LAGUNA COUNTY SANITATION DISTRICT

Groundwater Recharge Evaluation

FINAL / August 2023

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Abbreviations

%	percent
µg/L	micrograms per liter
ac-ft	acre-foot (feet)
AF	acre-foot
ALs	action levels
AOP	advanced oxidation process
AWPF	advanced water purification facility
AWTO	advanced treatment operator
AWWAWRF	American Water Works Association Water Research Foundation
bgs	below ground surface
BOD	biological oxygen demand
BWRO	brackish water RO
Carollo	Carollo Engineers
CAS	conventional activated sludge
CCR	California Code of Regulations
CCRWQCB	Central Coast Regional Water Quality Control Board
CEC	contaminants of emerging concern
CIP	cleaning in place
CT	contact time
DBP	disinfection byproducts
DDW	Division of Drinking Water
District	Laguna County Sanitation District
EC	Electrical Conductivity
ESCP	Enhanced Source Control Program
FOG	fats, oil, and grease
FRP	fiberglass reinforced plastic
ft	feet
ft/day	feet per day
gfd	gallons per square foot of membrane per day
gpm	gallons per minute
GRRP	Groundwater Replenishment Reuse Project
GSWC	Golden State Water Company
GWR	groundwater replenishment
I&C	instrumentation and controls
IAP	Independent Advisory Panel
IPR	indirect potable reuse
LCSD	Laguna County Sanitation District
LRV	log reduction values
MBR	membrane bioreactor

MCL	maximum contaminant level
MFL	million fibers per liter
MG	million gallons
mg/L	milligrams per liter
mgd	million gallons per day
MIBK	Methyl isobutyl ketone
mJ/cm^2	millijoule per square centimeter
ML/AI	machine learning and artificial intelligence
MTL	monitoring trigger levels
NDEA	N-Nitrosodiethylamine
NDMA	N-Nitrosodimethylamine
NDPA	N-Nitrosodi-n-propylamine
NLs	notification levels
NPDES	National Pollutant Discharge Elimination System
NPR	non-potable reuse
NTU	Nephelometric Turbidity Unit
NW	northwest
NWIS	National Water Information System
NWRI	National Water Research Institute
O&M	operations and maintenance
OAL	Office of Administrative Law
OCP	Orcutt Community Plan
OOP	Operation Optimization Plan
ORP	oxidation reduction potential
PDST	pressure decay testing
PDT	pressure decay test
PFASs	per-and poly-fluorinates substances
PFBS	Perfluorobutanesulfonic acid
PFHxS	Perfluorohexanesulfonic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PRW	purified recycled water
psig	pounds per square inch gauge
RDX	Royal Demolition Explosive
RMGC	Rancho Maria Golf Club
RO	reverse osmosis
ROC	RO concentrate
ROWD	Report of Waste Discharge
RRT	Response Retention Time
RWP	recycled water policy
RWQCB	Regional Water Quality Control Board

SD	storm drain
SGMA	Sustainable Groundwater Management Ace
sMCL	secondary maximum contaminant levels
sMCL	secondary MCL
SMGB	Santa Maria Groundwater Basin
SMPAD	Santa Maria Public Airport District
SMVMA	Santa Maria Valley Management Area
SNMP	Salt and Nutrient Management Plan
SRT	step-rate injectivity test
SUO	sewer use ordance
SWA	surface water augmentation
SWRCB	State Water Resources Control Board
SWRO	seawater RO
TBA	Tertiary butyl alcohol
TDS	total dissolved solids
TKN	Total Kieldahl Notrogen
TNT	2,4,6-Trinitrotoluene
TOC	total organic carbon
TSS	total dissolved solids
UF	ultrafiltration
UIC	Underground Injection Control
USBR	United States Bureau of Reclamation
USEPA	United States Environmental Protection Agency
USGS	United States Geologic Society
UV	ultraviolet light
UV AOP	ultraviolet light advanced oxidation process
UVT	UV transmittance
WRD	waste discharge requirements
WRP	wastewater reclamation plant
WWTP	wastewater treatment plant
ZEI	zone of endangering influence

EXECUTIVE SUMMARY

ES.1 Background

Like many utilities in drought-impacted California, Laguna County Sanitation District (LCSD/District) is proactively searching for sustainable measures to secure a safe, reliable, and long-term drinking water supply for their communities.

As a part of this effort, LCSD is conducting a preliminary evaluation of a potential Indirect Potable Reuse (IPR) project. If implemented, this project would utilize an advanced water purification facility (AWPF) at the District's Water Reclamation Plant (WRP) for groundwater augmentation via either surface spreading or direct injection.

The goal of this report is to clarify the requirements, challenges, opportunities, and costs associated with implementing an IPR project for LCSD. This study focuses on the approaches that can be taken to upgrade the current Water Reclamation Plant to produce IPR water at different facility sizes and locations, leveraging the existing treatment and infrastructure systems when possible.

ES.2 Regulatory Summary

Final regulations for groundwater recharge have been in place since 2014 and cover two forms of recharge: (1) surface spreading, which entails percolating tertiary effluent through spreading basins, and (2) direct injection, which entails injecting purified water directly into an aquifer. Projects involving both spreading and injection were analyzed for development by LCSD. Ultimately it was determined that for this project, all alternatives would involve treating water to the standards of direct injection. Key regulatory requirements for groundwater recharge projects are summarized below in Table ES-1.

Groundwater recharge projects are also subject to the requirements of the relevant groundwater Basin Plans. For this project, the major parameter of concern from the Basin Plan requirements is boron. Boron is difficult to remove through typical treatment processes and the objective concentration is very low. Potential future approaches for boron compliance include (1) additional investigations of boron sources to determine if boron concentrations can be reduced through source control, (2) investigation of potential treatment options to reduce boron below the objective concentration, and (3) investigation of alternative regulatory pathways for compliance.

Table ES-1 Key Regulatory Requirements for Indirect Potable Reuse via Groundwater Recharge

	Groundwater Recharge – Surface Spreading	Groundwater Recharge – Direct Injection
Project Structure and Interagency Coordination	Main entity is project sponsor.	
Source Control	Requires industrial pretreatment and pollutant source control program including: ▪ Assessment of the fate of site-specific chemicals through the wastewater and recycled water treatment systems. ▪ Monitoring and investigation of chemical sources. ▪ Outreach program to minimize discharge of chemicals into the source water.	
Pathogen Control	▪ 12-log enteric virus. ▪ 10-log Giardia. ▪ 10-log Cryptosporidium.	
Treatment Train (1)	Minimum treatment by tertiary filtration and disinfection.	RO + UV/AOP required.
Chemical Control	Must meet all current drinking water standards, including MCLs, DBPs, and ALs. Quarterly monitoring.	
Diluent Water	▪ Maximum recycled water TOC contribution of 0.5 mg/L. ▪ Initial recycled water contribution not to exceed 20 percent (i.e., need 4 gallons diluent water for every 1-gallon recycled water). ▪ Diluent water can be approved existing drinking water source; otherwise, must undergo characterization and meet MCLs, sMCLs, and NLs.	▪ Maximum recycled water TOC contribution of 0.5 mg/L. ▪ Initial recycled water contribution can be 100 percent. ▪ No diluent water required
Additional Monitoring	Quarterly sampling in recycled water and downgradient groundwater wells for priority pollutants, unregulated chemicals, and NLs.	
Environmental Buffer	Minimum aquifer retention time of 2 months.	
Operations	No specific requirements in regulations; projects are having requirements written into permits for AWTO Grade 3 operators.	
Plans	Operations Optimization Plan	
Reporting	Annual compliance reporting.	
Alternative Clause	Alternatives can be used provided the project sponsor demonstrates that the proposed alternative assures at least the same level of protection to public health.(3)F	

Notes:
(1) For both spreading and injection projects, 1-log virus credit is granted for each month of travel time in the aquifer. For a spreading project (only), the 10-log protozoa credit will be granted for disinfected tertiary recycled if the travel time is 6 months or greater in the groundwater basin.
(2) Alternatives to the requirements can be used if it is demonstrated to DDW that the alternative ensures at least the same level of public protection, receives written approval from DDW, and conducts a public hearing regarding the alternative. For this project, no alternative is proposed.
(3) RO – reverse osmosis; UV AOP ultraviolet light advanced oxidation process; DBP – disinfection byproducts; Als – action levels; TOC – total organic carbon; mg/L – milligrams per liter; sMCLs - secondary maximum contaminant levels; NLs – notification levels; AWTO – advanced water treatment operator

ES.3 Existing Conditions for LCSD

LSCD currently treats about 1.7 mgd and produces disinfected tertiary recycled water with additional RO filtration of a portion of the flow (0.5 mgd) to reduce dissolved solids concentrations (see current treatment approach in Figure ES.1). For a future potable reuse project, the source water would be the existing LCSD secondary effluent; therefore the water quality of secondary effluent is important for the IPR feasibility evaluation. An analysis of the existing water quality and performance characteristics of the existing treatment processes indicate that the MBR and RO systems can be used, with modifications, to produce purified water for groundwater recharge. Chapter 3 discusses the existing conditions at the LCSD WRP including water quantity, water quality, and existing treatment performance metrics.

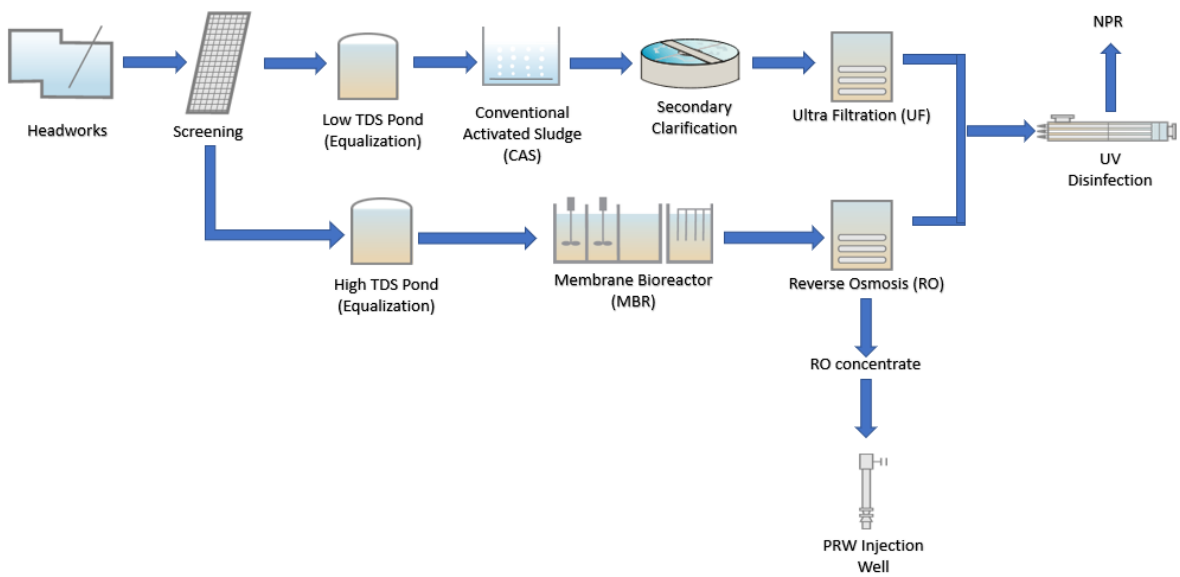


Figure ES-1 Current Treatment Scheme at the WRP

RO concentrate currently produced at the WRP leaves the facility through an existing 4-inch disposal line and is sent for disposal in a deep brine disposal well. The capacity of the existing brine line is approximately 140 gpm; as discussion in subsequent sections, new RO concentrate disposal infrastructure may be needed depending on the size of a future potable reuse project.

ES.4 Groundwater Recharge and Infrastructure Analysis

There are a number of infrastructure component options that can be utilized to integrate the AWPF and groundwater recharge process into existing infrastructure. In addition, construction of new infrastructure may be required depending on the flow and location of groundwater recharge. Further details on the use of existing assets and the need for new infrastructure components are discussed in Chapter 4.

There are three identified locations for potential groundwater recharge with PRW. These locations include:

1. Spreading (percolation) at the Getty Basin [existing infrastructure].
2. Injection near the Getty Basin [new infrastructure].
3. Injection northwest of LCSD [new infrastructure].

Analysis of the existing flood control infrastructure suggests that is could be used for groundwater recharge when not in use for flood control purposes. However, using this infrastructure would require significant coordination with the Flood Control District, and alternative uses for the purified water are needed in the wet season when flood control infrastructure is not available.

Injection of purified water northwest of LCSD provides the closes option (i.e. shortest new pipeline infrastructure), and allows for injection year-round. Based on preliminary analysis of the expected groundwater travel times, it is expected that injection in this location would allow for at least 6 months, and likely at least 12 months of travel time before impacting any nearby drinking water wells. Groundwater modeling is needed to further advance the understanding of groundwater travel times.

ES.5 Future IPR Configurations

Two main IPR project options were developed to capture the most promising alternatives. Additional project elements and modifications are also discussed to illustrate the range of potential future projects.

The first project alternative is Project 1 – Fast Track Project. In this project, the existing MBR/RO treatment train is upgraded to treat water to IPR standards, and continues to treat 0.5 mgd. This involves modification of the existing RO system, as well as the implementation of UV/AOP. The CAS treatment train remains in place and continues to treat 1.2 mgd for non-potable reuse. This project allows LCSD to produce IPR most immediately, with potential for expansion to a larger IPR facility in the future. This project also does not require any upgrades to the existing RO concentrate disposal system. New infrastructure needs include a pipeline to a new injection location northwest of LCSD, and a groundwater recharge injection well.

The second project alternative is Project 2 – Full IPR Implementation. In this project, the treatment system is fully upgraded to treat 1.7 mgd for groundwater recharge. This project configuration could be implemented as a Phase 2 to the Fast Track Project, but for this report the project was designed and costed for full implementation all at once. In this configuration, both the CAS and MBR are still used for wastewater treatment; the effluent from these treatment trains combines to go through RO and UV/AOP before being sent for injection northwest of LCSD. Because of the volume of RO concentrate produced, a new brine disposal pipeline and injection well would be needed for this project.

Additional factors considered for future project configurations are the purified water production (could range from 0.5 mgd to 1.7 mgd, with ability to expand to 3.5 mgd in the future); project implementation timeline (ability to phase projects); additional treatment options (such as implementing high recovery RO to avoid the need for new RO concentrate disposal infrastructure); and the ability to remove the MBR in the future.

ES.6 Planning Level Cost Estimates

Class 5 cost estimates were developed for the total project costs for each project. Annual O&M cost estimates were also developed. These costs were combined into an annual project cost used to estimate the cost/acre-foot of each alternative. These costs are summarized below in Table ES.2.

In addition to cost estimates, an implementation schedule and next steps summary was developed to support the continuation of project development. Continued work is proposed to take place under grants received and will be adjusted based on pending grant application(s). The next steps have been presented to LCSD in a separate scope of work containing details regarding Phase 1 and Phase 2 studies.

Table ES-2 Project Alternative Cost Summaries

Project	Feed Flow (mgd)	Purified Water Production (mgd)	Treatment Modifications	Treatment Costs	New Infrastructure Needs (PRW Injection Wells, Monitoring Wells, ROC Disposal Wells, and Conveyance Infrastructure)	New Infrastructure Costs	Total Project Capital Cost	Annualized Project Cost (Infrastructure and Treatment)(1) (2023 Dollars)	Annual O&M Costs	Total Cost per Acre-Foot
Project 1	0.5	0.43	Upgrade RO system Upgrade UV for UV AOP New UV System for NPR	$12.9 M	▪ PRW Injection wells near LCSD ▪ Conveyance pipeline from LCSD to injection NW of LCSD ▪ Pump Station ▪ Conveyance from LCSD to Agriculture Storage Reservoir	$8.4 M	$21.3	$1.1 M	$1.2 M	$4,950
Project 2	1.7	1.45	New RO system New UV System for UV AOP	$ 46.6 M	▪ PRW Injection wells near LCSD ▪ Conveyance pipeline from LCSD to injection NW of LCSD ▪ Pump Station ▪ Conveyance from LCSD to Agriculture Storage Reservoir ▪ New ROC disposal well and associated pumping ▪ New ROC disposal pipeline	$32 M	$78.6	$4.3 M	$2.4 M	$4,130

Notes
(1) Annualized project costs assume a 30 year loan with 3.5 percent interest rate.

CHAPTER 1 INTRODUCTION

1.1 Background and Purpose

The LCSD WRP is located southwest of the city of Santa Maria, and slightly northwest of the town of Orcutt, California. The Santa Maria River lies to the north of the treatment plant and outfalls to the Pacific Ocean. The Santa Maria Valley Groundwater Basin underlies this area and is within the larger coastal valley in northern Santa Barbara and southern San Luis Obispo counties. There are three management areas in the Basin, namely the Santa Maria Valley Management Area (SMVMA), Nipomo Mesa Management Area, and the Northern Cities Management Area. Of the three management areas, SMVMA is the largest. The wastewater reclamation plant is in the SMVMA (Figure 1.1). Water in the basin is used for agricultural and municipal purposes. Before the 1990s, municipal water needs in the SMVMA were met via groundwater pumping. In 1977, with the introduction of the State Water Project, imported water deliveries replaced some of the groundwater pumping used for municipal supply (Luhdorff & Scalmanini, 2021) thereby reducing some reliance on the groundwater basin.

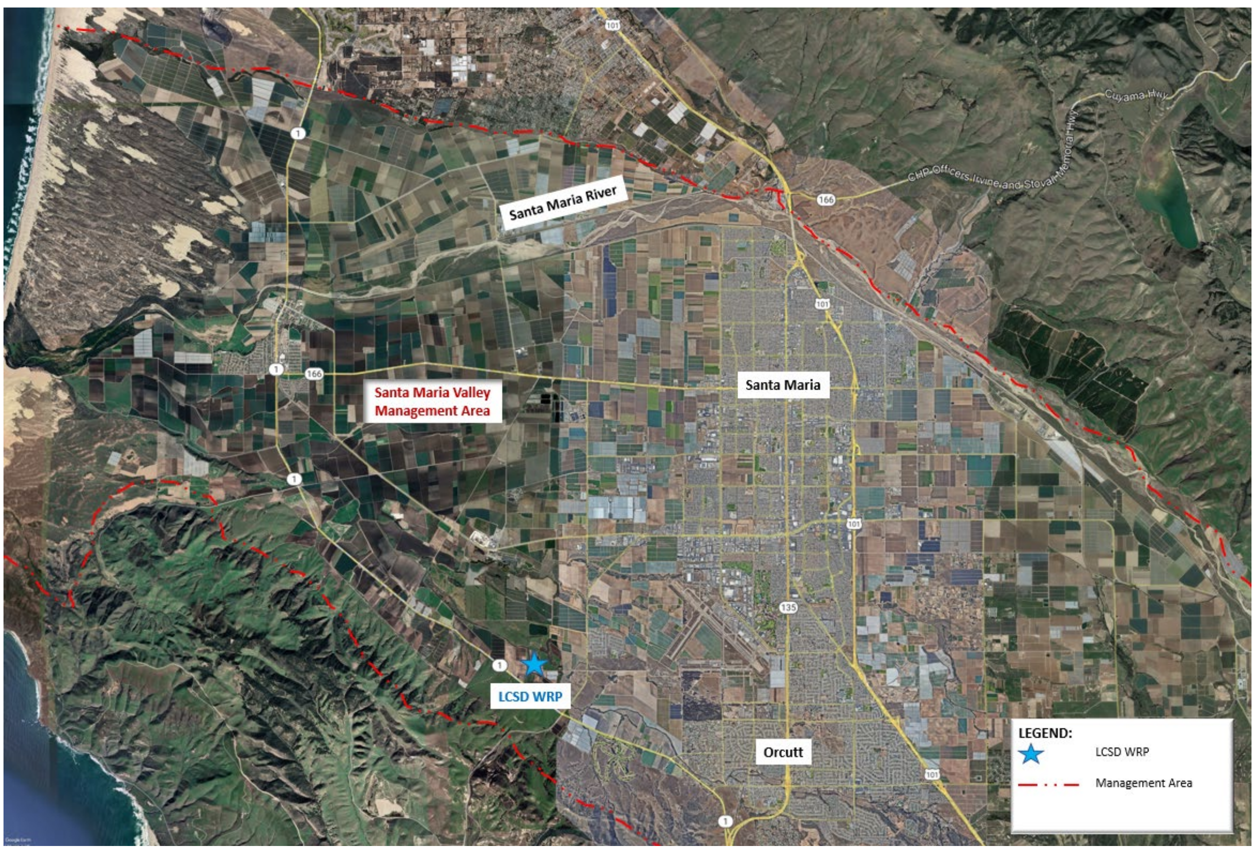


Figure 1.1 Project Location

Currently, the WRP effluent is treated and distributed as recycled non-potable water to local customers for landscape irrigation, agriculture, construction, and industrial purposes. Like many utilities in drought -impacted California, LCSD is proactively searching for sustainable measures to secure a safe, reliable, and long-term drinking water supply for their communities. As a result, they wish to evaluate potential future options for an IPR project that would make use of some or all of the treatment plant's effluent for IPR via groundwater recharge, including that which is currently being used for irrigation. Because of the technologies currently in use at the LCSD WRP, an IPR project could likely leverage much of the existing treatment process at LCSD, with some upgrades and additions.

The goal of this report is to define the planning level costs, opportunities, and challenges of implementing IPR for the WRP in the Santa Maria Valley area.

Similar IPR projects are underway in the Central Coast Region of California and include the Carpinteria Advanced Purification Project, Morro Bay Our Water Project, Pure Water Monterey, Ventura Water Pure, and Central Coast Blue in southern San Luis Obispo County. All five projects are IPR via groundwater augmentation. In addition, a Santa Barbara county-wide study is underway to evaluate potential potable reuse at four facilities in the area.

1.2 Project Summary

LCSD is well positioned to incorporate IPR into their treatment scheme, with extensive installed infrastructure that can be utilized for IPR: membrane systems MBR, UF, RO, ultraviolet light (UV) disinfection, and RO concentrate (ROC) waste disposal (via an existing disposal well). These technologies are all in use now for the non-potable reuse (NPR) irrigation disposal system.

The existing WRP consists of two parallel treatment trains that evolved for the purpose of treating both high and low total dissolved solids (TDS) wastewater. All effluent from the parallel trains is treated to Title 22 standards, blended, and distributed. The current treatment scheme at LCSD is depicted in Figure 1.2. The first train (low TDS train) consists of a trickling filter (not shown in Figure 1.2) that is currently undergoing replacement with a conventional activated sludge (CAS) process. Moving forward, this will be referred to as the CAS treatment train. The second treatment train (high TDS train) consists of an MBR/RO system. Moving forward, this will be referred to as the MBR/RO treatment train. Both treatment trains come together to send water through UV disinfection.

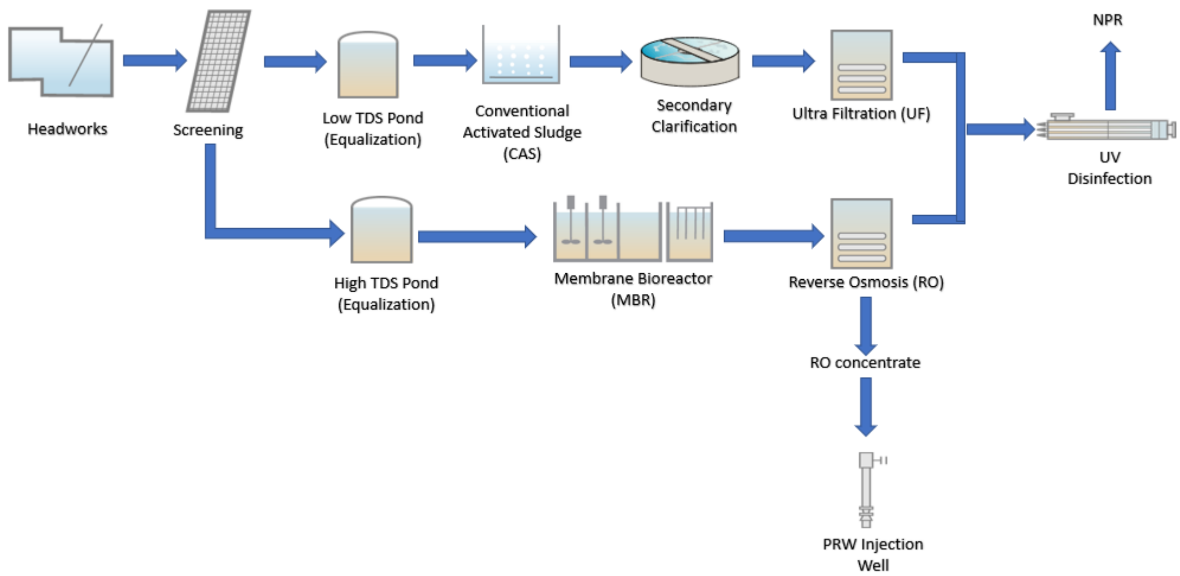


Figure 1.2 Current Treatment Scheme at the WRP

Title 22 non-potable water produced at the WRP is sent to Waller Park, Santa Maria Public Airport District (SMPAD), Northern Branch County Jail, an oil field for industrial use, agricultural pastures, recycled water storage reservoir, and lower storage ponds as shown in Figure 1.3 below.

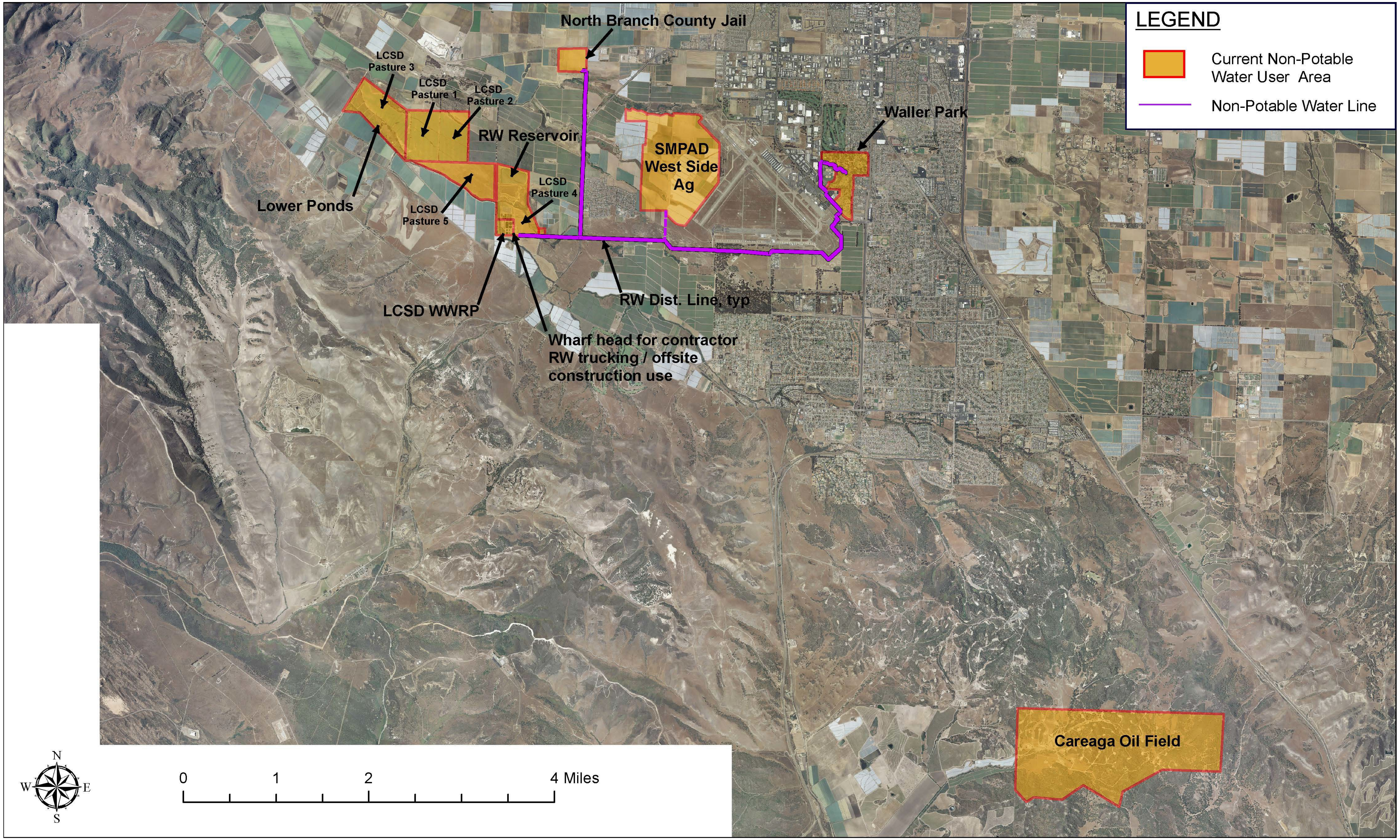


Figure 1.3 LCSD Areas of Non-Potable Recycled Water Use

There are two types of indirect potable reuse: (1) surface water augmentation (SWA), and (2) groundwater replenishment (GWR). Due to the WRP's proximity to a large groundwater basin and the lack of an available surface water reservoir, this analysis focuses on GWR for potable reuse. Further, there are two methods for GWR, which are percolation of disinfected tertiary recycled water via surface spreading and injection of purified recycled water (PRW) directly into the groundwater aquifer. For the purpose of this report it is assumed water will be treated to the requirements and standards of direct injection. Further details on the requirements and standards for the proposed use of the PRW will be discussed later in this report.

The approach for this project will consider the necessary treatment steps, plant operation requirements, source control, basin requirements, IPR regulations, and planning level costs associated with each alternative.

1.3 Topics Covered in this Report

This report covers the following topics:

- Regulatory Summary:
  - Current California potable water reuse regulations.
  - Basin specific objectives.
- Existing Conditions Analysis:
  - Source Water Analysis: Available flows for the AWPF feed.
  - Source Water Quality: Water quality and source control at LCSD.
  - Existing Treatment Systems Analysis.
  - Treatment Train and Phasing Analysis: Recommended treatment train, phasing, monitoring systems, layout, and estimated costs.
- Existing Infrastructure and Potential Groundwater Recharge Options.
  - Existing Infrastructure: benefits and drawbacks to leveraging use of existing infrastructure for IPR purposes.
  - Options for Purified Water Storage: where to place the purified water and how to recharge the groundwater basin.
  - ROC disposal.
- Future IPR Configurations:
  - Top project alternatives.
  - ROC disposal.
- Costs Summary:
  - Preliminary costs for infrastructure and treatment system components for proposed purified water flows. Includes construction and operations costs.
- Outline of IPR implementation plan:
  - IPR implementation timeline, including identification of project phases.

CHAPTER 2 REGULATORY SUMMARY

This chapter provides an overview of the State of California regulatory requirements for IPR projects.

2.1 Background and Context

Water recycling and potable reuse in California falls under the jurisdiction of the State Water Resources Control Board (SWRCB). Within the SWRCB, two departments are responsible for protecting the public health and environment with respect to water: (1) the Division of Drinking Water (DDW); and (2) the Regional Water Quality Control Boards (RWQCBs). The DDW regulates public drinking water systems and is responsible for developing regulations for recycled water and for reviewing recycled water projects. The RWQCBs, which are divided into nine regions across the state, develop and enforce water quality objectives and implementation plans to protect the beneficial uses of the state's water, and write the permits for recycled water projects. The applicable RWQCB for this project is the Central Coast RWQCB (Region 3).

Simply put, DDW protects drinking water quality and public health. The RWQCBs protect surface and groundwater quality. To permit an IPR project, they work together.

2.2 IPR Regulations

As previously mentioned, due to the proximity of a large groundwater basin, this project focuses upon GWR for potable reuse. Final regulations for GWR have been in place since 2014 and can take two forms: (1) surface spreading; and (2) direct injection.

GWR relies on the California Code of Regulations (CCR) Title 22 as a guiding tool for IPR project implementation. More specifically, each IPR solution will be required to meet the criteria provided in the Title 22 CCR Article 5.1 for groundwater replenishment – surface, and Article 5.2 for groundwater replenishment – subsurface. In addition, IPR product water must also meet the Central Coast Regional Water Quality Control Board (CCRWQCB) Basin Plan groundwater objectives for minerals and drinking water maximum contaminant levels (MCLs) and Recycled Water Policy requirements including Salt and Nutrient Management Plans (SNMPs), antidegradation, and contaminants of emerging concern (CEC) monitoring.

A summary of the elements of the potable reuse regulations for GWR is provided in Table 2.1.

Table 2.1 Key Regulatory Requirements for GWR IPR

	Groundwater Recharge – Surface Spreading	Groundwater Recharge – Direct Injection
Project Structure and Interagency Coordination	Main entity is project sponsor.	
Source Control	Requires industrial pretreatment and pollutant source control program including: ▪ Assessment of the fate of site-specific chemicals through the wastewater and recycled water treatment systems. ▪ Monitoring and investigation of chemical sources. ▪ Outreach program to minimize discharge of chemicals into the source water.	
Pathogen Control	▪ 12-log enteric virus. ▪ 10-log Giardia. ▪ 10-log Cryptosporidium.	
Treatment Train (1)	Minimum treatment by tertiary filtration and disinfection.	RO + UV/AOP required.
Chemical Control	Must meet all current drinking water standards, including MCLs, DBPs, and ALs. Quarterly monitoring.	
Diluent Water	▪ Maximum recycled water TOC contribution of 0.5 mg/L. ▪ Initial recycled water contribution not to exceed 20 percent (i.e., need 4 gallons diluent water for every 1-gallon recycled water). ▪ Diluent water can be approved existing drinking water source; otherwise, must undergo characterization and meet MCLs, sMCLs, and NLs.	▪ Maximum recycled water TOC contribution of 0.5 mg/L. ▪ Initial recycled water contribution can be 100 percent. ▪ No diluent water required
Additional Monitoring	Quarterly sampling in recycled water and downgradient groundwater wells for priority pollutants, unregulated chemicals, and NLs.	
Environmental Buffer	Minimum aquifer retention time of 2 months.	
Operations	No specific requirements in regulations; projects are having requirements written into permits for AWTO Grade 3 operators.	
Plans	Operations Optimization Plan	
Reporting	Annual compliance reporting.	
Alternative Clause	Alternatives can be used provided the project sponsor demonstrates that the proposed alternative assures at least the same level of protection to public health.(3)	

Notes:

(1) For both spreading and injection projects, 1-log virus credit is granted for each month of travel time in the aquifer. For a spreading project (only), the 10-log protozoa credit will be granted for disinfected tertiary recycled if the travel time is 6 months or greater in the groundwater basin.

(2) Alternatives to the requirements can be used if it is demonstrated to DDW that the alternative ensures at least the same level of public protection, receives written approval from DDW, and conducts a public hearing regarding the alternative. For this project, no alternative is proposed.

(3) RO – reverse osmosis; UV AOP ultraviolet light advanced oxidation process; DBP – disinfection byproducts; Als – action levels; TOC – total organic carbon; mg/L – milligrams per liter; sMCLs - secondary maximum contaminant levels; NLs – notification levels; AWTO – advanced water treatment operator.

2.2.1 Treatment Requirements

Title 22 CCR requires that potable reuse projects for groundwater recharge provide a combined level of treatment resulting in 12-log virus, 10-log Giardia, and 10-log Cryptosporidium reduction (12/10/10-log removal). No single process can receive more than 6-log reduction credit and at least three processes must provide at least 1-log reduction.

For each treatment process for which a pathogen credit is sought, the treatment process must be validated to demonstrate that it can achieve the proposed log reduction. The treatment processes must use monitoring to verify performance using microbial, chemical, or physical surrogate parameters.

GWR by means of injection must undergo full advanced treatment of RO and advanced oxidation process (AOP). GWR through surface spreading requires a minimum of tertiary filtration and disinfection prior to application to a spreading basin. A seemingly reasonable idea for this project would be to use a lower level of treatment and apply the water through spreading. However, for this project, there are several reasons that eliminate that option:

1. Per regulations, spreading projects require dilution of wastewater effluent total organic carbon (TOC) with another potable supply. This dilution must be, at least, a 5:1 blend of potable: reclaimed to start the project. While captured stormwater may be used for blending, that captured stormwater must (a) be reliable and reasonably consistent in terms of flow and (b) must meet drinking water quality standards.
2. No dilution water is needed if RO and AOP are utilized for the entire flow.
3. There will be times of the year where spreading basins are not available for potable reuse efforts, due to their use for stormwater capture. In those instances, PRW would either be sent to a storage pond or injected into the groundwater aquifer. Injection dictates a higher level of treatment.

Because this project will use injection, the treatment train must include the RO and UV AOP. While membrane pretreatment ahead of RO is not required from a regulatory standpoint, it is a necessary process for protection of the RO membranes. These pretreatment membranes can be either UF (as used at the WRP on the low TDS train) or MBR (also as used at the WRP). Note that UF provides for the reduction of protozoa (Giardia and Cryptosporidium) whereas MBR provides for virus reduction as well as reduction of the two listed protozoa.

The regulations contain an alternatives clause (Table 2.1), which allows for the use of other treatment technologies if the project can demonstrate under Title 22 the following conditions be met:

- Provides the same level of protection of public health.
- Requires an Independent Advisory Panel (IAP) to approve the project.
- Is approved by the DDW.
- The project sponsor must conduct a public hearing.

No alternatives are proposed pertaining to the LCSD project.

2.2.2 Enhanced Source Control

As a part of the wastewater collection system source control requirements, the reuse project sponsor must administer an industrial pretreatment and pollutant source control program that includes, at a minimum:

- An assessment of the fate of DDW-specified and RWQCB-specified chemicals and contaminants through the wastewater and recycled municipal wastewater treatment systems.
- Chemical and contaminant source investigation and monitoring that focuses on DDW-specified and RWQCB-specified chemicals and contaminants.
- 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 Groundwater Replenishment Reuse Project (GRRP), for the purpose of managing and minimizing the discharge of chemicals and contaminants at the source.
- A current inventory of chemicals and contaminants identified pursuant to this section, including new chemical and contaminants resulting from new sources or changes to existing sources, which may be discharged into the wastewater system.
- Compliance with the effluent limits established in the wastewater management agency's RWQCB permit.

2.2.3 Water Quality Requirements

The purified recycled water from the LCSD treatment plant must be of high quality and meet all regulated parameters prior to injection. Consequently, monitoring is required throughout the treatment system. This monitoring includes online and grab sample monitoring for performance indicators, performance surrogates, and a broad range of chemical pollutants (Maximum Contaminants Levels (MCLs), Notification Levels (NLs), secondary MCLs (sMCLs), Contaminants of Emerging Concern (CECs), per- and poly-fluorinates substances (PFASs), nitrosamines, disinfection byproducts, and Basin Plan Water Quality Objectives). The water quality limits for groundwater recharge with recycled water are defined in Appendix A.

In addition, regulations impose limits on TOC of wastewater origin. For GWR via direct injection, the PRW must have TOC concentrations less than 0.5 mg/L.

2.2.4 Monitoring Requirements

Inorganic chemicals (except nitrogen compounds), radionuclides, organic chemicals, DBPs, lead and copper require quarterly monitoring while secondary MCLs require annual monitoring per CCR 60320.112. Health-based constituents and bioanalytical screening tools are to be monitored for in the purified product water and prior to RO.

