Inland Empire

Brine Line Master Plan

DECEMBER 2024

Prepared for:

SANTA ANA WATERSHED PROJECT AUTHORITY
11615 Sterling Avenue
Riverside, CA 92503
Contact: David Ruhl, P.E., Executive Manager of Engineering and Operations

Prepared by:

DUDEK
605 Third Street
Encinitas, California 92024
Contact: Michael Metts, PE, Project Manager

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Acknowledgements

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Santa Ana Watershed Project Authority (SAWPA)

Jeff Mosher
General Manager

David Ruhl, P.E.
Executive Manager of Engineering and Operations

Dudek

Michael Metts, P.E.
Project Manager

Elizabeth Caliva, P.E.
Lead Engineer

Greg Guillen, P.E., PhD
Treatment Specialist

Shannon Brown, P.E.
Senior Engineer

Jenny Li, EIT
Project Engineer

Acronyms and Abbreviations

Acronym/Abbreviation	Definition
afy	acre-feet per year
ac	acre
BOD	Biological Oxygen Demand
CDA	Chino Basin Desalter Authority
CIP	Capital improvement Program
CoFA	Consequence of Failure Analysis
d/D	depth to diameter ratio
DPR	Direct Potable Reuse
EDR	electrodialysis reversal
EMWD	Eastern Municipal Water District
EOX	Electro-oxidation
EPA	United States Environmental Protection Agency
EPS	extended period simulation
FM	flow monitor or flow meter
FO	Forward Osmosis
fps	feet per second
FRP	fiberglass reinforced pipe
FRRO	Flow Reversal Reverse Osmosis
GAC	granular activated carbon
GIS	Geographic Information System
gpd	gallons per day
HDPE	high density polyethylene
HMI	Human Machine Interface
ICARP	Integrated Climate Adaptation and Resiliency Program
i.e.	that is
IEUA	Inland Empire Utilities Agency
I/I	inflow and infiltration
IPR	Indirect Potable Reuse
IRWM	Integrated Regional Water Management
JCSD	Jurupa Community Services District
kWh	kilowatt-hour
LF	Lineal feet
MAS	maintenance access structures
MD	Membrane Distillation
MG	million gallons
MGD or mgd	million gallons per day
mg/l	milligrams per liter
NAS	Novel Adsorbent System
ng/l	nanograms per liter
O&M	operation and maintenance

Acronym/Abbreviation	Definition
OC San	Orange County Sanitation District
OCWD	Orange County Water District
OWOW	One Water One Watershed
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutane sulfonic acid
PFHxS	perfluorohexane sulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonic acid
PLC	Programmable Logic Controller
PoFA	Probability of Failure Analysis
ppt	parts per trillion
psi	pounds per square inch
PVC	polyvinyl chloride
PWWF	peak wet weather flow
RCP	reinforced concrete pipe
RCSD	Rubidoux Community Services District
RCWD	Rancho California Water District
RO	reverse osmosis
RTU	Remote Terminal Unit
SARI	Santa Ana River Interceptor
SARW	Santa Ana River Watershed
SAWPA	Santa Ana Watershed Project Authority
SBVMWD	San Bernardino Valley Municipal Water District
SCADA	Supervisory Control and Data Acquisition
SCWO	supercritical water oxidation
SMS	SARI Metering Station
SWRP	Stormwater Resource Plan
TDS	Total Dissolved Solids
TMDL	total maximum daily load
TSS	Total Suspended Solids
UNK	unknown
VCP	vitrified clay pipe
WMWD	Western Municipal Water District
WWTP	Wastewater Treatment Plant
YVWD	Yucaipa Valley Water District
yr	year

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Executive Summary

This Executive Summary provides highlights from the Brine Line Master Plan report, summarizing the key findings and recommendations of each section. The Executive Summary consists of the following sections:

- Key Project Objectives
- Service Area and System Overview
- Market Research & Future Flow Projections
- Brine Line Hydraulic Model Development and Calibration
- Brine Line Capacity Analysis
- Capacity Management & Long-Term Planning Efforts
- Brine Line Multi-Use Benefits
- Future Facilities, Improvements & Expansion
- Policy Considerations

ES-1 Project Purpose and Objectives

The purpose of this master plan is to identify the current capacity of the Brine Line system under a variety of anticipated flow conditions, identify system deficiencies, develop near- and long-term system improvements to address identified deficiencies, as well as update and calibrate the existing SAWPA Brine Line hydraulic model. In addition, the project identifies potential capacity management activities that SAWPA may implement to maximize regional use of the Brine Line, over time. The project also identifies existing dischargers and the potential regional market for future dischargers.

The primary objectives of this project include management and implementation of needed improvements to support ongoing growth and expansion of the Brine Line, in a manner that best serves the Santa Ana Watershed, SAWPA Member Agencies, and Brine Line dischargers. The project also has the objective of addressing facility and infrastructure needs to convey and manage increasingly higher salinity discharges, as well as increasing regulatory requirements.

This Brine Line Master Plan report, prepared by Dudek for the Santa Ana Watershed Project Authority (SAWPA), evaluates the current operation and capacity of the Inland Empire Brine Line (Brine Line) system. It also makes strategic recommendations for future system improvements. This report aims to ensure that the Brine Line continues to meet the evolving needs of the Santa Ana Watershed by identifying capacity constraints, system deficiencies, and proposing enhancements to support future growth and regulatory requirements.

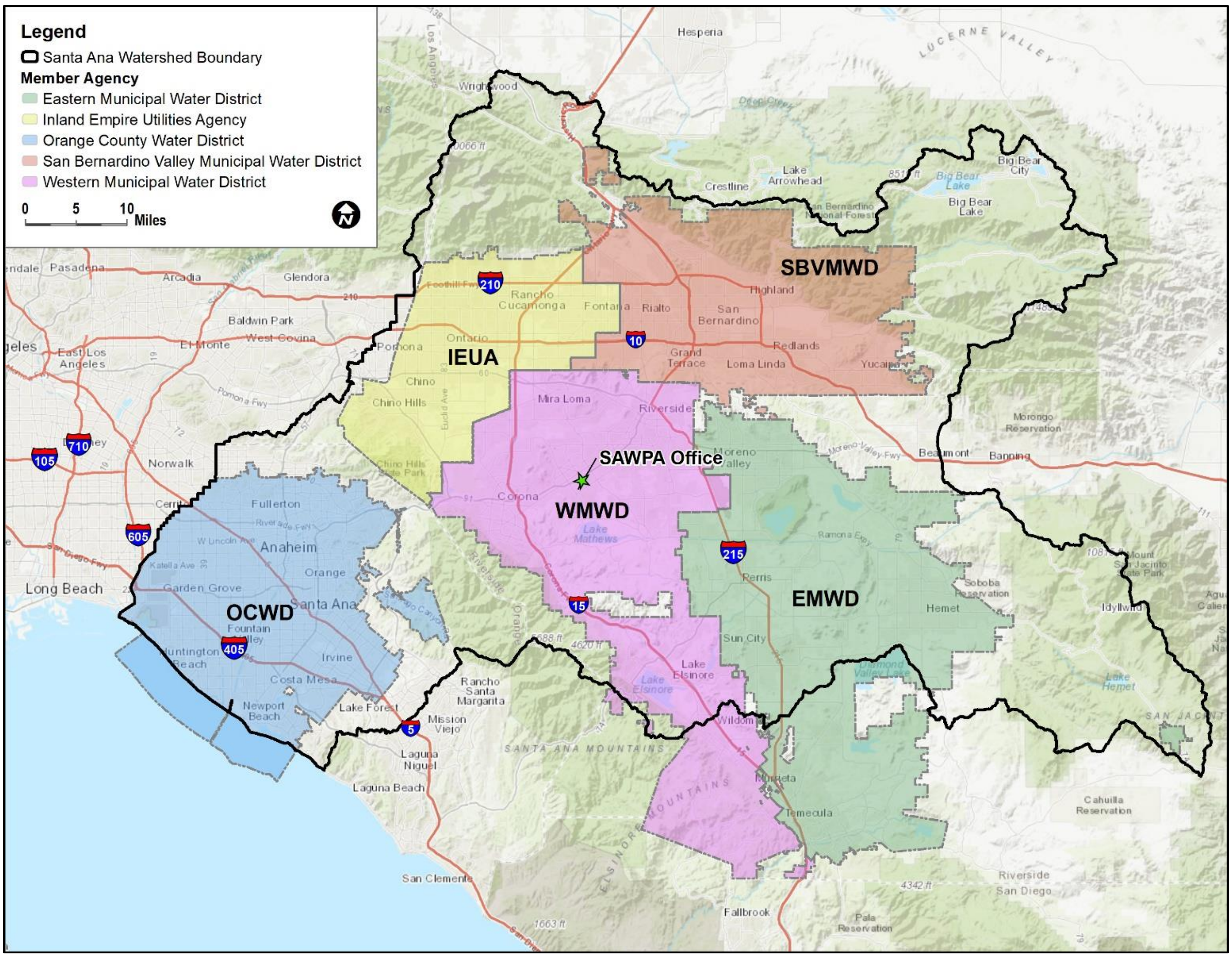
ES-2 Service Area and System Overview

The Brine Line network spans approximately 72 miles of pipelines with diameters ranging from 12 to 48 inches. It is segmented into various reaches: IV, IV-A, IV-B, IV-D, IV-E, and V. These segments collectively transport wastewater downstream to the Orange County Sanitation District (OC San) operated Santa Ana River Interceptor (SARI), which extends an additional 21 miles before discharging to OC San Treatment Facility No. 2 (Plant No. 2) in Huntington Beach before being released into the Pacific Ocean.

SAWPA's Member Agencies, including the Eastern Municipal Water District (EMWD), Inland Empire Utilities Agency (IEUA), San Bernardino Valley Municipal Water District (SBVMWD), and Western Municipal Water District (WMWD), have established capacity rights within the Brine Line. The Orange County Water District (OCWD), the fifth Member Agency, does not hold any capacity rights. Additionally, the Chino Basin Desalter Authority (CDA) has ownership within the system.

Figure ES-1 illustrates the geographical diversity of the Brine Line system service area. The system encompasses a large geographical area, extending from Orange County on the west, to San Bernardino County in the northeast, and to Riverside County to the southeast. The system is a 72-mile, gravity-pressure system; portions of the system convey flows under pressure flow and other portions are gravity flow, incorporating a variety of maintenance access structures (MASs) and other required appurtenances.

Figure ES.1 Service Area Boundary



ES-3 Market Research & Future Flow Projections

This Master Plan provides a comprehensive evaluation of the Brine Line system, detailing current and projected future brine discharges. The analysis draws on data from workshops conducted with various stakeholders and examines the capacity and requirements of the system to handle future growth and regulatory changes. At present, brine flows are identified by the following categories:

- Potable Water Production Facilities (Groundwater Desalters): 78-percent of total flow
- Industrial Dischargers (e.g., food processing, laundries): 11-percent of total flow
- Desalination of Recycled Water: 4-percent of total flow
- Power Generation: 4-percent of total flow
- Domestic Wastewater: 3-percent of total flow

Between February 2023 and April 2024, SAWPA conducted a series of workshops with its Member Agencies and other large dischargers. The workshops were developed to verify existing Brine Line discharges, as well as identify potential future discharges planned by the various agencies. The data was used to project the maximum anticipated discharge to the Brine Line, thereby evaluating the system's capacity to manage those projected flows. Future discharge scenarios are developed for different time frames, including:

- Existing Discharge Analysis (June 2023)
- Near-Term Discharge Analysis (2024 to 2034, 10 years)
- Long-Term Discharge Analysis (2035 to 2049, 25 years)
- Build-Out Discharge Analysis (beyond 2049)

The Brine Line system has a contractual hydraulic capacity of 30 million gallons per day (mgd) with OC San. At present, the combined pipeline capacity of the Member Agencies is 32.57-mgd, and the current treatment capacity is 17-mgd. Key findings with respect to existing and projected Brine Line discharges include:

- Western Municipal Water District (WMWD): Projected ultimate future discharge of 16.1-mgd, exceeding its ownership capacity by approximately 5.0-mgd.

- Inland Empire Utilities Agency (IEUA): Projected ultimate future discharge of 1.9-mgd, well within its ownership capacity of 4.1-mgd.

- Chino Basin Desalter Authority (CDA): Current and future discharges are expected to match its ownership capacity of 3.7-mgd.

- San Bernardino Valley Municipal Water District (SBVMWD): Projected ultimate future discharge of 4.9-mgd, within its ownership capacity of 7.7-mgd.

- Eastern Municipal Water District (EMWD): Projected ultimate future discharge of 5.2-mgd, slightly under its ownership capacity of 5.9-mgd.

- Treatment Capacity: The current average discharge to the Brine Line is 13.5-mgd, with a maximum measured flow of 17.75-mgd. The maximum flow exceeds the available treatment and disposal capacity of 17.0-mgd.

- Capacity Management: Dischargers will need to reduce maximum flows and manage discharges more consistently to stay within their allocated capacities.
- Future Investments: Additional treatment and disposal capacity will be required to accommodate future growth. It is projected that further capacity purchases will be needed in 2034, 2042, and 2051.

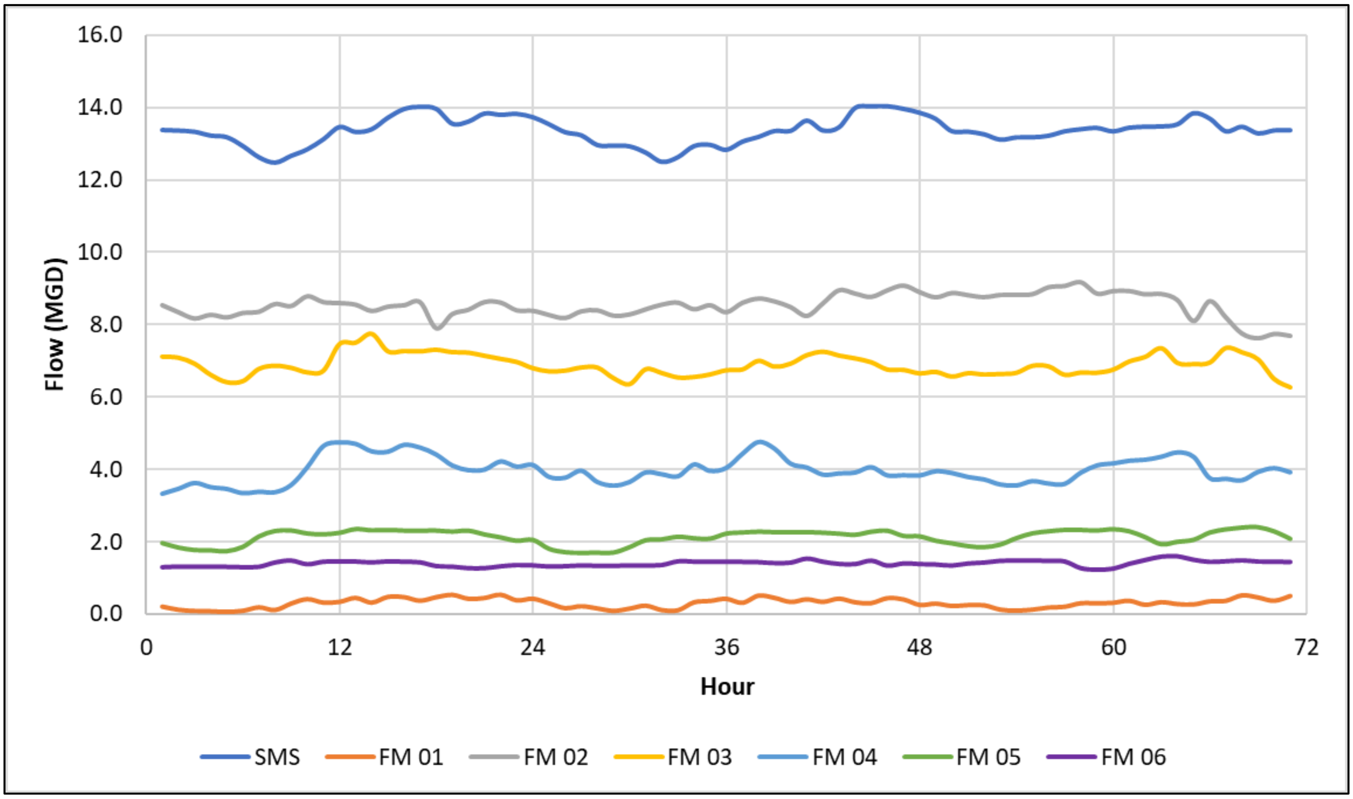
The Brine Line system is projected to handle increasing discharges up to a maximum of 33.5-mgd at buildout. Strategic management and investment in additional treatment capacity are essential to ensure compliance with regulatory limits and to support future growth. The workshops provided valuable insights into future needs, enabling a proactive approach to capacity planning and system upgrades.

ES-4 Brine Line Hydraulic Model Development and Calibration

As part of the Brine Line master plan and hydraulic model development, flow monitoring was performed throughout the Brine Line system to evaluate system capacity and to calibrate the existing InfoSWMM hydraulic model. To evaluate the overall system capacity and performance, the existing Brine Line system was subdivided into smaller calibration reaches. Those calibration reaches were then used in conjunction with extended-period flow monitoring to provide field data for hydraulic model validation and calibration. Flow monitoring was performed by ADS Environmental at six (6) selected locations between the dates of June 1 and June 15, 2023. Flow metering was used to develop basin-specific data for model validation and calibration.

Based on review of the flow monitoring data, it was determined that flows were highest at the SARI Metering Station (SMS) from June 7 through June 9, 2023. Therefore, that same 72-hour period was used for each of the monitoring locations to establish a conservative estimate of the basin's flow patterns. Concurrent flow data from each Brine Line discharger was collected and used to coincide with this same 72-hour monitoring period, which is discussed more in Section 4.3. Figure ES-2 presents the six (6) 72-hour flow patterns developed for each monitoring location and used for calibration of the Brine Line model.

Figure ES-2 72-Hour Flow Meter Brine Line Calibration Flow Curves



Flow data was collected for each discharger coinciding with the Brine Line flow monitoring period of June 1 through June 15, 2023 (refer to Section 4.1 for more information on the Flow Monitoring Program). Each discharger's flow was incorporated into the model at the specific discharge location on the Brine Line, including the average flow associated with the 2-week monitoring period. The same 72-hour period (June 7 through June 9, 2023), previously used to develop diurnal patterns for the six flow monitoring locations, were used to develop unique diurnal patterns for each discharger. In this manner, there is consistency between the flow monitoring and discharge data for the calibration process.

Average discharger flow and 72-hour diurnal patterns were incorporated into the hydraulic model, and extended period simulations were executed over a 7-day modeling analysis period. Flow values and patterns at each of the seven flow monitoring locations were compared to the modeling analysis results. Model calibration is achieved by observing average flow values at the six monitoring locations and adjusting the 72-hour flow patterns, as necessary, to achieve a consistent result between the average and maximum flow values and patterns between the model and the flow monitoring results. The hydraulic model is deemed to be "calibrated" when both average and maximum model predictions reflected field measurements with 10% or less. The following **Table ES-1** summarizes the results of the calibration process for each calibration reach.

Table ES-1: Model Calibration Results

Flow Meter	Calibration Results					
	Average Flows			Maximum Flows		
	Measured (mgd)	Modeled (mgd)	% Diff	Measured (mgd)	Modeled (mgd)	% Diff
SMS	13.34	13.53	1.4	14.02	14.99	6.9
FM 01	0.31	0.30	3.9	0.53	0.56	6.8
FM 02[1]	8.53	6.77	20.6	9.17	7.35	19.9
FM 03	6.87	6.48	5.8	7.74	7.54	2.5
FM 04	3.98	3.71	6.9	4.76	4.54	4.6
FM 05[2]	2.13	1.75	17.5	2.41	2.08	13.4
FM 06	1.40	1.46	3.9	1.60	1.70	6.5

Notes:
FM = flow meter
[1] The sum of the averages of FM 01, 02 and 03 should be approximately equal to the average flow at the SMS. The sum of the measured averages equal 15.7-mgd, while the sum of the modeled averages equal 13.5-mgd. Therefore, it was determined that the flow meter at FM 02 was measuring inaccurately.
[2] The calibration of FM 05 was reviewed and determined that FM 05 was also measuring inaccurately. Both the upstream (FM 06) and downstream (FM 04) flow data calibrated well.

It is noted that two of the six flow monitoring locations (FM 02 and FM 05) did not calibrate within the desired 10 percent accuracy. Section 4.2.3 provides more information on the calibration process for the hydraulic model and what investigation of the data found as two why FM 02 and FM 05 modeled versus measured flows did not result in values within 10 percent.

The updated and calibrated InfoSWMM hydraulic model provides a reliable tool for simulating the Brine Line system's hydraulic performance. The model accurately reflects average and maximum flow conditions, allowing for effective capacity analysis and system planning. The identified discrepancies and subsequent adjustments underscore the importance of continuous monitoring and validation to maintain model accuracy. This calibration effort ensures that the Brine Line system is well-prepared to handle current and future demands.

ES-5 Brine Line Capacity Analysis

The Brine Line system Capacity Analysis evaluates the hydraulic capacity of the Brine Line under multiple discharge scenarios, including Existing, Near-Term, Long-Term, Buildout, and Ownership conditions. This analysis, based on the updated and calibrated Brine Line hydraulic model, identifies potential system deficiencies, and informs future infrastructure improvements to ensure reliable service and accommodate increasing discharge demands. Key findings of the Capacity Analysis include:

<u>Design Criteria</u>

- Gravity pipelines are intended to maintain a minimum velocity of 2.0 feet per second (fps) during maximum discharge to ensure self-cleaning and prevent solids deposition.

- The maximum depth-over-diameter ratio (d/D) for gravity pipelines is set at 0.75 to provide sufficient headspace for inflow and infiltration (I/I) during wet weather events. While there is currently no indication of I/I issues currently in the system, these issues may arise as the system ages.
- Pressurized pipelines have maximum pressure limits of 80 pounds per square inch (psi) for Reach V and 55 psi for the top of Reach IV-E.

Existing Discharge Capacity (June 2023)

- All gravity flow pipelines maintained a d/D below 0.75.
- Maximum pressure in Reach V was 56 psi, and in the top of Reach IV-E, it was 6 psi.
- Pipeline velocities met or exceeded 2.0 fps, except in specific low-flow segments, which are expected to improve with increased future flows.

Near-Term Discharge Capacity (2023-2033)

- No gravity pipelines are anticipated to exceed a d/D of 0.75.
- Maximum pressures remain within acceptable limits.
- Increased flows result in higher velocities, meeting the minimum 2.0 fps threshold.

Long-Term Discharge Capacity (2034-2058)

- Portions of Reaches IV-D, IV-A, and IV are projected to exceed the 0.75 d/D criterion, with some sections expected to flow at full capacity (d/D of 1.0).
- Maximum pressures and velocities remain within design limits, though closer to thresholds.

Buildout Discharge Capacity (Beyond 2058)

- Additional segments are expected to exceed the 0.75 d/D criterion, with increased risks of surcharging and overflows.
- Higher flows necessitate potential infrastructure improvements to prevent system deficiencies.

Ownership Discharge Capacity

- Similar to Long-Term and Buildout scenarios, specific segments are projected to exceed the d/D criterion, requiring monitoring and potential upgrades.
- Maximum pressures and velocities remain within acceptable ranges but approach critical limits.

To address the identified capacity issues and ensure the Brine Line can accommodate future discharge demands, the following improvements re anticipated, including:

- The 36-inch fiberglass reinforced pipe (FRP) pipeline along Prado Dam should be upsized to 48 inches and relocated to prevent surcharging and overflow risks.

- Implement smart manhole covers for real-time monitoring of critical segments to proactively manage and mitigate potential overflows and system failures.

ES-6 Capacity Management & Long-Term Planning Efforts

In 2021, Dudek performed a criticality analysis of the Brine Line system, spanning over 73 miles and composed of various materials such as lined reinforced concrete, PVC, and HDPE. The Brine Line, which uses both open channel and gravity pressure flow conditions, is equipped with maintenance access structures to ensure operational efficiency. The objective of the analysis was to identify and prioritize critical components within the system, guiding SAWPA's financial policy decisions and prioritizing asset maintenance and capital improvement projects (CIP).

To improve system reliability and reduce impacts on dischargers during outages, SAWPA is investigating the construction of off-line storage reservoirs. The proposed plan includes seven reservoirs, capable of storing a minimum of 8-hours of Brine Line flow, strategically spaced throughout the system. These reservoirs would facilitate Brine Line shutdowns for maintenance and provide additional system capabilities, such as capturing dry weather stormwater flows and potentially supporting future brine minimization efforts.

To enhance monitoring and control of the Brine Line system, SAWPA is proposing the implementation of a Supervisory Control and Data Acquisition (SCADA) based system. This system would provide remote, automated flow and water quality data collection, reducing staff time and improving compliance efforts. The SCADA system concept includes Remote Terminal Units (RTUs), communication infrastructure, a SCADA master station, a data historian, alarm management, and security features.

With projected tributary flows expected to exceed the 30-mgd discharge limitation to OC San by approximately 2065, SAWPA is exploring brine minimization strategies. These include potential implementation of secondary brine concentration processes at groundwater desalination facilities and advanced treatment technologies like Flow Reversal Reverse Osmosis (FRRO) and Ceramic Membrane with Electrodialysis Reversal (EDR).

As regulatory pressure for per- and polyfluoroalkyl substances (PFAS) management intensifies, SAWPA is evaluating various treatment processes to remove PFAS from the Brine Line, including Novel Adsorbent Systems, Electro-oxidation, and Granular Activated Carbon. The assessment recommends conducting a pilot study and collecting water samples from individual dischargers to better understand and manage PFAS concentrations.

ES-7 Multi-Use Benefits for the Future

SAWPA remains dedicated to conducting its regional activities in a manner that supports the Santa Ana Watershed and its communities. The One Water One Watershed (OWOW) program is a testament to this commitment, promoting integrated water resource management and supporting multi-benefit projects to ensure watershed sustainability. As part of California's Integrated Regional Water Management (IRWM) Program, OWOW emphasizes collaborative planning and management across various disciplines, including water supply, water quality, stormwater management, and habitat protection. It particularly addresses the needs of Disadvantaged Communities and Native American tribal communities.

SAWPA's Roundtables facilitate joint water resource management and regulatory compliance, creating value through stakeholder collaboration and cost-effective solutions to water management challenges. Recent environmental challenges, such as climate change and prolonged droughts, underscore the importance of SAWPA's initiatives. Projects like the 2020 feasibility study on cloud seeding for increasing water supply in the Santa Ana River Watershed exemplify SAWPA's innovative approach to regional water resiliency.

The Brine Line is a pivotal component of SAWPA's multi-use benefit system. It transports brine from desalination and water recycling facilities and regional industrial discharges to the ocean, providing an environmentally responsible and cost-effective solution for brine disposal. This system helps mitigate environmental impacts, improve water quality, and support groundwater recharge, stormwater capture, and water reuse. The Brine Line system also promotes water conservation, public awareness, and regulatory compliance, reinforcing its role as a critical multi-use benefit infrastructure.

In exploring future opportunities, SAWPA has investigated integrating renewable energy technologies within the Brine Line system, including in-pipe hydroelectric facilities and green hydrogen production from brine flows. While current feasibility indicates limited immediate opportunities for power generation, ongoing research and development could unlock future potential.

Overall, SAWPA's approach emphasizes the interconnected nature of water resources, advocating for integrated water management strategies that enhance sustainability, economic efficiency, and environmental stewardship. Through innovative projects and collaborative efforts, SAWPA aims to create a resilient, sustainable, and livable environment for the Santa Ana Watershed and its communities.

ES-8 Future Facilities, Improvements & Expansion

Chapter 8 of the Inland Empire Brine Line Master Plan focuses on future expansion opportunities, ongoing project evaluations, and the future Capital Improvement Program (CIP). This chapter highlights the critical planning and investment needed to support long-term operational needs, regulatory compliance, and strategic objectives. Key highlights include evaluation of new Brine Line management approaches:

- **Criticality Analysis**: Updates to prioritize infrastructure needs.
- **Off-Line Storage**: Reservoirs for brine storage during outages.
- **Real-Time Monitoring**: SCADA systems for enhanced system control.
- **Brine Minimization**: Advanced treatment and disposal technologies.
- **PFAS Management**: Compliance and treatment strategies.
- **Green Hydrogen**: Feasibility studies for renewable hydrogen production using brine.

Project Cost and Prioritization. Projects are evaluated based on urgency, cost-effectiveness, regulatory compliance, and environmental sustainability. Key considerations include critical infrastructure needs, operational efficiency, and regional goals. A phased approach distributes projects across:

- **Near-Term (2025–2034)**: Address immediate challenges and operational needs.
- **Long-Term (2035–2048)**: Support growth and adaptability.
- **Build-Out (Beyond 2049)**: Address long-term strategic goals.

Chapter 8 emphasizes the importance of strategic planning, regional collaboration, and phased investments to ensure the Brine Line system meets future demands. By prioritizing expansion opportunities, integrating advanced technologies, and aligning with regulatory requirements, SAWPA will secures the system's role as a critical water quality management resource for the Inland Empire well into the future.

ES-9 Policy Considerations

SAWPA is dedicated to protecting and enhancing the water resources of the Santa Ana River Watershed. Their mission involves developing and maintaining regional plans, programs, and projects that optimize the beneficial uses of the watershed in an economically and environmentally responsible manner. Key areas of focus include water supply reliability, water quality improvement, recycled water, wastewater treatment, groundwater management, brine disposal, and integrated regional planning.

As brine discharges increase, SAWPA faces the challenge of maintaining and/or expanding the Brine Line system. To address this, SAWPA is considering a variety of policy measures to improve brine management and efficiency. These policies address environmental, economic, social, and regulatory considerations to ensure sustainable and equitable brine management. Key policy areas for consideration include:

- **Environmental Policies.** SAWPA is considering enhanced monitoring and reporting capabilities for continuous monitoring of brine discharges. Limits on brine discharge concentrations and constituents may be needed, particularly with emerging concerns (i.e., PFAS). Policies are intended to promote projects that restore and protect natural habitats, mandate advanced brine treatment technologies, and support stricter permitting processes for industries discharging brine.
- **Economic Policies.** Current practices require dischargers to bear the cost of facilities necessary for brine disposal, which can be cost-prohibitive. SAWPA may consider cost-sharing mechanisms, financial assistance programs, and infrastructure investments to upgrade brine treatment facilities. Incentives for sustainable brine management practices and revised fee structures to encourage reduction in brine discharge volumes may also be explored.
- **Regulatory and Legal Policies.** Updating permitting processes to include more requirements for brine management can help control Brine Line flows. Enhancing interagency collaboration and establishing a regional task force to coordinate efforts and share best practices can improve compliance and enforcement. Policies ae intended to support innovative salinity control measures and advanced desalination or demineralization technologies.
- **Social and Community Policies.** SAWPA may establish regular forums for stakeholder engagement, including public meetings and community consultations, to educate the community about brine management issues and solutions. Policies would be intended to ensure that impacts on disadvantaged communities are considered, increasing transparency and accountability in decision-making processes.
- **Research and Development Policies.** Investing in research and development of new brine management technologies is crucial for the Brine Line's long-term viability. SAWPA could fund or cost-share research initiatives, partner with academic institutions, and invest in data collection infrastructure to support evidence-based policy making. Leveraging new technologies like remote sensing and real-time monitoring systems can enhance brine management.

Implementing these policies will assist SAWPA with ensuring sustainable brine management, protect the watershed's ecological health, and support the region's long-term water quality goals.

1 Introduction

This Brine Line Master Plan report for the Santa Ana Watershed Project Authority (SAWPA) evaluates the operation and capacity of the existing Inland Empire Brine Line (Brine Line) system and makes recommendations for future system improvements. The report was prepared by Dudek. The following section provides background information on the scope and objectives of the Master Plan project, the SAWPA Brine Line system and service area, and the contents and organization of the report.

1.1 Project Purpose and Objectives

The purpose of this master plan is to identify the current capacity of the Brine Line system under a variety of anticipated flow conditions, identify system deficiencies, develop near- and long-term system improvements to address identified deficiencies, as well as update and calibrate the existing SAWPA Brine Line hydraulic model. In addition, the project identifies potential capacity management activities that SAWPA may implement to maximize regional use of the Brine Line, over time. The project also identifies existing dischargers and the potential regional market for future dischargers.

The primary objectives of this project include management and implementation of needed improvements to support ongoing growth and expansion of the Brine Line, in a manner that best serves the Santa Ana Watershed, SAWPA Member Agencies, and Brine Line dischargers. The project also has the objective of addressing facility and infrastructure needs to convey and manage increasingly higher salinity discharges, as well as increasing regulatory requirements.

1.2 Background

SAWPA, formed in 1972, owns, plans, and operates facilities to protect water quality within the Santa Ana Watershed. **Figure 1-1** presents a regional map illustrating the extents of the watershed in Southern California. SAWPA is a Joint Powers Agency comprised of five (5) Member Agencies, including Eastern Municipal Water District (EMWD), Inland Empire Utilities Agency (IEUA), Orange County Water District (OCWD), San Bernardino Valley Municipal Water District (SBVMWD), and Western Municipal Water District (WMWD), as shown on **Figure 1-2**.

The SAWPA Brine Line accepts brine and other highly saline industrial wastewater discharges within the Santa Ana Watershed. The Brine Line is a regional facility with a pipeline capacity of 30 million gallons per day (mgd), tributary to the Orange County Sanitation District (OC San) system and ultimately to an ocean outfall. The Brine Line was constructed to dispose of high salinity wastes from groundwater desalination, power plants, and industrial users. Low initial flows resulted in allowing temporary discharges of lower salinity domestic wastewaters, increasing revenue, flow, and velocities. Removing excess salts from the watershed maintains watershed water quality, increasing groundwater resources and expanding recycled water beneficial use. The long-term regional goal achieves salt balance within the watershed, dependent on export of salt through the Brine Line system.

SAWPA and its Member Agencies conducted many studies focused on 1) understanding capabilities and conditions in the Brine Line, 2) planning future increases in high salinity discharges, and 3) planning for promulgation of new regulatory requirements affecting operation and maintenance of the Brine Line system. This master plan builds on these previous studies to provide an updated understanding of the system that addresses the current and future needs of the Brine Line. This master plan assists SAWPA, its Member Agencies, and other stakeholders in defining actions for improvement of Brine Line operation and maintenance, thereby achieving watershed-wide salt balance sustainability under multiple projected future growth scenarios.

1.3 Previous Studies

The following previous studies were reviewed as part of this study:

- Inland Empire Brine Line Criticality Assessment, March 2021, Dudek
- Inland Empire Brine Line Overflow Emergency Response Plan, March 2021, SAWPA
- Phase 1 Salinity Management Plan, January 2010, CDM/Carollo/Wildermuth
- Phase 2 SARI Planning, May 2010, CDM/Carollo/Wildermuth
- Phase 3 SARI Operations, May 2010, CDM/Carollo/Wildermuth
- Eastern Municipal Water District Brine Management System Basis of Design Report, March 2009, CDM
- Santa Ana Regional Interceptor Market Analysis, August 2009, Environmental Engineering & Contracting, Inc.
- Santa Ana Regional Interceptor Hydraulic Model and Capacity Assessment, January 2006, Kennedy/Jenks

1.4 Service Area Overview

The Brine Line is a pipeline system that protects the Santa Ana Watershed from desalter concentrates and various high saline wastewater. Industries whose processes create high-saline waste that does not qualify for reuse, reclamation or return to the region through the municipal sewer system domestic wastewater treatment plants, may be discharged to the Brine Line. The pipeline system conveys this high saline wastewater to OC San's Treatment Facility in Huntington Beach. After treatment, the high saline wastewater is discharged to the Pacific Ocean.

The Brine Line system is comprised of six reaches, extending from Orange County on the west, to San Bernardino County in the northeast, and to Riverside County to the southeast. The system has over 72 miles of pipeline, ranging in diameter, age, material, and other critical categories. The system is a gravity pressure system, such that portions of the system convey flows under pressure flow and other portions are gravity flow, incorporating a variety of maintenance access structures (MASs) and other required appurtenances. The age and materials of the system's construction have changed with time, with initial construction including lined reinforced concrete and more recent construction incorporating polyvinyl chloride (PVC) and high-density polyethylene (HDPE) pipeline materials.

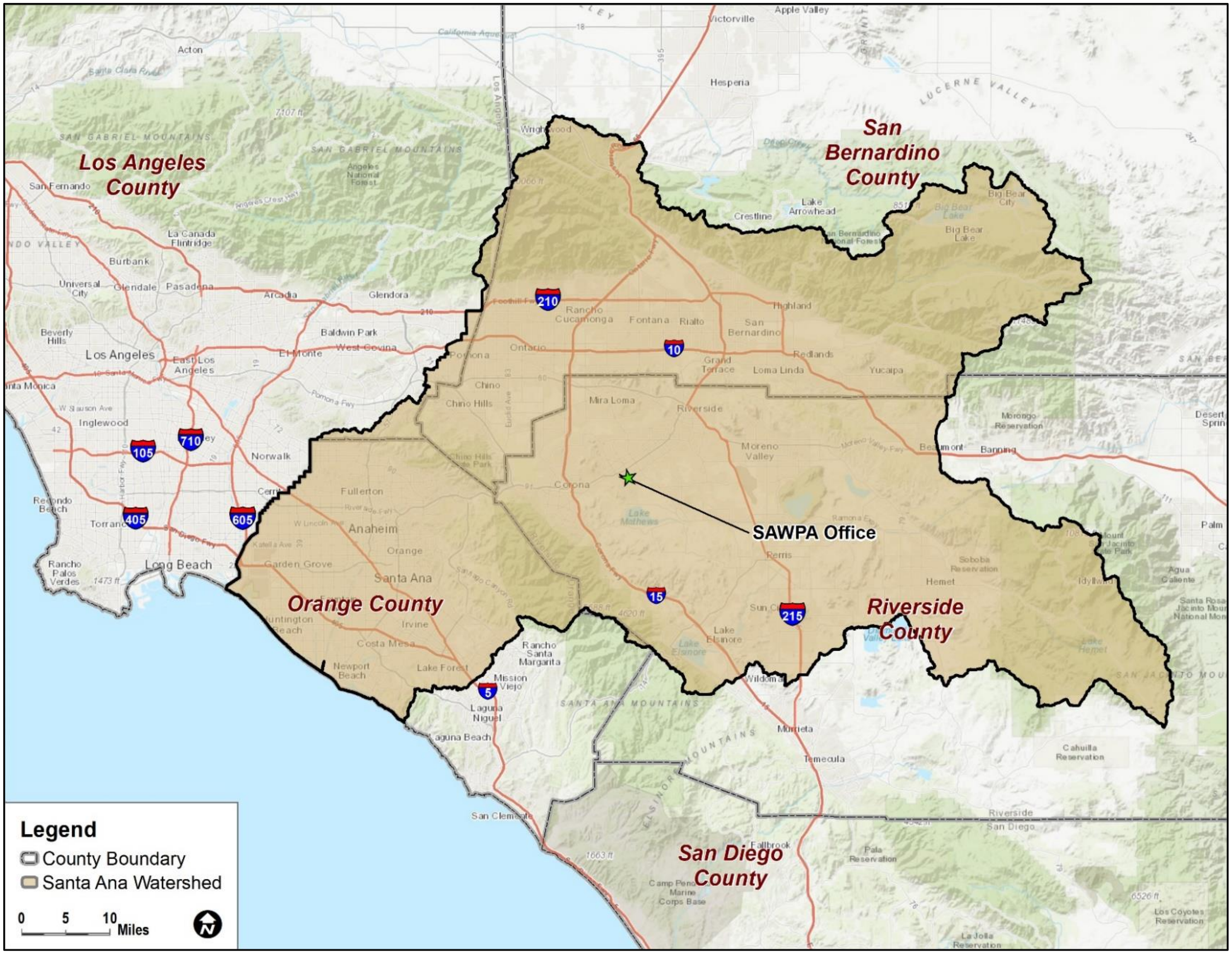


Figure 1-1 Regional Map

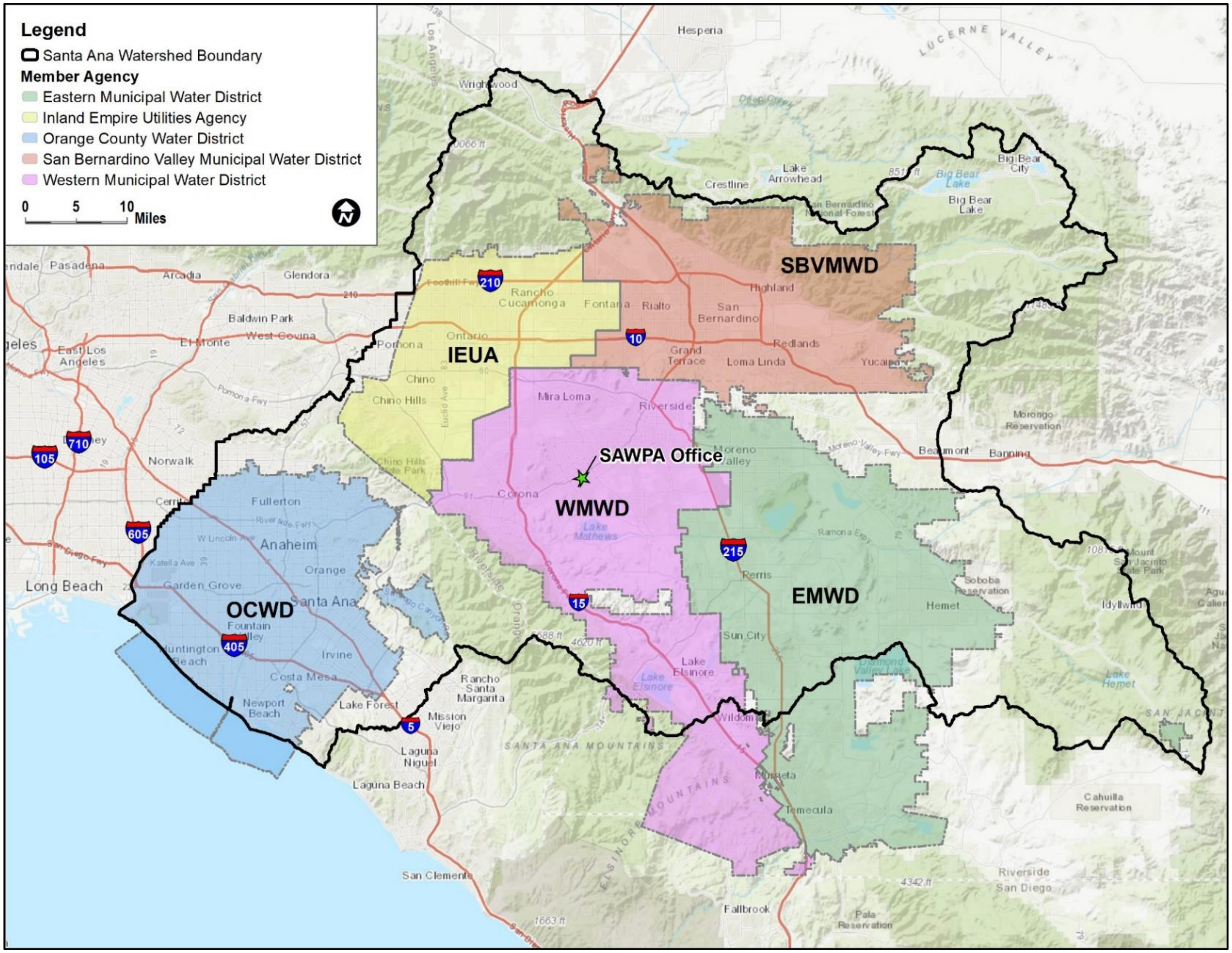


Figure 1-2 Service Area Boundary

1.5 Scope of Work

The following tasks are included in the scope of this Brine Line Master Plan:

- Data Collection and Review of Existing System
- Market Analysis and Future Growth Projections
- Flow Monitoring
- Hydraulic Model Update and Calibration
- Capacity Analysis
- Capacity Management and Long-Term Planning Efforts
- Brine Line Multi-Use Benefits
- Future Policy Considerations
- Development of CIP and Planning-Level Cost Opinion
- Report Delivery and Presentation to SAWPA Stakeholders

1.6 Report Organization

This Brine Line Master Plan report is organized into the following sections:

- Section 1 Introduction – Describes the background, objectives, scope of work, and structure of the report. Summarizes key characteristics of the Brine Line system and service area.
- Section 2 Existing System Description – Summarizes features of the existing Brine Line system including pipeline alignments, diameters, siphons, and flow characteristics.
- Section 3 Market Assessment & Future Flow Projections – Summarizes ownership capacities, anticipated growth in the Brine Line service area, and discharger loadings used to develop existing and future capacity analysis scenarios.
- Section 4 Hydraulic Model Update & Calibration – Describes updates to and calibration of the exiting Brine Line hydraulic model to recent (June 2023) flow monitoring data.
- Section 5 Brine Line System Capacity Analysis – Presents the results of the capacity analyses performed on the Brine Line system under existing, near-term, long-term, buildout, and ownership discharge conditions.
- Section 6 Capacity Management & Long-Term Planning Efforts – Summarizes potential long-term initiatives to improve management and performance of the Brine Line system, including reliability and redundancy analyses, real-time data collection, and brine minimization. Also addresses current and anticipated PFAS regulations and PFAS treatment options for the Brine Line system.
- Section 7 Brine Line Multi-Use Benefits – Describes how the Brine Line system is a multi-use benefit to the entire Santa Ana Watershed, enabling groundwater desalination, advanced recycled water treatment, industrial non-reclaimable water disposal, and a variety of other community-wide benefits.

- **Section 8 Future Facilities, Improvements & Expansion** – Presents a prioritized list of recommended Brine Line improvement projects and their estimated costs, organized into a 10-year Capital Improvement Program (CIP).
- **Section 9 Policy Considerations** – Discusses various policies that SAWPA and their Member Agencies may implement to enhance and strengthen Brine Line service throughout the Santa Ana Watershed.

2 Existing System Description

This section summarizes existing elements of the Brine Line system. The Brine Line features both a gravity collection system and pressurized pipelines designed to convey flows across the wide range of elevations within its service area. Information from the Brine Line Geographic Information System (GIS) database, existing hydraulic model, previous reports and studies, and as-built drawings were used to complete the following summary of the system.

2.1 Brine Line System Summary

The Brine Line system consists of approximately 72 miles of pipeline ranging in diameter from 12 to 48-inch, as summarized in **Table 2-1** and depicted in **Figure 2-1**. The Brine Line is divided into reaches, including Reach IV, IV-A, IV-B, IV-D, IV-E, and V as shown in **Figure 2-2**. Downstream of Reach IV, the OC San owned and operated Santa Ana River Interceptor (SARI) continues for 21 miles before discharging to OC San Treatment Facility No.2 (Plant No. 2) in Huntington Beach. The SARI line includes Reach I, II, and III. Finally, flows are discharges to the Pacific Ocean through OC San's ocean outfall.

Four of SAWPA's five Member Agencies – Eastern Municipal Water District (EMWD), Inland Empire Utilities Agency (IEUA), San Bernardino Valley Municipal Water District (SBVMWD), and Western Municipal Water District (WMWD) have established capacity rights in the Brine Line system. The fifth Member Agency, Orange County Water District (OCWD), does not own any capacity in the SARI or Brine Line systems. The Chino Basin Desalter Authority (CDA) also has ownership within the Brine Line.

To connect to the Brine Line, individual dischargers often construct and maintain dedicated laterals designed to convey flows from the discharge point (e.g., treatment plant, desalter, industrial facility) to a Brine Line reach. The privately owned and operated laterals were not evaluated as part of the Master Plan; however, efforts were made to research and describe the laterals herein for greater context of the overall Brine Line system. The following laterals are tributary to the Brine Line, but not owned or operated by SAWPA:

- **EMWD Brine Line Extension:** 15-mile pipeline connecting EMWD's Perris and Menifee desalters and other high saline industrial dischargers in EMWD's service area to Reach V. Constructed by EMWD in 1998 and 2001.
- **YVWD Brine Line Extension:** 16-mile pipeline connecting the Yucaipa Valley Water District's (YVWD) Wochholz Regional Water Recycling Facility to Reach IV-E. Constructed by YVWD in 2012.
- **City of Beaumont Brine Line Extension:** 23-mile pipeline connecting the City of Beaumont's wastewater treatment plant reverse osmosis facility to Reach IV-E. Constructed by Beaumont in 2020.
- **CRC Lateral:** 3-mile pipeline built as part of the original construction of Reach IV-B.
- **JCSD Laterals:** Ten (10) temporary connections to Reach IV-D, constructed by Jurupa Community Services District (JCSD). Only three (3) connections – Etiwanda, Wineville, and Hamner – remain active today.
- **Enertech (RBF) Lateral:** 0.5-mile pipeline connecting the Rialto Bioenergy Facility (RBF) to Reach IV-E. Constructed by Enertech.
- **Mountainview Power Plant Laterals:** Lateral connecting the Mountainview Power Plant to YVWD Brine Line Extension and subsequently, to Reach IV-E.

- **Corona Lateral:** 0.5-mile pipeline built as part of the original construction of Reach IV-B connecting high saline industrial dischargers and the WMWD collection station to Reach IV-B

Table 2-1: Brine Line Summary by Diameter and Material[1, 2]

Diameter (inches)	Length of Pipe (ft)							% of Total
	VCP	RCP	HDPE	PVC	FRP	Other	Subtotals	
12	-	-	-	5,084	-		5,084	1.3%
16	-	-	-	19,983	-	-	19,983	5.3%
18	-	-	-	4,433	-	-	4,433	1.2%
23	-	-	-	19,950[3]	-	-	19,950	5.3%
24	-	-	-	16,884	-	-	16,884	4.5%
26	-	21,657[4]	49,702	-	-	-	71,359	18.9%
27	-	3,123	-	-	-	-	3,123	0.8%
30	-	-	423	23,852	15,957	-	40,232	10.7%
32	-	-	4,900	-	-	-	4,900	1.3%
36	10,066	42,735	-	-	16,598	-	69,399	18.4%
39	52,409	715	-	-	-	-	53,124	14.1%
42	38,213	22,417	-	-	-	449	61,079	16.2%
48	-	8,185	-	-	-	4,773	8,185	2.2%
Totals	**100,688**	**98,832**	**55,025**	**90,186**	**32,555**	**449**	**377,735**	**100.0%**
% of Total	26.7%	26.2%	14.6%	23.9%	8.6%	0.1%	**100.0%**	**100.00%**

Notes:

1 Per "User Tag" attribute in existing Brine Line InfoSWMM model.

2 Material type definitions include vitrified clay pipe (VCP), reinforced concrete pipe (RCP), high density polyethylene (HDPE) and plastic/polyvinyl chloride (PVC), and fiberglass reinforced pipe (FRP).

3 23-inch PVC pipeline material refers to the CIPP-lined sections of Reach V, completed as part of recent rehabilitation projects.

4 26-inch RCP pipeline material refers to the CIPP-lined sections of Reach IV-A Upper.

