



# Proposed scwd<sup>2</sup> Desalination Project Watershed Sanitary Survey

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## **EXECUTIVE SUMMARY**

The City of Santa Cruz Water Department (SCWD) and the Soquel Creek Water District (District) established the **scwd**<sup>2</sup> Desalination Program to jointly pursue the development of the proposed Seawater Reverse Osmosis (SWRO) Desalination Plant. The proposed plant would have the capacity to provide up to 2.5 million gallons per day (mgd) of drinking water. The SCWD relies on surface water supplies that would be supplemented during drought conditions with up to 2.5 mgd of water from the proposed SWRO plant. The District relies on groundwater supplies that are threatened by seawater intrusion due to pumping that exceeds the natural replenishment rate of the aquifers. When the SCWD does not need supplemental water from the SWRO plant, the District may operate the facility up to 2.5 mgd to meet the system water needs and reduce groundwater pumping to help restore protective levels to prevent seawater intrusion. The District would receive water from the SCWD's other surface water supplies and those supplies would be replaced with an equal amount of desalinated water entering the City's distribution system. Once the aquifers have been recharged, the District would continue to exchange desalinated water for the SCWD's surface water supplies at lesser amounts to supplement its groundwater sources while retaining safe aquifer levels.

The California Surface Water Treatment Rule requires water supply systems using surface water sources (which is how ocean waters are classified) to conduct a sanitary survey of the watershed and to update the sanitary survey every five years. This Watershed Sanitary Survey was conducted to identify the potential sources of contaminants in the watershed draining to Monterey Bay in the vicinity of the proposed intake for the SWRO plant and to investigate the quality of the source water that would be drawn into the plant. At the time of this writing, the proposed intake is an abandoned pipeline located off the coast of Santa Cruz in approximately 40 feet of water. Modifications to this pipeline would be made including appropriate rehabilitation of the pipeline itself as well as installation of exclusion screens. The City and District are also investigating the possibility of a sub-seafloor intake between the San Lorenzo River and the Santa Cruz Municipal Wharf. However, for the purposes of this study, the abandoned pipeline was assumed to be the location of the intake. Should an intake of a different configuration or location be approved for this project, modifications to this Watershed Sanitary Survey would be needed.

### **DELINEATION OF THE WATERSHED**

For most surface water sources, the watershed is easily defined as the land area draining to the intake. For a seawater source, the watershed is not as easily defined. The terrestrial watershed for the proposed **scwd**<sup>2</sup> SWRO Desalination Plant has been defined as the watersheds of the San Lorenzo River, Soquel Creek, and several small creeks that drain directly to Monterey Bay in the vicinity of Santa Cruz. The Monterey Bay part of the watershed was defined as the near shore area in the vicinity of the proposed intake receiving drainage from the terrestrial watershed and extending about 1.5 miles from the coast to encompass the Santa Cruz Wastewater Treatment Facility (WWTF) outfall, which is located 2 miles southwest of the proposed intake.

The watershed delineation was based primarily on the SEDXPORT hydrodynamic model (Jenkins and Wasyl, 2010). The model examined the potential for the discharges of the San Lorenzo, Pajaro, and Salinas rivers, and Soquel Creek, to reach the proposed intake. The modeling results show that discharges from the Pajaro and Salinas rivers do not reach the proposed intake, even when worst case conditions are modeled. Discharge from the San Lorenzo River has the most potential to reach the intake. Due to the proximity of Soquel Creek, the Soquel Creek watershed was also included in the watershed. Several small creeks that drain to Monterey Bay in the vicinity of the proposed intake and immediately to the west of the proposed intake were also included in the watershed. The watershed is shown in **Figure 2-1** and described in more detail in **Section 2**.

## POTENTIAL CONTAMINANT SOURCES

The potential contaminant sources in the watershed can be divided into those that are present in Monterey Bay and those that are present in the terrestrial part of the watershed. Contaminant sources in Monterey Bay can potentially impact water quality at any time. Contaminant sources in the watersheds of the San Lorenzo River, Soquel Creek, and the other smaller creeks can potentially impact water quality only when the flows in these streams are sufficiently high to transport contaminants from the terrestrial watershed to the bay. **Section 3** contains a detailed discussion of the contaminant sources in the watershed and an evaluation of their ability to impact water quality at the proposed intake location.

