

MEETING NOTICE AND AGENDA
TECHNICAL ADVISORY COMMITTEE
OF THE
SEASIDE BASIN WATER MASTER

DATE: Wednesday, February 8, 2017

MEETING TIME: 1:30 p.m.

**Monterey Regional Water Pollution Control Agency Offices
5 Harris Court, Building D (Ryan Ranch)
Monterey, CA 93940**

If you wish to participate in the meeting from a remote location, please call in on the Watermaster Conference Line by dialing (712) 432-1212. Use the Meeting ID 355890617. Please note that if no telephone attendees have joined the meeting by 10 minutes after its start, the conference call will be ended.

OFFICERS

Chairperson: Nina Miller, California American Water Company

Vice-Chairperson: Jon Lear, MPWMD

MEMBERS

California American Water Company	City of Del Rey Oaks	City of Monterey
City of Sand City	City of Seaside	Coastal Subarea Landowners
Laguna Seca Property Owners	Monterey County Water Resources Agency	
Monterey Peninsula Water Management District		

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The next regular meeting will be held on Wednesday March 8, 2017 at 1:30 p.m. at the MRWPCA Board Room.	

**SEASIDE BASIN WATER MASTER
TECHNICAL ADVISORY COMMITTEE**

*** * * AGENDA TRANSMITTAL FORM * * ***

MEETING DATE:	February 8, 2017
AGENDA ITEM:	2.A
AGENDA TITLE:	Approve Minutes from the January 11, 2017 Meeting
PREPARED BY:	Robert Jaques, Technical Program Manager
SUMMARY:	<p>Draft Minutes from this meeting was emailed to all TAC members. Any changes requested by TAC members have been included in the attached version.</p>
ATTACHMENTS:	Minutes from this meeting
RECOMMENDED ACTION:	Approve the minutes

D-R-A-F-T
MINUTES

**Seaside Groundwater Basin Watermaster
Technical Advisory Committee Meeting
January 11, 2017**

Attendees: TAC Members

City of Seaside – Scott Ottmar
California American Water – Roger Hulbert
City of Monterey – Laurie Williamson (via telephone)
Laguna Seca Property Owners – No Representative
MPWMD – Jon Lear
MCWRA – Tamara Voss
City of Del Rey Oaks – No Representative
City of Sand City – Leon Gomez (via telephone)
Coastal Subarea Landowners – No Representative

Watermaster

Technical Program Manager - Robert Jaques

Consultants

Martin Feeney
HydroMetrics – Georgina King and Derrik Williams (via telephone)
Todd Groundwater – Gus Yates (via telephone)

Others

California American Water – Eric Sabolsice and Nina Miller
George Riley
Coast Weekly – David Schmalz

The meeting was convened at 1:36 p.m. after a quorum had been established.

1. Public Comments

There were no public comments.

2. Administrative Matters:

A. Approve Minutes from the November 16, 2016 Meeting

Mr Jaques reported that Mr. Riedl had emailed him some requested revisions to the Draft Minutes from that meeting, and in response to Mr. Riedl's request he proposed adding the following wording to the language on page 5 of the Agenda packet: *"In response to a question by Mr. Riedl, it was reported that field blanks are not performed as part of the Sentinel Well sampling. They are typically done when analyzing for organic constituents, but not for inorganic constituents."*

On a motion by Mr. Lear, seconded by Mr. Ottmar, the minutes from this meeting were unanimously approved with the addition of this language.

B. Elect New Chairperson

Mr. Hulbert opened nominations for a new Chairperson, due to the fact that he is moving into the Engineering Department at Cal Am and will no longer be attending the TAC meetings. No

nominations were made, and no one volunteered to fill the position. Mr. Hulbert then nominated Ms. Nina Miller of Cal Am, who had said she would accept the position following today's meeting. On a motion by Mr. Ottmar, seconded by Mr. Lear, Ms. Miller was unanimously elected to the position of Chairperson.

C. Update on MRWPCA's Title 22 Engineering Report for the Pure Water Monterey Groundwater Replenishment Project

Mr. Jaques summarized the Agenda packet materials for this item.

Mr. Lear reported that he did not know why MPWMD's Salt and Nutrient Management Plan had not yet been approved by the RWQCB.

Mr. Hulbert asked that the Watermaster's comment letter to the RWQCB also request that all of the water quality constituents that are monitored for under the Watermaster's Monitoring Program be included as constituents to be monitored by the Pure Water Monterey Project.

On a motion by Ms. Voss, seconded by Mr. Ottmar, the TAC unanimously approved sending the comment letter to the RWQCB, including the revision requested by Mr. Hulbert.

D. Sustainable Groundwater Management Act (SGMA) Update

Mr. Jaques summarized the Agenda packet materials for this item. There was no discussion.

E. Progress Update on Salinas River Groundwater Basin Investigation Model TAC

Mr. Jaques summarized the Agenda packet materials for this item. There was no discussion.

F. Amendment No. 1 to RFS No. 2017-01 to Martin Feeney

Mr. Jaques summarized the Agenda packet materials for this item. On a motion by Ms. Williamson, seconded by Mr. Lear, the TAC unanimously approved Amendment No. 1 to RFS No. 2017-01 to Martin Feeney.

3. Results from Resampling Verification of Wells

Mr. Jaques introduced this agenda topic and Ms. King proceeded to make a presentation using the attached PowerPoint slides.

Mr. Feeney added that the 900 foot depth sample from Sentinel Well No. 4 is from the Santa Margarita formation, all the rest are from the Purisima formation. The Santa Margarita formation has higher native salinity and should be considered in reviewing results from this sample depth.

Mr. Williams commented that an increase of approximately 5 mg per liter per year in chloride is very small, but the level is rising so it would be good to keep a close eye on this.

Ms. Voss said she had concerns about how the Piper and Stiff diagrams are being interpreted. She went on to say that Figures 6 and 7 in the Technical Memorandum do not show lateral seawater intrusion. She felt that these do not indicate seawater intrusion is occurring, rather it is an indication of mixing or degradation of waters from other sources, but not lateral seawater intrusion. She felt that the July data was "a bad data point" and should not be used. Mr. Williams felt there was a need to find a better way to explain this in the Technical Memorandum.

Mr. Yates noted that the cations will have a buffering (slower) rate of change, whereas the anions may show changes sooner.

Mr. Hulbert suggested matching the Conclusions with the Recommendations. For example Conclusion

No. 4 uses the term "closely monitored" - does this mean to continue to monitor at the same two times per year rate, or more often? Also, Conclusion No. 7 indicates that further investigation "may be inconclusive". Recommendation No. 4 is to prepare a Work Plan, but the Work Plan should lead to conclusions, not inconclusive findings.

Mr. Williams commented that the data from Sentinel Well No. 4 is of concern, but is not alarming. He will revise the wording in this part of the Technical Memorandum.

Mr. Williams commented that if "Material Injury" is being caused by lowering water levels, we need to know the actual cause of the degrading water quality. He went on to say that this is important in order to develop protective groundwater levels to avoid degradation. Degradation caused by upwelling would probably require a lower groundwater elevation in order to provide protection, compared to degradation being caused by seawater intrusion.

Mr. Lear commented that with regard to seasonality and change in water levels, it might be desirable to deploy continuous monitoring salinity probes at the water quality sampling depths. Mr. Feeney noted that there are no probes currently commercially available that can be used that deep, due to the high pressures there. He also said that the range of accuracy is very poor at low TDS levels. Mr. Lear said he felt that this should be looked into further.

Ms. Voss felt it was important to verify that proper quality assurance and quality control measures are being carried out with regard to the samples that are taken. She also noted that the sampling device could be causing unrepresentative samples to be collected. She recommended pumping three casing volumes of water out of the casing before sampling. Mr. Feeney said there would be no place to dispose of that volume of water at these sites, and that therefore this was not feasible. He also commented that changing sampling methods would result in new and different artifacts.

Mr. Hulbert then opened the discussion to the public for comments.

Mr. Sabolsice said he had attended the November 2016 TAC meeting, and that the SIAR presentation by HydroMetrics at that meeting had indicated that seawater intrusion was likely occurring. He said this led to resampling to see if the July 2016 sample data was correct, and now this has been done. He noted that the term "Material Injury" had been mentioned several times by Ms. King and Mr. Williams during today's presentation. He said that using these terms is concerning to lay persons, and is causing people to believe that seawater intrusion is already occurring. He expressed concern that the consultants are making recommendations to the TAC based on data that are uncertain or incorrectly presented. If seawater intrusion occurs, it should be addressed immediately. However, reporting that seawater intrusion is occurring should not be done if that conclusion is not factually supported by the data.

Mr. Riley said he had only previously stated that there was data suggesting that seawater intrusion might be occurring, but not that seawater intrusion was actually occurring. He commented that the finding that current groundwater levels are the lowest in recorded history is a new finding, and should be reported.

Ms. King said fluctuations in groundwater levels and changes in water quality seem to be related. Ms. Voss asked what the relationship was. Ms. King responded that there was likely some hydrogeologic complexity that was in play but that it did seem there was a relationship between the two. However, given the data that had so far been analyzed using the methods outlined in the SIAR it is not possible to say for sure what that relationship is.

Mr. Hulbert requested that revisions to the Technical Memorandum be made based on today's

discussions.

Mr. Lear said that the differing data raises concerns, and that monitoring should be continued to see if this is ongoing, and that brainstorming should be done to find a way to determine the causes of the changes in water quality.

Mr. Feeney asked Mr. Lear if he was supportive of having full-depth conductivity measurements made at the next sampling event, and Mr. Lear said that he was.

Mr. Hulbert recommended trying to find a method of getting more representative samples, if possible.

Mr. Feeney expressed the opinion that the water quality changes being observed were due to upwelling, not down-flow, since the mid-level elevation conductivity values are not showing changes. Mr. Feeney also noted that doing full-depth conductivity testing next time will add some cost to be fieldwork.

Mr. Lear reasserted that this is not a declaration of seawater intrusion, it is a recommendation to investigate what is causing changes in water quality.

Mr. Jaques recommended the following course of action for consideration by the TAC:
Inform the Board that:

1. More work needs to be done to revise and clarify/refine the Technical Memorandum, so it will be clearer and more conclusive.
2. The Watermaster's consultants all agree that the data is not a clear indicator of seawater intrusion.
3. The groundwater quality fluctuations that are being observed can be caused by several things.
4. Sampling should be continued to determine if the fluctuations are an ongoing phenomena or something that is temporary in nature.
5. A work plan should be prepared to define an approach to determine the causes of the groundwater quality fluctuations.

On a motion by Ms. Voss, seconded by Mr. Lear, there was unanimous TAC concurrence with Mr. Jaques' recommendation.

4. Schedule

Mr. Jaques briefly reported on this Agenda item. There was no discussion.

5. Other Business

Mr. Jaques asked if the TAC felt it would be desirable to update the Basin Management Action Plan this year. Following a brief discussion it was agreed that this topic would be agendized for discussion at the next TAC meeting.

6. Set Next Meeting Date

The next regular meeting was set for Wednesday February 8, 2017 at 1:30 p.m. at the MRWPCA Board Room.

The meeting adjourned at 3:22 p.m.

Seaside Groundwater Basin Results of Water Quality Resampling in December 2016

Presented to the Seaside Basin Technical Advisory Committee
January 11, 2017

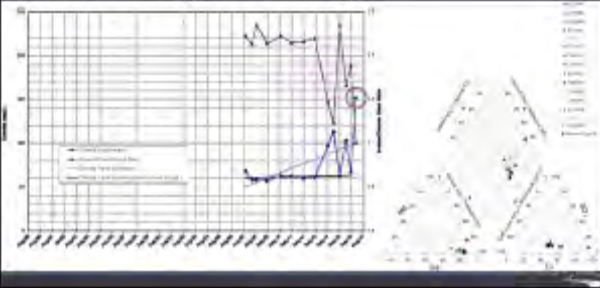
Background

- 2016 SIAR included results with elevated chlorides in samples taken in July 2016:
 - SBWM-2 at 1,470 ft depth
 - SBWM-4 at 900 ft depth
 - Ord Terrace Shallow

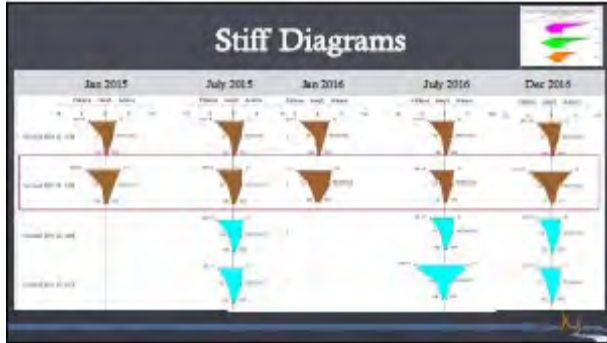


- Resampling took place in December 2016 (replaced Jan 2017 sampling)
 - Ord Terrace Shallow → Dec 5
 - SBWM-1, SBWM-2, SBWM-4 → Dec 14 (duplicate samples sent to Monterey Co. lab)

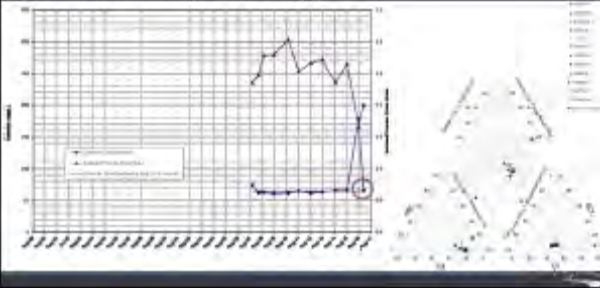
SBWM-1 at 1,390 foot depth



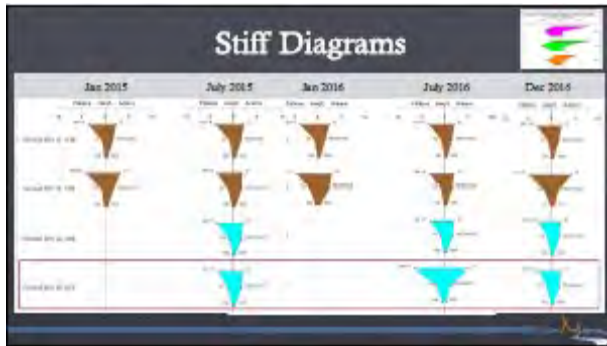
Stiff Diagrams



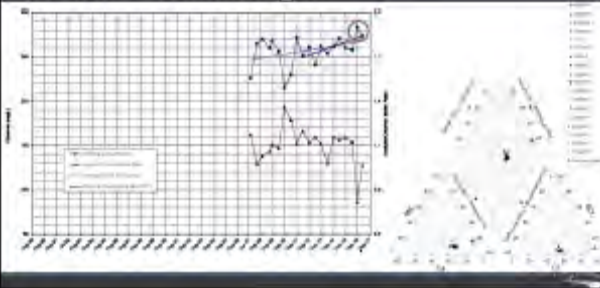
SBWM-2 at 1,470 ft depth



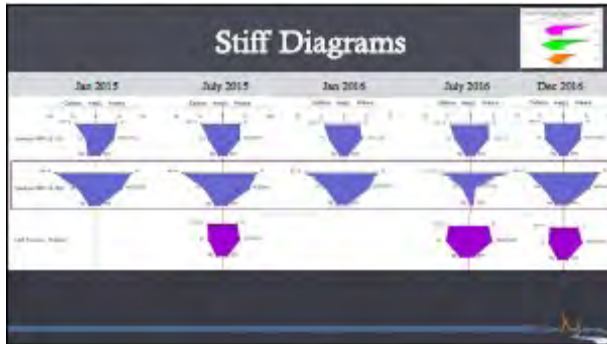
Stiff Diagrams



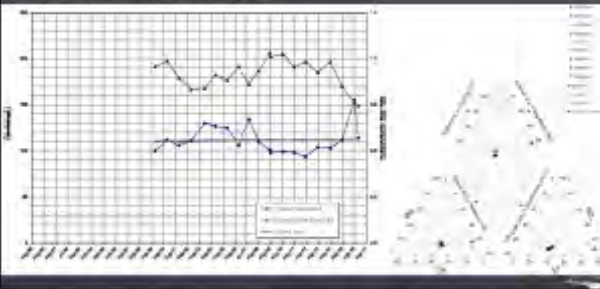
SBWM-4 at 900 ft depth



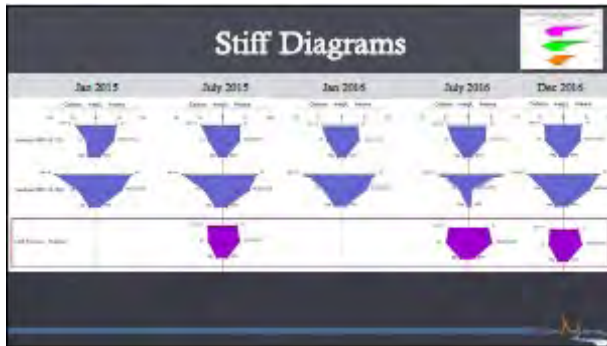
Stiff Diagrams

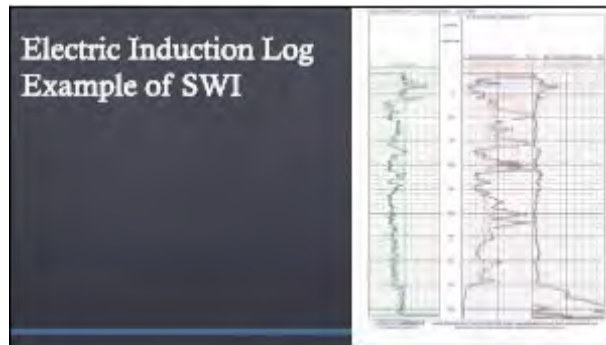
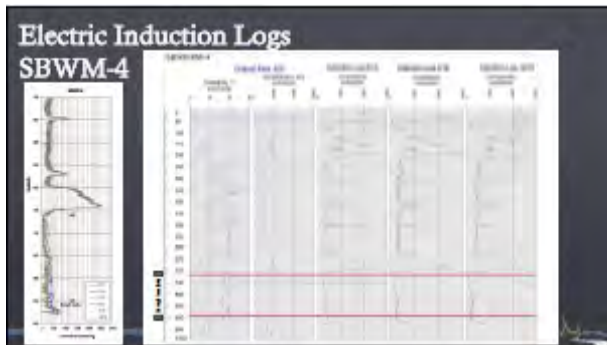
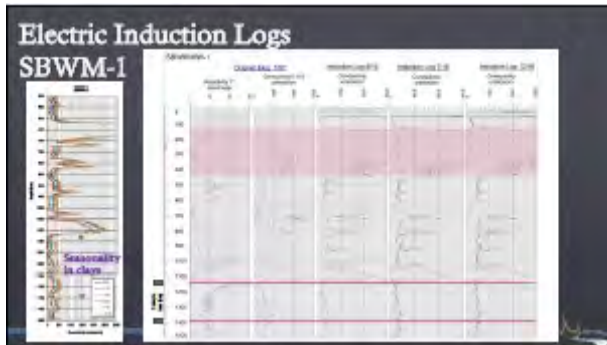


Ord Terrace Shallow



Stiff Diagrams





Trends and Fluctuations

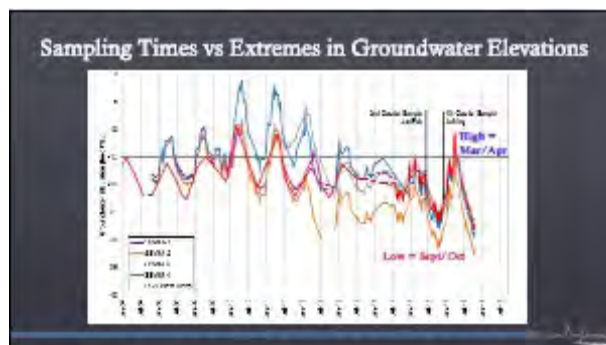
- As stated in the Seawater Intrusion Response Plan, at low salinity we do not expect to easily identify seawater intrusion trends
- We are starting to see fluctuations in SBWM-1 (1,390 ft)
- SBWM-4 (900 ft) has increasing trend, concentrations are approaching 300 mg/L
- Seawater intrusion should not be declared until there is a clear trend

Trends and Fluctuations

- Seasonal chloride concentrations may be tied to seasonal groundwater elevation fluctuations
- Likely results from a complex interplay of hydrogeologic structure and stratigraphy, pumping location, and seawater interface location
- Not enough data and types of analysis have been performed to understand what is causing seasonal fluctuations

Trends and Fluctuations

- Sources of saltwater intrusion other than seawater should be examined as possible causes of fluctuating chlorides:
 - Low groundwater levels causing compaction of clays which release higher salinity pore water
 - Low groundwater levels causing upwelling of saline water in the underlying Monterey Formation
- According to Decision, any degraded water quality is a material injury



Conclusions

- Wells SBWM-1 and SBWM-4 show fluctuating and slightly deteriorating groundwater quality. This is a cause for concern, but there is no definitive indication of seawater intrusion that requires immediate action
- Chloride levels in SBWM-1 (1,390 ft) increased in December 2016, but anions and cations distribution are not much different from previous years. Very slight increasing chloride trend
- Water quality at both SBWM-2 (1,470 ft) and SBWM-4 (900 ft) returned to anions/cation chemistry observed in previous years
- SBWM-4 (900 ft) has the highest coastal chloride concentrations and does appear to show an increasing chloride trend of about 5 mg/L per year. This needs to be closely monitored

Conclusions

- Monitoring well Ord Terrace Shallow chloride concentrations returned to historic values in December. Its anions and cations have never indicated seawater chemistry
- There could possibly be some seasonal effects on water quality in the deepest portions of the aquifer that cause increased chlorides in the summer samples. If this is true then we might start to see larger impacts in the fall (lowest gw levels) if groundwater levels continue to decline
- Sources of changing water quality in SBWM-1 and SBWM-4 are unclear at this point. Regardless of source, the changes likely result from chronically low groundwater levels

Recommendations

1. Continue to sample SBWM-1 and SBWM-4 twice a year
2. SBWM-2 should be resampled in July 2017 and based on the results evaluate whether to sample twice a year
3. For water quality samples to be more representative of extreme conditions in the basin, we recommend that samples in the future be collected in the last week of September for the 4th quarter and in the first week of March for the 2nd quarter samples
4. Prepare a work plan to identify source of chloride fluctuations. Plan will include additional data required and methods to analyze the data

Recommendations

5. Conduct downhole conductivity profile of well water during next sampling event. Might indicate if upwelling is occurring
6. A process has been implemented to review water quality results as soon as they are received. This will allow for action to take place immediately instead of at the end of the year when the data have historically been analyzed

Questions?

