



SAN JUAN BASIN AUTHORITY

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March 24, 2016

Municipal Water District of Orange County
18700 Ward Street
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Attn: Mr. Karl Seckel

The Metropolitan Water District of Southern California
Water Resources Management Group
700 North Alameda Street
Los Angeles, CA 90012
Attn: Ms. Stacie Takeguchi

Subject: **SAN JUAN BASIN GROUNDWATER AND DESALINATION
OPTIMIZATION PROGRAM, FOUNDATIONAL ACTIONS FUND
(FAF) PROGRAM FINAL REPORT**

Dear Mr. Seckel and Ms. Takeguchi:

San Juan Basin Authority (SJBA) is pleased to submit the attached San Juan Basin Groundwater and Desalination Optimization Program Final Report. This Report summarizes the project objectives, tasks performed, and accomplishments achieved by SJBA associated with the Foundational Actions Fund (FAF) Program.

The project remains consistent with the original funding budget and the project schedule as amended to extended project report delivery date to March 31, 2016.

I am informed and believe that the information contained in this report is true and that the supporting data is accurate and complete.

Respectfully,

SAN JUAN BASIN AUTHORITY

A handwritten signature in blue ink, appearing to read "Daniel R. Ferons".

Daniel R. Ferons
Administrator

San Juan Basin Authority Groundwater and Desalination Optimization Program Foundational Actions Fund (FAF) Program Final Report



March 2016



SAN JUAN BASIN
GROUNDWATER AND DESALINATION OPTIMIZATION PROGRAM
FOUNDATIONAL ACTIONS FUND (FAF) PROGRAM
FINAL REPORT

March 28, 2016

Prepared for:
Municipal Water District of Orange County
Metropolitan Water District of Southern California

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LIST OF ACRONYMS AND ABBREVIATIONS

AFY/afy	acre-feet per year
Ac-ft	acre-feet
ACEC	American Council of Engineering Companies
ACOE	United States Army Corps of Engineers
AOP	advanced oxidation process
APM	adaptive production management
AWT	advanced water treatment
Basin Plan	Water Quality Control Plan for the San Diego Region
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CEC	compounds of emerging contaminants
CEQA	California Environmental Quality Act
CSJC	City of San Juan Capistrano
DDW	Division of Drinking Water (State of California)
DPH	Department of Public Health (State of California)
DWR	Department of Water Resources (State of California)
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ET	evapotranspiration
FAF	MET Foundational Actions Fund Program
FAT	full advanced treatment
Ft	feet
Ft-bgs	feet below ground surface
GRRP	Groundwater Replenishment Reuse Project
GW	groundwater
GWFMF	Groundwater Facilities Management Plan
GWRF	Groundwater Recovery Facility
I-5	Interstate 5
INJ	injection recharge
IPR	indirect-potable reuse
JPA	Joint Powers Authority
Metropolitan / MET	Metropolitan Water District of Southern California
MF-RO	micro-filtration and reverse osmosis
MGD	million gallons per day

MNWD	Moulton Niguel Water District
MNWP	Multi-Node Well Package
MT3D	modular 3-D multi-species transport model
MWDOC	Metropolitan Water District of Orange County
NCCP/HCP	Natural Community Conservation Plan / Habitat Conservation Plan
NEPA	National Environmental Policy Act
NPR	non-potable recycled
NWRI	National Water Research Institute
OCWD	Orange County Water District
Qtr	quarter
RO	reverse osmosis
RW	recycled water
RWC	recycled water contribution
RWC	recycled water content
RWQCB	Regional Water Quality Control Board
SCWD	South Coast Water District
SJBA	San Juan Basin Authority
SJBGFMP	San Juan Basin Groundwater Facilities Management Plan
SMWD	Santa Margarita Water District
SOCOD	South Orange Coastal Ocean Desalination Project
SOCWA	South Orange County Wastewater Authority
SWR	surface water recharge
SWRCB	State Water Resources Control Board (State of California)
TAC	SJBA Technical Advisory Committee
TAG	SJBA Technical Advisory Group (formerly TAC)
TDS	total dissolved solids
TM	technical memorandum
USFWS	United States Fish and Wildlife Service
URT	underground retention time
UV	ultraviolet (light)
WEI	Wildermuth Environmental Inc.
WIP	Water Importation Pipeline
WRF	Water Recovery facility
WW	wastewater

1. EXECUTIVE SUMMARY

San Juan Basin Authority (SJBA) has been actively pursuing development and expansion of groundwater production facilities, while ensuring preservation and sustainability of the local water resources. Current water demands of the SJBA member agencies is approximately 86,400 acre-feet per year (afy) for a total service area population of about 406,200. This demand is satisfied through imported potable water sources (69,600 afy) augmented by local groundwater production (5,268 afy), and local recycled water (14,000 afy) supplies. Demand within the basin is expected to increase to about 106,400 afy by 2035 due to population growth.

The San Juan Basin Groundwater Facilities Management Plan (SJBGFMP) recognized that in-stream recharge along both San Juan Creek and Arroyo Trabuco Creek is the only viable large-scale recharge method for the San Juan Basin due to the lack of suitable off-stream sites for stormwater storage and recharge, and the inability of the basin to accept large amounts of recharge at a specific site. The San Juan Basin watershed has an alluvial stream morphology that extends offshore and currently the aquifer has storage capacity that is underutilized. Without adaptive management and expanded recharge of the watershed there is limited opportunity for production of potable water. Basin enhancement concepts include:

- increasing groundwater recharge utilizing stormwater capture
- introduction of recycled water for groundwater recharge
- dry-weather discharge of recycled water to creeks
- application of alternative groundwater production techniques
- protecting against seawater intrusion

In 2013 the SJBA, in conjunction with the Municipal Water District of Orange County, submitted a proposal to the Metropolitan Water District of Southern California for a Foundational Actions Fund (FAF) Program to evaluate the feasibility of implementing alternative six of the SJBGFMP. The objective of the FAF Program was to analyze options for sustainable, long-term use of an impaired watershed that is typical to Southern California.

Program alternatives evaluated in the FAF Program study included a seawater extraction barrier to ensure that seawater would not intrude into San Juan Basin due to upstream groundwater pumping and to produce a new source of water. Modeling work conducted for this project confirmed the hydrologic feasibility of the creation of a 3,000 afy extraction barrier would prohibit seawater intrusion along the coastal extent of San Juan Creek. For all Program alternatives the seawater barrier accounted for about 2,100 afy from the ocean, about 700 afy

from groundwater originating upstream, and the remaining 200 afy from vertical recharge that occurs between the coast and the SCWD wells.

Six conceptual strategies were developed from the project alternatives for refinement and cost evaluation. Each conceptual strategy contained some or all of the following program elements:

- seawater extraction barrier (in absence of a desalination facility)
- enhanced stormwater recharge
- recycled water recharge
- in-lieu recharge through the offset of private well pumping with direct recycled water deliveries to the pumpers.

The conceptual strategies were then grouped into two categories as they relate to the recharge elements of the Program:

- surface water recharge (SWR) and
- injection (INJ).

Surface water recharge involves recharge with rubber dams and/or incidental recycled water recharge. Injection involves construction of injection wells in strategic locations to inject recycled water into the basin and subsequently recover it downstream without allowing rising groundwater to occur. Rubber dams would create a series of ponds in the stream channel making the channel flow “bank to bank” thereby maximizing the wetted area and recharge to capture storm water runoff before it reaches the ocean. During wet periods, the rubber dams would remain inflated as long as the flow in the channel results in a stage less than one-foot greater than the rubber dam crest. When this stage limit is exceeded, the rubber dam would deflate restoring the full flood capacity of the channel. The rubber dam would re-inflate as soon as the flow in the channel is reduced for subsequent recharge.

Current State regulations for injection and for some surface recharge applications of recycled water require Full Advanced Treatment (FAT). There are a few options for achieving FAT, but the most typical process include micro-filtration and reverse osmosis (MF-RO) followed by advanced oxidations processes (AOP), which achieve the requisite chemical contaminant removal. For the facilities included in this planning project, a combination of ultraviolet (UV) light with a strong oxidant such as hydrogen peroxide (UV-AOP) has been considered for treating water prior to injection. However, due to the cost impact of advanced treatment of the recycled water prior to injection combined with the current requirements to treat the groundwater produced, the injection options were not considered in the final Concept Strategies.

The key findings from the San Juan Basin Desalination and Optimization Program include:

- injection of treated recycled water into an impaired groundwater basin is not currently economically feasible at this time due regulatory requirements to implement FAT water treatment processes for the recharge water combined with the current necessity for micro-filtration and reverse osmosis treatment for production water resulting in a “double treatment” of the water.
- installation of the seawater extraction barrier, although technically feasible, is not currently economically feasible at this time due to the necessity to construct a new groundwater treatment facility for a limited 3,000 afy production capacity.
- utilization of rubber dams for stormwater capture is feasible from both regulatory and environmental perspectives and can be a cost-effective source for groundwater recharge.
- utilization of rubber dams to promote groundwater recharge from recycled water during dry-periods is feasible from both regulatory and environmental perspectives and can be a cost-effective source for groundwater recharge.
- incidental recharge of recycled water is a viable alternative for groundwater recharge and has multiple environmental benefits for the local watershed.
- there is an adequate supply of recycled water from the existing wastewater treatment facilities, although some treatment modifications may be required at individual plants, provided that seasonal storage facilities are utilized (for off-peak water storage).

The final Concept Strategies (all surface water strategies) for project consideration included:

- SWR-1 *Storm Water Capture Rubber Dams*
- SWR-2 *Storm Water Capture + Recycled Water Recharge Using Rubber Dams*
- SWR-3 *Recycled Water “Incidental Recharge”*
- SWR-4 *Storm Water Capture + Recycled Water Recharge Using Rubber Dams + Recycled Water “Incidental Recharge”*

The average project yield for the final selected Concept Strategies was determined to be about 1,980 afy for SWR-1 up to 8,220 afy for SWR-4.

The project implementation phasing plan identified the preparation of the programmatic environmental impact report and CEQA documentation to be the initial “critical path” items to initiate any of the concept strategies. It was also concluded that a strong public outreach program would be required to develop community support for the project. Project planning and design efforts for strategy SWR-1 could be “fast-tracked” such that the rubber dam construction

could be implemented within 24-months (estimated June 2018). The construction of the rubber dams would occur concurrent with the required Title 22 studies for introduction of recycled water for groundwater recharge (in support of strategies SWR-2 thru SWR-4).

The estimated project cost for implementing Phase 1 and Phase 2 from 2016 thru 2026 was determined to be on the order of \$156,550,000. These estimated fees do not include typical design or construction contingency fees or project financing fees. These fees also do not include annual operations and maintenance charges or administrative fees.

Key findings from the San Juan Basin Desalination and Optimization Program that can be applied in other impaired coastal groundwater aquifers include:

Seawater Extraction Barrier

- An extraction barrier would produce water that otherwise may not have been produced thus increasing the project yield.

Recycled Water Recharge via Injection in an Impaired Basin

- Based on current State of California Division of Drinking Water (DDW) regulations, injection of recycled water requires advanced treatment and may be cost prohibitive for an impaired basin.

Recycled Water Recharge via Surface Water Recharge in an Impaired Basin

- Surface water recharge strategies are optimal because they also have the benefit of increasing storm water capture for recharge.
- Incidental recharge of stormwater or recycled water (also referred to as live stream recharge) has the multiple benefits of supporting riparian habitat, supporting elimination of non-native vegetation through selective abatement programs as well as providing food sources, breeding grounds, and a wintering ground for migratory birds.
- Monitoring and modeling will be required to optimize the location of recharge to minimize recycled water contributions (RWC) and underground retention time (URT).
- Incidental recharge operations will need to be adaptive: in wet years recharge will be less and in dry years recharge can increase.

Adaptive Production Management

- Groundwater pumping needs to be adaptive to match the basin recharge (with or without enhanced recharge).
- Monitoring and modeling will be required to develop an adaptive production management plan.

2. INTRODUCTION

San Juan Basin Authority Background and Overview

The San Juan Basin Authority (SJBA) was created in 1971 as a joint powers authority for the purpose of carrying out water resources development of the San Juan Basin. The SJBA member agencies are the Santa Margarita Water District (SMWD), Moulton Niguel Water District (MNWD), South Coast Water District (SCWD), and The City of San Juan Capistrano (CSJC).

The mission statement of the SJBA is:

“To develop and maintain a reliable, high quality economical local water supply for the residents in the San Juan Basin by maximizing water use through management of local ground and surface water of San Juan Creek and its tributaries, with due consideration for preservation, enhancement, and conservation of the environment, including, but not limited to, the natural resources, fish and wildlife, infrastructure improvements, and the cultural heritage of the area.”

In accordance with this mission statement, the SJBA has been actively pursuing development and expansion of groundwater production facilities, while ensuring preservation and sustainability of the local water resources.

The San Juan Basin

The San Juan Basin is categorized, from a water rights perspective, as a subterranean flowing stream and is comprised of four subbasins: Upper San Juan, Middle San Juan, Lower San Juan, and Arroyo Trabuco. Water extraction and diversion from the basin is regulated by the California State Water Resources Control Board (SWRCB) and the SJBA conducts regular monitoring activities to verify compliance with existing diversion permits. SJBA retains the rights to withdraw 8,026 acre-feet per year (afy) which can be expanded to 10,702 afy dependent upon approval from the SWRCB. Additional groundwater diversion permits and groundwater production agreements within the basin are held by other private and public entities.

Groundwater production occurs primarily within the Lower Arroyo Trabuco, the Middle San Juan, and the Lower San Juan subbasins due to lack of storage and production capacity further up basin. Groundwater production challenges within the basin include: shallow bedrock conditions, elevated dissolved solids (TDS) content of the water, riparian habitat constraints on groundwater level drawdown, permit limits, and climate changes/drought conditions. Active municipal groundwater production facilities include thirteen (13) groundwater wells and two desalters. CSJC currently operates twelve (12) of these wells with eight (8) wells supplying potable water to

the San Juan Basin Groundwater Recovery Plant desalter facility (see Figure 3.3-1). It is noted that the figure naming convention references the Technical Memorandum and figure number from which they were derived. Three of the remaining four CSJC wells produce non-potable water for recycled water use and one well produces domestic water. SCWD currently maintains one (1) well to supply groundwater to their Groundwater Recovery Facility and groundwater production is under a separate groundwater diversion permit.

Currently, the water demand of the SJBA member agencies is approximately 86,400 afy for a total service area population of about 406,200. This demand is satisfied through imported potable water sources (69,600 afy) augmented by local groundwater production (5,268 afy), and local recycled water (14,000 afy) supplies. Demand within the basin is expected to increase to about 106,400 afy by 2035 due to population growth.

Recycled water is currently produced from six (6) wastewater and urban runoff treatment facilities capable of producing tertiary Title 22 effluent. SMWD operates three (3) of these facilities, MNWD operates two (2) facilities, and SCWD operates one (1) facility.

Demand within the basin is expected to increase to about 106,400 afy by 2035 due to population growth. In the absence of developing local water supplies, all future demands will be reliant upon increase imported water supplies.

The San Juan Basin Groundwater and Facilities Management Plan

In 2014, Wildermuth Environmental completed the San Juan Basin Groundwater and Facilities Management Plan (SJBGFMP) for the SJBA. The report utilized numerous previous reports and management plans completed within the basin to provide a comprehensive description and understanding of the basin resources, demands, and management alternatives.

Goals for the SJBGFMP were established prior to completion of the report through discussion of the issues, needs, and interests by all member agencies. The common goals arrived at by the participants in the SJBGFMP included:

- 1) Enhanced Basin Water Supplies

In addition to local groundwater, this goal applies to all sources of water available for the enhancement of the San Juan Basin (Basin). The intent is to maximize the use of all available water in the Basin. This goal will be accomplished by increasing the recharge of all available waters, including stormwater discharge, dry-weather discharge, and recycled water.

2) Protect and Enhance Water Quality

The intent of this goal is to improve surface and groundwater quality to ensure the maximum use and reuse of available supplies and to minimize the cost of groundwater treatment. This goal will be accomplished by implementing activities that capture and treat contaminated groundwater for direct high-priority uses, implementing the recharge of stormwater discharge, and encouraging better management of waste discharges that impact groundwater.

3) Maximize the Use of Unused Storage Space

The intent of this goal is to maximize the use of the Basin's storage capacity to improve water supply availability. This goal will be accomplished by determining the temporal and spatial availability of unused storage space in the Basin and subsequently determining how best to use that space to increase operational flexibility and water supply reliability.

4) Satisfy State Requirements for a Groundwater Management Program

The intent of this goal is to integrate the SJBGFMP into the South Orange County Regional Water Quality Management Plan and to improve the opportunity of obtaining outside funding for SJBGFMP implementation. This goal will be accomplished by ensuring that the SJBGFMP contains the minimum elements required for a groundwater management plan and by inclusion of the SJBGFMP in the Municipal Water District of Orange County (MWDOC) Integrated Regional Water Management Plan.

5) Establish Equitable Share of Funding, Benefits, and Cost of the SJBGFMP

The intent of this goal is to align the benefits of the SJBGFMP with individual SJBA member agencies and SJBGFMP implementation costs. This goal will be accomplished by clearly articulating the benefits of the SJBGFMP to each SJBA member agency and subsequently allocating the funding and costs in an equitable manner.

The SJBGFMP also identified potential impediments to achieving the management goals. Meetings were held with the SJBA Technical Advisory Committee (TAC), subsequently changed to the SJBA Technical Advisory Group (TAG), to review the impediments to the goals and to develop management plans that could be implemented to remove those impediments. Ten (10) management alternatives were developed for evaluation and full descriptions of each management alternative can be found in Section 6 of the SJBGFMP. An adaptive production management plan was incorporated into all basin management alternatives recognizing that the annual yield of the basin is tied to the amount of water in storage and the conditions of the existing diversion permits. The SJBA established that annual groundwater production limits

would be set in the spring of each year based on groundwater level measurements and estimates of the groundwater storage determined at that time.

Management alternatives one (1) thru six (6) included various permutations of adaptive management techniques, groundwater recharge with stormwater and recycled water, construction of Ranney-style collection wells for enhanced groundwater production, and a seawater intrusion barrier (either groundwater injection or groundwater extraction) with an assumption that the then proposed South Orange County Ocean Desalter (SOCOD) project (now known as the South Coast Water District Doheny Ocean Desalination project) would not be implemented or would be deferred by ten or more years.

Management alternatives seven (7) thru ten (10) are based on the assumption that the SOCOD project would be implemented within the following ten years and include similar permutations of adaptive management techniques, groundwater recharge with stormwater and recycled water, construction of Ranney-style collection wells for enhanced production. A seawater intrusion barrier was not included in alternatives seven (7) thru ten (10) since it was considered that the SOCOD project would provide the seawater intrusion control.

Upon review of the management alternatives, the SJBA Board of Directors chose to pursue the recommended management alternatives six (6) and ten (10) for further evaluation. As previously described, both of these alternatives include adaptive production management, stormwater recharge, recycled water recharge, and enhanced groundwater production with Ranney-style wells. Alternative six (6) would provide seawater intrusion control through a groundwater injection barrier or through a groundwater extraction barrier and alternative ten (10) would provide seawater intrusion control through the SOCOD project.

At the time the SJBGFP was being prepared, there was some uncertainty about the timing and implementation of the SOCOD project, including uncertainties about which participating SOCOD agencies would remain interested in the desalination project, and the SJBA Board determined that further assessment of alternative six (6) should be initiated. The SJBGFP was adopted by SJBA in November, 2014.

Foundational Actions Fund (FAF) Program Project Background

In 2013 the SJBA, in conjunction with the Municipal Water District of Orange County (MWDOC), submitted a proposal to the Metropolitan Water District of Southern California (Metropolitan) for a Foundational Actions Fund (FAF) Program to evaluate the feasibility of implementing alternative six of the SJBGFP. SJBA partnered with MWDOC on this grant since they are a Metropolitan participating agency and had access to the grant program and funding. The

objective of the FAF Program is to analyze options for sustainable, long-term use of an impaired watershed that is typical to Southern California.

As Southern California has developed, smaller groundwater basins and sub-basins have largely been ignored due to high groundwater treatment cost compared to lower costs and availability of imported water supplies. In recent years however, there has been a resurgence in interest in smaller basins with the advent of new treatment technology and the desire to enhance local water supply reliability. Diverse regions along the California coast such as Port Hueneme, Los Alamitos, San Juan Capistrano, San Clemente, Carlsbad and San Diego and inland in areas such as Cucamonga, Riverside, Lake Elsinore and Temescal Basins have groundwater that may be underutilized.

The typical Southern California weather patterns of periodic intense storms have resulted in construction of significant infrastructure over the years that protect from flooding, but do not consider the beneficial use of the stormwater. Likewise, many of the same basins have potential access to recycled water, but do not have the distribution ability resulting in wastewater not being recognized as a resource. Other basins may be impaired with high salinity or other chemical impairments requiring significant treatment or isolation from poor quality water.

The FAF Program study was anticipated to provide critical information about the local basin structure, character, and behavior such that with this information as a foundation, a refined management program could be formulated. The information will also allow SJBA managers/consultants to develop an innovative approach not generally used on a small basin. This innovative approach utilized the tools that have historically been applied to larger basins and incorporates them with the goal of producing a new sustainable water supply. Without adaptive management and expanded recharge of the watershed there is limited opportunity for production of potable water. The watershed has an alluvial stream morphology that extends offshore and currently the aquifer has storage capacity that is underutilized.

At the time the SJBA FAF Program proposal was being prepared, concurrent with preparation of the SJBGFP and considering the uncertainty about the timing and implementation of the SOCOD project, the SJBA Board determined that further assessment of alternative six (6) adaptive management options, stormwater recharge, recycled water recharge, enhanced groundwater production, and seawater intrusion prevention should be initiated. Two distinct seawater intrusion barriers were evaluated including a groundwater injection barrier and a groundwater extraction barrier. In absence of a defined source of water for an injection barrier, a groundwater extraction barrier was selected for initial evaluation for the SJBA FAF Program. The effectiveness of a groundwater injection barrier assessment was a project element to be evaluated by South

Coast Water District through a separate FAF Program project in association with their current desalination project (successor to the SOCOD project).

The Agreement between Metropolitan and MWDOC was executed on January 30, 2014. MWDOC's current role is the coordinating funding agency between SJBA and Metropolitan. The Agreement extends from January 30, 2014 through June 30, 2017.

FAF Program Project Objectives

The SJBA FAF Program included performing feasibility studies for the SJBGFMP alternative six (6) project elements including:

- Implementing adaptive groundwater management techniques throughout the basin;
- Evaluating potential stormwater capture for groundwater recharge along the middle and lower San Juan Creek areas;
- Evaluating the potential use of recycled water for groundwater recharge along the middle and upper San Juan Creek areas;
- evaluating the potential for enhanced groundwater production (using Ranney style wells) in the middle San Juan Creek region; and
- Evaluating control of seawater intrusion in the lower basin area.

Specific Project Objectives included:

a) Conduct Groundwater Modeling Studies for Proposed Seawater Extraction Barrier

The SJBGFMP includes a seawater extraction barrier option that would prevent seawater intrusion and provide up to 4,000 acre-ft/yr of potable water. The scope of work for this project objective was to evaluate extraction barrier well sites, utilize the groundwater model prepared by Geoscience for the SOCOD project to optimize production rates and project salinity concentrations in the raw water produced by the extraction barrier wells, and determine sustainable production rates. The analysis could be applied elsewhere along the coast of California to similar stream morphology that extends offshore and may be currently underutilized.

b) Conduct Hydraulic Investigations to Increase Stormwater Recharge

The scope of work for this project objective was to conduct a hydraulic investigation to refine the "T" and "L" levees alternative, similar to those used by Orange County Water District (OCWD) along the Santa Ana River, develop hydraulic and fish passage requirements for both alternatives, and refine the stormwater recharge estimates for all three alternatives. Groundwater modeling, using an updated Geoscience model of the San Juan Basin, will be done to assess the groundwater basin response, groundwater

mounding, and the need to revise groundwater production plans to accommodate new recharge.

c) Conduct Hydraulic Investigations to Recycled Water Recharge

The SJBGFMP includes an option for in-stream recycled water recharge using live stream discharge, seasonally constructed ponds along San Juan Creek, and rubber dams. The scope of work for this project objective was to conduct a hydraulic investigation to refine the layout and operation of the temporary seasonal recharge ponds, develop hydraulic and fish passage requirements for both alternatives, and refine the recycled water recharge estimates for both alternatives. Groundwater modeling, using an updated Geoscience model of the San Juan Basin, was performed to assess the groundwater basin response, mounding, and the need to revise groundwater production plans to accommodate the new recharge. Recycled water distribution system retrofits for irrigation purposes in urban areas of Southern California may be difficult and costly, the Project recharge analysis may be applicable for beneficial indirect use analysis to other similar California coastal basins.

d) Develop Adaptive Production Management

The scope of work for this objective included: groundwater modeling to develop spatial and temporal groundwater production plans tied to groundwater storage, underground residence time for recycled water prior to production, and recycled water contribution; expected groundwater treatment requirements to produce potable water; and the water type and cost to replace the groundwater currently used by overlying producers. A reconnaissance-level Title 22 engineering assessment was prepared pursuant to the existing draft Title 22 regulations for a groundwater recycled reuse project and a facilities and operating plan was prepared along with cost estimates.

A potential implementation of a seawater extraction barrier and recharge program elements would change the location, magnitude, and timing of recharge in the basin. Existing groundwater production and treatment facilities would have to be modified, subject to agreement by the facility owners/operators, to maximize the new yield, to ensure there is groundwater storage capacity to accept the recharge, to minimize the potential for liquefaction, and to ensure the beneficial use of produced water. This program element contains efforts to develop practical spatial and temporal groundwater production plans based on storage conditions that are related to production, natural hydrologic variability, artificial recharge, and prevailing State of California Drinking Water Standards and State of California Regional Water Quality Control Board Basin Plan

requirements. There are also overlying producers that may have to convert to recycled or municipal water to enable the implementation of the SJBGFMP.

Better information and control, as determined by this project, will allow for a reduction in the subjectivity in decision processes regarding the utilization of basin resources. Similarly, the identification of strategic opportunities to better enhance basin capacity, recharge, and best uses of reclaimed water afforded by the program will go a long way to improving overall yields and productivity.

FAF Program Project Tasks

The FAF Program project included specific project tasks as described below:

Task 1 Project Management

Task 1.1 Project Management and Administration.

The work completed in this task included project management (resourcing, scheduling, cost controls, etc.), timely invoicing reconciliation and quarterly reporting, internal technical reviews, and coordination with MWDOC and Metropolitan Water District of Southern California.

Task 1.2 Progress Reports to the SJBA Board and Stakeholder Process Meetings.

Quarterly oral presentations were conducted at the SJBA Board meetings to brief the SJBA Board, other stakeholders and the public on the progress of the work. The objective of the oral presentations was to keep the SJBA Board and stakeholder's current on the ongoing work and to receive input and direction from the SJBA Board. In addition, progress presentations were made to participating agency Board of Directors to report on project status.

Task 1.3 Technical Advisory Committee Meetings.

The objective of this task is to meet and review the program elements as they evolve with the SJBA technical advisory committee (TAC).

Task 2 Develop Preliminary Alternatives for Each Program Element

Task 2.1 Develop Design Criteria, Cost Estimating Methodology and Identify Potential Project Participants and Points of Delivery.

The objectives of this task was: to identify and obtain agreement on facility design and operating criteria and assumptions before engineering work began; to obtain agreement on the cost and financial assumptions to be used in the preparation of cost opinions; and to identify potential purchasers of the water and where they would take delivery and the capacity limitations at the points of delivery.

A great deal of relevant information was available specific to the San Juan Basin area from recent investigations, and the design and construction of similar facilities. The SJBA TAC and other stakeholders have participated in a collaborative way in the development of the SJBGFMP and the SOCOD investigations and are well versed on the engineering, environmental and economic issues related to program elements considered for this project.

Task 2.2 Develop Preliminary Extraction Barrier Alternatives.

The objective of this task was to develop up to three extraction barrier alternatives that would prevent seawater intrusion and increase local supplies by intercepting and treating seawater induced landward by the extraction barrier wells. These alternatives were analyzed in detail in Task 3. The engineering team developed operating plans, well field layouts, raw water conveyance and treatment facilities, brine disposal facilities and product water conveyance facilities. The engineering team relied on the prior hydrogeologic work done for the SOCOD project and the ongoing SJBA groundwater-monitoring program.

Task 2.3 Develop Preliminary Storm Water Recharge Alternatives.

The objective of this task was to identify the range of storm water recharge alternatives overlying the San Juan Basin and to formulate up to six recharge alternatives for detailed analysis in Task 3. The SJBGFMP considered two in-stream recharge alternatives involving “T” and “L” levees as used by the Orange County Water District (OCWD) on the Santa Ana River, and a series of rubber dams. The engineering team considered these in-stream alternatives and as well as off-stream recharge in new recharge basins and infiltration galleries or within existing basins (augmented to increase effective capacity) located near San Juan Creek and Arroyo Trabuco. The engineering team developed facility layouts and operating schemes for each alternative. The engineering team relied on the 2013 SJBGFMP and recent extensive hydrology modeling work done for the SOCOD project.

Task 2.4 Develop Preliminary Recycled Water Recharge Alternatives.

The objective of this task was to identify the range of recycled water recharge alternatives overlying the San Juan Basin and to formulate up to six recharge alternatives for detailed analysis in Task 3. The SJBGFMP considered two in-stream recharge alternatives involving a series of seasonal temporary cascading ponds in San Juan Creek and Arroyo Trabuco, as well as a series of rubber dams on the same creeks. The engineering team considered these in-stream alternatives and off-stream recharge including recharge basins, injection wells and infiltration galleries located near San Juan Creek and Arroyo Trabuco. The engineering team developed facility layouts and operating schemes for each alternative. The engineering team will rely on the 2013 SJBGFMP, SJBA groundwater-monitoring program and planning

information provided by the South Orange County Wastewater Authority (SOCWA) to formulate these alternatives.

Task 2.5 Develop Preliminary Adaptive Production Management Alternatives.

The objectives of this task are: to identify the range of adaptive production management alternatives that include existing and new wells and expanded groundwater treatment to enable groundwater production to be increased to exploit the existing basin as well as possible storm and recycled water recharged as part of this project; and to determine how production should be managed during critical dry periods. The project consultant team will develop up to six alternatives involving: selected amounts of new storm and recycled water recharge; determination of the approximate number of new wells and treatment capacity required to increase groundwater production to recover the new recharge; to maximize groundwater production during dry periods and comply with the then current draft California Department of Public Health (DPH) Groundwater Replenishment Reuse Project (GRRP) regulations; and the location of existing wells that may need to be abandoned. The project consultant team will develop facility layouts and operating schemes for each alternative. The project consultant team will rely on the SJBGFMP, SJBA groundwater-monitoring program, hydrogeologic and planning information from the proposed SOCOD project, and planning information provided by the South Orange County Wastewater Authority (SOCWA) to formulate these alternatives.

Task 2.6 Develop a Presentation Summarizing Preliminary Program Elements.

The objective of this task was to prepare a comprehensive presentation with notes to document the history of the project and the results of Task 2-1 through 2-5.

Task 2.7 Review Program Elements with SJBA Board, Other Stakeholders, DPH, California State Water Resources Control Board (SWRCB) and the California State Regional Water Quality Control Board (RWQCB).

The objective of this task was to conduct one or more workshops with the above-mentioned parties to summarize Task 2 results, answer questions, and to receive comments and suggestions.

Task 3 Evaluate Feasibility of All Program Elements

Task 3.1 Evaluate Groundwater Extraction Barrier Program Element Alternatives.

The objective of this task was to evaluate the preliminary extraction barrier alternatives, refine them as necessary, rank them and recommend an alternative. The project consultant team evaluation included modifying and updating the groundwater model and applying that

model for each of the preliminary alternatives to determine extraction barrier effectiveness, sustainable yield, and expected salinity. These model results were used to refine the operating and facilities plan including: the phasing of groundwater treatment capacity; and the preparation of a construction cost opinion and unit cost of water produced. The project consultant team prepared a preliminary recommendation for the extraction barrier alternative. The project consultant team also described the factors that contribute to uncertainty in extraction barrier performance, the investigations required to reduce the uncertainty to an acceptable level, and the cost of these investigations.

Task 3.2 Evaluate Storm and Recycled Water Recharge Program Element Alternatives.

The objective of this task was to evaluate the preliminary storm and recycled water recharge alternatives, refine them as necessary, rank them and recommend an alternative. The evaluation of storm and recycled water recharge alternatives were combined herein because many of the same types of proposed facilities are being considered for both types of water.

The project consultant team evaluation included: modifying and updating a recently calibrated, fine-grain regional groundwater model and applying that model for each of the preliminary recharge alternatives to determine: recharge capacity for each type of water and combinations of water types; mounding limitations; mitigation measures that can be incorporated into the project to maximize recharge; refining the facility and operating plans for each alternative based on model results; and preparing a construction cost opinion and unit cost of water recharged.

The project consultant team prepared preliminary recommendations for the top three recharge alternatives, the recommended alternative and the basis for the recommendation. The project consultant team also described the factors that contribute to uncertainty in storm and recycled water recharge performance, the investigations required to reduce the uncertainty to an acceptable level, and the cost of these investigations.

Task 3.3 Evaluate and Refine Adaptive Management Alternatives.

The objective of this task was to evaluate the preliminary management alternatives for production of raw water, refine them as necessary based on work in Task 3-2, rank them and recommend an alternative. The project consultant team evaluation included: development and application of a new MT3D (solute transport) model to be used in conjunction with the existing fine-grain regional flow model to assess underground residence time for recycled water for each existing and proposed well, and to estimate recycled water contribution for each existing and proposed well; refining the facility and operating plans for each alternative based on model results; refining recycled water and groundwater treatment plans and cost;

conducting a salt and nutrient loading assessment consistent with the Basin Plan and SWRCB policy; and, preparing a construction cost opinion and unit cost of water produced.

The project consultant team prepared recommendations for the top three adaptive management alternatives, including a recommended alternative and the basis for the recommendation. The project consultant team also described the factors that contribute to uncertainty in adaptive production management performance, the investigations required to reduce the uncertainty to an acceptable level, and the cost of these investigations.

Task 3.4 Develop a Presentation Summarizing Preliminary Program Elements.

The objective of this task was to prepare a comprehensive presentation with notes to document the history of the project and the results of Task 3-1 through 3-3 in a technical memorandum (Task 3-4) and at a project workshop presentation (Task 3-5). All documents have been made available on the SJBA website to all stakeholders and the public for their subsequent review and use.

Task 3.5 Review Task 3 Results with SJBA Board, Other Stakeholders, DPH, SWRCB and the RWQCB.

The objective of this task was to conduct workshops with the above-mentioned parties to summarize the results of Task 3, answer questions, and to receive comments and suggestions.

Task 4 Develop Implementation Plan

Task 4.1 Identify Potential Habitat and Environmental Opportunities for the Project Alternatives.

The objectives of this task were to identify the types of environmental impacts and to determine elements to include in the planning effort to move the project forward, including development of preliminary cost estimates.

Task 4.2 Develop Phasing and Monitoring Plans.

The objective of this task was to develop an implementation plan for the project in phases that would allow the project participants to move forward with some of the project elements immediately and the remainder of the program elements in an incremental manner. For example the extraction barrier program element could be implemented independently of the recharge and adaptive management program for production of raw water elements, can be implemented more rapidly than the other program elements, and will likely be easier to implement.

The recharge and adaptive production management program elements would still have some technical uncertainty and the regulators, specifically the Department of Public Health (DPH), will likely require that the recycled water recharge be slowly ramped up and monitoring be done to demonstrate compliance to the then current GRRP regulations. The project consultant team developed a phasing and monitoring plan based: on the work completed in Task 3; input from the project participants and regulatory community; funding availability; cost of alternative water supplies; the initial study findings from Task 4.1; and other considerations.

Task 4.3 Revise Cost Opinions.

The objective of this task was to revise the cost opinions and unit water cost projections based on the results of Tasks 3.5, 4.1 and 4.2.

Task 5 Prepare Project Report

The objective of this task was to prepare a formal project report to document the technical work and the stakeholder process. The project consultant team prepared the project report using the following process: prepare an administrative draft report for review by the SJBA TAC; preparation and distribution of the public review draft; public workshop to summarize the report findings, answer questions, receive comments and suggestions; and finalize and distribute final report.

Key Project Findings

Recharge and Recovery Options

The SJBGFP recognized that in-stream recharge is the only viable large-scale recharge method for the San Juan Basin due to the lack of suitable off-stream sites for stormwater storage and recharge, and the inability of the basin to accept large amounts of recharge at a specific site.

Storm Water Recharge – In-Stream Options

The term *in-stream recharge*, as used herein, refers to the use of the existing Arroyo Trabuco and San Juan Creek channels for recharge. These channels contain natural bottoms that are highly permeable and will readily recharge water that is flowing in them. In the SJBGFP, WEI developed two in-stream recharge concepts for storm water recharge that included:

- The construction of temporary in-stream “T” and “L” levees in San Juan Creek between Stonehill Drive and I-5.
- The construction of rubber dams in San Juan Creek between Stonehill Drive and the I-5, and in the Arroyo Trabuco between its confluence with San Juan Creek and the end of the concrete channel revetment.

Storm Water Recharge – Off-Stream Options

Several agencies provided information on the Galivan Basin, and the City of San Juan Capistrano provided information on the Calle Arroyo, Acu Canyon, and La Novia basins. The largest off-stream basin, the Galivan Basin, has been studied by the SJBA in the past and found to be an unfeasible option. The remaining three basins are very small, and the two basins located off the stream channel (Acu Canyon and La Novia) would need conveyance facilities to discharge the water to the San Juan Creek channel given that they do not overlie the alluvial basin. Given these limitations, and that the basins did not meet the design criteria described above, these off-stream basins were not recommended for further hydrologic evaluation.

