



Summary of Raw Water Quality

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To: California American Water

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Subject: **Raw Water Characterization for the MPWSP**

1 - INTRODUCTION

California-American Water Company (CAW) is preparing for the design, construction, and permitting of the Monterey Peninsula Water Supply Project (MPWSP) slant intake wells, brackish water pipelines and pump station, adesalination plant, product water pipelines, brine disposal facilities, and related appurtenant facilities. Depending on the availability of water from a MPWSP Groundwater Recharge (GWR) project, the desalination plant will be sized at either 9.6 MGD or 6.4 MGD.

The raw water for the desalination plant will be almost completely ocean-floor filtered water from the Pacific Ocean. The slant wells are assumed to pull approximately 97% ocean water and approximately 3% brackish groundwater from the shallow Sand Dune Aquifer and 180-Aquifer. Based on the slant well testing and subsequent modeling, the percent brackish water will be confirmed in 2014. Treatment at the plant shall consist of oxidation with sodium hypochlorite, granular media filtration, dechlorination, pH adjustment with sulfuric acid, cartridge filtration, a first pass of seawater reverse osmosis (SWRO), a partial second pass of brackish water reverse osmosis (BWRO), provision for disinfection with ultraviolet light, post-stabilization treatment with carbon dioxide and either calcite or hydrated lime, pH adjustment with sodium hydroxide, addition of an orthophosphate corrosion inhibitor and post-chlorination with sodium hypochlorite.

The purpose of this Technical Memorandum (TM) is to characterize the raw water quality that will be used as the basis of design for the pretreatment and Reverse Osmosis systems by summarizing raw water quality data available from nearby projects. Data from both open seawater projects and brackish groundwater projects were reviewed as follows:

- (1) Desalination pilot studies conducted along the California coast—Moss Landing (MWH, May 2010) and Santa Cruz/Soquel Creek (CDM, April 2010),
- (2) The Santa Cruz/Soquel Creek Watershed Sanitary Survey (Archibald Consulting et al., July 2010),
- (3) Monterey Bay water quality reported by the Central & Northern California Ocean Observing System (CeNCOOS), typical Pacific Ocean water quality (June 2007 – May 2010),
- (4) Vertical monitoring well data in the 180-Aquifer, from Well DMW-2, collected as part of the Regional Water Supply Project, and
- (5) Source water well data for the Sand City Desalination Plant, screened in the shallow Sand Dune Aquifer.

CAW will be constructing a test slant well in the vicinity of the proposed well field for the Project. Due to environmental constraints, it is anticipated that the test well will only be running for 5 months in the Fall 2013. While the well is operating, samples will be taken and analyzed and this data will be made available to the Design-Builder. However, even water from this test slant well may not be an exact representation of the water that will be produced when the full-scale well field has been constructed and in operation for some time.

In the mean time, this TM summarizes water quality data from nearby ocean and groundwater projects, along with calculated estimates of Pacific Ocean salt and ion concentrations based on salinity measurements made by CeNCOOS, and comes up with an estimated “average” and “maximum” raw water quality that the Design-Builder can use as a basis for design.

2 - MEASURED RAW WATER QUALITY DATA

Raw water quality measurements made for nearby projects are summarized in Table 1 for selected key water quality parameters. This summary presents the lower, upper, and central tendency concentrations for the listed parameters. The numbers in this summary are representative of ocean water, unless otherwise indicated, because the slant wells are anticipated to pull a very high percentage ocean water. “Central tendency” is a qualitative assessment of the central point of the data. It is considered qualitative because some projects reported average values while others reported median values, and because several sets of data were reviewed to come up with a central tendency value. For those parameters that are regulated by CDPH with a primary MCL (pMCL), a secondary MCL (sMCL), or a notification level (NL), the regulatory limit is also shown in Table 1 for comparison.

The constituents that have been measured above the regulatory limits(i.e., other than the standard ocean water ions) in the referenced projects, along with a brief discussion of their concern for this desalination project, are the following:

- **Arsenic** – Arsenic was measured above the pMCL in a few brackish well water samples, but several measurements were below the MDL. Arsenic was below the pMCL in all open ocean project samples. Because the slant wells for the MPWSP are projected to pull approximately 97% ocean water, the potentially higher concentrations in the groundwater will be diluted by the ocean water to a level below the MCL. Additionally, the Santa Cruz pilot study (CDM, 2010) reported effective removal of arsenic through the RO system, with all arsenic concentrations in the permeate being below the detection limit (<0.005 µg/L).
- **Boron** – The RO system will be designed with a second pass to ensure effective boron removal. The target level for the finished water, based on the maximum average of measurements, is 0.5 mg/L.
- **Chromium, total** – Open ocean total chromium concentrations were measured above the pMCL. The RO system will effectively remove chromium, as demonstrated in the Santa Cruz pilot (CDM, 2010), where all permeate chromium concentrations were well below the pMCL.
- **Iron** – The pretreatment system will be designed to remove iron potentially present in the raw water. The maximum average target concentration for the pretreatment effluent is 0.02 mg/L.
- **Perchlorate** –The pMCL for perchlorate is 0.006 mg/L. Because of seawater matrix interference, the analysis for perchlorate in seawater had a MCL of 0.04 mg/L, which is above the pMCL. During the Santa Cruz pilot study (CDM, 2010), perchlorate above the MDL was measured only once; the source was unknown but thought to be associated with stormwater runoff during a storm event. Perchlorate was never detected above the MDL (1 µg/L) in the RO permeate.
- **Gross Beta** –Per the USEPA’s Radionuclides Rule, gross beta particle activity can be adjusted by subtracting the naturally occurring potassium-40 activity. For vulnerable systems, quarterly sampling for beta activity is required. If the gross beta activity minus the naturally occurring potassium-40 activity is greater than 50 pCi/L, the system must speciate to determine the specific source of the beta activity. Thus, 50 pCi/L serves as a relevant trigger level. It is unclear whether the levels reported in the referenced pilot studies were adjusted for naturally occurring potassium-40. In the referenced open ocean projects, the gross beta activity in the RO permeate was well below the 50 pCi/L trigger level.

All Title 22 regulated organics, other than perchlorate, measured above the method detection limit (MDL) in any of the open ocean or brackish groundwater projects reviewed, were well below their regulatory limit.

Complete summary tables of all referenced data are found in Attachment 1 through 3 of this TM. Attachment 1 is a summary of projects with open ocean intakes. Attachment 2 is a summary of projects with brackish groundwater wells. Attachment 3 is the complete data set from Monitoring Well DMW-2. The complete 2010 to 2012 data spreadsheet for the Sand City desalination plant

source water wells listed in Attachment 2 is available from California American upon request.

DRAFT

Table 1 –Raw Water Quality Conditions Measured in Nearby Projects for Select Parameters^A

Parameter	Units	Range of Concentrations ¹			Regulatory List	Regulatory Limit
		Lower	Central Tendency ^B	Upper		
General						
Color	color units	<3	3.5	9	sMCL	15
Temperature (Santa Cruz Wharf) ^C	°C	9	13	18		
Temperature (Monterey Bay at 20 meters) ^D	°C	9	12	15		
Temperature ^A	°C	10	Not calculated	16		
Temperature (Sand City Desalination Plant Intake) ^O	°C	16.1	17.3	18.5		
pH	pH units	7.4	8.0	8.8		
Total Alkalinity	mg/L as CaCO ₃	100	120	130		
Salinity (Santa Cruz Wharf) ^C	PSU	19.35	33.31	33.94		
Salinity (Monterey Bay at 20 meters) ^E	PSS	32.51	33.57	34.14		
Specific Conductance	µS/cm	43,000	51,000	57,000		
TDS (Brackish Groundwater - 180 Aquifer)	mg/L	36,000	36,220	36,770		
TDS (Brackish Groundwater - Sand Dune Aquifer)	mg/L	9,700	18,000	31,000		
TDS	mg/L	26,000	37,000	41,000	sMCL	500
Turbidity (Groundwater - shallow well) ^F	NTU	<0.1	<1	22		
Turbidity (Ocean Intake) ^G	NTU	0.9	3.1	32 - 40		
Inorganic						
Ammonia	mg/L as N	<1	<1	<1		
Arsenic (Brackish Groundwater) ^F	mg/L	<0.005	0.01 to	0.044	pMCL	0.01