**SEASIDE BASIN WATER MASTER
TECHNICAL ADVISORY COMMITTEE**

*** * * AGENDA TRANSMITTAL FORM * * ***

MEETING DATE:	February 8, 2017
AGENDA ITEM:	2.B
AGENDA TITLE:	Sustainable Groundwater Management Act (SGMA) Update
PREPARED BY:	Robert Jaques, Technical Program Manager

At the State level:

I participated in the Webinar for adjudicated basins, hosted by DWR on January 24. Improvements to the data reporting portal on DWR's website were discussed, along with a number of other topics.

HydroMetrics will evaluate the change in storage within the Seaside Basin during WY 2016 and will provide its report on this to the Watermaster by March 1.

Staff will include that information, along with the other data that SGMA requires adjudicated basins to report to DWR, and will submit this data prior to the reporting deadline of March 31, 2017.

At the Monterey County level:

There are ongoing meetings and discussions at the County level and among cities in the Salinas Valley pertaining to the development of the JPA for the Salinas Valley Basin Groundwater Sustainability Agency.

ATTACHMENTS:	None
RECOMMENDED ACTION:	None required – information only

**SEASIDE BASIN WATER MASTER
TECHNICAL ADVISORY COMMITTEE**

*** * * AGENDA TRANSMITTAL FORM * * ***

MEETING DATE:	February 8, 2017
AGENDA ITEM:	2.C
AGENDA TITLE:	Progress Update on Salinas River Groundwater Basin Investigation Model TAC
PREPARED BY:	Robert Jaques, Technical Program Manager
<p>There have been no meetings of this TAC since the last Watermaster TAC meeting. The next meeting of that TAC is scheduled for March 14, 2017.</p>	
ATTACHMENTS:	None
RECOMMENDED ACTION:	None required – information only

**SEASIDE BASIN WATER MASTER
TECHNICAL ADVISORY COMMITTEE
* * * AGENDA TRANSMITTAL FORM * * ***

MEETING DATE:	February 8, 2017
AGENDA ITEM:	3
AGENDA TITLE:	Continued Discussion of Technical Memorandum Regarding Results from Resampling Verification of Wells
PREPARED BY:	Robert Jaques, Technical Program Manager
SUMMARY:	<p>At the January 11 TAC meeting there was initial discussion of HydroMetrics' January 5, 2017 Draft Technical Memorandum - <i>Seaside Groundwater Basin Analysis of Wells Sampled in December 2016</i>. There was agreement that further discussion and revisions to the Draft were in order and that the topic would be continued over for discussion at today's TAC meeting.</p> <p>Attached is a revised Final Draft version of the Technical Memorandum addressing the issues raised at the January 5 TAC meeting. At today's meeting the TAC is asked to either approve this as the Final version of the Technical Memorandum, or request final revisions to be made to it.</p> <p>Once the TAC is satisfied that the Technical Memorandum provides a clear and understandable presentation of the findings from the resampling of the Sentinel Wells, it will be presented to the Board at its March 1, 2017 meeting.</p>
ATTACHMENTS:	Revised Final Draft Technical Memorandum from HydroMetrics
RECOMMENDED ACTION:	Approve the Final Draft Technical Memorandum as-is, or request revisions to it

TECHNICAL MEMORANDUM

To: Bob Jaques, Seaside Watermaster Program Manager
From: Georgina King and Derrik Williams
Date: February 2, 2017
Subject: Seaside Groundwater Basin Analysis of Wells Sampled in December 2016

1. EXECUTIVE SUMMARY

Three sentinel wells and one monitoring wells were sampled in December 2016. Three of these wells (Sentinel Well #2 (SBWM-2) at the 1,470 foot depth, Sentinel Well #4 (SBWM-4) at the 900 foot depth, and Ord Terrace Shallow well) were being resampled to verify anomalous results from samples collected in July 2016. Sentinel Well #1 was included in the sampling event to complete the suite of wells that are normally sampled in January. The December sampling event effectively replaced the normal January event.

Of the seven groundwater quality samples analyzed, SBWM-1 (1,140 ft), SBWM-2 (1,000 ft), and SBWM-4 (715 ft) results were within the range of normal historical values. Results from samples with observed anomalies in either the July 2016 or December 2016 samples are summarized below.

- Well SBWM-1 (1,390 ft): Based on the well's piper diagram, and shape of its stiff diagram, the increased chloride concentration in December 2016 is not indicative of incipient seawater intrusion. This well has experienced fluctuating chloride concentrations since 2014 with higher chloride concentrations being observed in winter samples and lower concentrations in summer samples. Prior to 2014, its chloride concentrations were fairly stable. The induction log at the deeper depths of well SBWM-1 show no clear evidence of increased salinity over time.
- Well SBWM-2 (1,470 ft): The chloride concentration in December 2016 returned to within the range of historical concentrations. The well's piper and stiff diagrams both indicate that the anions and cations from the December 2016 sample returned to within their pre-July 2016 range. The high chlorides and

anomalous sodium/chloride ratios observed in the July, 2016 sample may have been due to seasonal fluctuations, similar to what is observed in well SBWM-1 (1,390 ft). The induction logs for this well shows increased conductivity in the July 2016 log at the 1,470 foot depth which corroborates the higher chloride concentration on that date and rules out sampling/laboratory error for this sample.

- Well SBWM-4 (900 ft): The chloride concentration in December 2016 is higher than historical concentrations, with the exception of the July 2016 sample. The well's piper and stiff diagrams show that its anions and cations have returned to within the range of pre-July 2016 conditions. The anomalous anion and cation distribution observed in July 2016 may have been due to seasonal fluctuations, similar to what is observed in well SBWM-1 (1,390 ft). This well has the highest chloride elevations of all the coastal monitoring wells and appears to have an increasing chloride trend. The electrical conductivity logs for this well are very similar over time, indicating there has been no major increase in salinity in the aquifer at the 900 foot depth
- Ord Terrace Shallow well chloride concentrations have declined to within the range of historical concentrations. Its piper and stiff diagrams, and inland location do not suggest a seawater source.

None of the samples definitively indicate incipient seawater intrusion. However, variations in groundwater quality from samples collected over the last year from wells SBWM-1 and SBWM-4 warrant increased vigilance regarding potential changes to the Basin's groundwater quality in the vicinity of the Sentinel Wells. There may be some seasonal changes in groundwater quality in the deepest portions of the aquifer that could be related to seasonal groundwater elevation changes. If this is true and groundwater elevations continue to decline, larger fluctuations might be seen in the fall when groundwater levels are at their lowest.

The sources of increasing and fluctuating chlorides in wells SBWM-1 and SBWM-4 are unclear. Potential sources may include natural groundwater quality variations, upwelling or upconing of saline water in wells in response to declining groundwater levels, seawater intrusion, or downward leakage of shallow, poor quality groundwater. Regardless of the source, the increasing and fluctuating chlorides likely result from chronically low groundwater levels.

Recommendations on future work and monitoring include:

1. Continue to sample SBWM-1 and SBWM-4 twice a year.
2. SBWM-2 should be resampled at the end of summer in 2017 and based on those results a decision should be made as to whether it should be sampled twice a year on an ongoing basis.
3. For groundwater quality samples to reflect the influence of fluctuating groundwater elevations, it is recommended that samples in the future be collected in the last week of September for the 4th quarter samples and in the first week of March for the 2nd quarter samples.
4. Prepare a work plan that will direct an effort towards identifying the source of fluctuating chloride concentrations. The work plan should outline the types of analyses and data to be used in identifying the chloride source. If the source of fluctuating chlorides is understood, it will help in developing management actions to prevent the higher concentrations increasing to the point that they cause groundwater degradation.
5. Conduct downhole conductivity profiles within each of the Sentinel Wells during the next sampling event. This tool measures the conductivity within the well, as opposed to induction logging which measures conductivity within the adjacent sediments. This technique may help identify if upwelling is occurring.
6. Continue the process that has recently been implemented to review water quality results as soon as they are received, rather than waiting until they are used to prepare the annual Seawater Intrusion Analysis Report. This will enable action to be taken, if appropriate, immediately instead of at the end of the year when the data have historically been analyzed.
7. Continue conducting all groundwater quality sampling and analysis conducted in accordance with standard quality assurance and quality control procedures.

2. BACKGROUND

The 2016 Seawater Intrusion Analysis Report (SIAR) reported on groundwater samples obtained during July 2016 that contained several anomalous chloride concentrations and other anion and cations concentrations. These anomalous results triggered resampling of those wells with the anomalies. The wells with the increased chlorides were:

- Sentinel Well #2 (SBWM-2) at the 1,470 ft depth,
- Sentinel Well #4 (SBWM-4) at the 900 ft depth, and
- Ord Terrace Shallow well.

The Technical Advisory Committee (TAC) approved the SIAR recommendation to resample those wells as soon as possible to verify the water quality. The Ord Terrace Shallow well was resampled on December 5, 2016 by Monterey Peninsula Water Management District; and the sentinel wells were resampled by Martin Feeney on December 14, 2016.

The December samples effectively replace the samples that were scheduled to be collected in January 2017. Samples were analyzed by Monterey Bay Analytical Services (MBAS), which is the laboratory that has historically analyzed the Seaside Basin groundwater samples. Duplicate samples of the sentinel wells were sent to the Monterey County laboratory for general minerals analysis. Samples were not collected for Sentinel Well 3 (SBWM-3) which is only sampled in July of each year. No duplicate samples for the Ord Terrace Shallow well were analyzed.

3. LABORATORY RESULTS

Table 1 summarizes the results obtained from both MBAS and Monterey County laboratories. The analyses in the following section of this memorandum are based on the MBAS results to maintain consistency with previous years' reports.

With one exception, the results from duplicate samples analyzed by Monterey County were close to those results from MBAS; and there were no results that would indicate MBAS laboratory error. Some differences in the cations and anions are to be expected, but overall the results were similar. The exception is the SBWM-1 (1,390 ft) duplicate sample from the Monterey County laboratory which has higher chloride, sodium, specific conductivity than the MBAS sample. The concentrations of these constituents collected at the well's 1,140 foot depth did not have as great a difference.

Table 1: Summary of Laboratory Results

Well	Constituent	MBAS Result	Monterey County Result	Units
SBWM 1 at 1,140 ft Sampled 12/14/2016	Calcium	12	9.1	mg/L
	Chloride	74	72	mg/L
	Fluoride	0.2	-	mg/L
	Hardness (as CaCO3)	34	-	mg/L
	Bicarbonate (as HCO3-)	89	-	mg/L
	Potassium	3.3	2.5	mg/L
	Langlier Index, 60°C	0.56	-	
	Magnesium	1.0	0.3	mg/L
	Manganese, Total	21	-	µg/L
	Sodium	73	80	mg/L
	Nitrate as NO3	ND	ND	mg/L
	pH (Laboratory)	8.5	7.9	pH (H)
	Specific Conductance (E.C)	457	443	µmhos/cm
	Total Diss. Solids	254	-	mg/L
	Sulfate	22	25	mg/L
	QC Anion-Cation Balance	-1	-	%
	QC Ratio TDS/SEC	0.56	-	
	o-Phosphate-P, Dissolved	ND	-	mg/L
	Langlier Index, 15°C	-0.04	-	
	Alkalinity, Total (as CaCO3)	73	75	mg/L
	Iron	1359	-	µg/L
	Nitrite as NO2-N	0.1	-	mg/L
	QC Anion Sum x 100	88%	-	%
	QC Cation Sum x 100	86%	-	%
	Hydroxide	ND	-	mg/L
	Carbonate as CaCO3	ND	-	mg/L
	Bromide	0.2	-	mg/L
	Barium, Total	26	-	µg/L
	Iron, Dissolved	ND	-	µg/L
	Manganese, Dissolved	ND	-	µg/L
Boron	0.09	-	mg/L	
Iodide	28	-	µg/L	

ND = Not Detected

Well	Constituent	MBAS Result	Monterey County Result	Units
SBWM 1 at 1,390 ft Sampled 12/14/2016	Calcium	29	27	mg/L
	Chloride	152	201	mg/L
	Fluoride	0.2	-	mg/L
	Hardness (as CaCO3)	81	-	mg/L
	Bicarbonate (as HCO3-)	83	-	mg/L
	Potassium	5.3	4.2	mg/L
	Langlier Index, 60°C	0.97	-	
	Magnesium	2.0	0.3	mg/L
	Manganese, Total	58		µg/L
	Sodium	109	149	mg/L
	Nitrate as NO3	ND	ND	mg/L
	pH (Laboratory)	8.6	7.6	pH (H)
	Specific Conductance (E.C)	706	889	µmhos/cm
	Total Diss. Solids	383	-	mg/L
	Sulfate	29	35	mg/L
	QC Anion-Cation Balance	2	-	%
	QC Ratio TDS/SEC	0.54	-	
	o-Phosphate-P, Dissolved	ND	-	mg/L
	Langlier Index, 15°C	0.38	-	
	Alkalinity, Total (as CaCO3)	68	74	mg/L
	Iron	6400	-	µg/L
	Nitrite as NO2-N	ND	-	mg/L
	QC Anion Sum x 100	89%	-	%
	QC Cation Sum x 100	92%	-	%
	Hydroxide	ND	-	mg/L
	Carbonate as CaCO3	ND	-	mg/L
	Bromide	0.4	-	mg/L
	Barium, Total	72	-	µg/L
	Iron, Dissolved	40	-	µg/L
	Manganese, Dissolved	ND	-	µg/L
Boron	0.09	-	mg/L	
Iodide	30	-	µg/L	

ND = Not Detected

Well	Constituent	MBAS Result	Monterey County Result	Units
SBWM 2 at 1,000 ft Sampled 12/14/2016	Calcium	16	14	mg/L
	Chloride	67	66	mg/L
	Fluoride	0.2	-	mg/L
	Hardness (as CaCO3)	48	-	mg/L
	Bicarbonate (as HCO3-)	99	-	mg/L
	Potassium	3.3	2.8	mg/L
	Langlier Index, 60°C	0.64	-	
	Magnesium	2.0	0.7	mg/L
	Manganese, Total	36	-	µg/L
	Sodium	61	69	mg/L
	Nitrate as NO3	ND	ND	mg/L
	pH (Laboratory)	8.4	8.2	pH (H)
	Specific Conductance (E.C)	432	417	µmhos/cm
	Total Diss. Solids	234	-	mg/L
	Sulfate	17	19	mg/L
	QC Anion-Cation Balance	-2	-2	%
	QC Ratio TDS/SEC	0.54	-	
	o-Phosphate-P, Dissolved	ND	-	mg/L
	Langlier Index, 15°C	0.04	-	
	Alkalinity, Total (as CaCO3)	81	86	mg/L
	Iron	6585	-	µg/L
	Nitrite as NO2-N	0.2	-	mg/L
	QC Anion Sum x 100	89%	-	%
	QC Cation Sum x 100	86%	-	%
	Hydroxide	ND	-	mg/L
	Carbonate as CaCO3	ND	-	mg/L
	Bromide	0.2	-	mg/L
	Barium, Total	40	-	µg/L
	Iron, Dissolved	34	-	µg/L
	Manganese, Dissolved	ND	-	µg/L
Boron	0.08	-	mg/L	
Iodide	32	-	µg/L	

ND = Not Detected

Well	Constituent	MBAS Result	Monterey County Result	Units
SBWM 2 at 1,470 ft Sampled 12/14/2016	Calcium	18	18	mg/L
	Chloride	66	65	mg/L
	Fluoride	0.2	-	mg/L
	Hardness (as CaCO3)	53	-	mg/L
	Bicarbonate (as HCO3-)	100	-	mg/L
	Potassium	3.4	3.0	mg/L
	Langlier Index, 60°C	0.69	-	
	Magnesium	2.0	1.0	mg/L
	Manganese, Total	47	-	µg/L
	Sodium	60	69	mg/L
	Nitrate as NO3	ND	ND	mg/L
	pH (Laboratory)	8.4	7.9	pH (H)
	Specific Conductance (E.C)	431	419	µmhos/cm
	Total Diss. Solids	234	-	mg/L
	Sulfate	18	18	mg/L
	QC Anion-Cation Balance	-2	1	%
	QC Ratio TDS/SEC	0.54	-	
	o-Phosphate-P, Dissolved	ND	-	mg/L
	Langlier Index, 15°C	0.10	-	
	Alkalinity, Total (as CaCO3)	82	89	mg/L
	Iron	5448	-	µg/L
	Nitrite as NO2-N	0.2	-	mg/L
	QC Anion Sum x 100	90%	-	%
	QC Cation Sum x 100	87%	-	%
	Hydroxide	ND	-	mg/L
	Carbonate as CaCO3	ND	-	mg/L
	Bromide	0.2	-	mg/L
	Barium, Total	50	-	µg/L
	Iron, Dissolved	77	-	µg/L
	Manganese, Dissolved	ND	-	µg/L
Boron	0.08	-	mg/L	
Iodide	34	-	µg/L	

ND = Not Detected

Well	Constituent	MBAS Result	Monterey County Result	Units
SBWM 4 at 715 ft Sampled 12/14/2016	Calcium	78	69	mg/L
	Chloride	139	135	mg/L
	Fluoride	0.2	-	mg/L
	Hardness (as CaCO3)	232	-	mg/L
	Bicarbonate (as HCO3-)	224	-	mg/L
	Potassium	8.5	7.5	mg/L
	Langlier Index, 60°C	0.62	-	
	Magnesium	9.0	9.4	mg/L
	Manganese, Total	133	-	µg/L
	Sodium	91	103	mg/L
	Nitrate as NO3	ND	ND	mg/L
	pH (Laboratory)	7.4	7.5	pH (H)
	Specific Conductance (E.C)	866	866	µmhos/cm
	Total Diss. Solids	503	-	mg/L
	Sulfate	37	36	mg/L
	QC Anion-Cation Balance	3	2	%
	QC Ratio TDS/SEC	0.58	-	
	o-Phosphate-P, Dissolved	ND	-	mg/L
	Langlier Index, 15°C	0.02	-	
	Alkalinity, Total (as CaCO3)	184	195	mg/L
	Iron	12,985	-	µg/L
	Nitrite as NO2-N	0.2	-	mg/L
	QC Anion Sum x 100	97%	-	%
	QC Cation Sum x 100	102%	-	%
	Hydroxide	ND	-	mg/L
	Carbonate as CaCO3	ND	-	mg/L
	Bromide	0.4	-	mg/L
	Barium, Total	133	-	µg/L
	Iron, Dissolved	29	-	µg/L
	Manganese, Dissolved	27	-	µg/L
Boron	0.10	-	mg/L	
Iodide	50	-	µg/L	

