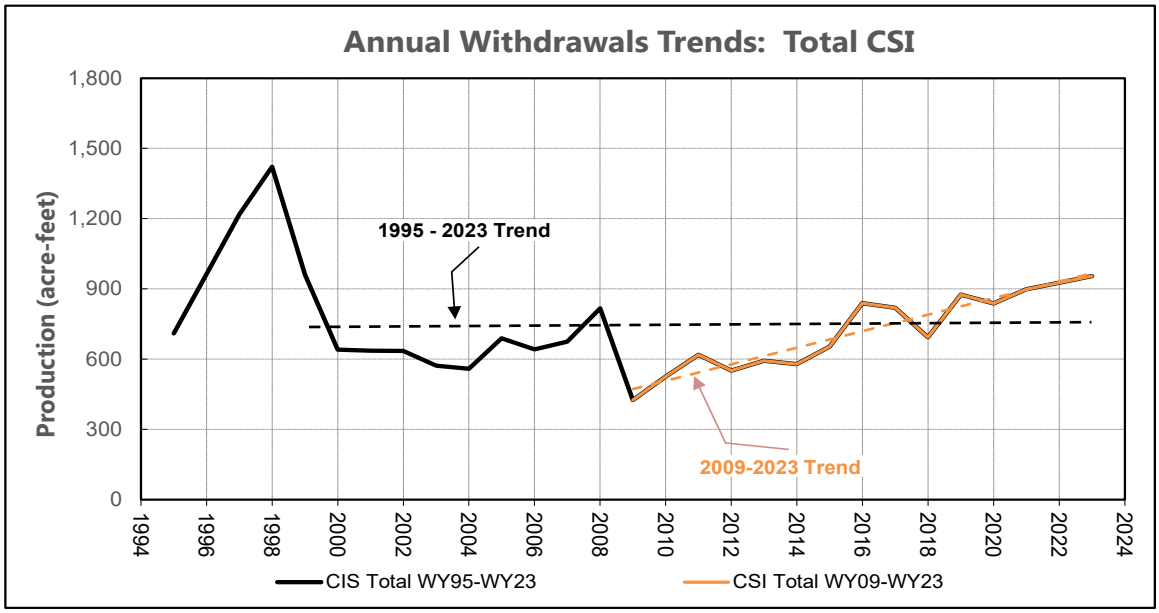

Figure 6. CSI withdrawals trends for 1995 – 2023.

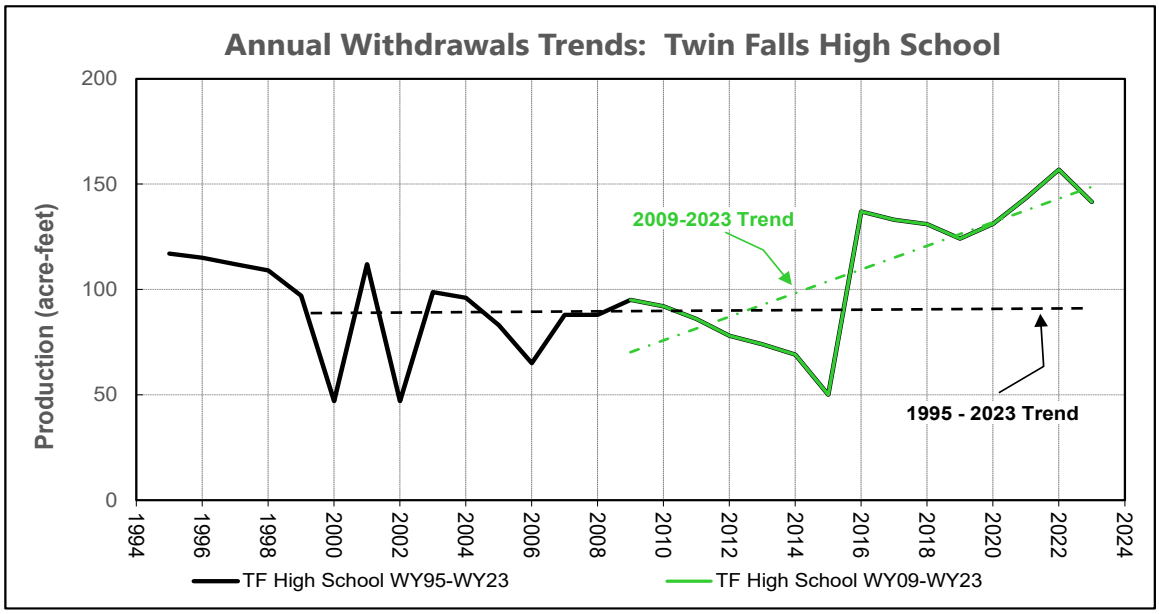

Figure 7. Twin Falls High School withdrawals trends for 1995 – 2023.

