RECLAMATION

Managing Water in the West

Desalination and Water Purification Research and Development Program Report No. 194

Pilot Testing Program for the Potential Camp Pendleton Seawater Desalination Project

U.S. Department of the Interior
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Jeremy Crutchfield – Principal Engineer
Eric Rubalcava – Senior Water Resource Specialist

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San Diego County Water Authority
4677 Overland Ave.
San Diego, CA 92123

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14. ABSTRACT
The Camp Pendleton Seawater Intake Testing Program (Project) was designed to test both a screened (wedge-wire) open ocean and subsurface intake to determine the differences in water quality and pre-treatment requirements for a screened open ocean intake versus a subsurface intake. This project would have also analyzed the economic trade-offs between higher capital costs for full-scale installation of a subsurface intake versus the higher capital and operations and maintenance (O&M) costs associated with the pre-treatment facilities for a screened open ocean intake. The project encountered two issues that were not anticipated:

1) Applicability of the recently adopted California Ocean Plan Amendment (OPA) focusing on seawater desalination intake and discharge facilities

2) Expectations for environmental documentation through the California Environmental Quality Act (CEQA) process.

The Water Authority withdrew its application for State Lands approval and decided to terminate the Pilot Testing Program for the Potential Camp Pendleton Seawater Desalination Project due to extraordinary permitting challenges.

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Prepared for the Bureau of Reclamation Under Agreement No. R14AP00154

by
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Water Resources Department
4677 Overland Avenue
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Mission Statements

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Disclaimer

Acknowledgments

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- Bureau of Reclamation
- United States Marine Corps – Marine Corps Installation West – Marine Corps Base – Camp Pendleton
- U.S. Army Corps of Engineers
- California Department of Water Resources
- Michael Baker International
- Separation Process Inc.
- Trussell Technologies

Acronyms and Abbreviations

BCR	BCR Consulting
BMP	Best Management Practices
Camp Pendleton	Camp Pendleton Marine Corps Base
CE	Categorical Exclusion
CCC	California Coastal Commission
CDP	Coastal Development Permit
CEQA	California Environmental Quality Act
EFH	Essential Fish Habitat
ES	Camp Pendleton Environmental Security Office
FRP	fiberglass reinforced plastic
GIS	Geographic Information System
GMF	granular media filter
HDD	horizontal directional drilling
HDPE	high-density polyethylene
HMI	human-machine interface
HVAC	heating, ventilation, and air conditioning
INRMP	Pendleton's Integrated Natural Resources Management Plan
ISO	International Standards Organization
IWS	Integrated Water Services Inc.
MBC	MBC Aquatic Sciences
MBI	Michael Baker International Inc.
MCTSSA	Marine Corps Tactical Systems Support Activity
MOU	Memorandum of Understanding
MWDOC	Municipal Water District of Orange County
NAVFAC	Naval Facilities Engineering Command
NEPA	National Environmental Protection Act
NPDES	National Pollutant Discharge Elimination System
NMFS	National Marine Fisheries Services
NTP	Notice to Proceed
NWP7	Nationwide Permit 7 under Section 404 of the Clean Water Act
O&M	operations and maintenance
OHL	overhead power lines
OPA	Ocean Plan Amendment
PAMS	Process and Management Support Module
PLC	programmable logic controller
Project	Camp Pendleton Seawater Intake Testing Program
PWP	Permitting Work Plan
REIR	Request for Environmental Impact Review
RWQCB	Regional Water Quality Control Board
SCE	Southern California Edison
SDI	silt density index
SE	Statutory Exemption
SLC	California State Lands Commission
SMR	Santa Margarita River

SPI	Separation Process Inc.
SRTTP	Southern Region Tertiary Treatment Plant
SONGS	San Onofre Nuclear Generating Station
SWRO	seawater reverse osmosis
TOC	total organic compounds
TPP	Test Plan Protocol
TSS	total suspended solids
TT	Trussell Technologies
USACE	U.S. Army Corps of Engineers
USA	Underground Services Alert
Water Authority	San Diego County Water Authority
WRD	Camp Pendleton Base Water Resource Division

Measurements

AFY	acre-feet per year
dB	decibels
ft	feet
gpm	gallon per minute
mgd	million gallons per day
mg/L	milligrams per liter
mm	millimeter
sec	second

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Executive Summary

The San Diego County Water Authority (Water Authority) was pursuing the Camp Pendleton Seawater Intake Testing Program (Project) to test both a screened (wedge-wire) open ocean and subsurface intake. It is generally understood that the feedwater from a subsurface intake requires less pre-treatment prior to SWRO than seawater taken from a screened open-ocean intake. The study would have tested the pre-treatment process to determine effective methods to produce high-quality feedwater from each type of intake for the reverse osmosis (RO) desalination treatment process. While the study was not focused on the actual operating capability of the intakes themselves, the intake systems would have been monitored for pressure and power anomalies associated with intake performance (i.e. clogging, etc.), recorded, and analyzed. The project accomplished the production of a detailed final test plan and construction drawings that could be beneficial for future projects. There were also additional lessons learned about working through California’s challenging permitting process for seawater treatment projects.

Problem and Need

To some extent, the amendments to the California Ocean Plan in May 2015 clarify the regulatory framework for seawater desalination project intakes and brine discharges. However, no seawater desalination project has tested these amendments with permit applications, so intake and discharge practitioners expect that the amendments will be interpreted and perhaps modified in coming years. The amendments favor subsurface intakes to the extent that an applicant must first demonstrate that a subsurface intake is not feasible before proceeding to proposing a screened open ocean intake. Also, an applicant must first implement and use a subsurface intake to the maximum practical extent. A screened open ocean intake can then be considered to provide the additional capacity for the project.

Purpose

The purpose of this research was to reduce the cost of seawater desalination while minimizing environmental impacts. The Water Authority desired to undertake the Project to accomplish the following goals:

1. Determine the differences in water quality and pre-treatment requirements for a screened open ocean intake versus a subsurface intake

2. Understand the economic trade-offs between higher capital costs for full-scale installation of a subsurface intake versus the higher capital and operations and maintenance (O&M) costs associated with the pre-treatment facilities for a screened open ocean intake.

3. Disseminate the information obtained to the regulatory community, stakeholders, and the public

Status

Due to the difficulty of obtaining the required permits, the project was cancelled at the 90 percent design stage, with equipment procured.

1. Introduction

The Intake Testing Program will provide essential information that will guide the selection of an intake configuration and pretreatment processes for the full-scale desalination project. The Intake Testing Program will be designed to provide information regarding the effectiveness of each of the intake and process alternatives with respect to operating cost, energy use, water quality and robustness of the process to withstand algal blooms or high turbidity events. The performance of the pretreatment alternatives will be compared with the pretreatment requirements (if any) for feedwater produced by the pilot subsurface intake. The information generated from pilot testing will be used to refine capital and operating costs for each intake option. The Water Authority has completed a series of feasibility and technical studies allowing for the phased implementation of a SWRO project with an initial capacity of 50 MGD, potentially expanding to an ultimate capacity of 150 MGD. The project would consist of intake facilities, brine discharge facilities, and a desalination plant at one of two locations on MCBCP.

1.1. Participants and Partnerships

The Water Authority and Marine Corps Base Camp Pendleton executed a Memorandum of Understanding (MOU) (M0-2214-20151109-0092) to establish the framework for cooperation to conduct the Seawater Intake Testing Program.

Camp Pendleton has a complete interest in all aspects of activities that occur on the Base, as it must ensure that any activities do not conflict, impede, or interfere with Camp Pendleton's primary mission of training the operational force. Camp Pendleton understands the need for an adequate supply of water for regional needs, and therefore, desires to cooperate with the Water Authority as provided in the MOU.

1.2. Project Needs and Objectives

The proposed Intake Plant would have a feedwater intake capacity of 40 gallons per minute. The Water Authority, with support from MCBCP representatives, has identified potential pilot plant sites in the Del Mar beach area of the Base. Water Authority staff will coordinate with MCBCP to determine the preferred location and final approval of the pilot plant site. A critical component and challenge of the testing program is to obtain a suitable source of ocean water that will closely represent the water that would be drawn into the full-scale plant from either wedge-wire screen installed on the ocean floor, or from a subsurface intake system installed beneath the ocean floor. To obtain feedwater that would be representative of these two types of intakes, the recommended intake facilities for the pilot program will (1) use a Neodren Pipeline (porous pipeline) system for the subsurface intake, and (2) install a pilot-sized wedge wire screen approximated 40 feet in depth approximately 3,000 from the shoreline.

During the initial six months of the operational testing period, feedwater will be obtained from the ocean intakes and processed in parallel through two parallel pretreatment trains. Pre- treatment processes to be tested include disc filter, flocculation, GMF and SWRO. Following this initial period, the trains will be modified for continued testing on feedwater from the subsurface intake.

1.2.1. Needs

An extensive literature search was conducted to investigate research on open ocean and subsurface intake options using the same source water. Among the nine pilot studies found that were recently conducted in California, none appear to have simultaneously pilot tested an open ocean and subsurface intake to determine the long-term viability of the intake and the subsequent pretreatment needs based on feedwater quality. Simultaneous testing guarantees that both intake technologies are seeing the same source water, an important factor when comparing technologies. Therefore, there is a research need for simultaneous testing of open ocean and subsurface intake technologies. Also, none of the previous studies have pilot tested the Neodren system as an option to investigate potential benefits in primarily addressing red tide events, but also normal operations.

1.2.2. Objectives

Project objectives to accomplish the project goals include:

- Determine variability in water quality from subsurface and open ocean intakes.
- Evaluate the optimum pretreatment(s) for SWRO for both types of intakes.
- Compare energy use and operating costs for both types of intakes.
- Establish baseline feedwater and product water quality data for future plant design.
- Evaluate need for a partial second pass to produce acceptable water quality.

- Confirm chemical dosages and develop design criteria for post-treatment system.

- Obtain all necessary information to characterize waste streams.

- Provide valuable information to the desalination community regarding initial capital cost, performance, and ongoing operational impacts of open ocean and subsurface feedwater intake systems, particularly as it relates to downstream pretreatment requirements.

Therefore, a key objective of this Project is to analyze the economic trade-offs between higher capital costs for full-scale installation of a subsurface intake versus the higher capital and operations and maintenance (O&M) costs associated with the pre-treatment facilities for a screened open ocean intake.

1.3. Background and Timeline

Initial studies focused on constructing a 50 mgd SWRO desalination plant, with subsequent expansions at 50 mgd increments to a maximum capacity of 150 mgd. In addition to the SWRO membranes as the preferred desalination technology other key components of the treatment process include pre-treatment to prevent membrane fouling; chemical feed systems to increase pre-treatment and membrane efficiencies; post-treatment to condition the treated water to resemble existing potable water supplies; and energy recovery systems to assist in reducing energy costs. Feedwater for the desalination plant would have been seawater drawn through a dedicated intake facility. Seawater intake options included a subsurface or a screened (wedge-wire) open ocean intake.

The Water Authority and Camp Pendleton performed and reviewed several preliminary studies and site evaluations. In March 2005, the Water Authority and the Municipal Water District of Orange County (MWDOC), with co-funding from Reclamation, and in cooperation with Camp Pendleton and Southern California Edison (SCE), concluded a Pre-Feasibility Level Assessment/Fatal Flaw Analysis Study to determine whether there were sites suitable for a regional seawater desalination facility located at or near the San Onofre Nuclear Generating Station (SONGS).

1.3.1. Seawater Desalination Project at San Onofre Nuclear Generating Station

In early 2005, the Water Authority was given authorization by Major General Donovan to proceed with a detailed Feasibility Study for a seawater desalination facility in Camp Pendleton, California using the decommissioned Unit 1 Reactor intake and outfall tunnels at San Onofre Nuclear Generating Station (SONGS).

In April 2006, SCE informed Camp Pendleton and the Water Authority of its opposition to locating a desalination facility at, or near SONGS, citing conflicts with nuclear power plant operations and permits.

1.3.2. Seawater Desalination Project at Camp Pendleton

In April 2007, the Water Authority with Camp Pendleton's approval, proceeded with a revised Feasibility Study to focus on southern coastal sites within Camp Pendleton.

From April 2007 to July 2008, several site evaluation memos were prepared to potentially locate a desalination plant in the southern region of Camp Pendleton. Each memo was reviewed and commented on by Camp Pendleton departments to provide comments and indicate any fatal flaws associated with each site.

In December 2008, the Water Authority received a letter from Colonel Storey, authorizing approval to conduct a detailed Feasibility Study on the final two approved sites, the Marine Corps Tactical Systems Support Activity (MCTSSA) Site and the Southern Region Tertiary Treatment Plant (SRTTP) Site.

The study area covered a three-mile stretch of Camp Pendleton coastline between the MCTSSA Site and the Del Mar Boat Basin and included the near-shore land area extending east to the SRTTP Site as well as the offshore area extending west approximately two miles from the coastline.

In December 2009, the Water Authority completed the Camp Pendleton Seawater Desalination Project Feasibility Study for 50 to 150 million gallons per day (mgd) [56,000 - 168,000 acre-feet per year (AFY)] seawater desalination facility on Marine Corps Base Camp Pendleton (Camp Pendleton) focusing on two desalination plant location alternatives in the southwest corner of the base near the mouth of the Santa Margarita River (SMR). The study provided a feasibility level analysis of new facilities, environmental and permitting requirements, capital and O&M cost estimates, and project implementation issues associated with the sites approved for study by Camp Pendleton.

In October 2013, the Water Authority completed the Technical Studies Project to gain insight into the feasibility and design considerations for feedwater intake and concentrate (brine) discharge infrastructure, including

- Subsurface intake alternatives
- Open ocean intake alternatives
- Concentrate discharge diffuser systems
- Associated offshore and near- shore tunnel facilities needed for the proposed seawater desalination facility

The technical studies consisted of data gathering and analyzing geotechnical and hydrogeologic conditions to determine the viability of a subsurface intake. In addition to the marine environment studies to assess the physical characteristics, water quality, sediments, and marine biological resources of the near-shore coastal environment were evaluated to determine the viability of a screened open ocean intake. After the data was collected and analyzed, the study recommended the optimal locations for intake and discharge infrastructure, while providing capital and O&M costs associated with them.

1.3.3. Pilot Testing Program for the Potential Camp Pendleton Seawater Desalination Project

A Memorandum of Understanding (MOU M0-2214-20151109-0092) was executed between the Water Authority and Marine Corps Base Camp Pendleton to establish the framework for cooperation to conduct the Intake Testing Program for the potential seawater desalination facility in the southwest region of Camp Pendleton. Camp Pendleton has a complete interest in all aspects of activities that occur on the Base, as it must ensure that any activities do not conflict, impede, or interfere with Camp Pendleton's primary mission of training the operational force. Camp Pendleton understands the need for an adequate supply of water for regional needs, and therefore, desires to cooperate with the Water Authority as provided in the MOU.

In October 2013, the Water Authority completed the Technical Studies Project. The Technical Studies Project objectives were to gain insight into the feasibility and design considerations for feedwater intake and concentrate (brine) discharge infrastructure, including subsurface intake alternatives, open ocean intake alternatives, concentrate discharge diffuser systems, and associated offshore and near-shore tunnel facilities required for the proposed desalination facility. The technical studies consisted of data gathering and analysis of geotechnical and hydrogeologic conditions to determine the viability of a subsurface intake. In addition to the marine environment studies to assess the physical characteristics, water quality, sediments, and marine biological resources of the near-shore coastal environment to determine the viability of a screened open ocean intake. After the data was collected and analyzed, the technical studies recommended the ideal locations to site each intake type, while providing capital and O&M costs associated with them.

The Water Authority's Camp Pendleton Seawater Desalination Project – Intake Testing Program involves pilot testing the intake systems and pre-treatment and treatment processes that were evaluated and configured during the Technical Studies Phase. The Project will allow the Water Authority to further evaluate, validate, and optimize the proposed:

- Intake systems (open ocean and subsurface)

- Pre-treatment process consisting of granular media filtration (GMF)
- Desalination treatment process consisting of seawater reverse osmosis (SWRO) membranes

All facilities are assumed to be generally located north of the Del Mar Recreational Beach on Camp Pendleton, approximately 3,000 ft north of the Del Mar Boat Basin, with intake facilities extending westerly into the Pacific Ocean. On-shore facilities are assumed to be sited adjacent to an existing MCCS Maintenance Facility on unimproved/disturbed ground with underground conveyance lines traversing westerly along a recreational vehicle (RV) access road north of Camp Pendleton's RV parking area.

Once fully constructed and online, the facility would operate for a minimum of 12 months to capture seasonal variations in ocean conditions. The testing would involve the extraction of seawater via the two proposed intake systems, conveying the water to the plant, treating the water through multiple process configurations, then recombining of the water before returning it back to the ocean (the discharge would essentially be identical to the raw ocean water intake, with the addition of nominal pre-treatment chemicals that will be neutralized prior to discharge). The water would be sampled and analyzed at various points throughout the treatment process.

1.4. Project Status

The Water Authority withdrew its application for State Lands approval and decided to terminate the Pilot Testing Program for the Potential Camp Pendleton Seawater Desalination Project due to extraordinary permitting challenges (see Attachment A letter from the Water Authority to California State Land Commission dated September 27, 2018). The equipment procurement began in November 2016, prior to environmental permits being finalized. The 1-mm wedge-wire screen, Intuitech GMF pilot unit, and Neodren porous pipeline were procured, and the RO pilot trailer had been leased. Status at the end of the project was:

- Approval of the consultant contractor by Water Authority Board of Directors. *(Completed)*
- Execution of a Memorandum of Understanding with the Marine Corps Base at Camp Pendleton (MCBCP) for siting and operational procedures of the pilot plant. *(Completed)*
- Issuance of a Notice to Proceed to the selected consultant contractor. *(Completed)*
- Pilot Testing Protocol, Design and Permitting

a. The geotechnical boring hole permit was approved on April 1, 2016 and the final geotechnical report was submitted in September 2016. *(Completed)*

b. Health and Safety Plan was submitted to the Water Authority and Camp Pendleton for review on May 16, 2016 and was accepted without comment. *(Completed)*

c. The 90% Design was submitted for review on September 2, 2016 and held at this level while the necessary permits were being sought. The design process was not completed due to delays and challenges in obtaining the required permits leading to the ultimate termination of the project.

d. The California Coastal Commission application was submitted for approval on July 13, 2016. *(Application was pulled due to project termination.)*

e. An Application/Report of Waste Discharge was submitted to the Regional Water Quality Control Board for approval on August 23, 2016. *(Application was pulled due to project termination.)*

f. An application for a State Lands Lease was submitted to the California State Lands Commission for approval on July 17, 2016. *(Application was pulled due to project termination.)*

g. A sewer discharge request form was submitted for review and approval on May 3, 2016. The sewer discharge will come from the backwashing cycle of the media filters pre-treatment process. The sewer discharge permit was approved on September 13, 2016. *(Completed)*

h. A CEQA Notice of Exemption was filed with the County of San Diego on August 8, 2016. No public comments were received during the review period. *(Completed)*

i. A License for Nonfederal Use of Real Property was submitted to Naval Facilities Engineering Command (NAVFAC) on May 2016. *(Application was pulled due to project termination.)*

j. MCIWest –Camp Pendleton intended to complete the National Environmental Protection Act (NEPA) process once all the regulatory consultations are completed and provided a letter dated March 21, 2017 stating that a Categorical Exclusion was anticipated. *(Project was halted due to project termination.)*

k. Test Plan Protocol – Prepared by Michael Baker International (MBI) and Trussell Technologies Inc. was submitted May 16, 2016. *(Completed)*

Table 1 details the last schedule (as of October 31, 2018) (* Denotes completed task).

Table 1. Project Schedule and Ending Status

Activity	**Completion**
Consultant Contractor Notice to Proceed (NTP)*	November 6, 2015
Base Kick-Off Meeting*	November 16, 2015
NTP to Sub Consultants*	February 11, 2016
Task No. 1 Pilot Testing Protocol*	February 12, 2016
Design Workshop #1*	February 16, 2016
Complete Design [1]	**Not Completed - Project Canceled**
Regional Water Quality Control Board Meeting	**Not Completed - Project Canceled**
Coastal Commission Board Meeting	**Not Completed - Project Canceled**
State Lands Board Meeting	**Not Completed - Project Canceled**
Begin Construction	**Not Completed - Project Canceled**
Begin Commissioning	**Not Completed - Project Canceled**
Begin Operations	**Not Completed - Project Canceled**
Final Presentation & Report	**Not Completed - Project Canceled**

1. Design advanced to the 90% stage

2. Technical Approach and Methods

2.1. Project Description

The open ocean intake would have consisted of a wedge-wire (1-millimeter [mm] opening) intake screen, capable of approximately 20 gallons per minute (gpm), located approximately 3,000 feet offshore about 40 feet deep. This location represents the preferred site of a screened open ocean intake for the full-scale project based on the previous technical studies. The technical studies recommended that the open ocean intake be in approximately 60 to 90-foot water depth, north of the artificial reefs, but 40 feet was chosen based on a cost benefit analysis with substantially more pipe required to reach 60+ feet. The pre-treatment process for the open ocean intake feedwater would have consisted of a deep-bed granular media filter (GMF), to filter out the organics and suspended solids in the seawater. The GMF treatment process was selected based on cost comparisons for membrane pre-treatment.

The subsurface intake, capable of approximately 20 gpm, would have consisted of a micro-porous pipe installed using horizontal directional drilling (HDD) under the seafloor. The proposed subsurface intake system was anticipated to produce high-quality feedwater minimizing the need for pretreatment. Therefore, feedwater from the subsurface intake would have been fed directly to cartridge filters, followed by seawater reverse osmosis (SWRO) membrane treatment. However, if required, feedwater from the subsurface intake could be pretreated prior to RO with a disc filter (strainer), or the GMF unit.

The permeate and brine produced by the SWRO desalination process would have been recombined and then combined with some of the filtrate of the open ocean intake GMF pre-treatment process before being discharged back to the ocean. The remaining filtrate water would have been stored and used for GMF backwash water. Backwash from the GMF pre-treatment process would have been contained in a backwash tank and slowly discharged to the sanitary sewer system with approval from the Camp Pendleton Base Water Resource Division (WRD).

2.2. Work Elements

The key components of the Intake Testing Program were organized into nine (9) work elements

1. Test Plan Protocol (TPP) (including Monitoring and Reporting Plan)
2. Screened Open Ocean Intake (location and construction)
3. Subsurface Intake (location and construction)
4. Intake Testing Facility (location and construction)
5. Treated Seawater and Backwash Disposal
6. Commissioning, Operation, and Maintenance of Testing Facility
7. Collection, Testing, & Analysis of Feedwater and System Performance
8. Environmental Documentation and Permitting
9. Reporting

2.2.1. Test Plan Protocol

The Test Plan Protocol (TPP) describes the testing program objectives and regimen, including, but not limited to

- Treatment processes to be tested
- Sizing of treatment components
- Chemicals to be tested and dosing requirements
- Layout and set-up requirements
- Sampling, monitoring, and testing protocols

- Facility staffing needs
- Roles and responsibilities for monitoring, operating, maintaining, assessing, and reporting treatment process performance

In addition to monitoring the treatment processes, the intake systems would have been monitored on a limited basis for any pressure and power anomalies associated with intake performance (e.g., clogging) and recorded.

Trussell Technologies (TT) was the lead author of the TPP, with Separation Process Inc. (SPI) providing information concerning the operation of the facility, the SWRO desalination unit, and site safety. TT would revise the TPP as necessary following review of the document by MBI, the Water Authority, and Camp Pendleton. Updates to the TPP shall occur during the12-month operating period based on treatment process changes due to unanticipated water quality data. The proposed treatment process flow schematic is provided in Figure 1.

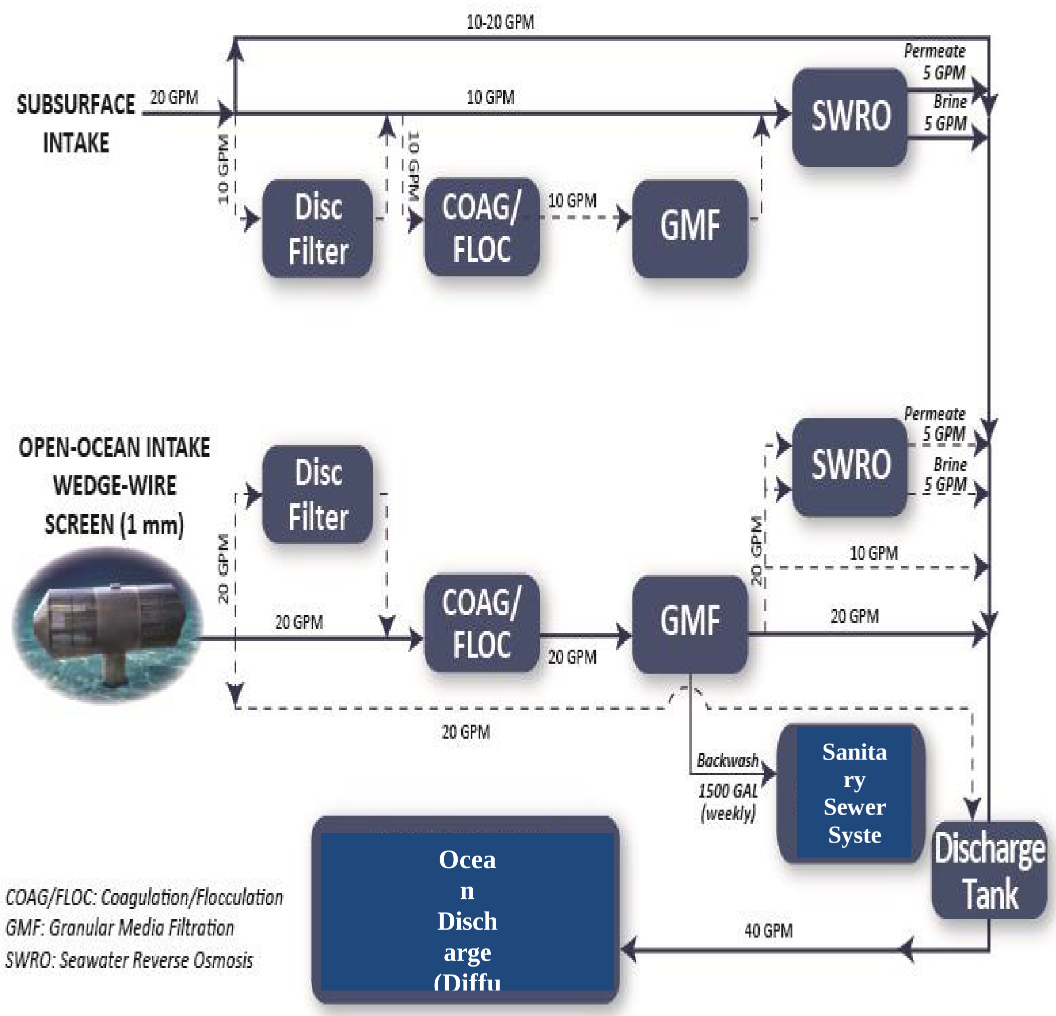

Figure 1. Intake Testing Program - treatment process flow diagram.

2.2.2. Screened Open Ocean Intake

The design criteria for the screened open ocean intake included:

- Cylindrical wedge-wire screen
- Approx. Distance Offshore: 3,000 feet
- Approx. Water Depth: 40 feet
- Max. Flow Rate: 20 gpm
- Max. Screen Slot Opening: 1.0 mm
- Max. Through Screen Velocity: 0.2 ft/sec
- Screen Material: Z-Alloy
- Concrete support base
- 2,000 feet of 6”-8” high-density polyethylene (HDPE) (DR-11) seafloor pipeline with concrete ballast weights
- 1,200 feet of 8” HDPE (DR-9) pipeline installed using HDD through the surf zone
- 8’ x 10’ x 6’ pre-cast concrete intake vault
- Submersible pump (accessible from the intake vault)
- Below-grade onshore pipeline and electrical conduit from vault to testing facility

The intake screen would have been bolted (flange) to a concrete support base. The structure would have had accessible blind flanges on a tee and wyes that could be removed by a diver to conduct periodic cleaning, if necessary. The structure would have been attached with flanges to the final pipeline segment laid on the seafloor.

The raw seawater (feedwater) would have been conveyed in a 6- or 8-inch HDPE (DR-11) pipeline laid on the seafloor for approximately 2,000 feet with accessible wyes every 500 feet for potential maintenance. The pipeline would have had concrete weight collars spaced every 10 feet apart to prevent it from moving. The HDPE pipeline would have been fused into two (2), 1,000-foot segments with a stainless-steel flange fused on each end. The 1,000-foot segments would have been fused onshore along the dirt road south of the Santa Margarita Estuary and east of the Project Site.

The pipe segments would have then been pulled to the shore along the amphibious vehicle beach access road. The marine contractor would have pulled them out to sea and floated them to their destination. Once in place, the pipe segments would have been flooded and sunk into place on the seafloor as a diver bolts together the flange connections. The vessel shown in Figure 2 would have been used for installation of the bottom laid pipeline and intake screen.