Projection of Recycled Water Available for the Program

Information was provided by each agency on their recent NPR system demands, as well as their projected demands in 2035. The agencies' recycled water demands are currently being met by the following facilities: Regional Treatment Plant, 3A Plant, Coastal Treatment Plant, Chiquita WRF, and Oso Creek WRP. By 2035, the demands for each agency increase. This will be accommodated by planned improvements at the 3A Plant and the Chiquita WRF. Additionally, improvements are being evaluated at the J.B. Latham plant to meet the City of San Juan Capistrano's (CSJC) NPR system needs.

Regional Wastewater and Non-Potable Recycled Water Summary

Based on the projected recycled water demands, an average of 1,185 ac-ft of recycled water is needed to be stored during off-peak seasons to meet the estimated peak season demands. An average of 11,114 ac-ft of recycled water available in excess of the NPR demands during the non-peak seasons. Therefore, an average of 9,929 ac-ft of recycled water could be available during off-peak seasons for use by a groundwater optimization program. However, the amount of recycled water supply that could be available for such a program could be less due to several factors, including:

- Some years when the NPR system may require more than 1,185 ac-ft of storage
- Potential losses due to plant shutdown and maintenance periods
- Evaporation losses that occur in the seasonal storage reservoirs

Therefore, it is recommended that the maximum available recycled water from seasonal storage be planned for 7,500 ac-ft.

Seawater Intrusion Barrier Alternatives

All program alternatives evaluated included the same proposed seawater extraction barrier to ensure that seawater would not intrude into San Juan Basin due to upstream groundwater pumping and to produce a new source of water. The SJBGFMF suggested that the extraction barrier pumping would range between 3,000 to 6,000 afy. A reconnaissance-level analysis of a 6,000 afy extraction barrier was conducted by Geoscience Support Services as part of the initial Task 2 feasibility study. These analyses suggested that a 6,000 afy extraction barrier was not feasible due to water level drawdown impacts and locations of proposed wells. A 3,000 afy extraction barrier concept was subsequently developed which suggested that the initial well locations and assigned pumping rates were insufficient to protect against seawater intrusion into the basin.

Modeling work conducted in Task 3 confirmed the hydrologic feasibility of the creation of a robust extraction barrier that would prohibit seawater intrusion at 3,000 afy of pumping. This additional analysis modified the well locations and instituted pumping constraints based on water levels and identified that the groundwater flow direction derived from the groundwater model simulations of the extraction barrier indicated that seawater would flow to and be captured by the extraction barrier well field.

A zone water budget was prepared to confirm the sources of groundwater being produced by the extraction barrier wells. Under the baseline alternative the average discharge out of the barrier zone is 134 afy towards the SCWD wells and averages 97 afy into the ocean (see Figure 3.3-12). For all Program alternatives the ocean discharge direction is reversed. For all Program alternatives the seawater barrier draws about 2,100 afy from the ocean, about 700 afy from groundwater originating upstream, and the remaining 200 afy from vertical recharge that occurs between the coast and the SCWD wells.

The projected decline at the SCWD Stonehill well is about 2 feet. That said, because of the use of the Multi-Node Well Package (MNWP) in the groundwater model to comply with the SWRCB permits, the projected pumping for SCWD is very sensitive to the decline in groundwater elevations caused by the extraction barrier pumping. The MNWP used in the SJBA model limits the pumping at the SCWD Stonehill and Creekside wells to an average of about 30 to 36 percent of the SCWD's pumping goal of 1,300 afy during the 1947 to 2014 hydrologic period – which is slightly less than half of the 74 percent of the pumping goal achieved in the baseline alternative. Based on the current analyses, the proposed extraction barrier interferes with the SCWD ability to meet its pumping goal.

Hydrologic Analysis of SJBGFMP Project Alternatives

The planning scenario underlying the analysis of the Program alternatives is based on Scenario 2h that was developed for the Doheny Desalter Feasibility Investigation and that was subsequently used in the SJBGFMP. The major assumptions used in Scenario 2h include: current (2010) land use and cultural conditions, current storm water management conditions, a hydrologic period running from 1947 through 2010, and pumping goals for the major groundwater users. For this investigation the hydrologic period was extended to run from 1947 through 2014 and the production goals for the major producers were revised in Task 2 by the TAG and are listed below:

Annual Pumping Goal by Producer	
Producer	Annual Pumping Goal (afy)
City of San Juan Capistrano Non-Potable Wells	1,023
City of San Juan Capistrano GWRP Wells	7,705
South Coast Water District	1,300
Private Pumpers	866
Total	10,894

It is noted that the “Pumping Goals” specified above are not to be construed, interpreted, inferred, or implied to represent or authorize “water rights” to such production levels.

The Program alternatives were evaluated by simulating the hydrologic response of the San Juan Basin with a groundwater model. A 68-year planning hydrology from 1947 through 2014 was used to evaluate the baseline, or no-project alternative, and four Program alternatives.

Conceptual Strategies

Six conceptual strategies were developed for further refinement and cost evaluation. Each conceptual strategy contains some or all of the following program elements: seawater extraction barrier, enhanced stormwater recharge, recycled water recharge, and in-lieu recharge through the offset of private well pumping with direct recycled water deliveries to the pumpers.

Conceptual Strategies Capital Cost Estimates

The cost criteria developed for this study are used to estimate capital costs for the identified facilities for each of the different conceptual strategies. However, the criteria should not be interpreted as the method to develop the best or final estimate of the total cost of the project.

The accuracy of an estimate is directly related to the amount of detail available; the more detailed the estimate, the more accurate it will be. Any resulting conclusions on project financial or economic feasibility or funding requirements are prepared for guidance in project evaluation and implementation and use the information available at the time of the estimate.

The final costs of the conceptual strategies and resulting feasibility will depend on a variety of factors, including but not limited to, actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel, engineering, and construction phases. Therefore, the final costs will vary from the estimates developed using the information in this document. Because of these factors, project feasibility, benefit-cost ratios, alternative evaluations, project risks, and funding needs must be carefully reviewed and updated, prior to making specific financial decisions or establishing project budgets, to help ensure adequate funding for the project.

Estimated Costs for Conceptual Strategies

The following table summarize the estimated capital cost and project yield for the six different Conceptual Strategies. In addition, a unit capital cost estimated is provided based on two alternatives: 30- and 50-year lifecycle. Both unit costs assume an interest rate of 3%.

Conceptual Strategies Yield and Cost Summary				
Conceptual Strategy	Capital Cost (\$M)	Yield (afy)	Unit Capital Cost	
			30-Year Lifecycle	50-Year Lifecycle
SWR-1	\$ 171	1,980	\$ 4,410	\$ 3,360
SWR-2	\$ 306	4,380	\$ 3,560	\$ 2,720
SWR-3	\$ 172	2,660	\$ 3,300	\$ 2,510
SWR-4	\$ 555	8,220	\$ 3,440	\$ 2,620
INJ-1	\$ 315	3,260	\$ 4,930	\$ 3,760
INJ-2	\$ 376	4,460	\$ 4,300	\$ 3,280

Project Implementation Phasing Plan

Based on the analysis performed, the recommended strategy for accomplishing the goals of the San Juan Basin Groundwater Facilities and Management Plan (SJBGFMP), hereafter referred to as the SJBGFMP Implementation Plan, includes the following Program Elements:

- Adaptive Production Management (APM), which consists of the continuation of the SJBA's existing program of monitoring and reporting and the development and periodic update of an APM policy to set annual production limits consistent with water rights permits and related agreements.

- Construction of rubber dams within San Juan Creek and the Arroyo Trabuco to increase storm water recharge and provide future recharge sites for instream recharge of recycled water.
- Construction of recycled water recharge and recovery facilities (conveyance, wells, and expanded groundwater treatment) and conversion of private groundwater pumpers to alternative sources of water. The facilities should be phased in over time based on recycled water availability and the need to demonstrate project success at small scales to the DDW and Regional Board.

The seawater extraction barrier which was included in all of the Project Alternatives was not included in the SJBGFMP Implementation Plan for the following reasons:

- It is projected to be very costly for the limited yield
- SCWD is now actively pursuing their Doheny Desalination project
- Conflicting consensus from SJBA project participants on conflicting impacts of a seawater extraction barrier and the proposed Doheny Desalination project.

Excluding the seawater extraction barrier at this time does not prohibit including the barrier concept in the next phase of planning particularly if the SCWD Doheny Desalination project does not develop. In the absence of the seawater extraction barrier the SJBA would use adaptive production management (APM) techniques to ensure seawater intrusion does not occur.

The recommended phasing strategy for the SJBGFMP implementation plan is as follows:

- Phase 1:
 - Complete planning, permitting, design and construction of rubber dams within San Juan Creek and/or Arroyo Trabuco, and
 - Complete Title 22 Engineering and permitting process for the indirect potable reuse (IPR) of recycled water in the San Juan Basin.
- Phase 2
 - Refine the planning, project specific permitting, and design of the recycled water recharge and recovery facilities and construct the facilities to enable up to 4.0 mgd of recycled water recharge. (This would yield about 3.0 mgd of treated product water. Actual capacities would be established in the planning and engineering work in Phase 2.)
 - Convert private groundwater producers to other sources of water

- Subsequent phases of the SJBGFP implementation would include the refined planning, design and construction of facilities that maximize the recharge of recycled water in the basin and could include: recycled water treatment improvements, additional groundwater extraction and conveyance facilities, and expansion of the groundwater treatment facilities constructed in Phase 2.

Participating Agencies

As previously noted, the SJBA is composed of SMWD, MNWD, SCWD, and CSJC. Each agency is represented on the SJBA Board of Directors for governance and financial matters and in the SJBA Technical Advisory Committee (TAC), subsequently renamed the SJBA Technical Advisory Group (TAG), for operational and strategic planning matters.

The participating agencies and their project roles for this project are described below:

MWDOC (Contracting Authority)

SMWD (Project Management and Technical Advisor Support)

MNWD (Technical Advisor Support)

SCWD (Technical Advisor Support)

CSJC (Technical Advisor Support)

*Note: **BOLD** indicates agencies participation in SJBA*

Individuals from SMWD, MNWD, SCWD, and CSJC constitute the TAC/TAG which has provided technical review and input to various studies and monitoring/reporting programs for the basin.

Project Consultant Team

The project consultant team, and key principals for each consulting firm, for the project are described below:

Project Manager: Cathrene Glick, PG, CEG, CHG, QSD
G₃SoilWorks, Inc.

G₃SoilWorks has provided project management services including: task scheduling and budget control, preparation of quarterly reports to MWDOC and MET, preparing presentations to the participating agencies, and coordinated the public meetings for project outreach programs.

As Project Manager, Ms. Glick has been a participant in the SJBA TAC to facilitate completion of the project goals.

Hydrologist/Hydrogeologist: Mark Wildermuth, PE
Samantha Adams
Wildermuth Environmental, Inc.

Wildermuth Environmental has provided hydrogeologic and hydrologic analyses for the groundwater monitoring activities, basin hydrology planning, assessing the stormwater and recycled water recharge options, performing the seawater extraction barrier analyses, and preparing the basin optimization options for project definition.

As Basin Hydrogeologist, Mr. Wildermuth and Ms. Adams have also been participants in the SJBA TAC to assist in basin management strategies and to facilitate completion of the project goals.

Civil Engineering and Cost Estimating: Mr. Scott Lynch, PE
Mr. Matt Thomas, PE
Black and Veatch, Inc.

Black and Veatch has provided civil engineering, environmental engineering, and cost estimating services for the recycled water availability/distribution analyses, for the stormwater and recycled water recharge treatment and distribution options, and performing the seawater extraction barrier treatment, and preparing the phasing plans and cost estimates for the various basin optimization options.

Hydrology/Hydrogeology Modeling: Mr. Dennis Williams
Mr. Johnson Yea
Geoscience Support Services, Inc.

Geoscience Support Services provided the update to the San Juan Creek Watershed Model and San Juan Basin Regional Groundwater Model used for the hydrogeologic and hydrologic analyses for the stormwater and recycled water recharge options and for the seawater extraction barrier analyses. Geoscience Support Services was integral in the development of the basin watershed model and regional groundwater model which were initially developed for the SOCOD project and had been retained by SCWD to provide some updates the model for their FAF Program project. As such, Geoscience Support Services was retained for the SJBA FAF Program project to provide the revised model with additional updates to the hydrology model to account for the recent drought conditions and to validate that the model supported the proposed seawater extraction barrier well analysis.

Environmental Regulations: Mr. Michael Welch, PE
Michael Welch

Mr. Welch provided evaluations of regulatory and permitting issues for in-stream recharge within the basin including: evaluating regulations governing groundwater recharge projects under The State Water Resources Control Board Division of Drinking Water and the Regional Water Quality Control Board, San Diego Region.

Water Wells Location Evaluation: Mr. John Thornton, PE
Hunt Thornton Resources, LLP

Mr. Thornton, in conjunction with Psomas Engineers, prepared an update to the San Juan Basin Water Well Database to document the locations and current status/use of groundwater production wells within the project area. One of the purposes of this database update was to ascertain sufficient information to verify current ownership and to perform a visual site reconnaissance of critical wells to determine current uses.

Geophysicist: GeoVision

Geovision was retained in conjunction with G₃SoilWorks to perform subsurface geophysical surveys of key reaches of San Juan Creek to verify basin bottom boundaries for the updated groundwater modeling efforts and for planning of proposed seawater extraction barrier wells and stormwater/recycled water recharge zones along San Juan Creek.

3. FAF PROGRAM COST SUMMARY

Project Budget

The FAF Program provided funding for projects aimed at reducing barriers to future water resource production. The objective of the FAF Program has been to advance the field of knowledge in water resource production, and identify new supply options that are unique and catalytic to water resource implementation in the region. The FAF Program was instituted as a “matching funds” approach which allowed participating member agencies to partner with other water districts or agencies to accomplish the project goals.

The project budget for the SJBA FAF Program was \$400,000 with a maximum reimbursement from Metropolitan of \$200,000. The project budget task/cost breakdown is presented below:

	Total	Maximum Cost To
	<u>Project Cost</u>	<u>Metropolitan</u>
Task 1 - Project Management	\$68,000	\$34,000
Task 2 - Develop Preliminary Alternatives		
For Each Program Element.....	\$64,400	\$32,200
Task 3 - Evaluate Feasibility of All		
Program Elements.....	\$162,400	\$81,200
Task 4 - Develop Implementation Plan.....	\$47,000	\$23,500
Task 5 - Prepare Project Report	<u>\$58,200</u>	<u>\$29,100</u>
Grand Total	\$400,000	\$200,000

The project budget for reimbursement remains per the original proposed budget cited above.

Project Expenditures

To date all project task items have been accomplished utilizing SJBA funds on a common equity basis (equal cost sharing) between the four participating agencies. Program charges initiated in 2014 and continue thru the first quarter of 2016. The total charges for the project not only include the specific tasks identified in the FAF Program scope of work but include fees authorized by the SJBA Board for necessary supplemental services and studies to complete the project. These “value added” services include:

- Project Management
- Adaptive Management Monitoring of the San Juan Basin to assess drought impacts
- Adaptive Production Management of groundwater production within the San Juan Basin

- Monitoring of groundwater level recovery associated with voluntary pumping limitations and/or pumping cessation and response to precipitation events
- Updating the existing groundwater production well database for San Juan Basin

Project scheduled charges for 2014 thru February 2016 and the actual expenditures are summarized in the Table below:

PROJECT RELATED CHARGES THRU FEBRUARY 2016

	2014 Total	1 st Qtr 2015	2 nd Qtr 2015	3 rd Qtr 2015	4 th Qtr 2015	1 st Qtr 2016 (Jan-Feb)	Task Totals 2014-2016
<u>Task 1</u>							
Scheduled	\$34,000	\$7,250	\$9,750	\$7,250	\$9,750	\$0	\$68,000
Actual	\$4,719	\$27,705	\$30,985	\$30,801	\$42,722	\$16,959	\$153,891
<u>Task 2</u>							
Scheduled	\$64,400	\$0	\$0	\$0	\$0	\$0	\$64,400
Actual	\$38,532	\$33,866	\$37,626	\$74,375	\$31,922	\$29,195	\$245,516
<u>Task 3</u>							
Scheduled	\$123,200	\$34,850	\$4,350	\$0	\$0	\$0	\$162,400
Actual	\$0	\$19,100	\$16,335	\$105,122	\$70,219	\$59,281	\$270,057
<u>Task 4</u>							
Scheduled	\$0	\$0	\$0	\$47,000	\$0	\$0	\$47,000
Actual	\$0	\$0	\$0	\$0	\$0	\$34,887	\$34,887
<u>Task 5</u>							
Scheduled	\$8,000	\$0	\$15,400	\$15,400	\$15,400	\$0	\$58,200
Actual	\$0	\$0	\$0	\$0	\$6,413	\$20,068	\$26,481
<u>Total</u>							
Scheduled	\$229,600	\$42,100	\$29,500	\$69,650	\$25,150	\$0	\$400,000
Actual	\$43,251	\$80,671	\$84,946	\$210,298	\$151,276	\$160,390	\$730,832

A summary of the project fees by consultant and Task is presented in the Table below:

PROJECT RELATED FEES THRU FEBRUARY 2016

Consultant	Project Task Fees	Total Fees
G ₃ SoilWorks	Task 1 \$92,397 Task 2 \$48,423 Task 3 \$20,912 Task 4 \$4,390 Task 5 \$ 10,900	\$177,022
Wildermuth Environmental	Task 1 \$50,175 Task 2 \$150,517 Task 3 \$158,245 Task 4 \$9,695 Task 5 \$15,580	\$384,212
Geoscience Support Services	Task 2 36,584	\$36,584
Michael Welch	Task 3 \$12,640	\$12,640
Hunt-Thornton Resource Strategies	Task 3 \$17,545	\$17,545
GeoVision	Task 3 \$19,100	\$19,100
Todd Groundwater	Task 1 \$517	\$517
Black & Veatch	Task 2 \$20,803 Task 3 \$41,606 Task 4 \$20,803	\$83,212
Total Fees Thru February 29, 2016		\$730,832

As documented in the Tables above, SJBA has expended \$730,832 in project related fees to date to accomplish the project tasks and is anticipated to expend additional fees to complete the grant program.

Budget Variances

As identified above, at the end of February 2016 SJBA had expended \$730,832 for project related work compared to the estimated project budget of \$400,000. The budget variances include the following items:

Project Management Fees

At the time the FAF Program proposal was submitted to Metropolitan it had been anticipated that the principal project management efforts would be accomplished by participating agency staff and only the cost associated with the various consultants' participation in project meetings and in report review was included in the budget.

However, due to the initial delays in proceeding with the grant in 2014, it was determined that SJBA required a contract project manager to facilitate completion of the project. SJBA

retained Ms. Glick with G₃SoilWorks as the Project Manager in December, 2014 to develop appropriate work scopes and facilitate contract solicitations, to implement accelerated scheduling of project activities, to coordinate project submittal reviews, to track and maintain budget constraints, and to prepare quarterly progress reports. In addition, Ms. Glick was requested to participate in the TAC/TAG meetings and to prepare and deliver project status presentations to the SJBA Board of Directors and to the participating agency Boards.

The fees associated with the Project Manager position through February, 2016 have been associated with the following tasks:

Task 1 - Project Management:	\$92,397	
Task 2 - Develop Preliminary Alternatives	\$48,223	
Task 3 - Evaluate Feasibility of Program Elements	\$20,912	
Task 4 – Develop Implementation Plan	\$4,390	
Task 5 – Project Reporting	\$10,900	Total: \$177,022

Basin Seawater Intrusion Monitoring and Adaptive Management Implementation Fees

During the course of initiating the FAF Program project activities the on-going groundwater monitoring for the basin performed by Wildermuth Environmental detected elevated Chloride levels in the water samples obtained from the coastal monitoring wells indicating that seawater intrusion could be occurring. Subsequent to these findings, SCWD unilaterally ceased groundwater production from their groundwater recovery facility due to their concerns for the health of the basin and its biological resources. At the same time, the City of San Juan Capistrano implemented a Drought Management Plan which reduced groundwater production due to water level declines and associated vegetation impacts along San Juan Creek.

The on-going groundwater monitoring activities along the coastal area by Wildermuth Environmental were increased from “monthly” to “bi-weekly” to establish rate of intrusion and subsequent rate of dispersion which could be directly attributed to understanding the importance of a implementing coastal seawater barrier as well as understanding the hydrogeologic properties of the shallow aquifer which exhibited the elevated Chloride levels. In addition, the City of San Juan Capistrano instituted weekly groundwater level monitoring from their consultant (Stetson Engineers) and reported this data to the participating agencies, Wildermuth Environmental, and G₃SoilWorks personnel to assist in establishing and implementing an adaptive management strategy applicable to the FAF Program. The results of these monitoring activities addressed the ability to stress the basin (water level drawdown) and evaluate the recovery rates (water level rise) throughout the basin for future production and recharge programs.

The fees associated with Wildermuth Environmental were accomplished over two (2) successive monitoring contracts with SJBA. The first contract covered calendar year 2014 and the second contract covered calendar year 2015. These fees have been distributed/associated with the following tasks:

Task 1 – Project Management (2015)	\$27,307	
Task 1 – Project Management (2016)	\$1,634	
Task 2 - Develop Preliminary Alternatives (2014)	\$33,824	
Task 2 - Develop Preliminary Alternatives (2015)	\$41,842	
Task 2 – Develop Preliminary Alternatives (2016)	\$4,744	Total: \$109,349

Groundwater Well Database Update and Field Verification Fees

In addition, as a critical component of the recycled water recharge option, the identification of existing groundwater production wells located within the lower San Juan Basin needed to be updated from previous data records. The prior groundwater well database was compiled by Mr. John Thornton during his tenure with NBS Lowry and Psomas Engineers. Although Mr. Thornton has established a new business venture (Hunt-Thornton Resource Strategies, LLC), he has maintained engineering support services to SJBA and the participating agencies for water rights and for production well site evaluations. Mr. Thornton was contracted to work with Psomas Engineers to update the existing groundwater well database and to perform a site reconnaissance to ascertain the current status of production wells which may be impacted by the proposed groundwater recharge program. The fees for the well survey have been associated with the following task:

Task 3 - Evaluate Feasibility of Program Elements	\$17,545	Total: \$17,545
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Geophysical Survey Fees

Noting the limited subsurface and geologic data for definition of the bottom of San Juan Creek, and the highly variable depth to bedrock where data does exist, it was determined that supplemental characterization efforts using GeoVision were beneficial to better define the coastal aquifer zone and the upper reaches of San Juan Creek where groundwater recharge has been proposed. As such, geophysical surveys were completed along San Juan Creek to better define the stratigraphy and correlation of existing data. The fees associated with the geophysical survey were associated with the following task:

Task 3 - Evaluate Feasibility of Program Elements	\$19,100	Total: \$19,100
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4. FAF PROGRAM SCHEDULE SUMMARY

Project Task Overview

Project Task 1 (*Project Management*) continues in progress to complete the final tasks and preparation of the final report.

Project Task 2 (*Develop Preliminary Alternatives for Each Program Element*) has been completed at this time and project deliverables include:

The Task 2 Technical Memorandum "*Develop Design Criteria and Cost Estimating Methodology and Identify Potential Project Participants and Points of Delivery*" has been finalized and presented to the SJBA Board, participating member agencies, the regulatory community, and the public (attached to this report as Appendix A).

The Task 2 Technical Memorandum "*Preliminary Alternative Descriptions for the San Juan Basin Groundwater and Desalination Optimization Program Elements*" has been finalized and presented to the SJBA Board, participating member agencies, the regulatory community, and the public (attached to this report as Appendix B).

Project Task 3 (*Evaluate Feasibility of All Program Elements*) has been completed at this time and the project deliverables include:

The Task 3 Draft Technical Memorandum "*Evaluation of the Preliminary Options for the San Juan Basin Groundwater and Desalination Optimization Program*" has been finalized and presented to the SJBA TAC and will be presented to the SJBA Board, participating agencies, regulatory community, and the public (attached to this report as Appendix C).

Project Task 4 (*Develop Implementation Plan*) has been completed at this time.

Project Task 5 (*Project Report*) has been completed at this time.

Project Schedule Variances

During the first two quarters of 2014, Wildermuth Environmental proceeded with finalization of the GWFMP and implemented an adaptive management groundwater monitoring program for the basin. Following initial presentation of the GWFMP, several of the SJBA Board members requested that a "Third Party Peer Review" be performed to validate/challenge the basin model parameters (fatal flaw analysis) with particular emphasis on evaluating the groundwater production safe yield specified in the GWFMP. SJBA participating agencies agreed to delay the start of the FAF Program project work until the GWFMP had been completed and adopted.

Todd Groundwater was selected in June, 2014 and the peer review was accomplished during the third quarter of 2014 with Todd Groundwater presenting their findings/analysis to the SJBA Board

and TAC in September 2014. The peer review did not identify fatal flaws in the analysis or recommendations. The peer review recommended some improvements to the document (mostly administrative) to better comply with State Water Code compliance (for maximizing funding opportunities) and questioned some of the baseline parameters Geoscience used in the groundwater model. Conversations between Todd, WEI, and Geoscience personnel resolved the model uncertainties and inclusions of supplemental narratives of the model parameters and participating agency documentation which culminated in finalization of the GWMFP in November 2014 (4th Quarter).

Concurrent with the GWFMP finalization was the implementation of the adaptive management groundwater monitoring program which established new quarterly monitoring criteria including: selection of key monitoring points within the watershed, improvements of depth to groundwater monitoring, increased water quality testing, and introduction of vegetation/habitat monitoring (including establishing baseline monitoring locations). The intent of the revised groundwater monitoring program is attributed to better understanding the seawater production options and basin recharge considerations of the FAF Program project tasks. The GWFMP was adopted by the SJBA Board in November, 2014.

In November 2014, SJBA issued a Request For Proposal for Project Management services to facilitate execution and management of the FAF Program project tasks and to facilitate scheduling/cost management of other basin management projects. On December 9, 2014, SJBA Board selected G₃SoilWorks as the SJBA Project Manager and immediately tasked the designated Project Manager with establishing a comprehensive and condensed project schedule for the project.

During the fourth quarter of 2014, the TAC in cooperation with G₃SoilWorks developed the scope of work for necessary subsurface investigations (geophysical surveys) to further define the basin boundary conditions and fresh/saline boundaries along the coastal margin of the basin. The need for additional groundwater monitoring wells (cluster wells) was also established to support further analysis of the seawater production option.

During the 1st quarter of 2015, the SJBA contracted with Wildermuth Environmental to proceed with the technical studies related to Task 2 and Task 3 of the FAF Program project. In addition the SJBA contracted with Geoscience Support Services to update the San Juan Basin HSPF Watershed Model and the Regional Groundwater Model and to proceed the baseline analysis for the seawater barrier vertical extraction well analysis (basis for subsequent Wildermuth Environmental basin management analyses).

The contracting efforts for the engineering support services to evaluate the availability of recycled water and necessary treatment/distribution systems were delayed by the SJBA Board pending receipt of the preliminary findings from Task 2 (Feasibility Study) and further clarification of potential

project impacts to existing facilities/infrastructure and program capital construction projects. In June, 2015 SJBA Board approved retention of Black and Veatch to perform the engineering analyses for Task 3 (Detailed analysis of Program Elements) and Task 4 (Implementation Plan) and concurrently approved Wildermuth Environmental to proceed with Task 3 work efforts.

Subsequent project delays for Task 3 and Task 4 occurred in the fourth quarter of 2015 resulting from participating agencies slow responses to the consultant's request for existing facility operating capacity, capital expansion program information, existing wastewater treatment capacity at various facilities, projected recycled water demand, and potential impacts related to acceptance and/or transfer of potable water and recycled water produced from the proposed program elements. Task 3 work efforts were finally approved at the January 6, 2016 TAC meeting and the work proceeded to completion in February, 2016.

Task 4 (Implementation Plan) was initiated in February, 2016 and completed in March, 2016.

Metropolitan and MWDOC personnel have previously advised us that the report due date has been extended to March 31, 2016.

A comparison of the initial project schedule to the revised project schedule is presented on the following page.

SAN JUAN BASIN GROUNDWATER AND DESALINATION OPTIMIZATION PROJECT SCHEDULE													
FAF TASK	FAF SUBTASK / TASK DESCRIPTION	BUDGET SJBA/METROPOLITAN	2014				2015				2016		
			Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept
1	PROJECT MANAGEMENT	\$68,000											
1.1	Project Management and Administration	\$19,000 / \$19,000	√	√	√	√	√	√	√	√	√		
1.1a	Prepare Quarterly Progress Reports					√	√	√	√	√			
1.1b	Prepare Final Report To MET										√		
1.1c	Long-Term Reporting/Post-Project Update Report											√	√
1.2	Progress Reports To SJBA and Stakeholders	\$5,000 / \$5,000	√		√		√	√	√	√	√	√	√
1.3	Technical Advisory Committee Meetings	\$10,000 / \$10,000	√	√	√	√	√	√	√	√	√	√	√
2	DEVELOP PRELIMINARY ALTERNATIVES FOR EACH PROGRAM ELEMENT	\$64,400											
2.1	Develop Design Criteria	\$2,000 / \$2,000			√	√	√						
2.1a	Develop Cost Estimating Methodology					√	√						
2.1b	Identify Project Participants and Consulting Team Members			√	√	√	√						
2.1c	Identify Project Delivery Points					√	√						
2.2	Develop Preliminary Extraction Barrier Alternatives	\$5,000 / \$5,000		√	√	√	√	√	√				
2.3	Develop Preliminary Stormwater Recharge Alternatives	\$3,000 / \$3,000			√	√	√	√	√				
2.4	Develop Preliminary Recycled Water Recharge Alternatives	\$3,000 / \$3,000			√	√	√	√	√				
2.5	Develop Preliminary Adaptive Production Management Alternatives	\$10,500 / \$10,500				√	√	√	√				
2.6	Develop Preliminary Program Elements Presentation	\$4,350 / \$4,350						√	√				
2.7	Program Element Review with SJBA Board, Stakeholders, Agencies	\$4,350 / \$4,350							√	√			
3	EVALATE FEASIBILITY OF ALL PROGRAM ELEMENTS	\$162,400											
3.1	Evaluate Groundwater Extraction Barrier Alternatives	\$20,000 / \$20,000				√	√	√	√	√	√		
3.2	Evaluate Stormwater and Recycled Water Recharge Alternatives	\$22,000 / \$22,000			√	√	√	√	√	√	√		
3.3	Evaluate and Refine Adaptive Management Alternatives	\$30,500 / \$30,500			√	√	√	√	√	√	√		
3.4	Develop Presentation of Program Elements	\$4,350 / \$4,350								√	√		
3.5	Task 3 Review with SJBA Board, Stakeholders, Agencies	\$4,350 / \$4,350								√	√		
4	DEVELOP IMPLEMENTATION PLAN	\$47,000											
4.1	Identify Potential Habitat and Environmental Opportunities	\$13,500 / \$13,500									√	√	
4.2	Develop Phasing and Monitoring Plans	\$6,000 / \$6,000									√	√	
4.3	Revise Cost Estimates	\$4,000 / \$4,000									√	√	
5	PREPARE PROJECT REPORT	\$57,120											
5.1	Prepare Administrative Draft Report	\$17,500 / \$17,500							√	√	√		
5.2	Review Admin Draft Report with SJBA TAC	\$600 / \$600							√	√	√		
5.3	Prepare Draft Technical Report for Public Release/Review	5,000 / \$5,000								√	√		
5.4	Review Admin Draft Report with DPH and RWQCB Staff	\$1,500 / \$1,500										√	
5.5	Prepare Final Administrative Report	\$4,500 / \$4,500										√	
			√	Denotes Completed Scheduled Action Item									
			√	Denotes Revised Scheduled Action Item									

5. PROJECT RESULTS AND ANALYSIS

Task 2 Summary of Findings

Facility Design and Operating Criteria

The following criteria were developed to plan the location and sizing of in-channel and off-channel recharge facilities as well as the number and locations of wells sites for injection and production. Figure 3.3-1 shows the location of wells in the San Juan Basin.

Off-Channel Recharge Facilities Siting Criteria

The siting criteria for the off-channel recharge facilities proposed for this effort include:

- The site must be within the San Juan Basin (on the valley floor area) and recharge at the site must be tributary to production wells in the Basin.
- The site must be at least 5 acres in size, including setbacks and ancillary facilities.
- The surface soils at the site must contain Type A, B, and/or AB soils.
- The current thickness of the vadose zone underlying the site must be ≥ 50 feet, or the combination of proposed recharge and production should be such that there is no potential for liquefaction due to recharge.
- The site must be in public ownership or available for purchase.
- The site must not have any unresolvable environmental, institutional, or other challenges for use as a recharge basin.

In-Channel Recharge Facilities

In-channel recharge facilities will consist of:

- Temporary earthen berms that slow down stormwater discharge and maximize channel bottom area inundation;
- Temporary earthen impoundments to contain storm and recycled water in the channel for subsequent recharge; and
- Inflatable rubber dams that will be used to impound storm and recycled waters

The in-stream facilities will be assumed to have an average infiltration rate of 2 ft/day.

New Injection Well Location

Injection well locations will be developed to maximize the underground retention time and meet the desired injection rate for each alternative. Preference will be given to well sites that are likely to support desirable injection capacity, that are in public ownership, and that in conjunction with production wells and other recharge, maximize the underground

retention time and minimize the recycled water contribution (achieves the highest dilution of recycled water in the groundwater system).

New Injection Well Capacity

The capacity assumed for new injection wells will be 750 gallons per minute with a 90 percent utilization rate.

New Production Well Locations

Production wells will be required to recover the increase in storm water and recycled water recharge that will be included in the planning alternatives. WEI reviewed DWR Water Well Standards, reviewed AWWA Standards, and contacted the County of Orange for information on water well setback distances. There is no reference to setback distances in the AWWA standards. The County of Orange follows the DWR standards for setback distances, and in addition, the County stated that they will closely evaluate the 100-yr flood inundation area in approving well sites. Because most of the existing City of San Juan Capistrano and South Coast Water District wells are located within the 100-yr flood inundation area, it is assumed that this siting criteria is flexible.

New Production Well Capacity

The capacity assumed for new production wells will be based on the average of the greatest monthly production capacity achieved by wells used to supply City of San Juan Capistrano (CSJC) and South Coast Water District (SCWD) desalter supply wells.

Recycled Water Recharge Compliance

Compliance with the State Water Resources Control Board Division of Drinking Water (DDW) recycled water recharge regulations will be based on underground retention time (URT) and recycled water contribution (RWC). Metrics for URT and RWC were developed in Task 3 based on the technical memorandum prepared for the project by Dr. Michael Welch (included as Attachment D).

Preliminary Design of the Seawater Extraction Barrier

The reconnaissance-level engineering work for the SJBGFMP suggested that the plausible range of coastal groundwater production required to create a groundwater barrier to seawater intrusion was 3,000 to 6,000 afy. The following criteria were used for the initial siting of the extraction barrier well site areas:

- The depth to the effective base of the freshwater aquifer is approximately equal to or greater than 120 ft-bgs. The well field layout was configured to ensure high production capacity when the barrier is fully developed and to completely cutoff seawater intrusion.

- Wells must be at least 50 ft away from any sewer line or storm drain.
- Wells must be at least 100 ft away from any septic tank.

Conveyance and Treatment Facilities for the Extraction Barrier

A groundwater desalter/treatment plant would be required to treat the groundwater supplied by the extraction barrier wells to drinking water standards.

Pipelines would also be needed to convey groundwater pumped by the eight extraction barrier wells to a groundwater treatment plant. Approximately 6,500 feet of pipeline ranging from approximately 12 to 24 inches would be needed to convey the groundwater to the treatment plant.

A typical desalter/treatment plant utilizing seawater will recover about 50 percent of the water and would require disposal of the brine-concentrate flows back to the ocean. This would be most easily accomplished by discharging the brine-concentrate flows to the South Orange County Wastewater Authority's (SOCWA) 57-inch San Juan Creek Ocean Outfall. Additionally, the Chiquita Land Outfall is located on the east side of the San Juan Creek near the potential groundwater treatment plant locations.

Treated water from the new groundwater desalter would require product water conveyance facilities to convey product water to end users. For planning purposes, it is assumed that the product water would be conveyed from the new groundwater desalter to the existing Water Importation Pipeline (WIP). For this alternative, approximately 250 feet of 12-inch diameter pipeline would be required to convey the product water from the potential groundwater treatment plant location to the WIP.

Preliminary Design of the Storm Water and Recycled Water Recharge and Recovery Alternatives

Recharge and Recovery Options

The SJBGFMP recognized that in-stream recharge is the only viable large-scale recharge method for the San Juan Basin due to the lack of suitable off-stream sites for stormwater storage and recharge, and the inability of the basin to accept large amounts of recharge at a specific site.

Storm Water Recharge – In-Stream Options

The term *in-stream recharge*, as used herein, refers to the use of the existing Arroyo Trabuco and San Juan Creek channels for recharge. These channels contain natural bottoms that are highly permeable and will readily recharge water that is flowing in them. In the SJBGFMP, WEI developed two in-stream recharge concepts for storm water recharge that included:

- The construction of temporary in-stream “T” and “L” levees in San Juan Creek between Stonehill Drive and I-5.
- The construction of rubber dams in San Juan Creek between Stonehill Drive and the I-5, and in the Arroyo Trabuco between its confluence with San Juan Creek and the end of the concrete channel revetment.