The withdrawals trends for all users are statistically significant during the 2009-2023 period. All users have increasing trends in withdrawals during the period 1995-2023; however, only the trend in Canyon Springs withdrawals is statistically significant (Figures 4-7; Table 2).

Table 2. Withdrawal trends in Twin Falls Moratorium Area Users.

Location	Trend 2009-2023 (acre-feet/year)	p-value[1]	Trend 1995-2023 (acre-feet/year)	p-value[1]
Pristine Springs	**22.0**	**0.00**	1.1	0.87
Canyon Springs	**172.2**	**0.00**	**65.1**	**0.00**
CSI	**36.2**	**0.00**	2.9	0.59
Twin Falls High School	**4.8**	**0.04**	1.1	0.25
Combined	**302.3**	**0.00**	**112.4**	**0.00**

[1] p- values < 0.05 indicates the trend is significant.

Water Level Monitoring

IDWR monitors water levels at the two CSI low-temperature geothermal wells, as well as the Filer Test well which has a reported water temperature of 79 °F (Figure 1). The Filer test well is not a low-temperature geothermal well; however, it appears to be connected with the warmer CSI wells based on water-level behavior. The three wells all derive water from basalt and/or rhyolite layers. Well completion information, well use, and types of data collected are listed in Table 3.

Table 3. Well completion information.

Well	Elevation (ft)	Total Depth (ft)	Open Interval (ft)	Production Elevation (ft)[1]	Well Use	Data Collected[2,3]
CSI #1	3,661	2,220	1,191-2,220	1,996	Production	WL, Prod
CSI #2	3,662	1,480	1,290-1,480	2,277	Production	WL, Prod
Filer Test	3,487	1,247	715-1,247	2,506	Observation	WL

[1]Production elevation is the average of the open interval.
[2]WL = water-level data.
[3]Prod = production data.

Water Levels

Water levels in CSI#1 and CSI#2 declined by 22.4 and 26.2 feet, respectively during the 1995 – 2008 period, then rose sharply from January 2009 to September 2009 in response to reduced withdrawals at Pristine Springs, with changes of 9.3 and 19.4 feet, respectively (Figure 8).

Water levels in the Filer Test well also declined from 1995 to 2008, with a change of -16.4 feet. Water level changes in the Filer Test well were similar to the CSI wells from 1995 – 2008; however, the large water-level increase observed in the CSI wells in 2009 did not occur in the Filer Test well, and it even appears that water levels drop in 2009 (Figure 8). It is important to note that the USGS monitored the Filer well until 2009 when IDWR assumed monitoring responsibilities; therefore, there could have been changes in measurement equipment or method that caused the apparent drop in water levels.

Water levels in the three wells are characterized by stable to slightly declining conditions for 3-5 years after 2009, followed by steeper declines that continue through 2023 (Figure 8).

