Valley Water

MEMORANDUM

FC 14 (08-21-19)

TO: Vanessa De La Piedra
Groundwater Unit Manager

FROM: George Cook
Chanie Abuye

SUBJECT: Staff Evaluation of Request to Modify Groundwater Benefit Zone W-2 to Exclude Well 08S02E31E014

DATE: September 27, 2022

SUMMARY:

This memorandum summarizes the staff evaluation of the petition to modify Groundwater Benefit Zone W-2 to exclude well 08S02E31E014 (Attachment 1). The petition was filed by the property owners Jennifer & Chris Morris for a well that is used for water supply on their property (Figure 1).

Well Owner: Jennifer and Chris Morris
APN: 708-39-012
Well umber: 08S02E31E014
Address: 21392 Tierra Grande Ct, San Jose, CA 95120
Well Location: Southeast corner of parcel

The petition for exclusion from Zone W-2 notes that:

- The well does not pull water from a Valley Water aquifer as the well is 500 feet deep and is in shale.
- The 2020 revision to the Zone W-2 boundary removed their neighbor's well, which is only 250 feet away.

As described below, staff recommends that the petition to modify the Zone W-2 boundary to exclude Well 08S02E31E014 be denied since the well benefits from Valley Water activities.

INFORMATION REVIEWED:

Information provided by well owner (Attachment 2):

- Well log
- July 10, 2000 pump report
- February 15, 2013 pump test (for neighbor's well approximately 50 feet south of subject well)
- May 27, 2021 water quality testing results

Valley Water information:

- Groundwater Benefit Zone Study, Santa Clara County, California prepared for Valley Water by Montgomery & Associates, December 2020
- 9 well logs from nearby wells
- Geologic maps
- Water quality sampling results from Well 08S02E31E014, other wells, and Calero Creek

BACKGROUND

According to District Act § 26, "The board shall have the power, in addition to the powers enumerated elsewhere in this act, to levy and collect a groundwater charge for the production of water from the groundwater supplies within a zone or zones of the district which will benefit from the recharge of underground water supplies or the distribution of imported water in such zone or zones."

The current groundwater benefit zones became effective in July 2020 following completion of a multi-year Groundwater Benefit Zone Study (Study). The Study was an independent, science-based, comprehensive review of the zones and their boundaries.

As defined in the Study, a groundwater benefit zone includes any area within Valley Water's legal jurisdiction where any of the following criteria are met:

- A Valley Water activity provides water supply
- Valley Water activities improve groundwater supply reliability
- Valley Water activities prevent or limit land subsidence
- Valley Water activities reverse or control salt water intrusion
- Valley Water activities improve or maintain groundwater quality
- Valley Water activities improve groundwater levels

The Study was based on the premise that benefits from Valley Water activities extend throughout areas connected by groundwater flow in similar geologic deposits (called hydrogeologically connected areas). The hydrogeologically connected areas are generally defined as the areas in the valley floors overlying alluvium (permeable sediments deposited by streams), excluding bedrock of the adjacent mountain ranges. Groundwater generally flows through the alluvium until encountering bedrock or other hydrogeologic boundaries, so continuous areas of alluvium are generally hydrogeologically connected.

The extent of the hydrogeologically connected areas is based on the regional mapping of alluvium by the U.S. Geological Survey (USGS). Given the large areas covered by these maps, they are generally based on non-site-specific data such as aerial photographs and topographic maps. In adopting the zone boundaries, Valley Water was conservative in accounting for mapping error or inconclusive evidence to minimize the possibility of including wells that do not benefit from Valley Water activities within a zone. Therefore, it is likely that some wells near the basin margins that benefit from Valley Water activities were excluded from the zones.

Well owners can request a modification of the zone boundaries if they believe they are not benefitting from Valley Water groundwater management activities. A modification request process is warranted due to the uncertainties associated with the regional mapping and changes in Valley Water activities that can occur over time. To support granting such a request, Valley Water should have convincing evidence that supports the petitioner's belief that there is no benefit to their well from Valley Water activities.

EVALUATION

Well 08S02E31E014 is located at the south end of the Almaden Valley (Figure 1), within the Santa Clara Plain groundwater management area of the Santa Clara Subbasin and Zone W-2. The parcel is located adjacent to Calero Creek and is underlain by alluvium (Figure 2). As the Study was based on regional mapping and did not consider site specific information and the parcel's location within 200 feet of the zone boundary, a more detailed review of the area is warranted.

The staff evaluation focused on available well logs, geologic mapping, and water quality sampling as described below. Other information provided by the petitioner was reviewed but was not determined to be conclusive in assessing potential benefit.

Well Logs

The well log for well 08S02E31E014 (Attachment 2) indicates alluvium in the upper 55 feet of the well. The well is screened from 60 to 430 feet, with the total depth of the well at 430 feet. According to the well log, the well screen is entirely within bedrock, indicating the well is not drawing water directly from alluvium.

Staff reviewed nine available well logs within a quarter mile of the petitioner's property (Figure 3). This review found that well 08S02E31E014 was representative of the lithology and construction of most wells in the vicinity. The two most northeastern wells in the area differ from well 08S02E31E014 in that 25% or more of the well screen is within the alluvium. Six wells, including well 08S02E31E014, are screened entirely in bedrock. One well, which has reported no pumping since 2013 and is adjacent to the Morris parcel, is screened entirely within the alluvium according to the well log. This apparent outlier could be the result of geologic variation or a poor quality well log at this well or other wells.

Hydrogeologic Connection

The Morris parcel (708-39-012) and the surrounding area is underlain by alluvium (Figure 3). This alluvium benefits from Valley Water managed recharge activities through releases to Calero Creek from Calero Reservoir. Calero Creek runs along the western edge of the Morris parcel. The hydrogeologic connection between the creeks and groundwater in this area can be evaluated by comparing hydrographs from stream gages on Calero Creek and Alamitos Creek with Valley Water monitoring well 08S02W25N003 (Figure 4). The stream gages on Calero Creek and Alamitos Creek are upgradient and downgradient, respectively, of Valley Water monitoring well 08S02W25N003. The variability in stage level of the creeks and water levels of well 08S02W25N003 is very similar, with groundwater levels responding quickly to changes in creek stage (Figure 5). This indicates that streamflow from the creeks infiltrates the streambed, recharges the alluvium, and thus affects water levels in the monitoring well. Well 08S02W25N003 is approximately 1 mile northwest of well 08S02E31E014 and is slightly more distant from Calero Creek. Water level data are not available for well 08S02E31E014 or other deep wells in this area to more directly assess potential water level changes related to Valley Water activities.

Although it is clear the alluvium is benefitting from Valley Water managed recharge activities, the alluvium appears to be fairly thin in the area (Figure 3). Well 08S02E31E014, like most other wells in the area, is screened in (drawing groundwater from) bedrock. Groundwater flows in bedrock through fractures. Where these fractures are present and connected to the alluvium, the bedrock benefits from Valley Water managed recharge activity in the area through vertical flow from the alluvium into bedrock. If the wells are drawing groundwater from bedrock fractures not connected to the alluvium, the wells would not be receiving this benefit.

