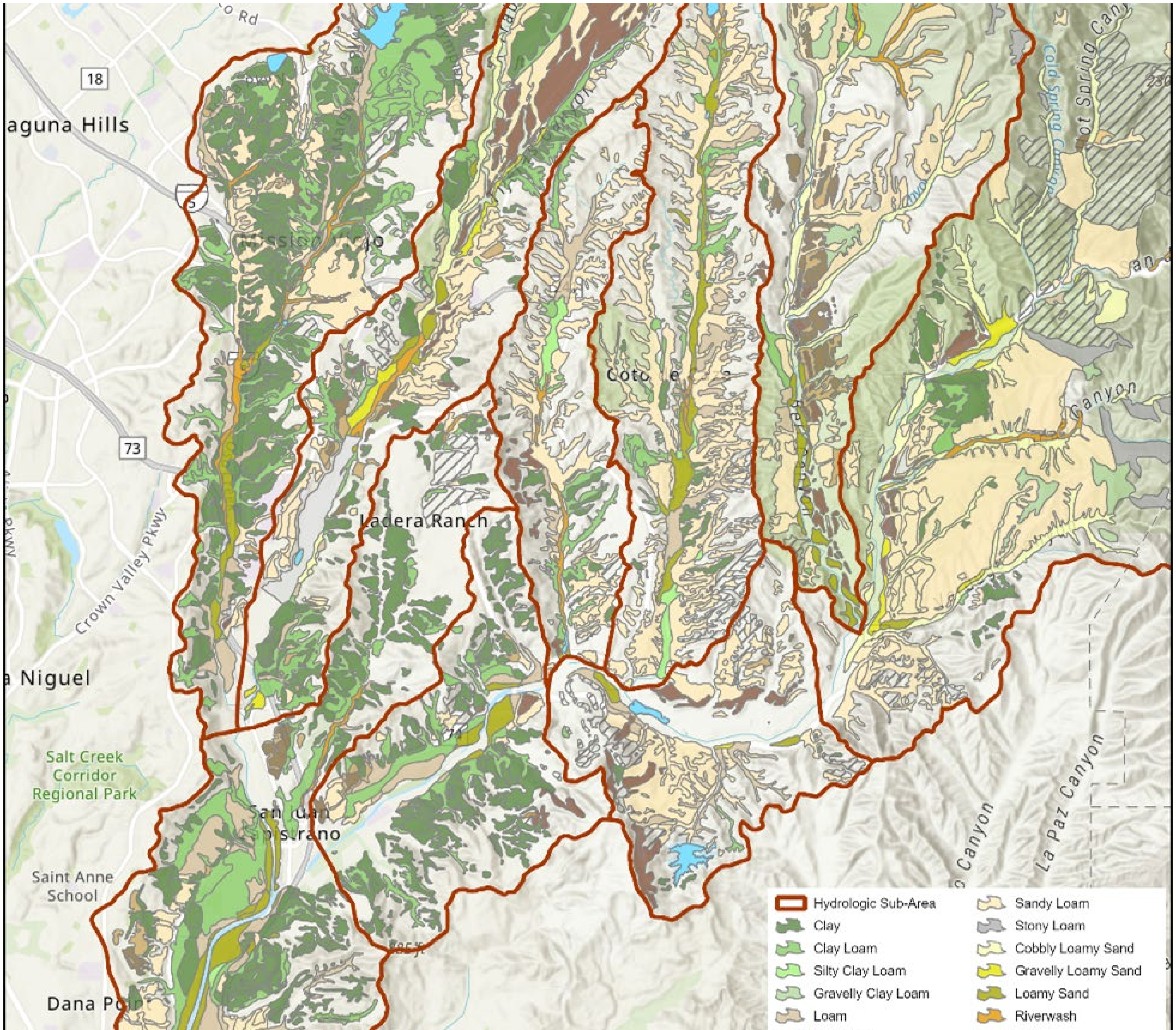


2024 Salt and Nutrient Management Plan

South Orange County Wastewater Authority

San Juan Creek Basin

August 2024

This page is left intentionally blank.

Executive Summary

Salt and Nutrient Management Plan Goals and Objectives

This Salt and Nutrient Management Plan (SNMP) is prepared by the South Orange County Wastewater Authority (SOCWA) and interested stakeholders to comply with SNMP requirements established by the State Water Resources Control Board (SWRCB) in the 2018 Recycled Water Policy. SOCWA is a joint powers agency whose seven member agencies[1] provide water, recycled water and/or wastewater service in southwestern Orange County.

The 2018 Recycled Water Policy requires the state's nine Regional Water Quality Control Boards to identify groundwater basins that require SNMPs. The Regional Water Quality Control Board, San Diego Region (RWQCB), has determined that an SNMP is required for the lower portion[2] of the San Juan Creek Watershed (also known as the Mission Viejo Hydrologic Area or HA 901.2), which comprises a portion of the San Juan Hydrologic Unit (HU 901).[3]

SNMP Goals. The goals of this SNMP are to (1) identify and evaluate management strategies that support the planned level of recycled water use within the SOCWA service area, and (2) demonstrate consistency of this planned level of reuse with the 2018 Recycled Water Policy and the San Diego Region Basin Plan.

Stakeholder Objectives. Specific stakeholder objectives of this SNMP are to:

- Offset demands for imported water by increasing use of recycled water, local groundwater, stormwater, and urban runoff.
- Maximize the reuse of recycled water in the SOCWA service area in a manner that is protective of beneficial uses of local ground and surface water resources.
- Maximize the capture of stormwater and urban runoff in a manner that is protective of beneficial uses of local groundwater and surface water resources.
- Support increasing groundwater production and stabilize or improve groundwater quality in the Lower San Juan Creek Basin by recharging stormwater and recycled water.
- Continue and expand existing diversion projects that divert and reuse high-TDS urban surface water runoff that would otherwise impact ground and surface water quality.
- Continue and expand existing programs to desalt groundwater in the Lower San Juan Basin to increase local supply, remove salt from the basin, and stabilize or improve groundwater quality.
- Develop and implement a monitoring plan to (1) assess the effectiveness of groundwater management actions, (2) assess compliance and/or determine appropriateness of existing Basin Plan water quality objectives, (3) increase understanding of salt and nutrient transport, and (4) support the evaluation and implementation of future water management opportunities.

---

[1] Current SOCWA member agencies include City of San Clemente, City of Laguna Beach, El Toro Water District, Emerald Bay Service District, Irvine Ranch Water District, Moulton Niguel Water District, South Coast Water District and Santa Margarita Water District.

[2] Department of Water Resources Bulletin No. 118 defines the San Juan Creek Valley Basin as the lower 16,700 acres of the San Juan Creek Basin (HA 901.2). Per RWQCB Order No. R9-2010-0157, the alluvial downstream portion of the San Juan Creek Basin was defined as a "Tier A" basin for which a SNMP is required.

[3] The San Juan Hydrologic Unit is comprised of the following five hydrologic areas: Laguna (HA 901.1), Mission Viejo (HA 901.2), San Clemente (HA 901.3), San Mateo (HA 901.4) and San Onofre (HA 901.5). The SOCWA service area extends over the Laguna HA, Mission Viejo HA and San Clemente HA. A small portion of the City of San Clemente service area is tributary to the San Mateo HA, but a groundwater diversion barrier prevents San Clemente recycled water operations from affecting the San Mateo HA.

Study Area. This SNMP focuses on the San Juan Creek Watershed (Mission Viejo HA 901.2), which is comprised of the following hydrologic subareas (HSAs):

- Oso (HSA 901.21)
- Upper Trabuco (HSA 901.22)
- Middle Trabuco (HSA 901.23)
- Gobernadora (HSA 901.24)
- Upper San Juan (HSA 901.25)
- Middle San Juan (HSA 901.26)
- Lower San Juan (HSA 901.27)
- Ortega (HSA 901.28)

While this SNMP focuses on the San Juan Creek Watershed, the SNMP presents an overview of recycled water use and groundwater issues within an overall study area that encompasses the portion of the San Juan Hydrologic Unit (HU 901) that is within the SOCWA service area. This study area includes the Laguna HA (901.1), Mission Viejo HA (901.2), San Clemente HA (901.3) and a portion of the San Mateo HA (901.4).

History of SNMP Effort. SOCWA previously prepared an SNMP for the San Juan Basin in 2014 and updated the SNMP in 2021. The 2021 SNMP, however, was largely prepared prior to the issuance of SNMP requirements specified in the 2018 Recycled Water Policy. The RWQCB reviewed the 2021 SNMP, and in correspondence dated December 21, 2021, cited a list of requirements within the 2018 Recycled Water Policy that were not adequately addressed in the 2021 SNMP. In this correspondence, the RWQCB also provided recommendations to SOCWA on how to modify the 2021 SNMP to conform to the 2018 Recycled Water Policy Requirements.

This 2024 SNMP addresses the requirements and recommendations presented by the RWQCB in the December 21, 2021, correspondence. Major tasks undertaken by SOCWA as part of this 2024 SNMP to address the RWQCB requirements and recommendations included:

- Reassessment of monitoring data to better characterize groundwater quality, salt sources and water quality issues.
- Identification of planned and proposed water management strategies, including water management actions planned both by San Juan Basin water and recycled water agencies.
- Preparation of salt fate and transport modeling in the "Tier A" portion of the basin (Lower San Juan Basin).
- Use of a salt/transport model to assess the Lower San Juan Basin under existing conditions and under conditions where near-term planned water management strategies are implemented.
- Revise the proposed monitoring plan to develop data required to address unresolved questions.
- Address antidegradation compliance per requirements of the 2018 Recycled Water Policy.

Basin Overview

Groundwater Occurrence. Groundwater within the San Juan Creek Basin (HA 901.2) exists in an unconfined state in alluvial sediments in the relatively thin alluvial deposits along the valley floors within the major stream channels of the basin. Alluvial sediments are sufficiently thick in the downstream portion of the basin to support groundwater production from wells. Key sources of recharge to the valley alluvium includes (1) streamflow infiltration, (2) infiltrating applied water, (3) infiltrating precipitation, (4) subsurface groundwater inflow from geologic formations which surround the alluvium, and (5) septic tank discharges.

Groundwater within the upstream sub-basins tributary to this alluvial basin exists in narrow, shallow deposits of sediments along washes and stream channels. Depths of sediments in these narrow sub-basins are typically too shallow to support meaningful groundwater production. Groundwater within the thin sedimentary deposits in the upstream sub-basins occurs functionally more as an underground stream, as opposed to a groundwater reservoir.

Basin Hydrology. Streamflow infiltration (loss of surface flow to groundwater) and surfacing groundwater (loss of groundwater to surface water) occur along virtually every stretch of the Basin's streams and tributaries. This interchange can result in varying streamflow along a given watercourse, where in one stretch, significant surface flow occurs, while most or all surface flow disappears underground in upstream or downstream stretches. The interchange is such that in the upstream narrow and shallow basins, surface water quality data can be used to characterize the groundwater quality.

Precipitation and streamflow infiltration are the largest drivers of replenishment into the usable portion of the basin (e.g., a portion of the basin that can support groundwater wells). Significant seasonal variation in precipitation occurs, with most precipitation falling between November and April. Average annual precipitation across the study area is approximately 14 inches, but precipitation within the San Juan Creek watershed can range from 15 inches per year in the lower basin to 22 inches per year in the upper reaches. Peak wet weather San Juan Creek streamflow can exceed 20,000 cubic feet per second (cfs) during storm periods, but dry season streamflow is typically less than 3 cfs.

Focus on Total Dissolved Solids. A significant data base of historical water quality data is available to characterize groundwater quality in the San Juan Creek Basin. This database has been supplemented with comprehensive monitoring conducted pursuant to a monitoring program developed as part of the 2014 SNMP. Review of the water quality database demonstrates that the SNMP should focus on total dissolved solids (TDS). In addition to being a key recycled water compliance parameter, TDS can serve as a surrogate parameter for other dissolved minerals such as chloride and sulfate.

Groundwater nitrate (as nitrogen) concentrations throughout the basin are significantly and consistently below 10 milligrams per liter (mg/L)[4] as illustrated in Section 4. Recycled water and other nutrient loads do not represent a threat to beneficial uses or to groundwater quality, but nitrate is included in the updated monitoring plan as a key oversight strategy.

As is common in the northwestern portion of the San Diego Region, iron and manganese, which naturally exist within the geologic aquifer media, result in historically high iron and manganese concentrations in groundwater.[5] As a result of these high historic iron and manganese concentrations, the groundwater supply developed from the study area has historically employed iron and manganese treatment to develop municipal supply.[6] Because of the natural geologic influence of iron and manganese in the basin,

---

4 The Basin Plan establishes a groundwater quality objective for nitrate as nitrogen as 10 mg/L throughout the San Juan Creek Basin. The state and federal drinking water Maximum Contaminant Levels (MCLs) for nitrate as nitrogen are also 10 mg/L.

5 State and federal secondary (aesthetic) MCLs for iron and manganese are respectively 0.3 mg/L and 0.05 mg/L. Due to the naturally occurring iron and manganese in aquifer geologic media, groundwater within the San Juan Creek Basin often is found in concentrations an order of magnitude or higher than these MCLs.

6 Includes historic treatment provided by the San Juan Basin Authority in supply developed from the Mission Viejo HA and treatment provided by the City of San Clemente for supply developed from the San Clemente HA.

no viable water quality improvement strategy exists. Further, groundwater treatment represents the only viable management strategy for rendering the basin's groundwater usable as a source of municipal supply. Iron and manganese ions are added to the monitoring plan to provide continuity with historical monitoring efforts.

Recycled Water Use. RWQCB Order No. 97-52 regulates the use of recycled water by SOCWA member agencies within the study area. Effluent limits and allowed recycled water flows established in Order No. 97-52 are largely based on salt balance and assimilative capacity studies conducted in the 1990s. Order No. 97-52 currently allows up to 52,279 acre-feet per year (AFY) of recycled water use in the overall study area and up to 24,099 AFY of recycled water use within the San Juan Creek Basin (Mission Viejo HA). Existing recycled water use is typically much less than these permitted flows, but recycled water as a percent of total water demand has steadily increased over the past quarter century; recycled water now satisfies approximately 25 percent of the total water demand within the SOCWA service area. Currently, planned recycled water use in the San Juan Creek Basin is projected at 17,870 AFY, which is approximately one-third of the reuse volume presently regulated within Order No. 97-52.

Recycled water TDS concentrations vary depending on the quality of the imported supply, but recycled water TDS concentrations applied in the San Juan Creek Basin are typically less than 1,000 mg/L.[7] Recycled water TDS concentrations are less than Basin Plan objectives within the Oso (HSA 901.21), Gobernadora (HSA 901.24), Lower San Juan (HSA 901.27), and Ortega (HSA 901.28) basins.

Groundwater Quality. The lowest groundwater TDS concentrations occur in the upper reaches of the basin; TDS concentrations are higher in the downstream sub-basins. Groundwater quality drivers in the San Juan Creek Basin include (1) geochemistry and soils, (2) basin hydrogeology, (3) natural replenishment, (4) applied water, (5) evapotranspiration, (6) groundwater extraction and groundwater basin detention, and (7) salt export. Key salt loads are contributed by the geology of the aquifer media and applied water (e.g., loads from irrigated imported potable water or recycled water).

Existing groundwater TDS concentrations are less than Basin Plan objectives within the Upper Trabuco (HSA 901.22), Middle Trabuco (HSA 901.23), and Upper San Juan (HSA 901.25) basins. Existing groundwater TDS concentrations are typically higher than the Basin Plan objectives in the following hydrologic subareas: Oso (HSA 901.21), Gobernadora (HA 901.24), Middle San Juan (HSA 901.26), Lower San Juan (HSA 901.27) and Ortega (HSA 901.28).

Basin Assessment

Management Strategies. Management strategies being implemented or planned for implementation by SOCWA member agencies include:

- Diversion barriers to intercept and reuse poor-quality runoff.
- Seawater desalination.
- Source control.

7 Recycled water TDS concentrations are typically proportional to water supply TDS. Recycled water TDS concentrations can be significantly lower during periods when imported water TDS concentrations are low. Recycled water TDS concentrations can be higher for coastal agencies which experience sewer system infiltration and inflow from seawater or brackish groundwater.

- Advanced treatment of recycled water.
- Groundwater extraction and demineralization treatment.
- Salt export via brine discharges to ocean outfalls.
- Artificial recharge of good-quality storm runoff into the groundwater basin.

Because of the historic nature of natural salt loads, reducing contributions of applied water salt loads is unlikely to result in significant groundwater quality improvement. Reducing basin detention time, however, offers the opportunity for controlling or improving groundwater quality for both natural and man-induced salt loads. Reducing basin detention time can be achieved by increasing groundwater pumping and implementing artificial recharge of good-quality storm runoff (or other high-quality water or recycled water). When combined with groundwater treatment (which results in decreased TDS concentrations in both the applied domestic water and applied recycled water), such management strategies offer the opportunity for significant groundwater quality improvement in the larger capacity portions of the San Juan Creek basin.

Specific water management strategies planned for near-term implementation in the San Juan Creek Basin include:

- The SCWD Doheny Desalination Project, which will result in a reduction in TDS in source waters and recycled waters within the SCWD service area.
- The SMWD Ranch Filtration Plant Project, which will involve extracting poor-quality groundwater from the Middle San Juan HSA (901.26), treating the groundwater to generate high-quality local water supply, and exporting salts from the basin via brine connection to the San Juan Creek Ocean Outfall. In addition to reducing groundwater detention time in the Middle San Juan Basin (which will improve groundwater quality), the project will result in a reduction in TDS concentrations both in the SMWD domestic water supply and in the SMWD recycled water supply.
- Phase 1 of the SMWD San Juan Watershed Project, which involves the use of rubber inflatable dams to capture high-quality storm runoff and recharge Lower San Juan HSA (901.27) to improve groundwater quality and to support increased groundwater withdrawals in the basin. This recharge/extraction project will also reduce overall groundwater detention times in the basin, resulting in improved groundwater quality by lessening adverse effects associated with geologic and applied water salt loads.[8]
- Phase 2 of the SMWD San Juan Watershed Project, which will make use of the inflatable rubber dams along with imported and/or recycled water supplies to augment stormwater runoff in the Lower San Juan HSA (901.27) and further improve the quality of recharge and reduce groundwater detention times.

Salt/Balance Studies. Salt/balance assessments presented in the 2014 SNMP are updated to address water quality in the thin, shallow, and narrow upstream basins where it is not feasible to assess salt

8 The higher the groundwater detention time, the greater the adverse water quality effects associated with applied water salt loads and geologic salt loads. Reducing the groundwater detention time reduces the amount of time groundwater is exposed to these salt loads and reduces the overall accumulation of salt per unit volume of groundwater.

transport.[9] Salt balance analyses compared conditions under planned recycled water use with conditions where no recycled water is used. In each basin, the presence or absence of recycled water use did not affect whether the basin complied with Basin Plan TDS objectives.

Salt Fate and Transport Modeling. In conformance with requirements of the 2018 Recycled Water Policy, a one-dimensional lumped parameter link-node (LPLN) model is applied to the Lower Basin to assess salt loads and transport in the Lower Basin. The LPLN model was developed in the late 1980s as a groundwater planning tool for assessing groundwater availability, groundwater quality and groundwater management strategies in narrow and relatively shallow coastal basins within the San Diego Region. The model has been applied to numerous San Diego Region coastal basins during the past 40 years.

The LPLN model divides the San Juan Creek Basin into 17 elements, each of which contains groundwater and surface water components. The model assesses groundwater occurrence, groundwater quality, surface water flows, surface water quality within each element, and assesses ground and surface water flows between elements as ground and surface water moves downgradient.

Key input parameters within the model include precipitation, land use, topography, geologic factors, applied water, evaporation, transpiration, and hydraulic conductivity. Internal functions within the model calculate runoff coefficients, precipitation infiltration, runoff water quality, streamflow width, streamflow infiltration, geologic salt leaching, urban runoff quality, applied water leaching factors, water uptake by phreatophytes, and water uptake by non-phreatophytes. TDS was used as an indicator parameter within the model to assess salt load effects.

After the initial assignment of parameters, sufficient agreement occurred between model results and observed values that little model calibration was necessary.[10] To test model performance, results from model simulations (using an input database representing 2001-2020) were compared with observed depth-to-groundwater, groundwater TDS, surface water TDS, and surface flow results from this same period. Good agreement was achieved between simulated and observed values in all parameters for this baseline period. On this basis, the LPLN model was concluded as being adequate for initial planning purposes, for assessing probable groundwater trends, and for complying with SNMP requirements for salt load and transport analysis.

Water management projects planned within the San Juan Creek Basin include;

Scenario 1 *Water Quality Improvement:* Implementation of the SCWD Doheny Desalination Project and the SMWD Ranch Filtration Plant Project.

---

[9] RWQCB Order No. R9-2010-0157 designates the Lower San Juan Creek Basin as a "Tier A" basin that requires a SNMP and salt transport modeling. The LPLN model is applied to this Tier A section of the San Juan Creek Basin. Within this downstream portion of the San Juan Creek Basin, sufficient groundwater capacity is available to allow the basin to function as an underground reservoir subject to physical laws of groundwater movement. Salt transport modeling is not reliably achievable in the shallow upstream tributary basins. These shallow and narrow upstream tributary basins behave as an "underground stream" where salt transport is highly dependent on the locations of transitions between surface and groundwater transport. Given the difficulty in accurately defining and simulating these highly variable ground and surface water transitions, it is impractical to implement salt transport modeling in these basins that achieve any usable degree of model accuracy.

[10] Because the LPLN model had been previously applied to so many similar San Diego Region coastal basins, initial assignment of model parameters proved sufficiently accurate as to require only minor calibration adjustment.

Scenario 2 Implementation of Phase 1 of the SMWD San Juan Watershed Project.

Scenario 3 Implementation of Phase 2 of the SMWD San Juan Watershed Project.

Scenario 4 Increasing recycled water use with in the Mission Viejo HA (901.2) by 5000 AFY.

Three of these scenarios (1, 2 and 4) are planned within the near-term and may be implemented within the five-year planning period of this SNMP. The following three combinations of near-term management scenarios were simulated using the LPLN model:

- Management Scenario 1 vs. Baseline Conditions
- Management Scenarios 1 and 2 vs. Baseline Conditions
- Management Scenarios 1, 2 and 4 vs. Baseline Conditions

The modeling demonstrated projected improvement in groundwater quality for the implementation of Scenarios 1 and for the implementation of Scenarios 1 and 2. Additionally, for the combination of Scenarios 1, 2 and 4, Scenarios 1 and 2 were simulated as offsetting additional recycled water applied salt loads, resulting in no projected change from existing conditions. Overall, the salt fate and transport modeling in the San Juan Creek Basin demonstrated that:

- Recycled water is only one of many factors influencing groundwater quality, and natural salt loads from geologic sources are an important factor influencing groundwater quality within the San Juan Creek Basin.
- Salt loads exiting the basin via underground groundwater flow are minimal. Further, in the absence of increased groundwater pumping and recharge, overall groundwater detention times will remain high, magnifying the combined effects of salt loads from applied water and geologic sources. As a result, it will not be possible to achieve a significant reduction in groundwater TDS concentrations solely by reducing TDS concentrations in potable and recycled water supplies. Further, Basin Plan compliance cannot be achieved simply by eliminating or reducing recycled water use or regulating (restricting) recycled water TDS concentrations.
- Proposed management strategies offer the potential for groundwater quality improvement in the Lower San Juan Basin. Decreasing groundwater detention time through increased pumping and recharge (when coupled with groundwater demineralization and brine export) offers great potential for groundwater quality improvement.

Antidegradation Assessment

SWRCB Resolution No. 68-16 establishes antidegradation requirements for state-regulated ground and surface waters:

> *Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies.*

Within the San Juan Creek Basin, historical groundwater quality data indicate that the following sub-basins have waters meeting the "high quality" criteria of SWRCB Resolution No. 68-16:

- Upper Trabuco (HSA 901.22)
- Gobernadora (HSA 901.24)
- Upper San Juan (HSA 901.25)
- Middle San Juan (HSA 901.26)

Of these four basins, only the Middle San Juan is found to not have assimilative capacity. Planned recycled water use in the Upper Trabuco, Gobernadora and Upper San Juan basins are consistent with antidegradation requirements of Resolution No. 68-16. Planned water management strategies within the Middle San Juan Basin, however, offer the potential for bringing that basin into compliance with Basin Plan groundwater quality objectives. Additional monitoring, modeling and salt balance assessments are required to confirm the projected degree of groundwater quality improvement. In the interim, SMWD proposes to move forward with implementing proposed groundwater improvement strategies within the Middle San Juan Basin, along with planned recycled water use.

The following sub-basins of the San Juan Creek Basin do not contain "high quality" waters as defined within Resolution SWRCB No. 68-16:

- Oso (HSA 901.21)
- Middle Trabuco (HSA 901.23)
- Lower San Juan (HSA 901.27)
- Ortega (HSA 901.28)

Consistent with the requirements of SWRCB Resolution No. 68-16, SOCWA and its member agencies will continue to implement a "best efforts" approach in these basins, which includes continued implementation of water quality improvement strategies such as barrier projects, treatment, reducing groundwater detention time through increased extraction/recharge and salt export. Recycled water TDS concentrations in three of these basins (Oso HSA 901.21, Lower San Juan HSA 901.27 and Ortega HSA 901.28) are lower than the corresponding Basin Plan groundwater TDS concentration objective.

While recycled water TDS concentrations are projected to be above the 750 mg/L Basin Plan objectives in the Middle Trabuco and Middle San Juan basins, the combination of existing implementation measures along with anticipated management strategies demonstrates that the SOCWA member agencies are implementing best efforts throughout the Basin. Additionally, salt balance assessments indicate that (1) recycled water is only one of many salt contributors in the basins, (2) management strategies offer the potential for groundwater quality improvement in the basins, and (3) significant reduction in groundwater TDS concentrations cannot be achieved by eliminating or reducing recycled water use in these basins.

Recommendations

The following RWQCB actions are recommended based on the information presented in this SNMP:

- Adopt the 2024 SOCWA SNMP.
- Adopt an updated recycled water permit for SOCWA member agencies that address planned recycled water use totals (see Table 8-2) and planned groundwater improvement projects in each of the San Juan Creek Basin sub-basins. Include increased interim discharge limits in the updated recycled water permit for TDS, iron, and manganese to reflect the geologic contributions in the San Juan Creek Basin and the micronutrient uptake effects of iron and manganese.

- Confirm the monitoring program presented within the 2024 SNMP to (1) assess Basin Plan compliance, (2) assess the performance of water management strategies in reducing salt loads, stabilizing and improving groundwater quality, and (3) support additional future evaluation of salinity loads and transport in the Lower San Juan Basin and Middle San Juan Basin. Future basin monitoring should include monitoring of depth-to-groundwater in static (non-pumping) wells to allow more accurate characterization of seasonal and long-term groundwater table elevations.
- Require detailed salt balance analyses and transport modeling of salt in the Middle Trabuco Basin (HSA 901.23) and Middle San Juan Basin (HSA 901.26) in the next five-year update of the San Juan Basin SNMP.
- Defer consideration of Basin Plan modifications within the Middle Trabuco (HSA 901.23) and Middle San Juan (HSA 901.26) to a future SNMP update when groundwater issues are better defined, and it can be determined whether the proposed management strategies are adequate to achieve Basin Plan compliance.
- Prior to completion of additional salt balance and modeling studies in the Middle San Juan Basin (to be completed as part of the next five-year SNMP update), as part of issuing an updated SOCWA recycled water permit, determine appropriate interim TDS effluent limits for recycled water used in the Middle San Juan Basin (HSA 901.26).[11]

[11] To allow SMWD to best achieve basin recycled water use goals and to provide for maximum benefit to the State, SMWD would prefer that the RWQCB establish interim recycled water TDS concentration limits in the Middle San Juan Basin (HSA 901.26) at 1000 mg/L (annual average), which would be consistent with concentration limits in other basins where SMWD applies recycled water. If the RWQCB were to impose the existing Basin Plan TDS objective of 750 mg/L in the Middle San Juan Basin, SMWD would have to implement special strategies within the Middle San Juan Basin (e.g., blending or treatment) to achieve compliance.

This page is left intentionally blank.

Table of Contents

List of Tables

List of Tables

List of Figures

List of Figures

AFY	Acre-Feet per Year
BMP	Best Management Practice
CAFO	Concentrated Animal Feeding Operation
CASGEM	California Statewide Groundwater Elevation Monitoring
CEQA	California Environmental Quality Act
CFS	Cubic Feet per Second
CIMIS	California Irrigation Management Information System
CRA	Colorado River Aqueduct
DWR	Department of Water Resources
ET	Evapotranspiration
eWRIMS	Electronic Water Rights Information Management System
GAMA	Groundwater Ambient Monitoring & Assessment
GRF	Groundwater Recovery Facility
HA	Hydrologic Area
HSA	Hydrologic Subarea
HU	Hydrologic Unit
I&I	Infiltration and Inflow
IPR	Indirect Potable Reuse
IRWM	Integrated Regional Water Management
LPLN	Lumped Parameter Linked-Node (model)
MCL	Maximum Contaminant Level
MF/UF	Microfiltration/Ultrafiltration
mg/L	Milligrams per liter
MGD	Million Gallons per Day
MWD	Metropolitan Water District
MNWD	Moulton Niguel Water District
MWDOC	Municipal Water District of Orange County
NGO	Non Governmental Organization
NPDES	National Pollutant Discharge Elimination System
Policy	Recycled Water Policy
RO	Reverse Osmosis
RWQCB	Regional Water Quality Control Board
SCWD	South Coast Water District
SMWD	Santa Margarita Water District
POTW	Publicly Owned Treatment Works
SJBA	San Juan Basin Authority
SJCOO	San Juan Creek Ocean Outfall
SMWD	Santa Margarita Water District
SNMP	Salt and Nutrient Management Plan
SOCRA	South Orange County Reclamation Authority
SOCWA	South Orange County Wastewater Authority
SWRCB	State Water Resources Control Board
SWP	State Water Project
TCWD	Trabuco Canyon Water District
TDS	Total Dissolved Solids
USGS	United States Geological Survey

Section 1: Introduction

1.1 State of California Recycled Water Policy

In 2018, the State Water Resources Control Board (SWRCB) adopted an amended *Water Quality Control Policy for Recycled Water* (Recycled Water Policy).[1] The updated 2018 Recycled Water Policy, which became effective on April 18, 2019, established revised requirements and directives governing:

- Statewide recycled water goals.
- The roles of state agencies in encouraging and regulating recycled water use.
- The development of Salt and Nutrient Management Plans (SNMPs) and Regional Water Quality Control Board (RWQCB) review and approval of SNMPs.
- Permitting and antidegradation requirements for non-potable recycled water use projects and groundwater recharge projects.
- Permitting requirements for surface water augmentation projects.
- Updated monitoring requirements for Constituents of Emerging Concern (CECs).

The 2018 Recycled Water Policy established that it is more effective to manage salt and nutrient sources on a basin-wide or watershed-wide basis rather than imposing requirements on individual recycled water projects or individual salt/nutrient sources. To achieve this goal, the Policy required each RWQCB to identify basins where salt and nutrients are a threat to water quality and where SNMPs are required to address these water quality threats.[2] The San Diego Region RWQCB complied with this requirement in 2010 by adopting Resolution No. R9-2010-0125 which:

- Established SNMP guidelines and a tiered approach for assessing Basin Plan[3] compliance risks based on groundwater basin capacity, degree and type of beneficial use, degree of existing and planned recycled water use, recycled water quality, Basin Plan groundwater objectives and historical groundwater quality trends.
- Evaluated San Diego Region groundwater basins and assigned each basin to one of five risk tiers based on the tier criteria.
- Identified basins where complete SNMPs are required to address groundwater quality risks.
- Identified the recommended level of SNMP evaluation commensurate with the estimated water groundwater quality risks.

As part of this RWQCB-adopted evaluation, the San Juan Creek Basin (which was defined as the downstream alluvial 16,700 acres of the Mission Viejo Hydrologic Area (HA 901.2)) was categorized as a "Tier A" basin. As a "Tier A" basin, the development of an SNMP was required for this segment of the San

---

1 The original Recycled Water Policy was established by the SWRCB in 2009 (SWRCB Resolution No. 2009-011). An amendment to the Recycled Water Policy that addressed the monitoring of constituents of emerging concern (CECs) was adopted by the SWRCB (Resolution No. 2013-0003) in 2013. The 2018 amendments to the Recycled Water Policy (Resolution No. 2018-0057) were adopted by the SWRCB on December 11, 2018, and in part established detailed procedures for the development and approval of SNMPs. The 2018 Recycled Water Policy amendments became effective on April 8, 2021.

2 The Policy required each RWQCB to identify (through resolution or Executive Officer determination) each groundwater basin where a SNMP is required. The Policy noted that RWQCB basin evaluations completed prior to April 8, 2019 can be used to satisfy this requirement if the prior evaluation clearly identifies which basins require SNMPs to achieve water quality objectives in the long term.

3 *Water Quality Control Plan for the San Diego Basin* (RWQCB, 2021).

Juan Basin. Smaller, narrow tributary sub-basins within the San Juan Creek watershed fall under the "Tier C" and "Tier D" SNMP criteria adopted by the RWQCB for which detailed SNMPs were not required. Consistent with this RWQCB direction, an SNMP meeting 2018 Recycled Water Policy requirements is required for the downstream alluvial portion of the San Juan Creek Basin (downstream portion of Mission Viejo Hydrologic Area 901.2).

1.2 Study Area and Prioritization of Sub-Basins

While this SNMP focuses on Mission Viejo HA (also known as called the San Juan Creek Basin), this 2024 SNMP also presents an overview of recycled water use and groundwater issues within an overall study area that encompasses the portion of the service area of the South Orange County Wastewater Authority (SOCWA) that is within the San Diego Region. Figure 1-1 presents the overall study area addressed within this SNMP.

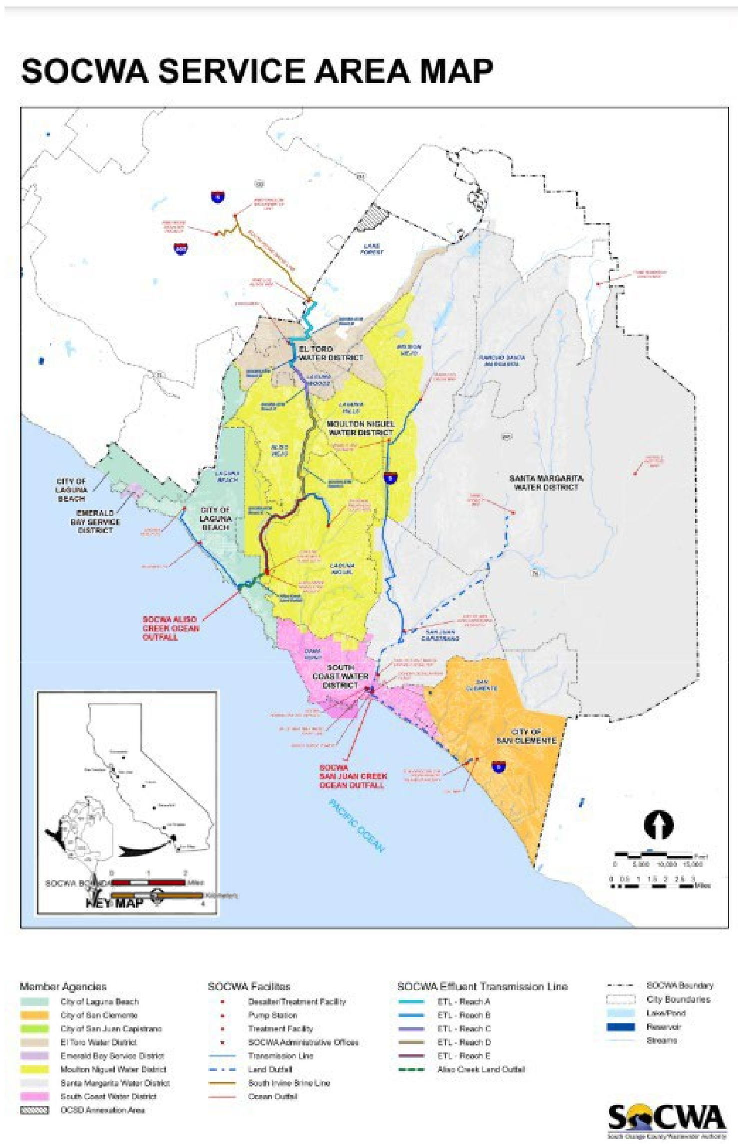


Figure 1-1 SNMP Study Area and SOCWA Member Agency Boundaries

Table 1-1 summarizes the basis for prioritizing the 2024 SNMP effort on the San Juan Creek Basin (Mission Viejo HA 901.2).

Table 1-1
Basis for SNMP Prioritization of Sub-Basins within the San Juan Hydrologic Unit

Category	High Priority Subbasin	Medium Priority Sub-basin	Low Priority Sub-basin
RWQCB Priority Designation [A]	Tier A [B]	Tier B [C]	Tier D [D]
Designated as a groundwater basin within Department of Water Resources Bulletin 118? [E]	Yes	Yes	No
Significant existing or planned recycled water use within the basin?	Yes	No	Yes
Are recycled water TDS concentrations less than Basin Plan concentration objectives?	Yes/No [F]	No	Yes
Assigned SNMP Prioritization	• Mission Viejo HA (901.2)	• San Mateo HSA (901.4)	• Laguna HA (901.1) • San Clemente HA (901.3)
Level of SNMP Analysis	Full SNMP analysis per requirements of the 2018 Recycled Water Policy [F]	Defer SNMP assessment to future date when recycled water use may occur	None

Table 1-1 Notes:

A Priority tier identified within *Proposed Guidelines Salinity/Nutrient Management Planning in the San Diego Region*, which was adopted by the RWQCB in 2010 (Resolution No. R9-2010-0125).

B Tier A basins include large groundwater basins (1) that are extensively used for water supply with good water quality in upstream areas and poorer quality in downstream areas, (2) where groundwater and recycled water salinity concentrations may not comply with existing Basin Plan objectives and (3) where groundwater management strategies have been implemented, proposed or studied. SNMPs are required for Tier A basins.

C Tier B basins include moderate-sized basins where a modest degree of groundwater use occurs, recycled water quality salinity concentrations may be near Basin Plan objectives and groundwater management alternatives have not been identified or extensively studied.

D Tier D basins include small coastal groundwater basins where recycled water compliance with existing Basin Plan salinity concentration objectives is not a problem. No SNMPs are required for Tier D basins.

E Groundwater basins identified within *California's Groundwater Update 2020, Bulletin 118* (California Department of Water Resources, 2020).

F Full SNMP analysis with transport modeling is required in the downstream alluvial portion of the San Juan Creek Basin (Tier A portion of basin). Salt balance analyses are presented to assess salinity issues and groundwater management strategies in the small, narrow Tier D basins upstream of the San Juan Creek watershed (Mission Viejo HA 901.2). See Table 1-2 on page 1-4.

Table 1-2 summarizes the general SNMP study area addressed herein, the specific portion of the study area (e.g., downstream Mission Viejo HA 901.2) for which complete SNMP analyses are presented, and the level of SNMP effort assigned to each area.

In accordance with the above prioritization, a full SNMP analysis (including salt transport modeling) is presented for the downstream alluvial portion (lower 26-square miles) of the San Juan Creek Basin (e.g., RWQCB-designated "Tier A" basin). Salt balance analyses are presented to assess groundwater conditions and management strategies within the small, narrow, upstream tributary sub-basins of the Mission Viejo HA (901.2).

Table 1-2
SNMP Study Area and Portion of Study Area for which Detailed SNMP Analyses are Presented

Parameter	General SNMP Study Area	Focus of this SNMP
Hydrologic Areas	• Laguna HA (901.1) • Mission Viejo HA (901.2) • San Clemente HA (901.3) • Portion of San Mateo HA (901.4)	• Mission Viejo HA 901.2 (also known as the San Juan Creek Basin)
Approximate Area	210 square miles	151 square miles
Level of Effort	General description of basin hydrogeology, recycled water use, groundwater issues and Basin Plan compliance	Detailed SNMP assessment in accordance with SNMP requirements of the Recycled Water Policy, including: ✓ Development and presentation of monitoring plans ✓ Identification of recycled water goals and objectives ✓ Identification of salt/nutrient sources and load estimates ✓ Identification of proposed management strategies ✓ Evaluation of salt balances for each sub-basin to assess and compare potential water quality effects associated with existing and planned levels of recycled water use ✓ Presentation of salt transport modeling for lower 26 square miles of the Mission Viejo HA (901.2) watershed to assess and compare potential water quality effects of various management strategies ✓ Presentation of revised monitoring program to assess/confirm projected water quality effects for management strategies proposed for implementation ✓ Identification of sub-basins that represent "high quality" waters and completion of antidegradation assessments within each sub-basin with high quality waters ✓ Identification of sub-basins which do not have high quality waters where a "best efforts" is appropriate for regulating salt/nutrient loads
SOCWA Member Agencies Service Areas	• City of Laguna Beach • City of San Juan Capistrano • City of San Clemente • El Toro Water District • Emerald Bay Service District • Irvine Ranch Water District • Moulton Niguel Water District • Santa Margarita Water District [A] • South Coast Water District • Trabuco Canyon Water District [B]	• Moulton Niguel Water District • Santa Margarita Water District [A] • South Coast Water District • Trabuco Canyon Water District [B]

Table 1-2 Notes:

A Santa Margarita Water District also provides water, wastewater and recycled water service within the City of San Juan Capistrano.

B Trabuco Canyon Water District is no longer a SOCWA member agency, but Trabuco Canyon recycled water operations are presently regulated under RWQCB Order No. 97-52 (as amended) issued to SOCWA. RWQCB issuance of a separate discharge permit to Trabuco Canyon and remove Trabuco Canyon from Order No. 97-52 is pending.

1.3 SNMP Background, Preparation and Approach

Background. SNMPs were originally required by the 2009 Recycled Water Policy, which was adopted by the SWRCB on February 3, 2009 (Resolution No. 2009-011). The 2009 Recycled Water Policy, however, did not provide specifics on which groundwater basins required SNMPs or what should be addressed within the SNMPs. Additionally, the 2009 Policy did not provide direction to RWQCBs on how SNMPs were to be reviewed and approved.

SOCWA submitted a proposed San Juan Creek Basin SNMP to the San Diego RWQCB on August 17, 2021. SOCWA's submitted San Juan Creek Basin SNMP, however, was largely prepared prior to the adoption of the 2018 Recycled Water Policy. As a result, the SNMP submitted by SOCWA failed to meet some of the new SNMP criteria established in the 2018 Recycled Water Policy. In correspondence dated December 21, 2021, the RWQCB identified elements of the 2021 SNMP that required update or revision to comply with the new SNMP requirements established in the 2018 Recycled Water Policy. SNMP revisions required by the RWQCB, in part, included the need to:

- include surface water quality monitoring as part of the proposed SNMP monitoring plan,
- identify and consider all sources of salt and nutrient loading within each sub-basin,
- document geologic-related impacts on groundwater salinity concentrations,
- present a model to assess the fate and transport of salt loads,
- present implementation measures proposed to manage or reduce salt loads,
- assess the effectiveness of proposed implementation measures to improve water quality and demonstrate Basin Plan compliance, and
- present antidegradation assessments that are consistent with requirements of the 2018 Recycled Water Policy.

Subsequent meetings between the RWQCB and SOCWA were conducted on February 16, 2022, April 6, 2022, and June 16, 2022, to discuss specific approaches and a proposed approach for addressing each of the above items. Based on guidance received from RWQCB staff, SOCWA developed a proposed SNMP compliance approach that included monitoring program changes and additional salt/nutrient load assessments that included modeling and evaluating the effectiveness of proposed management strategies. Additionally, SOCWA submitted a proposed approach to the RWQCB on July 5, 2022, for addressing antidegradation compliance. In correspondence dated August 9, 2022, the RWQCB staff notified SOCWA that the proposed antidegradation approach was accepted.

Preparation of Updated SNMP. In accordance with RWQCB guidance, a revised version of the San Juan Basin SNMP was prepared by SOCWA, with input provided by an Advisory Group that included SOCWA member agencies[4] and interested stakeholders. As shown in Figure 1-1, the majority of the downstream portion of the San Juan Creek Basin is served by the Santa Margarita Water District (SMWD) and South

4 SOCWA member agencies participating in the advisory group meetings included the South Coast Water District, Moulton Niguel Water District and Santa Margarita Water District. Also participating was the Trabuco Canyon Water District.

Coast Water District (SCWD).[5] As a result, SMWD and SCWD represented key stakeholders in identifying potential groundwater management strategies and water use issues within the Mission Viejo HA (901.2). Other key stakeholders invited to participate in the effort to update the San Juan Creek Basin SNMP included:

- Regulatory agencies, including the RWQCB (San Diego Region), SWRCB Division of Drinking Water, Orange County Department of Environmental Health.
- Water/wastewater agencies, including SOCWA member agencies, County of Orange, Municipal Water District of Southern California, San Juan Basin Authority, Southern California Salinity Coalition, Trabuco Canyon Water District[6] and U.S. Marine Corps Base Camp Pendleton.
- Municipal stormwater co-permittees.
- Non-government organizations, including the Audubon Society, Clean Water Now, Coastkeeper, Sierra Club, and the Surfrider Foundation.

Stakeholders were included in the process to update the San Juan Creek Basin SNMP through a variety of methods, including:

- Electronic distribution among stakeholders of SNMP data, project information, schedules and preliminary results.
- Regulatory scheduled teleconferences and online meetings and distribution of meeting presentation materials and meeting notes.
- The distribution of draft sections of the SNMP for stakeholder review and comment.
- A public comment period provided for additional input through the SOCWA Engineering Committee and SOCWA Board meetings in April and May 2024.

Stakeholder Goals. Consistent with stakeholder input, water management goals targeted by stakeholders for the San Juan Creek Basin (Mission Viejo HA 901.2) include:

- Offset demands for imported water by increasing the use of recycled water, stormwater, and urban runoff.
- Maximize the reuse of recycled water in the SOCWA service area in a manner that is protective of beneficial uses of local groundwater and surface water resources.
- Maximize the capture of stormwater and urban runoff in a manner that is protective of beneficial uses of local groundwater and surface water resources.
- Support increasing groundwater production and stabilize or improve groundwater quality in the Lower San Juan Creek Basin by recharging stormwater and recycled water.
- Continue and expand existing diversion projects that divert and reuse high-TDS urban surface water runoff that would otherwise impact ground and surface water quality.

---

[5] The Santa Margarita Water District provides water, wastewater and sewer service within the City of San Juan Capistrano.

[6] Trabuco Canyon Water District is no longer a SOCWA member agency, but Trabuco Canyon recycled water operations are presently regulated under a RWQCB permit issued to SOCWA pending RWQCB issuance of a separate discharge permit to Trabuco Canyon.

- Continue and expand existing programs to desalt groundwater in the Lower San Juan Basin to increase local supply, remove salt from the basin, and stabilize or improve groundwater quality.
- Develop and implement a monitoring plan to (1) assess effectiveness of groundwater management actions, (2) assess compliance and/or determine appropriateness of existing Basin Plan water quality objectives, (3) increase understanding of salt and nutrient transport, and (4) support the evaluation and implementation of future water management opportunities.
- Eliminate or reduce discharge to the ocean by recycling wastewater to the maximum extent possible.

Table 1-3 compares the volume of planned recycled water use within the San Juan Creek Basin to the volume of recycled water use currently allowed under RWQCB Order No. 97-52 (as amended). As shown in the table, while the total volume of planned recycled water use in the San Juan Creek Basin is less than the volume currently permitted under Order No. 97-52, recycled water use planned by the SMWD exceeds the currently permitted values within the Middle Trabuco (901.23), Gobernadora/Chiquita (901.24), and Middle San Juan (901.26).

The goal of this SNMP is to:

Identify and evaluate management strategies that support the planned level of recycled water use and demonstrate consistency of this planned level of reuse with the 2018 Recycled Water Policy and the San Diego Region Basin Plan.

Table 1-3
Planned and Permitted Recycled Water Use
Sub-basins of the San Juan Creek Basin (HA 901.2)

Hydrologic Subarea (HSA)	Basin	Permitted Recycled Water Use [A] (AFY)	Planned Recycled Water Use [B] (AFY)
901.21	Oso/La Paz	7,168	3,640
901.22	Upper Trabuco	420	23
901.23	Middle Trabuco	91	581
901.24	Gobernadora/Chiquita	4,148	2,531
901.25	Upper San Juan/Dove/Bell	977	91
901.26	Middle San Juan	0	2,000 [C]
901.27	Lower San Juan	4,396	3,349
901.28	Ortega	2,758	65
Totals		19,958	12,280

Table 1-3 Notes:

A Recycled water use (in acre-feet per year or AFY) permitted under RWQCB Order No. 97-52.

B Planned recycled water in AFY identified by each SOCWA member agency and the Trabuco Canyon Water District within the five-year planning window of this 2024 SNMP.

C Initial planning estimate for SMWD reuse within the Middle San Juan basin. Includes recycled water used for groundwater recharge.

1.4 Organization of the 2024 SNMP

In accordance with RWQCB guidance and input received by SNMP stakeholders, the following tasks were completed to update the San Juan Creek Basin SNMP:

- Updating the SNMP database to include ground and surface water data collected as part of a comprehensive San Juan Creek Basin monitoring plan.
- Using the updated data in combination with historical data and available literature to assess groundwater quality and document geologic factors influencing groundwater quality.
- Updating recycled water use plans of SOCWA member agencies.
- Identifying proposed water management implementation strategies proposed or being considered by SOCWA member agencies.
- Using the updated data to confirm the lack of nutrient-related adverse effects in the San Juan Creek Basin.
- Assessing and updating salt source identification and loading in sub-basins of the San Juan Creek Basin.
- Using the salt balance models to evaluate the effectiveness of proposed water management strategies.
- Applying a salt transport model to the downstream alluvial portion of the San Juan Creek Basin to assess salt fate and transport under existing conditions and under proposed implementation management strategies.
- Identifying additional monitoring needs (if applicable) to assess model performance and evaluate the effectiveness of proposed management strategies.
- Identifying sub-basins within the San Juan Creek Basin where “high-quality” waters exist and evaluating assimilative capacity and antidegradation policy compliance for recycled water use within these “high-quality” basins.
- In sub-basins where high-quality waters do not exist, identify the recommended “best efforts” approach for achieving antidegradation compliance.

SNMP is organized as follows to present the results of the above tasks and to document compliance with SNMP requirements established in the 2018 Recycled Water Policy:

Section 2 presents a planning overview of the SNMP study area, summarizes Basin Plan designated beneficial uses, presents the history and background of how the existing Basin Plan groundwater quality objectives came into being, and presents the overall approach for complying with Recycled Water Policy SNMP requirements, protecting beneficial uses, and encouraging recycled water use.

Section 3 describes the SNMP study area, institutional boundaries, land use, water supply, and recycled water use.

Section 4 presents a history of water supply planning within the study area and summarizes basin hydrogeology and soils, existing and historical groundwater quality, and factors which affect ground and surface water quality within the study area. Section 4 also presents the proposed monitoring plan to assess groundwater quality, Basin Plan compliance and the effectiveness of proposed groundwater management strategies.

Section 5 identifies potential and proposed groundwater management strategies and implementation measures to stabilize and improve groundwater quality and/or mitigate adverse effects associated with historical or projected salt loads.

Section 6 identifies salt sources and presents salt balances for each of the San Juan Basin sub-basins and utilizes a salt transport model to assess the fate and transport of salts in the lower portion of the San Juan Basin under existing and projected recycled water use conditions and groundwater management strategies.

Section 7 assesses compliance of existing and proposed recycled water use with antidegradation requirements established in SWRCB Resolution No. 68-16.[7] Section 7 also presents the proposed "best efforts" approach proposed for sub-basins for which are deemed to not represent high-quality water.

Section 8 summarizes SNMP conclusions and presents recommendations for the consideration of the RWQCB.

Table 1-4 presents a summary of SNMP requirements established in the 2018 Recycled Water Policy and documents the sections within the SNMP where the specific SNMP requirements are addressed. Table 1-5 summarizes RWQCB comments on the 2021 SNMP submitted by SOCWA, presents general responses, and identifies sections within the SNMP that address the deficiencies in SOCWA's 2021 SNMP.

Table 1-4
Required SNMP Elements

Recycled Water Policy Requirement [A]		SNMP Section that Addresses the Requirement
6.2.4.1	Monitoring plan to assess consistency with Basin Plan objectives	Section 4.4
6.2.4.2	Water recycling goals and objectives	Section 1.3
6.2.4.3	Salt and nutrient source identification, capacity and loading estimates and fate and transport of salts and nutrients	Section 6
6.2.4.4	Implementation measures to manage or reduce salt and nutrient loads	Section 5
6.2.4.5	Antidegradation analysis demonstrating compliance of existing and planned recycled water projects with SWRCB Resolution No. 68-16	Section 7

Table 1-4 Notes:
A Required components of SNMPs are established within Section 6.2.4 of the 2018 Recycled Water Policy.

[7] SWRCB Resolution No. 68-16, *Statement of Policy with Respect to Maintaining High Quality Waters in California* was adopted by the SWRCB in 1968.

Table 1-5
Locations in the SNMP where RWQCB Comments on the 2021 SNMP are Addressed

RWQCB Comment No.	RWQCB Comment	Response	SNMP Section that Addresses the Comment
1	**Recycled Water Policy Section 6.2.4.1** Monitoring plan: surface water discharge data are not available to calibrate the model	Historic U.S. Geological Survey streamflow data from 1928-1969 are presented in Section 4.	Section 4.2.2
		Lumped Parameter Link Node (LPLN) model projections for San Juan Creek streamflow are compared with historic data to demonstrate model consistency with observed historic data	Section 6.3
2	**Recycled Water Policy Section 6.2.4.1** Both natural and man-induced salt sources and loads must be characterized	Specific salt sources and loads are identified for salt balances for narrow, shallow upstream basins and with the modeled area for the LPLN salt transport model.	Section 6.3
3	**Recycled Water Policy Section 6.2.4.3** Natural and man-induced salt loads are not quantified.	The LPLN model quantifies both man-induced and natural salt loads. As shown in the model, natural geologic salt loads must be addressed in the model to ensure adequate model performance, but man-induced salt loads are a dominant portion of the total salt load.	Section 6.3
4	**Recycled Water Policy Section 6.2.4.3** The SNMP should not claim that the Basin Plan allows for exceptions for complying with groundwater quality objectives.	Noted.	Not Applicable
5/6	**Recycled Water Policy Section 6.2.4.3** The SNMP does not include a mathematical fate and transport analysis.	The LPLN model presented in Section 6.3 is a mathematical fate and transport model that meets the modeling requirements of the Recycled Water Policy.	Section 6.3
7/8	**Recycled Water Policy Section 6.2.4.3** The fate and transport model must mathematically address evaporation, evapotranspiration and infiltration.	The LPLN model presented in Section 6.3 is a mathematical fate and transport model that meets the modeling requirements of the Recycled Water Policy. The model includes mathematical estimation of evaporation, evapotranspiration and streamflow infiltration.	Section 6.3
9/10/11	**Recycled Water Policy Section 6.2.4.4** Implementation measures to improve water quality must be identified and projected water quality improvement effects quantified.	Section 5 identifies planned, proposed and potential water management strategies	Section 5
		LPLN model quantifies water quality improvements from planned management strategies.	Section 6.3
12/13/14 15/16/17	**Recycled Water Policy Section 6.2.4.5** Antidegradation analysis must demonstrate compliance with Basin Plan objectives and must assess effectiveness of management strategies in achieving Basin Plan objectives	Antidegradation analyses are presented to demonstrate compliance with Basin Plan objectives in basins meeting criteria as "high quality." A "best efforts" approach is utilized in basins without high quality.	Section 7
		Salt transport modeling is provided for the "Tier A" (e.g., Bulletin 118) portion of the San Juan Basin for which a SNMP is required. The salt transport modeling quantified projected water quality improvements from implementation of proposed and planned management strategies.	Section 6.3

Table 1-5 Notes:

A RWQCB comments and direction on the 2021 San Juan Basin SNMP presented within from RWQCB correspondence dated December 21, 2021.

Section 1 References:

California Department of Water Resources. California's Groundwater Update 2020 (Bulletin 118). 2020. Available online at: https://www.data,cbra,ca,gov/dataset/calgw_update2020.

Regional Water Quality Control Board, San Diego Region (RWQCB). 2021a. *Water Quality Control Plan for the San Diego Basin.* 1994 (with amendment effective on or before September 1, 2021). Available online at:

Regional Water Quality Control Board, San Diego Region. 2021b. Correspondence to SOCWA dated December 21, 2021 regarding South Orange County Wastewater Authority Salt and Nutrient Management Plan for the San Juan Creek Watershed, 2020 Update, August 2021. 12 pages.

Regional Water Quality Control Board, San Diego Region. Resolution No. R9-2010-0125. 2010. *A Resolution Endorsing the Proposed Guidelines for Salinity and Nutrient Management in the San Diego Region.*

Regional Water Quality Control Board, San Diego Region (RWQCB). 1997. *Waste Discharge and Water Recycling Requirements for the Production and Purveyance of Recycled Water by Member Agencies of the South Orange County Reclamation Authority.*

State Water Resources Control Board (SWRCB). 2018. *Resolution No. 2018-0057, Adoption of an Amendment to the Policy for Water Quality Control for Recycled Water and the Staff Report with Substitute Environmental Documentation.* Adopted December 18, 2018.

State Water Resources Control Board (SWRCB). 2018. *Water Quality Control Policy for Recycled Water.*

State Water Resources Control Board (SWRCB). 2013. *Resolution No. 2013-0003, Adoption of an Amendment to the Policy for Water Quality Control for Recycled Water Concerning Monitoring Requirements for Constituents of Emerging Concern*. Adopted January 22, 2013.

State Water Resources Control Board (SWRCB). 2009. *Resolution No. 2009-011, Adoption of a Policy for Water Quality Control for Recycled Water*. Adopted February 3, 2009.

State Water Resources Control Board (SWRCB). 2009. *Water Quality Control Policy for Recycled Water.*

State Water Resources Control Board (SWRCB). 1968. *Resolution 68-16, Statement of Policy with Respect to Maintaining High Quality Waters in California.*

Welch, Michael R., Southern California Salinity Coalition, San Diego County Water Authority and Regional Water Quality Control Board, San Diego Region. 2010. *Proposed Guidelines Salinity/Nutrient Management Planning in the San Diego Region.* Adopted by the RWQCB in 2010 (Resolution No. R9-2010-0125).

Section 2: Background and Planning Overview

2.1 Basin Overview

As documented in Section 1, the overall study area addressed within this SNMP is the portion of the San Juan Basin (Hydrologic Unit 901.00[1]) that is within the SOCWA service area. This SNMP specifically focuses on the Mission Viejo HA (901.2, also known as the San Juan Creek Basin or San Juan Creek watershed), which is the principal groundwater-bearing portion of the study area and the portion of the study area for which an SNMP is required.[2]

Groundwater Occurrence. Groundwater within the San Juan Creek Basin primarily occurs in unconfined conditions (e.g., a water table or phreatic surface) in the thin alluvial deposits along the valley floors and within the major stream channels. The alluvial filled valleys contain Montmorillonite mineralogy (i.e., clay) which can precipitate cationic particles under certain hydrologic conditions influenced by drought cycles. The San Juan Creek Basin is bound to the north by the Santa Ana Mountains (which are composed of impermeable granitic and metamorphic bedrock) and to the south by the Pacific Ocean. Sedimentary bedrock formations form the sides of the water bearing canyons of the Upper Basin and Arroyo Trabuco (i.e., Cañada Chiquita, Cañada Gobernadora, and Bell Canyon).

Historical Overview. As presented within Section 3, modern records and the study of water quality in the San Juan Creek Basin date back to as early as 1952 and are published in various Department of Water Resources (DWR) studies. The early DWR studies provide a historical background on water quality within the basin. To supplement the modern quantitative data, historical water quality information from the late 1700s is available which provides narratives from Spanish missionaries of the water quantity and quality in the San Juan Creek watershed. Records indicate that water resources and agricultural opportunities at the confluence of San Juan and Trabuco Creeks combined to support and sustain populations near the San Juan Capistrano Mission that were in excess of the historic 3,500 native population.[3] It is noteworthy that modern management of groundwater in the San Juan Creek Basin is still focused on the lower portion of the watershed which, unlike pre-1960s Southern California, currently supplies less than 10 percent of the potable water supply for the San Juan Basin's potable water needs.

Periodic extended drought cycles, inferior groundwater quality[4] (in part due to the underlying geology), and lack of sufficiently large groundwater basins restricted the availability of large-scale water development in the basin. This led DWR to conclude that imported water would be required to support the growing population of Southern California. Imported supplies began being delivered to the area in the 1960s, with the implementation of the State Water Project, which resulted in a significant increase in development and population growth in the San Juan Creek Basin. The lower part of the basin, which is

---

1 Regional Water Quality Control Board, San Diego Region (RWQCB). *Water Quality Control Plan for the San Diego Basin*. 1994 (with amendment effective on or before September 1, 2021.

2 As documented in Section 1, the RWQCB in 2010 designated the lower portion of the San Juan Creek Basin (HA 901.2) as a "Tier A" groundwater basin which requires the development of a SNMP. Per DWR Bulletin No. 118, the downstream portion of the San Juan Creek Basin covers the downstream 16,700 acres of the Mission Viejo HA (901.2).

3 O'Niel, Stephen. The Acjachemen in the Franciscan Mission System: Demographic Collapse and Social Change. 2002. p.ii.

4 State of California Department of Water Resources (DWR). June 1972. *Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104.*

the most productive, has had consistently poor groundwater quality for the past 60 years. This is due to increased salt from applied waters, natural geological factors, and seawater intrusion that started in the 1950s.

2.2 San Diego Region Basin Plan

Water quality regulation in California is the purview of the SRWCB and nine Regional Water Quality Control Boards. The SWRCB defines beneficial uses as:

> *Beneficial use of the water resources of the State is that use of water that is in general productive of public benefit and which promotes the peace, health, safety and welfare of the people of the State.*[5]

Under the State of California Porter-Cologne Water Quality Act, each of the nine Regional Water Quality Control Boards are required to adopt a Water Quality Control Plan (Basin Plan) that:

- Identifies beneficial uses of ground and surface waters for each watershed.
- Establishes numerical and narrative water quality objectives that protect the designated beneficial uses and are specific to address local and regional water quality conditions and problems.[6]

The San Diego Basin Plan[7] addresses water quality issues within the San Diego Region. The San Diego Region includes the portion of San Diego County tributary to the Pacific Ocean, the southern portion of Orange County, and the southwestern portion of Riverside County. The San Diego Region Basin Plan establishes beneficial uses, ground and surface water quality objectives, and implementation policies for the Region's eleven hydrologic units. The SOCWA service area is located within the San Juan Hydrologic Unit (HU 901) and this service area extends over four of the five hydrologic areas that comprise HU 901).[8]

Table 2-1 presents the designated beneficial uses for the San Juan HU (901). As shown in Table 2-1, designated beneficial uses within the Mission Viejo HA include municipal and domestic supply, agricultural supply, and industrial service supply. Each of these designated beneficial uses presently occurs within the basin, although groundwater demineralization is used to develop municipal supply from the poor-quality groundwater in the lower segment of the basin.

Numerical and narrative water quality objectives are established by the RWQCB to protect the designated beneficial uses under authority established in the Porter Cologne Water Quality Control Act.

---

5 State Water Resources Control Board (SWRCB). 1967. *Water Quality Control Policy for Recycled Water.*

6 Porter-Cologne Water Quality Control Act, California Water Code, Division 7. Originally enacted in 1969. Amended January 2024.

7 Regional Water Quality Control Board, San Diego Region (RWQCB). *Water Quality Control Plan for the San Diego Basin*. 1994 (with amendment effective on or before September 1, 2021.

8 The San Juan HU includes the Laguna Hydrologic Area (HA 901.1), Mission Viejo HA (901.2), San Clemente HA (901.3) San Mateo HA (901.4) and San Onofre HA (901.5). The SOCWA service area does not extend into the San Onofre HA.

Table 2-1
Beneficial Uses of Groundwater Designated by the Basin Plan for the San Juan Hydrologic Unit (901)[A]

Hydrologic Area	HSA No.	HSA Name	Municipal and Domestic Supply [B] (MUN)	Agricultural Supply [C] (AGR)	Industrial Service Supply [D] (IND)	Industrial Process Supply	Freshwater Replenishment	Groundwater Recharge
Laguna[E] (901.1)	901.11	San Joaquin Hills	●	●				
	901.12	Laguna Beach	●	●				
	901.13	Aliso	●	●				
	901.14	Dana Point	○	●				
Mission Viejo (901.2)	901.21	Oso	●	●	●			
	901.22	Upper Trabuco	●	●	●			
	901.23	Middle Trabuco	●	●	●			
	901.24	Gobernadora	●	●	●			
	901.25	Upper San Juan	●	●	●			
	901.26	Middle San Juan	●	●	●			
	901.27	Lower San Juan	●	●	●			
	901.28	Ortega	●	●	●			
San Clemente[E] (901.3)	901.31	Prima Deshecha	●	●				
	901.32	Segunda Deshecha	○					
San Mateo[F] (901.4)	---	---	●	●	●			
San Onofre[G] (901.5)	901.51	San Onofre	●	●				
	901.52	Las Pulgas	●	●				
	901.53	Stuart	●	●				

Table 2-1 Notes:

A Beneficial use designated within Table 2-5 of the San Diego Basin Plan (RWQCB, 2021a).

B Municipal and Domestic Supply (MUN) includes usual uses in community or military water systems and domestic uses in individual water systems.

C Agricultural Supply (AGR) includes landscape, crop, orchard and pasture irrigation, stock watering, support of vegetation for range grazing and all uses in support of farming and ranching operations.

D Industrial supply (IND) – Includes uses which do not depend primarily on water quality such as mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection and oil well repressurization.

E The Laguna watersheds (HSAs 901.11, 901.12, 901.13 and 901.14) and San Clemente watersheds (HAs 901.31 and 901.32) do not have any significant groundwater resources, are not identified as groundwater basins within DWQ Bulletin No. 118, are designated by the RWQCCB as "Tier D" basin which do not require SNMPs.

F A small portion of the City of San Clemente is tributary to the San Mateo HA, but a groundwater barrier exists to prevent applied water from the SOCWA service area from impacting the San Mateo Basin[9].

G The San Onofre HA is outside the SOCWA service area and is not part of the study area of this SNMP.

[9] Regional Water Quality Control Board (RWQCB). 2003. *Order No. R9-2003-0123, Master Reclamation Permit with Waste Discharge Requirements for Production and Purveyance of Recycled Water, City of San Clemente Water Reclamation Plant, Orange County.* Findings 11 and 12.

Section 13241 of the *California Water Code* provides the following direction for the establishment of water quality objectives by the RWQCB:

> *[Water quality objectives] Each regional board shall establish such water quality objectives in water quality control plans as in its judgment will ensure the reasonable protection of beneficial uses and the prevention of nuisance; however, it is recognized that it may be possible for the quality of water to be changed to some degree without unreasonably affecting beneficial uses. Factors to be considered by a regional board in establishing water quality objectives shall include, but not necessarily be limited to, all of the following:*
>
> *(a) Past, present, and probable future beneficial uses of water.*
>
> *(b) Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto.*
>
> *(c) Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area.*
>
> *(d) Economic considerations.*
>
> *(e) The need for developing housing within the region.*
>
> *(f) The need to develop and use recycled water.*

Table 2-2 presents groundwater quality objectives established in the Basin Plan to protect designated beneficial uses of groundwater in the SOCWA service area. Total dissolved solids (TDS) represent a key Basin Plan parameter, as TDS concentrations are typically reflective of other regulated minerals, including chloride, sulfate and sodium. Within the San Juan HU, Basin Plan groundwater TDS concentration objectives (which are not to be exceeded more than 10 percent of the time in any one year) range from 1,200 mg/L in coastal portions of the study area to 500 mg/L in the upper reaches of the study area.

Table 2-2

San Diego Basin Plan Water Quality Objectives

Ground Water Unit	Hydrologic Unit Basin Number	TDS (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Percent Sodium (%)	Nitrate (mg/L)	Iron (mg/L)	Manganese (mg/L)	Methylene Blue-Activated Substances (mg/L)	Boron (mg/L)	Odor	Turbidity (ntu)	Color (Units)	Fluoride (mg/L)
San Juan Hydrologic Unit	901.00													
Laguna Hydrologic Area	901.10													
San Joaquin Hills Hydrologic Sub Area	901.11	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Laguna Beach Hydrologic Area	901.12	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Aliso Hydrologic Sub Area	901.13	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Dana Point Hydrologic Area	901.14	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Mission Viejo Hydrologic Area	901.20													
Oso Hydrologic Sub Area	901.21	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Upper Trabuco Hydrologic Sub Area	901.22	500	250	250	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Middle Trabuco Hydrologic Sub Area	901.23	750	375	375	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Gobernadora Hydrologic Hydrologic Sub Area	901.24	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Upper San Juan Hydrologic Sub Area	901.25	500	250	250	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Middle San Juan Hydrologic Sub Area	901.26	750	375	375	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Lower San Juan Hydrologic Sub Area	901.27	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Ortega Hydrologic Sub Area	901.28	1100	375	450	60	45	0.3	0.05	0.5	0.75	None	5	15	1
San Clemente Hydrologic Area	901.30													
Prima Hydrologic Sub Area	901.31	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Seguna Deshecha Hydrologic Sub Area	901.32	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
San Mateo Canyon Hydrologic Area	901.40	500	250	250	60	45	0.3	0.05	0.5	0.75	None	5	15	1
San Onofre Hydrologic Area	901.50	500	250	250	60	45	0.3	0.05	0.5	0.75	None	5	15	1

2.3 Historical Overview of Recycled Water Use and Regulation in the San Juan Creek Basin

Both the Basin Plan and associated policies to implement Basin Plan water quality objectives have evolved over time, and it is instructive to review this evolution to better understand water quality planning needs and water quality regulation within the San Juan Creek Basin.

Original Basin Plan and Early Implementation. The San Diego RWQCB (hereinafter RWQCB) first adopted the San Diego Region Basin Plan in 1975.[10] The original 1975 Basin Plan designated groundwater uses for the San Juan Basin (Mission Viejo HA 901.2) as "potential" rather than "existing" beneficial uses due to the uncertain nature of the ability of the basin to support extensive groundwater development. Lacking detailed studies on beneficial uses, groundwater quality, and water quality drivers, the 1975 Basin Plan established beneficial uses and groundwater quality objectives based on available information with the understanding that more detailed studies would be performed in the future to develop more appropriate objectives. Chapter 3 of the 1975 Basin Plan notes that:

> *In general the objectives were developed on the basis of existing beneficial uses in the region at the time, the quality of water available in the area, and the potential uses of these waters. In some areas the setting of numerical values was somewhat arbitrary and done so with the intent that future modifications, pending the availability of additional data, would be possible.*

Recognizing the assumed interim role of the 1975 Basin Plan groundwater quality objectives, the objectives were established subject to the provision that:

> *Detailed salt balance studies are recommended for this area to determine limiting mineral concentration levels for discharges.*[11]

Amendments to the Basin Plan in 1978 were implemented to address existing beneficial uses for municipal supply, agricultural supply, and industrial service supply.

Some of the first recycled water use in the San Diego Region began in the San Juan Creek Basin in the 1970s. The 1975 Basin Plan did not provide any specific guidance on regulating recycled water projects and addressing compliance with the interim groundwater quality objectives.

Since many of the 1975 Basin Plan objectives were established as interim values which were expected to be updated in future years to reflect actual observed conditions, the 1975 Basin Plan groundwater quality objectives were largely considered as water quality goals which provided the RWQCB with considerable flexibility in regulating waste discharges. This occurred in contrast to the RWQCB implementation of Basin Plan surface water quality objectives. Basin Plan surface water quality objectives were adopted by EPA as federal water quality standards subject to Clean Water Act regulation and were treated as "not-to-be-exceeded" standards for regulating discharges to surface waters.

---

[10] Comprehensive Water Quality Control Plan for the San Diego Region. State Water Resources Control Board. 1975. Online access: https://babel.hathitrust.org/cgi/pt?id=uc1.31822039185558&view=1up&seq=9

[11] Chapter 4, Table 4-6 of the 1975 Basin Plan (RWQCB, 1975).

In accordance with the Basin Plan directive that “detailed salt balance studies” be used to assess the interim groundwater quality objectives, most early RWQCB recycled water permits utilized a salt balance approach to determine if recycled water projects were consistent with Basin Plan water quality goals. Using this approach, salt loads from all sources would be considered in determining whether a recycled water project was consistent with achieving the Basin Plan groundwater quality goals. Recycled water effluent limits could then be set at appropriate concentration values (including values in excess of the Basin Plan objectives) based on these salt balance assessments.