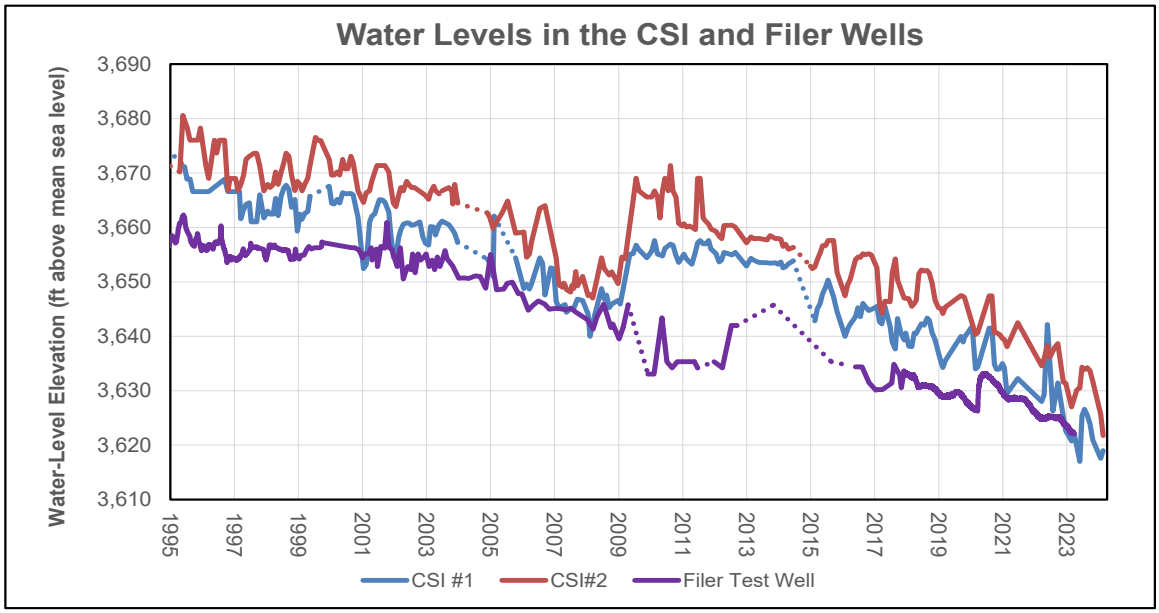

Figure 8. Water levels in the Filer Test and CSI wells.

Water levels in CSI#1 declined 15.6 feet, water levels in CSI#2 declined 4.3 feet, and water level in the Filer Test well declined 2.8 feet from 2022 to 2023.

Water-Level Trends

Like the trends in withdrawals, calculating a linear trend for a set of water-level data is a simple way to describe the long-term water-level changes. However, a calculated trend is not always representative of the behavior, and a statistical assessment of the calculated trend is an important step in determining water-level changes over time. Water-level trends in the CSI and Filer Test wells have been calculated for the periods 1995 – 2023 and 2009 – 2023 using the MK test.

Statistical significance indicates that the trend in the data at the chosen confidence interval is the best linear representation of changes over time. Lack of statistical significance indicates that the calculated trend does not represent changes over time. A confidence interval of 95% has been used to determine statistical significance for all Twin Falls GTMA trends (Table 4).

It is difficult to calculate a trend that describes the state of the aquifer using all the data because some of the variability is due to local and/or short-term water use. Peak water levels are the best indication of the aquifer water levels because they are the least affected by local water use; therefore, water-level trends have been calculated using the peak annual water levels.

The 1995-2023 water level-trends in the CSI#1, CSI#2, and the Filer Test wells are -1.2, -1.3, and -1.3 feet/year, respectively (Figures 9, 10, and 11; Table 4). Water-level trends in all wells were statistically significant. Visual inspection of Figure 8 indicates the CSI wells declined more from 2009-2023 than the Filer Test well; however, the long-term trends are very similar. This is due to the large water-level increase in the CSI wells in 2009 that did not occur in the Filer Test well.

The 2009-2023 water level-trends in the CSI#1, CSI#2, and the Filer Test wells are -2.0, -2.4, and -1.4 feet/year, respectively (Figures 9, 10, and 11; Table 4). Water-level trends in all wells were statistically significant. There are three possible reasons why the CSI wells exhibit larger declines compared to the Filer Test well: (1) the CSI wells are used for production and water-level declines in response to increased withdrawals are greatest in the pumping wells, whereas, the Filer Test well is a non-pumping observation well that is approximately seven miles away; (2) the CSI wells are closer to the Pristine Springs and Canyon Springs wells and water levels will have a greater response to increased withdrawals at these locations; and (3) the Filer Test well is cooler than the CSI wells and may be influenced by the overlying cold-water aquifer.

