Charting Local Waters:
San Dieguito Groundwater Study
An OMWD Sustainable Supplies Project

San Dieguito Valley Brackish Groundwater Desalination Study

Prepared for:

Olivenhain Municipal Water District
A Public Agency

Department of Water Resources
State of California

November 2017

Prepared by:

GEOSCIENCE
Groundwater Consultants

RMC water and environment
Woodard & Curran

National Experience. Local Focus.

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List of Abbreviations

AF	acre-foot or acre-feet
AFY	acre-feet per year
CASGEM	California Statewide Groundwater Elevation Monitoring
CEQA	California Environmental Quality Act
CGS	California Geological Survey
CIP	Capital Improvement Plan
CSD	community services district
CWC	California Water Code
DCMWTP	David C. McCollom Water Treatment Plant
DWR	Department of Water Resources
EIS	Environmental Impact Statement
ELO	Escondido Land Outfall
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
gpd	gallons per day
gpd/ft	gallons per day per foot
gpm	gallons per minute
GHG	greenhouse gas
HARRF	Hale Avenue Resource Recovery Facility
I-5	Interstate 5
LOMR	Letter of map revision
MFR	multi-family residential
MG	million gallons
mgd	million gallons per day
mg/L	milligrams per liter
MWD	Metropolitan Water District of Southern California
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NWQ	Northwest Quadrant
OMWD	Olivenhain Municipal Water District
O&M	operation and maintenance
Project	San Dieguito Valley Brackish Groundwater Desalination project

PZ	pressure zone
PS	pump station
RO	reverse osmosis
RSFCSD	Ranch Santa Fe Community Services District
RWQCB	Regional Water Quality Control Board
SANDAG	San Diego Association of Governments
SCE	Southern California Edison
SDCWA	San Diego County Water Authority
SDWD	San Dieguito Water District
SEJPA	San Elijo Joint Power Authority
SEOO	San Elijo Ocean Outfall
sf	square feet
SFID	Santa Fe Irrigation District
SFR	single family residential
SGMA	Sustainable Groundwater Management Act
SMCL	secondary maximum contaminant level
TDS	total dissolved solids
TFC	thin film composite
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
VWD	Vallecitos Water District
WMP	Water Master Plan
WRF	water reclamation facility
ZLD	zero liquid discharge

Executive Summary

Olivenhain Municipal Water District (OMWD) relies on purchased water for its potable water needs with limited local water supply options available. Faced with rising costs, decreasing availability, and uncertain future reliability of this purchased water supply, OMWD is focusing on developing a reliable local potable water supply through implementation of the San Dieguito Valley Brackish Groundwater Desalination Project (Project).

This feasibility study evaluates if 1.0 million gallons per day (mgd) of potable water can be produced from brackish groundwater in the San Dieguito Valley Groundwater Basin. The study evaluates numerous project considerations including production wells, conveyance pipelines, desalination treatment facilities, brine management; as well as project alternatives and costs, environmental and regulatory considerations, and implementation plans.

The San Dieguito Valley Groundwater Basin is a very low priority basin per the California Statewide Groundwater Elevation Monitoring (CASGEM) program. Thus, OMWD will not be subject to the provisions of the Sustainable Groundwater Management Act (SGMA). OMWD is nevertheless committed to managing the groundwater basin sustainably and has verified through a hydrogeological study, water balance, and groundwater modeling that the Project's groundwater production is sustainable. Results further indicate that the project will improve the water quality in the groundwater basin by removing salts and allowing more infiltration of less brackish water.

Six feasible project alternatives were considered based on combinations of two options for desalination treatment plant locations (North Project Area and South Project Area) and three options for brine disposal methods (San Elijo Ocean Outfall, Escondido Land Outfall, and Deep Well Injection). The six alternatives were compared for various criteria including cost, regulatory feasibility, time to implement, and other factors. The more favorable projects received higher scores. The three highest ranking alternatives are Project 1A, 1B and 2A. The project alternatives are summarized in the table below:

Table ES-1: Six Project Alternatives

Project	Brine Disposal Method	Desalination Treatment Plant Location	Rank
1A	San Elijo Ocean Outfall	North Treatment Site	1st
1B	Escondido Land Outfall	North Treatment Site	2nd
1C	Deep Well Injection	North Treatment Site	--
2A	San Elijo Ocean Outfall	South Treatment Site	3rd
2B	Escondido Land Outfall	South Treatment Site	--
2C	Deep Well Injection	South Treatment Site	--

Project 1A, which utilizes the north site and brine disposal to the San Elijo Ocean Outfall (SEOO), ranked the highest in all categories except for the cost-focused analysis. **Project 1B**, which utilizes the Escondido Land Outfall (ELO) from the north site, ranked first in the cost-focused analysis; however, it ranked third or fourth in all other categories. **Project 2A**, located at the south site and brine discharge to the SEOO, ranked second or third in all categories.

The highest scoring project overall is **Project 1A**, which takes brine disposal directly to the SEOO via direct connection at the San Elijo Water Reclamation Facility (WRF). The desalination treatment plant for this alternative is located on the north site, as indicated on **Figure ES-1.** The proposed facilities will include: two extraction wells, raw water conveyance, a 1.0 mgd groundwater desalter, a product water connection to OMWD's distribution system, and brine disposal via the SEOO. Brine disposal may be capacity-restricted during prolonged storm events and agreements need to be developed with San Elijo Joint Powers Authority (SEJPA).

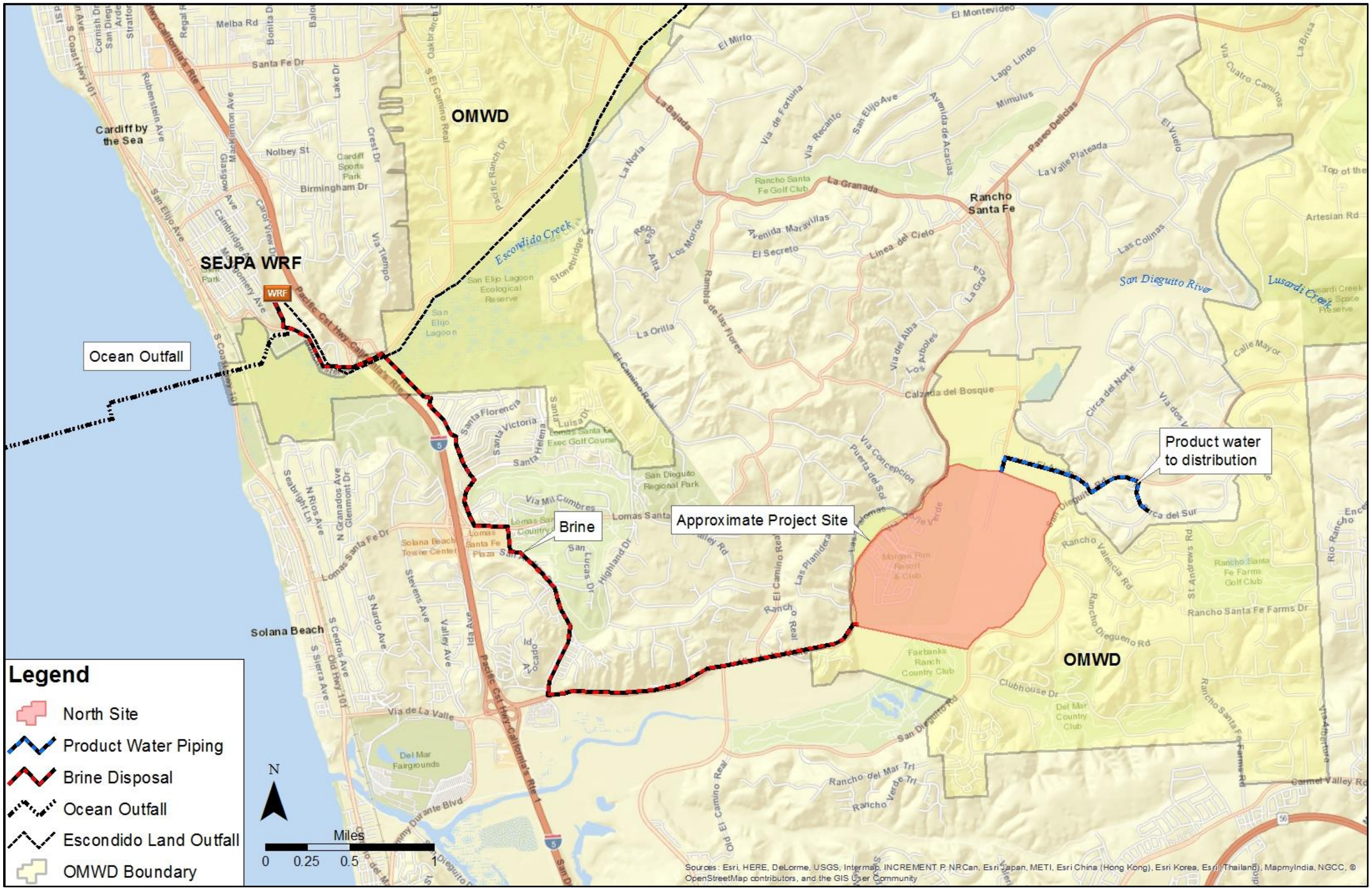


Figure ES-1: Project 1A

Although slightly higher in cost than Project 1B, **Project 1A** offers less institutional complexity and the ability for near-term implementation without dependency on other projects to be completed. The feasibility for Project 1B increases if capacity becomes available in the ELO because connecting to the ELO is more economical and opens potential for coordination with other regional water projects.

Land availability for a treatment plant site is limited in the project area. At the time of this report, detailed data on specific parcels of land were not available; land acquisition was therefore not part of the evaluation criteria. Land acquisition could become a crucial factor in feasibility and may affect the ranking of alternatives as the project develops.

The recommended project is **Project 1A**. With completion of the Feasibility Study in 2017, OMWD may begin pilot borings and test well construction. After test wells are constructed, water quality sampling and pretreatment field testing may commence. Pump tests would follow to update the groundwater model and verify basin capacities. Permitting and Environmental could occur concurrently with pilot testing. In 2019, the Project could move into design. Upon completion of the CEQA process, construction could begin in 2020. With testing and monitoring in 2021, the Project could be fully operational by 2022.

The projected unit cost of water for the Project is $2,021 per acre-foot (AF) in 2017 dollars. When the Project is operational in 2022, the projected cost of water produced is expected to be $2,105, which is comparable to San Diego County Water Authority (SDCWA) treated water costs ranging from $2,100 to $2,200. The unit cost of water from the Project is lower than the unit cost of desalinated water from the Claude “Bud” Lewis Carlsbad Desalination Plant in Carlsbad, which is approximately $ 2,131 to $2,367 per AF (SDCWA, 2012).

OMWD began its public outreach efforts for the Project by communicating with local government officials including the City and County of San Diego; the local water wholesaler, SDCWA; adjacent wastewater agencies SEJPA, Rancho Santa Fe Community Services District (CSD), Whispering Palms CSD, and Fairbanks Ranch CSD; and the adjacent water district, Santa Fe Irrigation District (SFID). OMWD received positive feedback and support for the project from these agencies.

OMWD has received funding for the Project from the California Department of Water Resources (DWR) Water Desalination Grant-Round 3 - $250,000 for this San Dieguito Brackish Groundwater Desalination Feasibility Study. OMWD will continue to pursue funding for the Project’s construction capital components as follows:

- California DWR Water Desalination Grant - Round 4 (currently soliciting for applications): $600,000 requested (grant maximum of $1,500,000) for Brackish Groundwater Desalination Design Pilot
- California DWR Water Desalination Grant - Round 5: $500,000 for Brackish Groundwater Desalination Environmental Documentation
- California DWR Water Desalination Grant - Round 5: $10,000,000 for Brackish Groundwater Desalination Construction

Overall the Project is a sustainable solution to creating a reliable drinking water without causing significant impacts to the environment or existing groundwater users. The models show improved groundwater basin water quality within the Project area. Implementation of the Project would create a reliable drinking water supply at predictable prices.

Section 1 Study Area

The goal of this feasibility study is to evaluate if 1.0 million gallons per day (mgd) of potable water can be produced from brackish groundwater in the San Dieguito Valley Groundwater Basin. This study evaluates the hydrogeologic conditions of the groundwater basin, necessary facilities, project alternatives and costs, and implementation plans. The recommended alternative is the San Dieguito Brackish Groundwater Desalination Project (Project).

The Project study area is the San Dieguito Valley Groundwater Basin in San Diego County as shown in **Figure 1-1**.

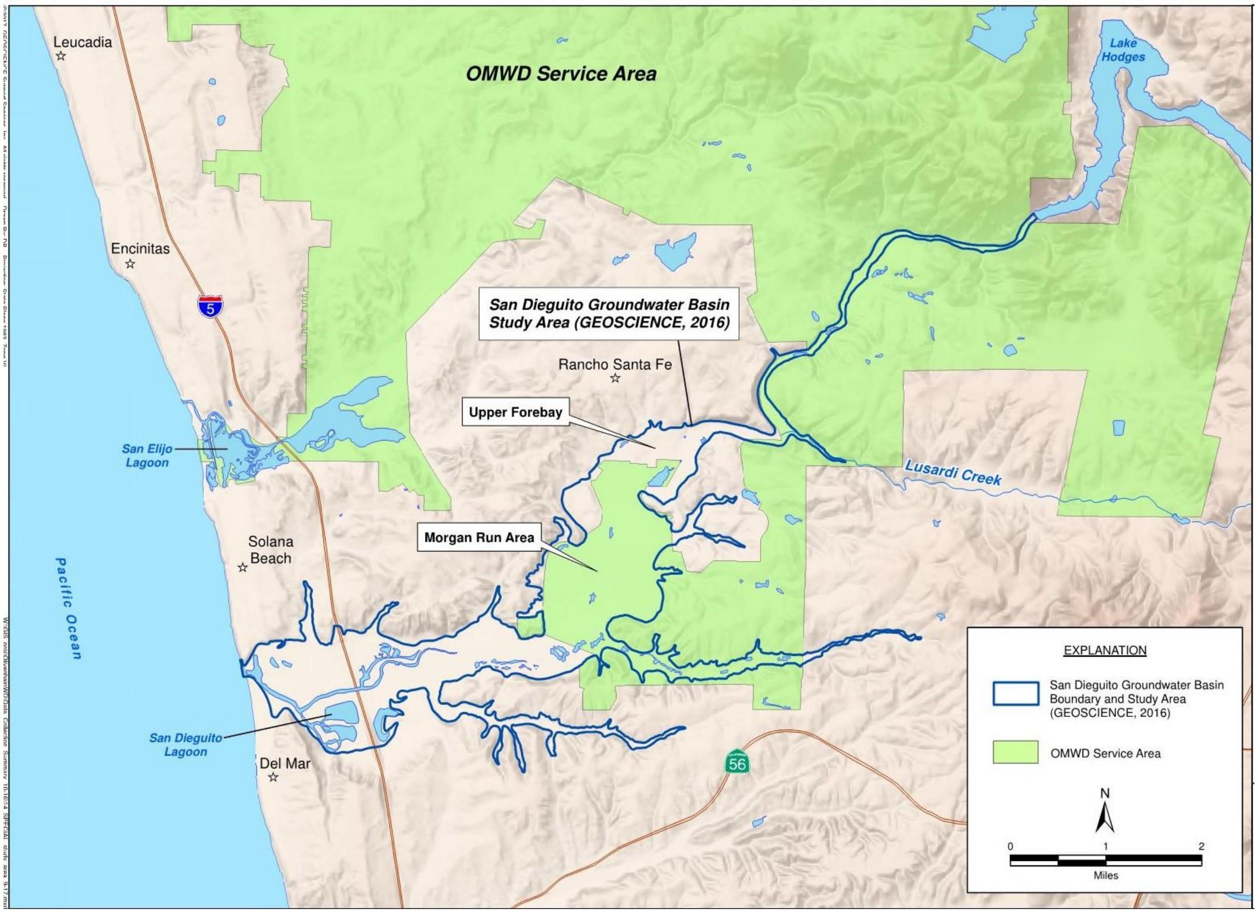


Figure 1-1: San Dieguito Valley Groundwater Basin Boundary

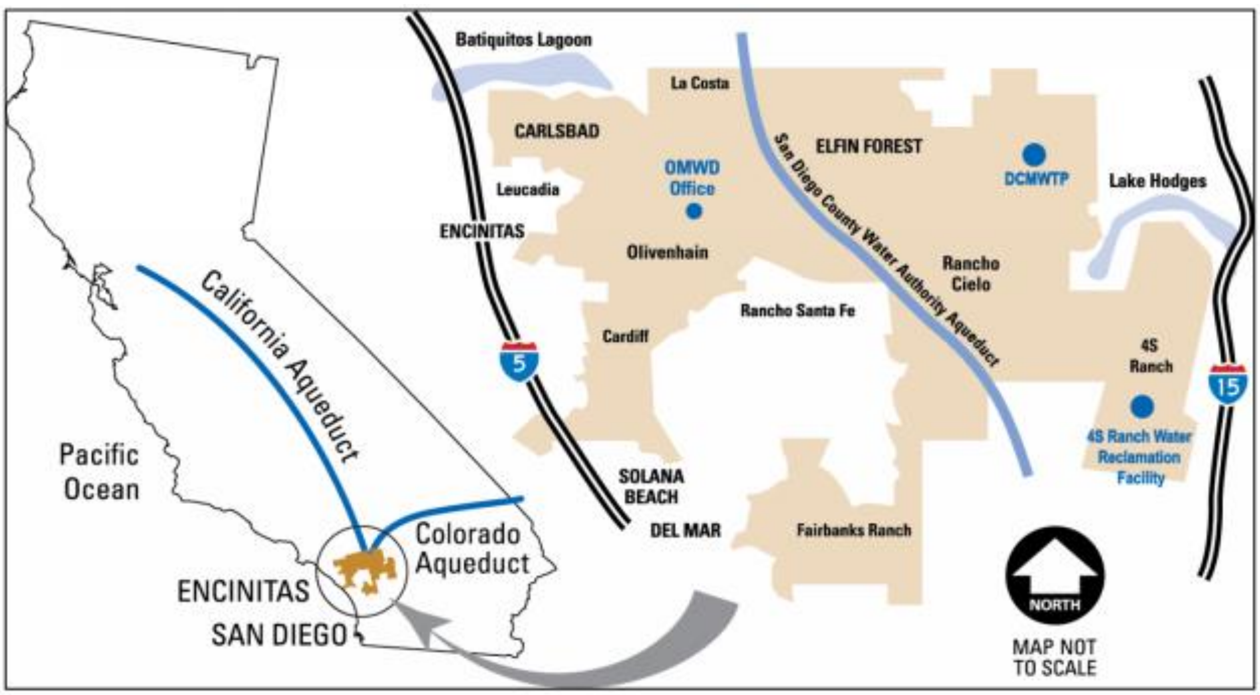
1.1 District Background

Olivenhain Municipal Water District (OMWD) is a municipal water district organized and operating pursuant to Water Code Sections 71000 et seq., and was incorporated on April 9, 1959, to develop an adequate water supply for landowners and residents. On June 14, 1960, residents of OMWD voted to become a member of the San Diego County Water Authority (SDCWA), thus becoming eligible to purchase water transported into San Diego County via the aqueduct systems of SDCWA and the Metropolitan Water District of Southern California (MWD).

At over 48 square miles, OMWD serves approximately 70,522 customers (UWMP, 2015) in the cities of Encinitas, Carlsbad, San Diego, San Marcos, Solana Beach, and neighboring unincorporated communities of Elfin Forest, Rancho Santa Fe, Fairbanks Ranch, Santa Fe Valley, and 4S Ranch, shown in **Figure 1-2**. The areas served by OMWD feature a mild coastal climate, varied topography, and proximity to major urban areas.

In 2016, 100 percent of OMWD's potable water supply was imported, with an average of 91 percent received through the Colorado Aqueduct and 9 percent through the California Aqueduct (OMWD, 2017). Approximately 97 percent of the raw water obtained from SDCWA is treated at the David C. McCollom Water Treatment Plant (DCMWTP) located within the northeastern portion of OMWD's service area. DCMWTP's potable water treatment capacity is 34 million gallons per day (mgd).

OMWD also serves approximately 2 mgd of recycled water. The 4S Ranch Water Reclamation Facility, located in the southeastern portion of the service area, produces 1 mgd. OMWD supplements the recycled water it produces with purchased recycled water from the Rancho Santa Fe Community Services District and the City of San Diego. OMWD also purchases recycled water from the Vallecitos Water District (VWD) and San Elijo Joint Powers Authority (SEJPA) to serve customers in portions of Encinitas and Carlsbad. Recycled water is used for irrigation of schools, parks, streetscapes, and golf courses.

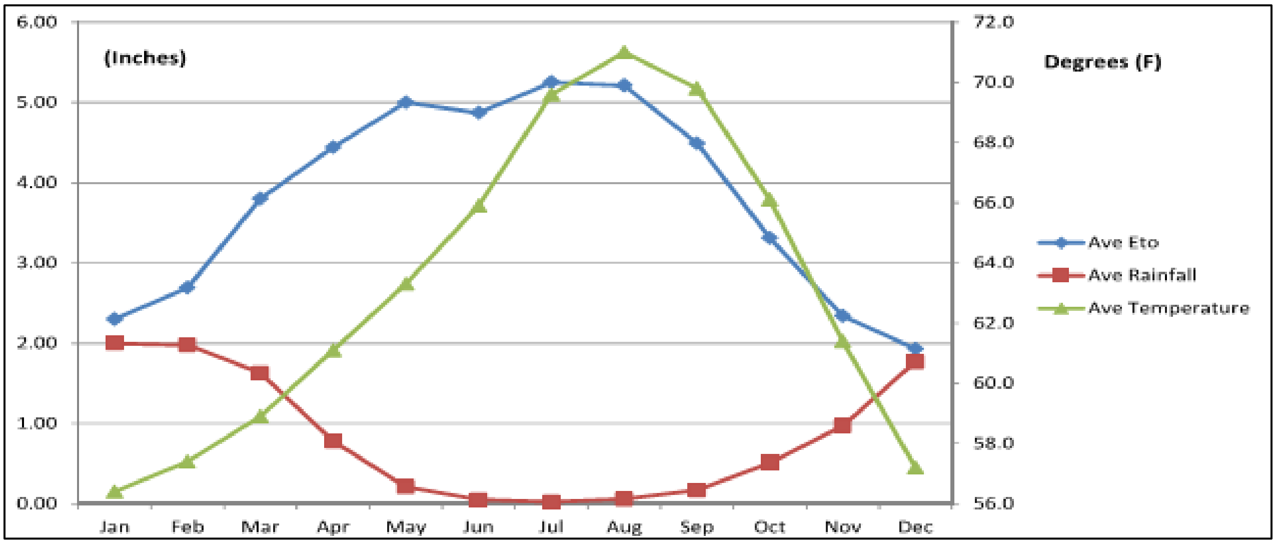


SOURCE: OMWD URBAN WATER MANAGEMENT PLAN (UWMP) 2015

Figure 1-2: OMWD Vicinity Map

1.2 Climate

The study area has a Mediterranean climate with an average annual rainfall of approximately 10.5 inches per year on the coast and more than 14 inches per year inland (UWMP, 2015). Inland areas are both hotter in the summer and cooler in the winter. More than 80 percent of the region's rainfall occurs between December and March. Water requirements tend to increase during the summer months when a decrease in rainfall combines with an increase in temperatures and evapotranspiration, as shown in **Figure 1-3**.