Water Quality Sampling

Valley Water collected water samples from Calero Creek and four wells on June 13, 2022 to support the evaluation of whether well 08S02E31E014 is benefiting from Valley Water managed recharge activities. Information on the sampling points is presented in Table 1 and the locations are presented in Figure 4. Two wells (08S01E36A014 and 8S01E25N003) were selected to represent relatively shallow groundwater, with well depths ranging from 40 to 65 feet, and two wells (08S02E31E014 and 08S01E36C009) were selected to represent relatively deep groundwater, with well depths ranging from 430 to 480 feet. These wells within the area of interest were selected to facilitate comparison of water quality between shallow groundwater, which benefits from Valley Water managed recharge activities (based on clear connection between creek and well hydrographs), and deeper groundwater (from wells primarily screened in bedrock) where this benefit is less certain based on previously existing data.

Water quality analyses conducted included testing for Volatile Organic Compounds (VOCs), Personal Care Products and Pharmaceuticals (PCPPs), major and minor ions, nutrients, trace metals, and stable isotopes of water (oxygen (oxygen-18) and hydrogen (deuterium)). These analyses were conducted for all well and creek samples, except PPCPs which were analyzed only at Well 08S02E31E014. These analyses were selected for the following purposes:

- VOCs and PCPPs: Most of these compounds are manmade and do not occur naturally. The presence of these compounds in bedrock groundwater would indicate a connection to the water within the alluvium because most of these manmade compounds are derived from sources at land surface or the shallow subsurface within the alluvium (e.g., septic systems or underground tanks).

Major and minor ions, nutrients, and trace metals: These analyses are used to compare water quality between the shallow and deeper bedrock groundwater. Additionally, some of these parameters, such as nitrate and boron, are associated with septic system discharges. In this area, septic systems are generally located within the alluvium.

- Stable isotopes of water (oxygen-18 and deuterium): The isotopic ratio of oxygen-18 and deuterium in precipitation follows a geographic pattern, with heavier isotopes becoming depleted further inland. This occurs because water with lighter isotopes tends to evaporate from the ocean, forming clouds. Condensation of water molecules in the clouds with the heavier isotopes tend to fall first as precipitation. As the clouds lose the heavy isotopes and move further inland, lighter isotopes fall in greater proportion. Therefore, water imported from the inland Sierra Nevada Range (used by Valley Water for managed recharge) can have a different, possibly lighter, isotopic signature and thus be used to differentiate it from local runoff also used for managed recharge in Santa Clara County[1].

Isotope analyses were performed by the University of Waterloo. All other analyses were completed by Valley Water's water quality laboratory. Table 2 presents the water quality results for all parameters that were detected and the regional median concentrations for the Santa Clara Plain for comparison. Table 3 presents data for oxygen-18 and deuterium for the June 2022 sampling event and regional values for the Santa Clara Plain[1].

The complexity of groundwater flow and the mixing of groundwater with varying sources and water quality have inherent uncertainty. The use of multiple lines of evidence, including isotopes and geochemical modeling, in evaluating this data helps to reduce the uncertainty in the conclusions that may be drawn.

Table 1. Summary of Water Quality Sampling Locations

Well ID	Well Depth (feet below ground surface)	Well Screen (feet below ground surface)	Screened Interval Lithology
08S01E36A014	40	20-40	20-40: Shale, some gravel
08S01E25N003	65	21-60	20-46: Clay/Gravel 46-47: Blue rock 47-59: Clay/Gravel 59-93: Bedrock
08S02E31E014 (Morris well)	430	60-430	55-80: Serpentinite 80-123: Hard rock with serpentinite fractures 123-175: Shale 175-500: Serpentinite with small streaks of shale/soapstone
08S01E36C009	480	80-480	69-215: Clay and shale 215-309: Claystone 309-460: Very hard bedrock/clay/shale 460-500: Claystone with shale
Calero Creek	NA	NA	NA (surface water sample collected at Morris property)

Note: Lithology was obtained from the well logs.

[1] Newhouse, M.W., Hanson, R.T., Wentworth, C.M., Everett, R.R., Williams, C.F., Tinsley, J.C., Noce, T.E., and Carkin, B.A., 2004, Geologic, water-chemistry, and hydrologic data from multiple-well monitoring sites and selected water supply wells in the Santa Clara Valley, California, 1999–2003: U.S. Geological Survey Scientific Investigations Report 2004–5250, 134 p.

Table 2. Water Quality Sampling Results

Parameter	Unit	Surface Water	Shallow Groundwater		Deep Groundwater		Santa Clara Plain Median	
		Calero Creek	08S01E25N003	08S01E36A014	08S01E36C009	08S02E31E014	Shallow	Principal
$\delta^{18}O$		-5.16	-5.90	-5.75	-6.34	-6.23	--	--
$\delta^{2}H$		-43.59	-45.47	-47.16	-43.51	-45.77	--	--
Aluminum	ug/L	34	34	23	390	23	<20	<50
Barium	ug/L	56	190	110	310	420	130	116
Bicarbonate (as HCO3)	mg/L	169	212	172	299	297	339	250
Bicarbonate Alkalinity (as CaCO3)	mg/L	138	174	141	245	244	278	225
Boron	ug/L	209	407	177	1,880	8,530	162	135
Bromide	mg/L	0.26	0.26	0.24	0.53	0.37	0.20	0.14
Calcium	mg/L	36.4	38.8	34.1	59.4	13	68	69
Calcium AS CaCO3	mg/L	90.9	96.9	85.2	148	32.4	171	140
Chloride	mg/L	73	60	70	233	92	57	47
Chromium	ug/L	1	<1	<1	6.8	<1	1	<1
Conductivity (VW/Waterloo)	uS/cm	598/617	600/598	606/628	1,360/1,369	806/901	736	655
Copper	ug/L	<1	7.2	<1	6	1.3	0.85	<5
Dilantin	ng/L	NA	NA	NA	NA	1.13	--	--
Fluoride	mg/L	0.16	0.44	0.17	2.22	0.72	0.16	0.12
Hardness	mg/L	164	233	203	<10	74	359	282
Iron	ug/L	47	740	1200	1,200	40	6	10.1
Lead	ug/L	<1	<1	<1	1.7	<1	<1	<5
Magnesium	mg/L	21.1	37.1	31.5	55.1	10.6	43	26
Manganese	ug/L	4.1	218	12.6	40.3	5.9	2.7	<20
Nickel	ug/L	3.1	1.3	1.5	10.6	1.6	0.77	<10
Nitrate as Nitrogen	mg/L	0.22	0.51	0.36	0.72	<0.1	2.2	2.8
pH	ug/L	7.89	7.62	6.98	8.2	7.71	--	7.58
Phosphate, Ortho (as PO4)	mg/L	0.39	<0.1	<0.1	<0.1	<0.1	0.11	0.13
Potassium	mg/L	3.5	0.7	1.4	1.9	1.2	1.4	1.5
Silica	mg/L	16.2	24.1	20.8	22.8	16.3	28	28
Silicon	mg/L	7.6	11.3	9.7	10.7	7.6	13	13
Sodium	mg/L	59.1	32.6	42.9	137	165	39	32
Sucralose	ng/L	NA	NA	NA	NA	128	--	--
Sulfate	mg/L	38.9	33.5	44.1	30.7	12.4	57	41
Total Alkalinity (as CaCO3)	mg/L	138	174	141	245	244	278	220
Total Coliforms	MPN/100mL	NA	NA	13.4	<1	<1	--	--
Total Dissolved Solids	mg/L	342	348	368	768	500	465	408
Turbidity	NTU	1.4	5.4	1.5	24	0.7	0.19	0.23
Vanadium	ug/L	1.4	<1	2	4.1	<1	1.7	1.9
Zinc	ug/L	<10	60	17	17	<10	<10	<50