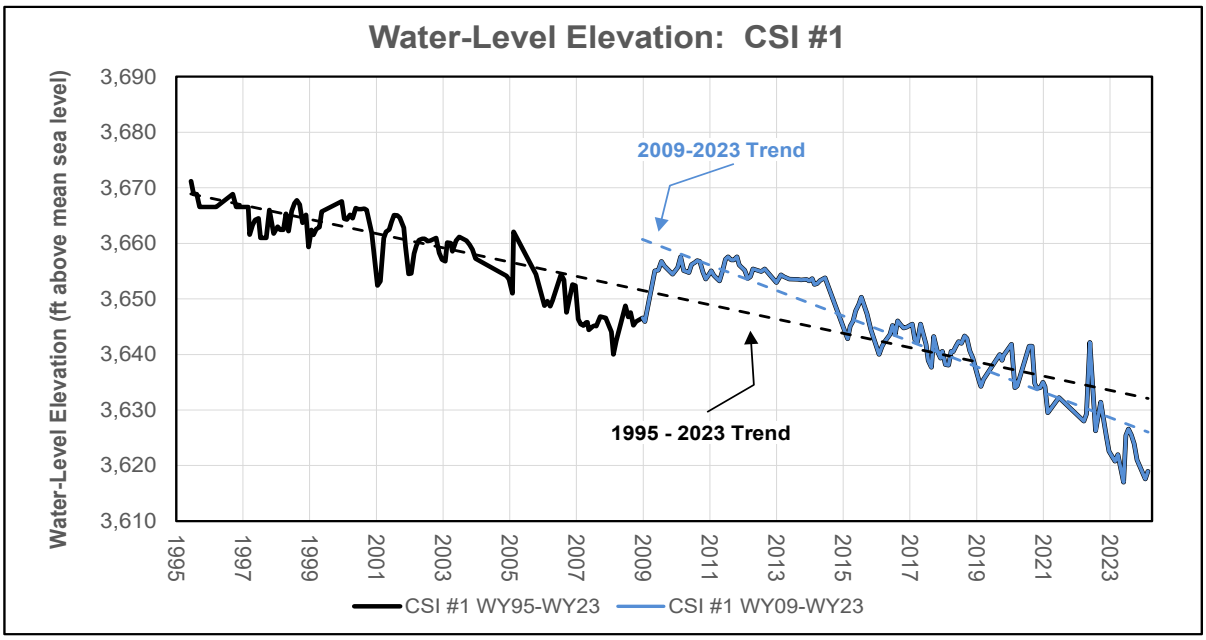

Figure 9. Water-level trends for the 1995-2008 and 2009-2023 periods in the CSI#1 well.

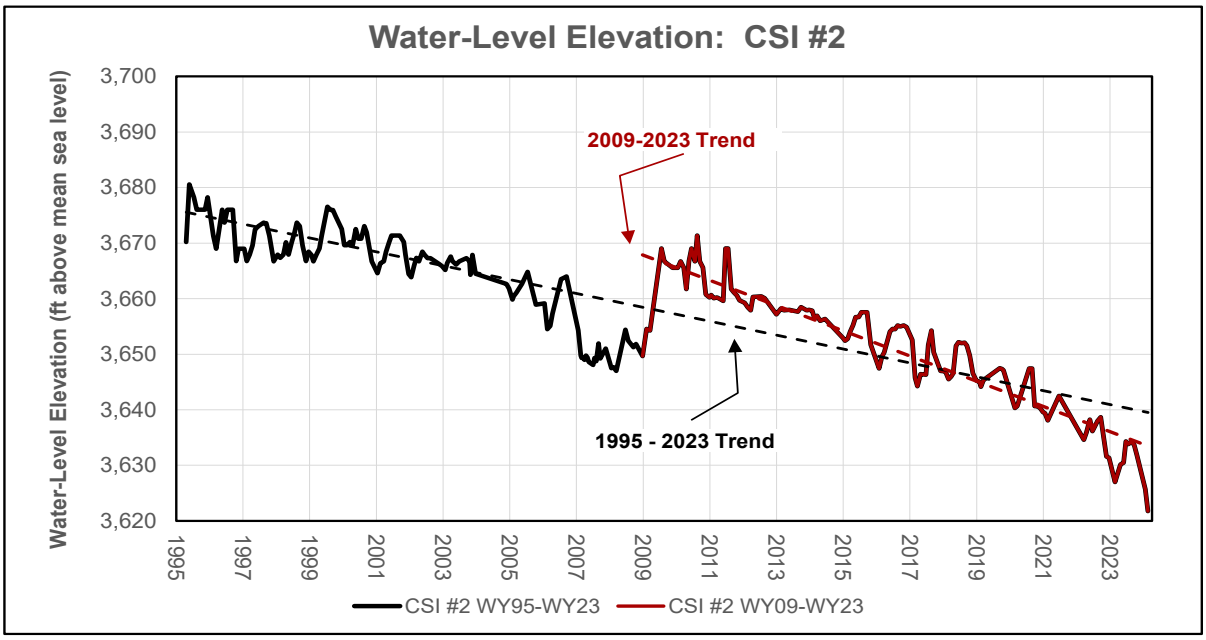

Figure 10. Water-level trends for the 1995-2008 and 2009-2023 periods in the CSI#2 well.