### Potential Contaminant Sources in Monterey Bay

The potential contaminant sources that are present in Monterey Bay are:

- ◆ Wastewater discharged to the bay
- ◆ Hazardous materials spills in the bay
- ◆ Marine mammals and birds
- ◆ Recreational boating and commercial fishing
- ◆ Santa Cruz Harbor dredging and disposal of dredged materials
- ◆ Large commercial vessels
- ◆ Cruise ships
- ◆ Harmful algal blooms

### *Wastewater Discharged to the Bay*

The City discharges approximately 10 mgd (average dry weather flow) of secondary treated wastewater to Monterey Bay via an ocean outfall that is two miles southwest from the proposed intake location. In addition, the City of Scotts Valley discharges approximately 1 mgd (average dry weather flow) through this same outfall. Water quality monitoring conducted at the proposed intake and several near shore sites in the vicinity of the proposed intake shows that fecal indicator bacteria levels are generally less than 10 most probable number per 100 milliliters (MPN/100 ml). A hydrodynamic modeling study conducted for this Watershed Sanitary Survey predicts that the combined wastewater and brine from the full-scale SWRO plant will be diluted

by at least 125,000 to 1 at the proposed intake location (Jenkins and Wasyl, 2010). The monitoring program data indicate that the treated wastewater discharge does not currently impact water quality at the proposed intake location. The modeling study predicts that the combined wastewater and brine discharge will not adversely impact water quality at the intake to the proposed SWRO plant.

### ***Hazardous Materials Spills in the Bay***

There were no significant spills that occurred near the proposed intake during the 2004 through 2009 period evaluated in this Watershed Sanitary Survey. There were seven incidents when oil sheens were observed in Monterey Bay, but the causes were not identified. The monitoring conducted at the intake showed no indication that unreported spills had affected water quality. Most organic chemicals were below the detection limits and the two that were detected were present at concentrations well below the maximum contaminant levels (MCLs). The fecal indicator bacteria levels were low, indicating that if there were unreported spills of sewage from boating activities they did not impact water quality at the proposed intake. It is unlikely that a spill of sufficient volume would occur near the proposed intake and be mixed down to the likely 30-foot depth of the intake. There is, however, always the remote possibility that a catastrophic boating accident could result in a spill that reaches the proposed intake.

### ***Marine Mammals and Birds***

Marine mammals and birds contribute fecal indicator bacteria, and possibly human pathogens, to Monterey Bay. A study on the sources of bacterial contamination at Santa Cruz County beaches found that birds contributed 71.1 percent of the indicator bacteria at the beaches in the summer and 65.1 percent in the winter. Marine mammals contributed 3.9 percent in the summer and 1.6 percent in the winter (County of Santa Cruz, 2006). Water quality monitoring conducted at the proposed intake shows that fecal indicator bacteria levels are low (generally less than 10 MPN/100 ml). Marine mammals and birds do not pose a significant hazard to water quality at the proposed intake. Fecal matter deposited in the vicinity of the proposed intake will be quickly diluted by the large volume of water moving through the bay naturally and carried away from the intake.

### ***Recreational Boating and Commercial Fishing***

The Santa Cruz Harbor, located over two miles east of the proposed intake, houses approximately 1,300 vessels, including commercial fishing boats, cruising boats, and racing sailboats. Activities at the harbor are not likely to affect water quality at the proposed intake due to the distance between the harbor and the intake. Minor amounts of illegally discharged sewage from boats in the vicinity of the proposed intake will not likely affect water quality because the intake will be located 30 feet below the surface in an area of high energy that facilitates mixing.

### ***Santa Cruz Harbor Dredging***

The Santa Cruz Harbor was dredged in 2008 and 2009, as it is every year between November and April, to remove sand that accumulates in the harbor and at its entrance. The dredged

material from the harbor entrance is typically deposited at Twin Lakes State Beach. Dredged material from the inner harbor is disposed near shore, offshore near Moss Landing, or in a landfill. The turbidity data collected continuously at the proposed intake between February 2008 and February 2009 showed that turbidity levels are generally less than 10 nephelometric turbidity units (NTU), except during storm events. There was no indication that dredging of the harbor affected turbidity, organics, or metals concentrations at the proposed intake location. Due to the distance of the harbor (two miles) and the distance of the dredged spoils offshore disposal site near Moss Landing (about ten miles) from the proposed intake location, combined with the limitations placed on the disposal of contaminated sediments, the dredging and disposal operation is not a threat to water quality at the proposed intake.

### ***Large Commercial Vessels***

Large commercial vessels, such as oil tankers and container ships, travel along the California coast. Due to concerns that spills from these ships could adversely impact the Monterey Bay National Marine Sanctuary (MBNMS), shipping lanes were moved further off the coast in 2000. The closest lane is 29 miles off the coast. Illegal or accidental discharges from large vessels will not likely impact water quality at the proposed intake due to the distance between the intake and the nearest shipping lane.