CECs are defined by the SWRCB (2019a) as constituents in personal care products; pharmaceuticals; antimicrobials; industrial, agricultural, and household chemicals; naturally occurring hormones; food additives; transformation products; inorganic constituents; microplastics; and nanomaterials. SWRCB (2019a) includes revised recommendations from the CEC monitoring list in 2013 that included contaminants with health-based significance, CECs that serve as performance indicators, and non-CECs that serve as performance surrogates. In addition, a new bioanalytical screening tool category was added with corresponding constituents. The recycled water policy (RWP) addresses CECs and acknowledges that the state of knowledge on CECs is incomplete. CEC concentrations in finished water should be minimized through effective source control and treatment programs. The RWP contains a provision to reconvene a Science Advisory Panel every five years to update the recommendations for CEC monitoring in recycled water. The reconvened panel published its recommendations in April 2018. Its recommendations have been incorporated into the amendment to the RWP approved by the OAL in April 2019 (SWRCB 2019a).

Monitoring requirements in SWRCB from 2019 along with monitoring trigger levels (MTL) are listed in Appendix A.

2.2.5 Groundwater Requirements

Groundwater IPR projects require a minimum retention time of 2 months that must be verified using a tracer study (either intrinsic or seeded).

Groundwater augmentation allows for storage of excess water underground, allows for increased groundwater pumping, and can push back seawater intrusion. The proposed groundwater augmentation for this project, via injection, requires construction of wells accompanied by the necessary monitoring wells per regulation. For this project, existing extraction wells would be used (no new extraction wells).

2.2.6 Operational Requirements

Prior to operation, a project sponsor shall submit an Operation Optimization Plan (OOP) to the DDW and Central Coast RWQCB. The OOP describes the operations, maintenance, analytical methods, operating procedures, response and action plans, monitoring and reporting, staffing plan and chain of command under normal and extenuating operating conditions to ensure regulatory compliance. The OOP describes how treatment processes will be operated in a manner providing optimal reduction of all chemicals and contaminants including pathogens and regulated and unregulated constituents.

2.2.7 Basin Plan Requirements

The Basin Plan requirements for groundwater subsurface injection of treated water based on the Water Quality Control Plan for the Central Coastal Basin (SWRCB 2019c) are summarized in Table 2.2. The proposed WRP injection locations (discussed in more detail in Chapter 4) occur in both the Santa Maria and Upper/Lower Guadalupe sub-basins. In Figure 2.1, the Getty Basin proposed injection location lies within the Santa Maria sub-basin. The second potential injection location was identified northwest (NW) of LCSD which lies within the Upper/Lower Guadalupe sub-basin (Figure 2.1). The project would only choose one of the two locations (Santa Maria or Guadalupe) for injection. The Orcutt sub-basin is adjacent and directly south of both the Santa Maria and Upper/Lower Guadalupe sub-basins.

The Basin Plan water quality objectives are shown in Table 2.2. The major parameter of concern for this project is boron, as it is difficult to remove through typical treatment processes and the objective concentration is very low. Further investigation of boron sources is needed to define if boron concentrations at the LCSD can be reduce through source control.

Initially, it was proposed to inject purified water at the LCSD WRP site, which lies within the Orcutt sub-basin[1]. However, due to the low boron Basin Plan objectives in this area (Table 2.2), it was later determined that the location to the northwest of the LCSD plant site in the Upper/Lower Guadalupe basin was preferred. Further information regarding boron challenges and solutions are discussed in Section 3.2.2.

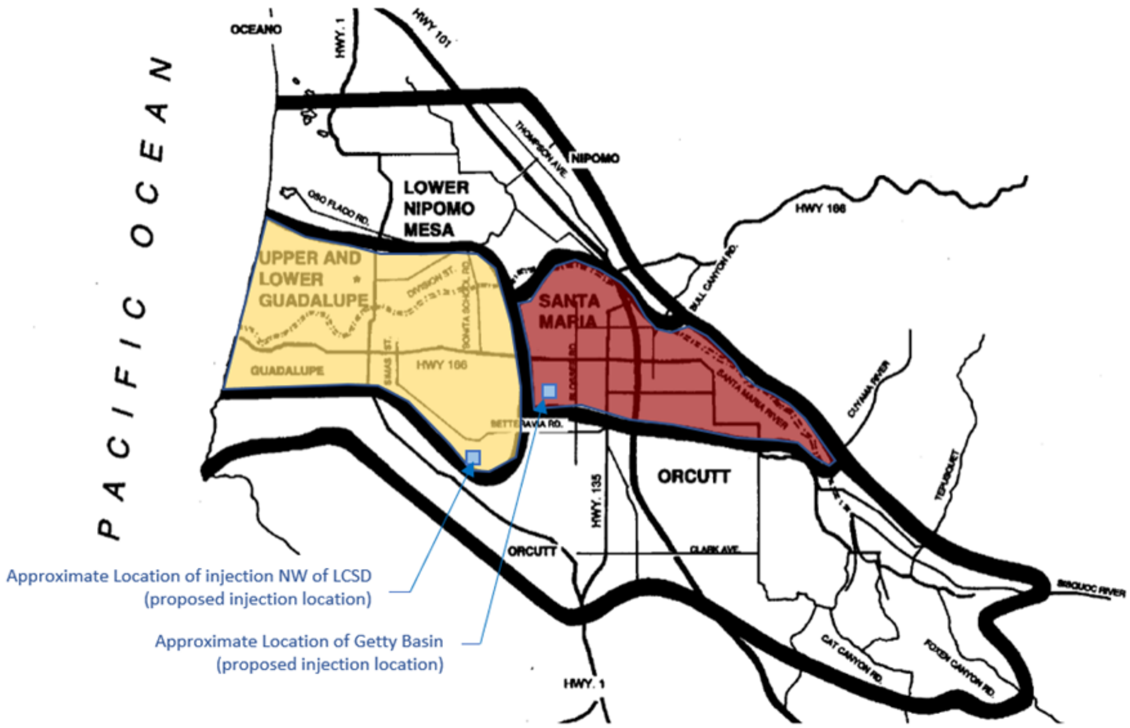


Figure 2.1 Santa Maria and Upper/Lower Guadalupe Sub-Basins and Potential Injection Locations

[1] Groundwater velocity in Orcutt Basin in the deep aquifer (where injection could occur) is slow (0.5 ft/day). Injection into the shallow aquifer is faster (17 ft/day). The distance from a potential LCSD PRW injection well to Guadalupe is ~9,200 ft. Thus, either way, travel time in the Orcutt Basin would be significant and the low boron level in that basin remains challenging.

Table 2.2 Central Coast Basin Median Groundwater Objectives

Parameter	Santa Maria Sub-Basin Criteria(1)	Lower Guadalupe Sub-Basin Criteria(1)	Upper Guadalupe Sub-Basin Criteria(1)	Orcutt Sub-Basin Criteria(1)
Boron, mg/L	0.2	0.2	0.5	0.1
Chloride, mg/L	90	85	165	65
Sodium, mg/L	105	90	230	65
Sulfate, mg/L	510	500(2)	500(2)	300
TDS(2), mg/L	1,000	1,000	1,000	740
Nitrogen as N(3, 4), mg/L	8	2	1.4	2.3

Notes:
(1) SWRCB 2019c. Objectives are median values.
(2) Maximum objective in accordance with Title 22 Code of Regulations.
(3) Groundwater basin currently exceeds usable mineral quality.
(4) Ammonia + Nitrate + Nitrite.
TDS – total dissolved solids

Groundwater monitoring has been performed north and northwest of LCSD. The monitoring locations can be seen in Figure 2.2.

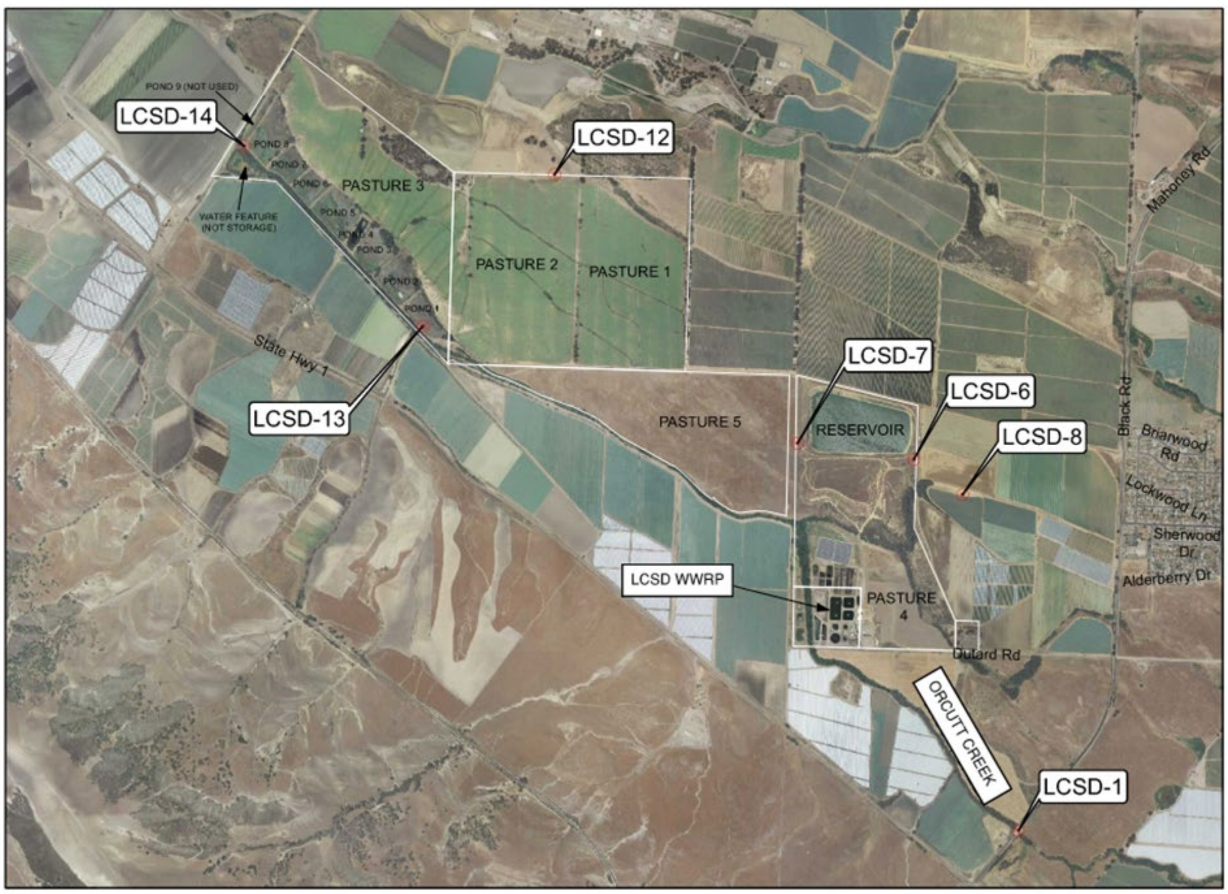


Figure 2.2 LCSD Groundwater Monitoring Sampling Locations

The monitoring locations shown fall within the following sub-basins:

- Orcutt Creek falls within the Orcutt sub-basin.
- LCSD #1 Monitoring Well falls within the Orcutt sub-basin.
- LCSD #6 Monitoring Well falls within the Orcutt sub-basin.
- LCSD #7 Monitoring Well falls within the Orcutt sub-basin.
- LCSD #8 Monitoring Well falls within the Orcutt sub-basin.
- LCSD #12 Monitoring Well falls within the Lower Guadalupe Basin[2].
- LCSD #13 Monitoring Well is on the Upper Guadalupe and Orcutt sub-basin border[3].
- LCSD #14 Monitoring Well is on the Upper Guadalupe and Orcutt sub-basin border[3].

The three main sub-basin areas and corresponding parameter results from 2019-2022 are summarized in Table 2.3 below. Note that where there is no information in the SMR reports on monitoring wells within the Santa Maria sub-basin, information from USGS was obtained for boron concentrations in this area. This is discussed below.

Table 2.3 LCSD Groundwater Monitoring Results for Basin Plan Parameters (2019-2022)

Groundwater Sub-Basin	Parameter	Average	Maximum	Number of Samples
Orcutt(1)	Boron, mg/L	0.38	0.58	16
	Chlorides, mg/L	174.4	230	16
	Sodium, mg/L	190	260	16
	Sulfate, mg/L	281.9	620	16
	TDS, mg/L	962.5	1,800	16
	Total N, mg/L	11	42	11
Lower Guadalupe(2)	Boron, mg/L	0.19	0.22	3
	Chlorides, mg/L	380	390	3
	Sodium, mg/L	263.3	290	3
	Sulfate, mg/L	386.7	440	3
	TDS, mg/L	1,933.3	2,100	3
	Total N, mg/L	74.3	99	3

[2] Average monitoring well depth (2019 through 2022) was 121 feet for LCSD #12. Upper Guadalupe is assumed to be the first 80 feet. Therefore, it was assumed this well falls within the Lower Guadalupe sub-basin.

[3] Average monitoring well depth (2019 through 2022) was 29 feet and 27 feet for LCSD #13 and LCSD #14, respectively. Upper Guadalupe is assumed to be the first 80 feet. Therefore, it was assumed these wells fall within Upper Guadalupe sub-basin.

Groundwater Sub-Basin	Parameter	Average	Maximum	Number of Samples
Upper Guadalupe/Orcutt Border(3)	Boron, mg/L	0.3	0.35	8
	Chlorides, mg/L	138.8	170	8
	Sodium, mg/L	138.8	180	8
	Sulfate, mg/L	831.3	1,400	8
	TDS, mg/L	1,975	2,900	8
	Total N, mg/L	1.2	3.1	7

Notes:
Source: Annual Self-Monitoring Reports (SMR 2019, SMR 2020, SMR 2021, and SMR 2022)
(1) Orcutt sub-basin includes sampling locations: Orcutt Creek, LCSD #1, LCSD #6, LCSD #7, and LCSD #8 Monitoring Wells.
(2) Lower Guadalupe sub-basin includes sampling location: LCSD #12 Monitoring Well.
(3) Upper Guadalupe/Orcutt sub-basin includes sampling locations: LCSD #13 and LCSD #14 Monitoring Wells.
LCSD # 1 was dry from 2019-2020.
LCSD #12 was dry in 2022.

Boron is the main constituent of concern as obtaining lower levels may require additional treatment. The average boron concentrations in the Orcutt sub-basin, based on monitoring well results, exceed the Orcutt basin objective in Table 2.2. The average boron concentrations in the Lower Guadalupe sub-basin listed in Table 2.3 do not exceed the basin objective listed in Table 2.2 Similarly, the average boron results of the monitoring wells located near the Upper Guadalupe/Orcutt border do not exceed the Upper Guadalupe basin levels; however, the average does exceed the Orcutt sub-basin requirements. It should be noted that the LCSD monitoring well data listed above is limited. Consequently, regional data was also assessed with a focus on boron concentrations. Further discussion regarding current boron levels at LCSD in comparison to current groundwater basin concentrations and basin objectives are discussed in Section 3.2.2.1

The National Water Information System (NWIS) Database (USGS) was reviewed for boron concentrations in the Santa Maria, Upper/Lower Guadalupe, and Orcutt sub-basins with results presented in Figure 2.3. All concentrations were found to be below the basin criteria, meaning that there is the potential that all sub-basins have assimilative capacity (discussed further in Section 2.2.9). Going forward in this analysis, the assumption is that through a combination of groundwater modeling and water quality sampling, assimilative capacity for boron can be documented and thus allow for the IPR project to proceed without requiring treatment solutions beyond the existing, or similar, RO system (e.g., two pass RO with pH adjustment for boron removal).

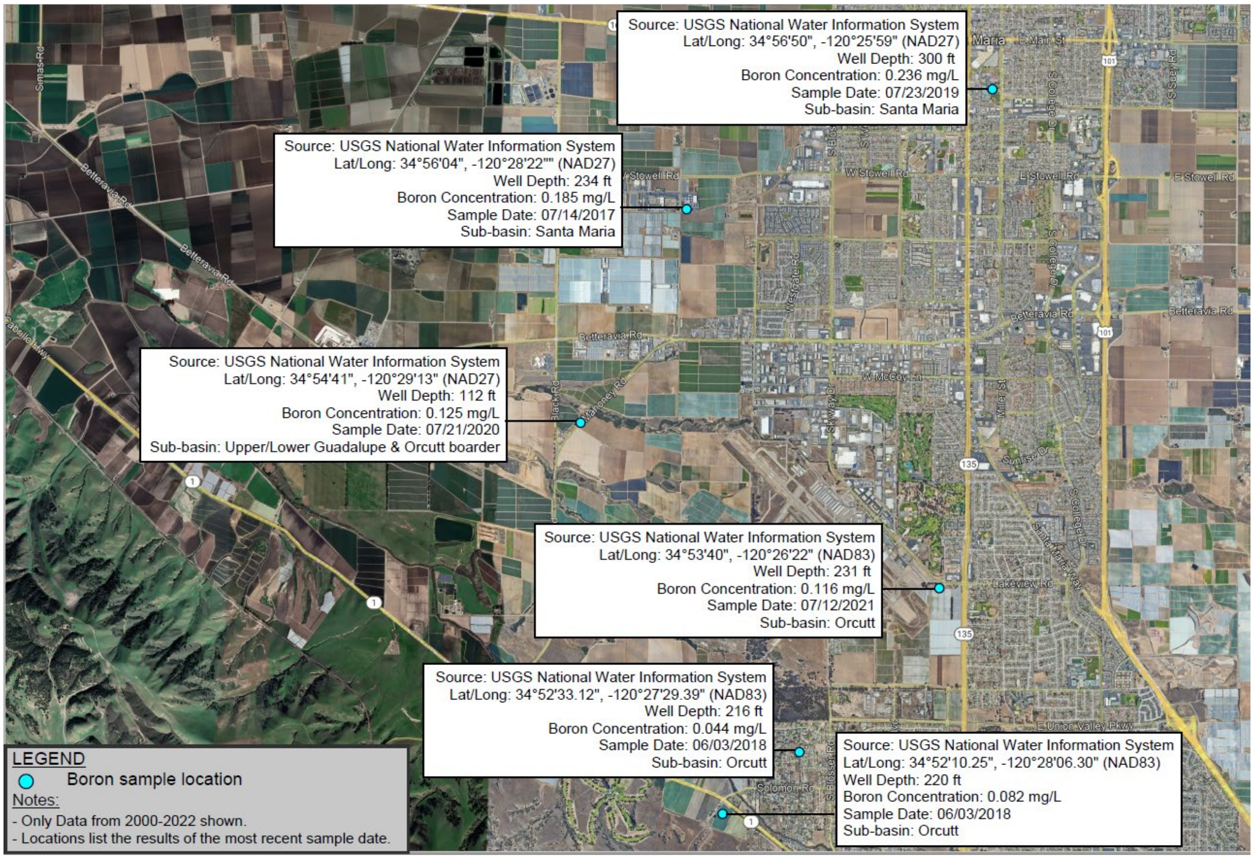


Figure 2.3 Boron Concentrations in the Santa Maria, Upper/Lower Guadalupe, and Orcutt Sub-Basins

The Rancho Maria Golf Course (RMGC) irrigates their facilities from the surrounding groundwater basin. A 2021 report of the RMGC, located south of LCSD, analyzed the boron concentrations in the groundwater aquifer (Irrigation & Turfgrass Services, 2021). Results revealed that the Rancho Maria Golf Course groundwater contained 0.12 mg/L of boron. The RMGC sits within the Orcutt sub-basin which has a boron objective of 0.1 mg/L. Therefore, the RMGC results reveal that the groundwater basin is already above Basin Plan objectives, and therefore has no assimilative capacity.

2.2.8 Recycled Water Policy Requirements

The RWP exists to encourage the safe use of recycled water from wastewater sources in a manner that implements state and federal water quality laws and protects public health and the environment. The RWP was adopted by the SWRCB in 2009 and revised in 2013. The SWRCB adopted Resolution No. 2018-0057 to amend the RWP in 2018. The amendment was approved by the Office of Administrative Law (OAL) and took effect in April 2019 to make up the current RWP. Relevant components to the RWP include SNMPs, antidegradation, and monitoring requirements for CECs.

The CEC monitoring requirements were previously discussed in Section 2.2.4, the remaining RWP components are discussed below.

2.2.8.1 Salt & Nutrient Management Plan

The objective of a SNMP is to manage salts and nutrients from all sources on a basin-wide or watershed-wide basis to ensure water quality objectives are met and a protection of beneficial use is in place. SNMPs are developed in accordance with the RWP and require ongoing analysis to evaluate inputs into the basin, the salt and nutrient mass balance, and available assimilative capacity. The purpose of the SNMP at LCSD is to ensure the recycled water is not degrading the quality of the groundwater source (CH2MHill, 2014). Under the waste discharge requirements (WRD), LCSD is expected to report on the salt and nutrient reduction efforts. This is incorporated into the SNMP. Based on the 2014 SNMP, with data from 2010 -2012, the following was note:

- Recycled water TDS, Electrical Conductivity (EC), Sulfate, and Nitrite as N are below the groundwater average.
- Recycled water Sodium, Chloride, Boron, and Total Nitrogen as N exceed the groundwater average.
- Nitrite as N, Ammonia as N, and Organic N are non-detect for the groundwater average.

With the replacement of the trickling filter with a conventional activated sludge process, the salt effluent is expected to be comparable to the current effluent; however, the nutrient content is expected to significantly reduce. In addition, implementation of planned management measures to maximize water use efficiency and nutrient use in the pasture reuse areas that LCSD supplies water to will aid in minimizing impacts to the groundwater source.

2.2.8.2 Antidegradation

Groundwater recharge projects must demonstrate compliance with Resolution No. 68-16, the state's Antidegradation Policy, entitled "Statement of Policy with Respect to Maintaining High Water Quality in California." The key components of this Resolution are:

- Existing water quality of greater quality than established policies shall be maintained until it can be demonstrated to the state that any change will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies.
- Waste discharge into existing high-quality waters must meet waste discharge requirements which ensure pollution will not occur and high-quality waters will be maintained.

For GRRPs, the project sponsor must submit an antidegradation analysis with the Report of Waste Discharge (ROWD) that demonstrates compliance with the Antidegradation Policy.

Further discussion on anti-degradation, as it applies to boron concentrations, is included further on within this report.

2.3 Waste Discharge

LCSD operates under the General Waste Discharge Requirements Order No. WQ 2016-0068-DDW, water reclamation requirements for recycled water use and transmittal of monitoring and reporting program Order No. R3-2022-0062 permit. Discharge of the ROC is performed under the Class I Nonhazardous Waste Injection Well Permit No. R9UIC-CA1-FY20-3R into the Union Sugar #13 Well.

CHAPTER 3 EXISTING CONDITIONS FOR LCSD

This IPR analysis includes an assessment of the complete water picture, from raw wastewater through potable use. Critical information focuses upon flows and water quality.

3.1 LCSD Wastewater Treatment

As mentioned, there are two parallel treatment trains at the WRP. The low TDS treatment train treats wastewater through screening, grit removal, CAS, secondary clarification, and UF. The high TDS treatment train treats wastewater through screening, grit removal, MBR, and RO. Both the low and high TDS treatment trains then combine for UV disinfection treatment. The WRP is undergoing a Phase 1 Expansion project that will replace the existing trickling filter system in the low TDS treatment train with a CAS process. When the Phase 1 Expansion is complete the low TDS treatment train will include screening, grit removal, CAS, secondary clarification, UF, and UV disinfection. Upgrading to CAS will result in a higher quality secondary effluent than the existing trickling filter system. Figure 3.1 depicts the site layout at LCSD upon completion of the Phase 1 Expansion project

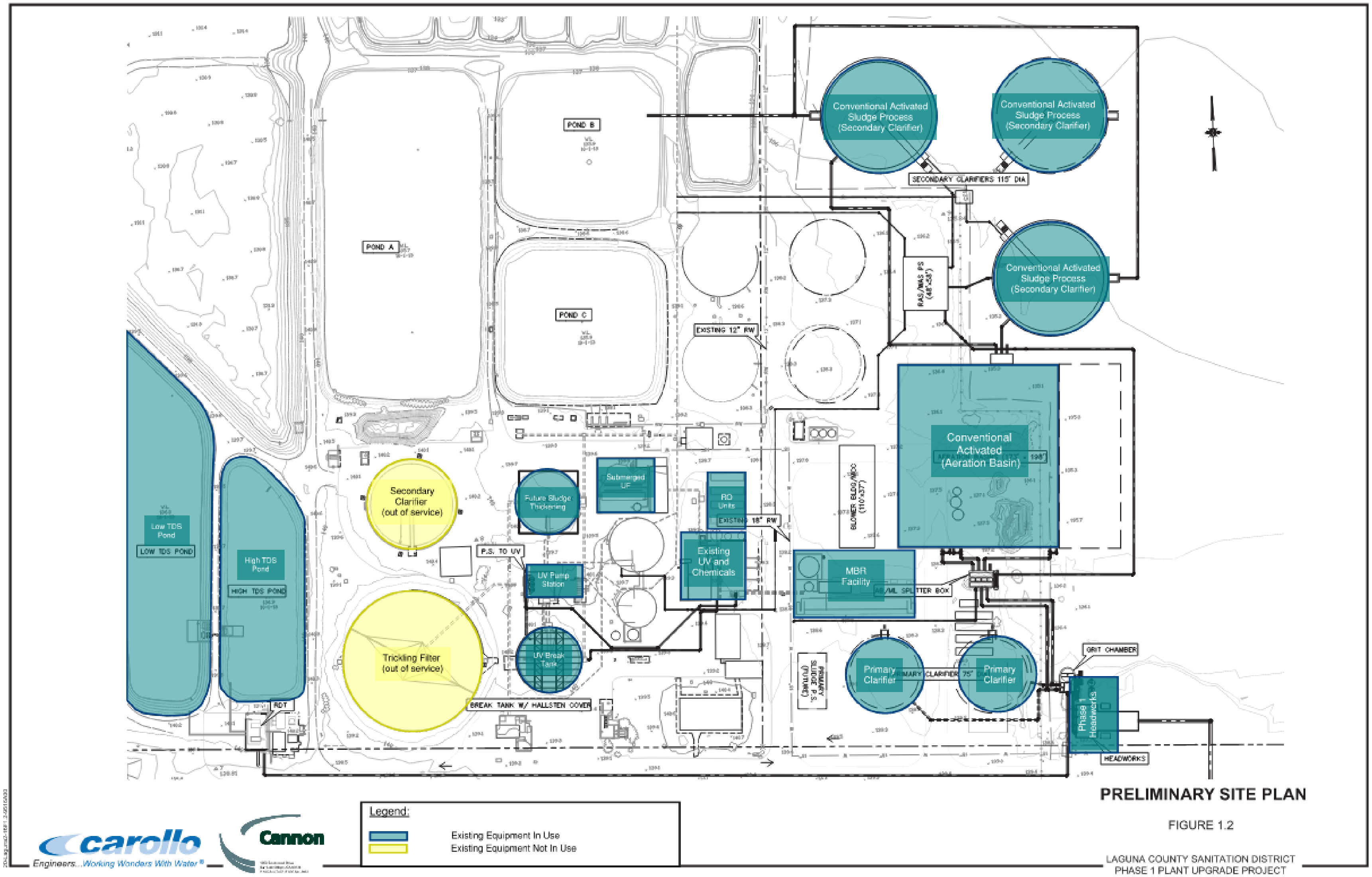


Figure 3.1 LCSD Facilities Upon Completion of Phase 1 Expansion

3.1.1 Flow and Equalization

The WRP is currently designed to handle a period of high TDS flow in the morning, which is sent through RO to reduce TDS, and blended with the lower-TDS stream to produce water suitable for non-potable reuse. The plant continuously monitors TDS in the influent and when the TDS exceeds the set limit (2,500 µs/cm), flow is diverted to the high TDS storage pond for the purpose of filling the pond. Once the pond is filled with 0.5 million gallons (MG), it is then used as a source to provide continuous, equalized flow through the MBR/RO system. The filling of the high TDS pond takes approximately 5 hours. Once high TDS pond diversion is satisfied, flow is diverted back to the low TDS treatment train. Backwash and CIP rinse water from the UF process is diverted to the low TDS storage pond. The low TDS storage pond is used to equalize the flow to the CAS treatment train and feed this train during the early morning high TDS diversion.

Currently LCSD is treating approximately 1.7 million gallons per day (mgd). The average annual daily flow from January 2016 through October 2022 is depicted in Figure 3.2 below. Note that this average annual daily flow will likely change over time, and would be re-evaluated as part of future phases of a potable reuse project.

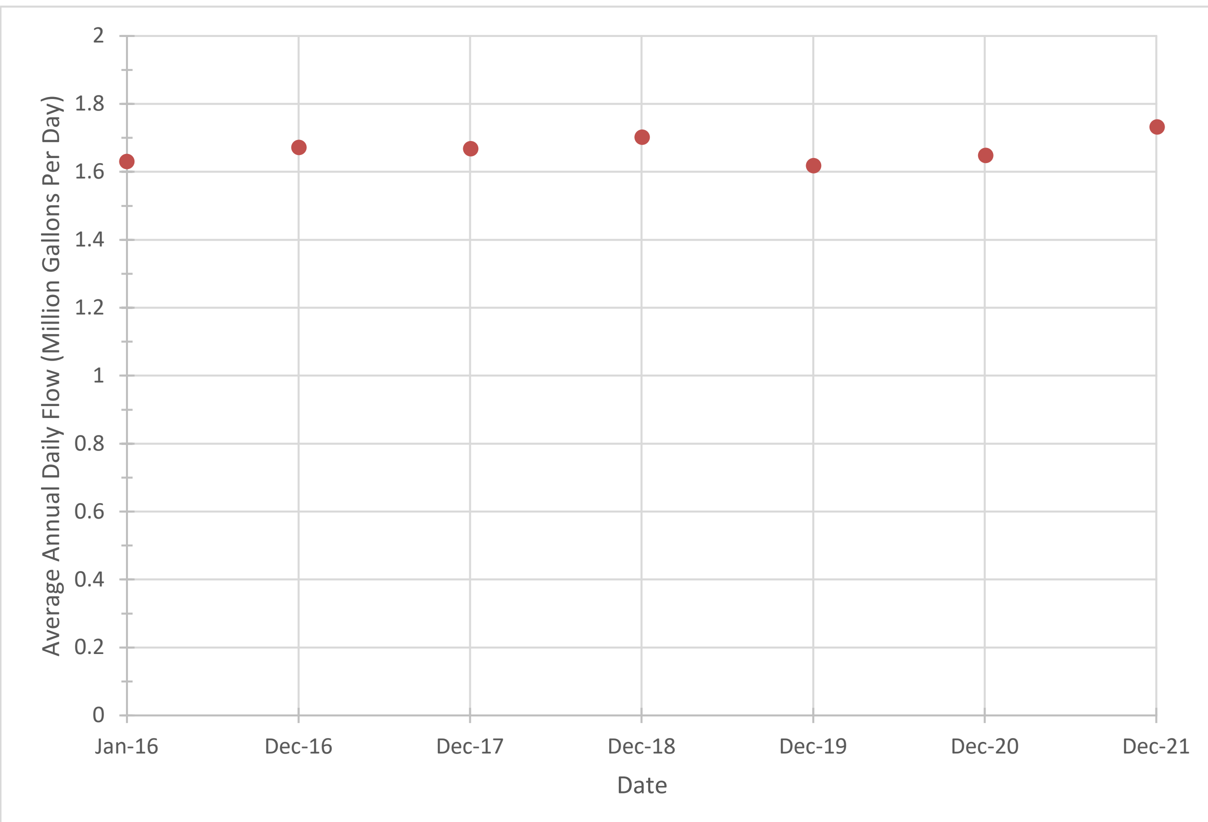


Figure 3.2 LCSD Wastewater Average Annual Daily Flow (2016-2022)

Under the current scenario of 1.7 mgd, about 0.5 mgd is sent to the high TDS treatment train (i.e. MBR/RO), with the remaining 1.2 mgd sent to low TDS treatment train (i.e. CAS).

In 2001, the plant upgrade expanded the capacity from 3.2 mgd to 3.7 mgd. In the future, there may be the need to upgrade the capacity of the WRP due to development of nearby areas causing an increase in wastewater production. For the purpose of this report, the future projected capacity scenario for the District was set at 3.7 mgd, which is approximately 80 percent of the total projected buildout.

3.1.2 Water Quality

Effluent data from the LCSD treatment plant from 2019 through 2022 Self-Monitoring Reports was averaged and is listed in Table 3.1 below. Note that this data is from the existing trickling filter-based treatment system; the upgrade of the trickling filter to a CAS system is not yet complete. The results in Table 3.1 are from the combined effluent stream.

Table 3.1 LCSD Wastewater Reclamation Plant Annual Final Effluent Monitoring Results (2019 – 2022)

Effluent Parameter	Units	Average	Minimum-Maximum
pH	--	7.5	4.5-8.2
Biological Oxygen Demand (BOD)	mg/L	4	0-51
Total Suspended Solids (TSS)	mg/L	1	0-5.5
Total Dissolved Solids (TDS), mg/L	mg/L	733	608-923
Sodium	mg/L	146	120-260
Chloride	mg/L	143	110-250
Sulfate	mg/L	189	150-280
Boron	mg/L	0.35	0.28-0.76
Nitrite (as N)	mg/L	1.0	0-14
Nitrate (as N)	mg/L	1.9	0.3-10
Ammonia (as N)	mg/L	18.5	0-36
Total Kjeldahl Nitrogen (TKN)	mg/L	19.4	2-29
Total Nitrogen (as N)	mg/L	22.2	3.9-32

Notes:
Source: SMR 2019, SMR 2020, SMR 2021, and SMR 2022/
(1) TSS results only include 2019 and 2020 results. All TSS results for 2021 and 2022 were 0 mg/L.

In 2016, an analysis of the LCSD WRP was performed using the design criteria from the 2010 CH2MHill Master Plan (Carollo, 2016). From this, the tertiary effluent quality was modeled to show the impacts of the Phase 1 upgrades (replacing the trickling filter with CAS). The results from the model are shown in Table 3.2.

Table 3.2 LCSD Wastewater Reclamation Plant Modeled Tertiary Effluent Quality

Effluent Parameter	Units	Tertiary Effluent Design Average (high TDS)	Tertiary Effluent Design Average (low TDS)
Biological Oxygen Demand (BOD)	mg/L	1.0	1.0
Suspended Solids (TSS)	mg/L	0.1	0.1
Ammonia (as N)	mg/L	0.1	0.2
Inorganic Nitrogen (Nitrite + Nitrate) (as N)	mg/L	3.1	2.3
Organic Nitrogen (as N)	mg/L	2.2	2.1
Total Nitrogen (as N)	mg/L	5.5	4.6

Notes:
Source: Carollo 2016.

Table 3.2 shows that the Phase 1 upgrades are expected to increase the effluent water quality at LCSD by significantly lowering BOD, TSS, ammonia, and total nitrogen. Once the Phase 1 upgrades have been completed, water quality changes will be verified through Self-Monitoring Reports.

3.1.3 Source Control

LCSD does not have a federally mandated or permitted pretreatment program due to the small size of the WRP. LCSD administers a pretreatment program focused on fats, oil, and grease (FOG) and pool permitees. Since the swimming pools produce high levels of minerals their backwash cycles and drainages are timed in coordination with the other high TDS dischargers. LCSD relies on the sewer use ordinance (SUO) by the County of Santa Barbara for regulating and enforcing industrial dischargers[1]. Beyond the FOG and pool permits, LCSD does not have any industrial dischargers.

As discussed in Chapter 2, for IPR projects, an Enhanced Source Control Program (ESCP) will be required to meet DDW standards. This ESCP will build upon the existing framework above but will be much more extensive with a focus on PRW quality (as compared to wastewater treatment plant performance and effluent discharge compliance).

3.2 Treatment Design and Performance

Log reduction values (LRV) must be obtained for each key unit process to provide the overall pathogen removal required for IPR. For each key process, performance is closely tied to specific performance indicators. These LRVs and indicators are shown in Table 3.3. The LRVs that need to be obtained in each proposed alternative for the LCSD upgrade to IPR will be discussed in Chapter 5.

The current LCSD performance of each treatment process is discussed in subsequent subsections.

[1] https://library.municode.com/ca/santa_barbara_county/codes/code_of_ordinances?nodeId=CH29STDRSASE_ARTIIIDIINLACOSADITRSY

Table 3.3 Unit Process Performance and Monitoring Standards for IPR

Process	Performance Surrogate/Indicator	Performance Standard	Expected pathogen LRV (virus/Giardia/Cryptospridium)
MBR[1]	Turbidity	0.2 NTU 95% of the time	1/2.5/2.5
		0.5 NTU 100% of the time	
UF	Turbidity	0.2 NTU 95% of the time	0+[2]/4/4
		0.5 NTU 100% of the time	
	Daily PDT	~4 LRV protozoa through PDT Calculation	
RO[3]	EC Reduction	1.5 to 2 LRV	1.5/1.5/1.5
UV AOP	UVT UV Dose	>97% >~900 mJ/cm2	6/6/6
Free Chlorination[4]	CT (free chlorine residual X contact time)	~4 to 6 mg-min/L	6/0+/0+[5]
Groundwater RRT	Travel time	2, 6, and 12 months	2+[6]/2+[7]/2+[7]

Notes:
(1) Based on conclusion of WRF 4997 (Salveson et al., 2021). Credits are based on turbidity results being below 0.2 NTU 95 percent of the time, and below 0.5 NTU 100 percent of the time.
(2) UF provides virus removal but will not be assigned virus removal credit due to the lack of online monitoring or periodic surrogates that will reliably demonstrate virus removal performance.
(3) Based on both the EC and TOC reduction across the RO system. Online analyzers for TOC can be used to increase LRV for virus and protozoa from 1.5 to 2.0.
(4) Virus disinfection credit is only sought for free chlorination. Credits requested to be flexible based upon CT. Longer groundwater travel times allow for less chlorine LRV credits to meet total 12 LRV virus target. Chlorine residual to be based on the CT required per the Australian WaterVal Validation Protocol Chlorine disinfection requirement guidelines, http://www.waterra.com.au/_r7273/media/system/attrib/file/1707/201702_WaterVal_Validation-Protocol_Chlorine-Disinfection.pdf.
(5) Some nominal level of Giardia inactivation, and less Cryptosporidium inactivation will occur due to free chlorine contact.
(6) For each month retained underground the recharge water will be credited with 1-log virus per 22 CCR.
(7) Six months retention underground allows for 10-log Giardia and 10-log Cryptosporidium reduction per 22 CCR.
MBR – membrane bioreactor; NTU – Nephelometric Turbidity Unit; PDT – pressure decay test; EC – electrical conductivity; UVT – UV transmittance; CT – contact time.

3.2.1 MBR

The current MBR system characteristics are detailed in Table 3.4.

Table 3.4 LCSD MBR Characteristics

Item	Value
MBR Capacity	0.5 mgd
Number of Trains	2
Membrane Manufacturer	Veolia (Zenon)
Membrane Module Model Number	ZeeWeed ZW500Ds
Membrane Nominal Pore size	0.04 µm
Area per Module	300 sf
Number of Cassettes per Train	4
Number of Modules per Cassette	16
Additional Space in Current Membrane Tank	0 percent
Total Installed Membrane Area per Train	19,200 sf

Item	Value
Filtration Cycle	12 min
Capacity per Train	0.25 mgd
Design Recycled Activated Sludge Flow	Unknown, at the low flux rates it should be driven by the nitrification needs.
Average Design Flux/Train	8.7/8.4[(1)] gfd
Design Solids Retention Time (Aerobic/Total)	Unknown, days
Design Total Hydraulic Retention Time	Unknown, hours
Year/Month of Membrane Install	MBR Train 1 was replaced in March 2019 and MBR Train 2 was replaced in late 2015/early 2016

Notes:
(1) First value is for Train 1, second value is for Train 2.

As shown in Table 3.3, to obtain LRV credits for MBR, effluent turbidity must be less than 0.2 NTU 95 percent of the time and less than 0.5 NTU 100 percent of the time.