ND = Not Detected

Well	Constituent	MBAS Result	Monterey County Result	Units
SBWM 4 at 900 ft Sampled 12/14/2016	Calcium	86	83	mg/L
	Chloride	274	259	mg/L
	Fluoride	0.2	-	mg/L
	Hardness (as CaCO3)	297	-	mg/L
	Bicarbonate (as HCO3-)	340	-	mg/L
	Potassium	8.6	8.1	mg/L
	Langlier Index, 60°C	0.79	-	
	Magnesium	20	18	mg/L
	Manganese, Total	140	-	µg/L
	Sodium	172	189	mg/L
	Nitrate as NO3	ND	ND	mg/L
	pH (Laboratory)	7.4	7.6	pH (H)
	Specific Conductance (E.C)	1,427	1,430	µmhos/cm
	Total Diss. Solids	806	-	mg/L
	Sulfate	40	50	mg/L
	QC Anion-Cation Balance	-2	0	%
	QC Ratio TDS/SEC	0.56	-	
	o-Phosphate-P, Dissolved	ND	-	mg/L
	Langlier Index, 15°C	0.20	-	
	Alkalinity, Total (as CaCO3)	279	284	mg/L
	Iron	4215	-	µg/L
	Nitrite as NO2-N	0.2	-	mg/L
	QC Anion Sum x 100	99%	-	%
	QC Cation Sum x 100	96%	-	%
	Hydroxide	ND	-	mg/L
	Carbonate as CaCO3	ND	-	mg/L
	Bromide	0.8	-	mg/L
	Barium, Total	347	-	µg/L
	Iron, Dissolved	37	-	µg/L
	Manganese, Dissolved	72	-	µg/L
Boron	0.31	-	mg/L	
Iodide	65	-	µg/L	

ND = Not Detected

Well	Constituent	MBAS Result	Units
Ord Terrace Shallow Sampled 12/14/2016	Calcium	64	mg/L
	Chloride	114	mg/L
	Fluoride	0.2	mg/L
	Hardness (as CaCO ₃)	217	mg/L
	Bicarbonate (as HCO ₃ ⁻)	249	mg/L
	Potassium	3.7	mg/L
	Langlier Index, 60°C	--	
	Magnesium	14	mg/L
	Manganese, Total	87	µg/L
	Sodium	66	mg/L
	Nitrate as NO ₃	6	mg/L
	pH (Laboratory)	7.6	pH (H)
	Specific Conductance (E.C)	868	µmhos/cm
	Total Diss. Solids	506	mg/L
	Sulfate	43	mg/L
	QC Anion-Cation Balance	-6	%
	QC Ratio TDS/SEC	0.58	
	o-Phosphate-P, Dissolved	ND	mg/L
	Langlier Index, 15°C	--	
	Alkalinity, Total (as CaCO ₃)	204	mg/L
	Iron	106	µg/L
	Nitrite as NO ₂ -N	0.2	mg/L
	QC Anion Sum x 100	95%	%
	QC Cation Sum x 100	84%	%
	Hydroxide	--	mg/L
	Carbonate as CaCO ₃	ND	mg/L
	Bromide	0.3	mg/L
	Barium, Total	51	µg/L
	Iron, Dissolved	ND	µg/L
	Manganese, Dissolved	ND	µg/L
	Boron	0.07	mg/L

ND = Not Detected

4. WATER QUALITY ANALYSIS

The analyses used to examine the water quality data collected in December 2016 are the same as those used in the SIAR: chloride concentrations over time, sodium/chloride ratios, and piper and stiff diagrams.

Groundwater quality results for the following wells were within the range of normal historical values, and are therefore not discussed further in this memorandum:

- Well SBWM-1 (1,140 ft),
- Well SBWM-2 (1,000 ft), and
- Well SBWM-4 (715 ft).

The analysis in this memorandum focuses on those wells with observed anomalies in either the July 2016 or December 2016 samples:

- Well SBWM-1 (1,390 ft),
- Well SBWM-2 (1,470 ft),
- Well SBWM-4 (900 ft), and
- Ord Terrace Shallow.

4.1. Chloride Concentrations and Sodium/Chloride Ratios

Figures 1 through 4 update the chloride concentration and sodium/chloride ratio charts from the 2016 SIAR with the December 2016 sample results, and include chloride trend lines. In summary, the charts show:

- Well SBWM-1 (1,390 ft) had a 85 mg/L chloride increase since July 2016 and its overall chloride concentrations are increasing. The increasing chloride trend (grey trend line) observed in this well is more pronounced because of seasonal fluctuations where the winter concentrations tend to be higher than summer concentrations. There is a slight, but inconsequential, increasing trend if the high winter concentrations are excluded (> 70 mg/L, black trend line). The sodium/chloride ratio is well above the ratio of 0.86, below which other investigators have proposed as an indicator of seawater intrusion.
- Well SBWM-2 (1,470 ft) chloride concentrations declined in December to less than 70 mg/L, back to within the range of historical concentrations. The overall chloride trend is virtually flat if the July 2016 sample is excluded. The

sodium/chloride ratio is well above the ratio of 0.86, below which other investigators have proposed as an indicator of seawater intrusion.

- Well SBWM-4 (900 ft) chloride concentrations are slightly less than in July 2016 but still higher than historical values. The overall chloride trend at this depth in the well is increasing over the period of record and increasing at a higher rate since January 2012. The sodium/chloride ratio has increased from less than 0.86 in July 2016 to above 1 in December 2016.
- Ord Terrace Shallow well chloride concentrations have declined to 114 mg/L, which is within the range of historical concentrations. There is a very slight increasing chloride trend over the period of record. The sodium/chloride ratio is between 0.86 and 0.9.

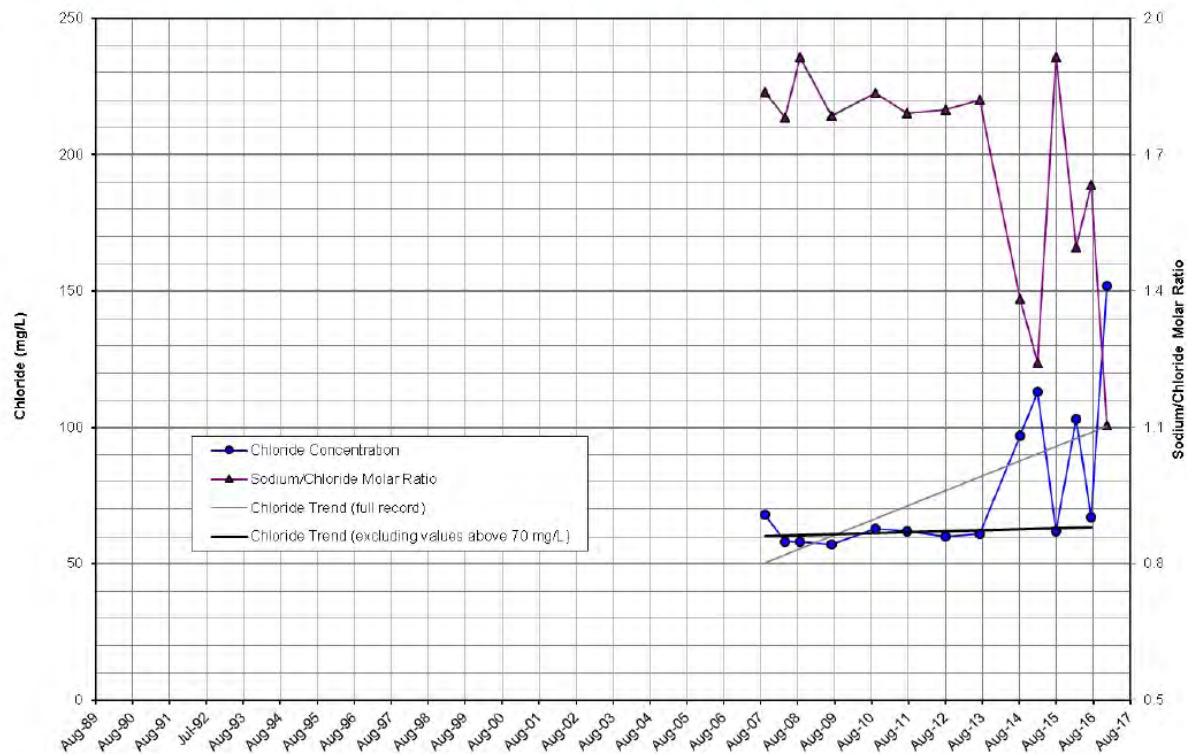


Figure 1: SBWM-1 (1,390 ft) Chloride Concentrations and Sodium/Chloride Ratios

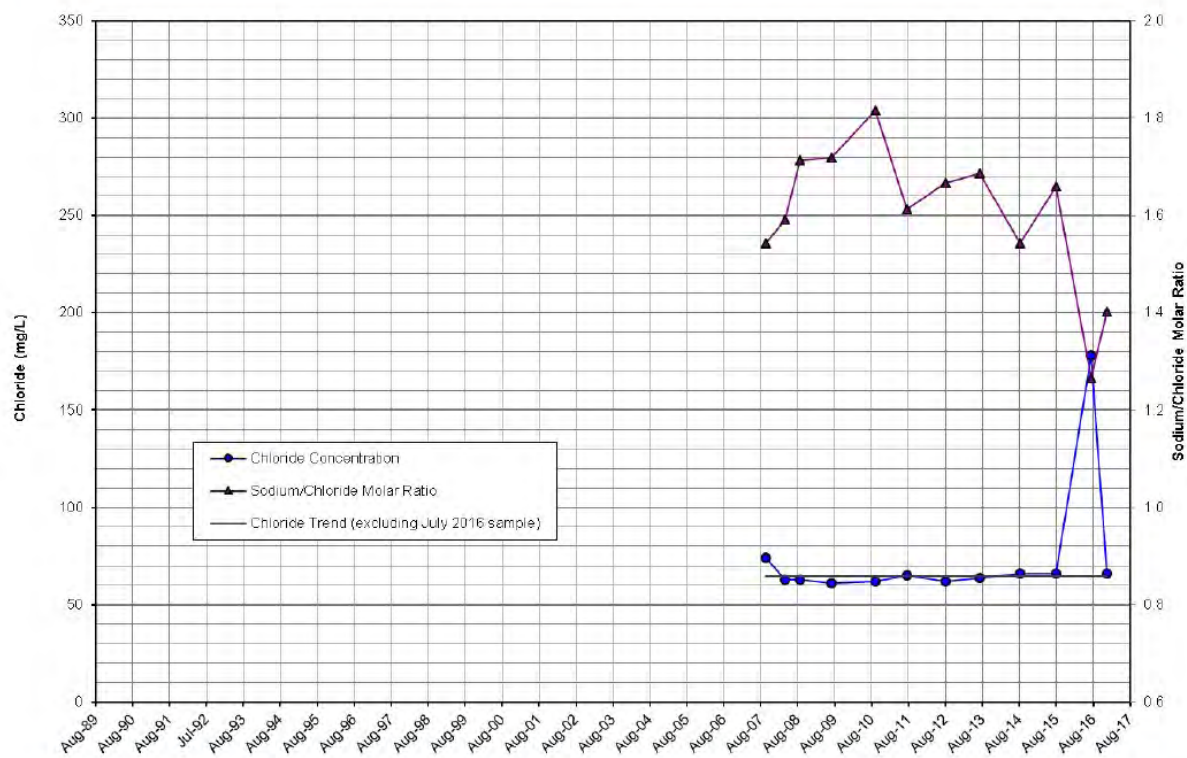


Figure 2: SBWM-2 (1,470 ft) Chloride Concentrations and Sodium/Chloride Ratios

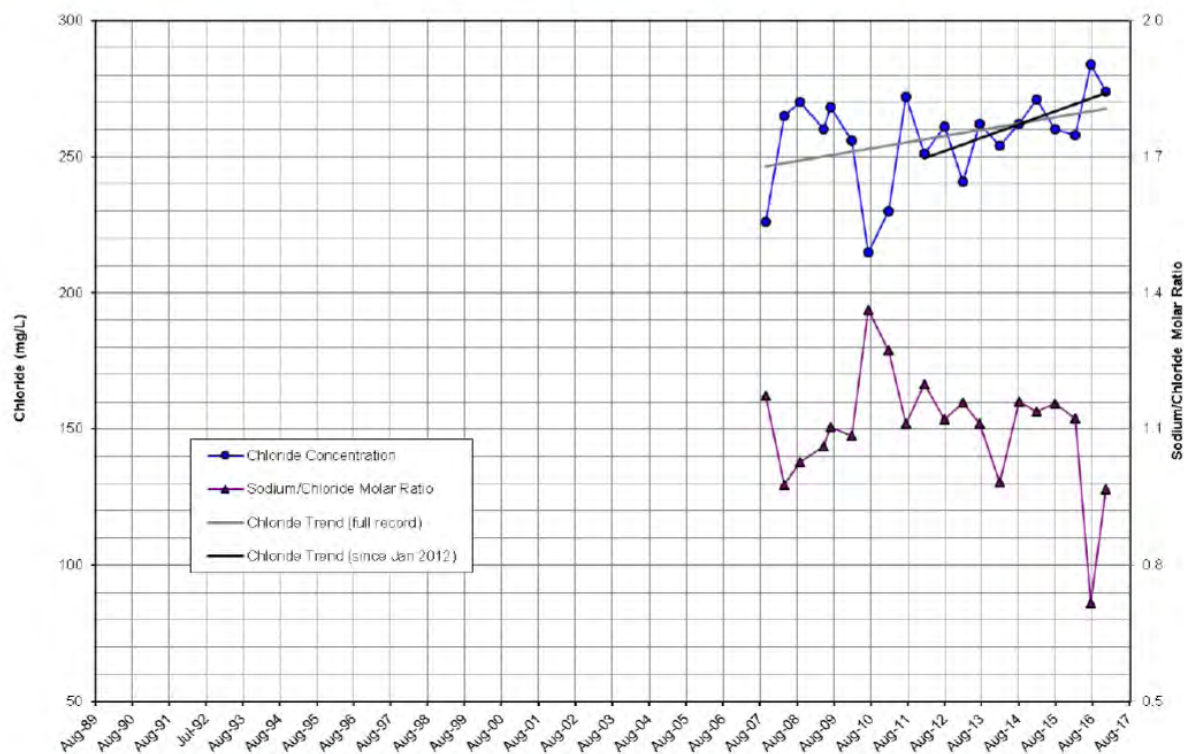


Figure 3: SBWM-4 (900 ft) Chloride Concentrations and Sodium/Chloride Ratios

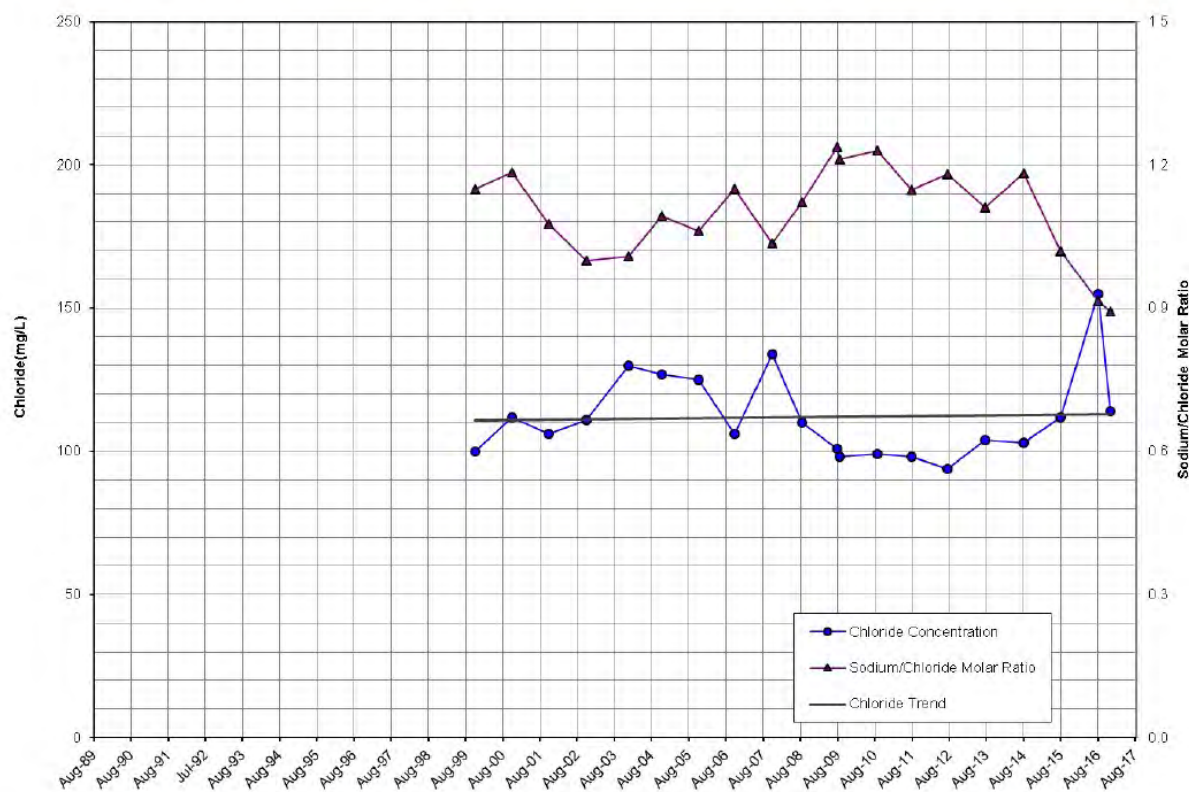


Figure 4: Ord Terrace Shallow Chloride Concentrations and Sodium/Chloride Ratios

4.2. Anion and Cation Analyses

4.2.1. Piper Diagrams

Piper diagrams for the four wells with anomalous data are shown on Figures 5 through 8. In summary the Piper diagrams show:

- Well SBWM-1 (1,390 ft)'s groundwater quality is generally of a sodium-chloride-bicarbonate type (Figure 5). The sample for December 2016, shown with the green solid triangle, has slightly increased calcium cations compared to the majority of the data points. Chloride anions increased such that the water type can be classified as more strongly sodium-chloride in character. The data points on the piper diagram show no consistent trend over time but rather appear to exhibit fluctuations.
- Well SBWM-2 (1,470 ft)'s groundwater quality is generally of a sodium-chloride-bicarbonate type (Figure 6). The sample for December 2016, shown with the green open triangle, plots within its historical cluster of data points. This is in contrast with the July 2016 sample, shown with the open circle, which had no apparent change in cations compared to historical values but a large increase in chloride anions with correspond decrease in bicarbonate anions. The data points on the piper diagram show no consistent trend over time but rather appear to exhibit fluctuations.
- Well SBWM-4 (900 ft)'s groundwater quality is generally of a sodium-chloride type (Figure 7). The sample for December 2016, shown with the green solid star, plots within its historical cluster of data points. This is in contrast with the July 2016 sample, shown with the open star symbol, which exhibits a more strongly sodium-chloride character than usual. The data points on the piper diagram show no consistent trend over time but rather appear to exhibit fluctuations.
- Ord Terrace Shallow well's groundwater quality is generally of a calcium-bicarbonate type (Figure 8). The sample for December 2016, shown with the green open triangle, plots within its historical cluster of data points. The data points on the piper diagram show no trend over time.