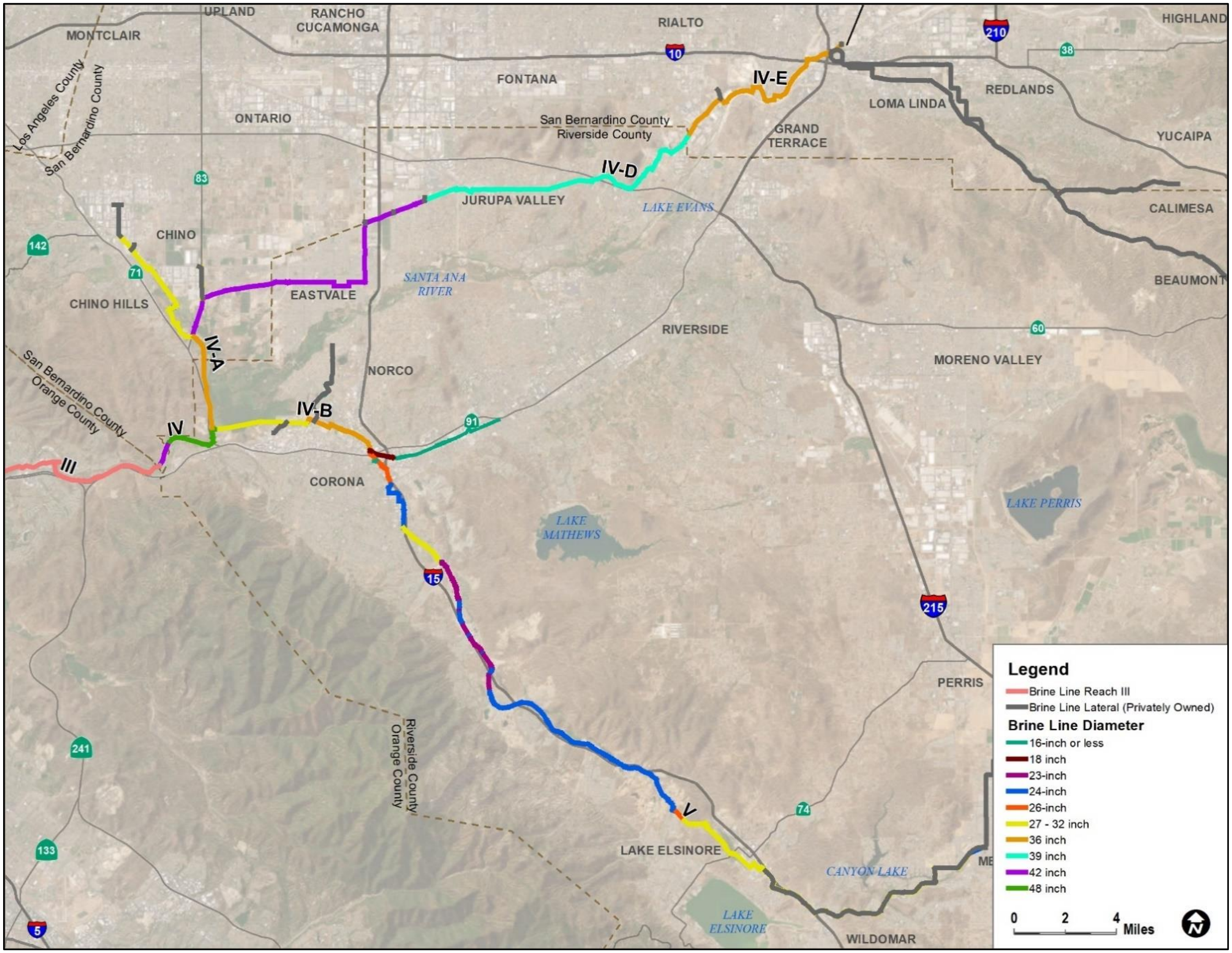


Figure 2-1 Existing Brine Line System by Diameter

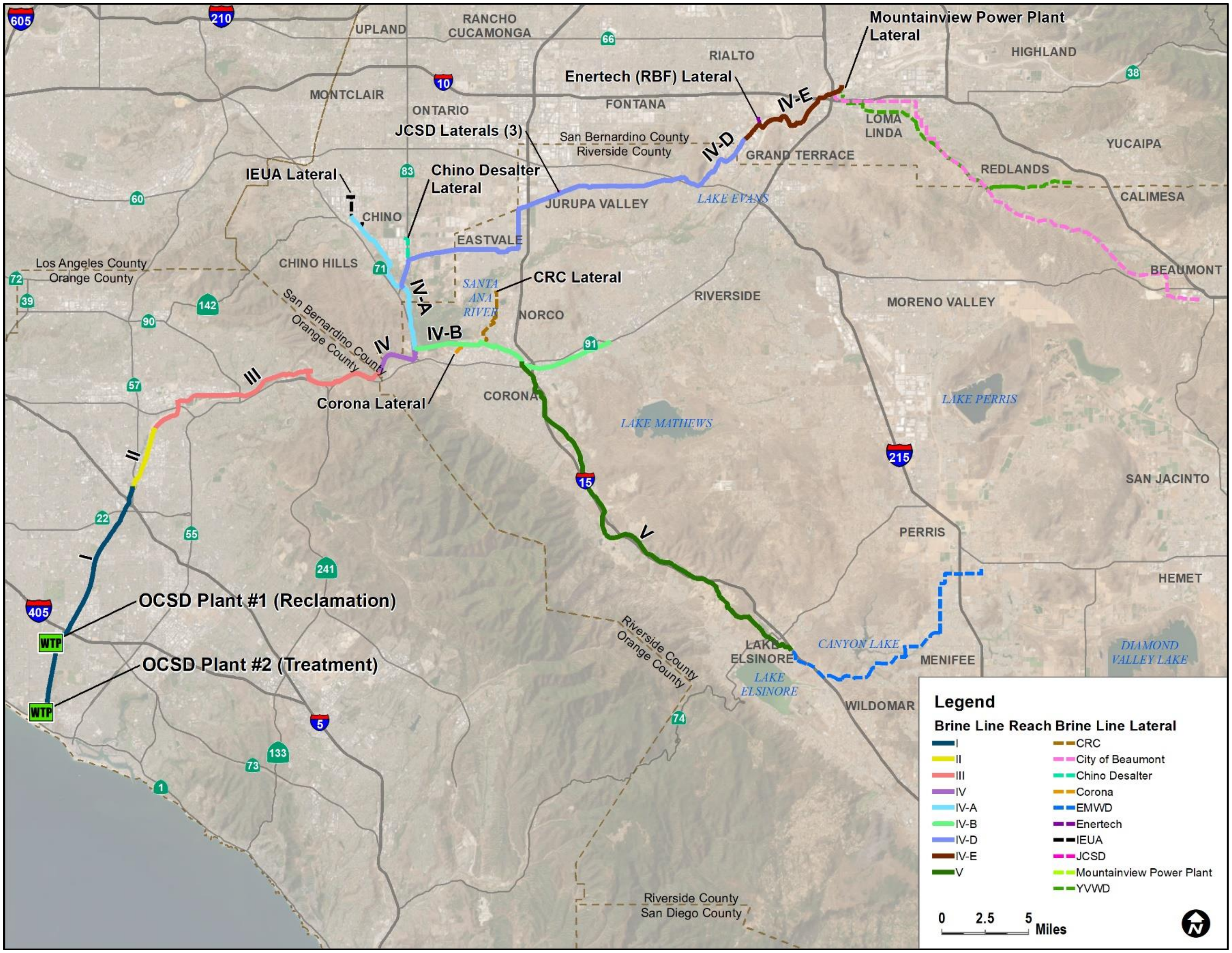


Figure 2-2 Existing Brine Line System by Reach and Lateral

Dischargers to the Brine Line system consist of direct dischargers (physical connections) and indirect dischargers (using wastehauler collection stations). Direct dischargers may own or lease pipeline, treatment, and disposal capacity in the Brine Line system, and include discharges of desalter brine, industrial high saline wastewater, and/or domestic wastewater. SAWPA also has authorized connections with specific agencies to provide fail-safe discharges for emergency situations. **Figures 2-3** and **2-4** summarize the 2024 Brine Line pipeline and treatment ownership, incorporating the current leased capacity program transfers of capacity.

Four (4) wastehauler collection stations are provided, one within each Member Agency's service area, operated by the corresponding Member Agency. The dump stations are located at: (1) EMWD's Perris/Menifee Desalter, (2) Upstream of IEUA's Regional Plant 2, (3) the City of San Bernardino's Wastewater Treatment Plant (WWTP), and (4) the City of Corona's WWTP.

The Brine Line exports an average of approximately 92,800 tons of salt from the Santa Ana River Watershed per year.

Figure 2-3 Pipeline Capacity Rights by Member Agency

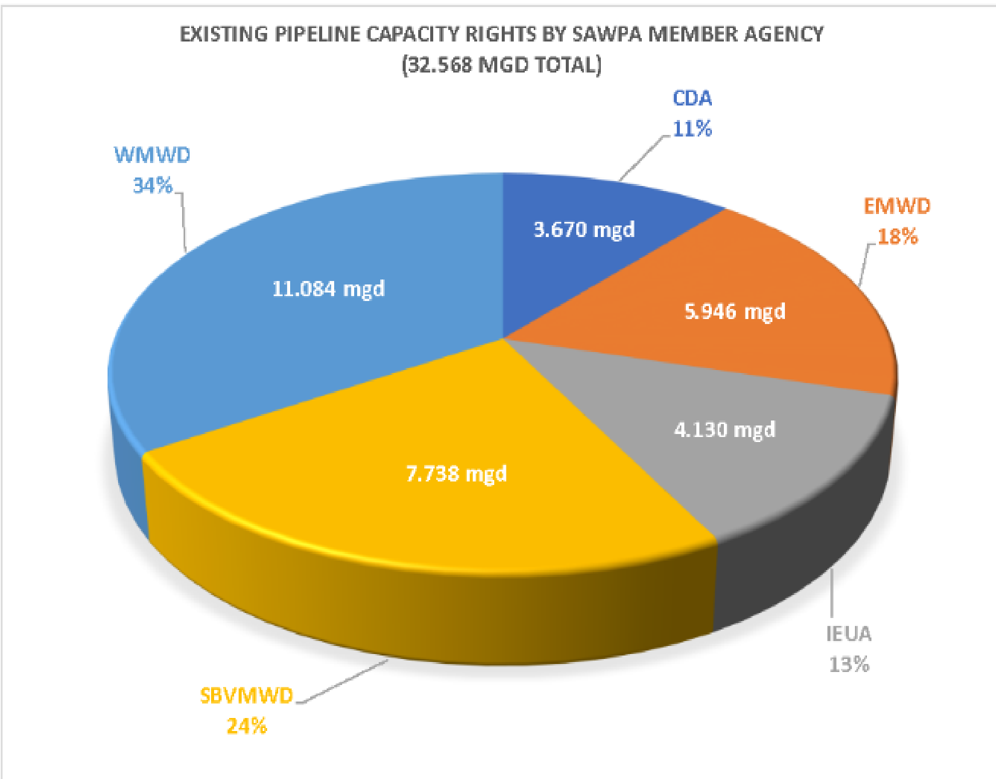
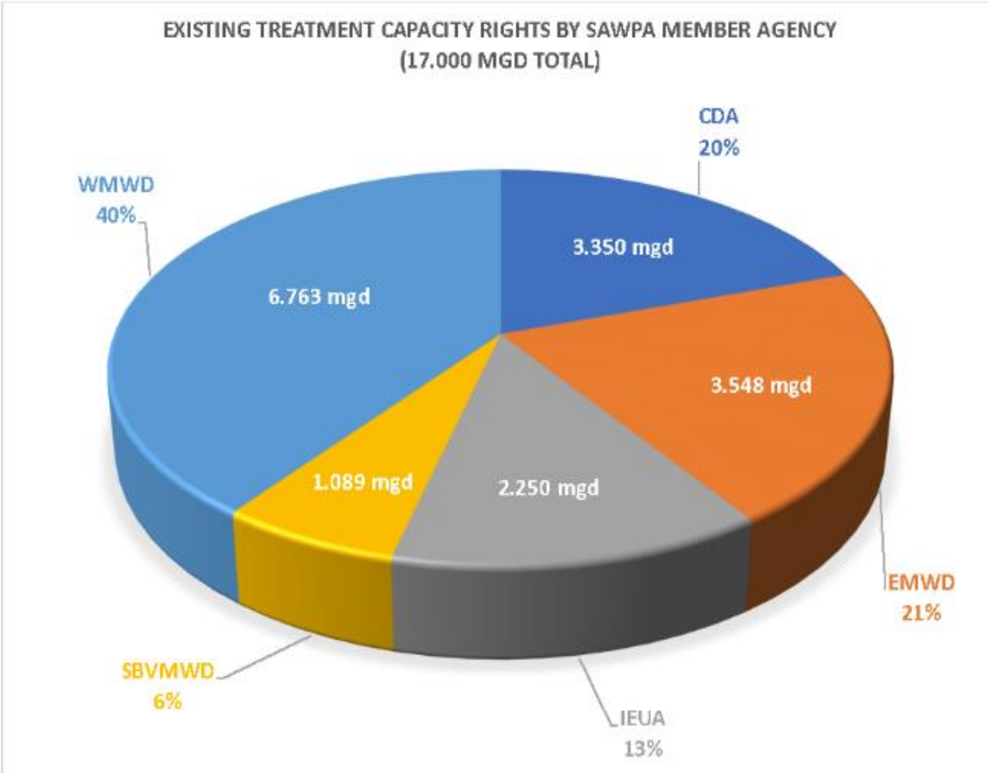


Figure 2-4 Treatment and Disposal Capacity Right by Member Agency



2.2 Brine Line Flow Characteristics & Quality

As of January 2024, the Brine Line conveys approximately 11.1-mgd (average monthly flow between January 2010 and January 2024), representing both direct and indirect dischargers. As shown by the trendline on **Figure 2-5**, Brine Line flows decreased from January 2010 through June 2017. Since June 2017, Brine Line flow has increased. As Brine Line flows increase, this is the most opportune time to complete the Brine Line Master Plan.

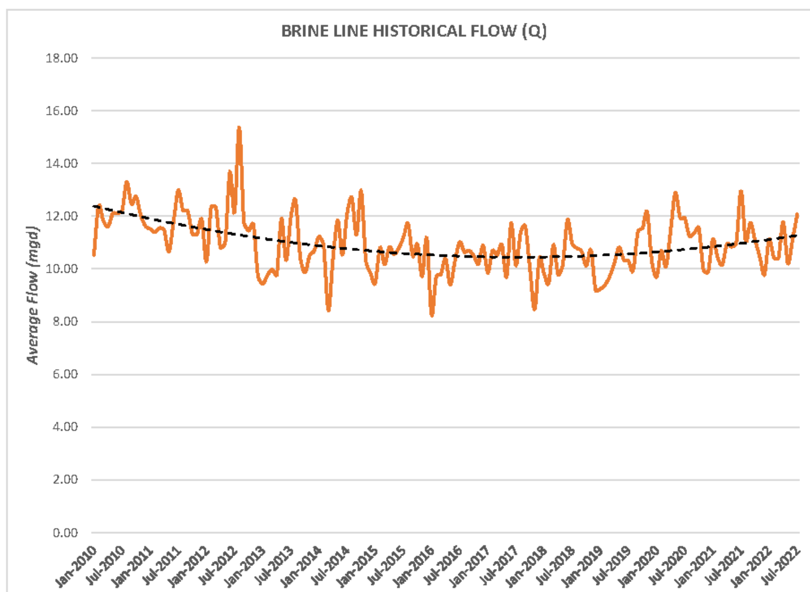
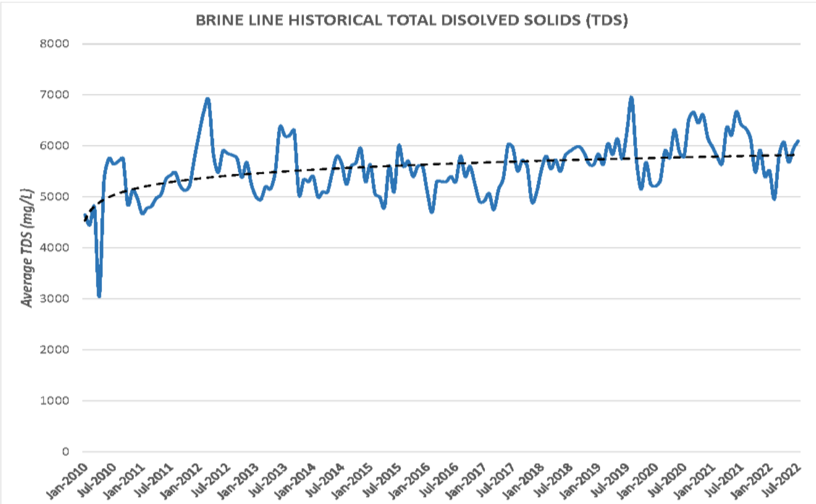


Figure 2-5 Brine Line Historical Flow



Although originally constructed to remove high salinity wastewater from the Santa Ana River watershed, domestic wastewater and low salinity flows have been accepted, which constituted most of the flow through 2005. With construction of brackish groundwater desalters and domestic discharge reduction, the percentage of low salinity flow has declined. Since 2009, approximately 75 percent of flow has been representative of municipal desalination facilities and power plants. **Figure 2-6** shows a gradual increase in Total Dissolved Solids (TDS) with time, and the trendline projects continuing increase in TDS (salt-content). The current average monthly TDS of Brine Line flows is approximately 5,575 mg/L (510,000 pounds of salt per day).

With flow changes, SAWPA has identified challenges related to suspended solids concentrations, not attributable to typical discharge water quality. SAWPA conducted studies evaluating Total Suspended Solids (TSS) generation relative to desalination brine and high Biological Oxygen Demand (BOD) wastewaters. **Figure 2-7** shows historical TSS concentrations in the Brine Line, with 2010-era TSS concentrations being more than 200 mg/L. Over time, TSS concentrations have decreased, the trendline showing reduction to 100 mg/L.

Solids generation resulting from TSS loadings at the downstream end of the Brine Line more than double the typical discharger loading. TSS imbalance continues to be an intermittent challenge for SAWPA, but TSS concentrations are continuing to decrease.

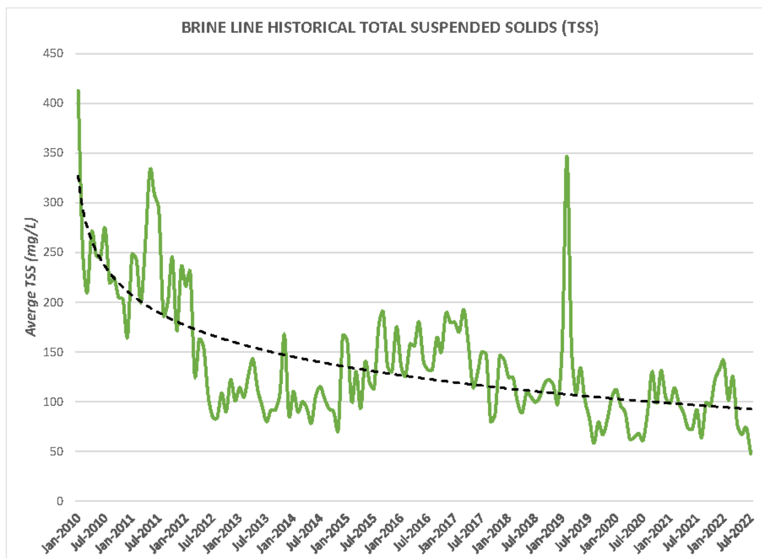


Figure 2-7 Brine Line Historical TSS

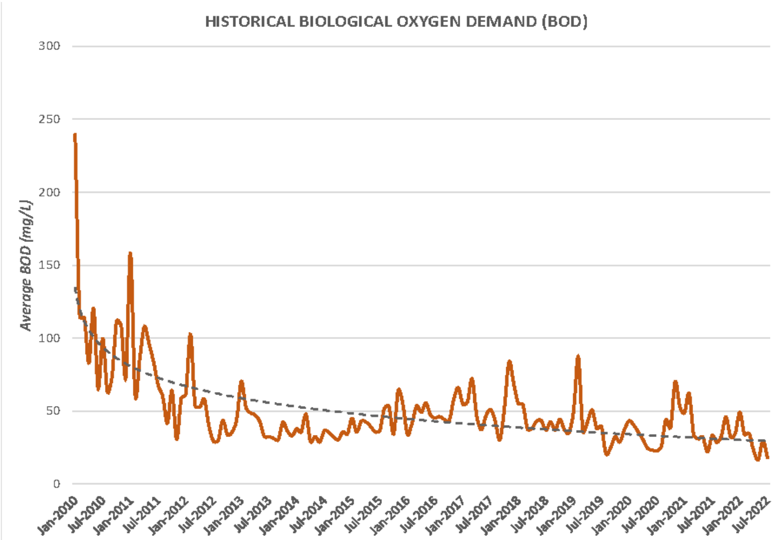


Figure 2-8 Brine Line Historical BOD

Figure 2-8 illustrates the historical BOD concentrations through July 2022. BOD concentrations have decreased, but are steady at an average monthly concentration of approximately 40 mg/L. BOD concentrations will continue to decrease as domestic dischargers are eliminated. Domestic dischargers represent approximately 0.37-mgd of the 11.0-mgd average flow, about three percent.

2.3 Pressurized Pipelines

The Brine Line system includes fifteen (15) inverted siphons as well as long stretches of gravity pressure flow, particularly in Reach V, as presented in **Table 2-2** and shown in **Figure 2-8.**

A siphon is a pipeline that dips or sags to cross under an existing storm channel, body of water (e.g., stream or creek), utilities, or other overlying structure. Inverted siphons are designed to operate below the hydraulic grade line and thus are always flowing full (i.e., under pressure).

Gravity pressure flow pipelines are longer reaches of pipe designed to flow under pressure depending on upstream flow conditions. These sections have sealed maintenance access structures (MAS) to ensure water does not escape the line.

Table 2-2: Existing Brine Line Siphons and Gravity Pressure

Siphon ID	To/From MAS ID	Structure Crossing	Pipe Size (inch)
1	4A-SS-7 to 4A-SS-10	Central Ave	26
2	4A-SS-1 to 4A-SS-4	Chino Creek	23
3	4B-0350 to 4B-0410	River Road & Temescal Creek	36
4	4D-0030 to 4D-0060	Chino Creek	42
5	4D-0190 to 4D-0200	Stormwater Infrastructure	42
6	4D-0330 to 4D-0360	Stormwater Channel	42
7	4D-0700 to 4D-073	Stormwater Channel	42
8	4D-0850 to 4D-0880	Stormwater Channel	39
9	4D-0940 to 4D-0970	Existing Utilities / Roadway	39
10	4D-0980 to 4D-1010	Stormwater Channel	39
11	4D-1080 to 4D-1090	Existing Utilities / Roadway	39
12	4E-0010 to 4E-0040	RIX Treatment Ponds	36
13	4E-0040 to 4E-0120	Santa Ana River	36
14	4E-0130 to 4E-0150	Santa Ana River	36
15	4E-0300 to 4E-0330	Warm Creek	36

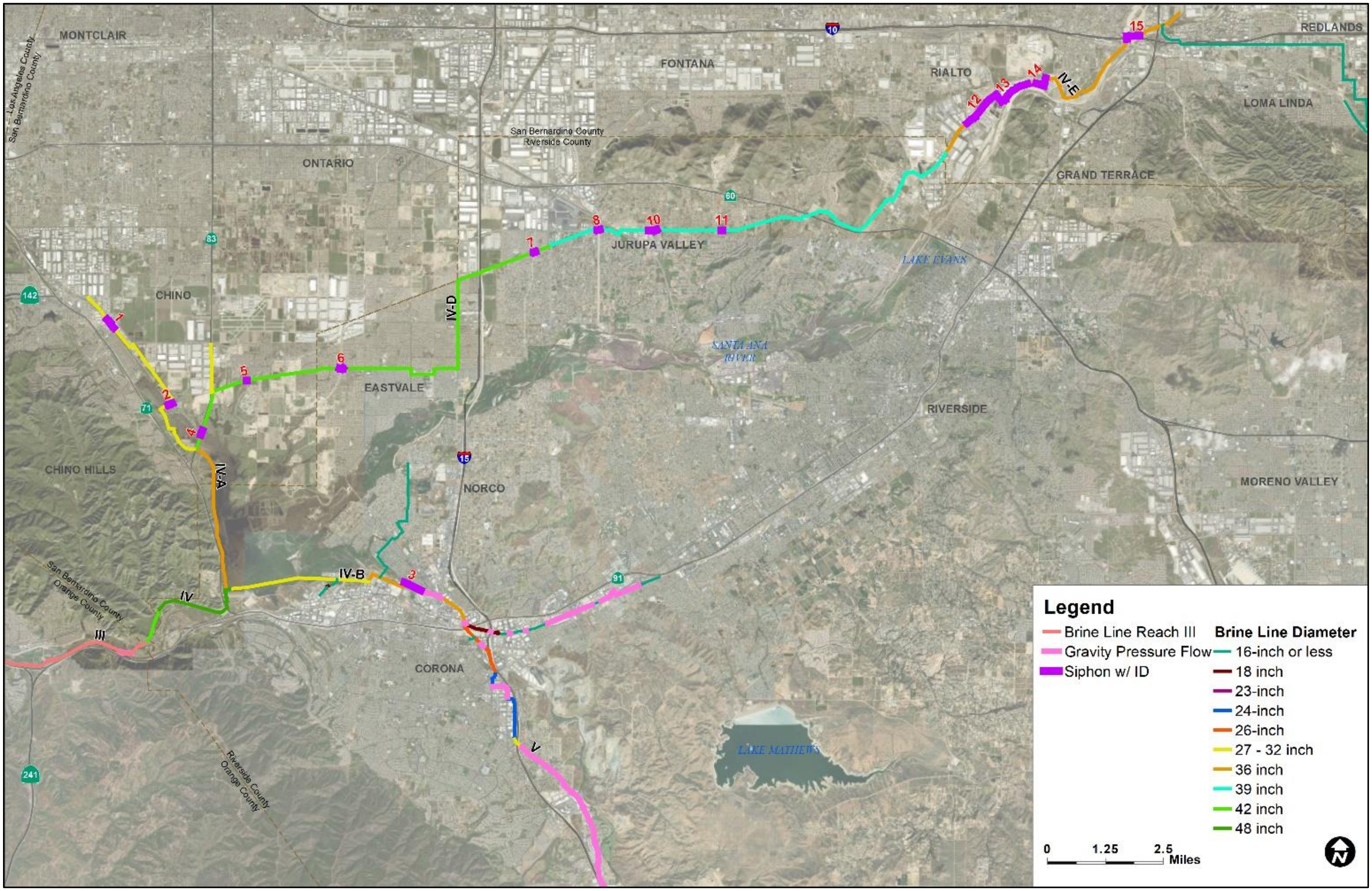
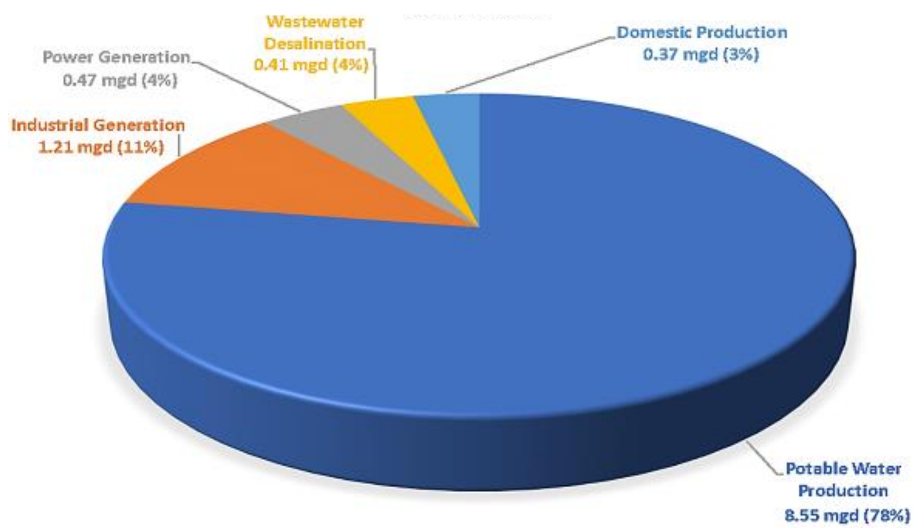


Figure 2-8 Brine Line Siphons and Gravity Pressure Flow Pipelines

3 Market Assessment & Future Flow Projections

Figure 3-1 Average Daily Discharge by Type (mgd)



Section 2 presented the configuration of, and existing dischargers associated with the Brine Line system, as well as some statistical information regarding brine conveyance characteristics. To complete a comprehensive evaluation of the Brine Line system, it is necessary to project both existing and future brine discharges. As shown on **Figure 3-1**, approximately 78 percent of current brine discharges are from potable water production facilities (i.e., groundwater desalters). The next largest category of brine discharger is industrial dischargers (i.e., food processing, laundries) at approximately 11 percent. Desalination of recycled water constitutes an additional 4 percent, with power generation and domestic wastewater constituting an additional 4 percent and 3 percent, respectively. Based on current usage information, potable water and recycled water desalination constitutes approximately 82 percent of the existing Brine Line flows. Incorporating industrial discharges, approximately 93 percent of current brine flow is from these three brine categories. Considering California's recurring extended drought conditions, it is reasonable to anticipate these brine categories will continue to constitute the majority of future Brine Line flows. Similarly, power generation in California has shifted toward renewable power systems, limiting the development of future brine producing facilities. Domestic discharges are intended to be reduced or eliminated from the Brine Line system.

3.1 Brine Line Discharger Workshops

To quantify both existing and future Brine Line discharges, SAWPA conducted a series of discharger workshops with its Member Agencies, their constituent cities and agencies, and other large Brine Line dischargers. These workshops were conducted both virtually and in-person between February 2023 and February 2024. Each workshop was conducted using a common agenda format, focusing on the five discharge categories identified on Figure 3.1 (above). Discussions included a brief history of the Brine Line system, a summary of each discharger's history, and identification of potential future discharge requirements of each discharger. Initially, workshops were held with the SAWPA Member Agencies, providing each Member Agency the opportunity to establish its near- and long-term planning within its service area. **Table 3-1** provides a summary of the workshop agencies and the date the workshop was held.

The intent of these workshops was to identify the maximum anticipated discharge to the Brine Line system, thereby allowing evaluation of the system's ability to convey those discharges and potentially identify and evaluate various brine management methodologies that would be needed to meet the 30-mgd Pipeline Capacity Right for discharges to OC San facilities.

Table 3-1: Discharger Workshops

Agency	Workshop Date
San Bernardino Valley Municipal Water District	February 23, 2023
San Bernardino Municipal Water Department	February 23,2023
City of Redlands	February 23, 2023
East Valley Water District	February 23, 2023
Eastern Municipal Water District	March 8, 2023
Western Municipal Water District	March 16, 2023
Inland Empire Utilities Agency	March 30, 2023
Chino Basin Desalter Authority	March 19, 2023
Elsinore Valley Municipal Water District	June 12, 2023
Jurupa Community Services District	June 15, 2023
Yucaipa Valley Water District	June 15, 2023
City of Colton	June 21, 2023
Riverside County Flood Control District	June 22, 2023
City of Beaumont	July 13, 2023
City of Chino	August 16, 2023
Temescal Valley Water District	August 17, 2023
City of Riverside	August 17, 2023
Rubidoux Community Services District	August 24, 2023
City of Corona	August 31, 2023
Rancho California Water District	February 28, 2024

Unlike typical gravity conveyance systems, capacity rights within the Brine Line system acquired by the Member Agencies are based on a maximum discharge capacity, not on an average discharge capacity. As such, dischargers that experience discharge variations throughout the day cannot exceed their acquired capacity right (no peaking is allowed). The agreement between SAWPA and OC San establishes the 30-mgd capacity right as an absolute discharge maximum between the two systems, and there is no peaking allowance incorporated. Similarly, individual dischargers are allocated a discharge capacity right from Member Agencies without peaking. This maximum discharge capacity will be further discussed in the later discussions. Note: SAWPA's agreement with OC San is currently slated to expire in 2046. However, based on increased flow, and resulting treatment and disposal requirements, SAWPA may need to initiate discussions with OC San prior to the expiration this agreement.

Based on the results of the workshops, five discharge scenarios were defined to encompass the current and future discharges to be analyzed using the SAWPA hydraulic modeling tool (discussed in Section 5 of this master plan). These five discharge scenarios include:

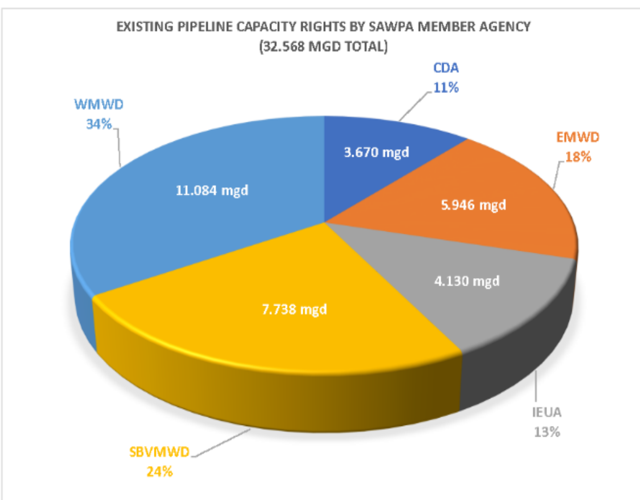
- Brine Line Ownership Capacity
- Existing Discharges (June 2023)
- Near-Team Discharges (2023-2033, 10-yrs)
- Long-Term Discharges (2034-2048, 25-yrs)
- Build-Out Discharges (beyond 2048)

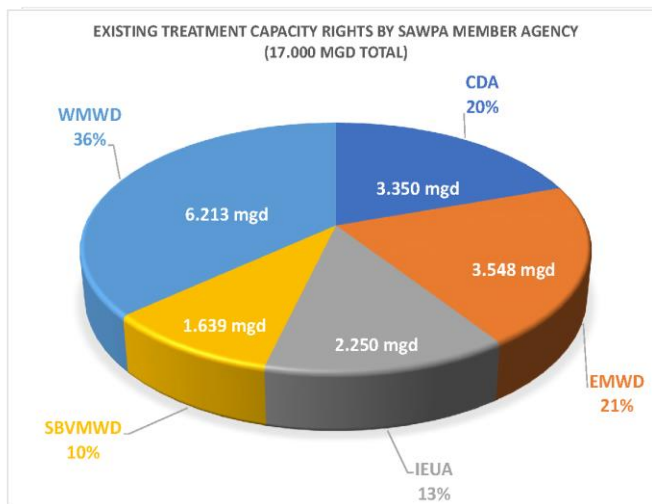
Discharges discussed in this section are subdivided by SAWPA Member Agency with respect to both pipeline capacity and treatment and disposal capacity. **Appendix A** provides a comprehensive accounting of Brine Line discharges within the above defined discharge scenarios, in one spreadsheet.

3.2 Pipeline, Treatment and Disposal Capacity Rights

Direct and indirect dischargers are dispersed throughout the Brine Line service area, discharging to the various reaches of the system. Each Member Agency is responsible for monitoring, management, and allocation of its capacity right within its defined agency service area. As stated, SAWPA has a contractual capacity right of 30-mgd in the OC San SARI pipeline and 30-mgd in certain wastewater treatment and disposal facilities owned by OC San. However, as shown on **Figure 3-2** below, the Member Agencies have purchased from SAWPA a combined pipeline capacity right of 32.57-mgd, exceeding the contracted pipeline capacity right by 2.57-mgd. The difference between the contracted pipeline capacity right and the allocated pipeline capacity right will be further addressed in Chapter 6 of this master plan. Relative to treatment and disposal capacity right, SAWPA has purchased from OC San 17-mgd of treatment and disposal capacity right and the Member Agencies have purchased from SAWPA a total of 17.0-mgd of treatment and disposal capacity right, which is currently slightly less than the current modeled maximum flow.

Figure 3-2 Pipeline Capacity Rights & Treatment/Disposal Capacity Rights by Member Agency





The Brine Line system is owned by SAWPA, and SAWPA Member Agencies have purchased pipeline capacity rights in the Brine Line system. Capacity rights are allocated by the Member Agencies to those dischargers requiring a capacity right or may be leased to dischargers through the SAWPA capacity leasing program. Member Agencies also own the identified treatment and disposal capacity rights. Treatment and disposal capacity represents a volume and strength of effluent that is treated at the OC San treatment plant at Huntington Beach.

As discussed, the total pipeline capacity right is approximately 32.57-mgd, and the current treatment and disposal capacity right is approximately 17.00-mgd. This difference is not currently a liability for SAWPA or the Brine Line dischargers, as the current average total discharge to OC San facilities is approximately 13.53-mgd. However, as brine flows continue to increase, purchase of additional treatment and disposal capacity will be required. Current discharge projects indicate that maximum flows in the Brine Line system are anticipated to exceed 17.00-mgd and will become critical in the next few years.

Table 3-2 summaries the current discharges from each Member Agency compared to their current pipeline capacity right. Based on current information, all of the Member Agencies have significant remaining pipeline rights for continue increase in Brine Line dischargers. CDA is the only agency that is currently conveying discharges approaching its Pipeline Capacity Right, with approximately 8.7 percent remaining.

Table 3-2: Pipeline Capacity Right Summary

Brine Line Discharger	Current Average Discharge (gpd)	Pipeline Capacity Right (gpd)	Remaining Capacity Right
Western Municipal Water District	4,607,700	11,084,000	58.4%
Inland Empire Utilities Agency	483,000	4,130,000	88.3%
Chino Basin Desalter Authority	3,350,000	3,670,000	8.7%
San Bernardino Valley Municipal Water District	1,558,000	7,738,000	79.9%
Eastern Municipal Water District	3,529,600	5,946,000	40.6%
Total Member Agency Discharge (gpd):	**13,528,300**	**32,568,000**	**58.5%**

Table 3-3 summarizes the current discharges from each Member Agency compared to their current treatment and disposal capacity right. Of the Member Agencies, CDA, SBVMWD, and EMWD have used their existing Treatment & Disposal Right. WMWD has a quarter of its right remaining, while IEUA has approximately ¾ of its capacity right remaining. Near-term increases in available Treatment & Disposal Capacity Rights are required.

Table 3-3: Treatment and Disposal Capacity Right Summary

Brine Line Discharger	Current Average Discharge (gpd)	Treatment & Disposal Capacity Right (gpd)	Remaining Treatment & Disposal Capacity Right
Western Municipal Water District	4,607,700	6,213,000	25.8%
Inland Empire Utilities Agency	483,000	2,250,000	78.5%
Chino Basin Desalter Authority	3,350,000	3,350,000	0.0%
San Bernardino Valley Municipal Water District	1,558,000	1,639,000	4.9%
Eastern Municipal Water District	3,529,600	3,548,000	0.5%
Total Member Agency Discharge (gpd):	**13,528,300**	**17,000,000**	**20.4%**

Overall, the Brine Line has average discharges of 13.53-mgd (79.6 percent), with existing maximum discharges of up to 17.75-mgd (104.4 percent of total rights). Dischargers to the Brine Line system will be required to reduce or eliminate maximum flows over the near-term, thereby staying within each agencies allocated treatment and disposal capacity limitations. However, treatment and disposal capacity will require monitoring over the next few years, as discharges approach the 17.00-mgd Treatment & Disposal Capacity Right. Some dischargers (i.e., Yucaipa Valley Water District) are currently projecting need to purchase additional Treatment & Disposal Capacity Rights to allow full utilization of their currently owned pipeline capacity.

The following discussion summarize the pipeline, treatment and disposal capacity rights of the five SAWPA Member Agencies and their associated dischargers, including their ownership rights, existing discharges, and projected discharges under the near-term, long-term, and build-out scenarios.

3.2.1 Chino Basin Desalter Authority (CDA) Summary

The Chino Basin Desalter Authority (CDA) contributes brine flows from its two groundwater desalters, including the Chino I and Chino II Desalters. The agency identified no planned expansion of these two facilities. The CDA has a

Brine Line ownership of approximately 3.67-mgd and is currently discharging at approximately that flow rate. **Table 3-4** summarizes the CDA Brine Line ownership and allowable discharge. CDA discharges are tributary to Reach IV-D of the Brine Line System.

Table 3-4: CDA Projected Brine Line Discharge

Brine Line Discharger	Reach	Pipeline Capacity Right (gpd)
Chino I Desalter	IV-D	2,370,000
Chino II Desalter (east) *[discharged at Etiwanda]*	IV-D	650,000
Chino II Desalter (west) *[discharged at Wineville]*	IV-D	650,000
	CDA Allocation (gpd):	**3,670,000**
	CDA Ownership (gpd):	**3,670,000**
	Surplus/(Deficit) (gpd):	**0**

Table 3-5 provides a summary of existing average and maximum discharges within the CDA service area. As shown, the CDA service area is making use of almost all its Pipeline Capacity Right.

Table 3-5: CDA Existing Brine Line Discharges

Existing Brine Line Discharger	Measured Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
Chino I Desalter	2,651,841	2,370,000	281,841
Chino II Desalter (east) *[discharged at Etiwanda]*	479,400	650,000	170,600
Chino II Desalter (west) *[discharged at Wineville]*	479,400	650,000	170,600
CDA Discharge (gpd):	**3,610,641**	**3,670,000[2]**	**59,359**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to 2023 measured maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

Table 3-6 summarizes projected near-term average and maximum discharges within the CDA service area. While the CDA service area is essentially making use of its entire Brine Line conveyance discharge capacity, the maximum rate from the Chino I Desalter is required to reduce its maximum discharge. The projected discharge exceeds the identified allowable discharge of 2.37-mgd by approximately 0.02-mgd. Treatment and disposal capacity for the IUEA service area is 3.35-mgd. The maximum discharge is within the existing treatment and disposal right for near-term projections.

Table 3-6: CDA Near-Term Brine Line Discharges

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
Chino I Desalter	2,391,200	2,370,000	(21,200)
Chino II Desalter (east) *[discharged at Etiwanda]*	479,400	650,000	170,600
Chino II Desalter (west) *[discharged at Wineville]*	479,400	650,000	170,600
CDA Discharge (gpd):	**3,350,000**	**3,670,000[2]**	**320,000**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to projected near-term maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

Table 3-7 summarizes projected long-term average and maximum discharges within the CDA service area. The CDA is using its entire Brine Line pipeline capacity. The projected discharge matches the identified allowable discharge of 3.67-mgd. The CDA service area is not anticipating increases in Brine Line discharges in the future. It is noted that CDA is projected to meet its maximum allowable discharge during the long-term planning horizon. Treatment and disposal capacity right for CDA service area is 3.35-mgd. Discharges from the CDA service will increase to 3.67-mgd, resulting in a required increase in Treatment & Capacity Right by 0.32-mgd.

Table 3-7: CDA Long-Term Brine Line Discharges

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
Chino I Desalter	2,370,000	2,370,000	---
Chino II Desalter (east) *[discharged at Etiwanda]*	650,000	650,000	---
Chino II Desalter (west) *[discharged at Wineville]*	650,000	650,000	---
CDA Discharge (gpd):	**3,670,000**	**3,670,000[2]**	**—**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to projected long-term maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

Table 3-8 provides a summary of projected build-out conditions within the CDA service area. The CDA service area shows no differences between the long-term planning horizons. Assuming the Treatment and disposal capacity right for the CDA service area is increased to 3.67-mgd, no additional treatment and disposal capacity right will be required based on build-out planning horizon.

Table 3-8: CDA Build-Out Brine Line Discharges

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
Chino I Desalter	2,370,000	2,370,000	---
Chino II Desalter (east) *[discharged at Etiwanda]*	650,000	650,000	---
Chino II Desalter (west) *[discharged at Wineville]*	650,000	650,000	---
CDA Discharge[2] (gpd):	**3,670,000**	**3,670,000**	**—**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to projected build-out maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

3.2.2 Eastern Municipal Water District (EMWD) Summary

The Eastern Municipal Water District (EMWD) service area is tributary to Reach V of the Brine Line system. EMWD has a pipeline capacity right of approximately 5.95-mgd. Discharges to the Brine Line are associated with the three EMWD groundwater desalters, including the existing Menifee, Perris, and Perris II groundwater desalter facilities. **Table 3-9** summarizes the EMWD service area pipeline capacity discharge conditions.

Table 3-9 summarizes the existing and future dischargers to the Brine Line from the EMWD service area. As with other existing dischargers, it is projected that these dischargers will increase discharge up to their allocated Pipeline Capacity Right. The shaded discharger is projected to be a new discharger added in the future, as defined by the following discussions:

1. Eastern Municipal Water District. EMWD identified a planned 5.4-mgd expansion of its Perris II Desalter that is projected to increase brine discharges by 900,000 gallons. The Project is projected to occur beyond the 10-year horizon. EMWD also identified its Perris North Program, which is intended to be a groundwater contamination and remediation project using evaporators to reduce the brine volume by a factor of eight times. The project is proposed to be located within the Moreno Valley area. EMWD is also discussing a potential new location for the PWR Project, located in San Jacinto. Since a connection to the Brine Line is too far, they are looking at 21 acres of evaporation ponds to manage brine. Also, in the Lakeview Nuevo Area, EMWD is conducting hydrogeological evaluations for siting a new desalter, to be online in the 20+ year timeframe. A total of approximately 32,000 gallons per day (gpd) is being hauled to the collection station, which is projected to increase with time.

Table 3-9: EMWD Projected Brine Line Discharges

Brine Line Discharger	Reach	Pipeline Capacity Right (gpd)
EMWD Perris & Menifee Desalination Facility	V	3,998,000
Perris II Expansion (Future)	V	900,000
Rancho California Water District	V	2,000,000
Collection Station	V	200,000
EMWD Allocation (gpd):		**7,098,000**
EMWD Ownership (gpd):		**5,946,000**
Surplus/(Deficit) (gpd):		**(1,152,000)**

Note: Shaded information represents identified future dischargers

2. Rancho California Water District. Previous evaluations conducted by the Rancho California Water District (Rancho Water) identified that brine from the Santa Rosa Water Reclamation Plant would be conveyed to the Fallbrook Public Utility District for ultimate discharge through their land outfall to the Oceanside Ocean Outfall. During our recent discussions with Rancho Water, it was identified that the final decision was not made, and that the potential for conveying approximately 2.0-mgd of brine to the Brine Line was still being evaluated. Based on the Rancho Water Workshop, approximately 1.0-mgd of brine is projected to be conveyed to the Brine Line in the near-term period, with another 1.0-mgd potentially discharged through the Build Out Period.

Table 3-10 provides a summary of existing average and maximum discharges within the EMWD service area. As shown, the EMWD service area exceeds the allowable discharge by approximately 0.1-mgd, a condition that is expected to be resolved in the near-term planning horizon.

Table 3-10: EMWD Existing Brine Line Discharges

Existing Brine Line Discharger	Measured Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
EMWD Perris & Menifee Desalination Facility	4,097,866	3,998,000	(99,866)
EMWD Discharge[2] (gpd):	**4,097,866**	**3,998,000**	**(99,866)**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to 2023 measured maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

Table 3-11 summarizes the projected near-term average and maximum discharges within the EMWD service area. As shown, EMWD service area eliminates peaked discharges during the near-term period and adds 50,000 gpd of flow at the collection station, while maintaining an excess Pipeline Capacity Right of approximately 0.90-mgd. The EMWD service area has a total treatment and disposal capacity right of 3.55-mgd. Within the near-term period, the EMWD service area is projected to exceed its treatment/disposal capacity right by approximately 1,500,000 gpd, necessitating that additional treatment and disposal capacity rights be acquired.

Table 3-11: EMWD Near-Term Brine Line Dischargers

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
EMWD Perris & Menifee Desalination Facility	3,998,000	3,998,000	---
Rancho California Water District	1,000,000	1,000,000	---
Collection Station	50,000	200,000	150,000
EMWD Discharge (gpd):	**5,048,000**	**5,946,000[2]**	**898,000**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to projected near-term maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

Table 3-12 summarizes projected long-term average and maximum discharges within the EMWD service area. As shown, EMWD service area is projected to add one additional discharge in the long-term period. Maximum discharge is projected to exceed the Pipeline Capacity Right by approximately 0.1-mgd. The EMWD service area has a total treatment and disposal capacity of 3.55-mgd. Within the long-term period, the EMWD service area will exceed its treatment/disposal capacity right by approximately 2.50-mgd, necessitating that approximately 2.5-mgd of additional treatment and disposal capacity right be acquired.

Table 3-12: EMWD Long-Term Brine Line Dischargers

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
EMWD Perris & Menifee Desalination Facility	3,998,000	3,998,000	---
Perris II Future Expansion	900,000	900,000	---
Rancho California Water District	1.000,000	1.,000,000	1,000,000
Collection Station	150,000	200,000	50,000
EMWD Discharge (gpd):	**6,048,000**	**5,946,000[2]**	**(102,000)**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to projected long-term maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

Table 3-13 provides a summary of build-out conditions within the EMWD service area. As shown, EMWD service area will add the remainder of the RCWD 2.0-mgd discharge, increasing discharge to 7.1-mgd. With a Pipeline Capacity Right of 5.9-mgd, EMWD is projected to exceed its Pipeline Capacity Right by approximately 1.2-mgd. As such, additional capacity right is required.

Table 3-13: EMWD Build-Out Brine Line Dischargers

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
EMWD Perris & Menifee Desalination Facility	3,998,000	3,998,000	---

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
Perris II Future Expansion	900,000	900,000	---
Rancho California Water District	2,000,000	2,000,000	---
Collection Station	200,000	200,000	---
EMWD Discharge[2] (gpd):	**7,098,000**	**5,946,000**	**(1,152,000)**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to projected build-out maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

The EMWD service area has a total treatment and disposal capacity right of 3.55-mgd. Within the long-term period, the EMWD service area will exceed its treatment/disposal capacity by approximately 3.55-mgd, necessitating that approximately 3.55-mgd of additional treatment and disposal capacity right be acquired.

3.2.3 Inland Empire Utilities Agency (IEUA) Summary

The Inland Empire Utilities Agency (IEUA) service area is unique in that IEUA owns and operates its own brine disposal system, referred to as the North Non-Reclaimable Wastewater System (North System), and discharges to the Brine Line through Reaches IV, IV-A, and IV-D. The 13.45-mgd North System consists of the Non-Reclaimable Wastewater System (NRWS) and the 2.7-mgd Etiwanda Wastewater Line (EWL) in the Agency's north service area, conveying wastewater to the County Sanitation Districts of Los Angeles County's sewer system. The Brine Line receives discharges from IEUA's south service area. **Table 3-14** summarizes existing and future discharges with respect to IEUA's pipeline capacity right.

Table 3-14: IEUA Projected Brine Line Discharges

Brine Line Discharger	Reach	Pipeline Capacity Right (gpd)
California Institution for Men	IV-A	194,000
California Institution for Women	IV-D	400,000
Green River Golf Club	IV	7,000
Mission Linen Supply	IV-A	713,000
In-N-Out Burger, Chino Distribution Center	IV-D	86,000
OLS Energy	V-A	130,000
Repet, Inc.	IV-A	64,800
Chino Eastside WTP	IV-D	65,500
Collection Station	IV-A	200,000
IEUA Allocation (gpd):		**1,860,300**
IEUA Ownership (gpd):		**4,130,000**
Surplus/(Deficit) (gpd):		**2,269,700**

As shown in the table, IEUA has a total pipeline capacity right of 4.13-mgd. There are nine (9) individual dischargers within the IEUA service area, including the IEUA collection station (located on Reach IV-A near Regional Plant 2). Based on the Discharger Workshops, discharges from the IEUA southern service are projected to be approximately 1.86-mgd, significantly less than the agency's ownership by approximately 4.13-mgd. Existing discharges total to an average of approximately 0.48-mgd. Discharges from the IEUA service area exhibit significant maximum flows, with the maximum flow at approximately 1.61-mgd (3.33 peaking factor). Operating with this peaking factor is possible as a result of the disparity between the Pipeline Capacity Right and the actual discharged flow. The workshops did not identify projections of large increases in discharge from the IEUA service area.

Table 3-15 provides a summary of current average and maximum discharges within the IEUA service area. As with the WMWD service area, IEUA exhibits a couple of dischargers that currently exceed their allocated capacity, IEUA has a significant amount of excess discharge capacity such that dischargers occasionally exceed their allocations, and the agency has its own brine disposal system, the North System, that limits discharges to the Brine Line system. IEUA is not projecting the potential for new dischargers to the Brine Line system, but as existing dischargers grow, the agency will need to continue to control maximum discharges to assure that their capacity right is not exceeded.

Table 3-15: IEUA Existing Brine Line Discharges

Existing Brine Line Discharger	Measured Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
California Institution for Men	152,376	194,000	41,624
California Institution for Women	679,528	400,000	(279,528)
Green River Golf Club	4,340	7,000	2,660
Mission Linen Supply	360,024	713,000	352,976
In-N-Out Burger, Chino Distribution Center	62,582[3]	86,000	23,418
OLS Energy	51,996	130,000	78,004
Repet, Inc.	61,404	43,200	(18,204)
Chino Eastside WTP	10,000	65,500	55,500
Collection Station	224,015	250,000	25,985
IEUA Discharge (gpd):	**1,606,265**	**4,130,000[2]**	**2,523,735**

Notes:

1 Excess capacity is based on comparison of contractual maximum allowable to 2023 measured maximum flow discharges.

2 Summary information based on Member Agency ownership, not on summation of columnar data.

3 In-n-Out intends to reduce flow to the Brine Line, with current estimates at diverting 31,000 gpd from the Brine Line.

It is noted that IEUA is studying future need for the Collection Station. As IEUA is required to vacate the RP-2 site and return it to the Army Corp of Engineers, evaluations are focused on condition of the collection station, costs and potential locations to relocate the station (Brine Line or North System), or the elimination of the Collection Station based on low use.

Table 3-16 provides a summary of projected near-term average and maximum discharges within the IEUA service area. Similar to the WMWD service area, the IEUA service area had several dischargers currently exceeding their allocated conveyance capacity. It is projected that, within the near-term period (10 years), IEUA dischargers will no longer exceed their conveyance capacities, shown in the table with zero excess capacity (i.e., "---"). The IEUA service area has significant excess capacity of approximately 2.89-mgd, increasing slightly as a result of maximum discharge management. No additional dischargers were identified in the Discharger Workshops for the IEUA service area during the near-term period.