Notes:

Table includes all parameters with at least one (1) detection

δ = delta; based on ratio of stable isotopes in the sample divided by the ratio of stable isotopes in an internationally recognized standard known as Vienna Standard Mean Ocean Water

ug/L = micrograms per Liter

mg/L = milligrams per Liter

uS/cm = microSiemens per centimeter

ng/L = nanograms per Liter

MPN/100ml = Most Probable Number per 100 milliliters

NTU = Nephlometric Turbidity Units

Table 3. Isotope Sampling Results

Source	δ^2H (Deuterium)	$\delta^{18}O$ (Oxygen-18)
Santa Clara County Regional Values[1]		
Imported Surface Water	-74	-10.2
Local Runoff	-40	-6
Native Groundwater	-41	-6.1
Monitoring Wells	-64 to -41.1	-8.3 to -6.1
Water Supply Wells	-57.7 to -40.1	-6.1
June 2022 Sample Results		
Calero Creek	-43.59	-5.16
Shallow Groundwater	-47.16 to -45.47	-5.90 to -5.75
Deep Groundwater	-45.77 to -43.51	-6.34 to -6.23

Water Quality Evaluation

VOCs were not detected in any of the samples. Two PPCPs were detected in well 08S02E31E014; dilantin, an anti-seizure medication, and sucralose, an artificial sweetener. The source of these two compounds, neither of which is naturally occurring, is likely through septic system discharges into shallow groundwater. The presence of PPCPs in the groundwater sampled from well 08S02E31E014 is notable since both are manmade compounds. The most likely source is overlying or upgradient septic systems. Because septic systems discharge to the shallow groundwater in the alluvium, the presence of these compounds in well 08S02E31E014 indicates that the well (although screened in bedrock) is connected to the shallow groundwater within the alluvium. This indicates that Valley Water activities to recharge the alluvium have a connection and benefit to well 08S02E31E014.

Graphical representations of water chemistry were prepared using the results from the five samples (Figure 6). These diagrams show a strong similarity between the Calero Creek sample and the two shallow groundwater wells (08S01E36A014 and 08S01E25N003), demonstrating the connection between surface water and the shallow groundwater. Figure 6 indicates differences between the shallow and deep groundwater, which are expected due to different geologic materials. Deep well 08S01E36C009 groups similarly to shallow groundwater and Calero Creek. Well 08S02E31E014 plots apart from other samples, primarily due to a much higher amount of sodium. The source of elevated sodium is unknown and could relate to local geologic materials or manmade source such as septic system discharges. Otherwise, the other anions and cations are relatively similar between the five samples.

To further evaluate potential mixing between the shallow and deep groundwater, Valley Water conducted geochemical modeling using PHREEQC[2], a widely used computer program developed by the USGS that can help determine the origin of groundwater[3]. For this modeling, two initial waters were selected to represent possible end members of the origin of well 08S02E31E014 groundwater: surface water recharging the Santa Clara Subbasin (represented by the Calero Creek sample) and groundwater from bedrock underlying the subbasin (represented by deep well 08S01E36C009). The modeling was used to estimate the mixing fraction (or percentage) of the two initial waters[4] that may be in well 08S02E31E014. Results show that well 08S02E31E014 groundwater is a mixture of about 60 to 100% Calero Creek water and 0 to 40% bedrock groundwater. These results suggest that groundwater

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[2] Parkhurst, D.L., and Appelo, C.A.J., 2013, Description of input and examples for PHREEQC version 3—A computer program for speciation, batch-reaction, one-dimensional transport, and inverse geochemical calculations: U.S. Geological Survey Techniques and Methods, book 6, chap. A43, 497 p., available only at https://pubs.usgs.gov/tm/06/a43/.

[3] Merkel, B. and Planer-Friedrich, B., 2008, Groundwater geochemistry – A practical guide to modeling of natural and contaminated aquatic systems, Springer, 230 p., ISBN: 978-3-540-74667-6.

[4] Zhu, C., and Anderson, G., 2002, Environmental applications of geochemical modeling, Cambridge University Press, 284 p.

in well 08S02E31E014 is strongly influenced by water recharging and flowing through the Santa Clara Subbasin, with relatively smaller input from the bedrock.

The isotopic composition of the Calero Creek sample indicates a relatively higher proportion of the heavier isotopes compared to the groundwater and prior imported water samples. This might indicate the source of the Calero Creek water is local surface water captured from the more recent hydrologic events. The similar isotopic composition of well 08S02E31E014 and other nearby groundwater wells may indicate that the source of groundwater recharge is the same as the other wells in the area. The isotopic composition of groundwater appears to be slightly more depleted of the heavier isotopes than the Calero Creek sample. This could be due the influence of imported water from past recharge, but additional study would be necessary to draw any conclusions.

Recommendations

Based on the information provided by the petitioner, water quality sampling, and other available data, staff recommends that the petitioner's request be denied, and the boundary of Zone W-2 remain as currently adopted.

The recommendation to deny the petition is based on the following rationale:

- Groundwater in the alluvium in the area surrounding well 08S02E31E014 is benefiting from Valley Water managed recharge activities along Calero Creek. This is demonstrated by the quick response of groundwater levels in the alluvium to the flow in Calero Creek.
- While well 08S02E31E014 is screened in bedrock, it is connected to the shallow groundwater in the alluvium. This is demonstrated by the presence of dilantin (an anti-seizure medication) and sucralose (an artificial sweetener) in the groundwater sample from well 08S02E31E014. These are manmade compounds that are not naturally occurring, likely originating from septic system discharges. These compounds would not be found in older groundwater that is not connected shallower, more recent groundwater in the alluvium.
- Although there are some differences in the general water quality, particularly in the amount of sodium, water quality is generally similar between shallow and deeper groundwater. This is also supported by geochemical modeling that suggests a significant portion of the groundwater in well 08S02E31E014 is from Calero Creek and the alluvium.

In summary, available evidence supports the conclusion that Well 08S02E31E014 is benefiting from Valley Water managed recharge activities and that the existing boundary of groundwater benefit zone W-2 should not be modified.

