

## MEMORANDUM

To: Board of Directors, Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA)  
Piret Harmon, General Manager, SVBGSA  
Board of Supervisors, County of Monterey

From: Anthony Brown, Principal-in-Charge, aquilogic, Inc.  
Robert H. Abrams, Ph.D., P.G., CHg., Senior Principal Consultant, aquilogic, Inc.

Date: September 9, 2024

**Subject: Comments on Deep Aquifers Study Final Report**  
Project No.: 018-09

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On behalf of our client, the Salinas Basin Water Alliance (SBWA), Aquilogic, Inc. (**aquilologic**) has prepared this memorandum in response to the Final Report (the “Report”) of the Deep Aquifers Study (DAS).<sup>1</sup> As noted in the **aquilologic** memorandum commenting on the Administrative Draft of the Report, dated February 2, 2024 (**Attachment 1**), our understanding is that the primary objectives of the DAS include: (1) compiling existing data and information regarding the Deep Aquifers; (2) identifying data gaps and collecting additional data; (3) defining the spatial extent of the Deep Aquifers; (4) estimating the Deep Aquifers water budget; (5) describing the current conditions of the Deep Aquifers in terms of groundwater quality and groundwater elevations; (6) commenting on risks to the Deep Aquifers and overlying land uses; and (7) discussing potential management guidance and monitoring recommendations for the Deep Aquifers.

The Report represents a significant effort prepared by a competent team of technical investigators and experts (Montgomery & Associates [M&A]). However, our analysis indicates that items (4) and (5) above are incomplete and the Report fails to acknowledge that the incomplete analyses may misinform items (6) and (7). For example, the management guidance presented in the Report (item 7, above) is flawed because it does not consider or discuss important aspects of recent groundwater elevation trends and the very high level of uncertainty in the estimated water budget.

According to item (3) above, the Deep Aquifers are situated in the northern Salinas Valley Groundwater Basin (SVGB) in the 180/400-Foot Aquifer Subbasin (180/400), East Side Aquifer Subbasin (East Side), Forebay Aquifer Subbasin (Forebay), Monterey Subbasin (Monterey), and Seaside Subbasin (Seaside). The southern extent of the Deep Aquifers is not known because there are no wells deep enough to detect the presence of Deep Aquifers in the Upper Valley

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<sup>1</sup> <https://svbgsa.org/deep-aquifer-study/>

Subbasin.<sup>2</sup> Furthermore, the isotopic ages given in the Report for Deep Aquifers groundwater are isolated to the coastal area. Younger and/or mixed-age groundwater may potentially exist in other areas.

The analyses presented in this memorandum indicate that the statement in the Report that *most* Deep Aquifers hydrographs in the Northern Region show decreasing groundwater elevation trends is, at best, misleading (item [5], above). For the nine hydrographs presented in the Report, 67% do not show statistically significant decreasing trends for the 2018-2024 period.<sup>3</sup> A total of ten Deep Aquifers hydrographs were analyzed in this memorandum. Seventy percent of these hydrographs do not show statistically significant decreasing groundwater elevation trends for the 2018-2024 period.

Another misleading aspect of the Report is found in the discussion regarding the water budget (item [4], above). The simulated Deep Aquifers water budget presented in the Report is highly uncertain and indicates upward vertical hydraulic gradients and substantial groundwater flow from the Deep Aquifers to the 400-Foot Aquifer. This simulated upward flow is not supported by the observed data presented in the Report.

Given the above issues, the Report consequently lacks sufficient, reliable information to inform proposed management actions for the Deep Aquifers.

## DEEP AQUIFERS GROUNDWATER ELEVATION TRENDS

In this memorandum, **aquilogic** statistically analyzed the groundwater elevation trends for hydrographs in the so-called Northern Region of the Deep Aquifers. These hydrographs are shown in the Report on Figures 5-6, 5-12 and G-1. **Figure 1** shows the locations of these wells, as well as one additional Deep Aquifers well that was analyzed herein (14S02E28C02).

Hydrographs for the wells shown on **Figure 1** contradict the Report's characterization that *"Groundwater elevations in most wells in the Northern and Seaside Regions are declining."*<sup>4</sup> On the contrary, the hydrographs show that for the last six years, most groundwater levels in Deep Aquifers wells identified in the Report have not changed significantly and in some cases are increasing.

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<sup>2</sup> It should be noted that previous investigators have suggested the Deep Aquifers extend as far south as San Ardo due to the presence of the Paso Robles Formation, e.g.,

Thorup, R.R. (1983). Hydrogeologic report on the Deep Aquifer, Salinas Valley, Monterey County, California: unpublished report to Monterey County Board of Supervisors, 40 p.

<sup>3</sup> The nine hydrographs are presented in the Report on Figures 5-6, 5-12, and G-1. Four additional hydrographs are presented in the Report on Figure 5-9. These four wells are not readily identifiable on the GSP Web Map and Data website (see footnote 5). One well on the website (MPWMD#FO-11D) may or may not be the same well as FO-11-Deep on Report Figure 5-9. The hydrograph for MPWMD#FO-11D appears to show a decreasing water-level trend for the 2018-2024 period.

<sup>4</sup> See page 100 of the Report, and note we do not present analyses for Seaside Deep Aquifers wells.

Groundwater elevation data for these and other wells were obtained from the SVGB Groundwater Sustainability Plan (GSP) Web Map and Data website.<sup>5</sup> Aquilologic conducted Mann-Kendall (MK) trend analyses for multiple aspects of the hydrographs shown on **Figures 2, 3, and 4**.<sup>6</sup> A MK trend analysis is a statistical hypothesis test, in which a “null hypothesis” is evaluated relative to an alternate hypothesis. MK trend analyses are often conducted when a normal distribution cannot be assumed or demonstrated for a given dataset (i.e., it is a non-parametric trend test). For the analyses presented in this memorandum, the null hypothesis is that no trend with time exists in the data. That is, groundwater elevations do not change with time. The alternate hypothesis is that groundwater elevations either increase or decrease with time. If the null hypothesis can be rejected, it follows that the data indicate the alternate hypothesis cannot be rejected.

The decision to reject or not reject the null hypothesis is subjective. However, most investigations use the 95% confidence level to inform the decision, which is obtained from the p-value derived from the MK calculations (i.e., confidence level = 1-[p-value]). The p-value represents the statistical confidence with which the null hypothesis can be rejected, or not rejected. A p-value of 0.05 or less indicates that the null hypothesis can be rejected at the 95% or greater confidence level (i.e., there is trend in the data).

## **Mann-Kendall Results**

The hydrographs presented on **Figures 2, 3, and 4** distinguish between the pre- (blue and other color plot symbols) and post-2018 (orange plot symbols) periods. Additionally, the MK trend lines<sup>7</sup> and p-values are shown on these Figures in corresponding colors.

The hydrograph for well 14S02E06L01 is divided into four periods (**Figure 2**). For the 1983-1994 period, there is a decreasing trend in groundwater elevation, as indicated by the p-value of <0.00005.<sup>8</sup> Groundwater elevations increased from 1995 to 2005, decreased from 2005-2017, and did not change significantly from 2018 to 2024. That is, the null hypothesis of no trend cannot be rejected for the 2018-2024 period (p-value of 0.9422). In other words, statistically speaking, observed groundwater elevations did not increase or decrease in the 2018-2024 period.

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<sup>5</sup> <https://svbgsa.org/gsp-web-map-and-data/>

<sup>6</sup> Helsel, D.R., Mueller, D.K., and Slack, J.R. (2006). Computer program for the Kendall family of trend tests. U.S. Geological Survey (USGS) Scientific Investigations Report 2005–5275, 4 p.

<sup>7</sup> That is, the trend lines shown are not derived from a linear regression, which assumes a normal distribution.

<sup>8</sup> The USGS program used here reports p-values to four decimal places.

The hydrograph for well 14S02E28H04 is divided into two periods (**Figure 3**). For the 2006-2017 period, groundwater elevations decreased (p-value of <0.00005). However, for the 2018-2024 period, groundwater elevations increased (p-value of 0.0258).

The hydrograph for well 14S02E33E01 is divided into two periods (**Figure 4**). For the 2005-2017 period, groundwater elevations appear visually to have decreased. However, the p-value of 0.0652 indicates that the null hypothesis cannot be rejected at the 95% confidence level. For the 2018-2024 period, groundwater elevations increased (p-value of <0.00005).

A summary of the MK analyses described above and presented on **Figures 2, 3, and 4** is shown in **Table 1**. The analyses provide quantitative evidence that hydrographs presented on Figure 5-12 of the Report indicate that groundwater elevations in the Deep Aquifer have not declined over the last six years. To support this evidence, **aquilogic** conducted MK analyses for several other Northern Region Deep Aquifers hydrographs, for which locations are also shown on **Figure 1**.

The hydrograph for well 14S02E22A03 is divided into two periods (**Figure 5; Table 1**). For the 2016-2017 period, groundwater elevations appear visually to have decreased. However, the limited timeframe and p-value of 0.3004 indicate that the null hypothesis cannot be rejected at the 95% confidence level. For the 2018-2024 period, groundwater elevations have not changed, statistically speaking (p-value of 0.7061).

The hydrograph for well 14S02E28C02 is divided into two periods (**Figure 6; Table 1**). For the 2008-2017 period, groundwater elevations decreased (p-value of <0.0041). However, for the 2018-2024 period, groundwater elevations increased (p-value of 0.0025).

## Annual Maximum and Minimum Groundwater Elevations Trends

**Aquilogic** further analyzed the hydrographs presented in **Figures 2 through 6**. Additional MK trend analyses were conducted for the annual maximum and annual minimum groundwater elevations for the 2018-2024 period. The results are summarized in **Table 1** and the MK trend lines are shown on the respective figures as light orange dashed lines. The p-values are shown with light orange text.

Visually, all but one hydrograph show increasing groundwater elevations, or no change, in both the annual maximum and annual minimum elevations. The exception is the well 14S02E22A03 annual minimum hydrograph, which shows visually a decreasing trend. Of note, the null hypothesis cannot be rejected for any of associated trends in annual maximums/minimums at the 95% confidence level (all p-values are greater than 0.05). This could be a data limitation issue, or it could indicate that there are no identifiable increasing or decreasing trends in annual maximum/ minimum groundwater elevations in hydrographs from these wells for the 2018-2024 period.

## Groundwater Elevations and Pumping

Groundwater elevations have either not changed or have increased in the 2018-2024 period for the five wells discussed above. The Report states that, *“The slight rise in recent years is due to a reduction in pumping in certain wells in the months preceding the fall measurements. The early reduction in pumping allows groundwater elevations in the coastal area to rebound prior to the fall measurements.”*<sup>9</sup>

In developed groundwater basins in California, especially in agricultural settings, groundwater elevations typically rise in the winter and fall in the summer due to seasonal recharge and temporal irrigation patterns.<sup>10</sup> Typically, annual peak groundwater elevations that occur in winter or spring are compared over a period of years to identify the presence or absence of trends through time, because it is during these periods when a given basin is closest to a “static” condition. The summer lows in groundwater elevations are not used for this purpose, because this period does not represent a static condition.

The fact that groundwater levels increase during periods of reduced pumping should not surprise technical experts or informed laypersons. Thus, the SVBGSA should view stabilizing or increasing groundwater levels as a success in terms of the Sustainable Groundwater Management Act (SGMA), rather than a data anomaly. In the Report, Appendix G and Figure G-1 (a hydrograph and pumping comparison for well 14S02E28H04) discuss the basis for the above quote. As shown on Figure G-1 of the Report, the increased data collection that has occurred since 2018 has revealed that annual peak groundwater elevations observed at this well generally occur after the time that the Monterey County Water Resources Agency (MCWRA) collects the “fall measurement,” which the SVBGSA relies on for SGMA annual reporting purposes. Regardless of pumping patterns, the data presented in this memorandum and the Report show that groundwater levels have generally stabilized, are increasing, or have no statistically significant water-level trends for the 2018-2024 period in most Deep Aquifers wells, as indicated by the analyses described above and the additional analyses described below.

## Additional Analyses of Groundwater Elevation Trends

Five additional hydrographs for the Northern Region of the Deep Aquifers are presented on Figure 5-6 of the Report. The hydrographs shown on Report Figure 5-6 appear to have used only portions of the available data (**Figure 7**). However, no explanation is provided in the Report text regarding why the full datasets were not used. **Aquilologic** has reproduced Report Figure 5-6 but included all the available data for each hydrograph and made other slight modifications to the

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<sup>9</sup> See Report pages 13-14.