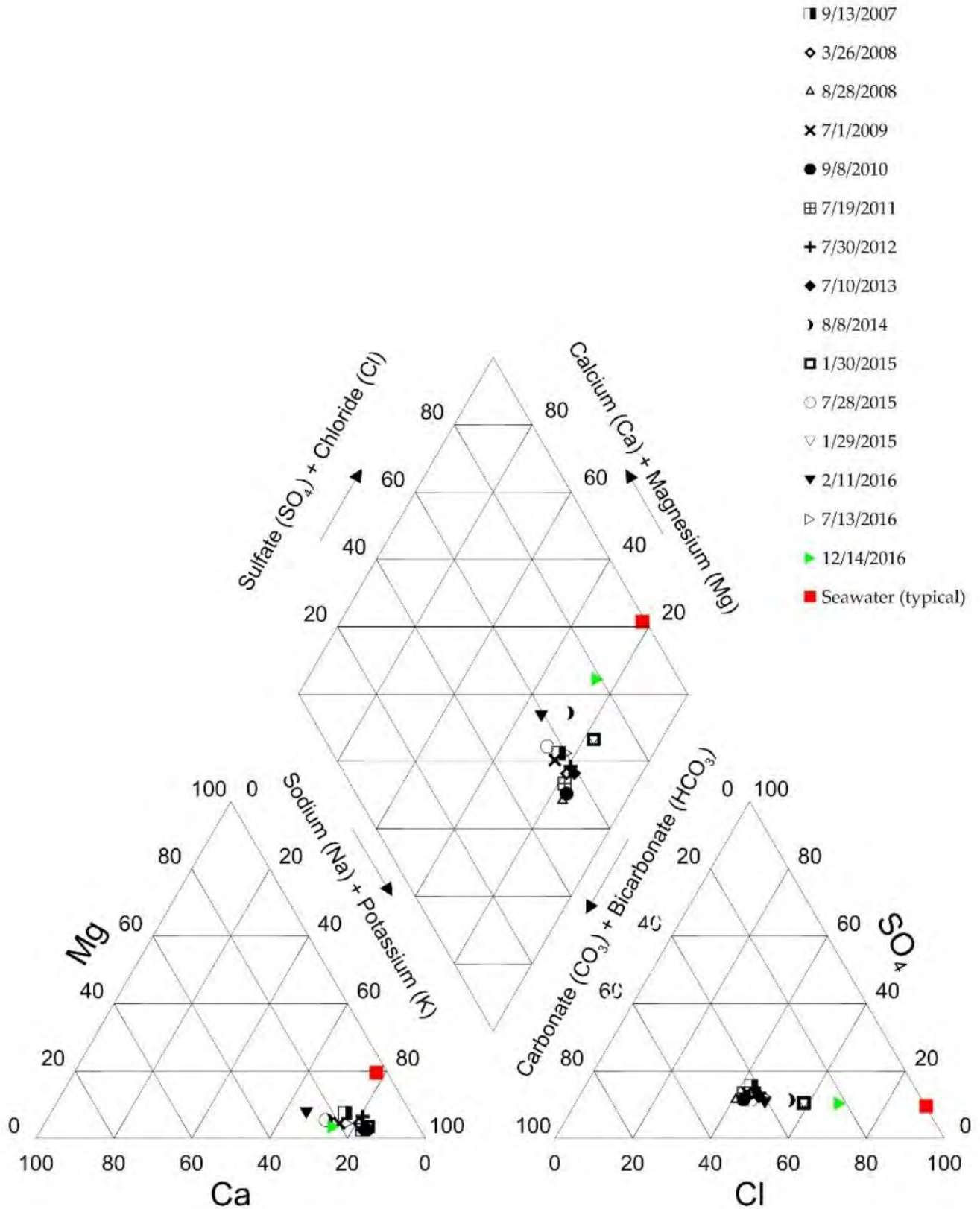


Figure 5: Piper Diagram for SBWM-1 (1,390 ft)

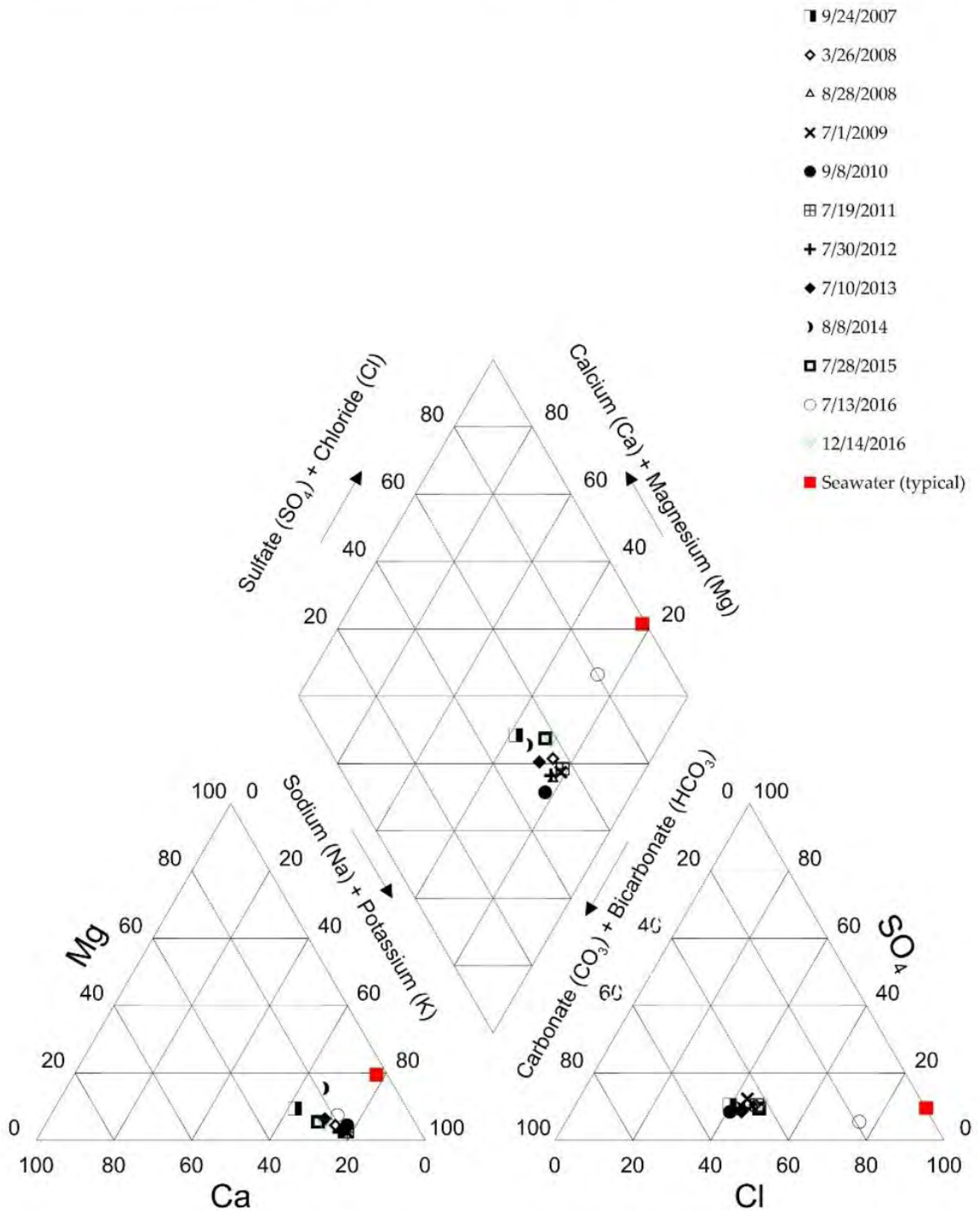


Figure 6: Piper Diagram for SBWM-2 (1,470 ft)

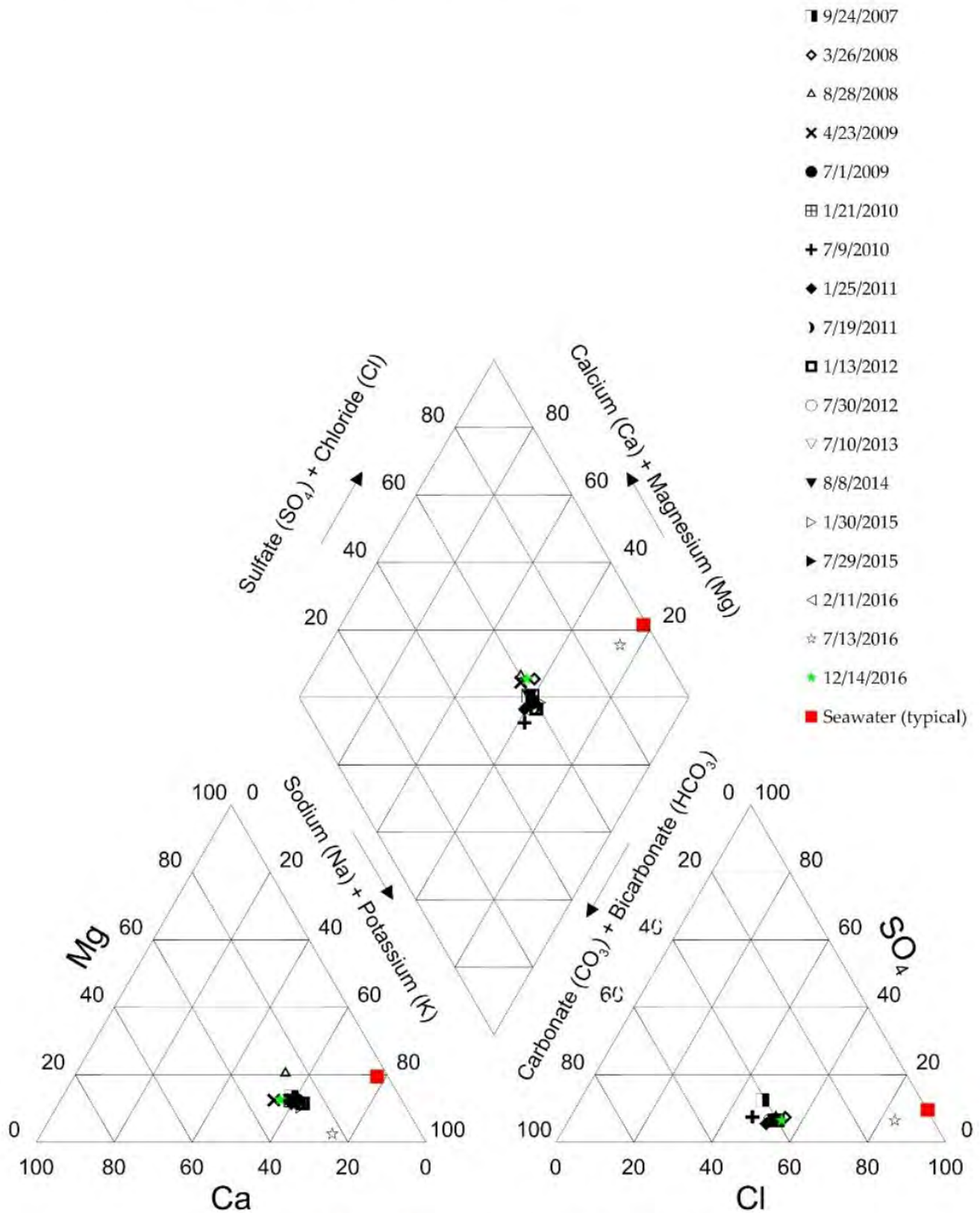


Figure 7: Piper Diagram for SBWM-4 (900 ft)

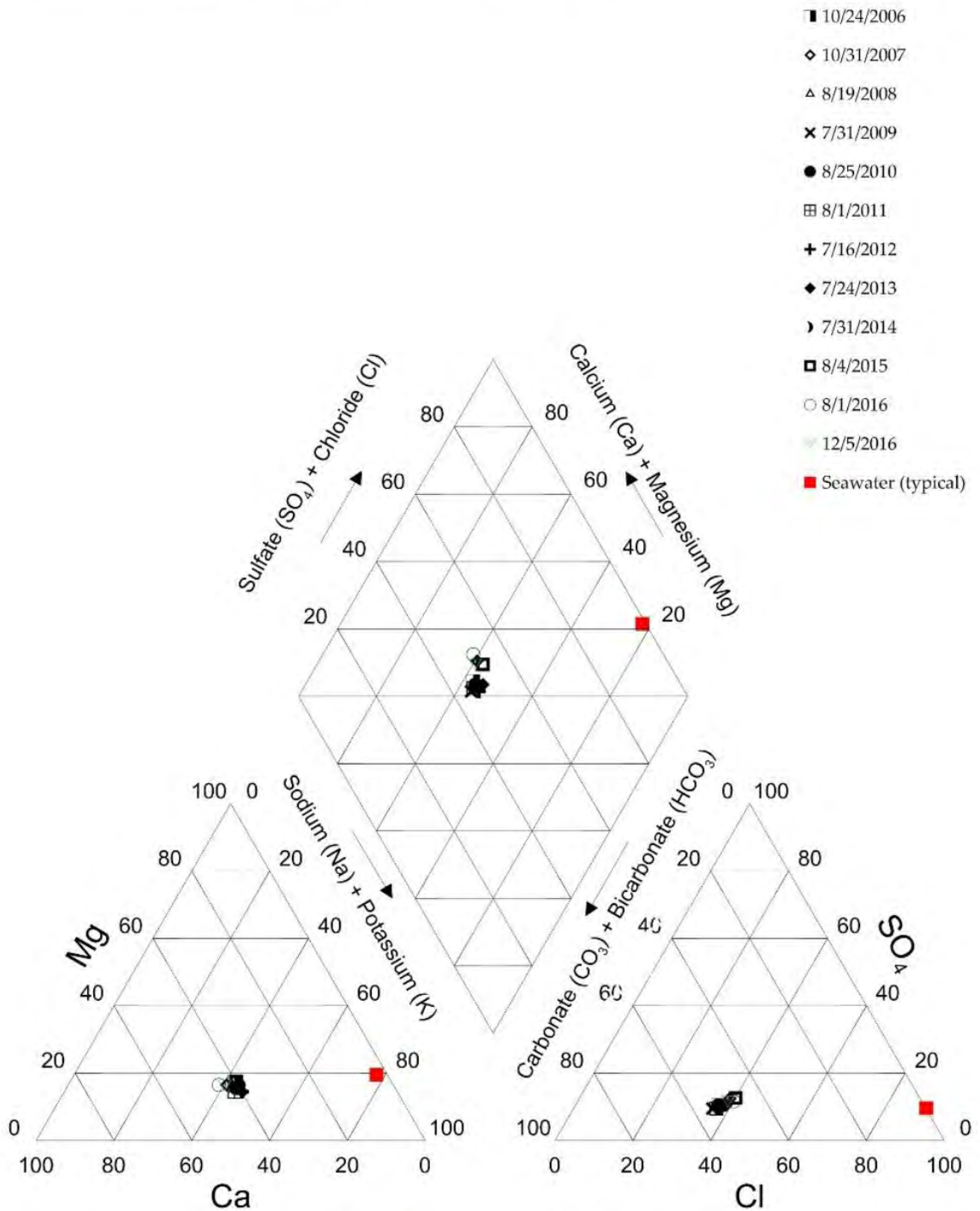


Figure 8: Piper Diagram for Ord Terrace Shallow

In the Pajaro Valley to the north, the evolution of groundwater quality y from fresh to seawater intruded followed the paths indicated with red arrows on the piper diagram shown on Figure 9. In the Pajaro Valley, unintruded groundwater was of a calcium-bicarbonate type. During the initial phase of seawater intrusion in the Pajaro Valley, the dominant chemical change in groundwater was an increase in chloride concentrations, as evidenced by the plotted samples moving up towards the peak of the diamond in Figure 9. The expected increase in sodium concentrations only occurs later, as evidenced by the later samples moving down and to the right of the diamond in Figure 9. Groundwater samples from the Pajaro Valley did not exhibit an immediate sodium increase during the initial phase of seawater intrusion because of an ion exchange reaction in which sodium in the groundwater replaces the calcium on the clays; effectively taking sodium out of the groundwater and replacing it with calcium.

The groundwater quality evolution shown Figure 9 is what we expect to see for any groundwater that is initially of a calcium-bicarbonate type. For wells starting off as a sodium-bicarbonate or sodium-chloride-bicarbonate water type, including wells SBWM-1, SBWM-2 and SBWM-4, it is unclear what the expected chemical evolution of groundwater will look like as seawater advances. To date, we have found no other examples of clearly documented seawater intrusion in these types of groundwater from which to examine whether calcium enrichment occurs or not in sodium-rich waters.

Sentinel Wells SBWM 1, 2 and 3 are completed in the Purisima Formation and have chloride concentrations that are typical of groundwater from that formation (Feeney, 2007). They also share a similar sodium-chloride-bicarbonate chemical character. Sentinel Well SBWM-4 is completed in the Santa Margarita Sandstone and has a different groundwater quality than the three sentinel wells completed in the Purisima Formation. Well SBWM4 has higher chloride concentrations and a stronger sodium-chloride character, which is consistent with wells completed in the Santa Margarita Sandstone (Feeney, 2007).

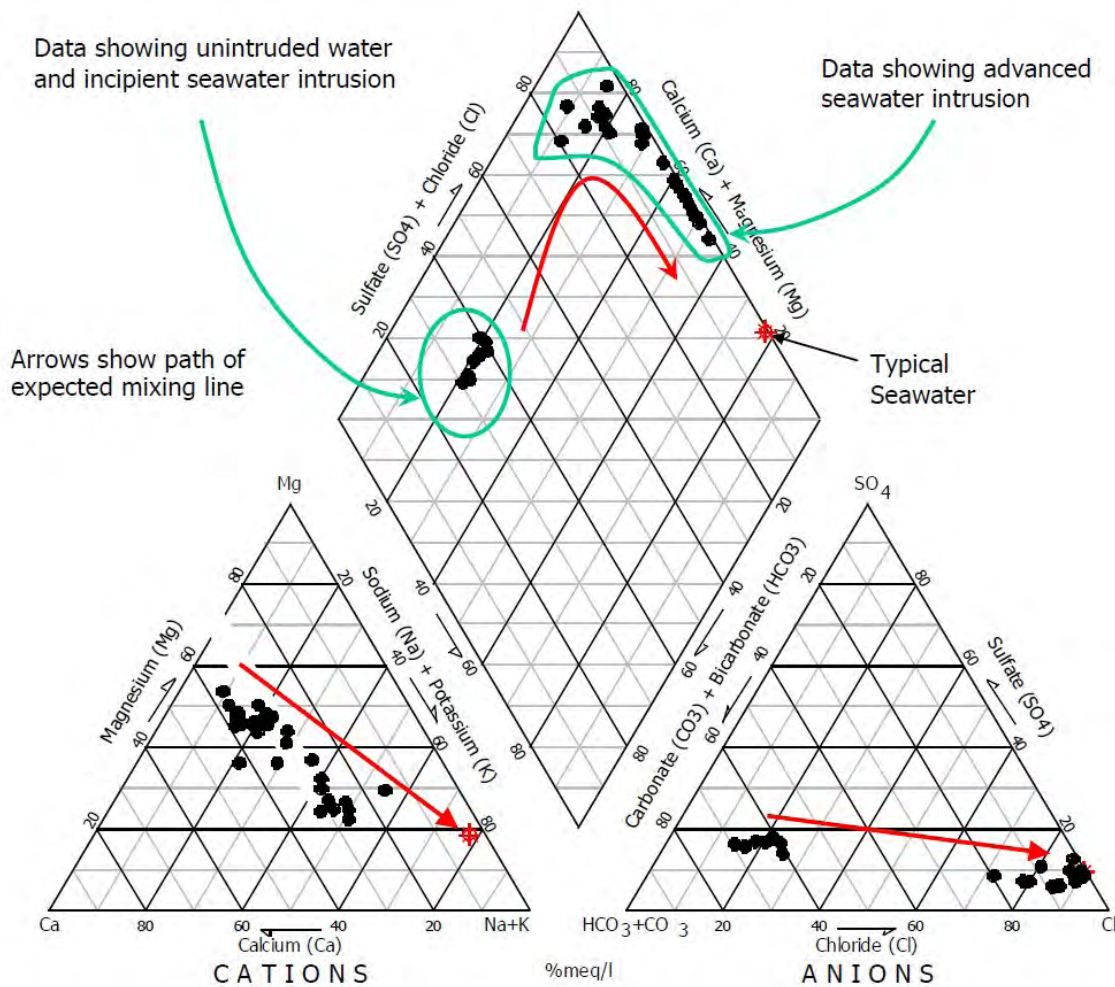


Figure 9: Piper Diagram for Groundwater in Pajaro Valley
 (Data source: PVWMA)

4.2.2. Stiff Diagrams

Stiff diagrams for SBWM-1 (1,470ft), SBWM-2 (1,390 ft), SBWM-4 (900 ft), and Ord Terrace Shallow are shown on Figures 10 and 11. Stiff diagrams for 2015 and 2016 are included to provide context, and show change over a two year period. All of the well's stiff diagrams for the December 2016 sample, except well SBWM-1 (1,390 ft)'s, are similar to historical diagrams before July 2016. Sentinel well SBWM-1 (1,390 ft)'s stiff diagram has a slightly different shape from previous years, but the shape of the stiff diagrams have varied over time for this well.