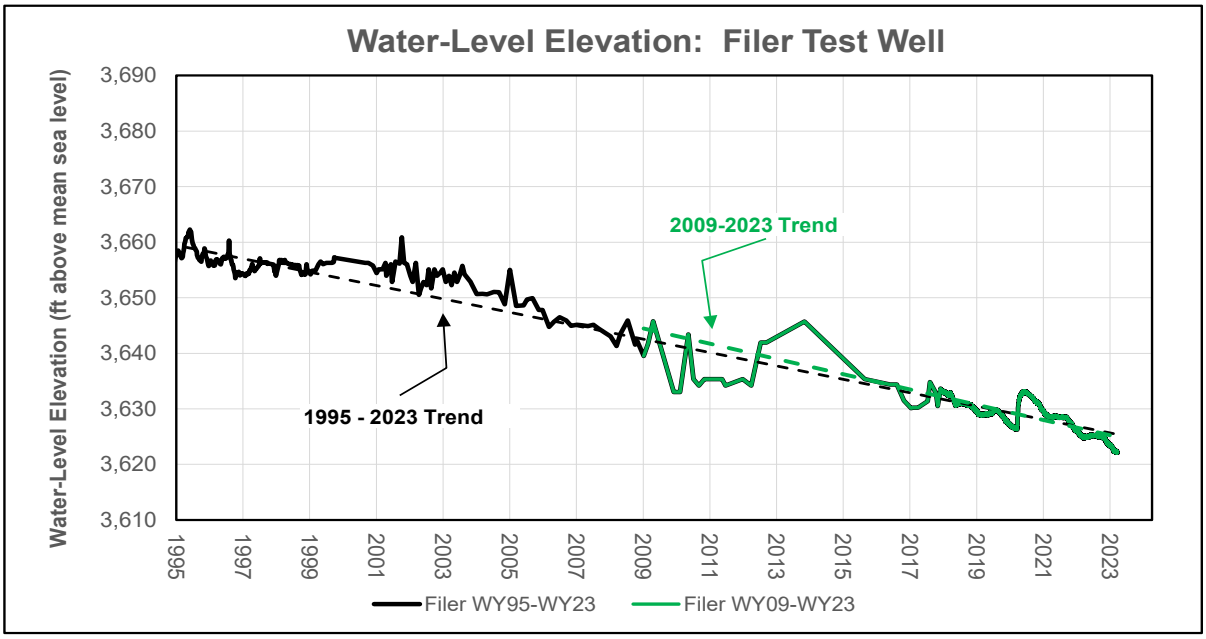

Figure 11. Water-level trends for the 1995-2008 and 2009-2023 periods in the Filer Test well.

Regional water-level trend analyses can provide simpler assessments of water-level behavior across the aquifer monitoring locations. The regional water-level trends for the 2009-2023 and 1995-2023 periods were -1.9 and -1.2 feet/year, respectively (Table 4).

Table 4. Water-level trends in Twin Falls Moratorium Area wells[1].

Well	Trend 2009-2023 (feet/year)	p-value[2]	Trend 1995-2023 (feet/year)	p-value[2]
CSI#1	**-2.0**	**0.00**	**-1.2**	**0.00**
CSI#2	**-2.4**	**0.00**	**-1.3**	**0.00**
Filer Test	**-1.4**	**0.00**	**-1.3**	**0.00**
Regional	**-1.9**	**0.00**	**-1.2**	**0.00**

[1] Trends and significance have been calculated using the Mann-Kendall statistical test.
[2] p- value < 0.05 indicates the trend is significant.

