APPENDIX 1

CBP Assumptions
Technical Memorandum #1

DRAFT

Chino Basin Program Assumptions

Technical Memorandum No. 1

August 4, 2020

Prepared for

18500 Von Karman Avenue, Suite 1100
Irvine, CA 92612
T: 714.730.7600

DRAFT

Technical Memorandum

Prepared for: Inland Empire Utilities Agency

Project Title: Chino Basin Program PDR

Project No.: 153489.080.004

Technical Memorandum No. 1

Subject: Chino Basin Program Assumptions

Date: August 4, 2020

To: Sylvie Lee, P.E., Manager of Planning & Environmental Resources
Liza Munoz, P.E., Project Manager

From: Andrew Lazenby, P.E., Director/Sr. Project Manager, Brown and Caldwell

Prepared by: ___________________________________
Jennifer K. Thompson, P.E., Sr. Project Manager, Brown and Caldwell
License No. C64820, Expiration 6/30/21

Reviewed by: ___________________________________
Andrew Lazenby, P.E., Director/Sr. Project Manager, Brown and Caldwell

**List of Additional Contributors and Reviewers are on the following page.*

List of Additional Contributors and Reviewers

Contributors:

Lauren Bray, Brown and Caldwell

Hannah Ford, P.E., Brown and Caldwell

Kirstin Byrne Kale, P.E., Brown and Caldwell

Windsor Lee, Brown and Caldwell

Marcus Maltby, P.E., Brown and Caldwell

Alan Mangosong, P.E., Brown and Caldwell

Taylor McCauley, Brown and Caldwell

Elizabeth Orozco, Brown and Caldwell

Troy Arashiro, WSC

Laine Carlson, P.E., WSC

Michael Cruikshank, PG, CHG, WSC

Heather Freed, P.E., WSC

Aaron Morland, WSC

Jeroen Olthof, P.E., WSC

Debra L. Burris, P.E., DDB Engineering, Inc.

Marvin Glotfelty, R.G., Clear Creek Associates

Nate Scheevel, P.E., Scheevel Engineering

Reviewed By:

Katie Porter, P.E., Brown and Caldwell

Adam Zacheis, P.E., Brown and Caldwell

Kirsten Plonka, P.E., WSC

Table of Contents

List of Figures

List of Tables

List of Abbreviations

1,2,3-TCP	1,2,3-Trichloropropane
A/S	air stripping
AFD	acre-feet per day
AFY	acre-feet per year
AWRCE	Australian Water Recycling Centre of Excellence
AWPF	advanced water purification facility
Caltrans	California Department of Transportation
CBP	Chino Basin Program
CBWM	Chino Basin Watermaster
CBWCD	Chino Basin Water Conservation District
CCR	California Code of Regulations
CCWRF	Carbon Canyon Water Recycling Facility
CDA	Chino Desalter Authority
CECs	constituents of emerging concern
CIP	Capital Improvement Program
CIP	clean-in-place
CIWQS	California Integrated Water Quality System
COD	chemical oxygen demand
CTC	carbon tetrachloride
CVWD	Cucamonga Valley Water District
DDW	Division of Drinking Water
DLR	detection limit for reporting purposes
EC	electrical conductivity
eSMR	Electronic Self-Monitoring and Reporting Program
EW	extraction well
EWL	Etiwanda Wastewater Line

FERC	Federal Energy Regulatory Commission
ft	feet
FWC	Fontana Water Company
GAC	granular activated carbon
gpd	gallons per day
gpm	gallons per minute
GRRP	Groundwater Replenishment Reuse Project
hP	horsepower
IEBL	Inland Empire Brine Line
IEUA	Inland Empire Utilities Agency
in	inches
IW	injection well
JCSD	Jurupa Community Services District
LACSD	Los Angeles County Sanitation Districts
LRV	log reduction value
MBR	membrane bioreactor
MCL	maximum contaminant level
mgd	million gallons per day
MPI	Material Physical Injury
MTBE	methyl tert-butyl ether
MVWD	Monte Vista Water District
MWD	Metropolitan Water District of Southern California
MZ	management zone
µg/L	micrograms per liter
µS/cm	microsiemens per centimeter
NDMA	N-Nitrosodimethylamine
NL	notification level
NRWS	Non-Reclaimable Wastewater System
NRWSCU	Non-Reclaimable Wastewater System Capacity Units
OBMP	Optimum Basin Management Plan
PDR	preliminary design report
PCE	perchloroethylene
PEIR	Program Environmental Impact Report
PS	pump station
RAS	return activated sludge
ROW	Right-of-Way
RP-1	Regional Water Recycling Plant No. 1

RP-2	Regional Water Recycling Plant No. 2
RP-4	Regional Water Recycling Plant No. 4
RP-5	Regional Water Recycling Plant No. 5
RW	recycled water
RWC	recycled municipal wastewater contribution
RWQCB	Regional Water Quality Control Board
SAR	Santa Ana River
SBCFCD	San Bernardino County Flood Control District
SFI	Storage Framework Investigation
sMCL	secondary maximum contaminant level
SNMP	Salt and Nitrogen Management Plan
SWRCB	State Water Resources Control Board
TAFY	thousand acre-feet per year
TCE	trichloroethylene
TDH	total dynamic head
TDS	total dissolved solids
TM	technical memorandum
TM1	Technical Memorandum 1
TSS	total suspended solids
TVMWD	Three Valleys Municipal Water District
VOC	volatile organic carbon
WAS	waste activated sludge
Watermaster	Chino Basin Watermaster
WEI	Wildermuth Environmental, Inc.
Western	Western Municipal Water District
WFA	Water Facilities Authority
WMWD	Western Municipal Water District
WRCRWA	Western Riverside County Regional Wastewater Authority
WRP	water reclamation plant
WSIP	Water Storage Investment Program
WWTP	wastewater treatment plant

Section 1: Introduction

The Chino Basin Program (CBP or Program) is an innovative local water supply project that combines local infrastructure needs and salinity management with groundwater storage and water supply needs and ecosystem benefits in Northern California. This project is being led by the Inland Empire Utilities Agency (IEUA) to develop necessary infrastructure within the IEUA service area and the area of the Chino Groundwater Basin (Chino Basin).

The CBP builds upon water supply needs that have been identified as part of the region's water supply planning. Recycled water, which is an increasingly essential asset to the region particularly with uncertainties with imported water supplies due to climate change, will require advanced treatment in the future to meet regulatory requirements for total dissolved solids (TDS) and other constituents of emerging concern (CECs). Additionally, new regional water supply infrastructure has been identified through IEUA's Integrated Water Resources Plan (IRP) development to enhance water supply reliability in the Chino Basin area. The advanced water purification facility (AWPF) and regional water supply infrastructure included in the CBP will help meet these regional needs. The remainder of this Technical Memorandum (TM) and TM2 CBP – PUT, TAKE, and Program Alternatives Evaluation focus on the development of the CBP components and alternatives and identification of the preferred program alternative.

This project, the CBP Technical Feasibility Study (Study), is being completed to advance the projects that comprise the CBP. This project includes two main elements:

1. Identification and evaluation of PUT, TAKE, and program alternatives to identify the preferred CBP approach.
2. The conceptual design for elements of the recommended program.

The CBP includes two main categories of facilities: PUT, the components to recharge purified water to the Chino Basin, and TAKE, the components to extract groundwater and convey potable water supply. The PUT and TAKE components are summarized in Table 1-1. Summary of PUT and TAKE Components.

Table 1-1. Summary of PUT and TAKE Components

PUT Components	TAKE Components
• Tertiary recycled water supply and conveyance • AWPF • Purified water pumping and conveyance • Groundwater recharge (injection wells and/or recharge basins)	• Groundwater extraction and treatment • Potable water pumping and conveyance • Potable water usage (MWD pump back or in lieu)
The CBP will comprise both PUT and TAKE components.	

Note: MWD = Metropolitan Water District of Southern California

The Technical Feasibility Study will be the primary deliverable for the overall project and will present the overall findings of the project, including the conceptual design for elements of the recommended program. The alternatives evaluation of the PUT, TAKE, and program alternatives, which will define the recommended CBP for documentation in the Technical Feasibility Study, is documented in the following TMs:

- **TM1 – Chino Basin Program Assumptions (this TM):** Documents the assumptions used to develop the PUT and TAKE alternatives and presents the alternatives evaluation approach used to evaluate the PUT, TAKE, and program alternatives.
- **TM2 – Chino Basin Program – PUT, TAKE, and Program Alternatives Evaluation**: Presents the development and formation of the PUT and TAKE alternatives and evaluation, the development of the program alternatives (based on the results of the PUT and TAKE alternatives evaluation), and the selected program alternative for the overall CBP.
- **TM3 – Brine Disposal System:** Presents a summary of the brine disposal systems in IEUA's service area and how the CBP facilities would connect to the systems.

These TMs support the development of the Study and will be appended to the Study as shown graphically in Figure 1-1.

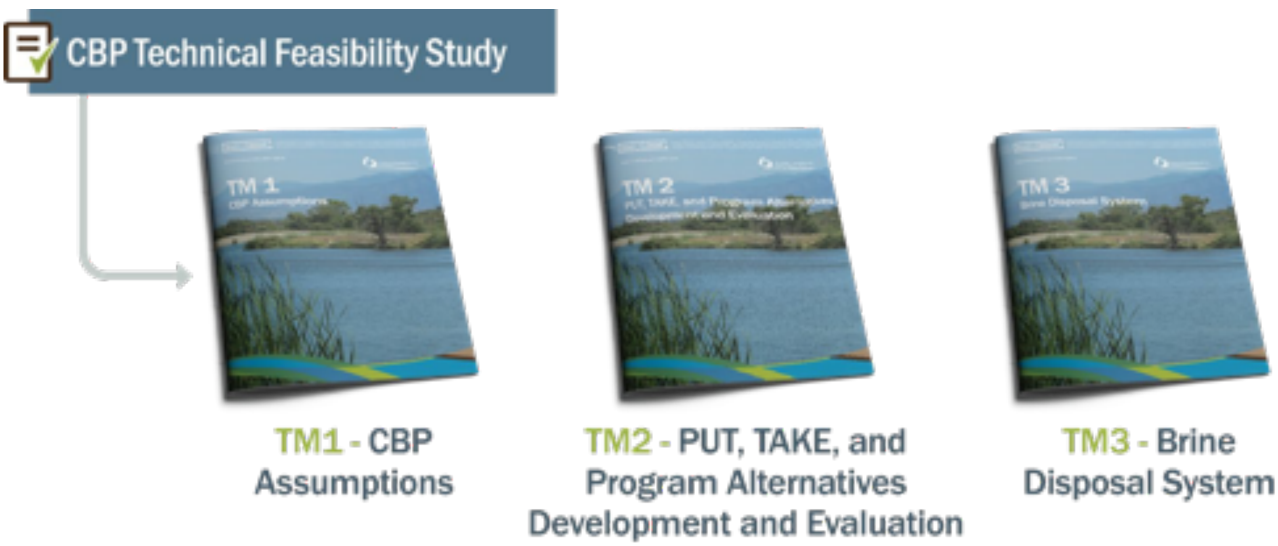

Figure 1-1. CBP Documents

1.1 Program Overview

The CBP was submitted for Proposition 1 – Water Storage Investment Program (WSIP) funding and was awarded $206.9M in conditional funding in July 2018. Under the WSIP, the CBP is proposed to be a 25-year conjunctive use project that proposes to use advanced water purification to treat and store up to 15 thousand acre-feet per year (TAFY) of recycled water in the Chino Basin and extract the water during call years, which will likely be in dry seasons. The program is intended to provide a reliable source of water during call years, while providing ecological benefits in the Sacramento-San Joaquin Delta watershed. Through agreements with the California Department of Water Resources (DWR), the California Department of Fish and Wildlife, the Metropolitan Water District of Southern California (MWD), and other project partners, the basin would be operated in a way which dedicates blocks of water of up to 50 TAFY towards ecosystem benefits north of the Delta. Advanced water purification is assumed to meet long-term salinity requirements in the Chino Basin and to meet the regulatory requirements for subsurface application of recycled water. The infrastructure included in the CBP is consistent with infrastructure identified to reduce recycled water salinity for regulatory compliance as well as water infrastructure that has been identified through IEUA's IRP effort.

The program would rely on water transfer agreements through MWD. For every acre-foot of water requested for north of the Delta ecosystem benefits, IEUA would pump locally stored groundwater and deliver it to MWD or use the water locally instead of taking raw imported water from MWD (referred to as in lieu). MWD would then leave behind an equivalent amount of water in Lake Oroville to be dedicated and released for the requested ecosystem benefit. It is also envisioned that the CBP would include both storage capacity and borrowing capacity in the Chino Basin as approved by the Chino Basin Watermaster (CBWM or Watermaster). The borrowing capacity would be used to help deliver multiple consecutive, dedicated blocks of water for ecosystem benefits. This water would be borrowed from previously stored groundwater, outside of this program, and replaced over time. Through this approach, the CBP can be operated in a way to provide up to 50 TAFY of water for up to 7.5 years of the 25-year program (375 TAF total) as long as the groundwater extraction does not exceed the approved borrow amount. This would result in balancing the PUTs and TAKEs to the Chino Basin at the end of the 25-year program, i.e., 375 TAF would be recharged over 25 years and the same amount would be extracted over 25 years.

The annual PUT and periodic TAKE cycles are shown graphically in Figure 1-2.

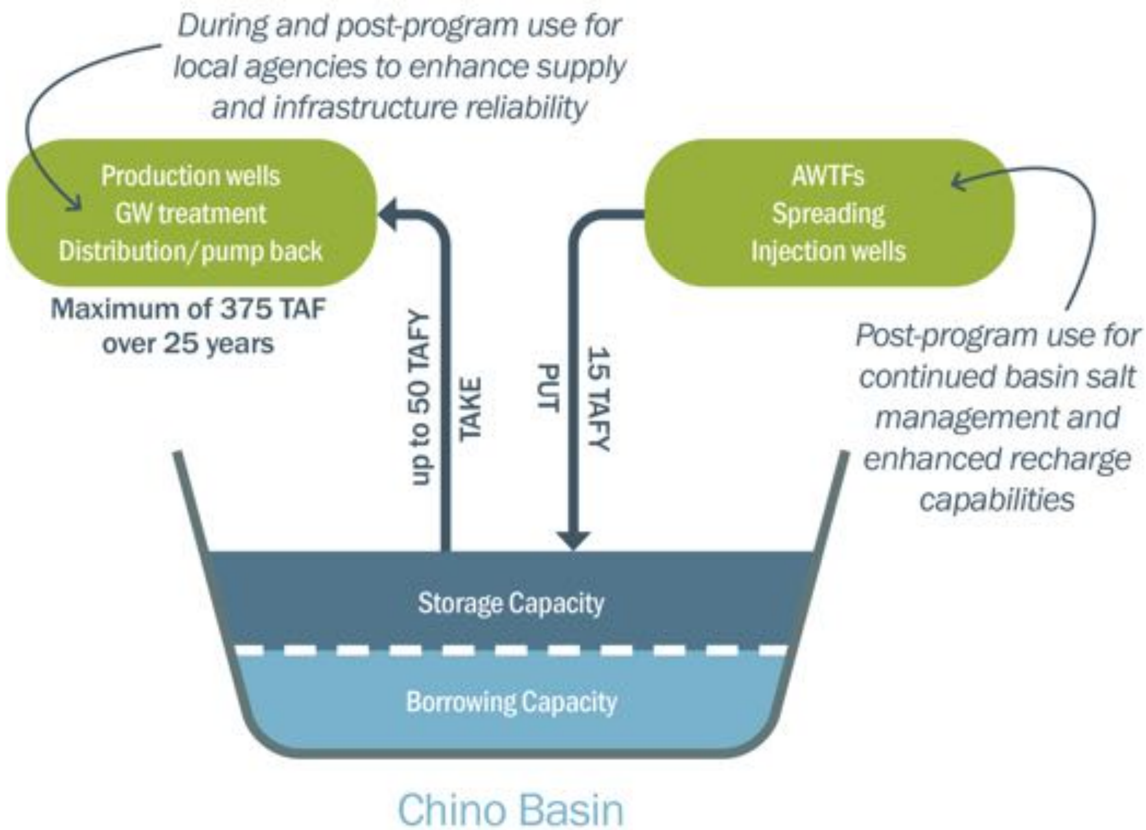

Figure 1-2. CBP Overview

1.2 Critical Success Factors

At the start of this project, IEUA and the consulting team established critical success factors to lay the foundation for the CBP alternatives and the big picture goals for developing the alternatives and establishing the recommended CBP projects. The critical success factors are as follows:

- Continue to protect and enhance the Chino Basin
- Align CBP operations and facilities with the 2020 Optimum Basin Management Plan (OBMP) Update, OBMP Update Implementation Plan, and Storage Management Plan
- Meet conditional funding requirements by Fall 2021
  - Technical Feasibility Study
  - Environmental Impact Report
- Collaborate with Stakeholders and identify planned projects
- Identify and secure source supplies
- Collaborate with MWD to define pump back requirements

1.3 PUT, TAKE, and Program Alternatives Approach

The CBP includes treatment plants, conveyance, and groundwater recharge and extraction facilities. An alternatives evaluation was completed to identify the recommended program alternative. The alternatives analysis was completed in two main steps, which are described below and shown graphically in Figure 1-3.

- **Step 1 – PUT and TAKE alternatives evaluation (component alternatives evaluation):** In the first step, the components of the CBP – PUT and TAKE – were separately identified, developed, and evaluated to identify the preferred PUT and TAKE components to build the overall program alternatives.
- **Step 2 – Program alternatives evaluation:** Once the component alternatives evaluations were completed, then the preferred PUT and TAKE alternatives were combined to develop the overall program alternatives. The alternatives will be evaluated using the same framework as for PUT and TAKE alternatives and the recommended alternative were identified with the support of the alternatives evaluation results. Each program alternative was evaluated using groundwater modeling to confirm the operating constraints of the Chino Basin were met.

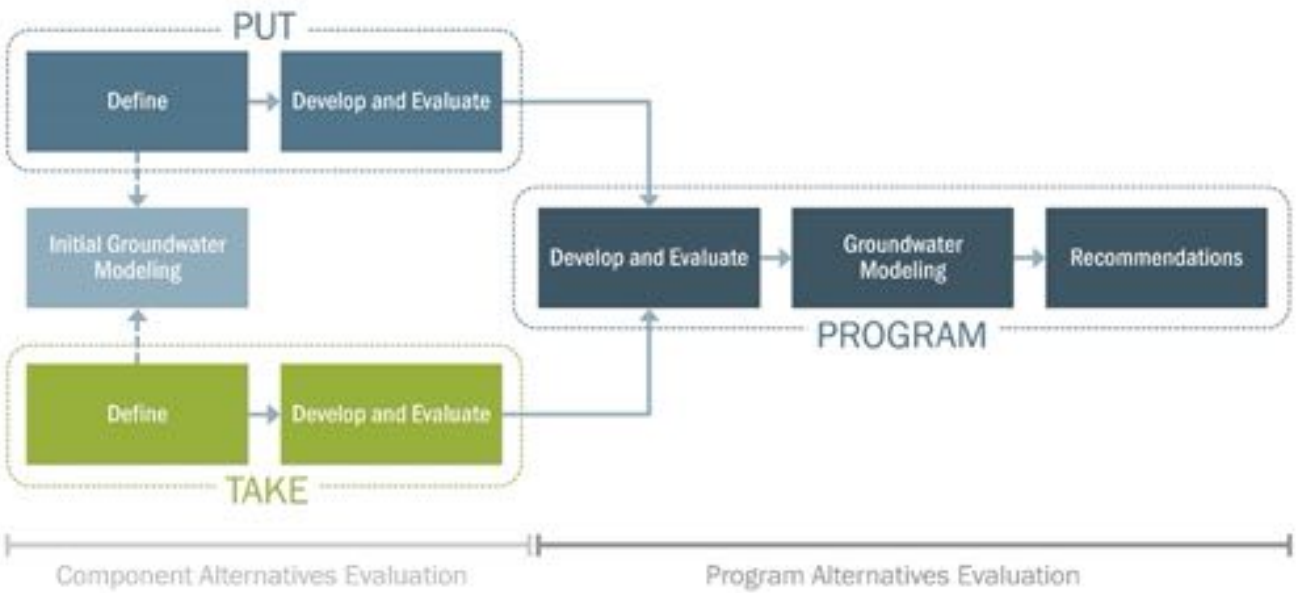

Figure 1-3. CBP Alternatives Analysis Approach

The alternatives evaluation approach and description of objectives and evaluation criteria are in Section 8 of this TM.

The background assumptions and information necessary to formulate the PUT and TAKE alternatives is presented in this TM. TM2 includes the development and evaluation alternatives: first, development and evaluation of the PUT and TAKE alternatives, and then, second, the development and evaluation of the CBP alternatives based on the recommended PUT and TAKE alternatives. TM2 also includes the identification of the recommended CBP alternative(s).

1.4 TM1 Overview

TM1 documents the assumptions used to create the PUT and TAKE alternatives that, when combined, comprise the CBP. The information presented in TM1 provides the foundation for the development of the PUT and TAKE alternatives, which are presented in TM2.

The following information is presented in TM1 (this TM):

- **Section 1: Introduction**
- **Section 2: Related Studies and Activities –** includes information about the CBP Workgroup, IEUA studies and activities, and information about the CBWM and the Chino Basin groundwater basin.
- **Section 3: Regulatory Requirements –** summarizes regulatory requirements that pertain to IEUA and the Chino Basin, including IEUA’s National Pollution Discharge Elimination System (NPDES) permit limitations, the RWQCB Water Quality Control Plan (Basin Plan) and Maximum Benefit Objective, groundwater replenishment regulations, anticipated requirements for future direct potable reuse (DPR), and drinking water regulations.
- **Section 4: PUT Alternatives Components –** presents the assumptions for the PUT alternatives including tertiary recycled water supply, AWPF assumptions, and recharge assumptions. Since conveyance applies to both PUT and TAKE alternatives, conveyance assumptions are presented in Section 6.
- **Section 5: TAKE Alternatives Components –** presents the assumptions for the TAKE alternatives including extraction well assumptions, pump back assumptions to MWD, and in lieu capacity assumptions. Since conveyance applies to both PUT and TAKE alternatives, conveyance assumptions are presented in Section 6.
- **Section 6: Conveyance Approach –** presents the conveyance assumptions for the PUT and TAKE alternatives, which includes sizing criteria for tertiary recycled water, purified water, brine conveyance, and potable water.
- **Section 7: Cost Estimating Approach –** presents the cost estimating approach for the PUT and TAKE alternatives, which included development of unit costs, markups, and a lifecycle evaluation approach that was developed in conjunction with GEI.
- **Section 8: Evaluation Approach –** documents the alternatives evaluation approach that is used to evaluate the PUT, TAKE, and program alternatives.

Section 2: Related Studies and Activities

There are several related activities and studies that provide the foundation for the components for the overall CBP. These related studies and activities are organized in four main categories:

- IEUA
- CBP
- Chino Basin Watermaster (Watermaster) and Chino Groundwater Basin (Chino Basin)
- Stakeholders

The related studies and activities for each of these four categories are described briefly below.

2.1 IEUA Studies and Activities

IEUA has completed a number of studies that were used to formulate the CBP components and overall program, which are summarized in this section.

2.1.1 Regulatory Challenges TM (April 2020)

IEUA prepared a Regulatory Challenges TM in April 2020 that discusses the challenges associated with recycled water salinity and water quality in the Chino Basin. Regulatory challenges facing IEUA in 2020 are as follows:

- Ambient water quality.
- IEUA's wastewater discharge NPDES permit limit for TDS.
- IEUA's recycled water GWR permit limit for TDS.
- Compliance with blended groundwater recharge permit limit and Basin Plan objective for TDS.
- Compliance with recycled water quality for groundwater recharge as provided by the 2014 Groundwater Replenishment Reuse Project (GRRP) Title 17 and Title 22 Regulations.

Recycled water is an increasingly essential asset to the region particularly with the uncertain future of imported water supplies due to climate change and environmental factors. Recycled water is the region's most climate resilient water supply because the amount of water available is not affected by dry years. Recycled water makes up approximately 15 percent of IEUA's water supply portfolio and hundreds of millions of dollars have been invested into the regional recycled water program. It is critical for IEUA to maintain this resource within the region.

The continued use of recycled water is compliance driven, with regulatory limitations for TDS in IEUA's recycled water and groundwater recharge. Levels of TDS in recycled water have been increasing, exacerbated by climate change, conservation and episodic periods of drought over the last twenty years. In 2015, IEUA's recycled water neared the permit limit for TDS. Today, IEUA estimates that, without taking additional action, TDS limits for recycled water direct use and groundwater recharge may be exceeded within the next ten years. Long-term solutions take years and can be as long as a decade to develop, finance and implement. Left unchecked, the possibility of noncompliance with regulatory requirements grows and risks the possibility of reduced recycled water use, challenges responding to changing water quality regulations, and greater reliance on imported supplies. This underscores IEUA's need for a long-term solution to secure recycled water as a resource within the region.

Based on findings supported by this memorandum and other planning efforts, IEUA is pursuing a suite of solutions, which are targeted at mitigating these TDS risks and that are fully aligned with IEUA's mission and vision. These solutions integrate structural elements, alternative and new water supplies, operational enhancements, potential permit modifications, and other management strategies, which when bundled together could improve water reliability, achieve multiple benefits, protect Chino Basin water quality, and maintain compliance for the long-term. Advanced treatment is an integral component of this suite of solutions.

In addition to the challenges associated with TDS, IEUA is also facing regulatory challenges with 1,2,3-Trichloropropane (1,2,3-TCP), perfluorooctanoic acid (PFOA), microplastics and other contaminants of emerging concern. In 2019, recycled water used for groundwater recharge exceeded the 1,2,3-TCP maximum contaminant level (MCL) and PFOA Notification Level (NL). It becomes evident, then, that advanced treatment may also be needed to address other regulatory challenges within the region. (IEUA and GEI, April 2020)

2.1.2 2015 Recycled Water Program Strategy and Recycled Water Model

In October 2015, Stantec completed the 2015 Recycled Water Program Strategy (RWPS) for IEUA. The major goals of the RWPS were to update the recycled water supply and demand forecasts through 2035 and identify needed improvements to maximize the use of recycled water within the service area (Stantec, October 2015). The projected recycled water demands were split between Santa Ana River (SAR) discharges, direct use demands on a 12-month basis, and groundwater recharge (GWR) demands on a 9-month basis. The 2015 RWPS provides a comprehensive list of recycled water system upgrades and a project implementation strategy with demand triggers. The projects that will be completed by the year 2026 will be included when performing the system analysis using the hydraulic model.

In 2016, Carollo updated and calibrated the recycled water system hydraulic model to represent existing 2016 conditions. Updates to the model included refining diurnal demand patterns for pressure zones and large recycled water customers, reviewing and updating controls, and scaling both direct use and recharge demands. The model calibration was completed for a 24-hour run over August 31, 2016, a peak demand day. The calibrated model was used as the basis for performing the alternative system analyses for CBP, which is described in further detail in Section 4.

2.1.3 Chino Basin Recycled Water Groundwater Recharge Program 2018 Annual Report

IEUA and CBWM obtained a GWR permit in 2005 to start the GWR program to protect the Chino Groundwater Basin. IEUA, CBWM, the Chino Basin Water Conservation District (CBWCD), and San Bernardino County Flood Control District through a Four Party Agreement collaboratively operate the groundwater recharge program. The program focuses on bolstering water supply reliability and water quality in the basin via increased recharge from stormwater, imported water, and recycled water sources. Each year, IEUA and the CBWM submit an annual report for the Chino Basin Recycled Water Groundwater Recharge Program to summarize the progress of the program per the California Regional Water Quality Control Board (RWQCB), Santa Ana Region, Order Nos. R8-2007-0039 and R8-2009-0057.

The 2018 Annual Report for the Chino Basin Recycled Water Groundwater Recharge Program was issued in May 2019, shortly after this Project was initiated in April 2019. The information in the report was used by the project team to better understand how the existing groundwater recharge program is operated. In 2018, the total amount of water recharged into the Chino Groundwater Basin was 23,944 acre-feet (AF), which included stormwater (6,751 AF), recycled water (12,942 AF), and imported water (4,251 AF) from the State Water Project.

2.1.4 2015 and 2020 IRPs

IEUA’s 2015 IRP was led by IEUA’s Planning and Environmental Resources Department to assess water supply and climate change impacts through 2040 in the IEUA service area. Two key goals of the IRP were to integrate and update water resource planning documents in a focused, holistic manner and to develop an implementation strategy that will improve near-term and long-term water resources management for the region. In addition, the IRP evaluated new growth, development, and water demand patterns within the service area and conducts an assessment of water needs and supply source vulnerabilities under climate change.

To achieve the aforementioned goals, the IRP has been split up into two phases: Phase 1 - Analysis and Recommendations (referred to as the 2015 IRP), and Phase 2 – Implementation and Capital Improvement Program (2020 IRP). The 2015 IRP is complete and documented in the 2015 *Integrated Water Resources Plan: Water Supply & Climate Change Impacts 2015-2040* (IEUA, 2015) (also referred to as IRP Phase 1), and development of the 2020 IRP began in Summer 2016 and is still in progress.

The 2015 IRP includes recommended regional water strategies, costs for different water supplies, and possible local and regional supply projects to provide water supply resilience to the area into the future. The 2015 IRP focused on an extensive analysis of future projected water needs and water supply strategies under conditions of climate change and growth. Results from the 2015 IRP include summaries of the recommended regional water resource strategies; corresponding ranges of costs for the various supply categories; and a regionally developed, all-inclusive list of potential supply projects (local and regional). The 2015 IRP was developed in three parts: Part 1 – Needs Assessment, Part 2 – Regional Strategy Development, and Part 3 – Strategy Testing. Five water supply strategies were developed to understand how the combinations of projects could meet future water needs and address the challenges and constraints facing the region. Eight project portfolios were developed to test the five water supply strategies and modeling was used to determine the effect of each portfolio on water supplies.

The two core findings of the 2015 IRP are as follows:

- The region’s past investments in local water supplies and the diversification of the available water resources have positioned the region well to deal with the future impacts of climate change. If no further actions were taken beyond the currently planned investments in regional supplies and water use efficiency, the region would be able to meet 80-90% of its projected water needs by 2040.
- Portfolios that combined water supply and water efficiency actions yielded the most adaptive strategies for the region. Many portfolios were able to reduce the region’s risk of not having sufficient water supplies to meet future needs. Several portfolios were able to dramatically increase the amount of water stored in the Chino Basin.

Based on these findings, IEUA determined the following recommendations to ensure water security for the region:

- Continue investment in recycled water projects to maximize the beneficial reuse.
- Acquire low total dissolved solids (TDS) supplemental water to enhance groundwater quality to sustain production and reduce salinity.
- Implement water use efficiency measures to reduce current urban demand by at least 10% to enhance water supply resiliency.
- Strategically maximize the purchase of supplemental water for recharge or in-lieu when available.
- Include external supplies, consisting of exchanges, storage, and water transfers, strategically in combination with conservation to augment groundwater recharge, recycled water, and build storage reserves. External supplies include surface, imported, and non-potable water.
- Continue to maximize stormwater recharge projects, including rainwater capture and infiltration.

To fund the possible projects and strategies summarized in the IRP, the recommendations were included in the IEUA Facilities Master Plan Program Environmental Impact Report (PEIR) (ESA, December 2016) (ESA, February 2017).

The 2020 IRP is currently being developed by IEUA and will address additional detailed project level analysis including project scopes, costs, prioritization, and implementation scheduling. As part of this phase, a regional infrastructure model has been created to simulate the potable water system water balance and distribution capacity between agencies and from pressure zone to pressure zone within agencies. The model is being used to identify existing operational constraints and redundant capabilities and identify and assess the potential local and regional benefits of various infrastructure projects (INTERA, August 2018). The CBP builds upon regional water supply infrastructure that have been identified as part of the 2015 IRP and the development of the 2020 IRP to enhance water supply reliability in the Chino Basin area.

2.1.5 Feasibility Study of Recycled Water Interconnections between City of Pomona, Monte Vista Water District and Inland Empire Utilities Agency (2016)

The Feasibility Study of Recycled Water Interconnections Between the City of Pomona, Monte Vista Water District (MVWD), and IEUA (Carollo, January 2016) assessed potential future projects and strategies to increase water supply to each of the aforementioned agencies. The evaluation focused on seven project alternatives that each provide a different approach to increase water supply via recycled water from the Sanitation Districts of Los Angeles County's Pomona Water Reclamation Plant (PWRP) and from IEUA's recycled water system. Additional non-potable water sources were also considered, such as groundwater from the Spadra Basin and brine from the City of Pomona's Anion Exchange Plant (AEP). MVWD's Plant 28 site was identified as a location for advanced treatment facilities.

The recommended alternative for Phase 1 of the project is Alternative 2a, which includes an AWPF that would source 3.7 million gallons per day (mgd) of recycled water from both the City of Pomona and from existing IEUA recycled water infrastructure for treatment at an AWPF to be built at MVWD's Plant 28 site. New infrastructure required by this alternative would require approximately six miles of 16-inch diameter pipeline, a 400-horsepower (hP) pump station, and a 3.1-mgd AWPF. This alternative was recommended because of its operational flexibility, high water quality production (for recharge), low travel time to pumping wells, and future potential for expansion. Alternatives 2b or 4, which both require the same infrastructure as Alternative 2a, could be considered for a future phase of the project.

For the CBP, a satellite AWPF in the western portion of the Chino Basin was considered in the PUT alternatives and, based on this study, it was assumed that the AWPF would be located at MVWD's Plant 28 site and the AWPF concept developed as part of this feasibility study was used as the basis for the CBP alternatives. The AWPF assumptions are discussed further in Section 4.2 of this TM and the AWPF components included in the PUT alternatives are discussed further in TM2 Section 3.2.2.

2.1.6 Wastewater Facilities Master Plan Update Report (2015)

The *Wastewater Facilities Master Plan Update Report (Volumes 1 and 2)* (CH2MHILL, June 2015) was an update to the 2002 Wastewater Facilities Master Plan to create a 20-year Capital Improvement Plan (CIP) for IEUA's Regional Water Recycling Plants (RWRPs), collection system, and organics management. The report was completed as a series of TMs which are as follows:

- TM 1 – Existing Facilities
- TM 2 – Hydraulic Modeling and GIS Implementation
- TM 3 – Regional Trunk Sewer Alternatives Analysis
- TM 4 – Wastewater Flow and Loading Forecast
- TM 5 – RP-1 Future Plans
- TM 6 – RP-4 Future Plans
- TM 7 – RP-5 and RP-2 Complex Future Plans
- TM 8 – Carbon Canyon WRF Future Plans
- TM 9 – Organics Management Plan
- TM 10 – Asset Management Program

These TMs were written to assess long-term water supply and growth projections, the usage of the four existing RWRPs, the use of RP-5 for all future RP-2 solids handling, and the effect of diverting RP-1 flow for increased groundwater recharge in certain areas of the IEUA service area. One of the products of this report is a table of the projects that must be implemented over the next 20 years to meet projected capacity goals. The projects of interest for this TM included those that affect RP-1 and RP-4 which are included in the PUT alternatives as discussed in this TM. The RP-1 projects included projects to expand liquid and solids treatment, and to eliminate primary effluent equalization. RP-4 has a liquid treatment expansion project in IEUA's 20-year CIP. The recommendations of the Wastewater Facilities Master Plan Update Report were included in the IEUA Facilities Master Plan PEIR (ESA, December 2016) (ESA, February 2017).

The RP-1 and RP-4 information was used to develop the AWPF concepts for the PUT alternatives, which are discussed further in Section 4.

2.1.7 RP-1 Liquids & Solids Capacity Recovery Preliminary Design Report (2019)

The *RP-1 Liquids & Solids Capacity Recovery Preliminary Design Report* (Carollo, April 2019) included the preliminary design for projects projected to be online by 2030 and site planning for the site through 2060, when RP-1 is expected to reach its built-out flow rate of 40 mgd, and beyond. RP-1 has lost some treatment capacity through increased mass loading, which will be restored to 40-mgd average day flow and 80-mgd peak day flow (without equalization) through the RP-1 Capacity Recovery Project. The improvements will include converting secondary treatment to a membrane bioreactor (MBR) system, new solids thickening, increased digestion capacity, and improved support facilities.

Beyond 2030 through 2060, new facilities to replace aging infrastructure are planned at RP-1 as well as an AWPF to reduce TDS of the MBR effluent to meet permit requirements for tertiary recycled water groundwater recharge and effluent discharge. Space was also planned for an ultraviolet (UV) advanced oxidation process (AOP) for future groundwater injection. The AWT facilities were planned to be located in the southwest corner of RP-1 in the location of the existing solar facilities. The existing solar facilities are contracted through June 2029 and are anticipated to be demolished after that date.

For the CBP, the RP-1 preliminary design for the new MBR and the AWT planning concepts were utilized for the PUT alternatives that assume the AWPF is located at RP-1. There is a time conflict with the proposed AWPF location since the CBP will be online by 2026 and the RP-1 solar will not be demolished until June 2029. If RP-1 is identified as the preferred AWPF location through the PUT and program alternatives analyses, then this site location conflict will need to be evaluated in more detail.

2.2 CBP Studies and Activities

In addition to this technical feasibility study, there are several ongoing efforts related to the CBP project, including the CBP workgroup and additional analyses on water supply sources, economics, and financial. The additional analyses are being developed by IEUA and others in conjunction with this study. The CBP alternatives evaluation relies on the net present value (NPV) analysis completed using the economic analysis tool described in the Draft Economic Analysis of Master Plan and CBP Alternatives TM (GEI, June 2020), which is described more in Section 7.3 of this TM.

IEUA formed a CBP Workgroup with IEUA local member agencies/local stakeholders after the conditional funding award from Proposition 1 WSIP for the CBP. Starting in December 2018, IEUA held a series of CBP workgroup meetings to develop a Memorandum of Understanding (MOU), which provided the collaborative forum to initiate the CBP feasibility studies and has continued to conduct workgroup meetings to discuss the ongoing CBP studies and evaluation. To date, information related to this Technical Feasibility Study project (also referred to as the Preliminary Design Report (PDR) project) was presented at the following CBP Workgroup meetings:

- May 14, 2019: PDR overview and update
- June 18, 2019: PDR approach, overview of PUT and TAKE alternatives, and overview of evaluation approach
- March 10, 2020: Overview and update of PUT and TAKE alternatives
- July 15, 2020: PUT and TAKE alternatives evaluations and overview of CBP program alternatives

In addition to these meetings, IEUA and the project team have met with many stakeholders in smaller group meetings to discuss detailed information about their service areas. IEUA continues to meet with the workgroup to present information, receive input, and discuss stakeholders' questions. The CBP workgroup stakeholders are presented in Table 2-1.

Table 2-1. CBP Workgroup Stakeholders

Stakeholder	Retail Member Agencies[1]	IEUA Member Agency	Wastewater Contract Agency[1]	Chino Basin Appropriative Pool[2]	Other
Chino Basin Water Conservation District					✓
Chino Basin Watermaster					✓
Chino Desalter Authority (CDA)					✓
City of Chino	✓		✓	✓	
City of Chino Hills	✓		✓	✓	
City of Fontana			✓	✓	
City of Montclair			✓		
City of Ontario	✓		✓	✓	
City of Pomona				✓	
City of Upland	✓		✓	✓	
Cucamonga Valley Water District (CVWD)	✓		✓	✓	
Fontana Water Company (FWC)	✓			✓	
Jurupa Community Services District (JCSD)				✓	
Metropolitan Water District (MWD)					✓
Monte Vista Water District (MVWD)	✓			✓	
San Antonio Water Company (SAWCO)	✓			✓	
Three Valleys Municipal Water District (TVMWD)					✓
Water Facilities Authority (WFA)		✓			
West Valley Water District (WVWD)				✓	
Western Municipal Water District (WMWD)					✓

Notes:

[1]*Source: IEUA-WFA Final 2015 Urban Water Management Plan (Arcadis, June 2016).*

[2]*Source: Appropriative Pool Committee, Calendar Year 2019.*

2.3 Chino Basin Watermaster and Chino Basin Studies and Activities

The Chino Basin is one of the largest groundwater basins in Southern California. The basin contains approximately 5,000,000 AF of water and has an unused storage capacity of approximately 1,000,000 AF. The Chino Basin consists of approximately 235 square miles of the upper Santa Ana River watershed and lies within portions of San Bernardino County, Riverside County, and Los Angeles County.

The groundwater pumping and storage rights in the Chino Basin were adjudicated pursuant to the Original Judgment in Chino Basin Municipal Water District vs. City of Chino et al (Judgment) in 1978. The Judgment also established the Watermaster to administer and enforce the provisions of the 1978 Judgment. The Watermaster also developed and implements the Optimum Basin Management Program (OBMP) and Peace Agreement per subsequent orders of the Court on February 19, 1998, which was completed in 1999 and 2000, respectively (Wildermuth Environmental, Inc. (WEI), 1999). The OBMP Implementation Plan, included as Exhibit B of the Peace Agreement, incorporated the operable features of the OBMP. The OBMP includes four goals for the basin:

1. Enhance Basin Water Supplies
2. Protect and Enhance Water Quality
3. Enhance Management of the Basin
4. Equitably Finance the OBMP

The OBMP also includes nine program elements or initiatives to reach these goals, provided in Table 2-2 below.

Table 2-2. OBMP Program Elements

Program Element	Description
1	Develop and Implement Comprehensive Monitoring Program
2	Develop and Implement Comprehensive Recharge Program
3	Develop and Implement Water Supply Plan for the Impaired Areas of the Basin
4	Develop and Implement Comprehensive Groundwater Management Plan for Management Zone 1
5	Develop and Implement Regional Supplemental Water Program
6	Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region (Regional Board), and Other Agencies to Improve Basin Management
7	Develop and Implement Salt Management Plan
8	Develop and Implement Groundwater Storage Management Program
9	Develop and Implement Conjunctive-Use Program

2.3.1 Completed Studies and Programs

Since the 1978 Judgement, the water users have taken a significant effort to study the Chino Basin, implement the Program Elements, and reach the goals set forth in the OBMP. Chino Basin management and operations are supported by groundwater modeling; the first three-dimensional groundwater model of the Chino Basin was developed in 1994, which has continued to be updated and refined. The groundwater model is being used to support the development and evaluation of the CBP alternatives as part of this project.

Table 2-3 includes a list of studies and actions that have happened in the Chino Basin since the Judgement. Following the table is additional information about the Recharge Master Plan, the Storage Framework Investigation, the Dry Year Yield (DYY) Program, and the 2020 OBMP Update. The Storage Framework Investigation was used as a data source for the CBP and provided the framework for the development of the PUT and TAKE alternatives.

Table 2-3. List of Studies and Actions in the Chino Basin since the 1978 Judgement

Year	Study/ Action Description
1978	1978 Judgement adjudicates the Chino Basin pumping and storage rights.
1994	Development of Three-Dimensional Groundwater Model.
1995	Conceptual Study Design to Review Existing Water Quality Objectives, Wasteload Allocations & Monitoring Programs for Total Inorganic Nitrogen (TIN) & Dissolved Solids in the Santa Ana River Watershed and to Develop Appropriate Alternatives Where Necessary completed.
1998	Chino Basin Recharge Master Plan, Phase 1 Final Report completed. Prepared for Chino Basin Water Conservation District and Chino Basin Watermaster.
1999	The OBMP is developed in response to a 1998 court ruling in continuance of the 1978 Judgment. The OBMP provides a strategy that provides for enhanced yield of the Chino Basin and seeks to provide reliable, high quality water supplies for the Basin. The OBMP Implementation Plan is the court approved governing document for achieving the goals defined in the OBMP (WEI, June 2019). The OBMP includes 9 program elements or initiatives to meet the goals of the OBMP.
2000	The Peace Agreement is finalized and programmatic EIR accepted.
2000	TIN/Total Dissolved Solids (TDS) Study of the Santa Ana Watershed Technical Memorandum developed. Prepared for the TIN/TDS Task Force.
2001	Recharge Master Plan completed. The plan included recommendations to modify 17 flood retention facilities to increase diversion and storage and to construct two new recharge facilities. The projects were estimated to increase recharge by 17.5 TAFY.
2002	Initial State of the Basin Report completed. The State of the Basin Report is updated every 2 years by the Watermaster.
2002	Dry Year Yield (DYY) Program was initiated in 2002 among Metropolitan Water District, IEUA, TVMWD, and Watermaster, with sub-agreements for participating Chino basin appropriators.
2007	Final Groundwater Modeling Report and Evaluation of the Peace II Project Description.
2007	Groundwater management zone 1 (MZ-1) Plan completed to study subsidence and establish a monitoring protocol for subsidence in MZ-1.
2008	DYY Program Expansion Report completed. The DYY Program Expansion is a comprehensive water resources program to maximize conjunctive-use opportunities in the Chino Basin but was not implemented. See additional information in Section 2.3.1.3.
2010	The Peace II Agreement accepted. This includes provisions for the expansion of desalters in the Chino Basin, the dedication for 400,000 AF of groundwater in storage for desalter replenishment, and changes in the Judgment to implement Peace Agreement II.
2013	2010 Recharge Master Plan Update and 2013 Amendment (Referred to as 2013 Recharge Master Plan Update) completed. The updated plan recommends constructing 10 new recharge facilities and an includes an implementation plan.

Table 2-3. List of Studies and Actions in the Chino Basin since the 1978 Judgement	
Year	**Study/ Action Description**
2013	The 2013 Chino Basin Groundwater Model Update and Recalculation of Safe Yield Pursuant to the Peace Agreement Report provided a reassessment of the hydrology of the basin and update of projections through 2050. The safe yield was reevaluated and reduced to reflect long-term hydrology and near-term cultural conditions.
2015	2015 Update to the Chino Basin Subsidence Management Plan.
2018	2018 Recharge Master Plan Update completed. Includes no new major updates from the 2013 Recharge Master Plan Update and recommends the implementation plan from that report be continued.
2018	2018 Storage Framework Investigation developed to provide the tools and technical information necessary to enable the development of storage management plan. The results will be used by the Watermaster to update the OBMP in 2020.
2019	2020 Storage Management Plan (SMP) was completed in December 2019 and is incorporated into the 2020 OBMP Update and implementation plan.
2020	The January 2020 OBMP Update provides an update to the original 2000 OBMP to reflect the most current understanding of basin hydrogeology and hydrology and new water management challenges to ensure long-term groundwater pumping sustainability.
Source: Chino Basin Water Bank Strategic Plan WaterSMART Grant (IEUA, July 2018)	

2.3.1.1 Recharge Master Plan and Updates

Program Element 2 of the OBMP Implementation Plan is to Develop and Implement Comprehensive Recharge Program. Recharge in the Chino Basin is key to meeting the goals of OBMP, including enhanced Basin supplies and protect and enhance water quality. Pursuant to the OBMP and Peace Agreement, the Watermaster, IEUA, the Chino Basin Water Conservation District (CBWCD), and the San Bernardino County Flood Control District (SBCFCD) completed the 2001 Recharge Master Plan with the purpose of evaluating existing and planning for future groundwater replenishment for water supply reliability in the Chino Basin. Major projects from the Recharge Master Plan included modifications to flood retention facilities to increase groundwater recharge. Since the 2001 plan, the Recharge Master Plan has been updated in 2010, amended in 2013, and updated again in 2018. Additional projects for new recharge facilities have been included in the updates (WEI, September 2018).

2.3.1.2 Storage Framework Investigation

In 2018, the Watermaster completed a Storage Framework Investigation (SFI) to describe how the Chino Basin would respond to the use of storage space, the expected Material Physical Injury (MPI) and other management challenges (if any) with storage projects, and conceptual descriptions of various approaches to mitigate MPI and other management challenges (WEI, October 2018). The SFI provided the technical support for the 2020 Storage Management Plan (WEI, December 2019).

The SFI found that through 2050 there would be no MPI related to land subsidence and net recharge and that Hydraulic Control could be maintained in the Basin under the baseline scenarios with no new storage projects. The SFI then evaluated the impacts to the Basin under multiple storage scenarios, including different ranges of managed storage and various cumulative PUT and TAKE capacities. The findings from the SFI were used to define the location and capacities of PUT and TAKE facilities for the CBP to limit MPI and negative impacts to the Chino Basin.