Online turbidity data from the two MBR treatment trains (MBR Train 1 and MBR Train 2) from April/May 2023 is shown in Figure 3.3. Figure 3.3 shows the cumulative distribution of MBR effluent turbidity achieved over the observed period. The following conclusions were made based on the effluent turbidity data:

- MBR Train 1 achieves turbidity values of less than or equal to 0.2 NTU 100 percent of the time.
- MBR Train 1 achieves turbidity values of less than or equal to 0.5 NTU 100 percent of the time.
- MBR Train 2 achieves turbidity values of less than or equal to 0.2 NTU 99.7 percent of the time.
- MBR Train 2 achieves turbidity values of less than or equal to 0.5 NTU 100% percent of the time.

Therefore, both MBR treatment trains are meeting the requirements necessary to achieve LRV credits for IPR purposes. The difference in performance between Train 1 and Train 2 is presumed to be due to membrane age, with Train 1 being replaced in March 2019 and Train 2 being replaced in late 2015/early 2016.

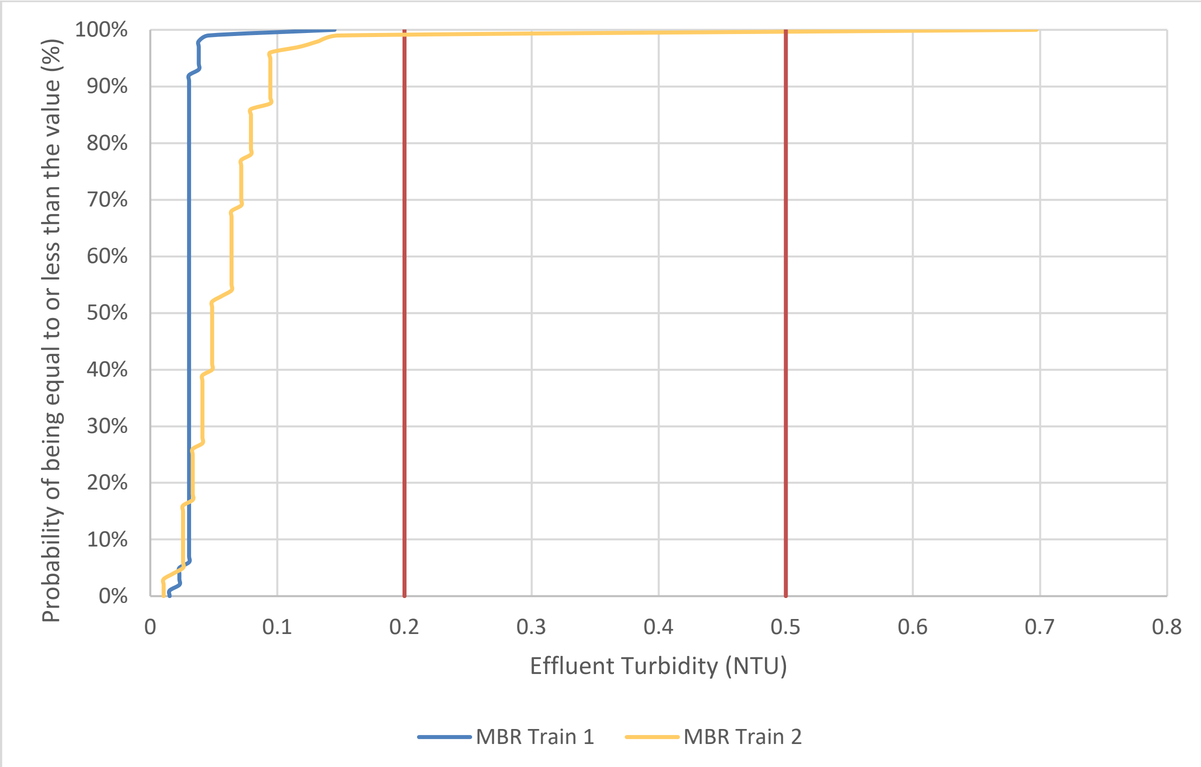


Figure 3.3 MBR Effluent Turbidity (April-May 2023)

3.2.2 RO

The current RO system characteristics are detailed in Table 3.5. A schematic of the current RO system is shown in Figure 3.4.

Table 3.5 LCSD RO Characteristics

Item	Value
RO Capacity	0.54 mgd(1)
Number of Trains	3 (2 duty)(2)
Number of Stages per Train	4
Number of Pressure Vessels Per Array	4:2:1:1 array
Number of Membranes per Pressure Vessel	5
Membrane Manufacturer	Toray Membrane USA Inc.
Membrane Module Model Number	TMG20D-400
Date of Last Membrane Replacement(3)	2019
Membrane Area per Train	16,000 sf
Design Recovery	81 percent
Design Permeate Flowrate per Unit	100 gpm
Design Average Flux per Unit	9 gpd/sf
Design Concentrate Flowrate per Unit	24 gpm

Item	Value
Antiscalant Chemical	Garatt Callahan Formula 6030
Antiscalant Dosage Rate	2.1 ppm
Feed Water pH Target	5.8-6.2
Feed Water pH Adjustment Chemical	Sulfuric Acid

Abbreviations: gpm – gallons per minute; gpd/sf - gallons per day per square foot
Notes:
(1) Capacity with all trains in operation.
(2) A 4th train is connected, but currently does not have membranes installed.
(3) LCSD acquired the RO trains in 1998 from the US Military surplus that were left over in Port Hueneme from the 1991 Gulf War. These membrane systems were retrofitted in El Cajon for the project in 2000. LCSD has changed out the RO elements two times over the project.

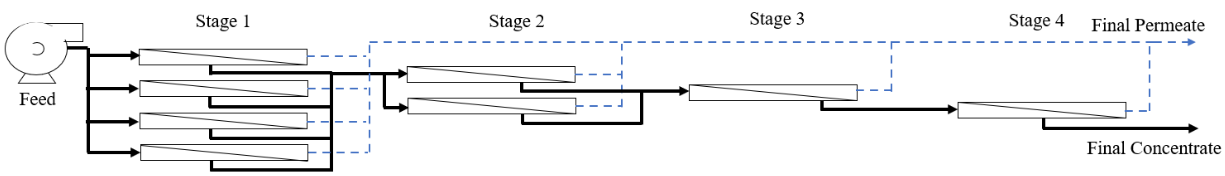


Figure 3.4 Current RO System

It is expected that EC reduction through RO systems used in potable reuse be between 1.5-2.0 LRV. The data in Figure 3.5 shows calculated LRVs ranging from 0.9-1.4, which is within the anticipated range for EC removal.[2] There is variation in performance between the three RO trains, with RO-A achieving the highest LRVs and generally remaining above 1-log EC removal. Because the calculated LRVs do drop below 1, especially for RO trains B and C, and there is some variability in performance, it is suggested to conduct additional analysis on the RO system prior to IPR conversion. In addition, there is a fourth RO unit that could be retrofitted for use. Evaluation of the current RO system may include, but is not limited to, data normalization, analysis of the online analyzers/control valves/O-rings, membrane performance, and profiling the system to better understand the variability in performance. In addition, normalization of data will help identify if there is a system operating, scaling, or integrity issue within the current RO system.

[2] Online data from the RO system was received from LCSD; however, there were challenges with this data as the result had a wide range of variability. In order to process the online data as part of a future analysis, it is recommended that the results are filtered to ensure the RO was on and producing at the LRV was calculated This is achievable with a time series export of permeate flow, permeate, and feed conductivity, and feed pressure.

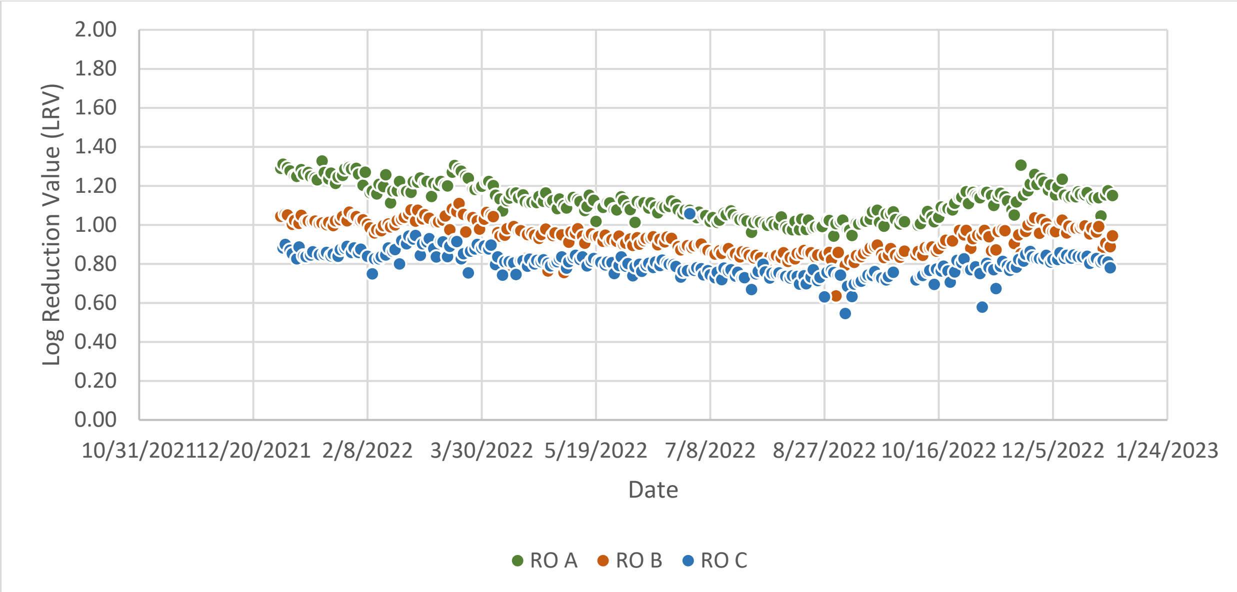


Figure 3.5 Calculated Electrical Conductivity Log Removal by RO: RO-A, RO-B, and RO-C (2022)

3.2.2.1 Boron Challenges

As mentioned in Section 2.2.7, the Basin Plan requirement for boron in the Santa Maria, Lower Guadalupe and Upper Guadalupe sub-basins (where injection is proposed to take place) are 0.2 mg/L, 0.2 mg/L, and 0.5 mg/L, respectively (Table 2.2). The average groundwater concentration from monitoring wells in the Lower Guadalupe is 0.19 mg/L and 0.3 mg/L in the Upper Guadalupe (Table 2.3). Therefore, the existing boron concentrations in the Lower Guadalupe are almost at the basin plan objectives whereas the existing boron concentrations in the Upper Guadalupe are less than the basin plan objective. There was no existing groundwater monitoring data for boron in the Santa Maria sub-basin. Boron objectives for the Santa Maria and the Upper/Lower Guadalupe sub-basins are compared to results from sampling that occurred at LCSD in 2023. ***Boron is not well removed by conventional RO systems, hence the focus upon this topic below.***

At LCSD, boron was sampled in the UF Permeate, RO Feed, and RO Permeate on January 19, 2023, February 2, 2023, and February 23, 2023. Pond C, located upstream of the UF system, and the High TDS Pond, located upstream of the MBR system, were sampled on February 23, 2023. On March 1st, a composite influent sample was collected. Results from the sampling event are found in Table 3.6. Summary points for this data are:

- RO provides between 25 and 30 percent reduction of boron. Boron levels in RO permeate range from 0.18 mg/L to 0.21 mg/L. The RO permeate results are right at the Santa Maria and Lower Guadalupe sub-basin objective limits of 0.2 mg/L.
- Boron is higher in the feed to the future CAS and UF systems compared to boron levels feeding into the MBR system. High salt flows occur diurnally from 5 am to 10 am when the salt from loaded water softeners reaches the plant. These flows are captured and treated by the MBR system.
  - » The UF provides no removal of boron (see Pond C to UF Permeate). This may not be an issue if the UF treated water is not used for IPR injection.

    - For the high salt feed water to MBR, the RO system is able to reduce boron to below 0.2 mg/L. Under no circumstance is boron reduced below 0.1 mg/L.

- The combined boron feed concentration, 0.32 mg/L from the single composite sampling event, would result in an estimated concentration of approximately 0.22 to approximately 0.24 mg/L, which is above Santa Maria and Lower Guadalupe basin requirements.

Further boron sampling is recommended prior to project implementation.

Table 3.6 LCSD Boron Results

Location	Result (mg/L) Sampled on 01/19/2023	Result (mg/L) Sampled on 02/02/2023	Result (mg/L) Sampled on 02/16/2023	Result (mg/L) Sampled on 02/23/2023	Result (mg/L) Sampled on 03/01/2023	Santa Maria sub-basin Criteria (mg/L)(1)	Upper Guadalupe sub-basin Criteria (mg/L)(1)	Lower Guadalupe sub-basin Criteria (mg/L)(1)	Orcutt sub-basin Criteria (mg/L)(1)
Raw Influent(2)	--	--	--	--	0.32	0.2	0.5	0.2	0.1
Pond C	--	--	0.39	0.45	0.45				
UF Permeate	0.43	0.49	0.42	0.44	0.44				
High TDS Pond	--	--	0.31	0.23	0.23				
RO Feed	0.28	0.28	0.24	0.26	0.26				
RO Permeate	0.21	0.2	0.18	0.19	0.19				

Notes:

(1) SWRCB 2019c. Objectives are median values.

(2) 24-hour composite sample of the raw influent.

There are several potential options to address the boron exceedance. These include:

- Implement a second pass RO system:
  - This is a costly solution.
  - The second pass RO would treat the permeate produced by the first past RO. pH adjustment would be performed to optimize boron removal.
  - A two-pass system will work but will almost double the capital and operating cost of the RO system.
- Investigate the feasibility of using seawater RO (SWRO) membranes which may achieve higher boron rejection in place of typical brackish water RO (BWRO) membranes used for municipal reuse:
  - This is a costly solution.
  - Desktop studies with RO production software could be used to determine if a suitable membrane design can be established to reduce Boron to acceptable levels.
  - It is anticipated that SWRO membranes will require higher operating pressures, resulting in replacement of the existing RO feed pumps and an increase in operational expenditure, but would likely be cheaper than a 2-pass system.
- Work with Central Coast RWQCB to define acceptable boron levels in PRW that is injected into the groundwater basin:
  - This is a low-cost solution.
  - A Basin Plan amendment is believed to not be necessary due to flexibility within the Basin Plan. Options that allow for injected PRW with boron levels above the Basin Plan include averaging periods, actual groundwater quality, protective agricultural objectives, and competing beneficial uses.
  - Through groundwater quality analysis and groundwater modeling, the concepts of assimilative capacity or compliance with anti-degradation can be evaluated and used for boron flexibility.
- Source Control:
  - This is a low-cost solution.
  - Boron levels appear to fluctuate daily, with lower levels during the high TDS discharge period of the day (which is diverted to the MBR).
  - It is assumed that the higher boron levels seen diurnally are due to laundry detergents. Community engagement and efforts to change laundry detergent types can be used to reduce boron levels.
- Implement other Emerging RO Membranes:
  - This is a low-cost solution.
  - Requires long term pilot testing.
  - Toray TMG20D, as one example, shows up to 50 percent boron removal as part of research at other facilities.

For this project, we are assuming that through a combination of regulatory flexibility and source control efforts reviewed above, boron levels in PRW will be acceptable for groundwater recharge. Accordingly, conventional RO for potable water reuse is evaluated for this project.

3.2.2.2 Additional Constituents of Interest

The majority of the remaining constituents with Basin Plan Objectives, including chloride, sodium, sulfate and TDS (in Table 2.2 and Table 2.3), will be reduced to concentrations well below objectives and current groundwater averages. Expected total nitrogen in the effluent after the Phase 1 upgrades at LCSD is less than 10 mg/L (4.6 mg/L – 5.5 mg/L), with approximately 2 mg/L expected for the organic nitrogen concentration (Table 3.2). It is important to note that the modeled effluent results in Table 3.2 should be confirmed with sample results. Therefore, conservatively taking total nitrogen to be 10 mg/L and assuming 80 percent removal with RO, the estimated total nitrogen in the purified water would be 2 mg/L. The Basin Plan only has total nitrogen limits for receiving streams which is not considered as part of this groundwater recharge project. The basin plan does list groundwater requirements for nitrogen. It is expected that if the total nitrogen is reduced to 2 mg/L through RO treatment, nitrogen concentrations (which is a portion of the total nitrogen) will be even lower than 2 mg/L. Consequently, expected nitrogen after AWPF treatment is within the Basin Plan Limits for the Santa Maria and Orcutt sub-basins (8 mg/L and 2.3 mg/L, respectively); exceeds the Upper Guadalupe Basin Plan objective (1.4 mg/L); and is at the Lower Guadalupe objective (2 mg/L) (Table 2.2). However, it should be noted that all sub-basins currently exceed usable mineral quality for Nitrogen as N.

3.2.2.3 Existing RO Concentrate Discharge

The ROC produced at the WRP leaves the facility through an existing 4-inch brine disposal line in a northwesterly direction 6-miles to the Union Sugar No. 13 brine disposal well. Figure 3.6 shows the ROC disposal line and Union Sugar No. 13 disposal well location. The brine disposal line also transports brine from an unloading station used to accept concentrated brine from authorized local water users (United States Environmental Protection Agency [USEPA], 2021a). LCSD allows a minor amount of brine disposal from homes through the District's canister exchange program. LCSD assumes the injection rate from these users will stay the same or increase slightly as the district adds more customers to the canister exchange program.

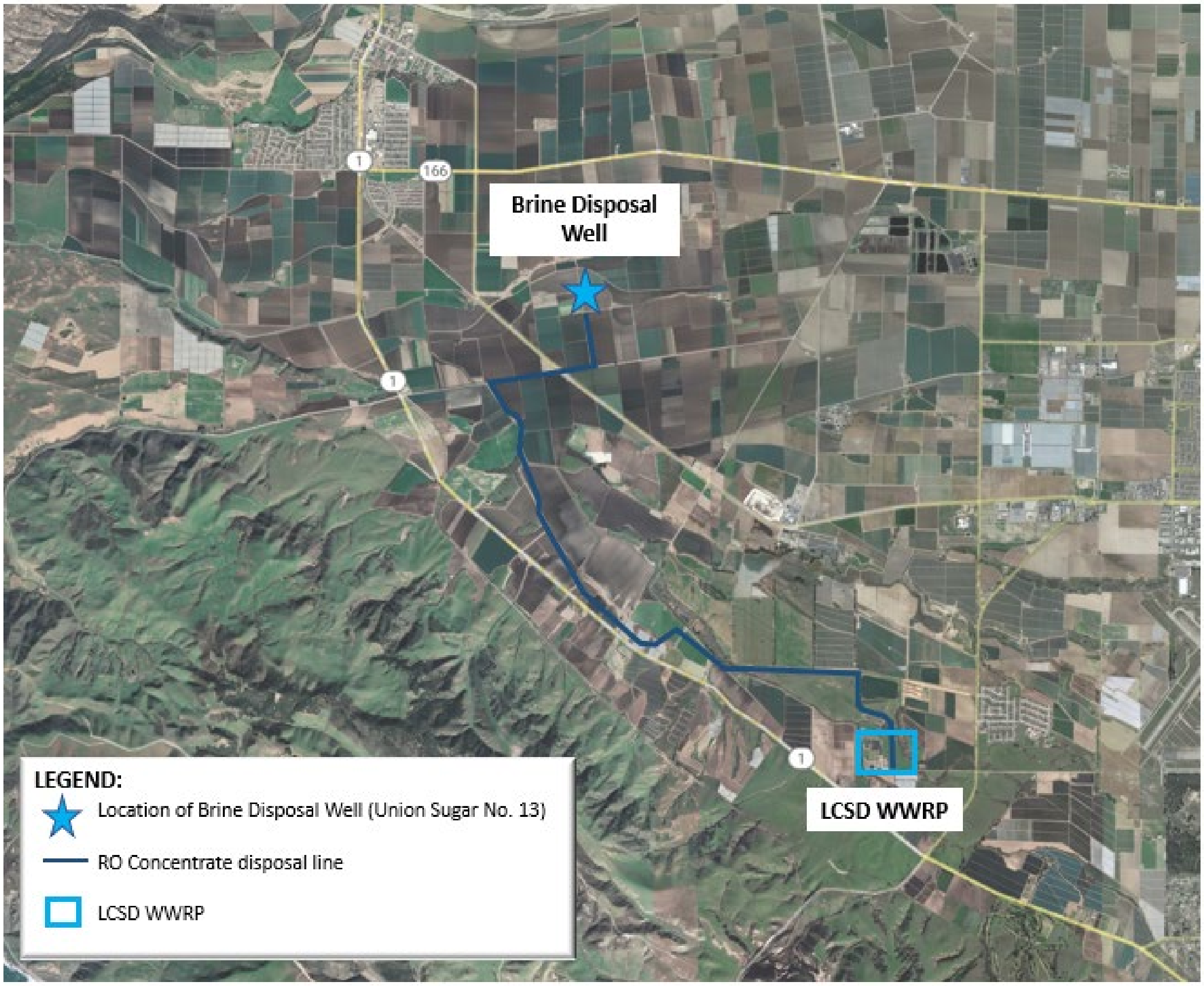


Figure 3.6 RO Concentrate Brine Disposal Line and Disposal Well

3.2.2.4 Brine Receiving Station

The RO system has enough pressure to transport the ROC through the disposal line to the disposal well. In addition, there is enough pressure to push the ROC into the well without the need for pumping.

Brine waste from the haulers is stored in two 20,000-gallon fiberglass reinforced plastic (FRP) tanks. The disposal system then uses two 7.5 horsepower pumps run as duty/standby to pump brine from the tanks to the disposal well. When one of the two pumps is in operation, pumping the brine into the ROC pipeline, it creates backpressure on the RO system, periodically resulting in a RO system shutdown. This backpressure apparently also results in an increase in TDS and electrical conductivity in the RO permeate. The current solution to this challenge requires pumping at a slower rate for a longer period. There is the potential to blend the ROC and brine hauler waste in the brine tanks prior to sending to the disposal well. However, the potential for scaling may be increased as a result of this solution and should be examined as part of future efforts.

As part of the next phase of the project it is recommended that the backpressure challenge be investigated, and a solution determined. In addition, video inspection of the existing ROC pipeline for any scaling is recommended. Inspection could be done with a camera and not require any damage to the ROC line.

3.2.2.5 Brine Line Capacity

LCSD staff used WaterGEMs to confirm the pipe has a capacity of approximately 140 gpm (201,600 gallons per day [gpd]). Therefore, any ROC flow above 140 gpm would require a new brine line.

3.2.2.6 Discharge Well Capacity

The Union Sugar No. 13 well is authorized for injection under the Underground Injection Control (UIC) regulations of the USEPA. Since 2000, and with additional re-permitting in 2011 and 2021, LCSD has been authorized to use the Union Sugar No. 13 well designated by EPA as a Class I non-hazardous waste injection facility. The permit allows injection of ROC into the Monterey Formation at an approximate depth of 4,800 to 5,366 feet below ground surface (bgs). The existing disposal well is confined by shale above and below. According to the permit, the injection rate within the Union Sugar No. 13 well is not to exceed 216,000 gpd (150 gpm) and the pressure is not to exceed 1,000 pounds per square inch gauge (psig) (USEPA, 2021a). Injection of the brine into this well is monitored quarterly (USEPA, 2021a, 2021b, 2021c, 2021d, 2021e, and 2021f). The monthly total volume for February 2023 from brine haulers averaged approximately 5.7 gpm (8,243 gpd). Throughout 2021, the largest maximum injection rate was 63 gpm. More recently, in 2022, LCSD recorded 45.8 gpm (65,894 gpd) as an average injection rate. Therefore, the combined injection rate from brine haulers and LCSD disposal demonstrates quantities well below the permit limit of 150 gpm (USEPA, 2021e). In addition, the maximum injection pressure recorded was 36 psig, well below the limit of 1,000 psig (USEPA, 2021b).

The injection rate is subject to an annual review based on the zone of endangering influence (ZEI) determination (40 CFR § 146.6). LCSD may request a change in the maximum rate provided they demonstrate to the satisfaction of the USEPA that the proposed increase will not interfere with the operation of the facility, its ability to meet conditions outlined in the permit report, changes its well classification, or cause migration of injectate or pressure buildup to occur beyond the Area of Review (40 CFR § 146.3. The request must be written and justified to the EPA with the results of a step-rate injectivity test (SRT) conducted.

With a WRP plant flow of 1.7 mgd and an assumed RO recovery of 85 percent (concentrate rejection of 15 percent), the ROC flowrate for LCSD will be 0.25 mgd (177 gpm). Therefore, any IPR scenario with a feed flow of 1.7 mgd or higher will produce ROC in excess of the pipe capacity of 140 gpm and the permitted injection capacity of 150 gpm. It may be that the groundwater aquifer can incorporate more flow than the permit or pipeline allow (pending a more detailed hydrogeologic analysis). However, it is likely that the disposal pipeline will be the limiting factor. Consequently, there will be a need for an additional ROC pipeline and disposal well or an upgrade to the permit when the capacity of the IPR project expands. Consideration of a new ROC well and disposal pipeline has been added into the cost section of Chapter 6.

3.2.3 UF

In November 2020, LCSD upgraded the two trains containing 14 Veolia ZW500C 26M cassettes with 250 ft^2 membrane modules to two trains containing 14 Veolia ZW500Ds 20M cassettes with 350 ft2 membranes. LCSD plans to retain Veolia to replace and upgrade of all mechanical/electrical components as well as installation of Pressure Decay Testing (PDT) for future potable reuse. The current UF system details are provided in Table 3.7.

Table 3.7 LCSD RO Characteristics

Item	Value
Total Design Capacity	3 mgd
Number of Trains	2
Membrane Manufacturer	Veolia (Zenon)
Membrane Module Model Number	ZeeWeed ZW500Ds
Membrane Nominal Pore size	0.04 µm
Area per Module	350 sf
Number of Cassettes per Train	14
Number of Modules per Cassette	20
Additional Space in Current Membrane Tank	0 percent
Total Design Capacity	98,000 sf
Train Target Recovery	92%
Number of Trains per Tank	1
Average Design Flux/Train	15.3 Net, gfd

This system has more than sufficient capacity for potable reuse, as shown in the table above. With the higher quality flow from the new nutrient removal activated sludge system, our expectations are that the UF flux can be far higher than the listed 15.3 gallons per square foot per membrane per day (gfd), further increasing capacity.

To gain LRV credits for the UF system, turbidity must be monitored, and pressure decay tests must be performed daily (Table 3.3). The current UF system can retain the existing membranes but will need to be upgraded to incorporate the capability to perform daily PDTs in all future IPR configurations. It is our understanding that such upgrades are being considered independent of IPR decisions.

3.2.4 UV

Currently, LCSD uses an Aquionics Inline Model 7500 Ultraviolet Disinfection System to treat tertiary effluent at the WRP. The latest validation testing of the system was performed in 2003 (CH2MHill, 2005). Based on validation testing the following operating conditions summarized in Table 3.8 were suggested for the UV system operation.

Table 3.8 LSCD UV Operating Conditions

Operating Parameter	Value	Action
Flow Rate	2,500 gpm	Adjust ZeeWeed to lower flow rate if flows through UV are higher than stated value (with three UV banks running).
UV dosage	110 mJ/cm2	Turn on fourth UV bank if total UV dose for three banks goes below stated value. If still below 100 mJ/cm2 with fourth bank turned on, divert all flows to effluent storage ponds and notify end users of problem.
Transmittance	65 percent	Turn on fourth UV bank if transmittance goes below stated value.
Turbidity	0.2 NTU	Turn on fourth UV bank if turbidity goes above stated value.

Notes:
(1) CH2MHill 2005. Table 11.

CHAPTER 4 GROUNDWATER RECHARGE AND INFRASTRUCTURE ANALYSIS

This chapter analyzes the existing infrastructure, storage, and groundwater recharge locations for the purpose of better understanding the feasibility and limitations of the locations identified for purified water use. In addition, impacts to the groundwater basin and nearby drinking water wells were considered.

4.1 Existing Infrastructure

Existing infrastructure surrounding LCSD consists of the following:

- Flood control infrastructure including the Getty, Kovar, and Hobbs basins located northeast of LCSD.
- Flood control channels used to transport water to the basins.
- Existing Waller Park pipeline (purple pipeline) which runs east from LCSD to Waller Park; currently used to convey NPW.
- Existing 18" storm drain (SD) or "Soft Water" pipeline that connects to the Waller Park pipeline and travels north towards the Getty Basin area.
- Additional existing storm drain pipelines.
- Agriculture Storage Reservoir located directly north of LCSD.
- Existing ROC disposal pipeline that runs northwest of LCSD.
- Existing brine disposal well located northwest of LCSD.

Figure 4.1 presents a map of this existing infrastructure.

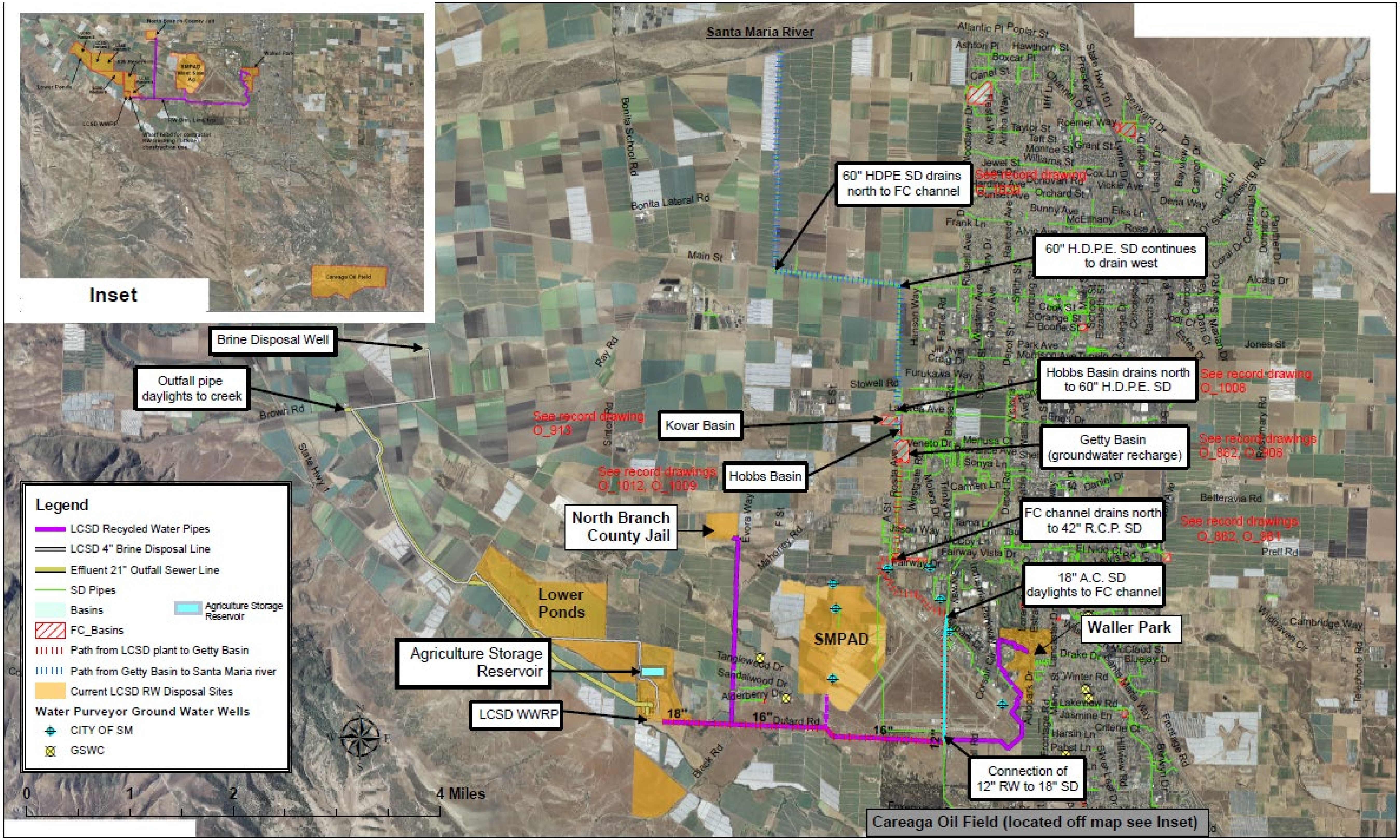


Figure 4.1 Existing Infrastructure

4.1.1 Potential Groundwater Recharge Locations

There are three identified locations for potential groundwater recharge with PRW. These locations include:

1. Spreading (percolation) at the Getty Basin [existing infrastructure].
2. Injection near the Getty Basin [new infrastructure].
3. Injection northwest of LCSD [new infrastructure].

The Getty, Kovar, and Hobbs basins are used by the Santa Barbara County Flood Control and Water Conservation District during wet weather events. However, only the Getty basin is designed for percolation. Therefore, only this basin was evaluated as part of the alternatives for PRW use.

During wet weather events the Getty Basin would not be available for PRW as it is used by the Flood Control District for stormwater management. Therefore, this alternative must be coordinated with an alternative that can handle PRW during wet weather events. The alternatives for PRW use during wet weather are:

- Use of the Agriculture Storage Reservoir during wet weather events.
- Injection near the Getty Basin during wet weather events.

Further details regarding the groundwater storage and recharge locations are discussed below.

4.1.2 Existing Flood Control Infrastructure

The Flood Control District conveyance infrastructure includes existing pipelines and channels used to move water towards the Getty, Kovar, and Hobbs basins. More specifically this includes the Channel near Skyway Drive (located north of the Santa Maria Airport), the 18-inch Soft Water pipeline, and the 42-inch storm drain pipelines. The Waller Park Pipeline leads to the 18-inch Soft Water Pipeline which daylights at the flood control channel (Figure 4.1). This channel leads north and connects to a 42-inch storm drain pipeline that eventually reaches the Getty Basin. The Getty Basin connects to the nearby Kovar and Hobbs basins. A 60-inch SD line heads north and west from the Hobbs Basin to the Santa Maria River (Figure 4.1).

As shown in Figure 4.2, the Getty, Kovar, and Hobbs basins are all interconnected. As mentioned, only the Getty basin is designed for percolation. Therefore, only this basin was evaluated as part of the alternatives for PRW use.

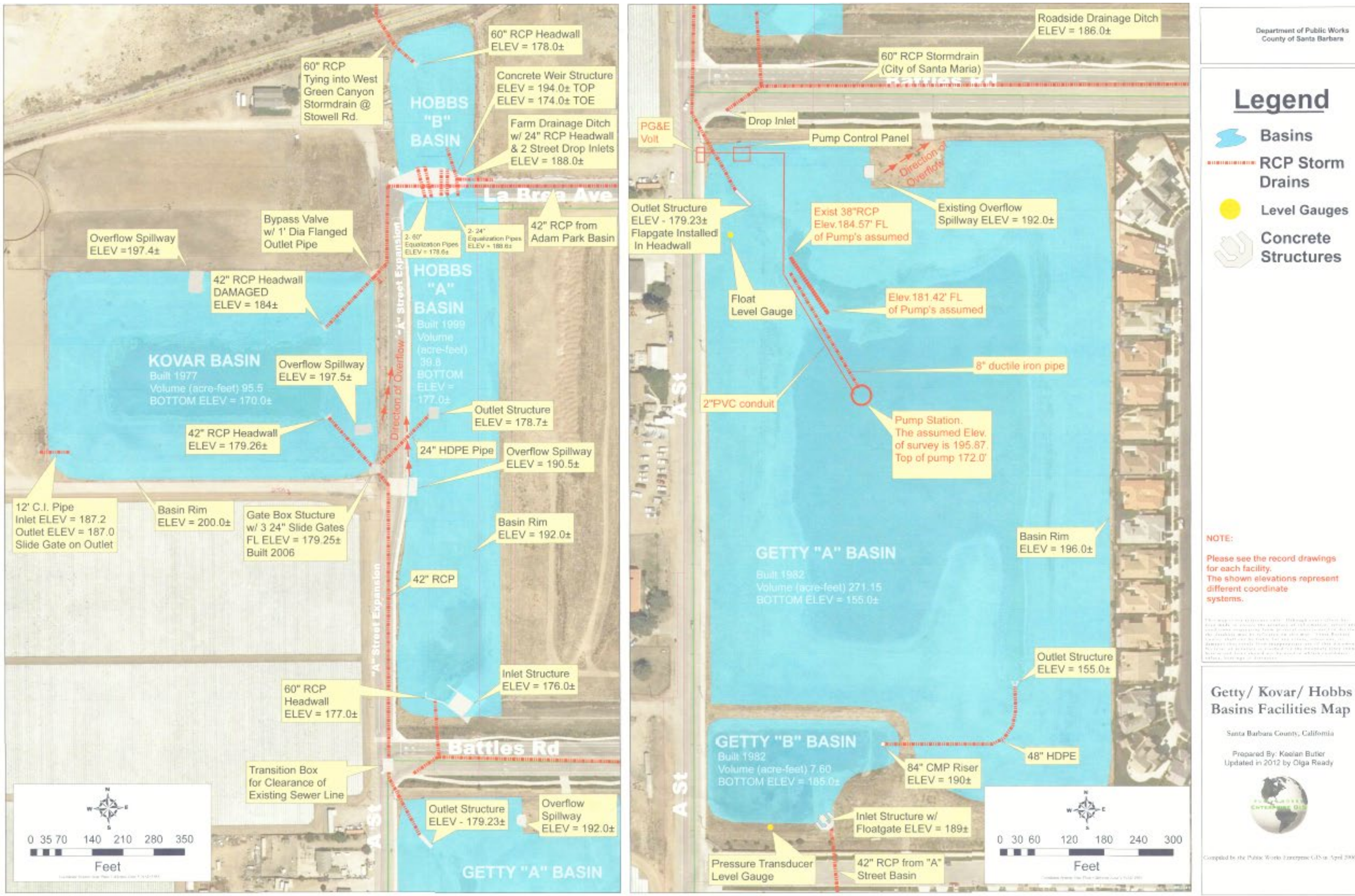


Figure 4.2 Interconnection of Getty, Kovar, and Hobbs Basins

4.1.3 Existing Waller Park Pipeline

The existing Waller Park recycled water NPR pipeline (purple) allows connection from the WRP to the following NPR users: SMPAD area to the east; Northern Branch County Jail to the north; LCSD agricultural fields to the north and west, northwest, and south; and Waller Park further to the east. An additional NPR user located southeast of LCSD receives water through a trucking service rather than pipeline conveyance. These areas are highlighted in yellow in Figure 4.1.

The Waller Park pipeline can be used to transport IPR water if it is fully converted to use for IPR. For NPR to continue at the same time as IPR, construction of a parallel pipeline to transport purified water would be necessary. Note that the Waller Park Pipeline can continue for NPR use if the chosen groundwater recharge location is injection northwest of LCSD.

The Waller Park pipeline connects to another potential infrastructure asset that could be utilized, the 18" SD pipe that runs north and through the airport, referred to as the Soft Water Pipeline. The 18-inch SD pipeline could be repurposed to carry purified water to the Getty Basin for percolation. However, during wet weather events it is assumed that the Flood Control District will want control of their infrastructure to send water to the Getty Basin. Therefore, the Soft Water Pipeline and Getty Basin can only be leveraged during dry weather. To continuously provide PRW to the Getty Basin area, a new pipeline parallel to the Soft Water Pipeline is required. This new pipeline would bypass the Getty Basin during wet weather events and inject the PRW into the Santa Maria Basin. It should be noted that if a pipeline parallel to the Soft Water line were constructed, it is suggested to create an alternate route around the Santa Maria Airport as running a new pipeline across this landmark could pose a significant challenge.

