Sterling Natural Resource Center

Title 22 Engineering Report

Draft for Public Review

June 2017

RMC water and environment

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San Bernardino Valley Municipal Water District

TITLE 22 ENGINEERING REPORT: Sterling Natural Resource Center

Draft for Public Review

Prepared for:

San Bernardino Valley Municipal Water District

Prepared by:

RMC water and environment

In association with:

John Robinson Consulting, Inc.

Geoscience

June 2017

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Acknowledgements

This *Title 22 Engineering Report: Sterling Natural Resource Center* was prepared by a core team of staff from the San Bernardino Valley Municipal Water District, East Valley Water District, RMC Water and Environment, GEOSCIENCE Support Services, Inc., and John Robinson Consulting, Inc.

Abbreviations

af	acre-foot / acre-feet
AFY	acre-feet per year
Amsl	Above mean sea level
AOP	advanced oxidation processes
AWT	Advanced Water Treatment or Advanced Treated Water
bgs	Below ground surface
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
DDW	SWRCB Division of Drinking Water
FAT	Full Advanced Treatment
ft	feet
GMZ	Groundwater Management Zone
gpd	gallons per day
gpm	gallons per minute
GRRP	Groundwater Recharge and Replenishment Project
GWR	Groundwater Recharge
IPR	Indirect Potable Reuse
IRWM	Integrated Regional Water Management
LCM	Lower Confining Member
LWM	Lower water bearing zone
MBR	Membrane Bioreactor
MCL(s)	Maximum Contaminant Level(s)
MCM	Middle Confining Member
MGD	million gallons per day
MWB	Middle water-bearing zone
NL	Notification Level
NPR	non-potable reuse
Project	Sterling Natural Resource Center Groundwater Replenishment Project
RIX	Rapid Infiltration and Extraction Facility
RMC	RMC Water and Environment
RWC	Recycled Water Contribution
RWMG	Regional Water Management Group
RWQCB	Regional Water Quality Control Board (Santa Ana)

SAR	Santa Ana River
SAT	Soil Aquifer Treatment
SBBA	San Bernardino Basin Area
Valley District	San Bernardino Valley Municipal Water District
SBWRP	San Bernardino Water Reclamation Plant
SNRC	Sterling Natural Resources Center
SWP	State Water Project
SWRCB	State Water Resources Control Board
TOC	total organic carbon
Title 22	Recycled Water Regulations in Title 22, California Code of Regulations
UCM	Upper Confining Member
UV	Ultra-violet disinfection
UWB	upper water bearing zone
Valley District	San Bernardino Valley Municipal Water District
Western	Western Municipal Water District

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Chapter 1 Introduction

This Title 22 Engineering Report was prepared by RMC Water and Environment (RMC) with support from John Robinson Consulting, Inc. and GEOSCIENCE Support Services, Inc. as consultants to the San Bernardino Valley Municipal Water District (Valley District), who is the Project Sponsor for the Sterling Natural Resource Center (SNRC or Project). This report supports the Project in compliance with the Water Recycling Criteria specified in the California Code of Regulations, Title 22, Division 4, Chapter 3 (California Code of Regulations, 2015). Chapter 1 describes the background and goals of the Project.

1.1 Background

The SNRC is a new groundwater replenishment project using recycled water that is being implemented by Valley District. Valley District entered into a Framework Agreement in September 2015 with East Valley Water District (EVWD) for the purpose of furthering efforts to treat recycled water for groundwater replenishment within the Bunker Hill Groundwater Subbasin (Basin) while maximizing benefits to the Santa Ana River and the region.

The reliability of water supplies is becoming an increasingly important consideration for the long-term health and economic wellbeing of communities throughout California. With increase in demand of water and more restrictions on water deliveries, it has become even more valuable for communities to consider means of recycling water and including recycled water in the overall water supply portfolio. Implementing this recycled water program would provide a new and reliable local water supply for the region and help offset the need for increased amounts of imported water.

The Project consists of a new wastewater treatment facility to treat wastewater generated within the EVWD service area and replenish the Bunker Hill Groundwater Basin. In addition to the wastewater treatment plant, the Project would include modifications to EVWD's wastewater collection facilities in order to convey flows to the new recycled water facility, as well as a treated water conveyance and discharge system. Currently, EVWD conveys wastewater for secondary treatment at the San Bernardino Water Reclamation Plant (SBWRP), which sends its treated water for tertiary treatment at the Rapid Infiltration and Extraction (RIX) Facility and discharges to the Santa Ana River. The SNRC would produce disinfected tertiary recycled water (Title 22 quality for unrestricted use) for discharge to local surface waters. This report considers discharge of the treated water to City Creek and to existing basins currently operated by the City of Redlands (Redlands Basins). Key benefits that would result from using recycled water for groundwater recharge are summarized in **Table 1-1.**

Table 1-1: Key Project Benefits

Benefit Category	Benefit Description
Water Supply Reliability	Provides new source of water supply that is reliable, "drought-proof," and locally-controlled
	Diversifies regional water supply portfolio
Resource Management	Provides year-round beneficial use for recycled water
	Promotes highest and greatest beneficial use of recycled water
Integration/Synergies with Other Practices	Augments current groundwater recharge practices employed by the San Bernardino Valley Municipal Water District
Consistency with State Goals and Objectives	Embraces State guidelines and policies relative to recycled water, groundwater management, and diversification of water supplies

1.2 Project Overview

Valley District, the regional water supply and groundwater replenishment agency, is implementing the SNRC to produce recycled water from EVWD's wastewater flows, to assist the region in reducing its reliance on imported water, and to retain water supplies higher in the watershed for regional benefit, including recharge of the Bunker Hill Groundwater Basin. EVWD provides domestic water and wastewater services to unincorporated areas of San Bernardino County, the City of Highland, and to portions of the City of San Bernardino. Valley District and EVWD entered into a Framework Agreement in September 2015 to advance their integrated recycled water management objectives.

A project vicinity map is shown in **Figure 1-1**. The SNRC will treat wastewater generated in the EVWD service area for beneficial reuse in the Upper Santa Ana River watershed. Recycled water will be used to recharge the basin with approximately 11,000 acre-feet per year (AFY) of recycled water at designated discharge locations. The Bunker Hill Groundwater Basin is made up of two sub-basins: Bunker Hill A to the northwest and Bunker Hill B to the southeast. The basin has experienced declining water levels due to declining local runoff and reduced imported water deliveries, resulting in increased groundwater pumping.

EVWD currently conveys its wastewater for secondary treatment at the SBWRP, which sends its treated water for tertiary treatment at the RIX facility and then discharges it to the Santa Ana River lower in the watershed than the proposed Project. Instead, the Project will treat and reuse EVWD's wastewater for multiple beneficial uses within the upper Santa Ana River watershed. The Project will also provide the local community with greater control over the cost of wastewater treatment, while producing a new supply of recycled water for local groundwater replenishment. In addition, the Project will provide an opportunity to create and enhance riparian and aquatic habitats in City Creek, home to a wide variety of rare and endangered species.

The Project includes construction of two new lift stations within the EVWD sewer system and associated forcemains to the SNRC; a new wastewater treatment facility in the City of Highland, that will treat the wastewater and produce Title 22 disinfected tertiary recycled water for unrestricted use; and conveyance pipelines to convey the recycled water to its discharge locations. The SNRC facility will have a maximum future capacity of 10 million gallons per day (MGD) and include primary treatment, a membrane bio-reactor (MBR), ultraviolet (UV) light disinfection, anaerobic solids processing with off-site solids disposal, and a recycled water pump station on the Project site.

Recharge of the treated recycled water has been evaluated at three potential locations: City Creek, Redlands Basins, and East Twin Creek Spreading Grounds. The geohydrologic evaluations of the three sites confirmed the ability of each of the sites to accept recycled water for groundwater recharge purposes. Valley District's objectives include maximizing recharge of the Bunker Hill Groundwater Basin with imported water, captured storm water, and recycled water. Valley District has the ability to recharge the basin with imported water and captured storm water at East Twin Creek Spreading Grounds with existing infrastructure. When considering the high cost of constructing additional infrastructure to convey treated recycled water to East Twin Creek Spreading Grounds, and the available capacity in City Creek and the Redlands Basins, it has been concluded that using East Twin Creek Spreading Grounds for recharge of recycled water is not a necessary project component at this time.

Therefore, this Title 22 Engineering Report recognizes discharge of the recycled water to two potential locations:

- City Creek – via a new discharge structure within the channel; and
- Redlands Basins – via multiple new discharge points/structures within the existing basins currently operated by the City of Redlands.

This Title 22 Engineering Report addresses discharge options for City Creek and the Redlands Basins in support of a National Pollutant Discharge Elimination System (NPDES) permit from the Santa Ana Regional Water Quality Control Board (RWQCB) and the State Water Resources Control Board (SWRCB) Division of Drinking Water. Project facilities, including both wastewater and treated water conveyance alternatives, as well as groundwater discharge locations, are shown in **Figure 1-2**.

1.3 Authority

Valley District, which provides water supply, groundwater replenishment, storm water and wastewater treatment and disposal services, is authorized to construct and operate the SNRC. Acting as a leader in regional recycled water supply development, Valley District entered into a *Framework Agreement for Construction and Operation of Potential Groundwater Replenishment Facilities* with EVWD in 2015 (Framework Agreement; see **Appendix A**). This Framework Agreement outlines the responsibilities and authorities of each agency in the construction, financing, and operation of the SNRC and the associated groundwater replenishment facilities.

1.4 Objectives

The primary objectives of the proposed Project are to:

- Treat and reuse wastewater for multiple beneficial uses within the upper Santa Ana River watershed to meet existing and future wastewater treatment needs within the East Valley Water District service area.
- Increase the use of recycled water to continue efforts toward resolving regional water supply challenges in a cost effective and environmentally responsible manner.
- Increase groundwater replenishment opportunities in the Bunker Hill Groundwater Basin with new local water resources.
- Provide an administrative center that benefits the community in a manner that is compatible with neighboring land uses.
- Increase local water supply operational flexibility within the San Bernardino Valley region to advance the integrated water management objectives of Valley District and the region.

Figure 1-1: Vicinity Map

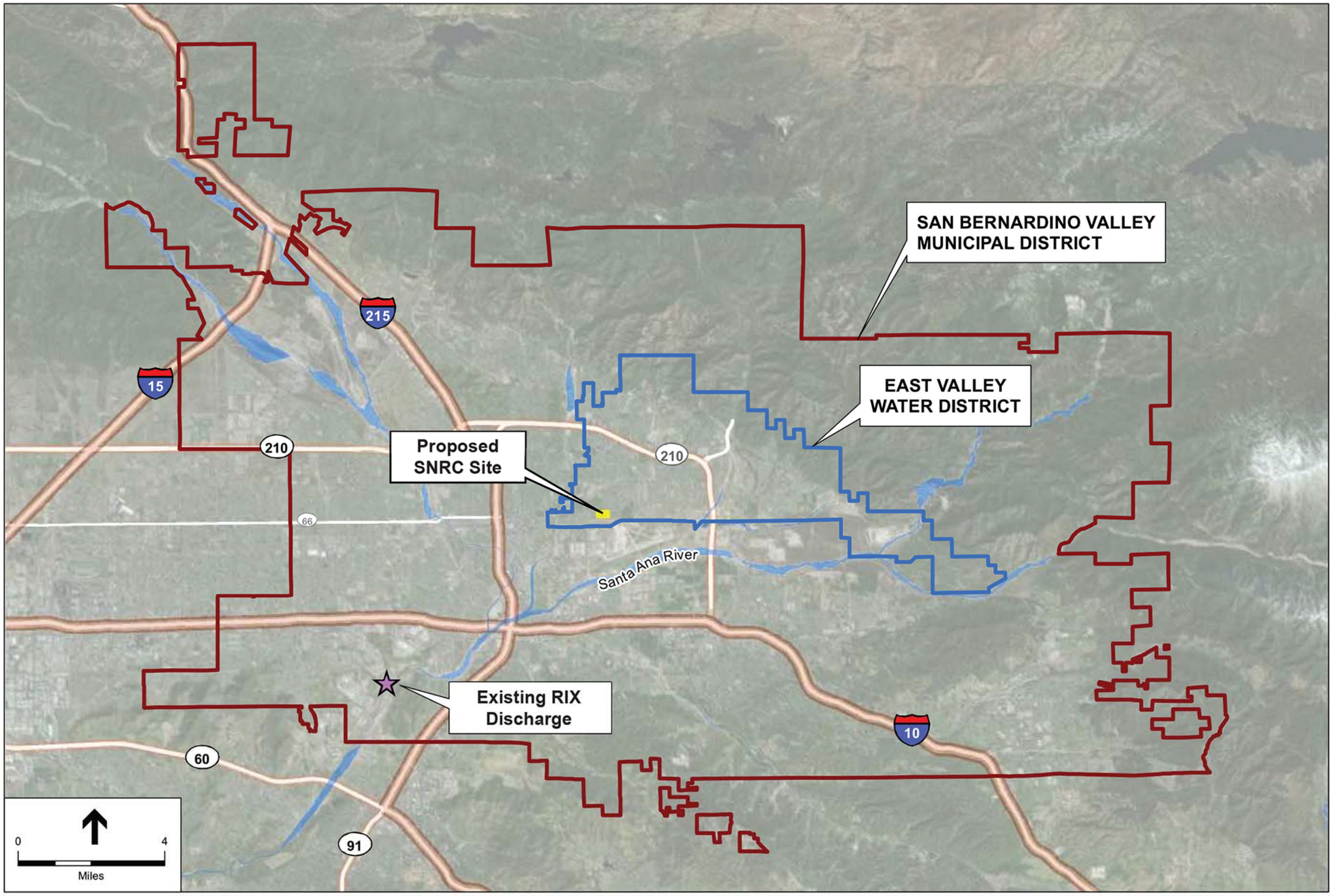
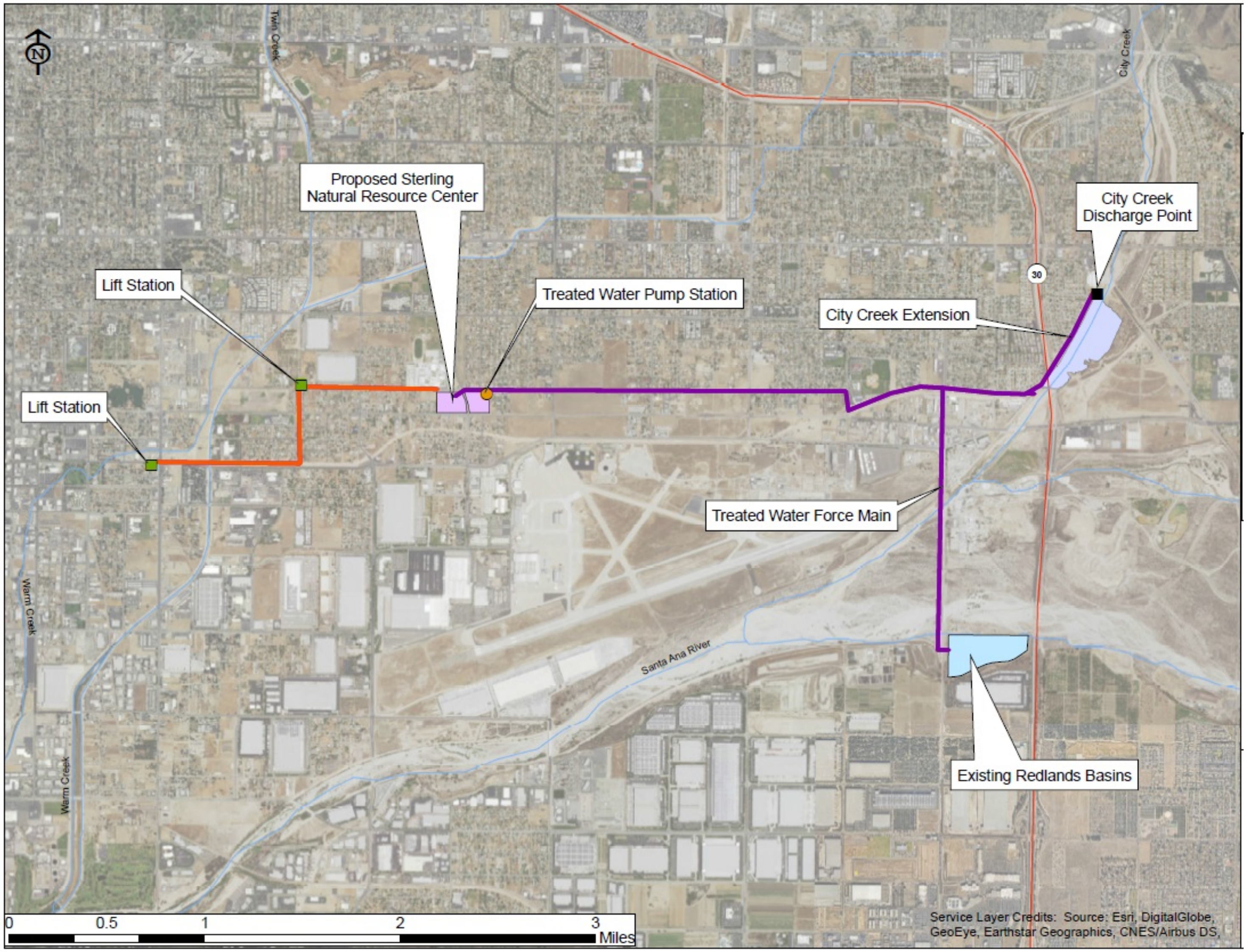


Figure 1-2: Project Facilities



1.5 Outreach and Coordination

Consistent with the California Environmental Quality Act (CEQA), and in its role as the lead agency, Valley District conducted an extensive outreach program to inform the community and receive input in the SNRC planning process. Multiple public hearings were conducted and a Final EIR was certified by Valley District on March 15, 2016, and by East Valley Water District in its capacity as a responsible agency on March 23, 2016. Several public meetings were conducted during the initial planning and feasibility study phases of project development where the agencies presented information on project drivers, status, siting, schedule, and budget, while providing an opportunity for public input and Q&A. Furthermore, EVWD has distributed fliers with customer's monthly bills to update customers on project status. There is also a project specific website outlining the planning process and project goals, as well as informing the community of public involvement opportunities and providing downloadable materials.

1.6 Purpose of the Engineering Report

The objective of this Title 22 Engineering Report is to demonstrate how the Project complies with the California Code of Regulations (CCR) Title 22, Division 4, Chapter 3, Water Recycled Criteria (CCR, 2014). Article 7, §60323 of these regulations requires that an Engineering Report be prepared and submitted to the Santa Ana RWQCB and the SWRCB DDW for approval prior to producing recycled water for reuse from a water reclamation plant. The purpose of this Engineering Report is to request regulatory approval for the Project and to form the basis for its NPDES permit.

Chapter 2 Project Participants and Regulations

2.1 Project Sponsors

Valley District and EVWD entered into a Framework Agreement in 2015 to advance their integrated recycled water management objectives. Recognizing their mutual goals, the Framework Agreement provides for the construction and operation of the SNRC by Valley District. Valley District is the project sponsor and CEQA lead agency, and will serve as the SNRC owner and operator. EVWD has submitted a Clean Water State Revolving Fund (SRF) application and will finance the Project costs consistent with the Framework Agreement between Valley District and EVWD.

Valley District is responsible for long-range water supply management, including importing supplemental water, and is also responsible for most of the groundwater basins within its boundaries and for groundwater extraction over the amount specified in the judgments. Valley District has specific responsibilities for monitoring groundwater supplies in the San Bernardino Basin Area (SBBA), which includes the Bunker Hill Groundwater Basin (see **Figure 2-1**), and maintaining flows at the Riverside Narrows on the Santa Ana River.

EVWD provides domestic water service to unincorporated areas of San Bernardino County, to the City of Highland and to portions of the City of San Bernardino. EVWD provides treatment and distribution of groundwater, Santa Ana River surface water, and imported water, as well as wastewater collection and disposal services.

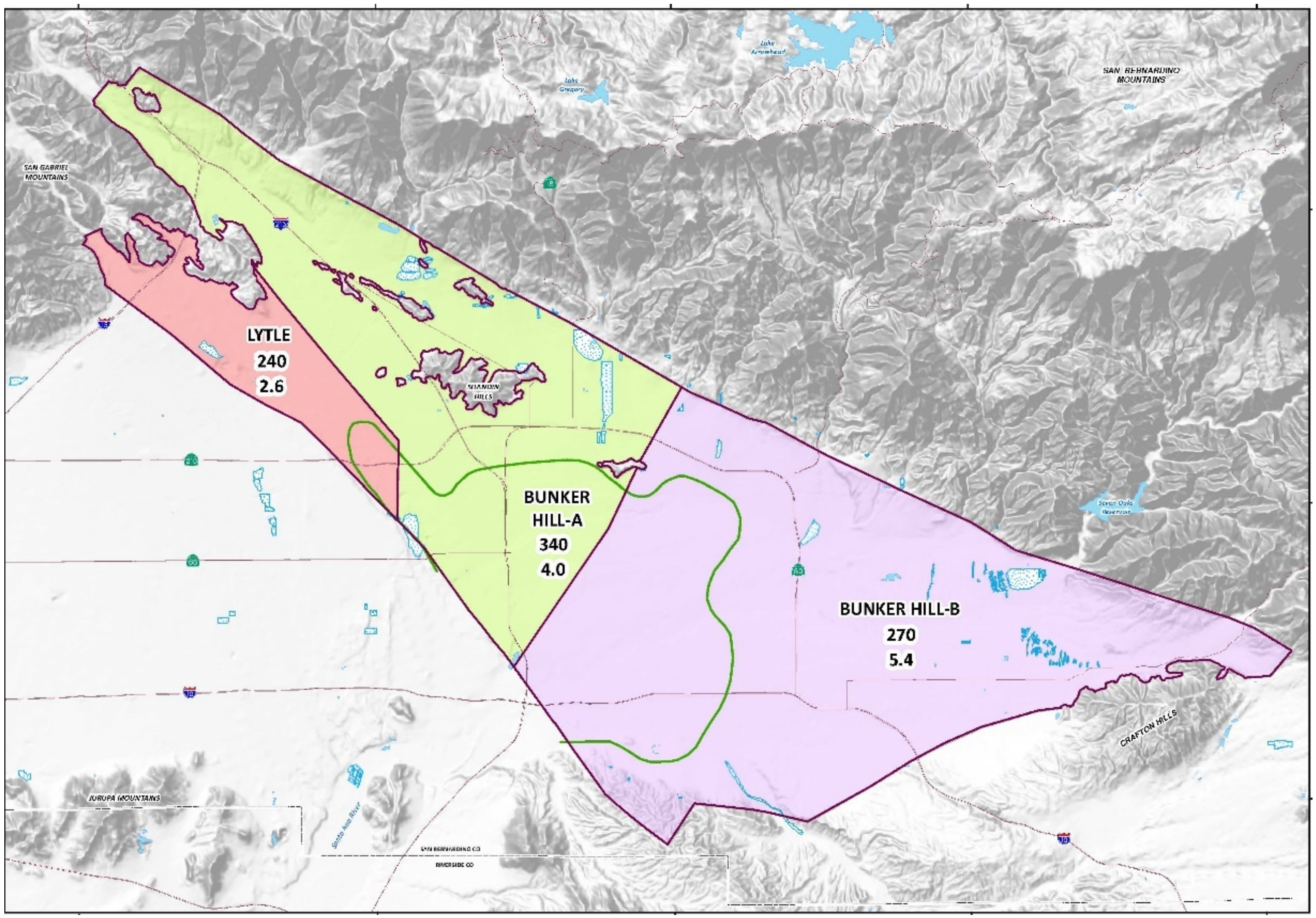
2.2 Project Participants

The Project provides benefit to and is supported by several entities in the region. Valley District is the Project sponsor and SNRC owner and operator. EVWD is the financial sponsor for the Project. The Project will be achieved through collaborative efforts from the following agencies: Valley District, EVWD, City of Redlands, San Bernardino County Flood Control District, DDW, and Santa Ana RWQCB. The following is a brief summary of each Project participant.

San Bernardino Valley Municipal Water District

- Owner and operator of the Project (producer and distributor).
- Regional agency responsible for long-range water supply planning in the San Bernardino Valley.
- Wholesaler of imported State Water Project (SWP) water it its service area.
- Imports SWP water for direct delivery and groundwater recharge.
- Funded construction and manages operation of the East Branch Extension of the State Water Project conveyance system.
- Manages groundwater storage within its service area.
- Provides storm water disposal, recreation, and fire protection services within its service area.
- Is the co-member of the two-seat Watermaster Committee under the Western Judgement.

Figure 2-1: Bunker Hill Groundwater Basin



East Valley Water District

- Financial sponsor for the SNRC Project.
- Established in 1954 and previously known as the East San Bernardino County Water District.
- Majority shareholder and manager of the North Fork Water Company, through which surface water from the Santa Ana River is diverted.
- Provides treatment and distribution of groundwater, Santa Ana River surface water, and imported water.
- Provides wastewater collection and disposal service.
- Contracts for wastewater treatment service through the City of San Bernardino.
- Regional Water Management Group (RWMG) member under the Upper Santa Ana River Watershed Integrated Regional Water Management (IRWM) Plan.

City of Redlands

- Provides water and wastewater service to an area partially overlying Bunker Hill B groundwater basin.
- Provides treatment and distribution of groundwater, surface water, and imported water.
- Provides wastewater collection, treatment, and disposal services.
- Provides approximately 6,000 AFY of Title 22 recycled water to Mountainview Power Company as cooling water.

San Bernardino County Flood Control District

- Conducts flood control and water conservation activities throughout San Bernardino County.
- Provides flood control protection by intercepting and transferring storm water flows through and away from developed areas.
- Owns and operates extensive facilities including dams, multipurpose (flow-through basins that control flow preventing downstream flooding) and conservation (off-channel basins that receive storm flows) basins, drainage channels, and storm drains.

California State Water Resources Control Board, Division of Drinking Water (DDW)

- Administers California's Drinking Water Program previously administered by California Department of Public Health (CDPH) and transferred to DDW on July 1, 2014.
- Responsible for establishing criteria to protect the public health with regard to recycled water use.
- Regulates Water Recycling Criteria contained in the California Code of Regulations, Title 22, Division 4, Chapter 3 (CCR, 2014) including regulations with specific criteria for groundwater recharge projects.
- Holds public hearings on projects and makes recommendations to the RWQCB for inclusion into the water recycling requirements, or project permit.

Santa Ana Regional Water Quality Control Board

- Responsible for overseeing surface and groundwater quality and establishing waste discharge requirements in the Santa Ana River Basin.
- Enforces the Water Recycling Criteria established by DDW.
- Incorporates recommendations of DDW into the water recycling requirements (permit) for projects.
- Issues and enforces water recycling permits and requirements.

2.3 Regulatory Requirements

State Water Resources Control Board, Division of Drinking Water Requirements

Prior to June 18, 2014, the Water Recycling Criteria in the California Code of Regulations, Title 22, Division 4, Chapter 3 (CCR, 2014) included narrative requirements for planned groundwater recharge projects. The regulations required that recycled water must be at all times of a quality that fully protects public health and that DDW recommendations would be made on an individual case basis and taking into consideration all relevant aspects of each project, including the following factors: treatment provided; effluent quality and quantity; spreading area operations; soil characteristics; hydrogeology; residence time; and distance to withdrawal.

Since 1976, DDW issued numerous draft versions of more detailed groundwater recharge regulations that served as guidance for the six permitted projects in California:

- Montebello Forebay Groundwater Recharge Project – surface spreading of tertiary recycled water, stormwater, untreated Colorado River water and State Project water (imported water) with plans to increase recycled water by 2017/18
- Chino Basin Groundwater Recharge Project – surface spreading of tertiary recycled water and stormwater;
- Alamitos Gap Seawater Intrusion Barrier – injection of advanced treated (AWT) recycled water and treated imported water; now using 100% AWT recycled water;
- West Coast Basin Seawater Intrusion Barrier – injection of 100% AWT recycled water in 2013;
- Dominguez Gap Seawater Intrusion Barrier – injection of AWT recycled water and treated imported water; plans for 100% AWT recycled water by 2017/18; and
- Groundwater Replenishment System (GWRS) – injection and surface spreading of 100% AWT recycled water, expanded to 100 MGD in 2015.

Final groundwater recharge regulations were adopted and went into effect June 18, 2014. The groundwater recharge regulations are organized by type of project: (1) surface application (surface spreading) and (2) subsurface application (injection or vadose zone wells).

The SNRC Project proposes groundwater recharge via surface spreading. Surface applications may spread either disinfected tertiary-treated (filtered) recycled water or full advanced treated (FAT) recycled water. The Project will comply with all specified Title 22 Criteria and Groundwater Recharge Criteria as outlined in this Engineering Report addressing the following key issues:

- **Source Control.** The municipal wastewater used as source water for the recharge project must be from a wastewater agency that administers an industrial pretreatment and pollutant source control program that has been enhanced to include chemicals specified by DDW and the RWQCB, and an inventory of chemicals that may be discharged to the sewer system in that area. The City of San Bernardino implements an effective regional pretreatment program which EVWD currently complies with. EVWD will continue to comply with the approved pretreatment program in accordance with the Pretreatment Regulations in the Code of Federal Regulations (CFR), Section 40, Part 403. EVWD's program is focused on residential compliance due to the lack of industrial facilities within its wastewater collection service area.
- **Recycled Water Contribution (RWC) and Diluent Water Requirements**. Recharged recycled water must be blended with diluent water to comply with the DDW-specified maximum RWC. For surface spreading projects, the initial maximum RWC allowed under the regulations is 20%, unless an alternative initial RWC is approved by DDW based on demonstration of the treatment processes

preceding soil aquifer treatment (SAT) can reliability meet the total organic carbon (TOC) limit calculated for the proposed maximum RWC.