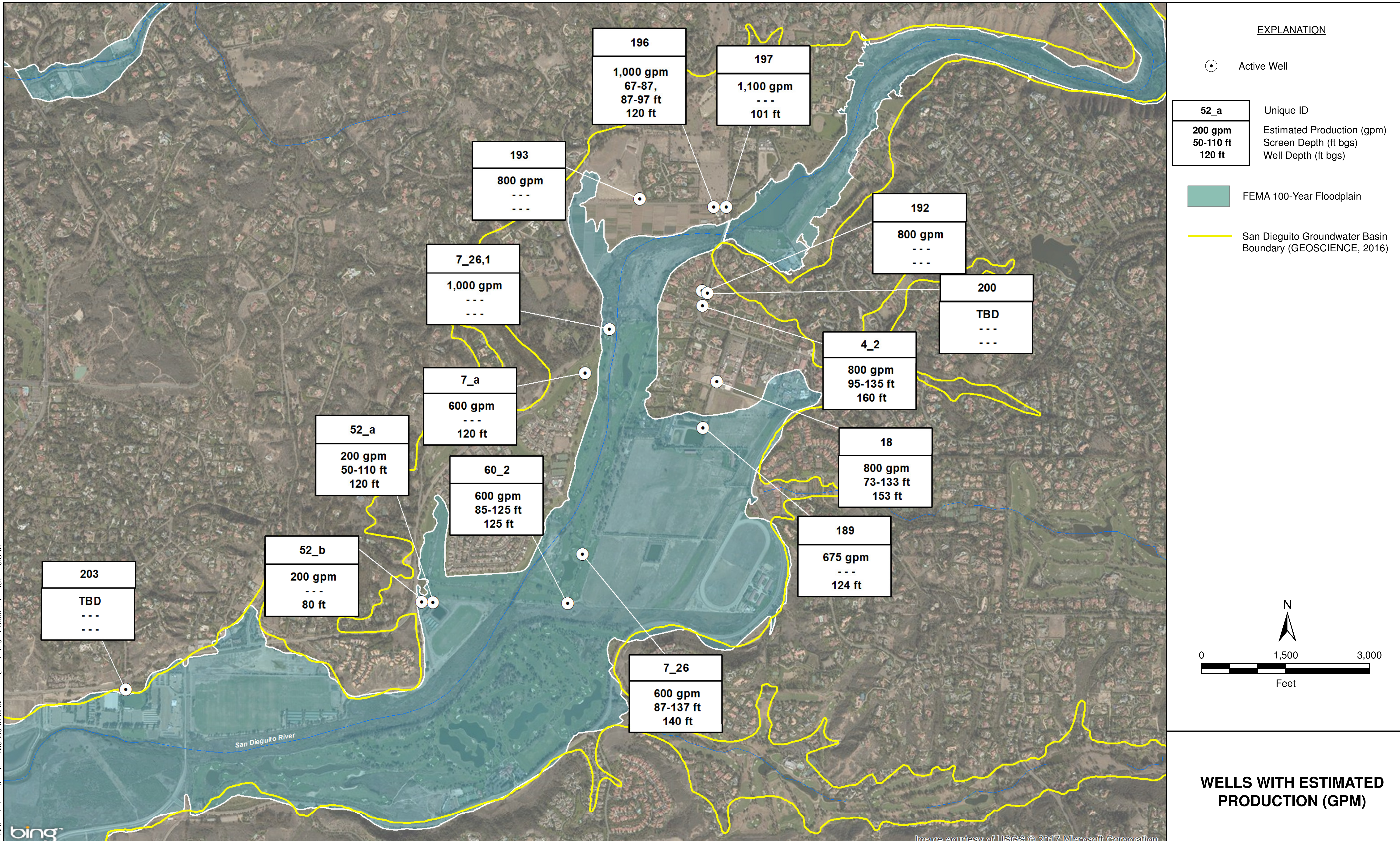
SOURCE: OMWD UWMP 2015

Figure 1-3: Climate Variables

1.3 Geology

The San Dieguito Valley Groundwater Basin, as shown in **Figure 1-1**, is located both within the Peninsular Range Geomorphic Province and Pacific Coastal Plain physiographic zones (Izbicki, 1983). Most of the basin is within the Pacific Coastal Plain - only the upper portion of the basin immediately downstream of Lake Hodges is within the Peninsular Range Geomorphic Province. Within the Pacific Coastal Plain, the basin is bounded by the Pacific Ocean to the west and by the La Jolla Group formations everywhere else (Izbicki, 1983). The Eocene-aged La Jolla Group in the region is composed of marine sedimentary rocks represented by six formations (Izbicki, 1983; Kennedy and Tan, 2007; Kennedy and Tan, 2008); however, in the basin, only the Delmar Formation, a massive marine mudstone, and the soft, friable Torrey Sandstone (Hargis, 2004) are present.

The groundwater basin is filled with Quaternary-aged alluvium which extends from the mouth of the San Dieguito River to the head of Osuna Valley approximately 6.5 miles upstream (Izbicki, 1983). The alluvium typically ranges in thickness from 125 to 180 feet along the axis of the basin, decreasing to less than 50 feet near the basin perimeter (Hargis, 2004; DWR, 2004). The eastern-most basin alluvium is composed of coarse-grained sand and gravel; the western portion has not been well-characterized (Hargis, 2004). Groundwater flow is vertically restricted within shallow and deeper coarse-grained aquifers by a shallow fine-grained, clayey aquitard unit (Hargis, 2004). Well yields have been reported between 700 gallons per minute (gpm) to 1,000 gpm in the upper portion in Osuna Valley. However, downstream in the mid-basin areas, well yields are less than 600 gpm (**Figure 1-4**).



WELLS WITH ESTIMATED PRODUCTION (GPM)

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17-Aug-17

OLIVENHAIN MUNICIPAL WATER DISTRICT

SAN DIEGUITO VALLEY BRACKISH GROUNDWATER DESALINATION STUDY

DRAFT

FIGURE 1-4

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1.4 Groundwater Basins

For the purposes of this investigation, the San Dieguito Valley Groundwater Basin boundary has been modified by Geoscience Support Services, Inc. (GSSI) based on lithology and bedrock geology **Figure 1-1**). The groundwater basin boundaries published in the 2003 DWR Bulletin 118 do not fully consider the relationship between the mapped geology and the extent of water-bearing materials that form the groundwater basin. The basin boundary was placed at the contact between older sedimentary geologic formations and Holocene or Pleistocene alluvium and alluvial fan deposits. The contact between the older geologic units and Quaternary deposits was based upon geologic mapping published by California Geological Survey (CGS) and United States Geological Survey (USGS). The modified San Dieguito Valley Groundwater Basin area is approximately 4,000 acres or 6.25 square miles in size and contains approximately 52,000 to 65,000 acre-feet (AF) of water when full (DWR, 2004).

The basin consists of an upper basin forebay area and middle and lower basin areas. Groundwater recharge occurs mainly in the upper basin forebay area in a generally unconfined sand and gravel aquifer located between Lusardi Creek and the Morgan Run area. The middle and lower basin areas are where a medial clay zone divides groundwater into two aquifers: a shallow upper unconfined aquifer and a deep lower confined aquifer.

Historically, groundwater recharge to the San Dieguito Valley Groundwater Basin was primarily the result of infiltration of surface flow in the stream bottom during the wet season. Groundwater levels in the shallow, narrow groundwater basins in Southern California typically respond quickly to rainfall events. After construction of Hodges Dam in 1918, recharge to the aquifer systems of the San Dieguito Valley Groundwater Basin occurs mainly through infiltration of spills from Hodges Dam. Additional recharge also occurs from irrigation and from the underlying rock formations.

1.5 Surface Waters

There are two major water courses that traverse OMWD’s service area, Escondido Creek and San Dieguito River. Escondido Creek is a part of the Carlsbad Hydrologic Unit, which drains the peninsular mountain ranges east of the Escondido Valley. Creek flows are controlled by dams at Lake Wohlford and Lake Dixon. It flows through the City of Escondido, Harmony Grove, San Elijo Canyon, and the San Elijo Valley to the San Elijo Lagoon and Pacific Ocean. Natural runoff is intermittent and is supplemented with urban and agricultural drainage. Runoff supplies riparian vegetation along the creek and recharges the groundwater basin; any remaining flow discharges into the lagoon.

The current study is focused on the San Dieguito Valley Groundwater Basin, which is fed by the San Dieguito River. The San Dieguito River is a part of the San Dieguito Hydrologic Unit and stretches east to west, originating near Santa Ysabel in the Cuyamaca Mountains. River flows are controlled by the dam at Lake Hodges. The river eventually discharges to the Pacific Ocean through the San Dieguito Lagoon near the communities of Del Mar and Solana Beach. The river is a primary source of recharge for the groundwater basin. Runoff to the study area occurs as seasonal storm flows and base flow in the river as well as spills from the Hodges Dam, which is owned and operated for water supply by the City of San Diego.

Lake Hodges lies within the San Dieguito River watershed with drainage from several hydrologic areas totaling 192,585 acres (about 301 square miles). When full, the reservoir has 1,234 surface acres and a water storage capacity of approximately 30,250 AF. The reservoir was built in 1918 with the construction of Hodges Dam on the San Dieguito River. The City of San Diego purchased the dam and reservoir in 1925. The dominant beneficial use of Hodges Reservoir is as a source of drinking water supply for Santa Fe Irrigation District (SFID) and San Dieguito Water District (SDWD), who jointly retain water rights to the surface water in Lake Hodges through an agreement with the City of San Diego. Following completion of the San Vicente Dam Raise project, SDCWA obtained 20,000 AF of storage rights in Lake Hodges under certain hydrologic conditions. SDCWA recently constructed the Hodges Olivenhain Pumped Storage Project which provides the ability to move additional water out of Lake Hodges, reducing the frequency of spills from the dam.

The Olivenhain Reservoir was put into service in 2003 with the completion of the Olivenhain Dam. The Olivenhain Reservoir has a storage capacity of 24,000 AF and is an important component of SDCWA's Emergency & Carryover Storage Project, which allows water to continue to flow throughout the region even if imported water supplies are disrupted. The Olivenhain Reservoir and Lake Hodges are hydraulically connected as indicated on **Figure 1-5.**

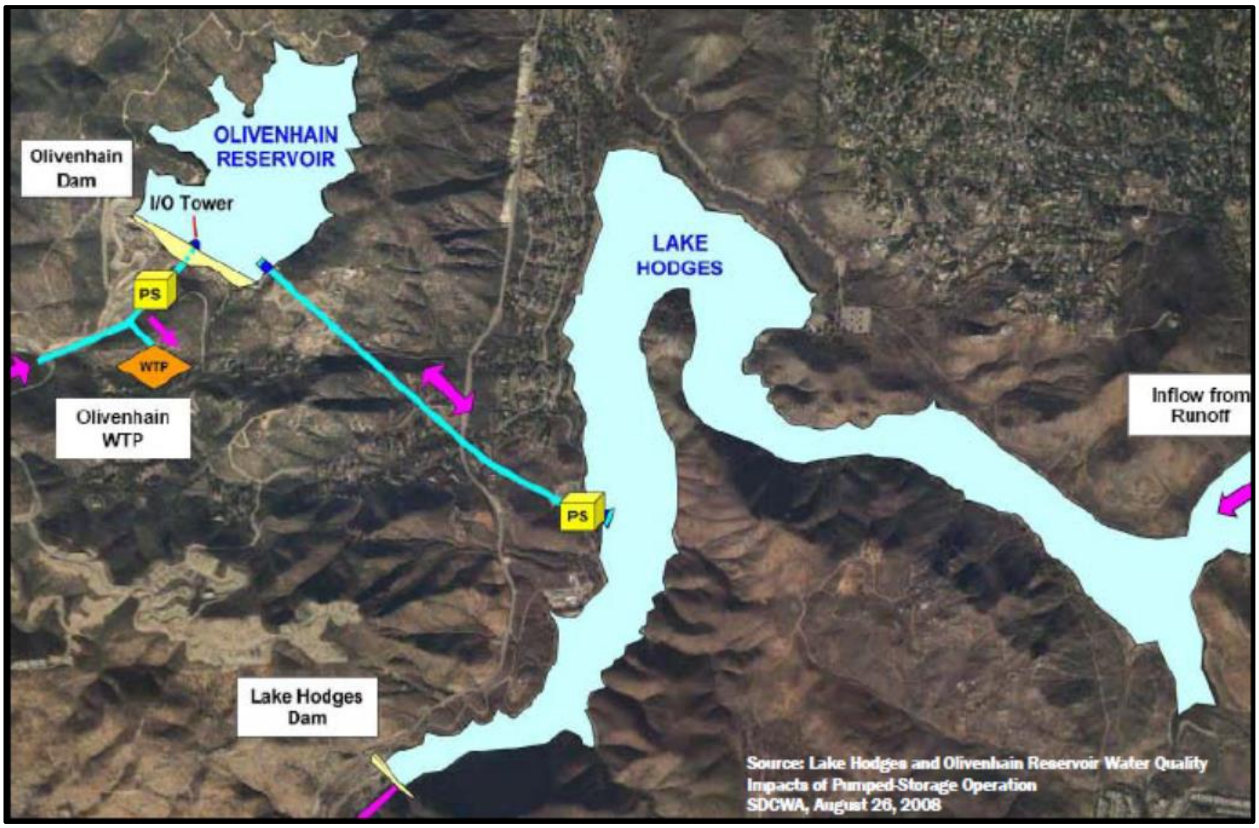


Figure 1-5: OMWD Reservoir Connection to Lake Hodges

SDCWA's Emergency & Carryover Storage Project allows Lake Hodges to be supplemented as needed with imported untreated water supplies from MWD via Pipeline 5 through Olivenhain Reservoir. Water in Lake Hodges can also be pumped to Olivenhain Reservoir, where it could be delivered in turn to Pipeline 5 and/or to the DCMWTP.

1.6 Land Use

In 1970, agriculture accounted for over 70 percent of OMWD's total water use, but this percentage has decreased over the years. Today agriculture represents only 3 percent of the total water demand in OMWD. As agriculture declined, domestic use grew and now accounts for most of the water use.

Residential water use per unit varies significantly, from approximately 100 gallons per day per unit for multi-family residential (MFR) units to approximately 2,000 gallons per day per unit for the inland lower density single family residential (SFR) areas. Accordingly, SFR land use has the highest water demand in acre-feet per year (AFY), as shown in **Table 1-1**.

Table 1-1: Total Water Demand FY 2015

Land Use	Percent	Volume (AFY)
Single Family Residential	64%	13,667
Multi-family Residential	3%	723
Commercial	4%	786
Landscape (includes schools)	12%	2,615
Agriculture	3%	694
Losses	5%	1,064
Recycled Water Irrigation	9%	1,928
TOTAL	**100%**	**21,477**

SOURCE: OMWD UWMP 2015

The projected change in land uses between 2015 and 2050 is estimated to be relatively small both in total numbers and percentage for each land use, as shown in **Table 1-2**.

Table 1-2: Changes in Future Land Use

Customer Class	2015 Units*	%	2020 Units*	%	2035 Units*	%	2050 Units*	%
Single Family Residential (SFR)	21,141	43	21,648	43	22,992	44	23,580	44
Multi-family Residential (MFR)	4,592	9	4,666	9	4,661	9	4,617	9
Commercial	23,439	48	24,065	48	24,801	47	25,418	47
TOTAL	**49,172**	**100**	**50,379**	**100**	**52,454**	**100**	**53,615**	**100**

*SANDAG Series Forecast SOURCE: OMWD UWMP 2015

1.7 Population Growth

OMWD's population is forecasted to increase by about 7,500 people, from 70,522 to 78,014, in the year 2050 as shown in **Table 1-3.**

Table 1-3: Current and Projected Service Area Population

2015	2020	2025	2030	2040	2050
70,522	72,567	74,105	75,918	77,535	78,014

SOURCE: OMWD UWMP 2015

Section 2 Water Supply Characteristics and Facilities

2.1 Agency Jurisdictions

In 1960, OMWD voted to become a member of the SDCWA, which is a member of MWD, thus becoming eligible to purchase imported water from SDCWA aqueducts. Member agency status entitles OMWD to directly purchase water for its needs on a wholesale basis. OMWD is one of the 24 SDCWA member agencies, and shares its imported water supply with all the California south coastal plain. OWMD and other member agencies depend on the SDCWA to plan for and provide a reliable water supply.

San Dieguito Valley Groundwater Basin is an unadjudicated basin. Review of the Statutory Water Rights Law (SWRCB, 2017) suggests that the water rights that govern the pumping of water in a groundwater basin are: rights that were acquired by priority of appropriation initiated before December 19, 1914, commonly referred to as “pre-1914 rights” (see Wells v. Mantes (1893) 99 Cal. 583) and riparian water rights, which are part and parcel of lands contiguous to streams or lakes (see Lux v. Haggin (1886) 69 Cal. 255). Although several provisions of the Water Code imply the existence of these other rights, they are essentially the product of the decisional law of the courts of this State.

Currently, OMWD has no surface or groundwater rights in the basin. OMWD could work with existing water rights holders in the basin to beneficially use the non-potable brackish water from the basin. OMWD could also obtain a water riparian right through purchase of land contiguous to the San Dieguito River. OMWD may have rights to water that it supplies to customers for irrigation that ends up recharging the groundwater.

The San Dieguito Valley Groundwater Basin (No. 9-12) is a very low priority basin per the CASGEM program. Thus, OMWD is not subject to the provisions of the Sustainable Groundwater Management Act (SGMA), which requires groundwater-dependent regions to actively manage their groundwater basins to prevent overdraft by balancing levels of pumping and recharge. The Project is in line with the requirements of SGMA through sustainable groundwater production as verified by hydrogeologic modeling of the basin and conducting a water balance. OMWD is committed to managing the groundwater basin sustainably.

2.2 Sources and Qualities of Supplies

OMWD water supply is made up of 91 percent purchased or imported water from the SDCWA for potable use and 9 percent recycled water for non-potable irrigation as summarized in **Table 2-1**. With limited local water supplies of its own, OMWD is completely reliant on purchased water for its potable water needs. Faced with rising costs, decreasing availability, and uncertain future reliability of this purchased water supply, OMWD is focusing on developing its own local potable water supply through implementation of the Project.

Table 2-1: Water Supplies FY 2015

Water Supply	Use	Purveyor	Percent	Volume (AF)
Purchased or Imported Water	Potable	SDCWA	91%	19,549
Recycled Water	Non-potable irrigation	OMWD, VWD, City of San Diego, SEJPA, Ranch Santa Fe CSD	9%	1,928
TOTAL			**100%**	**21,477**

SOURCE: OMWD UWMP 2015

Besides imported and recycled water, the other supplies of water discussed in this section include the proposed desalinated brackish groundwater supply, desalinated seawater, surface water, stormwater, and exchanges or transfers.

2.2.1 Purchased or Imported Water

In 2015, OMWD purchased 19,549 AF of imported water for distribution in its potable water system, which makes up 100 percent of OMWD's potable water supply. On average, 91 percent of imported water is received through the Colorado Aqueduct and 9 percent through the California Aqueduct. The raw water supply that feeds DCMWTP is usually taken from the SDCWA aqueduct, but can also be obtained from the Olivenhain Reservoir as described in **Section 1.5**. OMWD is completely reliant on purchased water for its potable water needs. Approximately 97 percent of OMWD's potable water is treated at DCMWTP, which has a treatment capacity of 34 mgd. A small amount of treated water is also obtained from the SDCWA, which goes directly into the potable water distribution system.

2.2.2 Recycled Water

In 2015, recycled water delivery to irrigation customers was 1,928 AF or approximately 9 percent of the total water supply. OMWD has two recycled water service areas, the Northwest Quadrant and the Southeast Quadrant, which together cover about 25 percent of OMWD's service area. The production and distribution of recycled water within OMWD's service area is accomplished through production of recycled water at OMWD's 4S Ranch WRF. OMWD also has cooperative interagency agreements to purchase recycled water from the City of San Diego, Rancho Santa Fe CSD, VWD, and SEJPA.

Recycled water is produced at two of the four water reclamation facilities (WRFs) within OMWD's service area: the 4S Ranch WRF and the Santa Fe Valley WRF, as indicated in **Table 2-2**. All effluent from the 4S Ranch WRF and the Santa Fe Valley WRF is recycled and used for irrigation in the Southeast Quadrant. Supplies are supplemented by two metered connections to the City of San Diego's recycled water system.

The Northwest Quadrant recycled water system is currently supplied through agreements with VWD from its Meadowlark Water Reclamation Facility and Mahr Reservoir, and SEJPA from its San Elijo WRF.

Table 2-2: Recycled Water Sources

Recycled Water Source	Owner	Treatment	Recycled Water System	FY 2015 Recycled Water Volume (AF)
4S Ranch WRF	OMWD	Tertiary	OMWD Southeast Quadrant Recycled Water System	1,139
Santa Fe Valley WRF	Rancho Santa Fe CSD	Tertiary	OMWD Southeast Quadrant Recycled Water System	140
Meadowlark WRF and San Elijo WRF	VWD and SEJPA	Tertiary	OMWD Northwest Quadrant Recycled Water System	649
TOTAL				**1,928**

SOURCE: OMWD UWMP 2015

SEJPA, SFID, and SDWD are considering a potable reuse project. Should this project proceed, OMWD may have the opportunity to serve an additional 400 AFY of recycled water.

2.2.3 Groundwater

OMWD does not receive any water supply from groundwater, but has identified the San Dieguito Valley Groundwater Basin as a potential source for potable water supply, which is the focus of this study. Historically, the aquifers of the groundwater basin have been used as a source of groundwater for irrigation by private landowners, but the basin was not developed for municipal supply due to the brackish water quality. Through investigation of the basin, OMWD has determined that it is feasible to desalinate the brackish water to augment the potable water supply. The proposed Project, the focus of this study, is estimated to deliver 1,120 AFY (1.0 mgd) of potable water by 2020.

2.2.4 Desalinated Water

Poseidon Water, in partnership with SDCWA, constructed the Claude "Bud" Lewis Carlsbad Desalination Plant which started production in December 2015. The plant provides 56,000 AFY, approximately 8 percent of San Diego County's supply. OMWD remained a partner in the original agreement with SDCWA-Poseidon but decided not to pursue the offer for additional and separate amounts with Poseidon. OMWD has determined that it is feasible to desalinate the brackish water from the San Dieguito Valley Groundwater Basin to create its own local supply of potable water.

2.2.5 Surface Water

OMWD does not currently use, or plan to use, self-supplied surface water. There is one major water course that traverses the study area, the San Dieguito River, as described in **Section 1.5**. The San Dieguito River has not been developed for municipal supplies because of the brackish water quality, typically low seasonal yield, and low spill volumes from reservoirs.

2.2.6 Stormwater

OMWD does not intentionally divert stormwater for beneficial use. Stormwater in the San Dieguito River upstream of the basin forebay is a source of recharge for the San Dieguito Valley Groundwater Basin as described in **Sections 1.4** and **2.2.3**.

2.2.7 Exchanges or Transfers

OMWD has no existing or planned exchanges. OMWD does not currently control any water resources or major storage facilities of its own and is generally not able to engage in significant exchanges and transfers. OMWD has an agreement with VWD, immediately adjacent to the north, for the sale of treated water services. The agreement term is 20 years and the minimum volume is 2,750 AFY. OMWD notifies SDCWA of the amount of water sold to VWD and SDCWA charges for the raw water costs, so this is not considered an exchange.

2.3 Description of Major Facilities and Existing Capacities

OMWD owns and operates a potable water treatment facility, potable water distribution system, a sewer collections system, a WRF, and three recycled water distribution systems. There are also three major water facilities within OMWD's service area that are owned by community services districts. Two major facilities, located just outside the boundary of OMWD's service area, are also discussed in this section. Please refer to **Figure 2-1** for locations of major treatment facilities.

2.3.1 Water Treatment Facilities

The DCMWTP is a membrane treatment plant that provides local treatment of raw water, purchased from SDCWA through the aqueduct or Olivenhain Reservoir. The DCMWTP began serving potable water in 2002 and can treat up to 34 mgd.

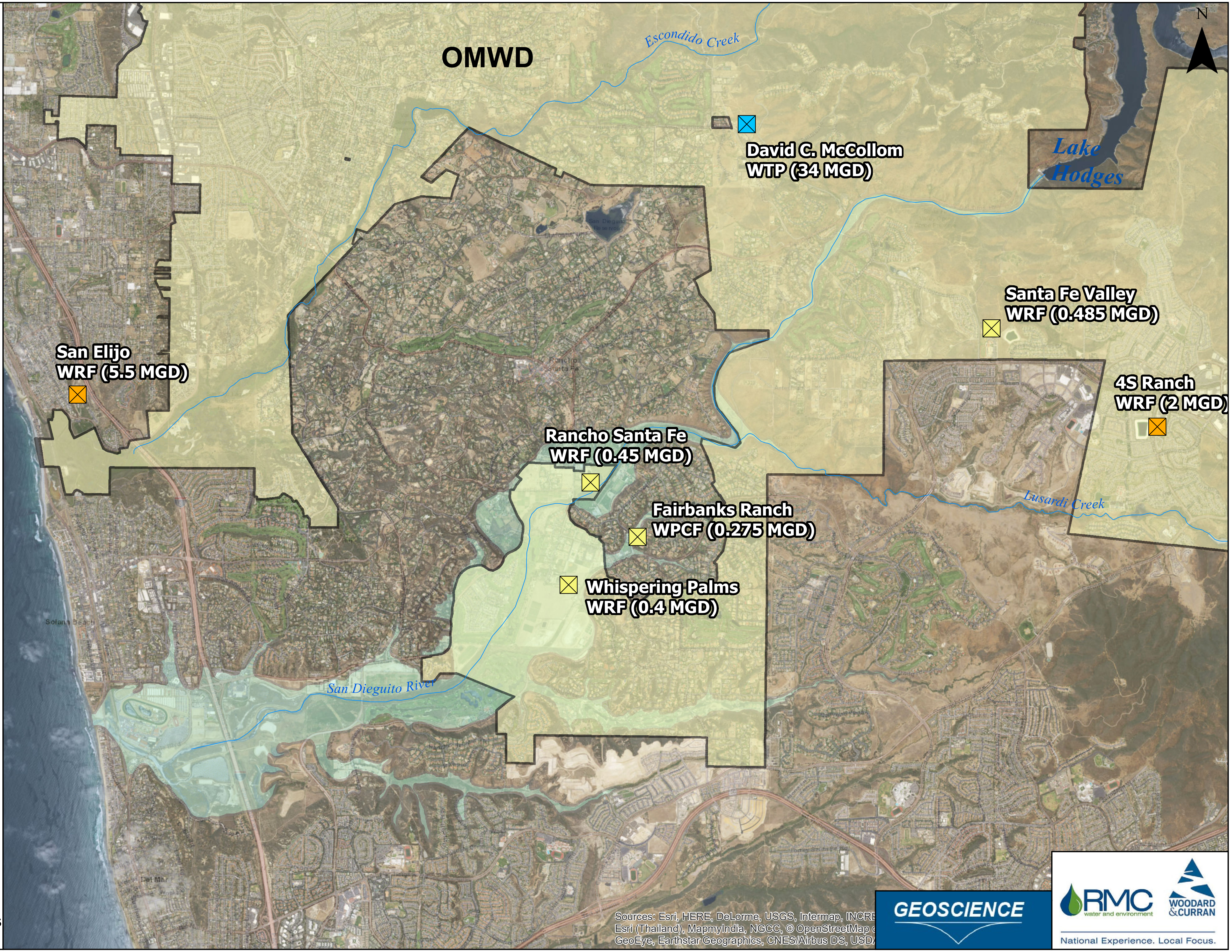
OLIVENHAIN Municipal Water District

FIGURE 2-1 Existing Treatment Facilities

Legend

- Water Treatment Plant
- Water Reclamation Facility
- Comm. Serv. Dist. Water Reclamation Facility
- OMWD Boundary
- San Dieguito GW Basin

0 0.5 1 2 Miles



Date: 10/6/2017

2.3.2 Wastewater Treatment Facilities

Wastewater generated in OMWD is treated in privately-owned septic systems and in wastewater treatment facilities located in or near the OMWD service area. The five major wastewater treatment facilities and capacities are depicted on **Figure 2-1** and summarized in **Table 2-3**.