4.1.4 Agriculture Storage Reservoir

The existing Agriculture Storage Reservoir (Figure 4.1) located directly north of LCSD WRP can be used to hold off-spec water from the advanced water treatment plant. In addition, the Agriculture Storage Reservoir can be used during wet weather events when the Getty Basin is not available for PRW recharge. Consequently, the Agriculture Storage Reservoir is useful for every project alternative (discussed in Chapter 5).

4.1.5 Existing Drinking Water Wells

The goal of the IPR project is to augment the drinking water supply in the LCSD area while maintaining a minimum of 2 months of travel time in the subsurface to existing drinking water wells (per Table 2.1). Therefore, it is necessary to know where in the groundwater basin the drinking water wells are located relative to the purified recycled water PRW injection wells considering both aquifer depth and distance. The municipal and domestic wells in the area near the proposed injection locations were reviewed across multiple sources including a list of wells in Santa Barbara County and the Well Completion Report Map Application inventory complied by DWR. In addition, maps of the Golden State Water Company (GSWC) wells were provided and considered.

A full list of the wells near the LCSD WRP and the proposed injection locations is found in Appendix B.

4.2 Groundwater Basin Analysis

An analysis of the Santa Maria Groundwater Basin was performed to delineate between the shallow and deep aquifers and determine directional flow and velocity. This information is then used to evaluate if the groundwater retention time requirements are met based on targeted pathogen removal and time. As previously mentioned, a minimum of 2 months travel time is mandatory before PRW reaches a drinking water well. Regarding pathogen removal, for each month retained underground the PRW is credited with 1-log virus reduction. For the purpose of this project, groundwater travel times of 6 months and 1-year were targeted, providing a measure of conservatism. Groundwater flow, velocity, and travel times are discussed below.

4.2.1 Deep and Shallow Aquifers

From Figure 4.3 it was determined that the shallow aquifer zone extends from 0-250 feet (ft) bgs and the deep zone extends from 250-2,200 ft bgs.

Upon reviewing the multiple sources of drinking water well information, it was concluded that most of the drinking water wells are found within the deep aquifer of the Santa Maria Groundwater Basin. Consequently, PRW injection into the groundwater basin will be into the deep aquifer zone to augment the drinking water supply.

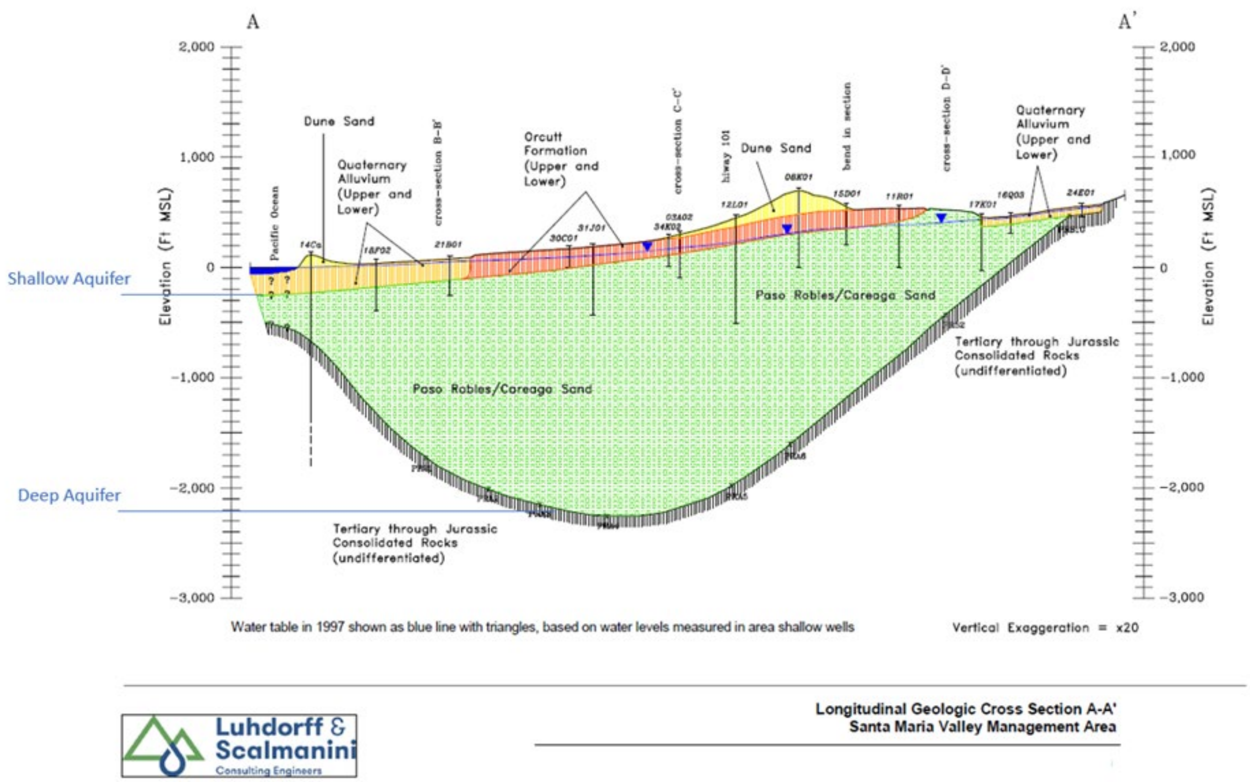


Figure 4.3 Shallow and Deep Aquifer Cross-Section Adapted from Luhdorff and Scalmanini (2022)

4.2.2 Groundwater Directional Flow, Velocity, and nearby Drinking Wells

Groundwater beneath the SMVMA is recorded as flowing west-northwest from the Sisquoc area to the ocean (Luhdorff & Scalmanini, 2022). The groundwater velocity was calculated using the equation below. Details regarding the hydraulic conductivity, hydraulic gradient, and effective porosity are found in Appendix C.

$$\text{Velocity}\left(\frac{\text{ft}}{\text{day}}\right) = -\frac{K}{n} * \left(\frac{\Delta h}{\Delta l}\right)$$

K = hydraulic conductivity

$\frac{\Delta h}{\Delta l}$ = Hydraulic Gradient

n = effective porosity

The groundwater velocities and travel distances calculated for the 6- and 12-month travel times were analyzed at the Getty Basin for percolation (shallow aquifer) and injection (deep aquifer) as well as the injection location northwest of LCSD (deep aquifer) to determine if any nearby drinking wells would be impacted by groundwater recharge activities. A summary of the velocities corresponding to the shallow and deep zones of each proposed injection location for 6- and 12-months is summarized in Table 4.1 below.

Table 4.1 Calculated Groundwater Velocity

Location	Groundwater Aquifer Zone	Velocity	Time Period	Travel Distance
Near the Getty/Kovar Basins	Shallow	3.4 ft./day	6 months	620 ft..
			12 months	1,200 ft.
	Deep	0.3 ft/day	6 months	60 ft.
			12 months	120 ft.
Northwest of LCSD	Deep	0.5 ft/day	6 months	100 ft.
			12 months	200 ft.

4.2.2.1 Percolation in the Getty Basin

Percolation will take place in the shallow aquifer; therefore, the 3.4 ft/day groundwater velocity was used (Table 4.1). Figure 4.4 shows the 6- and 12-month groundwater travel distances at approximately 620 ft and 1,200 ft, respectively. From Figure 4.4 it is determined that none of the nearby drinking water well will be impacted by percolation within the Getty Basin. More detailed modeling of the groundwater injection travel time will be required in further stages of the project per Title 22 CCR.

4.2.2.2 Injection in the Getty Basin

Groundwater recharge can also take place near the Getty Basin through PRW injection wells. As previously mentioned, most existing drinking water wells are found in the deep aquifer. Therefore, PRW injection wells near the Getty/Kovar/Hobbs Basin are proposed to be constructed in the deep aquifer zone (250- 2,200 ft bgs) to ensure PRW is adding supply to the drinking water portion of the basin. Consequently, the 0.3 ft/day groundwater velocity was used (Table 4.1). Figure 4.5 shows the 6- and 12- month groundwater travel distances at approximately 60 ft and 120 ft, respectively. From Figure 4.5 it is determined that none of the nearby drinking water well will be impacted by injection near the Getty Basin. More detailed modeling of the groundwater injection travel time will be required in further stages of the project per Title 22 CCR.

In addition, this area of injection lies within the Santa Maria sub-basin which has a boron target of 0.2 mg/L. Current boron results are close to the 0.2 mg/L objective and regulatory approval is anticipated based upon a detailed assimilative capacity study (future effort).

4.2.2.3 Injection NW of LCSD

An additional proposed location for PRW injection wells was identified northwest of LCSD. Injection northwest of LCSD is proposed to take place in the deep aquifer zone (250-2,200 ft bgs) to ensure PRW is augmenting the drinking water portion of the basin.

The 0.5 ft/day groundwater velocity was used for injection near LCSD (Table 4.1). Figure 4.6 shows the 6- and 12-month groundwater travel distances at approximately 100 ft and 200 ft, respectively. From Figure 4.6 it is determined that none of the nearby drinking water well will be impacted by injection NW of LCSD. More detailed modeling of the groundwater injection travel time will be required in further stages of the project per Title 22 CCR.

This injection area lies within the Lower Guadalupe sub-basin which has a boron target of 0.2 mg/L. Current boron results are close to the 0.2 mg/L goal and regulatory approval is anticipated based upon a detailed assimilative capacity study (future effort).

Figure 4.4 Getty Basin Percolation Location, Groundwater Velocity, and Nearby Drinking Wells

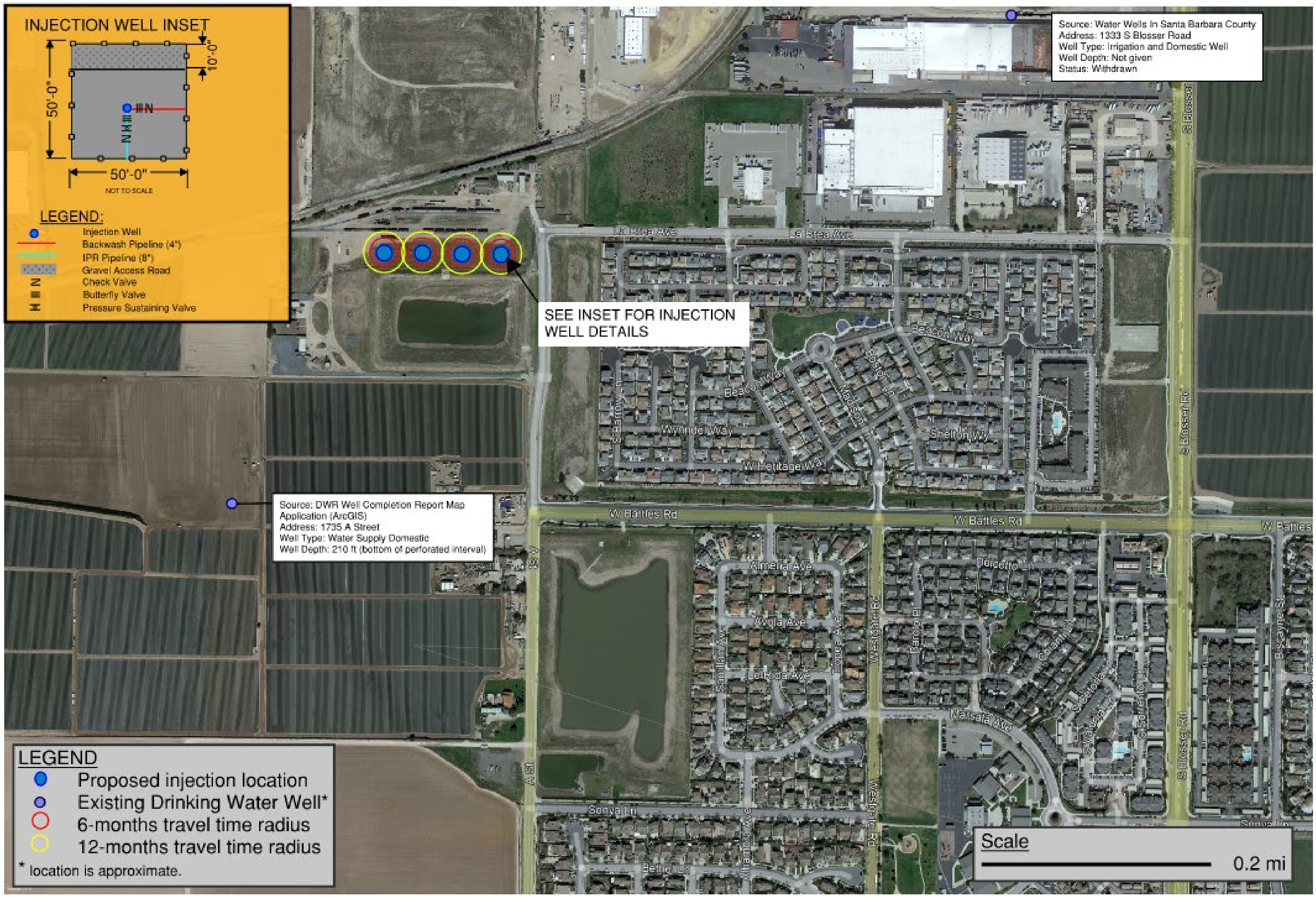


Figure 4.5 PRW Injection Near Getty/Kovar/Hobbs Basin, Groundwater Velocity, and Nearby Drinking Wells

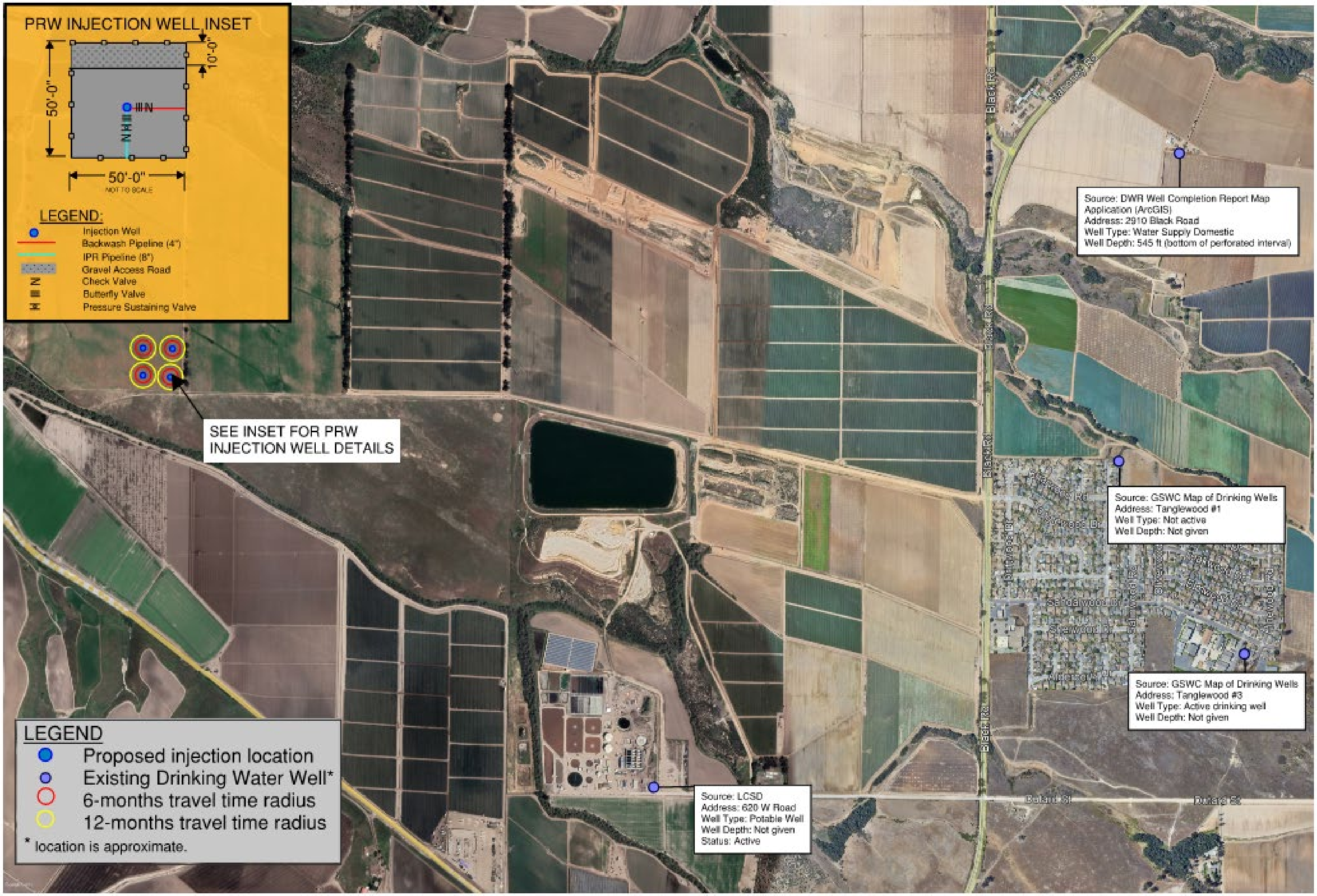


Figure 4.6 PRW Injection Near LCSD, Groundwater Velocity, and Nearby Drinking Wells

4.3 Analysis of Purified Water Storage and Recharge Locations

As mentioned in Section 4.1.1, the alternatives for groundwater recharge and storage of purified water include:

- Percolation in the Getty Basin.
- Injection near the Getty Basin.
- Injection northwest of the LCSD WRP.

Only the first bulleted option may have capacity limits depending on the percolation rate of the Getty Basin and storage capacity of the Agriculture Storage Reservoir to accept purified water. For these reasons an analysis of the Getty Basin and Agriculture Storage Reservoir was performed.

4.3.1 Analysis of the Getty Basin for Percolation

The percolation rates of the basin should meet or exceed the PRW production flow rate leaving the LCSD. Proposed project alternatives (see more details in Chapter 5) involve a feed flow rate of 0.5 mgd and 1.7 mgd. This corresponds to a production flow rate (assuming 85 percent RO recovery) of 0.43 mgd and 1.45 mgd. A future scenario in which the IPR project was doubled in size to treat a feed flow of 3.5 mgd, to produce 3.0 mgd, was also included for analysis here.

Both wet and dry years were analyzed to determine if the basin has sufficient percolation capacities during each scenario. Dry year percolation is the most conservative, as that data has lower water elevations in the basin which result in lower driving elevation head and thus lower percolation rates. Dry and wet weather events each occur within the calendar year and occur within both the dry and wet years.

The dry year evaluation included data from 2014-2015, whereas the wet year evaluation included data from 2020-2021 and 2021-2022. The reservoir volume change over time is equivalent to the percolation rate in the basin. This was calculated in ac-ft/day and converted to mgd to easily compare with the required volume of PRW expected at the WRP. Once the ideal percolations rates were analyzed and assessed, the corresponding reservoir levels were identified. This is the value at which the Getty Basin should be filled with water to meet the desired percolation rate. In other words, this is the line of equilibrium in which the rate of water into the basin is equal to the rate of water infiltrating the basin.

Existing basin data was analyzed to determine potential percolation rates. While purified water will not be put into the Getty Basin during wet weather events, these events can be used to inform maximum percolation potential. This is based on the notion that during wet weather events the basin has the largest volume of stored water and consequently the highest percolation rates. These high percolation rates and corresponding water levels will inform the water level at which the Getty Basin should ideally be set to optimize percolation.

A summary of the number of wet and dry weather days along with capacity requirement summaries for both dry and wet weather years is summarized in Table 4.2.

Table 4.2 Observed Number of Wet Weather and Dry Weather Days in both Dry and Wet Years

Year	Wet or Dry Year	Number of Dry Weather Days (Percolation Allowed)	Number of Wet Weather Days (Percolation **Not** Allowed)	Maximum Percolation Rate	Getty Basin Meets Required Production Flow Rate Capacity (Yes/No)	Getty Basin Water Level Height
2014-2015	Dry Year	340 days	25 days	2.77 mgd	0.43 mgd = yes 1.45 mgd = yes 3.0 mgd - no	179.23 ft. – 177.63 ft.
2020-2021	Wet Year	268 days	97 days	2.53 mgd – 4.24 mgd	0.43 mgd = yes 1.45 mgd = yes 3.0 mgd = yes	175.63 ft. – 182.09 ft.
2021-2022	Wet Year	298 days	67 days	2.33 mgd	0.43 mgd = yes 1.45 mgd = yes 3.0 mgd - no	179.09 ft. – 183.86 ft.

From Table 4.2 it is seen that there are approximately 25-97 days a year the Getty Basin cannot be used due to wet weather events. In addition, based on the detailed analysis found in Appendix E, maximum percolation rates within the basin were determined and summarized in Table 4.2. These are then compared with the production rates expected at LCSD. Based on Table 4.2, production flow rates of 0.43 mgd and 1.45 mgd are met in all three years analyzed; with issues arising at the future production flow (3.0 mgd). As mentioned, the maximum percolation rates correspond to a water height within the Getty Basin (Table 4.2). This determines the water level at which the Getty Basin should ideally be set to optimize percolation.

The percolation rate in 2014-2015 at 2.77 mgd meets the 0.43 mgd and 1.45 mgd product water capacity at LCSD and does not meet the future 3.0 mgd product water capacity. In the 2020-2021 season both all three LCSD PRW production flow rates are met and exceeded by calculated basin percolation rates of 2.53 and 4.24 mgd (Table 4.2). In 2021-2022 the largest percolation rate was calculated at 2.33 mgd which meets the 0.43 mgd and 1.45 mgd flow rates and is short of the projected future 3.0 mgd flow rate. If the Getty Basin is used for percolation with purified water, the inflow will be constant (unlike a drought year), and it is assumed that the ideal percolation rate seen in 2020-2021 (up to 4.24 mgd) is achievable.

Based on the data analyzed, in both the wet and dry years the ideal water elevation in the Getty Basin sits between 175 ft and 184 ft. The overall data supports the hypothesis that the Getty Basin has sufficient percolation capacity for both the 0.43 mgd and 1.45 mgd production flow rates, and may be sufficient for the 3.0 mgd flow rate. Further investigation and analysis of Getty Basin capacity is recommended prior to implementation.

A solution to the challenge of not being able to place purified water in the Getty Basin during certain times of the year includes using the Agriculture Storage Reservoir located north of LCSD WRP for wet weather events. Using the Agriculture Storage Reservoir in coordination with the Getty Basin will not serve the purpose of augmenting drinking water supplies, as water sent to the Agricultural Reservoir does not percolate and is used for non-potable purposes. Therefore, this solution detracts from the overall project goal of producing usable IPR water; and therefore some IPR water will be lost if the Getty Basin were used.

4.3.2 Analysis of the Agriculture Storage Reservoir

The Agricultural Storage Reservoir located north of the LCSD WRP provides water for nearby agricultural irrigation. The reservoir has a 300 MG volumetric capacity (LCSD is planning an expansion) and has direct value for any future potable reuse project, as follows:

- If the Getty Basin is used to percolate PRW and there are no PRW injection wells, PRW would be sent to the agricultural reservoir during wet weather events.
- During PRW off-spec events (e.g., not meeting DDW standards), non-compliant water would be sent to the agricultural reservoir.

Based on Table 4.2, the maximum amount of wet weather from the 2014-2015, 2020-2021, and 2021-2022 analysis was 97 days. At a 1.45 mgd production flow, the needed storage capacity would be 141 MG. Since the reservoir has 300 MG of storage, the 1.45 flow capacity is met for the worst-case wet weather event analyzed. At a production flow rate of 3.0 mgd, with 97 days of wet weather, approximately 292 MG of storage within the reservoir is needed. This 292 MG volume does not exceed the capacity of the reservoir. With the production flow rate of 3.0 mgd, there can be approximately 100 days of wet weather before the reservoir capacity is exceeded. With 97 days of wet weather the maximum production flow rate is 3.10 mgd (with 85 percent recovery this is a feed flow of 3.65 mgd). In addition, it is likely that there is less NPW use and extraction from the pond during wet weather events. Therefore, the NPW users of the Agricultural Storage Reservoir do not aid in increasing storage (drawing down the pond) during wet weather events. Overall, for a future potable reuse project, the Agricultural Reservoir is sufficient for the 0.43 mgd 1.45 mgd, and 3.0 mgd product flow rates with additional storage buffer for the 0.43 and 1.45 mgd production flow rates. The future product flow of 3.0 mgd is right close to the capacity limit and is vulnerable to exceedances. Additional storage may be beneficial to ensure capacity requirements for the larger flowrate of purified water.

4.3.3 Layout of the Purified Water Alternatives

A layout of the Getty Basin and Agriculture Storage Reservoir coordinated option for purified water is shown in Figure 4.7 below. In the dry season water is sent to the Getty Basin; any off-spec water from LCSD is sent to the Agriculture Storage Reservoir. In the wet season water can still be sent to the Getty Basin during periods of no rain. However, when wet weather or rain events do occur, purified water will be sent to the Agricultural Storage Reservoir. The viability of this option depends upon coordination and approval by the Flood Control district to allow use of the Getty Basin during dry weather events. The Flood Control District may want autonomy over the Getty Basin during the entire wet season.

A layout of the Getty Basin percolation, and Getty Basin injection option is shown in Figure 4.8 below. During dry weather events the Getty Basin will be used for percolation. During wet weather events the nearby PRW injection wells will be used for purified water. In this scenario, the Agriculture Storage Reservoir is only used for off-spec water.

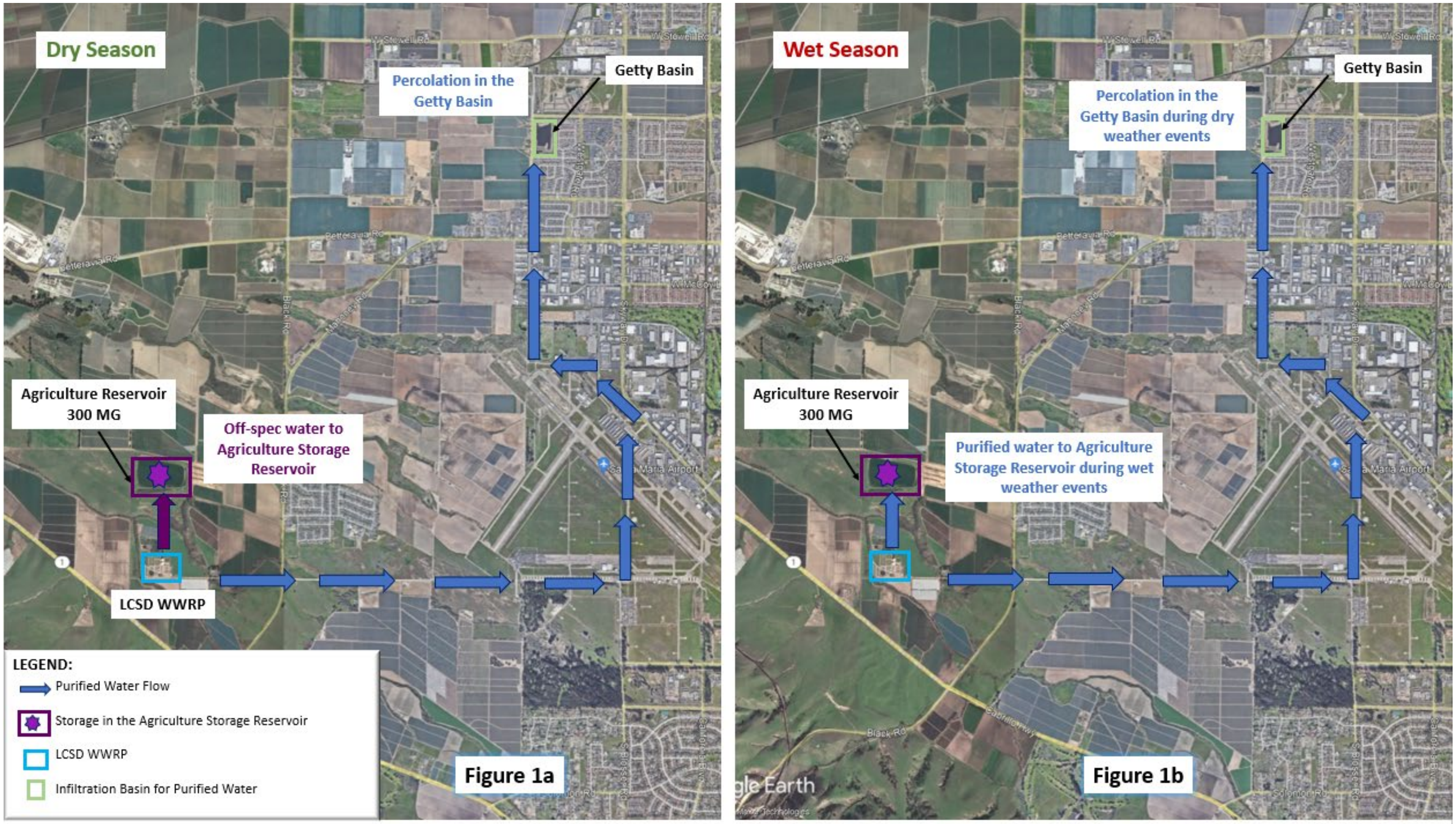


Figure 4.7 Getty Basin Spreading and Agriculture Storage Reservoir Use: Figure 1a – Dry Season, Figure 1b – Wet Season

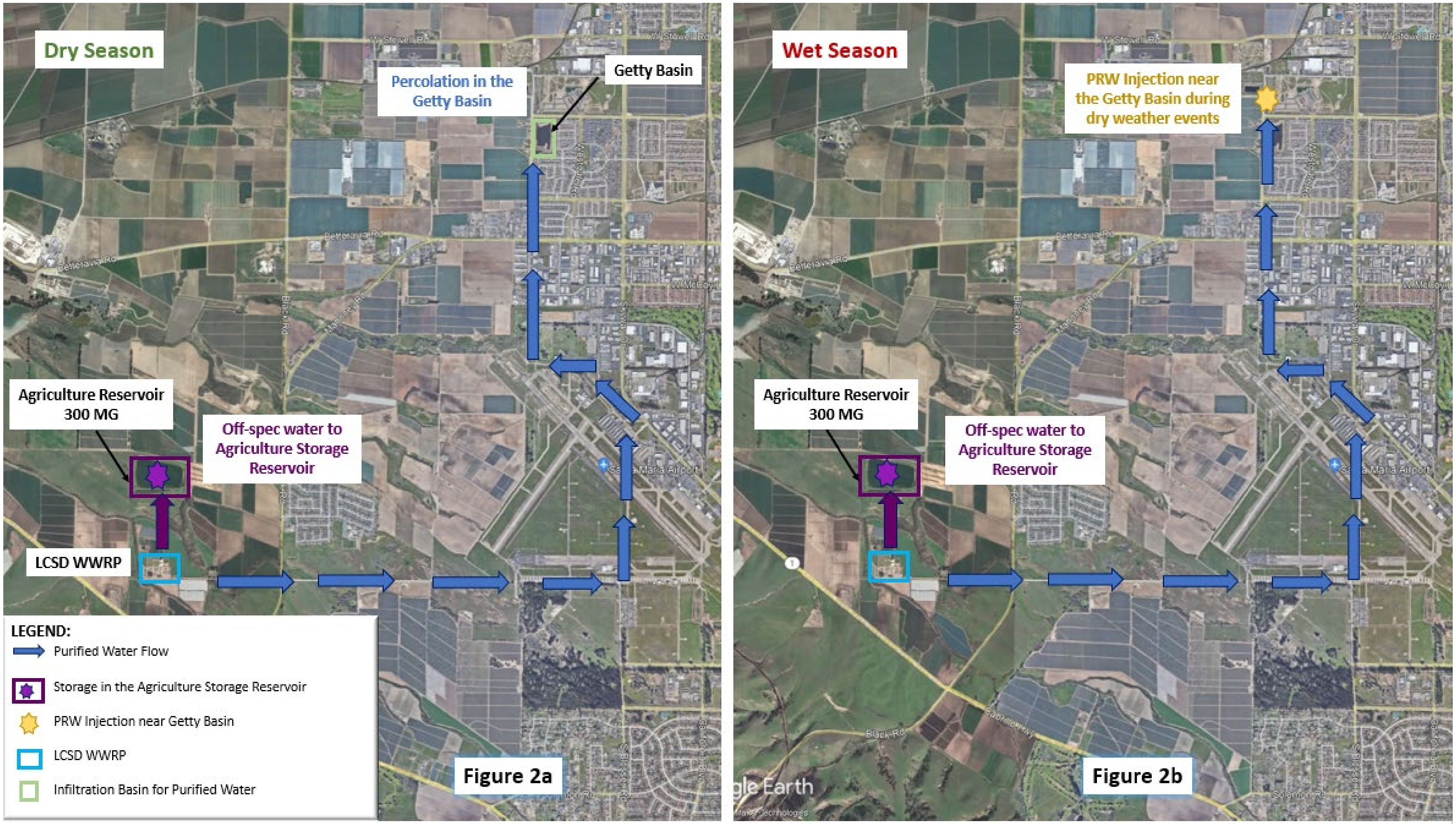


Figure 4.8 Getty Basin Spreading and Getty Basin PRW Injection: Figure 2a – Dry Season, Figure 2b – Wet Season

A layout of the injection northwest of LCSD option is shown in Figure 4.9 below. This option is performed year-round and will send all purified water to PRW injection wells located near LCSD.

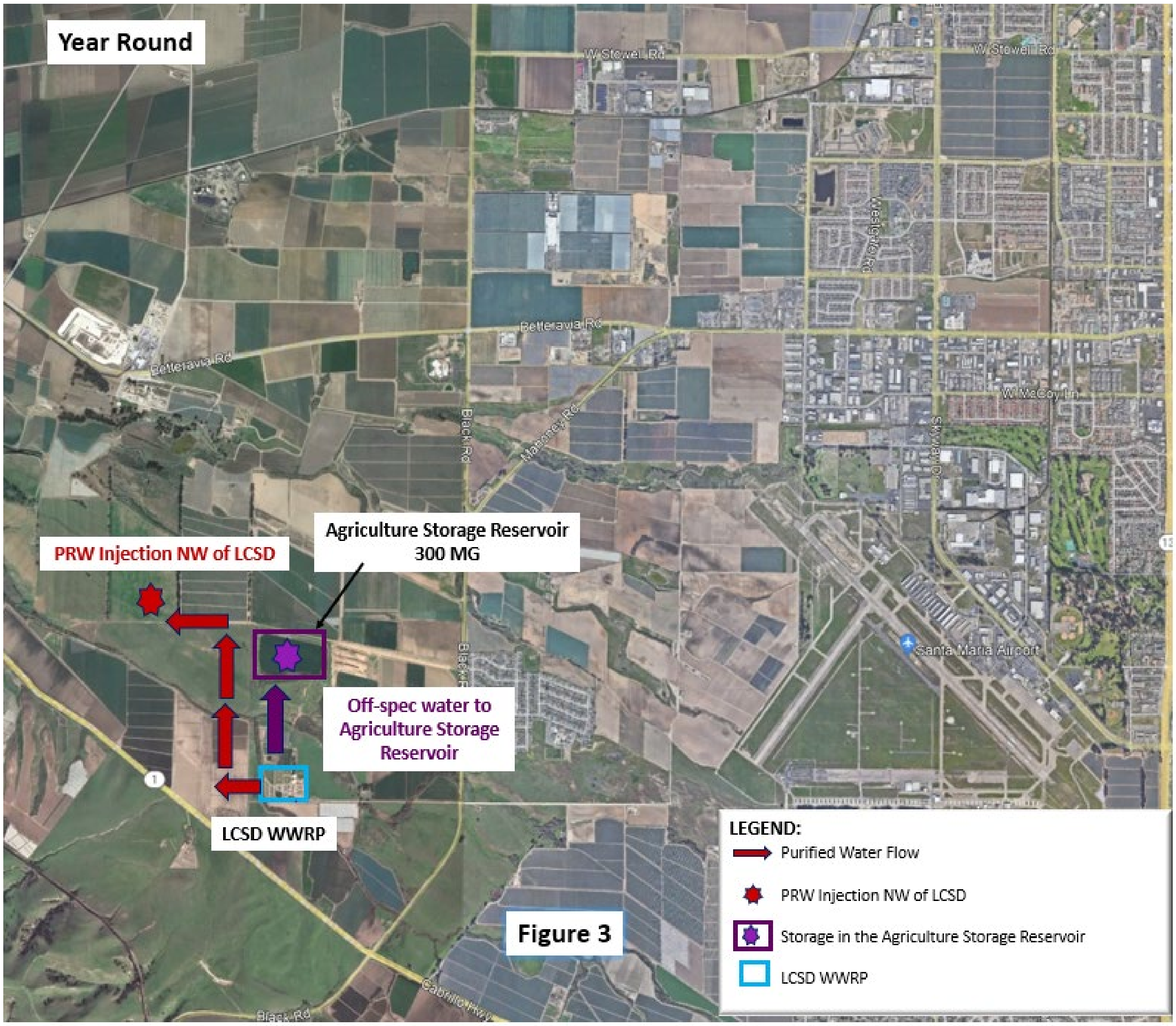


Figure 4.9 Getty Basin Spreading and Getty Basin Injection: Figure 2a – Dry Season, Figure 2b – Wet Season

4.3.4 Other Potential Alternatives

For the Getty Basin percolation alternatives, if the basin itself reaches an overflow capacity, water could potentially be sent to the Santa Maria River for continued groundwater spreading. However, it must be noted that spreading in the Santa Maria River would require National Pollutant Discharge Elimination System (NPDES) permitting. This option was not considered any further for this project.

Direct spreading in the Santa Maria River is also a potential alternative which requires, at a minimum, water to go through tertiary filtration and disinfection. However, this will also require NPDES permitting. This option was not considered any further for this project.

CHAPTER 5 FUTURE IPR CONFIGURATIONS

This chapter discusses the alternatives for future IPR configurations. All treatment configurations include the use of full advanced treatment, i.e., RO and UV/AOP to meet the groundwater recharge requirements for injection.

From the onset of the analysis, the goal was to find and use, where possible, existing assets to reduce the cost of an IPR program. These assets have been described previously, but include:

- Existing treatment systems.
  - MBR – meets turbidity criteria for regulatory credit. No modifications are needed for IPR, but modifications to achieve nitrogen removal should be implemented to meet Basin Plan objectives for total nitrogen.
  - UF – needs installation of Pressure Decay Testing (PDT) to be compliant for IPR. Such installation is currently being considered by LCSD.
  - RO – needs troubleshooting and likely repair of components to provide more consistent and higher performance rejection of salt. Also needs modifications to the ROC and brine hauler concentrate storage and pumping (management).
  - UV – needs validation for IPR applications to ensure sufficient dose for advanced oxidation.
- Existing ROC pipeline and disposal well. The existing ROC pipeline and disposal well can be utilized to the maximum of their physical and permittable limits for ROC discharge. A revised permit for greater injection is anticipated to be needed in future. Redundant or additional pipelines/disposal wells may be required depending upon the build out size of the IPR program.
- As previously discussed, although there is existing non-potable distribution infrastructure and stormwater management infrastructure that could be leveraged, there are significant complexities associated with doing so and therefore they have not been included in the project alternatives detailed herein.

5.1 Projects Overview

The LCSD IPR project contains two main components: (1) the treatment scheme and (2) the PRW recharge scheme. Both components contain multiple options for paired configurations.

To simplify the analysis, two projects having the most promising alternatives were identified. These projects are described in more detail below. Additional project elements and modifications are discussed later in this section to illustrate the range of potential future projects. The costs of the two proposed project options will be detailed in Chapter 6.