Figure 2. M/V Elliott Dive Support Vessel (photo courtesy of C&W Diving Services, Inc., all rights reserved).

Since it is not feasible to trench through the beach and surf zone due to environmental constraints and worker safety, horizontal directional drilling (HDD) would have been used to install the intake and discharge pipelines under the beach and surf zone, as shown in Figure 3. A borehole about 1,200 feet long borehole, beginning at the proposed intake vault location, and daylighting offshore, would have been needed to reach a safe distance offshore for a marine contractor to dive in. The HDD insertion point would have been east of the highest astronomical tide line. Three (3) pipelines (open ocean intake, subsurface intake, and discharge pipeline), would have been bundled together (with a spacer) and installed simultaneously within the HDD borehole.

Figure 4 shows a typical HDD rig setup. The HDD process begins with a pilot hole from the beach. The drilling head would follow a designed profile below the seafloor and exit approximately 1,200 feet offshore. For this initial step, Tru Tracker coil wire is placed on the beach to guide the drill head along the alignment. The second step entails reaming the pilot hole to a diameter sufficiently large enough to accept the pipelines. The approximate 1,280 feet of HDPE pipeline to be installed in the borehole would have been fused together onshore and floated out to sea. The pipeline bundle would have been floated offshore and then connected to the HDD pulling head by a diver and pulled simultaneously into the borehole from land. The open ocean intake pipeline will continue for an additional 2,000 feet offshore, located on the seafloor. The subsurface intake pipeline would have been capped with a blind flange for potential maintenance access (Section 4.0), while the discharge pipeline would have been fitted with two (2) Tideflex® check valves (Section 6.0).

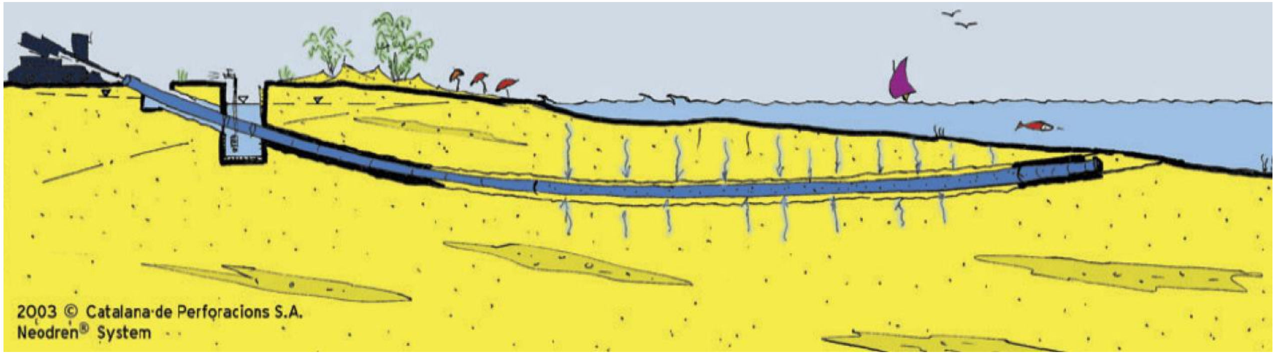

Figure 3. Intake/Discharge Pipelines Installed Using HDD under Surf Zone (Intake Works)

Figure 4. Typical HDD Light Rig Setup (The HDD Co.)

Biological/mussel growth inside the pipeline can clog the pipeline if not addressed. Rather than using shock chlorination to prevent mussel growth, the seabed pipeline would have been oversized (6 or 8-inch diameter) to allow mussel growth over the 12-month study period, yet still have enough capacity to get 20 gpm. Table 2 provides a summary of the screened intake construction.

Table 2. Screened Open-Ocean Intake Construction Summary

Location	Beach and offshore marine environment
Duration	2.0 months
Prerequisite	CEQA / NEPA Clearances / Permits / Base Access License
Equipment	HDD Rig and Support Equipment (HDD Co.) Crew Trucks (All) Excavator, Backhoe, Crane, Bobcat (Integrated Water Services [IWS]) 73’ M/V Elliot dive support vessel (C&W Diving) 40’ M/V Nicole support vessel (C&W Diving) 16’ Pontoon boat (C&W Diving) (All vessels to be moored in Oceanside Harbor)
Personnel	C&W Diving (Marine Contractor) Integrated Water Services (Onshore Contractor - Vault) HDD Co. (HDD Contractor) MBI (Onsite Engineer) HDPE Pipe Fusing Technician

2.2.3. Subsurface Intake

The design criteria for the Neodren® subsurface intake included:

- Max. Flow Rate 20 gpm
- Total Drill Length 1,200 feet
- Installed Depth 15 - 30 feet below seafloor
- Neodren® Pipe Section 60 feet
- Neodren® Pore Size 60 microns
- Neodren® Pipe Diameter 7-inch (180 mm)
- Neodren® Pipe Material HDPE (DR-9)
- 8’ x 10’ x 6’ pre-cast concrete intake vault (same vault as open ocean intake)
- Submersible pump (accessible from the intake vault)
- Below-grade onshore pipeline and electrical conduit from vault to testing facility

Figure 5 illustrates a cut section of the Neodren® micro-porous pipe. The Neodren® subsurface intake pipe segment would have been positioned about 800 feet offshore, 30 feet under the seafloor, installed using HDD. The Neodren® pipe section would have been about 60 feet long to be able to conduct performance testing with the 20 gpm rated pump. The remaining 1,140 feet of the subsurface intake pipeline would have been blank HDPE (DR-9) pipe.

The subsurface intake pipeline would have been bundled with two other pipelines (open ocean intake and discharge (return) pipeline) and pulled into place simultaneously from land

- The subsurface intake pipeline would have been capped offshore for potential maintenance access, while the open ocean intake pipeline would have continued for an additional 3,000 feet on the seafloor. Onshore, the subsurface intake pipeline would have been completed in the same intake vault as the open ocean intake and therefore the vault provides access to both intake submersible pumps.
- The discharge pipeline would have been fitted with a Tideflex® check valve.

A transducer would have been installed within the Neodren® subsurface intake to monitor pressure gradients, to determine the fouling potential of the micro-porous pipe.

Figure 5. 60-micron Neodren® HDPE pipe (intake works).

Design drawings (available upon request) were developed, including the proposed drilling location, plan and profile, drilling methodology, expected work hours, and access considerations. Plans for pre-drilling activities also included:

- **Health and Safety Plan** for execution of the field work in compliance with applicable safety requirements of Camp Pendleton and regulatory agencies.
- **Drilling Plan** for HDD protocols in accordance with standard procedures.
- **Frac-Out Plan** to provide protocols to be implemented for the protection of sensitive cultural and biological resources in the event of drilling mud frac-out.
- **Spill Prevention and Response Plan** to describe procedures for handling, storing, and disposing of contaminated soils and water that may be encountered.

Before mobilizing drilling equipment, the exact drilling locations would have been staked, and surface conditions verified for the selected drilling rig and support equipment. Underground Services Alert (USA) would have been contacted to mark the location of buried utilities that may exist near the drilling site. San Diego County Department of Environmental Health permits would have been obtained for the boring and installation of the subsurface intake. A containment area would have been constructed to enclose the drilling rig and other equipment to minimize the potential for releasing fuel, hydraulic fluid, or water from drilling operations to the surrounding environment or to the ocean.

The work site would have been underlain by heavy-duty plastic sheeting that is bermed at the edges and completely covers the area under and adjacent to the drilling rig. Additionally, absorbent materials would have been maintained on site during work operations as part of the Spill Prevention Plan.

The footprint required for the drilling operations is an area measuring approximately 100 feet wide by 130 feet long. To keep the drilling footprint to a minimum, an enclosed (temporary fencing) staging area would have been established in an off-site area (e.g., a parking lot) for the storage of drilling equipment.

Noise levels at the drilling work sites would have been approximately a maximum of 75 to 85 decibels (dB) at approximately 25 feet from the drilling rig; diminishing to less than 75 dB at 50 feet (normal conversation is 70 dB). The major sources of noise during drilling operations are the rig engine and the dropping of drill pipe into the slide while tripping out of the borehole.

Cuttings (borehole materials) generated during the drilling process would have been temporarily contained in hoppers prior to disposal. Best Management Practices (BMP) would have been used to ensure that all waste products are contained and controlled so that runoff does not occur. Water generated by the drilling operations would have been discharged to a 500-gallon tank for transport and discharge at a base-approved location. Table 3 provides the subsurface intake construction summary.

Table 3. Neodren® Subsurface Intake Construction Summary

Location	Del Mar Recreational Beach
Duration	2.0 months
Prerequisite	CEQA / NEPA Clearances / Permits / Base Access License
Equipment	HDD Rig and Support Equipment (HDD Co.) Crew Trucks (All) Excavator, Backhoe, Bobcat, Crane (IWS)
Personnel	HDD Co. (HDD Contractor) IWS (Onshore Contractor - Vault) MBI / Water Authority (Onsite Engineer / Inspection)

2.2.4. Intake Testing Facility

The Project was designed to simultaneously treat feedwater from each intake source (open ocean and subsurface) and would have consisted of :

- Water treatment equipment
- Temporary operations/laboratory space
- Power supply and distribution
- Potable water supply
- Miscellaneous yard piping
- Storage tanks

As mentioned previously, the Intake Testing Program would have focused on testing the feedwater quality produced from each intake and testing the pre-treatment process that would produce high-quality feedwater for the SWRO desalination treatment process. The intake systems would have been monitored on a limited basis for pressure and power anomalies associated with intake performance (e.g., clogging), recorded, and analyzed.

2.2.4.1. Electrical Power Service

The Project would have required a new metered 460 volt, 3-phase, 200-amp power service to operate the intake testing facility. The preferred new power service was overhead power lines (OHL), pole mounted transformer(s), and meter. Since the pole and OHL are considered perching sites for raptor birds, the power service would have been trenched. This portion of the electrical service (high voltage) would have been installed by a Base approved electrical contractor (Galindo Electric) since it would have tied into Camp Pendleton's electrical power supply.

2.2.4.2. Open Ocean Intake Treatment

The screened open ocean intake feedwater pre-treatment process would have consisted of a deep bed GMF unit to filter out the organics and suspended solids found in raw seawater.

Before filtration, the feedwater would have gone through a coagulation /flocculation treatment process. The feedwater would have been dosed with a coagulant (e.g., ferric chloride) which would have heled remove fine particulates by forming settleable solids in flocs, which would have been removed in the GMF treatment process.

The filtrate would have been analyzed for certain water quality characteristics (e.g., silt density index [SDI], total suspended solids [TSS], and total organic compounds [TOC]) used to determine if it would foul the SWRO membrane. Occasionally, treated filtrate water would have been conveyed to the SWRO unit to validate the water quality data.

The coagulation, flocculation, GMF pilot unit would have been housed in one standard International Standards Organization (ISO) shipping container, measuring 20 feet long, by 8 feet wide, by 9.5 feet tall (see Figure 6). The container includes a single one-man entry door, piping connection port, waterproof floor coating, power panel, lighting, ventilation, and a compressed air system. The container includes a two-section fiberglass reinforced plastic (FRP) pressure vessel with a maximum working pressure of 15 PSIG and a nozzle-based underdrain. The GMF pilot unit process includes a raw water pumping system, flocculation system, four chemical feed systems, backwash system, air scour system, and combined effluent system. All wetted materials are compatible with seawater. The process would have been monitored and controlled with a programmable logic controller (PLC) / human machine interface (HMI) system capable of remote monitoring and control through an internet connection.

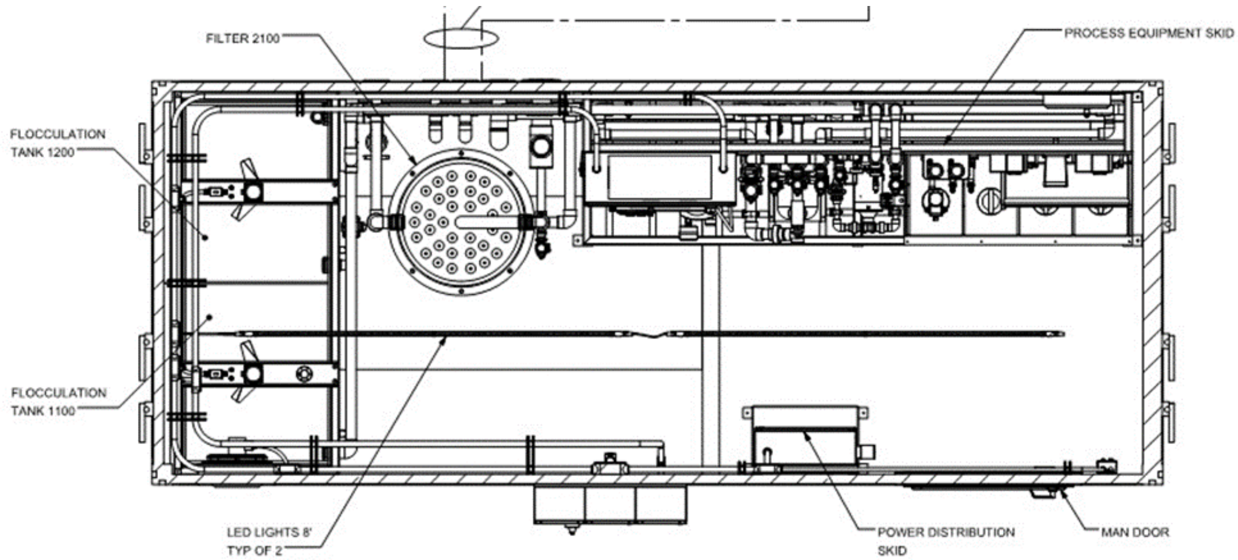

Figure 6. GMF Pilot Unit – 20-foot ISO Shipping Container

2.2.4.3. Subsurface Intake Treatment

The proposed subsurface intake system was anticipated to produce high-quality feedwater, minimizing the need for pretreatment. Therefore, feedwater from the micro-porous subsurface intake would have been fed directly to a cartridge filter, followed by SWRO membrane treatment. However, if required, feedwater from the subsurface intake could be pretreated prior to SWRO with a disc filter (strainer), or the GMF unit. Occasionally, subsurface SWRO treatment would stop temporarily so that filtrate water from the open ocean pre-treatment process could be conveyed to the SWRO unit to validate the water quality data (Figure 7).

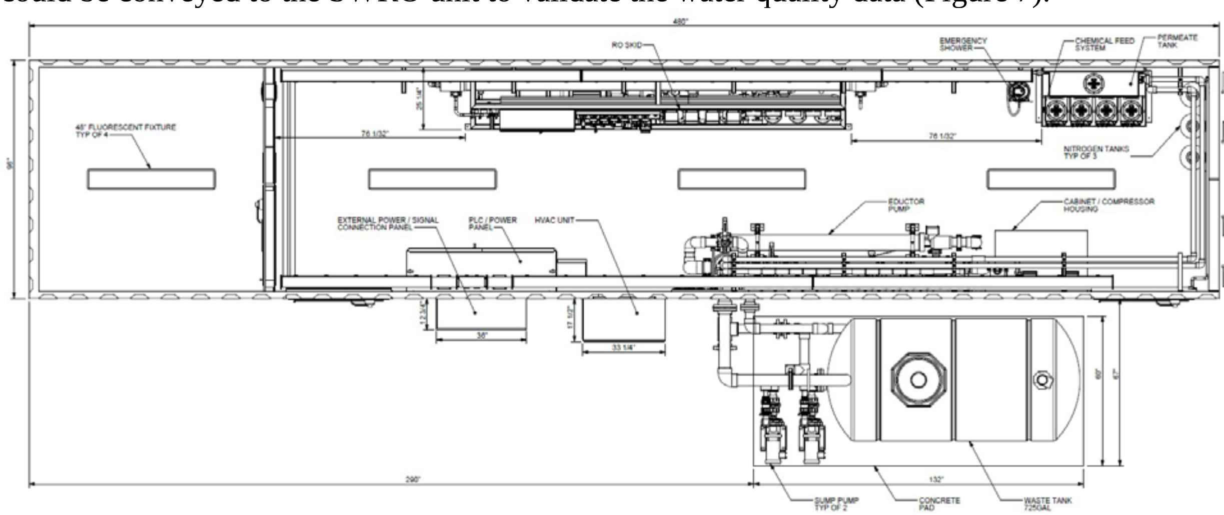

Figure 7. SWRO Unit – 40-foot ISO Shipping Container

The SWRO pilot skid, including cartridge filters and high-pressure pump would be housed in a standard ISO shipping container, measures 40 feet long, by 8 feet wide, by 9.5 feet tall (Figure 7). The container also includes two (2) one-man entry doors, chemical feed system, permeate tank, air compressor, piping connection ports, waterproof floor/wall coating; power panel; lighting; heating, ventilation, and air conditioning (HVAC), compressed air system, emergency eye wash shower, and lab space. The process would have been monitored and controlled with a PLC / HMI system capable of remote monitoring and control through an internet connection.

2.2.4.4. Chemicals

Chemicals that would have been used for the 12-month intake testing program are described in this subsection. Not all chemicals would have been required during the entire testing period. The initial 1 - 2 weeks, known as the initial chemical optimization period, would have been used to determine the most effective chemicals to use and proceed with those chemicals for the duration of the testing period. All chemicals would have been stored in a protected safe location with dual-containment. Further details on testing are provided in the Test Plan Protocol (TPP).

2.2.4.4.1. Coagulants / Polymers

Coagulants are used to neutralize the negative electrical charge on colloidal particles, which destabilizes the forces keeping colloids apart. These coagulants are comprised of positively charged molecules that, when added to the water and mixed, accomplish charge neutralization, and encourage suspended solids to bond to each other, which can be enhanced, using polymers. The specific coagulant type and polymer (if needed) would have been determined during the first 1-2 weeks of GMF operations, known as the initial chemical optimization period. The maximum doses are anticipated to be 8 milligrams per liter (mg/L) for the coagulants and 1.6 mg/L for any polymer. The coagulant and polymer (if needed) would have been stored in 20-gallon poly-propylene (PP) storage tanks included as part of the GMF container unit.

The coagulants and polymers are removed from the GMF unit via a backwash cycle that is anticipated to occur 1-2/week. The backwash is anticipated to produce approximately 1,500 gallons of turbid water (~10 nephelometric turbidity units [NTU)] that would require disposal to the sewer system.

- Ferric chloride ($FeCl_3$) (coagulant)
- Ferric sulfate ($FeSO_4$) (coagulant)
- Polyaluminum Chloride (PACl) (coagulant)
- Cationic polymer
- Non-ionic polymer

2.2.4.4.2. Disinfection

Chlorine would have been dosed and circulated within the GMF system to minimize microbial growth within the filter. The chlorine would have been neutralized / dechlorinated prior to being sent to the discharge tank for disposal. These chemicals would have been stored in 20-gallon PP storage tanks with secondary containment, included as part of the GMF container unit.

- Sodium Hypochlorite (NaOCl) (disinfectant).
- Sodium Bisulfite ($NaHSO_3$) (neutralize NaOCl before disposal)
- Sodium Sulfite ($Na2SO_3$) (neutralize NaOCl before disposal)

2.2.4.4.3. SWRO Membrane Cleaning

Over time, the SWRO membranes may require cleaning. SWRO cleaning chemicals would have been stored in 5-gallon pails (or smaller) on a containment platform, inside the SWRO container unit. The SWRO membrane cleaning chemicals would have been discharged to a sewer or taken off-site. If discharge requirements for these chemicals is problematic, membrane cleaning would have been performed off-site.

- Citric Acid (clean SWRO membranes)
- Avista Technologies (P-111) (clean SWRO membranes)
- Sodium Hydroxide (NaOH) (neutralize cleaning solution)
- Hydrochloric Acid (HCl) (neutralize cleaning solution)

2.2.4.4.4. SWRO Membrane Antiscalant

Scaling is the deposition of particles on a membrane, causing it to foul. Antiscalant is used to minimize scale buildup on the SWRO membranes. Antiscalant concentration within the combined discharge is anticipated to be less than 1 mg/L when both intakes are operating and approximately 1.5 mg/L if only the subsurface intake is operating.

- Nalco PermaTreat (PC-191) (antiscalant)

Upon approval of the design package by the Water Authority and Camp Pendleton, and once all necessary environmental clearances and permits were obtained, construction would have begun on the intake facilities, discharge piping, and the intake testing facility. MBI would have coordinated and documented a pre-construction site walk with the Water Authority and Camp Pendleton to establish the existing conditions of the work area. Table 4 provides an intake testing facility construction summary.

Table 4. Intake Testing Facility Construction Summary

Location	Proposed Intake Testing Facility Site
Duration	2.5 months
Prerequisite	CEQA / NEPA Clearances / Permits / Base Access License Equipment Procurement (Begin procurement process in early June 2016) Site walk with Camp Pendleton / Water Authority Staff (Late September 2016)
Equipment	Crew Trucks (IWS) Excavator, Backhoe, Bobcat, Crane (IWS)
Personnel	IWS (Onshore Contractor) MBI / Water Authority (Onsite Engineer / Inspection)

2.2.5. Treated Seawater and Backwash Disposal

As illustrated in Figure 1, the SWRO brine and permeate would have been re-combined, and then combined with the GMF treated open ocean intake flow in a discharge tank, producing treated raw seawater.

The preferred disposal method for this treated raw seawater is to discharge it back to the ocean in approximately 16-foot water depth, where wave/current activity would quickly disperse it. The combined treated seawater (40 gpm) would have been conveyed to a discharge tank, before being pumped to the ocean for disposal.

The discharge pipeline would have been installed under the beach and surf zone, simultaneously with both the open ocean and Neodren® subsurface intake pipelines, using HDD, as described previously in Section 3.0. The discharge pipeline would have two (2) Tideflex® check valves (or similar) installed on its ocean terminus to prevent sand and marine life from entering the discharge pipeline. Other design criteria for the seawater discharge includes

- Max. Flow Rate 40 gpm (split between two ports, 20 gpm each)
- Max. Discharge Velocity 6.0 feet per second
- Approx. Distance Offshore 1,000 feet
- Approx. Water Depth +/- 16 feet
- Pipe Diameter 3-inch
- Pipe Material HDPE (DR-7.3)

Backwash from the GMF pre-treatment process would not be allowed to be combined with the treated seawater being discharged back to the ocean due to the coagulant chemicals used to assist in the filtration process (environmental constraint). Therefore, the backwash from the GMF unit would have been discharged to a backwash holding tank and slowly released to the sanitary sewer system, with approval from the Base Water Resource Division (WRD). Table 5 provides construction summary for the disposal.

Table 5. Treated Seawater and Backwash Disposal Summary

Location	Ocean (treated seawater) and Sanitary Sewer System (backwash waste)
Duration	12 months
Prerequisite	Discharge Tank and Diffuser & Backwash Tank and connection to sewer
Permits	Regional Water Quality Control Board (RWQCB) National Pollutant Discharge Elimination System (NPDES) Permit required for ocean discharge Base WRD Approval to convey backwash waste to sewer
Personnel	SPI (SWRO Operator) TT (GMF Operator) MBI (Onsite Engineer / Inspection)

2.2.6. Commissioning, Operation, and Maintenance of Testing Facility

The following subsections would provide a summary of the commissioning / start-up activities of the intake testing facility, in addition to the operation and maintenance of the facility and intake infrastructure.

2.2.6.1. Commissioning / Start-up

Before starting the operational period, commission testing would have been used to verify that all instrumentation, test platforms, and appurtenant treatment equipment were operating properly. Startup would have followed a systematic procedure and included instrumentation and mechanical equipment at the intake testing facility, water supply, discharge from the testing facility, and any other appurtenant equipment at the facility.

Information from suppliers would have been used to develop proper startup and operating procedures for the process equipment. Table 6 summarizes intake testing.

Table 6. Intake Testing Equipment Commissioning Task Summary

Location	Intake Testing Facility
Duration	2-3 weeks
Prerequisite	Equipment Installation
Permits	Permits required to operate
Equipment	Intake Pumps, SWRO Unit, GMF Unit Incl. Coagulation / Flocculation
Personnel	IWS (Onshore Contractor) SPI (SWRO Start-up assist) TT (GMF Start-up assist) MBI (Onsite Engineer / Inspection)

2.2.6.2. Operation

SPI would have provided an experienced operator to oversee the daily operation and maintenance of the intake testing facility for twelve (12) months from the time commissioning activities were completed and operation readiness approved by the Water Authority. An operator/engineer would have been needed to be onsite 40 hours per week, Monday through Friday, at a minimum, to operate and maintain the facility, conduct testing as outlined in the TPP, troubleshoot issues, and coordinate activities with Water Authority and Camp Pendleton as necessary.

The intake testing facility would have operated continuously over the operational period and would have included the necessary instrumentation and controls to monitor status offsite and automatically shut down, if needed.

Any down time greater than three (3) days for any reason within the operators (SPI) control, would have been made up at the end of the 12-month operational period. TT, with assistance from SPI would have evaluated and optimized the GMF pre-treatment design and operation requirements for the open ocean intake source water, to produce suitable feedwater for a SWRO system. SPI would have evaluated and optimized the SWRO design and operation requirements for the subsurface intake source water to determine if pre-treatment is necessary prior to SWRO membranes. Table 7 summarizes operations.

Table 7. Operations Task Summary

Location	Intake Testing Facility
Duration	12 Months
Prerequisite	Equipment Commissioning / Start-up
Permits	Permits required to operate
Equipment	Intake Pumps SWRO Unit GMF Unit, including Coagulation/Flocculation
Personnel	SPI (Operations / Maintenance) TT (GMF Unit Assistance)

2.2.6.3. Maintenance

As the operator of the Intake Testing Facility, SPI would have been responsible for all aspects of maintaining the testing facility in a safe and secure manner, and responsible for any repairs that may be required during the 12-month operational period.

MBC Aquatic Sciences (MBC) would have performed two dive inspections of the open ocean wedge-wire screen intake and seabed pipeline during the operational period to evaluate condition and performance. MBC would have provided video and photographs to illustrate the condition of the wedge-wire screen. If necessary, MBC would have cleaned the wedge-wire screen to remove biological growth and any other material from the screen surface. In addition, access “sweeps,” using wyes with blind flanges, were proposed in the design of the open ocean intake to provide the ability to clean the inside of the open ocean intake pipeline if biological growth build-up is so extreme, that the required minimum flow rate to operate the equipment has been compromised. Table 8 summarizes maintenance.

Table 8. Maintenance Task Summary

Location	Intake Testing Facility and Wedge-Wire Screens
Duration	12 Months
Equipment	Small Boat for divers to conduct wedge-wire screen maintenance
Personnel	SPI (Testing Facility Maintenance) MBC (Wedge-wire screen cleaning)
Deliverable	Video/photographs of wedge-wire screen and seabed pipeline condition

2.2.7. Collection, Testing, and Analysis of Feedwater and System Performance

To determine variations in water quality that may be impacted by tidal changes, coastal processes, and seasonal variations over the operational period, SPI (facility operator) in coordination with TT would have collected raw seawater samples from both the screened open ocean intake and subsurface intake.

To determine the effectiveness of conventional coagulation, flocculation, and GMF on a screened open ocean intake feedwater in developing water quality adequate for SWRO, TT would have collected filtered water samples.

To determine the effectiveness of the micro-porous subsurface intake without the use of pre-treatment, SPI would have collect desalinated water samples.

The collected water samples would provide data on parameters such as metals, minerals, Total Suspended Solids (TSS), Total Organic Carbon (TOC), turbidity, temperature, conductivity, pH, chlorophyll content, silt density index (SDI), and the presence of hydrocarbons. The sampling approach and analyses for all parameters would have been reviewed monthly and after the first three months of sampling, a meeting would have been held between MBI and the Water Authority to determine whether the sampling frequency of certain parameters needs to be adjusted or eliminated. Any adjustments that occur would have been represented in a revised TPP.

TT would have monitored specific process performance of the GMF unit to evaluate characteristics such as filter ripening, filter head loss profile, and backwash frequency. TT would have provided Monthly Progress Reports to MBI, with input from SPI, concerning operations, data collection, testing, analysis, and performance, while also providing a look ahead of operations for the following month.

Further details on testing are provided in the Test Plan Protocol (TPP) (Attachment B). Table 9 summarizes data collection, testing, analysis, and management.