Parameter	Units	Range of Concentrations ¹			Regulatory List	Regulatory Limit
		Lower	Central Tendency ^B	Upper		
			0.016			
Arsenic (Ocean Intake)	mg/L	0.0008	0.0009	0.0014	pMCL	0.01
Barium (Brackish Groundwater) ^F	mg/L	0.05	0.08	0.16		
Barium (Ocean Intake)	mg/L	<0.01	0.013	0.029	pMCL	1
Boron	mg/L	2.5	4.8	5.4 ^H	pMCL	1
Bromide	mg/L	48	71	109		
Calcium	mg/L	360	425	470		
Chloride	mg/L	17,000	19,000	26,000	sMCL	250
Chromium, total ^I	µg/L	0.1	0.33	0.7	pMCL	0.05
Fluoride	mg/L	0.6	1.0	1.2	pMCL	2
Iron (Brackish Groundwater) ^F	mg/L	<0.1	NA	2.9	sMCL	0.3
Iron (Ocean Intake) ^J	mg/L	0.002	0.73	1.3	sMCL	0.3
Magnesium	mg/L	1,000	1,350	1,400		
Manganese (Brackish Groundwater) ^F	mg/L	<0.01	NA	0.6	sMCL	0.05
Manganese (Ocean Intake)	mg/L	0.0004	0.0015	0.02	sMCL	0.05
Nitrate	mg/L as N	0.1	0.2	0.3	pMCL	1
Potassium	mg/L	360	415	570		
Selenium (Brackish Groundwater) ^F	mg/L	<0.02	0.15	0.29		
Selenium (Ocean Intake)	mg/L	<0.00005	<0.00005	0.00006	pMCL	0.05
Silica (Brackish Groundwater) ^F	mg/L	28	29	30		
Silica (Ocean Intake)	mg/L	0.1	1.3	3.4		
Sodium	mg/L	7,000	11,000	14,000		
Strontium	mg/L	NA	7.4	11	UCMR3	–
Sulfate	mg/L	2,400	2,750	4,000	sMCL	250

Parameter	Units	Range of Concentrations ¹			Regulatory List	Regulatory Limit
		Lower	Central Tendency ^B	Upper		
Organics						
TOC (Brackish Groundwater) ^F	mg/L	<0.3	<0.3	3.6		
TOC (Ocean Intake)	mg/L	1.0	1.4	13.0 (spring algal bloom)		
Chlorophyll ^B	µg/L	0	2.2	26		
Domoic Acid, particulate (algal toxin) ^K	µg/L	below detection	NA	24		
Title 22 Regulated Organics (Ocean): ^L						
- 2,3,7,8-TCDD (Dioxin)	mg/l		6 E-10	1 E-09	pMCL	3 E-08
- Perchlorate ^M	mg/L		<0.040	0.057	pMCL	0.006
Title 22 Regulated Organics (Sand Dune Aquifer): ^L						
- Tetrachloroethylene (PCE)	mg/L	ND	ND	0.00062	pMCL	0.005
- Benzene	mg/L	ND	ND	0.00055	pMCL	0.001
- tert-Butyl Alcohol (TBA)	mg/L	ND	-	0.0033	NL	0.012
- Toluene	mg/L	ND	-	0.00063	pMCL	0.15
- Bromoform	mg/L	ND	< 0.001	0.0052	TTHM MCL	0.080
- Chloroform	mg/L	ND	-	0.003	TTHM MCL	0.080
- Bromodichloromethane	mg/L	-	-	0.0021	TTHM MCL	0.080
- Dibromochloromethane	mg/L	-	-	0.0088	TTHM MCL	0.080
Title 22 Regulated Organics (180 Aquifer):						

Parameter	Units	Range of Concentrations ¹			Regulatory List	Regulatory Limit
		Lower	Central Tendency ^B	Upper		
- Acetaldehyde	mg/L	ND		0.0013	not regulated	
- Chlorate	mg/L	<0.05		<0.2	NL	0.8
Radionuclides						
Gross Alpha	pCi/L	ND	ND	ND	pMCL	15
Gross Beta ^N	pCi/L	65	137	315	pMCL	4millirem/yr
Strontium-90	pCi/L	0.3	1.0	1.2	pMCL	8
Uranium	pCi/L	0.3	1.8	2.9	pMCL	

¹ Representative of ocean water concentrations unless otherwise indicated.

^A Unless specifically noted, references for the concentration ranges shown in this table are the Moss Landing Desalination Pilot Study (MWH, 2010) the Santa Cruz/Soquel Creek Desalination Pilot Study (CDM, 2010), and the Santa Cruz/Soquel Creek Watershed Sanitary Survey (Archibald, 2010).

^B Central Tendency is a qualitative assessment of the central point of the data based, on Average or Median concentrations reported by the different projects reviewed.

^C Reference was 2005-2008 data collected from Santa Cruz Wharf, at a depth of 5 meters, by Southern California Coastal Ocean Observing System (SCCOOS).

^D Reference was 2001-2005 data collected at a 20-meter depth in Monterey Bay, by Central & Northern California Ocean Observing System (CeNCOOS).

^E Reference was June 2007 - May 2010 salinity data collected from Monterey Bay, at a depth of 20-meters, by Central & Northern California Ocean Observing System.

^F Data reported in this table are based on monitoring data from monitoring wells in the Sand Dune Aquifer and the 180 Aquifer. Well data reviewed included (a) monitoring well DMW-2 (2009), (b) Bay Street and Tioga Street wells for the Sand City Desalination Plant (2010-2012)

Parameter	Units	Range of Concentrations ¹			Regulatory List	Regulatory Limit
		Lower	Central Tendency ^B	Upper		

^G Maximum turbidities are storm related.

^H Maximum value for boron measured during the Moss Landing pilot study, of 6 mg/L, is considered an outlier because it is much higher compared to other Pacific Ocean boron numbers.

^I Hexavalent chromium was measured above the detection limit in one of four quarterly samples, during the Santa Cruz pilot study (CDM, 2010). It was measured at 0.019 µg/L.

^J Maximum and Central Tendency concentrations in this table are based on the Moss Landing pilot study (MWH, 2010). Maximum and median concentrations reported for the Santa Cruz pilot study are roughly two orders of magnitude lower.

^K The concentrations for Domoic Acid reported in this table were measured in Monterey Bay, CA (Caron, et al., 2010). The Santa Cruz pilot study (CDM, 2010) also algae blooms and algal toxins, and domoic acid was not detected. A spiking study showed >99% removal of a surrogate algal toxin through RO treatment (CDM, 2010).

^L Only detected regulated organic compounds are included in this table.

^M This maximum concentration was associated with stormwater runoff during a storm event. Due to seawater matrix interference during laboratory analysis, the detection limit for perchlorate in seawater was 40 µg/L, which is higher than the primary MCL of 6 µg/L. All pilot plant RO permeate samples had perchlorate concentrations <1 µg/L.

^N Per the Radionuclides Rule, gross beta particle activity can be adjusted by subtracting the naturally occurring potassium-40 activity. For vulnerable systems, quarterly sampling for beta activity is required. If the gross beta activity minus the naturally occurring potassium-40 activity is greater than 50 pCi/L, the system must speciate to determine the specific source of the beta activity. Thus, 50 pCi/L serves as a relevant trigger level. It is unclear whether the levels reported in the referenced pilot studies were adjusted. It was reported in both studies that gross beta levels in the RO permeate was below the primary MCL for drinking water.

^O Based on a limited number of data points for 2011 only.

ND=Not Detected at or above the analytical Method Detection Limit

NA = Not Available

3 - CALCULATED RAW WATER QUALITY DATA

Some of the data summarized in Table 1 are not consistent with “typical seawater”—total dissolved solids (TDS) in particular. The analysis of seawater is very complex, and the groups collecting these data may not have been cognizant of these complexities. For example, the standard method for analysis of TDS tends to overestimate the salinity of seawater because (a) water of crystallization may remain, (b) highly mineralized water may contain constituents that are hygroscopic and require a prolonged drying time and proper desiccation, (c) colloidal material may pass through the glass fiber filter, (d) weight gain through oxidation of material, and (e) errors in measurement because only a small volume of sample can be used without forming a water-trapping crust on the dried solids (Eaton et al., 2005; Boerlage, 2011). Additionally, at the temperatures necessary to drive-off all water, bicarbonates and carbonates decompose to oxide, and some bromide, chloride and boric acid can be lost through vaporization which can reduce the measured TDS.

To provide another source of raw water characterization, concentrations of major ions in seawater were calculated from measured salinity concentrations. Three years of salinity data (June 2007 – May 2010) gathered in Monterey Bay, at a depth of 20-meters, were downloaded from the CeNCOOS Data Portal and analyzed. The average, maximum and minimum salinity values were calculated, from which, estimated concentrations of the major seawater constituents were calculated. The major seawater ions can be calculated from salinity because it is known that the proportions of major ion constituents in seawater are relatively constant(Stumm and Morgan, 1981; Millero, 2006).

Conceptually, salinity is a measure of the mass of dissolved inorganic matter in a given mass of seawater. Experimental determination of seawater is difficult because at the temperature necessary to drive off all water, some constituents are broken down and lost—carbonates and bicarbonates are decomposed to oxides, bromide and some chloride are lost as the diatomic gas, and boric acid ($B(OH)_3$) is vaporized. The only reliable way to measure the “true” salinity of a water is to perform a complete chemical analysis and then sum all the constituents. (Millero, 2006; Standard Methods On-line, SM2520, 2012)

Chlorinity, another seawater composition term, is the mass in grams of chloride equivalent to the mass of halogens in one kilogram of seawater (in parts per thousand) (Chester and Jickells, 2012). Chlorinity is measured through precipitation of the halogens with pure silver from a silver nitrate solution.