On April 4, 2019, IEUA hosted a charette with IEUA, the Watermaster, WEI, and the project team to brief the team on the SFI assumptions and findings and how the SFI could be used to develop PUT and TAKE alternatives. Based on the results of the SFI, the following constraints were identified for the CBP alternatives:

- **Spatially symmetrical PUT/TAKE:** for the most part, the PUT and TAKE operations should be symmetrical within management zones. The PUT facilities (injection wells) should be located upgradient of the TAKE facilities (extraction wells) to minimize the potential for prolonged water level declines. For example, if 15 TAFY is recharged in groundwater management zone (MZ) 2 (MZ-2), then the same amount should be extracted from MZ-2. (Note, see Figure 3-1 for a map showing the Chino Basin groundwater MZs.)
- **Maintain Hydraulic Control:** all CBP alternatives must maintain Hydraulic Control within the basin, which is confirmed through modeling. Hydraulic Control is the reduction of groundwater discharge from the Chino Basin to the Santa Ana River to less than 1.0 TAFY. Achieving Hydraulic Control is imperative as it is a requirement of the Regional Board to permit IEUA the ability to reuse recycled water per the Basin Plan. Any storage and recovery projects that impact Hydraulic Control would require mitigation, such as modified groundwater production operations. Hydraulic Control is evaluated with groundwater modeling and, based on the results of groundwater modeling, mitigations can be identified.
- **Net recharge implications and identify mitigation requirements:** net recharge needs to be considered and mitigation requirements need to be identified. Net recharge is net inflow to the basin excluding the direct recharge of Supplemental Water. Pumping in excess of net recharge will cause a decline in storage. Furthermore, net recharge is a key factor in the calculation of Safe Yield, and, therefore, a reduction in net recharge will cause a reduction in Safe Yield (WEI, October 2018). Net recharge is evaluated with groundwater modeling and, based on results of groundwater modeling, net recharge mitigations can be identified.
- **MZ-2:** the northern portion of MZ-2 was identified and evaluated as the primary recharge location for purified water. The northern portion of MZ-2 is generally outside of known areas of contamination and does not have subsidence constraints or significant pumping depressions.
- **MZ-1 potential future constraints:** the Watermaster will be continuing to monitor subsidence in MZ-1 and storage and recovery programs in MZ-1 will need to be coordinated with that future plan.
- **MZ-3 constraints:** pumping sustainability challenges related to low groundwater levels have the potential to limit storage and recovery programs in MZ-3.
- **Operating bands of the SFI:** for the purpose of evaluating storage and recovery, the SFI assumed four operational bands for storage and recovery programs. Managed storage without a new program is operational band 1 and assumed to be 700 TAF. Operational bands 2, 3, and 4 consist of 100 TAF each and represent ranges of 700 to 800 TAF, 800 to 900 TAF, and 900 to 1,000 TAF, respectively. CBP would fall within operational bands 2 and 3 corresponding to a cumulative PUT and TAKE capacity of 25.0 to 50.0 TAFY and 33.0 to 67.0 TAFY, respectively.

WEI completed groundwater modeling scenarios for initial CBP PUT and TAKE alternatives that informed the alternatives development and evaluation and the results are summarized in TM2 Section 2. WEI is currently in the process of modeling the CBP alternatives to confirm that the program meets the Chino Basin operating requirements and the results will be summarized in TM2 Section 5.

2.3.1.3 Dry Year Yield Program

This section is currently in development.

2.3.1.4 2020 OBMP Update Report

Since the OBMP was adopted in 2000, the understanding of the basin hydrogeology and hydrology has improved and new water management challenges have been identified that need to be addressed to ensure long-term groundwater pumping sustainability (Chino Basin Watermaster, July 2019). Some major drivers to update the OBMP included climate change, legislation and regulation, salt and nutrient management, outside interest in Chino Basin operations, grant and low-interest loan project funding, improvements in science and technology, and the need for the OBMP CEQA Document to be updated. The *2020 OBMP Update*, which was completed in January 2020 (WEI, January 2020), was developed through a collaborative stakeholder process, the same approach used to develop the original OBMP. The Watermaster held a series of public “Listening Sessions” in 2019 to obtain information, ideas, and feedback from all stakeholders. Through this process, the stakeholders have identified the collective goals, impediments to achieving the goals, and the actions required to remove the impediments (Watermaster, March 2020). The *2020 OBMP Update* and associated *Implementation Plan and California Environmental Quality Act* (CEQA) process will set the framework for the next 20 years of basin-management activities.

The CBP components need to align with the *2020 OBMP Update*. Compliance with the OBMP requirements was included as a minimum requirement in the in the alternatives evaluation process for all PUT, TAKE, and program alternatives. The recommended program alternative will be developed in more detail to confirm alignment with the *2020 OBMP Update* requirements.

2.3.2 In Progress and Future Studies

There are two in progress and future studies for the Chino Basin that need to be considered when planning for the CBP. These include the IEUA NPDES permit modification via Basin Plan Amendment (in progress) and the Subsidence Management Plan (future). These studies are described below.

2.3.2.1 IEUA NPDES Permit Modification via Basin Plan Amendment

An updated *Water Quality Control Plan for the Santa Ana River Basin* (Basin Plan) was adopted by the Regional Board in 1994. The updated Basin Plan incorporated a revised Total Inorganic Nitrogen (TIN) waste load allocation and revised Nitrogen and TDS management plan. The Basin Plan was amended in 2004 and included updated water quality objectives that would reduce former constraints on water recycling. The Basin Plan Amendment and water quality objectives still assure the reasonable protection of the beneficial uses of surface and groundwaters within the Region, including the Chino Basin, and are consistent with the state’s antidegradation policy.

IEUA, in conjunction with the Watermaster, is exploring the use of a longer-term averaging period for defining compliance with the TDS limitations in the Basin Plan and NPDES Permit. This approach could provide relief compared to the current permit conditions with the RWQCB. The current NPDES Permit and Basin Plan require TDS concentrations in recycled water and effluent to be monitored and computed on a 12-month running average basis for permit compliance. Computing averages over a longer period (such as a 5-year running average) could provide an average that is less susceptible to exceedances during droughts. The RWQCB has required that IEUA and CBWM performed detailed groundwater modeling analysis estimate the TDS concentration impacts to groundwater and recycled water supplies in the Chino Basin from allowing a longer-term averaging period (e.g., 3, 5, 10 years). If it can be demonstrated that beneficial uses of the basin and downstream users are protected under a longer-term averaging period, in combination with ongoing compliance with the maximum benefit commitments, the RWQCB would likely approve a longer-term averaging period for the compliance metric. Based on the modeling results, and RWQCB’s own analysis, there could be several resulting recommendations, ranging from no change to permit limits to an averaging period less than the requested 5-year running average (IEUA and GEI, April 2020).

Statistical analysis of the long-term data set from 1995 to 2019 with a 5-year running average instead of the 12-month running average was performed to develop a long-term trend analysis, but did not consider other factors such as the groundwater recharge TDS limitations, triggering management actions when the ambient water quality exceeds the maximum benefit objectives, source water salinity change, or climate change. At the request of the RWQCB, climate change considerations and impacts to source water quality in the groundwater modeling are being completed to show long term impacts to the Chino Basin. Since this analysis is still in progress, simulations of historical drought period or future climate change impacts are not included at this time and is part of the larger modeling effort being prepared under the guidance of the RWQCB. The study was initiated in 2017, and conclusion on the feasibility of the longer-term averaging could be reached by end of 2021, with permit modifications to follow (IEUA and GEI, April 2020).

If a Basin Plan Amendment is issued in the future, then the CBP would need to be reviewed for compliance with the new requirements. It is anticipated that the CBP would comply with this potential future Basin Plan Amendment since the CBP includes an AWPF and would decrease the TDS concentration of IEUA's recycled water.

2.3.2.2 Long-Term Subsidence Management Plan

In 2007 the Watermaster developed the Chino Basin MZ-1 Plan that focused on monitoring ground level and managing subsidence in a managed area within MZ-1. The plan was updated in 2014 to better describe the Watermaster's effort and obligations with regard to land subsidence, which has expanded to areas outside of MZ-1 (WEI, July 2015). The *2015 Update to the Chino Basin Subsidence Management Plan* includes a subsidence management program and provides a process for annual analysis of monitoring data and reporting. The plan is adaptive and is intended to be continually updated and revised to best protect the basin from subsidence. The process of the annual analysis of monitoring data includes the evaluation of the effectiveness of the Subsidence Management Plan to minimize or stop land subsidence and ground fissuring and, if warranted by the data, a recommendation to update the Subsidence Management Pan (WEI, January 2020).

Development of a storage and recovery program, such as the CBP, needs to consider the ongoing subsidence management program and ongoing monitoring. If a storage and recovery program is implemented in MZ-1, then it may need to be modified in the future to be consistent with an updated subsidence management approach.

2.4 Stakeholders' Studies and Information

The project team met with most of the Stakeholders individually at the start of the project to discuss the CBP and how Stakeholders could potentially participate in the Program. As part of these meetings, the project team requested input and information to support the development of the PUT and TAKE components that make up the CBP. Examples of input and information requested by the project team includes information about existing facilities, recent studies, recent project costs, and planned projects. The information received from Stakeholders were used to develop example concepts/projects for the various components that could potentially be included in the CBP and does not imply a commitment to the CBP. This section includes summaries of studies and information from the following stakeholders:

- MWD
- City of Chino
- City of Chino Hills
- City of Pomona
- City of Rialto (Rialto)
- CVWD
- FWC

- JCSD/Western Riverside County Regional Wastewater Authority (WRCRWA)
- WFA

2.4.1 MWD

MWD is a public agency that provides supplemental imported water from the northern California State Water Project and the Colorado River Aqueduct to 26 member agencies located in Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties. As a water wholesaler, MWD does not have retail customers and distributes treated and untreated imported water to its member agencies. IEUA is a wholesale supplier from MWD and provides wholesale water (untreated imported water) to retail agencies in the Chino Basin area. (Arcadis, June 2016) MWD would be the State Water Contractor partner for the CBP

MWD has participated in meetings and workshops provided input to explore potential PUT and TAKE components that are being considered for the CBP. Information provided by MWD to support this planning process include the following:

- Participation in meetings and discussions to explore potential alternatives and ideas, including potential ideas for a future storage and recovery program(s) in the Chino Basin.
- Confirmed minimum requirements for pumping potable water into the Rialto Pipeline including water quality and hydraulic assumptions.
- Discussed pre-delivery options with the project team and how to incorporate the costs in the economic analysis as a potential wheeling charge.
- Provided example drawings for a turnout on the Rialto Pipeline to support planning for a new connection to the Rialto Pipeline for pump back to MWD.

The coordination with MWD for the CBP has been beneficial to MWD’s future work for the Rialto Pipeline prestressed concrete cylinder pipe rehabilitation.

2.4.2 City of Chino

The City of Chino Water Quality Feasibility Study (Hazen and Sawyer, 2018) was conducted to investigate alternatives to utilize groundwater wells contaminated with 1,2,3-TCP, nitrate, perchlorate, and hexavalent chromium. Criteria for evaluation were process robustness, operational complexity, acquisition and disposal of chemicals and waste, ease of implementation, lifecycle cost, and uncertainty in cost and regulation. Non-treatment, interconnections, and blending were considered as non-treatment options, while granular activated carbon (GAC), ion exchange (IX), reverse osmosis, air stripping, and biological filtration were considered as treatment options. Of the treatment options, GAC and IX were determined to be the most feasible, and several alternatives were evaluated further. The top ranked programmatic alternative included four new facilities to treat Wells 4 and 6, Wells 10 and 12, Well 11, and Well 14, and the expansion of the Eastside Water Treatment Facility to treat Well 16. All facilities used a process consisting of cartridge filters, GAC, IX and chlorination. This alternative would cost an estimated $57.3M for 18.7 TAFY of expanded capacity (Hazen and Sawyer, 2018).

The study was used for this Project to develop an example wellhead treatment project that could potentially be included in the CBP as an In-Lieu Local option. The example project includes a centralized wellhead treatment facility connecting Wells 10, 12, and 14. Information obtained from the study included groundwater quality data, well capacities, and characteristics of the proposed site, located at the southwest corner of Philips Boulevard and Central Avenue.

2.4.3 City of Chino Hills

The *Preliminary Design Technical Memorandum for the Chino Hills 1,2,3-TCP Removal Project* (Michael Baker International 2018) was completed to investigate treatment alternatives for groundwater extraction wells contaminated with 1,2,3-TCP. The extraction wells of concern were Wells 1A, 7A, 7B, and 17. The report evaluated water quality data, treatment equipment requirements, and site layouts as a basis for recommending an alternative. Criteria for recommendation were lifecycle cost, ease of maintenance, permitting issues, land requirement, water quality improvement, and overall feasibility. The two alternatives presented were a centralized treatment facility or individual treatment facilities at each well site. Blending and GAC were determined as the most feasible in reducing the concentration of 1,2,3-TCP. The recommendation was a centralized treatment facility located adjacent to the City of Chino Hills Booster 9, with provisions for future expansion. The facility consists of four GAC treatment trains, with each vessel containing 20,000 pounds of carbon. This alternative would cost an estimated $4.1M for 4.4 TAFY of capacity (Michael Baker International 2018).

The study was used for this project to develop an example wellhead treatment project that could potentially be included in the CBP. The example project includes a centralized wellhead treatment facility connecting Wells 1A, 7A, 7B, and 17. Information obtained from the study included water quality data, well capacities and pump curves, and characteristics of the proposed site located on Eucalyptus Avenue in Chino.

2.4.4 City of Pomona

Based on the *Feasibility Study of Recycled Water Interconnections* (Carollo, January 2016) (see Section 2.1.5), recycled water from the City of Pomona was investigated as an additional supply source for the AWPF. While PWRP recycled water is available on an annual basis, the amount of water varies on a seasonal basis with more water available in the winter months and less water available in summer months when recycled water direct use demands are higher. The AWPF requires a constant water supply to most cost effectively produce purified water. Because IEUA's recycled water has the same seasonal variation (more in winter and less in summer), the PWRP recycled water supply was not pursued further as a supply for the CBP. The recycled water supply available from Pomona is summarized in Table 2-4. Recycled water supplies are discussed further in Section 4.1.

Table 2-4. City of Pomona Available Recycled Water

Month	2019 Available Recycled Water (AF)[1]	2026 Available Recycled Water (AF)[2]
January	315	521
February	262	434
March	226	374
April	173	286
May	105	174
June	39	64
July	1	2
August	3	4
September	53	88
October	132	218
November	220	364
December	285	472
Total	**1,811**	**3,000**

Notes:
[1]Provided by City of Pomona, May 21, 2019.
[2]2019 available recycled water scaled up to the anticipated 2026 supply of 3,000 AFY.

2.4.5 CVWD

CVWD provided background documents to support development of unit costs and other analysis. The information included:

- Drawings for the Royer Nesbit Water Treatment Plant (WTP) to provide background information for the planning.
- Project construction costs for a recent extraction well to support the unit cost development.
- General information about the Microvi biological groundwater treatment system which is being installed on a CVWD groundwater well.
- Minimum water treatment plant capacity for the Lloyd W. Michael WTP of 10 mgd (15.5 cubic feet per second [cfs]) to support the minimum water treatment plant flow analysis for the TAKE in-lieu usage analysis.

2.4.6 FWC

FWC provided information about the minimum water treatment plant capacity for the Sandhill WTP of 4 cfs (2.6 mgd) to support the minimum water treatment plant flow analysis for the TAKE in-lieu usage analysis.

2.4.7 JCSD/WRCRWA

IEUA and JCSD are in discussions to provide recycled water to the CBP from their portion of wastewater from WRCRWA. Information about the WRCRWA recycled water is included in Section 4.1 of this TM and TM2 Section 3.2.1.1.

IEUA and JCSD have studied alternatives for the recycled water connection between WRCRWA and IEUA's recycled water system, which are presented in the Joint IEUA-JCSD Recycled Water Intertie Project Title XVI/WIIN Feasibility Study (IEUA, December 2017) and the WaterSMART: Title XVI Water Reclamation and Reuse Project Funding Opportunity BOR-DO-18-F011 (IEUA, July 2018).

2.4.8 Rialto

IEUA and Rialto are in discussions to provide recycled water to the CBP from the Rialto WWTP. Information about the Rialto WWTP recycled water is included in Section 4.1 of this TM and TM2 Section 3.2.1.2.

2.4.9 TVMWD

TVMWD provided information about the minimum water treatment capacity for the Miramar WTP of 10 cfs (6.5 mgd) to support the minimum water treatment plant flow analysis for the TAKE in-lieu usage analysis.

2.4.10 WFA

WFA, which is a Joint Powers Authority for the member agencies of the cities of Chino, Chino Hills, Ontario, Upland and MVWD, provided information about the minimum water treatment plant capacity for the Agua de Legos Treatment Facility of 9 mgd (13.9 cfs) to support the minimum water treatment plant flow analysis for the TAKE in-lieu usage analysis.

Section 3: Regulatory Requirements

Alternatives developed for the CBP were screened for viability in the context of regulatory compliance. Key regulatory requirements are set forth by the California State Water Resources Control Board (SWRCB), Division of Drinking Water (DDW) and the Regional Water Quality Control Board (RWQCB), Santa Ana Region, which have the following responsibilities:

- SWRCB DDW
  - Administers California's Drinking Water and Recycled Water Programs;
  - Establishes criteria to protect public health regarding recycled water production and use;
  - Develops Water Recycling Criteria in the California Code of Regulations (CCR), Title 22, which includes regulations for non-potable and potable use projects; and,
  - Participates in public hearings and makes recommendations for recycled water permits issued by the RWQCBs.
- RWQCB, Santa Ana Region
  - Establishes and oversees surface water and groundwater quality objectives to protect designated beneficial uses of waters in the region;
  - Issues and enforces water recycling and waste discharge permits and requirements; and,
  - Incorporates Title 22 requirements and recommendations from the SWRCB DDW into permits for water recycling and groundwater recharge projects.

This section describes the regulatory requirements that will govern the various aspects of the CBP. Since the program will include both groundwater replenishment and potable water, the applicable regulations include:

- IEUA's existing water recycling and recharge permits: discussed in Section 3.1
- Groundwater replenishment regulations: discussed in Section 3.2
- Drinking water regulations: discussed in Section 3.3

The PUT, TAKE, and program alternatives were developed to comply with these regulatory requirements, as will the recommended alternative as it is developed in more detail throughout the Study.

Additionally, a description of future DPR regulations are discussed in Section 3.4. While the CBP does not specifically include DPR concepts, the program could be expanded to include DPR in the future.

3.1 IEUA's Existing Water Recycling and Recharge Permits

IEUA has existing permits for the operation of the regional water recycling facilities and the groundwater recharge program. The basis for both permits is the Basin Plan, which is discussed further in Section 3.2.1.

IEUA operates its four regional water recycling facilities in compliance with RWQCB Order No. R8-2015-0036 which sets forth waste discharge and master water reclamation requirements (RWQCB, 2015):

- Regional Water Recycling Plant No. 1 (RP-1);
- Regional Water Recycling Plant No. 4 (RP-4);
- Regional Water Recycling Plant No. 5 (RP-5); and,
- Carbon Canyon Water Recycling Facility (CCWRF).

IEUA also operates Regional Water Recycling Plant No. 2 (RP-2), which treats solids from RP-5 and CCWRF, and is included in the permit as part of the RP-5 facility design flow. RP-2 is within the flood zone upstream of the Prado Dam and will be decommissioned once the new RP-5 solids treatment facilities are constructed.

IEUA operates the existing Chino Basin Recycled Water Groundwater Recharge Program in accordance with water recycling requirements set forth in RWQCB Order No. R8-2007-0039, as amended by Order No. R8-2009-0057 (RWQCB, 2007a, 2007b). Furthermore, IEUA operates and maintains its groundwater recharge basins in accordance with waste discharge requirements set forth in RWQCB Order No. R8-2018-0088, which specifies provisions for sediment excavation, dredging, dewatering, and upkeep activities.

3.2 Groundwater Replenishment Using Recycled Water Regulations

This section describes the groundwater replenishment regulations that CBP alternatives will need to comply with, which include the Basin Plan and Maximum Benefit Objective and the groundwater replenishment regulations.

3.2.1 Basin Plan and Maximum Benefit Objectives

The *Basin Plan* (RWQCB, 2019) provides the basis for permits issued and enforced by the RWQCB to implement State water quality controls and plans. The *Basin Plan* designates beneficial uses and water quality objectives for surface water and groundwater in the Santa Ana River watershed. Permit requirements for non-potable and potable water recycling projects are based on Title 22 as well as the *Basin Plan*. Permit limits for groundwater replenishment projects using recycled water are established to ensure that groundwater quality is not degraded or affected such that it contains concentrations of chemicals in amounts that adversely impact beneficial uses, except for approved “maximum benefit” allowances to encourage water recycling.

Historically, it is interesting to note that the Basin Plan was amended in 2004 (RWQCB Resolution No. R8-2004-0001), which updated the groundwater basin boundaries and water quality objectives for TDS and nitrogen. The updated *Basin Plan* also incorporated (1) a revised *Salt and Nitrogen Management Plan* (SNMP), which revised TDS and nitrogen waste load allocations for discharges to the Santa Ana River and its tributaries, (2) revised findings regarding the assimilative capacity in groundwater, and (3) a plan for water recycling in the region. Based on its review of on-going water quality monitoring, the RWQCB updates the SNMP for the Santa Ana region periodically as amendments to the *Basin Plan*.

One of the important issues in the watershed is the accumulation of salts and nitrates, which adversely impact designated beneficial uses of surface water, groundwater, and downstream users. Surface water quality objectives are established to protect receiving waters. The *Basin Plan* establishes five groundwater management zones (MZ) – MZ-1, MZ-2, MZ-3, MZ-4, and MZ-5 – with TDS and nitrate-nitrogen objectives to support water reclamation. The groundwater management zones are numbered from west to east with MZ-1 in the west to MZ-5 in the southeast and are shown in Figure 3-1. For selected groundwater MZs, the *Basin Plan* establishes “maximum benefit” water quality objectives that allow for lower groundwater quality standards (i.e., higher TDS and nitrate-nitrogen concentrations) provided that beneficial uses remain protected. Recycled water agencies must agree to achieve certain water resource commitments in order to implement projects using the “maximum benefit” objectives designated for specific groundwater MZs. If the “maximum benefit” commitments are not met, then the Basin Plan specifies that more restrictive “antidegradation” water quality objectives (lower TDS and nitrate-nitrogen concentrations) would be enforced.

Table 3-1 summarizes the beneficial uses of waters specified in the *Basin Plan* in the Program area.

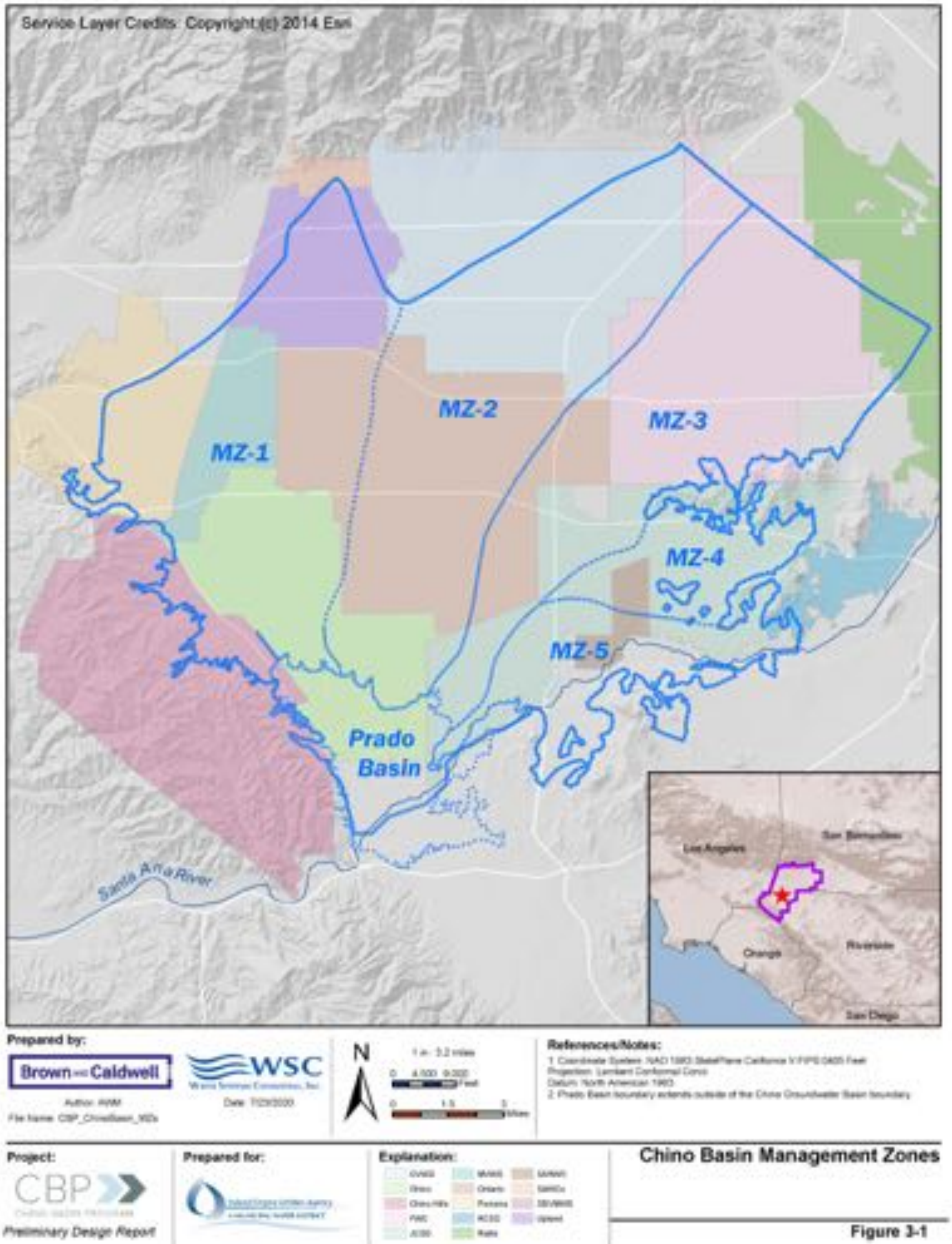

Figure 3-1. CBP Chino Basin MZs

Table 3-1. Beneficial Uses of Water in the Chino Basin Program Area														
		Summary of Existing or Potential Beneficial Uses[1]												
		Surface Waters								Groundwater Management Zones				
Abbreviation and Use Type		Prado Park Lake	Cuca-monga Creek, Reach 1	Chino Creek, Reach 1A	Chino Creek, Reach 1B	Chino Creek, Reach 2	Santa Ana River, Reach 3	Prado Flood Control Basin	Mill / Cuca-monga Creek Wetland	Chino North maximum benefit	Chino 1 antidegradation	Chino 2 antidegradation	Chino 3 antidegradation	Cuca-monga
MUN	Municipal and Domestic Supply									ü	✓	✓	✓	✓
AGR	Agricultural Supply						ü			ü	✓	✓	✓	✓
IND	Industrial Service Supply									ü	✓	✓	✓	✓
PROC	Industrial Process Supply									ü	✓	✓	✓	✓
GWR	Groundwater Recharge		ü			ü	ü							
REC1	Water Contact Recreation	ü		ü	ü	ü	ü	ü	ü					
REC2	Non-Contact Water Recreation	ü	ü	ü	ü	ü	ü	ü	ü					
COMM	Commercial and Sport Fishing	ü												
WARM	Warm Freshwater Habitat	ü		ü	ü		ü	ü	ü					
LWRM	Limited Warm Freshwater Habitat		ü			ü								
WILD	Wildlife Habitat	ü	ü	ü	ü	ü	ü	ü	ü					
RARE	Rare, Threatened or Endangered Species			ü	ü		ü	ü	ü					
SPWN	Spawning, Reproduction and Development						ü							

For inland surface waters, Chapter 4 of the Basin Plan establishes narrative and numeric water quality objectives for the following parameters depending on the associated beneficial use(s):

- Algae
- Ammonia (un-ionized)
- Boron
- Chemical Oxygen Demand
- Chloride
- Chlorine residual
- Color
- Floatables
- Fluoride
- Hardness (as calcium carbonate)
- Metals
- Methylene Blue-Activated Substances
- Nitrate
- Nitrogen, total inorganic
- Oil and grease
- Oxygen, dissolved
- Pathogen indicator bacteria
- pH
- Radioactivity
- Sodium
- Solids, suspended and settleable
- Sulfate
- Sulfides
- Surfactants
- Taste and odor
- Temperature
- TDS
- Toxic Substances
- Turbidity

The *Basin Plan* establishes similar water quality objectives for groundwater to those listed above with the exception of TDS and nitrate for designated management zones. The Basin Plan establishes "maximum benefit" and "antidegradation" groundwater quality objectives for TDS and nitrate-nitrogen for the Chino Basin area of IEUA as shown in Table 3-2.

Table 3-2. Groundwater Quality Objectives in Chino Basin

Groundwater MZ	Maximum TDS Concentration (mg/L)[1]		Maximum Nitrate-Nitrogen Concentration (mg/L)[1]	
	Maximum Benefit	Antidegradation	Maximum Benefit	Antidegradation
Chino North	420	--	5.0	--
MZ-1 (Chino 1)	--	280	--	5.0
MZ-2 (Chino 2)		250		2.9
MZ-3 (Chino 3)		260		3.5

[1] Source: Water Quality Control Plan (Basin Plan) for the Santa Ana River Basin Chapter 4 (RWQCB, 2019).

The Basin Plan divides the Chino North groundwater MZ into three parts for purposes of applying antidegradation objectives. The maximum benefit TDS objective established for the Chino North groundwater MZ is 420 mg/L. Antidegradation TDS objectives are established for MZ-1, MZ-2, and MZ-3 (also referred to as the Chino 1, Chino 2, and Chino 3 groundwater MZs, respectively) at 280, 250, and 260 mg/L, respectively. The same methodology is used for nitrate-nitrogen.

The Basin Plan allows for irrigation uses of recycled water to be credited for nitrogen uptake by plants. When recycled water is used for irrigation, no nitrate-nitrogen limit is set because nitrogen is anticipated to be used by plants and should not affect the underlying groundwater quality. For non-potable recycled water use (i.e., not groundwater recharge), only a TDS limit is established for maximum benefit.

IEUA's master reclamation permit (RWQCB Order No. R8-2015-0036) establishes agency-wide TDS maximum benefit limits for recycled water use, with the exception of groundwater recharge, in areas overlying the Chino North groundwater MZ. Compliance with the maximum benefit limit is based on the 12-month, flow-weighted (by facility) running average of 550 mg/L TDS. It should be noted that the IEUA permit limit is 550 mg/L TDS, which is higher than the aforementioned 420 mg/L groundwater quality objective, because IEUA's maximum benefit commitments call for blending of recycled water with other lower salinity sources of supply (e.g., storm water or imported State Water Project water). The permit specifies that should IEUA not comply with its commitments, then the more restrictive (antidegradation) TDS limits established for MZ-1, MZ-2, and MZ-3 would be imposed. The antidegradation TDS limits are the same as the water quality objectives because MZ-1, MZ-2, and MZ-3 lack assimilative capacity for TDS.

For the Chino Basin Recycled Water Groundwater Recharge Program, both the TDS and nitrate-nitrogen groundwater quality objectives are applicable for maximum benefit. IEUA operates the existing Program in accordance with water recycling requirements set forth in RWQCB Order No. R8-2007-0039, as amended by Order No. R8-2009-0057 (RWQCB, 2007a, 2007b). For groundwater recharge, recycled water from RP-1 and RP-4 must be blended with other water sources so that the five-year running average TDS and nitrate-nitrogen concentrations are equal to or less than the "maximum benefit" water quality objectives for the Chino North MZ of 420 mg/L and 5.0 mg/L, respectively. As part of this commitment, IEUA assures that the combined effluent quality from its reclamation plants will not exceed 550 mg/L TDS and 8 mg/L total inorganic nitrogen (on a 12-month, running average basis).

There are strict consequences associated with non-compliance with the maximum benefit commitments (e.g., failure to develop the required mitigation plans when the action limits are triggered) that could lead to recycled water and groundwater recharge program interruption and/or retroactive activities. If the NPDES permit limit is exceeded, IEUA will be in violation of its NPDES permit and if a plan to address it is not submitted to the RWQCB in a timely manner, this could result in the halting of all use of recycled water. Consequently, all effluent from IEUA's water recycling facilities will need to be discharged to the SAR, which would be above the discharge limitation (550 mg/L). Additionally, according to the Basin Plan, if the maximum benefit commitments (including the 550 mg/L limit) are not met, "the Regional Board will require that CBWM and IEUA mitigate the effects of discharges of recycled and imported water that took place under the maximum benefit objectives." This will require advanced water purification to mitigate the effects of the recycled water and groundwater recharge programs that have operated above the more stringent antidegradation objectives since the 2004 Basin Plan amendment was adopted. The Basin Plan also states that "The Regional Board will also require mitigation of any adverse effects on water quality downstream of the Chino Basin that result from failure to implement the 'maximum benefit' commitments." Non-compliance could result in permit modification with more stringent recycled water and groundwater recharge limits, severely impacting both the operability of the programs as well as the costs.

A summary of the Chino Basin "maximum benefit" commitments specified in the Basin Plan for IEUA and the Chino Basin Watermaster are:

1. Surface water monitoring
2. Groundwater monitoring
3. Chino Desalters
4. Future desalters
5. Recharge facilities
6. IEUA wastewater quality improvement plan
7. Recycled water blending with other sources to comply with "maximum benefit" TDS and nitrate-nitrogen objectives

8. Hydraulic control failure (eliminating groundwater discharge from Chino Basin to the SAR) (Note that IEUA's commitment is for hydraulic control to reduce groundwater discharge from the Chino Basin to the SAR to less than 1.0 TAFY)
9. Ambient groundwater quality determination

3.2.2 Groundwater Replenishment Using Recycled Water Regulations

Water recycling is regulated by Title 22, Division 4, Chapter 3 of the California Code of Regulations (CCR, 2018). Title 22 Water Recycling Criteria are developed and administered by the SWRCB DDW. Non-potable water production for reuse has been practiced for decades and was initially regulated under Title 22 as reclaimed water in 1978. Common non-potable uses of recycled water include irrigation, impoundments, and cooling water. Over the years, expanded beneficial uses were recognized and incorporated in the regulations. Requirements for groundwater replenishment with recycled water were added to Title 22 Water Recycling Criteria in 2014; requirements for surface water augmentation with recycled water were added in 2018. Both groundwater replenishment and surface water augmentation using recycled water are indirect forms of potable reuse.

Title 22 Water Recycling Criteria classify planned GRRPs by their method of recharge:

- Surface application (spreading); and
- Subsurface application (injection wells).

Surface application projects (Title 22, Article 5.1) are allowed to use recycled water that meets the Title 22 tertiary filtration and disinfection requirements with limitations on the amount of tertiary recycled water that can be applied and associated requirements for diluent water (i.e., dilution). Dilution, measured as the recycled municipal wastewater contribution (RWC) in the total recharge volume, may initially be limited to 0.2 (20% recycled water based on the running monthly average over the preceding 120 months). Demonstrated soil aquifer treatment can be used to remove total organic carbon (TOC) and support a GRRP's operation at a higher RWC (i.e., more recycled water and less diluent). Surface application projects can also use recycled water that has undergone advanced treatment as defined in the regulations and thus use higher quantities of recycled water relative to diluent water and potentially no diluent water (with DDW approval).

IEUA was one of the first agencies to be approved to use demonstrated soil aquifer treatment to remove TOC and TN, which allowed IEUA to increase the quantity of recycled water recharged to the Chino Basin. In addition, the 2007 permit was amended in 2009 to modify how IEUA tracks diluent water and recycled water blending, which effectively increased IEUA's ability to recharge using recycled water.

For subsurface application projects (Title 22, Article 5.2), the full volume of recycled water applied (e.g., injected) must receive advanced treatment that consists of reverse osmosis (RO) and an advanced oxidation process (AOP). The regulations establish RO and AOP performance criteria. Subsurface application projects utilize advanced treatment processes to remove TOC and may operate at higher RWC levels, potentially 1.0 (100% recycled water and no diluent) with DDW's approval.

All GRRPs must comply with other requirements for water quality, pathogenic microorganism control, underground retention, response retention time, and monitoring wells. In addition, all GRRPs are required to comply with the SWRCB Recycled Water Policy (SWRCB, 2019). Appendix A summarizes the Title 22 Water Recycling Criteria for groundwater replenishment using recycled water and compares the requirements for surface and subsurface applications.

3.3 Drinking Water Regulations

The SWRCB DDW regulates public water systems in accordance with federal and California Safe Drinking Water Acts (SDWAs). This section summarizes drinking water regulations/statutes including:

- Safe Drinking Water Plan for California
- Water Code and Health and Safety Code Statues
- California Code of Regulations for Drinking Water
- Federal and California Ground Water Rule
- Extremely Impaired Sources
- Upcoming Drinking Water Regulations

The DDW Field Operations Branches are responsible for the enforcement of the federal and California SDWAs by performing field inspections, issuing permits, reviewing plans and specifications for new facilities, taking enforcement actions for non-compliance with laws and regulations, reviewing water quality monitoring results, and supporting and promoting water system security. The staff from the Field Operations Branches also work with county health departments, planning departments, and boards of supervisors.

3.3.1 Safe Drinking Water Plan for California

In 1993, the California Department of Health Services (CDHS) submitted a draft plan called "*Drinking Water into the 21st Century: Safe Drinking Water Plan for California*" that included an overview of drinking water regulations, reviews and plans for drinking water quality/monitoring and threats, treatment technologies, funding aspects and financial assistance, and a focus on the challenges faced by small drinking water systems.

The CDHS, which became the California Department of Public Health (CDPH), transferred the Drinking Water Program (DWP) to the SWRCB in 2014 giving the authority to enforce federal and state Safe Drinking Water Acts. The SWRCB was also given responsibility for completion of the Draft Safe Drinking Water Plan in 2015. The 2015 Plan enhanced DDW's recommendations and implementation plan based on input from the public as well as the collaborations and resources resulting from incorporation of the CDPH DWP into the SWRCB as DDW.

The Safe Drinking Water Plan includes assessment of the quality of the state's drinking water, the identification of specific water quality problems, an analysis of the known and potential health risks that may be associated with drinking water contamination in California, and specific recommendations to improve drinking water quality. The Safe Drinking Water Plan is currently being updated (2020 Plan) to include the topics from previous plans as well as topics recently added and signed into law.

The requirements for the Safe Drinking Water Plan are set forth in Health & Safety Code Section 116355, which identifies the topics to be addressed and requires periodic updates.

3.3.2 Water code and Health and Safety Code Statutes

The California Code, Water Code includes statutes regarding drinking water. The Water Code was originally enacted in 1948 though most of California's water use laws were created by the Water Commission Act passed on 1914.

3.3.3 California Code of Regulation for Drinking Water

California Code of Regulations (CCR) Titles 17 and 22 pertaining to drinking water are listed below. Refer to Appendix B for more information on the CCR.

- Title 17, Division 1
  - Chapter 5, Subchapter 1, Group 4 – Drinking Water Supplies
- Title 22, Division 4
  - Chapter 13 – Operator Certification
  - Chapter 14 – Operator Water Permits

– Chapter 14.5 – Fees
– Chapter 15 – Domestic Water Quality and Monitoring Regulations
– Chapter 15.5 – Disinfectant Residuals, Disinfection Byproducts, and Disinfection Byproduct Precursors
– Division 4, Chapter 16 – California Waterworks Standards
– Division 4, Chapter 17 – Surface Water Treatment
– Division 4, Chapter 17.5 – Lead and Copper

In addition, Title 22 includes Addendums A and B, which include the California Ground Water Rule (see Section 3.3.4 below) and California Long Term 2 Enhanced Surface Water Treatment Rule, respectively.

3.3.3.1 Water Quality and Monitoring Regulations

Water quality and monitoring regulations are defined in Title 22, Division 4, Chapter 15.

3.3.3.2 Maximum Contaminant Levels (MCLs) and Detection Limits for Reporting Purposes (DLRs)

Regulations include monitoring and reporting of chemical constituent primary MCLs and DLRs and secondary MCLs (sMCLs). Table 3-3 lists the tables in Title 22, Chapter 15 of the CCR pertaining to MCLs and DLRs.

Table 3-3. CCR Tables for Primary MCLs and DLRs and Secondary MCLs

List of MCL/DLR	CCR Table Reference No.
MCL Inorganic Chemicals	64431-A
DLR Regulated Inorganic Chemicals	64432-A
Radionuclide (Gross Alpha Particle Activity, Radium-226, Radium-228, and Uranium) MCL and DLR	64442
Radionuclide (Beta Particle and Photon Radioactivity) MCL and DLR	64443
MCL Organic Chemicals	64444-A
DLR Regulated Organic Chemicals	64445.1-A
Secondary MCLs "Consumer Acceptance Contaminant Levels"	64449-A
Secondary MCLs "Consumer Acceptance Contaminant Level Ranges"	64449-B

[1] Refer to Title 22, Chapter 15 of the California Code of Regulations for more information.

Monitoring and compliance for inorganic chemicals listed in Table 64431-A shall be in accordance with Section 64432. Monitoring and compliance for nitrate/nitrite, asbestos and perchlorate shall be in accordance with Sections 64432.1, 64432.2 and 64432.3, respectively. Monitoring requirements for Gross Alpha Particle Activity, Radium-226, Radium-228, and Uranium shall be in accordance with Section 64442. Monitoring requirements for Beta Particle and Photon Radioactivity shall be in accordance with 64443.

Monitoring and compliance for organic chemicals shall be in accordance with Section 64445.1.

Secondary MCLs listed in Table 64449-A includes MCLs for aluminum, color, copper, MBAS, iron, manganese, methyl tert-butyl ether (MTBE), odor, silver, thiobencarb, turbidity, and zinc. If any of these constituents exceeds an MCL additional sampling is required per Section 64449.

Table 64449-B includes MCL ranges (recommended, upper and short term) for TDS, specific conductance, chloride and sulfate with level ranges. No fixed consumer acceptance contaminant level has been established for these constituents, however upper and short-term contaminant levels are only acceptable on a temporary basis for existing community water systems pending construction of treatment facilities or development of acceptable new water sources. New services from community water systems serving water which carries constituent concentrations between the upper and short-term contaminant levels are only acceptable if adequate progress is being demonstrated toward providing water of improved mineral quality or for other reasons acceptable to the State Water Board.

3.3.3.3 Notification Levels

Currently there are 31 chemicals with notification levels (as of February 6, 2020). Notification levels are health-based advisory levels established by the DDW for chemicals in drinking water that do not have an MCL. When chemicals are found at concentrations greater than their notification levels, certain requirements and recommendations apply. The level at which DDW recommends removal of a drinking water source from service is called the "response level."

When a notification level is exceeded in the drinking water, State law (Health & Safety Code Section 116455) requires the drinking water system to notify its governing body. In addition, DDW recommends that the utility inform its customers regarding the exceedance of the notification level and about health concerns associated with exposure to it.

If a chemical is present in drinking water at concentrations considerably greater than the notification level, DDW recommends that the drinking water system take the source out of service. The level prompting a recommendation for source removal is the "response level" of Health & Safety Code and depends upon the toxicological endpoint that is the basis for the notification level.

3.3.4 Federal and California Ground Water Rule

The Ground Water Rule applies to public water systems that use groundwater as a source of drinking water. The rule also applies to any system that delivers surface and groundwater to consumers where the groundwater is added to the distribution system without treatment. The Ground Water Rule was published in the Federal Register on November 8, 2006, and requires four major components:

- Routine sanitary surveys of systems required every three years (minimum);
- Triggered source water monitoring;
- Corrective action is required for any system with a significant deficiency or source water fecal contamination; and
- Compliance monitoring to ensure that treatment technology installed to treat drinking water reliably achieves 99.99 percent (4-log) inactivation or removal of viruses.

Ground Water Rule requirements are included in Section 64430 and Addendum A of the CCR. Section 64430 states that a public water system that uses groundwater shall comply with the following provisions of 40 Code of Federal Regulations as they appear in the Ground Water Rule published in 71 Federal Register 65574 (November 8, 2006) and amended in 71 Federal Register 67427 (November 21, 2006) and 74 Federal Register 30953 (June 29, 2009).

3.3.5 Extremely Impaired Sources

DDW follows Process Memorandum 97-005 for evaluating the use of extremely impaired sources for drinking water. The 97-005 Memorandum was updated in 2015, as a draft memorandum. The update is summarized in Appendix C. (SWRCB, DDW, 2015). An extremely impaired source is a water source that exceeds 10 times an MCL or action level (AL) based on chronic health effects, exceeds three times an MCL or AL based on acute health effects, is a surface water that requires more than 4 log Giardia and 5 log virus reduction, is extremely threatened with contamination due to proximity to know contaminating activities, contains a mixture of contaminants of health concern, and is designed to intercept known contaminants of health concern.

3.3.6 Upcoming Drinking Water Regulations

There are several drinking water regulations that are in process or planned that could potentially impact the drinking water concepts being developed for the CBP. The following upcoming regulations should be monitored as they relate to the drinking water concepts being developed for CBP.

- **Revised Total Coliform Rule:** The Federal Revised Coliform Rule became effective in 2016. California is preparing its version of the regulations. Until the state version is adopted, public water systems must comply with California's existing Total Coliform Rule and the new Federal Revised Coliform Rule.
- **Lead and Copper Rule:** Draft regulation packages are being prepared for the State and Federal Lead and Copper Rules. Since 2016, DDW has provided recommendations to California water systems about U.S. EPA's recommendations to provide additional information to the public related to lead pipes and fixtures. A draft of the Lead and Copper Rule Long-Term Revisions was published in November 2019 and a final rule is expected to be released shortly. Compliance is likely to begin around 2023.
- **Cross Connection Regulations:** Work on updating these regulations Title 17 CCR is conducted periodically as needed. Updates to these regulations are underway with a Policy Handbook. The SWQCB will request comments on the Draft Policy Handbook prior to adoption.
- **AB 2501 (Chu) (Statutes of 2018, Chapter 871):** amended drinking water requirements in 2018 to add additional topics, including a statement that every human being has the right to safe, clean, affordable and accessible water adequate for human consumption, cooking, and sanitary purposes, and a review of the use of administrators for disadvantaged communities' public water systems and an evaluation of the success of consolidation of drinking water systems.
- **Review of the Perchlorate Maximum Contaminant Level (MCL):** The DDW review of the perchlorate MCL was completed to determine whether it should be revised in response to the 2015 public health goal (PHG). In 2017, DDW proposed lowering the detection limit for purposes of reporting for perchlorate.
- **Microplastics: Senate Bill No. 1422 (filed on September 28, 2018):** requires the State Water Board to adopt a definition of microplastics in drinking water on or before July 1, 2020, and on or before July 1, 2021, to adopt a standard testing methodology for microplastics and requirements for four years of testing and reporting, including public disclosure of results.
- **MCL Review:** To meet requirements of the Health & Safety Code Section 116365(g), each year the State Water Board identifies the MCLs it intends to review.
- **DPR:** The report to the Legislature regarding the feasibility of developing DPR criteria was submitted in December 2016 with work on DPR continuing. DDW issued the Second Edition of the DPR Framework for public comment in August 2019. The Framework is not a regulatory document.
- **Per- and Polyfluoroalkyl Substances (PFAS):** PFAS are a large class of emerging contaminants which includes perfluorooctanesulfonic acid (PFOS) and PFOA. These contaminants have been detected in water supplies and the SWRCB has established NLs of 6.5 parts per trillion (ppt) for PFOS and 5.1 ppt for PFOA and Response Level (RL) of 40 ppt for PFOS and 10 ppt for PFOA. Starting in January 2020, water suppliers that detect PFOS and PFOA at levels higher than the RLs must take that water supply out of service, treat the water delivered, and provide public notification.
- **Hexavalent Chromium:** A hexavalent chromium MCL of 10 micrograms per liter (µg/L) was established in California on July 1, 2014 and invalidated by a court judgement on May 31, 2017. It is anticipated to be re-proposed at this same level in the future.

3.4 Future Potential DPR Regulations

The CBP concept is based on indirect potable reuse (IPR) to be able to use the Chino Basin as a storage basin. DPR is not currently included in the CBP, but IEUA's recycled water program could be expanded to include DPR in the future. A DPR concept could expand upon the advanced water purification concepts developed for the CBP with additional treatment/buffers and mix the water with a raw imported water source prior to water treatment, such as the Rialto Pipeline or upstream of CVWD's Lloyd. W. Michael WTP.

The main difference between IPR projects and DPR projects is the presence of an environmental buffer. An IPR project features an aquifer or reservoir that provides measurable and significant public health benefits. Lacking such an environmental buffer, a DPR project can utilize enhanced reliability from mechanical systems and treatment plant performance to replace the environmental buffer benefits and maintain an equivalent level of public health protection. DPR was defined in March 2019 under California Assembly Bill (AB) 292 by removing the term "direct" and defining based on purified water application instead through the following two terms: raw water augmentation (RWA) and treated water augmentation (TWA).

In August 2019, the SWRCB DDW issued "*A Proposed Framework for Regulating Direct Potable Reuse in California, Second Edition*" (SWRCB, 2019) for public review. The Framework, Second Edition, is an update of an earlier Framework completed in April 2018; the Framework, Second Edition represents DDW's current thinking on regulating DPR. DDW presented the Framework, Second Edition along with a summary of public comments to the SWRCB Board in November 2019. The Framework, Second Edition, focuses on development of a single regulatory package that covers the range of DPR, from TWA through RWA. DPR is defined in AB 574 as the planned introduction of recycled water either directly into a public domestic water system (i.e., TWA) or into a raw water supply immediately upstream of a drinking water treatment plant (i.e., RWA).