Storm Water Recharge – Off-Stream Options

The storage capacity of the available off-stream basins is very small, ranging from 15 ac-ft to 215 ac-ft. The largest off-stream basin, the Galivan Basin, has been studied by the SJBA in the past and found to be an unfeasible option for recharge due to shallow groundwater, low-permeability of underlying sediments, small storage, and the landslide and liquefaction potential that could be exacerbated by constant inundation. The remaining three basins are very small, and the two basins located off the stream channel (Acu Canyon and La Novia) would need conveyance facilities to discharge the water to the San Juan Creek channel given that they do not overly the alluvial basin. Given these limitations, and that the basins did not meet the design criteria described above, these off-stream basins were not recommended for hydrologic evaluation in Task 3.

Recycled Water Recharge

Pursuant to the FAF Program scope of work, the hydrologic feasibility of recycled water recharge facilities was conceptualized for in-stream recharge and groundwater injection wells. The in-stream concepts include:

- Incidental recharge from the discharge of recycled water in the Arroyo Trabuco downstream of the I-5 and in San Juan Creek between Stonehill Drive and Ortega Highway.
- A combination of incidental recharge and in-stream temporary “T” and “L” levees.
- In-stream impoundments formed by rubber dams.
- A combination of incidental recharge and rubber dams.

The same in-stream improvements used for storm water recharge can be used to recharge recycled water during the dry-weather period of May through September. The facility layouts and operating schemes for these concepts were developed to potentially recharge up to 10,000 ac-ft and are described herein.

Balance of Recharge and Discharge and Adaptive Production Management

The SJBGFMP included a program element called “adaptive production management” whose purpose was to set annual groundwater production limits to ensure sustainable production. As

contemplated in the SJBGFMP Alternative 1, the annual sustainable production would be established each year based on the volume of groundwater in storage in the spring. The SJBGFMP Alternative 1 included only adaptive production management with existing facilities. The SJBGFMP Alternative 6 includes new recharge in the amount of about 11,500 afy (from the combination of estimated storm water recharge [average of 1,000 afy], recycled water recharge [average of 10,000 afy], and in-lieu recharge through replacement of private pumping with alternative water sources [average of 500 afy]). Therefore, groundwater pumping will need to increase by 11,500 afy to balance the increase in recharge and produce a project yield of 9,200 afy.

Each storm and recycled water recharge alternative considered herein will require a custom-designed well field to recover the water recharged. These well fields were approximately identified and are described herein.

Recycled Water Source

One of the potential sources of recycled water for the SJBGFMP Alternative 6 recharge is the Jay B. Latham Plant. The plant will have to be upgraded to enable it to produce Title 22 recycled water for recharge. Additional recycled water may also be available at the Chiquita Water Reclamation Plant, Oso Creek, and the 3A Plant. The availability, including seasonal limits, of wastewater or recycled water flows at these upstream plants is being evaluated in coordination with the SJBA member agencies.

“T and L” Levees and Incidental Recycled Water Recharge

Locations where “T and L” levees could be constructed were identified where incidental recharge would occur utilizing recycled water from the Jay B. Latham Plant conveyed to the points of discharge. The levees would be constructed from in-situ channel bottom sediments in a balanced cut and fill arrangement. The levees would be about five feet high when constructed and would be designed to wash out during storm events. This alternative would also include the same five-foot temporary earthen berm across San Juan Creek upstream from Stonehill Drive to ensure that no recycled water and other dry-weather flows would discharge to the ocean.

Rubber Dams and Incidental Recycled Water Recharge

Location along the reaches where rubber dams would be constructed, where incidental recharge would occur and the recycled water facilities to convey recycled water from the Jay B. Latham Plant to the points of discharge were also identified. Rubber dams would be constructed in San Juan Creek in the reach between I-5 and Stonehill Drive and in the Arroyo Trabuco in the reach from about 2,000 feet upstream of the Del Obispo Street bridge to the confluence with San Juan Creek.

Similar to the other in-stream recharge options, recycled water turn outs would be located downstream of I-5 on San Juan Creek and along the Arroyo Trabuco to maximize wetted area and recharge, and to provide operational flexibility. This recharge option would include the same main recycled water conveyance pipeline as the “T” and “L” Levee option.

Injection Well Recharge

The potential areas where injection well fields capable of recharging up to 10,000 afy of recycled water are located along San Juan Creek and Arroyo Trabuco. The injection wells will likely be located in a linear fashion along San Juan Creek and the Arroyo Trabuco. Injection is assumed to occur year-round. Conceptually, twelve injection wells would be constructed with ten injection wells used to recharge 5,000 to 10,000 afy of recycled water with backup wells. This option includes recycled water conveyance pipelines that would follow the same alignments as the incidental recharge option.

Recovery Well-Fields

The new groundwater recovery wells will be constructed to work with existing wells to recover the new storm and recycled water recharge and ensure there is no rising discharge to the ocean and no groundwater discharge to the ocean. Groundwater production associated with recovering the new recharge is assumed to occur year-round.

In the case that groundwater injection causes rising groundwater or other undesirable high groundwater elevations within the injection well field itself and cannot be practically mitigated through injection well siting and capacity adjustments, some of the extraction wells may have to be sited within the injection well field to act as relief wells.

Groundwater Desalter

A new or upgraded groundwater desalter/treatment plant will be required to treat the groundwater supplied by the recovery wells to drinking water standards. Given the proximity of the recovery wells to the recharge areas, the recycled water contribution (RWC) of water extracted will likely be greater than 20 percent and so full advanced (RO typically) treatment would be required.

Task 3 Summary of Findings

Projection of Recycled Water Available for the Program

One of the elements in assessing the potential options for groundwater management is the amount and availability of recycled water that could be utilized. In this section, a summary of the projected non-potable recycled (NPR) water demands for each agency along with the projected wastewater flows for each of the areas wastewater treatment plants is provided.

Non-Potable Reuse Demand Projections

Information was provided by each agency on their recent NPR system demands, as well as their projected demands in 2035. The agencies' recycled water demands are currently being met by the following facilities: Regional Treatment Plant, 3A Plant, Coastal Treatment Plant, Chiquita WRF, and Oso Creek WRP. By 2035, the demands for each agency increase. This will be accommodated by planned improvements at the 3A Plant and the Chiquita WRF. Additionally, improvements are being evaluated at the J.B. Latham plant to meet the City of San Juan Capistrano's (CSJC) NPR system needs.

Monthly projections for the City of San Juan Capistrano and Santa Margarita Water District (SMWD) were based on data provided by each agency. For the South Coast Water District (SCWD), the monthly projections were assumed to be the same as the average 2010-2014 monthly percentage of recycled water use as provided by the South Orange County Wastewater Authority (SOCWA). Monthly splits for the Moulton Niguel Water District (MNWD) were assumed to be the average of the other three agencies.

Wastewater Flow Projections

The following is a summary of the existing and projected flows at each of the five wastewater treatment plants considered as a potential supply sources. Assessment of each plant considers the projected average daily wastewater flows, seasonal or monthly variations, the level of existing and planned tertiary treatment, as well as what is considered the dependable supply. For some plants, the dependable supply may be lower than the projected inflow due to historical variations or uncertainty in the projected 2035 inflows.

Coastal Treatment Plant

The projected dependable average annual wastewater inflow for Coastal Treatment Plant is estimated to be 3 million gallons per day (MGD). However, 1.2 MGD of this wastewater is contributed by the City of Laguna Beach and may not be available for use by SCWD or SJBA should the City of Laguna Beach choose to use it. The tertiary treatment capacity of the existing plant is 2.61 MGD and no improvements are being planned at this time. Therefore, the tertiary treatment capacity is a potential limit to future recycled water availability unless its capacity is increased. During non-peak seasons an average of 582 ac-ft of recycled water from SCWD flows could be made available for use as part of a groundwater optimization program.

Regional Treatment Plant

Data collected through July of 2015 showed wastewater inflows as low as 7.75 MGD. Following this trend, a conservative assumption was used that the dependable average

annual wastewater inflow for Regional Treatment plant is 7.75 MGD even though the projected average annual wastewater flow is 8 MGD. The tertiary treatment capacity of the existing plant is 11.40 MGD and no improvements are being planned at this time as the projected wastewater inflows are lower than the existing tertiary capacity. During peak demand seasons the entire available wastewater flow of the plant is utilized to meet MNWD NPR demands. Therefore, only off-peak season flows would be available from the Regional Treatment Plant for use as part of a groundwater optimization program.

3A Plant

The current average daily flow to the plant is 1.8 MGD and is entirely from MNWD's service area. However, SMWD and MNWD are planning to increase flows to the plant such that it would be able to treat up to 6 MGD of flow year-round for their NPR systems. Under these plans, the Santa Margarita Water District will contribute 3 MGD of wastewater flow and MNWD will provide another 1.2 MGD of flow by diverting flows that currently go to the J.B. Latham Plant. The tertiary capacity of the existing plant is 2.4 MGD, but will increase to 6 MGD under the SMWD/MNWD plan. During peak demand seasons the entire available wastewater flow of the 3A Plant is utilized to meet help meet SMWD and MNWD NPR demands. Therefore, only off-peak season flows would be available from the 3A Plant for use as part of a groundwater optimization program.

Oso Creek Treatment Plant

The dependable average annual wastewater inflow for Oso Creek Treatment Plant is 1.8 MGD. The tertiary treatment capacity of the existing plant is 1.8 MGD and no improvements are being planned at this time since the tertiary capacity exceed the projected inflows. The majority of the Oso Creek Treatment Plant's flows are utilized to meet SMWD's NPR demands. However, SMWD can move the flows around to where they are needed to meet NPR demands and where wastewater flow is available, such that only some off-peak season flows would be available from the plant for use as part of a groundwater optimization program.

Chiquita WRF

The wastewater inflow to the Chiquita WRF is expected to increase over the next 20 years as the Rancho Mission Viejo development is built. Therefore, the 2035 projected average annual wastewater inflow for the Chiquita Plant is 9.5 MGD and the estimated dependable flow is 9.0 MGD. The tertiary capacity of the existing plant is 6.00 MGD, but a planned improvement of the facility will bring the tertiary capacity to 9.00 MGD prior to 2035. During peak demand seasons the entire available wastewater flow of the Chiquita Plant is utilized to meet help

meet SMWD NPR demands. However, in combination with SMWD's other recycled water supply sources, including other raw water/non-potable sources, there will be off-peak season flows available to meet the SMWD's peak season NPR demands along with additional supplies that could be available for use as part of a groundwater optimization program.

J.B. Latham Plant

Data collected through July of 2015 showed wastewater inflow as low as 6 MGD. This was likely due to the high level of water conservation occurring as a result of the Governor's mandated cutbacks. More recently, wastewater flows have increased to more typical levels. However, there is some uncertainty in how much the most recent conservation measures will become more permanent in the long-term. As noted above, improvements to the 3A Plant system will divert about 1.2 MGD from the J.B. Latham Plant. Based on these conditions, a conservative assumption was used that the 2035 projected dependable average annual wastewater inflow for J.B. Latham is 5 MGD.

The existing plant does not have any tertiary capacity, and therefore, improvements to the plant would be required to provide Title 22 quality water for recycled water projects. The City of San Juan Capistrano has also studied and is considering upgrading a portion of the plant to provide tertiary treated water for its NPR system in the future. Even if the City of San Juan Capistrano moved forward with its recycled water expansion plans, there would still be potential wastewater flow available during peak and off-peak seasons that could be available for use as part of a groundwater optimization program.

Regional Wastewater and Non-Potable Recycled Water Summary

With the potential to utilize the existing Upper Oso Reservoir and the SMWD's planned Trampas Reservoir, both of which are capable of providing seasonal storage, there is potential to utilize recycled water that is not being used by the agencies' NPR systems. However, both NPR and IPR systems require seasonal storage, so a regional assessment of the total available wastewater and recycled water is necessary to understand what is truly allocated for NPR vs. what may be available for a future IPR program.

Based on the projected recycled water demands, an average of 1,185 ac-ft of recycled water is needed to be stored during off-peak seasons to meet the estimated peak season demands. With all the plants contributing, a projected average of 11,114 ac-ft of recycled water could be available for seasonal storage reservoirs. After subtracting the projected seasonal storage needs of the NPR demands, the net result is a projected average of 9,929 ac-ft of recycled water. However, the amount of recycled water supply that could be available for such a program could be less due to several factors, including:

-
- Project NPR demands are based on current use and planned expansions
 - Some years when the NPR system may require more than 1,185 ac-ft of storage
 - Potential losses due to plant shutdown and maintenance periods
 - Evaporation losses that occur in the seasonal storage reservoirs

Therefore, future analysis and design of a groundwater program should take into consideration both the average annual projections as well as the range of supplies that could be available to a groundwater recharge program. Another scenario being considered is to not include flows from the J.B. Latham Plant or the Coastal Treatment Plant. This scenario would reduce the amount of available recycled water but would avoid expensive conveyance systems and treatment upgrades at the J.B. Latham Plant as well as avoiding the potential concern of using the City of Laguna Beach's wastewater via the SCWD's system. Under this scenario, the projected NPR demands from the City of San Juan Capistrano are still met from a combination of MNWD and SMWD excess supplies. This scenario requires fewer improvements but at the cost of reduced recycled water supplies. The projected recycled water available for IPR decreases to 3,336 ac-ft after meeting the peak season NPR demands from seasonal storage. If additional supplies were needed, excess off-peak supplies from the Coastal Treatment Plant could be conveyed into and through the City of San Juan Capistrano's system to the Trampas Reservoir. This would result in 4,328 ac-ft recycled water available for a groundwater recharge program without the need to make improvements at the J.B. Latham Plant.

Hydrologic Analysis of the Project Alternatives

The Program alternatives were evaluated by simulating the hydrologic response of the San Juan Basin and overlying streams to them with a groundwater model. The model used herein is based on the regional San Juan Basin Groundwater Model developed for the South Orange County Ocean Desalination Feasibility Investigation (SOCOD). The regional model was recently updated by Geoscience for the SJBA to perform an initial assessment of the seawater extraction barrier. WEI revised the latter model to more accurately simulate the basin response to streambed recharge and recharge from storm water impounded behind rubber dams. The resulting model used herein is called the SJBA model. A 68-year planning hydrology from 1947 through 2014 was used to evaluate the baseline, or no project alternative, and four Program alternatives.

The following hydrologic responses were evaluated with the SJBA model to characterize the hydrologic changes, yield and other impacts of the baseline and Program alternatives.

- Water budget. Includes the recharge and discharge components in the basin, net recharge and project yield; and is used to characterize how the hydrology of the basin changes with various management schemes.

- Groundwater elevation time series. These plots show the projected time series of groundwater elevations at wells for the baseline and Program alternatives.
- Seawater intrusion charts. These charts include a time series of discharge across the aquifer-seawater interface and a map showing the spatial movement of groundwater in the vicinity of the proposed seawater extraction barrier near the coast.
- Groundwater pumping frequency curves. These curves show exceedance probability of production by various entities and groups of entities with pumping expressed either in absolute terms (afy) or as fraction of the entity's pumping goal. These curves are useful in characterizing how various project components and the native hydrology impact the ability to produce water from the basin and provide a fair comparison of the change in production capabilities among the project alternatives as well as how the pumping capabilities change for the producing entities.
- Recycled water contribution (RWC). The RWC is expressed in maps that show the spatial distribution of the RWC and as time series plots that show the 120-month volume weighted average RWC of the aggregate supply of groundwater to the CSJC GWRP, SCWD GRF and the proposed new groundwater treatment plant.

Project Alternatives

Baseline "No-Project" Alternative

The purpose of a baseline or "no-project" alternative is to project how the San Juan Basin will respond in the future in the absence of the Program and to provide a baseline from which to determine the changes in yield and the hydrologic impacts attributable to implementation of the Program.

Baseline Alternative Planning Assumptions

The planning scenario underlying the analysis of the Program alternatives is based on Scenario 2h that was developed for the SOCOD Feasibility Investigation and that was subsequently used in the SJBGFP. The major assumptions used in Scenario 2h include: current (2010) land use and cultural conditions, current storm water management conditions, a hydrologic period running from 1947 through 2010, and pumping goals for the major groundwater users. With the exception of the hydrologic period and the pumping goals, these assumptions were used in the evaluation of the Program alternatives herein. For this investigation the hydrologic period was extended to run from 1947 through 2014 and the production goals for the major producers were revised in Task 2 by the TAG and are listed below:

Annual Pumping Goal by Producer	
Producer	Annual Pumping Goal (afy)
City of San Juan Capistrano Non-Potable Wells	1,023
City of San Juan Capistrano GWRP Wells	7,705
South Coast Water District	1,300
Private Pumpers	866
Total	10,894

It is noted that the “Pumping Goals” specified above are not to be construed, interpreted, inferred, or implied to represent or authorize “water rights” to such production levels.

Groundwater pumping at the CSJC’s GWRP wells is subject to SWRCB Permit 21074, held by the SJBA, which limits pumping to maximum annual quantity of 8,026 afy provided that, among several conditions, the storage in the basin remains greater than 50 percent of the basin storage capacity, that the pumping does not contribute to groundwater degradation and that the pumping doesn’t adversely impact riparian vegetation on San Juan Creek. The SCWD has a similar permit, Permit 21138, that limits its pumping to a maximum annual quantity of 1,300 afy and is subject to the same limitations mentioned above. The MODFLOW Multi-Node Well Package (MNWP) was used in the SJBA model in the simulation of the baseline alternative to proportionately limit pumping from the CSJC GWRP and SCWD GRF wells by maintaining storage greater than 50 percent full and maintaining a subsurface discharge to the ocean, the latter required to ensure that seawater intrusion (groundwater quality degradation) would not occur.

Hydrologic Response to the Baseline Alternative

The MNWP incorporated into the SJBA model enabled the setting of water level controls at each of the CSJC GWRP and SCWD GRF wells such that the end of year storage in the basin always remains above 50 percent of maximum storage and ensures that seawater intrusion does not occur. During dry periods the SJBA model reduces groundwater pumping and during wet periods it increases pumping towards the goals of the CSJC and SCWD.

Water Budget

The modeling results for the annual water budget for the baseline alternative are shown in Table 3.3-1. The annual net recharge, groundwater pumping (based on goals and adjustments

to comply with SWRCB diversion permits) and project yield (water produced and subsequently recovered for use after treatment) are listed in the table below:

Summary of the Baseline Alternative Results (afy)			
Statistic	Net Recharge	Total Pumping	Project Yield
Minimum	3,480	6,770	5,750
Maximum	16,480	10,130	8,480
Average	8,360	8,510	7,180

Annual net recharge is equal to the annual groundwater pumping minus the annual change in storage. Project yield is equal to annual groundwater pumping minus losses that occur in the treatment process. The minimum statistic corresponds to the driest year in the planning hydrology. In this year, the net recharge is less than the total pumping indicating that the groundwater storage declined by about 3,300 ac-ft. Note that in the driest year the pumping is less than the pumping goal by about 4,100 ac-ft: the MNWP reduced pumping by the SCWD and the CSJC GWRP wells to meet the permit requirements.

The maximum statistic corresponds to the wettest year in the planning hydrology. In this year, the net recharge is greater than the total pumping indicating that the groundwater storage increased that year by about 6,350 ac-ft. Note that the pumping in the wettest year is less than the pumping goal by about 800 ac-ft: the MNWP reduced pumping to meet the permit requirements even in the wettest year in the hydrologic period.

In the baseline alternative, the storage in the basin ranges from a minimum of about 25,000 afy (61 percent of full) to a maximum of about 40,600 ac-ft (98 percent of full) and averaged about 30,900 ac-ft (75 percent of full). Pumping was managed in the baseline alternative with the MNWP over a range of 61 percent to 100 percent of storage capacity in order to control seawater intrusion.

Groundwater Pumping

The annual groundwater pumping goals assumed in the baseline alternative and the model-projected groundwater pumping are summarized in Table 3.3-2. The projected groundwater pumping for the CSJC GWRP wells and the SCWD GRF wells averaged about 74 percent of their respective pumping goal.

Seawater Intrusion

The average subsurface discharge to the ocean is about 100 afy and ranges from a minimum of -26 afy to a maximum of 377 afy (a positive value means that the discharge is to the ocean

and a negative value means seawater intrusion). Fourteen of 68 years were projected to have negative subsurface outflow to the ocean, indicating seawater intrusion ranging from 1 to 26 afy in those years.

Groundwater Elevations

Projected groundwater elevations for the baseline alternative were determined for the following wells: MWDOC MW-2M, SCWD Stonehill, CSJC Kinoshita, CSJC SJBA 4, CSJC Tirador, CSJC CVWD 5A, CSJC Hollywood 2A and SJBA MW-8. The cumulative departure from mean (CDFM) for precipitation was utilized to correlate the precipitation trend to the projected groundwater elevations.

For the wells closer to the ocean (MWDOC MW-2M and SCWD Stonehill) the projected groundwater elevation time histories in the baseline alternative are stable showing seasonal responses to recharge and pumping and muted responses to large storm events. Up gradient of the SCWD Stonehill well, the projected groundwater elevation time histories have greater seasonal variability. The magnitude of the range in groundwater elevation changes generally increase moving upstream from the SCWD Stonehill well. The projected groundwater elevations for wells located along San Juan Creek upstream of the SCWD Stonehill well show a decline near the end of the planning period, which hydrologically corresponds to current drought (e.g., CSJC's Tirador and CVWD 5A). Similarly, the wells located along the Arroyo Trabuco show similar projected groundwater elevation responses as wells located along San Juan Creek (e.g., CSJC Hollywood 2A and SJBA MW-8).

Hydrologic Response to the Program Alternatives

The Program alternatives proposed in the Task 2 TM were initially screened by simulating the alternatives with the SJBA model to determine if there were obvious capacity constraints or other physical limitations.

The following changes were made to the alternatives described in TM 2 based on the initial screening and information learned in the baseline alternative:

- Seawater extraction barrier, common to all alternatives – production capacity was reduced from 6,000 afy to 3,000 afy;
- Storm water recharge from rubber dams in Alternatives 1b and 2b – the new storm water recharge from the construction of rubber dams on San Juan Creek was estimated to be about 1,400 afy and this total increased to about 1,660 afy if rubber dams were constructed on the Arroyo Trabuco – this an increase from 1,000 afy estimated in the SJBGFP and assumed in Task 2;

- Alternative 1b – recycled water recharge was increased from 5,000 afy to 7,727 afy with 5,000 afy recharged in the rubber dam system and 2,727 afy of incidental recharge;
- Alternative 2b – the recycled water recharge capacity was increased from 10,000 afy to 10,227 afy with 7,500 afy recharged in the rubber dam system and 2,727 aft of incidental recharge;
- Alternative 4c – the recycled water injection was reduced from 10,000 afy to 5,000 afy.

The Program alternatives that were hydrologically evaluated herein as part of Task 3 are summarized in the table below. Note that the alternative projects are additive to the baseline pumping goals. In other words, the baseline pumping goals for all producers remain the same in each Program alternative.

Summary of Program Alternatives					
Program Alternative	Seawater Extraction Barrier Raw-water Pumping		Recharge Options and Capacities	Pumping Requirements to Recover New Recharge	
	Annual Extraction (afy)	Number of New Wells		New Pumping Capacity (afy)	Number of New Wells
Alternative 1b	3,000	Eight with six operating and two in standby	1,400 afy of new storm water created by rubber dam in San Juan Creek; 5,000 afy of recycled water; 2,727 afy incidental recharge in San Juan Creek and Arroyo Trabuco	5,000	Six with five operating and one in standby
Alternative 2b	3,000	Eight with six operating and two in standby	1,660 afy of new storm water created by rubber dam in San Juan Creek and Arroyo Trabuco; 7,500 afy of recycled water; 2,727 afy incidental recharge in San Juan Creek and Arroyo Trabuco	7,500	Ten with eight operating and two in standby
Alternative 3a	3,000	Eight with six operating and two in standby	5,000 afy of recycled water injection along San Juan Creek	5,000	Six with five operating and one in standby
Alternative 4c	3,000	Eight with six operating and two in standby	2,500 afy of recycled water injection along San Juan Creek and 2,500 afy along Arroyo Trabuco	5,000	Eight with six operating and two in standby

Hydrologic Evaluation of Seawater Extraction Barrier

All four Program alternatives included the same proposed seawater extraction barrier to ensure that seawater would not intrude into San Juan Basin due to upstream groundwater pumping and to produce a new source of water. The SJBGFMP suggested that the extraction barrier pumping would range between 3,000 to 6,000 afy. A reconnaissance-level analysis of a 6,000 afy extraction barrier was conducted early in the present investigation (Task 3.1), the results of which suggested that a 6,000 afy extraction barrier was not feasible.

A 3,000 afy extraction barrier concept was subsequently developed based on the Task 2 TM and the aforementioned reconnaissance-level analysis. Modeling work conducted in Task 3 confirmed the hydrologic feasibility of the creation of a robust extraction barrier that would prohibit seawater intrusion at 3,000 afy of pumping. Figure 3.3-12 shows the conceptual location of the extraction barrier wells (EBW-1 through EBW-8) and the SCWD's Stonehill and Creekside wells. Figure 3.3-12 also shows the groundwater flow direction derived from the groundwater model simulations of the extraction barrier indicating that seawater would flow to and be captured by the extraction barrier well field.

Under the baseline alternative the average discharge out of the barrier zone is 134 afy towards the SCWD wells and averages 97 afy into the ocean. For all Program alternatives the ocean discharge direction is reversed. For all Program alternatives the seawater barrier draws about 2,100 afy from the ocean, about 700 afy from groundwater originating upstream, and the remaining 200 afy from vertical recharge that occurs between the coast and the SCWD wells.

Figure 3.3-13 shows a projected groundwater elevation time history for an extraction barrier well and shows that the drawdown at the well is about 20 feet greater as compared to the baseline alternative. The projected decline at the Stonehill well is about 2 feet. That said, because of the use of the MNWP to comply with the SWRCB permits, the projected pumping for the SCWD is very sensitive to the decline in groundwater elevations caused by the extraction barrier pumping. The MNWP used in the SJBA model limits the pumping at the SCWD Stonehill and Creekside wells to an average of about 30 to 36 percent of the SCWD's pumping goal of 1,300 afy during the 1947 to 2014 hydrologic period – which is slightly less than half of the 74 percent of the pumping goal achieved in the baseline alternative. The proposed extraction barrier interferes with the SCWD ability to meet its pumping goal.

Hydrologic Evaluation of the Program Alternatives

Each alternative was simulated with the SJBA model and the modeling results were evaluated to characterize the hydrologic response of the basin to each alternative. The hydrologic response of each alternative was compared to the baseline alternative and the other Program alternatives.

Water Budget

Water budgets were prepared for each SJBGFMP alternative and the average value for each recharge and discharge component in each alternative is listed in Table 3.3-7.

Groundwater Pumping

The impact of the Program alternatives on groundwater pumping at the CJSC's GWRP and SCWD GRF wells is characterized in Table 3.3-2. As currently conceptualized, all of the Program alternatives would reduce the SCWD's ability to pump from its existing wells compared to the baseline alternative. Pumping from the CSJC GRWP wells is projected to increase for the alternatives that utilize rubber dams (1b and 2b) and decrease with the injection alternatives (3a and 4c).

The projected groundwater pumping at the CJSC GWRP and SCWD GRF wells is controlled as in the baseline alternative by the MNWP settings developed in the baseline alternative. These settings could be relaxed given the existence of the extraction barrier in such a way as to allow the storage to approach the 50 percent full metric. If the private producers, the interests of which are intended to be protected by the 50 percent metric, were given an alternative supply then the 50 percent full management metric could be eliminated altogether and replaced with other management metrics to protect water quality and riparian vegetation. This would likely allow the CSJC and SCWD to produce more water at their wells and in amounts greater than in the baseline alternative.

Recycled Water Contribution and Underground Retention Time

The California Title 22 Regulations for a Groundwater Replenishment Reuse Project (GRRP) require the project proponent to prepare a Title 22 engineering report that among other things produces estimates of the amount of recycled water present in groundwater produced at a well, known as the recycled water contribution (RWC), and the underground residence time (URT) from the point of recharge to recovery at wells. The 120-month average RWC is a metric used by the Division of Drinking Water (DDW) in the permitting of indirect potable reuse projects. For an indirect potable reuse project that recharges tertiary-treated effluent, the allowable 120-month average RWC ranges between 20 to 100 percent, but is also a function of total organic carbon concentrations. Under current regulations, the minimum allowable URT for a GRRP is 2 months. Demonstrations of URT can also be used to obtain credits toward the requirements for virus log-reduction. To achieve the required log reductions, as much as 6 months URT could be required for surface water recharge GRRPs and as much as 12 months URT could be required for injection GRRPs. The MT3D solute transport model was used to estimate the RWC and the URT.

The URT at wells are shortest in alternative 2b, ranging from one month to five months at wells downgradient of recycled water recharge locations. The URT at wells are longest in alternative 4c, ranging from two months to 129 months for wells downgradient of the recycled water injection locations.

Figures 3.3-18 through 3.3-21 show the projected volume-weighted 120-month average RWC for groundwater pumped to the CSJC GWRP, the SCWD GRF, the new groundwater treatment plant, and the Extraction Barrier treatment plant, for alternatives 1b, 2b, 3a and 4c, respectively. Figures 3.3-22 through 3.3-25 are maps that show the spatial extent of the RWC for two short-term URT's and at the end of a dry (August 1976) and wet (March 1983) period, for alternatives 1b, 2b, 3c and 4c, respectively.

The 120-month RWC plots for the various groundwater treatment plants were developed from the projected volume-weighted RWC at each well that pumps to the plant. The table below lists the asymptotic estimate of the 120-month average RWC for the Program alternatives.

A fundamental assumption for the Program alternatives is that the new and existing treatment plants will need to be constructed or modified to treat all the groundwater, the treatment level being dependent on RWC and URT at the plants. Because the Program alternatives are designed differently than many IPR projects permitted by DDW (e.g. high RWC, low URT, and treatment after extraction from the groundwater basin), the SJBA should anticipate having to perform specific studies unique to the basin to obtain approval for alternative compliance strategies the Program alternatives.

120-month Asymptotic RWC at Treatment Plants (percent)				
Program Alternative	SCWD GRF	CSJC GWRP	SJBGFMP Treatment Plant	Extraction Barrier Treatment Plant
1b	70	40	55	10
2b	65	45	45	10
3a	0	20	75	0
4c	25	35	55	5

Figures 3.3-22 and 3.3-23 show the spatial distribution of RWC for two and six months after initiation of recharge at the end of a dry (August 1976) and wet (March 1983) period for the surface recharge alternatives 1b and 2b, respectively.

Figures 3.3-24 and 3.3-25 show the spatial distribution of RWC for two and twelve months after initiation of recharge, at the end of a dry (August 1976) and wet (March 1983) period for the groundwater injection alternatives 3a and 4c, respectively.

The scope of this investigation described above was to evaluate the Program alternatives developed in Task 2 not to optimally design the alternatives. The amounts of recycled water recharge, location of the recycled water recharge, the location of recovery wells and the pumping rates at the recovery wells were not optimized to maximize URT and minimize RWC. These alternatives can be refined to determine the maximum URT and minimum RWC.

Project Yield

Project yield is equal to the total annual pumping minus the water lost in the treatment process to make the water potable. Figure 3.3-26 shows the probability over the planning period of achieving levels of project yield: the y-axis represents the projected total project yield and the x-axis represents the probability of achieving the project yield.

Review of these charts reveals the following:

- All Program alternatives produce more project yield than the baseline alternative.
- The surface water recharge alternatives (1b and 2b) have the greater project yield and generally produce about twice the yield of the baseline alternative.

Table 3.3-7 lists the project yield for the baseline and Program alternatives. The average project yield for the baseline alternative is about 7,200 afy. The average project yields for the Program alternatives are estimated to be:

- Alternative 1b – project yield is about 13,300 afy, an increase over the baseline alternative of 6,100 afy
- Alternative 2b – project yield is about 15,000 afy, an increase over the baseline alternative of 7,800 afy
- Alternative 3a – project yield is about 11,200 afy, an increase over the baseline alternative of 4,000 afy
- Alternative 4c – project yield is about 11,300 afy, an increase over the baseline alternative of 4,100 afy

Use of the Hydrologic Evaluation

Table 3.3-9 summarizes for each Program alternative the amount of recycled water recharge, the amount of rising groundwater projected to occur, the amount of ET projected to occur, the amount of recharge lost, and suggested refinements to the alternatives and the estimated impacts on the total project yield from implementing the refinement. The suggested refinements are based on reducing the rising groundwater and ET to no greater than that which would occur under the baseline alternative. The calculations to arrive at the suggested refinements are also

shown in the column headings. Based on the groundwater basin response to the Program alternatives, the Program alternatives could be refined as follows to achieve the same project yield:

- Alternative 1b – reduce the recycled water recharge by an average of about 2,500 afy so that recharge ranges from about 2,700 afy during wet years to about 6,900 afy in dry years and average about 5,200 afy.
- Alternative 2b – reduce the recycled water recharge by an average of about 3,200 afy so that recharge ranges from about 2,700 afy during wet years to about 8,600 afy in dry years and averages about 7,000 afy.
- Alternative 3a – reduce the recycled water injection recharge by an average of about 1,000 afy so that recharge ranges from about 0 afy during wet years to about 4,600 afy in dry years and averages about 4,000 afy.
- Alternative 4c – reduce the recycled water injection recharge by an average of about 800 afy so that recharge ranges from about 0 afy during wet years to about 4,800 afy in dry years and averages about 4,200 afy.

Conceptual Strategies

Six conceptual strategies were developed for further refinement and cost evaluation. Each conceptual strategy contains some or all of the following program elements: seawater extraction barrier, enhanced stormwater recharge, recycled water recharge, and in-lieu recharge through the offset of private well pumping with direct recycled water deliveries to the pumpers. Table 3.4-4 summarizes the size of the included program elements and provides the estimated new project yield attributed to each strategy. The conceptual strategies are grouped into two categories as they relate to the recharge elements of the Program: surface water recharge (SWR) and injection (INJ). Surface water recharge involves recharge with rubber dams and/or incidental recycled water recharge. Injection involves construction of injection wells in strategic locations to inject recycled water into the basin and subsequently recover it downstream without allowing rising groundwater to occur.

Consistent with SJBGFM Alternative 6, each conceptual strategy includes a seawater extraction barrier and treatment facility component that is the same across all alternatives. The extraction barrier size was determined based upon the groundwater modeling work and is assumed to operate at a total raw-water pumping capacity of 3,000 afy.

The new project yields attributable to the conceptual strategies were estimated based on Table 3.3-9, the model-generated water budget tables for the baseline and Program alternatives and

professional judgement. The project yield attributable to the conceptual strategies is equal to the new annual pumping minus the water lost in treatment and was calculated as follows:

- Yield from the extraction barrier (Q_{eb}) was assumed equal to 50 percent of the extraction barrier pumping and equals 1,500 afy ($0.5 * 3,000$ afy)
- Yield from the recovery of recharge of recycled water (Q_{rw}) was assumed equal to 80 percent of the recycled water recharge
- Yield from the recovery of recharge of storm water (Q_{sw}) was assumed equal to 80 percent of the stormwater recharge
- Yield from reducing groundwater pumping by private pumpers (Q_{pp}) was assumed equal to 80 percent of private pumping and equals 400 afy ($0.8 * 500$ afy)
- Modeling results for the extraction barrier indicate that the groundwater pumping at the SCWD GRF would likely have to be reduced on average by about 800 afy (ΔQ_{grf}). This would reduce the product water produced at the SCWD GRF by 640 afy ($0.8 * 800$ afy).

Thus the project yield attributable to any of the conceptual strategies (PY_{new}) can be estimated as:

$$PY_{new} = Q_{eb} * 0.5 + (Q_{rw} + Q_{sw} + Q_{pp} - \Delta Q_{grf}) * 0.8$$

The components of the strategies are described in greater detail below.

Conceptual Strategy SWR-1

SWR-1 consists of enhanced stormwater recharge in San Juan Creek using rubber dams and a seawater extraction barrier. There is no recycled water recharge in SWR-1. Figure 3.4-1 provides an overview of the facilities associated with this strategy, which include construction of rubber dams in the San Juan Creek channel from Stonehill Drive to the I-5. Assuming the storm water benefit is similar to that projected in alternative 1b, the average storm water recharge for SWR-1 is 1,400 afy. The new storm water recharge would be recovered at existing wells and treated at the existing SCWD and CSJC GWRPs. The existing CSJC GWRP would need to be expanded to its maximum capacity to utilize the full benefit of storm water recharge in wet years.

The estimated new project yield attributable to SWR-1 is 1,980 afy.

Conceptual Strategy SWR-2

SWR-2 consists of enhanced storm water and recycled water recharge in San Juan Creek using rubber dams, 500 afy of in-lieu recharge through private pumping offsets, and a seawater

extraction barrier. Figure 3.4-2 provides an overview of the facilities associated with this strategy. This strategy includes construction of rubber dams in San Juan Creek from Stonehill Drive to the I-5. In addition to recharging an average of 1,400 afy of storm water during the wet season, about 2,500 afy recycled water would be introduced to the San Juan Creek via new turnouts from a recycled water pipeline during dry periods.

Based on the analysis per Section 3.2, this amount could go as high as 3,336 afy without the need for improvements at the J.B. Latham Plant or improvements to connect SCWD's system to the City of San Jan Capistrano's system. However, as noted previously, there is some uncertainty as to the availability of supplies in the future. In addition, amounts higher than around 2,500 afy would require pipe sizes larger than 18-inches because of the limited window (153 days) that recycled water could be recharged under some climatic conditions. So the 2,500 afy level of recycled water supply was selected for this Conceptual Strategy, with the intent that SWR-2 is a predecessor strategy to a larger program that could be developed over time, such as SWR-4.