Diluent water is used to reduce the RWC. Typical diluent waters are drinking water or water from a DDW-approved source (e.g., storm water, imported untreated water, or groundwater underflow). With the exception of potable water used for blending, diluent water must demonstrate compliance with drinking water standards for nitrate, nitrite, and the sum of nitrate and nitrite. Except for potable water used as diluent, a source water evaluation of the diluent source shall be conducted and approved by DDW. Diluent water quality must also comply with drinking water standards (primary maximum contaminant levels [MCL], secondary MCLs, and notification levels [NL]).

In order to comply with the maximum RWC limit, diluent water may be blended (1) directly with the recycled water (e.g., in the same spreading basins or in storage tanks or piping), or (2) indirectly with the recycled water (e.g., in nearby spreading basins or as underflow within the "buffer zone" surrounding the recharge area, which is a three-dimensional area of restricted well development designated to provide the required underground retention time).

- **Pathogen Control and Multiple Barrier Requirements.** With regard to pathogen control, the Title 22 Water Recycling Criteria require multiple barriers (at least three) be used from raw sewage to extracted, usable groundwater in order to achieve at least:
  - 12-log enteric virus reduction
  - 10-log Giardia cyst reduction
  - 10-log Cryptosporidium oocyst reduction

  Projects must suspend operation if the virus reduction achieved is less than 9-log or if the Giardia cyst or Cryptosporidium oocyst reduction achieved is less than 8-log.

  Each barrier must achieve a minimum of 1-log reduction and will not be credited for more than a 6-log reduction in each of the above pathogens. Underground retention time may be credited with 1-log/month for virus reduction. Barriers must be validated to receive credit for the log reduction using demonstration reports or challenge testing. Underground retention time must be verified using an added tracer study in order to receive credit for the full log removal (1 log/month). Depending on the method used for project planning purposes, the regulations give partial log-reduction credit for intrinsic tracer studies (0.67 log/month), numerical modeling (0.5 log/month), or analytical modeling (0.25 log/month). For demonstration purposes, retention time is defined as the time between when the water with the added or intrinsic tracer is recharged at the site and when water with either 2% of the tracer has reached the downgradient monitoring well, or 10% of the peak tracer value is observed at a downgradient monitoring well. The regulations require that a tracer study be initiated within three months of project start-up.

  For projects without FAT, filtration and disinfection are required to attain Title 22 disinfected tertiary effluent requirements and the underground retention time must be at least six months in order to be credited with 10-log Giardia cyst and 10-log Cryptosporidium oocyst reduction.

- **Response Retention Time.** RRT is the time recycled water must be retained underground to identify any treatment failure and implement actions so that inadequately treated recycled water does not enter a potable water system, including the plan to provide an alternative water supply or treatment. The minimum RRT is 2 months, but must be justified by the project sponsor(s).

  The greatest of the horizontal and vertical distances reflecting the retention times required for Pathogen Control or for RRT establish the zone within which drinking water wells cannot be constructed (i.e., "buffer zone" that effectively establishes a boundary between potable and non-potable use of the groundwater basin).

For planning purposes, the Groundwater Recharge Regulations allow use of modeling to estimate residence time for project facility siting. A project sponsor must validate retention time using an added tracer or a DDW approved intrinsic tracer within the first three months of operation.

- **Total Organic Carbon Requirements.** The Title 22 Water Recycling Criteria include provisions for increasing the maximum RWC based on the recycled water total organic carbon (TOC) concentration. The maximum allowable TOC concentration is established by the following equation:

  $$TOCmax = 0.5\ mg/L \div RWC$$

  For surface spreading projects, the point of TOC compliance may be in the (1) undiluted recycled water or within the percolation zone, (2) diluted percolated recycled water adjusted for dilution, or (3) undiluted recycled water with a DDW-approved SAT factor, demonstrating TOC removal using SAT. For example, the TOCmax for a surface spreading project operating with an initial RWC of 20% would be 2.5 mg/L. Compliance with the TOC limit is based on weekly samples (as a minimum frequency) and a 20-week running average of all TOC results as well as the average of the last four TOC results.

- **Total Nitrogen (N).** An MBR system alone or in combination with SAT should be able to produce a recycled water that meets the total N of 10 mg/L. However, the nitrogen requirements may be more stringent based on the Basin Plan groundwater objectives. An anti-degradation analysis is required to demonstrate that less than 10% of the available basin assimilative capacity is utilized.

- **Drinking Water Standards.** An MBR system alone or in combination with SAT will produce recycled water that meets primary and secondary MCLs, with the exception of secondary MCLs for salts. The regulations allow compliance with secondary MCLs in the recharge water, which is the combination of recycled water and credited diluent water. Compliance with primary MCLs is based on the running annual average of quarterly samples. For those primary MCLs with acute toxicity (e.g., perchlorate), compliance is based on the running four-week results. For secondary MCLs, compliance is based on a single annual sample. Recharge water may be monitored in lieu of recycled water where the recharge water is comprised primarily of recycled water or a dilution factor is applied (i.e. recharge water monitoring may be applicable to disinfection byproducts in some cases). Recycled water and groundwater from the downgradient monitoring wells must also be monitored for priority toxic pollutants and chemicals specified by DDW.

2.3.2 Regional Water Quality Control Board Requirements

Valley District and EVWD's service area is located within the jurisdiction of the Santa Ana RWQCB. The Santa Ana RWQCB is one of nine regional boards under the SWRCB and has the responsibility for regulating recycled water discharges to groundwater and surface water that are subject to state water quality regulations and statutes. The RWQCB's mission is "to preserve, enhance, and restore the quality of California's water resources, and ensure their proper allocation and efficient use for the benefit of present and future generations." Locally, the RWQCB implements policies and regulations, develops long-range plans, issues water recycling and waste discharge permits, and takes enforcement actions against violators of State and federal environmental regulations.

Basin Plan

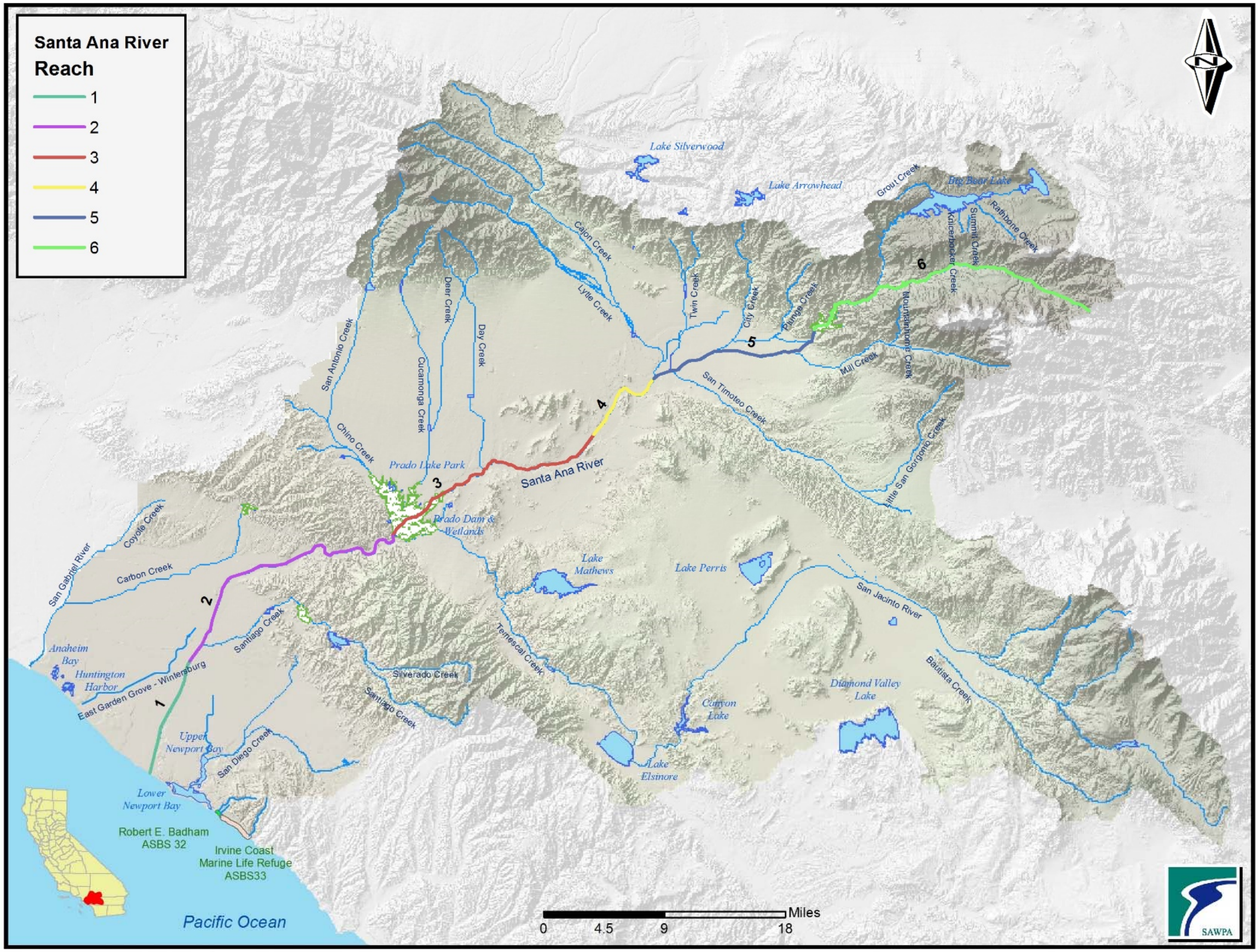
Waste Discharge Requirements (WDR) issued by the Santa Ana RWQCB are required to implement applicable State water quality control policies and plans, including water quality objectives and implementation policies established in the Basin Plan (RWQCB, 2011). The Basin Plan designates beneficial uses of surface water and groundwater resources in the watershed and sets water quality objectives that must be attained to protect these beneficial uses and conform to the State's anti-degradation policy. The Basin Plan also designates well implementation policies as well as monitoring and assessment programs. Discharges to groundwater must be of sufficient quality to not impact beneficial uses. **Table 2-1** shows the beneficial uses for Basin, City Creek (tributary to the Santa Ana River), as well as selected reaches of the Santa Ana River adjacent to and downstream of the Project area. **Figure 2-2** shows the reaches of the Santa Ana River.

Table 2-1: Beneficial Uses in the Basin Plan for the Bunker Hill Groundwater Basins, City Creek, and Upper Reaches of the Santa Ana

Beneficial Use	Bunker Hill Groundwater Basin	City Creek (Valley Reach)	Santa Ana River Reach 5[1]	Santa Ana River Reach 4	Santa Ana River Reach 3
Municipal (MUN)	X	I	X[2]	+	+
Agricultural Supply (AGR)	X		X		X
Industrial Service Supply (IND)	X				
Industrial Process Supply (PROC)	X				
Groundwater Recharge (GWR)		I	X	X	X
Navigation (NAV)					
Hydropower Generation (POW)					
Water Contract Recreation (REC1)		I	X[3]	X[3]	X
Non-contact Water Recreation (REC2)		I	X	X	X
Commercial and Sportfishing (COMM)					
Warm Freshwater Habitat (WARM)		I	X	X	X
Limited Warm Freshwater Habitat (LWRM)					
Cold Freshwater Habitat (COLD)					
Preservation of Biological Habitats of Special Significance (BIOL)					
Wildlife Habitat (WILD)		I	X	X	X
Rare, Threatened or Endangered Species (RARE)			X		X
Spawning, Reproduction and Development (SPWN)					
Marine Habitat (MAR)					
Shellfish Harvesting (SHEL)					
Estuarine Habitat (EST)					

Adapted from Basin Plan, Source: RWQCB, 2011
Notes: X = Present or Potential Beneficial Use; I = Intermittent Beneficial Use; + = Excepted from MUN
1. Reach 5 uses are intermittent upstream of Waterman Avenue
2. MUN applies upstream of Orange Avenue (Redlands); downstream, water is excepted from MUN
3. Access prohibited in some portions by San Bernardino County Flood Control

Figure 2-2: Santa Ana River Reaches



Source: Santa Ana Watershed Project Authority

In 2014, the Santa Ana RWQCB adopted an amendment to the Basin Plan that updated the 2004 Salt Management Plan (Resolution R8-2014-0005). Also in 2014, the Santa Ana RWQCB adopted Resolution R8-2014-0072, which accepted the TDS and nitrate-N groundwater management zones ambient water quality determinations as required in the Salt Nitrogen Management Plan. **Table 2-2** shows the water quality objectives, ambient water quality, and assimilative capacity for TDS for the Bunker Hill subbasins. **Table 2-3** shows the water quality objectives, ambient water quality, and assimilative capacity for Nitrate-Nitrogen (Nitrate-N) for the Bunker Hill subbasins. As shown in the tables, assimilative capacity for TDS and nitrate-N exists in Bunker Bill B, but not in Bunker Hill A.

Table 2-2: Water Quality Objectives, Ambient Water Quality, and Assimilative Capacity for TDS in the Bunker Hill Groundwater Basin

Management Zone	Water Quality Objective (mg/L)	1997 Ambient (mg/L)	2003 Ambient (mg/L)	2006 Ambient (mg/L)	2009 Ambient (mg/L)	2012 Ambient (mg/L)	Assimilative Capacity (mg/L)
Bunker Hill A	310	350	320	330	340	340	-30
Bunker Hill B	330	260	280	280	270	280	50
Excerpt from Resolution R8-2014-0072, Table 1. Source: RWQCB, 2014							

Table 2-3: Water Quality Objectives, Ambient Water Quality, and Assimilative Capacity for Nitrate-Nitrogen in the Bunker Hill Groundwater Basin

Management Zone	Water Quality Objective (mg/L)	1997 Ambient (mg/L)	2003 Ambient (mg/L)	2006 Ambient (mg/L)	2009 Ambient (mg/L)	2012 Ambient (mg/L)	Assimilative Capacity (mg/L)
Bunker Hill A	2.7	4.5	4.3	4.0	4.0	4.0	-1.3
Bunker Hill B	7.3	5.5	5.8	5.4	5.4	5.6	1.7
Excerpt from Resolution R8-2014-0072, Table 2. Source: RWQCB, 2014							

The Basin Plan addresses antidegradation for groundwater recharge of recycled water in terms of how the discharge of recycled water and diluent water compare to the ambient water quality. If the concentration is at or below (i.e., better than the current ambient TDS and nitrate quality), then the discharge will not be expected to result in a lowering of water quality and no antidegradation analysis will be required – TDS and nitrate groundwater objectives are expected to be met. If the discharge exceeds the current ambient TDS and/or nitrate ambient quality, then the RWQCB would require the discharger to conduct an antidegradation analysis to demonstrate whether and to what extent the discharge would result in a lowering of ambient water quality (e.g., the extent, if any, the discharge uses available assimilative capacity). If the discharger demonstrates that no lowering of water quality would occur, then antidegradation requirements would be met, water quality objectives would be achieved, and the RWQCB could permit such discharges to proceed. If the analysis indicates that a lowering of current ambient water quality would occur, other than on a minor or temporally or spatially limited basis, then the discharger would have to demonstrate that: (1) beneficial uses would continue to be protected and the established water quality objectives would be met; and (2) that the resultant water quality would be consistent with maximum benefit to the people of California; and, (3) that best practicable treatment or control has been implemented.

2.3.3 State Water Resources Control Board Requirements

There are two policies of particular importance with respect to groundwater recharge projects for protection of water quality and human health: (1) antidegradation policies, and (2) the Recycled Water Policy.

Antidegradation Policies

California's anti-degradation policies are found in Resolution 68-16, Policy with Respect to Maintaining Higher Quality Waters in California, and Resolution 88-63, Sources of Drinking Water Policy. These resolutions are binding on all State agencies. They apply to both surface waters and groundwaters, protect both existing and potential uses, and are incorporated into RWQCB Basin Plans.

- **Resolution 68-16 (Antidegradation Policy):** The Antidegradation Policy requires that existing high water quality be maintained to the maximum extent possible, but allows lowering of water quality if the change is "consistent with maximum benefit to the people of the state, will not unreasonably effect present and anticipated use of such water (including drinking), and will not result in water quality less than prescribed in policies." The Antidegradation Policy also stipulates that any discharge to existing high quality waters will be required to "meet waste discharge requirements which will result in the best practicable treatment or control of the discharge to ensure that (a) pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained."
- **Resolution 88-63 (Sources of Drinking Water Policy)**: The Sources of Drinking Water Policy designates the municipal and domestic supply (MUN) beneficial use for all surface waters and groundwater except for those: (1) with TDS exceeding 3,000 milligrams per liter (mg/L), (2) with contamination that cannot reasonably be treated for domestic use, (3) where there is insufficient water supply, (4) in systems designed for wastewater collection or conveying or holding agricultural drainage, or (5) regulated as a geothermal energy producing source. Resolution 88-63 addresses only designation of water as drinking water source; it does not establish objectives for constituents that threaten source waters designated as MUN.

Recycled Water Policy

The Recycled Water Policy was adopted by the SWRCB on February 3, 2009 and became effective on May 14, 2009. It was subsequently amended in January 22, 2013 with regard to Contaminants of Emerging Concern (CEC) monitoring with an effective date of April 25, 2013. The Policy was a critical step in creating uniformity in how RWQCBs were individually interpreting and implementing Resolution 68-16 for water recycling projects, including landscape irrigation projects and groundwater recharge projects. The critical provisions in the Policy are discussed in the following subsections.

- **Salt Nutrient Management Plans:** The Recycled Water Policy requires Salt Nutrient Management Plans (SNMPs) to be developed for every groundwater basin/sub-basin by May 2014 (May 2016 with a RWQCB-approved extension). The Santa Ana RWQCB adopted an SNMP in 2004, which was amended in 2014 (Resolution R8-2014-0005).
- **RWQCB Groundwater Requirements:** The Recycled Water Policy does not limit the authority of a RWQCB to include more stringent requirements for groundwater recharge projects to protect designated beneficial uses of groundwater, *provided* that any proposed limitations for the protection of public health may only be imposed following consultation with DDW. The Recycled Water Policy also does not limit the authority of a RWQCB to impose additional requirements for a proposed groundwater recharge of recycled water project that has a substantial adverse effect on the fate and transport of a contaminant plume (for example those caused by industrial contamination or gas stations), or changes the geochemistry of an aquifer thereby causing the dissolution of naturally occurring constituents, such as arsenic, from the geologic formation into

groundwater. This provision requires additional assessment of impacts of a groundwater recharge of recycled water project on areas of contamination in a basin and/or if the quality of the water used for recharge (for example low salinity) causes constituents, such as naturally occurring arsenic, to become mobile and impact groundwater.

- **Antidegradation and Assimilative Capacity:** Assimilative capacity is typically defined as the difference between the ambient groundwater concentration and the concomitant groundwater quality objective. In accordance with the Recycled Water Policy, two assimilative capacity thresholds were established for groundwater recharge of recycled water. A project that utilizes less than 10% of the available assimilative capacity in a groundwater basin/sub-basin (or multiple projects utilizing less than 20% of the available assimilative capacity in a groundwater basin/sub-basin) must conduct an antidegradation analysis verifying the use of the assimilative capacity. In the event a project or multiple projects utilize more than the fraction of the assimilative capacity (e.g., 10% or 20%), then the project proponent must conduct an antidegradation analysis acceptable to the RWQCB. Some SNMPs use these assimilative capacity values as thresholds for evaluating impacts of salt and nutrient loadings and implementation measures.
- **CECs:** As part of the Recycled Water Policy, a Science Advisory Panel was formed to identify a list of CECs for monitoring in recycled water used for groundwater recharge and landscape irrigation. The Panel completed its report in June 2010 and recommended monitoring selected health-based and treatment performance indicator CECs and surrogates for groundwater recharge of recycled water projects. The Panel concluded that CEC monitoring was unnecessary for landscape irrigation. The groundwater recharge monitoring recommendations were directed at surface spreading using tertiary recycled water (specifically monitoring recycled water and groundwater) and injection projects using RO and advanced oxidation processes (AOP) (specifically monitoring recycled water). The Recycled Water Policy was amended by the SWRCB on January 22, 2013 to include the CEC monitoring program and the Office of Administrative Law approved the Amendment on April 25, 2013. The Amendment provides the final list of specific CECs and monitoring frequencies for groundwater recharge projects and procedures for evaluating the data and responding to the results. The requirements for groundwater recharge projects will be incorporated into the permits for existing groundwater recharge projects, and will be included as requirements for all future projects. As part of the final Groundwater Recharge Regulations, DDW has its own CEC requirements and monitoring locations that must be met in addition to the Recycled Water Policy requirements.

2.4 Environmental Compliance

All public projects in California must comply with CEQA. Valley District prepared a CEQA-Plus Environmental Impact Report (EIR) for the SNRC Project. The Notice of Preparation (NOP) was issued on October 16, 2015. The Draft EIR was released in December 2015 (ESA, 2015). The Final EIR was certified by Valley District on March 15, 2016 and East Valley Water District on March 23, 2016 (ESA, 2016) and Notices of Determination were filed on March 16 and 24, 2016, respectively.

Chapter 3 Project Facilities

The SNRC will be constructed with an initial capacity of 7.5 MGD, based on initial flow rate of 6.0 MGD. Anticipated build-out of the EVWD service area will require a future expansion of the SNRC to 10.0 MGD. Valley District will be responsible for the operation of the proposed SNRC. The Project will be implemented under a design-build alternative delivery method. An overview of the collection and treatment process are provided in this chapter. The facilities will be further refined during the design phase, at which time an updated Title 22 Engineering Report will be provided to DDW with the specific design criteria.

3.1 Overview

The SNRC will be constructed on two parcels in the City of Highland and will produce Title 22 recycled water for multiple recycled water uses, including groundwater replenishment and habitat enhancement. **Figure 3-1** shows a conceptual layout of the SNRC, including both the Treatment Facility and Administration Center.

Treatment Facility. The Treatment Facility will provide tertiary treatment to wastewater generated within the EVWD service area, having an initial maximum capacity of 7.5 MGD to produce tertiary treated water in compliance with Title 22 recycled water quality requirements for unrestricted reuse. It will include primary treatment, an MBR, UV disinfection, and anaerobic solids processing with off-site solids disposal. All treatment processes will either be covered or housed in specific buildings equipped with noise and odor control facilities. Effluent that does not meet discharge standards will be re-routed back to the Treatment Plant headworks for further treatment.

Administration Center. The 6-acre parcel west of North Del Rosa Drive will be developed with an Administration Center. The Administration Center will consist of administration buildings and pavilions for administrative offices needed for the treatment plant, surrounded by publically-accessible open space. The Administration Center will also include an interpretive center, which will also act as an Emergency Operations Center during emergencies, with community gardens, retention pond, and pavilions. Signage will be provided at the onsite retention pond. The administration buildings will be approximately 25,000 square feet equipped with offices, control systems, and meeting rooms. A large meeting room will be available for community functions. A parking lot with approximately 160 parking spaces will be constructed to accommodate the administration building routine operations as well as any community related events.

As shown in **Figure 3-1**, the Administration Center will utilize the recycled water in on-site impoundments. Signage will be included along the walking trails and publically-accessible areas at intervals as specified by DDW.

3.1.1 Anticipated Flowrates

Anticipated flow data and peaking factors are presented in **Table 3-1**.

Table 3-1: Summary of Anticipated Flowrates and Peaking Factors

Category	Calculation	Initial Capacity (MGD)	Ultimate Capacity (MGD)
Average Daily Flow, Dry Weather	ADWF	7.5	10
Maximum Daily Flow	ADWF x 1.5	11.3	15
Peak Daily Flow	ADWF x 3.0	22.5	30

Figure 3-1: Conceptual Layout of SNRC

Source: Adapted from Sterling Natural Resource Center Draft Environmental Impact Report, ESA 2015.

3.2 Wastewater Collection System

Wastewater generated in the EVWD service area is primarily from residential and commercial uses. Negligible industrial wastewater is generated in the service area. Various wastewater collection system improvements are required within the EVWD service area in order to convey flows to the SNRC.

Two new sewer lift stations and force mains would be constructed at East 3rd Street and Waterman Avenue and near 6th Street and Pedley Road in order to convey flows to the SNRC as shown in Figure 3-1. The 0.6 MGD lift station would be located at East 3rd Street and Waterman Avenue, with a six-inch double-barrel force main located in East Little 3rd Steet and Pedley Road to the 5.4 MGD lift station near 6th Street and Pedley Road. From there, a 16-inch double-barrel force main would be located in East 6th Street from near Tippecanoe Avenue and 6th Street to the SNRC facility. The lift station would transfer flow from the EVWD collection system to the SNRC. In addition, several diversion points will be installed internal to the existing collection system to help capture and divert all of EVWD's gravity fed wastewater flows to the SNRC facility.

3.3 SNRC Treatment Plant Facilities

The following sections describe the SNRC treatment processes, staffing, and reliability features. The Project will be delivered by design-build procurement, therefore full design criteria will be provided at a later date, as part of an updated Title 22 Engineering Report. The plant design will allow for efficiency and convenience of operation to permit the highest possible degree of treatment to be obtained under varying circumstances and will include the necessary alarms and process reliability requirements as required by Title 22.

3.3.1 Treatment Processes

All treatment processes will either be covered or housed in a building with state-of-the-art odor control facilities. The SNRC will consist of treatment trains, each with a uniform capacity, and combined will have an initial capacity of 7.2 to 7.5 MGD. Space will be provided for additional trains, for an ultimate capacity of 10 MGD, to meet planned growth within the service area. The proposed treatment facility components described next are shown in the conceptual layout in **Figure 3-1** and the process flow diagram is shown in **Figure 3-2**.

Headworks

Headworks will include preliminary screening and grit removal tanks. Influent screening will consist of three multi-rake mechanical bar screens with clear 3/8-inch openings. Screenings will be diverted to a washer/compactor onsite then to a dumpster and trucked offsite to a permitted landfill. Two vortex-type grit tanks will be provided to remove grit from the liquid stream. The collected grit will be pumped to the grit washer/classifiers and then trucked offsite to a permitted landfill.

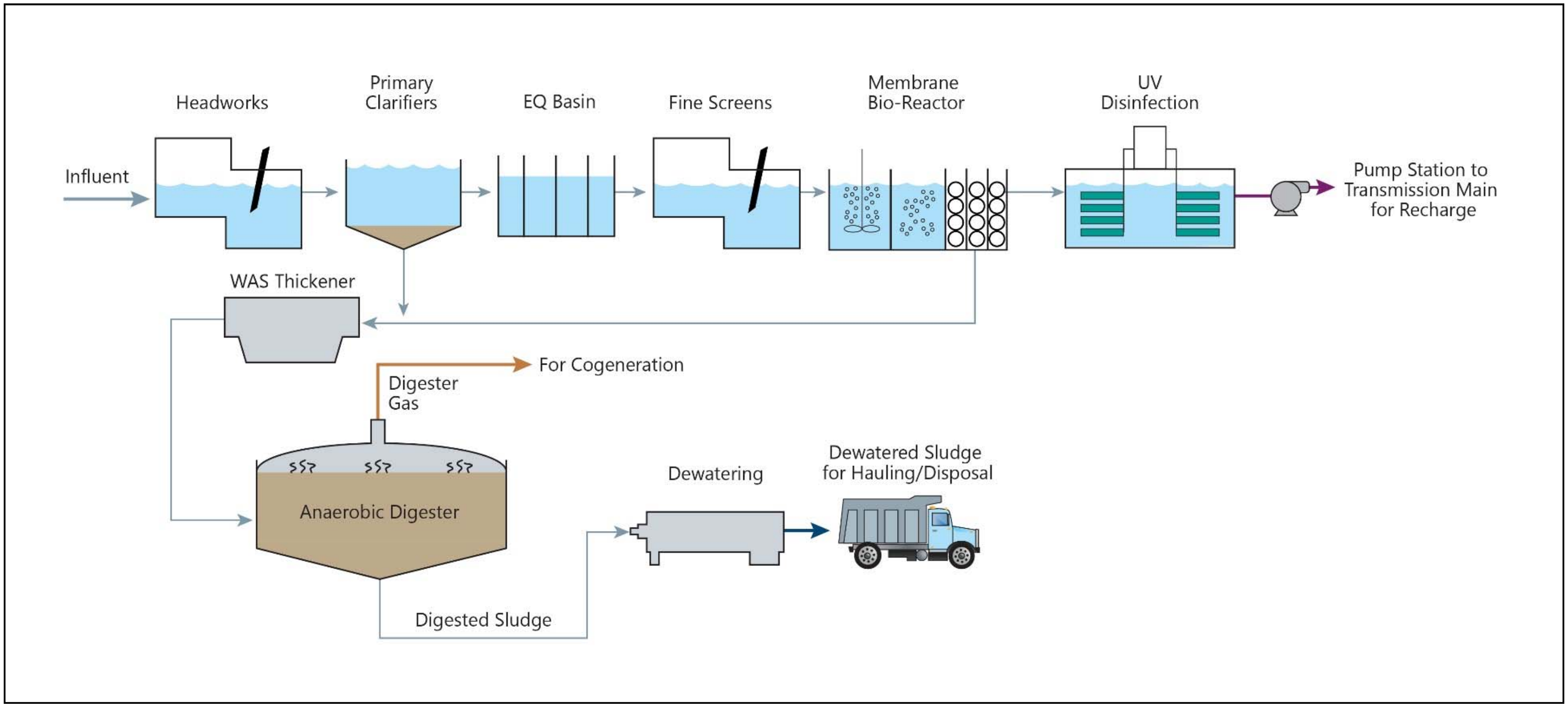
Primary Clarifiers

Primary sedimentation will consist of four rectangular, common wall or circular tanks. Primary sludge will be removed via collection mechanism (e.g. flight and chains) and pumped to the digesters.

Secondary Screenings

Primary clarifiers will be followed by two perforated plate fine screens with maximum openings of two millimeters (mm). Screenings will be diverted to dumpsters and hauled off site to a landfill.