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Figures:

Figure 1. Well Location
Figure 2. Site Geologic Setting
Figure 3. Well Construction for Well 08S02E31E014 and Nearby Active Wells
Figure 4: Hydrographs from Well 08S02W25N003 and Stream Gages on Calero Creek and Alamitos Creek.
Figure 5: Sample Location Map
Figure 6: Piper and Schoeller Diagrams
Figure 7: Stable Isotopes in Santa Clara Subbasin

Attachments:

Attachment 1. Groundwater Benefit Zone Exemption Petition
Attachment 2. Information Provided by Petitioner

cc: G. Williams, A. Baker, C. Narayanan

Figure 1: Well Location

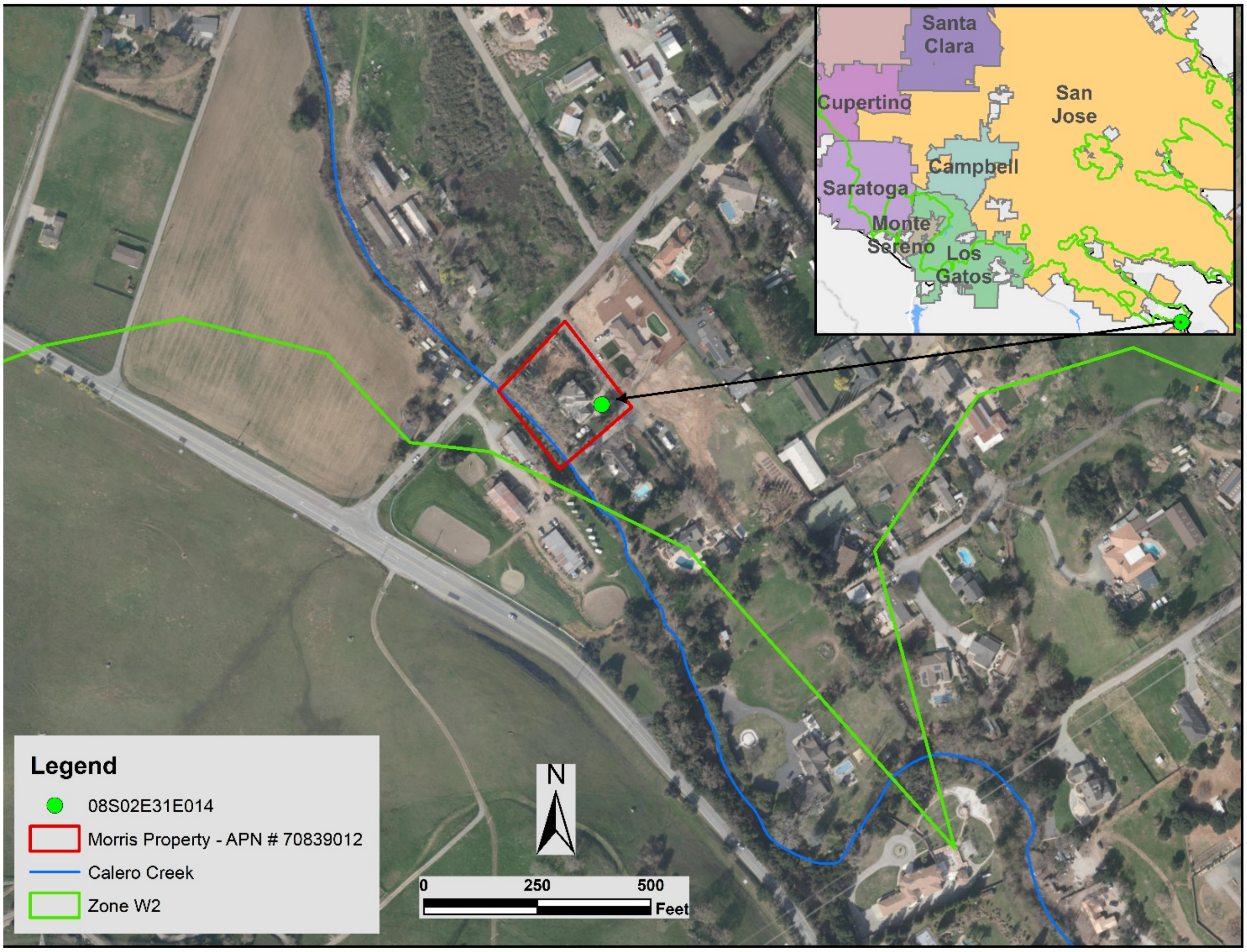
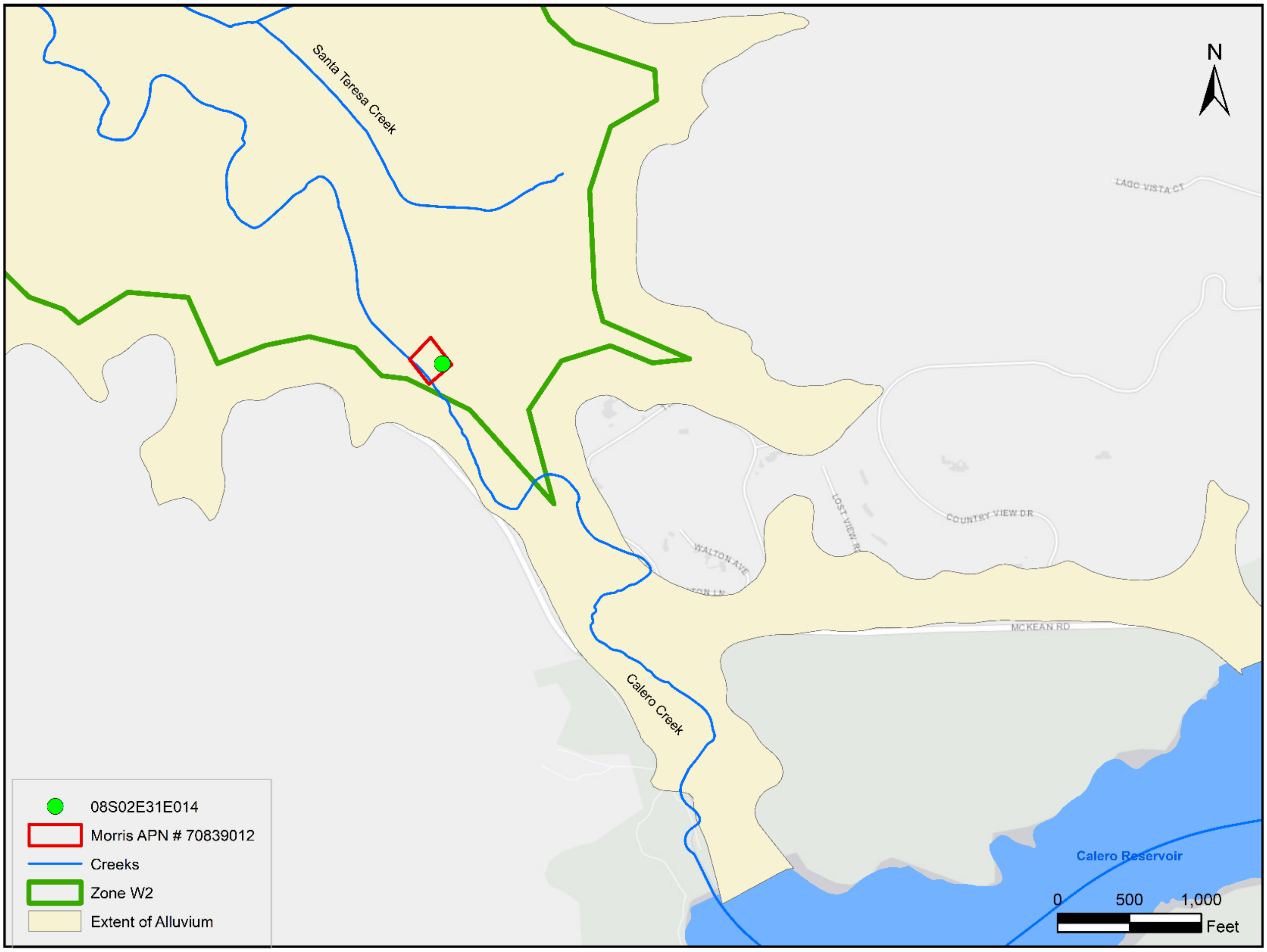
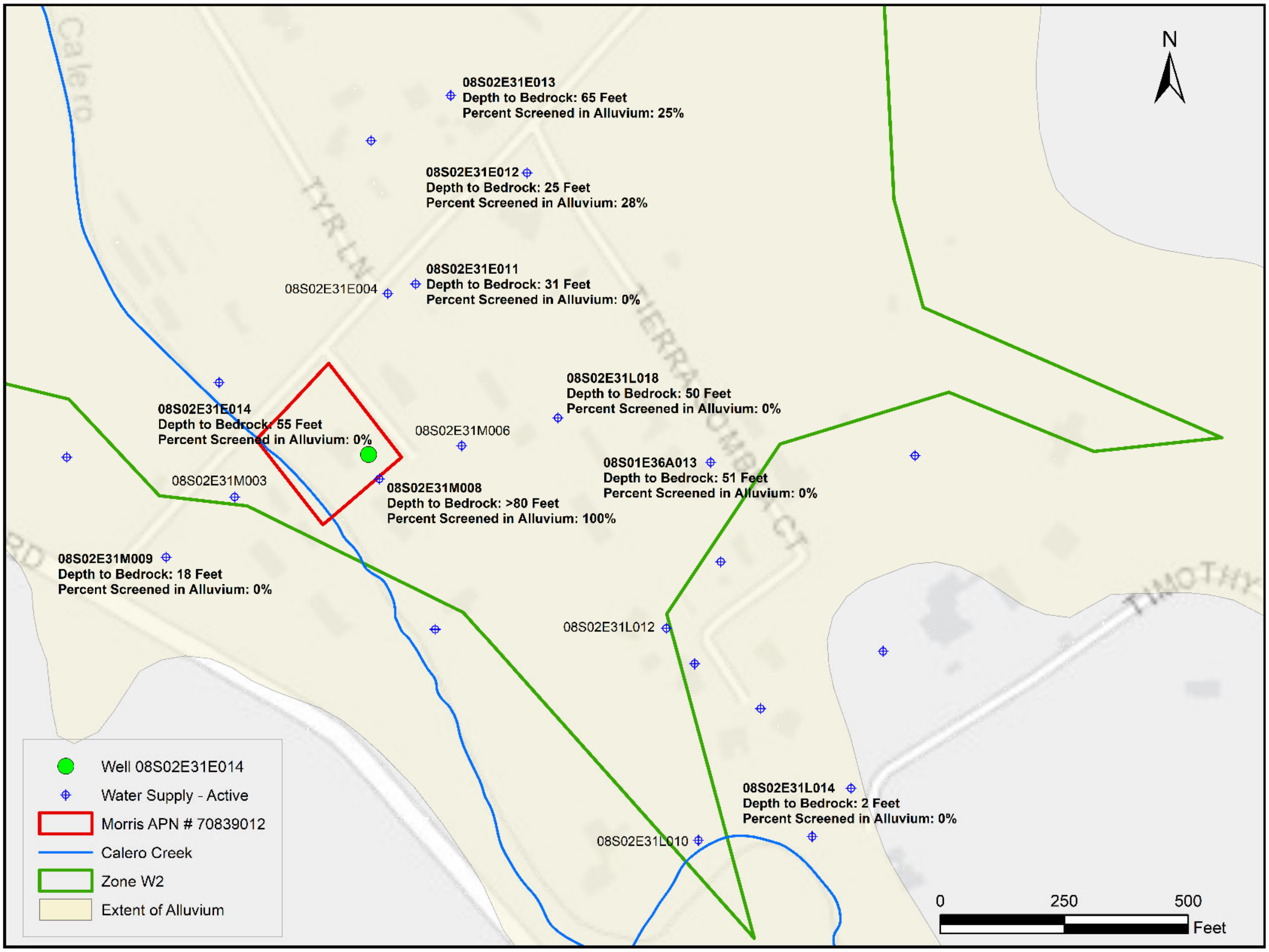