5.1.1 Project 1 – Fast Track Project

The Fast Track project allows LCSD to produce IPR water most immediately with potential for expansion to an even larger sized IPR facility. Details regarding this proposed project are discussed in subsequent sub-sections with a focus on flow rate, treatment trains, injection locations and infrastructure, and pathogen control requirements.

5.1.1.1 Flow Rate and Treatment Train of the Fast Track Project

From Table 2.1, RO and UV AOP are required to meet DDW regulations for groundwater recharge of PRW. All project alternatives therefore must include either the MBR/RO/UV AOP treatment train, the UF/RO/UV AOP treatment train, or both.

As mentioned in Section 3.1.1, currently 1.2 mgd is sent through the low TDS treatment train (CAS/UF/UV) and 0.5 mgd is sent through the high TDS treatment train (MBR/RO/UV). With this project the current flow sent through the MBR/RO/UV treatment train will be used for IPR purposes. Therefore, the MBR/RO/UV treatment train will need to be upgraded to include UV AOP to meet IPR requirements. The CAS/UF/UV treatment train will continue to treat the existing flow to meet NPR requirements. This project will allow for an easier conversion to IPR with minimal treatment modifications required. In addition, by allowing the smaller flow of water to be treated to IPR standards first, this project allows trouble shooting to be done prior to implementing a larger scale IPR project which may promote un-accounted for cost savings. As mentioned, the existing flow split between the two treatment trains will stay as is. As capacity or interest in producing IPR water increases, the existing flow split can be combined so that the MBR and UF effluent co-mingle prior to treatment by RO and UV AOP; thereby allowing this project to be up-scaled.

A diagram of the treatment process upgrades and flow split (NPR and IPR treatment trains) for Project 1 can be seen in Figure 5.1. More details regarding system upgrades and treatment costs will be discussed in the costs portion of this report (Chapter 6).

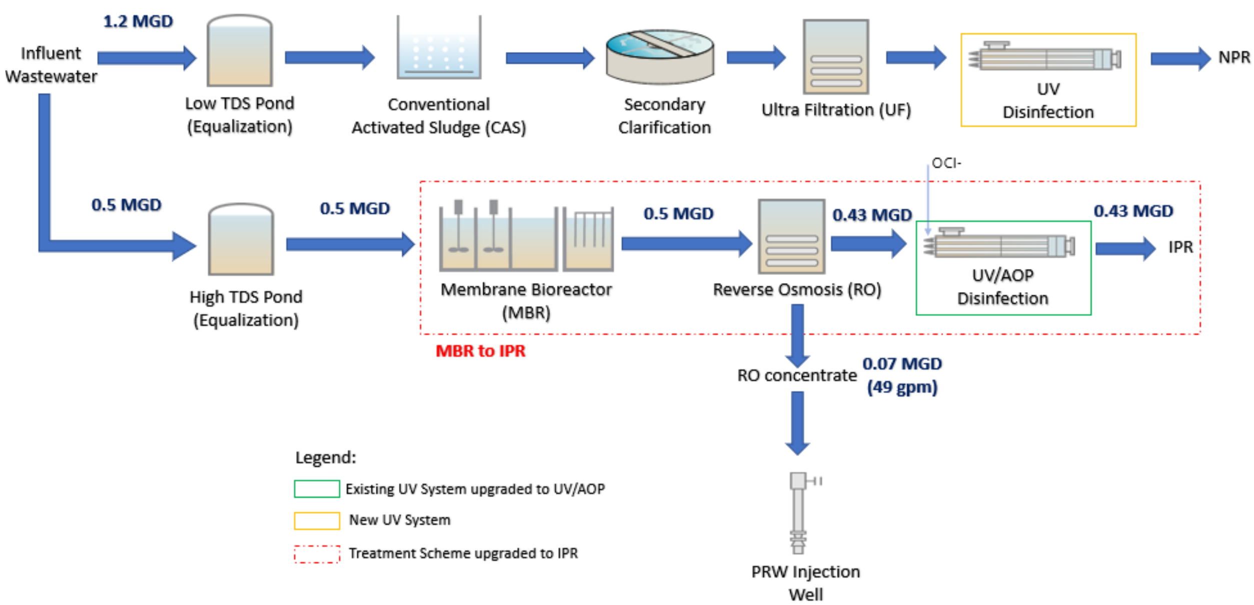


Figure 5.1 Fast Track Project Process Flow Diagram

5.1.1.2 Injection locations and infrastructure in the Fast Track Project

As part of the Fast Track project, purified water will be injected into wells located northwest of LCSD. While this will require the construction of new infrastructure (conveyance pipeline and PRW injection well(s)), it will decrease the need for coordination and/or complications that may arise if purified water were to be sent to the Getty Basin for spreading or injection. The limitations of using the Getty Basin area and existing conveyance infrastructure include:

- The Getty Bain can only be used during dry weather periods when not in use by the Flood Control District. Consequently, this will likely require coordination with the Flood Control District regarding when the basin can be used and to what water level the basin should be kept at.
- During wet weather periods, IPR water cannot be sent to the Getty Basin.
- Existing conveyance infrastructure, while it may be able to be leveraged, must consider the following:
  - The transport of purified water from LCSD to the Getty Basin area requires a combination of using the existing NPR water pipeline, soft water pipeline, flood control channels, and additional storm drain pipelines. While this could allow for some cost savings, the Flood Control district will need to be involved as some of this infrastructure belongs to them.
  - Utilizing the NPR water pipeline for purified water means the water in the CAS/UF/UV train will need to be sent somewhere as this pipeline cannot be switched between use for IPR and NPR.

Consequently, the injection location northwest of LCSD allows for a project that is more easily implemented and maintained year-round thereby increasing IPR production. In addition, injection northwest of LCSD allows for NPR water to be sent to existing customers via existing infrastructure. Details regarding infrastructure costs are found in Chapter 6.

An additional benefit to this project is that the lower flow rate through RO will produce a RO concentrate that is low enough to still meet the pipeline capacity and permit requirements. Assuming a 15 percent RO reject the expected ROC is 0.07 mgd or 49 gpm. Therefore, a new ROC disposal line will not be required, and the existing pipeline and disposal well can be utilized.

Details of the Fast Track project are summarized in Table 5.1.

Table 5.1 Fast Track Project Details

Project Element	Description
Purified Water Production(1)	0.43 mgd (assuming 85% RO recovery)
IPR Treatment Train	MBR/RO/UV AOP
RO Concentrate Flow RO Concentration Impacts	0.07 mgd or 49 gpm (assuming 15% RO reject) flow rate is low enough to meet existing permit and pipeline capacity limits
Purified Water Injection Location	Northwest of LCSD

Notes:
(1) Initial feed flow of 0.5 mgd.

5.1.1.3 Site Layout of the Fast Track Project

As shown in Figure 4.1 the following new treatment systems or upgrades will be implemented:

- Existing UV system will be upgraded to UV AOP to meet IPR standards for the MBR/RO/UV AOP treatment train.
- New UV system will be needed for NPR (CAS/UF) treatment train thereby meeting Title 22 tertiary UV requirements for non-potable use.

A layout of the Fast Track project is shown in Figure 5.2 with the blue arrows delineating the IPR treatment train and the purple allows delineating the NPR treatment train at the site.

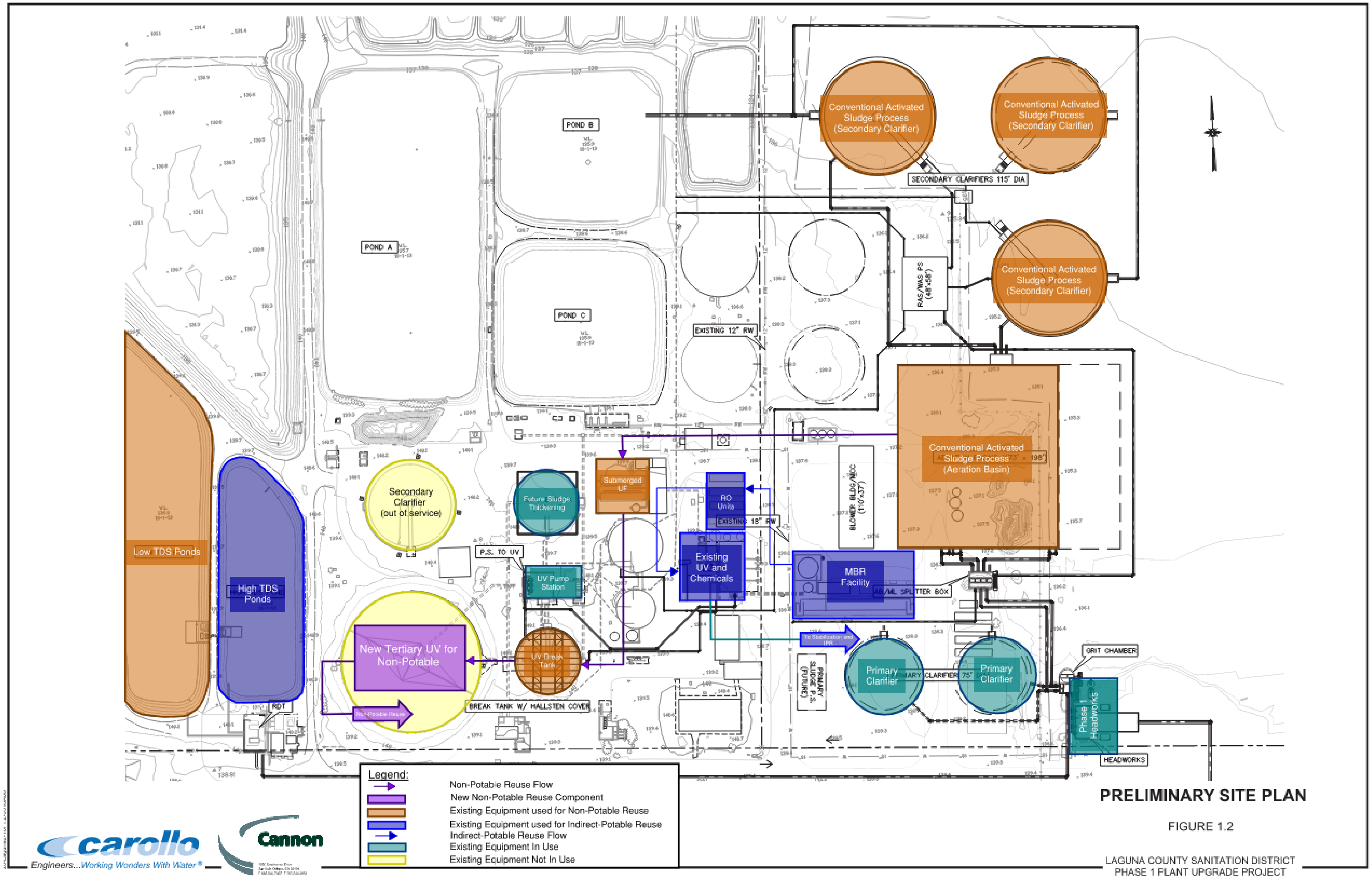


Figure 5.2 Fast Track Site Layout

A schematic of the new UV system for the CAS/UF treatment train is shown in Figure 5.3 (plan view) below. This schematic also shows the location of the sodium hypochlorite tanks needed for advanced oxidation. Figure 5.3 also shows the additional chemicals and equipment needed. Chemical usages are as follows:

- Sodium Hypochlorite – used for advanced oxidation, used to create monochloramines to negate biofouling and provide free chlorine for final disinfection.
- Ammonium Sulfate – used to create monochloramine to mitigate biofouling.
- Stabilization is provided through a calcite contactor.
- Disinfection is provided through a chlorine contact tank.

Figure 5.3 Fast Track Site Layout – new UV system and upgrades to existing UV system (Plan View)

5.1.1.4 Pathogen Control for the Fast Track Project

As stated in Section 2.2, Title 22 CCR requires potable reuse projects to provide a combined level of treatment resulting in 12-log virus reduction, 10-log Giardia reduction, and 10-log Cryptosporidium reduction (12/10/10-log removal). The anticipated log reduction values (LRVs) for the Fast Track project are summarized in Table 5.2 below.

Table 5.2 Fast Track Log Reduction Values

Process	Virus	Giardia cysts	Cryptosporidium oocysts
MBR Based Treatment			
MBR(1)	1	2.5	2.5
RO(2)	2	2	2
UV AOP	6	6	6
Free Chlorination(3)	0 to 6	-	-
Groundwater response retention time (RRT)(4)	2+	0	0
Total	12+	10.5	10.5
Minimum Required	12	10	10

Notes:
(1) Based on conclusion of WRF 4997 (Salveson et al., 2021). Credits are based on turbidity results being below 0.2 NTU 95 percent of the time, and below 0.5 NTU 100% of the time.
(2) RO credits can be based upon EC (anticipated value of 1.5), TOC (anticipated value of 2.0), or other surrogates (e.g., strontium, sulfate) that may have a higher LRV (up to 2.5).
(3) Virus disinfection credit is only sought for free chlorination. Credits requested to be flexible based upon CT. Longer groundwater travel times allow for less chlorine LRV credits to meet total 12 LRV virus target. Chlorine residual to be based on the CT required per the Australian WaterVal Validation Protocol Chlorine disinfection requirement guidelines, http://www.waterra.com.au/_r7273/media/system/attrib/file/1707/201702_WaterVal_Validation-Protocol_Chlorine-Disinfection.pdf.
(4) Based on 2-month travel time, which is the minimum allowed. Longer travel times allow for greater virus credits, which then allows for reduced chlorine CT while still meeting the 12 LRV requirements.

5.1.2 Project 2 – Full IPR Implementation

The Full IPR Implementation project allows LCSD to optimize the amount purified water produced by utilizing the entire 1.7 mgd flow for IPR purposes. As mentioned earlier, the average daily flow through the plant may change over time and the appropriate design value would be identified in a subsequent phase of planning for a potable reuse project. This project will be implemented all at once. It should be noted that this project could also be phased-up from the Fast Track Project (0.5 mgd flow). However, moving forward the assumption is that Project 2 will be done immediately. Details regarding this proposed project are discussed in subsequent sub-sections.

5.1.2.1 Flow Rate and Treatment Train of the Full IPR Implementation Project

As mentioned, RO and UV AOP are required to meet DDW regulations for IPR groundwater recharge projects. Therefore, all alternatives must incorporate either the MBR/RO/UV AOP treatment train, the UF/RO/UV AOP treatment train, or both.

With this project the 1.2 mgd UF effluent flow and the 0.5 mgd MBR effluent flow will be combined for a full 1.7 mgd treatment through RO and UV AOP allowing for high quality effluent that meets IPR standards. At this point in project development, the assumption is that wastewater flows beyond 1.7 mgd would be sent to the agricultural pond. This assumption can be revisited in the next phase of project planning, as there are potential alternative configurations.

A diagram of the treatment process upgrades and flow for the IPR treatment train can be seen in Figure 5.4. More details regarding system upgrades and treatment costs will be discussed in the costs portion of this report (Chapter 6).

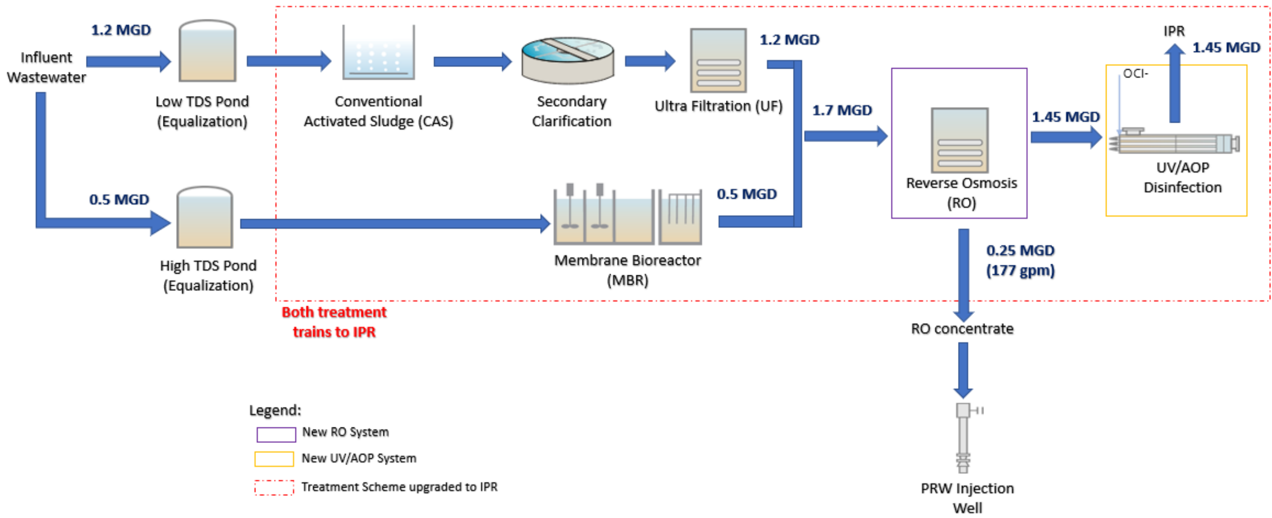


Figure 5.4 Full IPR Implementation Project Process Flow Diagram

5.1.2.2 Injection locations and infrastructure in the Full IPR Implementation Project

Similar to the Fast Track project, the Full IPR Implementation project will inject purified water into PRW injection wells located northwest of LCSD. This will require a new conveyance pipeline and PRW injection wells. Unlike the Fast Track project, the Full IPR Implementation project will treat the full existing 1.7 mgd flow. Assuming a 15 percent reject, the ROC for this project will be 0.25 mgd or 177 gpm which exceeds the pipeline capacity of 140 gpm and the permit capacity of 150 gpm outlined in Section 3.2.2.5 and Section 3.2.2.6, respectively. Therefore, with this project alternative a new ROC disposal line and new ROC disposal wells will need to be constructed.

Details of the Fast Track project are summarized in Table 5.3.

Table 5.3 Fast Track Project Details

Project Element	Description
Purified Water Production(1)	1.45 mgd (assuming 85% RO recovery)
IPR Treatment Train	MBR/RO/UV AOP
RO Concentrate Flow RO Concentration Impacts	0.25 mgd or 177 gpm (assuming 15% RO reject) flow rate will require construction of new ROC disposal pipeline and well(s)
Purified Water Injection Location	Northwest of LCSD

Notes:
(1) Initial feed flow of 1.2 mgd.

5.1.2.3 Site Layout of the Full IPR Implementation Project

As shown in Figure 5.5 the following new treatment systems or upgrades will be implemented:

- New RO system large enough to treat the 1.7 mgd flow will be required.
- New UV system will be upgraded to UV AOP to meet IPR standards for the combined MBR/UF to RO/UV AOP treatment train.

A layout of the Full IPR Implementation project is shown in Figure 4.4 with the blue arrows delineating the IPR treatment train at the site.

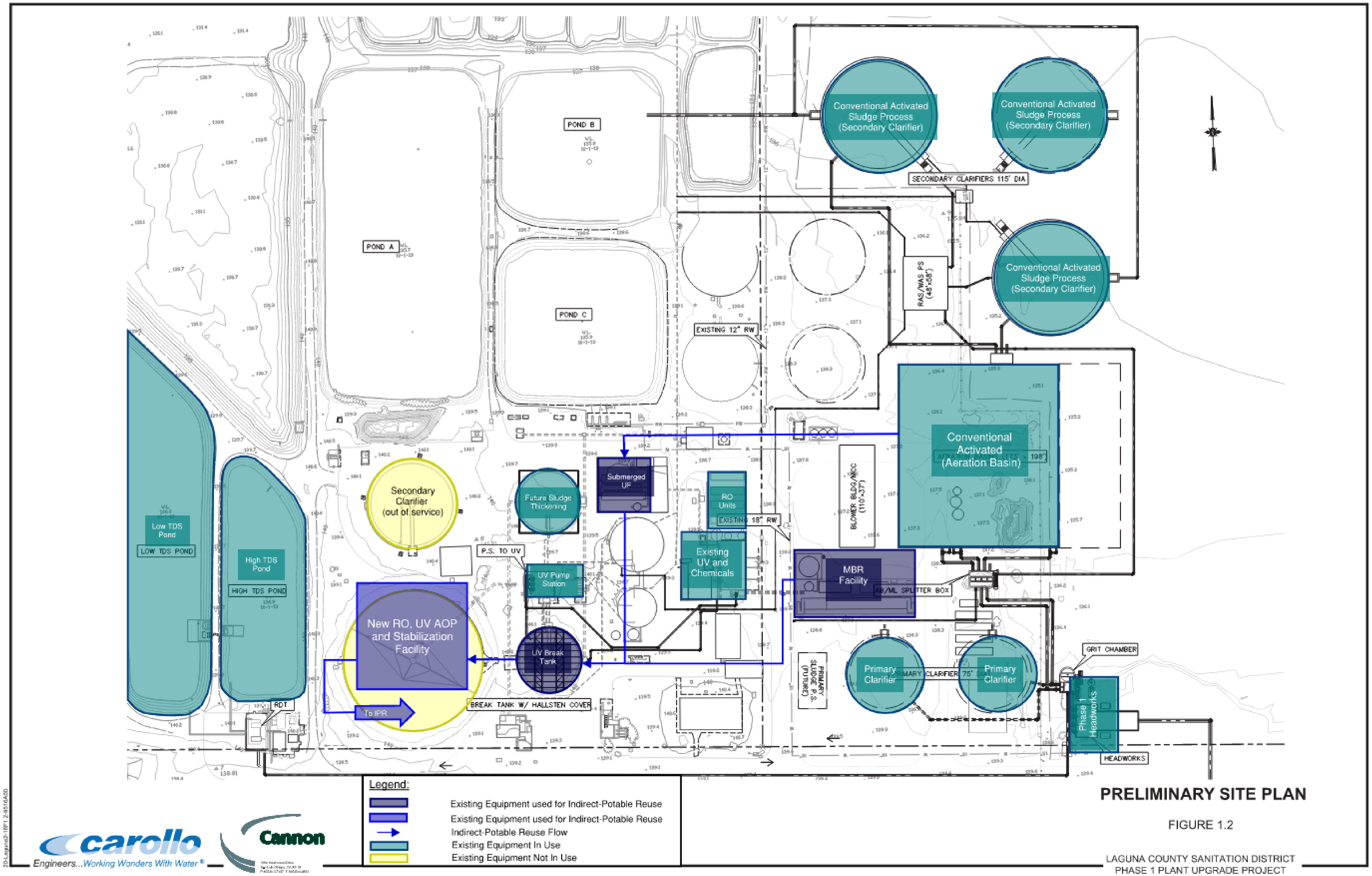


Figure 5.5 Full IPR Implementation Site Layout

A schematic of the new RO and new UV systems for combined flow is shown in Figure 5.6 (plan view) below. The sodium hypochlorite needed for advanced oxidation and corresponding tanks is shown. In addition, Figure 5.6 shows the additional chemicals and equipment needed. Chemical usages are as follows:

- Sodium Hypochlorite – used for advanced oxidation, used to create monochlorime to negate biofouling and provide free chlorine for final disinfection.
- Ammonium Sulfate – used to create monochloramine to mitigate biofouling.
- Sulfuric Acid – pH adjustment or neutralization for membrane cleaning solutions and pH reduction ahead of RO to reduce scaling.
- Antiscalant – used to reduce scaling of RO membranes.
- Sodium Hydroxide – pH adjustment or neutralization for membrane cleaning solutions and pH increase as part of stabilization of AWPF product water downstream of RO.
- Calcium Chloride – used as part of stabilization of AWPF produce water downstream of RO.
- Carbon dioxide – used as part of stabilization of AWPF produce water downstream of RO.
- Citric Acid – used as a cleaning chemical for membranes.

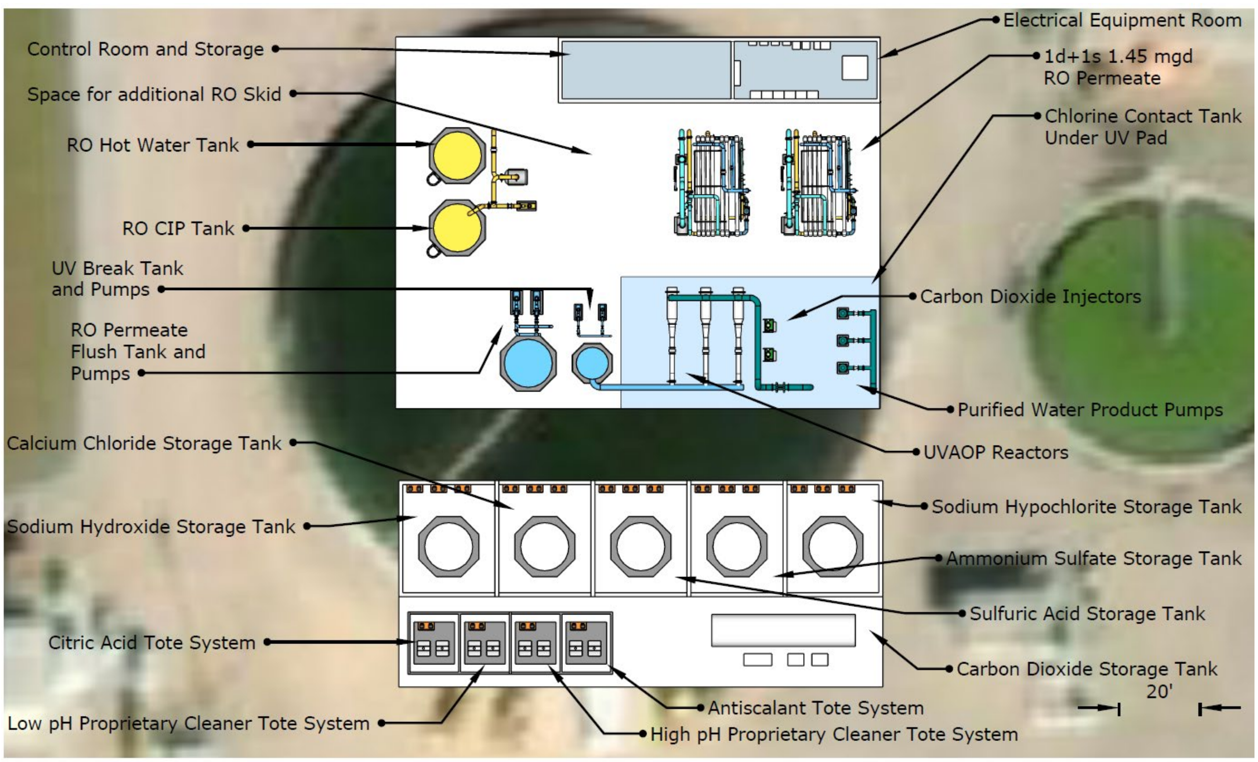


Figure 5.6 Full IPR Implementation Site Layout – new RO and UV systems (Plan View)

5.1.2.4 Pathogen Control for the Full IPR Implementation Project

The anticipated log reduction values for the Full IPR Implementation project involves combining all water sent through MBR and CAS/UF treatment systems to flow through one RO and UV AOP system for IPR Figure 5.4. With this there are two main treatment trains for IPR accreditation, (1) CAS/UF/RO/UV AOP and (2) MBR/RO/UV AOP. Consequently, both treatment trains were assessed for LRV crediting. The MBR/RO/UV AOP treatment train is shown in the first half of Table 5.4. The CAS/UF/RO/UV AOP treatment train is shown in the second half of Table 5.4. Both treatment trains meet the pathogen requirements for this proposed project.

Table 5.4 Full Implementation IPR Log Reduction Values

Process	Virus	*Giardia cysts*	*Cryptosporidium oocysts*
MBR Based Treatment			
MBR(1)	1	2.5	2.5
RO(2)	2	2	2
UV AOP	6	6	6
Free Chlorination(3)	0 to 6	-	-
Groundwater RRT(4)	2+	0	0
Total	12+	10.5	10.5
Minimum Required	12	10	10
CAS+UF Based Treatment			
UF	0+(4)	4	4
RO(2)	2	2	2
UV AOP	6	6	6
Free Chlorination(3)	0 to 6	-	-
Groundwater RRT(4)	2+	0	0
Total	12+	12	12
Minimum Required	12	10	10

Notes:
(1) Based on conclusion of WRF 4997 (Salveson et al., 2021). Credits are based on turbidity results being below 0.2 NTU 95 percent of the time, and below 0.5 NTU 100% of the time.
(2) RO credits can be based upon EC (anticipated value of 1.5), TOC (anticipated value of 2.0), or other surrogates (e.g., strontium, sulfate) that may have a higher LRV (up to 2.5).
(3) Virus disinfection credit is only sought for free chlorination. Credits requested to be flexible based upon CT. Longer groundwater travel times allow for less chlorine LRV credits to meet total 12 LRV virus target. Chlorine residual to be based on the CT required per the Australian WaterVal Validation Protocol Chlorine disinfection requirement guidelines, http://www.waterra.com.au/_r7273/media/system/attrib/file/1707/201702_WaterVal_Validation-Protocol_Chlorine-Disinfection.pdf.
(4) Based on 2-month travel time, which is the minimum allowed. Longer travel times allow for greater virus credits, which then allows for reduced chlorine CT while still meeting the 12 LRV requirements.
(5) UF provides virus removal but will not be assigned virus removal credit due to the lack of online monitoring or periodic surrogates that will reliably demonstrate virus removal performance.

5.2 Additional Project Considerations

The two projects described above represent the most viable project alternatives. However, there are additional considerations that could lead to modified versions of these projects based on LCSD's preferences and priorities. These alternatives may be focused on the purified water production, the timeline of implementing IPR, potential treatment options, and ROC disposal options.

5.2.1 Purified Water Production

The quantity of purified water produced varies between the two project alternatives.

- The existing MBR, RO, and UV equipment can be repurposed for IPR purposes in Project 1 thereby utilizing the existing 0.5 mgd of feed flow.
- Currently, the maximum available flow for purification is 1.7 mgd. This is represented in Project 2.
- Future buildout of the region assumes up to 5 mgd of average day flow. If a larger project is desired, the 1.7 mgd treatment train could be designed in a modular fashion such that it could accommodate up to 3.5 mgd with a fairly straightforward expansion.

Building an IPR system for either the initial 0.5 mgd feed flow or for higher flows up to 1.7 mgd are reasonable options. The future buildout flow of 3.5 mgd is speculative at this time.

5.2.2 Project Implementation Timeline

As shown, both project alternatives assume that they are built all at once. However, it would also be possible to do a phased project in which the IPR capacity is increased over time. This could spread out the required capital expenditures over time and provide a ramp-up period for LCSD staff.

Benefits of a phased approach:

- Phased approach allows costs to be spread out over time rather than one large up-front cost.
- Phased approach allows for trouble shooting of new systems and upgrades at a smaller scale.

Downsides of a phased approach:

- Phased approach does not leverage the full flow potential until later in the project.
- The total costs of a phased approach will be higher than if the Full IPR Implementation project is built all at once.

5.2.3 Additional Treatment Options

Additional treatment options include RO systems designed for high recovery and/or boron removal.

- High recovery RO can generate more PRW and consequently reduce brine flows, potentially eliminating the need for a new ROC line. This would result in more concentrated brine, which could have impacts on the existing ROC discharge line and well and would need to be studied further.
- If injection were to occur within a sub-basin with a lower boron level objective, and the boron challenge cannot be addressed thorough anti-degradation or assimilative capacity, additional treatment will be needed. Options to reduce boron levels through treatment include implementing a two pass RO system with a pH adjustment, SWRO, or new emerging RO membranes. As stated previously, if boron is a challenge, the solution will first address regulatory and source control measures versus treatment options.

5.2.4 RO Concentrate Disposal

As mentioned previously, the Fast Track project will not require a new ROC disposal pipeline or well, whereas the Full IPR Implementation project will. There is a possibility to implement a project in between these two project options that maximizes the IPR flow while eliminating the need for new ROC infrastructure. A 1.35 mgd flow project will meet these two requirements. At 1.35 mgd, assuming a 15 percent RO rejection, the ROC is 0.2 mgd or 141 gpm. Therefore, this flow rate just meets the pipeline capacity requirements while maximizing the amount of purified water produced. While this project was not detailed out any further in this analysis, the option can be expanded if chosen as a preferred alternative. With the 1.35 mgd flow rate, there are two options for the flow split:

5.2.4.1 Removal of MBR Approach

Currently high and low salt loads are segregated so that the high salt concentration can be treated through the RO system. To decommission the MBR the entire flow would then be sent through CAS/UF/RO/UV AOP as depicted in Figure 5.7. Currently the UF accepts a flow rate of 1.2 mgd; therefore, at flow rates between 0.5 mgd and 1.2 mgd the existing UF system works. However, a new RO system is needed for higher flow rates as it currently only treats 0.5 mgd.

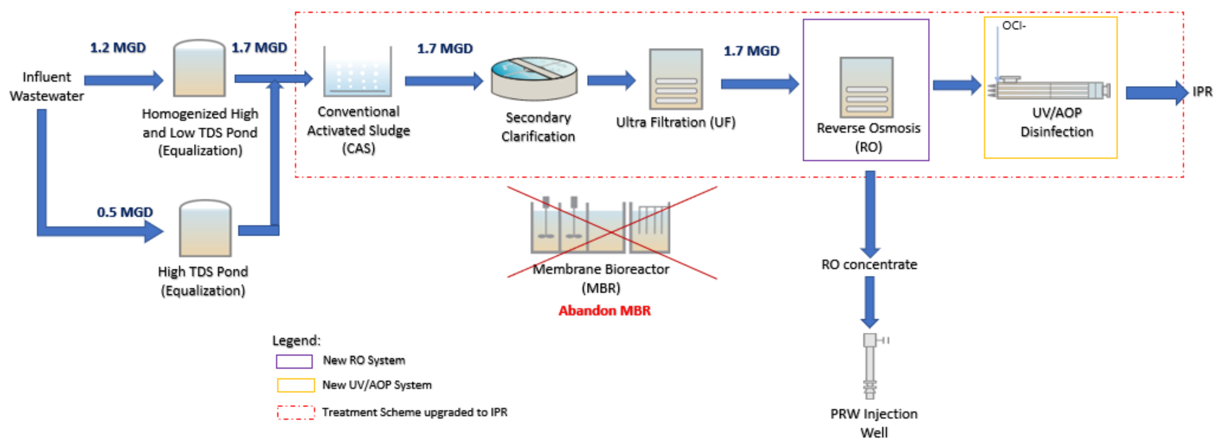


Figure 5.7 Removal of MBR Process Flow Diagram

CHAPTER 6 PROJECT SUMMARY & COSTS

6.1 Cost Estimating Methodology

The costs presented in this section are preliminary and therefore considered an estimate. As such, costs should be refined and updated as the project progresses. The costs detailed herein are Class 5 level estimates, i.e. concept screening-level estimates. Class 5 estimates are considered to be 0-2% of the total project maturity level and should be considered only for concept screening as expected accuracy has potential to have great variance. The expected range of accuracy for a Class 5 cost estimate is -30 percent to +50 percent; this means that for a $100 estimated project cost, future bids would be expected to fall into a range of $67 to $130.

Project cost estimates are comprised of both direct costs and indirect or "soft" costs. Direct costs are those directly attributed to the physical make-up of the work (e.g., site development, treatment equipment, pumps, piping, etc.). The sum of all direct costs is the "Total Direct Cost."

Indirect costs consist of contingency factors, including estimating contingency, general conditions, contractor overhead and profit, sales tax, and engineering/legal/administration. In the summary table below, markups are included below the "Total Direct Cost" row. A summary of the markups that were included here is provided in Table 6.1. The assumed percentage for each markup, and the order in which they were applied, is shown in Table 6.2.

Table 6.1 Indirect Cost Factors Included in Cost Estimates

Factor	Description
Estimating Contingency	Captures miscellaneous direct costs that would not otherwise be itemized within a direct cost category.
Sales Tax	State and local sales taxes on material goods, applied to 50 percent of total direct costs.
General Conditions	Accounts for items such as mobilization, demobilization, the contractor's temporary facilities, major construction equipment that cannot be distributed to a specific item of work, testing, start-up, commissioning, and project site supervision.
Contractor Overhead and Profit	This value includes general contractor home office overheads, sales tax, and profit.
Engineering, Legal, and Administrative	Engineering design and services during construction, construction management, legal, and administrative costs.
Owner's Reserve for Change Orders	Unforeseen site conditions and contractor change orders or claims that increase the final as-built price above the anticipated bid value for the Project.

Table 6.2 Summary of Project Cost Estimating Methodology

No.	Description	Percentage	Example
01	Treatment Equipment		$100
02	Site Work		$100
03	Pump Station		$100
04	Other		$100
05	Other 2		$100
	TOTAL DIRECT COST		**$500 (A)**
	Estimating Contingency	30 percent of A	$150 (B)
	Sales Tax (On Materials and Construction Equipment)	7.75 percent of 0.5*(A)	$19 (C)
	General Conditions	20 percent of (A+B)	$130 (D)
	Contractor Overhead and Profit	15 percent of (A+B)	$98 (E)
	TOTAL CONSTRUCTION COST	**A+B+C+D+E**	**$897 (F)**
	Engineering, Legal and Administration Fees	12 percent of (F)	$108 (G)
	Owner's Reserve for Change Orders	5 percent of (F)	$45 (H)
	TOTAL ESTIMATED PROJECT COST	**F+G+H**	**$1,050**

It is important to note that the project cost estimates provided are in today's dollars at the time of writing. If a project is implemented in the future, the cost estimate would need to be escalated to account for cost increases over time. Escalation can significantly impact project costs, especially given recent economic trends where annual escalation rates of 5-10% have been observed. For example, if the project were to be implemented in 5 years, with an assumed escalation rate of 5%, the total project cost would increase by 28 percent. An annual escalation rate of 10% would result in a project cost increase of 60 percent over 5 years.

At the end of this chapter, project costs are presented as cost per acre-foot (AF) of water produced. Total project costs were annualized assuming a 30-year loan with a 3.5 percent interest rate. This annualized cost would be impacted by the financing mechanism determined for the project; for example, if a low- interest loan with a 2 percent interest rate were secured, the annualized cost would decrease from what is shown.

6.2 Project Summaries

The two projects identified in Chapter 5 propose a combination of different flow rates and treatment phasing. A summary of the key components considered for costs purposes of each project alternative is listed below.

- **Project 1 – Fast Track Project:**
  - Feed Flow rate: 0.5 mgd:
    - Production Flow rate: 0.43 mgd.
  - Treatment Scheme: Use existing MBR/RO/UV system to produce IPR water. CAS/UF/UV will continue to treat NPR water. The UV system for NPR would be new.
  - Groundwater Recharge: Injection of PRW northwest of the LCSD WRP.

- **Project 2 – Full IPR Implementation Project:**
  - Feed Flow rate: 1.7 mgd:
    - Production Flow Rate: 1.45 mgd.
  - Treatment Scheme: CAS/UF and MBR come together for RO/UV AOP treatment producing IPR water.
  - Groundwater Recharge: Injection of PRW northwest of the LCSD WRP.

6.3 Project Components and Costs

Project components of the two project alternatives can be summarized into three main categories: treatment system upgrades and new system components; conveyance infrastructure to transport purified water to the chosen groundwater recharge location; and injection and monitoring well costs for the proposed flow and injection location. Costs for each project component are summarized in subsequent sub-sections.

6.3.1 Treatment System Upgrades, Installation, and Costs

Treatment system components include either the upgrade of existing systems to meet IPR requirements or the addition of new systems. Treatment cost components for the two projects are detailed below.