<sup>10</sup> In confined aquifers, some of the seasonal increases in groundwater elevations are related to the compressibility of the bulk aquifer material and water.

layout of the figure (**Figure 8**).<sup>11</sup> For **Figure 8**, emphasis was placed on groundwater elevation trends for the 2018-2024 period. A summary of the MK analyses for the five additional wells presented on **Figure 8** is shown in **Table 2**.

On **Figure 8**, the annual maximum and minimum groundwater elevations and trend lines for 2018-2024 are shown with green plot symbols/lines and black plot symbols/lines, respectively, if sufficient data are available. As with the hydrographs shown on **Figures 2** through **6**, none of the additional hydrographs indicate annual maximum/minimum groundwater elevation trends at the 95% confidence level (i.e., the null hypothesis cannot be rejected). This could be due to limited available data or it could indicate that the annual maximum/minimum groundwater elevations are not significantly increasing or decreasing during this period.

The hydrographs for wells 14S03E19C01 and 14S02E20E01 (**Figure 8**) indicate that the null hypothesis cannot be rejected at the 95% confidence level for the complete datasets (p-values of 0.1543 and 0.1282, respectively). However, visually all three versions of the hydrographs for each well show an increasing trend in groundwater elevations during the 2021-2024 period for both hydrographs.

The hydrograph for well 14S02E33E02 (**Figure 8**) indicates that the null hypothesis can be rejected for the complete dataset for the 2018-2024 period (p-value of 0.0034). Thus, the data indicate that groundwater elevations have been decreasing at this well in recent years. However, as indicated above there are no significant trends in the annual maximum/minimum groundwater elevations at the 95% confidence level.

The hydrograph for well 13S01E36J02 (**Figure 8**) indicates that the null hypothesis can be rejected for the complete dataset for the 2018-2024 period (p-value of 0.0009). Thus, the data indicate that groundwater elevations have been decreasing at this well in recent years. However, as indicated above there are no significant trends in the annual maximum/minimum groundwater elevations at the 95% confidence level. Moreover, the annual minimum groundwater elevation measured at this well has increased every year for the last three years (see black plot symbols), as has the annual maximum groundwater elevation (see green plot symbols).

The hydrograph for well 13S02E28L03 (**Figure 8**) indicates that the null hypothesis can be rejected for the complete dataset for the 2018-2024 period (p-value of 0.0059). Thus, the data indicate that groundwater elevations have been decreasing at this well in recent years. However, as indicated above there are no significant trends in the annual maximum/minimum groundwater elevations at the 95% confidence level. The annual maximum groundwater elevations appear visually to be increasing at this well.

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<sup>11</sup> Four of the hydrographs shown on **Figure 8** were previously shown on **Figures 2** through **5**.

## Are Deep Aquifers Groundwater Elevations Decreasing?

Most of the hydrographs analyzed statistically herein do not show decreasing groundwater elevation trends at the 95% confidence level during the 2018-2024 period. Of the nine Deep Aquifers hydrographs selected by M&A to illustrate that “Groundwater elevations in most wells in the Northern...Region[s] are declining” [emphasis added], only three (13S02E28L03, 14S02E33E02, and 13S01E36J02; **Figure 8**) show statistically significant decreasing trends in groundwater elevations (i.e., at the 95% confidence level) during the 2018-2024 period (33% of hydrographs shown by M&A). **Aquilogic** analyzed an additional hydrograph (14S02E28C02; **Figure 6**), which did not show a statistically significant decreasing groundwater elevation trend. Of the ten Northern Region hydrographs analyzed herein, only 30% show statistically significant decreasing trends in groundwater elevations during the 2018-2024 period. The other 70% of the hydrographs analyzed herein (i.e., the nine presented in the Report and one additional hydrograph) show stable water levels, increasing water levels, or no statistically significant water-level trends.

## SIMULATED WATER BUDGET

The Deep Aquifers water budget was estimated using two groundwater models: The USGS provisional Salinas Valley Integrated Hydrologic Model (SVIHM) and the Salinas Valley Seawater Intrusion Model (SWI Model). Neither of these models are particularly focused on the Deep Aquifers. Consequently, neither of these models are well-calibrated to observed groundwater elevations in the Deep Aquifers.

In our February 2, 2024 memorandum commenting of the Administrative Draft of this Report (**Attachment 1**), **aquilogic** suggested that the statement on page 71 of the Report, “Groundwater models are the best available tools for developing water budgets.” be revised to read, “Well-calibrated groundwater models are the best available tools for developing water budgets.”<sup>12</sup> But **aquilogic**’s proposed revision was not accepted.

It is understood that there are limited groundwater elevation data available for the Deep Aquifers, especially in the Southern Region of the Deep Aquifers. Thus, the model-estimated groundwater flow from the Southern Region to the Northern Region is highly uncertain and poorly constrained.

Dr. Abrams of **aquilogic** is a member of the SVBGSA Groundwater Technical Advisory Committee (GTAC). During one of the GTAC meetings prior to the issuance of the Administrative Draft, Dr. Abrams suggested that one way to further constrain estimated groundwater flow from the Southern Region to the Northern Region was to conduct a sensitivity analysis on the hydraulic

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<sup>12</sup> The statement in question appeared on page 69 of the DAS Administrative Draft Report.

conductivities in the broad vicinity of this area. At least one member of the M&A team attending the GTAC meeting, Staffan Schorr, agreed that such an analysis would indeed provide further insight into these flows. To the best of our knowledge, no such sensitivity analysis has been conducted, but should be completed prior to proposed management actions.

An additional area of high uncertainty in the Deep Aquifers water budget involves the vertical flow of groundwater from the Deep Aquifers to the overlying 400-Foot Aquifer (i.e., upward flow through the thick 400-Foot/Deep Aquitard).<sup>13</sup> Figure 5-12 of the Report and discussions in the Report text emphasize the existence of observed downward vertical hydraulic gradients between the 400-Foot Aquifer and the Deep Aquifers. It should be noted that these hydraulic gradients do not indicate that vertical groundwater flow is occurring between these two aquifers.<sup>14</sup>

Despite including in the Report observed data that indicate a downward vertical hydraulic gradient, the estimated Deep Aquifers water budget presented in the Report indicates significant upward vertical flow *from* the Deep Aquifers *to* the 400-Foot Aquifer. The incorrect simulated upward flow is on the order of 6,900 acre-feet per year (AFY) in the Northern Region of the Deep Aquifers for the 2004-2017 period (see Table 4-1 of the Report). The simulated net change in groundwater storage in the Northern Region of the Deep Aquifers is reported to be -5,700 AFY (Table 4-1 of the Report), which represents a significant loss of storage.

For an aquifer in which warnings of potential downward flow from above have been issued, this is an unacceptable level of uncertainty. For example, what if the model-estimated upward flow from the Deep Aquifers to the 400-Foot flow is wrong? If the 6,900 AFY shown in Table 4-1 of the Report to be flowing out of the Deep Aquifers does not occur in reality, then the water budget presented in the Report indicates the potential for there to be a net storage gain of 1,200 AFY in the Northern Region of the Deep Aquifers.

## SUMMARY

The Report lacks sufficient, reliable information to inform proposed management actions for the Deep Aquifers, as indicated herein by **aquilogic**'s assessment of three of the primary topics discussed in the Report. We recommend that the SVBGSA address these issues prior to issuing management actions.

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<sup>13</sup> The 400-Foot/Deep Aquitard is known to contain discontinuous permeable sections in some areas.

<sup>14</sup> The presence of vertical hydraulic gradients suggests that there is the potential for downward flow given sufficient vertical hydraulic conductivity and a reasonable timeframe.

**Table 1: Mann-Kendall Trends at the 95% Confidence Level**  
**BHFS - Salinas Basin Water Alliance**

Well	Period	S	Z	P-Value	P-value Annual Maximums 2018-2024 <sup>1</sup>	P-value Annual Minimums 2018-2024 <sup>1</sup>	Tau	Trend/No Trend <sup>2</sup>
14S02E06L01	1983-1994	-1582	-4.256	<0.00005	-	-	-0.279	Decreasing
	1995-2004	4771	11.097	<0.00005	-	-	0.691	Increasing
	2005-2017	-7133	-12.581	<0.00005	-	-	-0.713	Decreasing
	2018-2024	15	0.073	0.9422	0.7639	0.3675	0.006	No Trend
14S02E28H04	2006-2017	-158	-4.745	<0.00005	-	-	-0.752	Decreasing
	2018-2024	368	2.229	0.0258	0.0715	0.0715	0.195	Increasing
14S02E33E01	2005-2017	-2,565	-8.244	0.0652	-	-	-0.574	No Trend
	2018-2023	255	1.844	<0.00005	0.7071	0.7071	0.172	Increasing
14S02E22A03	2016-2017	-24	-1.036	0.3004	-	-	-0.200	No Trend
	2018-2024	31	0.377	0.7061	1.0000	0.0603	0.044	No Trend
14S02E28C02	2008-2017	-96	-2.869	0.0041	-	-	-0.457	Decreasing
	2018-2024	205	3.025	0.0025	0.7639	0.7071	0.365	Increasing

Notes:

S: Mann-Kendall Statistic.

Z: Standard Normal Variate.

Tau: Mann-Kendall Rank Correlation Coefficient.

1. None of the trends in annual maximum/minimum are significant to the 95% confidence level.
2. Trend/no trend when all data considered

**Table 2: Mann-Kendall Trends at the 95% Confidence Level for Recent Periods**  
**BHFS - Salinas Basin Water Alliance**

Well	Period	S	Z	P-Value	P-value Annual Maximums 2018-2024 <sup>1</sup>	P-value Annual Minimums 2018-2024 <sup>1</sup>	Tau	Trend/No Trend <sup>2</sup>
<b>14S03E19C01</b>	2021-2024	62	1.425	0.1543	0.7341	0.0894	0.207	No trend
<b>14S02E20E01</b>	2018-2024	122	1.521	0.1282	0.4624	1.0000	0.174	No trend
<b>13S02E28L03</b>	2018-2024	-857	-2.754	0.0059	0.8793	-0.4670	-0.192	Decreasing
<b>14S02E33E02</b>	2018-2024	-438	-2.931	0.0034	0.1329	0.2597	-0.265	Decreasing
<b>13S01E36J02</b>	2018-2024	-629	-3.325	0.0009	0.7639	0.4524	-0.276	Decreasing

Notes:

