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Seaside Groundwater Basin
2023 Seawater Intrusion Analysis Report

Prepared for:

Seaside Groundwater Basin Watermaster

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Contents

Table

Figures

Appendices

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ACRONYMS & ABBREVIATIONS

ASR................aquifer storage and recovery
bgs..................below ground surface
Ca...................calcium
CAWC...........California American Water Company
Cl....................chloride
CO_3................carbonate
FO..................Fort Ord
HCO_3..............bicarbonate
K.....................potassium
MCWD GSA...Marina Coast Water District Groundwater Sustainability Agency
MCWRA........Monterey County Water Resources Agency
Mg..................magnesium
mg/L...............milligrams per liter
MPWMD........Monterey Peninsula Water Management District
MSC...............Monterey Sand Company
MWCRA........Monterey County Water Resources Agency
Na...................sodium
PCA................Pacific Cement Aggregates
PVWMA........Pajaro Valley Water Management Agency
PWM.............Pure Water Monterey
SIAR..............Seawater Intrusion Analysis Report
SIRP...............Seawater Intrusion Response Plan
SO_4.................sulfate
WY.................Water Year

EXECUTIVE SUMMARY

This report fulfills part of the annual reporting requirements contained in the Seaside Groundwater Basin Adjudication (California American Water v. City of Seaside, Monterey County Superior Court, Case Number M66343). The annual report addresses the potential for, and extent of, seawater intrusion in the Seaside Groundwater Basin (Basin).

Seawater intrusion may occur under basic hydrogeologic conditions as a wedge beneath fresh groundwater or in more complex hydrogeology with various intrusion interfaces among the different aquifers. Continued pumping in excess of recharge and freshwater inflows, coastal groundwater levels well below sea level, and ongoing seawater intrusion in the nearby Salinas Valley all suggest that seawater intrusion could occur in the Basin.

Seawater intrusion is typically identified through regular chemical analyses of groundwater which can identify geochemical changes in response to seawater intrusion. No single analysis definitively identifies seawater intrusion, however by examining various analyses it is possible to determine when fresh groundwater mixes with seawater. At low chloride concentrations, it is often difficult to identify incipient seawater intrusion. This is due to the natural variation in freshwater chemistry at chloride concentrations below 1,000 milligrams per liter (mg/L). Mixing trends between groundwater and seawater are more easily defined when chloride concentrations exceed 1,000 mg/L. Common geochemical indicators of seawater intrusion are cation and anion ratios, chloride trends, sodium/chloride ratios, and electric induction logging.

Data collected in Water Year (WY) 2023 from monitoring and production wells do not indicate that seawater intrusion is occurring within the Basin. However, induction logging has revealed small incremental increases in conductivity over time in Sentinel wells SBWM-1, 2, and 4 within the Paso Robles Formation that may be a precursor to seawater intrusion. With SBWM-1 and SBWM-2 located north of the Basin, the focus is on SBWM-4 which has the greater conductivity changes of the 3 wells and is in the Northern Coastal subarea where most of the Basin's groundwater extraction occurs. A zone of increasing conductivity in SBWM-4 is found between 140 to 200 feet below ground surface (bgs) within a coarser-grained unit of the Paso Robles Formation. Because the conductivity changes are relatively small, roughly equating to a total dissolved solids concentration of 100-200 mg/L, and the zone of increasing conductivity is confined to a specific zone in the Paso Robles Formation, no immediate action is warranted.

Since WY 2020, chloride concentrations in FO-10 Shallow, located outside and to the north of the Basin, have been elevated above historical concentrations. Five of the last 7 samples have a sodium/chloride molar ratio below 0.86, which may suggest a seawater chloride source. Of the 4 samples collected from the Shallow well in WY 2023, the first 2 were above 90 mg/L, while the May and August 2023 samples were just below 90 mg/L. Induction logging of FO-10 Deep in 2021 was inconclusive regarding the presence of seawater intrusion in the well. It was complicated by the presence of a 1,300-foot steel pipe that has been left in the borehole since the well's construction and which is believed to be acting as a conduit across the borehole. Evidence of hydraulic connection between FO-10 Shallow and Deep wells is that the 2 wells have shown extremely similar groundwater elevations over the past 4 years. However, in WY 2023, FO-10 Deep had a 68.4 mg/L chloride decrease bringing concentrations down to those last seen 3 years ago. Regardless, the presence of this steel pipe clouds interpretation of groundwater quality results and may act as a conduit for groundwater in overlying sediments to enter underlying aquifers.

Groundwater levels below sea level, the cumulative effect of pumping in excess of recharge and freshwater inflows, and ongoing seawater intrusion in the nearby Salinas Valley all suggest that seawater intrusion has the potential to occur in the Seaside Groundwater Basin.

Based on the findings of this report, the following ongoing detrimental groundwater conditions pose a direct threat of seawater intrusion:

- Both the Paso Robles and Santa Margarita aquifers in the Seaside Groundwater Basin are susceptible to seawater intrusion. The Paso Robles aquifer is in direct hydrogeologic connection with Monterey Bay, and seawater will eventually flow into it if inland groundwater levels continue to be below sea level. The Santa Margarita aquifer may not be in direct connection with Monterey Bay. If that is the case, then seawater intrusion will take longer as seawater in the Paso Robles aquifer would need to move downward through the clay rich deposits overlying the Santa Margarita aquifer before entering the aquifer itself and making its way into Santa Margarita production wells. It is not if, but when, seawater intrusion into these aquifers will occur if protective water elevations are not achieved.
- Over a number of years conductivity data from induction logging of Sentinel Wells 1, 2, and 4 have shown small but steady increases in conductivity within defined coarser-grained zones within the Paso Robles Formation. The estimated total dissolved solids (TDS) increase associated with the change in conductivity since 2019 is approximately 100 mg/L – 200 mg/L. The Secondary Drinking Water limit is 500 mg/L.
- Groundwater levels in some portions of both the Paso Robles and Santa Margarita aquifers in the Northern Coastal subarea continue to be below sea level year-round. WY 2023 fourth quarter (summer/fall) groundwater levels in the Santa Margarita aquifer are approximately 40 feet below sea level. However, pumping depressions in both the Paso Robles and Santa Margarita aquifers are slightly smaller than the previous year.

- Groundwater levels remain below protective elevations in all 3 Santa Margarita aquifer protective elevation monitoring wells (MSC deep, PCA-W Deep, and sentinel well SBWM-3), and 1 of the 3 Paso Robles protective elevation monitoring wells (MSC Shallow). All 3 Santa Margarita monitoring well groundwater elevations recovered slightly in WY 2023 since being the lowest in their historical record the previous year. Other than PCA-W Shallow, the shallow aquifer protective elevation monitoring wells have all consistently been below protective elevations over the period of record shown on Figure 44 through Figure 47. Elevations at PCA-W Shallow were above protective elevations from the late 1990s through 2020 but have since dropped below, though they recovered close to the protective elevation briefly in WY 2023.

The following evidence from this report demonstrates that seawater intrusion has not been detected in monitoring and production wells from which water quality samples are collected:

- Most groundwater samples for WY 2023 from depth-discreet monitoring wells generally plot in a single cluster on Piper diagrams, with no water chemistry changes toward seawater.
- In some production wells, groundwater quality plots on Piper diagrams are different than groundwater quality in monitoring wells. This may be a result of mixed water quality because these wells are perforated in both the Paso Robles and Santa Margarita aquifers. None of the production wells' groundwater qualities are indicative of seawater intrusion.
- None of the Stiff diagrams for monitoring and production wells show the characteristic chloride spike that typically indicates seawater intrusion in Stiff diagrams. The Stiff diagrams for monitoring well FO-10 Shallow show a slightly different shape than other shallow wells because of increased chloride. The stiff diagram for FO-10 Deep, which showed a spike of increased chloride in WY 2022, returned to a shape consistent with its historical shape.
- Chloride concentration trends are stable for most monitoring wells, except FO-10 Shallow and FO-10 Deep. FO-10 Shallow experienced a 13.8 mg/L decrease in chloride concentrations in WY 2023. FO-10 Deep experienced a 68.4 mg/L chloride decrease in WY 2023. The reason for this is not apparent.
- Maps of chloride concentrations for the shallow aquifer do not show chlorides increasing toward the coast. Santa Margarita aquifer chloride concentration maps show that the highest chloride concentrations are limited to coastal monitoring wells PCA-West Deep and MSC Deep, but these are not indicative of seawater intrusion since their concentrations are less than 155 mg/L and they do not have increasing trends.

Other important findings from the analysis contained in this report include the following:

- Due to its distance from the coast, seawater intrusion is not an issue of concern in the Laguna Seca subarea. However, groundwater levels in the eastern Laguna Seca subarea have historically declined at rates of 0.6 feet per year in the shallow aquifers, and up to 4 feet per year in the deep aquifers. These declines have occurred since 2001 despite triennial reductions in allowable pumping and CAWC ceasing pumping its Ryan Ranch and Bishop wells. The cause of the declines is due to the subarea's limited groundwater inflows and natural recharge compounded by the influence of wells pumping east of the Basin. Since WY 2021, groundwater elevations in the area have appeared to experience some stabilization and recovery, potentially correlated with a cessation of pumping at California American Water Company's (CAWC) Ryan Ranch and Bishop wells.
- Native groundwater production in the Basin for WY 2023 was 2,173 acre-feet, which is 698 acre-feet less than WY 2022 and 827 acre-feet less than the Decision-ordered Operating Yield for WY 2023 of 3,000 acre-feet. In addition to WY 2023 being an above average year for rainfall, recovery of 3,458 acre-feet of recycled water from Pure Water Monterey project (PWM) and use of recycled water at the Bayonet/Blackhorse Golf Courses helped offset pumping of native groundwater. Native groundwater production was below the Decision-estimated Natural Safe Yield of 3,000 acre-feet for the fourth year in a row.

The following recommendations should be implemented to monitor and track seawater intrusion.

- Induction logging in the very bottom of SBWM-3 was hampered by the lost transducer and steel cable in the bottom of the well. Given increased conductivity occurring within the Paso Robles aquifer in SBWM-1, 2, and 4, the transducer and cable should be fished out prior to conducting the fall 2024 induction logging so a complete log of conductivity can be obtained.
- EKI and MCWD GSA (Marina Coast Water District Groundwater Sustainability Agency) should be informed that Sentinel wells SBWM-1 and SBWM-2 are starting to show an increase in conductivity in defined coarser-grained zones in the Paso Robles Aquifer. These wells are located outside of the Basin and are within the Marina Subarea of the Monterey Subbasin.
- It is recommended that options for verifying seawater intrusion occurring in the Paso Robles Formation at or near SBWM-4 be evaluated in WY 2024. This may involve finding a site for a new monitoring well, adapting an existing well, induction logging a nearby monitoring well, or some other solution. If the fall 2024 induction logging results

confirm increasing conductivity, the Watermaster should see if it would be feasible to monitor groundwater quality in the affected zone.

- It is recommended that FO-10 Shallow and FO-10 Deep be destroyed and replaced to maintain continuous water quality monitoring and to prevent cross contamination between the Paso Robles and Santa Margarita aquifers, and the overlying Dune Sands. These wells are located outside of the Basin, so destruction would need to be performed by the well owner, MPWMD, and replacement wells would need to be installed by the MCWD GSA.
- It is important to remain vigilant and to closely monitor groundwater quality even though seawater intrusion has not yet been observed in monitoring or production wells in the Basin. As outlined in the most recent Basin Management Action Plan (M&A, 2018a), it is important that the Watermaster continue to promote projects to obtain replenishment water for the Basin that is not extracted out as water supply.
- Based on the WY 2020's SIAR recommendation, groundwater elevation data from the Carmel River water Aquifer Storage and Recovery (ASR) project and PWM monitoring wells are now incorporated into the analysis of groundwater elevations if available. Groundwater level data from PWM monitoring wells are typically available for the second quarter of the water year, but fourth quarter data from are less likely to be posted online at GeoTracker at the time of reporting. Inclusion of groundwater level data from ASR monitoring wells is reliant on direct transmittal from applicable monitoring entity and is not always provided in time for reporting. As these and any future projects are implemented, groundwater levels, groundwater flow directions, and potentially groundwater quality will change in response. It is important data from monitoring wells associated with these projects continue to be evaluated in future SIARs.
- Seawater intrusion is a threat to the Basin, and data must be collected and analyzed regularly to identify incipient intrusion. Maps, graphs, and analyses like those found in this report should continue to be developed every year.

1 BACKGROUND AND INTRODUCTION

Historical and persistent low groundwater elevations caused by pumping in the Seaside Groundwater Basin have led to concerns that seawater intrusion may threaten the Basin's groundwater resources. This report addresses the potential for, and extent of, seawater intrusion in the Seaside Groundwater Basin. The report first reviews seawater intrusion mechanisms, analyzes historical water quality data for indications of seawater intrusion in the Seaside Groundwater Basin, and finally reaches conclusions on the extent of seawater intrusion and proposes recommendations for continued monitoring.

This report fulfills part of the annual reporting requirements contained in the Seaside Groundwater Basin Adjudication (California American Water v. City of Seaside, Monterey County Superior Court, Case Number M66343). The analyses in this report were developed by HydroMetrics Water Resources Inc. of Oakland, California, in cooperation with members of the Watermaster Technical Advisory Committee. Staff from the Monterey County Water Resources Agency (MWCRA) and Monterey Peninsula Water Management District (MPWMD) provided invaluable assistance, data, and review during the preparation of this report.

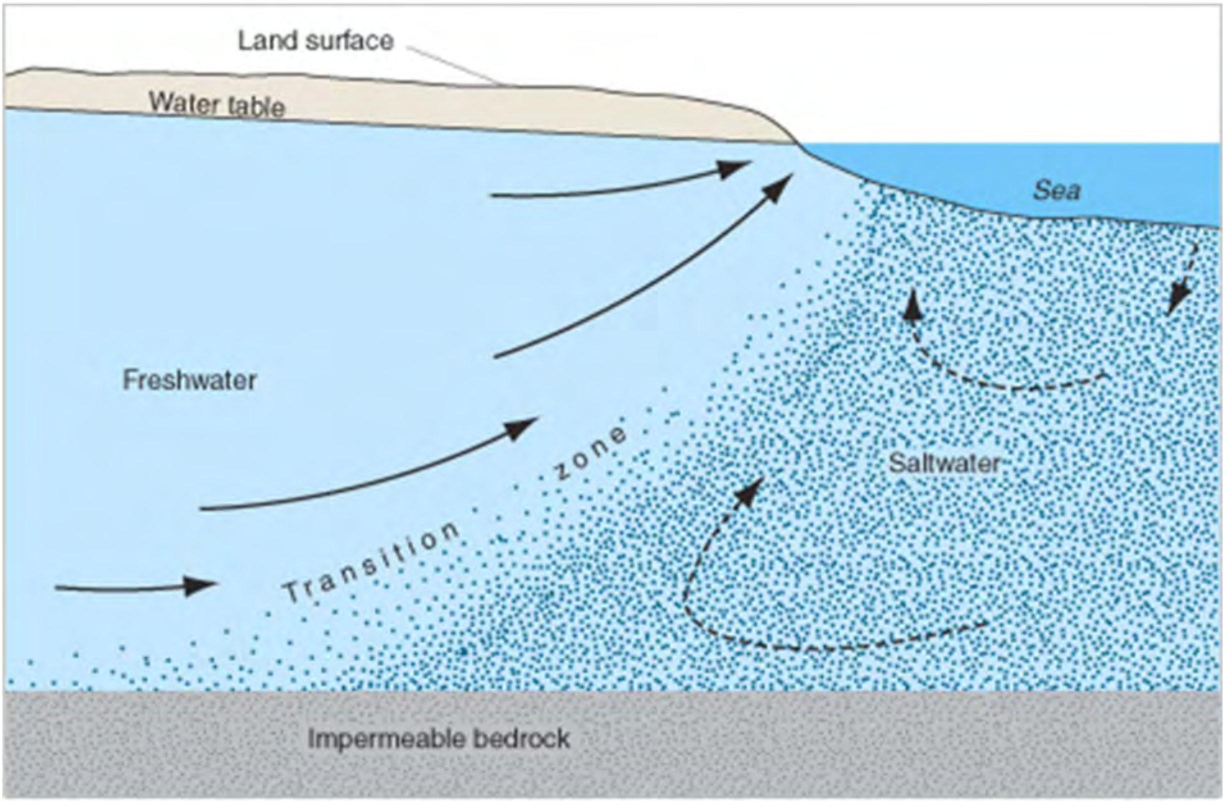
This report is the twelfth in a series of Seawater Intrusion Analysis Reports (SIAR) which are produced annually by the Watermaster. It builds on the work conducted in the preceding SIARs.

1.1 Overview of Seawater Intrusion

Seawater intrusion is a threat to many coastal groundwater basins along the California Coast. It has been observed and documented in a number of groundwater basins in both southern and central California.

In general, groundwater in coastal basins flows from recharge areas in local highlands toward discharge areas along the coast. In most undeveloped coastal groundwater basins, there is a net outflow of fresh water into the ocean. Seawater intrusion occurs when the outflow of freshwater ceases and seawater flows into the groundwater basin from the ocean.

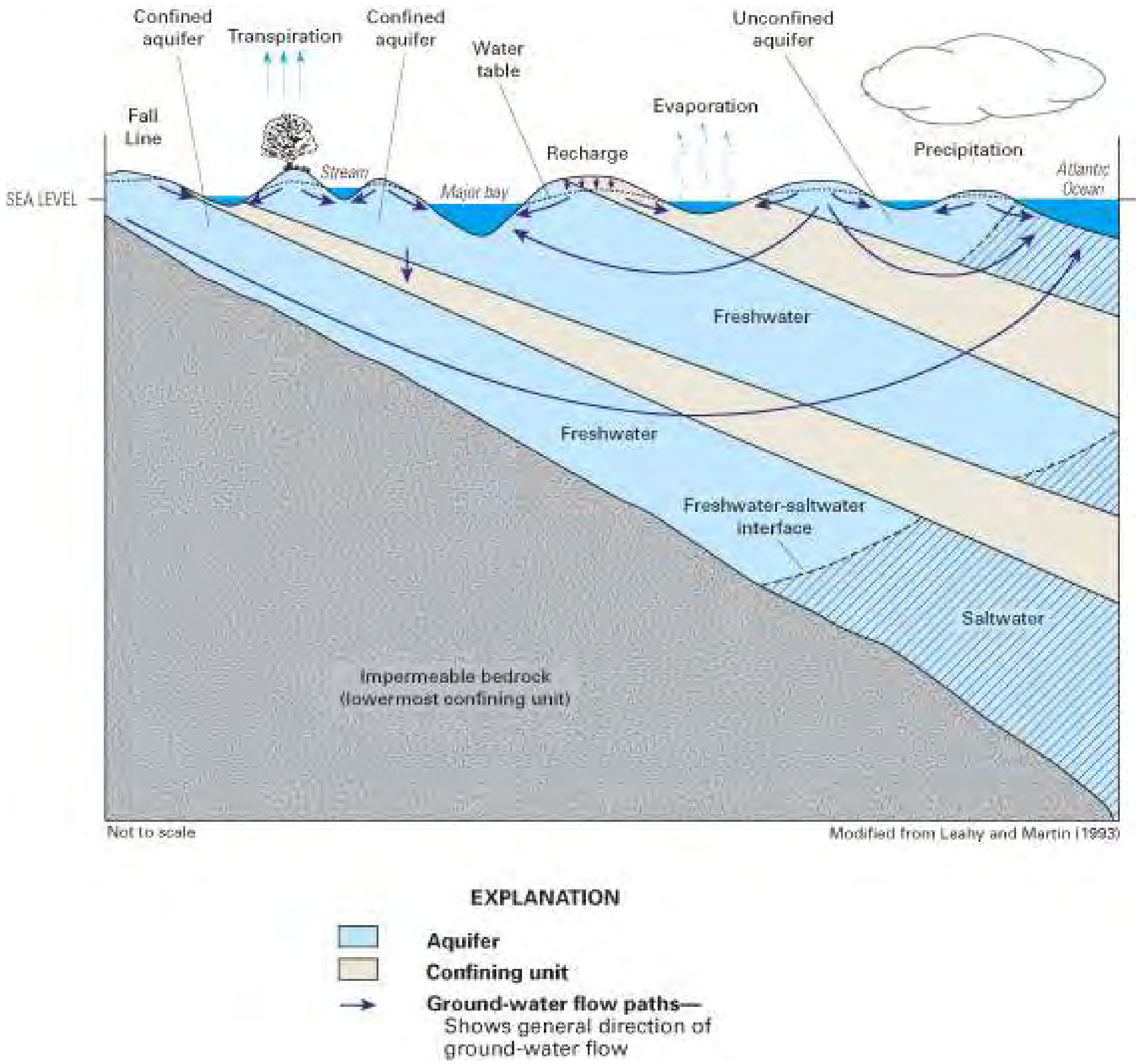
In the simplest condition, seawater intrudes as a wedge beneath the fresh groundwater (Figure 1). This wedge shape is a result of seawater being denser than freshwater.



(Source: Barlow, 2003)

Figure 1. Seawater Wedge in a Simple Coastal Aquifer

In more complex, layered groundwater systems, the location of the seawater/freshwater interface may vary among the different aquifers. Such a situation is illustrated on Figure 2, which shows a series of aquifers in blue that transmit water easily. The aquifers are separated by a series of tan aquitards, which transmit water relatively slowly. Each aquifer has a unique rate of outflow to the ocean, and therefore a unique location of the seawater interface. In these more complex situations, the locations of the seawater/freshwater interfaces are a complex function of the horizontal groundwater gradient in each aquifer, the aquifer hydraulic conductivities, and the vertical conductivity of the inter-layer aquitards.



(Source: Barlow, 2003)

Figure 2. Seawater Wedge in a Layered Coastal Aquifer

Figure 2 shows that under non-pumping conditions, the seawater interface in confined units can be located farther offshore than in surficial unconfined aquifers. The fresh water in an unconfined aquifer can flow readily into the ocean, allowing the seawater interface to exist near shore. Fresh water in the lower confined aquifers must seep out slowly through the overlying confining units. The slow seepage rates allow the fresh water to maintain pressure beneath the sea floor, pushing the seawater interface away from the coastline.

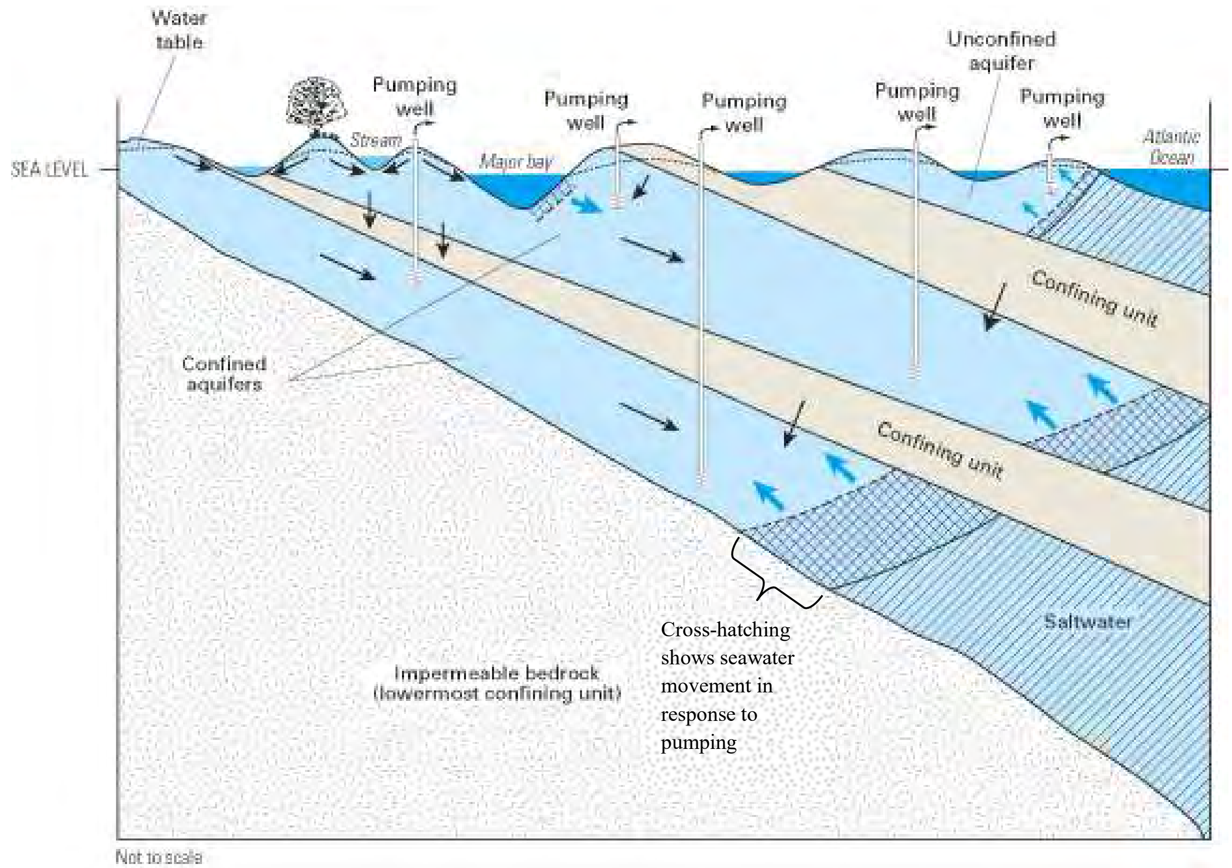
1.2 Groundwater Pumping and Seawater Intrusion

Pumping groundwater in a coastal aquifer reduces the amount of water discharging to the ocean. Sufficient pumping can eliminate ocean discharges, either locally or basin-wide, triggering seawater intrusion. The response of the seawater interface to groundwater pumping is manifested in 2 related ways: upconing and interface migration. Upconing refers to the ability of a pumping well to draw seawater up from below and only occurs if seawater exists directly below a pumping well. Because no seawater intrusion has been observed in the Seaside Groundwater Basin, upconing cannot occur and only seawater interface migration will be further addressed in this report.

As mentioned earlier, groundwater pumping reduces the amount of freshwater outflow to the ocean. This allows the interface to migrate shoreward. Substantial pumping can allow the interface to move onshore, potentially impacting municipal wells, private wells, or agricultural wells. Figure 3 shows a 2D cross section of how the freshwater/seawater interface may migrate in response to pumping.

As can be inferred from Figure 3, the degree of interface migration depends on the amount of water pumped from a particular aquifer, as well as the amount of leakage from overlying or underlying aquifers. Groundwater extracted from the lowest aquifer might be replaced by rainfall recharge, by seawater migrating shoreward, or by groundwater leaking from the overlying aquifer.

An additional issue that must be considered with seawater interface migration is the initial location of the seawater interface. An interface that starts far from the shore may take a considerable amount of time, often on the order of decades, to reach any production or monitoring well. Furthermore, the farther the interface is from the pumping well, the more area is available for fresh water to leak from overlying aquifers into the producing aquifer. This slows, or may completely stop, seawater intrusion in the pumped aquifer. Downward leakage, however, removes fresh water from overlying aquifers. This leakage may therefore exacerbate seawater intrusion in the overlying aquifer.



(Source: Barlow, 2003)

Figure 3. Interface Migration in Response to Groundwater Pumping

1.3 Indicators of Seawater Intrusion

Seawater intrusion is generally identified through chemical analyses of groundwater. Groundwater levels below or near sea level indicate an opportunity for seawater intrusion, but the actual seawater intrusion is indicated by various geochemical changes in groundwater.

No single analysis definitively identifies seawater intrusion, however by looking at various analyses we can ascertain when fresh groundwater mixes with seawater. At low chloride concentrations, it is often difficult to identify incipient seawater intrusion. This is due to the natural variation in freshwater chemistry at chloride concentrations below 1,000 milligrams per liter (mg/L) (Richter and Kreitler, 1993). Mixing trends between groundwater and seawater are more easily defined when chloride concentrations exceed 1,000 mg/L.

Common geochemical indicators of seawater intrusion are discussed and example analyses are presented in the following sections.

1.3.1 Cation/Anion Ratios

Molar ratios of cations and anions can prove distinctive for various groundwater systems. Seawater intrusion is often indicated by graphically analyzing shifts in these molar ratios. Two common graphical techniques for these analyses are Piper diagrams and Stiff diagrams.

1.3.1.1 Piper Diagrams

Example Piper diagrams are shown for data from the Pajaro Valley and Salinas Valley on Figure 4 and Figure 5, respectively. These figures are included to demonstrate the utility of Piper diagrams and show how they have been used in nearby basins. These figures are not provided for directly comparing data between basins; groundwater quality trends in the Seaside Basin will not necessarily correlate with trends in other basins.

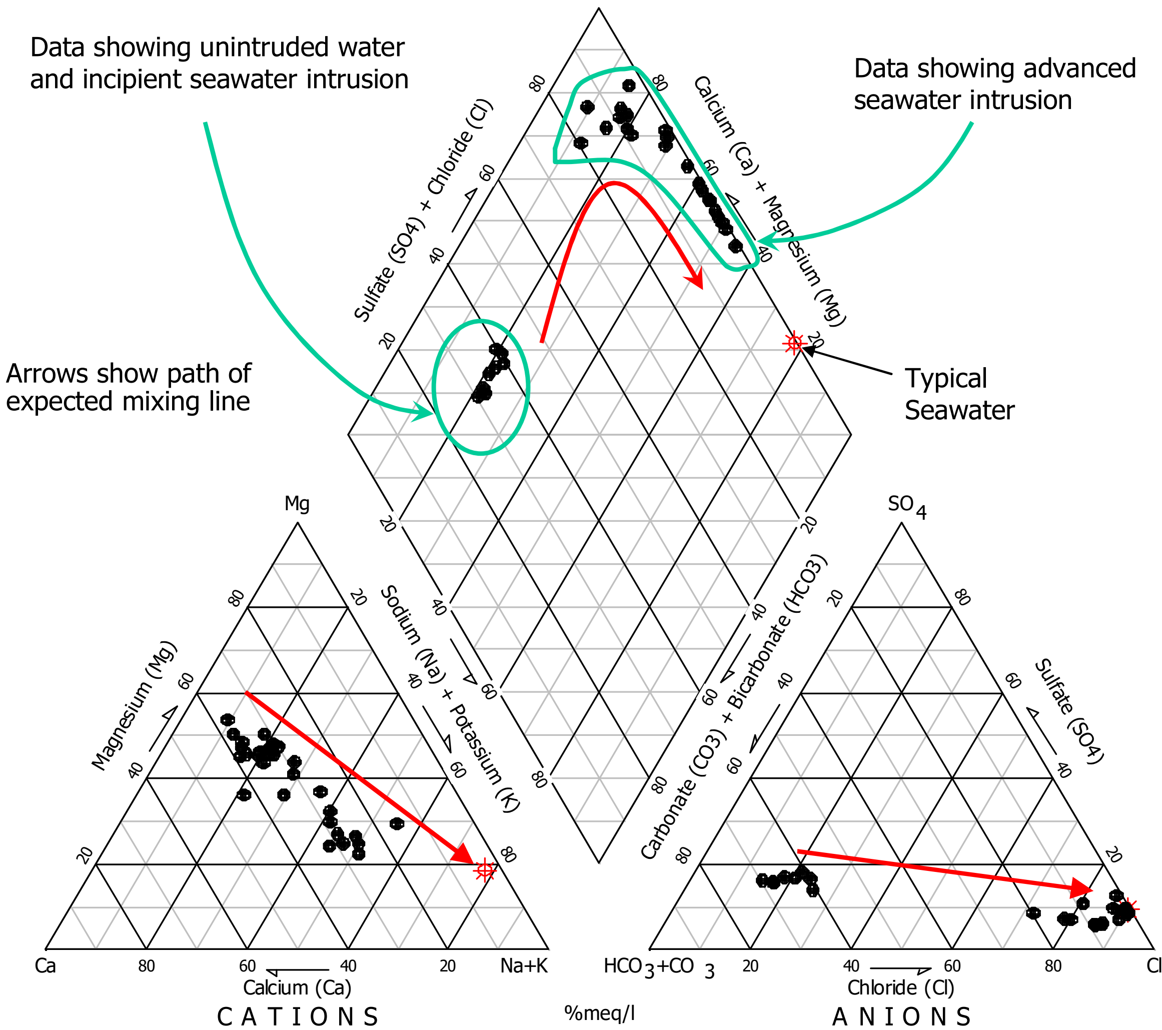
On these Piper diagrams, the relative abundances of individual cations and anions are plotted in the left and right triangles, respectively, and their combined distribution is plotted in the central diamond. Waters from similar or related sources will generally plot together. The mixture of 2 waters will generally plot along a straight line between the 2 end-member types within the central diamond. The trend toward seawater intrusion, however, often plots along a curved path as shown on Figure 4. The red arrows track the evolution of water chemistry from freshwater to seawater. Often only the first, upward leg of this curve is observed, because wells become too saline to use before reaching the downward leg, and sampling is usually discontinued.

1.3.1.2 Stiff Diagrams

Example Stiff diagrams from the Salinas Valley are shown on Figure 6 and Figure 7. These figures are included to demonstrate the utility of Stiff diagrams and show how they have been used in nearby basins. On Stiff diagrams, the relative abundances of individual cations are plotted on the left side of the graph and the relative abundances of anions are plotted on the right side of the graph. Waters with similar chemistries will have similarly shaped Stiff diagrams.

Figure 6 shows Stiff diagrams characteristic of the unintruded portions of the Salinas Valley Pressure 400-Foot Aquifer. By contrast, Figure 7 shows Stiff diagrams from the intruded portion of the Salinas Valley Pressure 400-Foot Aquifer. The significantly higher chloride levels in the intruded aquifer result in the noticeable spike at the upper right side of the Stiff diagrams on Figure 7. This spike is indicative of incipient seawater intrusion.

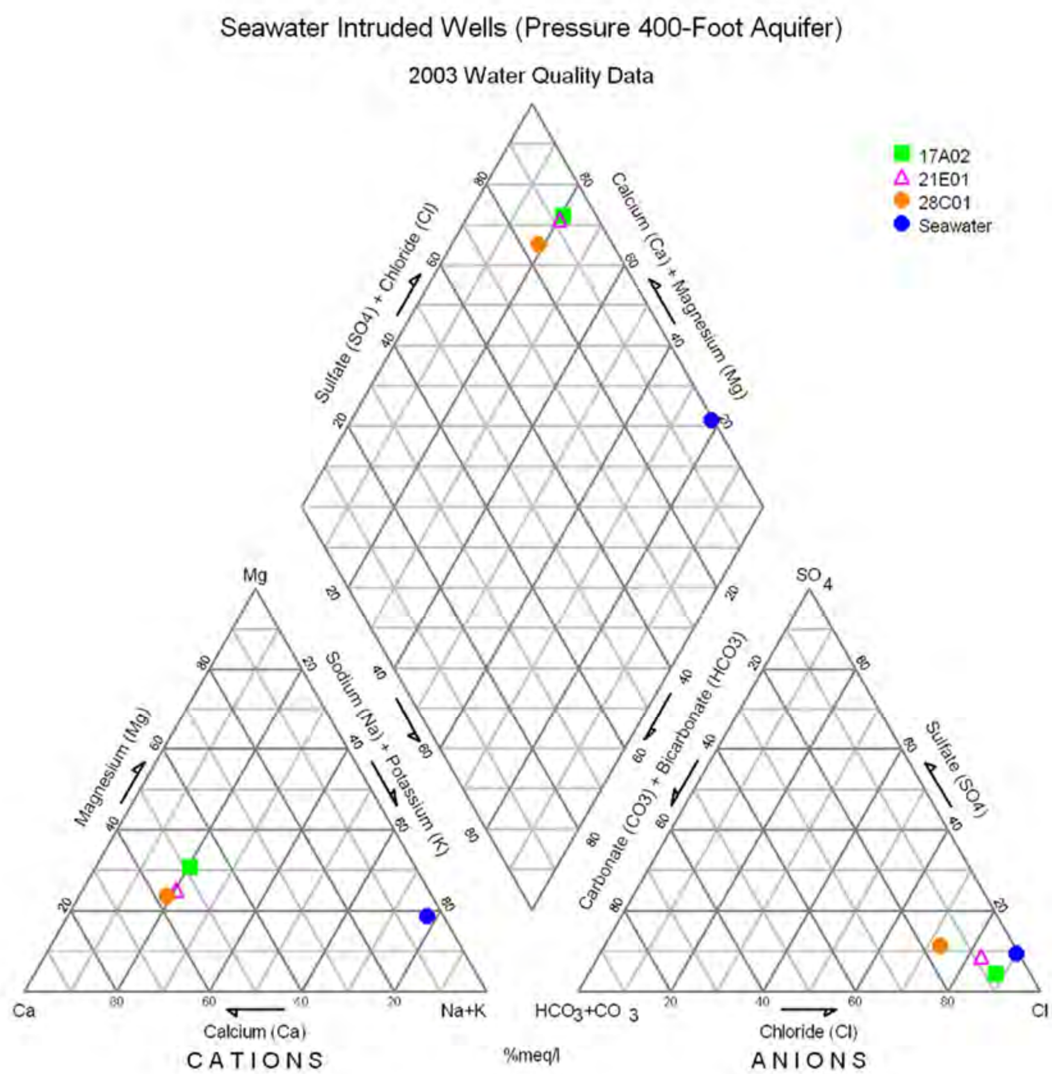
The Stiff diagrams shown on Figure 7 are from wells that have acknowledged seawater intrusion based on multiple lines of evidence. The Stiff diagrams alone are often not sufficient to identify seawater intrusion because there is no standard for Stiff diagram shapes; the diagrams are most useful as a comparative tool, showing the evolution of water chemistry over time and space. The shape of these Stiff diagrams is considered indicative of seawater intrusion in Salinas Valley only because considerable data analyses have shown that locally, Stiff diagrams adopt this shape as seawater encroaches.



(Data source: Pajaro Valley Water Management Agency [PVWMA])

Figure 4. Piper Diagram for Groundwater in Pajaro Valley

The Stiff diagrams of seawater intruded wells on Figure 7 show calcium concentrations greater than sodium concentrations, although sodium is the dominant cation in seawater. Incipient seawater intrusion is often characterized by increasing calcium and decreasing sodium, due to cation exchange between sodium and calcium on the aquifer material. This concept is discussed further on page 15.



(Source: Monterey County Water Resources Agency [MCWRA])

Figure 5. Piper Diagram for Groundwater in Salinas Valley

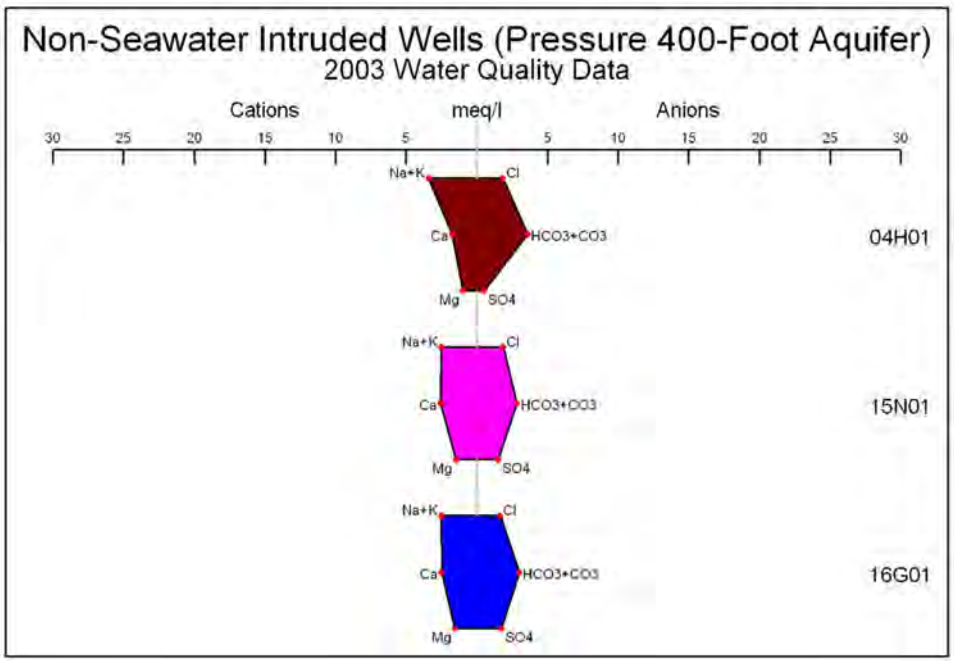
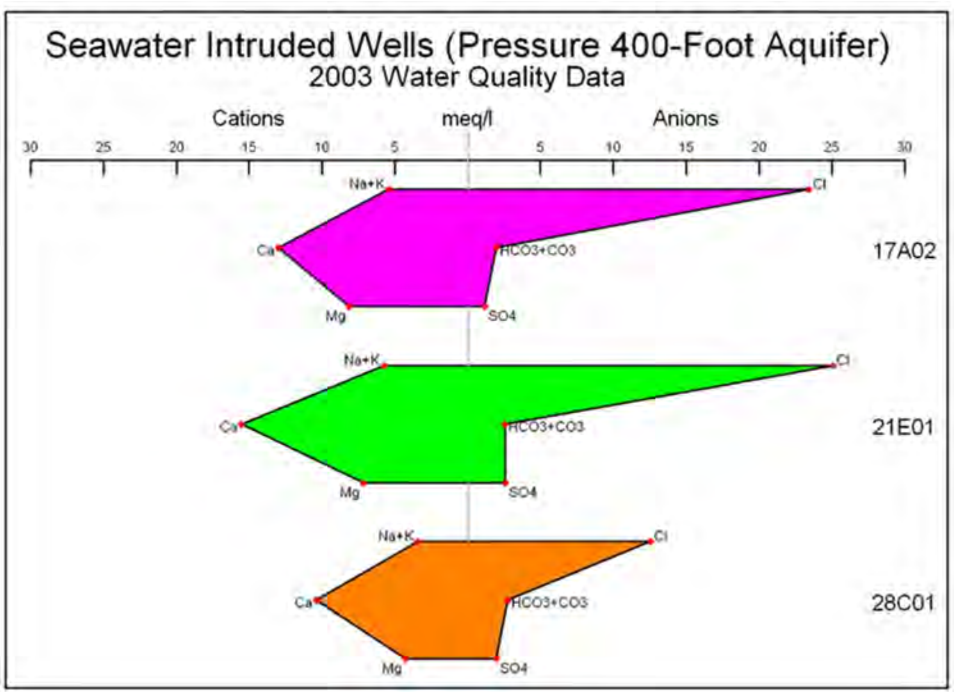


Figure 6. Stiff Diagrams from Salinas Valley Wells without Seawater Intrusion



(Source: MCWRA)

Figure 7. Stiff Diagrams from Salinas Valley Wells with Seawater Intrusion

1.3.2 Increasing Chloride Concentrations

Seawater is chloride rich, whereas bicarbonate or sulfate are the dominant anions in many groundwater systems. Steadily increasing chloride concentrations over time is one of the most commonly used indicators of seawater intrusion. At low chloride concentrations, trends are often as important as absolute concentrations because of natural variations in groundwater chemistry. As an example, in 2004 the coastal shallow Pacific Cement Aggregates (PCA) West well had a chloride concentration of 46 mg/L, whereas the much more inland well 2701882-016, located in the Laguna Seca subarea, had a chloride concentration of 225 mg/L. The higher chloride concentration in well 2701882-016 is fairly consistent, showing no increasing trend, and is clearly not an indicator of seawater intrusion.

Example graphs showing historical chloride concentration increases indicative of seawater intrusion are shown on Figure 8 and Figure 9. Figure 8 graphs steadily increasing chloride concentrations in a shallow well in the Salinas Valley and Figure 9 graphs increasing chloride concentrations in a well in the Pajaro Valley. Both of these graphs show that the rise in chlorides is a lengthy and persistent process; chloride concentrations began to increase in the representative Salinas Valley well in 1982, and took 6 years before exceeding the Safe Drinking Water Act secondary drinking water standard of 250 mg/L. This long-term and relatively slow increase in chlorides suggests that while chloride concentrations are strongly indicative of seawater intrusion, it often takes time for the increasing chloride trend to be recognizable.

1.3.3 Sodium/Chloride Molar Ratios

As mentioned earlier in this report, sodium often replaces calcium on the aquifer matrix through ion exchange in advance of the seawater front. This effectively removes sodium from the water and sodium/chloride ratios drop in advance of the seawater front. This can sometimes be used as an early indicator of seawater intrusion. Sodium/chloride ratios can also be used to differentiate between seawater intrusion and other sources of saltwater. Jones *et al*. (1999) suggest that sodium/chloride ratios in advance of a seawater intrusion front will be below 0.86 (molar ratio). This distinguishes seawater intrusion from domestic waste water, which typically has sodium/chloride ratios above 1.

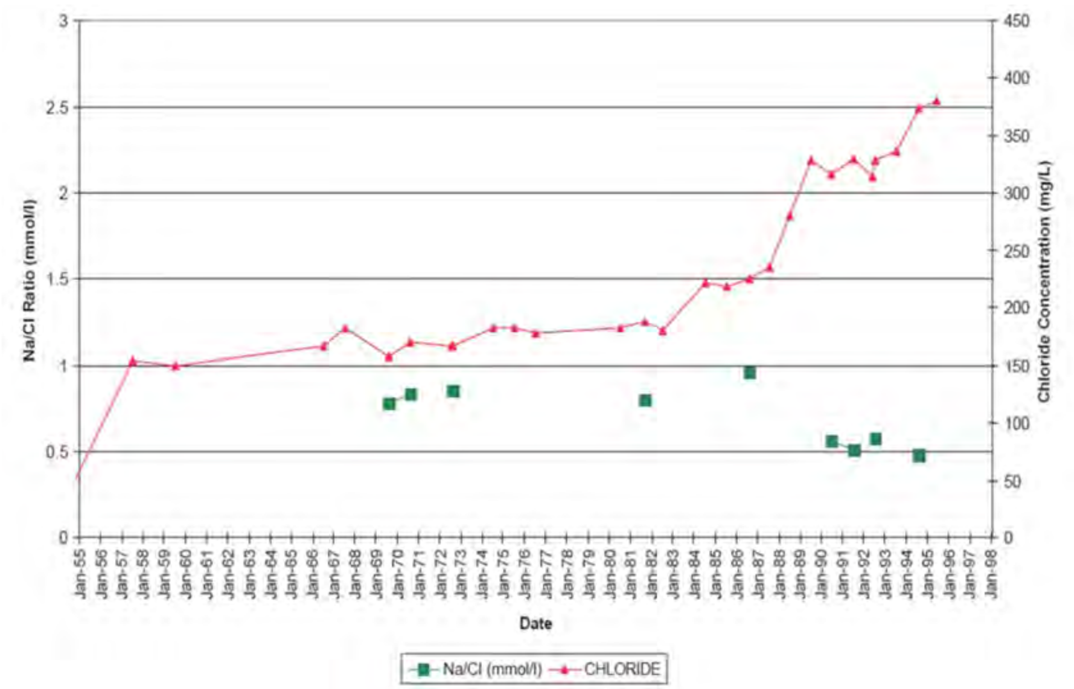


Figure 8. Historical Chloride Concentrations and Sodium/Chloride Ratios for a Well in Salinas Valley Showing Incipient Intrusion (Data source: MCWRA)

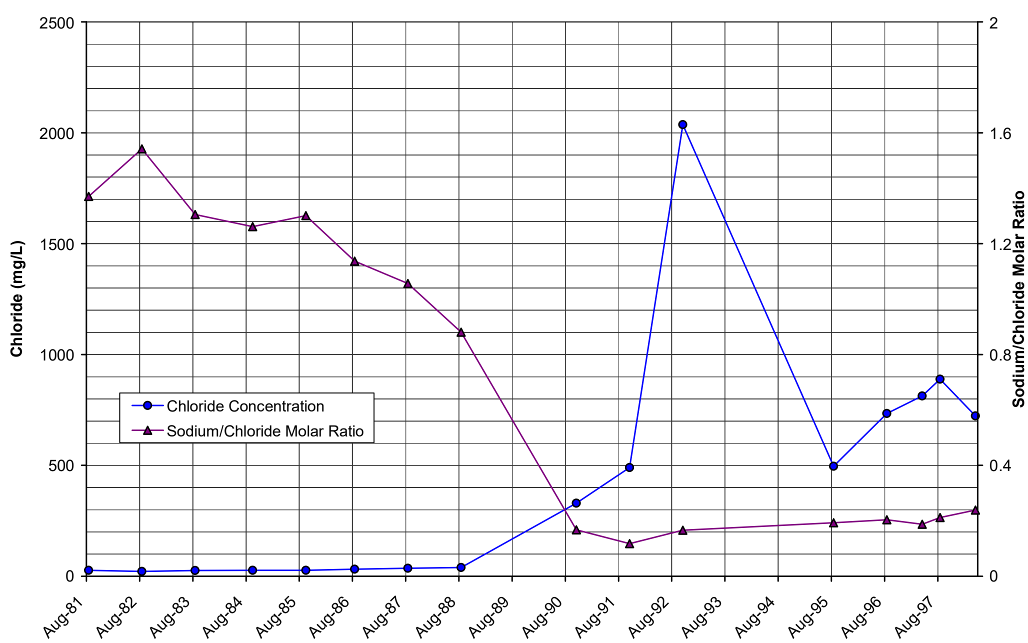


Figure 9. Historical Chloride Concentrations and Sodium/Chloride Ratios for a Well in Pajaro Valley Showing Incipient Intrusion (Data source: PVWMA)

In addition to plotting increasing chloride concentrations, decreasing sodium/chloride ratios are plotted on Figure 8 and Figure 9. The strong correlation between the 2 indicators of seawater intrusion can be observed on these 2 figures. The potential utility of sodium/chloride ratios as an early indicator of seawater intrusion is shown on Figure 9. This figure shows that by August 1988, chloride concentrations in the Pajaro Valley well had remained relatively constant yet sodium/chloride ratios were beginning to drop, suggesting incipient seawater intrusion. By September 1990, the rising chloride levels can be clearly correlated to dropping sodium/chloride ratios; definitively associating the high chlorides with seawater intrusion.

1.3.4 Chloride-Bicarbonate Ratios

The ratio of chloride to bicarbonate-plus-carbonate contrasts the relative abundance of the dominant seawater and freshwater anions. As a ratio of concentrations expressed in mg/L, the ratio for seawater exceeds 100 and values for groundwater unaffected by seawater are generally less than 0.3. For groundwater with relatively low total dissolved solids, this ratio provides little benefit over evaluating chloride concentrations alone and therefore is not used in the current analyses.

1.3.5 Electric Induction Logs

Changes in formation salinity can be measured from within a well using electric induction logging. Induction logging within the well measures the fluid conductivity within the adjacent formation up to a distance of 3 feet from the well casing. This technique can be used in wells that are completed with PVC casings and screens.

This method can be used as a cost-effective method of detecting seawater intrusion by measuring the electrical conductivity of the formation throughout the depth of the well. If over time, the conductivity increases relative to the baseline value, it could indicate seawater intrusion. One limitation of this method is that it does not provide concentrations of chloride or other ions that contribute to salinity. Therefore, the use of electric induction logs can only be used qualitatively.

Induction logging has been performed on the Watermaster's coastal Sentinel Wells since their completion in 2007.

1.3.6 Other Indicators

Hem (1989) suggested several other indicators for seawater intrusion, including the concentration ratio of calcium to magnesium (approximately 0.3 in seawater and greater in fresh water); the percentage of sulfate among all ions (approximately 8% in seawater and larger in fresh water); and the concentrations of minor constituents such as iodide, bromide, boron, and barium. These other indicators are not used in the current analyses for the following 2 reasons:

1. The analyses presented in the following sections suggest seawater intrusion has not advanced onshore in the Seaside Groundwater Basin, although there may be increasing salinity in the Paso Robles Formation (see Section 2.5).
2. Watermaster analyzing samples from selected coastal monitoring and production wells for iodide, bromide, boron, and barium from 2012 to 2022. Because it was felt that 10 years of barium and chloride data was sufficient for baseline purposes, analysis for these 2 constituents was discontinued starting in Water Year (WY) 2023.

It is not necessary to use the above 2 indicators because as discussed in the preceding sections, there are other methods available for indicating seawater intrusion. Should the other methods start showing seawater intrusion, the minor constituents of iodide, bromide, boron, and/or barium may be included in future water quality analyses so that they can be used as supplemental indicators.

2 SEAWATER INTRUSION IN THE SEASIDE GROUNDWATER BASIN

The geochemical criteria discussed above, along with various maps showing spatial distributions of concentrations, can be used to estimate the presence or lack of seawater intrusion in the Seaside Groundwater Basin. While no single analysis is a definitive indicator of seawater intrusion, the combined weight of all analyses may be instrumental in detecting seawater intrusion.

2.1 Analysis Approach

As was used in previous Seawater Intrusion Analysis Reports (RBF, 2007; HydroMetrics LLC, 2008; HydroMetrics LLC, 2009a; HydroMetrics WRI, 2010; HydroMetrics WRI, 2011; HydroMetrics WRI, 2012; HydroMetrics WRI, 2013a; HydroMetrics WRI, 2014; HydroMetrics WRI, 2015; HydroMetrics WRI, 2016b; HydroMetrics WRI, 2017b; Montgomery & Associates, 2018b; M&A, 2019; M&A, 2020; M&A, 2021; M&A, 2022), this SIAR includes multiple approaches to evaluate seawater intrusion. Results from all groundwater quality testing in WY 2023 are included in Appendix A.

Data for the second quarter of WY 2023 (sampled and measured January-March 2023) and fourth quarter of WY 2023 (sampled and measured July-September 2023) are analyzed and mapped to show the spatial distribution of groundwater quality and groundwater elevations. In addition to spatial mapping, historical data are graphed to assess geochemical trends. Data from the second quarter represent conditions during the wet time of the year; data from the fourth quarter represent conditions during the dry time of the year. In some cases when samples or measurements are not collected strictly within the second or fourth quarter, the quarter in which they were collected is provided with the data.

Where possible, analyses are separated by depth zone. Two depth zones have been chosen, following the system of Yates *et al*. (2005). Wells assigned to the shallow depth zone generally correlate to the Paso Robles Formation where it exists. This shallow zone is roughly at the same depth as the Salinas Valley Pressure 400-Foot Aquifer. Wells assigned to the deep zone correlate with the Santa Margarita Sandstone where it exists in the Seaside Groundwater Basin. The deep zone is roughly at the same depth as the Salinas Valley Pressure Deep Aquifers (900-foot and 1,500-foot Aquifers).

Analysis of current and historical precipitation is also included to help inform trends in groundwater elevations and production.

2.2 Cation/Anion Ratios

For the WY 2023 SIAR, 11 monitoring wells and 15 production wells were used for geochemical trend analyses. Locations of all monitoring and production wells used in the SIAR analysis are shown on Figure 10. Some of the production wells included in previous years' analysis are not included in this year's analysis because they were not pumped during the year and thus not sampled. Groundwater quality data are not collected in the Sentinel Wells for seawater intrusion analysis because in early 2017 it was concluded that groundwater samples collected using the low flow sampler were more representative of water within the well casing and not from the groundwater in the aquifer surrounding the well (HydroMetrics LLC, 2017a).

Eight monitoring wells used in this analysis represent 1 or both well pairs from the MPWMD monitoring well network and 1 is an observation well (Figure 10). A well pair comprises 2 wells drilled close to one another: 1 perforated in the Paso Robles aquifer (shallow zone) and the other perforated in the Santa Margarita aquifer (deep zone). Each well pair is represented with a unique color and symbol on Piper and Stiff diagrams.

Production wells included in the analysis are water purveyor wells that are sampled annually for general inorganic minerals per the Seaside Basin Monitoring and Management Program (Seaside Groundwater Basin Watermaster, 2006). The current schedule includes quarterly sampling at selected coastal monitoring wells. All other monitoring and production wells are sampled annually during the fourth quarter. Where samples are not available for analysis, the text and figures indicate as such.

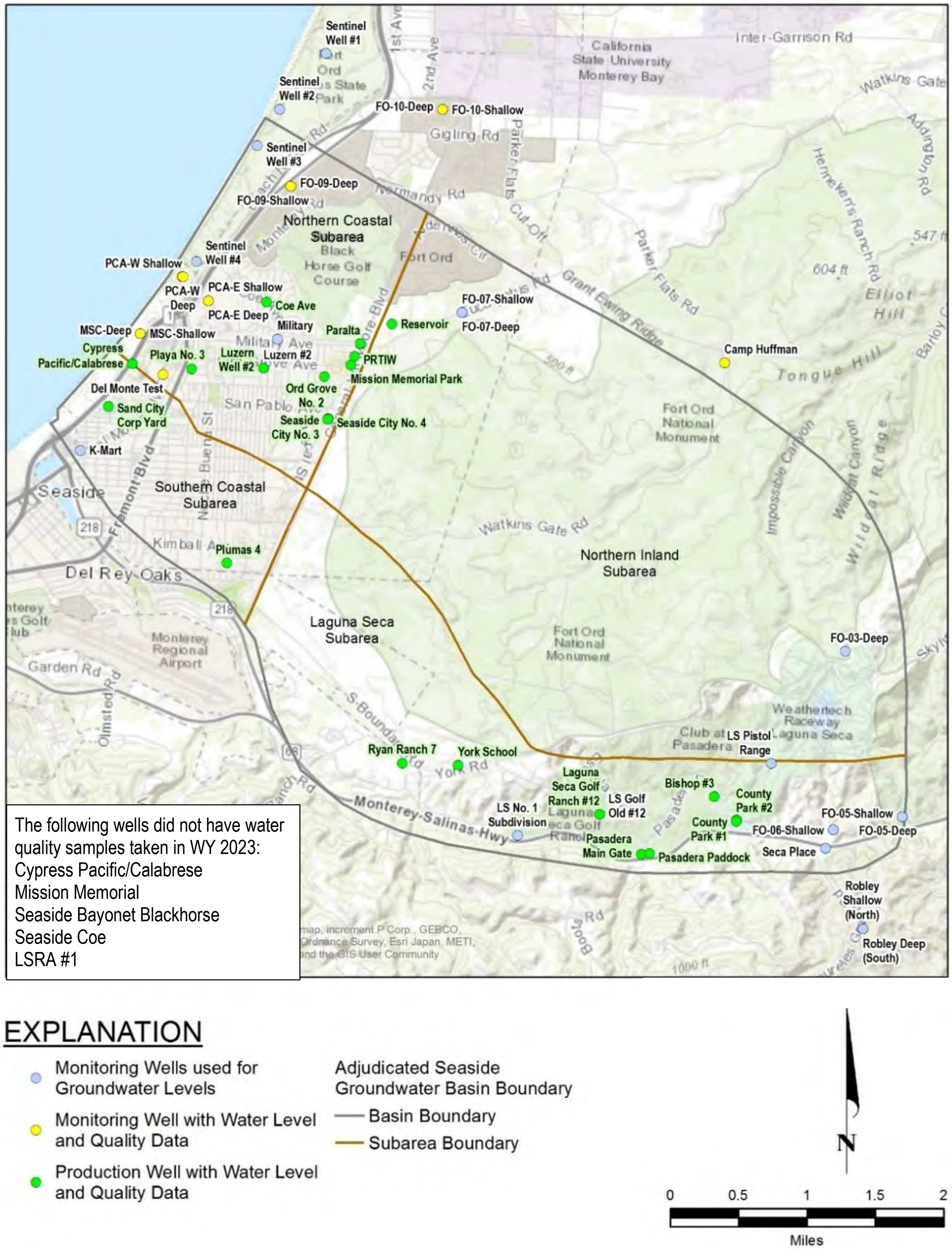


Figure 10. Wells Used for Seawater Intrusion Analyses Second Quarter Water Year 2023 (January-March 2023)

2.2.1 Second Quarter Water Year 2023 (January-March 2023)

A Piper diagram plotting 6 monitoring wells in the Northern Coastal subarea for the second quarter WY 2023 (January-March 2023) is shown on Figure 11. Analyses from only 6 wells are shown because the Sentinel Wells are only used for induction logging and are no longer sampled, and most of the monitoring well pairs are only sampled in the fourth quarter. Further, monitoring well FO-09 Shallow was destroyed 2 years ago due to a compromised casing. It has since been replaced and data from the replacement well will be included in future SIARs. Appendix C includes individual Piper diagrams for each well to track their anions and cations over time. Note that bicarbonate (HCO_3) presented on Piper and Stiff diagrams is derived from Total Alkalinity (as CaCO3).