Table 3-16: IEUA Near-Term Brine Line Dischargers

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
California Institution for Men	152,376	194,000	41,624
California Institution for Women	400,000	400,000	---
Green River Golf Club	4,340	7,000	2,660
Mission Linen Supply	360,024	713,000	352,976
In-N-Out Burger, Chino Distribution Center	62,582	86,000	23,418
OLS Energy	51,996	130,000	78,004

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
Repet, Inc.	43,200	43,200	---
Chino Eastside WTP	65,500	65,500	---
Collection Station	100,000	200,000	100,000
IEUA Discharge (gpd):	**1,240,018**	**4,130,000[2]**	**2,889,982**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to projected near-term maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

With respect to treatment and disposal capacity, IEUA has a total capacity of 2.25-mgd. Based on the projected near-term maximum discharges of 1.24-mgd, IEUA is not anticipated to require additional treatment and disposal capacity.

Table 3-17 provides a summary of projected long-term average and maximum discharges within the IEUA service area. It is projected that within the long-term period, IEUA discharges will no longer exceed their pipeline capacities, shown in the table with zero excess capacity (i.e., "---"). The IEUA service area has significant excess capacity of approximately 2.81-mgd. No additional dischargers were identified in the Discharger Workshops for the IEUA service area during the long-term period.

With respect to treatment and disposal capacity, IEUA has a total capacity of 2.25-mgd. Based on the projected long-term discharges of 1.32-mgd, IEUA is not anticipated to require additional treatment and disposal capacity during the long-term period. In the future, IEUA could consider selling excess capacity back to SAWPA.

Table 3-17: IEUA Long-Term Brine Line Dischargers

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
California Institution for Men	152,376	194,000	41,624
California Institution for Women	400,000	400,000	---
Green River Golf Club	4,340	7,000	2,660
Mission Linen Supply	360,024	713,000	352,976
In-N-Out Burger, Chino Distribution Center	62,582	86,000	23,418
OLS Energy	51,996	130,000	78,004
Repet, Inc.	43,200	43,200	---
Chino Eastside WTP	65,500	65,500	---
Collection Station	150,000	200,000	50,000
IEUA Discharge (gpd):	**1,290,018**	**4,130,000[2]**	**2,839,982**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to projected long-term maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

Table 3-18 provides a summary of projected build-out conditions within the IEUA service area. No new build-out discharges were identified, and existing discharges maximize use of their allowed pipeline capacity. With respect to treatment and disposal capacity, IEUA has a total capacity of 2.25-mgd. Based on the projected build-out discharges of 1.89-mgd, IEUA is not anticipated to require additional treatment and disposal capacity to meet build-out conditions.

Table 3-18: IEUA Build-Out Brine Line Dischargers

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
California Institution for Men	194,000	194,000	---
California Institution for Women	400,000	400,000	---
Green River Golf Club	7,000	7,000	---
Mission Linen Supply	713,000	713,000	---
In-N-Out Burger, Chino Distribution Center	86,000	86,000	---
OLS Energy	130,000	130,000	---
Repet, Inc.	43,200	43,200	---
Chino Eastside WTP	65,500	65,500	---
Collection Station	200,000	200,000	---
IEUA Discharge[2] (gpd):	**1,838,700**	**4,130,000**	**2,291,300**

Notes:

1 Excess capacity is based on comparison of contractual maximum allowable to projected build-out maximum flow discharges.

2 Summary information based on Member Agency ownership, not on summation of columnar data.

3.2.4 San Bernardino Valley Municipal Water District (SBVMWD) Summary

Table 3-19 summarizes existing and future discharges with respect to San Bernardino Valley Municipal Water District's (SBVMWD) Brine Line pipeline capacity right. As shown in the table, SBVMWD has a total pipeline capacity right of 7.74-mgd. There are seven (7) existing and future dischargers from the SBVMWD service area, including the collection station (located at the City of San Bernardino WWTP). Based on the information collected during the Discharger Workshops, discharges from the SBVMWD service area are projected to be approximately 4.83-mgd, approximately 2.91-mgd less than the Pipeline Capacity Right. Current discharges total to an average of approximately 1.56-mgd. The significant disparity between pipeline capacity right and the current discharges allow discharges to exhibit an existing maximum flow of approximately 2.02-mgd (peaking factor of 1.29). Dischargers in the SBVMWD service area are projecting significant growth from the Regional Recycled Water Facilities Project and Yucaipa Valley Water District increased brine flows, both representing increased recycled water demineralization. Dischargers within the SBVMWD service area discharge to Reach IV-E of the Brine Line system.

Table 3-19: SBVMWD Projected Brine Line Discharges

Brine Line Discharger	Reach	Pipeline Capacity Right (gpd)
Agua Mansa Power Plant	IV-E	62,000
Mountainview Generating Station	IV-E	432,000
Rialto Bioenergy Facility, LLC	IV-E	250,000
YVWD - Henry Wochholz Regional Water Recycling Facility	IV-E	1,756,000
Regional Recycled Water Facilities Project	IV-E	1,550,000
City of Beaumont Wastewater TP	IV-E	580,000
Collection Station	IV-E	200,000
SBVMWD Allocation (gpd):		**4,830,000**
SBVMWD Ownership (gpd):		**7,738,000**
Surplus/(Deficit) (gpd):		**2,908,000**

Note: Shaded information represents identified future dischargers

Table 3-15 summarizes Brine Line dischargers located within the SBVMWD service area. These dischargers are contributing less than their existing pipeline capacity right. For purposes of the Master Plan, it is assumed the dischargers will over time increase their discharge to their total pipeline capacity right. However, SBVMWD is projected to increase capacity for two existing dischargers, and add one additional discharger (shaded dischargers) as defined in the following discussions:

1. Bunker Hill Regional Recycled Water Feasibility Study. San Bernardino Valley MWD (as lead agency), City of San Bernardino, East Valley WD, and the City of Redlands are participating in the future development of the Bunker Hill Basin Regional RW Feasibility Study as part of the Salinity Management Coalition. (Project). The Project participants are studying a program where each agency will individually construct necessary facilities, and coordinate operations to meet local groundwater basin objectives through an indirect potable reuse project. East Valley constructed the Sterling Natural Resource Center to recycle wastewater from its service area and recharge via Weaver Basins. San Bernardino is developing a Tertiary Treatment System to produce recycled water from the San Bernardino Water Reclamation Plant for general plant use and irrigation. Valley District's recycled conveyance system conveys recycled water for recharge via the Weaver Basins. Redlands has existing Waste Discharge Requirements for treatment and discharge of recycled water from its service area into Bunker Hill-B Groundwater Management Zone. Phase 2 of the Redlands Wastewater Treatment Facility will focus on infrastructure and process upgrades to the existing facility. Recycled water replenishment of the Bunker Hill-B Groundwater Management Zone provides a drought tolerant water supply, improving supply reliability and a drought buffer in the event of a prolonged drought. Projected treatment capacity and recycled water product by agency includes:
   a. San Bernardino: 21-mgd from its WRP and 33-mgd from RIX, with 3.8-mgd starting in 2027 and another 4.0-mgd starting around 2040 (7.8-mgd total).
   b. East Valley: Projected treatment capacity of 10.0-mgd, with 8.6-mgd of recycled water production
   c. Redlands: 6.5-mgd treatment capacity, with 4.5-mgd of recycled water production

2. Yucaipa Velley Water District. Yucaipa Valley Water District (YVWD) constructed its own 15.5-mile Brine Line lateral, extending from the Wochholz Regional Water Recycling Facility (WRWRF), with a treatment capacity of 8.0-mgd (current flow approximately 4.0-mgd), to Reach 4E of the Brine Line (adjacent to San Bernardino WWTP). YVWD has a total pipeline capacity of 1.756-mgd and a total treatment capacity of 0.595-mgd. The District is currently projecting an increase to its WRWRF capacity, resulting in an increase brine flow of approximately 400,000 gpd. Additionally, the District may extend its regional brine line to its existing WTP, thereby allowing additional brine discharge to the Brine Line up to existing pipeline capacity of 1.756-mgd. Plant improvements are planned to be online by December 2026, with proposed WTP connection in the following years. YVWD will require additional Brine Line treatment and disposal capacity rights to support its projected WRWRF expansion plans.

3. City of Beaumont. The City of Beaumont (Beaumont) currently operates a wastewater treatment plant with a permitted capacity of 6.0-mgd. Total Dissolved Solids (TDS) tributary to the Beaumont plant range between 180 to 250 milligrams per liter (mg/l). New membrane systems were installed in November 2022 with a capacity of 220,000 gpd, resulting is a brine flow of approximately 550,000 gpd. Beaumont currently makes use of its full allocated flow capacity. In February 2024, Beaumont identified an additional 30,000 gpd of needed brine capacity, bringing their total brine discharge to 580,000 gpd (0.58-mgd).

Table 3-20 provides a summary of current average and maximum discharges within the SBVMWD service area. The SBVMWD service area also has several dischargers that are currently exceeding their allocated capacity. Similarly, the significant amount of excess pipeline capacity accommodating maximum flows. However, as dischargers increase and/or are added to the agencies service area, maximum dischargers will be required to not exceed their allotted capacity.

Table 3-20: SBVMWD Existing Brine Line Discharges

Existing Brine Line Discharger	Measured Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
Agua Mansa Power Plant	92,820	62,000	(33,820)
Mountainview Generating Station	478,880	432,000	(46,880)
Rialto Bioenergy Facility, LLC	141,173	250,000	108,827
YVWD - Henry Wochholz Regional Water Recycling Facility	463,325	1,756,000	1,292,675
City of Beaumont Wastewater TP	604,884	550,000	(54,884)
Collection Station	235,060	250,000	14,940
SBVMWD Discharge (gpd):	**2,016,142**	**7,738,000[2]**	**5,721,858**

4. Notes:
5. [1]Excess capacity is based on comparison of contractual maximum allowable to 2023 measured maximum flow discharges.
6. [2]Summary information based on Member Agency ownership, not on summation of columnar data.

Table 3-21 provides a summary of projected near-term average and maximum discharges within the SBVMWD service area. The SBVMWD service area has dischargers that are currently exceeding their allotted discharge capacity based on maximum discharge volumes. Similarly, these maximum discharges are mitigated through storage or other means by the discharger to maintain flow within the required limits. The SBVMWD service area discharge is projected to increase significantly during the near-term (10-year) period, particularly associated with increases from Yucaipa Valley Water District and proposed new discharges from the Regional Recycled Water Facilities Project. Despite these increases, the conveyance capacity in the SBVMWD service area exceeds the maximum discharge by approximately 3.04-mgd.

Table 3-21: SBVMWD Near-Term Brine Line Dischargers

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
Agua Mansa Power Plant	62,000	62,000	---
Mountainview Generating Station	432,000	432,000	---
Rialto Bioenergy Facility, LLC	230,523	250,000	19,477
YVWD - Henry Wochholz Regional Water Recycling Facility	1,756,000	1,756,000	---
City of Beaumont Wastewater TP	532,000	550,000	18,000
Regional Recycled Water Facilities Project	1,550,000	1,550,000	---
Collection Station	140,000	200,000	60,000
SBVMWD Discharge (gpd):	**4,702,523**	**7,738,000[2]**	**3,035,477**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to projected near-term maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

The SBVMWD service area maintains a treatment and disposal capacity of 1.64-mgd. As shown in the table, the projected near-term discharges significantly exceed the available treatment/disposal capacity by approximately 3.06-mgd, necessitating an increase of 3.0-mgd in treatment and disposal capacity in the near-term period.

Table 3-22 provides a summary of projected long-term average and maximum discharges within the SBVMWD service area. The SBVMWD service area will mitigate all maximum discharges by the long-term period, with accompanying increases in existing discharger flows. Despite these increases, the pipeline capacity in the SBVMWD service area exceeds the maximum discharge by approximately 2.97-mgd.

The SBVMWD service area maintains a treatment and disposal capacity of 1.64-mgd. Therefore, the projected long-term discharge significantly exceeds the available treatment/disposal capacity by approximately 3.11-mgd, necessitating increase in treatment/disposal capacity of approximately 3.0-mgd in the long-term period.

Table 3-22: SBVMWD Long-Term Brine Line Dischargers

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
Agua Mansa Power Plant	62,000	62,000	---
Mountainview Generating Station	432,000	432,000	---
Rialto Bioenergy Facility, LLC	230,523	250,000	19,477
YVWD - Henry Wochholz Regional Water Recycling Facility	1,756,000	1,756,000	---
City of Beaumont Wastewater TP	550,000	550,000	---
Regional Recycled Water Facilities Project	1,550,000	1,550,000	---
Collection Station	170,000	200,000	30,000
SBVMWD Discharge (gpd):	**4,750,523**	**7,738,000[2]**	**2,987,477**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to projected long-term maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

Table 3-23 provides a summary of projected build-out conditions within the SBVMWD service area. The SBVMWD service area will mitigate maximum discharges at build-out. No increases in discharge are projected, with build-out conditions the same as the long-term condition. The pipeline capacity in the SBVMWD service area exceeds the maximum discharge by approximately 2.89-mgd.

Table 3-23: SBVMWD Build-Out Brine Line Dischargers

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
Agua Mansa Power Plant	62,000	62,000	---
Mountainview Generating Station	432,000	432,000	---
Rialto Bioenergy Facility, LLC	250,000	250,000	---
YVWD - Henry Wochholz Regional Water Recycling Facility	1,756,000	1,756,000	---
City of Beaumont Wastewater TP	550,000	550,000	---
Regional Recycled Water Facilities Project	1,550,000	1,550,000	---
Collection Station	200,000	200,000	---
SBVMWD Discharge[2] (gpd):	**4,800,000**	**7,738,000**	**2,938,000**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to projected build-out maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

The SBVMWD service area maintains a treatment and disposal capacity of 1.64-mgd. As shown in the table, the projected build-out condition significantly exceeds the available treatment/disposal capacity by approximately 3.16-mgd, necessitating increase in treatment/disposal capacity.

3.2.5 Western Municipal Water District (WMWD) Summary

Table 3-24 summarizes existing and future discharges with respect to Western Municipal Water District's (WMWD) pipeline capacity right. As shown in the table, WMWD has a total pipeline capacity of 11.08-mgd. There are 24 discrete dischargers within the WMWD service area, including the WMWD collection station (located at WWTP No. 1 within the City of Corona). Based on the information collected during the Discharger Workshops, discharges from the WMWD service area are projected to be approximately 16.04-mgd, exceeding the WMWD pipeline capacity right by approximately 4.96-mgd. Existing discharge is approximately 4.61-mgd. Dischargers in the WMWD service area are projecting significant growth, particularly regarding new or expanded groundwater desalter facilities and increase recycled water demineralization for groundwater recharge. It is noted that dischargers within the WMWD service area discharge to Reaches IV-B, IV-D, and V of the Brine Line system.

Table 3-24: WMWD Projected Brine Line Discharges

Brine Line Discharger	Reach	Pipeline Capacity Right (gpd)
Anita B. Smith Treatment Facility	IV-D	30,000
Aramark Uniform & Career Apparel, LLC	IV-D	330,000
Dart Container Corporation	IV-B	60,000
Frutarom USA, Inc.	IV-B	5,000
Pyrite Canyon Treatment Facility (Stringfellow)	IV-D	259,000
Wellington Foods, Inc. (International Foods)	V	30,000
JCSD - Etiwanda Metering Station [includes discharges below]	IV-D	854,500
• *Magnolia Foods, LLC [3,560 gpd]*		
• *Metal Container Corporation [165,000 gpd]*		
• *Del Real, LLC [190,164 gpd]*		
• *JCSD Roger D. Teagarden Ion Exchange WTP [225,000 gpd]*		
• *JSCD Wells 17 & 18 Ion Exchange Treatment Facility [225,000 gpd]*		
JCSD - Hamner Metering Station	IV-D	49,000
Southern California Edison Mira Loma Peaker Plant	IV-D	2,500
JCSD - Wineville Metering Station	IV-D	249,000
WMWD Arlington Desalter	IV-B	1,400,000
Temescal Desalter (City of Corona)	IV-B	2,150,000
Rubidoux CSD	IV-D	2,000,000
Riverside County Flood Control and Water Conservation District	IV-D	2,000,000
Elsinore Valley MWD	V	1,200,000
Temescal Valley Water District	V	225,000
JCSD Future Desalter [Future Etiwanda discharge]	IV-D	4,000,000
Riverside Future Recycled Water Desal	IV-D	1,000,000
Collection Station (Waste Haulers)	IV-D	200,000
Western MWD Allocation (gpd):		**16,044,000**
Western MWD Pipeline Capacity(gpd):		**11,084,000**
Surplus/(Deficit) (gpd):		**(4,960,000)**

Note: Shaded information represents identified future dischargers.
(1) Future and existing pipeline capacity right

As shown in Table 3-2, the WMWD service area has several existing Brine Line dischargers that are assumed to continue to increase discharge to their allocated capacity right. The shaded dischargers are identified future discharges, as discussed in the following discussions:

1. Rubidoux Community Services District. Currently, Rubidoux Community Services District (RCSD or Rubidoux CSD) has no desalter operations and is wholly reliant on local groundwater supply to meet potable water demands of its water customers. Water is produced from six wells with an average TDS concentration of approximately 500 mg/l, ultimately reaching an average discharge TDS concentration of approximately 740 mg/l. District sewage is conveyed to the City of Riverside for treatment and disposal, with a discharge TDS concentration limit of 650 mg/l. As a result, the District will require approximately 2.0-mgd of Brine Line capacity for a proposed 7.0-mgd future desalter facility. RCSD projects the facility to be construction beyond the 10-year planning horizon.

2. Riverside County Flood Control & Water Conservation District. During the agency workshops, Riverside County Flood Control and Water Conservation District (RCFC&WCD) identified their desire to explore diversion to the Brine Line as an option for compliance with the MSAR Bacterial Indicators total maximum daily load (TMDL). The dry weather deadline for that TMDL has passed. Therefore, the agency may enter into TSO territory (i.e., diversions must be completed within <10 years). RCFC&WCD projects that these flows will increase over time, estimated to be up to 2.0-mgd. The first 1.0-mgd is projected within the near-term horizon (<10 years) and the second 1.0-mgd should be added to the long term (25 years). These projected discharges are based information gain during the agency workshops. Projected discharges will be reevaluated on a five-to-ten-year basis, thereby updating, and verifying demand increases over time. The purpose of the Brine Line is to remove salts from the Santa Ana Watershed. MS4 diversions flows with high salinity would be a benefit to the Watershed and support the purpose of the Brine Line. Approval to discharge these flows would be required by both the General Managers of SAWPA and OC San.

3. Elsinore Valley Municipal Water District. Elsinore Valley Municipal Water District (EVMWD) currently has a Brine Line pipeline capacity right of 0.80-mgd. The agency is required to discharge up to 7.5-mgd of tertiary treated effluent to Lake Elsinore. EVMWD is planning implementation of an Indirect Potable Reuse (IPR) project with the remaining effluent, which would increase its brine flow by approximately 0.65-mgd. EVMWD also projects that emerging regulations on groundwater supplies may result in the need for additional demineralization effort for their 5,500 afy of groundwater supplies (up to 0.50-mgd of brine production). EVMWD projects that its brine discharges will double in capacity within the next 25 years. Discharges to the Brine Line are projected to be approximately 1.2-mgd by 2045. This master plan includes 0.65-mgd of discharge outside the 10-year planning period, with the remainder discharged outside the 25-year planning horizon.

4. Temescal Valley Water District. The Temescal Valley Water District (TVWD) has no specific plans in the near future for discharges to the Brine Line. However, based on the potential of IPR/direct potable reuse (DPR) projects in the future, TVWD projected a small discharge to the Brine Line of 225,000 gpd, projecting that to occur well outside the 25-year planning horizon.

5. Jurupa Community Services District. Jurupa Community Services District (JCSD) operates the Chino II Desalter, owned by the Chino Basin Desalter Authority (CDA). JCSD has expressed concern about future regulatory changes and how those might impact discharges to the Brine Line, particularly potential per- and polyfluoroalkyl substances (PFAS) regulations. Based on these regulatory considerations, JCSD identified the potential for a future groundwater desalter outside the 10- to 20-year planning horizon. This future desalter is proposed to be a maximum capacity of 30-mgd. Buildout of JCSD is approximately 40-mgd of demand and expected to occur in approximately 2040. Discharge from this proposed desalter would be at the Etiwanda connection, similar to the existing desalter, at a flow of 4.0-mgd.

6. City of Riverside. The City of Riverside (City) projects the need for a future recycled water desalination plant, with a brine production of 1.0-mgd. Discharge would be to Reach IV-D of the Brine Line. The City discussed capacity rights to its existing WWTP. JCSD has 4-mgd, Rubidoux CSD has 3-mgd, Edgemont Community Services District has 0.80-mgd, and High Grove has 0.80-mgd. JCSD is projected to increase its capacity right by 1.0-mgd in 2030. Total flow is approximately 9.0-mgd. The plant also has significant tributary stormwater flows. It was identified that a 7- to 8-mile Brine Line lateral may be required to connect the City to the Brine Line.

Table 3-25 provides a summary of current average and maximum discharges from dischargers within the WMWD service area. As shown, several existing dischargers within the WMWD service area exhibit maximum flow values that exceed the current flow allocation. Discharge agreements restrict discharge, not allowing for flow peaking. However, as shown, the overall ownership capacity within the WMWD service area is sufficient to accommodate these maximum discharges currently.

As future dischargers are connected, the available excess capacity with the WMWD service will be reduced. Under these future conditions, it will become necessary to reduce, and ultimately eliminate, peaking of discharges to the Brine Line system. Individual dischargers will be faced with options including storage of flow to allow for a more consistent discharge profile or potentially reduction in overall discharge to reduce discharge variability. As the Brine Line system approaches capacity, discharge variations from individual discharges may result in violation of the OC San discharge limitations. Monitoring and control of discharge variations will be critical in the future.

Table 3-25: WMWD Existing Brine Line Discharges

Existing Brine Line Discharger	Measured Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
Anita B. Smith Treatment Facility	60,000	30,000	(30,000)
Aramark Uniform & Career Apparel, LLC	375,804	330,000	(45,804)
Dart Container Corporation	75,081	60,000	(15,081)
Frutarom USA, Inc.	28,800	5,000	(23,800)
Pyrite Canyon Treatment Facility (Stringfellow)	198,855	259,000	60,145
Wellington Foods, Inc. (International Foods)	74,037	30,000	(44,037)
JCSD - Etiwanda Metering Station [includes discharges below]	1,184,680	854,500	(330,180)
• *Magnolia Foods, LLC*			
• *Metal Container Corporation*			
• *Del Real, LLC [190,164 gpd]*			
• *JCSD Roger D. Teagarden Ion Exchange WTP*			
• *JSCD Wells 17 & 18 Ion Exchange Treatment Facility*			
JCSD - Hamner Metering Station	92,994	49,000	(43,994)
JCSD - Wineville Metering Station	323,926	249,000	(74,926)
WMWD Arlington Desalter	1,275,608	1,400,000	124,392
Temescal Desalter (City of Corona)	2,159,801	2,150,000	(9.801)
Collection Station (Waste Haulers)	566,497	250,000	(316,497)
Western MWD Discharge (gpd):	**6,416,083**	**11,084,000[2]**	**4,677,917**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to 2023 measured maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

Table 3-26 provides a summary of projected near-term average and maximum discharges from dischargers within the WMWD service area. New dischargers are shown in yellow, including Rubidoux CSD and Elsinore Valley MWD, totaling an additional 1,650,000 gpd of additional flow. However, Rubidoux CSD will discharge to Reach IV-D and Elsinore Valley CSD will discharge to Reach V. Western MWD conveyance capacity ownership (11.08-mgd) continues to exceed the projected discharge volumes, so additional conveyance capacity is not anticipated during the near-term period.

As shown in the table, it is anticipated several existing dischargers will begin to control maximum discharges during the near-term period, identified by the lack of excess capacity (i.e., "---"). Dischargers with positive excess capacity values are projected to increase flows in the future, while dischargers with negative excess capacity values continue to exceed their conveyance capacity allocation (a condition that is controlled in the future analyses). Western MWD maintains an excess conveyance capacity of 3.90-mgd throughout the near-term period.

Table 3-26: WMWD Near-Term Brine Line Dischargers

Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
Anita B. Smith Treatment Facility	30,000	30,000	---
Aramark Uniform & Career Apparel, LLC	330,000	330,000	---
Dart Container Corporation	60,000	60,000	---
Frutarom USA, Inc.	28,800	5,000	(23,800)
Pyrite Canyon Treatment Facility (Stringfellow)	198,855	259,000	60,145
Wellington Foods, Inc. (International Foods)	30,000	30,000	---
JCSD - Etiwanda Metering Station [includes discharges below]	1,184,680	854,500	(330,180)
• *Magnolia Foods, LLC*			
• *Metal Container Corporation*			
• *Del Real, LLC [190,164 gpd]*			
• *JCSD Roger D. Teagarden Ion Exchange WTP*			
• *JSCD Wells 17 & 18 Ion Exchange Treatment Facility*			
JCSD - Hamner Metering Station	92,994	49,000	(43,994)
JCSD - Wineville Metering Station	323,926	249,000	(74,926)
WMWD Arlington Desalter	1,268,000	1,400,000	132,000
Riverside County Flood Control	1,000,000	2,000,000	1,000,000
Temescal Desalter (City of Corona)	1,883,000	2,150,000	267,000
Rubidoux CSD	1,000,000	2,000,000	1,000,000
Elsinore Valley MWD	650,000	1,200,000	550,000
Collection Station (Waste Haulers)	100,000	200,000	100,000
Western MWD Discharge (gpd):	**7,182,755**	**11,084,000[2]**	**3,901,245**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to projected near-term maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

Riverside County Flood Control and Water Conservation District (RCFCWCD) operates many flood control facilities, including dams, flood basins, levees, open channels, and major underground storm drains. During drought and non-rainy seasons, the majority of water collected by RCFCWCD facilities is considered non-reclaimable flows, or "urban drool." The RCFCWCD discussed the potential for collecting and diverting these flows to the Brine Line at various location throughout the RCFCWCD service area. It is currently estimated that approximately 2.0-mgd of non-reclaimable water could be discharged to the Brine Line. At present, this project is in the conceptual phase, with additional discussion and planning to be completed between WMWD, SAWPA and the RCFCWCD. Discharges are planned to be tributary to Reaches 4D and 4E of the Brine Line system. It is projected that the project could be operational within the near-term planning horizon, contributing 1.0-mgd to the Brine Line. The remaining 1.0-mgd is projected through the long-term planning horizon.

With regard to treatment and disposal, Western MWD has a total of 6.21-mgd of capacity. Therefore, based on the maximum discharge condition, there is a deficiency of 0.97-mgd (increase of approximately 0.20-mgd beyond the existing conditions). Therefore, it is anticipated the Western MWD would be required to purchase additional treatment and disposal capacity within the near-term period to accommodate its existing and new dischargers. As treatment and disposal capacity is required to be purchased in 1.0-mgd increments, Western MWD would be required to purchase 1.0-mgd of capacity within the near-term period to cover excess discharges of 0.97-mgd.

Table 3-27 provides a summary of projected long-term average and maximum discharges from dischargers within the WMWD service area. New dischargers are highlighted including future discharges from the Riverside County Flood Control, Temescal Valley Water District, Jurupa Community Services District, and the City of Riverside. Furthermore, remaining maximum discharges are minimized to the extent possible. It is noted that discharge from the WMWD service area is projected to more than double within the long-term period, resulting in exceeding the existing pipeline capacity by approximately 2.53-mgd, requiring purchase of additional pipeline capacity.

Table 3-27: WMWD Long-Term Brine Line Dischargers

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
Anita B. Smith Treatment Facility	30,000	30,000	---
Aramark Uniform & Career Apparel, LLC	330,000	330,000	---
Dart Container Corporation	60,000	60,000	---
Frutarom USA, Inc.	5,000	5,000	---
Pyrite Canyon Treatment Facility (Stringfellow)	259,000	259,000	---
Wellington Foods, Inc. (International Foods)	30,000	30,000	---
JCSD - Etiwanda Metering Station [includes discharges below]	854,500	854,500	---
• *Magnolia Foods, LLC*			
• *Metal Container Corporation*			
• *Del Real, LLC [190,164 gpd]*			
• *JCSD Roger D. Teagarden Ion Exchange WTP*			
• *JSCD Wells 17 & 18 Ion Exchange Treatment Facility*			
JCSD - Hamner Metering Station	49,000	49,000	---
JCSD - Wineville Metering Station	249,000	249,000	---
WMWD Arlington Desalter	1,400,000	1,400,000	---
Temescal Desalter (City of Corona)	2,150,000	2,150,000	---
Rubidoux CSD	2,000,000	2,000,000	---
Riverside County Flood Control	2,000,000	2,000,000	---
Elsinore Valley MWD	800,000	1,200,000	400,000
Temescal Valley Water District	225,000	225,000	---
JCSD Future Desalter (future Etiwanda discharge)	3,000,000	4,000,000	1,000,000
Riverside Future Recycled Water Desalination	1,000,000	1,000,000	---
Collection Station (Waste Haulers)	150,000	200,000	50,000
Western MWD Discharge (gpd):	**13,594,.000**	**11,084,000[2]**	**(2,510,000)**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to projected long-term maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

The WMWD service area has a total of 6.21-mgd of treatment and disposal capacity. Therefore, based on the maximum discharge condition, there is a deficient of 7.40-mgd in the long-term period. It is anticipated the WMWD would be required to purchase a total of approximately 8.0-mgd of additional treatment and disposal capacity within the long-term period to accommodate its total existing, near-term, and long-term dischargers.

Table 3-28 provides a summary of projected build-out conditions within the WMWD service area. New dischargers are highlighted. Remaining maximum discharges are minimized where possible. It is noted that discharge from the WMWD service area is projected to increase by approximately 2.5-mgd at build-out, resulting in exceeding the existing conveyance capacity by approximately 5.0-mgd, requiring purchase of additional pipeline capacity (cumulative among the various evaluation periods).

Table 3-28: WMWD Build-Out Brine Line Dischargers

Existing Brine Line Discharger	Projected Maximum Discharge (gpd)	Maximum Allowable Discharge (gpd)	Excess Discharge Capacity[1] (gpd)
Anita B. Smith Treatment Facility	30,000	30,000	---
Aramark Uniform & Career Apparel, LLC	330,000	330,000	---
Dart Container Corporation	60,000	60,000	---
Frutarom USA, Inc.	5,000	5,000	---
Pyrite Canyon Treatment Facility (Stringfellow)	259,000	259,000	---
Wellington Foods, Inc. (International Foods)	30,000	30,000	---
JCSD - Etiwanda Metering Station [includes discharges below]	854,500	854,500	---
• *Magnolia Foods, LLC*			
• *Metal Container Corporation*			
• *Del Real, LLC [190,164 gpd]*			
• *JCSD Roger D. Teagarden Ion Exchange WTP*			
• *JSCD Wells 17 & 18 Ion Exchange Treatment Facility*			
JCSD - Hamner Metering Station	49,000	49,000	---
SCE Mira Loma Peaker Power Plant	2,500	2,500	---
JCSD - Wineville Metering Station	249,000	249,000	---
WMWD Arlington Desalter	1,400,000	1,400,000	---
Temescal Desalter (City of Corona)	2,150,000	2,150,000	---
Rubidoux CSD	2,000,000	2,000,000	---
Riverside County Flood Control	2,000,000	2,000,000	---
Elsinore Valley MWD	1,200,000	1,200,000	---
Temescal Valley Water District	225,000	225,000	---
JCSD Future Desalter (future Etiwanda discharge)	4,000,000	4,000,000	---
Riverside Future Recycled Water Desalination	1,000,000	1,000,000	---
Collection Station (Waste Haulers)	200,000	200,000	---
Western MWD Discharge (gpd):	**16,094,000**	**11,084,000[2]**	**(4,960,000)**

Notes:
1 Excess capacity is based on comparison of contractual maximum allowable to projected build-out maximum flow discharges.
2 Summary information based on Member Agency ownership, not on summation of columnar data.

The WMWD service area has a total of 6.23-mgd of treatment and disposal capacity. Therefore, based on the maximum discharge condition, there is a deficiency of approximately 9.86-mgd through build-out. It is anticipated the WMWD would be required to purchase this additional treatment and disposal capacity or define methods of managing brine production to decrease discharges.

3.3 Projected Brine Line Flow Summary

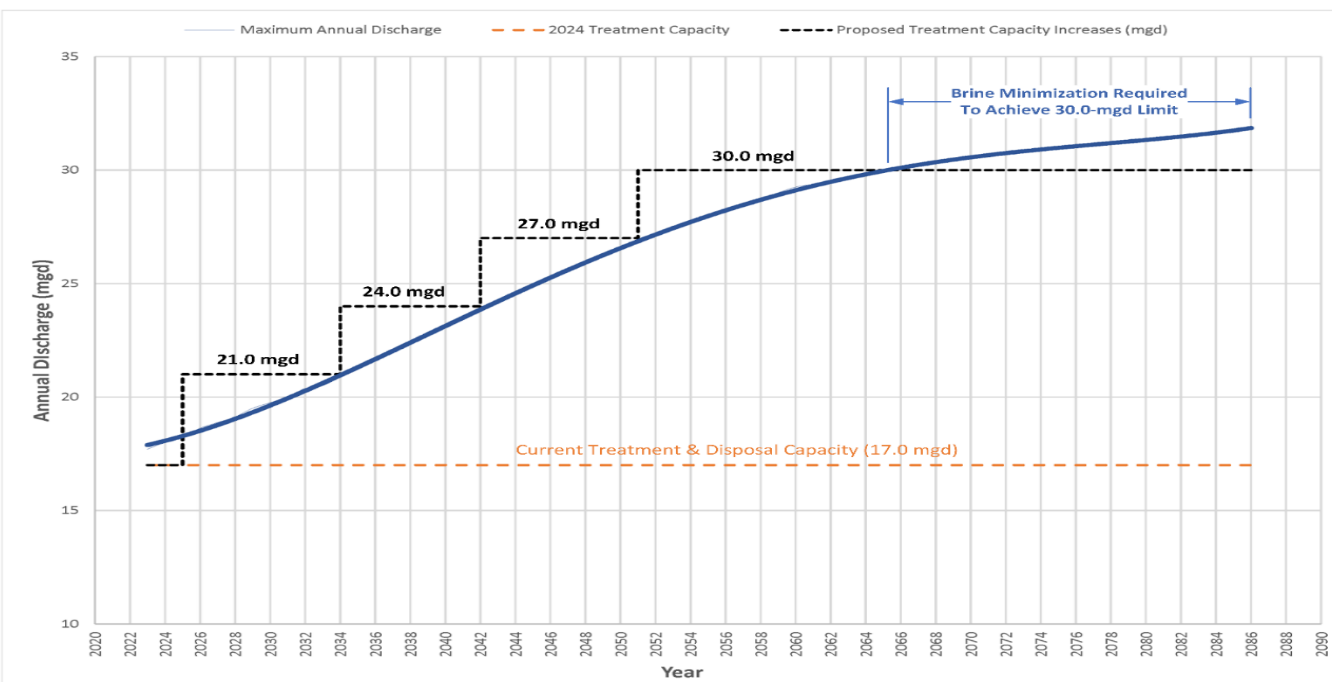
Table 3-29 summarizes the projected maximum discharge from the Member Agency service areas, as derived from the Discharger Workshops. Figure 3.3 illustrates the information provided in the table. As shown, discharges to the OC San system are projected to increase with time, with a projected maximum discharge of approximately 33.5-mgd. As the contracted limit between SAWPA and OC San is 30.0-mgd, brine management measures will be required to assure that the contracted limit is not exceeded. It is noted, however, that Brine Line system discharges are not projected to exceed the contract limit until approximately 2065, based on current projection by the various member agencies and other dischargers.

Figure 3-3 illustrates the projected growth in Brine Line discharges over time. As the current maximum discharge from the Brine Line is modeled to be approximately 17.7-mgd, SAWPA is projected to require additional treatment and disposal capacity. As shown on the figure, based on current projections, SAWPA will require additional treatment and disposal increases in 2026, 2034, 2042, and 2051 to stay ahead of the projected discharge increases. It is projected that brine minimization will be required beyond 2065 to maintain discharges below the 30.0-mgd limitation.

Table 3-29: Brine Line Discharge Summary

Year	Maximum Discharge (mgd)
2023	17.7
2024-2033	21.5
2034-2058	29.4
Build-Out	33.5

Figure 3-3 Brine Line Discharge to OC San System over Time



4 Hydraulic Model Update & Calibration

A hydraulic model is the primary tool for evaluating existing and anticipated future capacity of a collection system. The following section details the flow monitoring performed on the Brine Line system, the updates made on the existing InfoSWMM hydraulic model, and the model calibration performed to prepare the Authority's Brine Line hydraulic model for the capacity analysis component of this Study. Note: the InfoSWMM software is being phased out by AutoDesk; therefore, SAWPA should consider conversion of this software to a more current hydraulic modeling package such as Aquanuity's AquaTwin Sewer.

4.1 Flow Monitoring

In-line flow monitoring generally provides a current and accurate assessment of the capacity usage within a conveyance system. As part of the Brine Line hydraulic model update, flow monitoring was performed throughout the Brine Line system to evaluate system capacity and to calibrate the existing InfoSWMM hydraulic model. The following sections provide detail on the Brine Line flow monitoring locations and model calibration results.

4.1.1 Brine Line Calibration Reaches

To evaluate the overall system capacity and performance, the existing Brine Line system was subdivided into smaller calibration reaches. Those reaches were then used in conjunction with extended-period flow monitoring to provide field data for hydraulic model validation and calibration.

To accurately quantify tributary Brine Line flows from each reach, a clear understanding of how water moves into and out of each calibration reach was mapped. **Figure 4-1** illustrates each of the Brine Line calibration reaches, highlighting the locations where flow monitors (FM) were installed. **Table 4-1** presents a tabular report for the six flow monitoring locations.

Table 4-1: Flow Monitoring Locations

Flow Meter	MAS ID	Reach	Diameter (in)	Location Description
FM 01	4A-0220	IV-A	27	Pomona Rincon Rd NW of Euclid Ave
FM 02	4B-0100	IV-B	30	Butterfield Drive west of Clearwater Dr
FM 03	4D-0110	IV-D	42	Euclid Ave south of Pine Ave
FM 04	4D-0670	IV-D	42	Bellgrave Ave NE of Wineville Ave
FM 05	4D-1220	IV-D	39	Canal St NE of Mission Blvd
FM 06	4D-0280	IV-E	36	Santa Ana River (dry portion) east of Mt Vernon Ave

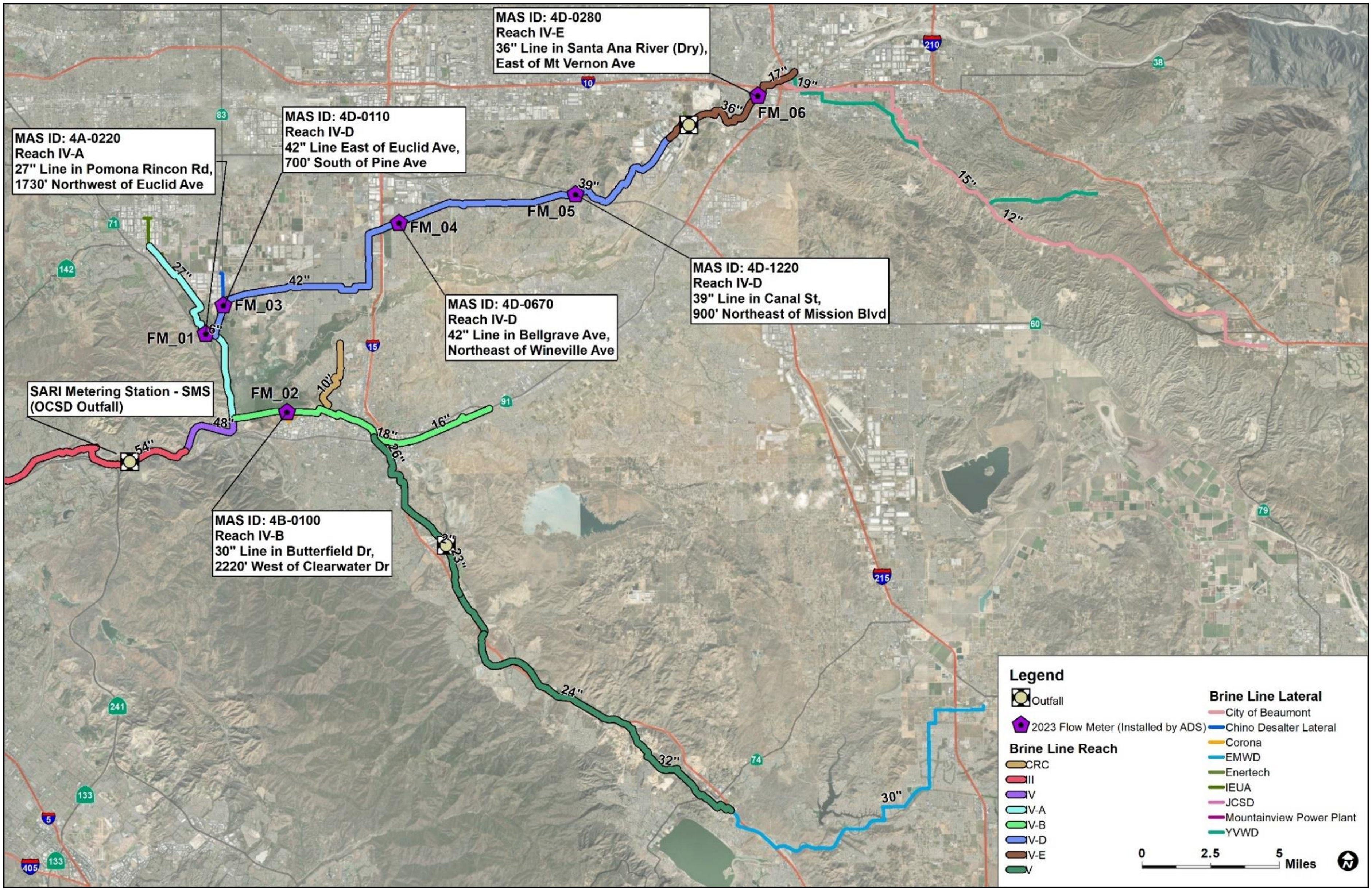


Figure 4-1 2023 Brine Line Flow Monitor Locations

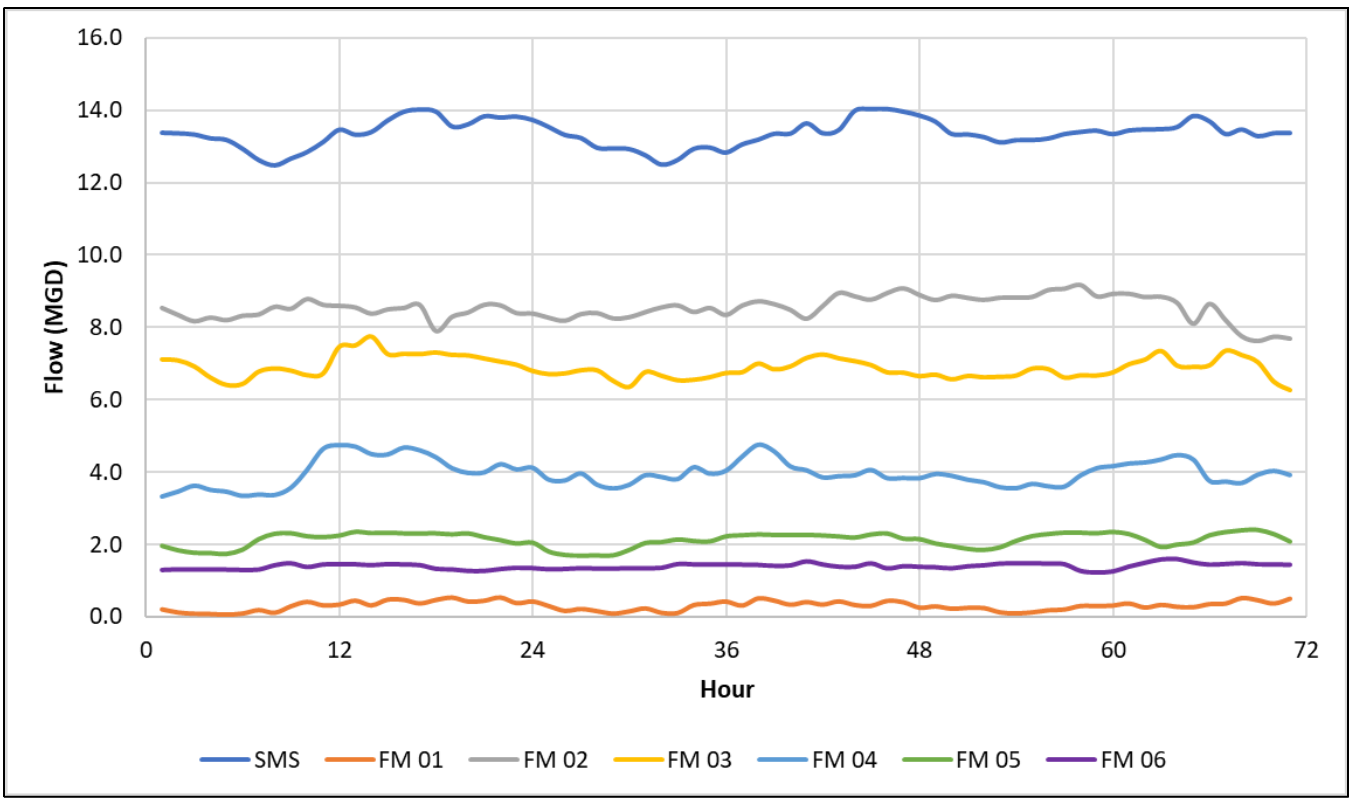
4.1.2 Flow Monitoring Program

Flow monitoring was performed by ADS Environmental Services at six (6) selected locations between the dates of June 1 and June 15, 2023. Flow data was collected at 5-minute intervals throughout the monitoring period. The flow monitoring equipment stored raw data, including ultrasonic depth, maximum velocity, and pressure depths. The continuity equation (Q = V x A) was used to convert depth and velocity data to flow. The flow monitoring equipment incorporates area-velocity measurement devices, such as the Doppler sensors, with an identified accuracy of ±10%.

4.1.3 Brine Flow Patterns

Flow monitoring data was used to develop basin-specific flow patterns for model validation and calibration. Based on review of the flow monitoring data, it was determined that flows were highest at the SARI Metering Station (SMS) from June 7 through June 9, 2023. Therefore, that same 72-hour period was used for each of the monitoring locations to establish a conservative estimate of the basin's flow patterns. Concurrent flow data from each Brine Line discharger was collected and used to coincide with this same 72-hour monitoring period, further discussed in Section 4.2.2. **Figure 4-2** presents the 6 72-hour flow patterns developed for each monitoring location and used for calibration of the Brine Line model.

Figure 4-2 72-Hour Brine Line Flow Patterns for Model Calibration



4.2 Hydraulic Model Update & Calibration

The primary tool for the hydraulic capacity analysis is the Brine Line hydraulic model, simulating flow scenarios, such as wastewater depth, flow rate, and velocity within the Brine Line system. As part of this master plan, SAWPA's existing Brine Line InfoSWMM hydraulic model was updated, calibrated, and used to evaluate system capacity. The following discussions outline the model update and calibration process implemented.

4.2.1 Model Updates

Updates were incorporated into the hydraulic model based on available system improvement plans, including the recently constructed City of Beaumont lateral. The following specific updates were incorporated into the hydraulic model:

- Reach V Rehabilitation & Improvement Project, 2014
- Reach V Rehabilitation & Improvement Project, Phase 2, 2017
- Brine Disposal Pipeline Project Reach 1 (City of Beaumont Lateral), 2018
- Brine Disposal Pipeline Project Reach 2 (City of Beaumont Lateral), 2018

4.2.2 Discharger Flows

Flow data was collected for each discharger coinciding with the Brine Line flow monitoring period of June 1 through June 15, 2023. Each discharger's flow was incorporated into the model at the specific discharge location on the Brine Line, including the average flow associated with the 2-week monitoring period. The same 72-hour period (June 7 through June 9, 2023), previously used to develop flow patterns for the 6 flow monitoring locations, were used to develop unique flow patterns for each discharger. In this manner, there is consistency between the flow monitoring and discharge data for the calibration process.

4.2.3 Model Calibration

Average discharger flow and 72-hour flow patterns were incorporated into the hydraulic model, and extended period simulations were executed over a 7-day modeling analysis period. Flow values and patterns at each of the 6 flow monitoring locations were compared to the modeling analysis results. Model calibration is achieved by observing average flow values at the six (6) monitoring locations and adjusting the 72-hour flow patterns, as necessary, to achieve a consistent result between the average and maximum flow values and patterns between the model and the flow monitoring results. The hydraulic model is deemed to be "calibrated" when both average and maximum model predictions reflected field measurements within 10% or less. The following **Table 4-2** summarizes the results of the calibration process for each calibration reach.

Table 4-2: Brine Line Model Calibration Results

Flow Meter	Calibration Results					
	Average Flows			Maximum Flows		
	Measured (mgd)	Modeled (mgd)	% Difference	Measured (mgd)	Modeled (mgd)	% Difference
SMS	13.34	13.53	1.4	14.02	14.99	6.9
FM 01	0.31	0.30	3.9	0.53	0.56	6.8
FM 02[1]	8.53	6.77	20.6	9.17	7.35	19.9
FM 03	6.87	6.48	5.8	7.74	7.54	2.5
FM 04	3.98	3.71	6.9	4.76	4.54	4.6
FM 05[2]	2.13	1.75	17.5	2.41	2.08	13.4
FM 06	1.40	1.46	3.9	1.60	1.70	6.5

Notes:

1 The sum of the averages of FM 01, 02 and 03 should be approximately equal to the average flow at the SMS. The sum of the measured averages equal 15.7-mgd, while the sum of the modeled averages equal 13.5-mgd. Therefore, it was determined that the flow meter at FM 02 was measuring inaccurately.

2 The calibration of FM 05 was reviewed and determined that FM 05 was also measuring inaccurately. Both the upstream (FM 06) and downstream (FM 04) flow data calibrated well.

It is noted that two of the six flow monitoring locations (FM 02 and FM 05) did not calibrate within the desired 10% accuracy. Both monitoring locations were subsequently investigated to determine the source of possible discrepancies. For FM 02, the sum of FM 01, FM 02 and FM 03 would be expected to equal the SMS flow measurement. The sum of these model-predicted flow values coincided with the SMS, while the sum for the flow monitored values reflects values that are approximately 2.0-mgd higher than would be expected. Dudek requested the flow monitoring subconsultant, ADS, to review the data for FM 02. The flow monitoring data analysis indicated a potential weir-like affect occurring downstream of the flow monitoring equipment, resulting in the calculated measurements being up to approximately 15% high. Reducing the measured value by 15% would result in the modeled and measured values for FM 02 being within the 10% accuracy threshold. As a result, FM 02 was not used in calibration of the hydraulic model.

ADS also evaluated the data for the FM 05 monitoring location. As the equipment operates on a depth to velocity relationship, the raw data did not show a specific issue with the hydraulic factors. However, should the Doppler sensors be biased, they tend to be biased to the high side of the scale. As a sensitivity analysis, reducing FM 05 measurements by 10%, to an average flow value of 1.92-mgd, results in the modeled and measured values falling within the 10% accuracy. As a result, monitoring location FM 05 was also not used in calibration of the hydraulic model.

Finally, it is noted that flow within the Brine Line is based on the individual discharger flows, which are not consistently repeatable as would typically be found in a sewer collection system. Discharger flows vary over a relatively large range based on the ongoing operations of the discharging entity. For example, desalters typically have multiple treatment trains within their process. These treatment trains may be impacted by a variety of operational, maintenance or other challenges, which may result in increases and decreases in actual brine discharge to the Brine Line system. Other dischargers may be impacted by similar operational or maintenance activities, resulting in similar flow fluctuations. The modeling analysis uses flow variation patterns to replicate actual flow variations but cannot exactly match the discharger flow variations at all times. This discrepancy exhibits itself by variation between the predicted and measured flow at the flow monitoring locations.

Furthermore, the calibration effort collected data from the dischargers to coincide with the Brine Line flow monitoring dates. The actual discharges have travel time and dampening effects that occur as the flows traverse the Brine Line system. As a result, comparison of the flow monitoring results with modeling predictions is displaced in time and do not exactly reflect the discharge conditions. As a result, for calibration, matching exact patterns was not the intention, rather matching average and maximum flow values is the goal. In this manner, the critical flow conditions (maximum and average) are reflected in the hydraulic model, allowing an accurate analysis of the hydraulic capabilities of the Brine Line system. The 10% accuracy allowance is a method of accounting for these variabilities within the analysis itself. **Figures 4-3** through **4-9** provide the calibration curves for each of the flow monitoring locations.