### ***Cruise Ships***

Cruise ships pass through the MBNMS and dock near Monterey, but not near Santa Cruz. Existing MBNMS regulations prohibit discharges from cruise ships. Illegal or accidental discharges from cruise ships will not likely impact water quality at the proposed intake because they do not dock in the vicinity of the intake.

### ***Harmful Algal Blooms***

Harmful algal blooms occur in Monterey Bay every year, primarily in the summer and fall months. *Pseudo-nitzschia*, a diatom, produces domoic acid which is a powerful neurotoxin. *Alexandrium catenella*, a dinoflagellate, produces saxitoxin. Algal toxins produced during these blooms are primarily contained in the algal cells, with low levels dissolved in water. The California Department of Public Health (CDPH) expressed concern that harmful levels of the toxins could be present in the source water to the SWRO plant and that the toxins present in the algal cells could be released into the water due to algal cell leakage and breakage during filtration. An algal toxin spiking study conducted at the pilot plant showed that the reverse osmosis (RO) membranes removed 99.5 percent of the algal toxins present in the source water (CDM, 2010). The full-scale SWRO plant will be designed to remove any algal toxins present in the source water or derived from cell damage in the water treatment plant.

## Potential Contaminant Sources in the Terrestrial Watershed

The potential contaminant sources that are present in the watersheds of the San Lorenzo River, Soquel Creek, and the smaller creeks that drain to the near shore ocean in the vicinity of the proposed intake are:

- ◆ Urban runoff
- ◆ Wastewater discharged to land
- ◆ Agricultural activities
- ◆ Timber harvesting
- ◆ Wildfires
- ◆ Hazardous materials spills
- ◆ Domestic and wild animals

### *Urban Runoff*

The San Lorenzo River and Soquel Creek are the main conduits for transporting urban runoff to the near shore ocean. The lower portions of these watersheds are heavily urbanized. There are also areas in the project watershed that drain directly to the near shore ocean. The pathogen Total Maximum Daily Load (TMDL) report identified urban runoff as a significant contributor of fecal indicator bacteria in the San Lorenzo River (California Regional Water Quality Control Board, Central Coast Region, 2009a).

Hydrodynamic modeling conducted for this Watershed Sanitary Survey indicated that 95 percent of the modeling outcomes predicted storm water dilution factors at the depth of the intake in excess of 3,000 to 1. Under maximum discharge conditions and with ocean conditions most likely to transport discharges from the San Lorenzo River and Soquel Creek toward the proposed intake, the dilution at the proposed intake is predicted to be 1,050 to 1. The monitoring conducted at the proposed intake location showed that fecal indicator bacteria are generally low (less than 10 MPN/100 ml). The minor amount of urban runoff that reaches the proposed intake location results in slightly elevated fecal indicator bacteria during storm events. This will not, however, create any operational problems for the proposed SWRO plant due to the ability of treatment processes to easily remove and inactivate low levels of bacteria in the source water.

### *Wastewater Discharged to Land*

The majority of residences and businesses in the upper San Lorenzo River and Soquel Creek watersheds are on septic systems. There are also a number of small package plants that discharge to land in the upper watershed. Septic systems can impact surface water during or following wet periods when runoff can convey surfacing sewage from failing systems into surface water bodies. The pathogen TMDL and the nitrate TMDL for the San Lorenzo River identified septic systems as significant contributors of fecal indicator bacteria and nitrate to the San Lorenzo River (California Regional Water Quality Control Board, Central Coast Region, 2009a and 2003). The fecal indicator bacteria and nitrate associated with septic systems are carried to the near shore ocean during storm events. As discussed in the Urban Runoff section, there is sufficient dilution between the mouths of the San Lorenzo River and Soquel Creek and

the proposed intake that contaminants carried to the ocean during storm events do not adversely impact water quality at the proposed intake.

### ***Agricultural Activities***

Agricultural activities comprise only three percent of land use in the watershed. Most of the agricultural land is along the marine terraces west of the City. The minor amounts of irrigation water and wet weather runoff from these lands do not impact water quality at the proposed intake.