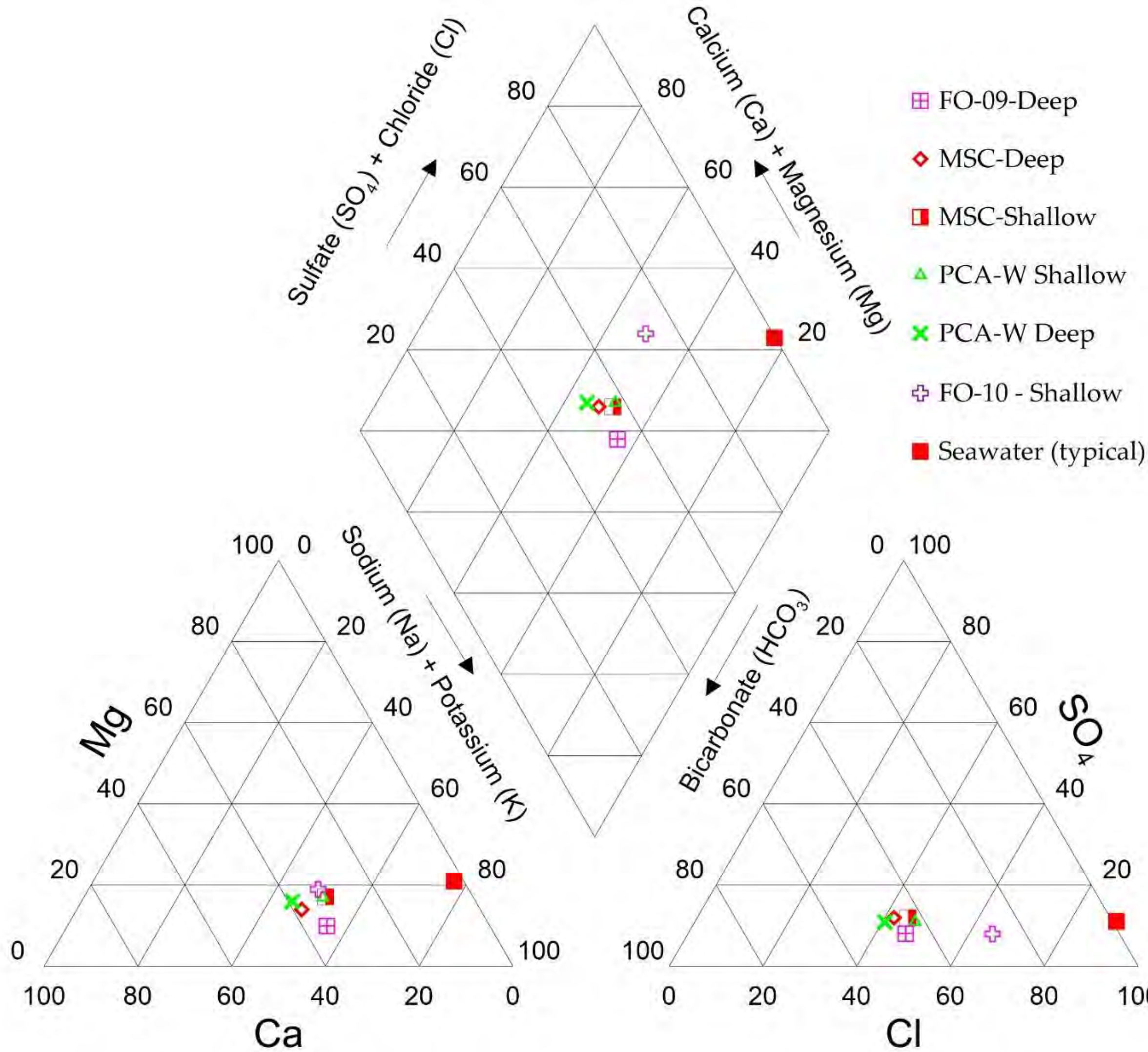
The monitoring wells on Figure 11 generally cluster in a single area on the Piper diagram that is consistent with previous data. The location on the Piper diagram indicates that groundwater from both the Santa Margarita (deep) and Paso Robles (shallow) well pairs straddle the sodium-chloride and sodium-bicarbonate type water[1.]

As noted in the previous 3 SIARs (M&A, 2020; M&A, 2021; M&A, 2022) and shown on Figure 11, monitoring well FO-10 Shallow plots differently than the other wells on the Piper diagram and has exhibited a marked increase in chloride over the past 3 years, departing significantly from its historical trends (Appendix D: Figure D-9). This year FO-10 Shallow continues to plot differently than other wells due to elevated chloride, though the trends do not appear to have worsened from the previous year (Appendix D: Figure D-10). Downhole logging at the FO-10 site and subsequent historical record search identified a 1,300 foot, 2-inch steel tremie pipe that has been left in the FO-10 borehole since the well's construction (Feeney, 2021; Feeney 2022). While comparison of WY 2021 resistivity at the well with a historical log does show increased conductivity in the well, which may be a sign of seawater intrusion, the presence of the steel pipe obfuscates water quality determinations by muting the induction log response. Further, this steel pipe may act as a conduit allowing flow between overlying intruded Dune Sands sediments and the underlying aquifer. In WY 2023, FO-10 Shallow's anions and cations on the Piper diagram plot similarly to the previous year while FO-10 Deep's anions and cations shifted slightly from the path towards seawater (Appendix D: Figure D-12)

Stiff diagrams for the monitoring wells sampled during the second quarter of WY 2023 are shown in the left column on Figure 12 through Figure 14. None of the Stiff diagrams, including monitoring well FO-10 Shallow and FO-10 Deep, show the high chloride spike shown on Figure 7 that indicates seawater intrusion. FO-10 Shallow does show a slightly different shape

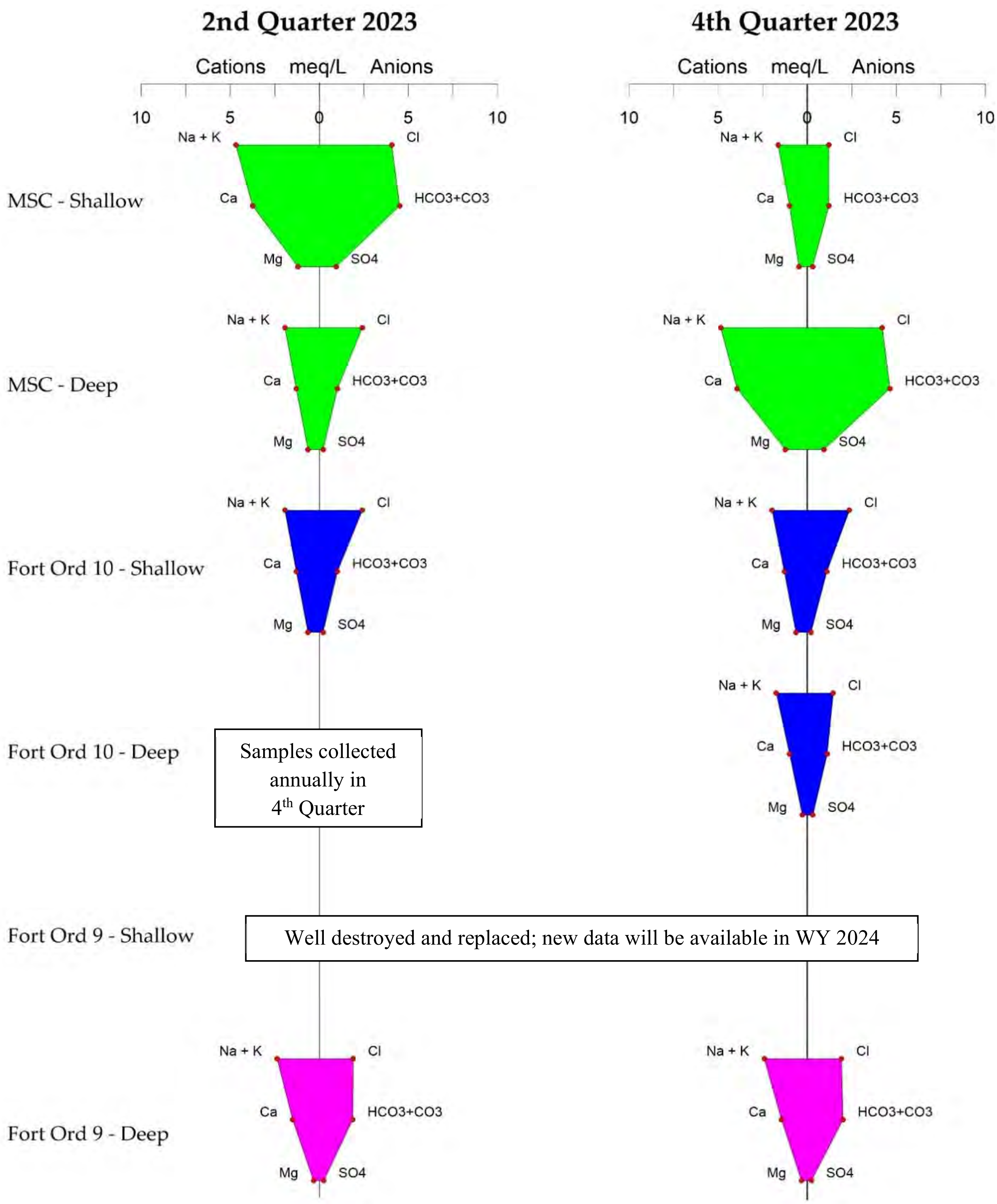
[1] Where the data points fall in the Piper diagram triangle for anions and the triangle for cations determines the type of water. For example, if the points plot in the lower right corner of the anion triangle, the water is classed as chloride type water.

than other shallow wells because of elevated chloride. In WY 2023, the shape of FO-10 Deep's stiff diagram is more similar to shallow wells than how it plotted in WY 2022. The mechanism behind the evolving shape of FO-10 Deep and FO-10 Shallow on the stiff diagrams is not currently known, and it is recommended that the nested well pair be destroyed and replaced.



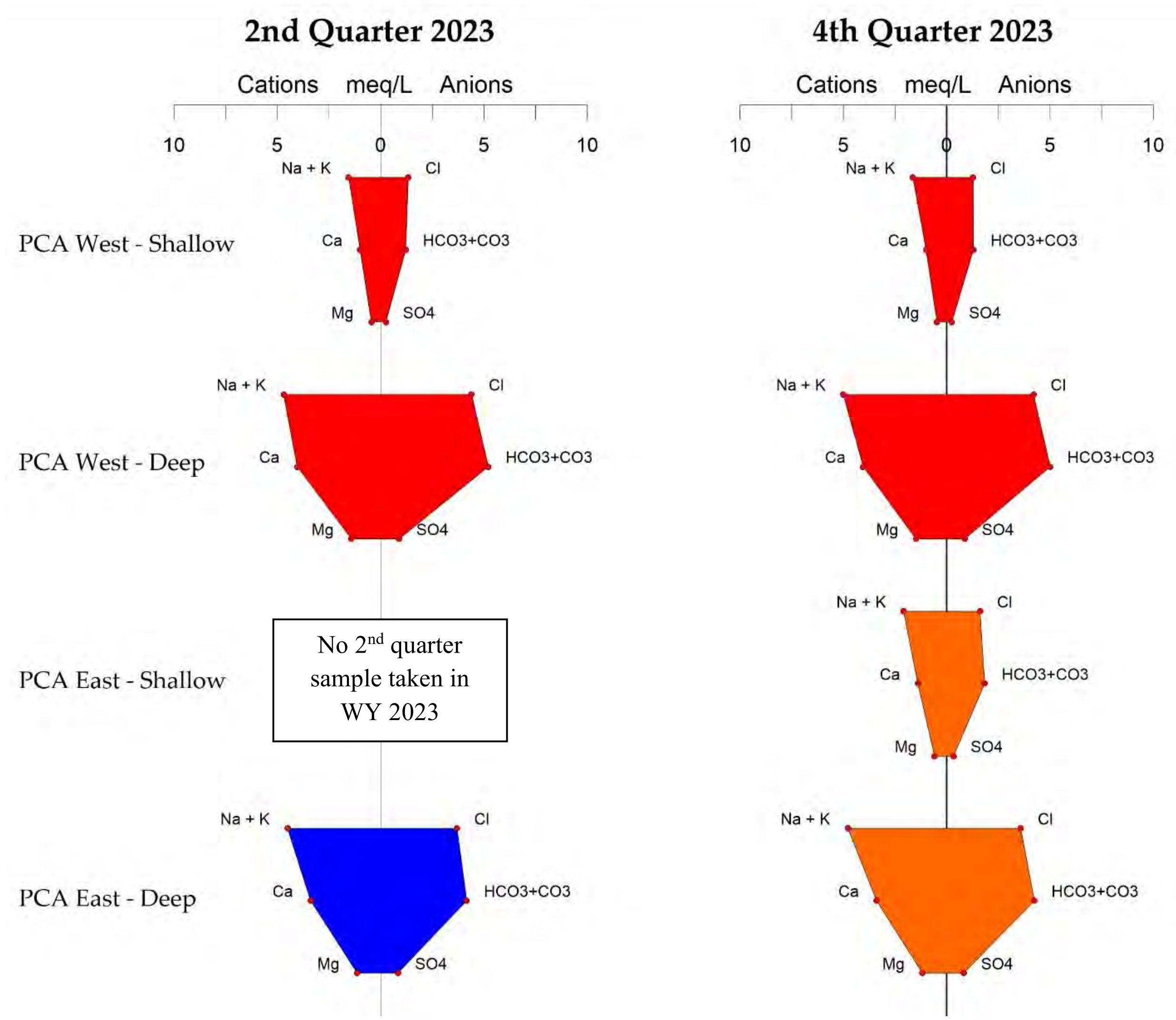
(Data source: Watermaster)

Figure 11. Piper Diagram for Seaside Groundwater Basin Monitoring Wells, Second Quarter Water Year 2023 (January-March 2023)



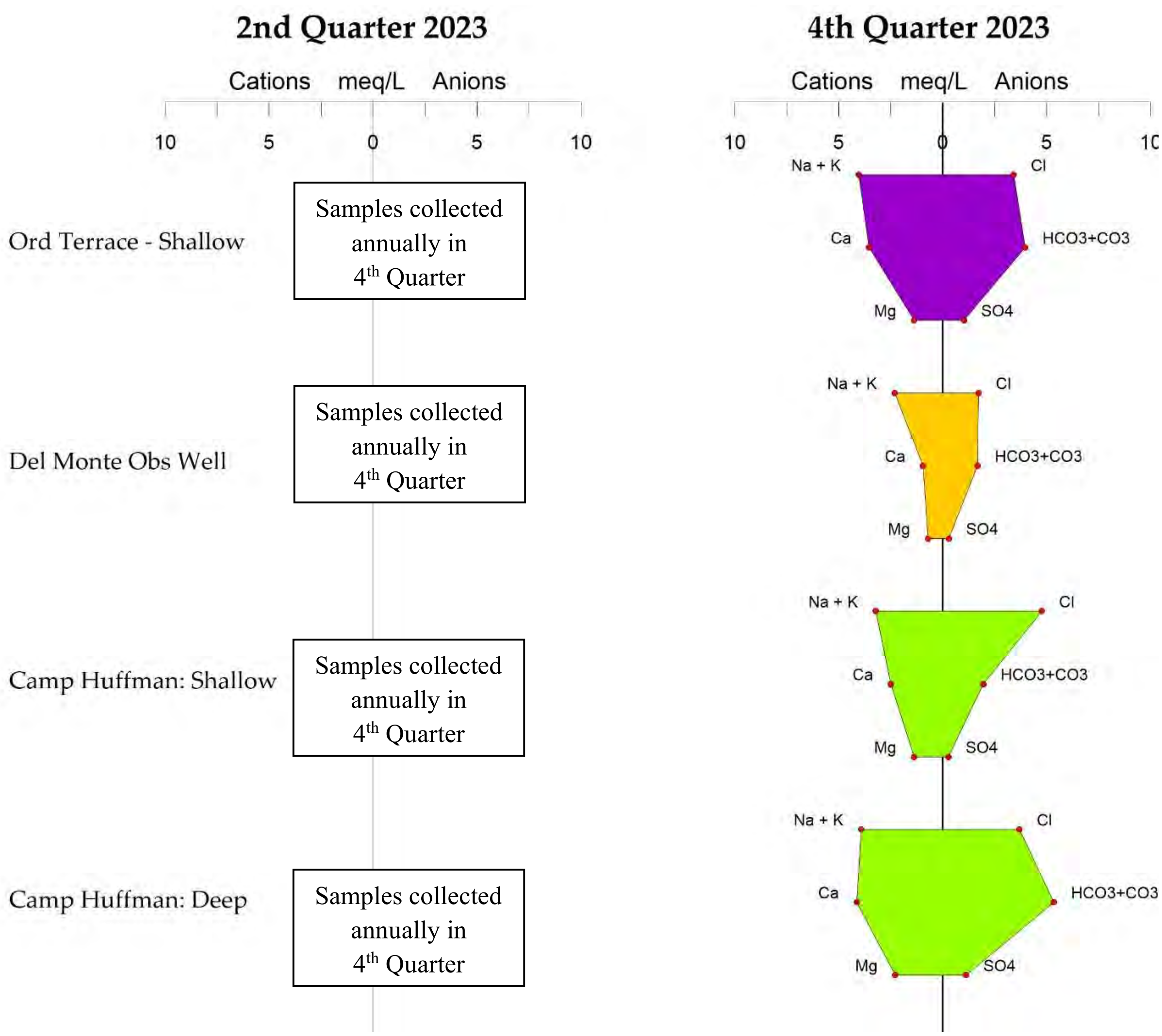
(Data source: Watermaster)

Figure 12. Stiff Diagrams for Monterey Sand Company (MSC), Fort Ord 9, and Fort Ord 10 Wells



(Data source: Watermaster)

Figure 13. Stiff Diagrams for PCA West and PCA East Wells



(Data source: Watermaster and MPWMD)

Figure 14. Stiff Diagrams for Watermaster Ord Terrace, Del Monte, and Camp Huffman Wells

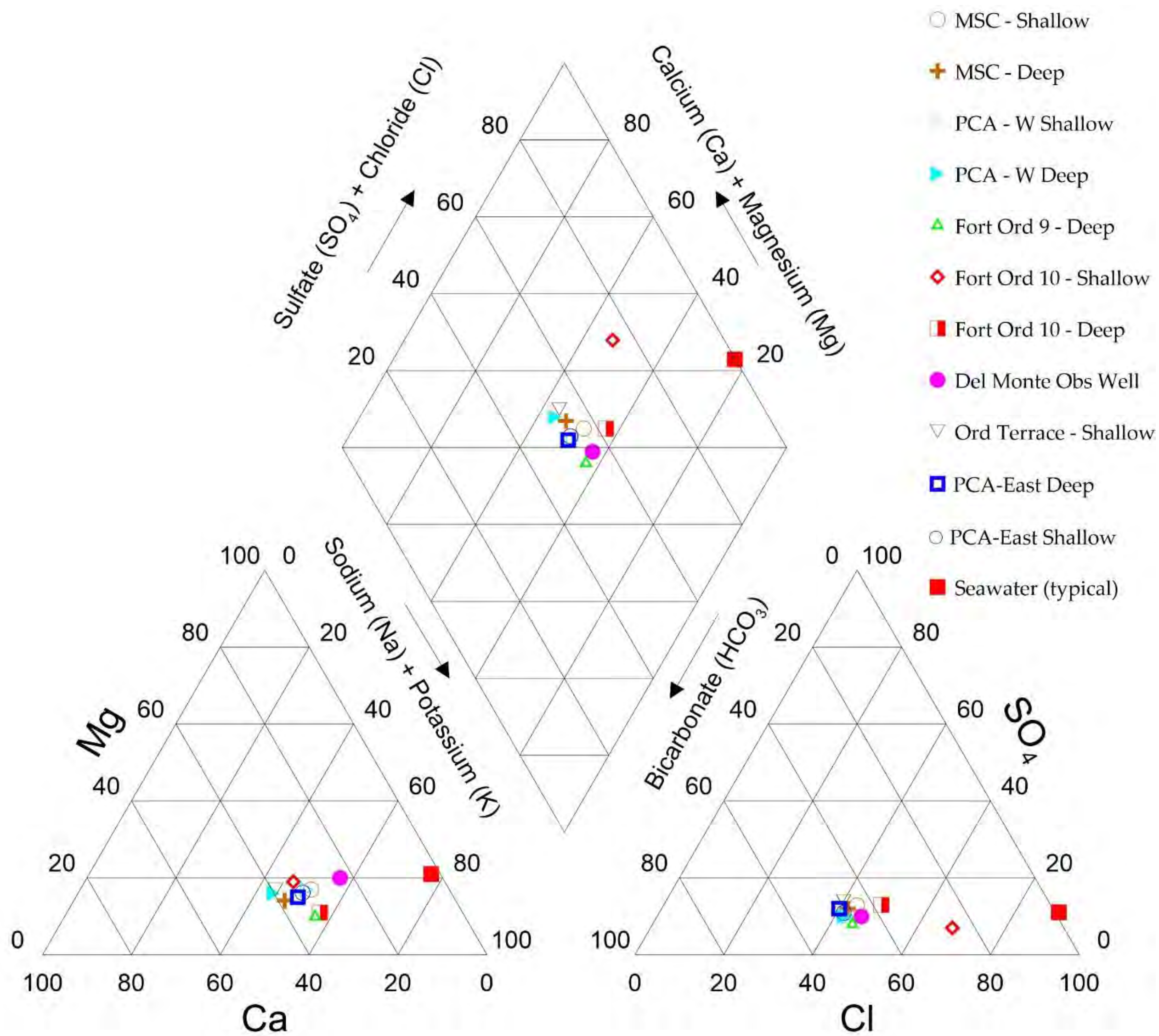
2.2.2 Fourth Quarter Water Year 2023 (July-September 2023)

Piper diagrams displaying groundwater quality data from 11 monitoring wells and 15 production wells in the Seaside Groundwater Basin for the fourth quarter of WY 2023 (July-September 2021) are shown on Figure 15 and Figure 16, respectively. Appendix C includes individual Piper diagrams for each well to show trends over time.

The Piper diagram for monitoring wells (Figure 15) shows groundwater quality data clustering generally in a single area on the diagram. Groundwater is generally of a sodium-chloride/sodium-bicarbonate type and is not impacted by seawater. Monitoring well FO-10 Shallow plots differently on both Piper (Figure 15) and Stiff (Figure 12) diagrams due to higher chloride than most other wells. As described above, current analysis is still inconclusive as to whether this is a result of seawater intrusion.

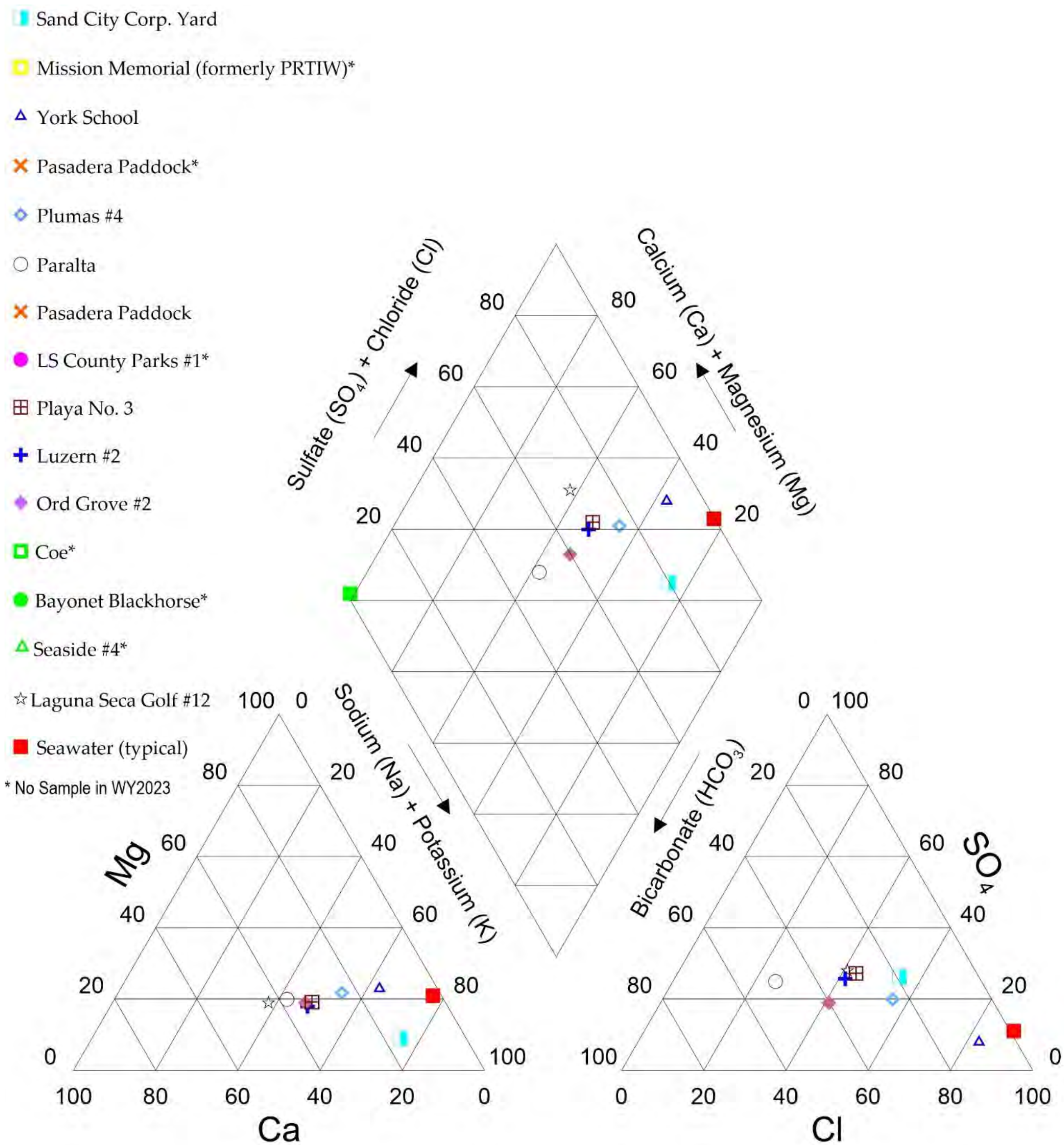
Figure 16 presents a Piper diagram for fourth quarter groundwater from production wells. The production wells plot in roughly the same location on the Piper diagram as most monitoring wells on Figure 15. The variation of the plot location on the Piper diagram for production wells is due to higher sulfate and chloride anions than in the monitoring wells. Groundwater from these wells is characterized as sodium-sulfate-chloride type waters. The York School well plots closest to typical seawater on this diagram; however, its inland location precludes seawater intrusion as the cause for its observed water chemistry. Overall, the Piper diagrams show no indication of seawater intrusion at any of the production wells.

Stiff diagrams for 11 monitoring wells sampled during the fourth quarter of WY 2023 are shown in the right column on Figure 12 through Figure 14. The shapes of the Stiff diagrams for the paired monitoring wells are similar to the shapes of Stiff diagrams for most prior years, with the exception of FO-10 Shallow which has a greater chloride equivalent concentration than HCO_3 compared to other shallow coastal wells.



(Data source: Watermaster)

Figure 15. Piper Diagram for Seaside Groundwater Basin Monitoring Wells, Fourth Quarter Water Year 2023 (July- September 2023)



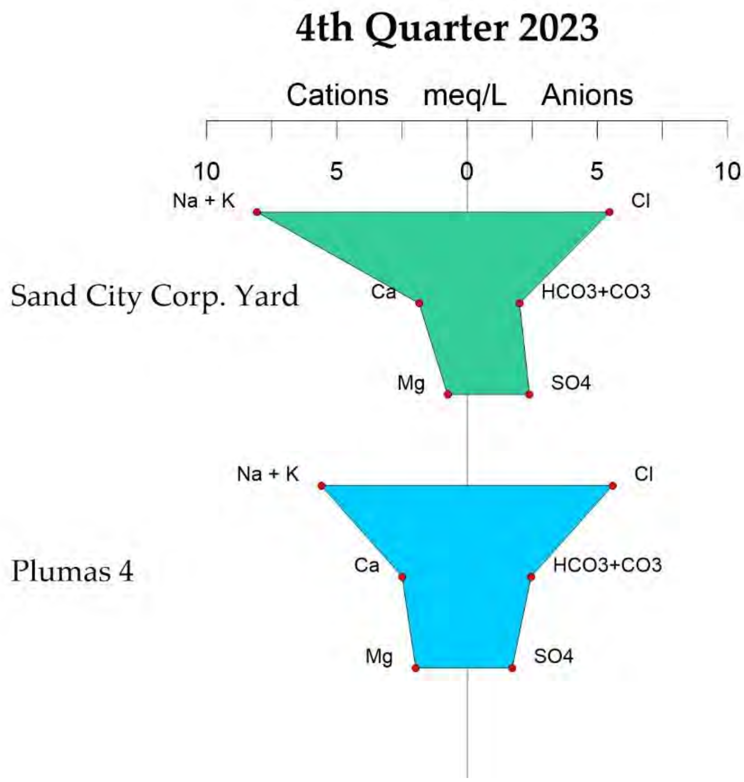
(Data source: Watermaster)

Figure 16. Piper Diagram for Seaside Groundwater Basin Production Wells, Fourth Quarter Water Year 2023 (July-September 2023)

Stiff diagrams for 13 of the production wells sampled during the fourth quarter of WY 2023 are shown on Figure 17 through Figure 20. Production well Stiff diagrams, where available, show no significant changes from the shapes observed in previous years. Ryan Ranch #7, #8, and #11 production wells were destroyed in 2021 and therefore groundwater quality data are no longer available for these wells. Data are likewise not available from wells that did not produce water in WY 2023. These include the City of Seaside Golf Course Wells (Coe and Bayonet Blackhorse), and Cypress Pacific. The City of Seaside Golf Course used recycled water during WY 2023 for golf course irrigation.

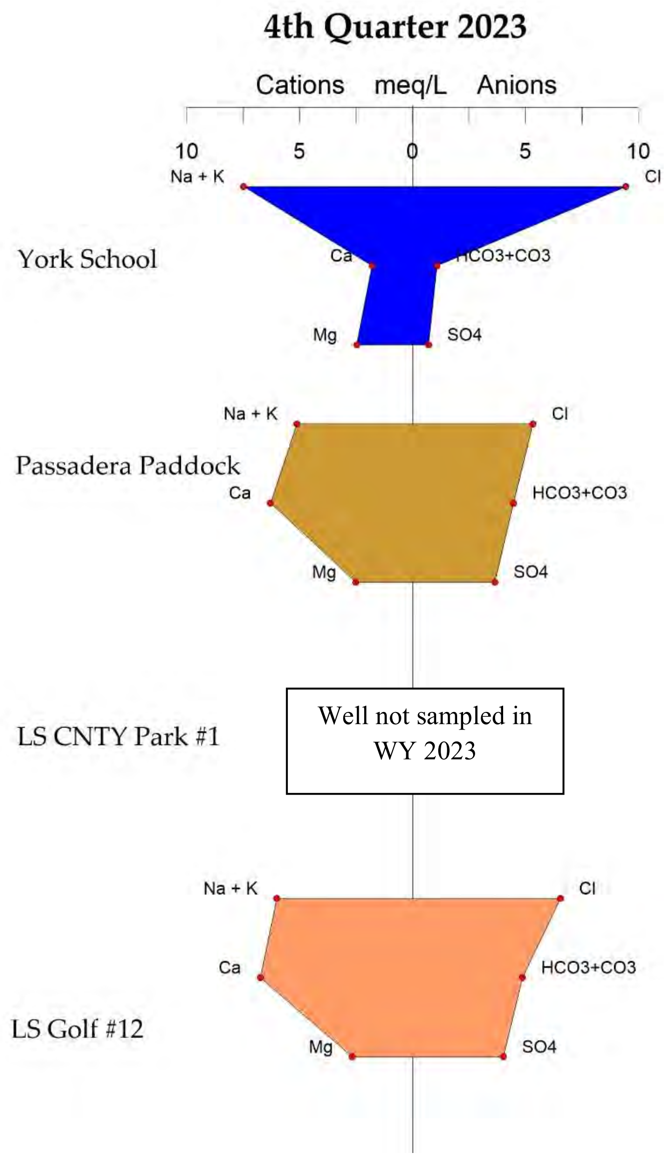
LS County Park #1, The Pasadera Paddock and LS Golf #12 production wells have a Stiff diagram shape that is slightly different from the other wells' chemistry. The cause of this could be localized mineralization. The Laguna Seca subarea is known to have higher salinity groundwater than the rest of the basin due to the underlying Monterey shale that was deposited in a marine environment. None of the Stiff diagrams for production wells near the coast show the high chloride spike shown on Figure 7 that indicates seawater intrusion.

The Sand City's Public Works Corp Yard production well in the Southern Coastal subarea and the York School production well in the Laguna Seca subarea typically have Stiff diagrams quite different from most other wells' groundwater quality. However, they do not have a large chloride spike associated with seawater intrusion as shown on Figure 7. None of the production wells sampled in WY 2023 and analyzed using Stiff and Piper diagrams show an indication of seawater intrusion.



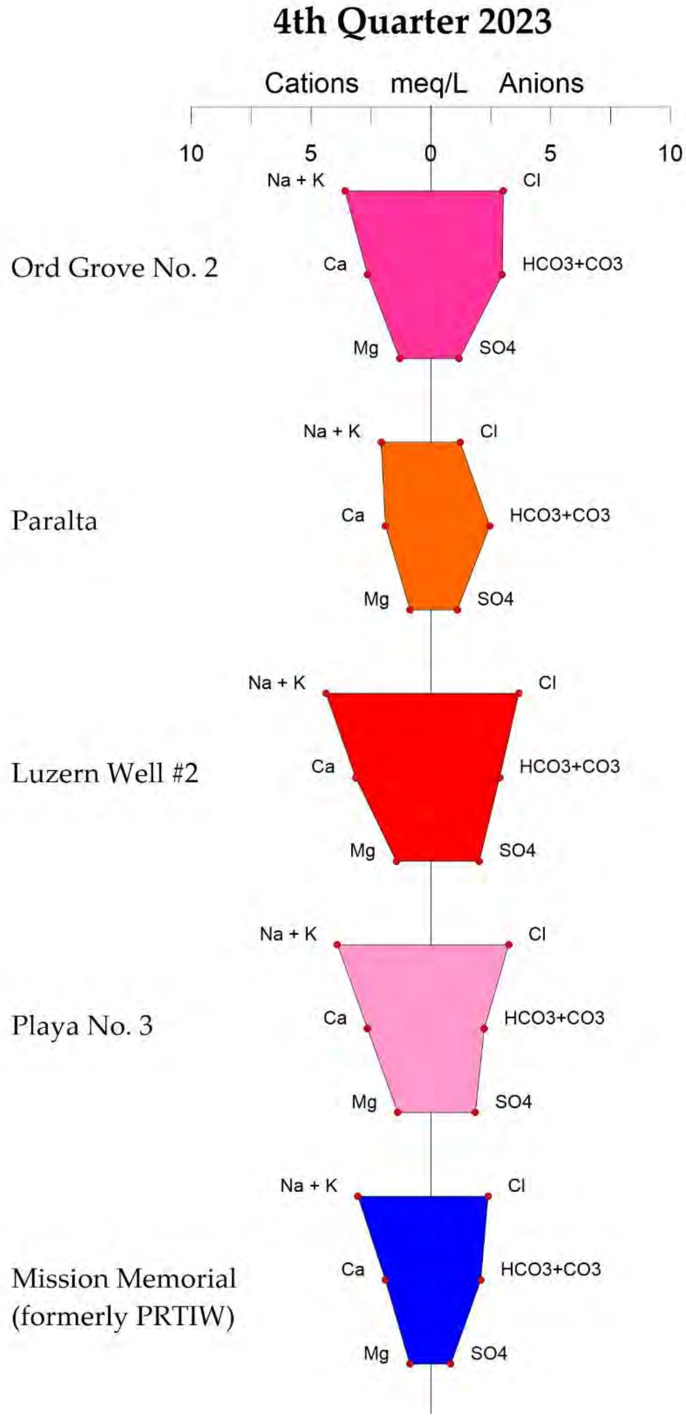
(Data source: Watermaster)

Figure 17. Stiff Diagrams for Southern Coastal Subarea Production Wells



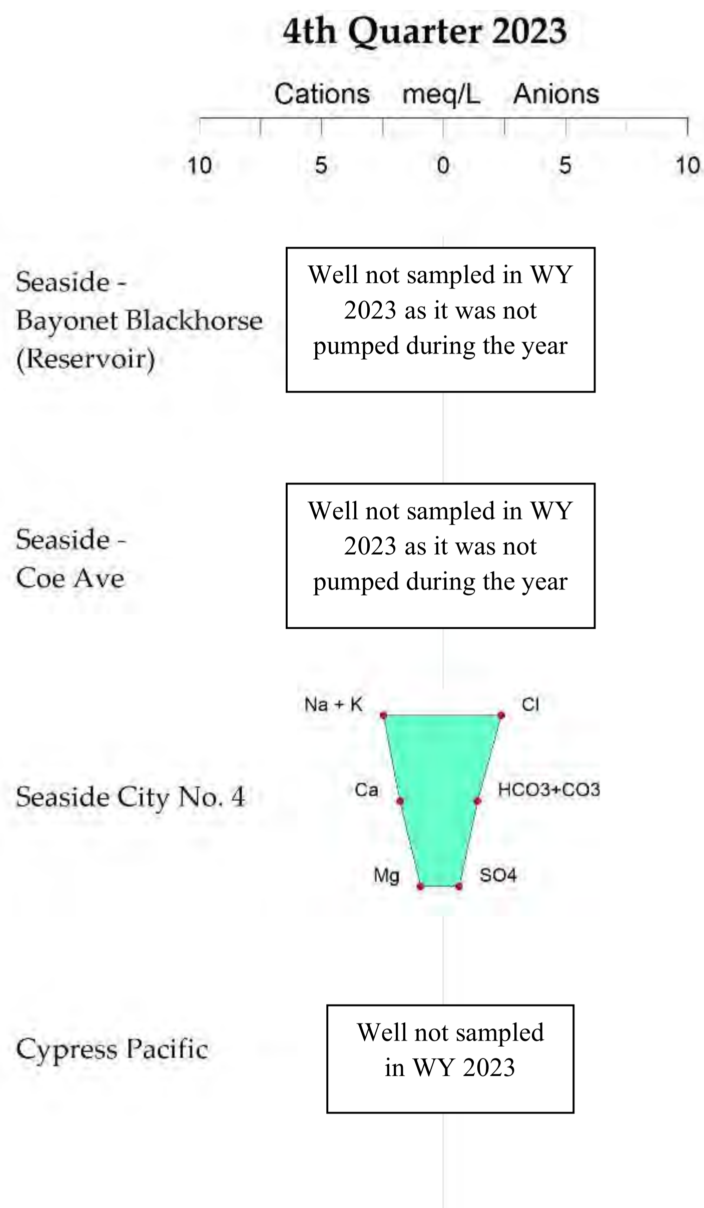
(Data source: Watermaster)

Figure 18. Stiff Diagrams for Laguna Seca Subarea Production Wells



(Data source: Watermaster)

Figure 19. Stiff Diagrams for Northern Coastal Subarea CAWC and Mission Memorial Production Wells



(Data source: Watermaster)

Figure 20. Stiff Diagrams for Northern Coastal Subarea City of Seaside and Cypress Pacific Wells

2.3 Chloride Concentrations

2.3.1 Chloride Trends

Chemographs showing chloride concentrations over time are plotted for each of the monitoring wells shown on the Piper and Stiff diagrams. An example plot displaying chloride concentrations for the shallow PCA-West Shallow monitoring well is shown on Figure 21. A complete set of chemographs is included in Appendix D. Chloride trends for most monitoring wells remain stable or fluctuate within a historical range.

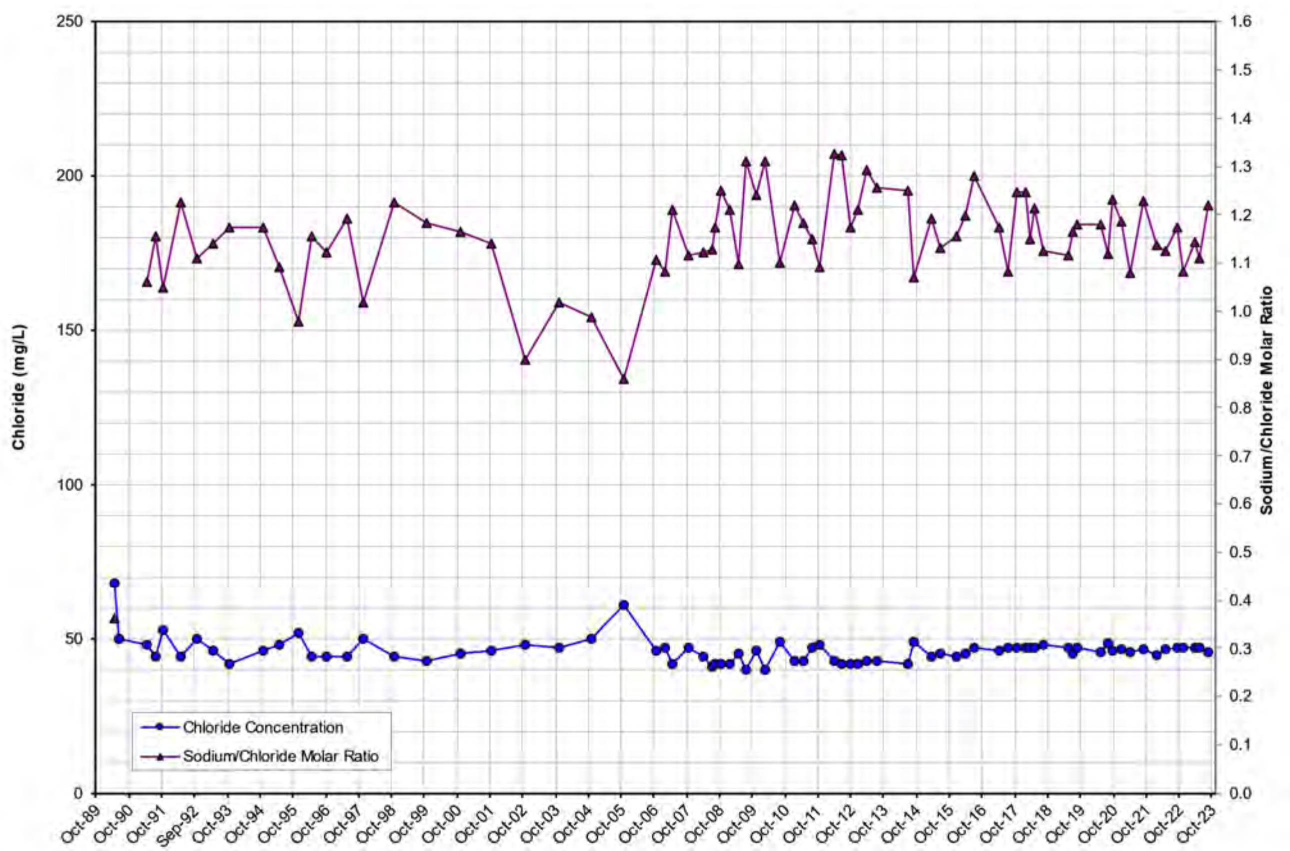


Figure 21. Historical Chloride and Sodium/Chloride Molar Ratios, PCA West Shallow

Since WY 2020, chloride concentrations in FO-10 Shallow have been elevated from historical baseline concentrations of less than 70 mg/L (Figure 22). Of the 4 samples collected from the well in WY 2023, the first 2 in November 2022 and March 2023 were above 90 mg/L, while the May and August 2023 samples were below 90 mg/L. Induction logging of FO-10 Deep in 2021 was inconclusive regarding the presence of seawater intrusion in the well and was complicated by discovery of a 1,300-foot steel pipe that has been left in the borehole since the well's construction. As the presence of this steel pipe clouds interpretation of groundwater quality results and may act as a conduit for groundwater in overlying sediments to enter underlying aquifers, it is recommended that both FO-10 Shallow and FO-10 Deep be destroyed and replaced to maintain a consistent water quality record in the area.

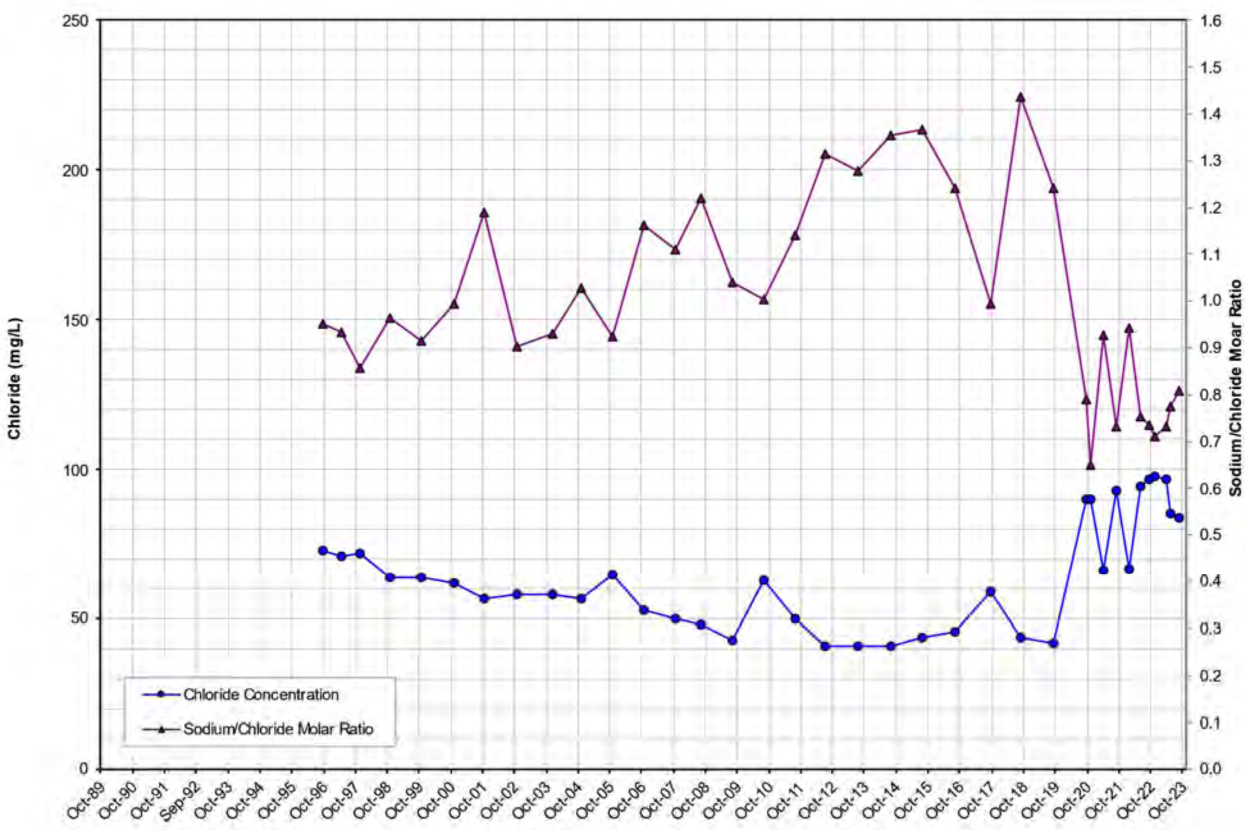


Figure 22. Historical Chloride and Sodium/Chloride Molar Ratios, FO-10 Shallow

In WY 2021, FO-09 Shallow was destroyed due to its damaged casing and was replaced in October 2023. This monitoring well's increasing chloride concentrations are believed to have been caused by the cracked casing that introduced shallower high chloride water into the well. Data will be available from the replacement well for next year's SIAR.

2.3.2 Chloride Concentration Maps

Fourth quarter WY 2023 chloride concentrations are mapped using data from August and September 2023. The maps for the Paso Robles (shallow) and Santa Margarita (deep) aquifer zones are included on Figure 23 and Figure 24 respectively.

The Paso Robles (shallow) aquifer fourth quarter WY 2023 chloride concentration map is shown on Figure 23. Chloride data are posted on this map but do not show a spatial distribution that can be readily contoured because of relatively large differences in concentrations in wells near each other. Except for FO-10 Shallow, Paso Robles aquifer chloride concentrations have not varied much from previous water years.

FO-10 Shallow is located 0.7 miles north of the Basin, just over 1 mile inland of the coast. Chloride concentrations at this well have steadily increased each year since WY 2020. While the November 2022 sample at this well was the highest on record (98 mg/L), chloride concentrations decreased 14 mg/L from March to August 2023. August's chloride concentration of 83.8 mg/L remains higher than most previous spring samples. As shown on Figure 22, chloride concentrations at the well jumped about 48 mg/L between September 2019 (42.2 mg/L) and September 2020 (89.9 mg/L) and continued increasing through August 2021 (92.8 mg/L) and September 2022 (96.6 mg/L), before dropping in August 2023 (83.8 mg/L). In summary, despite an improvement over WY 2023, chloride elevations at the well remain above historical norms.

Figure 23 shows chloride concentrations in the northern coastal portion of the Northern Coastal subarea, such as FO-10 Shallow, are approximately 80-85 mg/L. The more inland Northern Coastal subarea wells have slightly higher chloride concentrations that may be due to depositional mineralization differences in the Paso Robles Formation. Within the Monterey Subbasin, north of Seaside, chloride concentrations increase in a northward direction toward the currently understood extent of seawater intrusion (see Monterey Subbasin Groundwater Sustainability Plan (GSP) Figure 5-29).

Sand City's Public Works Corp Yard well in the Southern Coastal subarea has historically had the highest chloride concentration of all shallow coastal wells (Appendix D, Figure D-13). The Piper and Stiff diagrams and sodium/chloride molar ratio for the well suggest the source of high chloride in the well's groundwater is not seawater. It is notable that there was a significant decline in chloride concentration of approximately 88 mg/L, compared to the previous year, that is the lowest concentrations since 2018.

The Santa Margarita aquifer fourth quarter WY 2023 chloride concentration map is shown on Figure 24. Chloride concentrations for the Sentinel Wells are not shown on this map because it was found that groundwater samples collected from them are not representative of the aquifer. Santa Margarita aquifer chloride concentrations near the coast range roughly between 65 mg/L and 150 mg/L and are similar to last year. Chloride concentrations in the eastern portion of the Northern Coastal subarea are generally within the 100-130 mg/L range of historical concentrations. Within this area, the Ord Grove #2 production well experienced a 17 mg/L decrease in chloride concentration over the year, dropping to 107 mg/L which is similar to its concentration in WY 2021. Since the chloride data show no discernible spatial distribution with high concentrations close to low concentrations, the data cannot be readily contoured.

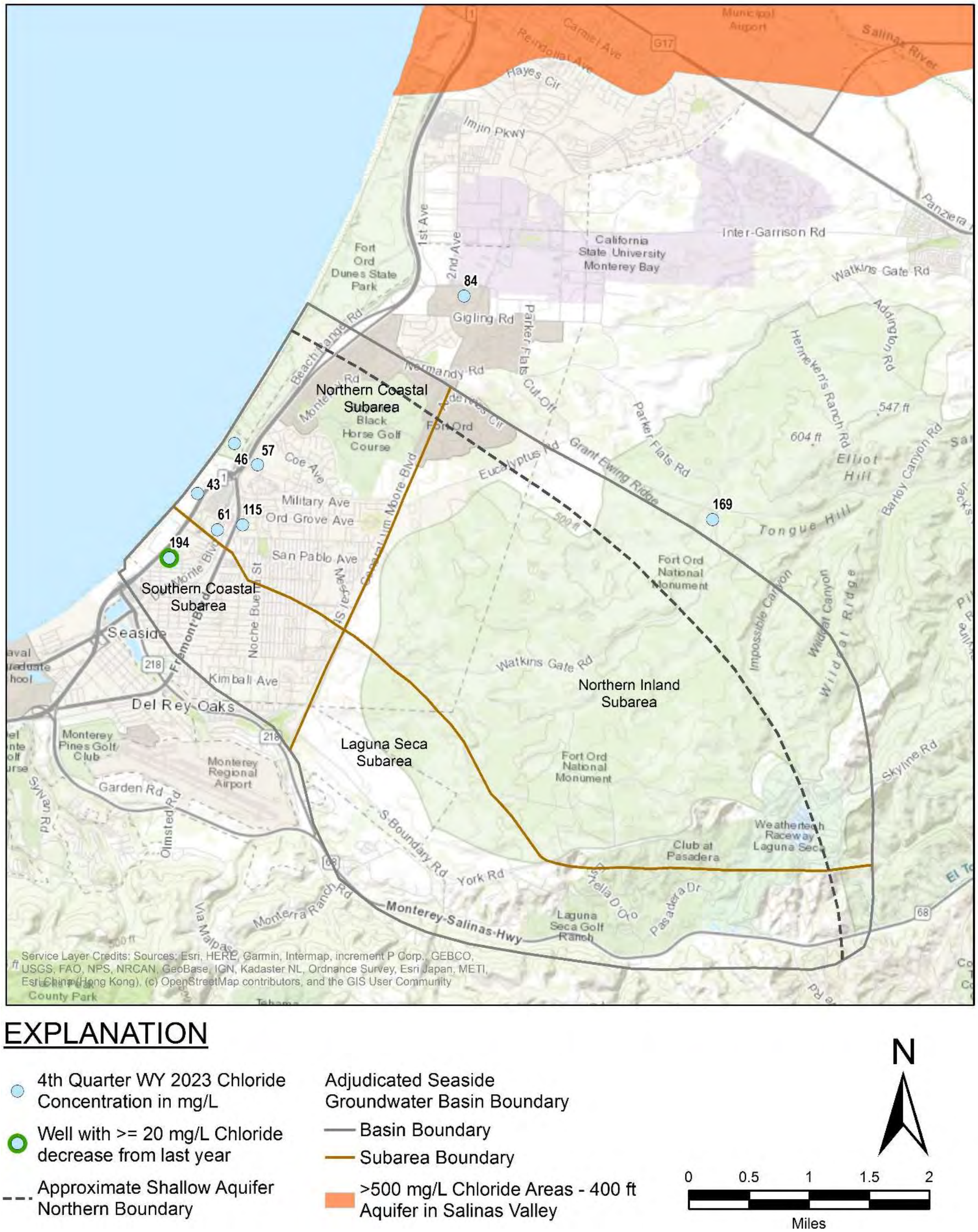


Figure 23. Paso Robles Aquifer (Shallow Zone) Chloride Concentration Map – Fourth Quarter Water Year 2023

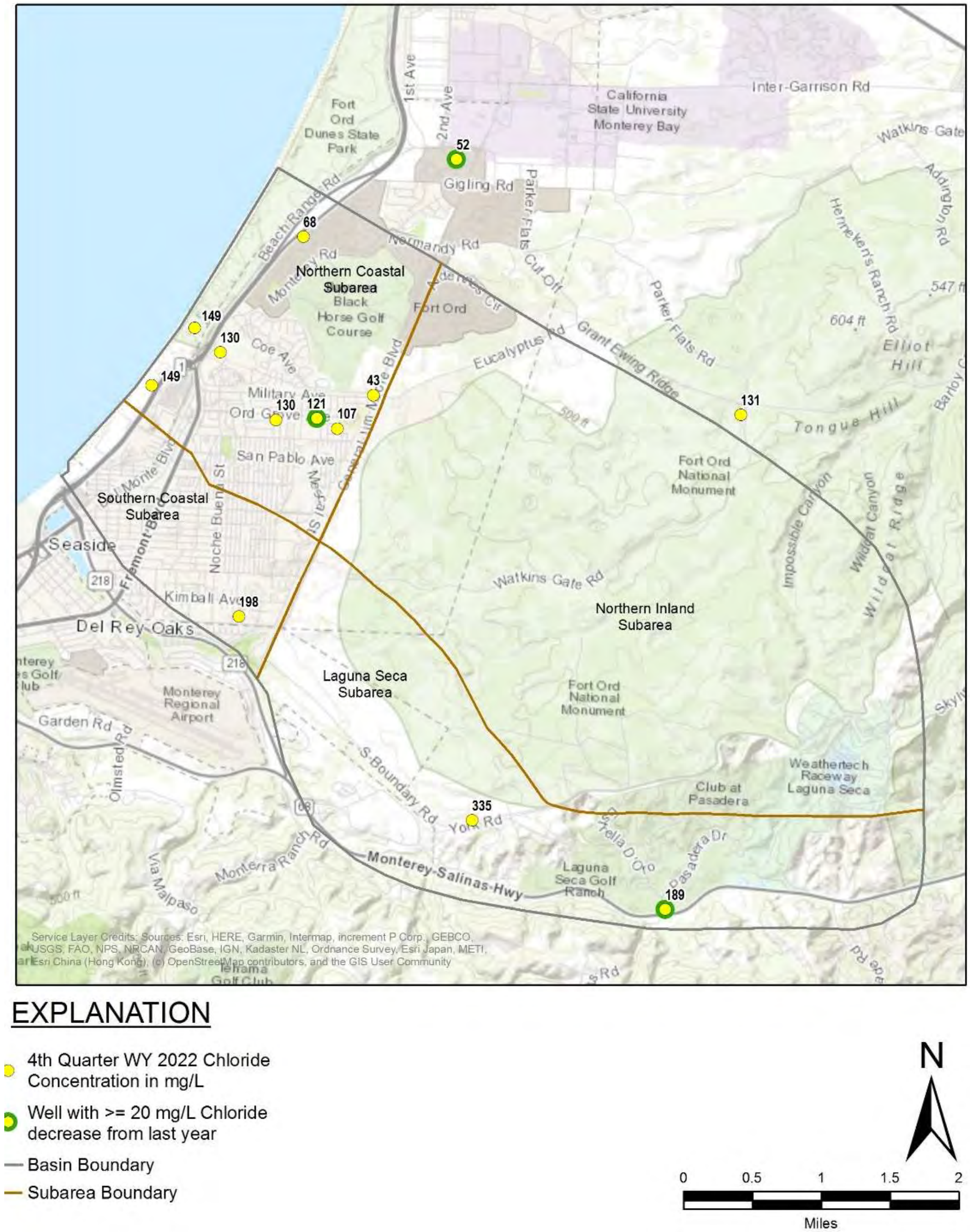


Figure 24. Santa Margarita Aquifer (Deep Zone) Chloride Concentration Map – Fourth Quarter Water Year 2023

Chloride concentrations at both the Pasadera Golf Course Paddock and the Ord Terrace Shallow wells decreased over 100 mg/L and over 20 mg/L respectively, from the previous year (Figure 24). This drop comes after an increase in the previous year resulting in WY 2022 having the highest measured concentrations at Pasadera Golf Course Paddock well, and the second highest at Ord Terrace Shallow. Due to its inland location, chloride concentrations at the Pasadera Golf-Paddock well are not related to seawater intrusion. Likewise, the Ord Terrace Shallow concentration of 121 mg/L remains within its historical range between 100 and 155 mg/L and does not reflect seawater intrusion. Chloride concentrations at FO-10 Deep dropped 68.4 mg/L bringing its chloride concentrations back to its historical range between 40 and 60 mg/L.

