Coachella Valley Groundwater Basin Salt and Nutrient Management Plan

Final

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MWH Project Number 10505158

Prepared for:
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List of Acronyms and Abbreviations

ACRE-FT	Acre-feet
ACRE-FT/YR	Acre-feet per Year
AFY	Acre-feet per Year
Basin	Coachella Valley Groundwater Basin
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CVWD	Coachella Valley Water District
CWA	Coachella Water Authority
DWA	Desert Water Agency
DWR	Department of Water Resources
EIR	Environmental Impact Report
EPA	Environmental Protection Agency
ET	Evapotranspiration
FT	Feet
GAMA	Groundwater Ambient Monitoring & Assessment Program
GIS	Geographic Information System
IWA	Indio Water Authority
MG/L	Milligrams per liter
MGD	Million Gallons per Day
MSL	Mean Sea Level
MSWD	Mission Spring Water District
MUN	Municipal and Domestic Supply
MWD	Metropolitan Water District of Southern California
MWH	MWH Americas, Inc.
MZ	Management Zone
N	Nitrogen
NEPA	National Environmental Policy Act
NO_3	Nitrate
NPDES	National Pollutant Discharge Elimination System
RWQCB	Colorado River Basin Regional Water Quality Control Board
SNMP	Salt and Nutrient Management Plan
SWP	State Water Project
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
Valley	Coachella Valley
WRF	Water Reclamation Facility
WRP	Water Reclamation Plant
WWTP	Wastewater Treatment Plant

Executive Summary

The Salt and Nutrient Management Plan (SNMP) for the Coachella Valley Groundwater Basin (Basin) was prepared in accordance with the State of California Water Resource Control Board Recycled Water Policy (Policy).

The Policy requires the preparation SNMPs, in an effort to manage salts and nutrients on a basin-wide or watershed-wide basis while encouraging recycled water use. Rather than imposing requirements solely on individual recycled water projects, the State Water Resources Control Board (SWRCB) finds the development of SNMPs as the best approach to quantify and address salt and nutrient issues. The summary and key findings of the SNMP are as follows.

FUTURE WATER QUALITY

Future water quality is estimated using a salt and nutrient loading model. The primary sources of salt to the Coachella Valley are return flows and imported water recharge. The primary sinks (removal from the system) are groundwater pumping and export via agricultural drains.

Based on modeling results, the average concentrations of total dissolved solids (TDS) and nitrate (as NO_3) in the Coachella Valley are not anticipated to exceed Water Quality Control Plan for the Colorado River Basin – Region 7 (Basin Plan) water quality objective (WQO) for nitrate or the water quality criterion for TDS. Based on the currently planned recycled water projects, a significant change in water quality that is inconsistent with the Basin Plan is not anticipated in the next 30-year water management planning period. No impact to beneficial uses from recycled water projects is anticipated.

REGULATORY FRAMEWORK

The Policy provides direction to California's nine Regional Water Quality Control Boards on appropriate criteria to be used in regulating recycled water projects (SWRCB, 2013). Beneficial uses of surface and groundwater for this region are designated by the California Regional Water Quality Control Board, Colorado River Basin Region (RWQCB).

WQOs are typically established by the Basin Plan to protect and maintain the integrity of each type of beneficial use. Objectives may be narrative or numeric, and vary by location, beneficial use category, and surface water body/groundwater basin.

The Basin Plan recognizes the lack of available data to develop specific numeric groundwater objectives for each subbasin in the region. Therefore, groundwater objectives are typically referenced at the applicable numeric objectives related to their beneficial use. The following municipal water quality criteria were used as the numeric criteria for the purpose of estimating the difference between the average water quality and the WQO, or assimilative capacity:

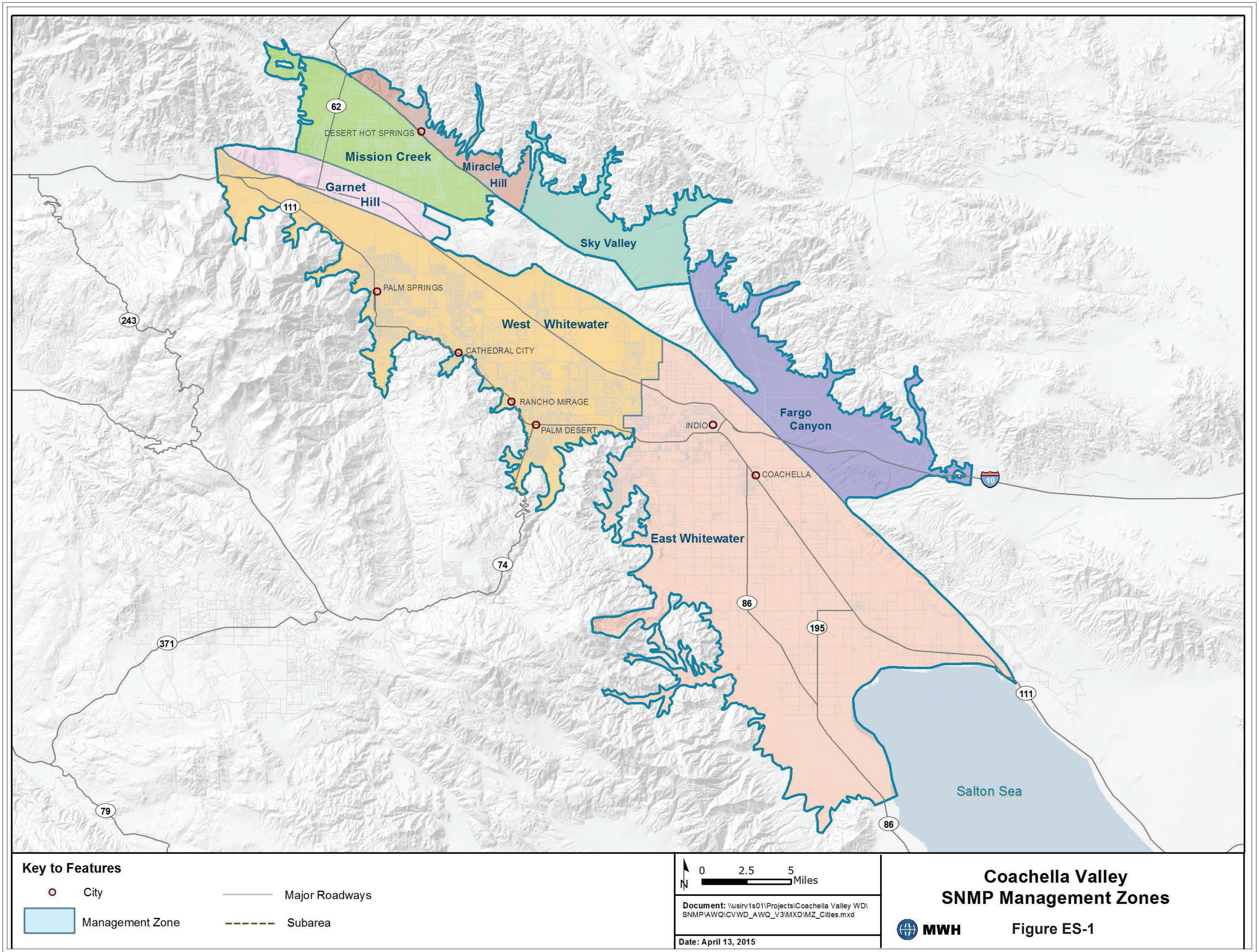
- Nitrate: 45 mg/L (as NO_3)
- TDS: 1,000 mg/L

BASIN CHARACTERIZATION

Coachella Valley lies in the northwestern portion of the Salton Trough, which extends from the Gulf of California in Mexico northwesterly to the Cabazon area. The Basin is bounded on the north and east by crystalline bedrock of the San Bernardino and Little San Bernardino Mountains and on the south and west by the crystalline rocks of the Santa Rosa and San Jacinto Mountains. The Basin is bounded on the west end of the San Gorgonio Pass groundwater divide. The southern boundary is the Salton Sea. Geologic faults and structures generally divide the Basin into four subbasins (Tyley, 1974); these faults limit groundwater flow between the subbasins. The four subbasins include: the Whitewater (Indio), Garnet Hill, Mission Creek, and Desert Hot Springs.

Distinct management zones (MZs) were delineated based on geology, hydrogeology, nd water quality. These MZs will allow the areas of recharge and discharge to be well defined and associated water quality of the recharge and discharge terms to be estimated, evaluated, and managed. The MZs of the SNMP are shown in **Figure ES-1**, and listed below.

- Whitewater River (Indio) Subbasin
    - MZ1: West Whitewater River
    - MZ2: East Whitewater River
- MZ3: Mission Creek
- MZ4: Garnet Hill
- Desert Hot Springs Subbasin
    - MZ5: Miracle Hill
    - MZ6: Sky Valley
    - MZ7: Fargo Canyon

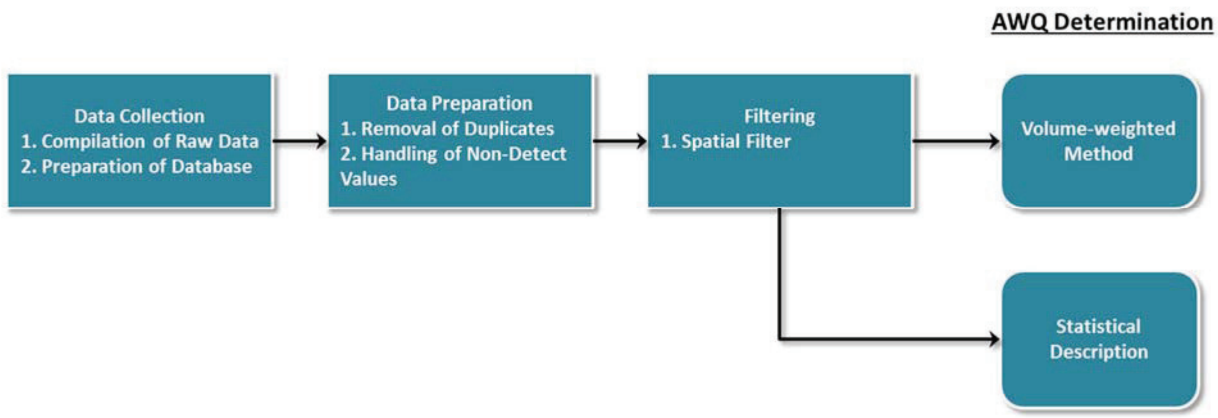


Mission Creek
Miracle Hill
Garnet Hill
Sky Valley
West Whitewater
Fargo Canyon
East Whitewater
Salton Sea
DESERT HOT SPRINGS
PALM SPRINGS
CATHEDRAL CITY
RANCHO MIRAGE
PALM DESERT
INDIO
COACHELLA
62
111
243
74
86
195
371
79
10
Key to Features
City
Management Zone
Major Roadways
Subarea
N
0 2.5 5 Miles
Document: \\usirv1s01\Projects\Coachella Valley WD\SNMP\AWQ\CVWD_AWQ_V3\MXD\MZ_Cities.mxd
Date: April 13, 2015
Coachella Valley
SNMP Management Zones
MWH
Figure ES-1

Water Quality

The Policy requires the determination of whether current average, or ambient water quality (AWQ), and projected salt and nutrient concentrations are consistent with applicable WQOs. Nitrate (as NO3) and TDS were selected as the primary constituents of concern (COCs) as they are materially affected by recycled water use or other salt/nutrient loads. **Figure ES-2** shows the steps leading to AWQ determination.

Figure ES-2
Diagram of Generalized Ambient Water Quality Determination



A statistical description of AWQ was completed for each MZ and a volume-weighted AWQ was computed for MZs with adequate data to support the volume-weighted method. Data adequacy for each MZ is summarized in TM-2 (**Appendix B**). Data required for the volume-weighted method includes sufficient water quality data for wells with known depth information, aquifer thickness and effective porosity, and groundwater level.

Based on the data available, the AWQ TDS and nitrate concentrations were calculated for each MZ. **Table ES-1** presents summarizes the AWQ method used and calculated AWQ for each management zone where sufficient data allowed for the calculation. **Table ES-2** lists the water quality criteria and current assimilative capacity for TDS and nitrate for each MZ.

Table ES-1
Ambient Water Quality Summary

Management Zone	Method	TDS (mg/L)	Nitrate (mg/L as NO_3)
West Whitewater River[1]	Volume-weighted	326	9.4
East Whitewater River	Volume-weighted	515	7.0
Mission Creek	Volume-weighted	540	3.0
Garnet Hill[2]	Statistical	Not determined	
Miracle Hill[2]	Statistical		
Sky Valley[2]	Statistical		
Fargo Canyon[2]	Statistical		

1. Layer 1 of West Whitewater River has too few data points for the volume-weighted method, therefore a median is used.
2. Insufficient data for calculation. Garnet Hill, Miracle Hill, and Sky Valley have less than 10 data points; Fargo Canyon has 13.

Table ES-2
Water Quality Criterion and Assimilative Capacity Summary

Management Zone	TDS (mg/L)	Nitrate (mg/L as NO_3)
Water Quality Criterion[1]	1,000	45.0
West Whitewater	674	30.7
East Whitewater	485	38.0
Mission Creek	460	42.0
Garnet Hill[2]	Not Determined	
Miracle Hill[2]		
Sky Valley[2]		
Fargo Canyon[2]		

1. TDS water quality criteria is based on the Title 22 CCR “Consumer Acceptance” for municipal beneficial use of 1,000 mg/L.
2. Garnet Hill, Miracle Hill, and Sky Valley have less than 10 data points; Fargo Canyon has 13.

ESTIMATED AVERAGE FUTURE WATER QUALITY

The evaluation of salt and nutrient sources and sinks in the Coachella Valley Groundwater Basin is driven largely by the water balance in the basin. Establishing the water balance, i.e., the inputs to and outputs from the system, is the first step in estimating future water quality. The Coachella Valley Water Management Plan and Mission Creek/Garnet Hill Water Management Plan were the guiding documents used to develop the baseline model (CVWD, 2012a; CVWD, 2013).

Inflows of water to each MZ are comprised of the following:

- Natural recharge from surface waters and precipitation
- Subsurface inflows to the MZ
- Artificial recharge of imported water
- Deep percolation of applied water, i.e., irrigation return flows
- Wastewater percolation and septic infiltration

Outflows of water from each MZ are comprised of the following:

- Groundwater pumping
- Subsurface outflows from the MZ
- Evapotranspiration
- Agricultural drain flows (only applicable to East Whitewater River MZ)

Quantifying the net movement of salt and nutrient to and from a MZ and accounting for any changes in storage provides the means to estimate changes to groundwater quality into the future.

The net change in TDS or nitrate mass is calculated as:

$$\sum_{i=1}^{m}(Inflow \times WQ)_i - \sum_{j=1}^{n}(Outflow \times WQ)_j = \Delta Mass$$

To determine the AWQ of a MZ in a given year:

$$Groundwater\ Quality = \frac{Mass + \Delta Mass}{Storage + \Delta Storage}$$

General assumptions of the salt/nutrient loading model include:

- Mass balances into and out of the groundwater basin are mixed to generate an average water quality for each year.

- Mass that passes the root zone instantly reaches the groundwater with no lag time.
- The quality of the groundwater used to determine the mass in outflows for a particular year is based on the previous year's concentration.

It is important to note that the model developed to estimate average future water quality is based on two families of assumptions: (1) estimated ambient water quality and (2) estimated loading parameters.

Estimated average future water quality by MZ is presented on **Figure ES-3** and **Figure ES-4** for TDS and nitrate, respectively.

Figure ES-3
Estimated Average Future Water Quality by Management Zone – Total Dissolved Solids

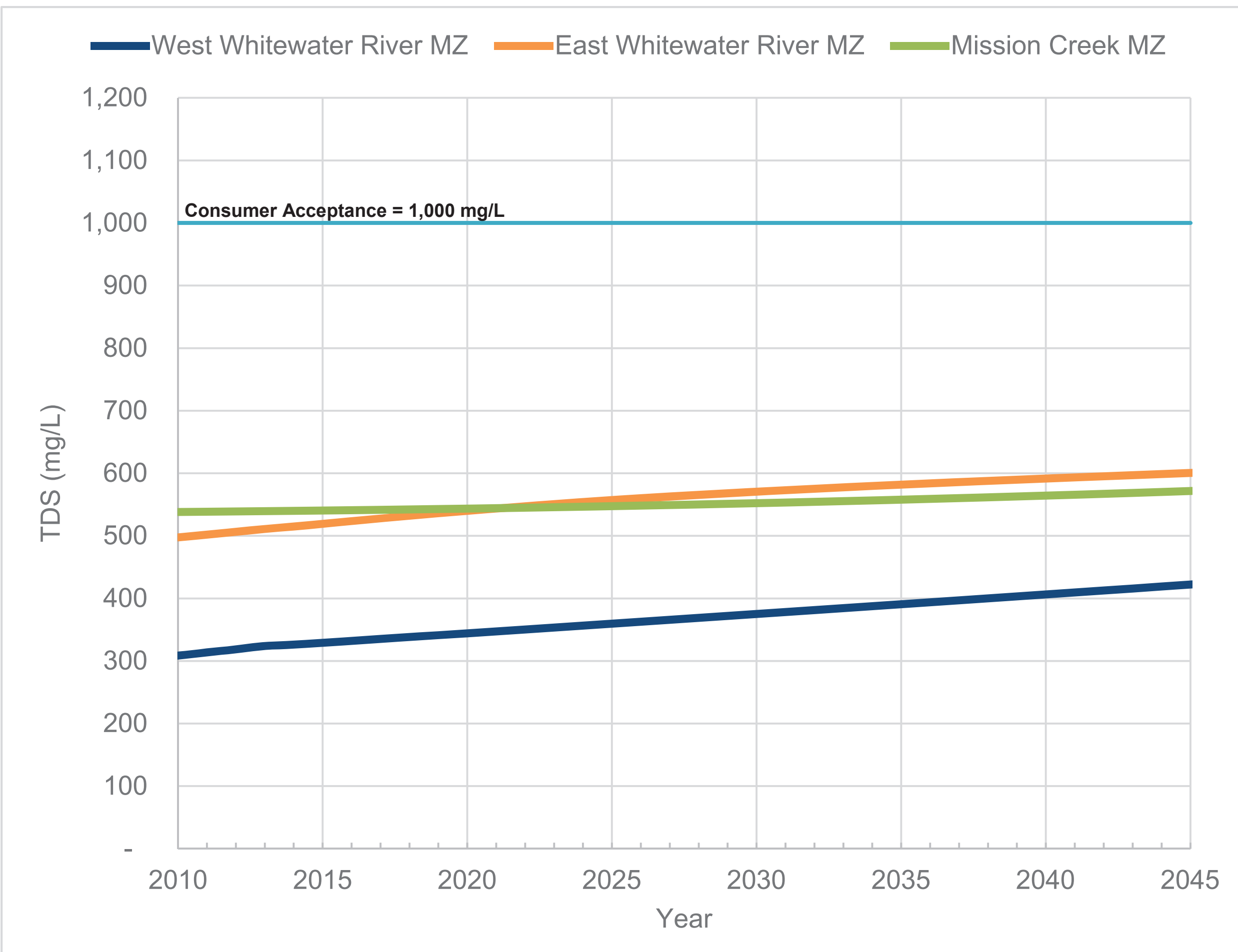
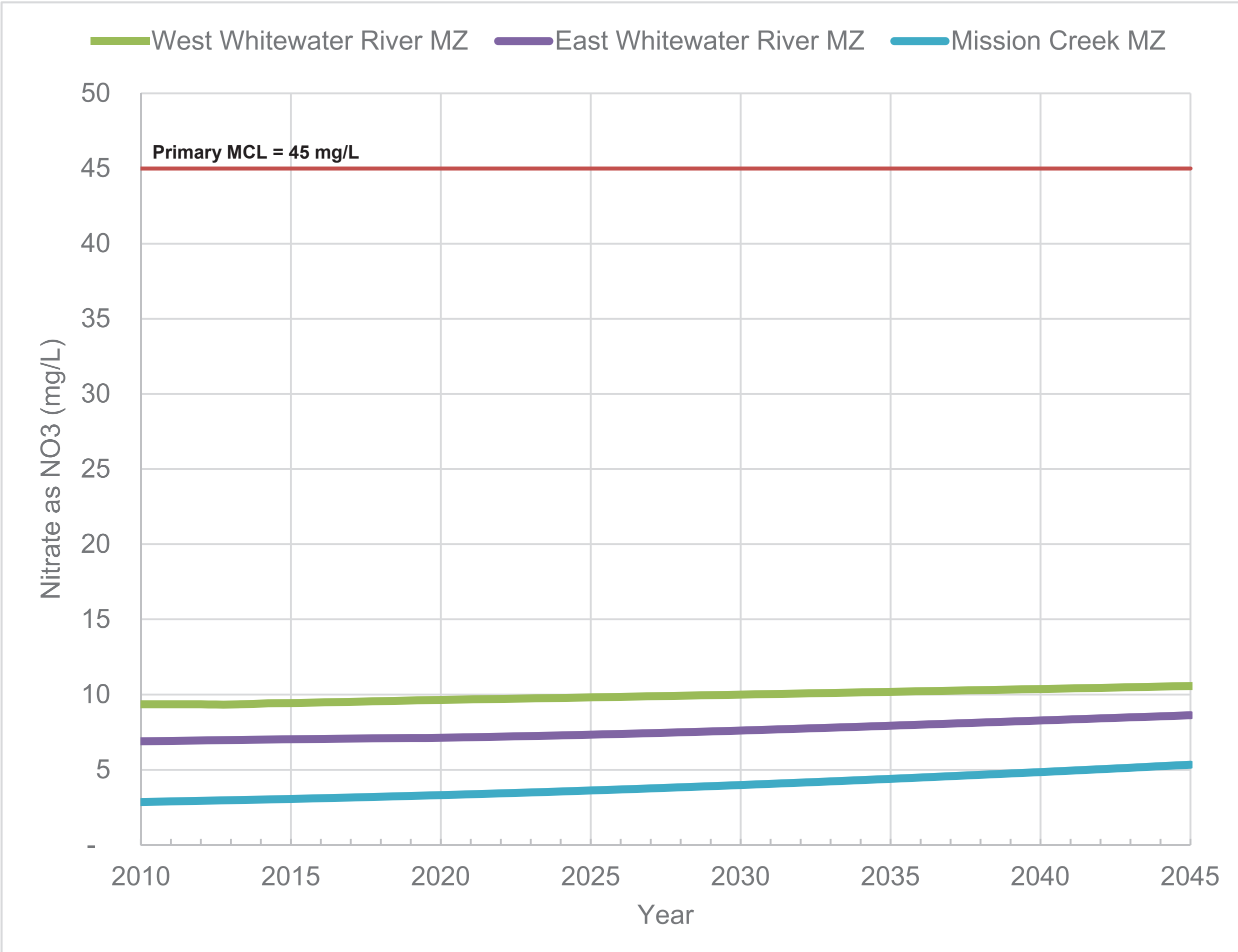


Figure ES-4
Estimated Average Future Water Quality by Management Zone – Nitrate



MANAGEMENT STRATEGIES

The water supply goals established for the Coachella Valley SNMP planning area are summarized in the Coachella Valley Water Management Plan and the Mission Creek/Garnet Hill Water Management Plan (CVWD, 2012a; CVWD *et al.*, 2013). The goals are to:

- meet current and future demands with a 10 percent supply buffer;
- eliminate long-term groundwater overdraft;
- manage and protect water quality;
- comply with state and federal laws and regulations;
- manage future costs; and
- minimize adverse environmental impacts.

These goals form the basis of SNMP management strategies described in this section. Management strategies ensure these goals are considered together with the management of salts and nutrients to protect the beneficial uses of groundwater in the Coachella Valley Groundwater Basin.

Planned projects were compiled from the Coachella Valley Integrated Regional Water Management Plan, Coachella Valley Water Management Plan (Update), Mission Creek/Garnet Hill Water Management Plan, and Urban Water Management Plans. These planned projects are aggregated to form programmatic management strategies to achieve the prescribed water supply planning goals with analysis of the impact to salt and nutrients in the groundwater basin. The following types of management strategies are presented in the SNMP:

- Public Outreach and Awareness
- Managing Source Water Quality
- Demand Management and Conservation
- Wastewater/Source Control and Infrastructure Improvements
- Stormwater Management
- Planned Projects
- Data Collection and Improved Basin Understanding

ANTI-DEGREDATION ANALYSIS

SWRCB Resolution No. 68-16 (also known as the Anti-degradation Policy) is a state policy that establishes the requirement that discharges to waters of the state shall be regulated to achieve the “highest water quality consistent with maximum benefit to the people of the State.” The intent of the Anti-Degradation Policy is to regulate discharges to protect surface water and groundwater quality. The Recycled Water Policy requires adherence with and an analysis of anti-degradation. Listed below are the steps to determine compliance with Resolution No. 68-16:

1. Determine if planned recycled water projects, if implemented, will significantly change the water quality in a MZ
2. Evaluate if projected changes to the groundwater exceed WQOs or unreasonably affect beneficial uses of the groundwater
3. If so, demonstrate whether any projected change would be consistent with the maximum benefit to the people of the State.

The average concentrations of TDS and nitrate (as NO_3) in the West Whitewater River, East Whitewater River, and Mission Creek MZs do not currently exceed Basin Plan WQOs. Based on the currently planned recycled water projects, a significant change in water quality that is inconsistent with the Basin Plan WQOs is not anticipated in the next 30-year water management planning period. Therefore, any impact of beneficial uses from recycled water projects is not anticipated.

The changes in water quality that do occur are consistent with the maximum benefit to the people of the State. As addressed in the policy, landscape irrigation (all planned recycled water projects) with recycled is to the benefit of the people of the State. Within the Policy, the SWRCB acknowledges use of recycled water for irrigation may, regardless of its source, collectively affect groundwater quality over time, its use is still a benefit. Use of recycled water also supports the sustainable and reliable use of groundwater by providing an alternative supply.

Planned recycled water projects meet the requirements of Resolution No. 68-16.

CEQA/NEPA COMPLIANCE

The goal of the SNMP is to identify a range of potential strategies for basin-wide management of salts and nutrients. The SNMP itself does not trigger CEQA compliance requirements, but a regulatory action such as a Basin Plan amendment would. Certification of a CEQA document for the SNMP is not anticipated to be required. Since preparation of the SNMP has no federal nexus at this time (i.e., funding for document preparation or federal approval of the SNMP), compliance under the NEPA is not required for SNMP preparation alone.

It is anticipated that implementation measures identified in the SNMP could be adopted by the RWQCB as amendments to the RWQCB's Basin Plan or developed as stakeholder projects. The RWQCB's basin planning process is certified by the Secretary for Resources as "functionally equivalent" to CEQA, and therefore exempt from the requirement for preparation of an Environmental Impact Report (EIR) or Negative Declaration and Initial Study (14 Cal. Code Regs. §15251(g)). Instead, the RWQCB, as CEQA Lead Agency, would prepare a CEQA-equivalent document.

The stakeholders that are public agencies who would carry out or implement projects associated with the SNMP, would be the lead agency under CEQA for these individual projects. The type of CEQA document necessary for each project would depend on the project's description, size and potential to cause significant environmental effects.

Section 1
Introduction

This section provides an overview of the Salt and Nutrient Management Plan (SNMP) for the Coachella Valley, including related state and local policy. This section also summarizes the stakeholder process conducted during development of the Coachella Valley SNMP.

A coordinated group of water agencies has organized to evaluate regional water management issues in the Coachella Valley. The Coachella Valley Regional Water Management Group (CVRWMG), whose purpose is to coordinate water resource planning and management efforts, consists of Coachella Valley Water District (CVWD), Desert Water Authority (DWA), Indio Water Authority (IWA), Coachella Water Authority (CWA), Mission Springs Water District (MSWD), and Valley Sanitary District (VSD).

The CVRWMG initially held a series of three public workshops educating stakeholders on the SNMP process and jointly developed a scope of work and budget consisting of a three-phase approach. As part of the development of the SNMP-related work that has been completed to date, the current CVRWMG and Stakeholders explored several of the issues that are likely to be addressed as part of the SNMP process. One of the challenges identified for this SNMP was the number of issues and the large size/scale of the SNMP, especially given the current Basin Plan's lack of subbasin distinction. Therefore, the SNMP process is being developed using a phased approach that will allow it to be completed over time in an incremental manner.

1. Phase I: Initial SNMP Scoping and Work Plan Development
2. Phase II: SNMP Development
3. Phase III: SNMP Monitoring and Other Follow-Up Work such as additional monitoring and data collection (if necessary and dependent on outcomes of Phase II)

Phase I of the SNMP development was completed by the CVRWMG; the result was a work plan for Phase II of the SNMP development. Phases II and III are being completed by CVWD, DWA and IWA, with input from the basin stakeholders. Phases II of the SNMP development is the preparation of the plan, including the monitoring plan, and is documented herein. Phase III of the process is the implementation of the monitoring plan.

Within Phase II, the process has been divided into three stages, preliminary data review and determination of quantitative methods; determination of ambient water quality and documentation of salt and nutrient sources and sinks; and identification of water management goals and salt and nutrient management strategies. Each of the first two stages have a technical memorandum documenting the work completed to that stage of the process: Technical Memorandum No.1 (TM-1) in **Appendix A** of this report and

Technical Memorandum No.2 (TM-2) in **Appendix B** of this report, respectively. Because the process evolved during plan development, the two technical memoranda represent the status of the work at the time of their preparation. This report documents the final findings, conclusions, and recommendations of the SNMP.

1.1 SALT AND NUTRIENT MANAGEMENT PLAN ORGANIZATION

The SNMP is organized as follows:

Section 1 – Introduction: Provides information regarding the SNMP purpose, description of the California Recycled Water Policy, definition of the study area and description of SNMP components.

Section 2 – Regulatory Framework and Beneficial Uses: This section describes the designated beneficial uses in the Basin Plan and identifies the specified beneficial uses for the Coachella Valley Groundwater Basin.

Section 3 – Water Quality Objectives: This section describes the state and federal policies that regulate WQOs in California and defines the current narrative and numerical WQOs for the Coachella Valley Groundwater Basin.

Section 4 – Basin Characterization: This section defines the geologic and hydrologic properties of the basin that pertain to salt and nutrient management.

Section 5 – Ambient Water Quality: This section identifies potential constituents of concerns and documents the ambient water quality, i.e., current salt and nutrient constituent water quality concentrations.

Section 6 – Future Water Quality: Background information on salt and nutrient sources and sinks and users of water are presented in this section; modeling assumptions are also documented. These different components are discussed to establish the foundation for estimating future water quality.

Section 7 – Management Strategies: Management and planning goals and strategies for the basin are described in this section. Specific projects are also listed and discussed relative to salt and nutrient management.

Section 8 – Monitoring Plan: This section of the report reviews current water quality monitoring programs and provides recommendations for future monitoring to better understand the ambient water quality of the Coachella Valley Groundwater Basin.

Section 9 – CEQA NEPA Compliance: This section of the report describes how the recommended management strategy conforms to California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) requirements.

1.2 PURPOSE OF THE SALT AND NUTRIENT MANAGEMENT PLAN

The State Water Resources Control Board (SWRCB) adopted Resolution No. 2009 011 in February 2009 that established the Recycled Water Policy (Policy). The Policy requires the SWRCB and the nine Regional Water Quality Control Boards (RWQCBs) to exercise the authority granted to them by the Legislature to encourage the use of recycled water, consistent with state and federal water quality laws. To achieve this goal, the Policy provides direction to California's nine RWQCBs on appropriate criteria to be used in regulating recycled water projects (SWRCB, 2009). One objective of the Policy is that salts and nutrients from all sources be managed on a basin-wide or watershed-wide basis that ensures meeting WQOs and protection of beneficial uses. The Policy states that the SWRCB finds the most appropriate way to address salt and nutrient issues is through the development of stakeholder-driven regional salt and nutrient management plans, as opposed to establishing requirements solely on individual recycled water projects.

The Coachella Valley is a desert region with little natural rainfall and high evapotranspiration, urban and agricultural development, past groundwater overdraft, heavily reliant on imported water supplies, and has a natural connection to the Colorado River with historic, periodic flooding. Additionally, recycled water use is planned to increase in the region to take advantage of reliable water supply alternatives. These factors, together with already naturally-occurring high salinity in parts of the groundwater basin, have the potential to change the long-term groundwater quality in the basin. If water resources in the Coachella Valley are not managed, long-term water quality degradation of the groundwater basin could occur, impacting the beneficial use of groundwater.

The Policy identifies the requirements of a SNMP, along with requirements for recycled water projects. Tabulated in **Table 1-1** are each requirement in the Policy related to SNMPs, and a brief description. Declining imported water supply conditions in California has led to the need to increase local water supplies. The Coachella Valley is dependent upon the Coachella Valley groundwater system as a reservoir for reliable municipal and irrigation water supply, and therefore the protection of this resource is important. Recycled water projects provide an alternative to augment and secure groundwater resources. This SNMP presents an opportunity to evaluate recycled water projects for the protection of long-term water supplies and to ensure reliability.

Table 1-1
Salt and Nutrient Management Plan Requirements

Policy Section	Component	Section in Plan
6(b)(3)(a)	Basin/subbasin wide monitoring plan including an appropriate network of monitoring locations	8
6(b)(3)(a)(i) 6(b)(3)(a)(iii)	Plan must focus on water quality near supply wells and areas near large water recycling projects (e.g., groundwater recharge); monitoring locations should target areas of groundwater/surface water connectivity, where appropriate Identify stakeholders responsible for conducting, compiling, and reporting monitoring data	8
6(b)(3)(b)	Provision for annual monitoring of Constituents of Emerging Concern (CECs)[1]	8
6(b)(3)(c)	Water recycling and stormwater recharge/use goals and objectives	7
6(b)(3)(d)	Salt and nutrient source identification; basin/sub-basin assimilative capacity and loading estimates; and fate and transport of salts and nutrients	7
6(b)(3)(e)	Implementation measures to manage salt and nutrient loading in the basin on a sustainable basis	7
6(b)(3)(f)	Anti-degradation analysis demonstrating that projects within the plan will, collectively, satisfy the requirements of Resolution No. 68-16[2]	5

1. Includes human health-based CECs (e.g., NDMA, 17β-estradiol), performance indicator CECs (e.g., DEET, sucralose), and surrogates (e.g., ammonia, TOC, electrical conductivity).
2. Resolution No. 68-16 establishes State policy with respect to the maintenance of high-quality waters consistent with maximum benefit to the people of the state.

The Coachella Valley SNMP seeks to support the following objectives:

- meet current and future demands with a 10 percent supply buffer;
- eliminate long-term groundwater overdraft;
- manage and protect water quality;
- comply with state and federal laws and regulations;
- manage future costs; and
- minimize adverse environmental impacts.

1.3 SALT AND NUTRIENT MANAGEMENT PLANNING AREA

The planning area for the SNMP includes most of the Coachella Valley as shown on **Figure 1-1**. The study area is defined as the Coachella Valley floor and underlying groundwater basins, extending from the Riverside County boundary at the northern end, to the Salton Sea at the southeast end. The planning area is bounded on the west end by the jurisdictional boundary separating DWA and from the San Gorgonio Pass Water Agency. This location also corresponds to the boundary between the Whitewater River[1] and the San Gorgonio Pass subbasins. Subbasins are subdivisions, or groundwater basins within the larger, Coachella Valley groundwater basin. Subareas are further subdivisions of subbasins based on geology, water quality, areas of confined groundwater, and groundwater divides (DWR, 1964). The planning area is bounded to the northeast by the Little San Bernardino Mountains and on the southwest by the San Jacinto and Santa Rosa mountain ranges. This area is coincident with the planning area of the Coachella Valley Integrated Regional Water Management Plan. **Figure 1-2** subbasins and subareas that comprise the Coachella Valley Groundwater Basin. Management zones are the areas established in the SNMP to evaluate and manage groundwater quality within the Coachella Valley. The determination of these zones is discussed in further detail in TM-1 (**Appendix A**).

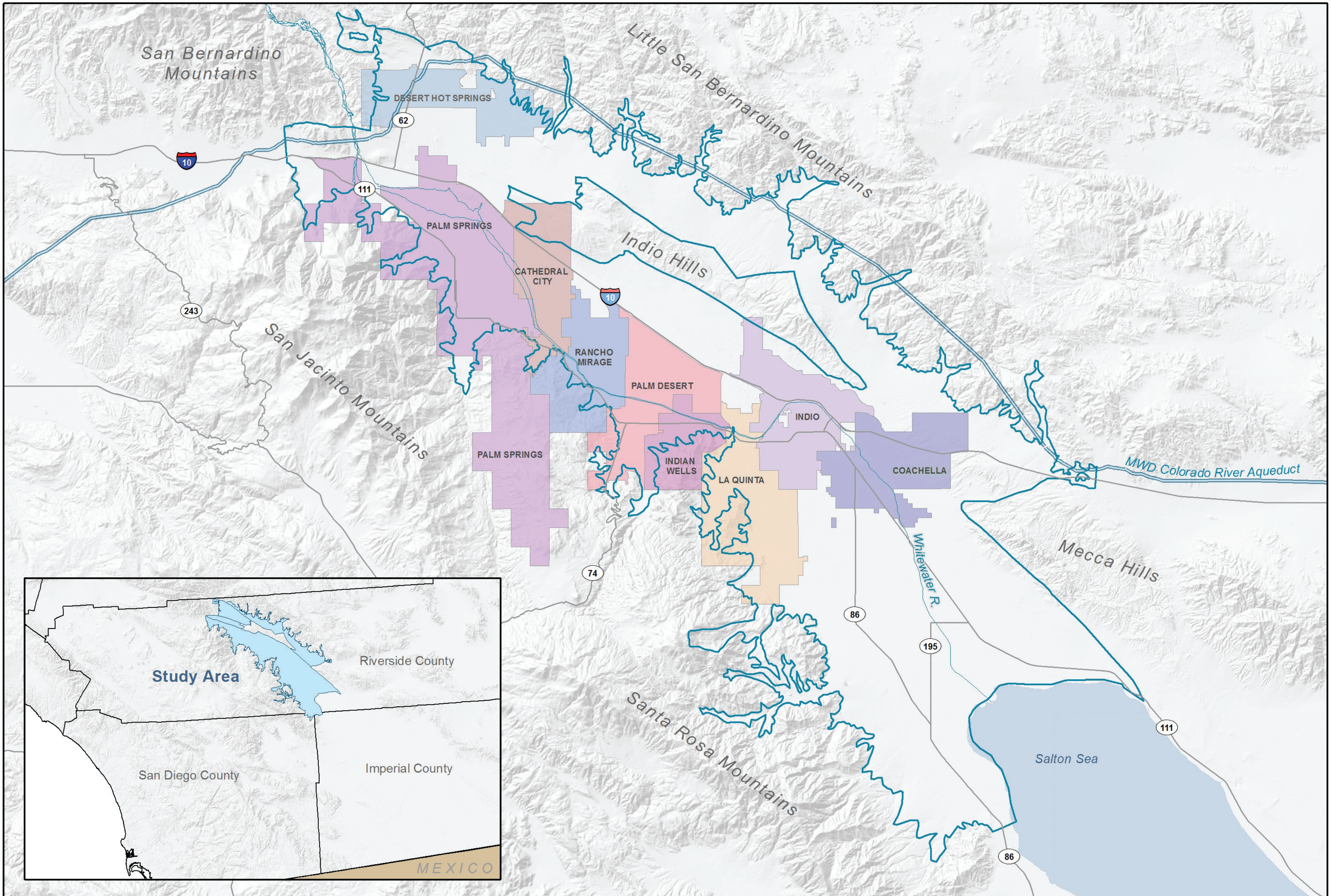
1.4 STAKEHOLDER PROCESS

Stakeholder participation is fundamental to ensure that this SNMP reflects the local requirements of the region and is required by the Policy. The Policy states that “local water and wastewater entities, together with local salt/nutrient contributing stakeholders, will fund locally driven and controlled, collaborative processes open to all stakeholders that will prepare salt and nutrient management plans…”

Key stakeholders include agencies associated with groundwater management, owners and operators of recharge facilities, water purveyors, water districts, and salt and nutrient contributing dischargers including wastewater dischargers. These agencies and entities have access to basin-specific data and information that is essential to the development of successful SNMPs. Private well owners may also have essential water quality information. Other parties from regulatory agencies, environmental groups, industry, and interested persons may also provide important support.

Most water users in the Coachella Valley receive water service from one of six primary purveyors: CVWD, DWA, IWA, MSWD, CWA and Myoma Dunes Mutual Water Company. Several isolated communities and commercial developments are supplied by smaller private water companies or by tribal water systems. In addition, private wells supply groundwater to many golf courses, farms, and private water users.

[1] DWR Bulletins 108 and 118 use the term “Indio Subbasin.”



Key to Features

Major Roads

Colorado River Aqueduct

Groundwater Basin (Study Area)

N

0 2.5 5 Miles

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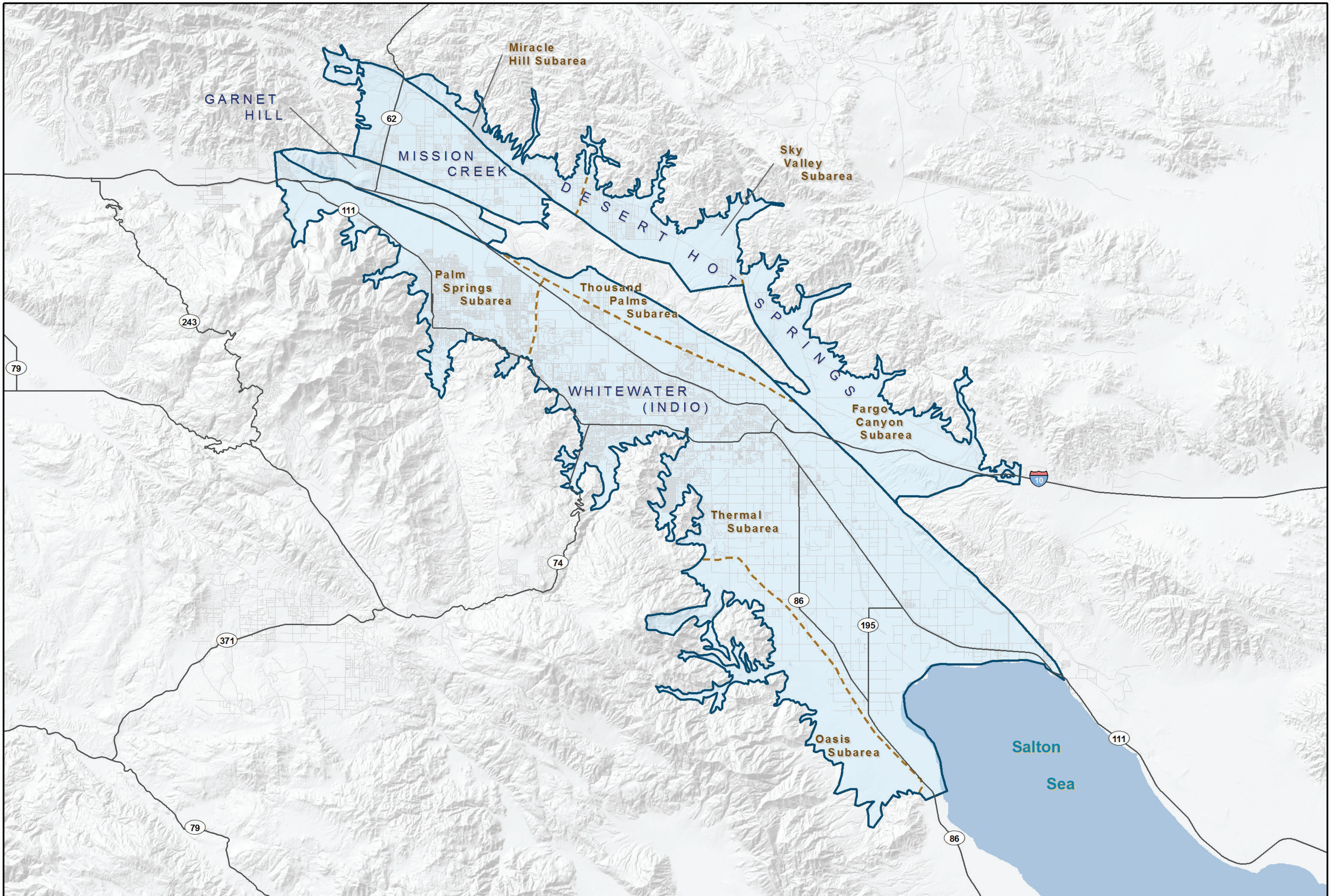
Date: April 23, 2015

Coachella Valley Cities in Study Area

MWH

Figure 1-1



Key to Features

Subbasins

Subareas

N 0 2.5 5 Miles

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Date: April 15, 2015

Coachella Valley Groundwater Basins

MWH

Figure 1-2

Wastewater collection and treatment service is provided by MSWD, CVWD, the City of Palm Springs, Coachella Sanitary District, and Valley Sanitary District (portions of Indio). Areas that are not served by one of these agencies rely on individual on-site waste disposal systems for wastewater treatment and disposal. City boundaries, service area boundaries of Valley water purveyors, wastewater service area boundaries, and locations of wastewater treatment plants (WWTPs) and wastewater reclamation plants (WRPs) are presented in **Figure 1-3**.

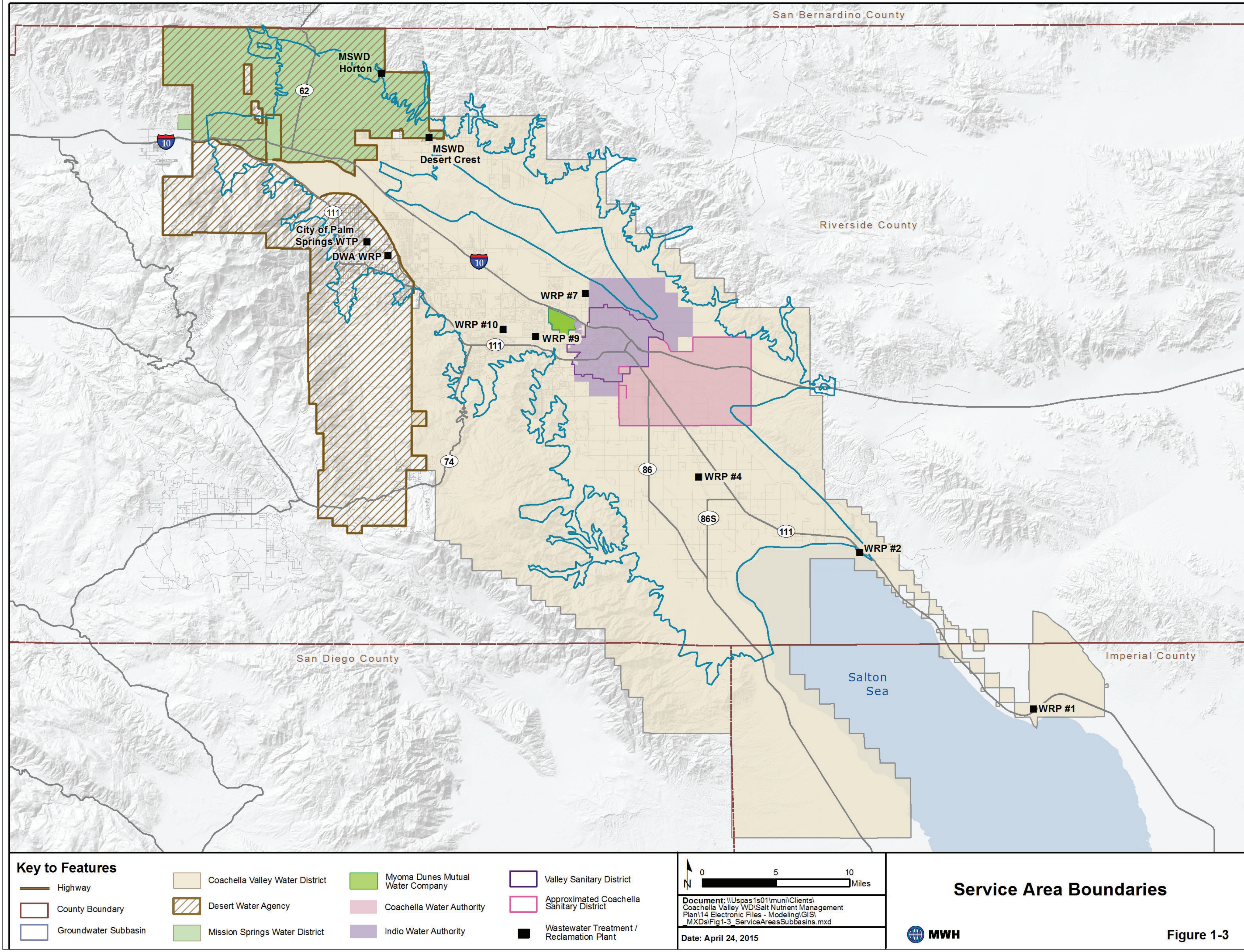
For these stakeholders, the results of this plan may have regulatory impacts related to permitting of their future projects and renewal of existing projects. If there is no capacity, to handle waste discharges this could potentially translate into additional costs for stakeholders to meet regulatory requirements.