As noted previously, the environmental buffer in a DPR scenario may be significantly reduced or eliminated compared to IPR. Consequently, there may be enhanced requirements for pathogen control, chemical attenuation, real-time monitoring, engineered storage, and blending. Though regulations for RWA and TWA have not yet been developed, potential future requirements can be inferred from recent publications and presentations from DDW and the California DPR Expert Panel.

Under legislative mandate in AB 574, the SWRCB is required to develop regulations for RWA by the end of 2023 (with a potential extension to mid-2025). The aforementioned *2019 Framework, Second Edition* indicated DDW's intent to develop a single DPR regulatory package encompassing requirements for both RWA and TWA. The timeline for the DPR regulatory package remains consistent with the AB 574 deadline of December 2023.

In marked contrast with earlier potable reuse regulations, the revised DPR regulations will require treatment to consistently meet a daily risk objective versus an annual risk objective. This shift will likely increase the log reduction value (LRV) requirements for DPR applications, though the specific criteria are still under development. The SWRCB is funding five priority DPR research topics to address knowledge gaps identified as critical for regulatory development. Centered around control of pathogens and toxic chemicals (Table 3-4), these research topics provide further insight into potential future DPR considerations and, thus, may influence the design of the CBP AWPF should RWA or TWA be a possible future.

Table 3-4. Approaches to Maintain Public Health Protection in DPR settings	
Approach	**Description**
Source Control	Source control is a management barrier that provides a first layer of protection against toxic chemicals. Controls chemical risks by reducing concentration and variability of chemicals entering an AWPF. More stringent source control requirements will apply to DPR compared to IPR, due to lack of an environmental buffer.
Wastewater Treatment	Upstream wastewater treatment that provides a consistently high-quality feedwater to AWPFs is key to more consistent AWPF performance. The State and Expert Panel recommend minimum criteria for WWTPs serving as source water to a DPR system, including a high degree of organics destruction (e.g., secondary processes providing biological nutrient removal) and tertiary filtration prior to the AWPF (Olivieri et al, 2016; Tchobanoglous et al, 2015; State Water Board, 2019). Other beneficial elements include management of flows into the system and rigorous process monitoring.
Pathogen Control	Pathogens represent the most important public health concern because a single exposure can result in a public health impact. The State will require additional redundancy in pathogen control for DPR, possibly extending beyond IPR requirements and based on complying with a daily risk goal (instead of annual risk goal used for IPR). Barriers include treatment and management (non-treatment) approaches. The DPR Regulatory Framework will likely require project sponsors to justify removal credits at each treatment location (e.g., WWTP, AWPF, and drinking WTP [DWTP]). Non-treatment barriers may include blending with other source waters and dilution/mixing through reservoirs or other large storage structures, offering variable degrees of protection depending on system size and configuration.
Chemical Control	DPR trains will likely need to provide additional control measures, including treatment, in order to attenuate chemical peaks and provide added protection against compounds known to pass through full advanced treatment trains (Olivieri et al, 2016) and unknown compounds with similar characteristics.
Response Time and Failures	In IPR settings, an environmental buffer enables more time for identifying failures and responding appropriately. With DPR retention time being hours (not months), DPR requires moving towards greater failure prevention and configuring the elements of a DPR system including monitoring, diversions, storage, treatment, automated controls, and operator training to achieve a balance that protects public health without much failure response time.

Section 4: PUT Assumptions

The CBP includes two main categories of facilities: PUT, the components to recharge purified water to the Chino Basin, and TAKE, the components to extract groundwater and convey potable water supply. The assumptions that were used to develop the PUT components are discussed in this section, except for conveyance, which is discussed for both PUT and TAKE components in Section 6.

The PUT components are as follows, with the corresponding section noted:

- **Tertiary recycled water supply** of 17 TAFY to produce 15 TAFY of purified water (discussed in Section 4.1).
- **Tertiary recycled water conveyance** to supply additional tertiary recycled water to IEUA's recycled water distribution system and the AWPF(s) (conveyance for both PUT and TAKE components is discussed in Section 6).
- **Advanced water purification** to treat the tertiary recycled water and produce purified water suitable for groundwater recharge through subsurface application (discussed in Section 4.2).
- **Purified water pumping and conveyance** to convey water from the AWPF(s) to the injection wells for groundwater recharge (conveyance for both PUT and TAKE components is discussed in Section 6).
- **Groundwater recharge using injection wells** and backup connections to recharge basins (discussed in Section 4.3).

To support the development of the PUT, TAKE, and program alternatives, WEI completed initial groundwater modeling for the PUT and TAKE components. The initial groundwater modeling results are discussed in TM2 Section 2.

4.1 Tertiary Recycled Water Supply and Quality

To meet the CBP objectives, various recycled water supply sources were considered that would allow IEUA to expand both direct use and groundwater recharge of tertiary recycled water as well as meet the future needs of CBP. The CBP will require 17.0 TAFY of tertiary recycled water to produce 15.0 TAFY of purified water.

For this Study, the recycled water supply sources considered for the CBP include IEUA, the Rialto WWTP, and the WRCRWA treatment plant. Recycled water supply is discussed further in Section 4.1.1 and recycled water quality in Section 4.1.2.

The seasonal and diurnal availability of recycled water could impact the AWPF sizing and operations. An evaluation of seasonal availability was also conducted to confirm that the AWPF could be supplied with a constant supply of recycled water to most cost-effectively produce purified water. New recycled water supplies that can provide constant flow year-round, such as WRCRWA and the Rialto WWTP, have the biggest benefit to the CBP to supply the AWPF at a constant rate and eliminate the need for seasonal storage. Due to the seasonal availability of recycled water from the PWRP (see Section 2.4.4), this source was not considered as a future supply for the CBP.

Diurnal recycled water supply fluctuations were assumed to be managed with existing and new equalization basins and recycled water storage tanks, which will be analyzed in more detail in future phases of the Program. The external recycled water supplies both have existing or planned equalization that will allow them to deliver a constant recycled water supply to IEUA's system (see Sections 4.1.1.2 and 4.1.1.3 in this TM). Equalization basins to manage diurnal recycled water supply fluctuations within IEUA's system were assumed for the AWPF components (see TM2 Section 3.2.2).

An analysis of IEUA's recycled water system was also completed using IEUA's recycled water model to confirm that recycled water can be conveyed to the appropriate locations in the recycled water system to meet current and future direct use and tertiary GWR demands as wells as future CBP demands

4.1.1 Recycled Water Supplies and Demands

This section is currently in development.

4.1.2 Recycled Water Quality

The following sections summarize the water quality for the three recycled water sources (IEUA, WRCRWA, and the Rialto WWTP) and potential water quality impacts on the AWPF design.

4.1.2.1 IEUA Recycled Water

There are two primary locations that are being considered for the primary AWPF in IEUA's system: RP-1 and

RP-4. The primary recycled water supply for the AWPF will be from the RP where the AWPF is located with additional recycled water supplied from IEUA's recycled water system and new external supplies. This section discusses the RP-1 and RP-4 treatment systems employed to treat wastewater and produce tertiary recycled water and presents recycled water quality and potential issues with future advanced water purification processes.

The treatment systems at RP-1 and RP-4 are as follows:

- RP-1 currently treats municipal wastewater through screening, grit removal, primary clarification, activated sludge aeration, secondary clarification, coagulation, dual-media gravity filtration, and final disinfection with sodium hypochlorite. As documented in the RP-1 Liquids & Solids Capacity Recovery Preliminary Design Report (Carollo, April 2019), RP-1 will be upgraded with an MBR system (expected to be online by 2030) to recover capacity at the plant and implement other upgrades to replace structures and facilities that have reached the end of their useful lives. The treatment capacity of RP-1 is currently 32 mgd and will be restored to 40 mgd with the RP-1 Capacity Recovery Project.
- RP-4 currently treats municipal wastewater through screening, grit removal, primary clarification, Bardenpho activated sludge treatment, secondary clarification, coagulation, filtration, and final disinfection with sodium hypochlorite. The treatment capacity of RP-4 is 14 mgd. IEUA is planning to expand/upgrade RP-4 around 2040 to an MBR treatment facility.

RP-1 and RP-4 dose polymer and ferric chloride for enhanced primary clarification and aluminum sulfate as a filter aid as part of the wastewater treatment process. Aluminum can react with silica to form aluminum silicate salts such as calcium aluminum silicate and sodium aluminum silicate that cause scaling in RO systems. Ferric hydroxide, aluminum hydroxide, and phosphate salts, such as ferric hydroxyphosphate and aluminum hydroxyphosphate, also can precipitate on the membrane surface, attract silica, and cause silica fouling. Total aluminum and iron levels reported in Table 4-1 are at acceptable levels for RO treatment. Should aluminum and iron levels become problematic in the future, IEUA may need to optimize its wastewater treatment chemical addition to avoid RO fouling in the future AWPF.

Table 4-1 summarizes RP-1 and RP-4 final effluent average, minimum, and maximum water quality as reported in IEUA's annual recycled water quality reports. To better characterize water quality for AWPF design and to fill in the gaps on missing parameters that influence membrane performance (i.e., strontium and bromide), a sampling plan has been recommended for IEUA to conduct at RP-1 and RP-4.

Table 4-1. IEUA RP-1 and RP-4 Recycled Water Quality						
Constituent [1]	IEUA RP-1			IEUA RP-4		
	Avg	Min	Max	Avg	Min	Max
Calcium (mg/L Ca^{2+})	45	25	51	39	28	51
Magnesium (mg/L Mg^{2+})	9	7	11	9	7	11
Sodium (mg/L Na^{+})	97	79	116	96	75	116
Potassium (mg/L K^{+})	16[2]	14[2]	18[2]	15[2]	14[2]	16[2]
Barium (mg/L Ba^{2+})	0.014	0.011	0.021	0.011[4]	0.008[4]	0.013[4]
Copper (mg/L Cu^{+2})	0.004	0.002	0.008	0.004[4]	0.001[4]	0.006[4]
Iron (mg/L Fe^{2+})	0.11[3]	0.11[3]	0.11[3]	0.038	0.000	0.073
Manganese (mg/L Mn^{2+})	0.010	0.002	0.037	0.023[2]	0.016[2]	0.032[2]
Ammonium (mg/L NH_4^+ as N)	< 0.1	< 0.1	< 0.3	< 0.1	< 0.1	0.1
Aluminum (mg/L Al^{3+})	0.084[2]	0.024[2]	0.141[2]	0.073[7]	0.056[7]	0.095[7]
Bicarbonate (mg/L HCO_3^-)	177	132	217	159	100	197
Sulfate (mg/L SO_4^{2-})	51	39	80	53	39	74
Chloride (mg/L Cl^-)	111	96	132	112	82	134
Fluoride (mg/L F^-)	0.3	0.1	0.3	0.2	0.1	0.3
Nitrate (mg/L NO_3^- as N)	5.9	3.0	9.6	4.6	2.7	7.3
Phosphate (mg/L PO_4^{3-})	0.6	0.6	2.5	4.0	0.1	11.5
Silica (mg/L SiO_2)	24	19	29	21	4	31
pH	7.1	6.8	7.4	7.0	6.8	7.3
Alkalinity (mg/L as $CaCO_3$)	145	108	178	130	82	161
Hardness (mg/L as $CaCO_3$)	150	91	173	137	99	173
Boron (mg/L)	0.2	0.2	0.3	0.3	0.2	0.3
TOC (mg/L)	5.6	4.8	6.6	4.3	3.4	6.1
TDS (mg/L))	499	408	602	459	384	526
1,4-Dioxane (µg/L) [5], [6]	1.02	ND	1.10	1.02	ND	1.10
N-Nitrosodimethylamine (NDMA) (ng/L) [5]	4.35	2.20	7.00	4.35	2.20	7.00
NMOR (ng/L) [5]	66.17	6.90	350	66.17	6.90	350
Temperature (°C) [8]	25.01	16.29	30.40	-	-	-

Notes:

(1) Unless otherwise noted, based on monthly averages from 2014 to 2018 as reported in IEUA's annual recycled water quality report.

(2) Based on monthly samples from January 2018 to July 2019.

(3) Based on one sample taken in February 2018.

(4) Based on monthly samples from April 2018 to July 2019.

(5) Based on quarterly sample from March 2018 to May 2019 of blended RP-1 and RP-4 recycled water for groundwater recharge.

(6) If non-detect (ND) was reported, reporting limit value of 1.0 µg/L was used to calculate average.

(7) Based on eight samples from May 2018 to August 2019.

(8) Based on daily samples from January 2018 to August 2019.

4.1.2.2 Rialto WWTP Recycled Water

The Rialto WWTP currently consists of five independent treatment plants: Claraetor No. 1 (out of service), Claraetor No. 2, Conventional Plant No. 3, Conventional Plant No. 4 and Conventional Pant No. 5. Each plant provides screening, grit removal, primary clarification, activated sludge treatment, and secondary clarification. Combined flows from the plants then receive tertiary treatment through filtration and disinfection through chlorination for non-potable reuse. Rialto WWTP has an UV disinfection system, which never was put into operation.

The Rialto WWTP is currently undergoing upgrades to their existing infrastructure, focused on Conventional Plant No. 5, that includes replacement of the influent meter, headworks improvements, a new primary clarifier, a new aeration basin, a new secondary clarifier, new blowers, new disk filters, expansion of the chlorine contact tank, upgrades to the yard piping, electrical and instrumentation, and modifications to the sludge holding tank and filtrate equalization tank. The upgrades are expected to be completed in 2020 (Rialto Water Services, 2018). Rialto has a limited recycled water system that currently only provides recycled water to Caltrans at the Interstate Highway 10 irrigation corridor.

Table 4-2 summarizes the Rialto WWTP's final effluent average, minimum, and maximum water quality post dechlorination as reported on California Integrated Water Quality System (CIWQS) Electronic Self-Monitoring and Reporting Program (eSMR) from 2014 through 2018. Iron data was not available. Alum and polymer are added upstream of the tertiary filters to aid in filtration. Should aluminum and iron levels become problematic in the future, Rialto may need to optimize its wastewater treatment chemical addition to minimize or avoid RO fouling in the future AWPF for the CBP.

Table 4-2. Rialto WWTP Recycled Water Quality

Constituent (1)	Avg	Min	Max
Magnesium (mg/L Mg^{2+})	9	8	11
Sodium (mg/L Na^{+})	87	80	98
Barium (mg/L Ba^{2+})	0.022	0.017	0.024
Copper (mg/L Cu^{+2})	0.018	0.005	0.079
Ammonium (mg/L NH_4^{+} as N)	0.16	<0.10	6.7
Aluminum (mg/L Al^{3+})	0.052	0.053	0.065
Bicarbonate (mg/L HCO_{3-})	183	160	200
Sulfate (mg/L SO_4^{2-})	70	64	76
Chloride (mg/L Cl^{-})	83	77	89
Fluoride (mg/L F^{-})	0.4	0.3	0.5
Nitrate (mg/L NO_{3-} as N)	8.9	6.8	12
pH	7.4	6.9	8.5
Alkalinity (mg/L as $CaCO_3$)	150	131	164
Hardness (mg/L as $CaCO_3$)	189	150	230
Boron (mg/L)	0.2	0.2	0.2
TOC (mg/L)	6.8	5.7	13.0

Table 4-2. Rialto WWTP Recycled Water Quality			
Constituent (1)	Avg	Min	Max
TDS (mg/L)	398	199	542
Temperature (°C)	25.7	18.7	31.5

Notes:
(1) Unless otherwise noted, samples are based on CIWQS eSMR from 2014 through 2018. These samples are taken post dechlorination.

4.1.2.3 WRCRWA Recycled Water

To produce tertiary effluent for non-potable reuse, WRCWRA currently treats municipal wastewater through screenings, grit removal, primary clarification, secondary oxidation, secondary clarification, coagulation, Dynasand filtration, and medium-pressure ultraviolet disinfection.

Table 4-3 summarizes WRCRWA's final effluent average, minimum, and maximum water quality from effluent pump station for discharge to Reach 3 of the SAR as reported on CIWQS eSMR from 2014 through 2018. WRCRWA adds polymer and aluminum sulfate as filter aids. Data for iron is missing and should iron levels become problematic in the future, WRCRWA may need to optimize its wastewater treatment chemical addition to avoid RO fouling in the future AWPF for the CBP. The high fluoride concentration in Table 4-3 reflects one sample point of 68 mg/L reported on July 18, 2018. All other measured fluoride concentrations were 0.4 mg/L or less. Because high fluoride concentrations can cause calcium fluoride scaling on the future AWPF RO system, BC recommends more sampling for fluoride to confirm if the July 18, 2018 is a non-repeating outlier in the data set or an indication of increasing fluoride concentrations in the future.

Table 4-3. WRCRWA Recycled Water Quality			
Constituent[1]	Avg	Min	Max
Calcium (mg/L Ca^{2+})	56.9	47.0	68.0
Magnesium (mg/L Mg^{2+})	9.5	7.8	11.0
Sodium (mg/L Na^{+})	104	87.0	140
Barium (mg/L Ba^{2+})	0.030	0.010	0.053
Copper (mg/L Cu^{+2})	0.002	0.0004	0.004
Ammonium (mg/L NH_4^{+} as N)	0.42	<0.048	14
Aluminum (mg/L Al^{3+})	0.56	0.28	0.87
Bicarbonate (mg/L HCO_{3-})	179	130	230
Sulfate (mg/L SO_4^{2-})	162	57	264
Chloride (mg/L Cl^{-})	150	58	190
Fluoride (mg/L F^{-})	0.27	0.18	68(2)
Total Nitrogen (mg/L N^{3+})	3.3	0.1	98(3)
pH	7.1	5.9	8.5
Alkalinity (mg/L as $CaCO_3$)	146	107	189

Table 4-3. WRCRWA Recycled Water Quality			
Constituent[1]	**Avg**	**Min**	**Max**
Hardness (mg/L as $CaCO_3$)	183	150	210
Boron (mg/L)	0.42	0.29	0.63
TOC (mg/L)	7.0	4.9	48(4)
TDS (mg/L)	538	330	660
NDMA (ng/L)	<1,400	<1,400	<1,400
Temperature (°C)	26	6.7(5)	36

Notes:

(1) Unless otherwise noted, samples are based on CIWQS eSMR from 2014 through 2018. These samples are taken from effluent pump station for discharge to Reach 3 of Santa Ana River.

(2) Outlier data point recorded on 7/18/2018. All other fluoride samples were 0.4 mg/L or less.

(3) Of the monthly nitrogen samples from 2014 to 2018, two samples were greater than 7 mg/L: 19 mg/L recorded on 1/4/2017 and 98 mg/L recorded on 3/8/2017.

(4) Of the weekly samples recorded from 2014 to 2018, two TOC samples were greater than 14 mg/L: 48 mg/L recorded on 8/26/2015 and 20 mg/L recorded on 12/17/2014. Average TOC concentrations were similar to IEUA and Rialto WWTP recycled water.

(5) Of daily samples recorded from 2014 to 2018, only one was as low as 6.7°C. The remainder were 16 or greater.

4.1.2.4 Overall Recycled Water Quality

The overall impact of recycled water quality on the AWPF design is discussed in this section.

For the RP-1 alternatives, it is assumed that the AWPF influent would largely reflect the RP-1 values reported in Table 4-5 under the IEUA RP-1 columns with slightly lower chloride, sodium, pH, and NDMA levels because AWPF effluent would be diverted immediately downstream of the tertiary filters, and upstream of chlorination. Because the AWPF would add chlorine and ammonia immediately upstream of the MF process, the preliminary design will assume values shown in Table 4-4 are the same as the AWPF influent following chlorination.

For the RP-4 alternatives, it is assumed that the AWPF influent would similarly reflect the RP-4 values reported in Table 4-4 with slightly lower chloride, sodium, pH, and NDMA levels for 60 percent of the influent flow on average. The remaining 40 percent of the RP-4 AWPF influent flow would reflect the water quality from IEUA's recycled water distribution system, comprised of a varying blend of recycled water from RP-1, WRCRWA, and/or the Rialto WWTP. Table 4-4 summarizes the projected water quality for the RP-4 AWPF alternatives assuming the following for each condition and this projected water quality was used to develop the RP-4 AWPF alternatives.

- **Average:** 60 percent RP-4 and 40 percent RP-1.
- **Minimum:** Minimum of RP-4, RP-1, WRCRWA, and the Rialto WWTP.
- **Maximum:** Maximum of RP-4, RP-1, WRCRWA, and the Rialto WWTP.

Table 4-4. Projected RP-4 AWPF Influent Water Quality			
Constituent [1]	**Avg**	**Min**	**Max**
Calcium (mg/L Ca^{2+})	41	25	68
Magnesium (mg/L Mg^{2+})	9.4	7.0	11
Sodium (mg/L Na^{+})	96	75	140
Potassium (mg/L K^{+})	15	14	18
Barium (mg/L Ba^{2+})	0.012	0.008	0.053
Copper (mg/L Cu^{+2})	0.004	0.0004	0.079
Iron (mg/L Fe^{2+})	0.068	0.000	0.112
Manganese (mg/L Mn^{2+})	0.018	0.002	0.037
Ammonium (mg/L NH_{4+} as N)	<0.1	<0.1	14.0
Aluminum (mg/L Al^{3+})	0.077	0.024	1.2
Bicarbonate (mg/L HCO_{3-})	166	100	230
Sulfate (mg/L SO_4^{2-})	52	39	264
Chloride (mg/L Cl^{-})	112	58	190
Fluoride (mg/L F^{-})	0.22	0.10	0.54[2]
Nitrate (mg/L NO_{3-} as N)	5.1	2.7	12
Phosphate (mg/L PO_4^{3-})	2.6	0.1	12
Silica (mg/L SiO_2)	22	4.0	31
pH	7.06	5.9	8.5
Alkalinity (mg/L as $CaCO_3$)	136	82	178
Hardness (mg/L as $CaCO_3$)	142	91	230
Boron (mg/L)	0.24	0.18	0.63
TOC (mg/L)	4.9	3.4	48
TDS (mg/L)	475	199	660
1,4-Dioxane (µg/L)	1.0	ND	1.1
NDMA (ng/L)	4.4	<1.4	7.0
NMOR (ng/L)	66	6.9	350
Temperature(°C)	25	16[3]	36

Notes:

(1) Refer to Table 4-5 for RP-1 and RP-4, Table 4-6 for Rialto WWTP recycled water and Table 4-7 for WRCRWA recycled water.

(2) Removed 68 mg/L outlier from WRCRWA data set.

(3) Removed 6.7°C outlier from WRCRWA data set.

4.1.3 Recycled Water Hydraulic Modeling

IEUA's recycled water model was originally constructed in 2003 in H¬2OMAP Water. Since then, the model has gone through multiple updates and has been converted into InfoWater model software. The model was most recently upgraded and calibrated in 2016 including updated controls and diurnal demand curves. The 2016 calibration scenario is considered representative of the system, and capital projects completed since 2016 were added to the model. The system hydraulic profile is shown in Figure 4-1 below. The recycled water model was used to support the development of CBP alternatives to (1) complete a recycled water distribution analysis to confirm that IEUA's existing recycled water system has sufficient capacity to convey water and maintain adequate pressures once the external supplies and the AWPF are incorporated into the system and (2) estimate tertiary recycled water pumping requirements whether the AWPF is located at RP-1 or RP-4.

The elements of the recycled water system included in the hydraulic model and recent system improvements are listed below:

- Pipelines: The recycled water pipelines are included in the hydraulic model, and include the pipeline length, diameter, roughness coefficient, and a check valve if the pipe does not allow reverse flow. The Baseline Pipeline and the Napa Lateral pipelines were constructed after the 2016 model calibration and are included in the model.
- Junction: The junctions in the recycled water model are necessary to connect joining pipelines at intersections. The elevation is defined at the junctions and necessary for the model to calculate system pressures. The system demands and demand patterns are also applied to the junctions.
- Tanks: The recycled water system includes 22.5 MG of available storage within six storage tanks. These tanks provide operational storage during times of peak demands. The modeled tanks include properties such as elevation, minimum and maximum water level, and diameter.
- Pumps: The pumps at each pump station are included in the model and run based on their pump curve and operational controls. The RP-1 1158 Pump Station was recently upgraded to include higher capacity pumps and was also updated in the model.
- Reservoirs: Fixed head reservoirs are used to model the water recycling plants.
- Valves: The model includes both pressure reducing valves (PRV) and flow control valves (FCV). The PRVs are representative of actual PRVs in the recycled water system that allow higher pressure zones to supply lower pressure zones. The PRVs includes the valve diameter, pressure setting, and operational controls as applicable. The FCVs in the model are located on the discharge side of IEUA's water recycling plants to control the recycled water supply. Diurnal production curves developed from the SCADA data during the 2016 calibration are applied to each plant to mimic the actual production at each plant throughout the day.

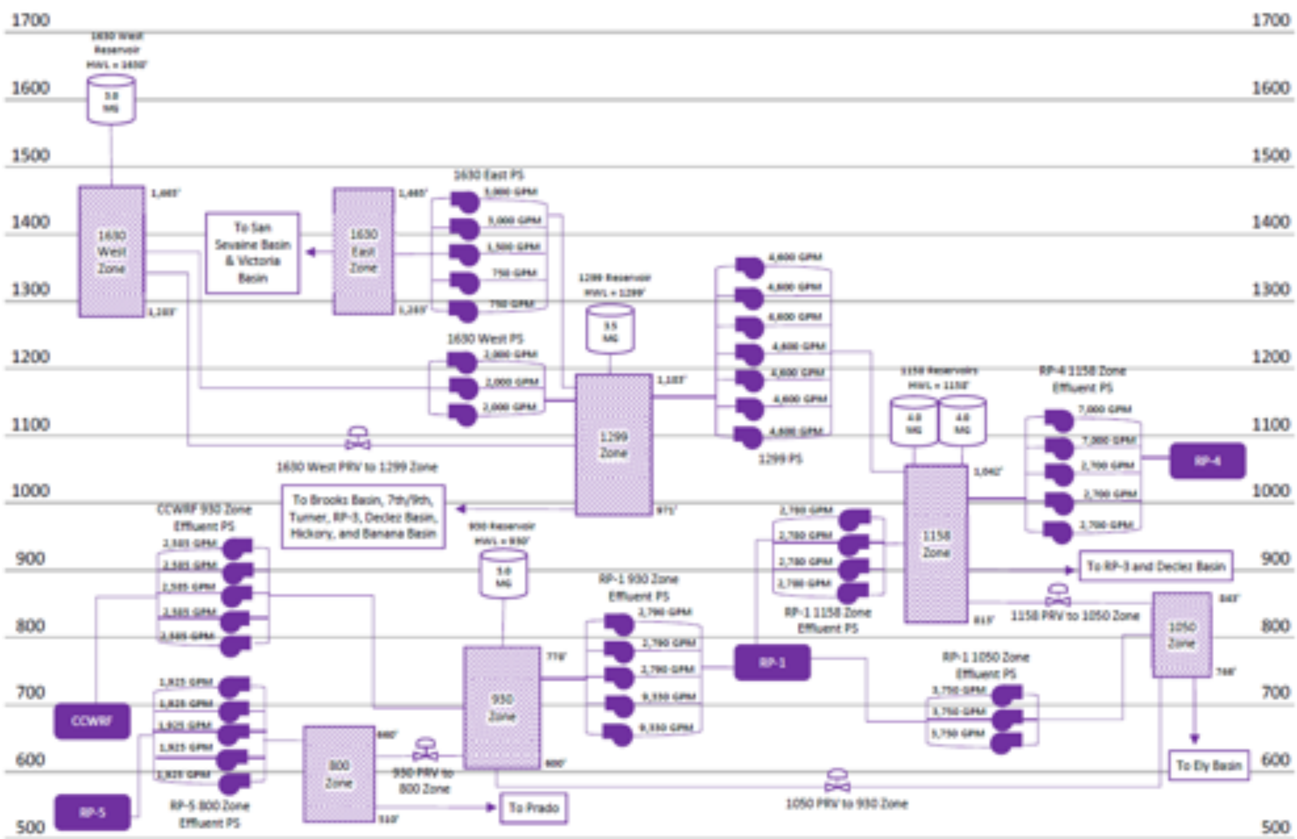

Figure 4-1. Recycled Water System Hydraulic Profile

4.1.3.1 Modeling Assumptions

The following sections describe the assumptions used in developing the modeling scenarios used to validate the CBP.

As part of the 2016 model update and calibration, diurnal production curves were developed for each IEUA recycling plant. The diurnal supply patterns from each plant follow expected patterns, with lower flows in the early morning and peak production later in the day. The future supply from each plant was scaled from the calibration day supply to maintain the same diurnal supply curve. During the 2016 model calibration, peaking factors and diurnal demand patterns were updated for each pressure zone and for large customers, spreading basins, and the Prado discharge. Figure 4-2 depicts the demand and the supply over the calibration day from the hydraulic model. Overall, demands are typically highest during the night and early morning, which is typical of a system with high agricultural demands. During these hours the demand exceeds supply and the system relies on storage to meet demands.

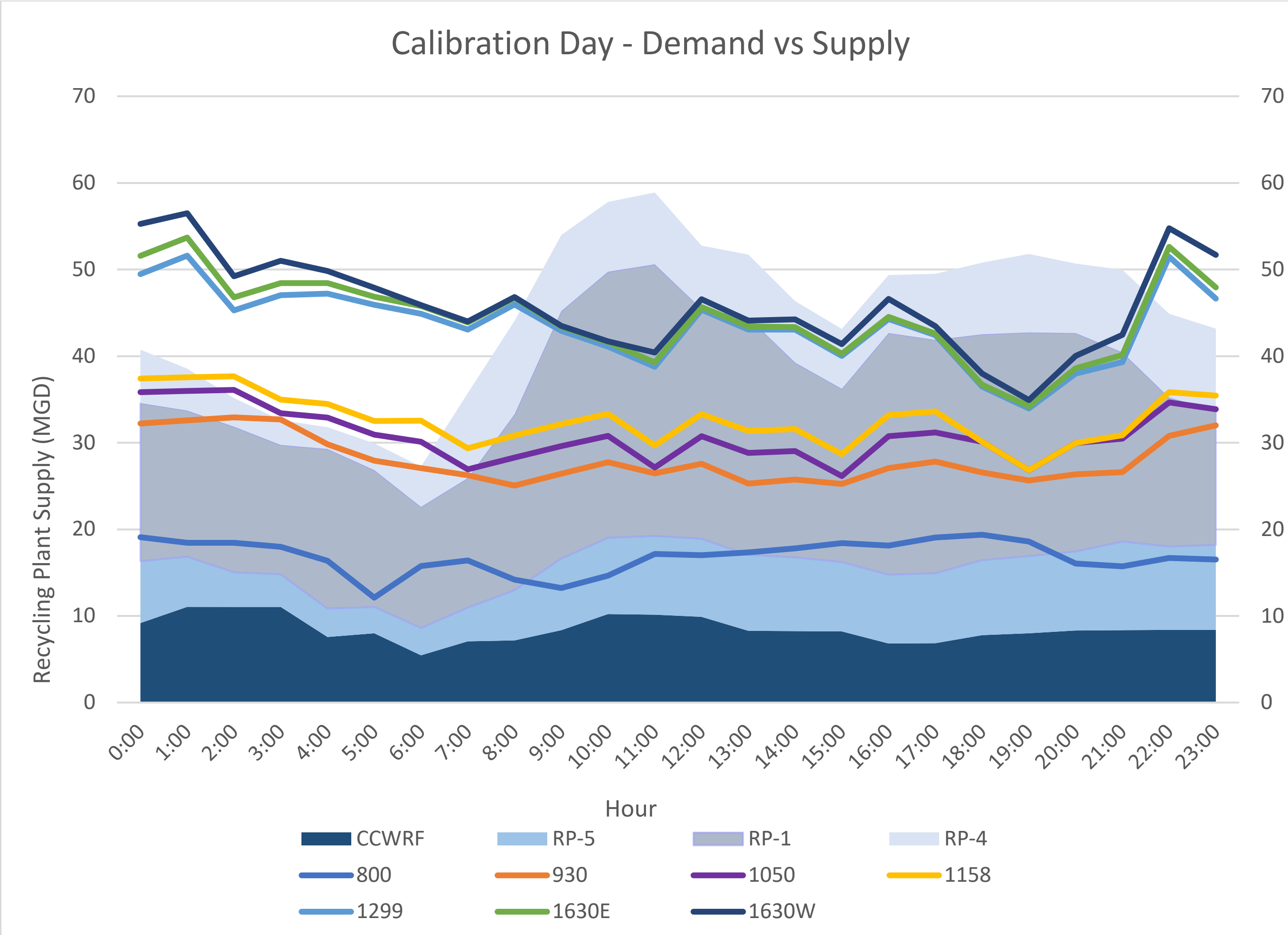

Figure 4-2. Supply and Demand Diurnal Patterns from the Hydraulic Model Calibration Day

For the recycled water distribution analysis using the hydraulic model, the demand allocation and diurnal patterns in the 2016 calibration scenario were maintained for the 2026 demand scenarios. The 2026 supply from each WRP was scaled from the 2016 calibration scenario to future projections, and assumes that utility water that is used onsite at the plant is excluded from these values. Demands were also scaled to future projections.

The supply projections from each IEUA recycling plant were developed based on the proportion of growth at each recycling plant between 2015 and 2026 from the Wastewater Facilities Master Plan Update Report (CH2MHILL, June 2015). The growth percentages for each plant were applied to the existing supply from the calibration day scenario to scale the future supply to the 62.4 TAFY 2026 projection.

The calibration day demand spatial allocation was used to scale projected summer demands. For projected winter demands, the 2012 fall/spring/winter demand sets were used to scale to projected non-summer month demands.

On the modeled calibration day, tertiary GWR demands are only allocated to the Ely, Hickory, and Banana Basin. When the tertiary GWR demands are scaled to 2026 projection, capacity in the Hickory and Banana Basins are maxed out, and the additional tertiary GWR demand is allocated evenly to the Ely and Turner Basins.

The peaking factors developed during the 2016 model update are shown in Table 4-5. Projected demands were scaled using the calibration demand spatial allocation for summer scenarios. The calibration day peaking factors by zone were used to calculate the average day demand spatial allocation. The demand spatial allocation for 2026 demands is assumed the same as the 2016 calibration scenario.

Table 4-5. Peaking Factors by Zone			
Zone	**Average Day**	**Max Day**	**Calibration Day**
800	1	2.5	2.2
930	1	2.5	1.9
1050	1	2.1	0.9
1158	1	2.7	1.7
1299	1	2.9	1.3
1630 E	1	4.1	1.6
1630 W	1	1.84	1.6
System	1	2.5	1.58
Source: TM 1 Recycled Water Hydraulic Model Calibration (Carollo, June, 2017)			

All diurnal demand patterns applied to each node in the model were maintained for future demand scenarios. For the CBP, the 17.0 TAFY demand for the AWPF was modeled as a constant point load at a single node. For the AWPF at RP-1, the demand node is located upstream of all pump stations and assumes the plant will be supplied directly from RP-1. A new PRV was also added to the model from the 1158 pressure zone to the AWPF to supply the AWPF when supply from RP-1 drops below the AWPF demand, which typically only occurs a few hours a day.

For the AWPF at RP-4, the demand node is located within the 1158 pressure zone to allow multiple sources of water to feed the facility because RP-4 cannot fully meet the demand of the AWPF. The outside supply sources (WRCRWA and the Rialto WWTP) are supplied at a constant rate throughout the day. The pipeline from the Rialto WWTP connects to the demand node at the RP-4 AWPF. The pipeline from WRCRWA ties into the 930 pressure zone.

4.1.3.2 Scenario Development

The hydraulic model was used to evaluate the existing recycled water system and the future system with the implementation of the CBP in year 2026. The model was used to establish the system baseline as it is currently operating and evaluate the CBP PUT alternatives impacts on the recycled water system. In order to do so, four new scenarios were created in the recycled water model, as described below. It was important to maintain consistency between the alternatives so the results are comparable. All four scenarios included the same supply and demand sets, system controls, the new recycled water supply sources from the Rialto WWTP and WRCRWA and were run for a 24-hour duration. The focus of the modeling scenarios is 2026 summer when the system demands can exceed the supply for short periods of time due to daily diurnal patterns. The major differences in the modeled scenarios is the location of the AWPF.

1. **Scenario 1: AWPF at RP-1.** The first scenario set up included a single AWPF located at RP-1. In this scenario, a 17.0-TAFY demand was added to a node located adjacent RP-1 in the model on the suction side of the RP-1 1158 Pump Station within the 1158 pressure zone. A new PRV was added from the 1158 pressure zone to the AWPF demand node as a supplemental supply when the supply from RP-1 drops below the AWPF demand.
2. **Scenario 2: AWPF at RP-4.** In the second scenario the 17.0-TAFY AWPF demand node located adjacent to RP-4 on the discharge side of the RP-4 1158 pump station, within the 1158 pressure zone. The recycled water pipeline from the Rialto WWTP ties directly into this demand node in all scenarios.
3. **Scenario 3: Combination at RP-1 and in MZ-1.** The third modeled scenario includes two AWPFs, a large plant located at RP-1 and a smaller plant located within MZ-1. The same AWPF demand node used in the first scenario was used in this scenario for the RP-1 AWPF, but the demands were reduced to 12.0 TAFY. A new demand node was created in the model for the MZ-1 AWPF 3.0-TAFY demand, along with a new 16-inch pipeline to serve that demand. The location of the MZ-1 AWPF is assumed to be located in Montclair, just south of Interstate 10 and along Palo Verde Street, and just west of the Montclair recharge basins.
4. **Scenario 4: Combination at RP-4 and in MZ-1.** The last modeling scenario includes two AWPFs, a large plant with a 12.0-TAFY demand located at RP-4 and a small AWPF with a 3.0-TAFY demand located in MZ-1. The locations of the plant demands are the same as described in Scenario 2 for the RP-4 plant and in Scenario 3 for the plant located in MZ-1.

Based on these four modeling scenarios, it was concluded that the IEUA recycled water system has sufficient capacity to (1) convey the additional external supplies from WRCRWA and the Rialto WWTP and (2) maintain adequate pressures while meeting anticipated demands, including direct use and tertiary GWR as well as the new AWPF(s) at either RP-1, RP-4, or at either RP-1 or RP-4 combined with a smaller AWPF in MZ-1. Based on these conclusions, additional upgrades to the IEUA recycled water system are not required for the CBP.

The model was also used to evaluate the difference in recycled water pumping costs when the AWPF is located at RP-1 and when it is located at RP-4 to include in the PUT alternatives evaluation. This evaluation is presented in TM2 Section 3.2.1.3.

4.2 Advanced Water Purification

The PUT alternatives include advanced water purification to meet long-term salinity requirements in the Chino Basin. In addition, as discussed further in Section 4.3, subsurface application through injection wells is assumed for groundwater replenishment, which also requires purified water. This section discusses the AWPF assumptions for the PUT alternatives, which are presented in the following sections:

- Potential AWPF locations (Section 4.2.1)
- Purified water goals (Section 4.2.2)
- Process rationale (Section 4.2.3)
- AWPF capacity (Section 4.2.4)
- Brine disposal (Section 4.2.5)

4.2.1 Potential AWPF Locations

The potential AWPF locations impact treatment process selection and infrastructure requirements for tertiary recycled water, purified water, and brine conveyance. The closer that the AWPFs can be sited to source water supply (tertiary recycled water), the groundwater recharge locations, and brine disposal will result in lower capital and operating costs. To avoid additional costs and schedule delays associated with siting and purchasing land for an AWPF, only IEUA-owned or stakeholder-owned properties are being considered for the CBP.

Of IEUA's existing four regional water recycling facilities (RP-1, RP-4, RP-5, and CCWRF), RP-1 and RP-4 were identified as the two most-feasible locations for the future AWPF for the following reasons:

- RP-1: this plant is being upgraded to MBR treatment (expected to be online by 2030), which could eliminate the membrane filtration (MF) process in the future AWPF and reduce overall treatment costs at RP-1 (discussed further in Section 4.2.3). RP-1 is further away from the proposed recharge locations in MZ-2 (discussed further in Section 4.3) and will require longer purified water pipelines.
- RP-4: this plant is the closest IEUA treatment plant to the proposed groundwater recharge locations in northern MZ-2 (discussed further in Section 4.3), which will result in the shortest purified water pipelines. RP-4 is also planned for an upgrade to MBR treatment, but the upgrade will be in the long term and is not considered in the process selection for the AWPF.

Both locations are located near extensions of the Non-Reclaimable Wastewater System (NRWS) for brine disposal (discussed further in Section 4.2.6).

RP-5 and CCWRF were eliminated from consideration due to their locations in the southern part of IEUA's service area and the distance to the areas in northern MZ-2 identified for groundwater replenishment, which would require extensive purified water piping systems.

Additionally, to support purified water recharge options in MZ-1, a small AWPF is considered at the MVWD Plant 28 site, which was identified as part of the *Feasibility Study of Recycled Water Interconnections* (Carollo, January 2016). Alternatives that include this small AWPF in MZ-1 will be coupled with an AWPF at either RP-1 or RP-4.

With additional supplies being brought into the IEUA's recycled water system and water being routed to the AWPF, the tertiary recycled water distribution would be impacted regardless of where the AWPF is located. The distribution of tertiary recycled water was assessed as part of the PUT alternatives development to confirm that the existing IEUA recycled water system has sufficient capacity for the additional supplies and the AWPF (discussed in Section 4.1.3 of this TM), and that energy costs are addressed in the assessment (discussed in TM2 Section 3.2.1.3.

4.2.2 Purified Water Goals

Purified water must meet the treatment goals set forth by the CCR Title 22 Division 4, Chapter 3, Article 5.2 for IPR and groundwater replenishment through subsurface application. In addition, product water must meet the Basin Plan groundwater objectives for minerals and drinking water MCLs and Recycled Water Policy requirements regarding the SNMP, maximum benefit, and monitoring constituents of CECs in the Upper Santa Ana River basin (hydraulic sub area 801.21). Table 4-6 summarizes the treated water goals based on this regulatory framework.

Table 4-6. Purified Water Goals for IPR Groundwater Replenishment via Subsurface Injection in the Upper Santa Ana River Basin

Parameter	Criteria	Regulation
Enteric Virus	≥12 log reduction	CCR
Giardia cysts	≥10 log reduction	CCR
Cryptosporidium oocysts	≥10 log reduction	CCR
TOC	≤ 0.25 mg/l in 95% of weekly samples within first 20 weeks ≤ 0.5 mg/L 20-week running average and average of last 4 weekly samples	CCR
Total Nitrogen	≤ 10 mg/L average of twice weekly samples	CCR

Table 4-6. Purified Water Goals for IPR Groundwater Replenishment via Subsurface Injection in the Upper Santa Ana River Basin		
Parameter	**Criteria**	**Regulation**
Nitrate (as N)[1]	≤ 4.2 mg/L 5-year running average	Basin Plan
1,4-dioxane	≥0.5 log reduction by AOP	CCR
Inorganic Chemicals in Table 64431-A, except for nitrogen compounds	≤ MCLs in quarterly samples	CCR
Radionuclide Chemicals in Tables 64442 and 64443	≤ MCLs in quarterly samples	CCR
Organic Chemicals in 64444-A	≤ MCLs in quarterly samples	CCR
Disinfection Byproducts in Table 64533-A	≤ MCLs in quarterly samples	CCR
Lead and Copper	90th percentiles ≤ Action Levels	CCR
Secondary Drinking Water Contaminants in Tables 64449-A and 64449-B	≤ sMCLs in annual samples	CCR
Priority Toxic Pollutants in 40 CFR Section 131.38	≤ DDW-specified priority toxic pollutants and NLs[(2)] in quarterly samples	CCR
DDW-Specified Chemicals based on Engineering Report, Affected Groundwater Basin(s), and Wastewater Source Control	As specified by DDW in quarterly samples	CCR
NDMA	≤ 10 ng/L	CCR
TDS[1]	≤ 680mg/L	Basin Plan
Chloride	≤ 500 mg/L	Basin Plan
Sulfate	≤ 500 mg/L	Basin Plan
Boron	≤ 0.75 mg/L	Basin Plan
Sodium	≤ 180 mg/L for municipality use	Basin Plan
Sodium Absorption Ratio	≤ 9 for agricultural use	Basin Plan

Notes:

[1]Criteria applies the Basin Plan's "Maximum Benefit" objectives but if the Regional Board determines it is lowering the water quality and not a maximum benefit to the basin, the "Antidegradation" objectives will apply with Nitrate (as N) and TDS needing to meet 2.9 mg/L and 250 mg/L, respectively, for a 5-year running average (RWQCB – SA, 2019).

[2]Notable among which is the NDMA goal of 10 ng/L or less. (Listed as a separate row in this table for emphasis)

[3]A draft of the Lead and Copper Rule Long-Term Revisions was published in November 2019 and a final rule is expected to be released in fall 2020. Compliance is likely to begin around 2023.

4.2.3 Process Rationale

For potable reuse via subsurface groundwater replenishment, CCR requires full advanced treatment for all flow. As defined in CCR §60320.201, full advanced treatment included RO with on-going performance monitoring (e.g., conductivity or TOC) to indicate when the integrity of the process has been compromised. In addition to RO, full advanced treatment requires AOP that can achieve 0.5-log 1,4-dioxane removal with on-going performance monitoring via an established surrogate and/or operational parameters. To comply with full advanced treatment requirements, both alternatives proposed for the future AWPF include RO and UV-AOP.

MF is used as pretreatment to RO to remove suspended solids and reduce turbidity upstream of RO. Historically, MF is used to treat secondary or tertiary effluent prior to RO. Alternatively, a secondary MBR, which combines secondary treatment with MF, can provide adequate pretreatment upstream of RO and thereby eliminate the need of an additional intermediate MF system between the MBR and RO. However, DDW has not yet granted credit for pathogen reduction to MBR systems.

As discussed previously, RP-1 and RP-4 are the two IEUA sites that are being considered further for the AWPF. IEUA is planning to upgrade the secondary treatment systems at both plants with MBRs, although the RP-1 upgrade is planned in the near term (online by 2030) and RP-4 is in the long term (approximately 2040). Therefore, it is assumed if the AWPF is implemented at RP-1 that the treatment train would be MBR-RO-AOP and if the AWPF is implemented at RP-4 the treatment train would be MF-RO-AOP. IEUA could potentially convert an AWPF at RP-4 to MBR-RO-AOP when the MBR is implemented at RP-4.

These two process trains, MF-RO-AOP and MBR-RO-AOP, are described in the subsequent sections.

4.2.3.1 MF-RO-AOP at RP-4

All existing potable reuse facilities in California utilize MF as pretreatment for RO. MF removes suspended solids, reduces turbidity, and achieves credit for up to 4-log reduction of protozoa through daily integrity testing. If the AWPF is constructed at RP-4, then the treatment train would be MF-RO-AOP since the future conversion at RP-4 to MBR is planned for the long term.

Table 4-7 summarizes the rationale for the MF-RO-AOP treatment alternative proposed for the future AWPF.

Table 4-7. MF-RO-AOP Treatment Train Rationale

Process	Rationale
MF	• Reduces turbidity in secondary effluent to CCR §60301.320 required level of less than: — 0.2 NTU more than 5% of the time within a 24-hour period; and — 0.5 NTU at any time. — Removes pathogens via size exclusion and disinfection with chlorine added upstream of MF. — Provides necessary pretreatment upstream of RO similar existing California potable reuse plants.
RO	• Removes TOC per CCR §60320.201 startup requirement to achieve 0.25 mg/L during the first 20 weeks of operation and §60320.218 long term requirement not to exceed 0.5 mg/L based on: — 20-week running average of all TOC results; and — Average of the last four TOC results. • Reduces salinity per CCR §60320.201 and to meet the secondary MCL of 500 mg/L. • Decreases level of high molecular weight, uncharged CECs. • Removes pathogens via size exclusion. • Reduces influent nitrogen below 10 mg/L as N per CCR.
UV-AOP	• Provides disinfection for pathogen removal. • Achieves oxidation requirement per CCR §60320.201 by providing no less than 0.5-log (69 percent) reduction of 1,4-dioxane. • Provides final chemical abatement of remaining CECs, including 1,4-dioxane and NDMA.

Table 4-8 summarizes the anticipated pathogen log removal credits each AWPF process will claim compared to the minimum regulatory requirements. If desired, IEUA could claim additional virus credit through final chlorine disinfection though not required at this time.

Table 4-8. Anticipated MF-RO-AOP Pathogen Log Removal Credits

Process	**Virus**	***Giardia* cysts**	***Cryptosporidium* oocysts**
MF	-	4.0	4.0
RO[(1)]	1.5	1.5	1.5
UV-AOP	6.0	6.0	6.0
Pipeline Chlorination[(2)]	0+	0+	-
Groundwater Retention Time[(3)]	6.0	-	-
Total	**13.5+**	**11.5+**	**11.5**
Minimum Required	**12**	**10**	**10**

Notes:

(1) Based on TOC reduction across the RO system, as monitored by online analyzers on the combined influent and combined permeate.