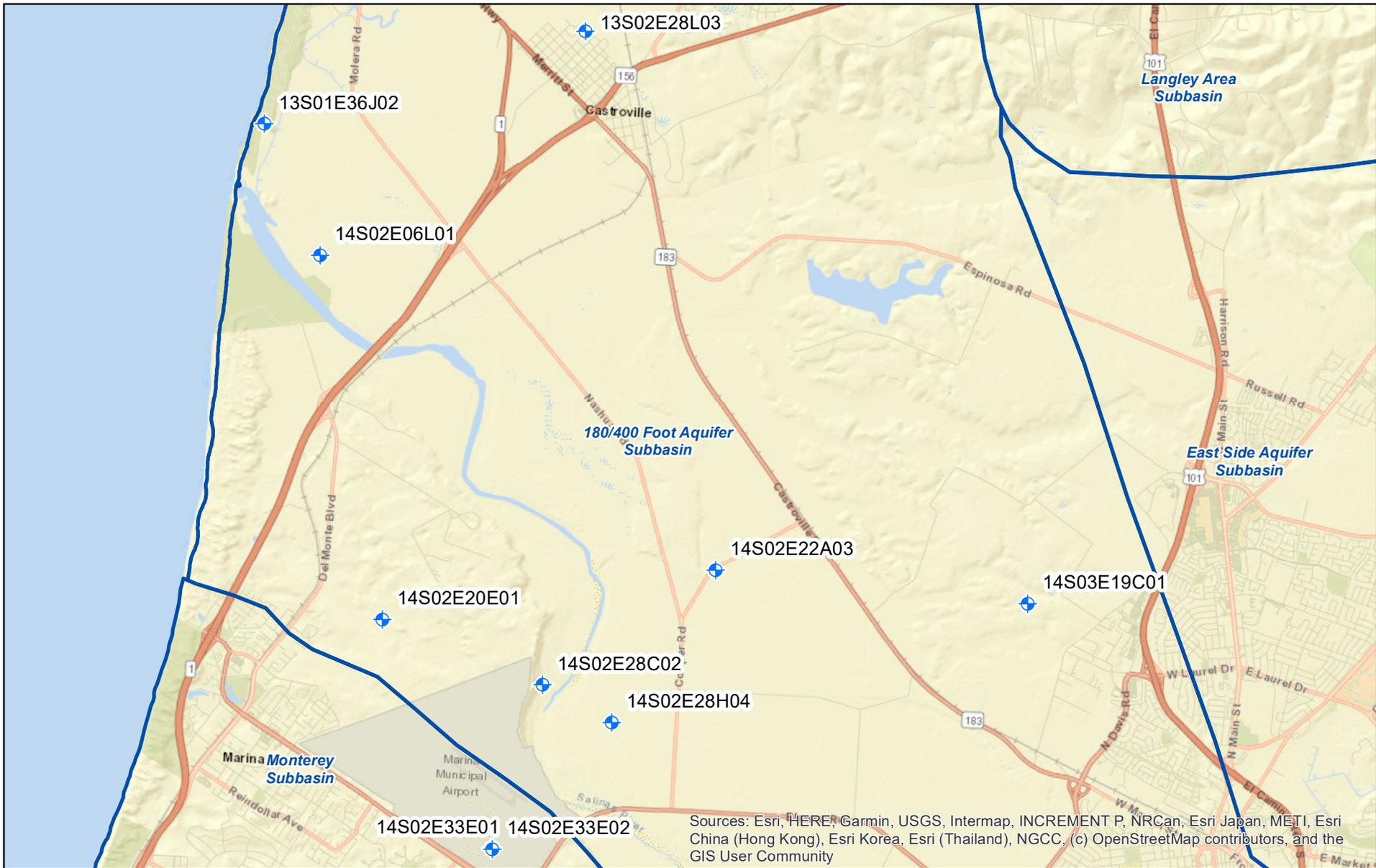
S: Mann-Kendall Statistic.

Z: Standard Normal Variate.

Tau: Mann-Kendall Rank Correlation Coefficient.

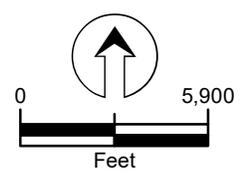
For well 14S02E20E01, the maximum/minimum trends were calculated for 2020-2024 due to data limitations

1. Only one of the trends in annual maximum/minimum are significant to the 95% confidence level.
2. Trend/no trend when all data considered

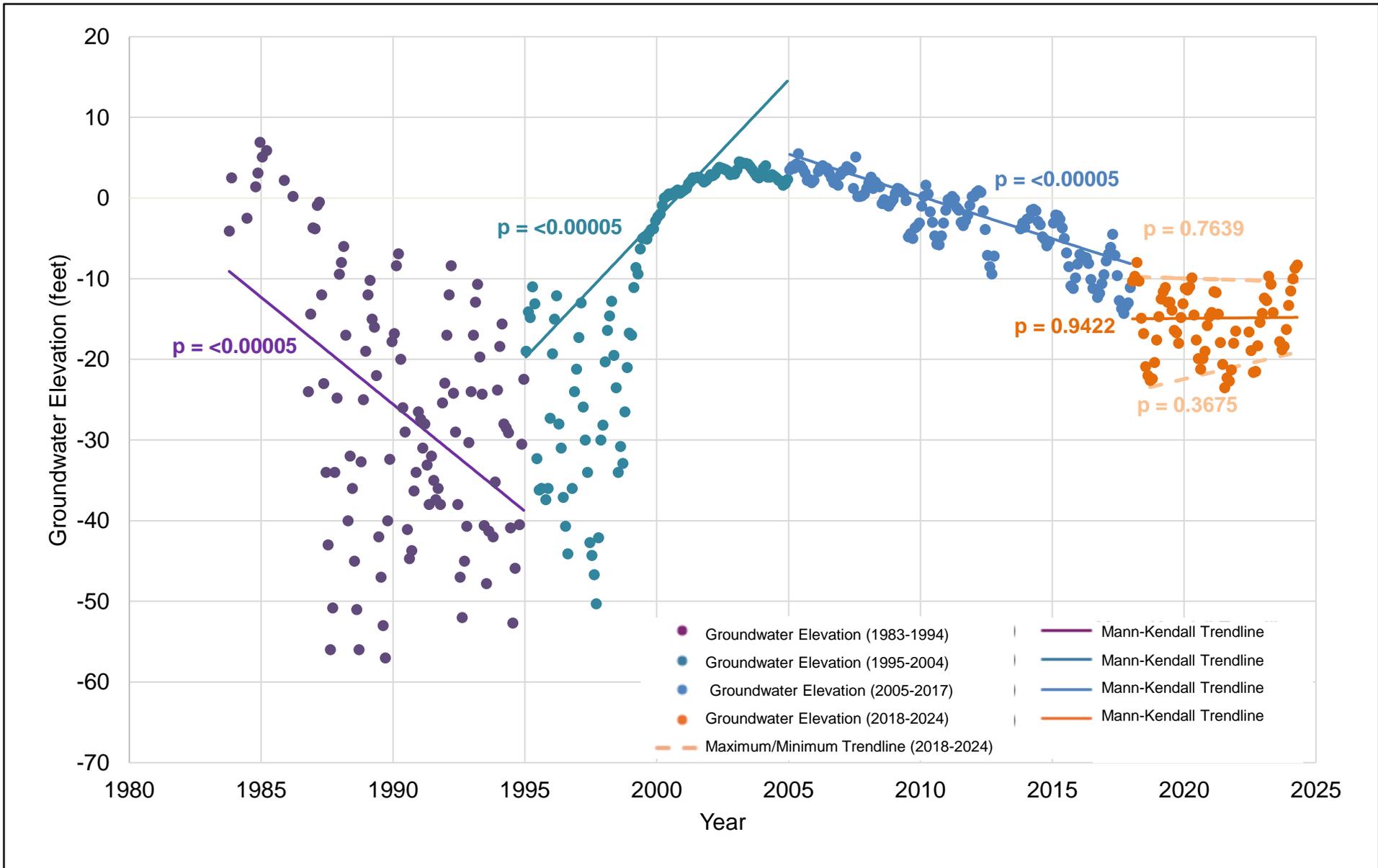


Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

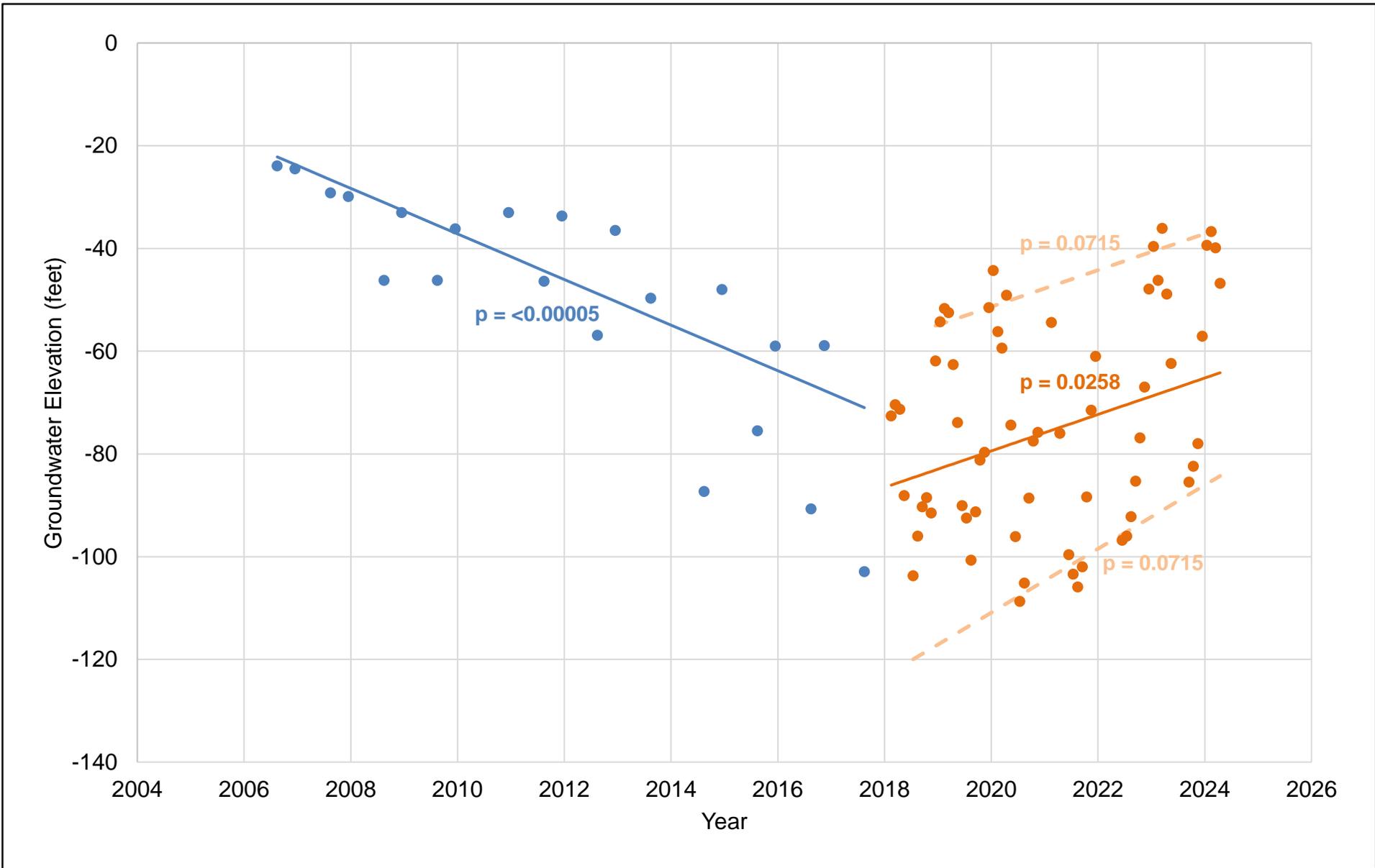
 Deep Aquifer Wells  
 DWR Bulletin 118 Groundwater Subbasins



 aquilologic, Inc. BHFS - Salinas Basin Water Alliance  
**Wells Selected for Analysis**  
 Date: 9/9/2024    Project #: 018-09    **Figure 1**