As part of Project 1 – Fast Track, the existing UV system will be upgraded for UV AOP operations as part of the IPR treatment train and a new UV system will be required for the NPR treatment train. The existing UV system is currently oversized and used to disinfect a combined UF/RO flow to meet NPR requirements. Due to the oversized system, it is assumed there is sufficient dose capacity for the UV system to be upgraded to UV AOP for IPR purposes. However, auditing and testing the system is recommended to confirm the viability of this approach. Testing of the system can determine if the IPR regulations of 6 LRV virus, 0.5 LRV of 1,4-dioxane, and NDMA compliance requirements can be met. The work related to this is proposed to take place as part of the next phase of this project. The RO system will require modifications to meet IPR compliance monitoring requirements; additional testing of this system is also recommended. A new UV system will be required for NPR purposes. Additional costs as part of the RO and UV modifications for IPR include instrumentation for system processes, dosing and feed pumps, a chlorine contact tank, and a calcite contactor for stabilization. In addition a new treatment building, treatment facility items, and engineering services were also included in the total direct costs. These systems are summarized in Table 6.3 below.

As part of Project 2 – Full IPR Implementation project, the UF system will need to be upgraded to meet IPR compliance monitoring standards (i.e. the ability to conduct PDTs). In addition, a new UV system (for UV AOP) and a new RO system will be implemented for the combined CAS/UF and MBR flow. Therefore, the audit and challenge testing will not be needed if this project alternative is chosen. The new RO system will be 3 stages with 85% recovery. Additional costs including system monitoring instrumentation, dosing and feed pumps, underpad chlorine contactor, CIP , hot water tank, and system ancillary equipment are included in the New UV and RO system cost line item. In addition, cleaning and chemical systems, a new treatment building, treatment facility items, and engineering services were also included in the total direct cost. These systems are summarized in Table 6.3 below.

Table 6.3 Treatment System Costs for Project Alternatives

Treatment Costs		
Treatment Component	Project 1 – Fast Track (0.5 mgd Feed)	Project 2 – Full IPR Implementation (1.7 mgd Feed)
Treatment Building	$2.4 M	$7.8 M
RO and UV Modifications for IPR(1)	$0.65 M	--
New UV System for NPR(2)	$0.46 M	--
New UV and RO System for IPR(3)	--	$4.2 M
Upgrade to UF System for IPR(4)	--	$3,000
Additional Cleaning and Chemical Systems	--	$0.97 M
Treatment Facility Items(5)	$0.50 M	$1.5 M
Engineering Services	$2.1 M	$7.8 M
Total Direct Costs	**$6.1 M**	**$22.2 M**
Total Project Costs(7)	**$12.9 M**	**$46.6 M**

Notes:
(1) Includes new instrumentation and instrumentation for AOP, sodium hypochlorite tank and dosing pumps, RO membranes for 4th skid, new chlorine contact tank, new calcite contactor, and an ammonium sulfate tank and dosing pumps.
(2) Includes new UV reactors, 800W lamps and UV pumps.
(3) Includes new instrumentation, UV reactors, 800W lamps, feed pumps, sodium hypochlorite system, under pad chlorine contactor, RO skid, RO flush tank and UV feed tank, and ammonium sulfate system.
(4) Includes UF Pressure Decay Test upgrades.
(5) Treatment facility items are scaled as a factor of direct Treatment Processes and Chemical Dosing Equipment and Tanks, excluding building and other Engineering Services.
(6) Includes process equipment installation, sitework, electrical instrumentation and control, mechanical, piping and valves, and a new treatment building.
(7) Includes contingency, sales tax, contractor overhead and profit, general conditions, engineering/legal/administrative fees, and owners reserve for change orders.

Detailed cost estimates for each project alternative can be found in Appendix F.

Once the current CAS upgrades are completed, a new RO system is in place and limitations on brine discharge are lifted by an upgrade to the ROC pipeline there is little to no need for the current MBR train to produce IPR. Under these conditions, the MBR, existing RO and upgraded UV AOP could be considered stranded assets. There may be capacity for use of some of the system components and new monitoring devices as spares in the new plant.

Treatment systems for flows beyond the current 1.7 mgd (feed flow) are not evaluated in this document.

6.3.2 New Infrastructure Costs

Infrastructure costs include conveyance infrastructure needed to transport the purified water and the injection and monitoring wells needed for groundwater recharge. In addition, if required by the higher flow rate, a new ROC disposal line and well may also be required.

As part of Project 1 – Fast Track, it was assumed one new PRW injection well will be required based on a well capacity of 0.45 mgd. Injection costs include the following:

- Onsite recycled water pump station and tank.
- General injection site costs: stormwater pollution prevention program best management practices and groundwater testing and handling costs.

- Site civil injection costs: costs associated with improving and preparing the site for PRW injection wells including grading, gravel roadway, fencing, yard piping and a backwash pumping pond.
- Well installation costs: cost of one 300-foot deep well, associated monitoring wells and infrastructure.

Conveyance costs for Project 1 include the pipeline needed to convey water to the injection location northwest of LCSD. Note the pipe for this was sized to allow for growth in the purified water flow. Consequently, the 1.7 mgd feed flow (product flow of 1.45 mgd) was considered for the conveyance pipeline costs in both projects. The infrastructure costs for Project 1 – Fast Track are shown in Table 6.4. Figure 6.1 shows the proposed and existing conveyance pipelines.

As part of Project 2 – Full IPR implementation, it was assumed four new PRW injection wells will be required based on a well capacity of 0.45 mgd. All other cost categories for Project 2 are similar to that of Project 1 and have been adjusted based on the larger number of wells and area needed. As mentioned, the conveyance pipeline to transport water from LCSD to the injection location northwest of LCSD is the same for both projects as it made sense to size with the intention of the IPR flow rate eventually increasing. In addition, for Project 2 the ROC flow rate results in the need for a new ROC disposal pipeline and well. The infrastructure costs for Project 2 – Full IPR Implementation are shown in Table 6.4. Figure 6.1 shows the proposed and existing conveyance pipelines.

Detailed infrastructure cost estimates are provided in Appendix F.

Table 6.4 Infrastructure System Costs for Project Alternatives

Infrastructure Costs		
Infrastructure Component	Project 1 – Fast Track (0.5 mgd Feed)	Project 2 – Full IPR Implementation (1.7 mgd Feed)
Purified Recycled Water Injection Well Costs		
Onsite Recycled Water Pump Station & Tank	$619,000	$1.31 M
General Injection Site Costs	$15,000	$30,000
Site Civil Injection Costs	$718,100	$867,600
Well Installation Costs	$1.01 M	$4.03 M
Engineering Instrumentation and Control	$259,000	$735,000
ROC Disposal Well Costs		
ROC Disposal Well(1)	--	$2.87 M
Conveyance Costs		
Pipeline from LCSD to PRW injection well northwest of LCSD	$1.24 M	$1.24 M
ROC Conveyance Pipeline	--	$4.16 M
Total Direct Costs	$3.9 M	$15.3 M
Total Project Costs(2)	$8.1 M	$32 M

Notes:
(1) Cost for ROC disposal well includes permitting, building pad and drilling, and surface facilities (tanks, pumps, anulus system).
(2) Includes contingency, sales tax, contractor overhead and profit, general conditions, engineering/legal/administrative fees, and owners reserve for change orders.

Costs for the use of the Getty Basin area were developed but not included in the summary tables above due to the previously discussed complexities with this option. Infrastructure costs for injection near the Getty Basin area can be found in Appendix F.

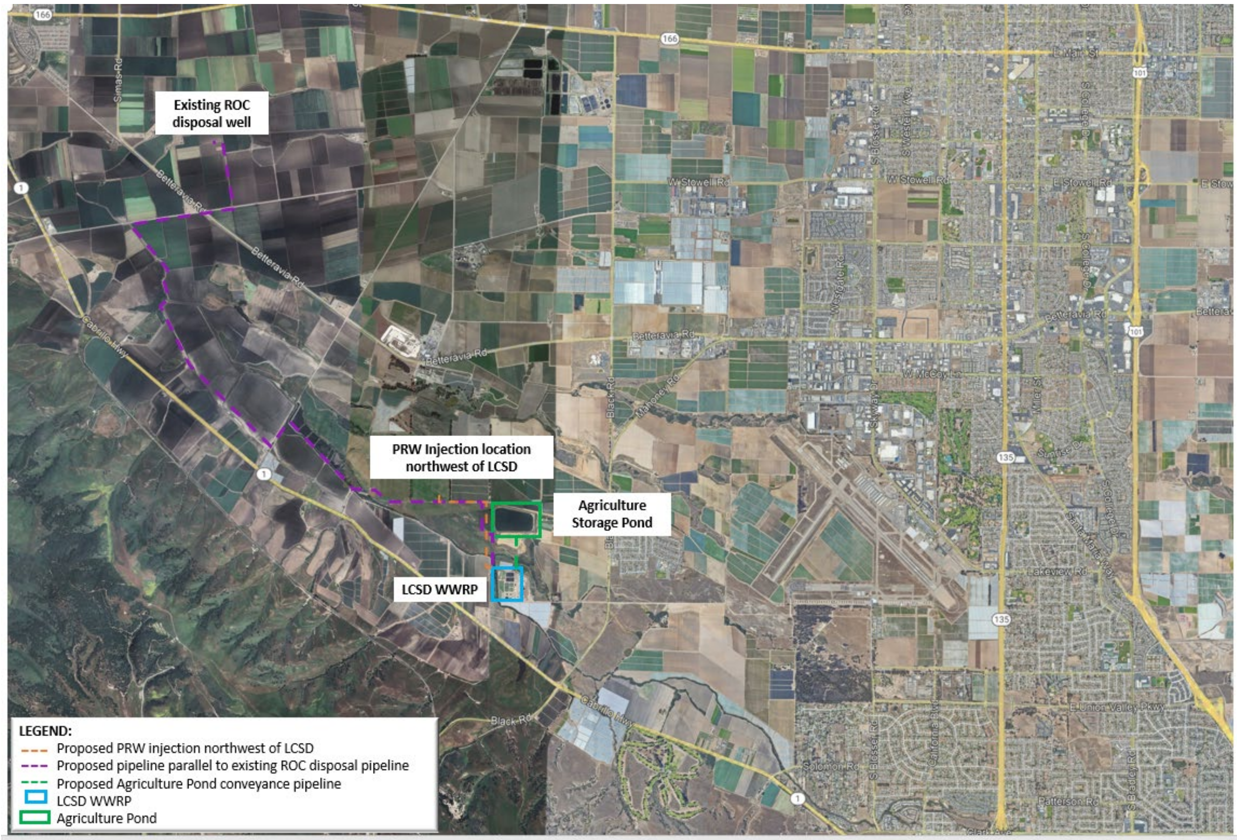


Figure 6.1 Proposed Conveyance Pipelines

6.3.3 Operations & Maintenance Costs

Operation and Maintenance (O&M) Costs include staffing costs needed to operate the facility, chemical and energy costs, process consumables, PRW injection well O&M costs, and treatment O&M.

6.3.3.1 Staffing Assumptions

Staffing considerations for a future AWPF include several functions: operating and maintaining the AWPF, managing instrumentation and controls (I&C), and managing regulatory efforts. Currently, LCSD has a plant staff of 14 personnel that includes:

- One chief plant operator.
- One supervising plant operator.
- 8 wastewater plant operators.
- 4 sewer system maintenance workers.

Currently, operators rotate on operations, maintenance, and repair work. Regulatory efforts are typically covered by the chief plant operator (permits and reporting) and an engineer (e.g. new permits). Instrumentation and control work is contracted with a third party.

It was assumed that the I&C work for the AWPF would be incorporated into the existing third-party contract, and that relevant regulatory work will be conducted by the existing engineering positions. Therefore the staffing assumptions for a future AWPF include only new operations staff. The assumptions for new operations staff needs were developed based on the staffing plan developed for a similar IPR project in the region. Three new operators would be needed to operate the AWPF: 1 new chief plant operator, and 2 Grade 3-level operators. It is assumed that each operator would need to obtain an Advanced Water Treatment Operator (AWTO) certification.

The cost estimates for staffing are based on the above new operators, with the fully-loaded salaries provided by LCSD.

As part of the Title 22 Engineering Report for the Morro Bay Water Reclamation Facility, a staffing plan was drafted. Due to further project development of Morro Bay and the close proximity to LCSD, this staffing plan is included as a refence in Appendix G.

6.3.3.2 Chemical and Energy Costs

Chemical costs were estimated based on anticipated annual chemical usage and current bulk chemical prices. As mentioned in Section 5.1.1.3 and Section 5.1.2.3, the chemicals needed for both project alternatives include:

- Sodium Hypochlorite.
- Ammonium Sulfate.
- Calcite contactor.
- Sulfuric Acid.
- Antiscalant.
- Sodium Hydroxide.
- Calcium Chloride.
- Carbon dioxide.
- Citric Acid.

Energy costs are associated with UV pumps, UV reactors, RO system, and the UV AOP process. System components (consumables) costs include parts replacement needed for the treatment system, such as UV lamps and RO membranes.

6.3.3.3 O&M Cost Summaries

Operations and Maintenance costs for both Project 1 – Fast Track and Project 2 – Full IPR Implementation are summarized in Table 6.5. Note that costs for staffing account for 3 AWTO trained personnel, which is conservative. If 2 staff are used on-site cost savings will be around $100,000 per year.

Table 6.5 Estimated Annual O&M Costs for Project Alternatives

O&M Costs		
O&M Component	Project 1 – Fast Track (0.5 mgd Feed)	Project 2 – Full IPR Implementation (1.7 mgd Feed)
Staffing Cost (3 staff/ 2 staff)	$329,500	$329,500
Process Energy Costs	$329,500	$631,900
Process Chemical Usage	$156,800	$706,900
Process Consumables	$52,700	$40,700
PRW Injection Well O&M	$65,900	$165,000
Subtotal O&M Costs	**$935,000 M**	**$1.9 M**
Total O&M Costs(1)	**$1.2 M**	**$2.4 M**

Notes:
(1) Includes estimating contingency.

O&M costs for the Getty Basin injection alternative project can be Found in Appendix F. More details regarding the O&M costs can be found in Appendix F.

6.3.4 Project Cost Summaries

Project elements, associated costs, and total project costs are summarized in Table 6.6. The treatment and infrastructure cost components for each project were annualized and added to the annual O&M costs. Cost per acre-foot was calculated for each project using the total annualized costs and the production flow rate; these values are also provided in Table 6.6 below. For reference, tentative preliminary capital costs for a nearby IPR project are $100 M for 1 mgd with infrastructure that can be expanded to 3.9 mgd.

Table 6.6 Project Alternative Cost Summaries

Project	Feed Flow (mgd)	Purified Water Production (mgd)	Treatment Modifications	Treatment Costs	New Infrastructure Needs (PRW Injection Wells, Monitoring Wells, ROC Disposal Wells, and Conveyance Infrastructure)	New Infrastructure Costs	Total Project Capital Cost	Annualized Project Cost (Infrastructure and Treatment)(1) (2023 Dollars)	Annual O&M Costs	Total Cost per Acre-Foot
Project 1	0.5	0.43	Upgrade RO system Upgrade UV for UV AOP New UV System for NPR	$12.9 M	▪ PRW Injection wells near LCSD ▪ Conveyance pipeline from LCSD to injection NW of LCSD ▪ Pump Station ▪ Conveyance from LCSD to Agriculture Storage Reservoir	$8.4 M	$21.3	$1.1 M	$1.2 M	$4,950
Project 2	1.7	1.45	New RO system New UV System for UV AOP	$ 46.6 M	▪ PRW Injection wells near LCSD ▪ Conveyance pipeline from LCSD to injection NW of LCSD ▪ Pump Station ▪ Conveyance from LCSD to Agriculture Storage Reservoir ▪ New ROC disposal well and associated pumping ▪ New ROC disposal pipeline	$32 M	$78.6	$4.3 M	$2.4 M	$4,130

Notes:
(1) Annualized project costs assume a 30-year loan with 3.5% interest rate.

6.3.5 Engineering Ideas for Cost Savings

One large cost element in Project Alternative 2 – Full IPR Implementation is the new RO concentrate disposal pipeline and well. It may be possible to avoid this cost using one of the following approaches:

- In order to achieve an RO concentrate flow within the existing capacity of the discharge pipe and well, the RO system would need to achieve a recovery of 88%. It is possible that this could be achieved by the proposed new RO system. One approach would be to implement the Fast Track project, test the RO recovery to see whether it could be sustainably operated at 88%, and then progress to the Full IPR Implementation project with confidence that a new ROC discharge pipe and well can be avoided. The RO system could also be pilot tested to allow for implementation of the full project without phasing.
- Higher RO recovery could also be achieved with a high recovery RO system (not designed or costed here). While the costs for the ROC disposal pipeline and well may be eliminated with this option, it should be noted that the treatment cost and O&M cost will increase. Increased RO recovery will also lead to a more concentrated brine that should be assessed for scaling potential in the existing ROC disposal line. Prior to implementing the high recovery RO system, it is suggested to (1) pilot test the system to determine the potential sustainable RO recovery, and (2) consider the potential for scaling due to more concentrated brine.

6.4 Implementation and Next Steps

The following sections describe the timeline for IPR implementation and the key elements for IPR success. The next steps are incorporated into the project implementation phases.

Project Timeline

The timeline to implement a potable reuse project can vary depending on the urgency and need, regulatory climate, and specific project details. The goal of this IPR implementation timeline and approach is to provide insight into key project elements and how they might fit within an overall project delivery timeline. The project timeline components can be broken into three parts: planning phase, demonstration phase, and implementation phase.

Planning Phase

This work represents the initial planning efforts. The next steps that would be part of the planning phase may include:

- Define a financial model and governing approach for a future potable reuse program.
- Identify grant funding opportunities. Focus will be on the application timing and components needed to secure funding.
- Work with appropriate agencies to create a reliable Boron Regulatory Pathway.
- Produce a USBR "compliant" report that can be used for federal grant funding.

The Planning Phase tasks are detailed in Figure 6.2.

Demonstration Phase

The demonstration phase focuses on project confidence and viability needed for regulatory approval. This confidence relies on confirmation of advanced treatment systems and their operation along with progression of IPR feasibility. By demonstrating potential for a successful project, regulatory and project approval is more easily obtained.

The goals of a demonstration phase can include items such as (1) conducting analyses and documentation that can support design and permitting, (2) training operations staff in advanced treatment, (3) facilitating public engagement, and (4) testing potential project innovations. The next steps that would be part of the demonstration phase include:

- Conduct groundwater modeling to demonstrate minimum travel time requirements are met under all potential operating conditions and seasons. Tasks include refining travel time, velocity, and distance at the proposed injection locations.
- Conduct additional testing of the RO and UV systems to ensure proposed upgrades can meet IPR standards.
  - LCSD is a key partner in on-going United States Bureau of Reclamation (USBR) research of machine learning and artificial intelligence (ML/AI) for potable reuse. Partnering with Veolia, LCSD will pilot test the latest RO innovation as part of the USBR research. This pilot testing effort (planned to start spring of 2024) will evaluate chemical removal and regulatory credits for a future IPR system in addition to ML/AI.
- Produce a Basis of Design Report. This report aids in greater project and cost confidence while also meeting requirements needed for SRF funding.
- Perform operator training alongside the analysis of the existing treatment systems and pilot study. Performing training and project demonstration tasks in parallel allows operators to get a head start on changes and adjustments while providing input prior to the implementation phase.
- Engage the public through distribution of information. Getting support early increases project backing and confidence.

The Demonstration Phase tasks are detailed in Figure 6.2.

Implementation Phase

The demonstration phase informs the decision about whether a full-scale project should move forward. If the project has confidence and commitment to move forward, the implementation phase can begin in parallel with the demonstration phase (pending the planning and funding is in place). The implementation phase includes permitting, as well as design and construction of the project.

Elements of the implementation phase include:

- Environmental permitting is conducted via the CEQA process.
- Regional Water Quality Board permitting requires preparation of a Title 22 Engineering Report (reviewed and approved by the Division of Drinking Water).
  - Both permitting tasks will start with the demonstration phase and continue throughout the implementation phase.
  - It should be noted that the timeline for permitting, and approval may fluctuate and are project and agency dependent.

- Project design is completed and the project goes out for bid.
- The project is constructed.

The Implementation Phase tasks are detailed in Figure 6.2.

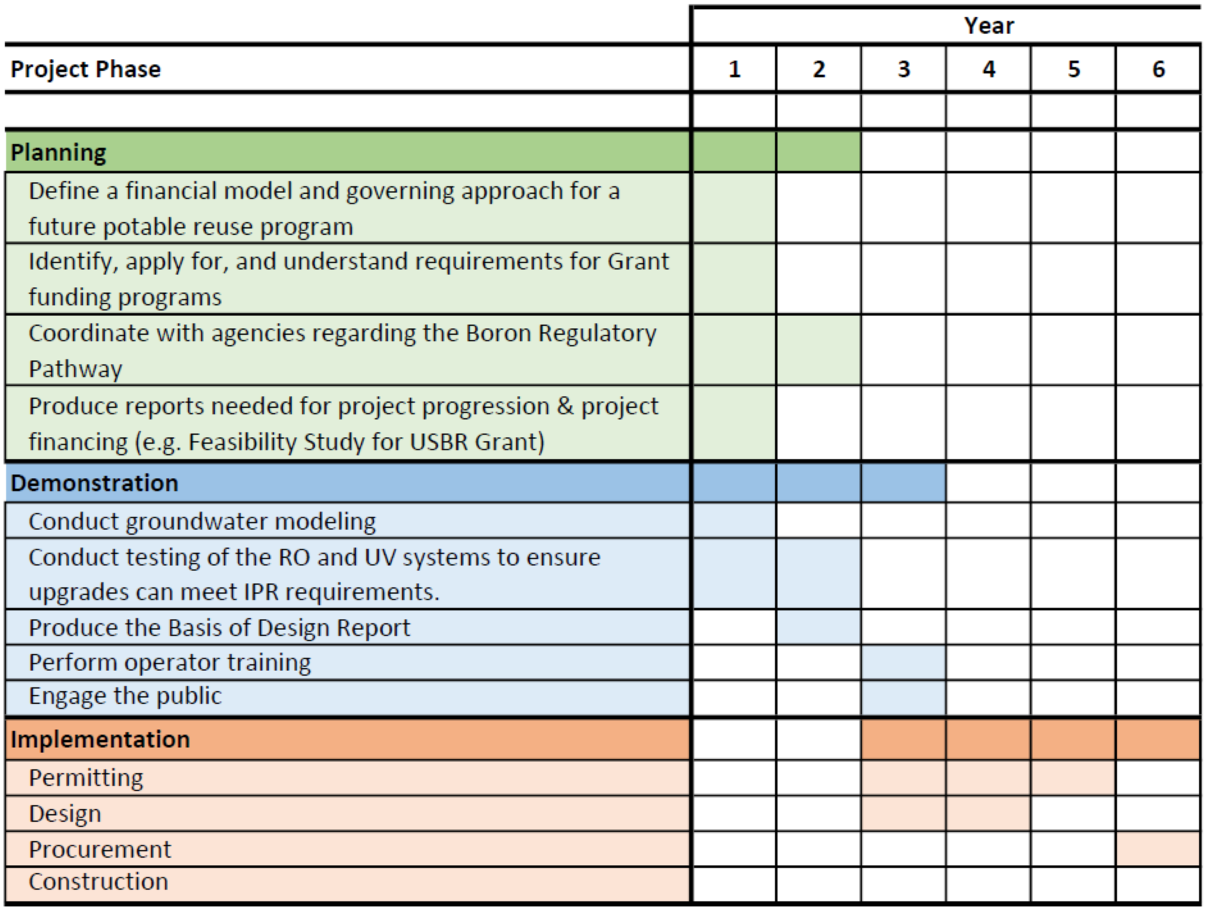


Figure 6.2 Implementation and Next Steps Schedule

Schedule Risks

Throughout the implementation timeline there are elements that can result in schedule delays or project uncertainty. Some challenge to be aware of are:

- Public Perception:
  - As a utility implements a potable reuse project, community confidence, understanding, acceptance, and support, along with stakeholder involvement, become essential.
    - Issues that commonly come up with the public include no-growth concerns, rate impacts, and general concerns over the concept of potable reuse. It is important the project sponsor become aware of the likely concerns in the service area to address these early on.
    - Initiating and maintaining an extensive public engagement campaign is critical.

- Inter-Agency Agreements:
  - To implement a successful IPR project, a high degree of interagency coordination is needed. An interagency agreement will be needed to define elements of a project including:
    - Cost sharing.
    - Responsibility for risk and liability.
    - Operational responsibilities.
    - Response to a system failure and/or interruption.
    - Meeting regulatory requirements.
  - Developing consensus between multiple agencies can be time consuming. Consequently, this should be an early priority in the project.

Loose Ends

- This feasibility study identified several items that would require further consideration and follow-up in the next phase of project development. These are documented here to acknowledge that they require additional thought, but are not within the scope of this study to fully address. As mentioned previously, the average daily flow that would be used for the design of a Full IPR Implementation Project would need to be defined and agreed upon during a subsequent phase of project development. Flow assumptions should also be confirmed for the Fast Track Project.
- Additional wastewater flows are expected to be generated within the LCSD service area in the future. In the scenario where a project is pursued to maximize the production of purified water at a particular average daily flow (see item above), this future excess wastewater could be used to serve NPR customers. This scenario was not fully developed here but could be explored.
- If a larger buildout project is desired, additional definition of the appropriate flow assumptions would be needed. There are several possible scenarios that could be designed, including (1) double the capacity of a 1.7 mgd IPR facility which has been designed in a modular fashion to allow for this expansion in a relatively simple way; (2) design to match the future capacity of the WRF, which is 3.7 mgd; (3) design for a capacity in which the MBR is decommissioned and flow is treated only through the CAS system, which has a capacity of 3.2 mgd. Additional decisions would need to be made about the future of the plant, anticipated future wastewater flows, and other factors.

APPENDIX A DRINKING WATER QUALITY TABLES

The water quality limits for groundwater recharge with recycled water, as required for the future WRP, are defined below.

Drinking Water Quality Requirements

Tables A.1 through A.6 constitute the required water quality performance, consistent with 22 CCR (2019a). Within each table is a specific reference to the table within the regulation.

Table A.1 Inorganics with Primary MCLs or ALs[1]

Constituents	Primary MCL or AL (in mg/L)	Constituents	Primary MCL or AL (in mg/L)
Aluminum	1.0	Fluoride	2
Antimony	0.006	Lead	0.015[3][4]
Arsenic	0.010	Mercury	0.002
Asbestos	7 (MFL)[2]	Nickel	0.1
Barium	1	Nitrate (as N)	10
Beryllium	0.004	Nitrite (as N)	1
Cadmium	0.005	Total Nitrate/Nitrite (as N)	10
Chromium	0.05	Perchlorate	0.006
Copper	1.3[3]	Selenium	0.05
Cyanide	0.15	Thallium	0.002

Notes:
(1) Based on Table 64431-A and Section 64678.
(2) MFL - Million fibers per liter, with fiber lengths > 10 microns.
(3) Regulatory Action Level; if system exceeds, it must take certain actions such as additional monitoring, corrosion control studies and treatment, and for lead, a public education program; replaces MCL.
(4) The MCL for lead was rescinded with the adoption of the regulatory action level described in footnote '3'.

Table A.2 Radioactivity[1]

Constituents	MCL (in pCi/L)	Constituents	MCL (in pCi/L)
Uranium	20	Beta/photon emitters	50[2]
Combined radium-226 & 228	5	Strontium-90	8[2]
Gross alpha particle activity	15	Tritium	20,000[2]

Notes:
(1) Based on Tables 64442 and 64443.
(2) MCLs are intended to ensure that exposure above 4 millirem/yr. does not occur.

Table A.3 Regulated Organics[1]

Constituents	MCL (in mg/L)	Constituents	MCL (in mg/L)
Volatile Organic Compounds			
Benzene	0.001	Monochlorobenzene	0.07
Carbon Tetrachloride	0.0005	Styrene	0.1
1,2-Dichlorobenzene	0.6	1,1,2,2-Tetrachloroethane	0.001
1,4-Dichlorobenzene	0.005	Tetrachloroethylene	0.005
1,1-Dichloroethane	0.005	Toluene	0.15
1,2-Dichloroethane	0.0005	1,2,4 Trichlorobenzene	0.005
1,1-Dichloroethylene	0.006	1,1,1-Trichloroethane	0.2
cis-1,2-Dichloroethylene	0.006	1,1,2-Trichloroethane	0.005

Constituents	MCL (in mg/L)	Constituents	MCL (in mg/L)
trans-1,2-Dichloroethylene	0.01	Trichloroethylene	0.005
Dichloromethane	0.005	Trichlorofluoromethane	0.15
1,3-Dichloropropene	0.0005	1,1,2-Trichloro-1,2,2-Trifluoroethane	1.2
1,2-Dichloropropane	0.005	Vinyl chloride	0.0005
Ethylbenzene	0.3	Xylenes	1.75
MTBE	0.013		
SVOCs			
Alachlor	0.002	Heptachlor	0.00001
Atrazine	0.001	Heptachlor Epoxide	0.00001
Bentazon	0.018	Hexachlorobenzene	0.001
Benzo(a) Pyrene	0.0002	Hexachlorocyclopentadiene	0.05
Carbofuran	0.018	Lindane	0.0002
Chlordane	0.0001	Methoxychlor	0.03
Dalapon	0.2	Molinate	0.02
Dibromochloropropane	0.0002	Oxamyl	0.05
Di(2-ethylhexyl)adipate	0.4	Pentachlorophenol	0.001
Di(2-ethylhexyl)phthalate	0.004	Picloram	0.5
2,4-D	0.07	Polychlorinated Biphenyls	0.0005
Dinoseb	0.007	Simazine	0.004
Diquat	0.02	Thiobencarb	0.07/0.001(2)
Endothall	0.1	Toxaphene	0.003
Endrin	0.002	1,2,3-Trichloropropane	5x10-6
Ethylene Dibromide	0.00005	2,3,7.8-TCDD (Dioxin)	3x10-8
Glyphosate	0.7	2,4,5-TP (Silvex)	0.05

Notes:
(1) Based on Table 64444-A.
(2) Second value is listed as a Secondary MCL.

Table A.4 Disinfection By-Products(1)

Constituents	MCL (in mg/L)	Constituents	MCL (in mg/L)
Total Trihalomethanes	0.080	Bromate	0.010
Total Haloacetic acids	0.060	Chlorite	1.0

Note:
(1) Based on Table 64533-A.

Table A.5 Constituents/Parameters with Secondary MCLs

Constituents[1]	MCL (in mg/L)	Constituents[2]	MCL (in mg/L)
Aluminum	0.2	TDS	500
Color	15 (units)	Specific Conductance	900 uS/cm
Copper	1	Chloride	250
Foaming Agents (MBAS)	0.5	Sulfate	250
Iron	0.3		
Manganese	0.05		
MTBE	0.005		
Odor Threshold	3 (units)		
Silver	0.1		
Thiobencarb	0.001		
Turbidity	5 (NTU)[3]		
Zinc	5		

Notes:
(1) Based on Table 64449-A.
(2) Based on Table 64449-B.
NTU - nephelometric turbidity unit; uS/cm - microsiemens per centimeter.

Table A.6 Constituents with Notification Levels[1][2]

Constituents	NL (in µg/L)	Constituents	NL (in µg/L)
Boron	1,000	Naphthalene	17
n-Butylbenzene	260	N-Nitrosodiethylamine (NDEA)	0.01
sec-Butylbenzene	260	N-Nitrosodimethylamine (NDMA)	0.01
tert-Butylbenzene	260	N-Nitrosodi-n-propylamine (NDPA)	0.01
Carbon disulfide	160	Perfluorohexanesulfonic acid (PFHxS)[3]	0.003
Chlorate	800	Perfluorobutanesulfonic acid (PFBS)[3]	0.5
2-Chlorotoluene	140	Perfluorooctanoic acid (PFOA)[4]	0.0051
4-Chlorotoluene	140	Perfluorooctanesulfonic acid (PFOS)[4]	0.0065
Diazinon	1.2	Propachlor	90
Dichlorodifluoromethane (Freon 12)	1,000	n-Propylbenzene	260
1,4-Dioxane	1	RDX	0.3
Ethylene glycol	14,000	Tertiary butyl alcohol (TBA)	12
Formaldehyde	100	1,2,4-Trimethylbenzene	330
HMX	350	1,3,5-Trimethylbenzene	330
Isopropylbenzene	770	2,4,6-Trinitrotoluene (TNT)	1
Manganese	500[2]	Vanadium	50
Methyl isobutyl ketone (MIBK)	120		

Notes:
(1) From SWRCB (2019a).
(2) The web link above also contains the levels of the pollutants in this table that must result in a removal of the water source from service.
(3) Drinking water Notification Level for PFBS and PFHxS added to the November 1, 2022, list by SWRCB (2022).
(4) Drinking water Notification Level for PFOA and PFOS updated by SWRCB (2022) on November 1, 2022.
µg/L – micrograms per liter; RDX – Royal Demolition Explosive (O2NNCH2)3.

CECs with Monitoring Triggering Levels (MTLs)

The SWRCB first adopted its RWP in 2009 and amended it in 2013 to specify monitoring requirements for CECs in recycled water based on the recommendations of an advisory panel, SWRCB (2010). The RWP contains a provision to reconvene a Science Advisory Panel every five years to update the recommendations for CEC monitoring in recycled water. In April 2018, the reconvened science advisory panel published Monitoring Strategies for CECs in Recycled water, Recommendations of a Science Advisory Panel (SCCWRP, 2018). On December 11, 2018, SWRCB adopted resolution No. 2018-0057 to amend the RWP. The amendment took effect in April 2019 when approved by the Office of Administrative Law. The amendment contains a revised list of CECs recommended for monitoring in potable water reuse projects (SWRCB 2019a).

CECs are defined by SWRCB (2019a) as constituents in personal care products; pharmaceuticals; antimicrobials; industrial, agricultural, and household chemicals; naturally occurring hormones; food additives; transformation products; inorganic constituents; microplastics; and nanomaterials.

SWRCB 2013 CEC monitoring included CECs with health-based significance, CECs that serve as performance indicators, and non-CECs that serve as performance surrogates. SWRCB (2019a) includes revised recommendations for CECs in all three aforementioned categories, as well as the addition of a new category for monitoring – bioanalytical screening tools. Health-based constituents and bioanalytical screening tools are to be monitored for purified product water prior to groundwater injection. Performance indicators are to be monitored in both in the purified product water and prior to RO. Surrogates listed in the RWP are examples – individual projects should determine appropriate surrogates to monitor effectiveness of CEC removal through individual unit processes.

Monitoring requirements for CECs per SWRCB (2013) and SWRCB (2019a) are included in Table A.7 and Table A.8, respectively. The monitoring requirements in SWRCB (2019a) replace those in SWRCB (2013).

The United States Environmental Protection Agency (EPA) has announced a proposed National Primary Drinking Water Regulation (NPDWR) for six per- and polyfluoroalkyl substances (PFAS). The EPA anticipates finalizing the NPDWR by the end of 2023 and enforcing regulation by 2026. Compliance is required within 3 years of when regulation is finalized. Table A.8 lists the expected MCLs for PFOA and PFOS.

Table A.7 Monitoring Requirements for CECs per SWRCB (2013)

Constituent	Relevance/Indicator Type	MTL (in µg/L)	Example Removal Percentages (%)
17B-estradiol(1)	Health	0.0009	--
Caffeine(1)	Health & Performance	0.35	>90
NDMA(1)	Health & Performance	0.01	25-50, >80(3)
Triclosan(1)	Health	0.35	--
DEET(1)	Performance	--	>90
Sucralose(1)	Performance	--	>90
TOC(2)	Surrogate	--	>90
EC(2)	Surrogate	--	>90

Notes:
(1) Monitored quarterly.
(2) Continuously monitored.
(3) 25 to 50 percent removal by RO, >80 percent removal by RO followed by UV, depending upon the UV dose.

Table A.8 Monitoring Requirements for CECs per SWRCB (2019a)

Constituent	Relevance	MTL (in µg/L)	Example Removal Percentages (%)
1,4-dioxane	Health	1	--
NDMA[1]	Health and Performance	0.010	>25-50, 80
NMOR[2]	Health	0.012	--
PFOS[3]	Health	0.004	--
PFOA[3]	Health	0.004	--
Sulfamethoxazole[2]	Performance	-	>90
Sucralose[2]	Performance	-	>90
Dissolved Organic Carbon[4]	Surrogate (example)	-	>90
UV Absorbance[4]	Surrogate (example)	-	>50
EC[4]	Surrogate (example)	-	>90

Notes:
(1) Health-based CECs and Bioanalytical Screening to be monitored following treatment.
(2) Performance indicator CECs to be monitored before RO and after treatment.
(3) The value listed is the Maximum Contaminants Level (MCL) expected pending finalization of the NPDWR by the end of 2023.
(4) Surrogates are provided as examples. Surrogates should be used to demonstrate the effectiveness of individual processes for removing CECs.

APPENDIX B LIST OF WELLS NEAR INJECTION AND PERCOLATION LOCATIONS

The list of existing wells near potential future injection locations is summarized below.

Drinking Water Quality Requirements

Tables B.1 through B.3 list information regarding the well location, well type, and any other associated information available for the wells located near the proposed IPR injection locations.

Table B.1 List of Wells in Santa Barbara County

Record ID	Site Address	Distance from LCSD WRP(2)	APN	Intended Use(3)	Well Depth (ft.)	Status
WP0005422	Blazing Saddles Drive	24.8 miles	131-200-013	Domestic Single Parcel	--	Approved for Construction
WP0005352	1485 North Blosser Road	6.8 miles	117-020-064	Domestic Single Parcel	--	Pending
WP0005269	2222 Richview Road	5.4 miles	129-151-072	Domestic Single Parcel	--	Approved for Construction
WP0005056	7476 Graciosa Road	5.5 miles	101-020-080	Domestic Single Parcel	360	Approved for Construction
WP0004995	2580 Bridle Trail Lane	7.5 miles	128-098-011	Domestic Single Parcel	500	Completed
WP0004908	5200 Dominion Road	6.6 miles	129-170-100	Irrigation and Domestic	600	Completed
WP0004895	555 Tepusquet Road	27.6 miles	131-200-027	Irrigation and Domestic	--	Abandoned/Destroyed
WP0004781	Cat Canyon Road	13.6 miles	101-070-069	Irrigation and Domestic	--	Approved for Construction
WP0004702	1685 West Main Street	7.2 miles	117-020-047	Domestic Single Parcel	420	Completed
WP0004607	1750 East Betteravia Road	5.5 miles	128-097-001	Irrigation and Domestic	642	Completed
WP0004586	1333 South Blosser Road	5.1 miles	117-240-26	Irrigation and Domestic	--	Withdrawn
WP0004232	West Betteravia Road(4)	4.5 miles	128-093-012	Irrigation and Domestic	670	Completed
WP0003751	3710 Tepusquet Road	18.1 miles	131-220-007	Irrigation and Domestic	260	Completed
WP0003750	8251 Foxen Canyon Road	20.9 miles	133-070-032	Irrigation and Domestic	335	Completed
WP0003747	3775 Foxen Canyon Road	9.7 miles	129-090-019	Irrigation and Domestic	490	Completed
WP0003512	7855 Old Careaga Ranch Road	11.8 miles	101-080-098	Irrigation and Domestic	275	Completed
WP0003507	Pine Canyon Road(4)	29.7 miles	131-070-031	Irrigation and Domestic	80	Constructed, pending WCR
WP0003445	Pine Canyon Road(4)	29.7 miles	131-070-009	Irrigation and Domestic	60	Constructed, pending WCR
WP0002912	500 Pine Canyon	28.1 miles	131-070-046	Irrigation and Domestic	100	Completed
WP0002910	7000 Long Canyon Road	14.6 miles	101-070-075	Irrigation and Domestic	530	Completed
WP0002882	Pine Canyon Road(4)	29.7 miles	131-070-035	Irrigation and Domestic	100	Approved for Construction
WP0002801	Tepsuquet Road		131-100-017	Irrigation and Domestic	300	Completed
WP0002699	6601 Foxen Canyon Road	14.7 miles	101-050-052	Irrigation and Domestic	320	Completed

Notes:
(1) Only listed wells that were recorded under the City Name of "Santa Maria," in the List of Wells in Santa Barbara County document. Note many of these wells are outside of the Santa Maria City limits. .
(2) Listed distances were based on the shortest distance in Google Maps.
(3) Only listed wells that were considered "Domestic Single Parcel," "Domestic Public," and "Irrigation and Domestic."
(4) Location is approximate due to minimal information.