Figure 2. Site Geologic Setting



Note: Extent of alluvium from the Groundwater Benefit Zone Study, based on U.S Geological Survey mapping.

Figure 3. Well Construction for Well 08S02E31E014 and Nearby Active Wells



Note: Well construction shown is based on well logs. Extent of alluvium shown is from the Groundwater Benefit Zone Study, based on U.S Geological Survey mapping.

Figure 4: Map of Stream Gages and Wells Sampled

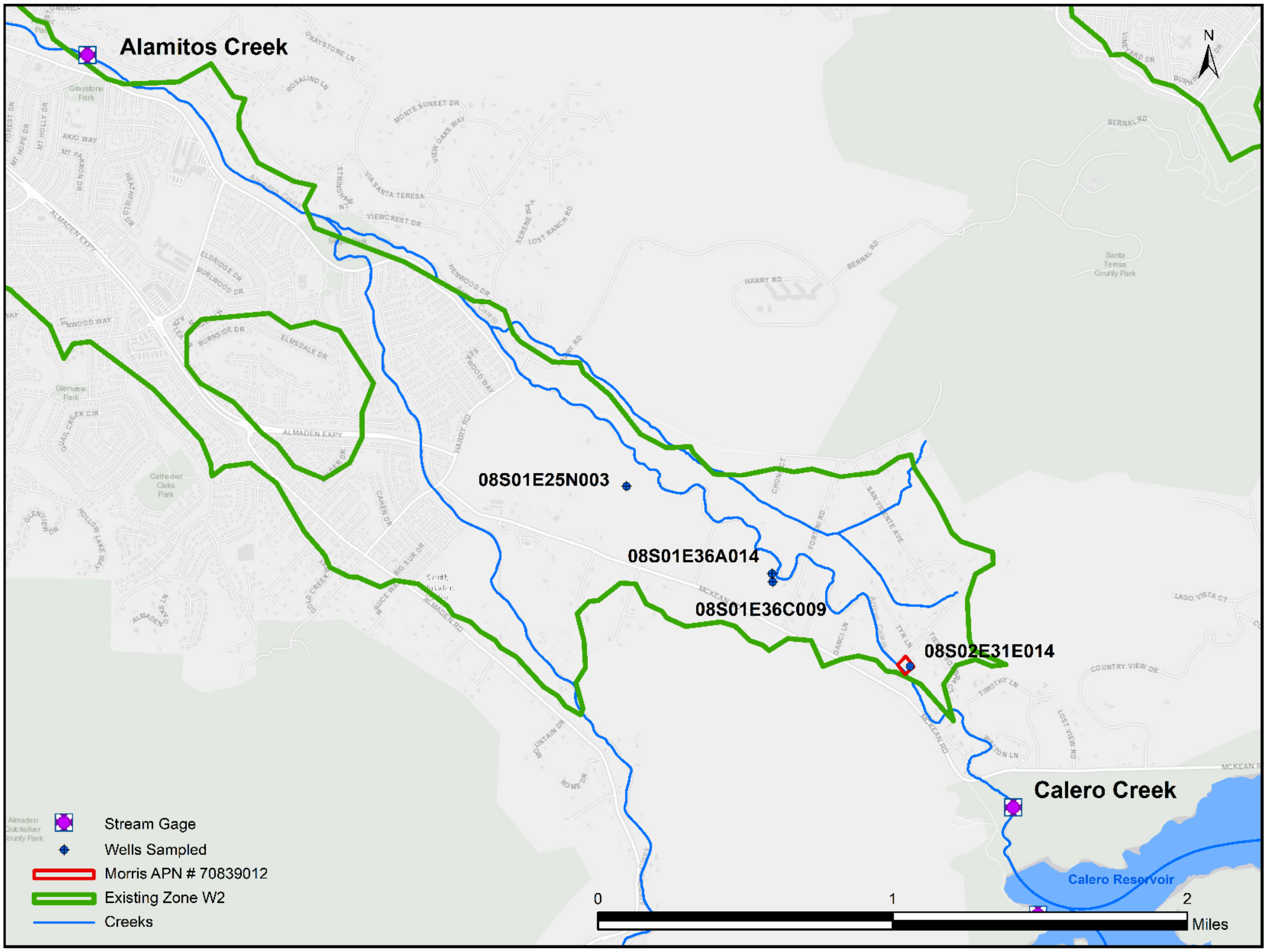


Figure 5: Hydrographs from Well 08S02W25N003 and Stream Gage on Calero Creek.

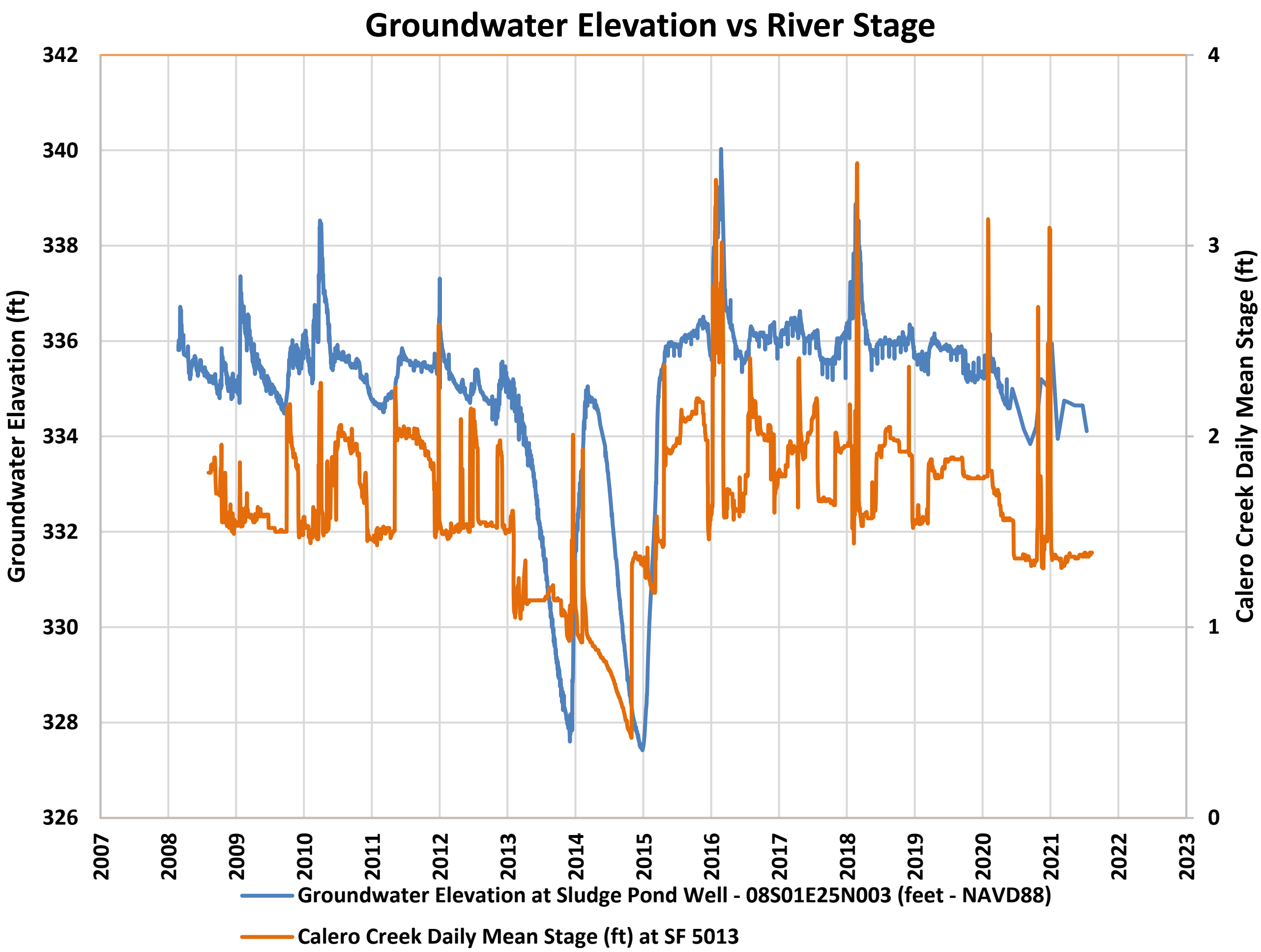


Figure 5 (Cont.): Hydrographs from Well 08S02W25N003 and Stream Gage on Alamitos Creek.