Figure 3-2: SNRC Process Flow Diagram



Membrane Bioreactor (MBR) System

MBRs use the combination of a membrane process like microfiltration or ultrafiltration with a suspended growth bioreactor (aeration basins). When used with domestic wastewater, MBR processes can produce high quality effluent that can be reclaimed and is an approved Title 22 tertiary filtration technology.

- **Anoxic Denitrification and Selector Zone -** Following primary treatment, each of the trains will have a completely mixed anoxic zone of approximately 125,000 gallons each. These zones will receive primary effluent and return activated sludge (RAS), and will be completely mixed by submersible mixers. Estimated influent ammonia levels are 40 mg/L NH_3 and anticipated product nitrate levels would be 5.5 mg/L N (see Tables 4-1 and 5-1 below).
- **Secondary Aeration -** The two oxic zones will be approximately 500,000 gallons each for a total volume of 1 million gallons (MG). These basins will be equipped with fine bubble diffusers, operated by four centrifugal blowers: two with 150 horsepower (hp) and two with 75 hp.
- **MBR Tanks -** The Project uses MBR units that are adjacent to the aeration basins. Air requirements for the MBR units will be used for pulsating air scour with three blowers. The MBR system will use citric acid, sulfuric acid, and sodium hypochlorite for clean-in-place cycles.

Ultra-Violet (UV) Disinfection

The Project includes UV disinfection, which uses short wavelength UV light to kill or inactivate microorganisms by destroying nucleic acids and disrupting their DNA which leaves them unable to perform vital cellular functions. Six UV trains are estimated to be provided. Section 3.3.5 provides a detailed description of the UV Disinfection System design.

Treated Water Pumping Station

The treated water pumping station will consist of a building to house the pumps and electrical/control gear, potentially a hydro-pneumatic or surge tank outside of the building, above-ground piping, power transformers, and associated sidewalks and fencing. The pumping station will likely house five 200-hp pumps.

Sludge Thickening

Two gravity belt thickeners will be used to thicken the sludge from the MBR system. Wasted Activated Sludge (WAS) and primary sludge (if needed) will be pumped to the thickeners before going to the anaerobic digesters. Dilute sludge is introduced at the feed end of a horizontal filter belt. As the slurry makes its way down the moving belt free water drains through the porous belt. Sludge is discharged at the end of the horizontal filter belt as a pumpable thickened sludge. Sludge thickening, biosolids dewatering, and truck loadout equipment will be in the same building.

Anaerobic Digestion

Primary sludge and thickened WAS will be digested anaerobically in two digesters, each approximately 90 feet in diameter to produce Class B biosolids. The digesters will require heating and mixing with a linear motion mixing technology.

Biosolids Dewatering and Offloading

Screw presses will be employed for biosolids dewatering. Biosolids will hauled offsite either to soil augmentation reuse facilities or to a landfill for disposal. An offloading facility will be constructed to convey treated biosolids onto haul trucks.

Chemicals Used and Stored Onsite

Chemicals will be used and stored onsite in compliance with hazardous materials storage and handling regulations. None of the proposed chemicals are classified as acutely hazardous.

Odor Control

The SNRC will be equipped with odor control systems to capture and treat foul smelling gases produced by raw wastewater and sludge before it is exhausted from buildings and tanks that process raw sewage or sludge. Solids handling facilities will also be equipped with high-rate ventilation systems necessary where these gases are present.

Energy Requirements

The SNRC will require electricity for the treatment processes and the treated water pumping station. The estimated power requirements for the treatment plant during average daily design flow is approximately 1,650 kilowatts. Total annual power consumption for the treated water pumping station will be approximately 5,378,500 kWh per year. Electrical power will be supplied by Southern California Edison. Cogeneration facilities will be constructed to provide a portion of the energy needed to operate the plant. Standby power will be installed on site to operate critical processes in the event of a power outage. Critical process facilities and equipment include pumps, aeration, mixers, MBR, and disinfection. An electrical substation may be required on site to accommodate the new power load requirements.

Cogeneration

The SNRC can use the digester gas for cogeneration, which has a high concentration of methane. Cogeneration works by converting the methane to mechanical power and heat, which will be used for digester sludge heating and building heating.

3.3.2 Facility Staffing

The SNRC will be staffed with both operations and maintenance employees. A state-certified Grade IV operator will be employed to supervise the operation of the plant. A summary of the plant staff will be provided at a later date, as part of an updated *Title 22 Engineering Report*.

3.3.3 Reliability Features

The SNRC will comply with Title 22 Water Recycling Criteria and provide reliability by providing (1) standby units and equipment, (2) reliance on downstream treatment processes, (3) standby generator for emergency power, and (4) on-site short-term emergency storage.

The influent lift stations will limit peak flow rates, to allow for constant and optimum plant performance, with sewer flows in excess of the plant's treatment capacity remaining in the sewer. The plant will be designed with SCADA system to monitor vital plant functions and provide alarms for loss of power and process failures. A summary of plant alarms and reliability features will be provided at a later date, as part of an updated *Title 22 Engineering Report*.

3.3.4 Preventative Maintenance Program

Valley District will implement a preventative maintenance program which details each piece of equipment and a standard duration between inspections and the performance of routine maintenance in order to proactively prevent equipment failures. The specific measures for each treatment component will be provided at a later date, as part of an updated *Title 22 Engineering Report*.

3.3.5 UV Disinfection System

This section provides additional detail on the proposed UV Disinfection System for the project. Chapter 11 includes a discussion of the UV Disinfection System monitoring procedure.

Following the MBR, the water will pass through UV disinfection treatment. Design has not been established, but we are proposing the use of Trojan UVFit – D72AL75 reactors for the purposes of the Engineering Report. Equipment layout and dimensions are shown in **Table 3-2**, **Table 3-3**, and **Figure 3-3**, below. This system is a closed-vessel type and is estimated to consist of a 5 duty and 1 standby train arrangement (6 total trains), each with a single UV reactor. Each reactor consists of 72 UV lamps (high-efficiency, high-output, low-pressure type). The anticipated flow is 7.5 MGD at peak conditions and 6.0 MGD under low-flow conditions.

Each TrojanUVFit™ lamp assembly is contained with its own quartz sleeve. One end of the quartz sleeve is of a closed domed shape. The open end is sealed against the reactor chamber endplate by means of an o-ring compressed by the sleeve bolt. The quartz sleeves are made of type 214/219 clear fused quartz. Transmits no less than 89% UV light @254nm.

Cleaning of the UV disinfection system will be automatically controlled by the process control system to maintain the required minimum UV dose. The SCADA system will vary the number of lamp trains/reactors that are operating, as well as the lamp intensity at which the reactors are operating based on the influent flow and the UV transmittance in the UV influent distribution header/chamber.

Following construction and prior to activation of the SNRC, the UV system will be tested to ensure that pathogen inactivation is achieved to the levels required by Title 22. A spotcheck bioassay test protocol will be developed consistent with NWRI 2012 UV Guidelines and submitted to DDW for review and approval. Upon receipt of approval, testing will be conducted in accordance with the finalized protocol. Testing will serve as the basis to demonstrate that the UV system performance is sufficient to allow DDW acceptance when operated to meet the requirements and conditions indicated in the letter dated August 24, 2012 from DDW to Trojan Technologies titled *Conditional Acceptance of TrojanUVFit™ Model 72AL75 for Recycled Water, Validation Report, November 2009* (see **Appendix B**). The test results will be summarized in a report and submitted to DDW for review and approval.

The UV PLC will interface with the Plant SCADA System. This will allow the SCADA to monitor the UV disinfection process. The UV control system will monitor and initiate alarms for the following:

- Lamp Failure
- Ballast Failure
- Low UV Intensity
- Reactor Failure
- Reactor High Temperature
- High Reactor Flow
- Wiper Failure
- Sensor Failure/loss of signal
- Ground Fault Interrupter failure (1 Per each Power Distribution Center (PDC))
- Low Dose (low alarm at ≤ 84 mJ/cm^2; low low alarm at ≤ 80 mJ/cm^2)
- Low UVT (≤ 65%)
- Valve Fault
- Communication fault

High influent turbidity from the MBR will also cause an alarm and potential diversion event. Power supply interruptions will also trigger an alarm and shutdown. The SNRC will not have backup onsite power generation. Once the power interruption has been corrected then the system will be re-started and UV calibration confirmed.

Table 3-2: UV Disinfection System Design Criteria

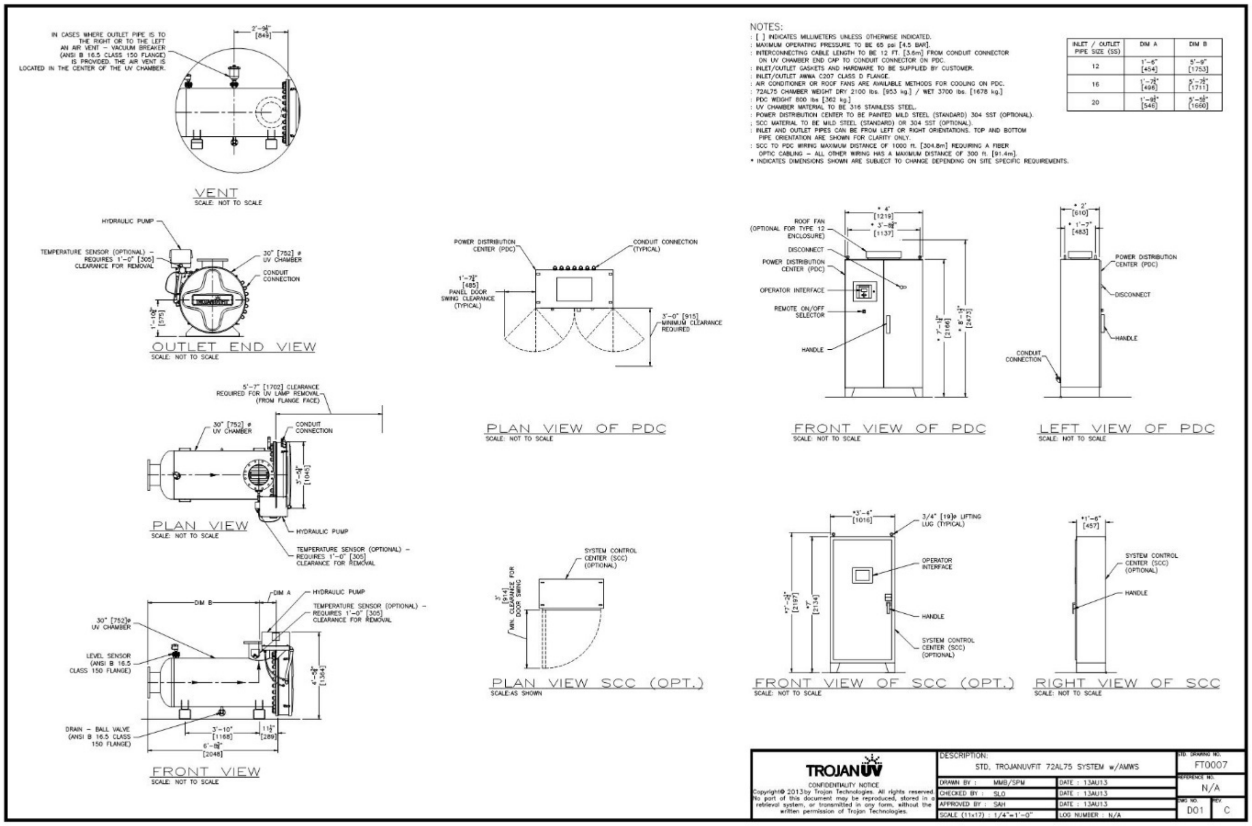
Description	Criteria
Type [1]	Closed-vessel (Example unit TrojanUVFit™ - 72AL75)
Lamp Type	High-efficiency, High-output, Low-pressure Amalgam
Required UV Dose [2]	Minimum: 80 mJ/cm^2 (NWRI 2012 Guidelines) Design: >84 mJ/cm^2 (DDW 2017 Pers.Comm.[3])
Required UV Transmittance	>65% following membrane filtration (NWRI 2012 Guidelines)
Peak Design Flow Rate	7.5 MGD (Current); 10 MGD (Future)
Number of Trains (Duty/Standby)	5/1 (Current); 6/1 (Future)
Number of Reactors Per Train	1
Lamps Per Reactor	72
Capacity (Each Reactor)	1.67 MGD (Peak capacity of a single 72 lamp UVFit unit is 1.67 MGD at >84mJ dose and 65% UVT)

1. Open channel and other UV models will be considered in the design which may change the number of trains and the arrangement. However, the design is required to meet Title 22 requirement and NWRI 2012 guidelines.
2. Each UV train would have a dedicated flow meter that is used by the control system to control UV delivered dose and confirm that required dose is met.
3. Pers.Comm. Email from DDW, Erica Wolski, 1/31/17: “DDW recommends a low dose alarm at 84 mJ/cm2 and a low low alarm at 80 mJ/cm2. The UVT alarm should be set at 65%.”

Table 3-3: UV Disinfection System Design Summary

UV REACTOR	
Reactor Model	TrojanUVFit™ - 72AL75
Current Number of SS316L Reactors	6 (including 1 redundant reactor)
Future Number of SS316L Reactors	7 (including 1 redundant reactor)
Number of Lamps per Reactor Chamber	72
Total Headloss at Peak Design Flow	4 in - H2O
Sleeve Wiping	Automatic Mechanical
CONTROL AND POWER PANELS	
Power Distribution Center (PDC) Quantity	6 (1 per reactor)
PDC Enclosure Rating	Mild Painted Steel (Type 12)
System Control Center (SCC) Quantity	1
SCC Enclosure Rating	Mild Painted Steel (Type 12)
EQUIPMENT LAYOUT & DIMENSIONS	
Reactor Flange Size	20 in. ANSI 150 lb
Approximate Reactor Length (+ clearance)	89 in. + 66 in. clearance at reactor endcap
PDC Dimensions (WxHxD)	48 in. x 86 in. x 24 in.
Cable Length Between PDC and Reactor	15 ft. – other options available
SCC Dimensions (WxHxD)	40 in. x 78 in. x 18 in.
ELECTRICAL REQUIREMENTS	
Each Power Distribution Center	One (1) 480Y/277 V, 3-phase, 4-wire + ground, 50/60Hz 18 kVA
System Control Center	One (1) 120 V, 1-phase, 2-wire + ground, 60Hz 1.2 kVA

Figure 3-3: UV Disinfection System Layout



Commissioning and Start-up

Commissiong, Start-up and Testing Plan

As part of Construction, a Commissioning, Start-Up and Testing Plan will be developed. The plan will discuss all the start-up activities to be conducted by the manufacturer and contractor and when these activities are to occur. The plan will be reviewed by the Owner and the Owner's representative to ensure that the staging of the activities will occur at an appropriate time for the plant. For instance, the plan should have provisions regarding postponing start up during peak flow and solids loading events.

After the UV manufacturer certifies that the equipment has been installed based on their specifications, then a series of startup and functional testing checks are conducted based on the requirements contained in the construction documents.

Start-up Checks

Before water is introduced into the UV system, a number of startup checks will be completed. The equipment/channels will be inspected and ensured that no foreign matter is in the Channel or reactor. In addition, comprehensive input/output checks will occur during the start-up activities. These checks are necessary to verify integrity and accuracy of signals between UV reactors, appurtenances such as gates, valves and analyzers, local control panels, master control panel, and any associated SCADA platform. Also, a check will be made of the status of each lamp and repair/replace as appropriate.

Functional Acceptance Testing

Functional acceptance testing will include activities that run the entire UV system through its "paces". This means ramping up and down of the flow, which should trigger the activation of additional banks and/or treatment trains, with associated closing/opening of gates and valves. Depending on actual flow variation as experienced by the utility, this may require the use of dummy signals to the control panels. Monitoring of the calculated dose, status of lamps, status of banks, power consumption, UV intensity, flow, UVT during this testing is important. It is particularly important to check that the calculated dose equation is correct and yields the correct dose under variable conditions as experienced during testing.

Reliability Features

The SNRC will comply with Title 22 Water Recycling Criteria and provide reliability by providing (1) standby units and equipment, (2) reliance on downstream treatment processes, (3) standby generator for emergency power, and (4) on-site short-term emergency storage.

The influent lift stations will limit peak flow rates, to allow for constant and optimum plant performance, with sewer flows in excess of the plant's treatment capacity remaining in the sewer. The plant will be designed with SCADA system to monitor vital plant functions and provide alarms for loss of power and process failures. A summary of plant alarms and reliability features will be provided at a later date, as part of an updated Title 22 Engineering Report.

The UV PLC will interface to the plant SCADA System via Modicon Modbus communication protocol. This will allow the SCADA to monitor the UV disinfection process and other additional I/O. A list of available UV system status addresses will be supplied upon completion of programming. There will be a redundant Modbus link to SCADA supplied. All alarms generated by the SCC will be logged and displayed on the Operator Interface. Each alarm will be time and date stamped when it occurs. The 20 most recent alarms are recorded and displayed in the alarm history register.

Operations and Maintenance

No specific operator certification is required for the operation of the UV disinfection system. However, on-site operations and training will be provided by Trojan staff to operators at SNRC.

A *System Operations and Maintenance Plan* will be developed and will address the control system, alarm functions, records and reports. The plan will outline procedures and frequency for sleeve cleaning, lamp replacement and maintenance of system components and frequency for calibrating monitoring equipment. The location, access, and quantity of a backup supply of lamps and other critical components. Following is an anticipated list of the spare equipment:

- UV Lamps: 30
- Quartz Sleeves: 5
- Ballasts: 5
- Wiper Seals: 30
- UV Intensity Sensor/Monitor: 1
- UV Transmittance Sensor/Monitor for On-line UVT Analyzer: 0[1]
- UV lamp for On-Line UVT Analyzer: 0[2]

[1] Pers.Comm. TrojanUV, Jordan Fournier, 2/1/17: "We do not recommend keeping a spare UVT sensor… If the sensor fails, the system will default to the design UVT."

[2] Pers.Comm. TrojanUV, Jordan Fournier, 2/1/17: "The HACH UVT Analyzer… does not have a lamp."

No special tools are required to perform maintenance on the TrojanUVFit™ system. For safety, the following will be located at the SNRC for use by the operators while performing maintenance on the equipment: UV resistant face shield and cotton or Latex gloves.

Contingency Plan

Per Section 60323(c) of the Water Recycling Criteria, the following outlines contingency planning for the proposed SNRC facility. Following is a list of conditions which would trigger an immediate diversion of the product water to take place:

- *High Filter Effluent Turbidity* – 24-hour total above 0.2 NTU exceeds 5% of 24 hours (or 72 minutes) and/or instantaneous turbidity exceeds 0.5 NTU for 10 seconds.
- *UV System Failure* – Applied UV dose of less than 84 millijoules/cm^2 and/or filtered effluent UV transmittance of less than 65%.

The following actions will be undertaken if the SNRC was not producing Title 22 compliant recycled water:

- *Lamp breakage (mercury release)* – The TrojanUVFit™ will include a UV sensor/monitor for intensity measurement as outlined in the alarm section. The UV sensor/monitor will detect a drop in the lamp output from the lamp breakage and will immediately alarm and shutdown the reactor.
- *Low-low operation UV dose, low-low UV intensity, or high-high turbidity alarms* - The TrojanUVFit™ will include a UV sensor/monitor which monitors operation UV dose, UV intensity and turbidity as outlined in the alarm section. The UV sensor/monitor will detect any of those three (3) alarm conditions and will immediately alarm and shutdown the reactor.
- *Failure of the upstream treatment process or UV disinfection system* - The TrojanUVFit™ will include a UV sensor/monitor which will identify failure of upstream treatment process (typically high-high turbidity) and will immediately alarm and shutdown the reactor.
- *Power supply interruptions* - The TrojanUVFit™ will include a PDC which will detect a power supply interruption and will immediately alarm and shutdown the reactor.
- *Activation of standby equipment including system and lamp start-up times* – At this time, it is not anticipated that the SNRC will have backup onsite power generation so no standby equipment will be provided. Once the power interruption has been corrected, the system will be re-started and UV calibration confirmed.

Any of the conditions listed above will trigger closing of motorized butterfly valves located between the UV disinfection system and recycled water storage/distribution. With the butterfly valves closed, flow will be diverted to the equalization basins and/or back to the headworks via a dedicated connection. This will be a requirement under the temporary RWQCB permit.

3.4 Recycled Water Conveyance and Discharge Facilities

The recycled water conveyance system includes a treated water pumping station on the SNRC site and a 24-inch diameter conveyance pipeline network conveying recycled water to each of two discharge locations to recharge the Bunker Hill Groundwater Basin. There are no additional customers or connections between the SNRC and the recharge areas.

The primary point of discharge will be City Creek, creating habitat opportunities and providing recharge of the Bunker Hill Groundwater Basin. Discharge will be diverted to Redlands Basins during periods of high native flow in City Creek, thus providing the ability to recharge the Bunker Hill Groundwater Basin during periods of high natural stream flows. A full operational plan is described in Section 6.4.

3.4.1 City Creek

For the City Creek discharge, approximately 38,700 lineal feet (LF) of 24-inch diameter distribution pipeline will be installed within East 6th Street or East 5th Street heading east from the SNRC for approximately two miles to Central Avenue and south across the City Creek Channel, then will follow the Channel north to the City Creek concrete discharge structure. Several pipeline alignments have been evaluated to reach the City Creek discharge structure. The pipeline will be installed either within San Bernardino County Flood Control District (SBCFCD) right-of-way along City Creek or will traverse under the creek levees. The discharge structure will consist of partially buried energy dissipation/flow control structures with a permanent footprint of up to 30-feet by 30-feet. The facility will include flow control valves, metering, and telemetry.

3.4.2 Redlands Basins

For the Redlands Basins, a 24-inch diameter conveyance pipeline will be installed within Alabama Street from East 6th Street or East 5th Street for approximately 7,000 LF south to the existing City of Redlands' basins (Redlands Basins). The conveyance pipeline will cross the Santa Ana River within an existing 30-inch diameter conduit attached to the Alabama Street Bridge that is owned by Valley District. The existing 30-inch pipeline will act as a casing for the proposed 24-inch pipeline. A discharge structure will be constructed at the Redlands Basins, similar to the existing structure, which will convey flows into multiple basins. The facility will be partially buried energy dissipation/flow control structures with a permanent footprint of less than 30-feet by 30-feet. Alternatively a pipeline (manifold) will be installed in the basin with multiple valves at a predetermined spacing that can be opened or closed at different times based on the incoming flow. The facility will include flow control valves, metering and telemetry.

Chapter 4 Source Wastewater

4.1 Influent Wastewater Characteristics

The characteristics of raw wastewater collected by the EVWD have not been historically monitored, since flows are treated at the SBWRP. EVWD conducted water quality sampling in April 2015 at sewer locations near the proposed influent pump station sites. The anticipated wastewater quality characteristics were developed based on the limited sampling data and information contained in the 2013 Annual Monitoring Report for the City of Redlands WRF (City of Redlands, 2014) as shown in **Table 4-1**. The City of Redlands raw wastewater quality has been utilized since Redlands most nearly represents the range of primarily domestic wastewater sources similar to the wastewater sources in the East Valley Water District service area.

Table 4-1: Estimated Raw Wastewater Quality

Constituent	Units	Average	Minimum	Maximum
pH	s.u.	8	7	9
Total Suspended Solids (TSS)	mg/L	220	200	250
Total Dissolved Solids (TDS)	mg/L	500	450	550
Biochemical Oxygen Demand (BOD)	mg/L	250	200	275
Total Inorganic Nitrogen (TIN)	mg/L	60.0	50.0	75.0
Total Kjehldahl Nitrogen (TKN)	mg/L	75.0	60.0	85.0
Nitrate (NO_3)	mg/L	-	-	-
Un-ionized Ammonia (NH_3)	mg/L	40.0	35.0	45.0
Total Hardness	mg/L as $CaCO_3$	175	160	200
Alkalinity	mg/L as $CaCO_3$	365	350	400
Boron	mg/L	0.18	0.20	0.25
Chloride	mg/L	100	65	130
Sulfate	mg/L	45	40	50
Sodium	mg/L	110	70	190
Copper	mg/L	35	25	45
Selenium	mg/L	ND	ND	ND
Total Coliform	MPN/100mL	6.28E+06	2.42E+06	1.90E+07

Source: City of Redlands, 2014. 2013 Annual Monitoring Report for the City of Redlands WRF. January 28.
Notes:
"-" = not analyzed, "ND" = non-detect

4.2 Industrial Pretreatment and Source Control Program

The purpose of an industrial pretreatment and source control program is to prevent discharges into the collections system that may have an adverse impact on treatment process performance or create hazardous conditions that may damage facilities or endanger workers and the public. Very few sources of industrial discharges exist within the EVWD service area; however, development of a comprehensive program and implementation process is essential for the EVWD to provide a high level of service and protect public health. The City of San Bernardino implements an effective regional pretreatment program which EVWD currently complies with. Valley District is currently applying for an NPDES permit to meet the U.S. Environmental Protection Agency (EPA) regulations in accordance with the Code of Federal Regulations Section 40, Part 403. Valley District will serve as the program administrator responsible for all permitting activities and establishing local limits for discharge to the collection system in addition to EPA and RWQCB specified pollutants of concern.

Compliance with DDW Groundwater Recharge Regulations

The program will comply with the applicable regulations below:

Title 22 Section 60320.106. Wastewater Source Control – *"A project sponsor shall ensure that the recycled municipal wastewater used for a GRRP shall be from a wastewater management agency that:*

(a) administers an industrial pretreatment and pollutant source control program; and

(b) implements and maintains a source control program that includes, at a minimum;

> *(1) an assessment of the fate of Department-specified and Regional Board-specified chemicals and contaminants through the wastewater and recycled municipal wastewater treatment systems,*
>
> *(2) chemical and contaminant source investigations and monitoring that focuses on Department-specified and Regional Board-specified chemicals and contaminants,*
>
> *(3) an outreach program to industrial, commercial, and residential communities within the portions of the sewage collection agency's service area that flows into the water reclamation plant subsequently supplying the GRRP, for the purpose of managing and minimizing the discharge of chemicals and contaminants at the source, and*
>
> *(4) a current inventory of chemicals and contaminants identified pursuant to this section, including new chemicals and contaminants resulting from new sources or changes to existing sources, that may be discharged into the wastewater collection system."*

Chapter 5 Recycled Water Quality

5.1 Estimated Treated Water Quality

The SNRC will produce Title 22 disinfected tertiary recycled water for unrestricted use and will meet effluent water quality and discharge requirements set forth by the Santa Ana RWQCB. Effluent water quality data cannot be presented at this time since the Project facilities are not yet constructed and operational. However, many WRPs utilizing MBR treatment technology produce tertiary effluent today, and a number of studies have been performed to analyze the technology's effectiveness in treating wastewater to such standards. The City of Redlands operates an MBR treatment system and **Table 5-1** presents the anticipated water quality resulting from MBR treatment of the EVWD's collected wastewater based on the City of Redland's Water Reclamation Facilities and input from MBR vendors.

Table 5-1: Estimated SNRC Recycled Water Quality

Constituent	Units	Avg	Min	Max
Flow	MGD	6.0	-	9.0
pH	s.u.	7.2	7.0	7.5
Total Suspended Solids (TSS)	mg/L	< 5.0	< 5.0	5.0
Total Dissolved Solids (TDS)	mg/L	463	400	500
Biochemical Oxygen Demand	mg/L	2.5	1.5	< 5.0
Total Inorganic Nitrogen	mg/L	6.0	5.5	9.5
Total Kjehldahl Nitrogen	mg/L	< 15.0	< 15.0	< 15.0
Nitrate (as N)	mg/L	5.5	-	-
Total Ammonia	mg/L	< 0.5	< 0.5	0.50
Total Phosphorus	mg/L	8.0	6.8	10.0
Total Hardness	mg/L as $CaCO_3$	150	135	160
Alkalinity	mg/L as $CaCO_3$	140	115	155
Boron	mg/L	0.18	0.20	0.25
Chloride	mg/L	105	85	135
Sulfate	mg/L	50	45	70
Sodium	mg/L	95	75	110
Copper	mg/L	5.3	3.8	6.8
Selenium	mg/L	ND	ND	ND
Total Coliform	MPN/100mL	< 2.2	< 2.2	< 2.2
Turbidity	NTU	< 0.5	< 0.5	< 0.5

Notes:
Values generally based on 2013 Annual Monitoring Report for City of Redlands Water Reclamation Facility (reported annual averages [avg] and reported monthly averages [min and max]) and input from GE Power & Water based on anticipated MBR design (with aerobic/anoxic zones).

5.2 Pathogenic Microorganism Control

Pathogen removal requirements for groundwater recharge (GWR) or groundwater replenishment reuse projects (GRRPs) are established by DDW in the Groundwater Recharge Regulations. The regulations require that recycled water used for groundwater recharge receives treatment that achieves 12-log enteric virus reduction, 10-log *Giardia* cyst reduction, and 10-log *Cryptosporidium* oocyst reduction. The treatment system must consist of at least three separate treatment processes where each process can be credited with no more than a 6-logs removal and must achieve at least a 1-log removal. Note that DDW has granted SNRC with 7-log removal for underground retention time given that modeled travel time exceeds 14 months (RWQCB-DDW Meeting, August 25, 2016). For each month recycled water is retained underground, the project can be credited with a maximum 1-log virus removal. For spreading projects, 10-log credit will be given for *Giardia* and *Cryptosporidium* if the Project meets Title 22 disinfected tertiary effluent and 6-months retention time. Process log removal credit can be based on information in the literature, previously conducted studies, and other information considered relevant by DDW.