Table B.2 SWR Well Completion Report (WRC) Map Application (ArcGIS)

WCR Number	Legacy Log Number	Well Location	Distance from LCSD WRP[(1)]	Intended Use[(2)]	Total Completed Depth (ft.)	Bottom of Perforated Interval (ft.)
WCR1966-002133	101,372	Dominion Rd[(3)]	6.6 miles	Water Supply Domestic Recondition	1,020	1,210
WCR2000-009808	538,842	Oructt-Garey Rd[(3)]	8.1 miles	Water Supply Domestic	1,090	1,070
WCR1986-011546	153,028	Clark Ave[(4)]	8.1 miles	Water Supply Public	1,010	990
WCR1995-011073	490,945	Santa Maria Public Airport	2.6 miles	Water Supply Public	930	910
WCR2021-015716	--	5200 Dominion Road	6.6 miles	Water Supply Domestic	800	800
WCR2006-010185	1,098,086	5828 Telephone Road	5.1 miles	Water Supply Domestic	800	800
WCR2002-013345	802,721	Highway 1[(3)]	8.8 miles	Water Supply Domestic	780	770
WCR1960-001701	39,343	Clark Ave[(4)]	8.1 miles	Water Supply Public	788	758
WCR2017-001013	--	5965 Long Canyon Road	13.6 miles	Water Supply Domestic	720	720
WCR2011-008422	1,083,182	2680 Morning Hill Road	8.8 miles	Water Supply Domestic	700	700
WCR1776-008567	39,378	Fairway Road	3.3 miles	Water Supply Public	963	684
WCR1992-017195	491,331	S McClelland	3.8 miles	Water Supply Public	1,014	623
WCR2009-009280	1,082,558	5911 Olivera Canyon	14.3 miles	Water Supply Domestic	600	600
WCR2008-010186	1,098,063	3810 Dominion Road	8.2 miles	Water Supply Domestic	580	580
WCR2020-002041	e0365058	2910 Black Road	5.8 miles	Water Supply Domestic	555	545
WCR2016-004584	--	5965 Long Canyon Road	13.6 miles	Water Supply Domestic	500	500
WCR1978-007971	22,111	--[(3)]	0.5 miles	Water Supply Domestic	510	494
WCR1981-007980	139,063	3555 Dominion Rd	8.6 miles	Water Supply Domestic	478	478
WCR2021-010442	--	3900 St Andrew Street[(3)]	24.2 miles	Water Supply Domestic	440	440
WCR2017-000292	1,082,653	Tepusquet Road & Santa Maria Mesa Road	14.5 miles	Water Supply Domestic	440	440
WCR1987-013728	182,638	Sunrise Drive[(4)]	2.9 miles	Water Supply Public	463	440
WCR1991-019962	351,558	Betteravia Road[(4)]	3.5 miles	Water Supply Domestic	420	415
WCR1979-007899	51,604	Olivera Canyon Road[(4)]	13.6 miles	Water Supply Domestic	405	405
WCR2020-009194	--	SE of Black Rd and Cabrillo Hwy	4.4 miles	Water Supply Public	400	400

WCR Number	Legacy Log Number	Well Location	Distance from LCSD WRP[1]	Intended Use[2]	Total Completed Depth (ft.)	Bottom of Perforated Interval (ft.)
WCR2010-009442	1,090,206	3551 Dominion Road	8.4 miles	Water Supply Domestic	400	400
WCR2004-011800	907,205	389 Foster Road	0.8 miles	Water Supply Public	400	400
WCR1956-001555	25,520	Orcutt Road[4]	0.6 miles	Water Supply Domestic	390	390
WCR2015-003363	--	5950 Foxen Canyon Road	13.6 miles	Water Supply Domestic	390	390
WCR2005-012555	905,324	2780 Telephone Road	7.4 miles	Water Supply Domestic	390	390
WCR1979-007905	51,671	3743 W Main Street	11.1 miles	Water Supply Domestic	390	380
WCR1980-009272	139,038	601 Black Road	7.6 miles	Water Supply Domestic	350	350
WCR2001-015414	763,312	Battles Rd, College Drive	4.4 miles	Water Supply Domestic	350	340
WCR1984-008146	139,230	Graciosa Road[4]	6.1 miles	Water Supply Domestic	344	335
WCR1951-002103	6,383	Boone, McClelland Street	5.0 miles	Water Supply Public	500	322
WCR2005-016162	905,294	3705 Foxen Canyon Road	9.8 miles	Water Supply Domestic	305	305
WCR1957-001762	30,602	Telephone Road[4]	6.7 miles	Water Supply Domestic	294	293
WCR1958-001237	38,346	3960 Orcutt Road	0.8 miles	Water Supply Domestic	280	280
WCR1958-001350	38,228	Highway 101[3]	5.2 miles	Water Supply Domestic	266	266
WCR1971-002513	38,105	Betteravia Rd, Telephone Rd, Prell Rd[3]	6.3 miles	Water Supply Domestic	260	255
WCR1997-009829	448,637	3425 Tepusquet Road	18.9 miles	Water Supply Domestic	250	250
WCR2004-012027	748,800	5414 Foxen Canyon	26.8 miles	Water Supply Domestic	237	233
WCR1957-001766	43,429	Guadalupe Road[3]	10.3 miles	Water Supply Domestic	230	230
WCR1975-003421	106,357	1386 Solomon Road	1.7 miles	Water Supply Domestic	221	221
WCR1955-002064	--	Orcutt Hwy[3]	10.3 miles	Water Supply Domestic	--	205
WCR1957-001763	43,505	N Blosser Road[3]	7.9 miles	Water Supply Domestic	215	201
WCR1957-001768	43,989	Blosser Road[3]	8.0 miles	Water Supply Domestic	200	197
WCR1956-001671	39,480	1945 N Broadway	7.0 miles	Water Supply Domestic	202	195
WCR1955-002135	25,948	Guadalupe Road[3]	5.8 miles	Water Supply Domestic	190	189
WCR1956-001698	25,980	615 S Blosser Road	5.4 miles	Water Supply Domestic	176	176
WCR1955-002138	25,852	1730 S Blosser Road	4.4 miles	Water Supply Domestic	177	176

WCR Number	Legacy Log Number	Well Location	Distance from LCSD WRP(1)	Intended Use(2)	Total Completed Depth (ft.)	Bottom of Perforated Interval (ft.)
WCR1957-001808	43,984	1454 W Main Street	6.4 miles	Water Supply Domestic	189	175
WCR1955-002108	25,947	W Main Street(3)	11.3 miles	Water Supply Domestic	156	154
WCR1969-001772	38,164	Graciosa Road(4)	6.1 miles	Water Supply Domestic	148	147
WCR2010-009841	e0116065	325 Cuyama Lane	9.8 miles	Water Supply Domestic	120	120
WCR2006-011785	1,079,321	7171 Foxen Canyon Road	17.8 miles	Water Supply Domestic	65	65
WCR1954-001913	5,378	Clark Ave	2.8 miles	Water Supply Unknown	167	--
WCR2017-001163	--	5965 Long Canyon Road	13.6 miles	Water Supply Domestic	--	--
WCR1776-005362	276,959	519 W Taylor Street	7.2 miles	Water Supply Unknown	--	--
WCR1980-008891	139,041	1858 Prell Road	7.3 miles	Water Supply Unknown	--	--
WCR1995-012212	490,945	Fairway Dr, Skyway Dr, Airport Dr(4)	3.1 miles	Water Supply Domestic	930	--
WCR2000-011453	538,872	Ray Road(3)	9.8 miles	Water Supply Domestic	410	--

Notes:
(1) Listed distances were based on the shortest distance in Google Maps.
(2) Only listed wells that were considered “Water Supply Domestic Recondition,” “Water Supply Domestic,” “Water Supply Public,” and “Water Supply Unknown.”
(3) Distance based on northing and easting listed in the WCR web application and shortest Google Earth Distance.
(4) Location is approximate due to minimal information.

Table B.3 Golden State Water Company (GSWC) Wells

Well Name[1]	Status
Tanglewood #1	Not Active
Tanglewood #3	Active
Sunrise Well	Not Active
Evergreen #1	Not Active - (Abandoned and filled)
Evergreen #2	Not Active - (Abandoned and filled)
Mira Flores #1	Active
Woodmere #1	Active
Woodmere #2	Active
Kenneth	Active
Mira Flores #2	Active
Mira Flores #3	Not Active
Mora Flores #4	Active
Mora Flores #5	Active
Mora Flores #6	Active
Mora Flores #7	Active
Olive Hill Well	Active
Crescent Well	Active
Oak Well	Active

Notes:
(1) Only listed wells within the areas and basins near LCSD and proposed injection locations.

APPENDIX C GROUNDWATER BASIN AND PERCOLATION ANALYSIS

Detailed below is the information used to calculate the groundwater travel velocities outlined in Chapter 4.

Hydraulic Conductivity, K

Estimates of hydraulic conductivity were obtained from a USGS study of the Santa Maria Valley groundwater basin (Hughes, 1977). Reported hydraulic conductivity for the upper alluvium aquifer ranged from 270 feet per day (ft/day) at the west end of the valley up to 540 ft/day at the east end. For the lower unconsolidated aquifers, hydraulic conductivity was reported to range up to 30 ft/day in the central part of the valley. To provide a conservative, upper bound estimate of groundwater velocity, the highest reported values for hydraulic conductivity were used to develop these estimates.

Hydraulic Gradient, Δh/Δl

Groundwater in the Santa Maria Valley groundwater basin flows to the west-northwest from the Sisquoc area toward the Ocean as illustrated by contour maps of equal groundwater elevation for the shallow and deep aquifer zones developed for the 2021 Annual Report for the Santa Maria Valley Management Area (Figures 2.1-3a through 2.1-3d, Luhdorff & Scalmanini, 2022). These figures can be found in Appendix D. The 2021 contour maps depict a widening of groundwater level contours beneath the central-south and western portions of the SMVMA indicating a reduced (flatter) groundwater gradient in this area. This is likely due to the area being dependent on streamflow recharge from the Sisquoc and Santa Maria rivers in combination with groundwater pumping near the Santa Maria Airport and Town of Orcutt where deep water wells are used for municipal purposes for the City of Santa Maria, GSWC, and nearby agriculture. In addition, increased groundwater gradient is noted in the eastern portion of the basin.

Hydraulic gradients were estimated for areas of the shallow and deep groundwater zones using the data presented on the 2021 gradient contour maps. The selected hydraulic gradient was the highest calculated value for the noted well pairs or contours for both spring and fall of 2021. For the area near the Getty and Kovar Basins, a shallow zone hydraulic gradient of 0.00094 was estimated based on the observed water levels for wells 20H3, 14E4, and 24B2. The estimated hydraulic gradient for the deep zone was 0.0016 based on the groundwater contours shown for that area (Figure 2.1-3c and 2.1-3d). For the area near the WRP, a hydraulic gradient of 0.0047 was estimated in the shallow zone based on observed contours north of well 08H1 (Figure 2.1-3a and 2.1-3b). In the deep zone near the WRP, the estimated hydraulic gradient was 0.0027 based on the observed contours located near well 35J2 (Figure 2.1-3c and 2.1-3d).

The hydraulic gradient was calculated using the equation below:

$$Hydraluic\ gradient = \frac{\Delta h}{\Delta l}$$

Effective Porosity, n

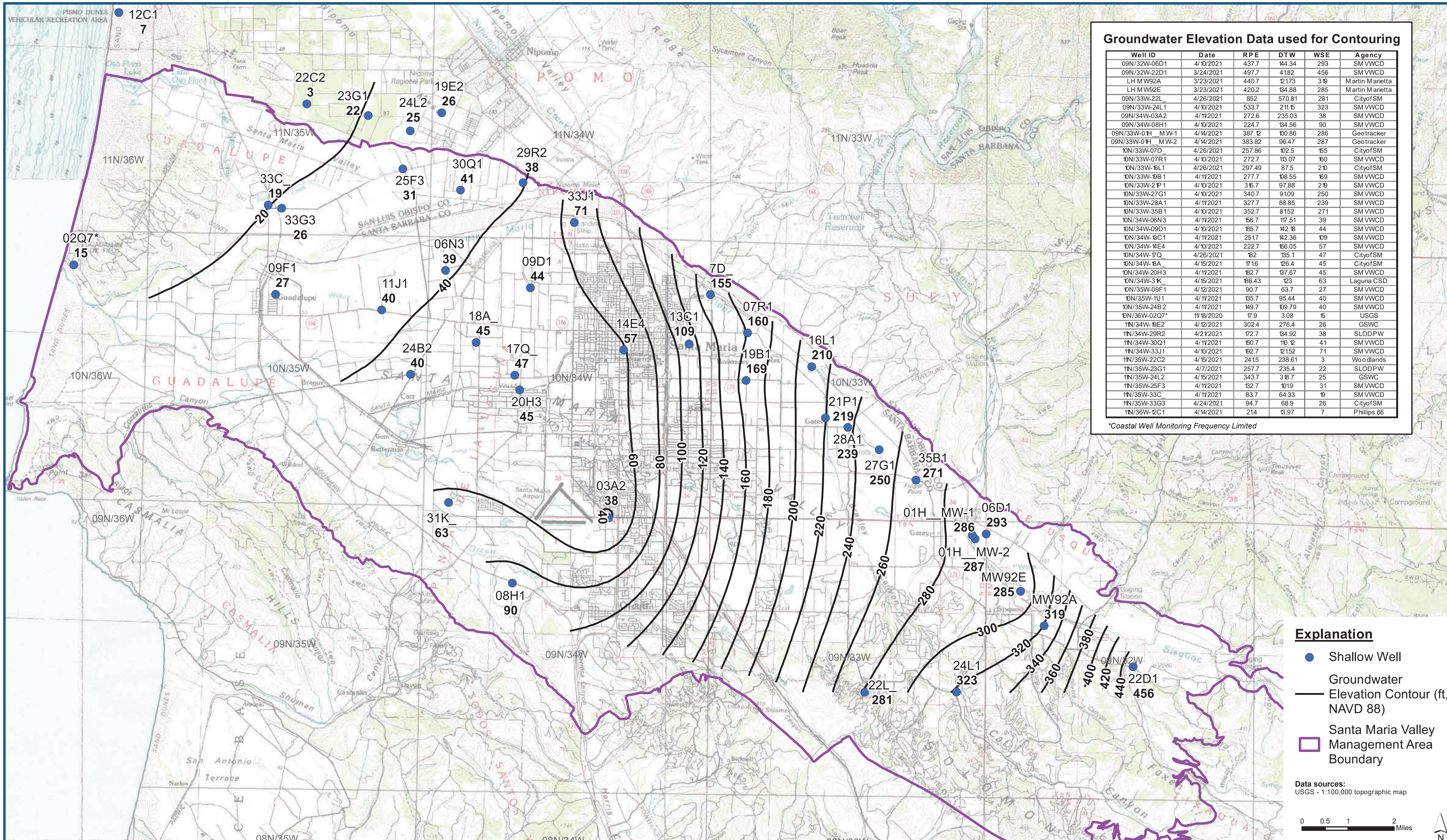
Effective porosity is generally defined as the portion of the saturated media that contributes to groundwater flow (Stephens et al., 1998). Effective porosity is less than the total porosity because, even if the medium is fully saturated, not all of the water-filled pores are interconnected or contribute to flow. Field tracer tests provide the most direct method for obtaining effective porosity; effective porosity cannot be reliably estimated from particle size, specific yield, or from measurements of soil–water retention (Stephens et al., 1998). Therefore, effective porosity is typically estimated using professional judgment.

Total porosity of sand and gravel aquifers generally ranges from 20 to 35 percent (Fetter, 1994). Effective porosity was estimated as 0.15 for use in estimating groundwater velocity.

The hydraulic conductivity, hydraulic gradient, and effective porosity were all used to calculate the groundwater velocity. The velocities for each injection location are summarized in Section 4.2.2

APPENDIX D

GROUNDWATER CONTOURS SMVA 2021 ANNUAL REPORT



Groundwater Elevation Data used for Contouring

Well ID	Date	RPE	DTW	WSE	Agency
09N/32W-06D1	4/10/2021	437.7	144.34	293	SM VWCD
09N/32W-22D1	3/24/2021	497.7	41.82	456	SM VWCD
LH MW92A	3/23/2021	440.7	121.73	319	Martin Marietta
LH MW92E	3/23/2021	420.2	134.88	285	Martin Marietta
09N/33W-22L_	4/26/2021	852	570.81	281	City of SM
09N/33W-24L1	4/10/2021	533.7	211.15	323	SM VWCD
09N/34W-03A2	4/11/2021	272.6	235.03	38	SM VWCD
09N/34W-08H1	4/10/2021	224.7	134.56	90	SM VWCD
09N/33W-01H__MW-1	4/14/2021	387.12	100.86	286	Geotracker
09N/33W-01H__MW-2	4/14/2021	383.82	96.47	287	Geotracker
10N/33W-07D_	4/26/2021	257.86	102.5	155	City of SM
10N/33W-07R1	4/10/2021	272.7	113.07	160	SM VWCD
10N/33W-16L1	4/26/2021	297.49	87.5	210	City of SM
10N/33W-19B1	4/11/2021	277.7	108.55	169	SM VWCD
10N/33W-21P1	4/10/2021	316.7	97.88	219	SM VWCD
10N/33W-27G1	4/10/2021	340.7	91.09	250	SM VWCD
10N/33W-28A1	4/11/2021	327.7	88.85	239	SM VWCD
10N/33W-35B1	4/10/2021	352.7	81.52	271	SM VWCD
10N/34W-06N3	4/11/2021	156.7	117.51	39	SM VWCD
10N/34W-09D1	4/10/2021	185.7	142.18	44	SM VWCD
10N/34W-13C1	4/11/2021	251.7	142.36	109	SM VWCD
10N/34W-14E4	4/10/2021	222.7	166.05	57	SM VWCD
10N/34W-17Q_	4/26/2021	182	135.1	47	City of SM
10N/34W-18A_	4/15/2021	171.6	126.4	45	City of SM
10N/34W-20H3	4/11/2021	182.7	137.67	45	SM VWCD
10N/34W-31K_	4/15/2021	186.43	123	63	Laguna CSD
10N/35W-09F1	4/12/2021	90.7	63.7	27	SM VWCD
10N/35W-11J1	4/11/2021	135.7	95.44	40	SM VWCD
10N/35W-24B2	4/11/2021	149.7	109.79	40	SM VWCD
10N/36W-02Q7*	11/18/2020	17.9	3.08	15	USGS
11N/34W-19E2	4/12/2021	302.4	276.4	26	GSWC
11N/34W-29R2	4/21/2021	172.7	134.92	38	SLODPW
11N/34W-30Q1	4/11/2021	150.7	110.12	41	SM VWCD
11N/34W-33J1	4/10/2021	192.7	121.52	71	SM VWCD
11N/35W-22C2	4/15/2021	241.5	238.61	3	Woodlands
11N/35W-23G1	4/7/2021	257.7	235.4	22	SLODPW
11N/35W-24L2	4/15/2021	343.7	318.7	25	GSWC
11N/35W-25F3	4/11/2021	132.7	101.9	31	SM VWCD
11N/35W-33C_	4/11/2021	83.7	64.33	19	SM VWCD
11N/35W-33G3	4/24/2021	94.7	68.9	26	City of SM
11N/36W-12C1	4/14/2021	21.4	13.97	7	Phillips 66

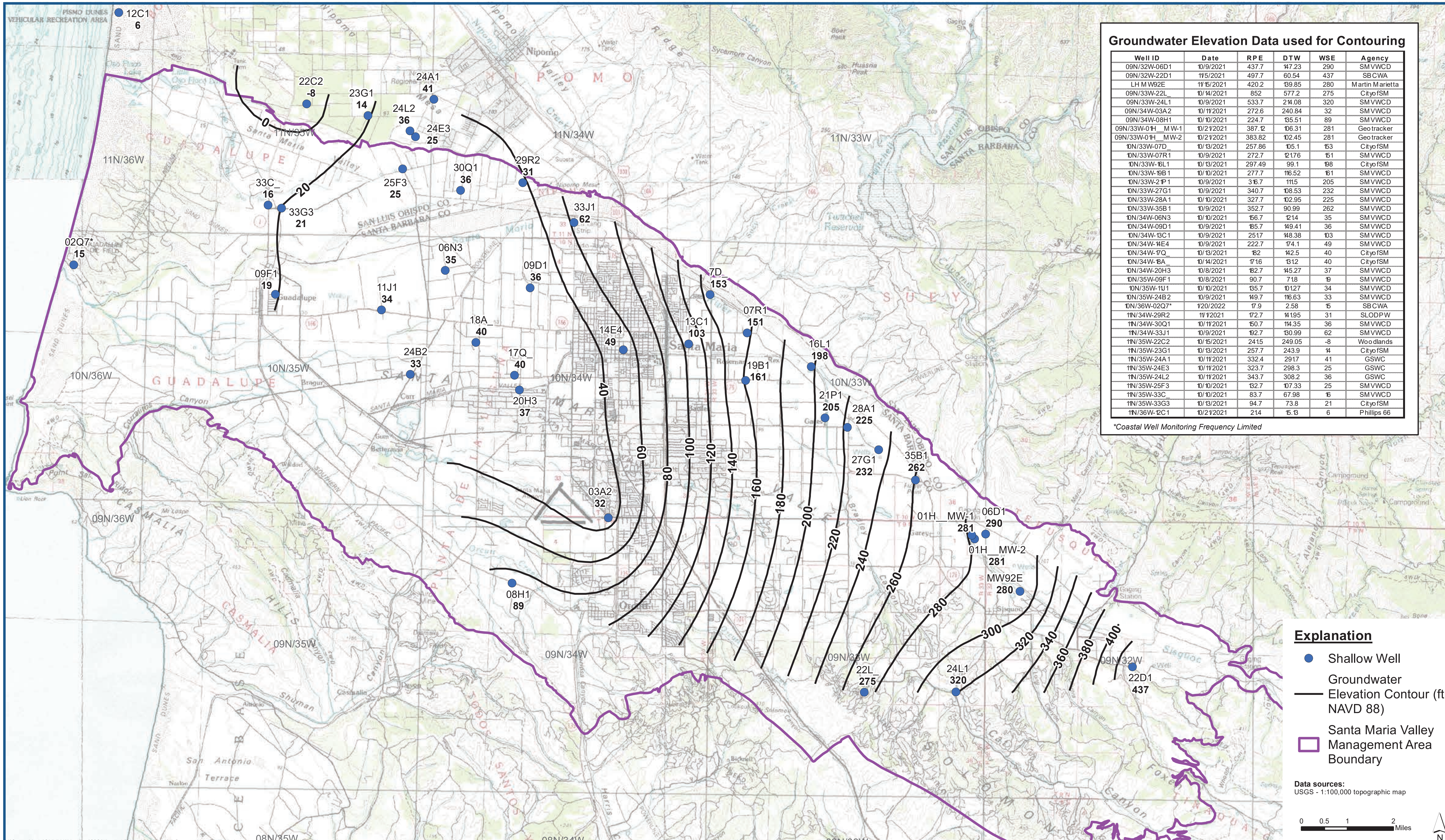
*Coastal Well Monitoring Frequency Limited

Luhdorff & Scalmanini
Consulting Engineers

Contours of Equal Groundwater Elevation, Shallow Zone, Spring (March 23 - April 26) 2021
Santa Maria Valley Management Area

21-1-026/Annual Report/Twitchell Management Authority/Santa Maria Valley, California

Figure 2.1-3a



Groundwater Elevation Data used for Contouring

Well ID	Date	RPE	DTW	WSE	Agency
09N/32W-06D1	10/9/2021	437.7	147.23	290	SMVWCD
09N/32W-22D1	11/5/2021	497.7	60.54	437	SBCWA
LH MW92E	11/15/2021	420.2	139.85	280	Martin Marietta
09N/33W-22L_	10/14/2021	852	577.2	275	City of SM
09N/33W-24L1	10/9/2021	533.7	214.08	320	SMVWCD
09N/34W-03A2	10/11/2021	272.6	240.84	32	SMVWCD
09N/34W-08H1	10/10/2021	224.7	135.51	89	SMVWCD
09N/33W-01H__MW-1	10/21/2021	387.12	106.31	281	Geotracker
09N/33W-01H__MW-2	10/21/2021	383.82	102.45	281	Geotracker
10N/33W-07D_	10/13/2021	257.86	105.1	153	City of SM
10N/33W-07R1	10/9/2021	272.7	121.76	151	SMVWCD
10N/33W-16L1	10/13/2021	297.49	99.1	198	City of SM
10N/33W-19B1	10/10/2021	277.7	116.52	161	SMVWCD
10N/33W-21P1	10/9/2021	316.7	111.5	205	SMVWCD
10N/33W-27G1	10/9/2021	340.7	108.53	232	SMVWCD
10N/33W-28A1	10/10/2021	327.7	102.95	225	SMVWCD
10N/33W-35B1	10/9/2021	352.7	90.99	262	SMVWCD
10N/34W-06N3	10/10/2021	156.7	121.4	35	SMVWCD
10N/34W-09D1	10/9/2021	185.7	149.41	36	SMVWCD
10N/34W-13C1	10/9/2021	251.7	148.38	103	SMVWCD
10N/34W-14E4	10/9/2021	222.7	174.1	49	SMVWCD
10N/34W-17Q_	10/13/2021	182	142.5	40	City of SM
10N/34W-18A_	10/14/2021	171.6	131.2	40	City of SM
10N/34W-20H3	10/8/2021	182.7	145.27	37	SMVWCD
10N/35W-09F1	10/8/2021	90.7	71.8	19	SMVWCD
10N/35W-11J1	10/10/2021	135.7	101.27	34	SMVWCD
10N/35W-24B2	10/9/2021	149.7	116.63	33	SMVWCD
10N/36W-02Q7*	1/20/2022	17.9	2.58	15	SBCWA
11N/34W-29R2	11/1/2021	172.7	141.95	31	SLODPW
11N/34W-30Q1	10/11/2021	150.7	114.35	36	SMVWCD
11N/34W-33J1	10/9/2021	192.7	130.99	62	SMVWCD
11N/35W-22C2	10/15/2021	241.5	249.05	-8	Woodlands
11N/35W-23G1	10/13/2021	257.7	243.9	14	City of SM
11N/35W-24A1	10/11/2021	332.4	291.7	41	GSWC
11N/35W-24E3	10/11/2021	323.7	298.3	25	GSWC
11N/35W-24L2	10/11/2021	343.7	308.2	36	GSWC
11N/35W-25F3	10/10/2021	132.7	107.33	25	SMVWCD
11N/35W-33C_	10/10/2021	83.7	67.98	16	SMVWCD
11N/35W-33G3	10/13/2021	94.7	73.8	21	City of SM
11N/36W-12C1	10/21/2021	21.4	15.13	6	Phillips 66

*Coastal Well Monitoring Frequency Limited

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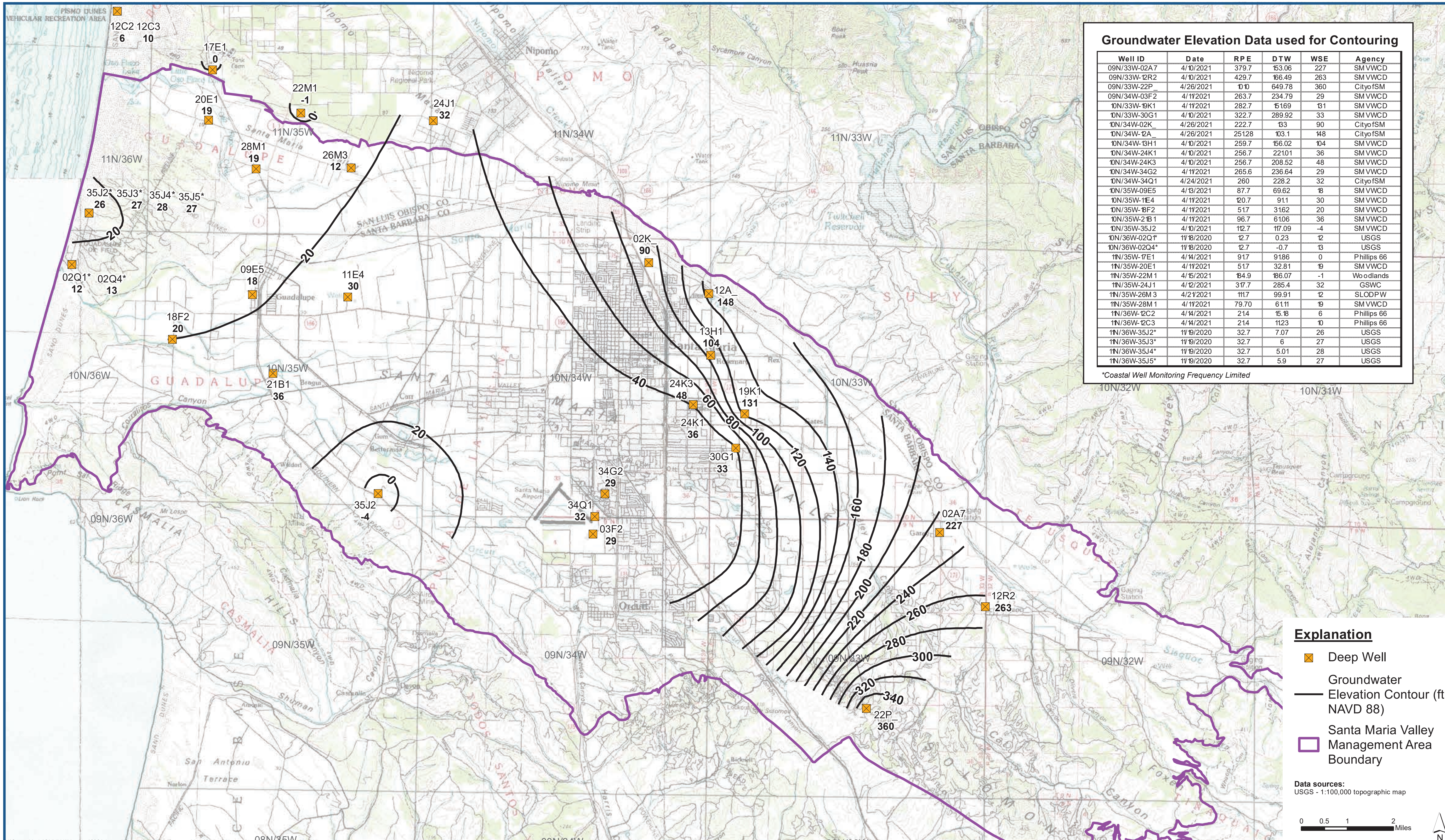
Consulting Engineers

Contours of Equal Groundwater Elevation, Shallow Zone, Fall (October 8 - November 15) 2021
Santa Maria Valley Management Area

21-1-026/Annual Report/Twitchell Management Authority/Santa Maria Valley, California

Figure 2.1-3b



Groundwater Elevation Data used for Contouring

Well ID	Date	RPE	DTW	WSE	Agency
09N/33W-02A7	4/10/2021	379.7	153.06	227	SMVWCD
09N/33W-12R2	4/10/2021	429.7	166.49	263	SMVWCD
09N/33W-22P_	4/26/2021	1010	649.78	360	CityofSM
09N/34W-03F2	4/11/2021	263.7	234.79	29	SMVWCD
10N/33W-19K1	4/11/2021	282.7	151.69	131	SMVWCD
10N/33W-30G1	4/10/2021	322.7	289.92	33	SMVWCD
10N/34W-02K_	4/26/2021	222.7	133	90	CityofSM
10N/34W-12A_	4/26/2021	251.28	103.1	148	CityofSM
10N/34W-13H1	4/10/2021	259.7	156.02	104	SMVWCD
10N/34W-24K1	4/10/2021	256.7	221.01	36	SMVWCD
10N/34W-24K3	4/10/2021	256.7	208.52	48	SMVWCD
10N/34W-34G2	4/11/2021	265.6	236.64	29	SMVWCD
10N/34W-34Q1	4/24/2021	260	228.2	32	CityofSM
10N/35W-09E5	4/13/2021	87.7	69.62	18	SMVWCD
10N/35W-11E4	4/11/2021	120.7	91.1	30	SMVWCD
10N/35W-18F2	4/11/2021	51.7	31.62	20	SMVWCD
10N/35W-21B1	4/11/2021	96.7	61.06	36	SMVWCD
10N/35W-35J2	4/10/2021	112.7	117.09	-4	SMVWCD
10N/36W-02Q1*	11/18/2020	12.7	0.23	12	USGS
10N/36W-02Q4*	11/18/2020	12.7	-0.7	13	USGS
11N/35W-17E1	4/14/2021	91.7	91.86	0	Phillips 66
11N/35W-20E1	4/11/2021	51.7	32.81	19	SMVWCD
11N/35W-22M1	4/15/2021	184.9	186.07	-1	Woodlands
11N/35W-24J1	4/12/2021	317.7	285.4	32	GSWC
11N/35W-26M3	4/21/2021	111.7	99.91	12	SLODPW
11N/35W-28M1	4/11/2021	79.70	61.11	19	SMVWCD
11N/36W-12C2	4/14/2021	21.4	15.18	6	Phillips 66
11N/36W-12C3	4/14/2021	21.4	11.23	10	Phillips 66
11N/36W-35J2*	11/19/2020	32.7	7.07	26	USGS
11N/36W-35J3*	11/19/2020	32.7	6	27	USGS
11N/36W-35J4*	11/19/2020	32.7	5.01	28	USGS
11N/36W-35J5*	11/19/2020	32.7	5.9	27	USGS

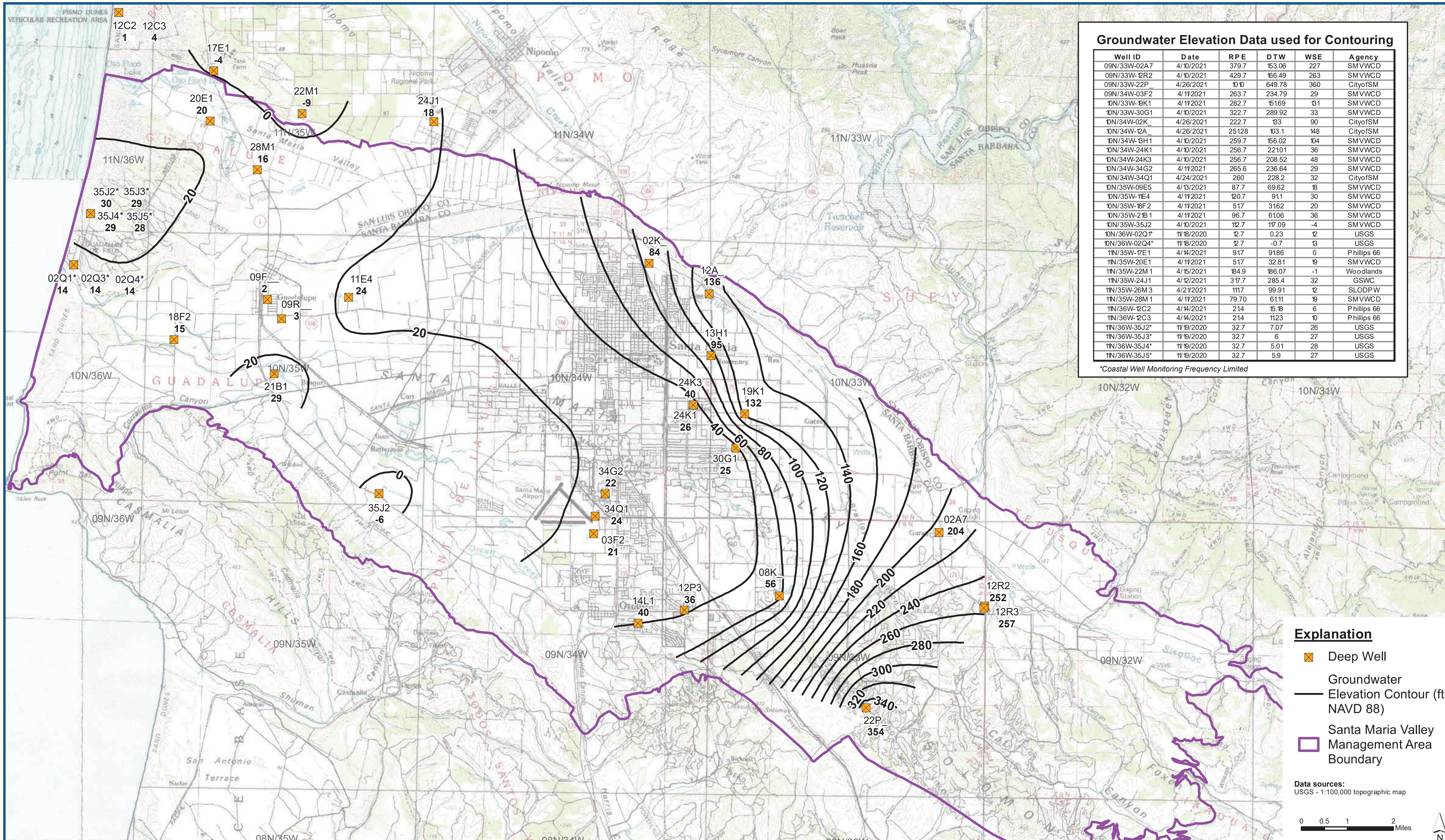
*Coastal Well Monitoring Frequency Limited

Luhdorff & Scalmanini Consulting Engineers

Contours of Equal Groundwater Elevation, Deep Zone, Spring (April 10 - 26) 2021
Santa Maria Valley Management Area

21-1-026/Annual Report/Twitchell Management Authority/Santa Maria Valley, California

Figure 2.1-3c



Groundwater Elevation Data used for Contouring

Well ID	Date	RPE	DTW	WSE	Agency
09N/33W-02A7	4/10/2021	379.7	153.06	227	SMVWCD
09N/33W-12R2	4/10/2021	429.7	166.49	263	SMVWCD
09N/33W-22P_	4/26/2021	1010	649.78	360	CityofSM
09N/34W-03F2	4/11/2021	263.7	234.79	29	SMVWCD
10N/33W-19K1	4/11/2021	282.7	151.69	131	SMVWCD
10N/33W-30G1	4/10/2021	322.7	289.92	33	SMVWCD
10N/34W-02K_	4/26/2021	222.7	133	90	CityofSM
10N/34W-12A_	4/26/2021	251.28	103.1	148	CityofSM
10N/34W-13H1	4/10/2021	259.7	156.02	104	SMVWCD
10N/34W-24K1	4/10/2021	256.7	221.01	36	SMVWCD
10N/34W-24K3	4/10/2021	256.7	208.52	48	SMVWCD
10N/34W-34G2	4/11/2021	265.6	236.64	29	SMVWCD
10N/34W-34Q1	4/24/2021	260	228.2	32	CityofSM
10N/35W-09E5	4/13/2021	87.7	69.62	18	SMVWCD
10N/35W-11E4	4/11/2021	120.7	91.1	30	SMVWCD
10N/35W-18F2	4/11/2021	51.7	31.62	20	SMVWCD
10N/35W-21B1	4/11/2021	96.7	61.06	36	SMVWCD
10N/35W-35J2	4/10/2021	112.7	117.09	-4	SMVWCD
10N/36W-02Q1*	11/18/2020	12.7	0.23	12	USGS
10N/36W-02Q4*	11/18/2020	12.7	-0.7	13	USGS
11N/35W-17E1	4/14/2021	91.7	91.86	0	Phillips 66
11N/35W-20E1	4/11/2021	51.7	32.81	19	SMVWCD
11N/35W-22M1	4/15/2021	184.9	186.07	-1	Woodlands
11N/35W-24J1	4/12/2021	317.7	285.4	32	GSWC
11N/35W-26M3	4/21/2021	111.7	99.91	12	SLODPW
11N/35W-28M1	4/11/2021	79.70	61.11	19	SMVWCD
11N/36W-12C2	4/14/2021	21.4	15.18	6	Phillips 66
11N/36W-12C3	4/14/2021	21.4	11.23	10	Phillips 66
11N/36W-35J2*	11/19/2020	32.7	7.07	26	USGS
11N/36W-35J3*	11/19/2020	32.7	6	27	USGS
11N/36W-35J4*	11/19/2020	32.7	5.01	28	USGS
11N/36W-35J5*	11/19/2020	32.7	5.9	27	USGS

*Coastal Well Monitoring Frequency Limited

Luhdorff & Scalmanini
Consulting Engineers

Contours of Equal Groundwater Elevation, Deep Zone, Fall (October 6 - 22) 2021
Santa Maria Valley Management Area

Figure 2.1-3d

21-1-026/Annual Report/Twitchell Management Authority/Santa Maria Valley, California

APPENDIX E GETTY BASIN PERCOLATION ANALYSIS

A more in-depth analysis of the Getty Basin (summarized in Chapter 4) can be found here.