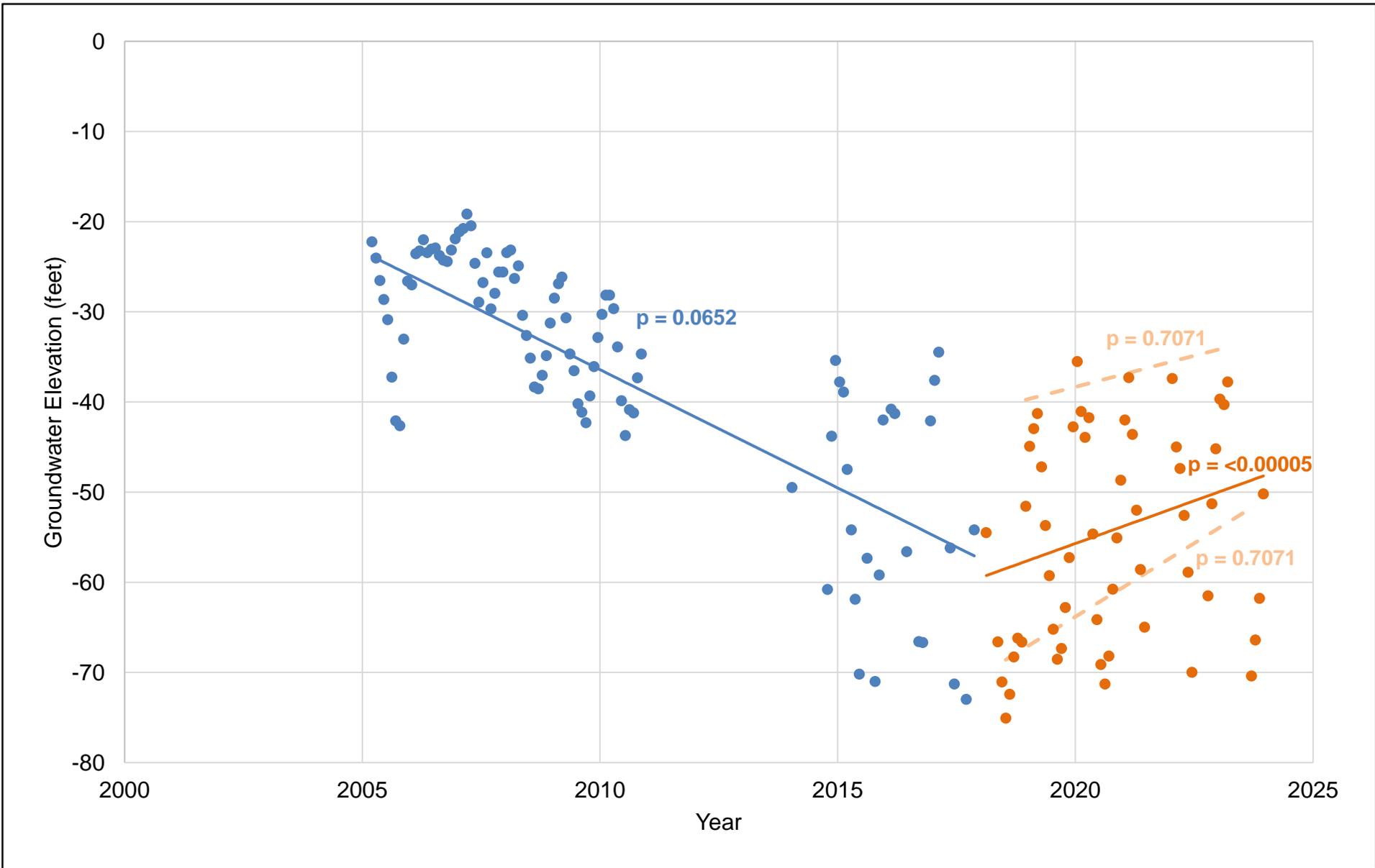
The p-value is the attained significance. The null hypothesis is that there are no temporal trends in the data. The smaller the p-value, the stronger the evidence for rejection of the null hypothesis and the more likely a temporal trend exists in the data. In general, p-values less than 0.05 are considered to strongly support the calculated trend (95% confidence level). Higher p-values indicate that the null hypothesis is more likely to be correct (i.e., no temporal trend).



- Groundwater Elevation (2006-2017)
- Groundwater Elevation (2018-2024)
- Mann-Kendall Trendline
- Mann-Kendall Trendline
- - - Maximum/Minimum Trendline (2018-2024)

The p-value is the attained significance. The null hypothesis is that there are no temporal trends in the data. The smaller the p-value, the stronger the evidence for rejection of the null hypothesis and the more likely a temporal trend exists in the data. In general, p-values less than 0.05 are considered to strongly support the calculated trend (95% confidence level). Higher p-values indicate that the null hypothesis is more likely to be correct (i.e., no temporal trend).

**Mann-Kendall Trend Analysis for  
Well No. 14S02E28H04**



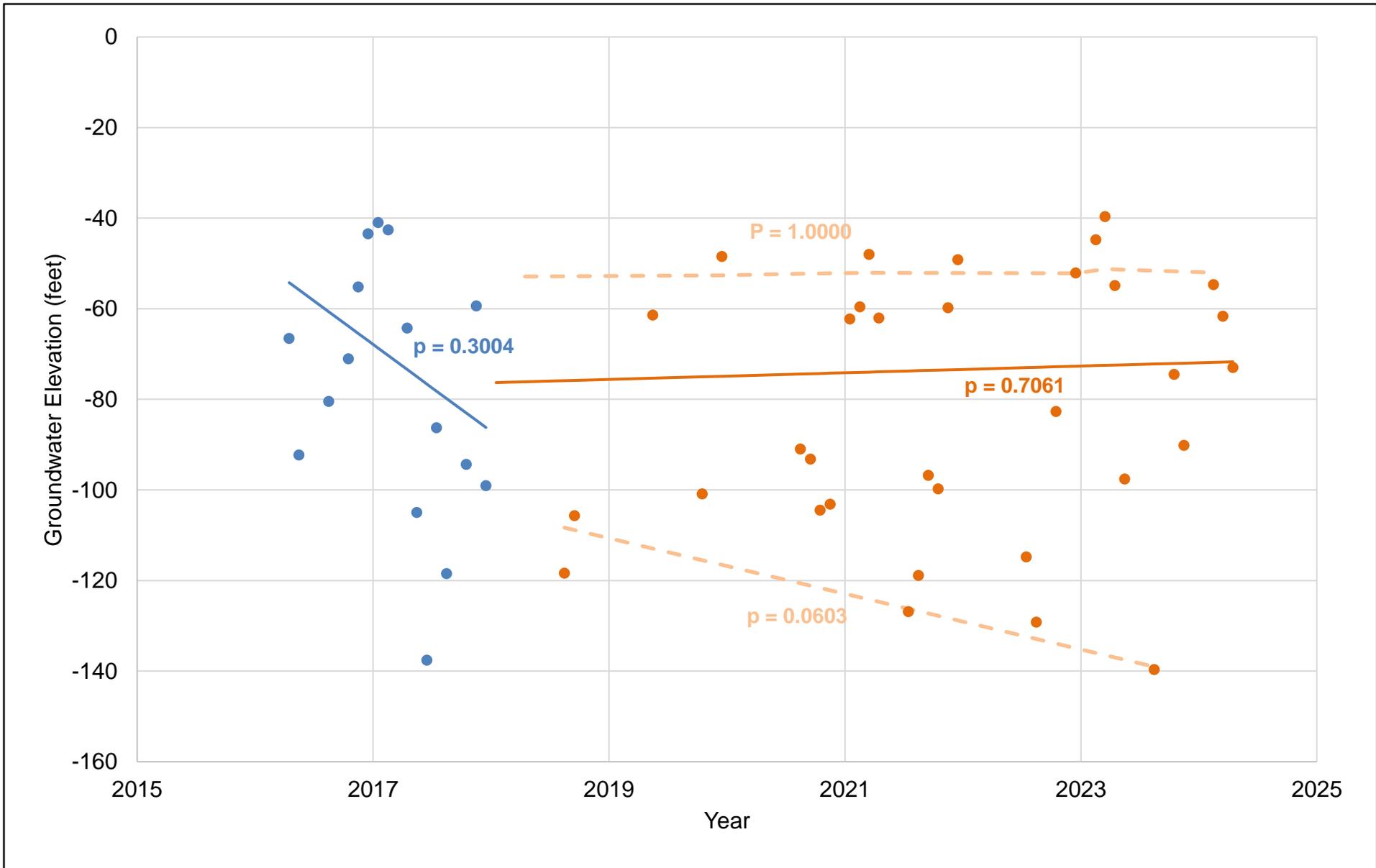
- Groundwater Elevation (2005-2017)
- Groundwater Elevation (2018-2023)
- Mann-Kendall Trendline
- Mann-Kendall Trendline
- - - Maximum/Minimum Trendline (2018-2023)

The p-value is the attained significance. The null hypothesis is that there are no temporal trends in the data. The smaller the p-value, the stronger the evidence for rejection of the null hypothesis and the more likely a temporal trend exists in the data. In general, p-values less than 0.05 are considered to strongly support the calculated trend (95% confidence level). Higher p-values indicate that the null hypothesis is more likely to be correct (i.e., no temporal trend).

**aquilogic, Inc.** BHFS-Salinas Basin Water Alliance

**Mann-Kendall Trend Analysis for Well No. 14S02E33E01**

Date: 9/6/2024	Project #: 018-09	<b>Figure 4</b>
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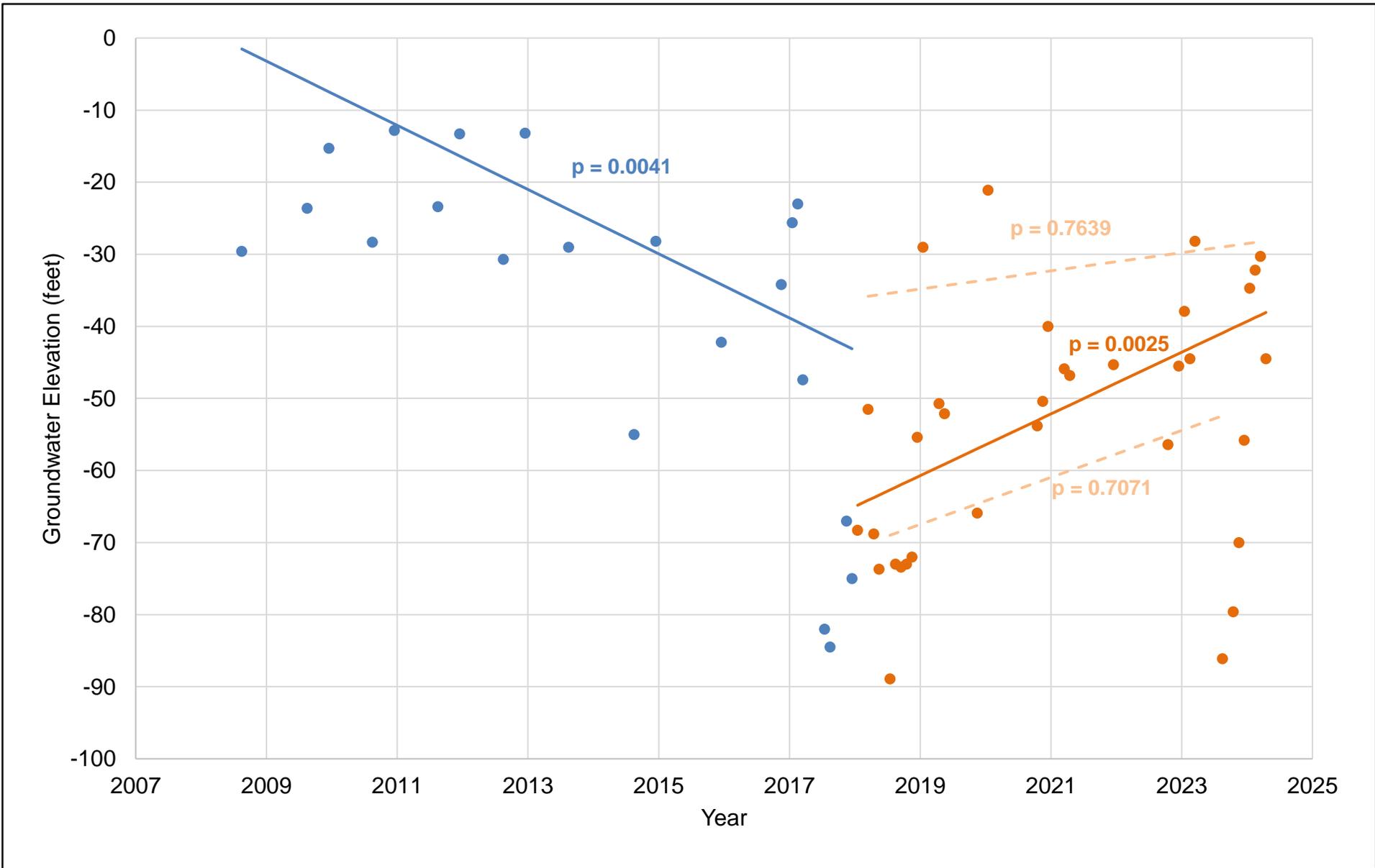
- Groundwater Elevation (2016-2017)
- Groundwater Elevation (2018-2024)
- Mann-Kendall Trendline
- Mann-Kendall Trendline
- - - Maximum/Minimum Trendline (2018-2024)

The p-value is the attained significance. The null hypothesis is that there are no temporal trends in the data. The smaller the p-value, the stronger the evidence for rejection of the null hypothesis and the more likely a temporal trend exists in the data. In general, p-values less than 0.05 are considered to strongly support the calculated trend (95% confidence level). Higher p-values indicate that the null hypothesis is more likely to be correct (i.e., no temporal trend).