The constant proportions of ions in seawater around the globe has been observed and documented by researchers as far back as 1779 by Bergman, and then in 1884 by Dittmar, among others (Millero, 2006). These proportions have been reassessed over time, with only very slight changes made. Ion proportions

representative of “average” seawater, which are consistent but not identical to ratios measured by Dittmar, are reported by Millero (2006) and are shown in Table 2, below. In Table 2, the second column reports “g/Cl” which is the mass of the ion species in grams per kilogram of seawater as a function of chlorinity (also in g/kg). These ratios are the basis for the calculation of major ion concentrations from measured salinity values.

Table 2. Ion Ratios in “Average” Seawater as a Function of Chlorinity (Millero, 2006)

Composition of 1 kg of Natural Seawater as a Function of Chlorinity ^a					
Species	g _r /Cl	M _i	n _r /Cl	e _r /Cl	n _i Z _i ² /Cl
Na ⁺	0.556614	22.9898	0.024211	0.024211	0.024211
Mg ²⁺	0.066260	24.3050	0.002726	0.005452	0.010905
Ca ²⁺	0.021270	40.0780	0.000531	0.001061	0.002123
K ⁺	0.020600	39.0983	0.000527	0.000527	0.000527
Sr ²⁺	0.000410	87.6200	0.000005	0.000009	0.000018
Cl ⁻	0.998910	35.4527	0.028176	0.028176	0.028176
SO ₄ ²⁻	0.140000	96.0636	0.001457	0.002915	0.005830
HCO ₃ ⁻	0.005524	61.0171	0.000091	0.000091	0.000091
Br ⁻	0.003470	79.9040	0.000043	0.000043	0.000043
CO ₃ ²⁻	0.000830	60.0092	0.000014	0.000028	0.000055
B(OH) ₄ ⁻	0.000407	78.8404	0.000005	0.000005	0.000005
F ⁻	0.000067	18.9984	0.000004	0.000004	0.000004
OH ⁻	0.000007	17.0034	0.0000004	0.0000004	0.0000004
1/2 Σ =	1.814369		0.028895	0.031261	0.035994
B(OH) ₃	0.000996	61.8322	0.000016	0.000016	
Σ =	1.815362		0.028911	0.031277	

^a For average seawater S = 35, Cl = 19.374, pH_{SWS} = 8.1, TA = 2.400 mmol kg⁻¹, and t = 25°C.

Millero (2006) also provides the relationship between chlorinity and salinity as being:

$$S(\text{‰}) = 1.80655 \text{ Cl}(\text{‰}).$$

Knowing the chlorinity as a function of salinity, and the mass of each ion species as a function of chlorinity, the mass (g/kg) of each of the major ion constituents in seawater was calculated for the minimum, average, and maximum salinity measured by CeNCOOS. The ion concentration as g/kg was converted to mg/L by multiplying by the density of seawater (approximately 1.025). Millero and Sohn(Millero and Sohn, 1992) provide an equation that relates density to the Practical Salinity Scale (PSS), which was used in converting ion concentration in g/kg to mg/L. For the range of measured salinity, the density of seawater ranged from 1.02440 to 1.02563. For example, the concentration of sodium in Pacific Ocean water when the salinity is 34.14 is calculated as follows:

$$ion\ conc\ (mg/L) = \left(\frac{34.14}{1.80655}\right) \left(\frac{g_{Na+}}{Cl(\%o)}\right) (1.02563)(1000) = 10,788\ mg/L$$

The calculated ion concentrations are reported in Table 3 for the major ions listed by Millero (2006). The respective ion concentrations were also calculated for a maximum chloride concentration of 24,000 mg/L, which is the maximum concentration reported for the Santa Cruz pilot study (CDM, 2010).

Table 3. Calculated Concentration of Major Ions in Seawater from Minimum, Average and Maximum Salinity Values Measured by CeNCOOS.

Parameter	Units	Calculated Ion Concentrations (mg/L seawater) ¹			
		Minimum Salinity	Average Salinity	Maximum Salinity	Maximum Chloride ² (24,000)
Salinity ³	PSS	32.51	33.57	34.14	≈ 42
Chloride	mg/L as Cl	18,415	19,030	19,361	24,000
Sodium	mg/L as Na	10,261	10,604	10,788	13,373
Sulfate	mg/L as SO ₄ ²⁻	2,581	2,667	2,714	3,364
Magnesium	mg/L as Mg	1,221	1,262	1,284	1,592
Calcium	mg/L as Ca	392	405	412	511
Potassium	mg/L as K	380	392	399	495
Bromide	mg/L as Br	64.0	66.1	67.3	83.4
Strontium	mg/L as Sr	7.56	7.81	7.95	9.85
Fluoride	mg/L as F	1.24	1.28	1.30	1.61
Bicarbonate	mg/L as HCO ₃ ⁻	101.8	105.2	107.1	132.7
Carbonate	mg/L as CO ₃ ²⁻	15.3	15.8	16.1	19.9
<i>Alkalinity</i>	<i>mg/L as CaCO₃</i>	<i>109.0</i>	<i>112.6</i>	<i>114.6</i>	<i>142.0</i>
Boric Acid - B(OH) ₃	mg/L as B(OH) ₃	18.36	18.97	19.30	23.93
Borate - B(OH) ₄ ⁻	mg/L as B(OH) ₄ ⁻	7.50	7.75	7.89	9.78
<i>Boron</i>	<i>mg/L as B</i>	<i>4.24</i>	<i>4.38</i>	<i>4.46</i>	<i>5.53</i>

¹ Ion concentrations were calculated from salinity, a measured quantity, knowing that the proportions of the major ion constituents in seawater are very constant. (Millero, 2006; Stumm & Morgan, 1981). All calculated concentrations were based on seawater with a pH=8.1 and temperature=25°C.

² Reference for the maximum chloride concentration is the Santa Cruz pilot study (CDM, 2010)

³ Reference for salinity values is Central & Northern California Ocean Observing System (CeNCOOS), Station MB0HR. Data from June 2007 - May 2010, collected at a depth of 20-meters in Monterey Bay, were used in calculating the Minimum, Average and Maximum.

4 - BASIS OF DESIGN SOURCE WATER CHARACTERISTICS

Basis of design concentrations for selected water quality parameters related to the pretreatment system and the reverse osmosis system are provided in Table 4. Facility design shall be based on the Design Maximum values in Table 4. The average values will be used during Acceptance Testing of the RO system. Referring to Appendix 7 of the Design-Build contract, Acceptance Testing of the RO system shall be based on computer model projected future performance after 5 years, for both average concentrations and maximum design concentrations, taking into account increased salt passage over time as the membranes age.

For some parameters, the concentrations reported in Table 4 are based on concentrations measured at nearby projects. For other parameters, concentrations are based on ion calculation as discussed in Section 3 of this TM.

The temperature range for the basis of design is 8 °C to 20°C. Because only three years of data were reviewed, a safety factor was applied to the measured temperatures. Thus the low temperature for design is 1°C below the lowest measured temperature (Monterey Bay) and the high temperature for design is 1°C above the maximum measured temperature (Sand City Desalination Plant intake).

Table 4. Raw Water Quality for the Basis of Design

Parameter	Units	Design Value ^{1, 2} (mg/L seawater)	
		Average	Design Maximum
Applicable for the Pretreatment System			
Color	color units	-	9
Turbidity	NTU	-	10
Total Organic Carbon	mg/L	-	4
Iron, total	mg/L	-	2
Manganese, total	mg/L	-	0.2
Applicable for the Reverse Osmosis System			
Salinity	PSS	33.57	37.00
Temperature	°C	12	8 to 20
Chloride	mg/L	19,030	21,000
Sodium	mg/L	10,604	11,700
Sulfate	mg/L	2,667	2,900
Magnesium	mg/L	1,262	1,400
Calcium	mg/L	405	500
Potassium	mg/L	392	570
Bicarbonate	mg/L	105	150
Carbonate	mg/L	16	-
Bromide	mg/L	71	110
Silica	mg/L	1.3	30
Barium	mg/L	0.013	0.16
Strontium	mg/L	7.81	15
Fluoride	mg/L	1.28	2
Boron	mg/L	4.8	5.4
pH	mg/L	8	8.3

¹Design of the RO system, including high-pressure feed pumps, 2nd pass feed pumps, and SWRO and BWRO membranes, shall be based on the maximum design values.

²Acceptance Testing of the RO system shall be based on computer model projected future performance after 5 years, for both average concentrations and maximum concentrations, taking into account increased salt passage over time as the membranes age.