The percolation rates of the basin should meet or exceed the PRW flow rate leaving the LCSD facility (production water) which is expected to be either 0.43 mgd or 1.45 mgd with potential for 3.15 mgd in the future.

Both wet and dry years were analyzed to determine if the basin has sufficient percolation capacities during each scenario. Dry year percolation is the most conservative, as that data has lower water elevations in the basin which result in lower driving elevation head and thus lower percolation rates. Dry and wet weather events each occur within the calendar year and occur within both the dry and wet years.

The dry year evaluation included data from 2014-2015, whereas the wet year evaluation included data from 2020-2021 and 2021-2022. The reservoir volume change over time is equivalent to the percolation rate in the basin. This was calculated in ac-ft/day and converted to mgd to easily compare with the required volume of PRW expected at the WRP. Once the ideal reservoir volume quantities were identified (meeting expected purified water flowrate capacity), the corresponding reservoir levels were chosen. This is the value at which the Getty Basin should be filled with water to meet the desired percolation rate and influent flow rate. In other words, this is the line of equilibrium in which the rate of water into the basin is equal to the rate of water infiltrating the basin.

In 2014-2015, there were 340 days of the year where percolation was possible (dry weather period) and 25 days where a wet weather event occurred Figure E.1. During wet weather events the Getty Basin cannot be used.

Figure E.1 Getty Basin Reservoir Level – Dry Year (2014-2015)

In 2020-2021, there were 268 days of the year where the Getty Basin can be used and 97 days where a wet weather event occurred, making the basin unusable for PRW (Figure E.2).

Figure E.2 Getty Basin Reservoir Level – Wet Year (2020-2021)

In 2021-2022, there were 298 days of the year where the Getty Basin was in a dry weather event and could be used for PRW, and 67 days where the basin would not be usable for PRW (Figure E.3).

Consequently, in both the dry and wet years there are periods throughout the year where the Getty Basin cannot be leveraged for PRW use.

Figure E.3 Getty Basin Reservoir Level – Wet Year (2021-2022)

Basin percolation analysis was based on rates achieved during the wet weather events of the year. This is based on the notion that during wet events the basin has the largest volume of water stored and consequently the highest percolation rates. These high percolation rates and corresponding water levels will inform the water level at which the Getty Basin should ideally be set.

Figure E.4 shows the reservoir volume and calculated percolation rates (in blue) for 2014-2015. Percolation occurs as the basin drains, corresponding to a decline in the volume (acre-foot [ac-ft]) within the basin. Therefore, the decline in basin volume from 108 ac-ft to 91 ac-ft over two days corresponds to a percolation rate of approximately 2.77 mgd. This meets the 0.43 mgd and 1.45 mgd production flow capacities, but does not meet the 3.15 mgd production flow capacity.

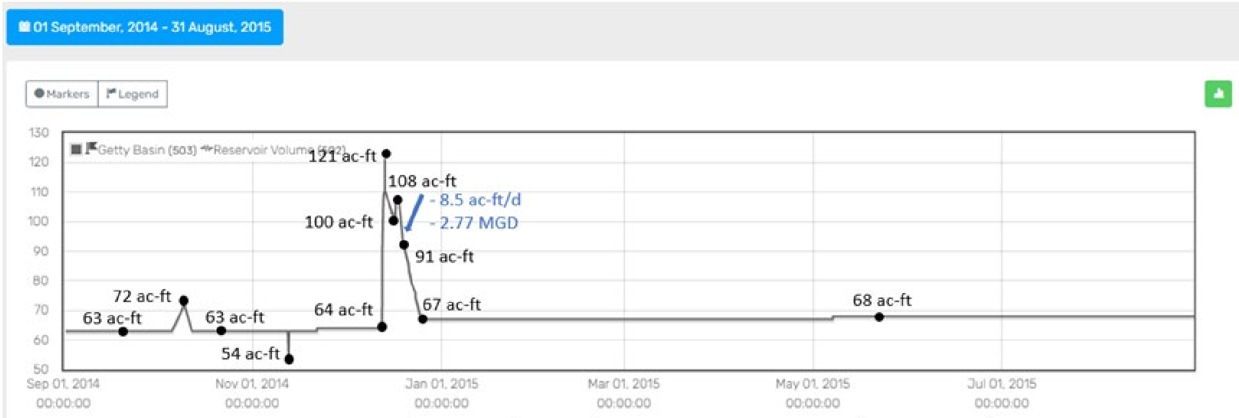


Figure E.4 Getty Basin Reservoir Volume and Percolation Rates – Dry Year (2014-2015)

Figure E.5 and Figure E.6 show the reservoir volumes and calculated percolation rates (in blue) for 2020-2021 and 2021-2022. In the 2020-2021 season all production flow rates (0.43 mgd, 1.45 and 3.15 mgd) are met and exceeded by calculated basin percolation rates of 2.53 and 4.24 mgd (Figure E.5), and correspond to a reservoir level of 175.63 ft -182.09 ft (Figure E.2). In 2021-2022 the largest percolation rate was calculated at 2.33 mgd (Figure D.6) which meets the 0.43 mgd and 1.45 mgd production flow rates and is short of the projected future 3.15 mgd production flow rate. The reservoir level corresponding to the 2.33 mgd flow rate is between 179.09 ft – 183.86 ft (Figure E.3).

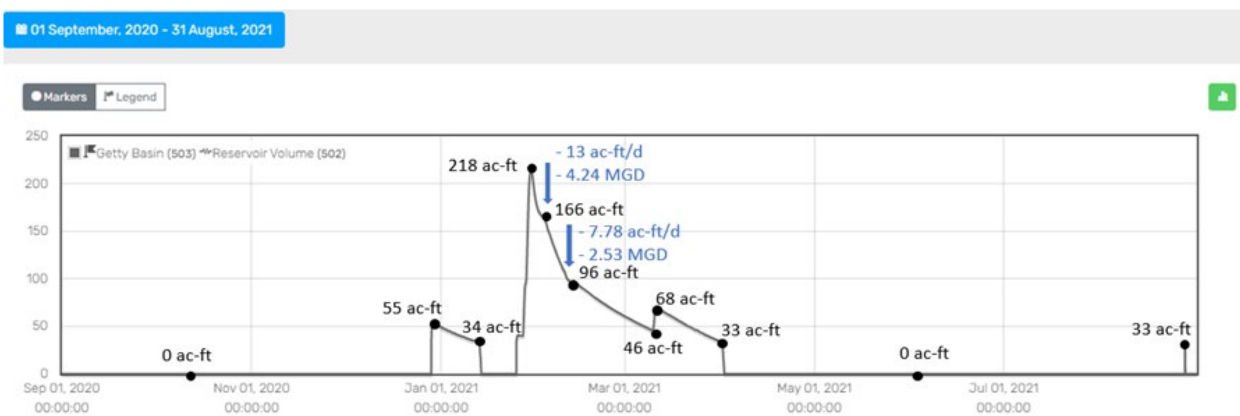


Figure E.5 Getty Basin Reservoir Volume and Percolation Rates – Wet Year (2020-2021)

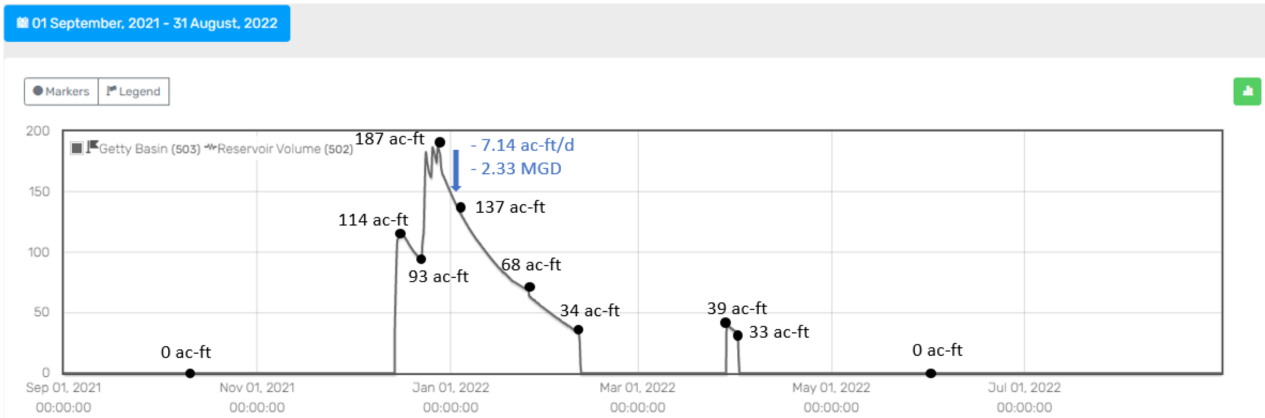


Figure E.6 Getty Basin Reservoir Volume and Percolation Rates – Wet Year (2021-2022)

APPENDIX F COST OF ALTERNATIVES

PROJECT:	Laguna County Sanitation District
JOB NO.:	201592
ALTERNATIVE:	0.5 MGD flow with injection northwest of LCSD
COST:	Project 1 - Treatment
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification	Quantity	Units	Unit Cost	Estimated Cost
Project 1 - 0.5 MGD flow Treatment Costs				
AWPF Building				
Treatment Building	5,302	SF	$ 450	$ 2,385,900
Treatment Process Equipment Cost: **RO and UV modifications for IPR**				
Instrumentation for IPR (pH, Total Chlorine, Free Chlorine, RO conductivity, Combined Feed and Permeate TOC, UVT, and ORP)	1	LS	$ 108,540	$ 109,000
Sodium Hypochlorite Tank and Dosing Pumps	1	LS	$ 98,000	$ 98,000
New RO membranes (4th skid, Toray TMG20D-400)	50	$/module	$ 680	$ 34,000
New RO feed pump	1	LS	$ 25,000	$ 25,000
New Chlorine Contact Tank (HDPE Tank)	1	LS	$ 35,200	$ 35,000
New Calcite Contactor	1	LS	$ 275,000	$ 275,000
Ammonium Sulfate Tank and Dosing Pumps	1	LS	$ 76,000	$ 76,000
			Subtotal	**$ 652,000**
Treatment Process Equipment Cost: **New UV System for NPR**				
Instrumentation for NPR (Total Chlorine and UVT)	1	LS	$ 12,018	$ 12,000
UV Reactors (LBX1500e)	2	$/reactor	$ 175,000	$ 350,000
UV Lamp (800W)[1]	120	$/lamp	$ 400	$ 48,000
UV Feed Pumps	2	LS	$ 25,000	$ 50,000
			Subtotal	**$ 460,000**
Treatment Facility Items[2]				
Process Equipment Installation	25%			$ 278,000
Piping and Valves	20%			$ 222,400
			Subtotal	**$ 500,400**
Engineering Services				
Civil and Sitework	10%			$ 615,200
Electrical & I/C[4]	25%			$ 1,538,000
			Subtotal	**$ 2,153,200**
Total Direct Cost				***$ 6,152,000***
Estimating Contingency	30%			$ 1,846,000
Sales Tax	7.75%			$ 238,000
Contractor Overhead & Profit	15%			$ 1,200,000
General Conditions	20%			$ 1,600,000
TOTAL TREATMENT COST				***$ 11,036,000***
Engineering, Legal, and Administrative	12%			$ 1,324,000
Owners Reserve for Change Orders	5%			$ 552,000
TOTAL PROJECT COST				**$ 12,912,000**

Notes

1. Option to turn down 800W lamp. Having the 800W lamp installed will be useful if phased to Full IPR Project.
2. Treatment facility items are scaled as a factor of direct Treatment Processes and Chemical Dosing Equipment and Tanks, excluding building and other Engineering Services

PROJECT:	Laguna County Sanitation District Potable Water Reuse Implementation Plan
JOB NO.:	201592
ALTERNATIVE:	0.5 MGD flow with injection northwest of LCSD
COST:	Project 1 - New Infrastructure
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification	Quantity	Units	Unit Cost		Estimated Cost
Project 1 - 0.5 MGD flow with injection northwest of LCSD New Infrastructure Costs					
Onsite Recycled Water Pump Station & Tank					
Welded Steel Tank[1]	1	LS	$ 375,000	$	375,000
Pump Station[2]	1	LS	$ 120,000	$	120,000
Tank & Pump Station Allowances[3]	1	LS	$ 123,750	$	124,000
			Subtotal	**$**	**619,000**
Purified Recycled Water Injection Sites - General					
SWPPP BMPs[4]	1	LS	$ 10,000	$	10,000
Groundwater Testing & Handling[5]	1	Ea	$ 5,000	$	5,000
			Subtotal	**$**	**15,000**
Purified Recycled Water Injection Sites - Site Civil					
Clearing & Grubbing[6]	5,625	SF	$ 0.5	$	2,800
Rough Grading[7]	104	CY	$ 25	$	2,600
Gravel Access Roadway[8]	69,930	SF	$ 3	$	209,800
Gravel Site Cover[9]	2,500	SF	$ 3	$	7,500
Perimeter Fencing and Gates[10]	200	LF	$ 75	$	15,000
Electrical Building	600	SF	$ 600	$	360,000
Yard Piping	1	EA	$ 120,000	$	120,000
Backwash Pumping Pond	25	CY	$ 15	$	400
			Subtotal	**$**	**718,100**
Purified Recycled Water Injection Site - Well Site					
300 foot deep wells[11]	300	VLF	$ 3,000	$	900,000
5 hp backwash pumps	1	Ea	$ 8,000	$	8,000
Aboveground Infrastructure	1	Ea	$ 40,000	$	40,000
Associated Monitoring Wells[12]	600	VLF	$ 100	$	60,000
			Subtotal	**$**	**1,008,000**
E&IC					
Supporting E&IC[13]	1	LS	$ 258,915	**$**	**259,000**
Entire Pipeline Conveyance: Pipeline from LCSD to injection wells Northwest of LCSD					
Pipeline[14]	6,864	LF	$ 180	**$**	**1,240,000**
Total Direct Cost				***$***	***3,859,100***

PROJECT:	Laguna County Sanitation District Potable Water Reuse Implementation Plan
JOB NO.:	201592
ALTERNATIVE:	0.5 MGD flow with injection northwest of LCSD
COST:	Project 1 - New Infrastructure
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification	Quantity	Units	Unit Cost		Estimated Cost
Estimating Contingency	30%			$	1,158,000
Sales Tax (applied to 50% of direct costs)	7.75%			$	150,000
Contractor Overhead & Profit	15%			$	753,000
General Conditions	20%			$	1,003,000
TOTAL CONSTRUCTION COST				***$***	***6,923,100***
Engineering, Legal, and Administrative	12%			$	831,000
Owners Reserve for Change Orders	5%			$	346,000
TOTAL PROJECT COST				**$**	**8,100,000**

Notes

1. Assumes a 250,000 gallon welded steel tank that can be used for an increased IPR flow.
2. Assumes two 20 hp horizontal split case pumps (1d +1s).
3. Assumes 25% of pump & tank direct costs for process equipment, gauges, concrete pipe supports, valving, etc.
4. SWPPP BMPs assume costs for silt fences, drag out drive ways, and water trucks.
5. Groundwater Testing & Handling assumes costs for constituent testing, sampling, etc. as needed during discharge and construction. Cost is per injection well (assumed 1).
6. Assumes a site size of 75 ft by 75 ft per each injection well.
7. Assumes 0.5 ft of grading across each 75 ft by 75 ft site.
8. Assumes use of the access road that leads from the Agriculture Pond directly east of the site (18 ft wide).
9. Assumes 50 ft by 50 ft area per injection well.
10. Assumes entire 50 foot perimeter with one access gate.
11. Assumes 12" casing.
12. Assumes 2 monitoring wells per 1 injection well.
13. Assumes 15% of Site Civil and Well Site costs.
14. Pipeline was sized to allow for an increase in purified water produced. Therefore, pipeline sizing and cost assumes an 85% recovery of 1.7 mgd. Pipe diameter of 12 in.

PROJECT:	Laguna County Sanitation District Potable Water Reuse Implementation Plan
JOB NO.:	201592
ALTERNATIVE:	0.5 MGD flow with injection northwest of LCSD
COST:	Project 1 - O&M
DESCRIPTION:	Level 5 Cost Estimate

O&M COST ESTIMATE

Classification		Quantity	Units		Unit Cost		Estimated Cost
	Project 1 - 0.5 MGD flow O&M Costs						
Staffing Cost							
	WWTO / AWTO Grade 3	2	$/yr.		$106,630		$213,260
	WWTO / AWTO Grade 5	1	$/yr.		$116,215		$116,215
					Subtotal	**$**	**329,475**
Process Energy Costs[1]							
	UV Feed Pumps Energy Consumption (NPR)	5	kW	$	0.35	$	15,700
	New NPR UV Reactors	24	kW	$	0.35	$	73,600
	RO Energy Consumption	1.36	kWh/kgal	$	0.35	$	75,100
	UV Feed Pumps Energy Consumption (IPR)	2	kW	$	0.35	$	5,600
	Existing UV Reactor for AOP	52	kW	$	0.35	$	159,500
					Subtotal	**$**	**329,500**
Process Chemical Usage[2]							
	Ammonium Sulfate (40 wt.%)	9	lbs/d	$	0.45	$	1,500
	Sodium Hydroxide (50 wt.%)	294	lbs/d	$	0.29	$	31,100
	Sodium Hypochlorite (12.5 wt.%)	37	lbs/d	$	2.12	$	28,400
	Sulfuric Acid (93 wt.%)	367	lbs/d	$	0.29	$	38,900
	Antiscalant	11	lbs/d	$	3.24	$	13,300
	Citric Acid 50%	7	lbs/d	$	5.80	$	15,500
	Calcite	248	lbs/d	$	0.31	$	28,100
					Subtotal	**$**	**156,800**
Process Consumables Costs							
	UV Lamp Replacement[3] (NPR)	30	lamps/yr.	$	400.00	$	12,000
	RO Membrane Replacement[4]	1	$/yr.	$	16,700.00	$	16,700
	UV Lamp Replacement[3] (IPR)	60	lamps/yr.	$	400.00	$	24,000
					Subtotal	**$**	**52,700**
Injection Well O&M Costs							
	O&M for Pumping[5] ($/year)	21.48	kW/h	$	0.35	$	65,872
					Subtotal	**$**	**65,872**
	TOTAL O&M COST					***$***	***935,000***
	Estimating Contingency	30%				$	280,500
	TOTAL PROJECT O&M COST		$/year			**$**	**1,215,500**

Notes

1. MBR O&M not included, same as current. Distribution Pumps Accounted for in Conveyance
2. Estimated from projections and material balance
3. Replacement of Duty Lamps Every 2 Years
4. Replacement of Duty Membranes Every 7 Years, Reported as Annualized Cost
5. O&M for pumping costs includes electricity needed for two 20 hp pumps at 90% efficiency and an 80% load factor.

PROJECT:	Laguna County Sanitation District
JOB NO.:	201592
ALTERNATIVE:	1.7 MGD flow with injection northwest of LCSD
COST:	Project 2 - Treatment
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification	Quantity	Units	Unit Cost		Estimated Cost
Project 2 and Alternative Project - 1.7 MGD flow Treatment Costs					
AWPF Building					
Treatment Building	17,303	SF	$ 450	$	7,786,350
Treatment Process Equipment Cost: **New UV and RO Systems for IPR**					
Instrumentation (pH, Total Chlorine, Free Chlorine, RO conductivity, Combined Feed and Permeate TOC, UVT, and ORP)	1	LS	$ 122,400	$	122,000
UV Reactors (LBX1500e)	3	$/reactor	$ 175,000	$	525,000
UV Lamps (800W)[1]	180	$/lamp	$ 400	$	72,000
UV Feed Pumps	2	LS	$ 25,000	$	50,000
Sodium Hypochlorite Tank and Dosing Pumps	1	LS	$ 98,000	$	98,000
Underpad Chlorine Contactor (concrete structure with underground baffled tank)	1	LS	$ 290,000	$	290,000
Ammonium Sulfate Tank and Dosing Pumps	1	LS	$ 76,000	$	76,000
RO Skids, Pumps, and Ancillary Equipment	1	LS	$ 2,730,000	$	2,730,000
RO Antiscalant Pumps	2	LS	$ 11,000	$	22,000
RO Flush Tank and UV Feed Tank	1	LS	$ 36,623	$	37,000
RO CIP Chemical Pumps (Citric and 2 x Specialty Chemical)	6	LS	$ 14,000	$	84,000
CIP Tank and Hot Water Tank	2	LS	$ 33,460	$	67,000
			Subtotal	**$**	**4,173,000**
Treatment Process Equipment Cost: **Upgrades to UF System for IPR**					
UF PDT Upgrade	1	LS	$ 3,000	**$**	**3,000**
Treatment Process Equipment Cost: **Additional Cleaning and Chemical Systems**					
CO2 System	1	LS	$ 500,000	$	500,000
Calcium Chloride Tank and Dosing Pumps	1	LS	$ 52,000	$	52,000
Sodium Hydroxide Tank and Dosing Pumps	1	LS	$ 210,000	$	210,000
Sulfuric Acid Tank Dosing Pumps	1	LS	$ 210,000	$	210,000
			Subtotal	**$**	**972,000**
Treatment Facility Items[2]					
Process Equipment Installation	25%			$	1,287,000
Piping and Valves	20%			$	195,000
			Subtotal	**$**	**1,482,000**
Engineering Services					
Civil and Sitework	10%			$	2,217,900
Electrical & I/C	25%			$	5,544,750
			Subtotal	**$**	**7,762,650**
Total Direct Cost				***$***	***22,179,000***
Estimating Contingency	30%			$	6,654,000
Sales Tax	7.75%			$	859,000
Contractor Overhead & Profit	15%			$	4,325,000
General Conditions	20%			$	5,767,000
TOTAL TREATMENT COST				***$***	***39,784,000***
Engineering, Legal, and Administrative	12%			$	4,774,000
Owners Reserve for Change Orders	5%			$	1,989,000
TOTAL PROJECT COST				**$**	**46,547,000**

Notes

1. If upgraded from Project 1 - Fast Track this cost will not be required. For now included as Project 2 is assumed to be separate.
2. Treatment facility items are scaled as a factor of direct Treatment Processes and Chemical Dosing Equipment and Tanks, excluding building and other Engineering Services

PROJECT:	Laguna County Sanitation District Potable Water Reuse Implementation Plan
JOB NO.:	201592
ALTERNATIVE:	1.7 MGD flow with injection northwest of LCSD
COST:	Project 2 - New Infrastructure
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification	Quantity	Units	Unit Cost	Estimated Cost
Project 2 - 1.7 MGD flow with injection northwest of LCSD New Infrastructure Costs				
Onsite Recycled Water Pump Station & Tank				
Welded Steel Tank[(1)]	1	LS	$ 750,000	$ 750,000
Pump Station[(2)]	1	LS	$ 300,000	$ 300,000
Tank & Pump Station Allowances[(3)]	1	LS	$ 262,500	$ 263,000
			Subtotal	**$ 1,313,000**
Purified Recycled Water Injection Sites - General				
SWPPP BMPs[(4)]	1	LS	$ 10,000	$ 10,000
Groundwater Testing & Handling[(5)]	4	Ea	$ 5,000	$ 20,000
			Subtotal	**$ 30,000**
Purified Recycled Water Injection Sites - Site Civil				
Clearing & Grubbing[(6)]	22,500	SF	$ 0.5	$ 11,300
Rough Grading[(7)]	417	CY	$ 25	$ 10,400
Gravel Access Roadway[(8)]	69,930	SF	$ 3	$ 209,800
Gravel Site Cover[(9)]	10,000	SF	$ 3	$ 30,000
Perimeter Fencing and Gates[(10)]	800	LF	$ 75	$ 60,000
Electrical Building	600	SF	$ 600	$ 360,000
Yard Piping	1	EA	$ 185,000	$ 185,000
Backwash Pumping Pond	75	CY	$ 15	$ 1,100
			Subtotal	**$ 867,600**
Purified Recycled Water Injection Site - Well Site				
300 foot deep wells[(11)]	1,200	VLF	$ 3,000	$ 3,600,000
5 hp backwash pumps	4	Ea	$ 8,000	$ 32,000
Aboveground Infrastructure	4	Ea	$ 40,000	$ 160,000
Associated Monitoring Wells[(12)]	2400	VLF	$ 100	$ 240,000
			Subtotal	**$ 4,032,000**
E&IC				
Supporting E&IC[(13)]	1	LS	$ 734,940	**$ 735,000**
Entire Pipeline Conveyance: Pipeline from LCSD to injection wells Northwest of LCSD				
Pipeline[(14)]	6,864	LF	$ 180	**$ 1,240,000**
RO Concentrate Disposal[(15)]				
Conveyance Pipeline from LCSD to ROC disposal	34,637	LF	$ 120	$ 4,160,000
Permitting for Well	1	LS	$ 120,000	$ 120,000
Building Pad & Drilling Well	1	ls	$ 2,250,000	$ 2,250,000
Surface Facilities (tank, pumps, anulus system)	1	LS	$ 500,000	$ 500,000
			Subtotal	**$ 7,030,000**
Total Direct Cost				***$ 15,247,600***

PROJECT:	Laguna County Sanitation District Potable Water Reuse Implementation Plan
JOB NO.:	201592
ALTERNATIVE:	1.7 MGD flow with injection northwest of LCSD
COST:	Project 2 - New Infrastructure
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification	Quantity	Units	Unit Cost		Estimated Cost
Estimating Contingency	30%			$	4,574,000
Sales Tax (applied to 50% of direct costs)	7.75%			$	591,000
Contractor Overhead & Profit	15%			$	2,973,000
General Conditions	20%			$	3,964,000
TOTAL CONSTRUCTION COST				***$***	***27,349,600***
Engineering, Legal, and Administrative	12%			$	3,282,000
Owners Reserve for Change Orders	5%			$	1,367,000
TOTAL PROJECT COST				**$**	**31,998,600**

Notes

1. Assumes a 500,000 gallon welded steel tank that can be used for an increased IPR flow.
2. Assumes two 50 hp horizontal split case pumps (2d +1s).
3. Assumes 25% of pump & tank direct costs for process equipment, gauges, concrete pipe supports, valving, etc.
4. SWPPP BMPs assume costs for silt fences, drag out drive ways, and water trucks.
5. Groundwater Testing & Handling assumes costs for constituent testing, sampling, etc. as needed during discharge and construction. Cost is per injection well (assumed 4).
6. Assumes a site size of 75 ft by 75 ft per each injection well.
7. Assumes 0.5 ft of grading across each 75 ft by 75 ft site.
8. Assumes use of the access road that leads from the Agriculture Pond directly east of the site (18 ft wide).
9. Assumes 50 ft by 50 ft area per injection well.
10. Assumes entire 50 foot perimeter with one access gate.
11. Assumes 12" casing.
12. Assumes 2 monitoring wells per 1 injection well.
13. Assumes 15% of Site Civil and Well Site costs.
14. Pipeline sizing and cost assumes an 85% recovery of 1.7 mgd. Pipe diameter of 12 in.
15. Assumes 15% recovery of 1.7 mgd. Pipe diameter of 8 in.

PROJECT:	Laguna County Sanitation District Potable Water Reuse Implementation Plan
JOB NO.:	201592
ALTERNATIVE:	1.7 MGD flow with injection northwest of LCSD
COST:	Project 2 - O&M
DESCRIPTION:	Level 5 Cost Estimate

O&M COST ESTIMATE

	Classification	Quantity	Units	Unit Cost	Estimated Cost
	Project 2 and Alternative Project - 1.7 MGD flow O&M Costs				
Staffing Cost					
	WWTO / AWTO Grade 3	2	$/yr.	$106,630	$213,260
	WWTO / AWTO Grade 5	1	$/yr.	$116,215	$116,215
				Subtotal	**$ 329,475**
Process Energy Costs[1]					
	RO Energy Consumption	1.72	kWh/kgal	$ 0.35	$ 318,700
	UV Feed Pumps Energy Consumption	6	kW	$ 0.35	$ 18,800
	Existing UV Reactor for AOP	96	kW	$ 0.35	$ 294,400
				Subtotal	**$ 631,900**
Process Chemical Usage[2]					
	Ammonium Sulfate (40 wt.%)	7	lbs/d	$ 0.45	$ 1,200
	Calcium Chloride	2831	lbs/d	$ 0.20	$ 206,700
	Sodium Hydroxide (50 wt.%)	1744	lbs/d	$ 0.29	$ 184,600
	Sodium Hypochlorite (12.5 wt.%)	101	lbs/d	$ 2.12	$ 78,300
	Sulfuric Acid (93 wt.%)	740	lbs/d	$ 0.29	$ 78,400
	Antiscalant	36	lbs/d	$ 3.24	$ 42,100
	Citric Acid 50%	43	lbs/d	$ 5.80	$ 91,500
	Carbon Dioxide	387	lbs/d	$ 0.17	$ 24,100
				Subtotal	**$ 706,900**
Process Consumables Costs					
	RO Membrane Replacement[3]	1	$/yr.	$ 16,700.00	$ 16,700
	UV Lamp Replacement[4]	60	lamps/yr.	$ 400.00	$ 24,000
				Subtotal	**$ 40,700**
Injection Well O&M Costs					
	O&M for Pumping[5] ($/year)	53.71	kW/h	$ 0.35	$ 165,000
				Subtotal	**$ 165,000**
	TOTAL O&M COST				**$ 1,874,000**
	Estimating Contingency	30%			$ 562,200
	TOTAL PROJECT O&M COST		$/year		**$ 2,436,200**

Notes

1. MBR O&M not included, same as current. Distribution Pumps Accounted for in Conveyance
2. Estimated from projections and material balance
3. Replacement of Duty Membranes Every 7 Years, Reported as Annualized Cost
4. Replacement of Duty Lamps Every 2 Years
5. O&M for pumping costs includes the electricity needed for two 50 hp pumps at 90% efficiency and an 80% load factor.

PROJECT:	Laguna County Sanitation District Potable Water Reuse Implementation Plan
JOB NO.:	201592
ALTERNATIVE:	1.7 MGD flow with injection near Getty Basin
COST:	Alternative Project - New Infrastructure
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification	Quantity	Units	Unit Cost	Estimated Cost
Alternative Project - 1.7 MGD flow with injection near Getty Basin New Infrastructure Costs				
Onsite Recycled Water Pump Station & Tank				
Welded Steel Tank[1]	1	LS	$ 750,000	$ 750,000
Pump Station[2]	1	LS	$ 450,000	$ 450,000
Tank & Pump Station Allowances[3]	1	LS	$ 300,000	$ 300,000
			Subtotal	**$ 1,500,000**
Purified Recycled Water Injection Sites - General				
SWPPP BMPs[4]	1	LS	$ 20,000	$ 20,000
Groundwater Testing & Handling[5]	4	Ea	$ 5,000	$ 20,000
			Subtotal	**$ 40,000**
Purified Recycled Water Injection Sites - Site Civil				
Clearing & Grubbing[6]	88,400	SF	$ 0.5	$ 44,200
Rough Grading[7]	1,637	CY	$ 25	$ 40,900
Gravel Access Roadway	28,350	SF	$ 3	$ 85,100
Gravel Site Cover[8]	10,000	SF	$ 3	$ 30,000
Perimeter Fencing and Gates[9]	1,820	LF	$ 75	$ 136,500
Electrical Building	600	SF	$ 600	$ 360,000
Yard Piping[10]	1	EA	$ 195,000	$ 195,000
			Subtotal	**$ 891,700**
Purified Recycled Water Injection Site - Well Site				
300 foot deep wells[12]	1,200	VLF	$ 3,000	$ 3,600,000
5 hp backwash pumps	4	Ea	$ 8,000	$ 32,000
Aboveground Infrastructure	4	Ea	$ 40,000	$ 160,000
Associated Monitoring Wells[13]	2400	VLF	$ 100	$ 240,000
			Subtotal	**$ 4,032,000**
E&IC				
Supporting E&IC[14]	1	LS	$ 738,555	**$ 739,000**
Entire Pipeline Conveyance: Pipeline from LCSD to the Getty Basin				
Alternate route to avoid Santa Maria Airport				
Pipeline[15]	28,090	LF	$ 230	**$ 6,470,000**
RO Concentrate Disposal[16]				
Conveyance Pipeline from LCSD to ROC disposal	34,637	LF	$ 120	$ 4,160,000
Permitting for Well	1	LS	$ 120,000	$ 120,000
Building Pad & Drilling Well	1	ls	$ 2,250,000	$ 2,250,000
Surface Facilities (tank, pumps, anulus system)	1	LS	$ 500,000	$ 500,000
			Subtotal	**$ 7,030,000**
Total Direct Cost				***$ 20,702,700***

PROJECT:	Laguna County Sanitation District Potable Water Reuse Implementation Plan
JOB NO.:	201592
ALTERNATIVE:	1.7 MGD flow with injection near Getty Basin
COST:	Alternative Project - New Infrastructure
DESCRIPTION:	Level 5 Cost Estimate

CAPITAL COST ESTIMATE

Classification	Quantity	Units	Unit Cost	Estimated Cost
Estimating Contingency	30%			$ 6,211,000
Sales Tax (applied to 50% of direct costs)	7.75%			$ 802,000
Contractor Overhead & Profit	15%			$ 4,037,000
General Conditions	20%			$ 5,383,000
TOTAL CONSTRUCTION COST				***$ 37,135,700***
Engineering, Legal, and Administrative	12%			$ 4,456,000
Owners Reserve for Change Orders	5%			$ 1,857,000
TOTAL PROJECT COST				**$ 43,448,700**

Notes

1. Assumes a 500,000 gallon welded steel tank that can be used for an increased IPR flow.
2. Assumes three 50 hp horizontal split case pumps (2d +1s).
3. Assumes 25% of direct costs for process equipment, gauges, concrete pipe supports, valving, etc.
4. SWPPP BMPs assume costs for silt fences, drag out drive ways, and water trucks.
7. Groundwater Testing & Handling assumes costs for constituent testing, sampling, etc. as needed during discharge and construction. Cost is per injection well (assumed 4).
6. Assumes a site size of 88,400 sf. Assumes entire site would need clearing and grubbing as it is adjacent to a very heavily used area.
7. Assumes 0.5 ft of grading across entire site.
8 Assumes 50 ft by 50 ft area per injection well.
9. Assumes entire site is fences as the area surrounding is urban.
10. Assumes backwash facilities will drain into existing storm drain system. Addition of a new manhole.
11. Assumes backwash pumping into existing pond.
12. Assumes 12" casing.
13. Assumes 2 monitoring wells per 1 injection well.
14. Assumes 15% of Site Civil and Well Site costs.
15. Pipeline sizing and cost assumes an 85% recovery of 1.7 mgd. Pipe diameter of 12 in.
16. Assumes 15% recovery of 1.7 mgd. Pipe diameter of 8 in.

APPENDIX G

MORRO BAY STAFFING PLAN

Staffing

The Morro Bay WRF operations team will be on site 5 days per week, Monday through Friday, with hours of approximately 7:00 am to 3:30 pm. For the first 8 to 12 months of WRF operation, the potable reuse injection wells will not be operational (well construction complete *after* WRF construction); thus allowing for a long training and operational performance demonstration period.

Over this 8-12 month period, the RO and UV AOP processes will initially be run constantly (24 hours per day) at ~1 mgd (production), with IPR purified water being sent to the ocean outfall. This period will last until the following has occurred:

1. Demonstration of performance of the treatment, monitoring, control, and diversion systems.
2. The OOP sufficiently reflects the operational performance and procedures for addressing alarm conditions remotely and restarting the WRF after a diversion or stoppage of production.

Over this continuous operational period, WRF staff will be on site during the 40-hour work week, demonstrating the reliable performance of the system and the effectiveness of the monitoring, control, and diversion system ability to operate unstaffed while the purified water is sent to the ocean outfall.

The system will subsequently be operated only three days per month to continue documenting MCLs and exercise equipment until the IPR wells have been constructed and are ready for tracer testing.

During IPR tracer testing, which would include the injection of purified water into the groundwater basin, the IPR facilities will be operated once again 24/7 with staff only on site during the 40-hour work week. After tracer testing is complete, the IPR processes will again be exercised intermittently (approximately three days per months) until drought conditions or otherwise call upon the IPR system to be operated as a back-up water supply. The proposed staffing plan is summarized in Table G.1.

Table G.1 Phased Staffing Plan

Approximate Date and Time Frame	Phase	Staffing Plan for that Phase
July 2022	WRF facility construction complete	--
October – December 2023	Start-up testing (acceptance and performance) of WRF treatment processes	Staff on site as needed, 40+ hours per week.
December 2022	RO / UV AOP processes operate 24/7 and sent to ocean outfall; alarms and continuity of system performance is proven out	Staff on site 40 hours per week
January – February 2025	MBR process operates 24/7; and RO / UV AOP processes are exercised approximately three days per month (24/7 for those three days) with IPR purified water sent to the ocean outfall to exercise equipment.	Staff on site 40 hours per week
February 2025	IPR wells construction complete	--

Approximate Date and Time Frame	Phase	Staffing Plan for that Phase
January 2025 – March 2025	MBR and IPR processes, and IPR wells are run 24/7 while tracer study is conducted	Staff on site 40 hours per week
April 2025 – indefinitely	MBR process operates 24/7; and IPR processes are operational when needed or to exercise equipment.	Staff on site 40 hours per week

During times when the facility is not staffed, the plant will operate automatically with the supervisor on call and automatically notified of alarms. Approval to operate in automatic operation needs will be requested prior to running the plant in Auto Mode. The request will specify results of alarm testing, time elapsed between an off-spec alarm trigger and remediation, and operator response time. Should there be a process failure, plant water will automatically divert to ocean outfall. The MBR will continue to run with MBR filtrate discharged to the existing outfall in the Pacific Ocean. Should a diversion event occur, the IPR processes will not be restarted automatically. Prior to restarting, the supervising operator will be on site, verify faults, fix process/monitoring problems, restart the system, verify that it is back on-spec, and restart the purified water feed pumps to the injection wells.

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