Table 2-3: Major Wastewater Treatment Facilities and Existing Capacities

Owner | Facility	Treatment	Capacity
OMWD 4S Ranch WRF	Tertiary for resale	2.0 mgd
Rancho Santa Fe CSD[1] Santa Fe Valley WRF	Tertiary for resale	0.48 mgd
Rancho Santa Fe CSD WRF	Secondary treatment, discharge to percolation ponds	0.45 mgd
Whispering Palms CSD WRF	Secondary treatment, discharge to percolation ponds	0.40 mgd
Fairbanks Ranch CSD Water Pollution Control Facility	Secondary treatment, discharge to percolation ponds	0.28 mgd
SEJPA San Elijo WRF	Secondary to ocean outfall, Tertiary for resale	5.25 mgd

1. Community Services District (CSD)

4S Ranch Water Reclamation Facility

The 4S Ranch WRF treats up to 2 mgd of wastewater, with the treated effluent meeting Title 22 tertiary requirements. In July 1998, OMWD assumed responsibility for sewage collection, treatment, and disposal for the 4S Ranch, Rancho Cielo, and a portion of the unincorporated area surrounding them, including Santa Luz North Affordable Housing (10 acres) and Black Mountain Ranch East Clusters (50 acres). In the future, OMWD will provide sewer service to the Heritage Bluffs Development (160 acres) within the City of San Diego. The service area encompasses a total of approximately 5,300 acres. The 4S Ranch WRF is sized to accommodate ultimate buildout of its service area, currently projected at approximately 3,700 single family residences, 1,500 multifamily residences, and 1,900 commercial parcels. Black Mountain Ranch East Clusters will add approximately 90 single family residences and Heritage Bluffs will add approximately 170 single family residences.

Santa Fe Valley Water Reclamation Facility

The Santa Fe Valley WRF is a 0.485 mgd wastewater treatment facility that produces Title 22 tertiary recycled water, which is subsequently sold to and distributed by OMWD for irrigation of local golf courses and other irrigation uses. The service area covers an area of approximately 3,000 acres, known as the Santa Fe Valley Specific Plan Area.

Rancho Santa Fe Water Reclamation Facility

The Rancho Santa Fe WRF has an average flow of 0.350 million gallons per day and a rated capacity of 0.450 mgd, and generally provides treatment services for Rancho Santa Fe and other surrounding communities in the unincorporated areas of the county.

Fairbanks Ranch Water Pollution Control Facility

The Fairbanks Ranch Water Pollution Control Facility treats an average wastewater flow of 145,000 gallons per day (gpd) with a maximum rated capacity of 275,000 gpd. The service boundary encompasses over 1,200 acres located near the intersection of San Dieguito Road and El Apajo, and serves approximately 610 homes, along with the Fairbanks Plaza, the Solana Santa Fe Elementary School, and the Fairbanks Ranch Fire Station.

San Elijo Water Reclamation Facility

Service for the southwestern portion of OMWD is provided by the San Elijo WRF, located in Cardiff By the Sea, where it is treated and disposed of by contract with the SEJPA. Secondary treatment facilities have a capacity of 5.25 mgd. The recycled water utility which includes treatment (both traditional sand filtration and micro filtration/reverse osmosis), disinfection, distribution, and storage has a treatment capacity of 3.02 mgd. SEJPA sells recycled water to OMWD, as well as SDWD, SFID, and the City of Del Mar, for resale to their customers.

2.3.3 Recycled Water Facilities

As described in **Section 2.3.2**, recycled water is produced at two of the four water WRFs within OMWD's service area: the 4S Ranch WRF and the Santa Fe Valley WRF. All effluent from the 4S Ranch WRF and the Santa Fe Valley WRF is recycled and used for irrigation in the Southeast Quadrant. Supplies are supplemented by two metered connections to the City of San Diego's recycled water system.

The Northwest Quadrant recycled water system is currently supplied through agreements with VWD from its Meadowlark WRF and Mahr Reservoir, and SEJPA from its San Elijo WRF.

Southeast Quadrant Recycled Water Distribution System

The Southeast Quadrant Recycled Water Distribution system facilities include a 3 million gallon (MG) recycled water blending reservoir, several pumping stations, a 1 MG water tank, and over 5 miles of recycled water pipeline ranging in size from 8 inches to 20 inches.

The 4S Ranch WRF recycles all wastewater for reuse as non-potable irrigation in golf courses, parks, schools, and greenbelts within developed areas. The 4S Ranch WRF is a 2.0 mgd water reclamation facility and has the capacity to provide sewer collection and Title 22 tertiary level treatment services to ultimate buildout currently projected at approximately 3,700 single family residences, 1,500 multi-family residences, and 1,900 commercial parcels.

Northwest Quadrant Recycled Water Distribution System

OMWD has constructed approximately 2.9 miles of 8- and 12-inch diameter recycled water pipelines within existing streets in the northern portion of the City of Encinitas and the southern portion of the City of Carlsbad as part of the "Northwest Quadrant (NWQ) Recycled Water Pipelines Project," which provides recycled water from VWD's Mahr Reservoir. In anticipation of future recycled water service, OMWD has previously installed or required developers to install pipelines in the NWQ that eventually became dedicated recycled water services. In 2014, OMWD added a second supply for this system from SEJPA. In 2015, VWD provided 360 AF and SEJPA provided 140 AF of recycled water for irrigation uses in the NWQ.

Village Park Recycled Water Distribution System

The Village Park Recycled Water Project is in the Village Park area of the City of Encinitas and bounded by Via Cantebria on the west and Glen Arbor Drive and Willowspring Drive on the east. The three-phase project consists of the construction of approximately 30,000 LF of 12-, 10-, 8-, 6-, and 4-inch recycled water pipeline and all related appurtenances, installation of a packaged pump station, pump station electrical service, SCADA system improvements, abandonment and/or removal of portions of existing pipeline, and all related landscape and paving improvements to return the area to the preconstruction condition (OMWD, 2017).

The Village Park Recycled Water Project was completed in 2016. The project distributes approximately 220 AFY of recycled water within the Village Park Community of the City of Encinitas. To supply its recycled water distribution system, OMWD recycled every drop of wastewater entering the 4S Ranch WRF and has agreements with VWD, the City of San Diego, Ranch Santa Fe CSD, and SEJPA for additional supply.

2.4 Water Use Trends

For almost 50 years following its founding in 1959, total water demands in the OMWD service area trended upwards as lands developed and population increased. Annual potable demands peaked in fiscal year 2008 at approximately 25,000 AF. After 2008, potable demands have declined in response to economic recession, price increases, the use of recycled water, drought restrictions, and increased adoption of water conservation measures. These factors have combined to produce a fundamental downward shift in per capita water use, with usage rates declining by almost 30 percent from 2007 to 2013 (**Table 2-4**). Per capita use reached a minimum during the period from 2010 to 2012 in response to economic recession, cooler than normal summer weather, and other impermanent conditions (WMP, 2015).

Table 2-4: Historical and Current Use

Fiscal Year	Population	Potable Deliveries (AF)	Per Capita Use (gpcd)
1995	39,111	12,230	279
1996	39,478	14,429	325
1997	40,153	15,234	339
1998	41,356	13,680	295
1999	42,590	16,165	339
2000	43,712	19,433	396
2001	49,965	18,586	332
2002	52,740	21,730	368
2003	55,121	21,425	347
2004	57,364	23,690	368
2005	57,248	21,052	328
2006	58,480	22,561	344
2007	62,006	24,613	354
2008	64,949	24,885	341
2009	65,505	23,455	320
2010	67,288	19,992	265
2011	67,986	18,440	242
2012	69,946	19,305	246
2013	69,245	20,887	269
2014	70,066	22,088	281
2015	70,522	19,549	247

SOURCE: OMWD WMP 2015

The following tables summarize the projected water demand and supply through 2040. Demands for raw and potable water are summarized in **Table 2-5**, not including recycled water.

Table 2-5: Projected Retail Demands

Use Type	Projected Water Use				
	2020	2025	2030	2035	2040
Single Family	14,160	14,410	14,490	14,900	14,720
Multi-Family	730	730	740	740	730
Commercial	780	780	790	790	800
Landscape	2,500	2,540	2,560	2,630	2,630
Agricultural irrigation	720	720	720	720	720
Temp. Construction Meters	20	20	20	20	20
Non-Revenue Water, including actual losses	1,520	1,520	1,520	1,570	1,560
TOTAL	**20,400**	**20,720**	**20,840**	**21,370**	**21,250**

SOURCE: OMWD UWMP 2015

Projected water supplies are summarized in **Table 2-6**, including the projected supply from the Project. The desalinated groundwater supply offsets the purchase of imported water by an estimated 1,120 AFY.

Table 2-6:Projected Water Supplies

Water Supply	Projected Water Supply				
	2020	2025	2030	2035	2040
Purchased or Imported Water	20,400	19,600	19,720	20,250	20,130
Desalinated Groundwater	0	1,120	1,120	1,120	1,120
TOTAL	**20,400**	**20,720**	**20,840**	**21,370**	**21,250**

SOURCE: OMWD UWMP 2015

2.5 Future Facility Needs

Actions to Encourage and Optimize Future Recycled Water Use Mandatory Use and Financial Incentives California's Recycling Law (California Water Code (CWC) § 13500 et seq.) establishes a policy to encourage the use of recycled water and provides that the use of potable domestic water for the irrigation of green belt areas, cemeteries, golf courses, parks, and highway landscaped areas constitutes an unreasonable use of water where recycled water is available for such uses. Among other provisions, CWC § 71610 and 71611 authorize OMWD to provide and sell recycled and non-potable water within OMWD's service area. It is the policy of OMWD's Board of Directors to encourage and mandate the development of recycled water and non-potable water within OMWD's service area to meet the growing demand for water.

To promote the use of recycled water by its customers, OMWD adopted Non-Potable Water Ordinance 173 that requires new irrigation and other qualifying customers to use recycled water when and where available. Conditions of the ordinance are incorporated into detailed “conditions of service” agreements that OMWD signs with new customers. The agreements stipulate that when recycled water is available, the users shall retrofit their facilities to utilize recycled water. OMWD also requires the installation of recycled water use when the water is available. The cost of recycled water is currently approximately 93 percent of the Tier 2 cost of treated water used for irrigation and 75 percent of the Tier 2 cost used for non-irrigation, and recycled water customers pay reduced capacity fees.

For developments constructed in OMWD’s service area before Ordinance 173, the financial means to retrofit systems for recycled water may not be readily available. To facilitate such retrofits, OMWD’s Board of Directors established the Recycled Water Loan Program. The loan provides the initial capital to start the retrofit project and requires the funds to be paid back to OMWD. Customers continue to pay the potable cost for water and the difference between the recycled rate and potable rate is used to pay off the loan. Recently, some customers have covered the installation and conversion costs involved specifically to take advantage of the lower cost and drought-proof supply.

District Recycled Water Projects

Building on its existing recycled water projects, OMWD is undertaking or planning several additional projects to further expand recycled water use and reduce potable water use in its service area. Planned OMWD projects are listed and described in **Table 2-7**.

Table 2-7:Projects to Expand Future Recycled Water Use

Project	Description	Planned Implementation Year	Recycled Water Demand (AFY)
Diegueño Middle School	Extension of Northwest Quadrant recycled water system - site conversion, athletic fields and landscape irrigation. Joint project with VWD.	2017	7
Villanitas, Summit	Conversion of two HOAs to Village Park recycled water distribution system. Common area and landscape irrigation. Joint project with SEJPA.	2020	9
Manchester Avenue Phase I	Pipeline extension, site conversions, landscape irrigation. Joint project with SEJPA.	2020	14
SD Polo Club	Pipeline extension, turf and landscape irrigation	2020	80
Manchester Avenue Phase II	Pipeline extension to Phase I, site conversions, and landscape irrigation. Joint project with SEJPA.	2025	30
Extension 153 Phase I	Pipeline extension, site conversions, common area and landscape irrigation.	2025	189

SOURCE: OMWD UWMP 2015

Regional Recycled Initiatives

In addition to OMWD's efforts, agencies throughout San Diego County are presently in an intensive phase of water recycling planning and construction. OMWD is coordinating its recycling planning activities with the North San Diego Water Reuse Coalition and SDCWA. Additional information on area wide recycling planning is set forth in SDCWA's UWMP.

2.6 Groundwater Management

A key challenge for additional groundwater development and management in the basin remains the development of an ongoing monitoring program of groundwater levels, groundwater quality, and a recordation of ongoing pumping from domestic and agricultural users. The recent hydrogeologic study used several methodologies to assess the historical use of groundwater in the basin. Previous investigators determined annual historical pumping to be between 1,335 AFY to 2,235 AFY; however, further evaluation of existing groundwater pumping is warranted. Groundwater extracted from portions of the basin is not suitable for some landscape irrigation due to brackish quality; therefore, extraction is proposed for higher salinity portions of the basin that have reported well capacities appropriate for project extraction goals. In the future, management of the groundwater basin can be conducted through the use of a groundwater audit, in which stakeholders report groundwater pumping and groundwater levels and work collaboratively to ensure that basin users extract groundwater sustainably considering groundwater levels, groundwater quality, and surface water flows.

2.7 Present and Future Water Costs

Currently, MWD owns the infrastructure that delivers water to SDCWA, who wholesales the water to local water agencies. The costs of maintaining the infrastructure are a large factor in the cost of water. Thus, wheeling charges are significant. SDCWA's fixed charges are allocated to its 24 member agencies based on each agency's historical water deliveries. The untreated purchased wholesale water cost is expected to increase 3.7 percent starting January 1, 2018. The total purchased water wholesale cost increases will vary, depending on each member agency's share of SDCWA fixed charges.

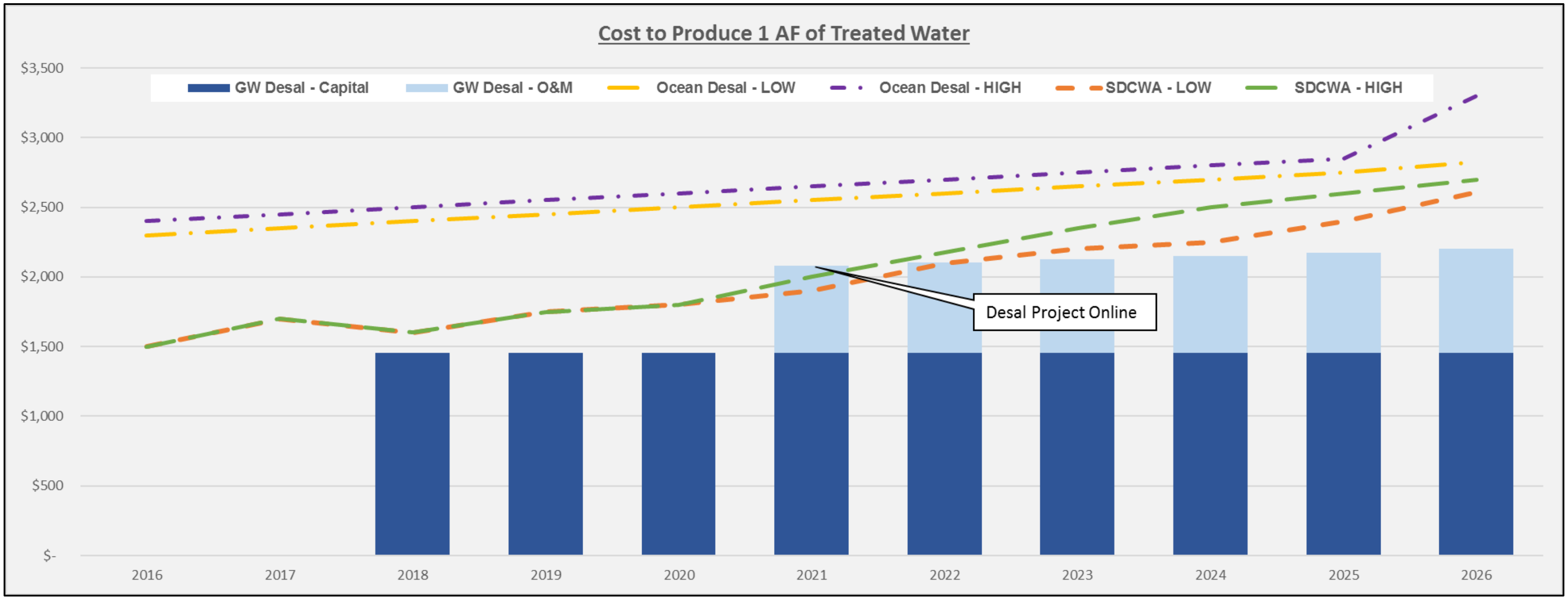
Raw water from SDCWA is treated at OMWD's DCMWTP. The costs for OMWD to produce treated potable water at DCMWTP are summarized in **Table 2-8**.

Table 2-8: Cost to Produce 1 AF of Potable Water at DCMWTP

	2015	2016
SDCWA Raw Water Cost Per AF	$748	$772
OMWD Treatment Cost per AF	$501	$547
SDCWA Wheeling Cost per AF	$99	$103
Total Cost to Produce 1 AF of Treated Water	**$1,349**	**$1,423**

As a comparison, the 2016 price of SDCWA's treated water is approximately $1,500 per AF and is projected to range between $1,900 and $2,100 per AF in the year 2021 as shown in **Figure 2-2.**

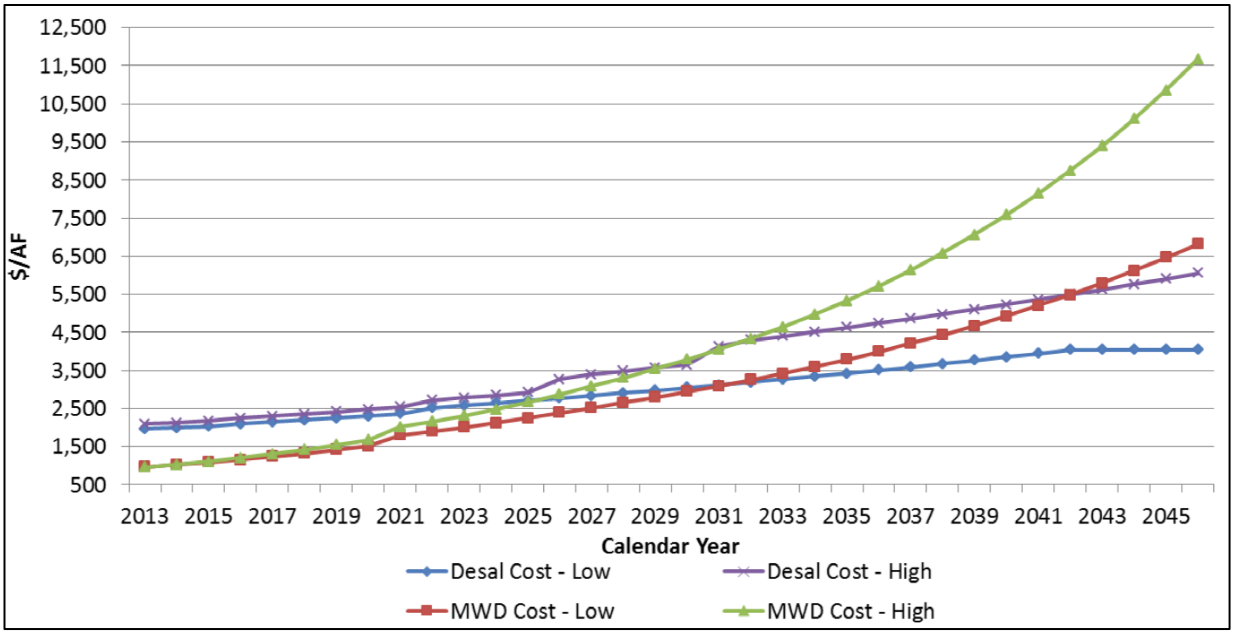
Assuming the same percentage rates of increase, rates in 2022 would range from a low of approximately $2,100 per AF to a high of approximately $2,200 per AF.



SOURCE: HTTP://WWW.SDCWA.ORG/SITES/DEFAULT/FILES/FILES/WATERMANAGEMENT/DESAL/SPECIAL%20BOARD%20MEETING%20DESAL%20BOARD%20MEMO%2011-21.PDF

Figure 2-2: Cost Comparison to Produce 1 AF of Treated Water

As another comparison, the unit cost of desalinated water from the Claude "Bud" Lewis Carlsbad Desalination Plant in Carlsbad is expected to be approximately $2,500 to $2,600 per AF in 2022 as shown in **Figure 2-3** (SDCWA, 2012).



SOURCE: SDCWA BOARD MEMO 2011-
HTTP://WWW.SDCWA.ORG/SITES/DEFAULT/FILES/FILES/WATERMANAGEMENT/DESAL/SPECIAL
%20BOARD%20MEETING%20DESAL%20BOARD%20MEMO%2011-21.PDF

Figure 2-3: SDCWA Desalinated and MWD Treated Water Rate Forecast

2.7.1 Customer Prices

For current customer prices see **Appendix A.**

2.8 Subsidies

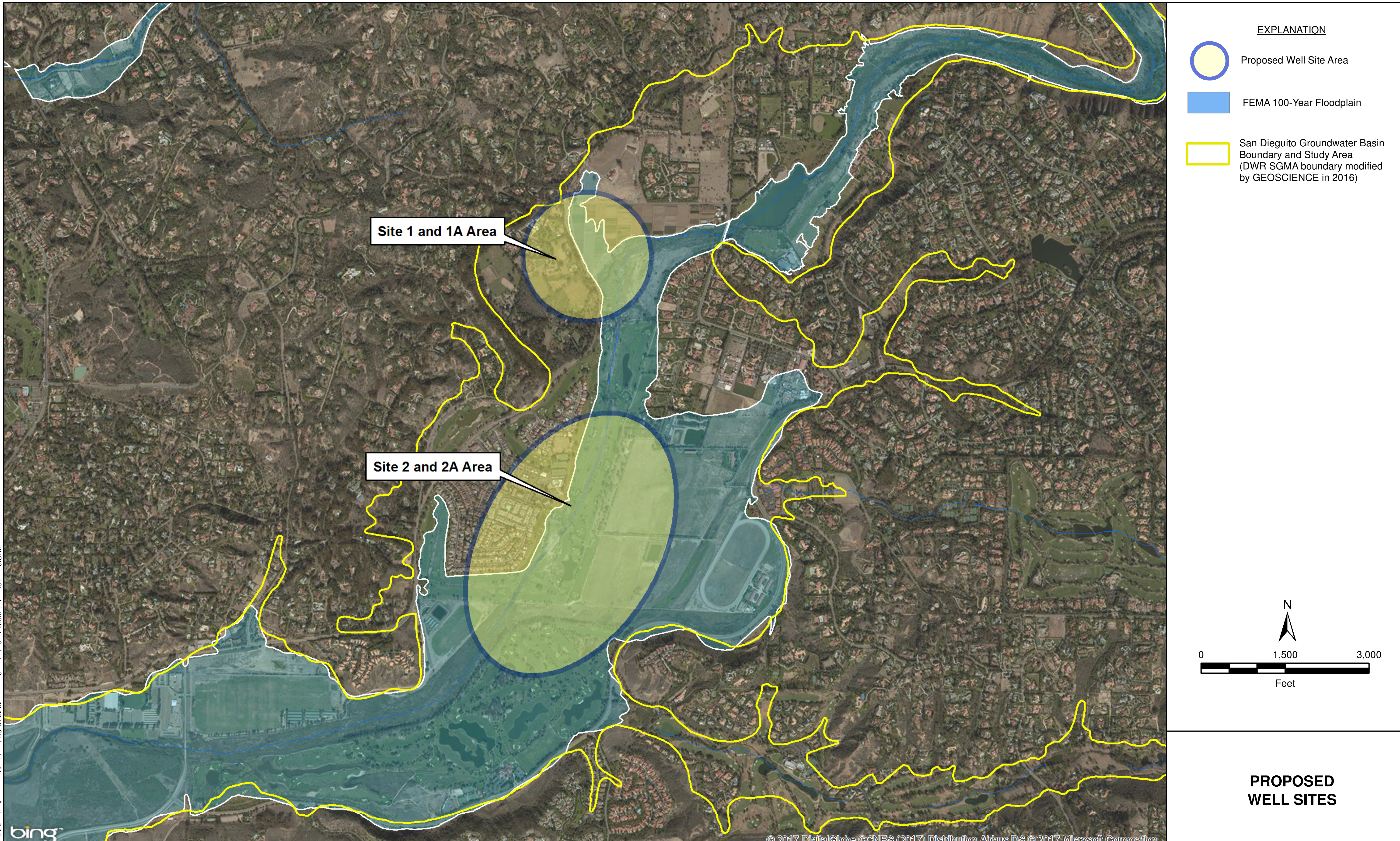
OMWD does not have any subsidies.