Tribal lands, federal lands, and other lands set aside for conservation represent a significant proportion of the Coachella Valley. **Figure 1-4** represents the federal land holdings, including tribal trust lands, stakeholder lands within the Coachella Valley basin.

While CVWD, DWA, and IWA have partnered to complete the plan, no single entity is wholly responsible for SNMP preparation. Lead agencies are required to initiate and coordinate the process, but the desired result of a collaborative process is to leverage collective knowledge of many participating stakeholders. The role of a stakeholder includes attendance at stakeholder meetings, providing data as needed, reviewing of materials distributed during the process, providing information and plans related to salt and nutrient management, and providing comments and feedback. A list of the project stakeholder meetings and their purpose is listed in **Table 1-2**; a Stakeholder list is provided in **Appendix C**.

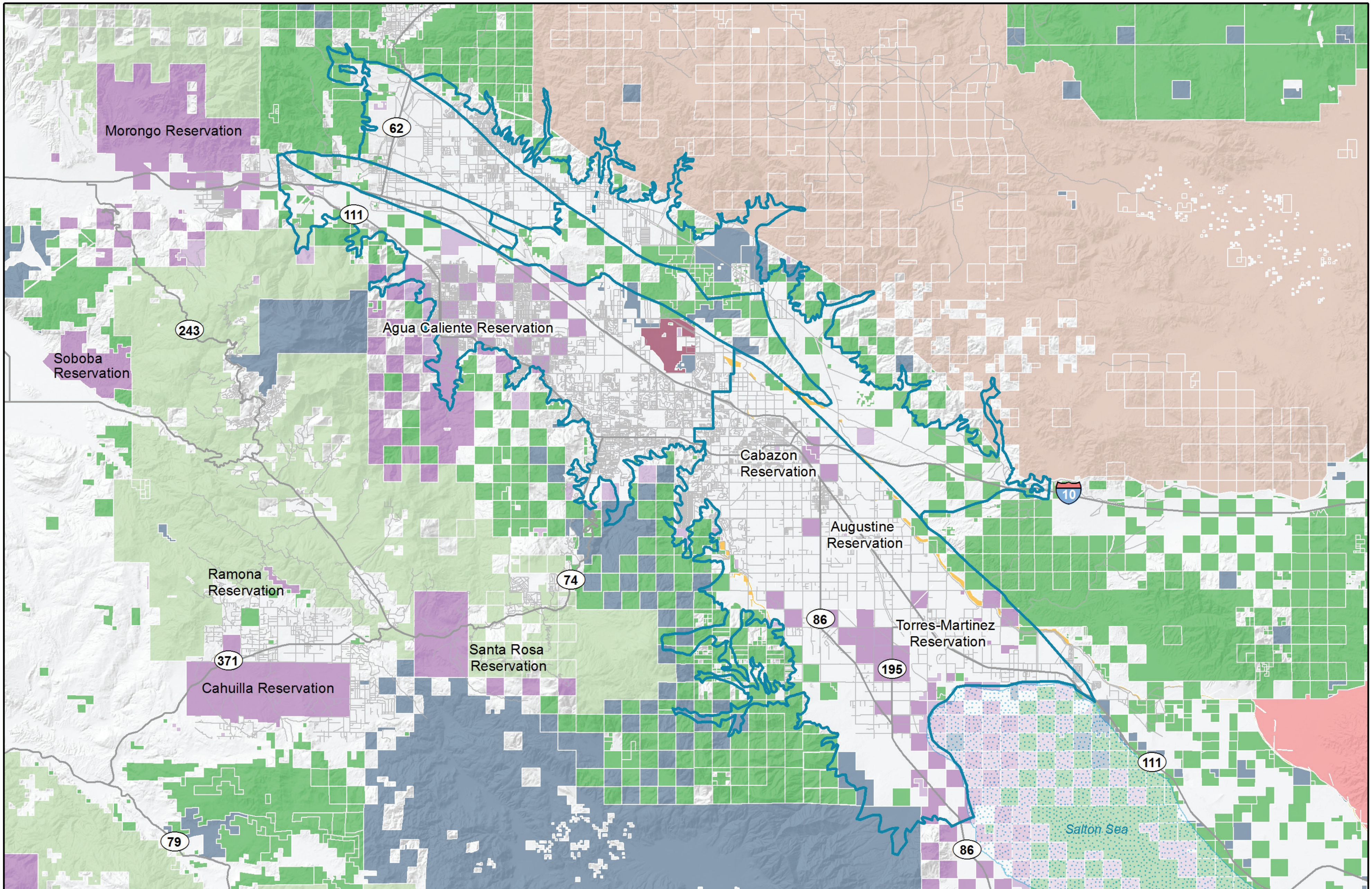
Table 1-2
Summary of Salt and Nutrient Plan Stakeholder Meetings

Meeting Date	Meeting and Purpose
June 4, 2014	Stakeholder Meeting: Introduction to the SNMP Process
September 4, 2014	Stakeholder Meeting: Review of Technical Memo No.1, SNMP Technical Methods for Calculation of Ambient Water Quality
October15, 2014	Stakeholder Meeting: Review of Technical Memo No.2, SNMP Ambient Water Quality
January. 7, 2015	Stakeholder Meeting: SNMP Progress Update
February 19, 2015	Public Workshop: Review of Methods and Revisions to TM-2
February 26, 2015	Stakeholder Meeting: SNMP Progress Update
April 13, 2015	Stakeholder Meeting: Review of Draft SNMP Plan.



Service Area Boundaries

Figure 1-3



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Date: 5/28/2015

Federal and State Lands

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Figure 1-4

Section 2
Regulatory Framework and Beneficial Uses

The SWRCB adopted Resolution No. 2009-011 in February 2009 (later updated in January 2013) that established the Recycled Water Policy. This Policy requires the SWRCB and RWQCBs to exercise their authority to encourage the use of recycled water, consistent with state and federal water quality laws. The Policy provides direction to California's nine RWQCBs on appropriate criteria to be used in regulating recycled water projects (SWRCB, 2013). The purpose of the Policy is to increase the use of recycled water, augmenting existing supplies, while meeting applicable state and federal water quality laws. This section summarizes the Recycled Water Policy, applicable other laws, as well as the Water Quality Control Plan for the Colorado River Basin – Region 7 (Basin Plan) specified beneficial uses.

2.1 RECYCLED WATER POLICY

Based on file data from CVWD and DWA, recycled water usage in the Coachella Valley is approximately 12,400 acre-feet per year (AFY) (8,200 AFY CVWD usage, 4,200 AFY DWA usage). Recycled water usage in the East Whitewater River area is approximately 700 AFY and is mainly for agricultural irrigation, duck clubs and fish farms. The amount of municipal wastewater available for reuse is expected to increase 150 percent by 2045 (MWH, 2013; IWA, 2011). Some pasture irrigation has historically occurred with recycled water from Valley Sanitary District and Coachella Sanitary District.

In California, declining water availability has led to the need to increase local water supplies and has encouraged water purveyors to develop water resources, technology, and policy. California water agencies are on the leading edge of the water resource management, supply portfolio diversification, and development of supplemental sources such as stormwater and recycled water. California agencies need to develop sustainable water supplies that meet economic and policy requirements.

In an effort to encourage the diversification of water supply portfolios and encourage the beneficial uses of water, the SWRCB developed a Recycled Water Policy in 2009, and later updated it in 2013. The purpose of the Recycled Water Policy is to increase the use of recycled water while meeting state and federal water quality requirements. The policy provides direction to the RWQCBs and recycled water advocates regarding the appropriate criteria to be used by the SWRCB and the RWQCBs in issuing permits for recycled water projects. The objective of this requirement is to "facilitate basin-wide management of salts and nutrients from all sources in a manner that optimizes recycled water use while ensuring protection of groundwater supply and beneficial uses, agricultural beneficial uses, and human health." The Policy compels stakeholders to develop implementation plans to meet objectives for salts and nutrients. These plans may then be adopted by a RWQCB as amendments to the region's water quality control plan, or Basin Plan. The Policy also requires that SNMPs be completed by May 2014; although, an extension may be granted, and has been, by the RWQCB if that the stakeholders have made substantial progress towards completion of an SNMP. On May 28, 2014, the Colorado River RWQCB granted a time extension for completion of the Coachella Valley SNMP until March 31, 2015.

2.2 PORTER-COLOGNE ACT

The Porter-Cologne Water Quality Control Act is the California law adopted to protect water quality and beneficial uses of the state's water. Under the law, the SWRCB has the ultimate authority over state water rights and water quality policy. It requires the adoption of water quality control plans (the Basin Plans) and WQOs (WQO) by the nine RWQCBs for respective their regions. California Water Code §13050(f) describes the beneficial uses of surface and ground waters that may be designated by the State or RWQCB for protection as follows:

> "Beneficial uses of the waters of the state that may be protected against quality degradation include, but are not necessarily limited to, domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves."

Also under the law, the SWRCB and nine RWQCBs, under the auspices of the U. S. Environmental Protection Agency (USEPA), have the responsibility of granting Clean Water Act National Pollutant Discharge Elimination System (NPDES) permits for certain point-source discharges to surface waters. The RWQCBs are also responsible for issuing and enforcing waste discharge requirements for discharges affecting water quality. The nine RWQCBs differ somewhat in the extent they choose to apply waste discharge requirements and other regulatory actions based on the unique hydrologic conditions of each region.

2.3 BASIN PLAN

The Basin Plan establishes beneficial uses and WQO for the Colorado River Basin Region.

The Basin Plan is designed to preserve and enhance water quality and protect the beneficial uses of all waters within the region (RWQCB, 2014). Specifically, the Basin Plan:

- Designates existing and potential future beneficial uses for surface and ground waters;
- Sets WQOs that must be maintained to reasonably protect the designated beneficial uses and conform to the state's anti-degradation policy;
- Describes implementation programs to protect the beneficial uses of all waters in the region;

- Describes monitoring activities to evaluate the effectiveness of the Basin Plan (Water Code §13240 through 13244, and 13050); and
- Incorporates all applicable State and RWQCB plans and policies.

The Colorado River Region, the region encompassing the planning area, incorporates all of Imperial County and portions of San Bernardino, Riverside, and San Diego Counties. For planning and reporting purposes, the Basin Plan area of coverage is divided into seven major planning areas on the basis of different economic and hydrologic characteristics: Lucerne Valley, Hayfield, Coachella Valley, Anza-Borrego, Imperial Valley, Salton Sea, and East Colorado River Basin. This SNMP covers the Coachella Valley.

The designation of beneficial uses for the waters of the State by the RWQCB is mandated under California Water Code §13240. The federal Clean Water Act Section 303 requires that the State adopt designated beneficial uses for surface waters. The requirements of both Acts relative to the designation of beneficial uses are summarized below (RWQCB, 2014).

The state must maintain the highest water quality which is reasonable while considering all demands being made and to be made on the water source and the total values involved. These values may be beneficial and detrimental, economic and social, tangible and intangible. In order to maintain a balance between water quality and total value, RWQCBs are required to consider the following issues when determining WQOs (California Water Code §13241):

- Past, present, and probable beneficial uses;
- Environmental characteristics of the hydrographic unit under consideration, including water available thereto;
- Water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect water quality in the area;
- Economic considerations;
- The need for developing housing in the region; and
- The need to develop and use recycled water.

The implementation portion of a Basin Plan must contain a description and nature of specific actions that are needed to achieve the WQOs, a time schedule, and a plan for monitoring compliance (California Water Code §13242).

2.3.1 Beneficial Uses

Beneficial uses are established in the Basin Plan for surface waters, groundwaters, and springs. Beneficial use categories, as defined in the Basin Plan, are summarized in **Table 2-1**.

Table 2-1
Definitions of Beneficial Use Categories

Category		Definition
MUN	Municipal and Domestic Supply	Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.
AGR	Agriculture Supply	Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.
AQUA	Aquaculture	Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.
IND	Industrial Service Supply	Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization.
GWR	Groundwater Recharge	Uses of water for natural or artificial recharge of ground water for purposes of future extraction, maintenance of water quality, or halting salt water intrusion into fresh water aquifers.
REC I	Water Contact Recreation	Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, and use of natural hot springs.
REC II	Non-Contact Water Recreation	Uses of water for recreational activities involving proximity to water, but not normally involving contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.
WARM	Warm Freshwater Habitat	Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.
COLD	Cold Freshwater Habitats	Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.
WILD	Wildlife Habitat	Uses of water that support terrestrial ecosystems including, but not limited to, the preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.
POW	Hydropower Generation	Uses of water for hydropower generation.
FRSH	Freshwater Replenishment	Uses of water for natural or artificial maintenance of surface water quantity or quality.
RARE	Preservation of Rare, Threatened, or Endangered Species	Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.

Source: RWQCB, 2014; Table 2-1

The intent of beneficial use establishment as defined in California Water Code §13241, Division 7 is as follows:

> "Beneficial uses of the waters of the State that may be protected against quality degradation include, but are not necessarily limited to, domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves."

Beneficial uses of surface waters for this region are designated by the California Regional Water Quality Control Board, Colorado River Basin Region. **Table 2-2** summarizes the designated beneficial uses of surface waters within the study area as identified in the Basin Plan for the region (RWQCB, 2014).

The Basin Plan designates three primary beneficial uses for groundwater in the Coachella Valley Planning Area: municipal, agricultural, and industrial supply. , the Miracle Hill subarea water has for Water Contact Recreation. Mission Creek and portions of Whitewater are designated for Aquaculture. Beneficial use designations for individual aquifers or sub-basins/subareas have not been defined at this time. The presumption in the Basin Plan is all groundwaters in Coachella Valley either are or could potentially be used for these purposes. The RWQCB identified "Beneficial Use Designations of Aquifers" as a potential water quality issue for investigation and review in the 2007 Triennial Review of the Basin Plan. The RWQCB envisioned "recommending changes to the beneficial use designations of groundwater to correspond to individual groundwater aquifers within hydrologic units." It should be noted that during CVRWMG scoping meetings for this plan, the problem associated with MUN beneficial use designations for naturally saline shallow groundwater in the Coachella Valley. This is another issue for consideration by the Regional Baord for the next Triennial Review of the Basin Plan. This SNMP documents the existing beneficial uses of groundwater within the Coachella Valley.

Several inconsistencies are apparent in the Basin Plan regarding the existing and potential beneficial uses. For example, several "existing" uses for the Coachella Canal such as contact and non-contact recreation are listed; however, these uses are prohibited by CVWD. Issues with the potential spread of Quagga mussels have resulted in closure of some surface water bodies (such as Lake Cahuilla) to watercraft recreation. A similar situation exists regarding potential contact recreation in the Colorado River Aqueduct and portions of the Whitewater River where contact recreation is both dangerous and illegal. It may be appropriate to designate these uses as "prohibited." Power generation is an existing beneficial use for Colorado River Aqueduct water released at the Whitewater turnout. Future Basin Plan updates should reflect these changes.

Table 2-2
Beneficial Uses for Study Area Surface Waters and Ground Waters Designated by the Regional Water Quality Control Board, Region 7

Beneficial Use	Use Code	Surface Water							Ground-water
		Salton Sea	Coachella Valley Storm-water Channel[1]	Coachella Valley Drains	Coachella Canal	White-water River[2]	Colorado River Aqueduct4	Unlisted Perennial and Inter-mittent Streams	Coachella Hydrologic Subunit
Municipal and Domestic Supply	MUN				P	X	X	P	X[6]
Agricultural Supply	AGR				X	X			X
Aquaculture	AQUA	X							
Freshwater Replenishment	FRSH		X	X					
Industrial Service Supply	IND	P							X
Groundwater Recharge	GWR				X	X	X	I X	
Water Contact Recreation	REC I	X	X[3]	X[3]	X[3]	X	P[3]	I P X	
Non-Contact Water Recreation	REC II	X	X[3]	X[3]	X[3]	X		I X	
Warm Freshwater Habitat	WARM	X	X	X	X	I	X	I X	
Cold Freshwater Habitats	COLD					X			
Wildlife Habitat	WILD	X	X	X	X	X	X	I X	
Hydropower Generation	POW					X	P		
Preservation of Rare, Threatened, or Endangered Species	RARE	X	X[5]	X[5]	X[5]			[5]	

Notes:
X – Existing Use
P – Potential Use
I – Intermittent Use
1 – Section of perennial flow from approximately Indio to the Salton Sea
2 – Includes the section of flow from the headwaters in the San Gorgonio Mountains to (and including) the Whitewater Spreading Facility recharge basins near Indian Avenue crossing in Palm Springs
3 – Unauthorized Use
4 – Metropolitan's Colorado River Aqueduct
5 – Rare, endangered, or threatened wildlife exists in or utilizes some of these waterway(s). If the RARE beneficial use may be affected by a water quality control decision, responsibility for substantiation of the existence of rare, endangered, or threatened species on a case-by-case basis is upon the California Department of Fish and Game on its own initiative and/or at the request of the RWQCB; and such substantiation must be provided within a reasonable time frame as approved by the RWQCB.
6 - At such time as the need arises to know whether a particular aquifer which has no known existing MUN use should be considered as a source of drinking water, the RWQCB will make such a determination based on the criteria listed in the "Sources of Drinking Water Policy" in Chapter 2 of this Basin Plan. An "X" placed under the MUN in this Table for a particular hydrologic unit indicates only that at least one of the aquifers in that unit currently supports a MUN beneficial use. For example, the actual MUN usage of the Imperial hydrologic unit is limited only to a small portion of that ground water unit.

2.4 RESOLUTION NO. 68-16 – STATE ANTIDEGRADATION POLICY

SWRCB Resolution No. 68-16 is a state policy that establishes the requirement that discharges to waters of the state shall be regulated to achieve the "highest water quality consistent with maximum benefit to the people of the State". Under SWRCB Resolution No. 68-16, the RWQCB and the SWRCB must have sufficient grounds to adopt findings which demonstrate that any water quality degradation will:

- Be consistent with maximum benefit to the people of the State;
- Not unreasonably affect present and anticipated beneficial use of such water; and
- Not result in water quality less than prescribed in the policies (RWQCB, 2014).

In addition, any activity that results in discharges to existing high quality waters are 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 the maximum benefit to the people of the State will be maintained.

Resolution No. 68-16 establishes a general principle of non-degradation. The policy does allow for flexibility as water quality pertains to the best interests of the people of the State. Changes in water quality are allowed only where it is in the public interest and beneficial uses are not unreasonably affected. The SWRCB has interpreted Resolution No. 68-16 as incorporating the three part principles set forth in the federal anti-degradation policy. These three principles include: 1) existing in-stream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected; 2) where the quality of the waters exceed levels necessary to support propagation of wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds after full satisfaction of the intergovernmental coordination and public participation provisions of the State's continuing planning process that allowing lower water quality is necessary to accommodate important economic or social development in the area. By allowing such degradation, the State shall assure water quality adequate to protect existing uses fully; and 3) where high quality waters constitute an outstanding National resource, such as waters of national and state parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected (40 C.F.R.§131.12a). The terms and conditions of Resolution No. 68-16 serve as a general narrative WQO in all state water quality control plans (RWQCB, 2014).

The Resolution does not require that existing high quality water always be maintained. It states that any change must be consistent with maximum benefit to the people of the State; it cannot unreasonably affect beneficial uses, and must comply with applicable water quality control policies (SWRCB, 1994). To be consistent with the resolution, discharges may range between ambient or background and the WQOs in the Basin Plan. The resolution assumes the discharger must use best practicable treatment and control technology (BPTC). If a treatment or control method results in a discharge that maintains the existing water quality, then use of a less stringent level of treatment or control would not be in compliance with the Resolution. If the discharge, even after treatment, unreasonably affects beneficial uses or does not comply with the Basin Plan, the discharge is prohibited. The discharge is not required to be treated to levels that are better than ambient background water quality (SWRCB, 1994).

In November 2012, the California Third District Court of Appeal ruled in the case *Asociacion de Gente Unida Por El Agua v. Central Valley Regional Water Quality Control Board* (210 Cal.App.4th 1255) that the anti-degradation policy applies whenever there is “an existing high quality water” and “an activity which produces or may produce waste … that will discharge into such high quality water.” The appeals court interpreted an existing high quality water to exist where the baseline water quality (that existed in 1968) is better than the WQO.

While this case related to waste discharges from dairies in the Central Valley, the SWRCB Chief Counsel issued a memorandum on the case in February 2013. That memorandum stated “The Court … based its analysis on existing State Water Board guidance, so the case does not establish new rules or legal principles. [The case] is nevertheless significant because it gives precedential effect to some of this guidance. The decision also underscores the importance of documenting the steps to support an antidegradation analysis or to support a finding that an antidegradation analysis is unnecessary.”

The Court relied extensively on existing State Water Board guidance, including Administrative Procedures Update (APU) 90-004 and the 1995 Question and Answer document on Resolution 68-16. While APU 90-004 technically only applies to NPDES permitting, the Court found it instructive in applying Resolution 68-16 in other contexts stating:

> APU-90-004 sets forth a procedure for determining whether the existing water quality is to be protected: “The baseline quality of the receiving water determines the level of water quality protection. Baseline quality is defined as the best quality of the receiving water that has existed since 1968 when considering Resolution No. 68-16 …, unless subsequent lowering was due to regulatory action consistent with State and federal antidegradation policies.”

When undertaking an antidegradation analysis, the RWQCB must compare the baseline water quality (the best quality that has existed since 1968) to the WQOs. 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. However, if the baseline water quality is better than the WQOs, the baseline water quality must be maintained in the absence of findings required by the antidegradation policy.

The SWRCB Chief Counsel offered several additional observations regarding the effect of this decision:

- Time schedules or phased implementation of anti-degradation requirements are appropriate. As with other requirements, time schedules must be justified by facts in the record and supported by findings.
- The case confirms that what constitutes BPTC can vary in different situations involving the same type of discharge only if the board finds that any lesser treatment or control requirements were necessary to accommodate important economic or social development in the area, would avoid pollution or nuisance (i.e., would not cause WQOs to be exceeded) and would maintain the highest water quality consistent with the maximum benefit to the people of the state.
- “Maximum benefit” findings must consider the costs to the affected public, such as costs to treat water supplies affected by a discharge. When cost savings to the discharger are part of the justification for allowing degradation, a Water Board must also demonstrate how the cost savings are necessary to accommodate important social and economic development.
- The decision does not require regulated facilities in other programs to conduct groundwater quality monitoring in addition to or instead of other types of monitoring. Specific monitoring requirements must be based on the facts of each case. Orders authorizing discharges of waste should include findings demonstrating that the order as a whole provides adequate assurance that only the authorized amount of degradation, if any, will occur, and that monitoring and reporting requirements are adequate to detect degradation or to prevent any additional degradation if it were to occur.
- BPTC determinations may consider relative benefits of proposed treatment or control methods to proven technologies; performance data; alternative methods of treatment or control; methods used by similarly situated dischargers; and/or promulgated BAT or other technology-based standards. Costs of treatment or control should also be considered.

The effect of this decision on development of the SNMP has not been determined.

Section 3
Water Quality Objectives

The Recycled Water Policy requires the determination of whether current and projected salt and nutrient concentrations are consistent with applicable WQOs. This section identifies the WQOs against which current and projected salt and nutrient concentrations will be compared.

3.1 REGIONAL WATER QUALITY OBJECTIVES

WQOs typically established by the Basin Plan to protect and maintain the integrity of each type of beneficial use. Objectives may be narrative or numeric, and vary by location, beneficial use category, and surface water body/groundwater basin.

General objectives that apply to the entire planning region include the antidegradation provision of the Basin Plan, which states:

> "Wherever the existing quality of water is better than the quality established herein as objectives, such existing quality shall be maintained unless otherwise provided for by the provisions of the State Water Resources Control Board Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California."

The Basin Plan recognizes the lack of available data to develop specific numeric groundwater objectives for each subbasin in the region. Therefore, groundwater objectives are typically referenced at the applicable numeric objectives related to their beneficial use. A summary of referenced codes and narrative objectives for groundwater is summarized in **Table 3-1**.

Table 3-1
Basin Plan Groundwater Objectives Relative to Salt and Nutrient Management

Constituent	Water Quality Objective
Taste and Odors	Ground waters for use as domestic or municipal supply shall not contain taste or odor-producing substances in concentrations that adversely affect beneficial uses as a result of human activity.
Chemical and Physical Quality	Sections 64431 (Inorganic Chemicals), 64444 (Organic Chemicals), and 64678 (Lead and Copper) of California Code of Regulations, Title 22.
Brines	Discharges of water softener regeneration brines, other mineralized wastes, and toxic wastes to disposal facilities which ultimately discharge in areas where such wastes can percolate to ground waters usable for domestic and municipal purposes are prohibited.

Numeric WQOs are needed to estimate the assimilative capacity of a receiving water for individual constituents of concern. As referenced in the Basin Plan, Section 64431 of Title 22 specifies 45 mg/L (nitrate as NO3) as the drinking water maximum contaminant level to protect public health and this level is used as the WQO for nitrate. Unlike nitrate, there is no primary drinking water maximum contaminant level for total dissolved solids (TDS), which is a taste and odor constituent. The Basin Plan lists no numeric WQO for TDS.

The TDS water quality criterion is based on consumer acceptance of taste and odor, and a narrative objective that water quality shall not adversely affect beneficial uses as a result of human activity. As there is no code referenced in the Basin Plan for TDS, the SNMP uses California Code of Regulations, Title 22. Title 22 states that there is no fixed consumer acceptance contaminant level established for TDS. Title 22 states constituent concentrations lower than the Recommended contaminant level (500 mg/L) are desirable for a higher degree of consumer acceptance; constituent concentrations ranging to the Upper contaminant level (1,000 mg/L) are acceptable if it is neither reasonable nor feasible to provide more suitable waters; and constituent concentrations ranging to the Short-Term contaminant level (1,500 mg/L) are acceptable only for existing community water systems on a temporary basis pending construction of treatment facilities or development of acceptable new water sources.

Based on Title 22, the "Upper" limit of the “Consumer Acceptance Contaminant Level Range” for TDS is 1,000 mg/L. If water being served containing TDS concentrations above 1,000 mg/L is deemed to be unacceptable by customers, the State may take action. This is analogous with the nitrate MCL of 45 mg/L at which the State takes action to protect human health. This is the basis for using 1,000 mg/L as the criterion to determine assimilative capacity. It should also be noted that the primary sources of imported water supply, the Colorado River Aqueduct and the Coachella Valley Canal have WQOs of 747 mg/L (at Lake Havasu) and 879 mg/L (at Imperial Dam), respectively. The criteria used to calculate assimilative capacity for the SNMP are listed in **Table 3-2**.

Table 3-2
Water Quality Criteria Used to Determine Assimilative Capacity

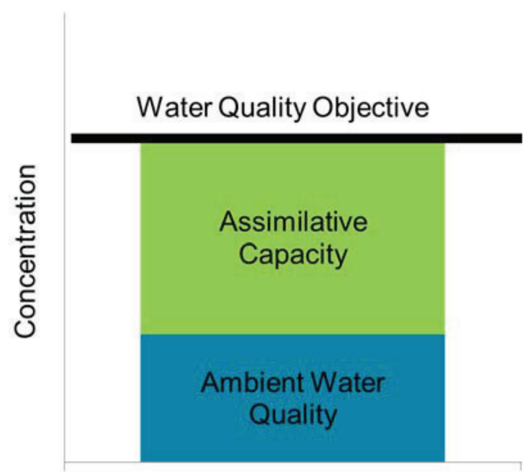
Constituent	Criterion (mg/L)
Nitrate (as NO_3)	45
Total Dissolved Solids	1,000

3.2 ASSIMILATIVE CAPACITY

The assimilative capacity of a surface water or groundwater is the ability of the water body to receive and accommodate natural and anthropogenic sources of pollutants, while maintaining water quality standards that are protective of the beneficial uses of the water resource. The SNMP discussion of assimilative capacity is focused exclusively on groundwater. Factors that affect the assimilative capacity of a basin depend on the contaminant, the soil type, and the groundwater chemistry and hydraulic parameters.

The available assimilative capacity of a water body or management zone is also defined as the difference between the applicable WQO for a pollutant parameter and the ambient water quality (AWQ) for that pollutant parameter (where it is lower than the objective). This is illustrated on **Figure 3-1**. Ambient water quality is the representative concentration of a water quality constituent within a water body or management zone. If the ambient water quality exceeds, the WQO, the presumption is that assimilative capacity does not exist.

Figure 3-1
Assimilative Capacity Relationship to Ambient Water Quality

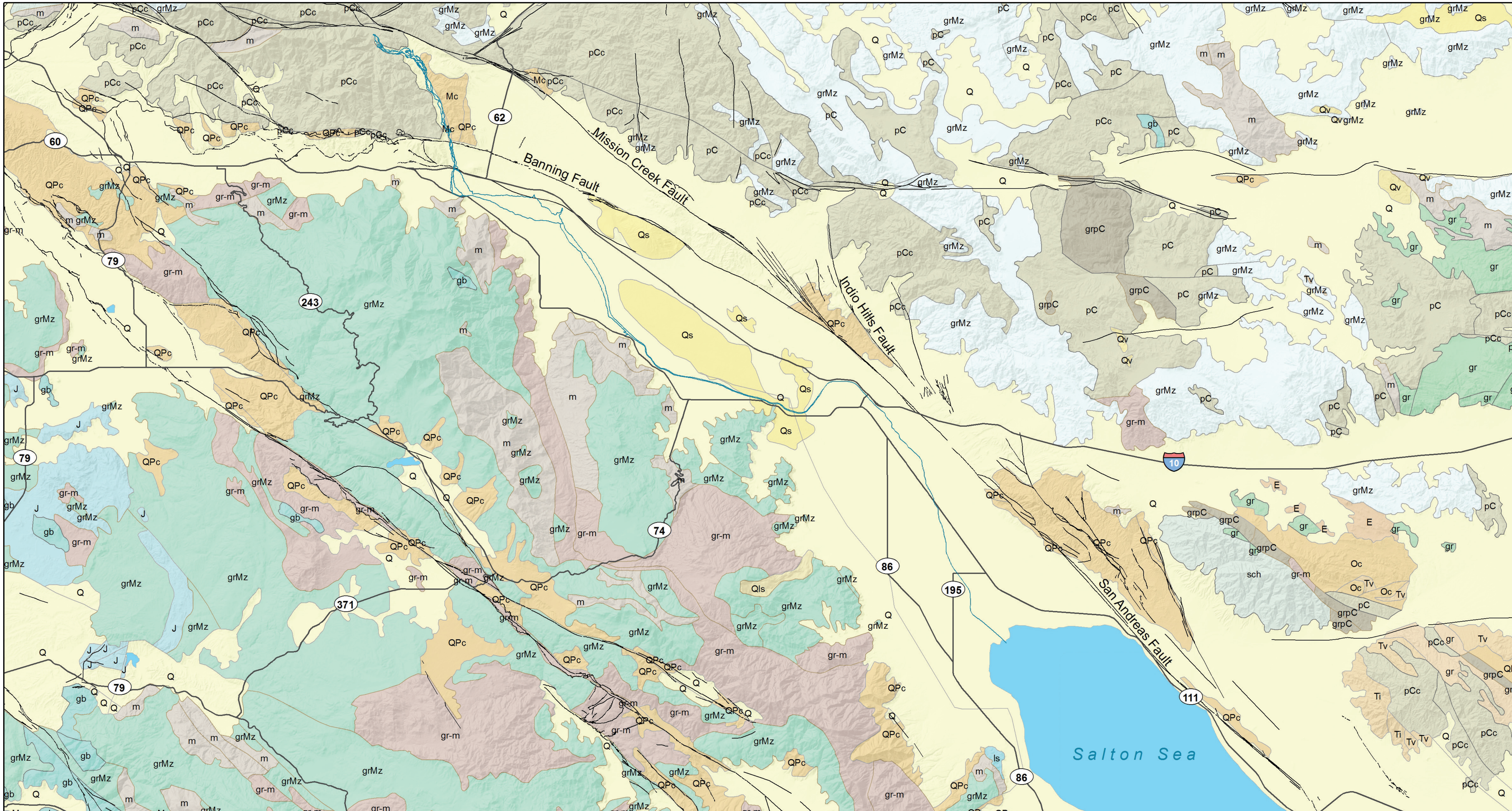


Section 4
Basin Characterization

This section briefly summarizes the geologic and hydrologic properties of the Coachella Valley groundwater basins that pertain to salt and nutrient management. A more detailed summary is provided in TM-1 (**Appendix A**). This includes a description of the Coachella Valley, groundwater basins within the Coachella Valley, and groundwater quality. This discussion is primarily based on Bulletin 108 (DWR, 1964), Bulletin 118 (DWR, 2003), the Coachella Valley Water Management Plan and Plan Update (Water Consult and MWH, 2002; MWH, 2012), the Mission Creek and Garnet Hill Subbasins Water Management Plan (MWH, 2013), and Engineers Reports on Water Supply and Replenishment Assessment (CVWD 2010; CVWD 2014). The California Department of Water Resources defines a groundwater basin as an alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined boundaries in a lateral direction and having a definable bottom. A groundwater subbasin is defined as a subdivision of a groundwater basin created by dividing the basin into smaller units using geologic and hydrologic conditions or institutional boundaries (DWR, 2003).

The Coachella Valley lies in the northwestern portion of the Salton Trough, which extends from the Gulf of California in Mexico northwesterly to the Cabazon area. The Basin is bounded on the north and east by crystalline bedrock of the San Bernardino and Little San Bernardino Mountains and on the south and west by the crystalline rocks of the Santa Rosa and San Jacinto Mountains. The Basin is bounded on the west end of the San Gorgonio Pass groundwater divide, in Beaumont. The southern boundary is the Salton Sea. Geologic faults and structures generally divide the Basin into four subbasins (Tyley, 1974); these faults limit groundwater flow between the subbasins. The five subbasins include: San Gorgonio Pass, Whitewater (Indio), Garnet Hill, Mission Creek, and Desert Hot Springs Subbasins; San Gorgonio Pass Subbasin is not included in the SNMP planning area.

The primary aquifer system in the Coachella Valley is unconsolidated Pleistocene-Holocene valley fill. **Figure 4-1** illustrates the Coachella Valley geology. Groundwater recharge is primarily runoff from the surrounding mountains, local precipitation, irrigation return, stream flow from the Whitewater River and other rivers and creeks, and from imported Colorado River water supplied to spreading grounds throughout the Coachella Valley. Groundwater discharge is to evapotranspiration, underflow to the Salton Sea and Imperial Valley areas, and to pumping wells.



Key to Features

- Quaternary Fault
- Major Roadway
- Whitewater River
- Water

Geology (USGS OFR 2005-1305, Updated 2007)

Quaternary

- Qv — Basalt
- Qs — Dune Sand
- Qls — Landslide

Tertiary

- Q — Alluvium
- Ti — Basalt
- E — Mudstone
- Tv — Rhyolite
- QPc/Oc/Qc/Mc — Sandstone

Cretaceous

- sch — Schist

Jurassic

- gr — Plutonic rock
- grMz — Tonalite

Triassic

- gb — Gabbro

Permian

- grMz — Diorite

Paleozoic

- J — Argillite
- ls — Limestone

PreCambrian

- pC/pCc — Gneiss
- grpC — Granite
- gr-m — Plutonic rock
- m — Schist

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Geologic Map of the Coachella Valley

MWH.

Figure 4-1

4.1 WHITEWATER RIVER (INDIO) SUBBASIN

The Whitewater River Subbasin, designated the Indio Subbasin (Basin No. 7-21.01) in DWR Bulletin No. 118 (DWR, 2003), underlies the major portion of the Coachella Valley floor and encompasses approximately 400 square miles. Beginning approximately one mile west of the junction of State Highway 111 and Interstate Highway 10, the Whitewater River Subbasin extends southeast approximately 70 miles to the Salton Sea. The subbasin underlies the cities of Palm Springs, Cathedral City, Rancho Mirage, Palm Desert, Indian Wells, La Quinta, Indio, and Coachella, and the unincorporated communities of Thousand Palms, Thermal, Bermuda Dunes, Oasis, and Mecca.

The Whitewater River Subbasin is divided into four subareas: Palm Springs, Thermal, Thousand Palms, and Oasis. The Palm Springs Subarea is the forebay or main area of recharge to the subbasin and the Thermal Subarea comprises the pressure or confined area within the basin. The other two subareas are peripheral areas having unconfined groundwater conditions and are characterized by differences in water quality compared to the Thermal subarea (DWR, 1964).

4.1.1 Geologic Structure

The geology of the subbasin varies with coarse-grained sediments located in the vicinity of Whitewater and Palm Springs, gradually transitioning to fine-grained sediments near the Salton Sea. From about Indio southeasterly to the Salton Sea, the subbasin contains increasingly thick layers of silt and clay, especially in the shallower portions of the subbasin. These silt and clay layers, which are remnants of ancient lake beds, impede the percolation of water applied for irrigation and limit groundwater recharge opportunities to the westerly fringe of the subbasin.

The subbasin is bordered on the southwest by the Santa Rosa and San Jacinto Mountains and is separated from Garnet Hill and Desert Hot Springs Subbasins to the north and east by the Garnet Hill and San Andreas Faults (CVWD, 2010; DWR, 1964). The Garnet Hill Fault, which extends southeastward from the north side of San Gorgonio Pass to the Indio Hills, is a relatively effective barrier to groundwater movement from the Garnet Hill Subbasin into the Whitewater River Subbasin, with some portions in the shallower zones more permeable. The San Andreas Fault, extending southeastward from the junction of the Mission Creek and Banning Faults in the Indio Hills and continuing out of the basin on the east flank of the Salton Sea, is also an effective barrier to groundwater movement from the northeast. Water placed on the ground surface in the West Whitewater River area will percolate through the sands and gravels directly into the groundwater aquifer. However, in the East Whitewater River area, several impervious clay layers lie between the ground surface and the main groundwater aquifer. Water applied to the surface in the East Whitewater River area does not easily reach the East groundwater aquifers due to these impervious clay layers. The only outlet for groundwater in the Whitewater River Subbasin is through natural subsurface outflow to the Salton Sea or through agricultural tile drains that transport shallow poor quality groundwater to the Salton Sea either directly or via the Coachella Valley Stormwater Channel (CVSC).

In 1964, the DWR estimated that the five subbasins that make up the Coachella Valley groundwater basin contained a total of approximately 39.2 million acre-feet (AF) of water in the first 1,000 feet below the ground surface; much of this water originated as runoff from the adjacent mountains. Of this amount, approximately 28.8 million AF of water was stored in the Whitewater River Subbasin. However, the amount of water in the Whitewater River Subbasin has decreased over the years due to pumping to serve urban, rural, and agricultural development in the Coachella Valley, which has withdrawn water at a rate faster than its rate of recharge.

The Whitewater River Subbasin is not adjudicated. From a management perspective, the subbasin is divided into two management areas referred to in this document as the West Whitewater River and the East Whitewater River. The division between these two areas is an irregular line trending northeast to southwest between the Indio Hills north of the City of Indio and Point Happy in La Quinta. The West Whitewater River is jointly managed by CVWD and DWA under the terms of the 2014 Water Management Agreement. DWA and CVWD jointly operate a groundwater replenishment program whereby groundwater pumpers (other than minimal pumpers[2]) within designated management areas pay a per acre-foot charge that is used to pay the cost of importing water and recharging the aquifer. The East Whitewater River is managed by CVWD, which operates a separate groundwater replenishment program and collects a per acre-foot charge on groundwater pumping to fund the program.

4.1.2 Hydrostratigraphy

The conceptual hydrostratigraphic section for the Coachella Valley consists of four zones (DWR, 1964):

- Semi-perched aquifer and intervening retarding layers (correlated with Recent lake deposits and alluvium)
- Upper aquifer (correlated with Upper Pleistocene alluvium)
- Aquitard
- Lower aquifer (correlated with the Pleistocene Ocotillo Conglomerate)

Each of the four water-bearing zones, from shallowest to deepest, are described briefly below. **Figure 4-2** illustrates the approximate area of semi-perched and confined aquifers. The following sections provide a brief description of each stratigraphic zone based upon the work of DWR (1964 and 1979), United States Geological Survey (1974), and more recent data collected as part of the 2010 CVWD Water Management Plan Update (MWH, 2012).

[2] CVWD's enabling legislation defines a minimal pumper as any producer who produces 25 or fewer AF in any year. DWA's legislation defines a minimal pumper as any producer who produces 10 or fewer AF in any year.

4.1.3 Semi-perched Aquifer

The semi-perched aquifer is characterized by fine-grained Holocene and Recent lake deposits and alluvium that form an effective barrier to the deep percolation of surface runoff and applied water within the central portion of the East Whitewater River area where present. This zone is not present in the West Whitewater River area. In the East Whitewater River area, the semi-perched aquifer extends across the central portion of the basin but is absent from the basin margins where coarser-grained alluvial fan deposits predominate. The general extent of the semi-perched aquifer is shown in **Figure 4-2**; cross-sections in **Appendix D** show generalized hydrogeologic profiles of the Coachella Valley. The semi-perched aquifer consists of interbedded layers of fine sand and clay and is separated from the underlying upper aquifer by a laterally discontinuous clay zone (DWR, 1964). Where the clay zone is absent in portions of the East Whitewater River area, the semi-perched aquifer merges with the underlying upper aquifer. The thickness of this aquifer unit is as much as 100 feet in the center of the basin.

Recharge of the semi-perched aquifer is largely from percolation of surface runoff and return flows of applied water. Water applied to the ground surface above the perched aquifer does not readily reach the lower groundwater aquifers due to these relatively impervious clay layers. As large-scale agricultural activities commenced using Colorado River water, a tile drain system was constructed to lower the shallow water table below the rooting zone. Groundwater leaves the semi-perched aquifer as surface flow into agricultural drains, evapotranspiration and vertical leakage to the upper aquifer. The majority of the semi-perched system is hydraulically connected to a drain system; the area served by drain network is illustrated on **Figure 4-3**.

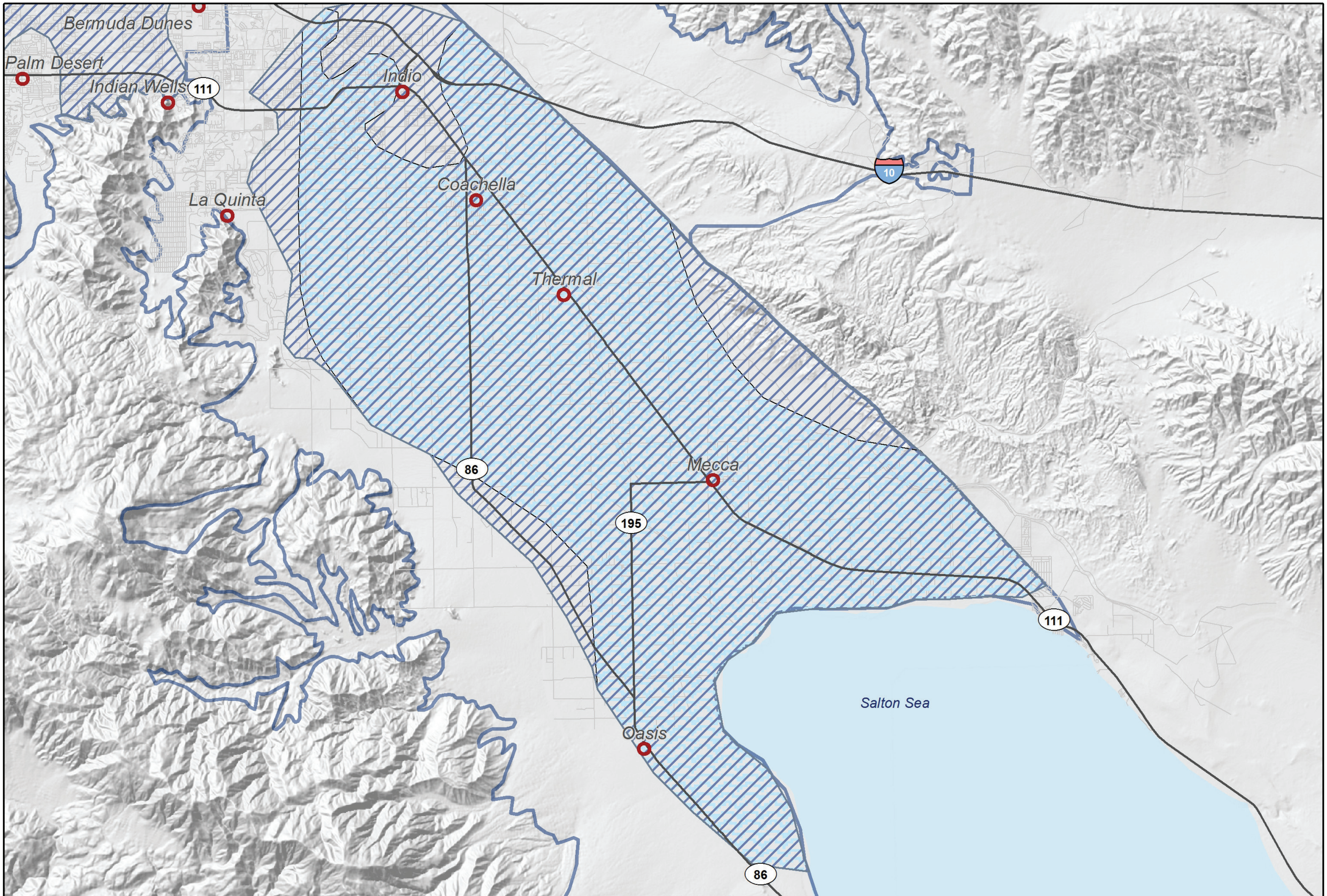
4.1.4 Upper Aquifer

Based on DWR (1964), the upper aquifer is formed of Upper Pleistocene alluvium. The upper aquifer typically consists of coarse sand and gravel with discontinuous clay lenses in the West Whitewater River area, and is believed to be unconfined or semi-confined in most of the West Whitewater River area and the northern part of the East Whitewater River area. The upper aquifer underlies the semi-perched aquifer in most of the East Whitewater River area and consists of finer sand and sandy clay. The upper aquifer is confined in most of the East Whitewater River area by the semi-perched aquifer and a discontinuous clay layer (referred to as the aquitard).

The upper aquifer is approximately 150 to 300 feet thick (DWR. 1964). It is relatively flat in the central part of the Coachella Valley and is upturned and thin along the basin margins, sub-parallel to the ground surface. In the northern portion of the East Whitewater River area, the top of the upper aquifer is located at elevations ranging from 100 feet above mean sea level (MSL) along the basin margins to 200 feet below MSL in the central portion of the basin. In the southern portion of the basin, the top of the upper aquifer is encountered at elevations ranging from approximately 100 feet above MSL along the basin margins to 500 feet below MSL in the center of the basin. Recharge to the upper aquifer is by:

- Percolation of stream flow runoff, particularly near the margins of the subbasin;
- Deep percolation of applied irrigation water and treated wastewater;
- Artificial recharge at the Whitewater Spreading Area, Thomas E. Levy Groundwater Replenishment Facility, and Martinez Canyon Recharge Facility;
- Vertical groundwater leakage from the semi-perched aquifer; and
- Subsurface inflow from outside the study area, both beneath the San Gorgonio Pass and, to a lesser extent, across the Banning Fault.