(2) Though not required, IEUA could capitalize on the chlorine disinfection that will take place from the product water pump station to the injection wells for additional pathogen removal redundancy.

(3) Based on 6-month travel time to be confirmed by a tracer study.

4.2.3.2 MBR-RO-AOP at RP-1

IEUA is planning to replace its existing secondary treatment process at RP-1 with an MBR to be online before 2030. MBR uses similar membranes to that of MF that can provide adequate pretreatment upstream of RO and thereby eliminate the need of an additional intermediate MF system. Therefore, an MBR-RO-AOP treatment train is being considered for the AWPF at RP-1.

DDW has not yet granted credit for pathogen reduction to MBR systems. An Australian study presented a three-tiered approach for granting pathogen reduction credit to MBR systems, summarized below (AWRCE 2016):

- **Tier 1** provides conservative pathogen reduction credit based on the lower 5th percentile of historical MBR data collected by Branch and Le-Clech (2015) for a broad range of MBR systems and operational conditions. Tier 1 credits are thus lower and more conservative then Tier 2 or Tier 3 credits. Tier 1 pathogen credits do not directly correlate online water quality monitoring or membrane integrity testing to pathogen reduction.
- **Tier 2** conducts site and membrane manufacturer specific testing to determine minimum anticipated pathogen reduction. Tier 2 credits, being MBR specific and based upon extensive data sets for a particular supplier, are anticipated to be higher than Tier 1 credits. Tier 2 pathogen credits do not directly correlate with online water quality monitoring or membrane integrity testing to pathogen reduction.
- **Tier 3** has not yet been attempted but requires challenge testing to demonstrate the correlation between online parameter(s) and pathogen removal performance of the MBR to establish critical limits specific to the pathogen reduction claimed. Tier 3 credits may be similar to Tier 2 credits. If successful, claiming pathogen reduction under Tier 3 would be independent of membrane supplier and provide greater confidence in pathogen removal in real time

DDW has expressed a willingness to accept the Australian Tier 1 approach, which establishes default LRVs for MBRs shown in Table 4-9. These default LRVs apply to MBRs with a nominal pore size of 0.04-0.1 µm operating within the envelope shown in Table 4-10.

Table 4-9. Australian Tier 1 Default LRVs

Pathogen Type	Credited Log of Pathogen Reduction
Viruses	1.5
Protozoa	2
Bacteria	4

Table 4-10. Australian Tier 1 Operating Envelope

Parameter	Units	Minimum	Maximum
Bioreactor pH	-	6	8
Bioreactor Dissolved Oxygen	mg/L	1	7
Bioreactor Temperature	°C	16	30
Solids Retention Time	d	11	-
Hydraulic Retention Time (HRT)	h	6	-
Mixed Liquor Suspended Solids (MLSS)	g/L	3	-
Transmembrane Pressure	kPa	3	-
Flux	$L/m^2/h$	-	30
Turbidity	NTU	-	0.2

The pathogen reduction credit provided by Tier 1 would not allow the proposed treatment train of MBR, RO, and UV-AOP to satisfy the required 10.0 LRV of *Cryptosporidium oocysts* and *Giardia* cysts. IEUA could attempt testing required by Tier 2 or 3 to achieve the protozoa reduction required. Alternatively, IEUA could attempt additional pathogen reduction credit through primary treatment or enhanced RO monitoring (i.e., daily indigenous chemical sampling or online fluorescent dye injection and monitoring). Other studies have indicated that the actual LRVs are higher than the Australian Tier 1 values.

Though a formal MBR validation pathway has yet to be formalized in California, several potable reuse projects are moving forward with MBR as a critical process for pathogen reduction. These projects include the MWD Regional Recycled Advanced Water Purification Center, the City of Morro Bay Water Reclamation Facility, and the City of Los Angeles Bureau of Sanitation Hyperion MBR Pilot Facility. Results from these ongoing projects could provide input to a potential, similar project at IEUA if the MBR-RO-AOP option is selected.

Table 4-11 summarizes the anticipated pathogen log removal credits each AWPF process will claim compared to the minimum regulatory requirement. To make up for the 0.5-log shortfall for each protozoa, IEUA could attempt testing required by Tier 2 or 3 or additional pathogen reduction credit through primary treatment or enhanced RO monitoring (i.e., daily indigenous chemical sampling or online fluorescent dye injection and monitoring). The most conservative approach would utilize an online fluorescent dye injection and monitoring system, such as Nalco's TRASAR, which DDW has approved at a baseline of 3.0-log for virus, *Giardia* cysts, and *Cryptosporidium oocysts*. Employing the TRASAR system would raise the pathogen LRV totals well above the minimum required to 18.0, 12.5, and 12.5, respectively.

Table 4-11. Anticipated MBR-RO-AOP Pathogen Log Removal Credits			
Process	**Virus**	***Giardia* cysts**	***Cryptosporidium* oocysts**
Primary Treatment(1)	0+	0+	0+
MBR(2)	1.5	2.0	2.0
RO(3)	1.5-3.0	1.5-3.0	1.5-3.0
UV-AOP	6.0	6.0	6.0
Pipeline Chlorination(4)	0+	0+	-
Groundwater Retention Time(5)	6.0	-	-
Total	**15.0-16.5+**	**9.5-11.0+**	**9.5-11.0+**
Minimum Required	**12**	**10**	**10**

Notes:

(1) *IEUA would need to conduct microbial testing to quantify predicted pathogen log removal values from primary treatment if pathogen LRVs are desired.*
(2) *Based on default Tier 1 values (AWRCE 2016).*
(3) *Based on TOC reduction across the RO system, as monitored by online analyzers on the combined influent and combined permeate. Higher log removals are achievable for RO with the use of an online monitoring system, such as TRASAR.*
(4) *Though not required, the City could capitalize on the chlorine disinfection that will take place from the product water pump station to the injection wells for additional pathogen removal redundancy.*
(5) *Based on 6-month travel time to be confirmed by a tracer study.*

4.2.4 AWPF Capacity and Redundancy Assumptions

The most economical approach to size an AWPF is to provide a near constant flow of approximately 17.0 TAFY to produce the purified water goal of 15.0 TAFY. As discussed in Section 4.1, additional tertiary recycled water source supplies are being considered for the CBP to provide constant flow to the AWPF to avoid the need for seasonal storage or to oversize the AWPF to accommodate seasonal fluctuations. Diurnal flow equalization is assumed at both RP-1 and RP-4 to provide a constant water supply to the AWPF.

Figure 4-3 shows the required flow rates and assumed recoveries for the two primary AWPF alternatives: MF-RO-AOP at RP-4 and MBR-RO-AOP at RP-1, respectively. For the RP-4 alternative, MF backwash waste would return to the upstream wastewater treatment plant in order to minimize losses through the system. With an assumed online factor of 95 percent and 138 AFY of losses of RO permeate for other process use (i.e., RO flush, membrane cleanings, and analyzer waste), the required RO system recovery in order to produce 15.0 TAFY is approximately 93 percent. Similar facilities typically target a RO system recovery between 80 to 85 percent. As an exception, Water Replenishment District of Southern California owns two potable reuse facilities with high recovery RO:

- Leo J. Vander Lans Advanced Water Treatment Facility, which started operation in 2014 and has achieved 92.7 percent recovery through a non-proprietary three-stage RO system, and
- Albert Robles Center for Water Recycling, which started up in 2019, is designed to achieve 92.8 percent recovery through a non-proprietary three-stage RO system.

While available proprietary and non-proprietary high recovery RO treatment technologies could conceivably achieve 93 recovery, pilot testing achievable recovery on the anticipated water quality and corresponding impacts to concentrate disposal is recommended before constructing a full-scale system.

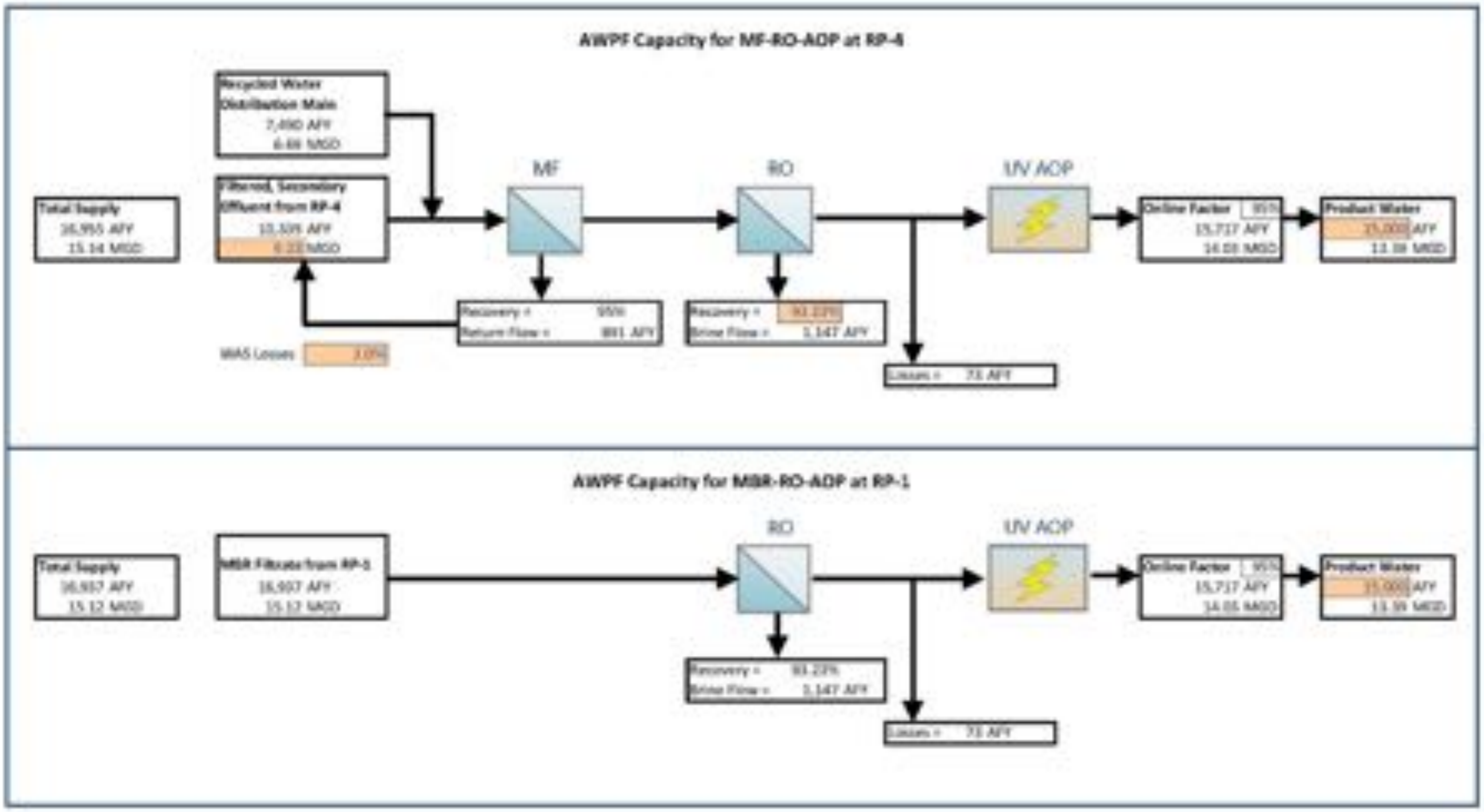

Figure 4-3. AWPF Capacities for MF-RO-AOP at RP-1 and MBR-RO-AOP at RP-1

The RP-1 with MBR alternative requires construction of either all or a portion of the future MBR trains to provide adequate flow for the AWPF. As described in the RP-1 Liquids & Solids Capacity Recovery Preliminary Design Report (Carollo, April 2019), RP-1 has a treatment capacity of 25 and 27.5 mgd with all six aeration basins and all six secondary clarifiers. Adding four MBR trains of the ten planned for full secondary conversion would supply the future AWPF with adequate supply of 14.4 mgd (17.0 TAFY). The partial MBR system would require adequate capacity in a dedicated aeration system upstream with fine screening, return activated sludge (RAS), and waste activated sludge (WAS) separate from the existing secondary system. To maintain RP-1's overall treatment capacity, at least 13.1 mgd of existing aeration and secondary clarification would need to remain in place. The need to keep the conventional existing and new MBR secondary treatment processes separate without losing treatment capacity creates complications with phasing the MBR system. Full conversion to MBR by constructing all ten MBR trains at once with complete dedication of Systems A, B, and C for upstream aeration is recommended for the least complicated and costly approach. Since the AWPF is planned to be constructed by 2026, the cost for the AWPF at RP-1 includes the portion of the MBR needed for the AWPF. It is assumed that the remainder of the MBR cost would be funded by IEUA's CIP.

Redundancy requirements are established by the function of the facility and criticality of continuous full capacity operations. In order to maintain the high online factor required to reliably produce 15.0 TAFY with limited supply, the design includes fully redundant trains for all processes. Table 4-12 summarizes the redundancy planned for the AWPF along with the anticipated offline time.

Table 4-12. Redundancy Requirements

Process	Duty + Standby	Online Factor	Required Downtime
MF System			
MF Feed Tanks	1 + 0	98.6%	5 days per year to drain, clean, and inspect
MF Feed Pumps	3 + 1	100%	21 days per 5 years per pump
MF Strainers	3 + 1	100%	14 days per year per strainer
MF Trains	7 + 2	100%	12 days per year per train for CIP; 7 days per year per train for maintenance; 100 minutes per day for MC/backwash/PDT
MF Backwash Pumps	1 + 1	100%	21 days per 5 years per pump
MF Backwash Blowers	1 + 1	100%	2 days per year per blower
RO System			
RO Feed Tank	1 + 0	98.6%	5 days per year to drain, clean, and inspect
RO Feed Pumps	4 + 1	100%	21 days per 5 years per pump
Cartridge Filters	4 + 1	100%	1 day per 3 months per cartridge filter
RO Trains	4 + 1	100%	1 day per train per year for CIP; 28 days per 5 years per train for maintenance
RO Interstage Booster Pumps	4 + 1	100%	21 days per 5 years per pump
RO Flush Tank	1 + 0	98.6%	5 days per year to drain, clean, and inspect
RO Flush Pumps	1 + 1	100%	21 days per 5 years per pump

Table 4-12. Redundancy Requirements			
Process	**Duty + Standby**	**Online Factor**	**Required Downtime**
UV-AOP System			
UV Reactors	1 + 1	100%	14 days per year per reactor for bulb, sleeve, and ballast replacement
Factor to Account for Time to Switch Over to Duty Train in the Event of Failure		99.5%	20 failures per year; 2 hours to recover from each
Anticipated Online Time		**95.4%**	

4.2.5 Brine Disposal

The AWPF requires brine disposal for the brine stream generated by RO treatment. This section summarizes the brine disposal approach for the AWPF depending on its location at either RP-1 or RP-4, and the potential smaller AWPF at the MVWD Plant 28 site. Brine disposal is discussed in more detail in TM3 Brine Disposal System.

IEUA operates the NRWS, which conveys brines and other non-reclaimable high-strength wastewater to facilities in Los Angeles and Orange Counties for eventual discharge to the Pacific Ocean. The NRWS is comprised of three trunklines: NRWS and Etiwanda Wastewater Line (EWL), which discharge to the Los Angeles County Sanitation Districts (LACSD) wastewater collection system, and the Inland Empire Brine Line (IEBL), which discharges to the Orange County Sanitation District (OCSD) wastewater collection system. The NRWS is shown in Figure 4-4, and described further below:

- NRWS and EWL: this system collects industrial and high-salinity wastewater in the northern portion of IEUA's service area and portions of the conveyance system run by RP-1, RP-4, and the MVWD Plant 28 site. The NRWS and EWL convey the wastewater to the LACSD sewer system for treatment and disposal.
- IEBL: the IEBL, formerly called the Santa Ana Regional Interceptor (SARI), collects non-reclaimable wastewater from industrial customers in the Santa Ana River Watershed including high-salinity waste flows from IEUA's southern service area. IEBL flows are conveyed to OCSD's sewer system for treatment and disposal.

Since the NRWS runs adjacent to both RP-1 and RP-4 and near the MVWD Plant 28 site, the NRWS was selected as the brine disposal location for the PUT alternatives. Additional details about the NRWS infrastructure, available capacity, existing connections, future considerations for brine conveyance and scaling mitigation, design considerations for new connections, and system costs for connection capacity and operations are discussed further in TM3 Brine Disposal System.

Figure 4-4. IEUA Non-Reclaimable Wastewater System

4.3 Groundwater Recharge

The PUT alternatives include recharging purified water to the Chino Basin to achieve two goals: capitalizing on storage within the basin as well as reducing the overall salinity of the basin. The groundwater recharge component includes both where to recharge the water and how to recharge the water.

This section discusses the groundwater recharge assumptions for the PUT alternatives, which are presented in the following sections:

- Recharge locations in the Chino Basin (Section 4.3.1), which need to consider the characteristics of the Chino Basin, groundwater quality, and recovery of the stored water.
- Recharge method, including injection wells and recharge basins (Section 4.3.2).
- Monitoring wells (Section 4.3.3).

4.3.1 Recharge Locations

The northern portion of MZ-2 was identified as the primary recharge location for purified water since it had been evaluated previously as part of the SFI (WEI, October 2018). The area is also generally outside of known areas of contamination and does not have subsidence or low groundwater levels. The SFI also included managed storage and recovery programs within operational bands 2, 3, and 4. For these storage and recovery programs, groundwater replenishment using wells was assumed in the northern MZ-2 area in two east-west alignments in Rancho Cucamonga.

For the PUT alternatives, two sets of potential injection well locations in MZ-2 were identified, which are as follows:

- Initially, potential injection well locations were identified in MZ-2 in Rancho Cucamonga in similar locations as assumed for the SFI. One east-west alignment was assumed on the Pacific Electric Inland Empire Trail and one along Foothill Boulevard.
- In order to reduce the infrastructure required to convey the purified water from the AWPF to the injection wells, a second set of injection well locations were identified in MZ-2. These were located further south than the initial set (closer to both RP-1 and RP-4) to reduce the overall purified water pipeline lengths. The east-west alignments of injection wells were assumed along Foothill Boulevard and Arrow Route in Rancho Cucamonga.

As described in TM2 Section 2, preliminary groundwater modeling was completed for both sets of preliminary injection well locations and results indicate that both alternatives align with the OBMP objectives and the SFI. The second set of injection wells (located on Foothill Boulevard and Arrow Route) are assumed for the PUT alternatives to reduce the overall infrastructure costs.

Injection wells in MZ-1 and MZ-3 were also investigated as part of the project:

- MZ-1: Injection wells in MZ-1 were assumed to be located near the Montclair Basins, which are north of the proposed AWPF at MVWD Plant 28. The Montclair Basins were originally assumed as a potential recharge location for purified water as part of the Feasibility Study of Recycled Water Interconnections Between the City of Pomona, MVWD, and IEUA (Carollo, January 2016). Insufficient groundwater travel time was identified between the recharge basins and nearby extraction wells. Due to the travel time issue and the need to prioritize stormwater recharge at these basins, injection wells are assumed for MZ-1.
- MZ-3: Injection well locations were identified in MZ-3 north of the JCSD wellfield. This area has experienced historically low groundwater levels and injection wells were considered in this area to potentially improve groundwater levels, as well as to support the program.

The injection well locations that were assumed for the PUT alternatives are discussed further in Section 2.

4.3.2 Recharge Method

Existing recharge basins are used to recharge a combination of stormwater, tertiary recycled water, and imported water into the basin. These recharge basins are highly utilized, especially seasonally during storm events, and do not have sufficient year-round capacity for the additional purified water (15 TAFY) to be recharged as part of the CBP. The PUT alternatives were developed assuming injection wells would be used to recharge purified water.

The following subsections discuss injections well assumptions, as well as additional information about recharge basins and opportunistic connections to backup injection wells as the primary recharge approach.

4.3.2.1 Injection Wells

Injection wells will be used to recharge purified water to the Chino Basin drinking water aquifers. Injection wells allow for consistent recharge of specific aquifers and are not subject to stormwater capacity restraints like recharge basins. This section describes the assumptions and considerations for the proposed injection wells to recharge 15.0 TAFY

Each injection well will be constructed to the State of California regulations. Each well site will include a concrete pad, superstructure, necessary safety features, signage, and flowmeters. Each injection well is estimated to require a site space of 100 feet by 100 feet (0.23 acres) that will accommodate the initial well construction, the wellhead equipment, and future well maintenance and redevelopment. It is assumed that land would need to be purchased for each injection well. An example injection well site is shown in Figure 4-5.

Figure 4-5. Example Injection Well Site

The capacity of each injection well is assumed to be 50 percent of the average pumping rate of nearby production wells. Based on the data included in the Storage Framework Investigation (WEI, October 2018) and the characterization of each management zone, the estimated injection wells capacities for each management zone are summarized in Table 4-13. In TM2, injection well capacities are used to estimate the number of injection wells for the PUT alternatives.

Table 4-13. Estimated Injection Well Capacity by Management Zone		
Management Zone	Estimated Capacity per Injection Well	
	gpm	AFD
MZ-1	850	3.65
MZ-2	830	3.77
MZ-3	1,130	3.99

Injection well capacities are dependent on the well maintenance and other operational assumptions. Standard injection well operational procedures include assuming wells do not sit idle for longer than one week, are exercised near design flow rates, are backflushed for approximately one hour a week, and are rehabbed every three to five years. Redundant injection wells are recommended to allow for backflushing and well rehabilitation while meeting the continuous recharge rate of 15.0 TAFY. Test injection wells are recommended to collect site specific information to guide injection well design.

The recommended redundancy for injection wells is one standby well for every three active wells. For example, if all 15.0 TAFY (41.1 acre-feet per day (AFD)) is proposed to be recharged in MZ-2, then 12 operating wells and four standby wells (16 wells total) are recommended based on the estimated MZ-2 injection well capacity in Table 4-13 and the recommended redundancy requirements. One example operating scenario would be to group the wells into four sets of four wells each where at any one time three wells would be active and one standby. The active wells would be cycled on a weekly basis to make sure that each well is not inactive for more than a week.

4.3.2.2 Recharge Basins

As discussed previously, due to the need to recharge stormwater when available, the existing recharge basins do not have sufficient year-round capacity to consistently recharge the purified water to the Chino Basin. As part of this project, WEI identified potential recharge basins that have excess capacity and could be used to recharge the purified water, which are summarized in Table 4-14. While these basins potentially have capacity during non-storm periods, they would not be able to recharge water year-round due to the need to prioritize recharge of stormwater during storm events.

Table 4-14. Recharge Capacity of Existing IEUA Basins		
Management Zone	Spreading Basin	Annual Recharge (TAFY)
MZ 1	Montclair Basins	3.0
	Subtotal	**3.0**
MZ 2	Lower Day	1.0
	San Sevaine	2.2
	Victoria	0.7
	Etiwanda Debris Basin	1.4
	Hickory	0.6
	Banana	0.7
	Turner	0.8
	Subtotal	**7.4**

Table 4-14. Recharge Capacity of Existing IEUA Basins		
Management Zone	**Spreading Basin**	**Annual Recharge (TAFY)**
MZ 3	IEUA RP-3	3.0
	Declez	1.6
	Subtotal	4.6
Total		**15.0**

As part of the PUT alternatives development, the feasibility of using the recharge basins presented in Table 4-14 as backup for the active injection wells (instead of standby injection wells) was evaluated. This would allow fewer standby injection wells, although the purified water recharge rate would be lower during winter months when the recharge basins are prioritized for stormwater. Extending purified water pipelines to the recharge basins in the northern portion of MZ-2 (i.e., Lower Day, San Sevaine, Victoria, and Etiwanda Debris Basin) would require approximately 10 miles of 8-inch to 16-inch diameter pipelines and additional 600-hP pump station near the Victoria recharge basin, which exceeded the cost of the standby injection wells and increased the annual operating costs. Therefore, using the recharge basins as backup to the injection wells was not included in the PUT alternatives. There may be opportunities to connect to existing recharge basins near the purified conveyance alignments to the injection well fields (i.e., Hickory and Banana basins) to increase overall recharge capacity and reliability.

In addition, the potential for new recharge basins has been studied by the Watermaster as part of the Recharge Master Plan and subsequent updates, which determined that there are few opportunities for new recharge basins in the Chino Basin. Therefore, new recharge basins were not evaluated further as part of this project.

4.3.3 Monitoring Wells

Per the Title 22 regulations for groundwater replenishment using recycled water, monitoring wells are required to monitor water quality in the groundwater basin. The regulations require that at least two monitoring wells be constructed downgradient of the replenishment location. One must be located at least two weeks but no more than six months downgradient travel time through the aquifer and at least 30 days upgradient from the nearest drinking water well, and the second well must be located between the replenishment location and the nearest downgradient drinking water well. A total of four monitoring wells were included in each PUT alternative to comply with these requirements.

Section 5: TAKE Assumptions

The CBP includes two main categories of facilities: PUT, the components to recharge purified water to the Chino Basin, and TAKE, the components to extract groundwater and convey potable water supply. The assumptions that were used to develop the TAKE components are discussed in this section, except for conveyance, which is discussed for both PUT and TAKE components in Section 6.

The TAKE components are as follows, with the corresponding section noted:

- **Groundwater extraction and treatment:** discussed in Section 5.1.
- **Potable water pumping and conveyance:** conveyance for both PUT and TAKE components is discussed in Section 6.
- **Potable water usage:**
  - **MWD pump back:** discussed in Section 5.2.
  - **In lieu usage:** discussed in Section 5.3.

To support the development of the PUT, TAKE, and program alternatives, WEI completed initial groundwater modeling for the PUT and TAKE components. The initial groundwater modeling results are discussed in TM2 Section 2.

5.1 Groundwater Extraction and Storage

The goal of the TAKE components is to deliver the 375 TAF of potable water from the Chino Basin over the 25-year life of the project. The 375 TAF is to replace water supply that would otherwise be imported from the Sacramento-San Joaquin Delta (Delta), which will be done either by delivering extracted groundwater to MWD's regional facilities for eventual distribution to member agencies (MWD pump back), or by delivering groundwater directly to member agencies for their use in-lieu of receiving imported water deliveries from MWD, which is referred to as In-Lieu CBP.

The 375 TAF would be used during dry years (call years) when less water is imported from the Delta. Two groundwater extraction scenarios were assumed for the TAKE alternatives:

- Standard delivery (no pre-delivery): Assuming a maximum pumping rate of 50.0 TAFY, 7.5 call years would occur over the 25-year life of the project. For this extraction scenario, the TAKE facilities were sized to deliver 50.0 TAFY of groundwater from the Chino Basin to MWD regional facilities or directly to member agencies.
- Pre-delivery: Pumping groundwater during non-call years was also considered to reduce the required size and capacity of the TAKE facilities. For pre-delivery, it was assumed that 10.0 TAFY would be delivered to MWD and/or member agencies during the 17.5 non-call years, and 26.7 TAFY would be delivered to MWD and/or member agencies during the 7.5 call years, totaling 375.0 TAF for the 25-year project life. For alternatives with pre-delivery, the capacity of the TAKE facilities was reduced from 50.0 TAFY to 26.7 TAFY. With pre-delivery, the water would be stored in MWD's system during non-call years for use during call years. Therefore, alternatives with pre-delivery include a wheeling charge from MWD to compensate for storage.

An alternative to directly delivering extracted CBP groundwater to member agencies for in-lieu use is to provide new local wells or wellhead treatment to existing wells, which is referred to as In-Lieu Local. Examples for this type of in-lieu use include adding groundwater treatment to wells in Chino and Chino Hills that are currently offline due to groundwater contamination. These example projects were included as example projects in some of the TAKE alternatives to demonstrate how existing wells with new wellhead treatment could be incorporated into the program. For these example In-Lieu Local projects, it was assumed that up to 3.0 TAFY could be treated for either Chino or Chino Hills wells, for a total of 6.0 TAFY if two such projects are implemented. This 6.0 TAFY would already be within Chino and Chino Hills' service areas and would not require any additional infrastructure other than wellhead treatment. This would reduce the total amount of water required to be extracted from the proposed extraction wellfield and conveyed through TAKE facilities by up to 6.0 TAFY.

This section discusses the groundwater extraction wells and the blending and storage reservoir assumptions for the TAKE alternatives.

5.1.1 Extraction Wells

Multiple extraction wells are required to meet baseline (50.0 TAFY) and pre-delivery options (20.7 to 26.7 TAFY depending on the size of In-Lieu Local projects). The following sections summarize the assumptions used for the conceptual design of the extraction wells.

5.1.1.1 Site Selection and Sizing

The location of potential extraction well sites was determined through the identification of land within the Chino Basin with the following attributes:

- Undeveloped parcels.
- Parcels located at the intersection of streets. These sites would provide for easy access to the site during construction, maintenance, and rehabilitation activities.
- Located within the groundwater MZ desired for extraction well options (predominantly MZ-2 as evaluated in the SFI [see Section 2.3.1.2]).

It was assumed that the minimum extraction well size would need to be a minimum of 100 feet by 100 feet (0.23 acres) to allow for construction, periodic well rehabilitation, and the drilling of a new well, should the original well fail and need to be replaced. Figure 5-1 is a photo of a well site measuring 100 feet by 100 feet during well rehabilitation. As shown, well rehabilitation (and drilling) activities required adequate space for pump column laydown, well rig placement, spoils placement, and decant tanks for well development.

Figure 5-1. Well Rehabilitation Activities

5.1.1.2 Production Capacity

In locating new extraction wells, existing well data was used to determine existing production well pump capacity. Data from multiple existing wells surrounding the proposed well field have demonstrated to produce between 2,000 gpm and 2,900 gpm. Therefore, the maximum capacity of proposed extraction wells was conservatively estimated at 2,000 gpm to accommodate wells that will produce less than existing nearby production wells.

Initially, it was desired to determine the specific capacity of neighboring wells but this data was not available. Specific capacity is the pumping capacity (in gpm) for each foot of water table drawdown during operation.

The following assumptions were made concerning the characteristics of new extraction wells:

- The specific capacity of a new well should be in the range of 10-20 gpm/ft, or more.
- Overall pumping draw-down (difference between static and dynamic pumping levels) should not exceed 100 feet. This is to prevent excessive drawdown of the water table and increased pumping costs.
- Well casing and screening materials should be 316 stainless steel to promote long life.

A simplified well construction diagram is presented in Figure 5-2.

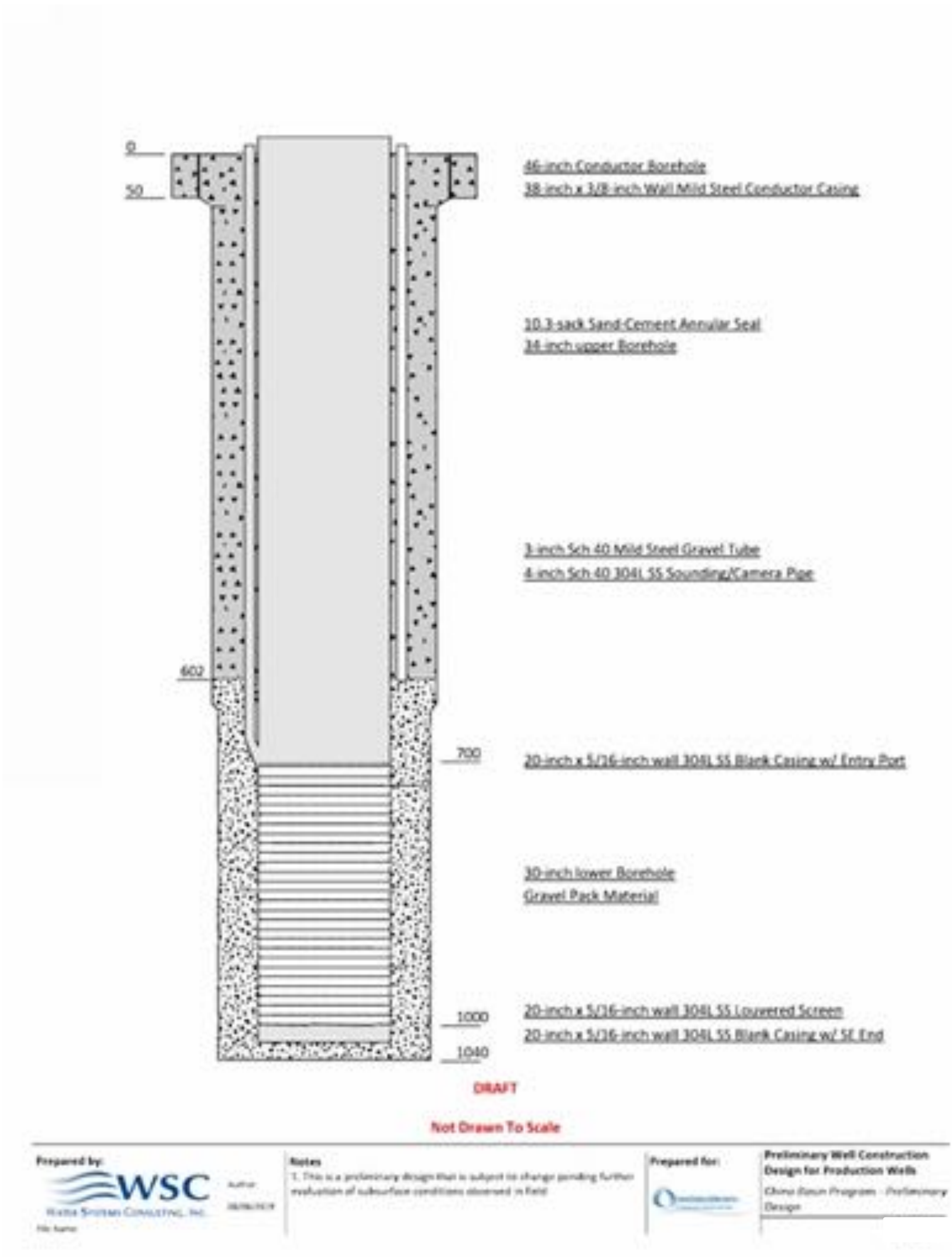

Figure 5-2. Example Extraction Well Design

5.1.1.3 Redundancy Requirements

It is assumed that one redundant well would be required for each alternative to accommodate capacity loss from hydrogeologic conditions, poor water quality, or maintenance shutdowns. In the event multiple wells are offline or have reduced production capacity at a given time, the online wells can be pumped at a higher rate until the wells are back online. The extraction wells design should include variable frequency drives (VFD) and the ultimate design point should be at maximum drawdown and lowest anticipated static groundwater level so that additional production is possible.

5.1.2 Blending and Storage Reservoir

A storage reservoir is recommended near the extraction wellfield to collect groundwater from all proposed wells prior to MWD pump back and/or in-lieu usage by agencies. The storage reservoir will have two purposes:

1. If an extraction well begins to pump contaminated groundwater, the reservoir will provide an opportunity for blending, which can avoid taking the well offline or the need for treatment.
2. The storage reservoir will serve as a forebay for the pump station that will be needed to boost water to elevations well above the extraction well field, and to break head for water to be delivered to lower elevations. This will also provide a constant head for the wells to pump against, rather than having the variability of discharge pressure that may come from having the wells pump directly into a high-pressure transmission line.

The reservoir would provide short-term storage and blending. Because the reservoir will primarily be used for blending and not storage, it is assumed that the reservoir volume would be determined based on retention time, and not hours of stored water available to meet demands. For blending purposes, it is assumed the retention time would need to be three hours. The reservoir outlet(s) will serve as the sampling point for water quality analyses for potable water.

Groundwater treatment for centralized extraction wells is not anticipated due to the groundwater extraction locations being focused in the better water quality areas of MZ-2, blending in the storage reservoir, and water quality in MWD's Rialto Pipeline (see Section 5.3.1 of this TM). But, in the event that treatment is needed in the future, the land acquired for the reservoir is recommended to be large enough to accommodate a future treatment system.

5.2 Groundwater Treatment

Groundwater treatment for the centralized extraction wells is not anticipated (see Section 5.3.1) but could be needed for In-Lieu Local projects where wellhead treatment is added to existing wells that are out of service due to groundwater contamination. This section discusses potential groundwater treatment technologies that could be used for wellhead treatment for potential In-Lieu Local projects, including reverse osmosis, advanced oxidation, ion exchange, GAC, and biological treatment.

Two example In-Lieu Local projects were included in the TAKE alternatives, which are wellhead treatment systems for out of service wells in the cities of Chino and Chino Hills. These are discussed in TM2 Section 4.2.2.

Based on the potential groundwater contaminants that may be found in the Chino Basin, a wide variety of treatment processes must be evaluated; these processes all have various degrees of efficacy depending on the mix of contaminants present. Groundwater treatment technologies may include more conventional best available technologies (BAT) or biological treatment, the latter being an emerging treatment technology in the water sector. Figure 5-3 shows the range of conventional treatment technologies that are available for various groundwater contaminants.

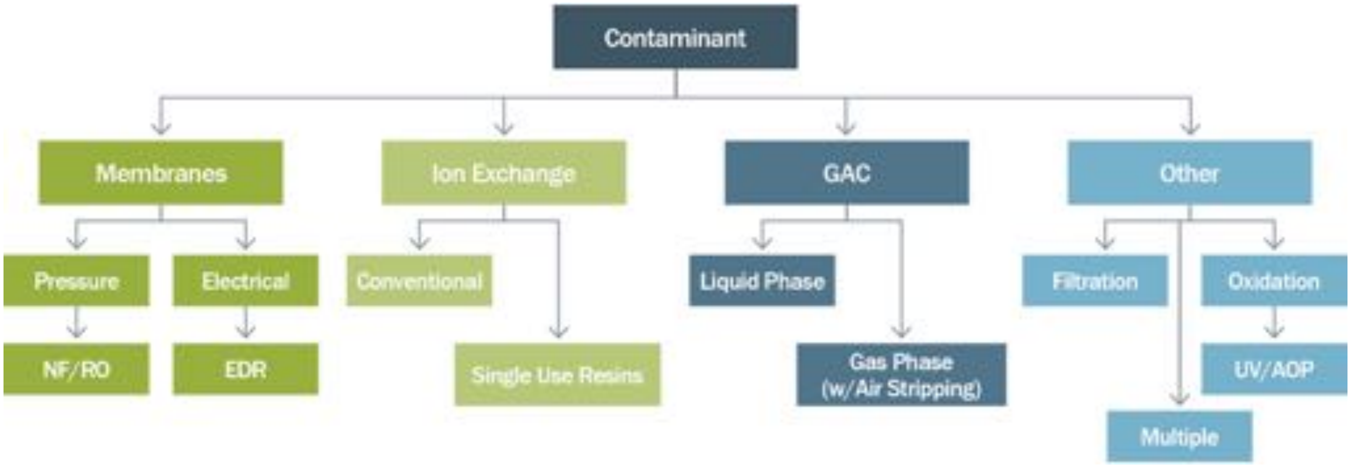

Figure 5-3. The Universe of Conventional Groundwater Contaminant Treatment Options

Membrane processes, especially RO, will remove many contaminants but is limited to higher molecular weight compounds and generally ineffective for the removal of compounds like NDMA and 1,4-dioxane. Ion exchange, while typically utilized by engineers for the removal of nitrate, perchlorate, hexavalent chromium, and some TDS, will be ineffective at volatile organic carbon (VOC) removal. GAC is often the treatment option of choice for VOCs but can become a costly option for some poorly absorbed compounds such as 1,2,3-TCP and trichloroethylene (TCE) and will require frequent change outs to meet effluent water quality objectives. Finally, advanced oxidation processes, such as UV-AOP, are well suited for some difficult to treat compounds like 1,4-dioxane and NDMA but cannot treat compounds such as 1,2,3-TCP and carbon tetrachloride (CTC) without using extremely high UV doses, which will result in significant power consumption. PFAS, a large class of emerging contaminants including PFOS and PFOA, has been detected in drinking water supplies across the United States and now have NLs and RLs established in California. GAC or IX are the two main treatment technologies used for PFAS; RO is also effective for PFAS removal, but more expensive to construct and operate.

Table 5-1 summarizes the efficacy of various treatment processes for different, nd common, groundwater contaminants.

Table 5-1. Candidate Technologies to Remove Possible Constituents of Concern								
Constituent	Treatment Technologies							Most Common Processes for this Constituent
	GAC	Air Stripping (A/S) + Vapor Phase GAC	IX	RO	AOPs	Biological (Fixed Bed/ Fluidized Bed)	MBR	
Organic Constituents								
TCE	✓	✓		✓	✓	✓	✓	A/S & GAC
Perchloroethylene (PCE)	✓	✓		✓	✓	✓	✓	A/S & GAC
MTBE	✓				✓	✓	✓	GAC
1,4-dioxane					✓	✓	✓	AOP
NDMA					✓	✓	✓	UV
1,2,3-TCP	✓				✓	✓		GAC
PFAS	✓		✓	✓				GAC/IX
Inorganic Constituents								
Nitrate			✓	✓		✓	✓	IX
Hexavalent Chromium			✓	✓		✓	✓	IX
Perchlorate			✓	✓		✓	✓	IX
Iron								Oxidation & Filtration
Manganese								Oxidation & Filtration

5.2.1 Reverse Osmosis

An RO system will remove a significant portion of the dissolved solids and some fraction of VOCs in groundwater sources. Thin-film composite polyamide membranes with 8-inch diameter and 400 square feet of membrane area are also typically used in reuse applications. RO systems are designed so that groundwater feedwater flows across the membrane surface in a cross-flow configuration on the feed-brine side of the membrane. High pressure on the feed-brine side of the membrane drives clean water through the membrane to the low-pressure permeate side of the membrane and becomes permeate. The concentrated reject water (brine) leaves the tail end of the membrane for disposal.

Permeate flows from the RO skids require post treatment stabilizing for alkalinity to meet applicable corrosion indices. RO permeate may also pass through decarbonators, which are essentially air strippers used to remove excess carbon dioxide. The advantages of using decarbonators is that the use of downstream stabilization chemicals (typically caustic soda) is reduced and additional VOCs, if present in the permeate, can be further removed.

5.2.2 Advanced Oxidation – UV-AOP

UV-AOP includes generation of hydroxyl radicals at ambient temperature and pressure in order to facilitate oxidation of organic compounds. Hydroxyl radicals react rapidly with organics, making UV-AOP an effective strategy for reducing the concentration of trace organic compounds and recalcitrant compounds. Hydroxyl radicals are generated through photolysis of an oxidant by UV light, which helps in the degradation of compounds such as NDMA and 1,4-dioxane.

UV-AOP systems can use both hydrogen peroxide and chlorine (sodium hypochlorite) although hydrogen peroxide is typical for direct groundwater treatment. For groundwater treatment using peroxide, catalytic carbon pressure vessels are used to remove residual hydrogen peroxide from the treated water stream. Currently, the Los Angeles Department of Water and Power is undertaking the construction of several groundwater treatment projects that utilize hydrogen peroxide UV-AOP for the removal of various groundwater VOCs.

A UV-AOP system would include a UV reactor, an electrical cabinet with ballasts and control panel, and an oxidant dosing system, an acid feed system for pH adjustment, and associated instrumentation for monitoring, control, and performance validation.

5.2.3 Ion Exchange

Ion exchange removes charged particles (ions) from solution in the feed water as it passes through a synthetic resin. An ion exchange process in water treatment depends on the reversible adsorption of charged molecules in solution to immobilized functional groups of opposite charge on an ion exchange resin. These resins are typically synthetic with either positively or negatively charged functional groups. Positively charged functional groups are used to remove negatively charged ions (anions) from water and are called anionic exchangers. Negatively charged functional groups are used to remove positively charged ions (cations) from water and are called cationic exchangers.

Ion exchanges can be unselective or have binding preferences for certain ions or classes of ions, depending on their chemical structure. This can be dependent on the size of the ions, their charge, or their structure. Typical examples of ions that can bind to ion exchangers are single-charged monatomic ions like sodium, potassium, and chloride; double-charged monatomic ions like calcium and magnesium (the main contributors to hardness) and; polyatomic inorganic ions like sulfate and phosphate.

The ion exchange process is typically implemented as a fixed bed in water treatment. As water flows from the top of the resin bed to the bottom, perchlorate, nitrate, sulfate, and other compounds may each be exchanged for one or more sodium ions, which is released into the effluent water. Ion exchange is a reversible process (Figure 5-4) and the ion exchange resin can be regenerated with a brine solution, which needs to be hauled off-site or discharged to a brine line.

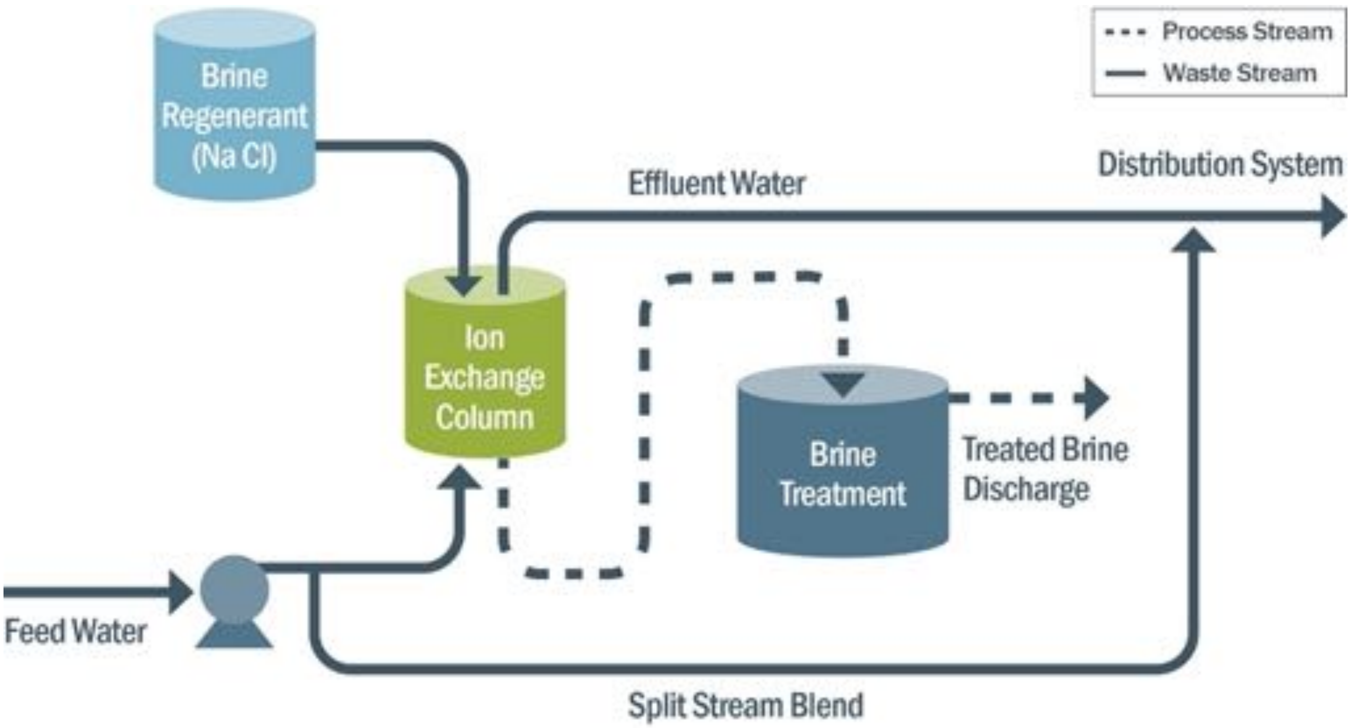

Figure 5-4. Schematic of Regeneratable Ion Exchange Process

Once the resin is exhausted or reaches a predetermined effluent breakthrough of contaminants of concern, the resin is regenerated with a brine solution, usually consisting of sodium chloride, or an inorganic acid, such as hydrochloric acid. The regenerant may be applied using co-current or countercurrent flow (as compare to the service flow). The high concentration of sodium of hydrogen ions in the regenerant causes them to displace the cations adsorbed on the resins, returning the resin to its original state. Under normal operating conditions (with no oxidants present), a resin may continuously operate for several years without deterioration of physical and chemical properties.

One disadvantage of the IX is the very frequent regeneration cycles that would be required. This will result in the delivery of tons of salts to the site and several unloading operations, which can be very loud given that salt must be blown into the salt storage tank and noise impacts need to be evaluated for the proposed groundwater treatment locations. The scaling of spent regenerant piping is a common problem in addition to equipment corrosion. The exchange of chloride ions for contaminant ions means that chloride is released into the potable water supply, increasing TDS.

Single pass and offsite regeneration are also options, but both would lead to more frequent media changeouts. Offsite regeneration needs to make sure that there is brine line with sufficient capacity for disposal of the brine solution.

For perchlorate treatment and hexavalent chromium treatment, many facilities use a single use ion exchange resin, which is simply replaced after break-through of the contaminant. However, careful attention must be giving to constituents in the raw water stream that may compete for exchange sites and that may accumulate to levels requiring special resin disposal (i.e., uranium).