References

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Attachment 1 – Raw Water Quality Summary for Open Ocean Projects

Parameter	Statistic	Moss Landing Pilot Study ¹	Santa Cruz Pilot Study Intake ²	Santa Cruz Proposed Ocean Intake ²	CeNCOOS ³ (Monterey Bay at 20-meters)	SCCOOS ⁴ (Santa Cruz Wharf at 5-meters)
General Parameters						
Color (Color units)	Max		9	6		
	Min		<3	<3		
	Average					
	Median		3.5	<3		
Dissolved Oxygen	Max					
	Min					
	Average					
	Median					
pH	Max	8.82	8.1	8.1		
	Min		7.8	7.4		
	Average					
	Median					
Specific Conductance (µS/cm)	Max	7.73	8.0	7.9		
	Min	50,000	56,000	57,000		
	Average	43,000	48,000	46,000		
	Median		50,100	51,000		
TDS ⁵ (mg/L)	Max	30,000	39,000	41,000		
	Min	25,800	33,000	33,000		
	Average					
	Median		37,000	37,000		
Salinity (PSS or PSU)	Max				34.14	33.94
	Min				32.51	19.35
	Average				33.57	33.31
	Median					
Temperature (°C)	Max	19 (estimate) ⁶	16	16	15	18
	Min	11 (estimate) ⁶	10	10	9	9
	Average				12	13
	Median	Not calculated	Not calculated	Not calculated		
Total Alkalinity	Max	130	120	130		

Parameter	Statistic	Moss Landing Pilot Study ¹	Santa Cruz Pilot Study Intake ²	Santa Cruz Proposed Ocean Intake ²	CeNCOOS ³ (Monterey Bay at 20-meters)	SCCOOS ⁴ (Santa Cruz Wharf at 5-meters)
(mg/L as CaCO ₃)	Min		110	100		
	Average					
	Median	120	120	120		
Total Hardness (mg/L as CaCO ₃)	Max	6,900	6,700	7,100		
	Min		6,400	6,300		
	Average					
TSS (mg/L)	Median	5,900	6,300	6,500		
	Max	100	15	18		
	Min		0.4	0.5		
Turbidity (NTU)	Average					
	Median	70	5.7	2.5		
	Max	12.58	40	9.6		
Ammonia (mg/L N)	Min		1.5	0.9		
	Average	8.47				
	Median		3.1	1.4		
Nitrate (mg/L as N)	Max	< 1.0				
	Min					
	Average					
Nitrite + Nitrate (mg/L as N)	Median	< 1.0				
	Max		0.27	0.33		
	Min		0.1	<0.02		
TKN (mg/L as N)	Average					
	Median		0.19	0.09		
	Max	2.2	0.27	0.33		
Total Nitrogen (mg/L N)	Min		0.1	0.09		
	Average					
	Median	2.1	0.19	0.33 (?)		
Total Nitrogen (mg/L N)	Max	2.2				
	Min					
	Average					
Total Nitrogen (mg/L N)	Median	1.4				
	Max	4.1				
	Min					
Total Nitrogen (mg/L N)	Average					

Parameter	Statistic	Moss Landing Pilot Study ¹	Santa Cruz Pilot Study Intake ²	Santa Cruz Proposed Ocean Intake ²	CeNCOOS ³ (Monterey Bay at 20-meters)	SCCOOS ⁴ (Santa Cruz Wharf at 5-meters)
Total Phosphorus (mg/L P)	Median	1.7				
	Max	0.18	0.08	0.07		
	Min		0.03	0.03		
	Average					
Orthophosphate (mg/L; filtered)	Median	0.082	0.05	0.04		
	Max	5.9				
	Min					
	Average					
Algae (cells/mL)	Median	1.7				
	Max	587 ⁽⁷⁾				
	Min	37 ⁽⁷⁾				
	Average					
Inorganics						
Aluminum (mg/L)	Max	1.5	0.04			
	Min		0.008			
	Average					
	Median	0.6	0.029			
Antimony (mg/L)	Max		0.00007			
	Min		<0.000005			
	Average					
	Median		0.00004			
Arsenic (mg/L)	Max		0.0011			
	Min		0.0008			
	Average					
	Median		0.0009			
Barium (mg/L)	Max	0.029	0.027			
	Min		<0.01			
	Average					
	Median	0.013	0.012			
Beryllium(mg/L)	Max		<0.00001			
	Min		<0.00001			
	Average					
	Median					

Parameter	Statistic	Moss Landing Pilot Study ¹	Santa Cruz Pilot Study Intake ²	Santa Cruz Proposed Ocean Intake ²	CeNCOOS ³ (Monterey Bay at 20-meters)	SCCOOS ⁴ (Santa Cruz Wharf at 5-meters)
Boron (mg/L)	Median					
	Max	6	5.4	5.0		
	Min		2.5	3.9		
	Average					
Bromide (mg/L)	Median	4.8	4.4	4.5		
	Max	83	80	109		
	Min		48	49		
	Average					
Cadmium (mg/L)	Median	64	71	67		
	Max		0.00008	0.00008		
	Min		0.00003	0.00002		
	Average					
Calcium (mg/L)	Median		0.00006	0.00005		
	Max	468	430	450		
	Min		360	410		
	Average					
Chromium, total (mg/L)	Median	390	411	425		
	Max		0.00071	0.00045		
	Min		0.00011	0.00002		
	Average					
Chromium, hexavalent (mg/L)	Median		0.00033	0.00006		
	Max			0.000019		
	Min			ND		
	Average			ND		
Chloride (mg/L)	Median			Detected only during the April quarterly sample		
	Max	26,000	23,000	24,000		
	Min		18,000	17,000		
	Average					
Copper (mg/L)	Median	20,000	18,500	19,000		
	Max	0.13	0.00027	0.00041		
	Min		0.0001	0.00006		
	Average					

Parameter	Statistic	Moss Landing Pilot Study ¹	Santa Cruz Pilot Study Intake ²	Santa Cruz Proposed Ocean Intake ²	CeNCOOS ³ (Monterey Bay at 20-meters)	SCCOOS ⁴ (Santa Cruz Wharf at 5-meters)
Fluoride (mg/L)	Median	0.1	0.00017	0.00014		
	Max	< 5.0	1.1	1.2		
	Min		0.62	0.58		
	Average					
Iron (mg/L)	Median	< 5.0	0.78	1.2		
	Max	1.3	0.024	0.025		
	Min		0.014	0.0018		
	Average					
Lead (mg/L)	Median	0.73	0.0183	0.0079		
	Max		0.00024	0.00003		
	Min		0.00001	0.00003		
	Average					
Magnesium (mg/L)	Median		0.00009	0.00003		
	Max	1,400	1,300	1,400		
	Min		1,100	1,000		
	Average					
Manganese (mg/L)	Median	1,200	1,300	1,350		
	Max	0.02	0.0077	0.002		
	Min		0.0009	0.0004		
	Average					
Nickel (mg/L)	Median	0.01	0.0016	0.0011		
	Max		0.00076	0.00065		
	Min		0.00027	0.00021		
	Average					
Perchlorate (µg/L)	Median		0.00044	0.00034		
	Max		< 40	57 ⁽⁸⁾		
	Min					
	Average					
Potassium (mg/L)	Median		< 40	< 40		
	Max	480	570	450		
	Min		370	360		
	Average					
Selenium (mg/L)	Median	369	400	415		
	Max		<0.00005	0.00006		

Parameter	Statistic	Moss Landing Pilot Study ¹	Santa Cruz Pilot Study Intake ²	Santa Cruz Proposed Ocean Intake ²	CeNCOOS ³ (Monterey Bay at 20-meters)	SCCOOS ⁴ (Santa Cruz Wharf at 5-meters)	
Silica (mg/L)	Min						
	Average						
	Median		<0.00005	<0.00005			
	Max		3.4	2.0			
	Min		0.1	0.2			
Sodium (mg/L)	Average						
	Median		1.3	0.8			
	Max	14,200	11,000	12,000			
	Min		9,000	7,400			
	Average						
Strontium (mg/L)	Median	9,890	10,000	11,000			
	Max	11					
	Min						
	Average						
	Median	7.4					
Sulfate (mg/L)	Max	4,000	2,900	4,000			
	Min		2,500	2,400			
	Average						
	Median	2,700	2,700	2,750			
	Max		0.0024	0.0016			
Vanadium (mg/L)	Min		0.0010	0.0016			
	Average		0.0016	0.0016			
	Median						
	Max	0.078	0.0081	0.0015			
	Min		0.00034	0.00005			
Zinc (mg/L)	Average						
	Median	0.0635	0.00056	0.00028			
	Organics						
	TOC (mg/L)	Max	5.9	13 (spring algal bloom)	3.6		
		Min		1.0	0.9		
Average							
UV-254	Median	1.7	1.4	1.4			
	Max	0.034					