2.4 Sodium/Chloride Molar Ratios

Chemographs showing long-term sodium/chloride molar ratios over time are plotted for 12 monitoring wells and 1 production well. Also included are historical chemographs for monitoring wells not sampled in WY 2023: FO-9 Shallow because of cracked casing making water quality results unreliable and Ord Terrace Deep because of access complications. An example plot displaying sodium/chloride molar ratios for the shallow PCA West well is shown on Figure 21. A complete set of chemographs is included in Appendix D.

Most of the sodium/chloride molar ratios in the monitoring wells remained constant or increased over the past year. Nine of the last 11 samples from FO-10 Shallow have sodium/chloride molar ratios less than 0.86 (Appendix D: Figure D-9). Sodium/chloride ratios below 0.86 are significant because Jones *et al*. (1999) suggest that sodium/chloride ratios in advance of a seawater intrusion front will be below 0.86. The increasing chloride trend and decreasing sodium/chloride molar ratio indicate that FO-10 Shallow may be showing signs of incipient seawater intrusion. As described above, analysis of ongoing seawater intrusion at this well is complicated by the discovery of a steel pipe in the well's borehole. It is recommended that the FO-10 Deep and Shallow wells be destroyed and replaced to maintain a robust water quality record in the area.

2.5 Electric Induction Logs

One induction logging event took place in the 4 Sentinel Wells for WY 2023. Logging would normally have been performed in October, but was delayed due to technical problems with the logging tool and was conducted in November 2023. Although logging took place in WY 2024, the data are included in this WY 2023 SIAR. Pacific Surveys conducted the logging as they have done since August 2014.

Three different induction tools have been used during the project history, and while different tools show responses that are different in terms of absolute values, each tool has had internally consistent "same-tool" responses. The current induction tool (Tool 3 LIM) displays repeatable responses and is consistent with the other 2 induction tools used historically on site (Feeney (2020). Moving forward, all data presentations will be referenced to the current tool, as was done in 2014 when the tool change previously occurred.

Feeney (2007) described the original 2007 baseline induction logs for each of the wells as follows:

> *SBWM-1 — The upper 50 feet of this well shows very high conductivities. This signature is present in all of the wells and is the result of the 50-foot steel conductor casing. However, because the water table is below the conductor casing at all locations, the steel casing does not interfere with data collection within the saturated sediments below. Below the conductor casing in SBWM-1, the sediment materials are dry to a depth of approximately 115 feet. Below this depth, there is approximately 10 feet of sand containing fresh water. Below 125 feet and extending to approximately 350 – 400 feet is sand containing saline water with conductivities measuring as high as 10,000 mhos/cm. This saline water is contained within the Dune /Beach Sand Deposits and the Aromas Sand. Below this depth, conductivities are relatively low with the exception of the thick marine clay between approximately 600 -700 feet. The other conductive zones also correlate with clay zones.*
>
> *SBWM-2 — As in SBWM-1 there is a thin layer of fresh water overlying a zone of saline water to approximately 130 feet within the Beach/Dune Sands and Aromas Sand. Below this depth, the materials become increasingly clayey, complicating the interpretation. Below this depth, there are no obvious zones of anomalous conductivity; that is, the zones that are more conductive correlate with clay zones.*
>
> *SBWM-3 — In SBWM-3 saline water extends to a depth of approximately 100 feet within the Dune/Beach Sand and Aromas Deposits. Below 100 feet, the materials become clay and conductivities rapidly decline. Again, below the shallow saline water in the sand deposits, all zones of increased conductivity correlate with clay zones.*
>
> *SBWM-4 — As with the other wells, the induction log reveals a thin layer of fresh water overlying saline water with the Dune Sands/Beach Deposits to a depth of approximately 100 feet. Below this depth the materials become clay and there are no additional zones of increased conductivity uncorrelated with clay zones.*

Salinity changes shown on Figure 25 through Figure 28 for Sentinel Wells 1–4 respectively, are only relative, and do not allow direct measurement of TDS or chloride concentrations in the aquifer. They do, however, provide a means to determine changes in salinity over time. Induction logging in previous years indicated salinity in the Dune Sands and Aromas Formation overlaying the main production aquifers fluctuates from season to season; becoming more saline in the fall months when stresses on the aquifer are greatest.

The induction logs show small increases in conductivity over time in SBWM-1, 2, and 4 within the Paso Robles Formation. Apart from localized conductivity increases in the Paso Robles Formation shown on zone of interest induction logs (Figure 29 through Figure 31), the remaining parts of the induction logs plot similarly to previous years. This suggests increased conductivity is preferentially confined to coarser-grained zones in the Paso Robles Formation and does not extend throughout the Paso Robles Formation or into the Santa Margarita Formation. Zones of increasing conductivity are as follows:

- SBWM-1, 500 – 540 feet below ground surface (bgs); see Figure 25 and Figure 29
- SBWM-3, 335 – 385 feet bgs; see Figure 26 and Figure 30
- SBWM-4, 140 – 200 feet bgs; see Figure 28 and Figure 31

Sentinel wells SBWM-1 and SBWM-2 are outside the Seaside Basin and closest to the known seawater intrusion in the 180-foot aquifer in the Salinas Valley – Monterey Subbasin. Of the 3 Sentinel wells, SBWM-4 has the greater increase in conductivity. SBWM-4 is located in the central coastal portion of the Northern Coastal subarea (Figure 10) in which the majority of the Basin's groundwater extraction occurs. The closest extraction well in the Paso Robles Formation to SBWM-4 is 1 of the Bayonet/Black Horse golf course's Coe Ave irrigation wells about 0.6 miles away. All the golf course irrigation wells are screened at least in part in the Paso Robles Formation. Almost all water supply wells are screened in both the Paso Robles and Santa Margarita Formations. CAWC's closest water supply wells to SBWM-4 are Playa #3 (0.8 miles to the south) and Luzern Well #2 (0.9 miles to the southeast). Other CAWC and City of Seaside water supply wells are over 1 mile away.

The Basin's Seawater Intrusion Response Plan (SIRP; HydroMetrics, 2009c) identifies chloride concentrations, sodium/chloride molar ratios, cation and anions, and spatial chloride changes as indicators of seawater intrusion. Since the Sentinel wells are no longer sampled due to inconsistent results because of their long screens, water quality as an additional line of evidence from the Sentinel wells are not available. Further, the SIRP provides threshold values in monitoring wells, excluding the Sentinel wells, that trigger a series of intrusion contingency actions included in the SIRP. The closest monitoring well to SBWM-4 is PCA-West Shallow (790 feet away). The well is screened from 525 to 575 feet bgs and cannot be used to verify chloride concentrations at SBWM-4 because the screens are 350 feet below the zone where conductivity is increasing in SBWM-4 (Figure 31). PCA West Shallow will likely not show any increase in chloride because of the heterogeneous nature of the Paso Robles Formation that appears to confine, at least for now, the increasing conductivity zone to the coarse-grained portions of the formation. Induction logging of PCA-West Shallow could potentially be used to determine if increased conductivity is also occurring in the Paso Robles Formation at that location, but data would need to be collected over a period of at least several years to see if these is a trend toward increased conductivity. The CDM monitoring wells are screened in the Dune Sands and are too shallow to be helpful.

It will not be feasible to directly measure chloride in the zone of increasing conductivity in SBWM-4, because that would require construction of a new monitoring well targeting that zone. Since SBWM-4 is in the coastal zone and within the Fort Ord Dunes State Park, it would likely not be possible to obtain permission from the Coastal Commission and the State Department of Parks and Recreation to construct a new well at that location. Because of this, ways to use existing wells should be explored. It is recommended that options should be evaluated in WY 2024 for ways to determine if chloride is increasing in the Paso Robles Formation within the Basin.

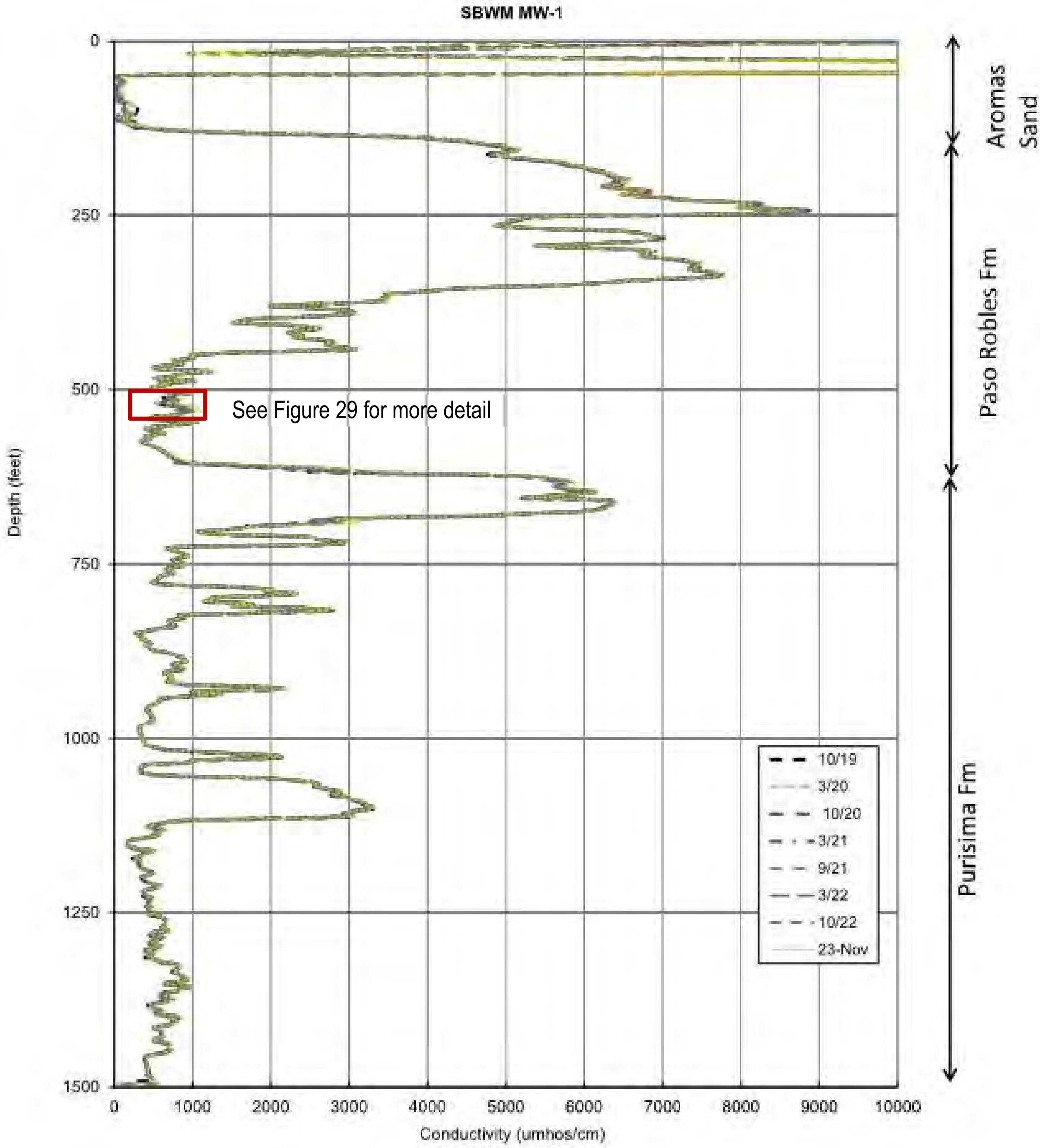


Figure 25. Sentinel Well SBWM MW-1 Induction Log

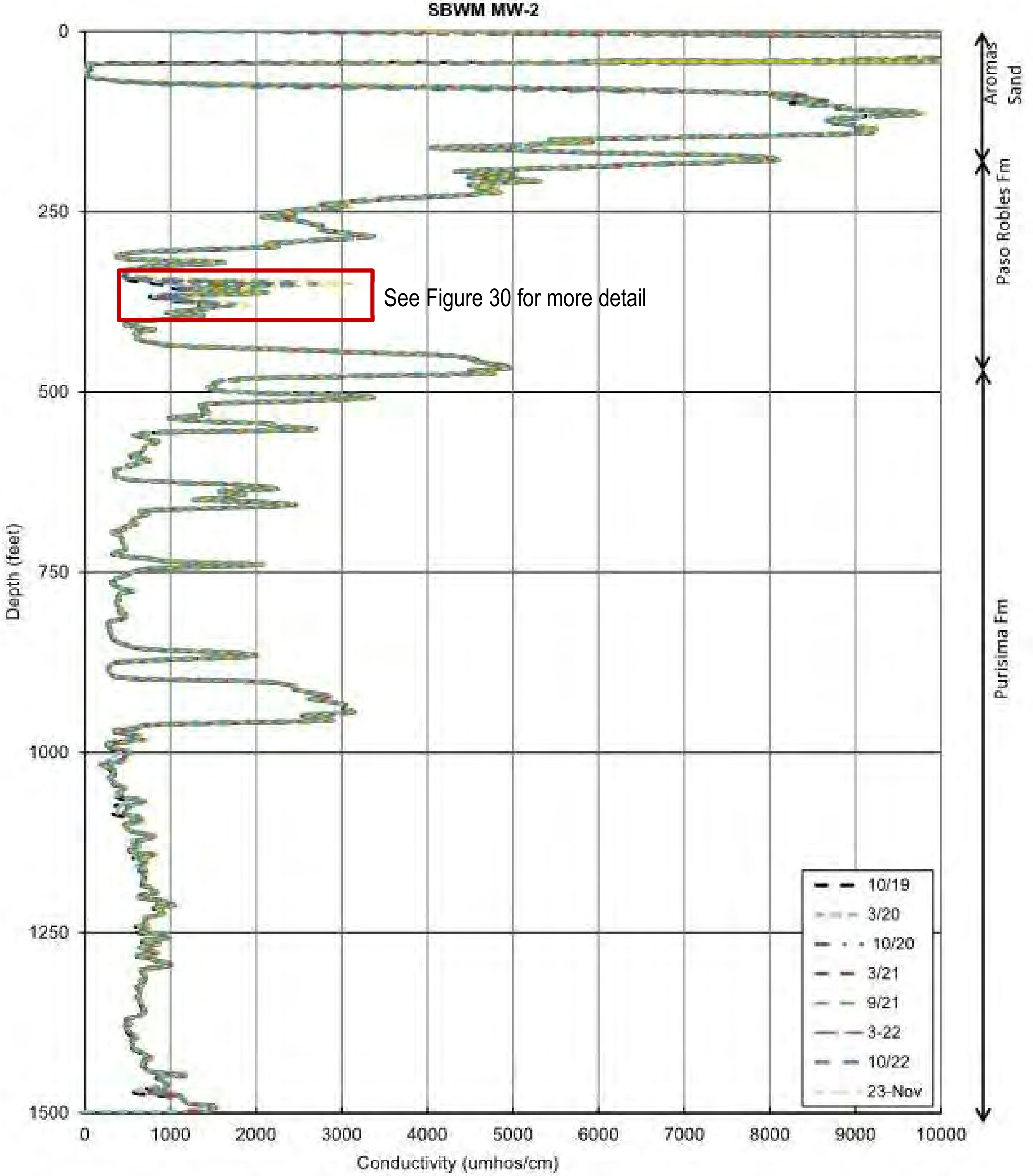


Figure 26. Sentinel Well SBWM MW-2 Induction Log

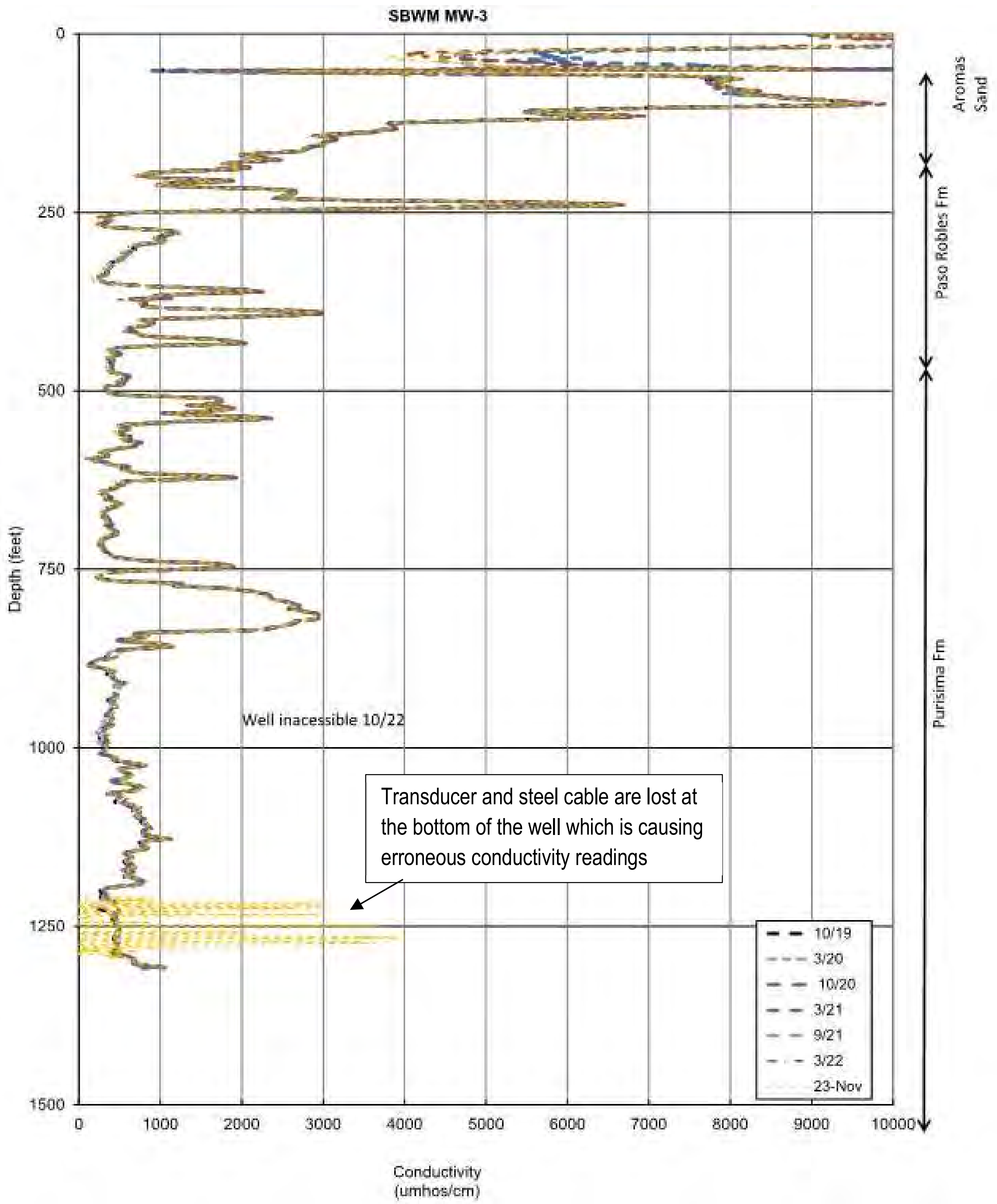


Figure 27. Sentinel Well SBWM MW-3 Induction Log

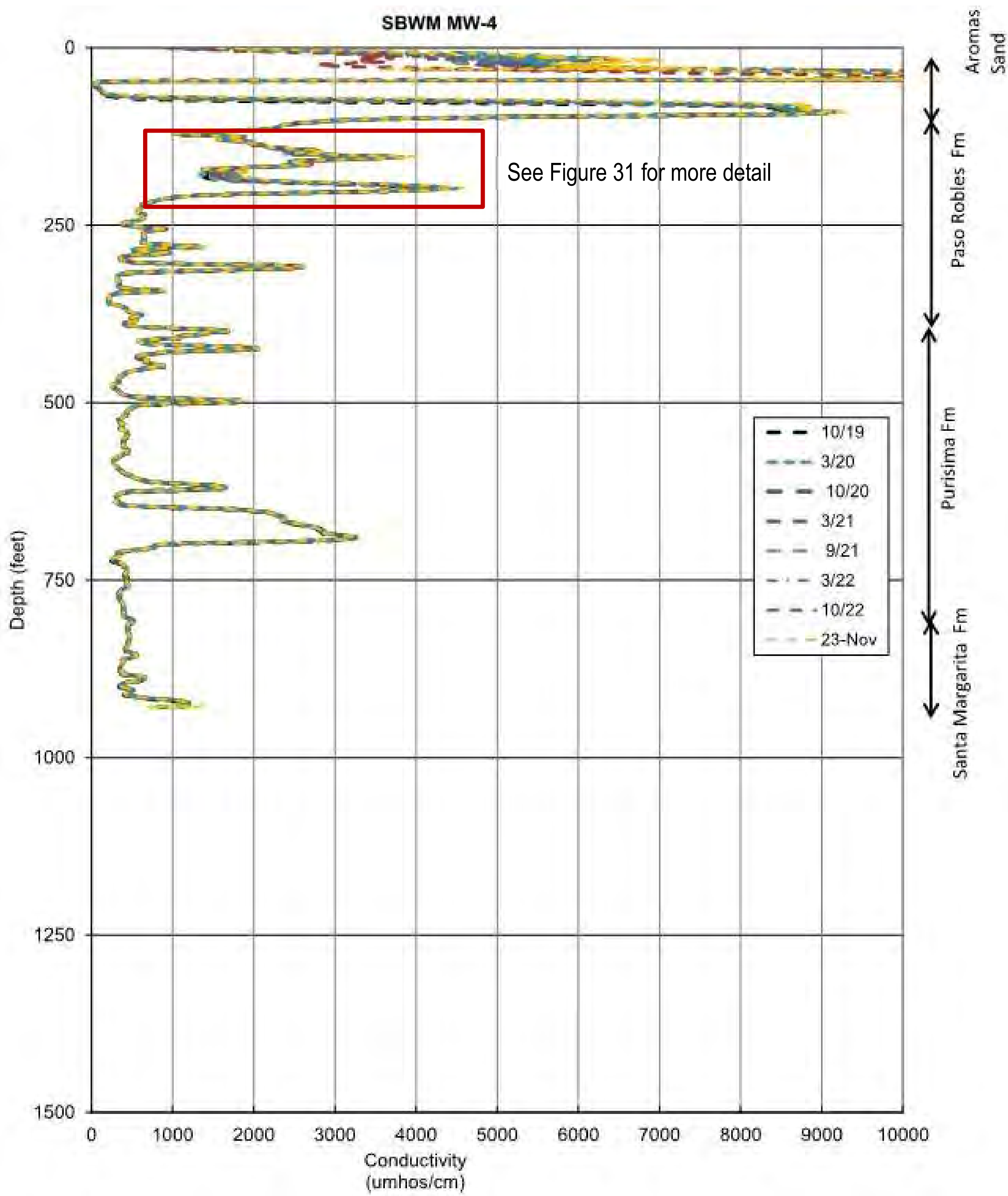


Figure 28. Sentinel Well SBWM MW-4 Induction Log

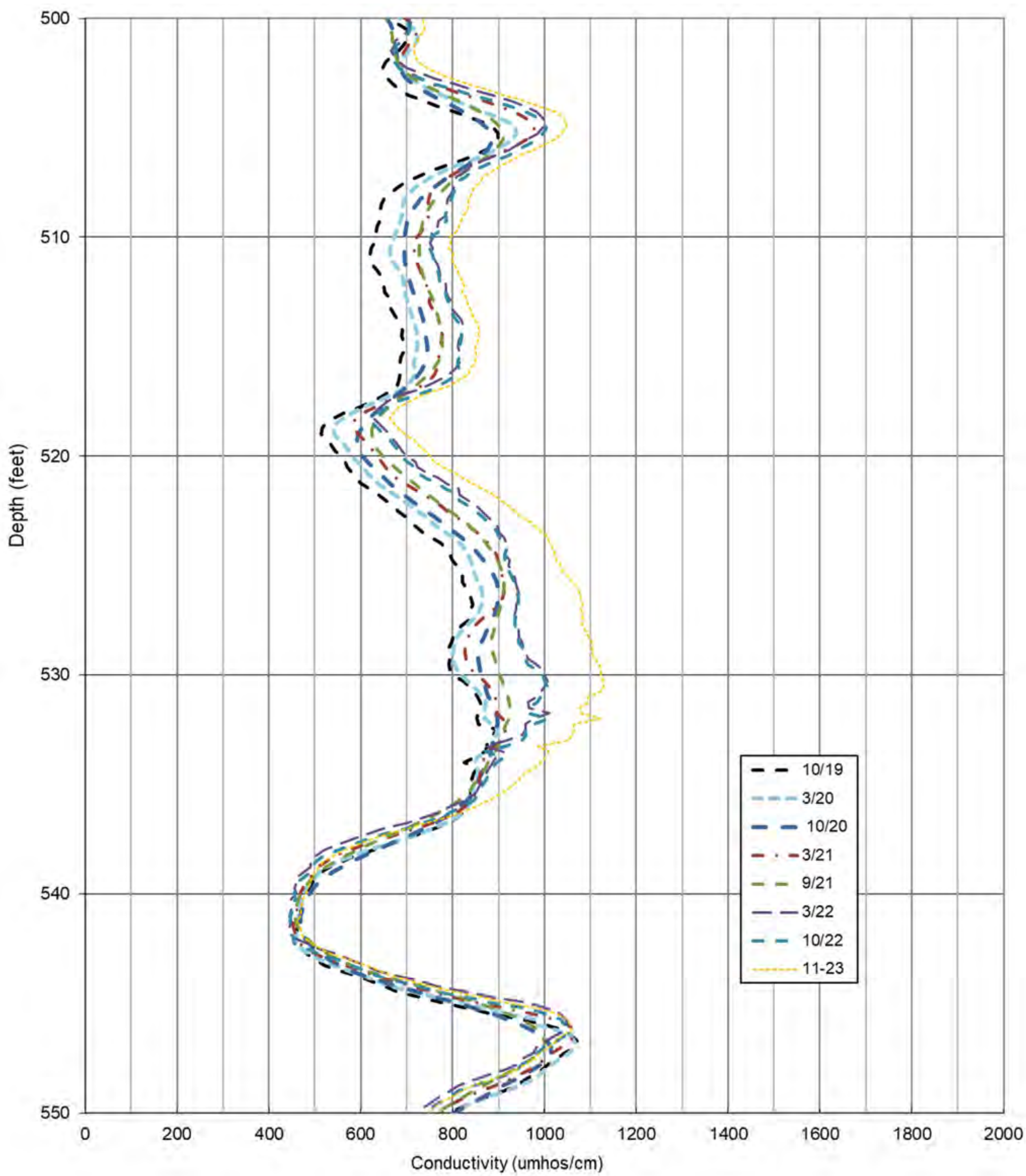


Figure 29. Sentinel Well SBWM-1 Zone of Interest on Induction Log

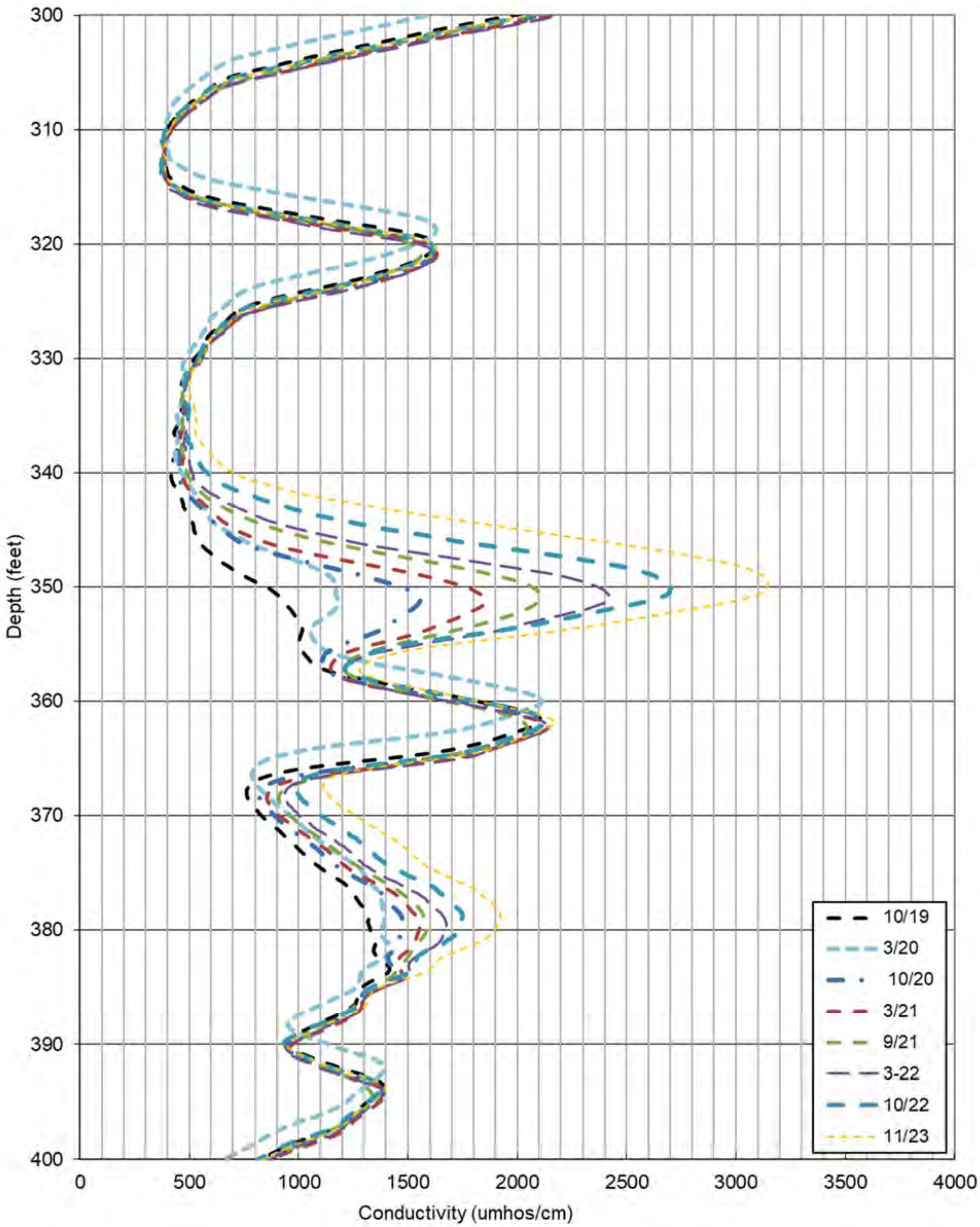


Figure 30. Sentinel Well SBWM-2 Zone of Interest on Induction Log

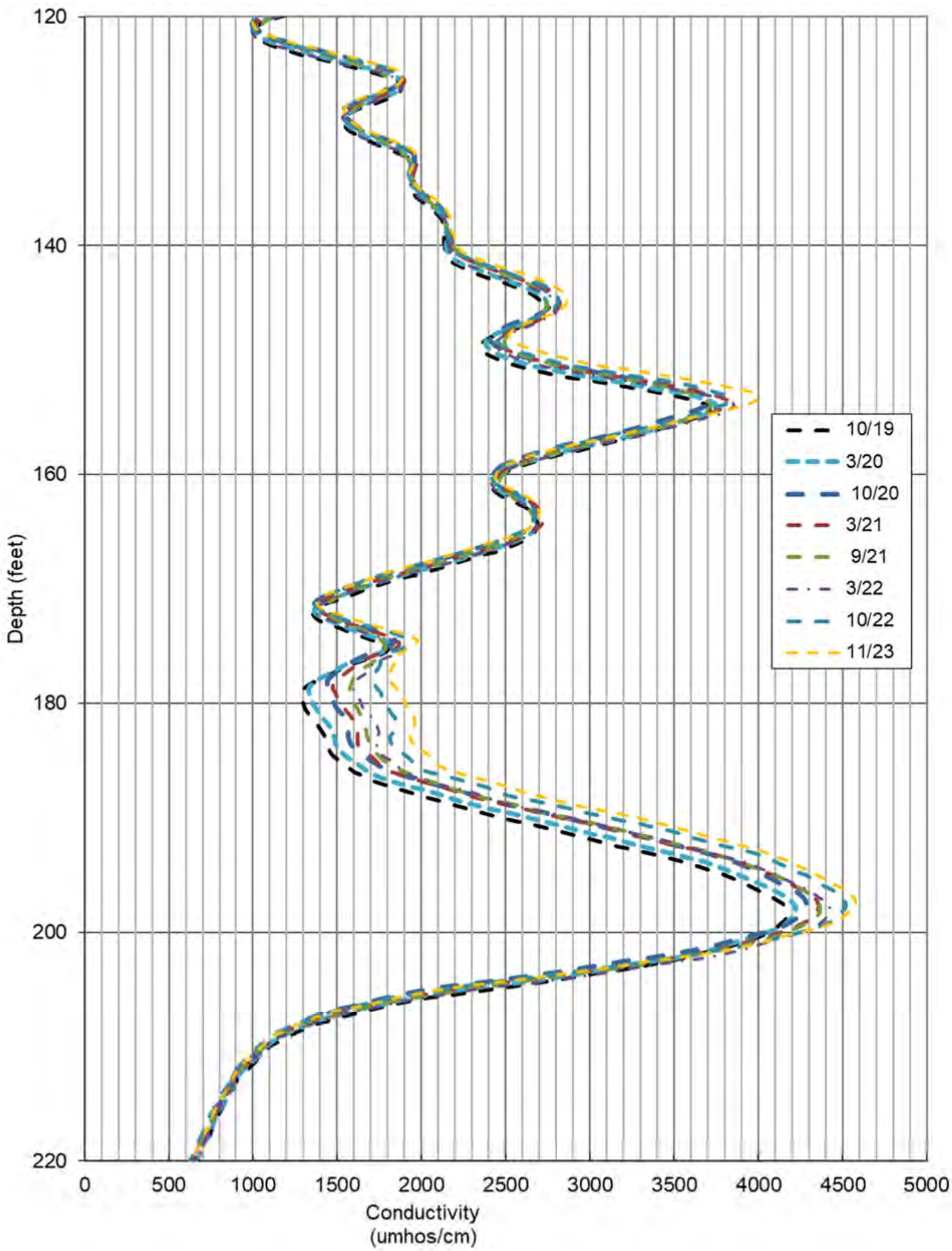


Figure 31. Sentinel Well SBWM-4 Zone of Interest on Induction Log

2.6 Groundwater Levels

Groundwater levels are not direct indicators of seawater intrusion, but indirectly suggest opportunities for seawater intrusion. Coastal groundwater levels at or near sea level are insufficient to repel seawater intrusion and will likely allow some amount of seawater intrusion unless groundwater levels increase. All groundwater level data collected in WY 2023 are included in Appendix B.

2.6.1 Precipitation

Precipitation is described here because of its relationship to groundwater recharge, which is 1 of the factors influencing groundwater levels. Figure 32 displays annual precipitation averaged for 2 National Oceanic and Atmospheric Administration climate stations in the Seaside area: the Monterey airport station (USC00045795) and the Salinas Airport station (USW00023233). Taking the average precipitation from these 2 stations results in a value representative of the spatial variation across the Basin.

In WY 2023, precipitation from the 2 stations averaged 20.9 inches. This is the most precipitation since WY 2005 and is well above the historical average of 15.7 inches. The solid line on Figure 32 tracks cumulative departure of annual precipitation from the historical average. While there was high precipitation in WY 2023 similar to WY 2019, the 3 years in between were substantially below average. WY 2023's high rainfall certainly resulted in groundwater recharge to the Basin. Typically, the effects of recharge are first seen in the shallow aquifer, which is unconfined by clay layers and most directly impacted. The deep aquifer exhibits more delayed recharge impacts because of its depth and confined nature.

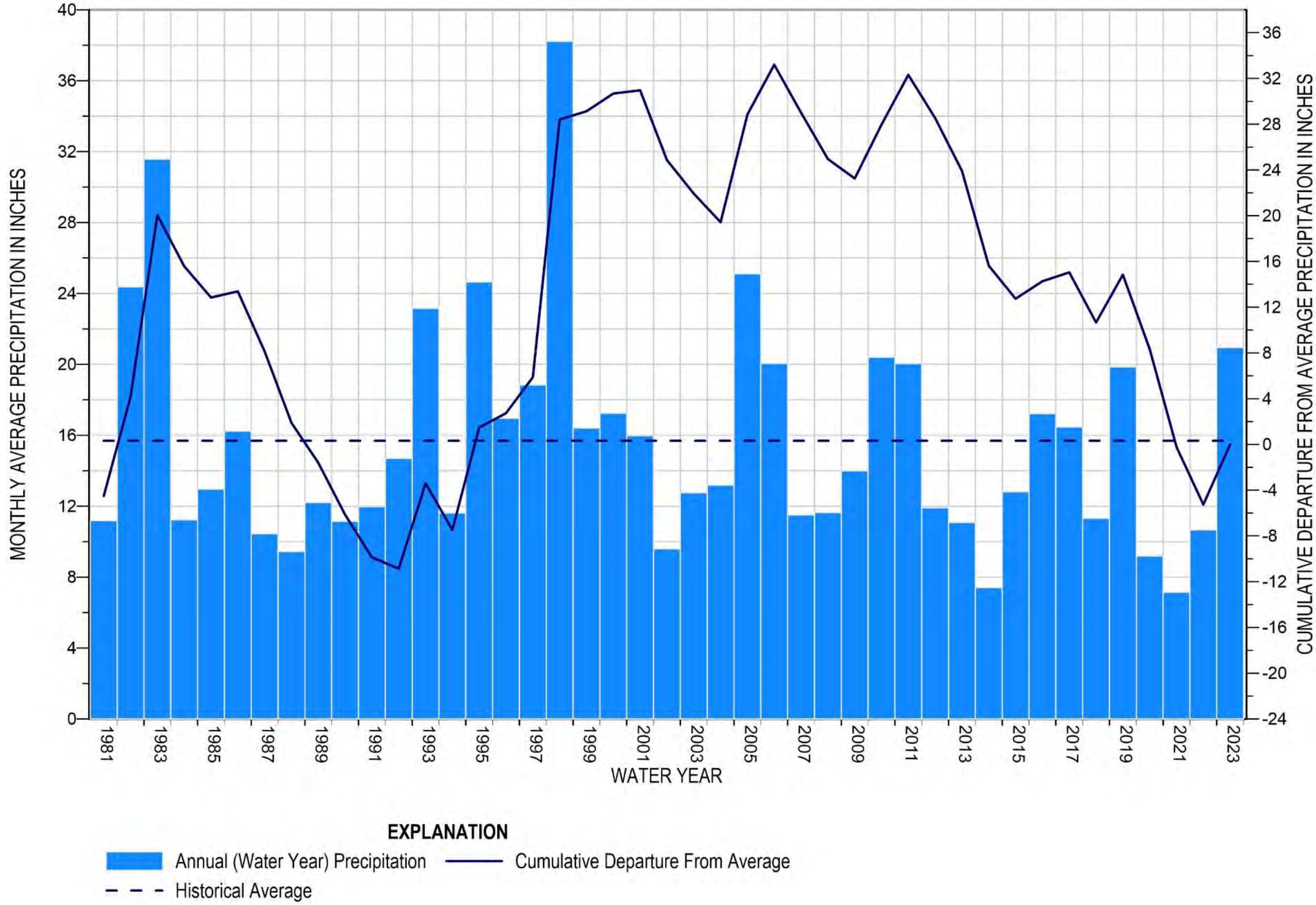


Figure 32. Annual Precipitation in Seaside Basin (Average of Monterey Airport and Salinas Airport Stations)

2.6.2 Groundwater Level Trends

The subsections below describe groundwater elevation trends for the Northern Coastal, Southern Coastal, and Laguna Seca subareas. No wells are monitored in the Northern Inland subarea.

2.6.2.1 Northern Coastal Subarea

Groundwater levels measured at the PCA-East well are generally representative of groundwater levels in the Northern Coastal subarea, west of nearby production wells. The hydrograph shows peaks and lows that are strongly influenced by pumping by the nearby CAWC production wells which draw from the deep aquifer, and injection of Carmel River ASR water and Pure Water Monterey (PWM) highly treated recycled water at the eastern boundary of the subarea (Figure 33). Other influences are also recognized, such as tides which can cause up to a 1-foot fluctuation in the deep completion of PCA-East. Because of all the possible influences on groundwater levels, it is difficult to compare the present year to the previous year directly. What is more important is to look at long-term trends.

The Santa Margarita aquifer (deep zone) has limited, if any, connection to the ocean and is highly confined by the layers above it. This means that the amount of recharge entering the Santa Margarita Sandstone is limited and is therefore always susceptible to depletion if more water is pumped than is being recharged.

PCA-East Deep (blue line on Figure 33) shows an overall decline in groundwater levels until WY 2009. Thereafter, levels increase and then more or less stabilize over the next 2 years. Then from WY 2011 to WY 2016 they continue to decline. Groundwater levels recovered slightly in WY 2017 due to above average rainfall, and remained at similar levels since through WY 2020, with no clear increasing or decreasing trend. The start of the overall decline in groundwater levels in PCA-East Deep corresponds with the shift in CAWC's production from their shallow Paso Robles aquifer wells to deeper Santa Margarita wells.

Seasonal fluctuations are noticeable in the winter season when Santa Margarita groundwater elevations are at their highest for the year. For example, the 2017 winter high in PCA-East Deep increased to a level last seen in 1995, because 2,345 acre-feet of excess Carmel River water was injected as it was a very wet year. As described in Section 2.6.1, WY 2023 was a wet year, resulting in available Carmel River Water for ASR injection. Wet conditions, 3,755 acre-feet of Pure Water Monterey injection, and ASR injection resulted in an increase in the seasonal high elevations shown on Figure 33. This marks a departure from very dry conditions over the previous 2 years; last year both seasonal high and low groundwater elevations were amongst the lowest on record. In WY 2023 both seasonal high and low groundwater elevations increased relative to the previous year and are similar to conditions in WY 2020.

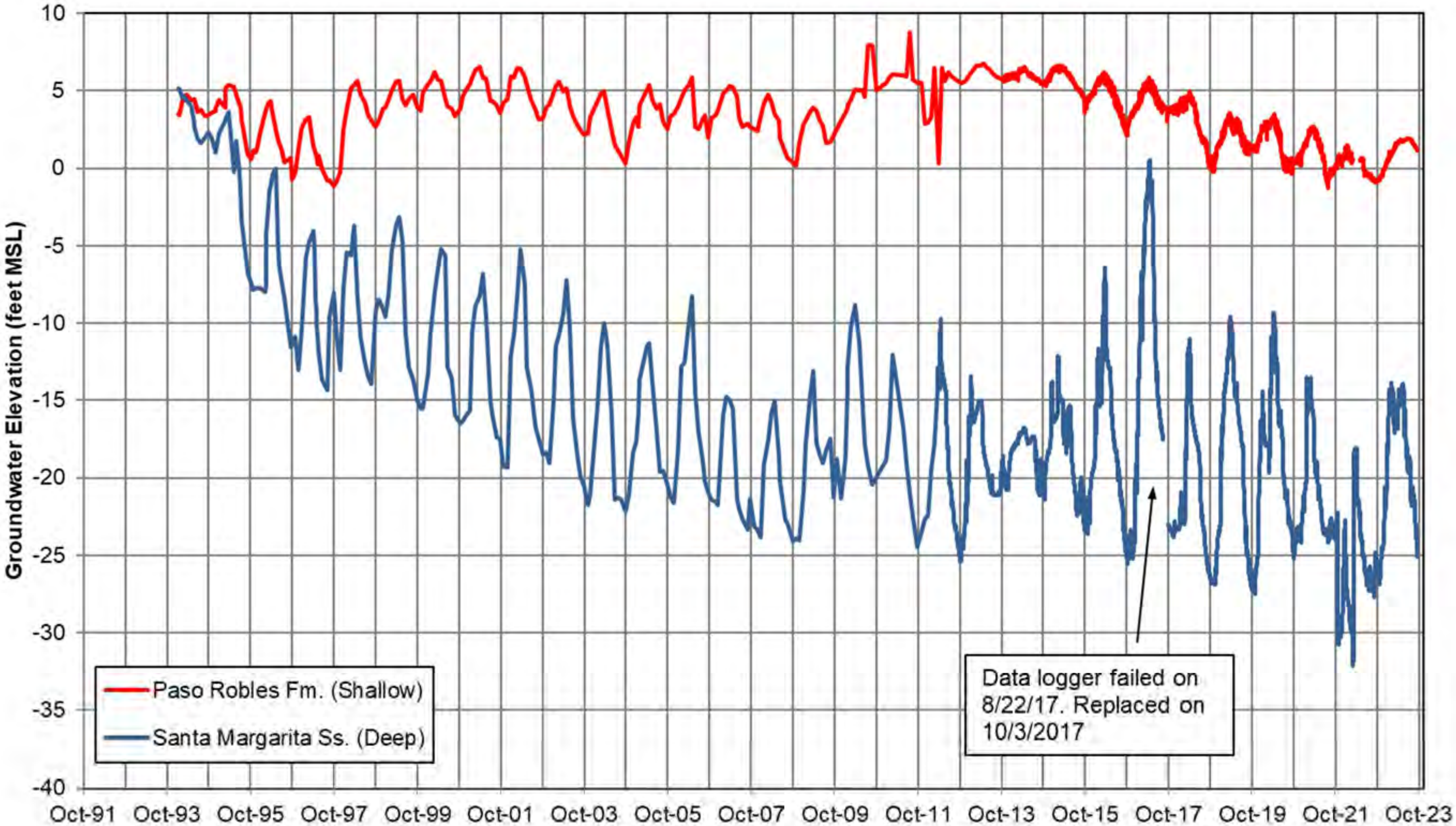


Figure 33. PCA-East Deep and Shallow Monitoring Well Hydrograph

Figure 34 displays groundwater elevations from the deep aquifer in a larger set of Santa Margarita aquifer Northern Coastal subarea wells, including PCA-East. Elevations in all these wells have been below sea level since the late 1990s. The discrepancy between wells near the center of the inland pumping depression (around Ord Grove Test) and more coastal and inland wells helps illustrate the gradient of the deep aquifer's pumping depression over time, shown for WY 2023 on Figure 41 and Figure 43. This discrepancy is illustrative of conditions near the very center of the pumping depression as compared to further from its center. Because the Ord Grove Test well is highly influenced by pumping at the Ord Grove #2 well, it is better to compare seasonal highs between this well and others in the Northern Coastal Subarea. The difference in groundwater elevations at Ord Grove Test and others in the Northern Coastal Subarea tends to increase during dry periods in response to reduced recharge and increased groundwater demand (See October 2012 through October 2016 on Figure 34). Over the past 5 years, the groundwater elevation difference has decreased for 2 reasons. First, elevations in the deeper portion of the pumping depression have risen somewhat over the past 5 years, likely a result of ASR injection in WY 2019, WY 2020, and WY 2023, and PWM injection in WY 2021 through WY 2023 (see October 2018 through October 2023 on Figure 34). Secondly, elevations in some of the wells further from the center of the pumping depression have fallen over the past 5 years (FO-07 Deep, FO-09 Deep, PCA-W Deep, MSC-Deep). Elevations at PCA-East Deep have likewise declined during WY 2021 and WY 2022 though they stabilized in WY 2023. From this it can be concluded that although the pumping depression's depth has decreased in the past few years, its lateral extent continues to grow during dry periods. The pumping depression's extent shrunk somewhat this year, in response to wet conditions, recycled water usage, net ASR injection, and PWM injection. How the shape and gradient of this deep pumping depression evolves over time should continue to be examined in these annual reports to inform projects and sustainability in the Northern Coastal Subarea.

Figure 35 includes hydrographs of groundwater elevations for the 4 deep coastal Sentinel Wells. Groundwater elevations on this chart are collected from dataloggers in each well that record levels every 30 minutes. The hydrographs plot daily average elevations, thereby smoothing out the more detailed data which are affected by tidal variations. Hydrographs for the Sentinel Wells are similar to the PCA-East Deep hydrograph and show that groundwater elevations over winter and spring were the highest in WY 2017 because of increased ASR injection. Comparison between WY 2022 and WY 2023 is complicated by a lack of WY 2021 data at SBWM-1 and WY 2022 data at SBWM- 2. Data at SBWM-1 were not available during WY 2021 due to an unresponsive datalogger, but the logger was reinstated in WY 2022. Data at SBWM-2 were not available during WY 2022 due to a lost field sheet.

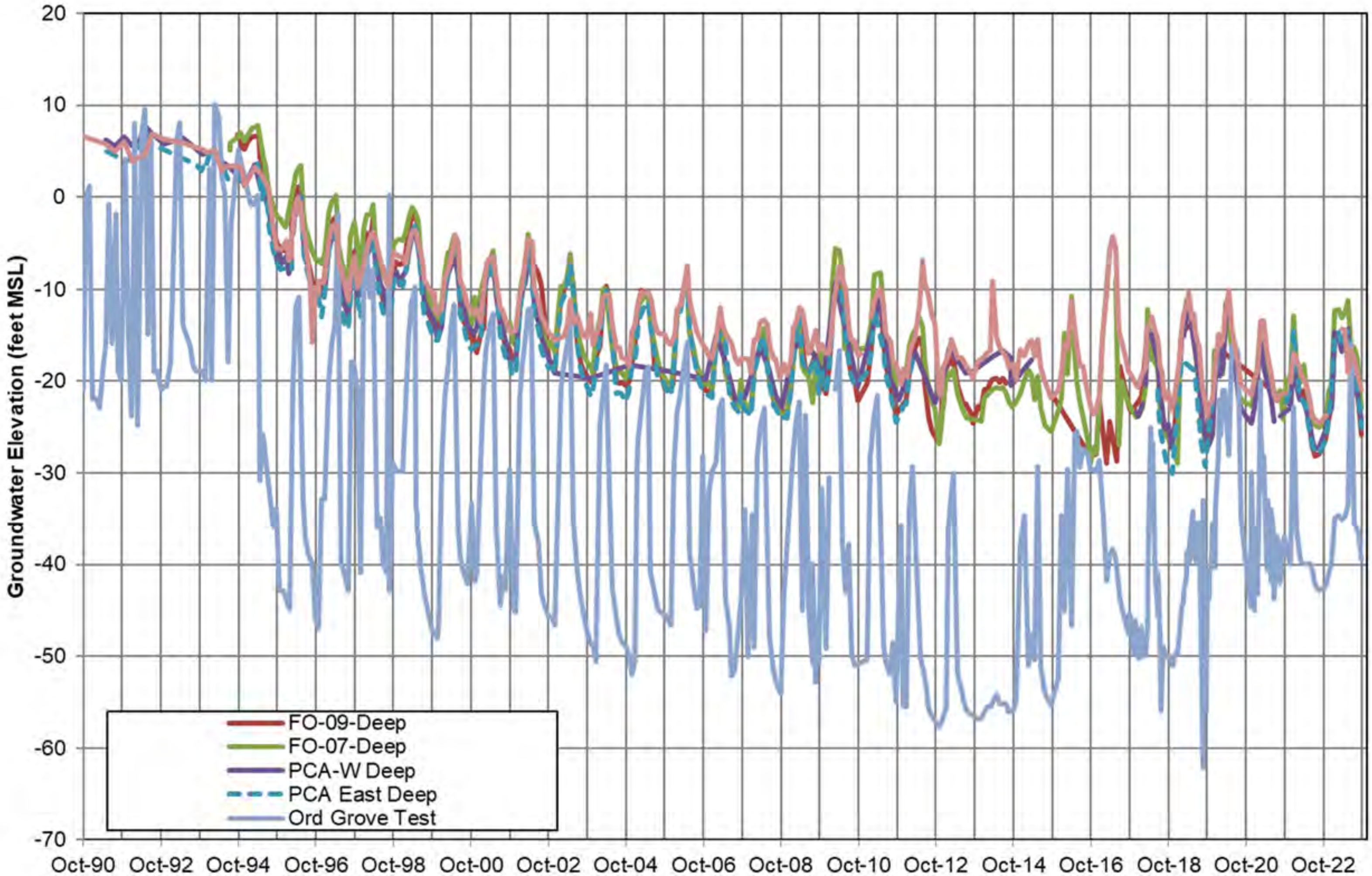


Figure 34. Santa Margarita Aquifer Northern Coastal Subarea Wells

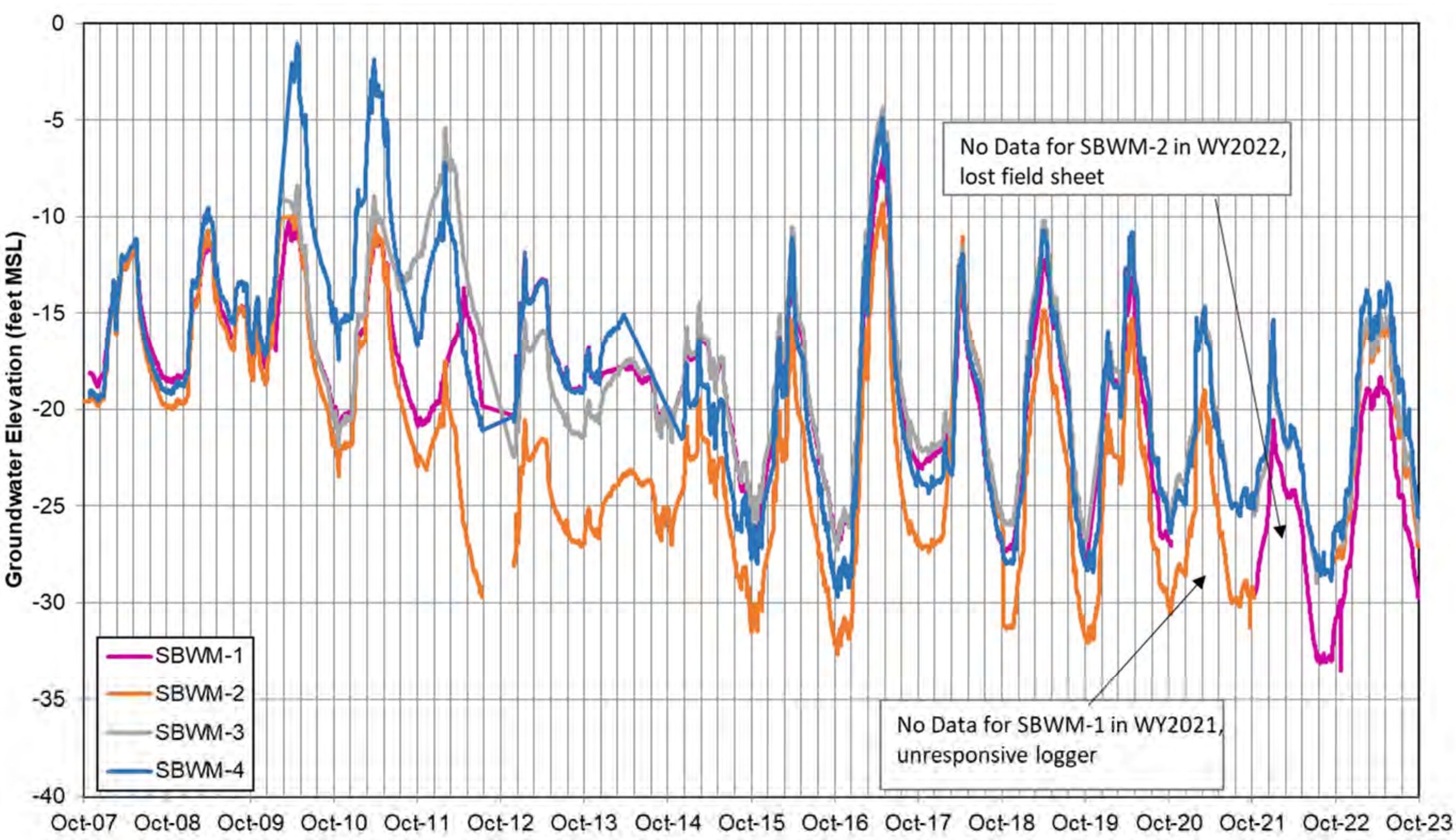


Figure 35. Sentinel Well Hydrographs

Following on from WY 2022 where both the seasonal high and low groundwater levels at SBWM-1 were the lowest over its period of record (Figure 35), groundwater levels in SBWM-1 increased slightly but still remain amongst the lowest on record. The modest increases are likely attributed to groundwater augmentation projects (PWM and ASR) and above normal precipitation in WY 2023. In WY 2023, seasonal lows at SBWM-2 were higher than the previous year and similar to WY 2020 and WY 2021. In WY 2023, SBWM-1 groundwater elevations are lower than SBWM-2 elevations. Missing data in WY 2021 and WY 2022 preclude knowing if this also occurred during those years, but in all previous years, SBWM-1 elevations have been higher than SBWM-2's elevations.

Overall, seasonal high groundwater elevations in WY 2023 are 1-5 feet higher than the previous year. Similarly, seasonal low elevations are roughly 1-5 feet higher than the previous year, likely a result of above normal rainfall and available surface water to support ASR injection (Section 2.6.1; Section 2.7). Seasonal high groundwater elevations in WY 2023 are higher than the 2 previous years but remain slightly lower than seasonal highs in WY 2018 though WY 2020.

The hydrograph of Paso Robles (shallow) aquifer groundwater levels in PCA-East shows a steadily declining trend since WY 2014, where levels have dropped about 7 feet over the past 10 years (Figure 33). The decline in Paso Robles aquifer groundwater levels and greater seasonal fluctuations corresponds with the recommencement of pumping at Black Horse and Bayonet golf course irrigation wells after being supplied water by MCWD from WY 2009 through 2014/2015. In WY 2023, the decline stabilized due to a combination of the Black Horse and Bayonet golf courses reinitiating use of recycled water for irrigation instead of pumping groundwater, PWM recharge, above normal rainfall and associated groundwater recharge. Since WY 2018, groundwater levels have been below protective elevations at PCA-East (see Section 2.6.4). Seasonal level changes in the Paso Robles aquifer are usually related to reduced wintertime production and increased pumping during summer. Although the Paso Robles aquifer seasonal fluctuations correspond with Santa Margarita aquifer fluctuations, it is because seasonal pumping occurs in both aquifers, and not because the aquifers are closely connected.