Table 9. Data Collection, Testing, Analysis, and Management Summary

Location	Intake Testing Facility
Duration	12 Months
Prerequisite	Test Plan Protocol (TPP)
Equipment	Lab Equipment / Lab Analytics
Personnel	SPI (Data Collection) MBI (Manage) TT (Data Collection, Analysis, Management, Reporting)
Deliverable	Monthly Progress Reports

2.2.8. Environmental Documentation and Permitting

Environmental compliance documentation and regulatory permitting is a crucial element for the success of the Intake Testing Program. This testing program would have provided important data for the Water Authority and the desalination community. The following would have been performed to fulfill the environmental and regulatory consultation and permitting requirements for the Intake Testing Program activities

- Permitting Work Plan (PWP)
- California Environmental Quality Act (CEQA) documentation
- National Environmental Policy Act (NEPA) documentation
- Regulatory Permits.
- Avoid use of temporary structures on ocean surface such as jack-up barge or platform
- Although known sensitive resources (snowy plover and least tern) are located near the HDD drilling site, the drilling activities to occur during the non-nesting season (Oct – Nov)
- HDD activity to occur east of the highest astronomical tide line elevation
- Permit conditions, such as marine mammal observers and anti-raptor perching to serve to avoid potential environmental concerns.
- Offshore pipeline, concrete ballast weights, intake structure, and discharge diffuser to be removed from seabed at completion of the study.
- Onshore testing facility to be decommissioned and site restored to original conditions at completion of the study.
- Design (mitigation) measures, such as…

- o Raptor perching deterrents, etc. to minimize or avoid potential environmental concerns.
- o No new power poles (perching sites for raptor birds/predators) to be installed.
- o 1-mm wedge wire Intake screen located in non-essential fish habitat area.
- o No ell grass or kelp beds located in project area.
- o Intake flow rates of 20 gpm are below CA Ocean Plan min. requirements.
- o Through screen velocity approximately 0.15 feet per second, below maximum of 0.5 feet per second.
- o Discharge location depth determined to be optimal for mixing based on previous technical studies.
- o No brine discharges. Permeate and brine are re-combined, therefore discharge to ocean is treated seawater.
- o Discharge velocity less than 6 feet per second to eliminate marine life mortality.
- o Use two discharge ports angled upward to eliminate sediment suspension.
- o Filter backwash waste conveyed to sewer system rather than being discharged to the ocean.
- o Seabed pipeline oversized to avoid using shock chlorination in the pipeline to reduce marine growth buildup.

The Statutory Exemption (SE)/Categorical Exclusion (CE) determination would have relied on existing data, site reconnaissance, extensive data developed from the Feasibility Study and Technical Studies, as well as available information from Camp Pendleton's Integrated Natural Resources Management Plan (INRMP) and Geographic Information System (GIS) databases. This assumption has been vetted through an initial kickoff meeting with the Camp Pendleton Environmental Security (ES) Office and would be repeated during the regulatory pre-application process.

The SE/CE determination would have first been supported by the Bases Request for Environmental Impact Review (REIR) in compliance with NEPA and Department of Defense Process and Management Support Module (PAMS). The necessary environmental documents depend on a determination by the lead agencies. The Base ES office was the NEPA lead and the Water Authority was the CEQA lead. As part of the NEPA/CEQA process, MBI would have prepared appropriate technical memos, conducted a site visit, and reviewed available literature/records with the intent of supporting the determination that the appropriate CEQA/NEPA document is a SE/CE. The technical studies and/or environmental data would be provided by the Base ES office, MBC for potential marine impacts, and BCR Consulting (BCR) for potential offshore cultural resource impacts.

The Base Real Estate office would have provided the NAVFAC 11011/29 (6-75) License(s) for Nonfederal Use of Real Estate (Base Access License) after the completion of the CEQA/NEPA process.

2.2.9. Regulatory Permits

MBI prepared and processed applicable regulatory permits for the Intake Testing Program. Refer to the Permitting Work Plan for a detailed description of the regulatory permits required for the Intake Testing Program. Below is a list of regulatory agencies that would need to be consulted:

- **CA Coastal Commission (CCC)** The Water Authority assumes the Intake Testing Program would be processed as a Coastal Development Permit (CDP) waiver under the Coastal Act, based on our review of similar projects.
- **CA State Lands Commission (SLC)** MBI would obtain a project-specific Surface Lease Permit for field work within State lands jurisdiction (ocean). This permit would include provisions to minimize marine life impacts, consistent with the Marine Mammal Protection Act and the Magnuson-Stevens Fishery Conservation and Management Act Observer Program.
- **Regional Water Quality Control Board (RWQCB)** MBI would prepare and process applicable Clean Water Act permitting through the RWQCB. A separate NPDES permit is required for treated seawater discharge back to the ocean. In addition, applicant needs to request for a W.C. Section 13142.5(B) determination based on the recent California Ocean Plan Amendment. The discharge is anticipated to be permitted as a Low Threat Discharge.
- **U.S. Army Corps of Engineers (USACE)** The Water Authority is covered under Section 404 Nationwide Permit 7 (NWP7) and Section 10 of the Rivers and Harbors Act for Clean Water Act compliance as it relates to the placement of the intake screen. The NWP7 includes consultation with the U.S. Coast Guard, and National Marine Fisheries Services (NMFS), particularly for Essential Fish Habitat (EFH).
- **Camp Pendleton** Obtain required Site Approval and Base Access License from Camp Pendleton for all onshore and offshore work.

2.2.10. Reporting

After testing, TT would have then prepared a Data Collection, Testing, and Analysis Report (with input from SPI) as a comprehensive resource for

- Literature research
- Water-quality data
- Pre-treatment pilot and overall testing results
- Performance and operating data
- Narrative and graphical summaries of the data
- Conclusions regarding performance and operation of the pre-treatment process for both subsurface and open ocean intake systems, including power usage
- Copies of the certified laboratory analytical results and equipment calibration certifications would then be provided

TT would have then revised the report as necessary following review of the document by MBI and Water Authority. MBI would have then incorporated it into an all-inclusive *Intake Testing Program Report*. In addition to the items listed above, the Intake Testing Program Report would have included implications regarding the capital and operating and maintenance (O&M) costs of the full-scale facility; including a life cycle cost analysis comparing the expected full-scale cost of a screened open ocean intake and associated pre-treatment to the expected full-scale cost of a subsurface intake system with minimal pre-treatment.

MBI would have then revised the draft report as necessary, based on comments following review of the document by the Water Authority and Camp Pendleton and prepare a Final Report.

3. Lessons Learned

The project encountered two issues that were not anticipated:

1. Applicability of the recently adopted California Ocean Plan Amendment (OPA) focusing on seawater desalination intake and discharge facilities

2. Expectations for environmental documentation through the CEQA process.

Navigating these challenges led to other project inefficiencies discussed in this section.

3.1. Permits

The Water Authority was required to obtain several permits/approvals to implement the Project. Key ones include a land lease permit from the State Lands Commission, a discharge permit/waiver from the San Diego Regional Water Quality Control Board (San Diego Water Board), and a coastal development permit from the California Coastal Commission. The Water Authority representative, MBI, submitted permit applications to these agencies.

San Diego Water Board staff, in consultation from the State Water Resources Control Board, sought to require a feasibility determination in alignment with the OPA. Uncertainties on how the OPA applied to a temporary testing program caused delays in processing a permit and required additional technical reviews to resolve. Ultimately, this issue was not resolved due to opposition from State Lands Commission on the Water Authority’s filing of a statutory exemption and the subsequent withdrawal of all permit applications.

The Water Authority withdrew its application for State Lands approval and decided to terminate the Project due to extraordinary permitting challenges created by State Lands Commission staff that go beyond the statutory and regulatory requirements of the project. See Attachment A for a full accounting of the Water Authority’s position.

Inability to get State Lands Commission and San Diego Water Board approvals caused missing the construction window in consecutive years and the final termination of the project. While California’s Permit Streamlining Act was supposed to resolve a lot of this permit coordination, it is apparent that more upfront work to navigate through the permitting process and engaging the permitting agencies early and often is necessary. While this is typical for most construction projects, it is even more so when regulatory sensitivities are elevated, and new regulations are being implemented.

3.2. Using the Statutory Exemption

About the same time as submitting applications for the land lease permit and discharge permit/waiver, the Water Authority also initiated the process to file a statutory exemption under the California Environmental Quality Act (CEQA) under California’s Public Resources Code §21150, consistent with the legislative intent supporting feasibility studies. The statutory exemption was not recognized by the California State Lands Commission as an appropriate CEQA document/determination.

3.3. Design

The project attempted to but ended up not following a standard design submittal process (30%, 60%, 90%, Final) because of several redesigns at the 90% phase as the project received comments/feedback during the permitting process. As new information or requirements were attained during the permit application process, features to the project were amended or added. This caused delays and overages in the design phase. The design should have paused at the initial 90% design level until all permits we properly obtained.

3.4. Cost

The project had a tight construction window that required all construction activities occur between November and March to avoid the nesting season for sensitive species. The project also had difficulty getting all required permits in a timely manner. The project missed its construction window in consecutive years due to permit issues. To avoid a third year of delays, the project started to purchase equipment/material that had long lead times. The purchased equipment/material were a significant cost, and the equipment is no longer usable or needed as the project terminated. Equipment purchase should have been delayed until key permits were obtained, specifically from the California State Lands Commission and the Regional Water Quality Control Board.

4. Attachments

Attachment A	Letter from the Water Authority to California State Land Commission dated September 27, 2018
Attachment B	Test Plan Protocol

Attachment A

September 27, 2018

Honorable Betty T. Yee, Chair
California State Lands Commission
100 Howe Avenue, Suite 100-South
Sacramento, CA 95825-8202

Dear Ms. Yee,

The Water Authority has been pursuing a one-year Camp Pendleton Seawater Desalination Project - Intake Testing Program (Study) to support future sustainable alternative water supply development as part of a long-term strategy. The purpose of this letter is to inform you of our intent to withdraw our application for State Lands Commission approval due to the extraordinary permitting challenges created by State Lands Commission staff, that go above and beyond the statutory and regulatory requirements for this project.

The temporary facilities required for the Study would consist of a small-scale pilot treatment plant with one small screened open ocean intake and one subsurface intake, that would pump up to 40 gallons per minute (gpm), and treat up to 20 gpm of seawater. Data obtained through the Study was intended to develop information that would support the desalination intake configuration regulations enacted as part of the 2015 Amendment to the Water Quality Control Plan for Ocean Waters of California Addressing Desalination Facility Intakes, Brine Discharges (OPA) for proposed desalination projects. The Study would have been the first in the State to investigate the feasibility of an innovative subsurface intake technology (Neodren®), which is a preferred technology under the OPA. Due to the Statewide and federal interest in this innovative new technology, both the Department of Water Resources and the US Bureau of Reclamation authorized $1.4 million in grant funding for the Study.

The Study requires State Lands Commission approval for a lease of state lands for the temporary installation of small subsurface and open ocean intakes. The Water Authority applied for the State Lands lease on July 21, 2016. Consistent with the legislative intent supporting feasibility studies, the Water Authority filed a Statutory Exemption for the project under Public Resources Code §21150. State Lands staff indicated in letters dated October 7, 2016 and June 7, 2017, that a mitigated negative declaration would be needed for the State Lands Commission's approval, as a responsible agency. In the interest of full public disclosure, and to support the State Lands Commission's CEQA determination, the Water Authority prepared and submitted to State Lands staff on March 2, 2018, a 214-page draft Negative Declaration with full supporting documentation. The documentation provided shows that the Study will have no significant impact on the environment.

State Lands staff responded with the attached letter and request for funding dated June 26, 2018, stating that staff now must prepare a full environmental impact report (EIR), because an EIR is required for any project that "*may* have a significant impact on the environment." The staff indicated that development of an EIR (for this 20 gpm temporary pilot facility) would be done at an additional cost of $626,000 to the Water Authority and its ratepayers. This amount is on top of the $130,000 the Water Authority expended to prepare the negative declaration previously requested by State Lands Commission staff. It is important to note here that the entire cost to construct this pilot unit is estimated at $2.5 million.

At issue are the extensive and unnecessary CEQA requirements being mandated by State Lands staff for a study which is statutorily exempt from CEQA, and for which we have provided substantial documentation demonstrating that the Study will have no significant impact on the environment. The staff at the State Lands Commission has placed significant hurdles for the project approval resulting in extensive delays and a disproportionately high cost on the permitting of this Study. Because of this we can no longer justify expending additional public agency funds to continue this pursuit, and we are planning to withdraw our application.

Because the Study will likely never reach the State Lands Commission for your consideration, we are sending you this letter to inform you of what we perceive to be untenable positions being taken by your staff, the net result of which will have a significant chilling effect on innovation and research of new technology to support environmentally sensitive, new water supplies for California. In particular, the Water Authority's research could have been used to optimize the development of ocean desalination, including the use of subsurface intakes, while protecting the environment and ensuring consistency with the OPA.

As we look toward the future of water supply in California, including the many challenges created by climate change, we are hoping that the State Lands Commission will reflect on your role in balancing the public interest and ensuring sensible environmental review. We encourage you to develop a policy approach that is more supportive of innovation and provides for more streamlined permitting and approvals for research projects as allowed by the statutes.

Sincerely,

Maureen A. Stapleton
General Manager

Attachment: State Lands Letter (June 26, 2018)

CC: San Diego County Water Authority Board of Directors
State Lands Commission:
Honorable Gavin Newsom, Lieutenant Governor (Member)
Keely Bosler, Finance Director (Member)
Jennifer Lucchesi, Executive Officer
Cheryl Hudson, Public Land Management Specialist

San Diego Regional Water Quality Control Board:
    Dave Gibson, Executive Officer
    David Barker, Supervising WRC Engineer
Department of Water Resources:
    Kamyar Guivetchi, Division Chief
    Richard Mills, Section Chief
California Coastal Commission – Tom Luster, Senior Environmental Scientist
MCI West-MCB Camp Pendleton – Jessica Spurlock
U.S. Bureau of Reclamation – Steve Dundorf, Grants Officer

STATE OF CALIFORNIA EDMUND G. BROWN JR., *Governor*

CALIFORNIA STATE LANDS COMMISSION
100 Howe Avenue, Suite 100-South
Sacramento, CA 95825-8202

JENNIFER LUCCHESI, *Executive Officer*
(916) 574-1800 *Fax* (916) 574-1810
California Relay Service TDD Phone 1-800-735-2929
from Voice Phone 1-800-735-2922

Contact Phone: (916) 574-1911
Contact Fax: (916) 574-1885

Established in 1938

June 26, 2018

File Ref: W 27039

Maureen A. Stapleton
General Manager
San Diego County Water Authority
4677 Overland Ave
San Diego, CA 92123

Dear Ms. Stapleton:

This letter is in response to your letter dated May 3, 2018, requesting that the State Lands Commission provide you with a letter stating its position regarding CEQA compliance for the application by San Diego County Water Authority (SDWCA) to lease state sovereign land for the Camp Pendleton Seawater Desalination Project – Intake Testing Program (Project). As noted in your letter, Commission staff determined that an Environmental Impact Report is required for the Commission's review of the Project.

SDCWA relied on a statutory exemption from CEQA for feasibility and planning studies[1] when it approved the Project and filed a Notice of Exemption on August 5, 2016. SDCWA informed Commission staff of its use of the exemption in a letter dated September 9, 2016. When reviewing SDCWA's application Commission staff concluded that the proposed physical construction and ground-disturbing activities required to implement the Project go beyond planning and feasibility studies. Therefore, staff cannot recommend that the Commission rely on the statutory exemption. As a result, the Commission has assumed the duties of Lead Agency for CEQA compliance when considering SDCWA's application as required by the State CEQA Guidelines.[2]

The Lead Agency is responsible for determining whether an EIR is required for a project under CEQA.[3] The CEQA process is meant to protect the environment along with fostering informed self-government.[4] A strong presumption in favor of preparing an EIR is built into CEQA: a lead agency "*shall* prepare . . . an environmental impact report on any project which they propose to carry out or approve that *may* have a significant effect

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[1] Cal. Code Regs., tit. 14, § 15262.
[2] Cal. Code Regs., tit. 14, § 15052.
[3] Pub. Resources Code, § 21080.1.
[4] *Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal.3d 376, 392.

on the environment."[5] An EIR demonstrates that the approving agency has analyzed and considered the environmental implications of its actions and serves as the principal method by which related environmental information is brought to the attention of the public.[6]

After reviewing the information submitted by SDCWA, including SDCWA's Applicant-prepared draft Negative Declaration, Commission staff determined that an EIR is required for the proposed Project. An EIR will provide the public with the information it needs to analyze the Project's potential benefits and environmental impacts. An EIR will also allow the Commission to make an informed decision regarding whether use of sovereign land for this Project is in the State's best interests.

To allow Commission staff to continue processing your application, please sign the attached Reimbursement Agreement Amendment to cover Commission staff's costs incurred in reviewing the application for the use of sovereign land and preparing the necessary EIR.[7]

Sincerely,

Cy R. Oggins, Chief
Environmental Planning and Management Division

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[5] Pub. Resources Code, § 21100 subd. (a) [emphasis added].
[6] *No Oil, Inc. v. City of Los Angeles* (1974) 13 Cal.3d 68, 84.
[7] Under Public Resources Code section 21089, a lead agency may require reimbursement for the cost to prepare an EIR.

STATE OF CALIFORNIA
STANDARD AGREEMENT
STD.213 (new 06/03)

AGREEMENT NUMBER
R03716 AMENDMENT 2
REGISTRATION NUMBER

1. This Agreement is entered into between the State Agency and the Contractor named below:

STATE AGENCY'S NAME
California State Lands Commission (State)

CONTRACTOR'S NAME
San Diego County Water Authority

2. The term of this Agreement is: August 8, 2016 through August 30, 2019

3. The maximum amount of this Agreement is: $ 626,000.00

4. The parties agree to comply with the terms and conditions of the following exhibits which are by this reference made a part of the Agreement:

Exhibit A – Scope of Work	2	Page(s)
Exhibit B – Budget Detail and Payment Provision/Definitions and Terms	2	Page(s)
Exhibit C* – General Terms and Conditions	GTC 610	
Check mark one item below as Exhibit D:	2	Page(s)

☒ Exhibit D – Special Terms and Conditions (attached hereto as part of this Agreement)
☐ Exhibit D* – Special Terms and Conditions

Items shown with an Asterisk (*) are hereby incorporated by reference and made part of this Agreement as if attached hereto. These documents can be viewed at http://www.dgs.ca.gov/ols/Resources/StandardContractLanguage.aspx.

IN WITNESS WHEREOF, this Agreement has been executed by parties hereto.

CONTRACTOR		**CALIFORNIA Department of General Services** Use only
CONTRACTOR'S NAME *(if other than individual, state whether a corporation, partnership, etc.)* San Diego County Water Authority		
BY *(Authorized Signature)*	DATE SIGNED	
PRINTED NAME AND TITLE OF PERSON SIGNING		
ADDRESS 4677 Overland Avenue, San Diego, California 92123		
STATE OF CALIFORNIA		
AGENCY NAME California State Lands Commission		
BY *(Authorized Signature)*	DATE SIGNED	
PRINTED NAME AND TITLE OF PERSON SIGNING Denise Cook, Fiscal Officer		
ADDRESS 100 Howe Avenue, Suite 100-South, Sacramento, California 95825		☐ Exempt per

EXHIBIT A

SCOPE OF WORK

1. Work to be Performed – San Diego County Water Authority, the "Applicant", enters into this Agreement with the California State Lands Commission, the "Commission" or the "State" (hereafter the Applicant and the Commission are referred to as the "Parties") for the processing of a General Lease application. The Applicant has submitted an application for the proposed construction, use and maintenance of the Camp Pendleton Seawater Desalination facility (intake testing program, located at the Marine Corp Base Camp Pendleton Del Mar Recreational Beach, 0.5 miles south of Highway 5, near the city of Oceanside in the County of San Diego. The State hereby agrees to perform the following services:

   A. Application Processing: The State shall process the Applicant's lease application. Processing costs shall include, but not be limited to, actual costs of the State staff time for document preparation, negotiation of terms and conditions, review of project impacts on the Public Trust, field inspections, preparation of field reports, technical review, boundary services (including land descriptions and exhibits), engineering review, appraisals, and coordination with other governmental agencies. Work performed in processing the Applicant's lease application shall not be considered worked performed for Environmental Analysis or the Mitigation Monitoring Program, as described below.

   B. Environmental Analysis: The State as the Responsible Agency for this project, agrees to conduct or contract separately for the necessary environmental analyses under CEQA for the Applicant's proposed project to determine the potential environmental impacts, mitigation measures and documentation as prescribed by CEQA.

   C. Mutual Understanding: This Agreement is entered into by the parties hereto with the express understanding that the State cannot assure: 1) final approval of the permit or lease for the proposed project; 2) that permits from other State or local permitting agencies are obtainable: 3) that either the State or the Applicant by entering into this Agreement is representing that the project will go forward as proposed; and 4) that either the State or the Applicant is irrevocably committed to proceeding with this project.

2. Parties' Agents

   A. The State's Project Officer shall be:

   Cheryl Hudson
   California State Lands Commission
   Land Management Division
   100 Howe Avenue, Suite 100-South
   Sacramento, CA 95825
   Tel. 916-574-0732
   Fax 916-
   Email: Cheryl.Hudson@slc.ca.gov

   B. The State Environmental Officer shall be:

   Alexandra Borack
   California State Lands Commission
   Environmental Planning & Management
   100 Howe Avenue, Suite 100-South
   Sacramento, CA 95825
   Tel. 916-574-2399
   Fax 916-574-1880
   Email: Alexandra.Borack@slc.ca.gov

   C. The Applicant's Project Manager shall be:

   Jeremy Crutchfield
   San Diego County Water Authority
   4677 Overland Avenue
   San Diego, CA 92123
   Tel. 858-522-6834
   Fax
   Email: JCrutchfield@sdcwa.org

   D. The Applicants Agent is:

   Chris Johnson
   Michael Baker International
   14725 Alton Parkway
   Irvine, CA 92618
   Tel. 949-855-3685
   Fax
   Email: chrijohnson@mbakerintl.com

EXHIBIT A

3. Notices and Authorities

A. Any notice or other written communications required or permitted under this Agreement may be personally delivered in writing to the State's Project Officer or Applicant's Project Manager, or may be sent by certified mail, return receipt requested, to the address stated above and shall, based on such delivery or sending, be deemed to have been effectively communicated. Either party may change such address by written notice to the other party.

   Any notice given other than as provided above, shall not be deemed to be effectively communicated until received in writing.

B. The Project Manager shall have full authority to act on behalf of the Applicant for administration of the project. All communications given to the Project Manager shall be as binding, as if given to the Applicant.

C. The State may change its Project Officer, at any time, by written notice to the Applicant. The Applicant may change its Project Manager, at any time, by written notice to the State's Project Officer.

EXHIBIT B

BUDGET AND PAYMENT PROVISIONS

1. Invoicing and Payment – Applicant agrees to reimburse the State for all reasonable costs associated with the processing of its application according to this Standard Agreement whether prior or subsequent to the execution of this Agreement. Processing costs shall include, but not be limited to, staff time associated with those tasks outlined in Exhibit A, Scope of Work. Staff costs shall be computed in accordance with Section 8752 of the State Administrative Manual and shall include salaries and wages, related staff benefits and administrative overhead.

   The invoice shall be mailed to the Applicant's Project Manager. Payments shall reference the Agreement number assigned to this project and must be mailed to the following address:

   California State Lands Commission
   100 Howe Avenue, Suite 100 South
   Sacramento, CA 95825-8202
   Attention Accounting

2. Estimated Reimbursable Costs – The initial estimated costs are based on the information and contracts existent as of the date of this Agreement, it is estimated that the itemized reimbursable costs for Work To Be Performed will be:

(a) Initial CSLC Application Processing Fees	$6,000
(b) Environmental Analysis and Review	$100,000
(c) Engineering Review	$20,000
(i) Estimated CSLC staff Costs:	
(ii) Environmental Consultant:	$500,000
(d) Engineering Compliance & Mitigation Monitoring	*to be determined*
(e) Approximate Total Cost	**$626,000**

   Estimated costs above are based on the initial processing of the application. Additional costs will be determined upon defining of the scope of the project and cost of consultant contracts.

3. Expense Deposits and Billings – **A deposit has been made by the Applicant in the amount of $3,025 minus $25.00 for filing fees.** Costs incurred by the State are charged on a monthly basis and will be applied against the deposit until exhausted. Then after, the applicant will be billed and all payments are due 30 days from the date of the invoice. The State reserves the right to demand an expense deposit equal to the remainder of the Agreement should the Applicant fail to pay invoices within the time specified. Total costs invoiced, including expense deposits, shall not exceed the dollar amount specified in this Agreement unless amended.

4. Additional Costs or Services – Applicant will be advised of any estimated cost increase in writing in accordance with this Agreement should the need for additional services become known or as costs previously estimated exceed the above estimate.

   Upon notification of the need for additional funds, the Applicant shall have the right to terminate this Agreement in accordance with the Termination clause; or dispute the change. The Applicant shall have the option to dispute or accept the increase with all the terms and conditions of this Agreement being unchanged and in effect. Applicant shall notify the State within five (5) days of notice of any intent to terminate the Agreement or dispute the change. Non-response shall be acknowledged as acceptance of the additional charges and Applicant will be billed for the balance in accordance with the terms above.

5. Definitions and Terms - Wherever the following abbreviations and terms (or pronouns in place of them) are used, the intent and meaning shall be interpreted as provided in this section. Working titles having a masculine gender, and pronouns referring to such said titles, are utilized in this Agreement for the sake of brevity and are not intended to refer to either sex or the neuter. All references to the singular shall refer also to the plural. All references to the plural shall refer also to the singular.

A. As used within this Agreement, the terms "Applicant" and "Contractor" are used interchangeably and are to be considered the same entity.

B. As used within this Agreement, the terms "State" and "CSLC" are used interchangeably and are to be considered the same entity.

C. The term "Agreement" refers to this document as executed by the Applicant and the State. This document includes Standard Form and any attached Exhibits.

D. The term "Application Processing" refers to all staff services necessary to process an Applicant's proposed lease application but shall not include staff services for environmental analysis or project mitigation monitoring pursuant to CEQA.

E. The term "Project" means that activity which is the subject of the application for a permit, lease or other entitlement from the State.

F. The term "Project Manager" refers to that person appointed or designated by the Applicant to administer the project for the Applicant.

G. The term "Project Officer" refers to that person appointed by the State to process the project application.

H. The term "CEQA" refers to the California Environmental Quality Act of 1970, as amended (Public Resources Code § 21000 et seq.).

I. The term "Environmental Officer" refers to that person designated by the State to be responsible for the preparation of the environmental analysis and conduct of the mitigation monitoring program.

J. The term "Applicant's Agent" refers to that person designated by the Applicant to provide technical assistance and support to the State in coordinating transmittal of project technical information and shall have no authority to act for the Applicant unless otherwise stated in writing by Applicant to the State's Project Officer.

K. The term "Mitigation Monitoring Program" refers to that program mandated by CEQA as found in Public Resources Code section 21081.6.

EXHIBIT D

SPECIAL TERMS AND CONDITIONS

1. Type of Agreement – This Agreement between the State and the Applicant is for the reimbursement of costs, from the Applicant to the State, for Application Processing and Project related activities, detailed in Exhibits A and B of this Agreement, performed by staff of the California State Lands Commission. This Agreement does not involve the procurement of goods or services from the Applicant.

2. Effective Reimbursement Period – Notwithstanding the date of Agreement approval in paragraph 1 of GTC 610, the Applicant agrees to reimburse the State for the costs of Application Processing and Project related activities detailed in Exhibits A and B of this Agreement, that accrue beginning on the date listed in form STD.213, paragraph 2 of this Agreement until the termination of this Agreement.

3. This paragraph supersedes paragraph 5 of, Exhibit C, "Indemnification":

   Indemnification – Applicant shall defend, indemnify, and hold harmless the State of California and any and all agencies or departments thereof, including but not limited to, any and all boards, commissions, officers, agents, employees, and representatives (Indemnitees), against any and all claims, liabilities, charges, losses, expenses, and costs including the State's attorneys' fees (Liabilities), that may arise from, or by reason of: (1) any action or inaction by the Indemnitees in connection with the issuance or denial of any lease, permit, or other entitlement; (2) as a result of approvals or authorizations given by the State to the Applicant pursuant to or as a result of Applicant's project application; or (3) provisions of the issued lease or permit, provisions of CEQA, an environmental document certified or adopted by the State related to the Applicant's project application, or any other regulations, requirements, or programs by the State, except for any such Liabilities caused solely by the gross negligence or intentional acts of the State or its officers, agents, and employees. This obligation of the Applicant to indemnify, defend, and hold harmless the Indemnitees shall not apply to the extent that any such obligation is void or otherwise unenforceable; and further, the provisions of the preceding sentence shall not apply to any claims, litigation, or other actions brought by the Applicant against the Indemnitees in relation to the Applicant's application or this Agreement.