Figure 4-3 presents the calibration curves for the SMS at the most downstream reach of the Brine Line. These curves track well, with the modeled maximum slightly more conservative than the measured maximum, which is preferred for capacity analysis.

Figure 4-3 SARI Metering Station (SMS) Calibration Curve

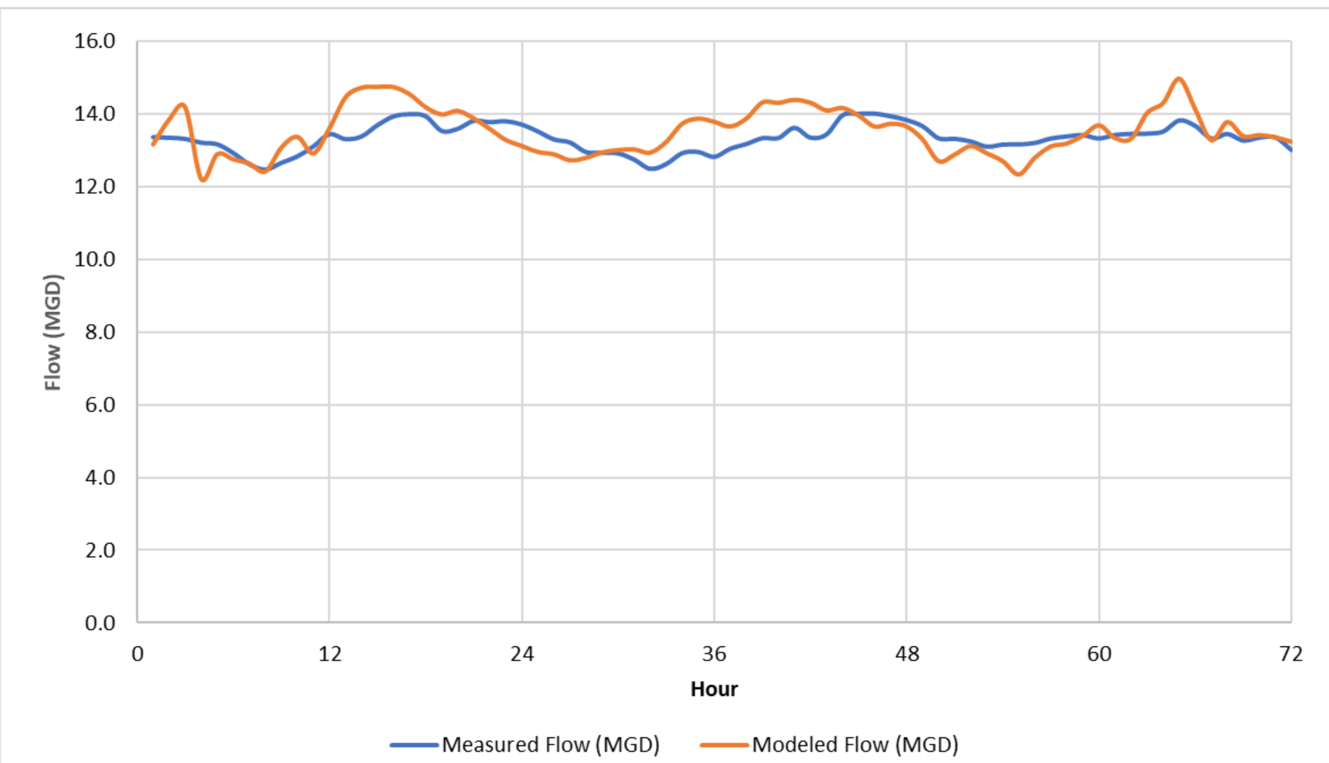


Figure 4-4 presents the curves for FM 01 at the base of Reach IV-A, which serves very few customers and has limited flow. Again, these curves track well with the modeled maximum slightly more conservative than the measured maximum indicating the discharger diurnal patterns entered into the model are resulting in accurately modeled flow conditions in Reach IV-A.

Figure 4-4 FM 01 Calibration Curve

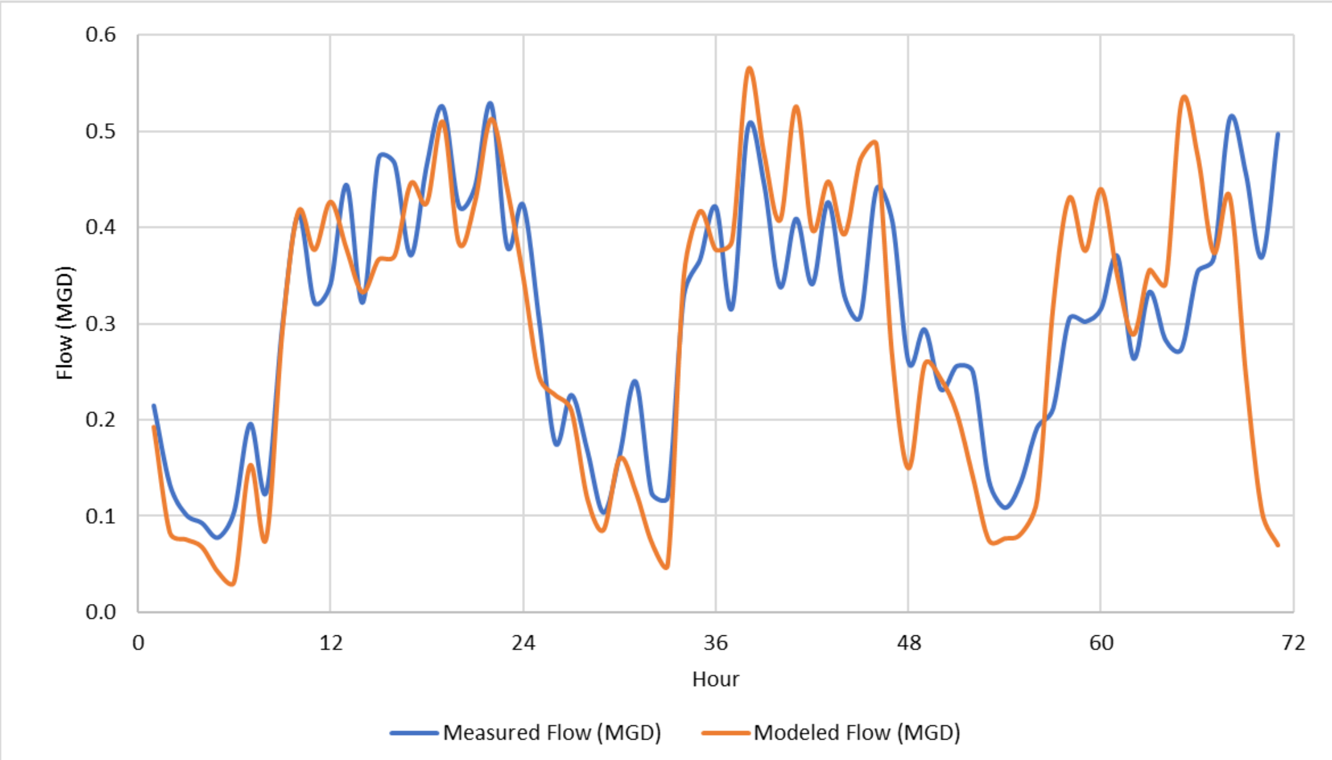


Figure 4-5 presents the curves for FM 02, which demonstrate the significant difference between the modeled and measured flows at the downstream end of Reach IV-B. As previously stated, a statistical analysis performed on the flow metering data points indicated a potential weir-like effect that could result in the flows measuring up to 15% high. Average flows were off by approximately 20% at this location. The similarity of the patterns of the two curves, however, indicates the diurnal patterns used for the dischargers upstream are resulting in downstream modeled flow variability that match measured conditions.

Figure 4-5 FM 02 Calibration Curve

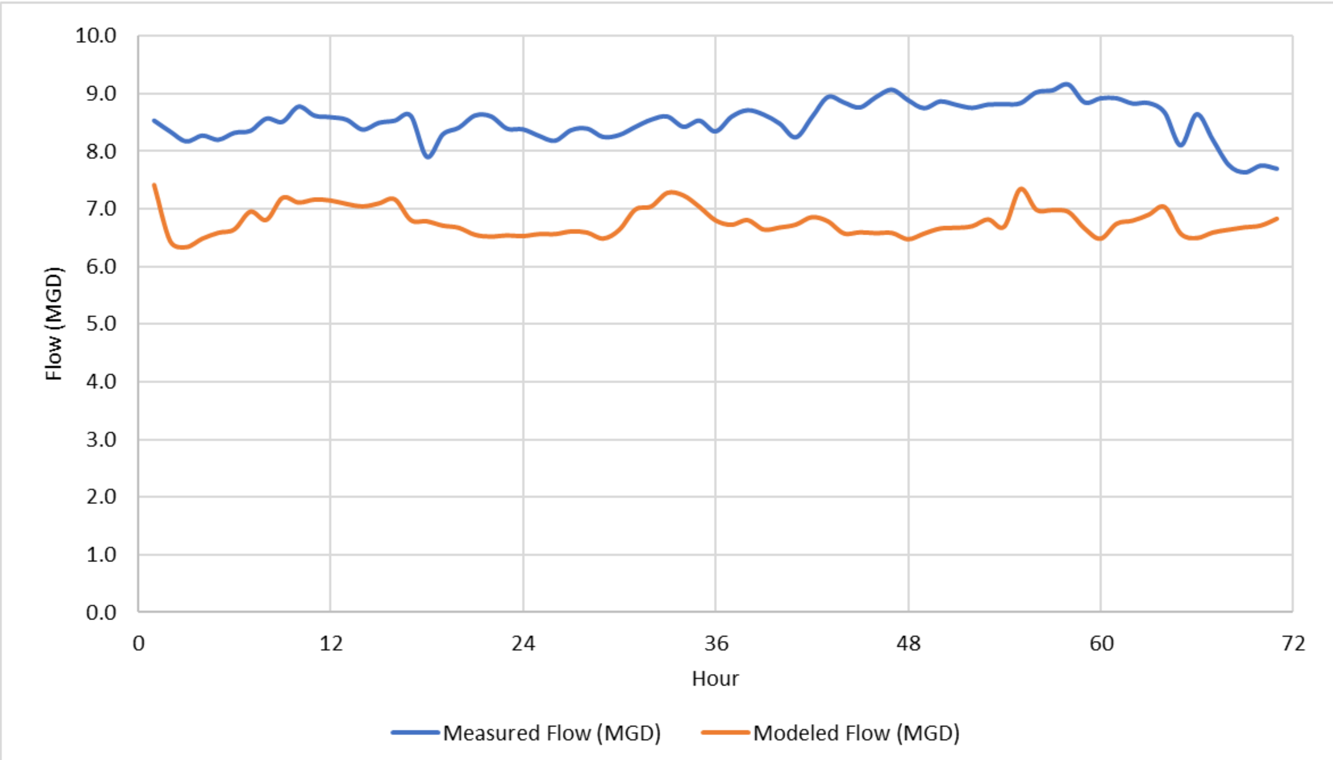


Figure 4-6 presents the calibration curves for FM 03, which is measuring flows in Reach IV-D, just upstream of the confluence with Reach IV-A. At this location, average and maximum flows calibrated within 6% and 2.5% respectively. The pattern of the curves indicates relatively accurate correlation of flow conditions in the Brine Line between the modeled and measured values.

The calibration curves for FM 04, as shown in Figure 4-7, located upstream of FM 03, indicate a minor time offset of the flows but patterns that correlate in overall flow variability, with a consistent daily maximum.

Figure 4-6 FM 03 Calibration Curve

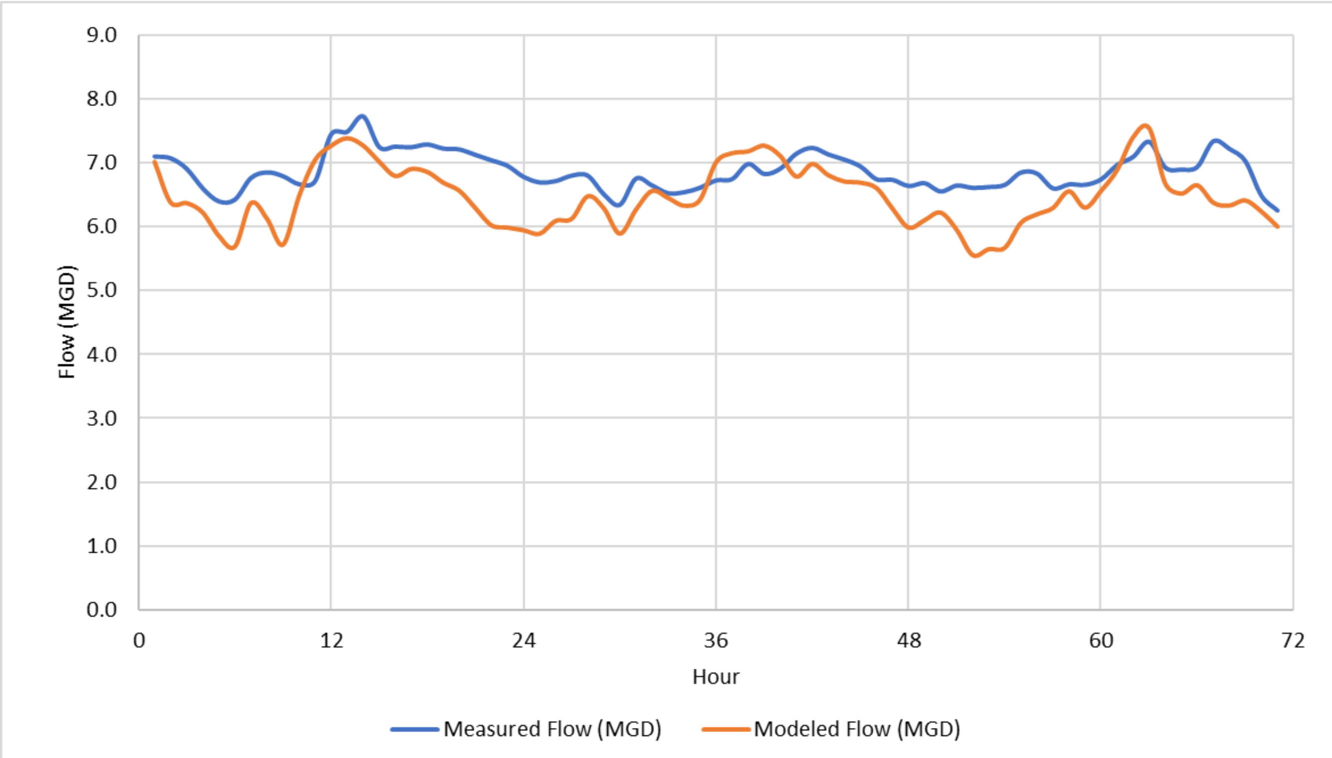


Figure 4-7 FM 04 Calibration Curve

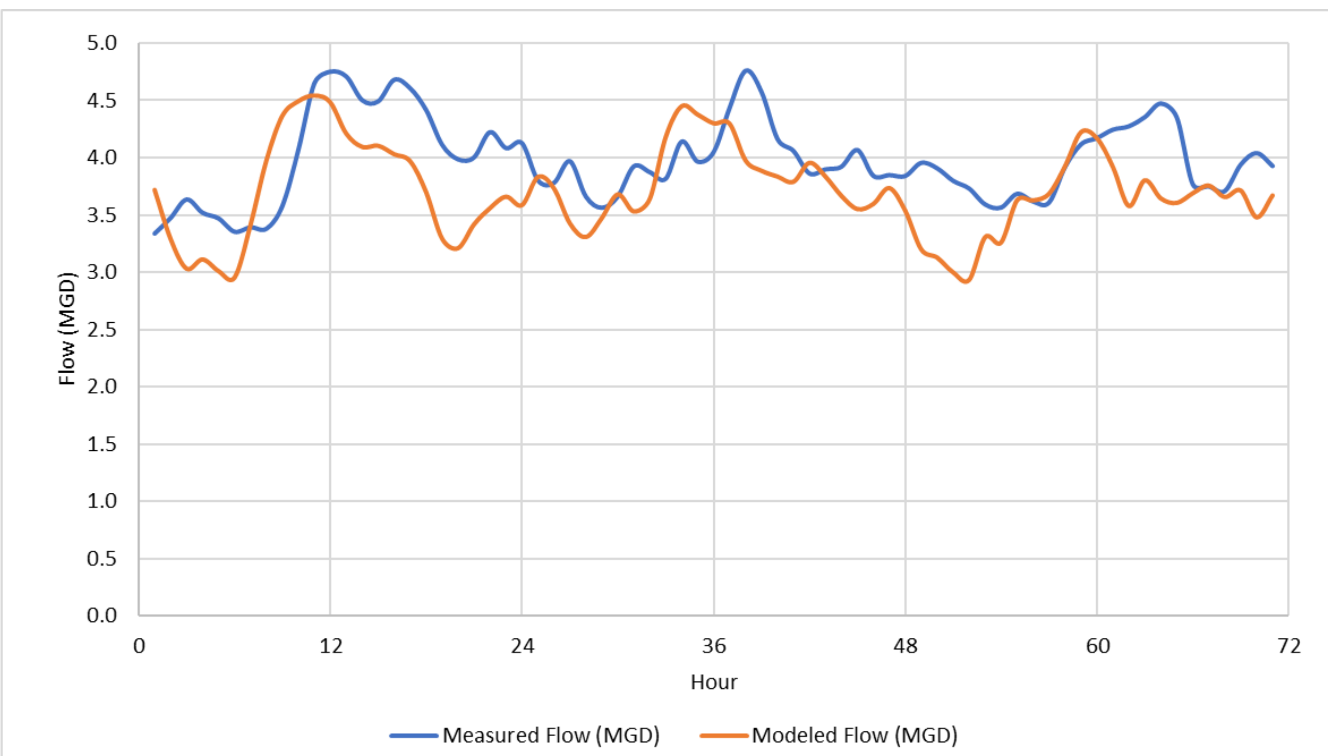


Figure 4-8 presents the curves for FM 05. As stated previously, the measured data for FM 05 was not used due to FM 04 and FM 06, located downstream and upstream of FM 05, respectively, calibrating well and the ADS review conceding that the flow meters, if biased, are typically biased high. The patterns, while again indicating a time offset, show a relatively consistent diurnal pattern between modeled and measured conditions.

Figure 4-8 FM 05 Calibration Curve

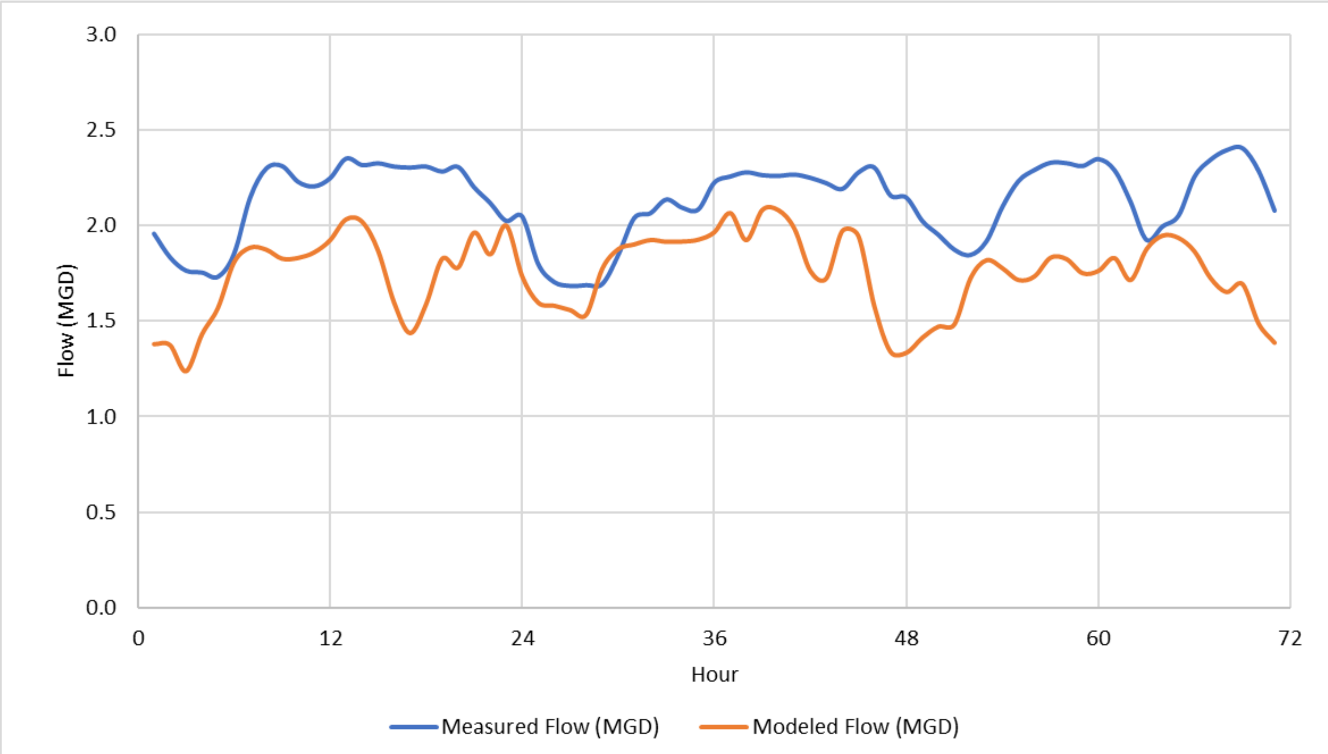
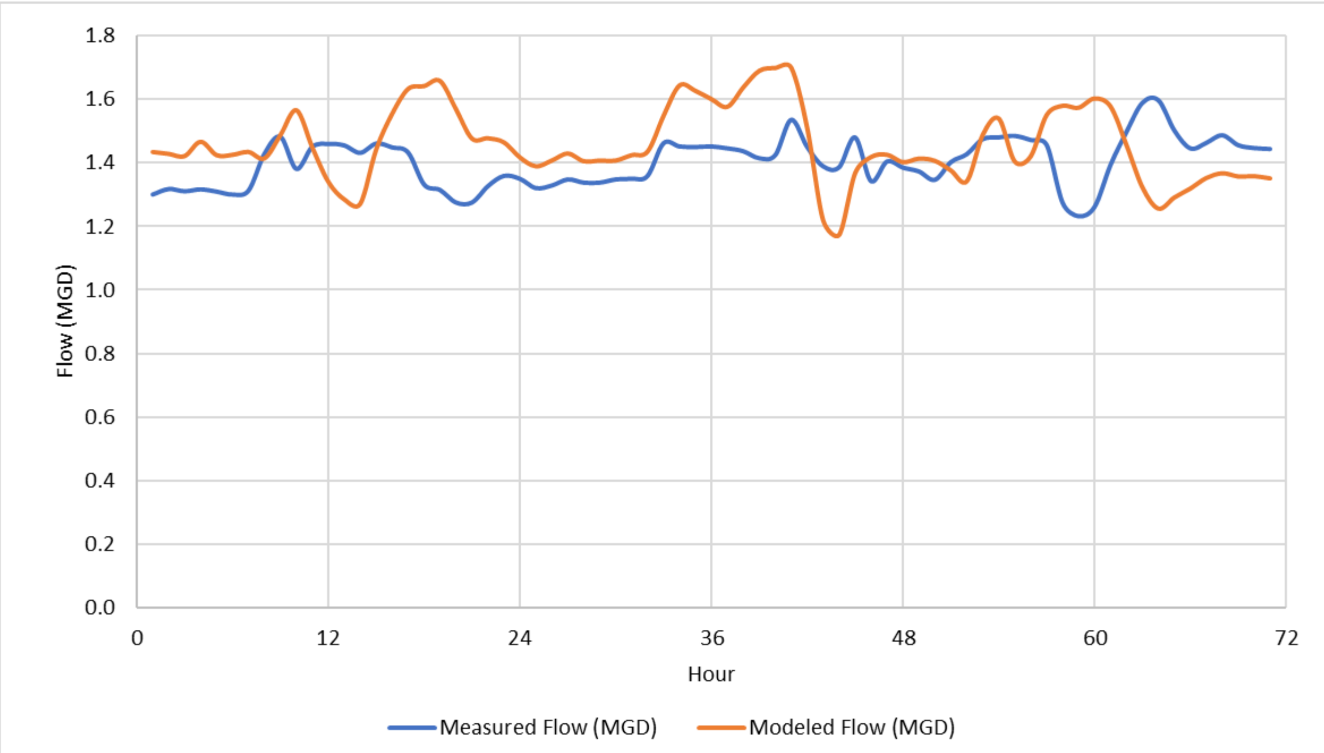


Figure 4-9 presents the curves for FM 06, at the upstream end of Reach IV-E, downstream of the Yucaipa and Beaumont laterals. The average and maximum flows calibrated within 4 and 6.5% respectively, with the modeled maximum slightly more conservative than the measured maximum. The patterns show consistent shape indicating the flow variability in the discharger diurnal patterns entered in the model are consistent with measured conditions.

Figure 4-9 FM 06 Calibration Curve



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5 Brine Line System Capacity Analysis

The following section summarizes the results of the Brine Line capacity analyses under Existing, Near-Term, Long-Term, Buildout, and Ownership discharge scenarios, as well as an overall reach-by-reach analysis. The Brine Line hydraulic model, updated and calibrated as discussed in Section 4, was used to analyze each defined discharge scenario. The model results were compared to design criteria, developed with concurrence from SAWPA staff, to identify potential Brine Line deficiencies under the various discharge conditions.

5.1 Brine Line Design Criteria

Brine Line capacity, under existing and future discharge conditions, was evaluated using the design criteria presented in **Table 5-1**. These criteria also serve as the basis for introduction of new or improved facilities intended to extend existing Brine Line service or accommodate increased discharge through the system across the various planning horizons. These design criteria were developed after consultation with SAWPA staff and industry standards for gravity and pressurized pipelines.

Table 5-1: Brine Line Design Criteria for Capacity Evaluation

Gravity Pipeline Parameter	Minimum Velocity during Maximum Discharge	2.0 fps
	Manning's Roughness Coefficient	0.013[1]
	Maximum Depth-over-Diameter during Maximum Discharge	0.75
Pressurized Pipeline Parameter	Maximum Pressure – Reach V	80 psi
	Maximum Pressure – Top of Reach IV-E	55 psi

Notes:
1 Unless material and/or age are otherwise specified. See Table 5.2 for other roughness coefficients used in Brine Line model when pipeline material was defined.

Typical criteria used for capacity evaluation of gravity (i.e., open channel flow) pipelines include the maximum depth-over-diameter ratio (d/D) and minimum flow velocity. Using Manning's equation, the flow within each segment of gravity pipeline is defined as a function of the depth of flow and pipeline diameter (i.e., d/D). Gravity pipelines are not designed to flow at full capacity (i.e., maximum d/D of 1.0), as the headspace in the pipeline accommodates potential inflow and infiltration (I&I) during wet weather events. For typical wastewater collection systems, gravity pipelines flowing at or near full capacity can increase the incidence of sanitary sewer spills at manholes and other open surface locations throughout the system.

Maintenance access structures (MASs) throughout the Brine Line system are sealed in portions of the Brine Line, including within the Prado Inundation Area and the gravity pressure lines. These sealed MAS can accommodate increased flows under potential pressure flow conditions (i.e., siphons). Nevertheless, this Master Plan evaluates gravity flow pipelines to maintain a maximum d/D of 0.75, or 75% full flow, during maximum discharge conditions. The Brine Line system can maintain pipeline capacity beyond a d/D of 0.75, and the following analyses consider this ability when identifying potential system deficiencies.

Under maximum discharge conditions, gravity pipelines should attain a minimum velocity of at least 2.0 fps to achieve desired "self-cleaning" properties, thereby minimizing solids settlement and eventual deposition. Velocities greater than 8.0 fps should be avoided over an extended period to prevent scouring and damage to the interior walls of pipelines. Design criteria for pressurized pipelines, which always flow full, typically do not specify a minimum velocity. However, maximum velocities in pressurized pipelines should remain below 10.0 fps, with 8.0 fps desired.

The Manning's roughness coefficient ("n" value) of a pipeline varies with material and age. The Brine Line model contains pipelines with Manning's roughness coefficients ranging from 0.009 to 0.018, with 0.013 predominant. Table 5-2 summarizes the typical Manning's coefficients assigned to pipelines in the model based on material type.

Table 5-2: Brine Line Model Manning's Roughness Coefficients ("n")

Pipeline Material	Minimum "n"	Maximum "n"	Model "n"
HDPE, PVC, or CIPP-Lined	0.009	0.011	0.010
RCP	0.011	0.015	0.013[1]
VCP	0.013	0.015	0.013
FRP (Slip-lined)[2]	0.009	0.0105	0.010

Notes:
1 The majority of RCP pipe in the Brine Line model has an "n" value of 0.013. A portion of Reach IV-B, from MAS 4B-0170 to MAS 4B-0010 (approximately 3.1 miles), was assigned an "n" value of 0.009 corresponding to the FRP material.
2 FRP slip-lined pipe extends from MAS 4A-0150 to MAS 4A-0010.

Consistent with industry standards, a roughness coefficient of 0.013 represents a conservative estimate of the average roughness of a typical gravity pipeline over its useful lifespan. A roughness coefficient of 0.013 was used for pipelines where age and/or material information was unknown.

Reach V and a portion of Reach IV-E, near the Colton Wastewater Treatment Plant, were designed to convey flow under gravity pressure conditions, effectively serving as an extended siphon. The maximum allowable pressure for these extended pressurized sections of the Brine Line is based on pipeline class, as identified on the record drawings.

5.2 Brine Line Evaluation Criteria

As stated in Section 5.1, the d/D design criterion for gravity flow pipelines accounts for the headspace above the flow line, in consideration of I&I during wet weather events. Unlike typical municipal wastewater collection systems, the Brine Line does not exhibit significant flow variations during wet weather events. Furthermore, the Brine Line does not follow a typical municipal layout, minimizing the likelihood of illicit storm drain connections.

Separate evaluation criteria are used to determine permissible flow levels or remaining available capacity under maximum flow conditions. Such evaluation criteria are referred to as "trigger" criteria. Based on discussions with SAWPA staff and criteria established by other agencies, gravity flow pipelines are permitted to flow up to 75% full at maximum discharge before improvement projects will be considered. Meanwhile, pressurized pipelines can experience maximum pressures up to those listed in Table 5-1, prior to triggering potential improvements.

5.3 Brine Line Capacity Analysis Results

The following discussions present the Brine Line capacity analysis results for the Existing, future (including Near-Term, Long-Term, and Buildout), and Ownership discharge scenarios. Each scenario was developed using information collected during the Discharge Workshops, as summarized in Section 3.

In addition, Brine Line capacity was analyzed on a Reach-by-Reach basis to establish the maximum allowable flow within each defined Reach, after which improvement projects may be required. The capacity of privately-owned laterals is not evaluated. However, the maximum d/D of privately-owned laterals is provided on each discharge scenario's capacity results figure for reference.

5.3.1 Existing Discharge Capacity Evaluation (June 2023)

A capacity analysis under Existing discharge conditions (June 2023) was performed using the calibrated Brine Line model. A five-day extended period simulation (EPS) was completed, with maximum d/D in gravity flow pipelines compared to the evaluation criteria, as summarized in Section 5.2. **Figure 5-1** illustrates the maximum d/D results for gravity flow pipelines of the Brine Line system under Existing discharge conditions.

Under Existing discharge conditions, no gravity flow pipelines are shown to achieve a maximum d/D greater than 0.75. The maximum pressure in Reach V as predicted by the model is approximately 56 psi. The maximum pressure at the top of Reach IV-E as predicted by the model is approximately 6 psi.

Additionally, **Figure 5-2** depicts the maximum pipeline velocities anticipated throughout the Brine Line system under Existing discharge conditions. In general, the gravity flow pipelines Reaches IV and IV-A through IV-E are expected to attain a velocity of at least 2.0 fps over a five-day period. Due to current low flows from IEUA dischargers, the maximum velocity in Reach IV-A north of Euclid Ave is expected to reach 1.9 fps only. However, as flows from IEUA dischargers increase over the future discharge scenarios, the maximum velocity in Reach IV-A north of Euclid Ave will also increase to at least 2.0 fps. SAWPA is recommended to consider increased observation and cleaning of this reach.

The maximum velocities within the extended siphons in Reach V were calculated using the continuity equation (Q = V x A). Under Existing maximum discharge conditions, velocities in Reach V are expected to reach 2.2 fps but not exceed 8.0 fps in the smallest diameter (i.e., 23-inch) segments.

No dischargers are connected to the CRC lateral in the Existing discharge scenario, resulting in a maximum velocity of zero throughout the lateral (i.e., no flow). Furthermore, the Discharge Workshops did not identify any new dischargers to the CRC lateral in future scenarios. It is assumed that no flow is conveyed to the Brine Line via the CRC lateral in any of the following discharge scenarios.

5.3.2 Near-Term Discharge Capacity Evaluation (2024 – 2034)

A capacity analysis of the Brine Line system under Near-Term discharge conditions was performed. Near-Term discharges were developed as discussed in Section 3 and represent the projected increase in discharge between 2024 and 2034. A five-day EPS was completed, with maximum d/D in gravity flow pipelines compared to the evaluation criteria summarized in Section 5.2. Figure 5-3 summarizes the maximum d/D in gravity flow pipelines of the Brine Line system under Near-Term discharge conditions.

Under Near-Term discharge conditions, no gravity flow pipelines are anticipated to achieve a maximum d/D greater than 0.75. The maximum pressure in Reach V as predicted by the model is 57 psi. The maximum pressure at the top of Reach IV-E as predicted by the model is approximately 6 psi.

Figure 5-4 depicts the maximum pipeline velocities anticipated throughout the Brine Line system under Near-Term discharge conditions. Compared to the Existing discharge scenario, velocities are expected to increase due to higher flows in the Near-Term scenario. For example, several pipelines in Reach IV-A north of Euclid Ave are expected to reach a maximum velocity of 2.0 fps instead of remaining at or below 1.9 fps.

Under Near-Term discharge conditions, the maximum velocity in Reach V will increase to approximately 2.5 fps in the smallest diameter segments as a result of additional flows from Elsinore Valley MWD's future connection to the Brine Line. As with the Existing discharge scenario, velocities are not anticipated to exceed 8.0 fps within Reach V under Near-Term discharge conditions.

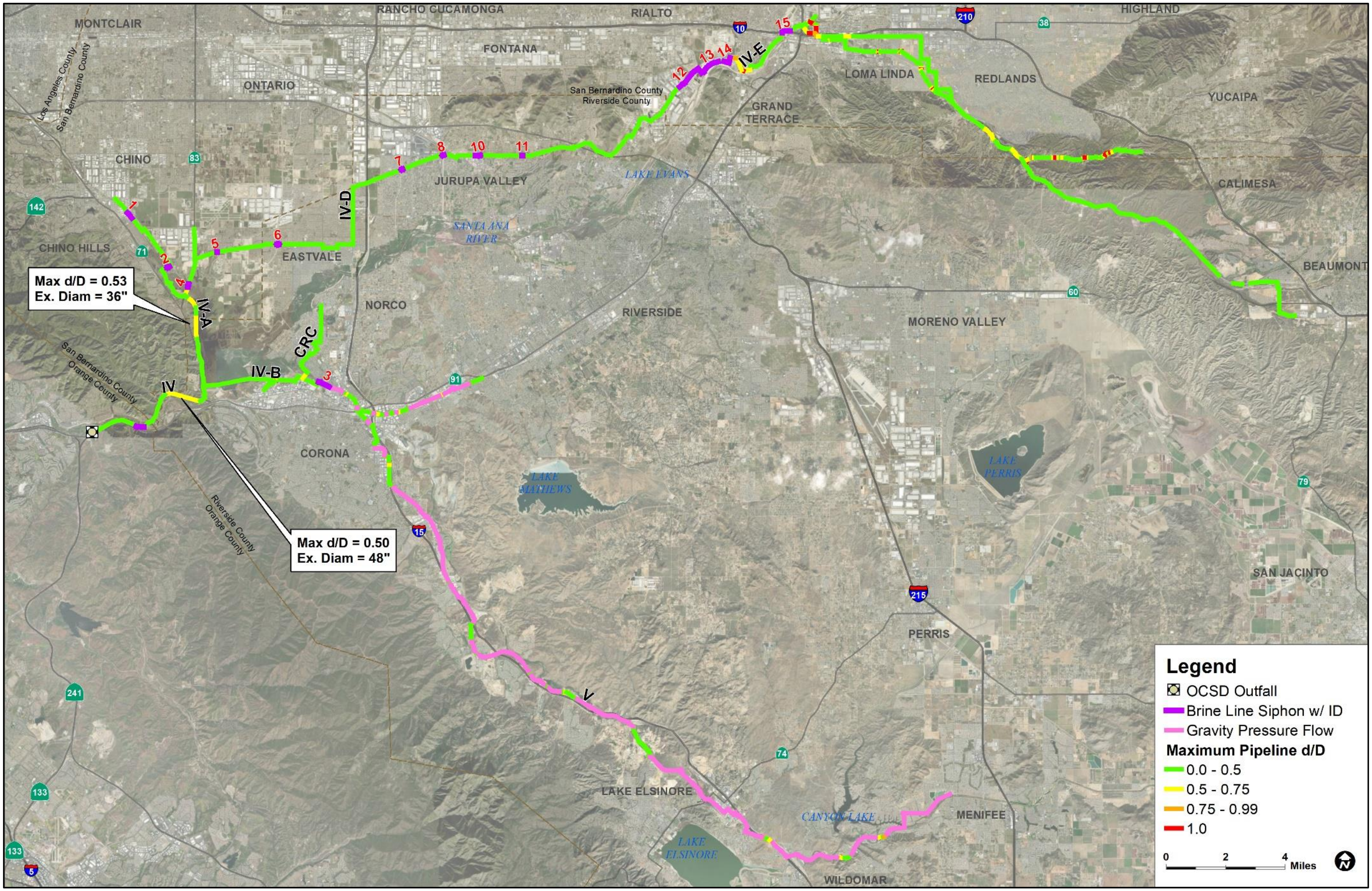


Figure 5-1 Existing Maximum Discharge Scenario – Maximum Pipeline d/D

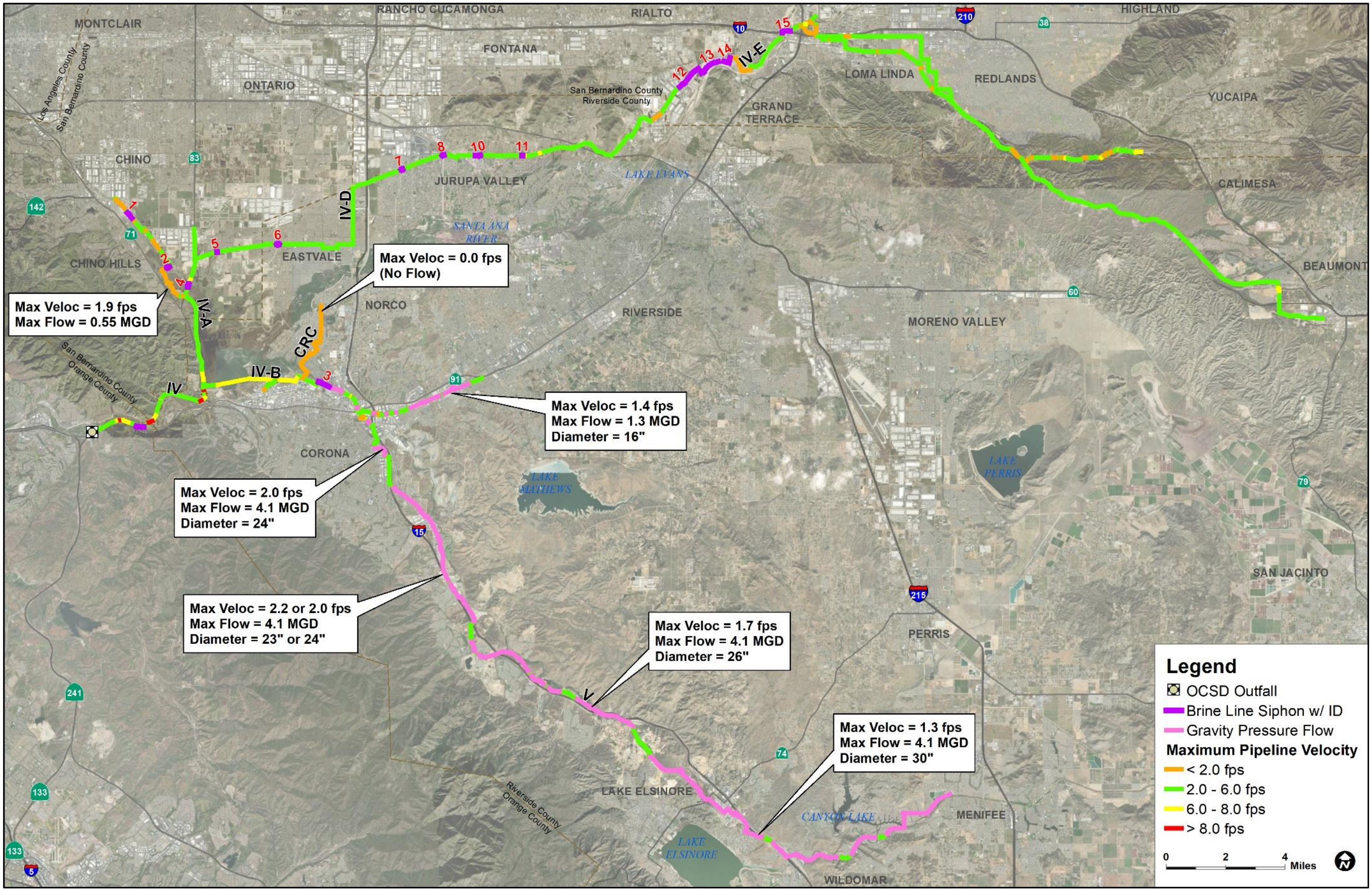


Figure 5-2 Existing Maximum Discharge Scenario – Maximum Pipeline Velocities

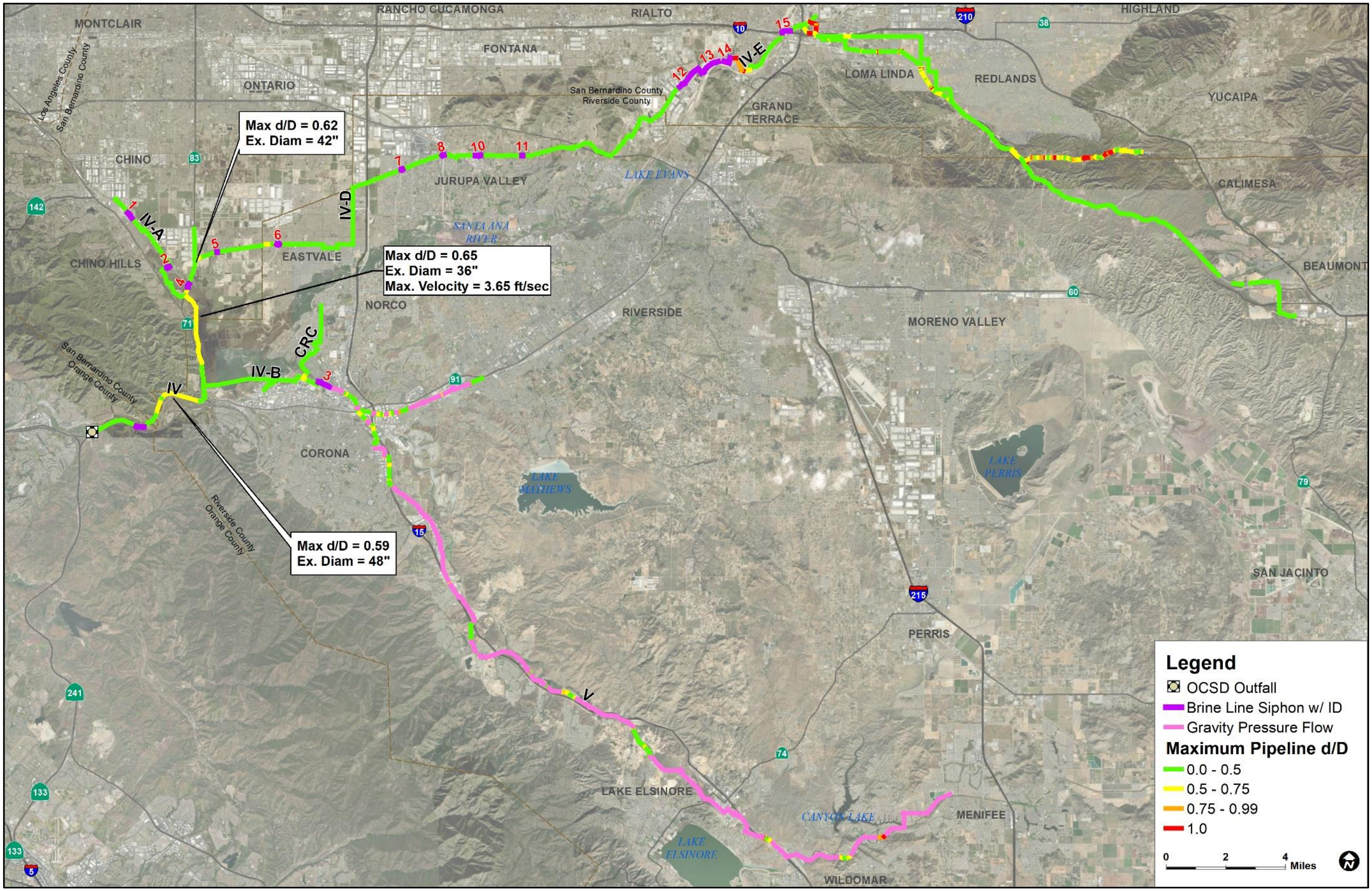


Figure 5-3 Near-Term Maximum Discharge Scenario – Maximum Pipeline d/D

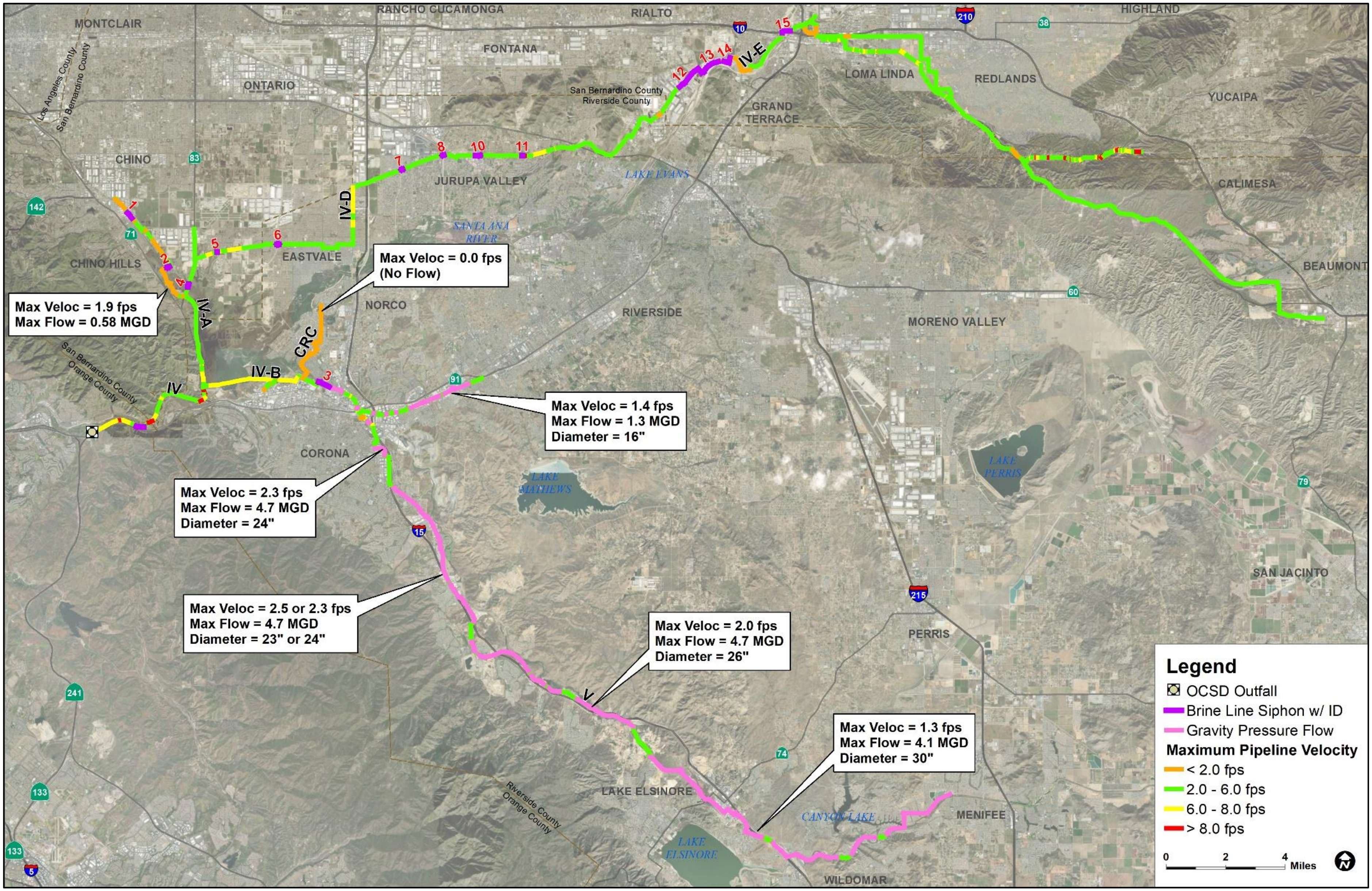


Figure 5-4 Near-Term Maximum Discharge Scenario – Maximum Pipeline Velocities

5.3.3 Long-Term Discharge Capacity Evaluation (2035 – 2049)

A capacity analysis of the Brine Line system under Long-Term discharge conditions was performed using the hydraulic model. Long-Term discharges were developed as discussed in Section 3 and represent the projected increase in discharges to the Brine Line between 2035 and 2049. A five-day EPS was completed, and maximum d/D in gravity flow pipelines compared to the evaluation criteria summarized in Section 5.2. **Figure 5-5** summarizes the maximum d/D in gravity flow pipelines of the Brine Line system under Long-Term discharge conditions.

Under Long-Term discharge conditions, portions of Reaches IV-D, IV-A, and IV are projected to experience maximum d/D values greater than 0.75. Of note, the lower segments of Reach IV-A, south of Euclid Avenue, are expected to reach a maximum d/D of 1.0 (i.e., pipeline flowing full). The lower portion of Reach IV-A was slip-lined with FRP in 2013. Upon completion of the slip-lining project, the diameter of the lower Reach IV-A pipeline was effectively reduced from 42-inch to 36-inch.

The results of the capacity analysis indicate that surcharge conditions are not projected in the lower Reach IV-A pipelines, while it is flowing full. In other words, under Long-Term discharge conditions, flow in lower Reach IV-A will not rise to surface elevations or potentially increase the likelihood of a Brine Line overflow. It is noted that the MAS along this reach are sealed to prevent potential overflows. Projected pressures within the MAS are less than 10 psi.

The maximum pressure in Reach V as predicted by the model is 58 psi. The maximum pressure at the top of Reach IV-E as predicted by the model is approximately 6 psi.

Figure 5-6 illustrates the maximum pipeline velocities anticipated throughout the Brine Line system under Long-Term discharge conditions. Compared to the Existing and Near-Term discharge scenarios, velocities are expected to increase due to higher flows in the Long-Term scenario. Nearly all pipelines in Reach IV-A north of Euclid Ave are expected to reach a maximum velocity of 2.0 fps.

Under Long-Term discharge conditions, the maximum velocity in Reach V will increase to approximately 3.3 fps in the smallest diameter segments as a result of additional flows from the EMWD service area and Temescal Valley Water District's future connection to the Brine Line. As with the Existing and Near-Term discharge scenarios, velocities are not anticipated to exceed 8.0 fps within Reach V under Long-Term discharge conditions.

5.3.4 Buildout Discharge Capacity Evaluation (Beyond 2049)

A capacity analysis of the Brine Line system under Buildout discharge conditions was performed using the hydraulic model. Buildout discharges were developed as outlined in Section 3 and represent the projected increase in discharges to the Brine Line beyond 2049. A five-day EPS was completed, and maximum d/D in gravity flow pipelines compared to the evaluation criteria summarized in Section 5.2. Figure 5-7 summarizes the maximum d/D in gravity flow pipelines of the Brine Line system under Buildout discharge conditions.