For dischargers who did not wish to present the requisite salt balance studies, the RWQCB during the 1970s and 1980s informally employed a “one third” rule. Under this concept, in the absence of salt balance studies, the RWQCB assigned recycled water effluent limits at one-third of the corresponding Basin Plan groundwater quality concentration objective. This practice assumed that salt concentrations in recycled waters would be concentrated by a factor of three (due to evapotranspirative effects) as recycled water traveled downward through the root zone.[12] This regulatory approach resulted in circumstances where the RQWCB implemented recycled water TDS effluent limits that were more stringent than the TDS concentrations in the non-regulated[13] imported supplies which would be used in the absence of the availability of recycled water.

1991 Basin Plan Amendments. To address this inconsistency and to provide more clarity on how the RWQCB should regulate recycled water, the RWQCB in 1990 adopted Resolution No. 90-26.[14] Resolution No. 90-26 approved modification of the Basin Plan to implement specific guidance on how the RWQCB should regulate recycled water reuse. After receipt of requirements and direction from the SWRCB, the RWQCB adopted a revised version (RWRCB Resolution No. 90-61) which incorporated modifications to the implementation provisions of the Basin Plan to address recycled water use.[15] The Basin Plan amendments became effective in 1991 upon approval by the SRWCB.[16] The 1991 Basin Plan amendments provided that recycled water effluent limits are to be established in accordance with the following:

1. *The constituent concentration of reclaimed water is not higher than applicable groundwater objectives, and*
2. *The quality ensures protection of beneficial uses, and*
3. *The wastewater will displace the use of imported water used in the area of groundwater having constituent concentrations higher than the applicable groundwater quality objectives in the areas[17].*

[12] This “one-third rule” concentration assumption neglected the fact root zone salts are typically leached downward by precipitation, and precipitation tends to dilute the concentration of salts being transported downward to saturated groundwater.

[13] The RWQCB is empowered to regulate “waste” which is defined to include highly treated recycled water. On the other hand, the use of domestic supply for irrigation use is not considered a waste and the RWQCB does not regulate such domestic irrigation use. Additionally, since TDS is a secondary (aesthetic) drinking water parameter, the SWRCB Division of Drinking Water does not require removal of TDS as part of potable water treatment.

[14] RWQCB Resolution No. 90-26 was adopted on April 23, 1990. (RWQCB, 1990a)

[15] RWQCB Resolution No. 90-61 was adopted on November 5, 1990. (RWQCB, 1990b).

[16] State Water Resources Control Board Resolution 91-10. Approval of an amendment to the Comprehensive Water Quality Control Plan for the San Diego Region Establishing a Regionwide Ground Water implementation Plan for the Use of Reclaimed Water. https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/1991/rs1991_0010.pdf

[17] As set forth in RWQCB Resolution No. 90-61. (RWQCB, 1990b).

Coordinated Recycled Water Use in the San Juan Basin. With the 1991 Basin Plan amendments providing clarity to RWQCB regulation of recycled water, eleven municipalities and water districts (see Table 2-3) formed the South Orange County Reclamation Authority (SOCRA) in 1991 to better coordinate recycled water sharing across jurisdictional boundaries.

Table 2-3
Original Member Agencies
South Orange County Reclamation Authority (SOCRA)

Agencies	Membership Status
Capistrano Beach County Water District	Member
Capistrano Valley Water District	Member
El Toro Water District	Member
Irvine Ranch Water District	Member
Laguna Beach County Water District	Non-Member
Los Alisos Water District	Member
Moulton Niguel Water District	Member
City of San Clemente	Non-Member
Santa Margarita Water District	Member
South Coast Water District	Member
Trabuco Canyon Water District	Member

SOCRA was formed with the support of the RWQCB through Resolution 91-76[18], which stated the SOCRA would:

1. *Act as a single agency responsible for compliance with one set of standard waste discharge requirements within the Aliso Water Management Agency and the Southeast Regional Reclamation Authority basins.*
2. *Develop a structure between the Regional Board and SOCRA that provides for the eventual participation of all reclaimed water purveyors in Region 9 South Orange County.*
3. *Develop water reclamation requirements between SOCRA, its member agencies, and end users incorporating minimum standard regulations for the delivery and use of reclaimed water, reclaimed water quality specifications, plan review and construction inspection procedures, user permit requirements, operational certification requirements, and distribution agreements.*
4. *Provide for monitoring and periodic inspections for the activities of SOCRA, its member agencies, and end users with reports to the Regional Board on the status of compliance with Board mandated requirements.*
5. *Encourage the regional planning and design of reclamation facilities so as to maximize cost economics and the availability of reclaimed water supply to users at all times during the year.*

In 1992, the RWQCB adopted Master Recycled Water Order No. 92-67, which consolidated SOCRA member agency recycled water operations in a single permit and implemented provisions of the 1991 Basin Plan amendments. Under this permit, SOCRA assumed responsibilities to coordinate with member agencies to ensure compliance with permit provisions.

1993 Basin Plan Studies. Recognizing inconsistencies between actual groundwater quality and Basin Plan groundwater quality objectives in several of the sub-basins of the San Juan Hydrologic Unit (HU 901),

18 As cited within Nolte and Associates. South Orange County Reclamation Authority Basin Plan Amendments Final Report. July 1993.

SOCRA agencies approached the RWQCB in the early 1990s to assess the potential for modifying the Basin Plan to better support proposed recycled water use. The RWQCB recommended that a study be undertaken to create regionwide standards for the development of recycled water permits in South Orange County. In 1993, Nolte and Associates (Nolte report) were hired to perform the study, which included collection and assessment of monitoring data, salt balance studies and modeling. Two additional drivers of the study included:

- Recycled water demands in some areas exceeded local recycled water production capacity, highlighting the need for SOCRA agencies to be able to share recycled water supplies across jurisdictional boundaries.
- The potential use of recycled water for supplementing natural streamflow and/or the potential use of surface streams to convey recycled water to downstream use sites.

The Nolte report assessed existing and planned recycled water use and the potential effects of proposed increase recycled water use on basin groundwater quality. The Nolte report (which focused on sub-basins within which recycled water use was proposed) concluded that recycled water was only one of many influences on groundwater quality, and that:

Modeling has shown that the impacts due to proposed water reclamation are relatively small[19].

Along with the modeling, the Nolte report assessed available water quality data, presented salt balance projections, and concluded that modification of Basin Plan groundwater quality objectives were appropriate given existing groundwater quality and the need to support planned recycled water use in the downstream portion of the Mission Viejo HA. SOCRA requested that the RWQCB modify the Basin Plan to implement the Nolte report recommendations.

1994 Basin Plan Amendments. In 1994, the RWQCB completed a comprehensive review of the Basin Plan and adopted significant revisions to Basin Plan implementation policies.[20] Implementation procedures for establishing recycled water effluent limits were revised as follows:

1. *For discharges upgradient of municipal water supply reservoirs the Regional Board shall adopt numerical levels no lower than the quality of the basin's water supply but no higher than the Basin Plan ground water quality objective.*
2. *In groundwater basins not upgradient of municipal water supply reservoirs, the Regional Board shall adopt numerical effluent limitations for constituents at levels no lower than the quality of the basin's water supply concentration plus an incremental increase equal to the typical incremental increase added to the water supply as a result of domestic use. The effluent limitations shall be no higher than the Basin Plan ground water quality objective.*
3. *For discharges where the discharger has demonstrated sufficient assimilative capacity exists and groundwater quality objectives will not be exceeded, the Regional Board may consider adoption of numerical effluent limitations for constituents based on the discharge quality and assimilative capacity analysis results.*[21]

[19] Nolte and Associates. South Orange County Reclamation Authority Basin Plan Amendments Final Report. July 1993.

[20] RWQCB Resolution No. 94-10 (adopted on September 8, 1994) approved the Basin Plan modification. (RWQCB, 1994).

[21] See Chapter 4 (Implementation) of the Basin Plan.

The 1994 Basin Plan modifications also relaxed boron groundwater quality objectives within the San Juan HU (901) from 0.5 mg/L to 0.75 mg/L. Further, perhaps in consideration of the 1993 Nolte study, the 1994 Basin Plan modifications removed the qualifier from the San Juan Basin groundwater quality objectives that “detailed salt balance studies are recommended to determine limiting mineral concentrations.”

Adoption of Order No. 97-52. Revisions to the Basin Plan adopted in 1994[22] addressed some of the recycled water issues identified in the Nolte report, but more extensive water quality, salt balance and assimilative capacity studies relating to the San Juan Creek Basin were presented to the RWQCB in 1997 as part of a SOCRA Report of Waste Discharge for updated master recycled water requirements. Order No. 97-52, adopted by the RWQCB in 1997, established master water reclamation requirements for SOCRA member agencies.[23]

Order No. 97-52 established uniform recycled water effluent limits throughout the SOCRA service area and allowed SOCRA member agencies to transport recycled water supplies across jurisdiction boundaries. Recycled water effluent limits established in Order No. 97-52 were based on salt balance, environmental studies, and assimilative capacity studies presented in the SOCRA Report of Waste Discharge that documented that planned recycled water use by SOCRA member agencies was consistent with implementing Basin Plan groundwater quality objectives. Table 2-4 summarizes recycled water use permitted within Order No. 97-52.

The discharge effluent limits and monitoring requirements of Order No. 97-52 have provided the basis for the implementation and regulatory oversight of recycled water use in South Orange County for more than a quarter century. SOCWA was formed in 2001 with the merger of SOCRA and the Aliso Water Management Agency, and since that time SOCWA has assumed responsibilities for coordinating with its member agencies to comply with the provisions of Order No. 97--52.

Water Agency Planning Efforts. For more than 50 years, water agencies within the San Juan Creek Basin have been engaged in groundwater assessment and groundwater management studies to attempt to optimize available groundwater resources. Management of the San Juan Basin has largely occurred through the San Juan Basin Authority (SJBA).[24] The SJBA mission 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,*

---

22 RWQCB Order No. 94-10, A Resolution Adopting an Update to the Water Quality Control Plan for the San Diego Basin.

23 Order No. 97-52 originally established requirements for the Capistrano Beach Water District, Capistrano Valley Water District, El Toro Water District, Irvine Ranch Water District, Los Alisos Water District, Moulton Niguel Water District, Santa Margarita Water District and Trabuco Canyon Water District. Addendum No. 1 added the South Coast Water District to the permit. Addendum No. 2 addressed the Irvine Ranch Water District taking over recycled water obligation from the Los Alisos Water District. Addendum No. 5 removed the Irvine Ranch Water District and El Toron Water District from the permit.

24 The San Juan Basin Authority is a joint powers agency created in 1971 to carry out water resources development in the San Juan Basin. Current SJBA member agencies include the Santa Margarita Water District and South Coast Water District.

including, but not limited to, the natural resources, fish and wildlife, infrastructure improvements, and the cultural heritage of the area.

SJBA water management efforts have, in part, included:

- Providing treatment to use the poor quality groundwaters within the coastal portions of the Mission Viejo HA as a source of municipal supply.
- Studying the lower portion of the basin to understand salt load sources, salt balances and potential groundwater management opportunities.
- Implementing groundwater management strategies in the lower portions of the basin to manage basin pumping, optimize recharge and stabilize groundwater quality to optimize available groundwater resources.

It should be noted that past groundwater optimization efforts conducted by the SJBA water agencies have largely been directed toward ensuring that adequate groundwater supply is available. Since municipal supply is derived using demineralization treatment of groundwater, groundwater quality has been a lesser management concern than groundwater availability.[25]

[25] As noted, TDS is a secondary (aesthetic) drinking water parameter, and TDS removal is not required as part of potable water treatment. SOCWA member agencies that implement groundwater production in the Lower San Juan Basin, however, implement demineralization treatment for a portion of the extracted groundwater to lower TDS concentrations in the potable supply and satisfy customer aesthetic preferences.

Table 2-4
Recycled Water Flows and Effluent Limits Established in RWQCB Order No. 97-52[A]

Hydrologic Area	HSA No.	HSA Name	Volume of Annual Recycled Water Use Allowed Under Order No. 97-52 (AFY)	Groundwater TDS Objective (mg/L)	Uniform Effluent TDS Concentration Limit Established in Order No. 97-52 (mg/L)
Laguna[B] (901.1)	901.11	San Joaquin Hills	0	1200	1000 (annual average) 1100 (daily maximum)
	901.12	Laguna Beach	1026	1200	
	901.13	Aliso	10,494	1200	
	901.14	Dana Point	5,804	1200	
Mission Viejo (901.2)	901.21	Oso	7,168	1200	
	901.22	Upper Trabuco	420	500	
	901.23	Middle Trabuco	4,232 [C]	750	
	901.24	Gobernadora	4,148	1200	
	901.25	Upper San Juan	977	500	
	901.26	Middle San Juan	0	750	
	901.27	Lower San Juan	4.396	1200	
	901.28	Ortega	2,758	1100	
San Clemente [B] (901.3)	901.31	Prima Deshecha	3,890	1200	
	901.32	Segunda Deshecha			
San Mateo (901.4)	---	---	837 [D]	500	

Table 2-2 Notes:

A Order No. 97-52 originally regulated recycled water use by SOCRA member agencies. Subsequent addenda established SOCWA as the succeeding discharge agency.

B The Laguna watersheds (HSAs 901.11, 901.12, 901.13 and 901.14) and San Clemente watersheds (HAs 901.31 and 901.32) do not have any significant groundwater resources, are not identified as groundwater basins within DWQ Bulletin No. 118, are designated by the RWQCCB as “Tier D” basin which do not require SNMPs.

C The Trabuco Creek barrier diverts poor quality surface flow from the Middle Trabuco HSA to protect downstream groundwater.

D A small portion of the City of San Clemente is tributary to the San Mateo HA, but a groundwater barrier exists to prevent applied water from the SOCWA service area from impacting the San Mateo Basin.

Salt and Nutrient Management Planning. The SWRCB in 2009 adopted a statewide Recycled Water Policy.[26] The 2009 Recycled Water Policy established recycled water goals for the state and determined that the appropriate way to address salt and nutrient issues is through the development of stakeholder-driven regional or subregional salt and nutrient management plans (SNMPs) rather than having the RWQCB impose requirements solely on recycled water projects. The 2009 Recycled Water Policy directed that each SNMP be tailored to address the specific water quality concerns and water management opportunities within the basin, and that the SNMPs should:

- Assess water quality and nutrient loads within each basin.
- Identify and evaluate strategies for achieving compliance with Basin Plan water quality objectives.

[26] Resolution No. 2009-011, which established the Recycled Water Policy, was adopted by the SWRCB on February 3, 2009.

The 2009 Recycled Water Policy left it up to stakeholder to define the required degree of specificity in the SNMPs but noted that the SNMP assessment should take into consideration the size and complexity of the basin, aquifer characteristics, water quality, and hydrogeology. The 2009 Recycled Water Policy also directed that RWQCBs to review and approve the SNMPs, but the Policy did not provide specifics on how the RWQCBs were to approve the SNMPs or what criteria the RWQCBs should use in evaluating the plans.

In the absence of specific SWRCB guidance, the San Diego RWQCB and regional stakeholders developed and approved SNMP guidelines in 2010 that categorized San Diego Region groundwater basins into tiers based on groundwater basin capacity, water quality issues, recycled water compliance issues, and level of beneficial use.[27] The guidelines then established recommended SNMP tasks and levels of efforts that were commensurate with the complexity of the basins. Through this process, the lower portion of the San Juan Basin was identified as a "Tier A" basin that required preparation of a SNMP.[28] Narrow, shallow tributary basins within the San Juan Hydrologic Unit were classified as "Tier D" basins which did not warrant SNMP analysis.

Based on these adopted guidelines, SOCWA in 2014 developed a SNMP for the San Juan Basin that was submitted to the RWQCB. Because the 2009 Recycled Water Policy did not specify how the RWQCB was to review and approve the submitted plan, no formal RWQCB action was taken.

As documented in Section 1, the SWRCB updated the Recycled Water Policy in 2018.[29] The 2018 Recycled Water Policy established specific technical guidance on what is to be included in the SNMP, including specific requirements governing salt transport modeling and requirements governing antidegradation analyses. Section 6.2.3 of the 2018 Recycled Water Policy also established specific procedures for RWQCB review and approval of submitted SNMPs, including that the RWQCBs shall review submitted SNMPs and within six months implement one of the following three courses of action:

> *6.2.3.1. The proposed salt and nutrient management plan does not satisfy the requirements of 6.2.4. In this case, the regional water board shall provide specific findings regarding which components in 6.2.4 are not adequately addressed and recommendations for what may need to be included or modified in the proposed salt and nutrient management plan for the regional water board to accept the plan.*
>
> *6.2.3.2. The proposed salt and nutrient management plan satisfies the requirements of 6.2.4, a basin plan amendment is not needed to implement the plan, and the regional water board will accept the plan. In this case, the accepted salt and nutrient management plan will serve as a technical document to support future regional water board decisions.*
>
> *6.2.3.3. The proposed salt and nutrient management plan satisfies the requirements of 6.2.4 and a basin plan amendment will be needed to implement the plan. In this case, the regional water board shall initiate a process to amend the basin plan based on the accepted salt and nutrient management plan and associated documentation.*

---

[27] *Guidelines: Salinity Nutrient management Planning in the San Diego Region* (Welch et. al, 2010) were endorsed by the RWQCB through the adoption of Resolution No. 2010-0125 on November 10, 2010.

[28] This includes the portion of the Mission Viejo HA (16,700 acres) identified by DWR Bulletin 118 as the "San Juan Valley" Basin.

[29] SWRCB Resolution No. 2018-0057 was adopted on December 11, 2018. The Recycled Water Policy became effective on April 8, 2019.

After adoption of the 2018 Recycled Water Policy, SOCWA and stakeholders reviewed the originally submitted 2014 SNMP and identified areas within the 2014 SNMP where updates were necessary to comply with the 2018 Recycled Water Policy. Several sections within the 2014 SNMP were updated and this revised 2020 version of the San Juan Basin SNMP (still largely based on the original submitted 2014 SNMP which addressed 2009 Recycled Water Policy requirements) was submitted to the RWQCB on August 17, 2021.

In correspondence dated December 21, 2021, the RWQCB identified deficiencies (see Table 1-5 in Section 1) in the 2020 SNMP and provided a list of recommendations for updating the SNMP to address the requirements of the 2018 Recycled Water Policy.[30] SOCWA subsequently withdrew the submitted SNMP. Since that time, SOCWA and San Juan Creek Basin stakeholders have been coordinating with the RWQCB to:

- Clarify SNMP requirements established in the 2018 Recycled Water Policy.
- Identify key water quality issues that need to be addressed in the SNMP and strategies for addressing the issues.
- Review the proposed technical work scope and technical approach proposed by SOCWA and regional stakeholders to address the 2018 Recycled Water Policy elements.
- Review the proposed monitoring plan elements required to meet the Regional Board's interpretation of the Policy.
- Review the proposed antidegradation approach based on SOCWA's review of the historical information.

Through this collaborative effort, SOCWA, the RWQCB and regional stakeholders have agreed on an overall task list and approach for preparing an updated SNMP that addresses RWQCB interpretation of Recycled Water Policy requirements. Table 1-5 in Section 1 summarizes key RWQCB comments on the 2021 SNMP and the compliance approach to address the RWQCB's comments within the 2024 SNMP.

Major tasks undertaken by SOCWA as part of the 2024 SNMP effort included:

- Reassessing monitoring data to better characterize groundwater quality, salt sources and water quality issues.
- Identifying planned and proposed water management strategies, including water management actions planned both by San Juan Basin water and recycled water agencies.
- Performing salt fate and transport modeling in the "Tier A" portion of the basin (Lower San Juan Basin).
- Using the salt/transport model to assess the lower basin under existing conditions and under near-term planned water management strategies.
- Revising the proposed monitoring plan to develop data required to address unresolved questions.
- Addressing antidegradation compliance per requirements of the 2018 Recycled Water Policy.

[30] RWQCB (2021b).

As these tasks were being completed, numerous workshops were conducted with RWQCB staff to update RWQCB staff and stakeholders on ongoing work, solicit RWQCB and stakeholder input, and present findings. The result of these coordination efforts is a new 2024 SNMP (presented herein) that focuses on Basin Plan compliance, water management strategies, salt transport modeling projections and antidegradation compliance.

Section 2 References:

California Water Code. Section 13245 (2023).

HDR and Wildermuth Environmental, Inc. 2016. *Salt and Nutrient Management Plan for the South Orange County Aliso Creek, San Juan Creek, and Portions of Other Basins, Phase 2 Services.* Available at: https://www.socwa.com/wp-content/uploads/2016/05/SNMPReport_Final.pdf

Nolte and Associates. 1993. *South Orange County Reclamation Authority Basin Plan Amendments Final Report.*

O'Niel, Stephen. 2002. The Acjachemen in the Franciscan Mission System: Demographic Collapse and Social Change.

Regional Water Quality Control Board, San Diego Region (RWQCB). 2024. About Us. Mission Statement. Available online at: https://www.waterboards.ca.gov/sandiego/about_us/

Regional Water Quality Control Board, San Diego Region (RWQCB). 2021a. Water Quality Control Plan for the San Diego Basin. 1994 (with amendment effective on or before September 1, 2021). https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2018/121118_7_final_amendment_oal.pdf

Regional Water Quality Control Board, San Diego Region (RWQCB). 2021b. Correspondence to SOCWA dated December 21, 2021 regarding South Orange County Wastewater Authority Salt and Nutrient Management Plan for the San Juan Creek Watershed, 2020 Update, August 2021. 12 pages.

Regional Water Quality Control Board, San Diego Region (RWQCB). 1997. *Order No. 97-52. Waste Discharge Requirements and Water Recycling Requirements for the Production and Purveyance of Recycled Water by Member Agencies of the South Orange County Reclamation Authority, Orange County California.* Adopted on October 15, 1997.

Regional Water Quality Control Board, San Diego Region (RWQCB). 1994. A Resolution Adopting an Update to the Water Quality Control Plan for the San Diego Basin. Adopted September 8, 1994.

Regional Water Quality Control Board, San Diego Region (RWQCB). 1992. *Order No. 92-67, South Orange County Reclamation Authority, Consolidation of Requirements.* Adopted on September 12, 1992.

Regional Water Quality Control Board, San Diego Region (RWQCB). 1990b. *Resolution No. 90-61, A Resolution Amending Resolution 90-40, A Regionwide Groundwater Amendment to the Comprehensive Water Quality Control Plan for the San Diego Region.* Adopted on September 20, 1990.

Regional Water Quality Control Board, San Diego Region (RWQCB). 1990a. *Resolution No. 90-40, A Regionwide Groundwater Amendment to the Comprehensive Water Quality Control Plan for the San Diego Region.* Adopted on April 23, 1990.

Regional Water Quality Control Board, San Diego Region (RWQCB). 1979. *Comprehensive Water Quality Control Plan Report: San Diego* (9). 1978 Amendments.

Regional Water Quality Control Board, San Diego Region (RWQCB). 1975. *Comprehensive Water Quality Control Plan Report: San Diego* (9).

State Water Resources Control Board (SWRCB). 1991. Resolution 91-10. Approval of an amendment to the Comprehensive Water Quality Control Plan for the San Diego Region Establishing a Regionwide Ground Water Implementation Plan for the Use of Reclaimed Water. https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/1991/rs1991_0010.pdf

State of California Department of Water Resources (DWR). June 1972. Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104.

State Water Resources Control Board (SWRCB). 1967. *Water Quality Control Policy for Recycled Water.*

Wildermuth Environmental, Inc. 2021. *South Orange County Wastewater Authority Salt and Nutrient Management Plan for the San Juan Creek Watershed, 2020 Update*.

Section 3: Basin Evaluation and Characterization

3.1 SWRCB 2018 Recycled Water Policy

Section 6.1.3 of the SWRCB[1] (2018 Policy) includes the basin evaluation factors that can affect exceedances of water quality objectives, which should be included in each five-year planning cycle. The basin evaluation factors are:

- Magnitude of trends in the concentration of salts and nutrients in groundwater.
- Contribution of imported water and recycled water to the basin water supply.
- Reliance on groundwater to supply the basin or subbasin.
- Population.
- Number and density of on-site wastewater treatment systems.
- Other sources of salts and nutrients, including irrigated agriculture and confined animal facilities.
- Hydrogeological factors, such as regional aquitards, depth to water, and other basin- or subbasin-specific factors.

Section 3 provides the basin evaluation and characterization of the San Juan Creek Basin for compliance with this five-year evaluation cycle. Section 3 begins with the institutional boundaries as the framework for compliance with the 2018 Policy, then systematically evaluates each of the requirements of Section 6.1.3 of the 2018 Policy, and concludes this section with the physical characteristics of the San Juan Creek Basin to lay the groundwork for the water quality information included in Section 4.

3.2 Institutional Boundaries

SOCWA was created on July 1, 2001, as a Joint Powers Authority and is the legal successor to the Aliso Water Management Agency, South East Regional Reclamation Authority, and South Orange County Reclamation Authority. SOCWA operates three treatment plants and two ocean outfalls, in addition to compliance and scientific research programs to meet the needs of its member agencies under the Clean Water Act and National Pollutant Discharge Elimination System (NPDES) permits for the sixteen facility discharges and two combined outfall discharge locations of the San Juan Creek and Aliso Creek watersheds. SOCWA is the lead agency in the development of this SNMP for the SOCWA service area. Substantial portions of the SOCWA SNMP are subject to funding under a State Proposition 84 planning grant. SOCWA is now an eight-member joint powers authority charged with the following mission:

> *South Orange County Wastewater Authority's mission is to collect, treat, beneficially reuse and dispose of wastewater in a manner that protects and respects the environment, maintains the public's health, and meets local, state and federal regulations.*

SOCWA facilitates and manages the transmission, treatment, and disposal of wastewater for more than 500,000 homes and businesses across South Orange County. SOCWA operates under San Diego Region RWQCB (Region 9) Master Reclamation Order No. 97-52 (as amended), which permits over 52,000 acre-feet per year (AFY) of recycled water use within its service area and saves approximately six billion gallons

[1] Regional Water Quality Control Board, San Diego Region (RWQCB). Water Quality Control Plan for the San Diego Basin. 1994 (with amendment effective on or before September 1, 2021). https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2018/121118_7_final_amendment_oal.pdf

of domestic water each year that otherwise would be used for those purposes. This order, adopted in 1997, and its predecessor were founded on regional salt-balance modeling in the early 1990s[2] and consider existing and contemplated basin pumping and treatment projects, urban water recovery facilities, and groundwater recharge projects.

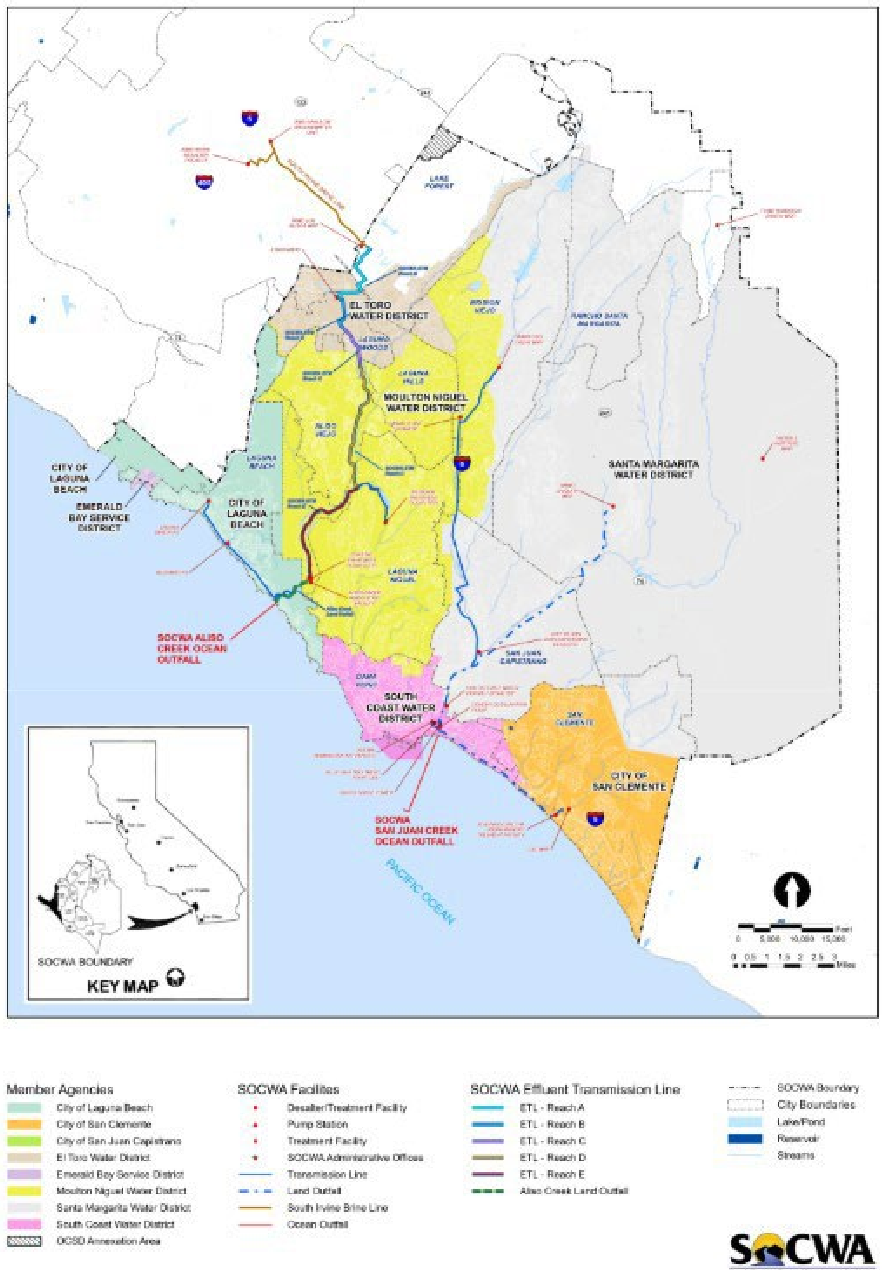


Figure 3-1: SOCWA Service Area and Member Agency Boundaries

[2] Nolte and Associates, SOCWA Basin Plan Amendments Final Report, July 1993

The SJBA is a joint powers authority created in 1971 for the purpose of managing water resources development in the lower San Juan Basin. The mission 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.*

From a water rights perspective, the SWRCB characterizes groundwater in the San Juan Creek Basin as an underground or subterranean stream. As such, groundwater pumping is regulated by the SWRCB as a diversion from surface flow. The SJBA pumps groundwater from the San Juan Groundwater Basin pursuant to Water Rights Permit 21074, which currently allows an annual production of up to 8,026 AFY. Due to high TDS concentrations in the basin due to geologic contributions pre-urban development, all water extracted is pretreated for iron, manganese, and arsenic removal, then treated by reverse osmosis to reduce the TDS concentration to municipal drinking water standards. In compliance with Permit 21074, the SJBA implements a groundwater, surface water, and vegetation monitoring program to collect the data needed to demonstrate the water supply, water quality, and environmental impacts to the basin that result from their diversions. The SJBA coordinates its monitoring and reporting efforts with the SCWD, which also diverts and treats groundwater for municipal use pursuant to a water rights permit from the SWRCB.

Today, the members of the SJBA include the Santa Margarita Water District (SMWD) and the South Coast Water District (SCWD). All member agencies of the SJBA are highly dependent on imported water from the Metropolitan Water District of Orange County (MWDOC). MWDOC supplies consist primarily of water derived from the State Water Project (SWP) and Colorado River Aqueduct (CRA).

In 2010, the SJBA engaged Wildermuth Environmental, Inc. (WEI) to update their San Juan Basin Groundwater Facilities and Management Plan[3] (SJBGFMPP). The draft SJBGFMP was released for public review by the SJBA in July 2013. The report documents the current conditions within the San Juan Basin, the conceptual model of the hydrologic system, the environmental and infrastructure resources in the investigation area, the management goals of the SJBA member agencies, the impediments to achieving the goals, the range of potential management alternatives, the recommended management plan(s), and a monitoring and reporting plan. There are overlapping requirements from the monitoring and reporting plan, which will be addressed in the updated water monitoring program specific to SNMP activities.

3.3 Basin Evaluation Factors

Magnitude of trends in the concentration of salts and nutrients in groundwater. Section 2 in this SNMP included referenced narrative accounts of the indigenous population that demonstrated the historic water management strategies used by the Spanish as they colonized the Basin. Section 4 of the SNMP provides the historical water quality and trends over the previous seventy years to provide the numeric trends in water quality in the San Juan Basin. The numeric water quality monitoring and geologic makeup

[3] Wildermuth Environmental. San Juan Basin Groundwater Facilities and Management Plan. San Juan Basin Authority. November 2013. https://www.sjbauthority.com/assets/downloads/20131126%20FINAL%20SJBA%20SJBGFMP.pdf

of the basin began with the publication of Bulletin 1 by the Department of Water Resources (formerly the Water Resources Board) in 1951 due to the California State Water Resources Act of 1945, enacted to conduct investigations of the water resources of the State.[4] Subsequent DWR surveys expanded the water quality monitoring of the San Juan basin, which is included as a summary in Section 4.

Contribution of imported water and recycled water to the basin water supply. The major source of groundwater supply is the San Juan Basin, but, as covered in the groundwater characterization in Section 3.4 below, the San Juan Basin is too small to provide the needed water supply for the expanded water production needs of the Basin due to the expanded population. The groundwater supply accounts for a maximum of 6% of local water supply as noted in the water supply section below. Agricultural operations represent a dominant use of groundwater within the basin, as untreated groundwater quality is adequate to support the irrigation of most salt-tolerant crops. . Due to increased urbanization, recycled water has become the driving force in water supply portfolio optimization. For example, once planned communities started to expand in South Orange County in the 1960s, Moulton Niguel Water District and Santa Margarita Water District began supplying Title 22 Recycled Water in the 1970's to offset import water demand. This section provides the historic imported water requirements and the development of recycled water in the Basin as a key component of the water supply portfolio.

In 1972, Bulletin 104-7 evaluated over 200 planning scenarios for the San Juan Basin. Bulletin 104-7 projected approximately 90,000 AFY of demand from the San Juan Basin due to population growth. Table 3-2 presents the potable water demands during 1996 through 2022, which ranged from 69,256 AFY in 2019 to 110,693 AFY in 2004.[5] Conservation measures, including various rebate programs and residential gallons per day per capita standards, have resulted in a water demand that is less than projected in 1972 despite population growth. Figure 3-2 represents the percent of recycled water that offsets the water supply demand. Recycled water is non-potable Title 22 water used for landscape demand for irrigation customers for each agency. Recycled water demand for all agencies comprises 6 to 21% of the total water demand across the San Juan Basin. However, non-domestic supply can account for up to 30% of total water supply for the Trabuco Canyon Water District.

4 California Department of Water Resources. Bulletin 1. 1951.

5 Metropolitan Water District of Orange County (MWDOC). Data tables obtained from personal communication from data request.

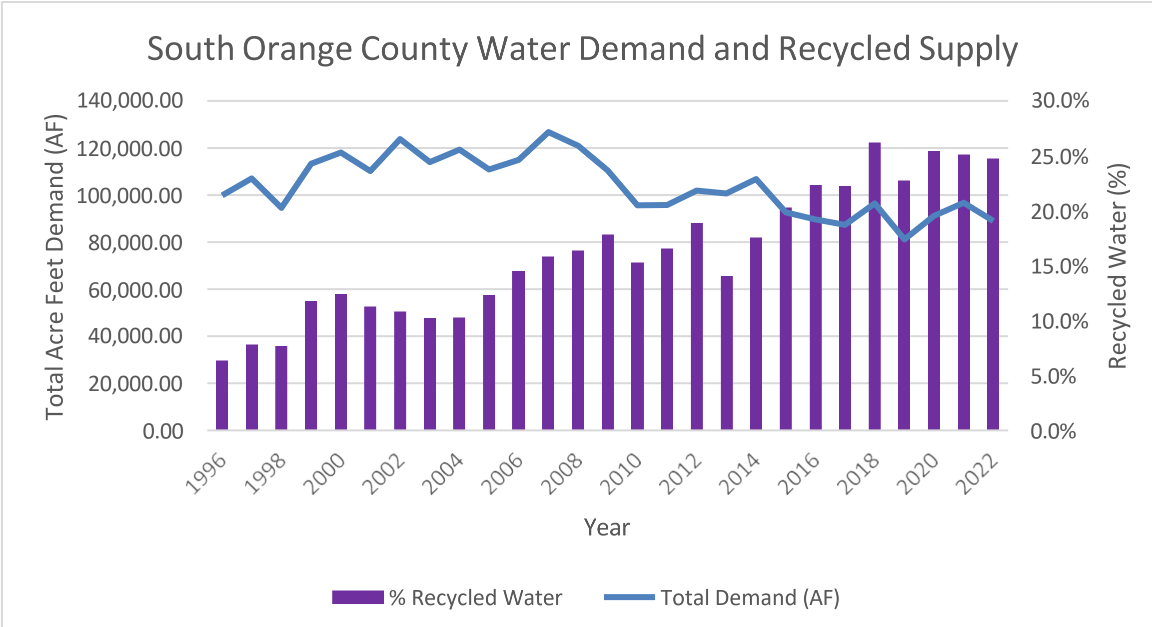


Figure 3-2: Recycled Water as a Percent of Total Potable Water Demand

Significant investment in purple pipe infrastructure to offset imported water demand is a time-intensive and financially intensive investment that retail water agencies make, which requires planning, oversight, and management of recycled water users under member agency Rules and Regulations for the safe distribution of recycled water in the SOCWA service area. SOCWA is the responsible authority under Order 97-52 to ensure that member agencies adhere to their Rules and Regulations. Annually, member agencies submit Recycled Water use reports by hydrologic subarea to SOCWA, which include violation summaries that may occur.

Recognizing the value of recycled water as an element in the overall water supply portfolio, SOCWA agencies have engaged in a concentrated effort to increase water reclamation. Despite population growth within the past 25 years, increased recycled water production has reduced annual average treated wastewater flows discharged via effluent transmission mains to the ocean. Figure 3-3 illustrates the steady increase in recycled water production in the San Juan Basin area from 1996 through 2022.

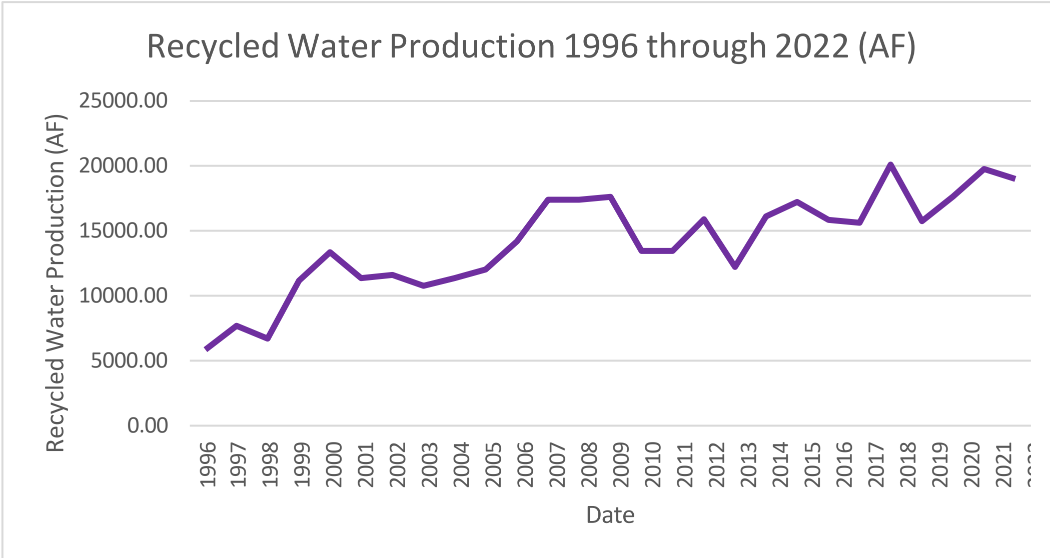


Figure 3-3: Recycled Water Production from 1996 through 2022

Figure 3-3 illustrates a fourfold increase in recycled water production over 26 years. Reservoirs and recycled water distribution systems need to be constructed to match the demand due to the use of recycled water for irrigation purposes. For example, Figure 3-4 includes the average demand per HSA from 2016 through 2022. Many factors, including recycled water distribution infrastructure, climate conditions, and land use requirements, impact demand within each HSA. Table 3-1 provides the sum, average, and maximum usage statistics for recycled water production by HSA from 2016 through 2022. Imported water demands during this 2016-2022 period have been offset by more than 100,000 acre-feet of recycled water production.

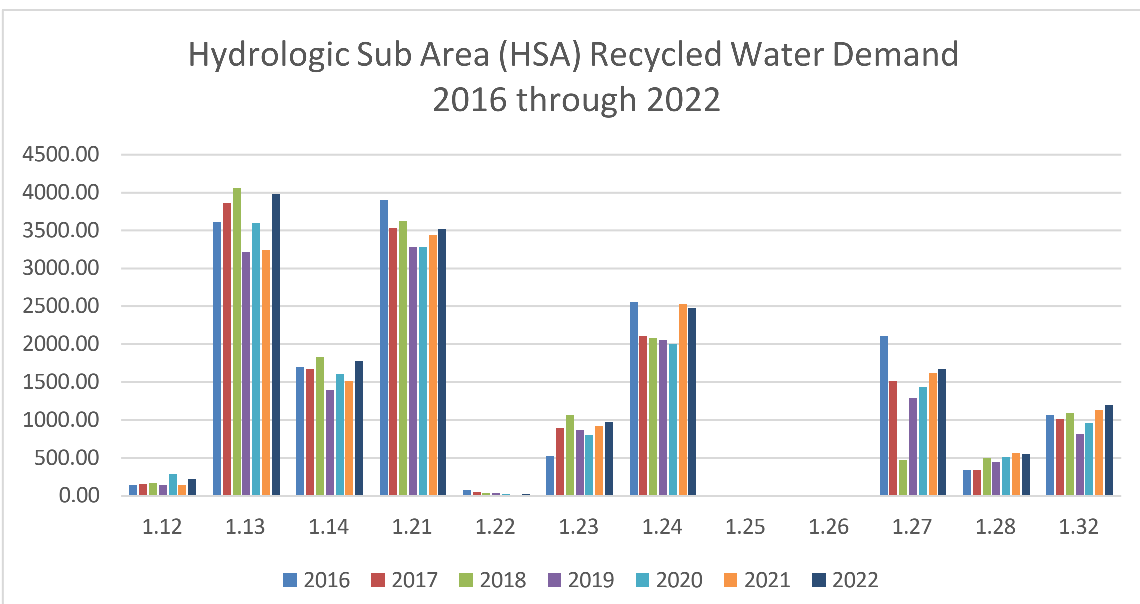


Figure 3-4: Recycled Water by HSA

Table 3-1
HSA Production from 2016 through 2022

Hydrologic Sub Area (HSA)	2016	2017	2018	2019	2020	2021	2022	Sum (AF)	Average Usage (AF)	Maximum Usage (AF)
1.12	144	155	167	135	284	144	225	1254	179	284
1.13	3607	3865	4057	3210	3597	3237	3982	25555	3651	4057
1.14	1700	1669	1826	1400	1608	1508	1771	11483	1640	1826
1.21	3903	3536	3628	3275	3282	3442	3523	24589	3513	3903
1.22	69	42	30	30	17	16	21	225	32	69
1.23	515	897	1066	868	794	915	974	6030	861	1066
1.24	2554	2108	2084	2048	1997	2524	2473	15787	2255	2554
1.25										
1.26										
1.27	2099	1519	471	1287	1432	1613	1675	10095	1442	2099
1.28	345	341	501	450	510	565	556	3267	467	565
1.32	1064	1013	1092	813	964	1133	1192	7271	1039	1192
Agency Total (Acre Feet)	16000	15144	14923	13516	14486	15098	16391	105557	15080	

Maximum allowable recycled water usage in each HAS is regulated within Order 97-52. Order 97-52 was established to allow agencies to share recycled water across jurisdictional boundaries and to standardize the water quality standards across the watersheds. The Nolte report provided the allowable limits of recycled water based on each HAS based on modeling per basin, which was included in the updated Order 97-52. It is important to note that from 1997 through 2023, there have been no exceedances of recycled water deliveries based on maximum limits owing to the significant financial investment for new purple pipe infrastructure or retrofitting recycled water infrastructure to meet additional supply needs. Table 3-2 provides summary information per HSA, Responsible Member Agencies, Maximum Use between 2016 and 2022, and the difference between maximum use and permit allowable in the San Juan Basin.

Table 3-2
SOCWA Member Agency Allowable and Maximum Recycled Water Used by HSA

Subbasin within the San Juan Hydrologic Unit (901.00)	Basin Number	Agency	Order 97-52 Maximum Allowance	2016-2022 Maximum Use (AF)	Difference (AF) between Allowable under Order 97-52 and Maximum Use
Laguna Hydrologic Area	1.1				
San Juan Hills	1.11	CLB	0		
Laguna Beach	1.12	CLB, ETWD, MNWD, SCWD	1026	284	742
Aliso Creek	1.13	CLB, ETWD, IRWD, MNWD, SCWD, SMWD, TCWD	10494	4057	6437
Dana Point	1.14	MNWD, SCWD	5804	1826	3978
Mission Viejo Hydrologic Area	1.2				
Oso	1.21	CSJC, ETWD, MNWD, SMWD, TCWD	7168	3903	3265
Upper Trabuco	1.22	TCWD	420	69	351
Middle Trabuco	1.23	CSJC, MNWD, SMWD, TCWD	4232	1066	3166
Gobernadora	1.24	SMWD, TCWD	4148	2554	1594
Upper San Juan	1.25	SMWD, TCWD	977		977
Middle San Juan	1.26	SMWD	0		0
Lower San Juan	1.27	CSC, CSJC, MNWD, SCWD, SMWD	4396	2099	2297
Ortega	1.28	CSJC, SMWD	2758	565	2193

Reliance on groundwater to supply the basin or subbasin. As early as approximately 250 years ago[6], the main seat of water supply was the confluence of the San Juan Creek and Arroyo Trabuco Creek for the early agricultural operation and water supply needs of early settlers. The San Juan Basin provides drinking water supplies approximately 5% of the drinking water needs for the Santa Margarita Water District and the South Coast Water District based on water rights and historical usage in the basin. The upper reaches of Arroyo Trabuco Creek also provided a small amount of groundwater for early, post-indigenous settlement, and continues to the present day, producing 279 AF of ground water for the Trabuco Canyon Water District (TCWD)[7], available seasonally based on climate conditions. Due to the expanded population's drinking water needs and the limited supply of drinking water in the upper reaches of Arroyo Trabuco, less than 6% of the drinking water from seasonal production wells is utilized to supply the water for Trabuco Canyon Water District. The inability of the San Juan Basin to produce a local supply of groundwater has driven agencies to utilize recycled water to offset irrigation demand, resulting in up to 30% of recycled water in the supply portfolios. The population projections through 2035 by the SJBA

6 O'Niel, Stephen. The Acjachemen in the Franciscan Mission System: Demographic Collapse and Social Change. 2002. p.ii.

7 TCWD Urban Water Management Plan. 2021: https://www.tcwd.ca.gov/home/showpublisheddocument/2616/637618584038870000MNWD

provides additional insight into the reliance on groundwater to meet population demands, as indicated below.

Population. Each SOCWA member agency must provide reports of their supplies by the Urban Water Management Plans (UWMPs). The UWMPs for each agency is provided by reference[8] and each contains the population, water demand projections, and the water supplies for expanding populations. Each UWMP also provides references for groundwater available to offset imported water demand. Locally, the SJBA assists with managing and monitoring the pumping from the San Juan Creek Basin and compliance with SMWD and SCWD water rights. In 2013, the SJBA[9] provided alternatives analysis for the groundwater basins, including a total of the current and projected water demand.

As reported by the SJBA from data from 2010 and projected through 2035, local agencies have a combined service area population of about 406,200 and a total water demand of about 86,400 AFY. Of this, 84 percent (about 72,300 AFY) is potable water demand, and 16 percent (about 14,100 AFY) is non-potable demand. Imported water satisfies most of the San Juan Basin area's potable water demand at about 69,600 AFY, compared to the 3,000 AFY produced from the San Juan Creek Basin. Non-potable demands of about 14,100 AFY are met with recycled water (about 11,700 AFY), local surface water diversions (about 2,000 AFY), and San Juan Basin Groundwater (400 AFY). By 2035, the population served by SJBA's portable water production is projected to increase to about 486,500 with a total water demand of about 106,400 AFY.

Compared to current conditions, the future ratio of potable to non-potable water demands is expected to decrease, primarily due to the planned increase in recycled water reuse by the SJBA member agencies: potable demands will account for about 76 percent (81,100 AFY) of the total demand and will be met with a mix of imported water (about 72,200 AFY) and groundwater from the San Juan Creek Basin (8,900 AFY), and non-potable demands will account for about 24 percent (25,300 AFY) of the total demand. They will be met with a mix of recycled water reuse (20,600 AFY), local surface water diversions (2,700 AFY) and untreated groundwater (2,700 AFY).

Since the early 1960s, the South Orange County area has become one of California's fastest growing urban development areas. From the coastline, development has expanded eastward. Although only 25 percent of the 134,000-acre SOCWA study area is developed, most of this development is concentrated within the northwestern portion of the basin. Developed land use is primarily urban residential with commercial

---

8 Based on information presented in the following Urban Water Management Plans:
(1) TCWD Urban Water Management Plan. 2021: https://www.tcwd.ca.gov/home/showpublisheddocument/2616/637618584038870000MNWD,
(2) MNWD Urban Water Management Plan 2021: https://www.mnwd.com/wp-content/uploads/2021/12/2020-Urban-Water-Management-Plan.pdf,
(3) SMWD Urban Water Management Plan. 2021: https://www.smwd.com/DocumentCenter/View/3156/2020-Urban-Water-Management-Plan,
(4) CSJC Urban Water Management Plan. 2015: http://sjc.granicus.com/MetaViewer.php?view_id=3&clip_id=1276&meta_id=70855,
(5) CSC Urban Water Management Plan. 2021: https://www.san-clemente.org/home/showpublisheddocument/64986/637612710083430000, and
(6) SCWD Urban Water Management Plan. 2021: https://cms9files.revize.com/scoastwaterdist/Document_center/Open%20Government/UWMP/SCWD%202020%20UWMP%20FINAL-2021.06.29.pdf

9 Wildermuth Environmental;. San Juan Basin Groundwater and Facilities Management Plan/ December 2013. https://www.sjbauthority.com/assets/downloads/20131126%20FINAL%20SJBA%20SJBGFMP.pdf

shopping centers, with parks and golf courses interspersed. The undeveloped portion, the Southern and interior portions, occupies 75 percent of the basin. Agricultural land use now occupies less than 1 percent of the land. A large and mostly undeveloped portion of the watershed is encompassed by the Camp Pendleton Marine Corps Base in northern San Diego County. Other large open space areas are found within local parks, regional parks, and the Cleveland National Forest. Caltrans is a major landowner with jurisdiction over the major freeways that traverse the watershed. Land use coverage information from the Southern California Association of Governments (SCAG)[10] provides information regarding the amount of each type of vegetation that is prevalent within each of the hydrologic subareas. General Plans for the area project a 7 percent increase in population development within the San Juan Hydrologic Unit through 2050.

Number and density of on-site wastewater treatment systems. The SOCWA service area is dominated by planned communities with connections to the sewer systems. However, there are a small number of on-site wastewater treatment systems within the SOCWA service area. As of 2019, there were 11,764 households in San Juan Capistrano, according to the Southern California Association of Governments (SCAG).[11] Through Correspondence[12] with Santa Margarita Water District, approximately 76 properties still use septic systems. This results in approximately 0.65% of households on septic systems, concentrated in the Lower San Juan HSA. This represents a de minimis impact on the ground water basin. However, Santa Margarita Water District is working with City of San Juan Capistrano residents on septic to sewer conversions.

Other salts and nutrients sources, including irrigated agriculture and confined animal facilities. As noted throughout the history of the development of the San Juan Basin, irrigated agriculture was the dominant source of industry in the San Juan Basin. While ranching operations and agriculture have been replaced by residential neighborhoods, horse stables, and riding parks are the dominant source of animal husbandry operations in South Orange County. The National Pollutant Discharge Elimination System (NPDES) regulations define animal feeding operations (AFOs) as operations where animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12 months, and where vegetation is not sustained in the confinement area during the normal growing season [40 C.F.R. § 122.12(b)(1)].[13] The Blenheim Riding Park is the only CAFO within the SOCWA service area due to the facility boarding over 8,000 horses in one year. However, this CAFO is not covered under an NPDES permit currently.

Hydrogeologic factors, such as regional aquitards, depth to water, and other basin- or subbasin-specific factors. The San Juan Basin is a shallow, alluvial basin with a recharge and turnover of available water of 1.5 to 4 years and is covered in more detail in Section 4 of the SNMP. The Basin Characterization excerpt within this section provides a complete overview of the hydrologic factors that contribute to the basin's groundwater storage capacity and water quality.

[10] Southern California Association of Governments (SCAG) Regional Data Platform. https://hub.scag.ca.gov/

[11] Southern California Association of Governments. The 2024 Regional Transportation Plan/Sustainable Communities Strategy. Local Data Exchange (LDX) Process Data/Book for the City of San Juan Capistrano. Southern California Association of Governments. Draft. May 2022. https://scag.ca.gov/sites/main/files/file-attachments/p0222-san-juan-capistrano.pdf?1655311406

[12] Personal correspondence between Don Bunts and Amber Baylor. December 2023.

[13] Concentrated Animal Feeding Operation, NPDES permit requirements. https://www.waterboards.ca.gov/rwqcb7/water_issues/programs/cafo/

The remainder of Section 3 contains the basin characterization, which provides the physical components of the basin and subbasins in the SOCWA service area as a basis for the water quality characterization included in Section 4.

3.4 Basin Characterization

The United States Geologic Survey, under the United States Department of the Interior, created numerical codes for river-basin units in the United States[14] to standardize hydrologic surveys resulting from efforts as early as 1910:

> *For the purpose of uniformity in presentation of reports, a general plan has been agreed upon by the U.S. Reclamation Service, the US. Weather Bureau, and the U.S. Geological Survey, according to which the area of the United States has been divided into 12 parts whose boundaries coincide with certain natural drainage areas (US Geological Survey, 1910, p. 10)*[15]

The naming conventions that resulted from the earlier surveys were consolidated into the hydrologic unit (HU) and hydrologic unit codes (HUC) and numerical system that present information on the drainage, culture, hydrography and hydrologic boundaries of the 21 major water-resource regions and the 222 subregions designated by the U.S. Water Resources Council, the 352 accounting units of the USGS's National Water Data Network and the 2,149 cataloging units of the USGS's "Catalog of Information on Water Data." The hydrologic units and subareas relevant to this watershed are coded as the 901.00 series and comprise five basins, with associated water quality basin plan objectives identified in Table 3-3 below.

The 2014 SNMP[16] and SJBA[17] reports provide a robust overview of the watersheds within the San Juan HU.[18] The SOCWA SNMP is included in the South Orange County Integrated Regional Watershed Management Program (IRWM), which provides a map that delineates the SOCWA boundaries and the watersheds within SOCWA's boundaries. A map of the boundaries is included in Figure 3-5. For this update, this SNMP includes a review of the watersheds both in the San Juan Creek Watershed and surrounding watersheds due to the ability of recycled water to be shared across watershed boundaries and for the expressed purposes of standardization of recycled water quality limits at reclamation facilities across watershed boundaries.[19] The subsections below contain physical descriptions of the watersheds and information about applicable groundwater basins in each sub-watershed.

---

[14] U.S. Geological Survey Water Supply Paper. https://pubs.usgs.gov/wsp/wsp2294/

[15] Seaber, Paul, Lapinos, Paul, Knapp, George. Water Supply Paper, USGS. https://pubs.usgs.gov/wsp/wsp2294/html/pdf.html

[16] South Orange County Wastewater Authority (2014). Salt and Nutrient Management Plan. Section 3.0. https://www.socwa.com/wp-content/uploads/2016/05/SNMPReport_Final.pdf

[17] San Juan Basin Authority Facilities and Groundwater Management Plan. 2013. San Juan Basin Authority. http://www.sjbauthority.com/assets/downloads/20131126%20FINAL%20SJBA%20SJBGFMP.pdf

[18] South Orange County Wastewater Authority (2014). Salt and Nutrient Management Plan. Section 3.0. https://www.socwa.com/wp-content/uploads/2016/05/SNMPReport_Final.pdf

[19] San Diego Regional Water Quality Control Board Order No. R9-2012-0026.

Table 3-3
Basin Plan Groundwater Quality Objectives for the San Juan Hydrologic Unit (901.1) [A]

Ground Water Unit	Hydrologic Unit Basin Number	TDS	Chloride	Sulfate	Percent Soduim	Nitrate	Iron	Manganese	Methylene Blue-Activated Substances	Boron	Odor	Turbidity (ntu)	Color (Units)	Fluoride
San Juan Hydrologic Unit	901.00													
Laguna Hydrologic Area	1.10													
San Joaquin Hills Hydrologic Sub Area	1.11	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Laguna Beach Hydrologic Area	1.12	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Aliso Hydrologic Sub Area	1.13	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Dana Point Hydrologic Area	1.14	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Mission Viejo Hydrologic Area	1.20													
Oso Hydrologic Sub Area	1.21	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Upper Trabuco Hydrologic Sub Area	1.22	500	250	250	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Middle Trabuco Hydrologic Sub Area	1.23	750	375	375	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Gobernadora Hydrologic Hydrologic Sub Area	1.24	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Upper San Juan Hydrologic Sub Area	1.25	500	250	250	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Middle San Juan Hydrologic Sub Area	1.26	750	375	375	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Lower San Juan Hydrologic Sub Area	1.27	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Ortega Hydrologic Sub Area	1.28	1100	375	450	60	45	0.3	0.05	0.5	0.75	None	5	15	1
San Clemente Hydrologic Area	1.30													
Prima Hydrologic Sub Area	1.31	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
Seguna Deshecha Hydrologic Sub Area	1.32	1200	400	500	60	45	0.3	0.05	0.5	0.75	None	5	15	1
San Mateo Canyon Hydrologic Area	1.40	500	250	250	60	45	0.3	0.05	0.5	0.75	None	5	15	1
San Onofre Hydrologic Area	1.50	500	250	250	60	45	0.3	0.05	0.5	0.75	None	5	15	1

Table 3-1 Notes:
A From Table 3-10 of the Basin Plan. Water quality objective not to be exceeded more than 10 percent of the time during any one-year period.

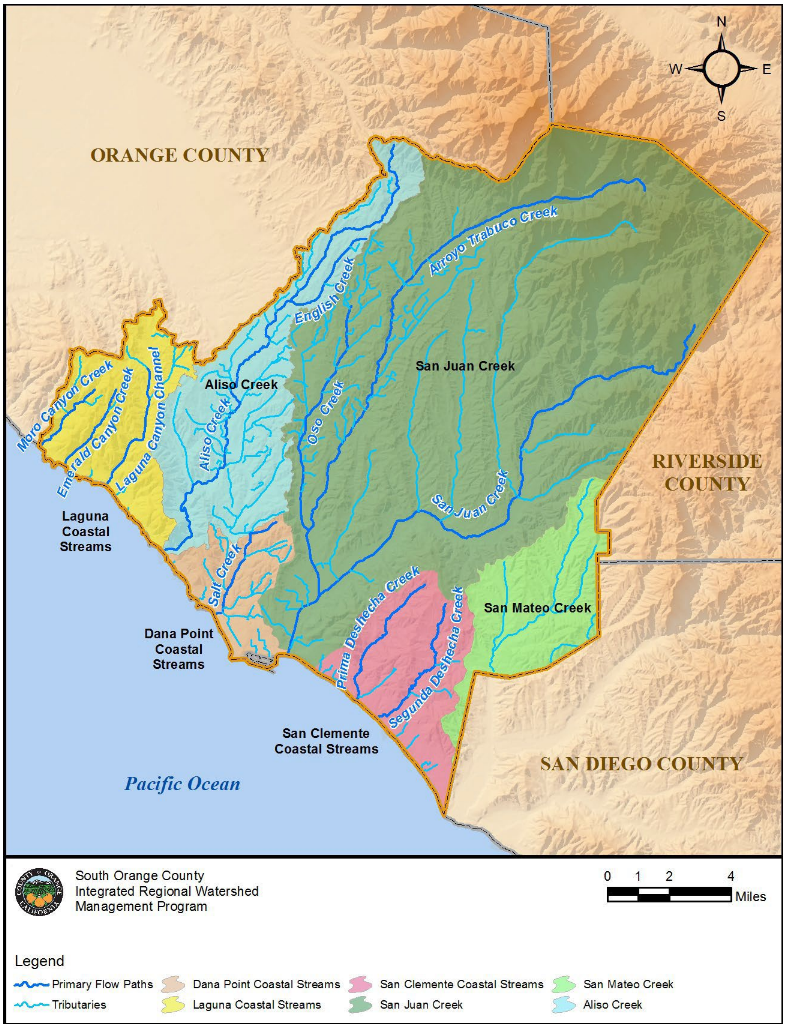


Figure 3-5: IRWM Plan boundaries within the SOCWA Service Area

Laguna Coastal Streams Watershed. The Laguna Coastal Streams watershed lies within the Laguna subunit of the San Juan Hydrologic Unit (designated HSAs 1.11 and 1.12). The watershed consists of the Laguna Canyon Creek watershed and several smaller coastal-draining watersheds adjacent to it. Laguna Canyon Creek runs north to south, directly through the middle of its watershed, and ultimately discharges into the Pacific Ocean at Laguna Beach.

The 11-square-mile watershed includes portions of the cities of Aliso Viejo, Laguna Beach, and Laguna Woods. Undeveloped areas include the Laguna Coast Wilderness Park and the Aliso and Wood Canyons Regional Park. Currently, no potable water supply is drawn from these surface waters, and no groundwater resources are associated with this watershed. Therefore, in accordance with criteria established in the Region 9 Salt and Nutrient Management Plan Guidelines, this sub-basin is defined as a "Tier D" groundwater basin where recycled water use is compliant with existing Basin Plan groundwater quality objectives and, as such, does not require the preparation of salt and nutrient management plans.

Aliso Creek Watershed. The Aliso Creek watershed falls under the Laguna subunit of the San Juan Hydrologic Unit (designated HSA 1.13). The watershed encompasses a drainage area of approximately 30 square miles, extending 19 miles from the foothills of the Santa Ana Mountains to the Pacific Ocean south of Laguna Beach. The watershed includes tributaries from Wood Canyon, Sulphur Creek, Aliso Hills Channel, Dairy Fork, Munger Creek, and English Canyon. Residential developments within the watershed include portions of Lake Forest, Laguna Beach, Foothill Ranch, Portola Hills, Mission Viejo, Laguna Hills, Aliso Viejo, and Laguna Niguel. As the region became heavily urbanized, Aliso Creek flows were significantly increased due to urban runoff. As reported in the 1993 SOCWA Basin Plan Amendment Final Report, the Aliso Creek watershed has limited water-bearing formations and has historically been a poor and unreliable source of groundwater.

The groundwater quality objective for this basin at that time was 3,500 mg/L of TDS, reflecting the historically poor water quality. Three aquifers exist: a shallow alluvial aquifer in the upper basin above Interstate 5, a deeper aquifer in the upper basin, and a shallow alluvial aquifer in the lower basin downstream of Interstate 5. The two alluvial aquifers are separated by a shale formation in the vicinity of I-5. The upper aquifer has formed in alluvial deposits that average about 50 feet in depth under the Aliso Creek bed. The lower aquifer is shallow and almost reaches the surface in many locations, likely because of the restricted canyon outlet to the ocean. Groundwater pumping is limited in the Aliso Creek Watershed as withdrawals run the risk of allowing saltwater intrusion into the aquifer. Therefore, in accordance with criteria established in the Region 9 Salt and Nutrient Management Plan Guidelines[20], this subbasin is defined as a "Tier D" groundwater basin where recycled water use is in compliance with existing Basin Plan groundwater quality objectives and, as such, does not require the preparation of salt and nutrient management plans.

Dana Point Coastal Streams Watershed. Dana Point Coastal Streams watershed falls under the Laguna subunit of the San Juan Hydrologic Unit (designated HSA 1.14). The main tributary of the Dana Point Coastal Streams Watershed is Salt Creek, which ultimately drains to the Pacific Ocean. The six-square-mile watershed is almost entirely developed, and therefore highly influenced by stormwater flows. Currently, no potable water supply is drawn from these surface waters, and no groundwater resources are associated with this watershed. Therefore, in accordance with criteria established in the Region 9 Salt and Nutrient Management Plan Guidelines, this subbasin is defined as a "Tier D" groundwater basin where recycled water use is in compliance with existing Basin Plan groundwater quality objectives and, as such, does not require the preparation of salt and nutrient management plans.

San Juan Creek Watershed. The San Juan Creek Basin watershed is the largest of the six sub-watersheds within the SOCWA service area. San Juan Creek Basin falls under the Mission Viejo subunit of the San Juan Hydrologic Unit (designated HSAs 901.21-901.28). The San Juan Creek watershed is located on the western flank of the Santa Ana Mountains. The San Juan Creek headwaters originate in the Cleveland National Forest near the Orange/Riverside County border at an elevation of approximately 3,300 feet above sea level and flow approximately 29 miles south-southwest to the Pacific Ocean at Doheny State Beach in Dana Point. The total watershed drainage area covers approximately 175 square miles. The

[20] Regional Water Quality Control Board, San Diego Region (RWQCB). 2010. *Guidelines, Salinity and Nutrient Management Planning in the San Diego Region*. Prepared by Michael R. Welch, Ph.D., P.E. Adopted by the RWQCB (via Order No. R9-2010-0126) on November 10, 2010.

upper third of the watershed is extremely rugged, with steep slopes and deep-cutting narrow canyons with minor tributaries from these areas flowing out from sharp canyons. The center third is dominated by rolling hills, and the downstream third is a highly developed floodplain. As the streams come out of the canyon mouth, they widen into several alluvial floodplains. These floodplains comprise the alluvial sediments that are the San Juan Creek groundwater basin. The land rises from sea level, where San Juan Creek discharges to the Pacific Ocean, to 5,687 feet at Santiago Peak. There are three principal creeks that drain the watershed: Oso Creek, the Arroyo Trabuco, and San Juan Creek. These sub-watersheds were recently described in the San Juan Creek Watershed Hydrology Study by PACE Engineering[21] and are summarized below:

San Juan Creek. The mainstem channel originates at an elevation of approximately 3,300 feet above sea level in the Santa Ana Mountains and flows approximately 29 miles southwesterly into the Pacific Ocean. The drainage area, excluding Trabuco and Oso Creeks, is approximately 122 square miles. The major tributaries to San Juan Creek (from upstream to downstream, respectively) include Decker Canyon, Long Canyon, Bear Canyon, Lion Canyon, Hot Spring Canyon, Cold Spring Canyon, Lucas Canyon, Bell Canyon, Verdugo Canyon, Cañada Gobernadora, Cañada Chiquita, Horno Creek, and Arroyo Trabuco. The main channel of San Juan Creek remains mainly in a natural condition except for the downstream 2½ miles, which is an improved trapezoidal channel with concrete side slopes and an earthen bottom. In non-storm conditions, surface flows in San Juan Creek are predominantly from dry-weather urban runoff and climate driven episodic rising groundwater. Upstream of its confluence with Arroyo Trabuco, San Juan Creek typically dries up in the late summer months in the reach.

Arroyo Trabuco. The Arroyo Trabuco Watershed, excluding the Oso Creek Watershed, originates from the Cleveland National Forest in the Santa Ana Mountains at an elevation of approximately 5,600 feet above sea level. Arroyo Trabuco flows approximately 23 miles to join San Juan Creek and has a drainage area, excluding Oso Creek, of approximately 38 square miles. This entire watershed is long and narrow. The headwaters originate within the steep and mountainous terrain, and the basin typically tilts from east to west. As the mountains gradually give way to ridges and moderately steep hillsides, the canyons yield to a wider floodplain, and the streambed gradually turns northeast to southwest. The downstream portion of Arroyo Trabuco meanders through the developed floodplain area and flows mainly in a north-to-south direction. The main channel of Arroyo Trabuco remains mainly in a natural condition. In non-storm conditions, surface flows in Arroyo Trabuco are predominately from dry-weather urban runoff.

Oso Creek. Oso Creek originates in the foothills of the Santa Ana Mountains at an elevation of 1,600 feet above sea level. Oso Creek flows for 13 miles to enter Arroyo Trabuco, with a drainage area of 16 square miles. The entire channel flows through the low, rolling foothills west of the Santa Ana Mountains in a north-to-south direction. Most of the Oso Creek Watershed is developed. In non-storm conditions, the surface flows in Oso Creek are predominately from dry-weather urban runoff, which is captured and diverted by the SMWD at the Oso Creek Barrier.

21 San Juan Creek Watershed Hydrology Study. PACE Engineering. 2008.

San Juan Creek Groundwater Basin. Groundwater within the San Juan Creek Basin primarily occurs in the relatively thin alluvial deposits along the valley floors and within the major stream channels. The SWRCB has characterized this groundwater, from a water rights perspective, as an underground stream. The groundwater basin is bound to the north by the Santa Ana Mountains, composed of impermeable granitic and metamorphic bedrock, and to the south by the Pacific Ocean. Sedimentary bedrock formations form the sides of the water-bearing canyons of the Upper Basin and Arroyo Trabuco (i.e., Cañada Chiquita, Cañada Gobernadora, and Bell Canyon). Four principal groundwater basins have been identified in the San Juan Creek watershed: (1) Lower Basin, (2) Middle Basin, (3) Upper Basin, and (4) Arroyo Trabuco. These sub-basins were first delineated by the California Department of Water Resources (DWR) in 1972 based on water quality differences through watershed surveys as early as 1952.

DWR estimated the available capacity of the San Juan Basin (depending on selected boundaries) at 60,000 to 90,000 AF.[22] DWR noted, however, that some of this storage capacity cannot be utilized due to poor water quality.[23] This storage estimate is commonly referenced in subsequent reports and studies, including the San Diego Basin Plan (1976). In more detailed studies relating to groundwater resources management, CDM (1987)[24] and NBS Lowry (1994)[25] presented modified basin delineations of the San Juan Basin alluvial aquifer and corresponding modifications in groundwater storage estimates. The most common modification to the DWR work is to exclude the basin's upper reaches where the alluvial aquifer is narrow, shallow, and functionally an underground stream, as opposed to a groundwater reservoir. Groundwater storage estimates from these studies range from about 26,000 AF to about 42,000 AF.

Most recently, the SJBA studied the storage capacity of the San Juan Creek Basin[26]. The San Juan Basin Groundwater and Facilities Management Plan (SJBGFMP) defines the active groundwater storage area (e.g., the management area) as the areas within the Lower Basin, Middle Basin, and lower Arroyo Trabuco that are bounded by the Ortega Highway on San Juan Creek, the confluence of the Arroyo Trabuco and Oso Creek, and the Pacific Ocean.

The Upper Basin, which underlies the Canada Chiquita, Canada Gobernadora, Bell Canyon, Dove Canyon, and Upper San Juan Creek watersheds, was excluded by the SJBA because: (1) the groundwater resource is insignificant; and (2) a majority of the land overlying the Upper Basin is privately owned and managed by the Rancho Mission Viejo (RMV), who would not make their data available to the SJBA. The upper Arroyo Trabuco was excluded by the SJBA because the groundwater resource is insignificant. The SJBA active groundwater storage area contains approximately 6 square miles of water-bearing alluvium and has a storage capacity of about 38,000 AF. Recharge of the basin is from streambed infiltration in San Juan Creek, Oso Creek, and Arroyo Trabuco; surface inflow from beneath these stream reaches; and deep infiltration of precipitation and applied water. Discharge from the basin occurs primarily through

---

22 State of California Department of Water Resources (DWR). 1975. *California's Groundwater, Bulletin 118.*

23 State of California Department of Water Resources (DWR). June 1972. *Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104.*

24 Camp Dresser and McKee, Inc. (CDM). 1987. Task 10- Groundwater Management Plan.

25 NBS/Lowry Engineers and Planners. 1994. San Juan Basin Groundwater Management and Facility Plan.

26 Wildermuth Environmental. San Juan Basin Groundwater Management and Facilities Plan. San Juan Basin Authority. 2013. https://www.sjbauthority.com/sjbgwmp.html

groundwater production, evapotranspiration, rising groundwater, and subsurface outflow to the Pacific Ocean.

San Clemente Watershed. San Clemente Coastal Streams watershed falls under the San Clemente subunit of the San Juan Hydrologic Unit (designated HSAs 1.31 and 1.32). Within the watershed, two main streams flow through the City of San Clemente, ultimately discharging into the Pacific Ocean. The Prima Deshecha originates near the Prima Deshecha landfill and flows along Camino de los Mares, underneath the Interstate 5 and N. El Camino Real, before discharging into the Pacific Ocean at Poche Beach. The Segunda Deshecha Canada, the second main stem draining the watershed, flows through the Talega development, along Avenida Pico, under Intestate 5 and N. El Camino Real, before discharging into the Pacific Ocean at North Beach. The 18-square-mile watershed is almost fully developed and includes parts of the cities of San Clemente, San Juan Capistrano, and Dana Point. In the San Clemente Master Reclamation Permit, as amended in March of 2012, it was established that this watershed is not within any groundwater basin identified by the DWR in Bulletin 118. Therefore, in accordance with criteria established in the Region 9 Salt and Nutrient Management Plan Guidelines, the Prima Deshecha and Segunda Deshecha subbasins are defined as a "Tier D" groundwater basin where recycled water use is in compliance with existing Basin Plan groundwater quality objectives and, as such, does not require the preparation of salt and nutrient management plans.