2.6.2.2 Southern Coastal Subarea

In the Southern Coastal subarea, the K-Mart and CDM MW4 monitoring wells are representative of groundwater levels near the coast. Figure 36 shows groundwater elevations have remained above sea level and slightly increased in WY 2023. K-Mart well groundwater elevations have increased slightly over the period of record with WY 2023 elevations being the highest on record for the well.

A data gap exists at the K-Mart monitoring well from November 2019 to July 2022 due to safety concerns associated with a nearby homeless encampment which precluded taking level measurements. While access to the well has been restored in late WY 2022, the nearby CDM MW4 monitoring well is added to the hydrograph on Figure 36 to show groundwater elevation trends in the subarea during the data gap period.

2.6.2.3 Laguna Seca Subarea

Although the Laguna Seca subarea is far enough from the coast not to have seawater intrusion, there is concern that since 2001 this area has experienced ongoing groundwater level declines that have not been controlled or improved by triennial pumping reductions. It is believed this is occuring due to the subarea's limited groundwater inflows and natural recharge compounded by the influence of wells pumping east of the Basin (HydroMetrics WRI, 2016a). Figure 10 shows the location of wells with hydrographs on Figure 37 while Figure 39 shows the location of all wells, including production wells in the eastern Laguna Seca subarea.

In the eastern portion of the subarea between 1999 and 2014, Paso Robles aquifer groundwater levels declined at a rate of approximately 0.6 feet per year and Santa Margarita groundwater levels declined up to 4 feet per year, as shown on Figure 37. Although there was some stabilization between WY 2014 and WY 2016, groundwater levels were declining at a general rate of roughly 0.5 feet per year in both the Paso Robles and Santa Margarita aquifer systems. In WY 2023, the declining trend stabilized at LS No. 1 Subdivision. No data was available in WY 2023 for LS Golf Old #12. In WY 2023, groundwater elevations at the Bishop #3 well continue to rise in response to CAWC ceasing pumping in the Bishop unit. There has been approximately 20 feet of recovery since 2020. Similar trends are present in the central portion of the subarea, as shown on Figure 38.

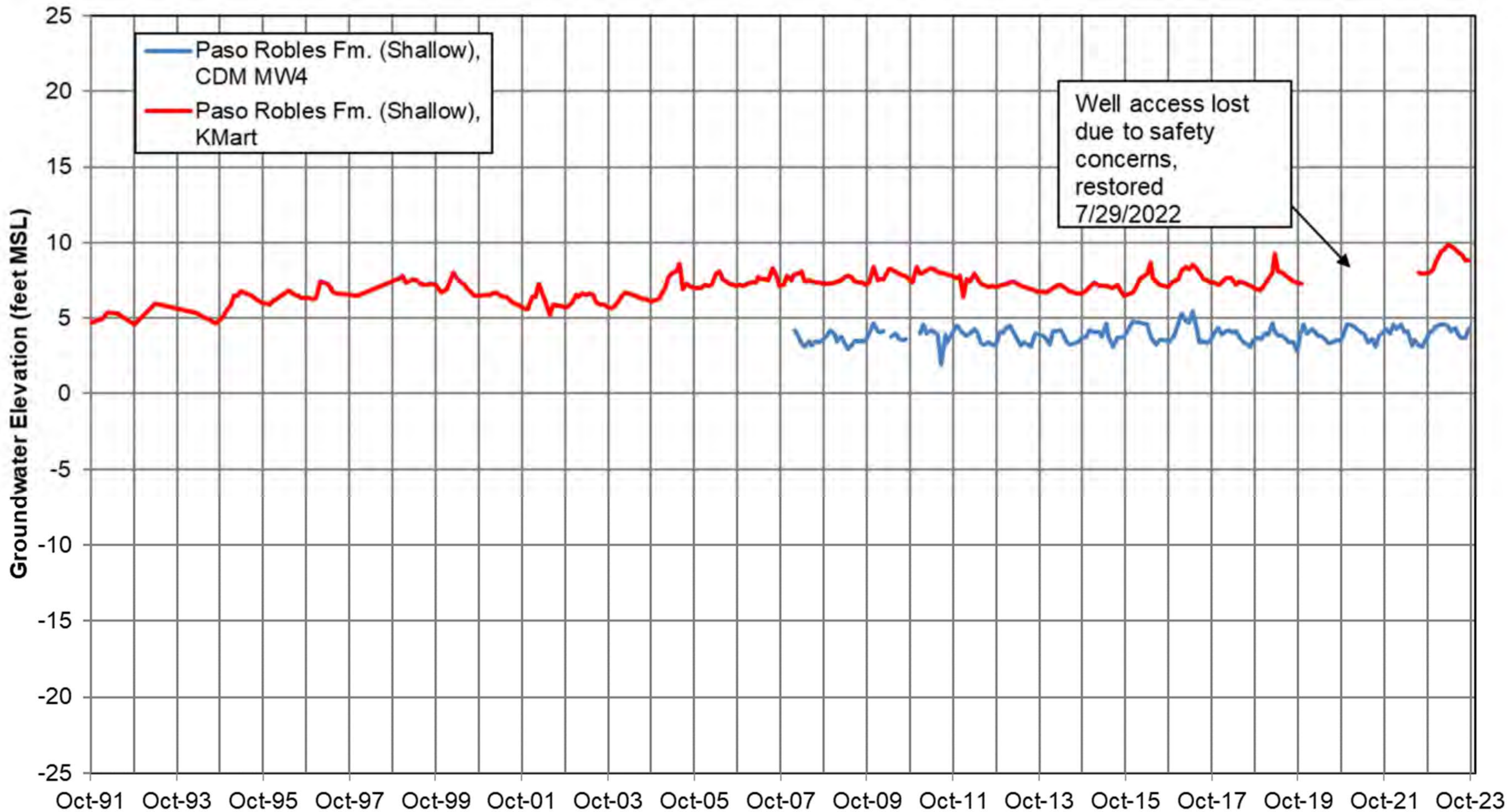


Figure 36. K-Mart and CDM MW4 Hydrographs, Southern Coastal Subarea

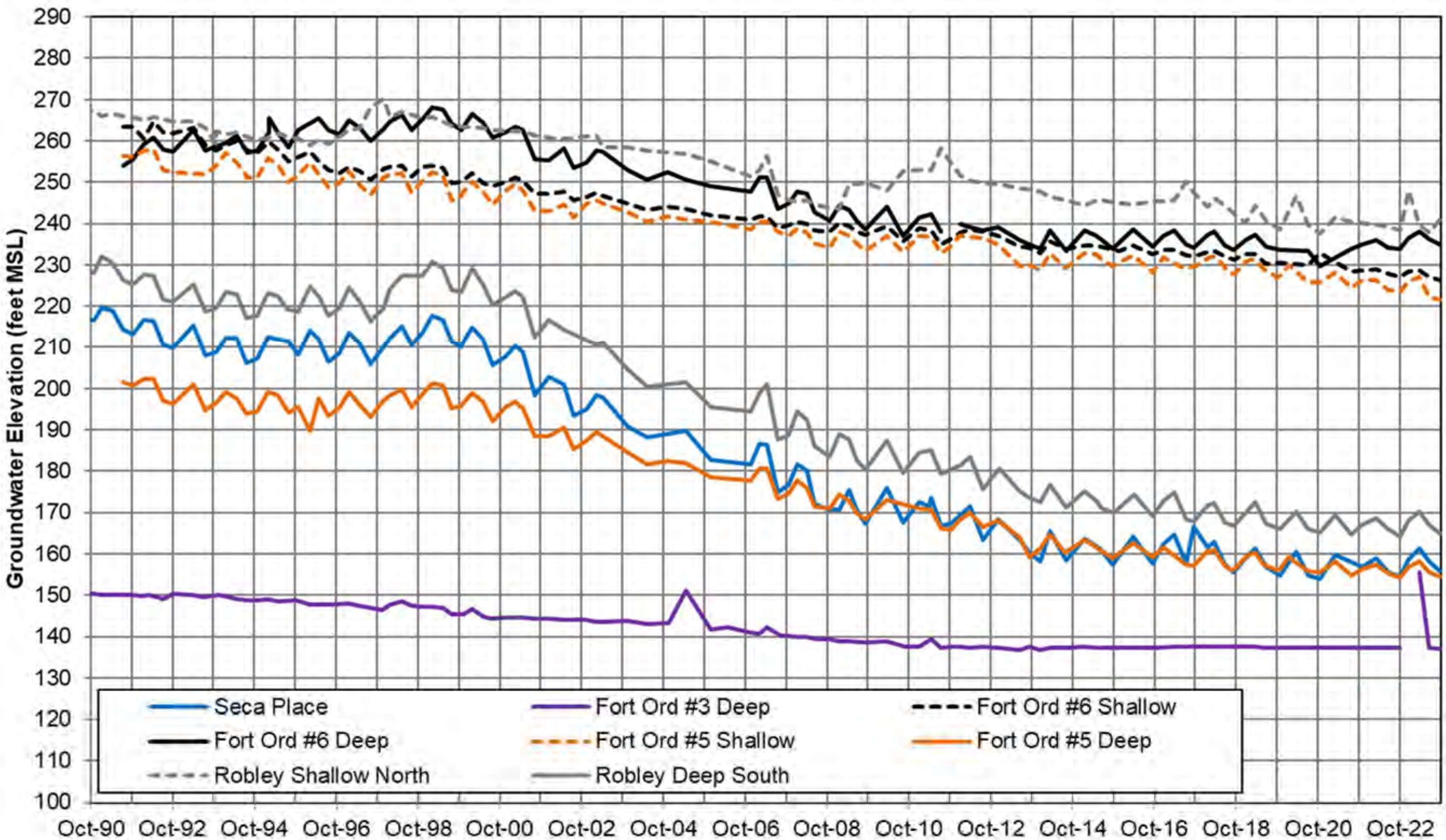


Figure 37. Eastern Laguna Seca Subarea Monitoring Well Hydrographs

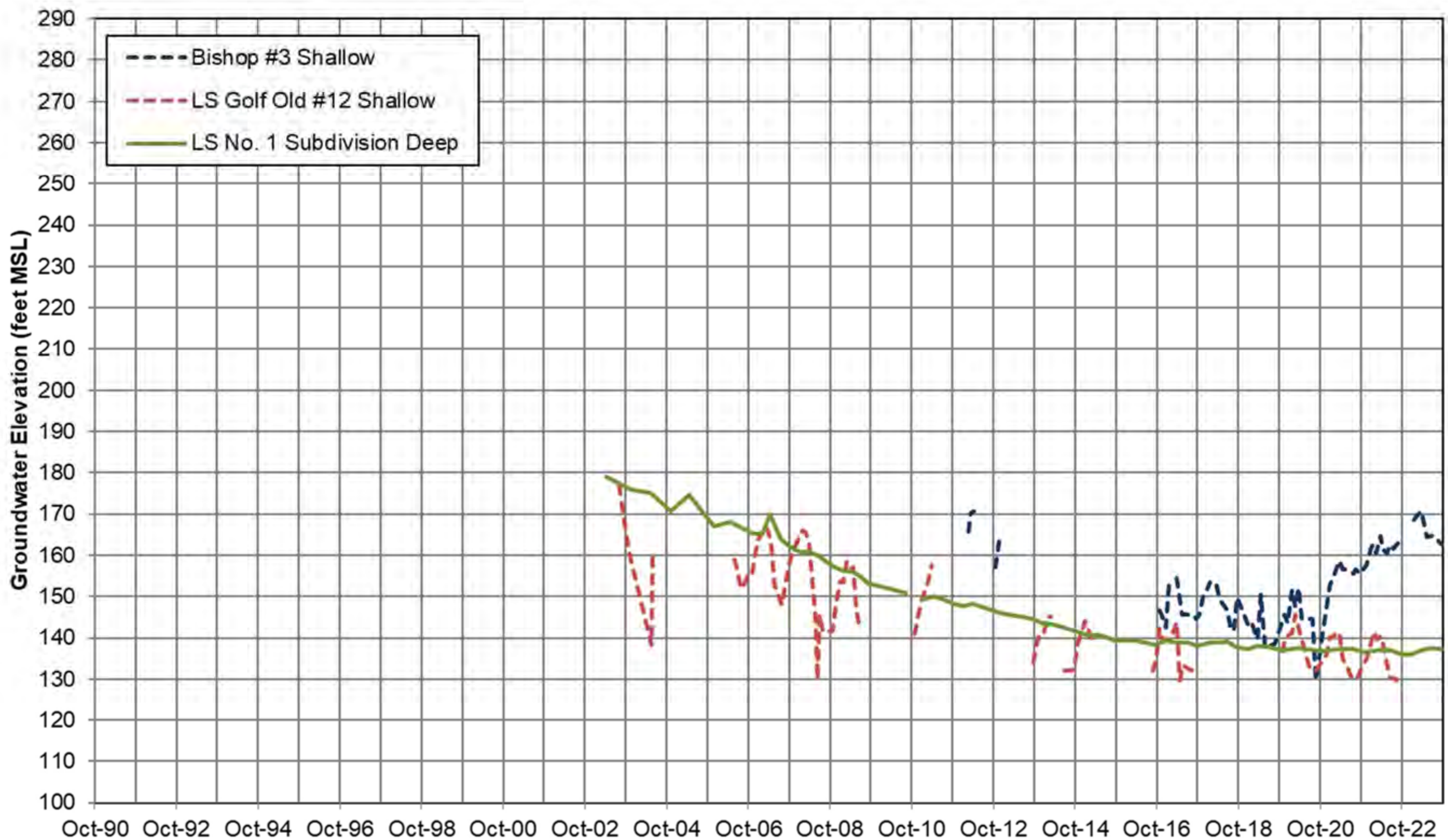
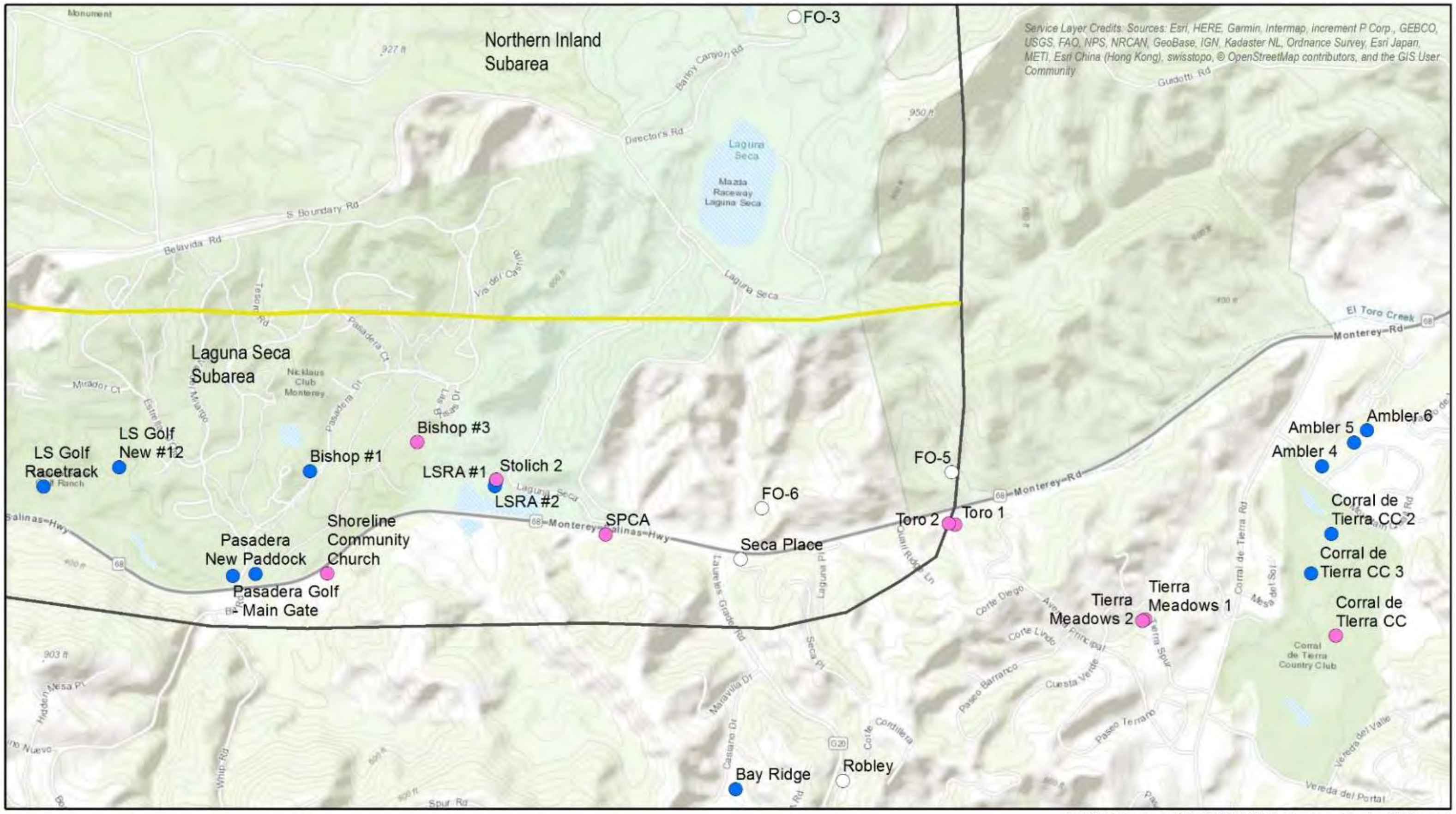


Figure 38. Eastern Laguna Seca Subarea Production Well Hydrographs



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EXPLANATION

Adjudicated Seaside Groundwater Basin
- Basin Boundary
- Subarea Boundary
- Select Monitoring Wells

Production Wells
- Well Screened Interval Entirely Within Paso Robles Aquifer (Shallow)
- Well Screened Interval Includes Santa Margarita Aquifer (Deep)

N

0 1,000 2,000 3,000 4,000
Feet

Figure 39. Eastern Laguna Seca Subarea Wells

2.6.3 Groundwater Elevation Maps

The subsections below map and describe groundwater elevation contours for the Basin for both the second quarter (January – March 2023) and fourth quarter (July – September 2023).

2.6.3.1 Second Quarter Water Year 2023 (January-March 2023)

Groundwater level maps for the Paso Robles aquifer (shallow) and Santa Margarita (deep) aquifers for the second quarter of WY 2023 are shown on Figure 40 and Figure 41, respectively. The groundwater elevation contour maps feature groundwater elevations derived from ASR and PWM monitoring wells in WY 2022. However, groundwater level data from ASR wells was not received in WY 2023, and data from PWM monitoring wells was only available for second quarter (spring) 2023 at the time of this report. The area of influence from injection is identified by an opaque blue shaded area, which approximates the influence of injection on each aquifer. Under current injection operations, the influence of PWM injection is significantly larger in the Santa Margarita aquifer than the Paso Robles aquifer.

The following are observations on the second quarter groundwater elevation contours for the Paso Robles aquifer (Figure 40):

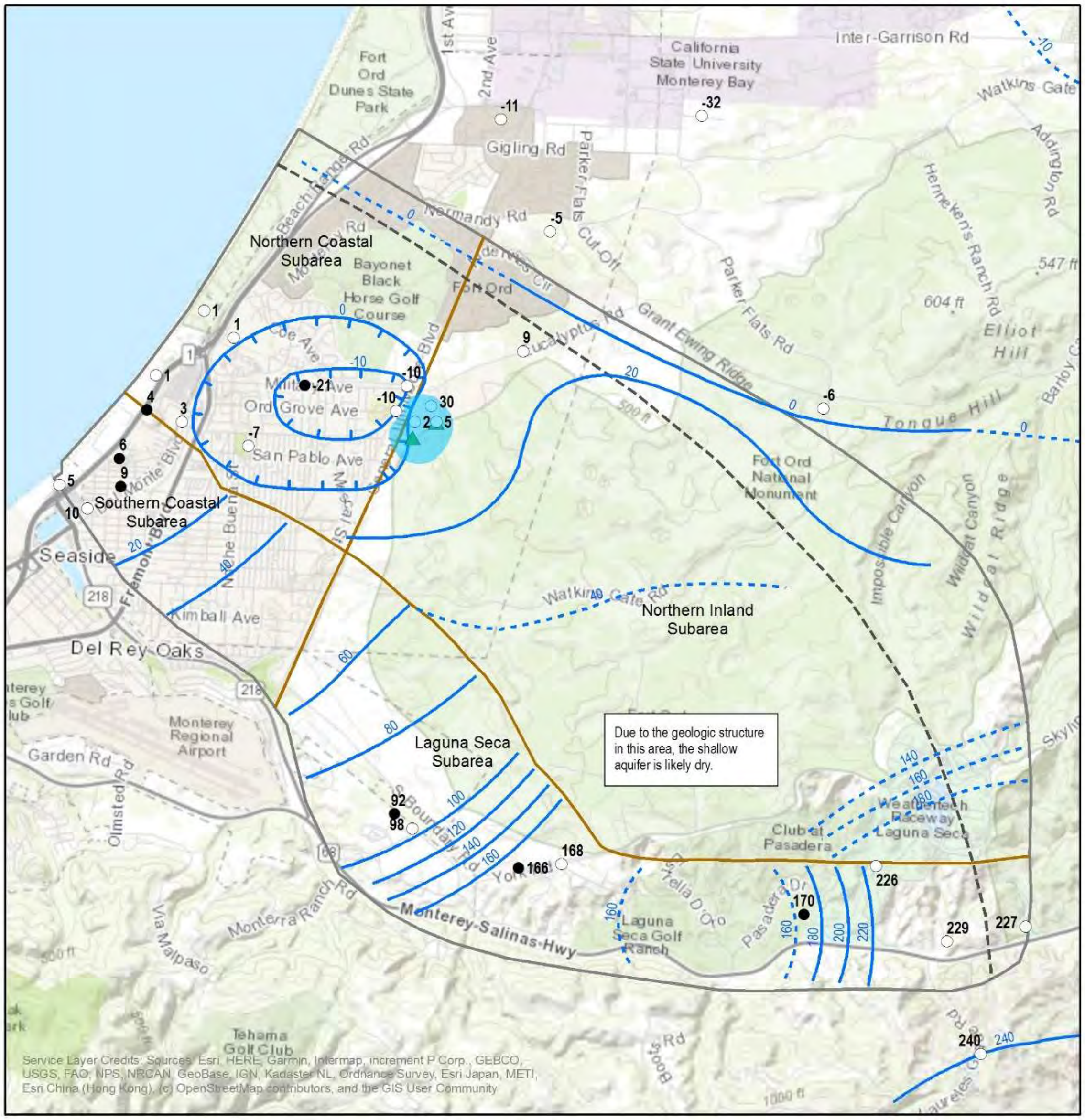
- In the Northern Coastal subarea and just north of the subarea (outside of the basin), second quarter (spring) Paso Robles groundwater elevations for WY 2023 remain generally stable, mirroring levels observed in the second quarter of WY 2022. Changes are limited to 1 to 2 feet of decline or increase, with no significant trend in either direction.
- The extent of the pumping depression in the Northern Coastal subarea was slightly more constrained than the previous year by PWM injection and ASR operations.
- The Southern Coastal subarea had a 1-foot increase in groundwater elevations in WY 2023.
- Available data indicate that the pumping depression caused by the Laguna Seca Golf Ranch wells in the central Laguna Seca subarea has likely reduced in size due to reduced pumping in WY 2023 and increased recharge from above-normal rainfall. Although spring groundwater elevation data for the well were not received, the typical pumping depression around the golf courses is still reflected on the contour map. Spring 2023 groundwater elevations at the Bishop #3 well rose roughly 7 feet from the previous year in response to CAWC ceasing pumping at the well.
- Spring groundwater elevations in the eastern Laguna Seca subarea are similar to the previous year.

- In the eastern portion of the Northern Inland subarea, an area of the Paso Robles aquifer is indicated to be potentially dry due to geologic structural control.

In the Santa Margarita aquifer, second quarter (spring) groundwater levels are usually higher than fourth quarter (fall) groundwater levels by up to 10 feet due to seasonal groundwater demand. This phenomenon is especially apparent along the coast. Other than in areas of active groundwater pumping, the Santa Margarita aquifer does not show seasonal fluctuations to the same extent as the Paso Robles aquifer.

The following are observations on the second quarter groundwater elevation contours for the Santa Margarita aquifer (Figure 41):

- In the Northern Coastal subarea, along the coast and just north of the subarea, Santa Margarita groundwater levels along the coast increased roughly 5 to 12 feet from last spring.
- The Santa Margarita aquifer pumping depression in the Northern Coastal subarea shrunk significantly since WY 2022, with the -20 feet msl contour line now within the Basin while last year it extended farther north into the Salinas Valley - Monterey Subbasin.
- PWM monitoring well data were available in WY 2023; elevations in these monitoring wells are now above sea level, except for MW-2AD.
- Available data indicate the pumping depression associated with pumping at the Laguna Seca golf courses is similar to spring levels last year.
- The eastern portion of the Laguna Seca subarea has groundwater levels similar to last year, with minor rises in groundwater elevations across wells ranging from 1 to 2 feet.



EXPLANATION

Wells with Water-Level Data (2nd Quarter WY 2023, Shallow Zone)
- ○ Monitoring Well
- ● Production Well
- ▲ Pure Water Monterey Shallow Injection Well

WY 2023 Shallow Zone Groundwater Elevation (feet MSL)
- Groundwater Elevation
- Pumping Depression
- Dashed where uncertain (no well data)
- Influence of Injection (2nd Quarter, WY 2023, Shallow Zone)

- Shallow Aquifer Northern Boundary

Adjudicated Seaside Groundwater Basin Boundary
- Basin Boundary
- Subarea Boundary

N

0 0.5 1 1.5 2
Miles

Figure 40. Paso Robles Aquifer (Shallow Zone) Water Elevation Map – Second Quarter Water Year 2023 (January-March 2023)

MONTGOMERY
& ASSOCIATES

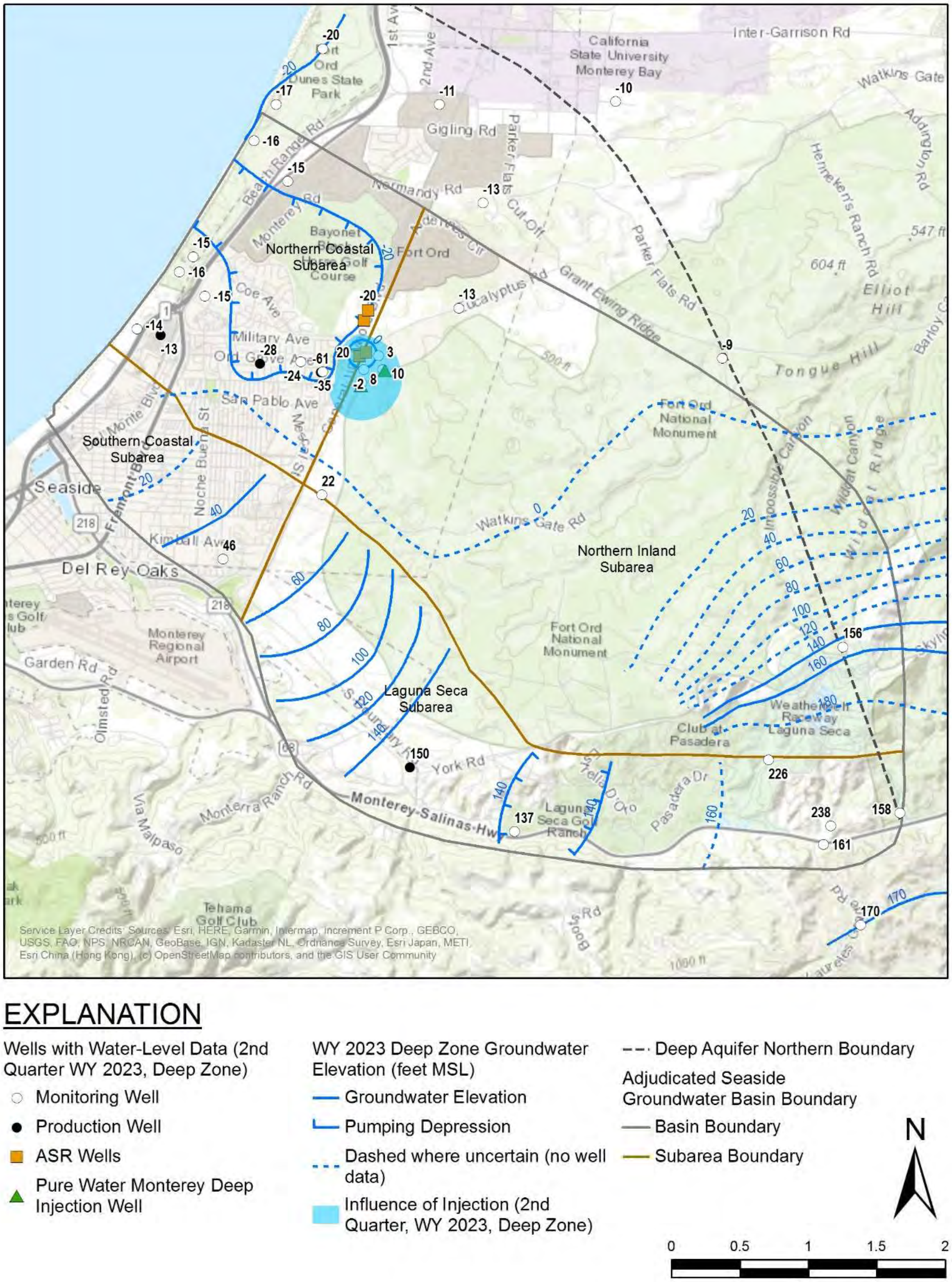


Figure 41. Santa Margarita Aquifer (Deep Zone) Water Elevation Map – Second Quarter Water Year 2023 (January-March 2023)

2.6.3.2 Fourth Quarter Water Year 2023 (July-September 2023)

Groundwater elevation maps for the Paso Robles (shallow) and Santa Margarita (deep) aquifers for the fourth quarter of WY 2023 are shown on Figure 42 and Figure 43, respectively.

The following are observations on the fourth quarter groundwater elevation contours for the Paso Robles aquifer (Figure 42):

- Northern Coastal subarea groundwater elevations, including just outside of the northern Basin boundary), increased up to 3 feet from the fourth quarter of WY 2022. Groundwater elevations at the coastal Sentinel wells are now 1 foot above sea level during fourth quarter of WY 2023, a 2-foot increase in all wells in comparison to the previous year.
- The area of the Northern Coastal subarea below sea level in the shallow aquifer has notably reduced in size in WY 2023. This is primarily due to higher groundwater elevations in the Sand City area near the coastal Sentinel wells.
- Despite increased pumping at the Ord Grove #2 and Paralta wells during this period, the surrounding monitoring wells experienced rising groundwater levels that are between 5 to 12 feet higher than the previous year. The rise is likely attributed to recharge from the above-normal rainfall and PWM and ASR injection.
- Southern Coastal subarea groundwater elevations remained similar to the previous year.
- Elevations in the eastern portion of the Laguna Seca subarea remain similar to last year. Following the cessation of pumping at CAWC’s Bishop unit, the Bishop #3 well in the central Laguna Seca area underwent recovery of more than 10 feet from late WY 2021 through WY 2022. The groundwater levels at Bishop #3 have remained unchanged from WY 2022, indicating levels have now equilibrated since pumping ceased last year.

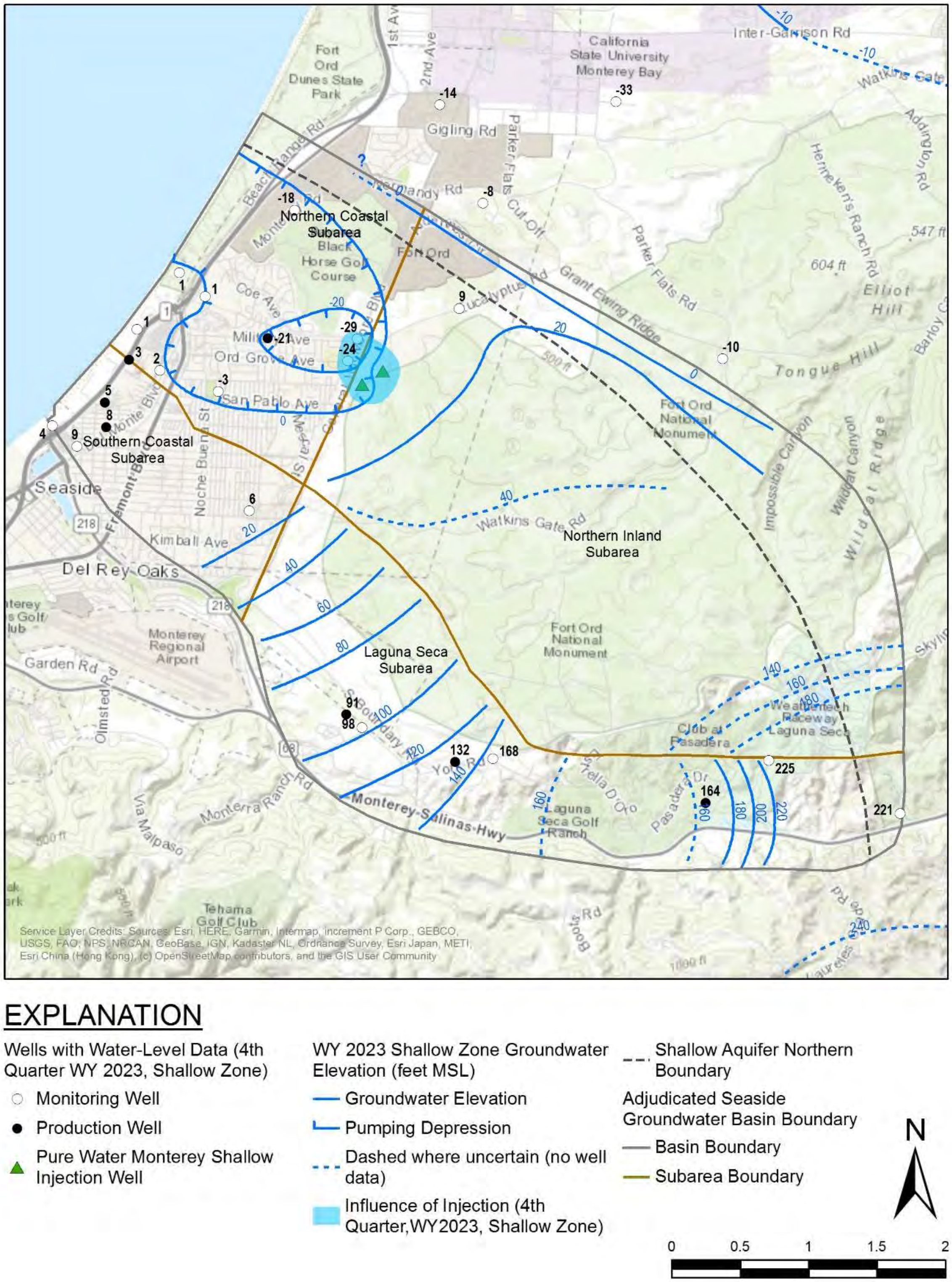
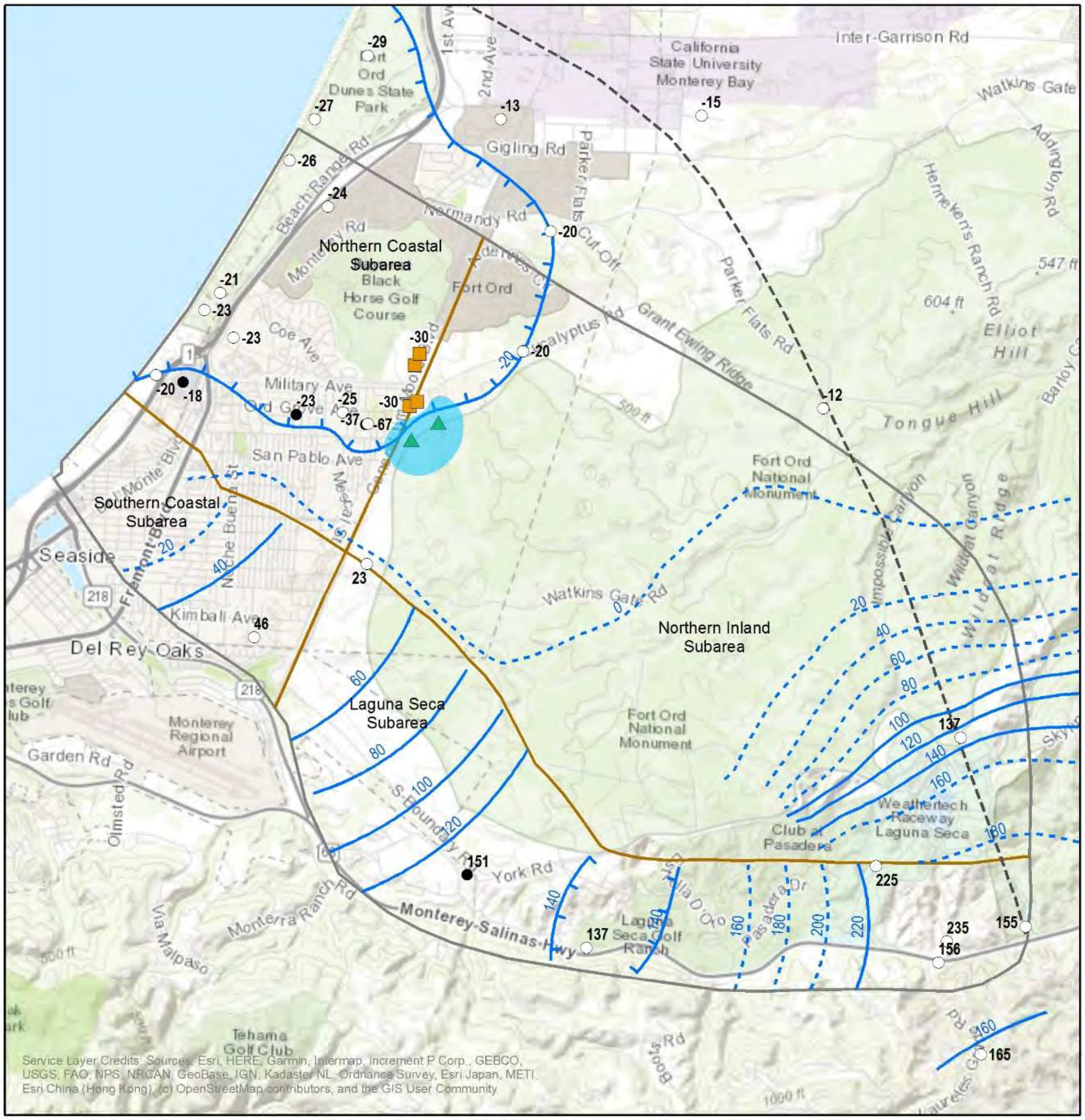


Figure 42. Paso Robles Aquifer (Shallow Zone) Water Elevation Map – Fourth Quarter Water Year 2023 (August/September 2023)

The following are observations on the fourth quarter groundwater elevation contours for the Santa Margarita aquifer (Figure 43):

- North of the Northern Coastal subarea, Santa Margarita aquifer groundwater elevations increased up to 4 feet from last year. The northern -20-foot contour has shrunk due to a 2- and 5-foot rise in groundwater elevations at FO-10 Deep and FO-08 Deep monitoring wells, respectively.
- At the coast, Santa Margarita aquifer groundwater levels in the Northern Coastal subarea increased 2 to 7 feet from the previous year.
- The Northern Coastal subarea deep aquifer's pumping depression is smaller in extent than last year. The southwestern extent of the depression no longer contains the MSC-Deep and Target monitoring wells, which had 4- and 5-foot increases in groundwater elevations, respectively, from the previous year. The depression's southeastern extent is strongly influenced by ASR and PWM operations where there was a combined total of 5,206 acre-feet injected and 3,458 acre-feet recovered in WY 2023.
- The pumping depression associated with pumping at the Laguna Seca golf courses is similar to fall levels last year.
- The eastern portion of the Laguna Seca Subarea has groundwater levels similar to last year. Groundwater elevations for the LS Pistol Range and Seca Place wells are now available in WY 2023.
- In the central portion of the Laguna Seca Subarea, groundwater elevations at Ryan Ranch #8 area increased roughly 7 feet compared to last fall.



EXPLANATION

Wells with Water-Level Data (4th Quarter WY 2023, Deep Zone)

- Monitoring Well
- Production Well
- Pure Water Monterey Deep Injection Well
- ASR Wells

WY 2023 Deep Zone Groundwater Elevation (feet MSL)

- Groundwater Elevation
- Pumping Depression
- Dashed where uncertain (no to limited well data)
- Influence of Injection (4th Quarter WY 2023, Deep Zone)

- Deep Aquifer Northern Boundary

Adjudicated Seaside Groundwater Basin Boundary

- Basin Boundary
- Subarea Boundary

N

0 0.5 1 1.5 2

Miles

Figure 43. Santa Margarita Aquifer (Deep Zone) Water Elevation Map – Fourth Quarter Water Year 2023 (July/September 2023)

2.6.4 Protective Groundwater Elevations

Protective groundwater elevations were determined in 2009 using the Seaside Groundwater Basin groundwater flow model and cross-sectional modeling (HydroMetrics LLC, 2009b). A subsequent study in 2013 to revisit and update the protective groundwater elevations concluded that the calibrated parameters in the basin wide model do not indicate that protective elevations should be lowered (HydroMetrics WRI, 2013b). Protective elevations for both the Santa Margarita (deep) and Paso Robles (shallow) aquifers were established for monitoring well pairs with both a shallow and deep completion. Protective elevations for the 6 wells with protective elevations are shown in Table 1. Groundwater levels below protective elevations have a greater potential to cause seawater intrusion that will impact production wells.

Table 1. Summary of Protective Elevations at Coastal Monitoring Wells

Subarea	Well	Completion	Protective Elevation, Feet above sea level	Currently Above or Below Protective Elevations
Northern Coastal	MSC	Santa Margarita (Deep)	17	below
		Paso Robles (Shallow)	11	below
	PCA-W	Santa Margarita (Deep)	17	below
		Paso Robles (Shallow)	2	below
	Sentinel Well 3	Santa Margarita (Deep)	4	below
Southern Coastal	CDM-MW4	Paso Robles (Shallow)	2	above

Figure 44 through Figure 47 show the historical groundwater elevations at each of the target protective elevation monitoring wells. Groundwater levels continue to be below protective elevations in all Santa Margarita target monitoring wells (MSC deep, PCA-West deep, and Sentinel Well 3). Last year, groundwater levels at all 3 Santa Margarita monitoring wells were the lowest over their historical records. In WY 2023, groundwater levels stabilized and are slightly higher than the previous year. Monitoring well CDM-MW4 is the only Paso Robles well (1 of 3 Paso Robles wells total) with groundwater level above its protective elevation. Groundwater levels in the PCA West Shallow well fell below protective elevations in WY 2020 and remained below through WY 2022. In WY 2023 groundwater elevations briefly increased to just below the protective elevation in June. Elevations at this well declined during the summer but the WY 2023 fall elevation remains 1 to 2 feet higher than the 2 previous years. Groundwater levels in the MSC Shallow well continue to be below its protective elevation.

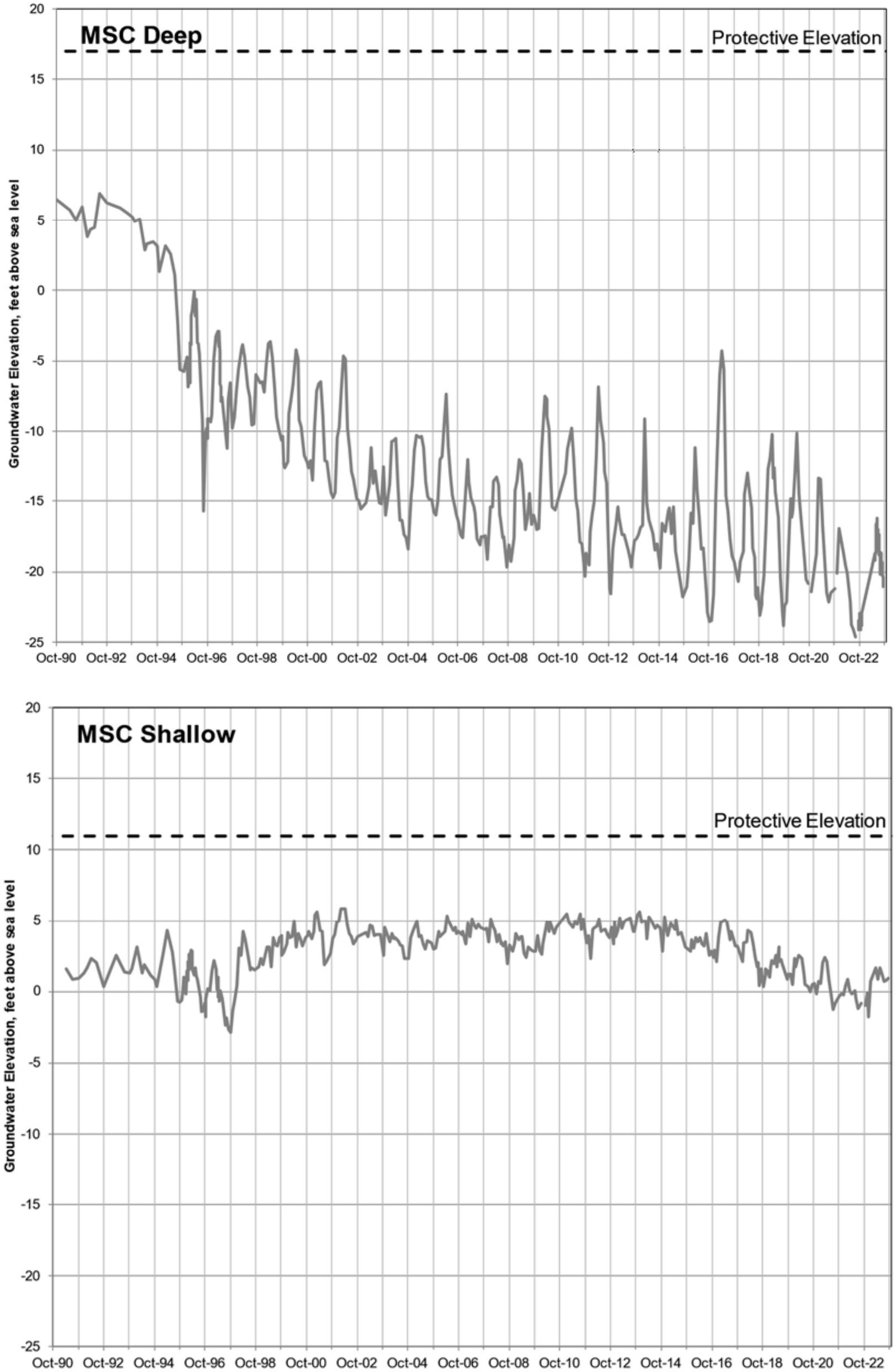


Figure 44. MSC Deep and Shallow Groundwater and Protective Elevations

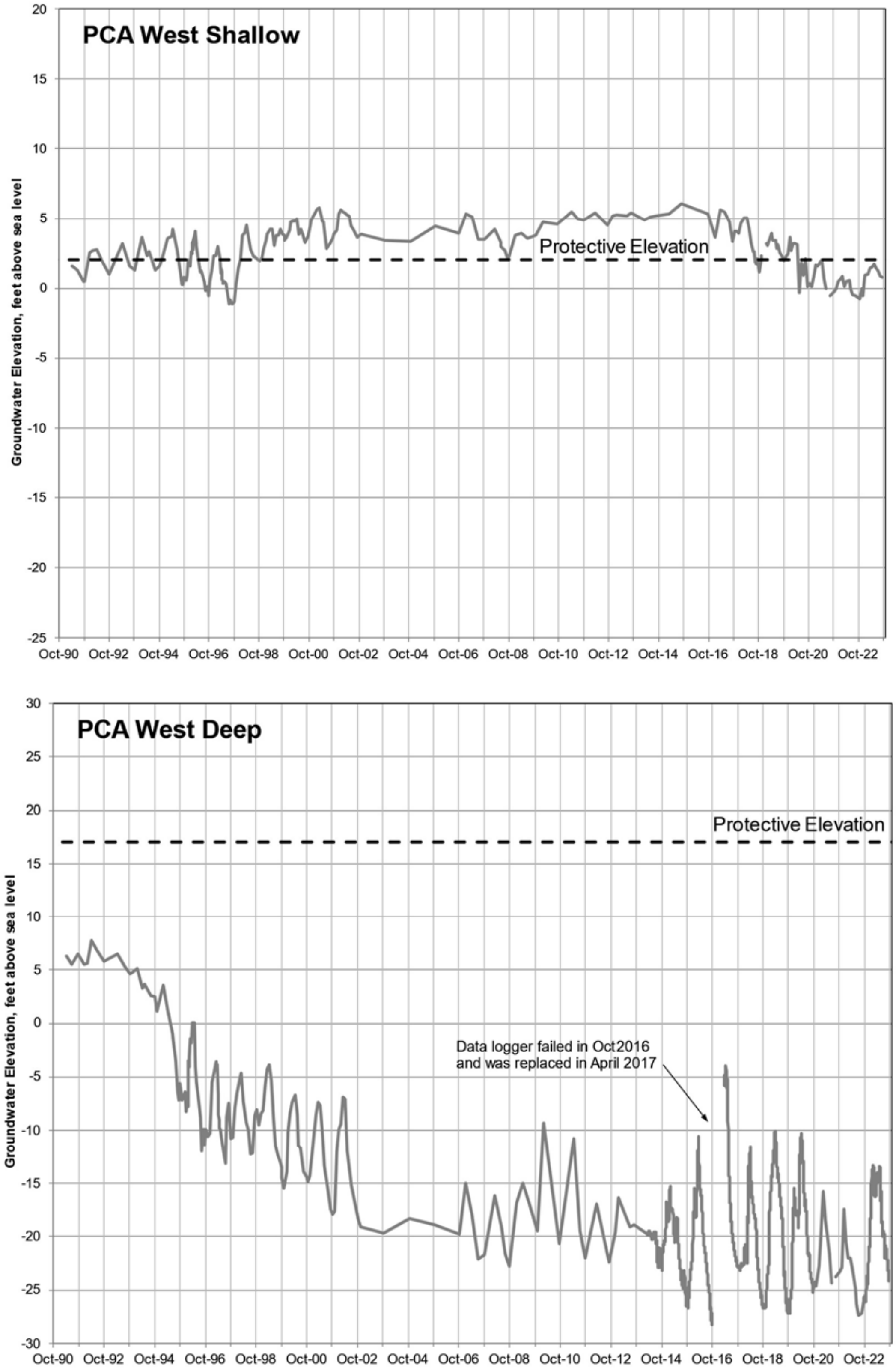


Figure 45. PCA West Deep and Shallow Groundwater and Protective Elevations

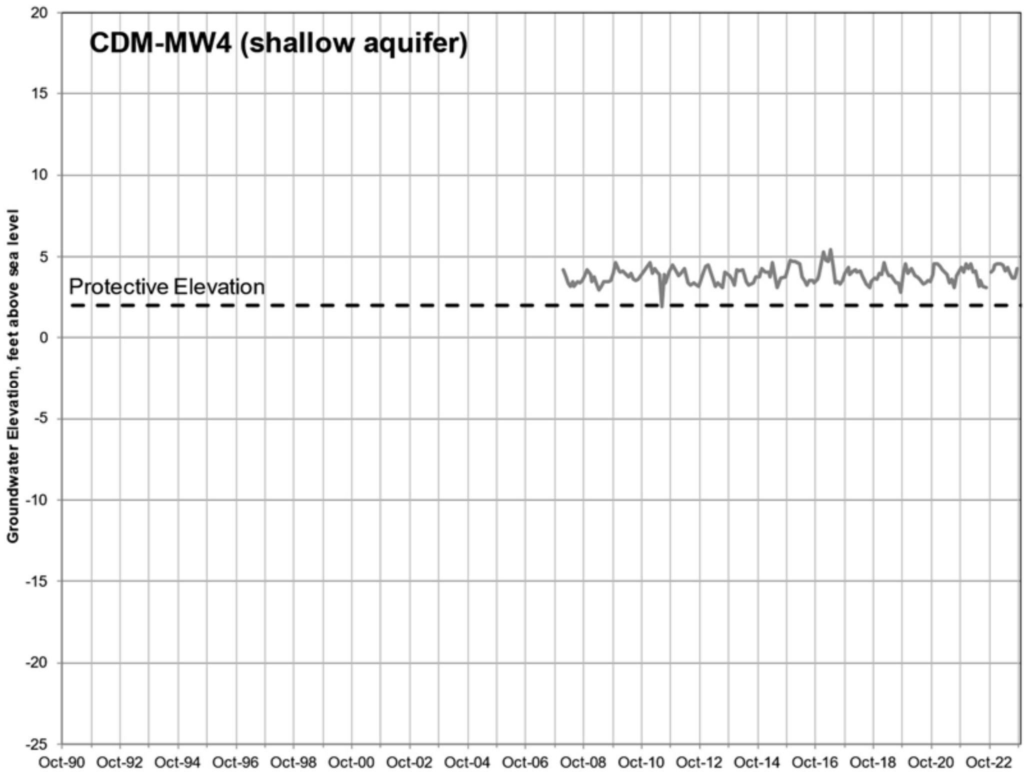


Figure 46. CDM-MW4 Groundwater and Protective Elevations

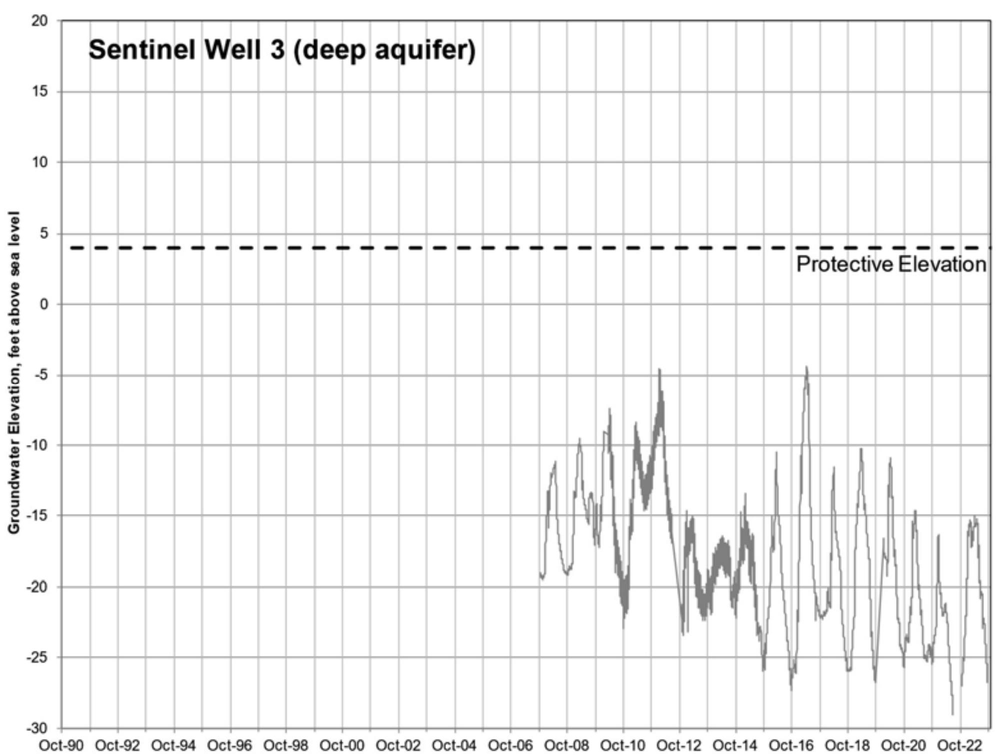


Figure 47. Sentinel Well 3 Groundwater and Protective Elevations

2.7 Groundwater Production

Groundwater pumping and subsurface outflows to adjacent basins in excess of freshwater recharge and subsurface inflow from adjacent areas is the primary cause of seawater intrusion. Mapping pumping volumes gives an indirect indication of the threat of seawater intrusion. Ideally, to avoid seawater intrusion, pumping should be equally distributed throughout a basin and occur inland of the coast.

Gross pumping by Watermaster producers in WY 2023 was 5,836 acre-feet, which includes 3,458 acre-feet of recovery from the PWM project. Net or native groundwater pumping is the amount of groundwater pumped after both ASR and PWM recovery are considered. It is possible that in years where there is water injected and recovered, more water may be pumped from CAWC's wells to recover water injected the previous operational year.

In WY 2023, ASR and PWM wells injected 1,451 and 3,755 acre-feet, respectively, for a total of 5,206 acre-feet of injection. Of the injected water, 3,458 acre-feet were recovered by production wells. As reported by the Watermaster, net or native groundwater production was 2,173 acre-feet (gross pumping less recovery), which is 827 acre-feet below the Decision-ordered Operating Yield for WY 2023 of 3,000 acre-feet (Figure 48). The net or native groundwater produced from the Basin in WY 2023 was roughly 698 acre-feet less than in WY 2022. The Decision-ordered Operating Yield will continue to be 3,000 acre-feet unless a revised Sustainable Yield is developed.

Figure 49 shows the distribution of pumping through the Basin and the volumes pumped at each production well for the past 2 years. The blue bar charts on Figure 49 reflect the actual or gross amounts pumped from each well and the green bar charts reflects the volume of ASR or PWM injection. In WY 2023, the majority of pumping in the Basin occurred at CAWC's Ord Grove No. 2, Santa Margarita #1, Santa Margarita #3, and Paralta production wells.