Table 5-2 presents a summary of the pathogen removal credits for the SNRC. The Project will achieve 5-log virus credit through tertiary treatment using the Australian Tier 1 MBR validation protocol and Equation 3.3 of the 2012 NWRI Guidelines for UV Disinfection. Modeled underground retention time is in excess of 14 months, which allows for 7-log credit for virus, *Giardia,* and *Cryptosporidium*. As the project is providing disinfected tertiary treatment and providing at least six months retention underground, 10-log credit for both *Giardia* and *Cryptosporidium* can be credited per §60320.108(c). The SNRC will meet the minimum required 12/10/10 log removal for pathogenic microorganisms. The basis for the log removal credits is discussed in Section 5.2.1.

Table 5-2: Anticipated Project Log Removal Credits

Pathogen	MBR	UV	SAT[1]	Undergound Retention Time	Total	Required
Virus	1.5[2]	3.5[3]	-	7	12	12
Giardia	10[4]				10	10
Cryptosporidium	10[4]				10	10

Notes:
1. Soil aquifer treatment (SAT) is not included in the total. Underground retention time is determined on a monthly basis by DDW, which does not distinguish between SAT through percolation and travel retention time. If SAT were included, log removal would exceed the totals indicated.
2. Based on the Australian Tier 1 MBR validation protocol provided the MBR operates within the required operating envelope.
3. At a UV dose of 80 mJ/cm2, equation 3.3 (Log inactivation = (UV dose * 0.0368) +0.5464)) of the 2012 NWRI UV Guidelines can be used to determine the corresponding inactivation of MS2 based on the UV dose. A UV dose of 80 mJ/cm2 would be equal to 3.5-log virus inactivation.
4. Project will meet requirements for treatment (tertiary) and retention (6 months) to be credited with full 10-log reduction per §60320.108(c).

5.2.1 Anticipated Pathogen Reduction

Membrane Bio-Reactor and UV Disinfection Credits

MBR is the combination of a membrane process, like microfiltration, with a biological process, a suspended growth bioreactor. The MBR will be the primary method of treatment and first effect pathogen barrier. UV disinfection will be the final treatment barrier at the SNRC. The process is intended to inactivate and prevent growth of microbes in the SNRC effluent. The SNRC will utilize UV irradiation to achieve disinfection of the effluent.

Per the conditional approval letter dated August 24, 2012 from DDW to Trojan Technologies titled *Conditional Acceptance of TrojanUVFit^tm Model 72AL75 for Recycled Water, Validation Report, November 2009* (see **Appendix B**), DDW finds that "the validation testing and report have demonstrated the ability of the TrojanUVFit™ Model 72AL75 UV reactor UV Disinfection System to meet the minimum coliform and virus disinfection criteria found in Title 22 of the California Code of Regulations for recycled waters that have received treatment through an tertiary filtration process accepted by CDPH [now DDW]." This acceptance is based on the following condition:

- The TrojanUVFitTM Model 72AL75 UV Disinfection System must be preceded by filtration meeting the definition of "filtered wastewater" under Title 22 §60301.320. The proposed SNRC MBR filtration process will meet §60301.320 requirements.

Per NWRI's *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse* (NWRI, 2012), when using membrane filtration as part of the treatment train upstream of UV, the following performace criteria shall apply. DDW's conditional acceptance letter for TrojanUVFit™ Model 72AL75 specifies these operating requirements.

- The design UV dose shall be at least 80 mJ/cm2 under maximum day flow.
- The filtered effluent UV transmittance shall be 65 percent or greater at 254 nm.
- The effluent turbidity shall be no greater than 0.2 ntu 95% of the time, not to exceed 0.5 ntu.

Per Title 22, disinfected tertiary recycled water is that which combines disinfection and filtration to "inactivate and/or remove 99.99% of the plaque forming units of F-specific bacteriophage MS2, or polio virus in the wastewater" (Title 22 §60301.230). Therefore, the MBR/UV treatment train will provide 5 log inactivation for virus.

The design UV dose to meet Title 22 disinfected tertiary recycled water following membrane filtration (see Section 3.3.5 for UV design criteria) is based upon the required amount of millijoules per centimeter squared to receive a 5-log reduction in virus. As a consequence, at least 4-log reduction of *Giardia* and *Cryptosporidium* is also provided by the treatment system (WateReuse, 2015).

Soil Aquifer Treatment Credit

Soil aquifer treatment allows the percolation through the vadose zone in the soil to be used as a biologically active filter. Percolation through this zone provides approximately 4-log removal of bacteria, viruses, protozoa and significant reductions in TOC (Hogg et al., 2012). However percolation through the vadose zone cannot be distinguished from the overall underground retention time, therefore no credit for pathogen log removal will be listed specifically for SAT.

Underground Retention Time Credit

Final pathogen removal is achieved within the aquifer, based on a credit of 1-log reduction per 1-month of underground retention for viruses if the retention time is demonstrated with an added tracer. Numerical modeling is only credited with 0.5-log/month. A minimum of 7-log removal is needed to meet 12-log virus removal target after accounting for MBR and UV, so a minimum 14 months of underground retention time must be demonstrated by numerical groundwater modeling. In addition, the regulations (§60320.108) grant 10-log removal of *giardia* and *cryptosporidium* for spreading projects if the Project meets Title 22 disinfected tertiary effluent and 6-months retention time as demonstrated with an added tracer (or 12-months retention time if demonstrated by numerical modeling).

From the hydrogeological analysis (which applied numerical modeling), the following underground retention times are expected:

- City Creek: Ranges from 2.8 years to more than 26 years.
- Redlands Basins: Ranges from 6.6 years to more than 26 years.

Based on numerical modeling, it is anticipated that each recharge location will provide an underground retention time in excess of 14 months, for which DDW has allowed for 7-log credit for virus (RWQCB-DDW Meeting, August 25, 2016).

Chapter 6 Recharge Basin Use Areas and Operations

This section describes each of the three groundwater recharge areas and the proposed operational strategy. The groundwater recharge areas are all existing facilities, with the Redlands Basins currently actively managed and used for recharge. The hydrogeological analyses and groundwater impacts are provided in Chapter 10.

6.1 City Creek

The City Creek discharge location will include groundwater replenishment and habitat enhancement. Conceptual design includes conveying up to 7.5 MGD of recycled water from the SNRC to one or multiple discharge locations at City Creek. The habitat enhancement objective consists of maintaining perennial surface flow within City Creek, while minimizing flow into the Santa Ana River. The portion of City Creek considered for the hydrogeologic analysis included the approximate point where it nears the mouth of the gorge (intersection of State Route 330 and Highland Ave.) to where it joins the Santa Ana River. The creek only flows periodically in response to rainstorm events. Since the channel bottom is unlined and runs over the unconsolidated sandy sediments of the Bunker Hill Groundwater Basin, this portion of City Creek is likely a "losing stream". A losing stream is condition where a significant percentage of surface flow will infiltrate into the unsaturated zone, potentially reaching the water table.

6.1.1 Recharge Site

The City Creek recharge site will incorporate the channel area from the recycled water discharge point down to where the creek becomes tributary to the Santa Ana River. The discharge area length along City Creek is approximately 2.2 miles and the average width is approximately 45 feet, totaling about 13 acres in size. The channel area consists primarily of loose to loosely compacted rock and sand, with areas that are either devoid of vegetation or consisting of multiple species of native and non-native plants. Channel bottom elevations (going from northeast to southwest), range from approximately 1,320 feet above mean sea level (msl) to 1,140 feet above msl. The infiltration rate is estimated to be 6.7 feet/day. The properties of the proposed City Creek facility are summarized in **Table 6-1**.

Table 6-1: Summary of City Creek Discharge Facility Properties

Effective Recharge Area (acres)	Estimated Infiltration Rate (ft/day)	Recharge Capacity (MGD)	Depth to Groundwater (ft)	Vadose Zone Travel Time (days)
13	6.7	28.4	200	30
Source: GEOSCIENCE, 2017.				

6.1.2 Delivery, Conveyance, and Blending of Sources

Project water will be conveyed from the SNRC via pipeline. Up to 7.5 MGD of treated wastewater will be discharged into City Creek at a discharge point located near Boulder Avenue. The discharge location was determined based on spreadsheet modeling (GEOSCIENCE, 2017) such that 6.7 feet/day infiltration rate remains uniform throughout the wetted channel bottom, and will satisfy the Project objective of maintaining perennial flows while minimizing flow into the Santa Ana River. The discharge structure will consist of partially buried energy dissipation/flow control structures. Groundwater underflow and City Creek infiltration will be relied upon as the source for dilution. Refer to **Chapter 7** for a discussion of groundwater underflow sources.

6.2 Redlands Basins

The Redlands Basins discharge location will include groundwater replenishment. Conceptual design consists of conveying up to 7.5 MGD of recycled water on an intermittent basis from the SNRC to the existing Redlands Basins, which are located between the Foothill Freeway (210) and Alabama Street immediately south of the Santa Ana River channel in the City of Redlands. The City of Redlands WRF and California Street Landfill are located immediately west. The San Bernardino International Airport (former Norton Air Force Base) is located approximately 1.5 miles to the west-northwest of the site.

6.2.1 Recharge Site

The existing Redlands Basins is 2,125 feet long (east/west), approximately 1,000 feet wide (north/south) on its west side, and approximately 360 feet wide (north/south) on its east side, totaling about 43 acres. The site consists of eight side-by-side infiltration basins that progressively increase in size going from east to west. The basins are bounded by an earthen dike that is approximately 10 feet above existing land surface. Each adjacent infiltration basin is separated by an earthen berm approximately 5 feet in height. Bottom elevations of adjacent basins range from approximately 2 to 4 feet below the eastern basin. Bottom elevations of the Redlands Basins, going from east to west, range from approximately 1,210 feet msl to 1,186 feet msl (GEOSCIENCE, 2017). An infiltration rate of 3 feet/day was assumed based on previous work in the region and percolation test results conducted by Koury (Koury Geotechnical Services, Inc., 2015) for the City of Redlands. The properties of the existing Redlands Basins facility are summarized in **Table 6-2** below.

Table 6-2: Summary of Redlands Basins Discharge Facility Properties

Effective Recharge Area (acres)	Estimated Infiltration Rate (ft/day)	Recharge Capacity (MGD)	Depth to Groundwater (ft)	Vadose Zone Travel Time (days)
43	3.0	42.0	190	63
Source: GEOSCIENCE, 2017.				

6.2.2 Delivery, Conveyance, and Blending of Sources

Effluent from the SNRC for discharge in Redlands Basins will be delivered via a conveyance system, including a pumping station and pipeline. Up to 7.5 MGD of recycled water could be discharged at the Redlands Basins. The discharge structure will convey flows to one or more of the existing infiltration basins. The discharge structure will consist of partially buried/partially above grade energy dissipation/flow control structures. Alternatively, a pipeline (manifold) will be installed at one or more infiltration basins having multiple valves at predetermined spacing that can be opened or closed at different times based on the incoming flow. Groundwater underflow will be relied upon as the only source for dilution. Refer to **Chapter 7** for a discussion of groundwater underflow sources.

6.3 Recharge Basin Use Area Containment Provisions

Since the hydraulic capacity at each location are greater than the flows associated with the proposed groundwater recharge operations, no additional flow containment provisions are deemed necessary for the discharge locations.

6.4 Proposed Operational Strategy

The objectives of the SNRC operational strategy are to 1) recharge the Bunker Hill Groundwater Basin to improve water supply reliability within Valley District's service area, and 2) provide a discharge to City Creek to create habitat within the creek channel in accordance with the Upper Santa Ana River HCP. In light of these objectives and the opportunities to use City Creek, and Redlands Basins, the following operational strategy has been developed.

1. Effluent from the SNRC will be discharged to City Creek whenever flows within City Creek allow for discharge, with minimal recycled water flow from the discharge entering into the Santa Ana River. For purposes of establishing the operational strategy for discharge, it is assumed that discharge to City Creek will occur year-round, except during wet weather conditions when City Creek flow enters into the Santa Ana River. This flow condition is defined for purposes of the operational plan as 1 cfs. Based on historic USGS gage data, a sustained flow of 1 cfs from City Creek into the Santa Ana River requires a precipitation year that is nearly double the long-term average (e.g., similar to the precipitation in the spring of 1998). A sustained flow is defined as a flow of 1 cfs or more for at least 2 weeks. During these times of sustained flow, discharge to City Creek will cease and flow will be directed to Redlands Basins.
2. The SNRC discharge will be directed to the Redlands Basins when native flow conditions in City Creek exceed 1 cfs flow into the Santa Ana River for at least 2 weeks. Based on historical watershed hydrology, discharge to Redlands Basins is assumed to have approximately 50% probability of occurring in each year for at least one month. The average annual diversion would then be 1.11 MGD.

Chapter 7 Diluent Water Sources

As specified in the CCR Title 22 Regulations, Division 4, Chapter 3, the source of diluent water is to be identified and quantified for a groundwater recharge and replenishment program that uses recycled water.

This Project is unique in that it assumes that groundwater underflow will be the primary source of diluent water at each discharge/recharge location. Model results suggest the volume of groundwater underflow within the primary aquifers is sufficient to satisfy groundwater recharge with recycled water regulatory requirements for RWC at the nearest water supply wells located downgradient. The flow net/Darcian calculation method was used to estimate the amount of groundwater underflow that is available as a source of diluent water for each facility. This calculation is detailed in the hydrogeological analysis for the Project (GEOSCIENCE 2017) and generally included the following steps:

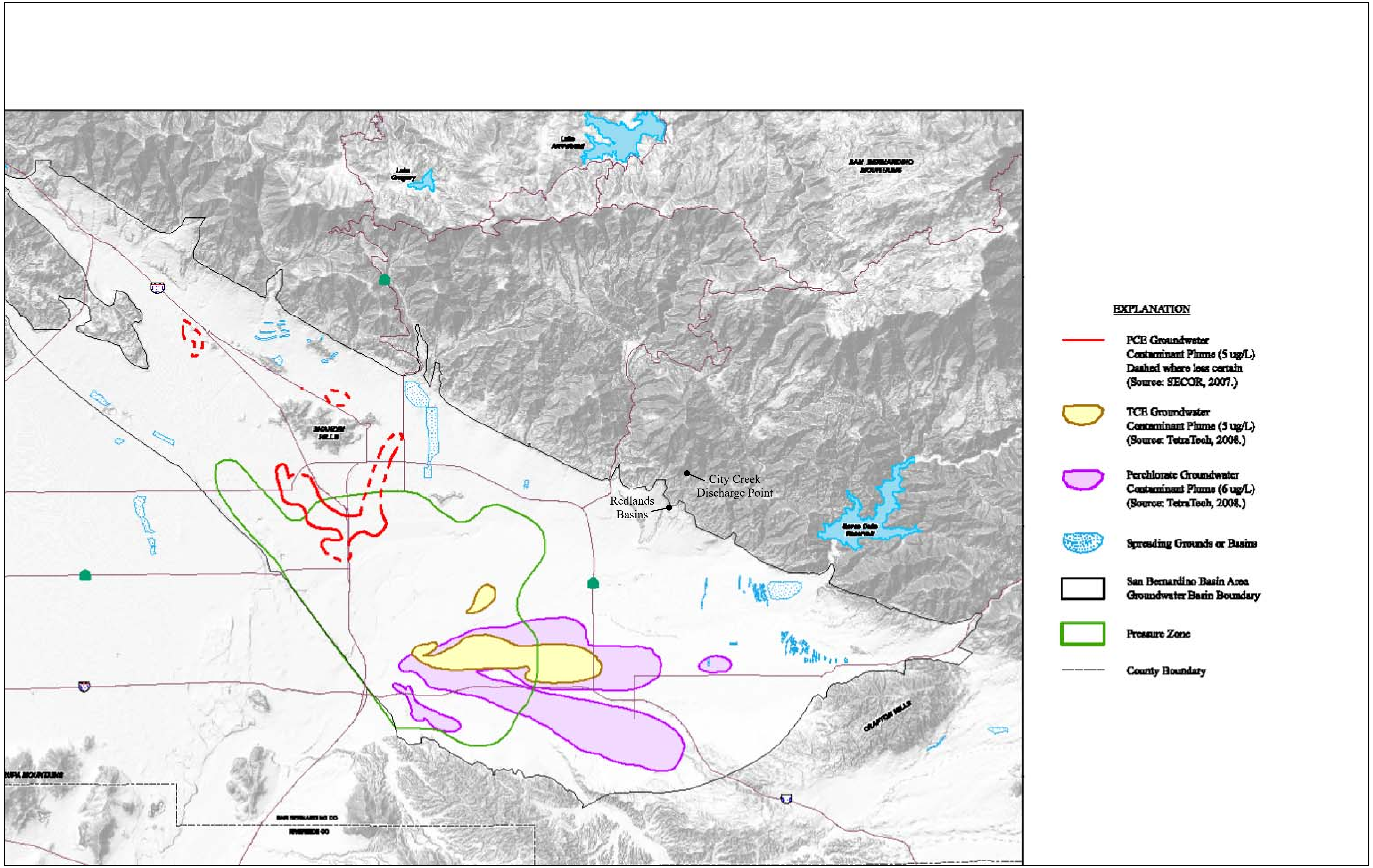
1. Compile and evaluate long-term precipitation for the Project area.
2. Compile and evaluate historic groundwater elevations for the Project area and select a representative year for above-normal, below-normal and average elevation conditions.
3. Compile and evaluate aquifer parameters estimated from lithologic, geophysical, construction details, and water level data for wells located in the Project area.
4. Construct a flow net for the area in the vicinity of and down gradient from the recharge site by sketching groundwater elevation contours (for wet, dry and average hydrology) and flow lines.
5. Identify the cross-sectional area to be used for the Darcian underflow calculation.
6. Determine the hydraulic gradient of the water table for the cross-sectional area.
7. Obtain hydraulic conductivity values and elevations for primary aquifer units from the numerical groundwater flow model.
8. Calculate saturated thickness of the uppermost aquifer unit and combined uppermost/deeper aquifer unit for above-normal, below-normal and average groundwater elevation conditions.
9. Quantify, using the Darcian equation, groundwater underflow at the cross-section for the uppermost aquifer layers and combined uppermost/deeper aquifer layers.
10. Perform a sensitivity analysis to determine which parameters have the most effect on the results.

7.1 Bunker Hill Subbasin Water Quality

The Bunker Hill Subbasin is generally calcium-carbonate type water. Water quality, in terms of TDS, is considered good with TDS concentrations ranging from approximately 150 to 550 mg/L, with an average 324 mg/L. The current maximum contaminant level (MCL) for nitrate is 45 mg/L (as N). The elevated levels of nitrate (around 55 mg/L near Redlands Basins) are likely due to historical use of Chilean nitrate fertilizer when much of the Bunker Hill Subbasin included agricultural land uses (GEOSCIENCE, 2010).

The Bunker Hill Subbasin has been long plagued by several major contaminant plumes of consisting of various inorganic compounds found above the MCL: Crafton-Redlands (TCE/PCE/CBCP), Norton Air Force Base (TCE and PCE), Muscoy and Newmark Superfund sites (TCE and PCE), and Santa Fe plume (PCE, TCE and 1,2-DCE). Cleanup of the plumes has been ongoing for several years, and includes the use of granulated active carbon to treat extracted groundwater which is blended for municipal distribution. **Figure 7-1** provides an overview of the plumes.

Figure 7-1: Overview of Plumes



Source: Recycled Water Feasibility Study, RMC 2014.

7.2 City Creek Diluent Water Source and Quality

7.2.1 City Creek Diluent Water Source

The primary source of diluent water is anticipated to include SWP water and/or diverted Santa Ana River water artificially spread at the existing Santa Ana River Spreading Grounds, located approximately 4 to 4.5 miles east of the City Creek facility. Due to the direction of regional groundwater flow and City Creek being located hydraulically downgradient from the Santa Ana River spreading grounds, portions of both sources of diluent water are anticipated to reach the area of the City Creek facility as groundwater underflow. Additional sources for groundwater underflow that may qualify as diluent water include the infiltration of natural and urban runoff that recharges the groundwater basin through either deep percolation from the ground surface or as inflow/underflow from areas outside the basin.

The flow net/Darcian method was used to estimate average groundwater underflow. This analysis was performed for both the uppermost aquifer unit and the combined uppermost/deeper aquifer unit. In order to evaluate the effect changing groundwater elevations have on the amount of available groundwater underflow at the recharge site, values representative of above-normal (Spring 1983), below-normal (Spring 2011) and average (Fall 1994) groundwater elevations were used to establish minimum, maximum and average estimated volumes. Scenarios 1a, 2a and 3a represent underflow within the uppermost aquifer unit for conditions of above-normal, below-normal and average groundwater elevations, respectively. Scenarios 1b, 2b and 3b represent underflow within the combined uppermost/deeper aquifer unit under the same sequence of groundwater elevation conditions.

Table 7-1 summarizes the input parameters and results of estimated groundwater underflow for scenarios 1a, 1b, 2a, 2b, 3a and 3b (six scenarios).

7.2.2 City Creek Diluent Water Quality

In general, TDS concentrations in water extracted by municipal production wells in the area west of City Creek ranges from approximately 200 to 640 milligrams per liter (mg/L), but are generally lower than secondary MCL of 500 mg/L. Nitrate concentrations were historically elevated in some wells located west of City Creek, but are generally less than the MCL of 45 mg/L.

Table 7-1: Range of Estimated Groundwater Flow at City Creek

Scenario No.	Aquifer System	Groundwater Conditions	Average Saturated Thickness (ft)	Hydraulic Gradient (ft/mile)	Estimated Groundwater Underflow (AFY)	Estimated Groundwater Underflow (MGD)
1a	Uppermost Alluvial Aquifer Unit	Above-normal (1983)	256	23	2,355	2.1
1b	All Alluvial Aquifer Unit		820	23	6,833	6.1
2a	Uppermost Alluvial Aquifer Unit	Below-normal (2011)	111	63	2,797	2.5
2b	All Alluvial Aquifer Unit		676	63	15,429	13.8
3a	Uppermost Alluvial Aquifer Unit	Average (1994)	152	39	2,371	2.1
3b	All Alluvial Aquifer Unit		717	39	10,130	9.0
Source: GEOSCIENCE, 2016a. Table 4-2.						

7.3 Redlands Basins

7.3.1 Redlands Basins Diluent Water Source

The primary source of diluent water for the Redlands Basins area is anticipated to include imported SWP water and/or diverted Santa Ana River water artificially spread at the existing Santa Ana River Spreading Grounds located approximately 4.5 miles east of the Redlands Basins. Due to the direction of regional groundwater flow and the Redlands Basins being located hydraulically down gradient from the Santa Ana River Spreading Grounds, portions of both sources of diluent water are anticipated to reach the area of the Redlands Basins as groundwater underflow. Natural recharge may qualify as an additional source of diluent water as groundwater underflow.

As with City Creek, the flow net/Darcian method was used to estimate the amount of groundwater underflow that is available as a source of diluent water for the proposed Project at the Redlands Basins. Also, this analysis was performed for the uppermost aquifer unit and the combined uppermost/deeper aquifer unit under three conditions: above-normal (Spring 1983), below-normal (spring 2011) and average (fall 1994) groundwater elevations were used to establish minimum, maximum and average estimated volumes. Scenarios 1a, 2a and 3a represent underflow within the uppermost aquifer unit for conditions of above-normal, below-normal, and average groundwater elevations, respectively. Scenarios 1b, 2b and 3b represent underflow within the combined uppermost/deeper aquifer unit under the same sequence of groundwater elevation conditions. Table 7-3 summarizes the input parameters and results of estimated groundwater underflow for scenarios 1a, 1b, 2a, 2b, 3a and 3b (six scenarios).

Table 7-2: Range of Estimated Groundwater Flow at Redlands Basins

Scenario No.	Aquifer System	Groundwater Conditions	Average Saturated Thickness (ft)	Hydraulic Gradient (ft/mile)	Estimated Groundwater Underflow (AFY)	Estimated Groundwater Underflow (MGD)
1a	Uppermost Alluvial Aquifer Unit	Above-normal (1983)	671	17	2,525	2.3
1b	All Alluvial Aquifer Unit		1,442	17	9,210	8.2
2a	Uppermost Alluvial Aquifer Unit	Below-normal (2011)	489	26	2,814	2.5
2b	All Alluvial Aquifer Unit		1,260	26	12,309	11.0
3a	Uppermost Alluvial Aquifer Unit	Average (1994)	558	16	1,976	1.8
3b	All Alluvial Aquifer Unit		1,329	16	17,989	17.1

Source: GEOSCIENCE, 2016b.

7.3.2 Redlands Basins Diluent Water Quality

Water quality, in terms of TDS, is considered good with concentrations ranging from approximately 200 to 300 mg/L. Concentrations of nitrate (as NO3) in the area of the Redlands Basins ranges from non-detect to approximately 55 mg/L. The MCL for nitrate is 45 mg/L. The elevated levels of nitrate are likely due to historical use of fertilizer when much of the Bunker Hill Subbasin included agricultural land uses (GEOSCIENCE, 2016b).

Chapter 8 Groundwater Basin

This section provides an overview of the groundwater basin characteristics. The hydrogeological analysis on the groundwater recharge impacts in provided in **Chapter 10**.

As described below, two court judgments, referred to as the Western Judgment (1969) and the Santa Ana River Judgment (1969), provide the overall framework for the division of rights and responsibilities for water users in the Santa Ana River basin.

- Santa Ana River Judgment - Stipulated Judgment in Orange County Water District v City of Chino et al., entered April 17, 1969.
- Western Judgment - Judgment in Western Municipal Water District (Western) of Riverside County et al., v East San Bernardino County Water District et al., entered April 17, 1969.

8.1 Surface Water Body Description and Management

The Project area is in the Santa Ana River watershed, which drains from the steep slopes of the San Bernardino Mountains to the valley floor of the Inland Empire, through the Prado Basin and on to Orange County and the Pacific Ocean. The Santa Ana River travels 75 miles from its origins near Big Bear Lake to the Pacific Ocean. In the mountainous areas, perennial surface water exists in segments of the Santa Ana River and tributaries. Big Bear Dam impounds surface water high in the mountains. Below Big Bear, Seven Oaks Dam, built by the US Army Corps of Engineers in the 1990s, provides flood control protection to the urbanized valley below. From below the Seven Oaks Dam through the City of San Bernardino, the river is a soft-bottom channel that is generally dry in the summer, but contains some seasonal flows in the winter and spring. Historically, the Santa Ana River likely exhibited perennial flows from groundwater upwelling; however, groundwater levels have declined since the 1800s eliminating perennial flows in much of the river.

Several large tributaries join the river in San Bernardino County including City Creek, Warm Creek, Lytle Creek, Plunge Creek, Mill Creek, the Rialto Drain, and San Timoteo Creek. These tributaries are usually dry in the summer, responding only to storm events and spring runoff. Some of the smaller drainages exhibit perennial urban runoff, but these flows generally infiltrate into the ground prior to the confluence with the Santa Ana River in the San Bernardino County portion of the watershed.

Downstream of the City of San Bernardino to the City of Riverside, the Santa Ana River flows perennially due to the discharges from wastewater treatment plants serving the upper valley cities including Highland, San Bernardino, Rialto, and Colton. Groundwater and urban runoff begin to enter the river as it flows past the City of Riverside. Downstream of Riverside, the river flows are increased by discharges from the City of Riverside and the City of Corona wastewater treatment plants. Near the City of Corona, the river flows through the Prado Reservoir and Dam through the Santa Ana Mountains and onto the Orange County Coastal Plain.

Surface water rights are largely governed by the Santa Ana River Judgment, which imposes a physical solution requiring parties in the upper Santa Ana River watershed to deliver a minimum quantity and quality of water to points downstream, most notably at the Riverside Narrows and Prado Dam. This information is documented annually in the Santa Ana River Watermaster report. The Watermaster consists of five members, with responsibilities for administering the judgment and reporting annually to the court and representative agencies. The Santa Ana River Watermaster is composed of members from each of the four representative agencies. Valley District, Inland Empire Utilities Agency, and Western Municipal Water District (Western) nominate one member each to the Watermaster; Orange County Water District nominates two members.

8.2 Groundwater Basin Description and Management

The Bunker Hill Groundwater Basin, encompassing an area of approximately 120 square miles, consists of alluvial material and is bounded by the San Gabriel Mountains, San Bernardino Mountains, Crafton Hills as well as several faults including the Banning, Redlands, San Andreas, Glen Helen, and San Jacinto faults. The Basin is located within what is referred to as the San Bernardino Basin Area (SBBA) and stores approximately six million AF of water, and is the primary water source for the EVWD service area. The Basin is made up of two sub-basins: Bunker Hill A to the northwest and Bunker Hill B to the southeast.

The Bunker Hill Groundwater Basin consists of alluvial materials deposited over igneous and metamorphic rocks. Alluvial deposits that make up the primary aquifers are separated into geohydrologic units: upper confining member (UCM) and its water bearing zone (UWB); middle confining member (MCM) and its water-bearing zone (MWB), and lower confining member (LCM) and its water-bearing zone (LWB). The UWB and MWB units yield the largest quantities of water to pumping wells.

The primary faults within the Bunker Hill Groundwater Basin are the San Andreas and San Jacinto fault zones. The San Andreas Fault Zone is located north of the Project area, at the front of the San Bernardino Mountains.

The right to groundwater, along with an established mechanism to account for "foreign" water such a recharged recycled water, is paramount to the implementation of the Project. The Western Judgment generally defines the SBBA as the region above the San Jacinto Fault, while excluding Yucaipa, San Timoteo, Oak Glen, and Beaumont Basins. This area produces 71% of groundwater extracted from the Santa Ana Watershed and includes the Bunker Hill subbasins.

8.2.1 Western Judgement

The Western Judgment identifies regional representative agencies to be responsible, on behalf of the numerous parties bound thereby, for implementing its replenishment obligations and other requirements. The representative entities are Valley District and Western Municipal Water District (Western). Valley District is solely responsible for providing replenishment of the SBBA if extractions exceed the safe yield of the Basin. The court-appointed Watermaster includes representatives from Valley District and Western. A summary of pertinent basin management information related to the Western Judgment is included below.