4. This paragraph supersedes paragraph 6 of GTC 610, Exhibit C, "Disputes":

   Disputes – Except as otherwise provided in this Agreement, any dispute concerning a question of fact arising under or relating to the performance of this Agreement which is not disposed of by Agreement shall be decided by the Project Officer, who shall reduce his decision to writing in regard to the dispute and shall transmit a copy thereof to the Applicant within thirty (30) days. The decision of the Project Officer shall be final and conclusive, unless within thirty (30) days from the date of receipt of such copy, the Applicant transmits to the State a written appeal. Said appeal shall be supported with specificity.

   a. In connection with any appeal proceeding under this clause, the Applicant shall be afforded an opportunity to be heard before the State Lands Commission within sixty (60) days of the receipt by the State of the Applicant's written appeal and to offer evidence in support of its appeal. Pending the final decision of any such dispute, the Applicant shall proceed diligently with the performance of the Agreement and in accordance with the written decision of the Project Officer which is the subject of the Applicant's appeal including the payment of invoices to the State.

   b. The procedure described herein shall not prejudice or deny the Applicant his remedies at law. However, the Applicant agrees to exhaust the procedure described herein before pursuing his remedies at law. All amounts paid to the State under protest shall be held by the State in trust until the dispute is resolved.

5. Termination – This paragraph supersedes paragraph 7 of GTC 610, Exhibit C, "Termination for Cause":

   Either party may elect to terminate this Agreement by written notice at any time prior to referral of the project to the Commission upon ten (10) days written notice to the other party. The Applicant agrees that in the event of termination of this Agreement by either party as provided above, it shall reimburse the State upon its written request one hundred percent (100%) of all costs incurred by the State in the performance of its obligations as described in this Agreement.

6. Reimbursement of Costs – Applicant shall reimburse the State in full for all reasonable costs and attorney's fees, including, but not limited to, those charged it by the California Office of the Attorney General, that the State incurs in connection with the defense of any action brought against the State challenging this Agreement or any other matter related to this Agreement or the work performed by the State under this Agreement. In addition, Applicant shall reimburse the State for any court costs and reasonable attorney fees that the State may be required by a court to pay as a result of such action. Applicant may participate in the defense of the action, but its participation shall not relieve it of its obligations under this Paragraph. The provision of this Paragraph shall not apply to any claims, litigation or other actions which may be brought by either Applicant or the State against each other and shall not apply to the extent that any such obligation is void or otherwise unenforceable under applicable law in effect on or validly retroactive to the date of this Agreement. Nothing in this Paragraph shall be construed to require the State to defend itself against all or any aspect of the challenge to this Agreement or work performed under this Agreement. However, Applicant may take whatever legal action is available to it to defend this Agreement or any work performed under this Agreement against any challenge by a third party, whether or not the State chooses to raise a defense against such a challenge.

7. Records – Upon five (5) business days' notice, the State's records relating to its costs shall be available for the Applicant's audit in the State's office in Sacramento. Said audit shall take place only during regular business hours of the State. Payment of costs by the Applicant shall not constitute a waiver of its rights to audit nor an acknowledgment by the Applicant of the validity of the costs that have been paid. Nothing herein shall be deemed to require the State, its consultants, other contractors and subcontractors to maintain books, records, or documents other than those usually maintained by them, provided that such books, records and documents reasonably segregate and identify the costs for which reimbursement is required hereunder. As used herein, "State's records" include any audit of the consultant by the State or its designated representative as authorized in this Agreement.

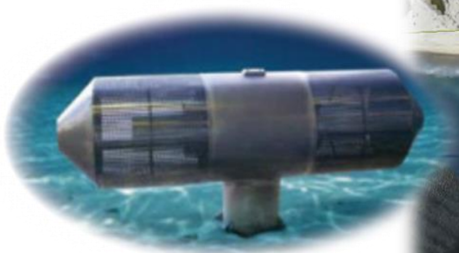
8. The following Paragraphs in Exhibit C does not apply to Reimbursement/Revenue Agreement therefore, 4, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, and 20 of GTC 610, Exhibit C, are hereby waived and shall have no force or effect upon this Agreement.

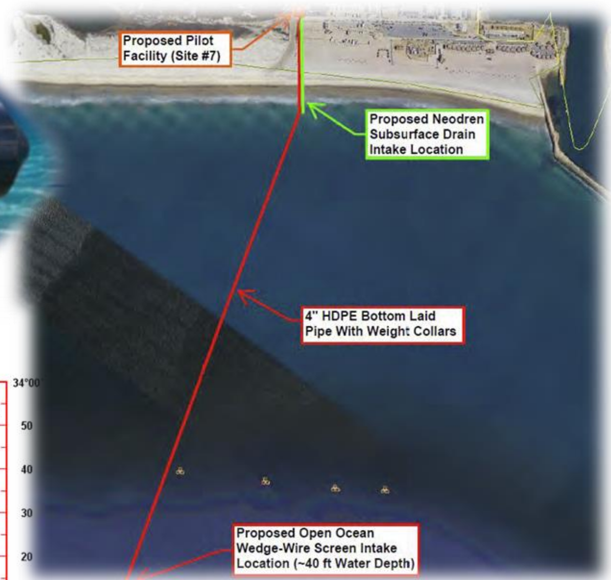
Attachment B

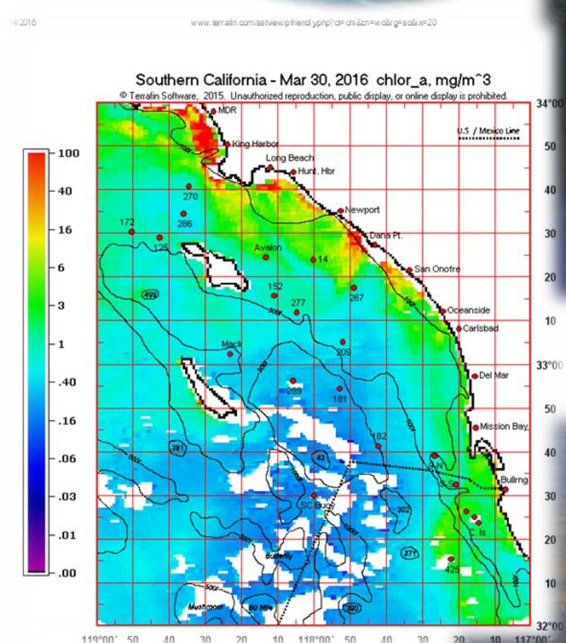
San Diego County Water Authority
Camp Pendleton Seawater Intake Testing Program

Test Plan Protocol

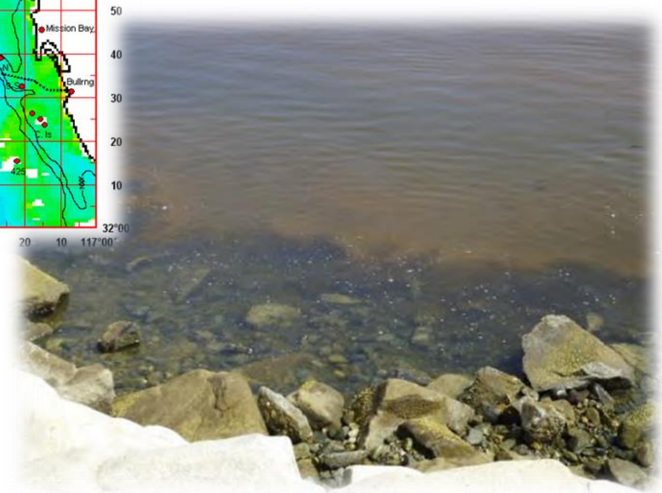
Prepared by Trussell Technologies, Inc. with Support from SPI







June 5, 2017 (DRAFT)



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APPENDICES AND ATTACHMENT

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

CIP	Clean-In-Place
DO	Dissolved Oxygen
EEM	Excitation Emission Matrix
EPDM	Ethylene Propylene Diene Monomer
FRP	Fiberglass Reinforced Plastic
GMF	Granular Media Filter
GPM	Gallons per Minute

HABs	Harmful Algal Blooms
HASP	Health and Safety Plan
HDD	Horizontal Directionally Drilled
HDPE	High Density Polyethylene
MOU	Memorandum of Understanding
ND	Non-detect
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
ORP	Oxidation Reduction Potential
P&ID	Process and Instrumentation Diagram
PFD	Process Flow Diagram
PSIG	Pounds per Square Inch Gauge
PV	Pressure Vessel
PVC	Polyvinyl Chloride
SBS	Sodium Bisulfite
SCCOOS	Southern California Coastal Ocean Observing System
SCFM	Standard Cubic Feet per Minute
SDI	Silt Density Index
SS	Stainless Steel
SVI	Sludge Volume Index
SWRO	Seawater Reverse Osmosis
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TPP	Test Plan Protocol
TSS	Total Suspended Solids
UV254	Ultraviolent absorption at 254 nm wavelength
UVA	Ultraviolet A

TEST PLAN PROTOCOL

Prepared for:

San Diego County Water Authority / Michael Baker Intl., Inc.

Revised Draft Date: June 5, 2017
Original Draft Date: May 16, 2016

Authors: Emily Owens-Bennett, P.E. (Trussell Technologies)
David R. Hokanson, Ph.D., P.E., BCEE (Trussell Technologies)
Sangam K. Tiwari, Ph.D., P.E. (Trussell Technologies)
Chao-Chun Yang (Trussell Technologies)
Gerry Filteau (SPI)
Mike Dummer, P.E. (SPI)

Reviewers: R. Rhodes Trussell, Ph.D., P.E., BCEE (Trussell Technologies)
R. Shane Trussell, Ph.D., P.E., BCEE (Trussell Technologies)

Subject: Test Plan Protocol for Intake Testing Program for SDCWA Proposed Camp Pendleton Seawater Desalination Project

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I. Introduction

The Water Authority has contracted the Michael Baker International Team to design, construct, permit, and operate the Camp Pendleton seawater Intake Testing Program (ITP).

The purpose of the Intake Testing Program (Project) is to compare source water quality and associated pre-treatment requirements for an open ocean intake and subsurface intake. The open ocean intake source water pretreatment testing will consist of coagulation, flocculation, and granular media filtration (GMF). The Neodren® subsurface intake testing will consist of a horizontal directionally drilled (HDD) drain installed 20-30 feet below the ocean floor. The Neodren® subsurface intake allows seawater to migrate through a micro-porous, high density polyethylene (HDPE) pipe, and is anticipated to produce a high quality feed water to the seawater reverse osmosis (SWRO) unit, without any additional pretreatment. At the outset, the open ocean intake will feed high rate GMF alone and the subsurface intake will feed SWRO, with the ability to change configurations during the pilot testing period[1]. This Test Plan Protocol (TPP) defines the Intake Testing Program that has been designed to assess

[1] As a consequence of available budgeting and permitting for ocean discharge, the testing will be limited to one SWRO unit. Within these constraints, the Michael Baker project team has developed a thorough and technically sound TPP.

performance differences for the two intake and pretreatment systems resulting from water quality variations related to seasonal, storm, and algal activities. Specific goals and sub-goals of the comparison are presented in Table 1.

Table 1. Project goals and sub-goals

	Goal		Sub-Goal	Strategies
1	Compare open ocean and subsurface intakes as to how well each manages source water under normal conditions as well as during biological events (e.g. algal bloom)	a	Evaluate the sustainability of the influent flow rates for both open ocean and subsurface intake.	Monitor and record the flow rate, headloss, and influent pump power consumption on a regular basis for both intakes. From the data obtained, evaluate any indications of increasing difficulty in the pumping of the influent flow.
		b	Evaluate the pretreatment system performance with respect to water quality and operability.	Keep an on-site log to record details pertaining to pretreatment system operations (e.g., shut-downs). Collect water quality data associated with RO fouling potential for subsurface intake without additional pretreatment and GMF on a regular basis.
		c	Compare RO membrane fouling following pre-treatment	Collect water quality data associated with RO fouling potential for subsurface intake and GMF on a regular basis. Perform SDI measurements for subsurface intake and GMF on a weekly basis.
		d	Evaluate Operational Cost, Energy use, and Chemical use	Data collection to support calculation of these parameters
		e	Evaluate the robustness of the treatment train to handle Algal Blooms and High Turbidity storm events	Monitor SDI and Turbidity. Monitor RO performance

Table 1. Project goals and sub-goals (continued)

	Goal		Sub-Goal	Strategies
1		f	Provide operational insight for both intakes and the GMF.	Monitor GMF performance and make changes in operations as appropriate. Monitor intakes for impacts of mussel growth and other unexpected occurrences.
		g	Evaluate the feasibility of the intake systems for cost, fouling, constructability, etc.	Apply the results in of the pilot testing in a life cycle cost analysis. Summarize fouling results observed under seasonal conditions with different RO feed conditions.
2	Evaluate the feasibility and practicality of subsurface intakes as a pretreatment option for seawater desalination	a	Evaluate the subsurface intake performance with respect to water quality and operability	Maintain an on-site log to record details pertaining to subsurface intake operations (e.g., shutdowns, critical alarms). Collect routine water quality data associated with RO fouling potential.
		b	Evaluate Operation Cost, Energy use, and Chemical use (see 1d, above)	Data collection to support calculation of these parameters
3	Assess ability of GMF pretreatment to produce high-quality RO feed water from an open ocean intake	a	Evaluate the GMF performance with respect to water quality and operability	Maintain an on-site log to record details pertaining to GMF operations in conjunction with open ocean intake (e.g., shutdowns, critical alarms). Collect routine water quality data associated with RO fouling potential.

A. Project Description

The Project will include testing of both a screened (wedge-wire) open ocean intake and Neodren® micro-porous subsurface intake. The focus of the study is the water quality produced from each type of intake and the ability of the intake itself, in the case of the subsurface intake, or the pretreatment downstream of the intake, in the case of the open ocean intake, to handle sudden changes in water quality. These changes in water quality could be brought about by seasonal changes, tidal changes, stormwater events, and harmful algal blooms (e.g. red tide), among others. An objective of the Project is to capture as many of these events as possible during the test period.

A pretreatment system (coagulation-flocculation-GMF, termed the "GMF system") will be applied downstream of the open ocean intake for the purpose of producing high-quality feed water. The subsurface intake will feed single pass SWRO membranes directly to test the ability of the SWRO to handle the feed water quality from the subsurface intake without additional pretreatment. Depending on testing results, the pilot plant has the ability to run additional process configurations including addition of disc filters (strainer) for added pretreatment and/or GMF downstream of the subsurface intake and upstream of SWRO. It is anticipated that the SWRO will be run downstream of the open ocean intake-GMF system process train for a portion of the test period.

Scenarios that may be tested during the intake study are summarized in Table 2. For each scenario, the upper row contains one train and the lower row contains another train, to be run simultaneously. The key location for the water quality comparisons in the intake study is shown by the highlighted cells in the table. Scenario #1 represents the initial testing condition, with subsurface intake water quality compared to GMF system treated water quality. Performance will also be evaluated for the different intake/pretreatment configurations feeding SWRO. It is likely that some of the scenarios in Table 2 will not be tested.

B. Objectives

The TPP is a working document that will evolve with the maturation of the Project. This preliminary draft presents the primary objectives of the Project, including, but not limited to:

- Treatment processes to be tested;
- Sizing of treatment components;
- Layout and set-up requirements;
- Sampling, monitoring, and testing protocols;
- Facility staffing needs; and
- Roles and responsibilities for monitoring, operating, maintaining, and assessing treatment process performance.

In addition to monitoring the treatment processes, the intake systems will be monitored on a limited basis for any pressure and power anomalies associated with intake performance (i.e., clogging, etc.) and recorded.

Table 2. Scenarios for which water quality may be compared.

SCENARIO[a]	INTAKE	PRETREATMENT	DOWNSTREAM PROCESS
Predominant Testing Configuration			
#1	subsurface	none	SWRO
	open ocean	GMF system	None
Additional Testing Configurations that May Be Tested			
#2	subsurface	none	none
	open ocean	GMF system	SWRO
#3	subsurface	GMF system	SWRO
	open ocean	No WQ data	No WQ data
Comparison of SWRO Permeate with Different Feed[b]			
#4	subsurface	none	SWRO
	open ocean	GMF system	SWRO
#5	subsurface	GMF system	SWRO
	open ocean	GMF system	SWRO

[a]Comparison of results for Scenarios #2, #3, #4, and #5 will only occur if pilot testing with these configurations is conducted.
[b]This testing will be run with different water as there is only one SWRO unit.

C. Program Schedule

The latest program schedule is provided in Appendix A. The pilot testing program is expected to run for one year. More information on the pilot testing schedule will be provided later in the TPP.

D. Process Flow Diagram

The process flow diagram (PFD) for the pilot-scale seawater intake and desalination treatment facilities is included in Figure 1. Dashed lines represent potential modifications to increase pretreatment capabilities for the subsurface or open-ocean intakes, if needed, based on system performance and water quality indicators. The scenarios represented in Table 2 are depicted on the PFD. The predominant testing configuration from Table 2 is shown for the subsurface intake near the top of the PFD, with the subsurface intake feeding directly into the SWRO process then out to ocean discharge (after all streams are recombined in the discharge tank). For the open ocean intake, the predominant testing configuration is shown near the bottom of the PFD, with the open ocean intake feeding coagulation/flocculation feeding GMF then out to ocean discharge.

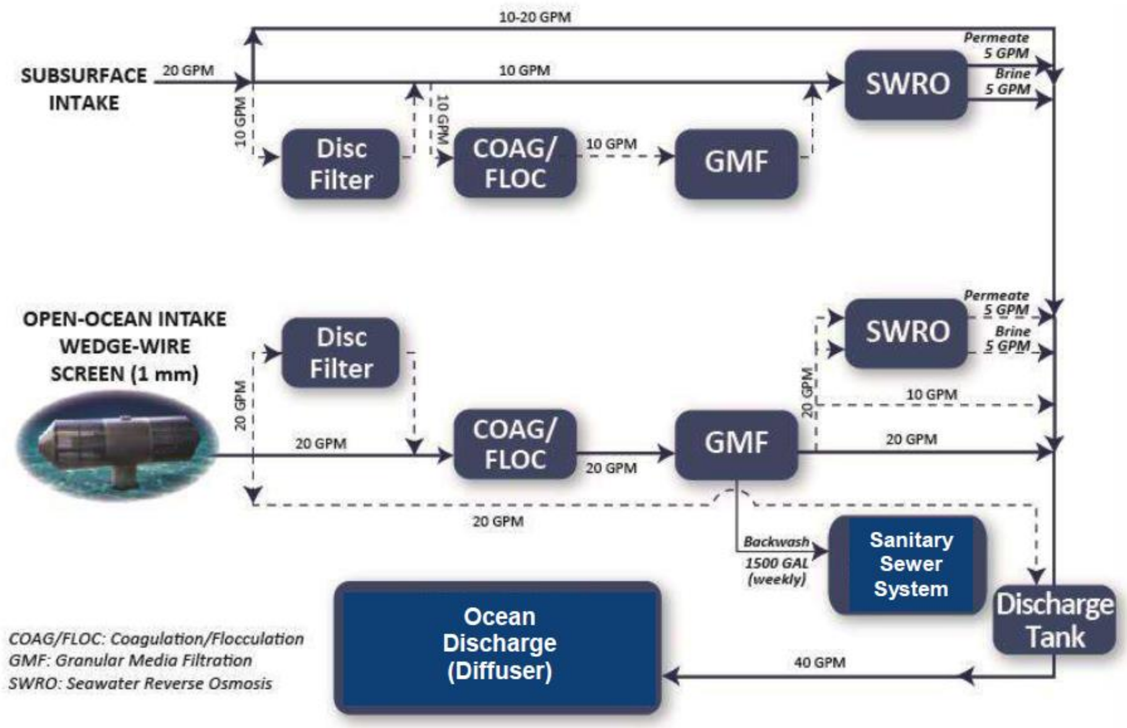


Figure 1. Process flow diagram for the Intake Testing Program

E. Treatment Process Description

The treatment process for this study is designed to produce high-quality feed water sufficient for SWRO from each of the two intake systems. Considering this objective and the potential fluctuations in source water quality due to seasonal, storm, and algal activities, the treatment process for each intake type has been designed with some flexibility. The treatment processes depicted in the PFD (Figure 1) are described in the following subsections, according to the intake.

Deep Bed Granular Media Filtration

Seawater will be pumped thorough a screened (1-mm wedge-wire) open ocean intake at approximately 20 gallons per minute (gpm). The intake screen will be located approximately 2,900 feet offshore, in approximately 40-foot water depth. The open ocean source water will be pumped into a pilot container equipped with coagulation-flocculation treatment ahead of deep bed GMF. Coagulation involves the addition of coagulants, which are comprised of positively charged molecules that neutralize negative electrical charges on colloidal particles in the seawater. Coagulation can be enhanced through the use of polymers. Once neutralized, the forces keeping the colloids apart are destabilized, and suspended solids bond together during flocculation. Following flocculation, a deep bed GMF will be used to filter out the organics and suspended solids found in the seawater. GMF filtrate will typically be routed to the discharge tank for recombination with all pilot waste and product streams prior to discharge via the open ocean outfall (current anticipated disposal strategy). Additional details on the GMF system are below.

Seawater Reverse Osmosis

The subsurface intake will pump water through the Nedoren® micro-porous HDPE pipe located under the seafloor and is anticipated to produce high-quality feed water, therefore minimizing the need for pretreatment. Feed water from the subsurface intake will be fed directly to the SWRO unit, which includes cartridge filter pretreatment followed by RO membrane treatment. However, if required, feed water from the subsurface intake can be pretreated prior to SWRO with a disc filter (strainer), and/or with coagulation-flocculation-GMF through the pilot pretreatment unit. Occasionally, treatment of the subsurface intake with SWRO will cease temporarily so that filtrate water from the open ocean pre-treatment process can be conveyed to the SWRO unit to validate the water quality data. During this time, water quality test samples will be collected from the subsurface intake water, and then this intake water will be routed into the recombined discharge tank for ocean discharge.

II. Equipment and Material Requirements

A. Components (sizing, chemicals, media specifications)

1. Neodren® Subsurface Intake

The subsurface intake pipeline will be positioned under the seafloor, using horizontal directional drains as depicted in Figure 2.

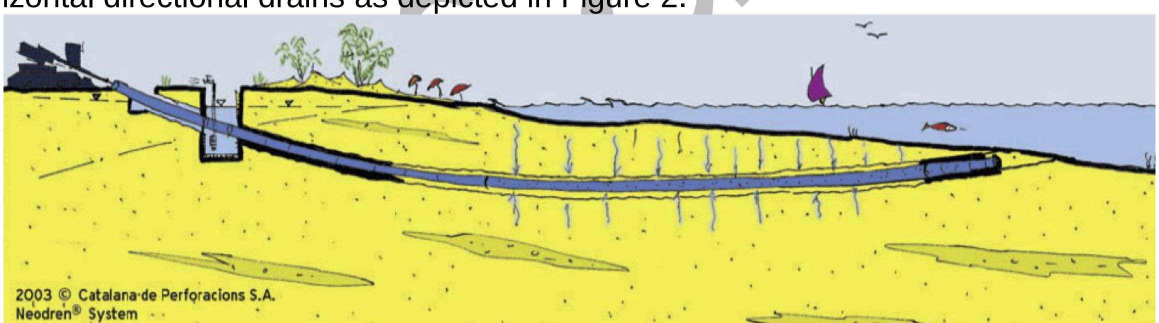


Figure 2. Micro-porous Pipe Subsurface Intake Profile Concept (Intake Works)

The design criteria for the subsurface intake includes:

- Micro-porous HDPE pipe (Figure 3):
  - Installed depth: 15 – 30 feet below seafloor
  - Total drill length: 1,200 feet
  - Max. flow rate: 20 gpm
  - Neodren pipe length: 60 feet
  - Neodren pore size: 60 micron
  - Pipe diameter: 7-inch
  - Pipe material: HDPE
- 8’ x 10’ x 6’ pre-cast concrete vault (same vault as open ocean intake);
- Submersible pump (accessible from the intake vault); and
- Below-grade onshore pipeline and electrical conduit from vault to testing

facility.

Figure 3. 60-micron Micro-porous HDPE Pipe (Intake Works)

The subsurface intake will be equipped with online analytical instrumentation in order to continuously monitor a number of important water quality parameters. Real time monitoring instrumentation is integrated into the containerized SWRO unit. The SWRO unit is used, and it is anticipated that the existing online analytical equipment will require refurbishment (e.g., sensor replacement). The online analytical equipment associated with the subsurface intake are summarized in Table 3 and include conductivity, turbidity, pH, temperature, oxidation reduction potential (ORP), as well as dissolved oxygen (DO). The specifications will be updated once the unit is procured and these details are available.

Table 3. Subsurface intake online analytical equipment specifications

Online Analytical Equipment		
Parameter	**Meter**	**Product #**
Subsurface Intake		
Conductivity	Rosemount 228 Series	
Turbidity	HF Scientific 20055	
pH/Temperature	Rosemount 399 VP Series	
Oxidation Reduction Potential	Rosemount 399 VP Series	
Dissolved Oxygen	Rosemount 499 ATrD - OP	

The continuous measurements defined in Table 3 will be verified through the use of handheld analytical instruments. Table 4 identifies the specific handheld analytical instruments that will be used to measure temperature, salinity, conductivity, pH, ORP, DO, ultraviolet absorption at 254 nanometer wavelength (UV-254), and turbidity. Grab samples will be collected according to the Data Sampling Sheets, with locations and frequencies presented in Appendix D, Table D1.

Table 4. Handheld analytical instrument specifications

Handheld Analytical Equipment		
Parameter:	**Meter:**	**Product #:**
Turbidity	Hach 2100Q Portable Turbidimeter	2100Q01
Salinity	YSI Professional Plus (Pro Plus) Multiparameter Instrument	6050000
	YSI Pro Series Lab pH/ORP Sensor w/ 4 M Cable	605179
	YSI Pro Series Galvanic Dissolved Oxygen Sensor	6052030-1
	YSI Pro Series DO/Conductivity Sensor w/ 4 M Cable	605202
UV 254	Real Tech, Inc. P200, battery pack, extra cuvette	P200
Chlorine/Iron	Hach DR890 Colorimeter	4847000
Silt Density Index	TT SDI Testing Kit	

2. Open-ocean Intake

The design criteria for the screened open ocean intake includes:

- Cylindrical wedge-wire screen (Figure 4):
    - Approx. distance offshore: 2,900 feet
    - Approx. water depth: 40 feet
    - Max. flow rate: 20 gpm
    - Max. screen slot opening: 1.0 mm
    - Max. through-screen velocity: 0.2 ft/sec
    - Screen Material: Z-Alloy
- Concrete support base;
- 2,000 feet of 6-8” HDPE seafloor pipeline with concrete ballast weights;
- 1,200 feet of 8” HDPE pipeline installed using HDD through the surf zone;
- 8’ x 10’ x 6’ pre-cast concrete vault;
- Submersible pump (accessible from the intake vault); and
- Below-grade onshore pipeline and electrical conduit from vault to testing facility.

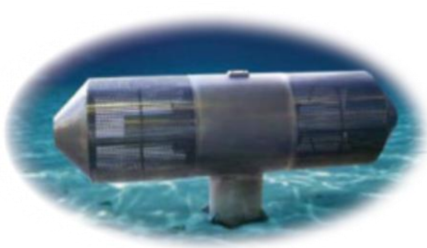


Figure 4. Wedgewire screen with 1-mm openings for open ocean intake

The open ocean intake will be equipped with online analytical instrumentation in order to continuously monitor a number of important water quality parameters. Real time monitoring instrumentation specifications for the open ocean intake are summarized in Table 5 and include conductivity, turbidity, pH, and temperature, as well as chlorophyll.

Table 5. Open ocean intake online analytical equipment specifications

Online Analytical Equipment		
Parameter	**Meter**	**Product #**
Open Ocean Intake		
Conductivity	Thermo Scientific DataStick 0-2,000,000 µS/cm conductivity transmitter with flow-thru cell	Conductivity DataStick
Turbidity	Hach ULTRATURB Seawater sc sensor with 10m cable	LPV415.99.32002
pH/Temperature	Thermo Scientific DataStick 0-14 differential pH transmitter with flow-thru cell	pH DataStick
Chlorophyll	Turner Designs Enviro-T In-Line Fluorometer with Chlorophyll Optics, 0.03-100 ppb	2800-000-C

As referenced in conjunction with the subsurface intake analytical equipment, the continuous measurements defined in Table 5 will be verified through the use of handheld analytical instruments identified in Table 4.

The raw seawater (feed water) will be conveyed in a 6-8-inch HDPE pipeline laid on the seafloor approximately 2,000 feet. The HDPE pipeline will be fused into two (2), 1,000-foot segments with a stainless steel flange fused on each end. The pipe segments will be pulled to the shore along the amphibious vehicle beach access road. The marine contractor will then pull the pipe segments out to sea and float them to their destination.

3. Coagulation-flocculation/GMF Container

The open ocean intake will be connected to a standard ISO container (20-foot long by 8-foot wide by 9.5-foot high) provided by Intuitech with pretreatment equipment. The pretreatment consists of coagulation via chemical addition, flocculation basins, and a high rate GMF. The Neodren® subsurface intake is designed to operate without the need for additional pretreatment ahead of SWRO, however plumbing connections will be established between the subsurface intake and the Intuitech pretreatment container. Should the subsurface intake water quality be insufficient for SWRO feed water, pretreatment with coagulation-flocculation-GMF will be moved to the subsurface intake for part of the test period. The components of each of the pretreatment processes are described in the following subsections.