A recovery well field and new GWRP are required to pump and treat the new recharge. Depending on RWC and URT, treatment process upgrades will be needed at the CJSC GWRP and SCWD GRP plants. This alternative was not simulated with the SJBA model, so the treatment needs are uncertain. To be conservative, upgrades will be assumed in the cost evaluation for both existing treatment plants.

The estimated new project yield attributable to SWR-2 is 4,380 afy.

Conceptual Strategy SWR-3

SWR-3 consists of recycled water recharge in San Juan Creek via in-stream recharge (incidental recharge), 500 afy of in-lieu recharge through private pumping offsets, and a seawater extraction barrier. Figure 3.4-3 provides an overview of the facilities associated with this strategy. Incidental recycled water recharge would typically occur during the dry-weather period of May through September. A discharge point is assumed to be located on San Juan Creek near the Ortega Highway crossing. The recharge strategy assumes a nominal flow width of 20 feet. The recharge capacity of the creek from Ortega Highway to Stonehill is about 1,750 afy.

Tertiary treatment improvements at J.B. Latham are not required for this strategy so long as SMWD and MNWD have excess off-peak supplies that can be stored in the seasonal storage reservoirs. The new recycled water and in-lieu recharge would be recovered at existing wells and treated at the existing SCWD and CSJC GWRPs. The existing CSJC GWRP would need to be expanded to its maximum capacity to utilize the full benefit of the recharge and depending

on RWC and URT. Treatment plant upgrades may be needed at the CJSC GWRP and/or the SCWD GRF to accommodate the increased pumping. This alternative was not simulated with the SJBA model, so the treatment needs are uncertain.

The estimated new project yield attributable to SWR-3 is 2,660 afy.

Conceptual Strategy SWR-4

SWR-4 consists of enhanced storm water and recycled water recharge in San Juan Creek and Arroyo Trabuco using rubber dams and incidental recharge, 500 afy of in-lieu recharge through private pumping offsets, and a seawater extraction barrier. Figure 3.4-4 provides an overview of facilities associated with this strategy. This strategy expands the rubber dam facilities onto Arroyo Trabuco and incorporates incidental recharge.

Assuming the storm water benefit is similar to that projected in alternative 2b, the average storm water recharge for SWR-4 is 1,700 afy. The total recycled water recharge would average about 7,000 afy, with a maximum of 8,500 afy in dry periods as suggested by the refinements to Program alternative 2b, described in Section 3.3 herein.

Tertiary treatment improvements at the J.B. Latham Plant would be required for this strategy, as well as conveyance system improvements between the J.B. Latham Plant and SMWD's recycled water system to be able to access seasonal storage via Trampas Reservoir. The CSJC would also utilize this treatment/storage corridor to supply its NPR system. A recovery wellfield and new GWRF are required to pump and treat the new recharge. Treatment process upgrades will be needed at the existing CJSC GWRP and SCWD GRF sites due to estimated RWCs and URTs in alternative 2b.

The estimated new project yield attributable to SWR-4 is 8,220 afy.

Conceptual Strategies INJ-1 and INJ-2

Conceptual Strategies INJ-1 and INJ-2 consist of recycled water recharge along San Juan Creek via injection wells, 500 afy of in-lieu recharge through private pumping offsets, and a seawater extraction barrier. Figure 3.4-5 provides an overview of the facilities associated with the INJ-1 and INJ-2 strategies.

Conceptual strategy INJ-1 involves the use of injection wells for recharge rather than surface spreading. The proposed injection capacity for this alternative is 2,500 afy. The potential injection wells would be located along the San Juan Creek. Injection is assumed to occur year-round. Injection well locations and injection rates are designed such that storm and recycled water recharge can be recovered and groundwater elevations are managed to avoid rising groundwater or liquefaction concerns.

A recovery wellfield and new GWRF are required to pump and treat the recharged recycled water. Advanced treatment (reverse osmosis and advanced oxidation process typically) improvements are also required under current state regulations to create a higher-quality recycled water for injection into the basin. Both the J.B. Latham Plant and the Chiquita WRF have enough flow capacity and space to allow for such improvements. For purposes of this study, the J.B. Latham Plant was chosen to provide a basis of cost and comparison of strategies as the plant has more available supply currently than the Chiquita WRF, which will expand over time as the Rancho Mission Viejo development is built out. Another option would be to construct a new advanced treatment plant that would be supplied recycled water from the transmission corridor pipeline and located near the injection well field. However, a new plant would require land and would need to mitigate any community impacts. The cost and other factors to determine the preferred location of the advanced treatment facility should be conducted in more detail as part of a future study.

The estimated new project yield attributable to INJ-1 is 3,260 afy.

Conceptual strategy INJ-2 is similar to INJ-1 except that the proposed injection capacity along San Juan Creek for this alternative is 4,000 afy. This is the maximum injection capacity along San Juan Creek, as suggested by the refinements to Program alternative 3a discussed in Section 3.3 of this TM.

The estimated new project yield attributable to INJ-2 is 4,460 afy.

Wastewater Treatment

Wastewater supplies are required to meet the groundwater recharge strategies developed for this Program. Depending on the strategy, this wastewater will either need to have tertiary or full advanced treatment. Under existing conditions, additional tertiary and advanced capacity is required for Conceptual Strategies SWR-4, INJ-1, and INJ-2. Tertiary and Advancement Improvements required for these Conceptual strategies is summarized in the table below:

Wastewater Treatment - Summary of Facilities	
Conceptual Strategy	Description
Surface Water Recharge Strategies	
SWR-4	This strategy would require 5 MGD (5,600 afy) of treatment capacity improvements at the J.B. Latham Plant and would provide enough recycled water to meet the City of San Juan Capistrano's NPR system needs as well as peak year (8,600 afy) needs of the SWR-4 strategy in conjunction with seasonal storage.
Injection Recharge Strategies	
INJ-1	The proposed injection capacity for this strategy is 2,500 afy of advanced treated water which would require this capacity of improvements at the J.B. Latham Plant, or an alternative site
INJ-2	The proposed injection capacity for this strategy is 4,000 afy of advanced treated water which would require this capacity of improvements at the J.B. Latham Plant, or an alternative site.

Groundwater Treatment

A new or upgraded groundwater desalter/treatment plant will be required to treat the recycled water recovered by the recovery wells, as well as seawater extraction barrier wells, to drinking water standards. As discussed in TM 2.2-2.5 and confirmed in TM 3, advanced treatment would be required.

New Seawater Extraction Barrier Water Treatment Plant

TM 2.2-2.5 identified a vacant property north of Stonehill Drive and on the east side of San Juan Creek as a possible location for a new treatment facility to treat groundwater from the extraction barrier wells. The feed water to this plant would have a high TDS concentration and would require additional levels of RO treatment versus the recharge strategies of this program due to the higher salinity levels. It has been assumed that a new treatment facility would be constructed adjacent to the proposed GWRP. This will allow the facilities to share various infrastructure and are the basis of the cost estimate completed during this Task. A seawater treatment process flow is outlined below and described in more detail in Appendix C - TM 3.

- **Pre-treatment.** The primary focus of the pre-treatment filtration system is removal of iron as well as small particles to minimize the fouling potential of downstream cartridge filters and/or RO membranes.
- **RO System.** The purpose of the RO system is to remove dissolved solids from the seawater and, in particular, meet boron, bromide, chloride and sodium water quality goals.

- **Disinfection.** UV disinfection may or may not be required depending on the required disinfection credit established by DDW. UV disinfection provides additional log removal credits for *Cryptosporidium* and *Giardia*.
- **Post-treatment.** RO permeate water is often corrosive as it lacks mineral, alkalinity, and is low in pH. Post-treatment stabilization is required to condition the product water for it to be suitable for potable use as well as to protect distribution piping and plumbing systems.

Based on these findings, a new seawater extraction barrier water treatment plant is needed to treat high TDS water as part of all of the recharge strategies.

The following table summarizes all the facilities required for each Conceptual Strategy.

Summary of Conceptual Strategies-Major Facility Needs						
	Surface Water Recharge Strategies				Injection Recharge Strategies	
	SWR-1	SWR-2	SWR-3	SWR-4	INJ-1	INJ-2
Description	Storm water via Rubber Dams on San Juan Creek	Storm water and Recycled Water via Rubber Dams on San Juan Creek	Recycled Water via Incidental Recharge on San Juan Creek	Storm water and Recycled Water via Rubber Dams and Incidental Recharge	Recycled Water via Injection	Recycled Water via Injection
Avg. Annual New Project Yield (afy)	1,980	4,380	2,660	8,220	3,260	4,460
Major Facilities						
JBL Treatment Improvements				• 5 MGD tertiary capacity	• 3.0 MGD advanced treatment capacity	• 5.0 MGD advanced treatment capacity
New Groundwater Recovery Facility		<ul style="list-style-type: none"> • New 3.4 MGD. treatment facility • 150-ft of 8-in pipe (brine) 		<ul style="list-style-type: none"> • New 8.54 MGD treatment facility • 150-ft of 10-in pipe (brine) 	<ul style="list-style-type: none"> • New 2.3 MGD treatment facility • 150-ft of 8-in pipe (brine) 	<ul style="list-style-type: none"> • New 3.6 MGD treatment facility • 150-ft of 8-in pipe (brine)

Summary of Conceptual Strategies-Major Facility Needs						
	Surface Water Recharge Strategies				Injection Recharge Strategies	
	SWR-1	SWR-2	SWR-3	SWR-4	INJ-1	INJ-2
Seawater Extraction Barrier and Treatment	<ul style="list-style-type: none"> • 8 wells • 2,530-ft of 6-in pipe • 1,400-ft of 8-in pipe • 450-ft of 10-in pipe • 5,000-ft of 12-in pipe • New 2.7 MGD Treatment Facility • 150-ft of 12-in pipe (brine) 	<ul style="list-style-type: none"> • 8 wells • 2,530-ft of 6-in pipe • 1,400-ft of 8-in pipe • 450-ft of 10-in pipe • 5,000-ft of 12-in pipe • New 2.7 MGD Treatment Facility • 150-ft of 12-in pipe (brine) 	<ul style="list-style-type: none"> • 8 wells • 2,530-ft of 6-in pipe • 1,400-ft of 8-in pipe • 450-ft of 10-in pipe • 5,000-ft of 12-in pipe • New 2.7 MGD Treatment Facility • 150-ft of 12-in pipe (brine) 	<ul style="list-style-type: none"> • 8 wells • 2,530-ft of 6-in pipe • 1,400-ft of 8-in pipe • 450-ft of 10-in pipe • 5,000-ft of 12-in pipe • New 2.7 MGD Treatment Facility • 150-ft of 12-in pipe (brine) 	<ul style="list-style-type: none"> • 8 wells • 2,530-ft of 6-in pipe • 1,400-ft of 8-in pipe • 450-ft of 10-in pipe • 5,000-ft of 12-in pipe • New 2.7 MGD Treatment Facility • 150-ft of 12-in pipe (brine) 	<ul style="list-style-type: none"> • 8 wells • 2,530-ft of 6-in pipe • 1,400-ft of 8-in pipe • 450-ft of 10-in pipe • 5,000-ft of 12-in pipe • New 2.7 MGD Treatment Facility • 150-ft of 12-in pipe (brine)
Seasonal Storage		<ul style="list-style-type: none"> • 28,990-ft of 18-in pipe 	<ul style="list-style-type: none"> • 9,200-ft of 10-in pipe 	<ul style="list-style-type: none"> • 29,020-ft of 30-in pipe • 6,360-ft of 18-in pipe 		
Conveyance	<ul style="list-style-type: none"> • 1,450-ft of 8-in pipe (product) 	<ul style="list-style-type: none"> • 1,450-ft of 16-in pipe (product) 	<ul style="list-style-type: none"> • 1,450-ft of 8-in pipe (product) 	<ul style="list-style-type: none"> • 7,765-ft of 24-in pipe • 10,770-ft of 12-in pipe • 1,700-ft of 12-in pipe • 1,450-ft of 18-in pipe (product) • 2,400 ft of 10-in pipe (turnouts) 	<ul style="list-style-type: none"> • 27,350-ft of 12-in pipe • 685-ft of 10-in pipe • 8,550-ft of 8-in pipe • 1,450-ft of 12-in pipe (product) 	<ul style="list-style-type: none"> • 27,350-ft of 16-in pipe • 685-ft of 12-in pipe • 4,450-ft of 10-in pipe • 6,350-ft of 8-in pipe • 1,450-ft of 16-in pipe (product)
New Production Wells		<ul style="list-style-type: none"> • 4 wells • 3,900-ft of 8-in pipe • 5,320-ft of 12-in pipe 		<ul style="list-style-type: none"> • 10 wells • 9,150-ft of 8-in pipe • 5,450-ft of 12-in pipe • 6,450-ft of 18-in pipe • 3,400-ft of 20-in pipe 	<ul style="list-style-type: none"> • 4 wells • 2,200-ft of 8-in pipe • 15,070-ft of 12-in pipe 	<ul style="list-style-type: none"> • 5 wells • 1,600-ft of 8-in pipe • 2,400-ft of 12-in pipe • 14,350-ft of 16-in pipe

Summary of Conceptual Strategies-Major Facility Needs						
	Surface Water Recharge Strategies				Injection Recharge Strategies	
	SWR-1	SWR-2	SWR-3	SWR-4	INJ-1	INJ-2
Injection Wells					• 4 injection wells	• 5 injection wells
Rubber Dams	<ul style="list-style-type: none"> • Seven 7-ft rubber dams 	<ul style="list-style-type: none"> • Seven 7-ft rubber dams • Seven turnouts • 3,460-ft of 8-in pipe • 2,320-ft of 12-in pipe • 680-ft of 16-in pipe 		<ul style="list-style-type: none"> • Seven 7-ft rubber dams • Five 5-ft rubber dams • Ten turnouts • 3,700-ft of 10-in pipe • 2,320-ft of 12-in pipe • 680-ft of 16-in pipe 		
Earthen Berm			<ul style="list-style-type: none"> • 5-ft earthen berm, 165-ft width 			

Conceptual Strategies Capital Cost Estimates

The cost criteria developed for this study are used to estimate capital costs for the identified facilities for each of the different conceptual strategies. However, the criteria should not be interpreted as the method to develop the best or final estimate of the total cost of the project. The accuracy of an estimate is directly related to the amount of detail available; the more detailed the estimate, the more accurate it will be. Any resulting conclusions on project financial or economic feasibility or funding requirements are prepared for guidance in project evaluation and implementation and use the information available at the time of the estimate.

The final costs of the conceptual strategies and resulting feasibility will depend on a variety of factors, including but not limited to, actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel, engineering, and construction phases. Therefore, the final costs will vary from the estimates developed using the information in this document. Because of these factors, project feasibility, benefit-cost ratios, alternative evaluations, project risks, and funding needs must be carefully reviewed and updated, prior to making specific financial decisions or establishing project budgets, to help ensure adequate funding for the project.

Cost Basis

Due to the nature of the project and the varied facility types being proposed, Black & Veatch developed unit costs using a variety of sources including:

- Historical construction cost data provided by the participating agencies
- Cost estimates and unit cost assumptions used in previous planning studies by the participating agencies as well as the South Orange County Wastewater Authority
- Cost data used in recent Black & Veatch design projects and planning studies
- Vendor provided cost data

The cost information was used to compile unit construction costs for each different facility types.

Cost Estimating Criteria

To estimate the capital cost of the various Concept Strategies, unit costs are used for a variety of facility types, including:

- Groundwater Facilities
 - New Production Well
 - New Monitoring Well
 - New Injection Well

- Conveyance Facilities
 - Pipelines
 - Collection/Distribution (open cut)
 - Sewer/Brine (open cut)
 - Tunnels Crossings (creek, freeway, railroad, etc.)
 - Pump Stations
 - Distribution system booster station
 - Transmission pipeline turnout
 - Connection to storm channel
 - Misc. valves & FM for interconnections

- Treatment Systems
 - Tertiary Upgrade (Title 22)
 - MF-RO
 - Groundwater Treatment
 - Seawater Extraction Barrier Treatment

- Groundwater Recharge Facilities
 - Rubber Dams

- T and L Levees
- Fish Passages (allowance per rubber dam)

Implementation Factors

Cost factors are included to try to capture the entire capital costs associated with the implementation of a project. While these costs can vary greatly from project to project and from component to component, for planning studies, it is most common to assume a standard factor on the estimated construction costs across all projects and project types when analyzing alternatives and project options. In addition, it is necessary to allow for many uncertainties associated with conceptual level project definitions by applying appropriate contingencies. The following defines the typical efforts and factors for these additional services and contingencies:

- **Planning, Environmental Documentation, and Permits.** These services include the early conceptual planning and environmental documentation that are often required of capital improvement projects. The amount of effort for such services can vary greatly depending on the type, scale, and location of the project and whether such services are needed. Typical costs for such services can vary from 2 to 15 percent of the construction costs.
- **Engineering Support-Design.** Engineering design services cover the preliminary investigations, site and route surveys, foundation exploration, and preliminary and final design phases. These services also include plan processing (agency review and approval) and may also include the preparation of detailed cost estimates and construction/phasing schedules. The typical costs for these services vary between 8 and 15 percent of the construction costs.
- **Engineering Support-Construction Management.** Engineering construction support services typically include submittal and shop drawing reviews as well as minor design modifications. The typical costs for these engineering construction support services vary between 5 and 10 percent of the construction costs. Costs for construction management services can vary greatly with project size and whether an agency performs this work with in-house staff or through a consultant. Regardless of the staffing, the costs for these services should still be accounted for and applied to the overall capital costs of the project. Typical costs for such services can vary from 5 to 20 percent of the construction costs.
- **Legal and Administrative Services.** These costs include such items as legal fees, financing expenses, general administration, and interest during construction. Typical costs for these items can vary from 1 to 15 percent of the construction costs depending on the size, complexity, and type of project.

- **Regulatory Compliance.** These services include obtaining permits from Federal, State, County, City, or other regulatory agencies, meeting mitigation requirements, and obtaining of any other permits not part of the construction bid package. This factor includes pre-construction fees that may be required. The amount of effort for such services can vary depending on the type, scale, and location of the project and whether such services are needed. Typical costs for such services can vary from 1 to 10 percent of the construction costs.
- **Market Adjustment Factor.** This factor is intended to account for the variability of cost estimating in volatile markets. This factor often varies in the same location for different types of work depending on the availability and work load of specialty contractors. Typical ranges for this factor are up to 10 percent. Issues that can affect the Market Adjustment Factor, include:
 - Busy contractors
 - Contractors selectively bidding jobs
 - Contractors selectively choosing which owners they want to do jobs for
 - Premium wages to keep skilled workers and management staff
 - Availability of crafts/trades
 - Immigration impacts and uncertainty
 - Abnormal fuel impacts and uncertainty
 - Public relations/communications
 - Availability of specialty equipment and materials
 - Local material supply availability or conditions
 - Prevailing wage/Project Labor Agreement requirements

Because market adjustments can vary from period to period, for purpose of developing capital improvement plan costs no market adjustment factors are applied to this study. However, in the future, such factors may be necessary, to adjust for short-term or local market conditions.

Due to the variability in the project types, a wide range of implementation costs is likely to occur. In addition, the services may vary by project or component depending on a variety of factors, including project complexity and need. Using the factors and contingencies listed previously, estimation of implementation costs could vary from as low as 15 percent of the estimated project construction cost to as high as 75 percent.

The recommended implementation factor for this study is 50% and is based on the type of facilities expected, including wastewater/recycled water treatment, conveyance systems, wells, and recharge facilities.

Excluded Costs

Several components may be needed to support the development of major recycled water program facilities. Because most of these items are unique and project specific, they should be applied on a project-by-project basis. Therefore, costs were not included in the estimates for the following items:

- Land Acquisition
- Maintenance Road Access Power Transmission Lines
- Overall Program Management and Public Information Program
- “Other” Costs (e.g. environmental mitigation and permitting costs; special legal, administrative, or financial assistance; easements or rights-of-way; expediting costs such as separate material procurement contracts).

Estimated Costs for Conceptual Strategies

The following table summarizes the estimated capital cost and project yield for the six different Conceptual Strategies. In addition, a unit capital cost estimated is provided based on two alternatives: 30- and 50-year lifecycle. Both unit costs assume an interest rate of 3%.

Conceptual Strategies Yield and Cost Summary				
Conceptual Strategy	Capital Cost (\$M)	Yield (afy)	Unit Capital Cost	
			30-Year Lifecycle	50-Year Lifecycle
SWR-1	\$ 171	1,980	\$ 4,410	\$ 3,360
SWR-2	\$ 306	4,380	\$ 3,560	\$ 2,720
SWR-3	\$ 172	2,660	\$ 3,300	\$ 2,510
SWR-4	\$ 555	8,220	\$ 3,440	\$ 2,620
INJ-1	\$ 315	3,260	\$ 4,930	\$ 3,760
INJ-2	\$ 376	4,460	\$ 4,300	\$ 3,280

Note: Each Conceptual Strategy listed above includes construction of a seawater extraction barrier and associated water treatment facility.

Task 4 Summary of Findings

Potential Habitat and Environmental Opportunities for Project Alternatives

This project would entail completion of various environmental studies and preparation of various State and Federal permits including: California Environmental Quality Act (CEQA), State of California Clean Water Act Section 401 Permit, National Environmental Policy Act (NEPA), and

the United States Environmental Protection Agency Clean Water Act Section 404 Permit (also referred to as the United States Army Corps of Engineers Section 404 Permit), and an incidental take permit from the United States Fish and Wildlife Service (USFWS). Each of these permit processes entails varied engineering, biological, geologic, hydrologic, environmental (air and noise) analyses. The objective of this section is to prepare a limited, reconnaissance-level study to identify the types of potential environmental benefits and impacts of the SWR conceptual strategies for the project.

Due to the variability in the size, scope, and complexity implementing the concept strategies, only the most significant benefits and impacts to the Trabuco and Oso Creek channels and immediate vicinity are identified including habitat and creek channel enhancements, and temporary impacts from construction. Other potential environmental impacts such as traffic, utilities, noise, air quality, esthetics, cultural resources, hazardous materials, and geologic constraints have not been included at this time. Upon selection of a final project strategy for implementation and initiating pre-project planning, a complete CEQA Initial Study and Environmental Impact Report for the project will be required.

A summary of the potential habitat and environmental benefits and impacts associated with each of the four stormwater and recycled water recharge conceptual strategies (SRW) is provided in the table below and detailed in the text following the table. Possible measures to mitigate the impacts are included where practical.

Conceptual Strategies Potential Habitat and Environmental Impacts and Benefits		
Conceptual Strategy	Potential Benefits	Potential Impacts
SWR-1	Increased Standing Water Vegetated Channel Banks Elimination of Non-native Vegetation Pacific Flyway Migration No Impediment to Fish Migration Native Riparian Habitat Mitigation Bank	Permanent Structure Installation Heavy Equipment Use Local, State, and Federal Permitting Sediment/Debris Removal and Channel Maintenance
SWR-2	Increased Standing Water Vegetated Channel Banks Elimination of Non-native Vegetation Pacific Flyway Migration No Impediment to Fish Migration Native Riparian Habitat Mitigation Bank	Permanent Structure Installation Heavy Equipment Use Local, State, and Federal Permitting Sediment/Debris Removal and Channel Maintenance Conveyance Pipeline Construction

Conceptual Strategies Potential Habitat and Environmental Impacts and Benefits		
Conceptual Strategy	Potential Benefits	Potential Impacts
SWR-3	Increased Standing Water Vegetated Channel Banks Elimination of Non-native Vegetation Pacific Flyway Migration No Impediment to Fish Migration Native Riparian Habitat Mitigation Bank	Arroyo Toad Habitat Coastal California Gnatcatcher Habitat Local, State, and Federal Permitting Sediment/Debris Removal and Channel Maintenance Conveyance Pipeline Construction
SWR-4	Increased Standing Water Vegetated Channel Banks Elimination of Non-native Vegetation Pacific Flyway Migration No Impediment to Fish Migration Native Riparian Habitat Mitigation Bank	Arroyo Toad Habitat Coastal California Gnatcatcher Habitat Permanent Structure Installation Heavy Equipment Use Local, State, and Federal Permitting Sediment/Debris Removal and Channel Maintenance Conveyance Pipeline Construction

Potential habitat and environmental benefits of the project include:

- Increased Standing Water - The increase in standing water behind the dams would provide added value to area wildlife, providing a more consistent water source, particularly during drier months of the year.
- Vegetated Channel Banks - Where possible, vegetation could be allowed to establish itself on the channel banks. This would create a cooler environment for aquatic animals and animals that depend on a nutrient rich aquatic environment, by providing a shady channel bottom.
- Eliminates Non-native Vegetation - Within the project boundaries, all non-native vegetation, i.e. Arundo donax (giant reed), Sorghum intrans (pampas grass) and Ricinus (castor bean) could be eliminated with maintenance on an on-going basis. If necessary, planting of native vegetation in place of non-native vegetation could occur.
- Pacific Flyway Migration - The project area is located within the Pacific Flyway, which extends from Alaska to Patagonia. Every year, migratory birds travel in both spring and fall, following food sources, to breeding grounds or overwintering sites. This project, and its ponded water could provide a necessary respite for migrating birds. It could also provide a wintering ground for migratory birds.

- No Impediment to Fish Migration - It is not expected that the inflatable dams that are included in this project would be an impediment to fish migration, since they will be deflated during peak flow periods when fish are migrating upstream.
- Native Riparian Habitat Mitigation Bank - Mitigation to offset the negative impacts of this project, if required, could include creation of native riparian habitat in areas within the project boundaries where this habitat does not currently exist. Depending upon the acreage of created riparian habitat, it may be possible for the Authority to create a mitigation bank within the San Juan Creek/Trabuco Creek corridor that would be available to be used as mitigation for other projects impacting the region. The creation of a mitigation bank would be dependent upon a number of factors and remains only a possibility. Creation of a mitigation bank could help to offset the cost of project implementation for the Authority. Further study is required on this effort based on the final project selection.

The potential impacts of the project include:

- Arroyo Toad - The arroyo toad is a small, dark spotted toad and is a mostly terrestrial species that uses streams primarily during the breeding season in January to September. Arroyo toads breed only in shallow, slow-moving water in riparian habitats that are typically disturbed naturally on a regular basis by flooding. Breeding pools must have a proximity to sandy terrace habitat, minimal current, a gently sloping shoreline and bordering vegetation low or set back so that most of the pool is open to the sky. Because of its specific needs and loss of habitat, the arroyo toad was listed as an endangered species on December 16, 1994. Critical habitat was designated in 2005 and designation is reviewed every 5 years. On March 26, 2014, The U.S. Fish And Wildlife Service proposed to reclassify the arroyo toad from endangered to threatened status. At this time it is difficult to project whether the areas of San Juan Creek and Trabuco Creek proposed in this project will impact the arroyo toad. These areas are not currently listed as critical habitat. Project areas do not, for the most part, meet the description of their habitat needs. During the planning process, a full biological reconnaissance survey by a qualified biologist, can determine the presence or absence of the arroyo toad. At that time, decisions can be made regarding possible mitigation measures, should the arroyo toad be found within the project boundaries. The arroyo toad is a listed species under the Orange County Southern Subregion NCCP/HCP issued 01/10/2007
- Coastal California Gnatcatcher - The coastal California gnatcatcher is a small blue-gray songbird which measures only 4.5 inches and weighs 0.2 ounces. It has dark blue-gray feathers on its back and grayish-white feathers on its underside. It is federally listed as a

threatened species. Its habitat is coastal sage scrub, from Ventura County to northern Baja California. At this time it is unlikely that the coastal California gnatcatcher will be found within the project area, since the impacts are not in coastal sage scrub habitat. However, during the planning process, a full biological reconnaissance survey will be performed by a qualified biologist. This study will determine the presence or absence of the coastal California gnatcatcher within the project boundaries. At that time, decisions can be made regarding possible mitigation measures that may be required. The coastal California gnatcatcher is a species listed under the Orange County Southern Subregion Natural Community Conservation Plan and Federal Habitat Conservation Plan (NCCP/HCP), issued January 10, 2007.

- Permanent Structure Installation - Permanent impacts within the soft bottom channel include the installation of a concrete apron and side anchors where each inflatable dam is located. Total acreage of permanent impacts depends upon which alternative is implemented. Additional permanent impacts may include rock riprap and/or gabions at each location to protect and stabilize the apron and dam.
- Heavy Equipment Use - Temporary impacts may include heavy equipment in the soft bottom channel during construction. These impacts could be reduced by using smaller equipment and handwork during construction. Additional measures to limit temporary impacts from construction activities may be to include staging areas at the top of the channel on adjacent access roads/bike trails.
- Local State and Federal Agency Permitting - Both permanent and temporary impacts will require permits/agreements from U.S. Army Corps of Engineers (ACOE) 404 CWA permit; California Department of Fish and Wildlife (CDFW) Streambed Alteration Agreement; and, Regional Water Quality Control Board (RWQCB) 401 CWA permit, City and local agency encroachment permits. Agency coordination should be evaluated based on final project components.
- Sediment/Debris Removal and Channel Maintenance - Due to ongoing maintenance within the soft bottom channel to maintain channel capacity, sediment removal would be an ongoing activity. This activity would limit the opportunity for vegetation to establish itself within the channel bottom for any length of time. It may be possible to time the majority of sediment and debris removal activities until after nesting season is over but before rainy season begins. This may allow seasonal growth of vegetation during peak nesting season.

- Conveyance Pipeline Construction - Three of the conceptual strategies include the installation of approximately 1,450 (SRW-2 and SRW-3) to 21,685 (SRW-4) linear feet of conveyance pipeline in the existing roads and easements throughout portions of the project area. Temporary construction impacts such as noise, air quality, and traffic are anticipated. Measures to mitigate these impacts include designated working hours, the application of water or dust suppressants, and the implementation of an approved traffic control plan.

Project Implementation Phasing Plan

Based on the analysis performed pursuant to the San Juan Basin Groundwater and Desalination Optimization Program investigation, the recommended strategy for accomplishing the goals of the San Juan Basin Groundwater Facilities and Management Plan (SJBGFMP), hereafter referred to as the SJBGFMP implementation plan, includes the following Program Elements:

- Adaptive Production Management (APM), which consists of the continuation of the SJBA's existing program of monitoring and reporting and the development and periodic update of an APM policy to set annual production limits consistent with water rights permits and related agreements.
- Construction of rubber dams within San Juan Creek and the Arroyo Trabuco to increase storm water recharge and provide future recharge sites for instream recharge of recycled water.
- Construction of recycled water recharge and recovery facilities (conveyance, wells, and expanded groundwater treatment) and conversion of private groundwater pumpers to alternative sources of water. The facilities should be phased in over time based on recycled water availability and the need to demonstrate project success at small scales to the DDW and Regional Board.

A seawater extraction barrier is not included in the SJBGFMP implementation plan as it is projected to be very costly; and excluding it in the next phase of planning does not preclude it from being reconsidered and included in subsequent phases. In the absence of the seawater extraction barrier the SJBA would use APM to ensure there is no seawater intrusion.

SJBGFMP Implementation Plan: A Phased Approach

A phasing strategy is proposed and is laid out in such a way that each phase can be an endpoint or off-ramp from further expansion (see Technical Memorandum 4.2, 4.3 included as Appendix H). At the end of each phase, a new source of water is available to the SJBA and the technical, engineering, and planning analyses for implementing the next phase of expansion are refined

enough to determine if that next phase should be implemented or revised in scope. The recommended phasing strategy for the SJBGFMP implementation plan is as follows:

- Phase 1:
 - Complete planning, permitting, design and construction of rubber dams within San Juan Creek and/or Arroyo Trabuco, and
 - Complete Title 22 Engineering and permitting process for the indirect potable reuse (IPR) of recycled water in the San Juan Basin.
- Phase 2
 - Refine the planning, project specific permitting, and design of the recycled water recharge and recovery facilities and construct the facilities to enable up to 4.0 mgd of recycled water recharge. (This would yield about 3.0 mgd of treated product water. Actual capacities would be established in the planning and engineering work in Phase 2.)
 - Convert private groundwater producers to other sources of water
- Subsequent phases of the SJBGFMP implementation would include the refined planning, design and construction of facilities that maximize the recharge of recycled water in the basin and could include: recycled water treatment improvements, additional groundwater extraction and conveyance facilities, and expansion of the groundwater treatment facilities constructed in Phase 2.

The on-going implementation of the SJBGFMP operations and APM activities, including monitoring and the update of the surface and groundwater models, plans and reports that support these activities, will provide the data and planning information to support each phase. This work is necessary even in the absence of the projects in Phase 1, 2, and subsequent phases.

The cumulative new project yield from the implementation of the SJBGFMP at the end of each phase is:

- Phase 1: 1,120 afy
- Phase 2: 4,920 afy (includes the 1,120 from Phase 1)
- Subsequent phases: 7,360 afy (includes the 4,920 from Phase 2)

Phasing Plan Tasks and Schedule

Figure 4-2.1 is a detailed schedule that demonstrates the process for implementing the SJBGFMP through Phase 2. In addition to Phases 1 and 2, Exhibit 1 include basin management tasks and

process to periodically update the SJBGFMP and the surface and groundwater models used to support the implementation process. The two updates are assumed to begin in fiscal 2017/18 and again in fiscal 2022/23.

The major implementation tasks in Phase 1 include:

- Preparation of a programmatic environmental document for the SJBGFMP and project specific documentation for the construction of rubber dams under CEQA/NEPA (EIR/EIS)
- Public outreach efforts to support the environmental documentation and Phase 1 efforts
- Submit for and obtain funding for construction of rubber dams
- Planning, permitting, design and construction of rubber dams (For the purpose of cost estimating, Phase 1 assumes construction of seven rubber dams along San Juan Creek, the actual number and locations will be determined during the planning/permitting process.)
- Title 22 Engineering and permitting process that enables the recharge and recovery of recycled water in Phase 2

Phase 1 begins in earnest in FY 2016/17 and is completed by the end of FY 2020/21. The schedule for completing the CEQA/NEPA process and the design and construction of the rubber dams is aggressive; if followed, the dams can be completed by the start of the wet season in FY 2018/19 (Fall 2018).

The major implementation tasks in Phase 2 include:

- Preparation of project specific environmental documentation for the construction and operation of the recycled water recharge and recovery facilities
- Public outreach efforts to support the environmental documentation and Phase 2 efforts
- Submit for and obtain funding for construction of recycled water recharge and recovery facilities
- Obtain facility specific permits and agreements
- Design and construction of the recycled water recharge and recovery facilities including new wells, a new groundwater treatment plant and treatment upgrade at the CSJC GWRP. It is assumed that the recycled water recharge and recovery will be designed in the Phase 1 planning efforts so that treatment upgrades are not required at the SCWD GRF. The pipelines to convey recycled and ground water will be constructed at the ultimate capacities. Subsequent expansions of the groundwater recovery and treatment facilities will occur when additional recycled water becomes available for recharge.

Phase 2 begins in earnest in FY 2020/21 and is completed in the beginning of FY 2024/25. Per this schedule, recycled water recharge and recovery would begin in the late summer of 2024.

Phasing Plan Costs

Table 4.2-1 summarizes the estimated annual costs for the major implementation steps for Phases 1 and 2 (excluding contingency) per the schedule shown in Figure 4.2-1. Table 4.2-1 also shows the total estimated cost to implement subsequent phases (excluding contingency). The cost estimates in Table 4.2-1 are refinements of the estimates contained in the January 25, 2016 Technical Memorandum summarizing the work performed pursuant to FAF Program Task 3 (TM 3). The implementation costs that were generalized in TM 3 (e.g. program management, public outreach, permitting, engineering design, etc.) are explicitly estimated in Table 4.2-1.

Table 4.2-2 summarizes the total program costs and unit capital costs, by phase; and for each phase, provides a breakdown of the construction and implementation costs. All of the costs shown in Tables 4.2-1 and 4.2-2 exclude contingency factors.

Table 4.2-3 summarizes the range of potential costs with contingencies for all phases of the SJBGFMP implementation. The range of costs shown (-30% to +50% of the estimated cost in Exhibit 2) are reflective of ACEC Cost Estimating Guidelines for Feasibility-Level Studies. Also shown in Table 4.2-3 are some of the potential sources of grant funding that could offset the cost of implementing the SJBGFMP. There are also low-interest loans available from the State Water Resources Control Board to implement recycled water reuse projects.

Notes on Implementation Plan Costs

The estimated costs contained herein are at a conceptual feasibility-level and actual costs may vary greatly in the future. The following assumptions apply:

- Estimated costs do not include:
 - escalation of costs in the future; all costs are present day values;
 - administration or financing charges of loans;
 - addressing institutional challenges/negotiations;
 - agency staff time;
 - purchase of recycled water supplies (whether from SJBA member agency or another agency);
 - benefits of cost share for shared infrastructure such as pipelines, treatment plants (GW and WW/RW), or pump stations with another agency(s);
 - converting existing non-potable groundwater pumpers to recycled water system;
 - well replacements that may be necessary;
 - impacts to current groundwater supply production;

- use of the proposed Trampas Reservoir seasonal storage;
- environmental mitigation requirements;
- land acquisition costs

As noted, no contingency costs were included in the implementation plan cost estimate shown in Tables 4.2-1 and 4.2-2. When agencies are budgeting for program implementation, they should consider using a contingency level appropriate to the activity being conducted in the current budget cycle. Refer to Table 4.2-3 for the potential range of program costs.