Parameter	Statistic	Moss Landing Pilot Study ¹	Santa Cruz Pilot Study Intake ²	Santa Cruz Proposed Ocean Intake ²	CeNCOOS ³ (Monterey Bay at 20-meters)	SCCOOS ⁴ (Santa Cruz Wharf at 5-meters)
DOC (mg/L)	Min					
	Average					
	Median	0.0125				
	Max		12	4		
	Min		0.9	0.8		
	Average					
Detected Regulated Organics (Only contaminants detected above their Method Detection Limit are included in this table)	Median		1.3	1.1		
	2,3,7,8-TCDD (dioxin) (µg/L)				1.0E-06	
	Median				6.0E-07	
Microbial Parameters						
Total Coliforms (MPN/100 mL)	Max		170	300		
	Min		<2	<2		
	Average					
	Median		7	<2		
Fecal Coliforms (MPN/100 mL)	Max		80	17		
	Min		<2	<2		
	Average					
	Median		7	<2		
E. Coli (MPN/100 mL)	Max		80	17		
	Min		<2	<2		
	Average					
	Median		7	<2		
Enterococcus (MPN/100 mL)	Max		340	31		
	Min		<10	<10		
	Average					
	Median		<10	<10		
Cryptosporidium (cysts/10 L sample)	Max		0	0		
	Min		0	0		
	Average					
	Median					
Giardia (oocysts/10 L)	Max		0	0		

Parameter	Statistic	Moss Landing Pilot Study ¹	Santa Cruz Pilot Study Intake ²	Santa Cruz Proposed Ocean Intake ²	CeNCOOS ³ (Monterey Bay at 20-meters)	SCCOOS ⁴ (Santa Cruz Wharf at 5-meters)
sample)	Min		0	1		
	Average					
	Median					
Radionuclides						
Uranium (pCi/L)	Max			2.93		
	Min			0.28		
	Average			1.75		
	Median					
Radium 226 (pCi/L)	Max			0.39		
	Min			0.11		
	Average			0.3		
	Median					
Radium 228 (pCi/L)	Max			0.7		
	Min			0.12		
	Average			0.37		
	Median					
Gross Alpha (pCi/L)	Max			ND (8.2)		
	Min			ND (1.0)		
	Average					
	Median			ND (4.7)		
Gross Beta (pCi/L)	Max			313		
	Min			65		
	Average			137		
	Median					
Strontium-90 (pCi/L)	Max			1.15		
	Min			0.28		
	Average			0.96		
	Median					

¹ Reference for the Moss Landing Pilot Study is MWH, 2010.

² Reference for the Santa Cruz/Soquel Creek Pilot Study is CDM, 2010

³ Central & Northern California Ocean Observing System (<http://204.115.180.244/CeNCOOS/DataPortal.html>)

⁴ Southern California Coastal Ocean Observing System (<http://www.sccoos.org/query/>)

⁵Calculated value based on conductivity.

Parameter	Statistic	Moss Landing Pilot Study ¹	Santa Cruz Pilot Study Intake ²	Santa Cruz Proposed Ocean Intake ²	CeNCOOS ³ (Monterey Bay at 20-meters)	SCCOOS ⁴ (Santa Cruz Wharf at 5-meters)
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⁶ Estimated from a figure in the report.

⁷ Measured during a fall algae bloom.

⁸ All measurements except one were below the detection limit. Because of seawater matrix, the detection limit was higher than the primary MCL for this contaminant. This max concentration was associated with a storm event and thought to be the result of stormwater runoff. Perchlorate in the pilot RO Permeate was always ND (<1 µg/L)

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Attachment 2 – Raw Water Quality Summary for Brackish Groundwater Projects

Parameter	Statistic	Marina Coast Monitoring Well DMW-2 (180 aquifer)	Sand City Desalination Plant Source Water Wells ^(A)			
			Bay Street (01) (2010-2012)	Bay Street (02) (2010-2012)	Tioga Street (04) (2010-2012)	Tioga Street (05) (2010-2012)
General Parameters						
Color (Color units)	Max	3.0	5	60	5	10
	Min	2.0	ND	ND	ND	ND
	Average	2.8				
	Median		ND		ND	ND
Dissolved Oxygen	Max	7.1	no data	no data	no data	no data
	Min	6.3				
	Average	6.6				
	Median					
pH	Max	6.8	7.6	7.7	7.8	7.8
	Min	6.6	7.4	7.6	7.4	7.5
	Average	6.7	7.5	7.6	7.62	7.62
	Median					
Specific Conductance (µS/cm)	Max	51,600	46,475	63,811	50,440	67,454
	Min	48,500	20,000	22,000	15,000	15,000
	Average	50,550	24,333	28,000	21,857	27,000
	Median					
TDS (mg/L)	Max	36,770	21,420	31,726	23,190	34,690
	Min	36,000	14,000	12,000	9,700	10,000
	Average	36,218	16,333	18,000	15,940	19,600
	Median					
Temperature (°C)	Max	16.8	18.5	18.5	18.5	18.5
	Min	15.5	16.1	16.1	16.1	16.1
	Average	16.2				
	Median					
Total Alkalinity (mg/L as CaCO ₃)	Max	105	90			
	Min	103	78			
	Average	104	85			
	Median					

Parameter	Statistic	Marina Coast Monitoring Well DMW-2 (180 aquifer)	Sand City Desalination Plant Source Water Wells ^(A)			
			Bay Street (01) (2010-2012)	Bay Street (02) (2010-2012)	Tioga Street (04) (2010-2012)	Tioga Street (05) (2010-2012)
Total Hardness (mg/L as CaCO ₃)	Max		3,700	5,200	4,000	5,500
	Min		2,400	2,300	1,700	1,900
	Average		30,333	3,925	3,113	3,967
	Median					
TSS (mg/L)	Max					
	Min					
	Average					
Turbidity (NTU)	Max	0.21	0.13	22	0.27	4.3
	Min	0.11	ND	ND	ND	ND
	Average	0.15		9.97	0.08	0.76
Ammonia (mg/L N)	Max	<0.05	no data	no data	no data	no data
	Min	<0.05				
	Average	<0.05				
Nitrate (mg/L as N)	Max	6.59	11.5	no data	(C)	no data
	Min	0.99	ND			
	Average	4.22				
Nitrite + Nitrate (mg/L as N)	Max	6.60				
	Min	0.99				
	Average	4.23				
TKN (mg/L as N)	Max					
	Min					
	Average					
Total Nitrogen (mg/L N)	Max					
	Min					
	Average					
	Median					

Parameter	Statistic	Sand City Desalination Plant Source Water Wells ^(A)				
		Marina Coast Monitoring Well DMW-2 (180 aquifer)	Bay Street (01) (2010-2012)	Bay Street (02) (2010-2012)	Tioga Street (04) (2010-2012)	Tioga Street (05) (2010-2012)
Total Phosphorus (mg/L P)	Max	0.078				
	Min	0.058				
	Average	0.067				
	Median					
Orthophosphate (mg/L; filtered)	Max	ND				
	Min	ND	ND			ND
	Average					
	Median					
Sulfate (mg/L)	Max	2,500	1,400	1900	1400	2400
	Min	2,418	880	1100	660	650
	Average	2,463	1,160	1337	1030	1358
	Median					
Inorganics						
Aluminum (mg/L)	Max	<0.1	ND			
	Min	ND	ND			
	Average					
	Median					
Antimony (mg/L)	Max	<0.02				
	Min	ND				
	Average					
	Median					
Arsenic (mg/L)	Max	0.022	ND	no data	0.042	0.044
	Min	<0.005	ND		0.0025	ND
	Average	0.011			0.0162	0.00945
	Median					
Barium (mg/L)	Max	0.061	0.085	0.085	0.16	0.13
	Min	0.054	0.083	0.07	ND	0.053
	Average	0.0573	0.084	0.075	0.078	0.080
	Median					
Beryllium(mg/L)	Max	<0.005				
	Min	<0.004				
	Average					

Parameter	Statistic	Sand City Desalination Plant Source Water Wells ^(A)				
		Marina Coast Monitoring Well DMW-2 (180 aquifer)	Bay Street (01) (2010-2012)	Bay Street (02) (2010-2012)	Tioga Street (04) (2010-2012)	Tioga Street (05) (2010-2012)
Boron (mg/L)	Median					
	Max	4.7	1.9	2.6	2.4	4.2
	Min	4.3	1.5	2	1.3	1.9
	Average	4.6			1.64	2.40
Bromide (mg/L)	Median					
	Max	102	no data	no data	no data	no data
	Min	88.3				
	Average	95.6				
Cadmium (mg/L)	Median					
	Max	0.0046				
	Min	<0.01				
	Average	0.004				
Calcium (mg/L)	Median					
	Max	484	210	420	420	400
	Min	432	290	200	150	170
	Average	449	250	300	295	280
Chromium, total (mg/L)	Median					
	Max	0.062	0.022	0.49	ND	0.088
	Min	<0.02	ND	ND	ND	
	Average	0.038				
Chromium, hexavalent (mg/L)	Median					
	Max	no data	no data	no data	no data	no data
	Min					
	Average					
Chloride (mg/L)	Median					
	Max	19,400	10,000	14,000	11,000	24,000
	Min	18,975	6,600	7,800	6,300	4,900
	Average	19,191	8,800	10,067	7,717	11,133
Copper (mg/L)	Median					
	Max	0.022	0.086	0.1	0.086	0.1
	Min	ND	0.05	0.037	0.031	0.04
	Average		0.071	0.074	0.05	0.058