San Mateo Watershed and Groundwater Basin. San Mateo Creek falls under the San Mateo Canyon subunit of the San Juan Hydrologic Unit (designated HSA 1.40). The portion of the San Mateo Creek Watershed covers 20 square miles of southeastern Orange County. It is largely unincorporated territory under the jurisdiction of the County of Orange but includes parts of the City of San Clemente in its downstream-most area. Tributaries to San Mateo Creek, the largest creek in the watershed, are Gabino Canyon, Paz Canyon, and Blind Canyon, which combine and flow into Cristianitos Creek. The San Mateo Creek watershed includes approximately 132 square miles of land upstream from the Camp Pendleton Marine Corp Base; the downstream portion of the watershed is largely within the Marine Corps Base boundaries. The Donna O'Neill Land Conservancy is located toward the southwestern side of the watershed at Rancho Mission Viejo. The portion of San Mateo Creek within Orange County flows through unincorporated Orange County before entering the City of San Clemente. It then reenters San Diego County, ultimately discharging into the Pacific Ocean at San Onofre State Beach. As most of this watershed is undeveloped, minimal watershed management has been implemented, and little water quality data has been collected.

As reported in the 2006 South Orange County IRWMP, the San Mateo Groundwater Basin is a small basin underlies San Mateo Valley and Cristianitos Canyon. Together, the San Mateo (including San Onofre Creek) watershed is 175 square miles. The Cristianitos Creek watershed is a little over 31 square miles. The aquifer consists of unconfined alluvium, and the basin is up to 100 feet in depth with an approximate storage capacity of 6,500 AF. Recharge is derived from the percolation of runoff from rainfall and effluent from a wastewater treatment plant. The infiltration is through natural reaches and five spreading basins in the San Mateo Creek stream channel. Water levels vary with wet and dry weather cycles, and low levels generally recover during wet periods. Pumping from this aquifer is thought to be partly met by increased deep percolation of runoff in San Mateo Creek and its tributaries, decreasing the length of channel available to sustain riparian vegetation.

San Clemente utilizes water from the northern portion of the basin, pumping up to 1,100 AF per year for potable sources. The City of San Clemente has extracted water from their local sub-basin since the 1950s. Historically, this groundwater contains high concentrations of iron and manganese, which removed at a water treatment plant before entering the City's potable water supply. The City of San Clemente's sub-basin is located in the northern flank of the main San Mateo groundwater basin, and therefore, the groundwater quality of its sub-basin is not entirely indicative of the water quality for the larger San Mateo groundwater basin. Camp Pendleton Marine Corps Base also pumps from the basin, which is currently the only water resource for domestic, municipal, industrial, and agricultural demand in the northern part of Camp Pendleton.

References

California Department of Water Resources. 1951. Bulletin 1.

Camp Dresser and McKee, Inc. (CDM). 1987. Task 10- Groundwater Management Plan.

Concentrated Animal Feeding Operation, NPDES permit requirements. https://www.waterboards.ca.gov/rwqcb7/water_issues/programs/cafo/

CSC Urban Water Management Plan. 2021: https://www.san-clemente.org/home/showpublisheddocument/64986/637612710083430000

Metropolitan Water District of Orange County (MWDOC). Data tables obtained from personal communication from data request.

Nolte and Associates, SOCWA Basin Plan Amendments Final Report, July 1993.

NBS/Lowry Engineers and Planners. 1994. San Juan Basin Groundwater Management and Facility Plan.

O'Niel, Stephen. The Acjachemen in the Franciscan Mission System: Demographic Collapse and Social Change. 2002. p.ii.

Regional Water Quality Control Board, San Diego Region (RWQCB). 1994. Water Quality Control Plan for the San Diego Basin. With amendment effective on or before September 1, 2021. https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2018/121118_7_final_amendment_oal.pdf

Regional Water Quality Control Board, San Diego Region (RWQCB). 2012. Order No. R9-2012-0026.

San Juan Basin Authority Facilities and Groundwater Management Plan. 2013. San Juan Basin Authority. http://www.sjbauthority.com/assets/downloads/20131126%20FINAL%20SJBA%20SJBGFMP.pdf

San Juan Creek Watershed Hydrology Study. PACE Engineering. 2008.

Seaber, Paul, Lapinos, Paul, Knapp, George. Water Supply Paper, USGS. https://pubs.usgs.gov/wsp/wsp2294/html/pdf.html

SCWD Urban Water Management Plan. 2021: https://cms9files.revize.com/scoastwaterdist/Document_center/Open%20Government/UWMP/SCWD%202020%20UWMP%20FINAL-2021.06.29.pdf

SMWD Urban Water Management Plan. 2021: https://www.smwd.com/DocumentCenter/View/3156/2020-Urban-Water-Management-Plan

South Orange County Wastewater Authority (2014). Salt and Nutrient Management Plan. Section 3.0. https://www.socwa.com/wp-content/uploads/2016/05/SNMPReport_Final.pdf

Southern California Association of Governments. The 2024 Regional Transportation Plan/Sustainable Communities Strategy. Local Data Exchange (LDX) Process Data/Book for the City of San Juan Capistrano. Southern California Association of Governments. Draft. May 2022. https://scag.ca.gov/sites/main/files/file-attachments/p0222-san-juan-capistrano.pdf?1655311406

Southern California Association of Governments (SCAG) Regional Data Platform. https://hub.scag.ca.gov/

State of California Department of Water Resources (DWR). 1975. California's Groundwater, Bulletin 118.

State of California Department of Water Resources (DWR). June 1972. Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104.

U.S. Geological Survey Water Supply Paper. https://pubs.usgs.gov/wsp/wsp2294/

Wildermuth Environmental. San Juan Basin Groundwater Facilities and Management Plan. San Juan Basin Authority. November 2013. https://www.sjbauthority.com/assets/downloads/20131126%20FINAL%20SJBA%20SJBGFMP.pdf

Section 4: Basin Hydrology and Water Quality

4.1 Basin Area Characterization Compliant with SWRCB's 2018 Recycled Water Policy

Amendments to the Recycled Water Policy adopted by the SWRCB in 2018 include the following:

> *Salt and nutrient management plans shall be tailored to address the water quality concerns of the basin and subbasin.*[1]

This section reviews the historic water quality in the San Juan Creek Basin, which informed efforts for the planning of importation of water resources to meet the increased population demand due to limited groundwater supplies. The historic poor water quality and limited basin size necessitated the importation of potable water and non-potable recycling as early as 1967 to address these geographic and hydrogeologic constraints. The water quality concerns applicable to the 2018 Recycled Water Policy for the San Juan Basin are addressed in detail in this section.

4.2 History of Water Supply Planning and Water Storage

Over the course of more than a century, significant study has been devoted to evaluating water supply and water quality in California's designated 286 groundwater basins. Because the population in the San Juan Valley exceeded the capacity of local water supplies to meet the water demand, imported water has been required to meet the area's potable water needs. The information contained herein includes summaries of the historical development of supply and how water quality dictated the development of infrastructure to meet water demands. This Section also contains the historical water quality characteristics of each of the subbasins, the geologic drivers of water quality, and the proposed monitoring program for compliance with the 2018 Recycled Water Policy.

The State of California, under the direction of the SWRCB, created an inventory of the various water supply and water quality studies up to 1947. This was published in 1951 as Bulletin 1 and provides the comprehensive starting basis of the water supply planning in California.[2] Bulletin 1 reviewed the investigations of the water resources of California by the State Engineer under the authority of acts of the Legislature in 1921, 1925, and 1929. The first reports of these investigations were presented by the Division of Engineering and Irrigation in a report published in 1930 by the Division of Water Resources Bulletin 25. This was entitled" Report to Legislature of 1931 on State Water Plan." The State Water Plan outlined a coordinated effort for conservation, development, and utilization of California's water resources. The plan was approved and adopted by the Legislature through Chapter 1185, Statutes of 1941. While Bulletin 1 provides a summary of the information to date, it was the first in a series of four bulletins to support a more comprehensive California Water Plan.

Until 1952, California had no comprehensive map of water-bearing aquifers. Bulletin3 accomplished this goal through the inclusion of information from the United States Geologic Survey (USGS), United States Bureau of Reclamation, California Department of Water Resources (DWR), Division of Mines, and

1 See Section 6.2.1.1. of the 2018 Recycled Water Policy (SWRCB, 2018a).

2 California Department of Water Resources. Bulletin 1. 1951.

California Universities. In Bulletin 3, DWR coordinated with the State Water Pollution Control Board (precursor to the SWRCB) and nine Regional Boards to create a numbering system for the 223 ground water basins. The San Juan Valley was designated with the numbering system 9-1. The numbering system expanded through basin plan designation and integration with the USGS water planning numbering system, as described in Section 3.

Bulletin 1 noted groundwater's usability based on the method and rate of replenishment of stored water and extraction for beneficial use. Bulletin 1 divided ground water basins geographically, with the San Juan Creek Group included in the South Coastal Area. The San Juan Creek Group included Aliso Creek, Trabuco Creek, and San Juan Creek. While Bulletin 1 summarized important precipitation, runoff, and flood frequencies for the San Juan Creek group, the Bulletin lacked water quality of this group. A comprehensive analysis of the water quality of the San Juan Creek group began in 1952 with a summary report released by DWR in 1967, titled *Bulletin 106-2, "Ground Water Occurrence and Quality, San Diego Region*." Bulletin 106-2 was a 2-year investigation as part of the 106 series. The San Diego region was selected for further investigation due to the "existence of water quality problems of various origins."

Bulletin 106-2 focused on the geologic and hydrologic features of the San Juan group to support an expanding water supply demand in the San Diego region. Bulletin 106-2 provided water supply and water quality monitoring in 1952, prior to the importation of water in the San Juan Valley region. As reported in Bulletin 106-2, imported water began in 1964 from the Colorado River due to the limited supply and poor water quality of the San Juan Basin. As noted in Bulletin 106-2, "The availability of an adequate supply of water of a quality suitable for beneficial uses is a prime factor in the future cultural development and growth in the San Diego Region." Bulletin 106-2 provides the baseline summary of water quality conditions and available supply that contributed to planning efforts that would occur through Bulletin 104-7.

In 1968, local water agencies worked through the Orange County Flood District in a cooperative agreement with DWR to investigate the San Juan Creek Basin to maximize local water supplies under DWR's authority in Sections 226 and 231 of the California Water Code. Bulletin 104-7 provided a "comprehensive evaluation of the geology, hydrology, water quality, and operation-economics of the San Juan Creek Basin." The Bulletin 104-7 investigation evaluated over 200 possible water management scenarios and outlined in detail 16 representative methods for groundwater basin management. In essence, Bulletin 104-7 is the basis of water supply and management planning for the San Juan Creek Basin, similar to the 2018 Recycled Water Policy requirements.

Both publications include tables of water quality and quantity monitoring. However, Bulletin 104-7 focused on evaluating 200 planning scenarios for the San Juan Valley area due to the earlier findings that poor water quality and limited supply would not be sufficient to support drinking water demand. Bulletin 104-7 estimated that in 1970, water supply demand in the San Juan Valley area would be 9,500 AF, and by 2020 the demand would be approximately 90,000 AF, a value that is significantly beyond the groundwater production capacity of the basin. Water demands estimated in Bulletin 104-7 proved to be accurate. The estimated year 2020 demand (see Section 2) was within 10% of the actual year 2020 demand across the San Juan Basin.

In 1975, DWR presented updated information on the San Juan Basin within Bulletin 118. Bulletin 118 (most recently updated by DWR in 2004) notes that the San Juan Basin is capacity largely depends on the geographic boundaries selected for defining the basin. DWR lists the surface area of the basin as 16,700 acres, which includes the Lower San Juan Basin and alluvial (downstream) portions of the contributing Oso Creek, San Juan Creek, and Trabuco Creek watersheds.

DWR estimated the available capacity of the San Juan Basin (depending on selected boundaries) at 60,000 to 90,000 AF.[3] DWR, however, noted that "some of the storage capacity may never be usable. This is because of poor water quality, economic reasons, or potential seawater intrusion."[4] In subsequent studies, DWR storage estimates and basin delineations were updated. Groundwater storage estimates from these studies range from about 26,000 AF to about 42,000 AF. Table 4-1 summarizes the basin capacity estimated presented within these studies, along with designations of agency oversight.

Table 4-1
Summary of Municipal Wells and Basin Storage Capacity
San Juan Creek Basin (Mission Viejo HA 901.2)

HSA No.	HSA Name	Number of Municipal Supply Wells	Agency Oversight	Sub-Basin	Estimated Basin Storage Capacity (acre-feet)		
					DWR (1972)[A]	HDR/WEI (2014)[B]	NBS/Lowry (1994)[C]
901.21	Oso	--	SMWD	--	6,550	--	--
901.22	Upper Trabuco	--	TCWD	--	1,580	--	--
901.23	Middle Trabuco	3	MNWD, SMWD TCWD	--	16,770	--	See note [D]
901.24	Gobernadora	--	SMWD	Chiquita	4,850	--	--
				Gobernadora	9,180	--	--
901.25	Upper San Juan	--	TCWD	Bell	3,490	--	--
				Upper San J.	3,360	--	--
901.26	Middle San Juan	--	SMWD	--	10,850	--	41,600 [D]
901.27	Lower San Juan	6	SCWD, SMWD	--	33,320	26,500	
901.28	Ortega	3	SMWD	--			

Table 4-1 Notes:
- A Basin storage capacity estimated by DWR (1972).
- B Basin storage capacity estimated in the 2014 San Juan Basin SNMP (HDR and Wildermuth Environmental, 2014).
- C Basin storage capacity estimated by NBS/Lowry (1994).
- D Total estimated storage capacity for the Middle Trabuco, Middle San Juan, Lower SanJuan and Ortega Basins (NBS/Lowry, 1994).

Although jurisdictional oversight in various HSAs is included in Table 4-1, the San Juan Basin Authority (SJBA) is a joint powers authority established in 1971 to oversee, monitor, and administer the water supply for the region. The SJBA began an updated plan for groundwater management in 2004.[5] Today, the SJBA

3 State of California Department of Water Resources (DWR). 1975. *California's Groundwater*, Bulletin. 118.

4 State of California Department of Water Resources (DWR). June 1972. *Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104.*

5 San Juan Basin Authority. Groundwater Management Program. http://www.sjbauthority.com/programs/groundwater.html

provides administrative support for management of water rights between SCWD and SMWD with oversight by the SWRCB. The SWRCB allows for up to 8,026 AF of groundwater extraction through Permit No. 21074[6] Other water rights holders also exist within the basin, as indicated by Table 4-2, but those rights are *de minimis* in comparison with the SJBA comprising most of the use.

Table 4-2
5-year storage rights in the San Juan Creek Basin

Permit Holder	Storage Rights (AF)	5-Year Average Use (AF)	Primary Use
American Golf Corporation	0	97	
Arroyo Trabuco Golf Club	0	67	
Barbara Shea-Han	0	0	
City of San Juan Capistrano	0	879	
Constance Winsberg	0	0	
County of Orange	4	0	
Development Solutions, OAK, LLC	0.0153	0	
DMB San Juan Investment North, LLC	687.4	1577	Irrigation, Stock watering
Jacqueline C. Brown	0	0	
Josephine Forester	0	0	
Rancho Mission Viejo	46.5	16	
RMV Community Development	98.2	0	
RMV Ortega Rock, LLC	0	4	
Robinson Ridge Owner, LLC	0	0	
Santa Margarita Water District (supply to SJGP)	10,702	2,128	Municipal Supply (Treated)
San Juan Hills Golf Club, LP	0	238	
Santa Margarita Water District	1618	529	Irrigation
South Coast Water District (supply to GRF)	1300	451	Municipal Supply (Treated)
Thabarwa Center USA	0	0	
The Conservation Fund	0	1	
Trabuco & Holy Jim Cabin Owners Improvement Association	0.4	0	
U.S. Cleveland National Forest	0	19	
Xavier Ledesma	0	0	
Total	14,456.52	6,006.00	

4.3 Water Quality Drivers

Studying hydrologic and geologic conditions in the San Juan Basin has a long and rich history. Starting in 1967, DWR Bulletin 106-2 provided the first scientific connections between water quality and the geology

6 Wildermuth Environmental. *San Juan Basin Groundwater Facilities and Management Plan*. San Juan Basin Authority. November 2013. https://www.sjbauthority.com/assets/downloads/20131126%20FINAL%20SJBA%20SJBGFMP.pdf

for the San Juan Basin[7], noting the unsuitable drinking water due to geologic contributions stemming from climatic conditions. Building on the early review of the geologic effects of water quality was Bulletin 104-7 and the Nolte Report, which extensively evaluated the key geologic factors influencing water quality in the San Juan Basin.

These geologic factors were most evident in portions of the basin where groundwater detention times were highest. These areas included small, shallow, and narrow tributary canyons where little groundwater withdrawal occurred and in lower portions of the basin where water quality degradation resulted in decreased pumping and increased groundwater detention times. In these areas, the geologic salt contributions to water quality resulted in increased TDS concentration within the San Juan Basin, which rendered salt loads in applied waters (both potable supplies and recycled water) less important in influencing groundwater TDS concentrations.[8] Due to the high TDS and limited supply of the San Juan Basin, management actions for drinking water treatment systems were concentrated at the bottom of the San Juan Basin. Summaries of geologic contributions by other authors are included in the subsections below to provide the baseline of water quality characterizations included later in this section.

As stated, Bulletin 104-7 detailed the fundamental factors that contribute to the quality of water in the alluvial aquifer in the San Juan Basin.[9] Each water quality factor will be discussed based on historical findings for each hydrologic subarea after a discussion of the driving forces of baseline TDS in the basin. The factors driving water quality include the following:

1. Geochemistry of the basin and surrounding geology.
    a. Chemical makeup of each HSA,
    b. Land-air interface that drives water quality,
    c. Vegetation inputs, and
    d. Ions of concern.
2. Hydrology of the basin
    a. Groundwater and surface water interaction, and
    b. Rate of groundwater movement.
3. Evapotranspiration
    a. Climatic forces,
    b. Vegetation factors,
    c. Soil makeup, and
    d. Weathering rates.
4. Replenishment
    a. Precipitation and runoff,
    b. Irrigation drainage,
    c. Domestic wastewater,
    d. Springs and surfacing groundwater,

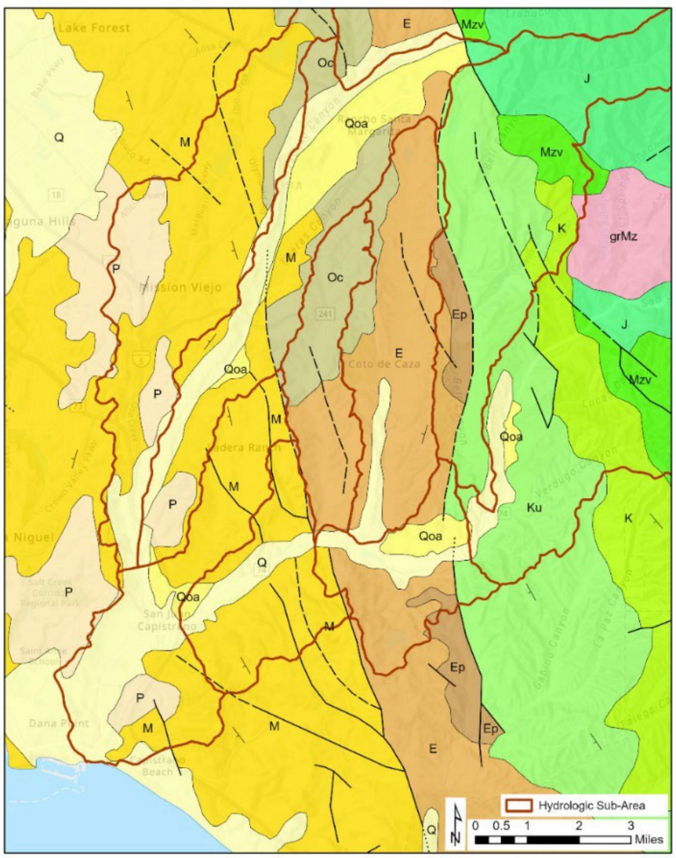
7 State of California Department of Water Resources (DWR). June 1972. Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104.

8 Nolte and Associates. South Orange County Reclamation Authority Basin Plan Amendments Final Report. 1993.

9 State of California Department of Water Resources (DWR). June 1972. Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104. P.99.

e. Inflow from adjacent older sediments, and
f. Sea water intrusion

Geochemistry Drivers. The geology of the San Juan Basin was first described in a summary format in DWR Bulletin 106-2. Field mapping of the water-producing areas was conducted by DWR staff, with geologic mapping conducted by the California Division of Mines and Geology in 1962 and 1966. Included in this geologic assessment were reports by Ellis and Lee in 1919, Larsen, Everhar and Marriam in 1952, and Weber in 1963.[10] The San Juan Basin was categorized as the "Coastal Plain Section" within the Peninsular Range in California, one of the 11 geomorphic provinces within California. The coastal plain section extends 10 miles from the coast inland and is underlain by Tertiary marine sediments with a thin cover of Quaternary deposits. Figure 4-1 provides a geologic map of the San Juan Basin.[11] To understand the link between the geologic contributions and baseline water quality, Table 4-3 provides a legend of the geologic contributions for the map as a reference to how the geology contributes to the effects on water quality.



SAN JUAN VALLEY GROUNDWATER BASIN GEOLOGY

Figure 4-1: Geologic Map of the San Juan Basin[12]

[10] State of California Department of Water Resources (DWR). June 1972. Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104. P.37.

[11] California Department of Conservation. California Geologic Survey. https://maps.conservation.ca.gov/cgs/gmc/

[12] Kennedy, M.P., Tan, S.S., Bovard, K.R., Alvarez, R.M., Watson, M.J., and Gutierrez, C.I. Geologic map of the Oceanside 30' x 60' quadrangle and adjacent areas, California. https://ngmdb.usgs.gov/Prodesc/proddesc_82679.htm

Table 4-3 Geologic Contribution to the San Juan Basin		
Geologic Time Period	**Designation**	**Description of Geology**
Mesozoic Sedimentary	Ku-Ep	Marine sedimentary and metasedimentary rocks (Paleocene-Cretaceous)
Metazoic Metavolcanic Rocks	MzV	Undivided Mesozoic volcanic and metavolcanic rocks. Andesite and rhyolite flow rocks, greenstone, volcanic breccia and other pyroclastic rocks; in part strongly metamorphosed. Includes volcanic rocks of Franciscan Complex: basaltic pillow lava, diabase, greenstone, and minor pyroclastic rocks.
Quaternary Sedimentary Rocks	Q	Marine and nonmarine (continental) sedimentary rocks (Pleistocene-Holocene) - Alluvium, lake, playa, and terrace deposits; unconsolidated and semi-consolidated. Mostly nonmarine but includes marine deposits near the coast.
Tertiary Sedimentary Rock	E	Marine sedimentary rocks (Eocene) - Shale, sandstone, conglomerate, minor limestone; mostly well consolidated
Tertiary Sedimentary Rock	M	Marine sedimentary rocks (Miocene) - Sandstone, shale, siltstone, conglomerate, and breccia; moderately to well consolidated.
Tertiary Sedimentary Rock	Ogc	Nonmarine (continental) sedimentary rocks (Oligocene) - Sandstone, shale, and conglomerate; mostly well consolidated
Tertiary Sedimentary Rock	P	Marine sedimentary rocks (Pliocene) - Sandstone, siltstone, shale, and conglomerate; mostly moderately consolidated.

As shown in Figure 4-1, the San Juan Creek Basin is compacted alluvial fill, which cuts into older sandstone formations with lower permeability.[13] The groundwater that rises and surface water that moves through the sandstone and siltstone formations picks up salt leached from the rock, gypsum crystals, and montmorillonite clays, which are located adjacent to the streambeds and further contribute to increased TDS concentrations seeping into the stream or alluvial aquifer.

The interface between land and air further contributes to the chemical makeup of the basin and are the driving forces of water quality. Based on the analysis in the per-HSA discussion below, the historic TDS ranges from 47% to over 200% of the water quality objectives established by the RWQCB in 1993. Due to the limited and poor water quality, the DWR planning efforts necessitated imported water supply for municipal use as indicated in Figure 4-2 planning map. To understand how the TDS is driven by baseline natural conditions, atmospheric and vegetation will be evaluated first as a function within the geochemistry drivers. DWR Bulletin 106-2 states that the bicarbonate anion is the predominant anion in the native waters of San Diego County. Carbonate and bicarbonate are derived from the atmosphere and vegetation, as described below.

[13] State of California Department of Water Resources (DWR). 1967. Ground Water Occurrence and Quality in the San Diego Region, Volume II., Bulletin 106-2. Plate 3.

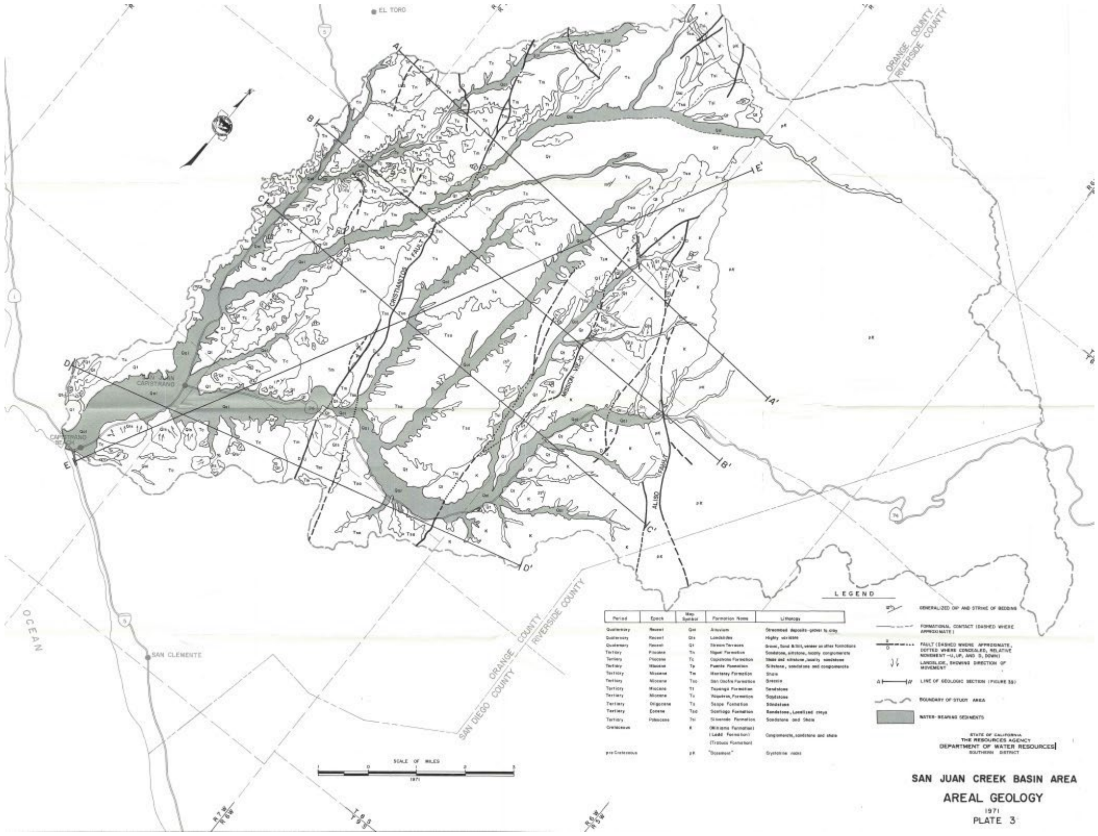


Figure 4-2: San Juan Creek Basin Plan Areal Geology

When carbon dioxide from the atmosphere combines with moisture, carbonic acid is formed and contributes to the weathering of the geology in the Basin. When carbonic acid dissociates, bicarbonate ions are combined with cations that are also leached from weathering of the rocks. For example, Bulletin 106-2 indicates that the rain from the atmosphere can dissolve up to 50 mg/L of calcium carbonate that is prolific within the San Juan Creek Basin.[14] While carbon dioxide from the atmosphere begins to drive the chemical reaction, it is the air space with the soil where biological action further drives the saturation of calcium carbonate and bicarbonate.

Geologic surveys of rock in Bulletin 106-2 provide a more exact evaluation into how each hydrologic subarea leaches TDS into the watershed based on natural processes intrinsic within the watershed based on its geology.[15] Bulletin 106-2 first provided a broad overview of the San Juan Basin, explaining that it is composed of Upper Cretaceous Mio-Pliocene marine sediments that have been incised and backfilled with recent alluvium that can be up to 200 feet deep. The mountain-valley section is composed of crystalline rocks (tonalites, granodiorites, and metamorphic rocks), which are up to 1 meter (m) in thickness.

[14] State of California Department of Water Resources (DWR). June 1972. Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104. P.100

[15] State of California Department of Water Resources (DWR). 1967. Ground Water Occurrence and Quality in the San Diego Region, Volume II., Bulletin 106-2. P. 112.

Tonalites are "inclusions of older rocks which increase their susceptibility to weathering."[16] Table 4-4 summarizes the predominant chemical driver of the geochemistry.

Table 4-4
Geologic Character of Each HSA
within the San Juan Creek Basin (Mission Viejo HA 901.2)

HAS	HSA #	Chemical Character
Oso Creek	901.21	Sodium-calcium sulfate to sodium sulfate
Upper Arroyo Trabuco	901.22	Calcium bicarbonate-sulfate (sulfate from gypsum, abundant in the Tertiary sediments bordering the stream)
Middle/Lower Arroyo Trabuco	901.23	Below Oso Creek confluence, sodium sulfate-chloride
Canada Chiquita	901.24	Sodium bicarbonate-chloride
Canada Gobernadora	901.24	Calcium-sodium chloride-sulfate-bicarbonate
Upper San Juan Creek	901.25	Calcium-sodium bicarbonate (upper), calcium sulfate-bicarbonate (lower/Bell)
Middle San Juan Creek	901.26	Calcium-sodium sulfate-chloride
Lower San Juan Creek	901.27	Varies from calcium bicarbonate to calcium-sodium sulfate
Ortega	901.28	Varies from calcium bicarbonate to calcium sodium sulfate-bicarbonate based on flow

As stated in DWR Bulletin 104-7, the chemical quality of the water in the San Juan Basin is dependent on the chemical makeup of the sediments.[17] To better understand the leaching of the rock materials and water quality, a review of the physical mechanisms by which clays leach into soils is provided. Montmorillonite clay is a type of clay material that is a layered soil type with a negative charge which allows it to attract and hold onto positively charged ions.[18] The layers within the montmorillonite are held together by weak forces, which allows for ion bonding to occur. Montmorillonite clay has high cation exchange rates that bind to and exchange cations in solutions.[19] The negative charge in the clays is balanced by the presence of exchangeable cations on the surface of clay particles. When montmorillonite is in contact with a solution containing other cations, the exchangeable cations can be replaced (leached into the water), and the new cations can be adsorbed onto the clay surface.[20] Montmorillonite clay leaching of ions can occur through cation exchange, dissolution, and desorption, as described earlier. All three mechanisms occur when related to water quality changes through precipitation or stream and groundwater interaction that occurs widespread throughout the San Juan Basin.

[16] State of California Department of Water Resources (DWR). 1967. Ground Water Occurrence and Quality in the San Diego Region, Volume II., Bulletin 106-2. P.27

[17] State of California Department of Water Resources (DWR). June 1972. Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104.

[18] Brady, N.C., Weil, R.R. (2008). "The Nature and Properties of Soils (14th edition). Pearson.

[19] Bergaya, F. Theng, B.K.D, Lagaly, G. (Eds.) (2006). "Handbook of Clay Science" (1st edition). Elsevier.

[20] Sposite, G. (2008). "The Chemistry of Soils" (2nd edition). Oxford University Press.

Gypsum is similar to montmorillonite clays in its leaching mechanisms. However, gypsum is more soluble than montmorillonite clays and is distinct in the physical distinct crystals in evaporite deposits or sedimentary layers that are a geologic feature of the San Juan Basin. Orange County geology is represented by Neogene sedimentary and igneous rocks, which were identified as early as 1930.[21] While this review of geology provides specific examples of the types of rocks that contribute to the water quality, this review is not extensive but provides information to support the statements in the Nolte Report that geology contributes to poor water quality from TDS in the San Juan Creek Basin.

Total dissolved solids include positively (cations) and negatively (anions) charged ions. The major cations contributing to TDS are calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}), potassium (K^{+}), and manganese (Mn^{+}). The anions are chloride (Cl^{-}), sulfate (SO_4^{2-}), Bicarbonate (HCO^{3-}), Nitrate (NO^{3-}), and Phosphate (PO_4^{3-}). As stated, montmorillonite clays have high cation exchange rates that bind to and exchange cations in solutions. Due to the location of montmorillonite clays within the San Juan Creek Basin and the exposure of the clays to water and organic acids from Saddleback Mountain runoff, as described below, the clays will swell, which allows for an increase in the cation exchange capacity, allowing the clays to bind to more cations and increase in the TDS downstream.

For a specific example for how ions leach from the geology, manganese is a cation that can be found in high concentrations in the San Juan Basin and adjacent to the San Juan Basin in the San Clemente coastal basin which has differing recycled water permit compliance requirements.[22] Manganese can leach from montmorillonite clay when the soil's pH is low or acidic. When acidic conditions occur, manganese is displaced by hydrogen ions, causing manganese to be released into the environment and increasing TDS. Many researchers have studied the leaching of manganese from montmorillonite clay. For example, a study by Wang et al.[23] found that the amount of manganese leached from montmorillonite clay increased with decreasing pH and that the leaching was highest at pH 4.0. Another study by Yuan et al.,[24] found that the leaching of manganese from montmorillonite clay increased with increasing concentrations of organic acids. The vegetation and soil type contribute to the leaching of groundwater quality.

The Natural Resources Conservation Service has published a map[25] of the soil type for Orange County. This information was utilized for a watershed specific map as illustrated in Figure 4-3. Clay and clay loam dominate the San Juan Basin area. The contribution of organic acids from the watershed from vegetation upstream contributes to the cation exchange mechanism inherent in clay soils. Previous submissions of the SNMPs based on earlier versions of the Recycled Water Policy have focused on the San Juan Basin as a closed system when assessing the study area. The following review provides additional drivers of water quality that expand on the interplay between the upstream vegetation in the watershed and the geology that drives changes in TDS throughout the watershed.

---

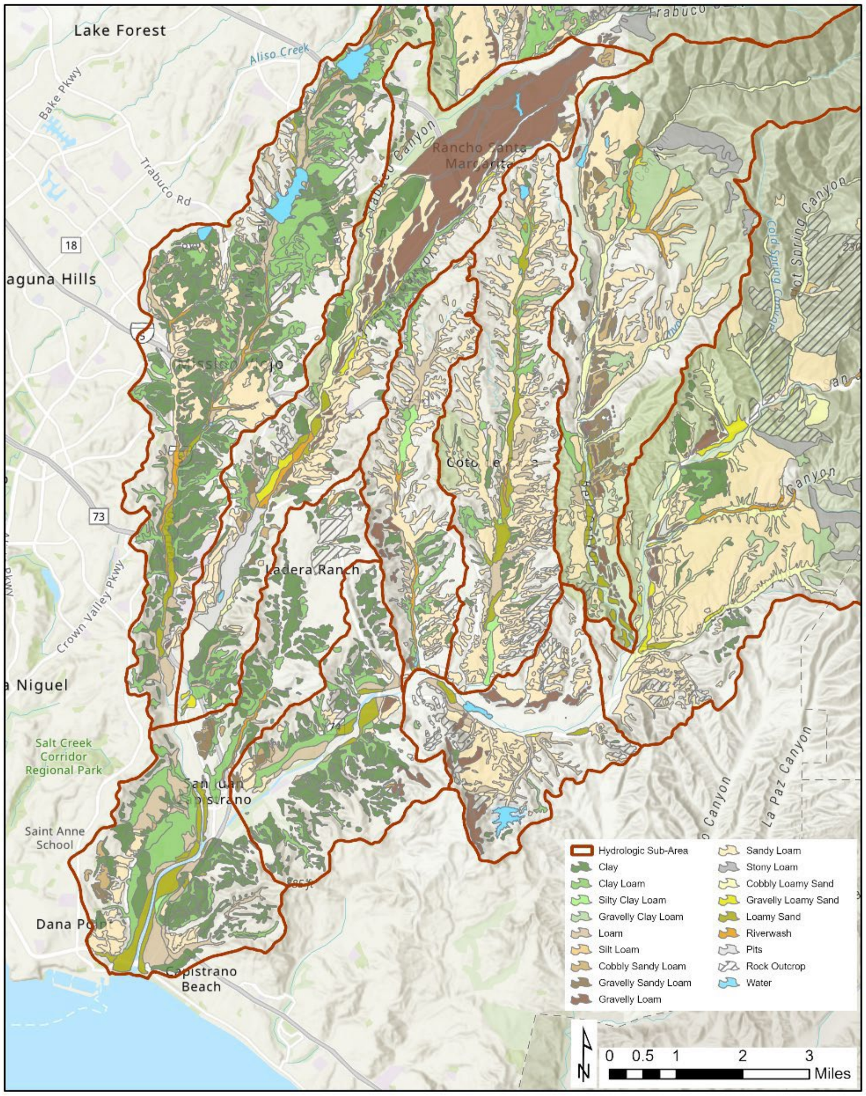
21 Moore, B. N. (1930). Structure sections: Supplement 1 from "Geology of the southern Santa Ana Mountains, Orange County, California" (Thesis) (1.0). CaltechDATA. https://doi.org/10.22002/D1.329

22 City of San Clemente, person correspondence on developing recycled water permit conditions.

23 Wang, Y., Li, Z., Gao, P., & Liu, W. (2015). Leaching of manganese from montmorillonite by low-molecular-weight organic acids under varying pH conditions. Environmental Science and Pollution Research, 22(18), 14063-14070

24 Yuan, H., Zhu, X., Li, X., Cao, H., & Yang, X (2013). Organic acid0induced leaching of manganese from montmorillonite: Implications for soil development. Journal of Soils and Sediments, 13(2), 299-307.

25 Surface Soil Textures of Orange County. Natural Resources Conservation Service. https://www.mwdoc.com/wp-content/uploads/2017/06/OC_Soils_Map.pdf



SAN JUAN CREEK WATERSHED SOILS

Figure 4-3: San Juan Creek Watershed Soils

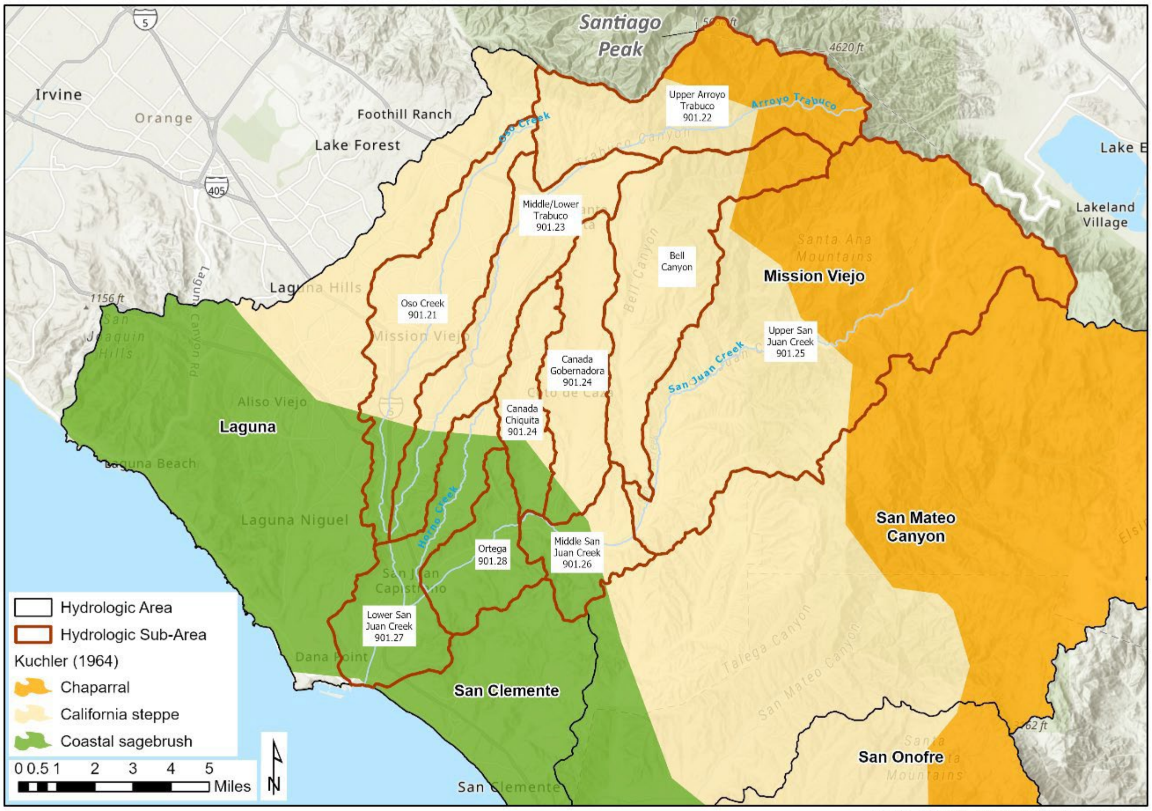
The top of the watershed in the San Juan Basin is Santiago Peak. Santiago Peak is 5,689 ft[26] and is the highest in Orange County.[27] Santiago Peak has an average grade of 7 degrees with a maximum grade of 20 degrees from the base of the mountain, which starts at elevation 1,259 above sea level and rising 5,394 feet to the top of the mountain.[28] This steep elevation change contributes to very fast runoff from the mountain during precipitation events. This steep change supports the rapid release of organic acids from leaf litter from the front side of the Saddleback Mountain draining into the Trabuco watershed dominated

26 Santiago Peak. https://en.wikipedia.org/wiki/Santiago_Peak

27 Saddleback Mountain (Santiago Peak). USDA and US Forest Service. https://www.fs.usda.gov/recarea/cleveland/recarea/?recid=81640

28 Santiago Peak. Trail Run Project. https://www.trailrunproject.com/trail/7098122/modjeskasantiago-peak

by chaparral, mixed hardwood, and coastal sage scrub, as illustrated in Figure 4-4 which was modified based on information from the Bureau of Reclamation.[29]



SAN JUAN CREEK WATERSHED VEGETATION

Kuchler, A.W. 1964. Potential Natural Vegetation of the Conterminous United States. American Geographical Society, Special Publication No. 36

Figure 4-4: San Juan Creek Watershed Vegetation Map

Chapparal vegetation dominates that vegetation growth on Saddleback Mountain, which drains to both the 100 square mile Santiago Creek[30] watershed and drains into the 54 square mile[31] Trabuco Creek watershed. To understand the impact of the runoff from the Chapparal vegetation, the soil chemistry will provide the baseline understanding of the ionic drivers of TDS downstream into Arroyo Trabuco Creek. Chaparral is characterized by dense, evergreen vegetation and thick, dry soils. Dissolved organic carbon (DOC) is a measure of the amount of organic carbon that is dissolved in water. In chaparral soils, DOC levels are typically high, ranging from 10 to 100 mg/L. This is due to chaparral soils rich in organic matter, which is released into the soil when plants die and decompose. DOC can play an important role in the water cycle, as it can help to transport nutrients and other dissolved substances through the soil. It can also be a source of food for microorganisms, which play an important role in the further decomposition of organic matter.

---

29 Fenn, Mark & Allen, E & Weiss, Stuart & Jovan, Sarah & Geiser, Linda & Tonnesen, Gail & Johnson, Robert & Rao, Leela & Gimeno, Benjamín & Yuan, Fengming & Meixner, Thomas & Bytnerowicz, Andrzej. (2010). Nitrogen critical loads and management alternatives for N-impacted ecosystems in California. Journal of environmental management. 91. 2404-23. 10.1016/j.jenvman.2010.07.034.

30 Santiago Creek. Wikipedia. https://en.wikipedia.org/wiki/Santiago_Creek

31 Arroyo Trabuco Creek. Wikipedia. https://en.wikipedia.org/wiki/Arroyo_Trabuco

Verberg, Megonigal, and Stark found[32] that episodic rewetting of chaparral soils can enhance the release of DOC. This rewetting of soils is consistent with the seasonal precipitation cycles that dominate this watershed. Rewetting of dry soils can cause the release of organic matter from the soil, which can then be transported into the water column. The study also found that the addition of litter to chaparral soils can also enhance the release of DOC. This is because the litter can provide a source of organic matter that microorganisms can break down, releasing DOC into the downstream water body.

Additional Stakeholder Input. On June 5, 2024, SOCWA and interested stakeholders met with staff from the RWQCB to discuss additional ions of concern based on the RWQCB's review of monitoring data from Order 97-52 (as amended). The RWQCB staff requested that iron, manganese, and nitrate be included in this SNMP as potential drivers of groundwater exceedances from using recycled water on groundwater quality. The following narrative provides additional details on this request, starting with iron and manganese and completing it by evaluating historical and modern nitrate data.

Historic Monitoring and Management of Iron and Manganese. While DWR Bulletin 104-7 contained a large number of monitoring records of TDS, Bulletin 104-7 did not contain iron and manganese data to provide a pre-1968 understanding of the ions of interest. This pre-1968 data paucity created an information gap when determining the driver of water quality objective exceedances in the San Juan Creek Basin for iron and manganese. To address this data information gap, groundwater monitoring data, and water reclamation effluent discharge data are reviewed to provide additional conclusions about the geologic contribution of iron and manganese in the effluent discharges from water reclamation facilities in the San Juan Creek Basin.

Iron and manganese groundwater quality monitoring data are available from 1972 through 2024 and are presented as summary statistics in Tables 4-5 and 4-6, with average concentrations presented in Figures 4-5 and 4-6. The Lower San Juan HSA of the San Juan Creek Basin contains the largest volume of monitoring records which coincide with the highest production volume of potable water

The Middle Trabuco HSA shows the most significant iron concentration. Iron concentrations are generally higher than manganese concentrations in most HSAs, except for the Oso HSA, where manganese concentration is significantly higher. The HSAs follow the same pattern of TDS, of lower to higher concentrations of iron and manganese downgradient from the Upper San HSA.

[32] Verburg, P. J. A., Megonigal, J. P., & Stark, J. M. (2004). Episodic rewetting enhances dissolved organic carbon (DOC) release from chaparral soils. Soil Biology & Biochemistry, 36(11), 2297-2306. https://doi.org/10.1016/j.soilbio.2004.07.013

Table 4-5
Summary Statistics for Iron Monitoring in the San Juan Creek Basin 1972-2024

	Middle Trabuco (901.23)	Ortega (901.28)	Middle San Juan (901.26)	Lower San Juan (901.27)	Oso (901.21)	Gobernadora (901.24)	Upper San Juan (901.25)
Average Value	26.05	6.64	3.62	3.56	1.34	0.59	0.13
Minimum Value	Non-Detect	Non-Detect	0.01	Non-Detect	0.01	0.01	0.02
Maximum Value	368.00	74.00	18.00	97.00	23.00	4.40	1.10
n	95	314	134	1906	23	63	21

Table 4-5 Notes:
n represents the total number of iron sampling data points for each HSA during 1972-2024.

Table 4-6
Summary Statistics for Manganese Monitoring in the San Juan Creek Basin 1973-2024

	Oso (901.21)	Middle Trabuco (901.23)	Ortega (901.28)	Lower San Juan (901.27)	Gobernadora (901.24)	Middle San Juan (901.26)	Upper San Juan (901.25)
Average Value	4.46	1.49	1.16	1.04	0.87	0.39	0.01
Minimum Value	3.80	Non-Detect	0.01	Non-Detect	0.02	0.00	Non-Detect
Maximum Value	5.40	8.82	3.10	5.30	3.90	1.30	0.02
n	30	76	324	1894	76	153	13

Table 4-6 Notes:
n represents the total number of manganese data points for each HSA during 1973-2024.

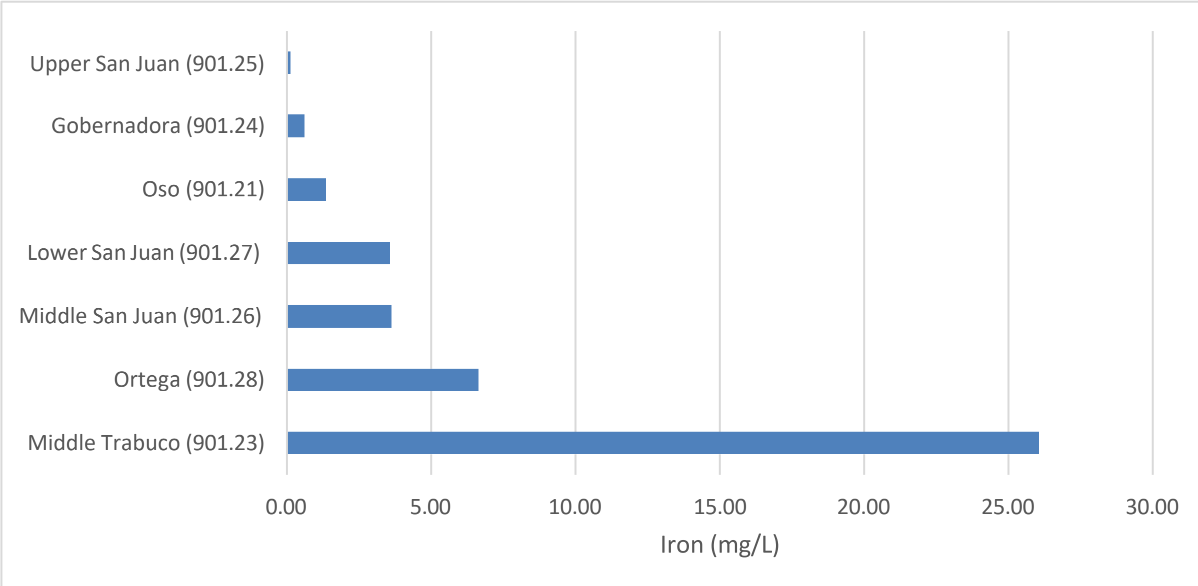


Figure 4-5: San Juan Creek Basin Average Iron 1972-2024

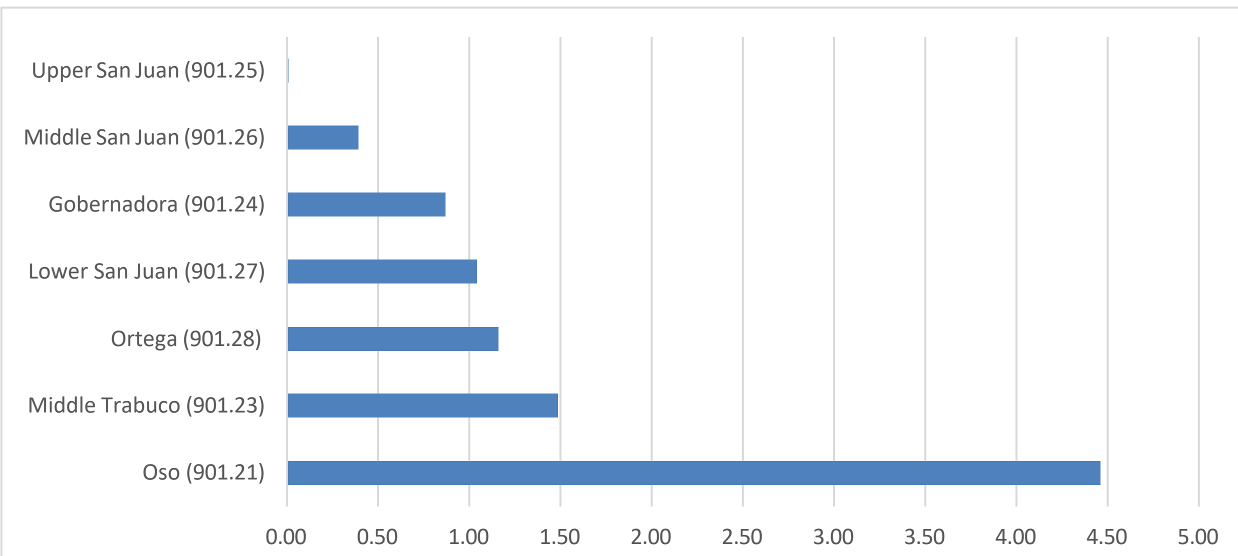


Figure 4-6: San Juan Creek Basin Average Manganese 1973-2024

Management actions (treatment options) for producing potable supply from poor-quality groundwater are summarized in Table 4-7. Greensand filters are used by SMWD and SCWD (bypass flow only) to lower iron and manganese concentrations in the groundwater Reverse Osmosis (RO) membranes further lower the iron and manganese concentrations in the feed water before potable water distribution in the Lower San Juan HSA. The Lower San Juan potable water production facilities owned and operated by SMWD and SCWD are the San Juan Capistrano Groundwater Treatment Plant and the SCWD Groundwater Recovery Facility. The residual discharge from the potable water treatment systems is regulated under NPDES

Order No. R9-2024-0005 with discharge limits on iron and manganese. Thus, these potable water systems do not contribute to further exceedances of groundwater quality objectives through the concentration of residuals in the wastewater treatment systems.

Greensand filters are used by SMWD to lower iron and manganese concentrations in the groundwater. RO membranes further lower the iron and manganese concentrations in the feed water before potable water distribution in the Ortega HSA. In the Middle Trabuco HSA, iron and manganese are below MCLs at SMWD North Open Space and Rosenbaum 1. However, RO is scheduled to be installed at the North Open Space well in 2025 to lower TDS levels in the groundwater. Any iron and manganese in the groundwater will also be removed by the RO membranes before potable water distribution.

Table 4-7
Potable Water Treatment Systems by HSA for TDS, Iron, and Manganese

Agency	Middle Trabuco (901.23)	Lower San Juan (901.27)	Ortega (901.28)
SMWD	Reverse Osmosis	Greensand, Reverse Osmosis	Greensand, Reverse Osmosis
SCWD	N/A	Greensand, Reverse Osmosis	N/A
TCWD	Greensand, Reverse Osmosis	N/A	N/A

Water Reclamation Plant Effluent Discharge Monitoring. Order 97-52 (as amended) contains provisions for routine and accelerated monitoring of TDS, nitrate, iron, manganese, and other regulated constituents. A review of the permit exceedances indicated that manganese and TDS are the two constituents that exceed current standards at the highest rate. Table 4-8 below provides further insight into the conclusion that reclamation facilities do not contribute to the groundwater quality objective exceedances in the San Juan Creek Basin.

Table 4-8
Treatment Facility and Water Quality Exceedance Percentage

	SMWD - Chiquita Water Reclamation Plant	TCWD Robinson Ranch Water Reclamation Facility	SOCWA - Coastal Treatment Plant	SOCWA - 3A Water Reclamation Treatment Plant	SOCWA - Regional Treatment Plant
Hydrologic Subarea	901.24	901.24	Outside San Juan Creek Basin	901.21	Outside San Juan Creek Basin
TDS Water Quality Standard Exceedance	0%	96%	8%	30%	58%
Manganese Water Quality Exceedance	0%	0%	92%	70%	39%
Iron Water Quality Standard Exceedance	0%	4%	0%	0%	3%

Figure 4-6 illustrates that the Oso HSA (1.21) contains the highest manganese concentration of all the HSAs in the San Juan Creek Basin, with a maximum concentration of 5.4mg/L. The high concentration of groundwater manganese is due to geologic contributions. In Table 4-8 above, while the 3A Treatment plant has the highest number of manganese exceedances compared to the other treatment facilities, the maximum effluent discharge is only 0.11m/L. Table 4-10 provides the iron and manganese monitoring statistics from January 2019 through June 2024 of water reclamation facilities' discharge concentrations for comparisons to groundwater concentrations. The discharge values in Table 4-9 are orders of magnitude lower than values in Table 4-5 and 4-6. For example, the maximum iron value of 0.76 mg/L is two orders lower than the maximum iron concentration in the Lower San Juan maximum values. The maximum manganese concentration in groundwater is 8.82 mg/L. In contrast the maximum recycled water manganese concentration is 0.24 mg/L, a value approximately one and a half orders of magnitude less than the maximum groundwater value. This significant difference demonstrates that recycled water use does not concentrate iron and manganese in the groundwater. Instead, geologic contributions appear to represent the dominant factor affecting groundwater concentrations of iron and manganese.

Because of the naturally high concentrations of iron and manganese in groundwater, groundwater inflow and infiltration (I&I) are likely key factors in affecting wastewater plant influent iron and manganese concentrations in the San Juan Basin. The Report of Wastewater Discharge for the San Juan Creek Ocean Outfall, originally submitted to the RWQCB on March 13, 2020, noted that an average of 150,000 gallons of I&I is estimated to enter the collection systems of facilities connected to the San Juan Creek Outfall and SSMPs further investigate and seek to eliminate I&I iteratively. MNWD is investigating sources of inflow and infiltration (I&I) through their Sanitary Sewer Management Plan (SSMP)[33]. The SSMP investigation results and the additional monitoring of iron and manganese in the SNMP monitoring plan will provide additional insight into the geologic contributions of both constituents in the next update of the SNMP.

[33] Moulton Niguel Water District. Sanitary Sewer Management Plan. March 2009, Revised September 2013 and February 2019.

Table 4-9
Recycled Water Iron and Manganese, 2019 through 2024

	SMWD - Chiquita WRP	TCWD Robinson Ranch WRF	SOCWA - Coastal TP	MNWD - 3A Treatment Plant	SOCWA - Regional TP	SMWD - OCWRP
Iron Permit Limit [A,B]	0.3, 0.4	0.3, 0.4	0.3, 0.4	0.3, 0.4	0.3, 0.4	0.3, 0.4
Iron Minimum	0.02	0	0.06	0.09	0.09	0
Iron Maximum	0.19	0.46	0.2	0.25	0.76	0.04
Iron Average	0.12	0.03	0.13	0.15	0.26	0.02
Manganese Permit Limit [A,B]	0.05, 0.06	0.05, 0.06	0.05, 0.06	0.05, 0.06	0.05, 0.06	0.05, 0.06
Manganese Minimum	0.02	0	0.031	0.05	0.065	0.005
Manganese Maximum	0.04	0.06	0.66	0.11	0.24	0.033
Manganese Average	0.035	0.007	0.08	0.08	0.11	0.022

Table 4-9 Notes:
A Order 97-52 (as amended) 12-month average permit limit
B Order 97-52 (as amended) Daily Maximum

Lack of Impact of Recycled Water Use on Iron and Manganese. As documented above, elevated iron and manganese concentrations occur within (and beyond) the San Juan Creek basin due to the presence of iron and manganese in the geologic composition of the aquifer media itself; iron and manganese can leach to saturated groundwater through direct contact between groundwater and the aquifer media. As a result of this leaching process, elevated concentrations of iron and manganese are common throughout southwestern Orange County, including virtually all sub-basins within the San Juan Hydrologic Unit (HU 901). As a result of these geology-induced iron and manganese contributions to groundwater, iron and manganese treatment is typically required[34] to ensure that groundwater supplies comply with secondary (aesthetic) drinking water standards[35] of 0.3 mg/L iron and 0.05 mg/L manganese. Because iron and manganese are part of the composition of the aquifer media itself, no management strategies exist that can address these geologic influences.[36] Further, recycled water use does not contribute to iron and manganese concentrations in the San Juan Creek Basin, as recycled water is predominantly used to irrigate turfgrass, and iron and manganese loads in applied recycled water are significantly below micronutrients demands of the turfgrass. Additionally, as discussed below, iron and manganese can be taken up directly by grass blades more efficiently than through root zone extraction, resulting in uptake of some applied micronutrients without the nutrients reaching the soil.

---

[34] In addition to the iron and manganese treatment provided by groundwater treatment facilities in the San Juan Creek Basin, the City of San Clemente operates an iron and manganese groundwater treatment facility in the Prima Deshecha basin.

[35] State and federal secondary (aesthetic) drinking water Maximum Contaminant Levels (MCLs) are established for iron and manganese at 0.3 and 0.05 mg/L, respectively, to prevent staining of porcelain plumbing fixtures.

[36] No practical management strategies are available for preventing geologic leaching of iron and manganese from aquifer media to saturated groundwater. Management strategies such as decreasing groundwater detention time can act to lessen (but not eliminate) the effect of these geologic factors on groundwater iron and manganese concentrations. Groundwater treatment can reduce iron and manganese concentrations in extracted groundwater, but such treatment does not reduce iron and manganese concentrations within *in situ* groundwater.

Because (1) no practical management strategies exist that can address geologic sources of iron and manganese and (2) recycled water is not a discernible contributory factor to iron and manganese concentrations in saturated groundwater within the San Juan Creek Basin, no useful end is served by attempting to address iron and manganese within this SNMP. Justification for this conclusion is presented in the following sub-sections.

Iron and Manganese Loads in Irrigated Recycled Water. Iron and manganese are important micronutrients that are essential for vegetation growth and health. Iron is required as a cofactor in three reactions leading to chlorophyll synthesis, and is a key nutrient in providing the "greening" effect of turfgrass.[37] Iron also serves important roles in the metabolic process of turfgrass, and is essential for detoxifying destructive oxygen radicals.[38] Depending on turfgrass species and soil factors, iron typically comprises 0.1 to 0.9 percent (by mass) of turfgrass, which is roughly an order of magnitude less than the typical nitrogen content of turfgrass.[39]

Iron is applied to turf more frequently than any other micronutrient and is used as means for addressing several issues.[40] Grounds managers often apply iron to turfgrass as a means of increasing the "greening" effect without stimulating excessive growth that may occur because of increased nitrogen fertilization.[41] Manganese serves many important functions in turfgrass. Manganese is an essential component of the oxygen generation complex in photosynthesis, and thus is an important turfgrass nutrient.[42] Manganese is also an activation factor for several enzymes and metabolic sequences and plays a role in root elongation and growth.[43] Manganese typically comprises 0.02 to 0.4 percent of the vegetation mass of turfgrass, or roughly half of the typical iron content by mass.[44] Manganese tends to be concentrated in roots, and manganese contents in the leaf area of turfgrass (e.g., grass clippings) may range 0.002 to 0.02 percent, depending on the grass species and soil conditions.[45]

RWQCB Order No. 97-52 (as amended) establishes annual average iron and manganese recycled water effluent concentration limits of 0.3 and 0.05 mg/L, respectively.[46] Daily maximum iron and manganese effluent limits are established at 0.4 and 0.06 mg/L.[47] Table 4-10 presents iron and manganese loads on a per acre basis for a range of application rates and iron and manganese concentrations. For illustrative purposes, annual iron and manganese loads per acre are presented for 3 and 4 feet per year irrigation rates, annual average iron concentrations ranging from 0.3 to 0.4 mg/L, and annual average manganese concentrations ranging from 0.05 to 0.06 mg/L.

---

37 Hull (1999).

38 *Ibid*.

39 Hull (1999); Landschoot (2016).

40 Hull (1999).

41 Landschoot (2016).

42 Hull (2001); Shaddox and Munshaw (2020).

43 Hull (2001).

44 Hull (1999, 2001); Landschoot (2016).

45 Vitosh et al. (1993); Vitosh et al. (1994); Koenig et al. (1998).

46 The Basin Plan iron and manganese groundwater quality objectives implement state and federal secondary (aesthetic) MCLs.

47 Daily maximum effluent limits are established at levels slightly above the Basin Plan objectives to account for variation in water quality. Because of the damping effect of groundwater storage, short-term fluctuations in recycled water concentrations do not discernibly affect groundwater quality.

As shown in Table 4-10, annual iron loads from applied recycled water are projected to be less than 5 pounds per acre for all scenarios. Annual recycled water manganese loads are projected to be less than two-thirds of a pound per acre for all scenarios.

Iron and Manganese Uptake. While most soils contain abundant iron, iron in soil is commonly immobilized as insoluble salts or as soil structural components.[48] To accommodate the virtual unavailability of iron in most soils, grasses have evolved an ability to make ferric ions soluble, enabling the iron to diffuse onto root surfaces.

Manganese can also be bound in soils, decreasing its availability, particularly in slows with higher pH values. [49] Additionally, iron and manganese (particularly manganese) are relatively immobile in turfgrass (e.g., unable to readily move from roots to grass blades), further limiting the ability of turfgrass to efficiently uptake iron and manganese from the root zone.[50]

Since iron and manganese can be readily (and effectively) taken up directly by grass blades (leaf area), turfgrass managers have recognized that foliar application of iron and manganese (e.g., spray irrigation) increases the effectiveness of applied iron and manganese. This can allow for a significant fraction of the applied iron and manganese to be taken up by turfgrass via foliar absorption before applied water reaches the soil surface and root zone. Iron and manganese in grass blades, however, is removed during mowing, so mowing may necessitate frequent foliar applications to replace micronutrients lost in the grass clippings. The consistent supply of iron and manganese in applied recycled water can remedy this effect.

As documented above, geologic factors result in elevated concentrations of iron and manganese within the San Juan Basin. As a result, soils within the SOCWA service area typically contain sufficient iron and manganese concentrations to sustain vegetation. It is common, however, for professional landscapers to seasonally apply fertilizers that contain iron and manganese. Such fertilization is common at golf courses and landscaped areas for a "greening" effect. While fertilizer needs may vary depending on vegetation, soil type, and whether grass cuttings are removed, iron and manganese in recycled water supplies can help meet the nutrient demands of irrigated vegetation, particularly when applied in the form of foliar application (spray irrigation) that directly provides iron and manganese to grass blades without the need for the iron and manganese to reach the root zone.

---

48 Hull (1999).

49 Hull (2001).

50 Samples et al. (2008a, 2008b); Hull (2001).

Table 4-10
Projected Range of Recycled Water Iron and Manganese Loads Applied to Irrigated Areas
SOCWA Recycled Water Service Area

Annual Irrigation Rate	Annual Iron Load (pounds per acre) [A]		Annual Manganese Load (pounds per acre) [A]	
	If Recycled Water Iron Concentration is 0.3 mg/L [B]	If Recycled Water Iron Concentration is 0.4 mg/L [C]	If Recycled Water Manganese Concentration is 0.05 mg/L [B]	If Recycled Water Manganese Concentration is 0.06 mg/L [D]
3.0 feet per year	2.4	3.3	0.41	0.49
4.0 feet per year	3.3	4.3	0.54	0.65

Table 4-10 Footnotes:

A Annual applied iron and manganese loads per acre for the listed irrigation application rate and effluent concentration.

B RWQCB Order No. 97-52 (as amended) establishes an annual average iron concentration limit of 0.3 mg/L and an annual average manganese concentration limit of 0.05 mg/L.

C RWQCB Order No. 97-52 (as amended) establishes a daily maximum iron concentration limit of 0.4 mg/L. The above scenarios present estimated annual iron loads per acre for a scenario in which recycled water iron concentrations remain at 0.4 mg/L throughout the year.

D RWQCB Order No. 97-52 (as amended) establishes a daily maximum manganese concentration limit of 0.06 mg/L. The above scenario presents estimated annual manganese loads per acre for a scenario in which recycled water manganese concentrations remain at 0.06 mg/L throughout the year.

Total vegetative iron and manganese requirements, in part, depend on the turfgrass species, soil pH, time of year, and climatic conditions. Iron fertilization is typically required when iron concentrations in leaf tissue is lower than 35 parts per million or when yellowing of leaf tissue is noted.[51] Manganese fertilization is typically required when soil concentrations are less than 1 part per million or if concentrations of manganese in leaf tissue is lower than 25 ppm.[52,53]

The City of Los Angeles Department of Public Works (2001) reports that turf grass annually generates approximately 5 to 20 tons of grass clippings per acre of irrigated turf. The total mass of iron and manganese lost to grass clippings can thus be estimated based on multiplying typical ranges for iron and manganese content within leaf tissue by the mass of clippings. Table 4-11 presents estimated annual iron and manganese losses through clippings. For comparison, Table 4-11 also presents published iron and manganese fertilization demands for turfgrass. As shown in the table, recommended iron and manganese fertilization rates are reasonably similar to estimated iron and manganese losses through turfgrass clippings.

Overall, projected turfgrass iron and manganese nutrient demands (see Table 4-11) are significantly higher than the maximum projected nutrient loads (see Table 4-10) from the SOCWA recycled water supply, even if the RWQCB were to establish iron and manganese effluent concentration limits that are more relaxed than the limits presently established in Order No. 97-52. As a result of the significant difference between

51 Hull (1999).

52 Jacobson and Bauder (1993).

53 [1] Hull (2001).

recycled water iron and manganese loads and nutrient demands, no further assessment of iron and manganese loads in recycled water is warranted within this SNMP.

Table 4-11
Estimated Iron and Manganese Demands for Turfgrass

Category	Estimated Annual Micronutrient Demand (pounds per acre)	
	Iron	Manganese
Estimate based on published fertilization requirements	20 – 65 [A]	1 - 12 [B]
Estimate based on micronutrient value in grass clippings [C]	10 – 90 [D]	2 - 20 [E]

Table 4-11 Footnotes:

- Based on 2 ounces of iron per 1000 square feet per application, as recommended by Shaddox (2023) and Hull (1999). Estimated values based on application frequency ranging from quarterly (4 applications per year) to monthly (12 per year).
- Manganese fertilization rates required for manganese-deficient soils, as presented in Christenson et al. (1992); Vitosh et al. (1994); Buchholz et al. (1993) and Ohio State University Extension (1995).
- The City of Los Angeles Department of Public Works (2001) estimated that irrigated golf course turf grass produces from 5 to 20 tons of clippings per year.
- Estimated mass of grass clippings (assumed at five tons per acre per year) multiplied by the estimated 0.1 to 0.9 percent iron within the clippings, per Hull (1999) and Landschoot (2016). Values rounded to nearest pound per acre.
- Estimated mass of grass clippings (assumed at five tons per acre per year), multiplied by the estimated 0.002 to 0.02 percent manganese in leaf tissue, per Vitosh et al. (1993), Vitosh et al. (1994); and Koenig et al (1998). Values rounded to nearest pound per acre.

Nitrate Monitoring. Unlike the lack of monitoring data from DWR Bulletin 104-7, there is significant monitoring data pre- and post-1968 to provide a water quality characterization of the groundwater in the San Juan Creek Basin. Figures 4-7 and 4-8 provide historical monitoring of the San Juan Creek during the pre- and post-1968 periods to assess the potential effect of using recycled water in the San Juan Creek Basin. The high nitrate concentration in the San Juan Basin during both monitoring periods was 9.2 mg/L in 1960 before recycled water was used throughout the basin. The primary drinking water MCL for Nitrate as Nitrogen is 10 mg/L. The modern monitoring data illustrates no concern for increased nitrate concentration stemming from recycled water use, as there have been no exceedances when recycled water use is at maximum production historically in the San Juan Creek Basin. However, nitrate was added to the monitoring plan to continue to assess the potential effects.