BHFS-Salinas Basin  
Water Alliance

Mann-Kendall Trend Analysis for  
 Well No.14S02E22A03

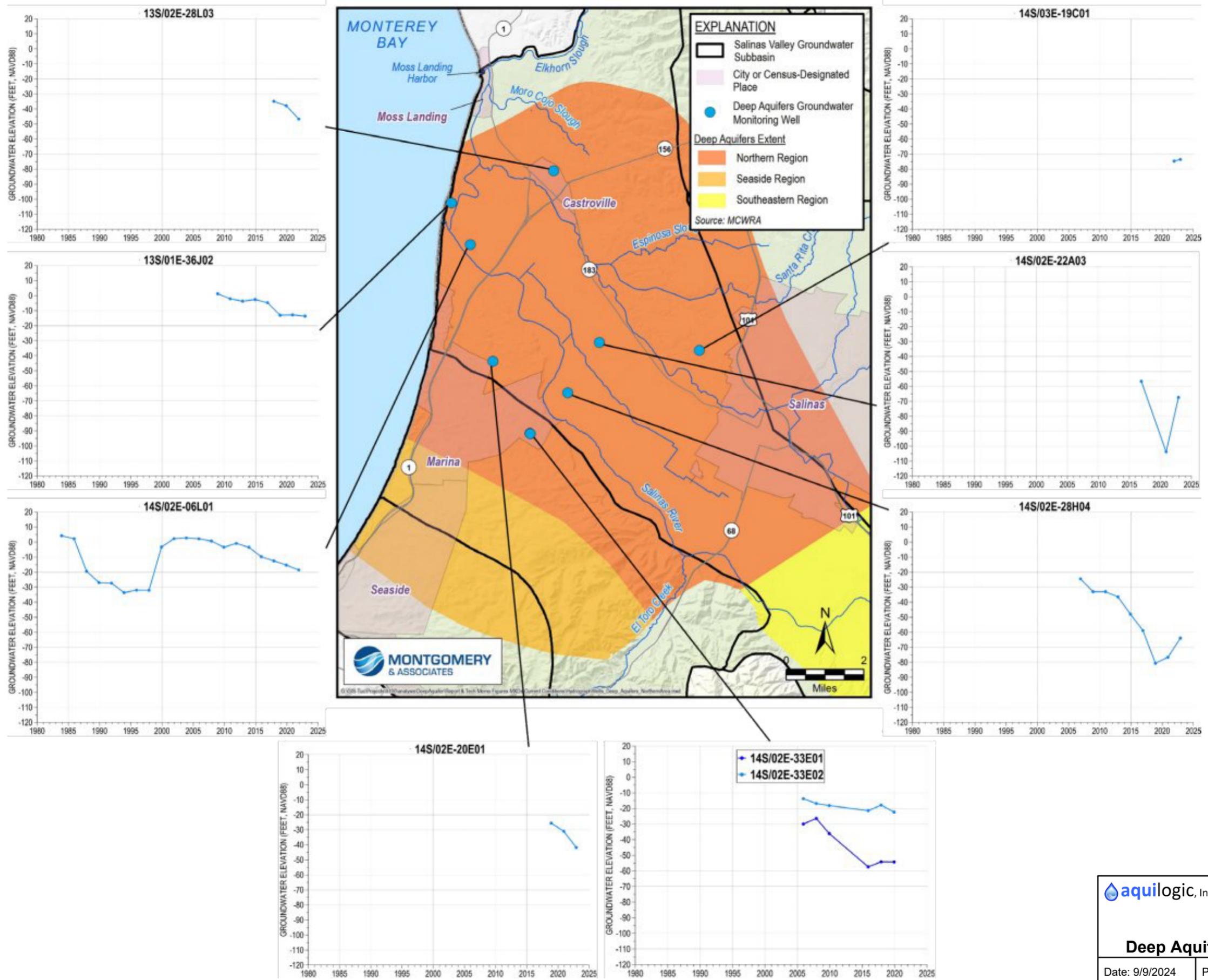
Date: 9/6/2024	Project #: 018-09	Figure 5
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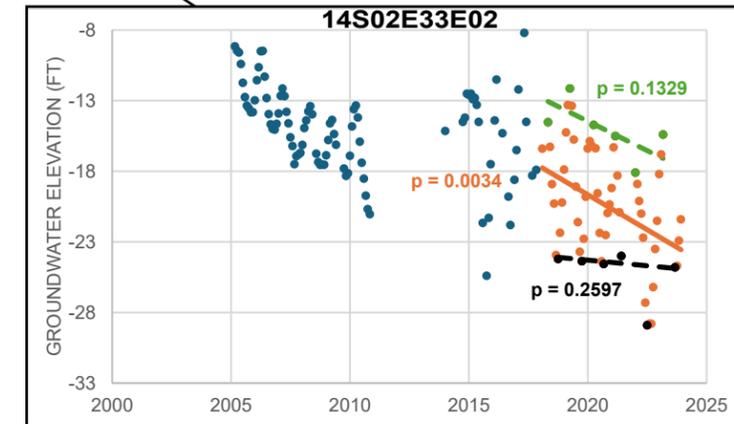
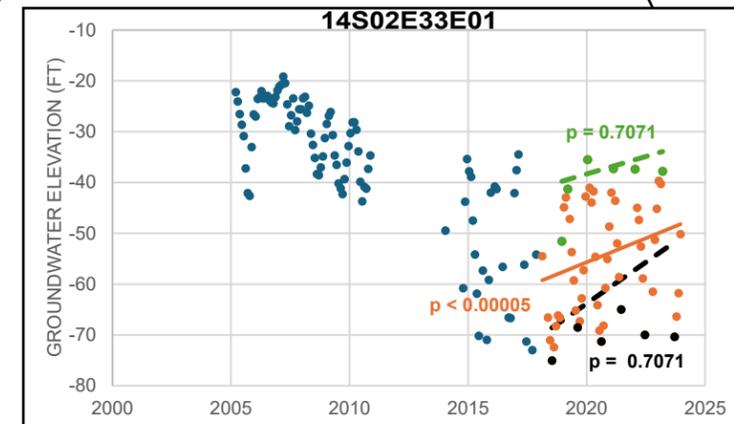
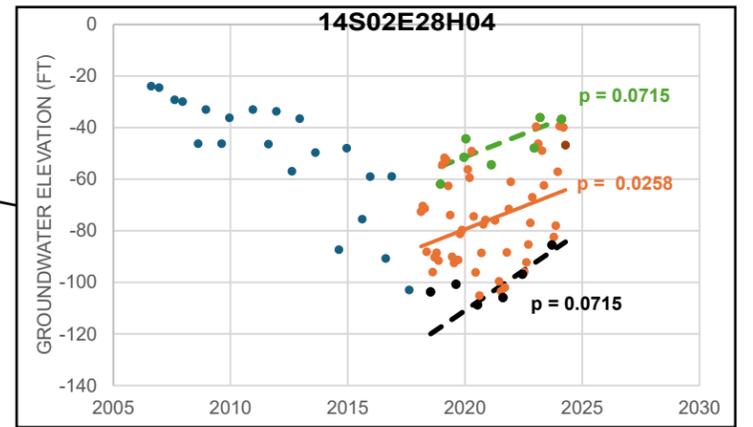
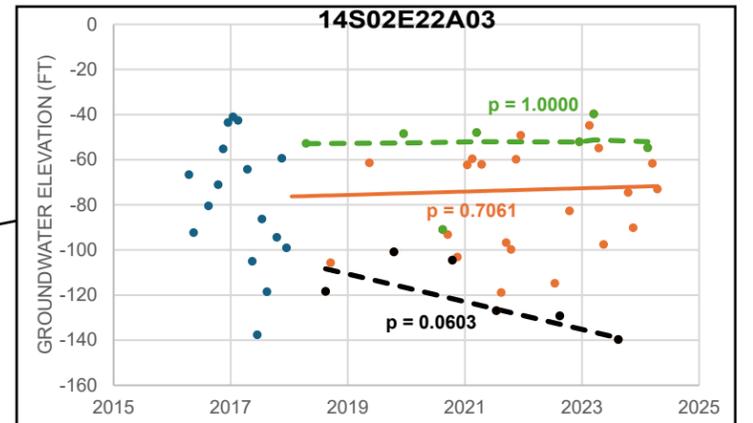
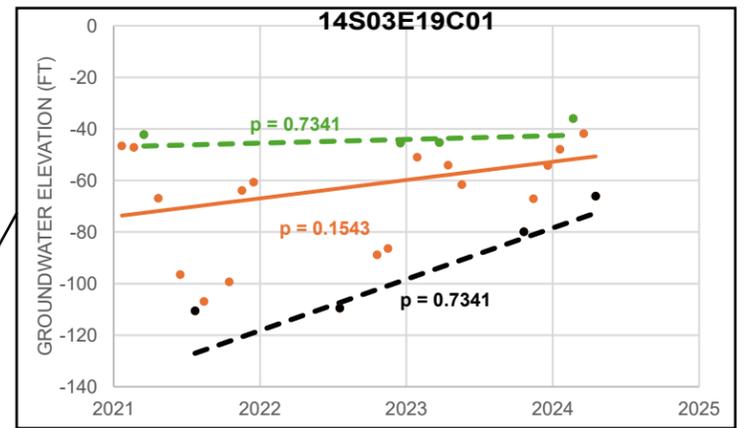
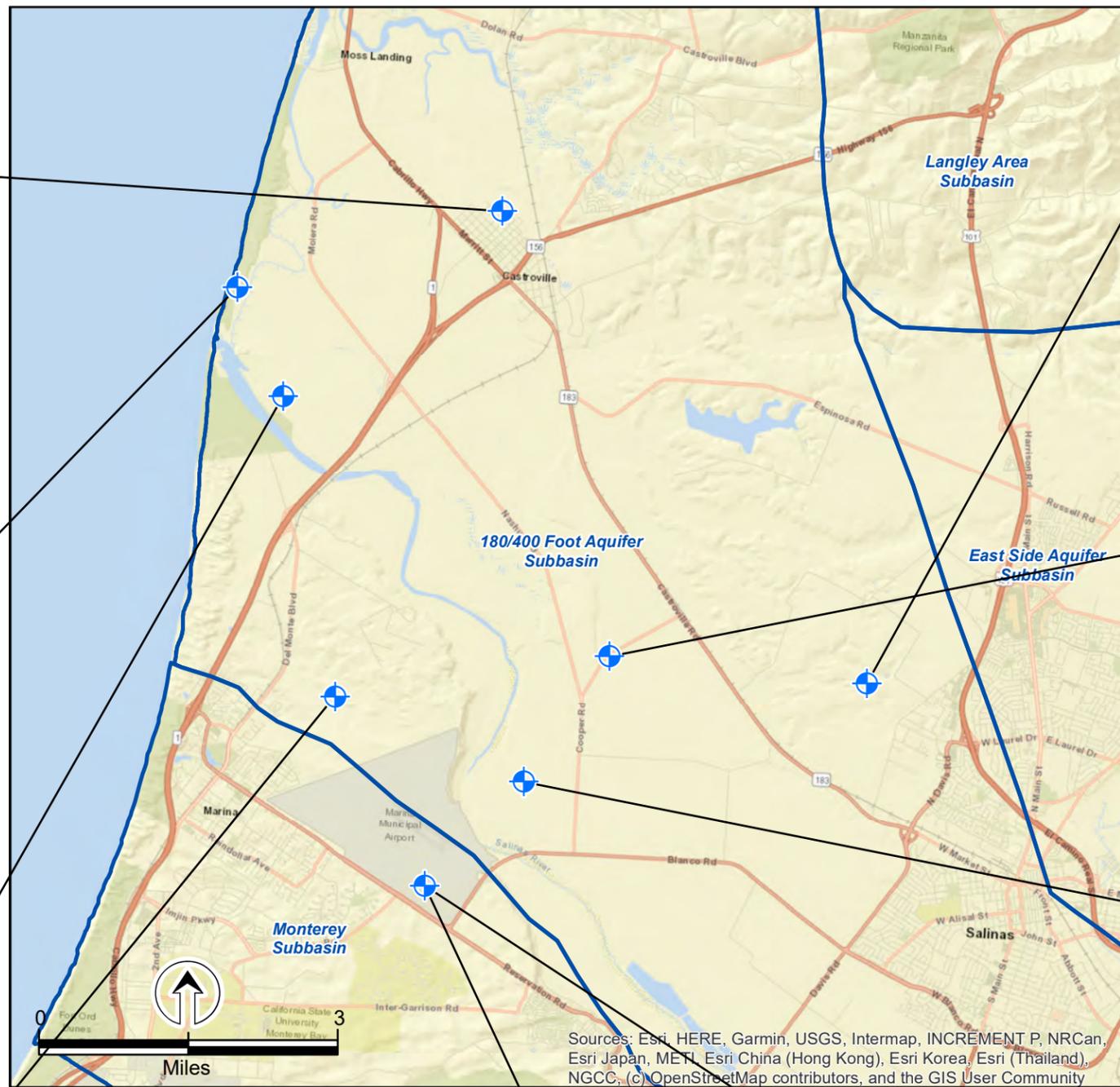
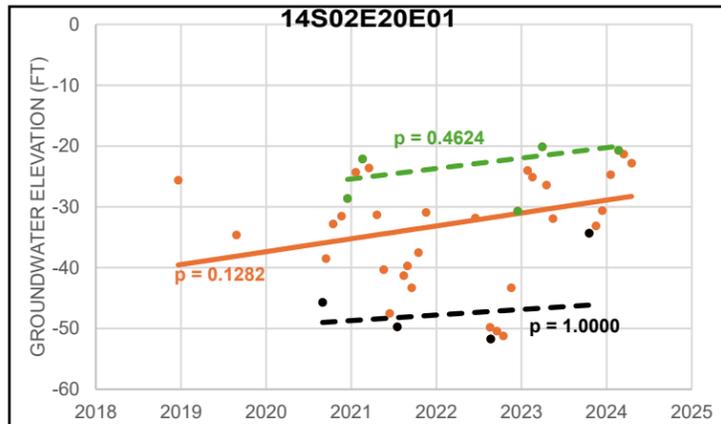
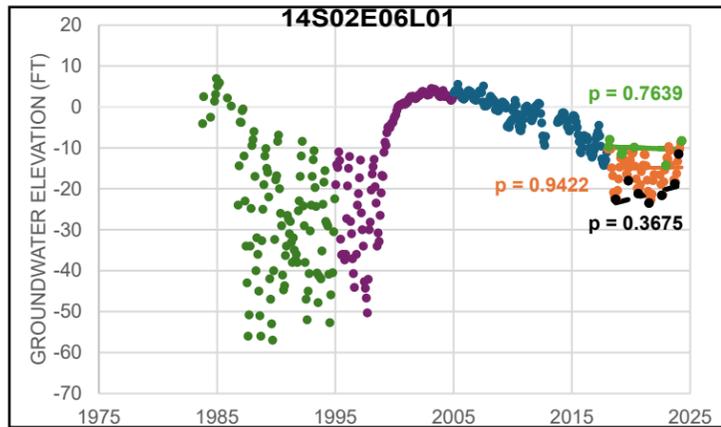
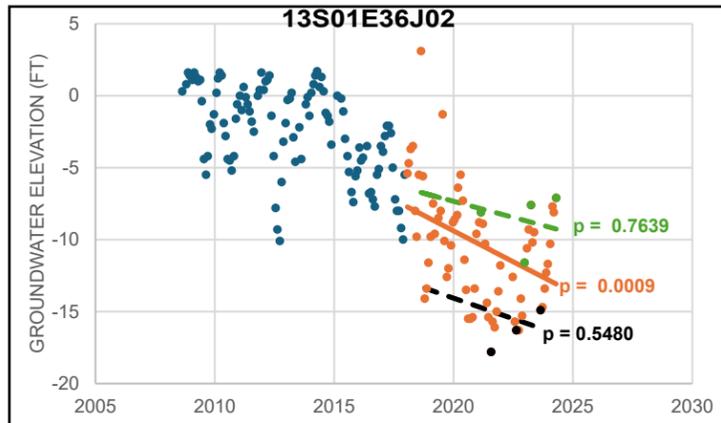
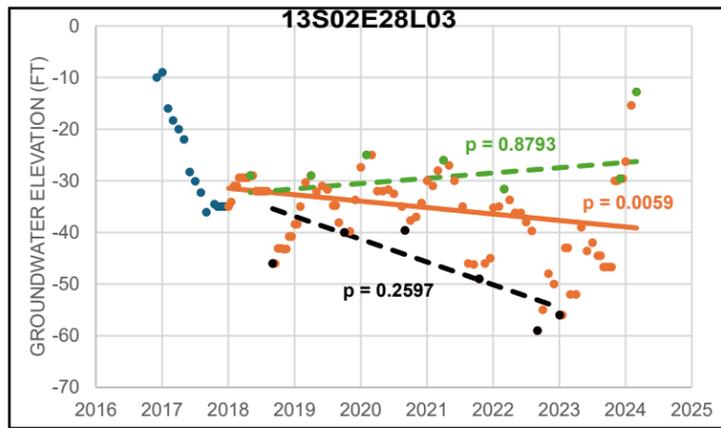