Under Buildout discharge conditions, pipelines in Reaches IV-D, IV-A, and IV are anticipated to experience maximum d/D values greater than 0.75. Compared to the results of the Long-Term capacity analysis, additional segments of Reach IV-A, south of Euclid Avenue, are projected to reach a maximum d/D of 1.0, resulting from the increase in discharge between the Long-Term and Buildout scenarios. Similarly, the maximum d/D of pipelines already identified as deficient (d/D > 0.75) under Long-Term discharge conditions is projected to worsen in the Buildout discharge scenario.

The results of the capacity analysis indicate that surcharge conditions are projected at MAS 4A-0160, in the lower Reach IV-A pipeline, while it is flowing full. In other words, under Buildout discharge conditions, the flow in lower Reach IV-A will rise to ground level at MAS 4A-0160 and potentially increase the likelihood of a Brine Line overflow. MAS structures in this portion of the reach are sealed to prevent potential overflows.

The maximum pressure in Reach V as predicted by the model is 58 psi. The maximum pressure at the top of Reach IV-E as predicted by the model is approximately 6 psi.

Figure 5-8 illustrates the maximum pipeline velocities anticipated throughout the Brine Line system under Buildout discharge conditions. Compared to the previous discharge scenarios, velocities are expected to increase due to higher flows in the Buildout scenario.

Under Buildout discharge conditions, the maximum velocity in Reach V will increase to approximately 3.5 fps in the smallest diameter segments as a result of additional flows from Elsinore Valley MWD. As with the previous discharge scenarios, velocities are not anticipated to exceed 8.0 fps within Reach V under Buildout discharge conditions.

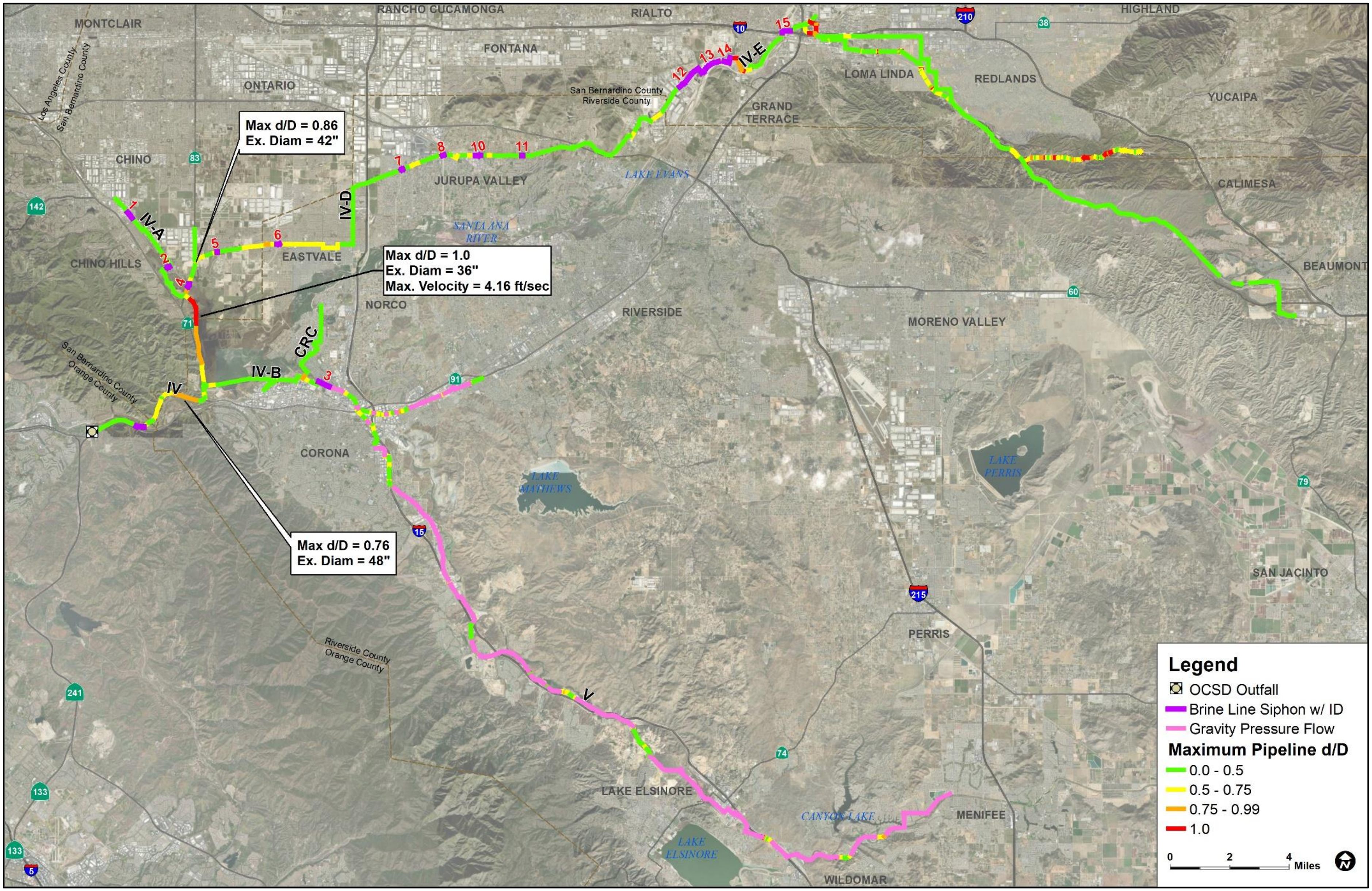


Figure 5-5 Long-Term Maximum Discharge Scenario – Maximum Pipeline d/D

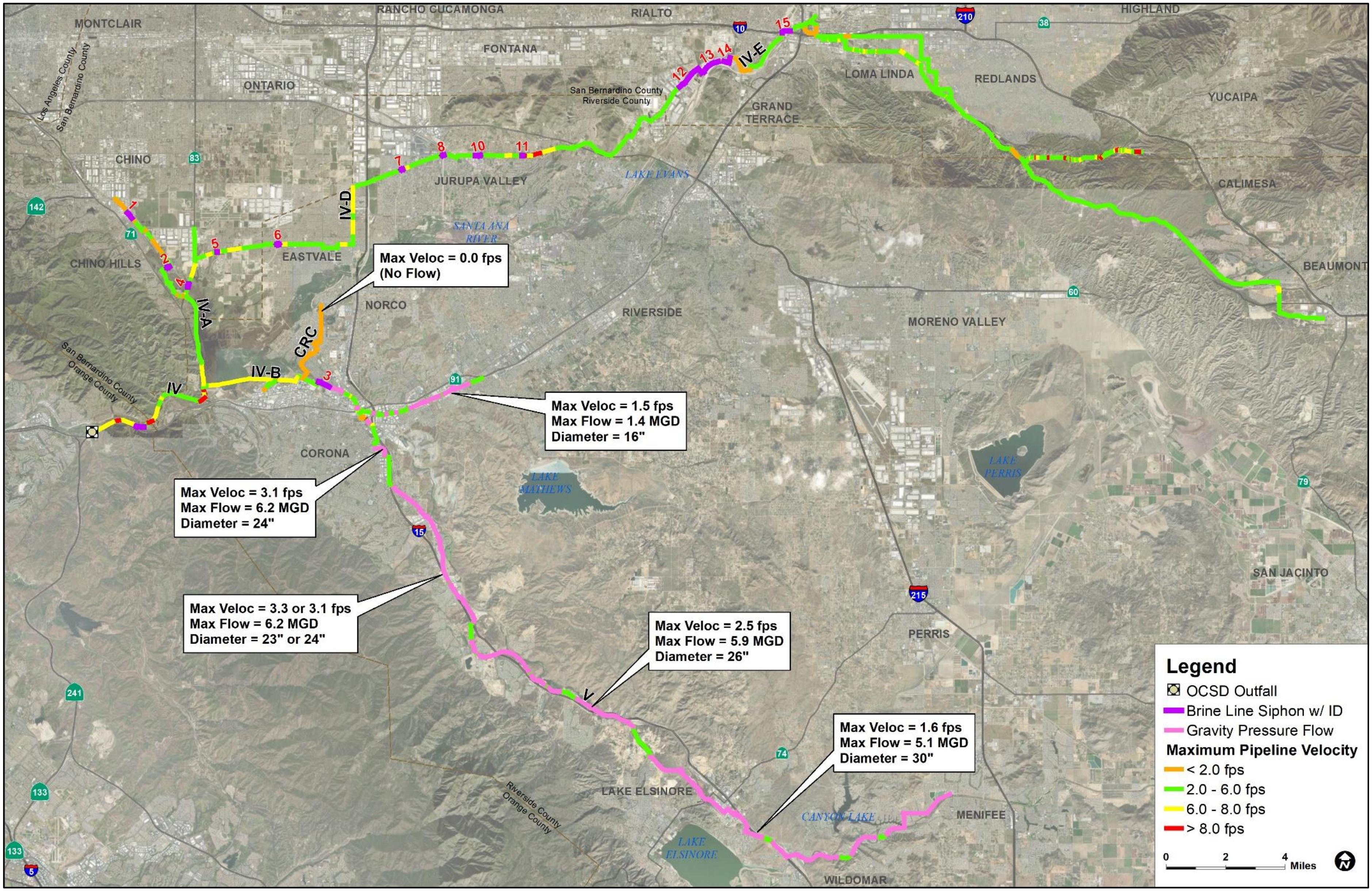


Figure 5-6 Long-Term Maximum Discharge Scenario – Maximum Pipeline Velocities

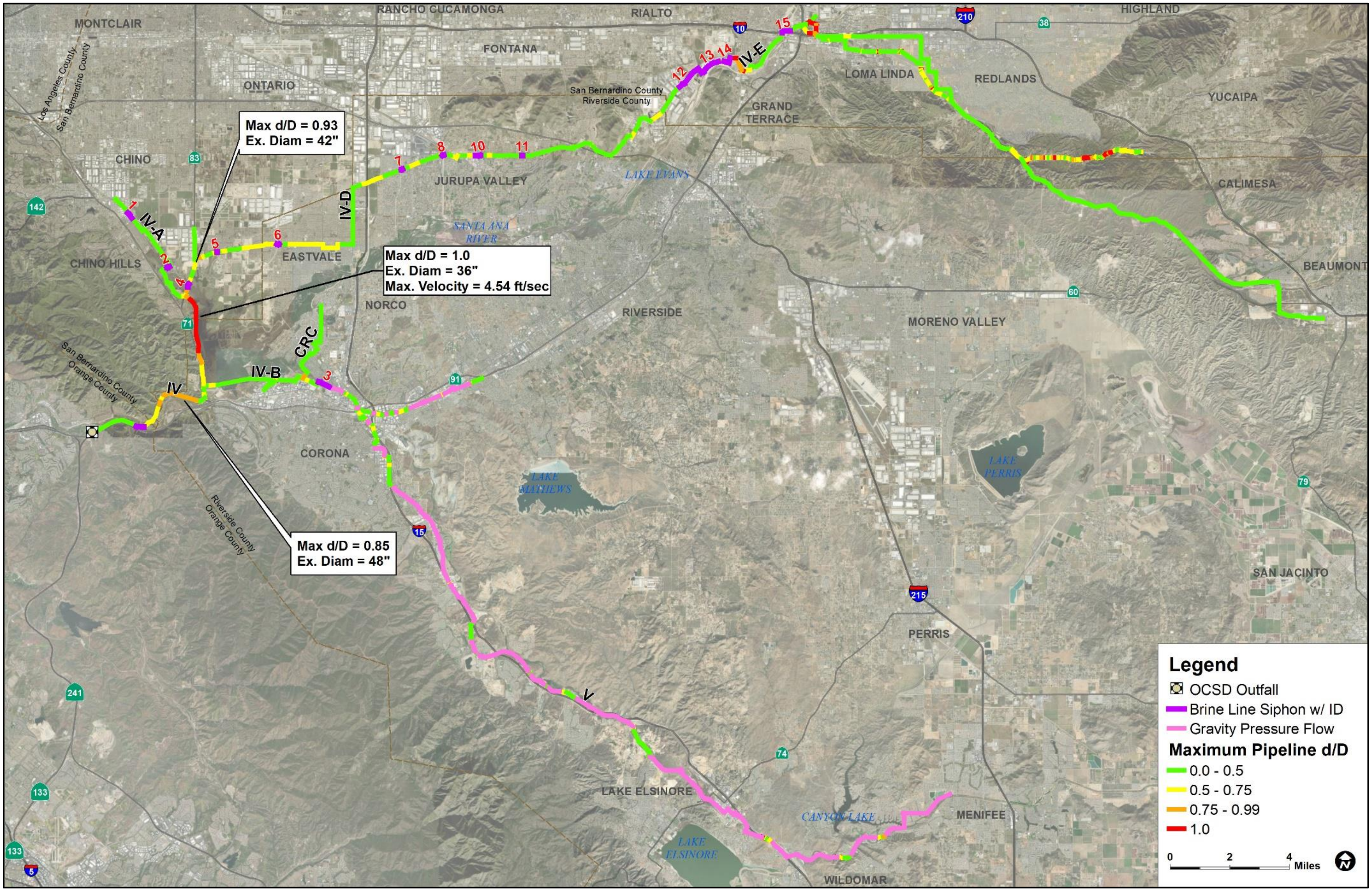


Figure 5-7 Buildout Maximum Discharge Scenario – Maximum Pipeline d/D

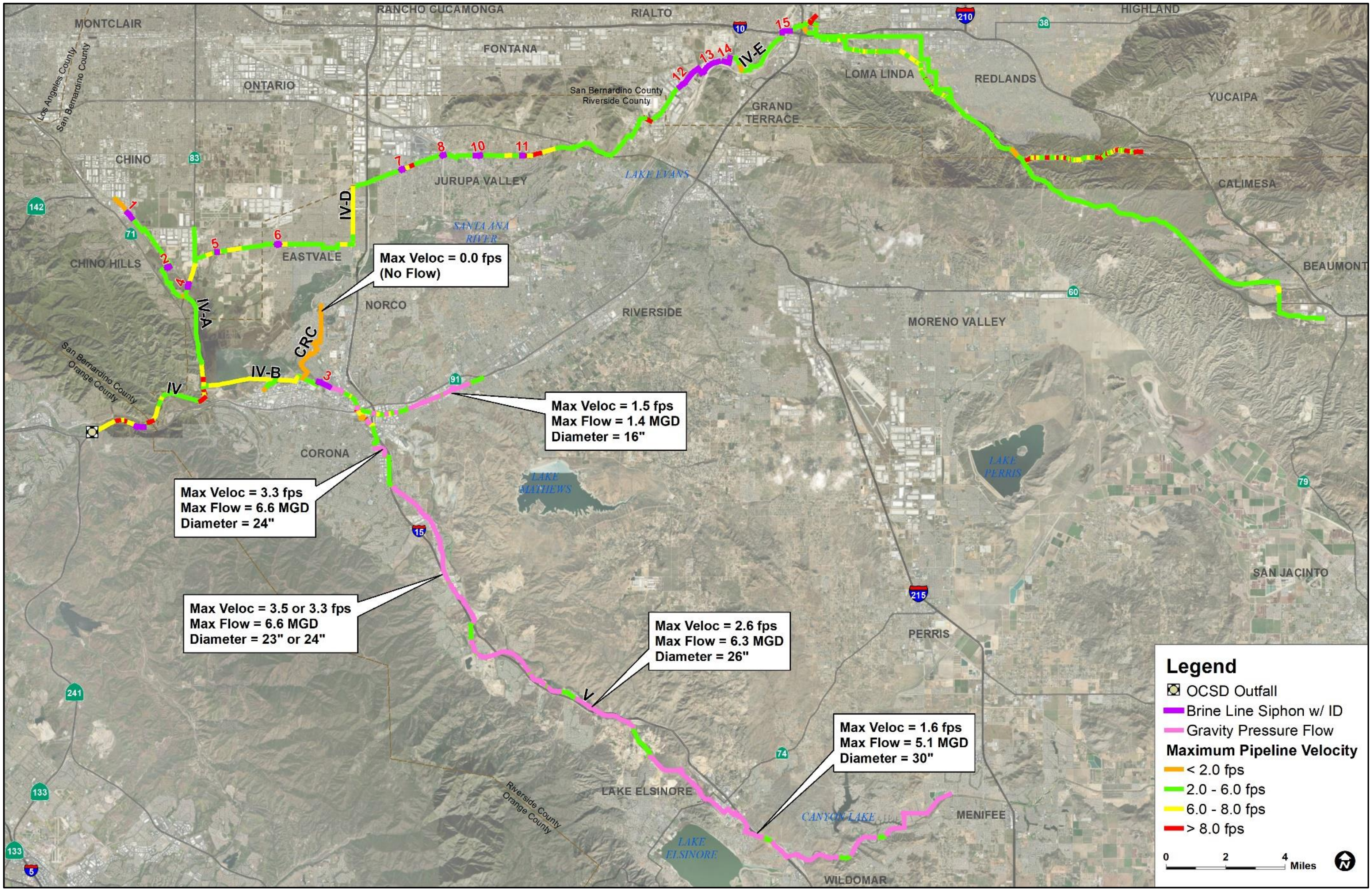


Figure 5-8 Buildout Maximum Discharge Scenario – Maximum Pipeline Velocities

5.3.5 Ownership Discharge Capacity Evaluation

A capacity analysis of the Brine Line system under Ownership discharge conditions was performed using the hydraulic model. Ownership discharges were developed as discussed in Section 3 and represent the maximum allowable discharge to the Brine Line based on existing Member Agency ownership and its distribution to specific dischargers. A five-day EPS was completed, and maximum d/D in gravity flow pipelines compared to the evaluation criteria summarized in Section 5.2. **Figure 5-9** summarizes the maximum d/D in gravity flow pipelines of the Brine Line system under Ownership discharge conditions.

Under Ownership discharge conditions, pipelines in Reaches IV-D, IV-A, and IV are projected to experience maximum d/D values greater than 0.75. Compared to the results of the Long-Term capacity analysis, the maximum d/D of pipelines already identified as deficient (d/D > 0.75) is projected to increase due to the additional discharge in the Ownership scenario. The lower segments of Reach IV-A, south of Euclid Avenue, are projected to continue flowing full at a maximum d/D of 1.0.

The results of the capacity analysis indicate that surcharge conditions are projected at MAS 4A-0160 in the lower Reach IV-A pipeline, while it is flowing full. In other words, under Ownership discharge conditions the flow in lower Reach IV-A will rise to the level of the ground surface at MAS 4A-0160 and potentially increase the likelihood of a Brine Line overflow. MAS structures in this portion of the reach are sealed to prevent potential overflows.

The maximum pressure in Reach V as predicted by the model is 58 psi. The maximum pressure at the top of Reach IV-E as predicted by the model is approximately 6 psi.

Figure 5-10 illustrates the maximum pipeline velocities anticipated throughout the Brine Line system under Ownership discharge conditions. Compared to the previous discharge scenarios, velocities are expected to increase due to higher flows in the Ownership scenario.

Under Ownership discharge conditions, the maximum velocity in Reach V will increase to approximately 4.0 fps in the smallest diameter segments. As with the previous discharge scenarios, velocities are not anticipated to exceed 8.0 fps within Reach V under Ownership discharge conditions.

5.3.6 Reach-by-Reach Analysis

The capacity of the individual Brine Line Reaches is estimated using the criteria summarized in Table 5-1. For Reaches governed by gravity flow, the pipeline with the lowest capacity before exceeding a maximum d/D of 0.75 establishes the maximum or limiting capacity of that entire Reach.

The Reach-by-Reach analysis addresses the capacity of gravity flow pipelines in Reach IV and IV-A through IV-E. Traditional siphons within these Reaches (as identified by their Siphon IDs in the d/D figures above) were not included in this analysis, as they were designed to convey greater discharges by increasing hydraulic gradients.

Instead of maximum d/D criteria, the capacity of Reach V is established based on the maximum acceptable velocity of 8.0 fps in pressurized pipelines. The smallest pressurized pipelines in Reach V with a diameter of 23 inches convey flow up to 15.0-mgd before velocities exceed 8.0 fps. Table 5-3 summarizes the limiting flow capacity of each Reach, based on the defined criteria.

Table 5-3: Limiting Capacity by Brine Line Reach per Design Criteria

Reach	Pipeline ID Limiting Reach Capacity	Pipeline Diameter (in)	Estimated Limiting Capacity at d/D = 0.75 (MGD)	Estimated Limiting Capacity at d/D = 1.0 (MGD)	Anticipated Maximum Flow at Buildout (MGD)
IV	P-4-0130	48	27.3	30.0	31.2
IV-A (U)[1]	P-4A-0300	26	7.3	8.0	1.3
IV-A (L)[2]	P- 4A-0160	36	12.5	13.7	20.8
IV-B (U)	P-4B-0550	18	3.4	3.7	1.4
IV-B (L)	P-4B-0220	36	13.0	14.2	10.5
IV-D (U)	P-4D-1510	36	12.4	13.6	4.8
IV-D (L)	P-4D-0250	42	18.7	20.6	16.8
IV-E	P-4E-0340	36	10.2	11.2	4.5
V	N/A	23	15.0[3]	15.0[3]	10.5

Notes:

1 North of Euclid Ave; (U) = Upper

2 South of Euclid Ave; (L) = Lower

3 Estimated limiting capacity of Reach V is based on a maximum velocity of 8.0 fps instead of d/D, as this Reach of the Brine Line is generally designed to flow full (i.e., under pressure).

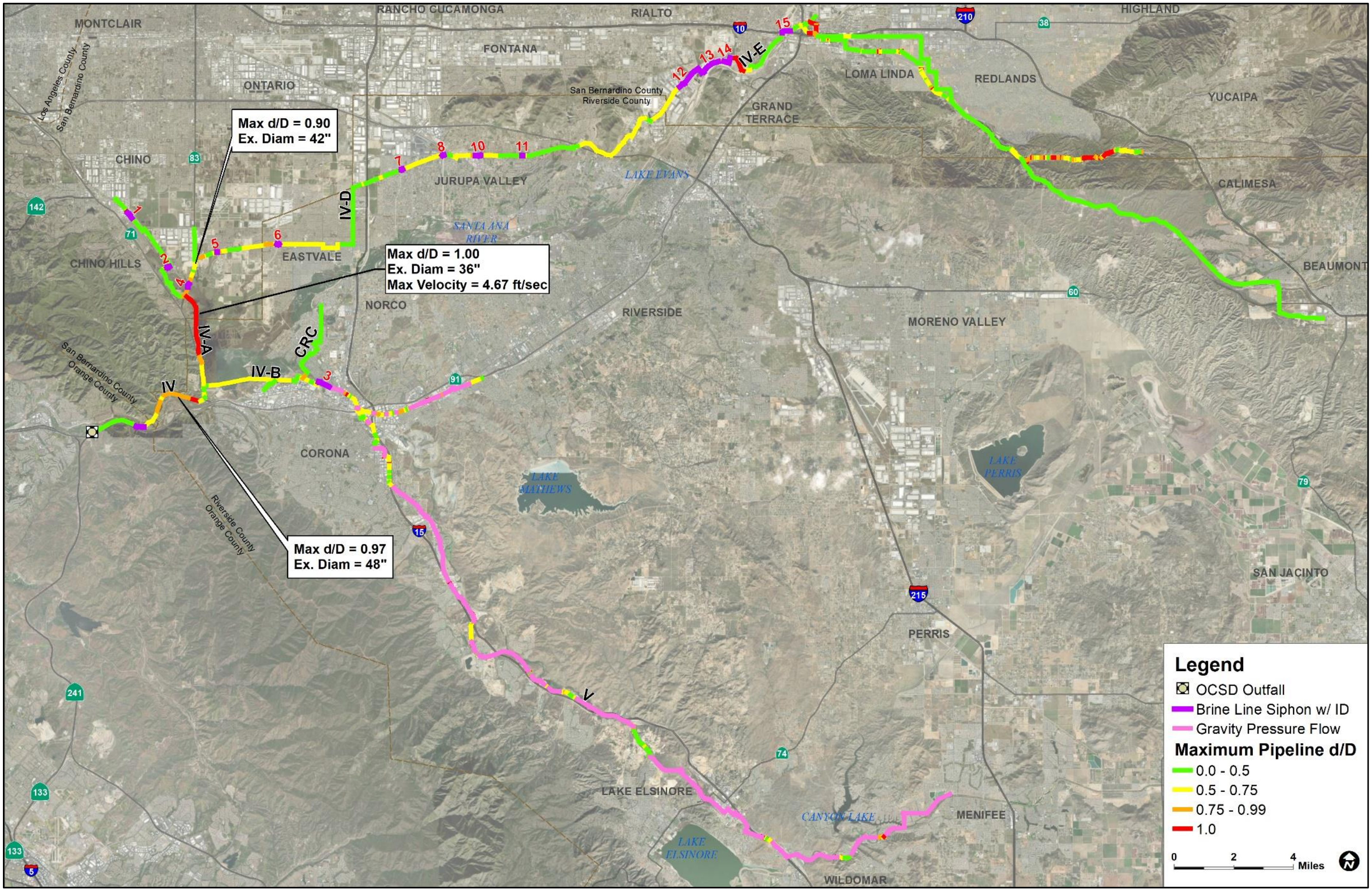


Figure 5-9 Ownership Discharge Scenario – Maximum Pipeline d/D

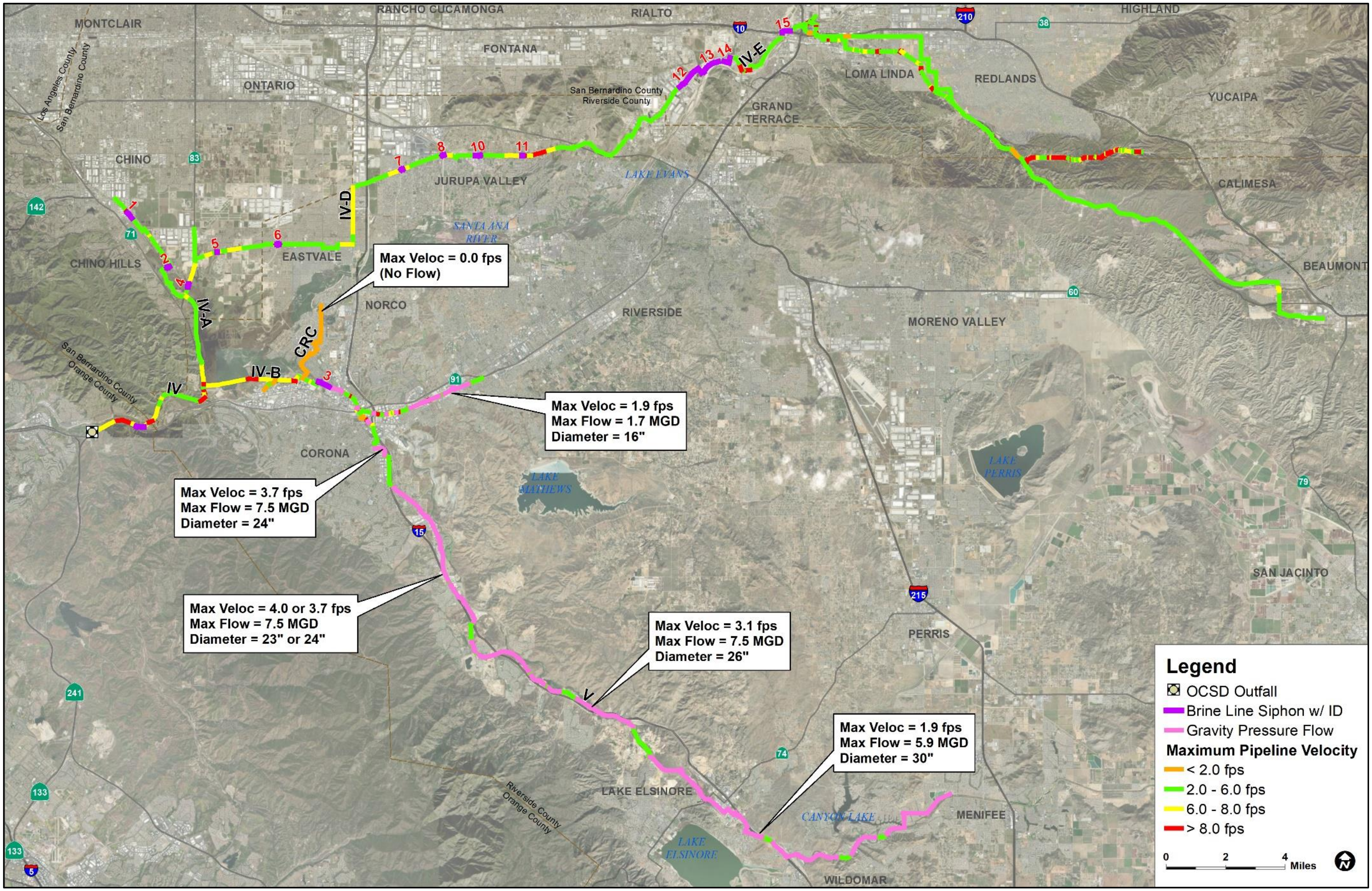


Figure 5-10 Ownership Discharge Scenario – Maximum Pipeline Velocities

5.4 Capacity Analysis Summary

The capacity analysis indicates there are six (6) sections of pipe in the Brine Line system that are anticipated to exceed SAWPA's maximum d/D criterion of 0.75 as conditions approach the Long-Term (2034-2058) planning scenario, as presented in **Table 5-4.** These "choke points" include six (6) sections with d/D values anticipated to be between 0.75 and 1.0 and one (1) section of pipe, the 36-inch section of FRP pipe along Prado Dam, which is anticipated to surcharge (d/D ≥ 1). All pipes are located within roadways.

Table 5-4: Pipeline Segments Exceeding Brine Line Capacity

Location	Reach	D/S MAS ID	U/S MAS ID	Diameter (in)	Max d/D	Length (LF)
1	IV-A	4A-0050	4D-0010	36	1.0	12,600
2	IV-D	4D-0110	4D-0150	42	0.91	2,000
3	IV-D[1]	4D-0020	4D-0030	42	0.82	1,550
4	CRC[2]	CRC-0010	CRC-0020	15	0.77	500
5	IV	4-0060	4-0130	48	0.86	7,000
6	IV	4-0030	4-0040	42	0.80	1,250

Notes:
[1] This section of pipeline of pipeline is downstream of a siphon and is of relatively low slope and was determined to not constitute a hydraulic deficiency requiring mitigation.
[2] The "choke point" listed as location 5 in Reach CRC is due to a backflow condition from Reach IV-B and is not indicative of a true capacity restriction in this section of pipe in the CRC reach.

Based on the capacity analysis results presented in Table 5-4, four system capacity improvement projects are recommended:

1. **Long-Term Planning Scenario Recommendation**:
   - **Location 1, Reach IV-A:** Upgrade the entire reach of 36-inch FRP pipeline along the west side of Prado Dam to a 48-inch pipeline. Relocate the pipeline further west, away from the dam.
2. **Buildout Planning Scenario Recommendations**:
   - **Location 2, Reach IV-D**: Construct a 36-inch parallel pipeline to alleviate the choke point at Location 2.
   - **Locations 5 and 6, Reach IV**: Construct a single parallel pipeline to increase capacity at choke points in Locations 5 and 6.
3. **Near-Term Planning Scenario Recommendation**:
   - **Locations 2 through 6:** Install smart manhole covers at choke points in Locations 2 through 6 to monitor long-term flow conditions. Adjust the timing of the recommended parallel pipeline projects based on changing conditions, if necessary.

A summary of the recommended improvement projects can be found in **Table 5-5.**

Table 5-5: Summary of Recommended System Capacity Improvements (All Phases)

Planning Scenario	Project ID	Location	Ex. Diameter (inch)	Length (LF)	Recommendation
Long-Term (2034-2058)	CAP-1	Reach IV-A FRP Piping west of Prado Dam (Location 1, Table 5-4)	36	18,000[1]	48-inch Replacement and Relocation
Near-Term (2024-2034)	CAP-2	Choke Points at Locations 2 through 6 in Table 5-4	Varies	–	Smart Manhole Cover Surveillance
Buildout (Beyond 2048)	CAP-3	Reach IV-D between MHs 4D-0110 and 4D-0150 (Location 2, Table 5-4)	42	2,100	36-inch Parallel
Buildout (Beyond 2048)	CAP-4	Reach IV between MHs 4-0030 and 4-0130 (Locations 5 - 6, Table 5-4)	42	10,200[2]	30-inch Parallel
			TOTAL	30,300	-

Notes:
[1] While the hydraulic deficiency in this reach of pipeline occurs in only 12,600 LF of pipe, it is recommended the entire reach of 36-inch RFP be upsized and relocated away from the Prado Dam.
[2] This recommended pipeline would parallel the entire reach of pipe between the two choke points identified as Locations 5 and 6 in Table 5-4.

6 Capacity Management & Long-Term Planning Efforts

6.1 Reliability and Redundancy

Reliability and redundancy are fundamental to the effective capacity management and long-term planning of the SAWPA Brine Line. Ensuring continuous operation, mitigating risks, and planning for future needs are essential for maintaining the functionality and sustainability of this critical infrastructure. Through careful planning and investment in reliable and redundant systems, the SAWPA Brine Line can continue to serve the region's brine disposal needs effectively and sustainably. The following sections provide the results from the 2021 risk assessment performed on the Brine Line system as well as other Brine Line studies focused on maintaining the long-term focus and reliability of the system.

6.1.1 Brine Line Criticality Analysis

In 2021, Dudek performed a system-wide criticality analysis of the Brine Line, with the objective of identifying and prioritizing the critical components of the system. The Criticality Analysis results influence the prioritization of identified Capital Improvement Projects, including projects required for operational or capacity-based purposes. The following is a summary of the Brine Line Criticality Analysis and the results obtained.

As previously discussed in this document the Brine Line spans over 73 miles, incorporating six reaches and various materials, such as lined reinforced concrete, PVC, and HDPE. The Brine Line uses both open channel and gravity pressure flow conditions to transport brine, with maintenance access structures for operational efficiency. SAWPA undertook the criticality assessment to evaluate the risk of infrastructure failure and its consequences. This assessment guides the agencies financial policy decisions, as well as helps prioritize asset maintenance and capital improvement projects.

A risk-based criticality assessment was used to develop and analyze failure probabilities and consequences. Failure Mode and Effects Analysis (FMEA) techniques were adapted to assess potential failure modes and their impacts on the Brine Line system operation. This approach helped identify high-risk assets requiring immediate attention and lower-risk assets for regular monitoring. The analysis performed include:

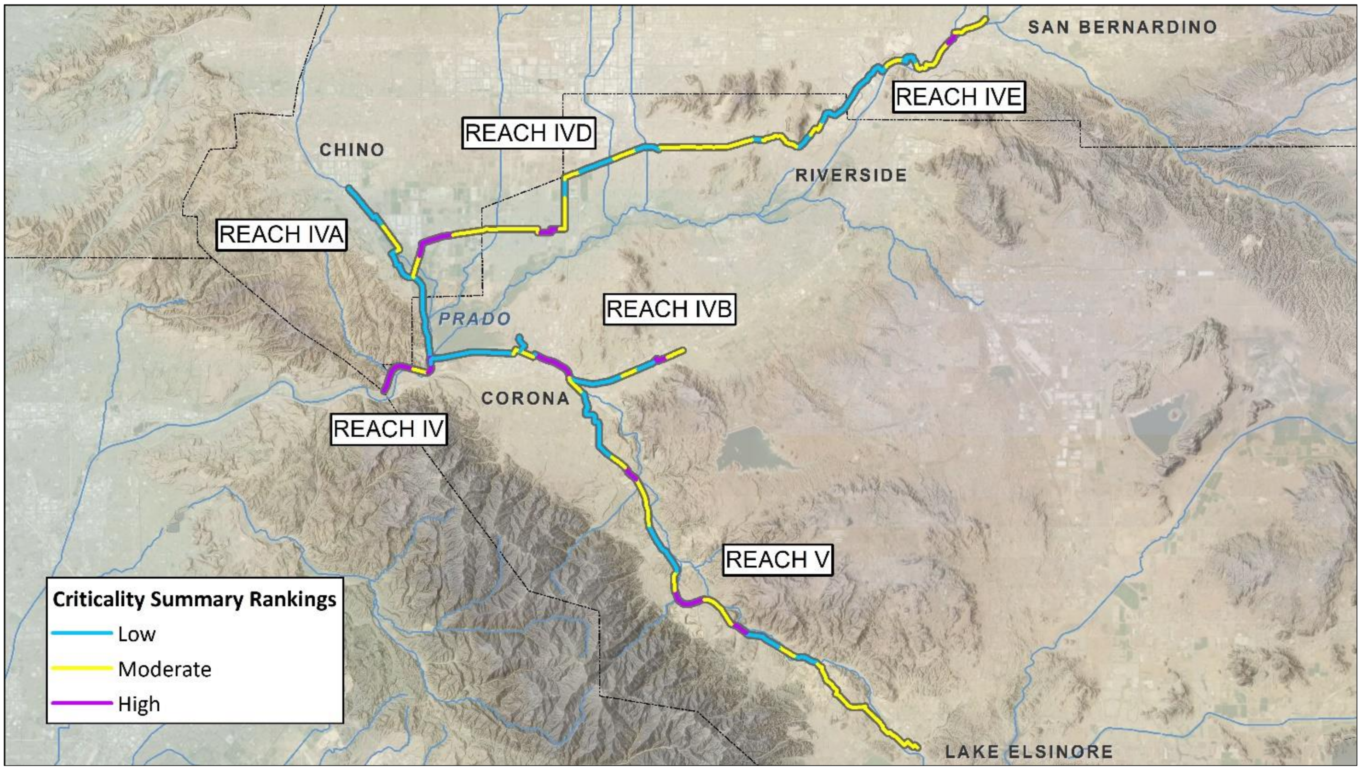
- Consequence of Failure Analysis (CoFA): Evaluates the impact of potential pipeline failures in categories like environmental/regulatory, health/safety, economic/personnel, and transportation. This analysis used Geographic Information System (GIS) techniques to analyze and visualize the consequences.

- Probability of Failure Analysis (PoFA): Assesses the likelihood of pipeline failures based on factors like pipe age, maintenance accessibility, material, fault zone proximity, and potential spill points.

Combining the CoFA and PoFA results allowed assignment of criticality scores and ranking (High, Medium, Low) for each Brine Line pipeline segment. Results guided the prioritization of then current CIP projects. Approximately 14 percent of the Brine Line system was identified to have high criticality, 39 percent medium criticality, and 47 percent low criticality. The then current CIP included a 10-year plan addressing immediate and long-term infrastructure needs, prioritized based on criticality, ensuring high criticality components receive attention first.

The criticality assessment provided a data-driven foundation for SAWPA to prioritize its CIP, ensuring long-term sustainability and resilience of the Brine Line system. Regular updates to the criticality analysis and CIP were recommended to maintain the system's viability and adapt to new challenges. **Figure 6-1** illustrates the resulting criticality of the overall Brine Line system.

Figure 6-1 Final Criticality Summary Rankings for Brine Line Segments (2021 Analysis)



6.1.2 Off-Line Storage Analysis

During Brine Line outages, typically associated with ongoing system improvements, system evaluations, or potentially a system failure, SAWPA is required to decrease or eliminate the transport of brine throughout or within only those affected reaches of the Brine Line system. Decreasing or eliminating flow in the system currently requires SAWPA staff to coordinate individually with affected dischargers, impacting the dischargers' operations. As a means of ongoing system reliability improvement and reducing impact on system dischargers, SAWPA is investigating construction of a series of off-line storage reservoirs, with the intent to use this available storage to dewater the system as opposed to eliminating discharger flow. Under the proposed plan, SAWPA would construct a series of off-line storage reservoirs capable of storing a minimum of 8-hours of tributary Brine Line flow. The proposed concept includes a total of seven reservoirs, spaced throughout the system, to receive diverted brine to effectively empty the Brine Line on an as-needed basis for needed rehabilitation or repair.

The initial concept includes one reservoir along Reach IV-A, one along Reach IV-B, three along Reach IV-D and two along Reach V, as shown on **Figure 6-2**. To establish projected reservoir sizing, existing and projected brine flow was identified using the hydraulic model for each identified reservoir location (future design efforts will determine the exact location of storage facilities). Depending on the location, the reservoirs upstream and one reservoir downstream of a potential shutdown location would be used simultaneously to receive diverted brine flow. This concept allows for storage to be shared across multiple reservoirs, reducing the size and cost of any one reservoir. Once the shutdown is complete, the stored flows would be required to be slowly released back into the Brine Line system, making use of available excess capacity. **Table 6-1** summarizes required reservoir storage volumes in million gallons (MG), by Reach, for each Brine Line flow condition, as well as the recommended reservoir sizing for each location.

Table 6-1: Off-Line Storage Reservoir Sizing for 8 Hours of Storage (MG)

Reach	Existing Flow Condition	Near-Term Flow Condition	Long-Term Flow Condition	Buildout Flow Condition	Recommended Sizing
IV-A	0.10	0.11	0.14	0.24	0.5-MG
IV-B/V	2.23	2.67	3.32	3.48	2 at 2-MG
IV-D	0.91	1.10	1.52	1.88	2-MG
IV-D	0.64	0.48	1.56	1.89	2-MG
IV-D	0.10	0.45	1.11	1.16	2-MG
IV-E	0.62	1.46	1.48	1.51	2-MG

It is noted that the sizing of the proposed storage reservoirs is based on the Buildout flow scenario, with an 8-hour storage capacity. As such, the reservoirs would be capable of providing extended storage capacity (12- to 24-hour storage capacity) during earlier planning horizons. Furthermore, reservoir draining would be easily accomplished in earlier planning horizons with significant excess system capacity and would likely take extended periods of time during later planning horizons when system capacity is more fully utilized.

Construction of the proposed off-line storage facilities, while facilitating Brine Line shutdowns, also provide extended system capabilities, including providing capture facilities for potential first-flush dry weather stormwater flows, thereby eliminating these typically contaminated flows from entering the groundwater or other drinking water resources. Also, as SAWPA contemplates brine minimization efforts for future Brine Line capacity management, these reservoirs could be used as forebay intake structures through which influent is routed to future flow minimization treatment facilities. Also, with respect to Green Hydrogen production, the proposed reservoirs could provide the locations from which water is directed to the hydrogen electrolyzer facilities. Considering the long-term needs of the Brine Line system, the proposed off-line reservoir system provides an array of benefits to SAWPA and its Member Agencies.

To fully evaluate the proposed reservoir facilities, it is recommended that a future study more thoroughly assess the feasibility of the proposed off-line storage concept. Factors requiring additional evaluation include:

- Construction of above- or below-ground reservoirs
- Methods of diverting flow into the reservoirs and returning stored water to the Brine Line
- Determination of the necessity for aeration and/or disinfection to mitigate potential odors
- Location of proposed reservoirs, potential for additional locations, and potential increased capacity
- Phasing of storge reservoirs over time

A planning level cost estimate for this project is included in Chapter 8.

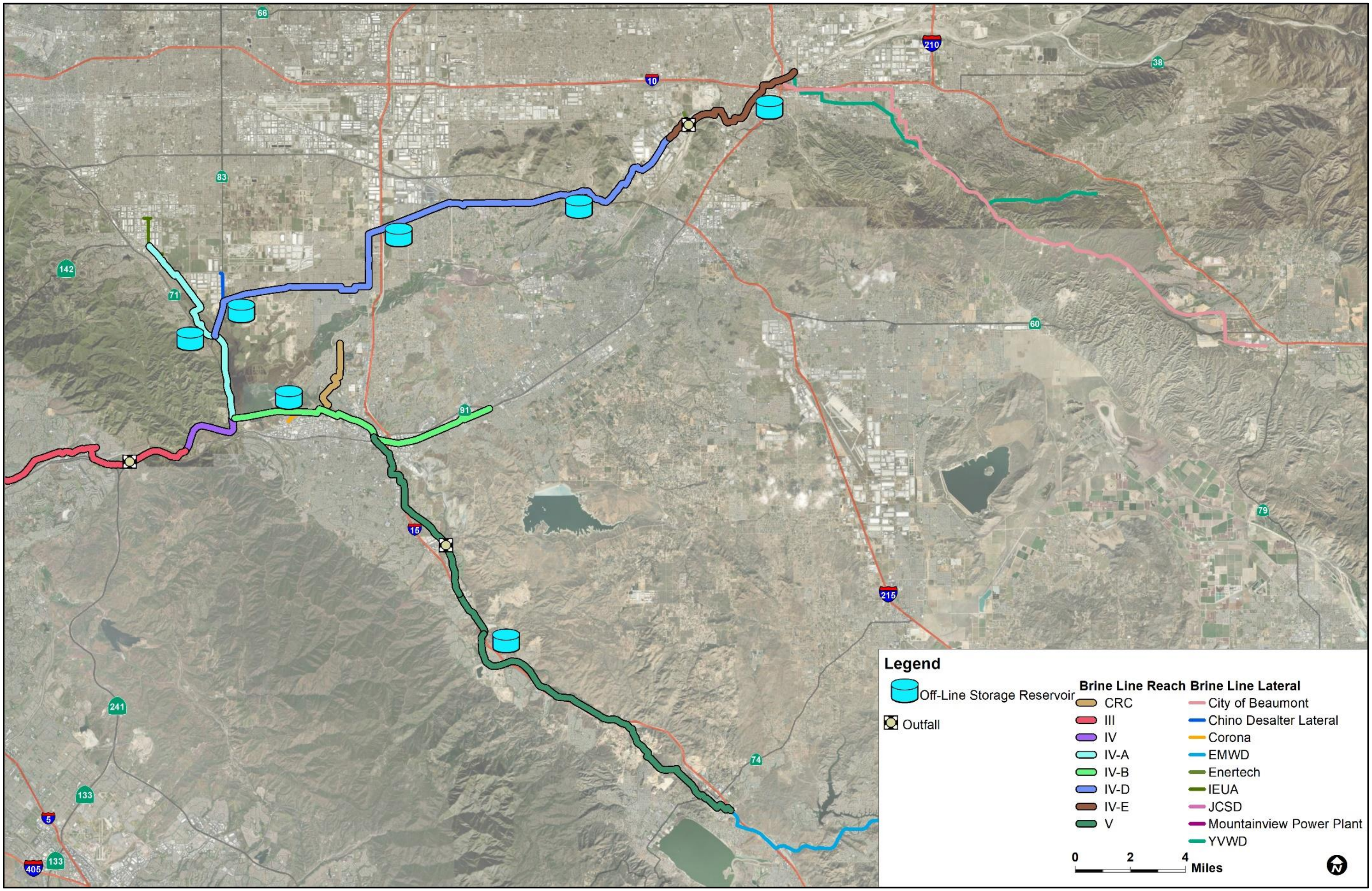


Figure 6-1 Conceptual Brine Line Off-Line Storage Reservoir Locations

6.2 Data Collection & Real Time Management

Collection of real-time flow and quality information increases SAWPA's ability to monitor, operate, and control the Brine Line system. Furthermore, real-time data gathering allows SAWPA to monitor system dischargers on a continuous basis, thereby recording potential discharge violations and facilitating future pretreatment enforcement. Finally, a real-time understanding of each discharger's flow and strength characteristics will allow for a more equitable distribution of cost between the dischargers, and ultimately between the SAWPA Member Agencies. For these reasons, SAWPA is proposing implementation of a Supervisory Control and Data Acquisition (SCADA) based system for the purpose of data collection, evaluation, and management.

It is recommended that the SCADA-based system be implemented (more for data acquisition than control at this time), with data collection and transmittal devices installed at each discharger location and at each in-line flow monitoring location. The SCADA system concept was originally investigated by SAWPA in 2010, as part of its Santa Ana Watershed Salinity Management Program, Phase 3 SARI Operations Technical Memorandum (Phase 3 TM).

The proposed SCADA-based system provides remote, automated flow (and ultimately water quality) data collection for each discharger, and the overall Brine Line system. The collected data provides SAWPA staff information for monitoring discharge flow and quality, understanding the movement of brine discharges throughout the Brine Line system, and accurately quantifying system capacity and conditions on a real-time basis. Furthermore, automated data collection reduces SAWPA staff time related to data management and enhances ongoing effort related to compliance. The collected data is also useful in maintenance of the Brine Line hydraulic model, providing more accurate information throughout the current and future conveyance system.

The SCADA-based review conducted in the Phase 3 TM developed a system concept, typical installation details, an implementation phasing concept, and an Engineer's Opinion of Probable Cost. As part of this Master Plan effort, Dudek has updated the SCADA-based system concept, including required field devices, anticipated communication protocols, and the anticipated system cost. It is anticipated that more accurate details for the proposed SCADA-based system will be developed during future preliminary and final design efforts. The information included herein updates the Phase 3 TM information to represent the current and projected discharge conditions through build-out of the Brine Line system.

6.2.1 SCADA-based System Overview

The proposed Brine Line SCADA-based system will monitor discharges into the system from the various industries, municipalities, and agencies tributary to the Brine Line, currently and into the future. Key components of the proposed SCADA-based system include:

1. **Remote Terminal Units (RTUs) or PLCs (Programmable Logic Controllers):** These devices are installed at remote sites within the Brine Line system. RTUs or PLCs are responsible for gathering data from sensors and instruments (i.e., flow meters, probes, or others) located at the discharger sites and various in-line flow monitoring stations. The Phase 3 TM identified RTUs to convert field device signals to digital signals that can be transmitted over the communications network. A small PLC or a smart data acquisition module (DAM) is proposed for this purpose. Currently, the industry standard uses PLC-based devices for these efforts. Therefore, this analysis assumes the PLC-based equipment.

   SAWPA is investigating automating its quarterly TSS and BOD sampling efforts. There are several options for in-line probes for TSS and TDS/conductivity, at reasonable cost, $8,000 and $1,000 per unit respectively. In-line BOD analyzers are on the order of $40,000 to $80,000 per unit. Therefore, it is anticipated that the initial SCADA system will focus on flow monitoring, with the ability to incorporate water quality monitoring in the future. The system will be capable of incorporating operator developed water quality information. Also, water quality probes will require calibration and ongoing maintenance to reliably provide accurate data.

2. **Communication Infrastructure:** A robust communication network is essential for transmitting data between the PLCs and the central SCADA-based system. These facilities include wired connections (such as Ethernet or fiber optic cables) or wireless technologies (i.e., cellular communication) depending on the geographic scope and location of the brine conveyance system. The Phase 3 TM identified then-available technologies to develop a practical SCADA-based approach. The most practical communication protocol was determined to be the cellular network. The identified system used Cellular Digital Packet Data (CDPD), which was an open IP-based standard for the transmission of data over cellular communications. The CDPD service was discontinued in conjunction with the retirement of the parent AMPS service, and has been functionally replaced by faster services, such as 1xRTT, Evolution-Data Optimized, and UMTS/High Speed Packet Access (HSPA). Preliminary and final design efforts will determine the exact protocol for implementation.

3. **SCADA Master Station/Human-Machine Interface (HMI)**: The SCADA-based master station serves as the central control hub of the entire system, collecting real-time data from the distributed PLCs and provides graphical interface for operators to monitor the status and performance of the Brine Line System. The master station can also facilitate control actions, allowing operators to remotely adjust parameters, if required. The HMI typically consists of computer monitors and software applications to display real-time data, alarms, and other optional information in a visual format. HMIs allow operators to interact with the system, view trends, acknowledge alarms, and make informed decisions based on the data presented.

   The Phase 3 TM recommended development of a stand-alone, PC-based HMI for the SCADA-based system. The proposed development was based on this use of Wonderware software. Software venders, including IOSight, AquaSight, and others, provide pre-developed data collection, management, and analysis capabilities within a single program suite. These venders were contacted to identify the best option for the proposed application. For the purposes of this analysis, the IOSight configuration is used for cost purposes. Data is collected and stored locally and, on the cloud, to facilitate data management and manipulation. The IOSight software has a $50,000 set up cost, with an annual cost of approximately $12,000 to $18,000, for the anticipated size of the SAWPA implementation.

4. **Data Historian:** A data historian is used to archive and store historical data collected by the SCADA-based system. This data is valuable for trend analysis, performance optimization, regulatory compliance reporting, and troubleshooting. The historian (database storage) ensures that a comprehensive record of system behavior is maintained. This database also archives the data in the event of a software failure.

5. **Alarm Management System:** SCADA-based systems typically include alarm management capabilities, which alert operators to abnormal conditions, equipment failures, or other potential system component failures. Alarms are displayed on the HMI and typically trigger notifications (i.e., emails, texts) to ensure timely response and corrective actions. This functionality would allow SAWPA to identify dischargers that are exceeding their permit requirements. This functionality may not be necessary during the initial stages of the implementation.

6. **Security Features:** Given the critical nature of brine line systems, SCADA-based systems typically incorporate security measures to protect against unauthorized access, cyber threats, and data breaches. These features include user authentication, encryption of communication channels, and adherence to industry standards for cybersecurity. The proposed software venders have these security measures built into their systems already.