The design criteria for the coagulation-flocculation-GMF container are shown in Table 6.

Table 6. Coagulation-flocculation-GMF Container Parts

Coagulation-Flocculation System	
Raw water system	
2	Hand-actuated ball valves
1	Ball check valve
1	¼-inch hand-actuated sampling valve
1	0-30 pounds per square inch gauge (psig) liquid-filled pressure gauge with PP/ ethylene propylene diene monomer (EPDM) diaphragm seal
1	0.6-25 gpm magnetic flow transmitter
2	Chemical injection assemblies (1/2 inch PP/FKM (ASTM D1418 standard)), ports, and one 6-element static mixer
Chemical feed system	
4	Chemical feed pumps (0.03-57 mL/min variable speed peristaltic)
4	20-gallon PP storage tanks, each with a constant speed axial turbine mixer
Flocculation system	
1	532 gallon PVC baffled rectangular tank with two chambers
1	Guided wave radar level transmitter with LDPE sheath (0-63 inch)
1	Temperature transmitter with PTFE sheath (0-180ºF)
2	Variable speed axial turbine mixers with hydrofoil impeller (10-140 S^{-1})
Granular Media Filtration System	
Single filter	
1	1½ HP EPOXY/NEOPRENE variable speed flexible impeller pump
1	30 inch diameter by 216 inch high fiberglass reinforced plastic (FRP) filter vessel
1	Underdrain system with 18 slotted PP nozzles
2	Hydrostatic level transmitters for measuring level and headloss
Backwash system	
1	1900 gallon cylindrical HDLPE tank with 16 inch threaded access port
1	5 HP PP/C276 variable speed magnetic drive centrifugal pump
1	0-60 psig liquid-filled pressure gauge with PP/EPDM diaphragm seal
1	Hydrostatic level transmitter
1	1.5-150 gpm magnetic flow transmitter
1	½ inch chemical injection assembly
1	Air scour system: • Air intake filter • 3 HP variable speed rotary vane blower • 0-30 psig liquid-filled pressure gauge • 1-25 standard cubic feet per minute (scfm) thermal dispersion flow transmitter
Backwash waste system	
1	1900 gallon cylindrical HDLPE tank with 16 inch threaded access port
1	Hydrostatic level transmitter
Filter effluent system	
1	2-channel universal transmitter
1	0.0001-1000 NTU turbidity transmitter (Hach: LPV415.99.32002)
Programmable logic controller	

Coagulation

The specific coagulant type and polymer (if needed) will be determined during the first 1-2 weeks of GMF operations, known as the initial chemical optimization period. During this period, up to three coagulants and two polymers will be tested and optimized, accordingly. The maximum doses are anticipated to be 8 mg/L for the coagulants and 1.6 mg/L for any polymer. The coagulant and polymer (if needed) will be stored in four 20-gallon PP storage tanks included as part of the GMF container unit. The coagulants and polymers to be tested during the initial chemical optimization period include:

- **Ferric chloride** FeCl3 (coagulant)
- **Ferric sulfate** FeSO4 (coagulant)
- **Polyaluminum Chloride** PACl (coagulant)
- **Cationic polymer**
- **Non-ionic polymer**

Flocculation

A baffled flocculation tank will be provided with the Intuitech unit, with two variable speed axial turbine mixers and a level transmitter. These features will be used to vary the total flocculation time, as needed, during the process optimization. As discussed below, the flocculation tank will be periodically shock chlorinated to control mussel growth, with subsequent dechlorination using sodium sulfite or sodium bisulfite.

GMF

One 30-inch diameter GMF column will project through the roof of the container to a total height of 18 feet (216 inches). The GMF column will contain dual media, including anthracite coal overlaying sand. Table 7 defines the media specifications for the GMF column.

GMF Unit Disinfection

In addition to the coagulation chemicals, chlorine will be used with the GMF system to minimize microbial growth within the filter. The following chemicals will be used in liquid or solid (powder) form and will be stored in either the 20-gallon storage tanks included in the chemical storage system or in sealed 5-gallon (or smaller) pails inside the GMF container unit:

- **Sodium Hypochlorite** NaOCl (disinfectant)
- **Sodium Bisulfite (SBS)** $NaHSO_3$ (neutralize NaOCl before disposal)
- **Sodium Sulfite** Na_2SO_3 (neutralize NaOCl before disposal)

Table 7. GMF media specifications for each dual media column

Granular Media Filter	
Anthracite Coal	
Effective Size	0.95 - 1.05 mm
Uniformity Coefficient	1.50 or less
Specific Gravity	1.6
Bed Height per Column	60 inches
Sand	
Effective Size	0.45 - 0.55 mm
Uniformity Coefficient	1.50 or less
Specific Gravity	2.6
Bed Height per Column	30 inches

4. Seawater Reverse Osmosis

The overall pilot treatment process is shown in the Pilot Process Flow Diagram (Figure 1). The SWRO process can operate with either feed source. The SWRO Pilot System is a containerized reverse osmosis system. Excluding a sump tank and pumps, all components of the SWRO treatment process are mounted within the container. The SWRO includes cartridge filters, high pressure SWRO feed pump, 4" diameter pressure vessels (PV), membrane elements, valves, piping (SS and PVC), chemical addition pumps, instrumentation and controls, and other miscellaneous appurtenances. The unit will operate two vessels in series (1:1 array) with four elements each vessel for a total of eight membrane elements. Appendix B provides piping and instrumentation drawings (P&IDs) that indicate overall SWRO equipment configuration.

The pilot SWRO system will employ four-inch diameter membrane elements (Hydranautics SWC5-LD4040 or similar) to treat approximately 8.4 gallons per minute (gpm) of feed water at 50% recovery. This will result in 4.2 gpm of permeate and 4.2 gpm of concentrate. The average flux in the system will be 9.5 gfd with a lead element flux of 18.2 gfd. The required feed pressure will be approximately 840 psi at 17 degrees Celsius (63°F). An example SWRO performance projection is provided in the appendices. The system is designed to accommodate pressures up to 1,000 psi. The specific energy required to run the SWRO pilot will be approximately 16.21 kwh/kgal. The pilot system electrical requirements are 460V, 3 Phase, 60 HZ, 40 Amp. The pilot system is capable of dosing antiscalant, if necessary. The SWRO pilot unit specifications are shown in Table 8.

Table 8. SWRO pilot unit specifications

Parameter	SWRO Pilot
Membrane Element	4"x 40" (80 sq. ft) Hydranautics SWC5-LD4040 or equivalent
Array	1:1
Elements per vessel	4
Total quantity of elements	8
Total membrane area	640 sq.ft.
Permeate Flow Setpoint	4.2 gpm
Concentrate Flow Setpoint	4.2 gpm
Average operating flux	9.5 gfd

B. Layout (diagrams, P&IDs for components)

Diagrams of the mobile shipping container pilot GMF unit that was custom-fabricated for this project by Intuitech are presented in Figures 5 and 6. The P&IDs for the flocculation, filtration, and chemical systems are presented in Appendix B, Figures B1, B2, and B3.

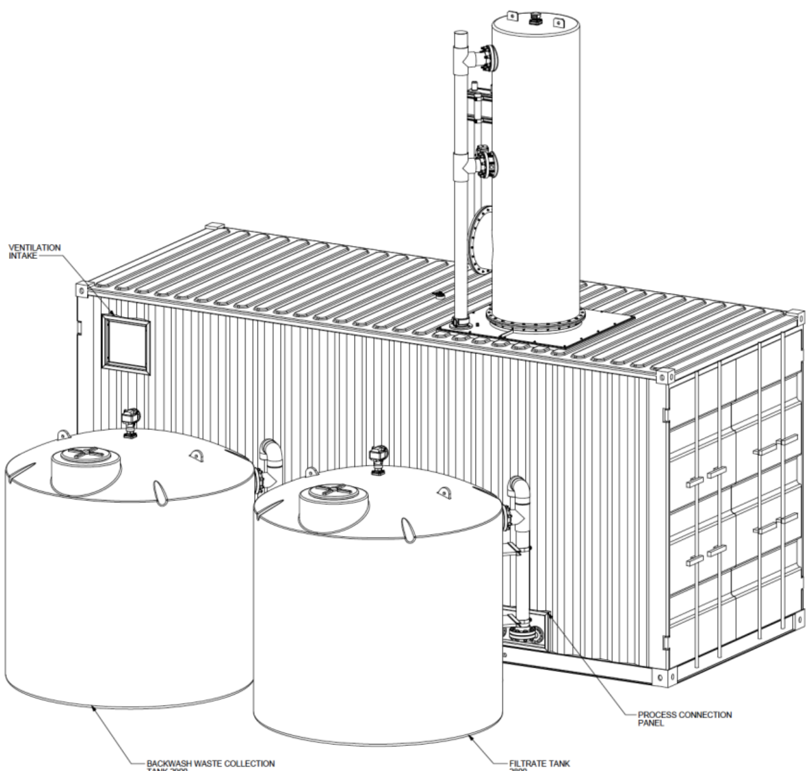


Figure 5. Diagram of Intuitech GMF container exterior

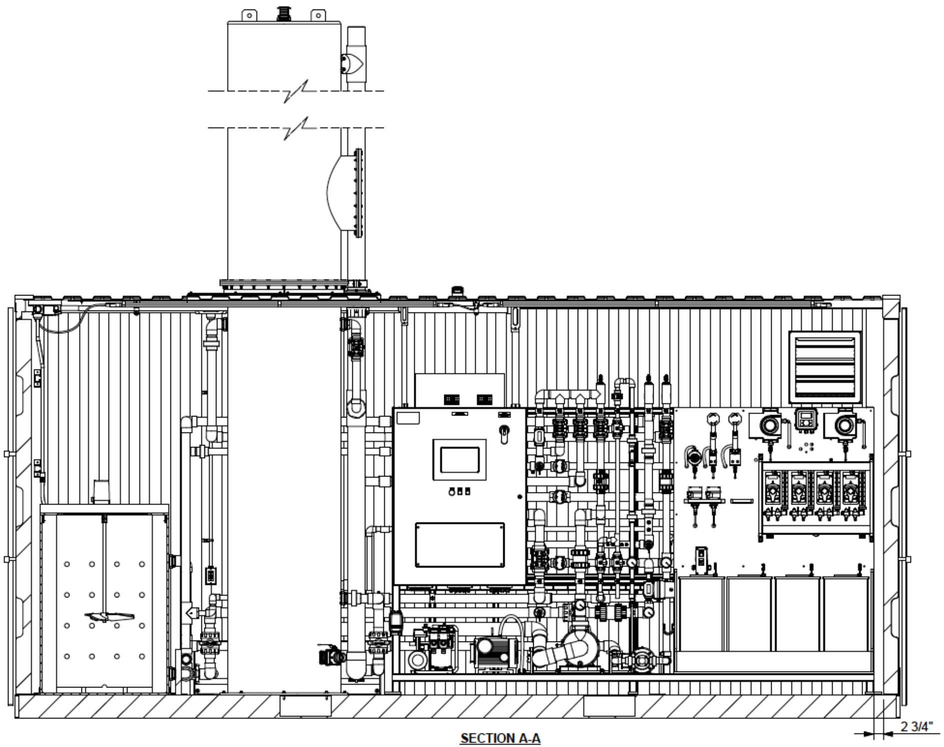


Figure 6. Diagram of Intuitech GMF container interior

The P&IDs for the SWRO unit are presented in Appendix B, Figures B3 and B4. A photo of the interior of the SWRO unit is presented in Figure 7.

Figure 7. Photo of the interior of the SWRO pilot unit

C. Setup Requirements

The custom-made, containerized Intuitech coagulation-flocculation-GMF unit will arrive fully functional, but without media or chemicals. Field commissioning includes plumbing of inlet (open ocean or submerged intake feed) and outlet connections (filtrate, backwash, and filter-to-waste), electrical connections, loading sand and anthracite media, and filling the chemical storage tanks.

The SWRO system arrives fully functional. Field commissioning includes plumbing of inlet (submerged inlet or GMF filtrate feed) and outlet connections (permeate, concentrate and dump line), as well as electrical connections.

D. Waste Discharge

There will be two discharge streams from the GMF unit: filtrate and backwash. The backwash will be plumbed to a 1900 gallon backwash waste tank, then slowly bled to the existing sewer system. The preliminary estimate for the weekly backwash volume is approximately 1,500 gallons discharged to the backwash waste tank over a 15 minute time period, once per week (manual backwash). The GMF filtrate stream will be either recombined in the discharge tank, directly, or routed to the SWRO, depending on the testing configuration being employed at the time.

There will be two discharge streams from the SWRO unit: permeate and concentrate. Both discharge streams will be recombined in the discharge tank and returned to the ocean. Other special discharges may include CIP cleaning solutions, although it is anticipated that cleanings will occur offsite. These solutions will consist of an acid (citric acid) or base (sodium hydroxide or a proprietary chemical such as Avista P or L 111). If used on-site these solutions will be neutralized before discharge to the sewer.

III. Operations and Maintenance Procedures

The trailer housing the SWRO contains an extra room that will serve as the onsite project office and laboratory space, while also providing storage for laboratory analytical equipment for onsite analytical testing. The O&M procedures are discussed below.

A. Neodren® Subsurface Intake

1. Operating Set Points

The Neodren® subsurface intake is initially set to directly feed the SWRO unit. The flow set point for the intake is 20 gpm.

2. Critical Alarm Set Points and Response

The critical alarm set point for the Neodren intake is 10 gpm. Should the intake flow unintentionally fall below 10 gpm, the flow meter will be verified and calibrated to evaluate the actual flow. If the flow is verified to be less than 10 gpm, pump performance and operational parameters will be analyzed to evaluate the cause of the decreased flow. The appropriate action will be decided at such a time when the cause of decreased flow is found.

3. General Maintenance and Instrumentation Calibration

The Neodren® subsurface intake will be equipped with continuous conductivity, temperature, turbidity, pH, ORP, and dissolved oxygen meters. The frequency of verification and calibration on an as-needed basis is presented in Table 9.

Table 9. Subsurface intake instrumentation verification frequency

Meter	Verification Frequency	Verification Method	Calibration Method
Temperature	Weekly	Calibrated thermometer	Calibrated thermometer
Conductivity	Weekly	Portable meter and calibration standard	Portable meter and calibration standard
Turbidity	Weekly		
pH	Weekly		
ORP	Weekly		
Dissolved Oxygen	Weekly		
Flow	Quarterly	Stopwatch and volumetric container	Stopwatch and volumetric container

B. Open Ocean Intake

1. Operating Set Points

The open ocean intake is initially set to feed the granular media filter. Flow from the intake is expected to be 20 gpm.

2. Critical Alarm Set Points and Response

The critical alarm setpoint for the open ocean intake is 15 gpm. Should the intake flow unintentionally fall below 15 gpm, the flow meter will be verified and calibrated to evaluate the actual flow. If the flow is verified to be less than 15 gpm, the pump will either be ramped up or repaired if necessary.

3. General Maintenance and Instrumentation Calibration

The open ocean intake will be equipped with conductivity, temperature, turbidity, and pH meters. The frequency of verification and calibration on an as-needed basis is presented in Table 10.

Table 10. Open ocean intake instrumentation verification frequency

Meter	Verification Frequency	Verification Method	Calibration Method
Temperature	Weekly	Calibrated thermometer	Calibrated thermometer
Conductivity	Weekly	Portable meter and calibration standard	Portable meter and calibration standard
Turbidity	Weekly		
pH	Weekly		
Flow	Quarterly	Stopwatch and volumetric container	Stopwatch and volumetric container

C. Coagulation-Flocculation/GMF Container

The coagulation-flocculation unit process is used in conjunction with deep bed granular media filters to provide pretreatment of seawater prior to SWRO technology. The main purpose is to mitigate risk of SWRO membrane element damage from particulates such as seashell fragments or sand. Furthermore, granular media filters remove turbidity and have the potential of reducing transmembrane pressure and fouling rate.

1. Operating Set Points

The operating setpoints for the coagulation process will be established during the initial startup period. Chemical optimization will occur during this startup phase, as well.

The chemical optimization for coagulation is expected to involve the testing of 3 different coagulants – ferric chloride, ferric sulfate, and poly-aluminum chloride. The optimization is expected to use effluent turbidity and silt density index (SDI) as surrogate for performance. Each of these coagulants will be tested separately at varying doses including but not limited to the doses presented Table 11. However, higher coagulant doses are not expected, as performance is likely to suffer from further increases in dose. After the testing of coagulant doses in Table 11, the range of optimal coagulant doses can be extrapolated. Test doses in intervals of 0.1 will be conducted to further optimize coagulant dose within this range.

Each of the test conditions is expected to consist of 35 minutes runs to account for the hydraulic retention time of the flocculation tanks and filter column. Testing of all the coagulant test conditions is expected to take two days to complete.

Table 11. Chemical optimization test conditions

Coagulant	Coagulant Dose (mg/L)
Ferric Chloride	0.1
	0.2
	0.4
	0.8
	1.6
Ferric Sulfate	0.1
	0.2
	0.4
	0.8
	1.6
Poly-aluminum chloride	0.1
	0.2
	0.4
	0.8
	1.6

Upon the selection of the preferred coagulant doses, a coagulant aid and filter aid will be tested for filter performance enhancement for each of the coagulants. Both of the polymers will be tested separately at varying doses with each of the optimized coagulants and doses. The testing is expected to include the test conditions presented in Table 12. The polymer will be tuned in to the nearest 0.1 mg/L if found to be beneficial.

Similarly, each of the test conditions is expected to consist of 35 minutes runs to account for the hydraulic retention time of the flocculation tanks and filter column. Testing of all the polymer test conditions is expected to take 2 days to complete.

Table 12. Polymer optimization test conditions

Coagulant	Polymer	Polymer Dose (mg/L)
Ferric Chloride	Cationic (coagulant aide) Anionic (filter aide)	0.1
		0.2
		0.4
		0.8
		1.6
Ferric Sulfate	Cationic (coagulant aide) Anionic (filter aide)	0.1
		0.2
		0.4
		0.8
		1.6
Poly-aluminum Chloride	Cationic (coagulant aide) Anionic (filter aide)	0.1
		0.2
		0.4
		0.8
		1.6

The coagulation setpoints will be decided based on the results from the chemical optimization testing. The target for optimization is 0.1 NTU for the filter effluent.

The effects of flocculation time on filter performance will also be evaluated during the startup period. The filters will be run with varying detention times in the flocculator. The flocculation detention time will be decided based on filter effluent turbidity correlated with flocculation time.

The granular media filter is set to a single filter column. The filter column is expected to run at 20 gpm. The set point for backwash is 7 psig headloss through the filter, or on a weekly basis, whichever occurs first. The tentative backwash procedure and set points are presented in Table 13.

Table 13. Backwash sequence

Process	Duration
Drain Down	6 minutes
Aeration Alone	2 minutes @ 8 scfm
Aeration w/ Backwash Flow	4 minutes @ 27.5 gpm | 4 scfm
Backwash Flow Only	6 minutes @ 78.5 gpm

The actual backwash flows and sequence will be optimized during the startup period to achieve a bed expansion of 15% while minimizing media loss. In addition, jar testing of backwash water will be done to evaluate the optimal chemical dose for gravity thickening. The testing involves mixing, flocculating, and settling backwash water at different coagulant doses used for the filter run. The sludge volume index (SVI) will be evaluated to assess sludge settleability.

2. Critical Alarm Set Points and Response

During the period of operation when the SWRO is fed by the subsurface intake, the GMF process is not expected to have any critical set points outside of mechanical failure. In the event of mechanical malfunctions, the GMF system will be troubleshot and returned to service in a timely manner.

As described later in Section III – F, GMF filtrate will feed SWRO in the test. During three months operation with GMF feeding SWRO, the critical set point will be filter effluent turbidity of 1.0 NTU. With an exceedance, coagulant dose will be re-evaluated for influent water quality and seasonal variation effects. The critical alarm set points and response are summarized in Table 14.

Table 14. Critical alarm setpoints and response for GMF System

Test Condition	Set Point	Response
GMF discharging to recombined effluent tank	Mechanical Failure	Troubleshoot and return to service
GMF feeding SWRO	Filter Effluent Turbidity > 1.0 NTU	Reevaluate coagulant dose and adjust to achieve turbidity < 0.1
GMF discharging to recombined effluent tank or feeding SWRO	Total chlorine detected	Cease discharge from the GMF. Dechlorinate the GMF discharge equalization tank. Reevaluate dechlorination practices and adjust to achieve non-detect free chlorine.

3. General Maintenance and Instrumentation Calibration

Based on Trussell Technologies' experience with other desalination projects, marine biological growth – such as mussels – is expected in the treatment trains. As general maintenance, the flocculation tanks will be shock chlorinated on a weekly basis. The shock chlorination entails chlorinating to 1,000 mg/L Cl_2 and mixing the flocculation tanks for a 1-hour duration. The flocculation tanks will then be dechlorinated with sodium sulfite and allowed to completely mix. Grab samples will be taken to confirm that the chlorine residual is quenched and the dissolved oxygen levels are adequate for resuming flow through the unit process.

Similarly, the granular media filter columns will be chlorinated during standby. The unit process is expected to run with one column in standby, with the standby column alternating weekly, as discussed below. Following a run of the active/inline GMF column, a backwash will be initiated, and then chlorine will be manually dosed and circulated to achieve a target residual of approximately 10 mg/L as chlorine (Cl_2). The chlorinated column will be left in standby mode, with contact time of approximately one week. Meanwhile, the contents of the previously offline/inactive GMF column will be recirculated and dosed with sodium bisulfite or sodium sulfite to neutralize/dechlorinate any residual. Grab sampling and testing will be done to confirm that no chlorine residual remains, prior to opening the valve and sending the effluent to the discharge tank for disposal.

The GMF system operating sequence described above is summarized in Table 15.

Table 15. Summary of GMF maintenance activities

Component	Action	Operational Criteria
Flocculation Tanks	Shock Chlorination	Frequency = weekly Feed 1000 mg/L as Cl_2 Duration = 1 hr
Flocculation Tanks	Dechlorination	Add sodium sulfite Allow to completely mix Add until grabs show: Free Chlorine non-detect (ND) D.O. levels adequate
Granular Media Filters	Chlorination during standby	Backwash active GMF after 1 wk Dose free chlorine and circulate Target chlorine residual = 10 mg/L Leave this GMF on standby 1 wk
Granular Media Filters	Dechlorination after standby	Recirculate Dose with Sodium Sulfite or SBS Add until grabs show ND chlorine

Turbidity

The turbidimeter will be verified and calibrated if necessary on a weekly basis using a portable turbidimeter and calibration standards. The turbidity will be verified on a weekly basis.

D. Seawater Reverse Osmosis

1. Operating Set Points

The system will operate at 3.7 gpm permeate and 3.7 gpm concentrate flow set points. As such it will receive 7.4 gpm of feed water and achieve 50% recovery. The feed water quality criteria shall be an SDI_{15} <3 and a turbidity of less than 1 NTU, as summarized in Table 16. Feed water chlorine level shall be 0 ppm and the ORP shall be less than 300 mV. Based on the operational set points the average flux in the system will be 9.5 gfd with a lead element flux of 18.3 gfd. The required feed pressure will be approximately 860 psi at 17°C (63°F).

Table 16. SWRO operating parameters

Parameter	Value
Permeate Flow	3.7 gpm
Concentrate Flow	3.7 gpm
Antiscalant dose	3 mg/L (if used)
Feed Turbidity	<1 NTU
Silt Density Index (15 minute)	<3

2. Critical Alarm Set Points and Response

The critical set points and responses for the SWRO unit is presented in Table 17 and Table 18.

The pilot systems membranes will require cleaning if either of the following conditions occur:

1. normalized permeate flow (Specific Flux) decrease of greater than 15%
2. normalized differential pressure, as measured between the feed and concentrate, increases by greater than 25%.

3. General Maintenance and Instrumentation Calibration

Electroconductivity

The conductivity meter will be calibrated using a low (1,000 uS/cm) conductivity standard for SWRO permeate and a high conductivity (100,000 uS/cm) standard for the feed. Calibrations will occur quarterly and as determined necessary by field readings.

Table 17. Alarms

Parameter	Value	Auto Shutdown	Response
Concentrate Flow	<3 gpm	No	Adjust concentrate control valve
SWRO Feed Pressure	>950 psi	No	Assess need for CIP

Table 18. Critical control points

Parameter	Value	Response
Permeate pressure	>25 psi	Eliminate piping/valve restriction
Cartridge filter dP	>10 psi	Change filters
Combined permeate Electrical Conductivity	>500 uS/cm	Investigate source
SDI	>3	Assess need to provide additional pretreatment or adjust operation of existing pretreatment
Turbidity	>1.0 NTU	Same as above
Total Chlorine	detected	Review flush and dechlorination practices following use of chlorine in intake or pretreatment.

Flow

Flow meters will be calibrated by the stopwatch & bucket method using either weight or volume. Calibrations will occur quarterly and as determined necessary by field readings.

Pressure

Analog pressure gauges will be calibrated before starting the testing. Values from these gages will be compared to the readouts from the pressure transducers on the unit. Any divergence of the values during operation will be investigated.

Turbidity

The turbidimeter will be verified and calibrated if necessary on a weekly basis using a portable turbidimeter and calibration standards. The turbidity will be verified on a weekly basis.

Free Chlorine

Free chlorine will be measured using DPD method weekly to verify chlorine residual free feed water.

E. Data Requirements

Data collections for the pilot will be performed using the data collection sheets presented in Appendix D.

F. Test Schedule

The pilot is expected to start operating in January 2018 and operate continuously for one year, as outlined in Table 19.

Table 19. Pilot Test Configuration Schedule

Train Configurations	Months During Testing											
	1	2	3	4	5	6	7	8	9	10	11	12
Open Ocean Intake → Coagulation/ Flocculation → Granular Media Filter → Discharge	■	■	■	■	■	■				■	■	■
Open Ocean Intake → Coagulation/ Flocculation → Granular Media Filter → Seawater Reverse Osmosis → Discharge							■	■	■			
Subsurface Intake → Seawater Reverse Osmosis → Discharge	■	■	■	■	■	■				■	■	■
Subsurface Intake → Discharge							■	■	■			

For the first six months, the GMF system will operate on feed from the open ocean intake and subsequently discharge to the ocean without further treatment. For months seven through nine, the GMF system will be fed by the open ocean intake prior to feeding the SWRO process. During this time, the subsurface intake will discharge directly into the ocean. For months ten through twelve, the pilot will be returned to its original configuration to continue looking at seasonal effects.

For the first six months, the SWRO will operate on feed water from the subsurface intake. Assuming feed water quality indicators (e.g. turbidity, Silt Density Index) are appropriate for direct feed to the SWRO membrane, the system will commence operation with only cartridge filtration as pretreatment. If turbidity is >1 NTU or SDI >3, an assessment will be made of the potential foulant(s) and additional pretreatment considered.

The expected analytical testing frequencies are presented in conjunction with the Water Quality Analysis Schedule in Appendix C, Table C1.

IV. Water Quality Assessment

The Intake Testing Program will build upon existing data and related seawater desalination testing experience and focus on testing site-specific variables. The twelve-month Intake Testing Program will explore and compare the response of two alternative treatment trains to ambient seawater quality, and assess the impacts of seasonal and seawater-specific fluctuations on operations of the piloted intake/treatment systems. There are various influences that impact water quality, such as algal bloom, storm, peak recreational season, and tidal events.

This section includes the following information:

- **Routine Water Quality Monitoring**: Routine water quality sampling plan to allow for comparison of subsurface and open-ocean intake alternatives, as well as a performance evaluation of downstream treatment processes being tested as a part of the proposed pilot testing
- **Special Water Quality Monitoring**: Special, more intensive water quality sampling programs that will be triggered when seawater quality has the potential to differ from ambient conditions to evaluation the alternative treatment trains

The data produced will be used to evaluate the most appropriate design for each intake configuration to produce suitable feed water for a SWRO system (e.g., GMF system pretreatment or no pretreatment after intake). The overall sampling and water quality monitoring program is provided in Appendix C, Table C1. This program is subject to change based review by the Water Authority and CAMPEN or changes that arise related to environmental permitting or during the course of the testing program.

A. Routine Water Quality Monitoring

Routine water quality monitoring will be completed to assess the intake and pretreatment alternatives, as well as SWRO performance, using water quality parameters that specifically aid in evaluating the piloted treatment train alternatives. In order to provide a baseline characterization of the dominant California Ocean Plan constituents, the combined effluent will be monitored for the Ocean Plan constituents, with the exception of toxicity testing (acute and chronic) and the full suite of radioactivity parameters (only gross alpha and beta radiochemistry are included). Other performance evaluation tools, such as headloss, energy consumption, and transmembrane pressure are discussed in Section III.