Section 3 Potential Desalination Water Source Characteristics

Groundwater extracted from the San Dieguito Valley Groundwater Basin is the source of water being considered for desalination. The groundwater basin is recharged from surface infiltration of storm and base flow in the San Dieguito River, seasonal rainfall, occasional spills from Lake Hodges, underflow from the adjacent hills, and infiltration of treated wastewater from percolation ponds. Extraction wells would be screened in the lower aquifer located below an aquitard thus eliminating influence from surface water.

3.1 Types and Locations of Potential Sources of Water

The source of water for the Project will be groundwater. Two areas for extraction from the San Dieguito Valley Groundwater Basin have been considered located mid-basin: Site 1 and 1A area; and Site 2 and 2A area, as shown in **Figure 3-1**.



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22-Sep-17

PROPOSED WELL SITES

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FIGURE 3-1

OLIVENHAIN MUNICIPAL WATER DISTRICT

HYDROGEOLOGIC STUDY OF THE SAN DIEGUITO VALLEY BRACKISH GROUNDWATER DESALINATION STUDY - SUSTAINABLE YIELD ASSESSMENT

GEOSCIENCE

3.2 Water Quality

Table 3-1 presents water quality data for the source areas that are being considered for the brackish water treatment plant. Groundwater quality data was sampled from eight groundwater wells within the San Dieguito Valley Groundwater Basin, as indicated on **Figure 3-2**. TDS values range from 631 to 4045 milligrams per liter (mg/L). The Morgan Run groundwater quality was chosen as a conservative basis for the conceptual design of the groundwater desalter since the key water quality parameters are slightly above the average of all well sites. Average TDS values from recent water samples from Morgan Run wells were measured at 3,105 mg/L.

Table 3-1: Groundwater Quality by Well Site

Parameter	Unit	River Estates	Surf Cup	Morgan Run	Chino	Horizon Prep	Fairbanks Ranch	Via De Santa Fe	Whispering Palms	Average
Alkalinity, Total	mg/L as CaCO3	270	432	340	210	130	410	----	----	**299**
Ammonia as N	mg/l	0.31	0.783	ND-0.13	0.415	ND	0.330	0.620	2.34	**0.800**
Barium	mg/l	0.01	ND-0.124	0.08	0.096	0.13	0.279	0.113	0.256	**0.14**
Calcium	mg/l	159	270	305	177	76	418	172	201	**222**
Chloride	mg/l	520	1615	1160	620	100	1660	660	1070	**926**
Fluoride	mg/l	0.179	0.460	0.341	0.174	0.467	0.319	0.294	3.21	**0.680**
Hardness	mg/l as CaCO3	689	1285	1475	802	311	2000	774	1020	**1044**
Iron	mg/l	2.8	ND-1.940	ND	2.95	0.024	61.6[1]	2.89	2.62	**1.7**
Magnesium	mg/l	75	163	167	86	30	234	43	124	**115.2**
Manganese	mg/l	1.7	1.175	1.75	2.075	0.0037	4.05	1.83	1.27	**1.73**
Nitrate as N	mg/l	ND	2.33	1.485	ND-0.22	0.63	ND	ND	ND	**1.48**
pH (lab)	-----	7.4	7.2	7.2	7.3	8.0	7.0	----	----	**7.34**
Phosphorus, Total	mg/l	0.1	0.5	0.1	0.1	ND	2.9	0.2	0.4	**0.606**
Potassium	mg/l	7.8	40.0	ND-9.56	6.1	5.3	21.2	----	20.6	**16.8**
Silica (as SiO2)	mg/l	-----	31	31	27	10	40	----	----	**27.8**
Sodium	mg/l	279	895	622	346	110	776	333	651	**501**
Strontium	mg/l	0.73	ND	ND	ND	1.13	-----	ND	1.39	**1.08**
Sulfate as SO4	mg/l	320	768	822	453	274	814	372	525	**543**
TDS	mg/l	1610	4045	3105	1780	631	3990	1750	2760	**2459**
Turbidity	NTU	30.3	5.54	0.31	21.2	0.19	535[1]	26.4	30.6	**16.4**

(1) Iron and Turbidity data for Fairbanks Ranch excluded from average due abnormally high values.

OLIVENHAIN
Municipal Water District

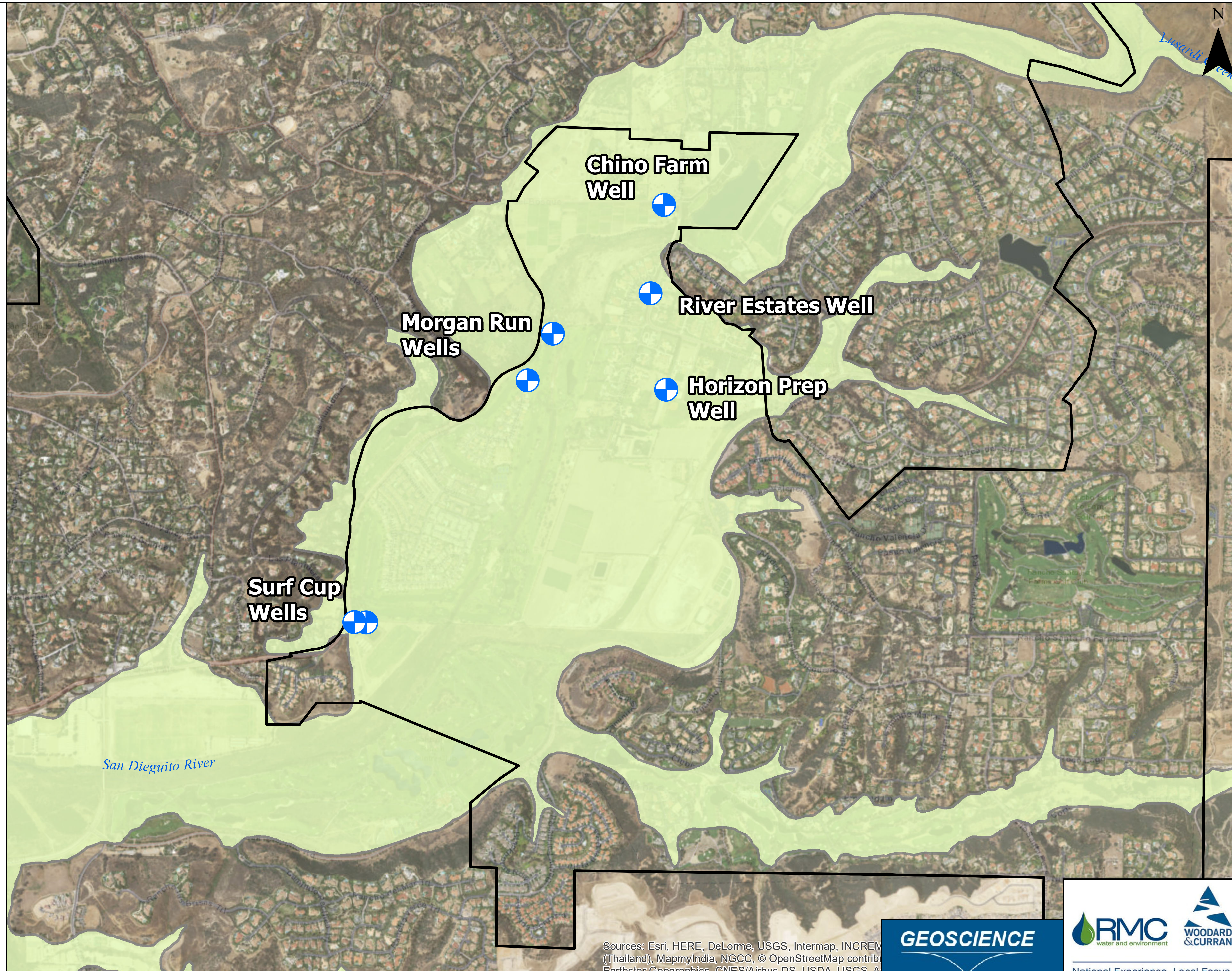
FIGURE 3-2 Groundwater Quality Sampling Wells

Legend

GW Quality Well

OMWD Boundary

San Dieguito GW Basin



0 0.2 0.4 0.8 Miles

Date: 10/6/2017

3.3 Characteristics of Groundwater Aquifers Affected by the Project

The San Dieguito Valley Groundwater Basin, like many of the coastal groundwater basins in southern California, is composed of a two-aquifer system separated by an aquitard. The aquitard is present from the coast to an approximate distance of five miles inland. Seawater intrusion into the San Dieguito Valley Groundwater Basin because of inland agricultural pumping was documented to have occurred in the 1960s (Izbicki, 1983). Inland agricultural pumping reduced groundwater levels to below sea level resulting in an inland flow of seawater.

The upper unconfined aquifer ranges in thickness from 35 to 104 feet, while the lower confined aquifer ranges in thickness from 5 to 76 feet. Brackish water extraction wells will be screened in the lower confined aquifer. The well(s) will be sealed through the upper aquifer and the aquitard that separates the aquifers. There is very limited data from controlled pumping tests in the basin; however, data from previous investigations indicated that the aquifer has a transmissivity that ranges from approximately 12,000 gallons per day per foot of drawdown (gpd/ft) to 20,000 gpd/ft near the western edge of the mid-basin area to 82,000 gpd/ft to 112,000 gpd/ft near the center of the mid-basin area.

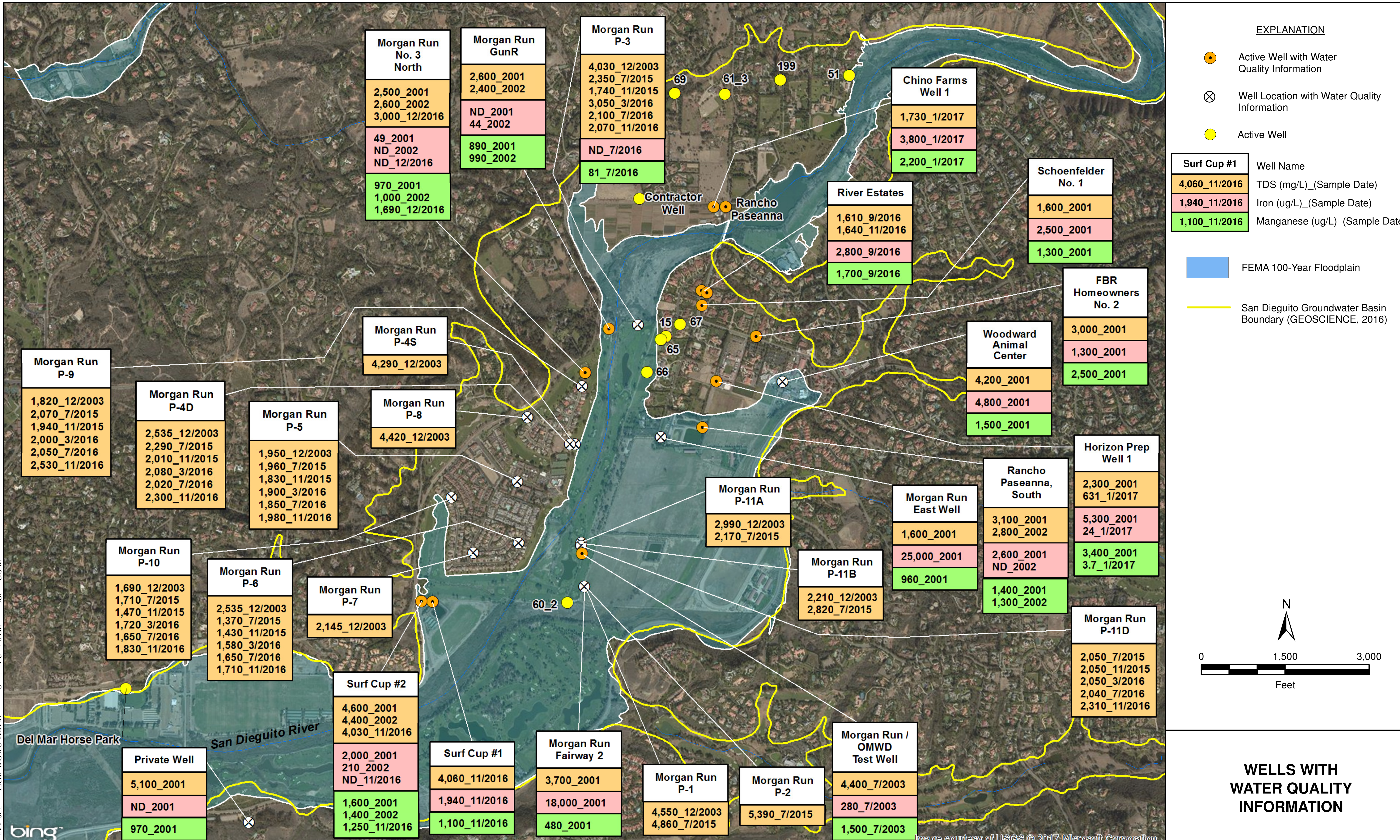
According to the USGS, historically, groundwater levels have been near the ground surface with groundwater moving westward toward the ocean (Ellis and Lee, 1919; DWR, 1959). By 1957, pumping depressions had created an inland flow of seawater (DWR, 1959). In 1965, groundwater levels reached a low of 49 feet below sea level or approximately 90 feet below land surface (Izbicki, 1983). Water-level contours showed that the gradient in the alluvium had been reversed and water moved inland from the Pacific Ocean to the mid-basin area at the south end of Osuna Valley.

From 1979 through 1983, USGS reports that water levels at one well in the central part of the basin ranged from about 1 to 5 feet below ground. By 2003 and 2004, a pumping depression continued to exist in the lower aquifer in the mid basin area near the intersection of El Apajo and Via De Santa Fe. A pumping depression appears to also be in the upper aquifer (unconfined) centered further south near the northern end of the Fairbanks Country Club.

Per the USGS, from observations made of water quality data from 1949 to 1981, total dissolved solids (TDS) exceed 1,000 mg/L and have been observed as high as 2,090 mg/L (Izbicki, 1983). In 1981 and 1982, water quality data for the San Dieguito River were updated. Two samples were collected, one during autumn to reflect baseflow and another during the recessional flow of a late spring storm. More recent electrical conductivity measurements of surface water made by Hargis and Associates indicate that surface TDS concentrations were 1,200 and 620 mg/L, respectively, reflecting the difference between baseflow and stormflow. Although historical TDS concentrations as low as 700 mg/L have been reported in the forebay area located in the Osuna Valley, natural surface flow typically has higher TDS concentrations.

Currently, the TDS in the aquifer is greatest near the coast becoming slightly less brackish inland. Where the aquitard terminates, the aquifers merge and receive direct recharge from surface flow in the San Dieguito River, from precipitation, and from spills from Lake Hodges located at the northern boundary of the groundwater basin providing a fresh component to the basin. The TDS component in the forebay area remains above 1,600 mg/L.

Groundwater TDS concentrations in the larger study area are shown on **Figure 3-3.**



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17-Aug-17

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FIGURE 3-3

OLIVENHAIN MUNICIPAL WATER DISTRICT

SAN DIEGUITO VALLEY BRACKISH GROUNDWATER DESALINATION STUDY

GEOSCIENCE

3.4 Sustainability of Groundwater Sources

A focus of the recent hydrogeological investigation was to evaluate the availability of a sustainable increment of groundwater from the basin. The evaluation of a potential sustainable increment included initially determining basin inflow and outflow terms and preparing a hydrologic water balance for the San Dieguito Valley Groundwater Basin. The result of the water balance was compared to the water balance completed using a calibrated groundwater model. The groundwater model simulated several pumping scenarios as summarized in **Table 3-2**.

Table 3-2: Groundwater Model Scenario Summary

Pumping Scenario	Well Site Area
1,600 acre-ft/yr (1.4 mgd)	Sites 1 and 1A
1,985 acre-ft/yr (1.8 mgd)	Sites 1 and 1A
1,600 acre-ft/yr (1.4 mgd)	Sites 2 and 2A
2,000 acre-ft/yr (1.8 mgd)	Sites 2 and 2A

The modeling showed that average extractions of up to 1,350 AFY at Sites 2 and 2A can be completed while sustainably managing groundwater levels in the basin with minimal change in storage. 1,350 AFY is required to produce 1,120 AFY (1.0 mgd) of product water after the desalination process, which accounts for the loss to brine.

The model also concluded that extraction of brackish water from the San Dieguito Valley Groundwater Basin benefits water quality overall by removing salts from the groundwater basin and inducing additional seepage and recharge of fresher storm flows with lower levels of dissolved solids. The sustainable yield assessment is presented in its entirety in **Appendix B.**

3.5 Characteristics of Coastal Environments

The coastal environment typically associated with conditions at the mouth of southern California streams includes the presence of a coastal lagoon partly the result of the development of a sand spit across the mouth of the stream or river. The sand spit will typically be breached and washed away during high stream flows releasing the lagoon water into the ocean along with storm flow from the stream. Hydrogeologically, the groundwater quality in the shallow aquifers will be influenced by the presence of standing freshwater or brackish lagoon water, while the lower aquifers are typically separated vertically from the influence of seasonal lagoon conditions. Groundwater pumping at the coast in shallow aquifers may influence the lagoon water levels and water quality. The study area, however, is greater than 2.4 miles from the coast east of El Camino Real, and extending up to Hodges Dam at the northern boundary of the study area. The proposed brackish water extraction wells will be screened in the lower aquifer at distances between 3.5 miles and 4 miles from the coast, which do not affect lagoon levels.

A water balance from the groundwater model was prepared for each modeling scenario and showed that pumping from the lower aquifer will increase groundwater outflow in the lower aquifers by inducing additional seepage into the shallow aquifer.

Section 4 Potential Brine Disposal Area Characteristics

The proposed Project will produce approximately 0.19 mgd of brine that will need to be managed and/or disposed. Several brine disposal alternatives were considered, as discussed in **Section 5.2.3.** This section provides an overview of the preferred option to dispose brine into coastal waters via the San Elijo Ocean Outfall (SEOO). This section discusses general institutional and environmental characteristics of disposing brine via an ocean outfall. See **Figure 6-1** for a Project map.

4.1 San Elijo Ocean Outfall

There are two options to connect to the SEOO: 1) Connect directly to the SEOO at the San Elijo WRF; or, 2) Connect further upstream to the City of Escondido Land Outfall (ELO). Currently the SEOO maintains a total capacity of 25.5 mgd, where SEJPA's capacity is 5.35 mgd and the City of Escondido's capacity is 20.15 mgd (SEJPA, 2015).

The original SEOO was commissioned in 1965 to discharge treated effluent from the San Elijo WRF, formally known as the San Elijo Water Pollution Control Facility. In 1974, the SEOO was extended to its current length of 8000 feet, and the City of Escondido Hale Avenue Resource Recovery Facility (HARRF) was connected to the SEOO via the 14-mile Escondido Land Outfall (ELO). The SEOO is co-owned by the City of Escondido and SEJPA, with the City of Escondido owning 79 percent of the outfall capacity and SEJPA owning the remaining 21 percent. The hydraulic capacity of the SEOO is 25.5 mgd for discharge of treated effluent from San Elijo WRF and HARRF. SEJPA's National Pollution Discharge Elimination System (NPDES) permit, however, limits SEJPA's discharge flow to the outfall to an average flow of 5.25 mgd, and the City of Escondido's NPDES permit currently limits the City's discharge to the SEOO to 18 mgd (RWQCB, 2010a, 2010b). The current combined permitted discharge flow to the SEOO is 23.25 mgd.

The ELO is owned by the City of Escondido and consists of pipelines that vary from 30 to 36 inches in diameter. The land outfall roughly parallels Escondido Creek in a 20-foot-wide easement and operates under gravity flow to a point near Lone Jack Road in Olivenhain. From that point to the land outfall's connection with the ocean outfall, the pipeline flows under pressure. The junction of the ELO and the SEOO is located just west of Interstate 5 (I-5) and north of the San Elijo Lagoon. The hydraulic design capacity of the ELO is reported at 27.6 mgd. Discharge from the ELO into the downstream SEOO is limited to 24.3 mgd by a flow-regulating valve.

The SEOO pipeline has a 30-inch internal diameter from the junction with the ELO to a point 4,000 feet west of the beach. Operating capacity of the SEOO is limited by a design pressure limitation in the inshore 30-inch diameter section. At the terminus of the 30-inch diameter section, the outfall turns south and parallels the beach for 200 feet in a 48-inch diameter pipeline. The pipeline then turns west and extends an additional 4,000 feet into the ocean. The last 1,200 feet of the SEOO consists of the underwater diffuser, located at an approximate water depth of 150 feet about 1.5 miles offshore.

4.2 Environmental and Institutional Considerations

To dispose brine via the SEOO, OMWD would be required to secure capacity through agreements with either SEJPA or the City of Escondido. SEJPA maintains 5.35 mgd capacity and the City of Escondido maintains 20.15 mgd (SEJPA, 2015). Preliminary discussions with SEJPA and the City of Escondido indicate that both are open to future discussions regarding accepting brine at a rate of 0.19 mgd from the Project.

There are existing capacity issues in the SEOO during peak wet weather events. Due to the increased inflow and infiltration to the SEOO during periods of rain, the brine capacity agreement could contain restrictions on discharge such as a requirement to stop brine discharge completely during periods of prolonged heavy rain.

Escondido is addressing existing capacity issues through implementing water recycling projects. The City of Escondido is in the process of pursuing an advanced water treatment facility to maximize non-potable and potable reuse. When implemented, the City of Escondido would be able to replace the flow of effluent to the ELO with a smaller, more concentrated, volume of brine from the advanced water treatment facility and an industrial brine collection system. The timing of these projects is not yet known.

Each discharger to the SEOO is subject to NPDES permits from the San Diego RWQCB (Region 9); SEJPA via Order No. R9-2010-0087 (NPDES CA0107999) and the City of Escondido via Order No. R9-2010-0086 (NPDES CA0107981). OMWD would be required to apply for and obtain a NPDES permit for the brine discharge, which would contain effluent limitations, pre-treatment requirements, and a monitoring and reporting program.

Section 5 Project Alternatives Analysis

5.1 Planning and Design Assumptions

This feasibility study process began in 2016, however development of the Project concept occurred over many years. As part of the effort to develop alternatives, previous data and studies were collected and analyzed. To supplement previous studies, a hydrogeologic investigation was performed, including analyzing existing pumping and water quality data from existing wells in the vicinity. In addition, new samples from existing wells were collected and analyzed to get up to date information on water quality. The hydrogeologic study, performed by Geoscience Support Services Inc., is included in its entirety in **Appendix B** and **Appendix C.**

Once sufficient data on water quality parameters were established, the treatment plant planning began by developing pipeline alignments to convey water from the well fields to the groundwater desalter, designing the treatment process train, estimating the size of the required facility, and estimating brine characteristics and disposal options. Hydraulic modeling of the existing water distribution system was also performed to check that the existing potable water distribution system has capacity to accept the new water supply.

5.2 Evaluated Options

Several options were evaluated for siting the wells, siting the desalter, and brine disposal. This section describes the alternatives considered and whether they were feasible for inclusion in project alternatives.

5.2.1 Well Field Location

As an outcome of the hydrogeologic investigation, the updated groundwater model reflected two general locations where groundwater extraction could occur in the San Dieguito Valley Groundwater Basin, as shown in **Figure 3-1**. Each of the two well sites will require a footprint of approximately 10,000 square feet (sf), for a total of 20,000 sf. Wells are estimated to be 18-inch diameter and drilled to depths of 150 to 190 feet.

Well Sites 1 and 1A

Located just south of Calzada de Bosque along Via de la Valle, Well Sites 1 and 1A are within OMWD boundaries and outside the floodplain. Based on the hydraulic model, Well Sites 1 and 1A can produce 1,250 AFY without affecting other wells in the area. Increased production to 1,350 AFY may influence local well drawdown. The model also estimates the travel time for surface flows from where it infiltrates the San Dieguito River to reach Well Sites 1 and 1A to be approximately 99 days. This is primarily due to the aquitard that restricts surface water flows from reaching the lower aquifer. With an estimated travel time of 99 days, it is possible that the groundwater at this site could be under the direct influence of surface water.

Well Sites 2 and 2A

Located along the San Dieguito River west of San Dieguito Road and east of Via de la Valle, Well Sites 2 and 2A are located within OMWD boundaries. This site is located within the floodplain and must be raised in elevation. A hydrological study must be performed to determine the new elevation of the site, as well as determine the bank improvements needed to protect the site from a 100-year storm event. A Letter of Map Revision (LOMR) will also be required to change the Flood Insurance Rate Map (FIRM) by the Federal Emergency Management Agency (FEMA) to remove the parcel from the 100-year floodplain following design of necessary protections. A hydrological study has not yet been performed and an estimated 5 feet of increased elevation was assumed for the cost estimate.

Based on the hydraulic model, Well Sites 2 and 2A can produce 1,350 AFY without affecting other wells in the area. Estimated travel time from the river to Well Sites 2 and 2A is 940 days, which indicates that the groundwater at this site is not under the direct influence of surface water.

Recommended Well Site Alternative for Project Development

Groundwater production of 1.2 mgd (1,350 AFY) is required to produce 1.0 mgd (1,120 AFY) of desalinated product water, accounting for brine and other process losses of approximately 19 percent. Although inside the floodplain, Well Sites 2 and 2A are capable of 1,350 AFY groundwater production with no impacts to local well drawdown. More importantly, the model indicates this location is not under the direct influence of surface water, which simplifies treatment and regulatory requirements. Despite being located in the 100-year flood plain, Well Sites 2 and 2A are the recommended locations for the well field.

5.2.2 Desalination Treatment Plant

Treatment Site Location and Raw Water Conveyance

Two site locations were considered for the desalination treatment plant (desalter), as depicted on **Figure 5-1.** The North site is located east of Via de la Valle, northwest of San Dieguito Road, and south of El Apajo. The South site is located east of El Camino Real, south of Via de la Valle, and north of San Dieguito Road. The required acreage for the groundwater desalter is approximately 0.5 acres.