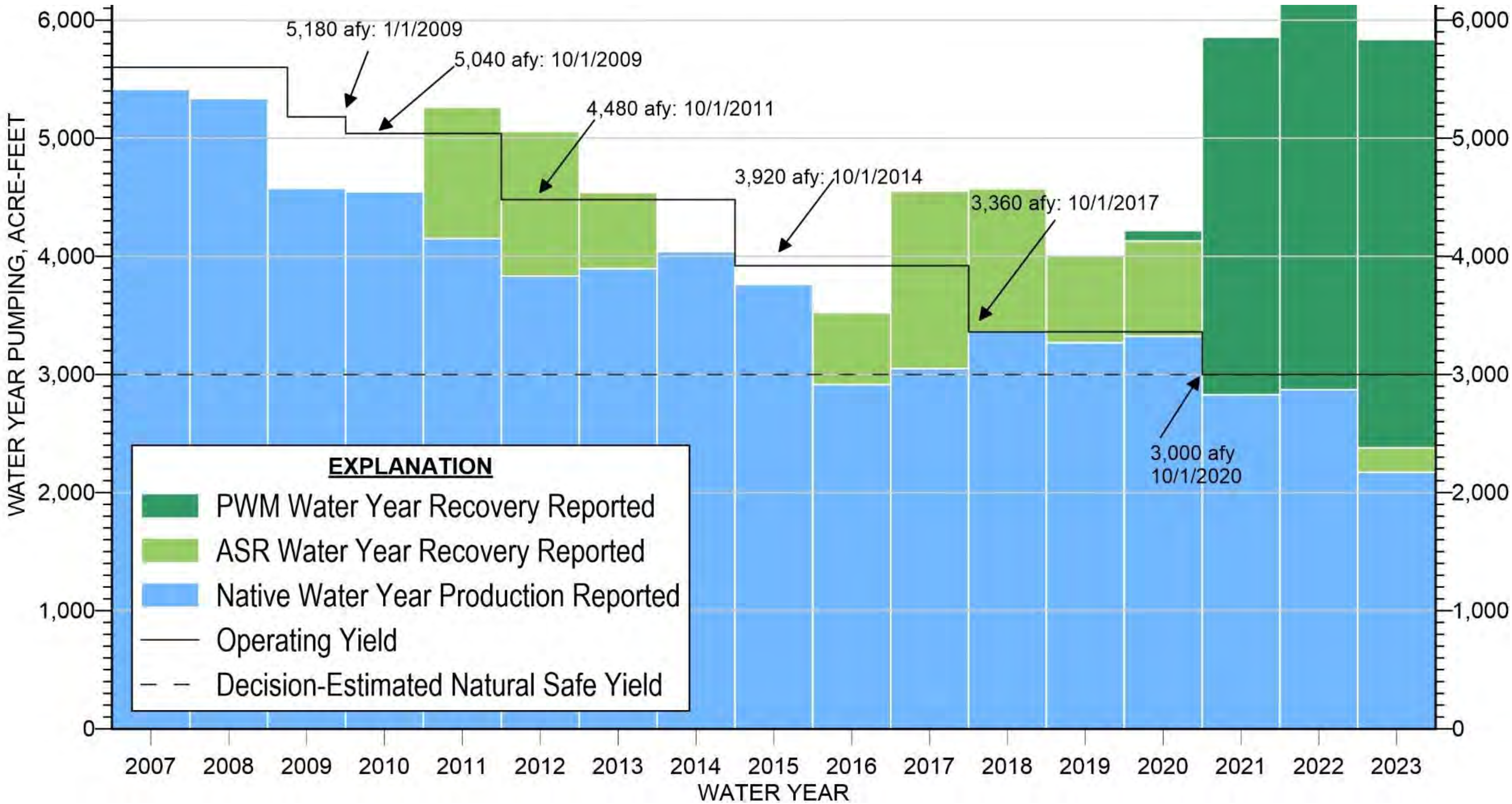


Figure 48. Annual Reported Groundwater Production and Operating Yield for Watermaster Producers

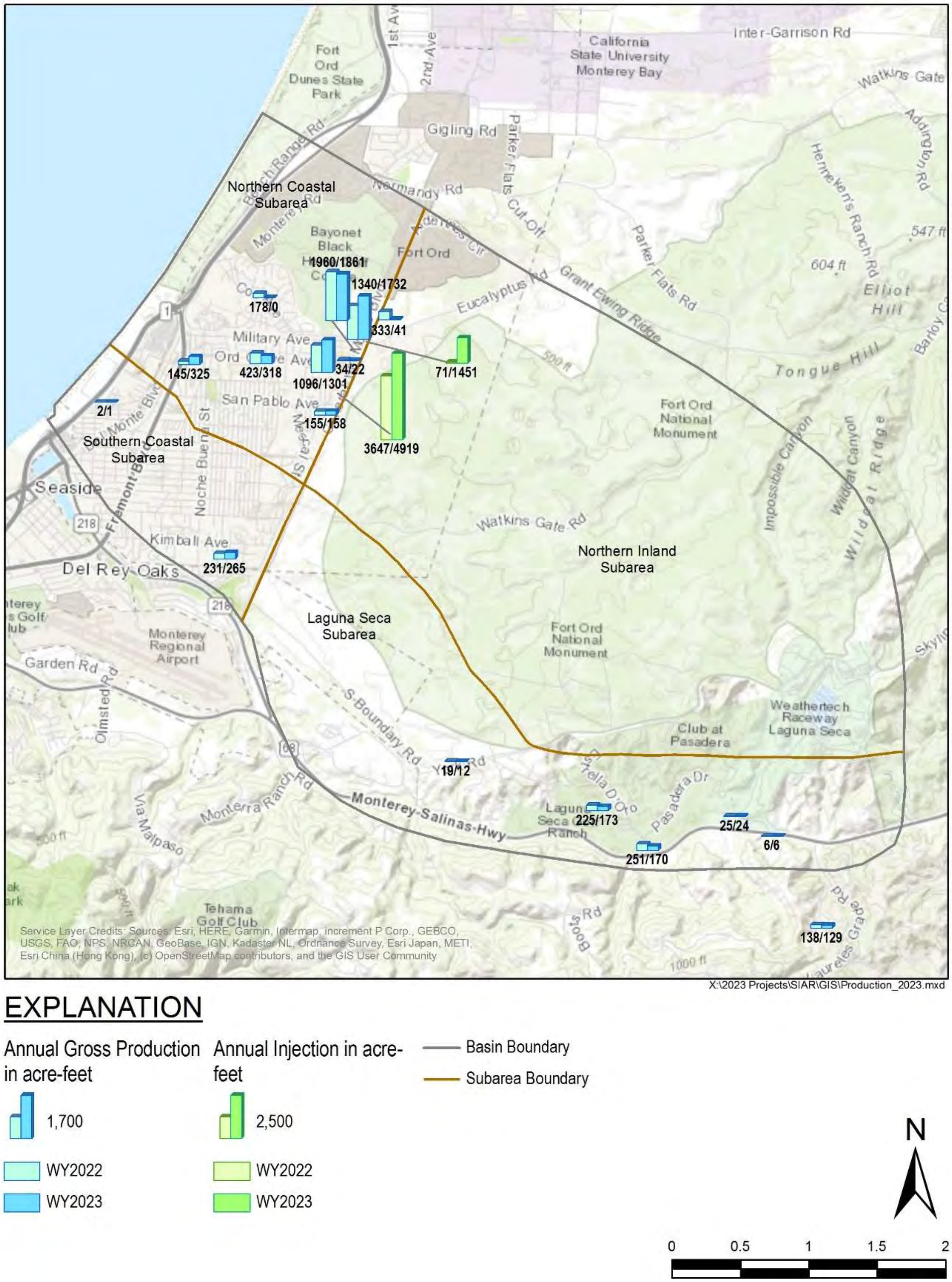


Figure 49. Watermaster Producers' Pumping Distribution for Water Years 2022 and 2023

3 CONCLUSIONS

Data collected in WY 2023 from monitoring and production wells do not indicate that seawater intrusion is occurring within the Seaside Groundwater Basin. However, induction logging has revealed small incremental increases in conductivity over time in Sentinel wells SBWM-1, 2, and 4 within the Paso Robles Formation that may be a precursor to seawater intrusion. With SBWM-1 and SBWM-2 located north of the Seaside Basin, the focus is on SBWM-4 which has the greater conductivity changes of the 3 wells and is in the Northern Coastal subarea where most of the Basin's groundwater extraction occurs. A zone of increasing conductivity in SBWM-4 is found between 140 and 200 feet bgs within a coarser-grained unit of the Paso Robles Formation. Because the conductivity changes are relatively small, roughly equating to a total dissolved solids concentration of 100 - 200 mg/L, and the zone of increasing conductivity is confined to a specific zone in the Paso Robles Formation, no immediate action is warranted. However, it is recommended that investigation into options for verifying if seawater intrusion is occurring in the Paso Robles Formation at or near SBWM-4 be a priority for WY 2024. This may involve finding a site for a new monitoring well, adapting an existing well, induction logging a nearby monitoring well, or some other solution. If the fall 2024 induction logging results confirm increasing conductivity, the Watermaster should be prepared to monitor groundwater quality in the affected zone.

Data collected in WY 2023 from monitoring and production wells do not indicate that seawater intrusion is occurring within the Basin. However, induction logging has revealed small incremental increases in conductivity over time in Sentinel wells SBWM-1, 2, and 4 within the Paso Robles Formation that may be a precursor to seawater intrusion. With SBWM-1 and SBWM-2 located north of the Basin, the focus is on SBWM-4 which has the greater conductivity changes of the 3 wells and is in the Northern Coastal subarea where most of the Basin's groundwater extraction occurs. A zone of increasing conductivity in SBWM-4 is found between 140 to 200 feet bgs within a coarser-grained unit of the Paso Robles Formation. Because the conductivity changes are relatively small, roughly equating to a total dissolved solids concentration of 100-200 mg/L, and the zone of increasing conductivity is confined to a specific zone in the Paso Robles Formation, no immediate action is warranted.

Since WY 2020, chloride concentrations in FO-10 Shallow, located outside and to the north of the Basin, have been elevated above historical concentrations. Five of the last 7 samples have a sodium/chloride molar ratio below 0.86, which may suggest a seawater chloride source. Of the 4 samples collected from the Shallow well in WY 2023, the first 2 were above 90 mg/L, while the May and August 2023 samples were just below 90 mg/L. Induction logging of FO-10 Deep in 2021 was inconclusive regarding the presence of seawater intrusion in the well. It was complicated by the presence of a 1,300-foot steel pipe that has been left in the borehole since the well's construction and which is believed to be acting as a conduit across the borehole. Evidence of hydraulic connection between FO-10 Shallow and Deep wells is that the 2 wells have shown extremely similar groundwater elevations over the past 4 years. However, in WY 2023, FO-10 Deep had a 68.4 mg/L chloride decrease bringing concentrations down to those last seen 3 years ago. Regardless, the presence of this steel pipe clouds interpretation of groundwater quality results and may act as a conduit for groundwater in overlying sediments to enter underlying aquifers.

Groundwater levels below sea level, the cumulative effect of pumping in excess of recharge and freshwater inflows, and ongoing seawater intrusion in the nearby Salinas Valley all suggest that seawater intrusion has the potential to occur in the Seaside Groundwater Basin.

Based on the findings of this report, the following ongoing detrimental groundwater conditions pose a direct threat of seawater intrusion:

- Both the Paso Robles and Santa Margarita aquifers in the Seaside Groundwater Basin are susceptible to seawater intrusion. The Paso Robles aquifer is in direct hydrogeologic connection with Monterey Bay, and seawater will eventually flow into it if inland groundwater levels continue to be below sea level. The Santa Margarita aquifer may not be in direct connection with Monterey Bay. If that is the case, then seawater intrusion will take longer as seawater in the Paso Robles aquifer would need to move downward through the clay rich deposits overlying the Santa Margarita aquifer before entering the aquifer itself and making its way into Santa Margarita production wells. It is not if, but when, seawater intrusion into these aquifers will occur if protective water elevations are not achieved.
- Over a number of years conductivity data from induction logging of Sentinel Wells 1, 2, and 4 have shown small but steady increases in conductivity within defined coarser-grained zones within the Paso Robles Formation. The estimated total dissolved solids (TDS) increase associated with the change in conductivity since 2019 is approximately 100 mg/L – 200 mg/L. The Secondary Drinking Water limit is 500 mg/L.
- Groundwater levels in some portions of both the Paso Robles and Santa Margarita aquifers in the Northern Coastal subarea continue to be below sea level year-round. WY 2023 fourth quarter (summer/fall) groundwater levels in the Santa Margarita aquifer are approximately 40 feet below sea level. However, pumping depressions in both the Paso Robles and Santa Margarita aquifers are slightly smaller than the previous year.
- Groundwater levels remain below protective elevations in all 3 Santa Margarita aquifer protective elevation monitoring wells (MSC deep, PCA-W Deep, and sentinel well SBWM-3), and 1 of the 3 Paso Robles protective elevation monitoring wells (MSC

Shallow). All 3 Santa Margarita monitoring well groundwater elevations recovered slightly in WY 2023 since being the lowest in their historical record the previous year. Other than PCA-W Shallow, the shallow aquifer protective elevation monitoring wells have all consistently been below protective elevations over the period of record shown on Figure 44 through Figure 47. Elevations at PCA-W Shallow were above protective elevations from the late 1990s through 2020 but have since dropped below, though they recovered close to the protective elevation briefly in WY 2023.

It is important to remain vigilant and to closely monitor groundwater quality even though seawater intrusion has not yet been observed in monitoring or production wells in the Seaside Groundwater Basin. As outlined in the Basin Management Action Plan (Montgomery & Associates, 2018a), it is important that the Watermaster continues to identify ways to reduce pumping native groundwater and/or to recover groundwater elevations with water that is left in the Basin and is not extracted out as water supply.

The following evidence from this report demonstrates that seawater intrusion has not been detected in monitoring and production wells from which water quality samples are collected:

- Most groundwater samples for WY 2023 from depth-discreet monitoring wells generally plot in a single cluster on Piper diagrams, with no water chemistry changes toward seawater.
- In some production wells, groundwater quality plots on Piper diagrams are different than groundwater quality in monitoring wells. This may be a result of mixed water quality because these wells are perforated in both the Paso Robles and Santa Margarita aquifers. None of the production wells' groundwater qualities are indicative of seawater intrusion.
- None of the Stiff diagrams for monitoring and production wells show the characteristic chloride spike that typically indicates seawater intrusion in Stiff diagrams. The Stiff diagrams for monitoring well FO-10 Shallow show a slightly different shape than other shallow wells because of increased chloride. The stiff diagram for FO-10 Deep, which showed a spike of increased chloride in WY 2022, returned to a shape consistent with its historical shape.
- Chloride concentration trends are stable for most monitoring wells, except FO-10 Shallow and FO-10 Deep. FO-10 Shallow experienced a 13.8 mg/L decrease in chloride concentrations in WY 2023. FO-10 Deep experienced a 68.4 mg/L chloride decrease in WY 2023. The reason for this is not apparent.
- Maps of chloride concentrations for the shallow aquifer do not show chlorides increasing toward the coast. Santa Margarita aquifer chloride concentration maps show that the highest chloride concentrations are limited to coastal monitoring wells PCA-West Deep

and MSC Deep, but these are not indicative of seawater intrusion since their concentrations are less than 155 mg/L and they do not have increasing trends.

Other important findings from the analysis contained in this report include the following:

- Due to its distance from the coast, seawater intrusion is not an issue of concern in the Laguna Seca subarea. However, groundwater levels in the eastern Laguna Seca subarea have historically declined at rates of 0.6 feet per year in the shallow aquifers, and up to 4 feet per year in the deep aquifers. These declines have occurred since 2001 despite triennial reductions in allowable pumping. The cause of the declines is due in part to the subarea's limited natural safe yield and in part due to the influence of wells east of the Basin. Since WY 2021, groundwater elevations in the area have appeared to experience some stabilization and recovery, potentially correlated with a cessation of pumping at California American Water Company's (CAWC) Ryan Ranch and Bishop wells.
- Native groundwater production in the Basin for WY 2023 was 2,173 acre-feet, which is 698 acre-feet less than WY 2022 and 827 acre-feet less than the Decision-ordered Operating Yield for WY 2023 of 3,000 acre-feet. In addition to WY 2023 being an above average year for rainfall, recovery of 3,458 acre-feet of recycled water from Pure Water Monterey project (PWM) and use of recycled water at the Bayonet/Blackhorse Golf Courses helped offset pumping of native groundwater. Native groundwater production was below the Decision-estimated Natural Safe Yield of 3,000 acre-feet for the fourth year in a row.

4 RECOMMENDATIONS

The following recommendations should be implemented to monitor and track seawater intrusion.

Remove Lost Transducer and Steel Cable from SBWM-3

Induction logging in the very bottom of SBWM-3 was hampered by the lost transducer and steel cable in the bottom of the well. Given increased conductivity occurring within the Paso Robles aquifer in SBWM-1, 2, and 4, the transducer and cable should be fished out prior to conducting the fall 2024 induction logging so a complete log of conductivity can be obtained.

Actions Regarding Increased Conductivity Observed in Induction Logs in SBWM-1, SBWM-2, and SBWM-4

EKI and MCWD GSA (Marina Coast Water District Groundwater Sustainability Agency) should be informed that Sentinel wells SBWM-1 and SBWM-2 are starting to show an increase in conductivity in defined coarser-grained zones in the Paso Robles Aquifer. These wells are located outside of the Basin and are within the Marina Subarea of the Monterey Subbasin.

Verify Chloride Concentrations and Water Chemistry in the 140 – 200 foot Zone of SBWM-4

Options for verifying seawater intrusion occurring in the Paso Robles Formation at or near SBWM-4 should be evaluated in WY 2024. This may involve finding a site for a new monitoring well, adapting an existing well, induction logging a nearby monitoring well, or some other solution. If the fall 2024 induction logging results confirm increasing conductivity, the Watermaster should see if it would be feasible to monitor groundwater quality in the affected zone.

Destroy and Replace FO-10 Shallow and FO-10 Deep

It is recommended that FO-10 Shallow and FO-10 Deep be destroyed and replaced to maintain continuous water quality monitoring and to prevent cross contamination between the Paso Robles and Santa Margarita aquifers, and the overlying Dune Sands. These wells are located outside of the Basin, so destruction would need to be performed by the well owner, MPWMD, and replacement wells would need to be installed by the MCWD GSA.

Incorporate PWM and ASR Monitoring Well Data in SIARs

Based on the WY 2020's SIAR recommendation, groundwater elevation data from the Carmel River water Aquifer Storage and Recovery (ASR) project and PWM monitoring wells are now incorporated into the analysis of groundwater elevations if available. Groundwater level data from PWM monitoring wells are typically available for the second quarter of the water year, but fourth quarter data from are less likely to be posted online at GeoTracker at the time of reporting. Inclusion of groundwater level data from ASR monitoring wells is reliant on direct transmittal from applicable monitoring entity and is not always provided in time for reporting. As these and any future projects are implemented, groundwater levels, groundwater flow directions, and potentially groundwater quality will change in response. It is important data from monitoring wells associated with these projects continue to be evaluated in future SIARs.

Continue to Analyze and Report on Water Quality Annually

Seawater intrusion is a threat to the basin, and data must be collected and analyzed regularly to identify incipient intrusion. Maps, graphs, and analyses similar to what are found in this report should continue to be developed every year.

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Appendix A

Seaside Basin Monitoring
Groundwater Quality Data for WY 2023

Seaside Basin Monitoring Groundwater Quality Data for WY 2023

ASR MW-1

WM No. 257

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230224_28-04	2/24/2023	45	50	12.8	3.5	191	58	0.1	39.2	0.3	<0.03	<0.015		<0.1	0.1	7.8	304	525
230524_78-01	5/24/2023	47	37	12.7	2.8	169	60	0.1	29.1	0.2	0.047	<0.015		<0.1	0.1	7.8	326	513
230824_25-01	8/24/2023	46	38	12.5	2.9	158	59	0.1	29.6	0.2	<0.01	<0.005			0.2	7.6	340	481

Camp Huffman (D)

WM No. 250

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230906_66-01	9/6/2023	83	87	27.7	5.3	326	54	0.4	131	<0.1	<0.03	0.038		<0.1	0.4	8.2	596	1041

Camp Huffman (S)

WM No. 249

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230906_66-02	9/6/2023	50	72	16.7	3.3	119	13	<0.1	169	0.6	<0.03	<0.015		<0.1	0.5	8.2	450	788

Del Monte Test

WM No. 231

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230913_33-01	9/13/2023	19	51	8.6	3.5	102	14	<0.04	61	0.6	3.5	0.064		<0.05	0.2	7.74	216	399

< = not detected above detection limit of value following <

all values other than pH and EC are in mg/L

FO-09-Deep

WM No. 112

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
221116_83-03	11/16/2022	29	53	4	4	106	10		67.9		1.75	0.032			0.2	7.4	230	416
230330_59-01	3/30/2023	27	53	3.8	4.4	123	11	<0.1	68.5	<0.1	0.793	0.025		<0.1	0.2	7.4	248	496
230518_63-02	5/18/2023	30	52	4	4.3	114	12	<0.1	67.5	<0.1	0.559	0.02		<0.1	0.2	7.5	268	453
230821_35-01	8/21/2023	29	53	4	4.4	122	11	<0.1	68	<0.1	1.31	0.027		<0.1	0.2	7.4	266	472

FO-10-Deep

WM No. 114

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230925_61-03	9/25/2023	20	38	3.4	3.5	68	15	0.2	51.6	0.2	0.516	0.088		<0.1	0.2	8	222	333

FO-10-Shallow

WM No. 113

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
221116_83-01	11/16/2022	30	45	8.8	2.6	64	10		97.6	0.5	0.05				0.3	7.5	308	451
230330_59-03	3/30/2023	26	46	8.5	2.7	67	9	<0.1	96.9	<0.1	0.072	<0.015		<0.1	0.3	7	290	498
230518_63-01	5/18/2023	26	43	7.8	2.5	62	10	<0.1	85.4	0.4	0.035	0.011		<0.1	0.3	7.6	314	433
230817_41-01	8/17/2023	26	44	7.8	2.6	67	10	<0.1	83.8	<0.1	0.09	<0.015		<0.1	0.3	7.1	284	460

LS Golf Old #12

WM No. 144

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230927_36-02	9/27/2023	135	135	32.4	5.3	297	193	0.5	232	0.2	0.927	0.048		0.1	0.8	7	986	1527

< = not detected above detection limit of value following <

all values other than pH and EC are in mg/L

LSRA #2 — WM No. 196

Sample Id	Sample Date	Major Cations				Major Anions					Major Ions					Physical		
		Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230927_36-03	9/27/2023	19	100	12.4	2.7	106	20	0.2	143	0.5	0.282	0.043		0.1	0.5	6.6	400	705

Luzern #2 — WM No. 159

Sample Id	Sample Date	Major Cations				Major Anions					Major Ions					Physical		
		Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230913_19-01	9/13/2023	63	98	17.6	4.6	175	97	0.2	130	4	0.016	0.013		0.2	0.4	7.3	538	901

MMP monitor — WM No. 154

Sample Id	Sample Date	Major Cations				Major Anions					Major Ions					Physical		
		Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230926_60-01	9/26/2023	38	68	10.7	3.4	127	40	<0.1	84.5	2.9	<0.03	<0.015		<0.1	0.3	7.7	352	595

MSC - Shallow — WM No. 101

Sample Id	Sample Date	Major Cations				Major Anions					Major Ions					Physical		
		Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
221116_83-02	11/16/2022	19	33	5.4	3	71	14		44.6	0.2					0.1	6.5	200	299
230330_59-02	3/30/2023	16	33	5	2.9	79	14	<0.1	44.3	0.2	<0.03	<0.015		<0.1	0.1	6.6	196	353
230518_63-03	5/18/2023	18	32	5.2	2.8	71	13	<0.1	43.3	0.2	<0.03	<0.015		<0.1	0.1	6.6	192	308
230818_28-02	8/18/2023	20	36	5.7	3.1	74	14	<0.1	43	0.2	<0.03	<0.015		<0.1	0.1	6.9	186	338

MSC-Deep — WM No. 102

Sample Id	Sample Date	Major Cations				Major Anions					Major Ions					Physical		
		Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230519_85-01	5/19/2023	75	105	14.6	4.8	275	45	0.2	144	<0.1	0.094	0.05		0.1	0.5	7.4	574	994

< = not detected above detection limit of value following <

all values other than pH and EC are in mg/L

230818_28-03	8/18/2023	79	109	15.1	4.8	283	45	0.2	149	<0.1	0.114	0.051		0.1	0.5	7.4	570	1023

Ord Grove #2

WM No. 153

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230913_18-01	9/13/2023	53	80	15.9	4.1	182	57	0.1	107	1.7	<0.01	0.006		0.1	0.3	7.2	454	753

Ord Terrace-Shallow

WM No. 109

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230926_60-04	9/26/2023	71	90	16.7	4.9	242	49	0.2	121	2	0.102	0.152		0.1	0.4	7.9	530	891

Paralta

WM No. 169

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
221115_83-02	11/15/2022	31	41	7.5	3	92	25	0.4	61.4	1.1	0.018			0.2	0.2	7.3	264	422
230224_28-02	2/24/2023	35	44	9.4	3.5	127	44	0.3	44.1	0.7	<0.03	<0.015		0.2	0.1	7.6	246	450
230524_78-02	5/24/2023	27	49	8.4	2.6	89	30	<0.1	71	0.7	<0.03	<0.015		<0.1	0.2	7.8	296	474
230823_43-02	8/23/2023	40	45	10.6	2.9	144	54	0.3	42.5	0.3	<0.03	<0.015		<0.1	0.2	7.4	286	485
230913_11-01	9/13/2023	38	46	10.6	3.1	150	53	0.3	43.3	0.3	<0.01	0.005		<0.05	0.1	7.4	292	482

Paralta Test Well

WM No. 108

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
221115_83-01	11/15/2022	30	48	8.8	2.9	86	31	0.1	77.7	0.9					0.2	7.7	302	468
230224_28-01	2/24/2023	27	52	8.7	3	92	31	<0.1	73.6	0.8	<0.03	<0.015		<0.1	0.2	7.7	260	465
230524_78-03	5/24/2023	42	43	11.2	3.1	150	57	0.2	37.1	0.2	0.021	0.007		<0.1	0.1	7.4	290	497

< = not detected above detection limit of value following <   all values other than pH and EC are in mg/L

Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230824_25-03	8/24/2023	28	51	8.5	2.8	91	29		72	0.7	<0.01	<0.005			0.2	7.8	268	457

Pasadera Golf - Paddock

WM No. 204

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230927_36-01	9/27/2023	126	115	30.5	4.6	273	175	0.5	189	0.6	0.172	0.036		0.1	0.6	6.8	866	1358

PCA East Deep

WM No. 106

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
221115_83-03	11/15/2022	69	96	13.3	4.9	248	39	0.2	128		0.117	0.13		0.1	0.4	7	512	863
230224_28-03	2/24/2023	64	104	13.6	5	255	39	0.2	129	<0.1	<0.03	0.079		0.1	0.4	7.2	510	881
230526_57-01	5/26/2023	68	101	13.8	4.6	254	40	0.2	131	<0.1	0.048	0.025		0.1	0.4	7.1	516	903
230824_25-02	8/24/2023	70	106	14.3	5.1	260	40	0.2	130		<0.01	0.035		0.1	0.4	7.1	520	893
230925_61-01	9/25/2023	68	107	14.3	5	259	40	0.2	127	<0.1	0.024	0.021		0.1	0.4	7	520	913

PCA-E Shallow

WM No. 105

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230925_61-02	9/25/2023	28	46	7.1	3.3	112	16	0.1	57.1	<0.1	<0.03	<0.015		<0.1	0.2	7.3	240	415

PCA-W Deep

WM No. 104

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
221122_02-02	11/21/2022	79	99	16.6	4.5	304	41	0.2	153	<0.1	28.7	0.304		0.1	0.5	6.7	574	1026
230331_48-01	3/31/2023	74	106	17	5.1	299	42	0.2	154	<0.1	21.9	0.289		0.1	0.5	6.9	594	1042
230523_88-01	5/23/2023	81	105	17.2	5.2	318	43	0.2	156	<0.1	20.3	0.314		0.1	0.6	6.9	612	1067

< = not detected above detection limit of value following <   all values other than pH and EC are in mg/L

230817_41-02	8/17/2023	81	112	18.1	5.3	306	42	0.2	149	<0.1	16	0.29		0.1	0.5	7	627	1013

PCA-W Shallow

WM No. 103

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
221122_02-01	11/21/2022	19	33	5.4	2.5	88	12	<0.1	47	0.7	0.382	<0.015		<0.1	0.1	6.3	194	327
230331_48-02	3/31/2023	18	35	5.4	2.7	82	12	<0.1	47.2	0.7	0.097	<0.015		<0.1	0.1	6.5	195	356
230523_88-02	5/23/2023	20	34	5.5	2.8	74	12	0.1	47.3	0.6	0.029	<0.015		<0.1	0.2	6.5	208	324
230818_28-01	8/18/2023	20	36	5.7	2.8	79	12	<0.1	45.5	0.7	0.102	<0.015		<0.1	0.2	6.6	198	356

Playa #3

WM No. 162

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230913_31-01	9/13/2023	53	87	16.8	4.6	136	89	0.1	115	6.8	<0.01	0.018		0.1	0.5	7.05	506	810

Plumas #4

WM No. 177

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230913_32-01	9/13/2023	50	126	24	4.7	150	83	0.1	198	2.5	<0.01	0.007		0.1	0.6	6.9	618	1037

Sand City Corp Yard

WM No. 165

		Major Cations				Major Anions					Major Ions					Physical		
Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
230926_60-03	9/26/2023	37	182	9.1	5.6	123	115	2.3	194	9.1	0.02	0.02		0.6	0.7	7.5	684	1157

Seaside Middle School (D)

WM No. 260

Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
		Major Cations				Major Anions					Major Ions					Physical		
221115_82-01	11/15/2022	91	107	23.5	6.3	335	72	0.2	142			0.028		0.1	0.4	7.2	630	1079
230224_31-01	2/24/2023	97	116	25.1	6.6	343	75	0.2	163	<0.1	0.011	0.042		0.2	0.5	7.4	668	1155

York School 2001

WM No. 212

Sample Id	Sample Date	Ca	Na	Mg	K	HCO3	SO4	F	Cl	N	Fe	Mn	HPO4	B	Br	pH	TDS	EC (us/cm)
		Major Cations				Major Anions					Major Ions					Physical		
230926_60-02	9/26/2023	36	169	30.1	4.8	66	34	0.2	335	1.2	<0.03	<0.015		<0.1	1.1	6.9	734	1287

< = not detected above detection limit of value following <

all values other than pH and EC are in mg/L

MONTGOMERY
& ASSOCIATES

Appendix B

Seaside Basin Monitoring
Groundwater Level Data for WY 2023

Seaside Basin Monitoring

Groundwater Level Data for WY 2023

Bishop #3

Watermaster No. 262

Southern Inland

Owner: CAW

Aquifer Unit:

Well Type: Producer

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/27/2022	374	420.58	46.58	off
11/23/2022	362	420.58	58.58	off
12/29/2022	370	420.58	50.58	off
01/26/2023	252	420.58	168.58	off
02/23/2023	251	420.58	169.58	off
03/30/2023	250	420.58	170.58	off
04/27/2023	253.8	420.58	166.78	off
05/25/2023	256.1	420.58	164.48	off
06/29/2023	256	420.58	164.58	off
07/27/2023	256	420.58	164.58	off
08/31/2023	257.2	420.58	163.38	off
09/28/2023	258	420.58	162.58	off

Blue Larkspur-East End

Watermaster No. 143

Southern Inland

Owner: Laguna Seca Resorts

Aquifer Unit:

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	117.99	253.29	135.30	0
12/29/2022	117.97	253.29	135.32	0
03/29/2023	117.01	253.29	136.28	0
06/29/2023	116.28	253.29	137.01	0
09/29/2023	116.66	253.29	136.63	0

CalAm Granite Construction

Watermaster No. 242

Southern Inland

Owner: California American Water

Aquifer Unit: Tsm

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	135.03	226.43	91.40	
10/11/2022	135.03	226.43	91.40	0
12/29/2022	134.82	226.43	91.61	0
03/29/2023	134.87	226.43	91.56	0
06/29/2023	134.93	226.43	91.50	0
09/29/2023	134.97	226.43	91.46	0

Camp Huffman (D)

Watermaster No. 250

Salinas Valley, Monterey

Owner: Seaside Groundwater Basin Watermas

Aquifer Unit:

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	415.61	401.21	-14.40	0
11/28/2022	414.62	401.21	-13.41	0
12/21/2022	413.88	401.21	-12.67	0
01/27/2023	410.87	401.21	-9.66	0
03/03/2023	409.72	401.21	-8.51	0
03/31/2023	409.89	401.21	-8.68	0
04/27/2023	409.35	401.21	-8.14	0
05/30/2023	408.79	401.21	-7.58	0
06/27/2023	410.56	401.21	-9.35	0
07/26/2023	411.05	401.21	-9.84	0
08/28/2023	411.94	401.21	-10.73	0
09/27/2023	413.72	401.21	-12.51	0

Camp Huffman (S) | Watermaster No. 249 | Salinas Valley, Monterey

Owner: Seaside Groundwater Basin Watermas | Aquifer Unit:

Well Type: Monitor | All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	410	401.21	-8.79	0
11/28/2022	409.09	401.21	-7.88	0
12/21/2022	408.71	401.21	-7.50	0
01/27/2023	407.94	401.21	-6.73	0
03/03/2023	407.4	401.21	-6.19	0
03/31/2023	406.91	401.21	-5.70	0
04/27/2023	406.73	401.21	-5.52	0
05/30/2023	407.57	401.21	-6.36	0
06/27/2023	408.3	401.21	-7.09	0
07/26/2023	409.25	401.21	-8.04	0
08/28/2023	410.37	401.21	-9.16	0
09/27/2023	411.13	401.21	-9.92	0

CDM MW#4 | Watermaster No. 238 | Southern Coastal

Owner: MPWMD | Aquifer Unit: Qod

Well Type: Monitor | All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	14.66	18.69	4.03	0
11/29/2022	14.51	18.69	4.18	0
12/21/2022	14.23	18.69	4.46	0
01/26/2023	14.13	18.69	4.56	0
03/09/2023	14.1	18.69	4.59	0
03/31/2023	14.22	18.69	4.47	0
04/28/2023	14.59	18.69	4.10	0

05/31/2023	14.31	18.69	4.38	0
06/28/2023	14.71	18.69	3.98	0
07/26/2023	14.99	18.69	3.70	0
08/28/2023	14.97	18.69	3.72	0
09/28/2023	14.39	18.69	4.30	0

CDM MW-1 Watermaster No. 251 Northern Coastal

Owner: MPWMD Aquifer Unit: Qod/Qar

Well Type: Monitor All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/04/2022	89.92	93.53	3.61	0
11/29/2022	89.69	93.53	3.84	0
12/21/2022	90	93.53	3.53	0
01/26/2023	88.18	93.53	5.35	0
03/02/2023	88.06	93.53	5.47	0
03/31/2023	88.65	93.53	4.88	0
05/01/2023	89.29	93.53	4.24	0
05/31/2023	89.5	93.53	4.03	0
06/29/2023	89.77	93.53	3.76	0
07/27/2023	90.11	93.53	3.42	0
08/28/2023	90.21	93.53	3.32	0
09/28/2023	89.33	93.53	4.20	0

CDM MW-2 Watermaster No. 252 Northern Coastal

Owner: MPWMD Aquifer Unit: Qod/Qar

Well Type: Monitor All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/04/2022	60.25	63.86	3.61	0
11/29/2022	60.1	63.86	3.76	0

12/21/2022	60.7	63.86	3.16	0
01/26/2023	58.43	63.86	5.43	0
03/02/2023	57.68	63.86	6.18	0
03/31/2023	58.62	63.86	5.24	0
05/01/2023	59.63	63.86	4.23	0
05/31/2023	60.06	63.86	3.80	0
06/29/2023	60.62	63.86	3.24	0
07/27/2023	60.87	63.86	2.99	0
08/28/2023	61.18	63.86	2.68	0
09/28/2023	59.71	63.86	4.15	0

CDM MW-3 Watermaster No. 239 Southern Coastal

Owner: MPWMD

Aquifer Unit: Qod/Qar

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	31.5	33.81	2.31	0
11/29/2022	31.5	33.81	2.31	0
12/21/2022	31.19	33.81	2.62	0
01/26/2023	31.01	33.81	2.80	0
02/28/2023	29.26	33.81	4.55	0
03/31/2023	30.29	33.81	3.52	0
04/28/2023	32.12	33.81	1.69	0
05/31/2023	31.18	33.81	2.63	0
06/28/2023	32.89	33.81	0.92	0
07/26/2023	33.2	33.81	0.61	0
08/28/2023	32.25	33.81	1.56	0
09/28/2023	30	33.81	3.81	0

Cypress Pacific Production

Watermaster No. 150

Southern Coastal

Owner: Paul Bruno

Aquifer Unit: QTc

Well Type: Producer

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	47.82	50.23	2.41	0
11/29/2022	47.58	50.23	2.65	0
12/21/2022	46.97	50.23	3.26	0
01/26/2023	46.29	50.23	3.94	0
02/28/2023	46.12	50.23	4.11	0
03/31/2023	45.85	50.23	4.38	0
04/28/2023	46.36	50.23	3.87	0
05/31/2023	46.59	50.23	3.64	0
06/28/2023	46.92	50.23	3.31	0
07/26/2023	47.29	50.23	2.94	0
08/28/2023	47.5	50.23	2.73	0
09/28/2023	47.12	50.23	3.11	394 off

Del Monte Test

Watermaster No. 231

Northern Coastal

Owner: California American Water

Aquifer Unit: QTc

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/27/2022	28	32.62	4.62	off
11/23/2022	29	32.62	3.62	off
12/29/2022	28.3	32.62	4.32	off
01/26/2023	29	32.62	3.62	off
02/23/2023	30	32.62	2.62	off
03/30/2023	31	32.62	1.62	off
04/27/2023	31	32.62	1.62	off

05/25/2023	31	32.62	1.62	off
06/29/2023	31	32.62	1.62	off
07/27/2023	31	32.62	1.62	off
08/31/2023	30	32.62	2.62	off
09/28/2023	31.5	32.62	1.12	off

Design Ctr.

Watermaster No. 167

Southern Coastal

Owner: City of Sand City

Aquifer Unit: Qod/Qar/QTc

Well Type: Producer

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	14.21	21.31	7.10	0
11/29/2022	14.11	21.31	7.20	0
12/21/2022	13.7	21.31	7.61	0
01/26/2023	13.11	21.31	8.20	0
03/02/2023	12.75	21.31	8.56	0
03/31/2023	12.53	21.31	8.78	0
04/28/2023	12.58	21.31	8.73	0
06/02/2023	12.66	21.31	8.65	0
06/29/2023	12.86	21.31	8.45	0
07/27/2023	13.93	21.31	7.38	0
08/28/2023	13.23	21.31	8.08	0
09/28/2023	13.25	21.31	8.06	0

FO-01-Deep

Watermaster No. 116

Northern Inland

Owner: MPWMD

Aquifer Unit: Tm

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	343.15	365.57	22.42	
10/11/2022	343.15	365.57	22.42	0

12/29/2022	343.84	365.57	21.73	0
06/30/2023	342.45	365.57	23.12	0
09/29/2023	342.6	365.57	22.97	0

FO-01-Shallow

Watermaster No. 115

Northern Inland

Owner: MPWMD

Aquifer Unit: QTc

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	203.54	362.61	159.07	0
10/11/2022	203.54	362.61	159.07	
12/29/2022	203.6	362.61	159.01	0
03/29/2023	203.64	362.61	158.97	0
06/30/2023	203.76	362.61	158.85	0
09/29/2023	203.8	362.61	158.81	0

FO-03-Deep

Watermaster No. 127

Southern Inland

Owner: MPWMD

Aquifer Unit: Tsm

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	637.48	774.74	137.26	
10/11/2022	637.48	774.74	137.26	0
12/29/2022				0
03/29/2023	619.13	774.74	155.61	0
06/29/2023	637.59	774.74	137.15	0
10/05/2023	637.67	774.74	137.07	0

FO-04-Deep (W)

Watermaster No. 130

Southern Inland

Owner: MPWMD

Aquifer Unit: Tsm

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	116.1	167.44	51.34	0

11/30/2022	116.45	167.44	50.99	0
12/22/2022	116.58	167.44	50.86	0
01/27/2023	116.95	167.44	50.49	0
03/02/2023	117	167.44	50.44	0
03/31/2023	117.15	167.44	50.29	0
04/28/2023	117.21	167.44	50.23	0
05/31/2023	117.42	167.44	50.02	0
06/28/2023	116.97	167.44	50.47	0
07/27/2023	116.68	167.44	50.76	0
08/28/2023	117.01	167.44	50.43	0
09/28/2023	117.31	167.44	50.13	0

FO-04-Shallow (E)

Watermaster No. 129

Southern Inland

Owner: MPWMD

Aquifer Unit: QTc

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	116.36	168.23	51.87	0
11/30/2022	116.05	168.23	52.18	0
12/22/2022	116.25	168.23	51.98	0
01/27/2023	116.67	168.23	51.56	0
03/02/2023	116.89	168.23	51.34	0
03/31/2023	117.07	168.23	51.16	0
04/28/2023	116.94	168.23	51.29	0
05/31/2023	117.1	168.23	51.13	0
06/28/2023	116.2	168.23	52.03	0
07/27/2023	115.86	168.23	52.37	0
08/28/2023	116.76	168.23	51.47	0
09/28/2023	117.04	168.23	51.19	0

FO-05-Deep

Watermaster No. 132

Southern Inland

Owner: MPWMD

Aquifer Unit: Tsm

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	325.1	479.29	154.19	
10/11/2022	325.1	479.29	154.19	0
12/29/2022	322.37	479.29	156.92	0
03/29/2023	321.16	479.29	158.13	0
06/29/2023	323.87	479.29	155.42	0
10/03/2023	324.67	479.29	154.62	0

FO-05-Shallow

Watermaster No. 131

Southern Inland

Owner: MPWMD

Aquifer Unit: QTc

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	255.5	478.97	223.47	
10/11/2022	255.5	478.97	223.47	0
12/29/2022	252.86	478.97	226.11	0
03/29/2023	251.98	478.97	226.99	0
06/29/2023	256.73	478.97	222.24	0
10/03/2023	257.43	478.97	221.54	0

FO-06-Deep

Watermaster No. 134

Southern Inland

Owner: MPWMD

Aquifer Unit: Tsm

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	236.82	470.63	233.81	
10/11/2022	236.82	470.63	233.81	0
12/29/2022	234.21	470.63	236.42	0
03/29/2023	232.51	470.63	238.12	0

06/29/2023	234.32	470.63	236.31	0
10/04/2023	235.61	470.63	235.02	0

FO-06-Shallow

Watermaster No. 133

Southern Inland

Owner: MPWMD

Aquifer Unit: QTc

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	242.92	470.13	227.21	
10/11/2022	242.92	470.13	227.21	0
12/29/2022	241.71	470.13	228.42	0
03/29/2023	241.36	470.13	228.77	0
06/29/2023	243.15	470.13	226.98	0
10/04/2023	243.91	470.13	226.22	0

FO-07-Deep

Watermaster No. 119

Northern Inland

Owner: MPWMD

Aquifer Unit: Tsm

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	494.55	470.15	-24.40	0
11/28/2022	491.43	470.15	-21.28	0
12/21/2022	490.52	470.15	-20.37	0
01/26/2023	482.41	470.15	-12.26	0
03/02/2023	482.4	470.15	-12.25	0
03/31/2023	483.19	470.15	-13.04	0
04/27/2023	482.66	470.15	-12.51	0
05/30/2023	481.38	470.15	-11.23	0
06/27/2023	486.77	470.15	-16.62	0
07/26/2023	486.45	470.15	-16.30	0
08/28/2023	487.73	470.15	-17.58	0

09/27/2023	493.04	470.15	-22.89	0

FO-07-Shallow

Watermaster No. 118

Northern Inland

Owner: MPWMD

Aquifer Unit: QTc

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	466.24	473.44	7.20	0
11/28/2022	465.45	473.44	7.99	0
12/21/2022	465.27	473.44	8.17	0
01/26/2023	464.74	473.44	8.70	0
03/02/2023	464.09	473.44	9.35	0
03/31/2023	463.8	473.44	9.64	0
04/27/2023	463.44	473.44	10.00	0
05/30/2023	463.43	473.44	10.01	0
06/27/2023	463.44	473.44	10.00	0
07/26/2023	463.66	473.44	9.78	0
08/28/2023	463.86	473.44	9.58	0
09/27/2023	464.21	473.44	9.23	0

FO-08-Deep

Watermaster No. 121

Northern Inland

Owner: MPWMD

Aquifer Unit: Tsm

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	402.12	378.1	-24.02	0
11/29/2022	399.95	378.1	-21.85	0
12/22/2022	398.35	378.1	-20.25	0
01/27/2023	391.57	378.1	-13.47	0
03/03/2023	390.9	378.1	-12.80	0
03/31/2023	391.6	378.1	-13.50	0

04/27/2023	391.27	378.1	-13.17	0
05/30/2023	390.41	378.1	-12.31	0
06/28/2023	394.4	378.1	-16.30	0
07/27/2023	395.57	378.1	-17.47	0
08/30/2023	396.75	378.1	-18.65	0
09/28/2023	400.82	378.1	-22.72	0

FO-08-Shallow — Watermaster No. 120 — Northern Inland

Owner: MPWMD — Aquifer Unit: QTc

Well Type: Monitor — All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	387.79	378.04	-9.75	0
11/29/2022	387.22	378.04	-9.18	0
12/22/2022	386.55	378.04	-8.51	0
01/27/2023	385.65	378.04	-7.61	0
03/03/2023	380	378.04	-1.96	0
03/31/2023	384.35	378.04	-6.31	0
04/27/2023	384.24	378.04	-6.20	0
05/30/2023	384.36	378.04	-6.32	0
06/28/2023	384.86	378.04	-6.82	0
07/27/2023	385.52	378.04	-7.48	0
08/30/2023	386.23	378.04	-8.19	0
09/28/2023	386.7	378.04	-8.66	0

FO-09-Deep — Watermaster No. 112 — Northern Coastal

Owner: MPWMD — Aquifer Unit: Tsm

Well Type: Monitor — All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/31/2022	145.19	118.85	-26.34	0

11/29/2022	143.09	118.85	-24.24	0
12/21/2022	141.29	118.85	-22.44	0
01/27/2023	134.29	118.85	-15.44	0
02/28/2023	133.69	118.85	-14.84	0
02/28/2023	133.69	118.85	-14.84	0
02/28/2023	133.69	118.85	-14.84	0
03/30/2023	134.6	118.85	-15.75	0
04/28/2023	134.01	118.85	-15.16	0
05/30/2023	133.57	118.85	-14.72	0
06/28/2023	138.03	118.85	-19.18	0
07/26/2023	138.7	118.85	-19.85	0
08/30/2023	140.8	118.85	-21.95	0
09/28/2023	144.66	118.85	-25.81	0

FO-10-Deep

Watermaster No. 114

Northern Coastal

Owner: MPWMD

Aquifer Unit: Tp

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	215.26	201.03	-14.23	0
11/29/2022	214.37	201.03	-13.34	0
12/21/2022	213.7	201.03	-12.67	0
01/27/2023	212.5	201.03	-11.47	0
03/03/2023	211.71	201.03	-10.68	0
03/31/2023	210.8	201.03	-9.77	0
04/27/2023	210.94	201.03	-9.91	0
05/30/2023	212	201.03	-10.97	0
06/28/2023	212.92	201.03	-11.89	0
07/27/2023	213.72	201.03	-12.69	0

08/28/2023	214.47	201.03	-13.44	0
09/28/2023	215.03	201.03	-14.00	0

FO-10-Shallow

Watermaster No. 113

Northern Coastal

Owner: MPWMD

Aquifer Unit: QTc

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	215.07	200.85	-14.22	0
11/29/2022	214.29	200.85	-13.44	0
12/21/2022	213.63	200.85	-12.78	0
01/27/2023	212.39	200.85	-11.54	0
03/03/2023	211.91	200.85	-11.06	0
03/30/2023	210.78	200.85	-9.93	0
04/27/2023	211.1	200.85	-10.25	0
05/30/2023	212.32	200.85	-11.47	0
06/28/2023	213.12	200.85	-12.27	0
07/27/2023	213.92	200.85	-13.07	0
08/28/2023	214.66	200.85	-13.81	0
09/28/2023	215.07	200.85	-14.22	0

FO-11-Deep

Watermaster No. 123

Northern Inland

Owner: MPWMD

Aquifer Unit: Tp

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	348.04	332.96	-15.08	0
11/29/2022	346.63	332.96	-13.67	0
12/21/2022	345.72	332.96	-12.76	0
01/27/2023	344.09	332.96	-11.13	0
03/03/2023	343.45	332.96	-10.49	0

03/31/2023	342.27	332.96	-9.31	0
04/27/2023	342.57	332.96	-9.61	0
05/30/2023	343.13	332.96	-10.17	0
06/28/2023	345.54	332.96	-12.58	0
07/27/2023	346.91	332.96	-13.95	0
08/28/2023	348.36	332.96	-15.40	0
09/28/2023	349.07	332.96	-16.11	0

FO-11-Shallow

Watermaster No. 122

Northern Inland

Owner: MPWMD

Aquifer Unit: QTc

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	366.15	332.93	-33.22	0
11/29/2022	365.23	332.93	-32.30	0
12/21/2022	364.14	332.93	-31.21	0
01/27/2023	362.54	332.93	-29.61	0
03/03/2023	372.02	332.93	-39.09	0
03/31/2023	360.96	332.93	-28.03	0
04/27/2023	361.63	332.93	-28.70	0
05/30/2023	363	332.93	-30.07	0
06/28/2023	364.32	332.93	-31.39	0
07/27/2023	365.35	332.93	-32.42	0
08/28/2023	366.41	332.93	-33.48	0
09/28/2023	366.98	332.93	-34.05	0

Hilby MGT

Watermaster No. 244

Southern Coastal

Owner: California American Water

Aquifer Unit: QTc

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/27/2022	241	248.04	7.04	0
11/23/2022	241	248.04	7.04	0
12/29/2022	241	248.04	7.04	0
01/26/2023	241	248.04	7.04	0
02/23/2023	249	248.04	-0.96	0
03/30/2023	241	248.04	7.04	0
04/27/2023	241	248.04	7.04	0
05/25/2023	241	248.04	7.04	0
06/29/2023	241	248.04	7.04	0
07/27/2023	241	248.04	7.04	0
08/31/2023	243	248.04	5.04	0
09/28/2023	242	248.04	6.04	0

Justin Court

Watermaster No. 135

Southern Inland

Owner: California American Water

Aquifer Unit: QTc

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	142.85	240.28	97.43	
10/11/2022	142.85	240.28	97.43	0
12/29/2022	142.72	240.28	97.56	0
03/29/2023	142.6	240.28	97.68	0
06/29/2023	142.78	240.28	97.50	0
09/29/2023	142.67	240.28	97.61	0

K-Mart

Watermaster No. 125

Southern Coastal

Owner: MPWMD

Aquifer Unit: Qod/Qar

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/04/2022	22.67	30.65	7.98	0
11/30/2022	22.4	30.65	8.25	0
12/21/2022	21.97	30.65	8.68	0
01/30/2023	21.25	30.65	9.40	0
03/02/2023	21.11	30.65	9.54	0
03/31/2023	20.8	30.65	9.85	0
04/28/2023	20.86	30.65	9.79	0
06/02/2023	21.13	30.65	9.52	0
06/29/2023	21.31	30.65	9.34	0
07/27/2023	21.46	30.65	9.19	0
08/28/2023	21.85	30.65	8.80	0
09/28/2023	21.85	30.65	8.80	0

LS No. 1 Subdivision

Watermaster No. 142

Southern Inland

Owner: Laguna Seca Resorts

Aquifer Unit: Tsm

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	141.2	277.13	135.93	
10/11/2022	141.2	277.13	135.93	0
12/29/2022	141.22	277.13	135.91	0
03/29/2023	140.07	277.13	137.06	0
06/29/2023	139.5	277.13	137.63	0
09/29/2023	139.95	277.13	137.18	0

LS Pistol Range

Watermaster No. 136

Southern Inland

Owner: County of Monterey

Aquifer Unit: Tsm

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	289.55	514.39	224.84	
10/11/2022	289.55	514.39	224.84	0
12/29/2022	287.78	514.39	226.61	0
03/29/2023	288.05	514.39	226.34	0
06/29/2023	288	514.39	226.39	0
10/04/2023	288.95	514.39	225.44	0

Luxton

Watermaster No. 243

Northern Coastal

Owner: California American Water

Aquifer Unit: QTc

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/27/2022	97	89.12	-7.88	off
11/23/2022	97	89.12	-7.88	off
12/29/2022	92	89.12	-2.88	off
01/26/2023	96	89.12	-6.88	off
02/23/2023	96	89.12	-6.88	off
03/30/2023	96	89.12	-6.88	off
04/27/2023	95	89.12	-5.88	off
05/25/2023	94	89.12	-4.88	off
06/29/2023	93	89.12	-3.88	off
07/27/2023	93	89.12	-3.88	off
08/31/2023	92	89.12	-2.88	off
09/28/2023	92	89.12	-2.88	off

Luzern #2

Watermaster No. 159

Northern Coastal

Owner: California American Water

Aquifer Unit: QTc/Tsm

Well Type: Producer

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/27/2022	202	159.99	-42.01	on
11/23/2022	185	159.99	-25.01	off
12/29/2022	182	159.99	-22.01	off
01/26/2023	179	159.99	-19.01	off
02/23/2023	192	159.99	-32.01	on
03/30/2023	193	159.99	-33.01	on
04/27/2023	193	159.99	-33.01	on
05/25/2023	193	159.99	-33.01	on
06/29/2023	174	159.99	-14.01	off
07/27/2023	174	159.99	-14.01	off
08/31/2023	193	159.99	-33.01	on
09/28/2023	181.3	159.99	-21.31	off

Military

Watermaster No. 151

Northern Coastal

Owner: California American Water

Aquifer Unit: QTc

Well Type: Producer

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/27/2022	165	135.8	-29.20	off
11/23/2022	161	135.8	-25.20	off
12/29/2022	159	135.8	-23.20	off
01/26/2023	157	135.8	-21.20	off
02/23/2023	154	135.8	-18.20	off
03/30/2023	158	135.8	-22.20	off
04/27/2023	158	135.8	-22.20	off

05/25/2023	154	135.8	-18.20	off
06/29/2023	155	135.8	-19.20	off
07/27/2023	158	135.8	-22.20	off
08/31/2023	157	135.8	-21.20	off
09/28/2023	156	135.8	-20.20	off

MMP monitor | Watermaster No. 154 | Northern Coastal

Owner: Mission Memorial Park | Aquifer Unit: QTc

Well Type: Monitor | All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	345.78	315.42	-30.36	0
11/29/2022	341.3	315.42	-25.88	0
12/22/2022	338.03	315.42	-22.61	0
01/27/2023	325.75	315.42	-10.33	0
03/02/2023	323.67	315.42	-8.25	0
03/31/2023	326.46	315.42	-11.04	0
04/28/2023	324.42	315.42	-9.00	on
05/31/2023	323.48	315.42	-8.06	on
06/28/2023	333.05	315.42	-17.63	on
07/27/2023	335.55	315.42	-20.13	Meter Read 67717
08/30/2023	338.6	315.42	-23.18	on
09/27/2023	344.09	315.42	-28.67	on

MSC - Shallow | Watermaster No. 101 | Northern Coastal

Owner: MPWMD | Aquifer Unit: QTc

Well Type: Monitor | All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	81.07	80.1	-0.97	0
11/29/2022	80.18	80.1	-0.08	0

12/21/2022	81.89	80.1	-1.79	0
01/26/2023	79.4	80.1	0.70	0
03/30/2023	78.45	80.1	1.65	0
04/28/2023	79.23	80.1	0.87	0
06/02/2023	78.43	80.1	1.67	0
06/28/2023	78.86	80.1	1.24	0
07/26/2023	79.42	80.1	0.68	0
08/28/2023	79.33	80.1	0.77	0
09/28/2023	79.2	80.1	0.90	0

MSC-Deep　　Watermaster No. 102　　Northern Coastal

Owner: MPWMD　　Aquifer Unit: Tsm

Well Type: Monitor　　All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	103.99	80.29	-23.70	0
11/29/2022				0
03/30/2023	94.6	80.29	-14.31	0
04/28/2023	94.7	80.29	-14.41	0
06/02/2023	99.37	80.29	-19.08	0
06/28/2023	96.82	80.29	-16.53	0
07/26/2023	97.95	80.29	-17.66	0
08/28/2023	99.3	80.29	-19.01	0
09/28/2023	101.21	80.29	-20.92	0

MW-BW-08-A　　Watermaster No. 240　　Southern Coastal

Owner: U.S.A. Fort Ord　　Aquifer Unit: Qod/Qar

Well Type: Monitor　　All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	61.68	205.18	143.50	0

11/29/2022	61.15	205.18	144.03	0
12/22/2022	61.03	205.18	144.15	0
01/27/2023	60.69	205.18	144.49	0
03/02/2023	60.62	205.18	144.56	0
03/31/2023	60.48	205.18	144.70	0
04/28/2023	60.36	205.18	144.82	0
05/31/2023	60.35	205.18	144.83	0
06/29/2023	60.38	205.18	144.80	0
07/27/2023	60.47	205.18	144.71	0
08/28/2023	60.56	205.18	144.62	0
09/27/2023	60.63	205.18	144.55	0

MW-BW-09-180 Watermaster No. 241 Southern Coastal

Owner: U.S.A. Fort Ord

Aquifer Unit: QTc

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	210.68	206.22	-4.46	0
11/29/2022	210.4	206.22	-4.18	0
12/22/2022	210.48	206.22	-4.26	0
01/27/2023	210.54	206.22	-4.32	0
03/02/2023	210.41	206.22	-4.19	0
03/31/2023	210.57	206.22	-4.35	0
04/28/2023	210.26	206.22	-4.04	0
05/31/2023	210.22	206.22	-4.00	0
06/27/2023	210.22	206.22	-4.00	0
07/27/2023	210.21	206.22	-3.99	0
08/28/2023	210.14	206.22	-3.92	0
09/27/2023	210.11	206.22	-3.89	0

Ord Grove #2

Watermaster No. 153

Northern Coastal

Owner: California American Water

Aquifer Unit: QTc/Tsm

Well Type: Producer

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/27/2022	351	292.39	-58.61	on
11/23/2022	357	292.39	-64.61	on
12/29/2022	355	292.39	-62.61	on
01/26/2023	351	292.39	-58.61	on
02/23/2023	354	292.39	-61.61	on
03/30/2023	354	292.39	-61.61	on
04/27/2023	355	292.39	-62.61	on
05/25/2023	358	292.39	-65.61	on
06/29/2023	310	292.39	-17.61	on
07/27/2023	358	292.39	-65.61	on
08/31/2023	358	292.39	-65.61	on
09/28/2023	363	292.39	-70.61	on

Ord Grove Test

Watermaster No. 107

Northern Coastal

Owner: California American Water

Aquifer Unit: QTc/Tsm

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/31/2022	336.4	294	-42.40	on
11/29/2022	335.05	294	-41.05	0
12/21/2022	333.72	294	-39.72	0
01/27/2023	329.02	294	-35.02	0
03/03/2023	328.6	294	-34.60	0
03/31/2023	329.11	294	-35.11	0
04/28/2023	328.7	294	-34.70	0

05/31/2023	327.57	294	-33.57	on
06/28/2023	309.97	294	-15.97	Well off
07/27/2023	329.48	294	-35.48	on
09/01/2023	330.47	294	-36.47	0
09/27/2023	333.48	294	-39.48	on

Ord Terrace-Shallow

Watermaster No. 109

Northern Coastal

Owner: MPWMD

Aquifer Unit: Tsm (upper)

