



1814 Franklin Street  
Suite 501  
Oakland, CA 94612

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Mr. Ron Duncan  
Interim General Manager  
Soquel Creek Water District  
PO Box 1550  
Capitola, CA 95010-1550

January 13, 2016

Subject: Quarterly Report for Coastal Monitoring Data through October 2015

Mr. Duncan:

This is the ninth quarterly report with updates on the attached groundwater level and salt concentration plots at the City of Santa Cruz (City) and Soquel Creek Water District's (SqCWD) coastal monitoring wells where target and protective elevations have been defined. These wells, as shown on Figure 1, include three City wells in the Purisima area (Moran Lake Medium, Soquel Point Medium, and Pleasure Point Medium), five wells in the Purisima area (SC-1A, SC-3A, SC-5A, SC-9C, and SC-8D) and five well clusters in the Aromas area (SC-A1A and B, SC-A8A and B, SC-A2A and B, SC-A3A and B, and SC-A4A and B). These wells are the key wells for assessing risk of seawater intrusion and the status of basin recovery in the Soquel-Aptos basin. Target and protective elevations<sup>1</sup> estimated to protect productive aquifer units from seawater intrusion and secondary drinking water standards (MCLs) for chlorides and total

<sup>1</sup> Target elevations for non-critically dry years for the City's wells and SC-1A were listed in the cooperative monitoring/adaptive groundwater management agreement between the City and SqCWD (2015). They are based on the generalized and conservative Ghyben-Herzberg relationship as seaward cross-sectional models have not been developed for the City wells. The target elevations for non-critically dry years represent the long-term recovery goals for that part of the basin. Protective elevations for the other SqCWD wells representing long-term recovery goals are based on seaward cross-sectional models. In the remainder of this quarterly report, protective elevations refer to both target elevations and protective elevations.

dissolved solids (TDS) are shown on the plots. Data through October 2015 are included, which includes groundwater level soundings at least quarterly at the wells. At the City wells and SC-1A, sampling for chlorides and TDS is quarterly with the last sampling event occurring in October. Sampling at the other SqCWD Purisima area monitoring wells occurs semi-annually with the last sampling event occurring in October. Sampling at the Aromas area wells occurs quarterly with the last sampling event included in the report occurring in September.

### **GROUNDWATER LEVEL LOGGER AVERAGES**

Groundwater level loggers are also installed in these monitoring wells recording groundwater levels at least hourly. This report includes calculations of averages for the latest 90 days and 365 days of logger data at each well. Using logger data to calculate averages better represents average conditions over the time period than using averages of manual soundings during the time period. Manual sounding data can be skewed by the timing of the measurement especially in coastal wells that show tidal variation.

The averages of logger data are compared with protective groundwater elevations. Protective elevations are calculated as the long-term groundwater levels for protecting the productive aquifers of the basin from seawater intrusion. Therefore, the 365 day average is more appropriate for comparison to protective elevations in evaluating recovery. Table 1 shows the calculated averages for the coastal wells. Only the results from the A or B screen with lower annual averages are shown for the Aromas wells.

The coastal monitoring wells in the Purisima with 365 day averages above the protective elevations are Moran Lake, SC-1A, and for the first time SC-3A. The coastal monitoring wells in the Aromas with 365 day averages above the protective elevations are SC-A1, SC-A2, and SC-A3.

We have also attached plots of the logger data collected since installation in 2012 at the coastal wells with protective elevations. For the Aromas wells, the hydrograph for the B screen is placed on top of the hydrograph for the A screen as the B screen is shallower than the A screen for SqCWD wells.

*Table 1. Groundwater Level Averages Calculated from Logger Data at Coastal Monitoring Wells*

<b>Well</b>	<b>Data Through</b>	<b>90 Day Avg (ft msl)</b>	<b>365 Day Avg (ft msl)</b>	<b>Protective Elevation (ft msl)</b>
Moran Lake Medium	10/31/2015	5.1	5.2	5.0
Soquel Point Medium	10/31/2015	4.7	4.8	6.0
Pleasure Point Medium	10/31/2015	5.7	5.6	6.1
SC-1A	10/31/2015	9.2	9.1	6.2 (4 <sup>1</sup> )
SC-3A	10/7/2015	10.8	10.6	10
SC-5A	10/31/2015	2.6	5.0	13
SC-9C	7/14/2015	2.7	1.6	10
SC-8D	10/31/2015	9.0	9.5	10
SC-A1B	10/31/2015	6.7	7.5	3
SC-A8A	10/31/2015	5.1	5.8	6
SC-A2A	10/31/2015	6.2	6.3	3
SC-A3A	10/31/2015	4.2	3.7	3
SC-A4A	10/31/2015	1.5	1.8	3

<sup>1</sup> The protective elevation based on the cross-sectional model at SC-1A is 4 feet msl.