### ***Timber Harvesting***

A large amount of the watershed is forest land and timber harvesting occurs in much of the upper watershed. Timber harvesting roads are significant contributors to the sediment load in the San Lorenzo River. The sediment TMDL requires a 53 percent reduction in the sediment load associated with timber harvesting roads by 2028 (California Regional Water Quality Control Board, Central Coast Region, 2003). The sediment and other contaminants associated with timber harvesting are carried to the near shore ocean during storm events. As discussed in the Urban Runoff section, there is sufficient dilution between the mouths of the San Lorenzo River and Soquel Creek and the proposed intake that contaminants carried to the ocean during storm events do not adversely impact water quality at the proposed intake.

### ***Wildfires***

The majority of the watershed is classified as moderate and high severity risk for wildfires by the California Department of Forestry and Fire Protection. Wildfires generally occur in the watershed during the summer and fall months and water quality impacts generally occur the following winter when fire-burned areas are eroded during storms and contaminants are carried to the rivers, creeks, and Monterey Bay. As discussed in the Urban Runoff section, there is sufficient dilution between the mouths of the San Lorenzo River and Soquel Creek and the proposed intake that contaminants carried to the ocean during storm events do not adversely impact water quality at the proposed intake.

### ***Hazardous Materials Spills***

Although there is always the potential for a large spill of sewage or other hazardous material to occur in the watershed, there were no significant spills in the 2004 through 2009 period. It is unlikely that even a large spill in the terrestrial watershed that reached Monterey Bay would affect water quality at the proposed intake due to the dilution capacity of the bay.

### ***Domestic and Wild Animals***

There are a number of domestic and wild animals present in the watershed. The study on the sources of bacteria at Santa Cruz County beaches found that animals contribute 78 percent of the fecal indicator bacteria at the mouth of the San Lorenzo River and 88 percent at the mouth of Soquel Creek (County of Santa Cruz, 2006). Although wild animals, particularly birds, were

found to be the major source of fecal contamination at the mouths of the river and creek, they do not pose a significant hazard to water quality at the proposed intake. As discussed in the Urban Runoff section, there is sufficient dilution between the mouths of the San Lorenzo River and Soquel Creek and the proposed intake that contaminants carried to the ocean during storm events do not adversely impact water quality at the proposed intake.

## WATER QUALITY

### Monitoring Program

Extensive water quality testing was conducted at the proposed intake location over a two-year period. Samples were analyzed for general physical/chemical constituents, inorganic chemicals, organic chemicals, and microbiological contaminants. A comprehensive SWRO pilot plant testing program was conducted to evaluate alternative treatment systems for the proposed SWRO plant. **Section 4** contains a detailed discussion of the water quality monitoring program and an evaluation of the water quality data.

### Compliance with Maximum Contaminant Levels

The monitoring showed that under most conditions, water quality at the proposed intake location is free of most inorganic and organic contaminants and contains low levels of fecal indicator bacteria and *Giardia* and no *Cryptosporidium*. As discussed previously, turbidity and fecal indicator bacteria are slightly elevated during storm events. All contaminants, except perchlorate (one sample) and gross beta particle radioactivity (naturally-occurring in seawater), were below the primary MCLs established by CDPH in samples collected at the proposed intake. As expected in seawater, the concentrations of total dissolved solids, chloride, and sulfate are substantially higher than the secondary MCLs.

### Pathogen Removal Requirements

CDPH has established trigger levels that require additional log removal of pathogens in water treatment plants. The monitoring conducted for this Watershed Sanitary Survey showed that the monthly median total coliform levels are well below the 1,000 MPN/100 ml trigger, and the fecal coliform and *Escherichia coli* levels are consistently well below the 200 MPN/100 ml trigger. *Giardia* was detected twice at 0.1 cysts/L, producing an annual average of 0.009 cysts/L during both years of monitoring. This is below the 0.01 cysts/L trigger for additional treatment. *Cryptosporidium* was not detected during two years of monthly monitoring.

## **FINDINGS AND RECOMMENDATIONS**

The only contaminant source investigated that could significantly affect the quality of water taken into the SWRO plant to such a degree that the plant may need to shut down is a hazardous materials spill in the vicinity of the proposed intake. While large algal blooms in the vicinity of the proposed intake and large storm events may result in some degradation of water quality at the proposed intake, the SWRO plant will be designed to handle these more challenging water quality conditions. No other contaminant sources investigated in this Watershed Sanitary Survey are likely to impact water quality at the proposed intake location.

### **Hazardous Materials**

#### ***Finding***

Large spills of petroleum hydrocarbons or untreated sewage in the vicinity of the proposed intake could adversely affect the quality of water entering the SWRO plant.