1. Raw Water

Raw seawater data is not being collected as a part of this effort, however there are water quality data generated by the Southern California Coastal Ocean Observing System (SCCOOS[2]). The following data available through SCCOOS at Newport and Scripps Piers will be downloaded weekly to provide insight on the raw water quality of seawater prior to entering the intake alternatives:

- Ammonia
- Chlorophyll[3]
- Nitrate
- Nitrite
- Phosphate
- Silicate
- Water Temperature

[2] http://sccoos.org/query/
[3] Chlorophyll-a measured via fluorescence is an indicator of the presence of phytoplankton

2. Intake Alternatives

The following routine water quality measures will be monitored regularly to assess intake performance (open-ocean versus subsurface). The constituent/ parameter and the monitoring frequency are shown below for routine monitoring at the outlet of the intake.

- Total Suspended Solids (TSS) - monthly
- Total Organic Carbon (TOC) - semimonthly
- Ultraviolet A (UVA) radiation - continuous
- Chlorophyll - monthly
- Excitation Emission Matrix (EEM) - monthly
- E. coli - monthly
- Enterococcus - monthly
- Temperature - continuous
- Turbidity - continuous
- pH - continuous
- Oxidation Reduction Potential – weekly, continuous for RO feed
- Dissolved Oxygen – weekly, continuous for RO feed
- Silt Density Index - weekly
- Salinity - weekly, see discussion below

Analysis of seawater is complex, in particular salinity. Conceptually, salinity is a measure of the mass of dissolved inorganic matter in a given mass of seawater. Salinity can be calculated using total dissolved solids (TDS), conductivity, or the sum all constituents from a complete chemical analysis (Millero, 2006; Standard Methods On-line, SM2520, 2012). The standard method for analysis of TDS tends to overestimate the salinity of seawater (Eaton et al., 2005; Boerlage, 2011) and a complete chemical analysis is time and resource intensive, so the preferred method is to calculate salinity is by using conductivity and density.

An accurate salinity measurement provides another source of raw water characterization, because concentrations of major ions in seawater can be calculated from the measured salinity concentrations. 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). The constant proportions of ions in seawater around the globe have 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 slight changes made.

The following major ion concentrations in seawater can be reliably estimated from the weekly salinity readings:

- Chloride
- Sodium
- Sulfate
- Magnesium

- Calcium
- Potassium
- Bromide
- Strontium
- Fluoride
- Bicarbonate
- Carbonate
- Alkalinity
- Boric Acid
- Borate
- Boron

3. Pretreatment Alternatives

The project explores Neodren® technology as a subsurface intake system, as well as a pretreatment step. Pretreatment provided by the Neodren® subsurface intake system will be compared to the pretreatment provided by the more conventional GMF setup using the following routine water quality measures to assess pretreatment performance (GMF filtrate versus subsurface intake):

- Kjeldahl Nitrogen (quarterly)
- Silica (quarterly)
- Iron (quarterly)
- Aluminum (triannual)
- Asbestos (triannual)
- TSS (monthly)
- TOC (semimonthly)
- UVA (continuous)
- Chlorophyll (monthly)
- EEM (monthly)
- Turbidity (continuous)
- pH (continuous)
- ORP (weekly)
- Dissolved Oxygen (weekly)
- SDI (weekly)

4. SWRO Performance

A single SWRO train is available for this pilot effort, so the SWRO train will be moved to test each intake/pretreatment alternative. The following routine water quality parameters will be monitored to assess SWRO performance (SWRO permeate from open-ocean train versus SWRO permeate from subsurface train):

- General minerals (all quarterly, but chloride assessed monthly in SWRO permeate)
- Trace elements (triannual)
- Conductivity (continuous)

5. Combined Effluent

Assessment of the combined effluent will include a one-time, baseline characterization for all of the Ocean Plan constituents except toxicity testing (acute and chronic) and the full suite of radioactivity parameters (only gross alpha and beta radiochemistry are included). Additionally, the following routine water quality parameters will be monitored on a monthly basis using field measurements:

- Conductivity
- Temperature
- Turbidity
- pH
- Oxidation Reduction Potential
- Dissolved Oxygen
- Total Chlorine Residual

B. Special Water Quality Monitoring Events

1. Algal activity

a) Background and Trigger Conditions

Algal blooms are commonly referred to as red tides and are a phenomenon associated with changes in nutrient availability, and can indicate the relative abundance of major nutrient elements such as nitrogen and phosphorus. A small proportion of the microalgae species related to red tides are capable of producing toxic compounds. Blooms of such algae are referred to as harmful algal blooms (HABs), and can cause illness or death in humans and other species. Human activities have been implicated in increasing both the intensity and global distribution of HABs (Hallegraeff et al., 2004). This increase in frequency of HABs has been paired with rising public health and economic impacts related to these events during the past two decades (Hallegraeff et al., 2004). It is hard to predict HABs. Algal species (e.g., Pseudo-nitzschia and Alexandrium) that produce algal toxins (e.g., domoic acid and saxitoxin) may be present in seawater and either produce or not produce algal toxins, for reasons not well understood. Formation of algal toxins is affected by many factors (Caron et al., 2011).

Along the California coast, the most significant concentrations of toxins typically occur from May through October, with DDW imposing an annual, statewide mussel quarantine during those months (Caron et al., 2011). During the Technical Studies, a red tide event occurred in both September and October 2011. Red tide events will be tracked using publicly available data sources. Information will be sourced from DDW's Preharvest Shellfish Protection and Marine Biotoxin Program (Biotoxin Program) and the multi-agency SCCOOS, as well as NASA JPL Physical Oceanography Distributed Active Achieve Center's State of the Ocean. The information available from these sources will be assessed for surveillance of algal blooms in the project vicinity.

The Biotoxin Program generates information on the safety of shellfish consumption. These data will serve as an indicator for the presence of biotoxins in the source water. There are multiple sampling sites within Orange and San Diego County. The closest site to the proposed intakes that is routinely (approximately weekly) measured for Alexandrium species (producers of the biotoxin saxitoxin) and Pseudo-nitzschia species (producers of the biotoxin domoic acid) is San Clemente Pier (ID# UA-2804-01) and Scripps Pier (ID# UA-2845-01). Biotoxin measurements in shellfish are routinely (approximately monthly) completed at Agua Hedionda Lagoon (ID# UA-1916-01) and San Diego Offshore (ID# UA-2793-01). In 2015, within San Diego and Orange counties, Alexandrium species were rarely detected and when detected (in March, October and December), the species was detected at a relative abundance of less than one percent. Pseudo-nitzschia species were present more often, with a relative abundance ranging from less than ten percent to fifty percent throughout the entire year. Within these counties, no saxitoxin (the toxin responsible for the human illness known as paralytic shellfish poising - PSP) or domoic acid (the toxin responsible for the human illness known as amnesic shellfish poising – ASP) were found in shellfish. An excerpt from the April 2015 monthly report (Technical Report No. 15-11) disseminated by DDW is shown in Figure 8. On a weekly basis the DDW site[4] will be accessed for data on the distribution of toxin-producing phytoplankton.

Figure 1. Distribution of toxin-producing phytoplankton in Southern California during April, 2015.

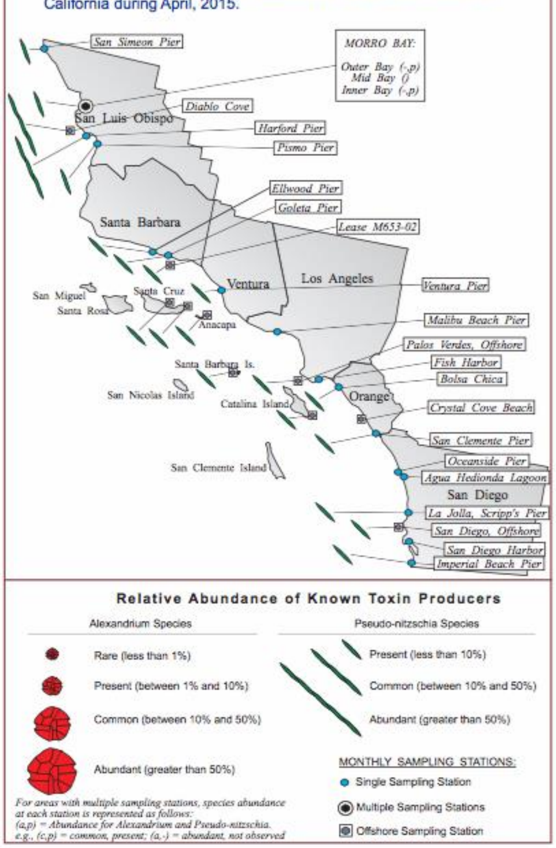
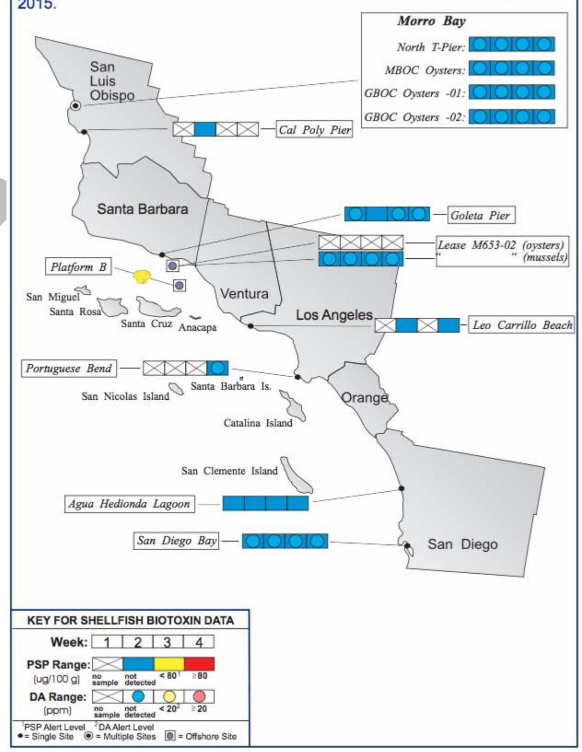


Figure 3. Distribution of shellfish biotoxins in Southern California during April, 2015.



[4] http://cdphdata.maps.arcgis.com/apps/MapTools/index.html?appid=42a78fba680c4c43970cfc5dfe878d8d

Figure 8. Excerpt from DDW Technical Report No. 15-11, showing the absence of Alexandrium species and the associated biotoxin saxitoxin and the presences of Pseudo-nitzschia species, but absence of associated biotoxin domoic acid.

SCCOOS has extensive water quality and HAB monitoring programs both north (Newport Pier) and south (Scripps Pier) of Camp Pendleton. Also available through SCCOOS are satellite imagery, plankton camera imagery, surface current mapping, wave conditions, and winds and rainfall forecasts. A map of the SCCOOS data inventory in the project vicinity is provided in Figure 9. On a weekly basis, the following data collected at Newport and Scripps Pier will be downloaded from SCCOOS[5]:

- Akashiwo sanguinea
- Alexandrium spp.
- Ammonia
- Chlorophyll
- Dinophysis spp.
- Domoic Acid
- Lingulodinium polyedrum
- Nitrate
- Nitrite
- Phaeophytin
- Phosphate
- Prorocentrum spp.
- Pseudo-nitzschia delicatissima group
- Pseudo-nitzschia seriata group
- Silicate
- Water Temperature

Additionally, the HAB nowcast site[6] (sponsored by the Central and Northern California Ocean Observing System, or CeNCOOS, the Northern and Central counterparts of SCCOOS) will be used to identify HABs using the probabilities of the following occurrences:

- Presence of greater than 10 picograms of cellular domoic acid per pseudo-nitzschia cell
- Presence of greater than 500 nanograms particulate domoic acid per liter
- Presence of greater than 10,000 pseudo-nitzschia cells per liter (the bloom threshold)

This map images generated by CeNCOOS uses sophisticated models to predict ocean conditions and satellite data on color and chlorophyll to predict bloom and toxin likelihoods. An example map is provided in Figure 10.

5 http://sccoos.org/query/
6 http://data.cencoos.org/#module-metadata/fff184a0-d1e0-11e4-9003-00265529168c/17117792-9441-414e-939b-271e511a0664

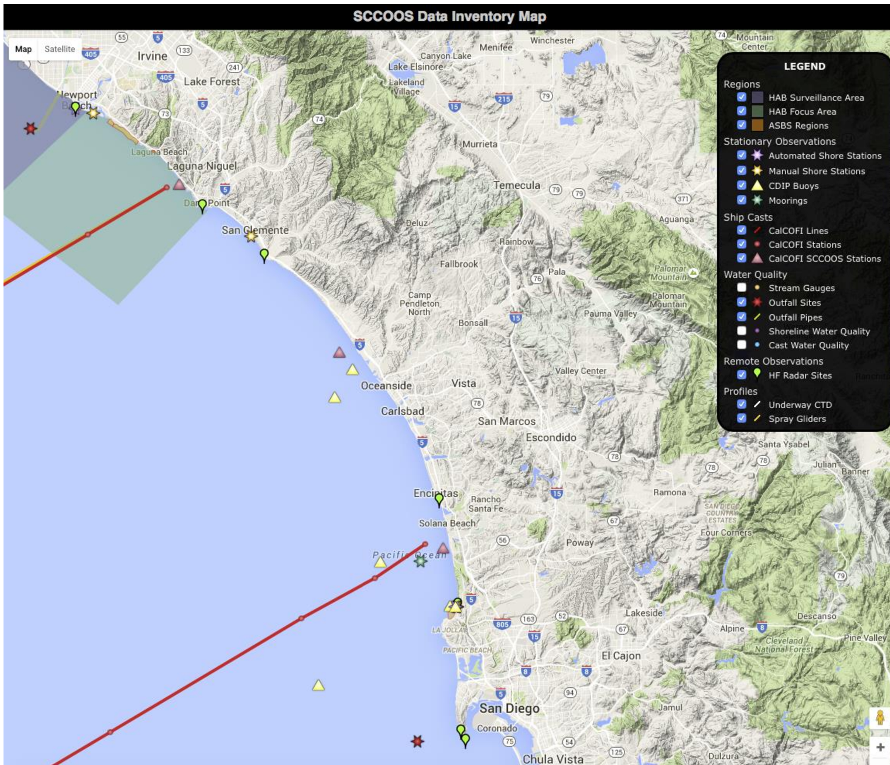


Figure 9. Map of SCCOOS data inventory

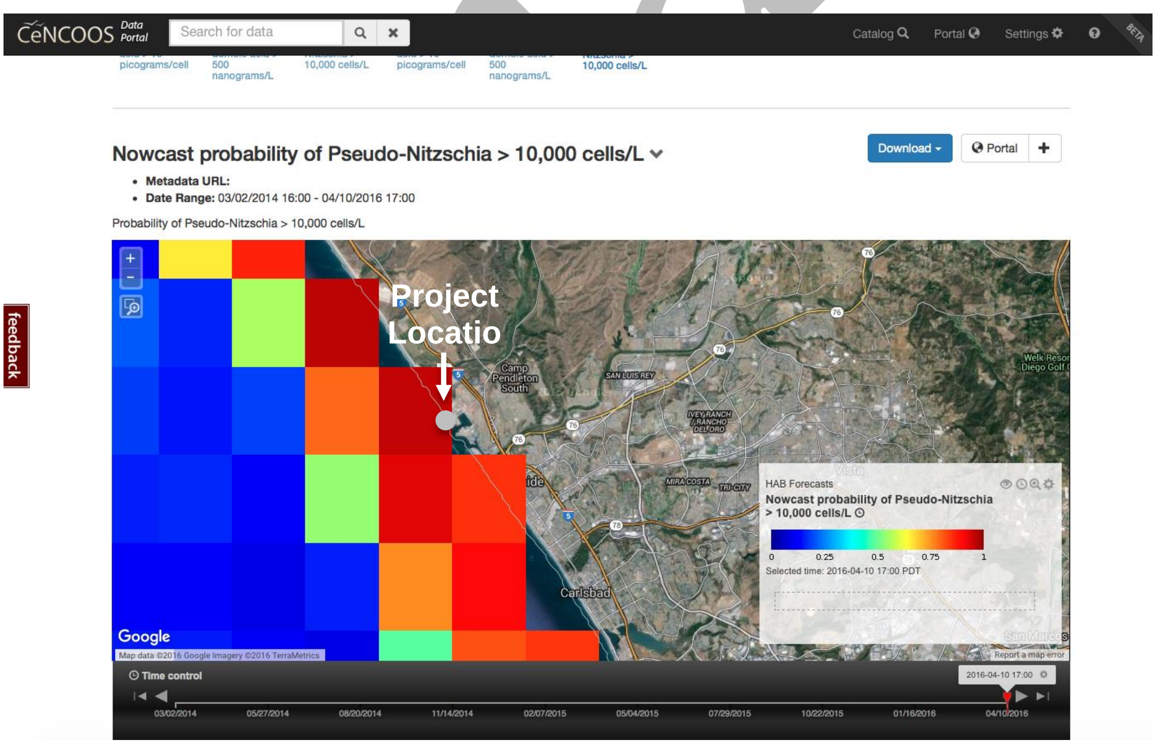


Figure 10. Nowcast for April 13, 2016 of the probability bloom in project vicinity, 96 percent-predicted probability of Pseudo-nitzschia bloom in the pixel nearest pilot intake site.

Satellite imagery of chlorophyll in the project vicinity is available through NASA JPL Physical Oceanography Distributed Active Achieve Center's State of the Ocean[7], as well as through Terrafin Software[8], a subscription-based satellite imaging website. On a daily basis, this map image will be saved for further analysis. Example map images are provided in Figure 11.

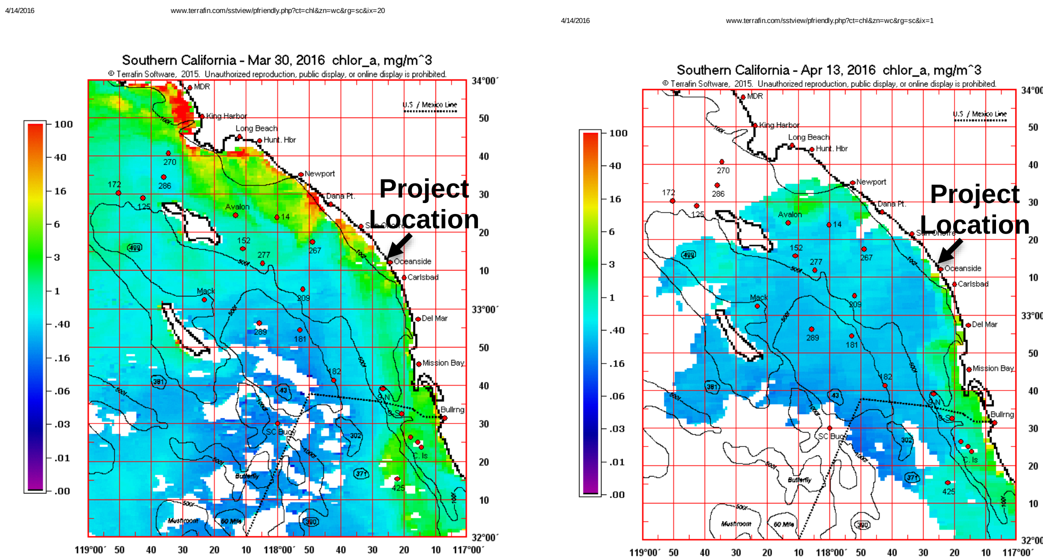


Figure 11. Recent images of Chlorophyll levels, with the one from March 30, 2016 during a bloom, and one from April 13, 2016 after bloom subsided

Red tide events are, for the most part unpredictable; however, chlorophyll data from continuous monitoring of the ocean water intake and publically available daily data will be used to assess the need for a more extensive sampling event to capture an algal bloom and assess its impacts on water quality and pretreatment effectiveness. This is likely to coincide with DDW's annual, statewide mussel quarantine from May through October.

The *Alexandrium* species of marine dinoflagellates can secrete a neurotoxin called saxitoxin that is severely harmful to humans. *Alexandrium* are rarely detected in southern California as part of the SCCOOS dataset. Unlike domoic acid and okadaic acid, the occurrence of saxitoxin is not well correlated with chlorophyll. Instead, the *Alexandrium* species of dinoflagellates tends to secrete saxitoxin when present at low concentration.

b) Special Monitoring Program – Algal Bloom

The special monitoring program related to algal blooms is under review in light of recent research activity associated with HABs. This section will be updated prior to the start of any testing activities.

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[7] http://podaac-tools.jpl.nasa.gov/soto-2d/soto.html?bounds[]=38.01544189453125,-21.50848388671875,8&layers[]=modis_aqua_l3_chla_daily_4km_l___chlorophyll_a___8640_x_4320___daynight&date=2016-03-29&layerOpacity[]=1&lineColors[=undefined

[8] http://www.terrafin.com/sstview/chlorhelp.php

2. Seasonal Variations

a) Background and Trigger Conditions

The source water quality varies throughout the seasons and these changes can affect the seawater desalination facility operations due to poor feed water quality. As a part of assessing the seasonal impact on water quality, to the extent possible, the following events will be captured:

- Two Storm conditions
- One week of peak recreational season conditions

Qualifying storm events will be defined as at least 3 inches of rain in a 2-week period. Monitoring will begin 3 days after 3 inches of rain has fallen and will continue for 5 days for open-ocean intake and GMF filtrate. Whereas for the subsurface intake, sampling will begin 7 days after the 3 inches of rain has fallen to account for the longer travel time of the storm-impacted seawater through the sand and into the Neodren® intake system.

July through September is the most popular time to visit the coast. With more people, there may be an increase in contaminants in the near-shore ocean waters that may impact the water quality of the open-ocean and subsurface intakes. An intensive water quality monitoring effort during one week of the peak recreational season will be initiated to assess the extent of potential impacts.

b) Special Monitoring Program– Seasonal Impacts

Seasonal variations will be revealed through routine water quality monitoring by comparing the data with weather conditions. During two storm events and one week of the peak recreational season, daily sampling will be conducted:

- Sampling Locations: Open-ocean intake, Subsurface intake GMF filtrate
    - TOC
    - TSS (only intake locations)
    - Turbidity
    - Total Kjehldahl Nitrogen
    - Nitrate
    - Nitrite
    - Phosphorous
    - E. coli
    - Enterococcus

In addition to water quality, meteorological[9] observations, physical oceanography[10,11] characteristics, and weather[12] conditions will be recorded.

[9] https://tidesandcurrents.noaa.gov/met.html?id=9410230
[10] https://tidesandcurrents.noaa.gov/physocean.html?id=9410230
[11] http://www.ndbc.noaa.gov/ (Station 46242-nearshore & 46224-offshore)
[12] http://w1.weather.gov/obhistory/KNFG.html

3. Tidal Cycles

a) Background and Trigger Conditions

Tidal conditions supplied by the National Data Buoy Center will be tracked[13] at Camp Pendleton nearshore (Station 46242) and Oceanside offshore (Station 46224) to capture three tidal conditions and the Perigean spring tide events:

- Ebb – period when coastal waters are moving towards low tide
- Flood – period when coastal waters are moving towards high tide
- Slack – period between Ebb and Flood, when there is no movement
- Perigean Spring Tide – occurs in the early spring months as a result of the full moon and new moon phases during times when the moon is closest to the earth. These tide events may wash an increased amount of contaminants from the beach into the near-shore ocean because this is when the greatest difference between the high high and low low tides occur. New and full moon phases will occur in the Spring of 2017 during the following dates: January 12, January 27, February 10, February 26, March 12, March 27, April 10, and April 26.

There will be extra sampling during the eight Perigean Spring tide events.

b) Special Monitoring – Tidal Impacts

The following routine measurements will be correlated to tidal cycles to assess the impacts of the tidal cycle:

- Temperature
- UV-254
- Conductivity
- Turbidity
- pH
- Salinity

Additionally, the following parameters will be monitored during the Perigean spring tide events that overlap the project timeline:

- Sampling Locations: Open-ocean intake, Subsurface intake, GMF filtrate
  - TOC
  - TSS (only intake locations)
  - Turbidity
  - Total Kjehldahl Nitrogen
  - Nitrate
  - Nitrite
  - Phosphorous
  - E. coli
  - Enterococcus

[13] http://www.ndbc.noaa.gov/ (Station 46242-nearshore & 46224-offshore)

C. Compliance

All process streams (treated water and brine) except the GMF backwash will be combined prior to being discharged back to the ocean. As discussed in Section A5 (Routine Water Quality Monitoring – Combined Effluent), baseline monitoring of the combined effluent is planned for the majority of the California Ocean Plan constituents. The environmental permitting associated with the project is ongoing, including permitting per the National Pollutant Discharge Elimination System (NPDES) by the San Diego Region Water Quality Control Board. Once related permitting (NPDES or other) is complete, the project's Water Quality Analysis Schedule (Appendix C, Table C1) will be updated, as needed, to reflect any associated water quality monitoring changes.

V. Staffing and roles for all involved in pilot operations and testing

The assigned project responsibilities for the project team members, Michael Baker International (Michael Baker), Trussell Technologies (Trussell Tech), and Separation Processes, Incorporated (SPI), are presented in Table 20.

Table 20. Staffing and roles

Task	Michael Baker	SPI	Trussell Tech
Test protocol preparation		Assist	Lead
Equipment – GMF **Design and procurement of unit**	Lead		Assist
Equipment – SWRO **Design and procurement of unit**	Lead	Assist	
Construction	Lead	Assist	Assist
SWRO	Lead	Assist	
GMF	Lead		Assist
Commissioning	Assist	Lead	Lead
SWRO	Assist	Lead	
GMF	Assist		Lead
Operations and maintenance of testing facilities		Lead	Assist
Operator/engineer on-site 40 hours per week **Weekend staffing requirements will be determined once process requirements are established (e.g. stability of the coagulation process and need for adjustments based on raw feed quality). The responsibilities of the on-site operator will include** • **Operation of the test equipment per the test protocol** • **Receive chemical deliveries and refill chemical day tanks.** • **Daily data collection, compilation and weekly distribution** • **Maintain on-site log book.** • **Collection of samples for off-site laboratory analyses**			

Task	Michael Baker	SPI	Trussell Tech
Evaluate and optimize pretreatment design and operations for each intake configuration		Assist	Lead
Monthly status memos concerning operations: Data collection, testing, analysis, and performance evaluation		Assist	Lead
Collection, testing, and analysis of seawater characteristics and system performance		Assist	Lead
Seawater characteristics		Assist	Lead
Raw water samples from both intakes		Assist	Lead
Evaluate impacts of tidal changes, coastal processes, and seasonal variations		Assist	Lead
Evaluate pretreatment process performance		Assist	Lead
Evaluate SWRO process performance		Lead	Assist
The SWRO system will be monitored for indications of membrane fouling due to particulate matter, organics or biological growth. The overall SWRO performance and membrane condition will be assessed by monitoring the following process indicators. • Specific Flux (gfd/psi) • Normalized Differential Pressure (psi) • Normalized Permeate Conductivity (uS/cm) If the Specific Flux declines by 15% or the Differential Pressure increases by 25% the SWRO membrane will chemically cleaned to assess the ability to restore the condition. The specific chemical cleaning procedure will be selected based on the engineer's review of feed water quality, performance symptoms and opinion of the nature of the foulant.			
Open ocean samples (coagulation-flocculation, GMF)		Assist	Lead
Desalinated water samples (Neodren® - SWRO)		Lead	Assist
Sampling per the water quality analysis schedule (Appendix C, Table C1)		Assist	Lead
Review of sampling approach: Project team: monthly review and re-evaluation of sampling frequency SDCWA: review after three initial months of piloting	Assist	Assist	Lead

Task	Michael Baker	SPI	Trussell Tech
Monitor process performance for characteristics: **Including filter ripening, filter headloss, and backwash frequency**		Assist	Lead

VI. Reporting

A. Monthly Status Memos

Trussell Tech will produce monthly status memos during the pilot test period, with input from SPI. The memos will include discussion of operations with input from SPI. They will also include discussion of data collection, testing, analysis, and performance, with SPI to provide RO performance data. Finally, the monthly status memos will provide a look ahead for the following month.

B. Data Collection, Testing, and Analysis Report

At the conclusion of the pilot operations and testing, currently projected for late-December 2017, Trussell Tech (with input from SPI) will prepare a *Data Collection, Testing, and Analysis Report*. This report will serve as a comprehensive resource for the Project outcome, including:

- Literature research;
- Testing results from the pilot treatment processes (intakes, pretreatment, SWRO, and overall);
- Water-quality data;
- Performance and operating data;
- Narrative and graphical summaries of the data;
- Conclusions regarding performance and operation of the pretreatment process for both subsurface and open ocean intake systems, including power usage;
- Copies of the certified laboratory analytical results and equipment calibration certifications (provided in the report appendices).

The draft report will be reviewed by Michael Baker and the Water Authority, then Trussell Tech will revise, as necessary. Michael Baker will incorporate the *Data Collection, Testing, and Analysis Report* into an all-inclusive *Intake Testing Program Report*. This final project report will include additional discussion of the implications of capital and operations and maintenance (O&M) costs of the full-scale facility for the two intakes. Estimates of expected full-scale life-cycle cost analysis will be provided and compared for a screened open intake with associated pretreatment and a subsurface intake system with any pretreatment deemed necessary based on study. The draft *Intake Testing Program Report* will be submitted for review by the Water Authority and Camp Pendleton. Michael Baker will revise the draft report as necessary and prepare a Final Report.