Task 5 Overview

SJBA participating agency personnel, and the technical consulting team members, have met with various regulatory agencies during the public review periods for both Task 2 and Task 3 of the FAF Program to present project concepts and strategies. The project meetings and attendees included:

- On September 29, 2015 the SJBA Project Manager facilitated a public meeting presenting the findings of the FAF Project Task 2 to stakeholders within the basin. Attendees included SJBA agency members, county and state regulators, local government representatives, local non-governmental organizations, and the general public. Fact sheets outlining the FAF Program and Technical Memorandum for Task 2 were prepared and distributed as informational review and comment items for attendees. These documents were also made available on the SJBA website.
- On October 20, 2015 the SJBA participating agencies held an in-person and teleconference workshop for planning of recycled water recharge with representatives from Orange County Environmental Health, Orange County Public Works, and the State of California Department of Water Resources.
- On December 21, 2015 the SJBA participating agencies held an in-person and teleconference workshop in regards to San Juan watershed management with representatives from Orange County Environmental Health, Orange County Public Works, CA State Fish and Game Department, and Orange County Parks.
- On February 9, 2016 the SJBA Project Manager and the consultant team facilitated a public meeting to present the findings of Task 3 to the SJBA Board and stakeholders within the basin. Attendees included SJBA agency members, stakeholders, local government representatives, local non-governmental organizations, and the general public. The presentation included an overview of the Task 3 objectives, scope of work, and findings. Fact sheets outlining the FAF Program, Tasks 2, and Task 3 were prepared and distributed

as informational review and comment items for attendees. These documents were also made available on the SJBA website.

- On March 8, 2016 the SJBA Project Manager and Scott Lynch from Black & Veatch (project consultant team member) facilitated a presentation of Task 4 Phasing Plan to the SJBA Board, stakeholders within the basin, local non-governmental organizations, and the general public. The presentation included an overview of the Task 4 objectives, scope of work, and findings. The technical documents were distributed to those present and were included as attachments to the Board packet for posting on the SJBA website.

Review comments were solicited at each of the public meetings and the comments were incorporated into the various Technical Memoranda as appropriate and Responses To Comments were included in each of the Technical Memoranda.

On March 22, 2016 the SJBA Project Manager presented the Groundwater and Desalination Optimization Program Foundation Actions Fund (FAF) Program Draft Final Report to the SJBA Board, SJBA agency members, stakeholders, local government representatives, local non-governmental organizations, and the general public at a public workshop. The Draft Final Report was published with the SJBA Board packet and was posted on the SJBA website. The comments on the Draft Final Report were incorporated as appropriate and the comments are included herein as Appendix I.

Preparation of the Draft Report, presentation of the Draft Final Report at a public workshop for agency and public review, and preparation of this Final Report constitute the principal objectives of Task 5.

Project Goals and Objectives Met

At this time we have not met with State and Local regulators (including State Water Resource Control Board, Regional Water Quality Control Board, Department of Public Health, and Orange County Flood Control) on the Final Report and Project Phasing Schedule (remaining item of Task 5). It is anticipated that these agencies will be invited to participate in a workshop to present our findings and implementation plan and to solicit comments from them. It is anticipated that this workshop will occur during the remainder of the first quarter and throughout the second quarter of 2016 to assist in development of a specific project. The results and feedback from these meetings will be presented in the 6-Month Progress Report due in June, 2016.

To date we have not initiated the proposed "Third Party Technical Review" of the project alternatives. Efforts have been made by SJBA and MWDOC personnel to coordinate and schedule the technical review through the National Water Research Institute (NWRI) and the completed Task 3 Technical Memorandum has been circulated to their staff for initial concept review. It is

anticipated that the NWRI panel review would be accomplished during the remainder of the first quarter and throughout the second quarter of 2016 to assist in development of a specific project. The results of this technical review will be presented in the 6-Month Progress Report due in June, 2016.

Major Problems Encountered

The most significant problem in completing the project was the year-long delay imposed by the SJBA Board debating the San Juan Basin GWFMP third party peer review and delayed authorization for finalization of the GWFMP and adaptive management groundwater monitoring program (approved in November, 2014).

Subsequent project delays occurred throughout 2015 resulting from combinations of the following factors:

- groundwater level declines and seawater intrusion associated with persistent drought conditions throughout the watershed
- agency concerns related to seawater extraction barrier compared to the proposed SCWD ocean desalination project
- agency concerns related to water rights and groundwater production allocations throughout the San Juan Basin
- delays in authorization of consultant contracts for approved project tasks
- delays in authorizing successive phases of work for individual consultants
- slow agency responses to the consultant's request for existing facility operating capacity, capital expansion program information, and projected recycled water demands
- agency concerns regarding potential impacts to existing water treatment facilities from introduction of recycled water
- uncertainties regarding existing wastewater treatment facility upgrades for recycled water availability.

Applications of Project Findings to Other Regions

Key findings from the San Juan Basin Desalination and Optimization Program that can be applied in other impaired coastal groundwater aquifers include:

Seawater Extraction Barrier

An extraction barrier is a feasible method of protecting inland groundwater from seawater intrusion and develops a new, reliable water supply. Considerations for developing an extraction barrier include:

- Monitoring and modeling will be required to appropriately size the extraction well barrier to ensure the effectiveness of the barrier.
- The extraction barrier wells will likely reduce the pumping capacity at existing inland production wells that are close to the coast. This lost capacity should be accounted for in estimating the project yield.
- The extraction barrier can capture recharge that is not captured by inland production wells.
- An extraction barrier project is expensive, but costs can be reduced by seeking Regional support. Decreasing imported water demand in one service area benefits all local water agencies and this is valuable from a reliability standpoint.

Recycled Water Recharge via Injection in an Impaired Basin

- Based on current DDW regulations, injection of recycled water requires advanced treatment and is cost prohibitive for an impaired basin.

Recycled Water Recharge via Surface Water Recharge in an Impaired Basin

- Surface water recharge strategies are optimal because they also have the benefit of increasing storm water capture for recharge.
- Live stream recharge of recycled water also has the multiple benefit of supporting riparian habitat.
- Monitoring and modeling will be required to optimize the location of recharge to minimize RWC and URT.
- Recharge operations will need to be adaptive: in wet years recharge will be less and in dry years recharge can increase.
- Facilities should be sized for the dry years, where the maximum amount of recharge can occur.
- Constructing Seasonal storage for recycled water will increase the amount of water available for recharge – both seasonally and in variable climates.
- Projects and facilities should be phased to incrementally increase recharge over time.

Adaptive Production Management

- Groundwater pumping needs to be adaptive to match the basin recharge (with or without enhanced recharge).
- If seawater barriers are cost prohibitive, groundwater pumping can be adapted from year to year in order to minimize groundwater outflow to the ocean and protect against seawater intrusion.

6. CONCLUSION

Lessons Learned

There are numerous small, coastal groundwater basins along the southern coast of California. Some of the common features of these coastal alluvial aquifers are: they are narrow, relatively shallow, and the water is impaired from a municipal drinking water standpoint, requiring treatment for constituents such as TDS, iron, and manganese. Producing a safe, reliable drinking water supply in impaired coastal basins is challenging in that the resource is small, the yield can be highly variable across wet and dry climate cycles, treatment is costly, and groundwater pumping can result in seawater intrusion.

The impacts of seawater intrusion and dry climate cycles are significant, especially in impaired groundwater basins that rely on desalination to produce potable water. Desalination technology is such that the RO membranes cannot be offline for significant periods of time without significant cost to restart the facility. If pumping wells that supply water to the treatment plant must be shut down to prevent seawater intrusion, or due to low water levels in dry periods with limited natural recharge, there may not be enough inflow to keep the plant operational. The member agencies of the SJBA experienced these challenges during current drought.

Supplemental recharge with imported or recycled water is a common groundwater management strategy to support groundwater levels and pumping. In a water quality impaired basin, it is not practical to recharge high-quality, lower-TDS sources of imported water into a high-TDS groundwater basin that requires the water be treated when it is extracted. Thus, recycled water is the most logical option for recharge in an impaired basin. And, it is a sustainable, local supply. However, in small, narrow alluvial aquifers recycled water recharge is challenging in that the amount of water available for blending in the aquifer is small (e.g. RWC is high) and underground travel times are short. Under current DDW regulations, such aquifer characteristics would typically require advanced treatment similar to that performed by the OCWD for its GWRS program. Again, it is not practical to advance treat water before it is recharged only to have to treat it again on the way out.

Recommended Further Investigations

Several assumptions were made to complete this work. These assumptions and their implications are listed below.

1. Surface water recharge with recycled water. The recharge capacity created by the rubber dam system is much larger than the range of in-stream recycled water recharge volumes investigated herein. The recycled water recharge was spread out among all the cells created by the rubber dams. Prioritizing certain cells (for example, recharging more

recycled water in some cells and recharging no recycled water in others) could lead to lower RWCs and longer URTs for some wells. The well locations and capacity to recover the recycled water recharged were not optimized to maximize URT, minimize RWC or explored to evaluate the logical range of recovery rates. Additional work is required to optimize the recharge and recovery plans associated with surface recharge.

2. Injection and recovery wells location and related project capacity. The locations of the injection and recovery wells were assumed and not optimized to maximize URT, minimize RWC or explored to evaluate the logical range of injection and recovery rates. Additional work is required to optimize the injection and recovery plans before a decision is made to proceed with groundwater injection.
3. Seawater extraction barrier. Per Alternative 6 of the SJBGFMP, it was assumed that an extraction barrier was included as a Program Element within each alternative. Additional work could be performed to determine a projected project yield under selected recharge alternatives in the absence of the extraction barrier. In such a scenario, the wells would need to be operated in a manner similar to the baseline alternative, where the MNWP controls pumping to ensure a positive subsurface discharge to the ocean to prevent seawater intrusion.
4. Compliance with SWRCB permits. It was assumed that the 50 percent storage metric would apply in all Program alternatives. For Program alternatives that incorporate a seawater extraction barrier, provide surface water flows that could support riparian vegetation, and replace pumping by private pumpers with alternative water supplies, it is reasonable to assume that the limits imposed with the MNWP could be relaxed to only limit pumping when elevations threaten sustainable pumping. Additional evaluation is needed to determine how much more water could be recharged and/or recovered if this limitation were relaxed and what other measures could be taken to protect water quality, habitat, and riparian producers. This new information would be used to request modifications to the existing SWRCB diversion permits to enable greater operational flexibility, increased yield and be protective of water quality, habitat, and riparian producers.
5. Subsurface boundary inflows to the model. The groundwater model used herein has a constant boundary inflow from Oso Creek, the Arroyo Trabuco, Horno Creek and San Juan Creek. In aggregate this boundary inflow is about 27 percent of the average inflow. This assumption could result in an underestimation of the RWC and an over estimation of pumping capability during drought periods. The boundary inflows need to be refined and incorporated into future investigations.

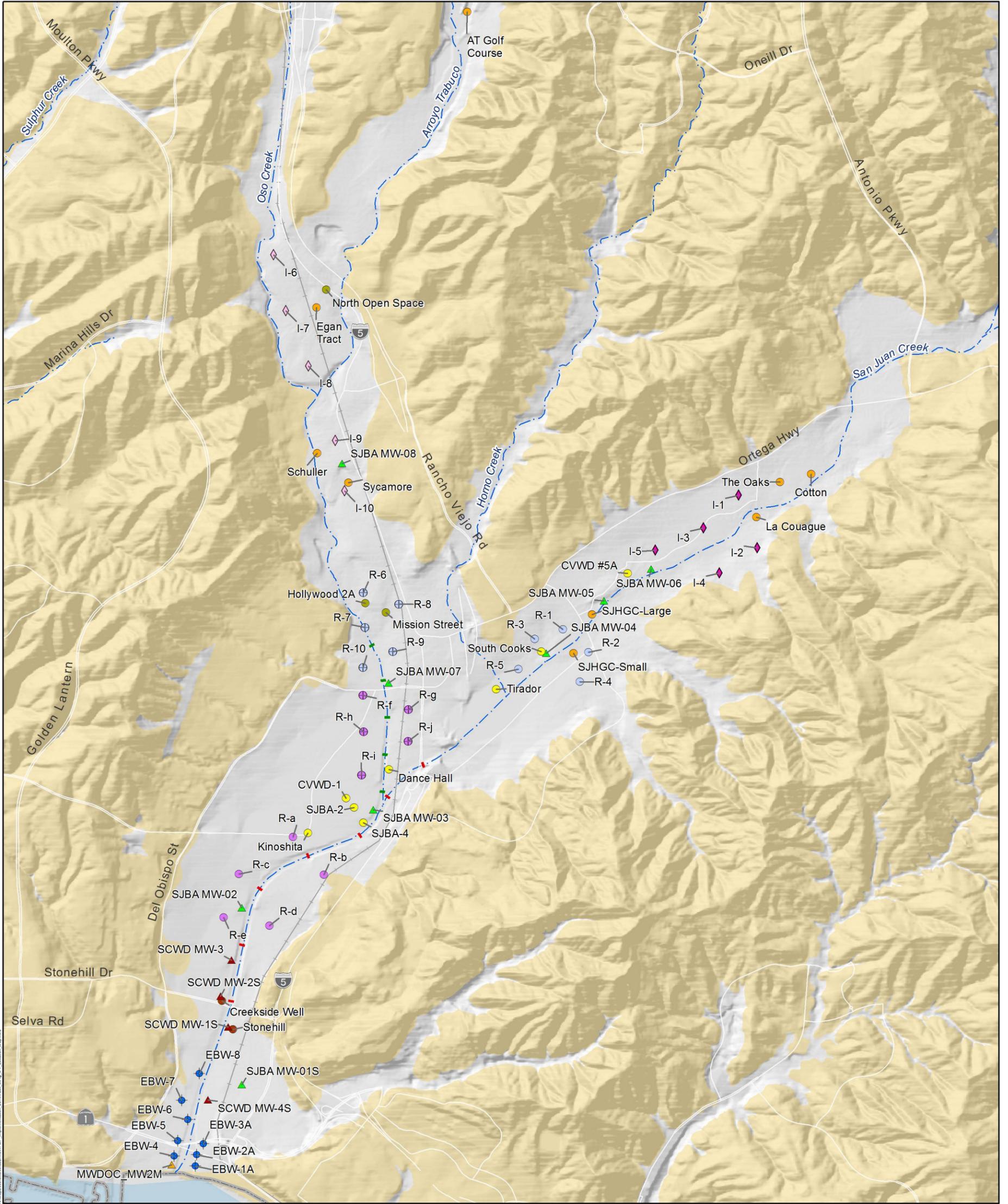
6. Groundwater Model. The groundwater model used in Task 3 evolved from a prior groundwater model developed by MWDOC to provide a boundary condition to another groundwater model developed by MWDOC that simulates the coastal groundwater response to and impacts from the then proposed SOCOD project and secondarily to project the impacts of the SOCOD project on the San Juan Basin. In going forward the SJBA should conduct a needs assessment to define the modeling specifications required to implement the SJBGFMP, compare these specifications to the SJBA model and consider updating or replacing the model to improve the accuracy of the model projections and resulting planning information.

Next Steps

The project implementation phasing plan has been presented to the SJBA Board for planning considerations and to evaluate which project elements could be incorporated in a project plan. It has been recommended to the SJBA Board that the TAG further review this phasing plan with current capital improvement projects for each agency to determine what “shared costs” could be captured with this project and to return a confirmed project schedule at the April, 2016 Board meeting.

It is anticipated that this report, and the technical supporting documents, will be submitted to the NWRI technical panel for review to assist SJBA in selection of the final project concept design elements.

Subject to completion of the NWRI technical review, it is anticipated that Board may request modifications to the implementation phasing plan to accelerate the preparation of the EIR and CEQA/NEPA documents along with the permitting and preliminary design phases which could lead to construction proceeding by 2018.



Existing Facilities

- SCWD GRF Desalter Well
- CSJC GWRP Desalter Well
- ▲ SJBA Monitoring Well
- ▲ SCWD Monitoring Well
- Other CSJC Pumping Well
- Private Pumping Well
- ▲ MWD OC Monitoring Well

Conceptual Facilities

- Extraction Barrier Well
- Recovery Wells Symbolized by Alternative
 - 1b: RD-SJC 5,000 and 2b: RD-AT-SJC 7,500
 - 2b: RD-AT-SJC 7,500
 - 3a: I-SJC 5,000 and 4c: I-SJC-AT 5,000
 - 4c: I-SJC-AT 5,000
- Injection Wells Symbolized by Alternative
 - ◆ 3a: I-SJC 5,000 and 4c: I-SJC-AT 5,000 Injection Well
 - ◆ 4c: I-SJC-AT 5,000 Injection Well

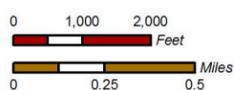
- 5-ft Rubber Dam on Arroyo Trabuco
 - 1b: RD-SJC 5,000 and
 - 2b: RD-AT-SJC 7,500
- 7-ft Rubber Dam on San Juan Creek
 - 2b: RD-AT-SJC 7,500



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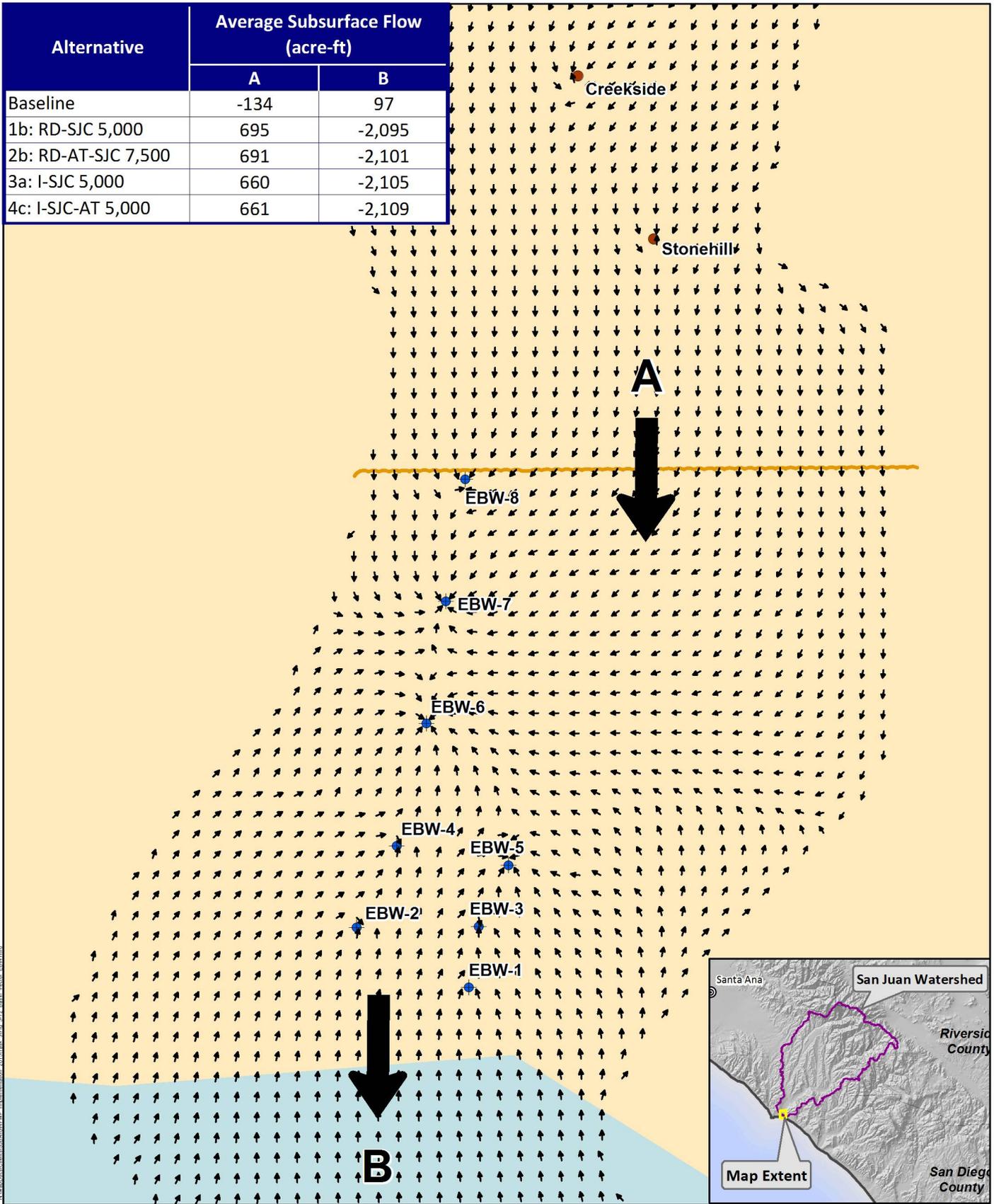


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 Date: 12/17/2015
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Well Location Map

Figure 3.3-1



● Existing SCWD GRF Desalter Well ● Conceptual Extraction Barrier Well

Flow Vectors
Aug 2014

1b: RD-SJC 5,000

Figure 3.3-12



Author: CS
Date: 20151103
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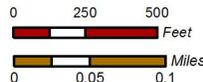


Figure 3.3-18
Projected 120-Month Average of Volume-Weighted Recycled Water Contribution
1b: RD-SJC 5,000

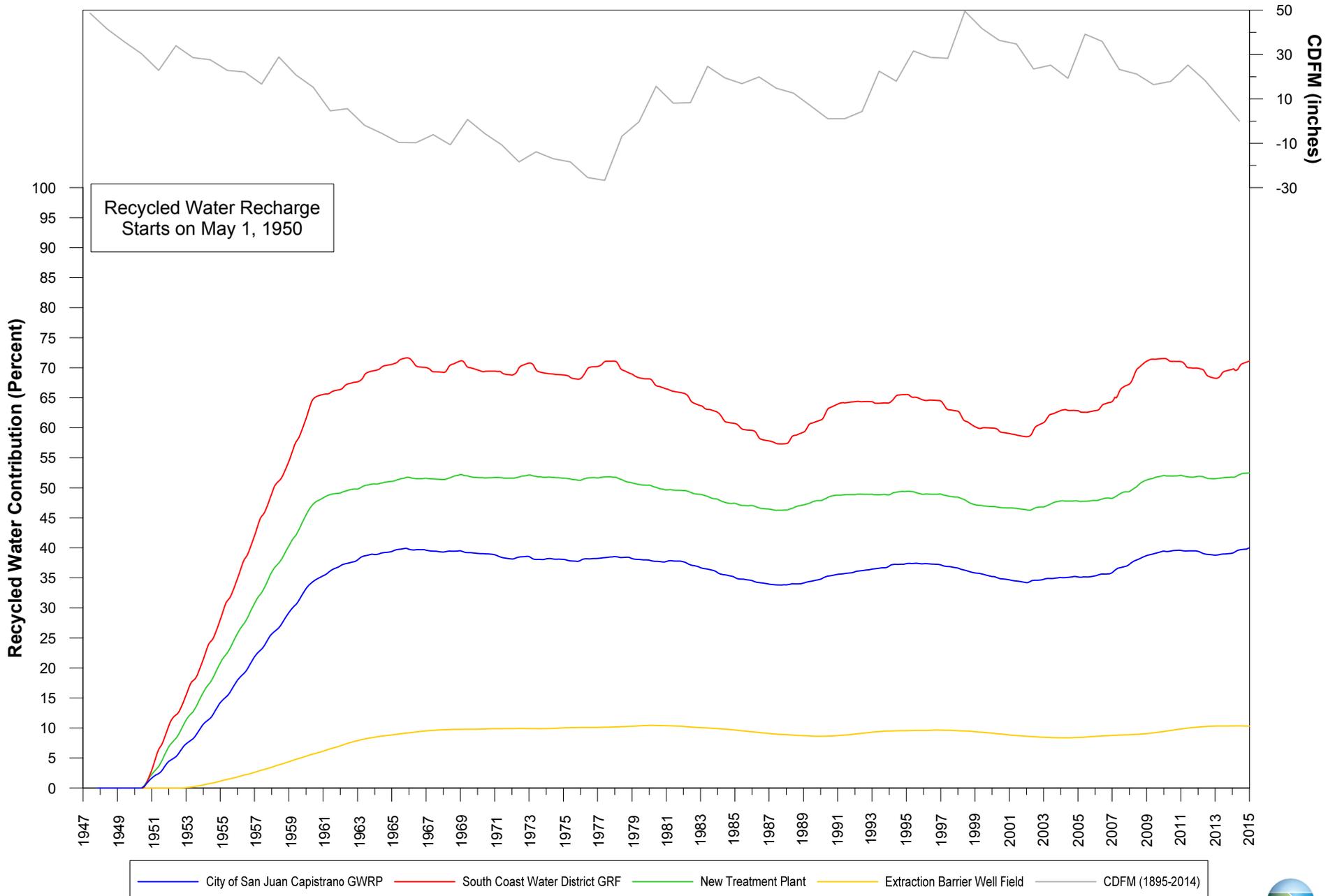


Figure 3.3-19
Projected 120-Month Average of Volume-Weighted Recycled Water Contribution
2b: RD-AT-SJC 7,500

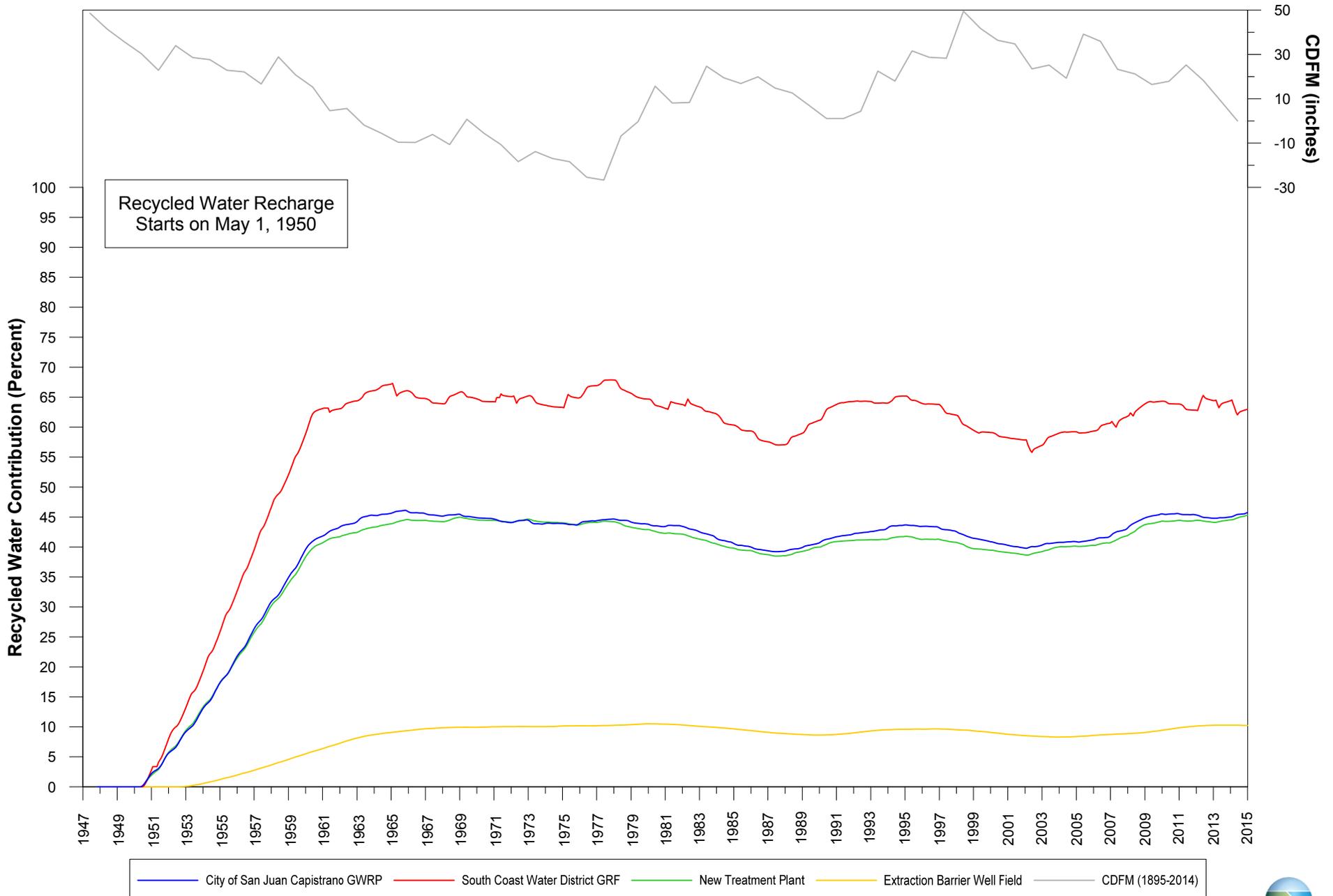


Figure 3.3-20
Projected 120-Month Average of Volume-Weighted Recycled Water Contribution
3a: I-SJC 5,000