7. **Database and Reporting Tools:** SCADA-based systems integrate with databases and reporting tools to generate performance reports, analyze historical trends, and support decision-making processes. These tools help operators and managers assess system efficiency, identify areas for improvement, and ensure compliance with operational objectives and regulatory requirements.

As noted, the Phase 3 TM recommends a phased approach to construction, based on the discharge conditions at each site. The existing Brine Line has approximately 36 dischargers. Phasing of the SCADA system is summarized in **Table 6-2**.

Table 6-2: Phasing and Projected Costs for Initial SCADA System

Phase	Description of Work	Cost[1]
1	Construction and installation of Master Station, operator workstation, setup, integration of programming and automation	$200,000
2	Construction and installation of first 12 discharger sites with the highest flow	$350,000
3	Construction and installation of next 12 discharger sites with medium flow	$350,000
4	Construction and installation of last 12 discharger sites with low flow	$350,000
5	Construction and installation of up to five (5) in-line flow monitoring stations	$1,500,000
	TOTAL	**$2,750,000**

Note:

1 Costs representative of 2010 TM, updated to 2024 costs using ENR Los Angeles CCI and current dischargers.

6.3 Brine Minimization

By accounting for planned and potential future sources of discharge to the Brine Line system through build out, it is projected that the total Brine Line flow will exceed the 30-mgd Brine Line capacity right. Current projections suggest that SAWPA will exceed their capacity right in approximately the year 2065, as shown on Figure 3-3. Sections 4 and 5 of this Master Plan identify the effect of these projected flows throughout the Brine Line system. Table 6-5of this master plan provides an existing Brine Line Water Quality summary.

Similarly, SAWPA owns 17-mgd of treatment and disposal capacity in the OC San treatment facilities. Understanding the contracted limit of 30-mgd, this section addresses the potential need for future brine minimization facilities to assure that discharges to the OC San system remain below the 30-mgd capacity right. As identified in previous sections, SAWPA Member Agencies currently own a total of 32.5-mgd of pipeline capacity within the Brine Line system.

SAWPA has previously evaluated various Brine Line configurations in its Phase 2 Brine Line Planning Technical Memorandum (Phase 2 TM), for the purpose of lowering brine discharge below the 30-mgd limitation. Six potential system reconfigurations were evaluated. Ultimately, among these long-range options for managing the projected future flows, the recommended action was to continue to direct brine flows into the OC San system. However, SAWPA and its Member Agencies could pursue implementation of a secondary brine concentration processes at existing and future groundwater desalination facilities. It is noted that the Phase 2 TM did not evaluate the impacts of brine minimization relative to ongoing wastewater and recycled water demineralization at local water reclamation facilities. At present, groundwater desalters and recycled water demineralization projects account for up to 82 percent of the tributary Brine Line flow as shown in Figure 6-3. Based on recent discharger workshops, it is projected that wastewater and recycled water demineralization will continue to increase, with comparable increases in

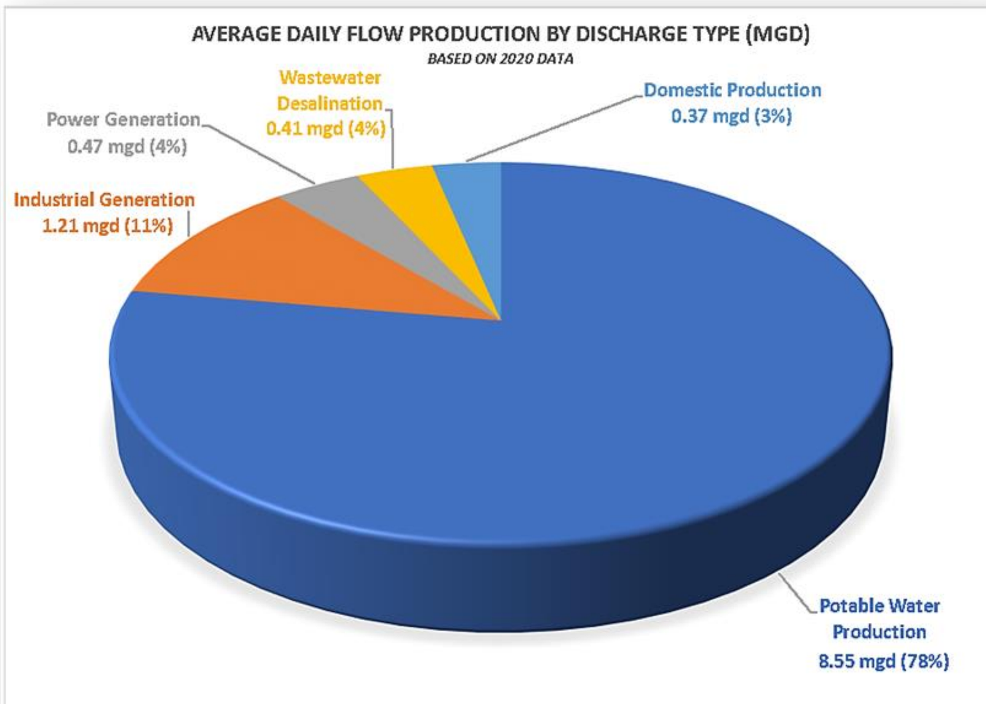


Figure 6-3 Current Average Daily Brine Flow Production

groundwater desalination, resulting in these two discharges contributing 90 percent of the Brine Line flow. Incorporating industrial discharges, these three discharger categories are projected to contribute over 97 percent of tributary Brine Line flow.

Considering that 82 percent of brine line flow to the Brine Line system will ultimately be discharged from groundwater desalination and recycled water demineralization facilities, concentrating on these dischargers with respect to brine management will provide the most efficient method of maintaining brine flows below the 30-mgd OC San limitation. In addition, the facilities within these two categories are owned and operated by public agencies, which have the ability and funding to implement the necessary brine management facilities. Again, it is projected that the Brine Line will exceed its 30-mgd capacity right in approximately the year 2065. Based on current projections, flows from existing and projected desalination and demineralization facilities would be required to be reduced by approximately 8 percent (2.3-mgd) to maintain SAWPA's capacity right.

During discussions with existing dischargers, it was identified that current groundwater desalination facilities within the tributary area are not implementing additional brine concentration efforts. Agencies involved in groundwater desalination as a means of producing drinking water are likely focused on increasing water production, not decreasing brine production. However, as brine disposal is a significant cost, reduction in brine volumes is a worthwhile undertaking for these agencies. As other constituents of concern are identified and regulated (i.e., PFAS), control of these emerging constituents will involve similar treatment technologies, allowing attainment of brine reduction more realistic in coordination with emerging constituent treatment processes.

6.3.1 SAWPA Salt Management Plans

SAWPA understands the discrepancy between Member Agency ownership and downstream discharge limitations and has taken steps to effectively manage the capacity discrepancy. SAWPA completed the Phase 1 Salt Management Plan Technical Memorandum (Phase 1 TM) in January 2010. The Phase 1 TM discussed brine minimization strategies and pilot testing conducted by the Eastern Municipal Water District (EMWD) and Western Municipal Water District (WMWD) for management of brine waste and potential increased water recovery. The following discussion summarize these and other brine minimization efforts:

- **EMWD Brine Minimization Pilot Testing**: EMWD conducted pilot testing using chemical softening techniques (caustic soda) to remove scaling precursors from the brine, followed by secondary treatments, including reverse osmosis (RO) and electro-dialysis reversal (EDR), to increase water recovery. Challenges included solids breakthrough causing irreversible fouling of membranes. In Phase II of the testing, EMWD refined the process using lime-soda ash softening and achieved improved recovery rates.

- **WMWD Brine Minimization Pilot Testing**: WMWD pilot tested concentrate treatment methods using pellet-softening reactors to remove calcium and silica from the RO concentrate. This testing allowed for recovery of up to 70 percent of the RO concentrate as permeate.

- **Future Scenarios**: Both districts planned at that time to expand their desalination and concentrate treatment capacities to reduce brine discharge and increase water recovery. The Phase 1 TM discusses potential actions, including best management practices, desalination for water supply, and zero liquid discharge to manage salt removal efforts.

SAWPA's Phase 2 SARI Planning Technical Memorandum (Phase 2 TM), dated May 2010 reviewed both centralized and decentralized brine minimization. Centralized in-line brine minimization represented by full Brine Line flows diverted to a centralized facility, where the total volume would undergo biological treatment, followed by chemical softening, microfiltration/reverse osmosis and disinfection. Concentrated waste from the centralized treatment plant would be returned to the Brine Line. Decentralized brine minimization considered installation of secondary RO processes at the groundwater desalters to reduce desalter discharges to the Brine Line. A 30-year Present Worth analysis comparison demonstrated that decentralized brine minimization was approximately three (3) times more cost effective that the centralized in-line plant option.

The Phase 2 TM discussed impacts of future technology within the Santa Ana watershed, specifically focusing on technologies that minimize brine flow volumes, summarized as follows:

- **Desalter Brine Minimization**: The selection of brine minimization technologies is dependent on brine water quality from the various RO desalination facilities. High calcium concentrations require chemical softening to prevent scaling in downstream RO treatment. Lime and soda-ash were defined for softening dependent on water composition.

- **Chemical Softening Process**: Chemical addition (lime and soda-ash) raises pH levels to precipitate inorganic species like calcium, magnesium, and silica, reducing their concentrations in the brine. This pre-treatment allows for higher recovery rates in downstream RO processes.

- **Wastewater Recycling**: Planned projects focused on recycling of wastewater for non-potable and indirect potable uses, mainly groundwater recharge, due to water scarcity and population growth. Recycled water quality is regulated and requires advanced treatment technologies, such as RO, prior to percolation in the local groundwater basin. Increasing local water supplies through groundwater augmentation continues to grow in popularity.

- **Industrial Dischargers**: Various industrial operations discharge wastewater into the Brine Line system, with diverse characteristics including organic material, total suspended solids (TSS), and total dissolved solids (TDS). Ongoing efforts are recommended to manage and treat these discharges.

- **Temporary Domestic Dischargers**: Temporary domestic dischargers are identified to be phased out, with plans to redirect flows to alternate facilities or treatment plants.

- **Fail-Safe Connections**: Fail-safe connections ensure emergency discharge locations in case of infrastructure failures, permitting controlled discharge of treated or untreated wastewater. SAWPA is also interested in minimizing these discharges in the future.

6.3.2 Arlington & Chino Desalter Studies

The Arlington and Chino Desalters are key components related to managing salt content within the Santa Ana River Watershed, but they face challenges related to brine disposal and scale formation. Implementation of pellet softening, particularly following successful pilot testing at the Arlington Desalter, appears promising for mitigating these challenges.

- **Purpose of Pellet Softening**: The primary goal of pellet softening is to reduce scale-forming minerals in the brine-concentrate discharged from the desalters. This reduction helps alleviate maintenance problems in the Brine Line system and reduces associated costs.

- **Effectiveness**: Pilot testing has shown that pellet softening effectively reduces silica concentrations and removes calcium carbonate, thus demonstrating its efficacy in addressing mineral scaling.

- **Future Considerations**: Full-scale implementation of pellet softening is being considered for the Arlington Desalter, with potential expansion to the Chino Desalters. This expansion could help further mitigate scaling issues and optimize brine disposal.

- **Institutional Arrangements**: The project funding and implementation would likely involve collaboration between the Chino Basin Desalter Authority (CDA) and SAWPA Member Agencies, reflecting the shared interest in addressing capacity constraints and operational challenges.

6.3.3 Rancho California Demineralization Studies

Rancho California Water District (RCWD) meets its water demand of 76,000 acre-feet per year (afy) from various sources. Agricultural needs make up 47 percent of its demand, with the remainder for domestic, commercial, and landscape use. To meet increasing agricultural demand and address supply challenges, RCWD plans to enhance water treatment capabilities, including reducing TDS levels in recycled water to expand agricultural usage. A demineralization/desalination plant is proposed to achieve TDS levels below 500 mg/L, enabling up to 16,000 afy of recycled water for agriculture. The plan involves advanced treatment (microfiltration followed by RO), with resulting brine-concentrate needing volume-reduction technology to manage waste flows. Implementation would require coordination with EMWD, potentially necessitating pilot testing, engineering, permits, and funding considerations, including addressing capacity limitations in the Brine Line system.

6.3.4 Emerging Brine Management Technologies

The SAWPA TM's assumed RO as the brine minimization technology. Since those studies, emerging technologies are offering additional options for brine minimization, with one even contributing the benefit of destroying per- and polyfluoroalkyl substances (PFAS), the "forever chemicals" currently being regulated as a drinking water contaminant. The recent designation of PFAS compounds as hazardous materials by the United States Environmental Protection Agency (EPA) has increased the focus on potential PFAS capture and treatment. Capture of PFAS within high salinity, non-reclaimable waste streams is a difficult and costly process (further discussed later in Section 6.4). The following discussions describe emerging treatment options for Brine Line flows, should flows need to be reduced to manage system capacity.

6.3.4.1 Flow Reversal Reverse Osmosis

One of the challenges facing the Brine Line system is that of increasing the capacity of the system using brine minimization and concentration techniques to improve recovery at the desalters. Typical reverse osmosis has a low recovery rate for high salinity waters and additional rounds of RO for brine minimization have typically offered significantly diminished returns and has thus not been financially feasible. Flow Reversal Reverse Osmosis (FRRO) is an innovative technique within the realm of membrane-based water desalination in which the conventional direction of feedwater flow is periodically reversed during operation, strategically altering the flow dynamics across the membrane surface. This periodic reversal serves to minimize concentration polarization and fouling, enhancing overall system efficiency and extending the lifespan of the membrane. FRRO exhibits notable advantages, such as reduced energy consumption, improved resistance to membrane fouling and significant increase in produce water capacity, making it an attractive option for water treatment applications. The method's ability to enhance performance metrics, coupled with its potential for integration with renewable energy sources, positions FRRO as a promising technology in the pursuit of sustainable and efficient water purification solutions.

One manufacturer, ROTEC, developed a patented approach for "block repositioning", which repositions blocks of pressure between the stages allowing the blocks to be switched. This new approach further improves treatment capacity as well as results in the need for less-frequent cleaning. FRRO is a technology that could potentially make brine concentration a more cost-effective solution for the Brine Line as system flows increase.

6.3.4.2 Ceramic Membrane with Electrodialysis Reversal

A ceramic membrane with EDR for brine concentration is a cutting-edge technology employed in the process of desalination and concentration of saline solutions. The ceramic membrane serves as a selective barrier, allowing the passage of water molecules while restricting the passage of salts and impurities. EDR is integrated into the system to facilitate the controlled migration of ions through ion-exchange membranes in response to an applied electric field. This not only aids in concentrating the brine but also assists in minimizing scaling on the ceramic membrane surface. The combination of ceramic membranes and EDR presents an efficient and durable solution for brine concentration processes, offering improved resistance to fouling and longer operational lifespans compared to traditional desalination methods. This integrated approach contributes to the sustainability and cost-effectiveness of brine concentration processes, especially in the context of water treatment and resource recovery and may prove to be a viable solution for brine concentration for the Brine Line in the future.

6.3.4.3 Other Considerations

Future advances in water treatment technologies may increase SAWPA's ability to manage its brine flows more effectively and, potentially, create multi-use benefits for the community at large. Section 7.3 discusses the fact that the Brine Line is, as a regional facility, a multi-use benefit system, providing a wide array of benefits to the Santa Ana River Watershed by exporting salt from the watershed. Over time, it is recommended that SAWPA investigate innovative and collaborative opportunities to reduce brine volume, increase brine management, and otherwise create beneficial use of its brine flows. Water is a valuable resource, and the Brine Line will ultimately convey up to 30.0-mgd of brine. Identifying emerging uses, treatment technologies, or multi-benefit uses for these flows will be beneficial to SAWPA and its Member Agencies. The following discussion identify areas of focus for potential identification of such opportunities:

1. **Membrane Distillation (MD)**: MD is an emerging desalination technology that utilizes a hydrophobic membrane to separate water vapor from the brine. MD operates at relatively low temperatures and pressures compared to traditional distillation methods like thermal distillation, making it more energy-efficient. The membrane selectively allows only water vapor to pass through, resulting in a purified permeate stream that is free from salts and contaminants. MD can be scaled for various applications, from small-scale portable units for remote areas to large-scale industrial systems for brine concentration and desalination. It can handle high salinity and complex feed waters, making it suitable for treating brine streams from various sources, including seawater desalination reject brine and industrial wastewater. MD systems can be designed in modular configurations, allowing for easier installation, maintenance, and integration into existing water treatment processes.

   While membrane distillation offers advantages, there are ongoing research efforts to address challenges such as membrane fouling, scaling, and improving process efficiency. Advances in membrane materials, module design, and system optimization are expanding the application of membrane distillation for brine concentration and water purification. MD is a promising technology for brine concentration and desalination, offering energy-efficient and versatile solutions for addressing water scarcity and wastewater management challenges. Continued research and development in this field will further enhance the performance and cost-effectiveness of membrane distillation systems.

2. **Forward Osmosis (FO)**: FO is an innovative separation process that has gained attention for various applications, including brine concentration and water purification. FO operates based on the natural osmotic phenomenon, utilizing a semi-permeable membrane to separate water from dissolved solutes, without applying external hydraulic pressure. A semi-permeable membrane allows water molecules to pass through while blocking dissolved solutes. A concentrated solution (known as the draw solution) and a feed solution (such as brine or wastewater) are separated by the semi-permeable membrane. The difference in solute concentrations between the solutions creates an osmotic pressure gradient across the membrane. Water molecules move from the lower concentration (feed solution) to the higher concentration (draw solution), driven by osmotic pressure. The draw solution, enriched with water from the feed solution, requires further processing to separate the water from the draw solutes, thereby regenerating the draw solution for reuse. Or, as in eh Brine Line scenario, the concentrated draw solution could be returned to the Brine Line with a reduced flow volume.

Despite its advantages, FO faces certain challenges. Efficient draw solution recovery and regeneration processes are essential to minimize operational costs and environmental impacts. Continued research is needed to develop more robust and selective membranes that withstand harsh operating conditions and improve separation performance. Enhancing overall process efficiency, reducing fouling potential, and optimizing system design are ongoing areas of research. Further research and development efforts are essential to overcome challenges and optimize FO processes for broader implementation in water and resource management sectors.

3. Electrodialysis Reversal (EDR): EDR is an advanced membrane-based technology used for desalination, brine concentration, and purification of water by utilizing ion-selective membranes and electrical potential to facilitate the separation of ions from a feed solution. EDR operates based on the principles of electrodialysis, with an additional feature of periodic reversal of electrical polarity to mitigate membrane fouling and enhance efficiency. EDR systems consist of alternating ion-exchange membranes (anion-selective and cation-selective membranes) arranged in a stack between electrode compartments. A feed solution containing ions to be separated (such as brine) is introduced into the system. When an electric potential is applied across the membranes, positively charged ions (cations) migrate towards the negatively charged electrode (cathode) and negatively charged ions (anions) migrate towards the positively charged electrode (anode). As ions migrate through the ion-exchange membranes under the influence of the electric field, they are selectively removed from the feed solution, resulting in two separate streams: a desalinated product stream (permeate) and a concentrated brine stream (concentrate or reject). In EDR, the polarity of the electrodes is periodically reversed, causing the migration of ions to alternate directions. This reversal helps prevent membrane fouling by redistributing the accumulated ions and reducing scaling on the membrane surfaces.

   Despite its advantages, EDR technology has challenges. Further research is needed to develop advanced membrane materials and cleaning techniques to minimize fouling and scaling issues. Enhancing energy efficiency and reducing operational costs through system optimization and integration with renewable energy sources. Developing innovative system designs and integrating EDR with other water treatment technologies for enhanced performance and cost-effectiveness. EDR is promising for desalination, brine concentration, and water purification, offering selective ion removal and energy-efficient operation. Continued research and development efforts are needed to overcome challenges and optimize EDR systems for broader applications in water treatment and resource recovery.

4. Solar-Driven Technologies: Solar-driven desalination technologies, such as solar stills or solar-assisted MD, are gaining attention for brine concentration. Using renewable energy sources for the energy-intensive process of brine concentration can reduce operational costs and environmental impacts.

   Solar thermal desalination systems utilize solar energy to generate heat, which is used to evaporate water and produce freshwater through condensation. Solar stills use a transparent cover to capture solar radiation and heat saline water, causing evaporation. The vapor condenses on the cover and is collected as freshwater, leaving behind concentrated brine. In multi-stage flash (MSF) distillation, solar thermal energy is used to heat multiple stages of brine, causing rapid evaporation and condensation. Freshwater is collected from the condensate, and brine is discharged as a concentrated stream. In multiple-effect distillation (MED), solar thermal energy drives multiple stages of evaporation and condensation, similar to MSF distillation. The concentrated brine is discharged from the final stage.

Solar-powered reverse osmosis (RO) systems use photovoltaic panels to directly convert solar energy into electricity, which powers high-pressure pumps for the RO process. RO membranes desalinate seawater or brackish water by separating salt ions from water molecules under pressure. Solar-powered RO systems are suitable for remote or off-grid locations where access to conventional electricity is limited.

Solar membrane distillation (SMD) combines membrane distillation with solar thermal energy to desalinate water. SMD systems use a hydrophobic membrane to separate water vapor from brine. Solar energy is used to heat the feedwater, driving the distillation process.

Challenges with solar driven process include developing efficient energy storage solutions (e.g., batteries, thermal storage) to ensure continuous operation during periods of low solar irradiance, optimizing system designs and integrating solar technologies with treatment processes to maximize efficiency and reliability, and further reducing the overall cost of solar-driven systems to enhance affordability and widespread adoption.

5. **Hybrid Systems**: Hybrid systems, in the context of water treatment and brine concentration, refer to integrated approaches that combine multiple technologies to optimize efficiency, enhance performance, and address specific challenges associated with desalination and brine management. These systems leverage the strengths of different technologies to achieve synergistic benefits and improve overall process sustainability. Hybrid systems are typically used in large-scale desalination plants to optimize water recovery and energy efficiency. Hybrid systems are also applied in industrial sectors to treat complex wastewater streams and recover valuable resources.

6. **Advanced Materials**: Advanced materials play a key role in enhancing the efficiency, performance, and sustainability of technologies used in various industries, including water treatment, desalination, and brine concentration. These materials are designed to exhibit specific properties such as high selectivity, durability, and resistance to fouling or corrosion, making them ideal for challenging environments and applications. Challenges include the ability to scale up advanced materials from laboratory-scale to commercial applications while maintaining performance and cost-effectiveness. Developing multifunctional materials and hybrid systems that combine multiple functionalities (e.g., adsorption and catalysis) for integrated water treatment processes. Conducting comprehensive lifecycle assessments to evaluate the environmental impact and sustainability of advanced materials throughout their lifecycle.

These emerging technologies offer promising solutions to the challenges associated with brine concentration, such as energy consumption, cost-effectiveness, and environmental sustainability. Continued research and development in this field are crucial to enabling widespread adoption and implementation of these innovative approaches.

6.3.5 Projected Brine Management Cost

As stated, it is currently projected that SAWPA will approach the OC San flow limitation of 30-mgd in approximately 2065. As such, brine management technological advancements will undoubtedly progress over this time. Similarly, the cost of current and future brine management options will undoubtedly increase as well. For the purposes of this master plan and considering the extended time by which brine management is required to be implemented, no specific costs for these facilities are projected. However, it is recommended that a specific planning study be completed within the next ten to fifteen years to evaluate the technological advancements related to brine concentration, with a specific focus on future costs for these treatment facilities.

From SAWPA's 2010 investigations, brine minimization facilities were projected to cost in excess of $12,000,000 per-mgd of treatment capacity. Based on the estimated flow of approximately 2.3-mgd required to reduce projected flows below the 30-mgd OC San limitation, the cost (in 2010 dollars) was projected to exceed $27,000,000. In 2024 dollars, this cost is approximately $35,000,000. From the 2010 analyses into brine minimization facilities based on cost and other considerations, SAWPA determined the following strategic recommendations:

- Moving forward with a "business as usual" approach will eventually present major impediments to implementing a brine minimization strategy to manage flow below the 30-mgd limitation, with a projected higher cost. However, it is noted that the Brine Line system is projected to be able to convey these higher "buildout" flows to the OC San discharge location.

- Implementation of brine concentration projects at as many existing or future groundwater desalter sites offers multiple benefits, including managing future flows below the 30-mgd limit and having less impact from and to OC San.

- Potential advantages exist relative to a direct ocean outfall approach including the possibility of a lower overall cost, while minimizing dependency on OC San for treating flows. However, significant challenges would exist relative to this option.

- Considering the substantial high cost and other implementation hurdles, a downstream, in-line brine concentration approach was not considered to be feasible. However, advancements in treatment technologies and treatment requirements for emerging constituents of concern could substantially change this conclusion.

The following discussions identify emerging technologies focused on PFAS removal. At present, it is not clear that many treatment technologies on the market are capable of removing PFAS from wastewater. For example, the efficacy of granular activated carbon filtration will vary depending on the nature of the wastewater. Wastewater can contain high concentrations of dissolved organic carbon, which may limit the utility of granular activated carbon (GAC) in removing PFAS from wastewater. At present, the only demonstrated treatment process for removal of PFAS from wastewater may be reverse osmosis.

6.4 PFAS Management

PFAS compounds are a group of synthetic organofluorine chemical compounds that are both widespread in use and persistent in the environment. Their occurrence in water is frequently associated with military installations, airports, firefighting training areas, and landfills where PFAS-containing materials have been used and/or disposed of. The presence of PFAS in water can typically result in health risks when individuals are exposed to contaminated water. To address this concern, the EPA announced, a National Primary Drinking Water Regulation targeting six specific PFAS compounds. These include:

- Perfluorooctanoic acid (PFOA)
- Perfluorooctane sulfonic acid (PFOS)
- Perfluorononanoic acid (PFNA)
- Hexafluoropropylene oxide dimer acid (HFPO-DA, commonly known as GenX)
- Perfluorohexane sulfonic acid (PFHxS)
- Perfluorobutane sulfonic acid (PFBS)

Currently, there are no established PFAS regulations for concentrated brine, although some states like Michigan are developing discharge limits for wastewater that exceed federal drinking water standards. Implementing industrial or commercial PFAS limits separate from drinking water standards is an ongoing process. Unlike typical drinking water systems, the Brine Line handles wastewater with potentially higher PFAS concentrations, necessitating tailored regulations. There are both advantages and challenges in including PFAS removal as part of overall management of the Brine Line. Some of the advantages include mitigating health risks associated with exposure to these persistent compounds, help to mitigate long-term health risks, promote environmental protection, and enhance confidence in regulatory responses to PFAS contamination. However, challenges arise from the complexity of removing PFAS compounds in brine, the environmental footprint of treatment, and high costs. There are many treatment technologies on the market, ranging from GAC filtration, to emerging methods like electrochemical oxidation or engineered adsorbent media, which demonstrate efficacy in removing PFAS from water and wastewater.

Capital and operational costs for PFAS treatment of brine are presented in the following sections. Cost estimates are conservative due to the complexity of treating PFAS compounds in brine and the current, undefined regulatory environment for PFAS in wastewater discharges. Specialized methods and treatment processes are required to treat PFAS in brine, which adds to costs. In the absence of regulations for wastewater PFAS concentrations, drinking water regulations have been used herein as a guideline for treatment requirements. Given the scale of contamination, these regulatory requirements could further inflate costs, placing financial burdens on affected communities and industries. Despite these challenges, the costs of not addressing PFAS contamination can be even greater, considering the potential long-term health impacts and environmental consequences. Balancing the need for effective management with financial constraints requires careful consideration and innovative approaches to minimize costs while maximizing effectiveness.

6.4.1 Overview

As new and emerging constituents are required to be removed from wastewaters, new treatment facilities will be designed to help meet permit requirements. Management and treatment to remove PFAS from the Brine Line is not currently required. However, regulation of these substances continues to increase, requiring advancement of the technologies required to remove and eliminate these substances from our society. As a result, PFAS management is becoming more critical, for the following reasons:

1. **Health Risks**: PFAS, often referred to as "forever chemicals," are linked to serious health issues, including cancer, liver damage, immune system disruption, and developmental problems in children.

2. **Environmental Persistence**: These chemicals are incredibly persistent in the environment, meaning they do not break down easily and can accumulate over time in soil, water, and living organisms.

3. **Widespread Contamination**: PFAS are found globally in water supplies, food products, and various consumer goods due to their extensive use in industrial applications and consumer products like non-stick cookware, water-repellent fabrics, and firefighting foams.

4. **Regulatory Pressure**: Governments and regulatory bodies are increasingly recognizing the need to control and limit PFAS emissions and contamination. This includes setting limits for PFAS levels in drinking water and establishing guidelines for their management and cleanup.

5. **Public Awareness and Demand**: There is growing public concern and demand for safer products and cleaner environments, prompting industries and policymakers to adopt more stringent PFAS management practices.

Effective PFAS management involves monitoring and reducing their release into the environment, remediating contaminated sites, and developing safer alternatives to these harmful substances. Regulatory pressure for PFAS management is intensifying with rising awareness of the environmental and health risks associated with these chemicals. Key aspects of this regulatory pressure include:

- **Stricter Regulations and Guidelines.** Governmental agencies are implementing stricter regulations and guidelines to limit PFAS concentrations in the environment, particularly in drinking water. The EPA has established health advisory levels for certain PFAS, such as PFOA and PFOS, and is working towards setting enforceable drinking water standards. The EPA recently categorized PFAS as a hazardous material. The European Chemicals Agency has restricted the use of certain PFAS and has proposed further restrictions on their use in various products. Many countries, including Canada, Australia, and Japan, have set limits on PFAS concentrations in drinking water and are developing comprehensive management plans.

- **Mandatory Reporting and Monitoring.** Several jurisdiction agencies now require industries to report the use, emissions, and presence of PFAS in products and waste streams. In the U.S., certain PFAS must be reported under the Toxicity Release Inventory (TRI), providing data on their release and disposal. The EU's Industrial Emissions Directive includes PFAS among the pollutants to be monitored and controlled at industrial facilities.

- **Cleanup and Remediation Requirements.** Regulators are mandating the cleanup of PFAS-contaminated sites, often with strict timelines and performance criteria. In the U.S., the EPA is identifying PFAS as contaminants of concern at Superfund sites, requiring responsible parties to remediate contamination. Various countries have launched initiatives to identify and remediate contaminated sites, often prioritizing areas near industrial facilities, military bases, and airports where PFAS use has been historically high. To reduce the future release of PFAS, regulatory agencies are banning or restricting their use in specific products and applications. Several U.S. states, such as Washington and New York, have banned PFAS in food packaging. The EU has proposed restrictions on PFAS in textiles, firefighting foams, and other consumer goods, aiming to phase out their use wherever possible.

- **Research and Innovation Incentives.** Governments are also funding research to better understand PFAS, their impacts, and alternative solutions. Funding for academic and industrial research to develop safer alternatives to PFAS and innovative technologies for their detection and removal. Collaborations between governments, industries, and research institutions to advance PFAS management practices and technologies.

- **International Cooperation and Standards.** Global coordination is critical given the widespread nature of PFAS contamination. International bodies like the United Nations and the Organization for Economic Co-operation and Development (OECD) are working on global standards and frameworks to manage PFAS. Some PFAS are listed under the Stockholm Convention on Persistent Organic Pollutants, which aims to eliminate or restrict their production and use globally. Initiatives to harmonize PFAS management efforts across countries, promoting shared strategies and technologies for monitoring, regulating, and remediating PFAS.

Regulatory pressure is a driving force behind improved PFAS management, compelling industries to adopt safer practices and governments to protect public health and the environment. This pressure is leading to a more comprehensive approach to managing PFAS, from limiting their use and emissions to ensuring effective cleanup and encouraging the development of safer alternatives.

6.4.2 PFAS Treatment Processes

The goal of this section is to evaluate three (3) alternative treatment processes to reduce PFAS concentrations in the Brine Line. The first alternative removes PFAS through a Novel Adsorption System (NAS) manufactured by CycloPure. The second alternative removes PFAS via an Electro-oxidation (EOX) System manufactured by Aclarity. The third alternative removes PFAS via a Granular Activated Carbon (GAC) system, manufactured by Calgon. An average day treatment capacity of 15-mgd has been assumed for each alternative.

This section is organized as follows:

- PFAS Treatment Overview
- Water Quality
- Summary of Regulatory Permits
- PFAS Alternatives
- PFAS Treatment Cost Comparisons
- PFAS Treatment Costs Summary

6.4.3 PFAS Treatment Overview

Per- and polyfluoroalkyl substances (PFAS) are a group of synthetic organofluorine chemical compounds that are both widespread in use and persistent in the environment. Their occurrence in water bodies including wastewater, groundwater, or drinking water, is typically associated with military installations, airports, firefighting training areas, and landfills where materials containing PFAS have been used and/or disposed of. The occurrence of PFAS in water bodies can pose health risks when individuals are exposed to contaminated water.

6.4.3.1 Summary of Current Regulations

There are no specific regulations in California addressing the levels of PFAS in brine water. In the absence of dedicated regulations for brine water, this master plan assumed that federal drinking water standards would be applied as a baseline for PFAS treatment requirements. This conservative assumption corresponds to a limit of 4 parts per trillion (ppt) of PFAS in the treated brine line. This approach considers that federal drinking water standards are the prevailing regulations for PFAS and provide a benchmark for developing effective treatment strategies within the existing regulatory framework. Note that if regulatory requirements for PFAS treatment in brine water are introduced in the future, necessary adjustments to the master plan should be considered.

Some states, including Michigan, have begun developing discharge limits for wastewater of 170 ppt for PFOA, 12 ppt for PFOS, 670,000 ppt for PFBS, 210 ppt for PFHxS, and 30 ppt for PFNA, which are all higher concentrations than the federal drinking water limits.

Drinking Water PFAS Standards

The EPA has recently established enforceable Maximum Contaminant Levels (MCLs) for PFAS compounds in drinking water, including individual MCLs for PFOA, PFOS, PFHxS, PFNA, and HFPO-DA, and for mixtures containing at least two or more PFAS compounds using a Hazard Index (HI) MCL. The HI is a tool used to evaluate potential health risks from exposure to chemical mixtures of PFAS based on an assumption of dose additivity. To compute the HI, the concentration of each of the four (4) PFAS compounds are divided by their associated Health Based Water Concentration (HBWC), which is the level below which no health effects are expected for that PFAS compound. The normalized concentrations are then summed according to the equation below to calculate the HI. The EPA has set the target HI for these four PFAS compounds to be less than or equal to 1, which indicates that adverse effects are not likely to occur. Public water systems have five years (i.e. until 2029) to implement solutions that reduce these PFAS if monitoring shows that drinking water levels exceed these MCLs. MCLs for individual PFAS compounds are listed in **Table 6-3**.

$$\mathrm{HI} = \frac{(\text{PFHxS, ppt})}{9.0\ \text{ppt}} + \frac{(\text{PFNA, ppt})}{10.0\ \text{ppt}} + \frac{(\text{PFBS, ppt})}{2{,}000\ \text{ppt}} + \frac{(\text{HFPO-DA, ppt})}{10.0\ \text{ppt}}$$

Table 6-3: Summary EPA Drinking Water Standards for PFAS Constituents

Compounds	Maximum Contaminant Levels
PFOS	4 parts per trillion (4.0 ng/l)
PFOA	4 parts per trillion (4.0 ng/l)
PFNA	10 parts per trillion (10 ng/l)
HFPO-DA	10 parts per trillion (10 ng/l)
PFHxS	10 parts per trillion (10 ng/l)
PFBS	Included in HI[1]
HI[1]	Hazard Index = 1.0 (unitless)[1]

Notes:

1. $Hazard\ Index = (\frac{PFHxS}{9.0\ ppt} + \frac{PFNA}{10\ ppt} + \frac{PFBS}{2{,}000\ ppt} + \frac{HFPO-DA}{10\ ppt})$

6.4.3.2 Future PFAS Requirements

Currently, there are no PFAS requirements for brine. Therefore, a treatment mass balance was estimated to understand how PFAS concentration and flow could change under future PFAS requirements. **Table 6-4** presents two scenarios for PFAS effluent limits and potential flow reduction. In Scenario 1, it is assumed that the effluent PFAS limit will be 5 times the drinking water PFAS MCL of 4 ppt, resulting in an effluent PFAS limit of 20 ppt. In the second scenario, the effluent PFAS limit will be 10 times the MCL, resulting in an effluent PFAS limit of 40 ppt. The influent PFAS and flow of 15-mgd remain the same.

Refer to Section 6.4.7 for construction and operation and maintenance (O&M) cost analysis.

Table 6-4: PFAS Effluent Scenarios

Parameter	Unit	Current System	Scenario 1	Scenario 2
Influent Flow	MGD	15		
Influent PFAS	ppt	136		
Effluent PFAS	ppt	4	20	40
Treated Flow	MGD	15	**13**	**11**
Untreated Flow	MGD	0	**2**	**4**

6.4.4 Brine Line Water Quality

An overview of Brine Line water quality is provided in **Table 6-5.** Data summarized in this section was captured between January 2010 through July 2022 and represents the initial baseline conditions for PFAS treatment. Long term average, maximum, and minimum values of monthly water quality parameters and flow conditions are provided as available, along with sample size for each measurement.

Table 6-5: Brine Line Water Quality Data

Parameter	Units	Value		
		Minimum	Average	Maximum
Flow	MGD	8	11	15
Biological Oxygen Demand (BOD)	mg/l	17	50	240
	lb/d	1,416	4,573	21,056
Total Suspended Solids (TSS)	mg/l	48	138	413
	lb/d	4,800	12,673	36,228
Total Dissolved Solids (TDS)	mg/l	3,050	5,571	6,940
	lb/d	295,183	509,654	745,218

Note: MGD = million gallons per day; mg/l = milligrams per liter; lb/d = pounds per day

PFAS in the SAWPA Brine Line was studied by Trussell Technologies and reported in the Technical Memorandum, 'Brine Line Monitoring results for PFAS', in 2022. Trussell Technologies employed method "537 Modified" based on liquid chromatography with tandem mass spectrometry to measure the amount of 38 PFAS compounds in the Brine Line water. Composite samples were collected over a 24-hour sampling period. The analysis performed by Trussell Technologies detected concentrations above the reportable detection limit (RDL) for the following analytes: PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFPeS, PFHxS, PFHpS, PFOS, and 6:2 fluorotelomer sulfonate. A summary of these results is shown in **Table 6-6**, below.

Table 6-6: Brine Line Water PFAS Characteristics[1]

Parameter	Units	Value			MCL[2]
		Minimum	Average	Maximum	
PFOS	ng/l	97	136	170	4
PFOA	ng/l	89	106	130	4
PFHxS	ng/l	70	87	90	10
PFNA	ng/l	NA	NA	NA	10
HFPO-DA	ng/l	NA	NA	NA	10
PFBA	ng/l	30	50	59	-
PFPeA	ng/l	50	58	65	-
PFHxA	ng/l	57	69	84	-
PFHpA	ng/l	28	33	37	-
PFBS	ng/l	43	48	52	-
PFPeS	ng/l	16	18	21	-
PFHpS	ng/l	5.3	6.3	7	-
6:2 Fluorotelomer Sulfonate	ng/l	15	41	84	-

Notes:
[1] ng/l = nanograms per liter; NA = not available. PFNA and HFPO-DA were not measured.
[2] MCL values listed are for drinking water.

Table 6-6 depicts brine water PFAS data. PFOA and PFOS concentrations range between 89-130 mg/l and 97-170 mg/l respectively. While there are no specific regulations in California addressing the treatment of PFAS in brine water, those concentrations are above the drinking water MCLs.

6.4.5 PFAS Treatment Alternatives

There are multiple technologies on the market to remove PFAS from water and wastewater, however only technologies suitable for use with a brine line were considered.

Typical RO treatment systems work by passing high-pressure water through a semi-permeable membrane, concentrating the impurities in the water on the upstream side of the membrane and passing water molecules through the membrane. This typically results in two streams; one treated water stream with lower concentrations of PFAS and a second stream of a lower volume of brine with higher concentrations of PFAS. This could potentially require additional treatment to remove or destroy the PFAS molecules in the remaining brine. Due to these reasons and the high costs associated with RO, this process was not considered as an alternative.

IX systems work by passing water through a vessel of small beads coated with a charged functional group, which attracts oppositely charged ions in the water, such as PFAS. The PFAS ions are then exchanged with the negatively charged ions on the resin, effectively removing them from the water. The high TDS in the brine would render PFAS removal by ion exchange highly ineffective. Due to this reason, IX was not considered as an alternative.

Supercritical water oxidation (SCWO) is an advanced and environmentally sustainable thermal treatment process employed in the field of chemical engineering. Operating at temperatures and pressures above the critical point of water (374°C, 22.1 MPa), SCWO facilitates the rapid and efficient destruction of organic contaminants in aqueous waste streams. In this supercritical state, water exhibits unique properties, enhancing its ability to solubilize and react with a wide range of organic compounds, converting them into benign end products such as water, carbon dioxide, and mineral ash. The process's efficacy in eliminating persistent pollutants makes it a promising technology for addressing complex industrial and hazardous waste challenges, aligning with the growing demand for cleaner and more sustainable engineering solutions. SCWO is currently being evaluated by OC San, however, cost projections for a full scale PFAS treatment system are unavailable. Due to this reason, SCWO was not considered as an alternative.

Three alternatives were evaluated as approaches to PFAS treatment of the Brine Line and are listed below. Each treatment technology, with pre-treatment, is estimated to produce PFAS concentrations at or below federal drinking water MCLs. However, actual PFAS removal would need to be tested with actual Brine Line wastewater.

- **Alternative 1**: Novel Adsorbent System (NAS) – This process utilizes engineered granular adsorptive particles which act like a sponge, attracting and binding PFAS molecules to the engineered media. This is an adsorptive process that concentrates PFAS on the engineered media. The PFAS is then desorbed and concentrated onsite into a concentration tank and the media is regenerated and ready to be reused.

- **Alternative 2**: Electro-oxidation (EOX) System – This process utilizes reactors fitted with multiple anodes that PFAS are adsorbed onto the surface of, when charged, the anodes produce free electrons that break the carbon-fluorine bonds in PFAS resulting in the constituents of carbon dioxide (CO_2), hydrogen fluoride (HF), and fluoride (F^-).

- **Alternative 3**: Granular Activated Carbon (GAC) – This process utilizes activated carbon which acts like a sponge, attracting and binding PFAS molecules to the GAC-media's surface area. This is an adsorptive process that concentrates PFAS on the activated carbon particles. It is unclear at this time if GAC will be ab efficient treatment method, as GAC may need to be changed out more frequently based on the pre-treatment provided and the brine line constituents. This treatment alternative is included for comparison purposes.

Each alternative treatment system capacity is 15-mgd. Each alternative will be capable of treating PFAS species to meet the EPA proposed drinking water quality standards. This analysis assumes that each treatment system will treat brine at one central location near Reach IV.

A specific site for the proposed alternatives is not identified in this section. Rather, the alternative treatment types are introduced, and site area requirements are developed. Each alternative discussed in this section could be constructed at any location, provided area requirements are satisfied. Alternative 1 (NAS) can be fit into 0.4 acres and Alternative 3 (GAC) can be fit to 0.52 acres with similar configurations. Alternative 2 (EOX) requires approximately seven (7) acres. Refer to Sections 6.4.5.1, 6.4.5.2, and 6.4.5.3 to see a schematic representation of the potential plant layouts.

A new lift station will be required. The pump station would be connected to the new treatment by a new force main. Treated water from the new proposed treatment system would be connected to the existing Brine Line by a new gravity pipe. The proposed pump station and force main will be discussed in further detail in a later section.

6.4.5.1 Novel Adsorbent System

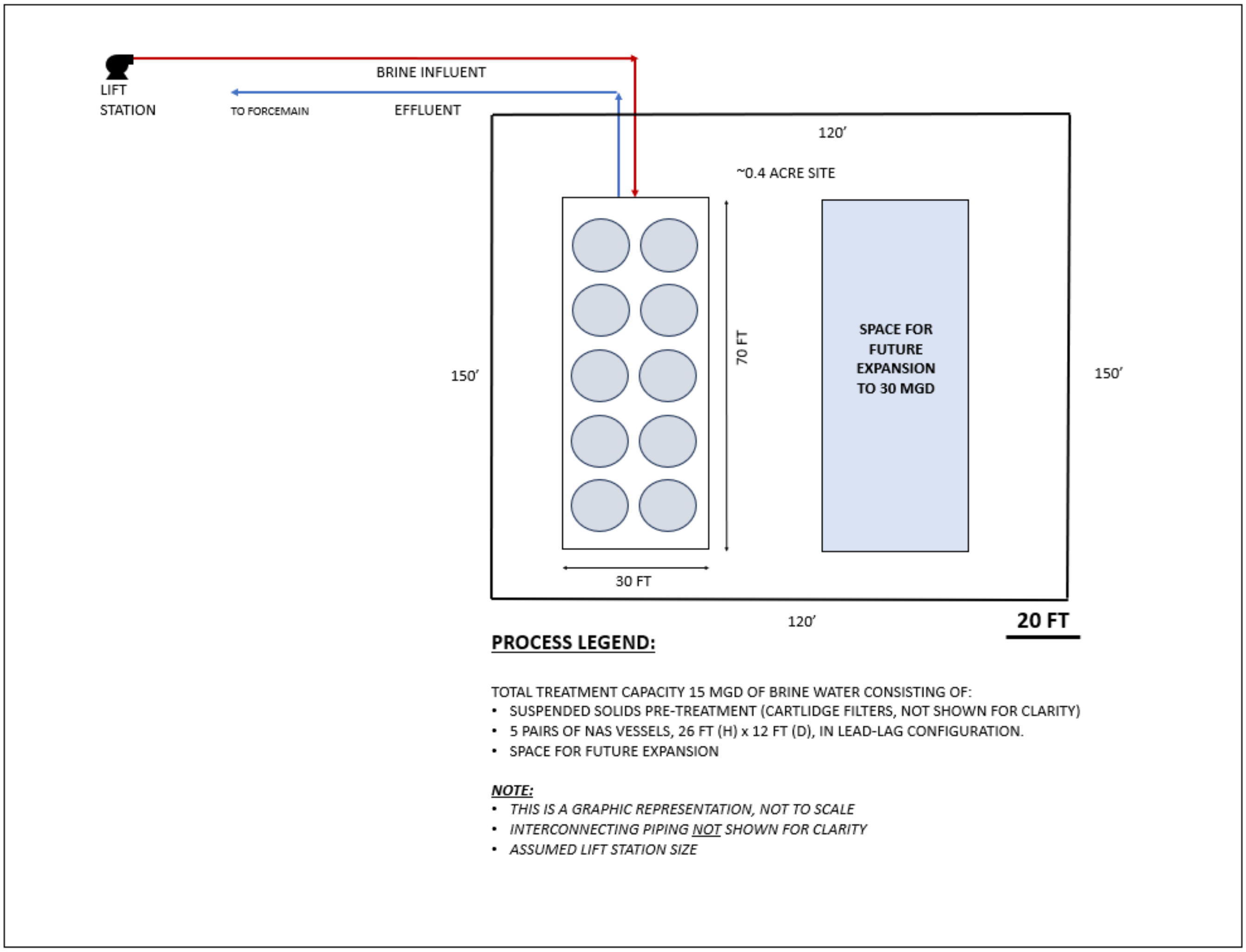
A Novel Adsorbent System (NAS), manufactured by CycloPure, was evaluated as an alternative treatment method for treating PFAS from brine line. The NAS system, shown in **Figure 6-4** and **Figure 6-5**, consists of a skid with multiple treatment vessels. Each vessel contains an engineered adsorbent particle-based media for PFAS removal. The particles are small and cup-shaped, making them ideal for binding PFAS to the particle bodies. Over time, the media accumulate solids and the differential pressure across the vessel reaches 16 psi. At this point, a short backwash cycle (1.6 bed volumes) is initiated to remove the accumulated solids and reduce the differential pressure back down to less than 2 psi. NAS has demonstrated effective removal of PFAS in similar matrices with high TDS, such as metal-plating wastewater (~5,000 mg/L). Advantages of the NAS system typically include a smaller system footprint, lower media volume and longer operational life when compared to GAC treatment systems. A potential disadvantage of this system is the high cost associated with replacing media.

Figure 6-4 Novel Adsorbent Treatment System Example (courtesy of CycloPure)

Figure 6-5 illustrates the components and potential schematic layout of brine line treatment using the Cyclopure treatment process. This is one potential layout which could be modified during the design process.

Brine from the Brine line is pumped via a new lift station to the NAS facility. At the NAS facility, the brine is pretreated to remove suspended solids (e.g., cartridge filtration, dissolved air flotation (DAF), or sand filtration). Pretreated brine then passes through the NAS vessels, configured in five parallel lead-lag systems, for PFAS removal. Each lead-lag system contains approximately 62.6 tons of dry granular engineered media, providing an empty bed contact time (EBCT) of approximately 15 minutes. The treated brine would then flow from the NAS vessels back out to the Brine line via a gravity pipeline.

Figure 6-5 Proposed NAS Site Layout



Based on the 15-mgd capacity of the proposed treatment system, it is estimated that a site of approximately 0.4 acres (120 ft x 150 ft) would be required. The vessels shown in Figure 6-5 would be at existing grade. The proposed system is designed in a lead-lag configuration consisting of five parallel systems for PFAS treatment, each vessel is 26 ft high and 12 ft diameter. Suspended solids pretreatment is required prior to the NAS treatment system. Refer to **Appendix B** for sizing and operational treatment plant performance.

6.4.5.2 Electro-oxidation System

Figure 6-6 Example of EOX Treatment System (courtesy of Aclarity)

Electro-oxidation (EOX) treatment system, manufactured by Aclarity, was evaluated as an alternative treatment method for treating PFAS from the brine line. The EOX system, shown in **Figure 6-6** and **Figure 6-7**, consists of a skid with multiple EOX vessels mounted to it. Each EOX vessel contains multiple titanium anodes. To ensure optimal efficiency, the EOX system is combined with a pre-treatment process to concentrate PFAS prior to treatment. These EOX systems work best with high concentration and low flows. A foam concentrator is typically used for pre-treatment in combination with 100-micron filtration units. The EOX system destroys PFAS based on a Watt-hour per gallon basis. Over time the anodes in the treatment vessels develop minor fouling, as the anodes foul, the amperage through the vessel drops and when this amperage reaches 90% of the baseline amperage the anodes must be cleaned. Cleaning at the point of reduced amperage requires the vessels to be run at reverse polarity. Additional, more in-depth cleaning is required monthly, where hydrochloric acid is run through the vessels in a flow-through method. Advantages of the EOX system include a potential ability to destroy PFAS with lower energy demands unlike NAS and GAC. Disadvantages of this system include the potential generation of toxic byproducts and incomplete destruction of some PFAS species. Moreover, the flow rate through each skid is low, therefore a large number of skids would be required. PFAS concentrations can be increased via preconcentration (e.g., foam fractionation), which would reduce the number of skids and the system footprint, however this is not cost effective. Currently there are no economically feasible concentration technologies on the market to reduce the required quantity of EOX skids.

Figure 6-7 illustrates the components and potential schematic layout of brine line treatment using the Aclarity treatment process. This is one potential layout which could be modified during the design process.

Brine from the Brine line is pumped via a new lift station to the EOX facility. At the EOX facility, the brine is passed through EOX skids for PFAS removal. Each EOX skid contains (8) parallel reactors, power supply, pumps, HMI, and controls. An influent flow meter is used upstream of the system to monitor incoming flow and to control the treatment level being applied. The treated brine would then flow from the EOX skids back out to the Brine line via a gravity pipeline.

Figure 6-7 Proposed EOX Site Layout

It is estimated that a site of approximately 7 acres (550 ft x 550 ft) would be required, based on the proposed treatment capacity of 15-mgd. The site will include a total 2,100 skids under the assumption that skids can be stacked on top of each other. Skids would be operated in parallel. If brine flow rates would increase to 30-mgd, the required area for AOX treatment would be approximately 14 acres. Refer to **Appendix C** for sizing and operational treatment plant performance.

The number of skids and site size can be decreased through brine concentration. Aclarity has identified an ideal concentration factor between 1,000 and 10,000. Existing concentration technologies include Foam Fractionation, Reverse Osmosis, Dissolved Air Flotation, and thermal concentration/evaporation. The recommended concentration technology from Aclarity is Foam Fractionation. Dudek reached out to multiple concentrator manufacturers and has confirmed that available foam fractionation systems on the market are not able to provide the desired level of concentration at the 15-mgd flow rate. This analysis assumes that the EOX treatment will not include a concentrator.