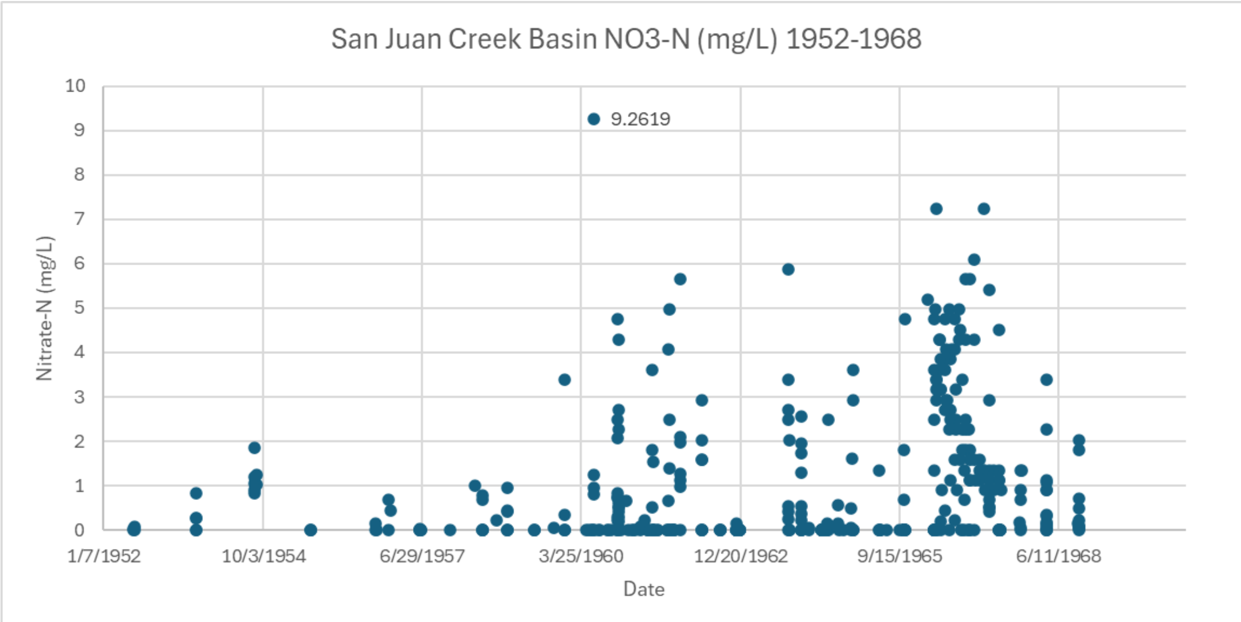


Figure 4-7: Nitrate-N Monitoring Results in the San Juan Creek Basin from 1952-1968

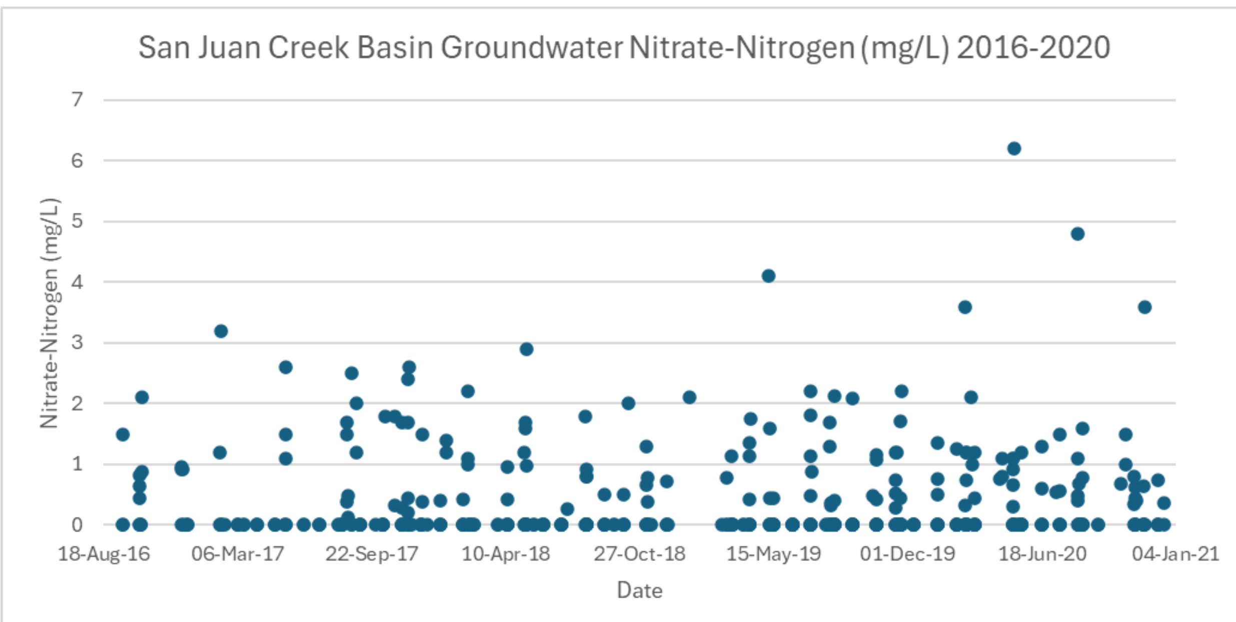


Figure 4-8: Nitrate-N Monitoring Results in the San Juan Creek Basin from 2016-2020

4.4 Hydrology of the Basin

Precipitation. Precipitation (primarily in the form of streamflow infiltration) is the major source of recharge to the ground water basin. The amount of precipitation has decreased in more recent records. Figure 4-9 presents precipitation within San Juan Basin for the period 1895-2020 illustrating that long term precipitation average is 16.9 in, and short-term precipitation (last 20+ years) is 14 inches.

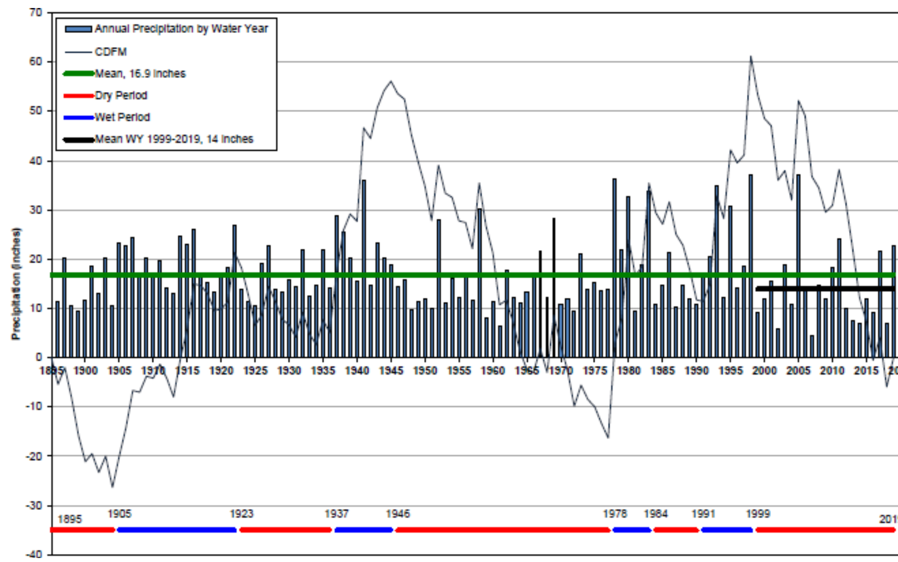


Figure 4-9: Precipitation from 1951-1968 in the San Juan Basin[54]

As shown in the figure, significant variation in annual precipitation occurs, oscillating between dry and wet periods. On average, significant drought conditions (precipitation significantly below average) occur in approximately 15-20 percent of the years, while significantly above average precipitation occurs approximately 15-20 percent of the years. Only a portion of the total precipitation that occurs within the basin reaches saturated groundwater. Most precipitation remains as moisture within unsaturated soils until it is evaporated or taken up and transpired by vegetation.

Surface Water Flows. It is well-established that the interaction between surface water and groundwater is a dominant factor affecting both streamflow and depth-to-groundwater. Streamflow infiltration (loss of surface flow to groundwater) and surfacing groundwater (loss of groundwater to surface water) occurs along virtually every stretch of the Basin's streams and tributaries. This interchange can result in varying streamflows along a given watercourse, where in one stretch significant surface flow occurs, while most or all surface flow disappears underground in upstream or downstream stretches. The interchange is sufficient that in the upstream narrow and shallow basins, surface water quality data can be used to characterize the groundwater quality. In larger downstream basins (e.g., Lower San Juan Basin), significant ground and surface water interchange can occur, and streamflow infiltration along San Juan, Trabuco and Oso Creeks represent a significant source of recharge to groundwater.

Because of the interchange between ground and surface water, stream gaging along the tributaries to the major streams of the San Juan Creek Basin is not practical. Historically, the USGS has maintained stream gaging stations along San Juan Creek at the following two locations:

- Station 11046530, San Juan Creek at Novia Street Bridge, and
- Station 11046500, San Juan Creek Near San Juan Capistrano.[55]

---

[54] Salt and Nutrient Management Plan, 2020. Chapter 4, p.54, Figure 3-16.

[55] The historical Station No. 11046500 was located approximately 2500 feet upstream from the present Station 11046530. Streamflow gaging records for this station exist for the period 1928-1969.

Station 11046500 was discontinued in 1969, but Station 11046530 (which is located upstream from the Trabuco/Oso Creek confluence) has provided streamflow records since 1985 to the present. Figure 4-10 presents peak wet weather streamflow at the San Juan Creek Station 11046530 for the period 1985-2023. As shown in the figure, San Juan Creek streamflow at Station 11046530 has exceeded 15,000 cfs on four occasions since 1985 and has exceeded 6,000 cfs on six occasions during this period.

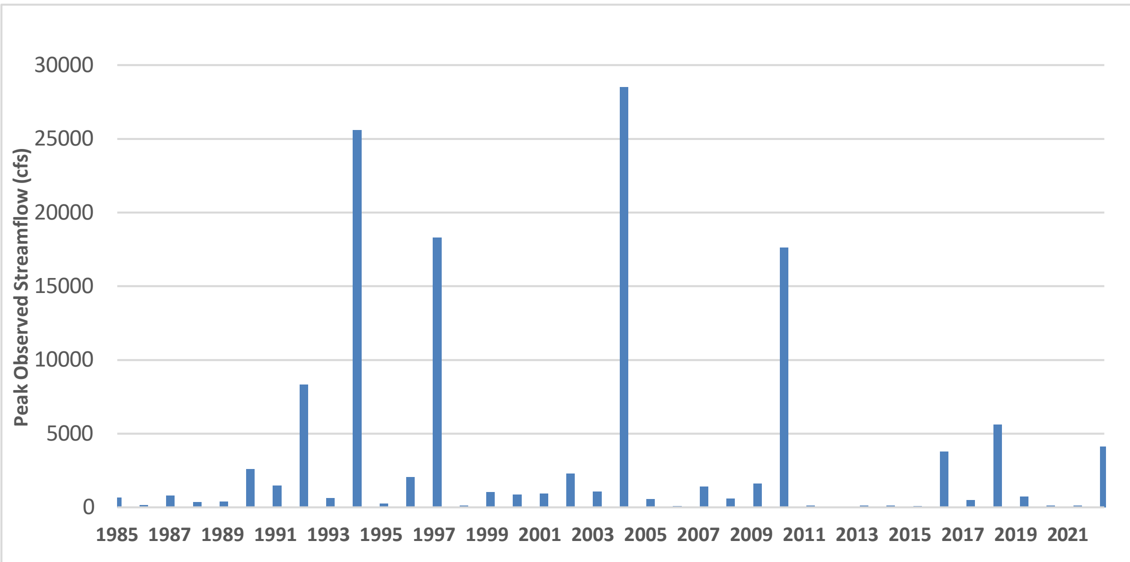


Figure 4-10 Peak San Juan Creek Wet Weather Streamflow, 1985-2023

Table 4-12 summarizes average monthly San Juan Creek streamflow at Station 11046530. The table shows that the highest observed monthly average streamflow during 1985-2023 was 816 cfs. Monthly average streamflows during summer months (June through October) ranged from 0.3 to 2.7 cfs. Table 4-12 summarizes monthly average streamflow statistics for wet and dry weather flows. As shown in Table 4-13, monthly average San Juan Creek streamflow at Station 11046530 exceeded 500 cfs on four occasions during 1985-2023 and exceeded 100 cfs on 16 occasions.

Section 3 of this SNMP describes the streams within the Basin and how the streams are influenced by surfacing groundwater within the basins. The historical influence of surfacing groundwater on streamflow within the San Juan Creek Basin is summarized in the five following points from Bulletin 104-7[56]:

[56] State of California Department of Water Resources (DWR). June 1972. *Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104.* P.57

Table 4-12
Monthly Average Streamflow
San Juan Creek at La Novia Street Bridge, 1985-2023

Month	Streamflow (cfs) [A]	
	Maximum Observed Monthly Average Value 1985-2023	Monthly Average for Listed Month 1985-2023
January	618	52
February	816	67
March	663	50
April	121	17
May	95	8
June	26	2.7
July	8.9	0.9
August	8.9	0.6
September	3.3	0.3
October	27	1.2
November	21	2.1
December	399	15

Table 4-12 Notes:

A From USGS streamflow gaging records for San Juan Creek at the La Novia Street bridge (USGS Station No. 11046530). Data available online at: https://nwis.waterdata.usgs.gov/usa/nwis/peak/?site_no=11046530

Table 4-13
Wet Weather Statistics – Monthly Average Flows
San Juan Creek at La Novia Street Bridge, 1985-2023 [A]

Monthly Average Streamflow (cfs)	Number of Months during 1985-2023 where Monthly Average Streamflow Exceeded the Listed Value
> 100	16
> 200	10
> 300	7
> 500	4
> 600	2

Table 4-13 Notes:

A From USGS streamflow gaging records for San Juan Creek at the La Novia Street bridge. (USGS Station No. 11046530). Data available online at: https://nwis.waterdata.usgs.gov/usa/nwis/peak/?site_no=11046530

1. Groundwater table elevations in the spring are usually within 20 ft of ground surface except during extended drought periods.
2. Groundwater table elevations that intersect the stream thalweg contribute to streamflow.
3. Historic groundwater table elevations have fluctuated between 5 and 30 feet of the ground surface, with greatest depth-to-groundwater occurring in the autumn months and greatest depth-to-groundwater fluctuations occurring in Arroyo Trabuco and San Juan Creek Valley.
4. During dry periods, groundwater table elevations can decline as much as 50 feet.
5. Following dry periods, one wet season can be sufficient to bring groundwater table levels back to their normal range, due to the small basin storage capacity relative to the infiltration capacity.

Groundwater Recharge. Appendix B of Bulletin 104-7 presents detailed information on San Juan Basin groundwater. Bulletin 104-7 reviewed the groundwater reservoir, determined the quantity of water naturally available from local sources, and established a criterion of estimating the annual quantity of deep percolation of natural local water supplies so that an estimate can be made of how much water might be added to the groundwater in storage in any year.[57] Due to the results of long-term planning through the SJBA that resulted from Bulletin 104-7 findings and the additional need for understanding the fate and transport of TDS throughout the basin, the 2020 SNMP went into detail in evaluating the water budgeting of the main locations where domestic water is being treated for distribution into the water agencies with water rights in the region. The small storage capacity of the basins was detailed in the water budgeting procedure in the development of the 2020 SNMP.

The 2020 SNMP water budgeting evaluated the recharge of the basins and the number of years that it takes to fill the basins, which has a direct role in the water quality of the streamflow and the groundwater. Table 4-14 summarizes these results, which are consistent with historical findings in Bulletin 104-7, which states that: “one wet season has been sufficient to bring water levels back to their normal range.” As noted in Table 4-14, detention times and recharge were not estimated for some of the smaller sub-basins of the San Juan Creek Basin since these basins do not contain significant groundwater storage capacities.

Evapotranspiration. Two types of evapotranspiration are important in affecting the availability and quality of groundwater. Most evapotranspiration occurs when soil moisture in unsaturated soils evaporates or is taken up and transpired by vegetation. Evapotranspiration losses from saturated groundwater occur when water is extracted by phreatophyte vegetation from or immediately above the groundwater table.

Evapotranspiration in a watershed is driven by various factors influencing the rate at which water is evaporated from the land and transpired by plants. These factors can be grouped into four main categories: climatic functions, vegetation factors, soil factors, and weathering rates. Evapotranspiration rates were used in modeling conducted in the 2014 SOCWA SNMP and described in detail further in this section.

[57] State of California Department of Water Resources (DWR). June 1972. *Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104.* P.48.

Table 4-14
Estimated Number of Years to Fill the Basin

HSA	HSA #	Estimated Number of Years to Fill the Basin [A]			
		Average	Median	Minimum	Maximum
Oso Creek	901.21	Not Modeled			
Upper Arroyo Trabuco	901.22				
Middle/Lower Arroyo Trabuco	901.23				
Canada Gobernadora	901.24				
Upper San Juan Creek	901.25				
Middle San Juan Creek	901.26	1.7	1.9	0.8	2.8
Lower San Juan Creek	901.27	4	4.4	1.9	8.7
Ortega	901.28	4	4.4	1.9	8.7

Table 4-14 Notes:
A Summary of information presented in Tables 3-19a and 3-19b from the 2020 San Juan Basin SNMP. Values less than 1.0 indicate that the basin can be filled in less than a single year of significantly above-average precipitation and runoff.

Climate factors are related to precipitation rates, temperature, solar radiation, humidity, and wind speed. Bulletin 104-7 provides a historical perspective that drives the baseline water quality data presented in sections below. The distribution of precipitation is not even in the watershed both geographically and temporally. The average annual precipitation from 1952 through 1968 was "about 19 inches, ranging from about 11 inches at the lower elevations to over 26 inches in the mountains."[58] A significant majority of this precipitation occurred during the months of November through May.

Evapotranspiration, due to solar radiation, humidity, and wind speed, drives calcium carbonate, sodium carbonate, and calcium sulfate (gypsum). Higher solar radiation and wind speed increase evapotranspiration rates. However, higher humidity levels result in potentially lower evapotranspiration rates due to the difference between the actual vapor pressure and the saturated vapor pressure.

Vegetation factors are due to total leaf area per unit ground area, vegetation type, plant density and coverage. Native vegetation accounts for the largest land use in the San Juan Creek Basin, starting at ~88% in 1950, peaking at 95% in 1964, and now is at ~ 77% as of 2014. The vegetation factors driving salts downstream have been discussed above. Evapotranspiration (ET) is highly variable and dependent on local soil types, including geology and the number of accumulated salts in the soil zone from ET processes. Typically, when plants uptake water via ET, they are not consuming the salt. Therefore the salts accumulate in the soil zone over time until those salts are dissolved into solution and flushed from the soil zone (typically by significant precipitation events).

[58] State of California Department of Water Resources (DWR). 1967. Ground Water Occurrence and Quality in the San Diego Region, Volume II., Bulletin 106-2. P. 89.

The San Juan Basin is an arid landscape with a substantial accumulation of salts in shallow soils due to low rainfall. When precipitation is higher in one year compared to another, the runoff that can flow through a watershed at a much higher rate will have less time to dissolve less minerals into solution as compared to precipitation that infiltrates into the soil zone. From the evaluation of SNMP in 2014, The average ET is two to four times the annual average rainfall, at almost 50 inches per year. As a result, there is a high demand for landscape irrigation for homes, commercial properties, parks, and golf courses and a propensity for drought conditions. To gain an understanding of ET in the watershed, a review of the landscape coverage from 1950 through 2014 is included in Table 4-15.

Table 4-15
Land Use Changes from 1950 through 2014

Land Use	2014 (mi^2)	2014 (% Area)	1970 (mi^2)	1970 (% Area)	1964 (mi^2)	1964 (% Area)	1957 (mi^2)	1957 (% Area)	1950 (mi^2)	1950 (% Area)
Native Vegetation [A]	131.0	77.4	158.4	93.7	163.3	94.9	166.0	96.1	152.9	87.9
Non-Irrigated Field Crops/ Fruits and Nuts, Pasture	0.2	0.1	2.7	1.6	2.6	1.5	2.0	1.2	5.5	8.9
Irrigated Field Crops/Citrus/Fruits and Nuts, Pasture, and Parks and Recreation Areas [B]	6.6	3.9	4.5	2.6	4.4	2.6	4.4	2.6	5.5	3.2
Urban Residential	24.0	14.2	3.1	1.8	1.5	0.9	0.2	0.1	0.1	0.1
Urban Commercial	4.0	2.3	0.4	0.2	0.3	0.1	0.1	0.1	0.1	0.0
Urban Industrial	0.8	0.5	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Special Impervious [C]	2.8	1.7	No Data							
Total Area [D]	169.4	100.1	169.2	99.9	172.2	100	172.75	100.1	164.1	100.1

Table 4-15 Notes:

A Includes wilderness parks, open spaces, protected land, and other developed areas.
B Includes public parks, athletic fields, and golf courses.
C Includes roads and parking lots, lined channels, and concrete covered areas.
D Land Use GIS Data and estimation based on Table 16 in Department of Water Resources Bulletin 104-7.

Soil factors are the final factor involved in evapotranspiration. The four components of soil factors that drive evapotranspiration are soil moisture content, soil texture, and infiltration rate, soil water holding capacity, and weathering rates. When there is less soil moisture, evapotranspiration can be limited. The infiltration rate will be discussed in more detail later in this section. Soils with higher water-holding capacities can sustain higher evapotranspiration rates. Weathering is divided into physical or mechanical breakdown of rocks into fragments and chemical weathering through reactions, as described in the land-air interface discussion above. Bulletin 104-7 notes that runoff water picks up its mineral content from weathered rock surfaces and evaporite salts in the watershed before being confined in the principal stream channels. The quality of the water in the creeks in the San Juan Creek Basin changes because of the effect of inflows of irrigation returns, evapotranspiration, and rising water.

Replenishment

Bulletin 104-7 describes the main factors that drive replenishment into the San Juan Basin, which are precipitation and runoff, irrigation drainage, domestic wastewater, springs, rising water, inflow from adjacent older sediments, and seawater intrusion. Replenishment of the basin includes supply in the form of precipitation and potable water imported minus consumptive use, surface outflow of the basin, freshwater export, and wastewater export. This relationship is illustrated in Figure 4-11 below.

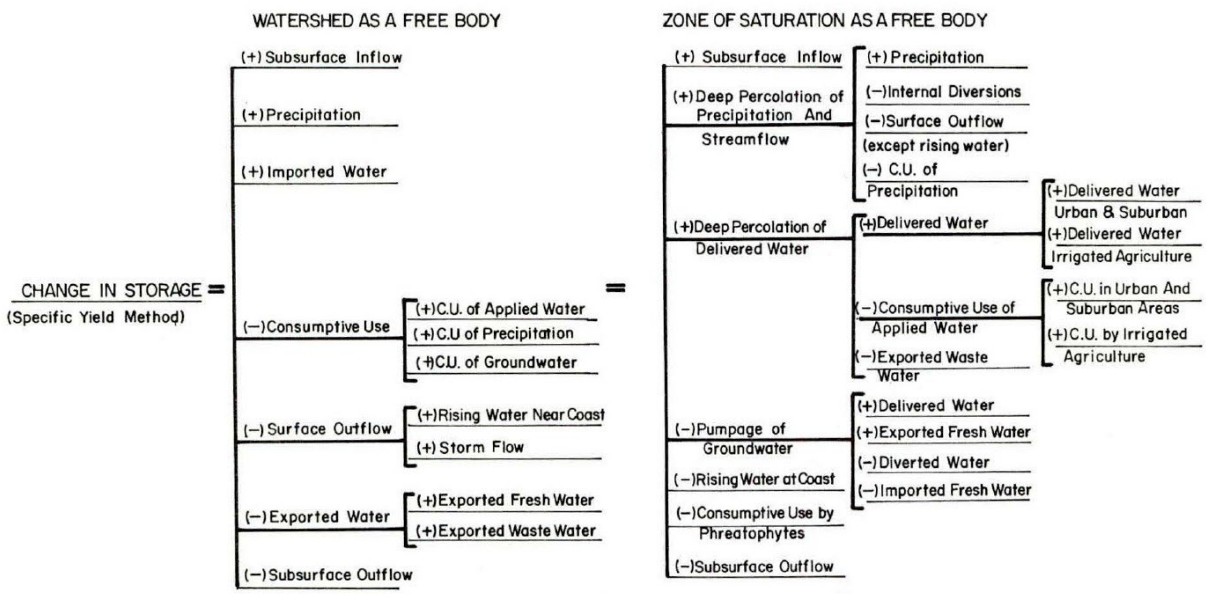


Figure 4-11: Bulletin 104-7 Imports and Exports of Water in the San Juan Basin[59]

Precipitation and streamflow infiltration are the largest drivers of replenishment into the basin. DWR Bulletin 104-7 notes that imported water was introduced to the basin in 1964 because precipitation was not sufficient to support the expanding population. Figure 4-12 provides the range of precipitation from 1951 through 1968. The graphic illustrates that 1957 through 1958 was the highest precipitation year, with 1960-1961 being the lowest precipitation year. While precipitation is the largest driver of replenishment into the basin, precipitation is generally higher in the mountainous portion of the San Juan Basin and is not consistent, as shown in Figure 4-12.[60] However, not all the water that falls on the watershed is available for domestic use. Water coming into San Juan Creek Basin is exported, consumptively used, is stored in the ground water basin, or becomes surface or subsurface outflow.

Due to the physical character of the basin, which is shallow and small, the interaction between rising groundwater and surface water are dominated by climatic cycles of precipitation and groundwater depth to surface levels. There are three principal areas in the San Juan Basin where rising water occurs, as

[59] State of California Department of Water Resources (DWR). June 1972. *Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104, Figure 18.*

[60] State of California Department of Water Resources (DWR). June 1972. *Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104, Table 12.*

indicated in Bulletin 104-7: "within a 2-mile reach of San Juan Creek below Canada Gobernadora, (2) a 3-mile reach of Arroyo Trabuco, near its confluence with Tijeras Canyon; and (3) frequently in the last 2 miles of San Juan Creek."[61]

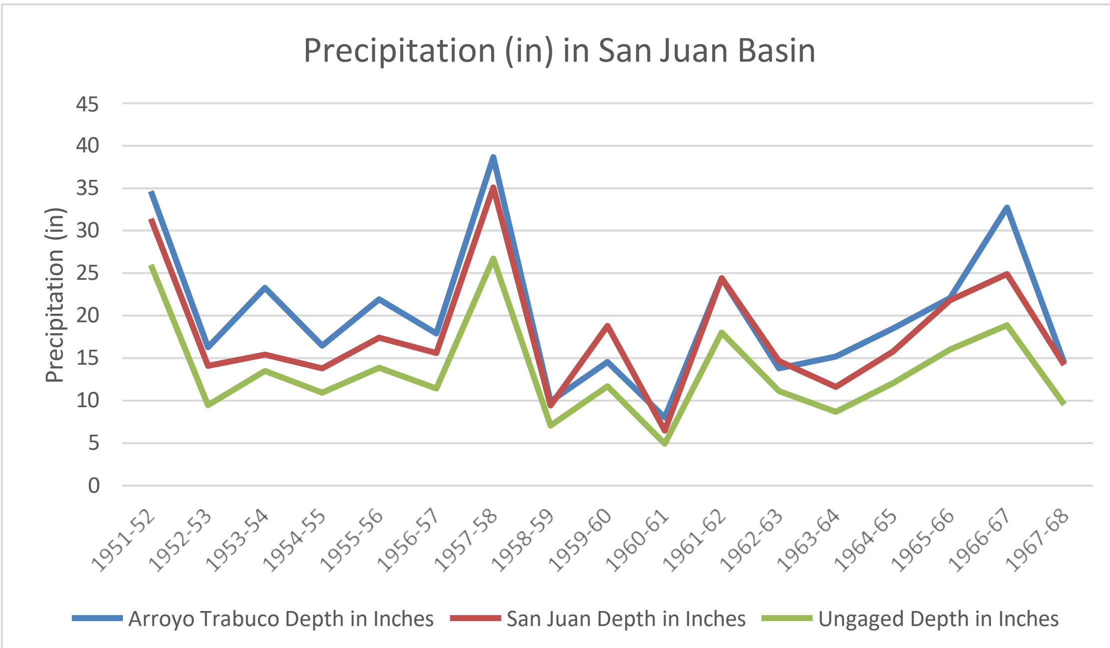


Figure 4-12: 1951-1968 Rain in San Juan Basin

DWR Bulletin 104-7 summed the total precipitation in the watershed based on the rain gauges in Arroyo Creek, San Juan Creek, Arroyo Creek, and other ungagged portions in the watershed. Figure 4-12 summarizes precipitation in inches from 1951 through 1968, as well as the average for the same period. Table 12 in Bulletin 104-7 indicates that the annual average total volume of water falling in the watershed during 1951-1968 was 163,100 AF and is depicted as a reference line (red) in Figure 4-13.

61 State of California Department of Water Resources (DWR). June 1972. *Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104.*

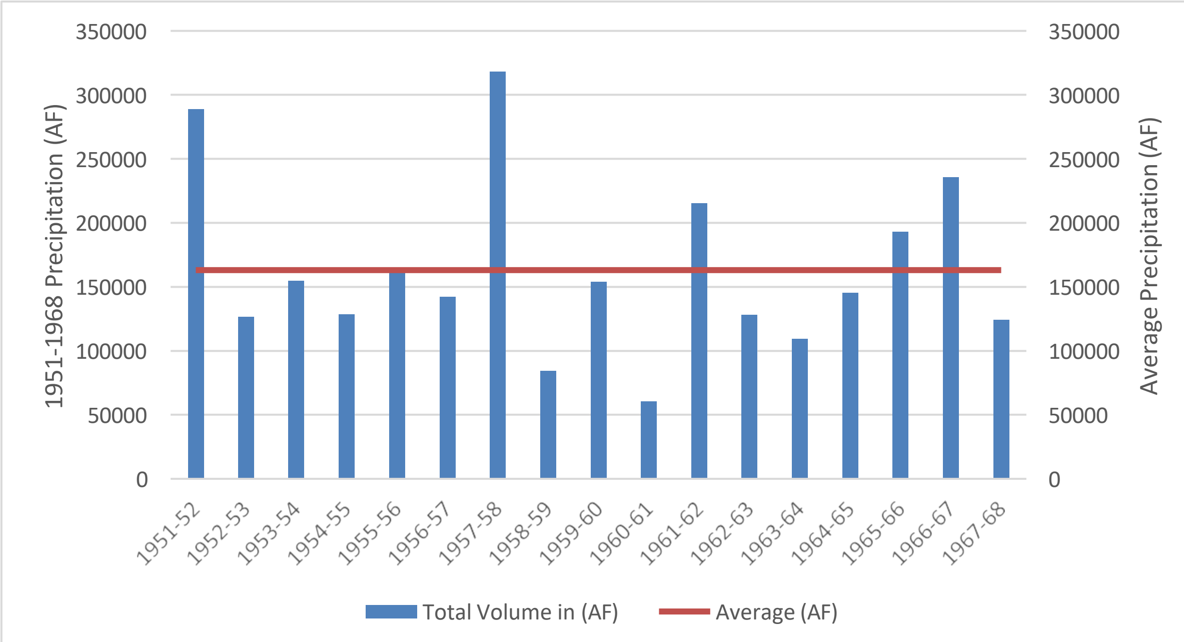


Figure 4-13: Precipitation Volume in the San Juan Basin from 1951 through 1968

Table 4-16 below provides the historical record of the importation of water that started in 1964, initially representing less than 10% of the total demand within the San Juan Basin. However, in following years as the population grew in Orange County, imported water would become more important and the dominant domestic water supply into the Basin, as described in more detail in Section 3.

Table 4-16
Fresh Water Imported into the San Juan Basin, 1951-1969

Water Year	Orange County Waterworks District No.4	Moulton Niguel Water District	Santa Ana Mountains County Water District	Total
1951-1963	0	0	0	0
1963-1964	400	0	50	450
1964-1965	560	350	70	980
1965-1966	820	560	100	1480
1966-1967	750	800	100	1650
1968-1969	1030	1720	100	2850

While volumes of imported water within the San Juan Basin steadily increased during the 1960s, groundwater remained the largest water supply component until the 1970s.

As noted, DWR Bulletin 104-7 was a planning document for managing water in the San Juan Basin. The authors of Bulletin 104-7 obtained a multitude of records that were used in the 16 major planning scenarios for the basin. Hydrologic balances for the San Juan Basin were presented for each scenario to determine how much water would be required within the San Juan watershed to serve projected population increases into the year 2020.

The total supply into the Basin is a function of the precipitation and percolation. Percolation rates were evaluated in depth in Bulletin 104-7 and described as a function of precipitation and streamflow. As noted in DWR Bulletin 104-7, percolation rates in the San Juan Basin are dependent on the previous years' initial ground water level, which determines the proportion of precipitation that will percolate and that those rates are, in part, inversely proportional to the quantity of groundwater in storage.

During this time, DWR engineers calculated the average percolation rate (e.g., amount of precipitation that would percolate to groundwater) within the San Juan Basin at 10,500 AF. Although the Basin was not included in the reporting of groundwater pumping as required in the Recordation Act,[62] the estimate of pumped water was calculated by adding the estimated quantity of water delivered for urban, suburban, and irrigated agriculture use (provided earlier) to the quantity of fresh water that was exported and subtracting the quantity of water that was imported or was diverted from San Juan Creek.

Table 4-17 summarizes historical hydrological balances in the San Juan Creek Basin during 1951-1968. Although over 160,000 AF of precipitation fell in the San Juan Basin during 1951-1968, an average of only 12,600 AF of groundwater supply was available during this period. The lack of groundwater supply during this period shaped the actions to optimize management of groundwater in the lower San Juan Creek Basin.

The export of water from the basin includes water loss due to the inability to percolate and wastewater export. The freshwater export will be covered in more detail in the evaluation of the groundwater quality of each HSA below. Wastewater began to be exported out of the basin starting in 1965 through the San Juan Capistrano-Capistrano Beach sewer outfall, starting at 700 AF in 1965-66 and increasing to 900 AF in 1967-1968, thus indicating the negligible effect wastewater from the limited wastewater effluent from non-domestic use which was about 2% of the surface area. Today, agencies are utilizing all available reclamation supplies within the San Juan Basin, continuing the pattern of a negligible effect of this reclamation export variable.

62 California Water Code §4999 through 5008. Recordation of Water Extractions and Diversions Act.

Table 4-17
Hydrologic Balance of the San Juan Watershed from 1951 through 1968

Water Year	Annual Groundwater Inflow (acre-feet)			Annual Groundwater Basin Outflow (acre-feet)					Net change in storage [C]
	Precipitation and Streamflow Infiltration[A]	Percolation of Applied Water[B]	Total Supply into Basin	Groundwater Pumping	Surfacing Groundwater	Consumptive Groundwater Use by Phreatophytes	Subsurface Outflow	Total Use or Outflow	
1951-52	24600	2200	26800	6400	1700	3900	400	12400	14400
1952-53	7100	2100	9200	6200	1700	3900	400	12200	-3000
1953-54	11700	2000	13700	6100	1700	3900	400	12100	1600
1954-55	6900	2000	8900	5800	1700	3900	400	11800	-2900
1955-56	11600	2000	13600	5800	1700	3900	400	11800	1800
1956-57	7100	2000	9100	5900	1700	3900	400	11900	-2800
1957-58	14900	2000	16900	5700	1700	3900	400	11700	5200
1958-59	5000	2000	7000	5500	1700	3900	300	11400	-4400
1959-60	7400	2000	9400	6200	1700	3900	400	12200	-2800
1960-61	5700	2100	7800	6600	1700	3900	200	12400	-4600
1961-62	14800	2100	16900	6900	1700	3900	300	12800	4100
1962-63	7800	2300	10100	6500	1700	3900	700	12800	-2700
1963-64	4600	2300	6900	6200	1700	3900	700	12500	-5600
1964-65	6800	2500	9300	6100	1700	3900	600	12300	-3000
1965-66	24800	1900	26700	5700	1700	3900	700	12000	14700
1966-67	13300	1800	15100	5500	1700	3900	800	11900	3200
1967-68	4700	2100	6800	4800	1700	3900	700	11100	-4300
Avg.	10500	2100	12600	6000	1700	3900	500	12100	500

Table 4-17 Notes:

A Percolation of precipitation and streamflow, including direct precipitation infiltration and infiltration of storm runoff.

B Portion of applied water (not including storm runoff) that infiltrates to groundwater directly or indirectly via dry season streamflow infiltration.

C Difference between Total Supply into Basin and Total Use or Outflow.

4.5 Water Quality by Hydrologic Subarea

The water quality data collected in the 1950s and 1960s and summarized through Bulletins 104-7 and 106-2 are different than the hydrologic subareas that were designated through the establishment of the San Diego Basin Plan. The differences in the designations are important distinctions for baseline geologic contributions and are included in this section to ensure quality assurance and data integrity throughout the report.

To illustrate the differences the following graphics are provided. Figure 4-14 shows the hydrologic subareas used in the modern designations of the basins with the black boundary the jurisdictional area of the RWQCB. Figure 4-15 illustrates the hydrologic divisions used in the Bulletins. Table 4-18 provides the overlap of the previous designations and the modern designations.

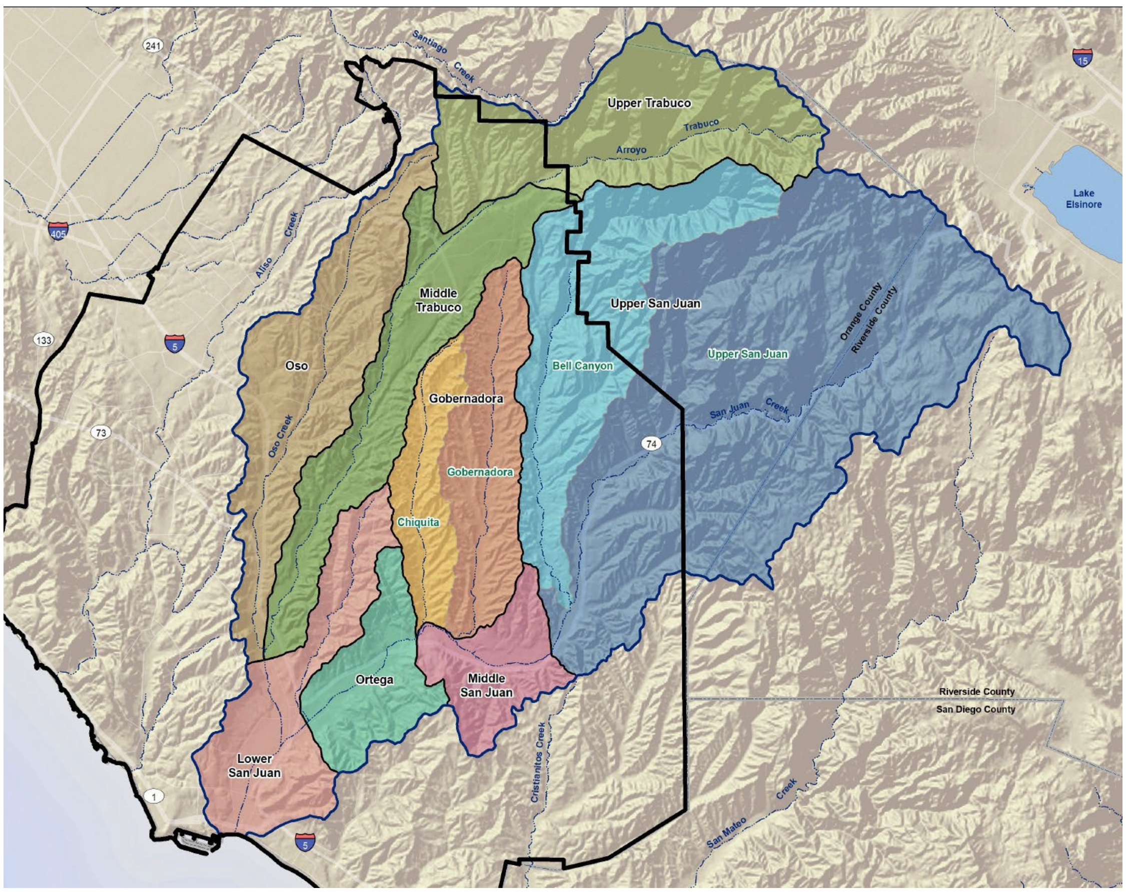


Figure 4-14: San Diego Regional Water Quality Control Plan HSA Designations

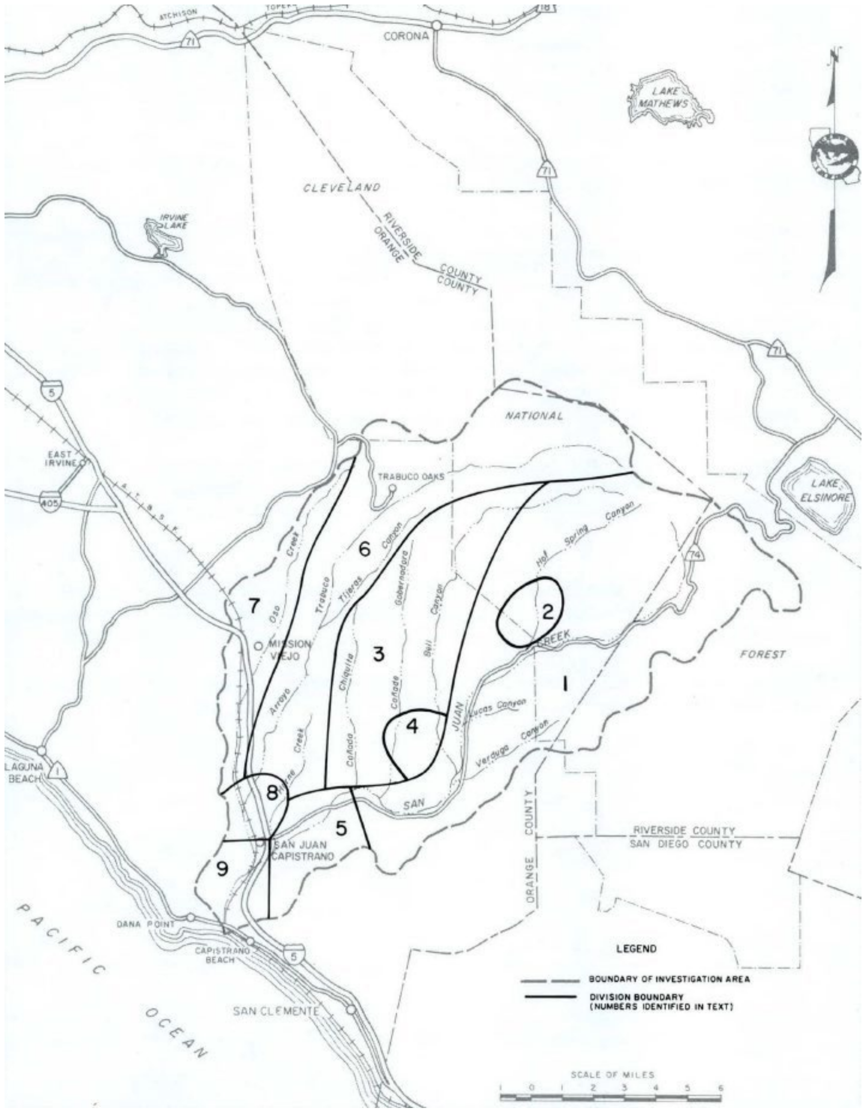


Figure 4-15: Historic (pre-1968) Hydrologic Divisions in the San Juan Basin[63]

[63] State of California Department of Water Resources (DWR). June 1972. *Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104, Figure 34.*

Table 4-18
Comparison of Water Quality Area Designations between Basin Plan and DWR

HSA	HSA #	Water Body	Tributaries	DWR Division	Tributaries
Oso Creek	901.21	Oso Creek		7	
Upper Arroyo Trabuco	901.22	Arroyo Trabuco	Holy Jim Canyon, Live Oak Canyon	6	Holy Jim Canyon, Live Oak Canyon
Lower & Middle Trabuco	901.23	Arroyo Trabuco	Tijeras Creek	6/7/8	Tijeras Creek
Gobernadora	901.24	Canada Chiquita & Canada Gobernadora		3	
Upper San Juan	901.25	San Juan Creek, Bell Creek	Crow Canyon, Hot Springs Canyon, Long Canyon, Decker Canyon, Morrel Canyon, Lucas Canyon, Verdugo Canyon	1/2	Crow Canyon, Hot Springs Canyon, Long Canyon, Decker Canyon, Morrel Canyon, Lucas Canyon, Verdugo Canyon
Middle San Juan	901.26	San Juan Creek	Canada Chiquita & Canada Gobernadora	1	Canada Chiquita & Canada Gobernadora
Lower San Juan	901.27	Confluence	Oso Creek, Arroyo Trabuco Creek, San Juan Creek	5/6/7/8/9	Oso Creek, Arroyo Trabuco Creek, San Juan Creek
Ortega	901.28	San Juan Creek	El Horno Creek	5/6	
NA				2	Hot Springs Canyon
NA				4	Canada Gobernadora, Bell Canyon

A recommendation from the Nolte Report was that "additional formal designations be made for hydrologic subareas in the Mission Viejo Hydrologic Area (1.2)."[64] The Nolte report used DWR summaries to formulate baseline conditions used to support modeling efforts for the 1993 Basin Plan amendment for the San Juan Basin. The archival data from the DWR Bulletins was not in a publicly available digital format for use in this SNMP. Therefore, this SNMP followed an established methodology for interpreting water quality information derived from archival data.[65] Figure 4-16 provides the methodology of the digitization process.

[64] Nolte and Associates. South Orange County Reclamation Authority Basin Plan Amendments Final Report. July 1993.

[65] el Mountassir, Otman & Bahir, Mohammed & Ouazar, D. & Ouhamdouch, Salah & Chehbouni, A. & Ouarani, Mohamed. (2020). The use of GIS and water quality index to assess groundwater quality of krimat aquifer (Essaouira; Morocco). SN Applied Sciences.

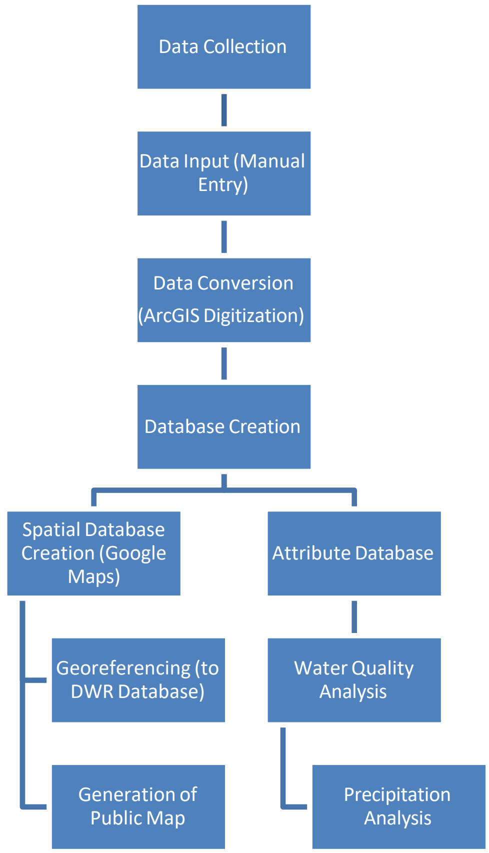


Figure 4-16: Data Validation Process for Digitization of Archival Data from DWR

Due to the differences from the DWR Bulletins, differences in the assigned surface areas of groundwater basins, and the modern designations of hydrologic subareas, a data review procedure was conducted to ensure an adequate accounting of geologic contribution of water quality since there was very little land use for urban settlement and agriculture as a proportion of the area of the San Juan Basin. The data review process first used the Mineral and Land Record System Numbers (MRLS) data set to assign a GIS location.

The DWR used the MRLS system for well designations. The wells were then entered into a Google Map as a placeholder. The DWR has a Water Data Library of digital data,[66] which was used to compare archival data from the DWR Bulletins to DWR Water Data Library data. Duplicates were removed, GIS locations were updated, and new data from the DWR Water Data Library was added into the Bulletins archival data set. Once a final quality control of the data set was completed, the wells were added to a GIS map as shown in Figure 4-17, to ensure that the assignment of historic well sites to hydrologic subarea was accurate.

[66] Department of Water Resources. Water Data Library. https://wdl.water.ca.gov/waterdatalibrary/Map.aspx

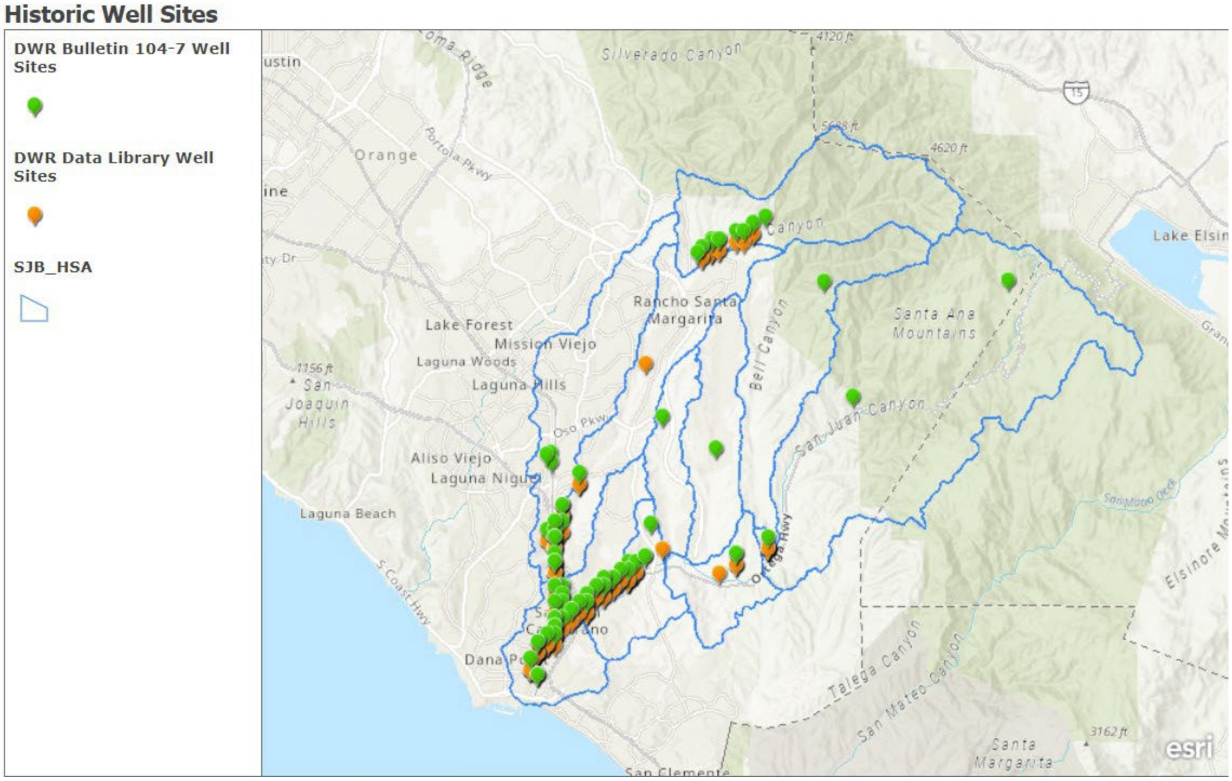


Figure 4-17: GIS Map of DWR Well Sites[67]

TDS was the constituent used to establish baseline water quality for comparison to basin plan objective standards consistent with the requirements of the 2018 Policy. However, while the 2018 Policy defers to WQOs established by Regional Boards due to jurisdictional oversight, it is important to note the historical development of those numerical limits for the San Juan Basin.

The Basin Plan Amendment modeling conducted by Nolte and Associates notes that TDS was the indicator parameter for demonstrating the projected impacts of recycled water into the San Juan Basin. In the 1993 Basin Plan Amendment Final Report[68], the following recommendations were provided:

> *Several TDS concentrations were considered for use as objectives to best fit the various circumstances of the hydrologic areas, based on existing data and modeling forecasts. A concentration of 500 mg/L was selected for more pristine quality groundwater and is the general health department limit for regular direct domestic use. A concentration of 750 mg/L was selected for good but less pristine quality groundwater, where dilution or treatment may be planned to achieve general domestic use or where restricted or higher-quality direct non-potable use is planned. A concentration of 1,100 mg/L was selected for groundwater in a smaller sub area with existing and planned non-potable use. And a concentration of 1,200 mg/L was selected for all lower quality groundwater, even those whose existing quality was considerably poorer than the Basin Plan objective. The 1,200 mg/L objective is based upon horticultural TDS concentration limits for the irrigation of general landscape*

67 SOCWA San Juan Basin Map of DWR Monitoring Sites. https://www.arcgis.com/home/webmap/viewer.html?webmap=9169e78d459840b5b8215c1790ea0887&extent=-117.8132,33.4138,-117.2831,33.7327

68 Nolte and Associates, SOCWA Basin Plan Amendments Final Report, July 1993, pp 1-9 and 1-13

> *plants over the entire study area. Also, this value allows the direct use of study area reclaimed water without the need for any demineralization treatment; it allows adequate quality local groundwater to be used directly for irrigation without demineralization or dilution; and it provides a blending limit for reclaimed water (or domestic water) and higher-TDS local groundwater and surface water. As applied to groundwaters whose quality has not been or never will be at the objective, the (1,200 mg/L TDS) objective becomes a monitoring parameter – focused on conjunctive water use – and not a quality goal to be met in the groundwater itself. This value thereby accommodates the cost-effective use of local water resources, both reclaimed water and surface/groundwater, while respecting use quality impacts.*

It is important to note that, as part of this Basin Plan evaluation, there was recognition that some groundwater in the San Juan Basin would never be able to meet the water quality objective. To understand the specific basins where groundwater data from 1952 through 1968 would or would not meet water quality objectives, and where monitoring would suffice for management purposes under California Water Code 13241, a review of the pre-1968 data was conducted. Figure 4-18 provides box plots of the data showing averages, ranges, and outliers. Including in the figure are the basin plan objectives for each hydrologic subareas.

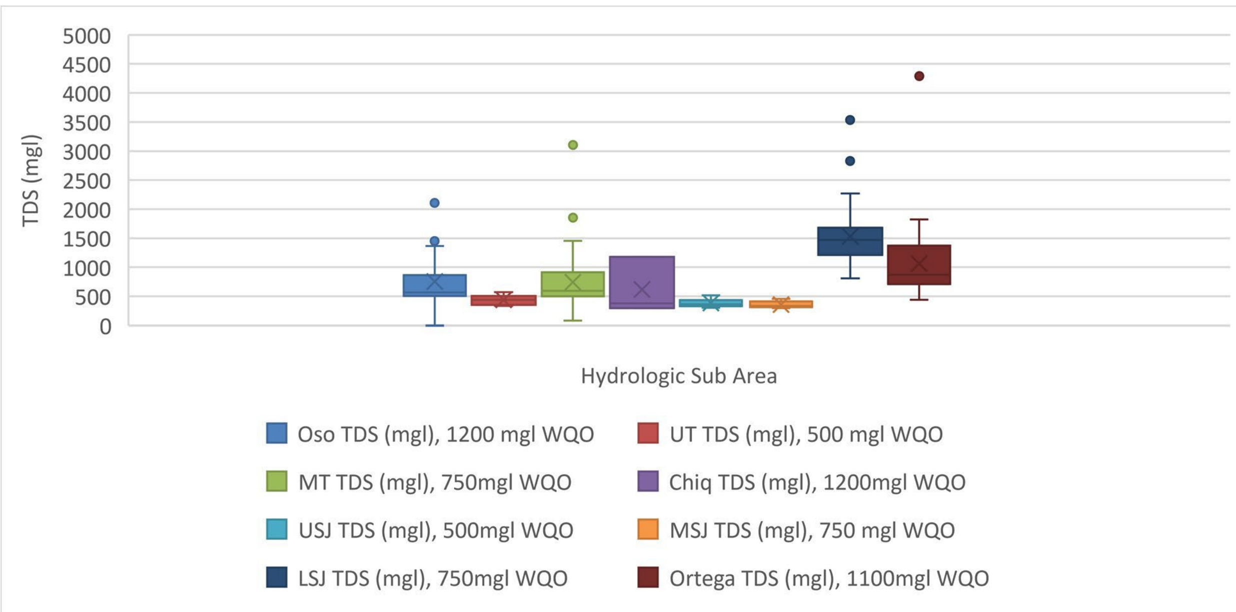


Figure 4-18: Box Plots of Data per HSA from 1952 through 1968

Figure 4-18 demonstrates that there were outliers of TDS in the Oso, Trabuco, Lower San Juan, and Ortega HSAs. This is driven by climatic cycles in precipitation and the ability for deep percolation within the San Juan Basin. Figure 4-19 plots the average depth of precipitation to the average annual percolation of precipitation in years from 1953 through 1968. In reference to Figure 4-19, the DWR 104-7 Report states:

> *These relationships suggest that, in the San Juan Basin, the initial ground water levels in any year have a strong influence on the proportion of the precipitation that will percolate to the zone of saturation, with percolation rates being, at least in part, inversely proportional to the quantity of ground water in storage.*

Thus, the precipitation and the amount of storage available for percolation drive the TDS within the basin.

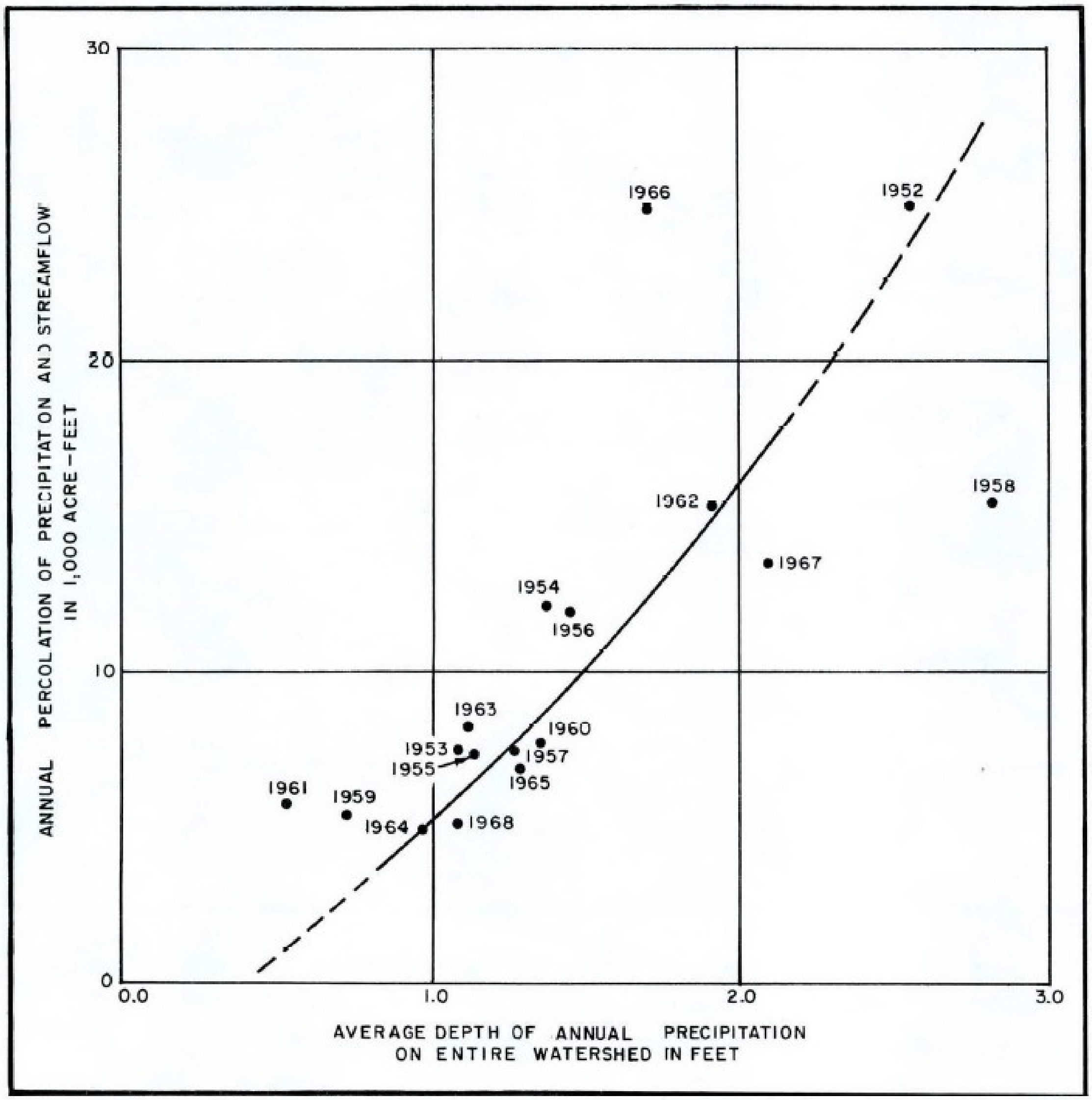


Figure 4-19: Criterion for Deep Percolation of Precipitation and Streamflow[69]

Utilizing this historical information, the outlier of 1958 best illustrates this dynamic. In 1958, the estimated percolation rate was much lower than in 1966 (the other outlier). This is attributed to differences in groundwater table elevations within the San Juan Basin. During the period from 1952 through 1968, 1958 was the highest years for precipitation, but ranked the third highest percolation rate above the mean. In contrast, 1966 ranked the 5th highest precipitation volume but was shared with 1952 as the highest percolation rate. To understand this relationship, the groundwater in storage at the beginning of the year was the lowest in 1966 for the period of 1952 through 1968, allowing a much larger

[69] State of California Department of Water Resources (DWR). June 1972. *Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104.* P. 73, figure 27.

area for the precipitation to fill compared to 1958, when the basin had was preceded by five years of a nearly full basin. Figure 4-20 provides the data summaries associated with the conclusions above.

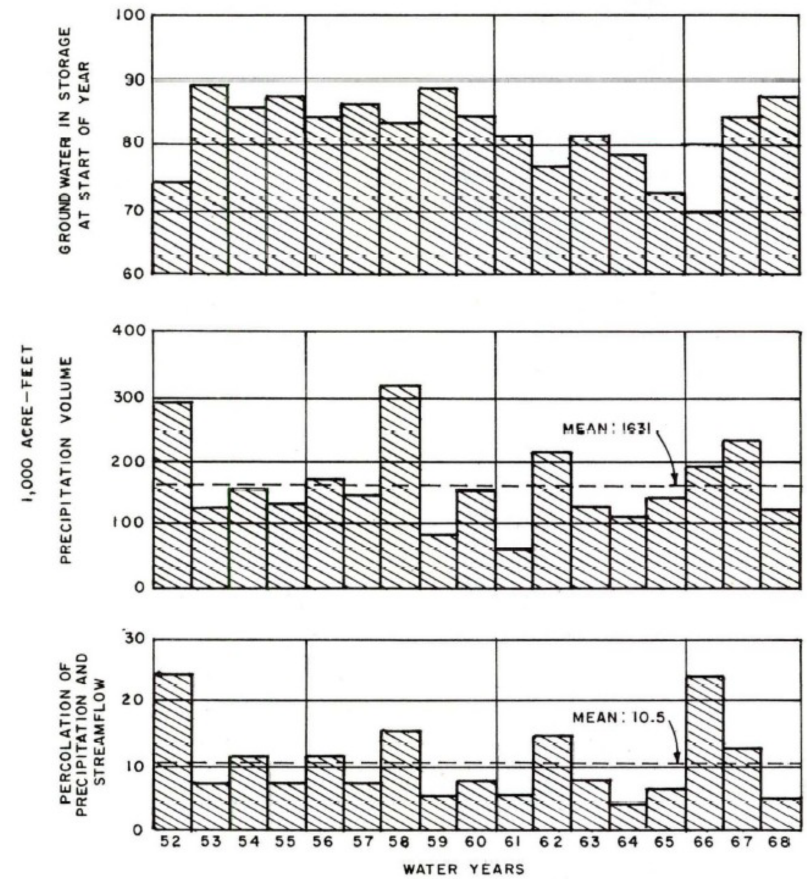


Figure 4-20: Groundwater storage, Precipitation, and Percolation, 1952-1968[70]

Figure 4-21 presents the relation between precipitation and TDS in the Lower San Juan Creek HSA (901.28). In 1958, due to the high storage volume in the basin, the TDS decreased from 1351 mg/L in 1958 to 1,332 mg/L in 1968, which reduced the ability of the high precipitation to decrease the TDS in the basin. In 1959, the TDS increased to 378 mg/L when the precipitation was low, and the storage volume was high.

This is compared to 1965 to 1966, where the TDS decreased by 509 mg/L when the groundwater storage was low (and the percolation rate was high). Thus, the combination of climate and storage volume are the largest drivers to mitigate naturally occurring TDS in the San Juan Basin.

[70] State of California Department of Water Resources (DWR). June 1972. *Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104.* P. 74, figure 28.

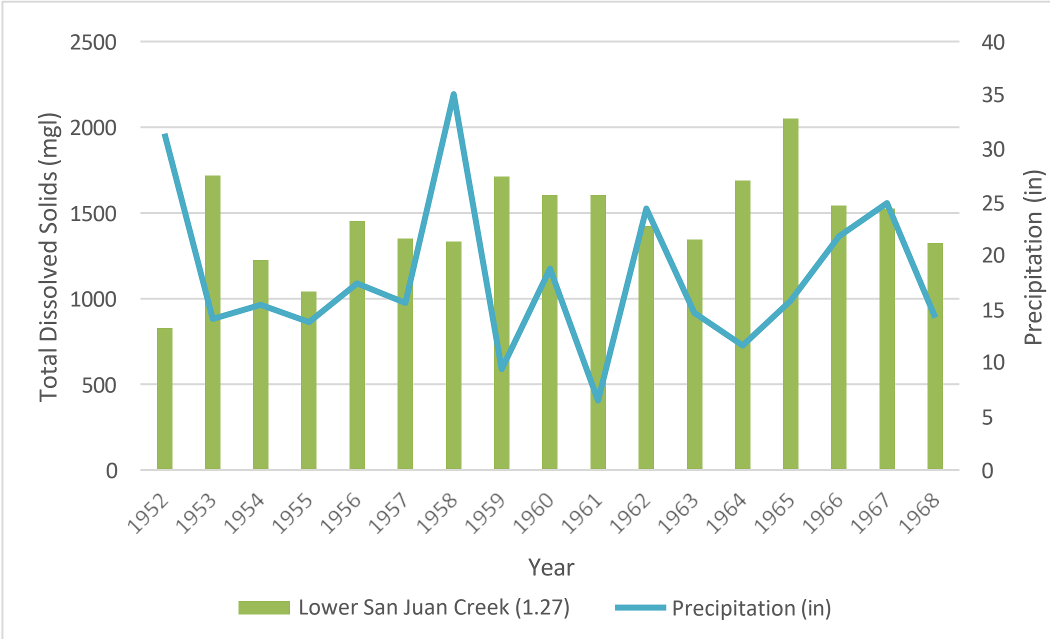


Figure 4-21: Precipitation and TDS in the San Juan Creek Basin

Table 4-19 provides the numerical values for each hydrologic subarea from 1952 through 1968. Also included is a column to determine if the data pre-1968 could meet the water quality objectives in the San Diego Water Quality Control Plan. For pre-1968 data, only half of the HSAs could meet water quality objectives, indicating that geologic conditions contribute a significant portion of TDS into the basins.

Table 4-19
Historical Groundwater TDS Concentrations in the San Juan Basin, 1952-1968

HSA #	HSA	Groundwater TDS Concentration, 1952-1968 (mg/L)				Compliance with Basin Plan[A]	Number of Samples
		Basin Plan Objective	Minimum Value	Maximum Value	Historic Average		
901.21	Oso	1200	497	2180	846	No	24
901.22	UT	500	346	517	438	Yes	8
901.23	MT	750	352	3106	768	No	55
901.24	Gob	1200	296	1176	617	Yes	3
901.25	USJ	500	300	515	384	Yes	16
901.26	MSJ	750	298	457	357	Yes	6
901.27	LSJ	750	811	3626	1532	No	101
901.28	Ortega	1100	438	4291	1062	No	48

Table 7-1 Notes:
A Compliance with the Basin Plan where no more than 10 percent of the samples in any year exceed the Basin Plan water quality objective.[71]

[71] Regional Water Quality Control Board, San Diego Region (RWQCB). *Water Quality Control Plan for the San Diego Basin*. 1994 (with amendments effective on or before September 1, 2021. Tables 3-2 & 3-3. https://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/docs/chapter_3.pdf

To understand the impact of development post-1968, Table 4-20 includes a review of the range of data post-1968 for groundwater in hydrologic subareas within the San Juan Basin. It is important to note that the data are concentrated within 2016 through 2022 through the SNMP monitoring program and is driven by a dry climatic cycle, further exacerbating the geologic contribution of salts to the basin.

Table 4-20
Modern Water Quality Data by HSA, 1969-2022

HSA #	HSA Name	Basin Plan Objective (mg/L)	Minimum Sample Value (mg/L)	Maximum Sample Value (mg/L)	Average 1969-2022 (mg/L)	Compliance[A] with Basin Plan?	Number of Samples
901.21	Oso	1200	930	7300	4500	No	48
901.22	UT	500	320	450	391	Yes	6
901.23	MT	750	506	1404	941	No	136
901.24	Chi/Gob	1200	530	1600	943	Yes	53
901.25	USJ	500	380	3430	1136	Yes	127
901.26	MSJ	750	430	1600	852	No	71
901.27	LSJ	750	940	7900	2115	No	386
901.28	Ortega	1110	920	2530	1794	No	82

Table 4-20 Notes:

A Compliance with Basin Plan groundwater quality objectives is demonstrated, defined as when no more than 10% of samples exceed the objective during anyone-year period.[72]

The Oso HSA is highly mineralized with up to 12,800 mg/L of TDS measured within the HSA from surface water samples with the highest salt concentration due to very low flows, with a dramatic decrease of 334 mg/L of TDS in April 1965 due to very high flows.[73] However, although the HSA is high in TDS, the Oso/La Paz alluvium has a very low transmissivity, as noted by Dr. Mann, a hydrogeologist cited in the Nolte report.[74,75] This lack of beneficial uses for drinking water in the Oso Creek HSA was also cited in 1977 by SWRCB Decision 1463, in finding 11: “A representative from the Orange County Municipal Water District testified that an emergency water supply reservoir is needed because of the lack of groundwater basin from which water could be pumped during an emergency.” Thus, while the Oso Creek HSA is designated as MUN to produce drinking water for beneficial use, it has, nor will it ever produce drinking water. However, RWQCB Resolution 90-61, requires that adequate source control measures be conducted by agencies distributing recycled water.[76] The Oso Creek barrier was constructed in 1977 with

72 Regional Water Quality Control Board, San Diego Region (RWQCB). *Water Quality Control Plan for the San Diego Basin*. 1994 (with amendments effective on or before September 1, 2021.
Tables 3-2 & 3-3. https://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/docs/chapter_3.pdf

73 State of California Department of Water Resources (DWR). June 1972. *Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104.* P. 18

74 Nolte and Associates, SOCWA Basin Plan Amendments Final Report, July 1993, pp 1-9 and 1-13

75 State Water Resources Control Board. Decision 1463. Decision Directing Prevention of Waste and Unreasonable Use of Water.
https://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1450_d1499/wrd1463.pdf

76 Regional Water Quality Control Board, San Diego (RWQCB). Resolution 90-61.

Proposition 13 monies to protect drinking water supplies in the Lower San Juan HSA, where the drinking water supplies are concentrated in the lower HSA.

The Lower San Juan Basin is the other notable HSA with high groundwater TDS concentrations within the San Juan Creek Basin. The highest observed TDS concentrations are from Costco Well #1 and may be attributable to potential seawater intrusion as evidenced by high chloride values. The SJBA, through the adaptive pumping plan[77], is monitoring this location, other monitoring wells, and the drinking water sources for quality while also monitoring pumping rates to prevent seawater intrusion. SCWD is treating the high TDS and chloride and putting the water to beneficial use, allowing high-quality stormwater to recharge and flush the salts. Monitoring for seawater intrusion, precipitation, and pumping rates from the SJBA are included in Figure 4-22 as an example of the information collected and reviewed.

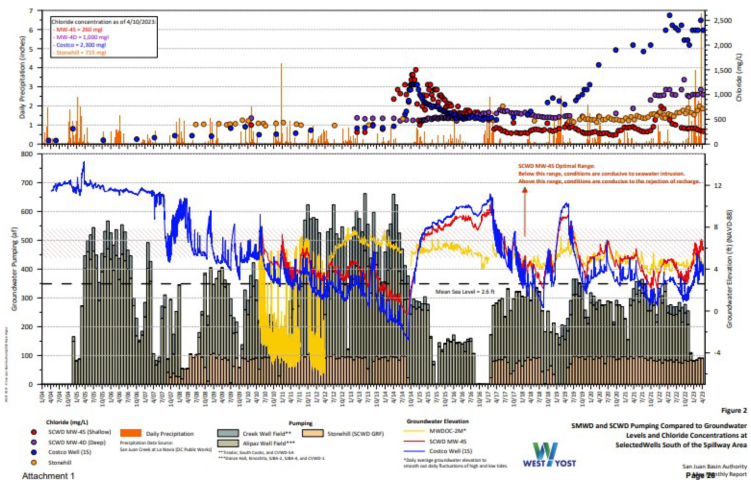


Figure 4-22: San Juan Basin Authority Monitoring Graphic

These results are reported to the governing Board of the SJBA and are reviewed for compliance with the SWRCB permits for drinking water extraction for SCWD and SMWD. For example, in May 2023[78], there was an extension discussion by SCWD and SMWD on the water quality in the Lower San Juan Basin based on monitoring results. The SJBA will continue to monitor and manage the potential seawater intrusion into the Basin.

Figure 4-23 summarizes TDS ranges observed in HSAs the San Juan Creek Basin. The results from Figure 4-23 are summarized in Table 4-20, which summarizes data post-1968 from the SNMP monitoring program, data included in the 2014 SNMP, and monitoring required under Order 97-52. Table 4-20 indicates that one additional basin, the Middle San Juan Basin, does not meet the Basin Plan criteria. However, the other three HSAs that did meet the basin plan objectives pre-1968 are still meeting the water quality objectives. Table 4-20 also compares to Table 4-19 (pre-1969 water quality), illustrating that management actions are in place to protect beneficial reuse, where appropriate. Section 5 of this SNMP

[77] San Juan Basin Authority. Adaptive Pumping Plan. 2016. https://www.sjbauthority.com/assets/downloads/20160830_APM_Memo.pdf
[78] San Juan Basin Authority. May 2023 Board Report. Agenda Item VI.A. https://www.sjbauthority.com/meetings/meetings-2023.html

provides further details on the management strategies in place or in planning stages to protect groundwater's beneficial use for drinking water.