### **GROUNDWATER LEVEL TRENDS**

The groundwater level trend in the City’s monitoring wells in the western Purisima area show a slight decline over the last five to ten years so averages groundwater levels are now below protective elevations at two of the three wells.

There has been a multi-year recovery trend in the SqCWD’s Purisima area groundwater levels over the last five to ten years, which has now resulted in annual average groundwater levels recovering to protective elevations at SC-3A as well as SC-1A. However, groundwater levels at three of the five wells remain below protective elevations in SqCWD’s Purisima area. As expected, there was a seasonal decline in summer and fall from groundwater levels observed in the late spring and early summer.

Even with the seasonal decline, groundwater levels at SC-3A, SC-9C and SC-8D in Water Year 2015 were at or near its highest level since the 1980s. Recovery since 2014 at these three wells likely relates to lower pumping in 2014-2015 related to drought curtailment. Over this time scale of several months, coastal groundwater levels have a greater response to reduced pumping than reduced

recharge caused by the four year drought through Water Year 2015. This is due to the coast being much closer to pumping wells compared to aquifer outcrops.

In the Aromas area, the groundwater level rise from October to December 2014 was reversed in the first quarter of 2015 and on whole stabilized through October 2015. Groundwater level trends over the last five years are increasing or stable. Over the last year, the data show that groundwater levels have been above protective elevations at the SC-A1, SC-A2, and SC-A3 wells.

In previous quarterly reports and the annual report, we have displayed equivalent freshwater head for Aromas area monitoring wells with high salt concentrations. We have decided it is more appropriate to conservatively use measured groundwater levels for comparison to protective elevations.

### **SALT CONCENTRATION TRENDS**

Salt concentrations at the Medium screened wells in the City's monitoring well clusters at Moran Lake and Soquel Point were elevated when sampling began at those wells in 2004. At Moran Lake, a downward trend in concentrations has resulted in chloride and TDS concentrations dropping below the MCLs. At Soquel Point, chloride and TDS concentrations remain elevated but there is a slightly decreasing trend. Sampling of the Medium well at Pleasure Point has only taken place since 2012 and chloride and TDS concentrations have been low.

There are no notable changes in salt concentration trends over the last few quarters in the Purisima or northwestern area of the Aromas. In the southeastern area of the Aromas, where the long term (> 5 years) salt concentration trend has generally been increasing, the recent trends (3-5 years) in chloride and TDS at SC-A2B has been decreasing and after an increase in concentrations between 2012 and 2013, salt concentrations at SC-A4A have been declining. Over 2015, salt concentrations at the Aromas wells except for SC-A3B have been stable or declining slightly.

It is also notable that concentrations at SC-A3B have risen since equipment was installed in 2012. The concentrations are lower than concentrations prior to 2012 as the new equipment appears to have samples only the well's upper screen. The rise in concentrations from the new equipment may indicate salt water has moved higher into the upper screen. We recommended ordering a new drop tube to sample the bottom screen of the well to better monitor the freshwater-seawater interface at this location, but silt had covered up the bottom screen.

Attempts at redeveloping the well did not fully remove the silt so our recommendation was to place the drop tube at the top of the bottom screen. The four most recent samples are from this lower depth and show a higher concentration than measurements from the upper screen and an increasing trend, but do not necessarily represent an increasing trend from prior samples. The most recent concentration is still lower than measurements from before 2012.

### **ADDITIONAL NOTES**

This quarterly report included averages based on available groundwater elevation data recorded by groundwater loggers that have been uploaded to SqCWD's new data management system.

Page numbers for the water quality plots are consistent with the Annual Report and Review figure sections 3B, 4B, and 5B, and therefore are not in consecutive order.

Thank you to City and District staff for making the data available expeditiously. Please let me know if you have any questions.

Sincerely,



Cameron Tana, Vice President  
HydroMetrics Water Resources Inc.

cc: Isidro Rivera, City of Santa Cruz Water Department  
Ralph Bracamonte, Central Water District  
John Ricker, Santa Cruz County Environmental Health

Attachment: City of Santa Cruz and Soquel Creek Water District coastal monitoring well hydrographs and chemographs



Figure 1. Locations of Coastal Monitoring Wells where Target or Protective Groundwater Elevations Have Been Estimated



















