Parameter	Statistic	Sand City Desalination Plant Source Water Wells ^(A)				
		Marina Coast Monitoring Well DMW-2 (180 aquifer)	Bay Street (01) (2010-2012)	Bay Street (02) (2010-2012)	Tioga Street (04) (2010-2012)	Tioga Street (05) (2010-2012)
Fluoride (mg/L)	Median	ND				
	Max	ND	0.21			
	Min	ND	0.44			
	Average		0.31			
Iron (mg/L)	Median					
	Max	<0.2	ND	2.9	ND	2.1
	Min	<0.2	ND	ND	ND	ND
	Average				ND	
Lead (mg/L)	Median	<0.2		ND		
	Max	0.0037	0.023	ND	ND	no data
	Min	ND	ND	ND	ND	
	Average					
Magnesium (mg/L)	Median					
	Max	1,300	720	1,000	740	1,100
	Min	1,200	450	450	320	360
	Average	1,250	587	673	517	665
Manganese (mg/L)	Median					
	Max	<0.04	0.17	0.59	0.16	0.13
	Min	<0.002	ND	0.028	0.019	ND
	Average			0.238	0.04	
Nickel (mg/L)	Median	ND				
	Max	ND	0.022	0.18	0.013	0.018
	Min	ND	0.013			0.015
	Average					
Perchlorate (µg/L)	Median					
	Max	ND	ND	ND	ND	ND
	Min	ND	ND	ND	ND	ND
	Average					
Potassium (mg/L)	Median		ND	ND	ND	ND
	Max	420	230	320	210	400
	Min	350	150	140	83	120
	Average	393	193	213	144	225

Parameter	Statistic	Sand City Desalination Plant Source Water Wells ^(A)				
		Marina Coast Monitoring Well DMW-2 (180 aquifer)	Bay Street (01) (2010-2012)	Bay Street (02) (2010-2012)	Tioga Street (04) (2010-2012)	Tioga Street (05) (2010-2012)
Selenium (mg/L)	Median					
	Max	0.032	0.12	0.29	0.26	0.23
	Min	<0.02	0.23	0.11	0.067	0.065
	Average	0.017	0.163	0.183	0.127	0.139
	Median					
Silica (mg/L)	Max	30	no data	no data	no data	no data
	Min	28				
	Average	29				
	Median					
Sodium (mg/L)	Max	10,600	6,100	8,400	6,100	8,900
	Min	10,000	3,700	3,700	2,800	2,700
	Average	10,275	4,933	5,667	4,050	5,400
	Median					
Strontium (mg/L)	Max	7.8	no data	no data	no data	no data
	Min	7.1				
	Average	7.5				
	Median					
Uranium (mg/L)	Max	< 0.02				
	Min	0.0022				
	Average					
	Median					
Vanadium (mg/L)	Max	0.026				
	Min	<0.015				
	Average	0.015				
	Median					
Zinc (mg/L)	Max	<0.1	ND	ND	0.35	0.16
	Min	ND	ND	ND	0.063	
	Average					
	Median					
Organics						
TOC (mg/L)	Max	3.6	no data	no data	no data	no data
	Min	< 0.3				

Parameter	Statistic	Marina Coast Monitoring Well DMW-2 (180 aquifer)	Sand City Desalination Plant Source Water Wells ^(A)			
			Bay Street (01) (2010-2012)	Bay Street (02) (2010-2012)	Tioga Street (04) (2010-2012)	Tioga Street (05) (2010-2012)
UV-254	Average					
	Median	< 0.3				
	Max	<0.009				
	Min	<0.009				
DOC (mg/L)	Average	<0.009				
	Median					
	Max		no data	no data	no data	no data
	Min					
Detected Regulated Organics (Only contaminants detected above their Method Detection Limit are included in this table)						
Acetaldehyde (mg/L)	Max	0.0013				
	Min	ND				
	Average					
	Median	<0.2				
Chlorate (mg/L)	Max	<0.05				
	Min					
	Average		0.00055	ND	ND	ND
	Median			ND	ND	ND
Benzene (mg/L)	Max			ND	ND	ND
	Min		0.0033	0.0021	ND	ND
	Average		0.0023		ND	ND
	Median				ND	ND
tert-Butyl Alcohol (TBA) (mg/L)	Max	0.0013				
	Min	ND				
	Average					
	Median	<0.2				
PCE (mg/L)	Max	ND	0.62	ND	ND	ND
	Min	ND	ND	ND	ND	ND
	Average		ND	ND	ND	ND
	Median		ND	ND	ND	ND
Bromoform (mg/L)	Max		0.00023	0.00097	0.0052	0.052

Parameter	Statistic	Marina Coast Monitoring Well DMW-2 (180 aquifer)	Sand City Desalination Plant Source Water Wells ^(A)			
			Bay Street (01) (2010-2012)	Bay Street (02) (2010-2012)	Tioga Street (04) (2010-2012)	Tioga Street (05) (2010-2012)
Chloroform (mg/L)	Min		0.00022	0.00023	0.00022	ND
	Average			0.00065	0.00024	0.0026
	Median		no data	0.00055	ND	0.003
	Max				ND	ND
	Min				ND	ND
Bromodichloromethane (mg/L)	Average		no data	no data	no data	0.0021
	Median					
	Max					
Dibromochloromethane (mg/L)	Min		no data	no data	no data	0.0088
	Average					
	Median					
	Max		no data	no data	0.00063	0.00056
Toluene (mg/L)	Min					
	Average		0.00023	0.00097	0.0052	0.052
	Median		0.00022	0.00023	0.00022	ND
Microbial Parameters	Min					
	Average		no data	0.00065	0.00024	0.0026
	Median		no data	0.00055	ND	0.003
Total Coliforms (MPN/100 mL)	Max	<2	no data	no data	no data	no data
	Min	<2				
	Average					
	Median					
Fecal Coliforms (MPN/100 mL)	Max	<2	no data	no data	no data	no data
	Min	<2				
	Average					
E. Coli (MPN/100 mL)	Median					
	Max	<2	no data	no data	no data	no data
	Min	<2				
	Average					
	Median					

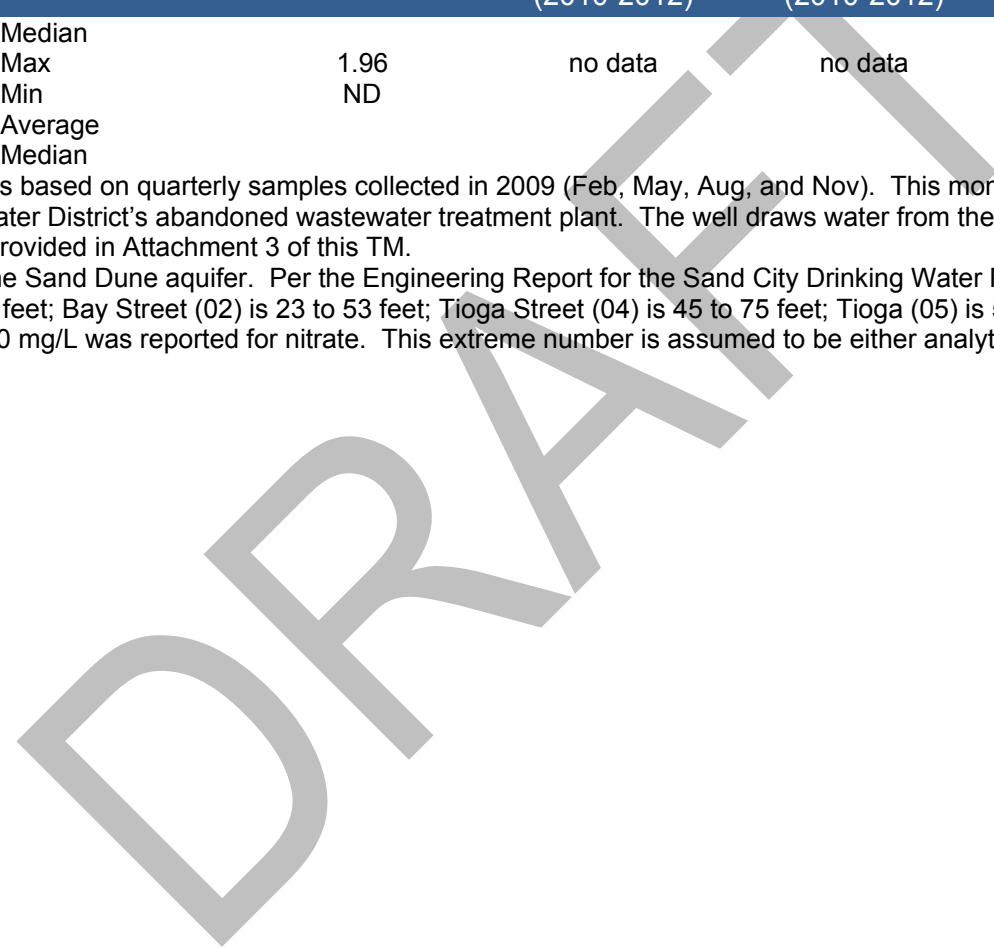
Parameter	Statistic	Sand City Desalination Plant Source Water Wells ^(A)				
		Marina Coast Monitoring Well DMW-2 (180 aquifer)	Bay Street (01) (2010-2012)	Bay Street (02) (2010-2012)	Tioga Street (04) (2010-2012)	Tioga Street (05) (2010-2012)
Enterococcus (MPN/100 mL)	Max		no data	no data	no data	no data
	Min					
	Average					
	Median					
Cryptosporidium (cysts/L sample)	Max	0	no data	no data	no data	no data
	Min	0				
	Average	0				
	Median					
Giardia (oocysts/L sample)	Max	0	no data	no data	no data	no data
	Min	0				
	Average	0				
	Median					
Radionuclides						
Uranium (pCi/L)	Max	1.5	0	0.74	1.4	1.5
	Min	<2.7	0	0.68	0.77	1
	Average			0.71	1.07	1.2
	Median					
Radium 226 (pCi/L)	Max	ND	no data	no data	no data	no data
	Min	ND				
	Average					
	Median					
Radium 228 (pCi/L)	Max	2.48	no data	no data	no data	no data
	Min	1.11				
	Average	2.04				
	Median					
Gross Alpha (pCi/L)	Max	14.5	1.9	0.66	3.1	ND
	Min	ND	ND	0.19	0.29	
	Average	8.7	0.72	0.28	1.79	
	Median					
Gross Beta (pCi/L)	Max		no data	no data	no data	no data
	Min					
	Average					