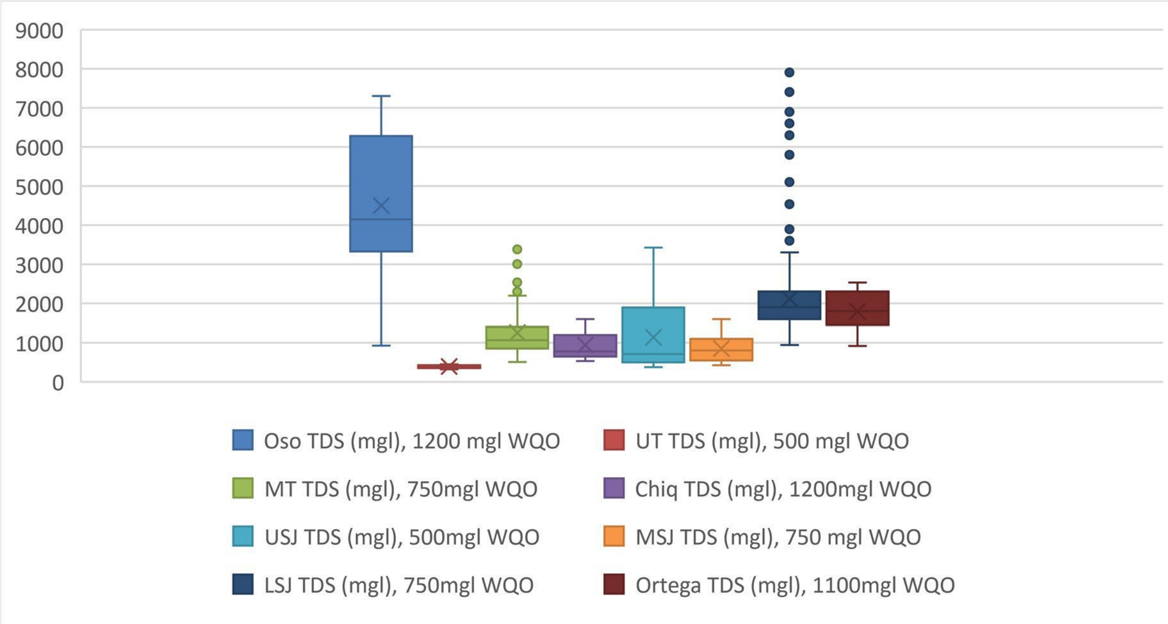


Figure 4-23: TDS Range of data from 1969 through 2022 in the San Juan Creek Basin

To determine how much geologic, climatic, and anthropogenic contributions contribute to the TDS in each HSA, Figure 4-24 was created based on the differences between TDS in each of the HSAs. A literature review was conducted for California to ascertain how much TDS contributions from anthropogenic sources are, to gain a more realistic viewpoint of the contribution of TDS from development in a post-1968 manner to determine the increase in TDS alone from development activities.

In 2018, Hansen, et al.[79], conducted a comprehensive review of the changes in TDS in the San Joaquin Valley, which has a very large agriculture footprint producing up to $24B in revenue.[80] The authors studying the changes in TDS found that when comparing data from 1910 to wells sampled in modern times (1993 through 2015), agricultural practices drove an increase in TDS of 100 mg/L in the modern sampling period. The authors concluded that agricultural practices from fertilizers and dissolution of silicate geology from irrigation waters. The San Joaquin Valley uses approximately 2 million AF of water over an 8,000 square-mile area.[81] This is compared to the San Juan Basin at 133.9 square miles[82] with applied water just under 100,000 AF.

79 Hansen, J., Jurgens, B., & Fram, M. & Quantifying anthropogenic contributions to century-scale groundwater salinity changes, San Joaquin Valley, California, USA. Science of the Total Environment. 2018. 10.1016/j.scitotenv.2018.05.333

80 Escriva-Bou, A., Hanak, E., Cole, S., Medellin-Azuara, & Rosser, A.Public Policy Institute of California, Policy Brief: The Future of Agriculture in the San Juaquin Valley. https://www.ppic.org/publication/policy-brief-the-future-of-agriculture-in-the-san-joaquin-valley/#:~:text=Valley%20agriculture%20employs%20around%20340%2C000,%243.2%20billion%20in%20revenues%2C%20respectively

81 California State University, Stanislaus. San Joaquin Valley Agriculture. https://www.csustan.edu/sites/default/files/groups/Geography/Images/sjvagjb.pdf

82 DWR Bulletin 118 (2004) assigns a 16,700-acre (26-square mile) surface area to the alluvial portion of the San Juan Basin. The total tributary area to the San Juan Basin is 133.9 square miles.

Figures 4-24 compare pre-1968 water quality with modern water quality to determine whether contributions from anthropogenic sources, like the San Juaquin study, dominate the salt loading.

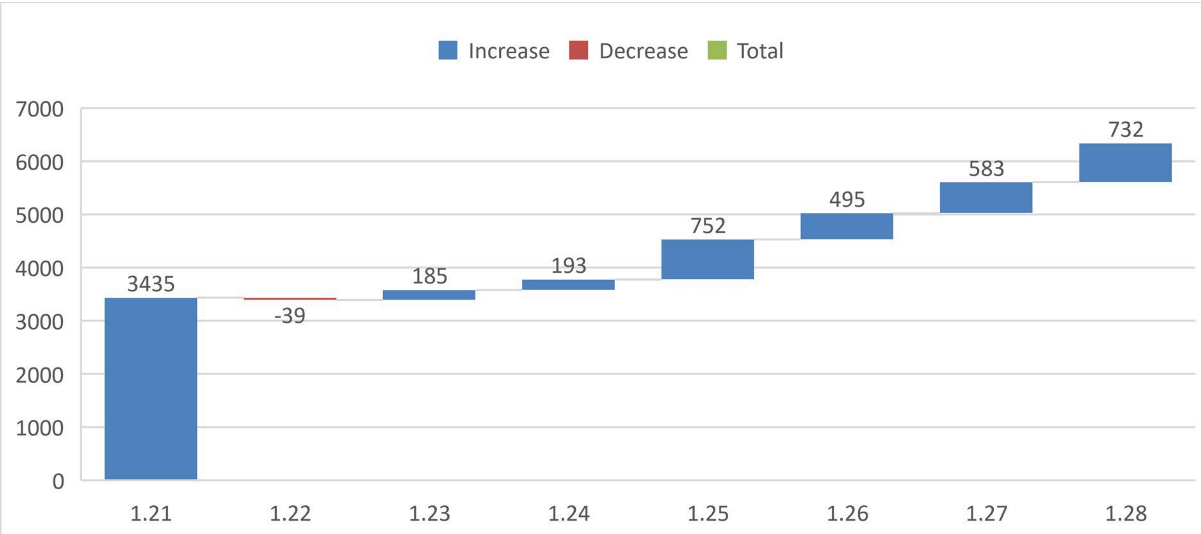


Figure 4-24: Difference in TDS Data Between Pre-1968 data and Modern TDS Data in the San Juan Creek Basin

With increases in TDS between 185 and 3,435 mg/L, the lack of precipitation in the San Juan Creek Basin is driving the increase in TDS due to poor geology, as described earlier in this section and by findings in Bulletin 104-7. While applied water and reclamation can contribute salt to a basin, those contributions are negligible compared to the natural conditions. The conclusion of the geologic contribution due to lack of precipitation is also founded on the fact that the contribution of salts from reclamation activities is not driving the TDS as governed by the limits in Order 97-52 (as amended), with effluent results not exceeding 1,400 mg/L. Thus, the management of salts from the Oso Creek Barrier (HSA 1.21) to prevent downstream further degradation and the cost of treating drinking water in the lower San Juan Basin is a strategy that is working. This evidence is found in the fact that the Lower San Juan Basin (HSA 1.27) did not increase at the same rate as the Oso Creek HSA, as indicated in Figure 4-24.

4.6 Monitoring Plan

The purpose of this monitoring plan is to observe the water quality in various locations within the Basin in compliance with Section 6.2.4.1 of the 2018 Recycled Water Policy (Policy), which provides the regulatory framework for a monitoring plan. The monitoring plan described in more detail below adheres to the following sections within the Policy:

> 6.2.4.1. A basin- or subbasin-wide monitoring plan that includes an appropriate network of monitoring locations to provide a reasonable, cost-effective means of determining whether the concentrations of salts, nutrients, and other constituents of concern as identified in the salt and nutrient management plans are consistent with applicable water quality objectives. The number, type, and density of monitoring locations to be sampled and other aspects of the monitoring

program shall be dependent upon basin-specific conditions and input from the regional water board. Salts, nutrients, and the constituents identified in

6.2.1.1 shall be monitored. The frequency of monitoring shall be proposed in the salt and nutrient management plan for review by the regional water board pursuant to 6.2.3.

6.2.4.1.1. The monitoring plan must be designed to effectively evaluate water quality in the basin. The monitoring plan must focus on water supply wells, areas proximate to large water recycling projects, particularly groundwater recharge projects, and other potential sources of salt and nutrients identified in the salt and nutrient management plan. Also, monitoring locations shall, where appropriate, target groundwater and surface waters where groundwater has connectivity with adjacent surface waters.

6.2.4.1.2. The monitoring plan may include water quality data from existing wells where the wells are located and screened appropriately to determine water quality throughout the most critical areas of the basin. The SWRCB supports monitoring approaches that leverage the use of groundwater monitoring wells from other regulatory programs, such as the Irrigated Lands Regulatory Program and the Sustainable Groundwater Management Act.

6.2.4.1.3. The monitoring plan shall identify those stakeholders responsible for conducting, compiling, and reporting the monitoring data. Where applicable, the regional water board will assist by encouraging other dischargers in the basin or subbasin to participate in the monitoring program. The data shall be electronically reported annually in a format that is compatible with a Groundwater Ambient Monitoring & Assessment (GAMA) information system and must be integrated into the GAMA information system or its successor.

Monitoring Network Design. In 2016, members of the SJBA created a monitoring plan in response to comments from the Regional Board for a management monitoring plan to be compliant with the 2009 SWRCB Recycled Water Policy.[83] The SJBA's monitoring plan leveraged compliance required monitoring wells to ascertain if the information could be integrated into the water supply modeling. After a thorough review of historical water quality data, it was determined that the local geologic conditions outlined in Section 2, combined with rainfall events, significantly impact water quality, thus necessitating an updated monitoring plan approach compliant with the 2018 Policy.

The design of this updated monitoring plan considers the following historical and future monitoring locations:

- Domestic well water quality data collected by the Department of Water Resources from 1952 through 1968,

[83] Policy for Water Quality Control for Recycled Water (Recycled Water Policy). Section 3a. Revised January 22, 2013, effective April 25, 2013. https://www.waterboards.ca.gov/water_issues/programs/recycled_water/docs/rwp_revtoc.pdf

- Water quality compliance monitoring results from 1997 through 2023 in Master Recycled Water Permit Order 97-52,
- SJBA monitoring plan results from 2016-2022,
- Domestic water quality data obtained from imported water, 1994 through 2023,
- Updated locations for future management actions, and
- Domestic well water quality requirements needed for the fate and transport model.

The network design of the monitoring plan in the San Juan Creek watershed is based on the delineation of the basin. As described in Section 3, groundwater within the San Juan Creek watershed primarily occurs in the relatively thin alluvial deposits along the valley floors and within the major stream channels. The SWRCB has characterized this groundwater, from a water rights perspective, as the flow of an underground stream. The groundwater basin is bound to the north by the Santa Ana Mountains, composed of impermeable granitic and metamorphic bedrock, and to the south by the Pacific Ocean. Sedimentary bedrock formations form the sides of the water-bearing canyons of the Upper Basin and Arroyo Trabuco (i.e., Cañada Chiquita, Cañada Gobernadora, and Bell Canyon). Four principal groundwater basins have been identified in the San Juan Creek watershed: (1) Lower Basin, (2) Middle Basin, (3) Upper Basin, and (4) Arroyo Trabuco. These sub-basins were first delineated by the California Department of Water Resources (DWR) in 1972 based on water quality differences through watershed surveys as early as 1952.

The Lower Basin (San Juan and Ortega HSAs) is the only sub-basin with a consistent groundwater supply and is the focus of this monitoring plan. Additionally, because the San Juan and Ortega HSAs have the highest number of monitoring locations, this region is also the focus of the fate and transport modeling (Section 6) in alignment with Section 6.2.4.1.2 of the Policy. Depending on climate conditions, certain sections within the Basin can also provide a domestic water supply. These sections were also considered in this plan and are detailed in the monitoring locations section. Furthermore, the monitoring approach leverages existing water quality monitoring already conducted by SOCWA member agencies.

Monitoring Locations. Monitoring locations described below consider the water quality objective selection criteria, location type, and density of proposed monitoring locations. Table 4-21 provides the evaluation attributes considered and a description of questions that were reviewed prior to the development of the monitoring locations.

The design of the SNMP is designed to effectively and efficiently provide testing intervals to assess how management actions and climatic drivers change the underlying water quality of the basin. The following narrative provides the rationale and logic for monitoring site locations.

Table 4-21
Monitoring Plan Evaluation Attributes

Evaluation Attributes	Description
Spatial Distribution	Are the sampling sites adequately spread out to capture the geographical variability of salt content in groundwater?
Groundwater Flow	Are the sites located at different points along the groundwater flow pathway? How are upstream and downstream sampling locations considered for monitoring locations?
Influence of Surface Water	If the groundwater is influenced by surface water, are there sites located near the areas of interaction between surface and groundwater?
Historical Data	Are there sites where historical data are available? How has the historical data been used for inclusion in the monitoring plan?
Variability in Salt Concentrations	Are some sites showing more variability in salt concentrations than others? How are seasonal and climatic conditions considered in the variability of salt concentrations?
Impact of Human Activities	Are there sites near areas of significant human activity, such as agriculture, industry, or urban development, which might influence salt levels?
Representativeness	Are the selected sites representative of different hydrogeological settings (e.g., different soil types, bedrock geology, hydrology)?
Logistical Considerations	Are the sites accessible for regular sampling?
Data Quality	How does the quality of data from each site meet the requirements for the analysis?

The SNMP monitoring plan focuses on several key monitoring locations to ensure comprehensive water quality management and to evaluate compliance with Basin Plan[84] groundwater quality objectives. These locations include areas with water supply wells and areas near significant water recycling projects. The monitoring plan also targets areas identified as potential sources (both natural and man-induced) of salts and nutrients. Additionally, areas where groundwater may interact with surface water are monitored. Existing wells, provided they are suitably located and screened, are also incorporated into the monitoring framework.

Criteria for Groundwater and Surface Water Monitoring Sites. Criteria for ground and surface water monitoring sites include:

- Monitoring sites identified in the 1994 basin plan amendment monitoring,
- Current Order No. 97-52 permit required monitoring or modified monitoring sites,
- Monitoring sites to improve information for fate and transport modeling, and
- Non-domestic water well sites used for recycled water supplementation.

[84] RWQCB *Water Quality Control Plan for the San Diego Basin*. 2021 (with amendment effective on or before September 1, 2021). Chapter 3. https://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/docs/chapter_3.pdf

Rationale for Proposed Location of Monitoring Sites. Table 4-22 includes the Recycled Water Policy section that is applicable to the chosen monitoring locations. Also included in Table 4-22 is the amount of recycled water produced in the HSA from 2016 through 2022. The recycled water distributed based on each HSA is included as a key component of this monitoring plan due to concentrated monitoring resources where recycled water is being produced at the largest capacity in the basin.

Table 4-22
Monitoring Locations and Policy References

HSA Number	HSA Name	Recycled Water (AF) 2016-2022	Groundwater wells for Drinking Water or Historic Monitoring Wells	Surface Water or Diversion Site	Impoundment Structure	Recycled Water Policy
901.21	Oso	24,589	Rosenbaum 1 Well	Oso Creek Barrier	Upper Oso Reservoir, Lake Mission Viejo	6.2.4.1.1., 6.2.4.1.2.
901.22	Upper Trabuco	225	No Groundwater Wells are used for Drinking Water	None	None	6.2.4.1.
901.23	Middle Trabuco	6,030	Trabuco Creek Wells Facility, MT-02, and North Open Space (NOS)	None	None	6.2.4.1.2.
901.24	Gobernadora	15,787	Ranch Filtration Plant, Chiquita DH-21, Chiquita DH-2, Gobernadora DH-2, Gobernadora-17	Gobernadora, Tick Creek, Deer Creek	Portola Reservoir	6.2.4.1.2.
901.25	Upper San Juan	None Reported	Upper & Lower MW, Audubon, USJ-03, RMV9	None	Dove Lake	6.2.4.1.2.
901.26	Middle San Juan	None Reported	RMV 6, RMV 7, RMV 12, RMV 25, RMV 27, RMV 28	None	None	6.2.4.1.2.
901.27	Lower San Juan	10,095	CVWD-1, SJBA-2, SJBA-5, Kinoshita, Stonehill	Horno Barrier	Trampas Reservoir	6.2.4.1.2.
901.28	Ortega	3,267	South Cooks, CVWD-#5A, Tirador	None	None	6.2.4.1.2.

As shown in Table 4-22, the updated monitoring plan includes monitoring at:

- Twenty drinking water or monitoring wells,
- Five surface water or diversion sites, and
- Five impoundment reservoirs.

To support Table 4-22, Table 4-23 includes the logic and justification behind the choice of monitoring locations based on the Recycled Water Policy as referenced in Table 4-22.

Table 4-23
Logic and Justification for Monitoring Locations

HSA Number	HSA Name	Recycled Water Policy	Comments on Recycled Water Section
901.21	Oso	6.2.4.1.1., 6.2.4.1.2.	The Oso HSA has the highest recycled water irrigation use of all HSAs in the San Juan Basin. This HSA is The Oso Creek Barrier, which has a long history of monitoring since 1979, serves as an excellent target for monitoring groundwater connected to surface water. Oso Creek is also a tributary to San Juan Creek; therefore, this location is considered a critical location in the Basin for monitoring. The Rosenbaum well is used in element 1 of the fate and transport model.
901.22	Upper Trabuco	6.2.4.1.	This HSA has no ground water wells used for drinking water purposes under the influence of recycled water.
901.23	Middle Trabuco	6.2.4.1.2.	This HSA is the fourth-highest recycled water use HSA, with drinking water monitoring leveraged under other regulatory monitoring programs. The NOS well is used for water supply inputs in element 1 of the fate and transport model.
901.24	Gobernadora	6.2.4.1.2.	This HSA has the second-highest recycled water use. The Ranch Filtration Plant is projected to be constructed as a management action. Water quality monitoring at the Ranch Site will serve as the main ground water quality monitoring location. Chiquita well is the named groundwater well in Order 97-52 but is no longer in service. South County pipeline station 2 is the reported drinking water comparison.
901.25	Upper San Juan	6.2.4.1.2.	While there is no reported recycled water in this HSA, these sites are included in Order 97-52 and the 1994 Basin Plan, thus leveraging the use of ground water monitoring wells in regulatory reporting requirements. Additionally, the Audubon Well is a drinking water production well.
901.26	Middle San Juan	6.2.4.1.2.	While there is no reported recycled water in this HSA, these sites are included in Order 97-52 and the 1994 Basin Plan, thus leveraging the use of ground water monitoring wells in regulatory reporting requirements. This HSA has an increase in monitoring wells in step with the monitoring approach based on the slight increase above the historical baseline compared to pre-1968 data. The additional monitoring will assess the effectiveness of management strategies.
901.27	Lower San Juan	6.2.4.1.2.	This HSA has the third-highest recycled water use. This HSA is the largest concentration of drinking water for the San Juan Basin, making up ~5% of all drinking water supplies for South Orange County. The wells leverage existing water quality wells covered under other regulatory programs. The wells included support the fate and transport model elements 6, 13, 14, & 16.
901.28	Ortega	6.2.4.1.2.	This HSA has the fifth-highest recycled water usage in the basin. Monitoring wells were chosen as they are all drinking water production wells and, therefore leverage the use of groundwater wells from other regulatory programs. Groundwater monitoring sites support elements 10,11, & 12 of the fate and transport model.

Monitoring Constituents. As stated within this SNMP, the local geologic contribution of naturally occurring salts contributes to historically poor quality in the basin, as reported by DWR, and represents the largest driver of poor water quality in the basin. A more modern analysis of the water quality concerns in the San Juan Hydrologic Unit was conducted in the 2014 SNMP.[85] Per Phase 1 recommendations in the 2014 SNMP, groundwater quality constituents to be addressed as part of the SOCWA service area SNMP included TDS, iron, manganese, nitrate, and constituents of emerging concern. TDS and nitrate received the primary focus in the 2014 SNMP effort.

[85] South Orange County Wastewater Authority (SOCWA). 2014. Salt and Nutrient Plan for the South Orange County Aliso Creek, San Juan Creek and Portions of Other Basins. Prepared by HDR and Wildermuth Environmental. P.42. https://www.socwa.com/wp-content/uploads/2016/05/SNMPReport_Final.pdf

The 2014 SNMP[86] provided ample evidence that nitrate was not a monitoring constituent of concern and, therefore, is not included in this monitoring plan based on the use of recycled water in the basin since the early 1970s without exceedance of nitrate maximum contaminant levels (MCL) Of the analysis provided in Section 6, one well exceeded the basin plan objective for nitrate but was due to a known contamination site and not attributable to recycled water.

Through the evaluation conducted by the 2014 SNMP, the following historical findings[87] are relevant to this updated monitoring program related to monitoring constituents:

- All wells in the SJBA groundwater area had a maximum TDS concentration that exceeded the secondary MCL for TDS of 500 mg/L, and the maximum TDS concentration measured at the majority of wells exceeded the Basin Plan groundwater objectives for TDS in their respective HSAs.
- The maximum TDS concentration measured at surface water monitoring sites was generally greater than the secondary MCL and the Basin Plan surface water objective, both of which are 500 mg/L.
- TDS concentrations in surface water are lowest in the upper reaches of the watershed and increase downstream towards the coast. The highest TDS concentrations in surface water were observed in the Oso and Lower San Juan HSAs.
- Nitrate-N concentrations in groundwater and surface water are well below the primary MCL and the Basin Plan objectives, all of which are 10 mg/L as nitrogen.
- The majority of wells had maximum iron concentrations that exceeded the secondary MCL and Basin Plan groundwater objective of 0.30 mg/L. The wells exceeded these criteria by as much as 60 times the regulatory standards.
- Apart from Arroyo Trabuco and the upper reaches of San Juan Creek, the maximum observed iron concentrations in surface water were generally greater than the MCL and Basin Plan objectives, all of which are 0.30 mg/L.
- The majority of wells had maximum manganese concentrations that exceed the secondary MCL and Basin Plan groundwater objective of 0.05 mg/L. The wells exceeded these criteria by as much as 40 times the regulatory standards.
- Manganese concentrations of surface water in Oso Creek and the lower reaches of San Juan Creek generally exceeded the secondary MCL and Basin Plan groundwater objective of 0.05 mg/L.

It is important to note that there are no exceedances of primary drinking water standards[88] under the California Safe Drinking Water standards. However, there are consistent exceedances of water quality objectives, as noted above. Section 4 of this SNMP provides a robust summary of the well-established

---

86 South Orange County Wastewater Authority (SOCWA). 2014. Salt and Nutrient Plan for the South Orange County Aliso Creek, San Juan Creek and Portions of Other Basins. Prepared by HDR and Wildermuth Environmental. Sections 4 &6. https://www.socwa.com/wp-content/uploads/2016/05/SNMPReport_Final.pdf

87 South Orange County Wastewater Authority (SOCWA). 2014. Salt and Nutrient Plan for the South Orange County Aliso Creek, San Juan Creek and Portions of Other Basins. Prepared by HDR and Wildermuth Environmental. P.49. https://www.socwa.com/wp-content/uploads/2016/05/SNMPReport_Final.pdf

88 California Safe Drinking Water Laws. https://www.waterboards.ca.gov/laws_regulations/docs/drinking_water_code_2021.pdf

poor water quality in the Basin that existed prior to 1968. The poor water quality also exceeded the Basin Plan objectives prior to 1968. As the development of water resources was a key need as urbanization increased, water management was developed early on to treat groundwater prior to delivery to customers to meet secondary drinking water standards. However, through discussion with the Regional Board staff, for purposes of this SNMP, TDS, iron, manganese, and nitrate are the primary monitoring constituents required for all sampling locations identified in this plan. [89]

Monitoring Sites and Sampling Frequency. Based on the requirements outlined in section 6.2.4.1 of the Policy, a comprehensive monitoring plan was developed for groundwater, surface water/diversions, impoundment structures, and recycled water effluent, spanning the entire San Juan Creek Basin. This plan strategically positioned a network of monitoring locations to offer a cost-effective method for determining whether concentrations of salts, nutrients, and other key constituents aligned with set water quality objectives. The exact number, kind, and distribution of these monitoring sites were influenced by specific conditions within the basin and guidance from the RWQCB. The frequency of these monitoring locations is proposed within the salt and nutrient management plan, pending review and approval by the RWQCB as stipulated in section 6.2.3.

Table 4-24 presents groundwater monitoring wells, monitoring frequency, and the agency responsible for the monitoring. Table 4-25 presents surface water or diversion monitoring locations, monitoring frequency, and agency responsible for the monitoring. Table 4-26 presents Title 22 Impoundment structure locations, monitoring frequency, and the agency responsible for the monitoring. Table 4-27 presents recycled water facilities within the San Juan Basin that produce recycled water. Appendix A includes a map of all the monitoring locations and responsible parties for reference with this plan.

[89] Personal email communication between Amber Baylor and Brandon Bushnell regarding addition of nitrate to monitoring constituents. November 14, 2023.

Table 4-24
Groundwater Monitoring Wells by HSA

HSA Number	HSA Name	Groundwater wells for Drinking Water or Historic Monitoring Wells	Monitoring Frequency	Agency Responsible for Monitoring
901.21	Oso	Rosenbaum 1 Well	Quarterly	SMWD
901.22	Upper Trabuco	No Groundwater Wells are used for Drinking Water	N/A	N/A
901.23	Middle Trabuco	Trabuco Creeks Wells Facility	Monthly when in Operation	TCWD
901.23	Middle Trabuco	MT-02, North Open Space (NOS)	Quarterly	SMWD
901.24	Gobernadora	Ranch Filtration Plant, Chiquita DH-21, Chiquita DH-2, Gobernadora DH-2, Gobernadora-17	Quarterly	SMWD
901.25	Upper San Juan	Upper & Lower Well Facility	Quarterly	TCWD
		Audubon Well	Quarterly	Audubon Society
		Nichols Well (RMV 29), RMV 9, USJ-03	Quarterly	SJBA
901.26	Middle San Juan	RMV 6, RMV 7, RMV 12, RMV 25, RMV 27, RMV 28	Quarterly	SMWD
901.27	Lower San Juan	Stonehill	Monthly when in Operation	SCWD
		CVWD-1, SJBA-2, SJBA-4, Kinoshita, Stonehill	Monthly when in Operation	SMWD
901.28	Ortega	SJBA MW-06, SJBA MW-05, SJBA MW-04	Monthly when in Operation	SJBA
		South Cooks, CVWD-#5A, Tirador	Monthly when in Operation	SMWD

Table 4-25
Surface Water Diversion Sites by HSA

HSA Number	HSA Name	Surface Water or Diversion Site	Monitoring Frequency	Agency Responsible for Monitoring
901.21	Oso	Oso Creek Barrier	Quarterly	SMWD
901.22	Upper Trabuco	None	N/A	N/A
901.23	Middle Trabuco	None	N/A	N/A
901.24	Gobernadora	Gobernadora	Quarterly	SMWD
901.24	Gobernadora	Tick Creek & Deer Creek	Quarterly	TCWD
901.26	Middle San Juan	Trampas Reservoir	Quarterly	SMWD
901.27	Lower San Juan	Horno Barrier	Quarterly	SMWD
901.28	Ortega	None	N/A	N/A

Table 4-26
Title 22 Impoundment Structures by HSA

HSA Number	HSA Name	Impoundment Structure	Monitoring Frequency	Agency Responsible for Monitoring
901.21	Oso	Upper Oso Reservoir	Quarterly	SMWD
901.22	Upper Trabuco	None	N/A	N/A
901.23	Middle Trabuco	None	N/A	N/A
901.24	Gobernadora	Portola Reservoir	Quarterly	SMWD
901.25	Upper San Juan	Dove Lake	Quarterly	TCWD
901.26	Middle San Juan	Trampas Reservoir	Quarterly	SMWD
901.27	Lower San Juan	None	N/A	N/A
901.28	Ortega	None	N/A	N/A

Table 4-27
Treatment Facilities Producing Recycled Water in the San Juan Basin

HSA Number	HSA Name	Responsible Agency	Recycled Water Facility
901.21	Oso	SMWD, MNWD	Oso Creek Water Reclamation Plant, 3A
901.22	Upper Trabuco	None	None
901.23	Middle Trabuco	None	None
901.24	Gobernadora	SMWD	Chiquita Water Reclamation Plant
901.25	Upper San Juan	TCWD	Robinson Ranch Water Reclamation Facility
901.26	Middle San Juan	SMWD	Nichols Water Reclamation Plant
901.27	Lower San Juan	None	None
901.28	Ortega	None	None

Leveraging Existing Resources. The Recycled Water Policy emphasizes using groundwater monitoring wells from other regulatory programs such as the Irrigated Lands Regulatory Program and the Sustainable Groundwater Management Act. However, wells in the San Juan Basin are not covered in any of the programs listed in the Policy, but drinking water quality is reported to the following databases for compliance with the Safe Drinking Water Act, individual agency drinking water permit conditions, SWRCB programs, and Department of Water Resource programs.

- eWRIMS,[90]
- SDWIS,[91]
- SAFER,[92]
- CASGEM.[93]

As discussed in Section 2, the San Juan Creek Basin supplies approximately 5% of the drinking water needs in South Orange County with established management actions in place for treatment of the poor quality water. The SJBA oversees groundwater management in a collective fashion between the SMWD, SCWD, and by contract with the Moulton Niguel Water District. The SJBA manages groundwater in the following programmatic manner:

> *"Facilities located within the San Juan Basin include 13 active groundwater wells, and a desalter plant; seven of the wells fall under the Municipal category, and the remaining six are under desalter operations. Currently, the greater part (90%) of the municipal groundwater is pumped for domestic use. SJBA makes it a primary goal to produce and use data to determine how to efficiently use the basin as a water storage facility and to increase the use of groundwater pumping for domestic uses. Currently, there are no active groundwater storage programs in the San Juan Basin.*[94]

SJBA, therefore is the lead agency for regulatory reporting, monitoring, and compliance with water rights determinations made by the SWRCB , both SJBA members. The SMWD currently holds a water rights permit[95] in the San Juan Basin and reports compliance requirements to the SWRCB through the SJBA. SCWD also reports compliance data to the SWRCB as required under their water rights permit.[96] The TCWD) has drinking water wells in the San Juan Creek Basin but manages regulatory reporting, monitoring, and compliance matters internally. Where appropriate, SOCWA will utilize groundwater data in the updated monitoring plan in a data-sharing protocol with SOCWA member agencies and SNMP stakeholders.

Stakeholder Identification and Responsibilities. For compliance with the 2018 Policy, incorporating a structured framework that delineates distinct roles, responsibilities, and data reporting protocols is imperative. Engaging a myriad of stakeholders, encompassing various entities, and elucidating their respective roles in the monitoring process, forms the bedrock of this initiative. These stakeholders

90 Electronic Water Rights Information Management System. https://ciwqs.waterboards.ca.gov/ciwqs/ewrims/EWPublicTerms.jsp

91 Safe Drinking Water Information System https://www.epa.gov/ground-water-and-drinking-water/safe-drinking-water-information-system-sdwis-federal-reporting

92 Safe and Affordable Funding for Equity and Resilience: https://www.waterboards.ca.gov/safer/

93 California Safe Groundwater Elevation Monitoring https://water.ca.gov/programs/groundwater-management/groundwater-elevation-monitoring--casgem

94 San Juan Basin Authority. Ground Water Programs. https://www.sjbauthority.com/programs.html

95 SJBA holds permit 21074 to pump 8,026 AFY, issued by the State Water Resources Control Board (SWRCB)

96 SCWD holds permit 21138 to pump 1,300 AFY, issued by the State Water Resources Control Board (SWRCB)

shoulder the responsibilities of conducting monitoring, compiling pertinent data, and subsequently reporting the results as reviewed by stakeholders and the Regional Board.[97]

Pertaining to data reporting, the following approach is proposed:

- Stakeholders identified in Table 4-28 report data to their respective regulatory agencies as required by their compliance requirements.
- Stakeholders can either elect to report their groundwater data annually in the Groundwater Ambient Monitoring & Assessment (GAMA) system directly or can report that data to SOCWA for inclusion and reporting purposes into GAMA through a shared services agreement.
- Stakeholders will share monitoring data from recycled water effluent, impoundment structure monitoring, surface water/diversion structure monitoring in Master Recycled Water Order 97-52, or the updated Master Recycled Water permit once available, including updated monitoring requirements.

Table 4-28
SNMP Stakeholders Roles and Responsibilities

Stakeholder	Monitoring Type(s)	Monitoring Responsibility & Data Compilation	Data Reporting	Data Sharing with SOCWA
Audubon Society	Groundwater	Self	DDW	Yes
MNWD	Recycled Water	Self	SOCWA	Yes
SCWD	Groundwater	Self	DDW	Yes
SJBA	Groundwater	Self	DDW	Yes
SMWD	Groundwater, Recycled Water, Reservoir, & Surface Water/Diversions	Self	SOCWA/DDW/ SWRCB	Yes
TCWD	Groundwater, Recycled Water, Reservoir, & Surface Water/Diversions	Self	SOCWA/DDW/ SWRCB	Yes

The SNMP Monitoring Plan ensures compliance with Section 6.2.4.1 of the 2018 Recycled Water Policy. By delineating the regulatory framework, requirements, stakeholder roles and responsibilities, and strategic monitoring locations, this plan underscores the imperative nature of safeguarding our water sources from excessive salts, nutrients, and other potential contaminants. In addition to monitoring, any entity that discharges salts and or nutrients into the basin at levels exceeding the best-efforts approach shall be responsible for all costs incurred by any public entity due to increased salt or nutrient loads. Determining whether an entity has discharged salt or nutrients above the best-efforts approach shall be based on monitoring and reporting requirements established by SOCWA and its member agencies. Additional costs for which the entity shall be responsible for, but are not limited to are

97 SNMP Stakeholder Monitoring Plan Meeting. SOCWA. Microsoft Teams. September 20, 2023

the costs of monitoring and assessing the impact of the increased salt or nutrient loads, costs of implementing remedial measures to mitigate the impact of the increased salt or nutrient loads, administrative costs incurred by the public entity in managing the response to the increased salt or nutrient loads, and any fines or penalties imposed on the public entity due to non-compliance with water quality standards resulting from the increased salt or nutrient loads. Through efficient monitoring and reporting, coupled with the dedication of all involved parties, protection oversight of the basin can be maintained in the San Juan Creek Basin.

References:

Arroyo Trabuco Creek. Wikipedia. Available online at: https://en.wikipedia.org/wiki/Arroyo_Trabuco

Buchholz, Daryl B., J.R. Brown, Roger G. Hanson. 1993. *Using Your Soil Test Results*. University of Missouri Extension Publication G9111. Available online at: https://mospace.umsystem.edu/xmlui/bitstream/handle/10355/51233/g9111-1993.pdf?isAllowed=y&sequence=1.

California Department of Conservation. California Geologic Survey. Available online at: https://maps.conservation.ca.gov/cgs/gmc/

California Department of Water Resources. 1951. Bulletin 1.

California Department of Water Resources. California Safe Groundwater Elevation Monitoring https://water.ca.gov/programs/groundwater-management/groundwater-elevation-monitoring--casgem

California Department of Water Resources. California Safe Groundwater Elevation Monitoring https://water.ca.gov/programs/groundwater-management/groundwater-elevation-monitoring--casgem

California Department of Water Resources. Water Data Library. Available online at: https://wdl.water.ca.gov/waterdatalibrary/Map.aspx

California Safe Drinking Water Laws. Available online at: https://www.waterboards.ca.gov/laws_regulations/docs/drinking_water_code_2021.pdf

California Water Code §4999 through 5008. Recordation of Water Extractions and Diversions Act.

Christenson, D.R., D.D. Warncke, M.L. Vitosh, L.W. Jacobs, and J.G. Dahl. 1992. *Fertilizer Recommendations for Field Crops in Michigan*. Michigan State University Extension Bulletin E-550A.

Electronic Water Rights Information Management System. Available online at: https://ciwqs.waterboards.ca.gov/ciwqs/ewrims/EWPublicTerms.jsp

Escriva-Bou, A., Hanak, E., Cole, S., Medellin-Azuara, & Rosser, A. Public Policy Institute of California, Policy Brief: The Future of Agriculture in the San Joaquin Valley. Available online at: https://www.ppic.org/publication/policy-brief-the-future-of-agriculture-in-the-san-joaquin-valley/#:~:text=Valley%20agriculture%20employs%20around%20340%2C000,%243.2%20billion%20in%20revenues%2C%20respectively

Fenn, Mark & Allen, E & Weiss, Stuart & Jovan, Sarah & Geiser, Linda & Tonnesen, Gail & Johnson, Robert & Rao, Leela & Gimeno, Benjamín & Yuan, Fengming & Meixner, Thomas & Bytnerowicz, Andrzej. 2010. Nitrogen critical loads and management alternatives for N-impacted ecosystems in California. Journal of environmental management. 91. 2404-23. 10.1016/j.jenvman.2010.07.034.

Hansen, J., Jurgens, B., & Fram, M. & Quantifying anthropogenic contributions to century-scale groundwater salinity changes, San Joaquin Valley, California, USA. 2018. Science of the Total Environment. 10.1016/j.scitotenv.2018.05.333

Hull, Richard J. Iron Usage by Turfgrasses. 1999. *Turfgrass Trends*, Volume 8, Issue No. 2.

Hull, Richard J. Manganese Usage by Turfgrasses. 2001. *Turfgrass Trends*, Volume 10, Issue No. 9.

Jacobson, Jeffrey S. and James W. Bauder. 1993. *Soil Testing Procedures, Interpretation and Fertilization Sources*. Montana State University Extension Service. Publication MT8704.

Koenig, Rich, Dean Miner, and Kerry Goodrich. 1998. *Land Application of Biosolids, A Guide for Farmers.* Utah State University Extension Service*.*

Landschoot, Peter. 2016. Turfgrass Fertilization: A basin Guide for Professional Turfgrass Managers. Available online at: extension.psu.edu/turfgrass-fertilization-a-basis-guide-for-professional-turfgrass-managers.

Los Angeles, City of, Department of Public Works. June 2021. *Grasscycling Source Reduction Study.*

Nolte and Associates. 1993. South Orange County Reclamation Authority Basin Plan Amendments Final Report.

Ohio State University Extension. 1995. *Ohio Agronomy Guide, 13th edition*. Bulletin 472.

Regional Water Quality Control Board, San Diego (RWQCB). 1990. Resolution 90-61.

Regional Water Quality Control Board, San Diego Region (RWQCB). 1994. Water Quality Control Plan for the San Diego Basin. With amendments effective on or before September 1, 2021. Available at: https://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2018/121118_7_final_amendment_oal.pdf

Regional Water Quality Control Board, San Diego Region (RWQCB). 1994. *Water Quality Control Plan for the San Diego Region* (Basin Plan). Updated 2021.

Regional Water Quality Control Board, San Diego Region (RWQCB). 1997. *Order No. 97-52, Waste Discharge and Water Recycling Requirements for the South Orange County Reclamation Authority.*

Regional Water Quality Control Board, San Diego Region (RWQCB). 1999. *Amendment No. 1 to Order No. 97-52, An Addendum Adding the South Coast Water District to the Waste Discharge and Water Recycling Requirements for the South Orange County Reclamation Authority.*

Safe Drinking Water Information System. Available online at: https://www.epa.gov/ground-water-and-drinking-water/safe-drinking-water-information-system-sdwis-federal-reporting

Samples, Tom and John Sorochan. Turfgrass Maintenance: Developing a Turf Fertilization Plan. University of Tennessee Publication W-161-C. 2008a. Available online at: https://utia.tennessee.edu/publications/wp-content/uploads/sites/269/2023/ 10/W161-C.pdf.

Samples, Tom, John Sorochan and Hugh Savoy. Turfgrass Essentials. 2008b. University of Tennessee Publication W-161D. Available online at: https://utia.tennessee.edu/publications/wp-content/uploads/sites/269/2023/10/W161-D.pdf.

San Juan Basin Authority. Adaptive Pumping Plan. 2016. Available online at: https://www.sjbauthority.com/assets/downloads/20160830_APM_Memo.pdf

San Juan Basin Authority. Groundwater Management Program. Available online at: http://www.sjbauthority.com/programs/groundwater.html

San Juan Basin Authority. May 2023 Board Report. Agenda Item VI.A. Available online at: https://www.sjbauthority.com/meetings/meetings-2023.html

Santiago Creek. Wikipedia. Available online at: https://en.wikipedia.org/wiki/Santiago_Creek

Santiago Peak. Available online at: https://en.wikipedia.org/wiki/Santiago_Peak

Santiago Peak. Trail Run Project. Available online at: https://www.trailrunproject.com/trail/7098122/modjeskasantiago-peak

Saddleback Mountain (Santiago Peak). 2023. USDA and US Forest Service. Available online at: Shaddox, Travis. General Recommendations for Fertilization of Turfgrasses on Florida Soils. University of Florida Extension Publication #SL21. Available online at: edis.ifas/ufl.edu/publication/LH014.

Shaddox, Travis and Gregg Munshaw. 2020. Manganese for Kentucky Turfgrasses. University of Kentucky College of Agriculture, Food and Environment, Cooperative Extension Service Publication AGR-247.

South Orange County Wastewater Authority (SOCWA). 2014. Salt and Nutrient Plan for the South Orange County Aliso Creek, San Juan Creek and Portions of Other Basins. Prepared by HDR and Wildermuth Environmental. Available online at: https://www.socwa.com/wp-content/uploads/2016/05/SNMPReport_Final.pdf

State of California Department of Water Resources (DWR). 1967. Ground Water Occurrence and Quality in the San Diego Region, Volume II., Bulletin 106-2. Plate 3.

State of California Department of Water Resources (DWR). 1975. California's Groundwater, Bulletin 118.

State of California Department of Water Resources (DWR). 2020. California's Groundwater, Update 2020, Bulletin 118.

State of California Department of Water Resources (DWR). June 1972. Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104.

State Water Resources Control Board (SWRCB). 2013. Policy for Water Quality Control for Recycled Water (Recycled Water Policy). Section 3a. Revised January 22, 2013, effective April 25, 2013. At: https://www.waterboards.ca.gov/water_issues/programs/recycled_water/docs/rwp_revtoc.pdf

State Water Resources Control Board (SWRCB). 2018a. *Water Quality Control Policy for Recycled Water.* Adopted December 11, 2018; effective April 8, 2019.

Surface Soil Textures of Orange County. Natural Resources Conservation Service. Available online at: https://www.mwdoc.com/wp-content/uploads/2017/06/OC_Soils_Map.pdf

United States Geologic Survey (USGS). 2024. USGS streamflow gaging records for San Juan Creek at the La Novia Street bridge (USGS Station No. 11046530). Data available online at: https://nwis.waterdata.usgs.gov/usa/nwis/peak/?site_no=11046530

Verburg, P. J. A., Megonigal, J. P., & Stark, J. M. 2004. Episodic rewetting enhances dissolved organic carbon (DOC) release from chaparral soils. Soil Biology & Biochemistry, 36(11), 2297-2306. Available online at: https://doi.org/10.1016/j.soilbio.2004.07.013

Vitosh, M.L., J.W. Johnson, and D.B. Mengel. 1993. *Tri-State Fertilizer Recommendations for Corn, Soybeans, Wheat, and Alfalfa.* Bulletin E-2567. Ohio State University Extension. 1993.

Vitosh, M.L., D.D. Warncke, and R.E. Lucas. 1994, *Secondary and Micronutrients for Vegetables and Field Crops*. Department of Crop and Soil Sciences, Michigan State University Extension. Extension Bulletin E-486. August 1994.

Section 5: Implementation Measures and Management Strategies

5.1 Focus on Lower Portion of San Juan Basin.

The 2018 SWRCB Recycled Water Policy[1] required Regional Water Quality Control Boards to identify through resolution or Executive Officer determination where (1) salts and/or nutrients are a threat to water quality and (2) where salt and nutrient management planning is required to achieve long-term compliance with water quality objectives.[2] The San Diego RWQCB achieved compliance with this SWRCB directive in advance of SWRCB adoption of the 2018 updates to the SWRCB Recycled Water Policy through RWQCB adoption of Order No. R9-2010-0125.

In the absence of guidance from the SWRCB at the time the original Recycled Water Policy was adopted in 2009, Order No. R9-2010-0125 established guidelines for SNMPs within the San Diego Region which implemented a tiered system for SNMP analysis and development based on basin size, groundwater use, groundwater quality, and water quality protection considerations. The alluvial portion of the San Juan Creek Basin (which included the Lower San Juan, Middle San Juan, Upper San Juan, and Lower Trabuco basin) was designated a "Tier A" basin by the RWQCB that required an SNMP. Subbasins within the San Juan Hydrologic Area (HA 901.2) that were excluded from this Tier A designation included the Laguna HA (901.1), Cristianitos HSA (901.42), and San Mateo HA (HA 901.4) [3,4]

In accordance with this designation, this SNMP addresses implementation measures and management strategies that affect groundwater quality and availability within the alluvial portions of the San Juan Basin. While the focus of this effort is directed toward evaluating groundwater quality in portions of the San Juan Creek alluvial aquifer that are sufficiently wide and thick to produce usable groundwater (e.g., Lower San Juan, Middle San Juan, Middle Trabuco basins), management strategies and salt balances are assessed for each of the following sub-basins or tributary sub-basins within the San Juan HA:

- Oso (HSA 901.21),
- Upper Trabuco (HSA 901.22),
- Middle Trabuco (HSA 901.23),
- Gobernadora (HSA 901.24),
- Upper San Juan (HSA 901.25),
- Middle San Juan (HSA 901.26),
- Lower San Juan (HSA 901.27), and
- Ortega (HSA 901.28).

---

1 The 2018 SWRCB Recycled Water Policy was adopted on December 11, 2018, and became effective on April 18, 2019.

2 SWRCB, 2019. P. 6. RWQCB were required to identify basins requiring a SNMP by April 9, 2021.

3 As documented herein, subbasins within the Laguna (HA 901.1) and San Clemente (HA 901.3) Hydrologic Areas are small shallow coastal basins not within any groundwater basin identified by the State of California. Further, Basin Plan groundwater quality objectives for these subbasins are consistent with existing and projected recycled water quality. As a result, detailed analyses of salt loads and management strategies within these subbasins are not required.

4 Within the San Mateo HA (HA 901.4), only the Cristianitos subbasin (HSA 901.42) is within the SOCWA service area. While the City of San Clemente implements recycled water use within a small portion of the Cristianitos HSA (HSA 901.42), this recycled water use area is protected by a subsurface interceptor that collects groundwater and exports it to the Prima Deshecha subbasin. Because of the lack of potential impact from SOCWA recycled water operations, recycled water use within the San Mateo HA is more properly addressed by a separate SNMP prepared by the U.S. Marine Corps Base Camp Pendleton for the San Mateo HA (901.4).

This section identifies and addresses existing and potential management strategies that may influence groundwater quality and availability within each of these sub-units. The following Section 6 presents updated salt balances for each the sub-units, and presents a link-node transport model that assesses movement of salts in the larger portions of the San Juan Creek Valley alluvial system.

5.2 SNMP Implementation Requirements

Section 6.2.1.1 of the 2018 Recycled Water Policy requires that SNMPs include implementation measures to manage and minimize sources of salt and nutrient loads:

> *6.2.1.1 Salt and nutrient management plans shall be tailored to address the water quality concerns of the basin and subbasin. Such plans shall include implementation measures, as appropriate, to address all sources of salt and/or nutrients to groundwater basins, including projects using recycled water for irrigation and groundwater recharge.*

Further, the Recycled Water Policy requires that these implementation measures must address sustainability and the intended outcome, as SNMPs are required to identify:

> *6.2.4.4 Implementation measures to manage or reduce the salt and nutrient loading in the basin on a sustainable basis and the intended outcome of each measure.*

Consistent with these requirements, Section 5 of this SNMP identifies management strategies to improve groundwater quality, including:

Existing Management Strategies. Includes management strategies that are presently being implemented by SOCWA member agencies or other entities, including strategies to reduce salt/nutrient loads from existing or projected sources and/or to improve groundwater quality.

Management Strategies Nearing Implementation. Includes strategies to reduce salt/nutrient loads from existing or projected sources and/or to improve groundwater quality that will soon be implemented by SOCWA member agencies or other entities and for which facilities/operations have been funded and construction is underway.

Planned Management Strategies. Includes strategies that have been planned by SOCWA member agencies or other entities to reduce salt/nutrient loads from existing or projected sources and/or to improve groundwater quality and for which implementation schedules have been developed and implementation/funding commitments have been or are being made.

Potential Management Strategies. Includes strategies to reduce salt/nutrient loads from existing or projected sources and/or to improve groundwater quality that are or may be considered by SOCWA member agencies or other entities for potential future implementation, but no agency commitment has yet occurred and no implementation schedules have been developed.

5.3 Overview of Available Strategies

A wide variety of strategies are available to manage, reduce or mitigate groundwater salinity concentrations. These strategies can be grouped into several general categories:

- water supply strategies,

- recycled water strategies,
- groundwater management strategies,
- irrigation management strategies, and
- brine management strategies.

Strategies to Reduce Salinity in Potable Water Supplies. Applied water comprises a significant source of salinity loads to groundwater basins. Reducing salinity concentrations in the potable water supply not only results in reduced salt loads in potable supplies applied to lands, but also results in reduced salt loads in non-potable water supplies applied to lands. Additionally, reducing salinity concentrations in potable supplies also results in reduced salt loads from septic tank discharges.

Table 5-1 summarizes potential strategies that may be used to reduce salinity concentrations in potable water supplies. Potential strategies for reducing salinity concentrations in potable water supplies include:

- modify or manage imported water sources,
- treat imported water supplies to reduce salinity,
- replace imported supplies with better quality supplies from seawater desalination,
- replace imported supplies with better quality supplies derived from treated groundwater, and
- replace imported supplies with better quality supplies from indirect potable reuse projects or direct potable reuse projects.

Strategies for reducing salinity concentrations in potable supplies offer the advantage of spreading salinity management benefits to all groundwater basins where imported or recycled waters are utilized. Additionally, every mg/L of reduced salinity concentrations in the water supply translates to an equivalent reduction in salinity concentrations in applied irrigation waters (both potable and non-potable) and within septic tank discharges. Implementation disadvantages, however, include institutional complexities, infrastructure limitations, brine management issues and costs.

Strategies to Reduce Salinity in Non-Potable Supplies. While potable supplies comprise virtually all waters applied by individual homeowners, recycled water supplies can comprise a significant portion of outdoor institutional use such as irrigation of golf courses, parks, medians, and properties managed by homeowners' associations.

Table 5-1
Summary of Potential Strategies for Reducing Salinity Concentrations in Potable Water Supplies

Potential Strategy	Purpose of Strategy	Description
Modify or Manage Imported Water Sources	Improve the quality of potable water supplies delivered by the Metropolitan Water District of Southern California (MWD) to water retail agencies that service the San Juan Basin.	Implement water quality improvements in the imported waters served within the San Juan Basin by: • Improving MWD management of the blend of State Water Project and Colorado River supplies supplied to San Juan Basin water retail agencies. • Improving the quality of Colorado River supplies through programs implemented as part of the U.S. Bureau of Reclamation Colorado River Basin Salinity Control Program. • Improving the quality of Colorado River supplies through evaluation of treatment of imported potable water to lower salinity within the service area. • Improving the quality of State Water Project supplies through California Department of Water Resources projects or actions to improve watershed management, improve reservoir flow-through and management, implement mitigation offsets to address salinity impacts, and/or implement other water quality management actions.
Treat Imported Water Supply	Use treatment to reduce salt loads in potable supplies delivered to San Juan Basin users.	Implement treatment, such as microfiltration/ultrafiltration (MF/UF) and reverse osmosis (RO) treatment of imported water treatment, including: • Treatment by MWD of imported water supplies of the regional water supply distributed to San Juan Basin water agencies. • Treatment by San Juan Basin water agencies to reduce salt loads in locally delivered water supplies.
Seawater Desalination	Improve the blended quality of potable water supply served within the San Juan Basin and reduce the need for imported supply.	Seawater desalination can produce treated water that contains reduced salt concentrations compared to present-day imported supplies. Implementing local seawater desalination projects (in conjunction with appropriate brine management strategies) can reduce water supply salt loads by replacing a portion of the existing imported supplies with better quality supplies from seawater desalination facilities.
Indirect Potable Reuse (IPR)	Create raw (untreated) water supplied from recycled water, which (with appropriate groundwater or reservoir storage) can undergo conventional potable water treatment to improve the quality of water served within the San Juan Basin, reduce the need for imported water supplies, and reduce wastewater discharges to the ocean.	In concert with applicable State of California regulations and water supply safeguards governing IPR projects, water treatment processes from tertiary treated water can be used to create a raw (untreated) water supply that can augment supplies in local groundwater basins or reservoirs. After subsequent conventional water treatment, potable water can be produced from this raw water supply which contains reduced salt concentrations compared to present-day imported supplies. Implementing IPR (in conjunction with appropriate brine management strategies) can reduce water supply salt loads by replacing a portion of the existing imported supplies with better quality water supplies derived from recycled water.
Direct Potable Reuse (DPR)	Using treatment technology, create treated water supplies directly from recycled water, which will improve the blended quality of potable water supply served within the San Juan Basin, reduce the need for imported supply, and reduce wastewater discharges to the ocean.	In concert with applicable State of California regulations and water supply safeguards governing DPR projects, treatment of recycled water supplies can be used to directly create treated water supply that contains reduced salt concentrations compared to present-day imported supplies. Implementing DPR (in conjunction with appropriate brine management strategies) can reduce water supply salt loads by replacing a portion of the existing imported supplies with better quality water supplies derived from recycled water.
Groundwater Treatment	Use treatment to convert poor quality groundwater or into usable potable or non-potable supplies that are better in quality than imported water.	Most groundwaters are unusable due to high salinity concentrations or high concentrations of specific ions. water treatment processes can be used to treat groundwater that contains high concentrations of salinity to create a new local source of potable supply or to create usable irrigation supplies that are superior in quality to existing imported water supplies.

Table 5-2 summarizes potential strategies available for reducing salinity concentrations in recycled water supplies. The incremental difference in salinity concentrations between the source water supply and wastewater has increased in recent years as a result of water conservation.[5] Infiltration of poor-quality groundwater into sewer collection facilities can add to this overall wastewater salinity load.

Strategies available to reduce salinity concentrations in recycled water include strategies to control infiltration and inflow (I&I), pretreatment controls on sewer discharges, treatment of recycled water using reverse osmosis or other demineralization processes, and blending.

Table 5-2
Summary of Potential Strategies for Reducing Salinity Concentrations in Non-Potable Supplies

Potential Strategy	Purpose of Strategy	Description
Source Control	Reduce salt loads in recycled water supplies by limiting salt loads to the sewer system.	Salinity concentrations in recycled water supplies can reduced through source control by implementing: • Sewer collection system improvements that minimize infiltration and inflow (I&I) into sewers from poor-quality groundwater. • Pretreatment controls, prohibitions or regulations that minimize salinity loads from industrial and/or non-industrial sources.
Recycled Water Treatment	Improve quality of non-potable supplies delivered to users or used for groundwater recharge.	When combined with appropriate brine management strategies, treatment of recycled water can reduce salt and nutrient concentrations in non-potable supplies that are used for irrigation or groundwater recharge.
Blending	Reduce concentrations of salinity in non-potable supplies applied to land or recharged to the ground.	Blend lower salinity supplies (e.g., imported supplies, treated supplies, good-quality groundwater, etc.) can reduce salinity concentrations in non-potable supplies that affect or recharge groundwater.

Groundwater Management Strategies. Groundwater management strategies seek to improve groundwater quality by decreasing recharge of poor-quality water, increasing recharge of high-quality water, decreasing groundwater detention time and/or restricting movement of poor-quality groundwater. Table 5-3 summarizes potential strategies for managing groundwater within the subbasins of the Mission Viejo HA (HA 901.2).

Stormwater. Section 6.2.1.2 of the 2018 Recycled Water Policy acknowledges the stormwater typically contains low concentrations of nutrients and salts and can be managed as a resource to improve groundwater quality. Consistent with this finding, potential San Juan Basin groundwater management strategies include programs to capture and recharge high-quality storm runoff of water from other high-quality sources.

5 While water conservation has reduced the volume of water discharged to the sewer, salinity loads added by homes and businesses remain relatively constant, resulting in an increase in wastewater salinity concentrations. In the absence of advanced treatment such as reverse osmosis, this increase in salinity is carried over to the final disinfected tertiary recycled water supplies used within the SOCWA service area.

Table 5-3
Potential Groundwater Management Strategies for Addressing Groundwater Salinity

Potential Strategy	Purpose of Strategy	Description
Groundwater Barriers	Prevent poor-quality groundwater from migrating to and impacting the quality of better-quality groundwater.	Groundwater barriers can serve as a mechanism for protecting existing high-quality groundwater and preventing adjoining groundwaters from flowing toward and impacting better quality groundwater. Potential groundwater barrier projects can include: • Physical groundwater flow barriers that reduce permeability and prevent the physical flow of waters through the barrier. • Interceptor barriers, where groundwater is collected and conveyed to offsite treatment or disposal. • Non-physical barriers, where the direction of groundwater flow can be managed and control by manipulating water table or piezometric levels. • Groundwater management projects where groundwater flow is controlled through maintaining or sustaining prescribed water table or piezometric levels.
Increase Groundwater Withdrawal	Improve groundwater quality by reducing underground detention time and encouraging good quality recharge.	When implemented as part of an overall groundwater management program, groundwater quality improvement can be achieved by increasing groundwater withdrawal rates which, in turn, can: • Reduce basin detention time (hence reducing the time basin management issues can affect groundwater quality). • Encourage and manage the recharge of better-quality water.
Artificial Recharge	Enhance the quantity and/or quality of storm runoff or low-flow runoff recharged to groundwater using instream modifications.	The rate and quantity of surface runoff that recharges groundwater can be enhanced through implementing: • Physical projects (temporary or permanent flow barriers, use of porous channels, instream infiltration basins, etc.) that are designed to create increased recharge of stormwater and low-flow runoff to groundwater. • Diversion projects that divert and convey runoff to off-stream infiltration basins.
	Improve groundwater quality by introducing an outside source of supply to recharge the basin.	Artificial groundwater recharge involves enhancing natural recharge to a groundwater basin by adding a new source of supply such as raw (untreated water), recycled water or treated water through: • Injection via water via recharge wells. • Infiltration via percolation ponds or infiltration basins.

These programs are of particular importance (see discussion in Section 3) given that San Juan Basin groundwater availability and quality is highly dependent on streamflow infiltration and precipitation events. As a result of high variability in precipitation and streamflow from year to year, both groundwater quality and groundwater storage levels in the basin can naturally vary significantly over time. Implementing recharge programs can help stabilize both groundwater storage levels and groundwater quality.

Groundwater Withdrawals. In subbasins with poorer water quality, increasing groundwater withdrawals can be an effective strategy for decreasing groundwater detention times, and creating capacity in the basin for accepting good-quality recharge.[6]

[6] Reducing groundwater basin detention time (e.g., increasing basin flow-through) can be effective in improving groundwater quality by reducing the time groundwater is exposed to salt loads from man-induced sources.

Barriers. Groundwater barriers represent a strategy for protecting groundwater basins from being adversely impacted by poor-quality water. Potential forms of groundwater barriers may include:

- physical (impermeable or semipermeable) barriers to block or minimize movement of poor-quality groundwater,
- Interceptor barriers to collect and remove poor-quality water before it impacts usable groundwater, and/or
- non-physical barriers where piezometric levels are controlled via recharge or withdrawals to reduce or direct groundwater flow.

Artificial Recharge. Artificial recharge is the practice of increasing the amount of water recharged to an aquifer via man-induced means. As documented in Table 5-3, groundwater recharge strategies can potentially be achieved through:

- streamflow modifications or engineered facilities that enhance infiltration of streamflow and storm runoff, or
- introducing outside sources of recharge (e.g., potable or non-potable supplies) to the basin via spreading basins (percolation ponds) or injection wells.

Irrigation Management Strategies. Irrigation management strategies seek to minimize salt loads to groundwater through modification of irrigation practices. Potential irrigation management strategies include modifying:

- irrigation practices to minimize water use and applied salt loads,
- the type of vegetation irrigated to minimize the impact of irrigation on groundwater quality, and/or
- land uses to reduce irrigated acreage.

Table 5-4 summarizes potential irrigation management strategies that can be considered for minimizing the impact of irrigation operations on groundwater quality.

Brine Management Strategies. Facilities to convey and dispose of waste brine would be required to support many of the above strategies that seek to manage, reduce or mitigate groundwater salinity concentrations. Such brine conveyance and management facilities would be required to support implementation of:

- Source control strategies that involve diverting industrial saline wastes from recycled water treatment facilities, and
- Water treatment facilities that create saline residual flows (e.g., brine) from treating potable water, groundwater or recycled water.

Table 5-4
Summary of Potential Irrigation Management Strategies

Potential Strategy	Purpose of Strategy	Description
Modify Irrigation Practices	Reduce salt and nutrient loads to groundwater by water agencies encouraging users to modify irrigation practices or implement more efficient irrigation systems or equipment.	Irrigation and landscaping operations can be modified to improve water efficiency, reduce salt loads and reduce nutrient loads to groundwater through: • Implementing water-efficient technology to reduce water use, minimize infiltration to groundwater, and reduce salinity loads to groundwater. • Implementing improved fertilization practices through nitrate management studies that match nutrient loads to vegetation needs and reduce nutrient loads to groundwater.
Land Use/Vegetation Changes	Reduce salt and nutrient loads to groundwater by encouraging users to modify landscapes to water-tolerant species.	Modification to land uses or modifications to landscapes can result in reduced irrigated acreages reduced water use, and reduced salt and nutrient loads to groundwater.

Brine collection and conveyance facilities can be used to collect brines from industrial, water or wastewater treatment facilities and convey the brine downstream for disposal, bypassing downstream wastewater collection facilities and wastewater treatment facilities. It may prove possible to utilize existing sewer infrastructure (where sewer capacity is available) to convey brine in instances where such sewer collection facilities are not tributary to a treatment plant that produces recycled water. Separate dedicated brine conveyance facilities may be required in areas where brine generation sources are upstream from existing facilities that produce recycled water supply.

5.4 Existing and Planned Management Strategies

Many of the above-listed potential management strategies are already being implemented by SOCWA and its member agencies. Additionally, several other strategies or measures are in the process of being implemented within the Basin. Table 5-5 summarizes implementation measures and management strategies that are being implemented and the implementation status of each strategy. Figure 5-1 presents the locations of key existing and planned SOCWA member agency projects that will help improve groundwater quality. Please note in Figure 5-1 that the SMWD has annexed the City of San Juan Capistrano's wastewater and potable water service area.

Existing Management Strategies. Existing groundwater management strategies presently in operation within the Mission Viejo HA include groundwater treatment, source control, groundwater barriers, treatment of recycled water, artificial recharge, and modification of irrigation practices or vegetation/land use.

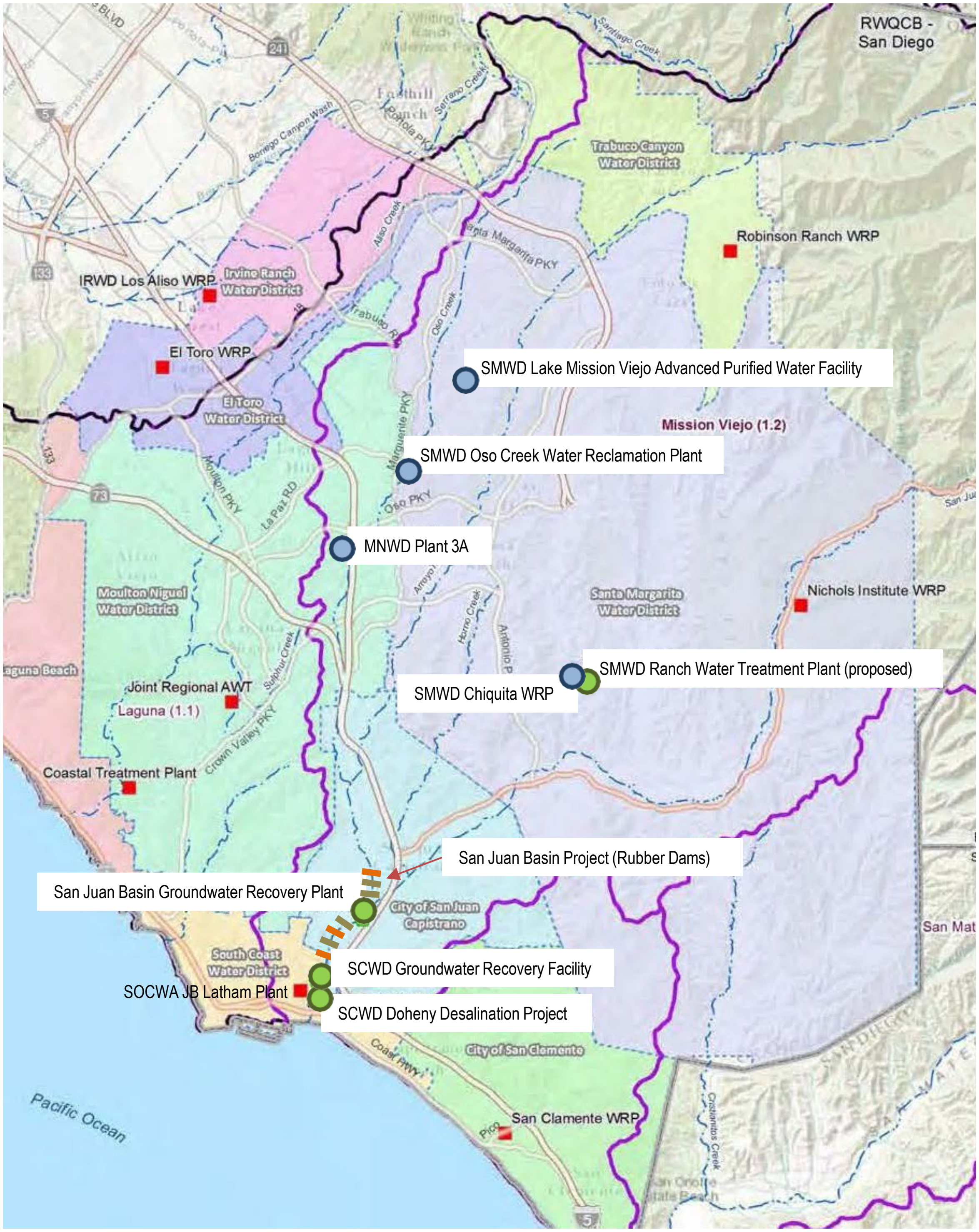


Figure 5-1 Location of Key Existing and Proposed Water Management Projects within the Mission Viejo HA

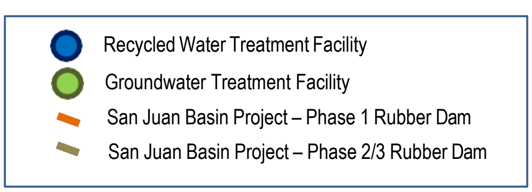


Table 5-5
Applicability and Implementation Status - Potential Basin Management Strategies for Subbasins of the Mission Viejo HA (HA 901.2)

Potential Management Strategy	Applicability to Mission Viejo Hydrologic Area (HA 901.2)	Implementing Agencies	Implementation Status	Potential Applicability to Mission Viejo Hydrologic Area (HA 901.2) ○ Potential Project ● Existing Operating Project ◉ Project Being Implemented							
				Oso 901.21	Upper Trabuco 901.22	Middle Trabuco 901.23	Gober-nadora[A] 901.24	Upper San Juan 901.25	Middle San Juan 901.26	Lower San Juan 901.27	Ortega 901.28
Modify Imported Water Sources	Strategy is being addressed as part of overall MWD efforts to manage salinity in imported supplies pursuant to the 1999 MWD *Salinity Management Study*. Such water supply improvements, however, are likely dependent on hydrologic conditions in the southwestern US.	MWD	In progress but outcome uncertain.	○	○	○	○	○	○	○	○
Treat Imported Water Supply	MWD is not currently considering this strategy, but the potential exists for SOCWA member agencies to evaluate the feasibility of imported water treatment.	NA	NA								
Seawater Desalination	Doheny Desalination Facility is planned to produce 5 mgd of water supply for the South Coast Water District (SCWD). Excess supply may be distributed to adjoining water agencies.	SCWD	Planned and designed project.							◉ B	
Indirect Potable Reuse (IPR)	IPR regulations have been implemented by the SWRCB. Future IPR projects are under consideration by the Santa Margarita Water District (SMWD) and the Moulton Niguel Water District (MNWD).	SMWD	Initial concept being evaluated.	○ B	○ B	○ B	○ B	○ B	○ B	○ B	○ B
Direct Potable Reuse (DPR)	Draft DPR regulations are being considered by a State expert panel. Multiple SOCWA member agencies may consider DPR when regulations are finalized.	To be determined	To be determined.	○ B	○ 2B	○ B	○ B	○ B	○ B	○ B	○ B
Groundwater Treatment	Groundwater withdrawal and treatment currently being implemented by the SCWD (South Coast Groundwater Recovery Facility) and SMWD (San Juan Groundwater Recovery Plant). SMWD is engaged in planning and development of the 2.9 mgd Ranch Drinking Water Filtration Plant which will produce a high-quality potable water supply from groundwater.	SCWD, SMWD	Projects in operation, with future upgrades and expansions planned.	◉ B		◉ B	◉ B		◉ B	● B	◉ B
Source Control	All SOCWA member agencies maintain aggressive I&I control programs pursuant to the Sewer System Management Plans (SSMPs) developed and adopted by each agency. Additionally, SOCWA and its member agencies maintain an EPA-approved pretreatment program that includes source controls for industrial sources of salinity.	SOCWA member agencies	Operating, with possibility of future enhanced controls on salinity.	●	●	●	●	●	●	●	●

Table 5-5
Applicability and Implementation Status - Potential Basin Management Strategies for Subbasins of the Mission Viejo HA (HA 901.2)

Potential Management Strategy	Applicability to Mission Viejo Hydrologic Area (HA 901.2)	Implementing Agencies	Implementation Status	Potential Applicability to Mission Viejo Hydrologic Area (HA 901.2) ○ Potential Project 🔴 Existing Operating Project 🟢 Project Being Implemented							
				Oso 901.21	Upper Trabuco 901.22	Middle Trabuco 901.23	Gober-nadora[A] 901.24	Upper San Juan 901.25	Middle San Juan 901.26	Lower San Juan 901.27	Ortega 901.28
Treatment of Recycled Water	Reverse osmosis (RO) treatment of recycled water is currently implemented by SMWD at the Lake Mission Viejo Plant. SMWD is planning treatment at the Oso Creek Barrier Treatment Plant. MNWD is planning treatment (RO) of recycled water at both Regional Wastewater Treatment Plant and Plant 3A Wastewater Treatment Plant to reduce overall salinity/TDS levels.	SMWD, SCWD, MNWD	Operating or planned.	🟢		🔴				🟢	
Blending	Potable supplies may be blended with non-potable supplies where necessary to meet peak non-potable demands, but no plans for blending exist for achieving water quality goals.	NA	NA								
Groundwater Barriers	SMWD currently operates the Oso Creek Barrier and Horno Creek Barrier, which capture and return poor quality groundwater to SMWD treatment and impoundment facilities. TCWD currently operates the Deer Creek and Tick Creek urban runoff/dry season recovery projects. SJBA monitors for seawater intrusion near the coast to protect inland groundwater.	SMWD	Facilities currently in operation.	🔴	🔴	🔴				🔴	
Increase Groundwater Withdrawal	SMWD is proposing increased groundwater withdrawals as part of its proposed Ranch Drinking Water Filtration Plant and expanded Groundwater Recovery Facility.	SMWD, SJBA	Facility being implemented.				🟢			🟢	🟢 B
Artificial Recharge	SMWD has implemented an initial planning phase of a program to enhance instream groundwater recharge and utilize storm runoff as a resource (per the SWRCB 2018 Recycled Water Policy directive).	SMWD	Initial planning phase implemented; future phases planned.			🟢 B	🟢 B		🟢 B	🔴	
	As part of expansion of its instream groundwater recharge program, SMWD will implement future phases of the San Juan Watershed Project further enhance basin recharge.	SMWD	Future phases planned.			🟢 B	🟢 B		🟢 B	🟢	🟢

Table 5-5
Applicability and Implementation Status - Potential Basin Management Strategies for Subbasins of the Mission Viejo HA (HA 901.2)

Potential Management Strategy	Applicability to Mission Viejo Hydrologic Area (HA 901.2)	Implementing Agencies	Implementation Status	Potential Applicability to Mission Viejo Hydrologic Area (HA 901.2) ○ Potential Project 🔴 Existing Operating Project 🟢 Project Being Implemented							
				Oso 901.21	Upper Trabuco 901.22	Middle Trabuco 901.23	Gober-nadora[A] 901.24	Upper San Juan 901.25	Middle San Juan 901.26	Lower San Juan 901.27	Ortega 901.28
Modify Irrigation Practices	SOCWA member agencies implement water conservation education programs to encourage conservation and efficient water use and to promote the implementation of water-efficient irrigation equipment.	NA	Varies by use site.	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Land Use/Vegetation Changes	SOCWA member agencies implement water conservation education programs to encourage conservation and efficient water use, including replacing high-water use vegetation with low-demand, drought-resistant vegetation.	NA	Varies by use site.	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Brine Management	SMWD is planning a brine conveyance pipeline that conveys reverse osmosis brine from the Ranch Water Filtration Plant and Lake Mission Viejo Plant to the San Juan Creek Ocean Outfall.	SMWD	Planning phase.			🟢	🟢		🟢	🟢	🟢
Basin Plan Modifications	Presently not being considered as part of this amended SNMP for most subbasins within the San Juan Basin. It may prove necessary in the future to pursue Basin Plan modifications for the Middle San Juan and Middle Trabuco Basins depending on monitoring program results and water quality improvement effects of implemented management strategies.	NA	NA			○			○		

Table 5-5 Notes:

A The Gobernadora Hydrologic Subarea (901.24) includes the parallel Chiquita subbasin.