- **Natural Safe Yield** – The natural safe yield was established at 232,100 AFY. The Plaintiffs' (Western entities) rights are capped at 27.95% of the natural safe yield, or 64,862 AF, notwithstanding any Additional Extraction Agreements or *"new conservation,"* as defined in the judgment. The Non- Plaintiffs' (Valley District entities) rights are unlimited provided that an equal amount of basin replenishment occurs to offset any amount that the Non-Plaintiff production exceeds—72.05% of the natural safe yield, or 167,238 AF. An annual report, entitled Annual Report of the Western-San Bernardino Watermaster, provides an *"accounting"* of basin extractions.
- **Replenishment** – Valley District is responsible for replenishing the SBBA for that amount of Non-Plaintiff extractions exceeding 167,238 AF. The replenishment obligation may be met by any of the following means:
    - Return flow from excess extractions
    - Replenishment provided in excess of that required
    - Amounts extracted without replenishment obligations (i.e., Additional Production Agreement)
    - That amount of water extracted below the natural safe yield
    - Return flow from imported water

- **New Conservation –** This is defined in the Western Judgment as *"any increase in replenishment from natural precipitation which results from operation of works and facilities not now in existence."* The judgment contemplated that the parties would develop facilities that would result in the capture of more natural runoff. The construction of the Seven Oaks Dam within the Santa Ana River has provided such an opportunity, and Valley District and Western are seeking to obtain a water right from the SWRCB and to construct the facilities necessary to capture Santa Ana River water that was not historically captured. The parties under the Western Judgment will have their adjusted extraction rights increased to include a proportionate share of any New Conservation, provided that each Plaintiff party pays its proportionate share of the costs to develop said New Conservation.

As a non-plaintiff party to the Western Judgment, EVWD was allotted production rights of 14,217 AFY. The Judgment states that EVWD may pump more than this to meet demands, while Valley District is responsible for recharging the basin. Through implementing a groundwater recharge recycled water project, EVWD will be contributing to basin recharge along with Valley District, which will provide an opportunity for this contribution to be credited to Valley District towards their current obligation (RMC, 2014; 2015a), therefore offsetting supplies currently utilized for groundwater recharge.

8.2.2 Seven Oaks Accord

The 2004 Seven Oaks Accord calls for Valley District and Western to recognize the prior rights of water users for a portion of the natural flow of the Santa Ana River. In exchange, the water users agreed to withdraw their protests to the Santa Ana River Water Right Applications for Supplemental Water Supply submitted by Valley District and Western to gain additional appropriations of Santa Ana River water.

The Seven Oaks Accord requires Valley District and Western to develop a groundwater spreading program in cooperation with other signed parties, including EVWD. The program is intended to maintain groundwater levels at specific wells in the region. This prompted local agencies to include groundwater management in the Upper Santa Ana River Integrated Resource Management Plan and collectively prepare an annual Regional Water Management Plan since 2008.

8.3 Basin Characteristics near City Creek

8.3.1 Geology

The areas of the proposed City Creek discharge and nearest down gradient active municipal supply wells evaluated for this study are located in the north-central portion of Bunker Hill B, a structural depression located between the San Gabriel Mountains, San Bernardino Mountains, and Crafton Hills, and between several faults. The depth to bedrock in the vicinity of the proposed City Creek discharge and closest active wells is estimated to occur at approximately 700-800 ft depth. There are no faults which may act as a barrier to groundwater flow known to occur in the vicinity of City Creek. The primary faults located in Bunker Hill B are located approximately a mile up gradient from the study area, along the base of the foothills.

8.3.2 Groundwater Flow

Groundwater generally flows by gravity westward paralleling the Santa Ana River. There are no indications that any of the known or otherwise postulated faults within this area of the Basin act as barriers to groundwater flow to these two sites.

8.3.3 Summary of Aquifer Characteristics

Table 8-1 provides an overview of aquifer characteristics near the City Creek discharge.

Table 8-1: Summary of Aquifer Characteristics Near City Creek

Parameter	Units	Value
Transmissivity	ft3/day	10,700 – 40,100
Hydraulic Conductivity	ft/day	3-220
Porosity	%	0.2
Storativity	%	0.01
Percolation Rate	ft/day	3.0 – 6.0
Depth to Groundwater	ft	219
Groundwater Flow Direction	-	West/southwest
Hydraulic Gradient	ft/ft	0.007
Source: GEOSCIENCE, 2016a. Table 4-1.		

8.3.4 Groundwater Quality

As groundwater is the diluent water source, groundwater quality in the City Creek area is provided in **Section 7.2.2**.

8.4 Basin Characteristics near Redlands Basins

8.4.1 Geology

The areas of the Redlands Basins and nearest down gradient active water supply wells evaluated for this study are located in the south-central portion of the Bunker Hill Subbasin, a structural depression located between the San Gabriel Mountains, San Bernardino Mountains, and Crafton Hills, and between several faults. The depth to bedrock in the vicinity of the Redlands Basins and closest active wells is estimated to occur at approximately 1,400 ft (GEOSCIENCE, 2009). The primary faults which occur within the Bunker Hill Subbasin, such as the San Andreas and San Jacinto fault zones, are located more than 3 miles away from the Redlands Basins.

8.4.2 Groundwater Flow

Groundwater in the area of the Redlands Basins generally flows by gravity drainage westward paralleling the Santa Ana River. There are no indications that any of the known or otherwise postulated faults within the Bunker Hill Subbasin act as barriers to groundwater flow within the Redlands Basins area.

8.4.3 Summary of Aquifer Characteristics

Table 8-3 provides an overview of aquifer characteristics near the Redlands Basins discharge.

Table 8-2: Summary of Aquifer Characteristics Near East Redlands Basins

Parameter	Units	Value
Transmissivity	ft^3/day	10,700 – 40,100
Hydraulic Conductivity	ft/day	3 – 220
Porosity	%	0.2
Storativity	%	0.01
Percolation Rate	ft/day	3.0 – 6.0
Depth to Groundwater	ft	165 – 195
Groundwater Flow Direction	-	west/southwest
Hydraulic Gradient	ft/ft	0.005
Source: GEOSCIENCE, 2016b. Table 4-1.		

8.4.4 Groundwater Quality

As groundwater is the diluent water source, groundwater quality in the Redlands Basins area is provided in **Section 7.3.2**.

8.5 Water Budget Summary

In the *Antidegradation Analysis: Sterling Natural Resource Center* (Valley District, 2017), a conceptual model for the Bunker Hill Groundwater Basin was developed based on the water balance in the *Second Report of Recharge Parties Pursuant to RWQCB Resolution No. R8-2008-0019* (Valley District 2013). The water budget estimates all of the basin inflows from infiltration, artificial recharge, subsurface inflow, and stream surface recharge, along with outflows from evapotranspiration, pumping, and underflow. Additional inflows for recycled water recharge from City of Redlands WRF were added to the conceptual model developed for the Antidegradation Analysis. **Table 8-3** lists the Bunker Hill B water balance. Note that proposed SNRC discharges and Valley District's planned stormwater recharge projects are not shown in the table.

Table 8-3: Bunker Hill B Water Balance

	Flux Term	Annual Average (AFY)
INFLOW	*Infiltration*	
	Precipitation and Local Runoff Recharge	3,366
	Return Flows (30% Non-Plaintiff; 3% Plaintiff)	19,029
	Artificial Recharge	
	SAR Artificial Recharge	19,730
	SWP Artificial Recharge - "Average" Scenario 3	3,300
	Subsurface Inflow	
	Underflow Recharge from Bunker Hill A, Scenario 3	11,566
	Recharge from Underflow	3,084
	Stream Surface Recharge	
	Gaged Streamflow	88,285
	Ungaged Mountain Runoff	7,550
	Recycled Water Recharge	
	Redlands WRF Effluent	6,720
	INFLOW TOTAL	**162,630**
OUTFLOW	*Evapotranspiration*	
	Evapotranspiration, Scenario 3	2,865
	Groundwater Pumping	
	Groundwater Pumping	114,160
	Subsurface Outflow	
	Underflow Across San Jacinto Fault Near SAR	84
	Underflow to Bunker Hill A, Scenario 3	20,954
	OUTFLOW TOTAL	**138,063**

Source: Valley District. 2013. 2013 Second Report of Recharge Parties Pursuant to RWQCB Resolution No. R8-2008-0019. Prepared by GEOSCIENCE.

Chapter 9 Production Wells

No new production wells are being installed as part of this project. This chapter details the existing production wells in the vicinity of each recharge location. Any impacts on the wells are detailed in **Chapter 10**.

9.1 Wells near City Creek Discharge

The nearest active down gradient municipal supply wells to the proposed City Creek recharge location are the EVWD Plant Nos. 9A, 141, 151, and 132-5, as summarized in **Figure 9-1**. EVWD Plant No. 136 (Dunkirk Wells 1 and 2) are both municipal supply wells located closer to City Creek (approximately 1,130 feet down gradient); however, both wells are inactive. Farther downstream, and also currently inactive, is municipal supply well EVWD Plant No. 40A, which is located approximately 850 feet west of City Creek. The active CEMEX industrial supply Well No. 2 is located approximately 1,200 feet up gradient of City Creek.

Table 9-1: Summary of Municipal Water Supply Wells near City Creek

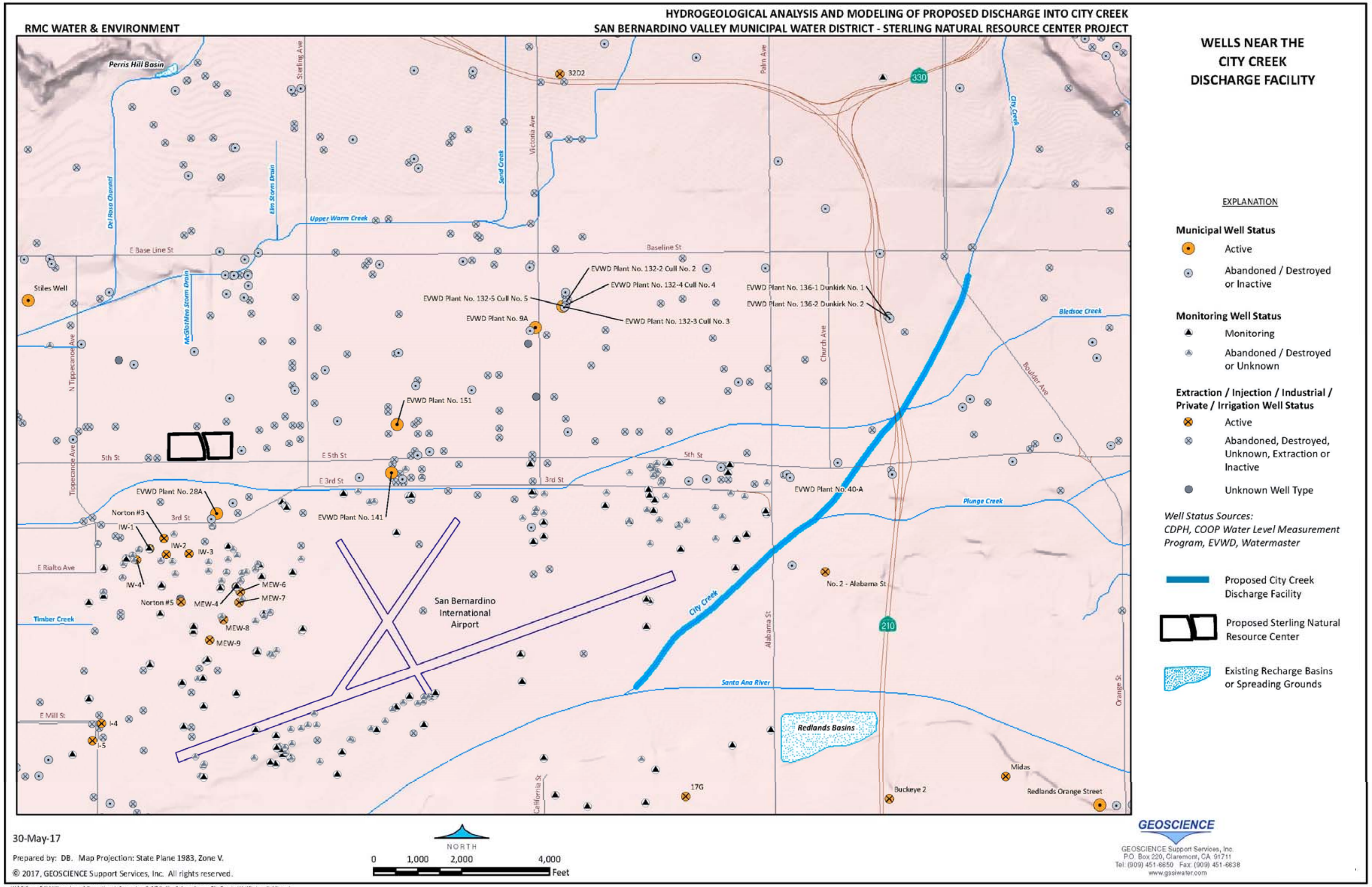
Well	State Well No.	Owner	Casing Depth (ft bgs)	Perforations[1] (ft bgs)	Distance from City Creek (ft)	Avg Production 2004-13 (afy)	Water Quality Concerns
EVWD Plant No. 141	1S/3W-06P18S	EVWD	1110	740-1,103	7,400	1,512	-
EVWD Plant No. 151	1S/3W-06L06S	EVWD	-[2]	-[2]	7,700	2,278	-
EVWD Plant No. 132-5	1S/3W-05D09S	EVWD	-[2]	-[2]	7,500	1,275	-
EVWD Plant No. 9A	1S/3W-06H04S	EVWD	421	173-415	7,500	826	-

Notes:

1. Only the top of the uppermost perforation or well screen and the bottom of the lowermost perforation or well screen are listed. Typically wells may have multiple screens between these intervals.
2. Casing depth and perforations data is not available for EVWD Plant No. 151 and 132-5.

Source: GEOSCIENCE, 2017.

Figure 9-1: Wells near City Creek



Source: GEOSCIENCE, 2017.

9.2 Wells Near Redlands Basin

The nearest municipal water supply wells located down gradient from the Redlands Basins include the Gage Canal Company 31-1R, 46-1R, 56-1, 92-2, and 92-3 wells as summarized in **Figure 9-2**, Gage 46-1R is the closest well to the Redlands Basins, located approximately 13,200 feet (2.5 miles) down gradient (west) from the Redlands Basins. Gage 92-2 is the furthest down gradient well located approximately 14,800 feet (2.8 miles) from the Redlands Basins.

Table 9-2: Summary of Municipal Water Supply Wells near Redlands Basins

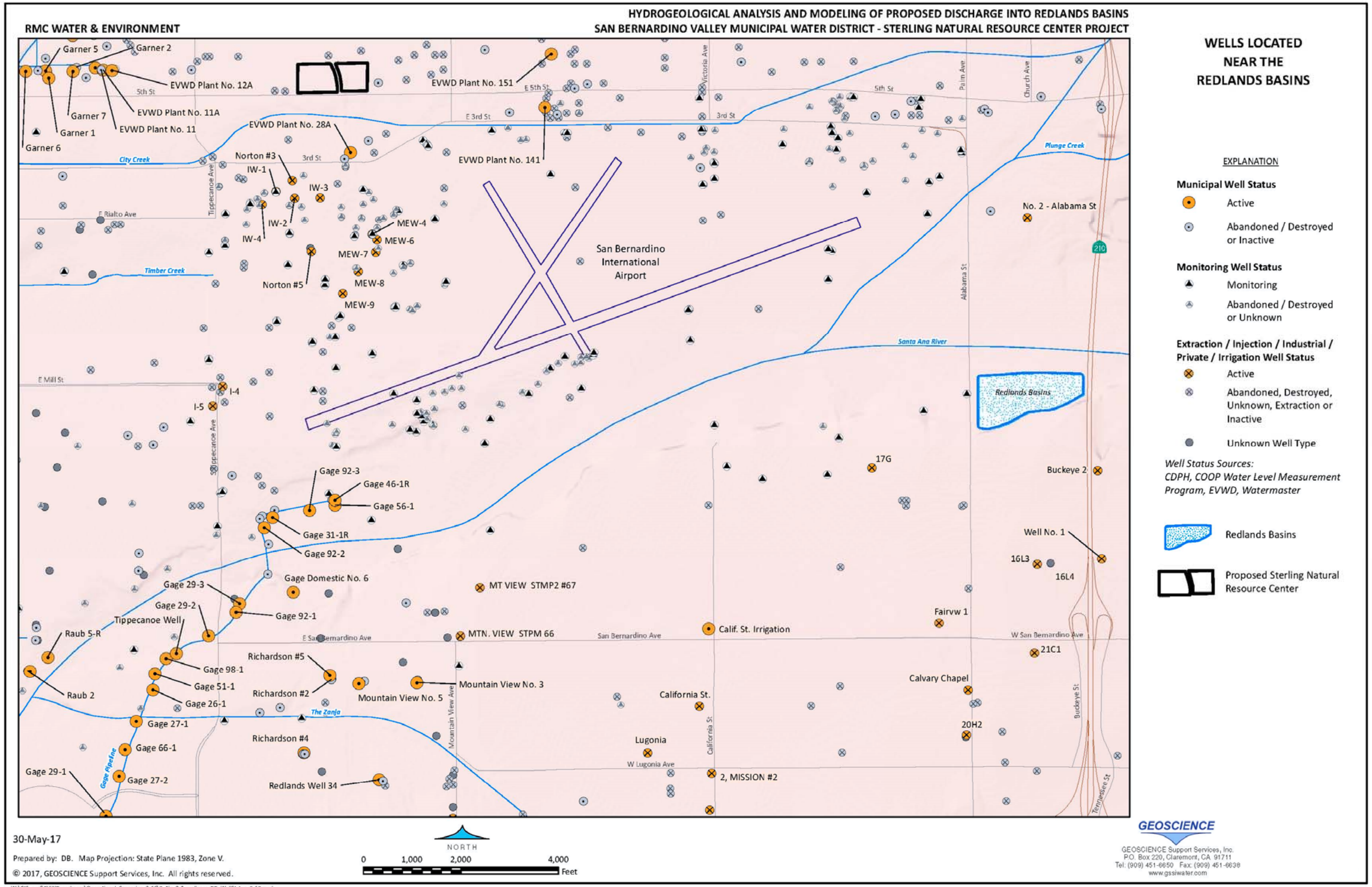
Well	State Well No.	Owner	Casing Depth (ft bgs)	Perforations[1] (ft bgs)	Distance from Redlands (ft)	Avg Production 2004-13 (afy)	Water Quality Concerns
Gage 46-1R	1S/4W-13G04	City of Riverside/Gage Canal Co.	690	180-674	13,300	1,076	Uranium, Gross Alpha, Radon 222
Gage 56-1	1S/4W-13G03	City of Riverside/Gage Canal Co.	1,126	467-1,104	13,300	2,418	Radon 222
EVWD Plant No. 28A	1S/4W-12B06	EVWD	1,052	704-1,052	13,800	1,772	-
Gage 92-3	1S/4W-13L08	City of Riverside/Gage Canal Co.	1,230	730-1,210	13,900	1,863	Uranium, Gross Alpha
Gage 31-1R	1S/4W-13L0X	City of Riverside/Gage Canal Co.	1,150	260-1,130	14,700	1,004	Uranium, Gross Alpha
Gage 92-2	1S/4W-13L07	City of Riverside/Gage Canal Co.	1,185	760-1,145	14,800	1,512	-

Note:

1. Only the top of the uppermost perforation or well screen and the bottom of the lowermost perforation or well screen are listed. Typically wells may have multiple screens between these intervals.

Source: GEOSCIENCE, 2017.

Figure 9-2: Wells near Redlands Basins



Source: GEOSCIENCE, 2017

Chapter 10 Groundwater Recharge Impacts

This section presents an assessment of the potential impacts of the proposed recharge activities on the underlying Bunker Hill Groundwater Basin, and evaluates the compliance with Title 22. The objectives of the SNRC are to:

- Recharge the Bunker Hill Groundwater Basin to improve water supply reliability within Valley District's service area,
- Provide a discharge to City Creek to create habitat within the creek channel in accordance with the Upper Santa Ana River HCP, and
- Meet all applicable regulatory requirements while minimizing any impacts on the groundwater basin.

The evaluation of groundwater recharge impacts were conducted in light of these three objectives.

10.1 Hydrogeological Analyses Overview

GEOSCIENCE conducted a series of analyses of the Bunker Hill Groundwater Subbasin as a part of the evaluation of the identified discharge location alternatives. The analyses focused on the evaluation of discharge to City Creek and Redlands Basins to evaluate compliance with Title 22 requirements for various recycled water recharge scenarios.

10.1.1 Groundwater Model Overview

In order to predict compliance with recycled water regulatory requirements, an existing calibrated numerical groundwater model was used. The model selected was the Refined Basin Flow Model developed jointly by the City of San Bernardino Municipal Water Department and Valley District. This model is an integrated streamflow, groundwater flow, and solute transport model developed for the SBBA. Details of the model are provided in GEOSCIENCE 2017.

The model was used to address to address key issues, including:

- Predicted travel distance and seepage velocity of recycled water after 12 months, 10 years and 20 years of Project recharge
- Predicted retention time of recycled water
- Predicted distribution of percent recycled water after 12 months, 10 years and 20 years of Project recharge
- Predicted percentage of RWC at the nearest active municipal wells

10.2 Summary of Project Scenarios

The initial analyses of the City Creek and Redlands Basins were conducted assuming a full 10 MGD projected discharge/recharge rate. Three preliminary hydrogeological analyses were completed for the Project assuming a 10 MGD discharge:

- **Scenario 1**: 10 MGD discharge to City Creek (GEOSCIENCE 2016a)
- **Scenario 2**: 10 MGD discharge to Redlands Basins (GEOSCIENCE 2016b)
- **Scenario 3**: 10 MGD discharge to East Twin Creek Spreading Grounds (GEOSCIENCE 2016c).

During this timeframe, the Project was refined to a maximum 7.5 MGD treatment plant in its first phase (with buildout to 10 MGD at a later date). An operational strategy was also developed for the Project (refer to **Section 6.4**). This operational strategy was further modeled as follows (GEOSCIENCE 2017):

- In **Scenario 4a**, 7.5 MGD discharge to City Creek except when flows in City Creek at the confluence to the Santa Ana River exceed 1 cfs for 14 days, then 7.5 MGD discharge to East Twin Creek Spreading Grounds – *Note that this alternative was eliminated*.
- In **Scenario 4b**, 7.5 MGD discharge to City Creek except when flows in City Creek at the confluence to the Santa Ana River exceed 1 cfs for 14 days, then 7.5 MGD discharge to Redlands Basins – *Note that this alternative is the proposed Project*.

As described above, it has been concluded that using East Twin Creek Spreading Grounds for recharge of recycled water is not a necessary project component at this time. **The groundwater quality analysis described below focuses on Scenario 4b, which will be referred to as the "SNRC Operational Scenario" for the remainder of this document.**

The technical memoranda summarizing the SNRC Operational Scenario was completed and stamped by hydrogeologists licensed in the state of California and is provided in **Appendix C**.

The analyses of the City Creek and Redlands Basins recharge locations provide insights into the operational flexibility of the recharge to the groundwater in the Bunker Hill Groundwater Basin and any wells that might be impacted. The analyses show that the City Creek and Redlands Basins both have recharge capacities that allow full recharge of the projected future SNRC flow of 7.5 to 10 MGD.

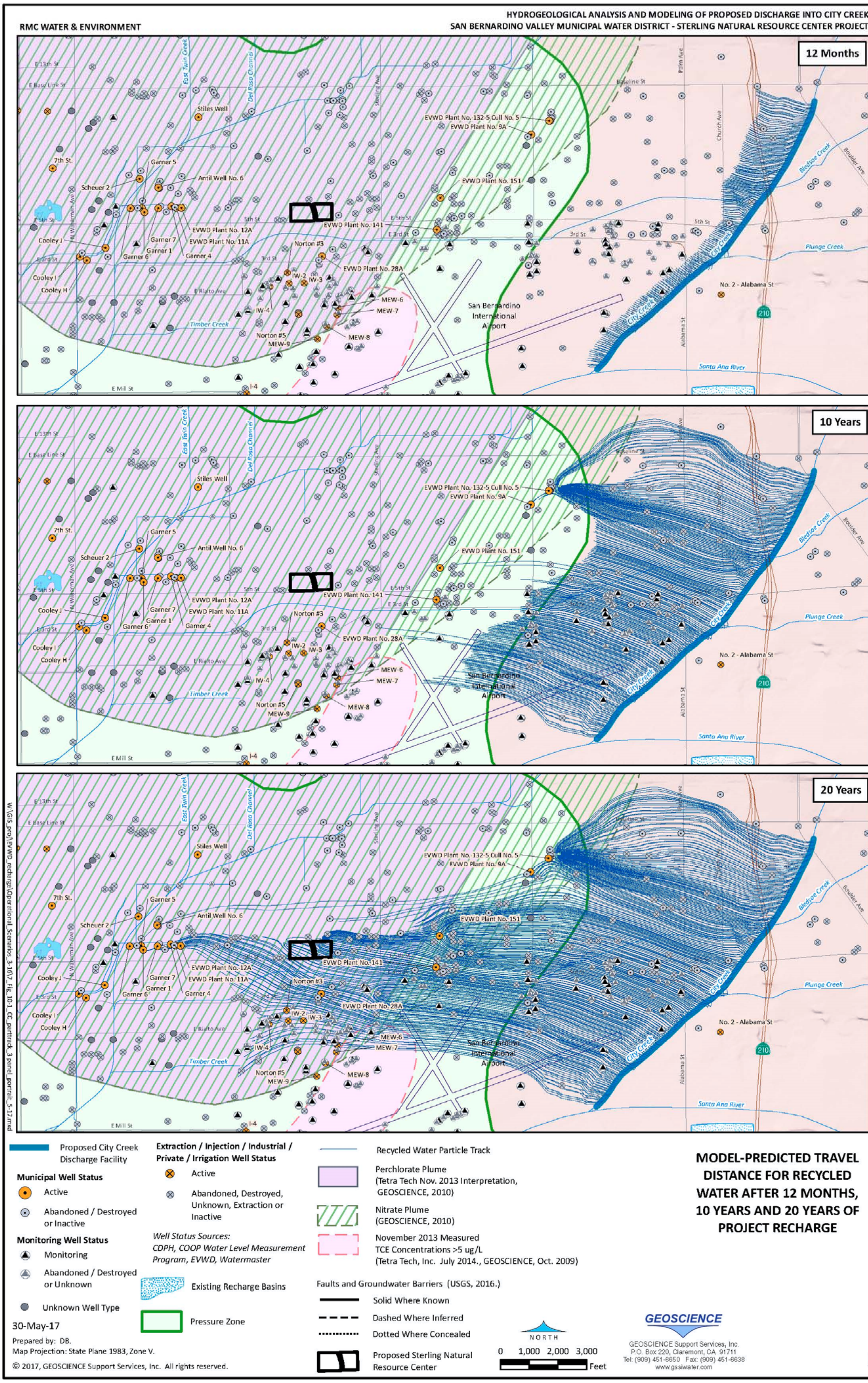
10.2.1 Retention Time and RWC – City Creek Discharge (10 MGD)

The analysis of recycled water recharge into City Creek under Scenario 1 assumes that 100% of the SNRC projected flow of 10 MGD is discharged into City Creek. The resulting analysis indicates there are no impacts to any drinking water wells located downstream of City Creek. **Figure 10-1** provides a graphic representation of the 12-month, 10-year, and 20-year travel times for a 10 MGD year-round discharge into City Creek. **Figure 10-2** provide a graphic representation of the RWC for each of the wells potentially affected by a City Creek discharge. As can be seen, there are no active drinking water wells that would be impacted by the travel time and 20% RWC regulatory requirements within the first 10 years.