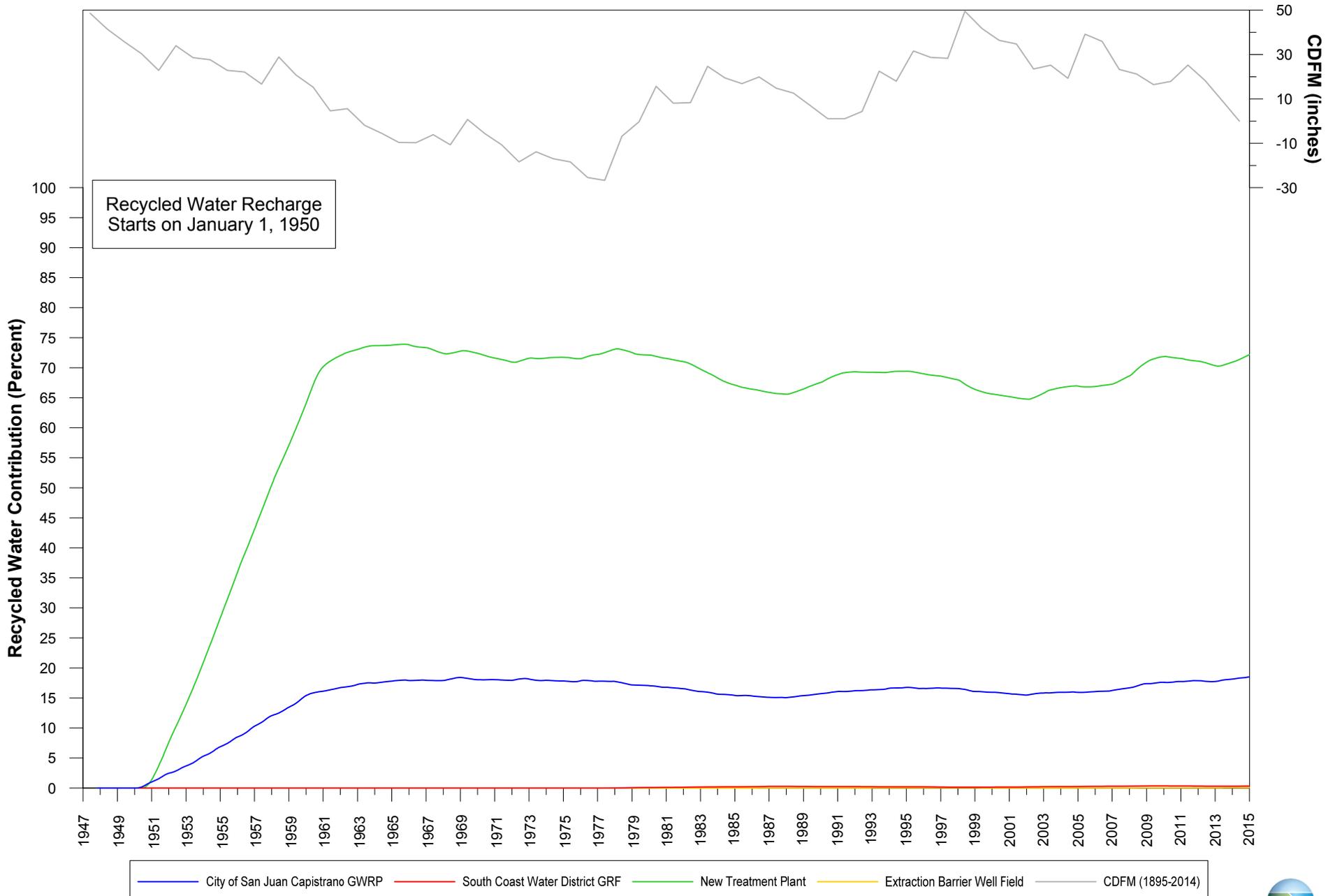
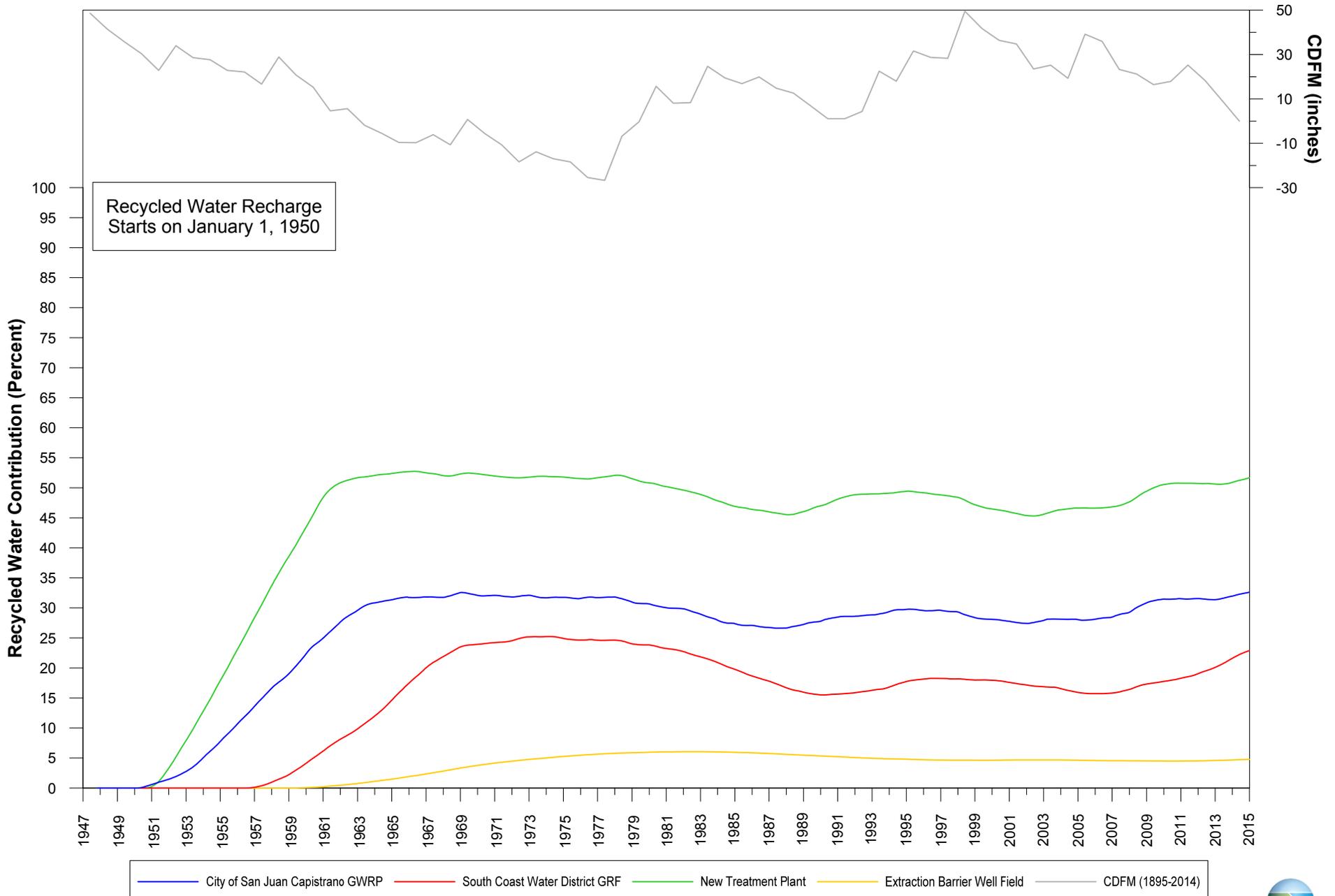
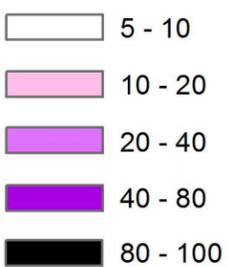
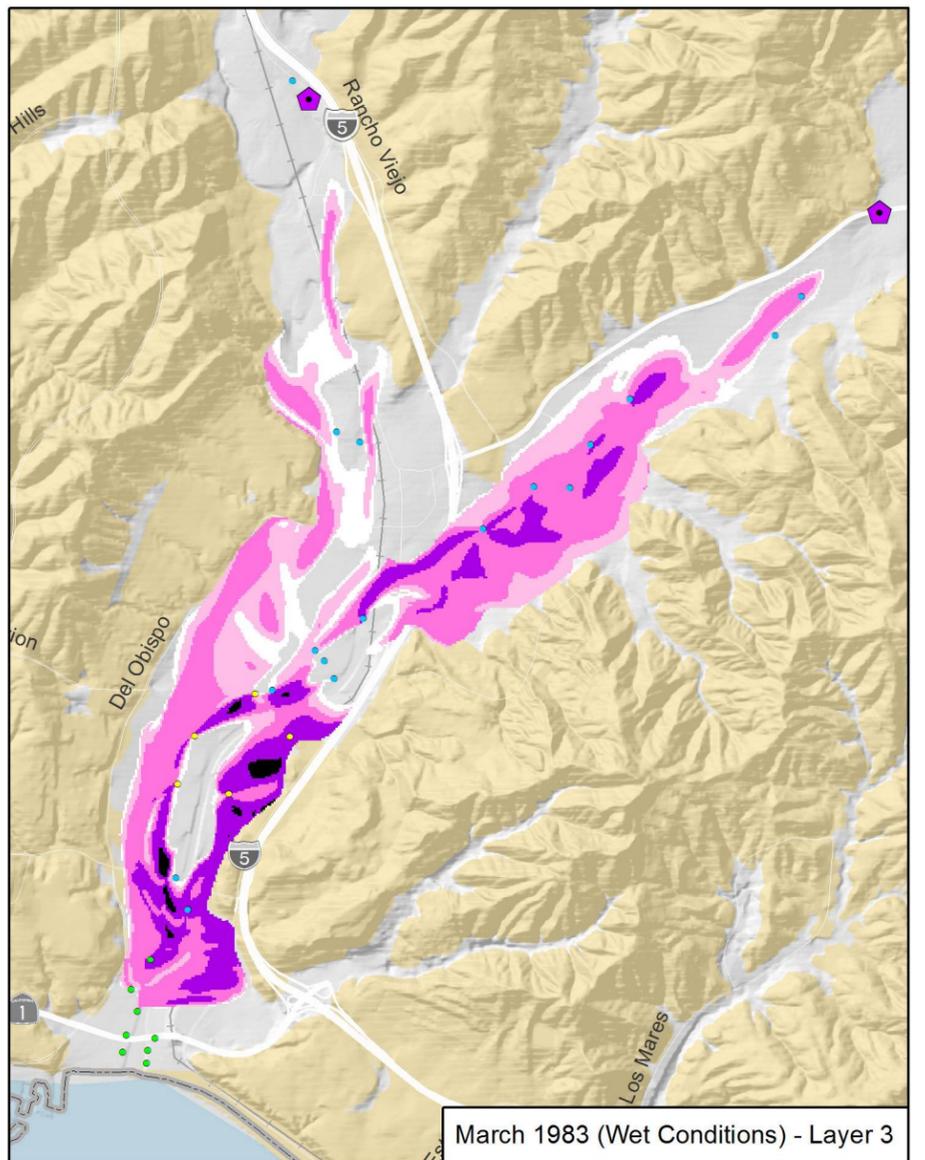
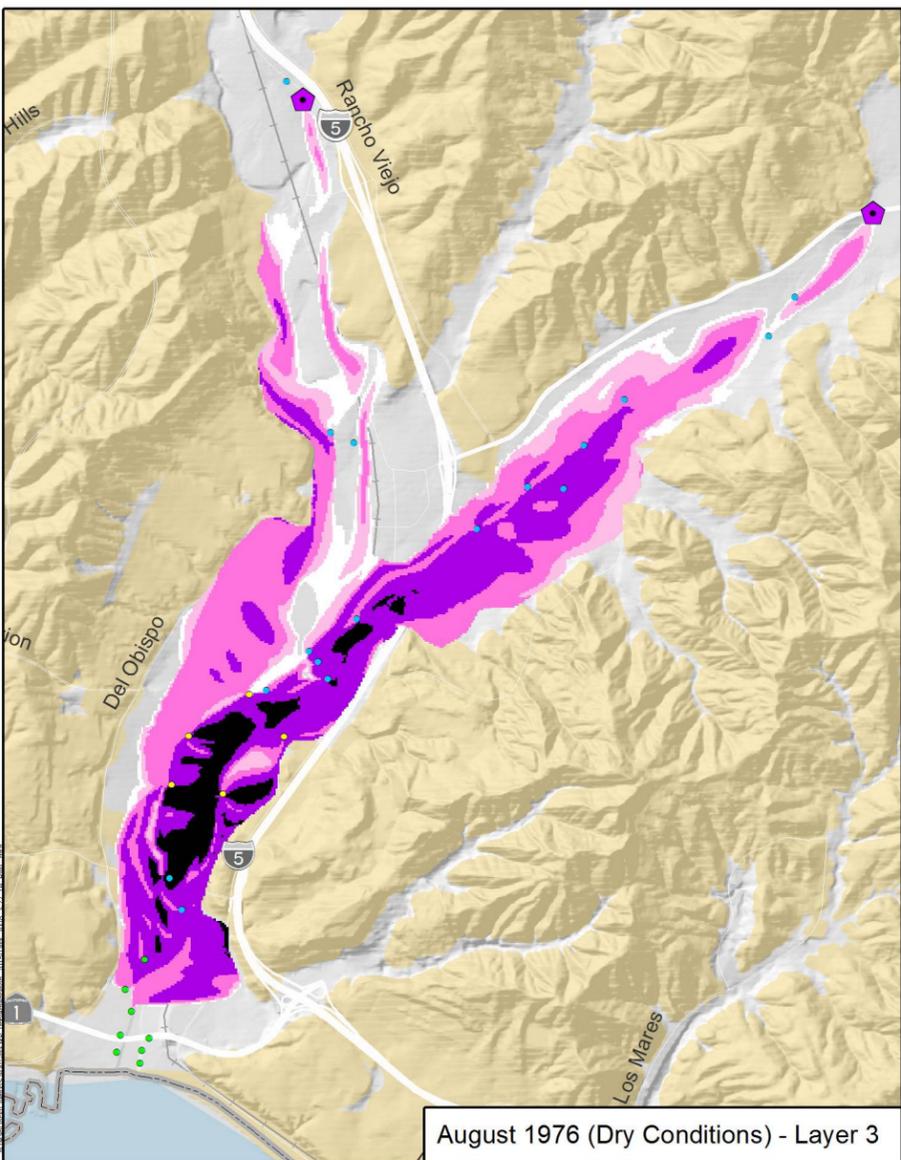
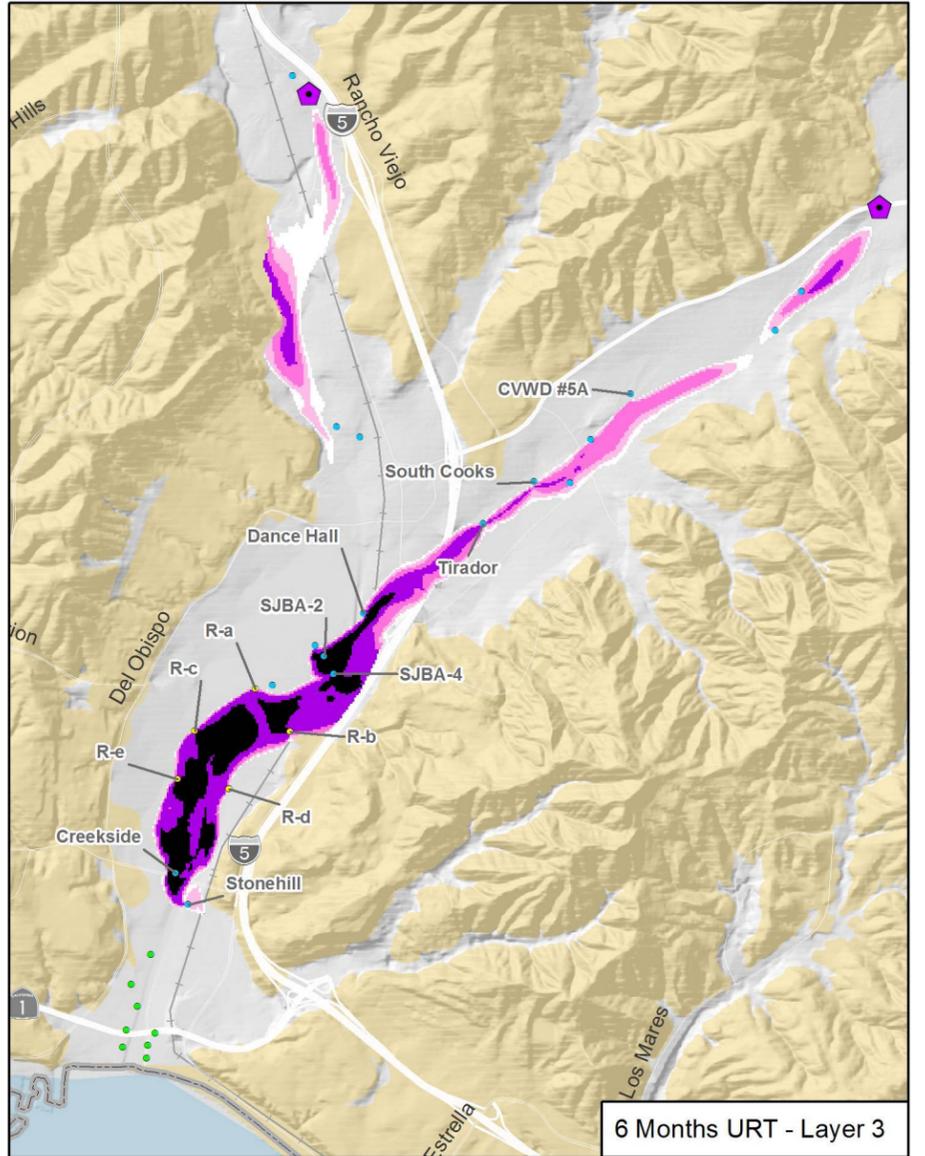
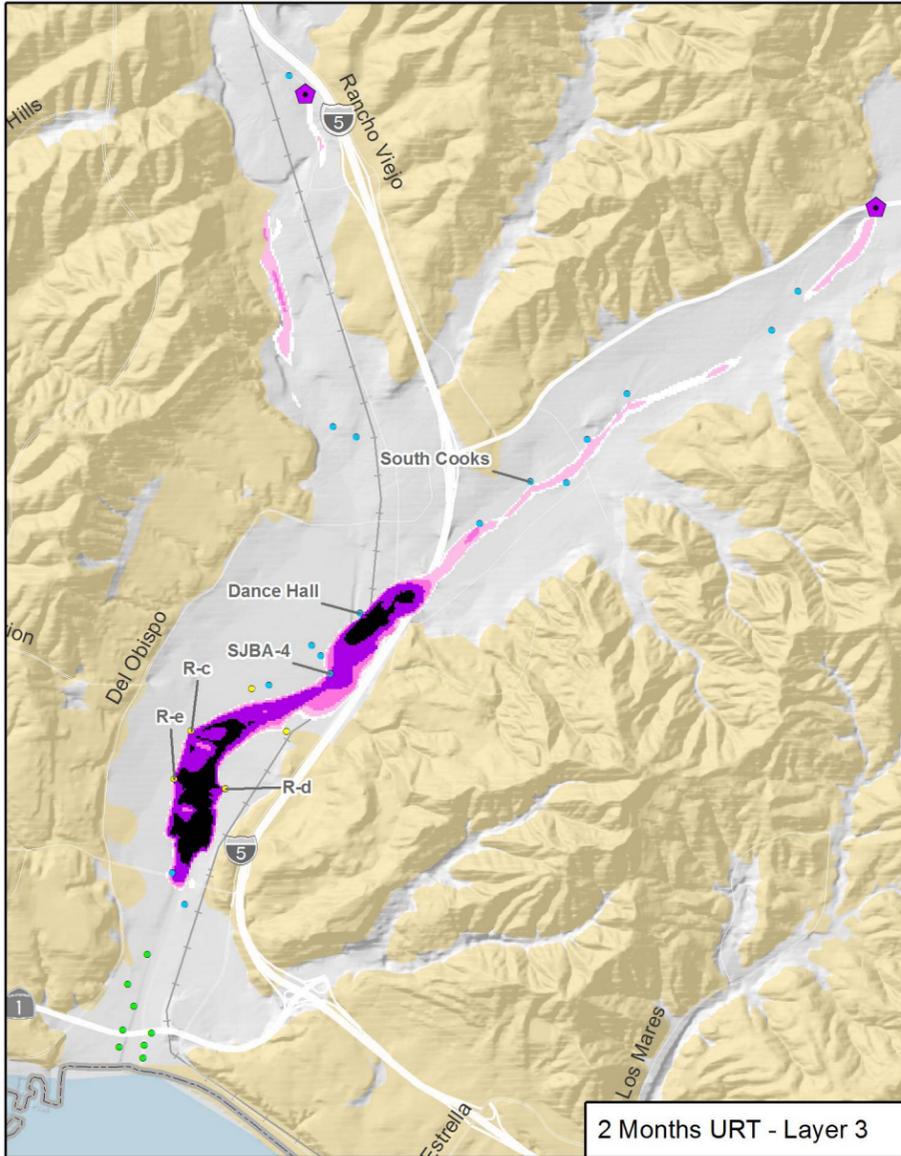


Figure 3.3-21
Projected 120-Month Average of Volume-Weighted Recycled Water Contribution
4c: I-SJC-AT 5,000

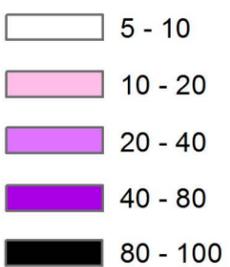
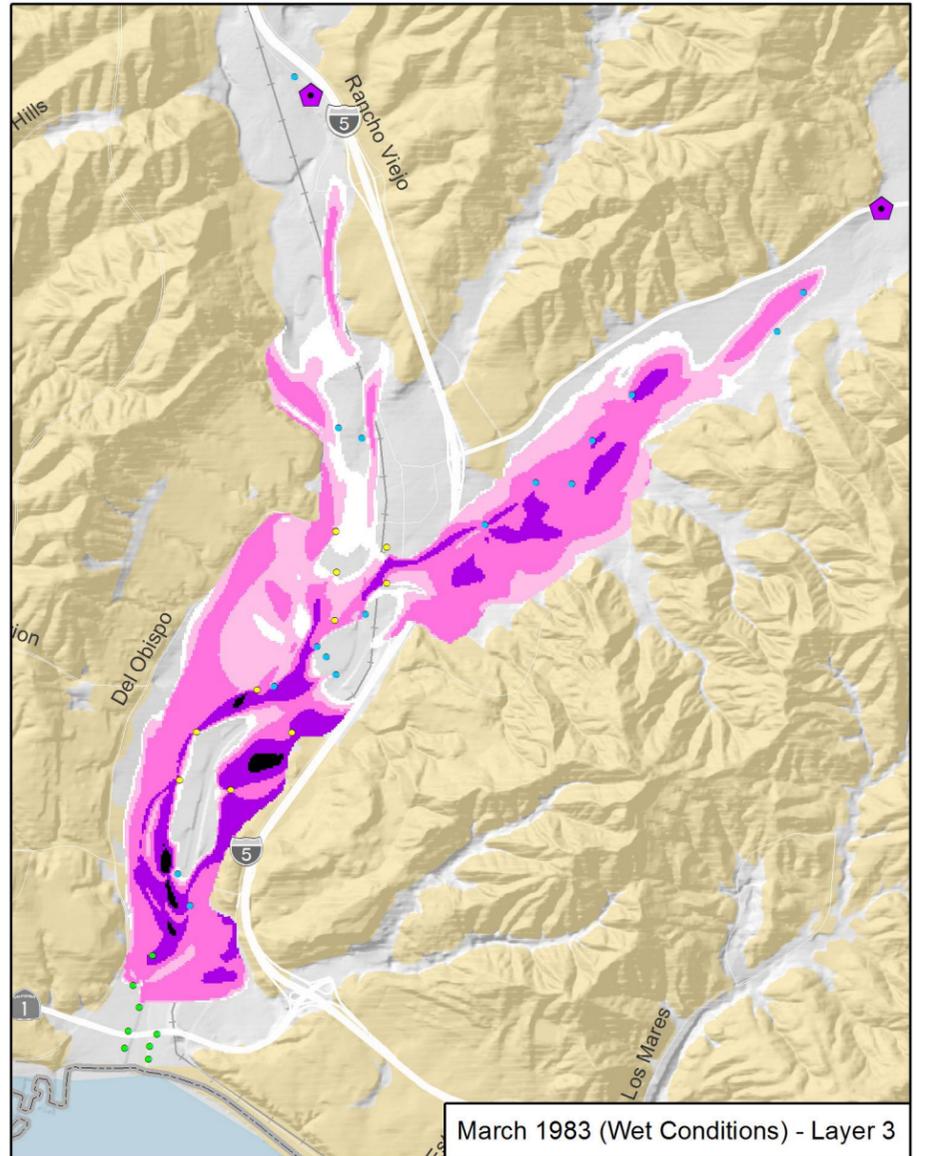
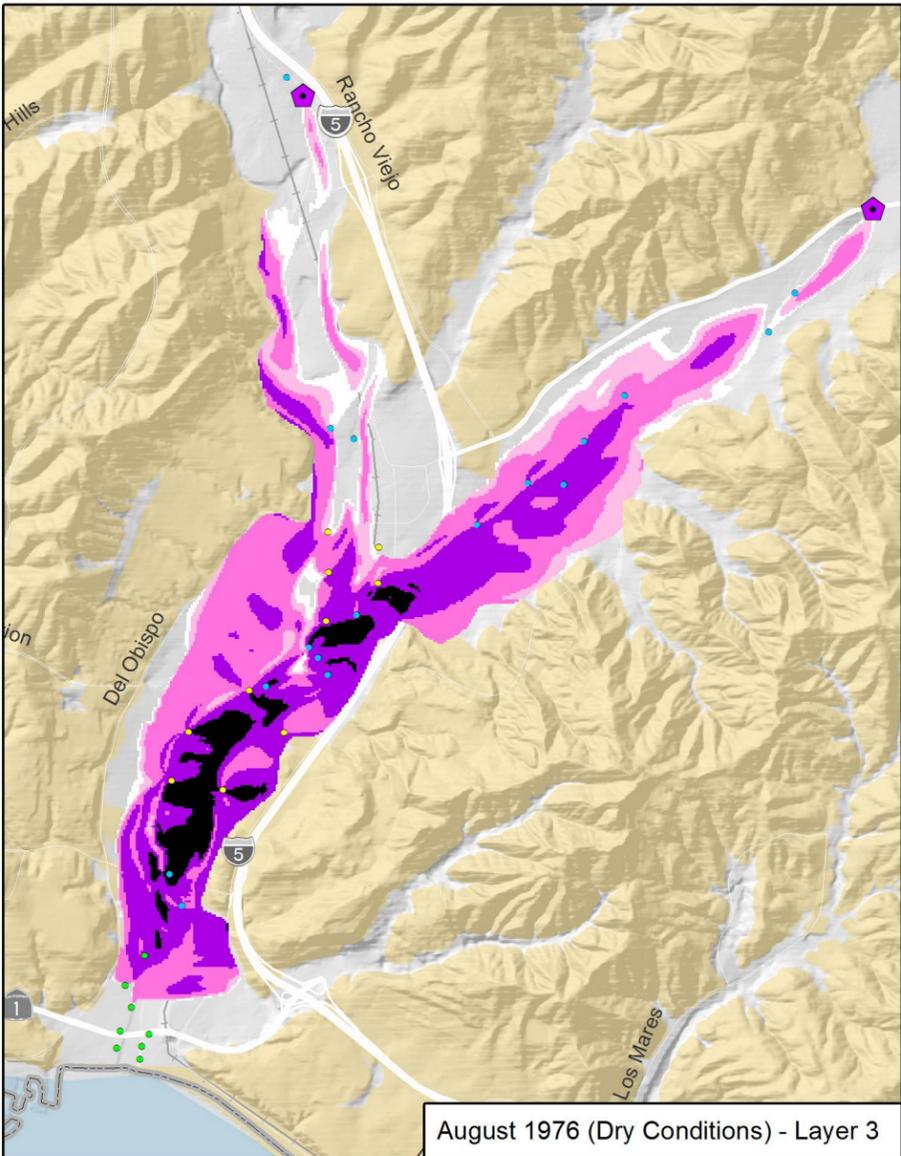
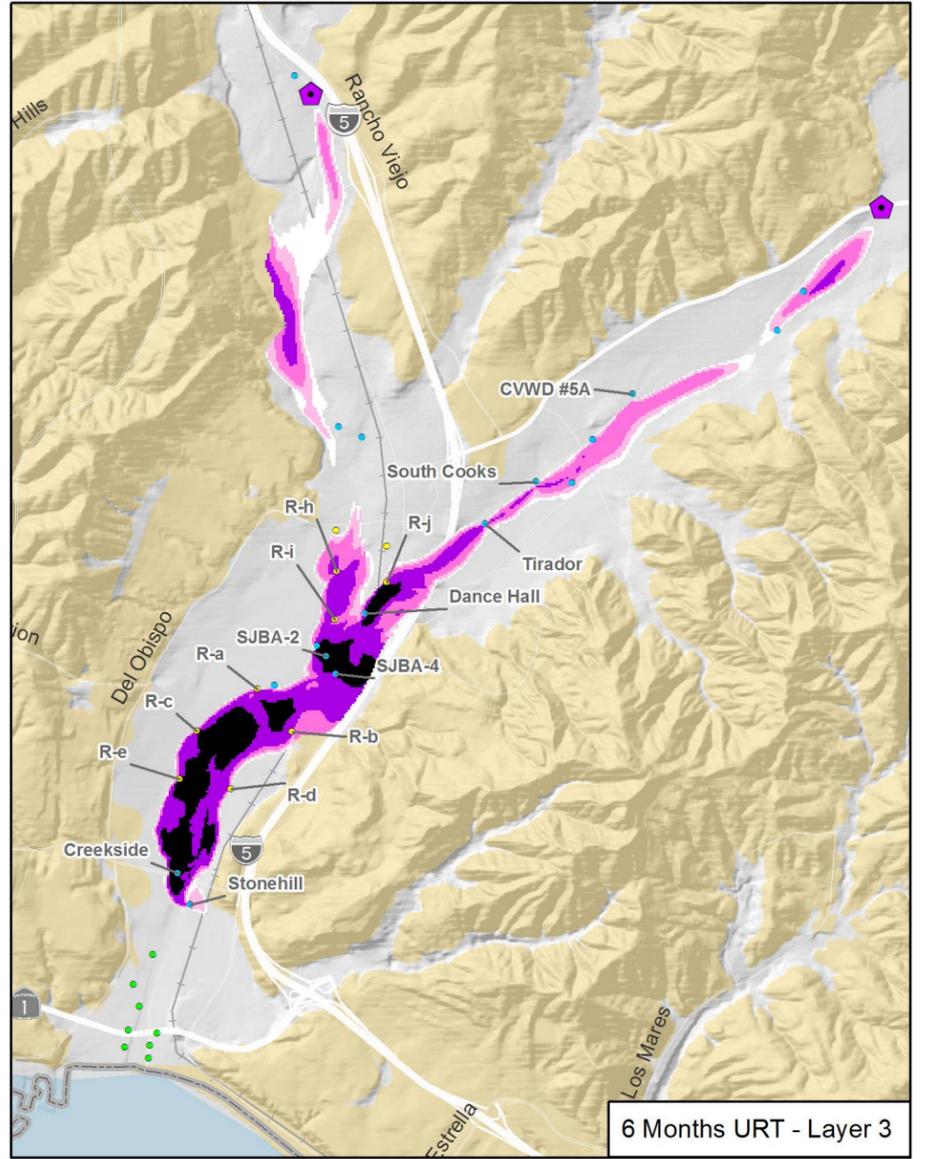
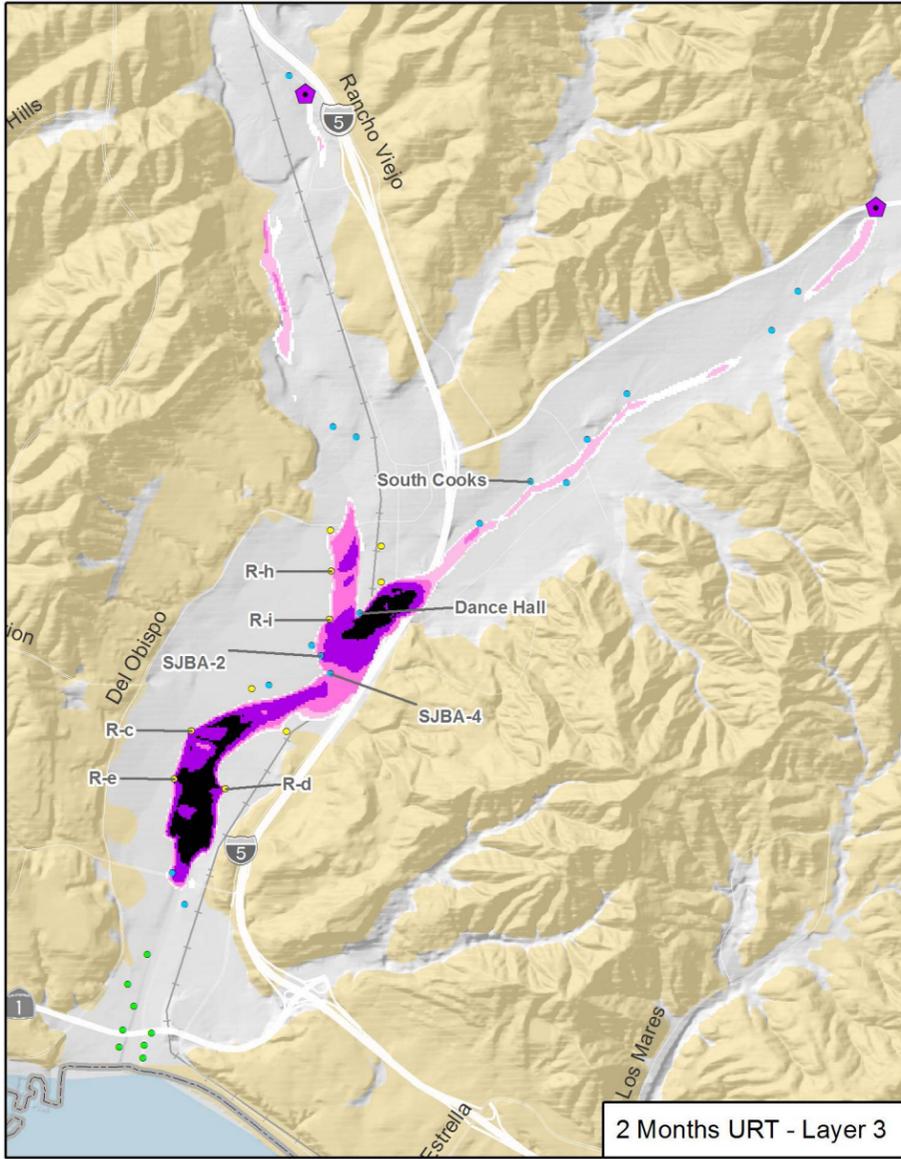




Recycled Water Contribution
(Percent)

Conceptual Facilities

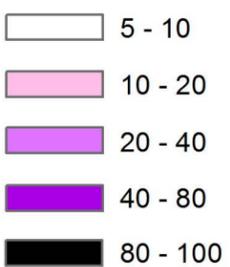
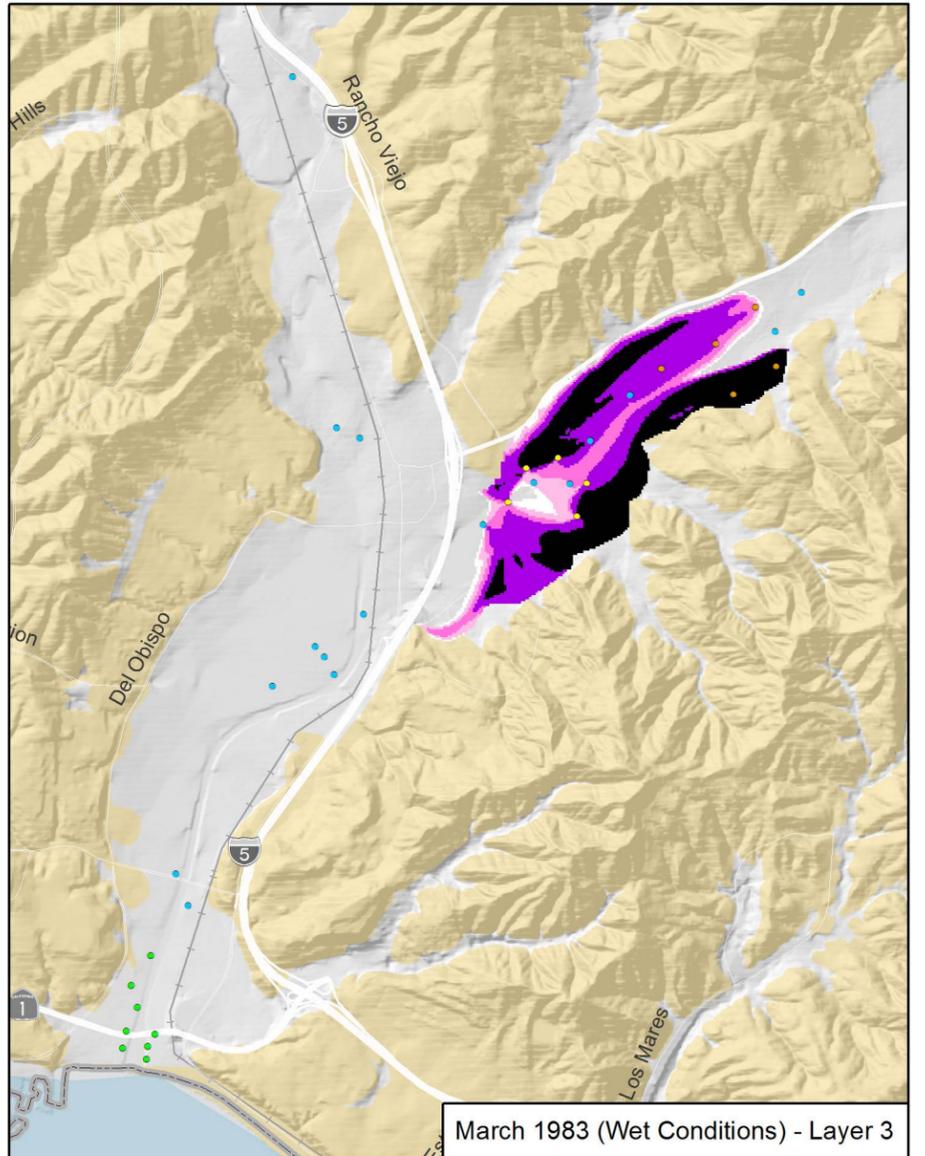
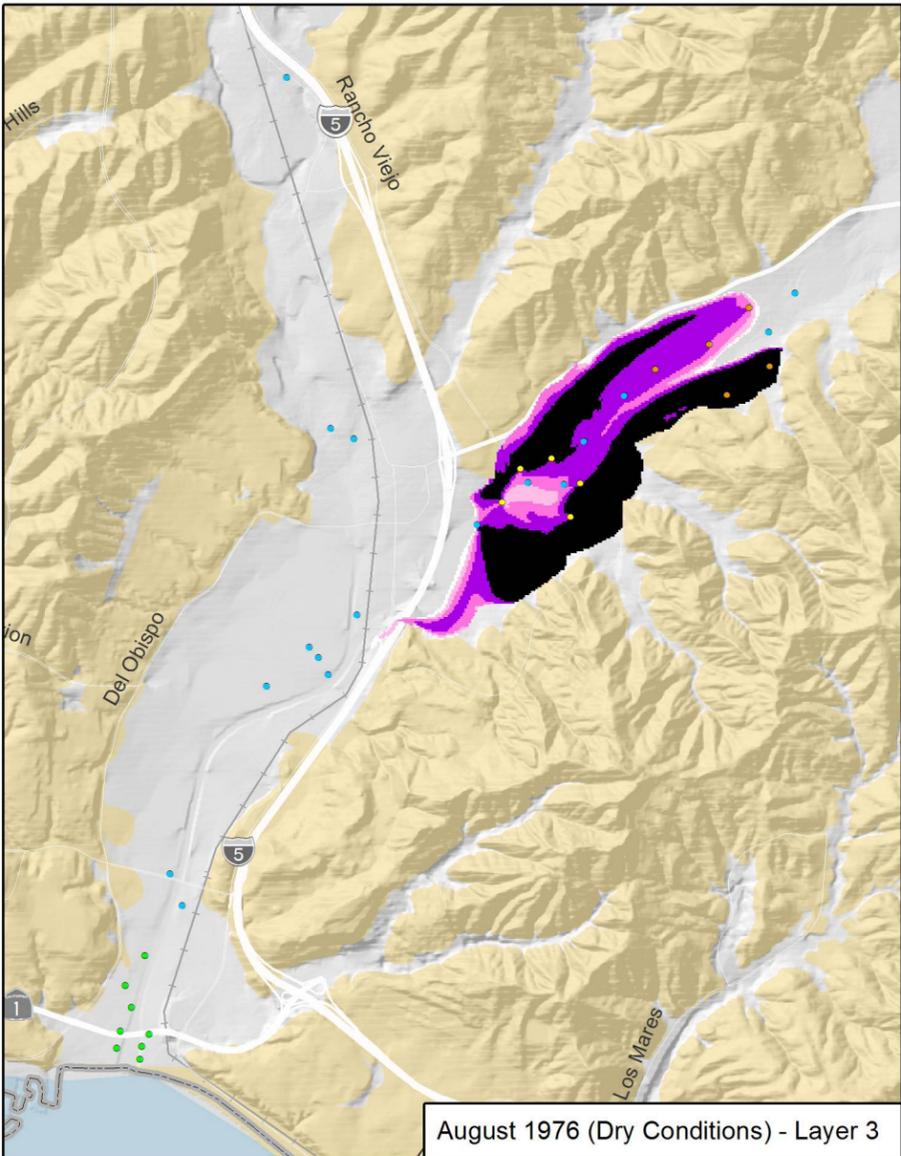
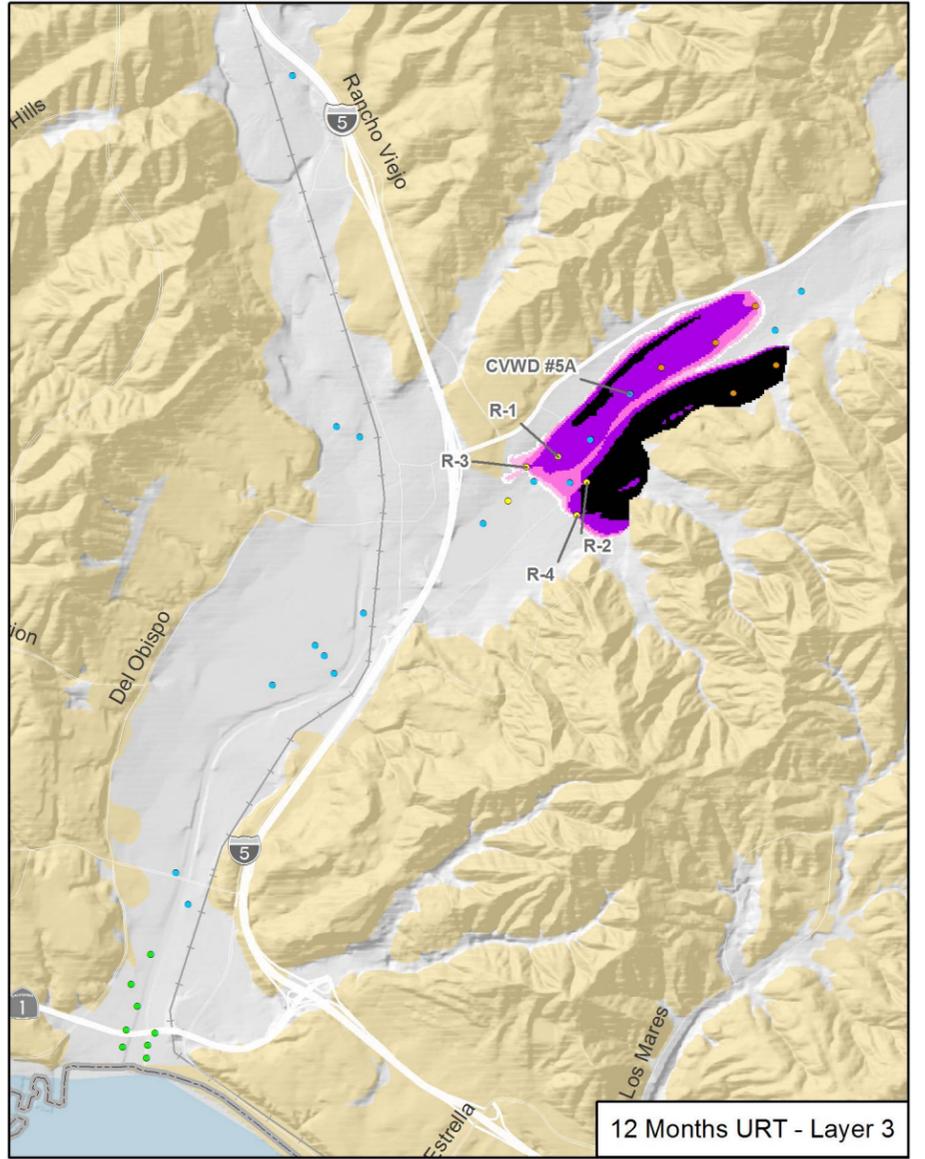
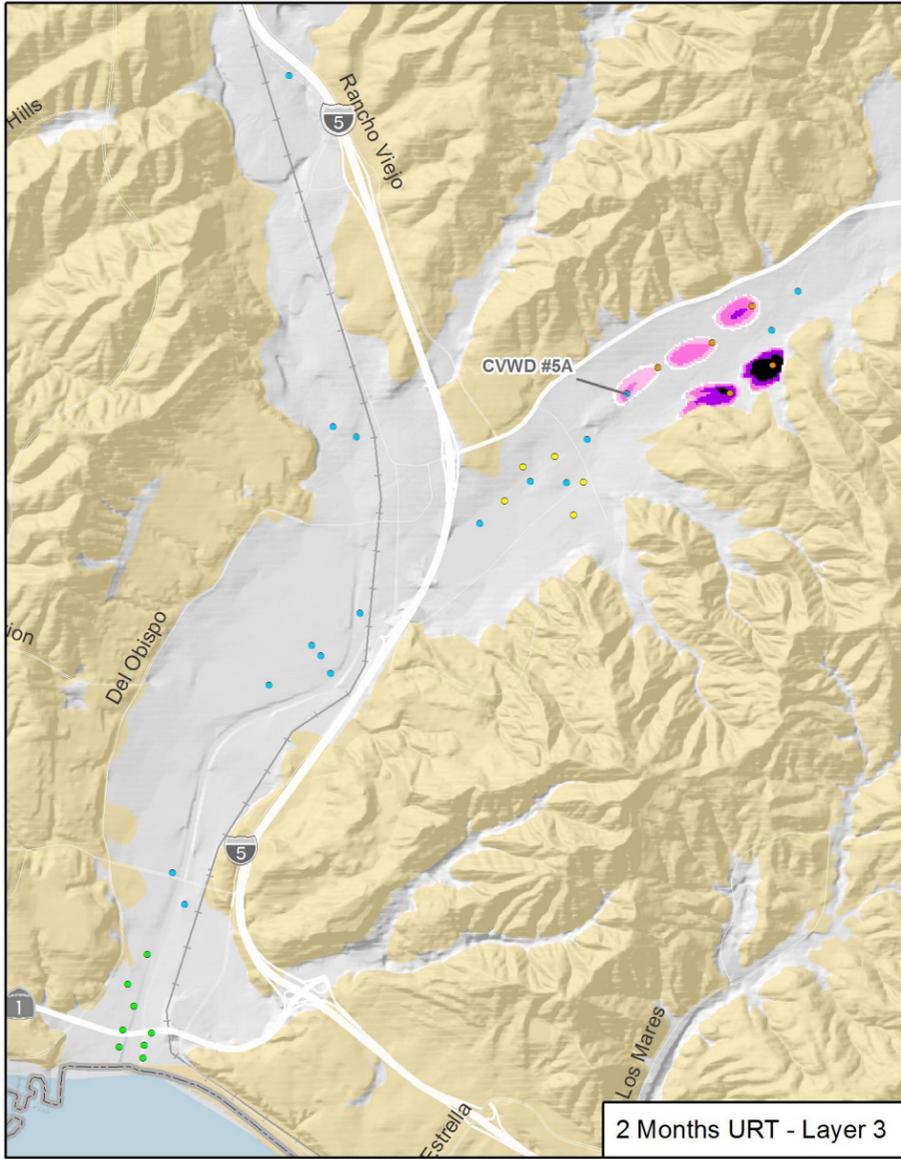
- Extraction Barrier Well
- Existing Pumping Wells
- Recovery Well
- Recycled Water Turnout for Incidental Recharge