B Subbasin may be potentially benefited by water quality improvements in the water supply that are derived from management strategies or projects implemented in adjoining or upstream basins.

Groundwater Treatment. Two groundwater treatment facilities are currently in operation within the Lower San Juan HSA (901.27). The San Juan Capistrano Groundwater Recovery Plant[7] extracts and treats up to 5.5 mgd of groundwater from the Lower San Juan HSA to produce approximately 3.3 mgd of potable supply. Treatment includes both iron and manganese removal and reverse osmosis. The facility generates up to 2.2 mgd of waste brine that is discharged to the San Juan Creek Ocean Outfall (SJCOO) via the SMWD Chiquita Land Outfall.

The SCWD Groundwater Recovery Facility (GRF) extracts an average of approximately 1.4 mgd of saline groundwater from the Lower San Juan HSA. The GRF produces approximately 0.834 mgd of potable water supply. Waste brine from the GRF (up to 0.6 mgd) is conveyed to the SJCOO for disposal.[8]

Groundwater within the Mission Viejo HA (also known as the San Juan Basin) is managed by the San Juan Basin Authority (SJBA).[9] Since the basin is categorized as a subterranean flowing stream, water extraction from the basin is regulated by the SWRCB. Presently, SCWD and SMWD have rights to withdraw 8,026 acre-feet per year (AFY) of groundwater, and these groundwater withdrawals can be expanded to 10,702 AFY with approval from the Department of Water Resources. Consistent with the SWRCB water extraction permits, SJBA manages water resources within the basin and conducts monitoring to assess both water availability and water quality.

Source Control. Wastewater salinity source controls are provided through two means: (1) sewer system infiltration and inflow (I&I) controls and (2) industrial pretreatment regulation and controls.

Each SOCWA member agency implements a program to reduce I&I into their respective sewer systems. I&I controls are established within each agency's adopted Sewer System Management Plan (SSMP), and include television inspections of sewer lines, scheduled cleaning and maintenance of sewer lines, I&I surveys, and Capital Improvements Programs that identify sewer lines in need of replacement or repair. SSMPs are updated on a five-year frequency. I&I-related salinity tends to be more of an issue in coastal areas with brackish groundwater and older sewer collection facilities. As a result, I&I is not believed to be a major contributor to wastewater salinity in inland subbasins of the Mission Viejo HA. For this reason, no further I&I-related management controls (over and above those presently implemented pursuant to SOCWA member agency SSMPs) are considered herein.

SOCWA maintains an EPA-approved pretreatment program that implements applicable federal pretreatment requirements and regulates discharges to the sewer from industrial sources. Through this program, SOCWA can identify and regulate any Significant Industrial Users (SIUs) and Categorical Industrial Users (CIUs) that discharge to the sewer through the issuance of sewer use permits. Non-SIU and non-CIU dischargers are regulated through local limits and required best management practices. While SOCWA does not presently impose a local limit on salinity, the SOCWA industrial use control

7 The San Juan Capistrano Groundwater Treatment Plant is operated by the SMWD, and the brome discharge is regulated under NPDES Order No. R9-2022-0005.

8 RWQCB Order No. R9-2022-0005 regulates the discharge of up to 0.6 mgd of waste brine from the GRF to the SOCWA San Juan Creek Ocean Outfall. Brine flows from the GRF are transported to the San Juan Creek Ocean Outfall via the SMWD Chiquita Land Outfall.

9 SJBA members include the City of San Juan Capistrano, Moulton Niguel Water District, Santa Margarita Water District and South Coast Water District.

ordinance[10] establishes a prohibition against the discharge of "excessive" salinity to the sewer. Given the low number of SIU/CIU dischargers within the SOCWA service area, only a small portion of the sewer salinity loads within the SOCWA service area are from industrial sources.[11]

Treatment of Recycled Water. The SMWD Mission Viejo Water Purification facility provides filtration and reverse osmosis treatment to tertiary treated recycled water to create a high-quality water supply that is used to maintain Lake Mission Viejo. The plant produces approximately 0.3 mgd of high-quality treated product water.

Groundwater Barriers. SMWD currently operates and maintains two groundwater barrier systems to prevent urban development and recycled water use from adversely affecting groundwater. The Oso Creek Barrier captures and returns up to 1.5 mgd of poor-quality water to SMWD treatment and impoundment facilities. Captured water is recycled and used to irrigate greenbelts, parks, roadway medians and golf courses in Mission Viejo. The Horno Creek barrier captures and diverts approximately 0.18 mgd of poor quality water from the Horno Creek portion of the Lower San Juan HSA.

The TCWD Dry Season Recovery Project (while not technically a barrier) captures urban runoff from the Dove Creek and Tick Creek watersheds and stores the captured runoff in Dove Lake for use in augmenting the TCWD non-potable irrigation system.

Artificial Recharge. SMWD has implemented early-stage planning of Phase 1 of the San Juan Watershed Project which involves constructing three rubber inflatable dams along San Juan Creek within the Lower San Juan HSA to enhance streamflow infiltration recharge to the ground and protect downstream surface water quality. During lower flow storm events, the rubber dams remain inflated to impound storm runoff and enhance recharge to the groundwater basin. To prevent flooding, the dams deflate during times of peak streamflow when stream levels crest more than a foot above the top of the inflatable dam.

In addition to enhancing the volume of water stored in the Lower San Juan Creek HSA, Phase 1 of the San Juan Watershed Project is projected to result in improved water quality within the basin.

Modify Irrigation Practices/Vegetation/Land Use. In accordance with SWRCB directives, each of the SOCWA member agencies have implemented programs to help achieve state-wide water conservation goals. These programs include the imposition of requirements governing the timing and application of irrigation water, along with enforcement of water conservation requirements. Additionally, each SOCWA member agency has implemented public education efforts directed toward:

- promoting application of best management practices to conserve water,
- modifying irrigation systems and/or improving the efficiency of irrigation operations, and
- reducing water use through encouraging re-vegetation efforts (including providing rebates or financial incentives for reducing irrigation water use).

[10] SOCWA Ordinance No. 2015-1, Waste Discharge Pretreatment and Source Control Program, adopted by SOCWA on April 15, 2015.

[11] Only four CIUs presently are in operation within the SOCWA service area (two electroplaters, one rubber manufacturer and one jewelry manufacturer), and none of these dischargers involve salinity concentrations above those typical to domestic wastewater.

In addition to achieving in-home conservation, through these programs SOCWA member agencies have achieved significant reduction in outdoor applied water along with corresponding reductions in applied salt loads.

Planned Management Strategies. In addition to the above-listed existing strategies, SOCWA member agencies are in the process of implementing a variety of additional strategies that will help reduce basin salt loads and improve groundwater quality.

Seawater Desalination. SCWD is implementing the Doheny Desalination Project, which will provide up to 5 mgd of water supply. Construction of the project is projected to be complete in 2026 and water supply production is scheduled to begin in 2027. The project would supply high-quality water to SCWD customers, with the potential for excess supply being distributed to other regional water agencies. Salinity concentrations within the desalinated supply are projected to be equal to or less than imported supplies, depending on the quality of the imported supply. As a result, the desalination project is projected to reduce overall salinity loads within the area within which the desalinated supply is served.

While no partners commitments, or funding agreements are presently in place for use of the supply beyond the SCWD service area, SCWD has received letters of interest from the Laguna Beach County Water District, City of San Clemente, Elsinore Valley Municipal Water District and Eastern Municipal Water District. Until water use agreements are finalized, however, it is not known whether or how much of the desalinated supply will be utilized within the Mission Viejo HA or what salt load benefit the project may provide within the subbasins of HA 901.2.

Groundwater Treatment. Expansion of existing groundwater treatment operations are being implemented by SOCWA member agencies. SCWD proposes to increase the production capacity of the GRF. With implementation of a planned second well[12] within the Lower San Juan HSA, SCWD groundwater extractions would be expanded to 1.7 mgd, and potable water production from the GRF would be increased to approximately 1 mgd.

Other major increases in groundwater withdrawal within the basin would occur as part of the SMWD Ranch Water Treatment project. The Ranch Water Treatment Plant would treat quality groundwater from existing wells within the Lower San Juan HSA to reduce concentrations of iron, manganese and TDS. The initial phase of the project would generate approximately 0.7 to 0.9 mgd (800 to 1,000 AFY). In concert with future groundwater augmentation projects that include stormwater capture and recycled water recharge, however, ultimate production of the Ranch Water Treatment Plant could be increased to 4.0 mgd (4,500 AFY).

Artificial Recharge. Phases 2 and 3 of the SMWD San Juan Watershed Project would expand on the rubber dam/streamflow infiltration concept to increase overall recharge to the basin. Phase 2 would supplement streamflow recharge with recycled water recharge to allow for expanded groundwater withdrawals in the Lower San Juan HSA. Phase 2 would target a total of seven inflatable rubber dams along Trabuco Creek and San Juan Creek. With these additional recharge structures, supplemental recharge to the basin would

[12] The second SCWD well would boost groundwater extraction from the Lower San Juan HSA (HSA 901.21) to 1200 gallons per minute (approximately 1.73 mgd).

be increased to support a water production capacity of 2.4 to 4.4 mgd (2,660 to 4,920 AFY). Phase 3 would include additional incidental recharge and recycled water recharge to support an ultimate groundwater extraction and water production capacity from the Lower San Juan and Ortega HSAs of 15.3 mgd.

Barriers. While not technically a barrier project, the prosed SMWD Gobernadora Multipurpose Basin project would intercept urban runoff from the Gobernadora HSA (HSA 901.24). Diverted flows would be directed to wetlands for treatment, to the SMWD Chiquita Water Reclamation Plant or to Portola Reservoir (a recycled water storage reservoir).

Recycled Water Treatment. SMWD's Oso Water Reclamation Plan Improvement Project will involve upgrading the existing Oso Treatment Plant and expanding the tertiary treatment capacity from 1.6 mgd to 3.3 mgd. The project also involves a 1 mgd water treatment facility to reduce salinity concentrations in recycled water. The facility is projected to be online by 2024.

MNWD is also planning to implement reverse osmosis (RO) treatment of recycled water at both the Regional Wastewater Treatment Plant and the 3A Wastewater Treatment Plant to reduce recycled water salinity concentrations.

5.5 Projected Water Quality Improvements

Table 5-6 summarizes qualitative water quality improvements that are projected to occur as a result of the newly implemented and planned management strategies outlined above. Improvements to salinity concentrations in potable supplies are projected to occur in several subbasins when the SMWD Ranch Treatment Plant is brought online. In addition to extracting salts from the basin, water produced by this facility will contain TDS concentrations that are as good or better in quality than the present-day water supplies. It is also possible that potable water quality improvements in the Lower San Juan HSAs will occur with implementation of the SCWD Doheny Desalination Project, which will produce water supply as good or better than imported supplies.

Improvements to recycled water quality are also projected to occur as a result of recycled water treatment facilities being brought online by SMWD and MNWD. SMWD projects such as the Lake Mission Viejo Treatment Facility, Oso Reclamation Plant improvements, and the Ranch Filtration Plant Projects will be of particular importance in reducing basin salt loads, as SMWD recycled water will be served throughout much of the middle portion of the Mission Viejo HA.

To demonstrate the planned benefit to the middle portion of the Mission Viejo HA, Figure 5-2 illustrates how the Ranch Filtration Plant will reduce the effluent TDS load into the HA. As the volume of groundwater increases, the reduction of TDS in the effluent to the Chiquita Water Reclamation Plant (CWRP) decreases due to the reduction of TDS as compared to the source water from the Diemer Plant. By 2030, the TDS of effluent should be reduced by approximately 150 mg/L, with an effluent concentration of approximately 724 mg/L. Section 4.4 includes the monitoring strategy to determine if this management strategy effectively reduces the TDS in the Middle San Juan and Middle Trabuco HSAs.

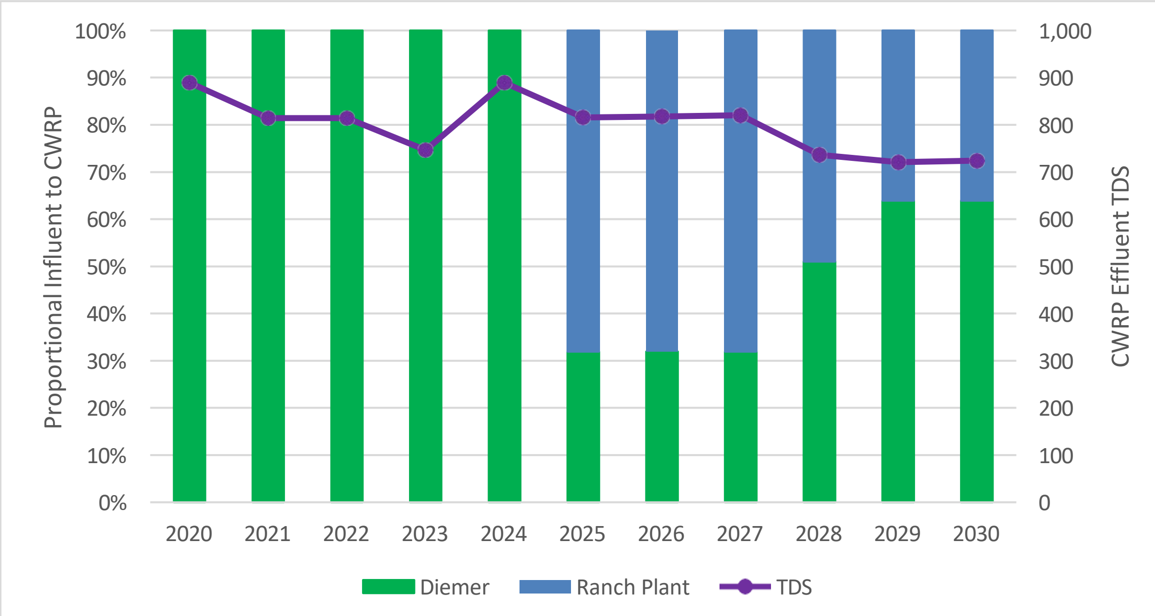


Figure 5-2 Projected Ranch Filtration Plant Effects on Chiquita Water Reclamation Plant (CWRP) Effluent TDS

Reductions in salt loads in applied water are projected to occur throughout the subbasins of the Mission Viejo HA as a result of water conservation, water-efficient improvements to irrigation systems, reduced acreages of irrigated vegetation, and replacing high-water use vegetation with drought-resistant vegetation.

Table 5-6
Summary of Improvements in Basin Conditions Projected to Occur with Implementation of Newly Implemented and Planned Management Strategies

HAS	Basin Name	Projected Improvement in Potable Water Quality	Projected Improvement in Recycled Water Quality	Reduced Salt Loads due to Irrigation Modifications	Increased Groundwater Withdrawal	Increased Groundwater Recharge with Improved Water Quality
902.1	Oso	✓	✓	✓		✓
902.2	Upper Trabuco	✓	✓	✓		
902.3	Middle Trabuco	✓	✓	✓		✓
902.4	Gobernadora	✓	✓	✓	✓	✓
902.5	Upper San Juan			✓		
902.6	Middle San Juan	✓	✓	✓		
902.7	Lower San Juan	✓	✓	✓	✓	✓
902.8	Ortega	✓	✓	✓	✓	✓

Also positively influencing groundwater quality are proposed increases in groundwater production and increases in the capacity to treat and extract salt from withdrawn groundwater. Finally, recharge projects such as Phases 1, 2 and 3 of the San Juan Watershed Project will enhance groundwater availability, support increased groundwater withdrawal (and corresponding reduced groundwater detention times), and improve groundwater quality.

Section 6 of this SNMP assesses salt loading within each subbasin, evaluates projected groundwater quality and transport of salts, and quantifies the projected water quality improvements addressed in Table 5-6.

5.6 Approach for Addressing need for Basin Plan Modifications

The goal of this SNMP is to identify implementation measures, strategies and levels of recycled water use that are consistent with existing Basin Plan groundwater quality objectives. It is recognized, however, that Basin Plan objectives in some subbasins may not be reflective of existing groundwater quality or groundwater quality that can be sustained by implementing available cost-effective groundwater management strategies. Where consistent with State policies and protection of existing beneficial uses, it may in the future be warranted to modify existing Basin Plan groundwater quality objectives to levels that (1) support existing or expanded recycled water use and (2) are consistent with maximum benefit to the people of the State.

To address the extent to which planned and proposed implementation measures and management strategies can implement existing Basin Plan objectives, the following section (Section 6) presents salt load quantifications and groundwater quality projections for each of the subbasins within the Mission Viejo HA under:

- existing salt load and recharge conditions, and
- projected salt load and recharge conditions with implementation of measures and management strategies currently being planned and implemented by SOCWA member agencies.

As part of this assessment, existing and projected groundwater quality conditions are evaluated to determine whether conformance with the existing Basin Plan objectives can be reasonably achieved.

Section 6: Salt Balance and Transport Modeling

6.1 Recycled Water Policy Requirements

Amendments to the Recycled Water Policy adopted by the SWRCB in 2018, in part, require that SNMPs include:

> *Salt and nutrient source identification, basin or subbasin assimilative capacity and loading estimates, together with fate and transport of salts and nutrients*.[1]

The Recycled Water Policy does not specify what type of fate and transport assessment is required within SNMPs, nor does the Policy specify the complexity of this analysis or require implementation of fate and transport groundwater models.[2] The SWRCB Staff Report supporting the 2018 Recycled Water Policy amendments, however, notes that:

> *Most SNMPs have relied upon a very simplistic mass-based approach that assumes complete mixing of salt and nutrient loads in the basin. However, salts and nutrients loaded into a basin from surface sources do not typically mix throughout the entire depth of the basin. Rather, salts and nutrients loaded into a basin from the surface can concentrate in shallower aquifers where they can end up affecting domestic water supplies, without mixing with groundwater in the deepest portions of the aquifer. Salt and nutrient loads also can remain in relatively confined areas laterally as well, without mixing over the entire basin area. Like the effect of relying on water quality data from deep domestic wells, the simplified total mixing assumption can result in an overestimate of the assimilative capacity of a basin and does not consider potentially significant impacts to shallow groundwater supplies or isolated areas that may have significant impacts.*[3]

As described in Sections 3 and 4, groundwater-bearing soils in the upper portions of the San Juan Basin are shallow and narrowly confined within swales, valleys and canyons. Because groundwater recharge in these narrow, ribbon-like alluvial areas is predominantly from infiltrating surface water, groundwater in the upstream portions of the San Juan Basin essentially functions as an underground stream.

As such, these narrow, shallow basins tend to take on the characteristics of the surface flows (both dry season runoff and storm runoff) that recharge the shallow aquifers. Because of the limited storage capacity and narrow, shallow nature of the groundwater-bearing sediments, groundwater quality (see Section 4) can vary considerably both seasonally and through long-term hydrologic cycles.

Unlike these upper areas that have limited storage capacity where groundwater yield and function can be characterized as an underground stream, the lower portion of the San Juan Basin consists of wider and deeper alluvial-filled valleys that can store significant quantities of groundwater[4] and support sustained groundwater production.[5]

---

1 See Section 6.2.4.3 of the 2018 Recycled Water Policy (SWRCB, 2018a).

2 See pages 25-26 of the SWRCB *Final Staff Report with Substitute Environmental Documentation, Amendment to Water Quality Control Policy for Recycled Water* (SWRCB, 2018b).

3 *Ibid*.

4 As documented in Section 3, prior studies estimate the total groundwater storage capacity of the Lower San Juan Basin as ranging from 26,000 to 42,000 acre-feet.

5 As documented in Section 3, annual groundwater production on the order of several thousand AFY can occur in the alluvial aquifers of the lower portion of the San Juan Basin.

Focus on Salinity. As noted, groundwater quality monitoring conducted in the San Juan Basin demonstrates (see Section 4) that groundwater concentrations of nitrate are significantly below Basin Plan objectives and the 10 mg/L (as nitrate) drinking water MCL. As a result, nitrate is not a constituent of concern in the basin. Instead, this SNMP focuses on TDS as a measure of groundwater quality. In addition to being a key Basin Plan parameter, TDS can be used as an indirect parameter for assessing compliance with such TDS constituent as chloride and sodium.

Approach. Consistent with nature of the upstream and downstream portions of the basin, two levels of analysis are presented for assessing TDS loads within the sub-basins of the San Juan Basin. The downstream alluvial valley portion of the San Juan Basin is sufficiently substantial to allow for the use of a fate and transport model to assess groundwater quality, availability and transport. Since the upper narrow, shallow portions of the San Juan Basin function as underground streams (as opposed to an underground reservoir), a mass-balance approach is used to characterize sources and loads to these narrow, shallow groundwater/surface water systems. This multi-level approach is consistent with the tiered SNMP approach approved by the RWQCB in 2010 and utilized within the 2014 San Juan Basin SNMP.[6,7]

Small, Shallow, Narrow Upstream Subbasins. Within the 2014 SNMP, salt balance estimates were used to characterize groundwater quality trends within the following small, narrow sub-basins that are tributary to the alluvial aquifer of the downstream portion of the San Juan Basin:

- Oso Basin (901.21),
- Upper Trabuco Basin (901.22),
- Middle Trabuco Basin (901.23),
- Gobernadora Basin (901.24), and
- Upper San Juan Basin (901.25).

Each of these small, shallow and narrow basins exist immediately beneath surface drainage channels. In the shallow and narrow subbasins, groundwater storage capacity is small, groundwater pumping is non-existent or limited, and significant interchange can occur between surface flow and groundwater.[8]

6 RWQCB Order No. R9-2010-0125 adopted SNMP guidelines that (1) implemented a tiered approach for groundwater analyses within San Diego Region Basins and (2) categorized San Diego Region groundwater basins into the tiers based on groundwater basin capacity, degree of beneficial use, groundwater quality, Basin Plan objectives, the quality of potable water supply and the quality of recycled water. On this basis, the San Juan Creek basin (defined within the guidelines as the lower alluvial portion of the San Juan Creek basin) was categorized as a "Tier A" basin. This designation was consistent with the DWR Bulletin 118 description of the San Juan Basin as covering a surface area of 16,700 acres. Smaller, narrow tributary sub-basins within the San Juan Creek watershed fell under the "Tier C" and "Tier D" criteria established within the guidelines. The 2018 SWRCB Recycled Water Policy required RWQCBs by April 8, 2021 to identity groundwater basins that required SNMPs. The RWQCB adoption of Order No. R9-2010-0125 satisfied this SWRCB requirement.

7 Consistent with RWQCB Order No. R9-2010-0125, the 2014 San Juan Basin SNMP included Level 3 analyses (salt balance assessments) for the Oso, Upper Trabuco, Middle Trabuco, Gobernadora and Upper San Juan Basins. As part of these analyses, assimilative capacity estimates were presented based on groundwater basin recharge estimates under both storm and non-storm conditions. Level 4 (detailed salt balance analyses combined with analysis of the geographic distribution groundwater quality) were conducted for the Lower San Juan Basin and Ortega Basin. The 2014 SNMP did not present a Level 4 analyses for the Middle San Juan Basin (901.26), as no recycled water use was occurring in this basin and data necessary to define the aquifer and salt balance terms were lacking.

8 As a result of the shallow nature of the sub-basins, streams can revert from gaining streams (rising groundwater) to losing streams (streamflow infiltration) over relatively short geographical distances. In such basins (particularly in basins where no wells exist), surface water data can be used in lieu of groundwater data as a means of estimating groundwater salt loads and groundwater quality.

Additionally, the small capacity of the basins in relation to volume of available recharge indicates the potential for rapid aquifer response to changes in recharge conditions.[9] These factors (along with the high degree of variability between storm runoff and non-storm runoff) make it difficult to reliably apply salt transport models to the Oso, Upper Trabuco, Middle Trabuco, Gobernadora and Upper San Juan Basins. As a result of these difficulties, a salt balance model analysis[10] was utilized within the 2014 SNMP in these sub-basins to assess groundwater quality trends, potential effects of management strategies on groundwater quality, and (where applicable) available assimilative capacity. As part of this salt balance approach, salt balance estimates from the 2014 version of the San Juan Basin SNMP are reviewed and updated as applicable, and assimilative capacity estimates are presented based on the updated salt balances.

Alluvial Downstream Portion of the San Juan Basin. As documented in Section 3, the lower portion of the San Juan Basin is characterized by wider alluvial-filled valleys that exist within the following sub-basins:

- downstream portion of Middle Trabuco Basin (901.23),
- Lower San Juan Basin (901.27), and
- Ortega Basin (901.28).

The alluvial valleys of these sub-basins combine to form an interlinked groundwater aquifer hereinafter referred to as the Lower Basin. As set forth in SNMP guidelines adopted by the RWQCB in 2010, the alluvial portion of the Lower Basin is designated a "Tier A" basin that warrants development of a SNMP and assessment of groundwater quality via a groundwater transport model.[11] This designation was consistent with:

- designation of the lower 16,700 acres of the alluvial aquifer of the San Juan Basin as one of California's 515 defined groundwater basins within DWR Bulletin 118,[12]
- the capacity of the Lower San Juan Basin to support sustained groundwater pumping,
- groundwater quality (current and historic) within the Lower San Juan Basin,
- the degree of groundwater use within the Lower San Juan Basin,
- the degree of existing and planned groundwater management within the basin to support and expand the beneficial use of groundwater, and
- provisions of the 2018 Recycled Water Policy.

[9] This response can include relatively rapid groundwater depletion and water quality degradation during summer periods or significant pumping, or rapid groundwater recovery and water quality improvement following storm periods.

[10] Salt balance model analysis was defined as a "Level 3" analysis within the 2014 SNMP, which represented the second-highest level of salt analysis within the 2014 SNMP. The Level 3 analysis was applied to basins with modest groundwater resources and significant downstream concerns. (See Section 5.0 of the 2014 SNMP).

[11] *Guidelines, Salinity and Nutrient Management Planning in the San Diego Regio*n were adopted by the RWQCB on November 10, 2010 through Order No. R9-2010-0125. Order No. R9-2010-0125 endorsed and encouraged use of the guidelines in developing and preparing SNMPs, but did not preclude stakeholders from developing alternative SNMP approaches that were consistent with State and Regional Water Board policies. The Guidelines implemented a tiered approach whereby the recommended level of groundwater basin analysis was proportional to the basin capacity, quality and use.

[12] California Department of Water Resources (2020), *California's Groundwater, Update 2020, Bulletin 118.* Bulletin 118 identifies the Lower San Juan Basin as a basin for which a Groundwater Sustainability Plan is not required under the 2014 Sustainable Groundwater Management Act (SGMA), but stakeholders have the option to develop such a Groundwater Sustainability Plan.

In accordance with this designation, groundwater fate and transport modeling of the Lower Basin is presented herein to assess Lower Basin salt loads and the transport and fate of salinity loads under a range of hydrologic conditions and range of potential groundwater management scenarios.[13]

It should be noted that groundwater transport within the Lower Basin under various management scenarios has been previously assessed using 3-dimensional transport models. In 2013, the Municipal Water District of Orange County (MWDOC) used a 3-dimensional model to assess San Juan Basin groundwater storage and transport for a proposed seawater desalination project.[14] A 3-dimensional transport model has also been used by the SJBA for assessing water management recharge and sustainability alternatives within the San Juan Basin.[15,16]

Prior San Juan Basin 3-dimensional transport modeling efforts, however, addressed only groundwater storage and transport, as the models lacked a water quality element. These prior modeling assessments have focused on groundwater availability for existing and proposed demineralization/desalination projects where water quality has not been the predominant concern. For such projects, the availability of groundwater is paramount and groundwater quality is not a key concern, as the projects are designed to treat groundwater under a range of groundwater TDS concentrations. Other than preventing seawater intrusion, assessment of groundwater quality has to date not been a priority for San Juan Basin groundwater agencies.[17,18]

6.2 Upper Basin Salt Balance Analyses in 2014 SNMP

Summary of 2014 SNMP Salt Balance Findings. Salt balances for the upstream San Juan subbasins were presented in the 2014 San Juan Basin SNMP that assessed groundwater flow and quality. Within these narrow, shallow, ribbon-like basins, salt balances presented within the 2014 SNMP assumed that surface water quality and groundwater quality were one and the same during non-storm conditions, which is most of the year. Salt balance conditions for the following three development scenarios were assessed in the 2014 SNMP:

- 2011 development level and recycled water use volumes from year 2011.[19]
- Future development with recycled water use planned by SOCWA agencies.[20]
- Future development with recycled water use permitted under Order No. 97-52.[21]

---

[13] Analysis of the Middle San Juan Basin (901.26) is deferred to future SNMP updates as recycled water use does not currently occur in this basin and additional monitoring (see Section 7) is required to define aquifer characteristics and salt loads within HAS 901.26.

[14] See *South Orange Coastal Ocean Desalination Project, Volume 3 – San Juan Basin Regional Watershed and Groundwater Models* (Geoscience Support Services, 2013).

[15] See *San Juan Basin Groundwater and Desalination Optimization Program Foundational Actions Fund (FAF) Program, Final Report* (G3 Soil Works, Wildermuth Environmental and Black and Veatch, 2016).

[16] West Yost is currently employing a 3-dimensional groundwater transport model (which lacks a water quality element) to assess SJBA groundwater management options. Results of the West Yost modeling efforts have not yet been published, but West Yost has provided preliminary model data and results to SOCWA for use in the salt balance and modeling efforts presented in this SNMP update.

[17] To date, no need for water quality assessment as part of SJBA groundwater management actions has arisen, as groundwater quality within the lower portions of the San Juan Basin alluvium does not meet secondary drinking water standards and withdrawn groundwaters in the lower basin receive demineralization treatment prior to potable use. Additionally, almost all groundwater pumping and active basin management occurs within the Lower San Juan and Ortega Basins where Basin Plan TDS objectives are respectively 1200 and 1100 mg/L.

[18] Seawater intrusion issues and the availability of groundwater supply to groundwater demineralization projects can effectively be assessed using groundwater transport models that do not include a water quality element.

[19] The 2014 SNMP addressed data, recycled water use volumes, land use and development levels through calendar year 2011.

[20] Includes future recycled water use from projects planned for implementation by SOCWA member agencies.

[21] Includes permitted quantities of recycled water identified for each SOCWA member agency within Table 5 of RWQCB Order No. 97-52.

Table 6-1 summarizes how salt loads were estimated within the 2014 SNMP Level 3 salt balance model for each of the sub-basins within the Upper Basin.

Table 6-1
Summary of Salt Balance Parameters [A]
2014 SNMP Level 3 Salt Balance Model

Salt Balance Model Parameter	Means of Estimating Parameter [B]
Input Parameter	
Precipitation recharge	• Regional precipitation data and runoff data • Rainfall vs. runoff curves for Upper Basin sub-basins
Streamflow infiltration: • Stormwater • Non-storm water • Urban runoff return	• Streamflow records and visual observations • Professional judgment based on literature review [C] • Water quality monitoring data from storm and non-storm runoff
Subsurface groundwater inflow	• Professional judgment based on geology
Geologic leaching	• Historical groundwater data • Professional judgment based on literature review [C]
Man-Induced recharge: • Potable water irrigation • Recycled water irrigation	• Potable water use and recycled water use data • Land use data, approved land use plans and aerial photos to estimate irrigated areas and type of vegetation • Literature review of irrigation efficiency [C] • Water quality monitoring of potable and recycled supplies • Estimated agronomic application rates [C]
Output Parameters	
Evaporation	• Observed or published evapotranspiration data
Well pumping	• Well pumping records or estimated groundwater use
Barrier diversions	• Observed flow and observed quality of captured groundwater
Percolation to deep groundwater	• Professional judgment based on literature review [C]
Subsurface groundwater outflow	• Estimated hydraulic conductivity and geology [C]
Surfacing groundwater	• Professional judgement, observations and mass balances • Surface water quality monitoring data

Table 6-1 Footnotes:

A See Section 5.1 of the 2014 SNMP for a detailed description of the Level 3 salt balance model used to assess sub-basins within the Upper Basin.

B See Appendix C of the 2014 SNMP for estimated values applied to each sub-basin of the Upper Basin.

C Includes use of data from prior mass balance studies including 1993 Basin Plan amendment studies. See Section 5.1 of the 2014 SNMP.

As noted in the 2014 SNMP, average precipitation in each of the sub-basins of the Upper Basin is typically equal to or greater than the storage capacity of each basin. The relatively small storage capacity of these basins compared to annual precipitation indicates that these aquifers can, when depleted, fill in a single precipitation event and water quality can quickly be restored commensurate with the quality of the storm runoff. As a result of the small groundwater storage volumes and potential rapid changes in groundwater quality, the concept of assimilative capacity is not meaningful or practicable for these sub-basins.

Mass balances for the sub-basins of the Upper Basin were developed within the 2014 SNMP based on estimated annual inputs and outputs. Since the groundwater bearing strata in each of the Upper Basin sub-basins consists of shallow alluvial deposits directly connected to overlying surface drainage, the mass balance model within the 2014 SNMP treated the surface water and groundwater quality as being the same during non-storm periods. This presumption was based on observations that the majority of non-storm surface flow was comprised of surfacing groundwater from the underlying alluvium.[22] Since non-storm conditions occur during a significant majority of the year, salt balance estimates (e.g., TDS concentrations) of non-storm runoff was used to estimate typical groundwater TDS concentrations in the sub-basins.[23]

Table 6-2 summarizes results of the 2014 SNMP mass balance modeling for the sub-basins that comprise the Upper Basin.

Table 6-2
Summary of Projected TDS Concentrations of Non-Storm Runoff
Upper Sub-basins of the Upper Basin - 2014 San Juan Basin SNMP [A]

Basin	Watershed Area (acres)	Planned Recycled Water Use (AFY)	Permitted Recycled Water Use (AFY)	Basin Plan TDS Objective (mg/L)	Projected Non-Storm TDS Concentration (mg/L) [B] Future Development with:		
					No Recycled Water Use	Planned Recycled Water Use [C]	Permitted Recycled Water Use [D]
Oso/La Paz	10,544	5,290	7,168	1200	2,315	2,447	2,538
Middle Trabuco	10,704	1,487	91	750	942	991	1,082
Upper Trabuco	13,339	23	420	500	263	264	273
Gobernadora	7,116	4,000	4,148	1200	546	677	682
Chiquita	4,085	676	---	1200	544	604	---
Dove/Bell	13,083	889	---	500	350	408	---
Upper San Juan	37,739	91	977	500	383	387	414

Table 6-2 Footnotes:

A See Sections 5.1 of the 2014 San Juan Basin SNMP.

B In the shallow, narrow ribbon-like sub-basins of the Upper Basin, Surface runoff and groundwater quality are projected to be the same. Non-storm runoff TDS concentrations are considered to represent the likely bound for groundwater TDS within the sub-basins.

C Planned recycled water use by SOCWA member agencies, as identified in the 2014 SNMP.

D Recycled water use identified for each SOCWA member agency within Table 5 of RWQCB Order No. 97-52.

Oso/La Paz. The Oso/La Paz basin (901.21) was fully built out by year 2011. As a result, no change occurs in the amount of development between projected future conditions and existing conditions assessed in the 2014 SNMP. As shown in Table 6-2, planned recycled water use in the basin accounts for less than

22 See Section 5.1.2 of the 2014 SNMP.

23 Using non-storm mass balance water quality estimates to assess typical groundwater quality is conservative, as groundwater in the shallow, narrow sub-basins of the Upper Basin can, when recharge capacity is available, rapidly improve during a single storm event.

6 percent of projected groundwater (non-storm flow) TDS within the Oso/La Paz sub-basin. The 2014 SNMP salt balance model concluded that recycled water use in the basin could increase stormwater TDS concentrations by approximately 6 percent (from 600 mg/L to 636 mg/L) because of storm runoff leaching salts from lands irrigated by recycled water. While groundwater TDS concentrations in the Oso/La Paz basin are higher than the existing Basin Plan groundwater TDS objective, the 2014 SNMP concluded that effects on groundwater TDS that are associated with recycled water use is still within the range of variability that would occur in the basin in the absence of recycled water use.[24]

Middle Trabuco. Similar to the Oso/La Paz basin, the Middle Trabuco basin (901.23) was already built out by year 2011. As a result, no change occurs in the amount of development between future conditions and existing conditions assessed in the 2014 SNMP. Groundwater TDS concentrations within the Middle Trabuco basin (as indicated by projected TDS concentrations of non-storm runoff) are projected to exceed the 750 mg/L Basin Plan groundwater TDS objective regardless of whether recycled water is used in the basin. Planned recycled water use within the basin is projected to increase groundwater TDS concentrations approximately 5 percent (942 mg/L vs. 991 mg/L) compared to conditions under which no recycled water is used in the Middle Trabuco basin. Planned recycled water use is also projected to increase storm runoff TDS concentrations by approximately 5 percent compared to conditions under which no recycled water is used. These small concentration increases in storm and non-storm runoff TDS, however, are within the natural range of TDS variations that would occur in the absence of recycled water use.[25]

Upper Trabuco. The Upper Trabuco basin (901.22) is not yet built out, and future water quality may be affected both by development and planned recycled water use. Because of the limited planned recycled water use within the basin, however, recycled water is not projected to discernibly affect basin salt loads or water quality. The 2014 SNMP mass balance model of the Upper Trabuco basin concluded that groundwater TDS concentrations (as indicated both by projected storm flow and non-storm flow) are projected to remain well below the existing Basin Plan groundwater TDS objective of 500 mg/L. [26]

Gobernadora. The Gobernadora basin (901.24) is also not fully built out, and future water quality may be affected both by development within the basin and by planned increased recycled water use. The 2014 SNMP mass balance model of the Gobernadora basin concluded that planned recycled water use may increase TDS concentrations in non-storm runoff (and thus TDS concentrations in the underlying groundwater) by approximately 18 percent. Projected TDS concentrations in both the storm and non-storm flow within the basin, however, were concluded as remaining well below the Basin Plan groundwater TDS concentration objective of 1200 mg/L. [27]

Chiquita. The Chiquita basin (which comprises the western portion of HSA 901.24) is not fully built out, and future water quality may be affected both by development within the basin and by planned increased

[24] See Section 5.1.4.1 of the 2014 SNMP.

[25] See Section 5.1.4.2 of the 2014 SNMP.

[26] See Section 5.1.4.8 of the 2014 SNMP.

[27] See Section 5.1.4.3 of the 2014 SNMP.

recycled water use. The 2014 SNMP mass balance model of the Chiquita basin concluded that planned recycled water use may increase TDS concentrations in non-storm runoff (and underlying groundwater) by approximately 11 percent. The 2014 SNMP mass balance model projected that TDS concentrations in both the storm and non-storm flow within the Chiquita basin would remain well below the Basin Plan groundwater TDS concentration objective of 1200 mg/L. [28]

Dove/Bell. The Dove/Bell basin (the upstream portion of HSA 901.24) was fully built out by year 2011, and planned recycled water use represents the only key difference between existing and future conditions. Because of the small size of the basin, the 2014 SNMP mass balance model projects that planned recycled water use will increase TDS concentrations in storm flow and non-storm flow by approximately 17 percent. The Dove/Bell mass balance model, however, concluded that groundwater TDS concentrations (as indicated both by projected storm flow and non-storm flow) will be below the existing Basin Plan groundwater TDS objective of 500 mg/L. [29]

Upper San Juan. The Upper San Juan basin (901.25) is substantially built out, and a relatively small amount of future recycled water use is planned. The 2014 SNMP mass balance model of the Upper San Juan basin concluded that planned recycled water use is unlikely to discernibly affect TDS concentrations in storm runoff, non-storm runoff, or the underlying groundwater. TDS concentrations in both the storm and non-storm runoff were concluded as being significantly below the Basin Plan TDS objective of 500 mg/L.[30]

2014 SNMP Mass Balance Conclusions for Sub-Basins of the Upper Basin. Salt balance conclusions for both planned and permitted recycled water use scenarios that were presented in the 2014 SNMP remain valid, and no need exists to revise these estimates or conduct transport modeling within these upper sub-basins. Table 6-3 summarizes general salt balance conclusions presented within the 2014 SNMP for the sub-basins of the Upper Basin.

While the concept of assimilative capacity is not practical to consider when assessing shallow, narrow sub-basins of the Upper Basin, the 2014 SNMP concluded (see Table 6-3) that recycled water use is unlikely to discernibly affect surface or groundwater quality within the Upper Trabuco (901.22) and Upper San Juan (901.25) basins. Groundwater TDS concentrations in these basins are projected to remain significantly below Basin Plan groundwater TDS concentration objectives. Recycled water use is projected to have only minimal effect on groundwater TDS within the Gobernadora, Chiquita and Dove/Bell basins of HSA 901.24. Groundwater TDS concentrations in the Gobernadora and Chiquita basins are projected to remain significantly below the 1200 mg/L Basin Plan groundwater TDS concentration objective for HSA 901.24. Concentrations of TDS in recycled water supplies used in HSA 901.24 are also projected to be lower than the corresponding Basin Plan groundwater quality TDS concentration objective.

Groundwater TDS concentrations are presently greater than Basin Plan TDS concentrations within the Oso/La Paz (901.21) and Middle Trabuco (901.23) basins. Planned recycled water use within these basins

---

28 See Section 5.1.4.4 of the 2014 SNMP.

29 See Section 5.1.4.6 of the 2014 SNMP.

30 See Section 5.1.4.7 of the 2014 SNMP.

is not projected to significantly affect groundwater TDS concentrations. TDS increases associated with recycled water use are projected to be within the range of natural variability of groundwater TDS concentrations within HSAs 901.21 and 901.23.

Table 6-3
Summary of Projected Recycled Water Impacts
Upper Sub-basins of the Upper Basin - 2014 San Juan Basin SNMP [A]

Basin	Basin Plan Groundwater TDS Objective (mg/L)	Are Recycled Water TDS Concentrations Less than the Basin Plan Objective?	Will Future Groundwater TDS Concentration Comply with the Basin Plan Objective? [B]		Does Adequate Assimilative Capacity Exist for Planned Recycled Water Use? [E]	Projected Groundwater TDS Increase Due to Existing and Planned Recycled Water Use [F] (percent increase)	Projected Future Groundwater TDS Concentration as a Percent of the Basin Plan Objective: Planned Recycled Water Use [G]
			Future Conditions if No Recycled Water Use [C]	Future Conditions: Under Planned Recyced Water Use [D]			
Oso/La Paz	1200	Yes	No	No	No	5 % [H]	> 100 % [H]
Middle Trabuco	750	No	No [I]	No [I]	No [I]	5 % [H,I]	> 100 % [H,I]
Upper Trabuco	500	No	Yes	Yes	Yes	< 1 %	53 %
Gobernadora	1200	Yes	Yes	Yes	Yes	24 %	56 %
Chiquita	1200	Yes	Yes	Yes	Yes	11 %	50 %
Dove/Bell	500	No	Yes	Yes	Yes	17 %	82 %
Upper San Juan	500	No	Yes	Yes	Yes	1 %	77 %

Table 6-3 Footnotes:

A See Sections 5.1 of the 2014 San Juan Basin SNMP.

B Based on projected TDS concentrations for the sub-basin, as reported in Section 5.1 of the 2014 SNMP.

C Projected groundwater TDS concentration in the absence of any recycled water use.

D Based on planned recycled water use by SOCWA member agencies, as identified in the 2014 SNMP and shown in Table 6-2.

E Assimilative capacity conclusions presented in the 2014 San Juan Basin SNMP. The 2018 Recycled Water Policy establishes updated assimilative capacity requirements that were not addressed within the 2014 SNMP. See Section 7 of this SNMP for an assessment of compliance with 2018 Recycled Water Policy assimilative capacity requirements.

F Percent increase computed as percent difference See Table 6-2 for groundwater TDS concentrations projected within the 2014 San Juan Basin SNMP.

G Computed as the projected groundwater TDS concentration under planned recycled water use as a percentage of the Basin Plan groundwater TDS objective. See Table 6-2 for projected groundwater TDS concentrations under planned recycled water use.

H The 2014 San Juan Basin SNMP concluded that planned recycled water use within Oso/La Paz and Middle Trabuco basins was not projected to increase groundwater TDS concentrations above the historical natural range of TDS variation.

I Projected groundwater quality under planned recycled water use (991 mg/L) is reasonably close to the 750 mg/L Basin Plan groundwater TDS objective in the Middle Trabuco Basin. The possibility may exist that future water treatment or salinity load reduction management strategies may reduce basin TDS concentrations to near or below the existing Basin Plan TDS objective.

As a final note, specific salt transport modeling of the sub-basins of the upper basin is neither practical nor required as part of this 2023 SNMP update.[31] Since groundwater and surface water is essentially interchangeable within the sub-basins of the Upper Basin, transport of salts from the sub-basins of the Upper Basin to the Lower Basin can be addressed through a Lower Basin transport model that assesses the transport of salts (via surface flows) from the Upper Basin to the Lower Basin.[32]

6.3 Fate and Transport Model of the Lower Basin

Model Selection. A proprietary one-dimensional lumped parameter, link-node (LPLN) model is applied to the Lower Basin to assess salt balance and transport in the Lower Basin. The LPLN model was developed in the late 1980s as a groundwater planning tool for assessing groundwater availability, groundwater quality and groundwater management strategies in narrow and relatively shallow coastal basins within the San Diego Region.[33] Table 6-4 summarizes past applications of the LPLN model in its various iterations.

Table 6-4
Prior San Diego Region Applications of the 1-Dimensional LPLN Model

Basins	Publication or Study	Agencies	Purpose of Study
• Upper Ysidora (902.13) • Chappo (902.12) • Lower Ysidora (902.11)	*Proposed Modification of Basin Plan Water Quality Objectives, Santa Margarita River Live Stream Discharge* [A]	• Eastern Municipal Water District • Rancho California Water District	Assess interaction between ground and surface water and assess potential feasibility of modifying water quality objectives in the Santa Margarita River Basin.
• Upper Ysidora (902.13) • Chappo (902.12) • Lower Ysidora (902.11)	*Water Quality Protection Study* [B]	• Marine Corps Base Camp Pendleton • Fallbrook Sanitary District • Eastern Municipal Water District • Rancho California Water District	Assess recycled water stream discharge as a management strategy to enhance groundwater availability and stabilize groundwater quality in the Santa Margarita River Basin.
• Jamacha (909.21)	*Middle Sweetwater River System Study* [C]	• Otay Water District • Sweetwater Authority • San Diego County Water Authority	Assess potential water management strategies to enhance groundwater availability, groundwater quality, and maximize efficiency of transfers from upstream reservoirs.
• Upper Ysidora (902.13) • Chappo (902.12)	*Conjunctive Use Study* [D]	• Marine Corps Base Camp Pendleton • Fallbrook Public Utility District • San Diego County Water Authority	Assess effects of planned groundwater recharge and treatment projects on groundwater quality and groundwater availability in the Santa Margarita River Basin.
• Lower Ysidora (902.21) • Las Pulgas (901.51) • San Onofre (901.52) • San Mateo (901.40)	*Programmatic Groundwater/ Riparian Habitat Assessment at Marine Corps Base Camp Pendleton* [E]	• Marine Corps Base Camp Pendleton	Assess effects of removing Camp Pendleton wastewater discharges to ground and surface waters on riparian habitat downstream from the discharges.

Table 6-4 Footnotes:
A Prepared by NBS/Lowry (October 1989).
B Prepared by NBS/Lowry, Almgren and Associates and Stetson Engineers (July 1990).
C Prepared by NBS/Lowry (May 1993).
D Prepared by NBS/Lowry (June 1994).
E Prepared by KEA Environmental (April 1995).

[31] Salt transport modeling within the sub-basins of the Upper Basin is not practical due to narrow, ribbon-like nature of the sub-basins and the high degree to which ground and surface water interchanges. Further, such transport modeling is not required, as the sub-basins of the Upper Basin have not been designated by the RWQCB as "Tier A" basins. Additionally, these upper sub-basins have not been identified by the SWRCB or DWR Bulletin 118 as being viable groundwater basins. Instead, salt balance modeling remains appropriate for assessing salt sources, Basin Plan compliance and assimilative capacity issues for the shallow and narrow sub-basins of the Upper Basin.

[32] As noted later in Section 6, the LPLN salt transport model applied to the Lower Basin includes algorithms that estimate salt transport from sub-basins of the Upper Basin that are transported to the Lower Basin via storm flows, non-storm flows and urban runoff.

[33] The proprietary 1-dimensional LPLN model was developed by Michael R. Welch, Ph.D., P.E., based on modeling algorithms suggested by Gary L. Guymon, Ph.D., P.E. (founding chair of the Civil Engineering Department, University of California, Irvine).

It should be noted that a 3-dimensional transport model has been previously been applied to the Lower Basin as part of an effort to assess seawater intrusion associated with ocean desalination.[34] Additionally, SJBA is employing a 3-dimensional transport model to assess potential groundwater management projects.[35] None of these 3-dimensional models, however, included a water quality component, as groundwater transport and availability (rather than groundwater quality) was the focus of the modeling efforts. Incorporating a water quality component into an existing 3-dimensional model was evaluated, but such model modifications were deemed impractical to implement as part of this SNMP update due to costs and scheduling concerns.[36] Additionally, several presently-unresolved 3-dimensional model input assumptions require resolution.[37] For these reasons, the 1-dimensional LPLN model is used herein to assess both groundwater transport and groundwater quality within the Lower Basin.

General Description of the 1-Dimensional LPLN Model. The 1-dimensional LPLN model is designed to apply to narrow, shallow coastal groundwater basins where:

- groundwater production is derived predominantly from narrow alluvium-filled valleys,
- significant interaction between ground and surface water (e.g., streamflow infiltration and surfacing groundwater) can occur,
- groundwater table gradients occur predominantly in the upstream/downstream direction,
- groundwater quality contours are predominantly oriented in an upstream/downstream direction,
- the alluvial aquifer is sufficiently shallow so that most wells fully penetrate the aquifer, and
- highly productive wells can have cones of depression that can extend over reasonable fraction of the width of the basin.

Such conditions occur in the lower 26,000-acre alluvial portion of the San Juan Basin, and the 1-dimensional LPLN model is well suited to address such largely 1-dimensional transport effects in the Lower Basin. Table 6-5 summarizes overall advantages and disadvantages of the 1-dimensional LPLN model.

The 1-dimensional LPLN model characterizes the lower 26,000 acres of the San Juan Basin as a series of slices (elements) oriented in an upstream-downstream direction. The model uses a “Y” shaped sequence of 17 elements to simulate the Lower Basin . Figure 6-1 presents the location of the LPLN model elements for the modeled area. As shown in Figure 6-1, Elements 1-6 are along Trabuco/Oso Creeks while Elements 7-12 are along San Juan Creek. Elements 7-11 are within the Ortega Basin (Basin Plan groundwater TDS objective of 1100 mg/L) while Elements 4-6 and 12-17 are within the Lower San Juan Creek Basin (Basin Plan groundwater TDS objective of 1200 mg/L) . Three elements (Elements 1-3) within the modeled area are included within the Middle Trabuco Basin. The confluence of Trabuco and San Juan Creeks occurs within Element 12.

---

[34] Includes modeling efforts conducted by Geoscience Support Services (on behalf of the Metropolitan Water District of Southern California) to assess seawater intrusion aspects associated the proposed Doheny Desalination Project

[35] Includes modeling efforts conducted by Wildermuth Environmental (on behalf of the SJBA) to assess groundwater recharge, extraction and barrier projects.

[36] Costs were estimated at approximately $30 million for incorporating a water quality element to the existing 3-dimensional Lower Basin transport model and refining model input assumptions. Additionally, developing and implementing the modeling effort would require a significant delay in the development of the San Juan Basin SNMP.

[37] To address stakeholder questions, additional monitoring and/or water quality modeling work may be required to refine or confirm several model input parameters presently used within the 3-dimensional model.

Table 6-5
Advantages/Disadvantages of 1-Dimensional LPLN Model [A]

Advantage	Disadvantage
• The LPLN model is an easy-to-use initial planning tool capable of simulating a wide variety of potential groundwater management scenarios	• LPLN element sizes are large (typically 0.1 - 0.3 square miles)
• The LPLN model does not need detailed geographic-specific input data and can make use of available monthly precipitation, water use, flow and evaporation data	• Use of monthly input/output data in the LPLN model does not characterize short-term intense storm events, short-term pumping spikes, or short-term water use events
• The LPLN model can operate on short time steps (on the order of a few hours) and can simulate 20 years of time in approximately 15 minutes of computer time per run	• Element-averaged results from the LPLN model are difficult to compare with location-specific monitoring data
• The LPLN model is suited for simulation of shallow, narrow aquifers where groundwater gradients are predominantly oriented in an upstream/downstream direction	• Applied salts within the LPLN model are assumed to immediately transport to saturated groundwater, resulting in simulated accelerated salt load effects [B]
• The LPLN model addresses both surface water flow and quality and groundwater occurrence and quality	• Complete mix assumption within the groundwater components of each LPLN element does not allow for geographic-specific effects to be assessed within any element or lateral groundwater movement to be addressed
• Built-in functions within the LPLN model allow many parameters to be handled as land-use or hydrologic-dependent variables instead of constants	• As with most models, LPLN model output can be sensitive to numerous input terms [C]
• The LPLN model provides monthly element-by-element output of: ▪ groundwater storage, TDS and depth-to-groundwater ▪ streamflow and stream TDS ▪ mean groundwater detention time ▪ surfacing groundwater and streamflow infiltration ▪ volume-weighted groundwater TDS	• Coarse nature of the LPLN model grid is appropriate only for initial planning; model is not suited for locating or sizing water management facilities or addressing compliance with underground travel time or detention requirements

Table 6-5 Footnotes:

A General advantages and disadvantages of the 1-dimensional LPLN model compared to more sophisticated 3-dimensional groundwater transport models such as the U.S. Geological Survey MODFLOW open code platform or the U.S. Army Corps of Engineers HEC-based (Hydrologic Engineering Center) models.

B This assumption is often employed in more sophisticated models that do not simulate conditions in the unsaturated zone.

C Model output from more sophisticated models is sometimes more sensitive to model input than the lumped parameter nature of the LPLN model.

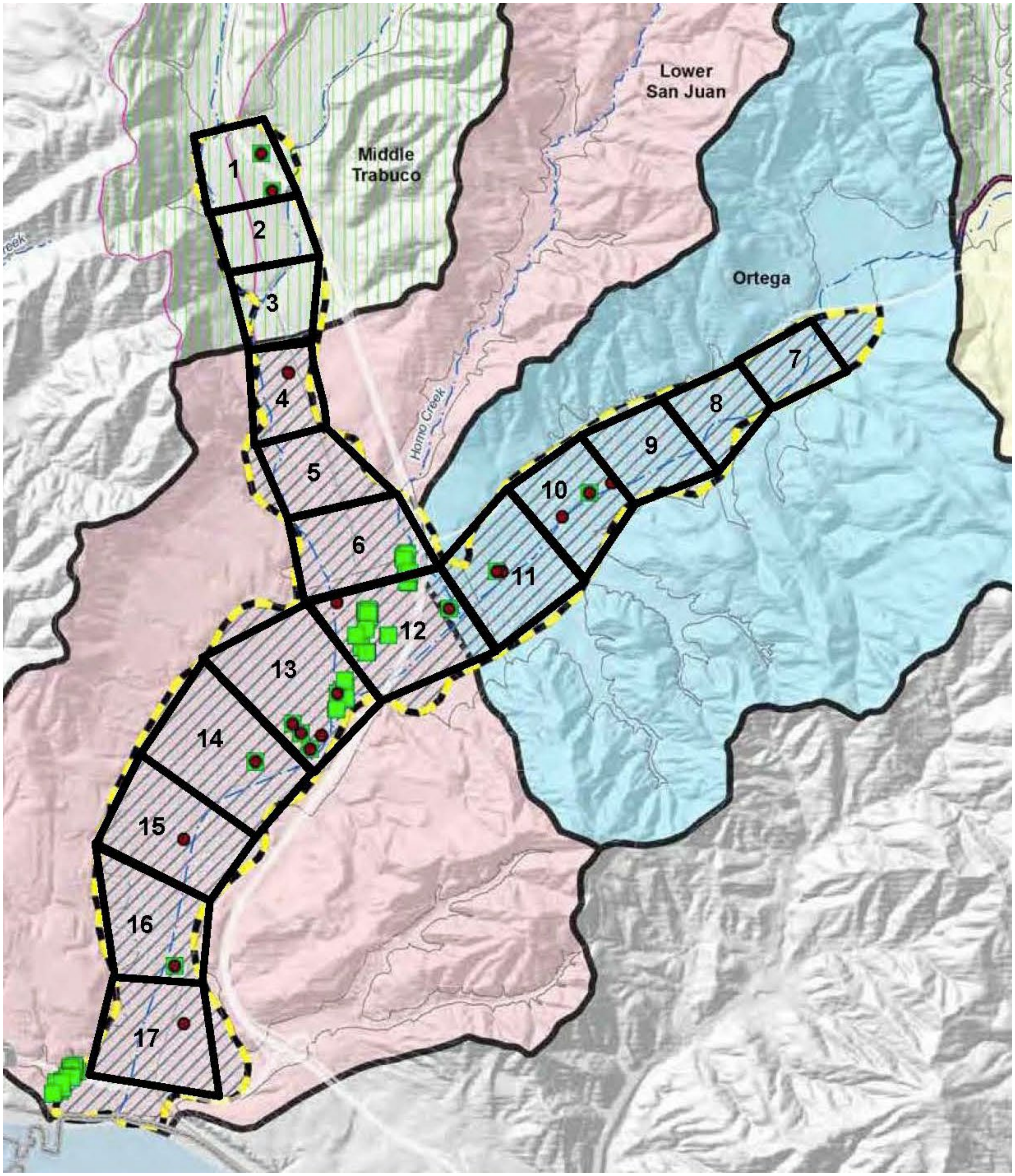


Figure 6-1 Elements of the Lower Basin LPLN Model

Each element within the 1-dimensional LPLN model contains both surface water and groundwater components. Figure 6-2 presents a schematic of the groundwater and surface water components within each model element.

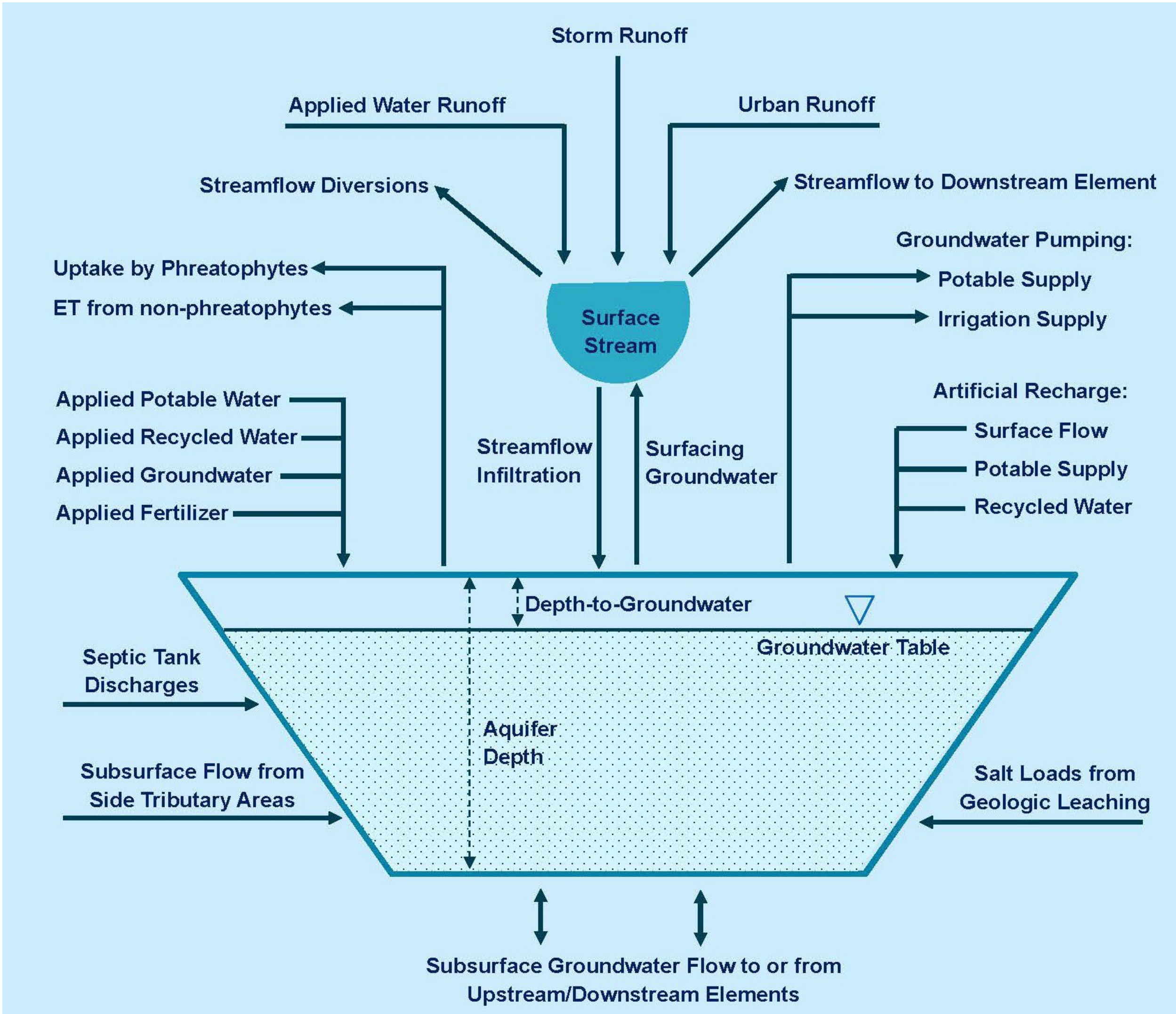


Figure 6-2 LPLN Element Schematic – Ground and Surface Water Components of Each Model Element

The current version of the LPLN Model (Version 1.5) has been updated from the prior 1995 version (Version 1.4) to address the "Y" shape of the lower 26,000 acres of the Lower Basin.[38] Model algorithms are encoded in spreadsheet format and time-step advancement, model computations and model output are controlled by programmable macros.[39] The model LPLN model is comprised of linked spreadsheets that include (1) tables of required input data and parameters, (2) computational spreadsheets where element-by-element computations are performed, and (3) programmable macros that control model time steps and output. Model output on an element-by-element basis is provided in tabulated monthly output data tables and output graphics for each element for the following output parameters:

- Groundwater storage volume (AF),
- Groundwater storage as a percent of maximum (%),

[38] Version 1.5 was updated in 2023 by Michael R. Welch, Ph.D., P.E.

[39] Version 1.5 of the LPLN model is coded in LOTUS 1-2-3 (Release 5) using LOTUS programmable "short-cut" commands and macro commands. The LPNL model may be run on a standard DOS-compatible personal computer that is equipped with "LOTUS 1-2-3" (Version 3.1 or higher) software.

- Mean groundwater detention time (years),
- Mean depth-to-groundwater (feet),
- Mean (arithmetic average) groundwater TDS (mg/L),[40]
- Volume-weighted groundwater TDS (mg/L),
- Streamflow (cfs),
- Streamflow TDS (mg/L),
- Surfacing groundwater (cfs), and
- Streamflow infiltration (AF/month).

A linear, finite-difference approach[41] and Darcy's Law[42] is used within the LPLN model to assess groundwater movement between elements. The model operates on monthly input data and can in a single model run simulate up to 20 years of time.

Figure 6-3 presents a schematic of how LPLN model elements are linked. For a given time step "t", salt and water input and output terms for within each model element are computed in the following sequence:

- Input data for ground and surface water inflows and outflows time step "t" are identified for each model element.
- Initial computations for the surface water component of element "i" are completed and preliminary surface flow and surface water quality for the element is computed.
- Initial computations for the groundwater component of element "i" are completed, and preliminary groundwater volume and quality is computed.
- The model determines whether streamflow infiltration is occurring, and, if so, computes the quantity and quality of streamflow infiltration.
- Preliminary surface water flows in element "i" are adjusted to reflect the loss to groundwater.
- Preliminary groundwater volumes and quality in Element "i" are adjusted to reflect the contribution of streamflow infiltration.
- The model computes the estimates groundwater interchange between element "i" and the downstream element "i+1" using finite difference approach and Darcy's Law.
- The model determines whether surfacing groundwater is occurring in Element "i", and if so, computes the quantity of the surfacing groundwater. Surfacing groundwater from Element "i" is applied to Element "i+1".

---

40 The LPLN model can assess water quality for any conservative constituent (e.g., a constituent that is not created, change form, or have a half-life when stored in groundwater). For application to the San Juan Basin, the model utilizes TDS for assessing groundwater quality.

41 Under the finite difference approach, piezometric gradients between elements are assumed to be linear and are computed as the difference in mean groundwater table elevations between the elements divided by the distance between the centerline of each element.

42 Darcy's Law estimates groundwater flow (Q) as the product of the hydraulic conductivity (K), cross-sectional area of underground flow (A), and piezometric gradient ($\frac{\Delta\Delta h}{\Delta\Delta\Delta}$)as follows:

$$QQ = KK * AA * \frac{\Delta\Delta h}{\Delta\Delta\Delta\Delta}$$ where Q is in units of ft^3/day, K is in units of ft/day, and A is in square feet

- The model adjusts the groundwater volume and groundwater quality element "i" to reflect the computed quantity of groundwater inflow or outflow.
- The model adjusts the groundwater volume and groundwater quality in the downstream element (Element "i+1") to reflect inflow received from Element "i" and, if applicable, adjusts the groundwater volume and quality in the upstream element (Element "i-1") to reflect any subsurface groundwater inflow from the downstream element (Element "i") to the upstream element (Element "i-1"),

Because groundwater flow is relatively slow, the model utilizes relatively small time-step increments (8 hours) to minimizes convergence error associated with back-and-forth inter-element computations. When computations within a given time step "t" are completed for each surface water and groundwater component of the 17 model elements, the time step is advanced and the iterative process begins for the subsequent time step (t+1).

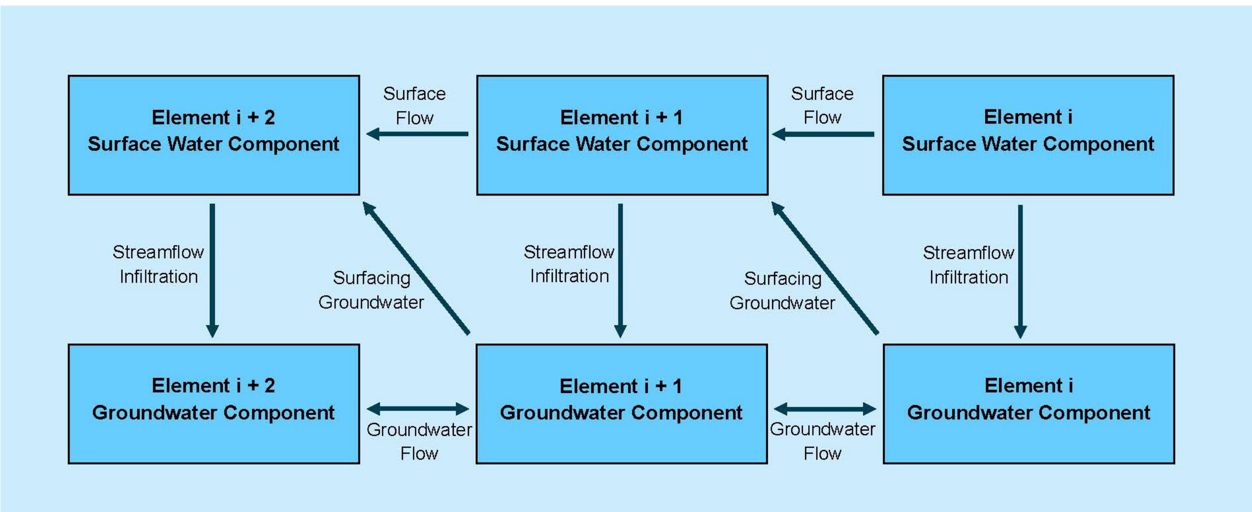


Figure 6-3 Schematic of LPLN Model Element Linkages

Key Model Assumptions. The LPLN model is based on two key assumptions. First, the model assumes a complete mix of surface waters within the surface water component of each element and complete mix of groundwaters within the groundwater component of each element. While surface waters introduced to the stream rapidly mix with ambient receiving water, *in situ* groundwater does not readily mix. As a result, such a complete-mix assumption would be inappropriate in large groundwater basins. In narrow, shallow basins (such as the San Juan Basin), however, groundwater pumping has the effect of collecting groundwater from virtually the entire depth profile of the shallow alluvial aquifer and from a zone of influence that may extend horizontally several hundred feet in radius. The quality of groundwater pumped from a given well, in effect, represents an integrated average of the quality of *in situ* groundwaters within the pumping zone.

A second key assumption is that all salt loads introduced to the ground surface of each element are assumed to instantly transport downward to saturated groundwater. In reality, significant transport lag times occur, and salts applied to the ground surface may take months or longer for a sufficient wetting event (e.g., major precipitation event) to transport salts downward through the unsaturated zone to saturated groundwater.

The effect of this assumption is that the LPLN model overestimates the effect of applied salt loads on groundwater quality during summer months (times of the year when salts are unlikely to be rapidly transported downward to saturated groundwater). During the wet season, the model may also underestimate the diluting effects of the wetting event that results in the downward salt transport. The net result is that the LPLN model may exaggerate seasonal variations in groundwater quality, while actual seasonal variations in water quality may be more dampened.

Required Input Data. The spreadsheet-based LPLN model can simulate a wide variety of land use, hydrologic, and water management conditions. Table 6-6 summarizes input data required to support the model simulations.

Table 6-6
Required Input Data for the LPLN Model

Data Category	Parameter:	
Geographic Data	▪ Mean Element width and length at ground surface [A,B] ▪ Element depth and width at depth [A,B] ▪ Mean element ground surface elevation [A]	▪ Mean element aquifer depth [A] ▪ Estimated side tributary area [A] ▪ Land use types and percent urbanized land [A]
Water Volume Data	▪ Monthly precipitation [C] ▪ Evaporation and monthly breakdown [C,D] ▪ Groundwater pumping (potable use) [A,D] ▪ Groundwater pumping (irrigation use) [A,D] ▪ Applied imported water (irrigation) [A,D] ▪ Applied recycled water (irrigation) [A,D] ▪ Applied groundwater (irrigation) [A,D]	▪ Mean irrigation efficiency for applied water ▪ Diversion capacities of groundwater barriers ▪ Artificial recharge (imported water) [A,D] ▪ Artificial recharge (surface water) [A,D] ▪ Artificial recharge (recycled water) [A,D] ▪ Septic tank flows [A] ▪ Streamflow infiltration coefficients
Water Quality Data	▪ Imported water TDS [A] ▪ Recycled water TDS [A] ▪ Coefficients for computing storm runoff TDS	▪ Septic tank TDS concentrations ▪ Applied fertilizer loads [A,D] ▪ Coefficients for computing non-storm TDS [A]

Table 6-6 Footnotes:

A Data is required on an element-by-element basis.

B The LPLN model simulates the alluvial-filled valleys of the lower portion of the San Juan Basin as having a trapezoidal cross-sectional area. Required input data include trapezoidal geometry (e.g., element widths at both the surface and at depth).

C The model accepts up to a 20-year database for precipitation, evaporation and pumping

D Includes annual data for the parameter and a month-by-month breakdown of how the parameter is distributed over the year.

Computed Model Variables. Streamflow, stream water quality, groundwater volumes and groundwater quality are computed on through an element-by-element mass-balance of nearly twenty input/output components (see Figure 6-2). Several of these input/output components are directly based on input data, such as groundwater pumping, domestic and recycled water use, septic tank discharges, and applied fertilizers. Other key input/output components are computed as functions of the input data. Table 6-7 summarizes computed variables within the LPLN Model.