The stiff diagrams demonstrating what a seawater intruded sample might look like are provided on Figure 12. Comparing the stiff diagrams on Figure 10 and Figure 11 with Figure 12 reveals that none of the December sample's stiff diagrams are indicative of seawater intrusion, which is characterized on the stiff diagram as having calcium enrichment and a chloride spike. The stiff diagrams in Figure 12 came from locations where the native, unintruded groundwater was a calcium-bicarbonate type. It is unclear what the stiff diagrams of incipient seawater intrusion look like for areas where the native groundwater is of sodium-chloride or sodium-chloride-bicarbonate types.

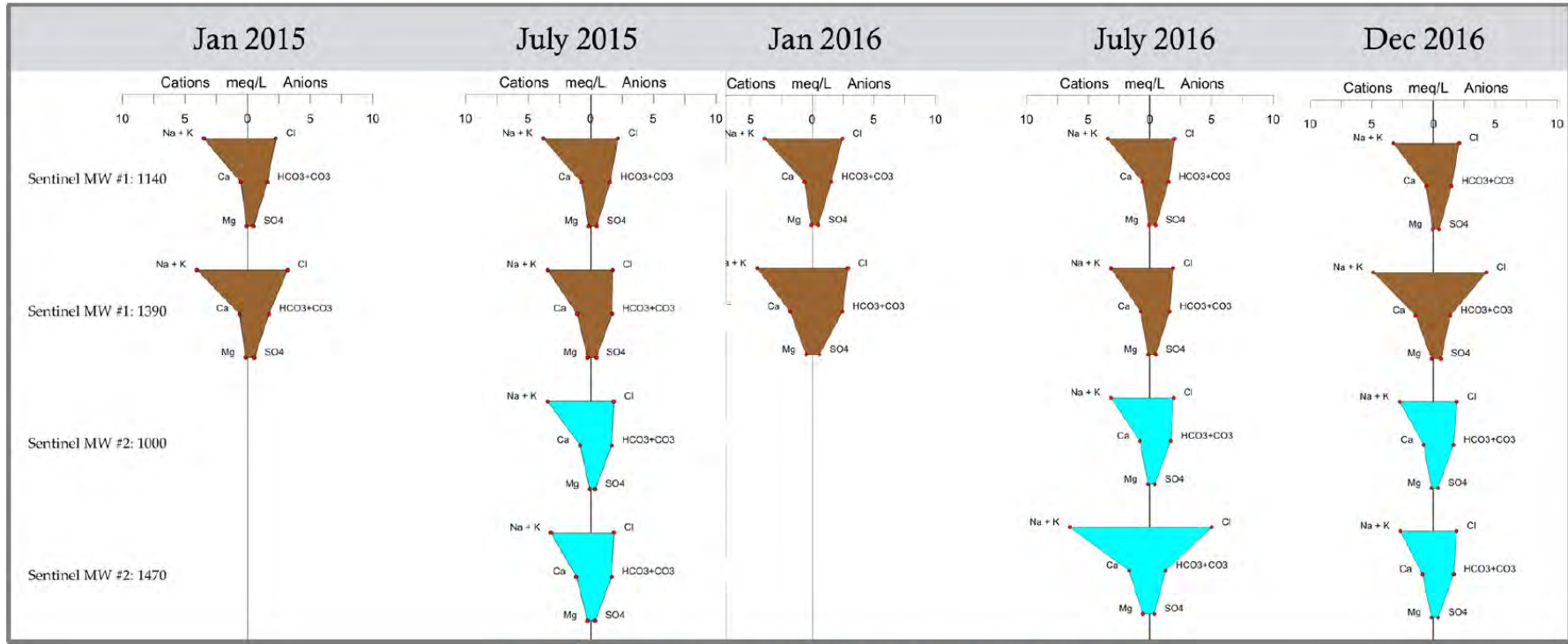


Figure 10: Stiff Diagram for SBWM-1 and SBWM-2

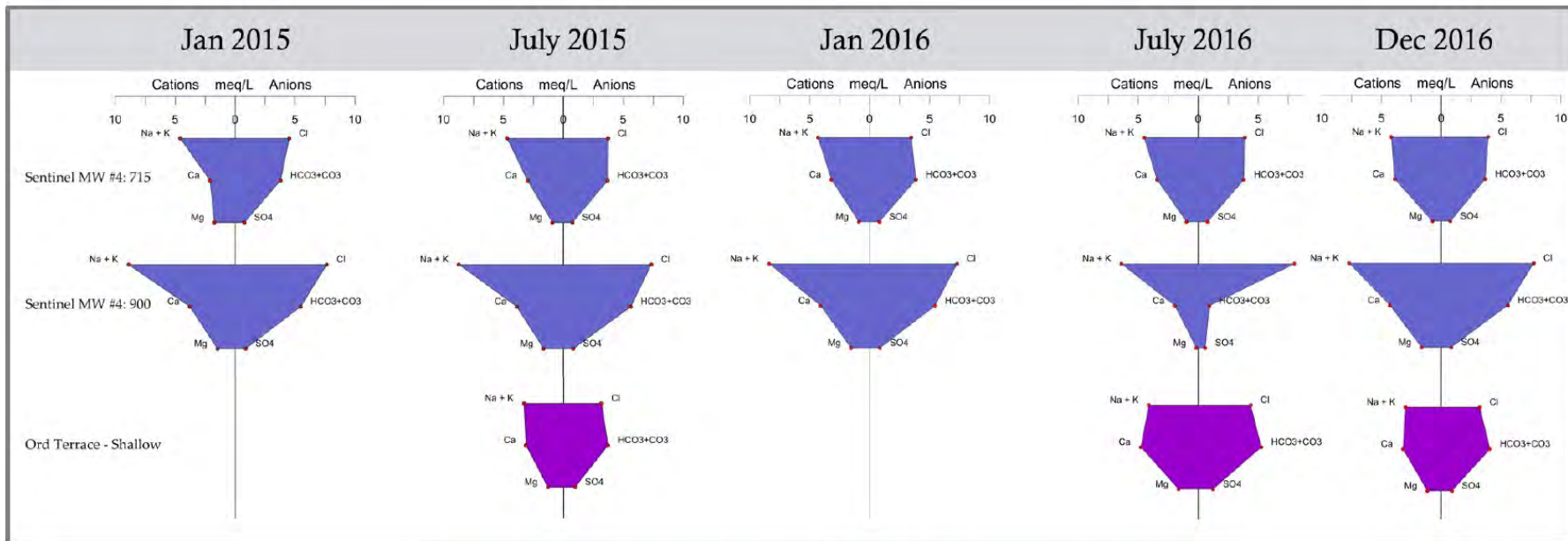


Figure 11: Stiff Diagram for SBWM-4 and Ord Terrace Shallow

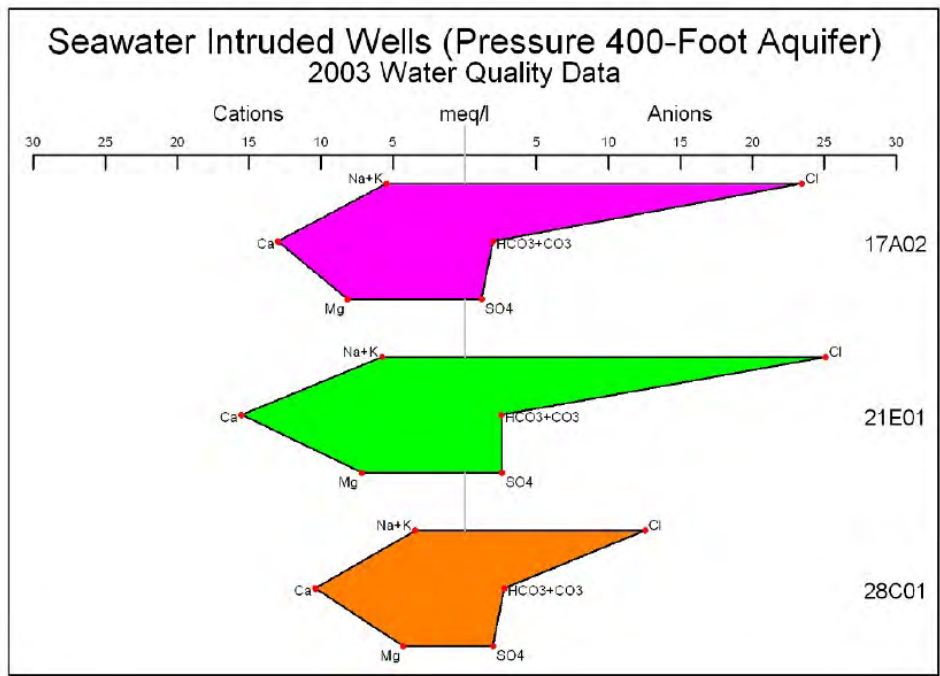


Figure 12: Stiff Diagrams from Salinas Valley Wells with Seawater Intrusion (Source: MWCRA)

5. DISCUSSION OF RESULTS

5.1. Well SBWM-1 (1,390 ft)

Based on the piper diagram (Figure 6), and shape of the stiff diagram (Figure 10), the increased chloride concentration in the December 2016 sample is not clearly indicative of incipient seawater intrusion. This well has experienced fluctuating chloride concentrations since 2014 (Figure 1) with higher chloride concentrations being observed in winter and lower concentrations in summer. Prior to 2014, its chloride concentrations were fairly stable. It is possible the observed chloride fluctuations are being controlled by seasonal groundwater fluctuations, and that may or may not be attributable to seawater intrusion. This is discussed in more detail in Section 5.5. However, the increasing trend of chloride and significant drop in sodium/chloride ratios that indicated seawater intrusion was occurring in the nearby Salinas and Pajaro valley are not apparent.

5.2. Well SBWM-2 (1,470 ft)

The December 2016 sample, the chloride concentration in SBWM-2 (1,470 ft) returned to within the range of historical concentrations of less than 70 mg/L, following a reading of over 150 mg/L in the July 2016 sample. The piper (Figure 6) and stiff diagrams (Figure 10) both indicate that the anions and cations from the December 2016 sample returned

to within their pre-July 2016 range. The high chlorides and anomalous sodium/chloride ratios observed in the July, 2016 sample may have been due to seasonal fluctuations, similar to what is observed in SBWM-1; or may have been the result of sampling/laboratory error. Continued monitoring of this well will determine whether seasonal fluctuations are responsible for the elevated chloride concentration observed in July 2016.

5.3. Well SBWM-4 (900 ft)

The 274 mg/L chloride concentration in SBWM-4 (900 ft) from December 2016 is above historical concentrations prior to July 2016 concentrations, but slightly lower than the July 2016 concentration of 284 mg/L (Figure 3). The piper (Figure 7) and stiff (Figure 11) diagrams for this well show that the anions and cations have returned to within the range of pre-July 2016 conditions. The anomalous anion and cation distribution observed in the July 2016 sample may have been due to seasonal fluctuations, similar to what is observed in well SBWM-1. This well has the highest chloride elevations of all the coastal monitoring wells and appears to have an increasing chloride trend (Figure 3).

5.4. Ord Terrace Shallow Well

The chloride concentration measured in the Ord Terrace Shallow well in December, 2016, returned to within its historical range of concentrations of less than 120 mg/L. In the 2016 SIAR, this well was ruled out as being potentially impacted by seawater because of its inland location, and because its piper and stiff diagrams did not indicate a seawater source of its anions and cations. The piper and stiff diagrams on Figure 7 and Figure 11, respectively, support this observation.

5.5. Trends and Fluctuations

The Seaside Basin Watermaster Seawater Intrusion Response Plan (SIRP) (HydroMetrics WRI, 2009) points out that:

Unusually high or steadily increasing chloride concentrations are 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. While chloride concentrations are strongly indicative of seawater intrusion, it often takes time for the increasing chloride trend to be recognizable due to the long-term and relatively slow increase in chlorides during seawater intrusion.

Most of the coastal wells have low chloride concentrations and trends are difficult to identify at those low concentrations because the trends can be masked by natural

variations in groundwater quality. However, we are starting to see an increasing trend in the well with the highest coastal chloride concentrations: SBWM-4.

The chloride fluctuations observed more recently in well SBWM-1 (1,390 ft) appear to be seasonal, with samples collected in January/February having higher concentrations than samples collected in July/August. It is apparent from groundwater level hydrographs of the coastal monitoring wells (An increasing chloride trend may underlie the seasonal fluctuations as evidenced by the slight increasing chloride trend even when the seasonal high concentrations are excluded from the trend line (Figure 1). If water quality is changing in response to seasonal groundwater elevation fluctuations, larger groundwater quality impacts may be seen in future fall months as groundwater levels continue to decline in the basin.

The types of analyses for the annual SIAR and this memorandum do not identify the source of the increased salinity or fluctuations. Potential sources of salinity may include natural groundwater quality variations, upwelling or upconing of saline water in wells in response to declining groundwater levels, seawater intrusion, or downward leakage of shallow, poor quality groundwater.

Figure 13) that the current sampling periods do not correspond with seasonal low and high groundwater levels. Both sampling periods occur midway between the seasonal fluctuation in groundwater levels that occurs in response to groundwater pumping. It may be possible to identify the relationship between chloride concentrations and seasonal changes in groundwater elevations if samples were collected when the extreme low and high groundwater levels were occurring. However, this relationship likely results from a complex interplay of hydrogeologic structure and stratigraphy, pumping location, and seawater interface location.

An increasing chloride trend may underlie the seasonal fluctuations as evidenced by the slight increasing chloride trend even when the seasonal high concentrations are excluded from the trend line (Figure 1). If water quality is changing in response to seasonal groundwater elevation fluctuations, larger groundwater quality impacts may be seen in future fall months as groundwater levels continue to decline in the basin.

The types of analyses for the annual SIAR and this memorandum do not identify the source of the increased salinity or fluctuations. Potential sources of salinity may include natural groundwater quality variations, upwelling or upconing of saline water in wells in response to declining groundwater levels, seawater intrusion, or downward leakage of shallow, poor quality groundwater.

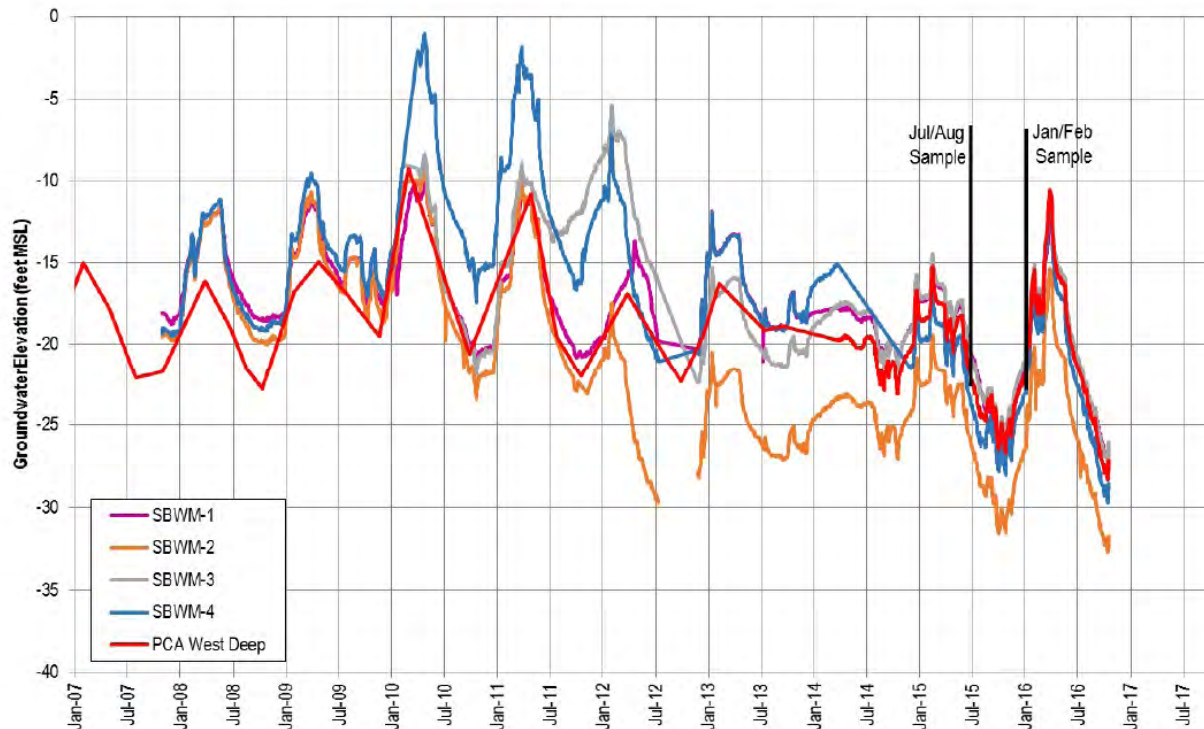


Figure 13: Hydrograph for Sentinel Wells and Monitoring Well PCA West Deep

In the Seaside Basin, declining groundwater levels may be causing upwelling of saline water from the Monterey Formation which underlies the Santa Margarita Formation. This saline water, known as connate water, is trapped in the sediment pore spaces at the time of deposition and is known to cause increased salinity. For example, groundwater in the Laguna Seca subarea is more saline than the rest of the Seaside Basin due to the Monterey Formation.

Poorer quality water from shallow depths, migrating down the outside of the well casing is not likely a source of higher chloride concentrations in the sentinel wells because they are constructed with concrete/bentonite seals in the annular space between the formation and well casing that extend from the surface to at least 620 feet down. Mixing of poorer quality water within the well is also not considered a source of higher chlorides. Each sentinel well is sampled at two different depths. The samples taken from shallower depths do not have the same high chloride concentrations as those taken from deeper depths; so there is no apparent water mixing within the well.

The source of fluctuating chloride concentrations at the deeper depths of the sentinel wells should be investigated so that management options to protect the basin can be appropriately developed. For example, managing salinity from upwelling may require lower protective groundwater elevations than incipient seawater intrusion will require.

6. ELECTRIC INDUCTION LOGGING

Induction logging measures the fluid conductivity up to a distance of three feet away from the well, within the formation adjacent to the well being logged. If conductivity increases relative to a baseline value over time, it indicates increased salinity. A 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 logs are run in the sentinel wells because they are deep wells screened at select depths. The induction logs provide qualitative salinity information throughout the entire well depth, including unscreened areas of the well. The groundwater grab samples taken within the screened intervals only provide groundwater quality at that particular screened depth.

Figure 14 through Figure 16 shows the initial induction logs for the entire length of wells SBWM-1, SBWM-2 and SBWM-4 when they were installed (blue), and for all induction logs run by Pacific Surveys since 2014. Welenco performed the logging between 2007 and 2013 but due to a different tool used by Pacific Survey, a new baseline was established in August 2014. To improve readability of the lower portion of the wells, Figure 17 and Figure 18 provide a zoomed in view with the logs overlain on one another.

The induction logs for well SBWM-1 shows there has been an increase in the shallow seawater intrusion zone above 450 feet depth since the well was constructed in 2007 (Figure 14). This intrusion was evident at the time SBWM-1 was constructed (HydroMetrics WRI, 2016). The deeper depths of well SBWM-1 show no clear evidence of increased salinity over time, although seasonal fluctuations are observed in the clays (zones with lower resistivity); summer conductivities (July 2015 and July 2016) plot close together and the conductivities in winter are more varied (Figure 17).

The induction logs for well SBWM-2 shows that there has been an increase in the shallow seawater intrusion zone above 300 feet depth since the well was constructed in 2007 (Figure 15). The logs show seasonal fluctuations in the clays (zones with lower resistivity), with similar conductivities in January 2015 and February 2016, and increased conductivities in summer (August 2014, July 2015 and July 2016) (Figure 17). At a depth of 1,470 feet within the screened sandy part of the aquifer (higher resistivity), the July 2016 conductivity is higher than all previous conductivities, except the initial log in 2007 (Figure 17). This might corroborate the higher chloride concentration observed in the July 2016 sample and rule out sampling/laboratory error for this sample.

At the 900 foot depth in well SBWM-4, it is difficult to see changes in conductivity because most of the logs plot too close together (Figure 18). These similar conductivities indicate that there has been no major increase in salinity at this depth. The seasonal fluctuations observed in SBWM-1 and SBWM-2 are not obvious in this well.