Parameter	Statistic	Sand City Desalination Plant Source Water Wells ^(A)				
		Marina Coast Monitoring Well DMW-2 (180 aquifer)	Bay Street (01) (2010-2012)	Bay Street (02) (2010-2012)	Tioga Street (04) (2010-2012)	Tioga Street (05) (2010-2012)
Strontium-90 (pCi/L)	Median					
	Max	1.96	no data	no data	no data	no data
	Min	ND				
	Average					
	Median					

^(A) Data summarized here is based on quarterly samples collected in 2009 (Feb, May, Aug, and Nov). This monitoring well was located next to the ocean, at Marina Coast Water District's abandoned wastewater treatment plant. The well draws water from the 180-Aquifer. The complete set of data for this monitoring well is provided in Attachment 3 of this TM.

^(B) Wells are screened in the Sand Dune aquifer. Per the Engineering Report for the Sand City Drinking Water Permit, the screened internal depths are: Bay Street (01) is 22 to 52 feet; Bay Street (02) is 23 to 53 feet; Tioga Street (04) is 45 to 75 feet; Tioga (05) is 57 to 82 feet.

^(C) A maximum value of 280 mg/L was reported for nitrate. This extreme number is assumed to be either analytical error or reporting error.



Attachment 3 – Quarterly Monitoring Data from Monitoring Well DMW-2

Parameter	Units	CDPH MCL/NL	CDPH DLR	1st Quarter 2/24/2009	2nd Quarter 5/19/2009	3rd Quarter 8/11/2009	4th Quarter 11/10/2009
General Water Characteristics (Physical and Chemical)							
pH	--	--	--	6.6	6.8	6.8	6.7
Temperature	°C	--	--	16	15.5	16.4	17
Dissolved Oxygen	mg/L	--	--	6.3	6.5	6.7	7.1
Turbidity	NTU	5	--	0.13	0.11	0.13	0.21
Specific Conductance	µS/cm	900	--	51,600	51,100	51,000	48,500
Total Dissolved Solids (TDS)	mg/L	500	--	36,000	36,000	36,100	36,770
Alkalinity	mg/L	--	--	104	105	103	104
Calcium	mg/L	--	--	446	435	484	432
Bromide	mg/L	--	--	96	88.3	96.2	102
Chloride	mg/L	250	--	19,400	18,975	19,300	19,090
Nitrate (as NO ₃)	mg/L	45	2	29.2	21	20.2	4.38
Nitrite (as N)	mg-N/L	1	0.4	ND	ND	ND	ND
Nitrate + Nitrite (as N)	mg-N/L	10	--	6.6	4.75	4.57	0.99
Phosphate	mg-P/L	--	--	ND	ND	ND	ND
Sulfate	mg/L	250	0.5	2,500	2,445	2,489	2,418
Organic Carbon, Total (TOC)		--	0.3	ND	3.6	ND	ND
Iron	mg/L	0.3	0.1	<0.2	ND	<0.2	<0.2
Magnesium	mg/L	--	--	1,300	1,300	1,200	1200
Potassium	mg/L	--	--	420	410	390	350
Silica	mg/L	--	--	29	28	30	30
Strontium	mg/L	--	--	7.8	7.1		7.5
Sodium	mg/L	--	--	10,000	10,600	10,500	10,000
Manganese	mg/L	0.05/0.5	0.02	ND	ND	ND	<0.04
Ammonia	mg/L	--	--	<0.05	<0.05	<0.05	<0.05
Phosphorus (total as P)	mg/L	--	--	0.07	0.061	0.058	0.078

Parameter	Units	CDPH MCL/NL	CDPH DLR	1st Quarter 2/24/2009	2nd Quarter 5/19/2009	3rd Quarter 8/11/2009	4th Quarter 11/10/2009
UV-254	1/cm	--	--	<0.009	<0.009	<0.009	<0.009
UVT	%	--	--	>98%	>98%	>98%	>98%
Other Physical/Chemical Characteristics							
Color	units	15	--	3	2	3	3
Odor-Threshold	units	3	--	<1	<1	<1	<1
Foaming Agents (MBAS)	mg/L	0.5	--	0.179	0.065	2.4	0.12
Microbiological							
Giardia	cysts/L	TT	--	0	0	0	0
Cryptosporidium	oocysts/L	TT	--	0	0	0	0
MPA	organisms	TT	--	0			
Total Coliform	MPN/100mL	TT	--				
<i>E. Coli</i>	MPN/100mL	TT	--				
Inorganic Contaminants (not previously included in general characteristics)							
Asbestos	MFL	7	0.2	ND		ND	
Aluminum	mg/L	1/0.2	0.05	<0.1		ND	
Antimony	mg/L	0.006	0.006	0.0096	ND	ND	<0.02
Arsenic	mg/L	0.010	0.002	<0.005	0.022	0.010	<0.02
Barium	mg/L	1	0.1	0.054	0.061	0.059	0.055
Beryllium	mg/L	0.004	0.001	<0.005		<0.004	
Cadmium	mg/L	0.005	0.001	0.004	0.0046	0.0039	<0.01
Chromium (Total)	mg/L	0.05	0.01	0.043	0.062	0.036	<0.02
Copper	mg/L	1.3/1.0	0.05	0.022	ND	ND	ND
Lead	mg/L	0.015	0.005	0.0037	ND	ND	<0.01
Nickel	mg/L	0.1	0.01	ND (<0.025)		ND	
Selenium	mg/L	0.05	0.005	<0.025	0.032	0.015	<0.02
Silver	mg/L	0.1	0.01	0.0049	ND	ND	ND
Thallium	mg/L	0.002	0.001	<0.005		ND	

Parameter	Units	CDPH MCL/NL	CDPH DLR	1st Quarter 2/24/2009	2nd Quarter 5/19/2009	3rd Quarter 8/11/2009	4th Quarter 11/10/2009
Zinc	mg/L	5	0.05	<0.1		ND	
Mercury (inorganic)	mg/L	0.002	0.001	ND		ND	
Perchlorate	mg/L	0.006	0.004	ND		ND	
Cyanide	mg/L	0.15	0.1	ND		ND	
Fluoride	mg/L	2.0	0.1	ND	ND	ND	ND
Volatile Organic Chemicals (VOCs)							
Benzene	mg/L	0.001	0.0005	ND	ND	ND	ND
Carbon Tetrachloride	mg/L	0.0005	0.0005	ND	ND	ND	ND
1,2-Dichlorobenzene	mg/L	0.6	0.0005	ND	ND	ND	ND
1,4-Dichlorobenzene (p-DCB)	mg/L	0.005	0.0005	ND	ND	ND	ND
1,1-Dichloroethane (1,1-DCA)	mg/L	0.005	0.0005	ND	ND	ND	ND
1,2-Dichloroethane (1,2-DCA)	mg/L	0.0005	0.0005	ND	ND	ND	ND
1,1-Dichloroethylene (1,1-DCE)	mg/L	0.006	0.0005	ND	ND	ND	ND
cis-1,2-Dichloroethylene	mg/L	0.006	0.0005	ND	ND	ND	ND
trans-1,2-Dichloroethylene	mg/L	0.01	0.0005	ND	ND	ND	ND
Dichloromethane (Methylene chloride)	mg/L	0.005	0.0005	ND	ND	ND	ND
1,2-Dichloropropane	mg/L	0.005	0.0005	ND	ND	ND	ND
1,3-Dichloropropene	mg/L	0.0005	0.0005	ND	ND	ND	ND
Ethylbenzene	mg/L	0.3	0.0005	ND	ND	ND	ND
Methyl tert butyl ether (MTBE)	mg/L	0.013/0.005	0.003	ND	ND	ND	ND
Monochlorobenzene	mg/L	0.07	0.0005	ND	ND	ND	ND
Styrene	mg/L	0.1	0.0005	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	mg/L	0.001	0.0005	ND	ND	ND	ND
Tetrachloroethylene (PCE)	mg/L	0.005	0.0005	ND	ND	ND	ND
Toluene	mg/L	0.15	0.0005	ND	ND	ND	ND
1,2,4-Trichlorobenzene	mg/L	0.005	0.0005	ND	ND	ND	ND