VII. Project Management (Michael Baker lead, support from Trussell Tech and SPI)

Michael Baker will lead the project management for the Intake Testing Program, with support from Trussell Technologies and SPI. The full project team will work together to update the Water Authority on Intake Testing Program progress, including the preparation of slides for periodic project meetings. The Water Authority will lead the reporting effort in support of grant funding associated with the project. Michael Baker, Trussell Tech, and SPI will provide updates with operations and monitoring data, as requested. All team members will abide by the CAMPEN memorandum of understanding (MOU) for the project.

VIII. Risk and Risk Mitigation

There are foreseeable risks associated with the Project, as defined in this test plan. In some cases, the project approach has been reconfigured in response to available budgeting and constraints related to permitting or site restrictions. To acknowledge the risks, a risk registry is presented in Table 21. This table outlines identified risks and suggests strategies to mitigate the impact of these project risks.

Table 21. Risk Registry

(continued)

Chance of Occurrence Low 1 to 5 High	Potential Impact Low 1 to 5 High	Risk	Risk Mitigation / Evaluation of Risk Significance
2	3	**Permitting issues, delays, etc.**	Update project schedule to completion of permitting.
3	3	**Budget and Schedule:** Construction schedule overruns	Update project schedule to maximize remaining time to test critical items
1	4	**Operation Data:** Losing data through hard drive failure, corruption, vandalism,	Back up data frequently, Store in multiple locations, use routine cloud uploads.
2	3	**Vandalism**	Install security perimeter fence with barbed wire and locking doors.
2	3	**Information & Communication Failure**	Site visits or remote data access on a daily basis
2	4	**Corrosion**	Selection of appropriate material for seawater environment.
3	4	**Intake:** Intake fouling (mussels, etc.) or clogging of the subsurface porous pipe and surrounding strata loses permeability	Periodic shock chlorination of open intake. Evaluate cause in subsurface intake and balance cost of repair with schedule impacts and chance of recurrence.
Chance of Occurrence Low 1 to 5 High	**Potential Impact Low 1 to 5 High**	**Risk**	**Risk Mitigation / Evaluation of Risk Significance**
2	5	**Intake:** Intake is damaged, causing lost project time and additional expense	Evaluate schedule impacts and adjust the remaining testing time to gather high priority data
2	4	**Pretreatment:** Not capable of handling Algal Blooms and High Turbidity storm events	Adjust coagulant dose; if not sufficient, deploy a DAF pretreatment step
3	3	**Pretreatment:** Subsurface intake needs pretreatment before the RO	Evaluate the fouling mechanisms and deploy the proper pretreatment step
5	2	**Non-parallel RO operation**: Only one SWRO train is available for testing on only one intake option at a time. Influent water quality may vary between intake option tests, making results less comparable.	Regularly monitor water quality associated with membrane fouling potential for the subsurface intake and GMF.
2	5	**Irreversible Membrane Scaling**	Get new RO membranes, with substantive cost impact
3	3	**RO:** Bio-fouling	Evaluate cause and optimize pretreatment

2	**5**	**Irreversible RO Bio-fouling**	Acquire new RO membranes, with substantive cost impact
3	**3**	**Insufficient Run Time**: The occurrence of a harmful algal bloom event cannot be guaranteed to fall within the Project testing schedule.	Regularly monitor online data sources and water quality for indications of algal blooms so as not to miss a harmful algal bloom event. Be ready to run triggered testing when harmful algal bloom is in session.
2	**4**	**Outfall System:** Percolation ponds clog and overflows	Provide instrumentation on the percolation pond to shut the system down if the level is too high. Use a bobcat front loader to remove the fouled surface layer.

IX. Site Health and Safety Plan

A site-specific health and safety plan (HASP) has been prepared by SPI and reviewed by Michael Baker's Safety Officer, to define the program safety requirements and to designate protocols to be followed during the project pilot testing. The HASP, provided in Attachment A, summarizes potential hazards and defines protective measures planned for site activities. All on-site personnel, including Michael Baker and subcontractor personnel participating in any on-site activities, will be responsible for reading and abiding by the HASP.

References

Boerlage, S. (2011). "Measuring Seawater and Brine Salinity in Seawater Reverse Osmosis." Desalination & Water Resue **21**(3): 26-30.

Eaton, A. D., L. S. Clesceri, E. W. Rice and A. E. Greenberg (2005). Standard Methods for the Examination of Water and Wastewater, 21st Edition.

Millero, F. J. (2006). Chemical Oceanography. Boca Raton, Taylor & Francis Group, LLC (CRC Press).

Stumm, W. and J. J. Morgan (1981). Aquatic Chemistry, An Introduction Emphasizing Chemical Equilibria in Natural Waters, 2nd Edition, John Wiley & Sons.

Appendix A

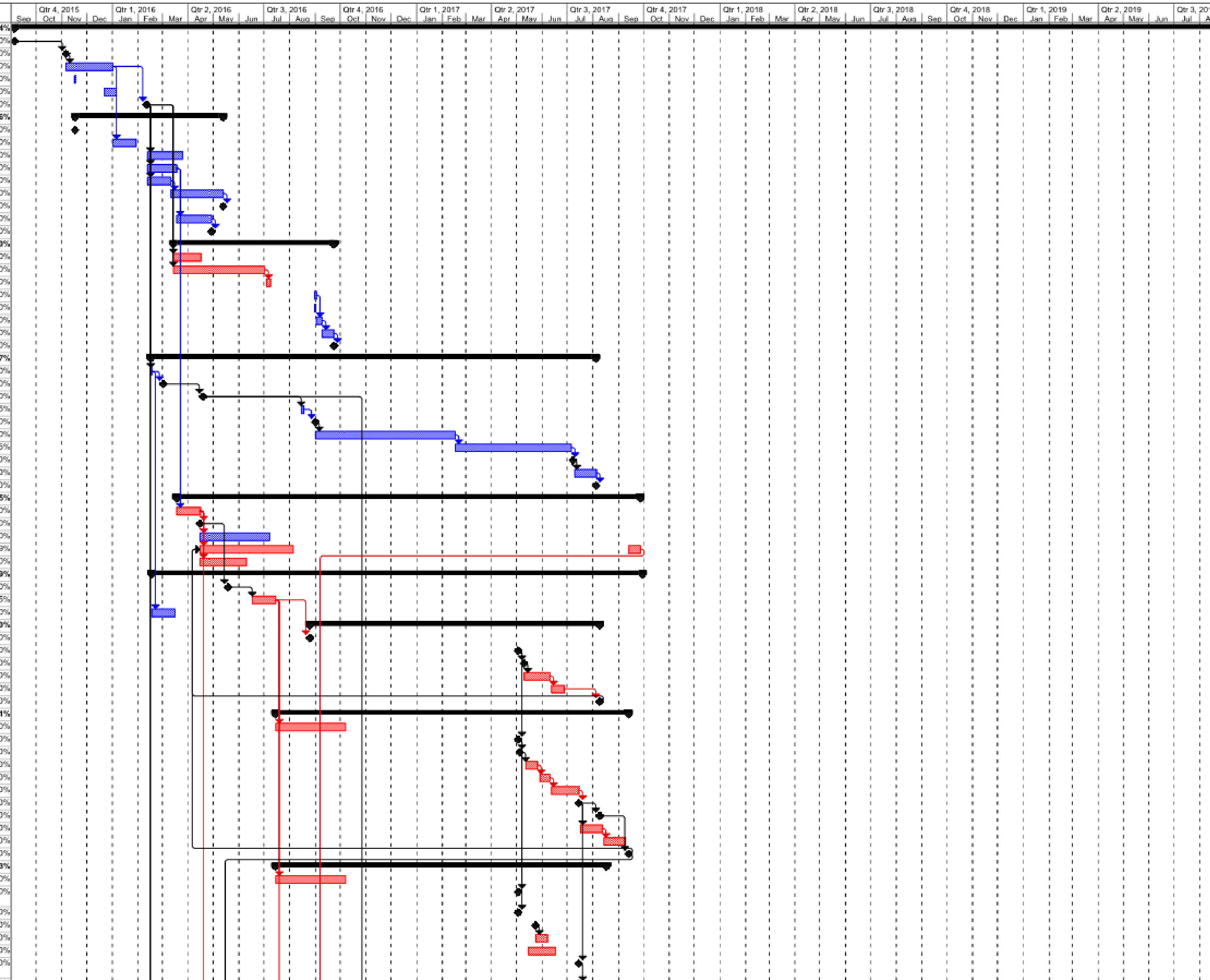
Program Schedule

San Diego County Water Authority

SDCWA PROPOSED CAMP PENDLETON SEAWATER DESALINATION PROJECT
INTAKE TESTING PROGRAM
PROJECT SCHEDULE
Revised: April 13, 2017

Michael Baker INTERNATIONAL

ID	Task Name	Duration	Start	Finish	% Complete
1	**SDCWA Seawater Desalination Intake Testing Program**	**1033 days**	**Fri 9/4/15**	**Wed 8/21/19**	**44%**
2	Contract Awarded	0 days	Fri 9/4/15	Fri 9/4/15	100%
3	Contract Signed / Notice to Proceed	0 days	Fri 11/6/15	Fri 11/6/15	100%
4	Subconsultant Contracts	8 wks	Fri 11/6/15	Thu 12/31/15	100%
5	Base Kick-off Meeting	1 day	Mon 11/16/15	Mon 11/16/15	100%
6	Happy Holidays!!	2 wks	Tue 12/22/15	Mon 1/4/16	100%
7	Team Kick-off Meeting (NTP to subs)	0 days	Thu 2/11/16	Thu 2/11/16	100%
8	**Initial Tasks / Documents**	**128 days**	**Tue 11/17/15**	**Thu 5/12/16**	**96%**
9	Memorandum of Understanding (Final)	0 days	Tue 11/17/15	Tue 11/17/15	100%
10	Base Access Letter (Business Pass/RAPIDGate)	4 wks	Fri 1/1/16	Thu 1/28/16	100%
11	Project Management Plan	6 wks	Fri 2/12/16	Thu 3/24/16	100%
12	Project Description (Draft)	5 wks	Fri 2/12/16	Thu 3/17/16	90%
13	Test Plan Protocol (Outline)	4 wks	Fri 2/12/16	Thu 3/10/16	100%
14	Test Plan Protocol (Draft)	9 wks	Fri 3/11/16	Thu 5/12/16	90%
15	Submit Test Plan to SDCWA	0 days	Thu 5/12/16	Thu 5/12/16	100%
16	Permitting Work Plan	6 wks	Fri 3/18/16	Thu 4/28/16	100%
17	Submit Permitting Work Plan to SDCWA	0 days	Thu 4/28/16	Thu 4/28/16	100%
18	**Geotechnical**	**139 days**	**Mon 3/14/16**	**Thu 9/22/16**	**100%**
19	Boring - NEPA CatEx / Site Approval (CAMPEN)	5 wks	Mon 3/14/16	Fri 4/15/16	100%
20	Boring - Base Access License (CAMPEN)	4 mons	Mon 3/14/16	Fri 7/1/16	100%
21	SDC - DEH: Boring Waiver	1 wk	Mon 7/4/16	Fri 7/8/16	100%
22	Exploratory Boring / Soil Samples	2 days	Wed 8/31/16	Thu 9/1/16	100%
23	Geotechnical Site Reconnaissance	1 day	Wed 8/31/16	Wed 8/31/16	100%
24	Soil Sample - Lab Analysis	1 wk	Fri 9/2/16	Thu 9/8/16	100%
25	Geotechnical Report	2 wks	Fri 9/9/16	Thu 9/22/16	100%
26	Submit Geotechnical Report to Team/SDCWA	0 days	Thu 9/22/16	Thu 9/22/16	100%
27	**Design**	**384 days**	**Tue 2/16/16**	**Fri 8/4/17**	**77%**
28	Design Workshop #1	1 day	Tue 2/16/16	Tue 2/16/16	100%
29	Contractor / Env. Team Site Visit	0 days	Wed 3/2/16	Wed 3/2/16	100%
30	Design Workshop #2	0 days	Mon 4/18/16	Mon 4/18/16	100%
31	Neodren® Design Consultation w/ CP	3 days	Mon 8/15/16	Wed 8/17/16	85%
32	Design Workshop #3	0 days	Wed 8/31/16	Wed 8/31/16	100%
33	**DESIGN ON HOLD DUE TO PERMITTING DELAYS**	6 mons	Thu 9/1/16	Wed 2/15/17	100%
34	Intake Testing Program Design Package	5 mons	Thu 2/16/17	Wed 7/5/17	65%
35	Submit 90% Design Package to SDCWA	0 days	Fri 7/7/17	Fri 7/7/17	0%
36	Comment Period / Design Revisions	4 wks	Mon 7/10/17	Fri 8/4/17	0%
37	Submit 100% Design Package to SDCWA	0 days	Fri 8/4/17	Fri 8/4/17	0%
38	**Environmental Documentation**	**398 days**	**Fri 3/18/16**	**Tue 9/26/17**	**95%**
39	NEPA REIR Form (CAMPEN ES)	4 wks	Fri 3/18/16	Thu 4/14/16	100%
40	Submit REIR to SDCWA & CAMPEN ES	0 days	Thu 4/14/16	Thu 4/14/16	100%
41	Technical Studies (Cultural, Marine, Terrestrial)	12 wks	Fri 4/15/16	Thu 7/7/16	100%
42	NEPA CatEx	4.5 mons	Fri 4/15/16	Tue 9/26/17	89%
43	CEQA NOE	2 mons	Fri 4/15/16	Thu 6/9/16	100%
44	**Permitting / Base Access License**	**422.88 days**	**Wed 2/17/16**	**Fri 9/29/17**	**69%**
45	Env. Team Meeting w/ SDCWA & CAMPEN ES	0 days	Thu 5/19/16	Thu 5/19/16	100%
46	Initial Consultation w/ Reg. Agencies (Onsite or WebEx)	4 wks	Fri 6/17/16	Thu 7/14/16	75%
47	Submit Draft Contractor Safety Plans	4 wks	Wed 2/17/16	Tue 3/15/16	100%
48	**State Water Resources Control Board**	**249 days**	**Thu 8/25/16**	**Wed 8/9/17**	**0%**
49	WDR/NPDES Permit Application Submitted	0 days	Thu 8/25/16	Thu 8/25/16	100%
50	Water Code Section 13142.5(b) Determination	0 days	Wed 5/3/17	Wed 5/3/17	50%
51	Public Notice Issued	0 days	Wed 5/10/17	Wed 5/10/17	0%
52	30-Day Public Review	23 days	Wed 5/10/17	Fri 6/9/17	0%
53	2 Week Comment Period	11 days	Mon 6/12/17	Mon 6/26/17	0%
54	Regional Board Meeting	0 days	Wed 8/9/17	Wed 8/9/17	0%
55	**CA Coastal Commission**	**303 days**	**Fri 7/15/16**	**Wed 9/13/17**	**41%**
56	CA Coastal Commission (CDP Waiver) App	3 mons	Fri 7/15/16	Thu 10/6/16	100%
57	WC Section 13142.5(b) Determination Provided to CCC	0 days	Wed 5/3/17	Wed 5/3/17	0%
58	File Date for CDP Application	0 days	Fri 5/5/17	Fri 5/5/17	0%
59	Public Notice	10 days	Fri 5/12/17	Thu 5/25/17	0%
60	Comment/Response	10 days	Mon 5/29/17	Fri 6/9/17	0%
61	Staff Report Preparation	25 days	Mon 6/12/17	Fri 7/14/17	0%
62	Staff Report Distribution	0 days	Fri 7/14/17	Fri 7/14/17	0%
63	Coastal Commision Hearing (OC/LA)	0 days	Wed 8/9/17	Wed 8/9/17	0%
64	Prior to Issuance of CDP Review Reponse	20 days	Mon 7/17/17	Fri 8/11/17	0%
65	Coastal Review of Prior to Issuance Responses	20 days	Mon 8/14/17	Fri 9/8/17	0%
66	Issuance of Coastal Development Permit	0 days	Wed 9/13/17	Wed 9/13/17	0%
67	**CA State Lands Commission**	**284 days**	**Fri 7/15/16**	**Thu 8/17/17**	**63%**
68	State Lands Commission (Surface Lease) App	3 mons	Fri 7/15/16	Thu 10/6/16	100%
69	SDCWA Response to 10/7/16 SLC Letter. Provide SLC with Regional Board Determination	0 days	Wed 5/3/17	Wed 5/3/17	50%
70	CCC & SLC Begin Coordination	0 days	Wed 5/3/17	Wed 5/3/17	0%
71	Public Notice Distribution	0 days	Wed 5/24/17	Wed 5/24/17	0%
72	Comment/Response	10 days	Wed 5/24/17	Tue 6/6/17	0%
73	Staff Report Preparation	25 days	Mon 5/15/17	Fri 6/16/17	0%
74	Coastal Commission Staff Report Provided to State Lands Commision	0 days	Fri 7/14/17	Fri 7/14/17	0%
75	Staff Report Distribution	0 days	Fri 7/14/17	Fri 7/14/17	0%



Date: Fri 4/14/17 Page 1

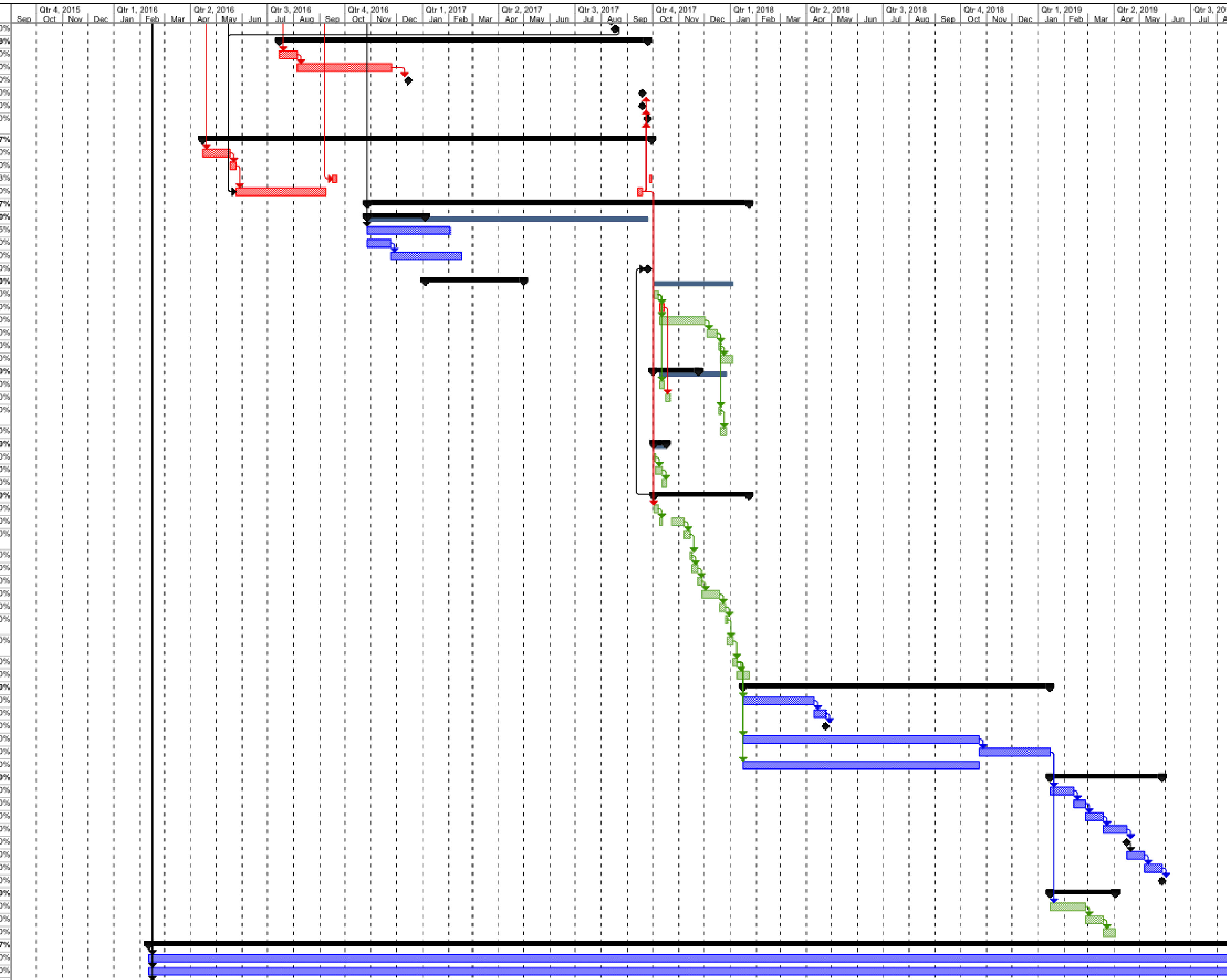
Task | Summary | Inactive Milestone | Manual Task | Manual Summary Rollup | Start-only
Milestone | Inactive Task | Inactive Summary | Duration-only | Manual Summary | Finish-only

San Diego County Water Authority

SDCWA PROPOSED CAMP PENDLETON SEAWATER DESALINATION PROJECT
INTAKE TESTING PROGRAM
PROJECT SCHEDULE
Revised: April 13, 2017

Michael Baker INTERNATIONAL

ID	Task Name	Duration	Start	Finish	% Complete
76	State Lands Commision Meeting	0 days	Thu 8/17/17	Thu 8/17/17	0%
77	**U.S. Army Corps of Engineers (ACOE)**	**311 days**	**Fri 7/15/16**	**Mon 9/25/17**	**99%**
78	Submit USACE Section 10 NWP Application	3 wks	Fri 7/15/16	Thu 8/4/16	100%
79	Comment / Response	4 mons	Fri 8/5/16	Thu 11/24/16	100%
80	USACE Section 10 Nationwide Permit (NWP) 7	0 days	Thu 12/15/16	Thu 12/15/16	100%
81	U.S. Coast Guard Notification	0 days	Mon 9/18/17	Mon 9/18/17	0%
82	USACE Commencement Notification	0 days	Mon 9/18/17	Mon 9/18/17	0%
83	Coastal Zone Management Act (CZMA) Consistency Certification to USACE	0 days	Mon 9/25/17	Mon 9/25/17	0%
84	**Base Access License**	**380.88 days**	**Fri 4/15/16**	**Fri 9/29/17**	**97%**
85	Prepare Base Access License Application	4.5 wks	Fri 4/15/16	Tue 5/17/16	100%
86	SDCWA - Review and Submit Base Access License	1 wk	Tue 5/17/16	Tue 5/24/16	100%
87	CAMPEN - Process Base Site Approval	1 wk	Fri 9/16/16	Fri 9/29/17	43%
88	CAMPEN - Process Base Access License	4 mons	Tue 5/24/16	Mon 9/18/17	100%
89	**Construction / Commissioning**	**323 days**	**Thu 10/27/16**	**Mon 1/22/18**	**37%**
90	**Initial Tasks / Documents**	**49 days**	**Thu 10/27/16**	**Tue 1/3/17**	**80%**
91	Treatment Equipment Procurement	3.5 mons	Thu 10/27/16	Wed 2/1/17	75%
92	SWRO Mobile Unit (Assessment - Dana Point)	4 wks	Thu 10/27/16	Wed 11/23/16	100%
93	SWRO Mobile Unit (Lease Negotiation w/ SCWD/MWDOC)	3 mons	Thu 11/24/16	Wed 2/15/17	80%
94	Site Walk with SDCWA & CAMPEN Personnel	0 days	Mon 9/25/17	Mon 9/25/17	0%
95	**Horizontal Directional Drilling (HDD) - The HDD Company**	**84 days**	**Wed 1/4/17**	**Sun 4/30/17**	**0%**
96	Mobilization	1 wk	Mon 10/2/17	Fri 10/6/17	0%
97	Pipe Fusing (can be done same time as drilling)	1 wk	Mon 10/9/17	Fri 10/13/17	0%
98	Drilling Operation	2 mons	Mon 10/9/17	Fri 12/1/17	0%
99	Pipe Installation	2 wks	Mon 12/4/17	Fri 12/15/17	0%
100	Neodren Cleaning and Pump Testing	2 days	Mon 12/18/17	Tue 12/19/17	0%
101	Demobilization	2 wks	Wed 12/20/17	Tue 1/2/18	0%
102	**Marine Construction - C&W Diving**	**40 days**	**Sun 10/1/17**	**Thu 11/23/17**	**0%**
103	Mobilization	5 days	Mon 10/9/17	Fri 10/13/17	0%
104	Pipe Fusing (can be done same time as drilling)	1 wk	Mon 10/16/17	Fri 10/20/17	0%
105	Offshore Pipe, Intake Screen, and Discharge Check Valve Installation	2 days	Mon 12/18/17	Tue 12/19/17	0%
106	Demobilization	5 days	Wed 12/20/17	Tue 12/26/17	0%
107	**High Voltage Electrical Installation - Galindo Elec.**	**11 days**	**Mon 10/2/17**	**Mon 10/16/17**	**0%**
108	Mobilization	2 days	Mon 10/2/17	Tue 10/3/17	0%
109	High Voltage Electrical Cable / Transformer Installation	6 days	Wed 10/4/17	Wed 10/11/17	0%
110	Demobilization	3 days	Thu 10/12/17	Mon 10/16/17	0%
111	**Land Construction - Integrated Water Services (IWS)**	**81 days**	**Mon 10/2/17**	**Mon 1/22/18**	**0%**
112	Mobilization	5 days	Mon 10/2/17	Fri 10/6/17	0%
113	Site Demolition / Site Preparation	14 days	Mon 10/9/17	Mon 11/6/17	0%
114	High Voltage Elec Trench and Conduit Placement (PP#2 to Transformer Location)	5 days	Tue 11/7/17	Mon 11/13/17	0%
115	Concrete Footings for Treatment Trailers	2 days	Tue 11/14/17	Wed 11/15/17	0%
116	Test Facility Field Piping / Elec Conduit Installation	5 days	Thu 11/16/17	Wed 11/22/17	0%
117	SWRO / GMF Unit Trailer Installation	3 days	Thu 11/23/17	Mon 11/27/17	0%
118	Electrical Meter Panel and Site Wiring	15 days	Tue 11/28/17	Mon 12/18/17	0%
119	Intake Vault Excavation and Installation	5 days	Tue 12/19/17	Mon 12/25/17	0%
120	Intake Pump(s), Pump Columns, and Discharge Head Installation	2 days	Tue 12/26/17	Wed 12/27/17	0%
121	Pipelines and Electrical Conduit / Cables Install from Intake Vault to Testing Facility	5 days	Thu 12/28/17	Wed 1/3/18	0%
122	Facility Start Up and Commissioning	3 days	Thu 1/4/18	Mon 1/8/18	0%
123	Demobilization	10 days	Tue 1/9/18	Mon 1/22/18	0%
124	**Operation**	**260 days**	**Tue 1/16/18**	**Mon 1/14/19**	**0%**
125	Water Quality Samples	3 mons	Tue 1/16/18	Mon 4/9/18	0%
126	Revise Test Plan Protocol (as needed)	2 wks	Tue 4/10/18	Mon 4/23/18	0%
127	Submit Revised Test Plan to SDCWA	0 days	Mon 4/23/18	Mon 4/23/18	0%
128	Open Ocean: Coagulation / Flocculation / GMF	10 mons	Tue 1/16/18	Mon 10/22/18	0%
129	Open Ocean: Reverse Osmosis (SWRO)	3 mons	Tue 10/23/18	Mon 1/14/19	0%
130	Subsurface: Reverse Osmosis (SWRO)	10 mons	Tue 1/16/18	Mon 10/22/18	0%
131	**Reporting**	**95 days**	**Tue 1/15/19**	**Mon 5/27/19**	**0%**
132	Draft: Data Collection, Testing, Analysis Report	1 mon	Tue 1/15/19	Mon 2/11/19	0%
133	Baker Review	2 wks	Tue 2/12/19	Mon 2/25/19	0%
134	Final: Data Collection, Testing, Analysis Report	3 wks	Tue 2/26/19	Mon 3/18/19	0%
135	Draft: Intake Testing Program Report	1 mon	Tue 3/19/19	Mon 4/15/19	0%
136	Submit Draft to SDCWA	0 days	Mon 4/15/19	Mon 4/15/19	0%
137	SDCWA / CAMPEN Review	3 wks	Tue 4/16/19	Mon 5/6/19	0%
138	Final: Intake Testing Program Report	3 wks	Tue 5/7/19	Mon 5/27/19	0%
139	Submit Final to SDCWA	0 days	Mon 5/27/19	Mon 5/27/19	0%
140	**Decommissioning**	**55 days**	**Tue 1/15/19**	**Mon 4/1/19**	**0%**
141	Decommissioning	1.5 mons	Tue 1/15/19	Mon 2/25/19	0%
142	Site Restoration	3 wks	Tue 2/26/19	Mon 3/18/19	0%
143	Demobilization	2 wks	Tue 3/19/19	Mon 4/1/19	0%
144	**Administration**	**920 days**	**Thu 2/11/16**	**Wed 8/21/19**	**37%**
145	Project Meetings	46 mons	Thu 2/11/16	Wed 8/21/19	50%
146	Grant Fund Reporting Support	46 mons	Thu 2/11/16	Wed 8/21/19	10%
147	Quality and Cost Control	46 mons	Thu 2/11/16	Wed 8/21/19	50%