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	261.96	228.65	-33.31	0
11/29/2022	260.28	228.65	-31.63	0
12/21/2022	258.8	228.65	-30.15	0
01/27/2023	253.84	228.65	-25.19	0
03/02/2023	252.58	228.65	-23.93	0
03/31/2023	252.92	228.65	-24.27	0
05/30/2023	251.39	228.65	-22.74	0
06/28/2023	247.29	228.65	-18.64	0
07/27/2023	251.28	228.65	-22.63	0
08/30/2023	253.59	228.65	-24.94	0
09/28/2023	256.17	228.65	-27.52	0

Paralta

Watermaster No. 169

Northern Coastal

Owner: California American Water

Aquifer Unit: QTc/Tsm

Well Type: Producer

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/27/2022	369	324.49	-44.51	on
11/23/2022	363	324.49	-38.51	on
12/29/2022	357	324.49	-32.51	on

01/26/2023	344	324.49	-19.51	on
02/23/2023	350	324.49	-25.51	on
03/30/2023	350	324.49	-25.51	on
04/27/2023	340	324.49	-15.51	on
05/25/2023	355	324.49	-30.51	on
06/29/2023	345	324.49	-20.51	on
07/27/2023	356	324.49	-31.51	on
08/31/2023	358	324.49	-33.51	on
09/28/2023	362	324.49	-37.51	on

Paralta Test Well | Watermaster No. 108 | Northern Coastal

Owner: MPWMD | Aquifer Unit: QTc/Tsm

Well Type: Monitor | All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	350	330.72	-19.28	From Bubbler
11/30/2022	350	330.72	-19.28	from external gauge. downloaded bubbler log
12/22/2022	345.2	330.72	-14.48	0
01/30/2023	339	330.72	-8.28	0
03/02/2023	342	330.72	-11.28	from outside gauge
03/31/2023	341	330.72	-10.28	from outside gage
04/28/2023	340	330.72	-9.28	from outside gage
05/31/2023	340	330.72	-9.28	on
06/28/2023	339	330.72	-8.28	on
07/27/2023	358	330.72	-27.28	on
08/28/2023	359	330.72	-28.28	on
09/27/2023	362	330.72	-31.28	on

PCA East Deep

Watermaster No. 106

Northern Coastal

Owner: MPWMD

Aquifer Unit: Tsm

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/31/2022	95.02	68.54	-26.48	0
11/29/2022	92.79	68.54	-24.25	0
12/27/2022	89.33	68.54	-20.79	0
01/27/2023	83.56	68.54	-15.02	0
02/28/2023	83.14	68.54	-14.60	0
03/31/2023	84.78	68.54	-16.24	0
04/28/2023	83.65	68.54	-15.11	0
06/01/2023	83.07	68.54	-14.53	0
06/28/2023	87.11	68.54	-18.57	0
07/26/2023	87.44	68.54	-18.90	0
08/30/2023	89.64	68.54	-21.10	0
09/28/2023	93.61	68.54	-25.07	0

PCA-E Shallow

Watermaster No. 105

Northern Coastal

Owner: MPWMD

Aquifer Unit: QTc

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/29/2022	68.79	68.51	-0.28	0
12/27/2022	68.24	68.51	0.27	0
01/27/2023	67.82	68.51	0.69	0
02/28/2023	67.34	68.51	1.17	0
02/28/2023	67.34	68.51	1.17	0
02/28/2023	67.34	68.51	1.17	0
03/31/2023	66.93	68.51	1.58	0

04/28/2023	66.68	68.51	1.83	0
06/01/2023	66.73	68.51	1.78	0
06/28/2023	66.59	68.51	1.92	0
07/26/2023	66.63	68.51	1.88	0
08/30/2023	66.94	68.51	1.57	0
09/28/2023	67.28	68.51	1.23	0

PCA-W Deep | Watermaster No. 104 | Northern Coastal

Owner: MPWMD | Aquifer Unit: Tsm

Well Type: Monitor | All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/31/2022	90.56	65.18	-25.38	0
11/29/2022	88.51	65.18	-23.33	295
12/21/2022	88.26	65.18	-23.08	0
01/26/2023	79.81	65.18	-14.63	downloaded logger. meter = 295
03/03/2023	80.48	65.18	-15.30	lock stuck. cut lock. need replacement
03/31/2023	81.97	65.18	-16.79	0
04/28/2023	80.48	65.18	-15.30	0
06/02/2023	79.47	65.18	-14.29	downloaded data. meter=295
06/28/2023	84.33	65.18	-19.15	0
07/26/2023	85	65.18	-19.82	0
08/28/2023	86.38	65.18	-21.20	0
09/28/2023	89.46	65.18	-24.28	0

PCA-W Shallow | Watermaster No. 103 | Northern Coastal

Owner: MPWMD | Aquifer Unit: QTc

Well Type: Monitor | All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	65.01	64.22	-0.79	0

11/29/2022	64.21	64.22	0.01	0
12/21/2022	64.76	64.22	-0.54	0
01/26/2023	63.27	64.22	0.95	downloaded logger
03/03/2023	63.18	64.22	1.04	meter = 295
03/31/2023	62.81	64.22	1.41	0
04/28/2023	62.68	64.22	1.54	0
06/02/2023	62.51	64.22	1.71	logger stuck. pump tubes starting to deteriorate. need plan to imrove setup
06/28/2023	62.74	64.22	1.48	0
07/26/2023	63.02	64.22	1.20	0
08/28/2023	63.37	64.22	0.85	No change
09/28/2023	63.42	64.22	0.80	0

Playa #3 Watermaster No. 162 Northern Coastal

Owner: California American Water

Aquifer Unit: QTc

Well Type: Producer

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/27/2022	136	53.02	-82.98	on
11/23/2022	137	53.02	-83.98	on
12/29/2022	136	53.02	-82.98	on
01/26/2023	136	53.02	-82.98	on
02/23/2023	140	53.02	-86.98	on
03/30/2023	137	53.02	-83.98	on
04/27/2023	142	53.02	-88.98	on
05/25/2023	137	53.02	-83.98	on
06/29/2023	51	53.02	2.02	off
07/27/2023	52	53.02	1.02	off
08/31/2023	135	53.02	-81.98	on
09/28/2023	135	53.02	-81.98	on

Plumas #4

Watermaster No. 177

Southern Coastal

Owner: California American Water

Aquifer Unit: Tsm

Well Type: Producer

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/27/2022	251	161.48	-89.52	on
11/23/2022	256	161.48	-94.52	on
12/29/2022	256	161.48	-94.52	on
01/26/2023	261	161.48	-99.52	on
02/23/2023	260	161.48	-98.52	on
03/30/2023	256	161.48	-94.52	on
04/27/2023	257	161.48	-95.52	on
05/25/2023	257	161.48	-95.52	on
06/29/2023	120	161.48	41.48	off
07/27/2023	256	161.48	-94.52	on
08/31/2023	257	161.48	-95.52	0
09/28/2023	255	161.48	-93.52	0

Plumas Test 1990

Watermaster No. 124

Southern Coastal

Owner: MPWMD

Aquifer Unit: Tsm

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/04/2022	111.19	157.83	46.64	0
11/30/2022	111.18	157.83	46.65	0
12/22/2022	111.41	157.83	46.42	on
01/27/2023	111.8	157.83	46.03	0
03/02/2023	111.93	157.83	45.90	0
03/31/2023	112.12	157.83	45.71	0
04/28/2023	112.06	157.83	45.77	on

05/31/2023	112.55	157.83	45.28	0
06/29/2023	111.61	157.83	46.22	0
07/27/2023	112.23	157.83	45.60	0
08/28/2023	111.67	157.83	46.16	on
09/28/2023	111.9	157.83	45.93	0

Robley Deep (South) Watermaster No. 140 Southern Inland

Owner: County of Monterey Aquifer Unit: Tsm

Well Type: Monitor All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	402.22	566.44	164.22	
10/11/2022	402.22	566.44	164.22	0
12/29/2022	398.38	566.44	168.06	0
03/29/2023	396.31	566.44	170.13	0
06/29/2023	399.36	566.44	167.08	0
10/05/2023	401.53	566.44	164.91	0

Robley Shallow (North) Watermaster No. 139 Southern Inland

Owner: County of Monterey Aquifer Unit: QTc

Well Type: Monitor All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	328.08	566.54	238.46	0
10/11/2022	328.08	566.54	238.46	
12/29/2022	318.48	566.54	248.06	0
03/29/2023	326.86	566.54	239.68	0
06/29/2023	328.68	566.54	237.86	0
10/05/2023	325.56	566.54	240.98	0

Ryan Ranch #11

Watermaster No. 215

Southern Inland

Owner: California American Water

Aquifer Unit: Tsm

Well Type: Producer

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/27/2022	161	307.59	146.59	off
11/23/2022	159	307.59	148.59	off
12/29/2022	161	307.59	146.59	off
01/26/2023	159	307.59	148.59	off
02/23/2023	159	307.59	148.59	off
03/30/2023	160	307.59	147.59	off
04/27/2023	158.9	307.59	148.69	off
05/25/2023	159.2	307.59	148.39	off
06/29/2023	160	307.59	147.59	off
07/27/2023	151.3	307.59	156.29	off
08/31/2023	150.2	307.59	157.39	off
09/28/2023	157	307.59	150.59	off

Ryan Ranch #7

Watermaster No. 213

Southern Inland

Owner: California American Water

Aquifer Unit: Tsm

Well Type: Producer

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/27/2022	152	294	142.00	off
11/23/2022	153	294	141.00	off
12/29/2022	150	294	144.00	off
01/26/2023	152	294	142.00	off
02/23/2023	152	294	142.00	off
03/30/2023	147.7	294	146.30	off
04/27/2023	147.2	294	146.80	off

05/25/2023	147	294	147.00	off
06/29/2023	147.1	294	146.90	off
07/27/2023	145.7	294	148.30	off
08/31/2023	149.1	294	144.90	off
09/28/2023	145	294	149.00	off

Ryan Ranch #8 Watermaster No. 216 Southern Inland

Owner: California American Water Aquifer Unit: Tsm

Well Type: Producer All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/27/2022	162	306.86	144.86	off
11/23/2022	161	306.86	145.86	off
12/29/2022	159	306.86	147.86	off
01/26/2023	161	306.86	145.86	off
02/23/2023	160	306.86	146.86	off
03/30/2023	148.6	306.86	158.26	off
04/27/2023	159	306.86	147.86	off
05/25/2023	159.1	306.86	147.76	off
06/29/2023	159.1	306.86	147.76	off
07/27/2023	155.6	306.86	151.26	off
08/31/2023	156.3	306.86	150.56	off
09/28/2023	155	306.86	151.86	off

Sand City Corp Yard Watermaster No. 165 Southern Coastal

Owner: City of Sand City Aquifer Unit: Qod/Qar/QTc

Well Type: Producer All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	42.39	47.25	4.86	eC:174
11/29/2022	42.21	47.25	5.04	ec 1445

12/21/2022	42.1	47.25	5.15	Meter Read:39398
01/26/2023	41.15	47.25	6.10	0
03/02/2023	41.05	47.25	6.20	0
03/31/2023	41.15	47.25	6.10	New Meter:1 Old Meter:426 eC87
04/28/2023	41.29	47.25	5.96	New Meter:1714 Old Meter:426 eC125
06/02/2023	41.59	47.25	5.66	0
06/29/2023	41.77	47.25	5.48	eC:143 Meter:971
07/27/2023	41.93	47.25	5.32	eC:145 Meter read 11296
08/28/2023	42	47.25	5.25	eC:133
09/28/2023	41.74	47.25	5.51	Meter:19164

Seca Place

Watermaster No. 138

Southern Inland

Owner: County of Monterey

Aquifer Unit: Tsm

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	273.13	427.58	154.45	0
10/11/2022	273.13	427.58	154.45	
12/29/2022	268.95	427.58	158.63	0
03/29/2023	266.18	427.58	161.40	0
06/29/2023	269.31	427.58	158.27	0
10/05/2023	271.75	427.58	155.83	0

Sentinel MW #1

Watermaster No. 245

Northern Coastal

Owner: Seaside Groundwater Basin Watermas

Aquifer Unit: Tsm/Tp

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/31/2022	122.72	93.03	-29.69	0
01/26/2023	112.81	93.03	-19.78	0
05/31/2023	112.36	93.03	-19.33	0

10/04/2023	122.23	93.03	-29.20	0

Sentinel MW #2 Watermaster No. 246 Northern Coastal

Owner: Seaside Groundwater Basin Watermas Aquifer Unit: Tp

Well Type: Monitor All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/31/2022	98.25	70.73	-27.52	0
01/26/2023	87.38	70.73	-16.65	0
05/31/2023	87.05	70.73	-16.32	0
10/04/2023	98.14	70.73	-27.41	0

Sentinel MW #3 Watermaster No. 247 Northern Coastal

Owner: Seaside Groundwater Basin Watermas Aquifer Unit: Tp

Well Type: Monitor All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/31/2022	82.98	56.53	-26.45	on
01/26/2023	72.32	56.53	-15.79	downloaded data
05/31/2023	71.8	56.53	-15.27	0
10/04/2023	82.78	56.53	-26.25	0

Sentinel MW #4 Watermaster No. 248 Northern Coastal

Owner: Seaside Groundwater Basin Watermas Aquifer Unit: Tsm/Tp

Well Type: Monitor All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/31/2022	85.59	59.43	-26.16	0
01/26/2023	74.42	59.43	-14.99	0
05/31/2023				0
08/23/2023	80.07	59.43	-20.64	0
10/04/2023	85.05	59.43	-25.62	0

Target Well

Watermaster No. 152

Northern Coastal

Owner: DBO Development

Aquifer Unit: QTc/Tsm

Well Type: Producer

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/03/2022	65.99	44.42	-21.57	0
11/29/2022	64.21	44.42	-19.79	0
12/21/2022	62.39	44.42	-17.97	0
01/26/2023	58.19	44.42	-13.77	0
02/28/2023	56.74	44.42	-12.32	0
03/31/2023	57.18	44.42	-12.76	0
04/28/2023	56.6	44.42	-12.18	0
05/31/2023	56.29	44.42	-11.87	0
06/28/2023	59.21	44.42	-14.79	0
07/26/2023	59.96	44.42	-15.54	0
08/28/2023	61.61	44.42	-17.19	0
09/28/2023	63.65	44.42	-19.23	0

York Rd-West

Watermaster No. 137

Southern Inland

Owner: County of Monterey

Aquifer Unit: Tsm

Well Type: Monitor

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
10/11/2022	324.75	490.28	165.53	
10/11/2022	324.75	490.28	165.53	0
12/29/2022	323.51	490.28	166.77	0
03/29/2023	322.04	490.28	168.24	0
06/29/2023	321.41	490.28	168.87	Downloaded logger
10/04/2023	321.98	490.28	168.30	0

York School 2001 | Watermaster No. 212 | Southern Inland

Owner: York School

Aquifer Unit: QTc/Tsm

Well Type: Producer

All Values in Feet

Date Measured	Depth to Water	Reference Point	Water Elevation	Comments
11/04/2022	281.35	384.3	102.95	on
11/29/2022	220.11	384.3	164.19	0
02/03/2023	219.5	384.3	164.80	meter = 324943
03/03/2023	218.1	384.3	166.20	meter= 324943
04/04/2023	219.14	384.3	165.16	0
05/01/2023	227.46	384.3	156.84	0
06/29/2023	221.3	384.3	163.00	0
08/01/2023	225.89	384.3	158.41	Meter read:347921
08/28/2023	278.51	384.3	105.79	on
10/06/2023	275.88	384.3	108.42	Meter:361721

MONTGOMERY & ASSOCIATES

Appendix C

Piper Diagrams

MONTGOMERY & ASSOCIATES

Appendix C Contents

MONTGOMERY
& ASSOCIATES

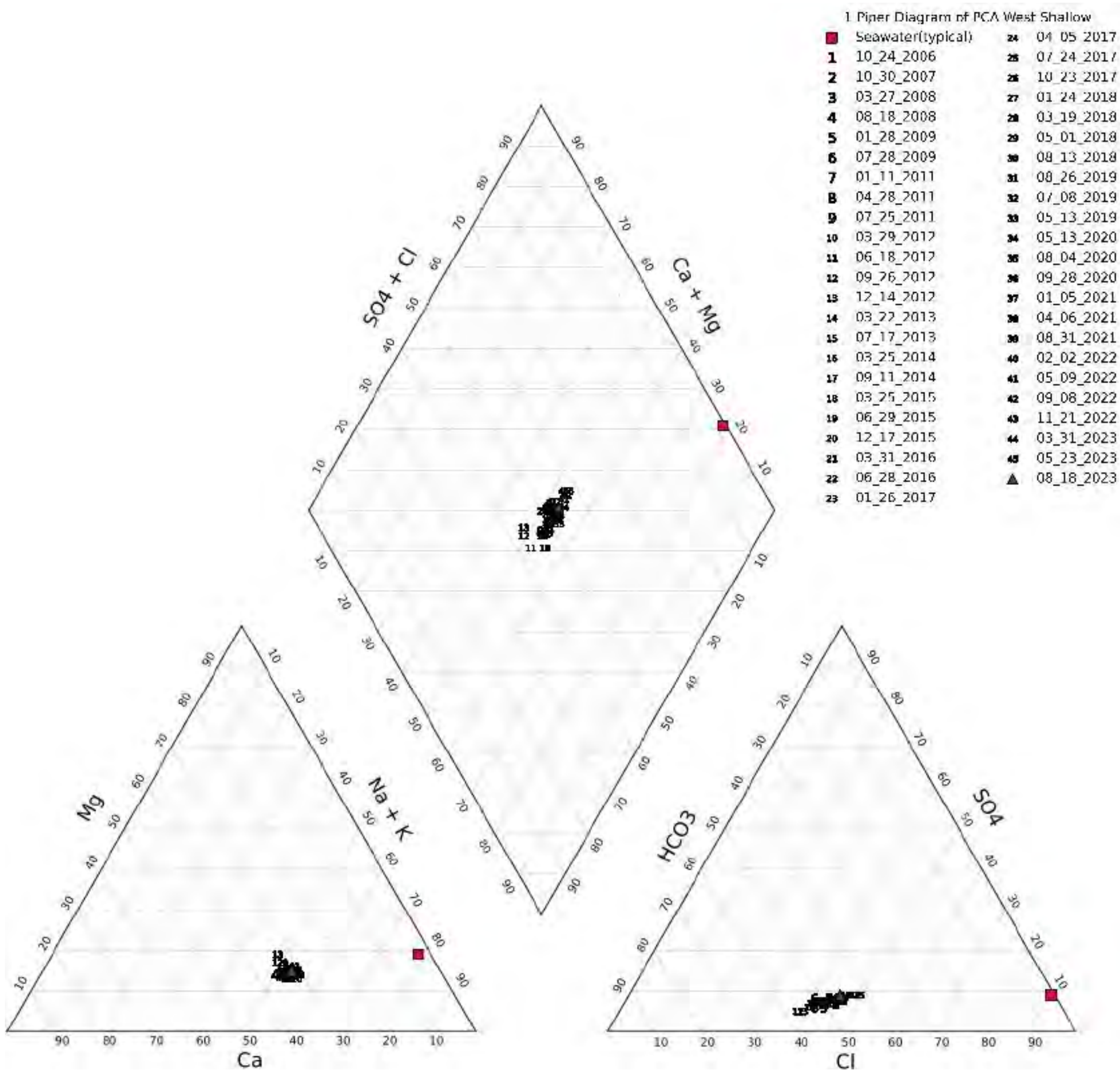

Figure C-1. Piper Diagram of PCA West Shallow

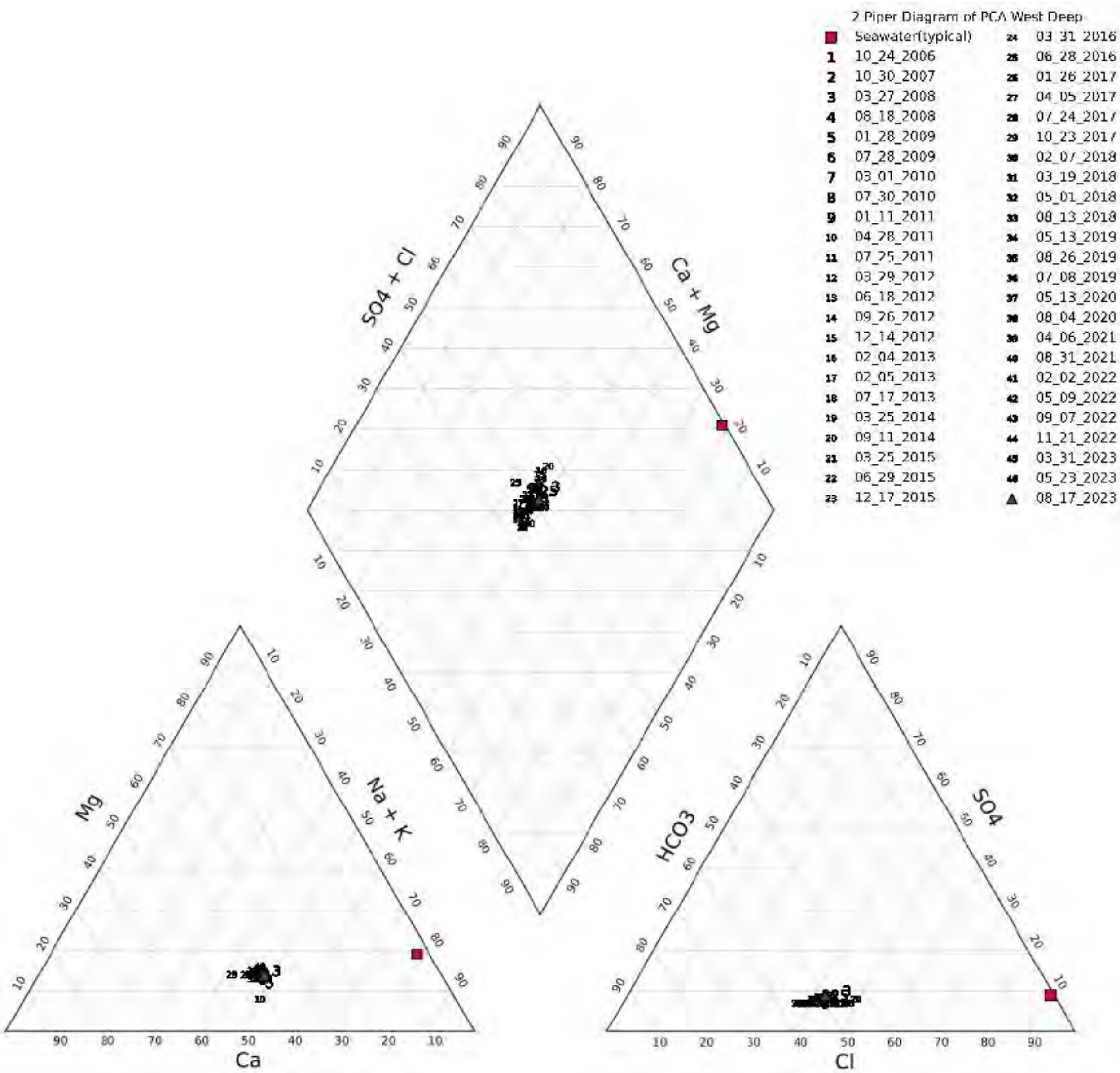

Figure C-2. Piper Diagram of PCA West Deep

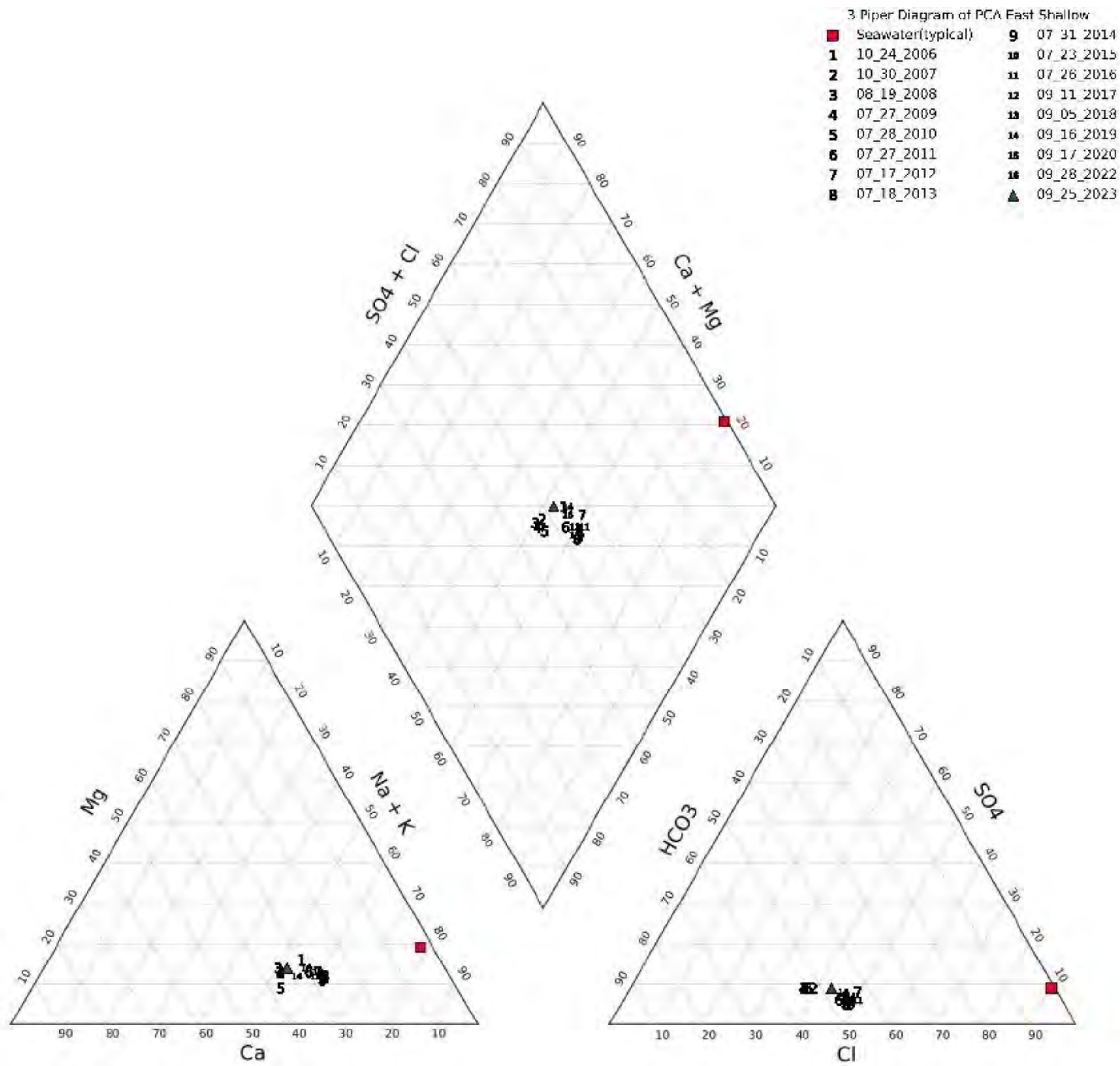

Figure C-3. Piper Diagram of PCA East Shallow

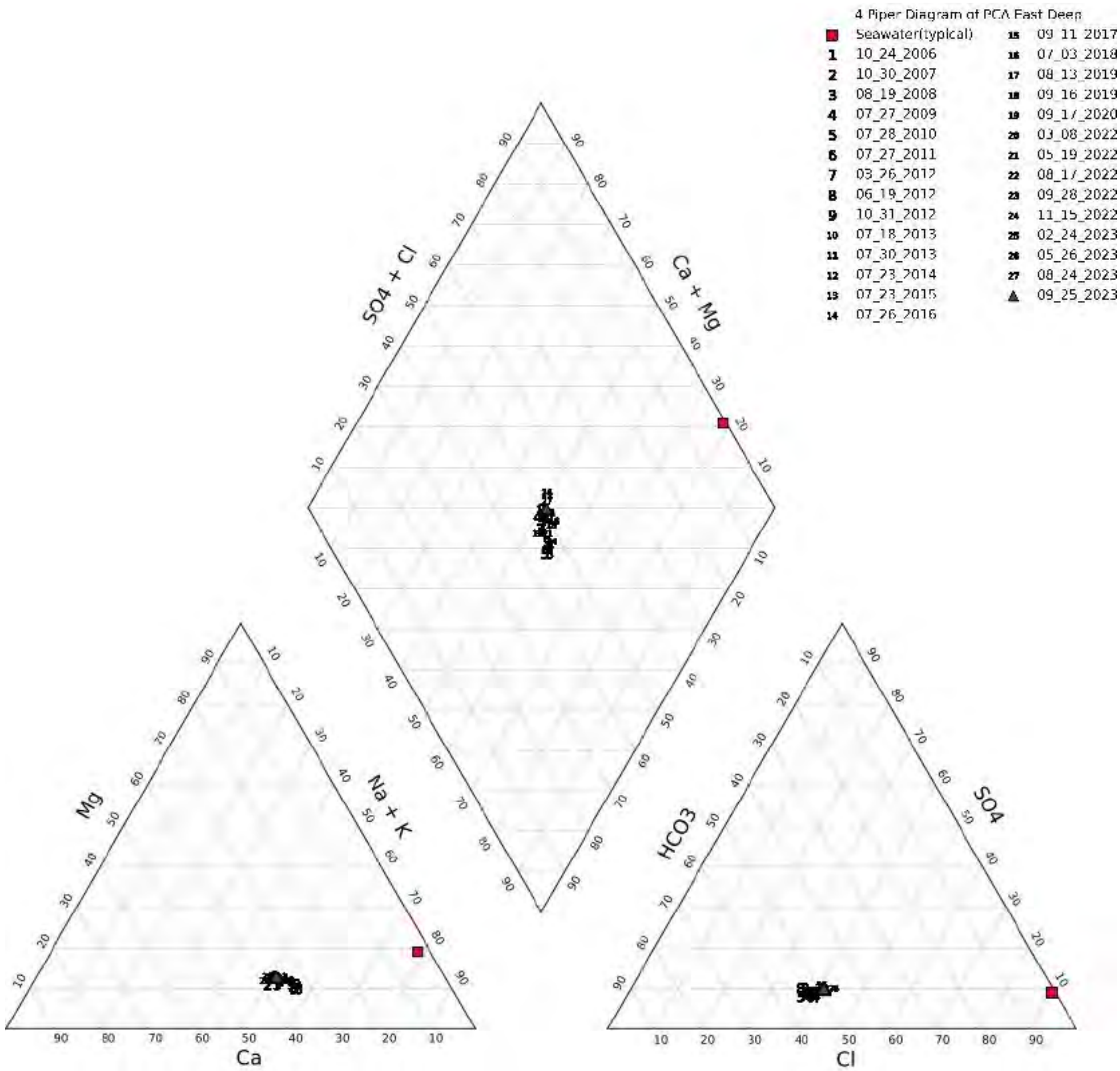

Figure C-4. Piper Diagram of PCA East Deep

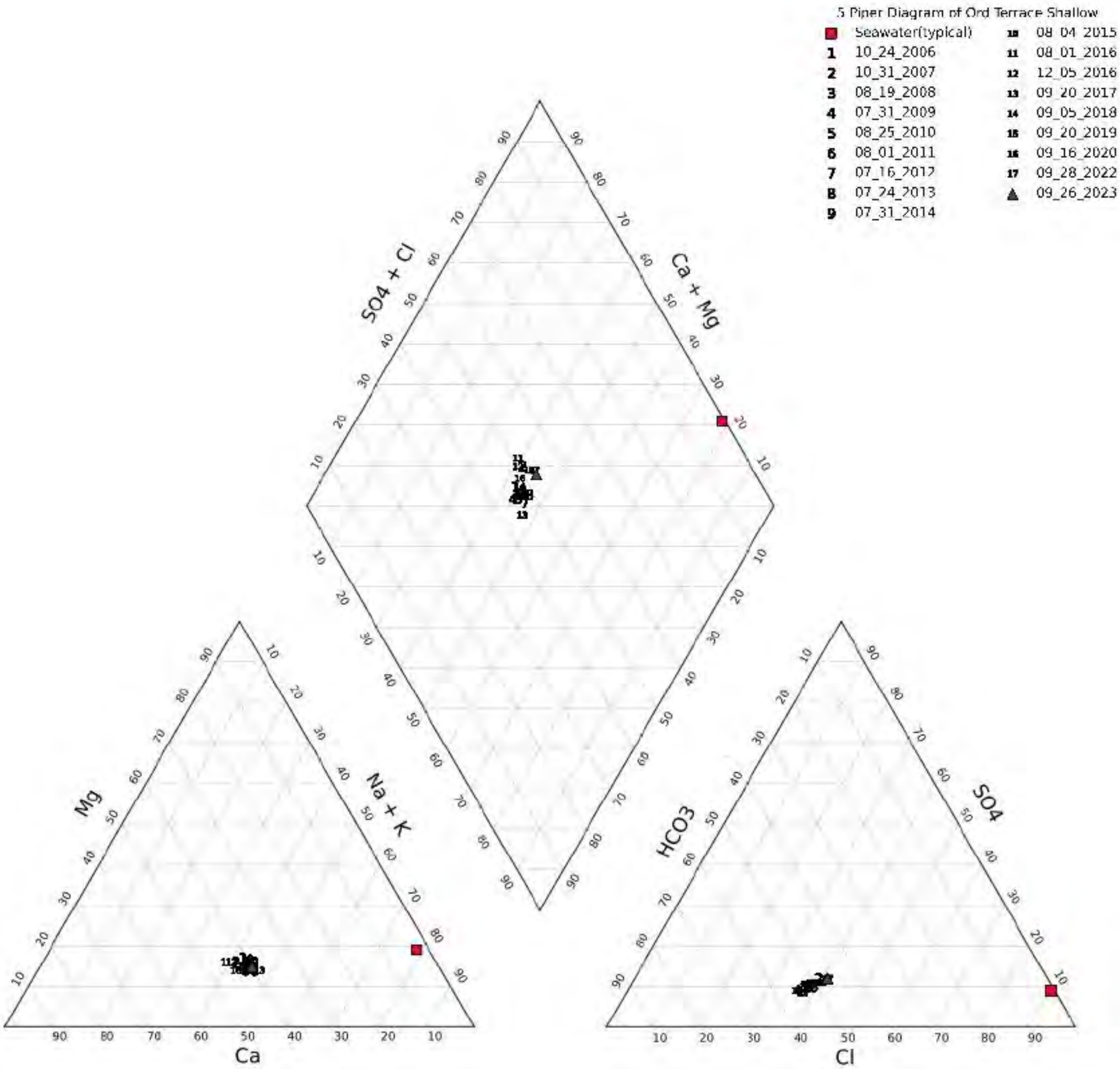

Figure C-5. Piper Diagram of Ord Terrace Shallow

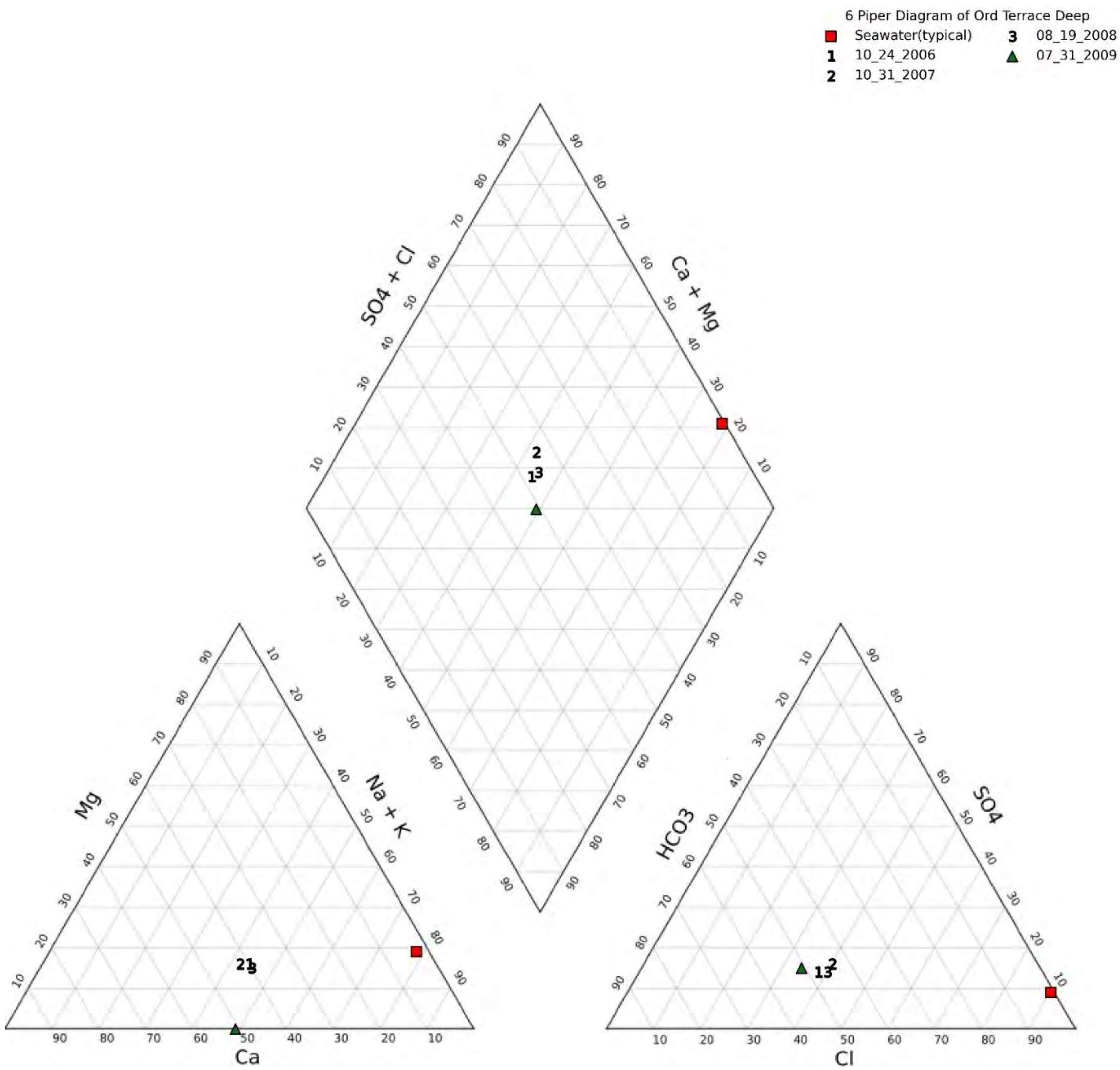

Figure C-6. Piper Diagram of Ord Terrace Deep

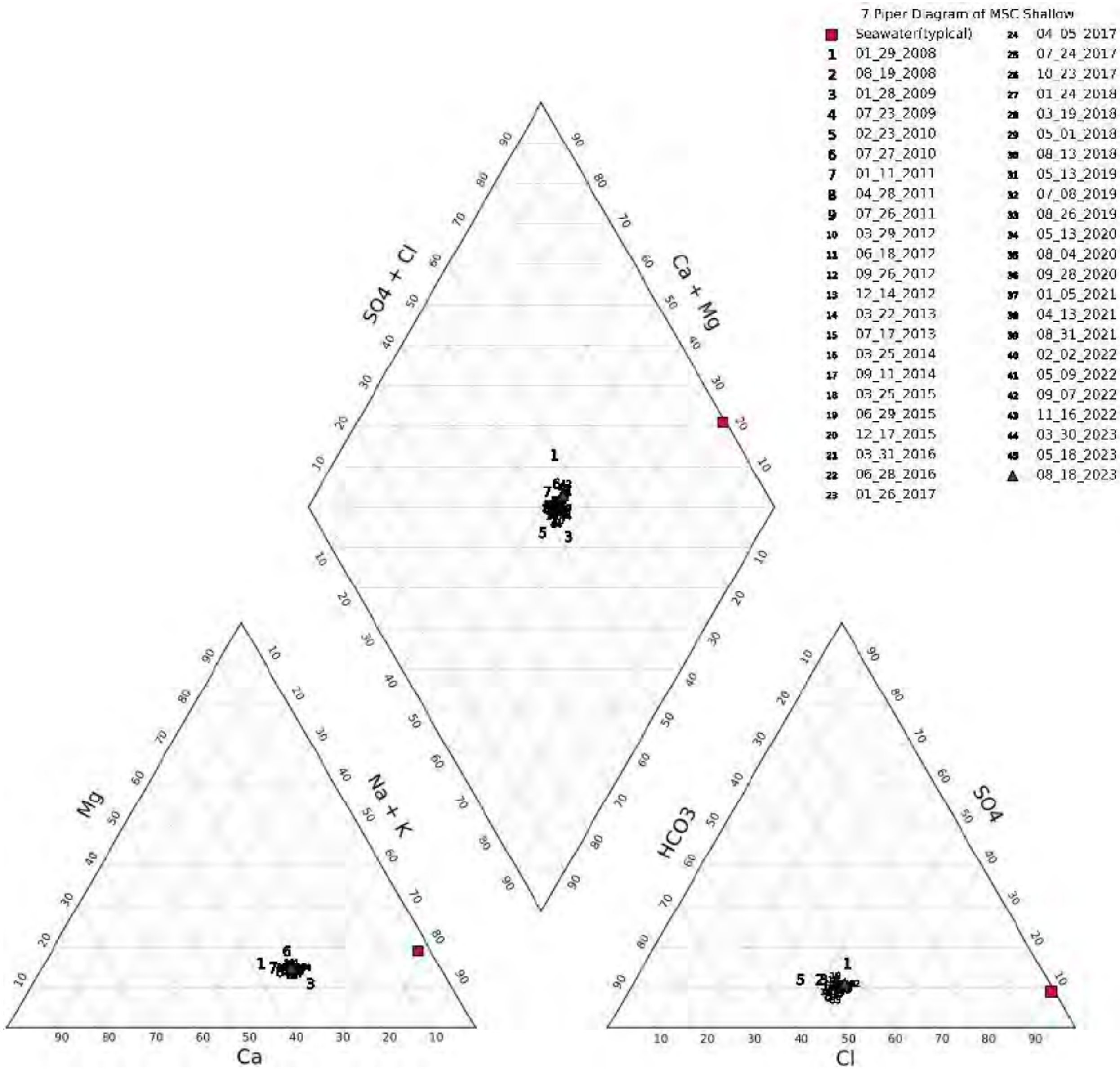

Figure C-7. Piper Diagram of MSC Shallow

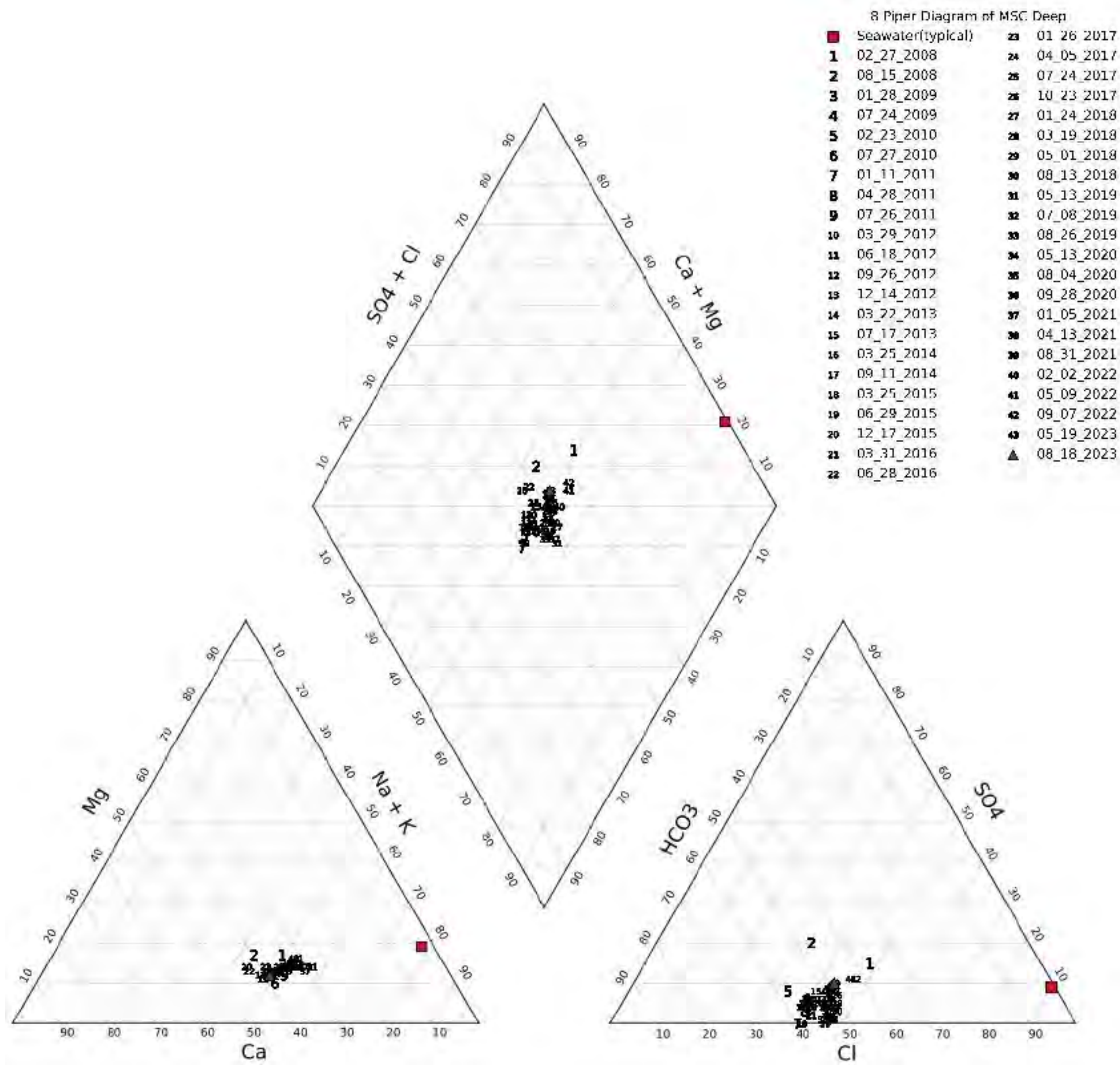

Figure C-8. Piper Diagram of MSC Deep

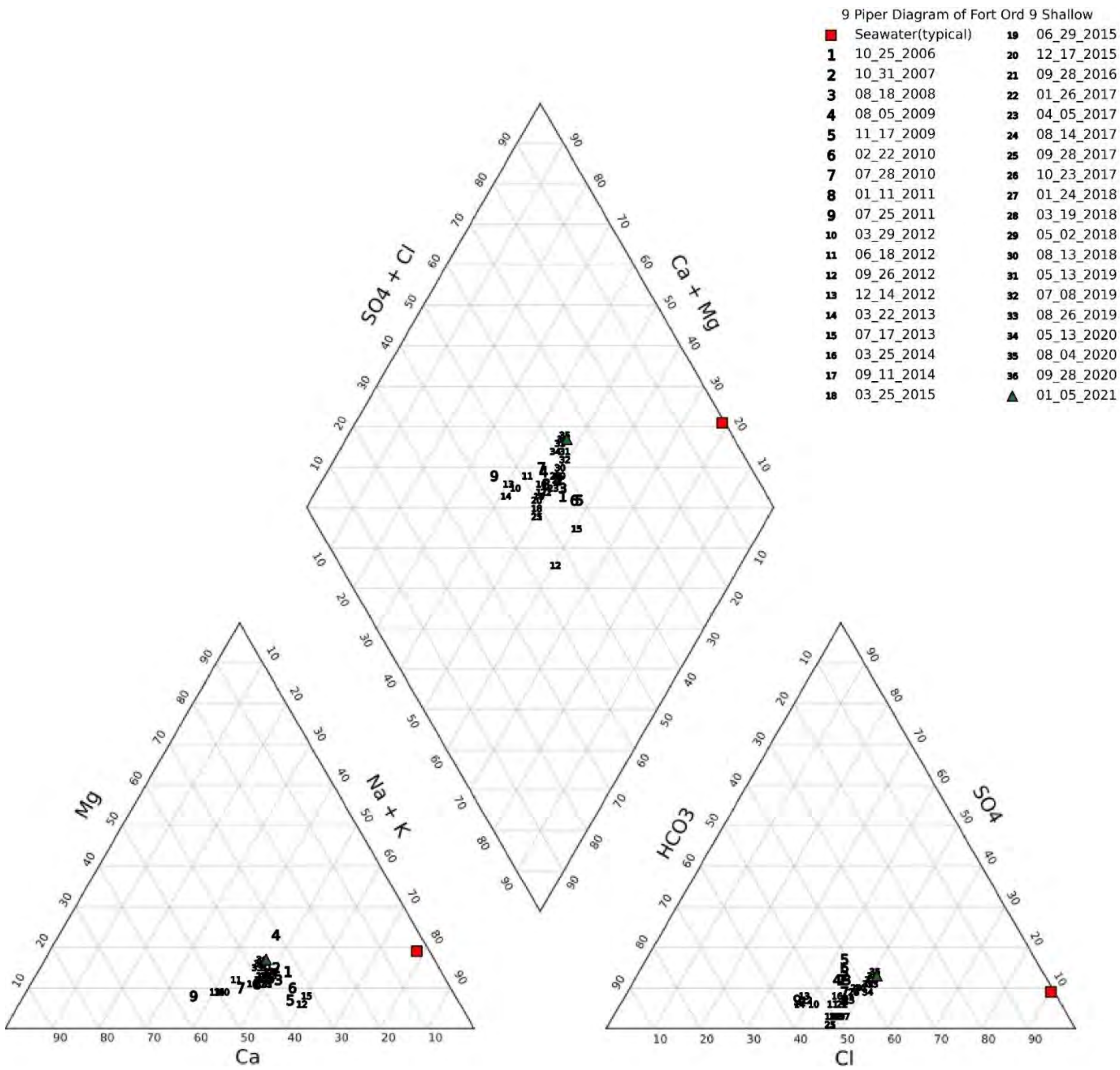

Figure C-9. Piper Diagram of Fort Ord 9 Shallow

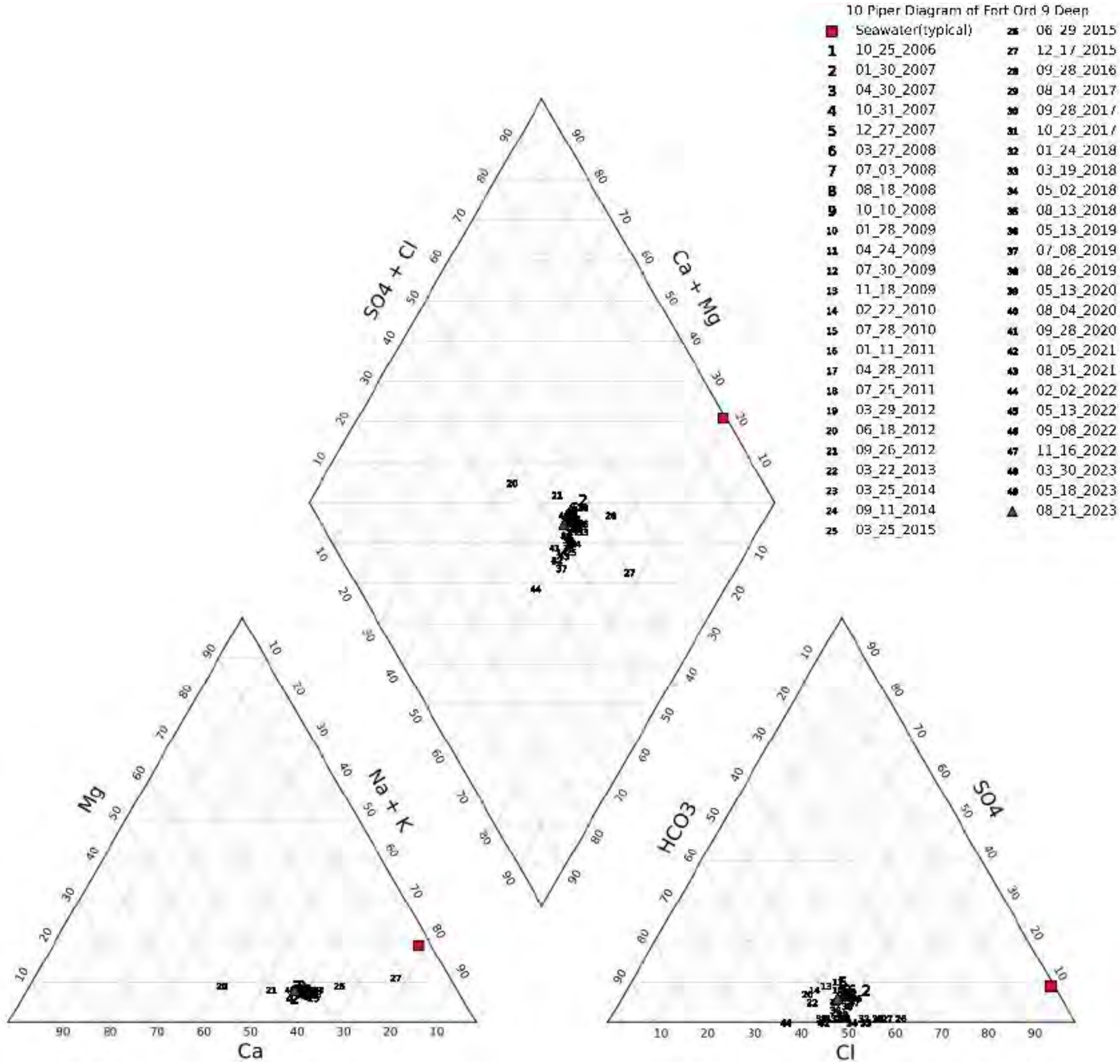

Figure C-10. Piper Diagram of Fort Ord 9 Deep

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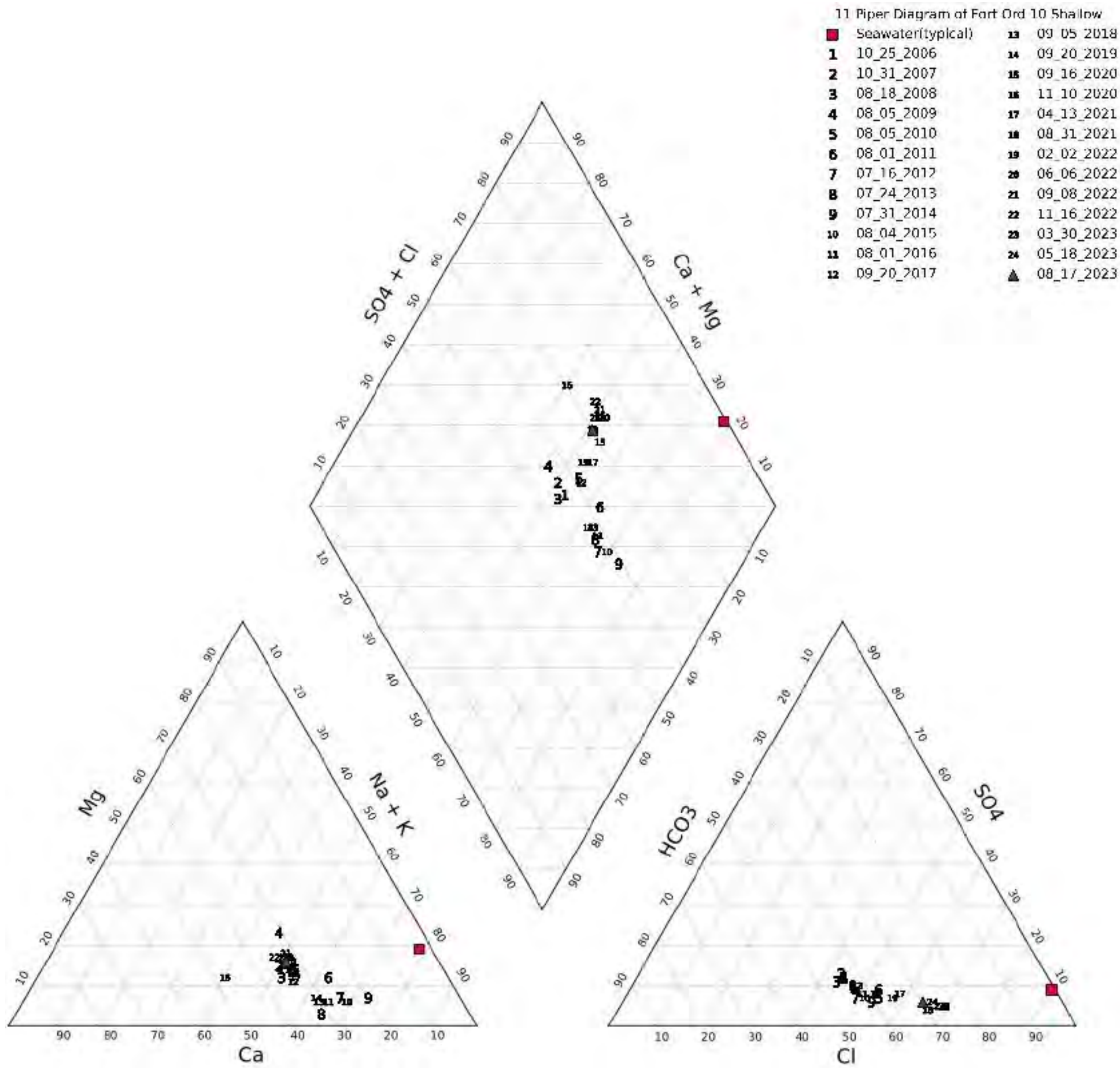