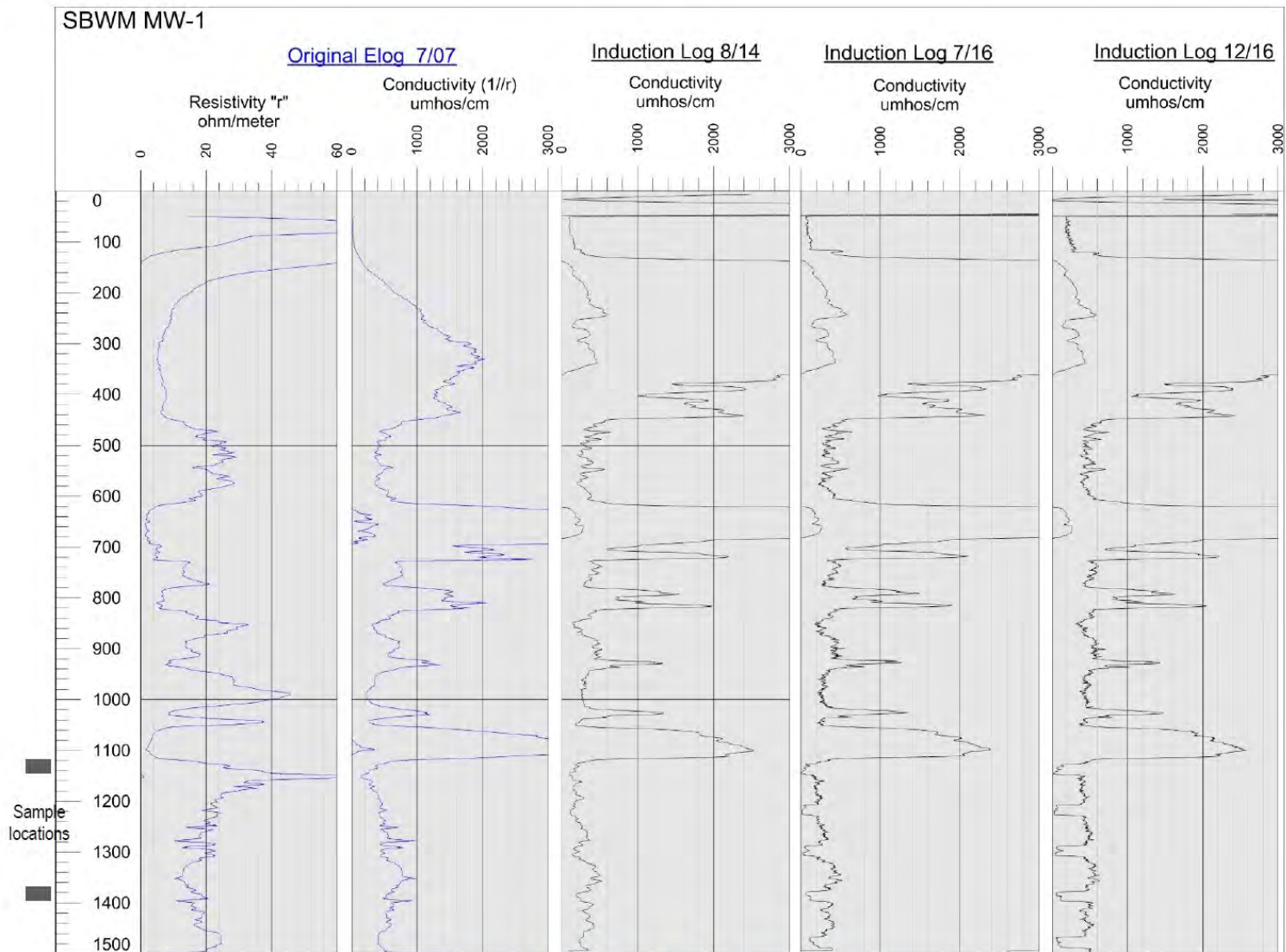


Figure 14: Sentinel Well 1 Induction Logs

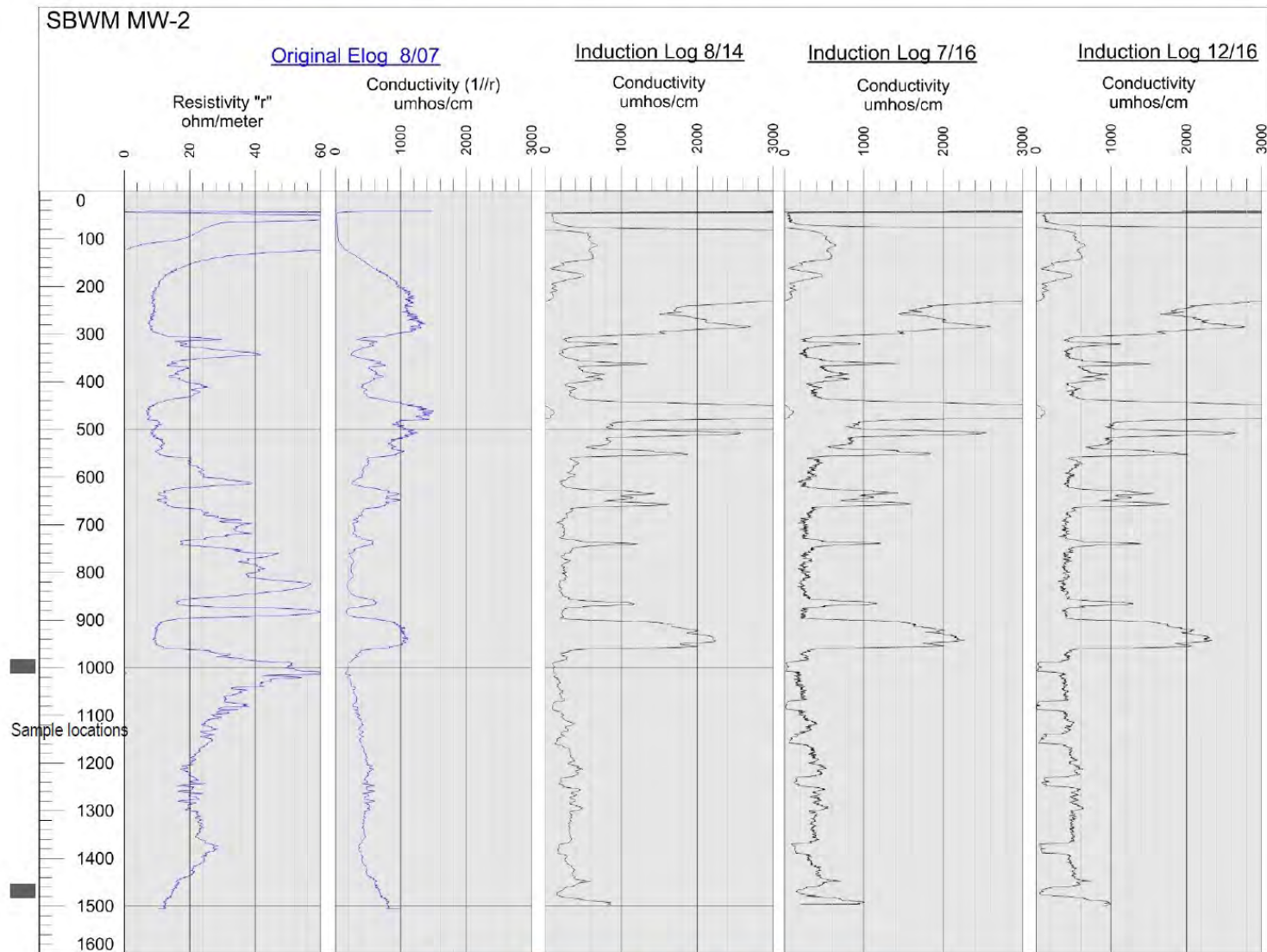


Figure 15: Sentinel Well 2 Induction Logs

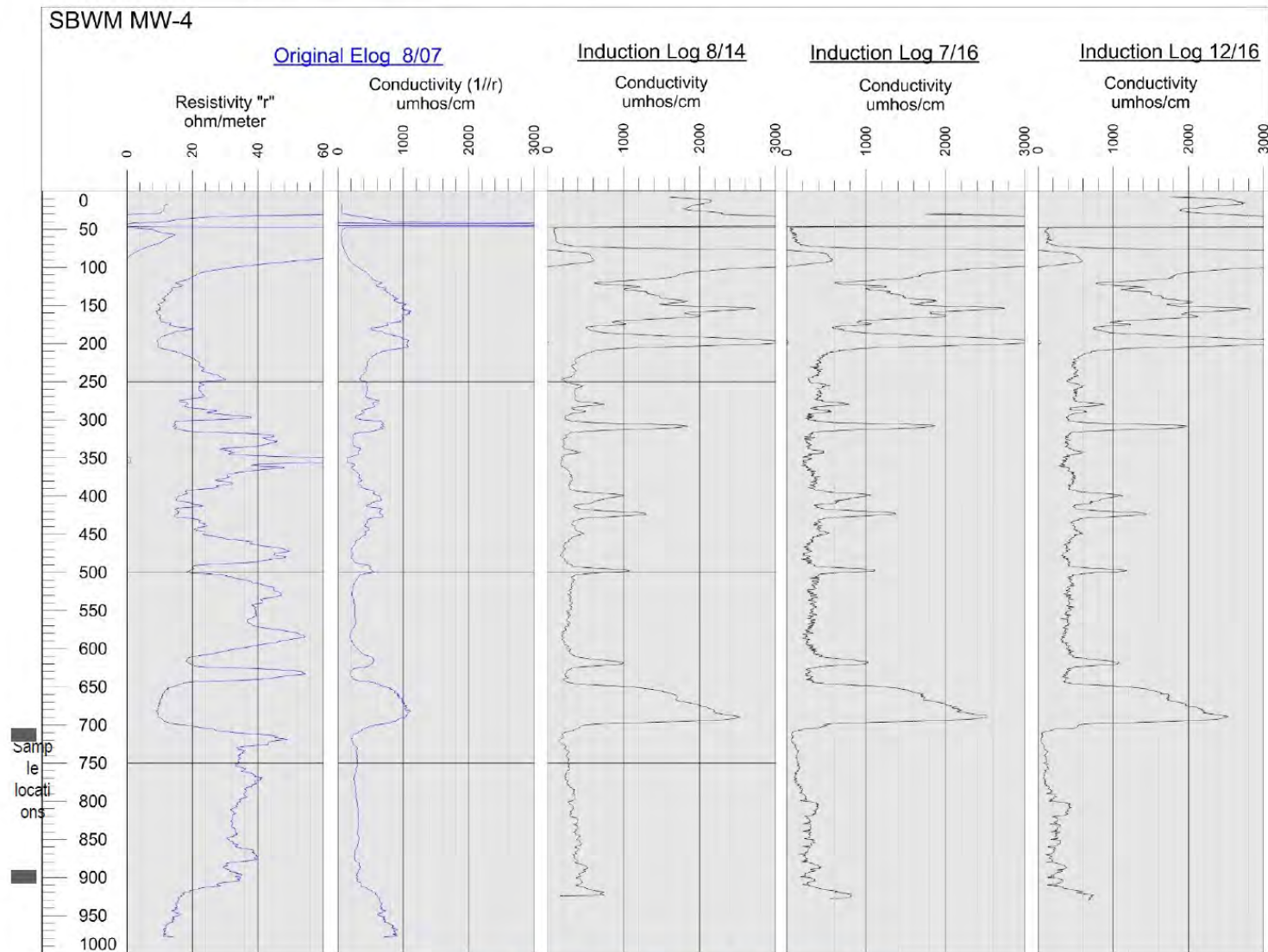


Figure 16: Sentinel Well 4 Induction Logs

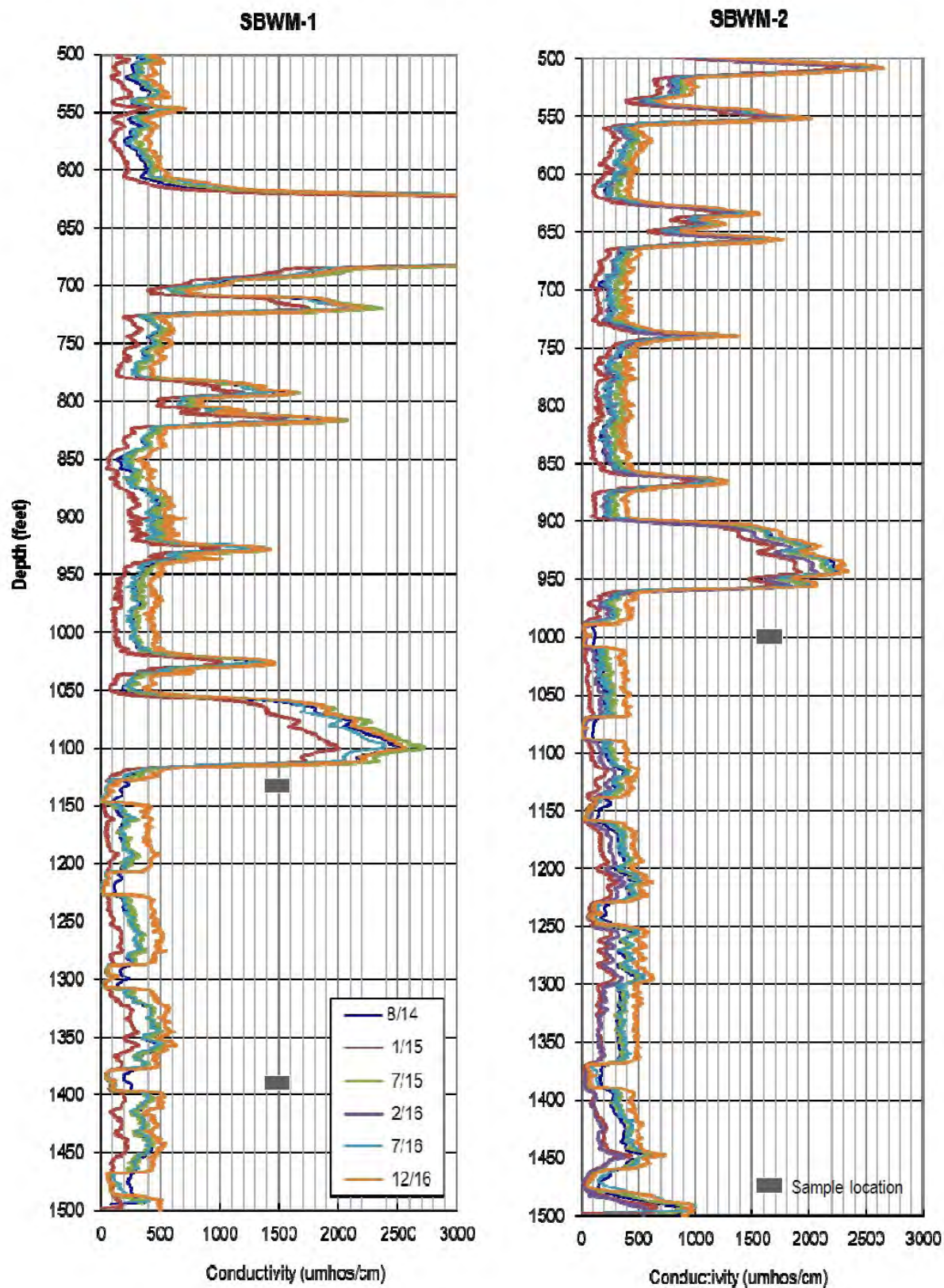


Figure 17: Induction Logs of Lowest 500 feet of Sentinel Wells 1 and 2

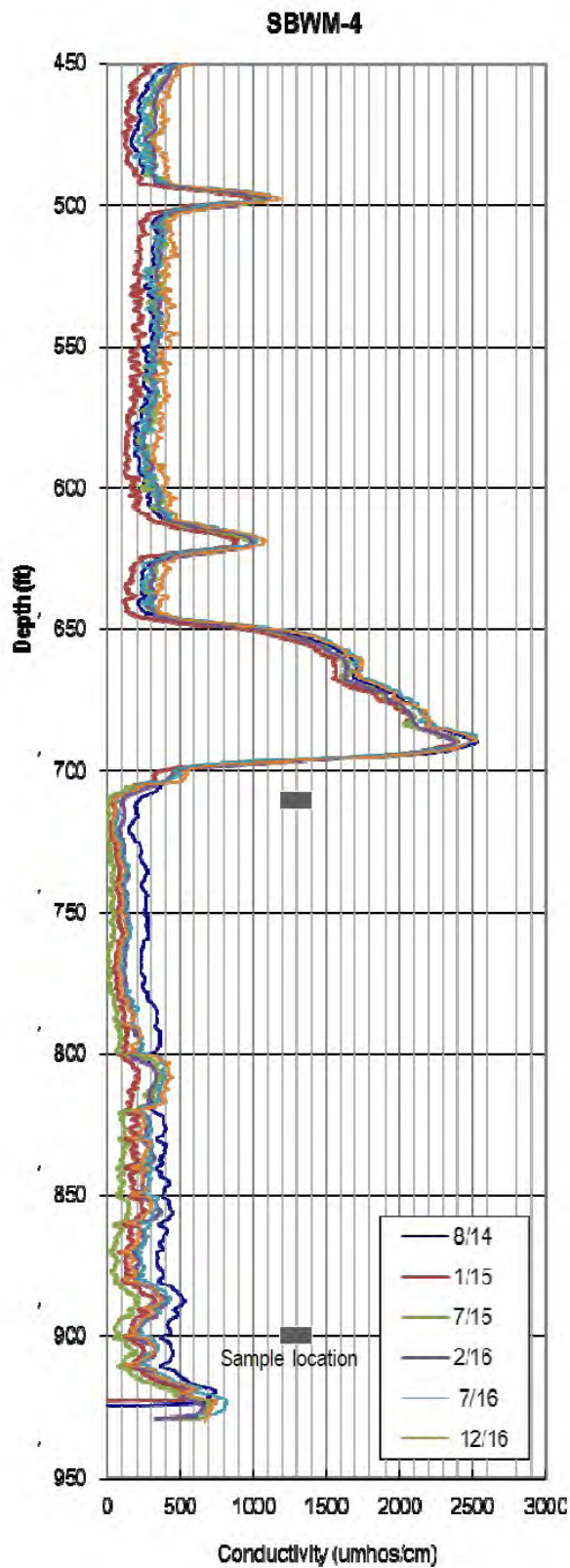


Figure 18: Induction Logs of Lowest 500 feet of Sentinel Well 4

7. CONCLUSIONS

1. None of the samples definitively indicate incipient seawater intrusion. However, variations in groundwater quality from samples collected over the last year from wells SBWM-1 and SBWM-4 warrant increased vigilance regarding potential changes to the Basin's groundwater quality in the vicinity of these Sentinel Wells.
2. Chloride concentrations at well SBWM-1 (1,390 ft) increased in December 2016 but the stiff diagram does not indicate that the anions and cations are much different from previous years. There is a very slight increasing chloride trend in this well.
3. Water quality at both well SBWM-2 (1,470 ft) and well SBWM-4 (900 ft) returned to within the range of historical groundwater quality observed in previous years.
4. Sentinel well SBWM- 4 (900 ft) has the highest coastal chloride concentrations and does appear to show an increasing chloride trend of approximately 5 mg/L per year since 2012. Although, this rate of increase is not significant, any increasing trend should continue to be monitored.
5. Monitoring well Ord Terrance Shallow chloride concentrations returned to the historic range. Its anions and cations both currently and historically do not indicate seawater chemistry.
6. There may be some seasonal changes in groundwater quality in the deepest portions of the aquifer that could be related to seasonal groundwater elevation changes. If this is true and groundwater elevations continue to decline, larger fluctuations might be seen in the fall when groundwater levels are at their lowest.
7. The sources of increasing and fluctuating chlorides in wells SBWM-1 and SBWM-4 are unclear. Further investigation may provide evidence for the chloride source. Regardless of the source, the increasing and fluctuating chlorides likely result from chronically low groundwater levels.
8. Poorer quality water from shallow depths, migrating down the outside of the well casing is not likely a source of higher chloride concentrations in the sentinel wells because they are constructed with deep concrete/bentonite seals. Mixing of poorer quality water within the well is also not considered a source of higher chlorides at the deeper sample depths of the sentinel wells because the samples taken above the deepest samples do not have the same higher chloride concentrations.
9. While there is no evidence that errors occurred in the July 2016 sampling event, errors in collection, labeling, handling, and/or laboratory analyses of water

quality samples is always a possibility in complex sampling events such as these. Consequently, the possibility of such errors cannot be ruled out. Resampling as soon as possible when anomalous results are obtained will verify such concentrations.