Table 6-7
Key Computed Variables within the LPLN Model

Model Variable	Computed as a Function of:
Width of Streamflow	Streamflow (empirical stream morphology); Channel characteristics and flow constraints [A]
Streamflow infiltration	Depth-to-groundwater; Stream width; Soil Infiltration capacity [A]
Mean depth-to-groundwater	Mass balance of inflow/outflow; Trapezoidal-shaped saturated cross-sectional area [B]
Horizontal groundwater movement	Groundwater gradient; Hydraulic conductivity; Saturated cross-sectional area [C]
Storm runoff flow and TDS	Precipitation; Land use; Assigned side tributary area [D]
Urban runoff flow and TDS	Land Use; Precipitation; Volume of applied water and applied salt loads [E]
Streamflow and TDS	Mass balance of inflow/outflow components
Phreatophyte ET	Pan evaporation; Depth-to-groundwater; Vegetated area [F]
Non-phreatophyte ET	Pan evaporation; Depth-to-groundwater; Vegetated area [F]
Direct precipitation recharge	Precipitation; Land use [G]
Subsurface flow from element sides	Depth-to-groundwater; Assigned aquifer characteristics [H]
Geologic TDS contribution	Groundwater volume; Groundwater detention time; Assigned aquifer characteristics
Surfacing groundwater	Depth-to-groundwater [I]

Table 6-7 Footnotes:

A Streamflow Infiltration is computed as a function of an assigned infiltration coefficient (based on stream soil characteristics), computed stream width, and depth-to-groundwater. For stream sections with non-channelized sediment-filled streambeds, stream width is computed as a function of streamflow (Q_{stream}) based on empirical fluvial morphology relations for San Diego Region streams where streamflow and sediment transport create an optimal stream width for a given level of flow.

B Depth-to-groundwater is computed as a function of the volume of water stored within the basin, and assuming a trapezoidal-shaped basin cross-section defined by input trapezoidal shape-geometry.

C Horizontal upstream/downstream groundwater movement is computed using Darcy's Law, computed cross-sectional areas of subsurface flow. Computations are based linear piezometric gradients between adjoining elements.

D Storm Runoff Flows are computed as a step-function that simulates exponentially increasing runoff as a function of increasing precipitation. Runoff coefficients range from 5 percent for months with less than 1 inch of precipitation to 80 percent for months where the monthly precipitation totals exceed 6 inches. The LPLN model has been applied exclusively to narrow San Diego Region coastal basins, and runoff coefficients embedded within the LPLN model are based on historic rainfall and runoff data from San Diego Region coastal basins. Storm Runoff TDS is computed as a function of monthly precipitation where the higher the monthly precipitation, the lower the estimated storm flow TDS.

E Urban runoff flows and TDS are computed as a function of urbanized acreages, irrigated acreages and applied salt loads. Assigned urban runoff flows and salt loads are consistent with estimated values presented in the 2014 SNMP.

F Vegetation cover is estimated from 2023 Google Earth aerial photos. Pan evaporation is converted to evapotranspiration using a coefficient of 0.7.

G Direct precipitation recharge to groundwater is computed as a step-function dependent on monthly precipitation. Assumed precipitation infiltration rates range from 0.1 percent for months with less than 1 inch of precipitation to 12 percent for months where the monthly precipitation exceeds 6 inches.

H Subsurface groundwater flow from the element sides is computed as a function of input aquifer characteristics, and (consistent with Darcy's Law) is computed as a linear function of element depth-to-groundwater.

I Surfacing groundwater is assumed to occur whenever basin storage and depth-to-groundwater within a given element exceeds assigned thresholds. All stored groundwater in excess of the assigned thresholds is assumed to be lost to surface flows entering the adjoining downstream element.

Modeling Approach. As noted, the 1-dimensional LPLN model has been previously applied to similar narrow coastal basins in the San Diego Region.[43] As a result of these prior LPLN model applications to nearby coastal basins within San Diego Region, considerable information was available on the range of parameter values that yield optimal model performance. Prior model experience from these nearby basins thus provided a valuable ”head start” in assigning and refining model input parameters to optimize model performance.

With respect to the transport of groundwater, prior model applications in San Diego Region basins demonstrated the sensitivity of the LPLN model to two key sets of input parameters: hydraulic conductivity and streamflow infiltration. Because the LPLN model averages conditions within an element and assumes a linear hydraulic gradient between elements (where actual gradients are parabolic in nature), prior experience with the LPLN model has shown the need for assigning hydraulic conductivity values for San Diego Region coastal basins on the order of 20 to 25 feet per day, even though pump tests on individual wells may show hydraulic conductivity values in excess of 100 feet per day.[44] Additionally, prior model experience has shown the need to limit maximum assigned streamflow infiltration values to 0.5 to 1.5 feet per day, even though infiltration or percolation tests may determine higher values.

Assigned Input Data and Boundary Conditions. Based on this prior modeling experience, initial model runs for the lower portion of the San Juan Basin assumed a uniform hydraulic conductivity of 20 feet per day, a uniform storage coefficient of 14 percent, a uniform irrigation efficiency of 85 percent, and a maximum streamflow infiltration rate of 1.0 feet per day. Baseline conditions simulated in the initial LPLN model runs included the following groundwater pumping[45] and recycled water use volumes:

- annual potable groundwater pumping in the modeled area of 5700 AFY,
- annual irrigation (non-potable) pumping in the modeled area of 500 AFY,
- annual recycled water use in the modeled area of 1650 AFY, and
- annual recycled water use of 3500 AFY upstream from Element 1 (Oso/Trabuco basin) and 1700 AFY upstream from Element 7 (Gobernadora, Chiquita, Dove/Bell, Upper San Juan basins).

As input to the model, uniform precipitation and evaporation rates were assumed to occur throughout the modeled area, and a 20-year precipitation[46] and evaporation[47] data base of historical data (2001-2020) was applied to the modeled area (see Tables 6-8 and 6-9).

43 Nearby coastal basins where the LPLN model has been previously applied include the San Mateo Basin, San Onofre Basin, Las Pulgas Basin, and the Lower Santa Margarita River Basin (Upper Ysidora, Chappo and Lower Ysidora basins). Within these basins, the model was calibrated using one time-dependent data base and the model was verified through comparison with another time-dependent data base.

44 Since the LPLN model assumes linear hydraulic gradients (based on average depths-to-groundwater within adjoining elements), the model tends to overestimate horizontal groundwater movement. As a result, it is necessary to assign conservative hydraulic conductivity values to achieve model performance that matches observed data. Additionally, since wells are typically sited in the most productive portions of the basin, hydraulic conductivity values derived from a given well may not be representative of conditions over an entire LPLN model element (which may range from 0.1 to 0.3 square miles in size). As a result of these factors, more sophisticated models (such as the San Juan Basin 3-dimensional transport model) can achieve realistic groundwater transport performance with higher assigned hydraulic conductivity values than those assigned within the LPLN model.

45 For groundwater wells near element boundaries of the LPLN model, the pumping volume (to yield more realistic model results) is distributed among the adjoining elements rather than assigning the entire pumped volume to a single model element.

46 A 20-year monthly precipitation data base for the period 2001-2020 was applied to the mode. Precipitation data were provided by SMWD.

47 A synthetic 20-year annual evaporation data base was created based on evaporation data from nearby locations and coastal zone ET rates presented within CIMIS (2023), statistically adjusted (e.g., years of high precipitation years paired with low evapotranspiration years) to match the 20-year San Juan Basin precipitation data base from 2001-2020.

Table 6-8
Simulated Annual Precipitation and Evaporation

Year	Annual Precipitation[A] (inches)	Annual Evaporation[B] (inches)
1	16.40	57.6
2	6.79	62.7
3	13.47	57.6
4	17.31	55.4
5	20.76	55.4
6	8.86	61.7
7	5.32	66.5
8	11.68	58.9
9	7.28	61.8
10	23.10	53.1
11	9.64	61.1
12	9.37	61.1
13	5.41	66.5
14	6.91	62.7
15	6.89	62.7
16	10.52	60.9
17	11.35	58.9
18	6.91	62.7
19	21.86	53.1
20	10.45	60.9
Average	11.51	60.1
Maximum	23.10	66.5
Minimum	5.32	53.1

Table 6-8 Footnotes:

A Annual precipitation data for the period 2001-2020 provided by SMWD.

B Annual evaporation data base statistically created based on evaporation data presented by the California Polytechnic Institute (2023) statistically paired to the 20-year annual precipitation data base.

Table 6-9
Monthly Breakdown of Evaporation and Applied Water

Month	Percent of Annual Pan Evaporation [A]	Percent of Annual Applied Water [B]
Jan	4.0 %	3.1 %
Feb	4.8 %	3.6 %
Mar	7.3 %	4.1 %
Apr	9.7 %	6.4 %
May	11.3 %	9.0 %
Jun	12.2 %	10.7 %
Jul	12.6 %	11.7 %
Aug	12.0 %	12.8 %
Sep	9.7 %	12.6 %
Oct	7.3 %	10.9 %
Nov	5.2 %	8.7 %
Dec	4.0 %	6.5 %

Table 6-9 Footnotes:

A Typical average percent of annual pan evaporation that occurs during the given month in Southern California Coastal zones. Data from CIMIS (2023).

B Typical average percent of applied water that occurs during the given month. Based on water use data provided by SOCWA member agencies.

Initial model runs showed reasonable agreement between "baseline" conditions and observed data, indicating that the initially assigned hydraulic conductivity and streamflow infiltration rates resulted in stable model results with predicted depth-to-groundwater values that were generally within the observed historical range. As a test, two additional model runs were conducted: one which assumed a 50% higher hydraulic conductivity and one which assumed a 50% lower hydraulic conductivity. The test case with 50% higher hydraulic conductivity resulted in nearly no depth-to-groundwater drawdown being simulated, while the 50% lower hydraulic conductivity test resulted in the creation of excessive depths-to-groundwater. Since neither of these outcomes presented realistic results, it was evident that only minor adjustment to the initial groundwater transport input parameters were required.

These minor adjustments including adjusting hydraulic conductivities in the San Juan Creek arm (Elements 7 through 11) upward to 25 feet/day, which is consistent with observed aquifer media and historic pumping effects within this portion of the modeled area. Additionally, maximum streamflow infiltration rates in the Oso/Trabuco arm of the model (Elements 1 through 6) were adjusted downward to rates ranging from 0.3 feet per day to 0.5 feet per day to improve model performance and produce depth-to-groundwater values in keeping with observed drawdown rates. Finally, maximum streamflow infiltration rates in Elements 10 through 13 were adjusted upward to 1.5 feet per day to better reflect streambed characteristics and groundwater recharge conditions in this wider and more productive portion of the basin.

While prior experience with the LPLN model in other basins in the northern portion of the San Diego Region proved valuable in establishing groundwater transport parameters, the prior experience proved less valuable in assessing water quality-related parameters. As documented in Section 4, TDS concentrations within aquifers of the San Juan Basin are affected not only by man-induced salt loads but also salt loads derived from the geology of the basin. As a result of these geologic influences, the longer the underground detention times within the basin, the greater the geology-driven salt load. Modification of the LPLN model was required to address the unique influences of San Juan Basin geology on groundwater quality. To this end, the LPLN model was modified to simulate geology-induced salt loads for each element of the San Juan Basin as a function of groundwater storage volumes and underground detention times as follows:

$$\mathit{GGGGGGGGGGGGGGG\ SSSSGGSS\ LLGGSSLL\ (kkGGGGGGGGGkkSSkkkk\ ppGGkk\ AAAA\ ppGGkk\ SSGGkkGG\ kkSSGGpp)} = CC_{gggggggggggggg} * \frac{TT_{dddddddddddddddd}\quad d}{\mathit{tttttgg\ ssttggssss\ ssggpp\ yyggggpp}}$$

Where: $C_{geoload}$ is an assigned annual geologic salt load coefficient (kg/AF/year) where greater the value, the greater the geologic-induced salt load, and

$T_{detention}$ is the underground detention time (in years) computed as groundwater storge volume divided by the sum of groundwater outflows.

Geologic load coefficients were initially assigned based on historic groundwater TDS, under the assumption that regions with historically higher TDS concentrations were likely to be more significantly affected by geologic salt loads than areas with historically lower TDS. Salt loads from man-induced sources were estimated based on historical TDS monitoring data and salt balance data presented in the 2014 SNMP. Initial model runs indicated that the model underestimated TDS in the central portion of the basin (Elements 9 – 13). Increasing assigned geologic loads within these elements resulted in significantly improved model performance. Adjustments were also made to stormwater vs. TDS coefficients in the downstream portion of the basin to simulate the fact that storm runoff from coastal areas typically contains higher TDS than runoff from upstream areas.

Tables 6-10 through 6-12 present model input data and boundary conditions assigned after refinements and calibration of LPLN groundwater transport and water quality parameters.

Table 6-10
Assigned Geometric and Hydrogeologic Parameters for the 1-Dimensional LPLN Model
Lower 26,000 Acres of the San Juan Basin

Assigned Parameter	Model Element																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
ASSIGNED GEOMETRIC/GEOGRAPHIC CHARACTERISTICS OF ELEMENTS																	
Element width at ground surface - upstream end (feet)	1500	1600	2200	1600	1800	2800	1900	1500	2200	2200	2900	3300[A]	3100	3800	3500	3100	2200
Element width at ground surface - downstream end (feet)	1600	2200	1600	1800	2800	3300	1500	2200	2200	2900	2500	3100	3800	3500	3100	2200	3300
Mean element width at ground surface (feet)	1550	1900	1900	1700	2300	3050	1700	1850	2200	2550	2700	1250	3450	3650	3300	2650	2750
Mean element width at depth (feet)	1000	1000	1000	1000	1000	1200	1000	1000	1000	1700	1800	1900	2000	2000	2000	2000	2000
Element centerline depth of alluvium (feet)	60	70	80	90	100	110	70	80	90	100	110	120	125	125	125	125	125
Mean element length at ground surface (feet)	2000	1600	2000	2200	2100	2100	2000	2000	2200	2200	2700	3200	2700	2400	2200	2700	2600
Mean ground surface elevation above mean sea level (feet MSL)	190	170	150	135	120	105	150	135	125	115	105	90	75	60	45	40	20
Computed element surface area (acres)	71	70	87	86	111	147	78	85	111	129	167	92	214	201	167	164	164
Estimated area tributary to sides of each element (acres)[B]	400[C]	400	400	400	400	2500[D]	800[E]	650	650	700	850	1000	500	500	500	325	300
Maximum groundwater storage capacity (AF)	490	520	750	860	1110	1580	610	730	1020	1500	2150	1940	2960	2720	2340	2520	2480
ASSIGNED HYDROGEOLOGIC PARAMETERS																	
Mean hydraulic conductivity (ft/day)	20	20	20	20	20	20	25	25	25	25	25	20	20	20	20	20	20
Mean storage coefficient (percent)	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Max. subsurface inflow from element sides[F] (AF/day/1000 linear ft)	0.005	0.005	0.005	0.005	0.005	0.005	0.002	0.002	0.002	0.005	0.05	0.05	0.05	0.005	0.005	0.005	0.005

Note: Blue font indicates assigned model input parameters. Red font indicates values computed within the model based on assigned input parameters.

Table 6-10 Footnotes:

- A Element 12 width at boundary with Element 6 is 3300 feet. Element 12 width at boundary with Element 11 is 2500 feet.
- B Watershed area tributary to side boundaries of each element. Does not include watershed area tributary to the upstream boundary of the element.
- C Watershed area tributary to the side boundaries of Element 1 is 400 acres. Area of Oso Basin that is upstream from Element 1 is 29,500 acres. Of this 29,500-acre watershed, approximately 3000 acres are downstream from the Oso Barrier. The Oso Barrier is assumed to capture 100 percent of the urban and non-storm runoff from the upstream area, but none of the storm runoff.
- D Watershed area tributary to the side boundaries of Element 8 is 2500 acres. Area of Trabuco Creek basin that is downstream from the Trabuco Creek barrier is 250 acres. The Trabuco Creek Barrier is assumed to capture 100 percent of the urban and non-storm runoff from the upstream area, but none of the storm runoff.
- E Watershed area tributary to the side boundaries of Element 7 is 800 acres. Area of San Juan Creek watershed upstream from Element 7 is 66,500 acres.
- F Subsurface inflow from element side boundaries is assigned as a function of depth-to-groundwater within the element. Maximum subsurface inflow from element sides occurs under conditions where the depth-to-groundwater in the element is greater than 20 feet. Subsurface inflow from element sides is assumed at zero for element depth-to-groundwater of less than 8 feet. Subsurface inflow from side tributary areas is linearly proportioned for element depths-to-groundwater between 8 and 20 feet.

Table 6-11
Assigned Streamflow Infiltration and Water Quality Parameters for the 1-Dimensional LPLN Model
Lower 26,000 Acres of the San Juan Basin

Assigned Parameter	Model Element																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
STREAMFLOW INFILTRATION PARAMETERS																	
Depth-to-water above which no streamflow infiltration occurs[A] (ft)	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Depth-to-water below which max streamflow infiltration occurs[B] (ft)	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Maximum streambed infiltration rate (feet/day) [B]	0.3	0.3	0.3	0.5	0.3	0.3	0.5	0.5	0.5	1.5	1.5	1.5	1.5	1	0.3	0.3	0.3
Infiltration rate curve reduction coefficient 'R_i' [C]	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Maximum width of stream within non-erodible banks (feet)	60	75	100	100	50	50	100	100	125	125	125	125	125	125	125	125	125
Stream width empirical coefficient 'A' [D]	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Stream width empirical coefficient 'B' [D]	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Stream width empirical equation coefficient 'k' [D]	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
WATER QUALITY PARAMETERS																	
TDS concentration of potable (M&I) water supply (mg/L)	475	475	475	475	475	475	475	475	475	475	475	475	475	475	475	475	475
TDS concentration of recycled water supply (mg/L) [E]	950	950	950	950	950	950	950	950	950	950	950	1000	1000	1100	1200	1200	1200
TDS of groundwater from element sides (mg/L) [F]	1400	1400	1400	1500	1400	1000	1000	1000	1000	1500	2000	2000	2000	1500	2000	2500	3000
TDS of urban runoff from side tributary areas (mg/L) [F]	1200	1200	1200	1200	1200	950	950	950	1000	1500	1500	1500	1500	1500	1500	1500	1500
Applied fertilizer (pounds/year per acre or irrigated land)	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Percent of applied salts that leach to groundwater (percent) [G]	70%	70%	70%	70%	70%	70%	60%	60%	70%	70%	70%	70%	70%	70%	70%	70%	70%
Percent of applied fertilizer that leaches to groundwater (percent) [G]	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Flow vs. TDS curve coefficient, 'A' [H]	1000	1000	1000	1000	1000	950	950	950	900	1000	1200	1300	1300	1300	1400	1400	1400
Flow vs. TDS curve coefficient, 'B' [H]	400	400	400	400	400	350	500	500	600	650	650	650	650	650	650	650	650
Flow vs. TDS curve coefficient, 'C' [H]	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Salt load increase due to geologic leaching (kg/AF/year) [F]	10	25	50	100	100	50	50	50	100	300	300	300	250	50	50	50	25

Note: Blue font indicates input parameters.

Table 6-11 Footnotes:

A Streamflow infiltration is computed as a function of depth-to-groundwater. Since the stream thalweg is typically 5-10 feet below the assigned mean surface elevation of the element, no streamflow infiltration is assumed to occur when depth-to-groundwater is above listed depth-to-groundwater threshold (D_{min}).

B The maximum streamflow infiltration rate (I_{max}) is assumed to occur when depth-to-groundwater is below the listed depth-to-groundwater threshold (D_{max}).

C For depths-to-groundwater (DTGW) between the minimum (D_{min}) and maximum (D_{max}) thresholds described in footnotes 1 and 2, streamflow infiltration computed as:

$$IIIIIIGGGGSSkkSSSSGGGII\ RRSSSSGG = II_{ttggmm} * \{1 - GG^{\frac{-(DDDDDDD - DD_{mmdddd})(DDDDDDDD - DD_{mmdddd})}{DD_{mmmmmm} * R_i}}\}$$

where R_i is the assigned infiltration reduction coefficient.

D Within sediment-filled channels, stream width is computed as a function of streamflow (Q in cfs) using empirical fluvial morphology relations developed by Dr. Gary Guymon (see NBS/Lowry (1994), as follows:

$$SSSSkkGGSSkk\ wwGGLLSSh\ (IISS) = AA * QQ^{kk} * (1 + \frac{BB}{QQ})$$

[subject to the constraint that stream width is not to exceed the listed maximum non-erodible channel width]

E Due to inflow and infiltration from saline coastal groundwater, TDS in recycled water supplies developed in coastal areas tends to be higher than recycled water TDS concentrations in inland areas.

F Estimated based on historical groundwater quality in the vicinity of the listed element.

G Estimated percent that leaches to saturated groundwater. The remaining percent is leached to surface water and contributes to TDS loads in storm and non-storm runoff.

H TDS concentrations in storm runoff are estimated as a function of flow (Q in cfs) and assigned constants A, B and C. Higher streamflow results in lower TDS concentrations, as follows:

- $SSSSGGkkkkIIGGGGww\ TTTTSS = AA - \{(AA - BB) * GG^{-\frac{CC}{QQ}}\}$

Table 6-12
Assigned Recharge/Discharge Parameters, Initial Conditions and Boundary Conditions for the 1-Dimensional LPLN Model
Lower 26,000 Acres of the San Juan Basin

Assigned Parameter	Model Element																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
RECHARGE/DISCHARGE PARAMETERS																	
Applied water irrigation efficiency (percent)	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
Mean annual applied water application rate (feet/year)	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Area of valley floor covered by non-irrigated non-phreatophytes (acres)[A]	20	20	20	20	10	10	10	15	15	15	15	15	10	10	3	3	3
Area of valley floor covered by phreatophytes (acres) [B]	9	8	10	10	6	3	8	8	13	19	20	11	11	10	2	2	2
Percent of land irrigated by M&I supply (percent) [C]	15%	16%	15%	10%	12%	8%	10%	10%	10%	12%	15%	15%	15%	15%	15%	15%	15%
Percent of land urbanized within element and side tributary area (%) [C]	30%	50%	50%	55%	55%	40%	20%	35%	50%	55%	60%	70%	70%	75%	80%	80%	80%
Depth-to-groundwater above which surfacing groundwater occurs (ft) [D]	8	8	8	8	8	8	8	8	8	8	8	8	8	8	6	5	5
ASSIGNED INITIAL CONDITIONS																	
Mean initial element depth to groundwater at time t = 0 (feet)	20	20	20	20	20	20	20	20	15	15	15	20	20	15	15	15	10
Initial groundwater in storage at time t = 0 (AF)	300	340	520	630	820	1190	400	510	800	1240	1800	1680	2380	2310	2000	2180	2250
Initial groundwater total dissolved solids (TDS) at time t = 0 (mg/L) [E]	1750	1775	1800	1800	1825	1850	1200	1300	1400	1600	1800	2000	1750	1500	1750	2000	2000
ASSIGNED BOUNDARY CONDITIONS																	
Constant head at upstream end of elements (feet above MSL)	190[F]	---	---	---	---	---	150[G]	---	---	---	---	---	---	---	---	---	---
Constant head boundary at downstream end of element (ft above MSL)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0[H]

Note: Blue font indicates input parameters. Red font indicates computed values based on input parameters.

Table 6-12 Footnotes:

A Includes vegetation with roots depths of less than 8 feet that can utilize groundwater from the unsaturated zone only when depth-to-groundwater is within 10 feet of the ground surface.

B Phreatophytic vegetation is assumed to have root depths capable of utilizing groundwater when the water table is within 35 feet of the ground surface. A decay function is used to simulate a linear reduction in phreatophytic evapotranspiration as the depth-to-groundwater approaches the 35-foot phreatophytic root zone threshold.

C Estimated from aerial photographs of the watershed.

D Since the stream thalweg is typically 5-10 feet below the assigned mean surface elevation of the element, surfacing groundwater is assumed to occur when depth-to-groundwater is above the listed threshold.

E Assigned based on groundwater quality monitoring data presented in the 2014 SNMP.

F Elevation of constant head boundary condition assigned upstream from Element 1. Corresponds to a depth-to-groundwater of 20 feet.

G Elevation of constant head boundary condition assigned upstream from Element 7. Corresponds to a depth-to-groundwater of 20 feet.

H Elevation of constant head boundary condition assigned downstream from Element 17. Corresponds to a depth-to-groundwater of zero (sea level).

Table 6-13 summarizes key mathematical elements used to compute terms within the LPLN model.

Table 6-13
Computational Methodology for LPLN Input Terms

Model Input Term	Basis for Computation
Runoff coefficient Percent of precipitation falling on a given model element that runs off to surface streamflow	Estimated as a step-function of monthly precipitation as follows: 80% if monthly precipitation > 6 inches 65% if monthly precipitation is 5-6 inches 50% if monthly precipitation is 4-5 inches 35% if monthly precipitation is 3-4 inches 20% if monthly precipitation is 2-3 inches 10% if monthly precipitation is 1-2 inches 5% if monthly precipitation is < 1 inch
Percent of precipitation falling on a given model element that directly percolates to saturated groundwater	Estimated as a step-function of monthly precipitation as follows: 12% if monthly precipitation > 6 inches 10% if monthly precipitation is 5-6 inches 7% if monthly precipitation is 4-5 inches 5% if monthly precipitation is 3-4 inches 3% if monthly precipitation is 2-3 inches 2% if monthly precipitation is 1-2 inches 0.1% if monthly precipitation is < 1 inch
Stream evaporation	Taken as 0.7 multiplied by the input pan evaporation rate, multiplied by the stream segment length and computed stream width (See Table 6-11 for computation methodology for computing stream width)
Salt load from geologic leaching	Assigned (see Table 6-11) on an element-by-element basis in terms of kg/AF/year to simulate geologic salt loads as a function of underground hydraulic detention time
Groundwater Uptake by Phreatophytes	Phreatophyte roots are assumed to extend to depths of 35 feet. Groundwater uptake by phreatophytes is computed as a function of depth-to-groundwater using an assigned exponential decay coefficient to simulate reduced ET with increasing depth-to-groundwater. Zero phreatophyte uptake is assumed to occur when depth-to-groundwater exceeds 35 feet.
Groundwater Uptake by Non-phreatophytes	When depth-to-groundwater values are within 8 feet of the ground surface, it is assumed that saturated groundwater can be accessed by the roots of non-phreatophytes. Non-phreatophyte uptake is computed as a function of depth-to-groundwater using an assigned decay coefficient to simulate reduced ET with increasing depth-to-groundwater. Zero non-phreatophyte uptake is assumed to occur when depth-to-groundwater exceeds 8 feet.
Underground inflow to alluvium from side tributary areas	Maximum side infiltration rate assigned in Table 6-10 is simulated to occur when element depth-to-groundwater values exceed 20 feet. The side tributary value is linearly adjusted as a function of depth-to-groundwater to where zero side infiltration is assigned if depth-to-groundwater is less than 8 feet (e.g., insufficient hydraulic gradient to induce side tributary inflow).

6.4 Simulation of Baseline Conditions in the Lower San Juan Basin

Parameters presented in Tables 6-10 through 6-12 were applied to the LPLN model to assess baseline simulated groundwater conditions for the 20-year data base of precipitation/evaporation.

Simulated Depth-to-Groundwater. Figure 6-4 presents simulated depth-to-groundwater along the San Juan Creek arm of the Y-shaped modeled area. Figure 6-5 presents simulated depth-to-groundwater along the Oso/Trabuco Creek arm of the modeled area. The model simulates depth water as varying both by season (lower groundwater table elevations during summer months of peak pumping) and by long-term hydrologic conditions. Depths-to-groundwater were generally simulated as ranging from 10 to 30 feet below the ground surface.

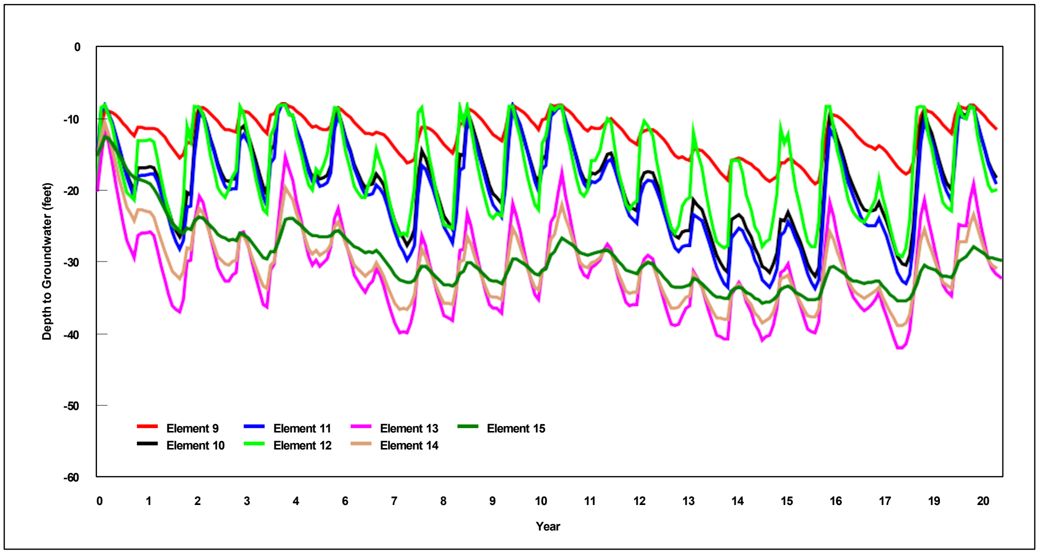


Figure 6-4 Simulated Depth-to-Groundwater under Baseline Conditions - San Juan Creek Arm

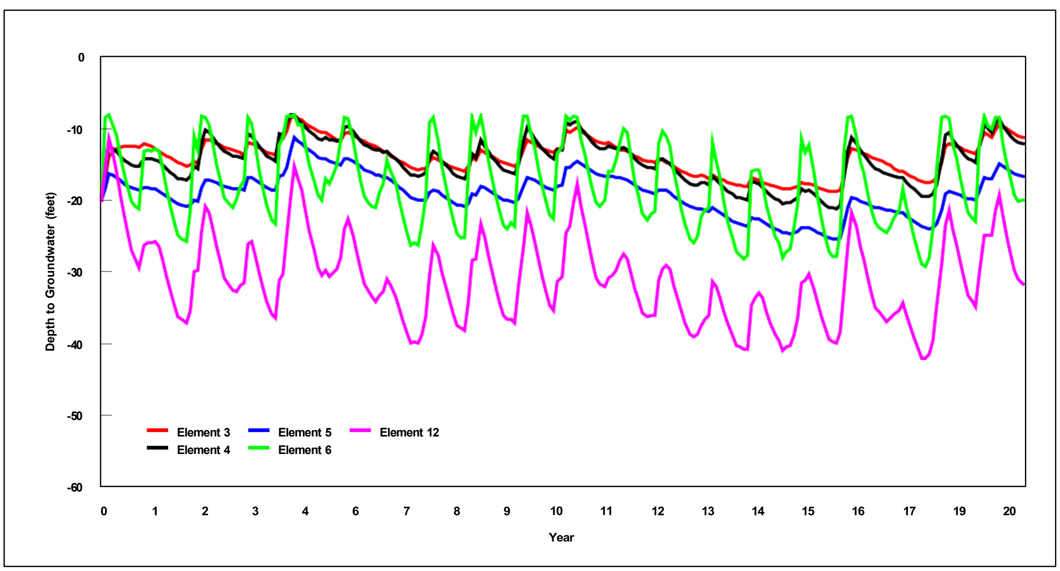


Figure 6-5 Simulated Depth-to-Groundwater under Baseline Conditions – Oso/Trabuco Creek Arm

Figures 6-6 and 6-7 present simulated groundwater table elevations for the 20-year baseline period. For comparison, the figures also show unpublished groundwater table elevations predicted by the SJBA 3-dimensional transport model which are representative of observed groundwater table elevations during this period near pumping wells.[48] Because the LPLN model simulates mean groundwater table elevations over the geographic extent of each element, the LPLN model does not reflect drawdown conditions associated with individual pumping wells. As a result, it would be expected that the LPLN model (which assesses average depth-to-groundwater within each element) would simulate consistently higher groundwater table elevations than would be observed near pumping wells or pumping fields. Accounting for this effect, reasonable agreement occurs between groundwater table elevations simulated by the 1-dimensional LPLN model and the 3-dimensional SJBA transport model (which are representative of observed groundwater table data).

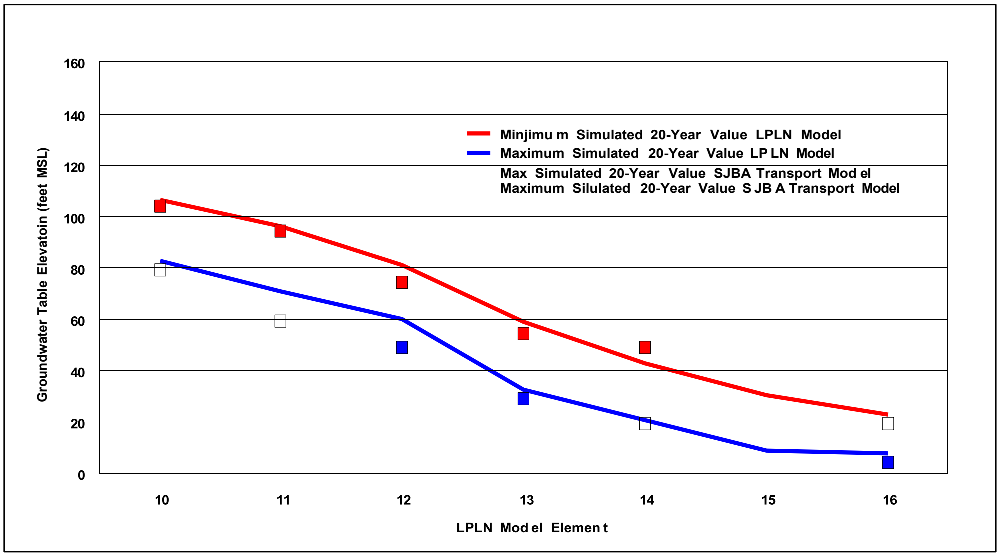


Figure 6-6 Simulated Groundwater Table Elevations, 2000-2020 - San Juan Creek Arm

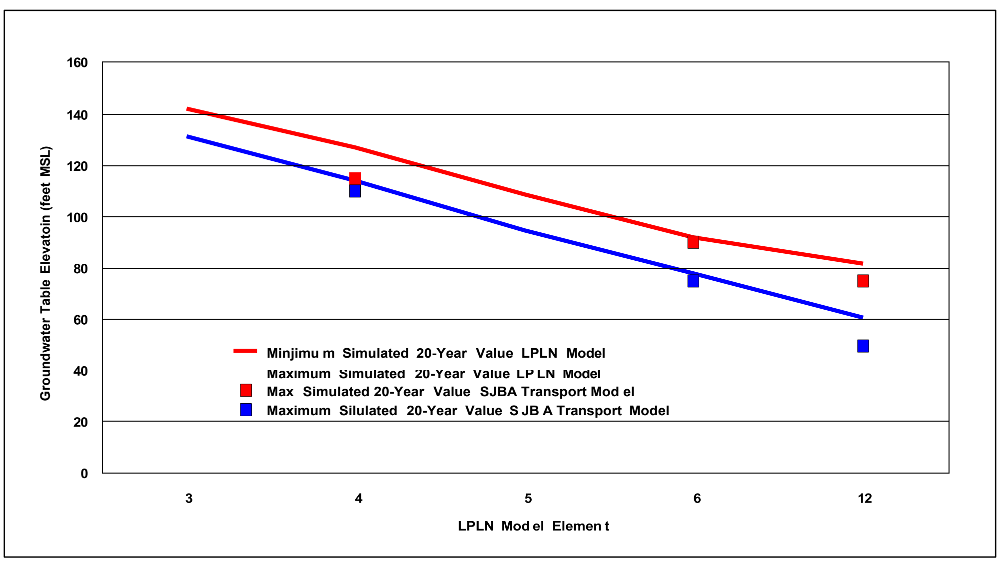


Figure 6-7 Simulated Groundwater Table Elevations. 2000-2020 – Oso/Trabuco Creek Arm

48 Unpublished model results and input data for the 3-dimensional SJBA model were provided to SOCWA by SMWD and West Yost (2023).

Simulated Groundwater TDS Concentrations. Figures 6-8 and 6-9 present simulated groundwater TDS concentrations under the 20-year baseline period. Both seasonal and long-term variations in groundwater TDS concentrations are simulated. As noted, the LPLN model assumes all salt loads immediately affect groundwater quality, so the model would tend to exaggerate seasonal variations in groundwater TDS. As shown in the figures, groundwater TDS concentrations are simulated as typically ranging from 1500 to 2000 mg/L in the central portion of the modeled area.

For comparison, the Basin Plan groundwater TDS concentration objective in the Ortega Basin (Elements 7-11 within the San Juan Creek arm of the modeled area) is 1100 mg/L. The Basin Plan groundwater TDS concentration objective in the Lower San Juan Basin (Elements 4-6 of the Oso/Trabuco arm and Elements 12-17 of the San Juan Creek arm of the model area) is 1200 mg/L. Recycled water used by SOCWA member agencies in these areas contains TDS concentrations that are lower than the corresponding Basin Plan groundwater quality objectives.

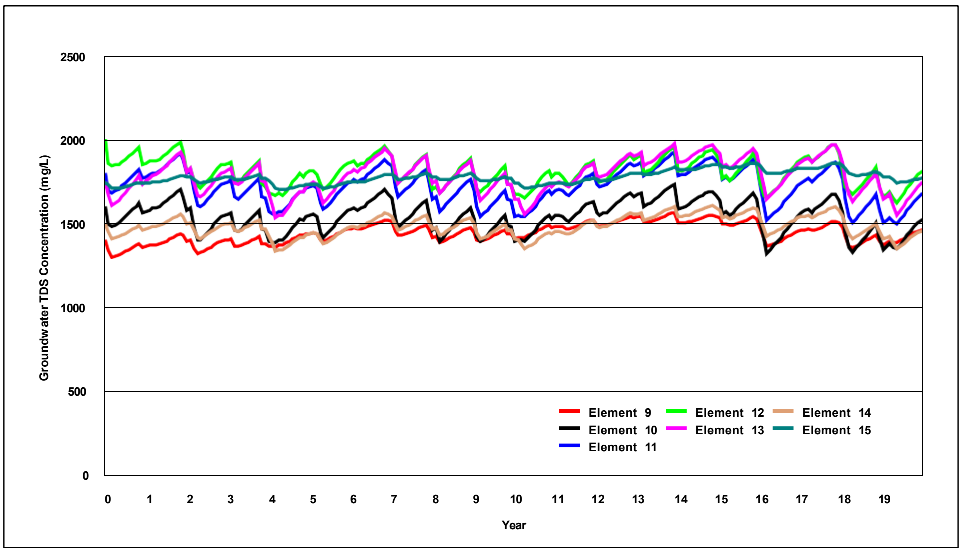


Figure 6-8 Simulated Groundwater TDS Concentrations – San Juan Creek Arm

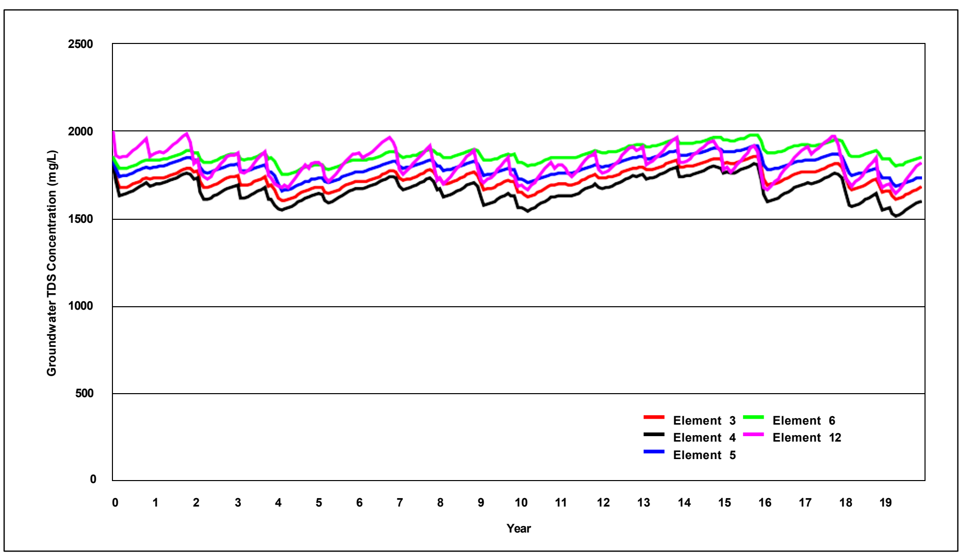


Figure 6-9 Simulated Groundwater TDS Concentrations – Oso/Trabuco Creek Arm

Figures 6-10 and 6-11 compare simulated groundwater TDS concentrations with observed TDS concentrations for the 20-year simulation period. As shown in the figures, reasonable agreement occurs between simulated average groundwater TDS concentrations and observed TDS concentrations. At noted, the LPLN model probably overstates seasonal variations in TDS concentrations due to the model assumption of instantaneous salt loading. For comparison, Figure 6-12 presents mean groundwater TDS concentration contours as reported in the 2014 SNMP. Highest concentrations occurred near the confluence of Oso, Trabuco and San Juan Creeks, which may be due to (1) higher geologic salt loads in this vicinity, and (2) the poor quality of non-storm runoff that occurs during mid-year and fall months when pumping creates the greatest opportunity for recharge.

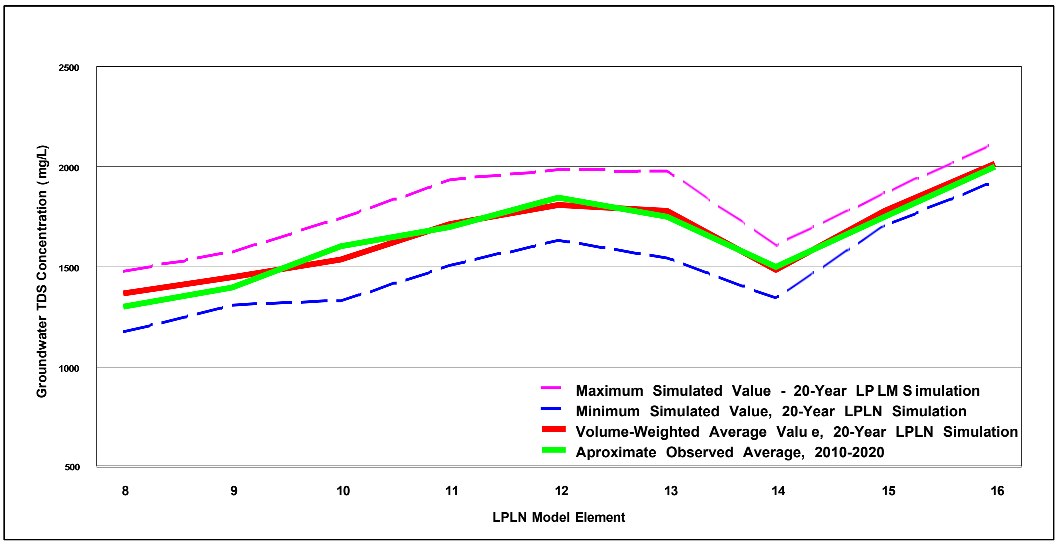


Figure 6-10 Simulated vs. Observed Groundwater TDS Concentrations in the 2000s– San Juan Creek Arm

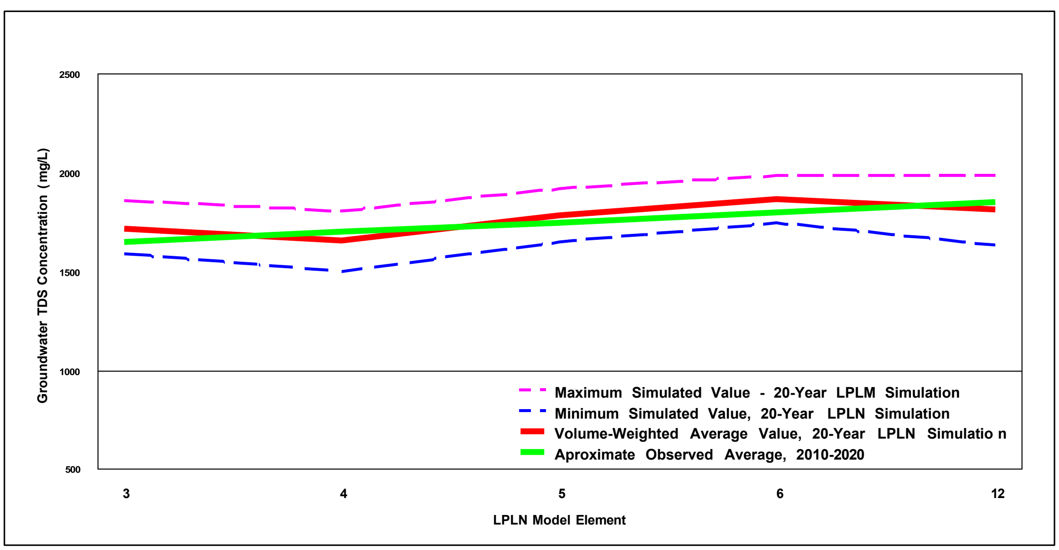


Figure 6-11 Simulated vs. Observed Groundwater TDS Concentrations in the 2000s– Oso/Trabuco Creek Arm

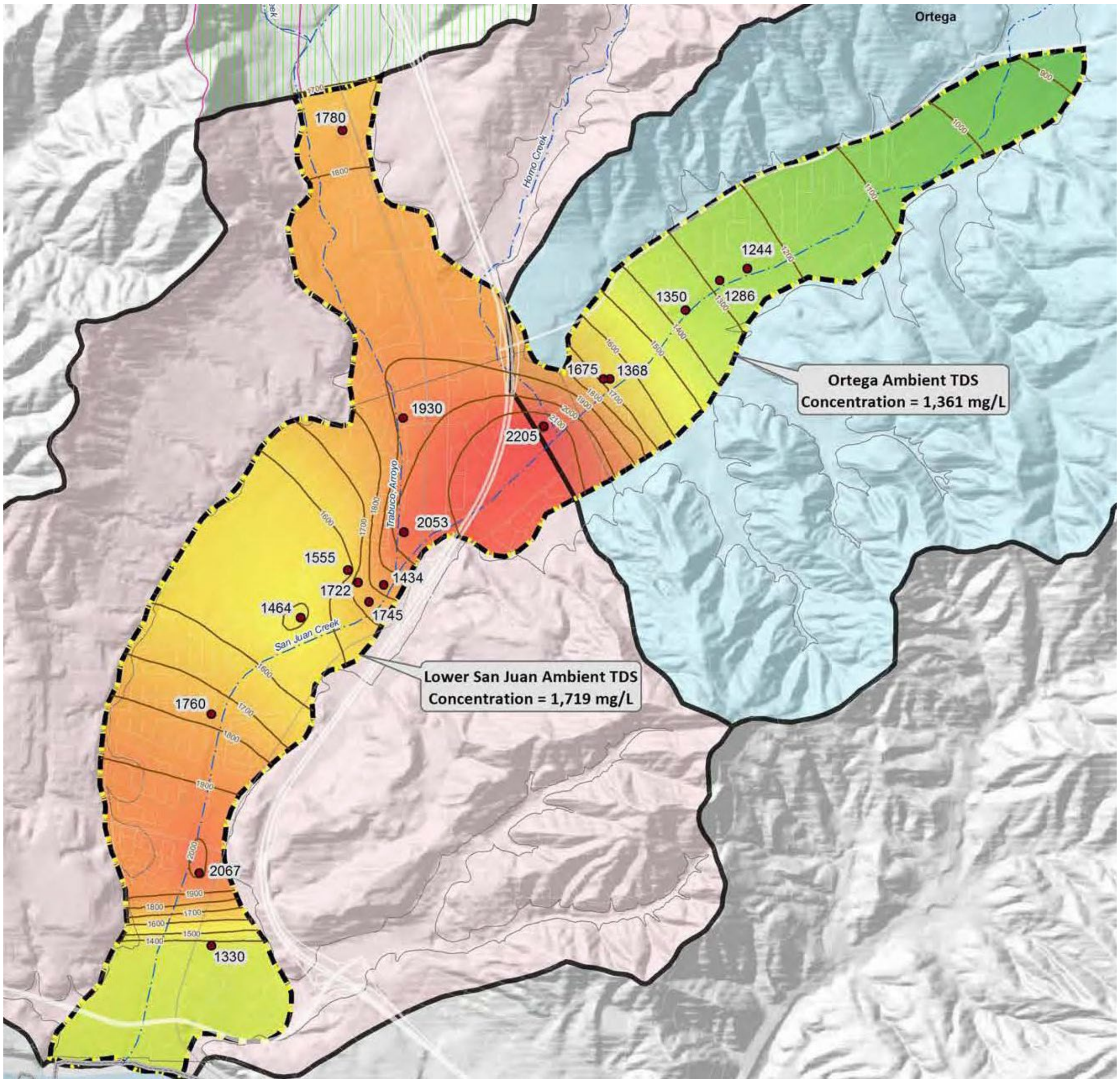


Figure 6-12 Groundwater TDS Concentrations in the Lower San Juan Basin (from the 2014 SNMP)

Simulated Surface Water Flows. Figures 6-13 and 6-14 respectively present average monthly simulated streamflow for the 20-year simulation period at the upstream reach of San Juan Creek (Element 7) and the downstream reach (Element 13). As shown in the figures, streamflow in the modeled area is highly variable, which is consistent with historical data and observations. Most of the streamflow volume during the 20-year simulation period (2001-2020) occurs during a few high precipitation events. During lengthy periods of no precipitation, non-storm streamflows in Oso Creek and Trabuco Creek are typically less than 1 cubic foot per second (cfs). During storm months, however, monthly average streamflows in the lower reaches of San Juan Creek are simulated as exceeding 200 cfs during 15 months of the 240-month simulation period. Since streamflow infiltration is a significant source of overall recharge to alluvial groundwater aquifer, seasonal and long-term hydrologic cycles would be expected to cause significant variability in the volume and quality of San Juan basin groundwater.

Simulated San Juan Creek flows are approximately 35 percent higher in the downstream portion of the model area compared to the upstream portion. Much of this increase results from surface runoff flowing into San Juan Creek from the Oso/Trabuco Creek watersheds.

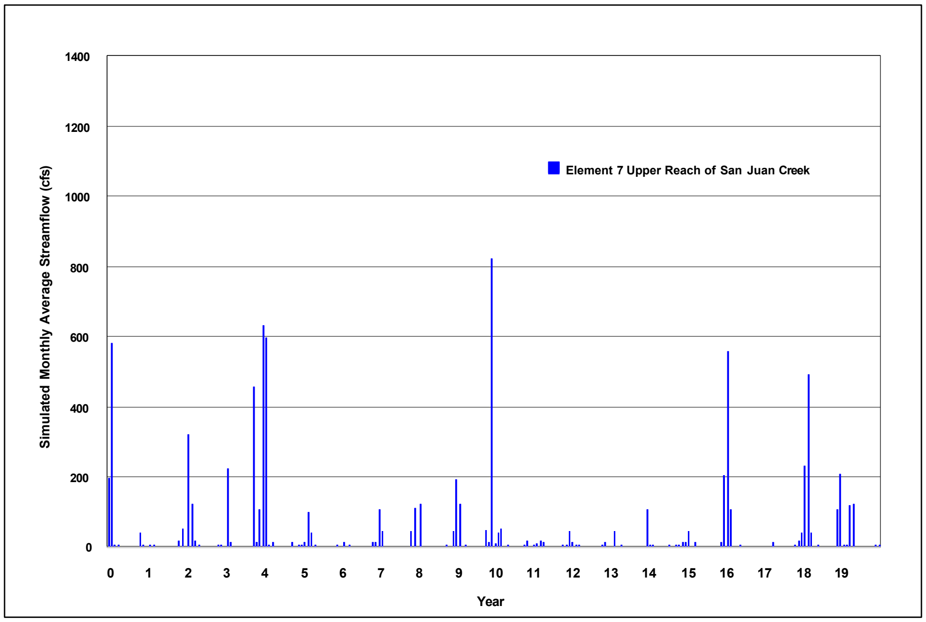


Figure 6-13 Simulated Streamflow at Element 7 (Upstream Reach of San Juan Creek)

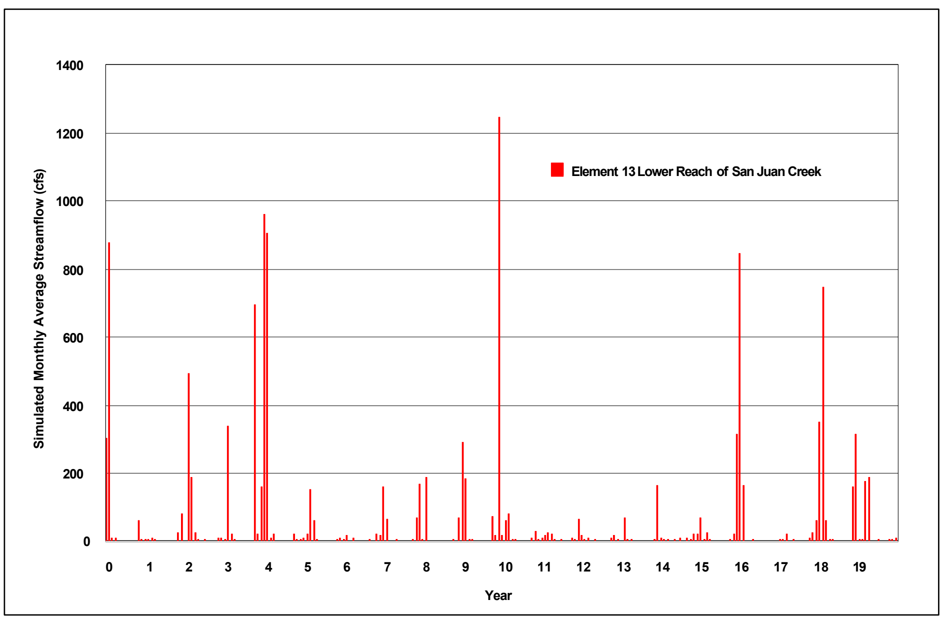


Figure 6-14 Simulated Streamflow at Element 13 (Downstream Reach of San Juan Creek)

Within the LPLN model, streamflow infiltration is largely dependent on the infiltration rate, which is assigned based on visual observation of soil characteristics. The computed width of streamflow is also important in influencing simulated streamflow infiltration, but stream width within the LPLN model is computed using an empirical geomorphological equation that dampens out the influence of streamflow (e.g., doubling the streamflow flow may result in only a small increase in simulated stream width and streamflow infiltration). As a result, the quantity of simulated streamflow infiltration is more dependent whether streamflow is occurring than the specific streamflow volume. Additionally, significant interchange between ground and surface water can occur within the San Juan Creek Basin. Observed streamflow at one location on San Juan Creek may not necessarily be representative of streamflow at an upstream or downstream location. As a result of these factors, depth-to-groundwater is a significantly more important calibrating parameter for the LPLN model than streamflow.

While streamflow is not a key calibration parameter for the LPLN model, comparing simulated LPLN streamflow values to observed streamflow values is useful as an overall indicator of LPLN model performance. As noted, the only current streamflow gaging stations in the San Juan Basin is located on San Juan Creek at the La Novia Bridge (USGS Station No. 11046530), upstream from the confluence with Oso and Trabuco Creeks. Streamflow data are available from this gaging location since 1985.[49]

Wet Weather Simulated Streamflow. As documented in Section 4.3, highest observed San Juan Creek monthly average streamflow at Station 11046530 during 1985-2023 was 816 cfs – a value (see Figure 6-13) almost identical to the maximum simulated monthly average streamflow projected for the 20-year period that is statistically similar to hydrologic data from the 1985-2023 period. As also documented in Section 4.3, the 1985-2023 period featured:

- two occasions when observed monthly average San Juan Creek streamflow exceeded 600 cfs,
- four occasions when observed monthly average streamflow exceeded 500 cfs,
- seven occasions when observed monthly average streamflow exceeded 300 cfs, and
- ten occasions when observed monthly average streamflow exceeded 200 cfs,

As shown in Figure 6-13, the number of occasions when high monthly average wet weather streamflows are simulated during the 20-year synthetic hydrologic period are reasonably consistent with the observed number of occasions when similar monthly average streamflows were observed. Overall, while the LPLN model is developed to focus on groundwater occurrence and quality, the model appears to perform well in evaluating monthly average streamflow under wet weather conditions. This occurs both in terms of accurately predicting peak monthly average flows and in predicting the statistical frequency of such flows.

Dry Season Simulated Streamflow. During 1985-2023, 90 percent of the monthly average San Juan Creek streamflow during June through November (dry season months) were less than 3.0 cfs. Monthly average dry weather streamflows during the 20-year LPLN modeling period were also simulated as almost always between zero and 3.0 cfs – values that are consistent with the observed summer values from 1985-2023 streamflow gaging record. It is concluded that simulated dry season streamflows projected by the LPLN model are consistent with the observed streamflow gaging records from USGS Station 11046530 at the La Novia Street bridge.

Simulated Surface Water TDS Concentrations. Streamflow TDS concentrations are simulated as being highly variable. The lowest monthly average TDS concentrations (of approximately 400 mg/L) are simulated as

[49] As reported by the U.S. Geological Survey (2024) for the San Juan Creek at San Juan Capistrano gage (No. 11046500). The La Novia Steet Bridge gaging station is located approximately at the boundary of Elements 11 and 12 (see Figure 6-1 on page 6-13)

occurring during months with high precipitation. Highest TDS concentrations (1500 mg/L) are simulated as occurring during extended periods with no precipitation where surface flows consist of urban runoff and direct or indirect runoff from irrigated lands. Simulated monthly average stream TDS concentrations (storm plus non-storm) ranged from 820 mg/L in the upstream portions (Element 7) to 1200 mg/L in the downstream portions (Elements 12-17). Overall, the range of TDS concentrations simulated within the LPLN model are consistent with streamflow water quality estimates presented in the 2014 LPLN.[50]

6.4 LPLN Modeling Conclusions - Baseline Conditions. Prior modeling experience with the LPLN model in other similar narrow coastal basins in the north portion of the San Diego Region was valuable in establishing and refining LPLN model input parameters.[51] Based on this prior LPLN modeling experience and salt load data and estimates presented in the 2014 SNMP, it was possible to refine model input parameters and salt load estimating algorithms to achieve reasonable agreement with recent historical data.

The LPLN model meets the requirements of the Recycled Water Policy that salt loads and "transport" be evaluated as part of the SNMP. Under the baseline conditions, the 1-dimensional LPLN model results provide reasonable agreement with:

- observed depth-to-groundwater data and trends in depth-to-groundwater during 2001-2020,
- depth-to-groundwater projections simulated for 2001-2020 by the SJBA 3-dimensional model, and
- observed groundwater TDS concentrations.

While an additional data base (other than the 20-year 2001-2020 simulation) period will be necessary to verify model results and LPLN computational algorithms, the LPLN transport model appears suited for use as an initial planning tool for assessing potential water quality trends associated with San Juan Basin management strategies and identifying monitoring data required to support future SNMP updates.

Evaluation of Water Management Alternatives. As documented in Section 5, SOCWA member agencies are planning (or considering) a range of potential water management strategies within the San Juan Basin including, in part:

- water supply strategies, including treatment of water supplies and/or expansion of groundwater withdrawals to improve the quality of applied water and recycled water,
- expansion of recycled water use to replace the existing use of potable supplies, and
- groundwater management strategies, including increasing basin recharge through stormwater recharge, potable water recharge or recycled water recharge.

[50] The 2014 SNMP assumed urban runoff salt loads at 400 pounds per acre per year throughout the San Juan Basin. The LPLN model assigns urban runoff loads on an element-by-element basis. This allows the LPLN model to simulate urban runoff in the lower portion of the modeled area as having higher TDS concentrations than urban runoff in the upstream portion of the modeled area. This model feature was designed to simulate effects associated with the denser nature of the urbanized portion of the modelled area compared to the less dense nature of the urbanized portion of the upstream portion of the modeled area.

[51] As noted, this prior experience demonstrated the need to assign conservative hydraulic conductivity values to achieve realistic simulation of depth-to-groundwater and groundwater TDS. It was necessary to assign hydraulic conductivity within the LPLN model that are lower than those used in the SJBA 3-dimensional model as (1) the LPLN elements are larger in size, (2) the LPLN model assumes homogeneous conditions within each element, and (3) the LPLN model computes groundwater movement between elements based on linear hydraulic gradients between adjoining elements and mean groundwater table elevations within each element.

Table 6-14 summarizes water management projects currently planned by SOCWA member agencies. Table 6-14 also categorizes the projects into four water management scenarios. SOCWA member agencies are in the process of implementing Management Scenarios 1, 2 and 4. The 1-dimensional LPLN model is applied to assess each of these management scenarios and evaluate the degree to which the strategies may affect groundwater quality. The following three combinations of management scenarios are simulated:

- Management Scenario 1 vs. Baseline Conditions
- Management Scenarios 1 and 2 vs. Baseline Conditions
- Management Scenarios 1, 2 and 4 vs. Baseline Conditions

At present, it is not certain whether Management Scenario 3 (recycled water groundwater recharge) can be implemented within the 5-year planning window of this SNMP. Additionally, implementation of this management strategy will require special study to address requirements of the SWRCB Division of Drinking Water. As a result, evaluation of Management Scenario 3 is reserved for a future update of this SNMP.

Table 6-14
Planned Water Management Strategies within the San Juan Basin

Management Scenario	Type of Management Strategy [A]	Project and Implementing Agency	Modeled Scenario
1	Water Quality Improvement	SMWD Ranch Filtration Plant SCWD Doheny Ocean Desalination Project	• Potable water concentration reduced by 25 mg/L • Recycled water concentrations reduced by 25 mg/L • Groundwater supply to the SMWD Ranch Filtration plant will be derived from wells upstream from Element 7
2	Enhanced Recharge & Expanded Recovery	San Juan Watershed Project Phase 1 [B]	• 700 AFY recharge of surface flow recharged to Trabuco/San Juan Creeks via rubber dams • Assumes 1000 AFY of add'l pumping from model area
3	Enhanced Recharge & Expanded Recovery	San Juan Watershed Project Phase 2 [C]	• 1000 AFY add'l recharge of surface flow recharged to Trabuco/San Juan Creeks via rubber dams • 3000 AFY of recycled water recharged to the Lower San Juan Creek basin • Assumes 4000 AFY of add'l pumping from model area
4	Expanded Recycled Water Use	Increase recycled water use within the San Juan Basin	• Increase recycled water use by 500 AFY in the model area • Increase recycled water use by 4500 AFY in upstream areas

Table 6-14 Footnotes:

A See Section 5 for a description of San Juan Basin water management strategies.

B Phase 1 of the San Juan Watershed Project involves the use of rubber dams to enhance groundwater recharge using surface flows

C Phase 2 of the San Juan Watershed Project involves providing supplemental groundwater recharge using both surface water and recycled water

Evaluation of Water Management Alternative 1. Management Scenario 1 addresses planned changes in potable supply, which includes bringing the SCWD Seawater Desalination Project and the SMWD Ranch

Filtration Plan online.[52] The SCWD Doheny Ocean Desalination Project will provide high quality potable supply to a downstream portion of the LPLN model area. The SMWD Rancho Filtration Plant will provide two key water management benefits. First, the facility will improve the quality of potable supply served within a significant portion of the SMWD service area within the Lower Basin. Second, the project will withdraw and treat poor quality groundwater, providing opportunity for the introduction of better-quality recharge to the basin.

Under Management Scenario 1, TDS concentrations in potable water supplies are likely to be slightly reduced. To simulate this effect, under Management Scenario 1 it is assumed that TDS concentrations in both potable and recycled water supplies will be reduced by 25 mg/L. Groundwater for the Ranch Filtration Plant will be derived from wells upstream from Element 7 of the LPLN model. To simulate effects of this withdrawal withing the modeled area, boundary conditions for Element 7 of the LPLN model are adjusted to account for this increased pumping.

Figures 6-15 and 6-16 present the results of LPLN model groundwater quality simulations for Management Scenario 1. The figures also compare the Management Scenario 1 results with baseline conditions (e.g., no implementation of the management strategies). As shown in the figures, the implementation of Management Scenario 1 is projected to have only a small effect on groundwater TDS concentrations. The limited magnitude of this effect is in keeping with salt balance projections presented in the 2014 SNMP under which salt loads from applied water and applied recycled water represented only a portion of the total basin salt load. The LPLN modeling results (and salt load projections presented in the 2014 SNMP) indicate that significant reductions in potable supply TDS concentrations would be required to achieve any meaningful reduction in groundwater TDS.

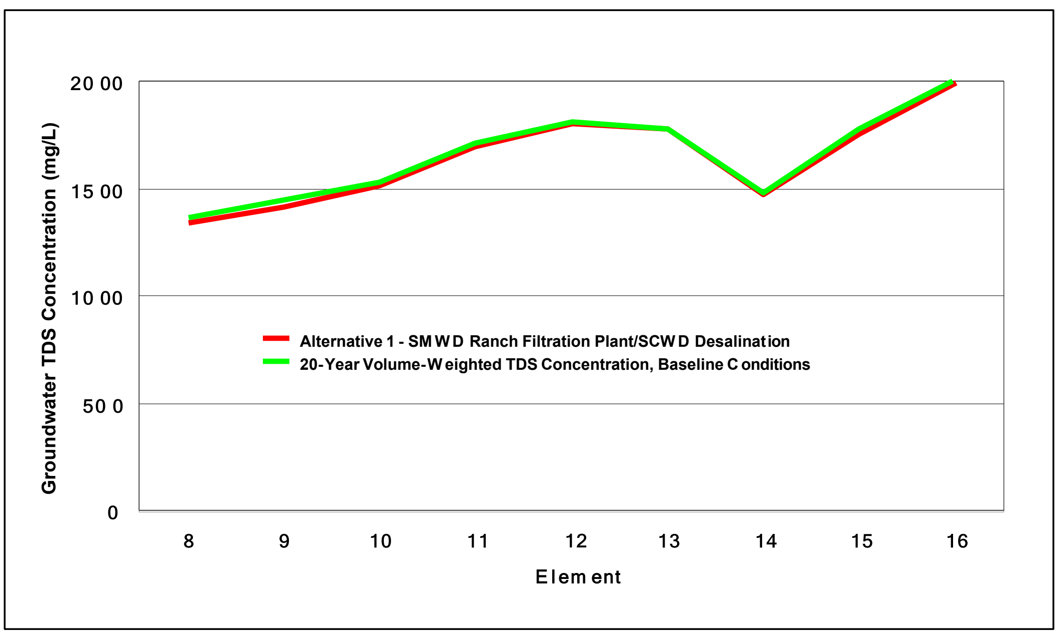


Figure 6-15 Comparison of Baseline Conditions with Management Alternative 1 – San Juan Creek Arm

[52] The Doheny Desalination Project brine discharge is addressed within the SOCWA San Juan Creek Ocean Outfall NPDES permit (RWQCB (Order No. R9-2022-0005). The SMWD Ranch Filtration Plant is presently in the planning process.

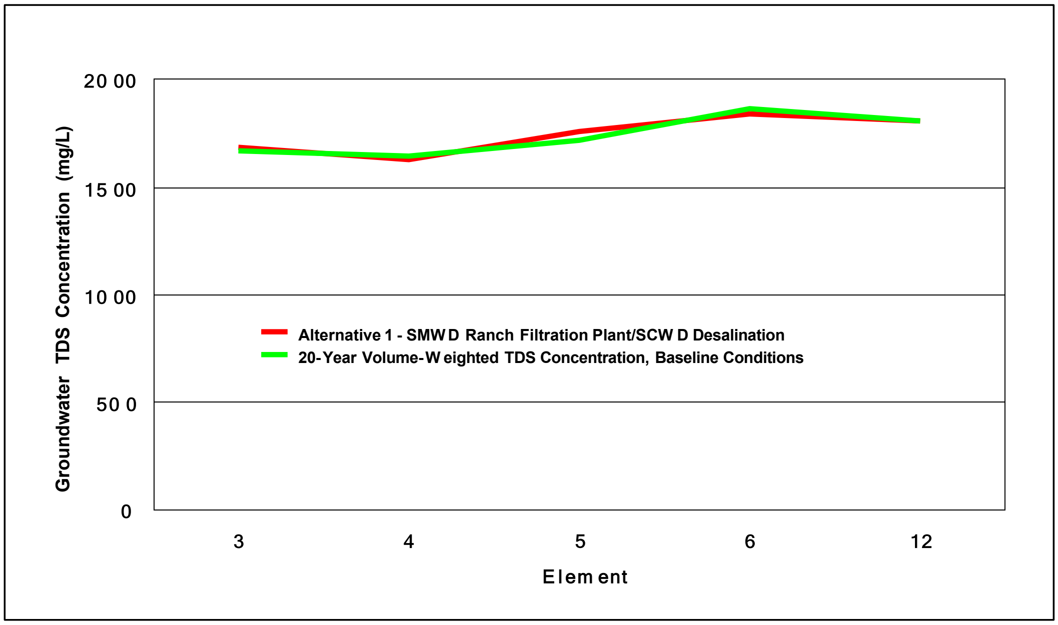


Figure 6-16 Comparison of Baseline Conditions with Management Alternative 1 – Oso/Trabuco Creek Arm)

Evaluation of Water Management Alternatives 1 and 2. The second combination of water management scenarios evaluated using the LPLN model is the implementation of both Water Management Scenarios 1 and 2. Under Water Management Scenario 2, approximately 700 AFY of surface water would be recharged to the lower portion of the basin (Oso/Trabuco arm of the modeled area) using inflatable rubber dams. This scenario would support an additional 1000 AFY of groundwater pumping, which would provide capacity for the basin to accept better-quality recharge.

Figures 6-17 and 6-18 present the results of LPLN model groundwater quality simulations for Management Scenarios 1 and 2. The figures also compare results from Management Scenarios 1 and 2 with baseline conditions (e.g., no implementation of the management strategies). As shown in the figures, the implementation of Management Scenarios 1 and 2 is projected to result in marked improvement in groundwater TDS concentrations in the downstream portions of the Oso/Trabuco arm (Elements 5, 6 and 12) and the middle portion of the San Juan Creek arm (Elements 12 and 13). Since Management Scenario 1 by itself is not projected to discernibly affect groundwater quality, the groundwater TDS improvement shown in Figures 6-17 and 6-18 is attributed to the recharge/recovery aspects of Management Strategy 2.

Results from the evaluation of Management Scenarios 1 and 2 offer encouragement that future expansion of this concept (e.g., Management Scenario 3) may result in a greater degree of groundwater quality improvement. The model results also support a conclusion that management of groundwater detention time (as opposed to attempting to regulate TDS loads in recycled water) represents a considerably more viable strategy for achieving groundwater quality improvement. This is particularly important in the San Juan Creek Basin where geologic salt loads can significantly affect groundwater quality.