Figure C-11. Piper Diagram of Fort Ord 10 Shallow

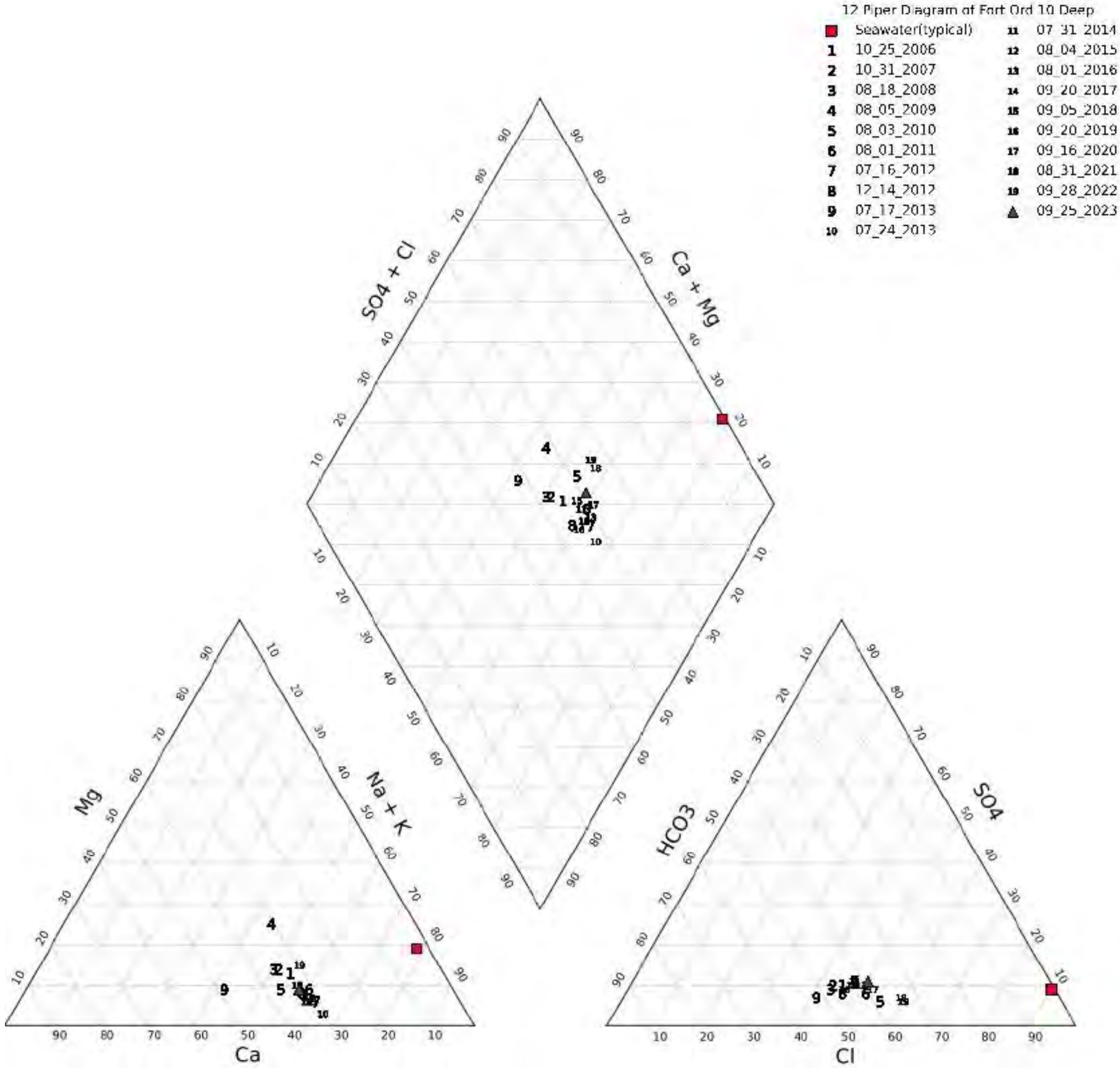

Figure C-12. Piper Diagram of Fort Ord 10 Deep

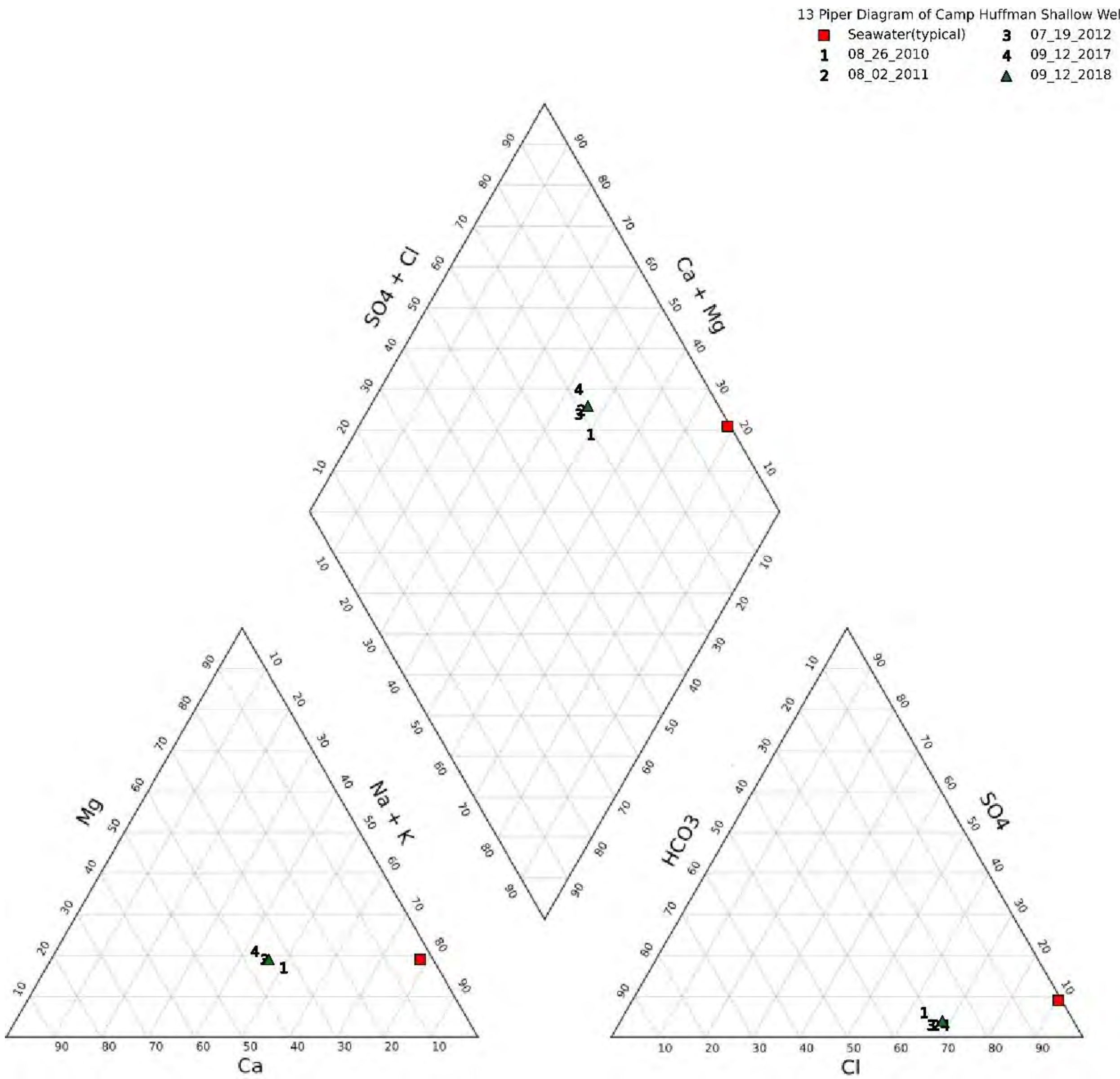

Figure C-13. Piper Diagram of Camp Huffman Shallow Well

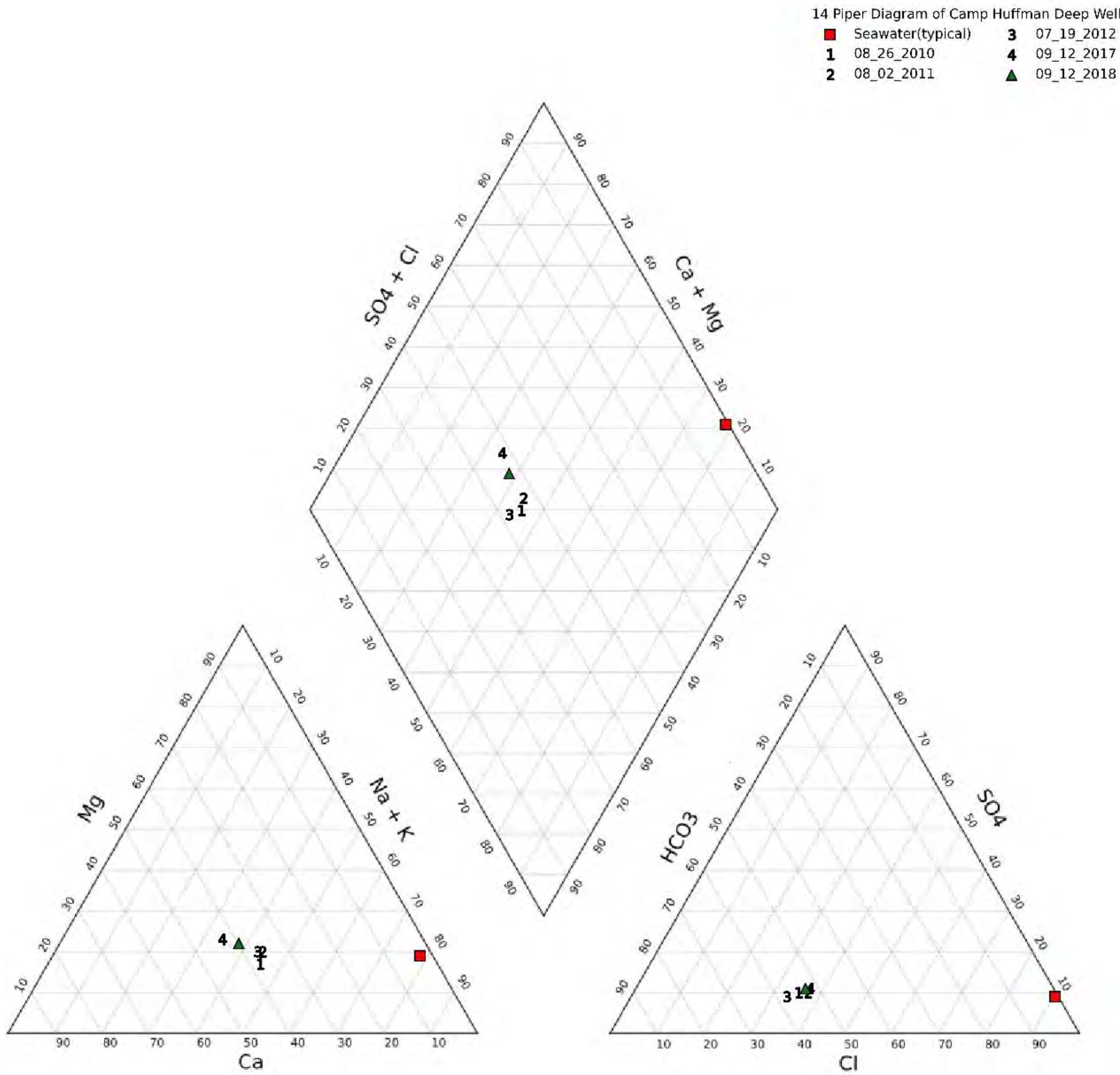

Figure C-14. Piper Diagram of Camp Huffman Deep Well

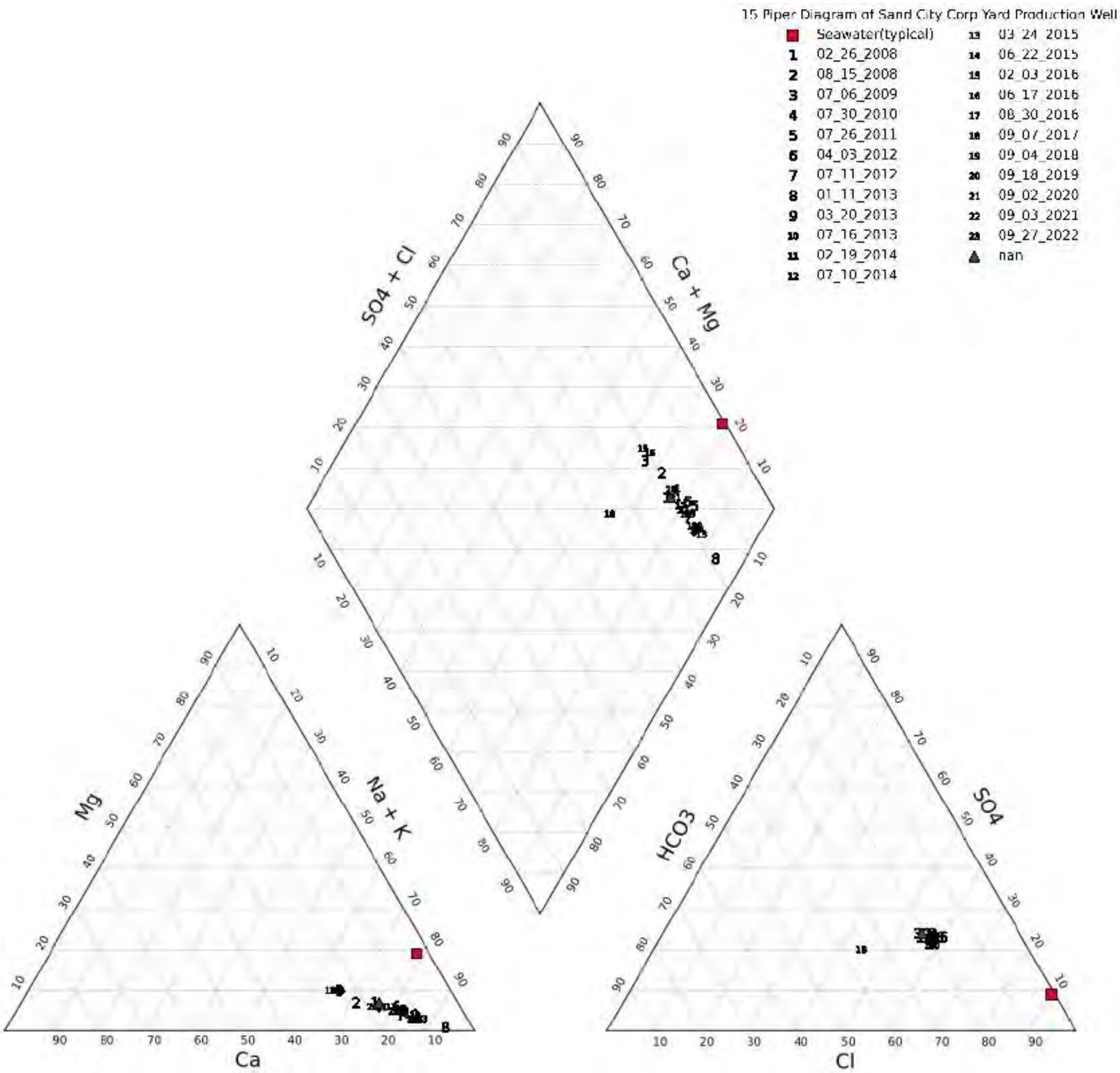

Figure C-15. Piper Diagram of Sand City Corp. Yard Production Well

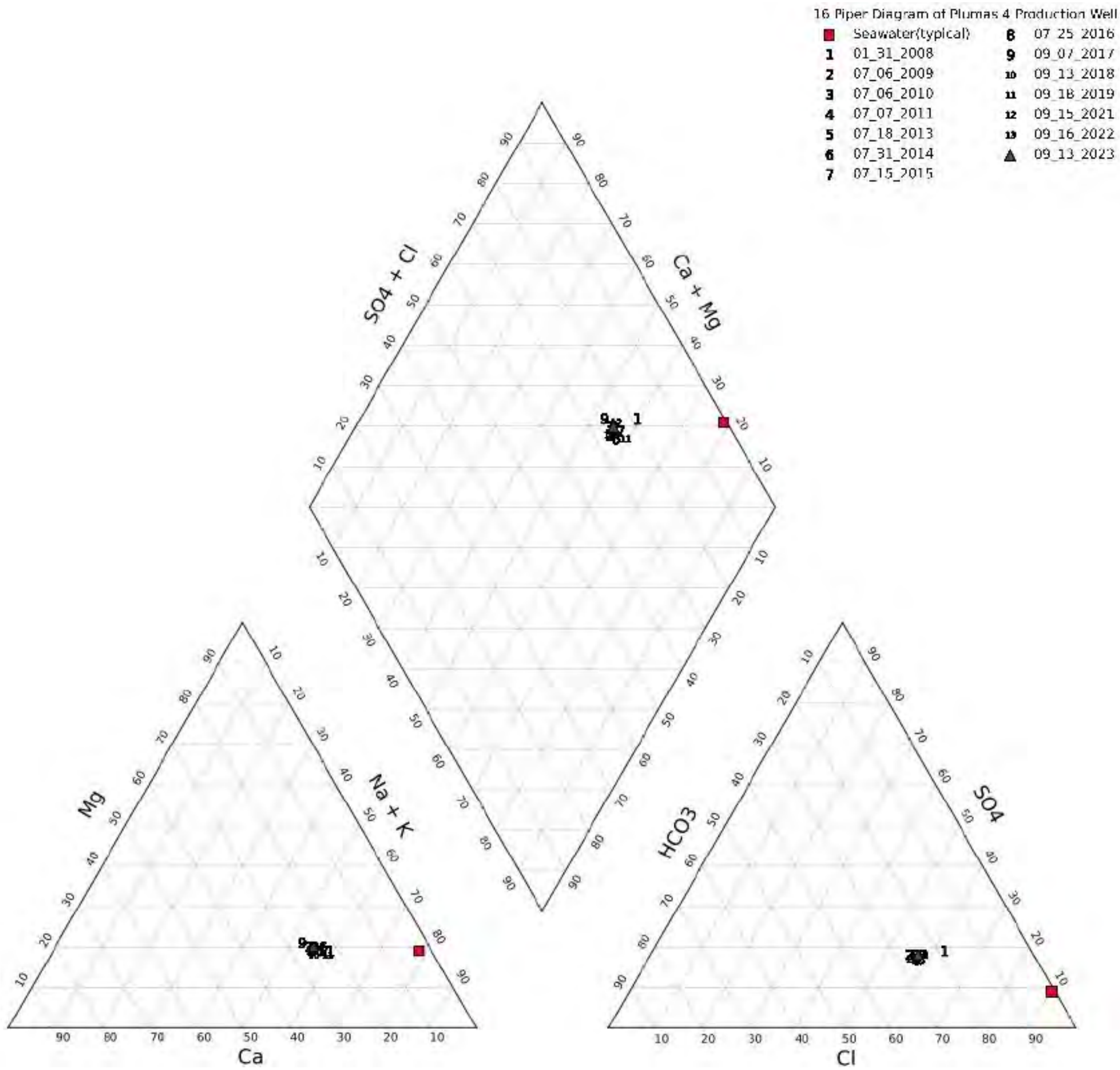

Figure C-16. Piper Diagram of Plumas 4 Production Well

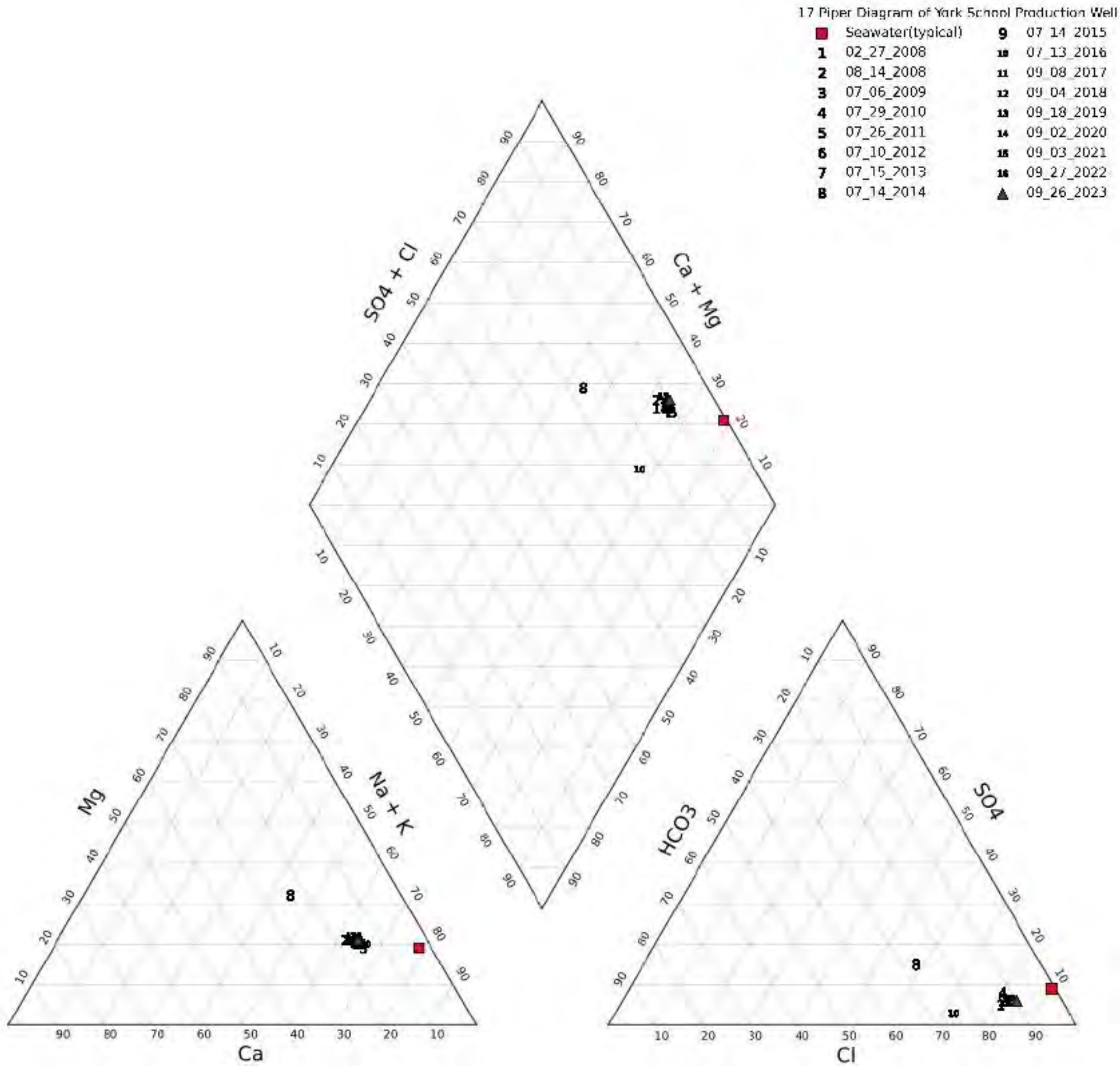

Figure C-17. Piper Diagram of York School Production Well

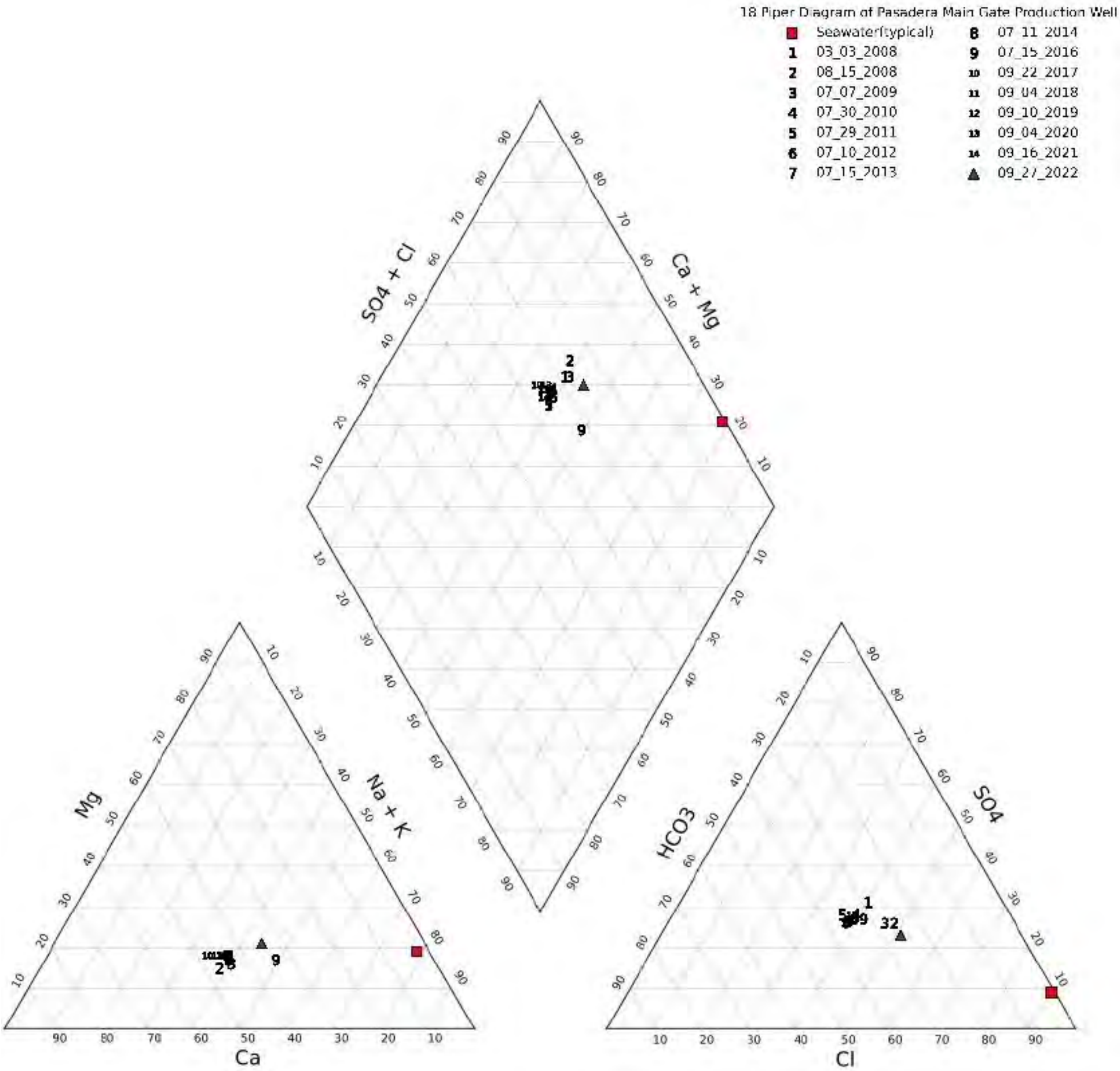

Figure C-18. Piper Diagram of Pasadera Main Gate Production Well

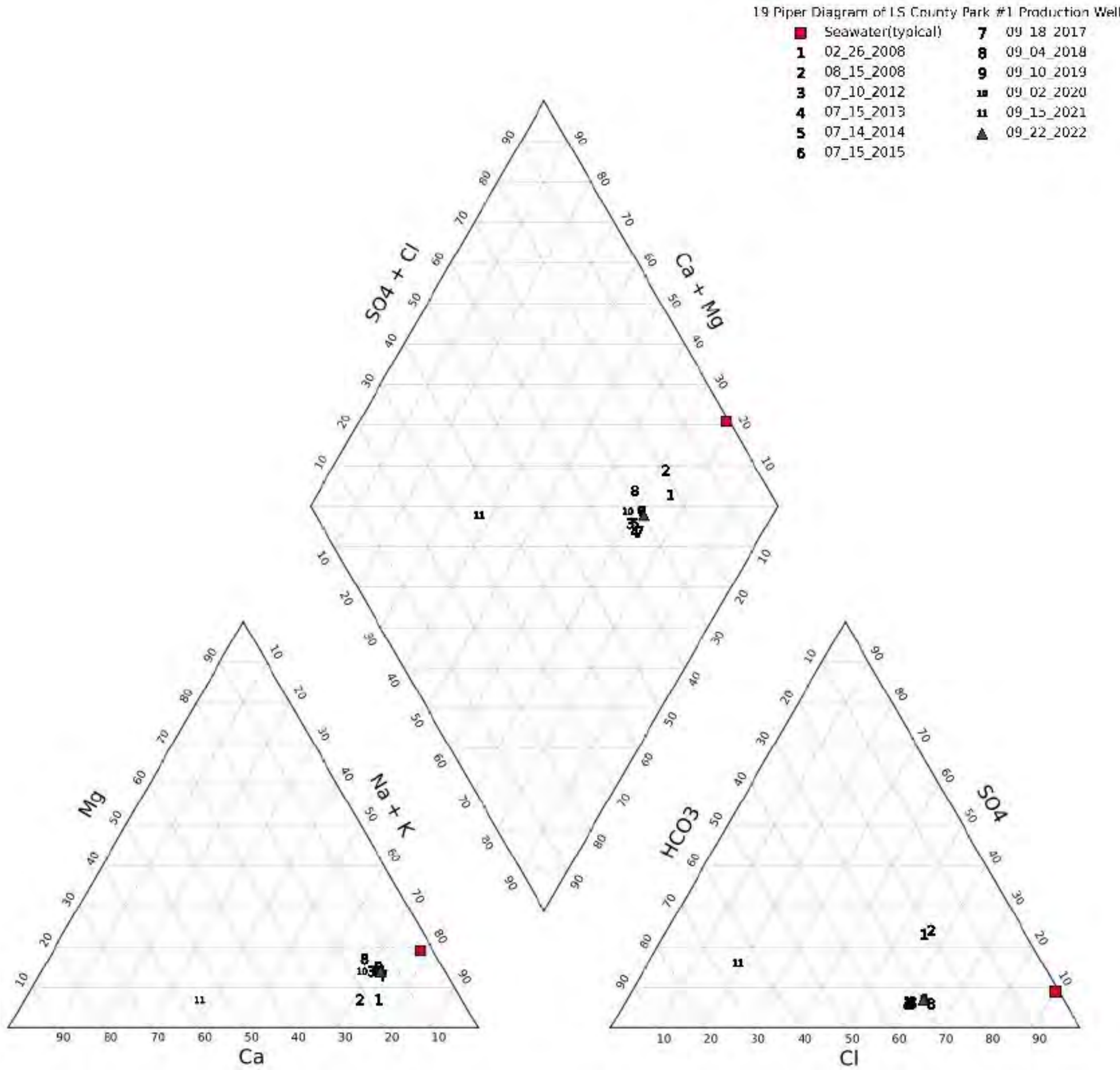

Figure C-19. Piper Diagram of LS County Park #1 Production Well

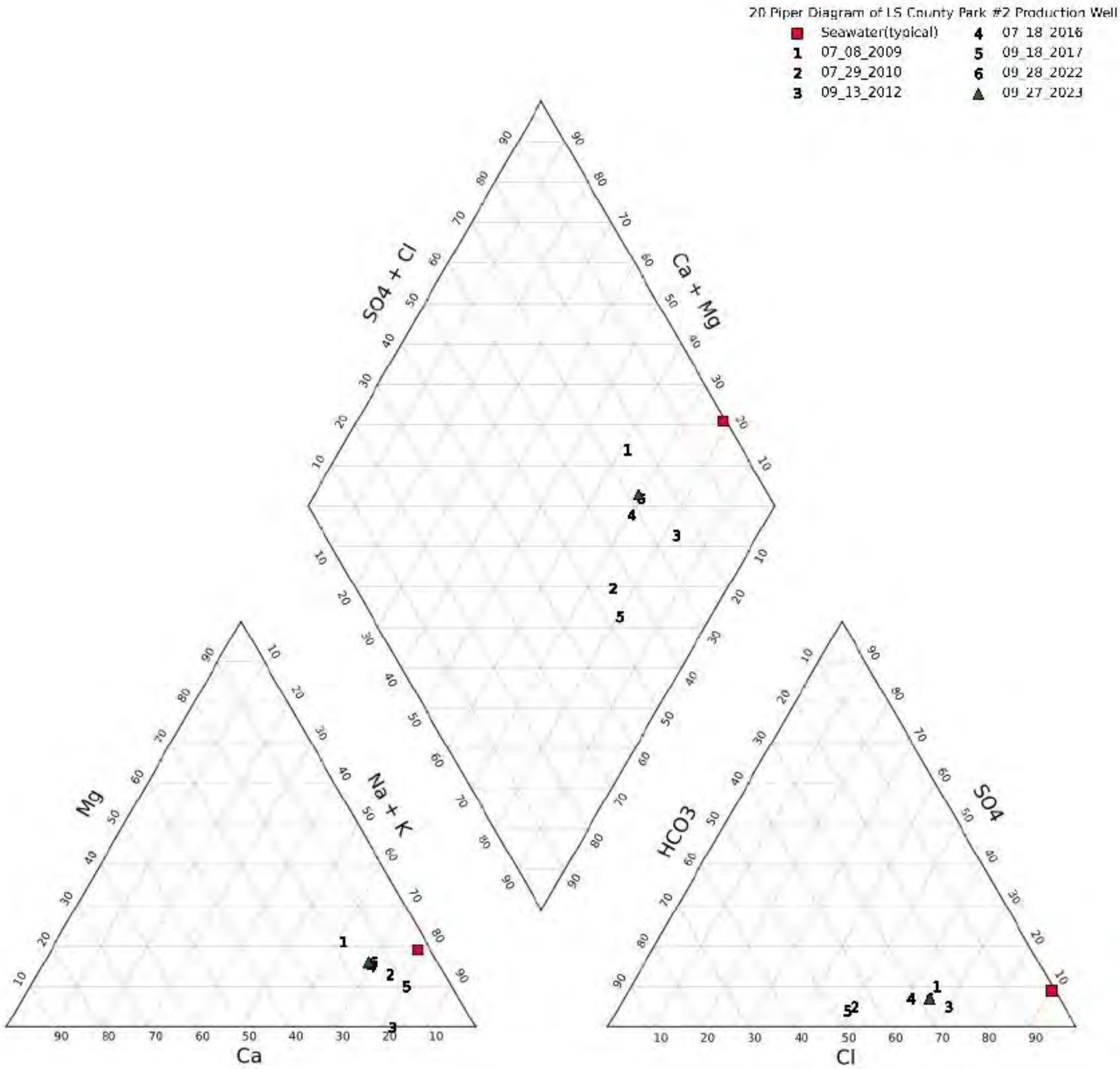

Figure C-20. Piper Diagram of LS County Park #2 Production Well

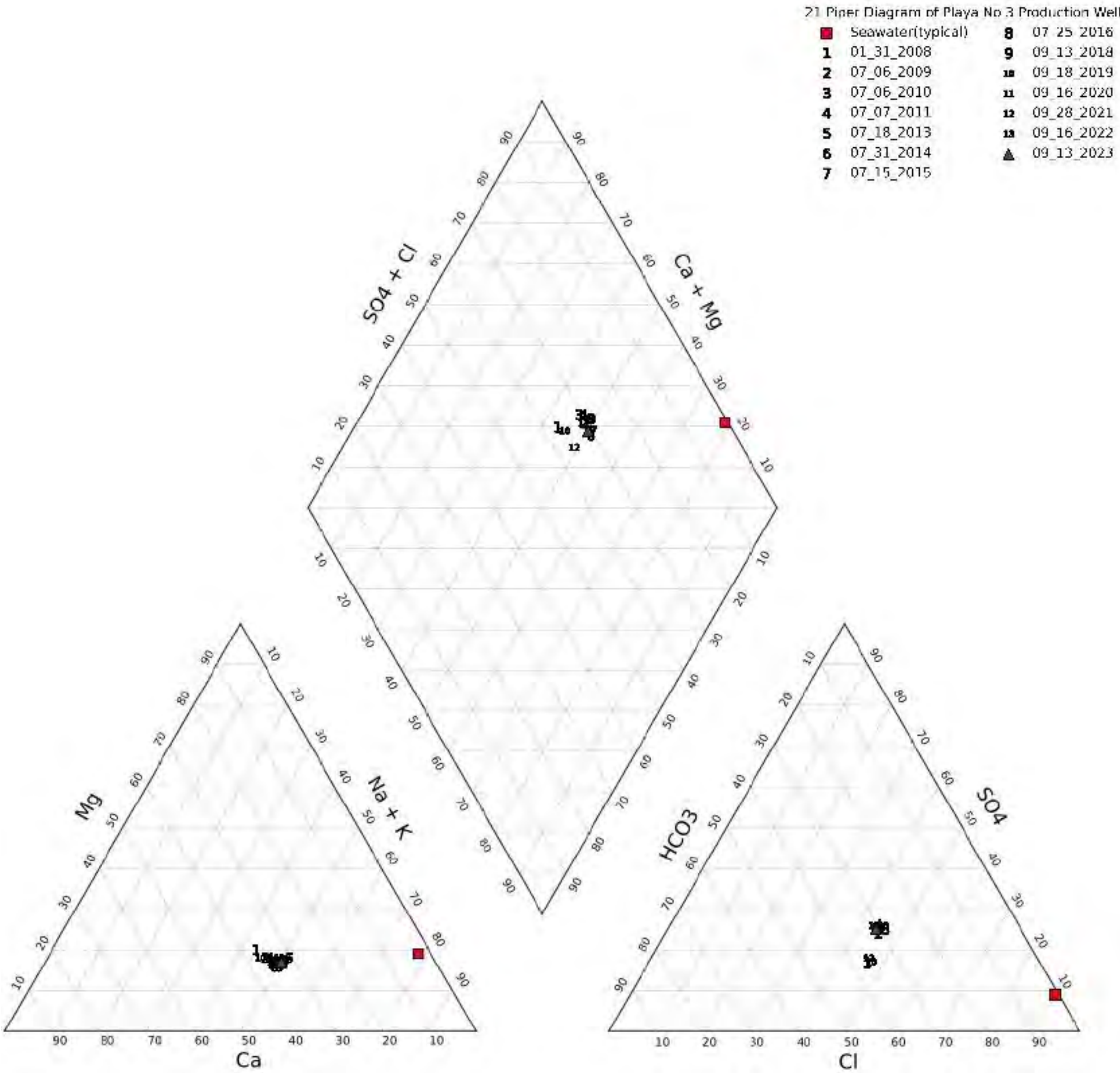

Figure C-21. Piper Diagram of Playa No. 3 Production Well

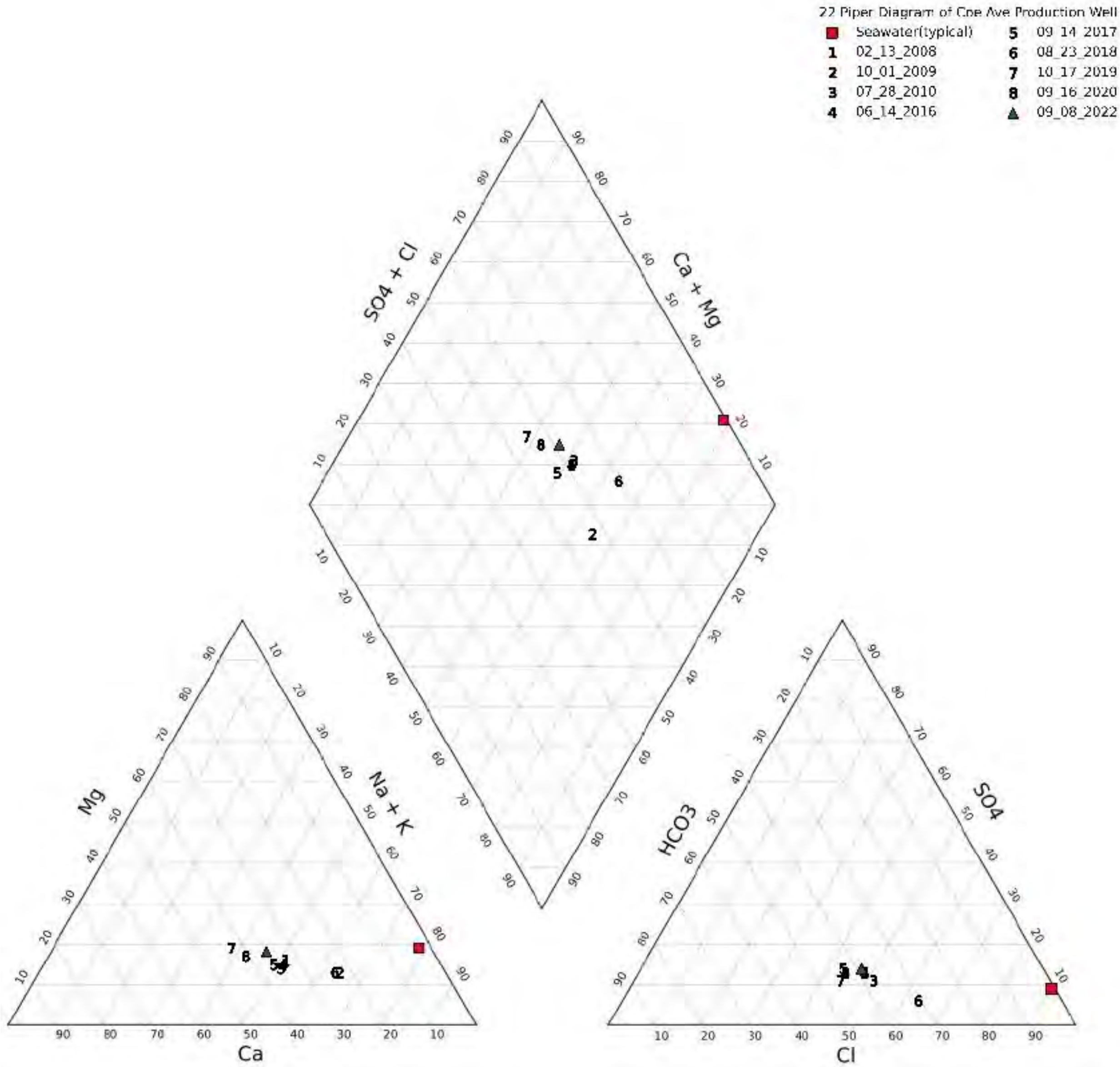

Figure C-22. Piper Diagram of Coe Ave. Production Well

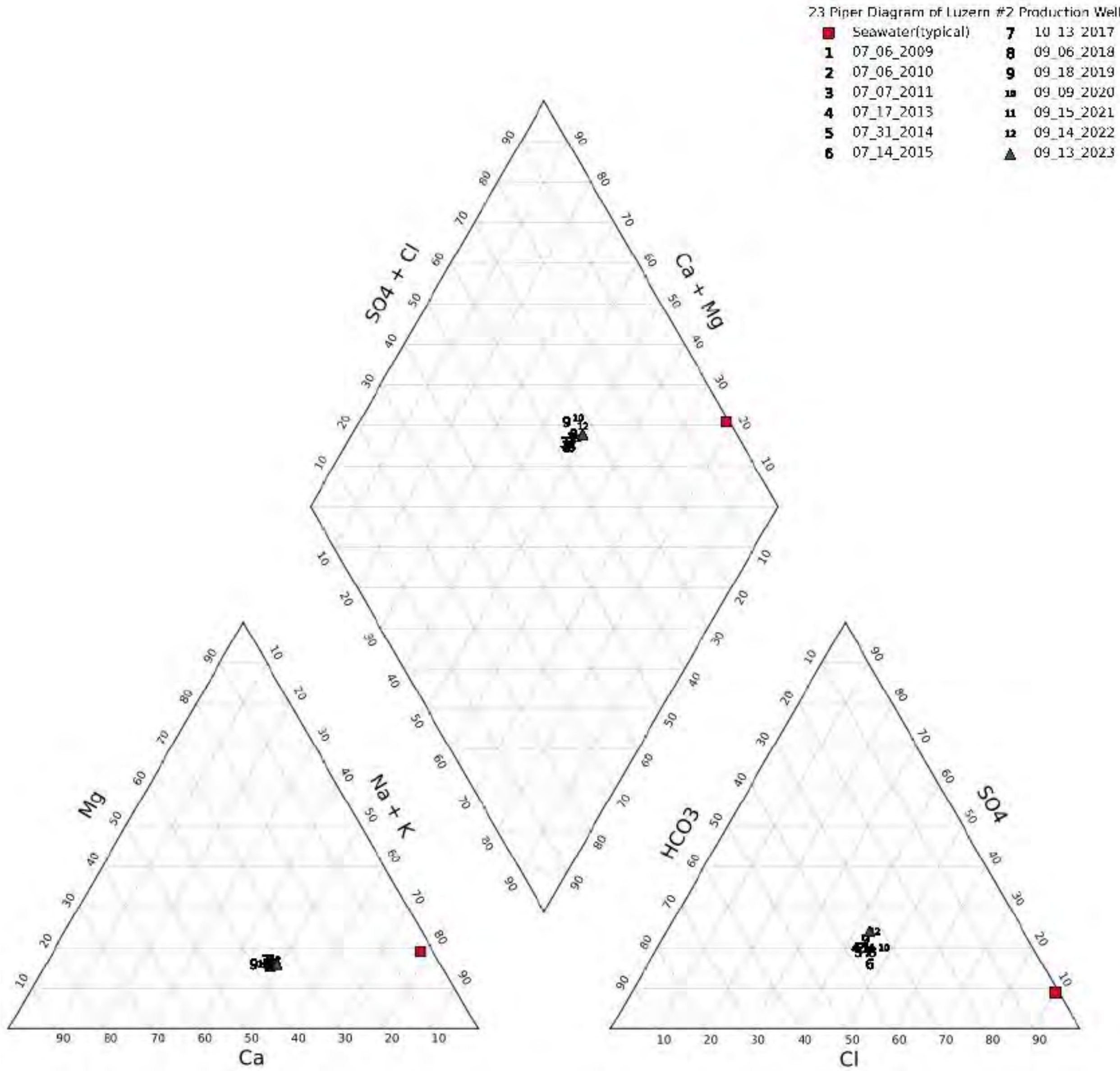

Figure C-23. Piper Diagram of Luzern #2 Production Well

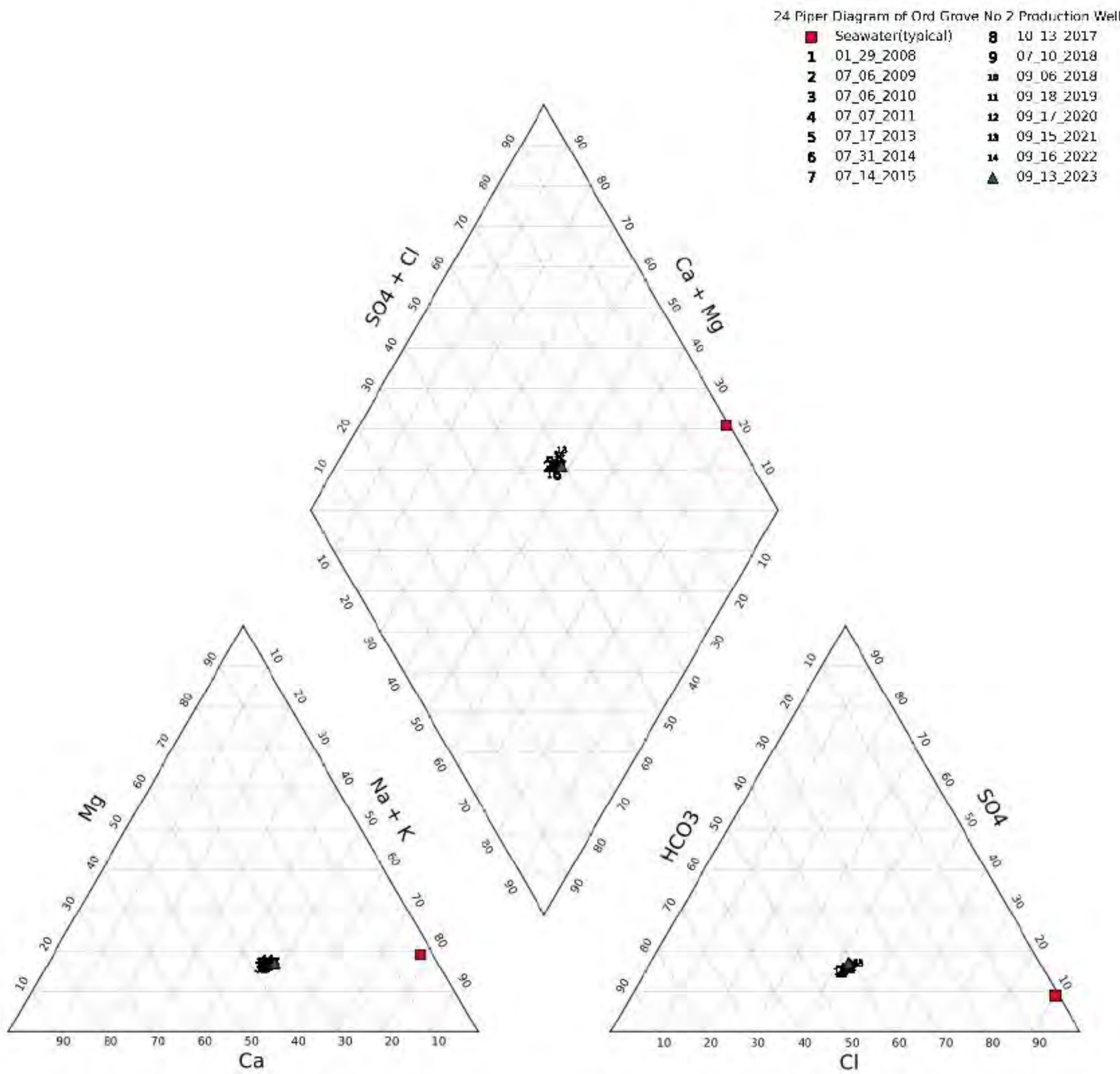

Figure C-24. Piper Diagram of Ord Grove No. 2 Production Well

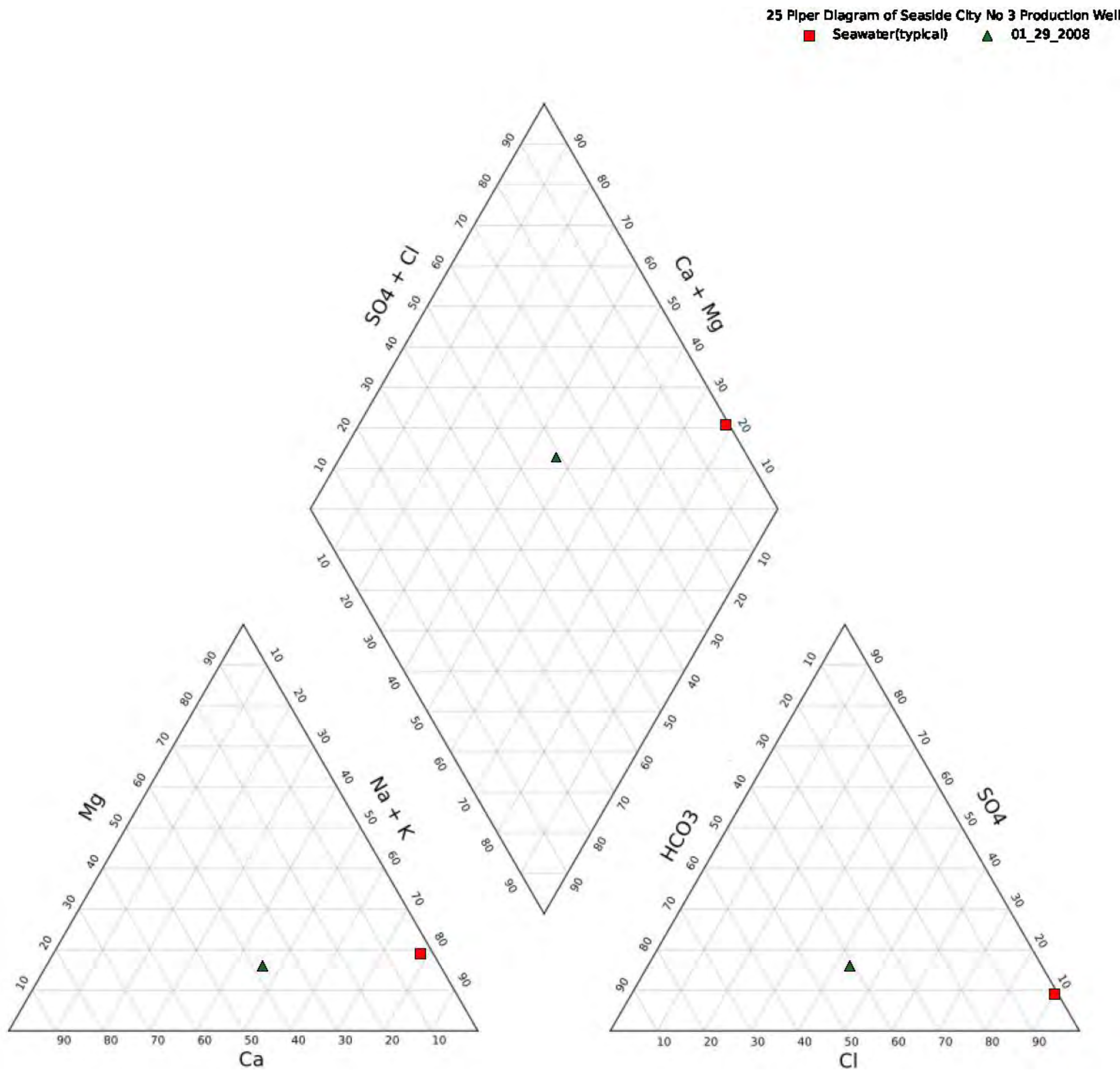

Figure C-25. Piper Diagram of Seaside City No. 3 Production Well

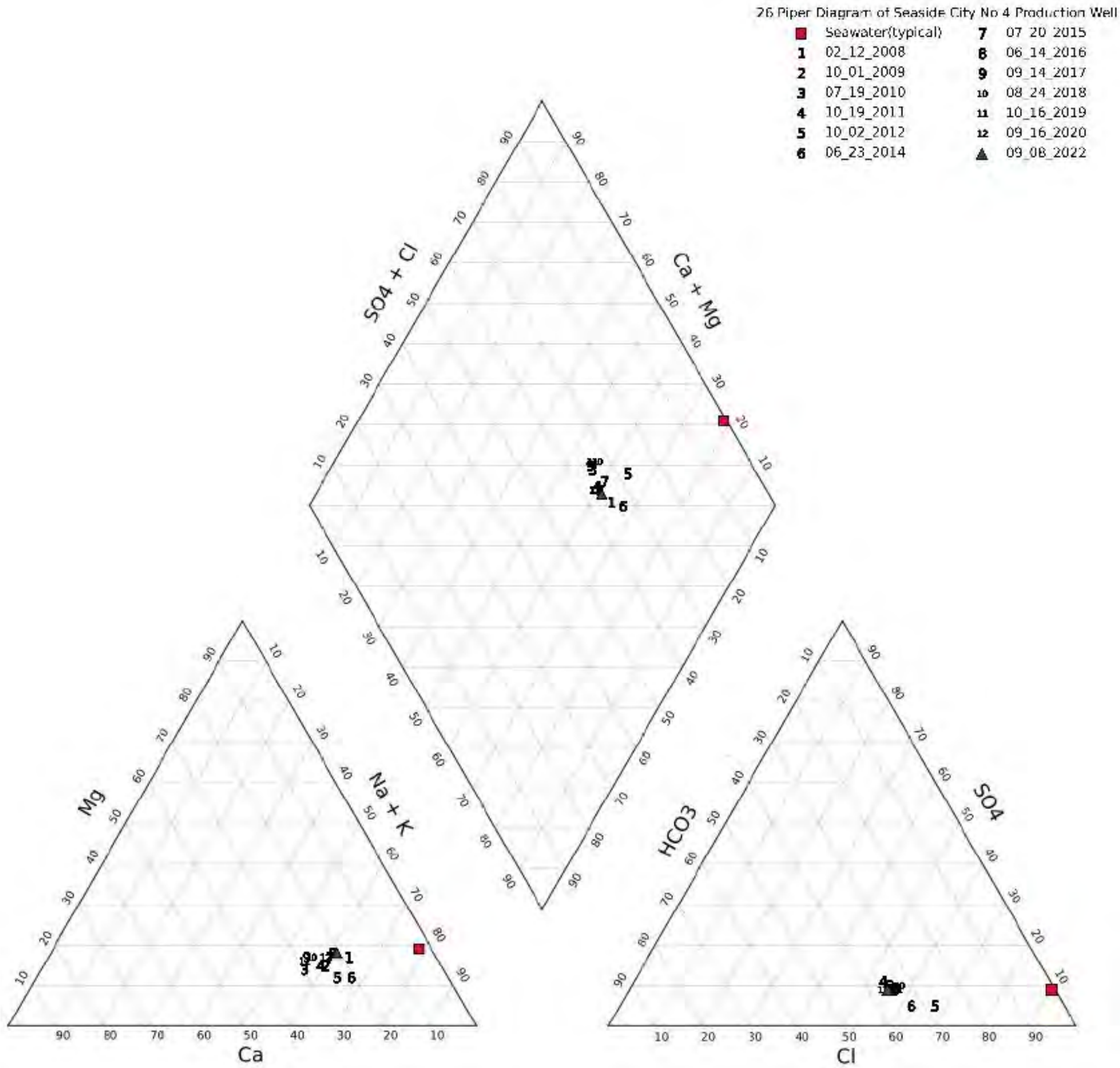

Figure C-26. Piper Diagram of Seaside City No. 4 Production Well

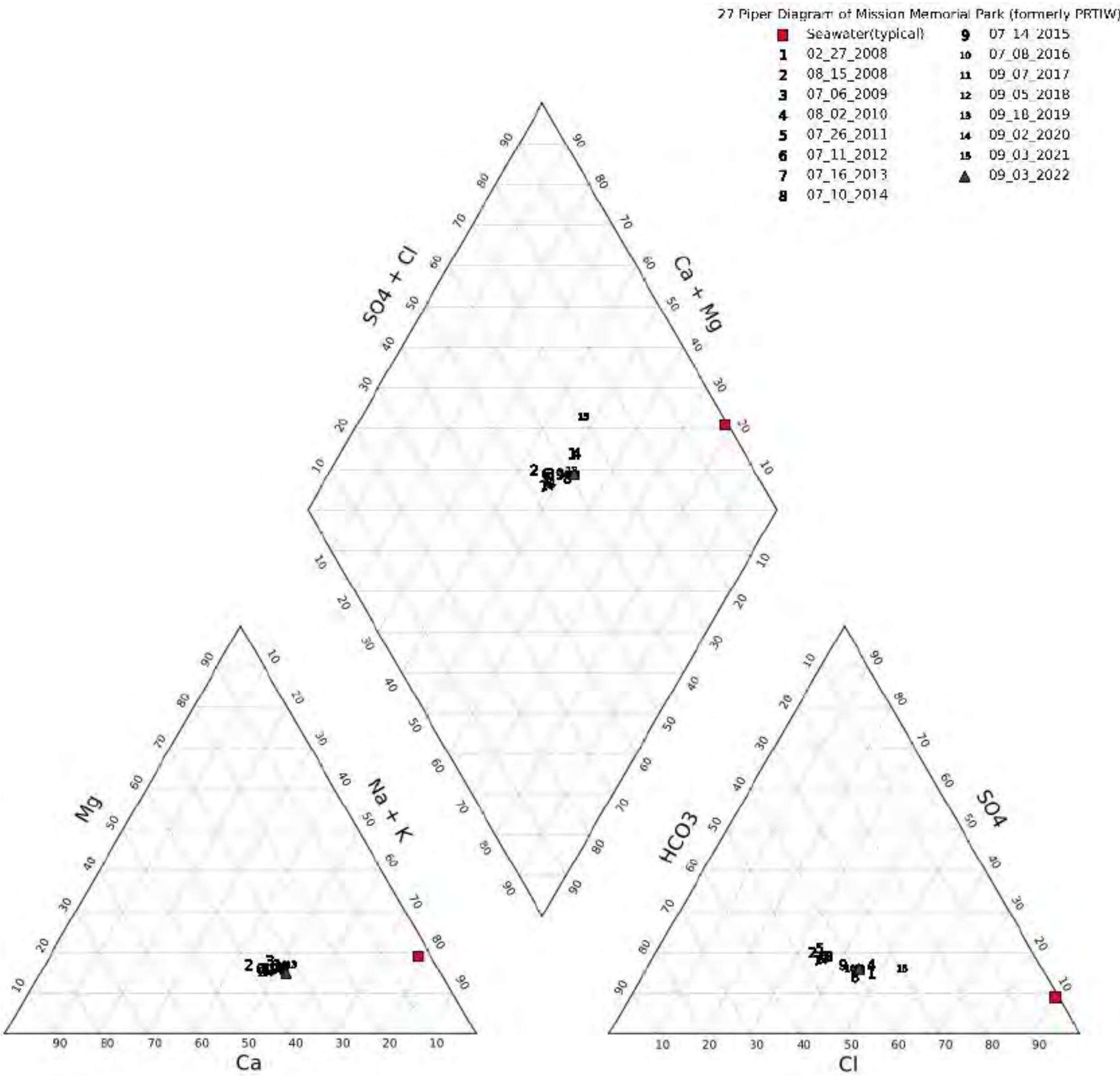

Figure C-27. Piper Diagram of Mission Memorial Park (formerly PRTIW)