8. RECOMMENDATIONS

1. Continue to sample SBWM-1 and SBWM-4 twice a year.
2. SBWM-2 should be resampled at the end of summer in 2017 and based on those results a decision should be made as to whether it should be sampled twice a year on an ongoing basis.
3. For groundwater quality samples to reflect the influence of fluctuating groundwater elevations, it is recommended that samples in the future be collected in the last week of September for the 4th quarter samples and in the first week of March for the 2nd quarter samples.
4. Prepare a work plan that will direct an effort towards identifying the source of fluctuating chloride concentrations. The work plan should outline the types of analyses and data to be used in identifying the chloride source. If the source of fluctuating chlorides is understood, it will help in developing management actions to prevent the higher concentrations increasing to the point that they cause groundwater degradation.
5. Conduct downhole conductivity profiles within each of the Sentinel Wells during the next sampling event. This tool measures the conductivity within the well, as opposed to induction logging which measures conductivity within the adjacent sediments. This technique may help identify if upwelling is occurring.
6. Continue the process that has recently been implemented to review water quality results as soon as they are received, rather than waiting until they are used to prepare the annual Seawater Intrusion Analysis Report. This will enable action to be taken, if appropriate, immediately instead of at the end of the year when the data have historically been analyzed.
7. Continue conducting all groundwater quality sampling and analysis conducted in accordance with standard quality assurance and quality control procedures.

9. REFERENCES

- Feeney, M.B., 2007. *Seaside Groundwater Basin Watermaster - Seawater sentinel wells project, summary of operations*, prepared for the Seaside Groundwater Basin Watermaster, October 2007.
- HydroMetrics LLC, 2009. *Seawater intrusion response plan, Seaside basin, Monterey County, California*, prepared for the Seaside Groundwater Basin Watermaster, February 2009.
- HydroMetrics Water Resources Inc., 2014. *Water year 2016 seawater intrusion analysis report*, prepared for the Seaside Groundwater Basin Watermaster, December 2016.

**SEASIDE BASIN WATER MASTER
TECHNICAL ADVISORY COMMITTEE**

***** AGENDA TRANSMITTAL FORM *****

MEETING DATE:	February 8, 2017
AGENDA ITEM:	4
AGENDA TITLE:	Work Plan to Investigate Cause(s) of Changing Water Quality in Sentinel Wells and Approval to Authorize HydroMetrics to Perform the Initial Portions of the Work Plan
PREPARED BY:	Robert Jaques, Technical Program Manager
SUMMARY:	<p>One of the recommendations made by HydroMetrics in its Technical Memorandum - <i>Seaside Groundwater Basin Analysis of Wells Sampled in December 2016</i> (discussed in the preceding agenda item) is to prepare and implement a work plan to try to identify the source of fluctuating chloride concentrations in the Sentinel Wells.</p> <p>I asked HydroMetrics to prepare a draft work plan for this purpose. I reviewed a preliminary draft version of the work plan and provided my comments to HydroMetrics, who then revised the work plan to address those comments. The revised draft work plan was then sent to our other hydrogeologic consultants (Martin Feeney and Gus Yates) as well as to Tamara Voss of MCWRA for their review. Subsequently, a conference call was held on February 1, 2017 amongst all of these parties, including myself, to discuss the work plan and to solicit further input on it.</p> <p>Attached is the final version of the work plan reflecting the input from all of these parties. Included at the end of the work plan is a cost proposal from HydroMetrics to perform the initial portions of the work plan.</p> <p>At today's meeting the TAC can discuss the work plan and provide comments and/or suggested revisions to it, and to then approve the work plan so it can be presented to the Board.</p> <p>At today's meeting the TAC is also asked to approve authorizing HydroMetrics to implement the initial portions of the work plan, as described under the heading <i>Estimated Cost for Phase 1</i>, and the costs contained in Table 1 at the end of the work plan. If the TAC approves this authorization, a Request for Service (RFS) will be prepared for HydroMetrics to perform this work. The RFS will then be presented to the Board for their approval.</p>
ATTACHMENTS:	Proposed Work Plan and Cost Proposal to Investigate Sources of Fluctuating Chlorides in the Sentinel Wells
RECOMMENDED ACTION:	<ol style="list-style-type: none"> 1. Approve the proposed work plan as-is, or with revisions to it to address issues raised by the TAC 2. Approve authorizing HydroMetrics to implement the initial portions of the work plan in accordance with the cost proposal contained at the end of the work plan

Mr. Robert S. Jaques
Seaside Groundwater Basin Watermaster
83 Via Encanto
Monterey, CA 93940

February 2, 2017

Subject: Proposed Work Plan to Investigate Sources of Fluctuating Chlorides in the Sentinel Wells

Mr. Jaques:

This letter outlines a proposed Work Plan to investigate sources of fluctuating chloride in some of the Seaside Basin's coastal sentinel wells. Preparation of the Work Plan was approved at the Technical Advisory Committee's January 11, 2017 meeting.

The Work Plan objectives are:

1. Investigate the source(s) of elevated chlorides.
2. Determine the mechanism causing the chloride fluctuations observed in recent groundwater samples.

Objective 1 – Investigate the Source of Elevated Chlorides

No single water quality analysis, or ratio between water quality constituents, can definitively differentiate between potential sources of chloride. This is partially because the source of the elevated chlorides may be from similar sources, e.g. ocean water. Figure 1 shows a number of potential salinization mechanisms, with three mechanisms highlighted are potential mechanisms introducing higher chloride water to the groundwater basin. Upwelling is not shown on Figure 1. The source of any potential upwelling water is the underlying Monterey Shale, which is a marine sediment containing connate water (seawater trapped at the time of sedimentation) that reflects its marine origin. The differences in the water chemistry of the various sources reflect

the amount of time the saline water has been separated from the ocean, and the amount of time the saline water has interacted with sediments. The proposed analyses can assess whether the chlorides are from recent seawater, or seawater that has been in contact with sediments for an extended period of time. Seawater intrusion, however, could occur through sediments that have had seawater in them for an extended period of time (bottom arrow on Figure 1), and that are geochemically similar to connate water. For this reason, the analyses may not definitively identify the source of the chlorides.

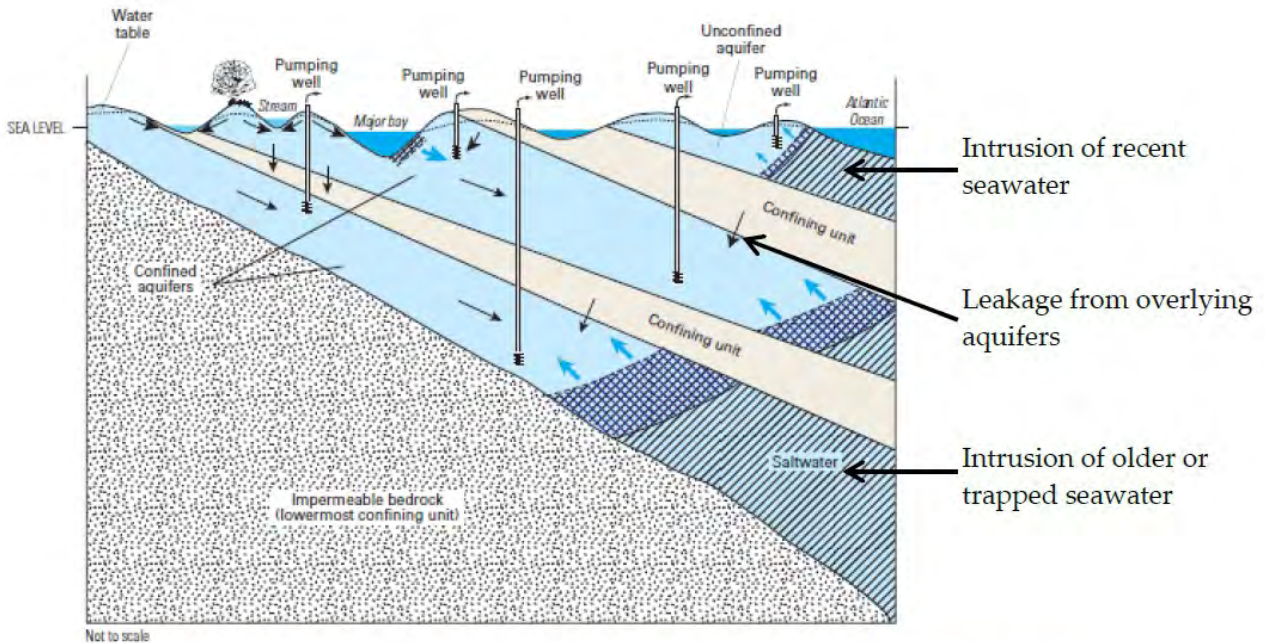


Figure 1: Potential Salinization Mechanisms (from Barlow, 2003)

As described above, comparing results from a number of analyses can suggest the source of elevated chlorides, although not always definitively. Typically, all or a combination of the following analyses are undertaken to investigate chloride sources (Izbicki et al., 2005; Martin, 1984; Klassen et al., 2014):

- Physical properties (temperature, pH, specific conductivity);
- Major-ion composition (piper and stiff diagrams; Na/Cl, Ca/Mg, Ca/(HCO₃ and SO₄), and Cl/EC plots);
- Selected minor ion and trace-element concentrations: boron, iodide, bromide, and barium;
- Minor ion ratio vs. chloride plots, e.g., Cl/Br vs. Cl, Cl/I vs. Cl, Cl/Ba vs. Cl, Cl/B vs. Cl); and
- Isotopic composition of groundwater using the stable isotopes of deuterium in hydrogen, oxygen-18 in oxygen, sulfur-34 in sulfur, and carbon-13 in inorganic carbon.

To control the costs of differentiating between differing chloride sources, we have divided the chloride source assessment into two phases.

Phase I

Phase I will compare the groundwater quality from the Northern Coastal Subarea with (1) seawater and (2) the groundwater quality in selected Laguna Seca wells or other nearby wells that are influenced by connate water in the underlying Monterey Shale. Most of the analyses on major ions are already included in the annual SIARs, but they do not provide an indication of the source(s) of the elevated chloride levels in the Sentinel Wells.

For Phase I, we recommend focusing analyses on the minor ions of boron, iodide, bromide, and barium, and including some additional major ion analyses as listed in the bullets below. The minor ion analyses were also recommended in the 2016 SIAR and have been used together with other indicators in similar studies to determine chloride sources in Santa Barbara and Oxnard (Martin, 1984 and Izbicki et al., 2005, respectively). The Watermaster has been analyzing samples from selected coastal monitoring and production wells for iodide, bromide, boron, and barium since 2012. Figure 2 shows the location of wells with minor ion data.

The Phase I work will consist of:

- Compare chloride to iodide ratios. Iodide is strongly depleted in seawater as a result of biological sequestration by marine organisms, such as kelp. Enriched iodide in groundwater indicates long residence time where iodide has had the opportunity to leach out of the sediments and may build up in groundwater (Kim et al., 2002). Changes in the chloride to iodide ratio in high-chloride water are often diagnostic of the source of high-chloride water in coastal aquifers (Kim et al., 2002).
- Compare barium concentrations. High barium concentrations are presumptive (but not conclusive) evidence that the source of high chloride in groundwater might be from the underlying Monterey Shale and not seawater. Barium is a reactive chemical constituent. Its concentrations may provide a means of determining whether ocean water or water from the Monterey Shale is the source of increasing chloride levels in the groundwater. The concentration of barium in seawater is typically less than 100 µg/L, whereas its concentration in groundwater from connate water sources is generally greater.

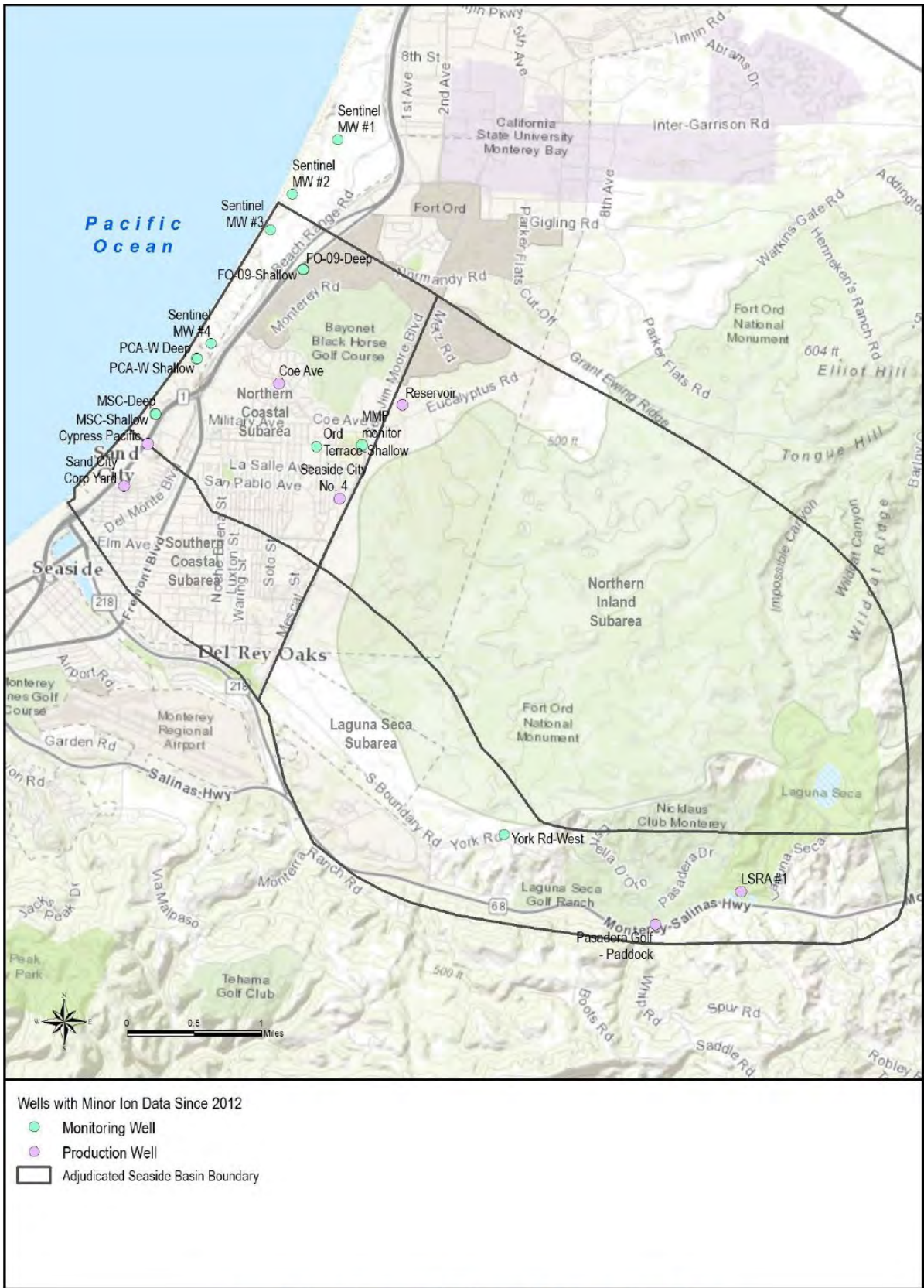


Figure 2: Location of Wells with Minor Ion Data

HydroMetrics Water Resources Inc. • 1814 Franklin St., Suite 501 • Oakland, CA 94612
 (510) 903-0458 • (510) 903-0468 (fax)

- Compare chloride to boron ratios. Chloride-to-boron ratios in the higher-chloride groundwater samples in the Sentinel Wells that are substantially less than the ratio for seawater is presumptive evidence that the source of the increased chloride levels is groundwater from the underlying Monterey Shale.
- Compare chloride to bromide ratios. Bromide is a generally nonreactive dissolved species, and like chloride, it behaves conservatively in groundwater environments (i.e., it does not take part in significant ion exchange reactions, nor are adsorbed onto mineral surfaces). Seawater typically has a bromide concentration of about 67 mg/L. Chloride-to-bromide ratios plotting along the native freshwater/seawater mixing line (blue line on Figure 2) may indicate evidence of groundwater mixing with seawater.

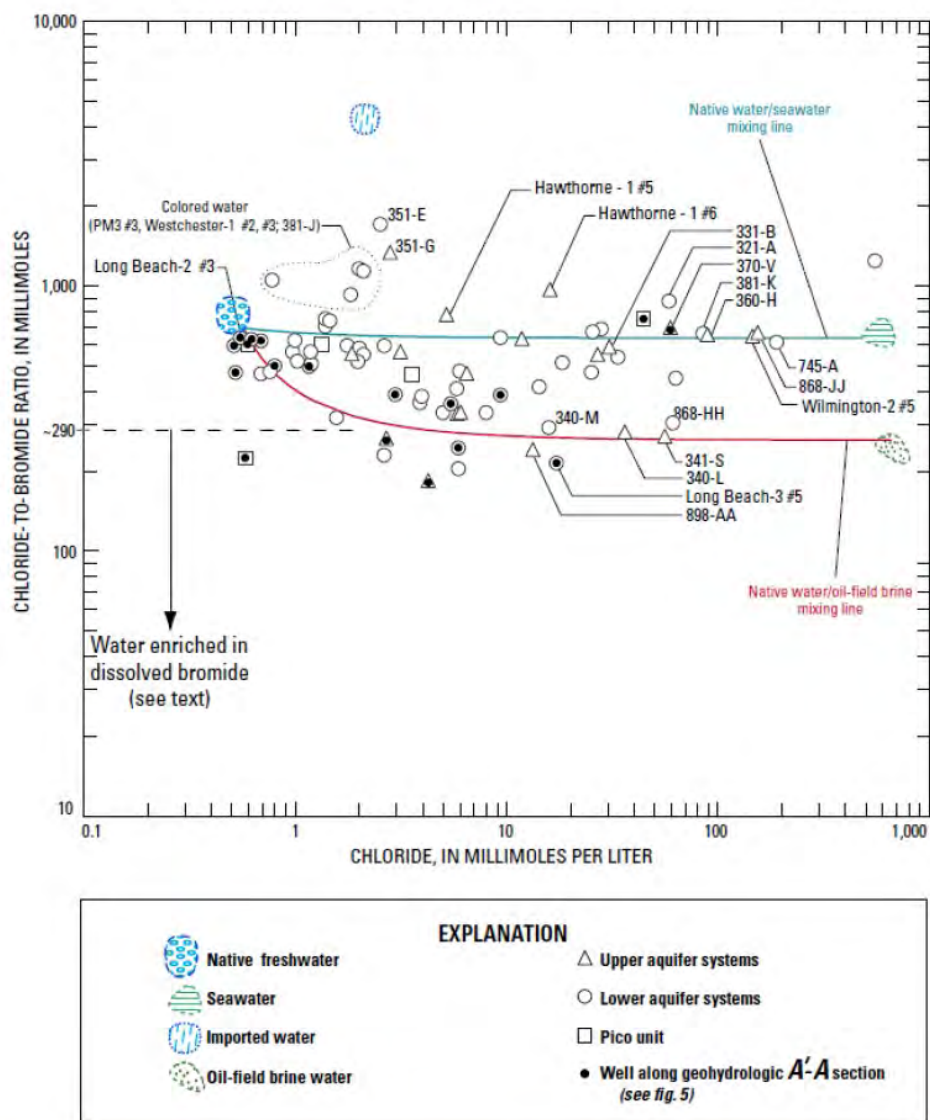


Figure 3: Example Chloride-to-Bromide Ratio of a Function of Chloride (from Land et al., 2004)

- Investigate whether calcium enrichment has occurred in any coastal monitoring wells. Evaluate whether calcium enrichment is taking place by plotting ratios of Ca/Mg and Ca/(HCO₃ and SO₄). Calcium enrichment may be occurring if Ca/Mg > 1 and Ca/(HCO₃ and SO₄) > 1. If it calcium enrichment is taking place, it may indicate incipient seawater intrusion.
- Profiling conductivity and temperature within each of the Sentinel Wells when they are next sampled in September/October 2017 may indicate whether upwelling is occurring within the wells.

Phase II

If determination of the source of elevated chloride levels in the Sentinel Wells from Phase I is inconclusive, it may be necessary to evaluate the isotopic composition of the coastal groundwater as a second phase of study. Isotopic analysis may be used to distinguish between waters of similar chemical character and to understand the source and movement of groundwater near the coast. Typically, the stable isotopes of deuterium in hydrogen and oxygen-18 in oxygen are the only isotopes analyzed. However, in Oxnard, Izbicki et al. (2005) included analysis of the stable isotopic composition in sulfur and inorganic carbon to evaluate the source of these dissolved constituents and to evaluate geochemical processes that may have altered their concentration and isotopic composition over time. If this phase is necessary, laboratory analyses will be needed from either Lawrence Livermore Laboratory, U.C Santa Cruz, University of Arizona or the USGS. If Phase II is required, a detailed work plan will be developed for TAC and Board approval.