Groundwater leaves the upper aquifer primarily by deep percolation into the underlying lower aquifer, particularly where the aquifers merge in the West Whitewater River area and at the margins of the East Whitewater River area. Additional groundwater discharge occurs by water supply wells throughout the Coachella Valley. If groundwater levels in the underlying lower aquifer are sufficiently high, upward migration of groundwater into the upper aquifer may occur in areas of mergence.



Key to Features

- City
- Highway
- Local Road
- Water
- Management Zone
- Confining Layer
- Semi-Perched

0 1.75 3.5 Miles

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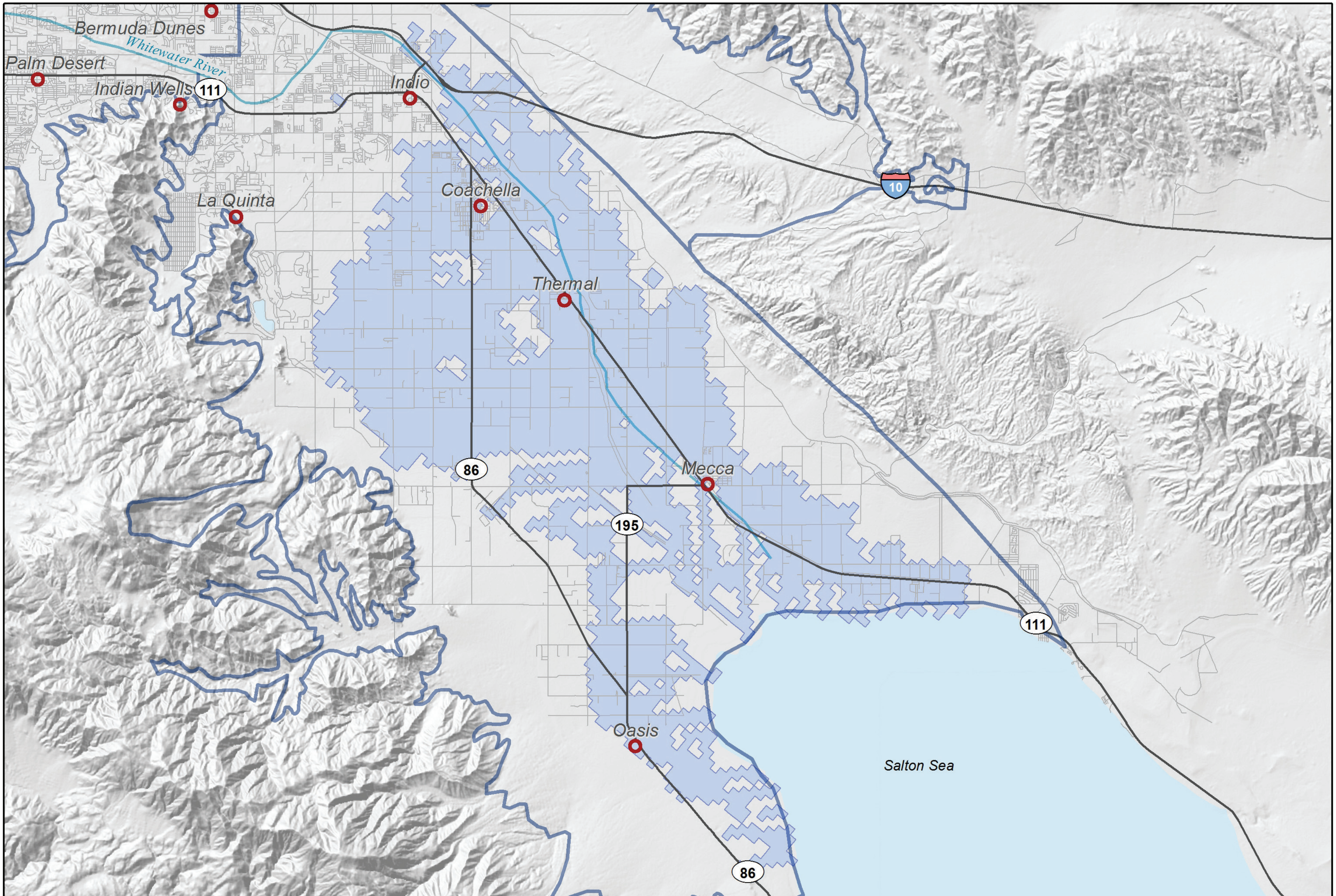
Date: April 15, 2015

Coachella Valley Confining Layer and Semi-perched Aquifers

MWH

Figure 4-2



Key to Features

City

Major Roadway

Local Road

Minor Drainage

Approximate Area Contributing to Drain System

Water

Management Zone

0 1.75 3.5 Miles

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Date: 4/23/2015

Coachella Valley Semi-Perched Aquifer Drain System

MWH.

Figure 4-3

4.1.5 Aquitard

A discontinuous aquitard separates the upper and lower aquifers in the East Whitewater River area. The aquitard typically consists of clay and sandy clay with discontinuous sand lenses having low permeability. Sand is more common in the northern portion of the aquitard, which thins in the West Whitewater River area but is identifiable as far north as Cathedral City. The aquitard cannot be found in all well construction logs, it is absent at the basin margins and reaches a maximum thickness of approximately 200 feet in the portions of the East Whitewater River area; in small areas adjacent to the Salton Sea, it is as much as 500 feet thick (DWR, 1964). It is underlain by the lower aquifer. The fine-grained materials making up the aquitard are not tight enough or persistent enough to completely restrict the vertical flow of water between the upper and the lower aquifers (DWR, 1964). Therefore, some water is believed to move both upward and downward through the aquitard. The lateral extent of the aquitard is presented in **Figure 4-2**.

4.1.6 Lower Aquifer

The lower aquifer is formed in part of the Ocotillo conglomerate and is the deepest and principal water-bearing zone of the subbasin. Rocks of the semiwater-bearing group and nonwater-bearing group underlie it at great depth. In the area generally described as the West Whitewater River area, the northern portion of the East Whitewater River area and the basin margins, the lower aquifer typically consists of coarse sand and gravel. In most of the East Whitewater River area, the lower aquifer is composed of sandy clay. One or two lower-permeability layers subdivide the lower aquifer through most of its extent.

Like the overlying units, the edges of the lower aquifer are upturned along the basin margins. The top of the lower aquifer is encountered at elevations ranging from 100 to 300 feet below MSL in the northern portion of the basin and at elevations ranging from 400 to 600 feet below MSL in the southern portion of the basin. The aquifer dips in the direction of the Salton Sea. It is typically 100 to over 1,000 feet thick. The deepest wells penetrating the lower aquifer are approximately 1,300 feet in depth.

The lower aquifer is recharged by leakage from the upper aquifer, particularly in areas where the two aquifers merge. Near the margins of the East Whitewater River area, where the semi-perched aquifer and the aquitard are absent, runoff from mountain streams percolates into the alluvial fans at the base of the mountains and provides an additional source of recharge to the merged upper and lower aquifers. Through most of the West Whitewater River area, the two aquifers are not clearly distinguishable and groundwater levels are approximately equal. The water levels in the aquifers begin to diverge where they become separated by the aquitard. With increased groundwater pumping to supply increasing urbanization and agricultural use, groundwater levels have declined in the area in which the aquifers are merged, and also where they are separated.

Outflow from the lower aquifer is primarily through water supply wells. Historically, some groundwater migrated out of the lower aquifer flowing into the area beneath the Salton Sea. Basin pumping, however, may have reversed the direction of this subsurface flow in some portions of the basin, as indicated by elevated TDS measurements and modeling studies. The increased TDS concentration may be a result of ancient saline water left by previous saline lakes (CVWD, 2011).

When water development first occurred in the East Whitewater River area, the hydrostatic pressure of the lower aquifer was above the ground surface. Wells drilled at the time frequently flowed. As more wells were drilled and pumping increased, pressure levels declined and artesian flowing conditions stopped. In recent years, reduction of pumping combined with artificial recharge programs have allowed pressure levels to increase such that artesian flowing wells are observed in some portions of the East Whitewater River area.

4.1.7 Description of Subareas

The following subsections summarize the subareas of the Whitewater River Subbasin.

Palm Springs Subarea

The triangular area between the Garnet Hill Fault and the east slope of the San Jacinto Mountains southeast to Cathedral City is designated the Palm Springs Subarea, and is an area in which groundwater is unconfined. The valley fill materials within the Palm Springs Subarea are essentially heterogeneous alluvial fan deposits with little sorting and little fine grained material content. The thickness of these water bearing materials is not known; however, it exceeds 1,000 feet (CVWD, 2010). The probable thickness of recent deposits suggests that Ocotillo conglomerate underlies Recent fanglomerate in the subarea at depths ranging from 300 to 400 feet (DWR, 1964).

Natural recharge to the aquifers in the Whitewater River Subbasin occurs primarily in the Palm Springs Subarea. The major natural sources include infiltration of stream runoff from the San Jacinto Mountains and the Whitewater River, and subsurface inflow from the San Gorgonio Pass and Garnet Hill Subbasins. Deep percolation of direct precipitation on the Palm Springs Subarea, and the entire Valley, is considered negligible as it is consumed by evapotranspiration.

Thermal Subarea

Groundwater of the Palm Springs Subarea moves southeastward through the interbedded sands, silts, and clays underlying the central portion of the Coachella Valley. The division between the Palm Springs Subarea and the Thermal Subarea is near Cathedral City. The permeabilities parallel to the bedding of the deposits in the Thermal Subarea are several times the permeabilities normal to the bedding and, therefore, movement of groundwater parallel to the bedding predominates. Confined or semi-confined groundwater conditions are present in the major portion of the Thermal Subarea. Movement of groundwater under these conditions is present in the major portion of the Thermal Subarea and is caused by differences in piezometric (pressure) level or head. Unconfined conditions are present in the alluvial fans at the base of the Santa Rosa Mountains, as in the fans at the mouth of Deep Canyon and in the La Quinta area.

Sand and gravel lenses underlying this Subarea are discontinuous and clay beds are not extensive. However, two aquifer zones separated by a zone of finer-grained materials were identified from well logs (DWR, 1964). The fine-grained materials within the intervening horizontal plane are not tight enough or persistent enough to restrict completely the vertical interflow of water, or to assign the term “aquiclude” to it. Therefore, the term “aquitard” is used for this zone of less permeable material that separates the upper and lower aquifer zones in the southeastern part of the Coachella Valley. Capping the upper aquifer at the surface are tight clays and silts with minor amounts of sands. Semi-perched groundwater occurs in this capping zone, which is up to 100 feet thick.

The lower aquifer zone, composed in part of the Ocotillo conglomerate, consists of silty sands and gravels with interbeds of silt and clay. It is the most important source of groundwater in the Whitewater River Subbasin. The top of the lower aquifer zone is present at depths ranging from 300 to 600 feet below the surface. The thickness of the zone is undetermined, as the deepest wells present in the Coachella Valley have not penetrated it in its entirety. The available data indicate that the zone is at least 500 feet thick and may be in excess of 1,800 feet thick; depth information for Well 06S08E36M01S indicate a screened depth to 1,880 feet below ground surface. DWR (1964) inferred the depth to bedrock was in excess of 12,000 feet below ground surface based on gravity survey data.

The aquitard overlying the lower aquifer zone is generally 100 to 200 feet thick, although in small areas on the periphery of the Salton Sea it is in excess of 500 feet in thickness. North and west of Indio, in a curving zone approximately one mile wide, the aquitard is apparently lacking and no distinction is made between the upper and lower aquifer zones. This may be the result of erosion and deposition from Whitewater River flood flows. The aquitard is also responsible for artesian groundwater conditions in the central portion of the Thermal Subarea. Wells perforating the lower aquifer in this area experience artesian flowing conditions.

Capping the upper aquifer zone in the Thermal Subarea is a shallow fine-grained zone in which semi-perched groundwater is present. This zone consists of Recent silts, clays, and fine sands and is relatively persistent southeast of Indio. It ranges from zero to 100 feet thick and is generally an effective barrier to deep percolation. However, north and west of Indio, the zone is composed mainly of clayey sands and silts and its effect in retarding deep percolation is believed to be limited. The low permeability of the materials southeast of Indio has contributed to the irrigation drainage problems of the area. Semi-perched groundwater has been maintained by irrigation water applied to agricultural lands south of Point Happy. This condition causes waterlogged soils and the accumulation of salts in the root zone in agricultural areas. Surface drains were constructed in the 1930s to alleviate this condition. Subsurface tile drainage systems were installed in the 1950s to control the high water table conditions, allow reclamation of saline soils, and intercept poor quality return flows. CVWD operates and maintains a collector system of 166 miles of pipe, ranging in diameter from 18 inches to 72 inches, along with 21 miles of open ditches, to serve as a drainage network for irrigated lands. All agricultural drains empty into the CVSC except those at the southern end of the Coachella Valley, which flow directly to the Salton Sea. This system serves nearly 38,000 acres and receives water from more than 2,293 miles of on-farm drain lines (Water Consult and MWH, 2002).

Thousand Palms Subarea

The small area along the southwest flank of the Indio Hills is designated the Thousand Palms Subarea. The southwest boundary of the Subarea was determined by tracing the limit of distinctive groundwater chemical characteristics (DWR, 1964). Whereas calcium bicarbonate water is characteristic of the major aquifers of the Whitewater River Subbasin, water in the Thousand Palms Subarea is sodium sulfate in character.

These quality differences suggest that recharge to the Thousand Palms Subarea comes primarily from the Indio Hills and is limited in supply. The relatively sharp boundary between chemical characteristics of water derived from the Indio Hills and groundwater in the Thermal Subarea suggests there is little intermixing of the two waters (DWR, 1964).

The configuration of the water table north of the community of Thousand Palms is such that the generally uniform, southeast gradient in the Palm Springs Subarea diverges and steepens to the east along the base of Edom Hill. This historical steepened gradient suggests a barrier to the movement of groundwater, or a reduction in permeability of the water bearing materials. A southeast extension of the Garnet Hill Fault could also coincide with this anomaly. However, there is no surface expression of such a fault, and the gravity measurements taken during the 1964 DWR investigation do not suggest a subsurface fault. The residual gravity profile across this area supports these observations. The sharp increase in gradient is therefore attributed to lower permeability of the materials to the east. Most of the Thousand Palms Subarea is located within the upper portion of the Whitewater River Subbasin. Groundwater levels in this area show similar patterns to those of the adjacent Thermal Subarea, this suggests a hydraulic connectivity.

Oasis Subarea

Another peripheral zone of unconfined groundwater that differs in chemical characteristics from water in the major aquifers of the Whitewater River Subbasin is found underlying the Oasis Piedmont slope. This zone, named the Oasis Subarea, extends along the base of the Santa Rosa Mountains. Water bearing materials underlying the Subarea consist of highly permeable alluvial fan deposits. Although groundwater elevation data suggest that the boundary between the Oasis and Thermal Subareas may be a buried fault extending from Travertine Rock to the community of

Oasis, the remainder of the boundary is a change from the coarse fan deposits of the Oasis Subarea to the interbedded sands, gravel, and silts of the Thermal Subarea. Little information is available as to the thickness of water bearing materials, but it is estimated to be in excess of 1,000 feet.

4.1.8 Surface Water Hydrology

Over geologic time, the Whitewater River and other local watercourses (including San Gorgonio, Snow, Falls, Chino, Tahquitz, and Andreas, Palm Canyon, Deep Canyon, Martinez Canyon, and smaller creeks) sent floodwaters into the Coachella Valley, discharging onto the floor of the desert. Early records indicate that the mouth of the Whitewater River was at what is now known as Point Happy in the City of La Quinta. Historically, floodwaters reaching Point Happy fanned out across the desert floor in this area, flooding areas downstream. DWR (1964) estimated the average seasonal mountain-front runoff to the Whitewater River (Indio) Subbasin totals 38,100 AFY. Subsequent hydrologic studies performed for the Coachella Valley Water Management Plan (Water Consult and MWH, 2002; MWH 2013) indicated the local surface and subsurface inflow from the mountain-front to the Whitewater River Subbasin has averaged 46,000 AFY, ranging from about 8,000 to more than 200,000 AFY.

The CVSC, a constructed extension of the Whitewater River that is managed and operated by CVWD, is the main drainage channel for the East Whitewater River area. This unlined earthen channel extends approximately 17 miles southeast from the City of Indio, through the agricultural communities of Coachella, Thermal and Mecca, to the north end of the Salton Sea. The construction of the CVSC was begun in the early 1920s to convey Whitewater River storm flows safely past Coachella Valley communities and to provide adequate drainage for agricultural return waters in the area of semi-perched groundwater (see Section 5.6). Its design capacity is 82,000 cfs (Dan Farris, CVWD, pers. comm. 2000). In addition to agricultural drainage, the CVSC also receives treated effluent from three municipal wastewater treatment plants (CVWD's Water Reclamation Plant 4, Valley Sanitary District, and Coachella Sanitary District).

Throughout the East Whitewater River Subbasin, agricultural drains have been installed to drain shallow groundwater perched on fine-grained, ancient lakebed soils. Most of the drains empty into the CVSC; however, 25 smaller open channel drains at the southern end of the Coachella Valley discharge directly to the Salton Sea. The quantity of flow in the drains, and therefore in the CVSC, depends upon water levels in the underlying aquifers and the quantities of applied irrigation water.

The Coachella Canal and Distribution System

As agriculture in the Imperial and Coachella valleys developed during the early 1900s, alternative sources of water including the Colorado River were considered to meet growing demand. The Imperial Valley began receiving Colorado River water in 1901 via the Imperial Canal that was partially located in Mexico. In the Coachella Valley, the rapid rate of groundwater extraction led to a substantial decline in groundwater levels, limiting the groundwater supply. Local supplies were not adequate to meet future demands. These problems generated interest in construction of a storage reservoir on the river and a canal that would be located entirely in the United States.

Under the *Seven Party Agreement* dated August 18, 1931, executed by the California agencies already using or seeking to use Colorado River water, a system of priorities was established that defined certain amounts and places of use for the water. Water delivered to the Coachella Valley via the Coachella Canal is diverted from the Imperial Dam 18 miles upstream from Yuma, Arizona into the All-American Canal. Coachella's supply is then diverted into the 122-mile-long Coachella branch, which extends from near the Mexican border northwestward to Lake Cahuilla near La Quinta. This man-made lake, located at the terminus of the Coachella Canal, serves as a storage reservoir to regulate irrigation water demands and provides opportunity for recreation. The capacity of the Coachella Canal is approximately 1,300 cubic feet per second.

Colorado River water delivered to the Coachella Valley is diverted from the Imperial Dam 18 miles upstream from Yuma, Arizona, into the All-American Canal. The CVWD supply is then diverted into the 122-mile-long Coachella Canal, which extends from near the Mexican border northwestward to Lake Cahuilla near La Quinta. The Canal is concrete-lined. The capacity of the Coachella Canal is approximately 1,300 cubic feet per second to 1,550 cubic feet per second. For a more detailed description of the Coachella Canal, the reader is referred to the Final EIS/EIR for the Coachella Canal Lining Project (USBR and CVWD, 2001).

Metropolitan's Colorado River Aqueduct

The Colorado River Aqueduct conveys river water from Lake Havasu to Lake Mathews in western Riverside County. Metropolitan Water District of Southern California completed construction of the aqueduct in 1941. The facility consists of 242 miles of canals, pipelines and tunnels along with five pumping stations that lift Colorado River water over 1,600 feet. The aqueduct has a capacity of 1,800 cfs or 1.3 million AFY. This aqueduct passes along the easterly side of CVWD and crosses the Whitewater River channel north of Palm Springs. The proximity of the aqueduct to the Coachella Valley made it a logical choice for delivering imported water to the valley. Consequently, beginning in 1973, CVWD and DWA commenced a program with Metropolitan to exchange the Coachella Valley's State Water Project (SWP) water for Colorado River water delivered at Whitewater to avoid the cost of constructing an extension to the California Aqueduct. This exchange program was expanded to the Mission Creek Subbasin in 2002.

Salton Sea

The Salton Sea is a terminal body of saline water that occupies the bottom of the Salton Sink, a topographic low located between the Coachella and Imperial Valleys. The Salton Sink is a structural trough formed by the San Andreas fault zone, which filled with sediments from the surrounding mountains and marine deposits from the Gulf of California that inundated the Coachella Valley as far north as San Gorgonio Pass. Near the close of the Tertiary period, the Colorado River formed a delta that stopped the marine water invasion. Periodically, the Colorado River would change course over its delta and flow northward into the Coachella Valley, creating a large shallow lake that would exist until the river again changed course. This lake, known originally as Lake LeConte or later as Lake Cahuilla, would occur and disappear periodically flooding as far north as Indio as evidenced by a so-called “bath-tub ring” of travertine deposits on the mountains near La Quinta (DWR, 1964).

The current Salton Sea was formed when flood flows from the Colorado River broke through a temporary canal heading that had been designed to bypass a silted section of the Imperial Canal. The Imperial Canal, which was routed from the Colorado River to the Imperial Valley through Mexico, was completed in 1901, but by 1904, it had become blocked by sediment. A series of high flows from February through April 1905 destroyed the temporary heading resulting in uncontrolled flows into the Salton Basin for the next 18 months. It flooded the railroad line, railroad stations, and the salt works on the basin floor (DeBuys and Myers, 1999). When the breach was finally repaired in 1907, the elevation of the Salton Sea had reached 195 feet below mean sea level (MSL), and had a surface area of 520 square miles. Today, the Salton Sea has a surface elevation of 235 feet below MSL and occupies a surface area of about 365 square miles (233,000 acres) out of the total 8,360 square miles within the watershed (Salton Sea Authority, 2014).

Executive Order of Withdrawal (Public Water Reserve No. 114, California No. 26), signed by the President of the United States on February 26, 1928, withdrew from all forms of entry all public lands of the United States in the Salton Sea area lying below the elevation of 220 feet below sea level for the purpose of creating a reservoir in the Salton Sea for storage of wastes and seepage water from irrigated land in the Coachella and Imperial Valleys (RWQCB, 2014).

4.1.9 Groundwater Quality

A general discussion on groundwater quality, pertaining to TDS and nitrate, within the Whitewater River Subbasin is presented in this section.

Total Dissolved Solids

During the 1930s, TDS concentrations throughout the Whitewater River Subbasin were typically less than 250 mg/L except in localized areas (DWR, 1979). In the 1970s, the groundwater typically contained 300 mg/L TDS in the upper aquifer and 150 to 200 mg/L TDS in the lower aquifer (DWR, 1979). Higher TDS concentrations in the upper aquifer are typically detected along the Coachella Valley margins, particularly in the vicinity of the San Andreas Fault system and in an area southeast of Oasis. Groundwater in areas south of Indio and east of Mecca also contain higher TDS concentrations. The water quality of the upper aquifer has decreased since the 1930s.

In general, the lower aquifer has lower TDS concentrations than the upper aquifer. TDS concentrations in some areas of the lower aquifer may be more representative of upper aquifer quality in areas where the upper and lower aquifers are merged (e.g., along the western margin of the Coachella Valley). Similarly, in other areas adjacent to major faults, the TDS content of the lower aquifer is greater than 1,000 mg/L TDS. One of these areas is along the fault zone separating the Thousand Palms and Fargo Canyon Subareas from the Thermal Subarea. Along this northern fringe of the basin, near the San Andreas Fault and the presumed extension of the Garnet Hill Fault, the TDS concentrations exceed 1,000 mg/L. Isolated wells near Indio and Coachella exhibit similar TDS concentrations. In portions of the Oasis Subarea, groundwater also ranges from 500 to 1,000 mg/L TDS. Unlike the shallower zones, the TDS concentrations in much of the lower aquifer have remained relatively constant since the 1930s.

Numerous areas within the Coachella Valley, such as Desert Hot Springs, Sky Valley, Indio Hills, Oasis, Salton City, and areas adjacent to the San Andreas Fault system have naturally-occurring high salinity.

Nitrate

Elevated nitrate concentrations have been a relatively localized problem in the Coachella Valley. Nitrate concentrations during the 1930s were typically less than 4 mg/L (as nitrate) throughout the Coachella Valley (DWR, 1979). A notable exception was the high nitrate content of some wells in the Palm Desert-Indian Wells area (Huberty *et al.*, 1948). Huberty *et al*. evaluated the source of nitrate and concluded that the area was at one time covered by extensive mesquite forests. Mesquite is known to fix atmospheric nitrogen in its roots and accumulate nitrogen in its leaves and stems. Huberty *et al*. discovered high amounts of nitrate in the soils under similar mesquite forests. Under natural conditions, there was insufficient moisture for the leaf and twig litter to decompose. However, when these lands were leveled and irrigated, the organic matter decomposed and nitrates appear to have leached into the shallow groundwater (Huberty *et al.*, 1948). By the late 1970s, a greater number of wells adjacent to the Whitewater River in this area exhibited elevated nitrate concentrations of more than 45 mg/L (DWR 1979). The area of high nitrate shallow groundwater follows the approximate trace of the Whitewater River from Cathedral City to east of La Quinta. Municipal wells generally avoid this high nitrate groundwater by using deep perforations.

In addition, a cluster of high nitrate concentrations is present northwest of the community of Oasis. These elevated concentrations may be a result of fertilizer use in the unconfined area. Municipal wells belonging to DWA in Palm Springs have experienced nitrate concentrations above the MCL. Discharges of wastes from individual domestic septic tank/leachfield systems, water recycling, widespread application of fertilizers, and discharges of domestic wastes to evaporation/percolation ponds may be the source of the elevated nitrate.

However, it is noted that studies conducted by the University of California, Riverside concluded most nitrogen applied to turfgrass usually stays within the “turfgrass system”. Fertilizer nitrogen applied to a dense, mature and well-maintained turf is normally rapidly used by the turfgrass plant and by soil microorganisms. There appears to be little chance of downward movement of nitrogen, other than on pure sand (Gibeault *et al*., 1998). An additional University of California, Riverside study suggests that “if turfgrass is properly managed, it may provide an opportunity to mitigate nitrate loading to surface and ground waters, even when [nitrogen] application rate is high" (Wu *et al.*, 2007). Uptake of nitrogen by managed turf should be addressed in this SNMP and future Basin Plan updates.

4.2 MISSION CREEK SUBBASIN

The Mission Creek Subbasin is located in the northwestern Coachella Valley in the north-central portion of Riverside County, California. DWR has designated this basin as No. 7-21.02 in Bulletin 118 (DWR, 2003). Groundwater is naturally replenished by subsurface flow from the Desert Hot Springs Subbasin to the north, as well as by mountain front recharge by subsurface flow. The Mission Creek Fault and the Banning Fault form the northern and southern boundaries of the subbasin, respectively. Both act to limit groundwater movement as these faults have folded sedimentary deposits, displaced water-bearing deposits, and caused once permeable sediments to become impermeable (DWR, 1964). The main water bearing units of the Mission Creek Subbasin are relatively undisturbed and unconsolidated Holocene and late Pleistocene alluvial deposits. These detritus deposits are eroded from the surrounding San Bernardino and Little San Bernardino Mountains, first as filled topographic depressions and then as deposits on the piedmont alluvial fans. The individual beds are lens shaped and not extensive, but coalesce with other beds to form larger water bearing areas. Hydrogeologic units included in these water-bearing deposits are: Ocotillo conglomerate, Cabazon fanglomerate and Holocene alluvial and sand dune deposits.

The Mission Creek Subbasin is considered an unconfined aquifer with a saturated thickness of 1,200 feet or more and an estimated total storage capacity of approximately 2.6 million AF (DWR, 1964). The volume of groundwater estimated to be in storage for the subbasin is 1.4 million AF (MSWD, 2006). The subbasin is naturally recharged by surface and subsurface flow from the Mission Creek, Dry, and Big Morongo Washes, the Painted Hills, and surrounding mountain drainages. Subsurface flow also occurs across the Mission Creek Fault from the adjacent Desert Hot Springs Subbasin. This water has a higher temperature and salinity than the rest of the subbasin. Return flow from applied water and discharges from municipal and individual subsurface wastewater disposal systems also contribute to recharge.

The principal outflows from the subbasin are groundwater production for municipal and private uses, evapotranspiration, and subsurface outflow across the Banning Fault into the Garnet Hill Subbasin. Groundwater generally flows from the northwest to the southeast until about mid-basin where the contour lines curve indicating a southerly flow on the eastern side of the subbasin.

CVWD, DWA, and MSWD jointly manage this subbasin under the terms of the Mission Creek Settlement Agreement (CVWD-DWA-MSWD, 2004). This agreement and the 2014 Mission Creek Groundwater Replenishment Agreement between CVWD and DWA specify that the available SWP will be allocated between the Mission Creek and Whitewater River Subbasins in proportion to the amount of water produced or diverted from each subbasin during the preceding year (CVWD-DWA, 2003). In 2009, production from the Mission Creek Subbasin was about 7 percent of the combined production from these two subbasins. A water management plan was prepared for the Mission Creek and Garnet Hill Subbasins in 2013 (MWH, 2013).

4.2.1 Surface Water Hydrology

Surface water flow in the Mission Creek Subbasin consists of ephemeral or intermittent streams that originate in the San Bernardino and Little San Bernardino mountains. Mission Creek is the only stream that flows to the valley floor on a consistent basis, but the stream usually disappears underground a short distance from its entrance into the Subbasin. The only stream gauge currently operated by the USGS in the Subbasin is on Mission Creek. Based on 44 years of record (1967-2011), this creek has an average annual streamflow of 2,160 AFY. Streams flowing through Morongo Valley, Big Morongo, Little Morongo, and Long Canyon periodically reach the valley floor for short periods when there are localized, intense storms in the mountains (Mayer and Mays, 1998). Investigations conducted for the Mission Creek-Garnet Hill Water Management Plan concluded the natural inflow to the Mission Creek Subbasin averages about 7,500 AFY (Psomas, 2013). None of the surface flow from the local watercourses is used directly for municipal, industrial, or agricultural uses in the Study area.

4.2.2 Groundwater Level

DWR Bulletin 118 identifies the Mission Creek Subbasin to be in an overdraft condition. However, since the commencement of the groundwater recharge program at the Mission Creek Spreading Facility, groundwater levels have generally increased in the Mission Creek Subbasin. Groundwater level increases in the Mission Creek Subbasin are observed in areas closer to the Mission Creek Recharge Facility as compared to the locations of the groundwater production wells.

The San Andreas Fault system has a significant impact on groundwater levels in the subbasin. Previous studies have shown that the various faults that make up the fault system act as partially effective barriers to groundwater flowing from north to south through the area. Groundwater levels and at times groundwater temperatures on either side of the fault trace are significantly different. Groundwater levels are generally higher on the northeast side of the fault because of its barrier effect, to the extent that springs have been recorded on the north. Groundwater levels within the Mission Creek Subbasin are generally higher in the northern and western portion of the subbasin than the southern and eastern portion of the subbasin. Groundwater temperatures in the subbasin are generally higher in the north because of the influence of the Desert Hot Springs Subbasin (GSi/water, 2005; URS, 2006).

In 1936, groundwater pumping in the subbasin was significantly lower than current conditions and groundwater is believed to have flowed under generally natural conditions. Water levels in the Mission Creek Subbasin have been declining since the early 1950s due to scarce annual precipitation and groundwater extractions (DWR, 2003). Valley-wide groundwater level data indicate that since 1952, water levels have declined at a rate of 0.5 to 1.5 feet per year (CVWD, 2000). MSWD monitoring data indicates a rate of decline of about 3 feet per year between 1999 and 2007.

Groundwater levels in the subbasin have increased since 2003 as a result of the artificial recharge activities (including normal and advanced deliveries) coupled with reduced pumping. Wells in the subbasin have shown varying responses to recharge. Water levels in a MSWD well located 0.5 mile south of the recharge facility responds similarly to the DWA monitoring well located at the recharge facility, increasing as much as 250 feet since 2004. However, MSWD wells located 1.2 miles south and 1.1 miles to the southeast show 20- and 50-foot increases, respectively. Prior to recharge, water levels in these two wells were 200 feet lower than levels near the recharge facility. The difference in level is now more than 400 feet. These differences in basin response may be the result of mounding near the recharge facility, a previously unknown geologic structure (fault or change in bedrock depth), insufficient transmissivity near the recharge facility or a combination of these factors (Psomas, 2013). Water levels in a CVWD well located 4.4 miles southeast of the recharge facility shows a 4-foot increase since 2004 (MWH, 2013).

4.2.3 Groundwater Quality

A general discussion on groundwater quality, pertaining to TDS and nitrate, within the Mission Creek Subbasin is presented in this section.

Total Dissolved Solids

TDS concentrations in groundwater improve across the Mission Creek Subbasin towards the Garnet Hill Fault. Wells located closer to the Garnet Hill Subbasin have TDS concentrations ranging between 300 mg/L and 400 mg/L. Wells located closer to the Desert Hot Springs Subbasin have higher TDS concentrations ranging between 400 mg/L and 500 mg/L. Wells in the southeastern portion of the subbasin show TDS concentrations as high as over 1,000 mg/L; this could be due to the flow of mineralized water from Desert Hot Springs Subbasin.

Nitrate

Nitrate is present in the unsaturated and shallow aquifer zones above 300 to 400 feet below ground surface, and has not been observed in the deeper aquifer zones below 500 feet. Activities in the basin that could cause nitrate to leach into higher quality groundwater include recharge, pumping, and overdraft reduction. A study conducted by MSWD to assess groundwater quality indicates that the use of septic tanks for waste disposal is a primary contributor of high nitrates to the groundwater (GSi/water, 2011). Nitrate concentrations are below the MCL for all recorded public water supply samples in the Mission Creek Subbasin; however, several private wells have recorded nitrate exceeding the MCL.

4.3 GARNET HILL SUBBASIN

The area between the Garnet Hill Fault and the Banning Fault, named the Garnet Hill Subarea by DWR (DWR, 1964), was considered a distinct subbasin by the USGS (Tyley, 1974) because of the effectiveness of the Banning and Garnet Hill Faults as barriers to groundwater movement. The Garnet Hill Fault is a branch of the San Andreas Fault system consisting of a series of northwest-trending right-lateral faults with active folds at each en echelon step. These folds are exhibited in a series of small hills (West Whitewater Hill, East Whitewater Hill, Garnet Hill, Edom Hill, and several small unnamed hills) between each fault segment (Yule and Sieh, 2003). This is illustrated by a difference of 170 feet in groundwater level elevation in a horizontal distance of 3,200 feet across the Garnet Hill Fault, as measured in the spring of 1961. This subbasin is considered part of the Whitewater River (Indio) Subbasin in DWR Bulletin 118 (2003); however, CVWD and DWA consider it a separate subbasin based on the USGS findings and water level observations. In 1964 when the initial DWR evaluation was conducted, it was observed that limited data existed to characterize the hydrogeology of this subbasin (DWR, 1964).

The Garnet Hill Subbasin is considered an unconfined aquifer with a saturated thickness of 1,000 feet or more based on well depths and has an estimated total storage capacity on the order of 1.0 million AF. The subbasin is naturally recharged by subsurface flow from the Mission Creek Subbasin and percolation of runoff from the Whitewater River watershed on the west. Irrigation return flow and discharges from municipal and individual subsurface wastewater disposal systems also contribute to recharge but is considered very small.

Although some recharge to this subbasin may come from Mission Creek and other streams that pass through during periods of high flood flows, the main sources of recharge to the subbasin are channel infiltration and subsurface flow in the Whitewater River, subsurface flow through the semi-permeable deposits which underlie Whitewater Hill and from subsurface flow across the Banning Fault from the Mission Creek Subbasin. In general, there is subsurface flow from the Garnet Hill Subbasin across the Garnet Hill Fault to the Whitewater River Subbasin westerly of the Garnet Hill outcrop. Based on groundwater level measurements, this area is partially influenced by artificial recharge activities at the Whitewater Spreading Facilities at Windy Point.

4.3.1 Surface Water Hydrology

The lower reaches of Mission Creek and Morongo Wash flow across the Garnet Hill Subbasin and are believed to contribute to recharge primarily through subsurface flows. The Whitewater River appears to contribute significant recharge to of the Garnet Hill Subbasin through subsurface flow in the alluvial channel across the Banning Fault and through the semi-permeable deposits that underlie the Whitewater Hill (GSi/water, 2005). Much of this water flows across the Garnet Hill Fault into the Whitewater River Subbasin.

4.3.2 Groundwater Levels

The Garnet Hill Subbasin has groundwater elevations approximately 200 to 250 feet lower than the Mission Creek Subbasin along the Banning Fault indicating that the groundwater flow is partially restricted by the Banning Fault (DWR, 1964). Groundwater in the Garnet Hill Subbasin flows to the east-southeast until the southeastern end of the subbasin where groundwater flow direction turns south and presumably discharges into the Upper Whitewater River Subbasin across the Garnet Hill Fault. The outcropping Garnet Hill appears to create a partial flow restriction that affects movement of groundwater to the southeastern portion of the subbasin.

The upper portion of the Whitewater River Subbasin has groundwater elevations approximately 150 feet to 200 feet lower than what is observed in the Garnet Hill Subbasin, indicating that groundwater flow is partially restricted by the Garnet Hill Fault. Groundwater in the Whitewater River Subbasin flows in an east to southeast direction towards the Salton Sea.

Measured groundwater levels in portions of the Garnet Hill Subbasin have shown a response to recharge activities in the Whitewater River Subbasin (MWH, 2013). Wells in the western portion the Garnet Hill Subbasin also show response to larger recharge events as in 1984-86, 1996-2001, 2005-06 and 2010-12. Water levels in the central portion of the subbasin show a more muted and delayed response to the largest recharge events; while the well in the eastern portion of the subbasin shows minimal response. Data have shown a 250-foot gradient between the northwest and southeast portions of the subbasin (MWH, 2013).

4.3.3 Groundwater Quality

A general discussion on groundwater quality, pertaining to TDS and nitrate, within the Garnet Hill Subbasin is presented in this section.

Total Dissolved Solids

Recorded TDS concentrations at different groundwater wells in the Garnet Hill Subbasin have ranged from a low of 156 mg/L to a high of 933 mg/L. TDS is generally low with averages below 300 mg/L. No significant have been observed with regard to TDS concentrations over time.

Nitrate

Nitrate concentrations are relatively low within the subbasin. Groundwater quality within Garnet Hill Subbasin is suitable for domestic water use and meets current drinking water standards. No trend is observed for nitrate concentrations over time.

4.4 DESERT HOT SPRINGS SUBBASIN

The Desert Hot Springs Subbasin is located adjacent to the Mission Creek and Whitewater River Subbasins and trends northwest-southeast along the foothills of Joshua Tree National Park. DWR Bulletin 118 (2003) has designated this subbasin as No. 7-21.03. The Desert Hot Springs Subbasin is bounded on the north by the Little San Bernardino Mountains and to the southeast by the Mission Creek and San Andreas Fault. The San Andreas Fault separates the Desert Hot Springs Subbasin from the Whitewater River Subbasin and serves as an effective barrier to groundwater flow. The subbasin has been divided into three subareas: Miracle Hill, Sky Valley, and Fargo Canyon. The subbasin is bounded on the southwest by the Banning and Mission Creek Faults and the semipermeable rocks of the Indio Hills. These faults act as groundwater barriers and direct the groundwater in a southeast direction. Hot thermal springs occur on the Mission Creek Fault and have been actively pumped for over 50 years to supply local resorts. The subbasin is comprised of late Pleistocene and Holocene alluvium, coarse sand and gravel (DWR, 2003).

The Desert Hot Springs Subbasin has little residential, industrial, or agricultural development with exception to the community of Desert Hot Springs; residential communities exist within the Sky Valley Subarea, and Indio Hills. The Miracle Hill subarea underlies portions of the City of Desert Hot Springs and is characterized by hot mineralized groundwater, which supplies a number of spas in that area. The Sky Valley Subarea underlies the central portion of the subbasin and is separated from the Fargo Canyon Subarea by the Indio Hills Fault. There is sparse data on this subarea. The Fargo Canyon Subarea underlies a portion of the study area along Dillon Road north of Interstate 10. This area is characterized by coarse alluvial fans and stream channels flowing out of Joshua Tree National Park. Based on limited groundwater data for this area, flow is generally to the southeast. Sand and gravel mining operations currently exist and urban development has been proposed within the Fargo Canyon Subarea.

4.4.1 Surface Water Hydrology

Long Canyon Creek and the Little Morongo Creek provide recharge in the Desert Hot Springs Subbasin. Other tributaries including those from the White House Canyon, Midway Canyon, Blind Canyon, Long Canyon, and North Short Canyon appear to contribute much smaller amounts of water. DWR (1964) estimates that amount of seasonal tributary runoff into the Desert Hot Springs Subbasin to be roughly 2,900 AFY, while GSi/water (2005) estimated that these canyons may provide up to 2,200 AFY in groundwater recharge. Previous investigations indicated the amount of recharge contributed through these canyons is negligible compared to the recharge from the major canyons within the Coachella Valley (Tyley, 1974). Subsurface outflow from the Miracle Hill Subarea to the Mission Creek Subbasin is estimated to be about 1,800 AFY (Psomas, 2013).

4.4.2 Groundwater Levels

A lack of historical data together and the scarcity of wells outside the Miracle Hill Subarea prevent rigorous analyses of fluctuations and trends of the water table within Desert Hot Springs. However, the available data suggest that water levels remain relatively unchanged except for a decline in water levels in the Miracle Hill Subarea (DWR, 1964).

4.4.3 Groundwater Quality

A general discussion on groundwater quality, pertaining to TDS and nitrate, within the Desert Hot Springs Subbasin is presented in this section.

Total Dissolved Solids

TDS within the Desert Hot Springs Subbasin is among the highest in the Coachella Valley. Naturally-occurring high TDS groundwater exists upwards of 2,000 mg/L. This hot mineral water is pumped for use in spas or domestic use. High concentrations of TDS in the groundwater throughout the subbasin limits agricultural or domestic water resources (CVWD, 2000).

Nitrate

Monitoring wells in Fargo Canyon Subarea have shown some high levels of nitrate exceeding the MCL after 2001. Most wells sampled indicate concentrations below the MCL of 45 mg/L as nitrate.

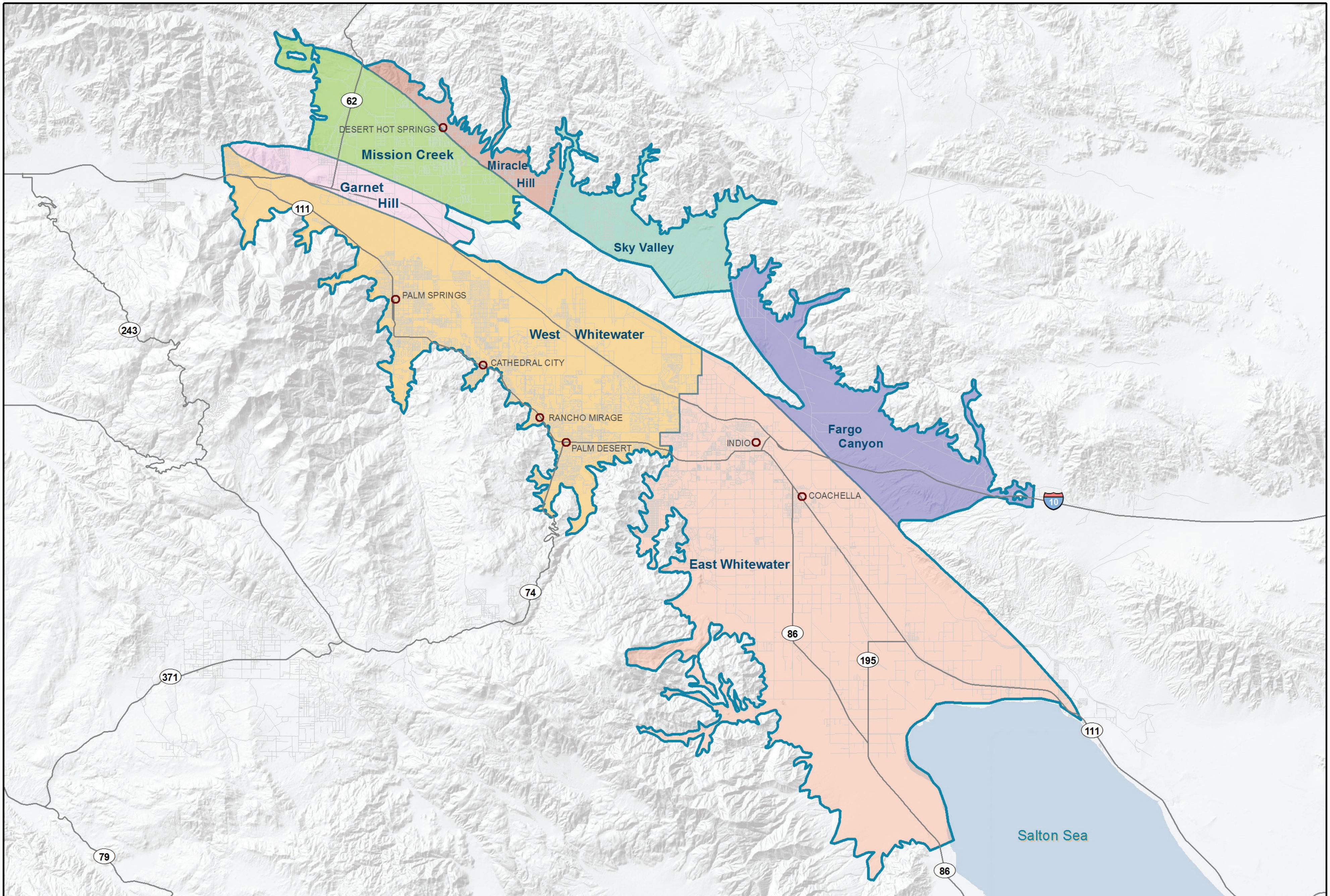
4.5 DEFINITION OF MANAGEMENT ZONES

Groundwater basins are often the smallest unit of management identified within the Basin Plans. Given the size of Coachella Valley groundwater basins, it may be more useful to evaluate and manage groundwater quality on a scale commensurate with the regulatory and resource management decisions that must be made with surface and groundwater sources of salt and nutrient as well as the available data. A large basin could be partitioned into smaller subbasins where the relationship between land use activities, water sources and uses, and constituents of concern concentration levels can be more accurately described and managed. A basin could also be partitioned into shallow or deep zones to allow consideration of management decisions or implementation alternatives that may differ based on groundwater depth. Given the complexity of land uses, water resource management needs, and water quality goals and objectives, it may be appropriate to manage groundwater using a framework that takes into account surface and groundwater management linkages. Each area within the state of California is different, and therefore the development of management zones (MZs) is not unique; some MZs may be based more on jurisdictional boundaries, such as regional management plans or natural jurisdictional relationships, rather than hydrologic boundaries.

To delineate MZs, geologic maps, groundwater levels, water quality, and hydrogeologic conditions were reviewed and feedback was obtained from the RWQCB. Based on this information, MZs were determined that are consistent with the groundwater subbasins for the Mission Creek and Garnet Hill Subbasins. The Whitewater River Subbasin is subdivided into two MZs, West Whitewater River and East Whitewater River. The division of the Whitewater River Subbasin in to two MZs was done due to the differing geology, aquifer systems, and water quality. The East Whitewater River MZ will include the Oasis Subarea and a portion of the Thousand Palms Subarea. The West Whitewater River MZ will also contain a portion of the Thousand Palms Subarea. The separation of the East Whitewater River and West Whitewater River MZs is the Whitewater recharge area of benefit line of demarcation. This line extends northeast of Point Happy and is shown on **Figure 4-4**. The West Whitewater River MZ is predominantly a single aquifer system, while the East Whitewater River MZ is a multiple aquifer system. The Desert Hot Springs Subbasin is subdivided into three MZs, Miracle Hill, Sky Valley, and Fargo Canyon. The Miracle Hill and Sky Valley MZs (subareas) are separated by a groundwater divide. The Sky Valley and Fargo Canyon MZs (subareas) are separated by the Indio Hills Fault, which appears to be a no-flow boundary. As additional data is collected over time, it may be reasonable to further discretize these MZs.