5.2.4 GAC-Based Treatment

GAC systems have the advantage of being a simple technology that may be used to remove several VOCs and PFAS from drinking water through the adsorption of contaminants to activated carbon. The process may be used in the liquid phase or vapor phase after air stripping, the latter used for the removal of highly volatile compounds such as CTC. GAC and air stripping have a proven track record with lower costs than other removal methods (i.e., reverse osmosis and electrodialysis reversal).

Liquid phase GAC adsorbers are typically installed in a lead-lag arrangement, which provides an additional barrier to prevent contaminant breakthrough. Once effluent contaminant levels reach a predetermined level, the lead GAC carbon is replaced and the order of vessel operation is switched. GAC is either regenerated on site or at a regeneration facility.

Multiple contaminants can be difficult to remove based on isotherm data (i.e. 1,2,3-TCP). New, poorly adsorbed contaminants would lead to more frequent carbon change outs or would require larger contactors and/or more vessels to provide more GAC and longer contact time to obtain the desired removal. The presence of multiple contaminants creates competition for adsorption sites and thus less opportunity for the poorly adsorbed constituents to be removed, accelerating breakthrough than if just that singular contaminant is present. For some groundwater treatment facilities, the use of UV-AOP for final contaminant removal or reduction of VOC prior to liquid phase GAC may be required, especially if chemicals such as 1,4-dioxane are in the groundwater.

Oxidation and air stripping processes need to be evaluated along with, and in combination with, adsorptive processes. While all the processes discussed may be applicable, some of those may be eliminated from further considerations based on potential fatal flaws or excessive cost. For example, air stripping is most likely not feasible due to the requirement to treat the vapor phase for TCE and PCE using GAC. In that case, the costs tend to be similar to straight GAC adsorption in the liquid phase. In addition, neighborhood impacts of air stripping towers may be unacceptable. Approval from regulating agencies may also be daunting.

5.2.5 Biological Treatment

Biological treatment can be an efficient, robust, and environmentally sustainable approach for addressing numerous organic and inorganic contaminants in groundwater and should be considered as a viable alternative to many of the groundwater treatment processes discussed in this section.

A fixed bed biological treatment system, which is shown schematically in Figure 5-5, is a two-step biological process for multiple contaminant removal: 1) Aerobic biological treatment to convert compounds such as PCE and TCE to vinyl chloride and nitrate and perchlorate to nitrogen. This is accomplished by adding an electron donor, such as acetic acid, to create the necessary reducing conditions, and 2) Aerobic biological treatment to further convert compounds such as vinyl chloride to carbon dioxide. The second stage also achieves final filtration and re-oxygenation.

Another huge benefit of this system is its ability to remove hexavalent chromium and arsenic from water sources. These compounds are reduced to their unstable, and particle form in the first stage of the reactor and backwashed out of the system. Especially in the case of hexavalent chromium , this process is much simpler to employ than other chemically intensive treatment processes such removal using reduction/coagulation/filtration processes or weak base anion or strong base anion IX.

This technology has been approved conditionally by DDW for the use in nitrate, perchlorate, and VOC removal. Proof-of-concept pilot testing is required before implementation and DDW approval.

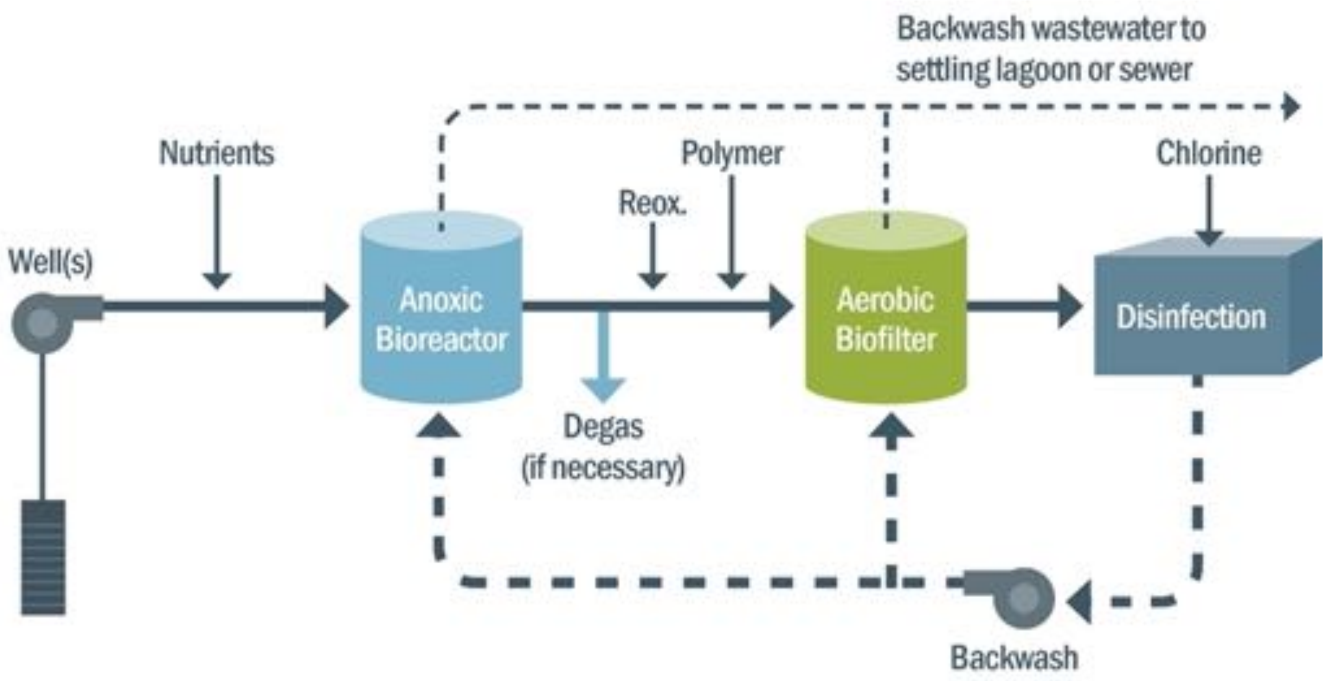

Figure 5-5. Schematic of Fixed Bed Biological Treatment System

The main advantage of biological treatment of VOCs is that no GAC replacement is required, contaminants are fully converted to carbon dioxide, and eliminating the need for brine disposal. Furthermore, the process results in ultimate destruction of contaminants and not sequestration (i.e. IX and GAC), where contaminated media must be processed or disposed of in an environmentally responsible manner. Other biologically processes are available on the market, such as fluidized bed biological reactors; these systems will not remove all of the contaminants that can be removed by fixed bed systems. The main disadvantages of biological treatment are higher capital costs than other treatment technologies and the requirement for proof-of-concept pilot testing.

5.3 MWD Pump Back

MWD operates three raw water transmission pipelines near the project area shown in Figure 5-6 that could all be suitable for MWD Pump Back:

- Rialto Pipeline
- Upper Feeder
- Etiwanda Pipeline

Under normal operation, the Rialto Pipeline delivers raw water from the Devil Canyon Afterbay (which receives water from the East Branch of the State Water Project) westerly to turnouts at the FWC Sandhill WTP, CVWD Lloyd W. Michael WTP, CVWD Royer Nesbit WTP (currently offline), WFA Agua de Lejos WTP, and Three Valleys Municipal Water District (TVMWD) Miramar WTP. The Rialto Pipeline also delivers raw water to various spreading basins for groundwater recharge in the Cucamonga Basin and northern areas of the Chino Basin. After turnouts to those agencies, the Rialto Pipeline delivers raw water west to the MWD F.E. Weymouth WTP (Weymouth), for ultimate delivery to Los Angeles and Orange Counties.

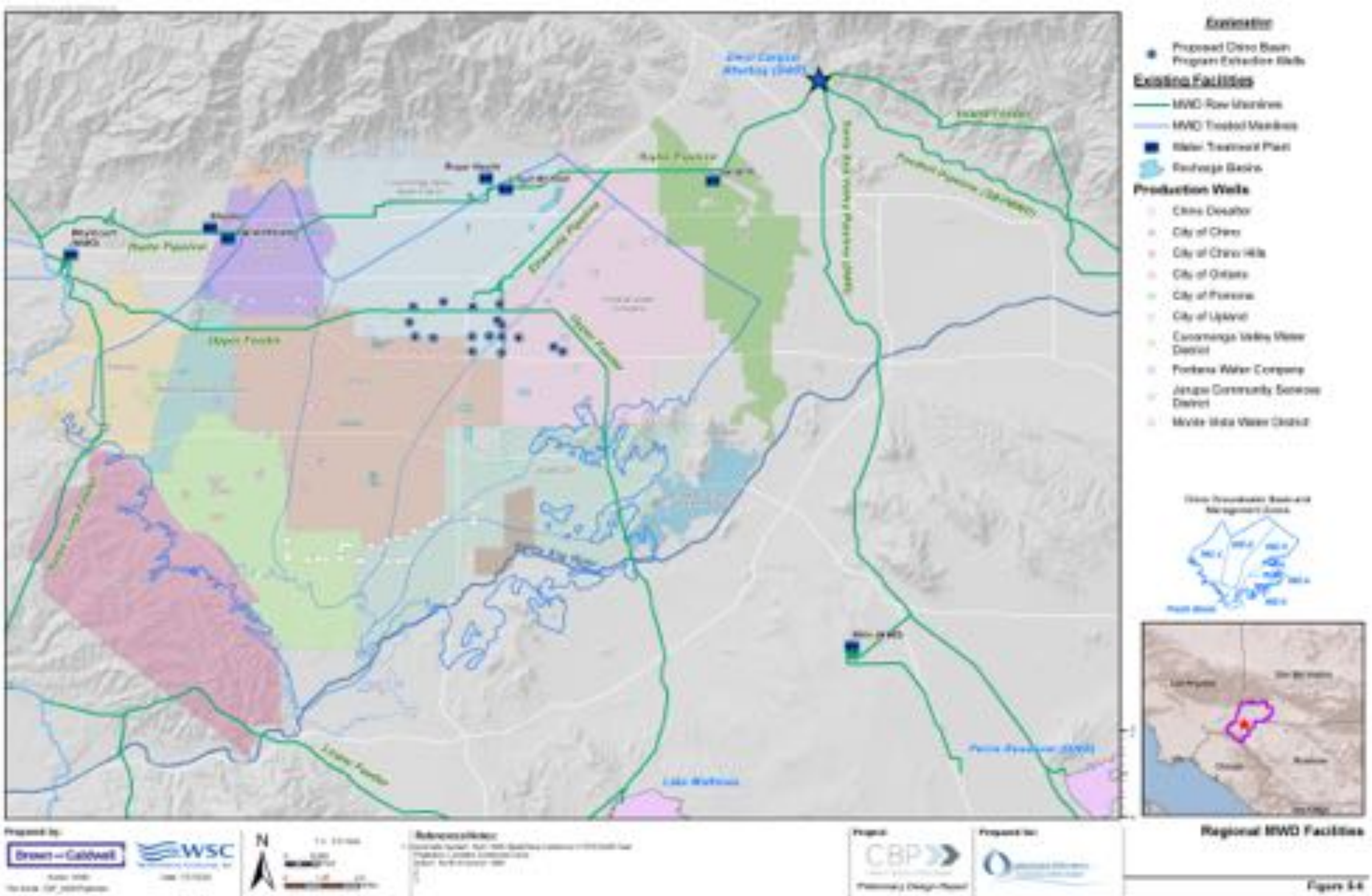

Figure 5-6. CBP Assumptions Regional MWD Facilities

The Upper Feeder is primarily used by MWD as a raw water transmission main from Lake Mathews to Weymouth, and the Etiwanda Pipeline is used as a means of delivering raw water from the Rialto Pipeline to the Upper Feeder as well as generating power from the high head of the Devil Canyon Afterbay. Because the Upper Feeder ultimately delivers water to Los Angeles and Orange Counties, the Rialto Pipeline is the only appropriate pipeline to pump CBP potable water into in order to keep reclaimed water within the Chino Basin. Since the Rialto Pipeline is a raw water pipeline, the potable water generated by CBP would be considered raw water once pumped into the Rialto Pipeline. Note that there are no MWD treated water pipelines near the proposed extraction wellfield.

TAKE alternatives that include MWD Pump Back will require a pump station to lift extracted groundwater from the elevation of the reservoir at the extraction wellfield (between 1,000 ft and 1,200 ft above mean sea level (AMSL) to the static HGL of the Rialto Pipeline of 1,936 ft AMSL. While the HGL of the Rialto Pipeline decreases from 1,936 ft AMSL as it flows west due to headloss, MWD requested the pump back facilities be capable of pumping to the Devil Canyon Afterbay static head of 1,936 ft AMSL to maintain operational flexibility. MWD Pump Back will also require a large-diameter pipeline from the extraction wellfield to the Rialto Pipeline, and a new or retrofitted turnout into the Rialto Pipeline. Assumptions for conveyance include pipelines and pump stations are included in Section 6.5.

5.3.1 Water Quality Considerations

The extracted groundwater being delivered to the Rialto Pipeline must be of quality not to significantly diminish the quality of existing raw water in the Rialto Pipeline and, per MWD requirements, must meet primary and secondary MCLs. Water quality data from existing production wells near the proposed extraction wellfield in northern MZ-2 were collected to estimate the water quality of extracted CBP groundwater. Likewise, water quality data from the Devil Canyon Afterbay were provided by MWD to represent Rialto Pipeline water quality. The blended Rialto Pipeline/CBP water quality was calculated using a mass balance based on the maximum annual CBP delivery of 50.0 TAFY and typical Rialto Pipeline flow of 614 mgd. The estimated water quality for CBP water, the Rialto Pipeline water quality, and the blended CBP and Rialto Pipeline water quality is presented in Table 5-2 along with treated water quality from MWD's Henry J. Mills Treatment Plant in Riverside, California for comparison.

Table 5-2. Blended Water Quality

Constituent	CBP Blended Extraction Wells[1]	Rialto Pipeline[2]	CBP/Rialto Pipeline Blend[3]	Mills Treatment Plant Effluent	Primary *(Secondary)* MCL
TDS (mg/L)	235.6	254.0	252.8	272.0	*(500.0)*
Nitrate-N (mg/L)	3.3	0.4	0.6	0.6	10.0
Hardness (mg/L)	146.7	94.0	97.6	92.0	-
EC (µS/cm)	3844.4	457.0	452.1	516.0	*(900.0)*
pH	7.8	8.1[4]	8.1	8.5	-
Calcium (mg/L)	45.1	20.0	21.8	18.0	-
Magnesium (mg/L)	7.7	11.0	10.8	12.0	-
Sodium (mg/L)	19.6	52.0	49.8	62.0	-

Table 5-2. Blended Water Quality					
Constituent	**CBP Blended Extraction Wells[1]**	**Rialto Pipeline[2]**	**CBP/Rialto Pipeline Blend[3]**	**Mills Treatment Plant Effluent**	**Primary *(Secondary)* MCL**
Potassium (mg/L)	1.8	N/A	N/A	2.8	-
Bicarbonate (mg/L)	178.7	72.0	79.2	70.0	-
Chloride (mg/L)	9.4	72.0	67.8	85.0	*(250.0)*
Sulfate (mg/L)	15.1	33.0	31.8	40.0	*(250.0)*
Perchlorate (µg/L)	2.4	0[5]	0.2	N/A	6.0
Hexavalent Chromium (µg/L)	3.4	0[5]	0.2	N/A	10.0[6]

Notes:

[1]Based on 5-10 years water quality data of nearby production wells.

[2]Rialto Pipeline water quality assumed to be equivalent to Devil Canyon Afterbay water quality as provided in MWD Bulletin 132-13 from April 2015, Table 4-1.

[3]Calculated by mass balance of typical Rialto Pipeline flowrate (614 mgd) and maximum proposed CBP flowrate (50.0 TAFY, 44.64 mgd). CBP water would account for approximately 6.8% of the combined flow.

[4]CVWD LWMWTP Master Plan, October 2010

[5]No data, which suggests that these constituents were not sampled because not typically present in surface water. For this analysis, they were assumed to be zero.

[6]The hexavalent chromium MCL was rescinded but is anticipated to be re-proposed at this same level in the future. Total chromium has an MCL of 60 µg/L.

Table 5-2 shows that the projected, blended water quality for the CBP extraction wells is of high quality and, in many cases, the extraction well water quality exceeds that in Rialto Pipeline. The lack of perchlorate and hexavalent chromium data for the Rialto Pipeline suggests that these constituents were not sampled. These constituents are not typically present in surface water and for this analysis it is assumed that they have low or zero concentration in the Rialto Pipeline. The projected levels for the CBP water alone are below the MCL for perchlorate and the assumed future MCL for hexavalent chromium. Considering the significant dilution that will occur in the Rialto Pipeline once the CBP water is pumped in, treatment was assumed to not be required and was not included in the TAKE alternatives.

It is assumed that the CBP water would be sampled and monitored at or near the turnout into the Rialto Pipeline. It is anticipated that MWD will provide a list of constituents to be monitored at regular intervals to verify the quality of water being delivered. Constituents to be monitored may include TDS, nitrate, hardness, chloride, sulfate, perchlorate, hexavalent chromium, 1,2,3-TCP, and other contaminants that may present treatment challenges or that have primary and secondary MCLs for drinking water.

PFAS. At the time that the water quality analysis was originally completed (summer 2019), limited PFAS data was available. Additional sampling was completed in 2019 and 2020 and results are forthcoming. The following describe sampling that has been undertaken to date:

- The only sampling completed on Chino Basin groundwater to date was through UCMR3, which was for 30 active wells.

- All UCMR3 data showed that all samples were non-detect. However, UCMR3 data was analyzed using older analytical methods with a higher detection limit than the current NLs. Therefore, it is inconclusive as to whether the CBP groundwater will require treatment for PFOA and PFOS.
- The CBWM monitors some wells in Chino Basin and have added PFOA and PFOS sampling to their constituents. The first samples were collected in 2019.
- A couple of drinking water agencies in the Chino Basin area were served sampling orders from DDW and had to start quarterly sampling in June. These agencies are waiting to see data has been uploaded to DDW's online database.
- The CDA started sampling at desalter wells, but data is not yet available.

5.3.2 Operational Considerations

It is assumed that the MWD Pump Back would operate at a constant rate over the entire calendar year and would not vary to meet seasonal demands. For alternatives with pre-delivery, the CBP would deliver water constantly to the Rialto Pipeline at 26.7 TAFY (~16,600 GPM) during call years, and 10.0 TAFY (~6,200 GPM) during non-call years. For standard delivery (i.e., non-pre-delivery) alternatives, the system would deliver water at 50.0 TAFY (~31,100 GPM) constantly during call years and would not operate during non-call years.

The HGL in the Rialto Pipeline changes as flow varies seasonally so MWD would likely maintain operational control over the pump back conveyance system for more streamlined operation of the pump station with MWD's control system. The interconnection between the MWD Pump Back and the Rialto Pipeline will also include a backflow prevention mechanism to prevent raw water in the Rialto Pipeline from contaminating the potable water in the CBP conveyance system since the MWD Pump Back will not be hydraulically isolated from the In-Lieu CBP system delivering potable water to member agencies (see Section 5.4 of this TM).

Water may be delivered back to the Rialto Pipeline either by retrofit of an existing turnout off the Rialto Pipeline, or by a newly constructed tap into the Rialto Pipeline. There is currently one turnout off the Rialto Pipeline that is unused, CB-7, which has an 18-inch diameter and a capacity of approximately 6,944 GPM as stated in the Integrated Regional Plan. Alternatives that include a maximum pump back flowrate of 11.0 TAFY or less to MWD will consider pumping back through CB-7, or a new connection to the Rialto Pipeline. All alternatives that require more than 11.0 TAFY of pump back to MWD will require construction of a new turnout. A new turnout would likely be placed between connections CB-16 (Lloyd W. Michael WTP) and PM-21 (Miramar WTP) to reduce the length of pipe required between the Rialto Pipeline and the extraction wellfield and/or other potable water distribution facilities.

5.4 In-Lieu CBP and In-Lieu Local

CBP water could also be delivered directly to local agencies and used in-lieu of imported water. Member agencies would receive a direct delivery of CBP water for use instead of imported water that originates from the Rialto Pipeline. In-Lieu CBP would be water from the extraction wellfield delivered to agencies through a new conveyance system, and In-Lieu Local would be water from wellhead treatment on existing wells or new wells delivered using only existing conveyance infrastructure, such as for the example projects for Chino and Chino Hills.

TAKE alternatives that include In-Lieu CBP would have a regional conveyance system including pipelines, pump stations, and turnouts and would be owned and operated by IEUA to deliver extracted CBP groundwater from the extraction wellfield to turnouts into the member agencies' distribution systems. Each member agency receiving CBP water will have a direct turnout into their local distribution system, and alternatives requiring member agencies to use existing interconnections to deliver CBP water to other member agencies will be avoided. An effort will be made to design the regional conveyance system to deliver CBP water directly to member agencies in the pressure zone that they currently receive imported water in order to avoid requiring operational changes from shifting water sources. Member agencies may also request their CBP turnout to be in pressure zones in their system with higher demands if it will give them operational flexibility, water supply reliability, and/or relieve some capacity-constrained portions of their system.

5.4.1 Minimum Plant Flows

The amount of CBP water member agencies can receive in-lieu of Rialto Pipeline raw water is limited by the minimum flowrate required to keep each WTP operating reliably. Because In-Lieu Use involves member agencies taking CBP water directly rather than Rialto Pipeline raw water through their respective WTP, only so much can in-lieu water can be received before demand on the WTPs falls below their minimum acceptable flowrate. TM 2 Section 4.1.3.2 evaluates each member agency’s WTP and projected imported water demands and establishes the maximum amount of in-lieu water they can receive from the CBP.

5.4.2 Water Quality Considerations

Extracted groundwater for in-lieu use would need to be of potable quality as it will be delivered directly to member agencies’ distribution systems. Table 5-2 provides the anticipated quality of extracted groundwater based on samples from existing nearby potable wells in the previous 5 to 10 years. Based on this analysis, the CBP water is expected to meet primary and secondary MCLs and is assumed to not require treatment prior to delivery into each member agency’s system. However, each well will include chlorine for disinfection, and the proposed reservoir at the extraction wellfield will also include chlorine to maintain chlorine residual in the tank and chlorine residual in the regional distribution pipelines.

The WFA Agua de Lejos WTP uses chloramines for disinfection at its WTP, leaving residual chloramine in the WFA distribution system and in its members’ systems as well. There may be adverse water quality affects from mixing water with residual chlorine and residual chloramine, such as disinfection byproduct production. If concerns arise from mixing the two types of disinfected water, the disinfection strategy at turnouts from chlorinated regional CBP facilities to local agency systems using chloramine must be evaluated to determine the optimum blending strategy.

Water quality will be monitored in the potable water reservoir near the extraction wellfield. Water will also be sampled at various locations throughout the regional distribution system to ensure that water being delivered to member agencies meets drinking water quality requirements. It is anticipated that agreements will be made between member agencies and IEUA that provides a set of water quality requirements, or that the CBP water deliveries will only be required to meet the primary and secondary MCLs for drinking water.

5.4.3 Operational Considerations

The regional CBP delivery system for In-Lieu CBP, including wells, reservoirs, pump stations, pipes, and turnouts, would be owned and operated by IEUA. The system would primarily operate as a constant flow system, simultaneously pumping, conveying, and delivering groundwater to member agencies at the designated flowrate for either a call year or non-call year. The system would not have the ability to increase production to accommodate increased summertime demands, except in non-call years for alternatives that include pre-delivery, as the average flow rate for the non-call year would be less than the maximum capacity of the conveyance system.

If a well began producing water with a high level of a contaminant that could not be blended out by the rest of the production wells, a redundant well would be operated to make up the water deficit. If a redundant well is unavailable or already producing water, the production of the other well could be increased slightly to make up the deficit of the offline well.

TAKE alternatives that include In-Lieu CBP, i.e., direct deliveries of extracted groundwater in-lieu of imported water to member agencies, will include dedicated pipelines, pump stations, and turnouts owned and operated by IEUA. Turnouts will be metered to track deliveries of CBP water made to member agencies to accurately determine how much water member agencies are using in-lieu of imported water. Like In-Lieu CBP, water deliveries from In-Lieu Local projects would need to be metered to track deliveries of CBP water made to member agencies for accurate accounting.

Section 6: Conveyance Assumptions

This section presents the conveyance approach and assumptions for both the PUT and TAKE alternatives. This section includes:

- **General criteria and alignment assumptions:** discussed in Section 6.1.
- **Recycled water conveyances:** discussed in Section 6.2.
- **Purified water conveyance:** discussed in Section 6.3.
- **Brine conveyance:** discussed in Section 6.4.
- **Potable water conveyance:** discussed in Section 6.5.

6.1 General Criteria and Alignment Assumptions

In general, all proposed conveyance pipelines will be aligned through the public Right-of-Way (ROW) and properties owned or to-be acquired by IEUA to reduce the number of easements required for construction and maintenance. Parallel alignments through ROWs governed by the California Department of Transportation (Caltrans) will also be avoided (though not excluded from consideration) to reduce permitting efforts. Constructing in areas requiring additional permitting will be considered to avoid known utility conflicts and/or narrow segments of road, or to shorten the length of the overall alignment.

Many existing utilities could conflict with proposed conveyance pipelines, potentially leading to increases in construction time and cost. It is assumed that each stretch of public ROW will include at least one local water main and services, one local sewer main and laterals, local communication and electricity facilities in a duct bank, and one local gas distribution main and services. In addition, regional facilities have been mapped in to Figure 6-1 identify larger utility conflicts, including the following:

- Large water transmission mains operated by MWD, San Gabriel Valley Municipal Water District, and CDA
- IEUA sewer trunk lines and force mains
- IEUA recycled water pipelines fuel transmission lines
- Groundwater recharge basins
- Natural gas transmission and distribution pipelines
- Regional brine transmission lines
- Regional storm drainage facilities
- Properties owned by the Southern California Edison Company (Edison)

While avoiding all utility conflicts is not feasible, all conveyance pipelines will be aligned to avoid known parallel utility conflicts with as many existing regional utility facilities as possible. Pipelines may be aligned through utility conflicts if alternatives to avoid utilities require excessive increases in pipe length, excessive segments that require horizontal directional drilling to construct, or acquisition of easements that are considered more costly and challenging than avoiding the utility. Lots owned by Edison that cannot be purchased outright by IEUA are also not being considered due to Edison's "No Permanent Facility" clause in its Transmission Line Right of Way Constraints and Guidelines.

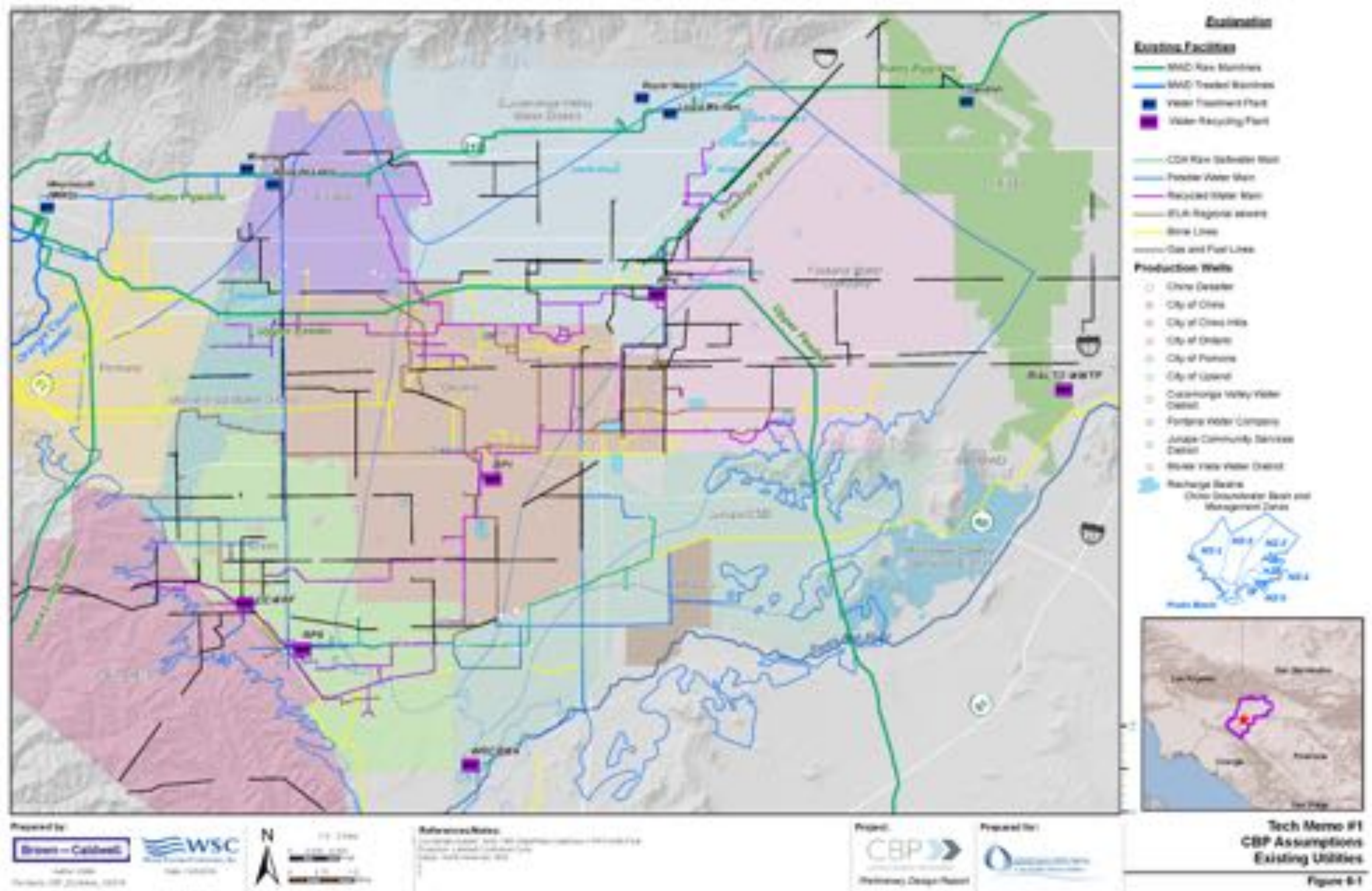

Figure 6-1. Existing Utilities Map

6.2 Recycled Water Conveyance

IEUA owns and operates a recycled water distribution system with five pressure zones to serve recycled water customers and deliver recycled water to recharge basins for groundwater replenishment. The proposed AWPFs are to be placed along existing recycled water mains; therefore no additional recycled water facilities will be required to move recycled water from IEUA's existing system to the AWPFs. However, due to the demand of the AWPFs on the existing recycled water system, IEUA will be receiving additional supply from Rialto WWTP and WRCRWA. Both new recycled water supply sources will require a pump station and pipeline to connect into the existing recycled water system. The assumptions and criteria for these recycled water pipelines and pump stations are listed below and in Table 6-1.

- Total dynamic head (TDH) required of pump stations to pump water into the existing recycled water system was calculated by the existing hydraulic model
  - The existing model uses the Hazen Williams equation used to determine friction head loss within pipelines
- Trenchless technologies will be required at freeway, flood channel, and railroad crossings
  - Jack and bore for lengths less than 500 feet
  - Horizontal directional drilling for lengths exceeding 500 feet

Table 6-1. Tertiary Recycled Water Pump Station and Pipeline Design Criteria and Planning Assumptions

Parameter	Criteria	Units	Demand Condition
Maximum System Velocity	5	fps	Constant Flow
Pipe Material, Diameter ≥ 16 in	Steel	-	-
Pipe Material, Diameter < 16 in	Unspecified	-	-
Hazen Williams Coefficient	120	-	-
Minor Losses (% of friction losses) (bends, valves, etc.)	5	%	-
Low water level plant and booster pump stations	20 ft below grade	-	-
Motor Efficiency	75	%	-
Pump Efficiency	93	%	
Total Pump Station Efficiency	70	%	

Because pump stations will be required to lift these recycled water sources into the appropriate pressure zone of the IEUA recycled water system, it is assumed that in-conduit hydropower facilities will not be applicable as there will be no surplus head to take advantage of.

6.2.1 Recycled Water Pipeline Alignment Assumptions

6.2.1.1 Connection from the Rialto WWTP

The connection from the Rialto WWTP is assumed to connect to IEUA's recycled water system near RP-4 within the 1158 pressure zone (HGL 1158 ft, typical). In scenarios with the AWPF located at RP-4, the pipeline connection from the Rialto WWTP will directly feed the AWPF. In order to make the connection near RP-4, the supply pipeline is required to cross the Union Pacific Railroad and Interstate 10. It is assumed that the pipeline will require jack-and-bore to cross both the railway and the freeway.

6.2.1.2 Connection from WRCWRA

The connection from WRCRWA to the IEUA recycled water system is assumed to connect within the 930 pressure zone near the 930/800 pressure reducing valve. This connection will allow the supplemental supply from WRCRWA to offset demands in the southern pressure zones where the highest agricultural demands exist and make available IEUA supply normally used to meet these demands to feed the AWPF. Due to limitation in how water can move between pressure zones, a connection to the 800 pressure zone would not allow for a maximum benefit of the new supply source. A connection within the 1158 pressure zone would allow the new supply to directly feed the AWPF if located near RP-1 but will also require about two additional miles of pipeline than a connection to the 930 pressure zone, making this connection cost prohibitive.

6.3 Purified Water Conveyance

The purified water distribution system consists of pump stations and pipelines. The treatment plant pump stations deliver water to injection wells and lower elevation recharge basins. Additional booster pump stations are required to deliver purified water to higher elevations and more distant recharge basins.

6.3.1 Pipelines

Purified water would be routed from the AWPF's located at either IEUA's RP-1, RP-4, or MVWD's Plant 28 site to injection wells located within the Chino Basin. Pipeline design criteria established for the purified water system in addition to the overall pipeline design criteria (Table 6-1) are shown in Table 6-2.

- Hazen Williams equation used to determine friction head loss within pipelines
- Trenchless technologies will be required at freeway, flood channel, and railroad crossings
  - Jack and bore for lengths less than 500 feet
  - Horizontal directional drilling for lengths exceeding 500 feet
- Pressure reducing valves will be included at each injection well to decrease head to the required residual pressure to feed the wells.

Table 6-2. Purified Recycled Water Pipeline Design Criteria and Planning Assumptions

Parameter	Criteria	Units	Demand Condition
Hazen Williams Coefficient	120	-	-
Maximum System Velocity	5	fps	Constant Flow
Pipe Material	Steel	-	-
Minor Losses (bends, valves, etc.)	5	%	-
Residual Head required at Injection Wells	10	psi	-

Table 6-2. Purified Recycled Water Pipeline Design Criteria and Planning Assumptions			
Parameter	**Criteria**	**Units**	**Demand Condition**
Low water level plant and booster pump stations	20 ft below grade	-	-
Motor Efficiency	75	%	
Pump Efficiency	93	%	
Total Pump Station Efficiency	70	%	-

6.3.2 Pump Stations

The proposed conveyance routings will require pump stations to deliver water to the injection wells in the event that an option including the recharge basins is selected. Only one pump station would be required to pump water from the AWPF to the conveyance pipeline to the injection wells. Design criteria for these pump stations is included in Table 6-2.

If a PUT alternative is developed that includes using recharge basins for groundwater replenishment of purified water, an additional pump station would be required to convey purified water to the northern recharge basins including Lower Day, Etiwanda Debris, and San Sevaine. The purified water conveyance system could be extended from the injection wells to Victoria, Hickory, and Banana recharge basins without an additional pump station (i.e., the purified water pump station could pump to the injection wells and these three recharge basins), if desired.

6.4 Brine Conveyance

RO concentrate created at IEUA's RP-1, RP-4, or Plant 28 AWPFs and brine concentrate from the example In-Lieu Local project for the City of Chino Hills wellhead treatment facility will be disposed of into the existing NRWS via the nearest existing manhole. Reference Section 4.2.5 and TM3 – Brine Disposal System for more information on the preferred brine disposal system for waste flows created at the proposed AWPF. The following assumptions were made to complete this phase of design:

- Hazen Williams equation used to determine friction head loss within pipelines
- RO concentrate will have sufficient pressure to deliver water from treatment plant to brine line discharge
- Jack and bore required at freeway crossings

Table 6-3. Brine Pipeline Design Criteria and Planning Assumptions			
Parameter	**Criteria**	**Units**	**Demand Condition**
Hazen Williams Coefficient	120	-	-
Maximum System Velocity	5	fps	Constant Flow
Pipe Material	HDPE	-	-
Minor Losses (bends, valves, etc.)	5	%	-

6.4.1 Pipelines

The RP-1 brine pipeline connection will connect into the NRWS pipeline via a pipeline parallel to the recycled water conveyance line also exiting the plant. The HDPE brine line will require one jack-and-bore trenchless crossing under the 60 freeway.

The RP-4 brine pipeline will connect into the NRWS pipeline via a pipeline on the southeastern side of the existing facility. No trenchless crossings are required for this pipeline.

The brine pipeline for the AWPF at MVWD's site would be routed parallel to the recycled water conveyance line also exiting the plant to connect to the EWL. No trenchless crossings are required for this pipeline.

The brine pipeline for the example In-Lieu Local project included for the City of Chino Hills wellhead treatment facility would connect into the IEBL via a pipeline on the southern side of the facility. The HDPE brine line would require one jack and bore trenchless crossing under the 71 Highway and Chino Creek.

The brine line design criteria can be found in Table 6-4.

Table 6-4. Brine Pipeline Design Criteria

Parameter	Diameter (in)	Approximate Length (ft)	Maximum Elevation (ft)
RP-1 Brine Line	8	3,900	835
RP-4 Brine Line	8	1,400	1,084
Plant 28 Brine Line	4	900	1,062
Example In-Lieu Local Project (City of Chino Hills Wellhead Treatment Facility)	8	6,800	657

6.5 Potable Water Conveyance

The potable water conveyance system will consist of extraction wells, a reservoir, pump stations, pipelines, and turnouts to member agencies and/or MWD. In general, the extraction wellfield will deliver potable water to a reservoir which will be used for blending and to break head between high and low HGL zones where potable water will be delivered. The reservoir will have two outlets – one directly into a proposed transmission main to deliver water to lower HGL member agencies, and one into the suction side of a proposed potable booster pump station to deliver water to higher HGL member agencies and/or into the Rialto Pipeline.

6.5.1 Pipelines and Pump Stations

For alternatives that include both MWD Pump Back and In-Lieu CBP, regional potable water facilities will be joined and used for both purposes to reduce costs. For instance, if water is to be pumped back to MWD at CB-7 and also delivered to CVWD at the Lloyd W. Michael WTP (about a half mile away from CB-7), a single pump station and pipeline with capacity for both deliveries would be installed to convey water from the extraction wellfield to the general area near CB-7 and Lloyd W. Michael WTP at which point the pipeline would diverge to two smaller diameter pipelines to deliver water to the each turnout.

The assumptions and criteria for the potable water pipelines and pump stations are listed below and in Table 6-5.

- Hazen Williams equation used to determine friction head loss within pipelines

- Pump suction side HGL set to 10 ft above ground elevation for pump stations with an open-atmosphere forebay
- Trenchless technologies will be required at freeway, flood channel, and railroad crossings
  - Jack and bore for lengths less than 500 feet
  - Horizontal directional drilling for lengths exceeding 500 feet
- For pre-delivery alternatives, pump stations and pipelines are sized based on their call year design flowrate.

Table 6-5. Potable Water Pump Station and Pipeline Design Criteria and Planning Assumptions

Parameter	Criteria	Units	Demand Condition
Maximum System Velocity	5	fps	Constant Flow
Pipe Material, Diameter ≥ 16 in	Steel	-	-
Pipe Material, Diameter < 16 in	Unspecified	-	-
Hazen Williams Coefficient	120		
Minor Losses (% of friction losses) (bends, valves, etc.)	5	%	-
Motor Efficiency	75	%	-
Pump Efficiency	93	%	-
Total Pump Station Efficiency	70	%	-

6.5.2 In-Conduit Hydropower Facilities

In-conduit hydropower facilities may be considered in locations of the potable water distribution system where the system pressure needs to be reduced and energy can be produced. Due to the various pressure zones that the regional potable system will be pumping into, it is likely that in some cases a single pump station may deliver water to multiple local pressure zones with different HGLs, and in-conduit hydropower facilities may be appropriate to recapture some of the energy used to lift the water to the higher HGL. This would only be appropriate where the energy loss from pumping water to an HGL and then attempting to recover it with a hydropower facility would be less costly than to build a second pump station and pipeline to deliver water to the lower HGL without any unnecessary additional lift.

Locations ideal for in-conduit hydropower generations should have an available pressure between 25 and 260 psi. The power output at the facility will depend on the available head and flow rate. Three types of in-line hydropower facilities were identified for the CBP:

1. Pump Turbines. A pump turbine is a centrifugal pump running in reverse and is a typically used in small output applications less than 300 kW. Economically, these start to make sense with a minimum power output of 50 kW. They work best with stable and relatively constant flow rates.
2. In-line Francis Turbines. Francis type turbines are the most widely used in-line hydraulic turbines. In-line Francis Turbines can be dropped into an existing PRV location. Unlike pump turbines, Francis Turbines can operate over a wide flow range. These typically have an efficiency of 70-75%. Economically, installation of a Francis Turbine makes sense in locations that can generate 150 kW or greater.

3. Custom Francis Turbines. A custom Francis Turbine has a higher efficiency, typically 80-85%, and are generally installed in locations that can produce much high power 500 kW or greater. These can also cover a wide range in flow.

Under the Federal Power Act, non-federal hydropower resources are regulated under the Federal Energy Regulatory Commission (FERC). FERC issues three types of authorizations: conduit exemptions, 10-megawatt exemptions, and licenses. FERC approval is required to construct and operate small/low-impact hydropower projects while assuring adequate protection of environmental resources. The FERC Small/Low Impact Hydropower Projects program is intended for small projects that would results in minor environmental effects, such as projects that involve little change to water flow and use and are unlikely to affect threatened and endangered species. The CBP would likely be classified as a small/low-impact hydropower project or would qualify for a conduit exemption as all proposed hydropower generation would be from in-conduit turbines.

6.5.3 Blending and Storage Reservoir

A single reservoir is proposed near the extraction wellfield to allow for blending of groundwater and serve as a forebay for the pump station. The proposed reservoir near the extraction wellfield should provide a retention time of approximately three hours from the extraction wellfield for adequate blending. The reservoir was sized at 2.5 MG for TAKE alternatives with pre-delivery and 5 MG for TAKE alternatives without pre-delivery.

The location for a potential reservoir site was determined through identifying land in the Chino Basin near the extraction wellfield suitable for reservoir construction. A GIS shapefile of parcels in San Bernardino County provided by the Assessor’s Office was used to identify potential reservoir sites with the following attributes for use in developing the TAKE alternatives:

- Undeveloped parcels.
- Parcels located at the intersection of streets. These sites would provide for easy access to the site during construction, maintenance, and rehabilitation activities.
- Parcels greater than one acre for a 2.5-MG reservoir and greater than 1.75 acres for 5-MG reservoir.
- Parcels not planned for development (such as the former Empire Lakes Golf Course site).
- Parcels with a vacant land use designation.

Section 7: Cost Estimating Approach

This section explains the methodology and considerations for developing the planning-level cost estimates for PUT, TAKE, and program alternatives using a unit cost approach. A unit cost estimating approach allows cost comparisons between several conceptual alternatives to support the alternatives evaluation to identify the recommended PUT, TAKE, and program alternatives. A more detailed Class 4 cost estimate will be prepared for the recommended program alternative as part of the Study.

The unit costs were developed for each major infrastructure element within the program. The resulting PUT, TAKE, and program cost estimates for capital and O&M costs are presented in TM2 Section 3.3.7 (PUT alternatives), Section 4.3.7 (TAKE alternatives), and Section 5 (program alternatives).

This section includes the following:

- General assumptions, including the estimate classification and markups: discussed in Section 7.1.
- Unit costs assumptions for capital and annual O&M costs for the PUT and TAKE components, and common facilities: discussed in Section 7.2.
- Net present value (NPV) cost approach: discussed in Section 7.3.

7.1 General Assumptions

This section summarizes the general assumptions for the cost estimate, including the estimate classification, the basis for estimate, cost contingencies and factors, and unit power cost assumptions.

7.1.1 Estimate Classification (AACE Class 5 Estimate)

Since the cost estimates are based on preliminary concepts and are used for the purposes of comparing alternatives, the cost estimates developed for the PUT, TAKE, and program alternatives evaluations are aligned with the AACE International Cost Estimate Classification System criteria for a Class 5 estimate for concept screening. Class 5 estimates are based on a level of project definition of 0 to 2 percent and are suitable for alternatives analysis. The typical accuracy ranges for a Class 5 estimate are -20 to -50 percent on the low end and +30 to +100 on the high end. An additional contingency cost is added to account for level of detail of the project concept and unknown or unforeseen construction cost (discussed further in Section 7.1.3 of this TM).

7.1.2 Basis for Estimate

The cost estimates are based on construction projects and estimates recently completed for IEUA and its member agencies, construction projects and estimates of similar projects performed in neighboring districts, equipment cost quotations from vendors, industry publications, client input, and engineering judgement. The developed unit costs include construction costs (equipment, labor, and contractor markup) and annual O&M costs.

All estimates were escalated to a current value based on Engineering News Record (ENR) Construction Cost Index (CCI). Values presented in this report are presented in August 2019 dollars, with an estimated Los Angeles ENR CCI value of 12,037.18.

7.1.3 Cost Contingencies and Factors

Cost contingencies and factors are added to estimated construction costs to account for unknown costs at the time of the estimate and to capture project implementation costs that are in addition to the construction costs associated with materials, labor, and construction administration. Two types of markups are included for the cost estimates for this Study: contingency and implementation.

7.1.3.1 Contingency Markup

A contingency markup is applied to the construction cost to account for unknown or unforeseen costs. In general, higher contingencies should be applied to projects of high risk or with significant unknown or uncertain conditions. Additionally, the lower the project definition at the time of the cost estimate generally leads to a higher contingency. The contingency will decrease as the design develops and many of the unknowns or uncertainties are defined and able to be estimated.

Since these are planning-level cost estimates based on a high-level of project definition, a contingency of 30 percent was used. The contingency was applied to the construction subtotal estimated for each alternative. The total construction cost is the sum of the construction subtotal plus the contingency.

7.1.3.2 Implementation Markup

An implementation markup is included to capture the entire capital costs associated with implementation of the project. This factor accounts for the costs of engineering services for design and during construction; client administration, including environmental documentation, permitting, legal, and administrative services; and construction management. This markup is applied to the total construction cost (which includes contingency). These costs vary based on many factors, such project type, project complexity (environmental, permitting, construction, etc.), financing approach, and other factors.

An implementation markup of 28% was assumed for this project, which is consistent with other planning studies, such as the Feasibility Study of Recycled Water Interconnections Between the City of Pomona, MVWD, and IEUA (Carollo, January 2016). The implementation markup was applied to the total construction cost for each alternative to estimate the implementation costs. The total capital cost is the sum of the total construction cost plus the implementation costs.

7.1.4 Unit Power Cost Assumption

Energy costs represent a significant amount of annual O&M costs to the program. Annual energy costs are included for PUT and TAKE components such as the AWPF, pump stations, and extraction wells.

Annual energy demands for the PUT and TAKE components were estimated using vendor quotes, existing facilities, and calculated based on motor horsepower and efficiency. The unit cost for energy was estimated by multiplying the annual energy demand by the assumed power cost. For this Study a power cost of $0.17 per kWh was assumed. The annual unit power costs are presented in Section 7.2.

7.2 Unit Costs Assumptions

This section introduces the methods used to develop unit costs and assumptions for the CBP cost components:

- PUT components – AWPFs, injection wells, monitoring wells, and recharge basin improvements
- TAKE components – turnouts and connections, extraction wells, wellhead treatment, pump back treatment, and MWD wheeling charge
- Common Facilities – piping (open cut and trenchless), pump stations, NRWS disposal, water storage tanks, and land acquisition

The following subsections will provide detailed information on the basis for each unit cost. The assumed unit costs are included in Appendix D for both construction costs and annual O&M costs.

7.2.1 Put Components

PUT facilities support the purification of recycled water supplies for groundwater replenishment through direct injection or spreading basins (see Section 4 of this TM for more information).

7.2.1.1 AWPFs

The primary AWPF facilities are assumed to be located at RP-1 or RP-4, with consideration of a smaller satellite AWPF at MVWD Plant 28. Locating an AWPF at an existing reclamation plant eliminates or reduces the cost associated with land acquisition and places the treatment facility at the major source of recycled water, thus reducing pipeline and pump station costs.