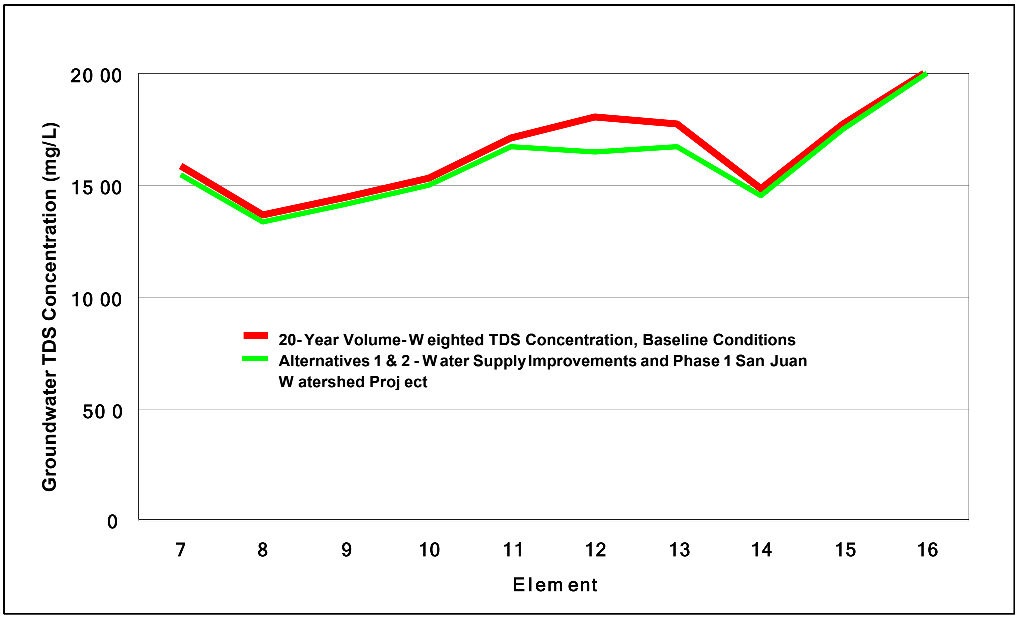


Figure 6-17 Comparison of Baseline Conditions with Management Alternatives 1 and 2 – San Juan Creek Arm

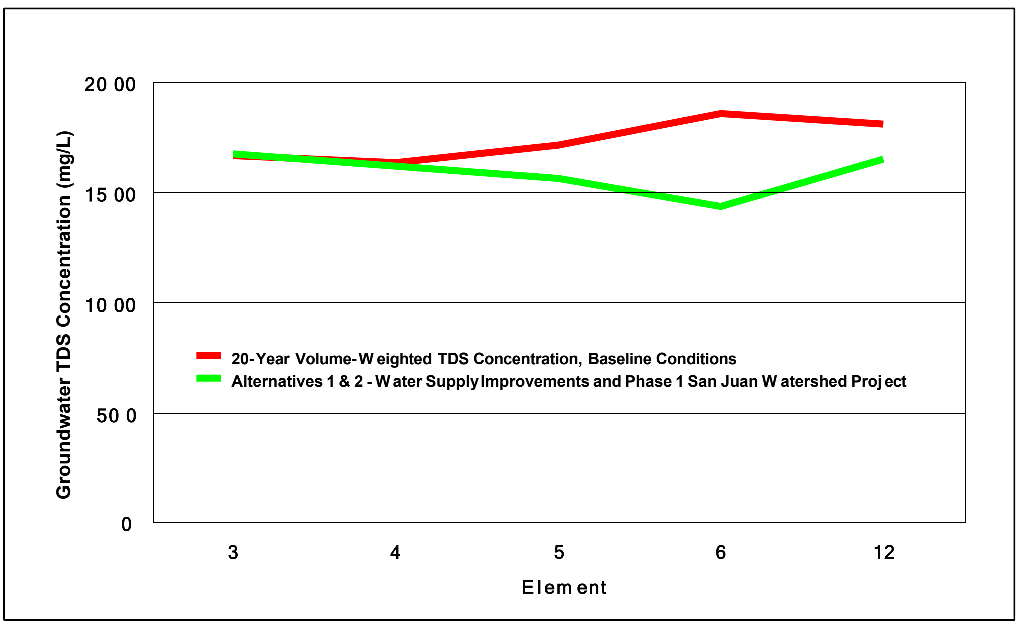


Figure 6-18 Comparison of Baseline Conditions with Management Alternatives 1 and 2 – Oso/Trabuco Creek Arm

Evaluation of Water Management Alternatives 1, 2, and 4. As noted, SOCWA member agencies have plans to increase recycled water use within the San Juan Basin to reduce potable water supply demands. The LPLN model is used to address groundwater quality effects associated with implementing Water Management Scenarios 1, 2 and 4. Under Management Scenario 4, recycled water use within the modeled area would be increased by approximately 500 AFY, while recycled water use in sub-basins upstream from the modeled area would be increased by 4500 AFY.

Figures 6-19 and 6-20 present the results of LPLN model groundwater quality simulations for Management Scenario 1, 2 and 4. The figures also compare the Management Scenario 1, 2 and 4 results with baseline conditions (e.g., no implementation of the management strategies). As shown in the figures, increased recycled water use upstream from the modeled area is projected to result in increased groundwater TDS concentrations in the upper portions of the San Juan Creek arm (Elements 7-9) and the Oso/Trabuco Creek arm (Elements 1-4). In the lower reaches of each arm, however, these increased salt loads would be more than offset by benefits associated with the inflatable dam/groundwater recovery aspects of Phase 1 of SMWD's San Juan Creek Watershed Project.

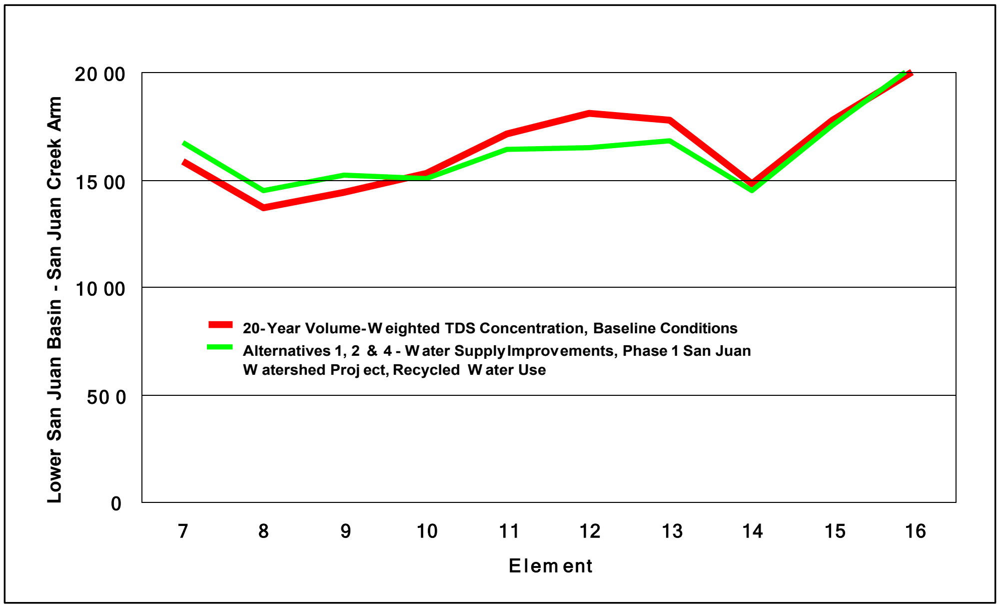


Figure 6-19 Comparison of Baseline Conditions with Management Alternatives 1, 2 and 4 – San Juan Creek Arm

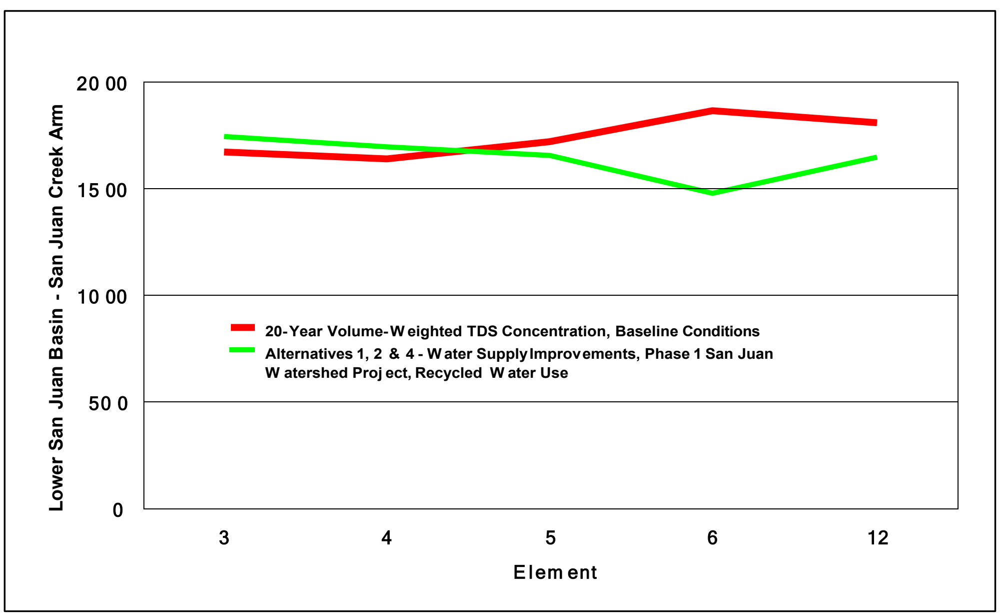


Figure 6-20 Comparison of Baseline Conditions with Management Alternatives 1, 2 and 4 – Oso/Trabuco Creek Arm

6.5 LPLN Model Conclusions

The following are concluded based on the LPLN transport modeling results for baseline and planned water management scenarios.

- Recycled water is only one of many factors influencing groundwater quality.
- Preliminary results indicate that it will not be possible to achieve significant reduction in groundwater TDS concentrations solely by reducing TDS concentrations in potable and recycled water supplies. Further, Basin Plan compliance cannot be achieved simply by eliminating or reducing recycled water use or regulating (restricting) recycled water TDS concentrations.
- Recycled water used by SOCWA member agencies within the Ortega and Lower San Juan Basins contains concentrations of TDS that are less than the corresponding Basin Plan groundwater TDS objectives and less than the quality of existing groundwater in these basins. Groundwater TDS concentrations in these basins, however, are generally higher than Basin Plan groundwater objectives.
- Geologic salt loads within the Lower Basin are an important factor influencing groundwater quality and must be addressed to accurately simulate groundwater quality in the Lower Basin.
- Decreasing groundwater detention time through increased pumping and recharge offers the greatest potential for groundwater quality improvement in the Lower Basin.
- Salt loads exiting the basin via underground groundwater flow are minimal. Further, in the absence of increased groundwater pumping and recharge, overall groundwater detention times will remain high, magnifying the combined effects of salt loads from applied water and geologic sources. As a result, it will not be possible to achieve significant reduction in groundwater TDS concentrations solely by reducing TDS concentrations in potable and recycled water supplies. Further, Basin Plan compliance cannot be achieved simply by eliminating or reducing recycled water use or regulating (restricting) recycled water TDS concentrations.
- Proposed management strategies offer the potential for groundwater quality improvement in the Lower San Juan Basin. Further, Phase 1 of the proposed San Juan Watershed Project will mitigate offset increased salt loads associated with planned increases in recycled water use.
- Existing barrier projects (e.g., Oso Creek Barrier, Trabuco Barrier) appear to be effective in reducing non-storm surface water salt loads that recharge downstream groundwater.
- The LPLN model is adequate for initial planning purposes, assessing probable groundwater trends, and complying with SNMP requirements for salt load and transport analysis. Additionally, based on data available to date, the model appears to provide reasonable agreement with unpublished 3-dimensional model transport results provided by SMWD and West Yost.
- Models more sophisticated than the LPLN model will be required as part of future SNMP updates to understand, fine-tune, design and implement proposed management strategies. Such modeling will also be required as part of Phase 2 of the San Juan Watershed Project to address

underground travel times and compliance with SWRCB Division of Drinking Water requirements for the use of recycled water as a source of groundwater recharge.

- Future groundwater and surface water quality groundwater monitoring (see Section 7) is required to (1) confirm the LPLN model results, (2) support implementation of proposed and planned water management strategies, and (3) assess compliance with Basin Plan groundwater quality objectives.
- Future monitoring (see Section 7) should include monitoring of depth-to-groundwater in static (non-pumping) wells to allow more accurate characterization of seasonal and long-term groundwater table trends.

Section 6 References

California Irrigation Management Irrigation System (CIMIS). 2023. *Reference Evapotranspiration Zones*. Located at: https://wwwcimis.water.ca.gov/Content/pdf/CimisRefEvapZones.pdf.

Eastern Municipal Water District and Rancho California Water District. October 1989. *Proposed Modification of Basin Plan Water Quality Objectives, Santa Margarita River Live Stream Discharge.* Prepared by NBS/Lowry Engineers and Planners.

Fallbrook Public Utility District, U.S. Marine Corps Base Camp Pendleton and the San Diego County Water Authority. June 1994. *Conjunctive Use Study, Lower Santa Margarita River Basin.* Prepared by NBS/Lowry Engineers and Planners.

G3 Soil Works, Wildermuth Environmental and Black and Veatch. 2016. *San Juan Basin Groundwater and Desalination Optimization Program Foundational Actions Fund (FAF) Program, Final Report.*

Geoscience Support Services, Inc. 2013. *South Orange Coastal Ocean Desalination Project, Volume 3 – San Juan Basin Regional Watershed and Groundwater Models.*

Municipal Water District of Orange County (MWDOC). 2013. *South Orange Coastal Ocean Desalination Project, Phase 3 Extended Pumping and Pilot Plant Testing, Volume 3 – San Juan Basin Regional Watershed and Groundwater Models.* Prepared by Geoscience Support Services.

Otay Water District, Sweetwater Authority and the San Diego County Water Authority. May 1993. Middle Sweetwater River System Study. Two volumes. Prepared by NBS/Lowry Engineers and Planners.

Regional Water Quality Control Board, San Diego Region (RWQCB). 2010. *Guidelines, Salinity and Nutrient Management Planning in the San Diego Regio*n. Prepared by Michael R. Welch, Ph.D., P.E. Adopted by the RWQCB (via Order No. R9-2010-0126) on November 10, 2010.

Regional Water Quality Control Board, San Diego Region (RWQCB). *Water Quality Control Plan for the San Diego Basin*. 1994 (with amendments effective on or before September 1, 2021.

Regional Water Quality Control Board, San Diego Region (RWQCB). 1997. *Order No. 97-52 and Addenda 1-5. Waste Discharge and Waer Recycling Requirements for the Production and Purveyance of Recycled Water by Member Agencies of the South Orange County Reclamation Authority, Orange County.*

Santa Margarita Water District and West Yost. 2023. Unpublished 3-dimensional model input data, monitoring data and model results provided to SOCWA.

South Orange County Wastewater Authority. 1993. *Basin Plan Amendments Final Report.* Prepared by Nolte and Associates.

South Orange County Wastewater Authority (SOCWA). 2014. *Salt and Nutrient Plan for the South Orange County Aliso Creek, San Juan Creek and Portions of Other Basins.* Prepared by HDR and Wildermuth Environmental.

State of California Department of Water Resources (DWR). 2020. C*alifornia's Groundwater, Update 2020, Bulletin 118.*

State of California Department of Water Resources (DWR). June 1972. *Planned Utilization of Water Resources in the San Juan Creek Basin Area, Bulletin 104.*

State Water Resources Control Board (SWRCB). 2018a. *Water Quality Control Policy for Recycled Water.* Adopted December 11, 2018; effective April 8, 2019.

State Water Resources Control Board (SWRCB). 2018b. *Final Staff Report with Substitute Environmental Documentation, Amendment to the Water Quality Control Policy for Recycled Water.*

U.S. Geological Survey. 2024. National Water Information System, Web Interface. Stream gaging records for San Juan Creek at San Juan Capistrano, 1928-1969. Available online at: https://waterdata.usgs.gov/ca/nwis/inventory/?site_no=11046500.

U.S. Marine Corps Base Camp Pendleton, Fallbrook Public Utility District, Eastern Municipal Water District and Rancho California Water District. *Water Quality Protection Study.* Prepared by NBS/Lowry Engineers and Planners, Almgren and Associates and Stetson Engineers (July 1990).

U.S. Marine Corps Base Camp Pendleton. April 1995. Programmatic Groundwater/Riparian Habitat Assessment and MCB Camp Pendleton, California. Prepared by KEA Environmental.

Section 7: Antidegradation Analysis

7.1 Background on the Antidegradation Policy

The State's Recycled Water Policy requires SNMPs to include, "[a]n antidegradation analysis demonstrating that the existing projects, reasonably foreseeable future projects, and other sources of loading to the basin included within the plan will, cumulatively, satisfy the requirements of State Water Resources Control Board (SWRCB) Resolution No. 68-16, Statement of Policy with Respect to Maintaining High Quality Waters in California (Antidegradation Policy)."[1] The SWRCB adopted Resolution 68-16 in October 1968 to maintain higher water quality "… to the maximum extent possible consistent with the declaration of the Legislature; …." The substantive components of the Antidegradation Policy are as follows:

1. *Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies.*
2. *Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.*
3. *In implementing this policy, the Secretary of the Interior will be kept advised and will be provided with such information as he will need to discharge his responsibilities under the Federal Water Pollution Control Act.*

A year later, when adopting the Porter-Cologne Water Quality Control Act (Porter-Cologne), the California legislature declared that waters of the state are to be regulated to attain the:

> *highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible.*[2]

The Antidegradation Policy must be applied in a manner consistent with Porter-Cologne.[3] Resolution 68-16 is not a 'zero-discharge' standard but rather a policy statement that existing quality be maintained when it is reasonable to do so. The resolution is consistent with state statutes.

Since 1968, the SWRCB has issued water quality orders and guidance documents interpreting Resolution 68-16, including APU 90-004[4] in 1990 and a Questions and Answers document in February of 1995.[5] APU 90-004 provided guidance for the implementation of Resolution 68-16 as applied to the point source National Pollutant Discharge Elimination System (NPDES) permitting process under the Clean Water Act. The 1995 Guidance was issued to provide uniform answers to frequently asked questions regarding

---

1 SWRCB (2019). 2019 Recycled Water Policy, § 6.2.4.5., p. 11.

2 Water Code, § 13000.

3 SWRCB (1986). *In the Matter of the Petitions for the County of Santa Clara et al.,* (1986) Order No. WQ 86-8, pp. 44-45.

4 SWRCB (1990). *Administrative Procedures Update No. 90-004, Antidegradation Policy Implementation for NPDES Permitting*, July 2, 1990 (APU 90-004).

5 *Questions and Answers, State Water Resources Control Board, Resolution No. 68-16*, February 16, 1995 (1995 Guidance).

Resolution 68-16. The 1995 Guidance's questions and answers were "based on SWRCB orders and guidance" issued prior to its release on February 16, 1995.[6]

7.2 Application of the Antidegradation Policy to High Quality Waters

In general, the Antidegradation Policy applies "… whenever (a) there is existing high-quality water, and (b) an activity which produces or may produce waste or an increased volume or concentration of waste will discharge into such quality water."[7] Thus, the first element in applying the Antidegradation Policy is to first determine if there is high quality water. To determine if it is high quality water, regional water quality control boards are generally directed to compare baseline water quality (which is the best quality that has existed since 1968) to applicable water quality objectives.[8] "If the baseline water quality is equal to or less than the objectives, the objectives set forth the water quality that must be maintained or achieved. In that case the antidegradation policy is not triggered."[9] Notably, if a decline in water quality was previously permitted consistent with the Antidegradation Policy, then the most recent water quality resulting from the permitted action constitutes the relevant baseline for determining if the water body is high quality.[10]

Determinations of baseline water quality as compared to water quality objectives are done on a constituent-by-constituent basis. Here, the constituent of concern is Total Dissolved Solids, or TDS. TDS is the focus due to previous analyses which identified that nitrate loading was not a significant issue in the Basin[11].

To satisfy the antidegradation requirement of Section 6.2.4.5. of the Recycled Water Policy, SOCWA must first determine if the groundwater basins in question are high quality waters as defined by the SWRCB and interpreted by previous SWRCB orders and the Court of Appeal in the *AGUA* decision. This entails assessing historical data to establish baseline water quality, determining if previous permitting decisions authorized subsequent degradation and comparing the established baseline quality to the applicable objective. If baseline water quality concentrations are higher than (i.e., worse than) the objective, then the water is not high quality and the Antidegradation Policy is not triggered. If baseline water quality is better (i.e., concentrations lower) than the objective, then the water is high quality and the remaining steps of the Antidegradation Policy apply to those waterbodies. Thus, if any of the identified groundwater basins in the SNMP are found to be high quality waters for TDS, then the SNMP must include an appropriate antidegradation analysis as required by section 6.2.4.5. of the Recycled Water Policy. When data are available, baseline water quality should be determined starting when the applicable TDS objective was adopted into the Water Quality Control Plan for the San Diego Region (Basin Plan).

[6] *Ibid*.

[7] *Asociacion de Gente Unida por el Agua v. Central Valley Regional Water Quality Control Board.* (2012) 210 Cal.App. 4th 1255, 1268.

[8] *Agua*, 210 Cal.App. 4th, 1270.

[9] *Ibid.*

[10] See, e.g., SWRCB Order WQ 2009-0007.

[11] SOCWA Salt and Nutrient Management Plan, July, 2014: https://www.socwa.com/wp-content/uploads/2016/05/SNMPReport_Final.pdf

7.3 Best Practicable Treatment or Control

The Antidegradation Policy requires that, where degradation of high-quality waters is permitted, best practicable treatment or control (BPTC) limits the amount of degradation that may occur. The term BPTC is not defined in statute or in the Antidegradation Policy. However, the SWRCB has provided direction with respect to the interpretation of BPTC. Specifically, the SWQCB has stated: "one factor to be considered in determining BPTC would be the water quality achieved by other similarly situated dischargers, and the methods used to achieve water quality."[12] In the 1995 above-referenced Questions and Answer document, BPTC is interpreted to additionally include a comparison of the proposed BPTC method to existing proven technology; evaluation of performance data; comparison of alternative methods of treatment or control; and, consideration of methods currently used by the discharger or similarly situation dischargers. Further, the costs of treatment or control need to also be considered.

Thus, if the San Diego RWQCB intends to allow degradation to a high-quality water, then the discharger must demonstrate that the proposed manner of compliance with permit provisions constitutes BPTC.

7.4 Maximum Benefit to the People of the State

The Antidegradation Policy further requires that where degradation of high-quality waters is permitted, then such degradation must be consistent with the "maximum benefit to people of the state." The 1995 Questions and Answer document describes factors that should be considered when determining if degradation to high quality waters is consistent with maximum benefit to people of the state. These factors include economic and social costs, tangible and intangible aspects of the proposed discharge, and environmental aspects of the proposed discharge, including benefits to be achieved by enhanced pollution controls. Like BPTC, the implementation of feasible alternative treatment or control methods should also be considered.

7.5 Waters that are Not High Quality: Best Efforts Approach

For waterbodies that are not high-quality waters, the analysis does not abruptly end. Rather, for waters that are not high quality, the best-efforts approach then applies. The best efforts approach was established by the SWRCB in precedential orders, and essentially states that "[w]here the constituent in a groundwater basin is already at or exceeding the water quality objective, the Regional Board must set the limitations no higher than the objectives set forth in the Basin Plan."[13] Notably, the SWRCB included a caveat with this statement noting that when limitations set at the objective cannot be achieved by reasonable efforts, "… review of the appropriateness of the water quality objective may be required."[14] Under the best-efforts approach, the SWRCB further directed Regional Water Boards to set limitations more stringent than the applicable Basin Plan objectives "if it can be shown that those limitations can be met using 'best efforts'. … [which] involves (a) making a showing that the constituent is in need of control; and (b) establishing limitations which the discharger can be expected to achieve using reasonable control methods."[15] The factors to be considered in a best efforts analysis include: (1) the water supply available to the discharger; (2) past effluent quality; (3) effluent quality achieved by other similarly dischargers; (4)

[12] SWRCB Order WQ 2000-07, pp. 10-11.

[13] SWRCB Order WQ 81-5, p. 6.

[14] *Ibid*.

[15] SWRCB Order WQ 81-5, p. 6-7.

good faith efforts of the discharger to limit the discharge of the constituent; and, (5) measures necessary to achieve compliance.[16] With this approach, the SWRCB was looking to address salt balance problems across the state specifically "… through the adoption of limitations for which compliance can be reasonably expected."[17]

7.6 Application of Antidegradation Policy and/or Best-Efforts Approach

When applying either the Antidegradation Policy or the best-efforts approach, the SNMP must also align with Section 6.1.2 of the Recycled Water Policy, which states: "Salts and nutrients from all sources must be managed on a basin-wide or watershed-wide basis in a manner that ensures attainment of water quality objectives and protection of beneficial uses." Currently, the overall watershed strategy employed for these Basins to protect the municipal beneficial use is through diversion projects and groundwater treatment facilities, which remove natural salt loadings to produce municipal supplies of local drinking water.

To satisfy section 6.2.4.5. of the Recycled Water Policy, SOCWA has implemented the following steps:

Step 1 – Using reasonably available historical data, SOCWA first determined if the hydrologic subareas are high quality waters by defining and establishing the appropriate baseline. Of the eight (8) hydrologic subareas that are addressed in this SNMP, historical data (i.e., baseline) indicates that two (2) of the hydrologic subareas are high quality waters and that the remaining six (6) of the hydrologic subareas are *not* high-quality waters.

Step 2 – For the hydrologic subareas that are high quality waters, SOCWA has applied the Antidegradation Policy to determine if there is available assimilative capacity for TDS. Where there is assimilative capacity, and where SOCWA's proposes to use available assimilative capacity for existing and future recycled water projects, the SNMP demonstrates how the implementation measures and management strategies satisfy the Antidegradation Policy and allow the San Diego Water Board to make the necessary findings to allow degradation of high-quality waters through implementation of the SNMP. This includes demonstrating that the implementation measures and management strategies constitute BPTC and that allowing use of assimilative capacity is to the maximum benefit to people of the state.

Step 3 – For the hydrologic subareas that are *not* high-quality waters, SOCWA has applied the best efforts approach in the SNMP. Using the best-efforts approach, the SNMP identifies which recycled water projects may be permitted in accordance with the SWRCB's direction - including setting limitations at a level that are at least equal to the applicable water quality objective. If cases where the SNMP anticipates that existing and future anticipated recycle water use cannot be permitted because the applicable water quality objective limits such uses, then the SNMP identifies the potential need for a future Basin Plan amendment for those hydrologic subareas.

[16] SWRCB Order WQ 81-5, p. 7.

[17] SWRCB Order WQ 81-5, p. 8.

Application of Step 1 in this SNMP - Identification of High-Quality Waters

To determine if water quality is considered high quality in each of the San Juan Creek Basin HSAs, SOCWA evaluated historical data for the period of 1952 through 1968, and data for the period of 1969 through 2022. (See Tables 7-1 and 7-2.)

Table 7-1
Historical Groundwater TDS Concentrations in the San Juan Basin, 1952-1968

HSA #	HSA	Groundwater TDS Concentration, 1952-1968 (mg/L)				Compliance with Basin Plan[A]	Number of Samples
		Basin Plan Objective	Minimum Value	Maximum Value	Historic Average		
1.21	Oso	1200	497	2180	846	No	24
1.22	UT	500	346	517	438	Yes	8
1.23	MT	750	352	3106	768	No	55
1.24	Gob	1200	296	1176	617	Yes	3
1.25	USJ	500	300	515	384	Yes	16
1.26	MSJ	750	298	457	357	Yes	6
1.27	LSJ	750	811	3626	1532	No	101
1.28	Ortega	1100	438	4291	1062	No	48

Table 7-1 Notes:
A Compliance with the Basin Plan where no more than 10 percent of the samples in any year exceed the Basin Plan water quality objective.[18]

Table 7-2
Groundwater TDS Concentrations in the San Juan Basin, 1969-2022

HSA #	HSA	Groundwater TDS Concentration, 1969-2022 (mg/L)				Compliance with Basin Plan[A]	Number of Samples
		Basin Plan Objective	Minimum Value	Maximum Value	Average 1969-2022		
1.21	Oso	1200	930	7300	4500	No	48
1.22	UT	500	320	450	391	Yes	6
1.23	MT	750	506	1404	941	No	136
1.24	Gob	1200	530	1600	943	Yes	53
1.25	USJ	500	380	3430	1136	Yes	127
1.26	MSJ	750	430	1600	852	No	71
1.27	LSJ	750	940	7900	2115	No	386
1.28	Ortega	1100	920	2530	1794	No	82

Table 7-2 Notes:
A Compliance with the Basin Plan where no more than 10 percent of the samples in any year exceed the Basin Plan water quality objective.[19]

18 Regional Water Quality Control Board, San Diego Region (RWQCB). *Water Quality Control Plan for the San Diego Basin*. 1994 (with amendments effective on or before September 1, 2021. Tables 3-2 & 3-3. https://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/docs/chapter_3.pdf

19 Regional Water Quality Control Board, San Diego Region (RWQCB). *Water Quality Control Plan for the San Diego Basin*. 1994 (with amendments effective on or before September 1, 2021. Tables 3-2 & 3-3. https://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/docs/chapter_3.pdf

Notably, the Basin Plan provides that compliance with water quality objectives is achieved if data shows that the objectives are not exceeded more than 10% of the time - "unless studies of the specific water body in question clearly show that water quality objective changes are permissible and changes are approved by the Regional Board." With respect to historic water quality data for the period of 1952 through 1968, SOCWA used this data to establish baseline water quality pursuant to the SWRCB Antidegradation Policy and to determine if historical water quality complied with the applicable water quality objectives. (The tables used in the analysis can be found in Appendix B.) As shown in Table 7-1 above for historic data (pre-1968 water quality data), four of the HSAs complied with the applicable Basin Plan objective and four did not during this period. Thus, four of the HSAs are not defined as high-quality waters (Oso, Middle Trabuco, Lower San Juan, and Ortega) because baseline water quality exceeded applicable water quality objectives. Conversely, four HSAs are considered high-quality waters (Upper Trabuco, Gobernadora, Upper San Juan, and Middle San Juan) because baseline water quality was better than applicable water quality objectives. Accordingly, HSAs Upper Trabuco, Gobernadora, Upper San Juan and Middle San Juan are subject to the State's Antidegradation Policy.

Of the four basins considered high-quality waters, only one basin no longer meets the Basin Plan objective when modern data is reviewed (period of 1969-2022). The Middle San Juan basin (HSA 901.26) went from an historical average of 357 mg/L of TDS to a modern-day average of 852 mg/L of TDS. This means that the HSA 901.26 may lack assimilative capacity for additional recycled water projects unless management measures can improve water quality to be below the water quality objective or the water quality objective is revised in the future. Before determining if the water quality objective should be revised, SOCWA recommends that as part of this SNMP, additional monitoring occur to evaluate the impact of the multitude of management measures already being implemented in has 901.26.

Application of Step 2 in this SNMP – Application of Antidegradation Policy to High Quality Waters

As indicated above, the high-quality waters within the San Juan Creek Basin include the following HSAs:

- Upper Trabuco (HSA 901.22)
- Gobernadora (HSA 901.24)
- Upper San Juan HSA 901.25)
- Middle San Juan HSA 901.26)

Of these four basins, only the Middle San Juan (HAS 901.26) is found to not have assimilative capacity based on review of modern data for the period of 1969-2022. For the three basins with assimilative capacity (HSAs 901.22, 901.24 and 901.25), the San Diego Water Board may approve use of the remaining assimilative capacity as long as it can make the proper findings, which are that (1) BPTC limits the amount of degradation (2) use of assimilative capacity will not cause groundwater to exceed the applicable TDS objective; and (3) allowing the degradation is to the maximum benefit to the people of the state.

In Section 5, the SNMP identifies the implementation measures and management strategies that SOCWA's member agencies are employing to protect and improve groundwater quality in the Mission Viejo subbasins. These efforts include existing and projected planning projects including groundwater treatment, source control, use of groundwater barriers, artificial recharge with lower salinity water, modification of irrigation practices, and brine management, as applicable (See Table 5-5). Considering the extensive efforts being employed, combined with the advanced level of treatment for some of the recycled water supplies, the agencies producing and using recycled water in this Basin satisfy the need for BPTC.

Moreover, allowing the use of recycled water in this Basin is to the maximum benefit to the people of the state because it maximizes use of limited water resources. As detailed in Section 3, there are limited groundwater resources in this basin and a majority of municipal water supplies come from imported water. By permitting use of recycled water for landscape irrigation, limited and valuable imported water supplies can be better used for drinking water purposes. This helps to stretch the state's limited surface water supplies to other municipal areas that also rely on imported water. It further implements the State's goals of increasing the use of recycled water to 2.5 million AFY by 2030.[20]

For the Middle San Juan, where it appears that no assimilative capacity currently exists, SOCWA recommends a monitoring approach. The monitoring approach is an appropriate solution as the Ranch Filtration Plant is projected to reduce the salt loading into the Basin as a key management strategy, which is discussed further in Section 5-4. By conducting monitoring, SOCWA's member agencies can evaluate the impact of the Ranch Filtration Plant on groundwater quality before determining if additional steps are necessary.

Application of Step 3 in this SNMP – Application of Best Efforts

For the four remaining HSAs that are not considered high-quality waters [Oso, Middle Trabuco, Lower San Juan and Ortega], SOCWA member agencies will continue to employ best efforts to improve water quality. As discussed in Section 5, significant implementation measures and management strategies are being employed in these four basins. For example, as shown on Table 5-5, treatment of recycled water is already being implemented in the Middle Trabuco basin and planned for the Oso (HSA 901.11) and Lower San Juan (HSA 901.27). Further, groundwater barriers are in place in several basins that capture and return poor-quality groundwater for treatment and impoundment. This is in addition to the source control efforts, modification of irrigation practices and many other management measures currently implemented or planned by SOCWA member agencies. The combination of existing implementation measures along with anticipated management strategies demonstrates that the SOCWA member agencies are implementing best efforts throughout the Basin.

Moreover, for recycled water that is used in the Oso, Lower San Juan, Gobernadora, and Ortega subbasins, TDS concentrations in recycled water are below the applicable Basin Plan objectives and likely below existing ambient groundwater quality conditions. This means that recycled water use may in fact help to improve water quality, and the San Diego Water Board can continue to permit such recycled water use even though the basins are not considered to be of high-water quality.

7.7 Next Steps

As demonstrated above, existing projects and reasonably foreseeable future projects satisfy compliance with the State's Antidegradation Policy in six of the eight basins. For the two remaining basins (Middle

[20] Recycled Water Policy, p. 2.

San Juan and Middle Trabuco), the continuation of existing implementation measures and projected, planned management strategies will allow the San Diego Water Board to find that such measures satisfy the State's Antidegradation Policy.

Importantly, SOCWA and its member agencies will continue to implement a monitoring plan to assess and confirm groundwater quality trends as part of the implementation of this SNMP (See Section 4.4). Based on the results of groundwater monitoring over the next 5 years, SOCWA will then reevaluate groundwater conditions in all the Basins and determine if water quality objectives need to be adjusted for any of the basins.

Section 7 References:

Asociacion de Gente Unida por el Agua v. Central Valley Regional Water Quality Control Board. (2012) 210 Cal.App. 4th 1255, 1268 (*AGUA*).

Administrative Procedures Update No. 90-004, Antidegradation Policy Implementation for NPDES Permitting, July 2, 1990 (APU 90-004).

AGUA, 210 Cal.App. 4th, 1270.

California Water Code § 13000.

Regional Water Quality Control Board, San Diego Region (RWQCB). *Water Quality Control Plan for the San Diego Basin*. 1994 (with amendments effective on or before September 2021. Tables 3-2 & 3-3. https://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/docs/chapter_3.pdf

South Orange County Wastewater Authority (SOCWA). 2014. Salt and Nutrient Plan for the South Orange County Aliso Creek, San Juan Creek and Portions of Other Basins. Prepared by HDR and Wildermuth Environmental. https://www.socwa.com/wp-content/uploads/2016/05/SNMPReport_Final.pdf

State Water Resources Control Board (SWRCB). 2018a. *Water Quality Control Policy for Recycled Water.* Adopted December 11, 2018; effective April 8, 2019.

State Water Resources Control Board (SWRCB). Order WQ 2009-0007.

State Water Resources Control Board (SWRCB). *Questions and Answers, State Water Resources Control Board, Resolution No. 68-16*, February 16, 1995 (1995 Guidance).

State Water Resources Control Board (SWRCB). *In the Matter of the Petitions for the County of Santa Clara et al.,* (1986) Order No. WQ 86-8, pp. 44-45.

State Water Resources Control Board (SWRCB). Order WQ 81-5, p. 6.

Section 8: Conclusions and Recommendations

8.1 Conclusions

As documented herein, designated beneficial uses and water quality objectives to protect the beneficial uses of the San Juan Creek Basin were originally established in the 1975 Basin Plan. Amendments to the Basin Plan in 1978 and 1995 expanded recycled water use opportunities within the San Juan Creek Basin (Mission Viejo HA 901.2). The 1995 Basin Plan modifications were, in part, based planned recycled water use in the basin and assimilative capacity assessments for individual sub-basins based on projected salt loads.

Current recycled water requirements for the San Juan Creek Basin are established within RWQCB Order No. 97-52 (as amended). Recycled water volume and effluent concentration limitations established in Order No. 97-52 are based on the 1995 Basin Plan modifications and assimilative capacity projections. To meet current water and recycled water demands, SOCWA member agencies have proposed the implementation of water management strategies that will support existing and planned recycled water use within the San Juan Creek Basin.

Based on the analyses presented herein, the following are concluded:

- Modern records of groundwater quality data in the San Juan Creek Basin date back more than 70 years.
- Consistent compliance is achieved with Basin Plan groundwater quality objectivesfor nitrate in all sub-basins of the San Juan Creek Basin (HA 901.2). Recycled water and other nutrient loads do not represent a threat to beneficial uses or to groundwater quality.
- Development within the basin has resulted in significant increases in water demand over the past 70 years and imported water supplies have been utilized to satisfy the bulk of this demand.
- Recycled water as a percent of total water demand has steadily increased over the past quarter century; recycled water now satisfies approximately 25 percent of the total water demand within the SOCWA service area.
- Water quality drivers in the San Juan Creek Basin include:
  - Geochemistry and soils.
  - Basin hydrogeology (e.g., groundwater movement and groundwater/surface water interaction.
  - Evapotranspiration.
  - Natural replenishment (precipitation recharge and streamflow infiltration).
  - Man-induced replenishment (applied water).
  - Amount and location of groundwater extraction.
  - Amount of salt export.
- Significant interchange between ground and surface water (e.g., surfacing groundwater and/or streamflow infiltration) can occur in each of the sub-basins of the San Juan Creek Basin. Surface

water sampling can be used within upstream narrow, shallow basins as a surrogate to estimate groundwater quality.

- Management strategies currently being implemented or planned for implementation by SOCWA member agencies include:
    - Diversion barriers to intercept and reuse poor quality runoff.
    - Seawater desalination.
    - Source control.
    - Advanced treatment of recycled water.
    - Groundwater extraction and demineralization treatment.
    - Salt export via brine discharges to ocean outfalls.
    - Artificial recharge of good-quality storm runoff into the groundwater basin.
    - Public education to modify irrigation practices to maximize irrigation efficiency.
    - Public education to modify land use/vegetation to minimize irrigation water needs.
- Existing recycled water use volumes and quality in the San Juan Hydrologic Unit (HU 901) are consistent with requirements established in Order No. 97-52 (as amended).
- Recycled water projects planned by SOCWA member agencies will require modification of Order No. 97-52 to address changes in projected recycled water use location and volumes.
- Existing recycled water TDS concentrations are less than Basin Plan objectives within the Oso/La Paz Basin (HSA 901.21), Gobernadora/Chiquita Basin (HSA 901.24), Lower San Juan Basin (HSA 901.27), and Ortega Basin (HSA 901.28).
- Existing groundwater TDS concentrations are less than Basin Plan objectives within the Upper Trabuco Basin (HSA 901.22), Middle Trabuco Basin (HSA 901.23), and Upper San Juan Basin (HSA 901.25).
- Salt balance and salt fate/transport modeling in the San Juan Creek Basin and assessment of existing and planned water management strategies demonstrate that:
    - Recycled water is only one of many factors influencing groundwater quality, and natural salt loads from geologic sources are an important factor influencing groundwater quality within the San Juan Creek Basin.
    - Salt loads exiting the basin via underground groundwater flow are minimal. Further, in the absence of increased groundwater pumping and recharge, overall groundwater detention times will remain high, magnifying the combined effects of salt loads from applied water and geologic sources. As a result, it will not be possible to achieve significant reduction in groundwater TDS concentrations solely by reducing TDS concentrations in potable and recycled water supplies. Further, Basin Plan compliance cannot be achieved simply by eliminating or reducing recycled water use or regulating (restricting) recycled water TDS concentrations.

  - Recycled water used by SOCWA member agencies within the Ortega and Lower San Juan Basins contains concentrations of TDS that are less than the corresponding Basin Plan groundwater TDS objectives and less than the quality of existing groundwater in these basins. Groundwater TDS concentrations in these basins, however, are generally higher than Basin Plan groundwater objectives.
  - Proposed management strategies offer the potential for groundwater quality improvement in the Lower San Juan Basin. In particular, decreasing groundwater detention time through increased pumping and recharge (when coupled with groundwater demineralization and brine export) offers great potential for groundwater quality improvement.
  - Phase 1 of the proposed San Juan Watershed Project may mitigate and offset increased salt loads associated with planned increases in recycled water use.
  - Existing barrier projects (e.g., Oso Creek Barrier, Trabuco Barrier) appear to be effective in reducing non-storm surface water salt loads that recharge downstream groundwater.
  - The LPLN model is adequate for initial planning purposes, assessing probable groundwater trends, and complying with SNMP requirements for salt load and transport analysis. Additionally, based on data available to date, the model appears to provide reasonable agreement with unpublished 3-dimensional model transport results provided by SMWD and West Yost.
  - Models more sophisticated than the LPLN model will be required as part of future SNMP updates to understand, fine-tune, design and implement proposed management strategies. Such modeling will also be required as part of Phase 2 of the San Juan Watershed Project to address underground travel times and compliance with SWRCB Division of Drinking Water requirements for the use of recycled water as a source of groundwater recharge.
  - Future groundwater and surface water quality groundwater monitoring (see Section 7) is required to (1) confirm the LPLN model results, (2) support implementation of proposed and planned water management strategies, and (3) assess compliance with Basin Plan groundwater quality objectives.

- High quality waters (as defined in SWRCB Resolution No. 68-16) occur in the Upper Trabuco Basin (HSA 901.22), Gobernadora Basin (HSA 901.24), Upper San Juan Basin (HSA 901.25) and Middle San Juan Basin (HSA 901.26).

- Adequate assimilative capacity exists in the Upper Trabuco Basin (HSA 901.22), Gobernadora Basin (HSA 901.24) and Upper San Juan Basin (HSA 901.25) to allow planned recycled water projects in these basins.

- Assimilative capacity does not presently exist in the Middle San Juan Basin (HA 901.26), but management strategiesplanned for implementationin this basin[1] will likely result in groundwater quality improvement.

[1] Management strategies planned for implementation in the Middle San Juan Basin (HSA 901.26) include groundwater extraction, demineralization, groundwater recharge, and water/recycled water quality improvements.

- Allowing planned recycled water use in the Middle San Juan Basin (HSA 901.26) is consistent with maximum benefit to the people of the State. Planned monitoring will be implemented to assess groundwater quality trends in the basin and to support more detailed analysis in the next SNMP update.

- High quality waters (as defined in SWRCB Resolution No. 68-16) do not exist in the Oso/La Paz Basin (HSA 901.21), Middle Trabuco Basin (HSA 901.23), Lower San Juan Basin (HSA 901.27), and Ortega Basin (HSA 901.28). Within these basins, however, TDS concentrations of recycled water supplies are lower than existing Basin Plan groundwater TDS objectives which should allow the RWQCB to continue to permit such recycled water use even though groundwaters in the basins are not high quality. (See Table 8-1.)

Table 8-1
Summary of Projected Basin Plan/Antidegradation Compliance

HSA	Basin	Basin Plan Groundwater TDS Objective (mg/L)	Recycled Water TDS Concentrations Lower than the Basin Plan TDS Groundwater Quality Objective?	Existing Groundwater TDS Concentrations Lower than the Basin Plan TDS Groundwater Quality Objective?	Basin Assimilative Capacity Exists to Allow for Planned Recycled Water Use	Management Strategies Proposed that Can Improve Groundwater TDS?	Groundwater Quality Degradation Projected if Planned Recycled Water Use is Implemented with Planned Management Strategies?	High Quality Waters Exist in the Basin?	Existing and Proposed Recycled Water Use Consistent with Antidegradation Policy Requirements?
901.21	Oso/La Paz	1200	✓			✓			✓
901.22	Upper Trabuco	500		✓	✓	✓		✓	✓
901.23	Middle Trabuco	750				✓			✓
901.24	Gobernadora Chiquita	1200	✓	✓	✓	✓		✓	✓
901.25	Upper San Juan Dove/Bell	500		✓	✓	✓		✓	✓
901.26	Middle San Juan	750				✓		✓	✓
901.27	Lower San Juan	1200	✓			✓			✓
901.28	Ortega	1100	✓			✓			✓

8.2 Recommendations for RWQCB Action

The following RWQCB actions are recommended based on the information presented in this SNMP:

- Adopt the 2024 SOCWA SNMP.
- Adopt an updated recycled water permit for SOCWA member agencies that addresses planned recycled water use totals (see Table 8-2) and planned groundwater improvement projects in each of the San Juan Creek Basin sub-basins. Include increased interim discharge limits in the updated recycled water permit for TDS to reflect the geologic contributions in the San Juan Creek Basin. Within the updated permit, include increased concentration limits for iron and manganese to reflect (1) vegetative uptake of iron and manganese in applied irrigated water and (2) the lack of affect between iron and manganese concentrations in recycled water and iron and manganese concentrations in groundwater.
- Confirm the monitoring program presented within the SNMP to (1) assess Basin Plan compliance, (2) assess the performance of water management strategies in reducing salt loads, stabilizing and improving groundwater quality, and (3) support additional future evaluation of salinity loads and transport in the Lower San Juan Basin and Middle San Juan Basin. Future basin monitoring should include monitoring of depth-to-groundwater in static (non-pumping) wells to allow more accurate characterization of seasonal and long-term groundwater table elevations.
- Require detailed salt balance analyses and transport modeling of salt in the Middle Trabuco Basin (HSA 901.23) and Middle San Juan Basin (HSA 901.26) in the next five-year update of the San Juan Basin SNMP.
- Defer consideration of Basin Plan modifications within the Middle Trabuco (HSA 901.23) and Middle San Juan (HSA 901.26) to a future SNMP update when groundwater issues are better defined and it can be determined whether the proposedmanagement strategies are adequate to achieve Basin Plan compliance.
- Prior to completion of additional salt balance and modeling studies in the Middle San Juan Basin (to be completed as part of the next five-year SNMPupdate), as part of issuing an updated SOCWA recycled water permit, determine appropriate interim TDS effluent limits for recycled water used in the Middle San Juan Basin (HSA 901.26).[2]

[2] SMWD continues to move forward with plans to utilize recycled water in the Middle San Juan Basin (HSA 901.26). For this recycled water use, SMWD may request implementation of interim effluent TDS concentration limits for recycled water used in the Middle San Juan Basin. SMWD would prefer that the RWQCB establish interim recycled water TDS concentration limits in the Middle San Juan Basin (HSA 901.26) at 1000 mg/L (annual average), which would be consistent with concentration limits in other basins where SMWD applies recycled water. If the RWQCB were to impose the existing Basin Plan TDS objective of 750 mg/L in the Middle San Juan Basin, SMWD would have to implement special strategies within the Middle San Juan Basin (e.g., blending or treatment) to achieve compliance.

Table 8-2
Recommended RWQCB Actions

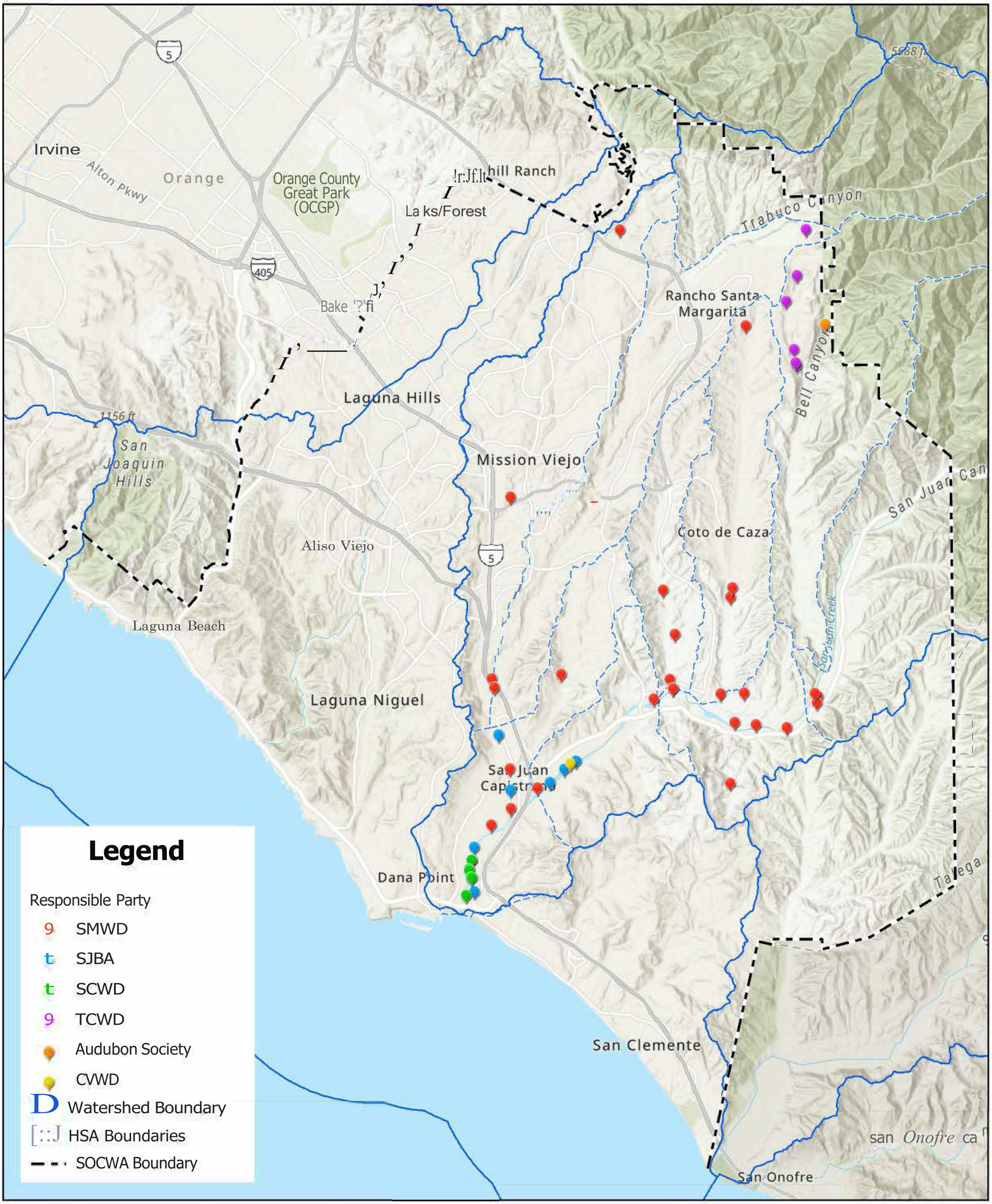
Hydrologic Subarea of the San Juan Creek Basin		Recommended RWQCB Action		
		Update Order No. 97-42 to Address Planned Recycled Water Use and Planned Management Strategies	Planned Recycled Water Use (AFY)	Approve the 2024 SNMP and Defer Assessment of the Need for Basin Plan Modification to a Future SNMP Update
901.21	Oso/La Paz	✓	5,290	
901.22	Upper Trabuco	✓	23	
901.23	Middle Trabuco	✓	1,487	✓
901.24	Gobernadora	✓	4,000	
	Chiquita	✓	676	
901.25	Upper San Juan	✓	91	
	Dove/Bell	✓	889	
901.26	Middle San Juan	✓	2,000 [A]	✓
901.27	Lower San Juan	✓	3,349	
901.28	Ortega	✓	65	

Table 8-2 Notes:

A Estimated total includes both recycled water irrigation use and recycled water groundwater recharge.

Appendix A

Map of Monitoring Sites



SNMP Monitoring Sites

Appendix B

Summary Tables

Table B-1			
Oso Creek (901.21) Historic Monitoring Data 1960-1968			
HSA	**Sample Date**	**TDS (mg/L)**	**State Well #**
Oso Creek (901.21)	11/14/1960	672	07S08W36C001S
Oso Creek (901.21)	2/15/1961	70	07S/08W-25N03S
Oso Creek (901.21)	6/12/1961	762	07S/08W-25L01S
Oso Creek (901.21)	6/19/1964	1251	07S/08W-13GS1S
Oso Creek (901.21)	10/21/1965	1454	07/08W-36C03S
Oso Creek (901.21)	3/11/1966	2107	07S/08W-36P01S
Oso Creek (901.21)	4/20/1966	704	07S/08W-25N01S
Oso Creek (901.21)	4/26/1966	1366	07S/08W-36P01S
Oso Creek (901.21)	5/3/1966	558	07S/08W-25P02S
Oso Creek (901.21)	5/5/1966	551	07S/08W-25P03S
Oso Creek (901.21)	5/6/1966	554	07/08W-36C03S
Oso Creek (901.21)	5/26/1966	1020	07S/08W-36P01S
Oso Creek (901.21)	6/2/1966	554	07/08W-36C03S
Oso Creek (901.21)	6/30/1966	881	07S/08W-36P01S
Oso Creek (901.21)	7/28/1966	825	07S/08W-36P01S
Oso Creek (901.21)	9/29/1966	782	07S/08W-36P01S
Oso Creek (901.21)	5/1/1967	525	07S08W-25P03S
Oso Creek (901.21)	5/1/1967	536	07S/08W-36C03S
Oso Creek (901.21)	5/31/1967	742	07S/08W-36P01S
Oso Creek (901.21)	6/5/1967	502	07S/08W-14H02S
Oso Creek (901.21)	6/13/1967	502	07S/08W-25P02S
Oso Creek (901.21)	10/25/1967	497	07S/08W-36C03S
Oso Creek (901.21)	3/25/1968	545	07S/08W-36P01S
Oso Creek (901.21)	10/14/1968	500	07S/08W-25P02S
Oso Creek (901.21)	10/17/1968	2180	07S/08W-12N01S

Table B-2			
Upper Trabuco (901.22) Historic Monitoring Data 1960-1968			
HSA	**Sample Date**	**TDS (mg/L)**	**State Well #**
Upper Trabuco (901.22)	11/17/1960	464	06S/07W-11P01S
Upper Trabuco (901.22)	9/26/1961	374	06S/07W-12F01S
Upper Trabuco (901.22)	5/29/1964	517	06S/7W-12B02S
Upper Trabuco (901.22)	5/29/1966	336	06S/07W-12F01S
Upper Trabuco (901.22)	5/29/1966	574	06S/07W-11J01S
Upper Trabuco (901.22)	11/23/1966	476	06S/07W-11P01S
Upper Trabuco (901.22)	6/8/1967	346	06S/07W-12B02S
Upper Trabuco (901.22)	3/26/1968	419	06S/07W-12B02S

Table B-3			
Middle Trabuco (901.23) Historic Monitoring Data 1960-1966			
HSA	**Sample Date**	**TDS (mg/L)**	**State Well #**
Middle Trabuco (901.23)	11/10/1960	710	07S/08W-36P03S
Middle Trabuco (901.23)	11/10/1960	764	07S/08W-36P04S
Middle Trabuco (901.23)	11/14/1960	804	06S/07W-15A01S
Middle Trabuco (901.23)	11/14/1960	798	06S/7W-15A02S
Middle Trabuco (901.23)	11/14/1960	3106	07S/08W-25N01S
Middle Trabuco (901.23)	11/14/1960	672	07/08W-36C01S
Middle Trabuco (901.23)	11/17/1960	508	06S/07W-11N02S
Middle Trabuco (901.23)	2/15/1961	780	07/08W-36C01S
Middle Trabuco (901.23)	6/13/1961	980	07/08W-36C01S
Middle Trabuco (901.23)	6/14/1961	600	07S/08W-25B03S
Middle Trabuco (901.23)	9/27/1961	1118	07S/08W-36P03S
Middle Trabuco (901.23)	9/28/1961	1856	07S/08W-36L02S
Middle Trabuco (901.23)	10/30/1961	557	07S/08W-25B02S
Middle Trabuco (901.23)	10/31/1961	420	07S/07W-19D02S
Middle Trabuco (901.23)	12/11/1961	1080	07S/08W-36P04S
Middle Trabuco (901.23)	4/25/1962	450	07S/08W-25B02S
Middle Trabuco (901.23)	4/25/1962	1225	07S/08W-36P03S
Middle Trabuco (901.23)	11/29/1962	512	07S/07W-19D02S
Middle Trabuco (901.23)	11/29/1962	467	07S/08W-25B01S
Middle Trabuco (901.23)	11/29/1962	477	07S/08W-25B04S
Middle Trabuco (901.23)	11/29/1962	518	07/08W-36C01S
Middle Trabuco (901.23)	11/29/1962	1017	07S/08W-36P03S
Middle Trabuco (901.23)	12/13/1962	506	07S/08W-25N02S
Middle Trabuco (901.23)	12/13/1962	1119	07S/08W-36P04S
Middle Trabuco (901.23)	10/21/1963	498	07S/07W-19D02S
Middle Trabuco (901.23)	10/21/1963	586	07/08W-36C01S
Middle Trabuco (901.23)	10/21/1963	1022	07S/08W-36L02S
Middle Trabuco (901.23)	10/21/1963	856	07S/08W-36P03S
Middle Trabuco (901.23)	1/8/1964	532	07S/08W-25B02S
Middle Trabuco (901.23)	1/8/1964	517	07S/08W-25B03S
Middle Trabuco (901.23)	1/8/1964	526	07S/08W-25B04S
Middle Trabuco (901.23)	11/12/1964	603	06S/07W-11N02S
Middle Trabuco (901.23)	5/13/1965	597	07S/08W-25B04S
Middle Trabuco (901.23)	4/20/1966	484	07S/08W-25B03S
Middle Trabuco (901.23)	4/20/1966	1456	07S/08W-36L02S
Middle Trabuco (901.23)	5/3/1966	520	07S/08W-25K02S
Middle Trabuco (901.23)	5/6/1966	543	07S/08W-25N02S
Middle Trabuco (901.23)	5/26/1966	1081	07S/08W-36L02S

Table B-3 (continued)			
Middle Trabuco (901.23) Historic Monitoring Data 1966-1968			
HSA	**Sample Date**	**TDS (mg/L)**	**State Well #**
Middle Trabuco (901.23)	6/30/1966	481	07S/08W-25B02S
Middle Trabuco (901.23)	6/30/1966	1083	07S/08W-36P03S
Middle Trabuco (901.23)	7/1/1966	940	07S/08W-36L02S
Middle Trabuco (901.23)	8/5/1966	920	07S/08W-36L02S
Middle Trabuco (901.23)	11/23/1966	573	06S/07W-11N01S
Middle Trabuco (901.23)	2/27/1967	893	07S/08W-36P03S
Middle Trabuco (901.23)	3/30/1967	876	07S/08W-36P03S
Middle Trabuco (901.23)	5/31/1967	502	07S/08W-25B04S
Middle Trabuco (901.23)	5/31/1967	828	07S/08W-36P03S
Middle Trabuco (901.23)	6/5/1967	450	07S/08W-25B03S
Middle Trabuco (901.23)	6/8/1967	363	06S/07W-11N01S
Middle Trabuco (901.23)	6/8/1967	352	06S/07W-12M01S
Middle Trabuco (901.23)	6/8/1967	439	06S/07W-15E03S
Middle Trabuco (901.23)	3/26/1968	1000	06S/07W-07P01S
Middle Trabuco (901.23)	3/26/1968	441	06S/07W-11N01S
Middle Trabuco (901.23)	3/26/1968	459	06S/07W-15E03S
Middle Trabuco (901.23)	10/14/1968	766	07S/08W-36L02S

Table B-4			
Chiquita (901.24) Historic Monitoring Data 1961-1964			
HSA	**Sample Date**	**TDS (mg/L)**	**State Well #**
Chiquita (901.24)	6/15/1961	378	07S/07W-09G01S
Chiquita (901.24)	10/20/1961	296	07/07W-14M01S
Chiquita (901.24)	6/19/1964	1176	06S/7W-17PS1S

Table B-5			
Upper San Juan (901.25) Historic Monitoring Data 1953-1968			
HSA	**Sample Date**	**TDS (mg/L)**	**State Well #**
Upper San Juan (901.25)	8/10/1953	330	07S/07W-36A01S
Upper San Juan (901.25)	8/12/1954	300	07S/07W-36A01S
Upper San Juan (901.25)	9/14/1956	336	07S/07W-36A01S
Upper San Juan (901.25)	12/16/1959	330	07S/07W-36A01S
Upper San Juan (901.25)	6/10/1960	368	07S/07W-36A01S
Upper San Juan (901.25)	9/28/1960	346	07S/06W-04ES1S
Upper San Juan (901.25)	11/9/1960	416	07S/07W-36A01S
Upper San Juan (901.25)	12/13/1962	444	07S/07W-36A01S
Upper San Juan (901.25)	1/8/1964	444	07S/07W-36A01S
Upper San Juan (901.25)	6/25/1964	515	06S/05W-17H01S
Upper San Juan (901.25)	9/2/1964	315	07S/06W-04ES1S
Upper San Juan (901.25)	11/18/1964	510	07S/07W-36A01S
Upper San Juan (901.25)	4/21/1966	394	07S/07W-36A01S
Upper San Juan (901.25)	6/1/1967	397	07S/07W-36A01S
Upper San Juan (901.25)	10/17/1967	344	07S/07W-36A01S
Upper San Juan (901.25)	3/27/1968	354	07S/07W-36A01S

Table B-6			
Middle San Juan (901.26) Historic Monitoring Data 1953-1967			
HSA	**Sample Date**	**TDS (mg/L)**	**State Well #**
Middle San Juan (901.26)	8/10/1953	322	07S/07W-35J01S
Middle San Juan (901.26)	8/12/1954	352	07S/07W-35J015
Middle San Juan (901.26)	12/16/1958	317	07S/07W-35J015
Middle San Juan (901.26)	6/5/1959	397	07S/07W-35J015
Middle San Juan (901.26)	6/20/1961	298	07S/07W-35J015
Middle San Juan (901.26)	6/5/1967	457	07S/07W-35P01S

Table B-7			
Lower San Juan (901.27) Historic Monitoring Data 1952-1968			
HSA	**Sample Date**	**TDS (mg/L)**	**State Well #**
Lower San Juan (901.27)	7/11/1952	811	08/08W-12K01S
Lower San Juan (901.27)	7/22/1952	843	08S/08W-23A02S
Lower San Juan (901.27)	8/10/1953	1716	08S/08W-14H03S
Lower San Juan (901.27)	8/12/1954	1048	08S/08W-12P01S
Lower San Juan (901.27)	8/12/1954	1385	08S/0814H02S
Lower San Juan (901.27)	8/24/1954	1175	08S/08W-23A02S
Lower San Juan (901.27)	8/24/1954	1120	08S/08W-23A04S
Lower San Juan (901.27)	8/1/1955	934	08S/08W-12P01S
Lower San Juan (901.27)	8/1/1955	1255	08S/08W-23A02S
Lower San Juan (901.27)	9/14/1956	1156	08S/08W-12P01S
Lower San Juan (901.27)	9/17/1956	1332	08S/08W-23A04S
Lower San Juan (901.27)	12/14/1956	1660	08S/0814H02S
Lower San Juan (901.27)	6/20/1957	1530	08S/08W-23A04S
Lower San Juan (901.27)	12/20/1957	1171	08S/08W-12P01S
Lower San Juan (901.27)	5/27/1958	927	08S/08W-12P01S
Lower San Juan (901.27)	7/16/1958	1490	08S/08W-23A02S
Lower San Juan (901.27)	10/10/1958	1580	08S/08W-23A04S
Lower San Juan (901.27)	10/6/1959	1650	08S/08W-23A04S
Lower San Juan (901.27)	12/16/1959	1770	08S/08W-14H02S
Lower San Juan (901.27)	5/12/1960	1680	08S/08W-23A04S
Lower San Juan (901.27)	5/27/1960	1890	08S/08W-14Q01S
Lower San Juan (901.27)	5/27/1960	1633	08S/08W-23A04S
Lower San Juan (901.27)	6/13/1960	1732	08S/08W-14H02S
Lower San Juan (901.27)	11/29/1962	1432	08S/08W-01Q05S
Lower San Juan (901.27)	11/29/1962	1357	08S/08W-12P03S
Lower San Juan (901.27)	11/30/1962	1557	08S/07W-07D01S
Lower San Juan (901.27)	11/30/1962	1668	08S/08W-13D01S
Lower San Juan (901.27)	12/13/1962	842	08S/08W-12R01S
Lower San Juan (901.27)	12/13/1962	1493	08S/08W-13D01S
Lower San Juan (901.27)	10/21/1963	1337	08S/08W-12L01S
Lower San Juan (901.27)	10/21/1963	1579	08S/08W-14H02S
Lower San Juan (901.27)	10/23/1963	1146	08/08W-01L01S
Lower San Juan (901.27)	10/23/1963	1086	08S/08W-12L04S

Table B-7 (continued)			
Lower San Juan (901.27) Historic Monitoring Data 1952-1968			
HSA	**Sample Date**	**TDS (mg/L)**	**State Well #**
Lower San Juan (901.27)	1/8/1964	1119	08/08W-01L01S
Lower San Juan (901.27)	1/8/1964	1364	08S/08W-12L03S
Lower San Juan (901.27)	1/8/1964	1112	08S/08W-12L04S
Lower San Juan (901.27)	2/21/1964	2270	08S/08W-23A04S
Lower San Juan (901.27)	2/21/1964	1381	08S/08W-23A07S
Lower San Juan (901.27)	8/27/1964	3626	08S/08W-14Q01S
Lower San Juan (901.27)	8/27/1964	2188	08S/08W-23A04S
Lower San Juan (901.27)	11/30/1964	1223	08/08W-01L01S
Lower San Juan (901.27)	11/30/1964	1191	08S/08W-12L04S
Lower San Juan (901.27)	11/30/1964	1401	08S/08W-14H02S
Lower San Juan (901.27)	5/13/1965	1676	08S/08W-14H04S
Lower San Juan (901.27)	5/14/1965	1599	08S/08W-12P02S
Lower San Juan (901.27)	6/28/1965	3550	08S/08W-14Q01S
Lower San Juan (901.27)	10/14/1965	1342	08/08W-01L01S
Lower San Juan (901.27)	10/15/1965	1968	08S/08W-13D01S
Lower San Juan (901.27)	10/15/1965	2170	08S/08W-23A04S
Lower San Juan (901.27)	4/21/1966	1542	08S/08W-13D01S
Lower San Juan (901.27)	4/5/1967	1410	08S/08W-12L02S
Lower San Juan (901.27)	4/5/1967	1580	08S/08W-14H03S
Lower San Juan (901.27)	3/25/1968	2070	08S/08W-13C02S
Lower San Juan (901.27)	10/17/1968	1050	08S/08W-12H01S
Lower San Juan (901.27)	10/17/1968	1220	08S/08W-12H02S

Table B-8			
Ortega (901.28) Historic Monitoring Data 1953-1968			
HSA	**Sample Date**	**TDS (mg/L)**	**State Well #**
Ortega (901.28)	8/10/1953	1629	08S/07W-06P01S
Ortega (901.28)	8/12/1954	862	07S/07W-32Q01S
Ortega (901.28)	12/4/1956	1388	08S/07W-06P01S
Ortega (901.28)	6/19/1957	683	07S/07W-32Q01S
Ortega (901.28)	6/19/1957	1500	08S/07W-06P01S
Ortega (901.28)	7/16/1958	690	07S/07W-32Q01S
Ortega (901.28)	12/16/1958	672	07S/07W-32Q01S
Ortega (901.28)	12/16/1958	1092	08S/07W-06P01S
Ortega (901.28)	6/10/1960	592	07S/07W-32Q01S
Ortega (901.28)	11/10/1960	638	07S/07W-32Q01S
Ortega (901.28)	11/10/1960	582	08S/07W-07C02S
Ortega (901.28)	11/17/1960	770	08S/07W-05B01S
Ortega (901.28)	11/17/1960	1066	08S/07W-06H01S
Ortega (901.28)	9/28/1961	1266	08S/07W-05E02S
Ortega (901.28)	10/30/1961	1382	08S/07W-05C02S
Ortega (901.28)	12/11/1961	871	08S/07W-05B01S
Ortega (901.28)	12/11/1961	1020	08S/07W-06K02S
Ortega (901.28)	12/11/1961	765	08S/07W-07C02S
Ortega (901.28)	4/25/1962	1450	08S/07W-05C02S
Ortega (901.28)	11/30/1962	763	08S/07W-05E01S
Ortega (901.28)	11/30/1962	1606	08S/07W-6K03S
Ortega (901.28)	11/30/1962	545	08S/07W-07C03S
Ortega (901.28)	12/13/1962	1064	08S/07W-06J02S

Table B-8 (Continued)			
Ortega (901.28) Historic Monitoring Data 1953-1968			
HSA	**Sample Date**	**TDS (mg/L)**	**State Well #**
Ortega (901.28)	10/21/1963	1176	08S/07W-05C02S
Ortega (901.28)	10/23/1963	1564	08S/07W-06H03S
Ortega (901.28)	1/8/1964	831	07S/07W-32R01S
Ortega (901.28)	1/8/1964	1424	08S/07W-06H01S
Ortega (901.28)	1/8/1964	1459	08S/07W-06H03S
Ortega (901.28)	1/8/1964	1340	08S/07W-06J05S
Ortega (901.28)	5/14/1964	635	08S/07W-06H03S
Ortega (901.28)	6/25/1964	440	07S/07W-33NS1S
Ortega (901.28)	11/13/1964	870	07S/07W-32R01S
Ortega (901.28)	11/13/1964	1585	08S/07W-06H03S
Ortega (901.28)	11/30/1964	4291	08S/07W-07C03S
Ortega (901.28)	5/14/1965	1823	08S/07W-06H01S
Ortega (901.28)	10/15/1965	852	07S/07W-32R01S
Ortega (901.28)	10/15/1965	860	08S/07W-05B01S
Ortega (901.28)	4/21/1966	845	08S/07W-05B01S
Ortega (901.28)	4/21/1966	826	08S/07W-06H01S
Ortega (901.28)	11/30/1966	974	07S/07W-32R01S
Ortega (901.28)	4/5/1967	774	08S/07W-06H03S
Ortega (901.28)	6/1/1967	1010	07S/07W-32R01S
Ortega (901.28)	6/5/1967	961	08S/07W-05B01S
Ortega (901.28)	10/18/1967	837	08S/07W-05B01S
Ortega (901.28)	3/25/1968	1060	07S/07W-32R01S
Ortega (901.28)	10/16/1968	550	07S/07W-32R01S

Table B-9

Summary Average per HSA

HSA #	HSA	Basin Plan Objective	1952 TDS (mg/L)	1953 TDS (mg/L)	1954 TDS (mg/L)	1955 TDS (mg/L)	1956 TDS (mg/L)	1957 TDS (mg/L)	1958 TDS (mg/L)	1959 TDS (mg/L)	1960 TDS (mg/L)	1961 TDS (mg/L)	1962 TDS (mg/L)
1.21	Oso	1200									672	762	
1.22	UT	500									464	374	
1.23	MT	750									1052	924	699
1.24	Chiquita	1200										337	
1.25	USJ	500		330	300		336			330	377		
1.26	MSJ	750		322	352				317	397		298	
1.27	LSJ	750	827	1716	1227	1095	1383	1351	1332	1710	1591	1616	1432
1.28	Ortega	1110		1629	862		1388	1500	818		730	1061	1086

Table B-9 (Continued)

Summary Average per HSA

HSA #	HSA	Basin Plan Objective	1963 TDS (mg/L)	1964 TDS (mg/L)	1965 TDS (mg/L)	1966 TDS (mg/L)	1967 TDS (mg/L)	1968 TDS (mg/L)	Min TDS (mg/L)	Max TDS (mg/L)	Average TDS (mg/L)	Number of Samples (n)
1.21	Oso	1200		1251	1454	900	1339	1075	497	2180	846	24
1.22	UT	500		517		462	346	419	346	517	438	8
1.23	MT	750	741	545	597	808	588	667	352	3106	768	55
1.24	Chiquita	1200		1176					296	1176	617	3
1.25	USJ	500		446		394	371	354	300	515	384	16
1.26	MSJ	750					457		298	457	357	6
1.27	LSJ	750	1287	1688	2051	1542	1495	1447	811	3626	1532	101
1.28	Ortega	1110	1370	1431	1178	882	896	805	438	4291	1062	48

Table B-10												
Compliance Summary for each HSA 1952-1968												
HSA #	HSA	Basin Plan Objective	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961
1.21	Oso	1200									Yes	Yes
Number of Samples/Year											1	1
1.22	UT	500									Yes	Yes
Number of Samples/Year											1	1
1.23	MT	750									No	No
Number of Samples/Year											7	8
1.24	Chiquita	1200										Yes
Number of Samples/Year												2
1.25	USJ	500		Yes	Yes		Yes			Yes	Yes	
Number of Samples/Year				1	1		1			1	2	
1.26	MSJ	750		Yes	Yes				Yes	Yes		Yes
Number of Samples/Year				1	1				1	1		1
1.27	LSJ	750	No	No	No	No	No	No	No	No	No	No
Number of Samples/Year			2	2	4	4	3	2	2	2	16	23
1.28	Ortega	1110	No	Yes		No	No	No		No	Yes	No
Number of Samples/Year			1	1		1	1	1		5	4	5

Table B-10												
Compliance Summary for each HSA 1952-1968												
HSA #	HSA	Basin Plan Objective	1962	1963	1964	1965	1966	1967	1968	Majority of Years in Compliance (Yes/No)	Number of Samples	Percent of Years in Compliance (%)
1.21	Oso	1200			No	No	No	No	No	No		29%
Number of Samples/Year					1	1	11	6	3		22	
1.22	UT	500			No		Yes	Yes		Yes		80%
Number of Samples/Year					1		3	2			6	
1.23	MT	750	No	No	Yes	Yes	No	No	No	No		22%
Number of Samples/Year			9	4	4	1	10	8	4		40	
1.24	Chiquita	1200			Yes					Yes		100%
Number of Samples/Year					1						1	
1.25	USJ	500			No		Yes	Yes	Yes	Yes		89%
Number of Samples/Year					4		1	2	1		8	
1.26	MSJ	750						Yes		Yes		100%
Number of Samples/Year								1			1	
1.27	LSJ	750	No	No	No	No	No	No	No	No		0%
Number of Samples/Year			17	4	10	6	1	2	3		43	
1.28	Ortega	1110	No	No	No	Yes	Yes	Yes		No		36%
Number of Samples/Year			1	7	3	5	3	1			20	