Being hydrologically distinct allows the areas of recharge and discharge to be well defined for each MZ and associated water quality of the recharge and discharge terms can be estimated, evaluated, and managed. These MZs are shown in **Figure 4-4**, and listed below.

- Whitewater River (Indio) Subbasin
  - MZ1: West Whitewater River
  - MZ2: East Whitewater River
- MZ3: Mission Creek
- MZ4: Garnet Hill
- Desert Hot Springs Subbasin
  - MZ5: Miracle Hill
  - MZ6: Sky Valley
  - MZ7: Fargo Canyon



Key to Features

- City
- Management Zone
- Major Roadways
- Subarea

0 2.5 5 Miles

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Date: April 13, 2015

Coachella Valley SNMP Management Zones

MWH

Figure 4-4

Section 5
Ambient Water Quality

The Policy requires the determination of whether current and projected salt and nutrient concentrations are consistent with applicable WQOs. This section identifies potential constituents of concerns and documents the ambient water quality, i.e., current salt and nutrient constituent water quality concentrations.

5.1 CONSTITUENTS OF CONCERN

Constituents of concern were reviewed with the RWQCB and stakeholders. The following constituents were considered for initial review:

- Ammonia-nitrogen
- Arsenic
- Chloride
- Total Chromium and Hexavalent Chromium
- Fluoride
- Iron
- Manganese
- Nitrate
- Nitrite
- Selenium
- Sulfate
- TDS
- Uranium

Many of these constituents are important for water supply management, but do not directly pertain to the management of salts and nutrients. Of the constituents identified in the initial review list, those of particular relevance to salt and nutrient management within the Coachella Valley include:

- Arsenic
- Hexavalent Chromium
- Nitrate
- TDS

Nitrate (as NO_3) and TDS are selected as the primary COCs as they are materially affected by recycled water use or other salt/nutrient loads. These parameters are most affected by human-induced activities. These constituents can be used as surrogates for other salt and nutrient constituents and also have a stronger monitoring history, which is a benefit, although not a requirement.

Naturally-occurring arsenic is found in the eastern Coachella Valley groundwater from Mecca to Oasis and appears to be associated with local faults and geothermal activity. In early 2006, CVWD completed construction of three groundwater treatment facilities that use an ion-exchange process with a brine minimization and treatment process to remove arsenic. Similarly, naturally-occurring hexavalent chromium is found in many areas of the Coachella Valley, likely an artifact of the erosion of ultra-mafic rock. Arsenic and hexavalent chromium have relatively new MCLs. Their potential impact on beneficial uses will be evaluated to determine how a salt and nutrient management strategy may impact constituent concentration within a MZ.

5.2 DATA SOURCES

Groundwater quality data for TDS and nitrate used in the determination of ambient water quality was received from the following list of stakeholders: CVWD, DWA, MSWD, IWA, CWA, County of Riverside, City of Palm Springs, and Cabazon Band of Mission Indians. Additional data was gathered from the SWRCB's GeoTracker Groundwater Ambient Monitoring and Assessment (GAMA) Program[3] public database.

5.3 WATER QUALITY ANALYSIS METHODS

As defined in Section 3, the assimilative capacity of a management zone is defined as the difference between the applicable WQO for a pollutant parameter and the AWQ for that pollutant parameter. AWQ is the representative concentration of a water quality constituent within a water body or management zone. If the ambient water quality exceeds the WQO, the presumption is that assimilative capacity does not exist.

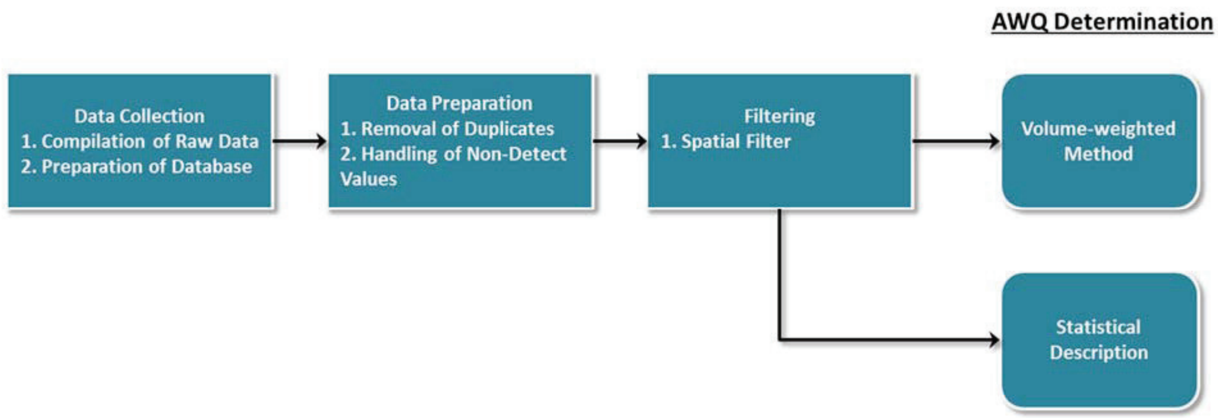
The Policy does not address or define AWQ or outline a method to determine ambient water quality, but does state "the available assimilative capacity shall be calculated by comparing the mineral WQO with the average concentration of the basin/sub-basin …" As outlined in TM-1 (**Appendix A**) and TM-2 (**Appendix B**), use of a single average value is proposed when data permits, or a statistical summary when data is limited. The approach of using a single value is consistent with the approaches used across the state (Todd Engineers, 2014; Santa Clara Valley Water District, 2014; Wildermuth Environmental, 2000; Los Angeles County Department of Public Works, 2014). Under the Policy, planned recycled water projects are permitted to use no more than 10 percent of the available assimilative capacity for a single project and no more than 20 percent for multiple projects; those planned projects using more assimilative capacity will require additional investigation.

The AWQ is determined for TDS and nitrate (as NO_3) for this SNMP, as these constituents are representative of salts and nutrients in the Coachella Valley within this

[3] http://www.waterboards.ca.gov/gama/geotracker_gama.shtml

SNMP. Two methods are used for the determination of AWQ. A statistical description of AWQ is presented for each management zone and a volume-weighted AWQ is computed for management zones with adequate data to support the volume-weighted method. Data required for the volume-weighted method includes sufficient water quality data for wells with known depth information, aquifer thickness and effective porosity, and groundwater level. **Figure 5-1** shows the steps leading to AWQ determination. These steps are described I detail in TM-2 (**Appendix B**). In summary, water quality data are collected and aggregated into a database. The database is evaluated for duplicates, errors, and handling of inconsistent fields. The data is then filtered for summary and then used for statistical and or volume-weighted ambient water quality calculation.

Figure 5-1
Diagram of Generalized AWQ Determination



A statistical description of AWQ was completed for each MZ and a volume-weighted AWQ was computed for MZs with adequate data to support the volume-weighted method. Data adequacy for each MZ is summarized in TM-2 (**Appendix A**). Data required for the volume-weighted method includes sufficient water quality data for wells with known depth information, aquifer thickness and effective porosity, and groundwater level.

During the development of TM-1 (**Appendix A**) and TM-2 (**Appendix B**), stakeholders made several comments regarding the determination of when the volume-weighted method should be applied to approximate management zone water quality. The RWQCB desired that the MZs were discretized vertically in aquifer where possible. The determination of data adequacy for contouring water quality within a MZ to thereby apply the volume-weighted AWQ method is typically based on professional judgment. Within TM-2 (**Appendix B**) is a summary of data adequacy for each MZ based upon spatial distribution of data points, autocorrelation (how values are related to each other), and supporting statistics.

The question of data adequacy is largely dependent on the amount of data available. Therefore, the baseline period chosen has large consequences. Baseline periods of 5-, 10-, 15-, and 20-Year were evaluated. The goal is to use the shortest baseline period possible (to represent current conditions) yet have enough data to support the contouring of groundwater quality necessary for the volume-weighted method.

Based on this evaluation, 5- and 10-Year baseline periods, it was determined that these periods were too short, i.e., too few data points, to support groundwater contouring. The 15-Year period was often sufficient. Accordingly, the results presented for statistical summaries use this baseline period. For water quality contouring, the most recent measurements for any well are always used so long as it is no older than in the 15 years (1999 to 2013). This approach has been accepted by the RWQCB.

Note that TM-1 (**Appendix A**) and TM-2 (**Appendix B**) introduce the filtering methods applied to raw groundwater quality data to prepare it for use in the AWQ determination described in this section. The results shown in **Section 5.4** pertain to the filtered dataset, the dataset used for AWQ.

5.3.1 Groundwater Models

Existing groundwater models are used for two purposes, quantifying the vertical and horizontal extent of the groundwater systems and to provide a vertical and horizontal grid system to work within. These models cover the Whitewater, Garnet Hill, and Mission Springs subbasins. CVWD (Fogg *et al.*, 2002) developed a groundwater model of the Whitewater and Garnet Hill Subbasins as part the 2002 Water Management Plan (MWH, 2002). The geometry (cell size, layering, and orientation) for this model was used as the base for the recently completed Mission Creek and Garnet Hill Subbasins groundwater model. These models were used as the basis for any AWQ. A summary of model characteristics is listed by subbasin in **Table 5-1**. Average layer depth and thickness by subbasin is shown on **Table 5-2**. The layering of these groundwater models was based on a best estimate of basin lithologic characteristics. The layering is used to categorize areas of the aquifer, e.g., perched aquifer, deep aquifer. When evaluating groundwater quality, well screen intervals are used to categorize a well into a particular model layer. This allows for a general quantification of measurements and quality with depth.

Table 5-1
Groundwater Model Characteristics for Mission Creek, Garnet Hill, and Whitewater River Subbasins

Model Characteristic	Mission Creek Subbasin[1]	Garnet Hill Subbasin[2]	Whitewater River Subbasin[3,4]
Calibration Period	1936-2009		1936-1996
Model Domain	75 rows x 86 columns		270 rows x 86 columns
Cell Size	1,000 feet x 1,000 feet		1,000 feet x 1,000 feet
Layers	4		4
Active Cells	12,360		48,396
Storage Coefficient	0.08 to 0.18		0.06 to 0.13

1. Psomas, 2013
2. Fogg, *et al*., 2002 and Psomas, 2013
3. Fogg *et al*., 2002.
4. The CVWD model was developed with the idea that it could be expanded to encompass the Mission Creek and Desert Hot Springs subbasins. However, the cells for those subbasins were left inactive in the original model.

Table 5-2
Groundwater Model Average Layer Depth and Thickness by Subbasin

Subbasin	Layer Depth and Thickness (feet below ground surface)			
	Layer 1	Layer 2	Layer 3	Layer 4
Whitewater River	0 - 190	190 - 300	300 - 410	410 - 1,270
Mission Creek	0 - 810	810 - 880	880 - 960	960 - 1,290
Garnet Hill	0 - 730	730 - 800	800 - 870	870 - 1,340
Desert Hot Springs	No groundwater model developed			

5.3.2 Statistical Description Method

Statistical analyses of water quality data are performed and summarized for each management zone over the period of 1999 to 2013. The statistical descriptions are useful for management zones that lack significant well depth information or have limited water quality data, as there is not sufficient water quality and aquifer information to complete the volume-weighted method. A summary of the statistical descriptors calculated for this method is presented in **Table 5-3**.

Descriptive statistics are provided for filtered datasets. AWQ is evaluated based on the filtered dataset; a 95 percent two-tailed confidence interval on the mean filtered water quality data may be used to determine a range for AWQ in management zones where the volume-weighted method is not appropriate.

Table 5-3
Statistical Descriptors Used to Describe Ambient Water Quality

Statistical Descriptor	Definition in this SNMP	As the Descriptor relates to:	
		Unfiltered Data	Filtered Data
Count	The total number of data points available for a particular constituent and time period within a management zone	Number of individual lab analysis results	Number of filtered data points (as defined in filtering methods)
Mean	The arithmetic mean of all results, or the sum of the results divided by the count	Average of all lab results	Average of filtered data points
Median	The value separating the upper half of all results from the lower half	Middle value of all lab results	Middle value of filtered data points
Mode	The value that appears most often in a set of results	Most common lab result (if one exists)	Most common filtered data point (if one exists)
Standard Deviation	A measure of the amount of variation or dispersion from the average; a lower standard deviation implies that the individual results are closer to the mean of the results	Variation of all lab results	Variation of filtered data points
Range	The lowest and highest result in the dataset	Lowest and highest lab result	Lowest and highest filtered data point; filtered data range will always be less than or equal to the range of unfiltered data
Confidence Interval	An estimated range of values which is likely to include the mean of the population; the width of the confidence interval indicates the possible uncertainty of the mean; e.g., a 95 percent confidence interval has a 95 percent probability of containing the population mean	Measure of how certain the computed mean is compared to the true mean; a wider interval indicates lower certainty	Filtered confidence interval will typically be greater than the confidence interval for unfiltered data due to the reduced size of data points

5.3.3 Volume-weighted Method

The volume-weighted method for determination of AWQ is used when an adequate amount of data exist for a particular management zone. This method weights the average water quality by the amount of mass of a constituent in groundwater storage. The volume-weighted method consists of the following steps:

- Filter water data points within a spatial grids to determine an annual water quality for a 1,000 square foot cell that contains water quality data;
- Create a map of gridded data points using the most recent water quality measurement within each cell;

- Contour the cell results to establish an approximated water quality for all cells in a MZ;
- Assign approximated water quality to cells lacking well data;
- Using the approximated concentration, determine the mass in the cell based on the groundwater in storage within the cell; and
- Sum the mass of the constituent on the MZ and divide by the total groundwater in storage.

These steps are conceptualized in **Figure 5-2**.

These steps can be completed for individual aquifers when sufficient data is available. Each layer is evaluated independently with the same steps and then aggregated to determine the total MZ AWQ. This is illustrated in **Figure 5-3** and further discussed in Section 5.3.4.

Water quality data is often clustered in areas of well density. Using all the wells in the calculation of AWQ will skew results towards the water quality around dense well zones. To address this, a 1,000 foot by 1,000 foot grid was applied to group well data within the same grid cell. Details of this method are provided in TM-2 (**Appendix B**).

Following the data preparation and filtering, the single cell concentration values are contoured to provide inferred concentration values where no wells are present. The concentrations are multiplied by the water in storage with the grid cell and the results are totaled to obtain a volume weighted AWQ. If the data is available by vertical layer (aquifer), this process can be completed at the model layer/aquifer level.

In addition to water quality, groundwater level data is also filtered and contoured in a similar fashion. The water level contours are then used to generate a water level surface and values from the surface at the cell centers are assigned to each cell within the MZ.

Figure 5-2
Conceptual Diagram of the Volume-weighted Method

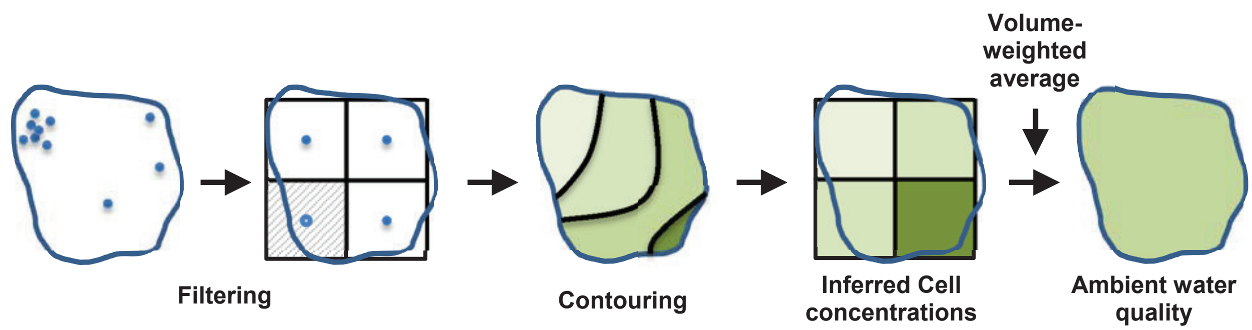
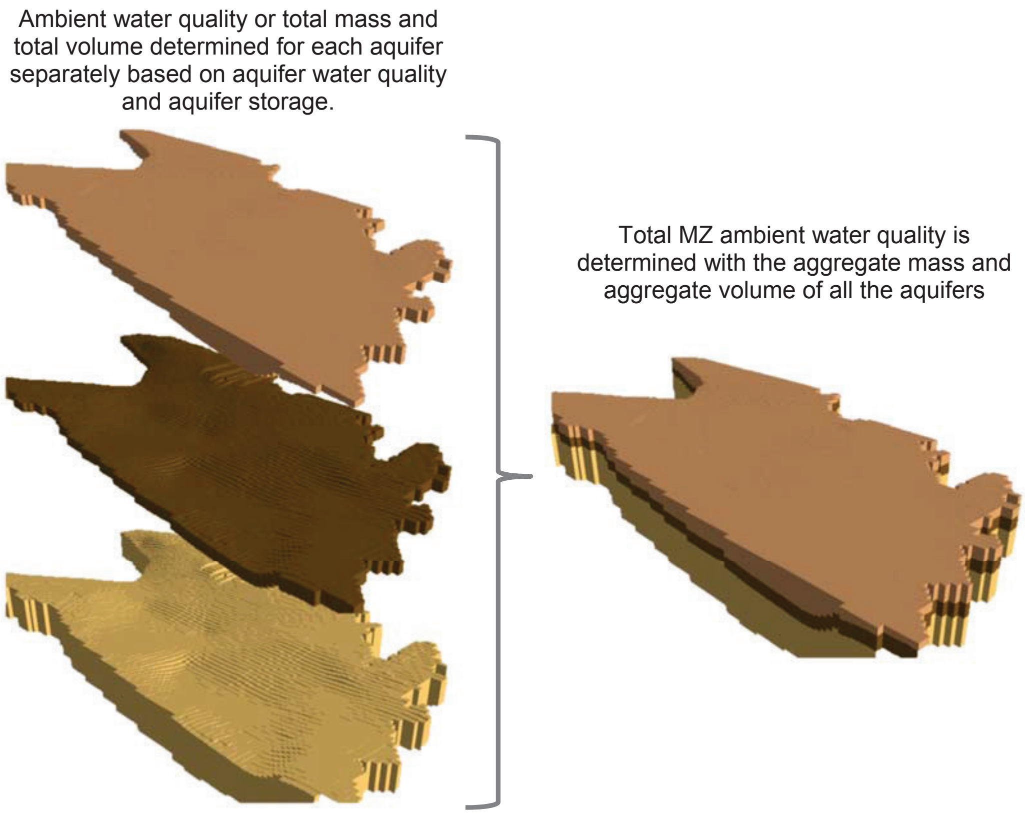


Figure 5-3
Conceptual Diagram of the Volume-weighted Method Applied to Multiple Aquifers



To determine the volume of water in each cell volume between the water level surface and the base of the aquifer, the effective porosity for each cell and layer is needed. Total porosity is defined as the ratio of void space to the total volume of a geologic formation. The effective porosity is the portion of the void space of a porous material that is capable of transmitting (and thereby mixing) a fluid and excludes clay-bound water (water that is electrochemically attached to clay particles that does not contribute to flow). Effective porosity occurs because a fluid in a saturated porous media will not flow through all voids, but only through the voids which are interconnected. Effective porosity is typically higher than specific yield (the volume of water that can be drained by gravity), but less than the total porosity.

The AWQ of a management zone is the total mass in all cells and layers divided by the total volume of water in storage in all cells and layers:

$$AWQ_{volume-weighted} = \frac{\sum_i \sum_j (C_{i,j} \times Vol_{i,j})}{\sum_i \sum_j Vol_{i,j}},$$

where $C_{i,j}$ is the concentration in cell i and layer j.

5.3.4 Ambient Water Quality Methods for Each Management Zone

TM-2 (**Appendix B**) describes the methods applied to determine AWQ and, specifically, determines how MZs are divided into layers for determining AWQ and if there is sufficient data to contour water quality for each MZ. The analysis completed provided recommendations for each management zone based on the spatial distribution of data points, spatial autocorrelation, and supporting summary statistics. Listed below is the AWQ method applied for each management zone.

West Whitewater River MZ: The volume-weighted AWQ method is recommended for West Whitewater River MZ based on separating the basin into three layers. The upper portion of the aquifer, approximately less than 450 feet below ground surface, is grouped into Layer 1; the middle of the aquifer, approximately 450 to 750 feet below ground surface, into Layer 2; and the bottom of the aquifer, depths greater than approximately 750 feet below ground surface, into Layer 3.

Layer 2 and Layer 3, use the most current data in each cell. These data were checked if they are outliers, consistent with older records, or continuing a trend.

Regarding Layer 1, all baseline periods (5- to 15-year) failed to provide enough data for contouring of water quality data. Given the lack of available data, it was recommended by MWH in TM-2 that in place of contouring a two concentration values are assumed for Layer 1 to bracket a volume weighted AWQ. This provided a very broad AWQ result, as such the median value was used for Layer 1 to calculate the AWQ for Layer 1 and aggregated with Layers 2 and 3.

East Whitewater River MZ: Two aquifers separated by a zone of fine-grained materials were identified from well logs (DWR, 1964). An aquitard separates the upper and lower aquifer zones in the management zone. In much of the management zone, the upper aquifer is capped at the ground surface with clays and silts with minor amounts of sand. Semi-perched groundwater occurs in this capping zone, which is up to 100 feet thick. No recent water quality data exists for the semi-perched aquifer as it is not used beneficially. Subsurface tile drainage systems were installed in the 1950s to control the high water table conditions, to allow reclamation of saline soils, and to intercept poor quality return flows. All agricultural drains empty into the Salton Sea, or into the Coachella Valley Stormwater Channel, which also flows into the Salton Sea. Each of the four water-bearing zones, from shallowest to deepest, is described earlier in TM-1 (**Appendix A**). It should be noted that the agricultural drain quality is assumed to be the quality of the semi-perched zone. There is very little data for the semi-perched zone. If this area had data, it would likely increase the AWQ value.

The volume-weighted AWQ method is recommended for East Whitewater River MZ based on separating the basin into three layers. The upper aquifer, approximately less than 400 feet below ground surface, is grouped into Layer 1; a top portion of the confined aquifer, approximately 400 to 600 feet below ground surface, into Layer 2; and the bottom of the confined aquifer, depths greater than approximately 600 feet below ground surface, is Layer 3.

For Layers 1 through 3, the most current data in each cell is used. These data were checked if for outliers, if they are consistent with older records, or if they continue a trend.

Mission Creek MZ: The main water bearing units of the Mission Creek MZ are unconsolidated Holocene and late Pleistocene alluvial deposits forming a single unconfined aquifer with a saturated thickness of approximately 1,200 feet. An attempt was made to separate the aquifer into layers, but continuous well perforations limited the number of data points exclusive to a single layer; therefore, separation of aquifer layers could not be completed. Data gaps also limited the horizontal extent of the AWQ of this aquifer. The AWQ was calculated only for the eastern half of the MZ based on these data limitation.

The volume-weighted AWQ method is recommended for Mission Creek MZ using a single layer and limiting the contouring and AWQ calculation to the eastern portion of the MZ. The contoured extent is determined as half the distance between the MZ boundary at the northwest and the nearest well with water quality data.

For this MZ, the most current data in each cell were used. These data were checked if for outliers, if they are consistent with older records, or if they continue a trend.

Garnet Hill MZ: No spatial autocorrelation could be evaluated for any baseline period within Garnet Hill MZ due to a lack of data. The recommendation for this MZ is to provide a statistical summary of water quality in lieu of AWQ.

Miracle Hill MZ: Due to a lack of data, the recommendation for this MZ is to provide a statistical summary of water quality in lieu of AWQ.

Sky Valley MZ: Due to a lack of data, the recommendation for this MZ was to provide a statistical summary of water quality in lieu of AWQ.

Fargo Canyon MZ: Due to a lack of data, the recommendation for this MZ was to provide a statistical summary of water quality in lieu of AWQ.

5.4 AMBIENT WATER QUALITY BY MANAGEMENT ZONE

This section summarizes the results of the AWQ determination. All statistical analyses used water quality data for wells during the 15-Year period of 1999 to 2013. All volume-weighted analyses used the most recent data points available, no older than 15-years, for groundwater contouring. This period was used to ensure a statistically significant sample of the historical water quality data because TDS is typically sampled once every three years.

Two sets of statistical descriptions of AWQ are prepared for each management zone: the first set provides statistical descriptions of the unfiltered data within a management zone, and the second set will describe AWQ using the filtered dataset within a management zone. These two sets are presented within TM-2 (**Appendix B**) to demonstrate the effects of the data filtering methods and to provide a deeper understanding of the AWQ. The statistical descriptors presented herein are solely based on the filtered data set.

A volume-weighted AWQ is calculated for those management zones with adequate horizontal and vertical groundwater quality, aquifer parameter, and water level data. The AWQ for West Whitewater River, East Whitewater River, and Mission Creek management zones include this volume-weighted analysis.

5.4.1 West Whitewater River Management Zone

The location of wells with water quality records used in the AWQ determination are shown on **Figure 5-4**. The statistical description of AWQ and volume-weighted AWQ for West Whitewater River MZ are presented in this subsection. All results are summarized by the layers used in the volume-weighted method.

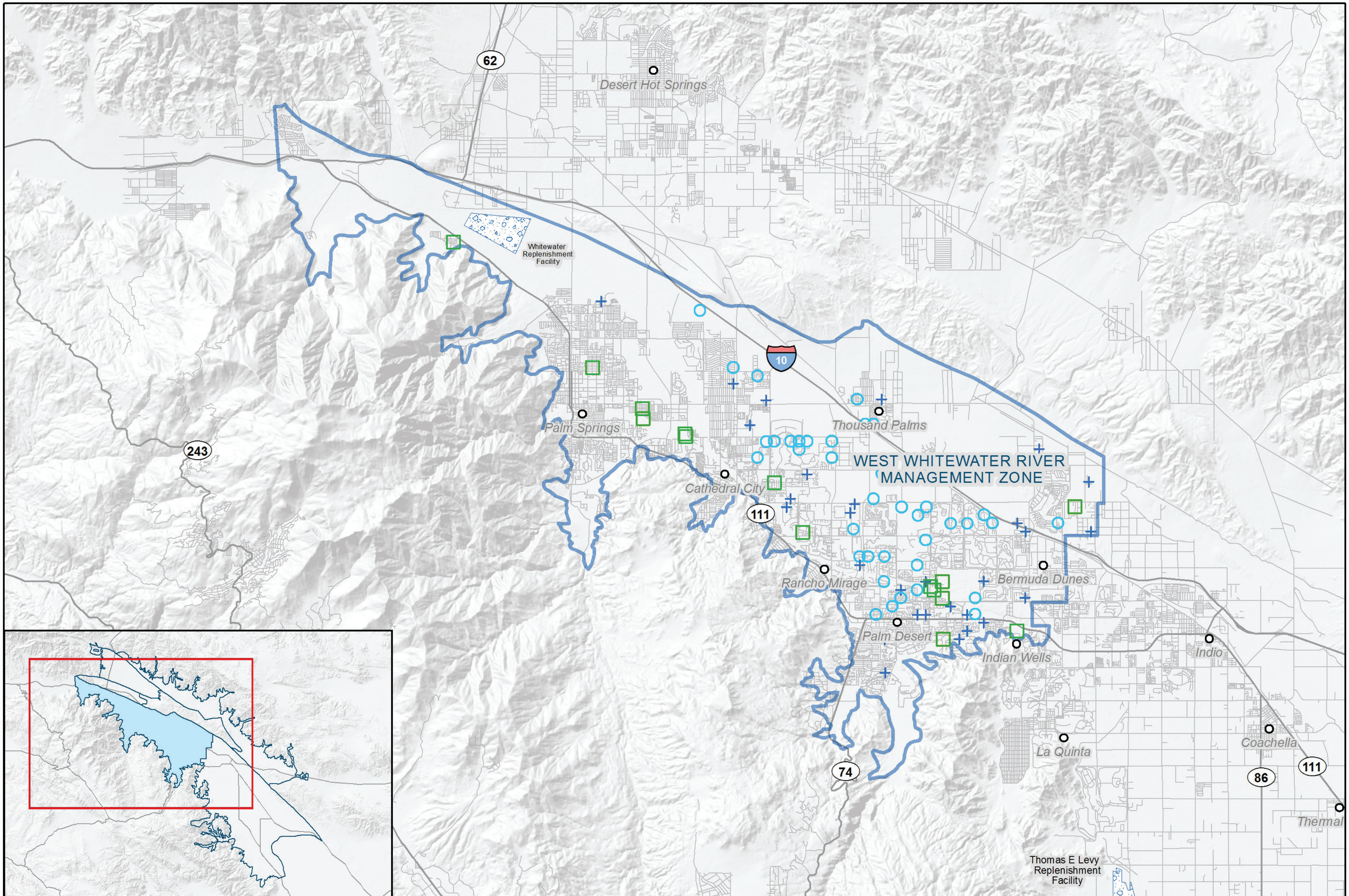
Statistical Description of Ambient Water Quality

The filtered dataset (temporal and spatial filter) for West Whitewater River MZ consists of 80 TDS values and 81 nitrate values. The statistical summary of filtered data for the West Whitewater River MZ is presented on **Table 5-4**.

TDS in West Whitewater River MZ typically decreases with depth. Higher TDS appears in the shallower part of the aquifer downgradient of the Whitewater Recharge Facility and in wells from Rancho Mirage to Palm Desert. Some higher TDS also occurs within the Thousand Palms Subarea at the east edge of the MZ, but there is little to no groundwater production in this area and no recycled water projects.

Nitrate concentrations within West Whitewater River MZ are generally less than the MCL except for high nitrates observed in wells of varying depths between Rancho Mirage and Palm Desert. There is a general decrease in nitrate concentrations with depth.

The mean TDS of the filtered dataset falls within the interval of 426 to 656 mg/L, 336 to 492 mg/L, and 188 to 220 mg/L for Layer 1, Layer 2, and Layer 3, respectively, with a probability of 95 percent. The mean nitrate (as NO_3) for this MZ is from 10.9 to 52.7 mg/L, 22.8 to 51 mg/L, and 3.6 to 12.8 mg/L for Layer 1, Layer 2, and Layer 3, respectively. The higher nitrates that appear from Rancho Mirage to Palm Desert have a large effect on the summary statistics of West Whitewater River MZ.



Key to Features

Management Zone
City
Highway
Local Roads

Groundwater Well Location
Type of Aquifer Penetrated

Layer 1
Layer 2
Layer 3

N
0 2.5 5 Miles

Document: \\Usirv1s01\Projects\Coachella Valley WD\SNMP\AWQ\CVWD_AWQ_V5\WQWells_EV_MC.mxd

Date: 4/28/2015

Map of Wells with Water Quality Data in the Baseline Period of 1999 to 2013 within West Whitewater River Management Zone

MWH

Figure 5-4

Table 5-4
Descriptive Statistics for West Whitewater River (1999-2013)

Statistic	Layer 1		Layer 2		Layer 3	
	Total Dissolved Solids	Nitrate as NO_3	Total Dissolved Solids	Nitrate as NO_3	Total Dissolved Solids	Nitrate as NO_3
Count	14	14	28	29	38	38
Mean (mg/L)	544	31.8	414	36.9	204	8.2
Median (mg/L)	520	10.4	375	28.5	195	3.2
Mode (mg/L)	N/A	N/A	302	2.7	210	3
Std. Dev. (mg/L)	194	36.2	201	37	49	14
Range (mg/L)	201 to 1,060	1.2 to 101	169 to 842	1.6 to 120	160 to 420	1.9 to 76
95% Confidence Interval (mg/L)	432 to 656	10.9 to 52.7	336 to 492	22.8 to 51	188 to 220	3.6 to 12.8

ND = non-detect

Volume-weighted Ambient Water Quality

Shallow groundwater quality data is a known data gap in West Whitewater River MZ. In a significant portion of this layer, it may be unsaturated. For this reason, Layer 1 is not contoured, and instead the 15-year median value for TDS and nitrate found for Layer 1 in **Table 5-4** is used to determine the AWQ. This approach is different than the method outlined in TM-2. Upon further review of the range and spatial distribution of the data in layer 1, it was determined that the range would not provide increased certainty in the process, in fact it would be quite the opposite. There are two areas of increased concentrations, near Palm Desert and near Rancho Mirage. A significant portion of the management zone area with no data is located where the management zone is undeveloped. Using the extreme values illustrates the sensitivity of the results, but may not be good representations of the actual range in the AWQ for layer 1. Using the median provided the best approximation of AWQ.

Table 5-5 summarizes the results of the volume-weighted AWQ determination for West Whitewater River MZ. Maps to illustrate the relative TDS and nitrate concentrations, respectively, are shown in TM-2 (**Appendix B**) for the West Whitewater River MZ by layer and aggregated total.

Table 5-5
Volume-weighted Ambient Water Quality for West Whitewater River Management Zone

Aquifer Zone	Total Dissolved Solids (mg/L)	Nitrate as NO_3 (mg/L)
Layer 1	520	10.4
Layer 2	323	14.3
Layer 3	224	5.0
Total	**326**	**9.4**

The volume-weighted AWQ for TDS in West Whitewater River MZ is 326 mg/L. The TDS exceeds the volume-weighted AWQ in three areas: (1) north of Palm Springs to the southeast of the Whitewater Recharge Facility, (2) areas in Thousand Palms Subarea, and (3) in the vicinity of Palm Desert and Indian Wells.

The volume-weighted AWQ for nitrate (as NO_3) in West Whitewater River MZ is between 9.4 mg/L. Nitrate concentrations are generally below the volume-weighted AWQ from the north end of West Whitewater River to Cathedral City. The Thousand Palms Subarea and surrounding areas are also relatively low in nitrate. The region above the nitrate AWQ is on the southern boundary of West Whitewater River MZ just southeast of Palm Springs extending to Palm Desert and the East Whitewater River MZ.

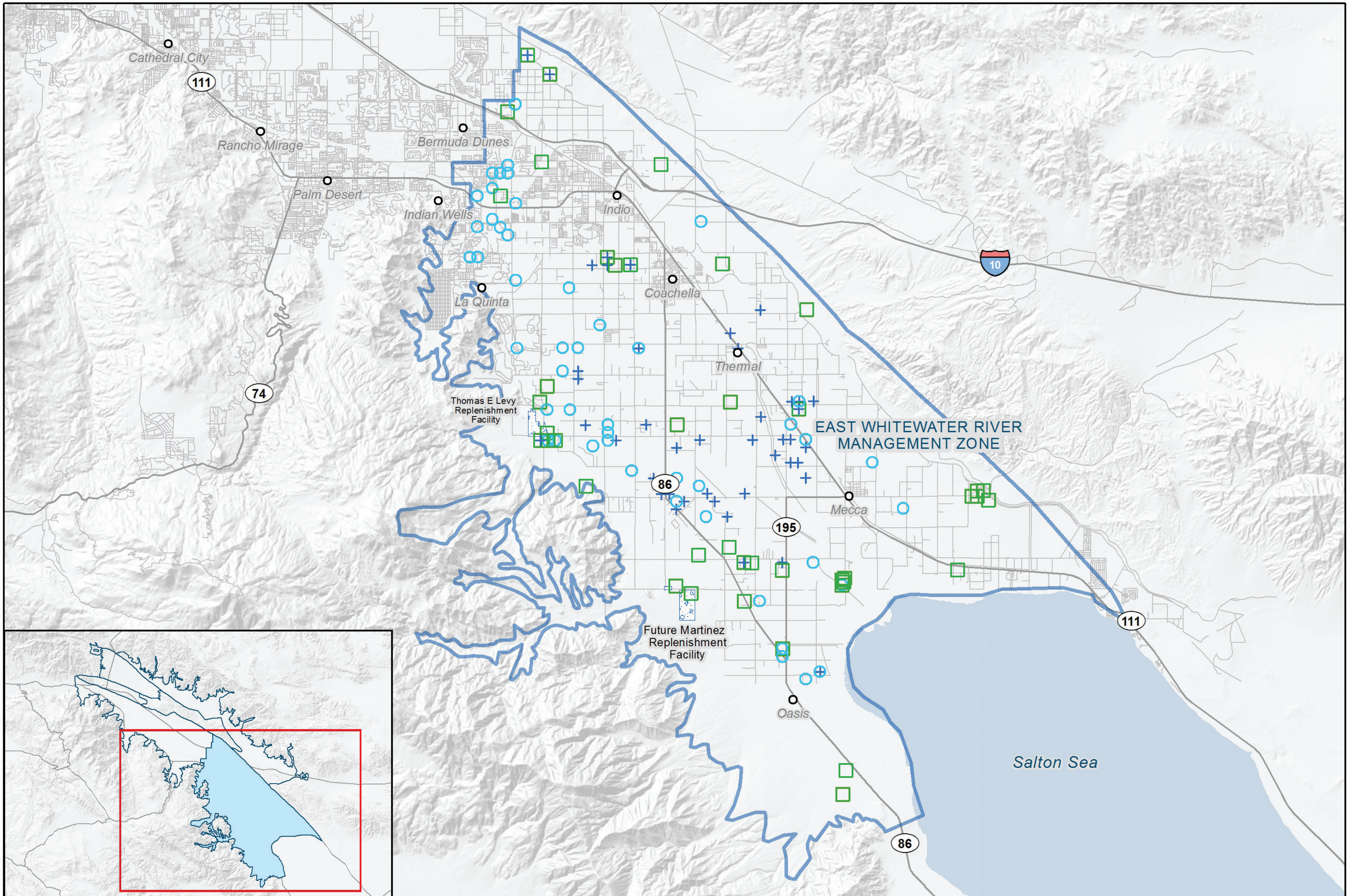
5.4.2 East Whitewater River Management Zone

The location of wells with water quality records used in the AWQ determination are shown on **Figure 5-5**. The statistical description of AWQ and volume-weighted AWQ for East Whitewater River MZ are presented in this subsection. All results are summarized by the layers used in the volume-weighted method.

Statistical Description of Ambient Water Quality

The filtered dataset for East Whitewater River MZ consists of 132 TDS values and 131 nitrate values. The statistical summary of filtered data for the East Whitewater River MZ is presented on **Table 5-6**.

Several CVWD nested monitoring wells are included in this dataset, one is located near the Salton Sea that is sampled much more frequently than other wells. High salinity is found in the lower two intervals, 1,220 to 1,260 feet and 1,430 to 1,470 below ground surface. These readings have a significant effect on the summary statistics of the unfiltered dataset. The filtered dataset minimizes the bias introduced by the more frequent sampling at these wells.



Key to Features

Management Zone

Highway

City

Local Roads

Groundwater Well Location
Type of Aquifer Penetrated

Layer 1

Layer 2

Layer 3

N 0 2.5 5 Miles

Document: \\Usirv1s01\Projects\Coachella Valley WD\SNMP\AWQ\CVWD_AWQ_V5\WQWells_EV_MC.mxd

Date: 4/28/2015

Map of Wells with Water Quality Data in the Baseline Period of 1999 to 2013 within East Whitewater River Management Zone

MWH

Figure 5-5

Table 5-6
Descriptive Statistics of Filtered Data for East Whitewater River (1999-2013)

Statistic	Layer 1		Layer 2		Layer 3	
	Total Dissolved Solids	Nitrate as NO_3	Total Dissolved Solids	Nitrate as NO_3	Total Dissolved Solids	Nitrate as NO_3
Count	41	41	43	43	48	47
Mean (mg/L)	1,509	24.7	362	3.9	355	6.5
Median (mg/L)	698	3.6	202	0.8	180	2.2
Mode (mg/L)	665	ND	162	ND	160	ND
Std. Dev. (mg/L)	3,081	45.4	360	6.5	510	18.3
Range (mg/L)	152 to 19,100	ND to 230	104 to 1,750	ND to 28	123 to 3,270	ND to 111
95% Confidence Interval (mg/L)	537 to 2,482	10.4 to 39	251 to 472	1.9 to 5.9	207 to 503	1.1 to 11.8

ND = non-detect

Higher TDS readings appear in some lower aquifer wells between La Quinta and Coachella, as well as in Oasis Subarea, and west of the Salton Sea. High TDS also appears in the lower aquifer in areas between Thermal and Mecca, south of La Quinta, and in a deep monitoring well near the Salton Sea. Higher TDS reading are also found in the upper aquifer within the Thousand Palms Subarea, to the north of the management zone. Very high TDS measurements were found in shallow groundwater monitoring wells at the Mecca Landfill site.

Nitrate is generally low within East Whitewater River MZ except for high nitrate in the Oasis area and the upper aquifer west of Desert Hot Springs MZ. In general, nitrate decreases from the upper to the lower aquifer of East Whitewater River MZ.

The mean TDS of the filtered dataset falls within the interval of 537 to 2,482 mg/L, 251 to 472 mg/L, 207 to 503 mg/L for Layer 1, Layer 2, and Layer 3, respectively, with a 90 percent probability; for nitrate (as NO_3), this interval is from 10.4 to 39 mg/L, 1.9 to 5.9 mg/L, and 1.1 to 11.8 mg/L for Layer 1, Layer 2, and Layer 3, respectively. The filtered dataset provides a substantially different view of TDS in the statistical summary because the contribution of the frequently sampled nested monitoring well with high TDS is normalized to that of other wells in the East Whitewater River. **Table 5-6** strongly suggests that TDS concentrations are generally lower in the lower aquifer compared to the upper aquifer, even with a skew from a few very high concentrations I the deep aquifer.

Volume-weighted Ambient Water Quality

Table 5-7 summarizes the results of the volume-weighted AWQ determination for East Whitewater River MZ. Maps to illustrate the relative TDS and nitrate concentrations, respectively, are shown in TM-2 (**Appendix B**) for the East Whitewater River MZ by layer and aggregated total.

Table 5-7
Volume-weighted Ambient Water Quality for East Whitewater River Management Zone

Aquifer Zone	Total Dissolved Solids (mg/L)	Nitrate as NO_3 (mg/L)
Layer 1	789	10.1
Layer 2	366	8.6
Layer 3	470	5.8
Total	**515**	**7.0**

The volume-weighted AWQ for TDS in East Whitewater River MZ is 515 mg/L. The lower aquifer generally has lower TDS than the upper aquifer; there are some locations in the lower aquifer near Salton Sea where high TDS concentrations have been observed with nested wells (e.g., nested well 07S09E30R01S screened at 1,430 to 1,470 feet below ground surface). It is not known if TDS concentration increases in very deep sediments farther from the Sea as there are no monitoring wells installed in this zone away from the Sea. Areas with TDS concentrations higher than the volume-weighted AWQ include: (1) areas near the Thousand Palms Subarea, (2) isolated zones southwest of Indio, (3) areas near Desert Hot Springs Subbasin, and (4) the east end of the Oasis Subarea.

The volume-weighted AWQ for nitrate (as NO_3) in East Whitewater River MZ is 7.0 mg/L. The lower aquifer has marginally less nitrate content than the upper aquifer, in general. Along the center of East Whitewater River, nitrate is generally below the volume-weighted AWQ with a large amount of undetected concentrations. Nitrate concentrations higher than the volume-weighted AWQ occur in: (1) the southern boundary of East Whitewater River at the border of West Whitewater River MZ extending to the southeast, (2) the southern parts of Thousand Palms Subarea, (3) the southern boundary with Desert Hot Springs MZ extending southeast to the Salton Sea, and (4) much of Oasis Subarea.

It should be noted that there are very few shallow wells that penetrate the semi-perched aquifer in the East Whitewater River MZ. The semi-perched aquifer extends across the central portion of the MZ, but is absent from the basin margins where coarser-grained alluvial fan deposits predominate. Recharge of the semi-perched aquifer is largely from percolation of surface runoff and return flows of applied water. Water applied to the ground surface above the perched aquifer does not readily reach the lower groundwater aquifers due to these relatively impervious clay layers. The tile drain system drains the shallow water table below the rooting zone. Based on drain flow water quality, if this aquifer could be characterized with groundwater quality measurements, it would likely increase the AWQ. This should be considered when reviewing the AWQ of the East Whitewater River MZ in total.

5.4.3 Mission Creek Management Zone

The location of wells with water quality records used in the AWQ determination are shown on **Figure 5-6**. The statistical description of AWQ and volume-weighted AWQ for Mission Creek MZ are presented in this subsection.

Statistical Description of Ambient Water Quality

The filtered dataset for Mission Creek MZ consists of 25 TDS values and 27 nitrate values. The statistical summary of filtered data for the Mission Creek MZ is presented on **Table 5-8**. The filtered dataset minimizes the effects of many of the biases discussed in Section 2.2, such as the abundance of high nitrate values from a single shallow well.

Table 5-8
Descriptive Statistics of Filtered Data for Mission Creek (1999-2013)

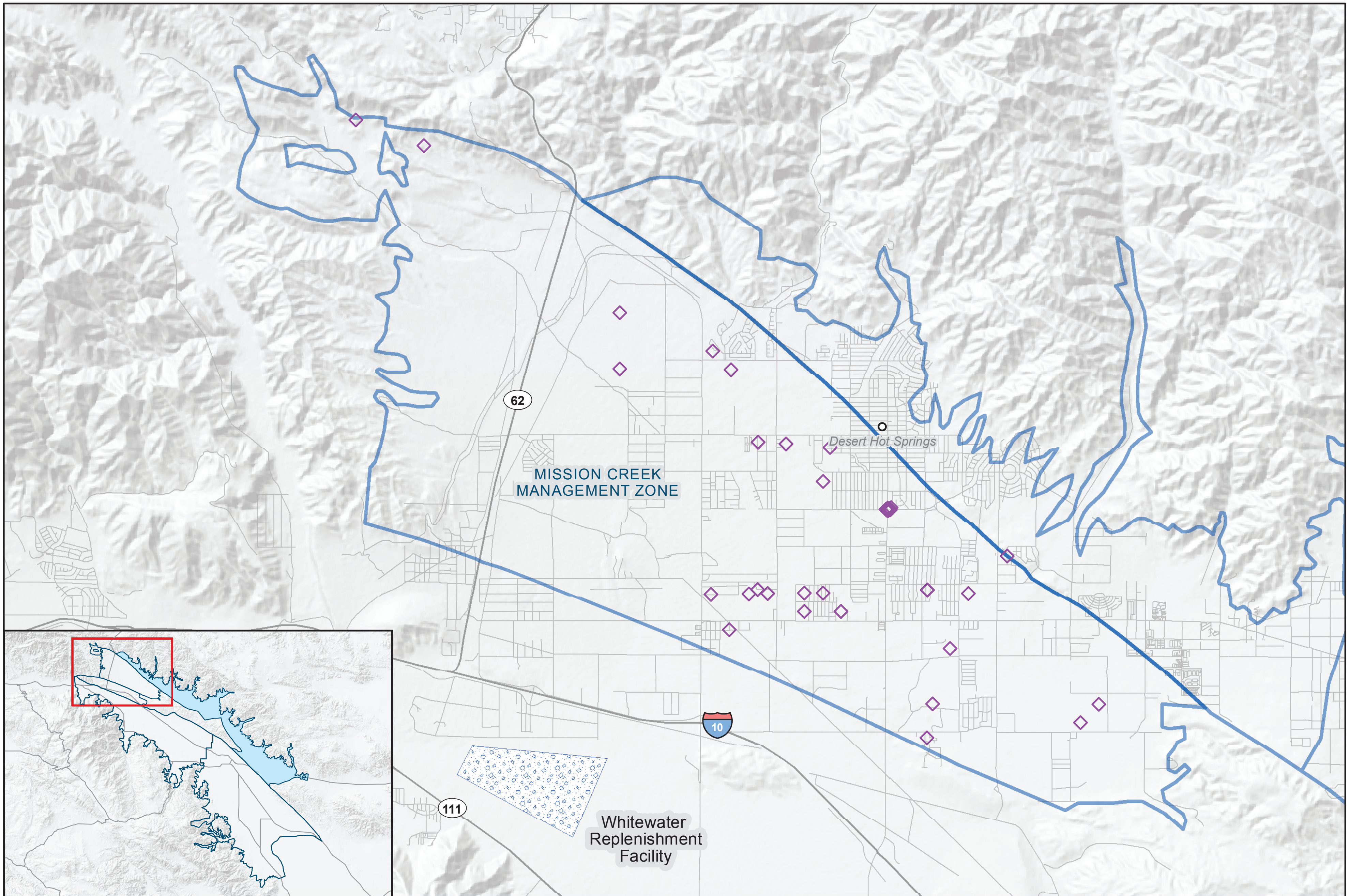
Statistic	Total Dissolved Solids	Nitrate as NO_3
Count	25	27
Mean (mg/L)	578	5.5
Median (mg/L)	488	3.8
Mode (mg/L)	N/A	ND
Std. Dev. (mg/L)	230	7.9
Range (mg/L)	300 to 1,096	ND to 42. 8
95% Confidence Interval (mg/L)	483 to 673	2.4 to 8.6

ND = non-detect

Influence from high salinity groundwater from Desert Hot Springs may contribute to the upper end of the range. TDS concentrations generally decrease from the Desert Hot Springs to the Garnet Hill management zones. Very few data exist in the northwest of the management zone.