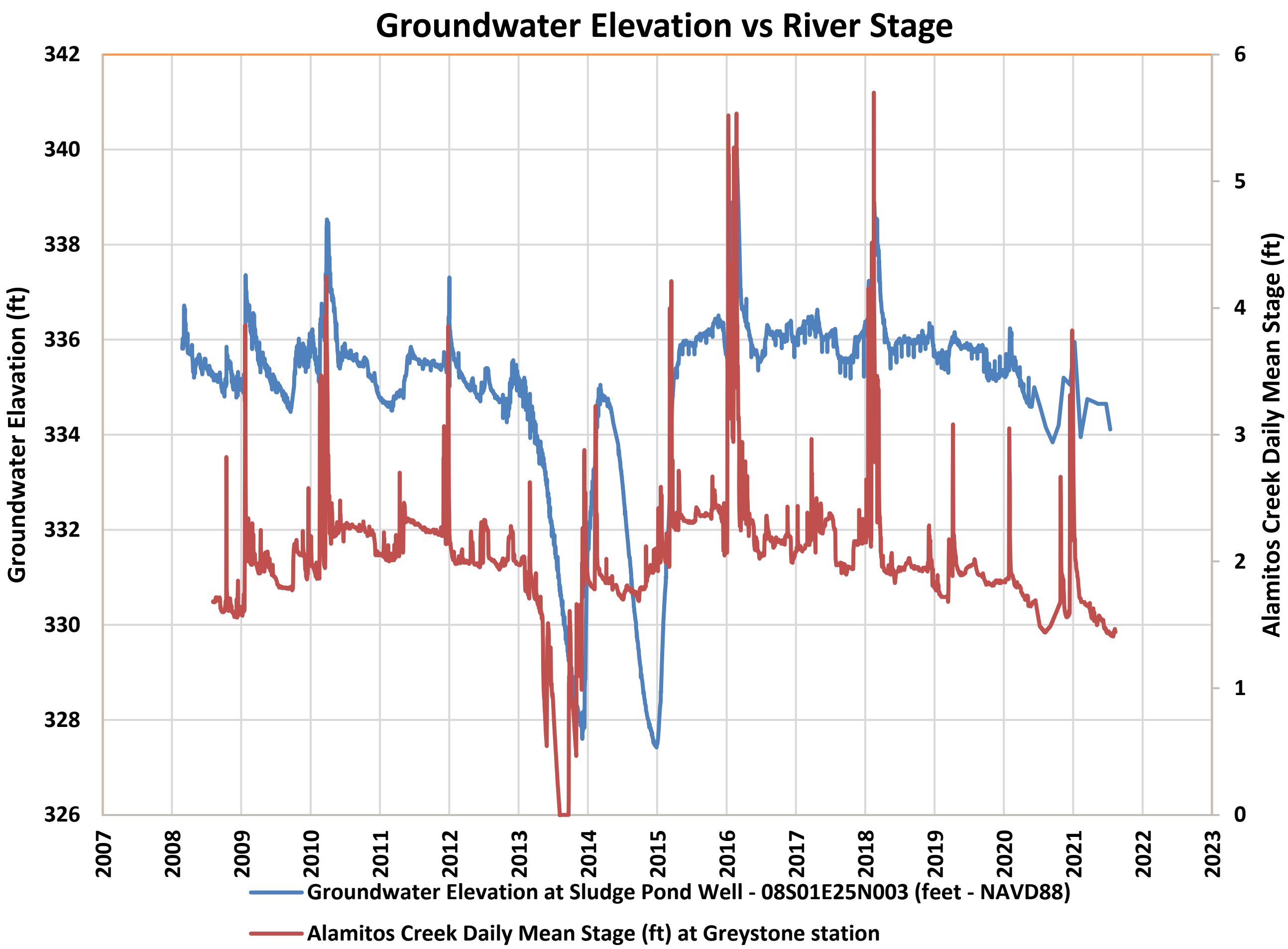


Figure 6: Piper and Schoeller Diagrams

Piper Diagram

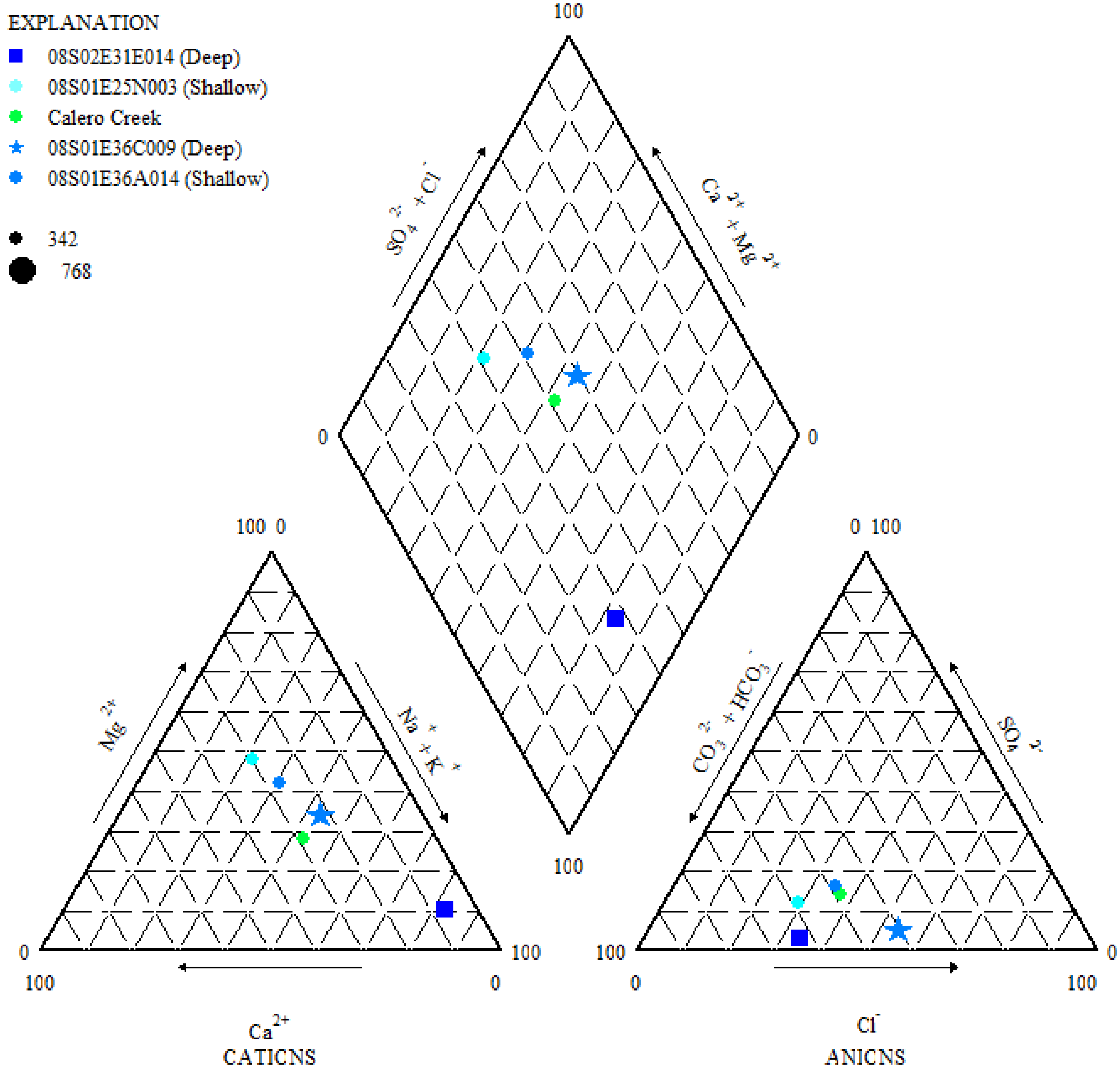


Figure 6 (cont.): Schoeller Diagram

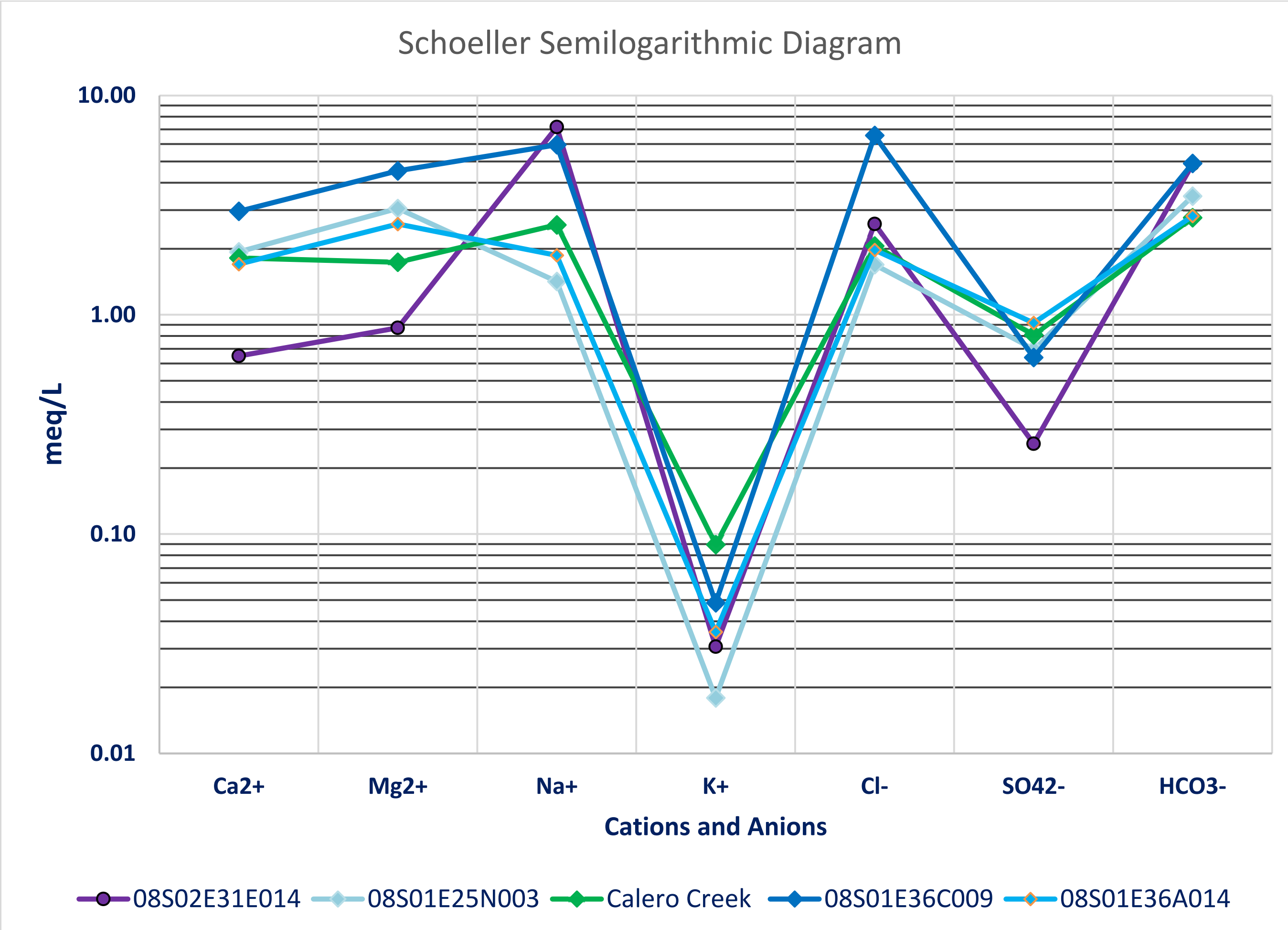
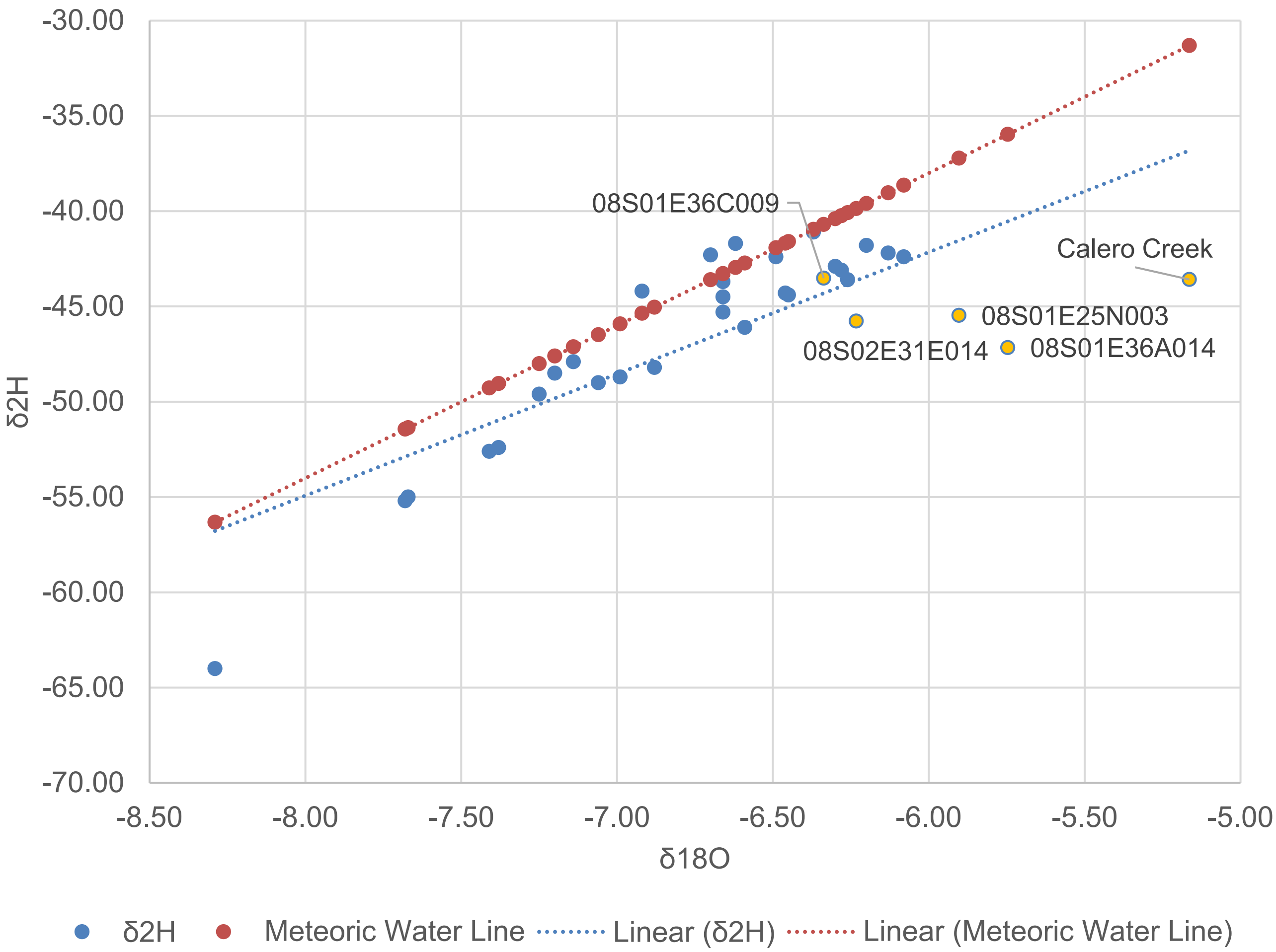


Figure 7: Stable Isotopes in the Santa Clara Subbasin



Source of non-labeled isotope data: Newhouse, M.W., Hanson, R.T., Wentworth, C.M., Everett, R.R., Williams, C.F., Tinsley, J.C., Noce, T.E., and Carkin, B.A., 2004, Geologic, water-chemistry, and hydrologic data from multiple-well monitoring sites and selected water supply wells in the Santa Clara Valley, California, 1999–2003: U.S. Geological Survey Scientific Investigations Report 2004–5250, 134 p.

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