10.2.2 Retention Time and RWC – Redlands Basins (10 MGD)

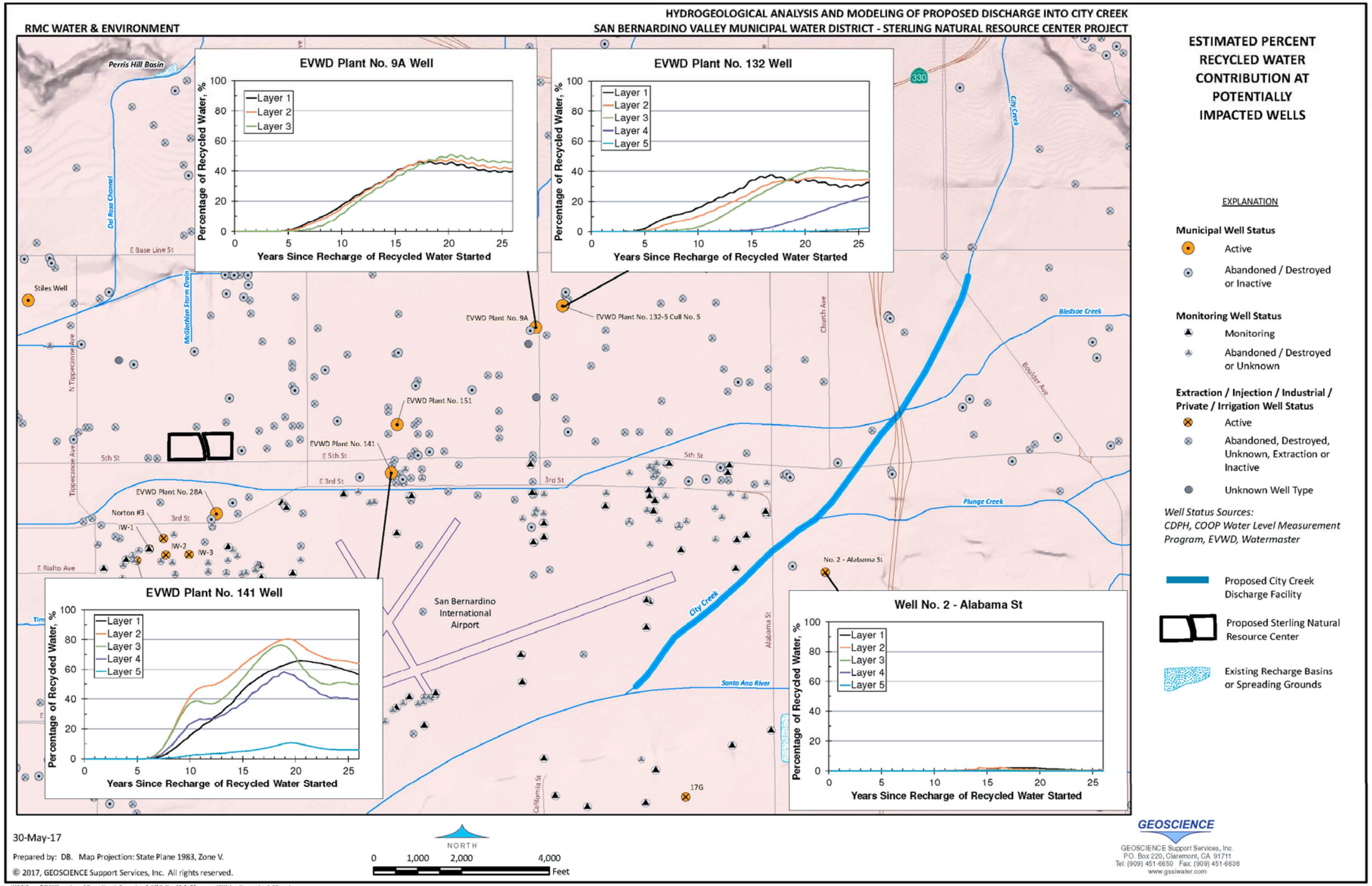
The analysis of recycled water recharge into the Redlands Basins under Scenario 2 assumes that 100% of the SNRC projected flow of 10 MGD is discharged into the Redlands Basins. The resulting analysis indicates there are no impacts to one any wells located downstream of the existing Redlands Basins. **Figure 10-3** provides a graphic representation of the 12-month, 10-year, and 20-year travel times for a 10 MGD year-round discharge into the Redlands Basins. **Figure 10-4** provide a graphic representation of the RWC for the wells located down gradient from the Redlands Basins. As can be seen, the travel time and 20% RWC are well within the regulatory requirements for the down gradient wells.

Figure 10-1: Travel Time for 10 MGD Discharge at City Creek



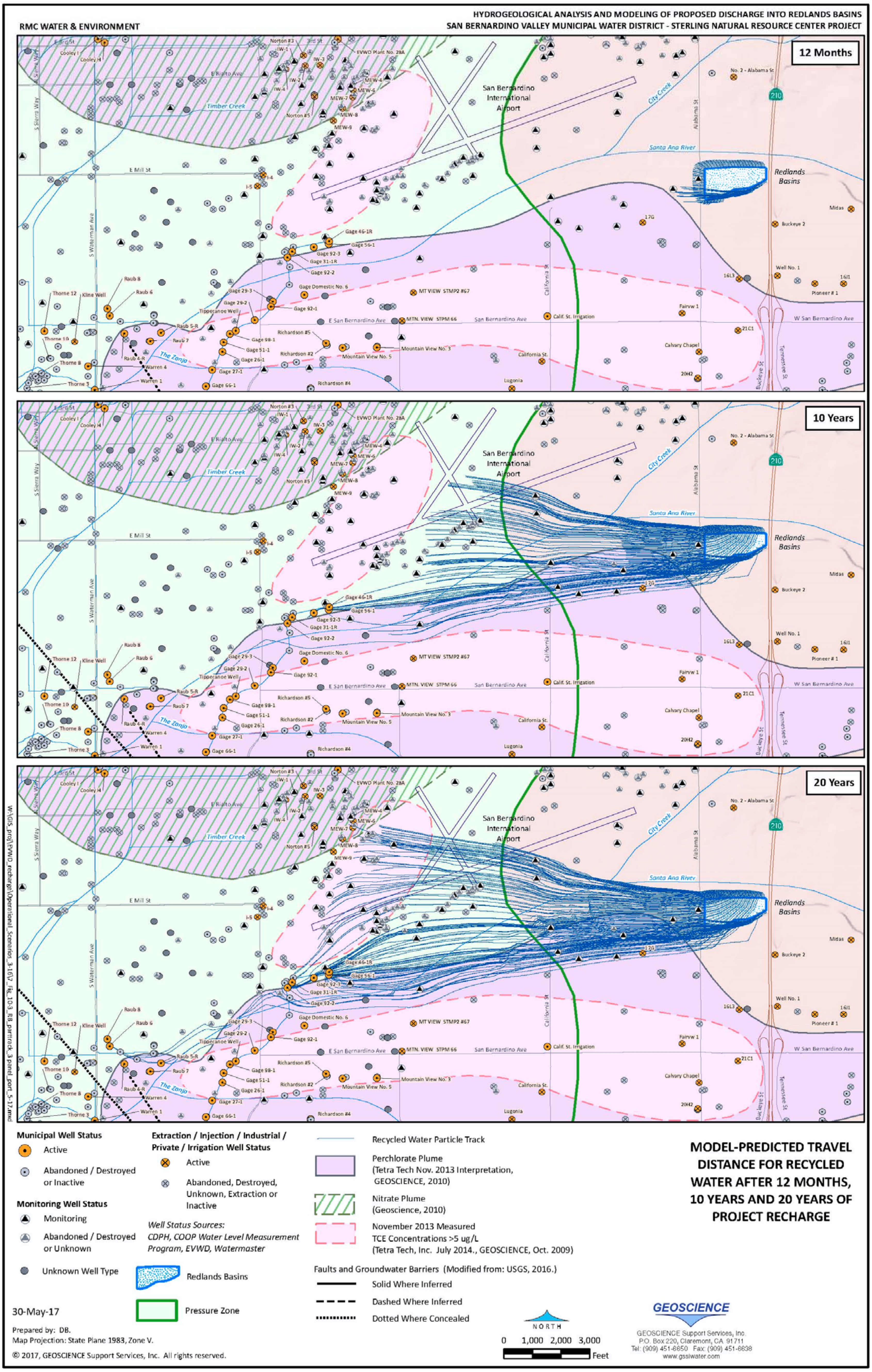
Source: GEOSCIENCES, 2016a.

Figure 10-2: RWC for 10 MGD Discharge at City Creek



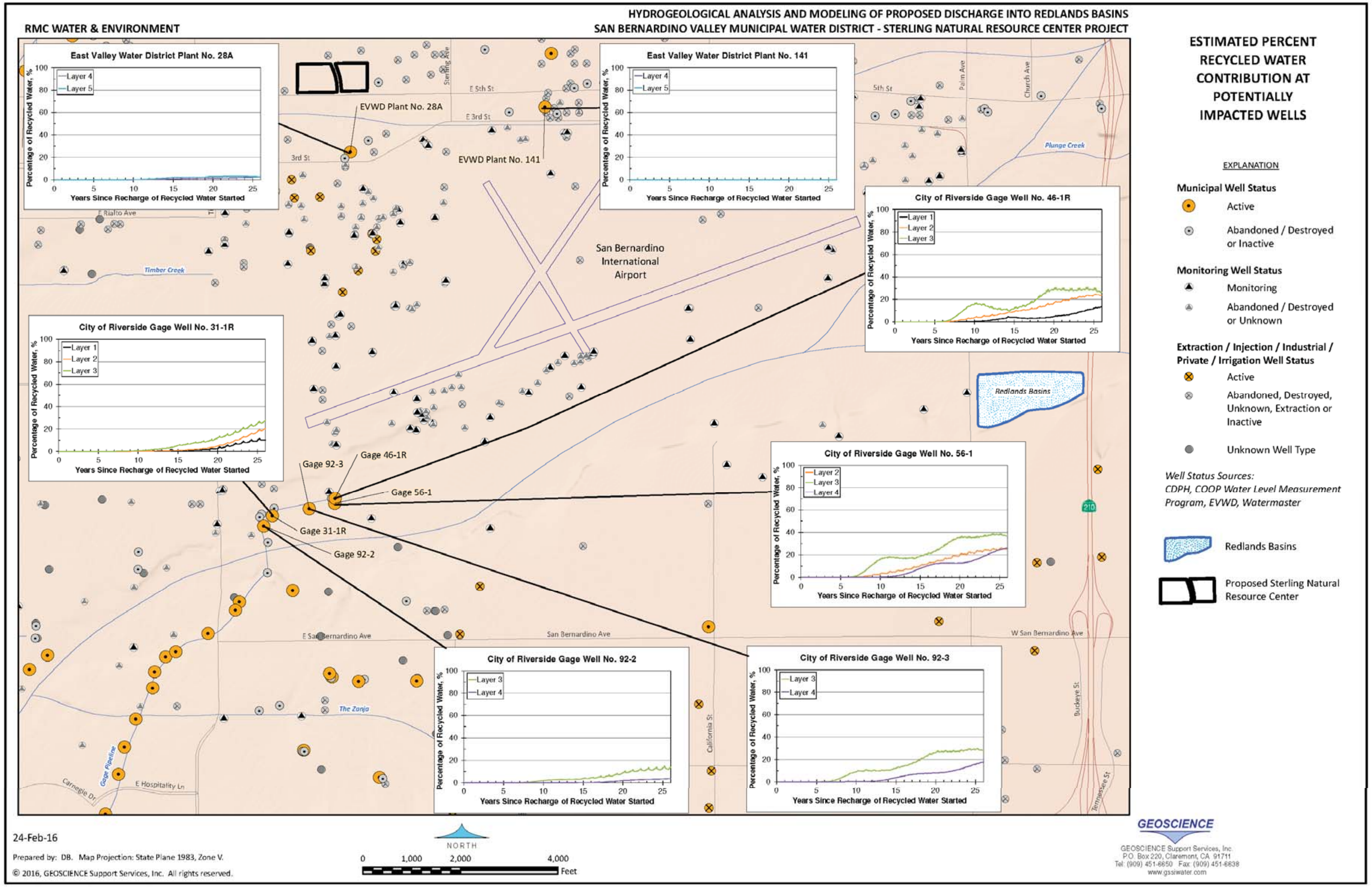
Source: GEOSCIENCES, 2016a.

Figure 10-3: Travel Time for 10 MGD Discharge at Redlands Basins



Source: GEOSCIENCES, 2016b.

Figure 10-4: RWC for 10 MGD Discharge at Redlands Basins



Source: GEOSCIENCES, 2016b.

10.3 SNRC Operational Scenario

The Refined Basin Flow Model was again used to evaluate the hydrogeological impacts of the proposed SNRC Operational Scenario of groundwater recharge of recycled water produced at the SNRC.

The analysis of recycled water recharge into City Creek assumes that 100% of the SNRC flow of 7.5 MGD is discharged to City Creek except when flow at the confluence of City Creek and the Santa Ana River exceeds 1 cfs for 14 days. Historic gage data is available upstream of the proposed discharge location, and no gage data are available at/near the confluence of City Creek with the Santa Ana River. The available historic flow data for City Creek were reviewed, and a model analysis of City Creek results of the estimated historic occurrences of 1 cfs at the confluence of City Creek and the Santa Ana River are shown in **Table 10-1**. The results indicate that the 1 cfs flow criteria occurs 23 times in the historic model data set that spans from 1979 to 2004, and that the 1 cfs flow criteria occurs up to 6 times in 3 different years (1980, 1993, and 1998). It should be noted that the flow model used for this analysis is constructed in a monthly time step, thus for modeling purposes it is assumed that flow diversion would occur for the full month for any month in which the 1 cfs threshold exceeds 14 days.

For the historic period of 1979 to 2004, diverting flow from discharging into City Creek to the Redlands Basins during high flow periods would result in up to 3.75 MGD in a single year and an equivalent average annual flow of 1.1 MGD to the Redlands Basins and 6.4 MGD to City Creek.

Table 10-1 shows the total projected recharge flow released into City Creek and the Redlands Basins. The analysis assumes that City of Redlands releases approximately 6 MGD into the Redlands Basins, alongside the proposed SNRC discharge.[3] As such, a combined recharge flow of up to 9.75 MGD could be released to Redlands Basins in some hydrologic years. However, it should be noted that the City of Redlands currently discharges a small amount of recycled water to the Redlands Basins, with the majority of its recycled water being used offsite for industrial cooling purposes.

[3] *Waste Discharge Requirements for the City of Redlands Wastewater Treatment Plant, San Bernardino County, Order No. 98-54* states that current flow rate is 6 MGD and plant design capacity is 9.5 MGD. Communications with Chris Diggs, City of Redlands, reports that annual discharge to Redlands Basins was 2.9 MGD in 2014. This analysis uses 6 MGD in modeling of the operational scenarios.

Table 10-1: Summary of Occurrences of 1 cfs flow in City Creek at the Confluence with Santa Ana River

Model Year	No. Months Flow in City Creek Exceeds 1 cfs at SAR	Scenario 4b: Redlands Basins	
		City of Redlands Discharge (MGD)[1]	Total Annual Discharge Flow (MGD)
1979	5	6.0	9.125
1980	6	6.0	9.75
1981	-	6.0	6.0
1982	2	6.0	7.25
1983	5	6.0	9.125
1984	-	6.0	6.0
1985	-	6.0	6.0
1986	2	6.0	7.25
1987	-	6.0	6.0
1988	-	6.0	6.0
1989	-	6.0	6.0
1990	-	6.0	6.0
1991	2	6.0	7.25
1992	3	6.0	7.875
1993	6	6.0	9.75
1994	-	6.0	6.0
1995	5	6.0	9.125
1996	1	6.0	6.625
1997	2	6.0	7.25
1998	6	6.0	9.75
1999	-	6.0	6.0
2000	-	6.0	6.0
2001	-	6.0	6.0
2002	-	6.0	6.0
2003	1	6.0	6.625
2004	-	6.0	6.0
Total (over 26 years)		**156.0**	**184.75**
Average Annual Discharge to Redlands Basins		**6.0**	**7.11**

Note: 1. Based on average flow rate reported in Santa Ana RWQCB Order No. 98-54.

10.3.1 Retention Time and RWC - City Creek and Redlands Basins (7.5 MGD)

The SNRC Operational Scenario assumes that 100% of the SNRC flow of 7.5 MGD is discharged to City Creek except when flow at the confluence of City Creek and the Santa Ana River exceeds 1 cfs for 14 days then flow is diverted to the Redlands Basins for recharge purposes. A detailed description of the impacts of the discharge of recycled water to City Creek in conjunction with the Redlands Basins is presented in **Appendix C**.

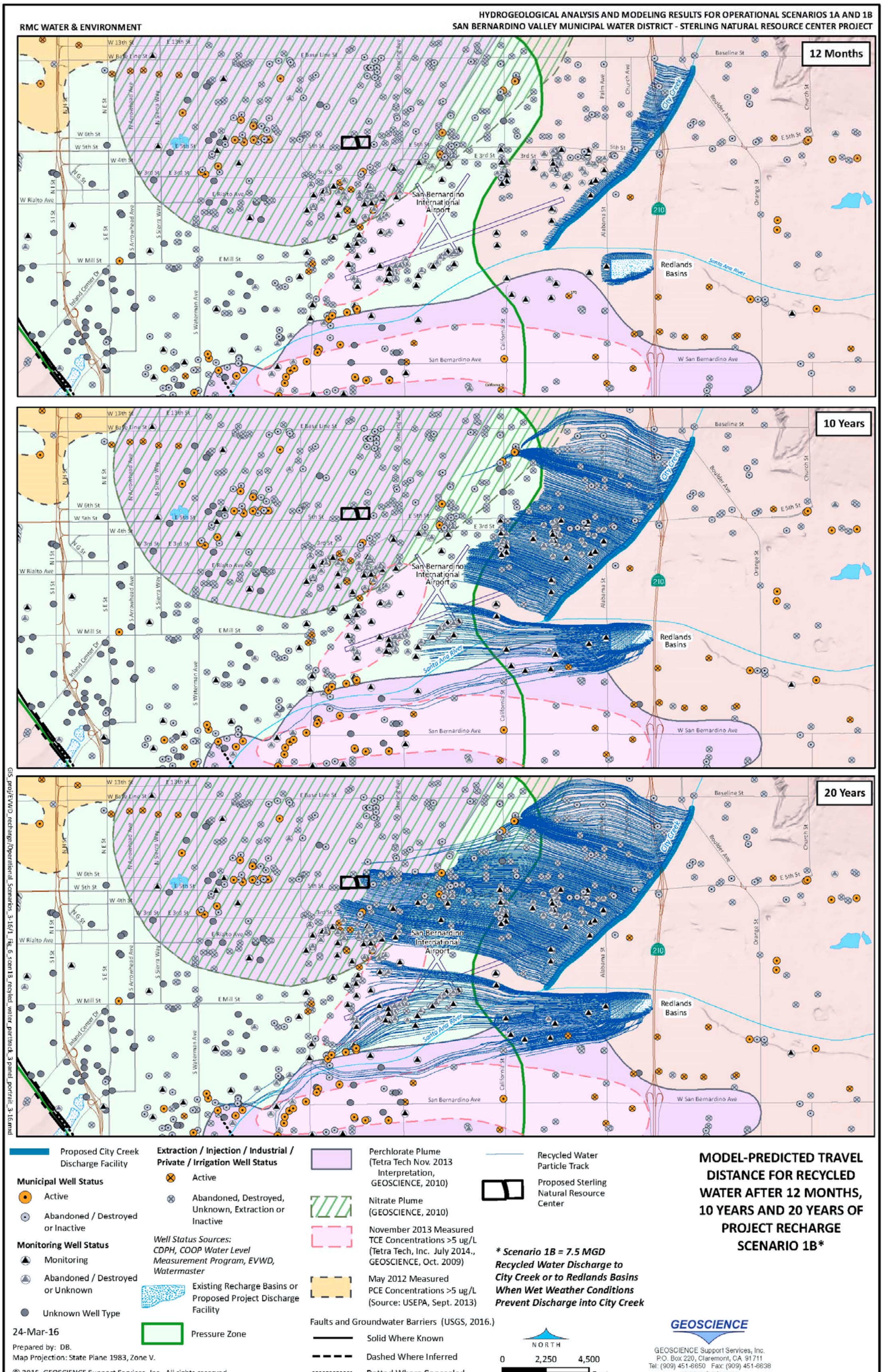
Table 10-2 provides a summary of the impacts to wells located downstream of the recharge areas in City Creek and the Redlands Basins. **Figure 10-5** provides a graphic representation of the 12-month, 10-year, and 20-year travel times for the SNRC Operational Scenario. As shown, the recycled water discharged into City Creek will infiltrate while it flows down the channel toward the Santa Ana River. Results from the modeling indicate that the minimum retention time requirements are net at both discharge locations. **Figure 10-6** provides a graphic representation of the RWC for the wells located down gradient from City Creek and the Redlands Basins recharge locations. The RWC at the nearest drinking water wells located downgradient of City Creek and Redlands Basins will slightly increase (although never approaching the 50% maximum RWC) after approximately 5.6 and 7 years, respectively. As can be seen, the retention time and 20% RWC are well within the regulatory requirements for all wells down gradient from City Creek and the Redlands Basins

Table 10-2: Summary of Municipal Wells Potentially Impacted

Well Identification	Distance from Recharge Facility (ft)	Aquifer Unit (Model Layer)	Recycled Water Retention Time (Years)	Time when 20% RWC is Exceeded (Years)
EVDA Plant No. 9A	7,500	UCM/UWB (1)	5.6	10.3
		MCM (2)	5.8	10.8
		MWB (3)	6.9	11.6
		LCM (4)	11.8	20.5
		LWB (5)	22.2	>26
EVWD Plant No. 132-5	7,500	UCM/UWB (1)	5.0	9.7
		MCM (2)	6.3	12.6
		MWB (3)	8.6	13.5
		LCM (4)	13.8	22.3
		LWB (5)	22.4	>26
EVDA Plant No. 28A	10,000	UCM/UWB (1)	12.5	20.6
		MCM (2)	13.1	21.8
		MWB (3)	14.2	23.4
		LCM (4)	12.3	>26
		LWB (5)	15.3	>26
EVDA Plant No. 141	7,400	UCM/UWB (1)	7.5	12.8
		MCM (2)	6.8	9.3
		MWB (3)	6.8	9.7
		LCM (4)	7.3	12.6
		LWB (5)	9.7	>26

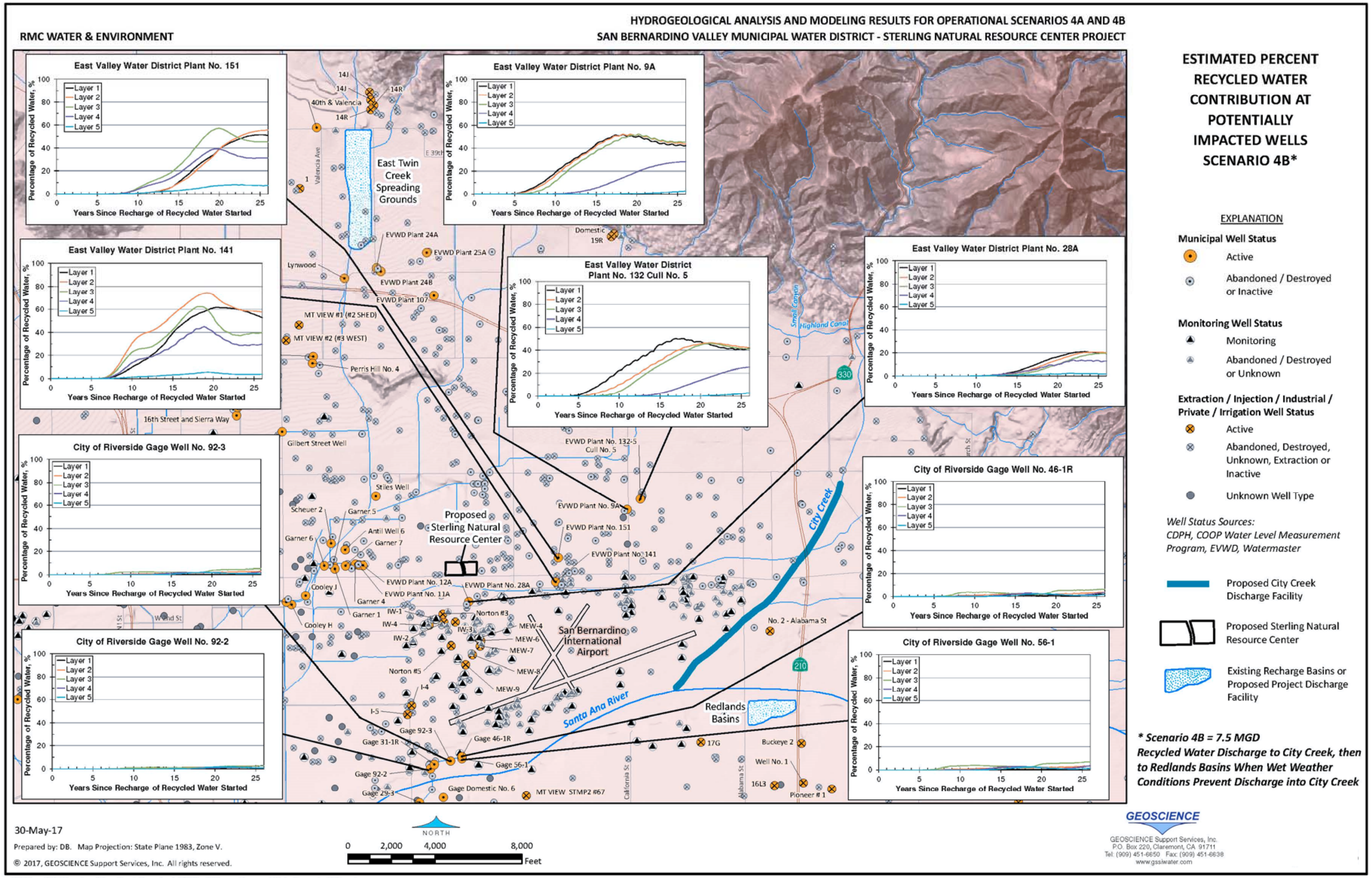
Well Identification	Distance from Recharge Facility (ft)	Aquifer Unit (Model Layer)	Recycled Water Retention Time (Years)	Time when 20% RWC is Exceeded (Years)
EVDA Plant No. 151		UCM/UWB (1)	11.4	16.9
		MCM (2)	11.3	17.3
		MWB (3)	8.5	14.3
		LCM (4)	8.6	15.3
		LWB (5)	10.8	>26
Gage Well No. 92-2	14,900	UCM/UWB (1)	11	>26
		MCM (2)	15.6	>26
		MWB (3)	10.5	>26
		LCM (4)	20.2	>26
		LWB (5)	18.6	>26
Gage Well No. 92-3	13,900	UCM/UWB (1)	>26	>26
		MCM (2)	12.3	>26
		MWB (3)	7.5	>26
		LCM (4)	14.3	>26
		LWB (5)	16.3	>26
Gage Well No. 56-1	13,400	UCM/UWB (1)	25.6	>26
		MCM (2)	11.1	>26
		MWB (3)	7.3	>26
		LCM (4)	13.1	>26
		LWB (5)	15.3	>26
Gage Well No. 46-1R	13,300	UCM/UWB (1)	14.1	>26
		MCM (2)	9.2	>26
		MWB (3)	7	>26
		LCM (4)	12.9	>26
		LWB (5)	15.1	>26

Figure 10-5: Travel Time for SNRC Operational Scenario (7.5 MGD)



Source: GEOSCIENCES, 2017.

Figure 10-6: RWC for SNRC Operational Scenario (7.5 MGD)



Source: GEOSCIENCES, 2017.

10.4 Antidegradation Analysis

As required by the Clean Water Act, the discharge of any pollutant to surface waters that are deemed waters of the United States (US) must be regulated by a National Pollutant Discharge Elimination System (NPDES) permit. Because the proposed Project discharge constitutes a new discharge to a surface water of the US, a NPDES permit governing the proposed discharge must be requested from the Santa Ana Regional Water Quality Control Board (Santa Ana RWQCB). In April 2016, an *Antidegradation Analysis: Sterling Natural Resource Center* (Valley District, 2016; see **Appendix D**) was prepared to support the RWQCB's finding that the Project discharge maintains the existing high quality of water to the maximum extent possible.

10.4.1 Assimilative Capacity and Groundwater Quality

The Basin Plan contains numeric and/or narrative water quality objectives for a wide range of constituents. All of the water quality objectives listed in the Basin Plan that are applicable to the Project were assessed in the Antidegradation Analysis; more specifically, Total Dissolved Solids (TDS) and Nitrate were the key water quality constituents addressed in the analysis. **Table 10-3** presents the site-specific water quality objectives that apply to City Creek and Bunker Hill subbasins for the select constituents.

Table 10-3: Site-Specific Basin Plan Objectives for Project Water Bodies

Constituent	City Creek, Valley Reaches: Bunker Hill B (mg/L)	Redlands Basin: Bunker Hill B (mg/L)
TDS	330	330
Nitrate (as N)	7.3	7.3
Source: Santa Ana Region Basin Plan, Updated July 2014. Available: http://www.swrcb.ca.gov/santaana/water_issues/programs/basin_plan/index.shtml		

Table 10-4 summarizes the assimilative capacity conclusions provided in a 2004 Basin Plan Amendment (Resolution No. R8-2004-0001) that incorporated a revised Salt and Nutrient Management Plan. Bunker Hill B has assimilative capacity remaining for both TDS and Nitrate.

Table 10-4: TDS and Nitrate Assimilative Capacity (mg/L)

	TDS			Nitrate (as N)		
	Water Quality Objective	Ambient Conditions	Assimilative Capacity	Water Quality Objective	Ambient Conditions	Assimilative Capacity
Bunker Hill B	330	280	50	7.3	5.6	1.7
Source: SAWPA. 2014. Recomputation of Ambient Water Quality in the Santa Ana Watershed for the Period 1993 to 2012, Technical Memorandum. Prepared for SAWPA Basin Monitoring Program Task Force. Prepared by Wildermuth Environmental, Inc. August. Available: http://www.swrcb.ca.gov/santaana/water_issues/programs/basin_plan/docs/SMP/2012_AWQ_Final_Tech_Memo.pdf						

10.4.2 Impacts on Groundwater Quality

For the groundwater quality analysis, the proposed Project operational strategy was modeled using a spreadsheet model to calculate mass loading of all basin inflows in comparison with allowable basin loading per adopted water quality objectives. The conceptual model established in the Second Report of Recharge Parties Pursuant to RWQCB Resolution No. R8-2008-0019 (Valley District 2013) was used to understand loading in the Bunker Hill Groundwater Basin.

As previously stated, the option of a combined discharge to City Creek and the East Twin Creeks Spreading Grounds has been dropped from further consideration for permitting purposes. Therefore, only the SNRC Operational Scenario was analyzed for its impacts on groundwater quality.

Table 10-5 summarizes the projected subbasin water quality for Years 10 and 20, both with and without proposedSNRC Operational Scenario. As shown, current Bunker Hill B basin inputs will ultimately result in a 1.0% increase in TDS and 1.1% increase in Nitrate by Year 20 without the Project. The City of Redlands discharges at maximum levels to the Bunker Hill B subbasin, combined with current inputs, would result in a 2.8% increase in TDS and 1.6% increase in Nitrate by Year 20 without the Project. The SNRC discharges to the Bunker Hill B basin would increase that combined input to a 5.0% increase in TDS and 1.6% increase in Nitrate by Year 20, or 2.1% increase in TDS and no change in Nitrate from baseline plus City of Redlands conditions. With the City Creek stormwater recharge project, TDS increases would be reduced to 4.1% in Year 20, while N would decrease by -0.2% over the same timeframe. Although groundwater water quality degradation would be degraded slightly by the SNRC, ambient TDS and Nitrate concentrations would be maintained within groundwater quality objectives for Bunker Hill B.