A shallow well with high nitrate concentrations that is sampled more frequently than others in this dataset are a cause for the large difference between the average and median nitrate.

The mean TDS of the filtered dataset falls within the interval of 483 to 673 mg/L with a 95 percent confidence; for nitrate (as NO_3), this interval is between 2.4 and 8.6 mg/L. This relatively wide range is caused by the data variability and the limited number of data points.



Key to Features

Management Zone

City

Highway

Local Roads

Groundwater Well Location

Well

0 1 2 Miles

N

Document: \\Usirv1s01\Projects\Coachella Valley WD\SNMP\AWQ\CVWD_AWQ_V5\WQWells_EV_MC.mxd

Date: 6/5/2015

Map of Wells with Water Quality Data in the Baseline Period of 1999 to 2013 within Mission Creek Management Zone

MWH

Figure 5-6

Volume-weighted Ambient Water Quality

Table 5-9 summarizes the results of the volume-weighted AWQ determination for the eastern portion of the Mission Creek MZ. Maps to illustrate the relative TDS and nitrate concentrations, respectively, have been updated since TM-2 and are shown in **Appendix E** for the Mission Creek MZ.[4]

Table 5-9
Volume-weighted Ambient Water Quality for Mission Creek Management Zone

Total Dissolved Solids (mg/L)	Nitrate as NO_3 (mg/L)
540	3.0

The volume-weighted AWQ for TDS in the Mission Creek MZ is 540 mg/L. TDS is above the volume-weighted AWQ towards the southeast of Mission Creek and where it borders Desert Hot Springs MZ. TDS decreases to the northwest end of Mission Creek MZ and near the Garnet Hill MZ. Few data are available in the western portion of Mission Creek MZ. Consequently, this area was excluded from the AWQ computation. Without data, it is uncertain how this exclusion impacts the AWQ.

The volume-weighted AWQ for nitrate (as NO_3) in the Mission Creek MZ is 3.0 mg/L. Nitrate is generally low throughout Mission Creek. The area above the volume-weighted AWQ is south of the Desert Hot Springs Subbasin extending to the Garnet Hill MZ, with the exception of the far southeast end of the Mission Creek MZ.

5.4.4 Garnet Hill Management Zone

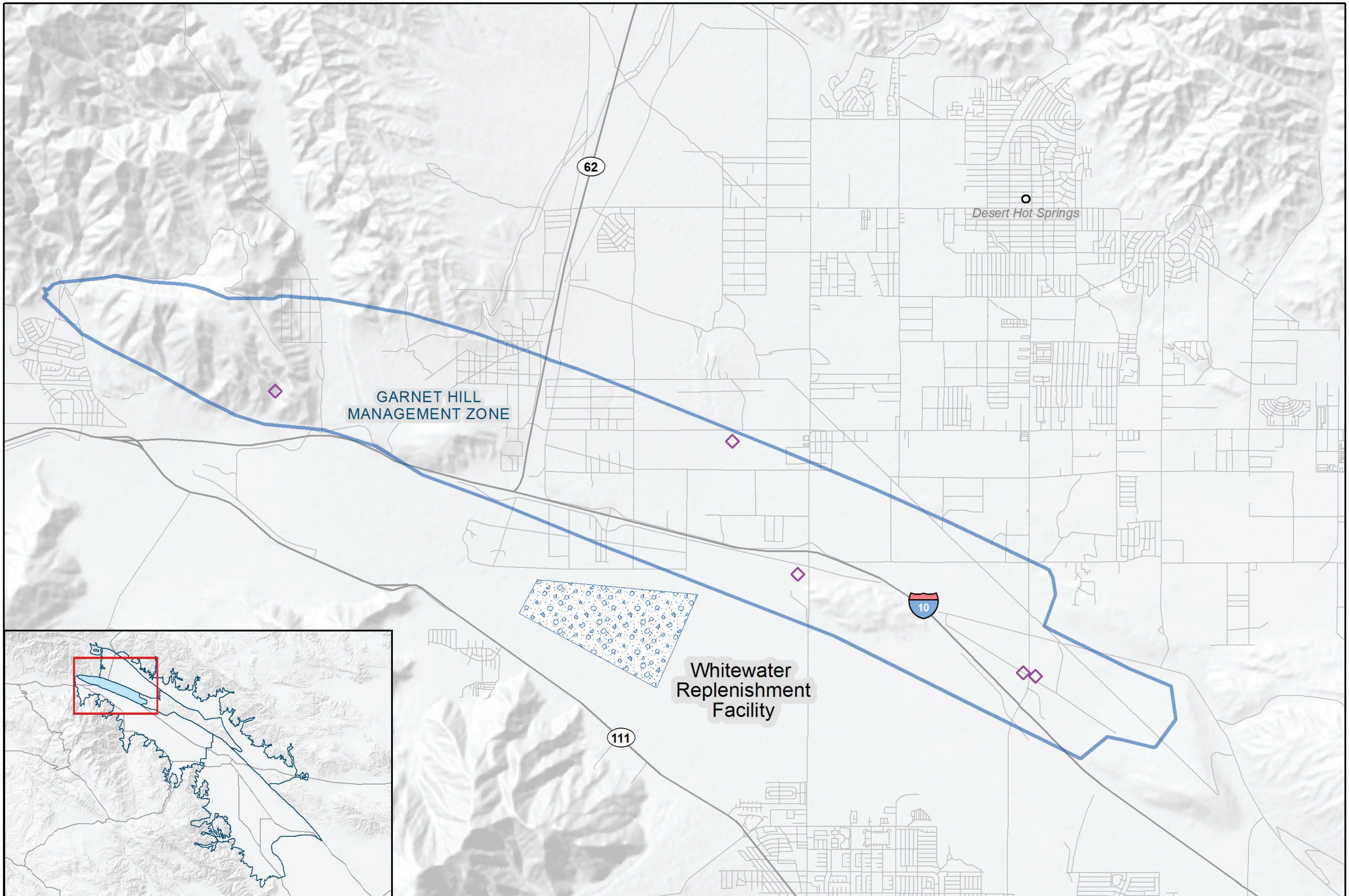
The location of wells with water quality records used in the AWQ determination are shown on **Figure 5-7**. The Garnet Hill Subbasin is considered an unconfined aquifer with a saturated thickness of 1,000 feet or more based on well depths and has an estimated total storage capacity on the order of 1.0 million acre-feet.

Statistical Description of Ambient Water Quality

The filtered dataset for Garnet Hill MZ consists of 4 TDS values and 4 nitrate values. The statistical summary of filtered data for the Garnet Hill MZ is presented on **Table 5-10**.

TDS concentrations within Garnet Hill MZ are very low compared to other management zones. Very few data are available for characterizing the spatial distribution of groundwater quality within Garnet Hill MZ. However, available data indicate that water quality is generally excellent.

[4] Note that Appendix E only contains a map showing concentrations in Mission Creek MZ, which has been updated since TM-2. Refer to TM-2 (Appendix B) for maps of East Whitewater River and West Whitewater River MZ concentrations.



Document: \\Usirv1s01\Projects\Coachella Valley WD\SNMP\AWQ\CVWD_AWQ_V5\WQWells_EV_MC.mxd

Date: 4/28/2015

Map of Wells with Water Quality Data in the Baseline Period of 1999 to 2013 within Garnet Hill Management Zone

MWH

Figure 5-7

Table 5-10
Descriptive Statistics of Filtered Data for Garnet Hill (1999-2013)

Statistic	Total Dissolved Solids	Nitrate as NO_3
Count	4	4
Mean (mg/L)	217	2.2
Median (mg/L)	212	1.8
Mode (mg/L)	N/A	N/A
Std. Dev. (mg/L)	58	1.6
Range (mg/L)	156 to 288	0.6 to 4.5
95% Confidence Interval (mg/L)	124 to 309	ND to 4.8

ND = non-detect

There are too few data points to draw meaningful conclusions on AWQ within the Garnet Hill MZ.

5.4.5 Desert Hot Springs Subbasin Management Zones

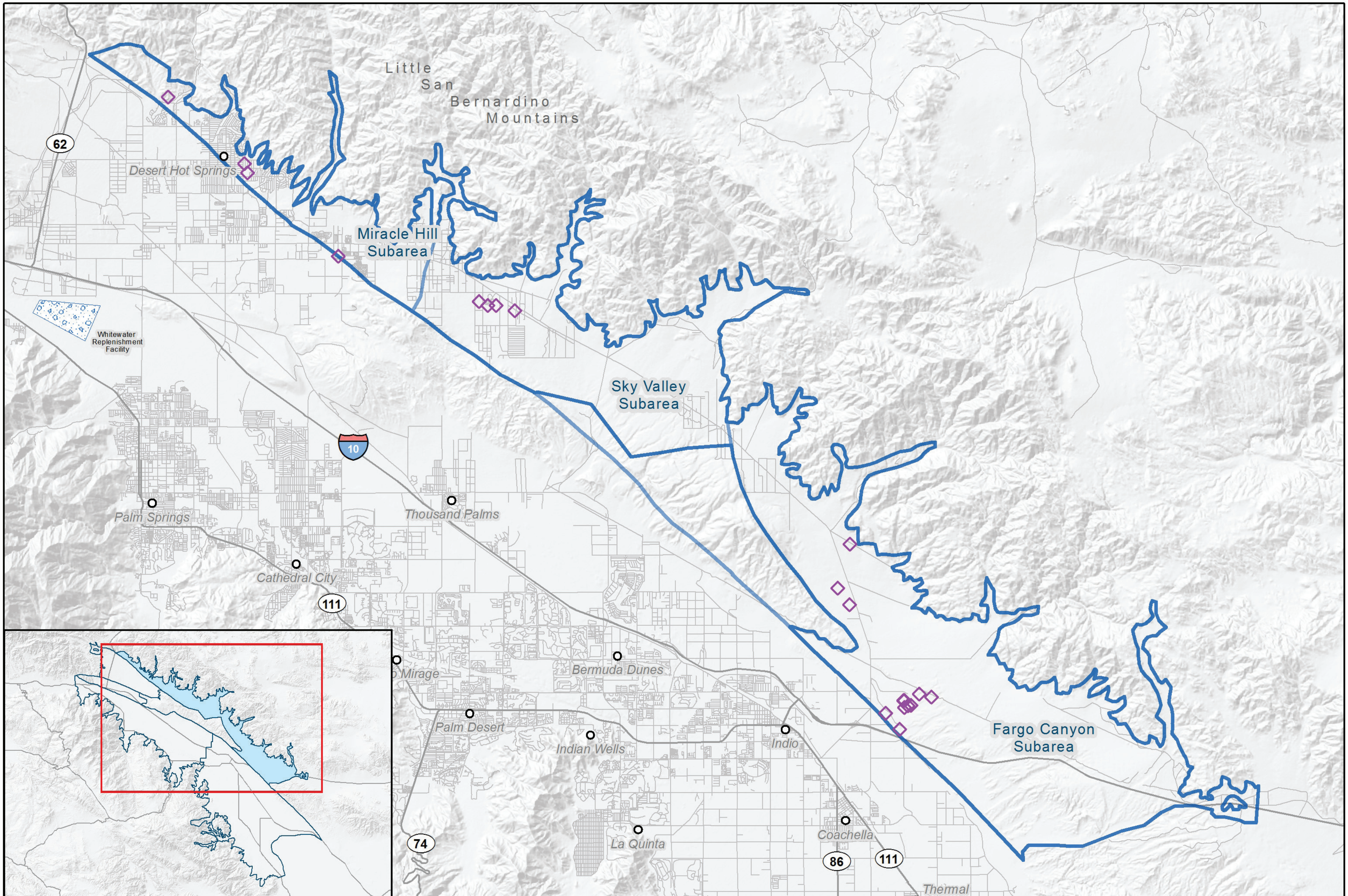
The location of wells with water quality records used in the AWQ determination are shown on **Figure 5-8**. The Desert Hot Springs Subbasin is located adjacent to the Mission Creek and Whitewater River Subbasins. The subbasin has been divided into three MZs: Miracle Hill, Sky Valley, and Fargo Canyon. Based on limited groundwater data for this area, flow is generally to the southeast.

Statistical Description of Ambient Water Quality

Too few data points are available relative to the size of Desert Hot Springs Subbasin to compute the volume-weighted AWQ.

High TDS groundwater comprises much of the Desert Hot Springs Subbasin MZs. The Fargo Canyon MZ near the East Whitewater River MZ has the highest TDS values and TDS values over 1,000 mg/L exist in the Sky Valley MZ. The Miracle Hill MZ has some of the lowest TDS concentrations in Desert Hot Springs Subbasin. In general, nitrate is lower in the Miracle Hill MZ while groundwater in the Sky Valley and Fargo Canyon MZs show higher nitrate concentrations.

The filtered dataset statistical summary for each MZ is presented on **Table 5-11**.



Key to Features

Management Zone

City

Highway

Local Roads

Groundwater Well Location

Well

Document: \\Usirv1s01\Projects\Coachella Valley WD\SNMP\AWQ\CVWD_AWQ_V5\WQWells_EV_MC.mxd

Date: 4/28/2015

Map of Wells with Water Quality Data in the Baseline Period of 1999 to 2013 within Desert Hot Springs Management Zone

MWH

Figure 5-8

Table 5-11
Descriptive Statistics of Filtered Data for Desert Hot Springs (1999-2013)

MZ	Statistic	Total Dissolved Solids	Nitrate as NO_3
Miracle Hill	Count	3	4
	Mean (mg/L)	558	4.8
	Median (mg/L)	440	4.2
	Mode (mg/L)	N/A	N/A
	Std. Dev. (mg/L)	250	4.1
	Range (mg/L)	390 to 845	0.5 to 10.2
	95% Confidence Interval (mg/L)	<100 to 1,178	ND to 11.2
Sky Valley	Count	4	4
	Mean (mg/L)	1,280	18.8
	Median (mg/L)	1,275	17.4
	Mode (mg/L)	N/A	N/A
	Std. Dev. (mg/L)	186	17.4
	Range (mg/L)	1,070 to 1,500	0.4 to 40
	95% Confidence Interval (mg/L)	984 to 1,576	ND to 46.5
Fargo Canyon	Count	13	13
	Mean (mg/L)	1,351	22.9
	Median (mg/L)	1,325	17.9
	Mode (mg/L)	1,800	24.8
	Std. Dev. (mg/L)	491	27
	Range (mg/L)	688 to 2,020	0.1 to 101
	95% Confidence Interval (mg/L)	1,054 to 1,648	6.6 to 39.3

ND = non-detect

There are too few data points to draw meaningful conclusions on AWQ within the Desert Hot Springs Subbasin MZs.

5.5 ASSIMILATIVE CAPACITY

The Policy defines assimilative capacity for a constituent as the difference between a WQO and the average concentration of the basin or subbasin. Based on the data available, the average TDS and nitrate concentrations were calculated for each MZ. **Table 5-12** presents summarizes the AWQ method used and calculated AWQ for each management zone. **Table 5-13** lists the WQOs and current assimilative capacity for TDS and nitrate for each MZ.

Table 5-12
Ambient Water Quality Summary

Management Zone	Method	TDS (mg/L)	Nitrate (mg/L as NO3)
West Whitewater River[1]	Volume-weighted	326	9.4
East Whitewater River	Volume-weighted	515	7.0
Mission Creek	Volume-weighted	540	3.0
Garnet Hill[2]	Statistical	Not determined	
Miracle Hill[2]	Statistical		
Sky Valley[2]	Statistical		
Fargo Canyon[2]	Statistical		

1. Layer 1 of West Whitewater River has too few data points for the volume-weighted method, therefore a range is used.
2. Garnet Hill, Miracle Hill, and Sky Valley have less than 10 data points; Fargo Canyon has 13.

Table 5-13
Water Quality Criterion and Assimilative Capacity Summary

Management Zone	TDS (mg/L)	Nitrate (mg/L as NO_3)
Water Quality Criterion[1]	1,000	45.0
West Whitewater[2]	674	30.7
East Whitewater	485	38.0
Mission Creek	460	42.0
Garnet Hill[3]	Not determined	
Miracle Hill[3]		
Sky Valley[3]		
Fargo Canyon[3]		

1. TDS water quality criterion is based on the Title 22 CCR Upper "Consumer Acceptance Contaminant Level Range" for municipal beneficial use of 1,000 mg/L. A protective water quality objective of 879 mg/L and 747 mg/L TDS is currently being used for this surface water at Imperial Dam and Lake Havasu, respectively.
2. Layer 1 of West Whitewater River has too few data points for the volume-weighted method, therefore the median is used for this layer.
3. Garnet Hill, Miracle Hill, and Sky Valley have less than 10 data points; Fargo Canyon has 13.

5.6 WATER QUALITY TRENDS

Water quality trends are reviewed in TM-1 (**Appendix A**) that considered historical and vertical records throughout the Coachella Valley. Trends indicated lower concentrations typically with depth and increasing concentration typically with time. To evaluate trends quantitatively, a Mann-Kendall analysis was also completed. Water quality trends for select wells are included in **Appendix F**. A Mann-Kendall trend analysis tests for statistically significant trending in water quality records.

5.6.1 Mann-Kendall Test

A Mann-Kendall test is a widely used method for evaluating trends that compares samples for a particular well and tests for a positive (increasing) or negative (decreasing) trend result for a particular level of statistical significance; see Data Quality Assessment: Statistical Methods for Practitioner (EPA, 2006). Only records with a prescribed number of well records could be considered, hence not all wells in the Coachella Valley could be evaluated. The results of the Mann-Kendall trend analyses for TDS and nitrate are shown on **Figure 5-9** and **Figure 5-10**, respectively. Note both analyses indicate an increasing trend in concentration with time. Based on this consistent result, using older records may underestimate the AWQ if the objective is to represent the most current water quality.

5.6.2 Vertical Water Quality

Two nested monitoring wells have been constructed near the Salton Sea to monitor changes in water levels and water quality for potential indications of saline intrusion into the production aquifers. A monitoring well network was constructed in conjunction with the Martinez Canyon Demonstration Recharge projects and the Thomas E. Levy Groundwater Replenishment Facility. CVWD, DWA and USGS installed and maintain monitoring wells near the Whitewater Recharge Facility. These wells are useful to characterize vertical water quality. **Figure 5-11** and **Table 5-14** show and also list existing wells that could be monitored or used to track water quality adjacent to existing recycled water projects. Water quality from these wells where data exists is presented in **Figure 5-12** through **Figure 5-15.**

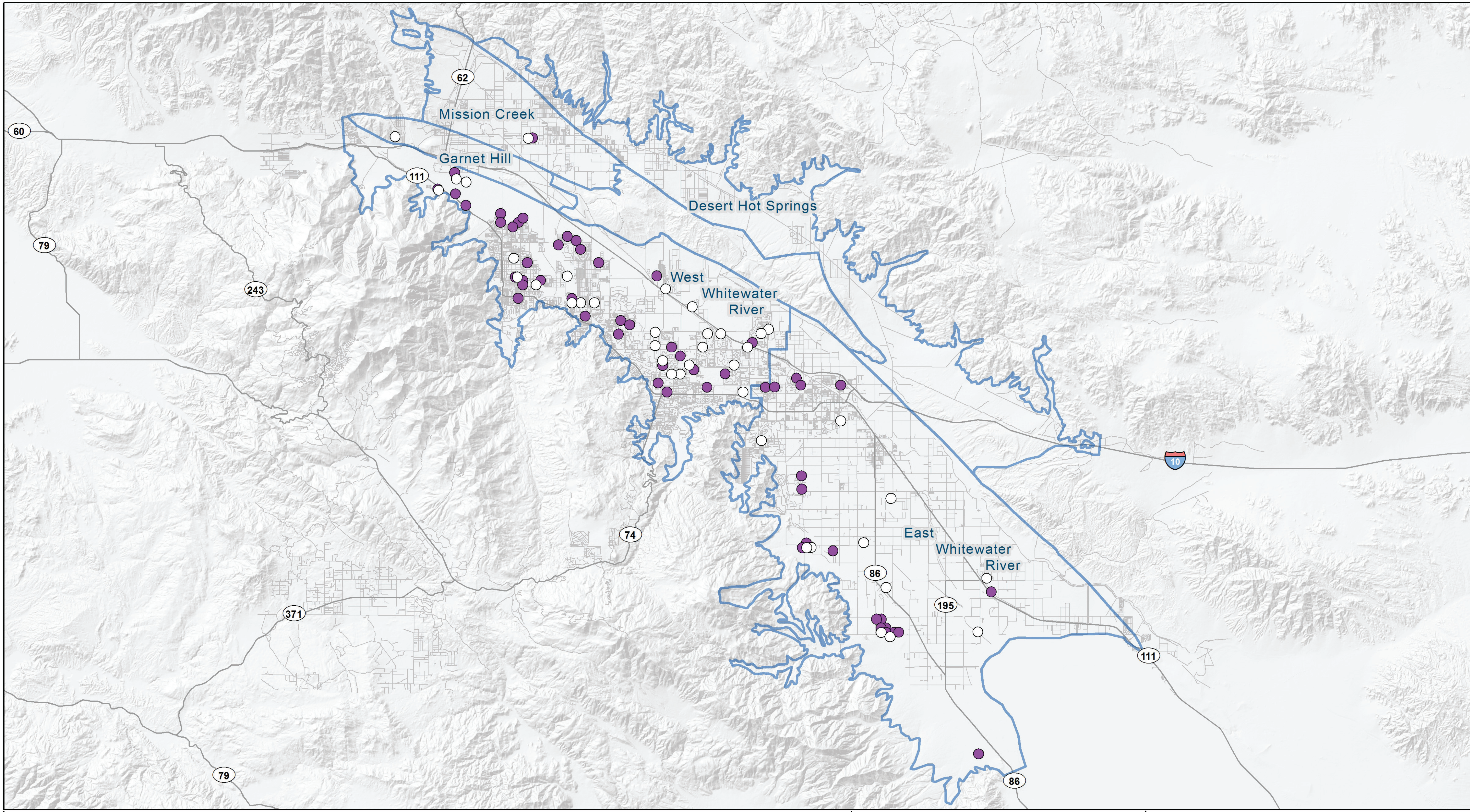
Based on the majority of nested or clustered wells, water quality has historically improved with depth. For wells near WRP10 (**Figure 5-12**), vertical water quality has historically improved with depth, wells of the same depth have varying water quality, some have improved steadily since 1995 (for nitrate), while others have increased in concentration of the last three to four years. The deep zone in this area as typically had a concentration less than 200 mg/L and 10 mg/L for TDS and nitrate, respectively; while the zones to 295 feet below ground surface have ranged from over 1,000 mg/L and 160 mg/L to 250 mg/L 3 mg/L for TDS and nitrate, respectively.

For wells near WRP7 (**Figure 5-13**), There is little difference in water quality with depth, although wells greater than 400 feet are limited in the area. WRP07-MW3S is a shallow well and has typically had higher concentrations than other wells of the same depth and deeper (280 to 400 feet below ground surface) wells. Other wells in this area range from 2,000 to 200 mg/L for TDS and 40 to less than 1 for nitrate.

Figure 5-14 illustrates the vertical water quality in the eastern portion of East Whitewater River MZ (the CVWD Ruth, Peggy, Sherrie, and Bernadine wells), near the Salton Sea and the community of Mecca. TDS concentration increases with depth, well 0709E30R01S, the deepest well ranges from nearly 19,500 mg/L TDS to approximately 7,100 mg/L, all other wells range from near 4,000 mg/L to less than 200 mg/L. Nitrate concentration also increase with depth. The two deepest wells range from 33.3 mg/L to less than 1 mg/L, while the shallow nitrate concentration ranges from 4.1 to less than 1 mg/L.

Figure 5-15 illustrates the vertical water quality in the eastern portion of East Whitewater River MZ (the CVWD Dave, Rosie, Gracie, Richard wells), near the Salton Sea, south of the CVWD Ruth, Peggy, Sherrie, and Bernadine wells, near the community of Oasis. TDS concentration generally decreases with depth. Since 2004, concentrations have generally been grouped between 200 and 300 mg/L, with the deepest well (08S09E07N04S) often (but not always) the lowest concentration. Nitrate concentration is generally less than 2 mg/L for all wells, concentration generally decreases with depth. Well 08S09E07N01S has the highest TDS and nitrate measurements recorded for these wells, it is perforated in the 725 to 785 feet below ground surface zone.

A DWA operated monitoring well (02S04E21H01S) downgradient of the Mission Creek Recharge Facility can provide water quality data for a significant data gap within the Mission Creek MZ. Nitrate in this well is typically below 3 mg/L as nitrate. TDS concentrations of the well range between 500 and 750 mg/L. This well does not provide water quality varying with depth but is important to understand the water quality occurring directly downstream of recharge operations.



Key to Features

Management Zone

Highway

Mann-Kendall test at 5% significance level

- Decreasing
- No Trend
- Increasing

N

0 5 10 Miles

Document: \\Usirv1s01\Projects\Coachella Valley WD\SNMP\AWQ\CVWD_AWQ_V3\MXD\MK\WQ_MannKendall.mxd

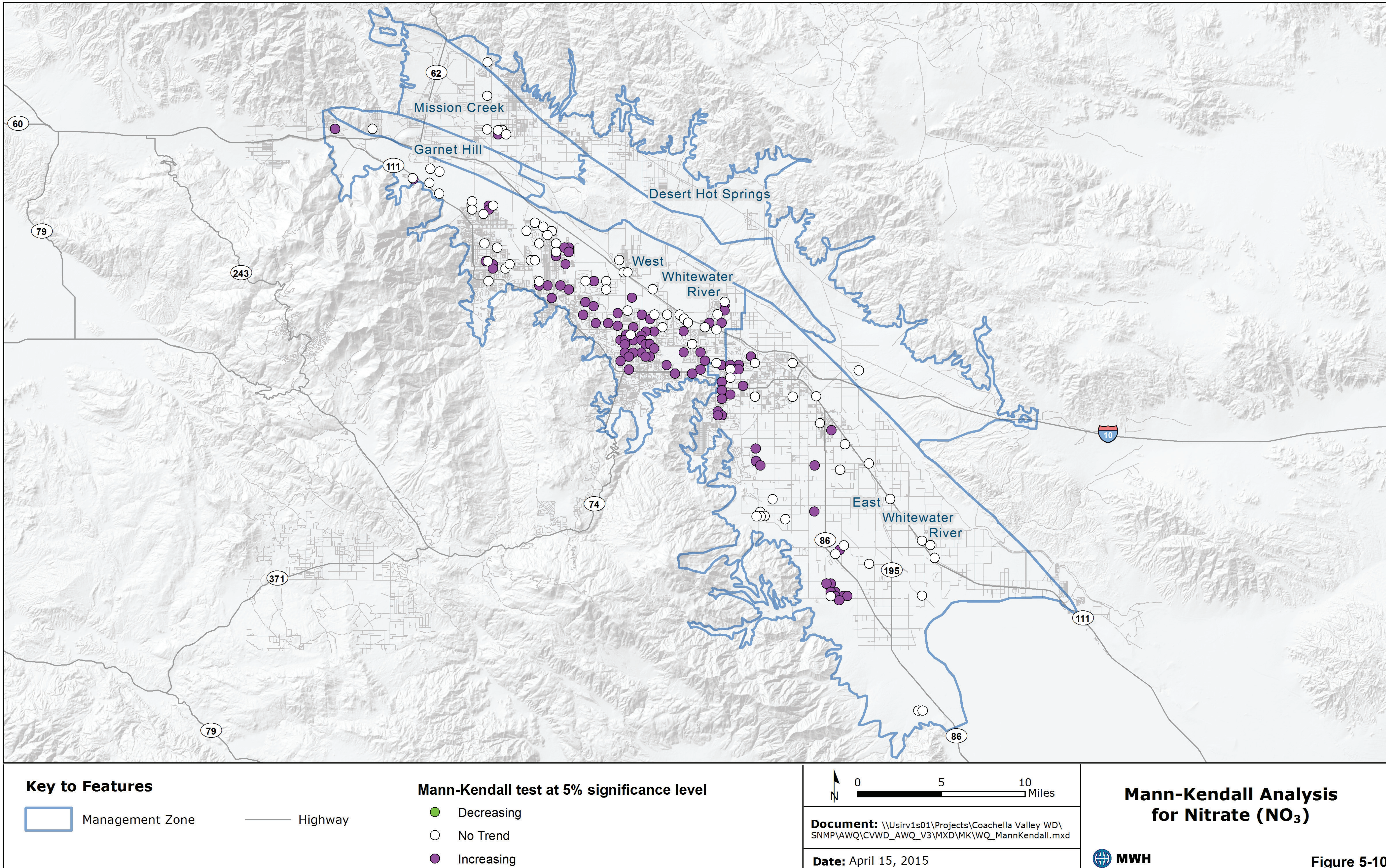
Date: April 15, 2015

Mann-Kendall Analysis for Total Dissolved Solids

MWH

Figure 5-9

This map has been designed to print size 11'' by 17''.



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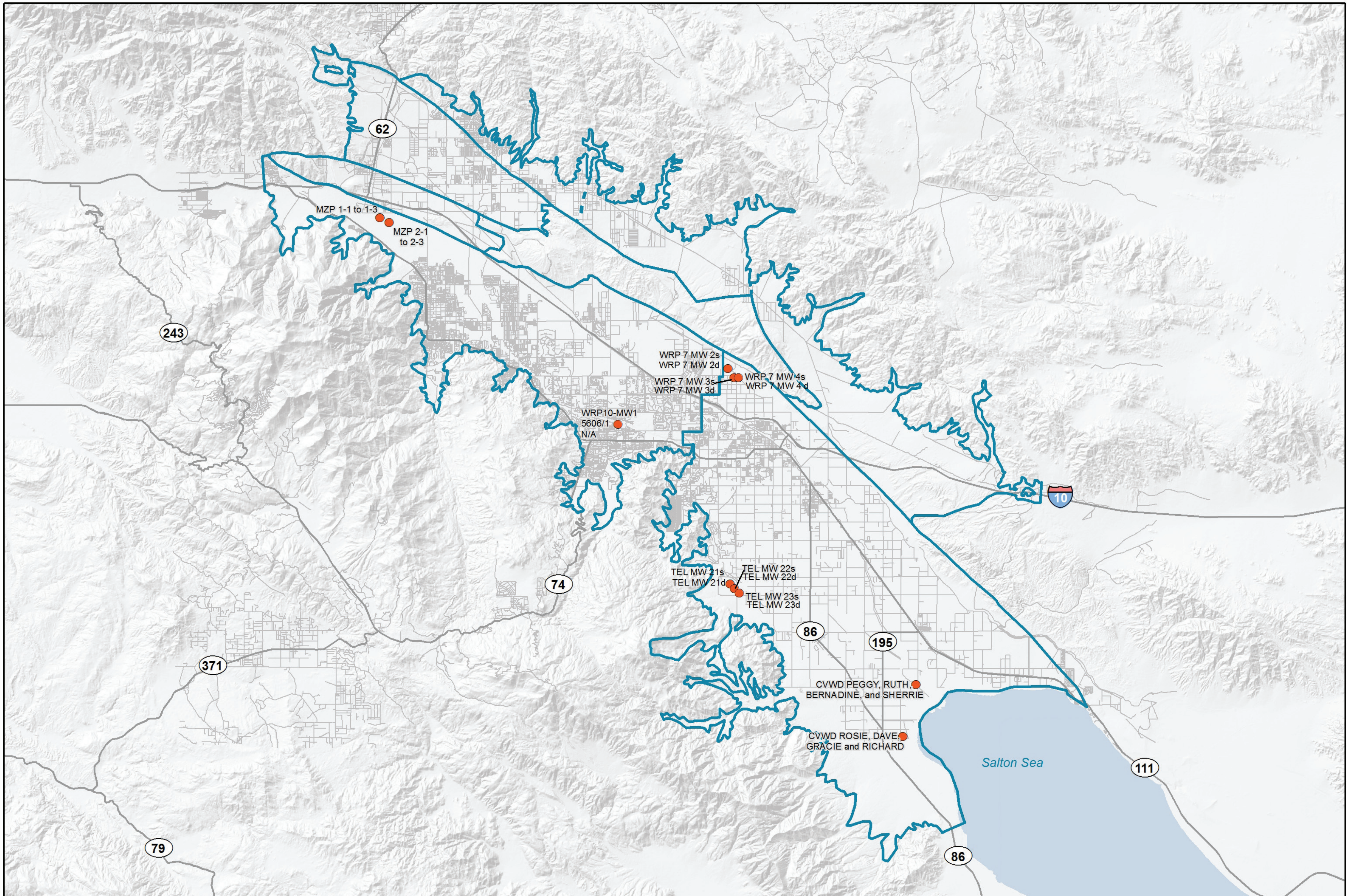
Date: April 15, 2015

Mann-Kendall Analysis for Nitrate (NO_3)

MWH

Figure 5-10

This map has been designed to print size 11'' by 17''.



Key to Features

Management Zone

Highway

Local Roads

Monitoring Wells for Vertical Water Quality

N

0 5 10 Miles

Document: \\Usirv1s01\Projects\Coachella Valley WD\SNMP\GIS_files\NestedWells.mxd

Date: 6/5/2015

Monitoring Wells for Vertical Water Quality

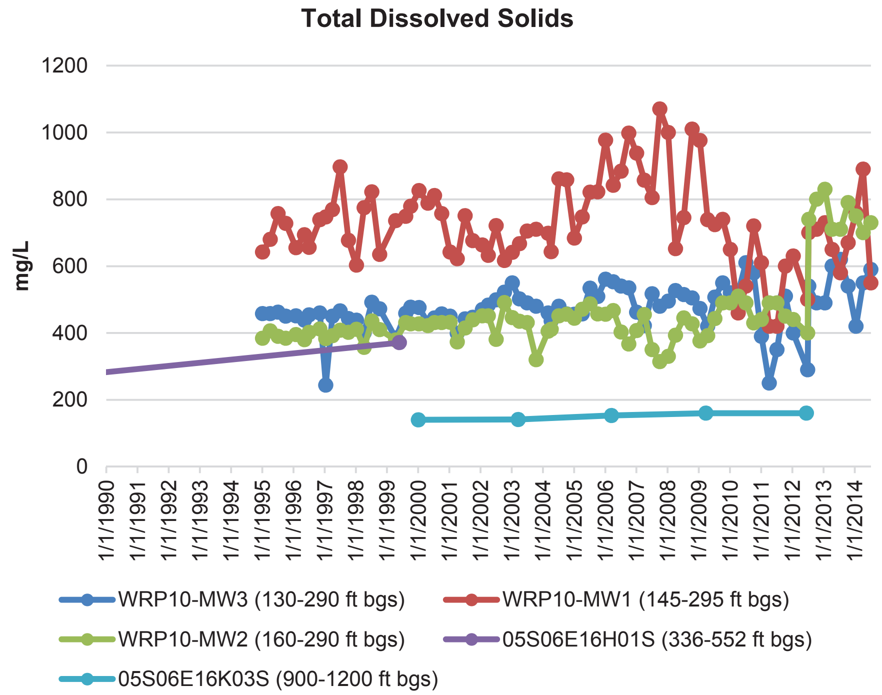
MWH

Figure 5-11

Table 5-14
Coachella Valley Clustered or Nested Monitoring Wells

State Well No.	Management Zone	Nested Group	Other Well Name	Depth
03S04E20F01S	West Whitewater River	MZP-1	MZP 1-1	Shallow
03S04E20F02S			MZP 1-2	Mid
03S04E20F03S			MZP 1-3	Deep
03S04E20J01S	West Whitewater River	MZP-2	MZP 2-1	Shallow
03S04E20J02S			MZP 2-2	Mid
03S04E20J03S			MZP 2-3	Deep
Unknown	West Whitewater River	Unrelated (Near Recycled Water Projects)	WRP10-MW1	Shallow
05S06E16H01S			5606//1	Mid
05S06E16K03S			N/A	Deep
06S07E33G02S	East Whitewater River	Tel MW 21	TEL MW 21s	shallow
06S07E33G01S			TEL MW 21d	Deep
06S07E33J02S	East Whitewater River	Tel MW 22	TEL MW 22s	Shallow
06S07E33J01S			TEL MW 22d	Deep
06S07E34N03S	East Whitewater River	Tel MW 23	TEL MW 23s	shallow
06S07E34N02S			TEL MW 23d	Deep
07S09E30R01S	East Whitewater River	CVWD	RUTH	Shallow
07S09E30R02S			PEGGY	Mid
07S09E30R03S			SHERRIE	Deep
07S09E30R04S			BERNADINE	Deepest
08S09E07N01S	East Whitewater River	CVWD	DAVE	Shallow
08S09E07N02S			ROSIE	Mid
08S09E07N03S			GRACIE	Deep
08S09E07N04S			RICHARD	Deepest
04S07E33L02S	East Whitewater River	WRP 7 2	WRP 7 MW 2S	Shallow
04S07E33L01S			WRP 7 MW 2d	Deep
05S07E04A04S	East Whitewater River	WRP 7 3	WRP 7 MW 3s	Shallow
05S07E04A03S			WRP 7 MW 3d	Deep
05S07E03D02S	East Whitewater River	WRP 7 4	WRP 7 MW 4s	Shallow
05S07E03D01S			WRP 7 MW 4 d	Deep
02S04E21H01S	Mission Creek	N/A	N/A	N/A

Figure 5-12
Vertical Water Quality in the Southern Portion of West Whitewater River Management Zone



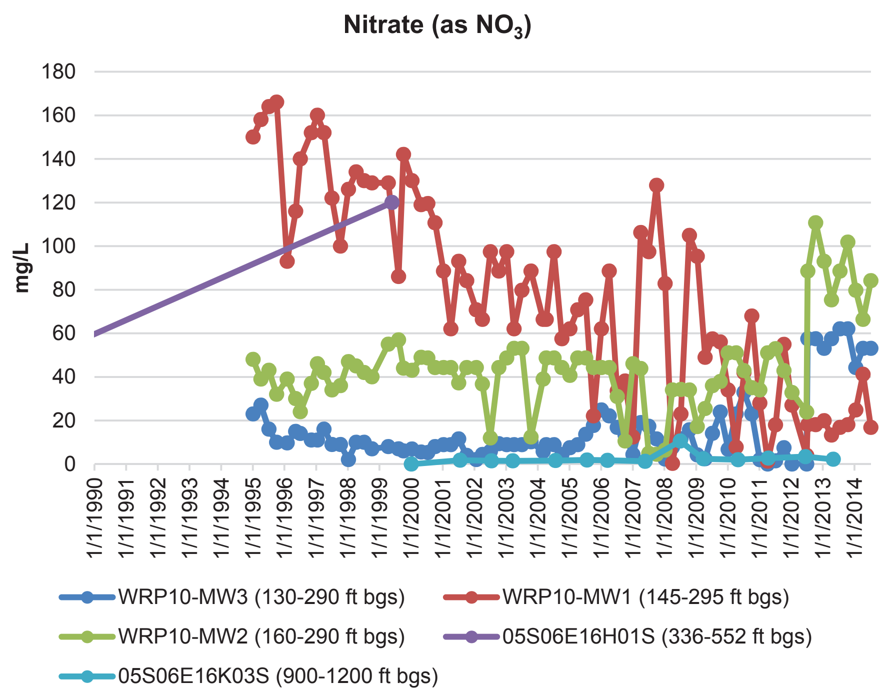
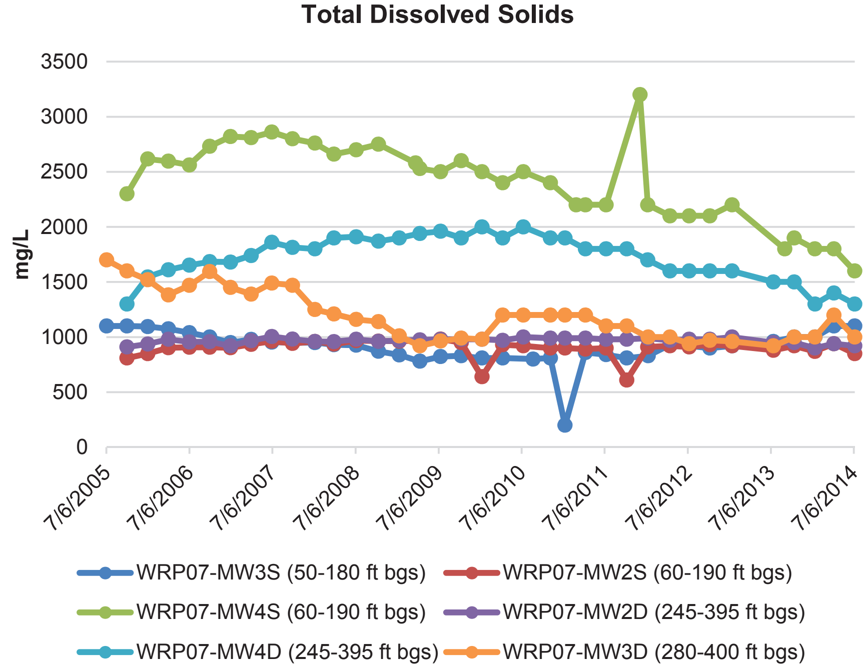


Figure 5-13
Vertical Water Quality in the Northern Portion of East Whitewater River Management Zone



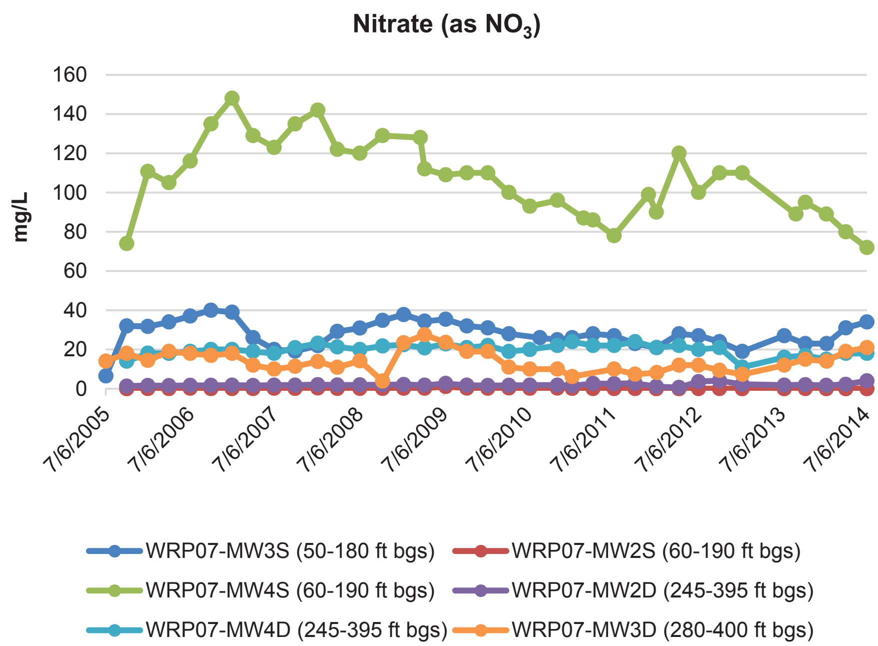
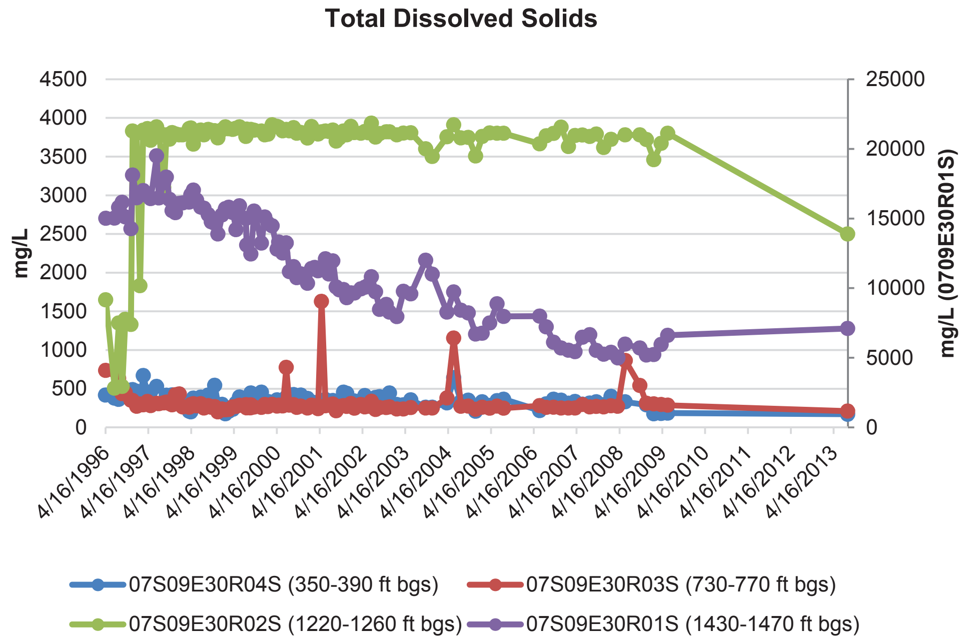


Figure 5-14
Vertical Water Quality in the Eastern Portion of East Whitewater River Management Zone (Ruth, Peggy, Sherrie, and Bernadine)



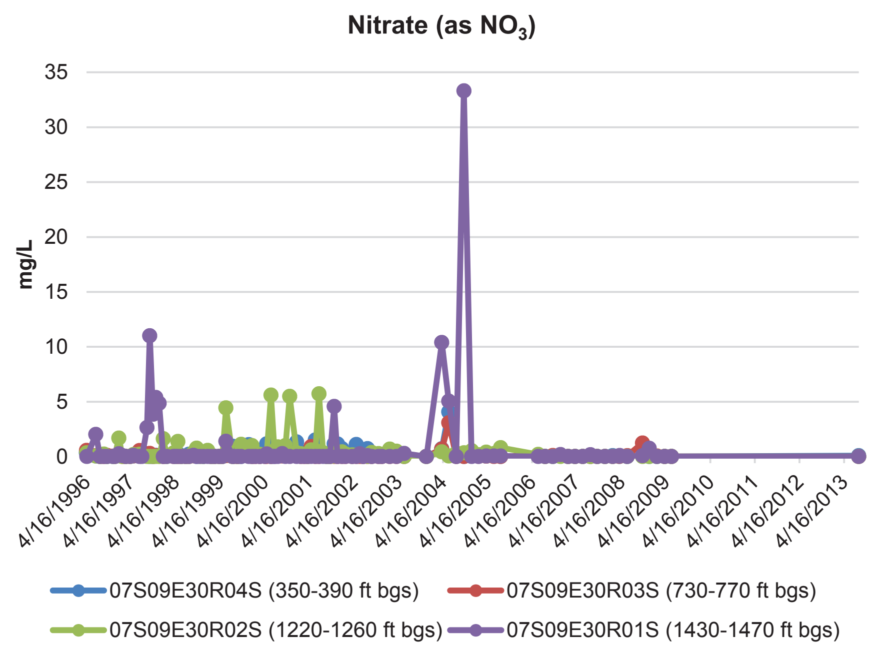
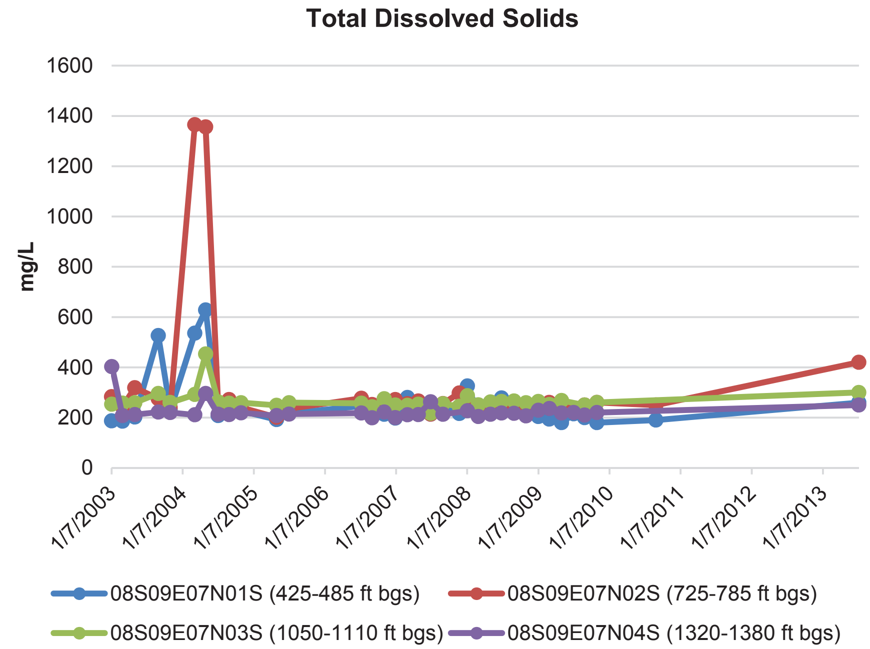
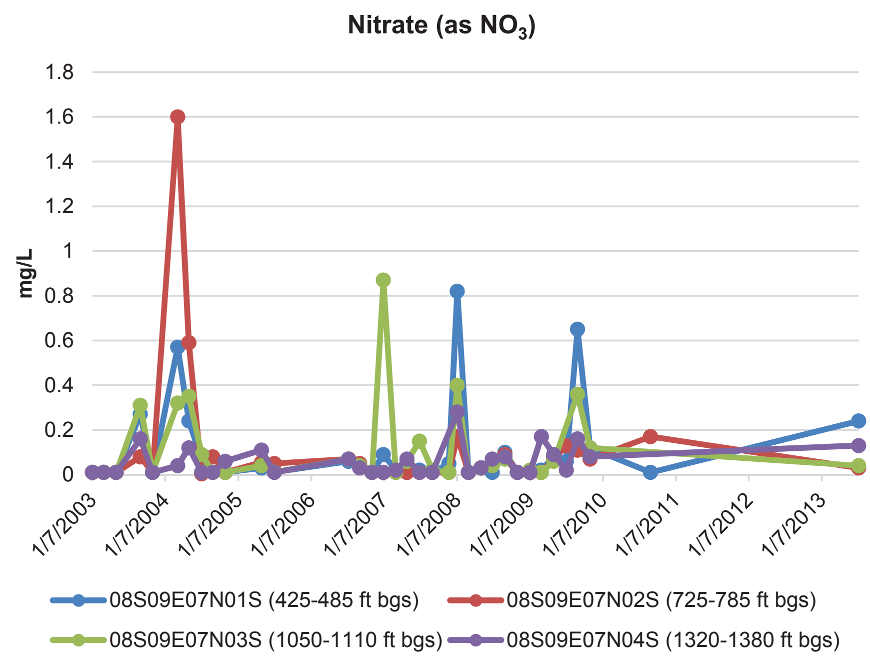


Figure 5-15
Vertical Water Quality in the Eastern Portion of East Whitewater River Management Zone (Dave, Rosie, Gracie, Richard)





5.7 RECOMMENDATIONS FOR IMPROVEMENT OF AMBIENT WATER QUALITY METHOD

The current volume-weighted method does not express the uncertainty associated with contouring directly, instead statistical descriptions of the data points used to contour are relied on to provide an indication of uncertainty. It is recommended that a method be developed to quantify uncertainty associated with interpolating beyond the extent of known data points.