Both treatment site alternatives are within the 100-year floodplain and must be raised in elevation to build the treatment plant. A hydrological study must be performed to determine the new elevation of the site, as well as determine the bank improvements needed to protect the site from a 100-year event. A LOMR will also be required to change the FEMA FIRM to remove the parcel from the 100-year flood plain following design of necessary protections. A hydrological study has not yet been performed and an estimated 5 feet of increased elevation was assumed for the cost estimate.

Both treatment sites are feasible options; however, the North treatment site is closer to the recommended Well Sites 2 and 2A, which decreases the cost for raw water conveyance pipelines. Both treatment site alternatives are carried forward for further analysis in **Section 5.5**.

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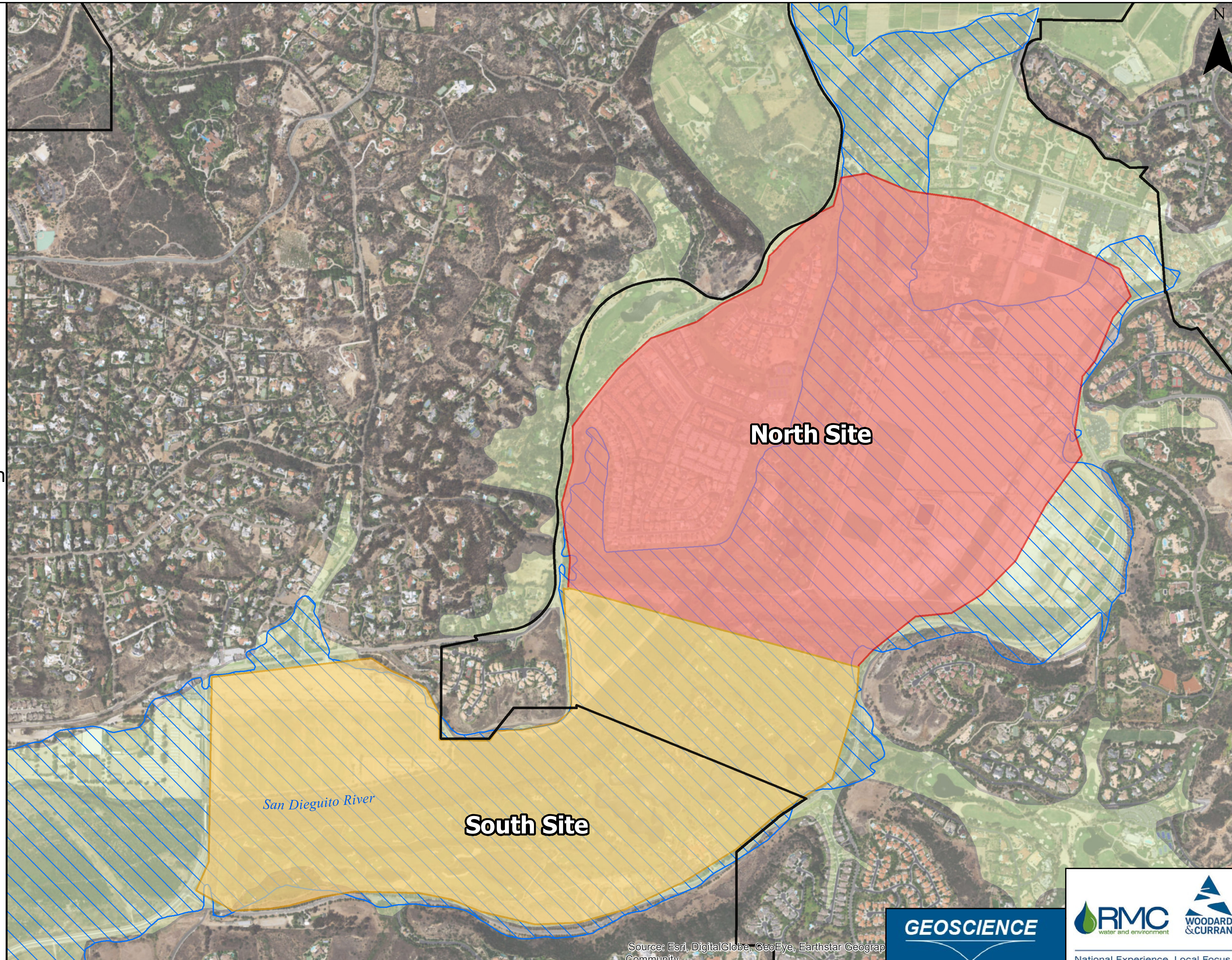
FIGURE 5-1
Treatment Site Alternatives

Legend

- OMWD Boundary
- North Site
- South Site
- Floodplain
- San Dieguito GW Basin

0 0.125 0.25 0.5 Miles



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5.2.3 Brine Management

Multiple brine management alternatives were evaluated for the estimated brine flow of 0.19 mgd. Brine characteristics are projected as follows:

- Flowrate of 0.19 mgd
- TDS range from 16,000 to 18,000 mg/L
- Phosphorous 0.6 mg/L
- Nitrate (as Nitrogen) 1.0 mg/l

Brine discharge will require a 6-inch pipeline for conveyance. Seven brine disposal options were evaluated:

1. Evaporation ponds
2. Live stream discharge
3. Municipal sewer discharge
4. Estuarine discharge to the San Dieguito Lagoon
5. Zero liquid discharge (ZLD)
6. Deep well injection
7. Discharge to coastal waters

Brine disposal alternatives are summarized in the following sections and are shown in **Figure 5-2** Construction of a new ocean outfall for the Project was not evaluated due to projected permitting requirements, construction cost and time to implement.

Evaporation Ponds

The evaporation pond alternative was previously evaluated by OMWD in 2010. Although previously rejected, all brine management alternatives were revisited to verify if conditions have changed. In this approach, brine is pumped to shallow, lined ponds and allowed to evaporate under the influence of solar energy. Once the water is evaporated, the remaining salt is either left in place or trucked off-site. Evaporation ponds work best in dry, hot regions with high evaporation rates and level terrain. A critical design consideration is the shallowness of the ponds; thus, they require large acreage. The assumption from the 2010 report estimated 50 acres as the requirement for evaporation ponds (Carollo, 2010). Due to the high cost of real estate and limited availability of large parcels in the Project vicinity, evaporation ponds are not considered a feasible method of brine disposal.

Live Stream Discharge

Brine discharge to the San Dieguito River was evaluated, however, it was determined that the discharge of brine to inland freshwaters was not feasible. Inland surface water quality objectives for TDS are 500 mg/L per the San Dieguito Hydrologic Unit for Solana Beach subunit (includes the San Dieguito River adjacent to the Project) of the San Diego Basin Plan (RWQCB, as amended 2016). Projected brine TDS levels are above 16,000 mg/L. Additional water quality objectives include manganese at 0.05 mg/L for surface waters. Blending brine with raw water or potable water to this level is not feasible; therefore, live stream discharge was not included in any project alternatives.

Municipal Sewer Discharge

Disposing brine into the local City of San Diego sewer via Pump Station #64 and finally to their North City WRF was also evaluated. As shown in **Table 5-1**, the North City WRF treats 15.4 mgd on average with a TDS effluent averaging 865 mg/L. At Pump Station #64, the average influent is 9.5 mgd with an average TDS level of 1,130 mg/L (City of San Diego, 2015). With a flowrate of 0.19 mgd of brine from the Project at a TDS concentration of 16,000 mg/L, TDS levels would increase to 1,442 mg/L and 1,049 mg/L at Pump Station #64 and the North City WRF, respectively, an increase of more than 20 percent.

The City of San Diego's Pure Water program at the North City WRF involves desalination. Increased TDS loading from the Project's brine discharge would negatively impact the cost and effectiveness of the Pure Water reverse osmosis treatment process.

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FIGURE 5-2
Brine Disposal Alternatives

Legend

- SEJPA WRF
- Comm. Srv. Dist. WRF
- Escondido Land Outfall
- Abd. SDWD Pipeline
- Ocean Outfall
- City of San Diego Sewer
- San Dieguito GW Basin

Brine Management Alts.

- 1-Ocean Outfall*
- 2-Deep Well Injection
- 3-Lagoon Discharge
- 4-Live Stream Discharge
- 5-City SD Sewer

* multiple alignments evaluated
for disposal via Ocean Outfall

0 0.25 0.5 1 Miles

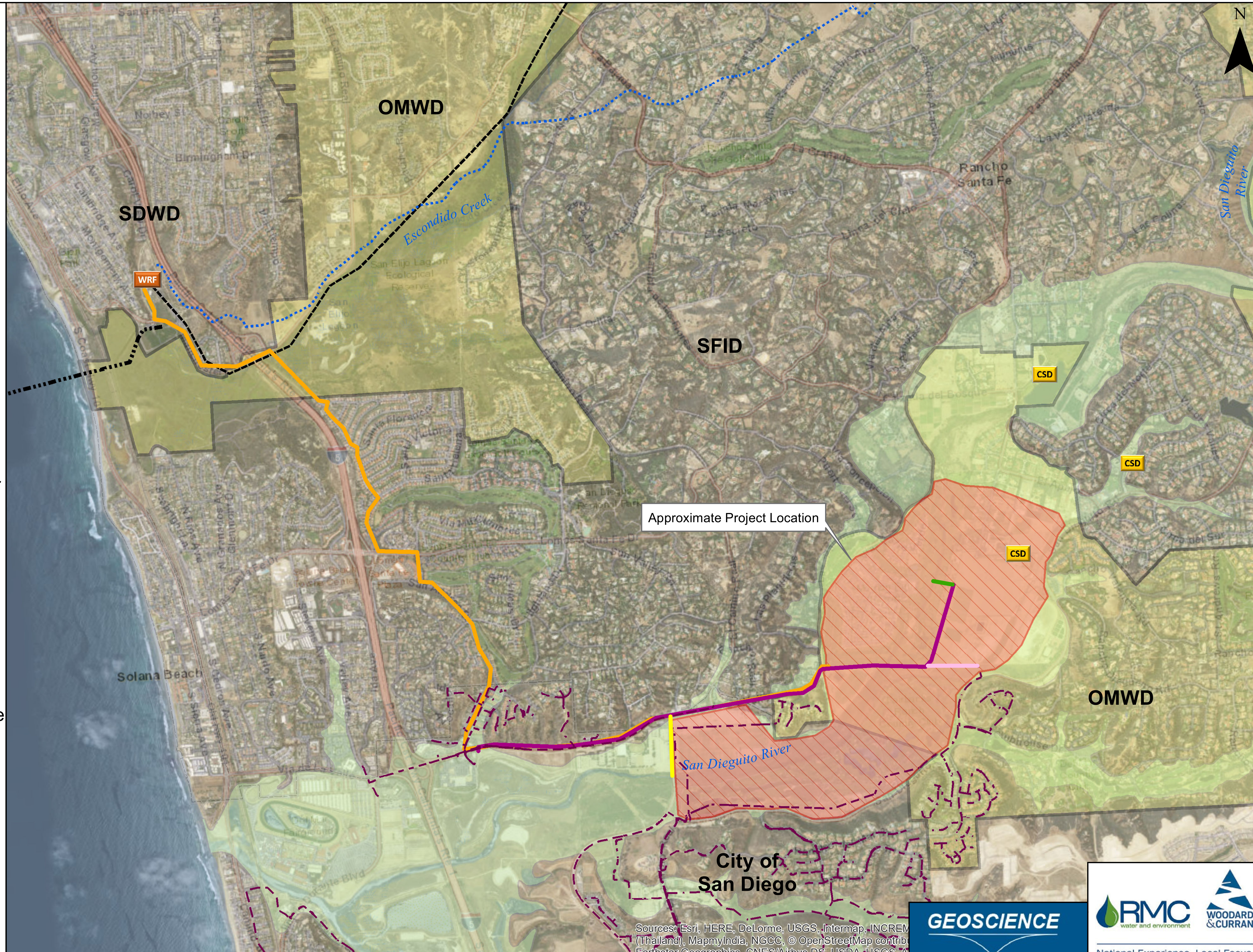

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Table 5-1: Brine Disposal Impacts on City of San Diego Sewer

OMWD San Dieguito Desalter Brine Quality				
Brine	TDS	16,000	mg/L	projected based on 81% recovery
Brine	Flow	0.19	mgd	projected based on 81% recovery
North City WRP				
PS #64 Influent	TDS	1,130	mg/L	2014 average
PS #64 Influent	Flow	9.5	mgd	2014 average
WRP Total Influent	TDS	865	mg/L	2014 average
WRP Total Influent	Flow	15.42	mgd	Full-rated capacity
Impact to PS #64				
Combined effluent	TDS	1,422	mg/L	Increases TDS from 1,130 to 1,422 (26%)
Impact to effluent at WRP				
Combined effluent	TDS	1,049	mg/L	Increases TDS from 865 to 1,049 (21%)

Discussions were also conducted with SEJPA about constructing a sewer force main to connect to the closest sewer line (greater than 10-inch diameter) in Solana Beach. SEJPA indicated that at the projected brine TDS levels, they would not accept the brine into their sewer collection system. Based on evaluating these two options, disposing brine to a local sewer is not considered feasible.

Estuarine Discharge to the San Dieguito Lagoon

Brine disposal to the San Dieguito Lagoon was evaluated for two discharge locations as shown in **Figure 5-3**. Estuarine waters are considered to extend from a bay or open ocean to a point upstream where there is no significant mixing of fresh water and sea water. Estuaries do not include inland surface waters nor ocean waters. Available tidal data indicates high water tidal influence of 5 vertical feet.

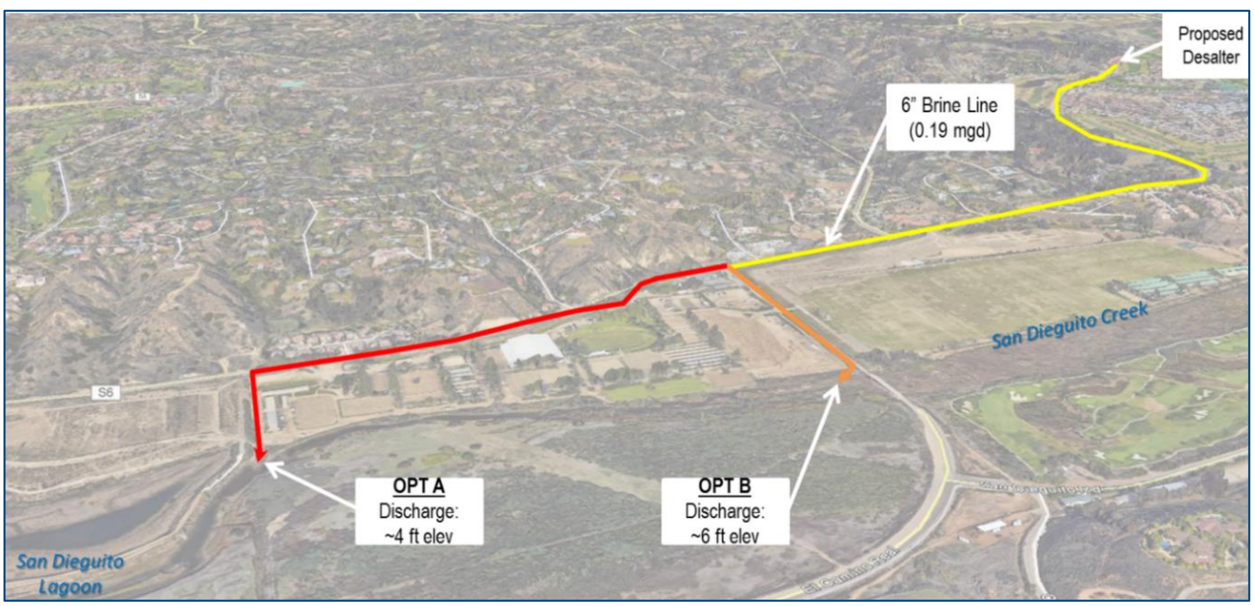

Figure 5-3: Brine Disposal – Lagoon Discharge

The lagoon discharge option was discussed with Southern California Edison (SCE) regarding potential impacts to the San Dieguito Wetlands Restoration Project. SCE would not permit discharge within their project limits due to risk impacts to their vegetation and disruption to project mitigation measures. This includes piping that would need to remain east of El Camino Real outside their project limits.

A meeting was held with the San Diego RWQCB on June 29, 2017. Overall, the RWQCB encouraged the Project to establish a local drinking water supply, but noted its preference is to dispose brine to an ocean outfall rather than a lagoon discharge. Brine discharge to the lagoon would be challenging due to the following regulatory guidelines:

- Effluent limits for lagoon brine discharge would likely be 0.1 mg/L for total phosphorus and 1.0 mg/L for total nitrogen, and
- NPDES permits need to be renewed every five years. If any lagoon impacts were to be observed, no guarantee exists that RWQCB would agree to renew the NPDES permit for lagoon brine discharge after the initial five-year period.

Comparison was made to the regulatory requirements for the Sweetwater Authority brine discharge to the Sweetwater River in San Diego. Based on Waste Discharge Requirements Order No. R9-2017-0020, the Sweetwater Authority was required to relocate their discharge point downstream in the estuary, almost to the San Diego Bay. In addition, the order notes that connection to an ocean outfall could be required in the future if the RWQCB did not renew the permit on the estuarine discharge.

Since a lagoon discharge permit could be temporary and require an ocean outfall, it makes the ocean outfall option stand out as the preferred option over lagoon discharge. This, combined with potential impacts to the San Dieguito Wetlands Restoration Project, makes the lagoon discharge option infeasible. Lagoon discharge is therefore not included in any project options.

Zero Liquid Discharge

The ZLD alternative was previously evaluated in 2010. ZLD was the previously selected brine management alternative. ZLD technologies are typically thermally driven processes that reduce the brine to a slurry (near ZLD) or a solid (ZLD) for land disposal. Although these technologies (brine concentrator, crystallizers, vapor compression) are well established, their high cost often makes them cost prohibitive for use in water treatment. For this alternative, O&M costs for energy consumption were evaluated and made this alternative cost prohibitive. In addition, use of a ZLD system requires 4-acres of land for evaporation of slurry which factored into the capital cost of this alternative. Due to the limited availability of land in the Project vicinity and the impact on O&M costs to operate a ZLD system, ZLD is therefore not considered a feasible method of brine disposal for the Project at this time. New developments in technology and alternative energy sources could make this option more appealing in the future.

Deep Well Injection

Deep well injection west of I-5 was evaluated as an alternative for brine disposal. The groundwater quality objective for TDS in the Solana Beach subunit of the San Dieguito Hydrologic Unit is 1,500 mg/L, but water quality objectives do not apply westerly of the easterly boundary of I-5 per Table 3-3 of San Diego Basin Plan. Projected brine TDS levels are above 16,000 mg/L. Additional water quality objectives include manganese at 0.15 mg/L for groundwater. Deep well injection would need to be below the lower aquitard, below an approximate depth of 200 feet.

From the proposed desalination plant site, the brine pipeline for deep well injection would follow Via de la Valle and cross I-5. West of I-5 along Via de la Valle is the Del Mar Fairground and Racetrack, which may present an obstacle for constructing the brine disposal pipeline and injection well.

Due to the heavily congested roads with traffic and utilities, a slant well was evaluated to avoid crossing I-5 with open cut trenches. A slant drill operation would require approximately 15,000 feet of 6-inch piping from the desalination plant to approximately 1-mile east of I-5 along Via de la Valle. The slant drill would end about 200 feet west of I-5 at a depth of approximately 200 feet.

Four to five monitoring wells would also need to be constructed to monitor groundwater quality along with additional surface survey monuments to monitor for land subsidence. Beyond groundwater monitoring, additional maintenance on the injection wells would be required.

Deep well injection will require obtaining permits from the San Diego RWQCB and the Coastal Commission, which is expected to be a complex multi-year process. Permit conditions will likely include installing survey monuments to monitor ground movement. Deep well injection may also entail significant liability risk, as implementing such an option opens up the potential of having to defend against lawsuits brought by property owners who may claim that their onsite geotechnical problems (e.g. earth movement, cliff erosion, foundation shifting, subsidence or settling) may result or be exacerbated by the groundwater injection operations.

The sensitivity analysis addresses the capital cost, operations and maintenance cost, regulatory complexity and long implementation time of this brine disposal alternative.

Discharge to Coastal Waters

Brine discharge to coastal waters is feasible due to the Project location being less than five miles from the SEOO. There are two possible connection points to the SEOO: 1) ELO, and 2) via direct connection to the SEOO at the San Elijo WRF, bypassing the ELO. The institutional and environmental aspects of coastal discharge via the SEOO are discussed in **Section 4.**

Five alignment alternatives were evaluated for connecting to the San Elijo Ocean Outfall as summarized in **Table 5-2** and shown in **Figure 5-4.** Alternative 1 connects to the ELO, and Alternatives 2 through 5 connect to San Elijo WRF along four different alignments with varying pipe lengths.

Connecting to the ELO is the shortest length alignment. For direct connection to San Elijo WRF, the San Andres Road alignment is the shortest. These two brine disposal alternatives are carried forward for further analysis in **Section 5.5.**

Table 5-2: Alignment Alternatives to San Elijo Ocean Outfall

Brine Connection Alternative	Brine Line Length
1) Escondido Land Outfall (ELO)	25,500 feet
2) San Elijo WRF (via Rancho Santa Fe Road)	44,300 feet
3) San Elijo WRF (via Stonebridge trail)	36,800 feet
4) San Elijo WRF (via San Andres Road)	33,800 feet
5) San Elijo WRF (via Caltrans Bike Path)	35,400 feet

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FIGURE 5-4
Brine Disposal Alternatives to Ocean Outfall

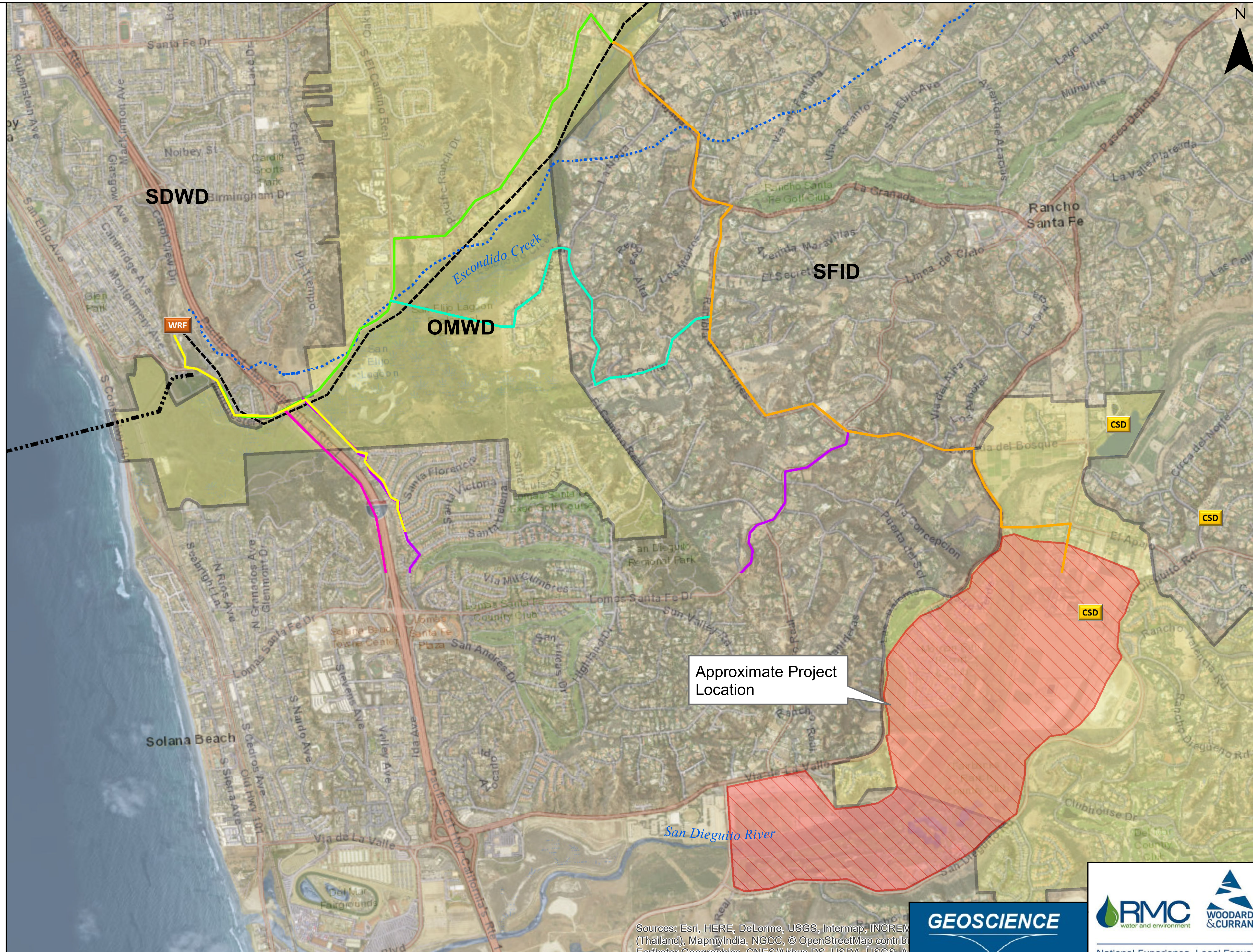
Legend

- SEJPA WRF
- Comm. Srv. Dist. WRF

Alignment Alternatives

- via Land Outfall
- via RSF Rd
- via Stonebridge Trail
- via Lomas SF Rd
- via Caltrans bikepath
- via San Andres Rd
- Abd. SDWD Pipeline
- Ocean Outfall
- Escondido Land Outfall
- OMWD Boundary

Miles
0 0.25 0.5 1



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5.2.4 Product Water Conveyance

Four product water conveyance options were evaluated for potable water distribution as discussed in this section. The feasible alternatives are summarized in **Table 5-3** and shown in **Figure 5-5** (reflects treatment plant location to the North site for purposes of the evaluation). Three of the four options were evaluated through simulated scenarios under peak summer demands within OMWD's hydraulic model using a constant input of 1.0 mgd of new potable water source water from the Project.