AWPF construction costs are expressed as a unit of dollars per gallons per day (gpd). Several treatment train options are provided to account for the most likely scenario for each alternative. For example, it was determined an AWPF placed at RP-1 would most likely utilize a purification treatment train of MBR-RO-AOP based on the RP-1 Master Plan recently performed under the RP-1 Liquids & Solids Capacity Recovery Preliminary Design Report (Carollo, April 2019). Several recent Southern California projects were used as the basis for AWPF unit costs, including Orange County Water District's Groundwater Replenishment System and the City of San Diego's Pure Water Program North City Facility.

Additionally, special circumstances may require CBP to pay for the relocation of existing facilities to make room for the proposed AWPF. For example, PUT alternatives that include an AWPF at the MVWD Plant 28 site in MZ-1 assume an "MVWD In-Kind Contribution" to provide MVWD with an alternate site for the existing facilities at the Plant 28 site. Engineering judgement was used to determine a lump sum value for the relocation of facilities at MVWD.

Determining an O&M unit cost for AWPF facilities, similar to AWPF construction costs, requires breaking down the unit cost into smaller components to allow for flexibility to apply to various AWPF treatment scenarios. Unit cost values were derived from similar projects in Southern California and vendor input.

Table 7-1 and Table 7-2 summarize the AWPF construction and annual O&M costs, respectively.

Table 7-1. AWPF Construction Cost (August 2019 Dollars)

AWPF	Cost	Unit
AWPF with MBR	$8.30	gpd
AWPF with RO-AOP Only	$7.00	gpd
AWPF with MF	$8.10	gpd
Offsite AWPF with MF	$8.91	gpd
MVWD In-Kind Contribution	$2,000,000	Each

Table 7-2. AWPF Annual O&M Cost (August 2019 Dollars)

AWPF	Cost	Unit
MBR – Power (MBR)	1.25	kWh/1000 Gal
MBR – Power (BNR Air)	1.42	kWh/1000 Gal
MBR – Chemicals	$0.01	$/1000 Gal
MBR – Membrane Replacement	$0.30	$/1000 Gal
AWPF – Power (MF-RO-AOP)	2.52	kWh/1000 Gal
AWPF – Chemicals (MF-RO-AOP)	$0.42	$/1000 Gal
AWPF - Consumables (MF-RO-AOP)	$0.21	$/1000 Gal

Table 7-2. AWPF Annual O&M Cost (August 2019 Dollars)		
AWPF	**Cost**	**Unit**
AWPF - Power (RO-AOP)	2.28	kWh/1000 Gal
AWPF - Chemicals (RO-AOP)	$0.32	$/1000 Gal
AWPF - Consumables (RO-AOP)	$0.12	$/1000 Gal

7.2.1.2 Injection Wells

Injection wells deliver purified water to the groundwater basin. The size and placement of injections wells were determined by model runs predicting the effect each well would have on the basin.

Injection well construction costs are a function of the well development, equipping, and an optional building housing the injection well equipment. For this estimate we assumed that a building would be provided for all injection wells. A recently installed well for CVWD was used as the basis for this estimate due to its proximity to the proposed wells in this study. Well costs provided by CVWD were compared with a database of recently installed wells in Southern California and reviewed using engineering judgement.

An annual sum was applied to each injection well to account for the general O&M that would be required to keep the injection well in operation. The annual O&M unit cost was developed using engineering judgement.

Table 7-3 and Table 7-4 provide unit costs for injection well construction and annual O&M costs, respectively.

Table 7-3. Injection Well Construction Cost (August 2019 Dollars)		
Injection Well	**Cost**	**Unit**
Development	$1,500,000	Each
Equipping and Building	$500,000	Each

Table 7-4. Injection Well Annual O&M Cost (August 2019 Dollars)		
Injection Well	**Cost**	**Unit**
General O&M	$30,000	Each

7.2.1.3 Monitoring Wells

Monitoring wells are required by Title 22 regulations for groundwater replenishment using recycled water to monitor water quality in the groundwater basin. Monitoring well construction costs were developed using a database of recent and local monitoring well projects. Cost information was reviewed for engineering judgement. An annual sum was applied to each monitoring well to account for the general O&M that would need to be performed to keep the monitoring well in operation. The annual O&M unit cost was developed using engineering judgement.

Table 7-5 and Table 7-6 present the monitoring well construction and annual O&M costs, respectively.

Table 7-5. Monitoring Well Construction Cost (August 2019 Dollars)		
Monitoring Well	**Cost**	**Unit**
Development	$750,000	Each

Table 7-6. Monitoring Well Annual O&M Cost (August 2019 Dollars)		
Monitoring Well	**Cost**	**Unit**
General O&M	$10,000	Each

7.2.1.4 Recharge Basin Improvements

While none of the PUT alternatives use recharge basins for PUT activities, it was added to the cost model to provide flexibility should this option become necessary. If it is decided to use recharge basins for purified water recharge, improvements would most likely need to take place at the existing recharge basin before adequate recharge can occur. Table 7-7 provides a unit cost associated with recharge basin improvements. A lump sum would be applied to each recharge basin to be used. The lump sum provided is based on engineering judgement for what is anticipated to be an average scenario.

Table 7-7. Recharge Basin Construction Cost (August 2019 Dollars)		
Recharge Basin Improvement	**Cost**	**Unit**
Development	$750,000	Each

7.2.2 TAKE Components

TAKE facilities support the extraction of groundwater and delivering potable water to MWD's system or used for in-lieu purposes (see Section 5 of this TM for more information).

7.2.2.1 Turnouts and Connections

Turnouts and connections provide an access point for the CBP to deliver potable water to either MWD's system or the potable water systems of local member agencies. Table 7-8 and Table 7-9 provide unit costs associated with turnout and connection construction and O&M costs, respectively.

Unit cost estimates for the creating or connecting to an existing turnout were developed using engineering judgement. These unit cost values will need to be further refined with input from MWD and member agencies during subsequent stages of program development.

Similar to construction costs associated with turnouts and connections, the unit annual O&M cost estimate provided below were developed using engineering judgement and will need to be further refined with MWD and member agency input.

Table 7-8. Turnout/Connection Construction Cost (August 2019 Dollars)		
Turnout/Connections	**Cost**	**Unit**
Connection to Existing MWD Turnout	$500,000	Each
Construct New Local Turnout	$500,000	Each

Table 7-9. Turnout/Connection Annual O&M Cost (August 2019 Dollars)		
Turnout/Connections	**Cost**	**Unit**
Maintenance and Monitoring	1%	% of Construction Cost

7.2.2.2 Extraction Wells

Extraction wells pull water from the ground for use as potable water for MWD pump back or in-lieu use.

Similar to injection wells, construction costs associated with extraction wells are comprised of well development, well equipping, and an optional building to house the extraction well equipment. An option building was assumed to be included for all extraction wells proposed in this study. Separate unit costs were developed for well development, well equipping, and building. These unit costs were established from a recently installed well for CVWD and verified with similar installations in Southern California using engineering judgement.

The annual O&M costs for extraction wells include the pumping power and the general O&M. The pumping power was estimated using the pump horsepower, pump efficiency, operating duration, and the unit power cost assumption. The general O&M was assumed for each extraction well to keep the well in operation and extend the life of the equipment and building and was developed through engineering judgement.

Table 7-10and Table 7-11 provide unit costs associated with extraction well construction and O&M costs, respectively.

Table 7-10. Extraction Well Construction Cost (August 2019 Dollars)		
Extraction Well	**Cost**	**Unit**
Development	$1,900,000	Each
Equipping and Building	$600,000	Each

Table 7-11. Extraction Well Annual O&M Cost (August 2019 Dollars)		
Extraction Well	**Cost**	**Unit**
General O&M	$30,000	Each

7.2.2.3 Wellhead Treatment

Wellhead treatment is used to bring extracted groundwater to drinking water standards. The type of wellhead treatment varies based on the contaminants. Some areas within the basin will require wellhead treatment while others will not. The unit costs developed below are broad and anticipated to cover most if not all technologies to treat water quality conditions assumed to be found within the basin.

Additionally, if blended water quality does not meet water quality requirements, then an additional centralized polishing treatment facility would be needed prior to pumping CBP water into MWD's system. For this study it was determined that the CBP blended water quality will not require this additional treatment (discussed in Section 5.3 of this TM). Wellhead treatment is included in the two example In-Lieu Local projects, which are included in some of the TAKE alternatives (discussed in TM2 Section 4.4.2).

Wellhead treatment costs were developed using several recent projects and studies. Since a wide variety of conditions could be applied when treating well water, we used a broader search to capture more data points to minimize the effects on more extreme scenarios. Unit costs for the construction of wellhead treatment are expressed in units of gpd.

O&M costs for operating the wellhead treatment facility include power, consumables, mechanical maintenance, and waste disposal. Unit cost values were derived from vendor quotes and recent projects and studies. O&M costs are provided in terms of dollars per 1,000 gallons.

Table 7-12 and Table 7-13 provide unit costs associated with wellhead treatment construction and O&M costs, respectively.

Table 7-12. Wellhead Treatment Construction Cost (August 2019 Dollars)

Wellhead Treatment	Cost	Unit
IX – Single Pass	$1.52	gpd
IX - Regenerable	$2.08	gpd
Air Stripping	$0.69	gpd
Liquid Phase GAC	$1.04	gpd
Reverse Osmosis	$0.94	gpd
AOP	$2.43	gpd
Biological	$1.83	gpd

Table 7-13. Wellhead Treatment Annual O&M Cost (August 2019 Dollars)

Wellhead Treatment	Cost	Unit
IX – Single Pass	$1.52	$/1000 Gal
IX - Regenerable	$2.08	$/1000 Gal
Air Stripping	$0.69	$/1000 Gal
Liquid Phase GAC	$1.04	$/1000 Gal
Reverse Osmosis	$0.94	$/1000 Gal
AOP	$2.43	$/1000 Gal
Biological	$1.83	$/1000 Gal

7.2.2.4 Pre-Delivery Charge (MWD Wheeling Charge)

Pre-delivery of extracted groundwater during non-call years to reduce the required size and capacity of the TAKE facilities is included in some TAKE alternatives. With pre-delivery, the water would be stored in MWD's system during non-call years for use during call years. Therefore, alternatives with pre-delivery include a wheeling charge from MWD to compensate for storage . This fee is captured as an annual O&M cost for this project since it will be applied annually and could potentially vary from year to year, depending on the alternative selected.

This fee was determined with input from MWD and is a combination of system access fees and water stewardship fees expressed in units of dollars per acre-feet per year. Table 7-14 provides unit costs associated with MWD wheeling charges and are based on MWD fees for the 2019 calendar year.

Table 7-14. Pre-Delivery Charge (MWD Wheeling Charge) Annual O&M Cost (August 2019 Dollars)		
MWD Wheeling Charge	**Cost**	**Unit**
Wheeling charge	$411	$/AFY

7.2.3 Common Facilities

Common facilities are infrastructure that support both PUT and TAKE components. Common facilities include pipelines, pumping stations, NRWS disposal, water storage/equalization, and land acquisition.

Unit costs associated with pipelines are broken out by the method of pipeline installation since the effort and ultimately the costs vary significantly between methods. Open cut construction is the most common and affordable option for pipeline installation. Trenchless piping is generally a more expensive alternative to open cut piping however it may be necessary at locations where access to the pipe alignment may not be feasible or price effective such as crossing a freeway or river. Trenchless piping allows the contractor to install piping of certain stretches without having to dig a trench for the whole pipe alignment. There are several trenchless piping technologies, and two approaches were included in the CBP costs: jack and bore and horizontal directional drilling (HDD). Therefore, the piping costs are split into three categories:

- Pipelines – Open Cut
- Pipelines – Trenchless, Jack and Bore
- Pipelines – Trenchless, HDD

7.2.3.1 Pipelines – Open Cut

Constructing a pipeline using open cut technology is the most common and affordable option for pipeline installation. Open cut construction involves digging a trench to the depth of the pipe alignment, laying the pipe in the trench, and backfilling over the pipe. Many factors could affect the unit cost for open cut piping such as depth of pipe, trench location, material of pipe, access to the pipe alignment, etc. For the level of estimate in this study an average condition was applied based on several projects recently completed in the general area.

Open cut pipeline construction unit costs were developed as a cost per inch diameter linear foot for pipelines dependent on their diameter size. Unit costs were developed using recent construction projects local to the Program site as well as engineering judgement. An annual O&M unit cost is applied to the installed pipelines on a dollar per mile basis and accounts for closed-circuit television (CCTV) monitoring and general repairs and maintenance. Table 7-15 and Table 7-16 provide unit costs associated with open cut pipeline construction and O&M costs, respectively.

Table 7-15. Pipeline (Open Cut) Construction Cost (August 2019 Dollars)		
Pipeline (Open Cut)	**Cost**	**Unit**
0" to 14" diameter pipe	$24	In*LF
16" to 20" diameter pipe	$22	In*LF
24" to 60" diameter pipe	$19	In*LF

Table 7-16. Pipeline (Open Cut) Annual O&M Cost (August 2019 Dollars)		
Pipeline (Open Cut)	**Cost**	**Unit**
Pipeline Maintenance and Monitoring	$5,000	$/Mile

7.2.3.2 Pipelines – Trenchless, Jack and Bore

Jack and bore piping construction is used when the trenchless piping spans a relatively short span compared to HDD. For this study, jack and bore was limited to reaches of no more than 500 feet.

Jack and bore piping require a pit to be placed at the launching and receiving locations. These pits are accounted for as a lump sum value for each pit. Piping cost are provided in a unit cost of inch diameter linear feet. Unit costs were developed from a combination of recent project bid values and estimates both locally and throughout the country as well as engineering experience.

The annual O&M cost for Jack and bore piping is the same as for open cut piping. An annual O&M unit cost is applied to the installed pipelines on a dollar per mile basis and accounts for CCTV monitoring and general repairs and maintenance.

Table 7-17 and Table 7-18 provide unit costs associated with jack and bore pipeline construction O&M costs, respectively.

Table 7-17. Trenchless Piping (Jack and Bore) Construction Cost (August 2019 Dollars)		
Trenchless Piping (Jack and Bore)	**Cost**	**Unit**
Pipeline (all diameters)	$60	In*LF
Launching/Receiving Pits	$40,000	Each

Table 7-18. Trenchless Piping (Jack and Bore) Annual O&M Cost (August 2019 Dollars)		
Trenchless Piping (Jack and Bore)	**Cost**	**Unit**
Pipeline Maintenance and Monitoring	$5,000	$/Mile

7.2.3.3 Pipelines – Trenchless, HDD

HDD piping construction is used when the trenchless piping is required over a relatively long span compared to jack and bore. For this study we assumed that trenchless reaches of greater than 500 feet would use HDD.

HDD piping can be performed with or without a launching and receiving pit depending on the conditions and available space. For this study, we assumed that HDD piping would be performed without launching and receiving pits. Piping costs are provided using a unit cost of inch diameter linear feet. Unit costs were developed from a combination of recent project bid values and estimates both locally and throughout the country as well as engineering experience.

The annual O&M cost for HDD piping is the same as open cut piping. An annual O&M unit cost is applied to the installed pipelines on a dollar per mile basis and accounts for CCTV monitoring and general repairs and maintenance.

Table 7-19 and Table 7-20 provide unit costs associated with HDD pipeline construction O&M costs, respectively.

Table 7-19. Trenchless Piping (HDD) Construction Cost (August 2019 Dollars)

Trenchless Piping (HDD)	Cost	Unit
Pipeline (all diameters)	$90	In*LF

Table 7-20. Trenchless Piping (HDD) Annual O&M Cost (August 2019 Dollars)

Trenchless Piping (HDD)	Cost	Unit
Pipeline Maintenance and Monitoring	$5,000	$/Mile

7.2.3.4 Pumping Stations

Pumping stations are used to move recycled water, purified water, or potable water throughout the system to support the CBP program. The unit cost developed for this study will apply to all three types of pump stations.

Costs related to the construction of a new pump station can vary greatly from project to project. In order to come up with a unit cost that could be applied to all pump stations, an average cost was developed based on greater than 10 pump stations recently constructed in the area. Each pump station was reviewed as a price per horsepower so that the same factor could be applied to each proposed pump station in this study.

Annual O&M costs for pump stations include general O&M and power usage. General O&M consists of rehabilitation and scheduled maintenance of the equipment to keep the pump station running and is expressed as a percent of the overall construction cost. The general O&M cost is applied as an equal amount for each year the pump station is in service. Power usage is a variable O&M cost and is directly tied to the usage of the pump station. The power consumption was estimated as follows:

- Pumping stations for recycled water (external supplies), purified water, and potable water were estimated using the estimated horsepower for the new pump stations, pump efficiency, operating duration, and the unit power cost assumption.
- Pumping for recycled water within IEUA's recycled water system was estimated using the recycled water model (see Section 4.1.3 of this TM).

Table 7-21 and Table 7-22 provide unit costs associated with pumping station construction and O&M costs, respectively.

Table 7-21. Pumping Station Construction Cost (August 2019 Dollars)		
Pumping Station	**Cost**	**Unit**
Booster Pump Station	$5,000	HP

Table 7-22. Pumping Station Annual O&M Cost (August 2019 Dollars)		
Pumping Station	**Cost**	**Unit**
General O&M	3%	% of construction

7.2.3.5 NRWS Disposal

NRWS disposal is the cost associated with the disposal of waste generated from treatment systems such as AWPFs and some technologies used for wellhead treatments. These waste streams produce waste above the allowable limits for sewer disposal and will require these streams to be sent to a dedicated pipeline.

To have access to the LACSD NRWS disposal pipeline, the CBP must first purchase Non-Reclaimable Wastewater System Capacity Units (NRWSCU) to reserve capacity in the NRWS pipeline. While the purchasing of NRWSCU are not considered a construction cost, for this study they will be treated as such since it will be applied as a one-time purchase.

Similar to construction costs, the majority of annual O&M cost for NRWS disposal is not considered O&M but for this study will be treated as such to capture the annual cost associated with NRWS disposal. Annual costs for the use of the LACSD pipeline are provided by LACSD guidelines. The annual costs are a function of total volume discharged, discharged levels of chemical oxygen demand (COD) and total suspended solids (TSS), and a flat rate for agency O&M and charges for clean-in-place (CIP) cleaning.

Table 7-23 and Table 7-24 provide unit costs associated with NRWS disposal costs.

Table 7-23. NRWS Disposal Construction Cost (August 2019 Dollars)		
NRWS Disposal	**Cost**	**Unit**
NRWSCU Purchase Rate	$4,172	CU

Table 7-24. NRWS Disposal Annual O&M Cost (August 2019 Dollars)		
NRWS Disposal	**Cost**	**Unit**
Volumetric Charges	$0.94	1,000 Gal
Strength Charges - COD	$166	1,000 lbs (dry weight)
Strength Charges - TSS	$470	1000 lbs (dry weight)
Agency O&M and CIP Charges	$28.25	CU/Month

7.2.3.6 Water Storage/Equalization Tanks

Water storage tanks are used for both PUT and TAKE alternatives to provide equalization to AWPF flows and extracted groundwater.

Wherever possible, existing basins were used to reduce the construction costs and minimize program footprint. Existing equalization basins are assumed to be concrete basins. Unit costs were developed for modifications to an existing concrete equalization basin using engineering judgement. When a new tank is needed, it is assumed to be made of welded steel. Unit costs for a new welded steel tank were developed using estimates from recent projects and quotes from steel tank manufacturers.

Annual O&M costs are applied to welded steel tanks only and account for the periodic draining, cleaning, and recoating of the steel tank. Repairs to the concrete equalization basins are expected to be minimal and not reflected in this study.

Table 7-25 and Table 7-26 provide unit costs associated with water storage and equalization tank construction and O&M costs, respectively.

Table 7-25. Water Storage/Equalization Tanks Construction Cost (August 2019 Dollars)

Water Storage/Equalization Tanks	Cost	Unit
Welded Steel Tank	$1.30	Gal
Equalization Basin Modifications	$50,000	Each

Table 7-26. Water Storage/Equalization Tanks Annual O&M Cost (August 2019 Dollars)

Water Storage/Equalization Tanks	Cost	Unit
Recoating	$0.02	Gal

7.2.3.7 Land Acquisition

New facilities proposed for this program will be constructed on IEUA property whenever possible to reduce construction costs associated with purchasing of land. When a new facility is to be constructed outside of an IEUA property the program must take into consideration the cost to purchase the land. Table 7-27 provides unit costs associated with land acquisition. The unit cost was developed in dollars per acre by using recent projects in the area and engineering judgement as reference. Land acquisition costs will change as market conditions change and may change at a different rate than typical construction cost escalation.

Table 7-27. Land Acquisition Construction Cost (August 2019 Dollars)

Land Acquisition	Cost	Unit
Land Acquisition	$750,000	Acres

7.3 NPV Costs

The NPV costs for the PUT, TAKE, and program alternatives were developed using economic analysis tool that is described in the Draft Economic Analysis of Master Plan and CBP Alternatives TM (GEI, June 2020). Benefits for each alternative were monetized and cost components were quantified to define the NPV of the benefits and costs associated with each alternative. Following is a summary of the primary NPV cost assumptions:

- Project life duration: 50 years
- Base year for capital, O&M, and NPV costs: 2019

- Proposition 1 WSIP funding: $206.9M
- Federal discount rate: 5% per year
- Economic growth rate: 5% per year
- Escalation rate: 3% per year
- O&M escalation rate: 5% per year
- Construction loan interest: 2.0% per year

The NPV costs for the PUT, TAKE, and program alternatives are presented in TM2 Sections 3.3.7, 4.3.7, and 5, respectively. Refer to the Draft Economic Analysis of Master Plan and CBP Alternatives TM (GEI, June 2020) for more information about the detailed NPV methodology and assumptions.

Section 8: Evaluation Approach

This section describes the evaluation approach for the PUT, TAKE, and program alternatives. The alternatives evaluations and results are presented in TM2.

The alternatives were evaluated using a two-step approach. In the first step, the PUT and TAKE were defined, developed, and evaluated in parallel using a multiple criteria evaluation approach, which includes NPV costs. The second step included the development and evaluation of program alternatives based on the preferred PUT and TAKE alternatives from the PUT and TAKE alternatives evaluations, respectively. Figure 8-1 illustrates the two-step evaluation approach.

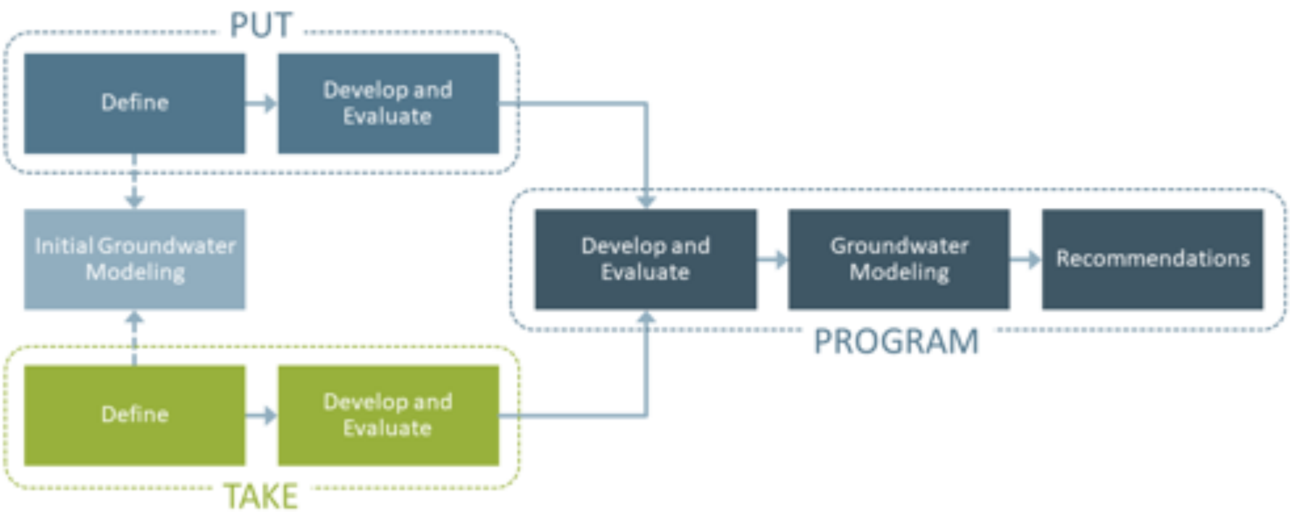

Figure 8-1. Two-Step Evaluation Approach

This two-step approach assists IEUA and stakeholders to identify the recommended program by analyzing the PUT and TAKE alternatives first and then combining the preferred PUT and TAKE alternatives into program alternatives. As part of the program alternatives evaluation, the program alternatives were evaluated to groundwater modeling to assess how the alternatives perform within the Chino Basin. This two-step process allows IEUA and stakeholders time to review and comment between steps and provide key input on the alternatives and the multi-criteria evaluation. The objective of the two-step approach is to:

1. Evaluate component alternatives to eliminate low scoring PUT and TAKE alternatives.
2. Combine the highest ranking PUT and TAKE alternatives into program alternatives for subsequent evaluation and to help identify the preferred program alternative.

The multi-criteria evaluation approach is aligned with the program objectives to directly demonstrate how well the alternatives meet the program objectives. The overall evaluation approach was developed based on the following elements:

- Establish minimum requirements that alternatives must meet to be considered.
- Organize the evaluation by critical objectives.
- Define evaluation criteria for each objective to measure how well each alternative performs against that objective and a normalized scoring approach for each criterion.
- Assign weighting factors to objectives and evaluation criteria to identify the relative importance of each objective and criterion within the overall evaluation.

- Complete scoring for each alternative and graphically display results.

The objectives and evaluation criteria were discussed with IEUA and stakeholders at CBP Workgroup meetings, and input was received by stakeholders on the weighting factors for the objectives to support a sensitivity analysis of the multi-criteria evaluation results.

The remainder of this section discusses the minimum requirements (Section 8.1) and the objectives and evaluation criteria and how the alternatives were scored (Section 8.2).

8.1 Minimum Requirements

All PUT, TAKE, and program alternatives must meet certain minimum requirements to be considered feasible for implementation and if an alternative does not meet these requirements, then it was revised or eliminated from consideration. The minimum requirements were developed with IEUA and stakeholder input and confirm that each alternative meets basin-wide objectives and regulatory requirements, and that CBP alternatives meet the program requirements that were the basis for the funding. The minimum requirements were split into two categories to allow both CBP and non-CBP alternatives to be compared using the same evaluation approach, if desired. Table 8-1 summarizes the minimum requirements and the CBP minimum requirements.

Table 8-1. Minimum Requirements for All Alternatives

Minimum Requirements (MR): Meet Basin-wide objectives and regulatory requirements	
MR-1	Meet Basin Plan objectives and requirements (TDS, Nitrogen)
MR-2	If the alternative includes a storage and recovery element, then align with OBMP objectives and Storage Framework Investigation (safe yield, existing contaminant plumes, water quality, land subsidence, hydraulic control).
MR-3	Meet NPDES Permit requirements.
MR-4	Meet groundwater replenishment and drinking water regulatory requirements.
MR-5	Meet SAR discharge obligation.
MR-6	In lieu project implementation does not impact a stakeholder's ability to meet planned water demands.
Chino Basin Plan Requirements: Provide water exchange for the benefit of the Delta Ecosystem	
CBP-1	Provide capacity of up to 50 TAFY as an exchange to MWD.
CBP-2	Store 15 TAFY for 25 years.
CBP-3	Meet CWC-approved physical benefits (TDS reduction and emergency supply).

8.2 Objectives and Evaluation Criteria

The multi-criteria evaluation was used for PUT, TAKE, and program alternatives that meet the minimum requirements. The evaluation criteria are developed from five key objectives that were identified based on stakeholder comments and overall goals for the program. The objectives are:

- Objective 1 – Develop Basin-wide water supply infrastructure
- Objective 2 – Increase water supply reliability
- Objective 3 – Streamline operations and maintenance
- Objective 4 – Minimize program complexity

- Objective 5 – Support cost effectiveness

Evaluation criteria were defined for each objective to measure how well each alternative performs against that objective. Baseline weightings were assigned for each objective and evaluation criterion. The objectives, evaluation criteria, and baseline weightings are presented in Table 8-2. Note that some evaluation criteria may apply to both PUT and TAKE alternatives or be mutually exclusive to either PUT or TAKE alternatives. If the criterion did not apply to either the PUT or TAKE alternatives, then the weighting for the criteria under that objective were adjusted accordingly.

Table 8-2. Objectives, Evaluation Criteria, and Baseline Weightings

Objectives			Evaluation Criteria					
No.	**Name**	**Baseline Weighting**	**No.**	**Name**	**PUT and/or TAKE**	**Baseline Weighting[1]**	**Baseline Weighting PUT[1]**	**Baseline Weighting TAKE[1]**
1	Develop Basin-wide water supply infrastructure	25%	1a	Create regional exchange opportunities	TAKE only	25%	0%	30%
			1b	Provide synergy with region's planned projects	PUT and TAKE	25%	50%	20%
			1c	Ability to meet future Direct Potable Reuse conveyance needs (raw water augmentation)	PUT only	10%	50%	0%
			1d	Enhance MWD Rialto Pipeline reliability	TAKE only	25%	0%	30%
			1e	Integrate with other storage programs	TAKE only	15%	0%	20%
			Subtotal			100%	100%	100%
2	Increase water supply reliability	15%	2a	Insurance water (critically dry year access to treatment and unused water) (access to emergency supply)	TAKE only	40%	0%	40%
			2b	Address CECs on the horizon (such as PFAS)	PUT and TAKE	20%	50%	20%
			2c	Increased potable water supply (beyond 25-year CBP)	PUT and TAKE	40%	50%	40%
			Subtotal			100%	100%	100%

Table 8-2. Objectives, Evaluation Criteria, and Baseline Weightings								
Objectives			**Evaluation Criteria**					
No.	**Name**	**Baseline Weighting**	**No.**	**Name**		**Baseline Weighting[1]**	**Baseline Weighting PUT[1]**	**Baseline Weighting TAKE[1]**
3	Streamlined operations and maintenance	15%	3a	Minimize operational complexity	PUT and TAKE	40%		
			3b	Minimize impacts to water levels in existing wells	PUT and TAKE	25%		
			3c	Optimize energy use	PUT and TAKE	35%		
			Subtotal			100%		
4	Minimize program complexity	20%	4a	Minimize institutional complexity	PUT and TAKE	30%		
			4b	Minimize implementation complexity	PUT and TAKE	30%		
			4c	Leverage existing available land to minimize land acquisition	PUT and TAKE	40%		
			Subtotal			100%		
5	Support cost effectiveness	25%	5a	Minimize NPV costs (includes $206.9M funding for CBP alternatives) (with pre-delivery charge)	PUT and TAKE	40%		
			5b	Minimize capital costs	PUT and TAKE	30%		
			5c	Minimize annual O&M costs (with pre-delivery charge)	PUT and TAKE	30%		
			Subtotal			100%		
Total		**100%**						

[1]Baseline weightings were adjusted for the PUT and TAKE evaluations when certain criteria did not apply to either the PUT or TAKE evaluation, respectively. These adjustments are shown in TM2.

Each alternative was scored against each criterion. The scores were assigned as follows:

- Each alternative was analyzed for each criterion and assigned a score of 1 through 5, with 5 being most advantageous and 1 being the least advantageous.

- The evaluation criteria were scored either quantitatively or qualitatively. Quantitative criteria are those criteria that are scored based on attributes that can be measured, such as pipeline length. Qualitative criteria are scored based on an opinion of how well that alternative supports the evaluation criterion, such as the ability to meet future direct potable reuse (DPR) needs. Criteria that require qualitative scored with whole numbers, while criteria that are scored qualitatively have rational numbers as scores.

The overall score for each alternative was calculated as follows:

- The score for each objective was calculated by summing the weighting times the score for each criterion.
- The total score was calculated by summing the weight times the subtotal for each objective.

The following sections provide a description and scoring methodology for each criterion.

8.2.1 Objective 1 – Develop Basin-Wide Water Supply Infrastructure

The CBP program will require new infrastructure and facilities for both PUT and TAKE alternatives; so it is important to have the first objective analyze basin-wide water supply infrastructure to be inclusive of IEUA's and stakeholders' goals. Five criteria were developed show how well the PUT and TAKE alternatives support the objective. The criteria are listed below with an indication of which PUT and TAKE evaluations they apply to (i.e., PUT only, TAKE only, or PUT and TAKE):

- 1a – Create Exchange Opportunities within Chino Basin (TAKE only),
- 1b – Provide Synergy with Region's Planned Projects (PUT and TAKE),
- 1c – Ability to Meet Future Direct Potable Reuse Conveyance Needs (PUT only),
- 1d – Enhance MWD Rialto Pipeline Reliability (TAKE only), and
- 1e – Integrate with Other Storage Programs (TAKE only).

8.2.1.1 Create Regional Exchange Opportunities – TAKE Only

This criterion analyzes new TAKE connections that are developed basin wide. The performance is measured by the ability to have access to new potable water infrastructure via number of new interconnections added to existing infrastructure. TAKE alternatives that provide more interconnections score better than those that provide fewer interconnections. A summary of the scoring methodology for creating regional exchange opportunities is provided in Table 8-3.

Table 8-3. Summary of Scoring – Create Regional Exchange Opportunities (Criterion 1a)

Score	Description	Scoring Definition
5	Largest number of intercon-nections	TAKE alternative provides the largest number of interconnections.
4	More than average number of interconnections	TAKE alternative provides more than average number of interconnections.
3	Average number of inter-connections	TAKE alternative provides an average number of interconnections.
2	Less than average number of interconnections.	TAKE alternative provides less than average number of interconnections.
1	Fewest number of intercon-nections	TAKE alternative provides the fewest number of interconnections

8.2.1.2 Provide Synergy with Region's Planned Projects – PUT and TAKE

The ability to combine stakeholders' planned projects with the alternatives is a significant component in developing the basin-wide water supply infrastructure for the CBP since it would enable the stakeholders to achieve more from the program. The performance measure is based on the number of planned projects incorporated in the alternative. Alternatives that provide more synergies with stakeholders' planned projects scored higher than alternatives that provide fewer synergies. Because all PUT alternative include an AWPF, they will score a 5 and are compared against this criterion to provide better assessment between CBP and non-CBP alternatives during the program alternatives evaluation. For TAKE alternatives, The scoring criterion is based on current understanding of stakeholders' planned projects. The current planned projects include the following:

- Wellhead treatment: treatment projects for existing wells at Chino and Chino Hills (example In-Lieu Local projects)
- North-south (or northern) pipeline: Projects to include north-south pipeline to JCSD that can provide dual benefit for the program in-lieu as well as CVWD imported water to JCSD.
- East-west pipeline: Project to extend east-west pipeline.

A summary of the scoring methodology for synergy with stakeholders planned projects is provided in Table 8-4.

Table 8-4. Summary of Scoring (1b) Provide Synergy with Stakeholders' Planned Projects – PUT and TAKE Only

Score	Description	Scoring Definition	
		PUT Alternatives	TAKE Alternatives
5	Most synergy with stakeholders planned projects	PUT alternative provides the most infrastructure to multiple stakeholders based on their planned projects compared to other alternatives. An alternative with a score of 5 would include an AWPF.	TAKE alternative provides the most infrastructure to multiple stakeholders based on their planned projects compared to other alternatives. An alternative with a score of 5 would include Chino and Chino Hills well head treatment, N-S pipeline to JCSD, connection to TVMWD, E-W pipeline.
4	Higher than moderate synergy with stakeholders planned projects	N/A	N/A
3	Moderate synergy with stakeholders' planned projects	N/A	TAKE alternative provides an average amount infrastructure based on stakeholders' planned projects compared to other alternatives. An alternative with a score of 3 would include two of the following projects: Chino and Chino Hills well head treatment, N-S pipeline to JCSD, connection to TVMWD, E-W pipeline.
2	Minimal synergy with stakeholders planned projects	N/A	N/A
1	No synergy with stakeholders planned projects	PUT alternative does not provide any synergy infrastructure based on stakeholders' planned projects.	TAKE alternative provides an average amount infrastructure based on stakeholders' planned projects compared to other alternatives. An alternative with a score of 1 would include one of the following projects: Chino and Chino Hills well head treatment, N-S pipeline to JCSD, connection to TVMWD, E-W pipeline.

8.2.1.3 Ability to Meet Future Direct Potable Reuse Conveyance Needs – PUT Only

The ability to meet future DPR conveyance needs is an interest to the stakeholders since they may decide to produce recycled water in the future once regulations are developed. This would only affect the PUT alternatives as it is assumed that any future DPR project would be RWA and purified water would need to be pumped back to either the Rialto Pipeline or a water treatment plant. All PUT alternatives score the same as they all provide at least one AWPF. This evaluation will be used as a differentiator between CBP and non-CBP alternatives during the program alternatives evaluation. The scoring methodology for the ability to meet future direct potable reuse regulations is provided in Table 8-5.

Table 8-5. Summary of Scoring (1c) Ability to Meet Future Direct Potable Reuse Conveyance Needs – PUT Only

Score	Description	Scoring Definition
5	N/A	N/A
4	AWPF	PUT alternative provides at least one AWPF.
3	N/A	N/A
2	N/A	PUT alternative does not provide an AWPF.
1	N/A	N/A

8.2.1.4 Enhance MWD Rialto Pipeline Reliability – TAKE Only

The ability to increase the reliability of imported water deliveries during a shutdown of the MWD Rialto Pipeline is important in planning and developing Basin-wide water supply infrastructure. TAKE alternatives that enhance the reliability of the MWD Rialto Pipeline by providing parallel east-west conveyance for imported water during Rialto Pipeline shutdowns, thus supplementing the Rialto Pipeline, are scored higher than alternatives that do not enhance reliability. The lengths of the pipelines and diameter are considered in the scoring. The scoring methodology for the ability to enhance the MWD Rialto feeder reliability is provided in Table 8-6

Table 8-6. Summary of Scoring (1d) Enhance MWD Rialto Feeder Reliability – TAKE Only

Score	Description	Scoring Definition
5	Largest enhancement of MWD Rialto Pipeline reliability	TAKE alternative provides longest parallel conveyance pipeline with large pipeline diameter (>24”) for imported water to the Rialto Pipeline to enhance MWD Rialto feeder reliability
4	Large enhancement of MWD Rialto Pipeline reliability	TAKE alternative provides long parallel conveyance pipeline with small pipeline diameter (<24”) for imported water to the Rialto Pipeline to enhance MWD Rialto feeder reliability
3	Modest enhancement of MWD Rialto Pipeline reliability	TAKE alternative provides short parallel conveyance pipeline with large pipeline diameter (>24”) for imported water to the Rialto Pipeline to enhance MWD Rialto feeder reliability
2	Slight enhancement of MWD Rialto Pipeline reliability	TAKE alternative provides short parallel conveyance pipeline with small pipeline diameter (<24”) for imported water to the Rialto Pipeline to enhance MWD Rialto feeder reliability
1	No enhanced MWD Rialto Pipeline reliability	TAKE alternative does not have a conveyance pipeline parallel to the Rialto pipeline to increase reliability.

8.2.1.5 Integrate with Other Storage Programs – TAKE Only

The ability to transport more water to storage programs outside of Chino Basin is significant in evaluating pump back to MWD. The performance measure is standard delivery (e.g., no pre-delivery) alternatives and non in-lieu alternatives score higher since standard delivery alternatives move more water and MWD pump back alternatives convey water to MWD. This movement of water allows for other programs outside of Chino Basin to capture the water and use it in their storage programs. The most advantageous score would require 100% pump back and no pre-delivery while the least advantageous would score would require 100 percent in-lieu with pre-delivery. The scoring methodology for the ability to increase recycled water supplies is provided in Table 8-7 below.

Table 8-7. Summary of Scoring (1e) Integrate with Other Storage Programs – TAKE Only		
Score	Description	Scoring Definition
5	Provides the most water to other storage programs	TAKE alternative is 100% pump back to MWD with no pre-delivery.
4	Provides large amount of water to other storage programs	TAKE alternative is 100% pump back with pre-delivery.
3	N/A	N/A
2	Provides some water to other storage programs	TAKE alternative is partial pump back to MWD and partial in lieu with pre-delivery or no pre-delivery.
1	Provides no water to other storage programs	TAKE alternative is 100% in lieu with pre-delivery.

8.2.2 Object 2 – Increase Water Supply Reliability

The CBP has the ability to diversify and increase the regional water supply portfolio for IEUA and stakeholders. This objective analyzes alternatives on the basis that it would increase the regions water supply and water quality. Three criteria were developed show how well the PUT and TAKE alternatives support the objective. The criteria are listed below with an indication of which PUT and TAKE evaluations they apply to (i.e., PUT only, TAKE only, or PUT and TAKE):

- 2a – Insurance Water (TAKE only),
- 2b – Address Contaminants of Emerging Concern (CECs) on the Horizon (PUT and TAKE), and
- 2c – Increased Potable Water Supply (PUT and TAKE).

8.2.2.1 Insurance Water (Criterion 2a) – TAKE Only

The ability to provide insurance water allows for the region to access unused water during critically dry years or during times of emergency. TAKE alternatives that provide more water to the Chino Basin score better than those that divert more water to MWD. Scores are based on Year 7 storage amounts for each TAKE alternative assuming that the first call year is Year 8. The TAKE alternative that has the largest storage volume score a 5 and the other alternatives were scaled proportional from the largest storage volume to their respective storage volumes. The scoring methodology for insurance water is provided in Table 8-8 below.

Table 8-8. Summary of Scoring (2a) Provide Insurance water – TAKE Only		
Score	**Description**	**Scoring Definition**
5	Supplies most water to the region	TAKE alternative provides the largest amount of emergency supply.
4	Supplies more than average amount of water to region	TAKE alternative provides more than average amount of emergency supply.
3	Supplies average amount of water to region	TAKE alternative provides average amount of emergency supply.
2	Supplies less than average amount of water to region	TAKE alternative provides less than average amount of emergency supply.
1	Supplies least amount of water to the region	TAKE alternative provides least amount of emergency supply.

8.2.2.2 Address CECs on Horizon (Criterion 2b) – PUT and TAKE

The ability to address CECs that are on the horizon are important as it allows for the technology to be implemented before a limit is placed by regulators. An example of a forthcoming CEC limit is for PFAS. PUT alternatives with full advanced treatment score better than those that do not since CECs are removed prior to groundwater discharge. Because all PUT alternative provide an AWPF, they all score a 5.0. The PUT alternatives are analyzed for this criterion to provide better assessment between CBP and non-CBP alternatives during the program alternatives evaluation

TAKE alternatives that have standard delivery alternatives score better because more extraction occurs in better water quality areas. Similarly, alternatives with groundwater treatment (e.g., Chino and Chino Hills example In-Lieu Local projects) score better. All TAKE alternatives provide extraction wells in better water quality areas, however alternatives with standard delivery provide more wells and provide more access to better quality water than those that have pre-delivery. Wells that have fewer extraction wells score lower since not as much higher-quality potable water can be extracted.

The scoring methodology for both PUT and TAKE alternatives for the ability to address CECs is provided in Table 8-9 below.

Table 8-9. Summary of Scoring (2b) Address CECs on Horizon – PUT and TAKE			
Score	**Description**	**Scoring Definition**	
		PUT Alternative	**TAKE Alternative**
5	Manages future CECs the best	Provides at least one AWPF with full advanced treatment.	Provides groundwater treatment and have the most extraction wells in better water quality areas due to no pre-delivery.
4	Manages future CECs on average	N/A	Provides groundwater treatment and fewer extraction wells in better water quality areas due to pre-delivery.
3	Manages future CECs the least	N/A	Provides fewer extraction wells in better water quality area due to pre-delivery.
2	N/A	N/A	N/A.
1	N/A	N/A	N/A

8.2.2.3 Increase Potable Water Supply (Criterion 2c) – PUT and TAKE

The ability to increase potable water supply for the region beyond the 25-year CBP is based on IEUA and stakeholders capitalizing on the existing assets developed from the program. The performance measure is the amount of new potable water generated in the Chino Basin area. Since each PUT Alternative provides 15.0 TAFY of purified water for groundwater recharge, all score a 5.0. TAKE alternatives that provide infrastructure that allows for the largest amount of new potable water to be generated in the Chino Basin area score better than those that limit water production. Because all TAKE alternatives generate 375.0 TAF beyond the 25-year program, they all score a 5.0. Both PUT and TAKE alternatives are evaluated for this criterion to provide better assessment between CBP and non-CBP alternatives during the program alternatives evaluation.

The scoring methodology for the ability to increase potable water supply beyond 25-year CBP is provided in Table 8-10 below.

Table 8-10. Summary of Scoring (2c) Increase Water Supply Beyond 25-yr CBP – PUT and TAKE

Score	Description	Scoring Definition	
		PUT Alternatives	TAKE Alternatives
5	Provides the largest increase in water supply beyond 25 year CBP.	Provides the most TAFY of purified water for groundwater recharge.	Generates the most TAFY in the 25 years beyond the program.
4	N/A	N/A	N/A
3	N/A	N/A	N/A
2	N/A	N/A.	N/A.
1	N/A	N/A	N/A

8.2.3 Object 3 – Streamline Operations and Maintenance

The CBP would introduce new treatment processes and multiple wells that would need to be operated and maintained, thus the ability to streamline the alternative's operation and maintenance is an important third objective. Streamlining these efforts provides efficiency and a smoother transition to these new services amongst stakeholders. Three criteria were developed show how well the PUT and TAKE alternatives support the objective and all criteria apply to both the PUT and TAKE alternatives. The criteria are listed below:

- 3a – Minimize Operational Complexity,
- 3b – Minimize Impacts to Water Levels in Existing Wells, and
- 3c – Optimize Energy Use.

8.2.3.1 Minimize Operational Complexity (Criterion 3a) – PUT and TAKE

The ability to minimize operational complexity is important for both PUT and TAKE alternatives. The ability to minimize operational complexity's PUT performance measure is based on the intricacy of operations measured in number of AWPFs and injection wellfields. PUT alternatives that have fewer AWPFs and injection wells fields score better than those that have more. The TAKE alternative's performance measures are based on the complexity of operations measured in number of extraction wells and booster pump stations, and wellhead treatment.

Due to their different performance measures, the scoring methodology for the ability to minimize operational complexities is provided in Table 8-11 includes separate scoring definitions for the PUT and TAKE alternatives.

Table 8-11. Summary of (3a) Minimize Operational Complexity – PUT and TAKE		
Score	**Description**	**Scoring Definition**
5	Least operational complexity	PUT/TAKE alternative provides the fewest number of operational complexities.
4	Less than moderate operational complexity	PUT/TAKE alternative provides the less than moderate number of operational complexities.
3	Moderate operational complexity	PUT/TAKE alternative provides moderate number of operational complexities.
2	More than moderate operational complexity	PUT/TAKE alternative provides more than moderate number of operational complexities.
1	Most operational complexity	PUT/TAKE alternative provides the greatest number of operational complexities.

8.2.3.2 Minimize Impacts to Water Levels in Existing Wells (Criterion 3b) – PUT and TAKE

Impacts to water levels in existing wells can be caused by both PUT and TAKE alternatives. The PUT alternatives may positively impact nearby existing wells by increasing groundwater levels at the existing wells. The new TAKE extraction wells may negatively affect the groundwater basin by overdrawing and reducing water levels in nearby existing wells. This criterion is evaluated by reviewing well hydrographs and analyzing the water levels at nearby existing wells.

The scoring methodology for the ability to minimize impacts to water levels in existing wells is provided for PUT and TAKE alternatives in Table 8-12.

Table 8-12. Summary of (3b) Minimize Impacts to Water Levels in Existing Wells – PUT and TAKE			
Score	**Description**	**Scoring Definition**	
		PUT Alternatives	**TAKE Alternatives**
5	Most advantageous impacts to existing wells	N/A	Insignificant drawdown at nearby wells.
4	Slight advantageous impacts to existing wells	PUT alternative increases water at nearby wells	N/A
3	Least advantageous impacts to existing wells	No not increase water levels at nearby wells.	Minimal drawdown at nearby wells
2	N/A	N/A	N/A
1	N/A	N/A	N/A

8.2.3.3 Optimize Energy Use – PUT and TAKE

There will be many new processes in the alternatives that will demand energy, so it is important to analyze the ability to optimize energy uses for both PUT and TAKE alternatives. The performance measure is based on the energy demand in 1,000 kilowatt-hours (kWh). A lower energy demand results in a higher (better) score.

The PUT alternatives incorporate infrastructure requiring significant energy and optimization of that energy use must be considered. The performance measure is based on the total energy demand for the AWPFs and the recycled water and purified water pumping. The TAKE alternatives are evaluated by the energy demand for the extraction wells, wellhead treatment, and pump stations. Because each TAKE alterative has differing energy demands between normal (non-call) years and call years, the energy use for the alternatives were evaluated across the lifetime of the program. Across the entirety of the program, there are 7.5 call years and 17.5 normal (non-call) years. A lower energy demand scores higher in the evaluation.

The scoring methodology to optimize energy use is provided in Table 8-13 below.