It is further recommended that as new data is gathered and data gaps are filled, layering is re-evaluated for potential modifications, particularly for Mission Creek MZ. If more data is gathered in the Garnet Hill MZ, it is recommended to evaluate whether there is sufficient data to determine AWQ in the MZ.

Section 6
Future Water Quality

Future water quality is estimated through the use of a salt/nutrient loading model. General background information on salt and nutrient sources and sinks and users of water are presented in this section; modeling assumptions are also discussed. These different components are discussed to establish the foundation for estimating future water quality.

Note that insufficient data was available to characterize ambient water quality for Garnet Hill and Desert Hot Springs MZs, so future water quality for these MZs is not estimated at this time. This section describes the methods and assumptions used for West Whitewater River, East Whitewater River, and Mission Creek MZs.

6.1 WATER BALANCE

The evaluation of salt and nutrient sources and sinks in the Coachella Valley Groundwater Basin is driven largely by the water balance in the basin. Establishing the water balance, i.e., the inputs to and outputs from the system, is the first step in estimating future water quality. The Coachella Valley Water Management Plan and Mission Creek/Garnet Hill Water Management Plan were the guiding documents used to develop the baseline model (CVWD, 2012a; CVWD, 2013).

For a groundwater basin, the water balance is calculated as:

$$\sum_{i=1}^{m} Inflow_i - \sum_{j=1}^{n} Outflow_j = \Delta Storage \ ,$$

where, for a given year, m is the number of inflows, n is the number of outflows, $Inflow$ is an inflow volume, $Outflow$ is an outflow volume, and $\Delta Storage$ is the change in groundwater storage.

Inflows of water to each MZ are comprised of the following:

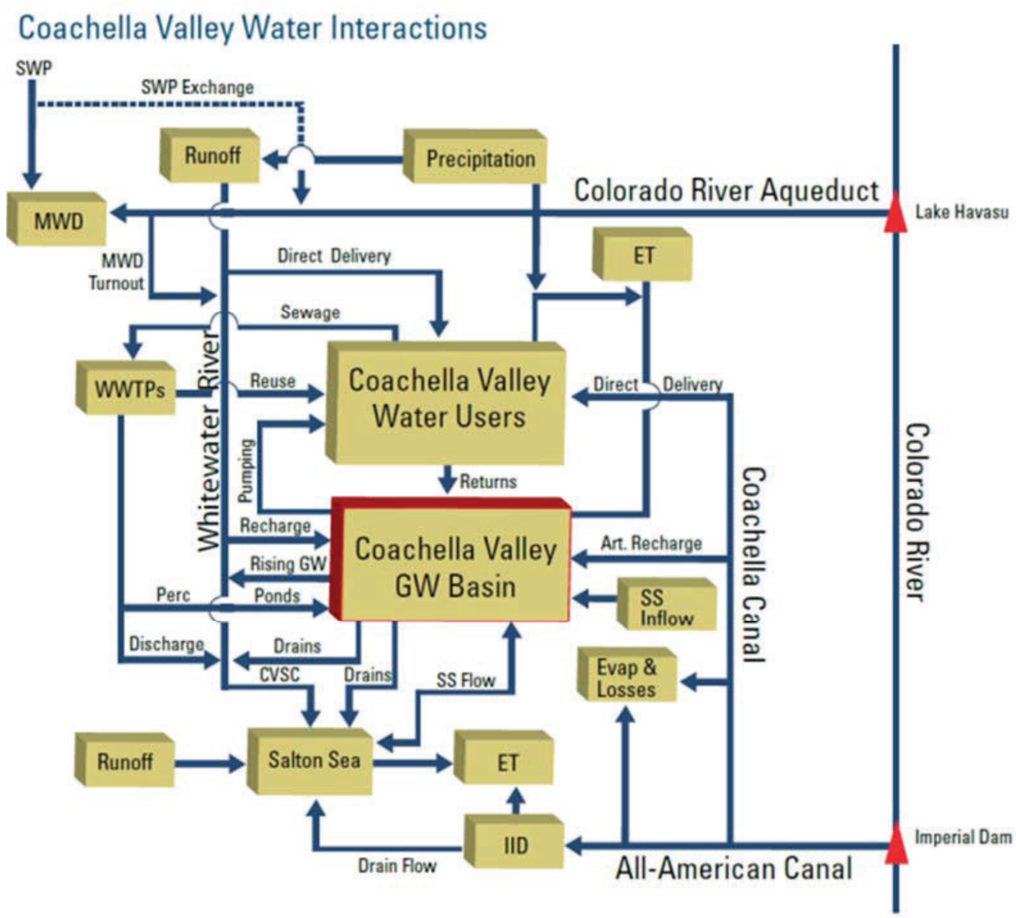
- Natural recharge from precipitation and surface waters
- Subsurface inflows to the MZ
- Artificial recharge of imported water
- Deep percolation of applied water, i.e., irrigation return flows
- Wastewater percolation and septic infiltration

Outflows of water from each MZ are comprised of the following:

- Groundwater pumping
- Subsurface outflows from the MZ
- Evapotranspiration
- Agricultural drain flows (only applicable to East Whitewater River MZ)

A conceptual illustration of inflows and outflows to the entire Coachella Valley Groundwater Basin is presented in **Figure 6-1**. A detailed discussion of inflows and outflows follows in the subsections below.

Figure 6-1
Water Interactions in the Coachella Valley



6.1.1 Inflows

The inflows of water to a MZ are described below. These are combined into the following categories: natural recharge, subsurface inflow, artificial recharge, applied water and return flows, and wastewater percolation and septic infiltration.

Natural Recharge

Average precipitation in the Coachella Valley varies from 4 inches on the valley floor to more than 30 inches in the nearby mountain regions annually (DWR, 1964). Precipitation predominantly occurs during the December through March period, with occasional intense precipitation events during the summer months resulting from subtropical thunderstorms. The precipitation that occurs within the tributary watersheds of the SNMP planning area either evaporates, is consumed by native vegetation, percolates into underlying alluvium and fractured rock or becomes runoff. A portion of the flow percolating into the mountain watersheds eventually becomes subsurface inflow to the groundwater basins.

Weighted-average seasonal precipitation over the SNMP planning area is 4.6 inches. DWR (1964) suggests that for areas with average seasonal rainfall less than 12 inches, deep percolation of precipitation is negligible. The salt/nutrient loading model assumes no recharge from direct precipitation, but instead from streams and local runoff.

Surface water supplies come from several local rivers and streams including the Whitewater River, Snow Creek, Falls Creek, Chino Creek, Mission Creek, Dry Morongo Wash, and Big Morongo Canyon as well as a number of smaller creeks and washes. Some of this water is diverted for direct delivery to customers while the remainder becomes part of the groundwater supply through percolation of runoff.

Surface runoff from the adjacent mountain slopes percolates to the groundwater table and is the main source of natural water supply to the groundwater basin. Streams which drain the San Jacinto and San Bernardino Mountains are the main contributors to this inflow (DWR, 1964).

Natural recharge by MZ is summarized in **Table 6-1**. Volumes of water recharged naturally are assumed to stay constant over the planning period and represent long-term hydrologic averages based on the period from 1936 to 2009 for the West Whitewater River and East Whitewater River MZs. Natural recharge in West Whitewater River MZ was estimated to range from 7,800 to 161,800 acre-feet per year over this period and 100 to 32,000 acre-feet per year over this period in East Whitewater River MZ. The natural recharge to Mission Creek MZ is approximately 7,500 acre-feet per year as presented in the Mission Creek / Garnet Hill Water Management Plan (CVWD, 2013).

Table 6-1
Natural Recharge Model Assumptions – Modified from CVWD (2012a; 2013)

Management Zone	Average Annual Natural Recharge [1] (acre-feet per year)
West Whitewater River	40,800
East Whitewater River	5,100
Mission Creek	7,500

1 Annual average based on 1936-2009 mountain front runoff for West and East Whitewater MZs. Long-term average recharge for Mission Creek MZ is based on estimates prepared by Psomas (2012).

Subsurface Inflow

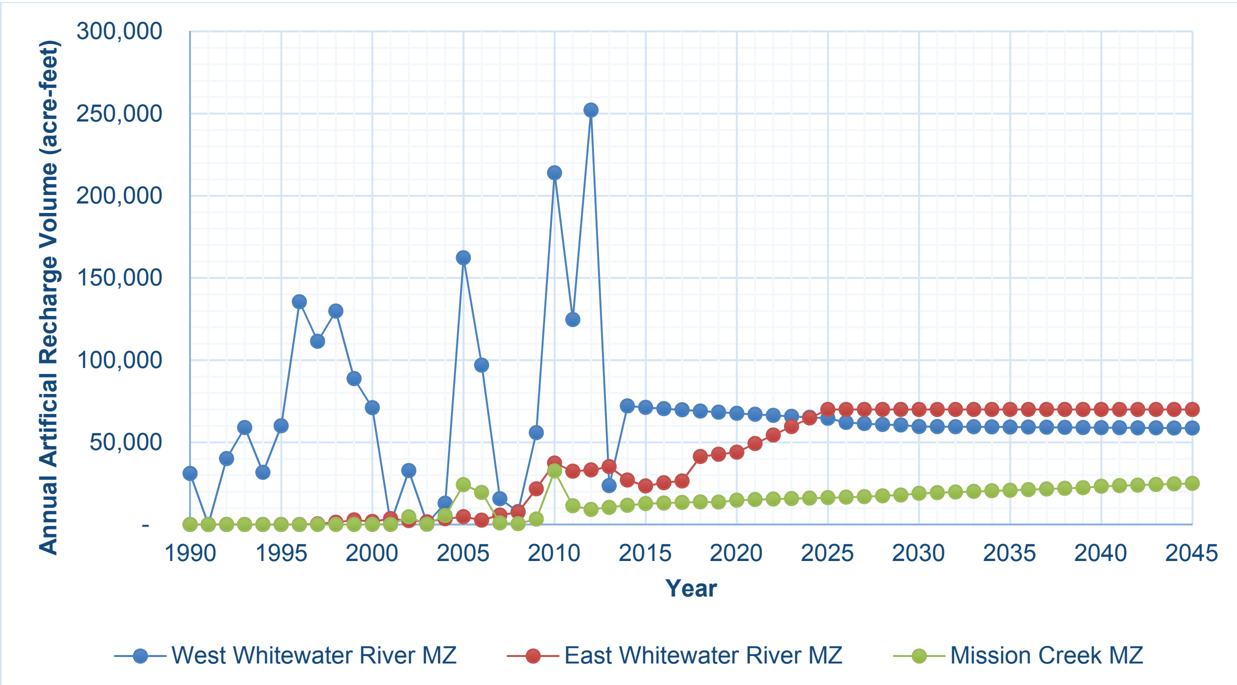
Subsurface inflows from outside the basin include underflow from the San Gorgonio Pass area and subsurface flow from the Salton Sea. Within the basin, subsurface flow occurs between MZs, particularly significant from West Whitewater River MZ to East Whitewater River MZ, and across faults. Subsurface flow occurs across the Banning Fault from Garnet Hill MZ to West Whitewater River MZ, across the Mission Creek Fault from Miracle Hill MZ to Mission Creek MZ, and across the San Andreas Fault from Fargo Canyon MZ to East Whitewater River MZ. In this manner, subsurface inflow to a MZ is balanced with a subsurface outflow from the originating MZ.

Artificial Recharge

Artificial recharge is a principal component of water management in the Coachella Valley. Natural recharge of the groundwater basin is not sufficient to support the water demand in the Coachella Valley. Reliance on groundwater to meet demands without importing the balance results in significant groundwater overdraft. Hence, CVWD and DWA have artificial recharge projects in place to meet the demands of the valley while maintaining sustainable groundwater levels.

Deliveries of SWP Exchange water from the Colorado River Aqueduct (CRA) to the Whitewater River subbasin commenced in 1973 and SWP Exchange water from the CRA has been recharged into the Mission Creek subbasin since 2002. CVWD and DWA’s SWP Exchange water is provided through an exchange agreement with Metropolitan. In addition, CVWD and DWA have purchased supplemental water since the mid-1990s when available, and CVWD has recharged SWP transfer water made available through the Quantification Settlement Agreement at the Whitewater facility. In the East Whitewater MZ, CVWD has also recharged Colorado River water at the test facilities since 1995 and at the Thomas E. Levy replenishment facility since 2009. **Figure 6-2** summarizes the total volume of water delivered, historical and projected, to each MZ as artificial recharge from 1993 to 2045 (CVWD, 2012a; CVWD, 2013). The annual deliveries of SWP Exchange water can vary significantly in response to statewide hydrologic conditions, SWP allocation, environmental restrictions in the California Delta, and Metropolitan’s water supply requirements. Long-term average deliveries are used for future water and salt loading estimates.

Figure 6-2
Annual Artificial Recharge by Management Zone



CVWD and DWA do not directly receive SWP water. Instead their SWP water is delivered to Metropolitan pursuant to the exchange agreement described above. Metropolitan in turn delivers an equal amount of Colorado River water to CVWD and DWA at the Whitewater River. During periods of available supply, Metropolitan also pre-delivers SWP exchange water; during dry periods, Metropolitan transfers the pre-delivered water to CVWD and DWA in place of actual deliveries. CVWD and DWA are participating in the East Branch Enlargement to provide the capacity to obtain additional SWP exchange water when it is available.

Applied Water Returns

Irrigation return flows are the amount of water applied for irrigation (either agricultural, golf course, or urban) not used by plants to satisfy their evapotranspiration (ET) requirements. Return flows are determined based on a percentage of water supply to each user. These percentages are summarized in **Table 6-2** and represent the conservation efforts described in the Coachella Valley and Mission Creek/Garnet Hill Water Management Plans (CVWD, 2012a; CVWD *et al.*, 2013).

Appendix G discusses the modeling assumptions used to determine agricultural, golf, and municipal irrigation demands; ET requirements; deep percolation; and calibration with the Coachella Valley Water Management Plan 2010 Update. In general, agriculture and golf parcel locations are identified using GIS for a 2014 dataset. The water supply plans from CVWD (2012a) and CVWD, DWA, and MSWD (2013) are used to scale parcel acreage to match supply and demand projects in the future. Golf assumptions are used for outdoor municipal irrigation.

Table 6-2
Percentage of Applied Water as Return Flow

Water User	Management Zone	Average (%)	Low (%)	High (%)
Agricultural	West Whitewater River	19	19	20
	East Whitewater River	16	15	18
	Mission Creek	19	19	20
Golf	West Whitewater River	21	21	23
	East Whitewater River	22	22	24
	Mission Creek	21	21	23
Municipal Irrigation	West Whitewater River	21	21	23
	East Whitewater River	22	22	24
	Mission Creek	21	21	23

Wastewater Returns

Wastewater return flows are comprised of water returned to the groundwater basin following domestic usage (septic tank flow or treated wastewater percolation) or other non-consumptive returns such as fish farm effluent.

In the West Whitewater River MZ, treated wastewater not delivered as recycled water is returned to the groundwater through percolation ponds; similarly, wastewater treatment plants in Mission Creek MZ percolate treated wastewater back to the groundwater. However, in the East Whitewater River MZ, treated wastewater not used for recycled water is discharged to the CVSC; a known exception is that VSD occasionally irrigates with recycled water on pasture land.

6.1.2 Outflows

The outflows of water from a MZ are described below. These are combined into the following categories: groundwater pumping, subsurface outflow, evapotranspiration, and agricultural drain flows.

Groundwater Pumping

Groundwater supplies most water users in the Coachella Valley including agricultural, municipal, golf, and industrial. Groundwater pumping results in extractions of water from the groundwater basin and represents a significant outflow for West Whitewater River, East Whitewater River, and Mission Creek MZs.

The amount of groundwater extracted for the planning period of 1993-2045 is determined from pumping records and projections for water demands. The Coachella Valley and Mission Creek/Garnet Hill Water Management Plans describe future projects to be implement and consequent groundwater pumping projections. In general, the amount pumped from groundwater in a MZ for a particular year is the difference between the projected water demand and the total supply of other water sources. **Table 6-3** summarizes the groundwater pumping in the salt/nutrient loading model.

Table 6-3
Groundwater Pumping Model Assumptions – Modified from CVWD (2012a; 2013)

Management Zone	1993-2013			2014-2045		
	Average Pumping (acre-feet per year)	Average YOY Change (%)	Percent of Total Water Supply (%)	Average Pumping (acre-feet per year)	Average YOY Change (%)	Percent of Total Water Supply (%)
West Whitewater River	191,933	0.00	92	142,701	-0.56	72
East Whitewater River	170,553	-1.49	39	100,026	-0.88	24
Mission Creek	14,823	3.22	100	31,118	2.15	100

YOY = Year-over-year

Subsurface Outflow

As discussed in subsurface inflows, flow between MZs occurs either directly or across geologic faults. Subsurface outflow can occur from the East Whitewater River MZ to the Salton Sea depending on groundwater levels.

Evapotranspiration

Native groundwater-dependent vegetation, or phreatophytes, may grow on undeveloped lands and receive their water supply from precipitation and shallow groundwater; plants like cottonwood, willow, tamarisk, and mesquite have roots that often extend to the groundwater table. These plants can use the groundwater directly and contribute to losses of storage through ET.

In the West Whitewater River MZ, phreatophytes exist along portions of the Chino Creek and Snow Creek stream channel, but water uptake requirements of this vegetation is largely met by percolating surface runoff; this is accounted for as a reduced inflow to the basin. Isolated patches of phreatophytic vegetation exist in the Whitewater River channel that are supported by local street runoff and are normally cleared as part of channel maintenance.

In the area underlain by the Semi-perched aquifer, ET was a significant water loss component in the East Whitewater River MZ. As lands were developed for agricultural uses, the amount of ET from native vegetation declined. The installation of drains in the 1950s and 1960s further reduced ET as the water table was lowered. Further ET reductions occurred in the 1980s and 1990s as increased pumping reduced groundwater levels.

In the Mission Creek MZ, phreatophytes found up-gradient from the Mission Creek and Banning Faults also contribute to losses to ET where faulting causes groundwater to approach the ground surface.

Agricultural Drain Flows

Semi-perched groundwater conditions in many parts of the East Whitewater River MZ impede the downward migration of applied water at the surface. This condition causes waterlogged soils and the accumulation of salts in the root zone. Surface (open) drains were constructed in the 1930s to alleviate this condition. Subsurface drainage systems were first installed in the 1950s to control the high water table conditions and to intercept poor quality return flows. Thus, the drains can act as a barrier to the percolation of poor quality return flows into the deeper potable aquifers.

Volumes of water extracted from East Whitewater River MZ by the drain system are determined by re-routing the percentage of applied water on parcels overlying the drain system that would otherwise deep percolate to groundwater. These drain flows represent a removal of water from the basin with a specific water quality.

6.1.3 Water Budget by Management Zone

The 2013 water budget for each management zone is presented in the following subsections. Note that the water budgets are not constant and change according to assumptions detailed above or in the water management plans for the SNMP planning area.

West Whitewater River Management Zone

The representative water budget for West Whitewater River MZ is presented on **Table 6-4**. The budget summarizes the generalized inflows to and outflows from West Whitewater River MZ groundwater and presents the generalized change in groundwater storage for future periods. The budget changes year over year consistent with the projections and plans presented in the Coachella Valley Water Management Plan (CVWD, 2012a). Artificial recharge delivery varies significantly from year to year depending on factors discussed previously; long-term averages are used to indicate supply trends.

Table 6-4
West Whitewater River Management Zone – Water Budget

Category	Volume (acre-feet)			
	2015-2020	**2020-2030**	**2030-2040**	**2040-2045**
Inflows				
Artificial Recharge	104,100	73,900	78,700	78,000
Natural Recharge	40,800	40,800	40,800	40,800
Return - Golf	13,400	13,700	13,500	13,800
Return - Municipal, Indoor (Septic)	7,700	6,400	6,000	5,800
Return - Municipal, Outdoor	21,700	21,900	22,600	23,300
Return - Wastewater Percolation	12,900	8,200	9,100	10,100
Subsurface Inflow - Garnet Hill MZ	20,300	19,900	19,400	19,000
Subsurface Inflow - San Gorgonio Pass	9,200	9,200	9,200	9,200
Total	**230,100**	**194,000**	**199,300**	**200,000**
Outflows				
Groundwater Pumping - Golf	42,800	6,100	2,500	1,300
Groundwater Pumping - Municipal, Indoor	33,600	35,800	38,900	42,200
Groundwater Pumping - Municipal, Outdoor	90,300	91,700	95,200	98,500
Subsurface Outflow - East Whitewater River MZ	25,800	16,300	13,500	11,900
Phreatophyte Evapotranspiration	< 100	< 100	< 100	< 100
Total	**192,500**	**149,900**	**150,100**	**153,900**
Balance	**37,600**	**44,100**	**49,200**	**46,100**

East Whitewater River Management Zone

The representative water budget for East Whitewater River MZ is presented on **Table 6-5**. The budget summarizes the inflows to and outflows from East Whitewater River MZ groundwater and presents the change in groundwater storage for future periods. The budget changes year over year consistent with the projections and plans presented in the Coachella Valley Water Management Plan (CVWD, 2012a). Groundwater pumping declines in the future as imported water and recycled water is used to meet current and future demand. Agricultural uses are expected to decrease as land is developed for urban uses.

Table 6-5
East Whitewater River Management Zone – Water Budget

Category	Volume (acre-feet)			
	2015-2020	**2020-2030**	**2030-2040**	**2040-2045**
Inflows				
Artificial Recharge	23,400	70,000	70,000	70,000
Natural Recharge	5,100	5,100	5,100	5,100
Return - Agricultural	41,900	34,800	28,800	21,100
Return - Fish Farms and Duck Clubs	10,500	10,500	10,500	10,500
Return - Golf	7,100	9,400	11,900	14,300
Return - Industrial	2,300	2,300	2,300	2,300
Return - Municipal, Indoor (septic)	7,400	39,700	50,400	58,200
Return - Municipal, Outdoor	13,200	15,600	21,700	27,000
Subsurface Inflow - Fargo Canyon MZ	200	200	200	200
Subsurface Inflow - Salton Sea	1,800	800	500	500
Subsurface Inflow - West Whitewater MZ	25,800	16,300	13,500	11,900
Total	**138,700**	**204,700**	**214,900**	**221,100**
Outflows				
Agricultural Drain Flows	43,700	73,100	101,600	112,500
Groundwater Pumping - Agricultural	26,000	10,800	9,400	8,000
Groundwater Pumping - Fish Farms and Duck Clubs	8,000	8,000	8,000	8,000
Groundwater Pumping - Golf	6,400	8,400	10,600	12,800
Groundwater Pumping - Industrial	2,300	2,300	2,300	2,300
Groundwater Pumping - Municipal, Indoor	27,900	20,500	21,400	20,100
Groundwater Pumping - Municipal, Outdoor	59,100	41,400	41,500	37,300
Phreatophyte Evapotranspiration	4,400	6,300	7,800	8,100
Subsurface Outflow - Salton Sea	600	700	1,400	1,600
Total	**178,400**	**171,500**	**204,000**	**210,700**
Balance	**(39,700)**	**33,200**	**10,900**	**10,400**

Mission Creek Management Zone

The representative water budget for Mission Creek MZ is presented on **Table 6-6**. The budget summarizes the inflows to and outflows from Mission Creek MZ groundwater and presents the generalized change in groundwater storage for future periods. The budget changes year over year consistent with the projections and plans presented in the Mission Creek/Garnet Hill Water Management Plan (CVWD, 2013). It should be noted that artificial recharge varies significantly depending on a several factors. What is listed is a long term average.

Table 6-6
Mission Creek Management Zone – Water Budget

Category	Volume (acre-feet)			
	2015-2020	2020-2030	2030-2040	2040-2045
Inflows				
Artificial Recharge	12,700	16,300	20,900	25,000
Natural Recharge	7,500	7,500	7,500	7,500
Return - Fish Farms and Duck Clubs	300	300	300	300
Return – Golf	500	700	800	900
Return – Industrial	500	500	500	500
Return - Municipal, Indoor (septic)	1,700	1,800	1,600	1,300
Return - Municipal, Outdoor	1,000	1,400	1,900	2,300
Return - Wastewater Percolation	2,500	4,100	6,300	8,300
Subsurface Inflow - Garnet Hill MZ	< 100	< 100	< 100	< 100
Subsurface Inflow - Miracle Hill MZ	1,800	1,800	1,800	1,800
Total	**28,500**	**34,400**	**41,600**	**47,900**
Outflows				
Groundwater Pumping - Fish Farms and Duck Clubs	300	300	300	300
Groundwater Pumping – Golf	2,700	3,300	3,900	4,600
Groundwater Pumping - Industrial	500	500	500	500
Groundwater Pumping - Municipal, Indoor	8,500	10,900	13,100	14,900
Groundwater Pumping - Municipal, Outdoor	11,000	13,900	16,400	18,400
Phreatophyte Evapotranspiration	900	900	900	900
Subsurface Outflow - Garnet Hill MZ	3,800	3,400	3,200	3,200
Total	**27,700**	**33,200**	**38,300**	**42,800**
Balance	**800**	**1,200**	**3,300**	**5,100**

6.2 SALT AND NUTRIENT BALANCE

The water balance described above is concerned with the movement of water into and out of a particular groundwater basin. Associated with those inflows and outflows is a water quality, specifically salt and nutrient. Together, these components can be used to determine the salt and nutrient balance of a basin. Inflows represent potential salt and nutrient *sources* whereas outflows are potential salt and nutrient *sinks*.

Quantifying the net movement of salt and nutrient to and from a MZ and accounting for any changes in storage provides the means to estimate changes to groundwater quality into the future.

The net change in TDS or nitrate mass is calculated as:

$$\sum_{i=1}^{m}(Inflow \times WQ)_i - \sum_{j=1}^{n}(Outflow \times WQ)_j = \Delta Mass$$

where, for a given year, m is the number of inflows, n is the number of outflows, $Inflow$ is an inflow volume, $Outflow$ is an outflow volume, WQ is the TDS or nitrate concentration of the inflow or outflow, and $\Delta Mass$ is the change in salt or nutrient mass in the groundwater basin. To determine the average groundwater quality of a management in a given year:

$$Groundwater\ Quality = \frac{Mass + \Delta Mass}{Storage + \Delta Storage}$$

General assumptions of the salt/nutrient loading model include:

- Mass balances into and out of the groundwater basin are combined to generate an average water quality for each year.
- Mass that passes the root zone instantly reaches the groundwater with no lag time.
- The quality of the groundwater used to determine the mass in outflows for a particular year is based on the previous year's concentration.

The following subsections discuss the water qualities associated with the different inflows to and outflows from a MZ and modeling assumptions specific to an inflow or outflow.

6.2.1 Salt and Nutrient Sources

The inflows of water and their corresponding salt and nutrient components are described below. These are combined into the following categories: natural recharge, subsurface inflow, artificial recharge, applied water and return flows, and wastewater percolation and septic infiltration.

Natural Recharge

Natural recharge includes inflows from San Gorgonio River, Whitewater River, San Gorgonio Pass, and across the Banning fault. The TDS of this input is approximately 210 mg/L (DWR, 1964). All natural recharge sources were assumed to have the average water quality from DWR (1964) of 210 mg/L TDS.

Nitrate concentrations of natural recharge are conservatively set at 2 mg/L as nitrate.

Subsurface Inflow

Subsurface flow across management zones assumes the water quality of the inflow is the groundwater quality of the source MZ it flows from. For Garnet Hill MZ and Desert Hot Springs Subbasin MZs, since a groundwater quality is not modeled and ambient water quality was not determined due to a lack of data, the statistical median is used as water quality.

The quality of the subsurface inflow from the Salton Sea has been assumed to be the 2010 quality of the Salton Sea with TDS concentrations of 53,000 mg/L. The nitrate concentration is conservatively assumed to be 1 mg/L as nitrate, based on a Tetra Tech (2007) study that showed nitrate levels less than 1 mg/L as nitrate.

Water quality of subsurface flow from San Gorgonio Pass is assumed to be similar to the water quality of MSWD well 26A in West Palm Springs Village (MSWD, 2012). **Table 6-7** summarizes the water quality of subsurface inflows/outflows used in the salt/nutrient loading model.

Table 6-7
Subsurface Water Quality Modeling Assumptions

Subsurface Flow Source	Variability	TDS (mg/L)	Nitrate as NO_3 (mg/L)
West Whitewater River MZ	Modeled	*326*[1]	*9.4*[1]
East Whitewater River MZ	Modeled	*515*[1]	*7.0*[1]
Mission Creek MZ	Modeled	*510*[1]	*3.6*[1]
Garnet Hill MZ	Fixed	212[2]	1.8[2]
Miracle Hill MZ	Fixed	440[2]	4.2[2]
Fargo Canyon MZ	Fixed	1,325[2]	17.9[2]
Salton Sea	Fixed	53,000[3]	1.0
San Gorgonio Pass	Fixed	325	12

Note: Sky Valley MZ is not shown because it has no direct connectivity with modeled MZs.
[1] Ambient water quality. These values are updated by the model each year.
[2] Not ambient water quality. These values are assumed to be constant in the model.
[3] Current Salton Sea salinity based on

Artificial Recharge

Imported water for artificial recharge, as described in the section on water balance above, is a significant component of water management in the Coachella Valley. Colorado River water is imported in two ways:

- MWD SWP Exchange water is delivered via MWD's Colorado River Aqueduct (CRA) that extends from Lake Havasu.
- Coachella Canal (CC) water is delivered via the CC branch of the All-American Canal that is diverted at Imperial Dam.

The water qualities associated with the two diversion points is different, SWP Exchange water having lower concentrations of TDS than CC water diverted at Imperial Dam. Historical water quality for the CC are derived from CVWD unpublished water quality data for the CC at Avenue 52. SWP Exchange water quality is calculated as the average water quality of the CRA at Lake Havasu and San Jacinto from MWD's Annual Reports (MWD, 2014).

TDS projections for the two sources is based on the US Bureau of Reclamation Final Environmental Impact Statement for the Interim Surplus Guidelines (2007). Projected nitrate concentrations for CC water assume a constant value equal to the average nitrate as NO_3 from 1982 to 1993. For SWP exchange water, nitrate as NO_3 is assumed to be the average nitrate between 1999 and 2014.

Table 6-8
Total Dissolved Solids and Nitrate Concentrations of Colorado River Water Sources

Source	TDS (mg/L)		Nitrate as NO_3 (mg/L)	
	1993-2013 Average	2014-2045 Average	1993-2013 Average	2014-2045 Average
MWD SWP Exchange	626	628	1.3	1.3
Coachella Canal	748	750	0.6	0.6

Source: CVWD, unpublished water quality data; USBR, 2007.

Applied Water Returns

Agricultural, golf, and outdoor municipal water uses have complex salt and nutrient interactions that include: concentration of mass due to ET losses; nitrogen uptake by plants; and application of fertilizers containing salts and nutrients. Water sources used for irrigation contain varying amounts of salt and nutrients. These sources consist of local surface water, groundwater, Colorado River water from the Coachella Canal, and recycled water.

Applied water not used to satisfy crop ET requirements is assumed to deep percolate (or exit through drains, see **Section 6.2.2** below). The soil profile is assumed to have no storage of water or salt and nutrient, so any TDS and nitrate left in the profile is transported with the return water to the underlying groundwater.

Appendix G discusses the methodology used to determine the balance for applied water (i.e., irrigation). The assumptions made for golf irrigation are used for outdoor municipal irrigation. In general, crop nutrient requirements are determined based on crop type and applied water quality. Nutrient requirement deficits are met by the application of fertilizer; all excess salt and nutrient added via fertilizer or applied water is assumed to flush down to the groundwater table.

Wastewater Returns

It is assumed that current wastewater treatment does not achieve any significant removal of TDS or nitrate from wastewater. Therefore, the water quality associated with percolated wastewater and recycled water is the quality of the groundwater in a particular MZ with the addition of TDS and nitrate increments presented for municipal indoor use.

Waste increments associated with indoor municipal use were calculated as the difference between average monthly wastewater effluent concentrations in 2013 and the average monthly groundwater supply in the same wastewater service area for 2013 as reported to the Regional Board. These increments were calculated for three wastewater treatment plants: Palm Springs (TDS and nitrate), Valley Sanitary District (TDS only), and WRP 4 (TDS and nitrate). Total nitrogen, converted to nitrate as NO_3, was used to determine the nitrate waste increment.

Indoor municipal water use waste increments are assumed to be constant for all years in the model:

- TDS waste increment is 209 mg/L
- Nitrate waste increment is 64 mg/L as NO_3

Unquantified Sources

Several additional sources of salt and nutrient may exist in the study area, but their impacts are difficult to quantify. Groundwater can become more salty as a result of dissolution of minerals in the aquifer matrix. The extent is dependent on the aquifer geology and the residence time. Absent detailed geochemistry studies, the effects of mineralization are not accounted for in this SNMP. However, the previous effects of mineralization on groundwater should be reflected in the ambient groundwater quality.

Another unquantified source of salt and nutrient may be salt storage in the vadose (unsaturated zone). Arid climates typically have relatively low amounts of deep percolation of precipitation. Any rainfall reaching in the root zone is consumed by native vegetation until the soil moisture causes plant death or dormancy. The ET process concentrates any salt in the vadose zone and lack of water inhibits vertical migration except in periods of high rainfall. In much of the Coachella Valley, there is a significant unsaturated thickness above the water table that can store salt. This unsaturated thickness can cause a substantial lag between salt application at the ground surface and salt reaching the water table. No studies documenting salt storage were readily available. This SNMP conservatively assumes that any salt or water containing salt applied at the ground surface reaches the water table within the year of application.

A potential source of nutrients in groundwater may originate from nitrogen-fixing plants, such as mesquite, which are able to convert atmospheric nitrogen to ammonia through the action of symbiotic bacteria present in root nodules. When these plants die, the nitrogen is released to the environment. As discussed in **Section 4.1.9**, previous investigators speculated that the removal and plowing under of mesquite forests may partially explain the elevated nitrated concentrations in the Palm Desert-Indian Wells area. This source of nitrogen is not quantified but its effects on groundwater are accounted for in the ambient water quality determination.

6.2.2 Salt and Nutrient Sinks

Outflows are potential sinks of salt and nutrients in a management zone. The outflows of water and their corresponding salt and nutrient components are described below. These are combined into the following categories: groundwater pumping, subsurface outflow, evapotranspiration, and agricultural drain flows.

Groundwater Pumping

Pumping of groundwater extracts an amount of salt and nutrient estimated as the average water quality of the groundwater in a management zone multiplied by the volume pumped. The modeling approach assumes groundwater is mixed each year such that the average groundwater quality of the total MZ is the water quality pumped from the groundwater regardless of where that pumping takes place. While this approach provides an indication of the general trend in salt removal and addition reapplication through return flow, it does not accommodate spatial differences in quality and loading. This is a limitation of the current modeling approach.

Subsurface Outflow

Subsurface flow between management zones is an outflow for one MZ and a corresponding inflow for another MZ; see subsection on subsurface inflows above. Travel time may affect the rate of salt movement between MZs; however, this impact is neglected in modeling.

Evapotranspiration

ET losses are modeled as losses of water only; salt and nutrient mass is left in the source water. Therefore, only groundwater storage is affected directly by ET losses.

Nitrogen uptake and salt added through fertilizers is handled differently and explicitly, as described in the section on applied water returns.

Plant Uptake of Nutrients

Nutrients are required for plant growth and represent a sink of nutrients for the Coachella Valley. Addition of fertilizer is often necessary to ensure the available amount of nutrients is adequate for plant growth. Nutrients become fixed in plant tissue and some are exported out of the basin with crop harvesting. **Appendix G** discusses the assumptions in determining crop nutrient requirement. Excess nutrients available in the applied water and any additional added by fertilizer that is not used by the crop is assumed to migrate into the groundwater with return flows.

Agricultural Drain Flows

A major export of salt and nutrient in the Coachella Valley is the agricultural drain system. Salt and nutrients are removed from the basin via the CVSC and 25 agricultural drains that drain directly into the Salton Sea. The CVSC contains several flow components including agricultural drainage, regulatory water (water released from the Canal distribution system), fish farm effluent, and wastewater treatment plant effluent. The quality of the agricultural drainage component is dependent upon the quality of the applied water for irrigation and the irrigation efficiency. In general, as the applied water TDS and the irrigation efficiency increase, the TDS of the agricultural returns also increase. Because the drain system underlies about two-thirds of the irrigated agricultural land, the quality of drain water should be comparable to the quality of irrigation return flow.

6.2.3 Salt and Nutrient Budget by Management Zone

The 2013 salt and nutrient budgets are presented in the following subsections; TDS and nitrate (as NO_3) additions and subtractions from the groundwater basin is tracked for each MZ. Note that the salt and nutrient budgets are not constant and vary according to assumptions detailed above or in the water management plans for the SNMP planning area.

West Whitewater River Management Zone

The representative salt and nutrient budgets for West Whitewater River MZ are presented on **Table 6-9** and **Table 6-10**, respectively. The budgets summarize the TDS and nitrate (as NO_3) mass inflows to and outflows from West Whitewater River MZ groundwater and present the change in mass in groundwater storage for future periods. The budgets change year over year consistent with the water budget (see **Table 6-4**) and water quality assumptions discussed earlier in this section.

Table 6-9
West Whitewater River Management Zone – Salt Budget

Category	TDS (tons)			
	2015-2020	2020-2030	2030-2040	2040-2045
Inflows				
Artificial Recharge	88,300	62,800	67,600	67,800
Natural Recharge	11,700	11,700	11,700	11,700
Return - Golf	35,100	56,300	58,400	61,500
Return - Municipal, Indoor (Septic)	5,600	4,900	4,800	4,800
Return - Municipal, Outdoor	41,900	46,300	52,100	58,100
Return - Wastewater Percolation	9,100	6,100	7,200	8,300
Subsurface Inflow - Garnet Hill MZ	5,800	5,700	5,600	5,500
Subsurface Inflow - San Gorgonio Pass	4,100	4,100	4,100	4,100
Total	**201,600**	**197,900**	**211,500**	**221,800**
Outflows				
Groundwater Pumping - Golf	19,100	3,000	1,300	800
Groundwater Pumping - Municipal, Indoor	15,000	17,500	20,700	24,200
Groundwater Pumping - Municipal, Outdoor	40,400	44,800	50,500	56,500
Subsurface Outflow - East Whitewater River MZ	11,500	8,000	7,200	6,800
Phreatophyte Evapotranspiration	0	0	0	0
Total	**86,000**	**73,300**	**79,700**	**88,300**
Balance	**115,600**	**124,600**	**131,800**	**133,500**

Table 6-10
West Whitewater River Management Zone – Nutrient Budget

Category	Nitrate (tons)			
	2015-2020	2020-2030	2030-2040	2040-2045
Inflows				
Artificial Recharge	180	130	140	130
Natural Recharge	110	110	110	110
Return - Golf	930	1,060	1,160	1,290
Return - Municipal, Indoor (Septic)	780	650	610	590
Return - Municipal, Outdoor	770	830	910	990
Return - Wastewater Percolation	1,240	790	890	990
Subsurface Inflow - Garnet Hill MZ	50	50	50	50
Subsurface Inflow - San Gorgonio Pass	150	150	150	150
Total	**4,210**	**3,770**	**4,020**	**4,300**
Outflows				
Groundwater Pumping - Golf	550	80	30	20
Groundwater Pumping - Municipal, Indoor	430	480	540	610
Groundwater Pumping - Municipal, Outdoor	1,160	1,220	1,320	1,420
Subsurface Outflow - East Whitewater River MZ	330	220	190	170
Phreatophyte Evapotranspiration	0	0	0	0
Total	**2,470**	**2,000**	**2,080**	**2,220**
Balance	**1,740**	**1,770**	**1,940**	**2,080**

East Whitewater River Management Zone

The salt and nutrient budgets for East Whitewater River MZ are presented on **Table 6-11** and **Table 6-12**, respectively. The budgets summarize the TDS and nitrate (as NO_3) mass inflows to and outflows from East Whitewater River MZ groundwater and present the change in mass in groundwater storage for future periods. The budgets change year over year consistent with the water budget (see **Table 6-5**) and water quality assumptions discussed earlier in this section.

Table 6-11
East Whitewater River Management Zone – Salt Budget

Category	TDS (tons)			
	2015-2020	2020-2030	2030-2040	2040-2045
Inflows				
Artificial Recharge	23,400	71,000	72,000	73,000
Natural Recharge	1,500	1,500	1,500	1,500
Return - Agricultural	258,100	221,800	186,000	138,300
Return - Fish Farms and Duck Clubs	8,100	8,600	8,900	9,100
Return - Golf	30,000	41,800	55,000	68,900
Return - Industrial	1,600	1,700	1,800	1,800
Return - Municipal, Indoor (septic)	7,500	52,100	67,500	79,400
Return - Municipal, Outdoor	41,900	60,700	91,100	118,700
Subsurface Inflow - Fargo Canyon MZ	300	300	300	300
Subsurface Inflow - Salton Sea	133,000	55,500	39,400	37,100
Subsurface Inflow - West Whitewater MZ	11,500	8,000	7,200	6,800
Total	**516,900**	**523,000**	**530,700**	**534,900**
Outflows				
Agricultural Drain Flows	124,300	208,100	289,200	320,300
Groundwater Pumping - Agricultural	18,300	8,200	7,500	6,600
Groundwater Pumping - Fish Farms and Duck Clubs	5,600	6,100	6,300	6,500
Groundwater Pumping - Golf	4,500	6,400	8,400	10,500
Groundwater Pumping - Industrial	1,600	1,700	1,800	1,800
Groundwater Pumping - Municipal, Indoor	19,700	15,500	16,900	16,400
Groundwater Pumping - Municipal, Outdoor	41,700	31,400	32,800	30,400
Phreatophyte Evapotranspiration	0	0	0	0
Subsurface Outflow - Salton Sea	1,800	2,100	4,100	4,700
Total	**217,500**	**279,500**	**367,000**	**397,200**
Balance	**299,400**	**243,500**	**163,700**	**137,700**

Table 6-12
East Whitewater River Management Zone – Nutrient Budget

Category	Nitrate (tons)			
	2015-2020	2020-2030	2030-2040	2040-2045
Inflows				
Artificial Recharge	20	60	60	60
Natural Recharge	10	10	10	10
Return - Agricultural	1,250	1,190	1,100	950
Return - Fish Farms and Duck Clubs	80	80	90	100
Return - Golf	170	260	500	750
Return - Industrial	20	20	20	30
Return - Municipal, Indoor (septic)	740	3,640	4,590	5,270
Return - Municipal, Outdoor	170	150	190	210
Subsurface Inflow - Fargo Canyon MZ	< 10	< 10	< 10	< 10
Subsurface Inflow - Salton Sea	< 10	< 10	< 10	< 10
Subsurface Inflow - West Whitewater MZ	330	220	190	170
Total	**2,790**	**5,630**	**6,750**	**7,550**
Outflows				
Agricultural Drain Flows	250	420	580	650
Groundwater Pumping - Agricultural	250	110	100	90
Groundwater Pumping - Fish Farms and Duck Clubs	80	80	90	90
Groundwater Pumping - Golf	60	80	110	150
Groundwater Pumping - Industrial	20	20	20	30
Groundwater Pumping - Municipal, Indoor	270	200	230	240
Groundwater Pumping - Municipal, Outdoor	560	410	450	440
Phreatophyte Evapotranspiration	0	0	0	0
Subsurface Outflow - Salton Sea	10	10	20	20
Total	**1,500**	**1,330**	**1,600**	**1,710**
Balance	**1,290**	**4,300**	**5,150**	**5,840**

Mission Creek Management Zone

The salt and nutrient budgets for Mission Creek MZ are presented on **Table 6-13** and **Table 6-14**, respectively. The budgets summarize the TDS and nitrate (as NO_3) mass inflows to and outflows from Mission Creek MZ groundwater and present the change in mass in groundwater storage for future periods. The budget changes year over year consistent with the water budget (see **Table 6-6**) and water quality assumptions discussed earlier in this section.