OMWD Distribution System Pressure Zone 215

Pressure Zone 215 (PZ-21) is the lowest pressure zone adjacent to the proposed project location. The hydraulic model results determined that there is not enough system demand for a constant inflow of 1.0 mgd within this pressure zone alone, as such this alternative is not feasible.

OMWD Pressure Zone 492 Distribution System

Pressure Zone 492 (PZ-19) was evaluated for connection at Gano Tank for the new 1.0 mgd water supply. The hydraulic analysis indicates there is enough system demand for the new water source. The PZ-19 connection point allows for storage of excess supply or distribution to the lower adjacent pressure zones (ex. PZ-20, PZ-21) during periods of lower demand. PZ-19 is the furthest connection point from the desalination site, requiring approximately 21,000 feet of a 10-inch pipe.

OMWD Pressure Zone 402 Distribution System

Pressure Zone 402 (PZ-20) was evaluated at a connection point to an existing 12-inch diameter pipe. Based on the hydraulic model results, PZ-20 can accommodate the constant inflow of 1.0 mgd and allows for distribution of excess supply to the lower adjacent pressure zone (PZ-21). PZ-20 requires approximately 8,300 feet of 10-inch pipe from the desalination site.

Santa Fe Irrigation System Distribution System

Based on review of SFID's potable water distribution system, a 20-inch water main feeding a 6 MG water tank could be considered as a potential connection point for the 1.0 mgd desalinated water supply. The existing 20-inch water main connection point is approximately 9,900 feet from the desalination site. SFID's system was not modeled because it is outside of outside of OMWD's service area and the model is not available.

Table 5-3: Product Water Conveyance

Product Water Conveyance Alternative	Conveyance Length
PZ 492 Gano Tank 24-inch feed to tank	21,000 feet
PZ-402 12-inch existing pipe	8,300 feet
SFID 20-inch feed to 6MG tank	9,900 feet

Connection to PZ-20 is the most feasible product conveyance alternative based on required pipe length. This alternative allows for connection to the nearest existing 12-inch pipe within PZ-20.

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FIGURE 5-5
Product Water Conveyance Alternatives

Legend

- Existing Storage Tank
- Point of Connection

Conveyance Alternative

- Alt. A - to Tank
- Alt. B - to Dist.
- Alt. C - to SFID

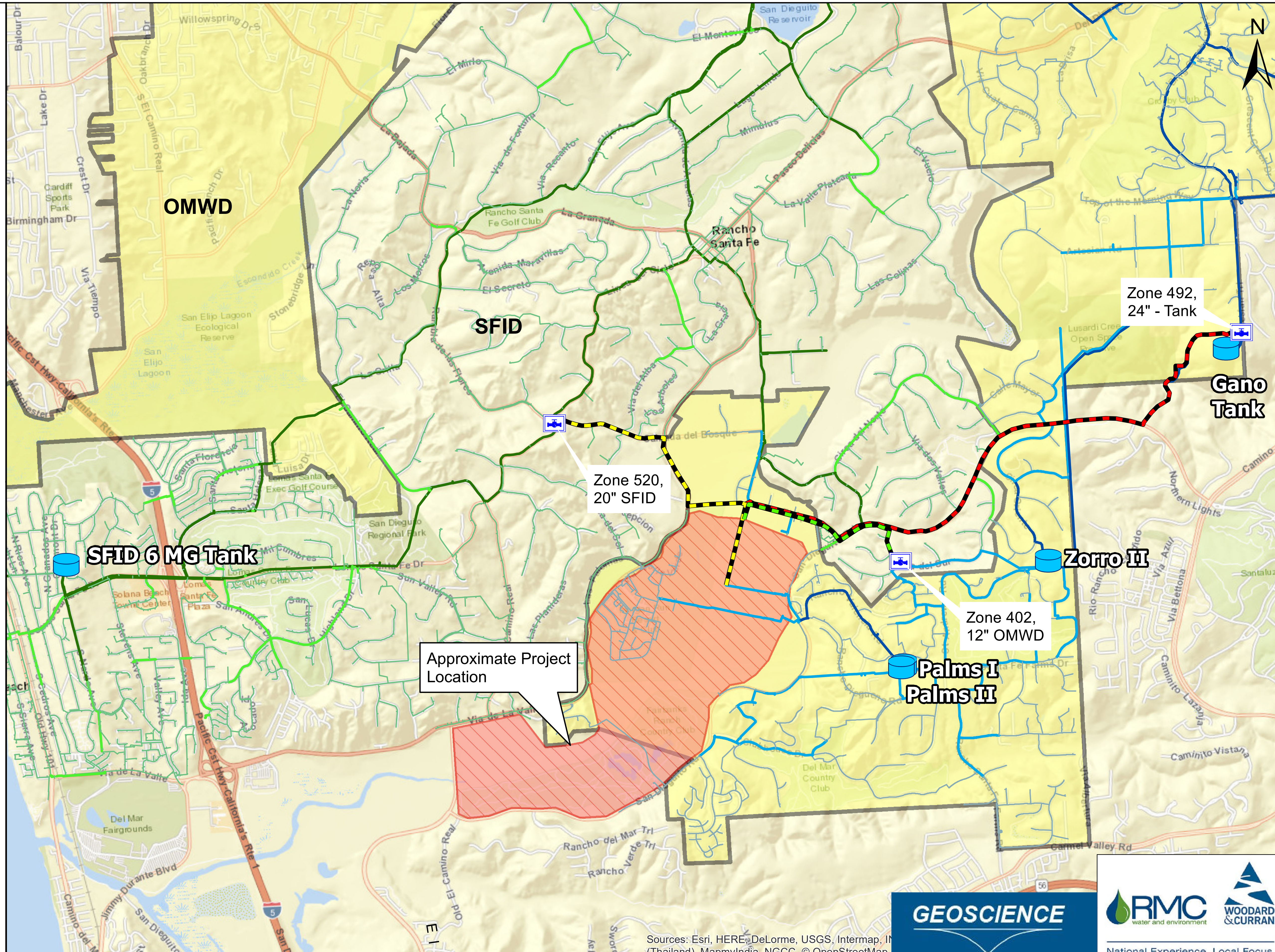
OMWD Pipe Dia.

- <10"
- 12-14"
- >16"

SFID Pipe Dia.

- <10"
- 12-14"
- >16"
- OMWD Boundary

0 0.25 0.5 1 Miles



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5.3 Option Costs

Costs for capital and operation & maintenance (O&M) were developed to evaluate each option. See **Appendix D** for detailed costs and assumptions.

5.3.1 Groundwater Extraction Wells and Raw Water Conveyance

Table 5-4 summarizes the capital and O&M costs for the two groundwater extraction wells and raw water conveyance to the two treatment site alternatives.

Table 5-4: Project Cost – Well Field and Raw Water Conveyance

Well Field and Raw Water Conveyance	Total Project Cost	O&M Cost	Total Annualized Cost
Groundwater Well Field at Site 2/2A	$2.3M	$42,000	$168,000
Conveyance to North Treatment Site	$1.0M	$15,000	$68,000
Conveyance to South Treatment Site	$4.5M	$22,000	$269,000

5.3.2 Desalination Treatment Plant

Table 5-5 summarizes the capital and O&M costs for the desalination facility. The required acreage for the groundwater desalter is approximately 0.5 acres.

Table 5-5: Project Cost - Groundwater Desalter

Desalination Plant	Total Project Cost	O&M Cost	Total Annualized Cost
1.0 mgd Groundwater Desalter	$9.7M	$342,000	$867,000

5.3.3 Brine Management Alternative

Table 5-6 and **Table 5-7** summarize the capital and O&M costs for the feasible brine disposal alternatives to the two treatment site locations.

Table 5-6: Project Cost Comparison - Brine Disposal Methods to North Site

Brine Management Alternative	Total Project Cost	O&M Cost	Total Annualized Cost
Ocean Outfall via Escondido Land Outfall	$7.4M	$161,000	$562,000
Ocean Outfall via SEJPA WRF	$10.5M	$108,000	$680,000
Deep Well Injection	$11.2M	$87,000	$698,000

Table 5-7: Project Cost Comparison – Brine Disposal Methods to South Site

Brine Management Alternative	Total Project Cost	O&M Cost	Total Annualized Cost
Ocean Outfall via Escondido Land Outfall	$10.7M	$175,000	$757,000
Ocean Outfall via SEJPA WRF	$10.5M	$108,000	$680,000
Deep Well Injection	$10.8M	$89,000	$674,000

5.3.4 Product Water Conveyance Costs

Table 5-8 and **Table 5-9** present the capital and O&M costs for the recommended product water conveyance alternative from the two treatment site locations.

Table 5-8: Project Cost Comparison – Product Water Conveyance from North Site

Product Water Conveyance Alternative	Total Project Cost	O&M Cost	Total Annualized Cost
PZ-402 - 12" point of connection	$6.5M	$128,000	$481,000

Table 5-9: Project Cost Comparison – Product Water Conveyance from South Site

Product Water Conveyance Alternative	Total Project Cost	O&M Cost	Total Annualized Cost
PZ-402 - 12" point of connection	$5.1M	$119,000	$396,000

5.4 Project Alternatives

Six project alternatives were considered in the alternatives analysis based on combinations of the following two options for location of the desalination plant and three options for brine disposal:

- **Desalination plant**:
  - North site location
  - South site location
- **Brine disposal**:
  - San Elijo Ocean Outfall
  - Escondido Land Outfall
  - Deep well injection

Figure 5-6 and **Figure 5-7** show the six project options. The well field location and product water connection are the same for all project options:

- **Well Field:**
  - Well Sites 2 and 2A
- **Product water connection**:
  - PZ-20 connection to nearest existing 12-inch pipe

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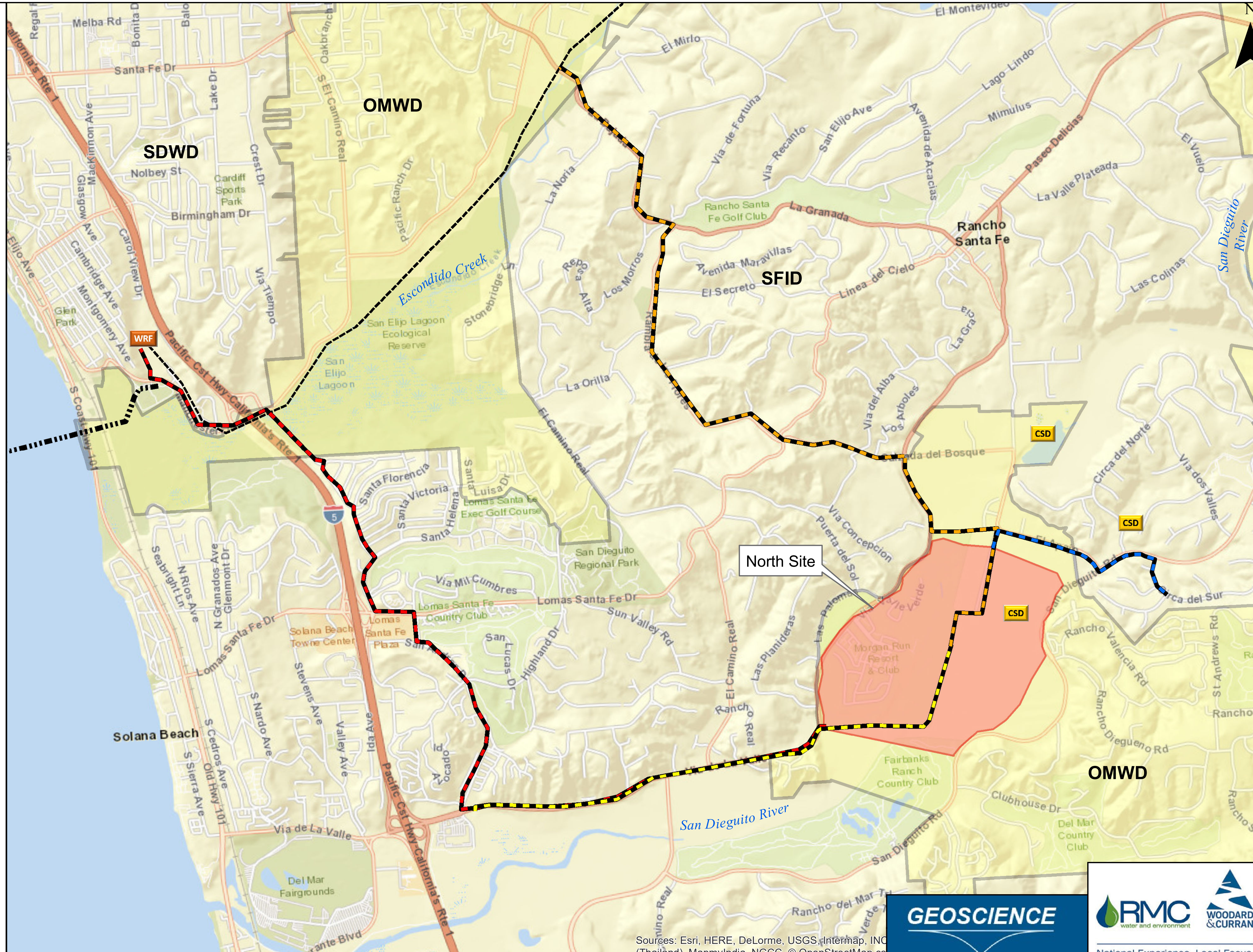
FIGURE 5-6
Project Options 1A, 1B and 1C



Legend

- SEJPA WRF
- Comm. Srv. Dist. WRF
- OMWD Boundary
- Escondido Land Outfall
- OceanOutfall
- Product Water Piping

Brine Alternative

- 1A to Ocean Outfall
- 1B to Land Outfall
- 1C to Deep Well Inj.

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FIGURE 5-7
Project Options 2A, 2B and 2C

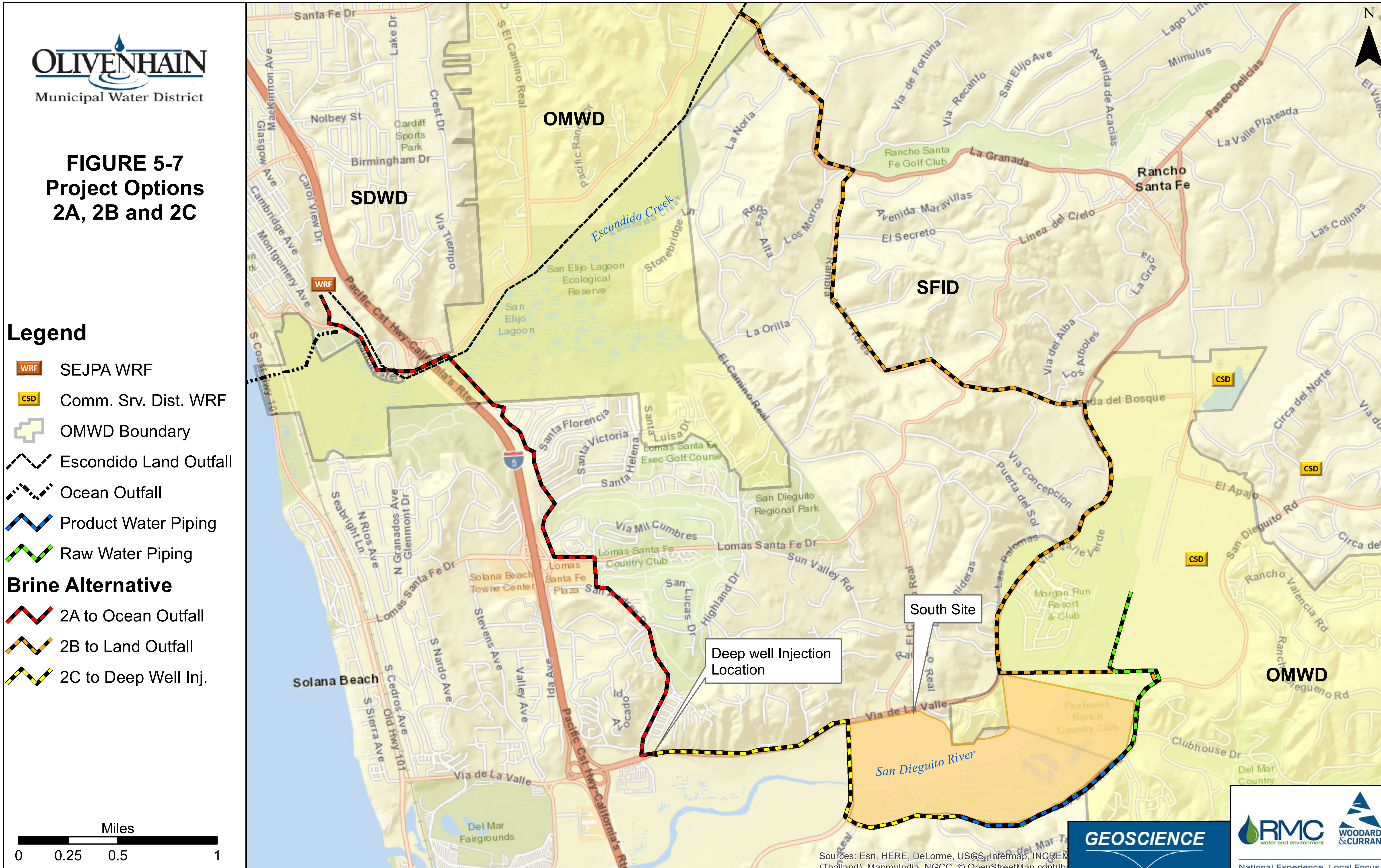

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Table 5-10 provides a summary of the six project alternatives with their associated capital, O&M and annualized costs along with the estimated unit cost of water. Costs include all associated facilities such as the well field, raw water conveyance, desalination plant, land acquisition, product water conveyance, and brine disposal. Refer to **Appendix D** for detailed costs and assumptions.

Table 5-10: Cost Comparison – Six Project Alternatives

	Project 1A	Project 1B	Project 1C	Project 2A	Project 2B	Project 2C
Treatment Site	North	North	North	South	South	South
Brine Management	Ocean Outfall	Land Outfall	Deep Well Injection	Ocean Outfall	Land Outfall	Deep Well Injection
Capital Cost	$29,982,000	$26,834,000	$30,697,000	$31,628,000	$32,335,000	$32,366,000
O&M Cost	$634,000	$688,000	$613,000	$707,000	$700,000	$615,000
Annualized Cost	$2,264,000	$2,147,000	$2,282,000	$2,427,000	$2,458,000	$2,375,000
Unit Cost of Water ($/AF)	**$2,021**	**$1,917**	**$2,038**	**$2,167**	**$2,195**	**$2,121**

No project alternative

A no project alternative is considered for comparison. This is the cost for OMWD to purchase imported water and treat it at DCMWTP or to purchase treated water from SCDWA. Refer to **Section 2.7** for prices of these supplies. SDCWA's treated water rates in 2022 are expected to range from a low of approximately $2,100 per AF to a high of approximately $2,200 per AF.

5.5 Sensitivity Analysis

The six project alternatives were scored from 1 (least favorable) to 5 (most favorable) as presented in **Table 5-11** based on the following evaluation criteria:

- Ability to Accommodate Future Regulatory Changes
- Cost – Capital (Lower Costs = Higher Scores)
- Cost – O&M (Lower Costs = Higher Scores)
- Environmental Constraints
- Regulatory Feasibility
- Expandability
- Institutional Complexity
- Operational Complexity
- Time to Implement

Table 5-11: Sensitivity Analysis – Scoring

Evaluation Criteria	Weighting	Project 1A	Project 1B	Project 1C	Project 2A	Project 2B	Project 2C
Treatment Site		North	North	North	South	South	South
Brine Management		Ocean Outfall	Land Outfall	Deep Well Inj.	Ocean Outfall	Land Outfall	Deep Well Inj.
Ability to Accommodate Future Regulatory Changes	--	5	4	1	5	4	1
Cost - Capital	--	2	5	2	1	1	1
Cost - O&M	--	3	2	4	2	2	4
Environmental Constraints	--	4	4	2	4	4	2
Regulatory Feasibility	--	4	4	1	4	4	1
Expandability	--	3	3	5	3	3	5
Institutional Complexity	--	5	3	2	4	2	1
Operational Complexity	--	4	3	2	4	3	2
Time to Implement	--	4	2	3	4	2	3

A sensitivity analysis was completed to score each of the six project alternatives against weighted criteria among the following focused areas:

- Equal
- Cost Focused
- Non-Cost Focused
- Operational Focused

Equal weighting analysis is presented in **Table 5-12**, Cost focused analysis is presented in **Table 5-13**, Non-Cost focused analysis is presented in **Table 5-14**, and Operational focused analysis is presented in **Table 5-15**.

Except for the cost-focused analysis, Project 1A (Ocean Outfall/North Site) ranked the highest in all other categories. Project 1B (Land Outfall/North Site) ranked first in the cost-focused analysis; however, it ranked third or fourth in all other categories. Project 2A (Ocean Outfall/South Site) ranked second or third in all categories. Based on the scoring methodology, Project 1A is the most favorable project alternative with a projected unit cost of water of $2,021/AFY.

Table 5-12: Sensitivity Analysis – Equal Weighting

Evaluation Criteria	Weighting	Project 1A	Project 1B	Project 1C	Project 2A	Project 2B	Project 2C
Treatment Site		North	North	North	South	South	South
Brine Management		Ocean Outfall	Land Outfall	Deep Well Inj.	Ocean Outfall	Land Outfall	Deep Well Inj.
Ability to Accommodate Future Regulatory Changes	11.1%	0.6	0.4	0.1	0.6	0.4	0.1
Cost - Capital	11.1%	0.2	0.6	0.2	0.1	0.1	0.1
Cost - O&M	11.1%	0.3	0.2	0.4	0.2	0.2	0.4
Environmental Constraints	11.1%	0.4	0.4	0.2	0.4	0.4	0.2
Regulatory Feasibility	11.1%	0.4	0.4	0.1	0.4	0.4	0.1
Expandability	11.1%	0.3	0.3	0.6	0.3	0.3	0.6
Institutional Complexity	11.1%	0.6	0.3	0.2	0.4	0.2	0.1
Operational Complexity	11.1%	0.4	0.3	0.2	0.4	0.3	0.2
Time to Implement	11.1%	0.4	0.2	0.3	0.4	0.2	0.3
Total Score – Equal	**100%**	**3.8**	**3.3**	**2.4**	**3.4**	**2.8**	**2.2**

Table 5-13: Sensitivity Analysis – Cost Focused Weighting

Evaluation Criteria	Weighting	Project 1A	Project 1B	Project 1C	Project 2A	Project 2B	Project 2C
Treatment Site		North	North	North	South	South	South
Brine Management		Ocean Outfall	Land Outfall	Deep Well Inj.	Ocean Outfall	Land Outfall	Deep Well Inj.
Ability to Accommodate Future Regulatory Changes	7.1%	0.4	0.3	0.1	0.4	0.3	0.1
Cost - Capital	25.0%	0.5	1.3	0.5	0.3	0.3	0.3
Cost - O&M	25.0%	0.8	0.5	1.0	0.5	0.5	1.0
Environmental Constraints	7.1%	0.3	0.3	0.1	0.3	0.3	0.1
Regulatory Feasibility	7.1%	0.3	0.3	0.1	0.3	0.3	0.1
Expandability	7.1%	0.2	0.2	0.4	0.2	0.2	0.4
Institutional Complexity	7.1%	0.4	0.2	0.1	0.3	0.1	0.1
Operational Complexity	7.1%	0.3	0.2	0.1	0.3	0.2	0.1
Time to Implement	7.1%	0.3	0.1	0.2	0.3	0.1	0.2
Total Score – Cost Focused	**100%**	**3.3**	**3.4**	**2.6**	**2.8**	**2.3**	**2.3**

Table 5-14: Sensitivity Analysis – Non-Cost Focused Weighting

Evaluation Criteria	Weighting	Project 1A	Project 1B	Project 1C	Project 2A	Project 2B	Project 2C
Treatment Site		North	North	North	South	South	South
Brine Management		Ocean Outfall	Land Outfall	Deep Well Inj.	Ocean Outfall	Land Outfall	Deep Well Inj.
Ability to Accommodate Future Regulatory Changes	14.3%	0.7	0.6	0.1	0.7	0.6	0.1
Cost - Capital	0.0%	0.0	0.0	0.0	0.0	0.0	0.0
Cost - O&M	0.0%	0.0	0.0	0.0	0.0	0.0	0.0
Environmental Constraints	14.3%	0.6	0.6	0.3	0.6	0.6	0.3
Regulatory Feasibility	14.3%	0.6	0.6	0.1	0.6	0.6	0.1
Expandability	14.3%	0.4	0.4	0.7	0.4	0.4	0.7
Institutional Complexity	14.3%	0.7	0.4	0.3	0.6	0.3	0.1
Operational Complexity	14.3%	0.6	0.4	0.3	0.6	0.4	0.3
Time to Implement	14.3%	0.6	0.3	0.4	0.6	0.3	0.4
Total Score – Non-Cost	**100%**	**4.1**	**3.3**	**2.3**	**4.0**	**3.1**	**2.1**

Table 5-15: Sensitivity Analysis – Operational Focused Weighting

Evaluation Criteria	Weighting	Project 1A	Project 1B	Project 1C	Project 2A	Project 2B	Project 2C
Treatment Site		North	North	North	South	South	South
Brine Management		Ocean Outfall	Land Outfall	Deep Well Inj.	Ocean Outfall	Land Outfall	Deep Well Inj.
Ability to Accommodate Future Regulatory Changes	15.0%	0.8	0.6	0.2	0.8	0.6	0.2
Cost - Capital	4.0%	0.1	0.2	0.1	0.0	0.0	0.0
Cost - O&M	25.0%	0.8	0.5	1.0	0.5	0.5	1.0
Environmental Constraints	4.0%	0.2	0.2	0.1	0.2	0.2	0.1
Regulatory Feasibility	4.0%	0.2	0.2	0.0	0.2	0.2	0.0
Expandability	15.0%	0.5	0.5	0.8	0.5	0.5	0.8
Institutional Complexity	4.0%	0.2	0.1	0.1	0.2	0.1	0.0
Operational Complexity	25.0%	1.0	0.8	0.5	1.0	0.8	0.5
Time to Implement	4.0%	0.2	0.1	0.1	0.2	0.1	0.1
Total Score – Operational	**100%**	**3.7**	**3.0**	**2.8**	**3.4**	**2.8**	**2.7**

Section 6 Recommended Project and Implementation

6.1 Description of Proposed Facilities

Project 1A is the recommended project. As described in **Section 5**, the proposed facilities will include: two extraction wells and raw water conveyance, a 1.0 mgd groundwater desalter, brine disposal via the SEOO, and a product water connection to OMWD's distribution system. **Figure 6-1** summarizes the recommended project.