- Groundwater Elevation (2008-2017)
- Groundwater Elevation (2018-2024)
- Mann-Kendall Trendline
- Mann-Kendall Trendline
- - - Maximum/Minimum Trendline (2018-2024)

The p-value is the attained significance. The null hypothesis is that there are no temporal trends in the data. The smaller the p-value, the stronger the evidence for rejection of the null hypothesis and the more likely a temporal trend exists in the data. In general, p-values less than 0.05 are considered to strongly support the calculated trend (95% confidence level). Higher p-values indicate that the null hypothesis is more likely to be correct (i.e., no temporal trend).

		BHFS-Salinas Basin Water Alliance
<b>Mann-Kendall Trend Analysis for Well No.14S02E28C02</b>		
Date: 9/6/2024	Project #: 018-09	<b>Figure 6</b>





- Groundwater Elevation (2018 to 2024)
  - Maximum Groundwater Elevation (2018 to 2024)
  - Minimum Groundwater Elevation (2018 to 2024)
  - Groundwater Elevation (2005 - 2017)
  - Groundwater Elevation (1994 - 2004)
  - Groundwater Elevation (1983 - 1994)
  - Mann-Kendall Trendline
  - Maximum Trendline (2018 - 2024)
  - Minimum Trendline (2018 - 2024)
- Notes:  
DAS = Deep Aquifer Study

**aquilogic, Inc.** BHFS  
- Salina Basin Water Alliance  
**Reproduction of DAS Final Report  
Figure 5-6 Showing All Available Data**

# **Attachment 1**

## MEMORANDUM

To: Emily Gardner, Deputy General Manager, Salinas Valley Basin Groundwater Sustainability Agency  
[gardnere@svbgsa.org](mailto:gardnere@svbgsa.org)  
Abby Ostovar, PhD, Water Policy Specialist, Montgomery & Associates  
[aostovar@elmontgomery.com](mailto:aostovar@elmontgomery.com)

From: Robert H. Abrams, PhD, PG, CHg, Principal Consultant, aquilogic, Inc.

Date: February 2, 2024

**Subject: Comments on Deep Aquifers Study December 2023 Administrative Draft  
Project No.: 018-09**

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Aquilologic, Inc. (**aquilogic**) participates on the Salinas Valley Basin Groundwater Sustainability Agency's (SVBGSA) Groundwater Technical Advisory Committee (GTAC). Montgomery & Associates (M&A) has conducted a Study of the Deep Aquifers (Study) within the Salinas Valley Groundwater Basin (SVGB) and prepared an Administrative Draft of the Deep Aquifers Study (DAS) report. The GTAC was asked to review the Administrative Draft and provide comments. The Administrative Draft has not been provided to stakeholders or the public. This memorandum provides **aquilogic**'s comments on the Administrative Draft.

## INTRODUCTION

Our understanding is that the primary objectives of the Study included (1) compiling existing data and information regarding the Deep Aquifers; (2) identifying data gaps and collecting additional data; (3) defining the spatial extent of the Deep Aquifers; (4) estimating the Deep Aquifers water budget; (5) describing the current conditions of the Deep Aquifers in terms of groundwater quality and groundwater elevations; (6) commenting on risks to the Deep Aquifers and overlying land uses; and (7) discussing potential management guidance and monitoring recommendations for the Deep Aquifers.

The Administrative Draft represents a significant and laudable effort prepared by a competent team of technical investigators and experts. The Study provides the most complete compendium of knowledge to date regarding the Deep Aquifers. The Study also appears to have reasonably met the stated objectives and has provided new insights into the general understanding of the Deep Aquifers. Indeed, the Study's conclusions regarding unsustainable groundwater extractions may be entirely correct. It is clear to the reader that M&A wants to make definitive statements about groundwater conditions in the Deep Aquifers and remove the sense of uncertainty felt by many stakeholders.

However, in many ways the Administrative Draft reads as if it were written to confirm preconceived notions regarding the Deep Aquifers, particularly with regard to the water budget and the implications of groundwater elevation trends. Study findings are often stated as facts, without consideration of uncertainty. This implies certainty in the Study results when in fact significant uncertainty remains. The overuse of superlatives, certain adjectives and adverbs (e.g., best, all, clearly, strongly, serious), and the apparent confirmation bias cause the Administrative Draft to read more like an expert report of opinions for a civil action rather than an unbiased technical report.

For example, the Administrative Draft states that one of the purposes of the Study is to develop a “*scientifically accurate report*” (p. 16). At the risk of being pedantic, the scientific method can only be used to test hypotheses and either reject or not reject (accept) them; hypotheses cannot be proven, they can only be disproven. In the Administrative Draft, observed data that contradict a Study finding are often explained away instead of interpreting these data in terms of their support (or lack thereof) of an implied hypothesis.<sup>1</sup> In such cases, consideration and discussion of alternative hypotheses would be appropriate.

## POTENTIAL ANALYSES FOR FUTURE WORK

- Estimate how long it would take for the Deep Aquifers to recover if pumping from the Deep Aquifers were stopped.
- Estimate the rate of groundwater flow in the Deep Aquifers from Chualar and the Southeastern Extent to the northwest by conducting a sensitivity analysis on hydraulic conductivity in the Seawater Intrusion Model and the Salinas Valley Integrated Hydrologic Model.

## SPECIFIC COMMENTS ON TEXT AND FIGURES THAT SHOULD BE ADDRESSED PRIOR TO FINALIZING THE REPORT

This section of the memorandum provides specific comments on portions of the text and figures, identified by page and/or figure number. Most of the comments are presented as direct quotes (in italics) from the Administrative Draft followed by **aquilogic**’s response, with suggested changes in red text.

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<sup>1</sup> For example, p. 95 of the Administrative Draft states, “*In some recent years, there has been an observed increase in fall groundwater elevation measurements in multiple wells, despite a total increase in annual pumping. Data suggests this is due to variations in pumping at nearby extraction wells in the months immediately preceding the water level measurements.*” The implied hypothesis is that increased annual pumping has caused groundwater elevations to decrease. The “*observed increase in groundwater elevations at multiple wells*” does not support the implied hypothesis. The explanation that increasing groundwater elevations are due to antecedent pumping conditions at other wells is not supported by data presented or discussed in the Administrative Draft. It should be noted that on Figure 5-6 (page 98), four of the nine hydrographs presented (44%) show increasing groundwater elevations in recent years.

General comment: Add a map explicitly showing the locations of the four new Deep Aquifers wells. Provide total depth, depth of screened interval, and the geological formation sampled by the screened interval.

### Executive Summary

Page 4:

- *“The Southeastern Region is the inland or up valley portion of the Deep Aquifers, delineated just south of the City of Salinas.”*
  - Suggest changing this sentence to: “The Southeastern Region is the inland or up valley portion of the Deep Aquifers, delineated **just to about 20 miles** south of the City of Salinas.”
- *“The Deep Aquifers water budget developed for this Study provides the best estimates of groundwater entering and leaving the Deep Aquifers, and annual changes in groundwater storage.”*
  - Suggest rewording as: “The Deep Aquifers water budget developed for this Study provides **the best reasonable** estimates of groundwater entering and leaving the Deep Aquifers, and annual changes in groundwater storage, **based on currently available data and the results of several previous studies and this Study. These estimates are subject to revision as additional data are acquired and groundwater models are refined.**”

Page 5:

- *“Current water year 2022 groundwater extraction from the Deep Aquifers ranges from 13,700 AF from the true Deep Aquifers wells to 21,700 AF, with the difference being extraction from wells that are screened in the Deep Aquifers and overlying 400-Foot Aquifer.”*
  - 2020 groundwater extractions may be more appropriate, so that Figure ES-2 on page 8 aligns with the water budget depicted in Figure ES-1 on page 5.