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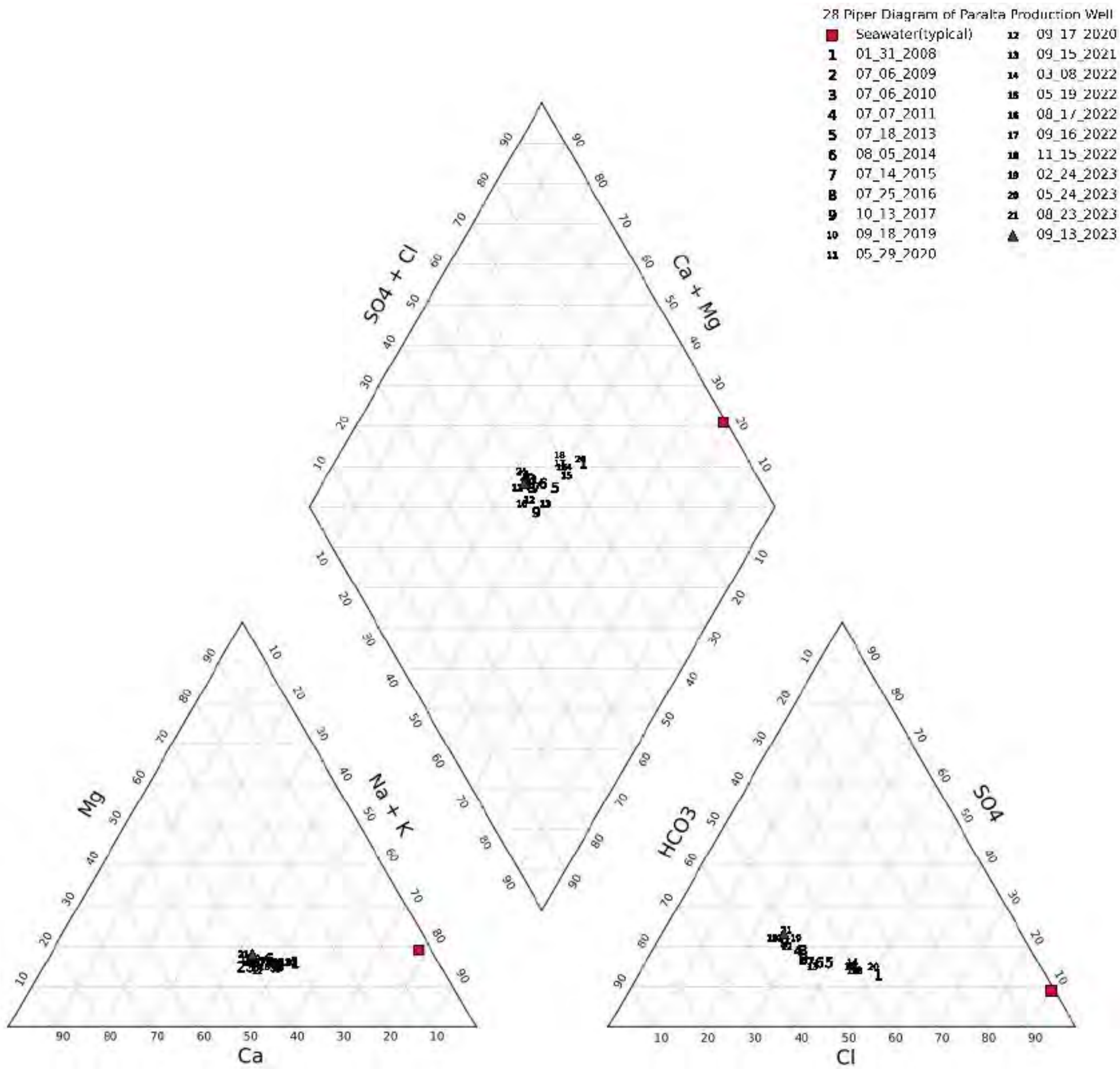

Figure C-28. Piper Diagram of Paralta Production Well

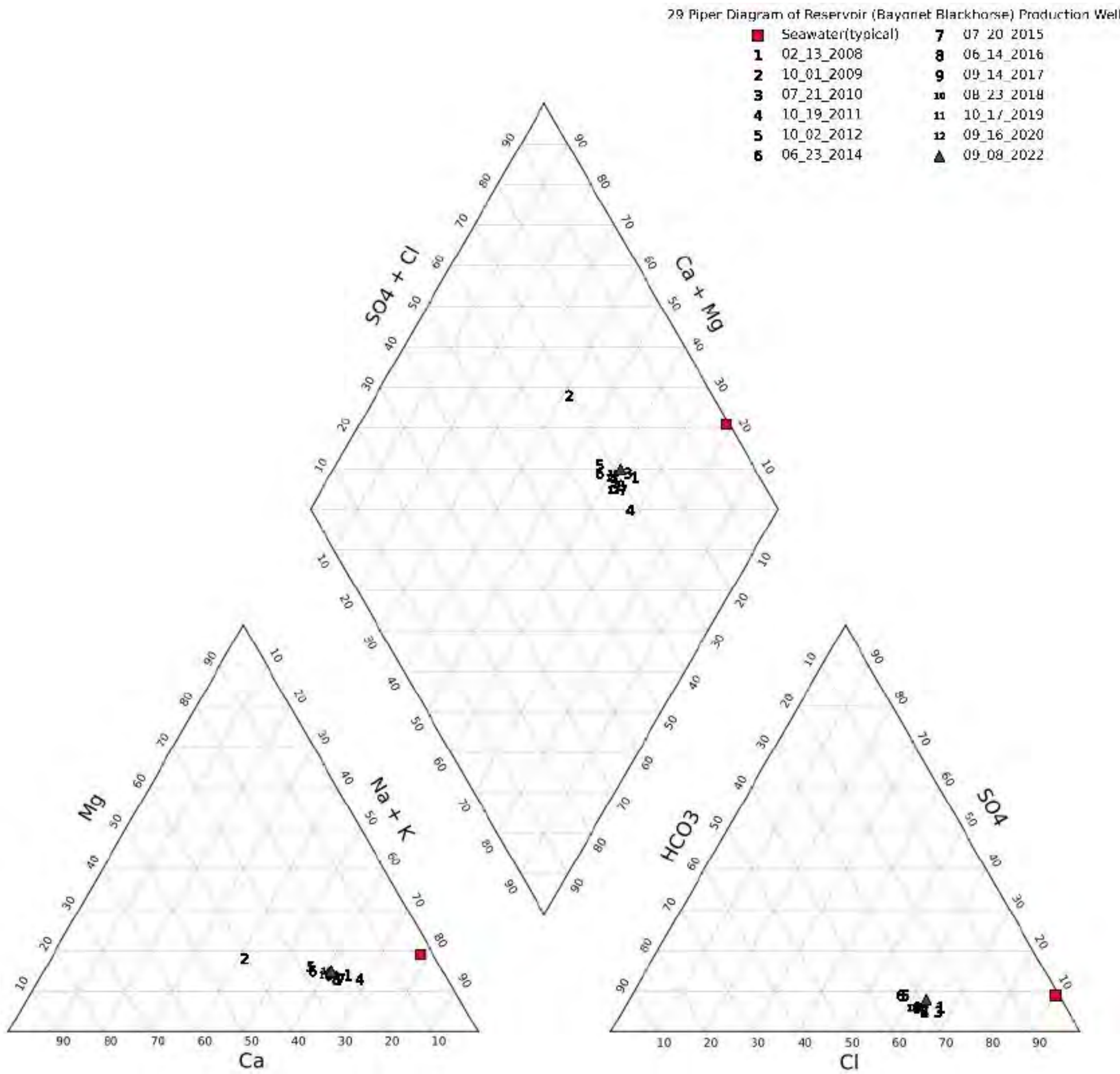

Figure C-29. Piper Diagram of Reservoir (Bayonet Blackhorse) Production Well

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Appendix D

Chloride and Sodium/Chloride Molar Ratio Graphs

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Appendix D Contents

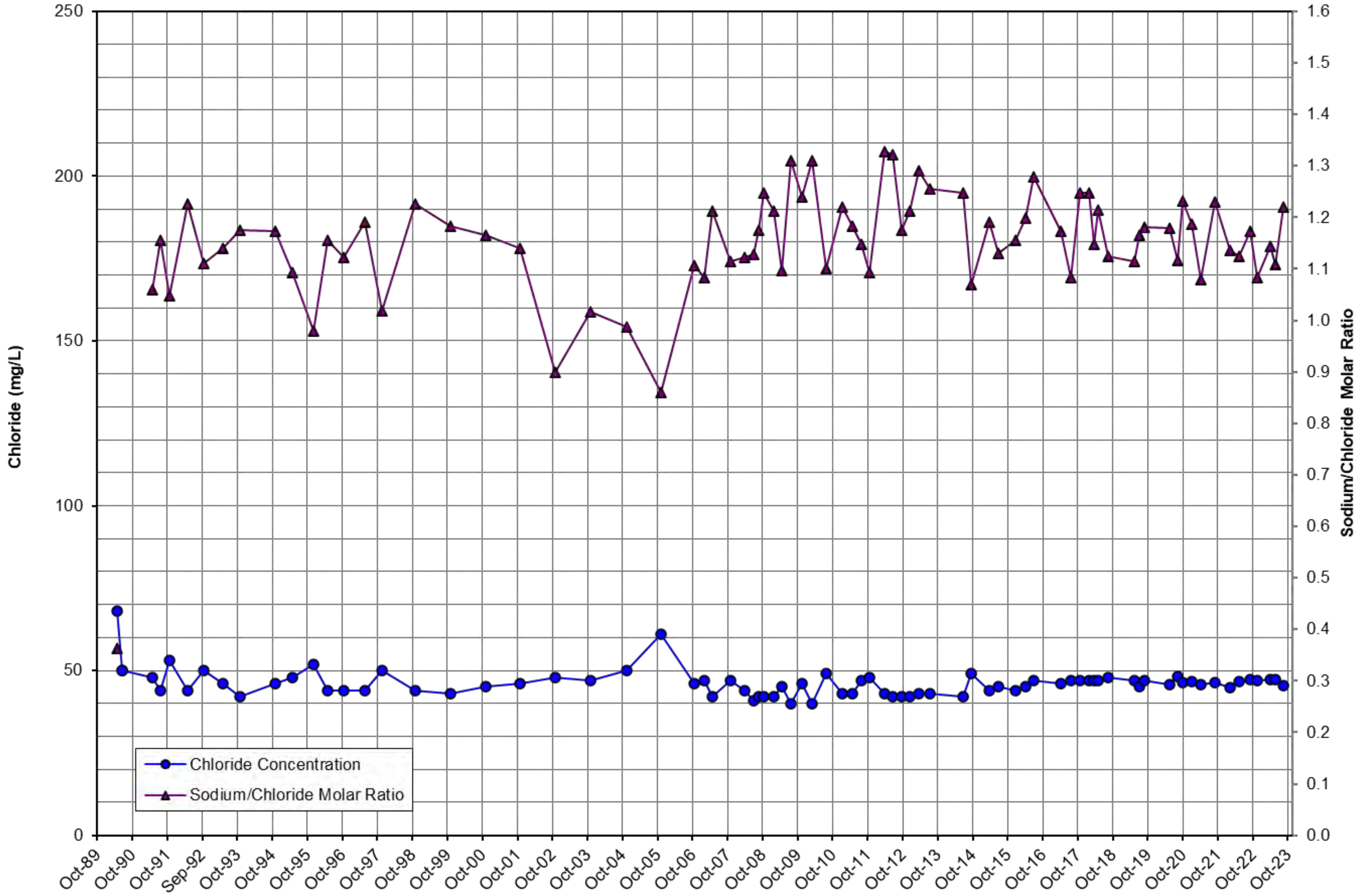

Figure D-1. PCA West Shallow Well Chloride and Sodium/Chloride Molar Ratio Graph

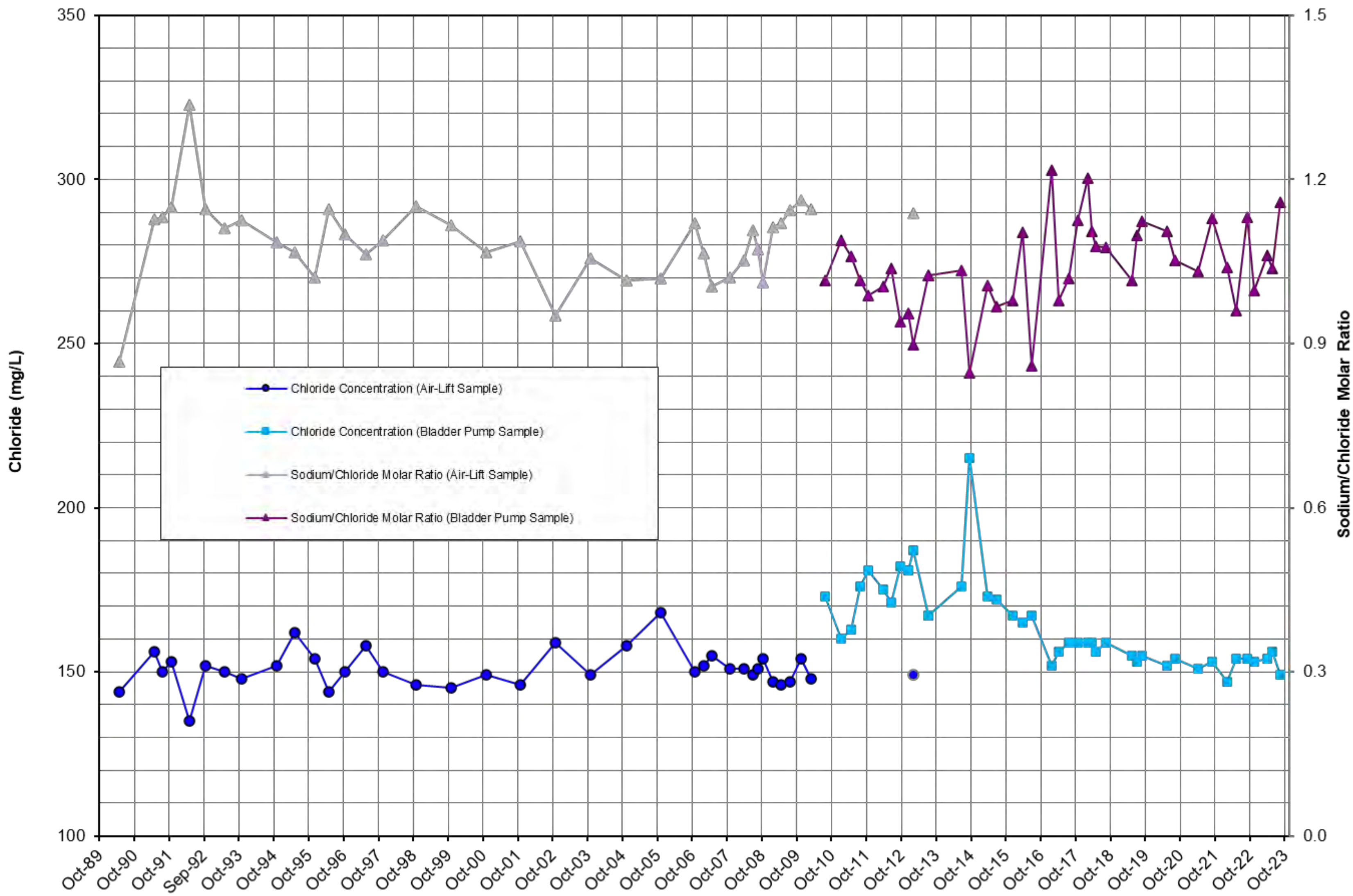

Figure D-2. PCA West Deep Well Chloride and Sodium/Chloride Molar Ratio Graph

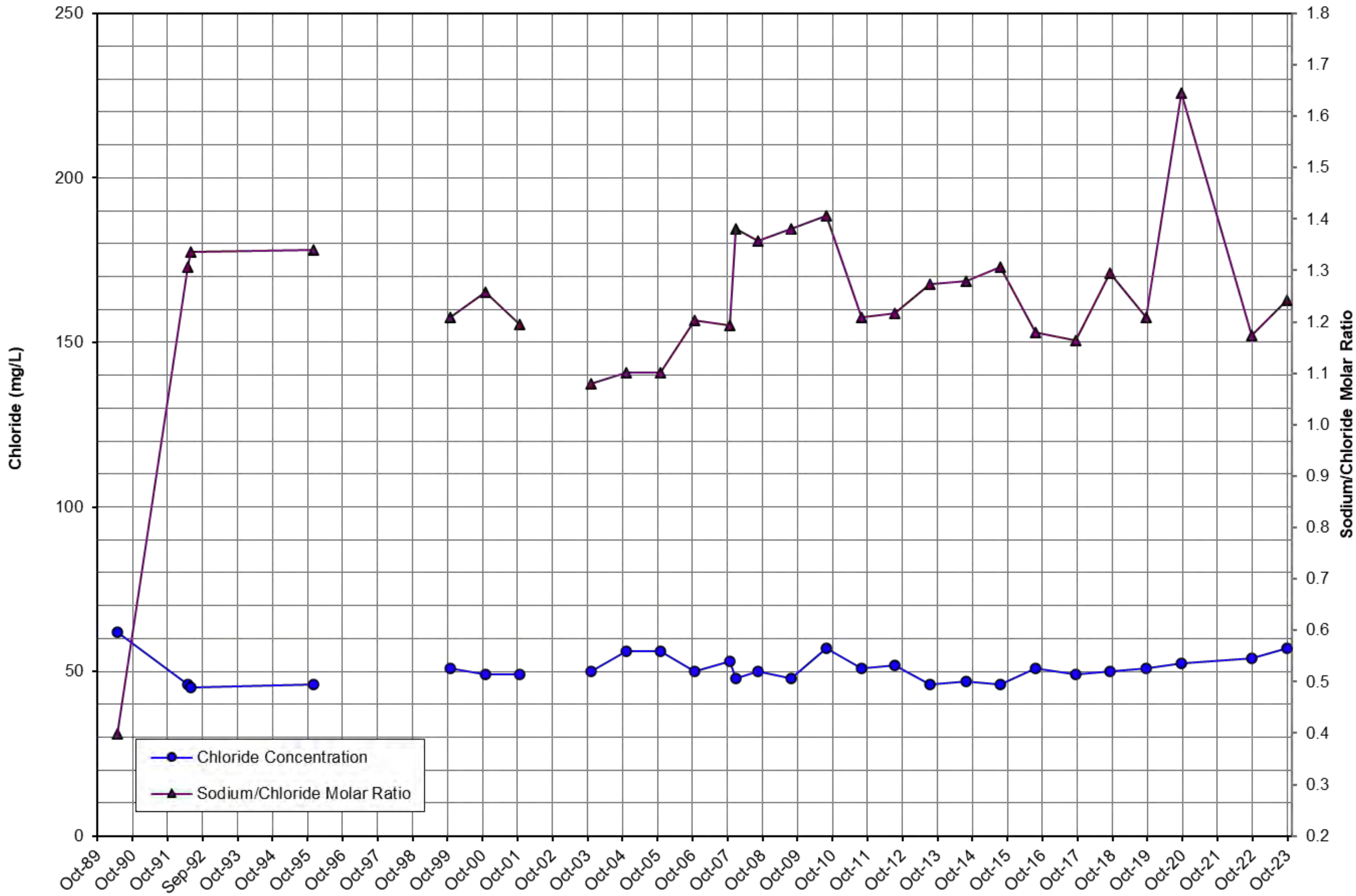

Figure D-3. PCA East Shallow Well Chloride and Sodium/Chloride Molar Ratio Graph

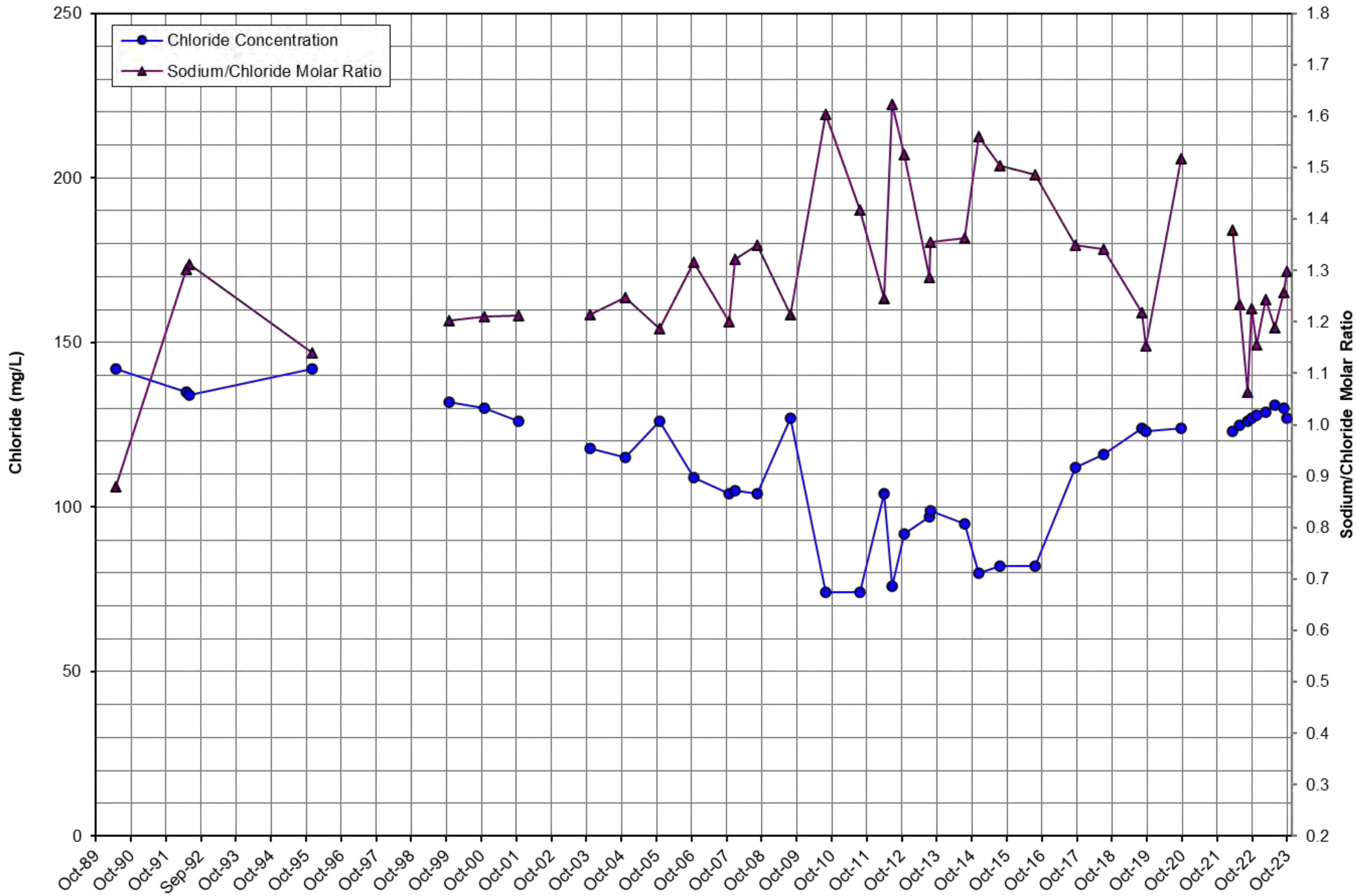

Figure D-4. PCA East Deep Well Chloride and Sodium/Chloride Molar Ratio Graph

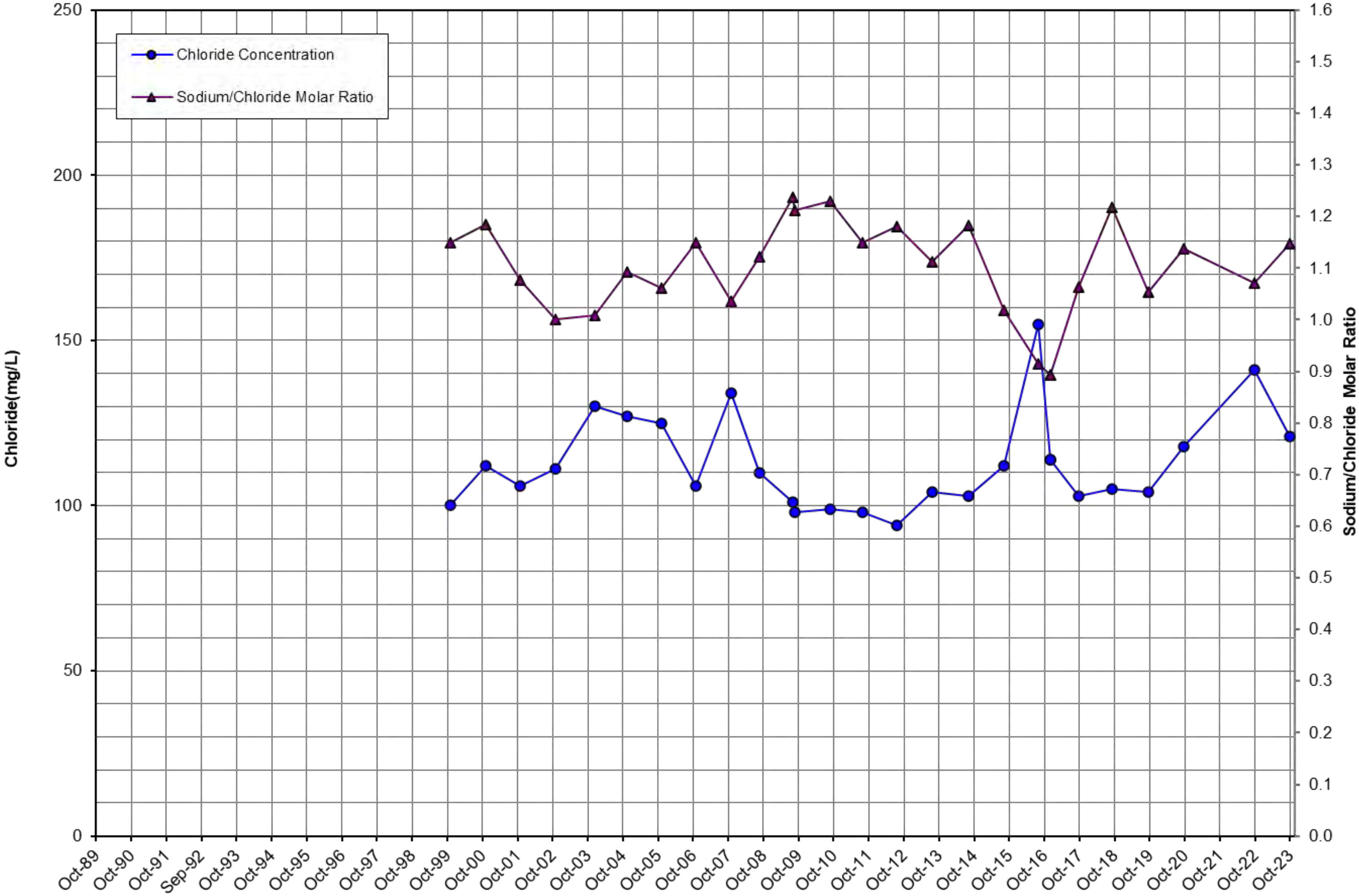

Figure D-5. Ord Terrace Shallow Well Chloride and Sodium/Chloride Molar Ratio Graph

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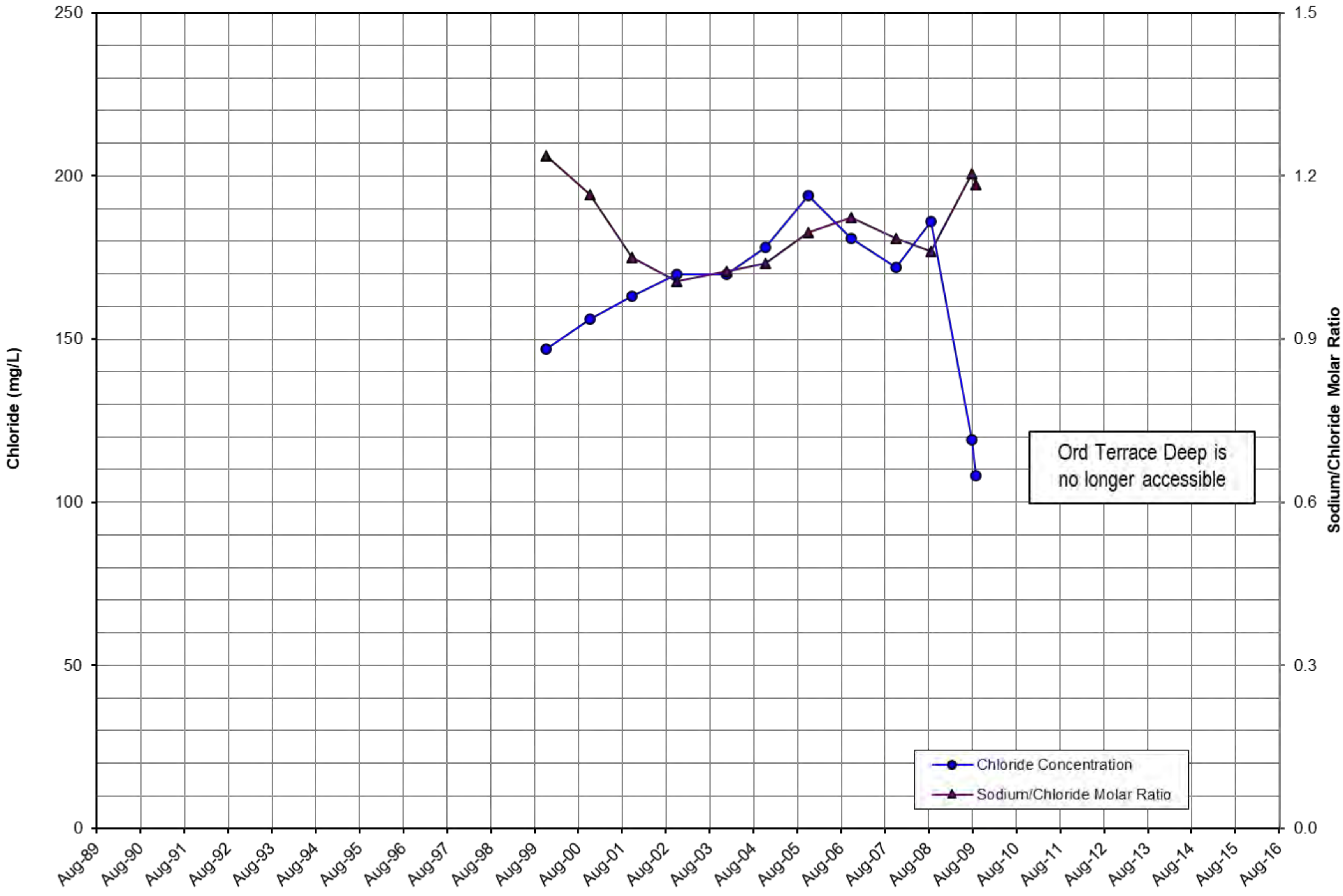

Figure D-6. Ord Terrace Deep Well Chloride and Sodium/Chloride Molar Ratio Graph

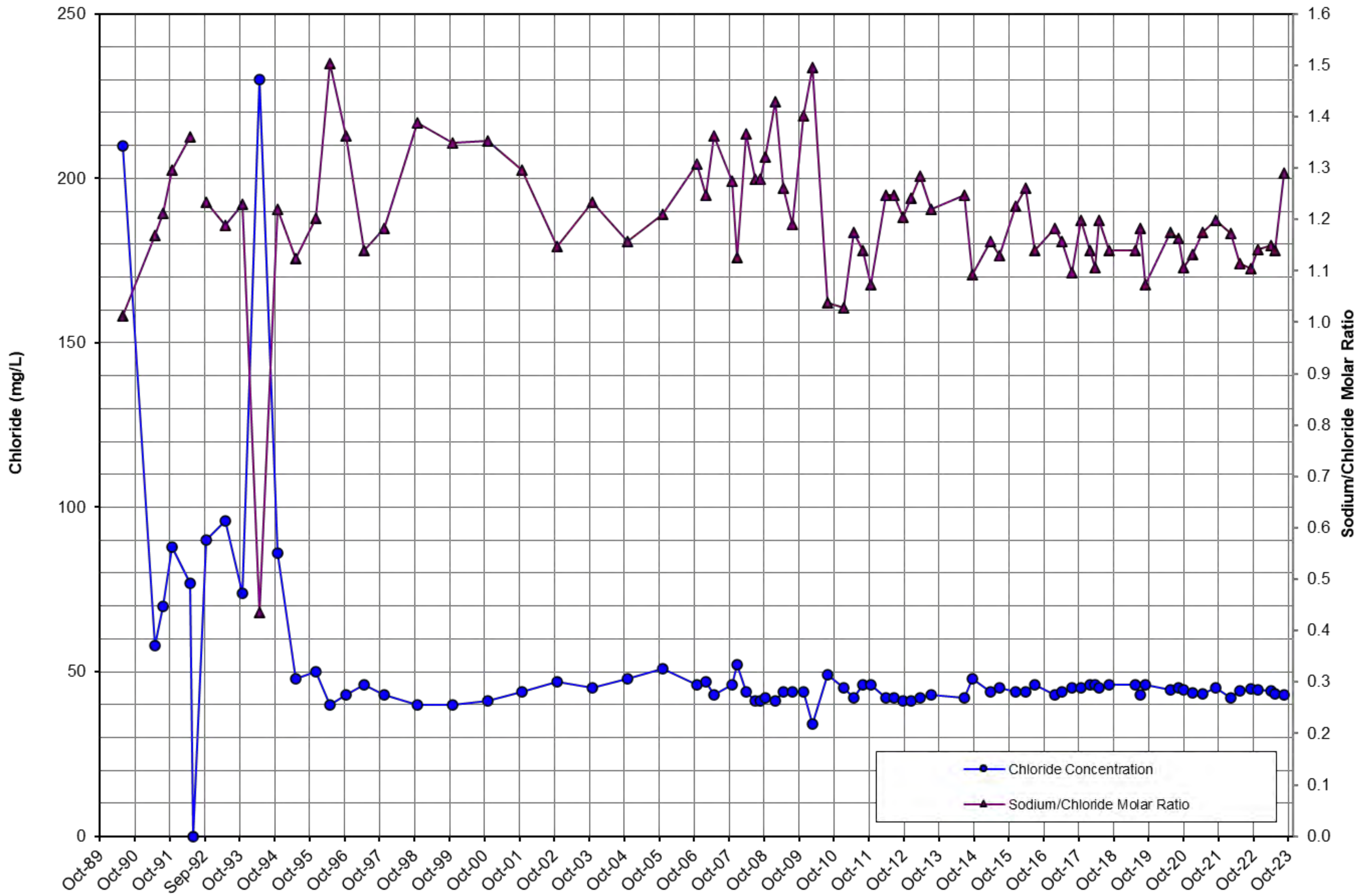

Figure D-7. MSC Shallow Well Chloride and Sodium/Chloride Molar Ratio Graph

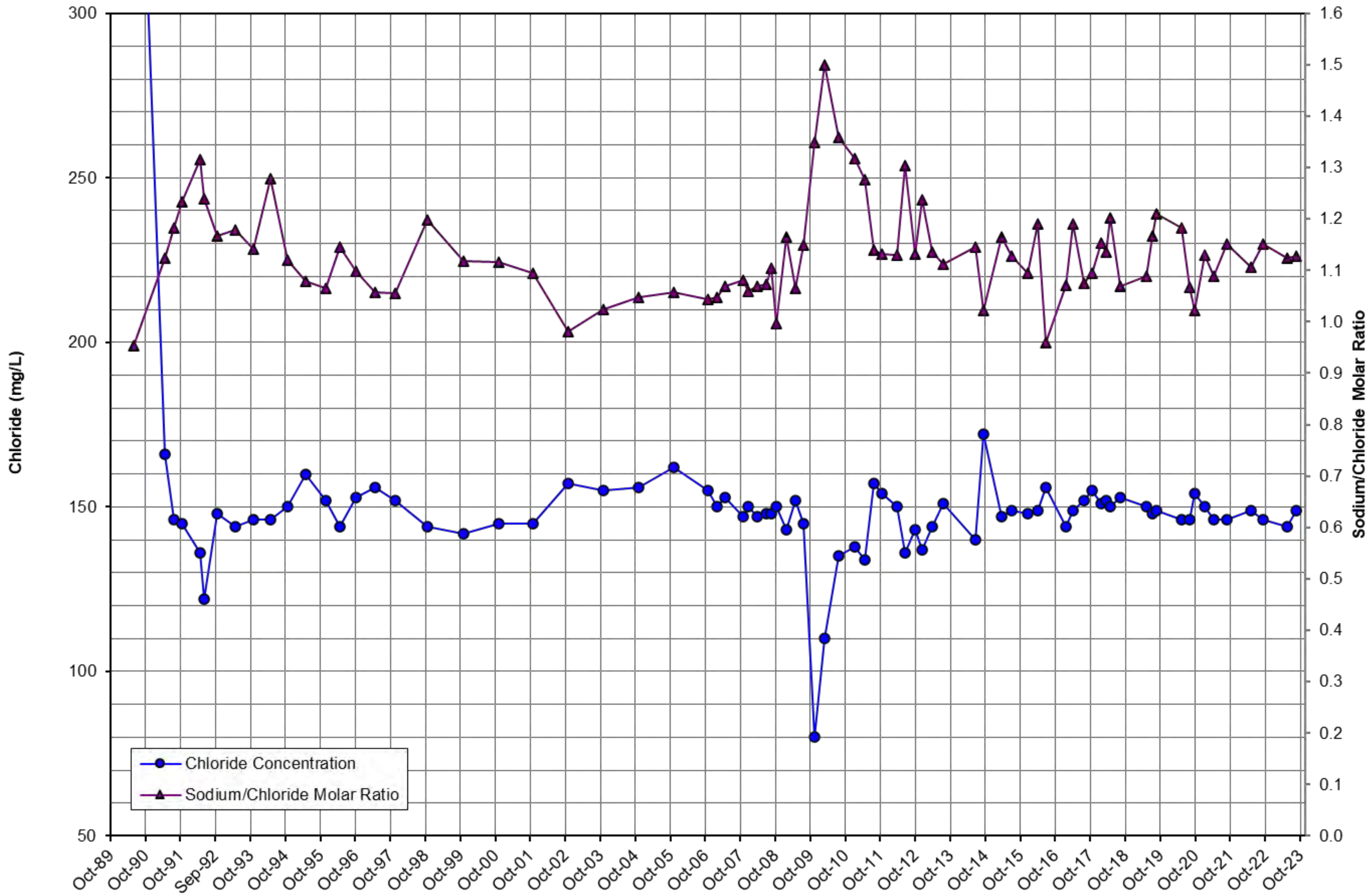

Figure D-8. MSC Deep Well Chloride and Sodium/Chloride Molar Ratio Graph

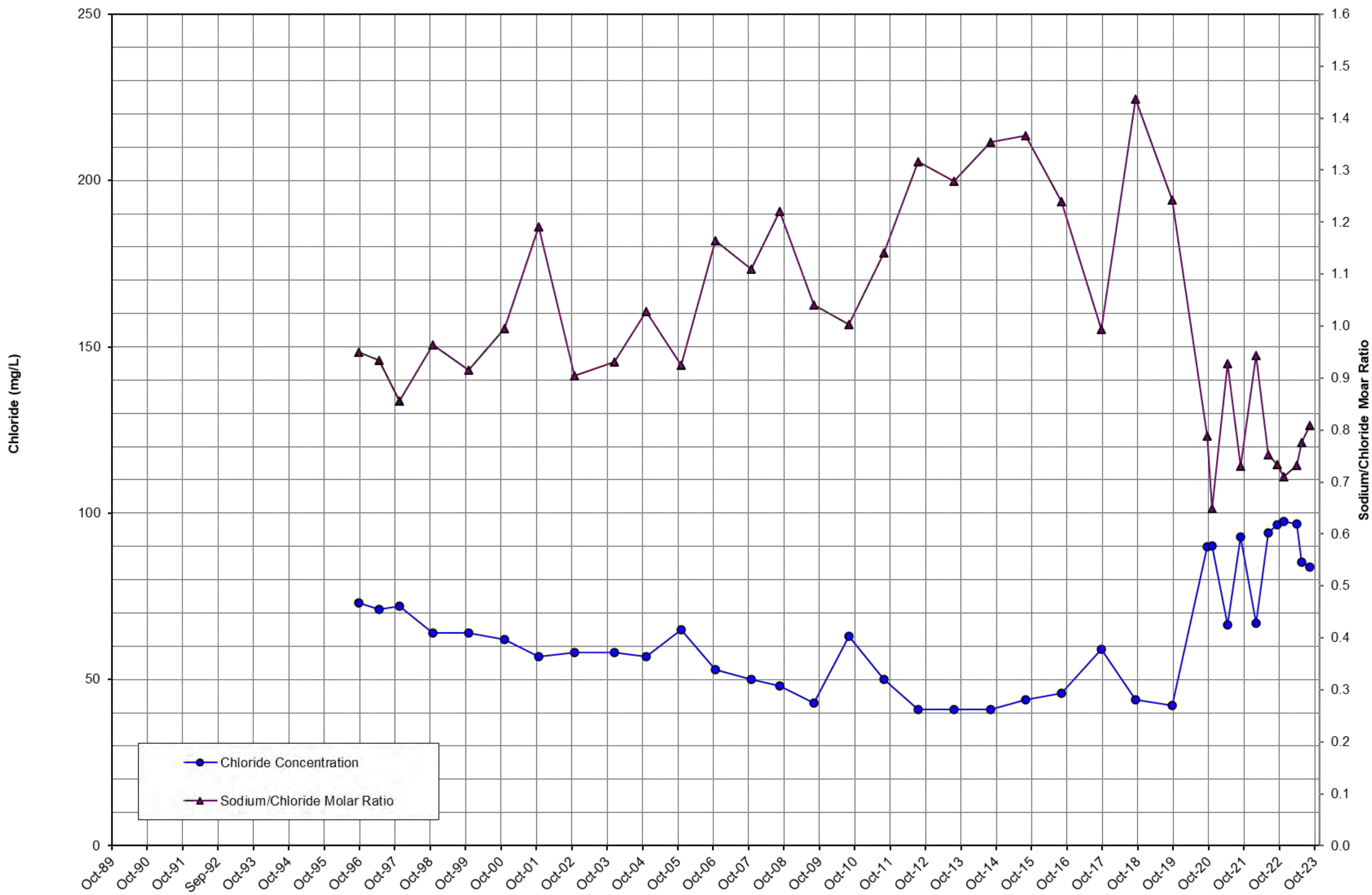

Figure D-9. Fort Ord 10 Shallow Well Chloride and Sodium/Chloride Molar Ratio Graph

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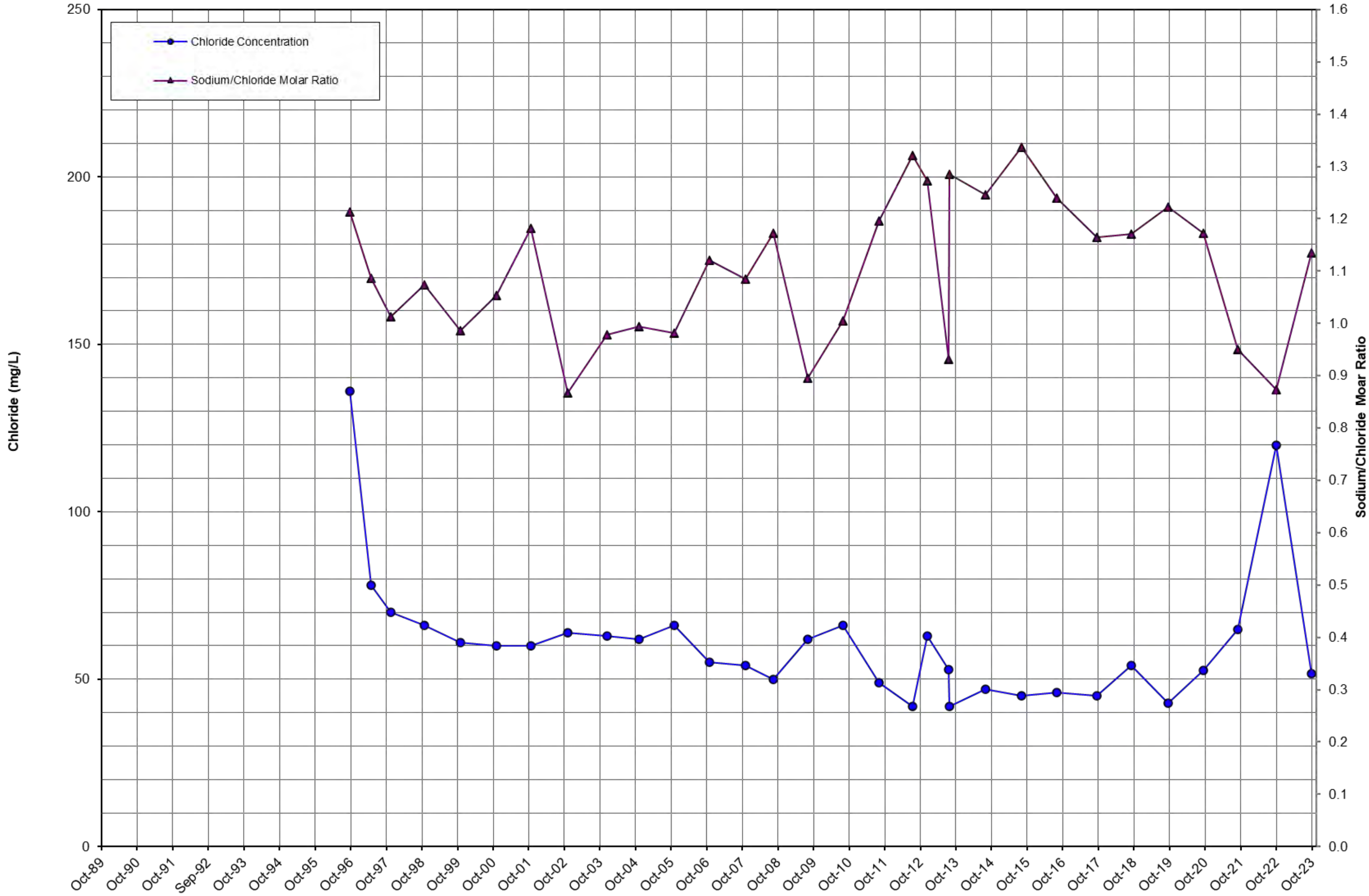

Figure D-10. Fort Ord 10 Deep Well Chloride and Sodium/Chloride Molar Ratio Graph

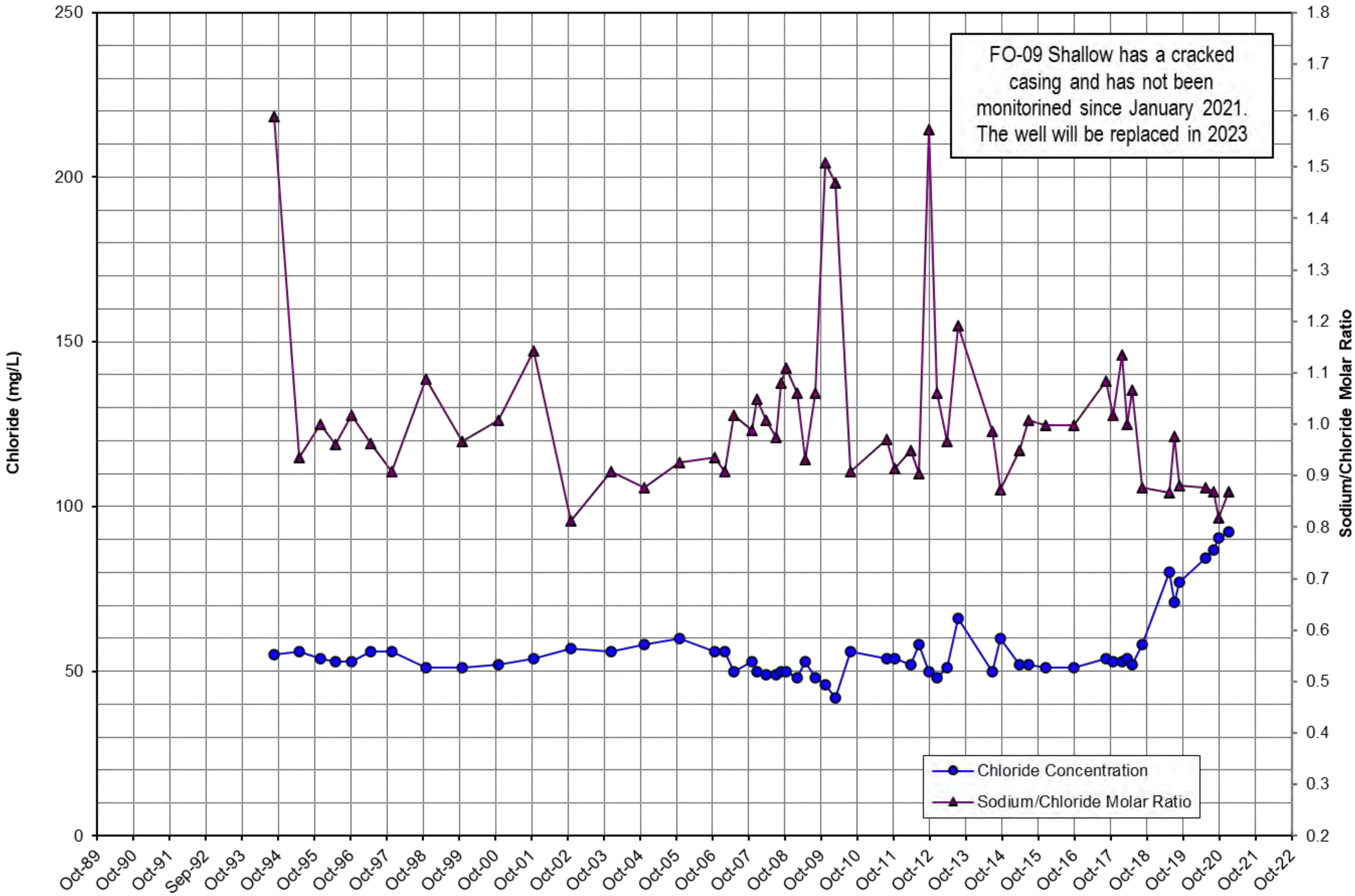

Figure D-11. Fort Ord 9 Shallow Well Chloride and Sodium/Chloride Molar Ratio Graph

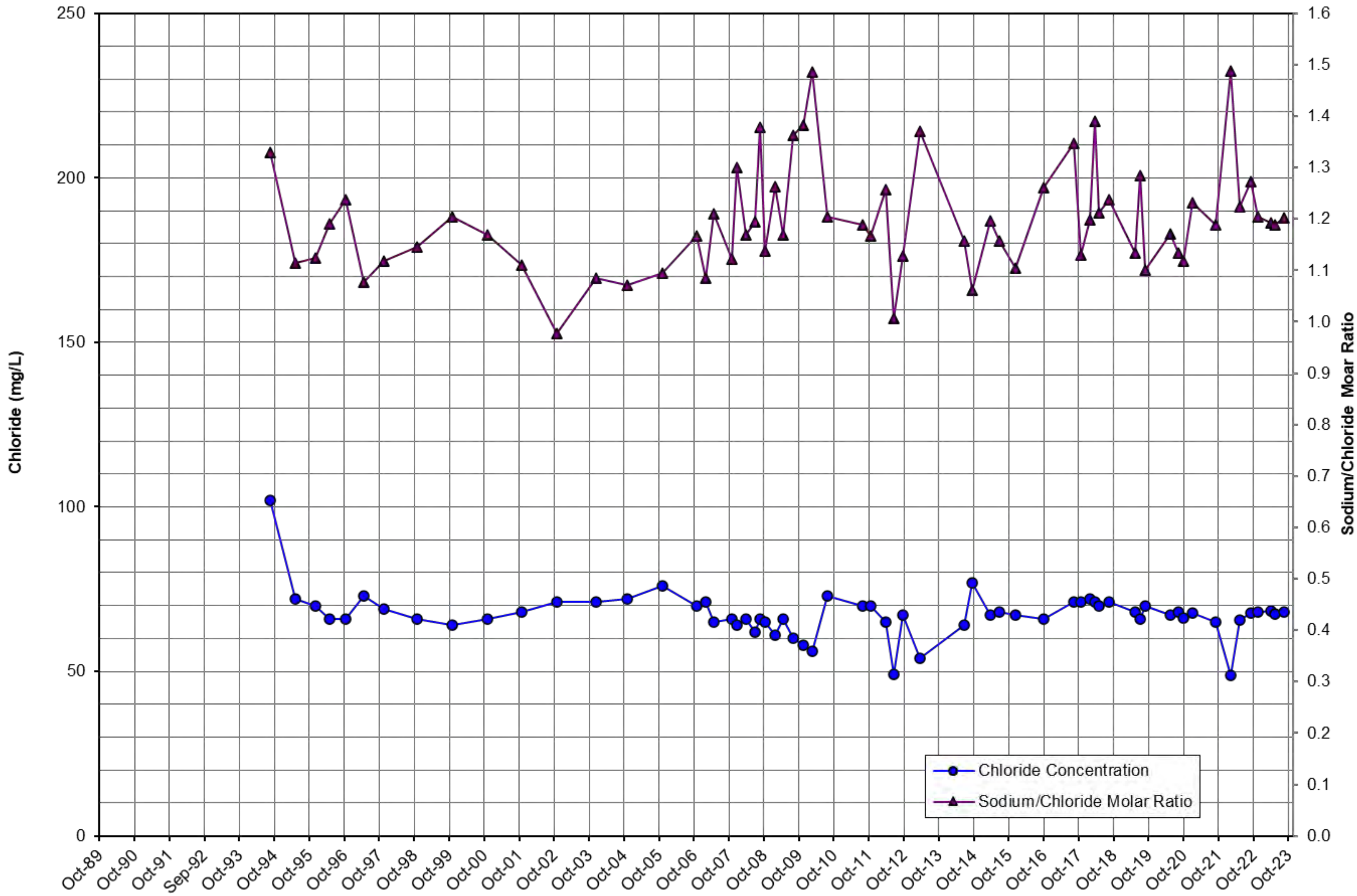

Figure D-12. Fort Ord 9 Deep Well Chloride and Sodium/Chloride Molar Ratio Graph

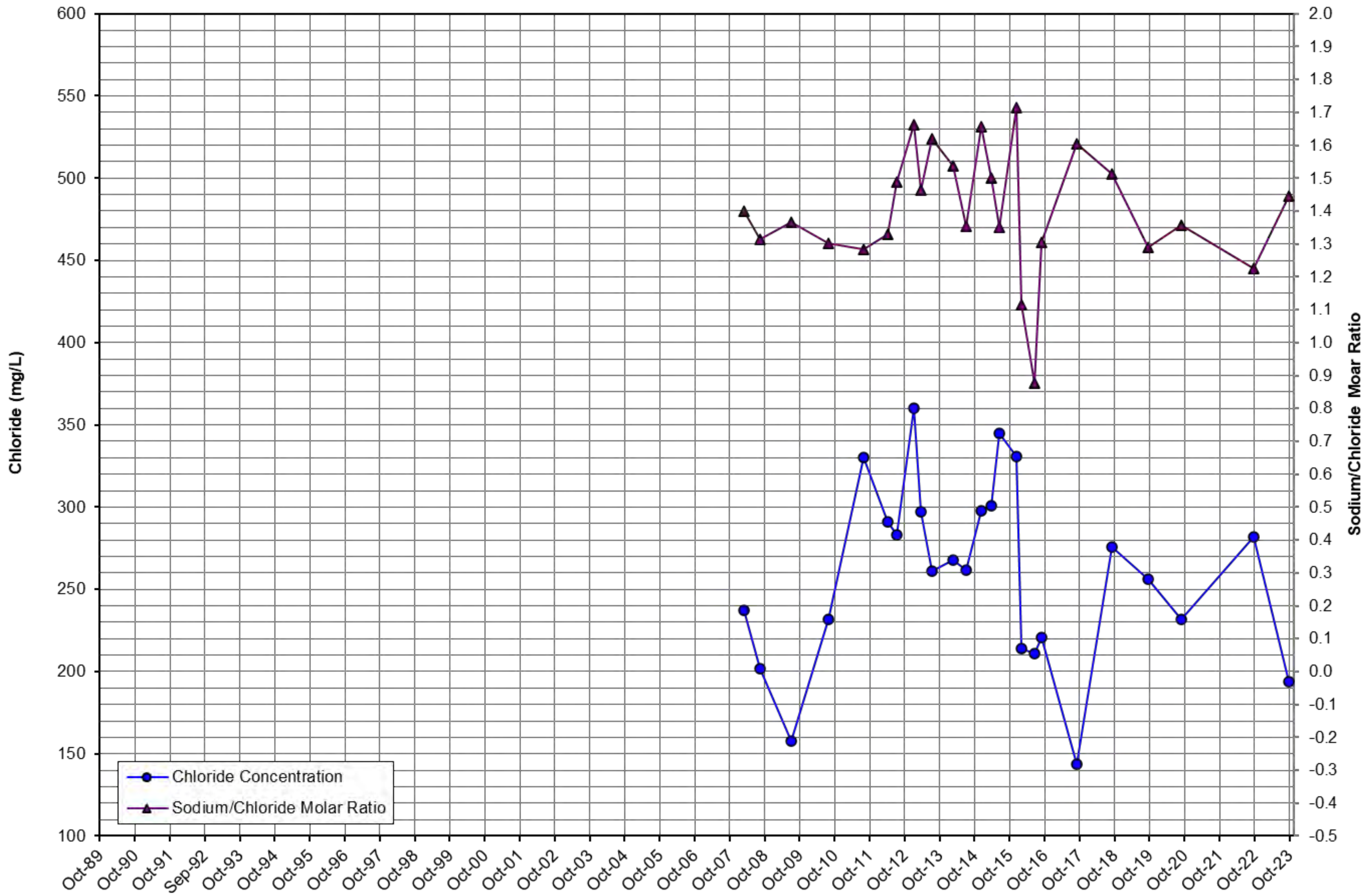

Figure D-13. Sand City Corp Yard Production Well Chloride and Sodium/Chloride Molar Ratio Graph