#### ***Recommendation***

The SCWD staff should meet with staff of the Hazardous Materials/Wastes Program of the Santa Cruz County Environmental Health Services Department to provide them with information on the intake location and request immediate notification of any spills in the vicinity of the intake. This should be done before the SWRO plant starts operating. If a spill occurs in the vicinity of the proposed intake, the staff can then determine if it is necessary to stop taking water into the plant or if additional monitoring of plant performance is needed to ensure the spill does not adversely affect the plant and the finished water quality.

### **Harmful Algal Blooms**

#### ***Finding***

Large algal blooms result in high concentrations of organic carbon and suspended solids that will create more challenging treatment conditions for the proposed SWRO plant. Harmful algal blooms will not result in any additional challenges.

#### ***Recommendation***

While the settling tanks, pretreatment filters, and RO membranes will be designed to handle algal blooms and remove algal toxins, measures can be taken to minimize the impact on the proposed SWRO plant.

Algal blooms generally start near shore and move outward in the bay, so the monitoring that is conducted at the Santa Cruz Municipal Wharf by researchers at the University of California, Santa Cruz (UCSC) can provide an early warning sign that an algal bloom may occur at the proposed intake location. Staff should contact researchers at UCSC to determine if an

arrangement can be made to have SCWD staff notified when algal blooms or algal toxins are detected at the wharf.

Dinoflagellates such as *Alexandrium catenella*, are strong vertical migrators. The algae are generally at the surface mid-day and at depths of 30 to 60 feet at night. Since the proposed intake will likely be about 30 feet deep, there is a greater probability of dinoflagellate blooms being at that depth at night. Design and operation of the SWRO plant should take this into consideration.

## **Storm Events**

### ***Finding***

The hydrodynamic model predicts that storm runoff from the terrestrial watershed will not significantly affect water quality at the proposed SWRO plant intake.

### ***Recommendation***

While it is unlikely that water quality will be significantly degraded at a depth of 30 feet during storm events, the SCWD should monitor raw water quality for the full suite of microbial, inorganic and organic contaminants during at least two significant storm events in the first couple of years that the SWRO plant is operating. This monitoring is needed to confirm that runoff from the watershed is not contributing contaminants at levels of concern.

## **Wastewater Discharged to Monterey Bay**

### ***Finding***

Treated wastewater discharged to Monterey Bay via an ocean outfall that is two miles southwest of the proposed intake location does not currently impact water quality and the combined wastewater and brine discharge from the full-scale SWRO plant will not adversely impact water quality at the proposed intake location.

### ***Recommendation***

While the discharge of treated wastewater does not pose a threat to water quality at the proposed intake location, staff should request that the Santa Cruz WWTF staff immediately notify SCWD staff if there are any operational problems at the WWTF that could adversely affect the quality of the effluent discharged to the Bay. The SCWD staff should also request the same notification from the Scotts Valley Wastewater/Recycling Department staff.

## **Other Potential Contaminant Sources in Monterey Bay**

### ***Finding***

Marine mammals and birds, recreational boating and commercial fishing, Santa Cruz Harbor dredging, large commercial vessels, and cruise ships will not adversely impact water quality at the proposed SWRO plant intake.

## **Potential Contaminant Sources in the Terrestrial Watershed**

### ***Finding***

There are a number of potential contaminant sources in the terrestrial watershed that contribute contaminants to the near shore ocean during storm events; however, the hydrodynamic modeling predicts that the discharges from the San Lorenzo River and Soquel Creek will not adversely affect water quality at the proposed intake. This was confirmed by the water quality monitoring program conducted between 2008 and 2010.

## **Compliance with Maximum Contaminant Levels**

### ***Finding***

Monterey Bay is a high quality source of water that is largely free of contaminants.

### ***Recommendation***

As discussed previously, storm events should be monitored during the first two years of the SWRO plant operation. Perchlorate was detected in the first sample collected at the proposed intake shortly after a January 2008 storm event. Although it was never detected again at the intake or in the RO permeate from the pilot plant, it should be included in the monitoring program to confirm that perchlorate is not present at the proposed intake location.

## **Pathogen Removal Requirements**

### ***Finding***

Based on the monitoring program data and the survey of potential contaminant sources in the watershed, 2-log removal/inactivation of *Cryptosporidium*, 3-log removal/inactivation of *Giardia*, and 4-log removal/inactivation of viruses is adequate to protect public health.

### ***Recommendation***

Based on the results of the monitoring program and the findings on contaminant sources present in the watershed, 2-log *Cryptosporidium*, 3-log *Giardia*, and 4-log virus removal and inactivation are recommended for the SWRO plant.

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