Recycled Water Contribution
(Percent)

Conceptual Facilities

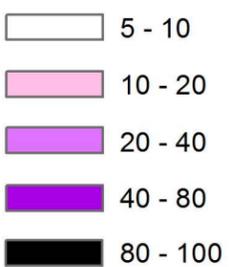
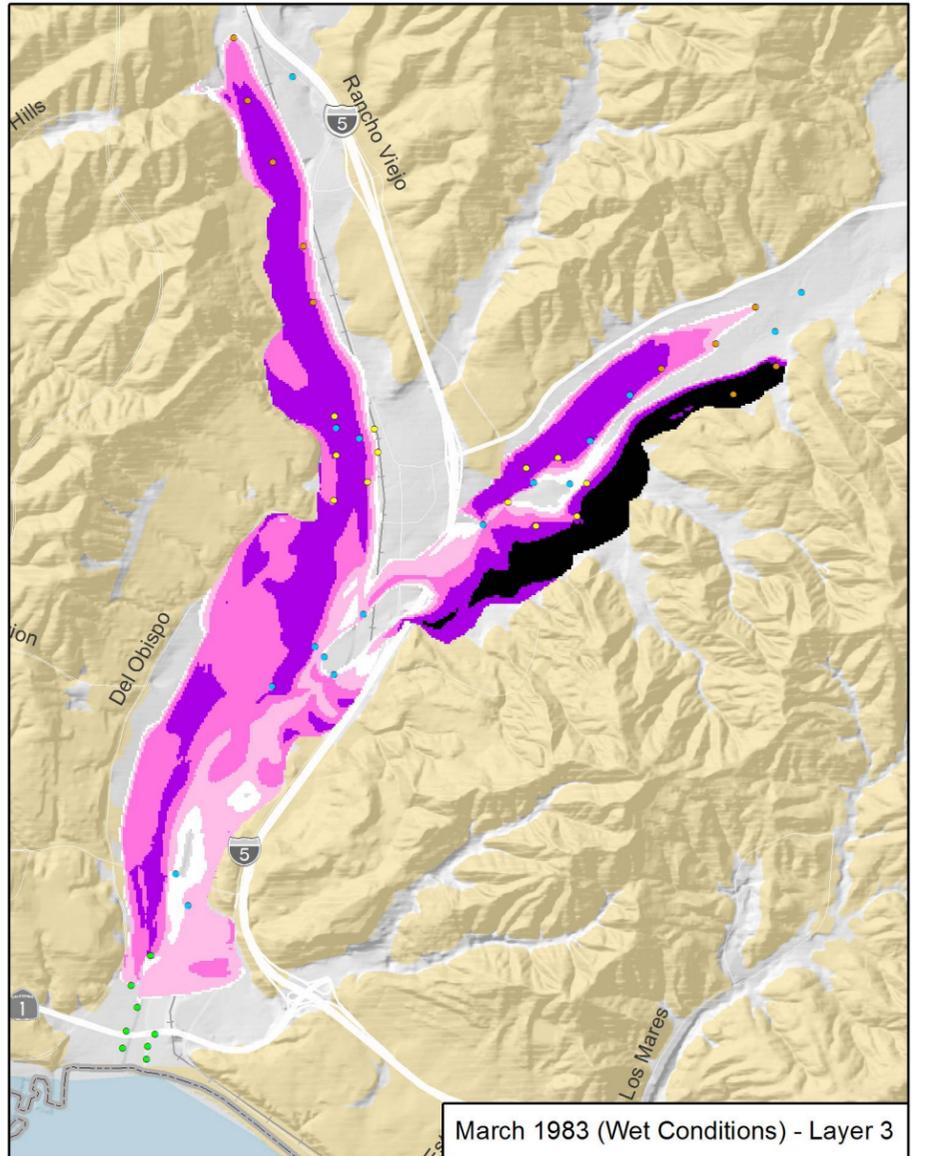
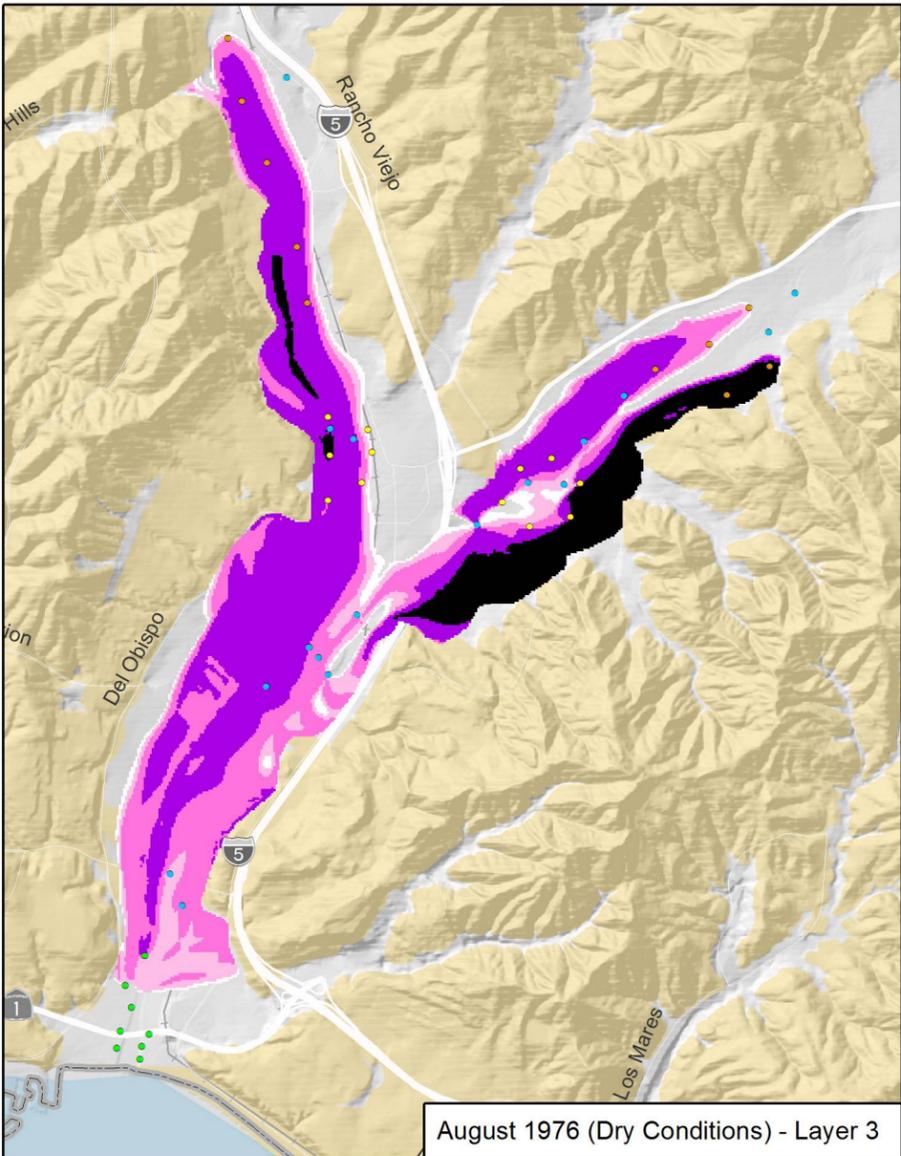
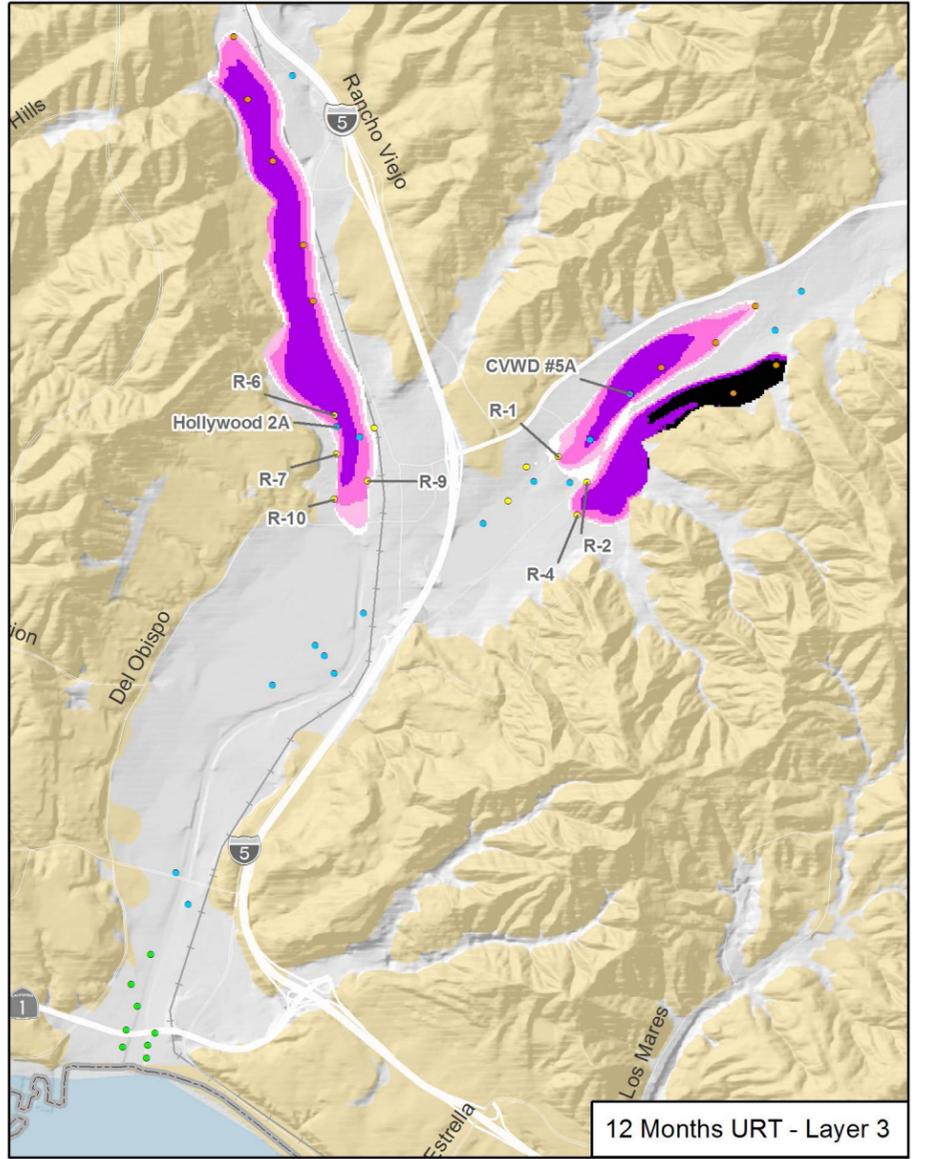
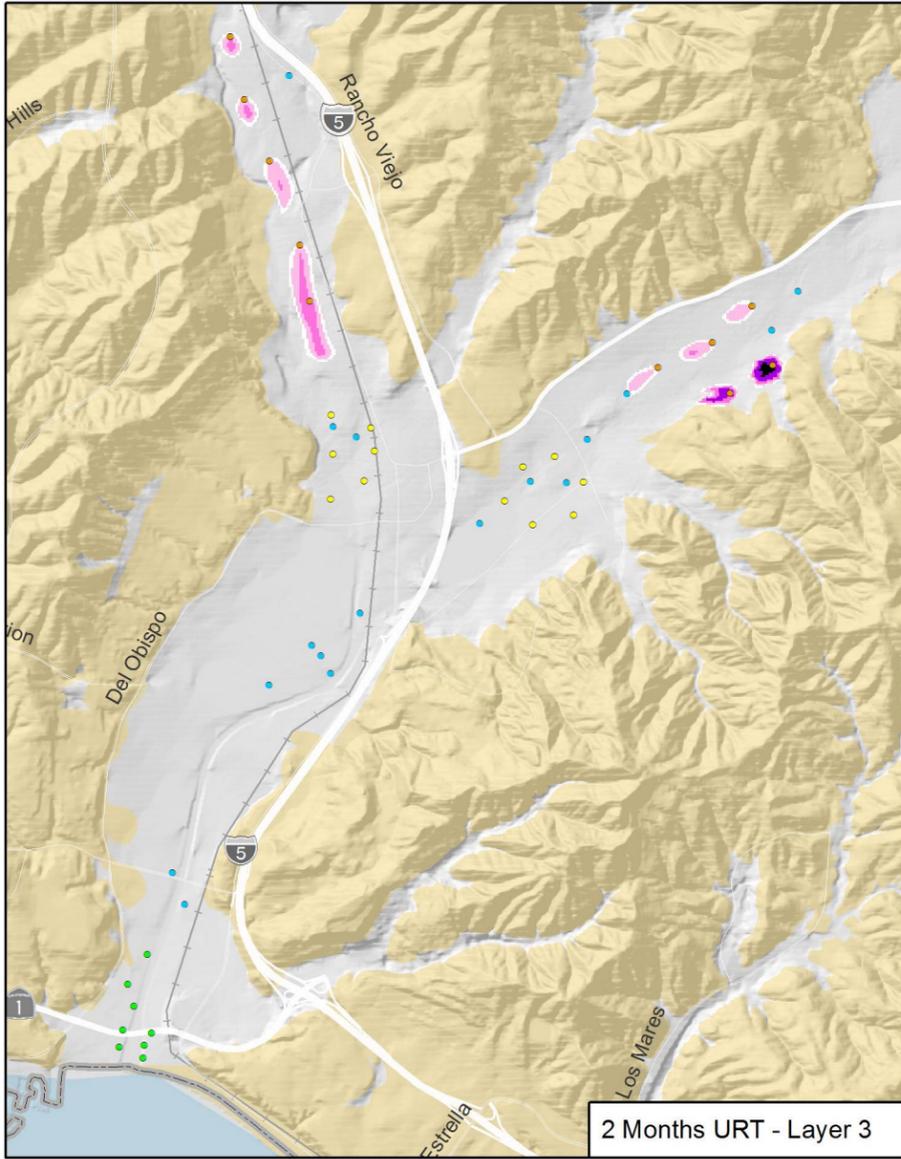
- Extraction Barrier Well
- Recovery Well
- ◆ Recycled Water Turnout for Incidental Recharge
- Existing Pumping Wells



Recycled Water Contribution
(Percent)

Conceptual Facilities

- Extraction Barrier Well
- Recovery Well
- Injection Well
- Existing Pumping Wells

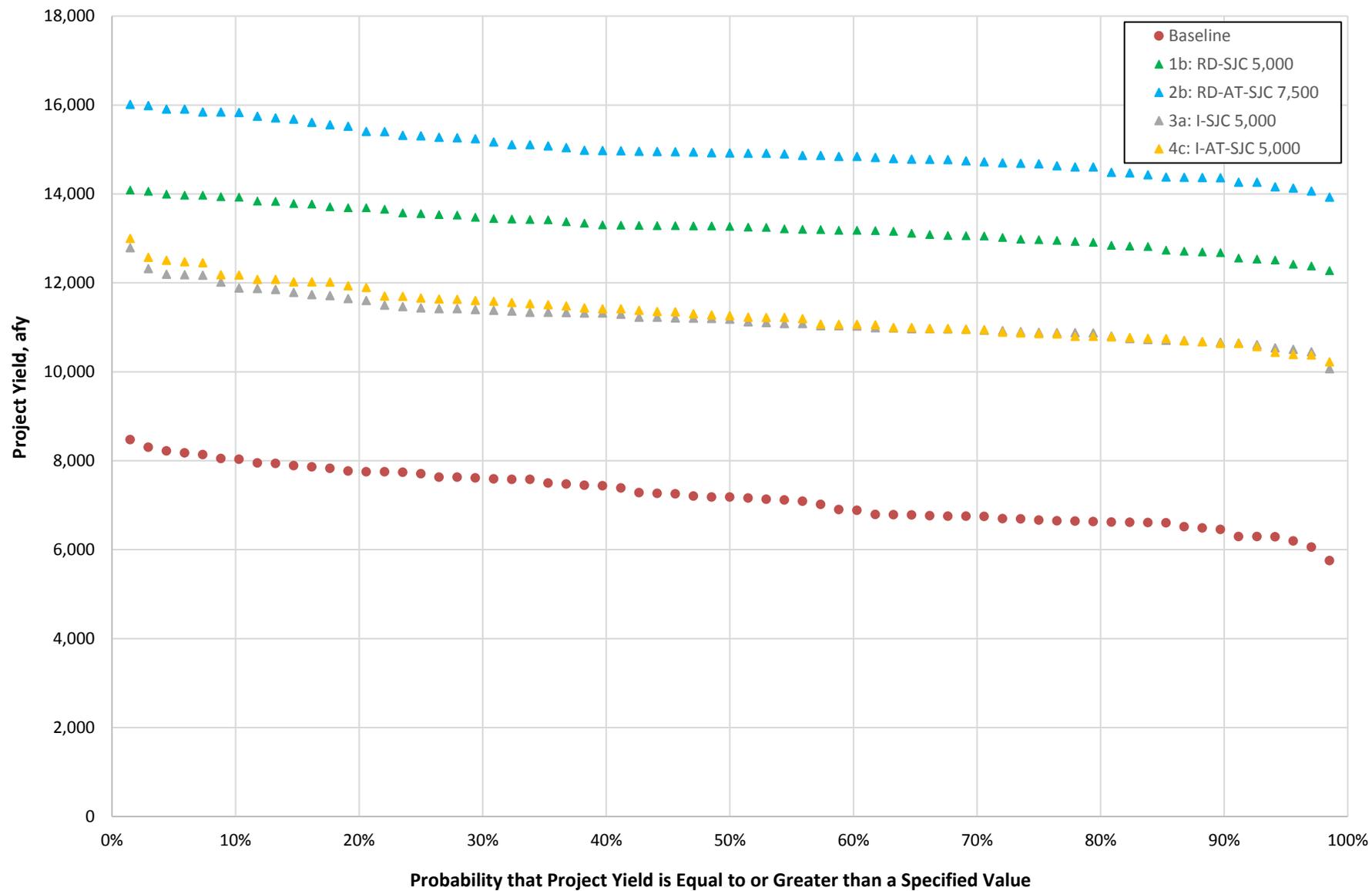


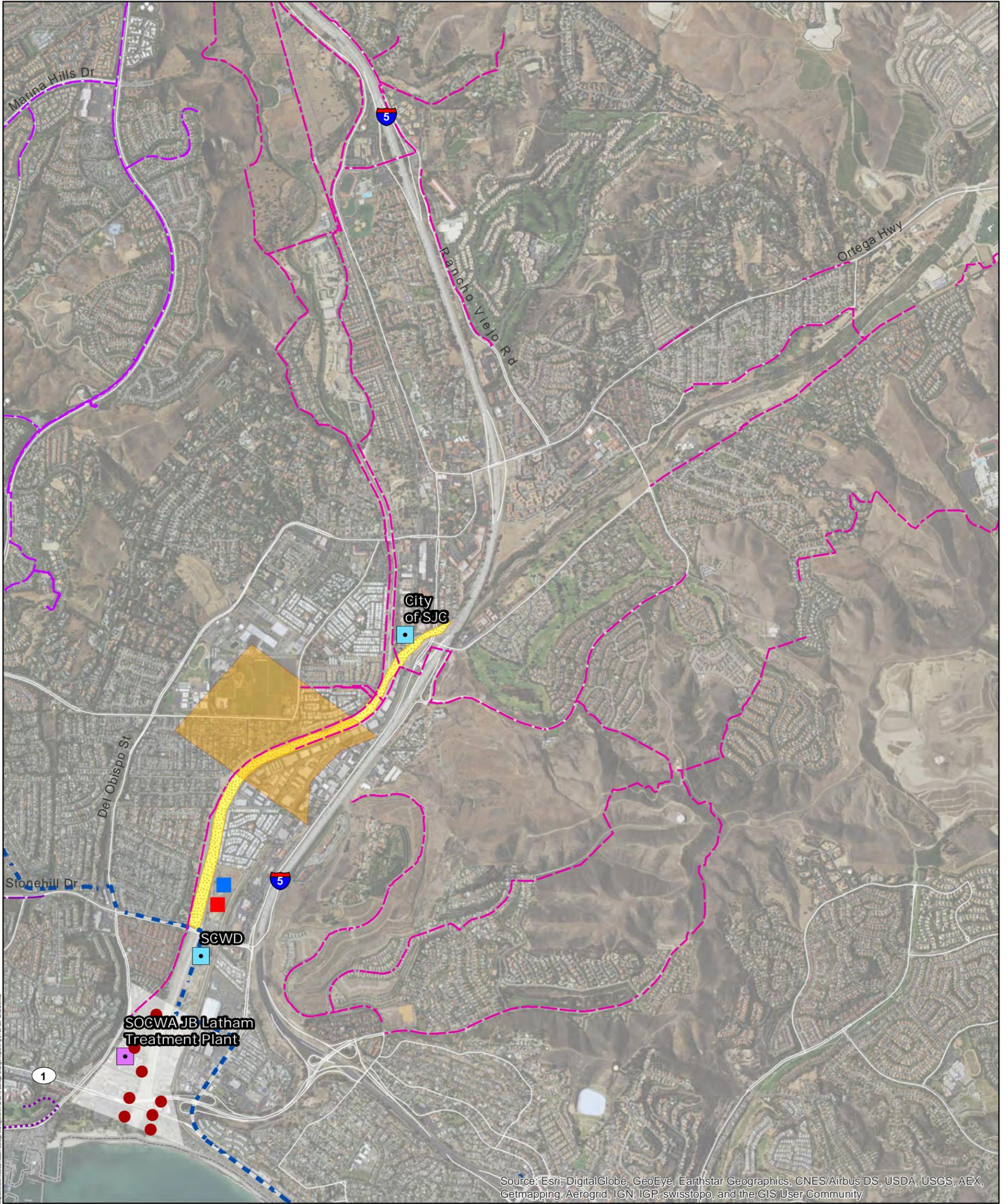
Recycled Water Contribution
(Percent)

Conceptual Facilities

- Extraction Barrier Well
- Recovery Well
- Injection Well
- Existing Pumping Wells

**Figure 3.3-26
Exceedance Frequency Curve for Project Yield**





Existing Facilities

Recycled Water Distribution Facilities (12" and larger)

- MNWD
- SMWD
- CSJC
- SCWD (6" and larger)
- SCWD RW Extension (planned)
- Water Importation Pipeline (WIP)
- Wastewater Treatment Plant
- Groundwater Recovery Facility

Proposed Facilities

- Extraction Barrier Well
- Groundwater Recovery Facility
- Seawater Extraction Barrier Water Treatment Plant
- Groundwater Recovery Wellfield
- Rubber Dams Area
- Seawater Extraction Barrier Wellfield



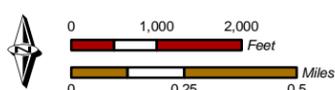
Conceptual Strategy SWR-1

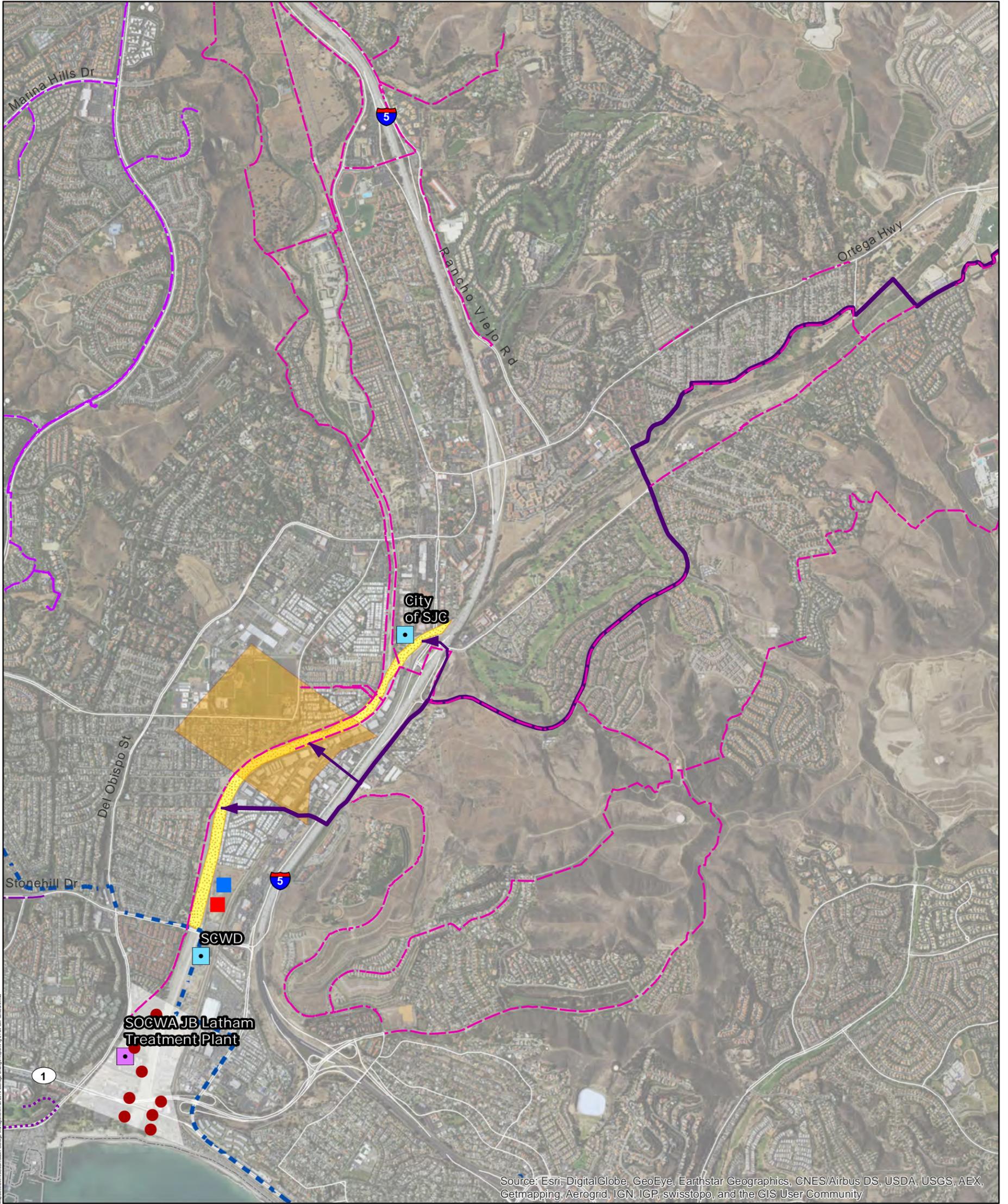
Stormwater Recharge via Rubber Dams

Figure 3.4-1



Author: MR
Date: 20151221
File: SWR1





Existing Facilities

Recycled Water Distribution Facilities (12" and larger)

- MNWD
- SMWD
- CSJC
- SCWD (6" and larger)
- SCWD RW Extension (planned)
- Water Importation Pipeline (WIP)
- Wastewater Treatment Plant
- Groundwater Recovery Facility

Proposed Facilities

- Extraction Barrier Well
- Groundwater Recovery Facility
- Seawater Extraction Barrier Water Treatment Plant
- Recycled Water Pipeline
- Groundwater Recovery Wellfield
- Rubber Dams Area
- Seawater Extraction Barrier Wellfield



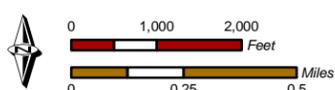
Conceptual Strategy SWR-2

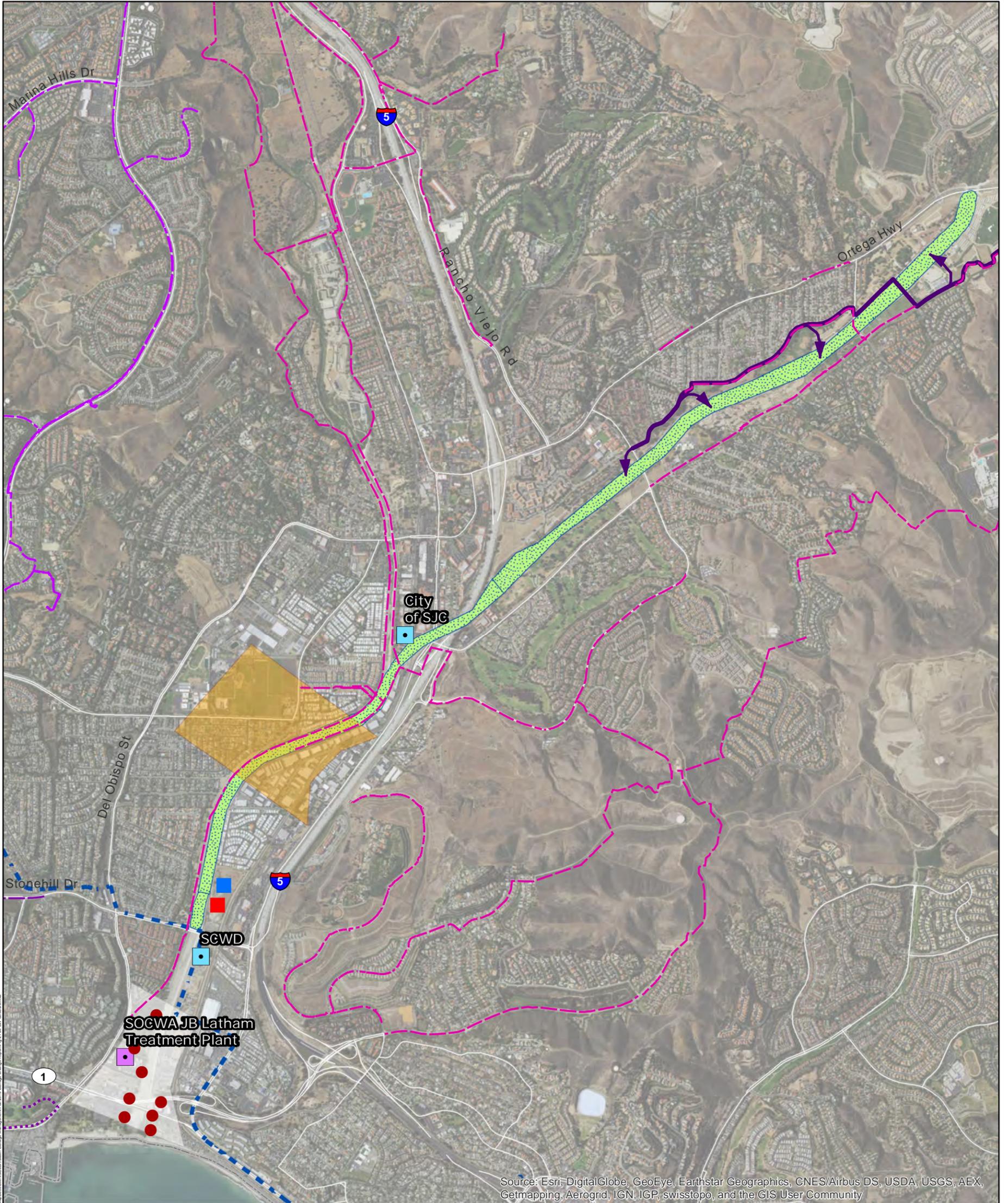
Stormwater and Recycled Water Recharge via Rubber Dams

Figure 3.4-2



Author: MR
Date: 20151221
File: SWR2





Existing Facilities

Recycled Water Distribution Facilities (12" and larger)

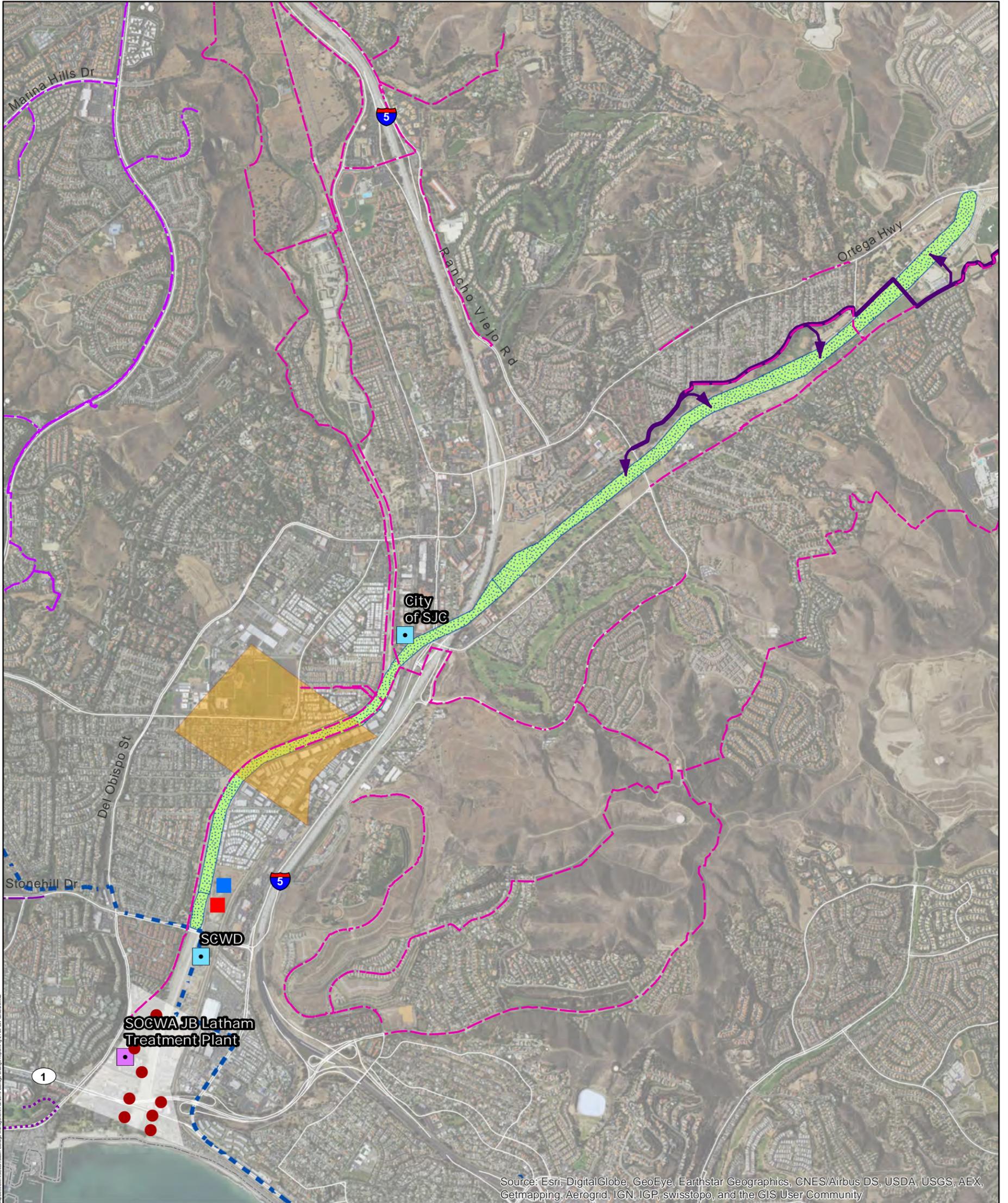
- Wastewater Treatment Plant
- Groundwater Recovery Facility
- MNWD
- SCWD (6" and larger)
- SMWD
- CSJC
- SCWD RW Extension (planned)
- Water Importation Pipeline (WIP)

Proposed Facilities

- Extraction Barrier Well
- Groundwater Recovery Facility
- Seawater Extraction Barrier Water Treatment Plant
- Recycled Water Pipeline
- Groundwater Recovery Wellfield
- Seawater Extraction Barrier Wellfield
- Incidental Recharge