Table 6-13
Mission Creek Management Zone – Salt Budget

Category	TDS (tons)			
	2015-2020	**2020-2030**	**2030-2040**	**2040-2045**
Inflows				
Artificial Recharge	10,800	13,900	17,900	21,800
Natural Recharge	2,100	2,100	2,100	2,100
Return - Fish Farms and Duck Clubs	200	200	200	200
Return - Golf	1,900	2,300	2,800	3,400
Return - Industrial	400	400	400	400
Return - Municipal, Indoor (septic)	1,800	1,900	1,700	1,500
Return - Municipal, Outdoor	3,600	5,000	6,800	8,600
Return - Wastewater Percolation	2,500	4,100	6,400	8,600
Subsurface Inflow - Garnet Hill MZ	< 100	< 100	< 100	< 100
Subsurface Inflow - Miracle Hill MZ	1,100	1,100	1,100	1,100
Total	**24,400**	**31,000**	**39,400**	**47,700**
Outflows				
Groundwater Pumping - Fish Farms and Duck Clubs	200	200	200	200
Groundwater Pumping - Golf	2,000	2,500	3,000	3,600
Groundwater Pumping - Industrial	400	400	400	400
Groundwater Pumping - Municipal, Indoor	6,200	8,100	9,900	11,600
Groundwater Pumping - Municipal, Outdoor	8,100	10,400	12,400	14,300
Phreatophyte Evapotranspiration	0	0	0	0
Subsurface Outflow - Garnet Hill MZ	2,800	2,500	2,400	2,500
Total	**19,700**	**24,100**	**28,300**	**32,600**
Balance	**4,700**	**6,900**	**11,100**	**15,100**

Table 6-14
Mission Creek Management Zone – Nutrient Budget

Category	Nitrate (tons)			
	2015-2020	**2020-2030**	**2030-2040**	**2040-2045**
Inflows				
Artificial Recharge	20	30	40	40
Natural Recharge	20	20	20	20
Return - Fish Farms and Duck Clubs	< 10	< 10	< 10	< 10
Return - Golf	< 10	< 10	< 10	10
Return - Industrial	< 10	< 10	< 10	< 10
Return - Municipal, Indoor (septic)	160	170	160	130
Return - Municipal, Outdoor	20	30	50	80
Return - Wastewater Percolation	220	370	570	760
Subsurface Inflow - Garnet Hill MZ	< 10	< 10	< 10	< 10
Subsurface Inflow - Miracle Hill MZ	10	10	10	10
Total	**450**	**630**	**850**	**1,050**
Outflows				
Groundwater Pumping - Fish Farms and Duck Clubs	< 10	< 10	< 10	< 10
Groundwater Pumping - Golf	10	20	20	30
Groundwater Pumping - Industrial	< 10	< 10	< 10	< 10
Groundwater Pumping - Municipal, Indoor	40	50	80	110
Groundwater Pumping - Municipal, Outdoor	50	70	100	130
Phreatophyte Evapotranspiration	0	0	0	0
Subsurface Outflow - Garnet Hill MZ	20	20	20	20
Total	**120**	**160**	**220**	**290**
Balance	**330**	**470**	**630**	**760**

6.3 ESTIMATED AVERAGE FUTURE WATER QUALITY

Average future water quality is estimated using a salt/nutrient loading model. The water and salt/nutrient budgets described above move water volumes and salt/nutrient mass into and from the groundwater basin. The balance at the end of each year updates the average water quality of the groundwater for each MZ; these results are presented in the following subsections.

The salt/nutrient loading model is an accounting model that computes the annual net change in TDS and nitrate of the groundwater in each MZ. The model assumes the following:

- Groundwater storage for 2014 is set based on the mixing storage used to determine ambient water quality as described in TM-2 (**Appendix B**); storage is then updated annually based on the water balance.
- Groundwater quality for 2014 is set as the ambient water quality calculated in **Section 5**; subsequent years are updated annually based on the salt/nutrient loading model
- Groundwater supply for a given year has a water quality equal to the computed water quality of the previous year.
- All inflows and returns to the groundwater are mixed throughout the entire modeled storage before outflow and pumped water quality is determined; consequently, all outflows and pumped groundwater for a particular MZ have the same water quality in a given year.
- All applied water (i.e., irrigation) that is not lost to ET is assumed to deep percolate; salts and nutrients left in the soil profile are pushed into the groundwater instantaneously.

It is important to note that the model developed to estimate average future water quality is based on two families of assumptions: (1) estimated ambient water quality and (2) estimated loading parameters. The uncertainty associated with the estimates of ambient water quality are described in **Section 5**. The estimate of average future water quality is sensitive to the ambient water quality as a different starting estimate will shift the estimated average future water quality by a similar amount. Likewise, assumptions such as population growth and land use changes (impact water demands), imported water reliability, local hydrology, and indoor waste increments are estimated based on available data. Factors such as crop ET and nutrient requirements are difficult to estimate directly; they are thus determined scientifically based on published literature values. In addition, the use of complete mixing dilutes any localized effects of salt and nutrient loading on groundwater quality. The high level of uncertainty associated with these estimates suggests that updating the model with newly collected data to improve and calibrate the model is imperative.

Although the model has inherent limitations, it provides an estimate of the overall water quality trends in response to the projected water demands and management practices implemented to eliminate groundwater overdraft.

6.3.1 West Whitewater River Management Zone

The estimated average future water quality of West Whitewater MZ for the planning period ending in year 2045 is presented on **Figure 6-3** and **Figure 6-4** for TDS and nitrate (as NO_3), respectively. TDS increases an average of 3 mg/L per year; nitrate as NO_3 at an average of 0.04 mg/L per year. The estimated future water quality for the MZ over the planning period remains below the criteria for TDS and WQO nitrate.

Figure 6-3
West Whitewater River MZ Estimated Future Water Quality – TDS

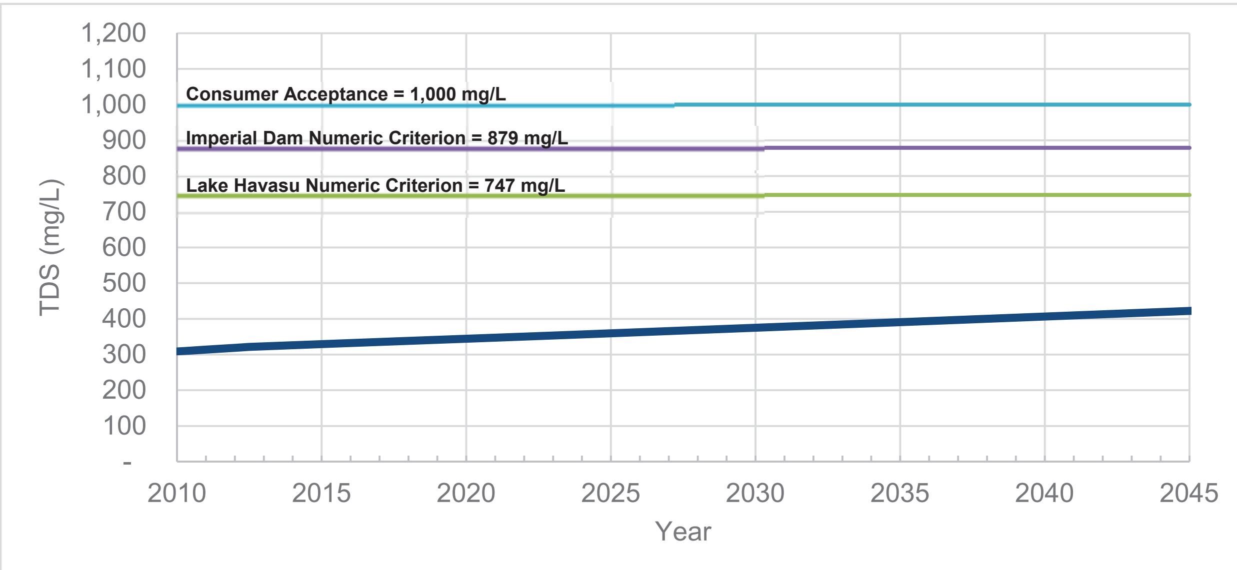
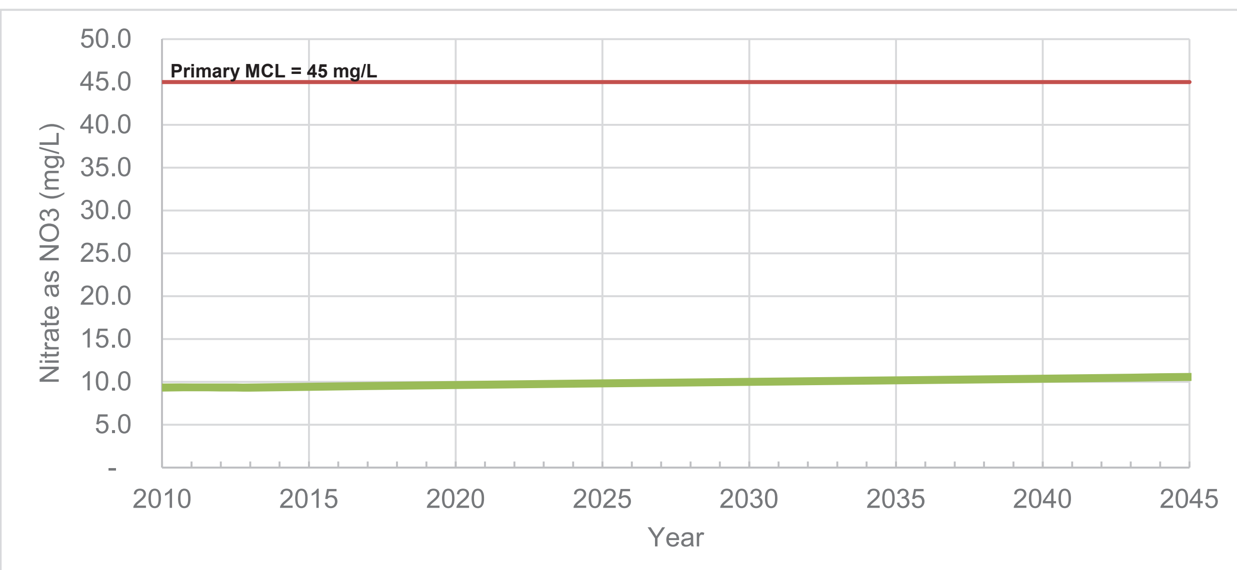


Figure 6-4
West Whitewater River MZ Estimated Future Water Quality – Nitrate as NO_3



6.3.2 East Whitewater River Management Zone

The estimated average future water quality of East Whitewater MZ for the planning period ending in year 2045 is presented on **Figure 6-5** and **Figure 6-6** for TDS and nitrate (as NO_3), respectively. TDS increases an average of 2.6 mg/L per year; nitrate as NO_3 at an average of 0.05 mg/L per year. The estimated future water quality for the MZ remains below the criteria for TDS and WQO nitrate.

Figure 6-5
East Whitewater River MZ Estimated Future Water Quality – TDS

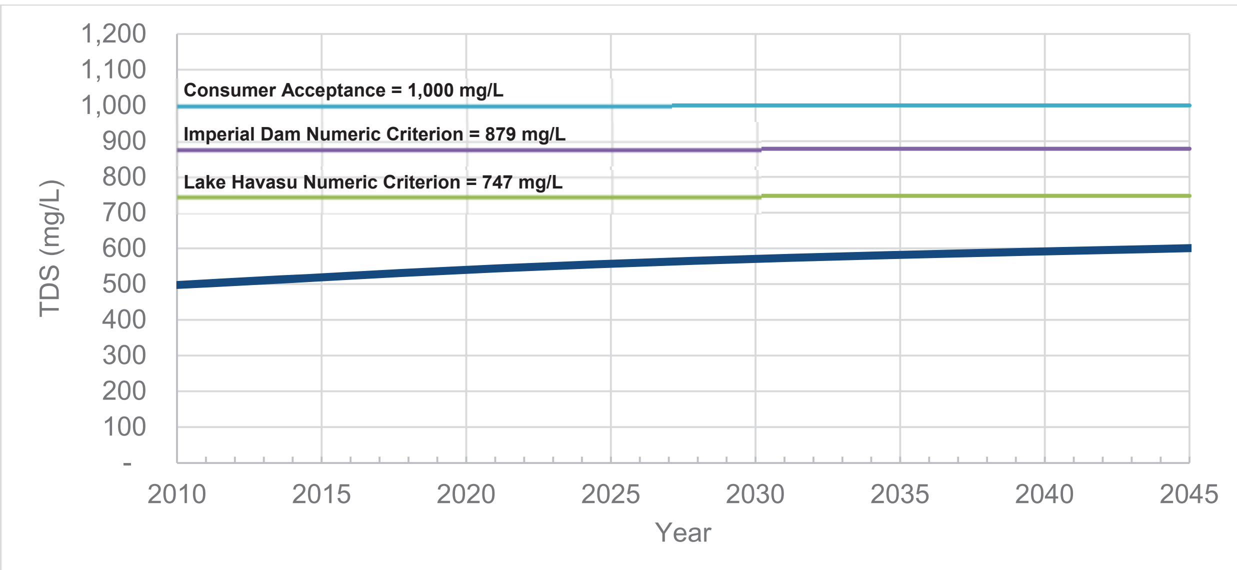
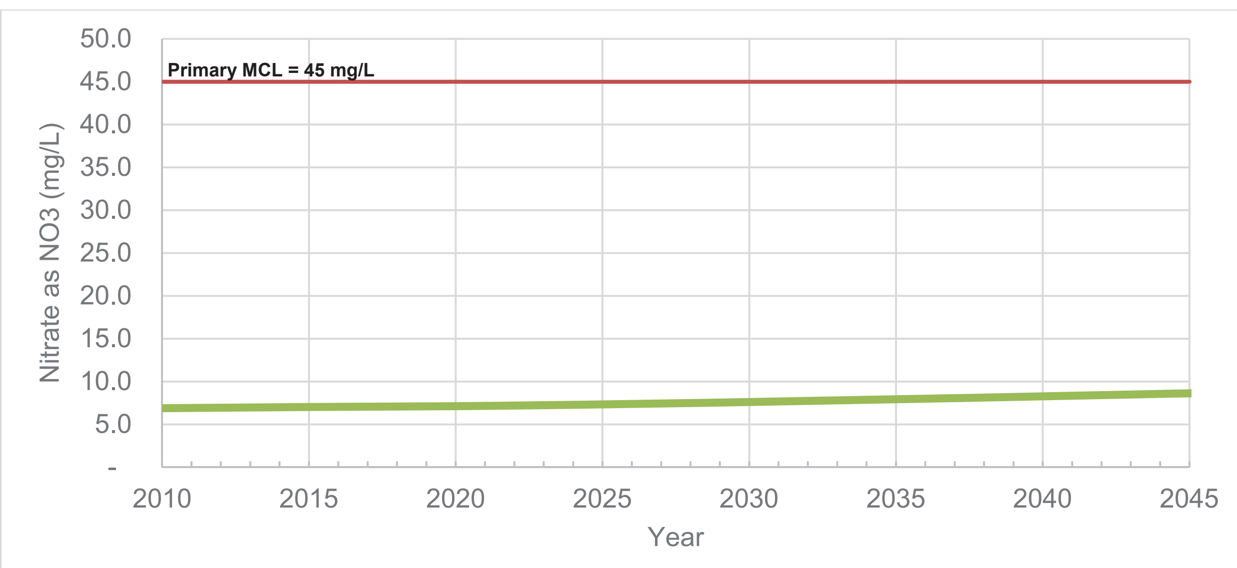


Figure 6-6
East Whitewater River MZ Estimated Future Water Quality – Nitrate as NO_3



6.3.3 Mission Creek Management Zone

The estimated average future water quality of Mission Creek MZ for the planning period ending in year 2045 is presented on **Figure 6-7** and **Figure 6-8** for TDS and nitrate (as NO_3), respectively. TDS increases an average of 1.2 mg/L per year; nitrate as NO_3 at an average of 0.08 mg/L per year. The estimated future water quality for the MZ remains below the criteria for TDS and WQO nitrate.

Figure 6-7
Mission Creek MZ Estimated Future Water Quality – TDS

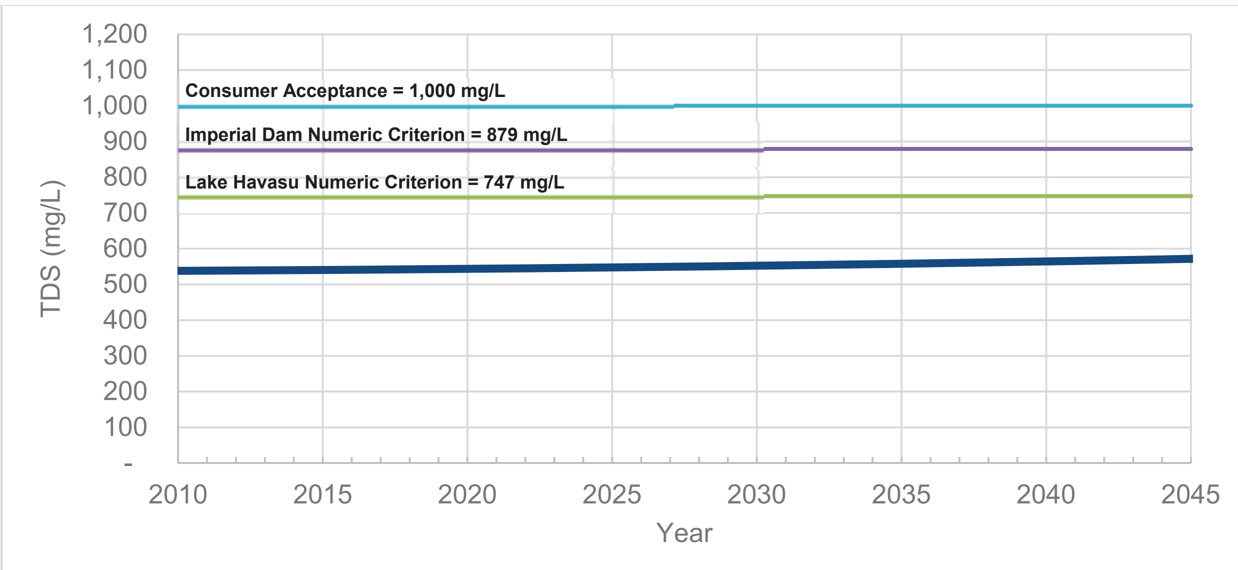
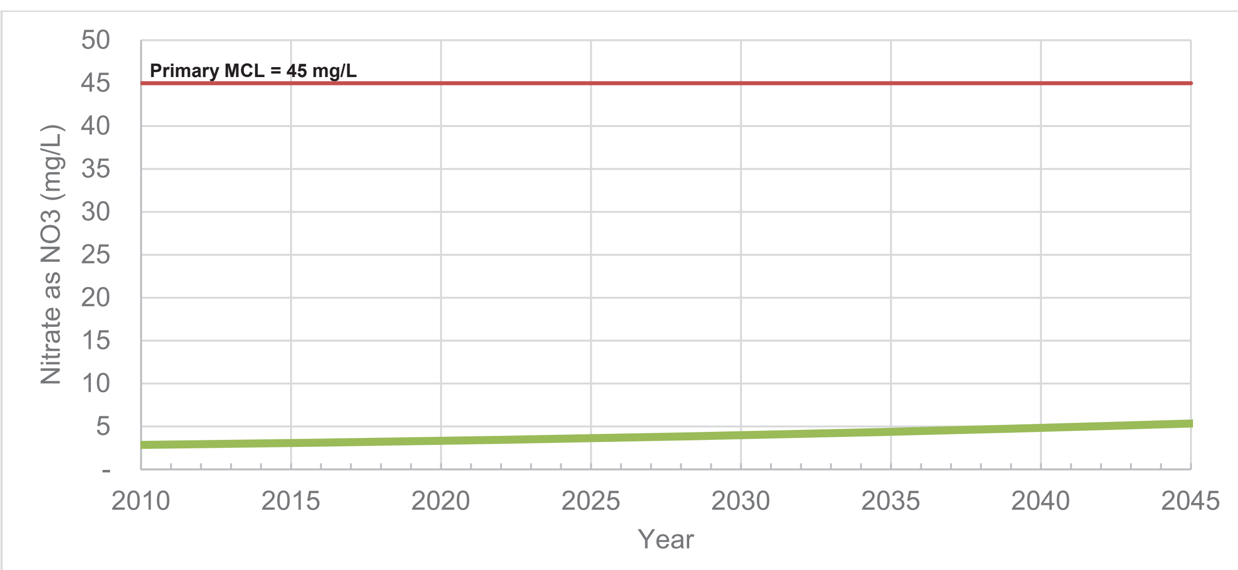


Figure 6-8
Mission Creek MZ Estimated Future Water Quality – Nitrate as NO_3



6.3.4 Garnet Hill Management Zone

Not enough data was available to determine the ambient water quality for the Garnet Hill MZ. Consequently, future water quality is not determined for the MZ.

6.3.5 Desert Hot Springs Subbasin Management Zones

Not enough data was available to determine the ambient water quality for the Miracle Hill, Sky Valley, and Fargo Canyon MZs. Consequently, future water quality is not determined for these MZs.

6.4 ANTIDEGRADATION ANALYSIS

SWRCB Resolution No. 68-16 (also known as the Antidegradation Policy) is a state policy that establishes the requirement that discharges to waters of the state shall be regulated to achieve the “highest water quality consistent with maximum benefit to the people of the State.” The intent of the Anti-Degradation Policy is to regulate discharges to protect surface water and groundwater quality.

The SWRCB Resolution No. 68-16 is applied by the RWQCBs and the SWRCB in waste discharge requirements and National Pollutant Discharge Elimination System (NPDES) permits. Each RWQCB has incorporated the resolution into its respective Basin Plan.

Resolution No. 68-16 does not mandate that existing high quality water be maintained; rather any change must be consistent with maximum benefit to the people of the State, not unreasonably affect beneficial uses, and comply with applicable water quality control policies. Discharges in compliance with Resolution No. 68-16 can vary between background and the WQOs in Basin Plans that are set to protect beneficial uses. A discharger must at all times use best practicable treatment or control. If the discharge, even after treatment, unreasonably affects beneficial uses or does not comply with applicable provisions of Basin Plans, the discharge would be prohibited. The discharge does need not be treated to levels that are better than background water quality.

6.4.1 Compliance with Resolution No. 68-16

Resolution No. 68-16, poses a process consisting of two steps for compliance. The first step is to determine if the discharge will degrade higher receiving water quality. If it will degrade the water body, the discharge may be allowed if the change in water quality 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 state policies. The second step is that any activities that result in discharges to such high quality receiving waters are required to use the best practicable treatment to avoid a pollution or nuisance and to maintain the high quality water consistent with the maximum benefit to the people of the State. Listed below are the steps to determine compliance with Resolution No. 68-16:

1. Determine if planned recycled water projects, if implemented, will significantly change the water quality in a MZ
2. Evaluate if projected changes to the groundwater exceed WQOs or unreasonably affect beneficial uses of the groundwater
3. If so, demonstrate whether any projected change would be consistent with the maximum benefit to the people of the State.

There are no numeric WQOs for salinity in the Basin Plan. For this SNMP, the Title 22 Upper Limit Secondary MCL for Consumer Acceptance is used to evaluate assimilative capacity as discussed in **Section 3.1**. The primary MCL for nitrate is the Basin Plan WQO for nitrate. The average concentrations of TDS and nitrate (as NO_3) in the West Whitewater River, East Whitewater River, and Mission Creek MZs do not currently exceed the water quality criteria for TDS or the WQO for nitrate. Based on the currently planned recycled water projects, a significant change in water quality that is inconsistent with the Basin Plan WQOs is not anticipated in the next 30-year water management planning period.

To conduct an antidegradation analysis for planned recycled water irrigation projects, the Policy states (Section 9.d.2 of Policy):

> "A project that meets the criteria for a streamlined irrigation permit and is within a basin where a salt/nutrient management plan satisfying the provisions of paragraph 6(b) is being prepared may be approved by the Regional Water Board by demonstrating through a salt/nutrient mass balance or similar analysis that the project uses less than 10 percent of the available assimilative capacity as estimated by the project proponent in a basin/sub-basin (or multiple projects using less than 20 percent of the available assimilative capacity as estimated by the project proponent in a groundwater basin)."

Listed below is the antidegradation analysis and specific discussion for each of these MZs.

6.4.2 West Whitewater River Management Zone

Treated wastewater effluent in the West Whitewater River MZ is either percolated into the groundwater basin or is delivered as recycled water for irrigation (recycled water project). It is important to note that the net effect of recycled water use is negligible for salt loading as it was a previously permitted discharge to the groundwater basin. Further, the nitrate loading is beneficial (net reduction) due to nitrogen uptake during irrigation of turf. Therefore, current and planned recycled water projects in the West Whitewater River MZ have no net impact on salt and nutrient loading.

In 2015, the salt loading into the basin due to recycled water and percolated wastewater is estimated at 52 percent and 48 percent, respectively; in 2045 it is estimated that the salt loading of recycled water and percolated wastewater will be 73 percent and 27 percent, respectively.

Impact of Projects: The impacts of currently planned recycled water projects are compared with the available assimilative capacity in West Whitewater River MZ on **Table 6-15**.

Table 6-15
Comparison of Assimilative Capacity and Estimated Impact of Recycled Water Projects in West Whitewater River Management Zone

Constituent	Assimilative Capacity (mg/L)	20 Percent of Assimilative Capacity (mg/L)	10 Percent of Assimilative Capacity (mg/L)	Impact of Recycled Water Projects[1] (mg/L)
Total Dissolved Solids	674	135	67	7
Nitrate (as NO_3)	30.7	6.1	3.1	0.5

[1] Estimated cumulative impact of currently planned recycled water projects from 2015 to 2045. Increases due to recycled water projects in West Whitewater River Management Zone are offset by decreases in percolated wastewater contributions.

Since the combined impact of planned recycled water projects utilize less than 20 percent of the assimilative capacity, planned recycled water projects are consistent with the Policy.

Impact Relative to WQOs: The water quality in the MZ, due to impacts from recycled water projects, will not exceed the nitrate WQO or the TDS water quality criterion and will not unreasonably affect beneficial uses of the groundwater. Anticipated changes in water quality are consistent with the Policy.

Maximum Benefit: The changes in water quality (which are negligible in West Whitewater River MZ due to transfer of permitted wastewater discharge to recycled water irrigation) that do occur are consistent with the maximum benefit to the people of the State. As addressed in the policy, landscape irrigation with recycled is to the benefit of the people of the State. Within the Policy, the SWRCB acknowledges use of recycled water for irrigation may, regardless of its source, collectively affect groundwater quality over time, its use is still a benefit. Use of recycled water also supports the sustainable and reliable use of groundwater by providing an alternative supply.

6.4.3 East Whitewater River Management Zone

Treated wastewater effluent in the East Whitewater River MZ is either discharged to the CVSC or is delivered as recycled water for irrigation. The net impact of recycled water projects is therefore the net increase of recycled water use within the MZ.

In 2015, the salt loading into the basin due to recycled water and percolated wastewater is estimated at 100 percent and 0 percent, respectively; in 2045 the relative contributions are estimated to remain unchanged.

Impact of Projects:
The impacts of currently planned recycled water projects are compared with the available assimilative capacity in East Whitewater River MZ on **Table 6-16**.

Table 6-16
Comparison of Assimilative Capacity and Estimated Impact of Recycled Water Projects in East Whitewater River Management Zone

Constituent	Assimilative Capacity (mg/L)	20 Percent of Assimilative Capacity (mg/L)	10 Percent of Assimilative Capacity (mg/L)	Impact of Recycled Water Projects[1] (mg/L)
Total Dissolved Solids	485	97	49	9
Nitrate (as NO_3)	38.0	7.6	3.8	0.3

[1] Estimated cumulative impact of currently planned recycled water projects from 2015 to 2045.

Since the combined impact of planned recycled water projects utilize less than 20 percent of the assimilative capacity, planned recycled water projects are consistent with the Policy.

Impact Relative to WQOs: The water quality in the MZ, due to impacts from recycled water projects, will not exceed the nitrate WQO or the TDS water quality criterion and will not unreasonably affect beneficial uses of the groundwater. Anticipated changes in water quality are consistent with the Policy.

Maximum Benefit: The changes in water quality that do occur in the East Whitewater River MZ are consistent with the maximum benefit to the people of the State. As addressed in the policy, landscape irrigation with recycled is to the benefit of the people of the State. Within the Policy, the SWRCB acknowledges use of recycled water for irrigation may, regardless of its source, collectively affect groundwater quality over time, its use is still a benefit. Use of recycled water also supports the sustainable and reliable use of groundwater by providing an alternative supply.

6.4.4 Mission Creek Management Zone

There are currently no planned recycled water projects in Mission Creek MZ. An antidegradation analysis will be completed when recycled water projects are planned for this MZ.

6.4.5 Garnet Hill Management Zone

There are currently no planned recycled water projects in Garnet Hill MZ. An antidegradation analysis will be completed when recycled water projects are planned for this MZ.

6.4.6 Desert Hot Springs Subbasin Management Zones

There are currently no planned recycled water projects in Miracle Hill, Sky Valley, or Fargo Canyon MZs. An antidegradation analysis will be completed when recycled water projects are planned for these MZs.

6.5 RECOMMENDATIONS FOR IMPROVEMENT OF SALT/NUTRIENT LOADING MODEL

Limitations of the current model have been described in **Section 6.3**. Assuming the data required to develop a numerical groundwater quality model is available, such a model would provide results at a significantly higher resolution than the current salt/nutrient loading model. Estimated future water quality for each MZ would be tracked cell-by-cell instead of MZ-wide. It has not been determined whether or not the benefits of a numerical groundwater quality model for basin-wide planning justify the additional cost to develop such a model. It is important to note that the data requirement to build and calibrate such a model is significantly greater than required for the salt/nutrient loading tool currently in use.

For the current model, improvements can be made to the quantification of uncertainty through a Monte Carlo simulation by varying input parameters based on historical variation. This will produce a simulated range of results that provides a better indication of estimated future water quality uncertainty.

Section 7
Management Strategies

The findings in previous sections support that the basin water quality is remaining within the WQOs for the constituents of concern and therefore corrective measures are not needed. The salt and nutrient management strategies discussed herein are actions the agencies should consider to help minimize impacts of recycled water projects and protect beneficial uses. Within this section, water supply planning goals are summarized and salt and nutrient management strategies are provided and discussed.

7.1 WATER SUPPLY PLANNING GOALS

The water supply goals established for the Coachella Valley SNMP planning area are summarized in the Coachella Valley Water Management Plan (WMP) and the Mission Creek/Garnet Hill WMP (CVWD, 2012a; CVWD *et al.*, 2013). The goals are to:

- meet current and future demands with a 10 percent supply buffer;
- eliminate long-term groundwater overdraft;
- manage and protect water quality;
- comply with state and federal laws and regulations;
- manage future costs; and
- minimize adverse environmental impacts.

These goals are considered along with protection of beneficial uses to develop SNMP management strategies described in this section. Water supply goals considered together with the management of salts and nutrients to protect the beneficial uses of groundwater in the Coachella Valley Groundwater Basin. Both water supply and salt and nutrient plans recommend programs to eliminate groundwater overdraft, develop new supplies and manage water quality.

7.2 MANAGEMENT STRATEGIES

Planned projects were compiled from the Coachella Valley Integrated Regional Water Management Plan (2014), Coachella Valley Water Management Plan (Update) (2011), Mission Creek/Garnet Hill Water Management Plan (2013), and Urban Water Management Plans. These projects are discussed in **Section 6**. Planned projects are aggregated to form strategies to achieve the prescribed water supply planning goals with analysis of the impact to salt and nutrients in the groundwater basin. The following subsections discuss salt and nutrient management strategies from a perspective of salt and nutrient loading to the basin.

7.2.1 Public Outreach and Awareness

The SNMP is a collaborative, stakeholder-driven process that has been developed through an effort that involves open discussion and integrated (multi- agency and multi-objective) planning. Through this process, information has been aggregated and salt/nutrient management strategies have been discussed among a broad spectrum of stakeholders, namely:

- Water purveyors
- Water managers
- Regional Water Quality Control Board
- Agricultural entities
- Golf courses
- Wastewater agencies
- Tribes
- General public

Progress on the SNMP and all communication related to the development of this plan have been made publicly available on the SNMP website available at www.cvwd.org/snmp. In addition to this, six (6) public stakeholder meetings/workshops have been held. These initiatives together with the water agencies' existing public outreach and education programs have led to greater awareness of the potential effects of salt and nutrients in groundwater. Collaborative efforts in implementing salt and nutrient management strategies will lead to higher adoption of salt and nutrient management practices.

7.2.2 Source Water Quality Management

The Coachella Valley is largely dependent on imported water to replenish groundwater resources because the basin receives limited natural recharge. As a result, a significant source of salt for the basin comes from imported Colorado River water. Accordingly, management strategies involving the substitution of a higher quality source or treatment of imported water can have significant impact on future salt concentrations of the groundwater basin.

Colorado River Salinity Control Program

The Colorado River Basin Salinity Control Act (SCA) was passed by the U. S. Congress in 1974 to address the growing salinity problem which would require cost-effective salinity control measures on the river. Existing state-adopted and USEPA-approved water quality standards for salinity on the Lower Colorado River are established at the locations shown in **Table 7-1.**

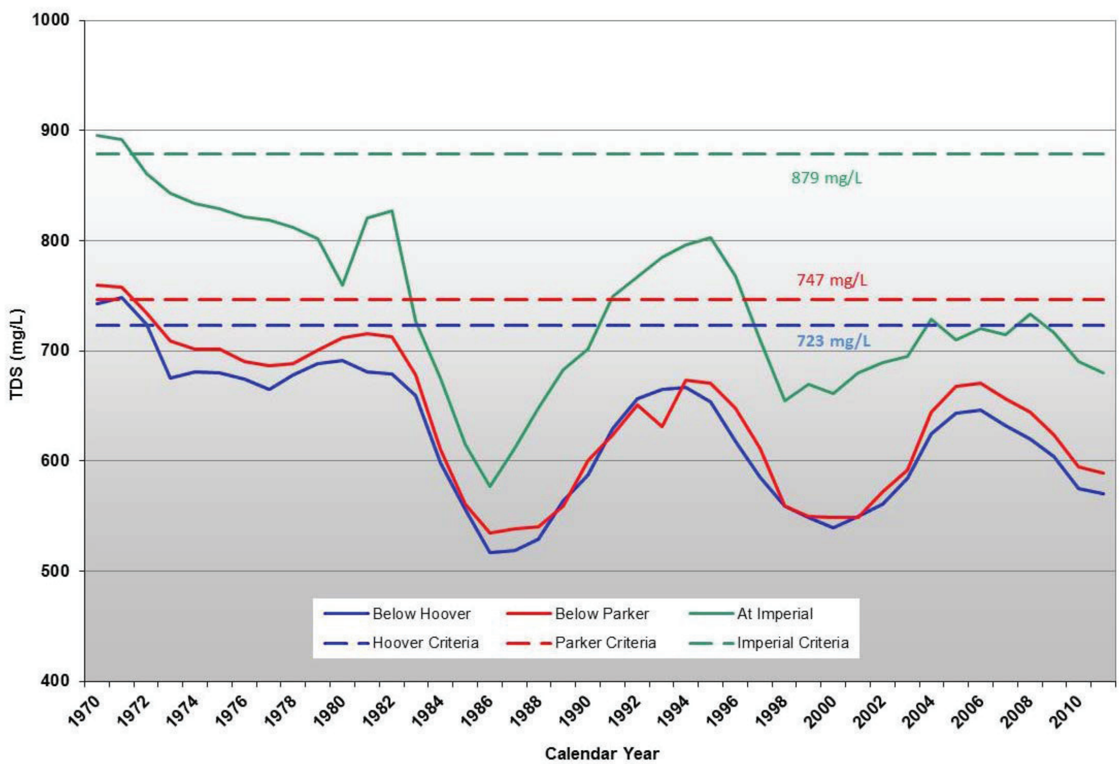
Table 7-1
Salinity Criteria and Water Quality for the Colorado River

Location	Salinity Criteria[1] (mg/L)	2013 Flow-weighted Average Salinity (mg/L)
Below Hoover Dam	723	580
Below Parker Dam	747	595
At Imperial Dam	879	677

Source: Colorado River Basin Salinity Control Forum, 2014.
[1] Flow-weighted average annual salinity

Approximately 62 percent of the salt load in the river above Hoover Dam comes from natural sources. Natural and human activities concentrate the dissolved salts in the River. Such activities include out-of-basin exports, crop and other consumptive uses, phreatophytic evapotranspiration and evaporation from reservoir surfaces. The seven-state Colorado River Basin Salinity Control Forum (Forum) conducts triennial reviews of water quality along the river and reports on progress achieved. In general, over the last thirty years the salinity concentrations have decreased at all three of the salinity criteria (**Figure 7-1**). Salinity levels in the Colorado River tend to be lower in years of higher flows, but the overall, long-term downward trend is a result of programs.

Figure 7-1
Total Dissolved Solids Concentrations at Three Numeric Criteria Stations (Salinity Forum, 2014)



The Forum adopts a Plan of Implementation that is designed to maintain the flow-weighted average annual salinity at or below the numeric criteria while the Basin States continue to develop their compact-apportioned water supply through projects and programs to meet water supply needs. The Plan of Implementation includes projects that remove the required salt tonnage. This will principally be accomplished by reducing the salt contributions to the Colorado River from existing sources and minimizing future increases in salt load caused by human activities. To date, it is estimated that the Program has reduced the salt loading in the Colorado River by approximately 1,326,000 tons per year. The program anticipates the removal of an additional 67,000 tons per year by 2017 (Salinity Forum, 2014). Continued salinity reductions are critical to managing the salt loads of the Colorado River supply to the Coachella Valley.

Direct State Water Project Delivery

The Coachella Valley has a combined allocation of 194,100 acre-feet per year of State Water Project (SWP) deliveries through separate contracts between CVWD and DWA and DWR. Based on reliability estimates prepared by DWR and CVWD, the average supply is currently about 120,000 AFY through an exchange agreement with Metropolitan. CVWD and DWA exchange their SWP allocation for Colorado River water at an exchange rate of one-to-one to leverage existing distribution infrastructure and minimize costs to the Coachella Valley. Water from the East Branch of the SWP has an average TDS concentration of approximately 250 mg/L, much lower than the water currently delivered through the SWP Exchange Program with Metropolitan (about 660 mg/L) (CVWD, 2012b). Direct SWP delivery would significantly reduce salt loading within the basin; however, the cost to build conveyance infrastructure is estimated to exceed $1 billion (CVWD, 2012b).

CVWD, DWA, Metropolitan, and other SWP contractors conducted a study in 2011 to evaluate alternatives and costs associated with direct importation of SWP water to the Coachella Valley. Two alternative routes were recommended for detailed evaluation – a San Gorgonio Pass route that conveyed SWP water from Metropolitan's Inland Feeder in Redlands to the Coachella Valley, and a Lucerne Valley route that conveyed water from the East Branch of the California Aqueduct along the north and east sides of the San Bernardino Mountains to the Coachella Valley. The estimated costs ranged from $774 million to $981 million for a 293 cubic feet per second capacity San Gorgonio Pass project and $1.05 billion to $1.43 billion for a 395 cubic feet per second capacity Lucerne Valley project (GEI et. al, 2011). The project participants elected to defer further action pending completion of the Bay Delta Conservation Plan process.

Desalination of Colorado River Water

Colorado River recharge is an important strategy of the Coachella Valley WMP for sustaining groundwater levels (CVWD, 2012a). Under current average conditions, imported Colorado River water conveys about 350,000 tons of salt into the basin each year. Desalination of Colorado River water is one approach for reducing the salt load in the recharged water. Technical challenges include the necessity and level of treatment, benefits of treatment, cost of treatment, methods and costs of brine disposal and how the costs of treatment would be recovered from basin water users. Methods for improving recharge water quality will be considered as part of the IRWMP or a similar approach involving broad stakeholder involvement (CVWD, 2012a).

Desalination of Colorado River water could provide a groundwater quality benefit by reducing the TDS concentration of imported water. The basic concept would involve desalination of some or all of the Colorado River water imported to the Coachella Valley for recharge, to be consistent with the average groundwater quality or to meet secondary (non-enforceable aesthetic) recommended drinking water standards of 500 mg/L. CVWD completed a pilot treatment study in conjunction with potable use. To date, no feasibility study has been performed for brine disposal methods. (CVWD, 2012b). Brine disposal is discussed in **Section 7.2.4**.

The TDS impacts of recharge were evaluated in the Water Management Plan Update EIR and it was determined that the benefits of recharge with Colorado River water to the basin are greater than the cumulative negative impacts (CVWD, 2012b).

Desalination of Drain Flows as a Water Supply

CVWD proposes to develop a program to recover, treat and distribute desalinated drain water and shallow groundwater for non-potable and potable uses in the East Whitewater River area. Treated drain water could be delivered to the Canal water distribution system and used as a non-potable supply for agricultural, golf course and landscape irrigation and potentially for potable water supply. The quality of the supply could be customized to meet a desired salt reduction target. Brine disposal will be a major component of implementation. Brine disposal is discussed in **Section 7.2.4**.

Under the CVWD 2010 WMP Update, the amount of water recovered through drain water desalination may range from 55,000 to 85,000 AFY by 2045, depending on the effectiveness of water conservation measures and the availability of other supplies. The lower end of the range reflects the successful implementation of the Bay Delta Conservation Plan and Delta conveyance facilities. The high end of the range is close to the maximum amount of drain water expected to be generated in the Coachella Valley and would be implemented if SWP Exchange water reliability remains low. The desalination program will be phased so that it can be expanded in response to future water supply conditions and needs of the Coachella Valley.

Wellhead Treatment

High concentrations of nitrate exist in portions of the Coachella Valley groundwater basin. Generally, nitrate occurs in the unsaturated and shallow aquifers and has not been observed in the deeper aquifers. Restoration of groundwater levels as a result of the WMPs could re-wet the vadose zone, mobilizing nitrate in the unsaturated and shallow aquifers, and increasing nitrate concentrations in pumped groundwater. The water agencies will continue to monitor and report nitrate concentrations in the groundwater.

Historically, when elevated nitrate approaching or exceeding the MCL is observed, a water agency discontinued pumping and operated other low nitrate wells or drilled a new deeper well to obtain low nitrate water. While a viable approach, it did not mitigate the existing nitrate, and could cause its migration to other wells. Water agencies should evaluate the feasibility of installing nitrate treatment on selected high nitrate wells as a means of removing a potential future source of groundwater contamination as an alternative to drilling new wells.

Groundwater can be treated directly as part of a wellhead treatment process involving ion exchange or reverse osmosis, prior to delivery to users. This approach would require a significant capital expenditure and ongoing operation and maintenance costs.

One form of wellhead treatment for nitrate would be the practice of selling higher nitrate water to golf courses. Nitrate concentrations would be reduced via microbial respiration, or denitrification. This would benefit the golf courses and act as a treatment mechanism for the shallow aquifer. CVWD has applied this method for several wells south of Highway 111 in the Palm Desert Cove area.

A benefit of this strategy is that the wellhead treatment technology can be designed to remove additional constituents of concern, e.g., arsenic and hexavalent chromium, in groundwaters that have unacceptable levels of these constituents for drinking water.

7.2.3 Demand Management and Conservation

Conservation strategies and programs that directly reduce water demand can considerably improve water security and provide water quality benefits as a result of curbed use. In particular, irrigation use results in water quality degradation due to evapotranspiration losses that concentrate salts and nutrients in return flows. Conservation programs exist currently, but additional strategies are identified in this section.

Improved Irrigation Efficiency

Improved irrigation efficiency as a result of the use of more advanced irrigation techniques or optimized water application rates can have an indirect effect on the average groundwater quality. A reduction in applied water results in lower volumes of water lost to evapotranspiration per unit area of irrigated land. Demands offset in this manner indirectly result in increased groundwater storage and reduced groundwater or imported water use. If salt mass import remains constant, but storage is greater, the average salt concentration in the basin is lower. Further, if external water sources are replaced by this conservation, salt addition to the basin is reduced all together.

Desert Landscaping Incentives

Implementing financial incentives for landscaping practices (including turf removal) that reduce outdoor irrigation demand can significantly reduce the water lost to evapotranspiration. This offset mitigates withdrawals from the basin and consequent risk of groundwater overdraft. Similar to improving irrigation efficiency, this strategy reduces applied water and losses to ET which reduces the addition and recirculation of salt.

7.2.4 Wastewater/Source Control and Infrastructure Improvements

Municipal wastewater discharges and irrigation return flows contain elevated concentrations of salts and nutrients and comprise a significant source of them for the Coachella Valley Groundwater Basins. Developing sewer infrastructure, expanding wastewater treatment plants, controlling additions of salts to wastewater, and improving management practices can help mitigate potential impacts to beneficial uses of the groundwater.

Septic to Sewer Conversion or Enhanced Septic Systems

Several residential areas within the Coachella Valley are largely dependent on septic systems for their wastewater disposal. These areas are Cathedral City Cove, City of Desert Hot Springs, Indio Hills/Sky Valley, Rancho Mirage, Thousand Palms, areas of Mecca Hills, and portions of Mission Creek.

Septic systems are a significant, documented source of nitrate to the groundwater basin. The RWQCB has adopted septic tank prohibitions in areas of where high septic tank density has caused water quality degradation. Conversion from septic systems to sewer can offset a large proportion of this existing nitrate source to the basin. Additionally, for areas where sewer conversion is not feasible due to economic or physical constraints, the use of enhanced septic technologies can provide additional nitrate removal; the EPA Environmental Technology Verification Program's Water Quality Protection Center provides several septic technology alternatives for enhanced nutrient reduction. Enhanced septic systems that achieve greater nutrient removal can be recommended for areas where connection to the sewer system is not feasible due to economic or physical constraints.

Agricultural Drain System

As discussed in **Section 4**, a large portion of the East Whitewater River MZ is underlain by shallow fine-grained sediments that impede vertical drainage. This causes waterlogged soils and salt accumulation in root zone that impacts agricultural production. The first subsurface tile drainage systems were installed in 1950. From the early 1950s through the 1970s, CVWD constructed more than 187 miles of open channel and pipe drains and farmers constructed nearly 2,300 miles of shallower tile drains. Today, about 37,400 acres of land have tile drains. Most of the drains empty into the CVSC; however, 25 smaller open channel drains at the southern end of the Coachella Valley discharge directly to the Salton Sea. These drains are the principal mechanism for exporting salt from the groundwater basin.

Because most of the original drainage system was constructed more than 50 years ago, it is approaching the end of its useful life. Significant maintenance and replacement will be required. The anticipated transition of land use from agriculture to urban will not eliminate this need because the underlying fine-grained sediments continue to impede the percolation of irrigation water. As development occurs in locations susceptible to shallow perched groundwater, the existing drainage system will need to be replaced and new drains constructed to control the shallow groundwater. The cost to construct and maintain these replacement drainage systems will need to be considered as development occurs. Funding sources will be needed to replace, expand, enhance and maintain the system for urban development in the future. CVWD is evaluating alternative methods for funding the drainage system and will undertake a study of the improvements needed to continue system operation in the future.

Actions have been taken and are planned to be taken over the next 35 years to halt overdraft and manage the Whitewater River basin in a sustainable manner. CVWD and DWA have made significant investments to acquire additional water supplies that put the Valley on a path toward sustainability. Long-term groundwater levels will increase; as they do drain flows will also increase. These increased drain flow will remove significant amounts of salt from the East Whitewater River MZ.

<u>Maintenance of Groundwater Levels</u>

A related component to the agricultural drainage system is the need to maintain adequate upward groundwater gradient to minimize the deep percolation of saline irrigation return flow within the semi-perched aquifer area. To achieve this gradient, a positive groundwater balance is needed where inflow exceeds outflow (including drain flow).

Recycled Water on Turf for Nitrogen Uptake

The Colorado River Basin Region currently has a general waste discharge permit (Order No. 97-700) for discharge of recycled water for golf course and landscape irrigation. The general permit is intended to streamline the permitting process and encourage recycled water use in the region, including the Coachella Valley.