Date: Fri 4/14/17 Page 2

Task | Milestone | Summary | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only

Appendix B

Drawings and Diagrams

Figure B1. GMF Pilot Unit P&ID 1 – Flocculation

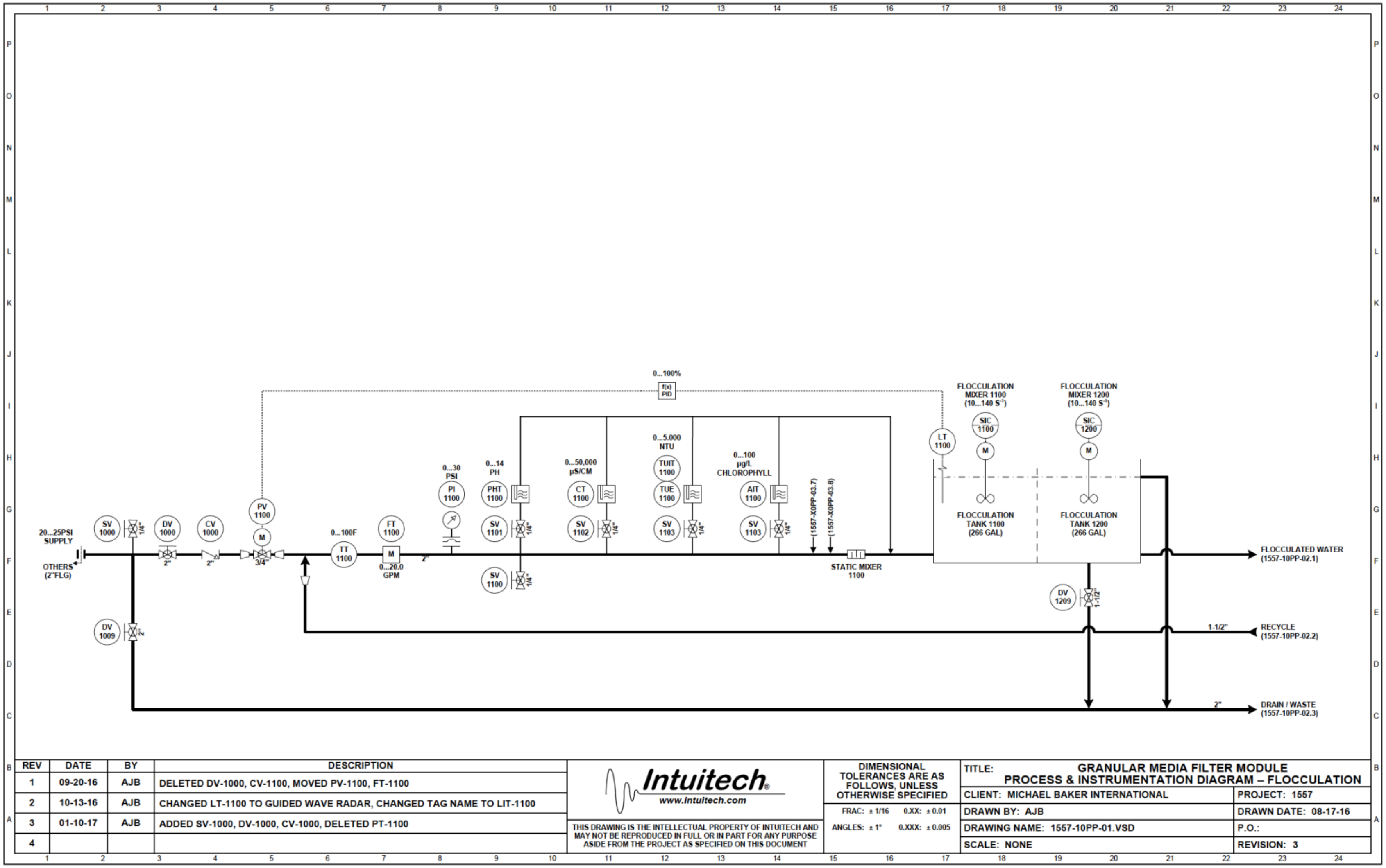


Figure B2. GMF Pilot Unit P&ID 2 - Filtration

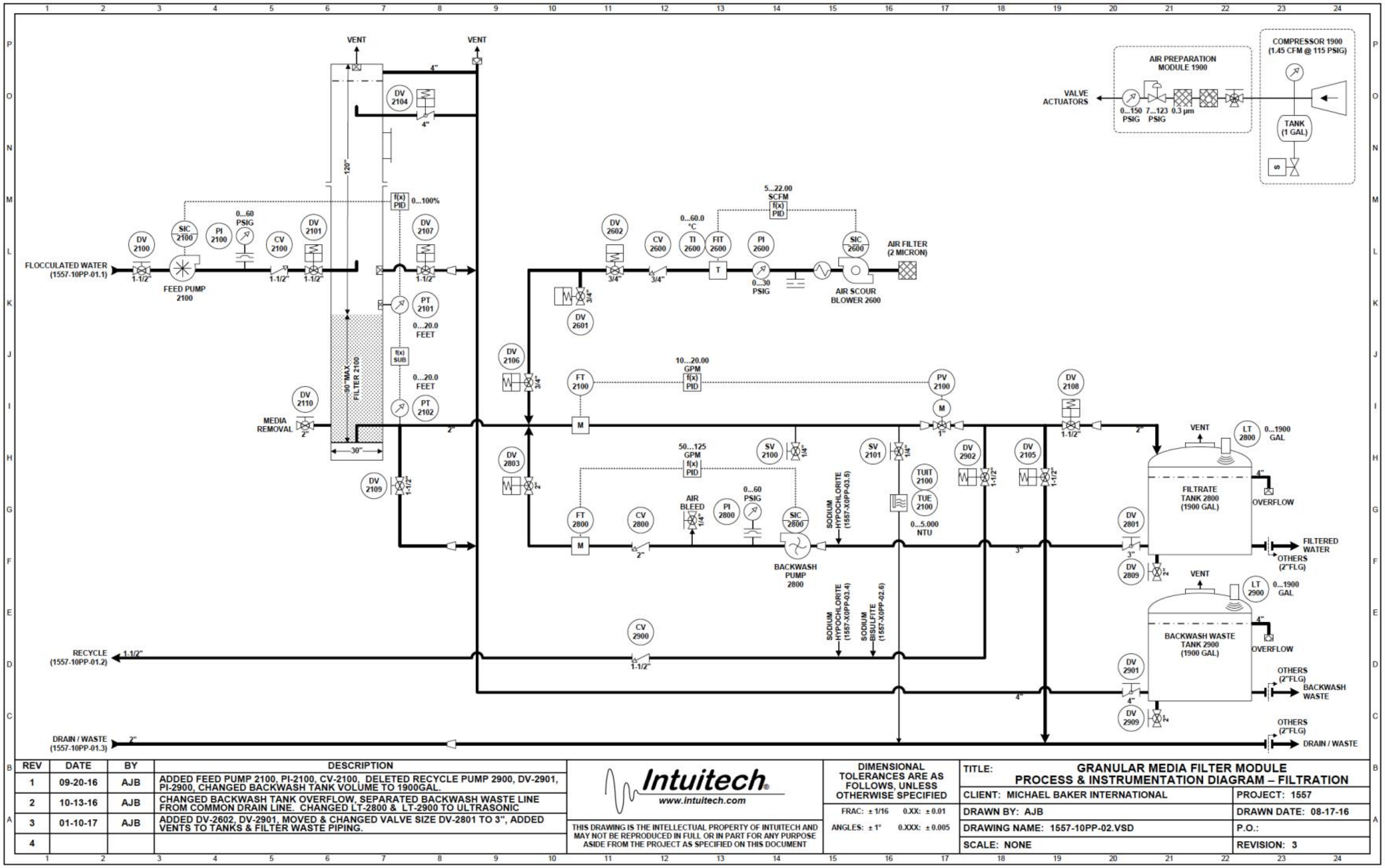


Figure B3. GMF Pilot Unit P&ID 3 - Chemicals

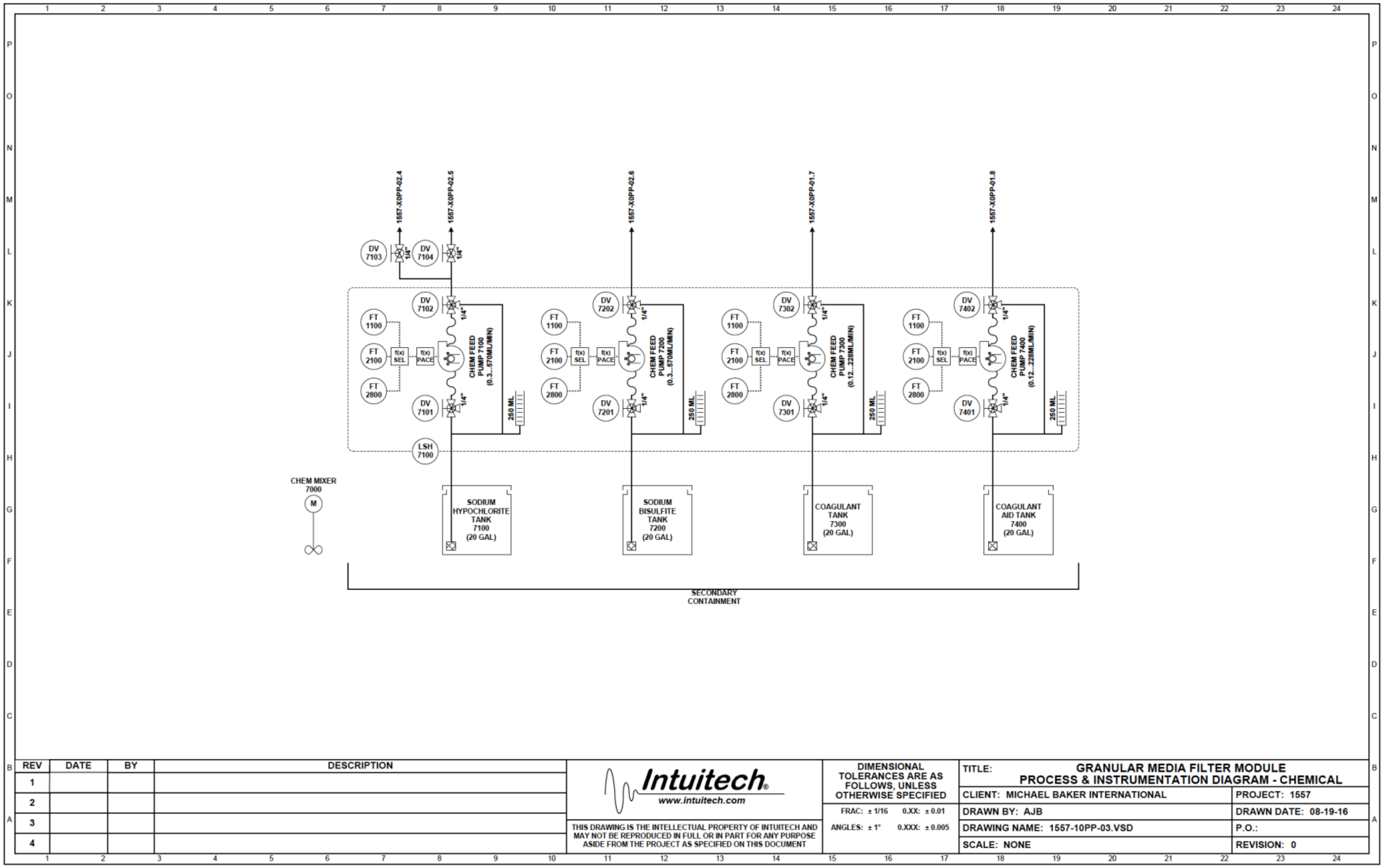


Figure B4. SWRO Pilot Unit P&ID 1

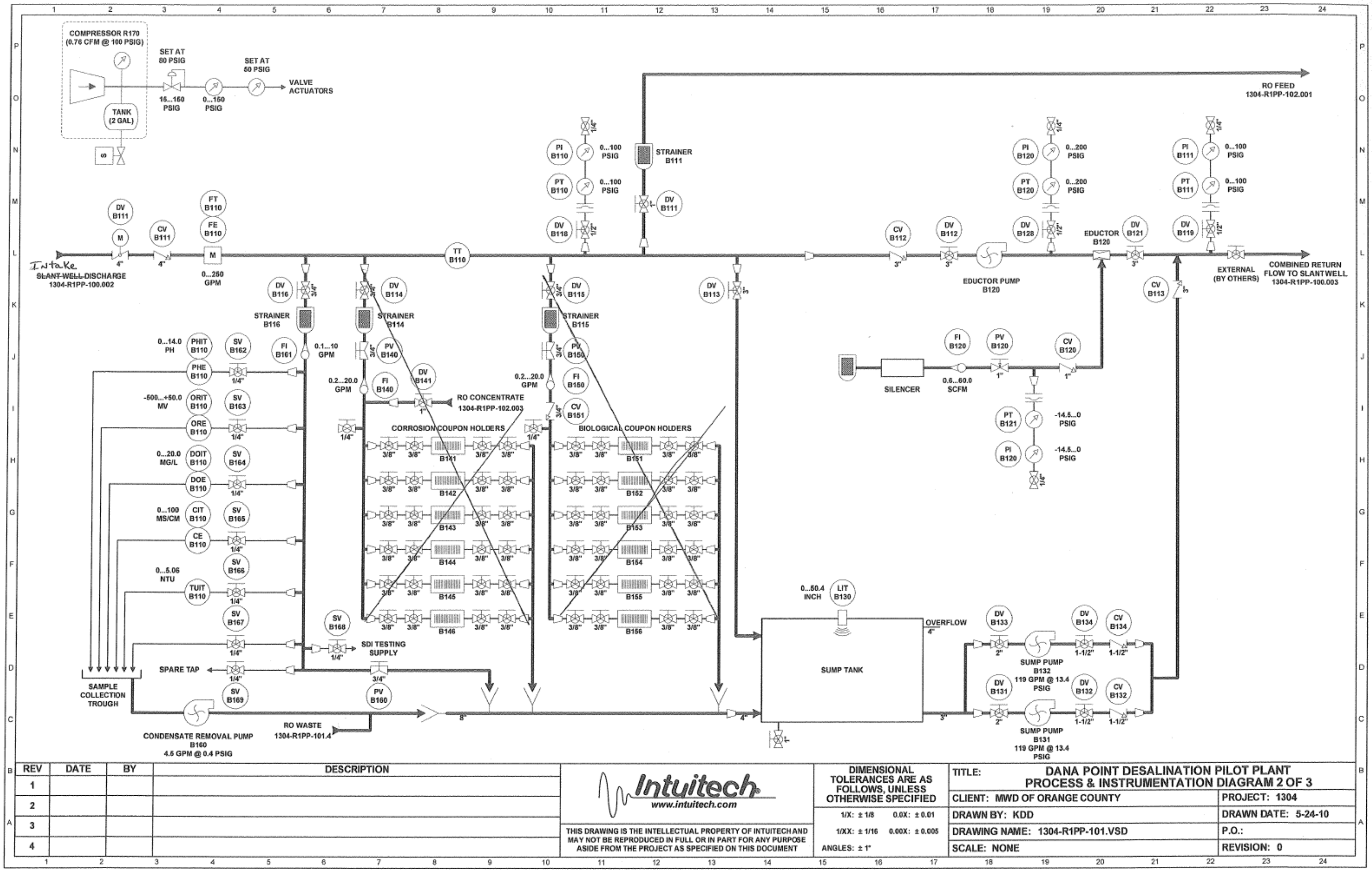
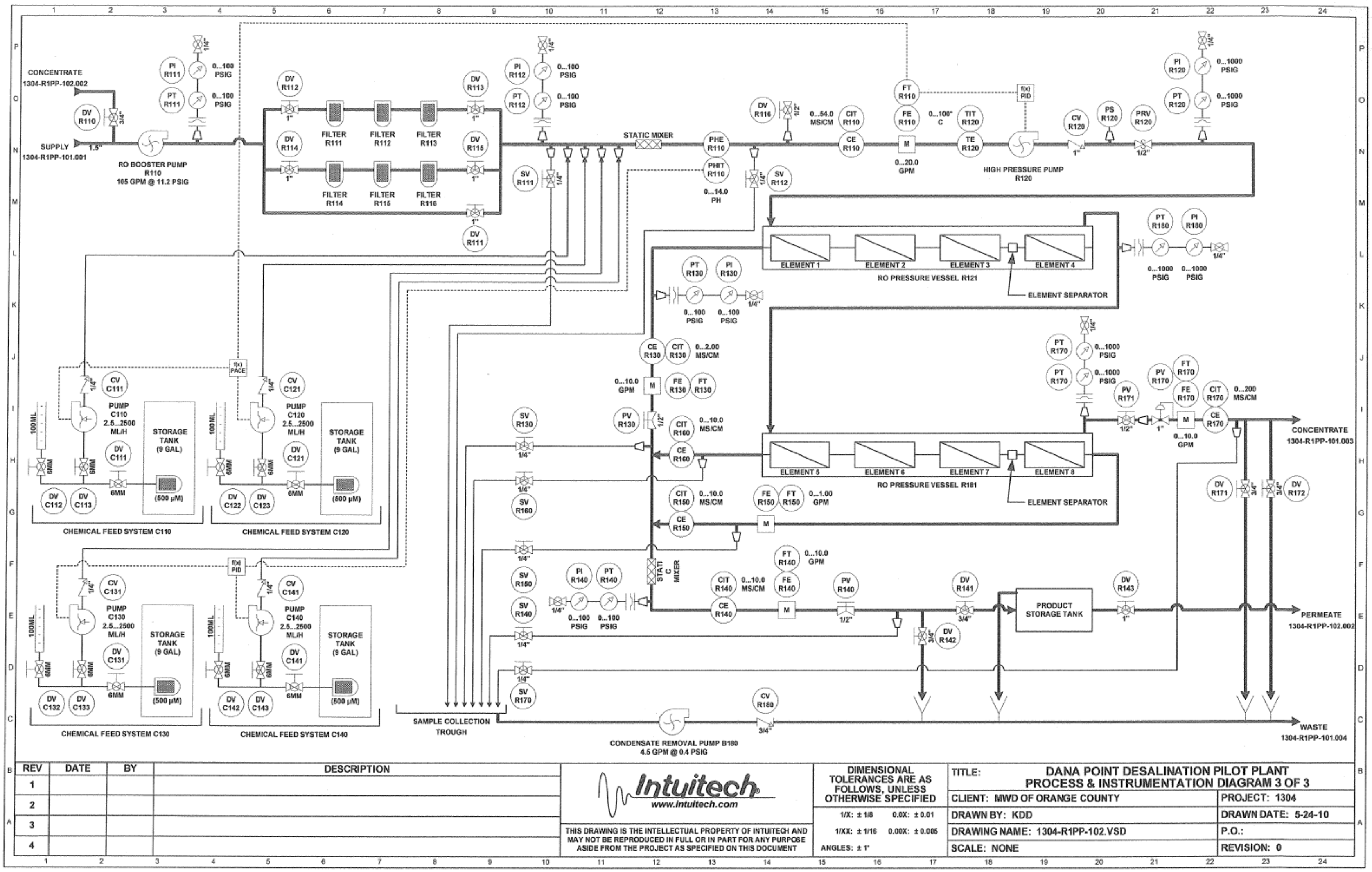


Figure B5. SWRO Pilot Unit P&ID 2



Appendix C

Table C1. Water Quality Analysis Schedule

Water Quality Analyses Schedule								
	Routine					*Seasonal (3 events - 15 days) & Tidal*		
	Intake	Pretreatment	RO Performance		Ocean Plan	Intake	Pretreatment	
	Open versus Subsurface	GMF filtrate versus Subsurface intake	RO permeate	RO Concentrate	Combined Effluent	Open versus Subsurface	GMF filtrate versus Subsurface intake	*Total No. of Special Sampling locations*
General Mineral								
Calcium - EPA 200.7	x (1*)		x (Q)	x (1)	x (1)			
Magnesium - EPA 200.7	x (1*)		x (Q)	x (1)	x (1)			
Sodium - EPA 200.7	x (1*)		x (Q)	x (1)	x (1)			
Potassium - EPA 200.7	x (1*)		x (Q)	x (1)	x (1)			
Ammonia-N - EPA 350.1	x (1*)		x (Q)	x (1)	x (1)			
Kjeldahl Nitrogen	x (1*)	x (Q)	x (Q)	x (1)		x (D)	x (D)	3
Barium - EPA 200.8	x (1*)		x (Q)	x (1)	x (1)			
Strontium - EPA 200.8	x (1*)		x (Q)	x (1)	x (1)			
Sulfate - EPA 300.0	x (1*)		x (Q)	x (1)	x (1)			
Chloride - EPA 300.0	x (1*)		x (M)	x (1)	x (1)			
Fluoride - EPA 300.0	x (1*)		x (Q)	x (1)	x (1)			
Nitrate-N & Nitrite-N EPA 353.2	x (1*)		x (Q)	x (1)	x (1)	x (D)	x (D)	3
Boron - EPA 200.8	x (1*)		x (Q)	x (1)	x (1)			
Silica - EPA 200.7	x (1*)	x (Q)	x (Q)	x (1)	x (1)			
Bromide - EPA 300.1	x (1*)		x (Q)	x (1)	x (1)			
Iron - EPA 200.7 (total & dissolved)	x (1*)	x (M) GMF; x (Q) Subsurface	x (Q)	x (1)	x (1) - total only			
Manganese - EPA 200.8 (total & dissolved)	x (1*)		x (Q)	x (1)	x (1) - total only			
Alkalinity, total - SM 2320B	x (1*)		x (Q)	x (1)	x (1)			
Phosphorus, Total as P - EPA 365.1	x (1*)		x (Q)	x (1)	x (1)	x (D)	x (D)	3
Orthophosphate-P - EPA 365.1	x (1*)		x (Q)	x (1)	x (1)			
Total Dissolved Solids - SM2540C	x (1*)		x (Q)	x (1)	x (1)			
Trace Elements								
Lead - EPA 200.8	x (1*)		x (T)	x (1)	x (1)			
Chromium - EPA 200.8	x (1*)		x (T)	x (1)				
Aluminum - EPA 200.8	x (1*)	x (x6/year) GMF; x(T) Subsurface	x (T)	x (1)				
Beryllium - EPA 200.8	x (1*)		x (T)	x (1)				
Mercury - EPA 245.1	x (1*)		x (T)	x (1)	x (1)			
Copper - EPA 200.8	x (6-O**)		x (T)	x (1)	x (1)			
Cadmium - EPA 200.8	x (1*)		x (T)	x (1)	x (1)			
Selenium - EPA 200.8	x (1*)		x (T)	x (1)	x (1)			
Antimony - EPA 200.8	x (1*)		x (T)	x (1)	x (1)			
Arsenic - EPA 200.8	x (1*)		x (T)	x (1)	x (1)			
Asbestos, water - TEM	x (1*)	x (T)	x (T)	x (1)				
Silver - EPA 200.8	x (1*)		x (T)	x (1)	x (1)			
Thallium - EPA 200.8	x (1*)		x (T)	x (1)				
Nickel - EPA 200.8	x (1*)		x (T)	x (1)	x (1)			
Zinc - EPA 200.8	x (1*)		x (T)	x (1)	x (1)			
Total Suspended Solids - SM2540D	x (M)	x (M)			x (1)	x (D)		2
Total Organic Carbon - SM 5310C	x (sM)	x (sM)				x (D)	x (D)	3
Discretionary TOC								
UV-254	x (C)	x (C)						
Chlorophyll	x (C) Open; x (M)Subsurface	x (M)						
EEM	x (M)	x (M)						
E. coli	x (M)				x (1)	x (D)	x (D)	3
Enterococcus	x (M)					x (D)	x (D)	3
Field/Bench Measurements								
Conductivity	x (C)		x (C)	Monthly	x (M)			
Temperature	x (C)				x (M)			
Turbidity	x (C)	x (C)			x (M)	x (D) - already continuous	x (D) - already continuous	3
pH	x (C)	x (W) GMF; x (W) Subsurface			x (M)			
ORP	x (W)	x (W) RO feed will be continuous			x (M)			
Dissolved Oxygen	x (W)	x (W) RO feed will be continuous			x (M)			
Total Chlorine Residual					x (M)			
Aluminum or Iron								
SDI	x (M)	x (W)						
Salinity	x (W)	x (W)						
Additional Ocean Plan Parameters								
Total Coliform					x (1)			
Fecal Coliform					x (1)			
Settleable Solids					x (1)			
Oil and Grease					x (1)			
Cyanide					x (1)			
Phenolic Compounds (non-chlorinated)					x (1)			
Chlorinated Phenolics					x (1)			
Organochlorine Pesticides & PCB Congeners and Aroclors					x (1)			
Toxaphene					x (1)			
Radioactivity (Gross Alpha & Beta only)					x (1)			
VOCs by EPA 624					x (1)			
Chromium VI					x (1)			
Phthalates					x (1)			
Organotins					x (1)			
PAHs					x (1)			
Base Neutral Extractables					x (1)			
Dibenzo-Dioxins/Furans by HRMS EPA Method 1613B					x (1)			

x (T): three times over the pilot duration
x (Q): quarterly
x (M): monthly
x (W): weekly
x (D): daily
x (1*): measure once; if results differ from historical data, measure quarterly for general minerals and three times for trace elements
x (6-O**): open ocean intake only; .measure once; if results differ from historical data, measure 6 times for the pilot duration

Appendix D

Data Sampling Sheets

Table D1. Intake and GMF Data Sampling Sheet

Intake & GMF Operating Data Log

Week:

				Open Ocean Intake:							
	Operator:	DATE:	TIME:	Flow (gpm)	EC (µS/cm)	Temp. (ºF)	Turb. (NTU)	pH	UV 254		
MON.											
TUES.											
WED.											
THURS.											
FRI.											

				Open Ocean Intake:							
	Operator:	DATE:	TIME:	Flow (gpm)	EC (µS/cm)	Temp. (ºF)	Turb. (NTU)	pH	ORP (mV)	DO (mg/L)	UV254
MON.											
TUES.											
WED.											
THURS.											
FRI.											

				Granular Media Filter							
	Operator:	DATE:	TIME:	Flow (gpm)	Headloss	Turbidity	UV 254				
MON.											
TUES.											
WED.											
THURS.											
FRI.											

Weekly Sampling	Open Ocean Intake	Subsurface Intake	Granular Media Filter
(handheld meters):	Temp. (ºF):	Temp. (ºF):	Temp. (ºF):
DATE:	pH:	pH:	pH:
TIME:	EC (µS/cm):	EC (µS/cm):	EC (µS/cm):
Operator:	Salinity (ppt):	Salinity (ppt):	Salinity (ppt):
	DO (mg/L)	DO (mg/L)	DO (mg/L)
Outfall	ORP (mV):	ORP (mV):	ORP (mV):
DO (mg/L):	UV 254:	UV 254:	UV 254:
		SDI:	SDI:

Table D2. SWRO Data Sampling Sheet

Seawater Reverse Osmosis Daily Operating Data Log Sheet

		Mon	Tues	Wed	Thurs	Fri
	Operator:					
	Date:					
	Time:					
	Run Time (hr):					
AIT 150	Feed Temp. (ºF):	/	/	/	/	/
AIT 150	Feed pH:					
	Inlet Cart. Filter Pressure (psi)					
	Outlet Cart. Filter Pressure (psi):					

		Digital	**Analog**	**Digital**	**Analog**	**Digital**	**Analog**	**Digital**	**Analog**	**Digital**	**Analog**
PIT 210	Main Pump Discharge Pressure (psi):										
PIT 202	Feed (1st stage) Pressure (psi):										
Pit 205	Concentrate Pressure (psi):										
AIT 130	Permeate Pressure (psi):										

		Handheld/Online	Handheld/Online	Handheld/Online	Handheld/Online	Handheld/Online
AIT 130	Feed Conductivity (µmhos):	/	/	/	/	/
SV-6/AIT 220	Permeate Conductivity (µmhos):	/	/	/	/	/
	Concentrate Conductivity (µmhos):	(handheld)	(handheld)	(handheld)	(handheld)	(handheld)
FIT 230	Total Permeate Flow (gpm):					
FIT 240	Concentrate Flow (gpm):					
	Permeate UV254:					
	Antiscalant Tank Level (gal):					

	Conductivity	**Conductivity**	**Conductivity**	**Conductivity**	**Conductivity**
V-1					
V-2					

Pump Speed P 200 (main)	Hz	Hz	Hz	Hz	Hz