6.1.1 Groundwater Extraction Wells

Well Sites 2 and 2A are located along the San Dieguito River west of San Dieguito Road and east of Via de la Valle. Each of the two groundwater extraction wells (Well Sites 2 and 2A) will require a square footprint of approximately 10,000 square feet, for a total of 20,000 square feet. The wells will be 18-inch diameter and drilled to depths of 150 to 190 feet.

This site is located within the floodplain and a hydrological study must be performed to determine the new elevation of the site, as well as determine the bank improvements needed to protect the site from a 100-year event. A LOMR will be required to change the FEMA FIRM to remove the parcel from the 100-year floodplain following design of necessary protections.

Based on the hydraulic model, the well field can produce 1,350 AFY without affecting other wells in the area. Estimated travel time from the river to the well field is 940 days, which indicates that the groundwater is not under the direct influence of surface water.

6.1.2 Raw Water Conveyance

Conveyance of groundwater from the well field Site 2 and 2A to the groundwater desalter at the North Site will require 2,500 feet of 12-inch pipe.

6.1.3 Desalination Treatment Plant

The treatment facility will be located on the North site and will consist of greensand filters, reverse osmosis treatment, a chemical building, and staff facilities. The required acreage for the groundwater desalter is approximately 0.5 acres.

This site is located within the floodplain and a hydrological study must be performed to determine the new elevation of the site, as well as determine the bank improvements needed to protect the site from a 100-year storm event. A LOMR will also be required to change the FEMA FIRM to remove the parcel from the 100-year floodplain following design of necessary protections.

6.1.4 Brine Management

The brine disposal method will be via the SEOO along San Andres Road. The brine flows are estimated to be 0.19 mgd and will require 33,800 feet of 6-inch pipe and a pump station to convey the brine from the groundwater desalter to the San Elijo WRF for disposal in the San Elijo Ocean Outfall.

6.1.5 Product Water Conveyance

The point of connection for the product water will be within PZ-20 in OMWD's service district. PZ-20 will be able to accommodate the 1.0 mgd supply and will allow for distribution of excess supply to the lower adjacent pressure zone (PZ-21). The PZ-20 point of connection will require approximately 8,300 feet of 10-inch conveyance pipeline from the treatment facility.

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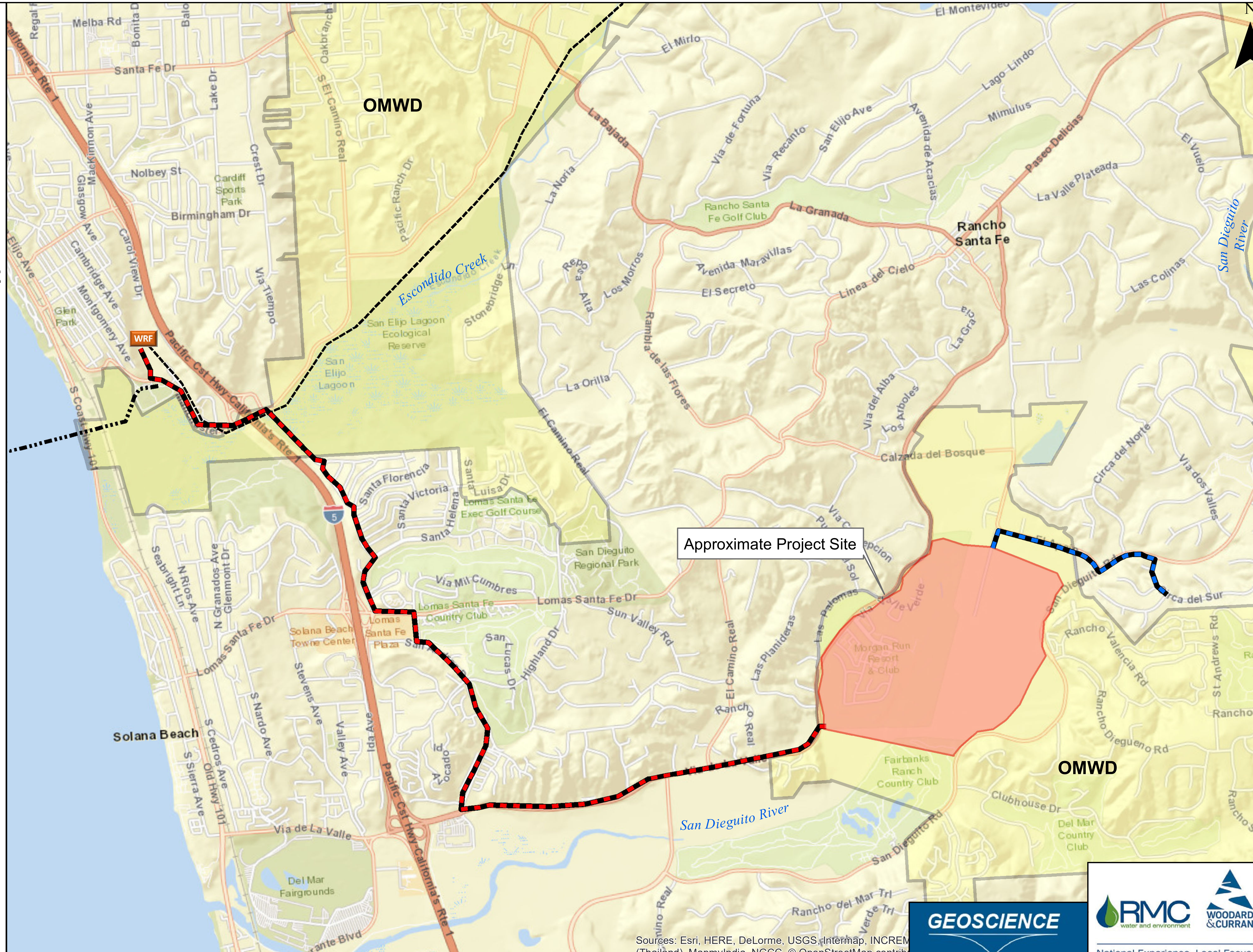
FIGURE 6-1
San Dieguito Valley Brackish Groundwater Desalination Study: Recommended Project



Legend

- North Site
- SEJPA WRF
- OMWD Boundary
- Escondido Land Outfall
- Ocean Outfall
- Product Water Piping
- Brine Disposal

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Date: 10/6/2017

6.1.6 Reliability of Supply

Based on the hydrogeological study, the groundwater supply is sustainable, as discussed in **Section 3.4.**

6.1.7 Projected Quantity of Deliveries

The Project is projected to deliver a constant flow of 1.0 mgd.

6.2 Preliminary Design Criteria

Design Source Water Quality

The design of the desalination process is based on source water quality representative of the recommended Well Sites 2 and 2A. **Table 6-1** summarizes the design source water quality, as discussed in **Section 3.2**, as a conservative basis for design.

Table 6-1: Design Source Water Quality

Parameter	Unit	Value
Alkalinity, Total	mg/L as CaCO3	340
Ammonia as N	mg/L	ND-0.13
Barium	mg/l	0.08
Calcium	mg/L	305
Chloride	mg/L	1160
Fluoride	mg/L	0.341
Hardness	mg/L as CaCO3	1475
Iron	mg/L	ND
Magnesium	mg/L	167
Manganese	mg/L	1.75
Nitrate as N	mg/L	1.485
pH (lab)	-----	7.2
Phosphorus, Total	mg/L	0.1
Potassium	mg/L	ND-9.56
Silica (as SiO2)	mg/L	31
Sodium	mg/L	622
Strontium	mg/l	ND
Sulfate as SO4	mg/L	822
TDS	mg/L	3105
Turbidity	NTU	0.31

Manganese Pretreatment

Design source water quality exceeds the California Secondary Maximum Contaminant Levels (SMCLs) for manganese (Mn) and total dissolves solids (TDS) of 0.05 mg/L and 500 mg/L, respectively. Secondary standards affect the aesthetic quality of the water (color, odor, and taste). More importantly, high Mn levels will adversely impact the reverse osmosis membranes of the desalination system by increasing cleaning requirements (i.e., greater system downtime), potentially shortening membrane life, and limiting the recovery of product water. The design Mn concentration in the feed water to the desalination process is

1.75 mg/L, which is based on the recent Morgan Run well site water quality data and is slightly above the average for the recent water quality data for the region. This value is 35 times higher than 0.05 mg/L, which is both the California SMCL for Mn and the upper limit recommended by manufacturers for waters to be treated by reverse osmosis membranes. Thus, it is important to reduce Mn upstream of the reverse osmosis membranes with a pretreatment process. The recommended pretreatment process is greensand filtration. The treatment mechanism for this process is as follows:

Mn in water is typically found in the +2 valence state (i.e., Mn^{2+}), which is soluble. For removal, an oxidant with reasonable potency is added to convert the Mn^{2+} to Mn^{4+}. Once oxidized, the Mn^{4+} will readily react with the dissolved oxygen present in the water to form manganese dioxide (MnO_2), which precipitates out of solution as a solid that can be filtered. The main limitation with oxidation/filtration as a removal process for Mn is the lengthy reaction times required to oxidize Mn from 2+ to 4+. In many cases, more than 60 minutes may be needed, thus requiring large contactors. Greensand filtration reduces the contact time requirement through the unique properties of the greensand media; the media can adsorb the Mn in its soluble 2+ valence form. Once adsorbed onto the media, the chlorine present in the water can oxidize it from its 2+ to 4+ valence state. Afterwards, the Mn^{4+} will react with the dissolved oxygen in the water to form MnO_2, precipitate out of solution as a solid, and become trapped in the greensand media bed. The MnO_2 that accumulate in the filter bed are removed through periodic backwashing of the media.

Reverse Osmosis

To produce 1.0 mgd of desalinated water, a reverse osmosis (RO) skid is recommended. RO skids come completely equipped with cartridge filters (needed as a protective measure to prevent solids, such as sand or silt, from fouling the RO membranes), feed pumps, piping, pressure vessels, RO membranes, instrumentation and controls, and a clean-in-place system. A clean-in-place system is needed to chemically clean and remove foulants (e.g. particles, mineral scale and biological components) from the RO membranes. Foulants result in additional head loss and increased energy requirements to maintain production flow rates. Additionally, foulants may result in a deterioration in permeate water quality. The design water quality parameters were used in manufacturer-provided modeling software to project the RO system recovery. The results indicate that a recovery of 81 percent is possible.

High pressure membrane processes such as RO provide a barrier for rejecting constituents such as TDS and hardness. The RO process uses a semi-permeable thin film composite (TFC) membrane to separate water from ions and large molecular weight molecules dissolved in the water, thus reducing the TDS concentration. Brine is a byproduct of the RO process that must be disposed of.

Operationally, raw water is introduced to the feed side of the RO membrane under pressure. When the applied pressure exceeds the osmotic pressure of the membrane, water on the feed side begins to pass through as permeate, or product water, which has a very low TDS concentration. The bulk of the TDS present in the raw water cannot pass through and is left to concentrate in the water remaining on the feed side of the membrane until it exits the treatment process as a brine waste stream.

For the Project, the feed water for the RO system will have first undergone pretreatment for manganese removal via greensand filtration.

Groundwater Desalter Process Design

The groundwater desalter process includes several elements: a pretreatment process, the RO system with a bypass, and a product water blending tank, as depicted in **Figure 6-2**. The bypass and product water blending tank are important to produce water that closely matches the quality of the potable water in OMWD's existing distribution system. The bypass and blending tank allow the pretreated source water to mix with the water treated by reverse osmosis. The pretreatment filters require sodium hypochlorite (chlorine) addition as an oxidant for manganese removal; then ammonia is required to remove chlorine prior to the RO membranes. After the RO process, additional chemicals are added to stabilize the water; ammonia and chlorine are added to for chloramine disinfection, and fluoride addition is required to match the target water quality of existing potable water.

Planning-level equipment quantities and design criteria are summarized in **Table 6-2**.

Table 6-2: Groundwater Desalter Design Criteria

Facility Description	Design Criteria
Influent Pump Station	1.2 mgd 2 pumps (1 duty, 1 standby)
Greensand Filters	1.19 mgd effluent 3 units (3 duty)
Greensand Effluent Tank	50,000 gallons 16-foot diameter
RO Skid System *(81% recovery)* With feed pump, cartridge filters, Clean-in-place system	0.81 mgd effluent 1 unit
Brine Production	0.19 mgd
Chemical storage and feed facilities Sodium Hypochlorite tank Ammonium Hydroxide storage Calcium Chloride tank Sodium Hydroxide tank Sodium Fluoride storage RO Antiscalant storage	 400 gallon, 3.75-foot diameter Two (2) 50 gallon barrels 2,000 gallons; 7.5-foot diameter 1,500 gallons, 7.2-foot diameter Four (4) 50-pound bags Two (2) 50 gallon barrels
Product Water Tank	42,000 gallons 15-foot diameter
Product Water Pumps	1.0 mgd 2 pumps (1 duty, 1 standby)

Figure 6-3 shows the schematic layout plan for the facility which was based on the planning-level footprint requirements summarized in **Table 6-3.** For property acquisition planning purposes, these layouts provide a suitable basis for determining the required parcel size for the treatment site, approximately 0.5 acres.

Table 6-4 presents design source water quality against primary and secondary MCL and the proposed product water quality resulting from the Project.

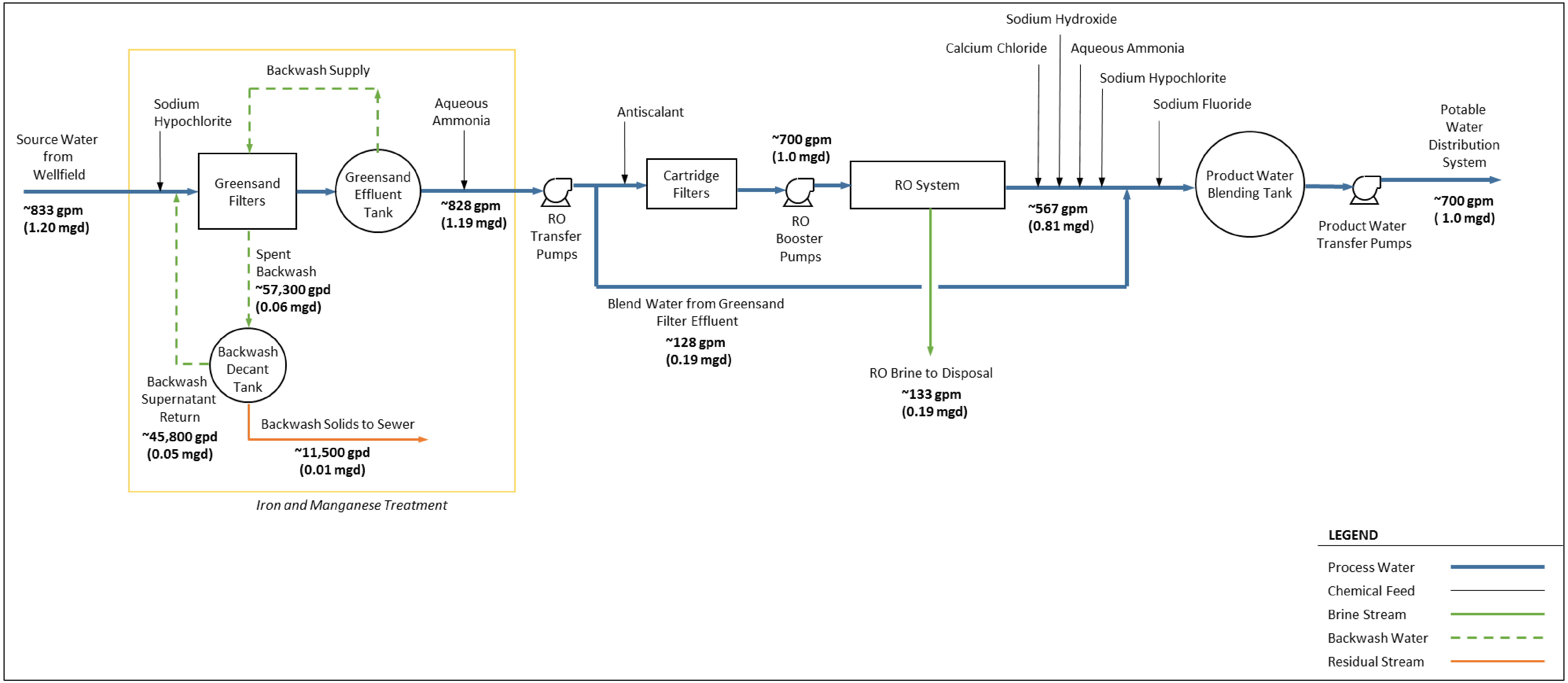


Figure 6-2: Groundwater Desalter Process Flow Diagram

Table 6-3: Groundwater Desalter Footprint Requirements

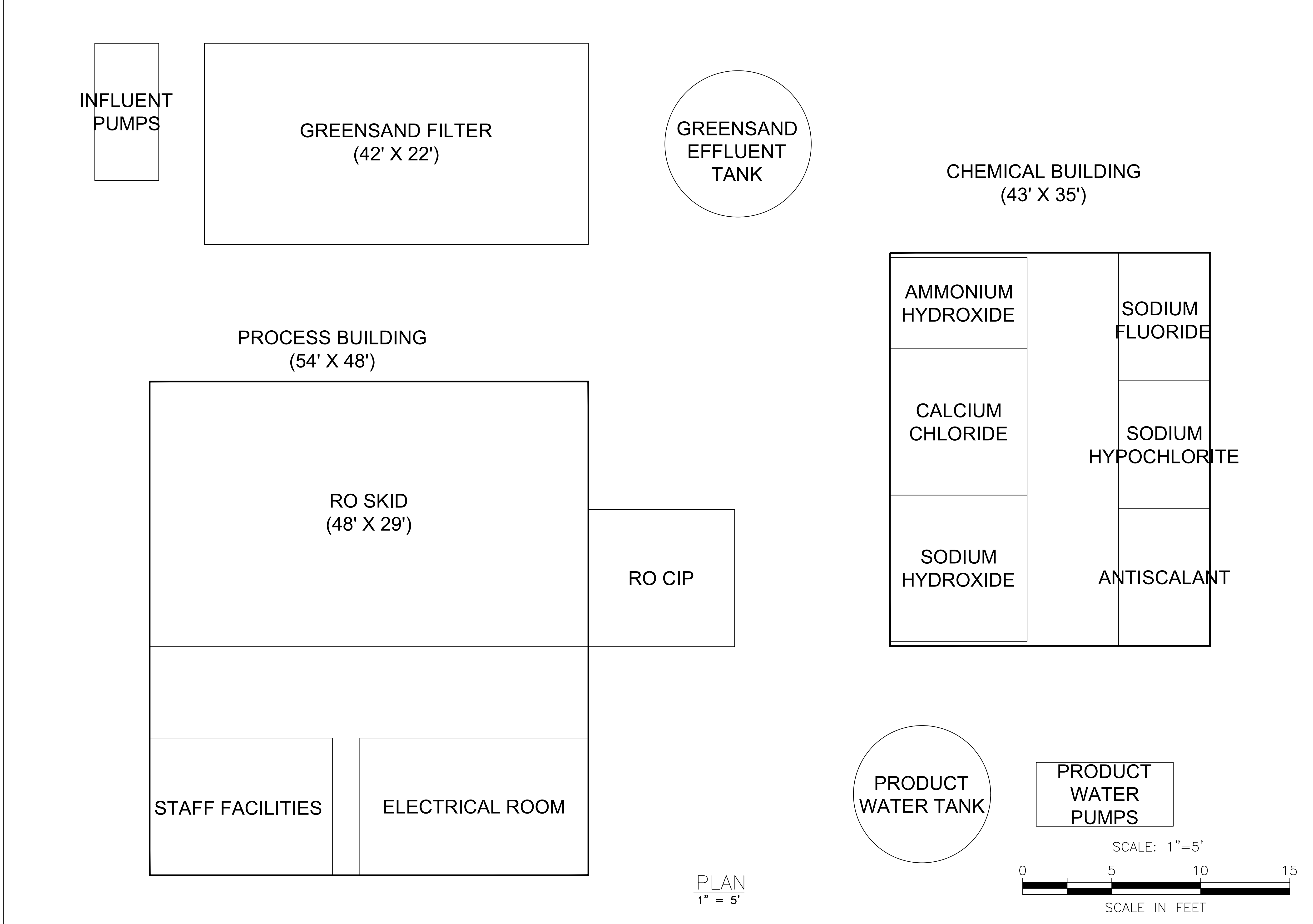
Facility Description	Footprint
Influent Pump Station	15' x 7'
Greensand Filter	42' x 22'
Greensand Effluent Tank	16' dia. tank
Process Building	**54' x 48'**
RO membrane system	48' x 29'
Electrical	15' x 25'
Staff Facilities	15' x 20'
RO clean-in-place system	16' x 15'
Product Water Tank	15' dia.
Product Water Pumps	15' x 7'
Chemical storage and feed facilities	
Sodium Hypochlorite	14' x 10' containment area
Ammonium Hydroxide	15' x 10' containment area
Calcium Chloride	16' x 15' containment area
Sodium Hydroxide	16' x 15' containment area
Sodium Fluoride	14' x 10' containment area
RO Antiscalant	15' x 10' containment area

Table 6-4: Water Quality for Treatment Planning

Parameter (1)	Unit	Source Groundwater (2)	Drinking Water MCL (3)	Proposed Product Water (4)
Calcium	mg/L	305	--	71
Chloride	mg/L	1,160	500	238
Iron	mg/L	ND	0.3	ND
Manganese	mg/L	1.75	0.05	0.01
Nitrate (as N)	mg/L	1.49	10	0.4
pH	--	7.20	--	7.4
Phosphourus	mg/L	0.10	--	0.02
Sodium	mg/L	622	--	136
Total Dissolved Solids	mg/L	3,105	1,000	680

Notes:

1) Key water quality parameter used in treatment design source water quality.
2) Source groundwater quality from the Morgan Run dataset.
3) Primary and Secondary Maximum Containment Levels (MCL) for drinking water.
4) Calculated design effluent for key water quality parameters resulting from proposed Groundwater Desalter Process Flow Diagram.



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PRELIMINARY PLANNING LEVEL DRAWINGS

NOTICE:
EXISTING UTILITY LOCATIONS SHOWN ARE APPROXIMATE AND SUBJECT TO CHANGE BASED ON FIELD VERIFICATION DURING FUTURE PHASES OF WORK. NOT ALL UTILITIES ARE SHOWN. DETAILED DESIGN AND FIELD INVESTIGATION NECESSARY TO DEVELOP FUTURE CONSTRUCTION CONTRACT DOCUMENTS.

OLIVENHAIN MUNICIPAL WATER DISTRICT
SAN DIEGUITO VALLEY BRACKSIH GROUNDWATER DESALINATION STUDY

FIGURE 6-3

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6.3 Projected Cost

Table 6-5 provides a summary of the Project capital, O&M and annualized costs along with the estimated unit cost of water in today's dollars. Costs include all associated facilities such as the well field, raw water conveyance, desalination plant, land acquisition, product water conveyance, and brine disposal. Refer to **Appendix D** for detailed costs and assumptions. As a comparison to imported water costs from SDCWA and to ocean desalination in Carlsbad, **Figure 2-2** provides the projected Project annualized capital costs along with the Project's O&M costs escalated through 2026. In 2022, the cost of water produced from this Project is expected to be $2,105 with O&M escalation as compared to SDCWA's imported treated water costs ranging from $2,100 to $2,200. By 2023, it is projected that this Project's cost of water will be $2,127 as compared to SDCWA's imported treated water costs ranging from $2,200 to $2,350.

Table 6-6 provides a breakdown of the $2,264,000 annualized cost of water.