Table 8-13. Summary of (3c) Optimize Energy Use – PUT and TAKE

Score	Description	Scoring Definition
5	Lowest energy demand	PUT/TAKE alternative requires least amount of energy.
4	Less than moderate energy demand	PUT/TAKE alternative requires less than moderate amount of energy.
3	Moderate energy demand	PUT/TAKE alternative requires moderate amount of energy.
2	More than moderate energy demand	PUT/TAKE alternative requires more than moderate amount of energy.
1	Highest energy demand	PUT/TAKE alternative requires highest amount of energy.

8.2.4 Objective 4 – Minimize Program Complexity

The CBP program includes many shared components amongst stakeholders so a significant objective is to minimize program complexities. The CBP would be a complex program including many stakeholders. This objective measures the complexity of the proposed PUT and TAKE alternatives. Three criteria were developed show how well the PUT and TAKE alternatives support the objective and all criteria apply to both the PUT and TAKE alternatives The criteria are listed below:

- 4a – Minimize Institutional Complexity,
- 4b – Minimize Implementation Complexity, and
- 4c – Leverage Existing Available Land to Minimize Land Acquisition.

8.2.4.1 Minimize Institutional Complexity (Criterion 4a) – PUT and TAKE

The performance measure for the ability to minimize institutional complexity is based on the numbers of contracts/agreements needed with stakeholders. The fewer the agreements with stakeholders the better the score. The PUT alternatives evaluate the contacts required for the AWPFs and injection wells and the TAKE alternatives evaluate the delivery contracts between all the agencies. The scoring methodology to minimize institutional complexity is provided in Table 8-14.

Table 8-14. Summary of (4a) Minimize Institutional Complexity – PUT and TAKE			
Score	Description	Scoring Definition	
		PUT Alternatives	TAKE Alternatives
5	Least institutional complexity	N/A	Least amount of institutional complexity with the smallest number of contracts.
4	Less than moderate institutional complexity	Less than moderate institutional complexity with a minimal number of contracts.	Less than moderate institutional complexity with a minimal number of contracts.
3	Moderate institutional complexity	N/A	Moderate institutional complexity with a moderate number of contracts.
2	More than moderate institutional complexity	More than moderate institutional complexity with a larger number of contracts.	More than moderate institutional complexity with a large number of contracts.
1	Most institutional complexity	N/A	Most amount of instructional complexity with the largest number of contracts.

8.2.4.2 Minimize Implementation Complexity (Criterion 4b) – PUT and TAKE

The performance measure for the ability to minimize implementation complexity is based on the numbers of projects elements and permits for each alternative. The fewer the projects and permits, the better the score. The PUT alternatives evaluate the number of projects based on pump stations, miles of pipeline, and pipeline crossings. Crossings refer to pipeline that has to go below highways or train tracks. The TAKE alternatives evaluate the number of projects is based on pump stations, miles of pipelines, pipeline crossings, and wellhead treatment. Note that all PUT and TAKE alternatives require the same number of permits; since this is not a differentiator, this was not taken into account in the scoring. The scoring methodology to minimize institutional complexity is provided in Table 8-15 below.

Table 8-15. Summary of (4b) Minimize implementation complexity – PUT and TAKE		
Score	Description	Scoring Definition
5	Least implementation complexity	PUT/TAKE alternative provide least amount of implementation complexity with the smallest number of projects.
4	Less than moderate implementation complexity	PUT/TAKE alternative provide less than moderate implementation complexity with a minimal number of projects.
3	Moderate implementation complexity	PUT/TAKE alternative provide moderate implementation complexity with a moderate number of projects.
2	More than moderate implementation complexity	PUT/TAKE alternative provide more than moderate implementation complexity with a large number of projects.
1	Most implementation complexity	PUT/TAKE alternative provide most amount of implementation complexity with the largest number of projects.

8.2.4.3 Leverage Existing Available Land to Minimize Lan Acquisition (Criterion 4c) – PUT and TAKE

Since the CBP needs to be implemented by 2026, using existing available land for CBP facilities was identified as a critical element to keep the project on schedule by avoiding complications with land purchases and rezoning or permitting new parcels. Using existing land also helps reduce program costs. Alternatives that require less land acquisition score better than alternatives that require more land acquisition.

The PUT alternatives require land acquisition for injection wells, monitoring wells, and for the Plant 28 site. The TAKE alternatives may require land acquisition for extraction wells, pump stations, and equalization tank locations. The scoring methodology to leverage existing available land to minimize land acquisition is shown in Table 8-16.

Table 8-16. Summary of (4c) Leverage Existing Available Land to Minimize Land Acquisition – PUT and TAKE

Score	Description	Scoring Definition
5	Minimal land acquisition	PUT/TAKE alternative provide least amount of acreage required for land acquisition.
4	More than moderate land acquisition	PUT/TAKE alternative provide less than moderate amount of acreage required for land acquisition.
3	Moderate land acquisition	PUT/TAKE alternative provide moderate amount of acreage required for land acquisition.
2	Less than moderate land acquisition	PUT/TAKE alternative provide more than moderate amount of acreage required for land acquisition.
1	Significant land acquisition	PUT/TAKE alternative provide largest amount of acreage required for land acquisition.

8.2.5 Objective 5 – Support Cost Effectiveness

The ability to support cost effectiveness is an important factor in the multi-criteria evaluation. The PUT and TAKE alternatives costs were developed for each alternative as described in Section 7. Three criteria were developed show how well the PUT and TAKE alternatives support the objective and all criteria apply to both the PUT and TAKE alternatives. The criteria are:

- 5a – Minimize NPV costs,
- 5b – Minimize capital costs, and
- 5c – Minimize annual O&M costs.

8.2.5.1 Minimize NPV Costs (Criterion 5a) – PUT and TAKE

NPV costs were developed over a project lifecycle of 50 years using the economic analysis tool that is described in the Draft Economic Analysis of Master Plan and CBP Alternatives TM (GEI, June 2020). The NPV costs represent the present value of cash flow over the 25-year CBP and the 25 years following the CBP. The NPV costs include capital costs, replacement costs, annual O&M costs, non-recoverable wastewater disposal costs, and supplemental external source water cost (i.e., recycled water supplies from JCSD and City of Rialto). For the CBP alternatives, the NPV costs take into account the Proposition 1 Water Storage Investment Program (WSIP) funding of $206.9M. The NPV costs are in 2019 dollars.

The economic analysis tool was developed to calculate the NPV costs for overall CBP costs. Therefore, the program costs were estimated for the PUT alternatives assuming that the TAKE portion was TAKE-4c, and then the PUT portion of the NPV cost was separated out. Similarly the eight TAKE alternatives were estimated assuming that the PUT portion was PUT-5 and then the TAKE portion of the NPV cost was separated out.

The scoring methodology to minimize NPV costs is shown in Table 8-17 below. Alternatives with lower NPV costs score higher.

Table 8-17. Summary of (5a) Minimize NPV Costs – PUT and TAKE		
Score	**Description**	**Scoring Definition**
5	Least Expensive	PUT/TAKE alternative provides lowest NPV cost.
4	Less than moderately expensive	PUT/TAKE alternative provides less than moderate NPV cost.
3	Moderately Expensive	PUT/TAKE alternative provides moderate NPV cost.
2	More than moderately expensive	PUT/TAKE alternative provides more than moderate NPV cost.
1	Most Expensive	PUT/TAKE alternative provides highest NPV cost.

8.2.5.2 Minimize Capital Costs (Criterion 5b) – PUT and TAKE

Capital costs include the cost of equipment and construction costs including direct and indirect costs of all elements. The capital costs for the PUT and TAKE alternatives include all of the respective PUT and TAKE components. The PUT alternatives include recycled water conveyance for supplies from JCSD and the City of Rialto), the AWPF(s), purified water conveyance (pump station and pipelines), injection wells for groundwater recharge and monitoring wells, and brine conveyance. The TAKE alternatives include extraction wells, wellhead treatment, potable water conveyance, and potable water storage. The capital costs include contingency and project implementation costs for engineering services, client administration, and construction management. The capital costs are in 2019 dollars.

Alternatives with lower capital costs score better than alternatives with higher capital costs. The scoring methodology to minimize capital costs is shown in Table 8-18 below.

Table 8-18. Summary of (5b) Minimize Capital Costs – PUT and TAKE		
Score	**Description**	**Scoring Definition**
5	Least Expensive	PUT/TAKE alternative provides lowest capital cost.
4	Less than moderately expensive	PUT/TAKE alternative provides less than moderate capital cost.
3	Moderately Expensive	PUT/TAKE alternative provides moderate capital cost.
2	More than moderately expensive	PUT/TAKE alternative provides more than moderate capital cost.
1	Most Expensive	PUT/TAKE alternative provides highest capital cost.

8.2.5.3 Minimize Annual O&M Costs (Criterion 5c) – PUT and TAKE

O&M costs include annual costs to operate, manage, and maintain the equipment and infrastructure for each alternative. The annual O&M costs for the PUT alternatives include annual O&M costs for recycled water conveyances, the AWPFs, purified water conveyance, brine disposal, and injection well and monitoring wells. The annual O&M costs for the TAKE alternatives include annual O&M costs for extraction wells, wellhead treatment, potable water conveyance, and potable water storage. The annual O&M costs for the TAKE alternatives are split between fixed and variable O&M costs and summed for the total annual O&M cost, which was used for the alternatives evaluation. The annual O&M costs are in 2019 dollars.

The lower the O&M cost, the higher the score. The scoring methodology for minimize O&M costs is shown in Table 8-19.

Table 8-19. Summary of (5c) Minimize Annual O&M Costs – PUT and TAKE

Score	Description	Scoring Definition
5	Least Expensive	PUT/TAKE alternative provides lowest O&M cost.
4	Less than moderately expensive	PUT/TAKE alternative provides less than moderate O&M cost.
3	Moderately Expensive	PUT/TAKE alternative provides moderate O&M cost.
2	More than moderately expensive	PUT/TAKE alternative provides more than moderate O&M cost.
1	Most Expensive	PUT/TAKE alternative provides highest O&M cost.

References

AECOM/W.M. Lyles, *S1 WWTP Improvements Project Basis of Design Report, City of Rialto/Veolia Water West Operating Services*, July 10, 2017.

Arcadis, *IEUA-WFA Final 2015 Urban Water Management Plan*, June 2016.

Australian Water Recycling Centre of Excellence (AWRCE), Membrane bio-reactor WaterVal validation protocol, Brisbane: Australian Water Recycling, 2016.

Branch, A and Le-Clech, P, National Validation Guidelines for Water Recycling: Membrane Bioreactors, AWRCE, 2015.

California Code of Regulations, Title 22, Division 4, Chapter 3, Water Recycling Criteria, October 1, 2018.

Carollo, *Feasibility Study of Recycled Water Interconnections between City of Pomona, Monte Vista Water District and Inland Empire Utilities Agency*, January 2016.

Carollo, *Inland Empire Utilities Agency, Title XVI, Feasibility Study of Recycled Water Interconnections, Final,* March 2018.

Carollo, *RP-1 Liquids & Solids Capacity Recovery Preliminary Design Report*, April 2019.

CH2MHILL, *Wastewater Facilities Master Plan Update Report Volumes 1 and 2*, June 2015.

Chino Basin Watermaster (Watermaster), *Optimum Basin Management Program Markers & Milestones Newsletter,* March 2020.

ESA, *IEUA Facilities Master Plan, Draft Program Environmental Impact Report, State Clearinghouse #2016061064*, December 2016.

ESA, *IEUA Facilities Master Plans, Final Program Environmental Impact Report, State Clearinghouse #2016061064*, February 2017.

Hazen and Sawyer, *City of Chino Water Quality Feasibility Study*, 2018.

IEUA, *Recycled Water Program Strategy*, 2015.

IEUA, *Chino Basin Recycled Water Groundwater Recharge Program 2018 Annual Report*, May 1, 2019.

IEUA, *Integrated Water Resources Plan: Water Supply & Climate Change Impacts 2015-2040 (2015 IRP)*, 2016.

IEUA, *Joint IEUA-JCSD Recycled Water Intertie Project, WaterSMART: Title XVI Water Reclamation and Reuse Project Funding Opportunity BOR-DO-18-F011*, July 27, 2018.

IEUA, *Joint IEUA-JCSD Recycled Water Intertie Project, Title XVI/WIIN Feasibility Study,* December 21, 2017.

IEUA, *Sources of Water Supply for CBP Memorandum*, February 2019.

IEUA and GEI, *Regulatory Challenges*, April 23, 2020.

IEUA, *2015 Urban Water Management Plan*, June 2015.

INTERA Incorporated, IEUA Infrastructure Model and 2015 Baseline Scenario Results, Draft Memorandum, August 31, 2018.

Michal Baker International, *Preliminary Design Technical Memorandum for the Chino Hills 1,2,3-TCP Removal Project*, 2018.

RWQCB, *Resolution No. R8-2004-0001, Resolution Amending the Water Quality Control Plan for the Santa Ana River Basin Plan to Incorporate an Updated Total Dissolved Solids (TDS) and Nitrogen Management Plan for the Santa Ana Region including Revised Groundwater Subbasin Boundaries, Revised TDS and Nitrate-Nitrogen Quality Objectives for Groundwater, Revised TDS and Nitrogen Wasteload Allocations, and Revised Reach Designations, TDS and Nitrogen Objectives and Beneficial Uses for Specific Surface Waters*, adopted January 22, 2004.

RWQCB, *Water Recycling Requirements, Order No. R8-2007-0039 for the Chino Basin Recycled Water Groundwater Recharge Program, Phase I and Phase II Projects - Inland Empire Utilities Agency and Chino Basin Watermaster*, adopted June 29, 2007.

RWQCB, *Order No. R8-2009-0057 Amending Order No. R8-2007-0039, Water Recycling Requirements for Inland Empire Utilities Agency and Chino Basin Watermaster Chino Basin Recycled Water Groundwater Recharge Program Phase I and Phase II Projects San Bernardino County*, adopted October 23, 2009.

RWQCB, *Order No. R8-2015-0036, NPDES No. CA8000409, Waste Discharge Requirements and Master Reclamation Permit for Inland Empire Utilities Agency Regional Water Recycling Facilities Surface Water Discharges and Recycled Water Use*, adopted October 30, 2015.

RWQCB, *Order No. R8-2018-0088, Waste Discharge Requirements for Inland Empire Utilities Agency, Ground Recharge Basin Operations and Maintenance Project in San Bernardino and Riverside Counties*, September 7, 2018.

RWQCB, *Water Quality Control Plan for the Santa Ana River Basin*, June 2019 Edition.

Stantec, *Recycled Water Program Strategy, Inland Empire Utilities Agency*, October 2015.

SWRCB, DDW 2015, Update of 97-005 Process Memo for Extremely Impaired Sources, Addressing the Direct Domestic Use of Extremely Impaired Sources, Process Memo 97-005, Initially Established November 5, 1997, Revised March 25, 2015 (draft).

SWRCB, 2019, “Water Quality Control Policy for Recycled Water”, filed April 8, 2019.

SWRCB, 2019, “A Proposed Framework for Regulating Direct Potable Reuse in California, Second Edition”, August 2019.

Water Research Foundation (WRF), Validation Protocols for Membrane Bioreactors and Ozone/Biologically Activated Carbon for Potable Reuse, Water Research Foundation Project 4997, Draft Literature Review, 2019.

WEI, *2018 Recharge Master Plan, Prepared for: Chino Basin Water Master and Inland Empire Utilities Agency*, September 6, 2018.

WEI, 2020 *Optimum Basin Management Program Update Report, Prepared for: Chino Basin Watermaster*, January 2020.

WEI, *2020 Storage Management Plan Final Report, Prepared for: Chino Basin Watermaster*, December 11, 2019.

WEI, *Optimum Basin Management Program Phase I Report, Prepared for: Chino Basin Watermaster*, August 19, 1999.

Appendix A: Summary of Title 22 Regulations for Groundwater Replenishment Using Recycled Water

<table>
<tr><th colspan="4">APPENDIX A – SUMMARY OF TITLE 22 REGULATIONS FOR GROUNDWATER REPLENISHMENT USING RECYCLED WATER</th></tr>
<tr><th>Title 22 Section(s)</th><th>Regulation</th><th>Article 5.1: Surface Applications - Spreading Basins</th><th>Article 5.2: Subsurface Applications - Injection Wells</th></tr>
<tr><td>60320.100
60320.200</td><td>General Requirements</td><td colspan="2">• Provide an alternative source of drinking water supply if water quality fails to meet drinking water standards or underground retention requirements for pathogen control.
• Sample affected aquifer(s) quarterly for at least one year for nitrogen compounds, regulated contaminants, physical characteristics, total organic carbon (TOC), priority toxic pollutants, DDW-specified chemicals, and DDW-specified chemicals with notification levels.
• Provide a hydrogeological assessment of the Groundwater Replenishment Reuse Project (GRRP) site(s) describing the groundwater basin's geologic and hydrogeological setting, stratigraphy, composition, extent, and physical properties of the affected aquifers; based on at least four quarters of groundwater monitoring, the existing hydrogeology and anticipated hydrogeology with the GRRP, and maps showing quarterly groundwater elevation contours, vector flow directions, and calculate hydraulic gradients.
• Maintain underground retention time no less than the requirements for pathogen control and response retention time.
• Design and operate the GRRP to comply with the recycled municipal wastewater contributions (RWC) requirements at and beyond the primary boundary zone.
• Provide map(s) to DDW, RWQCB, and local well-permitting authorities showing recharge site(s), primary boundary zone(s) of controlled drinking water well construction, secondary boundary zone(s) of potentially controlled existing or future drinking water well(s), and all monitoring wells and drinking water wells within 2 years travel time of the GRRP site(s).
• Demonstrate project sponsor's adequate technical, managerial, and financial capability to DDW and RWQCB.
• Demonstrate all treatment processes have been installed and can be operated to achieve their intended function per the Engineering Report.
• Submit available compliance monitoring and if incomplete, RWQCB shall determine water quality-related compliance based on available data.
• Comply with wastewater agency's RWQCB permit effluent limits pertaining to groundwater replenishment.
• Suspend recharge if so directed by DDW or RWQCB and not resume recharge without DDW and RWQCB approval.</td></tr>
<tr><td>60320.201[1]</td><td>Advanced Treatment Criteria[1]</td><td></td><td>• Provide full advanced treatment of an oxidized wastewater using reverse osmosis (RO) and an oxidation treatment process that meets specified advanced treatment criteria.
• Use RO membranes that have achieved sodium chloride rejections of at least 99.0% as a minimum and 99.2% on average as demonstrated per the requirements of this section.
• Use RO membranes that produce permeate with no more than 5% of the sample results having TOC concentrations greater than 0.25 mg/L based on weekly or more frequent monitoring.
• Propose at least one form of continuous monitoring (e.g., electrical conductivity or TOC) to indicate when membrane integrity has been compromised by designating operational parameters or limits and alarm settings for DDW review and approval.</td></tr>
</table>

APPENDIX A – SUMMARY OF TITLE 22 REGULATIONS FOR GROUNDWATER REPLENISHMENT USING RECYCLED WATER			
Title 22 Section(s)	Regulation	Article 5.1: Surface Applications - Spreading Basins	Article 5.2: Subsurface Applications - Injection Wells
			• Demonstrate the oxidation process has been designed for implementation by (1) performing an occurrence study using at least 9 indicator compounds from the list in this section for DDW approval, (2) utilizing an oxidation process that achieves designated levels of removal of the indicator compounds, (3) establishing at least one surrogate or operating parameter representative of removal of at least 5 of the indicator compounds for continuous monitoring, and (4) conducting a full-scale test using challenge or spiking tests to confirm the findings of the occurrence study and removal capability of the oxidation process. • Demonstrate in lieu of the above occurrence study and testing, the oxidation process has been designed for implementation by conducting testing using challenge or spiking tests under normal full-scale operating conditions that the oxidation process will provide at least 0.5-log (69%) reduction of 1,4-dioxane, and establish a surrogate or operational parameter capable of being continuously monitored and recorded with alarms that indicate when the minimum 0.5-log 1,4-dioxane reduction criteria is not met. • Monitor the surrogate or operational parameter during the aforementioned full-scale testing to performance of the oxidation process. • Submit a report to DDW and RWQCB within 60 days after completing the initial 12-months of monitoring describing the efficacy of the surrogate or operational parameter to reflect the removal of the indicator compounds and an action plan if it fails to demonstrate the oxidation process performance. • Submit a report to DDW and RWQCB within 60 days after completing the initial 12-months of RO process operation describing the effectiveness of the membrane integrity monitoring. • Report to DDW and RWQCB quarterly the percentage of the results that did not meet the surrogate or operational parameter limits for proper on-going RO and oxidation process performance; if greater than 10% of the results indicate failure occurred, describe corrective actions and consult with DDW. • Analyze AWT effluent monthly for contaminants having MCLs and notification levels. Monitoring frequency may be reduced to quarterly with DDW approval after 12

APPENDIX A – SUMMARY OF TITLE 22 REGULATIONS FOR GROUNDWATER REPLENISHMENT USING RECYCLED WATER			
Title 22 Section(s)	Regulation	Article 5.1: Surface Applications - Spreading Basins	Article 5.2: Subsurface Applications - Injection Wells
			consecutive months of results not exceeding an MCL or NL. AWT effluent shall not exceed an MCL.
60320.102 60320.202	Public Hearing	• Hold a public hearing prior to DDW submitting its recommendations to the RWQCB for the GRRP's permit. • Hold a public hearing any time an increase in the maximum recycled water contribution (RWC) is proposed that was not addressed in a prior public hearing. • Provide information for presentation at the public hearing to DDW for review and approval. • Place approved public hearing information on project sponsor's website and in a publically accessible repository at least 30 days prior to the public hearing. • Notify the public of: (1) the location and hours of operation of the repository, (2) internet address where information may be viewed, (3) purpose of the repository and public hearing, (4) manner for public to provide comments, and (5) date, time, and location of the public hearing. Public notice may be delivered via local newspaper(s), mail, statement in water bills, and/or television and/or radio. • Notify via direct mail at a minimum the first downgradient drinking water well owner and well owners who drinking water well is within 10 years underground travel time from the GRRP.	
60320.104 60320.204	Lab Analyses	• Perform analyses for contaminants having primary or secondary MCLs using laboratories and methods approved by DDW. • Perform analyses for other contaminants per the Operation Optimization Plan (OOP).	
60320.106 60320.206	Wastewater Source Control	• Ensure that the recycled municipal wastewater is from a wastewater management agency that administers an industrial pretreatment and pollutant source control program. • Implement and maintain an enhanced source control program that includes: (1) assessment of DDW & RWQCB-specified chemicals through the treatment systems; (2) investigation and monitoring for DDW & RWQCB-specified chemicals; (3) outreach program to manage and minimize discharge of contaminants at the source; and (4) inventory of chemicals and contaminants that maybe discharged into the sewer system.	
60320.108 60320.208	Pathogenic Microorganism Control	• Use at least 3 treatment processes that achieve at least 12-log enteric virus reduction, 10-log *Giardia* cyst reduction, and 10-log *Cryptosporidium* oocyst reduction. • Use at least three treatment processes that achieve at least 1.0-log reduction per process, and each process may be credited for up to 6-log reduction. • <u>Filter and disinfect recycled municipal wastewater per §60301,320 and §60301.230, respectively</u>.[2] • Retain recycled municipal wastewater or recharge water underground to be credited with 1-log virus reduction per month. • Meet above filtration and disinfection requirements or provide advanced treatment for the entire flow and demonstrate at least 6 months underground retention to be credited with 10-log *Giardia* cyst reduction and 10-log *Cryptosporidium* oocyst reduction.	• Use at least 3 treatment processes that achieve at least 12-log enteric virus reduction, 10-log *Giardia* cyst reduction, and 10-log *Cryptosporidium* oocyst reduction. • Use at least three treatment processes that achieve at least 1.0-log reduction per process, and each process may be credited for up to 6-log reduction. • Retain recycled municipal wastewater or recharge water underground to be credited with 1-log virus reduction per month. • Meet above filtration and disinfection requirements or provide advanced treatment for the entire flow and demonstrate at least 6 months underground retention to be credited with 10-log *Giardia* cyst reduction and 10-log *Cryptosporidium* oocyst reduction.

APPENDIX A – SUMMARY OF TITLE 22 REGULATIONS FOR GROUNDWATER REPLENISHMENT USING RECYCLED WATER			
Title 22 Section(s)	Regulation	Article 5.1: Surface Applications - Spreading Basins	Article 5.2: Subsurface Applications - Injection Wells
		• Validate each treatment process (except for underground retention time and SAT)[2] for their ability to reliably achieve log reduction by submitting a report for DDW approval or conducting a challenge test approved by DDW. • Provide on-going monitoring using pathogens or microbial, chemical, or physical surrogates to verify performance of each treatment process (not including underground retention time and soil aquifer treatment (SAT)) for its ability to achieve its credited log reduction. Investigate and report any failures to meet pathogen log reduction requirements per §60320.108(i). • Conduct a tracer study representative of normal GRRP operations to demonstrate underground retention time measured as the difference from when the tracer is applied at the GRRP to: (1) 2% of the initial tracer concentration reaches the downgradient monitoring point, or (2) 10% of the peak tracer unit value at the downgradient monitoring point reached the monitoring point. • Calculate virus log-reduction credit by method used to estimate underground retention time to nearest downgradient drinking water well: (1) tracer study using an added tracer for full 1.0-log, (2) tracer study using an intrinsic tracer for 0.67-log, (3) numerical modeling for 0.5-log, or (4) analytical modeling for 0.25-log. • Use above method 3 or 4 for planning a GRRP with approval of DDW. • Initiate tracer study prior to the end of the third month of GRRP operation (above method 1 or 2). Submit tracer study protocol to DDW for approval. • Demonstrate underground retention time if changed hydrogeological or climatic conditions have occurred and DDW requires a new tracer study. • Cease recycled water recharge and notify DDW and RWQCB if GRRP achieves less than 10-log enteric virus reduction or 8-log Giardia cyst reduction or 8-log Cryptosporidium oocyst reduction. Resume recharge if so directed by DDW or RWQCB.	• Validate each treatment process (except for underground retention time) for their ability to reliably achieve log reduction by submitting a report for DDW approval or conducting a challenge test approved by DDW. • Provide on-going monitoring using pathogens or microbial, chemical, or physical surrogates to verify performance of each treatment process (not including underground retention time and soil aquifer treatment (SAT)) for its ability to achieve its credited log reduction. Investigate and report any failures to meet pathogen log reduction requirements per §60320.208(i). • Conduct a tracer study representative of normal GRRP operations to demonstrate underground retention time measured as the difference from when the tracer is applied at the GRRP to: (1) 2% of the initial tracer concentration reaches the downgradient monitoring point, or (2) 10% of the peak tracer unit value at the downgradient monitoring point reached the monitoring point. • Calculate virus log-reduction credit by method used to estimate underground retention time to nearest downgradient drinking water well: (1) tracer study using an added tracer for full 1.0-log, (2) tracer study using an intrinsic tracer for 0.67-log, (3) numerical modeling for 0.5-log, or (4) analytical modeling for 0.25-log. • Use above method 3 or 4 for planning a GRRP with approval of DDW. • Initiate tracer study prior to the end of the third month of GRRP operation (above method 1 or 2). Submit tracer study protocol to DDW for approval. • Demonstrate underground retention time if changed hydrogeological or climatic conditions have occurred and DDW requires a new tracer study. • Cease recycled water recharge and notify DDW and RWQCB if GRRP achieves less than 10-log enteric virus reduction or 8-log Giardia cyst reduction or 8-log Cryptosporidium oocyst reduction. Resume recharge if so directed by DDW or RWQCB.
60320.110 60320.220	Nitrogen Compounds Control	• Sample recycled municipal wastewater or recharge water throughout the spreading area[2] before or after application at least twice per week, at least 3 days apart, and analyze for nitrogen compounds.	• Sample recycled municipal wastewater or recharge water before or after application at least twice per week, at least 3 days apart, and analyze for nitrogen compounds.

APPENDIX A – SUMMARY OF TITLE 22 REGULATIONS FOR GROUNDWATER REPLENISHMENT USING RECYCLED WATER			
Title 22 Section(s)	**Regulation**	**Article 5.1: Surface Applications - Spreading Basins**	**Article 5.2: Subsurface Applications - Injection Wells**
		• Investigate the cause and notify DDW and RWQCB if the confirmed result exceeds 10 mg/L total nitrogen; take corrective actions and initiate additional monitoring per the OOP to determine whether the elevated total nitrogen result may lead to an exceedance of a nitrogen-based MCL. • Suspend recycled municipal wastewater recharge if the average of four consecutive sample results exceeds 10 mg/L total nitrogen. After corrective actions, which may include utilization of a denitrification process as determined by DDW[2], recharge may resume if at least two consecutive sample results are less than 10 mg/L total nitrogen. • Initiate additional monitoring as determined by DDW to identify elevated concentrations of nitrogen compounds in the groundwater and spreading area[2] and determine if they may lead to an exceedance of a nitrogen-based MCL. • Initiate reduced monitoring frequencies for total nitrogen with approval of DDW and RWQCB. Apply for reduced monitoring frequencies if, for the recent 24 months: (1) average of all results did not exceed 5 mg/L total nitrogen; (2) average of a confirmed result did not exceed 10 mg/L total nitrogen. • Revert to original monitoring frequencies if the results for total nitrogen exceed the above criteria. Reduced monitoring frequencies may resume if the above criteria are met.	• Investigate the cause and notify DDW and RWQCB if the confirmed result exceeds 10 mg/L total nitrogen; take corrective actions and initiate additional monitoring per the OOP to determine whether the elevated total nitrogen result may lead to an exceedance of a nitrogen-based MCL. • Suspend recycled municipal wastewater recharge if the average of four consecutive sample results exceeds 10 mg/L total nitrogen. After corrective actions, recharge may resume if at least two consecutive sample results are less than 10 mg/L total nitrogen. • Initiate additional monitoring as determined by DDW to identify elevated concentrations of nitrogen compounds in the groundwater and determine if they may lead to an exceedance of a nitrogen-based MCL. • Initiate reduced monitoring frequencies for total nitrogen with approval of DDW and RWQCB. Apply for reduced monitoring frequencies if, for the recent 24 months: (1) average of all results did not exceed 5 mg/L total nitrogen; (2) average of a confirmed result did not exceed 10 mg/L total nitrogen. • Revert to original monitoring frequencies if the results for total nitrogen exceed the above criteria. Reduced monitoring frequencies may resume if the above criteria are met.
60320.112 60320.212	Regulated Contaminants and Physical Characteristics Control	• Analyze recycled municipal wastewater quarterly for primary MCLs: (1) inorganic chemicals in Table 64431-A, except for nitrogen compounds; (2) radionuclides in Tables 64442 & 64443; (3) organic chemicals in Table 64444-A; and (4) disinfection byproducts in Table 64533-A. • Analyze recycled municipal wastewater quarterly for action levels: lead and copper. • Recharge water (including recharge water after surface application)[2] may be monitored in lieu of recycled municipal wastewater for disinfection byproducts under designated conditions (§60320.112(b)). May require adjustments for dilution depending on fraction of recycled water in recharge water. • Analyze recycled municipal wastewater or recharge water[2] annually for secondary MCLs in Tables 64449-A and 64449-B.	• Analyze recycled municipal wastewater quarterly for primary MCLs: (1) inorganic chemicals in Table 64431-A, except for nitrogen compounds; (2) radionuclides in Tables 64442 & 64443; (3) organic chemicals in Table 64444-A; and (4) disinfection byproducts in Table 64533-A. • Analyze recycled municipal wastewater quarterly for action levels: lead and copper. • Recharge water may be monitored in lieu of recycled municipal wastewater for disinfection byproducts under designated conditions (§60320.212(b)). May require adjustments for dilution depending on fraction of recycled water in recharge water. • Analyze recycled municipal wastewater annually for secondary MCLs in Tables 64449-A and 64449-B.

APPENDIX A – SUMMARY OF TITLE 22 REGULATIONS FOR GROUNDWATER REPLENISHMENT USING RECYCLED WATER			
Title 22 Section(s)	Regulation	Article 5.1: Surface Applications - Spreading Basins	Article 5.2: Subsurface Applications - Injection Wells
		• Confirm any exceedances of a primary MCL or action level by re-analyzing within 72 hours of receiving the initial result. • Notify DDW and RWQCB if the average of the initial and confirmation results exceeds the primary MCL or action level for constituents not based on a running annual average, and follow requirements of §60320.112((d)(1). • Initiate weekly monitoring if the average of the initial and confirmation results exceeds the primary MCL for constituents based on a running annual average until the running 4-week average no longer exceeds the MCL. And follow the requirements of §60320.112(d)(2). • Initiate quarterly monitoring if a result exceeds a contaminant's secondary MCL or upper limit. Describe the reason(s) for the exceedance and provide a schedule for corrective actions to DDW and RWQCB if the running average of quarterly-averaged results exceeds a contaminant's secondary MCL or upper limit. Resume annual monitoring if the running annual average of quarterly results does not exceed a contaminant's secondary MCL or upper limit. • Reduce monitoring for asbestos to once per 3 years if 4 quarterly results are below the detection limit in Table 64432-A. Resume quarterly monitoring if asbestos is detected.	• Confirm any exceedances of a primary MCL or action level by re-analyzing within 72 hours of receiving the initial result. • Notify DDW and RWQCB if the average of the initial and confirmation results exceeds the primary MCL or action level for constituents not based on a running annual average, and follow requirements of §60320.212((d)(1). • Initiate weekly monitoring if the average of the initial and confirmation results exceeds the primary MCL for constituents based on a running annual average until the running 4-week average no longer exceeds the MCL. And follow the requirements of §60320.212(d)(2). • Initiate quarterly monitoring if a result exceeds a contaminant's secondary MCL or upper limit. Describe the reason(s) for the exceedance and provide a schedule for corrective actions to DDW and RWQCB if the running average of quarterly-averaged results exceeds a contaminant's secondary MCL or upper limit. Resume annual monitoring if the running annual average of quarterly results does not exceed a contaminant's secondary MCL or upper limit. • Reduce monitoring for asbestos to once per 3 years if 4 quarterly results are below the detection limit in Table 64432-A. Resume quarterly monitoring if asbestos is detected.
60320.114 60320.214	Diluent Water Requirements	• Comply with these requirements to be credited as diluent water for calculating a recycled municipal wastewater contribution (RWC). • Monitor diluent water quarterly for nitrate and nitrite, except if diluent water is potable water. Confirm any exceedance of a primary MCL within 72 hours of receiving the initial results and follow requirements of §60320.114(a). Diluent water may not be credited towards the RWC calculation per §60320.114(a). • Conduct a source water evaluation, except if diluent water is potable water, per Cal-Nev AWWA's Watershed Sanitary Survey Guidance Manual of the diluent water for review and approval by DDW. • Ensure diluent water does not exceed a primary MCL, secondary MCL upper limit (unless historically used for recharge)[2], or a notification level (NL), and implement a DDW-approved water quality monitoring plan for DDW-specified contaminants to comply with primary MCLs,	• Comply with these requirements to be credited as diluent water for calculating a recycled municipal wastewater contribution (RWC). • Monitor diluent water quarterly for nitrate and nitrite, except if diluent water is potable water. Confirm any exceedance of a primary MCL within 72 hours of receiving the initial results and follow requirements of §60320.214(a). Diluent water may not be credited towards the RWC calculation per §60320.214(a). • Conduct a source water evaluation, except if diluent water is potable water, per Cal-Nev AWWA's Watershed Sanitary Survey Guidance Manual of the diluent water for review and approval by DDW. • Ensure diluent water does not exceed a primary MCL, secondary MCL upper limit, or a notification level (NL), and implement a DDW-approved water quality monitoring plan for DDW-specified contaminants to comply with primary MCLs, secondary MCLs (except for turbidity, color, and

APPENDIX A – SUMMARY OF TITLE 22 REGULATIONS FOR GROUNDWATER REPLENISHMENT USING RECYCLED WATER			
Title 22 Section(s)	**Regulation**	**Article 5.1: Surface Applications - Spreading Basins**	**Article 5.2: Subsurface Applications - Injection Wells**
		secondary MCLs (except for turbidity, color, and odor) and NLs. Monitoring plan shall comply with §60320.114(c). • Determine the volume of credited diluent water and demonstrate how it will be used to comply with the GRRP's 120-month running monthly average RWC maximum limit at the primary boundary. Submit the methodology for diluent water management and RWC compliance including elements detailed in §60320.114(d) in the Engineering Report for DDW approval. • Demonstrate diluent water compliance with water quality and quantity requirements in §60320.114(e) and a source water evaluation to receive credit prior to the GRRP operation, but not to exceed 120 months. • Describe in the OOP how diluent water will be distributed to ensure compliance with the maximum RWC and actions to be taken in the event diluent water is curtailed or no longer available. • Monitor recharge water in lieu of a diluent water source if approved by DDW and if diluent water source cannot be monitored directly.	odor) and NLs. Monitoring plan shall comply with §60320.214(c). • Determine the volume of credited diluent water and demonstrate how it will be used to comply with the GRRP's 120-month running monthly average RWC maximum limit at the primary boundary. Submit the methodology for diluent water management and RWC compliance including elements detailed in §60320.214(d) in the Engineering Report for DDW approval. • Demonstrate diluent water compliance with water quality and quantity requirements in §60320.214(e) and a source water evaluation to receive credit prior to the GRRP operation, but not to exceed 120 months. • Describe in the OOP how diluent water will be distributed to ensure compliance with the maximum RWC and actions to be taken in the event diluent water is curtailed or no longer available. • Monitor recharge water in lieu of a diluent water source if approved by DDW and if diluent water source cannot be monitored directly.
60320.116 60320.216	Recycled Municipal Wastewater Contribution (RWC) Requirements	• Calculate each month the running monthly average (RMA) RWC based on the total volume of the recycled municipal wastewater and credited diluent for the preceding 120 months. For GRRPs in operation less than 120 months, calculate the RMA RWC commencing after 30 months of GRRP operation, based on the total volume of recycled municipal wastewater and credited diluent water introduced during the preceding months. • Ensure that the RMA RWC does not exceed the maximum RWC specified by DDW. • <u>Ensure that the RMA RWC does not exceed the initial maximum RWC of 0.20 or an alternative initial RWC (up to 1.0) approved by DDW based on its review of factors in §60320.116(c)</u>.[2] • Increase the maximum RWC with DDW and RWQCB approval provided that the TOC 20-week running average for the previous 52 weeks has not exceeded 0.5 mg/L <u>divided by the proposed maximum RWC</u>[2]. • <u>Update the Engineering Report and OOP prior to operating the GRRP at an RWC greater than 0.50 or 0.75 and provide evidence of compliance with monitoring well requirements in §60320.126(a)</u>.[2]	• Calculate each month the running monthly average (RMA) RWC based on the total volume of the recycled municipal wastewater and credited diluent for the preceding 120 months. For GRRPs in operation less than 120 months, calculate the RMA RWC commencing after 30 months of GRRP operation, based on the total volume of recycled municipal wastewater and credited diluent water introduced during the preceding months. • Ensure that the RMA RWC does not exceed the maximum RWC specified by DDW. • Demonstrate that the treatment processes will achieve TOC concentrations no greater than 0.5 mg/L for initial maximum RWC limit up to 1.0 based on DDW's review of the Engineering Report and information at the public hearing. • Increase the maximum RWC with DDW and RWQCB approval provided that the TOC 20-week running average for the previous 52 weeks has not exceeded 0.5 mg/L.

Title 22 Section(s)	Regulation	Article 5.1: Surface Applications - Spreading Basins	Article 5.2: Subsurface Applications - Injection Wells
		• Notify DDW and RWQCB within 7 days if the RMA RWC exceeds the maximum RWC with the reason(s) for the exceedance and corrective action(s) to be taken, and implement the corrective action(s) and report to DDW and RWQCB within 60 days of the exceedance.	• Notify DDW and RWQCB within 7 days if the RMA RWC exceeds the maximum RWC with the reason(s) for the exceedance and corrective action(s) to be taken, and implement the corrective action(s) and report to DDW and RWQCB within 60 days of the exceedance.
60320.118 60320.218	Total Organic Carbon (TOC) and Soil Aquifer Treatment (SAT) Process Requirements	• Assess the SAT process performance by monitoring TOC, indicator compounds, and surrogate parameters, as approved by DDW.[2] • Analyze TOC at least once per week from representative 24-hr composite samples of: (1) undiluted recycled municipal wastewater (prior to recharge or within zone of percolation); (2) diluted percolated recycled municipal wastewater, with the value amended to negate the effect of diluent water; or (3) undiluted recycled municipal wastewater prior to recharge, with the value amended by an SAT factor based on demonstration studies of the SAT removal efficiency and approved by DDW.[2] • Substitute grab samples for 24-hr composite samples if grab sample is representative throughout the 24-hr period or entire recycled municipal wastewater flow stream has been treated by RO per §60320.201(a) and (b). • Ensure that TOC results do not exceed 0.5 mg/L divided by the RMA RWC based on the 20-week running average of all TOC results, and the average of the last 4 TOC results. • Suspend recycled municipal wastewater recharge if the 20-week running average of all TOC results exceeds the approved limit until at least 2 consecutive results taken 3 days apart are less than the limit. Notify DDW and RWQCB and follow requirements in §60320.118(d). • Submit a report to DDW and RWQCB within 60 days of exceeding the TOC limit based on the average of the last 4 results and describe the reason(s) for the exceedance and corrective action(s), which shall include reduction of the RWC and/or additional treatment to reduce TOC.[2] • Conduct a study to determine the occurrence of indicator compounds in the recycled municipal wastewater prior to the GRRP initial operation and every 5 years thereafter and propose at least 3 indicator compounds for use in evaluating SAT performance.[2] • Monitor quarterly recycled municipal wastewater or recharge water prior to and after SAT (30 days or less	• Analyze TOC at least once per week from representative 24-hr composite samples of recycled municipal wastewater (prior to replenishment). • Substitute grab samples for 24-hr composite samples if grab sample is representative throughout the 24-hr period or entire recycled municipal wastewater flow stream has been treated by RO per §60320.201(a) and (b). • Ensure that TOC results do not exceed 0.5 mg/L divided by the RMA RWC based on the 20-week running average of all TOC results, and the average of the last 4 TOC results. • Suspend recycled municipal wastewater recharge if the 20-week running average of all TOC results exceeds the approved limit until at least 2 consecutive results taken 3 days apart are less than the limit. Notify DDW and RWQCB and follow requirements in §60320.218(c). • Submit a report to DDW and RWQCB within 60 days of exceeding the TOC limit based on the average of the last 4 results and describe the reason(s) for the exceedance and corrective action(s), which shall include reduction of the RWC.

APPENDIX A – SUMMARY OF TITLE 22 REGULATIONS FOR GROUNDWATER REPLENISHMENT USING RECYCLED WATER			
Title 22 Section(s)	**Regulation**	**Article 5.1: Surface Applications - Spreading Basins**	**Article 5.2: Subsurface Applications - Injection Wells**
		downgradient) for the 3 indicator compounds. If less than 90% reduction of the indicator compounds is found (excluding effects of dilution), investigate the reason(s) and report to and consult with DDW per §60320.118(h).[2] • Obtain DDW approval if alternative wastewater chemical(s) in lieu of TOC is proposed.	• Obtain DDW approval if alternative wastewater chemical(s) in lieu of TOC is proposed.
60320.120 60320.220	Additional Chemical and Contaminant Monitoring	• Analyze quarterly the recycled municipal wastewater and groundwater from downgradient monitoring wells (per §60320.126) for: (1) priority toxic pollutants (chemicals listed in 40 CFR section 131.38 "Establishment of numeric criteria for priority toxic pollutants for the State of California", as may be amended) specified by DDW; and (2) chemicals specified by DDW. • Analyze quarterly the recycled municipal wastewater for NLs specified by DDW. Recharge water (including recharge water after surface application)[2] may be substituted per §60320.120(b) requirements. If the average of the initial and confirmation result exceeds a NL, initiate weekly monitoring and follow requirements in §60320.120(b). • Analyze annually the recycled municipal wastewater for indicator compounds specified by DDW and RWQCB. • Notify DDW and RWQCB of any chemical or contaminant detected as a result of the above monitoring no later than the following quarter.	• Analyze quarterly the recycled municipal wastewater and groundwater from downgradient monitoring wells (per §60320.226) for: (1) priority toxic pollutants (chemicals listed in 40 CFR section 131.38 "Establishment of numeric criteria for priority toxic pollutants for the State of California", as may be amended) specified by DDW; and (2) chemicals specified by DDW. • Analyze quarterly the recycled municipal wastewater for NLs specified by DDW. Recharge water may be substituted per §60320.220(b) requirements. If the average of the initial and confirmation result exceeds a NL, initiate weekly monitoring and follow requirements in §60320.220(b). • Analyze annually the recycled municipal wastewater for indicator compounds specified by DDW and RWQCB. • Notify DDW and RWQCB of any chemical or contaminant detected as a result of the above monitoring no later than the following quarter.
60320.122 60320.222	Operation Optimization Plan (OOP)	• Submit an OOP for approval by DDW and RWQCB prior to operation of a GRRP. OOP shall include elements set forth in §60320.122(a) or §60320.222(a) and be representative at all times of current operations, maintenance, and monitoring of the GRRP. • Operate all treatment processes during the first year of the GRRP operation to provide optimal reduction of: (1) microbial contaminants; (2) regulated contaminants specified in §60320.112 or §60320.212; (3) nitrogen compounds pursuant to §60320.110 or §60320.210; and (4) chemicals and contaminants required per §60320.120 or §60320.220. • Update the OOP within 6 months following the first year of operation, and anytime thereafter, to include changes in operational procedures and submit to DDW for review.	
60320.124 60320.224	Response Retention Time (RRT)	• Retain recycled municipal wastewater underground for a period no less than the response retention time (RRT) approved by DDW. RRT shall allow sufficient response time to identify treatment failures and implement actions, including providing an alternative drinking water supply per §60320.100(b) or §60320.200(b), necessary to protect public health. RRT shall be no less than 2 months. • Conduct a tracer study representative of normal GRRP operations to demonstrate that the underground retention time is no less than the approved RRT. Tracer study shall be initiated within the first 3 months of GRRP operation and be based on a protocol approved by DDW. Underground retention time shall be measured as the difference from when the tracer is applied	

APPENDIX A – SUMMARY OF TITLE 22 REGULATIONS FOR GROUNDWATER REPLENISHMENT USING RECYCLED WATER			
Title 22 Section(s)	Regulation	Article 5.1: Surface Applications - Spreading Basins	Article 5.2: Subsurface Applications - Injection Wells
		at the GRRP to (1) 2% of the initial tracer concentration reaches the downgradient monitoring point, or (2) 10% of the peak tracer unit value at the downgradient monitoring point reached the monitoring well. • Receive tracer study credits for RRT compliance for each month of underground retention depending upon the methodology set forth in §60320.124(c) or §60320.224(c): (1) utilizing an added tracer for full 1.0 RRT credit/month, (2) utilizing an intrinsic tracer for 0.67 RRT credit/month, (3) numerical modeling for 0.5 RRT credit/month, or (4) analytical modeling for 0.25 RRT credit/month. • Use above method 3 or 4 for planning a GRRP with approval of DDW, prior to the GRRP commencing operation and conducting the required tracer study using method 1 or 2. • Submit protocol to establish RRT compliance to DDW for approval. • Demonstrate underground retention time if changed hydrogeological or climatic conditions have occurred and DDW requires a new tracer study.	
60320.126 60320.226	Monitoring Well Requirements	• Construct at least 2 monitoring wells downgradient of the GRRP complying with requirements in §60320.126(a). • Locate at least 1 monitoring well: (1) at least 2 weeks but no more than 6 months downgradient travel time <u>through the saturated zone</u>[2] of the aquifer affected by the GRRP; and (2) at least 30 days upgradient from the nearest drinking water well. • Locate at least 1 additional monitoring well between the GRRP and the nearest downgradient drinking water well. • Sample groundwater from the monitoring wells from each aquifer that will receive the GRRP's recharge water and that can be validated as receiving recharge water. • Sample groundwater from the monitoring wells two times prior to GRRP operation and analyze for total nitrogen, nitrate, nitrite, secondary MCLs, any chemicals and contaminants specified by DDW or RWQCB, and priority toxic pollutants specified in §60320.120. • Sample groundwater from the monitoring wells quarterly after GRRP operation begins and analyze for total nitrogen, nitrate, nitrite, secondary MCLs, any chemicals and contaminants specified by DDW or RWQCB, and priority toxic pollutants specified in §60320.120. • Confirm any results from the above monitoring that exceed 80% of a nitrate, nitrite, nitrate plus nitrite MCL, and if the average of the initial and confirmation results exceeds the contaminant's primary MCL, notify DDW and RWQCB and suspend recharge of recycled municipal wastewater until corrective actions have been taken or evidence is provided to DDW and RWQCB that the contamination was not caused by the GRRP.	• Construct at least 2 monitoring wells downgradient of the GRRP complying with requirements in §60320.226(a). • Locate at least 1 monitoring well: (1) at least 2 weeks but no more than 6 months downgradient travel time through the aquifer affected by the GRRP; and (2) at least 30 days upgradient from the nearest drinking water well. • Locate at least 1 additional monitoring well between the GRRP and the nearest downgradient drinking water well. • Sample groundwater from the monitoring wells from each aquifer that will receive the GRRP's recharge water and that can be validated as receiving recharge water. • Sample groundwater from the monitoring wells two times prior to GRRP operation and analyze for total nitrogen, nitrate, nitrite, secondary MCLs, any chemicals and contaminants specified by DDW or RWQCB, and priority toxic pollutants specified in §60320.220. • Sample groundwater from the monitoring wells quarterly after GRRP operation begins and analyze for total nitrogen, nitrate, nitrite, secondary MCLs, any chemicals and contaminants specified by DDW or RWQCB, and priority toxic pollutants specified in §60320.220. • Confirm any results from the above monitoring that exceed 80% of a nitrate, nitrite, nitrate plus nitrite MCL, and if the average of the initial and confirmation results exceeds the contaminant's primary MCL, notify DDW and RWQCB and suspend recharge of recycled municipal wastewater until corrective actions have been taken or evidence is provided to DDW and RWQCB that the contamination was not caused by the GRRP.