Currently, recycled water is delivered to golf courses and parks near the wastewater plants. Recycled water is fully used from spring through fall, but may be percolated in winter months when demand is low.

A significant portion of wastewater effluent within East Whitewater River Management Zone is currently discharged to the CVSC, but will need to be used as recycled water as demands increase. Reuse in this case will increase salt and nutrient load to the groundwater because effluent is currently discharged to the Salton Sea. Increased recycled water use in this management zone will send a portion of this salt and nutrient back to the groundwater, the remainder will still discharge to the Salton Sea for irrigation that occurs on land overlying the drain system.

A study conducted by Wu *et al.* (2007) examining nitrogen uptake in golf course turfgrass concluded that “average nitrate concentration of the leachate was lower than that of the irrigation water in five out of the six seasons, implying that if turfgrass is properly managed, it may provide an opportunity to mitigate nitrate loading to surface and ground waters, even when [nitrogen] application rate is high." If use of recycled water is maximized to reduce or eliminate percolation of wastewater, this source of nitrate to the groundwater can potentially be reduced.

Wastewater Treatment Upgrades

Wastewater treatment processes that target nutrient removal can contribute to improved water quality by providing additional removal of nitrogen and other nutrients in effluent wastewater. Specifically for nitrogen, aeration basins can be designed to achieve nitrification and de-nitrification of wastewater. A summary of existing wastewater treatment plants in the Coachella Valley SNMP planning area is summarized in **Table 7-2** below.

Table 7-2
Wastewater Treatment Plants in the Coachella Valley by Operator

Operator	Facility	Treatment	Discharge
CSD	CSD	Secondary*	CVSC
CVWD	WRP 4	Secondary*	CVSC
	WRP 7	Secondary	Percolation
		Tertiary	Recycled
	WRP 9	Secondary*	Percolation, Recycled
	WRP 10	Secondary	Percolation
		Tertiary	Recycled
DWA	DWA	Tertiary	Recycled
MSWD	Alan Horton	Secondary	Percolation
	Desert Crest	Secondary	Percolation
	MSWD Regional WWTP**	Secondary	Percolation
Palm Springs, City of	Palm Springs	Secondary	Percolation, DWA Tertiary
VSD	VSD	Secondary*	CVSC

* Disinfected secondary
** Planned, not currently in service
CVSC = Coachella Valley Stormwater Channel

Regulation of Self-regenerating Water Softeners

A preventable source of salts to the basin is the use of self-regenerating water softeners (SRWS). SRWS use an ion-exchange media to replace calcium and magnesium that contribute to hardness in water, with sodium and/or potassium. To regenerate the sodium and/or potassium, a SRWS is flushed with a saline solution to flush the calcium/magnesium ions from the media. The salt added through the use of SWRS enters the sewer system and returns to the groundwater basin through percolation ponds after waste treatment or through irrigation of recycled water. In some regions of the state, prohibitions on the installation/sale of SRWS have been implemented to manage salt addition to the wastewater stream.

To understand the impact of SRWS use in the Basin, it is recommended that agencies work with home improvement stores in the region to document salt sales in order to quantify the additional mass of salt introduced through their use.

Fertilizer Application Optimization

Fertilizers containing nitrogen are a known source of nitrate to the groundwater basin. The application of water on fertilized soils can mobilize nutrients into the groundwater basin through deep percolation. Fertilizer requirements depend on many factors including crop type, soil characteristics, and source water. A firm understanding of all these factors together can yield potential reductions in fertilization. The use of recycled water that contains higher concentrations of nutrients can reduce the reliance on fertilizers as the nutrient source to a particular crop, resulting in reduced importation of nutrients to the groundwater basin. It is recommended recycled water agencies communicate the nutrient loads of their recycled water supplies to their users and the users incorporate these nutrient loads when determining the need for fertilizer applications.

Brine Disposal

Construction of a regional brine disposal pipeline or brine recovery facilities would be required if desalination treatment is implemented to manage salt loads in imported water or to produce desalinated drain water. No studies have been conducted to evaluate the feasibility of constructing a regional brine line or the ultimate disposal of either brine or salt residues from brine recovery. It is recommended that a brine disposal feasibility study be conducted in conjunction with any future evaluations of desalination.

7.2.5 Stormwater Management

Stormwater capture has been identified as a potential method to augment local water supplies in the Coachella Valley. Generally, stormwater has a relatively low TDS making capture a good approach for reducing salinity.

The Coachella Valley drainage area is approximately 65 percent mountainous and 35 percent typical desert valley with alluvial fan topography buffering the valley floor from the steep mountain slopes. The mean annual precipitation ranges from 44 inches in the San Bernardino Mountains to less than 3 inches at the Salton Sea. Three types of storms produce precipitation in the drainage area: general winter storms, general summer storms and local thunderstorms. Longer duration, lower intensity rainfall events tend to have higher recharge rates, but runoff and flash flooding can result from all three types of storms. Otherwise, there is little or no flow in most of the streams in the drainage area (CVWD, 2012a).

Excerpts from the Whitewater River Watershed Annual Progress Report (County *et al.*, 2015) state:

TDS concentrations were measured above the RL in all five wet weather samples collected at the three MS4 outfall stations, ranging from 140 mg/L to 360 mg/L. The low flow sampled at the Portola Avenue Storm Drain MS4 outfall station (0.85 cfs) likely evaporated and/or infiltrated without impacting the intermittent beneficial uses of the receiving water…

Sampled wet weather flows at the Avenue 52 Storm Drain MS4 outfall station may have been sufficient to reach flows observed in the CVSC receiving water. TDS concentrations were measured above the RL in both wet weather samples collected at the CVSC at Avenue 52 Bridge receiving water station (640 and 800 mg/L). The receiving water station is located upstream of the MS4 outfall station and characterizes background conditions in the CVSC. TDS concentrations at the receiving water station were greater than detected at the MS4 outfall station.

Concentrations of nitrate collected during wet weather at the three MS4 outfall stations were above the RL, with concentrations ranging from 1.1 to 4.3 mg/L. The result for the May 22, 2014 dry weather event at the Avenue 52 Storm Drain MS4 outfall station was calculated for nitrate as N (4.07 mg/L) from the laboratory reported value for nitrate as NO3 (18 mg/L) using the methodology defined by the California Division of Drinking Water (California Department of Health, 2014). The low flow sampled at the Portola Avenue Storm Drain MS4 outfall station (0.85 cfs) likely evaporated and/or infiltrated without impacting the intermittent beneficial uses of the receiving water...

Nitrate was detected above the RL in both wet weather samples collected at the CVSC at Avenue 52 Bridge receiving water station (4.3 and 3.61 mg/L). The result for the May 22, 2014 wet weather event was calculated for nitrate as N (3.61 mg/L) from the laboratory reported value for nitrate as NO3 (16 mg/L) using the methodology defined by the California Division of Drinking Water (California Department of Health, 2014). The receiving water station is located upstream of the MS4 outfall station and characterizes background conditions in the CVSC. Sampled wet weather flows at the Avenue 52 Storm Drain MS4 outfall station may have been sufficient to reach flows observed in the CVSC receiving water. Nitrate results were similar at the two monitoring stations.

The majority of stormwater currently discharges to the Salt Sea via the CVSC. Although not identified as a substantial potential component to augment groundwater supplies in the Coachella Valley, stormwater capture projects are recommended through the implementation of Low Impact Development (LID) features in all new and planned developments throughout the region. Flood management projects should also evaluate the potential for stormwater capture throughout the Coachella Valley.

7.2.6 Planned Projects

A list of planned projects identified by the stakeholders, projects identified in the IRWM process, and projects submitted by the CVRWMG are summarized in **Appendix H**. Included in **Appendix H** for each project are the potential effects a particular project may have on salt and nutrient loading in the SNMP planning area.

Section 8
Monitoring Plan

Per the Policy, each SNMP shall include a basin/sub-basin wide monitoring plan that includes an appropriate network of monitoring locations. The plan is to be adequate to provide a reasonable, cost-effective means of determining whether the concentrations of salt, nutrients, and other constituents of concern, as identified in the salt and nutrient plan, are consistent with applicable WQOs. The policy also specifies that the monitoring plan shall:

- Focus on basin water quality near water supply wells and areas proximate to large water recycling projects, particularly groundwater recharge projects.
- Where appropriate, target groundwater and surface waters where groundwater has connectivity with adjacent surface waters.
- Target the collection of samples from existing wells if feasible as long as the existing wells are located appropriately to determine water quality throughout the most critical areas of the MZ.
- Identify stakeholders responsible for conducting, compiling, and reporting the monitoring data.

A significant effort currently is in place to track water quality relative to applicable WQOs. This section describes existing monitoring efforts, actions that may be implemented to enhance monitoring and eliminate data gaps, and provides recommendations to enhance the current monitoring program to meet and exceed the policy requirements.

8.1 PURPOSE OF THE MONITORING PLAN

The primary objective of the monitoring program is to guide the reasonable and adequate collection of groundwater and surface water information to determine water quality in the MZs. The monitoring plan identifies existing and new monitoring locations to be used to collect data to characterize groundwater quality. Recommendations are made regarding the additional data to be collected and the frequency of monitoring. The purpose of the data collection is to compile information to:

- Provide monitoring guidance to characterize future groundwater level and quality conditions throughout the MZs
- Identify and evaluate vertical and horizontal variations in water quality particularly with respect to constituents of concern (TDS and nitrates)
- Improve the understanding of the water balance in the MZs, including return flows to the MZs

- Provide the framework for evaluating future groundwater management actions in the basin
- Assess progress toward meeting MZ WQOs
- Comply with state laws and regulations

8.2 CONSTITUENTS FOR MONITORING

The program should include monitoring of: TDS and nitrate. Constituents of emerging concern (CECs; e.g., endocrine disrupters, personal care products or pharmaceuticals) and other constituents may be added to the monitoring program in consideration of the amendment to the Policy and its recommendations for monitoring CECs in recycled water. The Policy does not designate CEC monitoring requirements for recycled water used for landscape irrigation due to the low risk for ingestion of the water. All current and planned recycled water projects within the Coachella Valley are irrigation projects. The CEC monitoring requirements prescribed in the Policy are for groundwater recharge of recycled water projects.

8.3 CURRENT MONITORING

This section summarizes current groundwater monitoring efforts across the management zones. Groundwater monitoring consists of both water level and water quality measurements. Due to the level of assessment, well construction information is often required to characterize individual aquifer water quality (within the West Whitewater River and East Whitewater River MZs.) Monitoring is performed by multiple agencies and varies in availability and quality both spatially and temporally. Table 1 in **Appendix I** lists the existing groundwater level and quality monitoring efforts across the management zones. The table lists the State well number, alternate identification number, owner, responsible party of monitoring, and management zone. Wells in this table all have well construction information that is known. Table 2 lists currently monitored wells that do not have well construction information. These wells assist in characterizing the water quality in the region, but would be more valuable if well construction information were known such that the vertical profile and individual aquifer can be characterized. Other wells may be monitored within the valley but their records may not be recorded electronically, their locations may not be documented, or they have no record of TDS or nitrate sampling.

8.3.1 Groundwater Levels

Groundwater level changes provide a direct indication of changes in groundwater storage within the study area. Storage is used to determine the volume-weighted ambient water quality. In accordance with this amendment to the Water Code, DWR developed the California Statewide Groundwater Elevation Monitoring (CASGEM) program. The intent of the CASGEM program is to establish a permanent, locally-managed program of regular and systematic monitoring in all of California's alluvial groundwater basins, monitoring levels at non-potable water production wells.

CVWD and MSWD have been designated as monitoring entities for their respective portions of the Desert Hot Springs and Mission Creek subbasins; CVWD has been designated as the monitoring entity for the CVWD portion of the Whitewater River (Indio) Subbasin, excluding the IWA and CWA service areas, while DWA has received conditional designation for the DWA portion of the Whitewater River (Indio) Subbasin.

CVWD has monitored water levels for over 300 public and private wells in its service area three times per year on a rotating basis (approximately four month interval). These data are stored in a database and are plotted as hydrographs. Other agencies monitor groundwater levels in their own wells but these data are not collated in a central location. CVWD and MSWD monitor groundwater levels in wells within the study area. Ten wells are monitoring in Desert Hot Springs Subbasin, 22 wells are monitored in the Mission Creek subbasin and six wells are monitored in the Garnet Hill Subbasin. MSWD monitoring is limited to District wells with levels taken monthly.

8.3.2 Groundwater Quality

Groundwater quality monitoring is performed by a number of agencies in the Coachella Valley. Water purveyors are required by State Law to monitor and report the quality of their water sources. Reporting of delivered water quality is done through annual consumer confidence reports provided to each customer. Water quality results are also reported to the SWRCB Division of Drinking Water and are publicly available on the SWRCB's Groundwater Ambient Monitoring and Assessment Program (GAMA) website. Tribes monitor the quality of their wells and maintain records; however, these data are not publicly available for all tribes.

In accordance with current SWRCB monitoring schedules, water purveyors are required to monitor water quality for physical constituents, general minerals, metals, radiological constituents and regulated organic compounds at least once every three years and annually for nitrate. If previous analyses demonstrate that the quality is near or exceeds the MCL for any constituent, then more frequent monitoring may be required. For example, MSWD is required to monitor Well 34 monthly for uranium. If monitoring consistently shows results that are significantly below the pertinent MCL, then monitoring frequency may be reduced or waived at the discretion of SWRCB. MSWD also samples its wells on a monthly basis for temperature, pH and TDS when taking water level readings.

Small water systems sample less frequently depending on the level of constituents compared to the MCL. Private wells are not typically monitored on a routine basis; however, CVWD monitors several wells in the Mission Creek MZ, Garnet Hill MZ, and numerous in the West and East Whitewater River MZs; CVWD also samples wells in the Garnet Hill MZ and the MZs in Desert Hot Springs Subbasin.

This level of monitoring is sufficient under existing regulatory guidelines to ensure that the public is provided with a safe and reliable drinking water supply. However, additional water quality monitoring would be useful for assessing quality changes over time and ambient water quality within MZs.

Vertical Distribution of Groundwater Quality Data

Groundwater quality can vary by both well location and depth. The extent to which wells can be classified by depth is a function of available perforated interval data and distinct zone or aquifer sampling. Typically, production wells are perforated in aquifer zones that are expected to provide the best production rates and water quality. Zones of known poor water quality are usually avoided. Wells are not usually perforated within distinct aquifers; instead, they may be perforated across multiple aquifer zones. This results in a pumped water quality that is a blend of the waters from each aquifer zone or perforated interval. In the absence of sampling from distinct aquifer zones, water quality classification by depth is difficult.

Well screen intervals may allow an evaluation of water quality with depth. Based on a review of available well data as summarized in **Appendix I**, about one-third of all wells with water quality data in the last five years have unknown screened intervals. As discussed above, many wells with known screened intervals are perforated across multiple zones, making classification by aquifer difficult.

When possible, wells in close proximity are used to evaluate vertical water quality trends. Nested and clustered wells are ideal for this analysis. Nested wells consist of either a series of wells that are closely spaced so as to provide data from different vertical zones in close proximity to each other (clustered) or multiple wells that are constructed in a single borehole (nested). Wells of this design are used to provide samples from different zones of an aquifer(s) in the same manner as individual wells. Currently there are several nested wells constructed throughout the Coachella Valley, these wells are shown on **Figure 5-11** and listed in **Table 5-14**. These current wells are very important for salt and nutrient characterization. When provided the opportunity to construct new wells of this type, it is recommended particularly in MZs where no such wells exist. Although due to the cost associated with well construction, no new nested wells should be constructed unless associated with a project and would have other benefits as well.

8.4 DATA GAPS

Data gaps limit the ability to adequately characterize groundwater quality both spatially and vertically. The objective of this plan is to ensure portions of each MZ where there are recycled water projects, water supply wells, or areas that will improve the understanding of a MZ has monitoring prescribed. Data gaps in these areas are discussed below and summarized in **Table 8-1**.

Table 8-1
Data Gaps by Management Zone

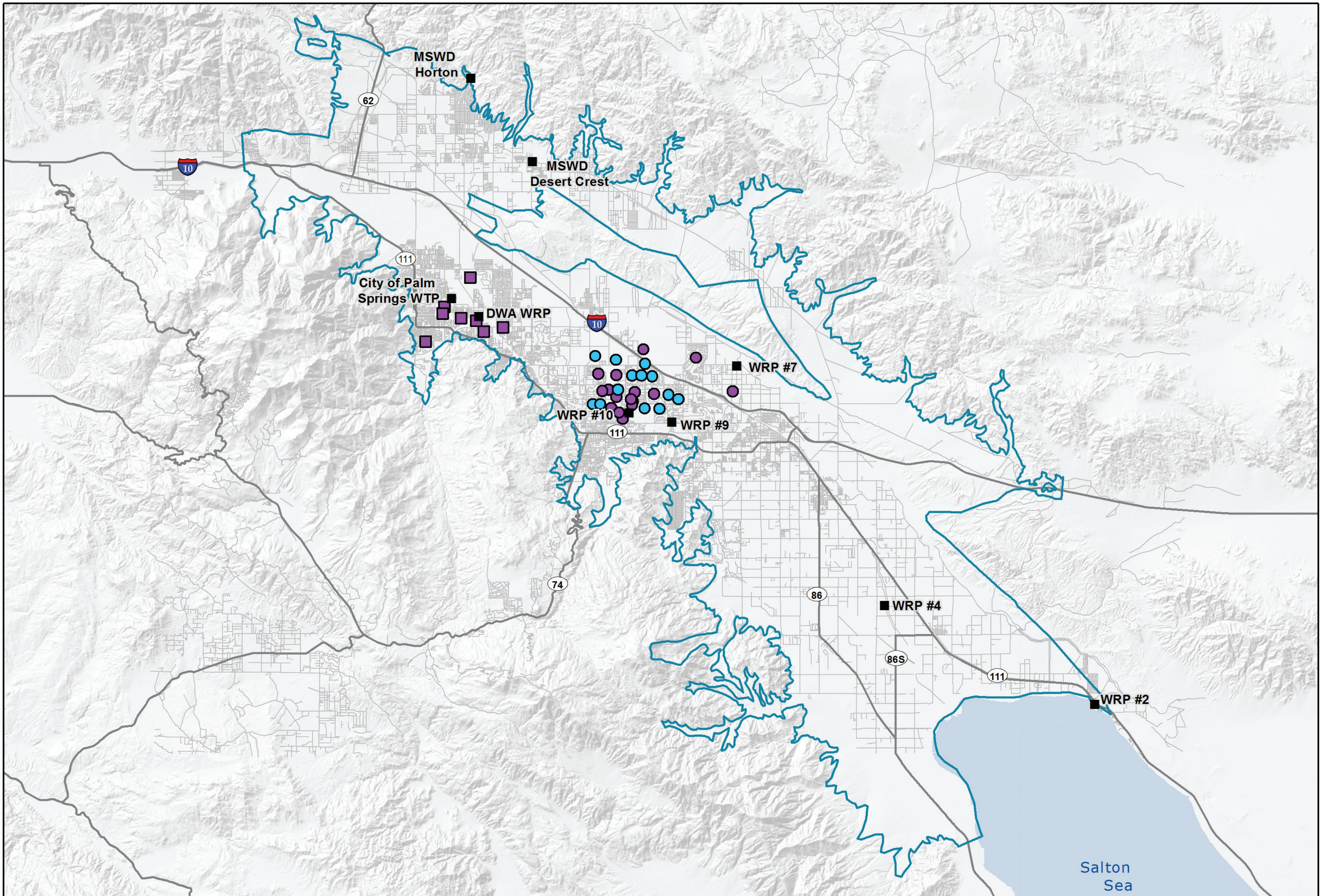
Management Zone	Data Gaps
West Whitewater River	Shallow data in northern portion of MZ, northern Cathedral City and northern Palm Springs, within I-10 corridor, Thousand Palms area (limited by conservation and preservation areas)
East Whitewater River	East of Grapefruit Blvd and north 66th Ave., deeper areas east of Grapefruit Blvd, the Oasis subarea: west of Harrison St. and south of 74th Ave. The semi-perched aquifer/shallow groundwater data
Mission Creek	Vertical water quality data, spatially distributed data across the MZ, west of N. Indian Canyon Dr., evaluate existing non-monitored wells for construction information/vertical water quality profile
Garnet Hill	Vertical water quality data, spatially distributed data across the MZ (recycled water projects and pumping for supply are limited)
Desert Hot Springs	Vertical water quality data, spatially distributed data across the MZ (recycled water projects and pumping for supply are limited)

In general, groundwater levels and quality is well characterized where there are recycled water projects and potable water supply wells in the West Whitewater River and East Whitewater River MZs. Recycled water projects are illustrated on **Figure 8-1**.

Groundwater quality data is sparse for the Garnet Hill, Miracle Hill, Sky Valley, Fargo Canyon MZs, and the semi-perched aquifer in the East Whitewater River MZ, because groundwater supply wells are limited. There are no recycled water projects in these MZs. Most of the groundwater quality in Mission Creek Subbasin comes from wells in the southeast portion of the MZ where there is more pumping for potable supply. Essentially no data exists in the southwestern portion of the MZ.

As noted earlier in the report, there are very few shallow wells that penetrate the semi-perched aquifer in the East Whitewater River MZ. Based on drain flow water quality, if this aquifer could be characterized with groundwater quality measurements, it would likely increase the AWQ. Any opportunities to better characterize the semi-perched aquifer should be employed to more accurately determine the AWQ.

Groundwater level data availability is generally sufficient to characterize the water table and subsequently the volume of groundwater in storage. Data gaps include southeast Whitewater River MZ, close to the Salton Sea, the northwestern portion of the Mission Creek MZ, and most area within the MZs contained in the Desert Hot Springs subbasin.



Key to Features

- Highway
- Local Roads
- Groundwater Subbasin
- CVWD Existing Recycled Water Projects
- CVWD Future Potential Recycled Water Projects
- DWA Existing Recycled Water Projects
- Wastewater Treatment / Reclamation Plant

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Date: Apriil 23, 2015

Recycled Water Projects

MWH

Figure 8-1

8.5 FUTURE GROUNDWATER MONITORING

CVWD has installed a number of monitoring wells over the past 15 years. Two nested monitoring wells were constructed near the Salton Sea to monitor changes in water levels and water quality for potential indications of saline intrusion into the production aquifers. A monitoring well network was constructed in conjunction with the Martinez Canyon Demonstration Recharge projects and the Thomas E. Levy Groundwater Replenishment Facility. CVWD, DWA and USGS installed and maintain monitoring wells near the Whitewater Recharge Facility. DWA constructed a monitoring well near the Mission Creek Recharge Facility.

Based on review of existing wells and the distribution of currently monitored wells, a list of prospective additional wells has been identified that could be included in the groundwater level monitoring program as shown in **Figure 5-11**. **Table 8-2** also lists existing wells that could be monitored or used to track water quality adjacent to existing recycled water projects. **Figure 8-2** illustrates the location of current and potential monitoring wells in the Coachella Valley. Because the status and physical condition of some of these wells are unknown, it is recommended that these wells be evaluated for suitability for inclusion in the monitoring program. Evaluation would include a site survey and video survey (if well construction information is not known). The intent of this list is to meet the policy requirements while utilizing existing wells.

Monitoring of additional private wells in the Mission Creek MZ located west of North Indian Canyon Ave. and south of Pierson Blvd. and in the portion of the MZ west of SR 62 would improve the understanding of groundwater flow and the effects of natural recharge in this portion of the MZ. Additional monitoring wells near the Mission Creek Spreading Basin would provide better information on the movement of recharge water and may help determine whether the observed mounding is the result of a subsurface geologic feature (such as faulting or offset in the basement rocks), a change in the permeability or storage changes. Wells south of MSWD Well 35 used to supply CPV Sentinel Power Plant with cooling water could be sampled for additional water quality data. A well was also constructed drilled west of highway 62 (at Pearson Street) that would provide data in an area that is currently lacking.

Selection or installation of additional monitoring wells in the Garnet Hill subbasin would provide a better picture of water level changes within this subbasin. But, if monitoring were limited to the existing MSWD production well, it would meet the requirements of the Policy. It should be noted that this area also has the constraints of conservation and special provision areas, limiting locations for monitoring.

Table 8-2
List of Potential Wells For Monitoring

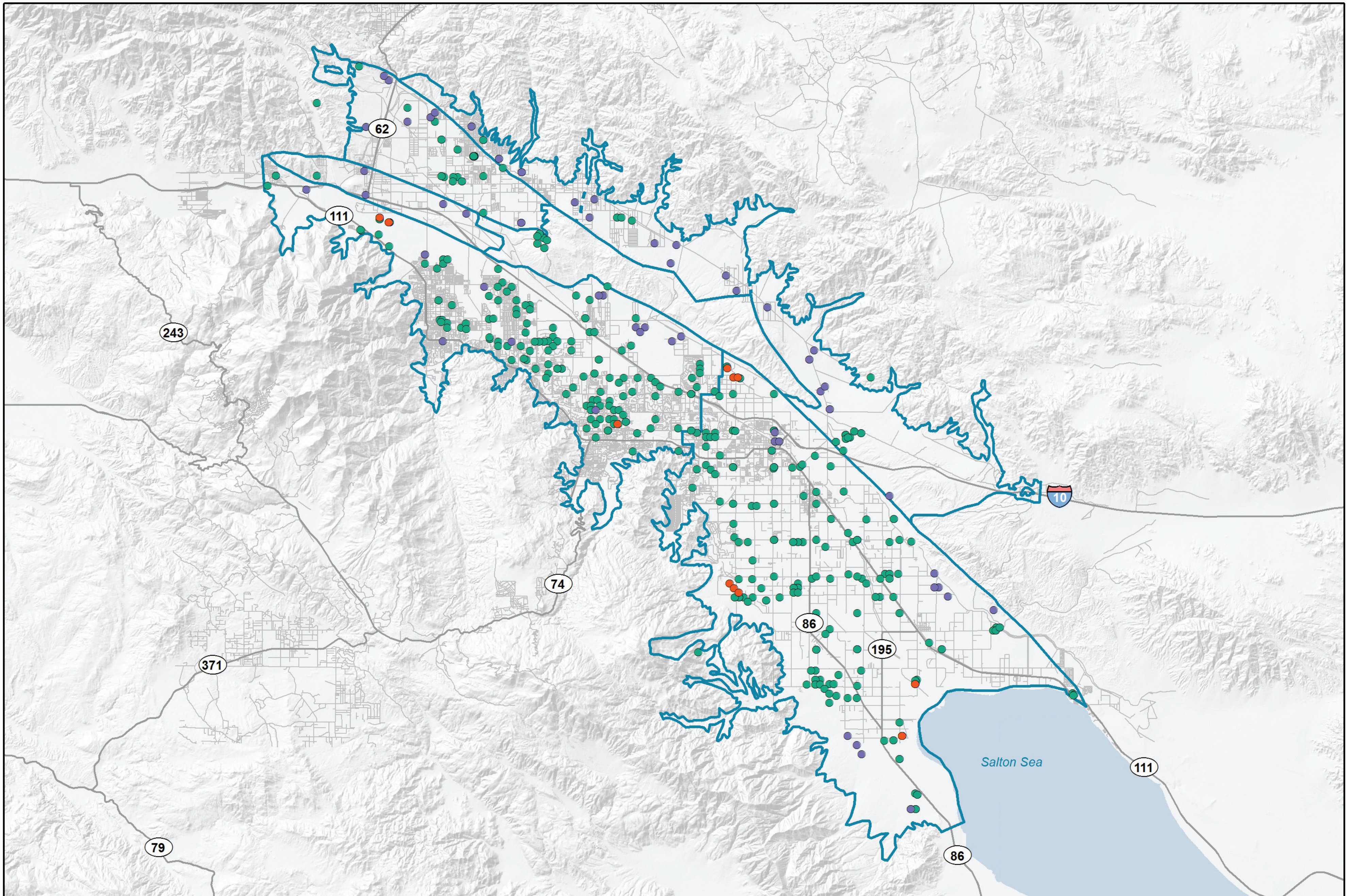
Management Zone	State Well No.	Owner	Status	Purpose	Comment
W. Whitewater River	03S03E10P01S	Unknown	Last monitored 2004, screened 476-776 ft bgs	Fill data gap west of recharge area	Screened in multiple layers, western-most known well with construction data and water quality
W. Whitewater River	04S04E26A01S	DWA	Actively monitored well, screened 450-780 ft bgs	Adjacent to a recycled water project	Did not fit into ambient water quality layering, but consturction data is available
W. Whitewater River	04S05E28B01S	Hillsboro Prop	Actively monitored well, screened 300-500 ft bgs	Adjacent to a recycled water project	Did not fit into ambient water quality layering, but consturction data is available
W. Whitewater River	05S06E08P02S	George Combs	Not actively monitored, screened 80-164 ft bgs	Shallow aquifer characterization and adjacent to recycled water projects	
W. Whitewater River	04S06E08K01S	Desert Moon Ranch	Not actively monitored, screened ?-716 ft bgs	Fill data gap for West Whitewater River MZ (northwest Thousand Palms Subarea)	
W. Whitewater River	04S06E08L01S	Clark	Not actively monitored, screened ?-402 ft bgs	Fill data gap for West Whitewater River MZ (northwest Thousand Palms Subarea)	
W. Whitewater River	04S06E22H02S	Fred Halstead	Not actively monitored, screened 232-352 ft bgs	Fill data gap for West Whitewater River MZ (central Thousand Palms Subarea)	
W. Whitewater River	04S06E22F01S	Lewis Kingsley	Not actively monitored, screened 360-800 ft bgs	Fill data gap for West Whitewater River MZ (central Thousand Palms Subarea)	
W. Whitewater River	04S06E22K01S	G. G. Hittson	Not actively monitored, screened 150-495 ft bgs	Fill data gap for West Whitewater River MZ (central Thousand Palms Subarea)	
W. Whitewater River	04S06E24R01S	Dan Patrick	Not actively monitored, screened 160-304 ft bgs	Fill data gap for West Whitewater River MZ (southeast Thousand Palms Subarea)	
W. Whitewater River	04S06E25C01S	Dr Bruce Merrill	Not actively monitored, screened 203-605 ft bgs	Fill data gap for West Whitewater River MZ (southeast Thousand Palms Subarea)	
W. Whitewater River	04S05E08D01S	CVWD	Actively monitored well, screened 500-900 ft bgs	Fill data gap north of Cathedral City	Did not fit into ambient water quality layering, but consturction data is available
W. Whitewater River	03S04E34H02S	CVWD	Actively monitored well, screened 600-1,000 ft bgs	Fill data gap in northern Palm Springs	Did not fit into ambient water quality layering, but consturction data is available
W. Whitewater River	03S04E34H01S	CVWD	Actively monitored well, screened 900-1,100 ft bgs	Fill data gap in northern Palm Springs	Did not fit into ambient water quality layering, but consturction data is available
E. Whitewater River	06S09E29R01S	Hillside - Mecca	Not actively monitored, screened 320-760 ft bgs	Fill data gap for East Whitewater MZ east of Grapefruit Blvd. and North of 66th Ave.	
E. Whitewater River	06S09E33M01S	Heggblade & Marguleas	Not actively monitored, screened 320-760 ft bgs	Fill data gap for East Whitewater MZ east of Grapefruit Blvd. and North of 66th Ave.	
E. Whitewater River	07S09E04B01S	John Reeder Jr.	Not actively monitored, screened 320-760 ft bgs	Fill data gap for East Whitewater MZ east of Grapefruit Blvd. and North of 66th Ave.	
E. Whitewater River	06S09E32J02S	I.K.I. Farms	Not actively monitored, screened 188-298 ft bgs	Shallow aquifer characterization and fill data gap east of Grapefruit Blvd. and North of 66th Ave.	
E. Whitewater River	07S09E01N01S	Oscar Ortega	Not actively monitored, screened 798-850 ft bgs	Deeper aquifer characterization and fill data gap east of Grapefruit Blvd.	
E. Whitewater River	05S07E24D01S	City of Indio	Not actively monitored, screened 171-339 ft bgs	Shallow aquifer characterization and fill data gap in Indio	
E. Whitewater River	05S07E24M02S	City of Indio	Not actively monitored, screened 190-410 ft bgs	Shallow aquifer characterization and fill data gap in Indio	
E. Whitewater River	05S07E24M04S	City of Indio	Not actively monitored, screened 250-660 ft bgs	Shallow to mid aquifer characterization and fill data gap in Indio	
E. Whitewater River	05S07E24L01S	City of Indio	Not actively monitored, screened 1,062-1,206 ft bgs	Deep aquifer characterization and fill data gap in Indio	
E. Whitewater River	05S07E24L02S	City of Indio	Not actively monitored, screened 208-500 ft bgs	Shallow to mid aquifer characterization and fill data gap in Indio	

Table 8-2
List of Potential Wells For Monitoring

Management Zone	State Well No.	Owner	Status	Purpose	Comment
E. Whitewater River	08S08E10N02S	Steve Buxton	Not actively monitored, screened 290-490 ft bgs	Fill data gap for East Whitewater MZ in Oasis Subarea	
E. Whitewater River	08S08E15G02S	Coachella Valley Citrus	Not actively monitored, screened 260-500 ft bgs	Fill data gap for East Whitewater MZ in Oasis Subarea	
E. Whitewater River	08S08E15R01S	Werner,Sterns	Not actively monitored, screened 200-440 ft bgs	Fill data gap for East Whitewater MZ in Oasis Subarea	
E. Whitewater River	08S09E31Q02S	CVWD	Actively monitored well, screened 300-450 ft bgs	Fill data gap for East Whitewater MZ in Oasis Subarea; near shallow well in southern Oasis Subarea	Did not fit into ambient water quality layering, but consturction data is available
Garnet Hill	03S04E14J01S	MSWD	No water quality data available, screened 360-650 ft bgs	Fill data gap for Garnet Hill MZ	
Garnet Hill	03S04E06Q01S	Unknown	Not actively monitored, screened 284-344 ft bgs	Fill data gap for Garnet Hill MZ (far west of MZ)	
Garnet Hill	03S04E18B01S	Unknown	Not actively monitored, screened 240-285 ft bgs	Fill data gap for Garnet Hill MZ (far west of MZ)	
Garnet Hill	03S05E19D01S	Hugo Spoentgen	Not actively monitored, screened ?-40? ft bgs	Fill data gap for Garnet Hill MZ (east of MZ near Mission Creek Subbasin)	
Mission Creek	02S04E28A01S	D.R.Horton	Not actively monitored, screened 550-980 ft bgs	Fill data gap for Mission Creek MZ (west of Indian Canyon Ave. and downstream of recharge)	
Mission Creek	02S04E23N01S	Wendell West Corporation	Not actively monitored, screened 526-830 ft bgs	Fill data gap for Mission Creek MZ (west of Indian Canyon Ave. and downstream of recharge)	
Mission Creek	02S04E23N02S	MSWD	Not actively monitored, screened 640-1,080 ft bgs	Fill data gap for Mission Creek MZ (west of Indian Canyon Ave. and downstream of recharge)	
Mission Creek	02S04E23L01S	Desert H.S.	Not actively monitored, screened 636-836 ft bgs	Fill data gap for Mission Creek MZ (west of Indian Canyon Ave. and downstream of recharge)	
Mission Creek	02S04E30G01S	Dr Jeanne Johnson	Not actively monitored, screened 205-315 ft bgs	Fill data gap for Mission Creek MZ (far west of MZ)	
Mission Creek	02S04E08R01S	Will Claiborne	Not actively monitored, screened 875-1,000 ft bgs	Fill data gap for Mission Creek MZ (far west of MZ and deep aquifer characterization)	
Mission Creek	02S04E08K02S	Roland Bates	Not actively monitored, screened ?-325 ft bgs	Fill data gap for Mission Creek MZ (far west of MZ and shallow aquifer characterization)	
Mission Creek	03S05E22M09S	Keith Mcgraw	Not actively monitored, screened 230-300 ft bgs	Group of wells to help characterize vertical water quality	
Mission Creek	03S05E22M03S	Leon Mason	Not actively monitored, screened 55-100 ft bgs	Group of wells to help characterize vertical water quality	
Mission Creek	03S05E22M04S	Tom Svenneby	Not actively monitored, screened 120-180 ft bgs	Group of wells to help characterize vertical water quality	
Miracle Hill	03S05E03N01S	Unknown	Not actively monitored, screened 136-262 ft bgs	Group of wells to help characterize vertical water quality	
Miracle Hill	03S05E03N02S	Unknown	Not actively monitored, screened 302-402 ft bgs	Group of wells to help characterize vertical water quality	
Miracle Hill	03S05E03N03S	Sandra Kirsner	Not actively monitored, screened 430-500 ft bgs	Group of wells to help characterize vertical water quality	
Miracle Hill	02S05E30F06S	Unique Construction	Not actively monitored, screened 282-450 ft bgs	Fill data gap for Miracle Hill MZ	

Table 8-2
List of Potential Wells For Monitoring

Management Zone	State Well No.	Owner	Status	Purpose	Comment
Miracle Hill	02S05E30F01S	L.W. Coffee	Not actively monitored, screened 195-285 ft bgs	Fill data gap for Miracle Hill MZ	
Miracle Hill	03S05E05A06S	Mr. Harold Reed	Not actively monitored, screened 70-129 ft bgs	Fill data gap for Miracle Hill MZ	
Miracle Hill	03S05E05A04S	Unknown	Not actively monitored, screened 110-200 ft bgs	Fill data gap for Miracle Hill MZ	
Sky Valley	03S06E26P01S	M. J. Grieshaber	Not actively monitored, screened 204-310 ft bgs	Fill data gap for Sky Valley MZ (central MZ)	
Sky Valley	03S06E25Q01S	Steven Honig	Not actively monitored, screened 371-511 ft bgs	Fill data gap for Sky Valley MZ (central MZ)	
Sky Valley	03S06E36P01S	Newman Windmill Well	Not actively monitored, screened 201-213 ft bgs	Fill data gap for Sky Valley MZ (central MZ)	
Sky Valley	04S07E04L01S	Barnett	Not actively monitored, screened ?-432 ft bgs	Fill data gap for Sky Valley MZ (east MZ)	
Sky Valley	04S07E09H01S	Tom Evans	Not actively monitored, screened 355-399 ft bgs	Fill data gap for Sky Valley MZ (east MZ)	
Sky Valley	03S06E18M02S	Lawrence James Maira	Not actively monitored, screened ?-120 ft bgs	Fill data gap for Sky Valley MZ (west MZ) and shallow aquifer characterization	
Sky Valley	03S06E19H01S	Rainbow Home For Children	Not actively monitored, screened 375-500 ft bgs	Fill data gap for Sky Valley MZ (west MZ)	
Sky Valley	03S06E17E01S	Fun Valley Water Co	Not actively monitored, screened 477-518 ft bgs	Fill data gap for Sky Valley MZ (west MZ)	
Fargo Canyon	04S07E14G01S	Dallke	Not actively monitored, screened 400-600 ft bgs	Fill data gap for Fargo Canyon MZ (far west MZ)	
Fargo Canyon	04S08E29M01S	Valley Rock And Sand	Not actively monitored, screened 450-650 ft bgs	Fill data gap for Fargo Canyon MZ (west MZ)	
Fargo Canyon	04S08E31A01S	James E. Simon Co Inc.	Not actively monitored, screened 250-500 ft bgs	Group of wells to help characterize vertical water quality	
Fargo Canyon	04S08E31A03S	James E. Simon	Not actively monitored, screened 380-620 ft bgs	Group of wells to help characterize vertical water quality	
Fargo Canyon	05S08E05Q01S	Robert Fischer	Not actively monitored, screened 280-464 ft bgs	Group of wells to help characterize vertical water quality	
Fargo Canyon	05S08E05J01S	Silas Stanley	Not actively monitored, screened 120-192 ft bgs	Group of wells to help characterize vertical water quality	
Fargo Canyon	05S08E09N01S	F.L.Merrifield Deceased	Not actively monitored, screened 26-216 ft bgs	Group of wells to help characterize vertical water quality	
Fargo Canyon	05S08E09N03S	Jamie Brack	Not actively monitored, screened 480-580 ft bgs	Group of wells to help characterize vertical water quality	
Fargo Canyon	06S08E01L01S	Cardinal Distributing Co.	Not actively monitored, screened 300-400 ft bgs	Fill data gap for Fargo Canyon MZ (far east MZ)	



Key to Features

Management Zone

Highway

Local Roads

Monitoring Wells for Vertical Water Quality

Potential well to monitor

Water Quality within last 6 years (2008-2013)

N

0 5 10 Miles

Document: \\Usirv1s01\Projects\Coachella Valley WD\SNMP\GIS_files\NestedMWWells.mxd

Date: 6/5/2015

Current and Proposed Monitoring Wells in the Coachella Valley

MWH

Figure 8-2

In addition to selection of existing wells for improved distribution of water level measurements, it is recommended that some dedicated monitoring wells be established if feasible. Near the Mission Creek Spreading Basin, it is recommended that construction of at least two monitoring wells be considered near the Mission Creek channel between the existing monitoring well to a point roughly halfway between MSWD's Wells 34 and 30. Additional wells in this area would provide a better indication of the extent of mounding due to recharge operations and allow tracking of water quality changes to document the movement of imported recharge water in the aquifer.

Currently, all of the groundwater level data in the subbasin are collected manually. To collect more accurate water level data on a regular basis during both static and pumping conditions, it would be ideal for all production wells to have transducers and data loggers installed to measure the groundwater levels. It is recommended that existing and proposed monitoring wells near the Mission Creek Spreading Basins also have transducers and data loggers installed to allow for regular monitoring of groundwater levels. For phasing purposes, priority should be given to installing transducers and data loggers at the wells closer to the supply wells than those further away. Such data would be valuable for future groundwater model calibration.

Since the current monitoring programs are sufficient for regulatory compliance, no changes to collection frequency are recommended. More frequent monitoring of private wells for nitrate, TDS and general minerals would provide a better indication of water quality variations across each MZ, but at a significant cost. Consideration should be given to construction of nested monitoring wells when possible, or performing aquifer zone testing when new wells are constructed, to allow collection of water samples and aquifer parameters at varying depths.

8.6 DATA COLLECTION AND REPORTING

Collection of data without reporting limits the usefulness of the data. Periodic data analysis allows evaluation of the current plan's on-going ability to meet the water management objectives and provides the water agencies with information to adaptively adjust the management activities in response to changing conditions.

8.6.1 Data Management

Currently, each water agency maintains its own water resources database. These databases generally include groundwater production, water level and water quality data. CVWD maintains separate groundwater production, water level and water quality databases for wells that it monitors. Tribes maintain water data for their wells. However, no common database exists that would allow ready access to all data for the basin.

A water resources database should be developed for the Coachella Valley which will be used as a mechanism for data sharing among the participating water agencies and tribes. As a minimum, the database should be capable of storing well ownership data, well logs, groundwater production, water level and water quality data. The database should also be capable of interfacing with other outside database systems as needed for reporting and utilizing common data. The database should have suitable access control to keep some data, such as well logs, confidential where required by State law.

8.6.2 Reporting

A triennial (every three years) Coachella Valley SNMP Monitoring Report shall be prepared for submittal to the RWQCB, consistent with the Policy. The responsibility of this report will be determined by CVWD, DWA, and IWA. This report will include:

- A summary of relevant monitoring data, as described above, including TDS, nitrate (as NO3), arsenic, hexavalent chromium
- Nitrate and TDS trend analysis for each MZ at wells throughout the MZ and should include any nested wells.
- Discussion of CECs for any recharge project using recycled water
- An update on current on planned recycled water projects
- Statistical summary of water quality for each MZ
- Discussion of the statistical summary of water quality relative to WQOs
- Summary of change in groundwater storage in MZs that have applied the volume-weighted method of AWQ calculation
- Discussion of AWQ and proposed schedule for calculation update
- Review of the SNMP monitoring plan and applicable modifications

Section 9
CEQA/NEPA Compliance

This section summarizes how the recommended strategy conforms to California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) requirements.

9.1 ENVIRONMENTAL COMPLIANCE FOR THE SNMP

The goal of the SNMP is to identify a range of potential strategies for basin-wide management of salts and nutrients. The SNMP itself does not trigger CEQA compliance requirements, but a regulatory action such as a Basin Plan amendment would. Certification of a CEQA document for the SNMP is not anticipated to be required. Planning documents that are not formally adopted by an agency are guides to potential future activities; future activities adopted as projects by any stakeholders would be subject to CEQA review. Since preparation of the SNMP has no federal nexus at this time (i.e., funding for document preparation or federal approval of the SNMP), compliance under the NEPA is not required for SNMP preparation alone.

It is anticipated that implementation measures identified in the SNMP would be adopted by the RWQCB as amendments to the RWQCB's Basin Plan. The RWQCB's basin planning process is certified by the Secretary for Resources as "functionally equivalent" to CEQA, and therefore exempt from the requirement for preparation of an Environmental Impact Report (EIR) or Negative Declaration and Initial Study (14 Cal. Code Regs. §15251(g)). Instead, the RWQCB, as CEQA Lead Agency, would prepare a CEQA-equivalent document.

Any regulatory program of the RWQCB certified as functionally equivalent must satisfy the documentation requirements of Title 23, California Code of Regulations, Section 3777(a), which requires an Environmental Checklist with a description of the proposed activity, and a determination with respect to significant environmental impacts. The Environmental Checklist together with a written report would constitute the Substitute Environmental Documentation (SED) for the Basin Plan amendment. Minimally, the SED would contain: 1) a brief description of the proposed activity, 2) reasonable alternatives to the proposed activity, and 3) mitigation measures to minimize any significant adverse environmental impacts of the proposed activity (Pub. Resources Code §21080.5(d)(3)). Additionally, where the RWQCB is adopting a rule or regulation that requires the installation of pollution control equipment, establishes a performance standard, or establishes a treatment requirement, the RWQCB must prepare an environmental analysis of the reasonably foreseeable methods by which compliance with that rule or regulation will be achieved, including: 1) an analysis of the reasonably foreseeable environmental impacts of the methods of compliance; 2) an analysis of the reasonably foreseeable feasible mitigation measures; 3) an analysis of reasonably foreseeable alternative means of compliance with the rule or regulation, which would avoid or eliminate any identified impacts; and 4) the environmental analysis must take into account a reasonable range of environmental, economic and technical factors, population and geographic areas, and specific sites (Pub. Resources Code §21159; 14 Cal. Code Regs). If the RWQCB determines that no fair argument exists that the Basin Plan Amendment could result in significant adverse environmental impacts, the SED shall include a finding to that effect in lieu of the analysis of alternative methods of compliance and associated mitigation measures. A CEQA scoping meeting is also held to gain public and agency input on the content of the environmental document.

While the SED would be approved by the RWQCB, the Policy requires stakeholders to fund SNMP development including any necessary analysis and documentation to comply with CEQA.

9.2 FUTURE ENVIRONMENTAL COMPLIANCE FOR THE SNMP ELEMENTS

The following strategies for the management of salts and nutrients in the basin are identified in the Coachella Valley SNMP:

- Public Outreach and Awareness
- Source Water Quality Management
- Demand Management and Conservation
- Wastewater/Source Control and Infrastructure Improvements
- Stormwater Management
- Development of Goals Supporting Planned Projects
- Data Collection and Further Development of System Understanding

Therefore a range of actions may be completed as elements under the SNMP, from preparation and distribution of an educational flyer to construction of new water treatment, storage, or recharge facilities.

The stakeholders that are public agencies who would carry out or implement projects associated with the SNMP, would be the lead agency under CEQA for these individual projects. The type of CEQA document necessary for each project would depend on the project's description, size and potential to cause significant environmental effects. For example, education campaigns without the potential to cause adverse environmental effects would be considered exempt from CEQA, while an indirect potable reuse project including construction of a membrane treatment plant may require preparation of an EIR. Federal environmental compliance may be triggered for SNMP elements by federal funding, federal permits (e.g., U.S. Army Corps of Engineers Section 404 permits), and/or federal land ownership of project sites. In the future, each SNMP element proposed to be implemented by the lead agency should be reviewed for exemption under CEQA and for nexus with NEPA. If not exempt, preparation of an Initial Study and public and agency scoping would determine the appropriate environmental document for CEQA compliance.

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