Table 10-5: Basin Water Quality for Years 10 and 20 (mg/L)

	BASELINE		BASELINE + CITY OF REDLANDS		BASELINE + CITY OF REDLANDS + SNRC		BASELINE + CITY OF REDLANDS + SNRC + CITY CREEK SP. GROUNDS	
	Concentration (mg/L)		Concentration (mg/L)		Concentration (mg/L)		Concentration (mg/L)	
	TDS	N	TDS	N	TDS	N	TDS	N
Year 1	280.2	5.60	280.6	5.61	281.1	5.61	280.9	5.60
Year 10	281.8	5.64	285.0	5.66	288.8	5.66	287.4	5.59
% Increase from Baseline	*0.6%*	*0.7%*	*1.7%*	*1.1%*	*3.1%*	*1.0%*	*2.6%*	*-0.2%*
% Increase from Baseline + City of Redlands	--	--	--	--	*1.3%*	*-0.1%*	--	--
Year 20	282.9	5.66	288.0	5.69	294.1	5.69	291.7	5.59
% Increase from Baseline	*1.0%*	*1.1%*	*2.8%*	*1.6%*	*5.0%*	*1.6%*	*4.1%*	*-0.2%*
% Increase from Baseline + City of Redlands	--	--	--	--	*2.1%*	*0.0%*	--	--

Chapter 11 Monitoring and Reporting

For the proposed SNRC, Valley District proposes to monitor the flow and quality of the following waters:

- Influent (raw wastewater);
- Recycled water;
- Groundwater (monitoring wells).

11.1 Sampling and Laboratory Analyses

All sampling and sample preservation activities will be conducted in accordance with the latest edition of *"Standard Methods for the Examination of Water and Wastewater"* (American Public Health Association). All lab procedures will be performed by a state-certified laboratory in accordance with procedures under 40 CFR 136 "Guidelines Establishing Test Procedures for the Analysis of Pollutants," promulgated by the U.S. EPA, unless otherwise specified by DDW or the RWQCB. The laboratory will be certified by the SWRCB Environmental Laboratory Accreditation Program (ELAP). In addition, the DDW, RWQCB and/or EPA may specify test methods which are more sensitive than those specified in 40 CFR 136.

Laboratories are required to calibrate the analytical system down to the Reportable Detection Limits (RDLs) or minimum levels (MLs) as listed in the permit and summarized in the tables included in this section. An alternative RDL may be used if approved by the DDW and RWQCB. For priority pollutants without effluent limitations, the laboratory is required to quantify constituent concentrations to the lowest achievable reporting limit as determined by the testing procedure in 40 CFR 136.

For unregulated chemical analyses and where practical, drinking water methods, or DDW-recommended methods, or EPA-approved methods if available, will be used. If those are unavailable, then the analyses will use methods available in published scientific literature or commercially available, after consultation with DDW.

The laboratory will have in place quality assurance/quality control (QA/QC) procedures, including documentation of the chain of custody. QA/QC analyses will be run on the same dates as the actual sample analyses. Copies of the QA/QC reports will be retained on file and available for inspection when requested by DDW or the RWQCB.

The reporting protocol calls for results greater than or equal to the ML to be reported as measured by the laboratory. Sample results less than the reported ML but greater than or equal to the laboratory's Method Detection Limit (MDL) are reported as "Detected, but Not Quantified (DNQ)". In that case, the estimated chemical concentration of the sample must also be reported. MDL is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the concentration is greater than zero, as defined in 40 CFR 136. Sample results not detected above the laboratory's MDL are reported as "non-detected (ND)".

Raw samples for bacterial analyses will be diluted as required to obtain meaningful results. Methods used for dilution will be reported with the results of the analyses.

Depending on the constituent, sampling will be conducted on a continuous, 24-hour composite, or grab specimen taken at regularly scheduled intervals (daily, weekly, monthly, quarterly, semi-annual, or annually) as defined below:

- A "grab" sample is defined as any individual sample collected in less than 15 minutes.
- A "composite" sample is defined as a combination of no fewer than eight individual grab samples obtained over the specified sampling period. The volume of each individual grab sample should be

proportional to the discharge flowrate at the time of sampling or, the number of equal volume samples should be proportional to the flow over the sampling period. The compositing period should be equal to the specific period, or 24 hours, if no period is specified in the permit.

- Daily samples should be collected on each day of the week.
- Maximum daily concentration is defined as the measurement made on any single grab sample or composite sample.
- Average weekly or monthly discharge limitations are determined from the average of the analytical results of all samples collected during a calendar week or month, respectively. Where a calendar week overlaps with two different months, compliance will be determined for the month in which the week ends.
- 12-month average limits should be determined monthly by arithmetic mean of the last twelve monthly averages.
- Monthly samples should be collected on any representative day of each month.
- Quarterly samples should be collected in January, April, July, and October.
- Semi-annual samples should be collected in January and July.
- Annual samples should be collected in accordance with the current Waste Discharge Requirements schedule for monitoring (RWQCB, 2012).

11.2 Influent Monitoring

Influent sampling stations at the SNRC facility will be located upstream of any grit removal or treatment processes. The SNRC facility influent flow will be measured by a flow meter before any side streams or flow diversions in the treatment process are reached. These parameters will ensure the total influent flow and quality of raw wastewater can be determined.

It is proposed the future influent monitoring requirements of WDR permit be used for the SNRC. **Table 11-1** summarizes influent water flow and quality monitoring requirements from the RWQCB 2012 WDR permit for the SBWRP, where the wastewater for the SNRC currently is treated. Frequency of sampling is included in the table and is assumed to be similar to the future WDR permit for the SNRC.

Table 11-1: Current Influent Monitoring at the SBWRP

Constituent	Units	Type of Sample	Minimum Monitoring Frequency
Flow	MGD	Recorder / Totalizer	Continuous
Specific Conductance	µmhos/cm	Recorder	Continuous
pH	pH units	Recorder	Continuous
Biochemical Oxygen Demand, 5-day (BOD_5)	mg/L	Composite	Daily
COD	mg/L	Composite	Daily
Total Inorganic Nitrogen	mg/L	Composite	Monthly
Nitrate-Nitrogen	mg/L	Composite	Monthly
Total Dissolved Solids	mg/L	Composite	Monthly
Cyanide	mg/L	Grab	Quarterly
Total Suspended Solids	mg/L	Composite	Weekly
Volatile Organic Portion of USEPA Priority Pollutants	µg/L	Grab	Annually
Remaining USEPA Priority Pollutants	µg/L	Composite	Annually

11.3 MBR System Monitoring

Title 22 requires that the turbidity of the filtered wastewater does not exceed (1) 0.2 NTU more than 5 percent of the time within a 24-hour period and (2) 0.5 NTU at any time (Title 22 §60301.320). Turbidity of the filtered wastewater will be monitored from each microfiltration or ultrafiltration train, prior to the UV disinfection system.

11.4 UV Disinfection System Monitoring

Each TrojanUVFit™ reactor will have one (1) Power Distribution Center (PDC) and one (1) System Control Center (SCC). The high operating temperature of UV lamps demands that a water flow be maintained through the reactor chamber to cool the lamps. If the water flow is shut off for any reason, the lamps must be shut off to prevent overheating. The temperature switch will trigger a warning alarm and shut down the system if the wall temperature of the reactor chamber exceeds 120 degrees F (50 degrees C). This alarm will be displayed on the PDC and SCC operator interface.

UV Sensor/Monitors measure the UV intensity within the reactor. One UV sensor/monitor is provided per reactor. Each UV sensor/monitor is aligned with one UV lamp. Its photodiode is mounted directly on the circuit board and the other electronics. This compact circuit contains all the necessary electronics to convert the input UV signal into a 4-20mA instrumentation signal. This signal is continuously displayed on the operator interface with the SCC in mW/cm^2. The UV intensity sensor alarm will be preset at the factory at a 25% reduction of lamp output.

11.4.1 Procedure Used To Derive Operation UV Dose

Source water is pumped through an enclosed pipe into the UV reactor. Prior to entry into the reactor, UV absorbers and challenge organisms are injected into the influent stream, passed through a static mixer to ensure complete mixing. A calibrated flow meter is used to verify influent flow. A sample is collected from the UV reactor outlet. Water containing a microbial surrogate is subjected to UV disinfection under a variety of conditions (flow, UVT, Power, number of banks). Both influent and effluent samples are taken for microbial enumeration. The log inactivation is determined under each condition and a model developed. In addition to ensuring the appropriate test conditions, equipment configuration, instrument calibration, it is important to confirm the actual functionality of the equipment. Key parameters to measure include: lamp output variability, UV intensity output, power consumption, UV sensor variability, and head-loss.

11.4.2 Lamp Control and Monitoring

Each TrojanUVFit™ reactor will respond to a 4-bit power level signal, which will instruct the lamp ballast to adjust to the correct power level as determined by the PLC. Each lamp is controlled directly from the lamp ballast, which is fully modulated between minimum and maximum power levels for each reactor. Specifically designed current sensing circuits detect lamp on/off status. The status of each individual lamp is displayed via the Train Control screen at the Operator Interface. Faulted lamps are indicated graphically on the Train control screen. A local display of lamp status is also provided on each PDC.

11.4.3 Automatic Cleaning System (Wiper) Control and Monitoring

During a wipe sequence, the reactors in the train will be wiped in a staggered sequence (i.e. only one reactor is in wiping mode at one time). A wipe sequence to clean each reactor may be initiated either manually at the PLC or PDC, or automatically as scheduled by the controller. In Automatic mode, the interval between wiping sequences is determined by the "wiper sequence" timer, which is pre-set at 24 hours and adjustable from 1 to 800 hours. At the start of the wiper extension, the reactor wiper extend motor is energized and a "wiper stroke" timer is initiated by the control board. When the wiper stroke time expires, the reactor extend solenoid is de-energized.

11.5 Recycled Water Monitoring

Recycled water sampling stations will be located at the SNRC facility, after the point of UV disinfection. Here representative samples of the tertiary treated effluent can be obtained before it is distributed to the appropriate spreading basin.

Recycled water quality will be monitored at this location as well as flow to continuously measure and record/totalize the amount of recycled water pumped to the spreading basins. The flow rates and total volumes of recycled water will be continuously measured and recorded for compliance with the RWC limit. Flow measurement devices will be calibrated at least once per year to ensure continued accuracy.

Table 11-2 summarizes the monitoring program for recycled water. Further discussion of specific constituents follows.

Table 11-2: Summary of Proposed Recycled Water Quality Monitoring Program

Constituent Category [1,2]	Monitoring Frequency
Flow	Continuous
Turbidity	Continuous
Inorganics, Except Nitrogen Compounds	Quarterly
Nitrate and Nitrite	Quarterly
Radionuclides	Quarterly
Organics	Quarterly
Disinfection Byproducts	Quarterly
Copper and Lead	Quarterly
Constituents with Secondary Drinking Water MCLs	Quarterly
Total Nitrogen	Twice per week
Total Organic Carbon	Weekly
Priority Toxic Pollutants	Quarterly
Chemicals with Notification Levels	Quarterly
Constituents of Emerging Concern[3]	Annually

Notes:
1. Abbreviations: MCLs = maximum contaminant levels, SAT = soil aquifer treatment, CECs = constituents of emerging concern, NLs = notification levels
2. The complete list of constituents to be monitored will be identified by the RWQCB as part of the Waste Discharge Requirements.
3. The complete list is identified in the Recycled Water Policy.

11.5.1 TOC and TN Compliance Monitoring

TOC is used as a surrogate for treatment performance, organics removal, CEC removal, and soil aquifer treatment performance. The maximum TOC concentration, measured in milligrams per liter (mg/L), is established by the following equation (Title 22 §60320.118, 2014):

$$TOC_{max} = 0.5 \text{ mg/L} \div RWC$$

Where: RWC is the running monthly average recycled water contribution

Compliance with the maximum TOC concentration is based on the 20-week running average of all TOC results and the average of the last four TOC results. TOC monitoring will be conducted at the location of undiluted recycled water discharged from the plant.

Total Nitrogen (TN) is the sum of nitrate, nitrite, ammonia, and organic nitrogen, all expressed as nitrogen (N). Monitoring for TN will be conducted twice a week, at least three days apart. Monitoring for TOC and TN will be conducted as described in **Table 11-2** above.

11.5.2 Regulated Contaminants Monitoring

Monitoring will be conducted for:

- Inorganics with primary drinking water MCLs (including nitrogen compounds) listed in **Table 11-3**;
- Radionuclides with primary MCLs listed in **Table 11-4**;
- Regulated organics with primary MCLs listed in **Table 11-5**;
- Disinfection byproducts listed in **Table 11-6**; and
- Constituents and parameters with secondary drinking water MCLs listed in **Table 11-7**.

Table 11-3: Inorganics with Primary MCLs

Constituent	
Aluminum	Fluoride
Antimony	Mercury
Arsenic	Nickel
Asbestos	Nitrate (as N)
Barium	Nitrite (as N)
Beryllium	Nitrate + Nitrite (as N)
Cadmium	Perchlorate
Chromium, Total	Selenium
Chromium, Hexavalent	Thallium
Cyanide	

Table 11-4: Radioactivity

Constituent	
Radium-226	Gross Beta particle activity
Radium-228	Strontium-90
Combined Radium 226 + Radium 228	Tritium
Gross Alpha particle activity (excluding radon and uranium	Uranium

Table 11-5: Organic Chemicals with Primary MCLs

Constituent	
Volatile Organic Chemicals (VOCs)	Non-Volatile Synthetic Organic Chemicals (SOCs)
Benzene	Alachlor
Carbon Tetrachloride	Atrazine
1,2-Dichlorobenzene	Bentazon
1,4-Dichlorobenzene	Benzo(a)pyrene
1,1-Dichloroethane	Carbofuran
1,2-Dichloroethane	Chlordane
1,1-Dichloroethylene	2,4-D
cis-1,2-Dichlorothylene	Dalapon
trans-1,2-Dichloroethylene	Dibromochloropropane
Dichloromethane	Di(2-ethylhexyl)adipate
1,2-Dichloropropane	Di(2-ethylhexyl)phthalate
1,3-Dichloropropane	Dinoseb
Ethylbenzene	Diquat
Methyl-tert-butyl ether	Endothall
Monochlorobenzene	Endrin
Styrene	Ethyl Dibromide
1,1,2,2-Tetrachloroethane	Glyphosate
Tetrachloroethylene	Heptachlor
Toluene	Heptachlor Epoxide
1,2,4-Trichlorobenzene	Hexachlorobenzene
1,1,1-Trichloroethane	Hexachlorocyclopentadiene
1,1,2-Trichloroethane	Lindane
Trichloroethylene	Methoxychlor
Trichlorofluoromethane	Molinate
1,1,2-Trichloro-1,2,2-Trifluoroethane	Oxamyl
Vinyl Chloride	Pentachlorophenol
Xylenes	Picloram
	Polychlorinated Byphenyls
	Simazine
	Thiobencarb
	Toxaphene
	2,3,7,8-TCDD (Dioxin)
	2,4,5-TP (Silvex)

Table 11-6: Disinfection Byproducts

Constituent	
Total Trihalomethanes (TTHM)	Haloacetic acids (five) (HAA5)
Bromodichloromethane	Monochloroacetic Acid
Bromoform	Dichloroacetic Acid
Chloroform	Trichloroacetic Acid
Dibromochloromethane	Monobromoacetic Acid
Bromate[1]	Dibromoacetic Acid
Chlorite[1]	
Note: 1. Bromate and chlorite monitoring are not required for this project.	

Table 11-7: Chemicals and Parameters with Secondary MCLs

Constituent	
Aluminum[1]	Odor – threshold
Chloride	Silver
Color	Specific Conductance
Copper	Sulfate
Foaming Agents (MBAS)	Thiobencarb[2]
Iron	Turbidity
Manganese	Total Dissolved Solids[3]
Methyl-tert-butyl ether[2]	Zinc
[1] Constituent is also a primary MCL. See Table 11-5. [2] Constituent is also a regulated organic primary MCL. See **Error! Reference source not found.**Table 11-5. [3] Constituent is also a RWQCB Basin Plan groundwater quality objective. See Table 10-5.	

11.5.3 Additional Chemical and Contaminant Monitoring

The SWRCB amended Recycled Water Policy requires groundwater recharge projects to monitor recycled water for Priority Toxic Pollutants (chemicals listed in 40 CFR section 131.38, "Establishment of numeric criteria for priority toxic pollutants for the State of California," as the foregoing may be amended) specified by the DDW. Upon review of the GRRP's engineering report, DDW has stated that all constituents on the Priority Toxic Pollutants list, **Table 11-8**, will be monitored quarterly.

Table 11-8: Priority Toxic Pollutants

Constituent	
Acenaphthene	Butyl Benzyl phthalate
Acrolein	Di-N-Butyl Phthalate
Acrylonitrile	Di-n-octyl phthalate
Benzene	Diethyl Phthalate
Benzidine	Dimethyl phthalate
Carbon tetrachloride	Benzo(a) anthracene
Chlorobenzene	Benzo(a) pyrene
1,2,4-trichlorobenzene	Benzo(b) fluoranthene
Hexachlorobenzene	Benzo(k) fluoranthene
1,2-dichloroethane	Chrysene
1,1,1-trichloroethane	Acenaphthylene
Hexachloroethane	Anthracene
1,1-dichloroethane	Benzo(ghi) perylene
1,1,2-trichloroethane	Fluorene
1,1,2,2-tetrachloroethane	Phenanthrene
Chloroethane	Dibenzo(,h) anthracene
Bis(2-chloroethyl) ether	Indeno (1,2,3-cd) pyrene
2-chloroethyl Vinyl ethers	Pyrene
2-chloronaphthalene	Tetrachloroethylene
2,4,6-trichlorophenol	Toluene
Parachlorometa cresol	Trichloroethylene
Chloroform	Vinyl chloride
2-chlorophenol	Aldrin
1,2-dichlorobenzene	Dieldrin 91
1,3-dichlorobenzene	Chlordane
1,4-dichlorobenzene	4,4-DDT
3,3-dichlorobenzidine	4,4-DDE
1,1-dichloroethylene	4,4-DDD
1,2-trans-dichloroethylene	Alpha-endosulfan
2,4-dichlorophenol	Beta-endosulfan
1,2-dichloropropane	Endosulfan sulfate
1,3-dichloropropylene	Endrin
2,4-dimethylphenol	Endrin aldehyde
2,4-dinitrotoluene	Heptachlor
2,6-dinitrotoluene	Heptachlor epoxide
1,2-diphenylhydrazine	Alpha-BHC
Ethylbenzene	Beta-BHC
Fluoranthene	Gamma-BHC
4-chlorophenyl phenyl ether	Delta-BHC
4-bromophenyl Phenyl ether	PCB-1242 (Arochlor 1242)
Bis(2-chloroisopropyl) ether	PCB-1254 (Arochlor 1254)
Bis(2-chloroethoxy) methane	PCB-1221 (Arochlor 1221)

Constituent	
Methylene chloride	PCB-1232 (Arochlor 1232)
Methyl chloride	PCB-1248 (Arochlor 1248)
Methyl bromide	PCB-1260 (Arochlor 1260)
Bromoform	PCB-1016 (Arochlor 1016)
Dichlorobromomethane	Toxaphene
Chlorodibromomethane	Antimony
Hexachlorobutadiene	Arsenic
Hexachlorocyclopentadiene	Asbestos
Isophorone	Beryllium
Naphthalene	Cadmium
Nitrobenzene	Chromium
2-nitrophenol	Copper
4-nitrophenol	Cyanide, Total
2,4-dinitrophenol	Lead
4,6-dinitro-o-cresol	Mercury
N-nitrosodimethylamine	Nickel
N-nitrosodiphenylamine	Selenium
N-nitrosodi-n-propylamine	Silver
Pentachlorophenol	Thallium
Phenol	Zinc
Bis(2-ethylhexyl) phthalate	2,3,7,8-TCDD

In addition, the recycled water will also be monitored quarterly for DDW specified chemicals having notification levels (NLs), as defined by DDW. **Table 11-9** summarize the potential monitoring program for priority toxic pollutants and chemicals having NLs.

Table 11-9: Chemicals having Notification Levels

Constituent	
Boron	Manganese
n-Butylbenzene	Methyl isobutyl ketone (MIBK)
sec-Butylbenzene	Naphthalene
tert-Butylbenzene	N-Nitrosodiethylamine (NDEA)
Carbon disulfide	N-Nitrosodimethylamine (NDMA)
Chlorate	N-Nitrosodi-n-propylamine (NDPA)
2-Chlorotoluene	Propachlor**
4-Chlorotoluene	n-Propylbenzene
Diazinon	RDX
Dichlorodifluoromethane (Freon 12)	Tertiary butyl alcohol (TBA)
1,4-Dioxane	1,2,3-Trichloropropane (1,2,3-TCP)
Ethylene glycol	1,2,4-Trimethylbenzene
Formaldehyde	1,3,5-Trimethylbenzene
HMX	2,4,6-Trinitrotoluene (TNT)
Isopropylbenzene	Vanadium

The monitoring frequency of both Priority Toxic Pollutants and Chemicals with NLs may be reduced to annually with DDW approval if the first two years' results show none of the remaining priority pollutants have been detected above the reporting limit (RL).

11.5.4 Recycled Water Policy CECs and Surrogates Monitoring

The amended Recycled Water Policy adopted by the SWRCB in Resolution 2013-0003 (SWRCB, 2013) establishes CEC monitoring requirements for recycled water groundwater recharge projects. It also instructs all RWQCBs to not issue requirements for monitoring of additional CECs in recycled water beyond the requirements provided in the Recycled Water Policy, except when recommended by DDW or requested by the project sponsor.

The SNRC Project at proposed surface application locations will comply with the SWRCB's amended Recycled Water Policy (SWRCB, 2013). The amended Recycled Water Policy provides for development of a CEC monitoring program for a recycled water groundwater recharge project by completing three phases:

1. Initial monitoring phase
2. Baseline monitoring phase
3. Standard operation phase

The Recycled Water Policy requires that an initial assessment monitoring phase be conducted to assess the occurrence of health-based CECs, performance-indicator CECs, and surrogates in recycled water and groundwater recharged via surface spreading. This initial phase requires quarterly monitoring of health-based and performance-indicator CECs, plus monitoring of surrogates on a project-by-project basis. Recycled water quality monitoring must be conducted prior to discharge at the spreading basin(s) for surface applications. Groundwater monitoring at a monitoring well located within 30-days downgradient from the spreading basin(s) is required for health-based CECs, performance indicated CECs and surrogates for that specific project.

Based on the findings of the initial assessment monitoring phase, the RWQCB with input from DDW selects project specific-performance indicator CECs and surrogates for monitoring during the subsequent baseline monitoring phase. The monitoring phase requirements are similar to those for the initial phase, except that the sampling frequency is reduced to semi-annually. Health-based CECs continue to be monitored, but only selected performance-indicator CECs and surrogates must be monitored to establish a project-specific baseline (For more information about the baseline monitoring requirements, see Table 4 of the Recycled Water Policy.)

The findings of the baseline monitoring phase are used to establish the standard operation monitoring program for the project. As above, the RWQCB with DDW refine and select the project-specific requirements for monitoring CECs and surrogates in the standard operation monitoring program for the project. The Recycled Water Policy requires semi-annual monitoring for health-based CECs and selected performance-indicator CECs, treatment process performance, and recycled water quality, and in that case, annual monitoring may be allowed. (For more information about standard operation monitoring program requirements, see Table 5 of the Recycled Water Policy.)

11.5.5 SAT Performance Monitoring

SAT may be used to lower the TOC and TN concentrations. Composite samples of percolated water, either undiluted recycled water or diluted recycled water, in the unsaturated zone will be taken for analyses if TOC and TN reductions through SAT is needed. Demonstration studies will be conducted to determine the removal efficiency of the SAT, which will be used to develop an SAT factor for review by DDW. The approved SAT factor will then be applied to the measured undiluted recycled water TOC, thereby yielding the post-SAT TOC and TN values.

SAT monitoring will also be conducted for three indicator compounds designated by DDW based on results of studies of the recycled water.

11.6 Recycled Water Contribution Monitoring

Flows of recycled water will be continuously metered and used to calculate the RWC. Daily flows will be recorded and used to determine the monthly volumes of recycled water applied at the twosurface application locations. The diluent water from groundwater underflow has been modeled at each of the twolocations as discussed in **Chapter 7.** Compliance with the RWC will be calculated monthly as the running monthly average RWC based on the total volumes of recycled water and credited diluent water during the preceding 120 months. The RWC calculation will begin after 30 months of spreading, and be based on the initial preceding 30 months' volumes of recycled water and credited diluent, gradually increasing to the allowable 120-month period.

11.7 Diluent Water Quality Monitoring

For the proposed GRRP project, diluent water will consist solely of groundwater underflow. Since no other sources of water will be used to supplement the recycled water in surface application, refer to **Section 11.8** for the two proposed upstream monitoring wells which will be used to gauge diluent water quality.

11.8 Groundwater Monitoring Wells

Groundwater monitoring will be used in the continuous assessment of groundwater quality and to determine any impacts from the recharge of recycled water. A finalized groundwater monitoring program will be developed in conjunction with the DDW and the RWQCB. Both agencies may specify any contaminants and chemicals be monitored based on the results of the recycled municipal wastewater monitoring conducted. Until such time, a preliminary draft of groundwater monitoring requirements is presented in **Table 11-10**.

Table 11-10: Proposed Groundwater Monitoring Well Sampling Requirements

Constituent Category [1]	Monitoring Frequency
Nitrate and Nitrite	Quarterly
Constituents with Secondary Drinking Water MCLs	Quarterly
Total Nitrogen	Quarterly
Total Organic Carbon	Quarterly
Note: 1. MCLs = maximum contaminant levels.	

Should any of the groundwater monitoring results exceed the MCL for a specific contaminant, a second sample shall be analyzed for the contaminant within 48 hours of being notified by the laboratory. If the second sample exceeds MCL, within 24 hours of being notified by the laboratory, the district will notify the DDW and RWQCB and the district shall discontinue surface application of recycled water. Continued surface application of recycled will begin once corrective actions have been taken or evidence is provided to the DDW and RWQCB that the contamination was not a result of the GRRP.

Table 11-11 provides a summary of the proposed monitoring wells discussed in further detail below. **Figure 11-1** provides an overview of the monitoring well locations. Six monitoring wells will be operational by the start of recycled water recharge at City Creek and Redlands Basins. The proposed monitoring network is to monitor and evaluate water quality impacts of recycled water recharged at spreading basins on the groundwater subbasin, and to ensure compliance with minimum retention times for recycled water.

Table 11-11: Summary of Proposed Monitoring Wells

Well	Owner	Distance	Travel Time (years)	Depth to Groundwater (ft bgs)	Perforations (ft bgs)	Sampling Frequency
Proposed for City Creek						
EVWD Plant No. 143	EVWD	8,700 ft up gradient of City Creek	N/A	200	500-930	Quarterly
MW-CC 1	Proposed	1,300 ft down gradient of City Creek	0.9	200 (estimated)	180-190 350-360 590-600 750-760	Quarterly
MW-CC 2	Proposed	400 ft down gradient of City Creek	0.7	200 (estimated)	180-190 330-340 550-560 730-740	Quarterly
MW-CC 3	Proposed	6,000 ft down gradient of City Creek	7.3	210 (estimated)	220-230 360-370 540-550 810-820	Quarterly
Proposed for Redlands Basins						
Orange #2	City of Redlands	6,500 ft up gradient of Redlands Basins	N/A	160	340-1,210	Quarterly
MW-RB 1	Proposed	150 ft down gradient of Redlands Basins	0.2	220 (estimated)	220-230 290-300 350-360 470-480	Quarterly

According to the Title 22 Monitoring Well Requirements (§60320.126) for surface spreading, at least two down gradient monitoring wells shall be constructed and located between the spreading basin discharge facility and the nearest down gradient municipal wells. One of these wells is required to be situated no less than two weeks but no more than six months of travel time through the saturated zone affected by the recharged water. The other shall be located at least 30 days upgradient of the nearest drinking water well. **Figure 11-2** provides anticipated RWC at the monitoring well locations.