<table>
<tr><th colspan="4">APPENDIX A – SUMMARY OF TITLE 22 REGULATIONS FOR GROUNDWATER REPLENISHMENT USING RECYCLED WATER</th></tr>
<tr><th>Title 22 Section(s)</th><th>Regulation</th><th>Article 5.1: Surface Applications - Spreading Basins</th><th>Article 5.2: Subsurface Applications - Injection Wells</th></tr>
<tr><td></td><td></td><td>• Ensure that the laboratory for DDW-specified chemicals electronically submits results to DDW’s database.
• Reduce groundwater monitoring frequency for the above chemicals and contaminants from quarterly to annually following DDW’s review and approval of the most recent 2 years’ of monitoring results.</td><td>• Ensure that the laboratory for DDW-specified chemicals electronically submits results to DDW’s database.
• Reduce groundwater monitoring frequency for the above chemicals and contaminants from quarterly to annually following DDW’s review and approval of the most recent 2 years’ of monitoring results.</td></tr>
<tr><td>60320.128
60320.228</td><td>Reporting</td><td colspan="2">• Submit an annual report no later than 6 months after the end of each calendar year to DDW, RWQCB, and public water systems and drinking water well owners within 10 years downgradient travel time of the GRRP. Annual report shall include information specified in §60320.128(a) or §60320.228(b).
• Update the Engineering Report every 5 years following approval of the initial Engineering Report to address any changes and submit to DDW and RWQCB. Updated Engineering Report shall include information specified in §60320.128(b) or §60320.228(b).</td></tr>
<tr><td>60320.130
60320.230</td><td>Alternatives</td><td>• Use an alternative to any requirement in Article 5.1 if the project sponsor: (1) demonstrates to DDW that the proposed alternative assures at least the same level of public health protection; (2) receives written approval from DDW prior to implementation of the alternative; and (3) conducts a public hearing on the proposed alternative pursuant to §60320.102(b) and (c).
• Include with the aforementioned demonstration a review of the proposed alternative by an independent scientific advisory panel per the requirements in §60320.130(b).
• <u>Increase the TOC limit if: (1) the increased TOC limit is approved by DDW and RWQCB; (2) the GRRP has been in operation for the most recent 10 consecutive years; (3) the project sponsor submits a proposal to DDW complying with §60320.130(c); and (4) the project sponsor performs a health effects evaluation assessing the health risks to consumers of water impacted by the GRRP and any anticipated water quality changes resulting from the proposed increased TOC, including information required in §60320.130(c) and reviewed by an independent scientific peer review advisory panel.</u>[2]</td><td>• Use an alternative to any requirement in Article 5.2 if the project sponsor: (1) demonstrates to DDW that the proposed alternative assures at least the same level of public health protection; (2) receives written approval from DDW prior to implementation of the alternative; and (3) conducts a public hearing on the proposed alternative pursuant to §60320.202(b) and (c).
• Include with the aforementioned demonstration a review of the proposed alternative by an independent scientific advisory panel per the requirements in §60320.230(a).</td></tr>
</table>

[1] Advanced treatment criteria in §60320.201 are not applicable to surface applications.
[2] Underlining denotes significant differences between requirements for surface applications in comparison with subsurface applications.
Note: This summary is not intended to be a substitute for the actual Title 22 Regulations.

Appendix B: Summary of Drinking Water Regulations in California

APPENDIX B – SUMMARY OF DRINKING WATER REGULATIONS IN CALIFORNIA		
Reference	**Regulation**	**Selected Requirements[1]**
Title 17, Chapter 5, Subchapter 1, Group 4 Drinking Water Supplies		
Article 2	Protection of Water System	• Provide devices to prevent backflow into the public water system commensurate with the degree of hazard that exists on the user's premises. Backflow prevention devices in increasing level of protection are: double check valve assembly (DC), reduced pressure principal backflow prevention device (RP), and an air gap separation (AG). See §7604, Table 1 "Type of Backflow Protection Required". • Provide backflow preventers that have been tested by a SWRCB-approved organization. • Provide a DC conforming to AWWA standards. Location shall be as close as practical to the user's connection and installed above grade where it can be readily tested and maintained. • Provide an RP conforming to AWWA standards. Location shall be as close as practical to the user's connection and between 12 and 36-inches above grade. • Provide an AG at least double the diameter of the supply pipe, measured vertically above the overflow level of the receiving vessel (at least 1-inch separation). Location shall be as close as practical to the user's connection and all piping between the user's connection and the receiving tank shall be visible. • Backflow preventers shall be tested and maintained per §7605.
Article 5	Domestic Water Supply Reservoirs	• Recreational use on or around the reservoir is prohibited unless specifically authorized in a water supply permit. Application procedures are in §7626-7629. • SWRCB may approve recreational use at domestic water supply reservoirs from which water is: (1) continuously and reliably filtered and chlorinated, or (2) withdrawn by open channels and subsequently stored again in reservoirs where the water is continuously and reliably filtered and chlorinated prior to distribution.
Title 22, Division 4, Chapter 13 Operator Certification		
Article 2	Operator Certification Grades	• Water treatment facility staff certification requirements are dependent on the treatment facility classification and specified as minimum levels for chief operators and shift operators in §63765. The 5 treatment facility operator certification grades range from T1 (lowest) to T5 (highest). Facility classifications are similar (See Chapter 15). • Distribution system staff certification requirements are dependent on the distribution system classification and are specified as minimum levels for chief operators and shift operators in §63770. The 5 distribution system operator certification grades range from D1 (lowest) to D5 (highest). Distribution system classifications are similar (See Chapter 15). • Duties of distribution system operators are restricted to those in §63770. • Eligibility criteria for taking certification exams are presented in Articles 3, 4, and 5.
Title 22, Division 4, Chapter 14 Water Permits		
Article 1	Water Permit Applications	• Submit an application for a permit or amended permit per Health and Safety Code Section 116525 or 116550.
Article 3	State Small Water Systems	• Requires a permit from local health officer to operate. • Submit a technical permit with the permit application per §64211. • Requires bacteriological and chemical monitoring and reporting per §64212 and §64213. • Limits service connections to 14 maximum. Greater than 14 service connections becomes a public water supply. • Demonstrate to the local health officer that a sufficient water supply exists (minimum 3 gpm for at least 24 hours per service connection).

APPENDIX B – SUMMARY OF DRINKING WATER REGULATIONS IN CALIFORNIA		
Reference	Regulation	Selected Requirements[1]
		• Requires continuous disinfection for use of a surface water supply. • Local primacy agency requirements per Article 4.
Title 22, Division 4, Chapter 14.5 Fees		
Article 1	Public Water System Annual Fees	• Pay annual fees to the SWRCB set forth in §64305. Fees are listed by water system type in Table 64305-A.
Title 22, Division 4, Chapter 15 Domestic Water Quality and Monitoring Regulations		
Article 2	General Requirements	• Provides classification of water treatment facilities in Table 64413-A based on the calculation of total points for the facility using factors for: (1) source water (groundwater and/or purchased treated water, or surface water and/or groundwater under the direct influence of surface water); (2) influent microbiological quality (median coliform density); (3) influent turbidity (for surface water or groundwater under the direct influence of surface water); (4) influent perchlorate, nitrate and nitrite; (5) influent chemical and radiological contaminants; (6) surface water filtration method; (7) disinfection process; (8) disinfection/oxidation treatment without inactivation credit; (9) any other treatment processes; and (10) flow rate. • Provides classification of distribution systems in Table 64413.3-A by population served. Classes are upgraded by one level depending on the number of pressure zones, disinfectants, largest single pump, number of reservoirs, existence of any uncovered reservoirs, and use of non-potable water in the service area. • Treatment facility staff certification requirements are presented in §64413.5. • Distribution system staff certification requirements are presented in §64413.7. • Comply with monitoring and reporting requirements for standby sources (§64414). • Use laboratories certified by the SWRCB to perform the required analyses using EPA-approved methods. • Submit a sampling plan for all monitoring except bacteriological.
Article 2.5	Point-of-Use Treatment	• Requirements for point-of-use treatment devices at a single tap.
Article 2.7	Point-of-Entry Treatment	• Requirements for point-of-entry treatment devices for drinking water entering a house or building.
Article 3	Primary Standards – Bacteriological Quality	• Develop a sample siting plan per §64422. Collect samples as required in §64423, 64424, and 64425, conduct analyses at an approved laboratory, and report the results per §64426 and 64426.1. • Notify the SWRCB when an increase in coliform bacteria occurs. • Comply with the total coliform MCL in §64426.1 and related reporting and notification requirements.
Article 3.5	Ground Water Rule	• Comply with the Ground Water Rule in 40 CFR 71, as amended and as may be modified by CCR Title 22.
Article 4	Primary Standards – Inorganic Chemicals	• Comply with primary MCLs in Table 64431-A (inorganic chemicals). • Conduct monitoring and reporting for compliance with primary MCLs in accordance with §64432 (inorganics), 64432.1 (nitrate and nitrite), 64432.2 (asbestos), and 64432.3 (perchlorate). Detection limits for purposes of reporting (DLRs) are defined in Table 64432-A. • Notify the SWRCB of results exceeding the MCL in accordance with the requirements in §64432(g), (h) and (i). • Monitoring frequency for certain chemicals may be reduced or waived with SWRCB approval.
Article 4.1	Fluoridation	• Install and operate fluoridation systems at public water systems with 10,000 service connections or more. • Comply with optimum fluoride levels in §64433.2 and monitor and report per §64433.3 and 64433.7.

APPENDIX B – SUMMARY OF DRINKING WATER REGULATIONS IN CALIFORNIA		
Reference	Regulation	Selected Requirements[1]
		• Submit a fluoride system operations contingency plan including operation, corrective actions, investigation steps, notification procedures, and public notification measures.
Article 5	Radioactivity	• Comply with primary MCLs in Table 64442 (radium-226, radium-228, gross alpha particle activity (excluding radon and uranium), and uranium). • Conduct monitoring and reporting for compliance with primary MCLs in accordance with §64442. DLRs are defined in Table 64442. • Comply with primary MCLs in Table 64443 (beta/photon emitters, strontium-90, and tritium). • Conduct monitoring and reporting for compliance with primary MCLs in accordance with §64443. DLRs are defined in Table 64443.
Article 5.5	Primary Standards – Organic Chemicals	• Comply with primary MCLs in Table 64444-A (organic chemicals). • Conduct monitoring and reporting for compliance with primary MCLs in accordance with §64445, 64445.1. DLRs are defined in Table 64445.1-A.
Article 12	Best Available Technologies (BAT)	• Utilize BAT for achieving compliance with microbiological contaminants, primary MCLs for inorganic chemicals, radionuclides, organic chemicals,
Article 14	Treatment Techniques	• Certify annually if using acrylamide and/or epichlorohydrin in water treatment processes that the dose does not exceed specified levels.
Article 15	Secondary Drinking Water Standards	• Comply with secondary MCLs in Tables 64449-A (consumer accepted levels) and Table 64449-B (level ranges). • Conduct monitoring and reporting for compliance with secondary MCLs in accordance with §64449. For community water systems, seek waiver for secondary MCL compliance per §64449.2.
Article 18	Notification of Water Consumers and the SWRCB	• Give public notice to users of the water system and the SWRCB of violations according to a tiered structure. • Give Tier 1 public notice as described in §64463.1for violation of the total coliform MCL, nitrate, nitrite, or total nitrate and nitrite MCLs, or maximum allowable turbidity levels (secondary MCL). • Give Tier 1 public notice of a waterborne microbial disease outbreak, significant interruption of treatment system, natural disaster disrupting the water treatment or distribution system, or chemical spill or pathogenic contamination in the source water that may adversely affect human health as a result of short-term exposure (acute). • Give Tier 1 public notice for violation of the perchlorate MCL or chlorite MCL per resampling requirements in §64463.1. • Give a Tier 2 public notice for any violation of the MCL, maximum residual disinfection level (MRDL), and treatment technique requirements, except where a Tier 1 public notice is required, in accordance with §64463.4. • Give a Tier 3 public notice for monitoring violations, non-compliance with testing procedures, or operation variance or exemption in accordance with §64463.7. • Follow the requirements for public notice content, format, and suggested language in §64465.
Article 19	Records, Reporting and Recordkeeping	• Comply with reporting requirements and maintain records for at least 5 years.
Article 20	Consumer Confidence Report	• Prepare and deliver a consumer confidence report annually that contains specified information about the water delivered: source, type, source water assessment, definitions of terminology, detections of contaminants with MCLs, action levels, MRDL, treatment techniques for regulated contaminants, levels for monitored, but unregulated contaminants, microbial contaminants, sodium, and hardness.

APPENDIX B – SUMMARY OF DRINKING WATER REGULATIONS IN CALIFORNIA		
Reference	Regulation	Selected Requirements[1]
Title 22, Division 4, Chapter 15.5 Disinfectant Residuals, Disinfection Byproducts, and Disinfection Byproduct Precursors		
Article 2	MCLs for Disinfection Byproducts and Maximum Residual Disinfection Levels	• Comply with primary MCLs for disinfection byproducts shown in Table 64533-A (total trihalomethanes, haloacetic acids (five), bromate, and chlorite) • Conduct monitoring and reporting for compliance with primary MCLs in accordance with §64533. DLRs are defined in Table 64533-A. • Use BAT for disinfection byproducts as described in Table 64533-B. • Calculate MRDLs per §64533.5.
Article 3	Monitoring Requirements	• Perform analyses at approved laboratories per §64534. • Monitor for disinfection byproducts at the frequencies specified in Table 64534.2. Reduced monitoring frequency may be approved as described in Table 64534.3. • Submit a monitoring plan to the SWRCB for approval and follow the approved plan.
Article 4	Compliance Requirements	• Use the methodology presented in §64535 and 64535.2 for determining compliance with primary MCLs and MRDLs.
Article 5	Treatment Technique for Control of Disinfection Byproduct Precursors	• Comply with alternative compliance criteria in §64536 or systems using surface water and conventional filtration. TOC removal requirements are specified in §64536.2 for enhanced coagulation or enhanced softening. • Calculate disinfection byproduct precursor levels per §64536.4 and follow public notification requirements as needed per §64536.6.
Article 6	Reporting and Recordkeeping Requirements	• Comply with reporting requirements and maintain records.
Title 22, Division 4, Chapter 16 California Waterworks Standards		
Article 1.5	Waivers and Alternatives	• Demonstrate to the SWRCB that the proposed alternative would provide at least the same level of protection of public health. • Secure written approval from the SWRCB prior to implementing the alternative.
Article 2	Permit Requirements	• Apply for initial domestic public water system permit as applicable per §64552. • Public water systems shall have sufficient capacity to meet the system's maximum day demand. • Public water systems with 1,000 or more service connections shall be able to meet 4 hours of peak hourly demand with source capacity, storage capacity and/or emergency connections. • Public water systems with 1,000 or more service connections shall have storage capacity equal to or greater than the maximum day demand. • Follow permit application, reporting, and testing requirements of §64554. • Amend a domestic water supply permit if necessary, following provisions in §64556. • Prepare a source capacity planning study if so directed by the SWRCB based on its determination that an existing or potential problem is observed. Study shall include anticipated growth of the water system over the next 10 years, estimates of water demands, maps, descriptions of facilities, water rights, surface water availability, wells, groundwater availability, source water assessment(s), descriptions of treatment and distribution systems,

APPENDIX B – SUMMARY OF DRINKING WATER REGULATIONS IN CALIFORNIA		
Reference	Regulation	Selected Requirements[1]
Article 3	Water Sources	• Provide a technical report to support an application to the SWRCB for a new or amended domestic water supply permit for a proposed well. Report shall include a source water assessment, documentation of the well site control zone (50-ft radius), design plans and specifications, CEQA documentation. • Provide information to the SWRCB pertaining to the well construction permit, pump tests, water quality analyses, and other information required by §64560 for each new public water supply well. • Destroy any public water supply well per Department of Water Resources Bulletins 74-81 and 74-90. • Install a flow meter for each water source and record the quantity of water flow from each source. Maintain monthly production records from each source.
Article 4	Materials and Installation of Water Mains and Appurtenances	• Comply with materials and installation standards of the American Water Works Association per §64570. • Separate new water mains by at least 10 ft horizontally from and 1 ft vertically above from parallel sewers (raw wastewater), primary or secondary treated wastewater pipelines, disinfected secondary recycled water pipelines, and hazardous fluids (fuels, industrial wastes, and wastewater sludge) pipelines per §64572(a). • Separate new water mains by at least 4 ft horizontally from and 1 ft vertically above from parallel disinfected tertiary recycled water pipelines and storm drains per §64572(b). • Install new raw water supply lines at least 4 ft horizontally from and 1 ft below any water main per §64572 (c). • Comply with other separation and installation requirements for water mains crossing other pipelines conveying the aforementioned fluids or located near the edge of any landfill, wastewater ponds, or hazardous waste sites per §64572(d), (e), (f), and (g). Exemptions may be approved by the SWRCB for certain circumstances per §64572(h). • Install water mains that are a minimum nominal diameter of 4 inches. • Provide flushing valves or blowoffs at the ends of dead-end water mains. • Install air release, air vacuum, and combination valves in accordance with §64576. • Install isolation valves on water mains in the distribution system at minimum distances and locations specified in §64577. • Install valve boxes over buried valve stems to locate and operate the valves.
Article 5	Disinfection Requirements	• Disinfect new water mains prior to use or water mains that have been taken out of service for maintenance or repair. Sample for bacteriological quality. Results shall be negative for coliform bacteria prior to planning the new water main in service. • Disinfect new distribution reservoirs prior to use or distribution reservoirs that have been taken out of service for maintenance or repair. Sample for bacteriological quality, and resample if results are positive for coliform bacteria. Submit the results to the SWRCB for approval prior to placing the reservoir in service. • Sample new or repaired wells or wells that have not been in service for more than 3 months for bacteriological quality prior to use. If results are positive for coliform bacteria, disinfect the well in accordance with American Water Works Association C654-03, resample, and submit test results to the SWRCB for approval prior to placing the well in service.
Article 6	Distribution Reservoirs	• Design and construct distribution reservoirs in accordance with requirements in §64585.
Article 7	Additives	• Any chemical or product directly added to drinking water shall be certified as meeting National Science Foundation International/American National Standard Institute (NSF/ANSI) standards. • Comply with provisions set forth in §64591 for indirect additives (chemicals, materials, lubricants or other products in the production, treatment or distribution of drinking water). • Use uncertified chemicals, materials, or products as allowed under §64593.

APPENDIX B – SUMMARY OF DRINKING WATER REGULATIONS IN CALIFORNIA		
Reference	**Regulation**	**Selected Requirements[1]**
Article 8	Distribution System Operation	• Submit a Water System Operations and Maintenance Plan to the SRWCB if directed to do so based on an identified deficiency. The Plan shall include information listed in §64600. • Operate the distribution system to maintain a minimum operating pressure in the water main at the user service line of at least 20 psi at all times. Expansions to existing distribution systems shall be designed to provide at least 40 psi of operating pressure at all times excluding fire flow. • Maintain "as built" plans, maps, and drawings. Prepare a schematic drawing or map showing locations of each water source, treatment facility, pumping plant, reservoir, water main and isolation valve. Update these documents as changes occur. • Maintain records of water main flushing and distribution reservoir inspections and cleanings for at least 3 years.
Title 22, Division 4, Chapter 17 Surface Water Treatment		
Article 2	Treatment Technique Requirements, Watershed Protection Requirements, and Performance Standards	• Provide multiple barrier treatment that meets the requirements set forth in §64652. • Provide treatment that reliability achieves at least: (1) 99.9% (3-log) reduction of *Giardia lamblia* cysts through filtration and disinfection; (2) 99.99% (4-log) reduction of viruses through filtration and disinfection; and (3) 99% (2-log) removal of *Cryptosporidium* oocysts through filtration. • Provide filtration of an approved surface water unless all the criteria of §64652.5 to avoid filtration have been met, including site inspections and approvals by the SWRCB. • Use filtration for approved surface water: (1) conventional filtration treatment, (2) direct filtration treatment, (3) diatomaceous earth filtration, or (4) slow sand filtration, unless an alternative process has been approved by the SWRCB. • Provide information to the SWRCB on any recycle flows per §64653.5. • Use continuous disinfection treatment that ensures inactivation of *Giardia lamblia* cysts and viruses in conjunction with the removals achieved by filtration. Comply with disinfection treatment performance standards in §64654.
Article 3	Monitoring Requirements	• Monitor source (raw) water and recycled filter backwash (if any) for turbidity and total coliform per §64654.8. • Conduct turbidity monitoring to determine compliance with filtration performance standards per §64655 • Monitor temperature and pH if chlorine id used, disinfectant contact time, and residual disinfectant concentration in accordance with the provisions of §64656.
Article 4	Design Standards	• Submit an engineering report to the SWRCB describing new or modified filtration and disinfection treatment facilities and how they are designed to comply with Chapter 17 requirements and criteria in §64658. • Include reliability features in all new or modified surface water treatment plants.
Article 5	Operation	• Comply with staffing requirements and operating criteria for surface water treatment plant including: (1) operator certifications, (2) filtration rates, and (3) disinfection failure prevention. • Operate the treatment plant in accordance with an operations plan that has been approved by the SWRCB. • Maintain operation records for at least 3 years that include: (1) water quality and treatment process monitoring results, (2) filter maintenance and inspections, (3) quantity of water produced, flow rates, filtration rates, operating hours, and backwash rates, and (5) dates and descriptions of major equipment and process failures and corrective actions taken.
Article 6	Reporting	• Notify the SWRCB if any exceedances described in §64663 occur. • Submit monthly reports signed by the chief water treatment plant operator, plant superintendent, or other responsible person to the SWRCB that include information listed in §64664.

APPENDIX B – SUMMARY OF DRINKING WATER REGULATIONS IN CALIFORNIA		
Reference	Regulation	Selected Requirements[1]
		• Submit supplemental reports if necessary per §64664.2
Article 7	Sanitary Surveys	• Conduct a sanitary survey of the watershed(s) at least every 5 years and submit the report to the SWRCB. Required elements of the survey and report are described in §64665.
Article 8	Public Notification	• Notify the public whenever a failure of the treatment systems occur that violate treatment or performance standards.
Article 9	Indirect Potable Reuse: Surface Water Augmentation	• Comply with the requirements of Article 9 when the approved surface water source of supply is augmented by a Surface Water Source Augmentation Project (SWSAP). (See Title 22, Chapter 3, Article 5.3) • Submit an application for a domestic water supply permit or permit amendment and have an approved joint plan between the SWSAP Public Water System (PWS) and SWSAP Water Recycling Agency (WRA). • Revise the emergency plan and operations plan to include elements of the joint plan to ensure a reliability supply of water is delivered that meets all drinking water standards in any of the events in §64668.10(b) should occur. • Demonstrate to the SWRCB and RWQCB that the SWSAP PWS has sufficient control over the operation of the augmented reservoir to comply with the requirements of Article 9 and Title 22, Chapter 3, Article 5.3. • Notify the SWRCB of a SWSAP WRA failing to meet a requirement in the SWSAP WRA's permit or Title 22, Chapter 3, Article 5.3. • Conduct at least 3 public hearings with the SWRCB and the SWSAP WRA. • Comply with the SWSAP augmented reservoir requirements set forth in §64668.30: (1) operating as an approved surface water supply for at least 5 years (or a minimum of 2 years with SWRCB approval); and (2) calculate and record monthly the theoretical retention time (in days) by dividing the volume of water in the reservoir at the end of each month by the total outflow/withdrawals from the reservoir during the month. Comply with an initial approved minimum theoretical retention time of at least 180 days with exceptions as allowed under §64668.30 for an alternative theoretical retention time and as approved by the SWRCB, and in no case less than 60 days (e.g. additional treatment at the SWSAP WRA to achieve an additional 1-log reduction in pathogens [virus, *Giardia* cysts, and *Cryptosporidium* oocysts} for theoretical retention time less than 120 days) • Conduct tracer studies and hydrodynamic modeling of the augmented reservoir to demonstrate to the SWRCB that at all times and under all operating conditions the volume of water withdrawn from the reservoir contains no more than: (1) 1% by volume of recycled municipal wastewater during any 24-hr period; or (2) 10% by volume of recycled municipal wastewater that was delivered to the reservoir during any 24-hr period, with the SWSAP WRA providing additional treatment that achieves 1-log of additional reduction in pathogens (virus, *Giardia* cysts, and *Cryptosporidium* oocysts). Requirements for additional treatment are described in §64668.30(c). • Utilize an independent scientific advisory panel to review the SWSAP per §64668.30(f). • Develop a plan for SWRCB approval describing the actions to be taken by the SWSAP PWS to address potential impacts of using advanced treated water as a source water supply for the SWSAP PWS's surface water treatment plant and distribution system. Details of the plan are described in §64668.30(g).
Title 22, Division 4, Chapter 17.5 Lead and Copper		
Article 1	General Requirements and Definitions	• Requirements of this chapter are applicable to community water systems and non-transient –non-community water systems. • Exceeding an action level shall not constitute a violation of this chapter. • Conduct analyses using methods in §64670(c). • Follow defined terminology for action level exceedances, corrosion control treatment, etc. in this Article.

APPENDIX B – SUMMARY OF DRINKING WATER REGULATIONS IN CALIFORNIA		
Reference	Regulation	Selected Requirements[1]
Article 2	Requirements According to System Size	• Comply with sampling and reporting requirements for small and medium-size water systems per §64673, and for large water systems per §64674.
Article 3	Monitoring for Lead and Copper	• Sample for lead and copper at sites specified in Table 64675-A, and at frequencies in §64675.5. • Follow the methodology in this article for selection of tap sampling sites, DLRs, and determination of exceedances of lead and copper action levels. Monitoring may be reduced or waived for small systems.
Article 4	Water Quality Parameter Monitoring	• Select tap sampling sites to be representative of the entire distribution system. • Monitor pH, alkalinity, orthophosphate, silica, calcium, conductivity, corrosion control inhibitor (if used), and temperature in systems using corrosion control treatment. • Monitoring frequency may be reduced if no exceedances of lead and copper action levels are identified.
Article 5	Corrosion Control	• Evaluate types of corrosion control treatment methods by following study procedures outline in §64683. Submit a report to the SWRCB indicating the study findings and recommended corrosion control treatment. • Install and operate the corrosion control treatment approved by the SWRCB. • Monitor the distribution system to validate performance for compliance with this Article.
Article 6	Source Water Requirements for Action Level Exceedances	• Sample and analyze the source water(s) for lead and copper within 6 months of an exceedance of an action level in the distribution system. • Comply with the SWRCB requirements for treatment and monitoring of source water if so directed by the SWRCB.
Article 7	Public Education Program for Lead Action Level Exceedances	• Conduct a lead public education program that includes elements described in this Article.
Article 8	Lead Service Line Replacements for Action Level Exceedances	• Replace lead service lines if the lead action level is exceeded after installing corrosion control treatment and/or source water treatment. • Conduct an assessment of piping materials in the distribution system. • Sample service lines for lead per §64689.
Article 9	Reporting and Recordkeeping	• Report results of lead and copper sampling and maintain records for at least 12 years.
Other Title 22 Requirements		
Addendum A	California Ground Water Rule	• Reference to text adopted pursuant to §64430.
Addendum B	California Long Term 2 Enhanced Surface Water Treatment Rule	• Reference to text adopted pursuant to §64650(f).
Appendix A	Endnotes	• See list at: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Lawbook.html

[1] Note: This summary is not intended to be a substitute for the actual Regulations.

Appendix C: Summary of DDW 2015 Draft Update of Process Memo 97-005 for Direct Domestic Use of Extremely Impaired Sources

APPENDIX C – SUMMARY OF DDW[1] 2015 DRAFT UPDATE OF PROCESS MEMO 97-005 FOR DIRECT DOMESTIC USE OF EXTREMELY IMPAIRED SOURCES		
Section[2]	Title	Summary
A.	General Philosophy	• Basic principle is that only the best quality sources of water reasonably available to a water utility should be used for drinking. • Sources presenting the least risk to public health should be utilized and protected against contamination. • Whenever possible, lower quality source waters should be used for non-consumptive uses. • Use of contaminated water as a drinking water source always poses a greater health risk and hazard to the public than the use of an uncontaminated source because of the chance that the necessary treatment may fail. • Use of an extremely impaired source should not be approved unless the additional health risk, relative to the use of other available drinking water sources, are known, minimized, and considered acceptable. • Extremely impaired sources contain or are likely to contain high concentrations of contaminants, multiple contaminants, or unknown contaminants (such as groundwater subject to contamination from a Superfund site). • Drinking water quality and public health shall be given greater consideration than costs or cost savings when evaluating alternative drinking water sources or treatment processes. • Extremely impaired sources exist that need to be remediated and for which the resulting product water represents a significant resource that should not be wasted. • Consideration of treated extremely impaired sources for domestic use may be reasonable, particularly where other sources may be unavailable. If the water cannot be reliably treated, or if the potential public health risk exceeds acceptable levels, the extremely impaired source should not be permitted for domestic use.
B.	Purpose of Policy Memo 97-005	• Original 1997 Memo was issued to provide DDW guidance in addressing proposals to use water generated from large remediation projects (e.g. Superfund sites under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)). • Sets forth the position and basic tenets by which DDW would evaluate proposals, establish appropriate permit conditions, and approve the use of an extremely impaired source for direct potable use.
C.	Extremely Impaired Sources	• Extremely impaired source meets two or more of the following criteria: o Contains a contaminant that exceeds 10 times its Maximum Contaminant Level (MCL) based on chronic health effects, o Contains a contaminant that exceeds 3 times its MCL based on acute health effects (e.g., nitrate or perchlorate), o Contains a contaminant that exceeds 10 times its Notification Level (NL) based on chronic health effects, o Contains a contaminant that exceeds 3 times its NL based on acute health effects, o Contains one or more contaminants that meet any of the four criteria above and has not been adequately characterized, o Is a surface water that requires more than 4 log Giardia/5 log virus reduction, o Is a surface water that on an annual average contains more than 5% treated wastewater, unless it is associated with an approved drinking water-related surface water augmentation project, o Is extremely threatened with contamination due to proximity to known contaminating activities within the long term, steady-state capture zone of a drinking water well or within the watershed of a surface water intake, o Contains a mixture of contaminants of health concern beyond what is typically seen in number and concentration of contaminants, o Is designed to intercept known contaminants of health concern. • Examples include: o Extremely contaminated ground water,

APPENDIX C – SUMMARY OF DDW[1] 2015 DRAFT UPDATE OF PROCESS MEMO 97-005 FOR DIRECT DOMESTIC USE OF EXTREMELY IMPAIRED SOURCES		
Section[2]	**Title**	**Summary**
		o Sewage effluent dominated surface water, o Oilfield produced water, o Water that is predominantly recycled water (unless associated with an approved drinking water-related project using groundwater replenishment or surface water augmentation), o Urban storm drainage, treated or untreated wastewater, or agricultural return water, o Products of toxic site cleanup programs. • Proposals for the use of extremely impaired sources will be considered on a case-by-case basis.
D.	Elements of an Evaluation Process for an Extremely Impaired Drinking Water Source	• DDW's evaluation process consists of a series of sequential steps • Each step should include clear, specific detailed statements of finding, interpretations, and conclusions as they relate to the goal of each step
D.1.	Elements of an Evaluation Process for an Extremely Impaired Drinking Water Source Step 1. Drinking Water Source Assessment and Contaminant Assessment	• Source Assessment o Purpose is to determine the extent to which the aquifer or surface water is vulnerable to contaminating activities in the area. Assessment should: ▪ Delineate the source water capture zones (groundwater) or watershed areas (surface water) ▪ Identify contaminant sources • Contaminant Assessment o Purpose is to provide a characterization of the contamination of soils and groundwater at and around the contamination and former contamination sites located within the long-term capture zone or watershed areas of the drinking water source. Assessment should: ▪ List known and potential drinking water contaminants (e.g., Title 22 regulated and unregulated chemicals, chemicals with NLs, chemicals in Safe Drinking Water and Toxic Enforcement Act of 1986, microbiological quality, priority pollutants, hazardous wastes, chemicals of emerging concern (CEC), et al.) ▪ Identify all contaminants with potential health effects ▪ Prepare Raw Water Quality Characterization with estimates of contaminant treatability
D.2.	Elements of an Evaluation Process for an Extremely Impaired Drinking Water Source Step 2. Full Characterization of the Raw Water Quality	• Characterize raw water quality for proper design of the treatment system. Evaluate: o Title 22 drinking water regulated and unregulated chemicals o All chemicals for which drinking water NLs are established o All chemicals listed pursuant to Safe Drinking Water and Toxic Enforcement Act of 1986 o Microbiological quality o Priority pollutants o Gross contaminant measures [total organic carbon (TOC), etc.] o Hazardous wastes and constituents in 40 CFR Part 261, including Appendices VII and VIII o CECs recommended by the SWRCB o Additional contaminants of concern from Step 1 Contaminant Assessment • Any additional contaminant detected in the raw water quality full characterization (Step 2) should be reassessed by the source and contaminant assessments in terms of that contaminant (Step 1).

APPENDIX C – SUMMARY OF DDW[1] 2015 DRAFT UPDATE OF PROCESS MEMO 97-005 FOR DIRECT DOMESTIC USE OF EXTREMELY IMPAIRED SOURCES		
Section[2]	Title	Summary
		• Determine variability of contaminant concentrations with time (seasonal and long term), pumping rate, or other variable that may change its concentration in the raw water to be treated. • List additional potential contaminants associated with the contaminating activities.
D.3.	Elements of an Evaluation Process for an Extremely Impaired Drinking Water Source Step 3. Drinking Water Source Protection	• If the use of an extremely impaired source is to be approved, the source of the contamination must be controlled to prevent the level of contamination from rising and to minimize the dependence on treatment for contaminant removal. • Best management practices for waste handling and waste reduction should be required at a minimum to control the level of contamination at its origin. • Evaluate cleanups, mitigations, and remediations within the capture zone of the source water to demonstrate releases of contaminants are not continuing. • Develop a program to protect all drinking water sources. • Include a source treatment facility at the origin of the contamination for low flow, hot spot treatment that will not be used as a domestic water source. • Monitoring between the origin of the contamination and the drinking water source should be conducted (e.g., monitoring well(s)) to determine the level of contamination, to reasonably assure that the contamination level will not increase at extraction/production wells.
D.4.	Elements of an Evaluation Process for an Extremely Impaired Drinking Water Source Step 4. Effective Treatment and Monitoring	• Treatment o Submit a treatability assessment for all contaminants projected to be at the extraction/production well(s). o Treatment of the extremely impaired source prior to direct domestic water system usage must be commensurate with the degree of risk associated with the contaminants present. o Treatment shall use best available treatment technology defined for the contaminant(s) by the Environmental Protection Agency or DDW and have reliability features consistent with the type and degree of contamination. o Treatment processes must be optimized to reliably produce water that contains the lowest concentration of contaminants feasible at all times. o Entire flow from the extremely impaired source must pass through the complete treatment process(es) unless a reasonable alternative is available. o Any water from other sources available for blending prior to entry into the distribution system should be used to provide an additional safety factor. o Multi-barrier treatment is a set of independent treatment processes placed in series, and designed and operated to reduce the levels of a contaminant. Each barrier should effectively reduce the contaminant by a significant fraction of the total required reduction. Treatment processes should address all contaminants of public health concern in an extremely impaired source. Multi-barrier treatment may be appropriate when: ▪ Primary treatment is not sufficiently reliable, ▪ Primary treatment is of uncertain effectiveness, ▪ There is no direct way to measure the contaminant (e.g., pathogenic microorganism), ▪ Health effect of the contaminant is acute, and/or ▪ Very large reductions in contaminant concentration are required. o Where there is a regional or basin-wide contaminant (e.g. nitrates or TDS) not coming from contamination areas, blending with another source not involved in the cleanup may be considered.

APPENDIX C – SUMMARY OF DDW[1] 2015 DRAFT UPDATE OF PROCESS MEMO 97-005 FOR DIRECT DOMESTIC USE OF EXTREMELY IMPAIRED SOURCES		
Section[2]	Title	Summary

		• Monitoring
		  o More extensive monitoring in terms of frequency of testing and numbers of contaminants will likely be required for use of an extremely impaired source than is associated with typical drinking water sources.
		  o Detection and reporting limits should be as low as practicable.
		  o Testing for regulated drinking water contaminants must use drinking water analytical methods.
		  o Supplemental monitoring wells are typically required to provide an early warning of unexpectedly high concentrations or new contaminants moving towards the extraction/production wells. A water quality surveillance plan including specific monitoring well locations and a sampling and analysis plan.
		  o Submit a sampling and analysis plan for the drinking water source and at appropriate locations in the treatment plant as well as for the plant effluent.
		• Treatment and Monitoring Program Proposal should include:
		  o Performance standards (using a field measurable indicator of treatment efficiency):
		    ▪ Identify level to assure compliance with the treatment objective,
		    ▪ Treatment objective for all contaminants should be optimized to the lowest extent feasible and must assure compliance with the MCL at all times.
		    ▪ Treatment should be optimized to reduce unregulated contaminants below NLs
		    ▪ Facilities for treating water containing specific contaminants for which the MCL is higher than the public health goal (PHG) should be designed and operated to meet the PHG where this can be accomplished in a cost-effective manner.
		  o Operations plan:
		    ▪ Identify all operational procedures, failure response triggers, and loading rates, and include a process monitoring plan, process optimization procedures, established water quality objectives or goals, level of operator qualification, and frequent inspections of equipment.
		  o Reliability features:
		    ▪ Response Plan for failure to meet the treatment objective,
		    ▪ Alternative disposal methods,
		    ▪ Shutdown triggers and restart procedures.
		  o Compliance monitoring and reporting program
		  o Notification plan
		  o Surveillance plan that includes water quality monitoring between the origin of the contamination and the extremely impaired source proposed for use as drinking water.
		• DDW Staff Evaluation of Treated Water Objectives or Goals
		  o Describes DDW's methodology for evaluating the treatment objectives or goals of the combined effluent of the proposed facility to ensure the cumulative risk of multiple contaminants under normal operation has been reasonably addressed (for details see 2015 Draft Update of 97-005 Memo, part 4.d)
		    ▪ Use of MCL-Equivalents to Evaluate Treated Water Goals
		    ▪ Detection Limits for Reporting (DLRs) Limit the Required Levels of Treatment
		    ▪ Consideration of Background Credit for Naturally-Occurring Contaminants

APPENDIX C – SUMMARY OF DDW[1] 2015 DRAFT UPDATE OF PROCESS MEMO 97-005 FOR DIRECT DOMESTIC USE OF EXTREMELY IMPAIRED SOURCES		
Section[2]	Title	Summary
D.5.	Elements of an Evaluation Process for an Extremely Impaired Drinking Water Source Step 5. Human Health Risks Associated with Failure of Proposed Treatment	• Treatment technologies are not failure-proof, and insufficiently treated or untreated water may, on occasion, pass through the treatment process and into the distribution system. An assessment must be performed that includes: o Evaluation of the risks of failure of the proposed treatment system. ▪ Proposed treatment system must be evaluated in terms of its probability to fail, thereby exposing customers to insufficiently-treated or untreated drinking water from the extremely impaired source. o Assessment of potential health risks associated with failure of the proposed treatment system. Health assessment must take into account: ▪ Duration of exposure to contaminated drinking water that would result from such a failure ▪ Human health risks associated with such exposure to insufficiently treated or untreated water over the course of that failure, considering the risks of disease from microbiological organism, and the risks of acute and chronic effects (including non-cancer and cancer risks) from chemical contaminants ▪ Potential cumulative risks, due to multiple failures ▪ When risks of adverse health effects from treatment failure are not acceptable, then additional treatment safeguards must be used for the protection of public health, or the proposal must be rejected by DDW.
D.6.	Elements of an Evaluation Process for an Extremely Impaired Drinking Water Source Step 6. Completion of CEQA	• Complete California Environmental Quality Act (CEQA) review of the project.
D.7.	Elements of an Evaluation Process for an Extremely Impaired Drinking Water Source Step 7. Submittal of Permit Application	• Public water system(s) collecting, treating and distributing water from the extremely impaired source must submit a permit application for the use of the extremely impaired source that includes the items identified in steps 1-6.
D.8.	Elements of an Evaluation Process for an Extremely Impaired Drinking Water Source Step 8. Public Hearing	• Hold a public hearing to identify concerns of consumers who will be served water from the extremely impaired source and to assure that all parties have a chance to provide relevant information. • Early public outreach activities are strongly recommended.
D.9.	Elements of an Evaluation Process for an Extremely Impaired Drinking Water Source Step 9. DDW Evaluation	• DDW staff will conduct an evaluation of the application and make recommendations.
D.10.	Elements of an Evaluation Process for an Extremely Impaired Drinking Water Source	• DDW must make the following findings for approval to use an extremely impaired source:

APPENDIX C – SUMMARY OF DDW[1] 2015 DRAFT UPDATE OF PROCESS MEMO 97-005 FOR DIRECT DOMESTIC USE OF EXTREMELY IMPAIRED SOURCES		
Section[2]	Title	Summary
	Step 10. Requirements for DDW Approval	o Drinking water MCLs and action levels for lead and copper, and NLs will not be exceeded if the permit is complied with, and o The potential for human health risk is minimized by treatment and the risk from treatment failure is minimized through good engineering practices that may involve redundancies in treatment, and efficiencies in maintenance, inspections, monitoring and alarms.
D.11.	Elements of an Evaluation Process for an Extremely Impaired Drinking Water Source Step 11. Issuance or Denial of Permit	• DDW either issues a permit or denies a permit for the use of the extremely impaired source. If a permit is issued, it must include all necessary treatment, compliance monitoring, operational, and reporting requirements.

[1] State Water Resources Control Board (SWRCB), Division of Drinking Water (DDW)

[2] For reference, section numbers and titles are from the 2015 Draft Update of 97-005 Process Memo.

Note: This summary is not intended to be a substitute for DDW's actual Policy Memo 97-005 "Policy Guidance for Direct Domestic Use of Extremely Impaired Sources" dated November 5, 1997, [by Department of Health Services at that time] or DDW's Draft Update of 97-005 Process Memo "Addressing the Direct Domestic Use of Extremely Impaired Sources" dated March 25, 2015.

Appendix D: Unit Costs Assumptions

Construction Cost Criteria

AWPF	Cost	Unit	Notes
AWPF with MBR	$8.30	GPD	Incl modifying exist BNR basins
AWPF with RO-AOP Only	$7.00	GPD	RP-5 MBR facility constuct by others
AWPF with MF	$8.10	GPD	
Offsite AWPF (with MF)	$8.91	GPD	
MVWD In-Kind (Plant 28)	$2,000,000	Each	Incl modifying exist BNR basins
RPU Contribution	$20,000,000	Each	

Pipeline			Cost	Unit	Notes
Open Cut					
- Range(in):	0	14	$24	Inch*LF	
- Range(in):	16	20	$22	Inch*LF	
- Range(in):	24	60	$19	Inch*LF	
Jack and Bore			$60	Inch*LF	
- Launch/Receiving Pit			$40,000	Each	
Horizontal Direction Drill			$90	Inch*LF	

Turnout/Connections	Cost	Unit	Notes
Connection to Existing MWD Turnou	$500,000	Each	
Construct New MA Turnout	$500,000	Each	

Pumping Station	Cost	Unit	Notes
Booster Pump Station	$5,000	HP	Includes Standby Capacity

Extraction Well	Cost	Unit	Notes
Development	$1,900,000	Each	
Equipping and Building	$600,000	Each	

Injection Well	Cost	Unit	Notes
Development	$1,500,000	Each	
Equipping and Building	$500,000	Each	

Monitoring Well	Cost	Unit	Notes
Development	$750,000	Each	

Wellhead Treatment	Cost	Unit	Notes
IX - Single Pass	$1.52	GPD	
IX - Regenerable	$2.08	GPD	Assume ISEP
Air Stripping	$0.69	GPD	includes gas phase GAC
Liquid Phase GAC	$1.04	GPD	
Reverse Osmosis	$0.94	GPD	
AOP	$2.43	GPD	
Biological	$1.83	GPD	

Pump Back Treatment	Cost	Unit	Notes
Central Treatment	$0	GPD	
CVWD Contribution	$10,000,000	Each	

MWD Wheeling Charge	Cost	Unit	Notes

NRW Disposal	Cost	Unit	Notes
NRWSCU Purchase Rate	$4,172	CU	

Water Storage Tanks/ Equalization	Cost	Unit	Notes
Welded Steel Tank	$1.30	Gal	
EQ Basin Modifications	$50,000	Each	

Recharge Basin Improvements	Cost	Unit	Notes
Misc Improvements	$25,000	Each	

Land Acquisition	Cost	Unit	Notes
Land Acquisition	$750,000	Ac	Excludes RP-1, RP-4, and Plant #28

O&M Annual Cost Criteria

AWPF	Cost	Unit	Notes
MBR - Power	1.25	kWh/1000 Gal	
MBR - Power - BNR Air	1.42	kWh/1000 Gal	
MBR - Chemicals	$0.01	$/1000 Gal	
MBR - Membrane Replacement	$0.30	$/1000 Gal	
AWPF - Power (MF-RO-AOP)	2.52	kWh/1000 Gal	
AWPF - Chemicals (MF-RO-AOP)	$0.42	$/1000 Gal	
AWPF - Consumables (MF-RO-AOP)	$0.21	$/1000 Gal	
AWPF - Power (RO-AOP)	2.28	kWh/1000 Gal	
AWPF - Chemicals (RO-AOP)	$0.32	$/1000 Gal	
AWPF - Consumables (RO-AOP)	$0.12	$/1000 Gal	

Pipeline	Cost	Unit	Notes
Pipeline Maint and Monitoring	$5,000	$/Mile	

Turnout/Connections	Cost	Unit	Notes
Maint and Monitoring	1%	% Construction	

Pumping Station	Cost	Unit	Notes
General	3%	% Construction	

Extraction Well	Cost	Unit	Notes
General O&M	$30,000	Each	

Injection Well	Cost	Unit	Notes
General O&M	$30,000	Each	

Monitoring Well	Cost	Unit	Notes
General O&M	$10,000	Each	

Wellhead Treatment	Cost	Unit	Notes
IX - Single Pass	$0.22	$/1000 Gal	
IX - Regenerable	$0.34	$/1000 Gal	
Air Stripping	$0.20	$/1000 Gal	
Liquid Phase GAC	$0.08	$/1000 Gal	
Reverse Osmosis	$0.58	$/1000 Gal	
AOP	$0.27	$/1000 Gal	
Biological	$1.53	$/1000 Gal	

Pump Back Treatment	Cost	Unit	Notes
Pump Back Treatment O&M	$0.00	$/1000 Gal	

MWD Wheeling Charge	Cost	Unit	Notes
Annual Pre-delivery amount	10000	AFY	
Wheeling Charge	$411	$/AFY	

NRW Disposal	Cost	Unit	Notes
Volumetric Charges	$0.94	1000 Gal	
Strength Charges - COD	$166	1000 Lbs (Dry Wt)	
Strength Charges - TSS	$470	1000 Lbs (Dry Wt)	
Agency O&M and CIP charges	$28.25	CU/Month	

Water Storage Tanks/ Equalization	Cost	Unit	Notes
Recoating	$0.02	Gal	

Recharge Basin Improvements	Cost	Unit	Notes
Misc Recharge Basin Improv.	$0	Each	

Land Acquisition	Cost	Unit	Notes
Land Acquisition	$0	Ac	

General Cost Criteria

General	Cost	Unit	Notes
Energy Cost	$0.17	kW-Hr	
Online Factor	100%	%	
Escalation	2%	%	
Financing Amortization Period	25	Years	
Financing Discount Rate	3%	%	
Mid-Point of Construction	2024	Year	
PUT Year Delivery	15,000	AFY	
TAKE Year Delivery	50,000	AFY	

Markups	Cost	Unit	Notes
Contigency	30%	%	
Engineering, Admin, CM	28%	%	