6.4.5.3 Granular Activated Carbon

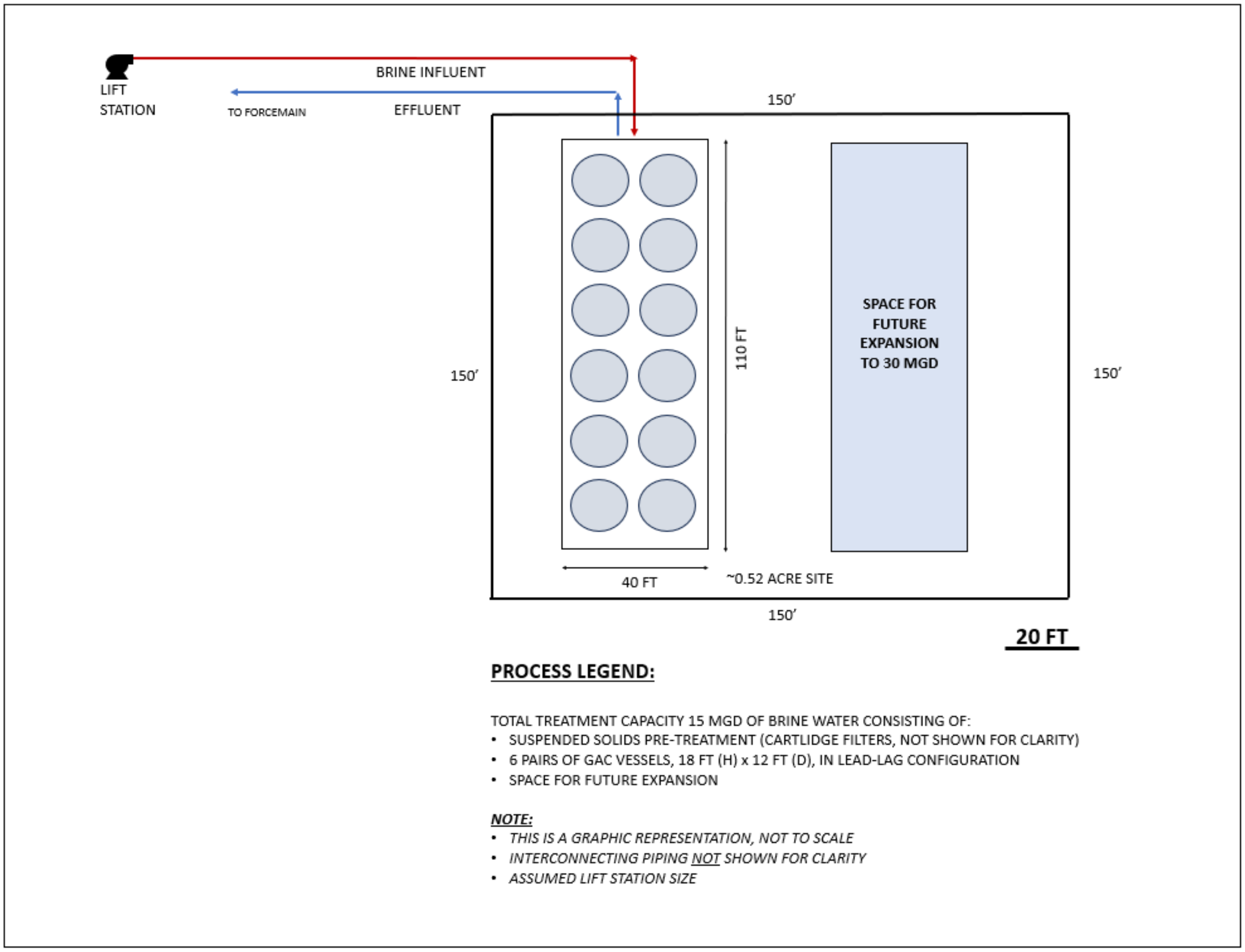
A Granular Activated Carbon (GAC) system was evaluated as an alternative treatment method for treating PFAS from the brine line. The GAC system, shown in **Figure 6-8** and **Figure 6-9**, consists of multiple treatment vessels. Each vessel contains granular activated carbon. To ensure optimal efficiency, the GAC vessels are designed to provide adequate contact time at the given flow rate of 15-mgd. Over time the GAC performance decreases with the accumulation of soluble and particulate materials onto and into the media. As the media becomes saturated and the performance decreases, replacement of the media is required. Advantages of the GAC system include a potentially lower capital costs compared to other treatment processes. One of the major disadvantages is the high operating cost related to media replacement. A Calgon GAC system was evaluated in the analysis, however this equipment is available from multiple manufacturers with similar configurations.

Figure 6-8 Example of GAC Treatment System (courtesy of Calgon)

Figure 6-9 illustrates the components and potential schematic layout of brine line treatment using a GAC treatment process. This is one potential layout which could be modified during the design process.

Brine from the Brine line is pumped via a new lift station to the GAC facility. At the GAC facility, the brine is passed through pre-treatment filters to remove suspended solids. Effluent from the filters than passes through the GAC vessels, configured in five parallel lead-lag systems, for PFAS removal. Each lead-lag system contains approximately 479.5 tons of GAC, providing a contact time of approximately 10.6 min per vessel. The treated brine would then flow from the GAC vessels back out to the Brine line via a gravity pipeline.

Figure 6-9 Proposed GAC Treatment System Site Layout



Based on the 15-mgd capacity of the proposed GAC treatment system, it is estimated that a site of approximately 0.52 acres would be required. The GAC vessels shown in Figure 6-9 can be constructed at grade. Refer to **Appendix D** for sizing and operational GAC treatment performance.

6.4.6 PFAS Treatment Cost Comparisons

The purpose of this section is to compare three (3) alternative approaches to Brine Line treatment in the Inland Empire (Location Reach IV). The following opinion of probable cost serves to establish an order of magnitude cost for the 15-mgd project alternatives. The cost opinion is based on the quantities and unit price estimates of treatment process developed from planning level concepts and preliminary vendor quotes. A more detailed cost information analysis would be developed during preliminary design.

6.4.6.1 Cost Opinion Methodology and Assumptions

For the purposes of this analysis, the cost opinion is a Class 5 Association for the Advancement of Cost Engineering (AACE) Construction Cost Opinion, based on the concept screening analysis. A Class 5 Construction Cost Estimate is known as the rough order of magnitude (ROM) estimate. It is used for the initial screening projects for capital expenditure planning. The cost opinion makes use of quantity takeoffs, vendor/supplier/manufacturer quotations, and recent data in the development of projected costs. Other general assumptions in construction cost analysis include:

- Escalation to Midpoint of 5% of construction subtotal per year
- Construction contingency of 40% of construction subtotal
- Cost of land acquisition is not included in the analysis
- O&M contingency of 40% of O&M costs
- Engineering soft costs is 25% of total construction cost
- Engineering easement and permitting is 25% of total construction cost
- General requirements are estimated to be 10% of total construction cost.
- Installation of civil piping is estimated to be 10% of total construction cost.
- Installation of electrical equipment is estimated to be 13% of total construction cost.
- Installation of instrumentation is estimated to be 3% of total construction cost.

6.4.6.2 Construction and Lifecycle Cost Analysis

A 10-year lifecycle cost model calculates capital and O&M costs for each alternative and expresses them in net present worth for comparison (see Section 6.4.7 for the costs summary). Unit O&M costs are escalated by an annual inflation rate of 3%. The present worth values of the annual loan payments and annual O&M costs are discounted at a rate of 5%, as summarized in Table 6-7 below.

Table 6-7: Lifecycle Cost Model Input

Parameter	Units	Value
Starting Year	-	2024
Ending Year	-	2033
Load Duration	yr	10
Loan Interest Rate	%/yr	3
Discount Rate	%/yr	5
Inflation Rate	%/yr	3

6.4.6.3 Novel Adsorbent System Costs

Alternative 1 evaluates NAS with a total brine wastewater treatment capacity of 15-mgd. Treated brine is estimated to contain PFAS concentrations at or below federal drinking water MCLs. This system includes: a lift station with a total of five (5) pumps (200 HP each), suspended solids pre-treatment, five parallel lead-lag vessels, interconnecting piping, as well as structural and electrical work. Refer to **Table 6-8** for detailed information about the Class 5 construction cost estimate.

Table 6-8: Novel Adsorbent System Construction Cost Range

Cost Item Description	Alternative 1 Novel Adsorbent System
Total Capital Cost	$100 million
AACE Class 5 Estimate, Low (-50% to -20%)	$50 million to $80 million
AACE Class 5 Estimate, High (+30% to +100%)	$130 million to $200 million

Annual O&M costs were developed using a vendor quotation, engineering judgment, and proposed vendor budgetary Service Agreement services as a baseline. Major assumptions include:

- Cost of power is $0.2 per kilowatt-hour (kWh).
- Cost of media is $38.56 per pound, including spent media handling and PFAS waste disposal by destruction technologies.
- A total mass of 313 tons of engineered media is required, with 31.3 tons of engineered media in each vessel to provide a 15-minute EBCT at a flow rate of 2,083 gpm (3-mgd) per lead-lag system.
- Assumed media replacement frequency for the lead vessel in each parallel lead-lag system (5 vessels in total) is estimated to be every 4 months to remove PFAS below EPA drinking water MCLs. PFOS can be removed to < 4 ng/L for 67 weeks and PFOA can be removed to < 4 ng/L for 17 weeks. In this scenario, media replacement frequency is driven by PFOA breakthrough estimates.
- Maintenance and labor costs are estimated to be 10% of total equipment cost.
- Single point of responsibility for maintenance. Costs for PFAS sampling on bi-weekly basis are included.
- Standard maintenance services are included.
- 40% contingency for media cost, maintenance, and labor costs due to inherent uncertainties, potential market fluctuations, and unforeseen events that may impact the operation and maintenance costs associated with the system.

Table 6-9 lists O&M for Novel-Adsorbent System below.

Table 6-9: O&M Cost Estimate for Novel Adsorbent System

O&M Cost Item Description	Quantity		Engineering Estimate	
	Number	Unit	Unit Cost	Total
Power, Year 2024	5,300,000	kWh	$0.20	$1,060,000
Media Cost, Year 2024	626,000	Total lbs/vessels/change	$38.56	$72,400,000
Maintenance + Labor, Year 2024	1	-	$2,100,600	$2,110,000
Contingency	1	-	40%	$30,228,000
			Total Annual O&M Cost, Year 2024	**$105,110,000**
			10-Year Present Worth O&M Cost	**$915,100,000**

The annual O&M unit cost for a NAS was identified as approximately $0.02 per gallon, which is a total cost of $290,000 per day at 15-mgd. The total annual O&M cost is equivalent to $105,400,000 per year while a ten-year present worth O&M cost is approximately $915,100,000.

6.4.6.4 Electro-Oxidation System Costs

Alternative 2 evaluates EOX with a total brine wastewater treatment capacity of 15-mgd. Treated brine is estimated to contain PFAS concentrations at or below federal drinking water MCLs. Aclarity operates on a leasing model for its equipment, and there is no purchasing option available. Therefore, the construction cost estimate for this alternative includes cost of a lift station with a total of four (4) pumps (35 HP each), interconnecting piping, shade structure, and new electrical service. Refer to Table 6-10 for detailed information about the Class 5 construction cost estimate.

Table 6-10: Electro-Oxidation System Construction Cost Range

Cost Item Description	Alternative 2 Electro-Oxidation System
Total Capital Cost	$156 million
AACE Class 5 Estimate, Low (-50% to -20%)	$78 million to $125 million
AACE Class 5 Estimate, High (+30% to +100%)	$203 million to $313 million

Note: All pricing is based on site conditions and desired results.

Annual O&M cost estimate includes a present worth of leasing equipment, anode replacement (7-10 year), financing, labor, engineering support, and $0.2 per kWh power cost.

Table 6-11 lists O&M for EOX System below.

Table 6-11: O&M Cost Estimate for Electro-Oxidation System

O&M Cost Item Description	Quantity		Engineering Estimate	
	Number	Unit	Unit Cost	Total
Power, Year 2024[1]	5,300,000	kWh/yr	$0.20	$140,000
Equipment Lease, Year 2024	1	LS	-	$542,100,000
			Total Annual O&M Cost, Year 2024	**$542,240,000**
			10-Year Present Worth O&M Cost	**$4,396,100,000**

Note: All pricing is based on site conditions and desired results.
1 Estimated cost of power for lift station.

The annual O&M unit cost for EOX was identified as approximately $0.01 per gallon, which is a total cost of $ $1,485,000 per day at 15-mgd. The total annual O&M cost is equivalent to $542,170,000 per year while a ten-year present worth O&M cost is approximately $4.4 billion.

6.4.6.5 Granular Activated Carbon Costs

Alternative 3 evaluates GAC with a total brine wastewater treatment capacity of 15-mgd. Treated brine is estimated to contain PFAS concentrations at or below federal drinking water MCLs. This system includes: a lift station with a total of five (5) pumps (200 HP each), suspended solids pre-treatment, six parallel lead-lag systems, interconnecting piping, as well as structural and electrical work. Refer to **Table 6-12** for detailed information about the Class 5 construction cost estimate.

Table 6-12: Granular Activated Carbon System Construction Cost Range

Cost Item	Alternative 2 Granular Activated Carbon
Total Capital Cost	$55 million
AACE Class 5 Estimate, Low (-50% to -20%)	$28 million to $44 million
AACE Class 5 Estimate, High (+30% to +100%)	$72 million to $110 million

- Annual O&M costs were estimated using vendor quotations, engineering judgment, and proposed vendor budgetary Service Agreement services as a baseline. Major assumptions include:
- Cost of power is $0.2 per kWh.
- Assumed media replacement frequency is estimated to be every 4 months to remove PFAS below EPA drinking water MCLs.
- Cost of media is $3.00 per pound including cost for Resource Conservation and Recovery Act (RCRA) Hazardous and CA Hazardous waste fee for spent carbon that can be potentially reactivated.
- Maintenance and labor costs are estimated to be 10% of total equipment cost.
- Costs include return freight of the spent carbon to a reactivation facility.
- 40% contingency for media cost, maintenance, and labor costs due to inherent uncertainties, potential market fluctuations, and unforeseen events that may impact the operation and maintenance costs associated with the system.

Table 6-13 lists O&M for GAC System below.

Table 6-13: O&M Cost Estimate for Granular Activated Carbon System

O&M Cost Item Description	Quantity		Engineering Estimate	
	Number	Unit	Unit Cost	Total
Power, Year 2024	3,920,000	kWH/yr	$ 0.20	$784,000
Media Cost, Year 2024	48,000	Total lbs/vessels/ change	$3.25	$4,680,000
Maintenance + Labor, Year 2024	1	LS	$1,401,900	$1,410,000
Contingency	1	LS	40%	$2,750,000
Total Annual O&M Cost, Year 2024				**$9,640,000**
10-Year Present Worth O&M Cost				**$83,600,000**

The annual O&M unit cost for GAC was identified as approximately $0.002 per gallon, which is a total cost of $ $20,000 per day at 15-mgd. The total annual O&M cost is equivalent to $9.6 million per year while a ten-year present worth O&M cost is approximately $83.6 million.

6.4.7 PFAS Treatment Costs Summary

The treatment cost summary, including life cycle costs in terms of present worth, is presented below in **Table 6-14.** Life cycle cost assumptions are provided in Section 6.4.6.2. These costs assume that each treatment technology will meet or exceed federal drinking water limits for PFAS.

Table 6-14: PFAS Treatment Costs Summary

Item	Alternative 1: Novel Adsorbent Media	Alternative 2: EOX System[3]	Alternative 3: Granular Activated Carbon
10-Year Capital Net Present Worth[1,2]	$95 million	$149 million	$52 million
10-Year O&M Net Present Worth	$918 million	$4.4 billion	$84 million
Total 10-Year Net Present Worth	$1 billion	$4.5 billion	$136 million
Key non-monetary considerations	Smaller system footprint and longer operation life when compared to other alternatives	Provides flexibility, continuous support, and the latest technology upgrades without the financial commitment of equipment ownership	Proven conventional treatment for PFAS

Notes:
1 Present worth based on 10-years at discount rate of 5%.
2 Construction Cost includes 10-year loan at 3%.
3 Construction Cost includes 10-year loan at 3%.

6.4.8 Potential for PFAS Treatment Cost Reduction

This section provides construction and O&M cost estimates based on assumed higher effluent PFAS limits of 5 (Scenario 1) to 10 (Scenario 2) times the current drinking water PFAS MCLS of 4 ppt. Smaller, side-stream PFAS treatment systems would produce non-detect treated PFAS concentrations. The PFAS-free treated stream would be blended with untreated brine to achieve the assumed higher PFAS limits. Table 6-15 represents a compilation of the 10-year capital net present worth, 10-year O&M net present worth, and the total (capital and O&M) net present worth for the three treatment facilities.

Table 6-15: PFAS Treatment Costs Reduction Summary[1]

Item	Alternative 1: Novel Adsorbent Media	Alternative 2: EOX System[2]	Alternative 3: Granular Activated Carbon
10-Year Capital Net Present Worth[3,4]	$70 - 83 million	$109 - 129 million	$39 - 46 million
10-Year O&M Net Present Worth	$674 - 796 million	$3.3 - 3.9 billion	$62 - 73 million
Total 10-Year Net Present Worth	$744 - 879 million	$3.4 - 4 billion	$100 - 118 million

Notes:
[1] Ranges in costs based on values for Scenario 1 (PFAS limit of 5x the drinking water MCL) to Scenario 2 (PFAS limit of 10x the drinking water MCL).
[2] Construction Cost includes 10-year loan at 3%.
[3] Present worth based on 10-years at discount rate of 5%.
[4] Construction Cost includes 10-year loan at 3%.

Key Findings: For the two assumed scenarios, the construction unit cost of a 15-mgd novel adsorbent media treatment facility was estimated to be approximately $6 million per-mgd. Therefore, the total 10-year capital present worth cost is estimated to be between $70 million and $83 million. Compared to previous analysis, this could potentially decrease costs between 13% and 26%. The 10-year O&M net present worth cost is estimated to be approximately $61 million per-mgd, resulting in a total cost of approximately $674 million to $790 million.

For the two assumed scenarios, the construction unit cost of a 15-mgd EOX treatment facility was estimated to be approximately $9.9 million per-mgd. Therefore, the total 10-year capital present worth cost is estimated to be between $109 million and $129 million. Compared to previous analysis, this could potentially decrease costs between 13% and 27%. The 10-year O&M net present worth cost is estimated to be approximately $293 million per-mgd, resulting in a total cost of approximately $3.3 billion to $3.9 billion.

For the two assumed scenarios, the construction unit cost of a 15-mgd granulated activated carbon treatment facility was estimated to be approximately $3.5 million per-mgd. Therefore, the total 10-year capital present worth cost is estimated to be between $39 million and $46 million. Compared to previous analysis, this could potentially decrease costs between 12% and 25%. The 10-year O&M net present worth cost is estimated to be approximately $5.6 million per-mgd, resulting in a total cost of approximately $62 million to $73 million.

6.4.9 PFAS Management Recommendations

Given the complexities associated with removing PFAS species in the brine line, limited availability of detailed water quality data, and the uncertainties surrounding PFAS regulations in brine, it is recommended to:

- Collect wastewater samples from individual dischargers to identify relative contributions of PFAS to the Brine Line. It may be more economical to remove PFAS from a few select dischargers rather than treating the entire Brine Line flow at a centralized treatment facility.
- Evaluate the viability of point source PFAS treatment using a smaller scalable system, after performing PFAS sampling from individual dischargers.

- Conduct a pilot study to better inform estimates of full scale PFAS treatment requirements and costs. This approach is considered the most effective means to estimate long-term consumption rates, including factors such as rapid kinetics, high treatment capacity, resistance to fouling, media lifetime, and concentration of PFAS waste. Additionally, it is important to note that equipment sizing depends on various factors, e.g., hydraulic rates, and a pilot study is essential to assess these specific needs for optimal equipment selection, performance, and cost.

- Continue to monitor PFAS regulations as they pertain to wastewater disposal and operations at OC San.

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7 Brine Line Multi-Use Benefits

7.1 Overview

As part of this Master Plan effort, SAWPA has maintained an interest and desire to conduct its regional activities in a manner that supports both the Santa Ana Watershed and the people that live and work within its boundaries. The One Water One Watershed (OWOW) program illustrates this concept. The purpose of the OWOW program is to encourage integrated management of water resources and provide funding for multi-benefit projects that support watershed sustainability. OWOW has been part of the California Department of Water Resources Integrated Regional Water Management (IRWM) Program and now part of the California's Integrated Climate Adaptation and Resiliency Program (ICARP), which promotes collaborative planning and water resource management. The OWOW program integrates different disciplines such as: water supply, water quality, recycled water, stormwater management, water use efficiency, land use, energy use, climate change, and habitat, while Disadvantaged Communities and Native American tribal community water issues receive special focus. Through this integration, regional participants conduct planning and produce shared goals and integrated projects. When it comes time to implement projects, because the plan was crafted together, those projects have multiple benefits that reflect the interests of the entire community.

California's ICARP is an initiative designed to address the impacts of climate change through coordinated and comprehensive adaptation and resilience strategies. Established by the state, ICARP aims to integrate climate adaptation planning and implementation efforts across different levels of government and sectors, fostering collaboration among state agencies, local governments, and other stakeholders. The ICARP program facilitates coordination among various state agencies to ensure a unified approach to climate adaptation and resilience, as well as providing guidance and support to local governments for development and implementation of their own climate adaptation plans. ICARP also provides tools and resources to help local governments and communities develop effective adaptation strategies, with a council of experts and practitioners that provides guidance and recommendations on climate adaptation policies and practices. ICARP includes grant programs to fund local and regional adaptation projects, helping communities enhance their resilience to climate impacts, while encouraging leveraging of state and federal funds to maximize the impact of adaptation investments. ICARP represents California's commitment to proactive and integrated climate adaptation, recognizing that effective resilience planning requires collaboration, innovation, and a comprehensive approach to addressing the complex challenges posed by climate change.

SAWPA Roundtables, also known as Task Forces, provide a forum for joint water resource management to address watershed issues and regulatory compliance. The SAWPA Roundtables operate under formal and informal agreements, often with the Santa Ana Regional Water Quality Control Board as a member and are designed to work cooperatively with the regulated community to address water quality issues. The Roundtables have a long and strong track record of partnerships with organizations with shared interests pursing overall watershed sustainability. The Roundtables create shared value between regulators, regulated parties, and SAWPA Member Agencies by facilitating stakeholder collaboration, producing significant savings through joint efforts that address water management issues.

Climate change, extended periods of drought, and other weather extremes occur more frequently. Recent research released by the University of California, Los Angeles, identified recent drought conditions in the American West to be the worst 22-year dry-period in at least 1,200 years. The typical response to worsening drought conditions are declared a water shortage emergency and orders for outdoor usage restrictions. SAWPA's work in the Santa Ana River Watershed advances projects and programs that build water resiliency and promote collaborative, innovative responses to water planning, all of which help address drought conditions.

In an effort to further benefit the Santa Ana Watershed, SAWPA conducted a feasibility study in 2020 to access the potential benefits of cloud seeding in increasing water supply in the Santa Ana River Watershed. SAWPA is conducting a pilot program to investigate these potential regional benefits. Cloud seeding is used to increase the amount of precipitation, including snow or rain, during the storm season. The process works through releasing particles of silver iodide into clouds, which increase the chances of droplet condensation. The effort is an example of SAWPA's commitment to multi-use benefits for the watershed and the Southern California region.

7.2 Brine Line is a Multi-Use Benefit System

The Brine Line is a significant example of a multi-use benefit system that integrates water management and environmental stewardship with economic efficiency. The Brine Line transports brine from inland desalination and water recycling facilities, as well as regional industrial discharges. The Brine Line exemplifies the concept of multi-use benefits in several ways, as discussed in the subsequent sections.

7.2.1 Brine Management

A primary goal of the Brine Line System is to provide a cost-effective and environmentally responsible solution for disposing of brine generated by inland dischargers. By transporting brine to the ocean, the Brine Line relieves the need for inland disposal operations that would be costly and potentially harmful to local ecosystems. In this manner, the Brine Line helps mitigate environmental impact associated with brine disposal throughout the Santa Ana River Watershed, including potential groundwater contamination or soil salinization. By exporting brine from the watershed, the Brine Line System minimizes regional risk, while promoting water management and production for regional consumers.

7.2.2 Stormwater Capture

Rain and snowmelt wash pollutants from streets, construction sites, and other lands into storm drains and ditches. Eventually, these stormwater facilities discharge directly into streams and rivers, typically with no treatment. The Riverside County Flood Control and Water Conservation District (Flood Control District) developed a Stormwater Resource Plan (SWRP) for the Riverside County portion of the Santa Ana River Watershed. The SWRP development process included involvement from various stakeholders. The State Water Resources Control Board provided their consensus letter to the Flood Control District, approving its SWRP. The SWRP leverages ongoing cooperative water management planning efforts in the Planning Area, including the Integrated Regional Water Management (IRWM) Program. The IRWM Program, administered in the Santa Ana River Watershed (SARW) Region by SAWPA, supports a regional understanding of water resources, advances regional water projects, and maximizes project benefits through agency collaboration and integration. The SARW IRWM Program's OWOW Plan is a key document referenced in this SWRP.

Recommended stormwater management strategies developed by stakeholders and included in the OWOW Plan recognize the importance of stormwater as a watershed resource and highlight the potential to preserve areas for open space, habitat, and natural hydraulic functions through floodplain management. Several nonprofit organizations participated in the OWOW Plan, particularly through identification of habitat restoration and water quality improvement strategies and projects. Environmental stewardship organizations in the SARW are identified in Table 2.1-6 of the OWOW Plan, several of which are working on stormwater and dry weather resource planning. Capture of dry weather runoff, often referred to as "urban drool," from urban communities offers several positive benefits, including:

- Water Quality Improvement: Capturing low flow runoff helps reduce the quantity of pollutants, such as oils, heavy metals, and nutrients, entering natural water bodies, leading to improved water quality in rivers, lakes, and coastal areas.

- Flood Mitigation: Capturing and managing runoff, reduces the risk of flooding in urban areas, thereby protecting infrastructure, property, and natural habitats.

- Groundwater Recharge: Capturing runoff allows for the water to infiltrate into the ground, which helps replenish groundwater supplies.

- Ecosystem Support: Reducing the flow of pollutants and sediments into natural water bodies protects and supports aquatic ecosystems, maintaining biodiversity and ecological balance.

- Urban Heat Island Mitigation: Properly managed runoff can be used in green infrastructure projects, such as green roofs and urban green spaces, to help reduce the urban heat island effect and improve overall urban climate conditions.

- Sustainable Water Management: Capturing and reusing runoff can contribute to sustainable water management practices by reducing the reliance on potable water for non-potable uses, such as irrigation and industrial processes.

- Economic Benefits: Reducing flood damage, improving water quality, and enhancing urban environments lead to economic benefits, including increased property values and savings on water treatment and flood control infrastructure.

- Aesthetic and Recreational Improvements: Properly managed runoff creates attractive urban landscapes, parks, and recreational areas, enhancing the local quality of life.

Overall, capturing dry weather runoff from urban communities is a crucial component of integrated water management strategies aimed at creating more resilient, sustainable, and livable urban environments. The Flood Control District and SAWPA project approximately 2,000,000 gpd of dry weather flow diverted to the Brine Line system, thereby protecting the Santa Ana River Watershed from potential dry weather pollutants. The County of Riverside has identified these potential flows as high in TDS, and removal is proposed to protect the environment.

7.2.3 Water Reuse (Recharge, IPR, DPR)

Water reuse and conservation play critical roles in sustainable water management, particularly in regions facing water scarcity and increasing demands from growing populations and economic activities. Types of water reuse include treating wastewater to levels suitable for irrigation, industrial processes, groundwater recharge, or now potable (drinking) water production (DPR). Augmentation of regional water supplies using treated wastewater expands available water resources, reducing reliance on imported or local freshwater sources and mitigating the diverse impacts of water scarcity. During droughts or periods of reduced water availability, water reuse provides a dependable and drought-resistant water supply for non-potable applications. Water reuse has been shown to be a cost-effective alternative to development of new water sources or expanding existing infrastructure, especially in southern California where demand for water is high. Water reuse also reduces discharge of treated effluent to natural water bodies, minimizing potential pollution and protecting aquatic ecosystems.

Water reuse and conservation can be implemented in many forms. Many municipalities and other regional agencies implement water reuse to meet non-potable water demand, such as landscape irrigation, street cleaning, and other industrial processes. Treated wastewater is also used for agricultural irrigation, reducing the need for potable water importation or potential depletion of regional surface or ground water resources. Many industries use recycle and reuse process water to decrease operational cost and their perceived environmental footprint. Recycled water, when injected into aquifers for groundwater replenishment, helps sustain groundwater levels and prevent saltwater intrusion in coastal regions. The Brine Line system, as a regional facility, supports a variety of water recycling and desalination activities throughout the Santa Ana River Watershed, and therefore is a multi-use benefit facility to many regional and local communities.

7.2.4 Water Conservation

Water conservation focuses on reducing water consumption through efficient technologies, practices, and regional water use changes. Conserving water reduces overall demand, preserving water resources for future uses and minimizing need for costly infrastructure expansions. Pumping, treating, and distributing water requires energy. By conserving water, energy consumption associated with water supply and treatment processes is reduced. Furthermore, conserving water protects aquatic habitats, sustains natural river flow, and reduces the carbon footprint associated with regional water management activities.

Water conservation activities include a wide variety of regional and local actions. Membrane filtration (e.g., reverse osmosis, ultrafiltration), ultraviolet disinfection, and advanced oxidation processes are used to treat wastewater to high-quality standards suitable for reuse, as well as for desalination of impaired groundwater resources. Use of water-efficient fixtures (e.g., low-flow toilets, faucets, and showerheads), implementing smart irrigation systems, and promoting water-wise landscaping techniques contribute to water conservation efforts. Governmental agencies implement policies and regulations to promote water reuse and conservation, such as water recycling mandates, water-use efficiency standards, and incentives for adopting water-saving technologies. The Brine Line System provides a means of producing needed regional water supplies, with SAWPA's focus on regional water management makes them a leader in the area of water management and conservation.

7.2.5 Public Awareness and Education

SAWPA, through its operation and management of the Brine Line System conduct many public awareness and educational activities. Public outreach and education campaigns raise awareness about the importance of water reuse and conservation, encouraging individuals and businesses to adopt water-saving practices. Collaboration among stakeholders including governmental agencies, water utilities, industries, and non-profit organizations fosters innovation and implementation of effective water reuse and conservation strategies. Water reuse and conservation are integral components of sustainable water management strategies aimed at enhancing water security, protecting the environment, and promoting resilience in the face of climate change and population growth (multi-use benefit).

7.2.6 Environmental Protection & Regulatory Compliance

The Brine Line System enables the construction of regional desalination facilities, as well as assisting these plants in complying with environmental regulations governing brine disposal, ensuring that ultimate disposal of the brine meets stringent quality standards and assuring the regional community of needed water resources. By removing salt loading from the Santa Ana River Watershed, the SAWPA minimizes impacts on inland water bodies and ecosystems, preserving local habitats and biodiversity.

Facility management of the Brine Line System involve collaboration among many governmental agencies, water utilities, private companies, and environmental organizations. This multi-stakeholder approach ensures that the system is managed in a sustainable and socially responsible manner. The Brine Line exemplifies the concept of a multi-use benefit system by addressing complex water management challenges while fostering economic development and environmental stewardship. The existence of the Brine Line underscores the potential of integrated approaches to water infrastructure that maximize resource efficiency, sustainability, and regional water management in water-stressed southern California region.

7.3 Multi-Use Benefits in Water Projects

In June 2020, the Pacific Institute issued a guidebook focused specifically on the integration of multiple benefits into water projects. The following discussions are excerpts from the Pacific Institutes guidebook, provided to broaden understanding and integration of multi-benefit thinking into various components of water management practices.

There is general agreement that climate change, our aging water infrastructure, and population growth require investment into water systems, as well as the environment. Typically, such investments can include infrastructure repair, replacement and rehabilitation, watershed restoration, overall energy and efficiency improvements, and stormwater management addressing flood risk, water quality, and water supply needs. Many of these strategies provide important community benefits, in the form of reducing energy use or greenhouse gas emissions, as well as providing improved habitat and enhanced community benefit. While the importance of multi-benefit projects is understood, these benefits are typically added at the end of projects. Integrating multi-benefit components into the decision-making process allows development of partnerships that can leverage resources and garner public support. The Pacific Institute’s workbook identifies the following multi-benefit process that can benefit a water agency:

- Provide an objective and transparent basis for comparison of water management options
- Identify opportunities for shared cost between project beneficiaries
- Identify design improvements that leverage added value and benefit
- Engage stakeholders to improve public and community support
- Optimize investment of time, money, and other resources
- Increase investment in communities, while identifying and managing unintended consequences

7.3.1 Multi-Benefit Framework

To increase consideration of multi-benefits, the Pacific Institute collaborated with various partners to define a framework that promotes incorporation of co-benefits into water infrastructure and management decisions. In turn, water managers identify potential project partners and/or opportunities, thereby enhancing project design to maximize value. This framework is outline in **Figure 7-1** and includes four steps:

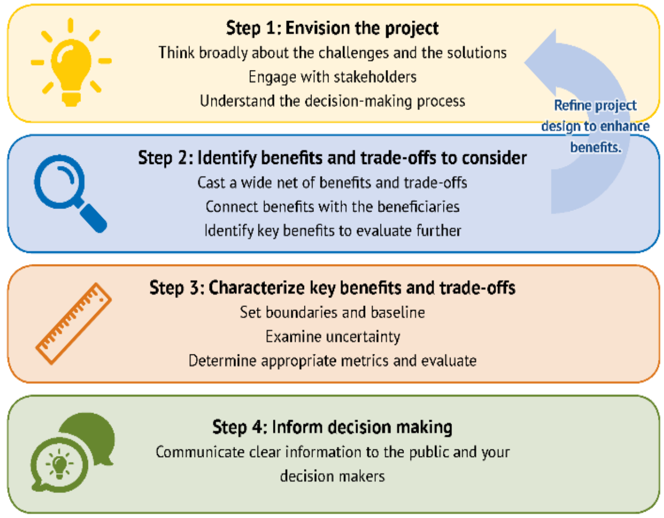

Figure 7-1 Multi-Benefit Framework Steps to Inform Water Management Decisions (Pacific Institute, 2020)

Step 1: Envision the Project. Define the project vision and determine potential project options, including identifying goals and potential alternatives, as well as identifying relevant stakeholders.

Figure 7-2 Benefit Themes (Pacific Institute, 2020)

Step 2: Identify Benefits & Trade-Offs. Determine potential benefits and trade-offs, even if outcomes can't be quantified. To facilitate the process, Pacific Institute defined five benefit themes as shown on **Figure 7-2**.

Step 3: Characterize Key Benefits & Trade-Offs. Characterize benefits and trade-offs toward greatest interest to stakeholders, including methods of evaluating the benefits/trade-offs, as well as setting the baseline for project comparison and uncertainty.

Step 4: Inform Decision Making. Inform decision making by communicating results to stakeholders. As a result of effectively communicating, decision makers are equipped to make more informed and transparent decisions.

Investments in water management provide multiple benefits to communities, the economy, and the environment. However, those benefits are realized when water managers actively incorporate them into a project design and implementation. Identifying and evaluating multi-benefit solutions is just the beginning. Figure 7.2 highlights the interconnectivity of various benefit themes.

Scaling these strategies into sustained effort toward multiple benefit results and developing long-term policy and program level decision making is the ultimate goal. For a project, multiple benefits can be used to evaluate the "business case" for a project or provide insight into project design to maximize the benefit. At a program level, water managers may prioritize funding among various projects. At a policy level, multiple benefits help determine strategic direction that provides benefit to customers and community members.

7.4 Multi-Use Benefit Considerations

Considering multi-use benefits in water systems involves recognizing and leveraging the interconnected nature of water resources for various purposes, beyond their traditional uses. This approach acknowledges that water is a resource that can simultaneously support multiple needs and activities, including agricultural irrigation, domestic water supply, industry, hydropower generation, ecosystem services, recreation, and environmental conservation. The principles of multi-use benefits are also directly applicable to brine management and transport systems, particularly in the context of desalination plants and industries that produce concentrated non-reclaimable waste streams (brine). Brine management presents unique challenges as a result of its high salinity and potential environmental impacts. With respect to the Brine Line System, the following considerations are identified:

1. **Resource Optimization:** Brine management benefits from integrated approaches that optimize resource utilization. For instance, instead of treating brine as a waste product, it can be viewed as a resource for various applications, such as mineral recovery, energy production, or other industrial processes.

2. **Multi-Industry Collaboration:** Collaboration among industries that generate and use brine unlocks innovation and reduces cost. For example, sharing brine infrastructure (e.g., pipelines, storage facilities) among desalination plants and other brine producing activities can maximize efficiency and minimize environmental impact.

3. **Environmental Considerations:** Adopting multi-use benefits in brine management involves minimizing environmental impact. This consideration includes reducing the volume and salinity of brine discharged into water bodies, implementing brine treatment technologies, and exploring alternative disposal methods, such as deep-well injection or evaporation ponds.

4. **Circular Economy Approaches:** Embracing circular economy principles can transform brine management into a resource recovery process. By extracting valuable components (e.g., minerals, metals) from brine, the economic and environmental value of brine is maximized.

5. **Innovation and Technology:** Research and development of innovative technologies for brine treatment, reuse, and disposal are critical. This consideration includes membrane processes, crystallization techniques, and electrochemical facilities that can improve brine management efficiency and reduce energy consumption.

6. **Policy and Regulation:** Regulatory frameworks can encourage the adoption of sustainable brine management practices, which involve setting discharge limits, incentivizing resource recovery from brine, and promoting collaboration among stakeholders.

7. **Ecosystem Services:** Considering the potential impacts of brine discharge on aquatic ecosystems is necessary. Protecting ecosystem such as water quality, habitat preservation, and biodiversity can then be integrated into brine management strategies.

8. **Public Engagement and Awareness:** Engaging communities and stakeholders in discussions about brine management can foster support for sustainable practices. Public awareness campaigns can highlight the importance of responsible brine disposal and the potential benefits of resource recovery.

By applying the principles of multi-use benefits to brine management and transport systems, stakeholders work towards more sustainable and efficient utilization of saline resources while minimizing environmental impact. This approach requires collaboration, innovation, and an understanding of the interconnected nature of water and industrial discharges. Beyond brine management considerations, multi-use benefits throughout the community are enhanced through additional water management actions, including:

1. **Integrated Water Resources Management (IWRM)**: Multi-use benefits align with the community principles of IWRM, which emphasize the approach to managing water resources across different sectors and stakeholders. IWRM promotes coordination and cooperation among various agencies to optimize water allocation and achieve sustainable goals.

2. **Synergies and Trade-offs**: Identifying synergies and trade-offs among different water uses is crucial. For example, a reservoir managed for irrigation can also be used for hydropower generation or flood control. However, these uses may have competing demands during dry or wet seasons, requiring careful planning to optimize benefits without compromising sustainability.

3. **Ecosystem Services**: Water systems provide essential ecosystem services, such as maintaining water quality, supporting biodiversity, and regulating flows. Incorporating these considerations into water management decisions ensures that natural processes are sustained.

4. **Stakeholder Engagement**: Engaging diverse stakeholders, including communities, businesses, governments, and environmental organizations, is assist in identifying and prioritizing multi-use benefits. Participation fosters collaboration, builds consensus, and identifies competing interests.

5. **Infrastructure Planning and Design**: Designing water infrastructure with multi-use benefits in mind enhances efficiency and resilience. For instance, constructing multipurpose infrastructure that integrates compatible services can maximize benefits and minimizing impacts.

6. **Policy and Regulatory Frameworks**: Developing flexible and adaptive policy frameworks is promotes multi-use benefits. Policies can incentivize integrated approaches, provide clear guidelines for resource allocation, and address potential conflicts.

7. **Climate Resilience**: Considering climate change ensures the sustainability of multi-use water systems. Climate-resilient facilities include incorporating adaptive measures like water recycling, rainwater harvesting or enhancement, and enhancing water use efficiency.

8. **Data and Information Systems**: Robust data collection, monitoring, and modeling are essential for understanding complex water systems and predicting future need. Information systems that integrate hydrological, ecological, and socio-economic data support informed decision making.

9. **Capacity Building and Knowledge Sharing:** Investing in capacity advancement and knowledge sharing among water managers, policymakers, and communities enhances adoption of innovative solutions.

In summary, embracing multi-use benefits throughout a brine management or water system promotes an integrated and sustainable management strategy. By adopting the perspective of considering social, economic, and environmental consequences, water resources and facilities can be effectively managed to meet diverse need while preserving long-term viability.

7.4.1 Energy Production

7.4.1.1 Power Generation

While the primary purpose of the Brine Line is brine management and environmental protection, SAWPA has been interested in opportunities to incorporate power generation technologies within the overall conveyance system, if viable. Various technologies existing for power production from water conveyance systems. The salinity of brine flows complicates these efforts, in that operation and maintenance of such systems can be labor and cost intensive.

As part of this master plan effort, the use of in-pipe hydroelectric facilities as a source of renewable energy. LucidPipes was investigated, by Lucid Energy, installed a $1.3 million system in Portland, Oregon, producing renewable energy to power about 150 homes, as well as revenues to help pay for needed infrastructure upgrades. Up to four LucidPipe units can produce as much as three megawatts of electricity, depending on the hydraulic conditions. The lift based vertical axis spherical turbines generate electricity by extracting excess pressure head in larger diameter (24" to 96"), gravity water pipelines and effluent streams. The Brine Line System could potentially accommodate in-pipe hydroelectric facilities. Brine scaling of hydroelectric facilities, as well as open manholes that exist throughout the Brine Line System, may negatively impact implementation of these facilities.

Micro-hydro power refers to the generation of electricity using small-scale hydroelectric systems that harness energy of flowing water. While micro-hydro power is not directly related to brine transport systems, exploring the integration of renewable energy technologies with water infrastructure for overall sustainability and energy efficiency has merit. In the context of the Brine Line System, micro-hydro power could potentially be integrated at pumping stations (which are not present in the system) or along the pipeline route if suitable hydraulic conditions exist. The potential for micro-hydro power generation was evaluated based on the general hydraulic characteristics of the Brine Line facilities. **Figure 7-3** illustrates the results of that analysis.

As illustrated on Figure 7.3, the production of power is primarily associated with the available water flow and the available hydraulic head within the pipeline system. The Brine Line does not have reaches of significant hydraulic grade variations, under which hydraulic energy can be harnessed. For the purposes of the analysis, flows of 11.06-mgd and 30.0-mgd were assumed, representing the current and ultimate flow conditions. Hydraulic head was varied between 5 and 80 feet. Based on these parameters, power generation within the Brine Line System might vary between 5 and 120 kW, with a value of between $3,000 and $140,000. Considering the cost of implementing a project of this magnitude, the payback period for such a project would not make the project economically viable.

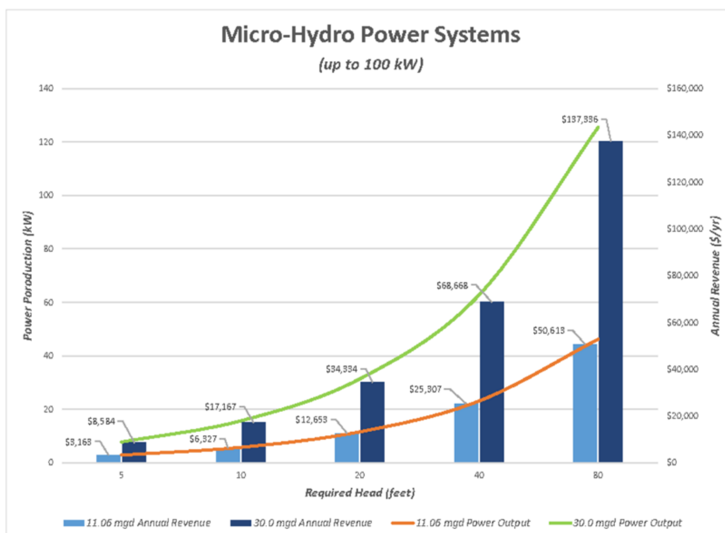

Figure 7-3 Projected Micro-Hydro Power Capabilities

Other power generation options exist. Research and development in the future may make power generation more viable. Therefore, focusing on exploring innovative technologies that are specifically tailored to extract energy from high-salinity brine streams should be maintained. Such efforts could involve collaborations between water utilities, technology developers, and research institutions to identify and deploy suitable power generation solutions. However, before implementing power generation technologies within the Brine Line System, feasibility studies would be necessary to assess the technical, economic, and environmental viability of such facilities. Factors such as energy efficiency, capital costs, and regulatory considerations would be evaluated to determine the practicality of integrating power generation with SAWPA's brine transport operations.

While the primary function of the Brine Line is brine management and environmental protection, there are currently limited opportunities to explore power generation technologies. However, further research, planning, and investment would be required to assess and implement such opportunities effectively.

7.4.1.2 Green Hydrogen

Producing green hydrogen from brine flows involves using a process that leverages renewable energy to split water into hydrogen and oxygen. Brine presents an interesting opportunity for this operation because it is typically a byproduct of certain industrial processes, such as desalination or resource extraction, and can have a higher salt content than seawater.

To produce green hydrogen, brine is collected from industrial operations like desalination plants or from natural salt deposits. The brine may be purified and diluted to remove impurities and adjust the salt concentration to optimal levels for electrolysis. Electrolysis is used to split water molecules (H_2O) into hydrogen (H_2) and oxygen (O_2) using electricity. In the case of brine, the process involves using an electrolyzer that can handle the higher salinity levels. The choice of electrolysis technology is crucial. Some advanced electrolyzers are specifically designed to handle brine solutions. These systems must be resistant to corrosion caused by the salt content. To ensure the process is truly green, renewable energy sources such as solar, wind, or hydroelectric power are used to provide the electricity needed for electrolysis. This process ensures that the hydrogen produced is environmentally friendly and does not contribute to greenhouse gas emissions. Once produced, the hydrogen is purified to remove any remaining impurities before it can be used as a clean fuel source.

Challenges with the green hydrogen process include the corrosive nature of brine that may require specialized materials and maintenance. The cost of electrolysis, especially using brine, needs to be competitive with other hydrogen production methods to be economically viable. Optimizing the efficiency of the electrolysis process, especially with brine, is critical for cost-effectiveness and overall environmental impact. Green hydrogen production from brine flows is an innovative pathway towards sustainable hydrogen production.

7.4.2 Water Production

Brine discharged to the Brine Line System varies considerably in total dissolved solids (TDS). Considering the current discharge limitation of 30.0-mgd to the OC San system and the projected ultimate brine flow of approximately 33.5-mgd, brine concentration and/or management effort will likely be required to avoid regulatory restrictions. Figure 3.3 projects, based on current information, that the Brine Line will exceed the 30.0-mgd limitation in approximately 2065. While this date is over 40 years in the future, other regulatory challenges (e.g., PFAS) may accelerate the need for advanced treatment of brine discharges, which may result in reaching the regulatory threshold sooner. Despite having significant time before brine concentration is required, SAWPA may selectively implement brine management where opportunities may exist.

The opportunity to extract water from the existing Brine Line flow will be highly dependent on location within the system. For example, extracting additional water from the brine flow along Agua Mansa Road would provide an opportunity to discharge the recovered water to the RIX facility, thereby creating a multi-use benefit for the community through increased groundwater replenishment. Similarly, if an industrial use of recycled water were available adjacent to a brine concentration facility, the water could be used for that industrial use, thereby creating a community benefit, while reducing the brine volume for ultimate disposal. It will be necessary to weigh the cost, operation, and maintenance of such a facility against the magnitude of the overall benefit. During the agency workshops conducted for this master plan, the agencies operating existing groundwater desalters identified that brine concentration was not cost effective beyond what they are already doing. Therefore, the driving factor for brine concentration and management activities will be the regulatory discharge limitation, and not the multi-use benefit that can be attained.

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8 Future Facilities, Improvements & Expansion

The following section summarizes the recommended Brine Line improvement projects related to pipeline capacity, operations and maintenance (O&M), and data collection developed throughout this Master Plan. The recommended improvement projects are intended to improve the performance of the existing Brine Line or address anticipated future needs of the system based on results of the capacity analysis, discussion with SAWPA staff, and review of historical data and studies.

The advanced monitoring and real time data collection, included as a recommendation in the following discussion, will optimize the timing of improvements. The primary recommendation is for SAWPA to reconsider the market analysis and infrastructure improvements identified herein periodically, with the first review in five years.

Furthermore, decentralized PFAS treatment is a likely option and, as such. it is recommended that SAWPA evaluate the future economics of this approach further. OC San is in the process of developing Local Limits to regulate the discharge of PFAS to their treatment facilities, which may require dischargers to limit the amount of PFAS discharged to the Brine Line System.

This Master Plan is intended to inform the process of rate setting but does not set rates in and of itself. Exploration of funding strategies, including state and federal grants, will certainly be required on many fronts to implement many of the identified recommendations. The Brine Line Master Plan is intended to provide a solid framework for managing future infrastructure needs. Discussions of funding through grants, reserves and/or rate increases introduce dynamics that are beyond the scope of this master plan and should be carefully reviewed and managed.

8.1 Recommended Improvement Projects

The following recommendations include those to correct identified capacity deficiencies, improve facility management and perform system monitoring. Additionally, potential laterals for expanded Brine Line service as well as recommendations for future project evaluations are included within this section.

8.1.1 Pipeline Capacity Improvement Projects

Based on the results of the Brine Line capacity analysis presented in Section 5, projects summarized in **Table 8-1** are recommended for consideration by SAWPA. **Figure 8-1** illustrates the approximate location of Projects CAP-1 and CAP-2. It is noted that these projects are defined to be needed within the Near- (2024-2034) and Long-Term (2034-2058) planning horizon, as these challenges become evident as brine flows increase in the future.

Table 8-1: Recommended Pipeline Capacity Improvement Projects Summary

Project ID	Planning Scenario	Project Description
CAP-1	Long-Term (2035-2059)	Reach IV-A Lower (Prado Inundations Area) Pipeline Replacement and Relocation: Replace 18,000 LF of existing 36-inch pipe with 48-inch pipe in Reach IV-A, west of Prado Dam.
CAP-2	Near-Term (2024-2034)	Smart Manhole Cover Installation: Install smart manhole covers at five (5) locations (Locations 2 through 6 per Table 5.4) to monitor water levels during maximum flow conditions.
CAP-3	Build-Out Term (Beyond 2048)	Reach 4D – Parallel: Construct a 2,100-LF, 36-inch parallel line along the stretch of Reach 4D anticipated to be capacity deficient in the Buildout scenario.
CAP-4	Build-Out Term (Beyond 2048)	Reach 4 – Parallel: Construct a 10,200-LF, 30-inch parallel line along the stretch of Reach 4 anticipated to be capacity deficient in the Buildout scenario.
CAP-5	Near-Term (2024-2034)	Future Study on Green Hydrogen: Evaluate the feasibility of Green Hydrogen for the Brine Line system. This project provides capacity management when in operation by removing flow from the Brine Line
CAP-6	Near-Term (2024-2034)	Future Study on Brine Minimization and PFAS: Conduct future studies and pilot programs on Brine Minimization (commence in approximately 2034)

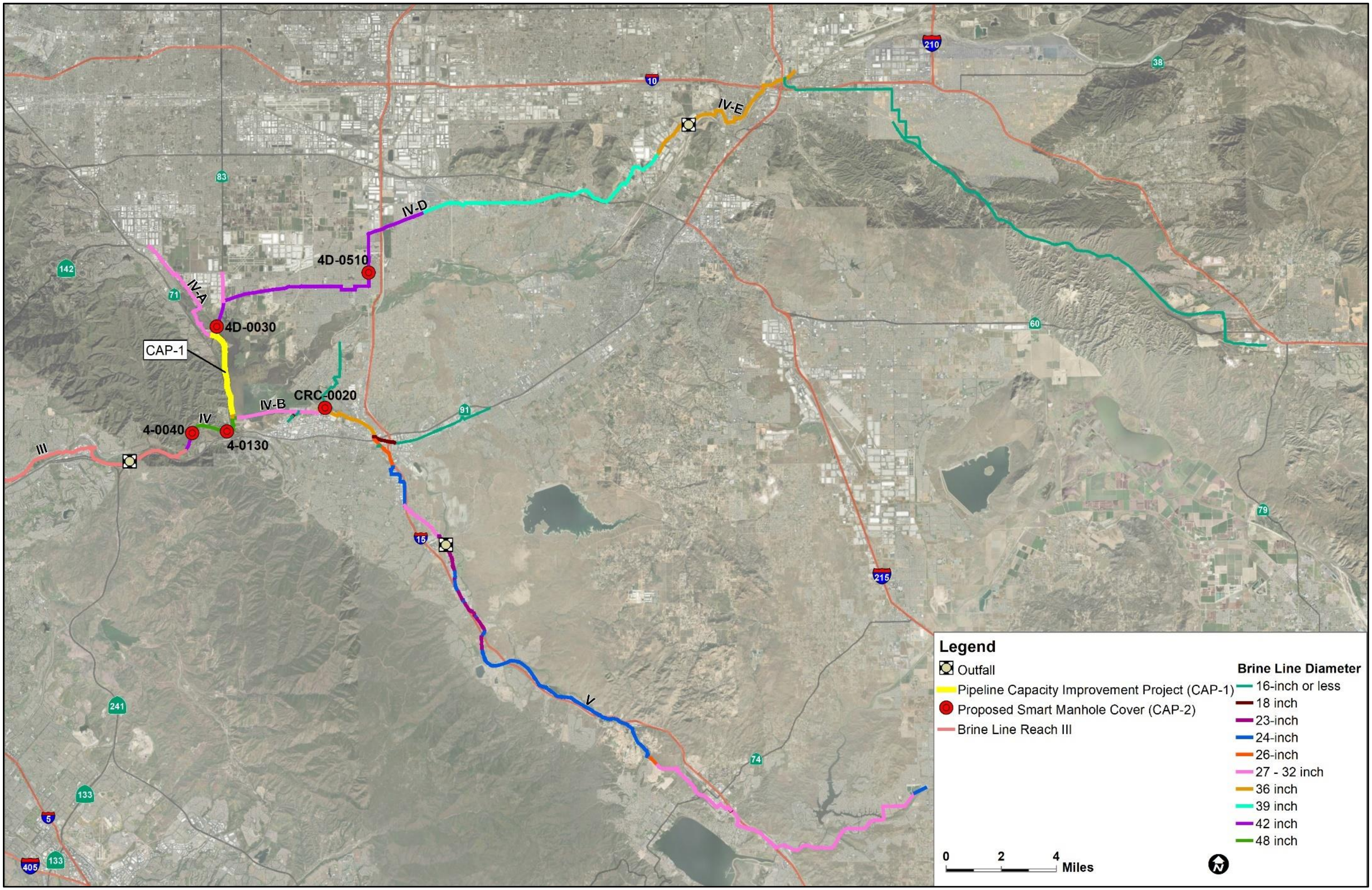


Figure 8-1 Recommended Brine Line Capacity Improvement Projects

8.1.2 Facility Management (FM) Projects

The physical condition of pipelines throughout the Brine Line system varies based on installation date, material, and other characteristics throughout the service area. SAWPA has historically focused on facility management (FM) projects, including targeted inspection or condition assessment of the existing Brine Line system. **Table 8-2** summarizes one (1) recommended O&M project, resulting from the master planning effort. The table also identifies several projects currently included in SAWPA's existing Capital Improvement Program (CIP). The newly recommended O&M Project (FM-2) is associated with proposed off-line storage facilities discussed in Section 6.1.2, intended to facilitate dewatering of the Brine Line during planned shutdowns lessening impact to existing dischargers. SAWPA will need to complete preliminary studies prior to final design and construction of the off-line storage facilities. It is assumed that SAWPA will implement these facilities in a phased approach, constructing facilities as funding permits.