Parameter	Units	CDPH MCL/NL	CDPH DLR	1st Quarter 2/24/2009	2nd Quarter 5/19/2009	3rd Quarter 8/11/2009	4th Quarter 11/10/2009
1,1,1-Trichloroethane (1,1,1-TCA)	mg/L	0.2	0.0005	ND	ND	ND	ND
1,1,2-Trichloroethane (1,1,2-TCA)	mg/L	0.005	0.0005	ND	ND	ND	ND
Trichloroethylene (TCE)	mg/L	0.005	0.0005	ND	ND	ND	ND
Trichlorofluoromethane (Freon 11)	mg/L	0.15	0.005	ND	ND	ND	ND
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	mg/L	1.2	0.01	ND	ND	ND	ND
Vinyl Chloride	mg/L	0.0005	0.0005	ND	ND	ND	ND
m,p-Xylenes	mg/L	--	0.0005	ND	ND	ND	ND
o-Xylenes	mg/L	--	0.0005	ND	ND	ND	ND
Total Xylenes	mg/L	1.75	--	ND	ND	ND	ND
n-Butylbenzene	mg/L	0.26	0.0005	ND	ND	ND	ND
sec-Butylbenzene	mg/L	0.26	0.0005	ND	ND	ND	ND
tert-Butylbenzene	mg/L	0.26	0.0005	ND	ND	ND	ND
Carbon disulfide	mg/L	0.16	0.0005	ND	ND	ND	ND
2-Chlorotoluene	mg/L	0.14	0.0005	ND	ND	ND	ND
4-Chlorotoluene	mg/L	0.14	0.0005	ND	ND	ND	ND
Dichlorodifluoromethane (Freon 12)	mg/L	1	0.0005	ND	ND	ND	ND
Isopropylbenzene	mg/L	0.77	0.0005	ND	ND	ND	ND
Methyl isobutyl ketone (MIBK)	mg/L	0.12	0.005	ND	ND	ND	ND
Naphthalene	mg/L	0.017	0.0005	ND	ND	ND	ND
n-Propylbenzene	mg/L	0.26	0.0005	ND	ND	ND	ND
1,2,4-Trimethylbenzene	mg/L	0.33	0.0005	ND	ND	ND	ND
1,3,5-Trimethylbenzene	mg/L	0.33	0.0005	ND	ND	ND	ND
Non-Volatile Synthetic Organic Chemicals (SOCs)							
Dibromochloropropane (DBCP)	mg/L	0.0002	0.00001	ND		ND	

Parameter	Units	CDPH MCL/NL	CDPH DLR	1st Quarter 2/24/2009	2nd Quarter 5/19/2009	3rd Quarter 8/11/2009	4th Quarter 11/10/2009
Ethylene Dibromide (EDB)	mg/L	0.00005	0.00002	ND		ND	
Chlordane	mg/L	0.0001	0.0001	ND		ND	
Dieldrin	mg/L	--	0.00002	ND	ND	ND	ND
Endrin	mg/L	0.002	0.0001	ND		ND	ND
Heptachlor	mg/L	0.00001	0.00001	ND		ND	
Heptachlor Epoxide	mg/L	0.00001	0.00001	ND		ND	
Polychlorinated Biphenyls (PCBs)	mg/L	0.0005	0.0005	ND		ND	
Toxaphene	mg/L	0.003	0.001	ND		ND	
2,4-Dichlorophenoxyacetic acid (2,4-D)	mg/L	0.07	0.01	ND		ND	
2,4,5-TP (Silvex)	mg/L	0.05	0.001	ND		ND	
Bentazon	mg/L	0.018	0.002	ND		ND	
Dalapon	mg/L	0.2	0.001	ND		ND	
Dinoseb	mg/L	0.007	0.002	ND		ND	
Pentachlorophenol	mg/L	0.001	0.0002	ND		ND	
Picloram	mg/L	0.5	0.001	ND		ND	
Alachlor	mg/L	0.002	0.001	ND	ND	ND	ND
Atrazine	mg/L	0.001	0.0005	ND	ND	ND	ND
Benzo(a)pyrene	mg/L	0.0002	0.0001	ND	ND	ND	ND
Di(2-ethylhexyl)adipate	mg/L	0.4	0.005	ND	ND	ND	ND
Di(2-ethylhexyl)phthalate	mg/L	0.004	0.003	ND	ND	ND	ND
Hexachlorobenzene	mg/L	0.001	0.0005	ND	ND	ND	ND
Hexachlorocyclopentadiene	mg/L	0.05	0.001	ND	ND	ND	ND
Lindane	mg/L	0.0002	0.0002	ND	ND	ND	ND
Methoxychlor	mg/L	0.03	0.01	ND	ND	ND	ND
Molinate	mg/L	0.02	0.002	ND	ND	ND	ND
Simazine	mg/L	0.004	0.004	ND	ND	ND	ND

Parameter	Units	CDPH MCL/NL	CDPH DLR	1st Quarter 2/24/2009	2nd Quarter 5/19/2009	3rd Quarter 8/11/2009	4th Quarter 11/10/2009
Thiobencarb	mg/L	0.07/0.001	0.001	ND	ND	ND	ND
Propachlor	mg/L	0.09	0.0005	ND	ND	ND	ND
Carbofuran	mg/L	0.018	0.005	ND		ND	
Oxamyl	mg/L	0.05	0.02	ND		ND	
Glyphosate	mg/L	0.7	0.025	ND		ND	
Endothall	mg/L	0.1	0.045	ND		ND	
Diquat	mg/L	0.02	0.004	ND		ND	
2,3,7,8-TCDD (Dioxin)	mg/L	3.E-08	5.E-09	ND		ND	
Radionuclides							
Gross Alpha Particle	pCi/L	15	3	ND ± 1.16	8.82 ± 1.97	14.5±1.7	10.3±1.8
Uranium	mg/L	--	--	<0.02		0.0022	<0.004
Uranium	pCi/L	20	1	<13.4		1.5	<2.7
Beta/photon emitters (K40 adjusted)	pCi/L	4 mrem/yr	4	ND	ND	81±78	
Radium-226	pCi/L	--	1	ND ± 0.46	ND ± 0.41	ND±0.39	ND±0.17
Radium-228	pCi/L	--	1	1.11 ± 0.33	2.07 ± 0.64	2.48±0.76	2.50±0.54
Radium-226 + Radium 228	pCi/L	5	--	1.11 ± 0.57	2.07 ± 0.76	2.48±0.85	2.5±0.57
Strontium-90	pCi/L	8	2	ND ± 1.18		0.46±0.27	1.96±1.79
Tritium	pCi/L	20,000	1,000	ND ± 128		ND±144	ND±119
Contaminants with CDPH Notification Level (NL) not covered under previously identified method							
Boron	mg/L	1	0.1	4.7	4.7	4.7	4.3
Chlorate	mg/L	0.8	0.02	<0.05		<0.2	
Acetaldehyde	mg/L	--	--	0.0013	ND	ND	ND
Formaldehyde	mg/L	0.1	--	ND	ND	ND	ND
N-Nitrosodiethylamine (NDEA)	mg/L	1.E-05	--	ND		ND	
N-Nitrosodimethylamine (NDMA)	mg/L	1.E-05	--	ND		ND	

Parameter	Units	CDPH MCL/NL	CDPH DLR	1st Quarter 2/24/2009	2nd Quarter 5/19/2009	3rd Quarter 8/11/2009	4th Quarter 11/10/2009
N-Nitrosodi-n-propylamine (NDPA)	mg/L	1.E-05	--	ND		ND	
Tertiary butyl alcohol (TBA)	mg/L	0.012	0.002	ND		ND	
1,2,3-Trichloropropane (1,2,3-TCP)	mg/L	5E-06	5E-06	ND		ND	
2,4,6-Trinitrotoluene (TNT)	mg/L	0.001	--	ND		ND	
Vanadium	mg/L	0.05	0.003	<0.015		0.012	0.026
1,4-Dioxane	mg/L	0.003	0.003	ND		ND	
Ethylene glycol	mg/L	14	--	ND		ND	
RDX	mg/L	0.0003	--	ND		ND	
HMX	mg/L	0.35	--	ND		ND	

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