Conceptual Strategy SWR-3



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Existing Facilities

Recycled Water Distribution Facilities (12" and larger)

- Wastewater Treatment Plant
- Groundwater Recovery Facility
- MNWD
- SCWD (6" and larger)
- SMWD
- CSJC
- SCWD RW Extension (planned)
- Water Importation Pipeline (WIP)

Proposed Facilities

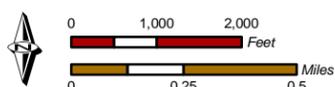
- Extraction Barrier Well
- Groundwater Recovery Facility
- Seawater Extraction Barrier Water Treatment Plant
- Recycled Water Pipeline
- Groundwater Recovery Wellfield
- Seawater Extraction Barrier Wellfield
- Incidental Recharge



Conceptual Strategy SWR-3

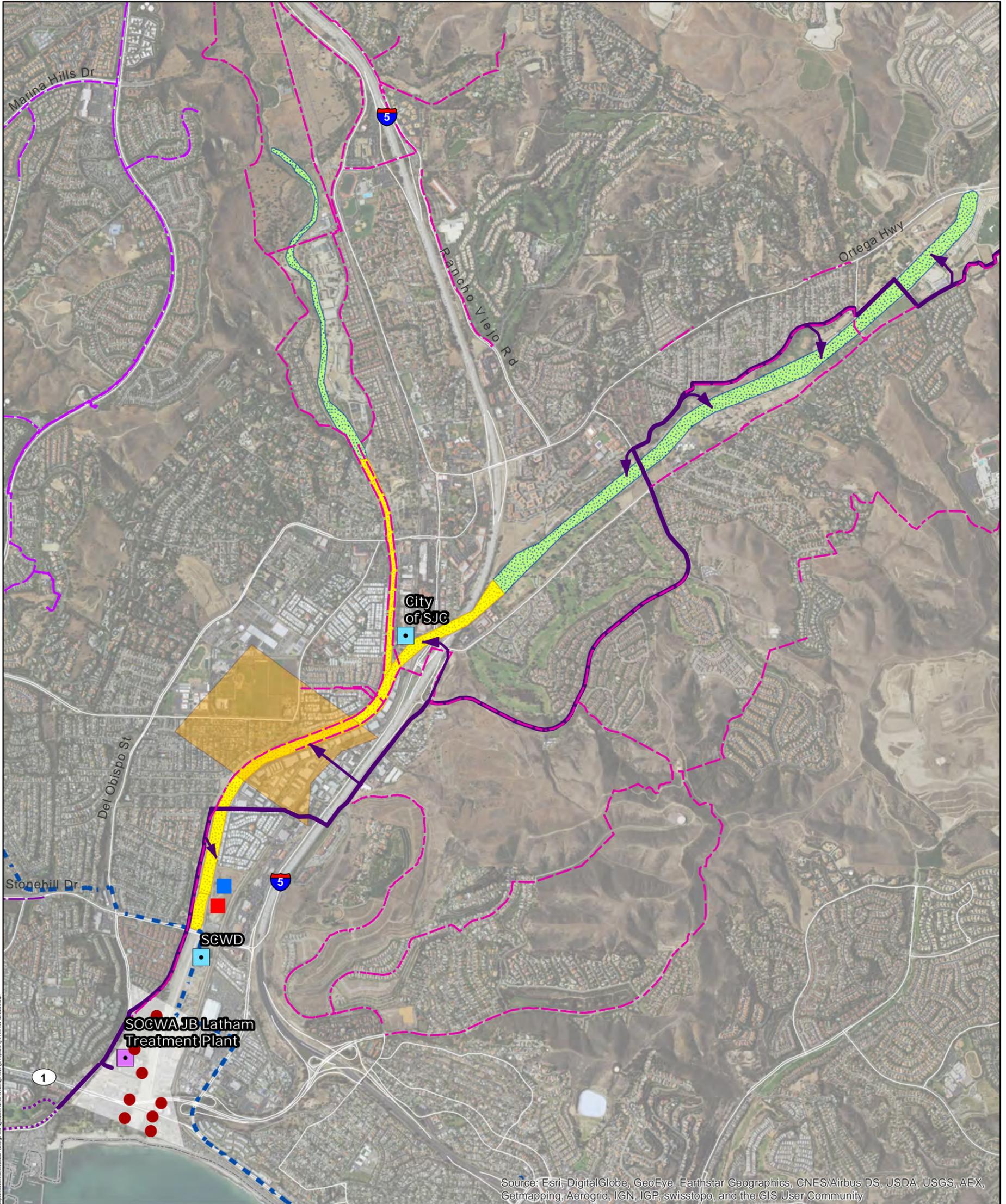


Author: MR
Date: 20151221
File: SWR3



Incidental Recharge

Figure 3.4-3



Existing Facilities

Recycled Water Distribution Facilities (12" and larger)

- Wastewater Treatment Plant
- Groundwater Recovery Facility
- MNWD
- SCWD (6" and larger)
- SMWD
- CSJC
- SCWD RW Extension (planned)
- Water Importation Pipeline (WIP)

Proposed Facilities

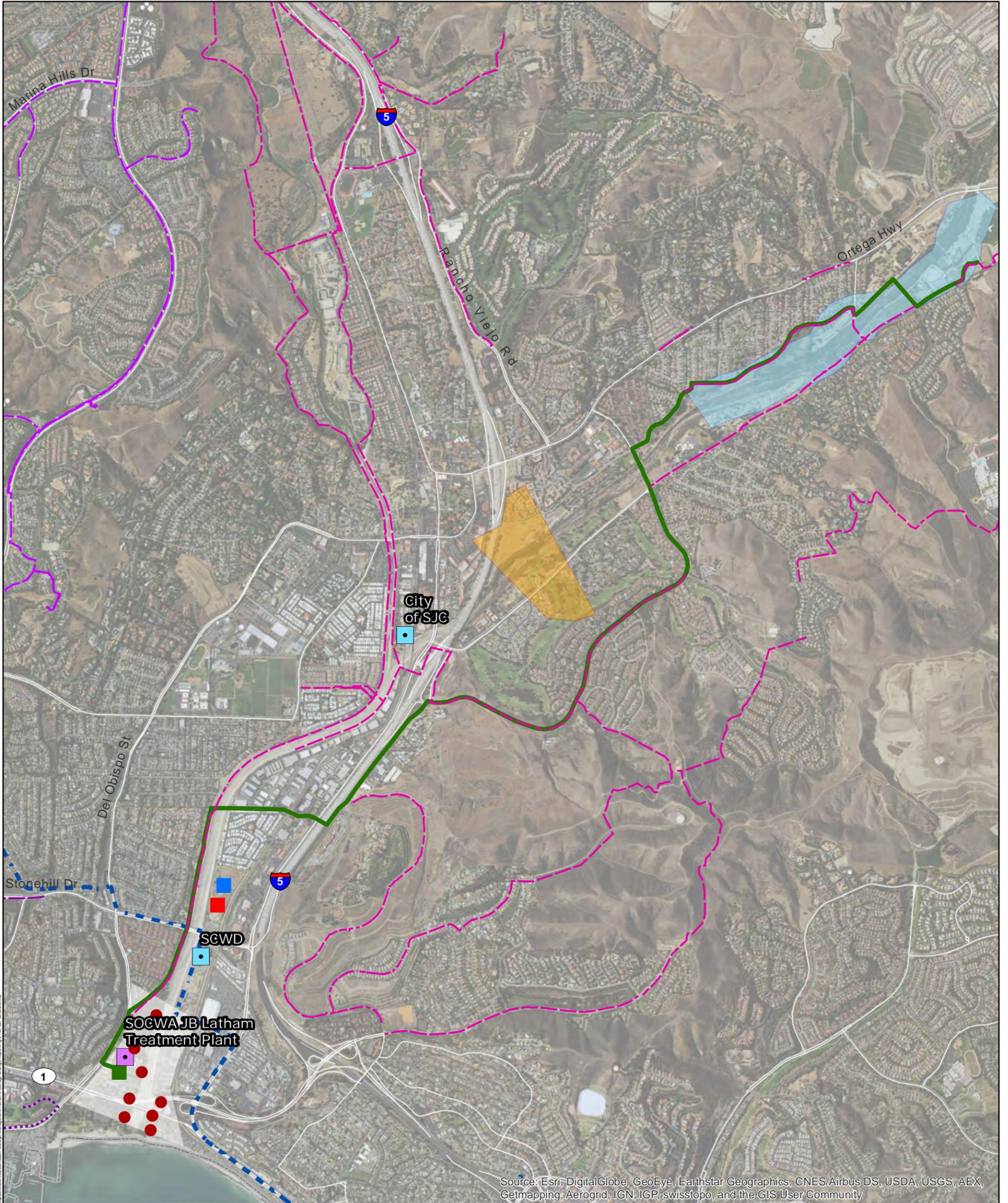
- Extraction Barrier Well
- Groundwater Recovery Facility
- Seawater Extraction Barrier Water Treatment Plant
- Recycled Water Pipeline
- Groundwater Recovery Wellfield
- Rubber Dams Area
- Incidental Recharge
- Seawater Extraction Barrier Wellfield



Conceptual Strategy SWR-4

Stormwater and Recycled Water Recharge via Rubber Dams and Incidental Recharge

Figure 3.4-4



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Existing Facilities

Recycled Water Distribution Facilities (12" and larger)

- MNWD
- SMWD
- CSJC
- SCWD (6" and larger)
- SCWD RW Extension (planned)
- Water Importation Pipeline (WIP)
- Wastewater Treatment Plant
- Groundwater Recovery Facility

Proposed Facilities

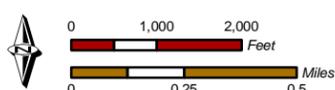
- Extraction Barrier Well
- Groundwater Recovery Facility
- Seawater Extraction Barrier Water Treatment Plant
- Advanced Treatment at JBL
- Recycled Water Advanced Treated Pipeline
- Seawater Extraction Barrier Wellfield
- Recovery Wellfield
- Injection Wellfield



Conceptual Strategy INJ-1 and INJ-2



Author: MR
Date: 20151221
File: INJ1



Recharge via Injection Wells

Figure 3.4-5

Figure 4-2.1 Projected Ten-Year Schedule for Implementation of the San Juan Basin Groundwater and Facilities Management Plan

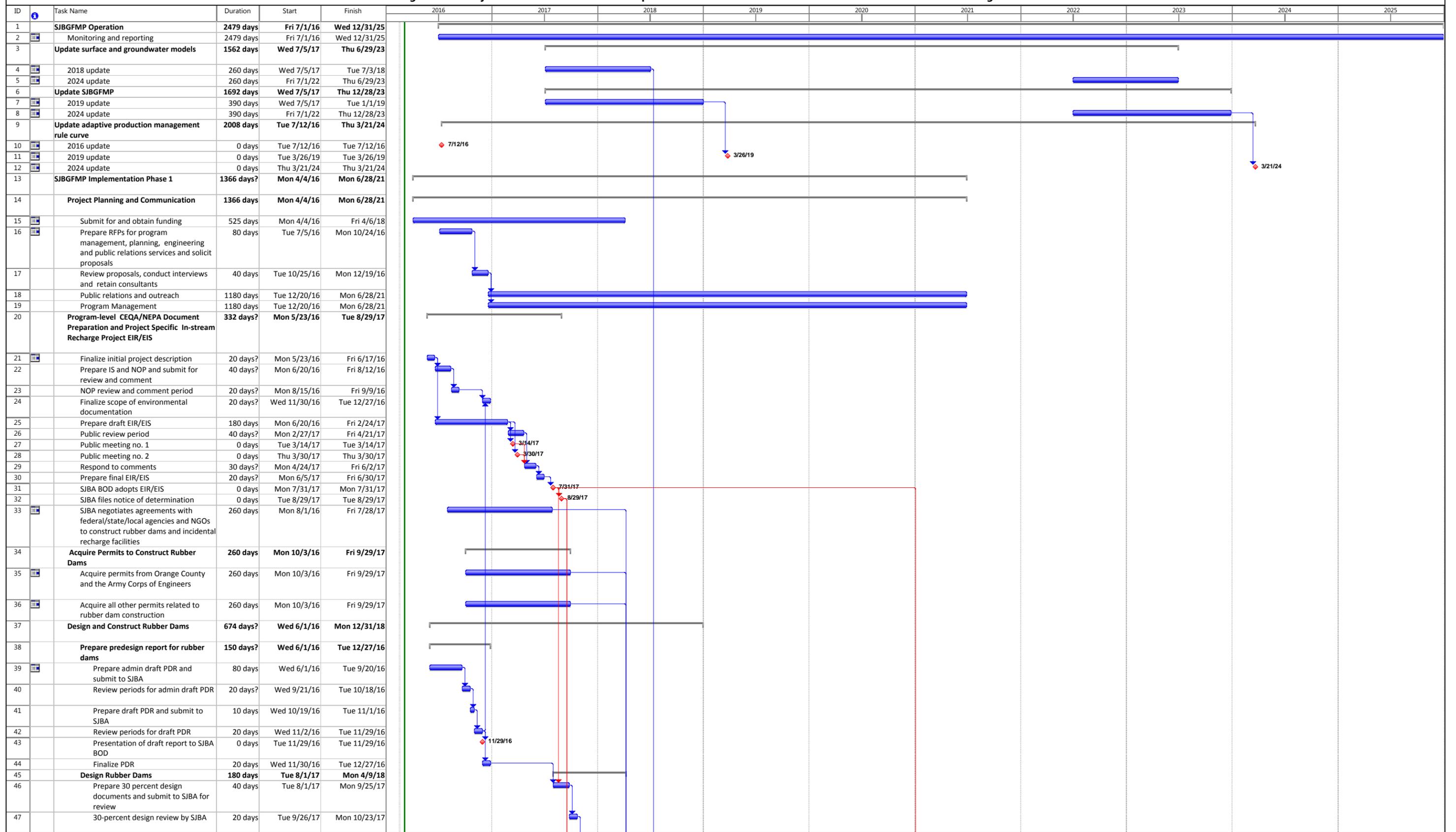


Figure 4-2.1 Projected Ten-Year Schedule for Implementation of the San Juan Basin Groundwater and Facilities Management Plan

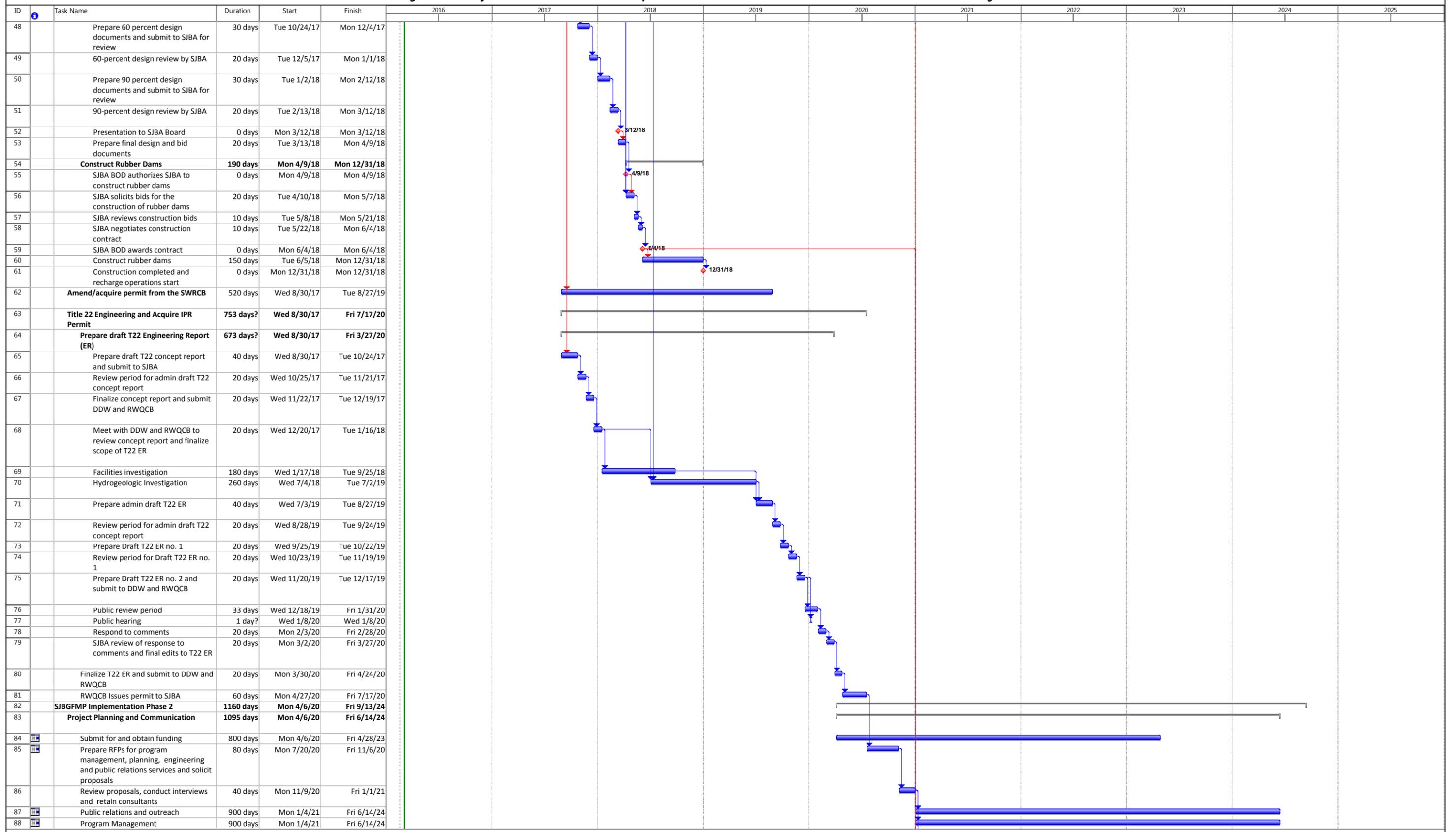
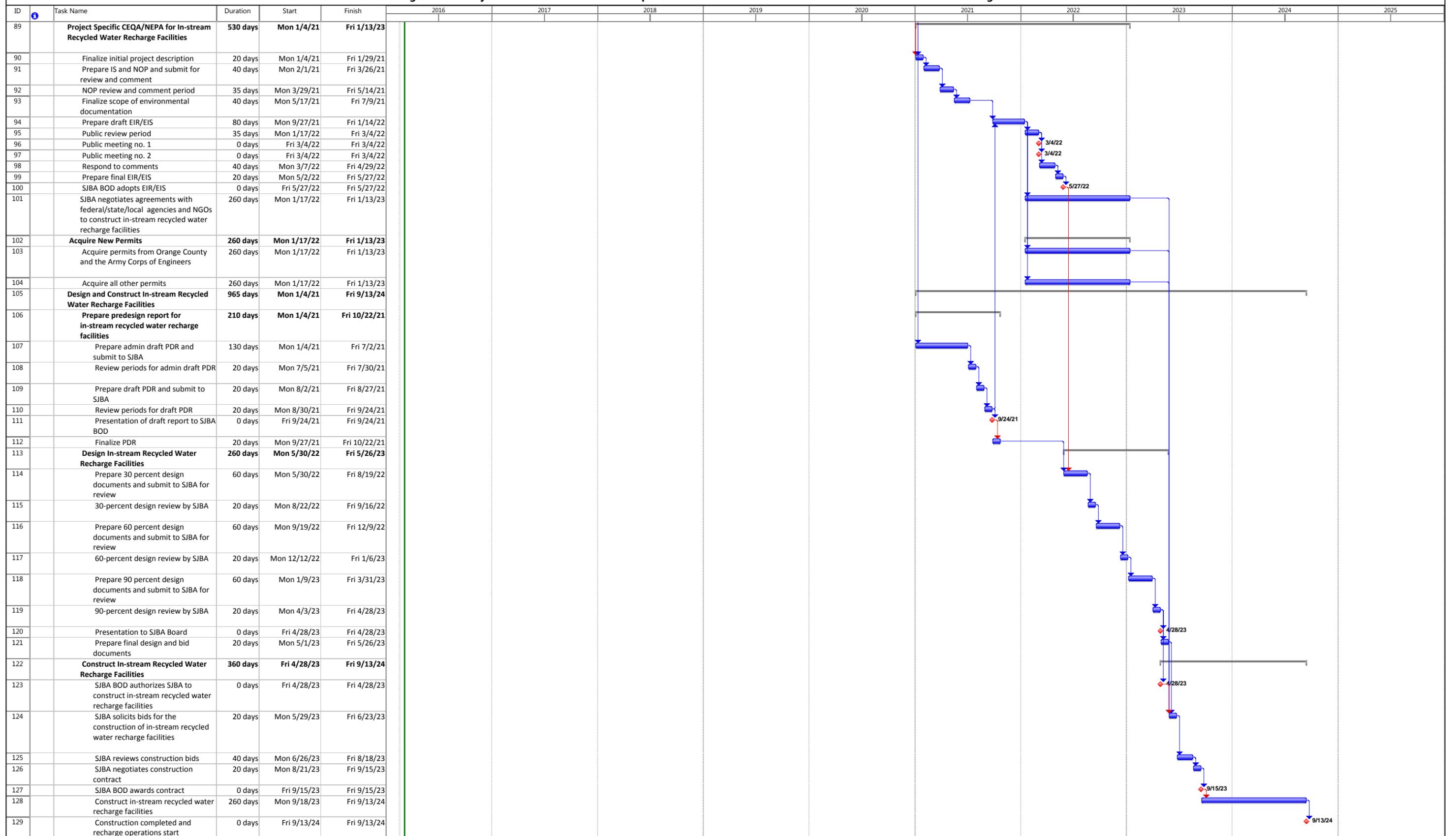


Figure 4-2.1 Projected Ten-Year Schedule for Implementation of the San Juan Basin Groundwater and Facilities Management Plan



**Table 3.3-2
Projected Pumping by Agency**

Producer Goal (afy)	Alternative	Projected Pumping					
		Minimum		Maximum		Average	
		(afy)	(%)	(afy)	(%)	(afy)	(%)
SCWD 1,300	Baseline	856	66%	1,196	92%	966	74%
	1B: RD-SJC 5,000	222	17%	834	64%	466	36%
	2B: RD-AT-SJC 7,500	209	16%	832	64%	448	34%
	3A: I-SJC 5,000	263	20%	900	69%	387	30%
	4C: I-SJC-AT 5,000	257	20%	892	69%	376	29%
CSJC 7,705	Baseline	4,211	55%	7,172	93%	5,675	74%
	1B: RD-SJC 5,000	5,953	77%	7,666	99%	6,886	89%
	2B: RD-AT-SJC 7,500	5,577	72%	7,652	99%	6,557	85%
	3A: I-SJC 5,000	3,414	44%	6,250	81%	4,454	58%
	4C: I-SJC-AT 5,000	3,263	42%	6,553	85%	4,578	59%
Recovery Well Field 5,000 7,500 5,000 5,000	Baseline	-	-	-	-	-	-
	1B: RD-SJC 5,000	4,975	99%	5,010	100%	4,999	100%
	2B: RD-AT-SJC 7,500	7,455	99%	7,515	100%	7,496	100%
	3A: I-SJC 5,000	4,997	100%	5,010	100%	5,000	100%
	4C: I-SJC-AT 5,000	4,997	100%	5,010	100%	5,000	100%



Table 3.3-7
Comparison of Average Water Budget Terms, Net Recharge and Project Yield for the Baseline and Program Alternatives
 (afy)

(1) Hydrologic Component	(2) Baseline Value	(3) (4) = (3) - (2)		(5) (6) = (5) - (2)		(7) (8) = (7) - (2)		(9) (10) = (9) - (2)	
		1b: RD-SJC 5,000		2b: RD-AT-SJC 7,500		3a: I-SJC 5,000		4c: I-AT-SJC 5,000	
		Value	Δ	Value	Δ	Value	Δ	Value	Δ
Recharge Components									
Subsurface Boundary Inflow from the San Juan, Horno, Trabuco and Oso Creeks	2,705	2,705	0	2,705	0	2,705	0	2,705	0
Deep Infiltration of Precipitation, Applied Water and Mountain Front Runoff	428	428	0	428	0	428	0	428	0
Streambed Infiltration from Flow Head Boundary Package	6,542	7,947	1,405	8,205	1,663	6,542	0	6,542	0
Streamflow Routed Percolation from Streamflow Package	271	1,205	934	1,839	1,567	683	412	501	230
Subsurface Inflow from Ocean	2	2,095	2,093	2,101	2,099	2,105	2,103	2,109	2,106
Surface Recycled Water Recharge	0	7,727	7,727	10,227	10,227	0	0	0	0
Recycled Water Injection along San Juan Creek	0	0	0	0	0	5,002	5,002	2,500	2,500
Recycled Water Injection along the Arroyo Trabuco	0	0	0	0	0	0	0	2,500	2,500
Average Total Recharge	<u>9,948</u>	<u>22,107</u>	<u>12,159</u>	<u>25,504</u>	<u>15,556</u>	<u>17,465</u>	<u>7,517</u>	<u>17,284</u>	<u>7,336</u>
Discharge Components									
South Coast Water District GRF Pumping	964	461	-503	443	-521	380	-583	369	-595
City of San Juan GWRP Pumping	5,664	6,875	1,210	6,546	882	4,430	-1,234	4,554	-1,110
City of San Juan Non-Potable Wells and Private Wells Pumping	1,881	1,889	8	1,889	8	1,872	-9	1,889	8
Extraction Barrier Well Pumping	0	3,002	3,002	3,002	3,002	3,002	3,002	3,002	3,002
San Juan Creek Recovery Wells Pumping	0	5,000	5,000	4,998	4,998	5,002	5,002	2,500	2,500
Arroyo Trabuco Recovery Wells Pumping	0	0	0	2,500	2,500	0	0	2,500	2,500
Subsurface Outflow to Ocean	99	0	-99	0	-99	0	-99	0	-99
Evapotranspiration	517	1,125	608	1,105	588	789	272	811	294
Rising Water from Streamflow Package	974	3,841	2,867	5,114	4,140	2,130	1,156	1,755	781
Average Total Discharge	<u>10,100</u>	<u>22,194</u>	<u>12,094</u>	<u>25,598</u>	<u>15,498</u>	<u>17,605</u>	<u>7,505</u>	<u>17,382</u>	<u>7,282</u>
Recharge - Discharge	<u>-152</u>	<u>-87</u>	<u>64</u>	<u>-94</u>	<u>58</u>	<u>-140</u>	<u>11</u>	<u>-97</u>	<u>55</u>
Net Recharge	8,357	17,140	8,783	19,285	10,928	14,546	6,189	14,718	6,360
Project Yield	7,183	13,259	6,076	14,980	7,797	11,222	4,039	11,329	4,145



Table 3.3-9

Analysis of Water Budget Tables, Comparison of Program Alternatives to the Baseline, and Recommended Changes to the Program Alternative to Avoid Lost Recharge (afy)

(1) Alternative	(2) Statistic	(3) - (12) Performance of the Initial Alternative										(13) - (17) Suggested Refinements for Facilities Plan				
		(4) - (5) Recycled Water Recharge			(6) - (8) Rising Groundwater			(9) - (11) ET			(12) Lost Recharge	(13) Year Type	(14) - (15) Recycled Water Recharge ¹			(17) Change in Total Project Yield
		(3) Rubber Dams	(4) Incidental	(5) Total	(6) Alt	(7) Baseline	(8) Δ	(9) Alt	(10) Baseline	(11) Δ			(14) Rubber Dams	(15) Incidental	(16) Total	
Alternative 1b	Average	5,000	2,727	7,727	2,636	703	1,933	1,125	517	608	2,541	Wet Dry	2,459	2,727	5,186	None
	Maximum	5,000	2,727	7,727	16,135	8,422	7,714	1,688	1,483	205	7,918		0	2,727	2,727	
	Minimum	5,000	2,727	7,727	297	1	296	708	141	566	862		4,138	2,727	6,865	
Alternative 2b	Average	7,500	2,727	10,227	3,321	703	2,617	1,105	517	588	3,205	Wet Dry	4,295	2,727	7,022	None
	Maximum	7,500	2,727	10,227	16,855	8,422	8,433	1,689	1,483	206	8,639		0	2,727	2,727	
	Minimum	7,500	2,727	10,227	1,139	1	1,138	663	141	522	1,660		5,840	2,727	8,567	
Alternative	Statistic	Performance of the Initial Alternative										Suggested Refinements for Facilities Plan				
		Recycled Water Recharge			Rising Groundwater			ET			Lost Recharge	Year Type	Recycled Water Recharge ¹			Change in Total Project Yield
		Injection Wells	Incidental	Total	Alt	Baseline	Δ	Alt	Baseline	Δ			Injection Wells	Incidental	Total	
Alternative 3a	Average	5,000	0	5,000	1,479	703	776	789	517	272	1,048	Wet Dry	3,952	0	3,952	None
	Maximum	5,000	0	5,000	9,822	8,422	1,400	1,374	1,483	-109	1,291		0	0	0	
	Minimum	5,000	0	5,000	49	1	48	475	141	334	382		4,618	0	4,618	
Alternative 4c	Average	5,000	0	5,000	1,254	703	551	811	517	294	845	Wet Dry	4,155	0	4,155	None
	Maximum	5,000	0	5,000	9,793	8,422	1,371	1,530	1,483	47	1,418		0	0	0	
	Minimum	5,000	0	5,000	26	1	24	358	141	217	241		4,759	0	4,759	

¹ Allocation of recycled water between rubber dams and incidental recharge shown here is arbitrary. The SJBA should use its discretion to program the recharge in such a ways as to ensure that the recharged water will not cause an increase in rising groundwater.



**Table 3.4-1
Summary of Conceptual Strategies-Major Facility Needs**

Conceptual Strategy	Size of Program Elements (afy)				New Project Yield (afy)	Facilities Required								
	Extraction Barrier Pumping	Storm Water Recharge	Recycled Water Recharge	In-Lieu Recharge (Private Pumping Offset)		Rubber Dams	JBL Treatment Improvements	Seasonal Storage	New Pumping Wells	Conveyance	Injection Wells	New Groundwater Recovery Facility ¹	Seawater Extraction	
Surface Water Recharge Strategies														
SWR-1	1,400 afy storm water via rubber dams on San Juan Creek	3,000	1,400	0	0	1,980	✓			✓	✓			✓
SWR-2	1,400 afy storm water and 2,500 afy recycled water via rubber dams on San Juan Creek	3,000	1,400	2,500	500	4,780	✓		✓	✓	✓		✓	✓
SWR-3	1,750 afy recycled water via incidental recharge on San Juan Creek	3,000	0	1,750	500	2,660			✓	✓	✓			✓
SWR-4	1,700 afy storm water and 7,000 afy Recycled Water via rubber dams and incidental recharge on San Juan Creek and Arroyo Trabuco	3,000	1,700	1,700	500	8,220	✓	✓	✓	✓	✓		✓	✓
Injection Recharge Strategies														
INJ-1	2,500 afy recycled water injection along San Juan Creek	3,000	0	2,500	500	3,260		✓		✓	✓	✓	✓	✓
INJ-2	4,000 afy recycled water via injection along San Juan Creek	3,000	0	4,000	500	4,460		✓		✓	✓	✓	✓	✓

Notes

[1] For some of the conceptual strategies, a new groundwater recovery facility may not be needed as the existing SCWD and CSIC desalters may be expandable to accommodate the increased production capacity and treatment needs. This will be further assessed in Section 3.5.



Table 4.2-1: Implementation Plan for the San Juan Basin Groundwater Facilities and Management Plan	Annual Implementation Cost by Fiscal Year (\$1,000)										
	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	Next Ten Fiscal Years
SJBGFMP Basin Operations and Adaptive Management	\$300	\$650	\$375	\$300	\$300	\$300	\$300	\$300	\$650	\$375	\$3,500
Monitoring and reporting	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$3,500
Update surface and groundwater models		\$300							\$300		
Update the SJBGFMP		\$50	\$75						\$50	\$75	
SJBGFMP Implementation Phase 1	\$1,385	\$13,665	\$18,025	\$485	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Project Planning, Management and Communication	\$180	\$150	\$140	\$140							
<i>Prepare RFPs for program management, planning, engineering and public relations services and solicit proposals</i>	\$15										
<i>Review proposals, conduct interviews, and retain consultants</i>	\$15										
<i>Public relations and outreach</i>	\$50	\$50	\$40	\$40							
<i>Program management, including submit for and obtain funding</i>	\$100	\$100	\$100	\$100							
Program-level CEQA/NEPA Document Preparation and Project Specific Instream Recharge Project EIR/EIS	\$550	\$50									
SJBA negotiates agreements with federal/state/local agencies and NGOs to construct rubber dams and incidental recharge facilities consistent with CEQA	\$180	\$20									
Acquire permits from Orange County and the Army Corps of Engineers	\$150	\$50									
Acquire all other permits related to rubber dam construction	\$75	\$25									
Design and Construct Rubber Dams	\$250	\$12,860	\$17,340								
<i>Preliminary Design Report</i>	\$250										
<i>Design Rubber Dams</i>		\$1,300									
<i>Construct Rubber Dams</i>		\$11,560	\$17,340								
Amend/acquire permit from the SWRCB		\$200	\$200								
Acquire IPR Permit		\$310	\$345	\$345							
SJBGFMP Implementation Phase 2	\$0	\$0	\$0	\$0	\$800	\$7,720	\$20,128	\$77,465	\$13,028	\$0	\$0
Project Planning and Communication					\$180	\$140	\$140	\$140	\$140		
<i>Prepare RFPs for program management, planning, engineering and public relations services and solicit proposals</i>					\$15						
<i>Review proposals, conduct interviews and retain consultants</i>					\$15						
<i>Public relations and outreach</i>					\$50	\$40	\$40	\$40	\$40		
<i>Program management, including submit for and obtain funding</i>					\$100	\$100	\$100	\$100	\$100		
Project Specific CEQA/NEPA for Instream Recycled Water Recharge Facilities					\$200	\$400	\$200				
SJBA negotiates agreements with federal/state/local agencies and NGOs to construct instream recycled water recharge facilities consistent with CEQA						\$50	\$50				
Acquire permits from Orange County and the Army Corps of Engineers						\$100	\$100				
Acquire all other permits						\$50	\$50				
Design and Construct Instream Recycled Water Recharge Facilities					\$420	\$6,980	\$19,588	\$77,325	\$12,888		
<i>Prepare predesign report for instream recycled water recharge facilities</i>					\$420	\$280					
<i>Design Instream Recycled Water Recharge Facilities</i>						\$6,700	\$6,700				
<i>Construct Instream Recycled Water Recharge Facilities</i>							\$12,888	\$77,325	\$12,888		
Subsequent Phases to Increase IPR to Maximum Capacity											\$160,900
Total Annual Cost (does not include contingency)	\$1,685	\$14,315	\$18,400	\$785	\$1,100	\$8,020	\$20,428	\$77,765	\$13,678	\$375	\$164,400
Cumulative Implementation Cost (does not include contingency)	\$1,685	\$16,000	\$34,400	\$35,185	\$36,285	\$44,305	\$64,733	\$142,498	\$156,175	\$156,550	\$320,950

Table 4.2-2: Breakdown of Construction and Implementation Cost Components of the Total Phased Cost to Implement the Recommended SJBGFMP

Implementation Phase	Cost Breakdown by Phase (\$1,000) Excluding Contingency			Cumulative Yield (AFY)	Potential Unit Capital Costs	
	Total Program <i>a = b + c</i>	Construction <i>b</i>	Implementation <i>c</i>		30-Year Lifecycle	50-Year Lifecycle
	SJBGFMP Basin Operations and Adaptive Management	\$7,350	\$0		\$7,350	0
Phase 1	\$33,560	\$26,300	\$7,260	1,120	\$1,530	\$1,160
Phase 2 ¹	\$119,140	\$89,600	\$29,540	4,920	\$1,580	\$1,210
Subsequent Phases ²	\$160,900	\$123,700	\$37,200	7,360	\$2,170	\$1,660
Total	\$320,950	\$239,600	\$81,350			

Notes

1. Unit capital cost estimates for Phase 2 include Phase 1 costs and yield.
2. Unit capital cost estimates for subsequent phases include Phase 2 costs and yield.

**Table 4.2-3: Range of Potential Costs for the Implementation
of all SJBGFMP Phases (FY 2016/17 through FY 2034/35)**

Cost Component	Range of Potential Costs (\$1,000) by Contingency Percentage		
	-30%	\$0	+50%
Range of Construction Costs	\$167,720	\$239,600	\$359,400
Range of Implementation Costs	\$56,945	\$81,350	\$122,025
Range of Total Costs	\$224,665	\$320,950	\$481,425
Potential Sources of Grant Funding to Offset the Cost of the SJBGFMP			
USBR Title XVI	\$11,667	\$16,667	\$25,000
Calif. State Funding (Prop. 1, etc.)	\$9,333	\$13,333	\$20,000
Potential Funding Total	\$21,000	\$30,000	\$45,000
Potential Range of Costs with Funding	\$203,665	\$290,950	\$436,425
Range of Potential Unit Capital Costs without Potential Funding			
Project Yield (AFY)	7,360		
30-Year Lifecycle	\$1,560	\$2,220	\$3,340
50-Year Lifecycle	\$1,190	\$1,690	\$2,540
Range of Potential Unit Capital Costs with Potential Funding¹			
Project Yield (AFY)	7,360		
30-Year Lifecycle	\$1,410	\$2,020	\$3,030
50-Year Lifecycle	\$1,080	\$1,540	\$2,300

Notes

1. MWD LRP funding up to \$340/AF for 25 years is also available and could further reduce the net unit capital costs.