Page 6:

- *“As pumping has increased in the Deep Aquifers, groundwater elevations in the Deep Aquifers have fallen below the overlying 400-Foot or equivalent aquifer, reversing the vertical gradient from upward to downward across most of the Northern and Seaside Regions of the Deep Aquifers.”*
  - Please clarify if the Deep Aquifers groundwater elevations have fallen below the 400-Foot or equivalent aquifer or if they have fallen below groundwater elevations in the 400-Foot or equivalent aquifer.

Page 10:

- “3. To prevent seawater intrusion from downward migration through the 400/Deep Aquitard or wells, maintain protective groundwater levels higher than the overlying 400-Foot or equivalent aquifer where intrusion is present.”
  - Same comment as above for Page 6.

### Definition of Deep Aquifers

Page 11:

- “Destroy wells that may facilitate seawater intrusion leakage into the Deep Aquifers if evidence of leakage is detected.”
  - Suggest changing this sentence to: “Destroy wells that may facilitate seawater intrusion leakage into the Deep Aquifers if evidence of leakage is detected **and the leakage can be demonstrated to have been caused by the well.**”

### Introduction

Page 13:

- “The slight rise in recent years is likely due to a reduction in pumping in certain wells in the months preceding these fall measurements; however, groundwater elevations continue to decline across most of the Deep Aquifers.”
  - Suggest changing this sentence to: “The slight rise in recent years **is may be** due to a reduction in pumping in certain wells in the months preceding these fall measurements **or increased recharge and subsurface inflow**; however, groundwater elevations continue to decline across **portions** of the Deep Aquifers.”

### Hydrogeological Conceptual Model

Page 15:

- “Downward migration of high-saline water through leaky wells could occur from the overlying 400-Foot or equivalent aquifer to the Deep Aquifers, like what has occurred from the 180-Foot Aquifer to the 400-Foot Aquifer.”
  - **Aquilologic** and others have shown that downward migration to the 400-Foot Aquifer is much more likely to occur through the 180/400-Foot Aquitard or through gaps in the aquitard than through leaky wells.
    - Suggest changing this sentence to: “Downward migration of high-saline water through leaky wells **or through the 400-Foot/Deep Aquitard (or gaps therein)** could occur from the overlying 400-Foot or equivalent aquifer to the Deep Aquifers, **which is analogous to groundwater**

migration that appears to have occurred from the 180-Foot Aquifer to the 400-Foot Aquifer.”

Page 16:

- *“The Study provides a basis for management based on science.”*
  - Suggest changing this sentence to: “The Study provides a basis for management based on **science currently available data and use of the scientific method.**”

Page 18:

- *“Existing data, Study-generated data, and previously published reports were synthesized to finalize the conceptual model of the Deep Aquifers.”*
  - Suggest changing this sentence to: “Existing data, Study-generated data, and previously published reports were synthesized to **finalize develop** the conceptual model of the Deep Aquifers.” (note, conceptual models are always subject to revision as new data are acquired).

Page 20, Figure 2-1:

- Is there an extra line in the second level of the flow chart? This line has does not have a Yes/No or an arrow.

Page 21:

- *“The Basin was formed in a tectonically active area on the eastern edge of the Pacific Plate and went through periods of structural changes of faulting, fracturing, and folding, as well as periods of marine and terrestrial sedimentation.”*
  - Please provide references for this sentence.
- *“The geologic formations that form the Deep Aquifers rarely outcrop on the land surface.”*
  - This statement is not accurate. According to geologic maps, there are many outcrops of the Paso Robles Formation in the Upper Valley Subbasin, as well as many outcrops south of Monterey County. Please modify this sentence.

Page 25:

- *“Some studies have shown different depths to the Basin bottom in specific areas; however, this is still the best comprehensive understanding of the bottom of the Basin.”*
  - Suggest changing this sentence to: “Some studies have shown different depths to the Basin bottom in specific areas; however, this is **the best-comprehensive most complete current** understanding of the bottom of the Basin.”

Page 29:

- *“This Study establishes the best approximation of the Deep Aquifers’ extent based on the definition of the Deep Aquifers presented above.”*
  - Suggest changing this sentence to: “This Study establishes **the best an** approximation of the Deep Aquifers’ extent **based-on consistent with** the definition of the Deep Aquifers presented above.”

- *“To delineate the extent, this Study integrates all available data, including well completion reports (WCRs) of 133 deep wells, basin structure from previous geologic reports, 2 previous AEM surveys, and 91 borehole e-logs.”*
  - Suggest changing this sentence to: “To delineate the extent, this Study integrates ~~all~~ known available data, including well completion reports (WCRs) of 133 deep wells, basin structure from previous geologic reports, 2 previous AEM surveys, and 91 borehole e-logs.”
- *“Then, AEM surveys and all data were integrated to produce the refined final Deep Aquifers extent presented here.”*
  - Suggest changing this sentence to: “Then, AEM surveys and ~~all~~ available data were integrated to produce the refined final Deep Aquifers extent presented here.”

Page 42, Figure 3-11:

- Except for the black-outlined arch superimposed on the AEM cross section, the Laguna Seca Anticline is not so clearly visible on Figure 3-11, as is stated in the text on Page 41. The location of the Laguna Seca Anticline on Figure 3-11 is an interpretation of the AEM data
- The location of this cross section should be shown on a map.

Page 44:

- *“To address this data gap, this Study aggregated all existing aquifer property data, extracted aquifer property estimates from regional numerical groundwater flow models for the Salinas Valley, and analyzed results of 2 additional aquifer tests of deep wells.”*
  - Suggest changing this sentence to: “To address this data gap, this Study aggregated ~~all~~ available existing aquifer property data, extracted aquifer property estimates from provisional regional numerical groundwater flow models for the Salinas Valley, and analyzed results of 2 additional aquifer tests of deep wells.”

Page 45:

- *“All available data are for wells in the coastal Deep Aquifers area, and they represent a variety of depth intervals with screen lengths ranging from 20 to more than 800 feet.”*
  - Suggest deleting the word “all.”
- Section 3.3.2 Aquifer Flow Properties
  - Please provide references for values given.

Page 46:

- *“All water quality samples of wells solely screened in the Deep Aquifers confirm MCWRA’s description of the groundwater being relatively low in calcium and high in sodium, particularly compared to the overlying 400-Foot or equivalent aquifer.”*
  - Suggest changing this sentence to: “~~All~~ Available water quality samples of wells solely screened in the Deep Aquifers confirm MCWRA’s description of the

groundwater being relatively low in calcium and high in sodium, particularly compared to the overlying 400-Foot or equivalent aquifer.”

Page 47:

- “No water chemistry data are available for deep wells within the Deep Aquifers extent south of Salinas or outside of the extent up-valley.”
  - Suggest providing an explanation of why water chemistry data south of Salinas were not collected as part of the Study – it is not clear why.

Page 48:

- “It shows the calcium is relatively high in 400-Foot Aquifer wells and comparatively low in Deep Aquifers wells. The plot also shows the 400-Foot Aquifer wells have relatively low sodium when compared to the Deep Aquifers wells that have relatively high sodium.”
  - Suggest changing these sentences to: “Although there is significant overlap in the water quality data for the 400-Foot Aquifer and the Deep Aquifers, ~~Figure 3-13~~ shows ~~the that~~ calcium is relatively higher in many 400-Foot Aquifer wells and comparatively lower in some Deep Aquifers wells. The plot also shows that many 400-Foot Aquifer wells have relatively lower sodium when compared to some Deep Aquifers wells that have relatively higher sodium.”

Page 50:

- “Additional samples are needed to verify this possible trend.”
  - Suggest changing this sentence to: “Additional samples are needed to ~~verify~~ evaluate this possible trend.”

Page 52 and Appendix E:

- Please provide ancillary information for these Stiff diagrams, e.g.:
  - Do they represent more than one sampling event?
  - What are the sampling dates of the water quality data shown in the various diagrams?

Page 60:

- “Appendix E shows the historical trend plots.”
  - I do not see historical trend plots in Appendix E.
- “Stable isotopes of oxygen-18 and hydrogen-2 in water ( $\delta^{18}O$  and  $\delta^2H$ ) are frequently used in hydrologic studies to identify groundwater sources.”
  - Please provide references for this sentence.

Figures 3-18 through 3-21:

- There is a significant amount of overlap between the data shown on the trilinear plots for the various regions and between the 400-Foot Aquifer and the Deep Aquifers. The inferences drawn from these plots are not very conclusive. Some kind of disclaimer should be added to the text. One could argue that the geochemical differences between regions and aquifers are not as pronounced as implied in the text.

Page 61:

- *“Although there is some overlap in stable isotopic composition between samples from the 2 aquifers and surface waters,  $\delta^{18}O$  and  $\delta^2H$  values in 400-Foot Aquifer and surface waters water tend to be greater (heavier) than about -7 ‰ and -46 ‰, respectively, using the Vienna Standard Mean Ocean Water (VSMOW) as a reference, and Deep Aquifers water tends to be less (lighter) than those values Figure 3-23.”*
  - Which part(s) of the Deep Aquifers have samples that are lighter or heavier?
- *“This suggests the Deep Aquifers either do not receive inflow or that any inflow received is from aquifers located at depths such that they are not experiencing surficial recharge.”*
  - This sentence lacks clarity. The water must have come from somewhere/sometime. Please clarify.
- *“The reason for isotopically heavier water to occur within the Deep Aquifers extent is unclear. The similar isotopic compositions could indicate a hydraulic connection between the aquifers, possibly through the perforated intervals of wells intercepting both aquifers; however, the data are not conclusive evidence of connection.”*
  - An alternative hypothesis is that the similar isotopic compositions are indicative of the fact that both the 400-Foot Aquifer and the Deep Aquifers are at least partially comprised of the Paso Robles Formation. Please include this hypothesis in the above discussion.

Page 63:

- *“Previous tritium and carbon-14 analyses of Deep Aquifers groundwater indicated that the water is old and recharged thousands of years before the present time (Hanson et al., 2002; MCWRA, 2017).”*
  - Suggest changing this sentence to: “Previous tritium and carbon-14 analyses of Deep Aquifers groundwater **samples collected from wells in the coastal area** indicated that the water is old and recharged thousands of years before the present time (Hanson et al., 2002; MCWRA, 2017).”

Page 64:

- *“Carbon-14 data for the Deep Aquifers is very limited.”*
  - Suggest changing this sentence to: “Carbon-14 data for the Deep Aquifers is very limited, **which makes it difficult to draw broad conclusions.**”

Page 66:

- *“Lack of surficial recharge is supported by the fact that isotope data indicate that Deep Aquifers water has long residence times and is thousands of years old. No surficial recharge of modern water to the Deep Aquifers is observed in the data, indicating no evidence of surficial water since 1953 entering the aquifer.”*
  - Suggest changing the above to: “**Based on limited data, the** lack of surficial recharge is supported by the fact that isotope data indicate that Deep Aquifers **near the coast** water has long residence times and **is has been in situ for**

thousands of years ~~old~~. The limited data suggest that little to no surficial recharge of modern water to the Deep Aquifers is observed in the data, indicating no evidence of surficial water since 1953 entering the aquifer.”

- “*Surficial outcrops of the formations that constitute the Deep Aquifers are located too far from the delineated extent of the Deep Aquifers to have an effect within a management timeframe.*”
  - Suggest changing this sentence as shown and appending the discussion with: “*Surficial outcrops of the formations that constitute the Deep Aquifers ~~are may be~~ located too far from the delineated extent of the Deep Aquifers to have an effect within a management timeframe. However, it should be noted that groundwater immediately upgradient of the Deep Aquifers may still provide significant inflow to the Deep Aquifers.*”

Page 67:

- “*However, since data do not show younger water in the Deep Aquifers in this region, this location of inflow is still unsupported.*”
  - Suggest changing this sentence to: “*However, since data do not show younger water in the Deep Aquifers in this region, the potential for this location ~~of inflow is still unsupported to provide~~ inflow remains unknown.*”
- “*However, there may be gaps that allow for hydraulic connection with the overlying aquifer, such as has been identified through the drilling of an oil well near Somavia Road (Thorup, 1976). Furthermore, the clays may allow for slow diffusion of water between the Deep Aquifers and overlying aquifer, as other investigators have hypothesized (MCWD GSA and SVBGSA, 2022). Slow diffusion could be significant if it occurs over a large area, and it likely would be variable at different locations across the Deep Aquifers extent.*”
  - This process likely also applies to downward migration from the 180-Foot Aquifer to the 400-Foot Aquifer and should be considered for the SVBGSA’s Seawater Intrusion Model.