Table 6-5: Projected Cost

	2017 $	2022 $
Capital Cost (1)	$29,982,000	--
O&M Cost (2)	$634,000	$728,000
Annualized Cost (2)	$2,264,000	$2,357,000
Unit Cost of Water ($/AF)	**$2,021**	**$2,105**

Notes:
1) Capital costs based on 2017 dollars.
2) Escalated at 3.5% annually from 2017.

Table 6-6: Projected Annualized Cost Breakdown

	2017 $	% of Cost
Debt Service	$1,630,000	72%
Power (1)	$347,000	15%
Maint. & Replacmt. (2)	$101,500	4%
Op Staff & Testing (3)	$130,000	6%
Brine Disposal (4)	$55,500	2%
Total	**$2,264,000**	**100%**

Notes:
1) Reflects 1,927,000 kWh of annual consumption for Well pumping, pretreatment, RO pumping, Brine pumping, and Product water pumping
2) Maintenance & Replacement of Production wells, Well wiping, Backwash solids line, Brineline, Brine pump, Product water piping, Product water pump.
3) Operations staff and Testing includes Chemical handing & purchase costs, operation of Iron & Manganese pretreatment system, operation of Desalter, Sewer discharge of Backwash.
4) Brine disposal estimate fee for connection to SEJPA ocean outfall based on 0.19 mgd flowrate.

6.4 Institutional Arrangements and Commitments

OMWD began its public outreach efforts for the Project by communicating with local government officials including the City and County of San Diego; the local water wholesaler, SDCWA; adjacent wastewater agencies SEJPA, Rancho Santa Fe CSD, Whispering Palms CSD, and Fairbanks Ranch CSD and the adjacent water district, SFID.

OMWD received positive feedback and general support for the Project from these agencies. The City of San Diego, SFID and SDCWA, key stakeholders within the jurisdiction area, have provided letters of support (**Appendix E**). OMWD has also met with staff of non-governmental organizations including the San Dieguito River Park Joint Powers Authority and the San Dieguito River Valley Conservancy and will continue to communicate with them as information about the study and possible project becomes available.

In late June 2017, OMWD staff presented to the San Diego RWQCB and received positive feedback confirming that the Project aligns with the board's "Practical Vision."

Staff also reached out to several key stakeholders and land owners in the project area where a well or desalination plant may be placed and received no opposition. Although formal agreements are not necessary at this time, OMWD staff is optimistic about the potential for collaboration with these parties based on positive feedback from these meetings.

6.5 Environmental

OMWD does not anticipate that the Project will have significant impacts on endangered or threatened species, public health or safety, hydrology and water quality, regulated waters of the United States, or cultural resources. OMWD does not anticipate that the Project will have significant environmental effects as defined by State and federal environmental laws, with the possible exception of air quality and greenhouse gas (GHG) emissions. OMWD will prepare an environmental impact report (EIR), and possibly an environmental impact statement (EIS) depending on federal involvement in the Project, to obtain California Environmental Quality Act (CEQA) and/or National Environmental Policy Act (NEPA) coverage for the Project. While specific sites for project facilities have not yet been selected, OMWD has identified the potential environmental impacts described in **Table 6-7,** along with potential mitigation measures.

Table 6-7: Potential Environmental Impacts and Mitigation Measures

Potential Impact	Potential Mitigation
Air quality and greenhouse gases (GHGs) during construction and operation.	Project construction will comply with local air quality requirements. At the plant and pipeline sites, typical dust control measures, like watering, will be employed. Emergency generators will comply with and be permitted by the State of California Air Quality Management District. Operational air quality emissions may exceed local regulations, however, due to the RO system. A detailed air quality analysis will be completed as part of the CEQA process and mitigation will likely be necessary.
Greenhouse gas emissions during operation.	Operational GHG emissions may exceed local regulations due to the RO system. However, OMWD will comply with State of California Assembly Bill 32 regarding the reduction of GHGs on a district-wide basis, including the desalter. Calculation of GHG emissions would be

Potential Impact	Potential Mitigation
	necessary, but would likely be de minimus because OMWD has a contract for 100 percent renewable energy.
Biological resources impacts during construction and operation.	Construction of the well, plant, and pipelines may have minor impacts to biological resources, such as nesting birds located within adjacent riparian habitat. Biological resources will be surveyed prior to design and mitigation measures, such as restricted construction activity during nesting season, will be established to ensure that potential impacts to identified species are avoided or minimized. Sensitive species and their habitats will be avoided wherever possible. The Project is not expected to impact wetlands or waters of the U.S. as regulated by U.S. Army Corps of Engineers, San Diego RWQCB, and California Department of Fish and Wildlife. The Project will comply with adopted Habitat Conservation Plans and Natural Community Conservation Plans. Operation of the Project is not anticipated to affect biological resources as all O&M activities will be constrained to the developed well and plant sites.
Long-term biological resources impacts during operation.	Pumping rates will be sustainable and not impact riparian and aquatic habitats along the San Dieguito River.
Cultural resources impacts during construction and operation.	Cultural resources will be surveyed prior to design and the Project will be designed to avoid identified cultural sites. Onsite construction monitoring will likely be necessary to ensure that discovery of any unidentified archeological resources are handled appropriately. OMWD will comply with California Assembly Bill 52 regarding formal consultation with Native American tribes about the proposed Project.
Hydrologic impacts during construction and operation.	OMWD will obtain an NPDES discharge permit for its brine discharge to the SEOO and will need to comply with the effluent limitations in the permit. Hydrologic impacts, including erosion and siltation during construction of the wells, plant, and pipeline alignments, would be mitigated through enrollment in an NPDES construction general permit, completion of a storm water pollution prevention plan, and implementation of required BMPs. The proposed well and plant sites are within the 100-year floodplain and must be raised in elevation to protect them from a 100-year storm event. Design of these facilities will need to ensure protection from flooding and damage to persons or property. A LOMR will be required to change the FEMA FIRM to reflect the facility protections.
Groundwater levels, supplies, and recharge during operation.	The Project will be sustainable with extraction rates matching recharge rates. The Project will not impact private wells.
Transport, use, and disposal of hazardous materials during construction and operation.	The desalter will use a variety of chemicals typically used in water treatment, possibly including potassium permanganate, scale inhibitors, membrane cleaning solutions, chlorine, ammonia, and caustic soda. Some of the chemicals will be delivered to the plant while others, like chlorine, may be generated on-site. Chemical storage will

Potential Impact	Potential Mitigation
	have full containment structures to prevent spills along with alarms. OMWD will prepare Business Plans and Risk Management and Prevention Plans and submit them to the County of San Diego.
Noise impacts during construction and operation.	Construction noise is considered a nuisance and is regulated by the local municipalities. Construction equipment will be fitted with approved mufflers and temporary soundwalls may be utilized. To minimize operational noise for adjacent parcels, well and treatment plant equipment will be equipped with noise mitigation enclosures, if necessary.
Traffic impacts during construction and operation.	Construction traffic associated with well, plant, and pipeline construction will be temporary. However, the workforce will be relatively small and the impacts should be insignificant. Construction traffic controls will be employed to reduce public hazards. The desalter will be operated by one to three staff and will not affect long-term traffic patterns.

6.6 Implementation Plan

Figure 6-4 provides an overview of the key project components of the recommended Project in the San Dieguito Valley. With completion of the Feasibility Study in 2017, OMWD may begin pilot test borings. Test well operation will commence with water quality sampling and pretreatment field testing to verify design criteria. Well pump tests will also be completed and the groundwater model updated to verify basin capabilities. See **Appendix F** for draft scope of work document for pilot testing of the proposed project. The Project would then move into design in 2019. Permitting and Environmental activities could commence concurrently with pilot testing. The CEQA process would need to be completed prior to construction in 2020 with the Project operational in 2021.

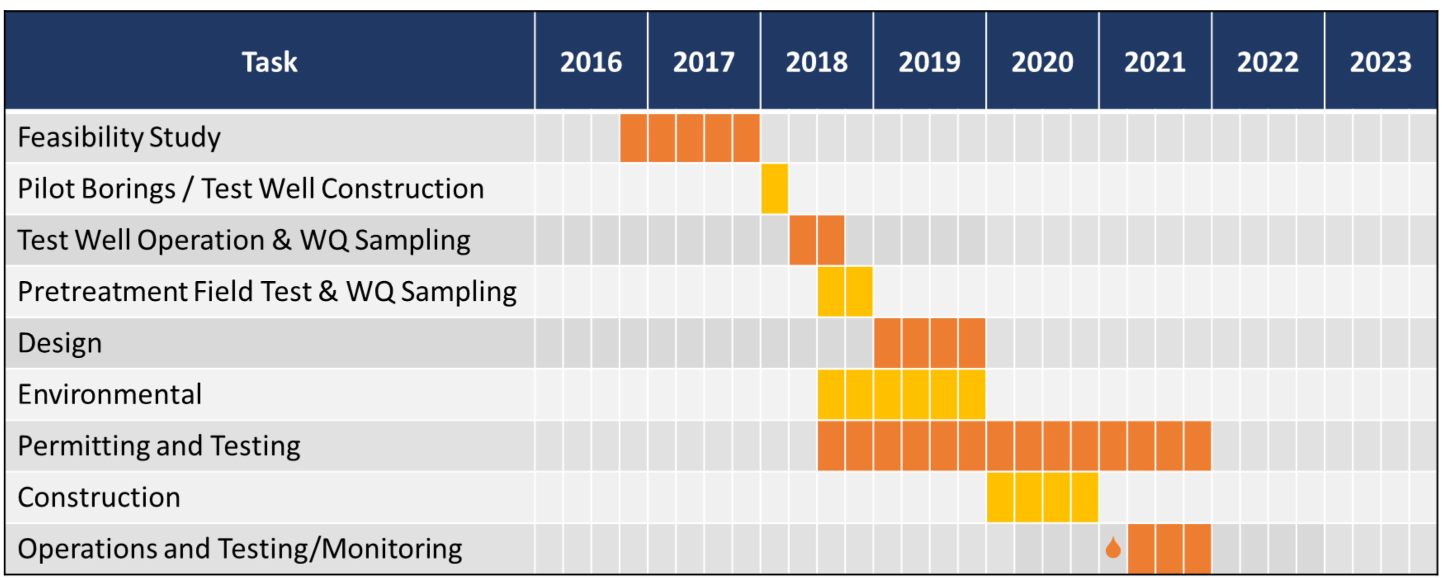

Figure 6-4: Recommended Groundwater Desalination Project Schedule

6.7 Operational Plan

Operation of a water treatment plant with RO technologies requires specialized training. OMWD will need to train staff, hire new staff, or contract-out maintenance of the proposed facility.

6.8 Public and Stakeholder Involvement

Public Outreach Goals and Objectives

In order to educate stakeholders and the general public about the San Dieguito Valley Brackish Groundwater Desalination Study and its potential as a locally sourced water supply, OMWD implemented a comprehensive public outreach program to accompany the study. The overarching public outreach goals of the program are to provide accurate and timely information about this important study, share the benefits and constraints of the potential Project, and garner support for moving it forward.

The objectives of the public outreach program include:

1) Providing branded project information in layman's terms to target audiences via a variety of communication methods.
2) Educating audiences about the Project study and the importance of local water reliability.
3) Providing opportunities for stakeholders to have an open dialogue and provide feedback about the Project.
4) Garnering support for the Project should study results support moving it forward.
5) Providing an accurate gauge of public and political will to OMWD leadership in order to guide future decisions about the Project.
6) Preparing to address questions from stakeholders about the effects of the Project.

Public Outreach Implementation

To implement these objectives, OMWD created a strategic communications outreach plan; identified primary, secondary and tertiary targeted audiences; created key messages to address various audiences in layman's terms; and developed a unique project brand used in multiple project collateral pieces (see project logo right and supporting tactics below).

Project Logo

Public Outreach Tactics - Completed

A number of tactics have been implemented in order to educate a targeted group of key stakeholders about the study and potential project. This group includes political officials, potential end users and nearby land owners who may be partners should the project move forward. Project information has also been provided in a variety of forms for the general public.

A summary of the outreach tactics completed to date include:

- **Outreach Strategy**: Developed goals, objectives, strategy and tactics for outreach – January 2017
- **Key Messages:** Developed project narrative and key messages along with internal talking points and FAQs – February 2017
- **Creative Concept and Collateral:** Developed overall creative concept to give the project a clear identity. Created project collateral including process infographic, fact sheet, FAQs, postcard and PowerPoint presentation– February 2017

- **Website:** Developed project web content for OMWD website including landing page for overall Groundwater Project, San Elijo Valley Groundwater Basin page, San Dieguito Valley Groundwater Basin page – February 2017
- **Key Stakeholder Meeting:** Coordinated a public meeting to bring together key stakeholders to discuss project, solicit feedback and gain support of project potential – March 2017.
- **Key Stakeholder 1x1 Outreach:** Coordinated more than 20 one-on-one meetings to educate and garner support from key elected officials, NGOs and other stakeholders – Ongoing
- **Watching Water Newsletter:** Developed article on potential project for OMWD's newsletter – May 2017

Refer to **Appendix G** for developed outreach figures.

Public Outreach Tactics: Ongoing and Pending

OMWD will provide updated outreach and educational materials to key stakeholders and the general public. These tactics are being used to maintain project interest and to distribute study findings while showcasing the Project. The tactics include:

- **Public Meeting**: Plan, publicize and execute a public outreach meeting to educate the general public on project and solicit feedback/support – Fall 2017
- **Media Relations:** Develop news release to announce public workshops and to frame project for key media outlets in OMWD's sphere of influence – Fall 2017 then ongoing
- **Social Media:** Post approved messages at key intervals of study – Fall 2017 then ongoing
- **Letters of Support:** Solicit and collect letters supporting the project from government and non-government agencies – Fall 2017
- **Video**: Produce a two-minute video showcasing the study results and potential project to be shown at public meetings, speaking engagements and used on OMWD's website and social media channels (if funding permits) – Fall 2017
- **Website:** Update project webpages as new information becomes available – Ongoing
- **Watching Water Newsletter:** Develop articles for OMWD's newsletter as new project information becomes available – Ongoing

Results, Agreements, and Feedback

Outreach was also conducted with potential end-users of the Project. A positive reception was received about the potential utilization of this new water source.

In late June 2017, OMWD staff presented to the San Diego RWQCB and received positive feedback confirming that the Project aligns with the board's "Practical Vision."

Overall, there is no known opposition to the Project at this point. OMWD has sustained efforts in its outreach campaigns over the last several years to emphasize the critical nature of water supply diversification and believe this effort will return dividends if and when the Project moves forward.

Closing

This Project will benefit OMWD's customers through improved water supply reliability and water rate stability. As San Diego County's major sources of potable water—the State Water Project and the Colorado River—are facing significant challenges, local supplies such as desalinated groundwater are imperative to maintaining a $186 billion regional economy that is dependent upon a reliable source of water.

Additionally, several thousand residents in the valley will potentially benefit directly from improved groundwater quality and overall resource management. The study also provides valuable information to others who are considering similar brackish groundwater desalination projects.

6.9 Potential for Regional Project

The goal of this feasibility study is to determine if 1.0 mgd of brackish groundwater can provide a reliable, local potable water supply to OMWD. The study area covers more than 20 square miles and is a major project for the region. Although not a project driver or evaluation factor in the recommended project selection, the Project has potential to be combined with others under consideration by regional stakeholders. Below are potential regional efforts that could offer opportunities for sharing facilities and/or cost of construction:

- San Elijo Valley Brackish Groundwater Desalination Study includes groundwater production wells in the San Elijo Valley, a desalination plant, and associated brine disposal. Potential for shared brine line and/or other major facilities.
- SEJPA/SDWD/SFID/OMWD Recycled Water Expansion Plan Development is a study evaluating the alternatives for both potable reuse at the San Dieguito Reservoir and expansion of the non-potable recycled water system to the SFID eastern service area and the Bridges development within OMWD. Potential for shared construction costs for pipelines along Rambla de las Flores route.
- Rancho Santa Fe CSD WRF desalination concept includes desalinating effluent from the Rancho Santa Fe CSD WRF and blending with non-potable recycled water for a source of irrigation at the RSF Golf Course. Potential for cost sharing for brine disposal. Project depends on whether non-potable water will be available to the golf course.
- Fairbanks Ranch CSD Water Pollution Control Facility and Whispering Palms CSD WRF could potentially participate in contributing effluent to the Rancho Santa Fe CSD WRF desalination facility.

Section 7 Potential Construction Financing Plan and Revenue Program

This section provides a discussion of the Project implementation financing plan, willingness of OMWD to pay for its share of the Project's costs, a funding plan, and description of funding sources. OMWD is working to diversify its water supply via water recycling and possible future investments in brackish water treatment. Investments that diversify the OMWD's water supply are positive for credit quality in the long-term because they provide more reliable supplies at more predictable prices. However, new projects are likely to pressure customer rates to fund the projects.

7.1 Funding Sources

OMWD has received funding for the Project from the California Department of Water Resources (DWR) Water Desalination Grant-Round 3 - $250,000 for this San Dieguito Brackish Groundwater Desalination Feasibility Study. OMWD will continue to pursue funding for the Project's construction capital components as follows:

- California DWR Water Desalination Grant-Round 4 (currently soliciting for applications) - $600,000 requested (grant maximum of $1,500,000) for Brackish Groundwater Desalination Design Pilot
- California DWR Water Desalination Grant-Round 5 - $500,000 for Brackish Groundwater Desalination Environmental Documentation
- California DWR Water Desalination Grant-Round 5 - $10,000,000 for Brackish Groundwater Desalination Construction

To fund the Project, OMWD will issue Water Revenue Bonds which will be re-paid through capacity fees and water sales. Fitch Ratings has assigned a 'AAA' rating to OMWD (Fitch, September 2016) with a $16.6 million financing in authority water revenue bond. **Table 7-1** provides a summary of the proposed project funding from OMWD's 10-year Capital Improvement Plan (CIP). The current $55-million CIP includes approximately $17-million of debt issuance for this potential brackish water treatment facility. Per the Fitch Ratings report, this plan is manageable and would not meaningfully change OMWD's debt burden given the rapid amortization of outstanding bonds. On an annual basis, OMWD Board of Directors will authorize and appropriate the expenditures.

Table 7-1: Potable Water Capital Improvement Plan (CIP) Fund

Project	FY 16/17	FY 17/18	FY 18/19	FY 19/20	FY 20/21	Total
Groundwater Desalination	$1,000,000	$1,560,000	$3,245,000	$6,974,000	$7,183,000	**$19,962,000**
Potential Funding	-	$1,500,000 Pilot	-	$500,000 Enviro.	$10,000,000 Const.	**$12,000,000**

7.2 Subsidies

OMWD has no subsidies reported.

7.3 Sunk Costs and Indebtedness

OMWD is willing to fund its share of the Project. To date, OMWD has invested in studying the feasibility of brackish groundwater desalination with no sunk capital costs in critical infrastructure for the Project.

To fund the Project, OMWD will issue Water Revenue Bonds starting in FY19 which will be re-paid through capacity fees and water sales. For FY19, OMWD water system revenue to debt service ratio is projected to be 2.69 compared to a minimum requirement of 1.25 as shown in **Table 7-2**. Fitch Ratings has assigned a 'AAA' rating to OMWD (Fitch, September 2016) with a $16.6 million financing in authority water revenue bond. The current $55-million CIP includes approximately $17-million of debt issuance for this potential brackish water treatment facility. Per the Fitch Ratings report, this plan is manageable and would not meaningfully change OMWD's debt burden given the rapid amortization of outstanding bonds.

S&P Global Ratings assigned a 'AA+' rating to OMWD and affirmed a 'AA+' long-term rating and underlying rating (SPUR) on OMWD's parity obligations. The rating reflects the general creditworthiness of OMWD's water system and view of the combination of extremely strong enterprise and financial risk profiles which continued to be limited by OMWD's heavy reliance on imported water; exposing OMWD to wholesale cost increases. The outlook on all ratings is stable (S&P Global, September 2016).

Table 7-2: OMWD Projected Revenue to Debt Coverage

Olivenhain Municipal Water District
Projected Financial Water Operations (Potable and Recycled)
($1,000s - Fiscal Years Ending June 30)

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Water System Revenue										
Water Sales [1]	46,541	49,369	52,104	55,257	59,014	60,336	64,281	68,006	71,949	76,125
Other Operating Revenues	2,679	2,733	2,864	2,983	3,108	3,240	3,378	3,523	3,676	3,837
Capacity Fee, Net of Credit	923	1,444	1,815	2,122	1,591	975	707	655	591	555
Investment Income [2]	400	464	470	478	556	587	668	734	826	954
Property Taxes	3,200	3,200	3,201	3,201	3,201	3,202	3,202	3,202	3,203	3,203
Other Non-Operating Revenues	82	82	82	82	25	25	25	25	25	25
Total Water System Revenue	**53,825**	**57,293**	**60,535**	**64,124**	**67,496**	**68,365**	**72,260**	**76,146**	**80,270**	**84,698**
Water System Expenditures										
Purchased Water Cost - Potable	24,756	26,191	27,617	29,239	30,938	32,737	34,640	36,652	38,782	41,037
Purchased Water Cost - Recycled	852	1,325	1,877	1,968	2,064	2,165	2,271	2,383	2,489	2,599
Operations and Maintenance	17,286	17,805	19,229	19,806	20,400	21,012	21,642	22,292	22,960	23,649
Total Water System Expenditures	**42,894**	**45,321**	**48,723**	**51,013**	**53,402**	**55,915**	**58,553**	**61,327**	**64,231**	**67,285**
Net System Revenues	**10,931**	**11,972**	**11,812**	**13,111**	**14,094**	**12,450**	**13,707**	**14,819**	**16,039**	**17,413**
Coverage Calculation										
2015A Refunding Bond Debt Services	2,406	2,409	2,408	2,403	2,405	2,413	2,410	2,414	2,407	2,405
2016A Refunding Bond Debt Services	975	979	976	977	976	980	977	978	977	975
2012 SRF Debt Services	1,070	1,070	1,069	1,070	1,070	1,070	1,070	1,070	1,070	1,070
Total Debt Services	**4,451**	**4,458**	**4,453**	**4,450**	**4,451**	**4,463**	**4,457**	**4,462**	**4,454**	**4,450**
REVENUE TO DEBT COVERAGE RATIO	**2.46**	**2.69**	**2.65**	**2.95**	**3.17**	**2.79**	**3.08**	**3.32**	**3.60**	**3.91**
Debt Coverage Ratio Requirement: 1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25

[1] Estimated based on projected increases in fund balances, assuming a 5% planned rate increase for the next 10 years at level 1 rates.
[2] Investment income is calculated based on projected fund balances in the District's reserves.

7.4 Pricing Policy

The price of the potable water (desalinated brackish groundwater) produced from this Project will be same as OMWD rates.

The cost of untreated imported water from SDCWA has increased by 32% to $885/AF for 2016 from $672/AF for 2011. It is forecasted that rates will rise to $1,226/AF by 2020. To purchase treated water, OMWD pays an additional treatment charge currently set at $280/AF (2016) that is forecasted to increase to $479/AFY by 2020 for a total treated water cost of $1,705/AF in 2020.

S&P Global indicates that OMWD's CIP is manageable at $55.9 million. $16.6 million of additional parity obligations in the FY2018 are planned to fund a portion of the Project. The balance of the CIP will be funded on a pay-as-you-go method, including from grants, surplus rate revenue and capacity fees.

7.5 Future Desalinated Water Sales

As discussed in **Section 2** and **Section 3** of this Study, the San Dieguito Valley Groundwater Basin can accommodate 1,350 AFY (1.2 mgd) of raw groundwater extraction while sustainably managing groundwater levels in the basin to produce 1,120 AFY (1.0 mgd) of treated water. As shown in **Appendix B**, the model reflects that up to 1,950 AFY could be extracted if water rights are obtained. As shown in OMWD's 2015 UWMP (Table 40-3), the Potable and Raw Water demands are projected to increase from 19,549 AFY in 2015 to 21,250 AFY in 2040. If water rights can be obtained, there will be a demand for future brackish groundwater desalination sales within OMWD. Desalinated brackish groundwater pricing will continue to be the same as potable water pricing when implemented within OWMD service area.

7.6 Projected Annual Costs

For the recommended Project 1A, the estimated annual O&M cost is $634,000. The projected capital cost of Project 1A is $29,982,000 with a total annualized cost of $2,264,000.

The comparable No-project alternative is to purchase treated water from SDCWA. The groundwater desalination project horizon for start-up is 2022. SDCWA treated water costs are expected to be $2,200/AFY per **Figure 2-2.**

The recommended groundwater desalination Project 1A cost of water is $2,021/AFY.

7.7 Sensitivity Analysis

As shown previously in **Section 5.5**, a sensitivity analysis was completed among the 6 project alternatives. The sensitivity analysis scored each alternative against key project criteria and then weighted that criteria among the following focused areas: Equal, Cost-Focused, Non-Cost Focused, and Operational Focused.

A cost allocation issue would occur if outside funding cannot be obtained for this Project. The selected project criteria did not account for outside funding as it would impact all project alternatives equally. If outside funding cannot be obtained, the sensitivity analysis that is Cost-Focused should be re-evaluated as cost may be the major project driver. Note, OMWD is committed to funding the Project through Water Revenue Bonds. $17-million of debt issuance is committed for this potential brackish water treatment project.

Another cost allocation issue will be a potential increased cost for OMWD treatment of raw water from SDCWA. As OMWD introduces a new groundwater supply, it will reduce the production from the DCMWTP by an equal amount, increasing the unit cost of water from this facility.

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