Objective 2 – Mechanism for Fluctuating Chloride Concentrations

To determine a mechanism for the fluctuations in chloride concentrations in the Sentinel Wells, we will first need to identify the likely source of chloride (Objective 1) and also examine groundwater quality results from the October 2017 sampling event. These data are key to establishing a relationship between groundwater levels and chloride fluctuations.

As part of the analysis of fluctuating chloride concentrations, we propose to use a specialized diagram that can be used to categorize the hydrochemical environment of water types, also known as a hydrochemical facies evolution diagram (Figure 3) that has been used to track the onshore (intrusion) and offshore (freshening) movement of seawater in aquifers (Giménez-Forcada, 2010). Using the percentage content of principal major ions, the multi-rectangular diagram classifies groundwater by hydrochemical environment.

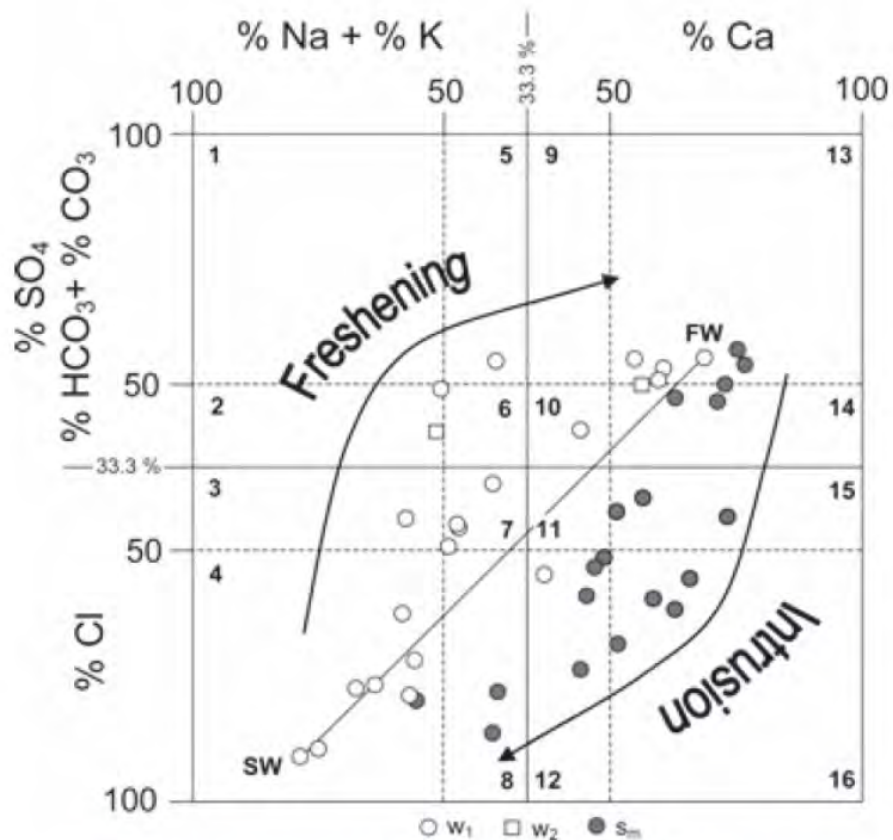


Figure 4: Example Hydrochemical Facies Diagram

References

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- Kim, R.H., B.W. Yum, H.W. Chang. 2002. Hydrogeochemical and isotopic characteristics for selenide station office shallow groundwater in a coastal area, Youngkwang, Korea, In: Boekelman, R.H., Hornschub, J.C.S, Olsthoorn, T.N., Oude ssink, G.H.P., Peute, L., Stark, J.M. (Eds), 2002 Proceedings of the 17th salt water intrusion meeting, Delft 6-10 May 2002. Delft Univ. technology, Delft, Netherlands. Accessed online at: http://swim-site.nl/pdf/swim17//301_kim.pdf, January 26, 2017.
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Martin, P. 1984. Ground-water monitoring at Santa Barbara, California: phase 2 – effects of pumping on water levels and on water quality in the Santa Barbara ground-water basin. US Geological Survey Water-Supply Paper 2197. pp. 31

United States Geological Survey. 1996. Seawater intrusion in a coastal California aquifer. Fact Sheet 6.

Estimated cost for Phase I

The estimated cost for Phase I (Objectives 1 and 2) are included in Table 1 at the end of this Work Plan. Work to investigate the source of elevated chlorides can be completed within six weeks from receiving a notice to proceed. However, work on determining the mechanism causing the chloride fluctuations can only be completed in November 2017 once the 4th quarter samples have been analyzed and conductivity and temperature profiling has been completed.

It is assumed that HydroMetrics WRI will prepare for and attend two TAC meetings by phone to present the results. The cost estimate includes time for Derrik Williams to present study results in-person at up to two Board meetings, if needed.

Please call if you have any questions.

Sincerely,



Georgina King, Principal Hydrogeologist
HydroMetrics Water Resources Inc.

Table 1: Cost Estimate for Phase I

Phase I Tasks	HydroMetrics WRI Labor				Other Direct Costs	TOTALS
	Derrick Williams	Georgina King	Labor Total			
	President	Principal Hydrogeologist				
Rates	\$220	\$195	Hours	(\$)	(\$)	(\$)
Task 1. Characterize Monterey Shale Groundwater Chemistry	2	12	14	\$ 2,780	\$ -	\$ 2,780
Task 2. Analyze Major Ions	1	8	9	\$ 1,780	\$ -	\$ 1,780
Task 3. Analyze Minor Ions	2	16	18	\$ 3,560	\$ -	\$ 3,560
Task 4: Analyze Conductivity and Temperature Profiling Data	2	8	10	\$ 2,000	\$ -	\$ 2,000
Task 5: Prepare Technical Memorandum with Charts and Maps	6	32	38	\$ 7,560	\$ -	\$ 7,560
Task 6: Prepare for and Present Results by Phone to TAC (assume 2 meetings)	4	8	12	\$ 2,440	\$ -	\$ 2,440
Task 7: Prepare for and Present Results in Person to Board (assume 2 meetings)	16	8	24	\$ 5,080	\$ 400	\$ 5,480
TOTAL			125	\$ 25,200	\$ 400	\$ 25,600

Notes

Cost estimate does not include field work related to conductivity and temperature profiling in Sentinel Wells

Other direct costs include per diem, transportation, office supplies, photocopies, postage, and equipment rental

Per diem rate is \$150 per day, mileage is at current IRS rate

**SEASIDE BASIN WATER MASTER
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*** * * AGENDA TRANSMITTAL FORM * * ***

MEETING DATE:	February 8, 2017
AGENDA ITEM:	5
AGENDA TITLE:	Discuss Updating the Basin Management Action Plan
PREPARED BY:	Robert Jaques, Technical Program Manager

SUMMARY:

Background

The Basin Management Action Plan (BMAP) summarizes both short-term and long-term strategies to manage the Basin in accordance with the Adjudication Decision and the Watermaster's Management and Monitoring Program. Included in the BMAP are:

- A description of the state of the Seaside Groundwater Basin with emphasis on those basin properties that are called out in the Amended Decision, e.g. groundwater storage, and which have an impact on basin management;
- Potential supplemental supplies that are being considered for long-term augmentation of production from the Seaside Groundwater Basin,
- Potential management actions and interim water supplies that could be implemented in the short-term prior to developing supplemental supplies, and
- Recommended management actions and strategies that the Watermaster should support and/or encourage, which will help meet the groundwater pumping reductions required by the Amended Decision, and help prevent seawater intrusion.

Also discussed in the BMAP are issues from the Decision that the Watermaster is required to address, including (with Decision section shown in parenthesis):

- Determining *Total Useable Storage Space* and allocated storage for each producer in the Basin (III.H.4);
- Addressing efficiencies of storage (III.H.5); and
- Monitoring and studying the Seaside Groundwater Basin and all Seaside Groundwater Basin activities (III.L.3.j.xxii).

This BMAP is one of a number of documents and actions necessary for managing the Seaside Groundwater Basin. It is in effect a seawater intrusion prevention plan that focuses on providing groundwater management options to control groundwater levels, that if allowed to decline would lead to seawater intrusion. This document is intended to be used in coordination with the Watermaster's ongoing activities and the Seawater Intrusion Response Plan. Implementing the recommendations included in the BMAP is intended to result in a number of actions and strategies that will be necessary for effective groundwater management in the Seaside Groundwater Basin.

Discussion

The BMAP is a document for the Watermaster to use to help achieve the following two objectives: (1) bring the Basin into balance (pumping and other losses are less than or equal to natural recharge and inflows so that groundwater levels are stabilized and no longer falling due to overpumping), and (2) bring

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*** * * AGENDA TRANSMITTAL FORM * * ***

AGENDA ITEM:

5 (Continued)

groundwater levels up to elevations that will prevent seawater intrusion from occurring (these are called “protective levels”). It is the tool for the Watermaster to use to develop plans for future projects or activities that will be needed to achieve these two objectives, after the currently in-progress supplemental water projects (Cal Am’s Monterey Peninsula Water Supply Project (MPWSP) consisting of the desalination facilities and the Pure Water Monterey Groundwater Replenishment Project) have been implemented.

Numerous studies and evaluations have been performed after the BMAP was prepared in February 2009. These include:

1. Development of a groundwater model (updated with data through September 2013).
2. Development of protective groundwater elevations at the coast.
3. Modeling of the impacts of Cal Am’s MPWSP on groundwater levels in the Seaside Basin.
4. Modeling the impacts of Cal Am’s 700 AFY-for-25 years over-pumping payback plan.
5. Modeling of the potential benefit of installing coastal injection wells to form a seawater intrusion barrier.
6. Modeling of the Laguna Seca Subarea and the causes of declining groundwater levels in that subarea.
7. Modeling of the impacts of MRWPCA’s Pure Water Monterey groundwater replenishment project. Some of this analysis takes into account recent operating assumptions on Cal Am’s MPWSP.

In addition considerable additional data (8 year’s worth) on groundwater quality and groundwater levels throughout the Basin have been collected since the BMAP was prepared. Drought conditions have also been experienced over the past four years, which has impacted aquifer recharge more than anticipated in 2009. Also, even though pumping in recent years has been below the required amounts required under the Decision, groundwater levels have continued to fall. This suggests that the Natural Safe Yield of 3,000 AFY in the Decision may be too high.

Integrating this information into an updated BMAP would be beneficial to provide a more complete understanding of the state of the basin. This information could also be used to refine the earlier findings, conclusions, and recommendations contained in the 2009 BMAP. An updated BMAP could provide improved knowledge of:

1. The useable quantities of groundwater stored in the basin.
2. The annual loss of storage in the basin due to overpumping. (The BMAP estimated this to be between 1,300 and 1,430 AFY).
3. The Natural Safe Yield of the basin. (This is the quantity of water than can be extracted through pumping while achieving the first of the two objectives listed above. The Decision set this at an assumed value of 3,000 AFY).

Specific portions of the BMAP that would benefit from being updated include:

1. The listing and discussion of Supplemental Water Supply Projects in Section 3 of the BMAP. The BMAP explains that implementing the projects listed in this section would help to halt the decline in groundwater levels, but would not create protective water levels throughout the basin, thus leaving the basin vulnerable to seawater intrusion at some unknown future date. Additional supplemental water supplies will be needed to achieve protective water levels.
2. The northern and eastern boundaries of the Basin have been determined to be dynamic rather than

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*** * * AGENDA TRANSMITTAL FORM * * ***

AGENDA ITEM:	5 (Continued)
<p>static boundaries. This means that they can move depending on pumping rates and other changeable conditions. More may be known now about these boundary conditions, as a result of the modeling work that has been done, than was known when the BMAP was prepared. Integrating this knowledge into the BMAP might help produce more accurate projections of future groundwater conditions in the basin.</p> <ol style="list-style-type: none"> 3. The optimal locations of extraction wells to make the most efficient use of useable stored groundwater would benefit from being updated based on the data obtained since the BMAP was prepared. 4. The listing of Groundwater Management Actions in Section 4 of the BMAP is out of date and would benefit from being updated to reflect actions that have already been taken as well, actions that are no longer viable, and potential future actions that could be taken. 5. The Recommendations contained in Section 5 of the BMAP would benefit from being updated to reflect actions that have already been taken and to identify future actions that could be taken to achieve the two objectives listed above. 6. Development of a long-term financing plan for replenishment water, as discussed in Section 5, would be especially beneficial, since the monies collected through the Decision-mandated Replenishment Assessment process do not address the acquisition of replenishment water to offset overpumping that occurred <u>prior</u> to the date of the Decision. 7. In addition, the Watermaster’s Seaside Basin Groundwater Model is currently only updated to end of WY2013. HydroMetrics recommends updating the model to reflect the last three years of data. HydroMetrics did some modeling for the Pure Water Monterey Project, but the purpose of that modeling was to see if the Project would harm the Basin, not to see if groundwater levels would rise to protective elevations. <p><u>Recommendation</u> Update the BMAP to:</p> <ul style="list-style-type: none"> • Reflect the additional information obtained since the 2009 BMAP was prepared. • Provide an updated listing of findings, conclusions, and recommendations. • Provide an updated listing and description of potential future actions that the Watermaster could consider taking to bring the basin into balance and to achieve protective groundwater elevations that will prevent seawater intrusion from occurring in the future. <p>If the TAC is supportive of updating the BMAP, a scope of work and cost proposal will be solicited from HydroMetrics to perform this work. This will be used to develop a Request for Services (RFS) to be issued to HydroMetrics. The RFS would be presented to the TAC at a future TAC meeting for approval.</p>	
ATTACHMENTS:	None
RECOMMENDED ACTION:	Update the BMAP as discussed above

**SEASIDE BASIN WATER MASTER
TECHNICAL ADVISORY COMMITTEE**

*** * * AGENDA TRANSMITTAL FORM * * ***

MEETING DATE:	February 8, 2017
AGENDA ITEM:	6
AGENDA TITLE:	Schedule
PREPARED BY:	Robert Jaques, Technical Program Manager
SUMMARY:	
<p>As a regular part of each monthly TAC meeting, I will provide the TAC with an updated Schedule of the activities being performed by the Watermaster, its consultants, and the public entity, MPWMD, which is performing certain portions of the work.</p> <p>Attached is the most recent update of the Work Schedule for FY 2017.</p>	
ATTACHMENTS:	Schedule of Work Activities for FY 2017
RECOMMENDED ACTION:	Provide Input to Technical Program Manager Regarding Any Corrections or Additions to the Schedule

Seaside Basin Watermaster Monitoring and Management Program 2017 Work Schedule

ID	Task Name	2017												2018								
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1	CRITICAL PROJECT MILESTONES ASSOCIATED WITH TAC, BOARD, AND/OR CONSULTANT WORK																					
2	2017 Administration, Operations and Replenishment Budgets																					
3	Prepare M&MP Draft Budgets (Same as Task 19)																					
4	TAC Approves M&MP Budgets (Same as Task 20)																					
5	Board Approves M&MP Budgets (Same as Task 21)																					
6	Watermaster Prepares Quarterly Water Production, Water Level, and Water Quality Reports																					
7	Watermaster Prepares Combined Quarterly Water Production, Water Level, and Water Quality Reports for 1st & 2nd Quarters (Same as Task 46)																					
8	Watermaster Prepares Annual Water Production, Water Level, and Water Quality Report for 2016 (Same as Task 42)																					
9	Replenishment Assessment Unit Costs for Water Year 2018																					
10	B&F Committee Develops Replenishment Assessment Unit Cost for 2018 Water Year																					
11	If Requested, TAC Provides Assistance to B&F Committee in Development of 2018 Water Year Replenishment Assessment Unit Cost																					
12	Board Adopts and Declares 2018 Water Year Replenishment Assessment Unit Cost																					
13	Replenishment Assessments for Water Year 2017																					
14	Watermaster Prepares Replenishment Assessments for Water Year 2017																					
15	Watermaster Board Approves Replenishment Assessments for Water Year 2017 (At December Meeting)																					
16	Watermaster Levies Replenishment Assessment for 2017																					
17	Monitoring & Management Program (M&MP) Budgets for 2018 and 2019																					

Seaside Basin Watermaster Monitoring and Management Program 2017 Work Schedule

ID	Task Name	2017												2018									
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
18	Preliminary Discussion of Potential Scope of Work for 2018 M&MP												◆ 8/9										
19	Prepare Draft 2017 M&MP Work Plan and 2018 and 2019 O&M and Capital Budgets												■										
20	TAC approves Draft 2017 M&MP Work Plan and 2018 and 2019 O&M and Capital Budgets												◆ 9/13										
21	Board approves 2018 M&MP O&M and Capital Budgets												◆ 10/4										
22	2017 Annual Report (Note: Schedule Reflects Court Approval of Later Submittal Date for Annual Report)																						
23	Prepare Preliminary Draft 2017 Annual Report																						
24	TAC Provides Input on Preliminary Draft 2017 Annual Report																						
25	Prepare Draft 2017 Annual Report (Incorporating TAC Input)																						
26	Board Provides Input on Draft 2017 Annual Report (At December Board Meeting)																						
27	Prepare Final 2017 Annual Report (Incorporating Board Input)																						
28	Watermaster Submits Final 2017 Annual Report to Judge																						
29	MANAGEMENT																						
30	M.1 PROGRAM ADMINISTRATION																						
31	Prepare Initial Consultant Contracts for 2018																						
32	TAC Approval of Initial Consultant Contracts for 2018																						
33	Board Approval of Initial Consultant Contracts for 2018																						
34	M.1.g – Sustainable Groundwater Management Act Reporting Requirements																						
35	HydroMetrics Prepares Draft Groundwater Storage Analysis																						
36	TAC Reviews HydroMetrics Draft Storage Analysis																						

Seaside Basin Watermaster Monitoring and Management Program 2017 Work Schedule

ID	Task Name	2017												2018								
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
37	HydroMetrics Revises Draft Storage Analysis if Necessary																					
38	Submit SGMA Documentation to DWR																					
39	IMPLEMENTATION																					
40	I.2.a DATABASE MANAGEMENT																					
41	I.2.a.1 Conduct Ongoing Data Entry/Database Maintenance																					
42	I.2.b DATA COLLECTION PROGRAM																					
43	I.2.b.2 Collect Monthly Water Levels (MPWMD)																					
44	I.2.b.3 Collect Quarterly Water Quality Samples (MPWMD)																					
45	I.2.b.6 Reports (from MPWMD)																					
46	Watermaster Prepares Combined Quarterly Water Production, Water Level, and Water Quality Reports for 1st & 2nd Quarters																					
47	Watermaster Prepares Annual Water Production, Water Level, and Water Quality Report for 2016																					
48	I.3.a ENHANCED SEASIDE BASIN GROUNDWATER MODEL																					
49	Develop and Schedule Additional Tasks as Directed by Board																					
50	I.3.c Refine and/or Update the BMAP																					
51	I.4.c Annual Seawater Intrusion Analysis Report (SIAR)																					
52	HydroMetrics Provides Draft SIAR to Watermaster																					
53	TAC Approves Annual Seawater Intrusion Analysis Report (SIAR)																					
54	Board Approves Annual Seawater Intrusion Analysis Report (SIAR)																					
55	I.4.d Complete Preparation of Seawater Intrusion Response Plan (SIRP)																					

Seaside Basin Watermaster Monitoring and Management Program 2017 Work Schedule

ID	Task Name	2017												2018									
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
56	I.4.e Refine and/or Update the SIRP																						

ONLY IF FOUND TO BE NECESSARY

**SEASIDE BASIN WATER MASTER
TECHNICAL ADVISORY COMMITTEE**

*** * * AGENDA TRANSMITTAL FORM * * ***

MEETING DATE:	February 8, 2017
AGENDA ITEM:	7
AGENDA TITLE:	Other Business
PREPARED BY:	Robert Jaques, Technical Program Manager
SUMMARY:	<p>The “Other Business” agenda item is intended to provide an opportunity for TAC members or others present at the meeting to discuss items not on the agenda that may be of interest to the TAC.</p>
ATTACHMENTS:	None
RECOMMENDED ACTION:	None required – information only