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Figure 11-1: Proposed Monitoring Wells

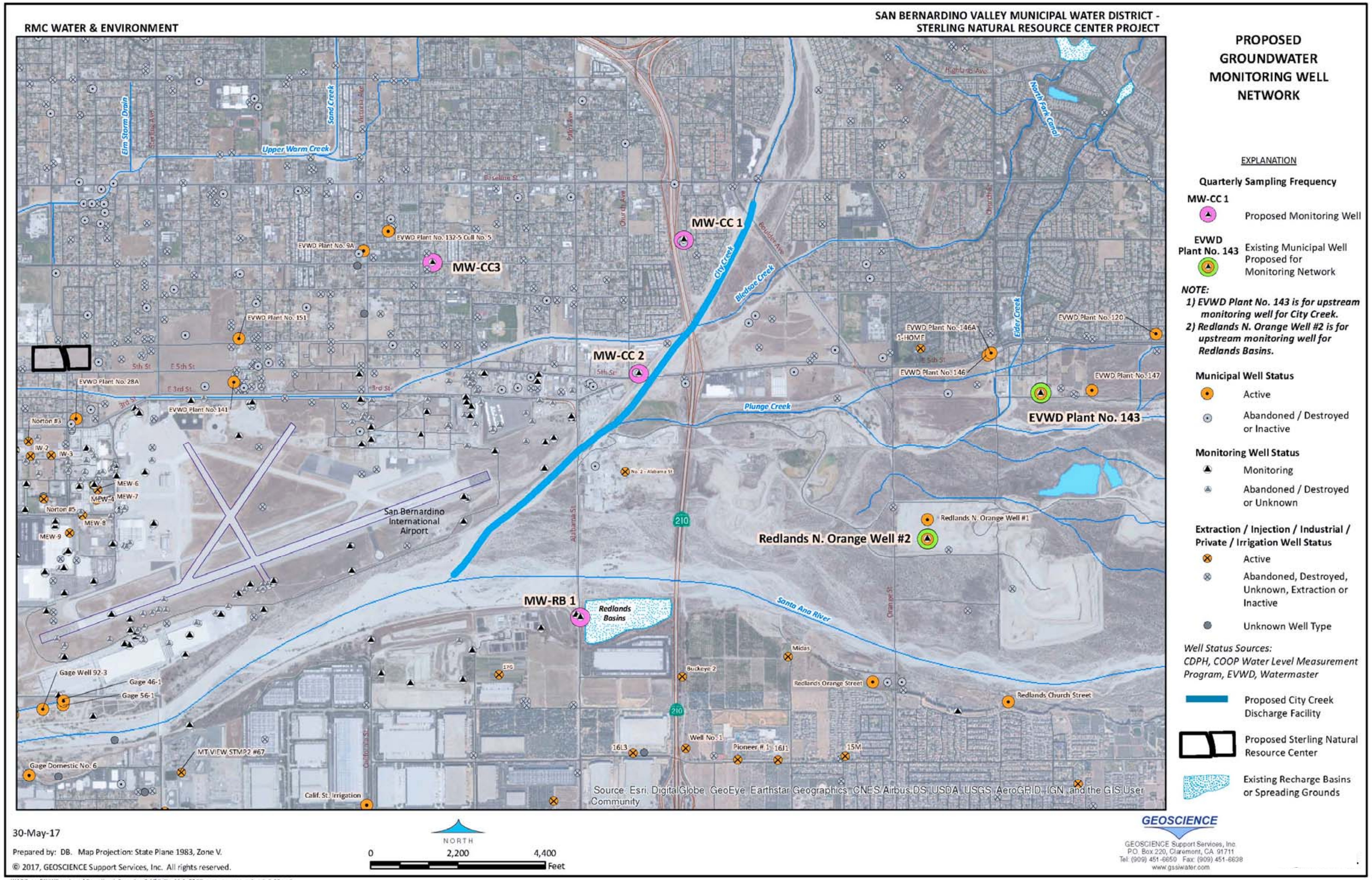
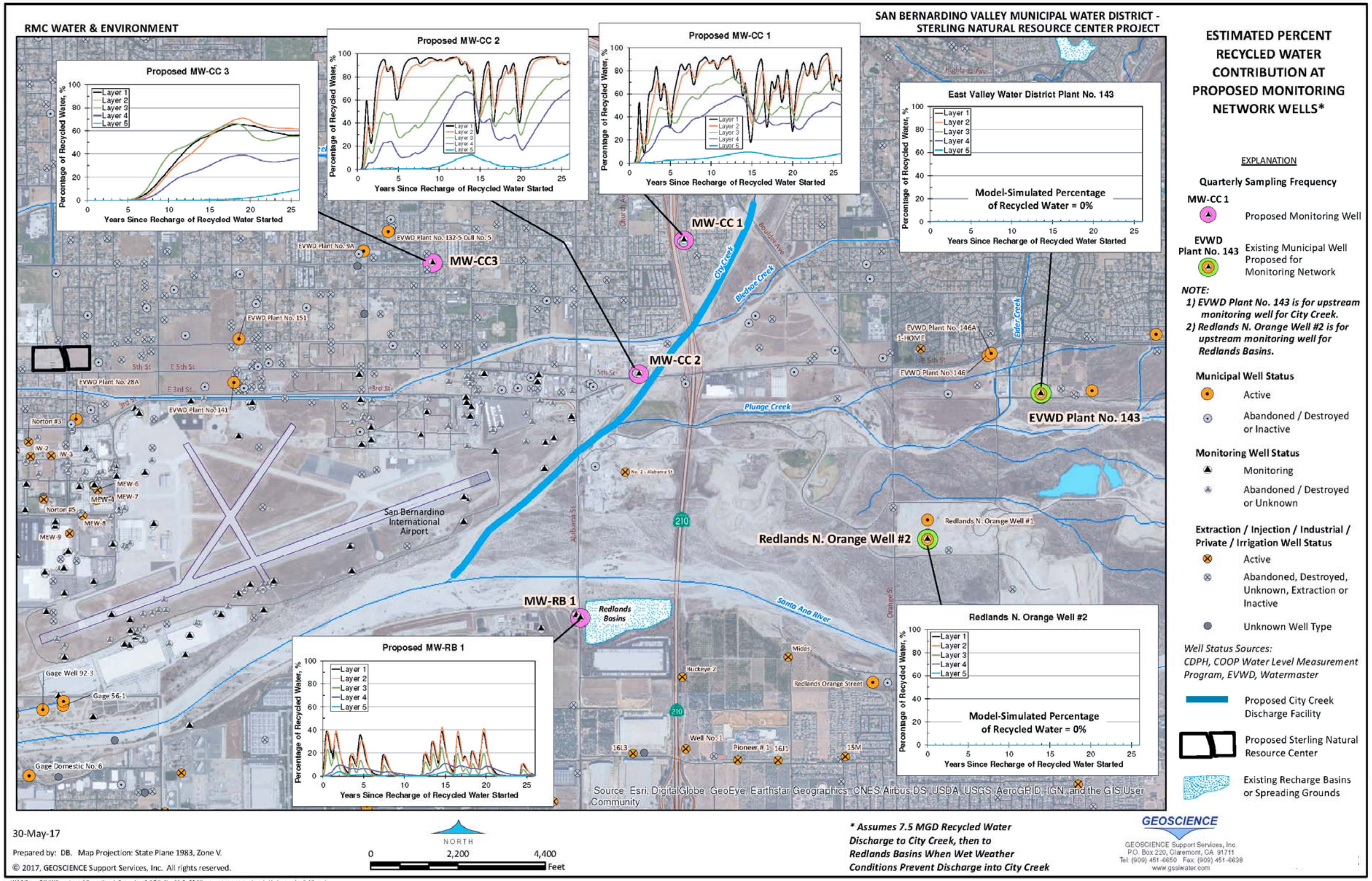


Figure 11-2: Proposed Monitoring Wells with RWC Hydrograph



11.8.1 Monitoring Wells for City Creek

At City Creek, there are several monitoring wells already located down gradient in the southern portion of the proposed in-channel spreading area, currently used for monitoring groundwater for the former Norton Air Force Base. Three new monitoring wells are proposed for the SNRC:

- MW-CC 1 located at the northern end of the recharge site and 1,300 ft downgradient of the City Creek recharge,
- MW-CC 2 located midway down the recharge site and 400 feet downgradient of the City Creek recharge, and
- MW-CC 3 located 6,000 feet downgradient of the City Creek recharge and up gradient of the nearest drinking water wells (EVWD Plant No 9A and Plant No 132-5).

Figure 11-3 provides a conceptual design of the proposed City Creek downstream monitoring wells. The proposed design provides ability to collect water level and quality data for the UWB, MWB and LWB layers.

EVWD Plant No. 143 is a well upstream of the City Creek recharge area that can be used to characterize the underflow water quality prior to recharge. **Figure 11-4** provides a cross-section of the proposed City Creek upstream monitoring well.

11.8.2 Monitoring Wells for Redlands Basins

For the Redlands Basins, in accordance with the regulations and guidance (see summary in Section 2.3) and because the recharge site is located up gradient of the Redlands Wastewater Treatment Facility, the Redlands California Street Landfill, an old Lockheed-Martin site, and the former Norton Air Force Base (currently the San Bernardino International Airport), several monitoring wells are already in place. One new monitoring well is proposed for SNRC:

- MW-RB 1 is located 150 feet downgradient of the Redlands Basins.

Figure 11-3 provides a conceptual design of the proposed Redlands Basins downstream monitoring wells. The proposed design provides ability to collect water level and quality data for the UWB, MWB and LWB layers.

Redlands No. Orange #2 is a well upstream of the Redlands Basin recharge area that can be used to characterize the underflow water quality prior to recharge. **Figure 11-5** provides a cross-section of the proposed Redlands Basin upstream monitoring well

Figure 11-3: Conceptual Design of Proposed Downstream Monitoring Wells for City Creek

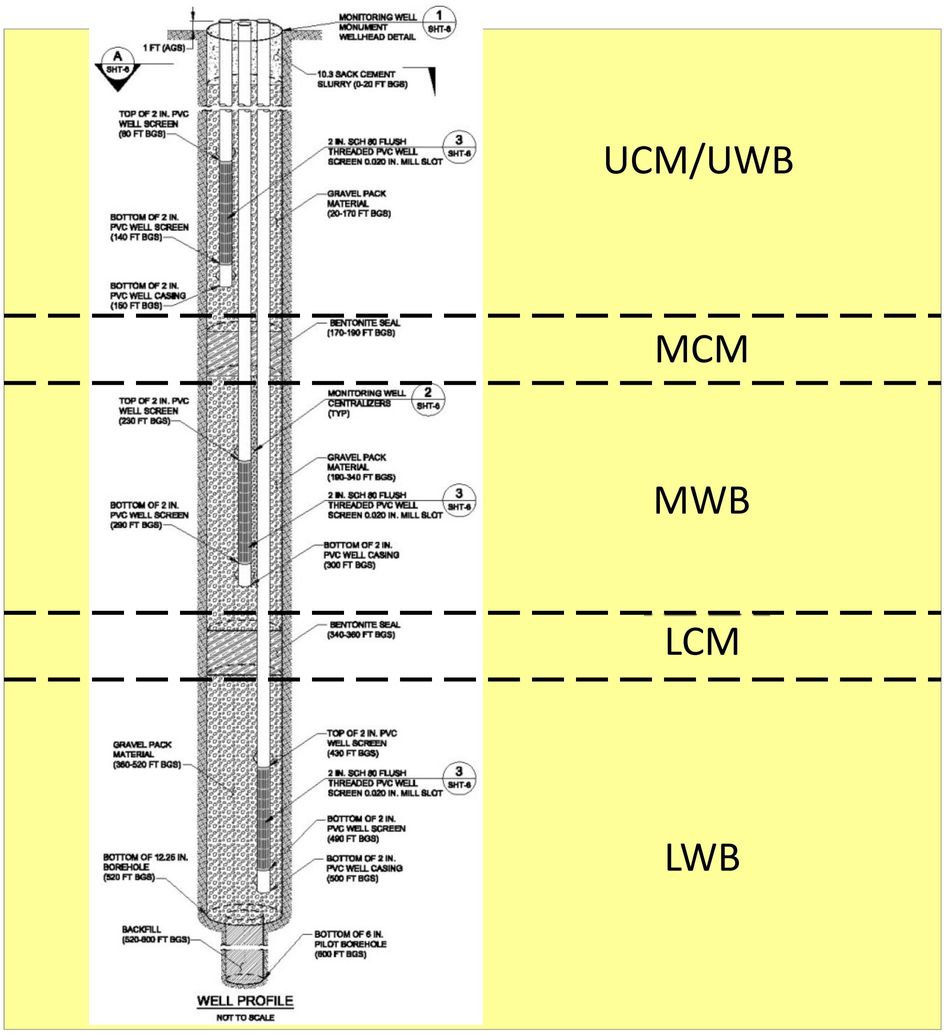


Figure 11-4: Cross-Section of Upstream Monitoring Well for City Creek

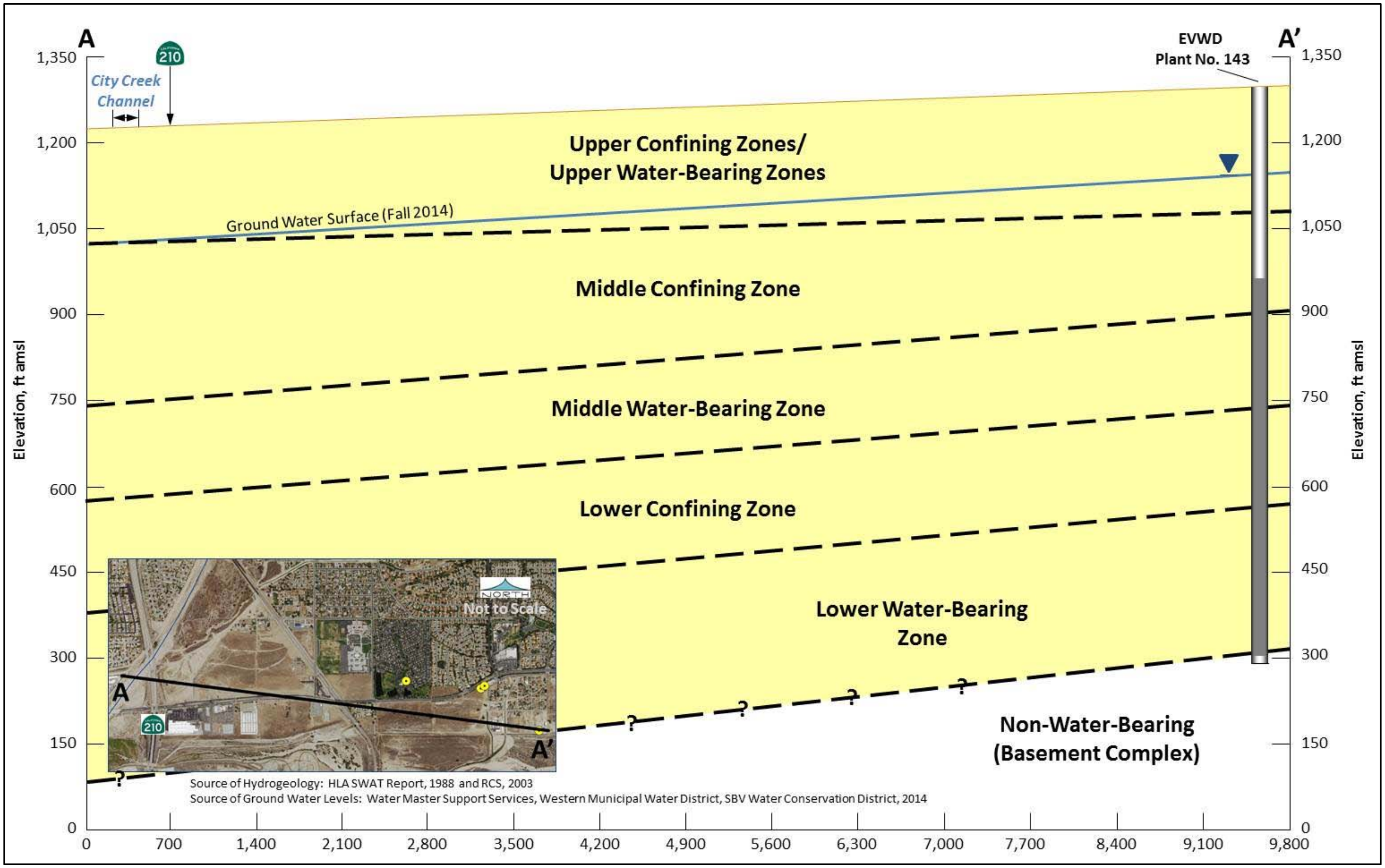
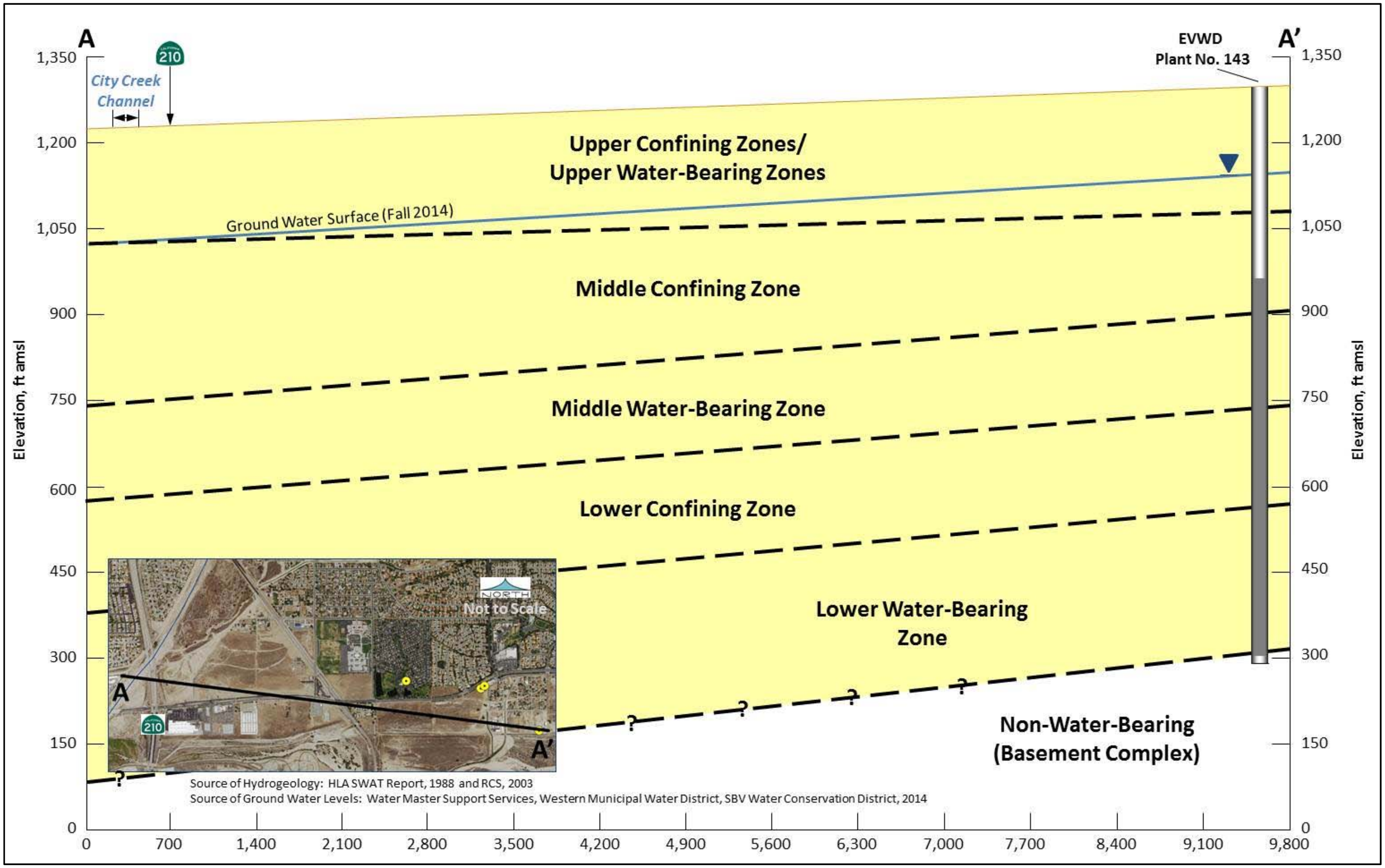


Figure 11-4: Cross-Section of Upstream Monitoring Well for City Creek



11.8.3 Background Water Quality Monitoring

Prior to the commencement of GRRP operation at least two samples will be analyzed from each monitoring well that has recharge water located within one year of travel time of the well(s). Each sample will be analyzed for total nitrogen, nitrate, nitrite, the contaminants in Tables 64449-A and B or §64449 and any contaminants and chemicals specified by the DDW or the Santa Ana RWQCB based on the results of the recycled municipal wastewater monitoring conducted pursuant to Title 22 §60320.126.

11.8.4 Standard Operation Groundwater Monitoring

Following the commencement of GRRP operation at least one sample per quarter will be analyzed from each monitoring well that has recharge water located within one year of travel time of the well(s). Each sample will be analyzed for total nitrogen, nitrate, nitrite, the contaminants in Tables 64449-A and B or §64449 and any contaminants and chemicals specified by the DDW or the Santa Ana RWQCB based on the results of the recycled municipal wastewater monitoring conducted pursuant to Title 22 §60320.126. In addition the groundwater shall be tested quarterly for specified priority toxic pollutants listed in 40 CFR section 131.38 of "Establishment of numeric criteria for priority toxic pollutants for the State of California" and other chemicals that the DDW has deemed necessary based on the GRRP's engineering report, affected groundwater basin, and the results of the assessment performed pursuant to Title 22 §60320.106.

11.8.5 Groundwater Monitoring Summary

As mandated by Title 22, groundwater monitoring will occur at least once per quarter, for all required constituents and report all required information.

11.9 Well Control Zone

Per Title 22 (§60320.100(e)(2) and 60320.100(e)(3)), no new drinking water wells may be developed within the primary (14 months travel time) and secondary boundaries surrounding the City Creek and Redlands Basins recharge sites. **Figure 11-6** and **Figure 11-7** provide the well control zones for the SNRC.

As set forth in the Judgment in Case No. 78426, Valley District, in coordination with Western Municipal Water District of Riverside County, serves as the Watermaster for the Bunker Hill Groundwater Subbasin. In this court adjudicated role, Valley District has full control over the location and volume of pumping in the Bunker Hill Groundwater Subbasin. As the Watermaster, Valley District will not allow pumping in the Well Control Zone, thus ensuring adequate response retention time of at least 6 months (12 months as estimated by numerical groundwater modeling).To ensure that no new drinking water wells are drilled in the well control zones, the following steps will be taken by the project partners:

- Because the proposed recycled water recharge overlies the Valley District service area, and Valley District serves as the Watermaster for the Bunker Hill Groundwater Subbasin, Valley District will not allow any new well drilling activity within the Well Control Zone.
- The proposed recharge overlies the EVWD service area, who will notify Valley District of any well drilling activitiy in the vicinity.
- Valley District will coordinate directly with the County Department of Environmental Health and develop a memorandum of understanding to ensure that Valley District is notified of any new well drilling activity.

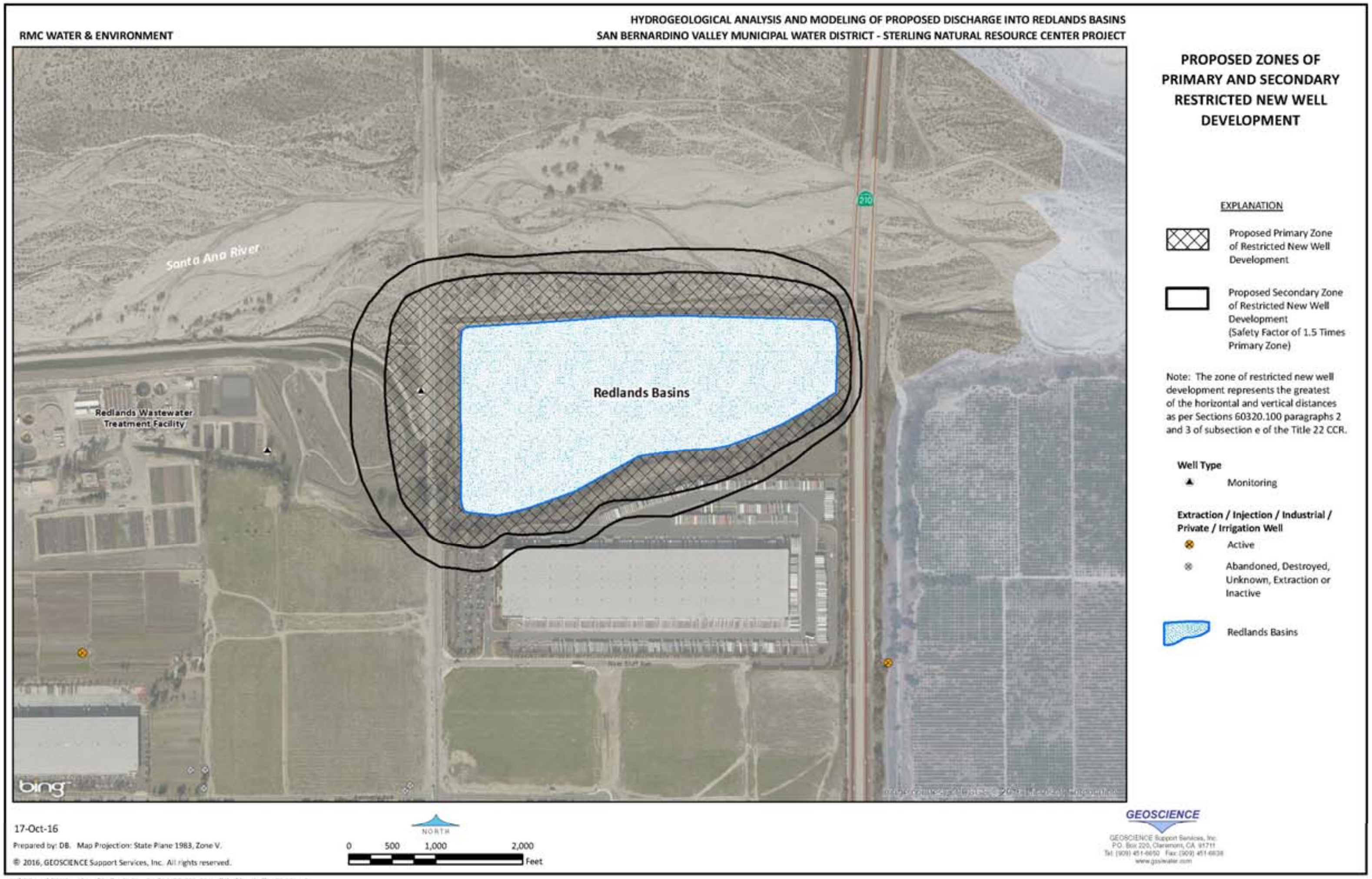
Tracer studies are recommended to confirm travel time to the four closest municipal wells, including EVWD Plant No. 9a, EVWD Plant No. 132-5, Gage Well 46-1R, and Gage Well 56-1.

Table 111-12: Summary of Municipal Water Supply Wells near Recharge Sites

Well	Owner	Perforations (ft bgs)	Recommended Actions
EVWD Plant No 9A	EVWD	173-415	• Not Impacted • Tracer Study only
EVWD Plant No 132-5	EVWD	NA	• Not Impacted • Tracer Study only
Gage 46-1R	City of Riverside/Gage Canal Co.	180-674	• Not Impacted • Tracer Study only
Gage 56-1	City of Riverside/Gage Canal Co.	467-1,104	• Not Impacted • Tracer Study only

Figure 11-6: Well Control Zone for City Creek

Figure 11-7: Well Control Zone for Redlands Basins



11.10 Reports and Records

In accordance with all requirements, Valley District will provide reports and records of past, current and projected operational information.

11.10.1 Monitoring Reports

The following monitoring records will be retained for a time as directed by DDW and the RWQCB:

- Sampling location, date, and time;
- Name(s) of individual(s) performing the sampling;
- Analytical results;
- Analytical methods/techniques used;
- Date of the analyses;
- Name of laboratory conducting the analyses with its ELAP certification documentation; and
- Documentation of quality assurance/quality control, including chain of custody

11.10.2 Annual Report

As required by Title 22, Valley District will submit a report at the end of each calendar year. The report will be provided to the DDW and RWQCB within six months after the end of each calendar year. Public water systems and drinking water well owners with water sources within 10 years of groundwater travel time downgradient of City Creek and Redlands Basins will be notified by mail of the availability of the report. The report will be prepared by a licensed California engineer with experience in wastewater treatment and public water supply. The report will include the following topics:

- Compliance status with monitoring requirements
- Violations incurred and corrective actions
- Detections and trends of monitored chemicals or contaminants
- Migration of the recharge water plume
- Description of changes and anticipated changes in processes or facilities
- Projected quality and quantity of recycled water and diluent water
- Measures taken to comply with specific Title 22 requirements
- Increases and projected increases in the recycled water contribution

11.10.3 Engineering Report Update

In accordance with Title 22, an updated engineering report will be provided to the DDW and RWQCB every five years from the date of approval of the initial engineering report. The engineering report update will serve to address any project changes. At a minimum, the report will include the following:

- Anticipated recycled water contribution increases
- Information showing retention time compliance
- Groundwater modelling updates and measured observations.

Chapter 12 Operating and Contingency Plans

As the SNRC begins the design phase, an operating and contingency plan will be developed for the Project which will include the following:

- **Influent Toxic Flow Response Procedures**: The influent lift stations installed within the EVWD sewer system will be equipped with continuous monitors for specific parameters (such as pH and specific conductance) that will automatically stop sewer diversions to the SNRC.
- **Power Failure Safeguards and Safety Plan**: The SNRC will be equipped with an automatic generator for the purposed of treating wastewater during power outages. If the emergency generator were to fail, flows would not be diverted from the sewer at the influent pump stations.
- **Standard Operating Procedures (SOPs)**: A full suite of SOPs will be developed for the operation of the various treatment process at SNRC, the discharge structures at each recharge location, and the overall operations strategy for treatment and recharge.
- **Contingency Plan**: Procedures will be to be put in place to assure that no untreated or inadequately treated wastewater will be delivered to the use area.
- **Emergency Response Plan**: Procedures will be put in place to assure that any discharge of untreated or partially treated wastewater to the use area will be reported immediately by telephone to the regulatory agency, the State Department of Health, and the local health officer.
- **Recycled Water Training**: Training on the safe use of recycled water will be provided to all employees involved in the productions and recharge of recycled water.

As stated previously, the Project will be implemented under a design-build procurementt. The facilities will be further refined during the design phase, at which time an updated *Title 22 Engineering Report* will be provided to DDW, including more detailed information on the operating and contingency plans as process bypass and treatment upset return flow elements are designed.

Chapter 13 References

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Appendix A - Framework Agreement

Appendix B - Conditional Acceptance of TrojanUVFittm Model 72AL75 for Recycled Water, Validation Report, November 2009

Appendix C - Hydrogeological Analysis and Modeling Results for Operational Scenarios 4A and 4B – Sterling Natural Resource Center Project

Appendix D – Antidegradation Analysis: Sterling Natural Resource Center

10509 Vista Sorrento Pkwy, Suite 205
San Diego, CA 92121

858.875.7400

rmcwater.com