Water Level – Withdrawals Analysis

In general, water levels in the CSI and Filer Test wells have declined in response to increases in system withdrawals (Figure 12). This relationship is apparent during the 1995-2008 period as increased withdrawals result in declining water levels, and decreased withdrawals result in recovering water levels. However, the large water-level increase observed in the CSI wells in 2009 did not occur in the Filer Test well, and it even appears that water levels drop in 2009. However, the different water-level response in the Filer Test well may be due to changes in measurement equipment or method that occurred with the transfer of monitoring responsibilities from the USGS to IDWR in 2009.

Despite the difference in water-level response to the withdrawal changes in 2009, the water levels in the Filer Test well behaved similarly to the CSI well after 2009. Withdrawals and water levels were somewhat stable during the period 2009-2012, and water levels in all wells have

dropped steadily in response to steadily increasing withdrawals since 2012-2023 (Figure 12). It is important to note that there were water-level monitoring issues in the Filer Test well from 2012 through 2015 and the data may not be representative.

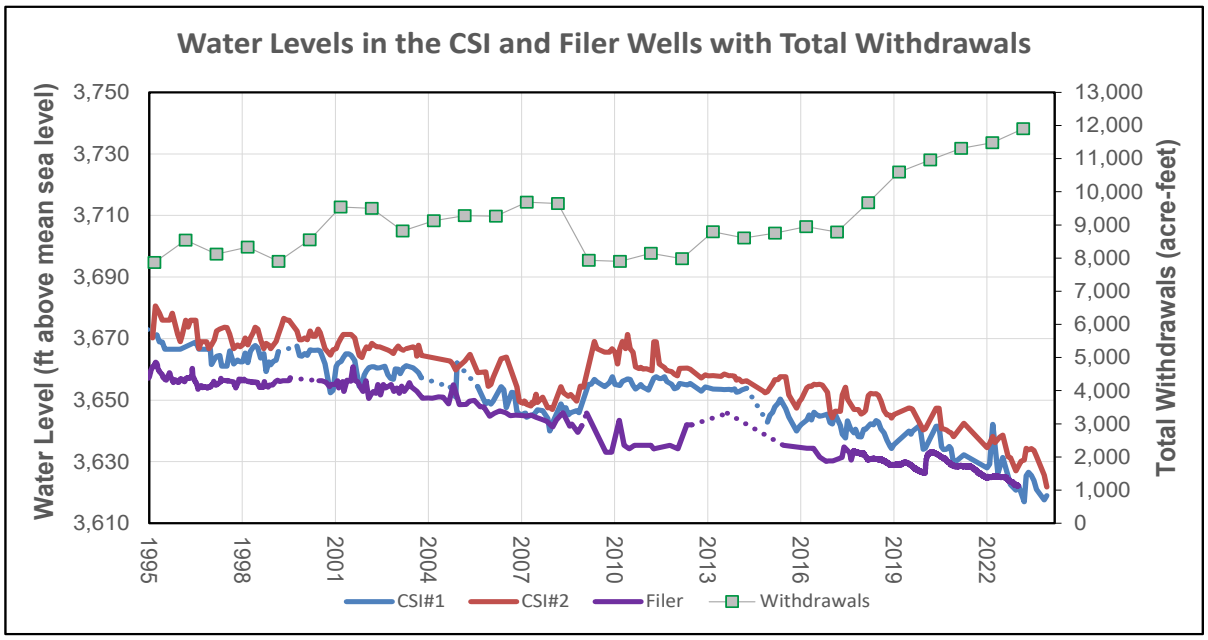

Figure 12. Water levels for the CSI #1, CSI #2, and Filer wells plotted with total withdrawals.

The similarity in water-level changes in the Filer Test and CSI wells are evident in the 1995-2023 trends. Water levels in the CSI#1, CSI#2, and Filer Test wells have declined 1.2, 1.3, and 1.3 feet/year, respectively (Table 4). The comparable water-level responses to withdrawals from the aquifer indicate that all three wells are monitoring the same water source.

Summary

The data collected from the Twin Falls GTMA monitoring network indicate that water levels in all wells exhibit statistically significant decreasing trends during the 1995-2023 and 2009-2023 periods. Regionally, water levels in the Twin Falls GTMA are declining at a median rate of 1.2 feet/year for the period 1995-2023 and 1.9 feet per year for the period 2009-2023.

Combined total withdrawals exhibit statistically significant increasing trends during the 1995-2023 and 2009-2023 periods of 112.4 and 302.3 acre-feet/year.