Page 68:

- “*Additional tritium data from areas near Gonzales might also provide insight on possible recharge pathways related to the upgradient portions of the Deep Aquifers.*”
  - Suggest changing this sentence to: “*Additional tritium data from areas near Gonzales might also provide insight on possible ~~recharge subsurface inflow~~ pathways related to the upgradient portions of the Deep Aquifers.*”

## Water Budget

Page 69:

- *“Groundwater models are the best available tools for developing water budgets.”*
  - Suggest changing this to: *“Well-calibrated groundwater models are the best available tools for developing water budgets.”*

Page 72:

- *“Inflows to the Deep Aquifers are injection of surface or recycled water and subsurface inflows from the underlying Monterey Formation (from below), the overlying aquitard (from above), the ocean, and adjacent aquifers.”*
  - Suggest changing this sentence to: *“Inflows to the Deep Aquifers are injection of surface or recycled water and subsurface inflows from the underlying Monterey Formation (from below), the overlying aquitard (from above), ~~the ocean~~ adjacent aquifers, and potentially the ocean.”*
- *“Aerial and stream recharge are negligible compared to other components of the water budget and are an artifact of model layering, not actual flows.”*
  - Suggest changing this sentence to: *“Aerial and stream recharge are negligible compared to other components of the water budget and ~~are may be~~ an artifact of model layering, ~~not rather than~~ actual flows.”*
- *“Outflows from the Deep Aquifers include groundwater extraction and subsurface outflows to overlying and adjacent aquifers and to the ocean.”*
  - Suggest changing this sentence to: *“Outflows from the Deep Aquifers include groundwater extraction and subsurface outflows to overlying and adjacent aquifers, and potentially to the ocean.”*

Page 74:

- *“Figure 4-4 shows that the periods selected for the historical and recent periods include average precipitation at the Salinas Airport gage with a mix of wet and dry years.”*
  - Suggest appending this sentence with: *“Figure 4-4 shows that the periods selected for the historical and recent periods include average precipitation at the Salinas Airport gage with a mix of wet and dry years. However, it should be noted that two episodes of severe drought occurred during the historical and recent periods.”*

Page 78:

- *“The reported data only contains wells that are screened fully in the Deep Aquifers.”*
  - It is unclear why the same restriction cannot be used for the simulated data. A line could be added to Figure 4-6 that shows the more restricted simulated pumping.

Page 80:

- *“Similarly, simulated vertical gradients across the 400/Deep Aquitard do not always match estimated gradients based on observed water level data, and the SWI Model is potentially overpredicting the amount of groundwater flow exiting the Deep Aquifers into the overlying layers.”*
  - Suggest modifying this sentence to (break into two sentences): “Similarly, simulated vertical gradients across the 400/Deep Aquitard do not always match estimated gradients based on observed water level data. ~~and~~ The SWI Model is potentially overpredicting the amount of groundwater flow exiting the Deep Aquifers into the overlying layers, **but this is currently unknown.**”
- *“When additional monitoring data become available, the simulated distribution and magnitude of exchange between the Deep Aquifer and the 400-Foot or overlying Aquifer should be validated.”*
  - Suggest changing this sentence to: “When additional monitoring data become available, the simulated distribution and magnitude of exchange between the Deep Aquifer and the 400-Foot or overlying Aquifer **should may be validated clarified.**”

Page 81, Figure 4-7:

- Please explain why the annual change in storage is shown to increase between 2004 and 2006, but the cumulative change in storage is shown to be decreasing. Please include the 2009-2011 and 2016-2017 periods in the explanation. This pattern is repeated on Figures 4-8 and 4-9.

Page 85:

- *“Groundwater flow is entering from the south and west and exiting the Region into the Gabilan Range Bajada to the east and to the Northern Region of the Deep Aquifers to the north.”*
  - Suggest modifying this sentence (append two sentences) to: “Groundwater flow is entering from the south and west and exiting the Region into the Gabilan Range Bajada to the east and to the Northern Region of the Deep Aquifers to the north. **However, the flow volumes are uncertain because the associated aquifer parameters in the underlying models are not well-characterized. This uncertainty can be evaluated with a sensitivity analysis on hydraulic conductivity, which may show flow volumes are higher (or lower) than presented herein.**”
- *“A small amount of recharge and stream leakage occurs within this Region in portions of the Deep Aquifers that are exposed at the surface within the SVIHM.”*
  - Please indicate where geographically this occurs.

Page 87:

- *“The groundwater flows produced by the models used for this water budget analysis reflect the best conceptual understanding of the Deep Aquifers.”*
  - Please change this sentence to: “The groundwater flows produced by the models used for this water budget analysis reflect ~~the best~~ a reasonable conceptual understanding of the Deep Aquifers, ~~based on currently available data and models.~~”

### Historical and Current Conditions

Page 88:

- *“Reported extraction and injection, observed groundwater elevations, and groundwater quality strongly suggest current declining groundwater elevations in the Deep Aquifers pose serious risk of seawater intrusion or land subsidence.”*
  - Please explain how groundwater quality suggests a risk of seawater intrusion when no evidence of seawater intrusion has been detected by water quality sampling conducted in the Deep Aquifers.
  - Suggest changing this sentence to: “Reported extraction and injection, observed groundwater elevations, and groundwater quality ~~strongly~~ suggest current declining groundwater elevations in the Deep Aquifers ~~may~~ pose an ~~ongoing~~ risk of seawater intrusion or land subsidence.”
- *“Because the Deep Aquifers are a confined aquifer system, groundwater extraction and injection drive its groundwater elevation changes.”*
  - This sentence is unclear. Furthermore, subsurface inflow and outflow also drive groundwater elevation changes.

Page 90:

- *“As shown on Figure 5-2, the total extraction from the Deep Aquifers is between the pumping from just Deep Aquifers wells on the lower portion and the pumping from both Deep Aquifers wells and wells screened in both the 400-Foot and Deep Aquifers on the upper portion of this figure.”*
  - This sentence is unclear and difficult to decipher. Please break into two or more sentences and/or otherwise clarify.

Page 92:

- *“Given that extraction from wells screened in both the 400-Foot and Deep Aquifers only partially comes from the Deep Aquifers and cannot be separately quantified, this implies that current extraction from the Deep Aquifers is between 13,700 AF/yr and 21,700 AF/yr.”*
  - Suggest changing this sentence to: “Given that extraction from wells screened in both the 400-Foot and Deep Aquifers only partially comes from the Deep Aquifers and cannot be separately quantified, this implies that ~~current~~ 2022

extraction from the Deep Aquifers is between 13,700 ~~AF/yr AF~~ and a volume somewhat less than 21,700 ~~AF/yr AF~~.”

- PDF p. 106 (p. 98) Figure 5-6
  - As noted in the footnote on page 2 herein, four of the nine well hydrographs show flat or increasing groundwater levels for the last few years.

Page 10, Figure 5-8:

- It is problematic to draw conclusions from this one well screened in both the 400-Foot Aquifer and the Deep Aquifers. Furthermore, water levels rose between 2017 and 2020 and then started falling. Water levels at this well may be influenced by the two recent periods of drought.

Page 108, Figure 5-12:

- The following observations contradict earlier statements that groundwater elevations are currently declining across most of the Deep Aquifers. Seventy-five percent (three of four) of the Deep Aquifers well hydrographs shown on Figure 5-12 are stable or increasing since approximately 2019:
  - The upper left panel shows that water levels have stabilized in well 14S/02E-06L01 since approximately 2019.
  - The lower left panel shows that water levels have stabilized in well 14S/02E-33E01 since approximately 2018.
  - The upper right panel shows that water levels in well 14S/02E-28H04 are stable-to-increasing since approximately 2019.

Page 117:

- *“These low groundwater levels will either contribute to seawater moving towards the low groundwater elevations or will depressurize the clays that could cause subsidence.”*
  - Suggest changing this sentence to: “These low groundwater levels ~~will either~~ **may** contribute to seawater moving towards the low groundwater elevations or ~~will~~ **may** depressurize the clays that could cause subsidence.”

## Management Guidance

Page 121:

- *“Groundwater levels in the Deep Aquifers are at new lows, and there is now a downward vertical hydraulic gradient in parts of the Deep Aquifers.”*
  - Suggest changing this sentence to: “**Some** groundwater levels in ~~the~~ Deep Aquifers **wells** are at new lows, and there is ~~now~~ a downward vertical hydraulic gradient in parts of the Deep Aquifers.”

Page 122:

- *“Results from analyzing existing data as part of the preliminary investigation indicate that the Deep Aquifers are likely hydraulically connected to the overlying 400-Foot Aquifer and surrounding aquifers.”*

- Suggest changing this sentence to: “Results from analyzing existing data as part of the preliminary investigation indicate that the Deep Aquifers are likely hydraulically connected to the overlying 400-Foot Aquifer and surrounding aquifers, **which may facilitate groundwater flow.**”
- *“Existing monitoring shows that current groundwater level declines are unsustainable.”*
  - Suggest changing this sentence to: “Existing monitoring **data** shows that **some** current groundwater level declines **are may be** unsustainable.”
- *“This Study has shown that current extraction of the Deep Aquifers is not sustainable, and will lead to undesirable results such as declining groundwater levels, land subsidence, and seawater intrusion.”*
  - This conclusion is not supported by the Study and evidence presented. Suggest changing this sentence to: “This Study has shown that current extraction **is not from some** Deep Aquifers **wells may not be** sustainable, and **may** lead to undesirable results such as declining groundwater levels, land subsidence, and seawater intrusion.”

Page 123:

- *“The Study recommends separating management between the Seaside Region and Northern Region based on distinct water chemistry...”*
  - As noted previously, much of the water chemistry is not so distinct between regions and overlaps with the water chemistry of other regions and aquifers. Compare Figures 3-18 and 3-19.

Page 124:

- *“It is impossible to know when subsidence will occur...”*
  - Suggest changing this clause to: “It is impossible to know **if and** when subsidence will occur...”

Page 125:

- *“The Northern and Seaside Regions have declining groundwater elevations that indicate current extraction is not sustainable.”*
  - Suggest changing this sentence to: “**Some wells in** the Northern and Seaside Regions have declining groundwater elevations, ~~that~~ **which may** indicate current extraction is not sustainable.”

Page 126:

- *“As the current conditions show, current net extraction is not sustainable in the Northern and Seaside Regions, with net extraction meaning injection and extraction combined.”*
  - Suggest changing this sentence to: “As **some** current conditions show, current net extraction **is may not be** sustainable in the Northern and Seaside Regions, with net extraction meaning injection and extraction combined.”

Page 127:

- *“Numerous factors influence groundwater elevations’ response to injection and extraction, such as variation in hydraulic conductivities within zones in the Deep Aquifers, presence of clay layers, and concentration of injection or extraction wells.”*
  - Suggest changing this sentence to: “Numerous factors influence groundwater elevations’ response to injection and extraction, such as variation in hydraulic conductivities within zones in the Deep Aquifers, presence of clay layers, and **concentration density** of injection or extraction wells.”
- *“Groundwater conditions of the Deep Aquifers continue to degrade as extraction and outflows exceed subsurface inflows into the aquifer system.”*
  - Suggest changing this sentence to: “Groundwater conditions of the Deep Aquifers continue to degrade **in some areas as-because** extraction and outflows **may** exceed subsurface inflows into the aquifer system.”

### Monitoring Recommendations

Page 13, Figures 7-1 and Figure 7-2

- The data gap south of Salinas is much larger than implied by the small oval near the Chualar well. Please expand the oval showing the data gap area.

Page 138:

- *“Stable isotope data from adjacent aquifers could help provide insight on relationships with the Deep Aquifers, particularly from the Eastside alluvial fans, El Toro Primary Aquifer System in the Corral de Tierra Management Area, and areas of the Seaside Subbasin that are outside of the Deep Aquifers extent.”*
  - Suggest changing this sentence to: “Stable isotope data from adjacent aquifers could help provide insight on relationships with the Deep Aquifers, particularly from the Eastside alluvial fans, El Toro Primary Aquifer System in the Corral de Tierra Management Area, and areas of the Seaside Subbasin **and southeast of Salinas** that are outside of the Deep Aquifers extent.”