Brief descriptions of Projects FM-1 through FM-21 are provided in Table 8-2, based on current information provided by SAWPA staff.

Table 8-2: Recommended Facility Management Projects Summary

Project ID	Planning Scenario	Project Description
FM-1	Near-Term (2024-2034)	Reach IV-E Mainline Valve: Installation of a new MAS within the Brine Line downstream of existing MAS 4E-0040 to facilitate newly constructed Agua Mansa Lateral to be used as a low flow bypass, thereby allowing dewatering of the existing siphon section.
FM-2	Near- & Long-Term (2025-2034)	Off-Line Storage: Install six (6) 2-MG and one (1) 0.5-MG off-line storage reservoirs (locations TBD); Project to be phased over 10 years.
FM-3	Long-Term (2034-2045)	Reach IV Pipeline Inspection & Condition Assessment/Rehabilitation: A complete inspection and condition assessment of the Reach to identify existing structural or maintenance issues. Based on recommendations from the 2024 Condition Assessment.
FM-4A	Near-Term (2024-2034)	Reach IV-B Ductile Iron Pipe (DIP) Pipeline Inspection & Condition Assessment/Rehabilitation: Heavy cleaning, CCTV and Sonar inspection of 8,600 LF of pipe. Perform Joint repairs and spot repairs. Based on recommendations from the 2024 Condition Assessment.
FM-4B	Long-Term (2035-2059)	Reach IV-B Ductile Iron Pipe Rehabilitation Project: Rehabilitate approximately 8,600 feet of 36-inch DIP with CIPP Liner. Based on recommendations from the 2024 Condition. Reevaluate after mid-term condition assessment.
FM-5A	Near-Term (2024-2034)	Reach IV-D Corrosion Rehabilitation: Cleaning, CCTV and Concrete and liner repairs in the near term. Reinspecting entire 7 miles including siphons in the mid-term. Based on recommendations form the 2024 Condition Assessment.
FM-5B	Long-Term (2034-2045)	Reach IV-D Corrosion Rehabilitation, Phase 1 and 2: Lining of 7-miles of 42-inch pipeline.
FM-6	Near-Term (2024-2034)	Reach V MAS Condition Assessment: Approximately 15 miles of Reach V is currently not accessible due to the lack of an adequate number of MAS. Access to Reach V is critical for performing routine inspections, cleaning of the pipeline, and mitigating operational issues. A catastrophic failure of the Brine Line in 2013 initiated the rehabilitation of about 5 miles of Reach V, including access points for future monitoring and flow bypasses in the event of another failure. Additional study is necessary to identify a suitable number and placement of MAS within Reach V.

Project ID	Planning Scenario	Project Description
FM-7	Near-Term (2024-2034)	Reach IV-B Pipeline Inspection & Condition Assessment/Rehabilitation: Approximately 30,000 LF of Reach IV-B, constructed between 1981 and 1996, will be inspected and evaluated.
FM-8	Near-Term (2024-2034)	Reach IV-B DIP Section Additional MAS Structures: Construct additional MAS on Reach IV-B. Based on recommendations from the 2024 Condition Assessment.
FM-9	Near-Term (2024-2034)	Reach IV-E Inspection / Repairs: Perform an investigation and assessment to understand the reliability and performance of Reach IVE and identify potential issues and actions needed to extend the remaining useful life of the system.
FM-10	Near-Term (2024-2034)	Reach V - Temescal Canyon Rd (El Cerrito Segment) Widening: Relocate existing Air Release Valves and protect Brine Line during street widening project.
FM-11	Near-Term (2024-2034)	Reach V Air Vac Modifications: Relocations or modification to place the Air Vacuum Valves in vaults will protect them from damage and uncontrolled spills.
FM-12	Near-Term (2024-2034)	Reach IV-D Inspection / Repairs - Project 1: Perform an assessment to identify potential issues and actions needed to extend the remaining useful life of the system. Project 1 includes approximately 38,000 feet of pipe.
FM-13	Near-Term (2024-2034)	Reach V Indian Truck Trail Protection: A portion of the Reach V Brine Line on Indian Truck Trail in Temescal Valley is subject to erosion due to stormwater. This project would provide protection of the Brine Line to prevent further erosion and impact to the Brine Line.
FM-14	Near-Term (2024-2034)	Reach IV-D Inspection / Repairs - Project 2: Perform an assessment to identify potential issues and actions needed to extend the remaining useful life of the system. Project 1 includes approximately 38,000 feet of pipe.
FM-15	Near-Term (2024-2034)	Reach IV-D Inspection / Repairs - Project 3: Perform an assessment to identify potential issues and actions needed to extend the remaining useful life of the system. Project 1 includes approximately 38,000 feet of pipe.
FM-16	Near-Term (2024-2034)	Reach V Baker St Protection: Protect approximately 2 miles of Reach V on the unpaved portion of Baker Street from erosion and human activity.
FM-17	Near-Term (2024-2034)	Prado Access Road Improvements: This project would improve about 3 to 6 miles of the Brine Line access road giving access to critical Brine Line facilities immediately once the reservoir has drained. Protect the Brine Line from erosion and scouring due to the Santa Ana River and tributaries.
FM-18	Near-Term (2024-2034)	Capacity Management: Project involves planning for future discharges and understanding and controlling peak flows. Capacity management projects could include flow stabilization and peak discharge elimination and concentration of brine flows.
FM-19	Near-Term (2024-2034)	Reach IV-D Mission Tunnel: Correct an existing joint lead on Reach IV-D in the Mission Tunnel.
FM-20A	Near-Term (2024-2034)	Alcoa Dike Protection Relocation (Raise 2 MAS upon completion of project): Raise two new MAS upon completion of project.
FM-20B	Near-Term (2024-2034)	Prado Reservoir (below 556") MAS Projection: Modify 1 - 3 MAS below 556' to be watertight.
FM-21	Near-Term (2024-2034)	OC San Future CIP: SAWPA, through the cost sharing agreement for the Facility management of the SARI in Orange County, is obligated to pay a portion of the costs for this CIP. Annual contribution of $400,000 for future OC San CIP. SAWPA is working with OCSD to further define their future CIP.

8.1.3 System Monitoring Projects

As described in detail in Section 6.2, it is recommended that within the next 10 years, SAWPA implement a SCADA-based program intended to collect real-time flow and quality data throughout the Brine Line system. Data collected by the proposed SCADA system will aid in continuous monitoring of the myriad individual dischargers to the Brine Line, while reducing manual data compilation and management efforts by SAWPA staff.

Section 6.2 presented a preliminary phasing plan for the proposed SCADA system, beginning with initial setup and programming, followed by a phased approach to installing data collection devices at each discharger site and culminating in the installation of several flow monitors within the main Brine Line itself.

The following **Table 8-3** organizes the proposed SCADA system phasing plan into several improvement projects that should be completed in order. While implementation of a SCADA system at the individual sites as described in Projects MON-1, MON-2, and MON-3 will provide SAWPA with discharger-specific data, the in-line flow monitoring program in Project MON-4 will assist in more accurate estimation of overall Brine Line capacity and condition.

Table 8-3: Recommended SCADA Projects Summary

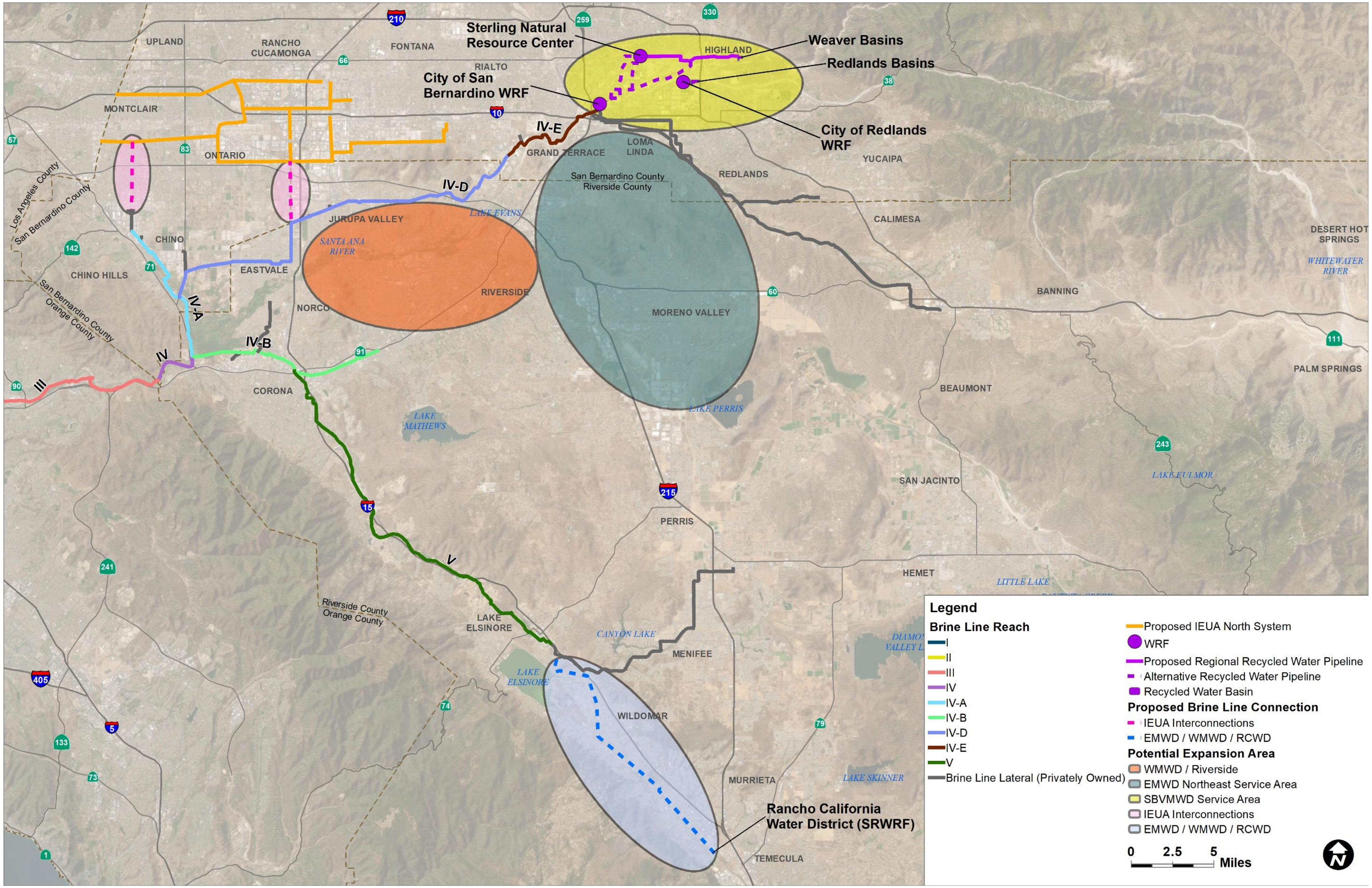
Project ID	Planning Scenario	Project Description
MON-1	Near-Term (2024-2034)	SCADA System: Construct Master Station, operation workstation; initial set-up, integration of programming and automation. Install SCADA system at twelve (12) existing discharger sites that currently produce highest flows.
MON-2	Near-Term (2024-2034)	SCADA System: Install SCADA system at twelve (12) existing discharger sites that currently produce next highest flows, after those included in Project MON-1.
MON-3	Near-Term (2024-2034)	SCADA System: Install SCADA system at remaining twelve (12) existing discharger sites that currently produce lowest flows, after those included in Project MON-1 and MON-2.
MON-4	Near-Term (2024-2034)	SCADA System: Install Brine Line for in-line flow monitoring stations #1 through #5 with monitoring program (locations TBD) (Phased over 5 years)

8.1.4 Potential Expansion Laterals

In 2009, the State Water Resources Control Board adopted the Recycled Water Policy encouraging public agencies to recycle municipal wastewater as an increasingly valuable water resource. The Recycled Water Policy requires management of salt and nutrient loading to groundwater resulting from basin-wide recycled water use. The Recycled Water Policy also requires Antidegradation Analysis (State Water Resources Control Board Resolution 68-16) for groundwater recharge projects to identify assimilative capacity available for salt and nutrient loading, with projects permitted to consume up to 10% of available assimilative capacity in a basin, while multiple projects may consume up to 20% of available assimilative capacity.

The Brine Line system provides substantial brine management facilities to assist local agencies in achieving these mandates. However, within the Santa Ana River Watershed, there are areas that do not have convenient access to the Brine Line system, thereby making desalter and recycled water demineralization more costly to implement. **Figure 8.2** illustrates areas of potential future need that require significant cooperation and planning to facilitate economical brine management opportunities. The projects discussed were identified during the Agency Workshops, with the understanding that future projects, including significant industrial dischargers, may be identified. The following discussion highlight potential facilities that would benefit from extension of the Brine Line system.

Figure 8-2 Expansion Areas for Potential Brine Line Service



8.1.4.1 Eastern MWD Northeast Service Area

During the workshop held between SAWPA and Eastern Municipal Water District (EMWD) staff on March 8, 2023, EMWD identified the potential for future facilities within the northern and eastern portions of their service area, including the following facilities:

- EMWD identified the Perris North project to be a groundwater contamination and remediation project within the Moreno Valley area. The project is proposed to use evaporators to reduce brine volume by a factor of up to eight times.
- EMWD identified a potential new plant location for the District's Purified Water Replenishment (PWR) program, to be located in the San Jacinto area. The PWR program will improve the quality and quantity of local groundwater supplies through replenishment of purified recycled water. As the distance to the Brine Line is substantial, the District has been evaluating up to 21 acres of evaporation ponds for brine management.
- In the Lakeview Nuevo Area, EMWD is conducting hydrogeological evaluations for siting a new desalter, which was identified to be operational in the 20+ year time frame.
- Within the San Jacinto area, EMWD recharges up to 7,500 afy of local tribal settlement water. with excess recharge in years of with surplus water.
- EMWD has plans to construct additional recycled water plants in the Moreno Valley and Hemet areas. Current evaluations include providing effluent desalinization at the individual plant locations versus a basin-wide concept.

Based on EMWD planning within its northern and eastern service areas, exploring new opportunities to extend the Brine Line system into these areas may assist SAWPA with its brine management requirements. Yucaipa Valley Water District and the City of Beaumont constructed extended brine laterals similar to that needed for service to these EMWD areas. Alternative options have involved identification of potential abandoned pipelines (i.e., oil, petroleum, gas, other) that could be repurposed to transport brine to the Brine Line system. Ongoing discussions between SAWPA and EMWD are recommended to identify opportunities to extend Brine Line service to these areas. Service to these areas is projected to require up to 20 miles of new pipeline lateral, between 12 and 16 inches in diameter, at an approximate cost between $30,000,000 and $40,000,000, depending on the flow and alignment of the lateral.

8.1.4.2 San Bernardino Valley MWD Service Area

San Bernardino Valley MWD (Valley District), in conjunction with East Valley WD and the cities of Redlands and San Bernardino, is currently constructing the Regional Recycled Water Facilities Project. This project includes a recycled water conveyance system and groundwater recharge facility (Weaver Basins and Redlands Basins). These facilities allow recycled water from the San Bernardino WRF and Sterling Natural Resource Center to be conveyed from to the Weaver Basins, and from the Redlands WRF to the Redlands Basins.

East Valley WD constructed the Sterling Natural Resource Center to recycle wastewater from its service area and recharge via Weaver Basins.

San Bernardino is developing a Tertiary Treatment System to produce recycled water from the San Bernardino WRF for general plant use and irrigation. Valley District's recycled conveyance system will convey recycled water for recharge via the Weaver Basins.

Redlands has existing Waste Discharge Requirements for treatment and discharge of recycled water from its service area into Bunker Hill-B Groundwater Management Zone. Phase 2 expansion of the Redlands WRF will increase recycled water discharges via the Redlands Basins. Recycled water replenishment of the Bunker Hill-B Groundwater Management Zone provides a drought tolerant water supply, improving supply reliability and a drought buffer in the event of a prolonged drought.

These agencies are working to develop a collaborative regional plan (Upper Santa Ana River Watershed Salt & Nutrient Management Plan) supporting increasing recycled water use for groundwater replenishment, while managing groundwater quality. The agencies developed an MOU intended to implement salt mitigation including regional groundwater quality monitoring, brine line discharge for high-TDS water, optimized chemical use at wastewater treatment and reclamation facilities, a regional recycled water desalter, and enhanced upstream recharge of low-TDS water. There may be potential for additional industrial dischargers in the event that Brine Line extensions or laterals are constructed.

Reach 4E of the Brine Line terminates at the San Bernardino WRF, providing access for brine management operations. However, the Sterling Natural Resources Center and Redlands WRF facilities would require lateral extensions to provide brine disposal service. Considering the extensive impact the Regional Recycled Water System project will have, cooperation and ongoing discussions of potential Brine Line extension or other connection opportunities is warranted. The Redlands WRF, for example, could negotiate connection to the Yucaipa Valley WD brine lateral, thereby taking advantage of that laterals existing crossing of the Santa Ana River. Such a lateral is projected to be approximately 2.75 miles of 8-inch pipe, at a cost of approximately $4,000,000 to $5,000,000 depending on the alignment of the lateral. The other two facilities are located north of the Santa Ana River and are proposing regional recycled water pipelines that could be paralleled during construction with brine conveyance facilities at an incremental increase in cost.

8.1.4.3 Inland Empire Utilities Agency Service Area

Within the Inland Empire Utilities Agency's (IEUA's) service area, the agency owns and operates a non-reclaimable wastewater system (North Brine System). The North Brine System has approximately 34 active dischargers, mainly high TDS industrial dischargers. IEUA has stated that the North Brine System has sufficient capacity for additional dischargers.

During the recent agency workshops, it was discussed whether the possibility of emergency interconnections between the North Brine System and the Brine Line would be advantageous to allow bi-direction flow for emergency situations. From preliminary investigations, the North Brine System is constructed at an elevation higher than the Brine Line system. Therefore, gravity flow from the IEUA system to the SAWPA system would be possible, but a pump station may be required to convey flow in the opposite direction.

In the event that an emergency interconnect would be implemented, two advantageous locations for the interconnect are identified. One connects to the existing IEUA lateral, while the other connects to the mid-point of the North system. These connections would be approximately 3.0 to 3.5 miles of 12- to 16-inch pipeline, at a cost of approximately $10,500,000.

8.1.4.4 Rancho California Water District

During discussions with Rancho California Water District (RCWD), RCWD identified that they have a need to dispose of approximately 2.0-mgd of brine from the Santa Rosa WRF, consisting of both demineralization reject water and local industrial brine dischargers. Previous analysis indicated that RCWD proposed to convey brine to the Fallbrook Land Outfall through a newly constructed brine line. However, during our discussion, RCWD was interested in further evaluation of a new brine lateral connection to the Brine Line.

Based on preliminary analysis, the RCWD brine lateral would traverse north along Washington Avenue, Palomar Street, Mission Trail Road, East Lakeshore Drive, South Main Street, and Collier Avenue, connecting to the Brine Line at approximately Callier Avenue and Chaney Street. Additional discussions are required between SAWPA and RCWD before such a connection can be established. The proposed lateral would be a maximum of 8-inches in diameter at a length of approximately 14.75 miles, with an approximate cost of $22,000,000.

8.1.4.5 City of Riverside and Western Municipal Water District

During the recent agency workshop, the City of Riverside expressed a future requirement for approximately 1.0-mgd of Brine Line capacity associated with future recycled water desalination efforts. The City indicated that their recent Salinity Study evaluated discharging brine to Reach IV-D of the Brine Line system. The City also identified a need for future Brine Line capacity, based on its existing plant being configured to support anticipated Direct Potable Reuse (DPR) requirements. Also, PFAS regulations may result in increased need for Brine Line capacity, as RO is most likely means of removal. The same systems are anticipated for TDS and PFAS control.

It is noted that Rubidoux Community Services District (RCSD) discharges to the Riverside system, constituting approximately 10 percent of the City's high TDS flow. RCSD has also requested a direct connection to the Brine Line system in the future, which may reduce the City's brine discharge. Additional industrial dischargers may be identified along the proposed brine lateral, depending on its alignment.

The projected Riverside Lateral, at a length of 3.5 miles and a diameter of 8 inches, would have a construction cost of approximately $7,500,000. The lateral could also be increased in size to effectively provide service to additional industrial discharges along the pipeline alignment, as may be appropriate.

8.1.5 Ongoing or Future Project Evaluations

As presented In Chapter 6 of this Master Plan, there are a variety of projects proposed to meet future Brine Line contractual (i.e., brine minimization), regulatory (i.e., PFAS Control), or other community benefits (i.e., Green Hydrogen). Each of these proposed projects, while currently conceptual in nature, require significant additional study prior to conceptualization of a specific project for implementation. The following discussion outline future evaluation needed to support proposed future SAWPA projects. Funding for these additional studies are not addressed in this Master Plan, as specific definition of each evaluation is not defined.

8.1.5.1 Brine Line Criticality Analysis

Conducted in 2021, the Brine Line Criticality Analysis identifies and prioritizes critical components of the Brine Line system, which influences the prioritization of Capital Improvement Projects (CIP) for both operational and capacity-based needs. Update of this analysis on a 5- to 10-year basis will assist SAWPA with focusing its efforts on the most critical components of the Brine Line system, as well as prioritizing its CIP appropriately.

8.1.5.2 Off-Line Storage Analysis

During Brine Line outages or improvements, SAWPA needs to be able to manage and/or stop brine flow. The proposed solution involves constructing off-line storage reservoirs to store diverted brine, avoiding disruption to dischargers' operations. Seven reservoirs throughout the system are proposed, with preliminary sizing and siting criteria. These reservoirs are also capable of capturing first-flush dry weather stormwater flows, supporting brine minimization efforts, and potentially supporting green hydrogen production. Additional studies related to off-line storage operational concepts, specific reservoir siting, land acquisition, and other project details are required prior to development and implementation of these facilities.

8.1.5.3 Data Collection & Real Time System Management

For enhanced monitoring, operation, and control of the Brine Line system, this Master Plan proposes implementing a SCADA-based system for data collection and management. The concept includes a variety of system components, as well as the overall integration of field and office system components, coordination with existing and future Brine Line dischargers and other key system considerations, SAWPA will need a conceptual analysis of this proposed system to specifically design the project architecture prior to implementation.

8.1.5.4 Brine Minimization

Based on the information developed in this Master Plan, SAWPA is not projected to exceed the 30-mgd OC San flow limitation until approximately 2065. Prior to that time, AWPA will need to complete an evaluation of existing and emerging brine management processes, with associated preliminary site identification, operational details, and other information critical to the implementation of such a project. This evaluation will allow SAWPA to identify the monetary challenges of such a project. It is noted that secondary RO processes located at groundwater desalters, or other recycled water facilities were identified as more cost-effective than a centralized treatment concept. Furthermore, emerging technologies such as Flow Reversal Reverse Osmosis (FRRO), ceramic membrane with electrodialysis reversal (EDR), Membrane Distillation (MD), Forward Osmosis (FO), EDR, and potential solar-driven systems offer potential for improved brine concentration. Ongoing evaluation of these and other potential processes will be needed to effectively identify a preferred project, as well as define the information needed for its implementation.

8.1.5.5 PFAS Management

While PFAS management is not currently required, current regulatory actions have identified PFAS as a hazardous substance, and many ongoing efforts target elimination of PFAS from our society, Addressing emerging contaminants like PFAS, with potential treatment methods including Novel Adsorbent Systems (NAS), Electro-oxidation (EOX), and Granular Activated Carbon (GAC) will require additional study with respect to how these processes can and would be implemented. Identification of the PFAS contributions from individual dischargers will be required, as well as consideration of small scalable systems and pilot studies to accurately estimate full-scale PFAS treatment requirements and costs. Continue monitoring PFAS regulations relevant to groundwater recharge, and wastewater disposal will be required.

8.1.5.6 Green Hydrogen

Producing green hydrogen from brine flows involves using a process that leverages renewable energy to split water into hydrogen and oxygen. Brine presents an interesting opportunity for this operation because it is typically a byproduct of certain industrial processes, such as desalination or resource extraction, and can have a higher salt content than seawater. Challenges with the green hydrogen process include the corrosive nature of brine that may require specialized materials and maintenance. The cost of electrolysis, especially using brine, needs to be competitive with other hydrogen production methods to be economically viable. Optimizing the efficiency of the electrolysis process, especially with brine, is critical for cost-effectiveness and overall environmental impact. Green hydrogen production from brine flows is an innovative pathway towards sustainable hydrogen production.

Additional studies necessary for the implementation of a Green Hydrogen project would include a comprehensive analysis of the costs associated with implementation, including capital expenditure, operation, and maintenance costs versus the expected revenue. While this analysis would be borne by a third party, SAWPA would be required to undertake parallel studies to define its abilities to meet the potential requirements of such an agreement. Other studies might include environmental impact evaluations, regulatory compliance reviews, and community education efforts. Collaboration between various stakeholders, SAWPA Member Agencies, and other affected parties would be needed.

8.2 Identified Project Cost Summaries

Probable planning-level costs were developed for the identified improvement projects. A summary of these costs, as well as the detailed planning level cost options, are included in **Appendix E.** Note: the Engineering News Record Construction Cost Index (ENR CCI) for Los Angeles at the time of the development of this cost estimate is 15315.12 for July 2024. It is anticipated that more detailed cost opinions will be developed during preliminary design each project.

8.3 Project Prioritization

Prioritization of capital improvement projects involves evaluating and balancing multiple factors to determine which projects are to be implemented first. Contributing key factors include:

- **Urgency and Necessity**: Projects addressing critical infrastructure needs, safety concerns, or compliance with regulatory requirements receive higher priority.
- **Cost and Budget Impact**: The total cost of the project, availability of funding, and potential impact on the budget are crucial considerations. Projects that provide the most value or have secured funding would likely receive higher priority.
- **Benefit to the Community**: Projects that offer significant benefits to the community, such as improved public services, economic development, or enhanced quality of life, are often prioritized.
- **Risk Management**: Projects that mitigate high risks, such as natural disaster preparedness or critical infrastructure failures, are typically given precedence. The previously completed Brine Line Criticality Analysis provides significant insight into the risk associated with various Brine Line reaches.
- **Alignment with Strategic Goals**: Projects that align with the organization's long-term strategic goals and plans are prioritized to ensure consistency with overall objectives.

- **Stakeholder Support and Political Will**: Projects with strong support from stakeholders, including the public, government officials, SAWPA Member Agencies, and other influential groups, are more likely to be prioritized.
- **Feasibility and Readiness**: The readiness of the project for implementation, including the availability of designs, permits, and other preparatory work, can influence its prioritization.
- **Sustainability and Environmental Impact**: Projects that promote sustainability, reduce environmental impact, or improve resilience to climate change are increasingly prioritized. Also, completion of necessary environmental documentation affect project prioritization.
- **Economic Impact**: The potential for economic benefits, such as job creation, increased property values, or economic development, can elevate a project's priority.
- **Operational Efficiency**: Projects that enhance the efficiency or effectiveness of existing operations, such as upgrading outdated systems or infrastructure, are often prioritized.
- **Regulatory Requirements**: Projects that are necessary to meet existing or projected regulatory requirements are often prioritized to assure implementation prior to or in conjunction with permit requirements or restrictions.

Through consideration of these factors, decision-makers can effectively prioritize capital improvement projects to assure that resources are allocated to the most impactful and necessary initiatives. For this master plan, prioritization was evaluated and incorporated into the Year Capital Improvement Project (CIP) schedule, discussed in the following section.

8.4 Capital Improvement Program

Appendix E provides an overview of the proposed Inland Empire Brine Line Capital Improvement Program (CIP), incorporating projects identified by the 2024 Inland Empire Brine Line Master Plan. The table illustrates the distribution of proposed projects over the Near-Term (2025 to 2034), Long-Term (2035 to 2048), and Build-Out (beyond 2049) planning horizons. It is important to note that specific timing of required projects will be impacted by budget availability, ongoing Brine Line operational investigations, and other factors as time progresses.

The initial 10 years of the CIP (10-YR CIP) are the primary focus for SAWPA, concentrating on known operational challenges and near-term system initiatives. Revisions to the 10-YR CIP are also anticipated over time. Future updates of this master plan will undoubtedly identify new or updated projects and initiatives, as well as reschedule those projects within the 10-YR CIP and beyond.

9 Policy Considerations

SAWPA has expressed its mission of focusing on protecting and enhancing the water resources of the Santa Ana River Watershed. Their mission is to develop and maintain regional plans, programs, and projects that maximize the beneficial uses of the watershed in an economically and environmentally responsible manner. This mission includes addressing water supply reliability, water quality improvement, recycled water, wastewater treatment, groundwater management, brine disposal, and integrated regional planning.

This mission is supported by a strategic plan that includes goals such as promoting solutions to manage waterways, supporting invasive species removal, building public understanding and support for watershed sustainability, facilitating the incorporation of water resources management into land use planning, and securing external funding for watershed initiatives.

SAWPA has consistently and effectively met this mission through ongoing service to its Member Agencies and the various community dischargers that currently use the Inland Empire Brine Line today. As Brine Line discharges increase over time, SAWPA will be challenged to maintain the Brine Line system while increasing system use through the watershed. To achieve these goals, SAWPA will need to consider a range of potential policy measures or changes to improve brine management efficiency.

SAWPA could consider policy improvements to manage brine more effectively in the Santa Ana River Watershed. These policies could address environmental, economic, and social considerations to ensure sustainable and equitable brine management. The following discussions identify potential policy considerations recommended for ongoing discussion between SAWPA management, the SAWPA Commission, and its Member Agencies.

9.1 Environmental Policies

While SAWPA and its Member Agencies have a long track record of excellent stewardship throughout the Santa Ana River Watershed, enhanced monitoring and reporting capabilities would provide continuous monitoring of brine discharge points (i.e., SCADA-based Brine Line system data collection). At present, SAWPA requires regular reporting of brine composition and volumes from dischargers but lacks a means of continuous monitoring to assure that all dischargers adhere to prescribed permit requirements. With increase regulatory requirements and the potential for emerging constituents of concern, SAWPA will likely be faced with the need to establish stricter limits on concentration and/or constituents in brine discharges. The emergence of PFAS treatment and control could result in the development and enforcement of Total Maximum Daily Loads (TMDLs) for critical pollutants.

Over time, SAWPA will be charged with a variety of environmental challenges, which will require policies that promote projects that restore and protect natural habitats potentially affected by brine discharge, as well as potential implementation of conservation easements or other land-use controls to protect sensitive areas. Elsewhere, SAWPA may be required to encourage or mandate the use of advanced brine treatment technologies to minimize environmental impact or seek incentives or grants for upgrade of existing brine treatment systems. Development of an enhanced permitting process may be necessary to support stricter permitting processes for industries discharging brine, thereby ensuring compliance with existing and future environmental standards. The establishment of a robust monitoring and reporting system will assist SAWPA in ensuring adherence to regulations.

9.2 Economic Policies

At present, dischargers are required to incur the cost of any and all pipeline, treatment, or other facilities necessary to convey brine to the Brine Line system for disposal and continue to maintain ownership of those facilities separate from SAWPA. Many public agencies and local businesses have expressed that construction of the necessary facilities can be cost prohibitive, necessitating that alternative planning be implemented. SAWPA and its Member Agencies may consider future mechanisms for cost-sharing and/or funding of facilities that provide a regional benefit to the Santa Ana River Watershed. SAWPA could develop cost-sharing frameworks that support infrastructure upgrades and/or maintenance. Establishing a dedicated fund or financial assistance program for brine management projects could be discussed with the emphasis on expanding the regional brine pipeline network to ensure adequate pipeline capacity and coverage. Such a fund may be similar to the existing Capacity Leasing Program, with the new fund providing for Capacity Buy-Back that allows SAWPA and its Member Agencies to balance capacity distribution based on discharger location.

SAWPA and its Member Agencies might consider methods of infrastructure investment to upgrade treatment capabilities or invest in upgrading existing brine treatment facilities to improve efficiency and/or capacity. Other economic incentives may be reasonable, including potential incentives or subsidies for companies adopting improved/sustainable brine management practices. SAWPA might consider revised fee structures that encourage reduction in brine discharge volumes and/or emerging pollutant loads, thereby incentivizing Brine Line system improvements from dischargers. Public-Private Partnerships may be useful to facilitate partnerships between public agencies and private companies to develop and implement increased brine management solutions or encourage collaborative research and development initiatives.

9.3 Regulatory and Legal Policies

Based on the analyses completed under this master plan, it is clear that SAWPA and its Member Agencies will be faced with considerable challenges in management of both conveyance and treatment capacity in the future. While these challenges remain distant at this time, discussion of potential policy revisions that will ultimately support the needs of future growth and expansion is prudent. Updating current permitting processes to include stricter requirements for brine management can assist SAWPA with ongoing control of Brine Line flows, assuring that the 30-mgd limitation by OC San is not exceeded.

Improvements in Inter-agency collaboration between SAWPA and other regulatory agencies can foster the promulgation of improved brine management policies. While SAWPA effectively fills this role currently, a potential consideration may be the establishment of a regional task force to coordinate efforts and share best management practices. These collaborative efforts may enhance compliance and strengthen potential enforcement requirements. Collaboration will support implementation of new and innovative salinity control measures to enhance salinity levels in the watershed and facilitate advanced desalination technologies in the future.

9.4 Social and Community Policies

SAWPA and its Member Agencies maintain high marks with respect to stakeholder engagement. SAWPA may consider establishment of regular forums for stakeholder engagement, including public meetings and community consultations, as well as developing outreach programs to educate the community about brine management issues and solutions. Such community engagement strengthens environmental justice and equity perceptions by ensuring that policies consider the impact on disadvantaged communities and implement measures to mitigate disproportionate impacts on vulnerable populations. Discussions should increase transparency and accountability in decision-making processes and policy implementations.

9.5 Research and Development Policies

Research and development of new technical approaches to brine management, brine concentration, and other challenges with facility management of the Brine Line system are critical to the long-term viability of the Brine Line. SAWPA and its Member Agencies can promote policies that support innovation by funding or cost-sharing research on innovative brine management technologies and practices. In addition, SAWPA may partner with academic institutions and researchers to advance solutions to brine challenges, with policy statements that explain established goals to the public. SAWPA could discuss policies for the investment into data collection infrastructure to support evidence-based policy making, using data analytics to identify trends, predict impacts, and optimize management strategies. The proposed SCADA-based monitoring system greatly enhances data collection for these purposes. Research grants and support of ongoing pilot testing efforts can be discussed, with supporting policy statements. SAWPA should leverage new technologies, such as remote sensing and real-time monitoring systems, to enhance brine management. Implementing these policies may help SAWPA ensure sustainable brine management, protect the watershed's ecological health, and support the region's long-term water quality goals.

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Appendix A
Brine Line Discharger Information

Santa Ana Watershed Project Authority
Inland Empire Brine Line Master Plan

APPENDIX A - Summary of Brine Line Discharger Flow Information

Dudek
March 2024

	Reach	Maximum Discharge Allowed (gpd)	Existing Discharge: 2023 Avg Discharge (gpd)	Existing Discharge: Maximum Discharge (gpd)	Near-Term Projected Discharge: Avg Discharge Increment (gpd)	Near-Term Projected Discharge: Average Discharge (gpd)	Near-Term Projected Discharge: Maximum Discharge (gpd)	Long-Term Projected Discharge: Avg Discharge Increment (gpd)	Long-Term Projected Discharge: Average Discharge (gpd)	Long-Term Projected Discharge: Maximum Discharge (gpd)	Build-Out Projected Discharge: Avg Discharge Increment (gpd)	Build-Out Projected Discharge: Average Discharge (gpd)	Build-Out Projected Discharge: Maximum Discharge (gpd)
Western Municipal Water District													
Anita B. Smith Treatment Facility	IV-D	30,000	5,000	60,000	0	5,000	30,000	0	5,000	30,000	0	5,000	30,000
Aramark Uniform & Career Apparel, LLC	IV-D	330,000	198,000	375,804	0	198,000	330,000	0	198,000	330,000	0	198,000	330,000
Dart Container Corporation	IV-B	60,000	29,000	75,081	0	29,000	60,000	0	29,000	60,000	0	29,000	60,000
Frutarom USA, Inc.	IV-B	5,000	6,000	28,800	0	6,000	28,800	(1,000)	5,000	5,000	0	5,000	5,000
Pyrite Canyon Treatment Facility (Stringfellow)	IV-D	259,000	135,000	198,855	0	135,000	198,855	40,832	175,832	259,000	0	175,832	259,000
Wellington Foods, Inc. (International Foods)	V	30,000	14,500	74,037	0	14,500	30,000	0	14,500	30,000	0	14,500	30,000
Magnolia Foods, LLC *[included in Etiwanda discharge]*	IV-D	3,560	[E] *Flow incl. at Etiwande MS*		[E] *Flow incl. at Etiwande MS*			[E] *Flow incl. at Etiwande MS*			[E] *Flow incl. at Etiwande MS*		
Metal Container Corporation *[included in Etiwanda discharge]*	IV-D	165,000	[E] *Flow incl. at Etiwande MS*		[E] *Flow incl. at Etiwande MS*			[E] *Flow incl. at Etiwande MS*			[E] *Flow incl. at Etiwande MS*		
Del Real, LLC *[included in Etiwanda discharge]*	IV-D	190,164	[E] *Flow incl. at Etiwande MS*		[E] *Flow incl. at Etiwande MS*			[E] *Flow incl. at Etiwande MS*			[E] *Flow incl. at Etiwande MS*		
JCSD Roger D. Teagarden Ion Exchange WTP *[included in Etiwanda discharge]*	IV-D	225,000	[E] *Flow incl. at Etiwande MS*		[E] *Flow incl. at Etiwande MS*			[E] *Flow incl. at Etiwande MS*			[E] *Flow incl. at Etiwande MS*		
JSCD Wells 17 & 18 Ion Exchange Treatment Facility *[included in Etiwanda discharge]*	IV-D	225,000	[E] *Flow incl. at Etiwande MS*		[E] *Flow incl. at Etiwande MS*			[E] *Flow incl. at Etiwande MS*			[E] *Flow incl. at Etiwande MS*		
JCSD - Etiwanda Metering Station[E] [multiple discharge capacities]	IV-D	854,500	846,200	1,184,680	0	846,200	1,184,680	8,300	854,500	854,500	0	854,500	854,500
JCSD - Hamner Metering Station	IV-D	49,000	33,000	92,994	0	33,000	92,994	16,000	49,000	49,000	0	49,000	49,000
SCE Mira Loma Peaker Plant	IV-D	2,500	2,500	0	0	2,500	2,500	0	2,500	2,500	0	2,500	2,500
JCSD - Wineville Metering Station	IV-D	249,000	149,000	323,926	0	149,000	323,926	100,000	249,000	249,000	0	249,000	249,000
WMWD Arlington Desalter	IV-B	1,400,000	1,268,000	1,275,608	0	1,268,000	1,268,000	132,000	1,400,000	1,400,000	0	1,400,000	1,400,000
Temescal Desalter (City of Corona)	IV-B	2,150,000	1,883,000	2,159,801	0	1,883,000	1,883,000	267,000	2,150,000	2,150,000	0	2,150,000	2,150,000
Rubidoux CSD	IV-D	2,000,000	0	0	0	0	0	1,000,000	1,000,000	1,000,000	1,000,000	2,000,000	2,000,000
Riverside County Flood Control	IV-D	2,000,000	0	0	1,000,000	1,000,000	1,000,000	1,000,000	2,000,000	2,000,000	0	2,000,000	2,000,000
Elsinore Valley MWD	V	1,200,000	0	0	650,000	650,000	650,000	150,000	800,000	800,000	400,000	1,200,000	1,200,000
Temescal Valley Water District	V	225,000	0	0	0	0	0	225,000	225,000	225,000	0	225,000	225,000
JCSD Future Desalter [Future Etiwanda discharge]	IV-D	4,000,000	0	0	0	0	0	3,000,000	3,000,000	3,000,000	1,000,000	4,000,000	4,000,000
Riverside Future Recycled Water Desal	IV-D	1,000,000	0	0	0	0	0	1,000,000	1,000,000	1,000,000	0	1,000,000	1,000,000
Collection Station (Waste Haulers)	IV-D	200,000	41,000	566,497	59,000	100,000	100,000	50,000	150,000	150,000	50,000	200,000	200,000
Leased Capacity		666,000											
Western Water Ownership Allocated (gpd)		**16,044,000**	**4,610,200**	**6,416,083**	**1,709,000**	**6,319,200**	**7,182,755**	**6,988,132**	**13,307,332**	**13,594,000**	**2,450,000**	**15,757,332**	**16,044,000**
Western Water Ownership Capacity (gpd)		**11,084,000**	**11,084,000**			**11,084,000**			**11,084,000**			**11,084,000**	
Remaining Ownership Capacity (gpd)		**(4,960,000)**	**6,473,800**	**4,667,917**		**4,764,800**	**3,901,245**		**(2,223,332)**	**(2,510,000)**		**(4,673,332)**	**(4,960,000)**
Remaining Ownership (%)		**-44.7%**	**58.4%**			**43.0%**			**-20.1%**			**-42.2%**	
Inland Empire Utilities Agency													
California Institution for Men	IV-A	194,000	24,000	152,376	0	24,000	152,376	0	24,000	152,376	38,000	62,000	194,000
California Institution for Women	IV-D	400,000	116,000	679,528	0	116,000	400,000	0	116,000	400,000	61,000	177,000	400,000
Green River Golf Club	IV	7,000	4,000	4,340	0	4,000	4,340	0	4,000	4,340	2,452	6,452	7,000
Mission Linen Supply	IV-A	713,000	168,000	360,024	0	168,000	360,024	0	168,000	360,024	175,550	343,550	713,000
In-N-Out Burger, Chino Distribution Center	IV-D	86,000	58,000	62,582	0	58,000	62,582	0	58,000	62,582	28,000	86,000	86,000
OLS Energy	IV-A	130,000	6,000	51,996	0	6,000	51,996	0	6,000	51,996	24,000	30,000	130,000
Repet, Inc.	IV-A	64,800	42,000	61,404	22800	64,800	64,800	0	64,800	64,800	0	64,800	64,800
Chino Eastside WTP	IV-D	65,500	10,000	10,000	55,500	65,500	65,500	0	65,500	65,500	0	65,500	65,500
Collection Station	IV-A	200,000	55,000	224,015	45000	100,000	100,000	50000	150,000	150,000	50,000	200,000	200,000
Leased Capacity		350,000											
IEUA Total Discharge (gal)		**1,860,300**	**483,000**	**1,606,265**		**606,300**	**1,261,618**		**656,300**	**1,311,618**		**1,035,302**	**1,860,299**
IEUA Ownership Capacity (gal)		**4,130,000**	**4,130,000**			**4,130,000**			**4,130,000**			**4,130,000**	
Remaining Ownership Capacity (gal)		**2,269,700**	**3,647,000**	**2,523,735**		**3,523,700**	**2,868,382**		**3,473,700**	**2,818,382**		**3,094,698**	**2,269,701**
Remaining Ownership (%)		**55.0%**	**88.3%**			**85.3%**			**84.1%**			**74.9%**	
Chino Basin Desalter Authority													
Chino I Desalter	IV-D	2,370,000	2,391,200	2,651,841	0	2,391,200	2,391,200	(21,200)	2,370,000	2,370,000	0	2,370,000	2,370,000
Chino II Desalter (east) *[included in Etiwanda discharge]*	IV-D	650,000	479,400 *	479,400	0	479,400	479,400	170600	650,000	650,000	0	650,000	650,000
Chino II Desalter (west) *[included in Wineville disccharge]*	IV-D	650,000	479,400 *	479,400	0	479,400	479,400	170600	650,000	650,000	0	650,000	650,000
CDA Total Discharge (gal)		**3,670,000**	**3,350,000**	**3,610,641**		**3,350,000**	**3,350,000**		**3,670,000**	**3,670,000**		**3,670,000**	**3,670,000**
CDA Ownership Capacity (gal)		**3,670,000**	**3,670,000**			**3,670,000**			**3,670,000**			**3,670,000**	
Remaining Ownership Capacity (gal)		**0**	**320,000**	**59,359**		**320,000**	**320,000**		**0**	**0**		**0**	**0**
Remaining Ownership (%)		**0.0%**	**8.7%**			**8.7%**			**0.0%**			**0.0%**	
San Bernardino Valley Municipal Water District													
Agua Mansa Power Plant	IV-E	62,000	14,000	92,820	0	14,000	62,000	0	14,000	62,000	0	14,000	62,000
Mountainview Generating Station	IV-E	432,000	410,000	478,880	0	410,000	432,000	0	410,000	432,000	22,000	432,000	432,000
Rialto Bioenergy Facility, LLC	IV-E	250,000	79,000	141,173	50,000	129,000	230,523	0	129,000	230,523	121,000	250,000	250,000
YVWD - Henry Wochholz Regional Water Recycling Facility	IV-E	1,756,000	431,000	463,325	1,325,000	1,756,000	1,756,000	0	1,756,000	1,756,000	0	1,756,000	1,756,000
Regional Recycled Water Facilities Project	IV-E	1,550,000	0	0	1,550,000	1,550,000	1,550,000	0	1,550,000	1,550,000	0	1,550,000	1,550,000
City of Beaumont Wastewater TP	IV-E	580,000	532,000	604,884	30,000	562,000	562,000	18,000	580,000	580,000	0	580,000	580,000
Collection Station	IV-E	200,000	92,000	235,060	48,000	140,000	140,000	30,000	170,000	170,000	30,000	200,000	200,000
Leased Capacity		(250,000)											
Valley District Total Discharge (gal)		**4,830,000**	**1,558,000**	**2,016,142**		**4,561,000**	**4,732,523**		**4,609,000**	**4,780,523**		**4,782,000**	**4,830,000**
Valley District Ownership Capacity (gal)		**7,738,000**	**7,738,000**			**7,738,000**			**7,738,000**			**7,738,000**	
Remaining Ownership Capacity (gal)		**2,908,000**	**6,180,000**	**5,721,858**		**3,177,000**	**3,005,477**		**3,129,000**	**2,957,477**		**2,956,000**	**2,908,000**
Remaining Ownership (%)		**37.6%**	**79.9%**			**41.1%**			**40.4%**			**38.2%**	
Eastern Municipal Water District													
EMWD Perris & Menifee Desalination Facility	V	3,998,000	3,529,600	4,097,866	468,400	3,998,000	3,998,000	0	3,998,000	3,998,000	0	3,998,000	3,998,000
Perris II Expansion (Future)	V	900,000	0	0	0	0	0.000	900,000	900,000	900,000	0	900,000	900,000
Rancho California Water District	V	2,000,000	0	0	1,000,000	1,000,000	1,000,000	0	1,000,000	1,000,000	1,000,000	2,000,000	2,000,000
Collection Station *[included in Menifee discharge]*	V	200,000	0	0	50,000	50,000	50,000	100,000	150,000	150,000	50000	200,000	200,000
Leased Capacity		(500,000)											
EMWD Total Discharge (gal)		**7,098,000**	**3,529,600**	**4,097,866**		**5,048,000**	**5,048,000**		**6,048,000**	**6,048,000**		**7,098,000**	**7,098,000**
EMWD Ownership Capacity (gal)		**5,946,000**	**5,946,000**			**5,946,000**			**5,946,000**			**5,946,000**	
Remaining Ownership Capacity (gal)		**(1,152,000)**	**2,416,400**	**1,848,134**		**898,000**	**898,000**		(102,000)	(102,000)		(1,152,000)	(1,152,000)
Remaining Ownership (%)		**-19.4%**	**40.6%**			**15.1%**			**-1.7%**			**-19.4%**	

	Reach	Maximum Discharge (gpd)	Existing Discharge: 2023 Avg Discharge (gpd)	Existing Discharge: Peak Discharge (gpd)	Near-Term Projected Discharge: Average Discharge (gpd)	Near-Term Projected Discharge: Peak Discharge (gpd)	Long-Term Projected Discharge: Average Discharge (gpd)	Long-Term Projected Discharge: Peak Discharge (gpd)	Build-Out Projected Discharge: Average Discharge (gpd)	Build-Out Projected Discharge: Peak Discharge (gpd)
Total Discharge (gal)	**SMS**	**33,502,300**	**13,530,800**	**17,746,996**	**19,884,500**	**21,574,896**	**28,290,632**	**29,404,141**	**32,342,633**	**33,502,299**
Total Ownership Capacity (gal)		**32,568,000**	**32,568,000**		**32,568,000**		**32,568,000**		**32,568,000**	
Remaining Ownership Capacity (gal)		**(934,300)**	**19,037,200**	**14,821,004**	**12,683,500**	**10,993,104**	**4,277,368**	**3,163,859**	**225,367**	(934,299)
Remaining Ownership (%)		**-2.9%**	**58.5%**		**38.9%**		**13.1%**		**0.7%**	

Appendix B
Novel Adsorbent Treatment System Sizing and Performance Information

Preliminary Full-Scale Design
January 11, 2024

Using DEXSORB® Adsorbents for Per- and Polyfluoroalkyl Substances (PFAS) Treatment in Brine Wastewater

Prepared for:
DUDEK
San Diego, CA

cyclopure

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SAWPA PFAS Treatment Overview

Santa Ana Watershed Project Authority (SAWPA), based in Riverside, CA, addresses various regional water resource issues surrounding the Santa Ana River watershed, including brine disposal. Orange County Water District (OCWD) wastewater treatment plant is downstream of SAWPA's brine discharge line.

General Water Quality. The brine line currently measures maximum values for Total Suspended Solids (TSS) at 400 mg/L, Biochemical Oxygen Demand (BOD) at 250 mg/L, and Total Dissolved Solids (TDS) at 5,500 mg/L.

PFAS Background. Maximum PFAS levels detected in the brine line are provided in Table 1. A total of 11 PFAS are detected at total peak concentration of 840 ng/L. PFOA and PFOS are detected at 130 ng/L and 170 ng/L respectively.

PFAS Treatment Target. The US EPA has proposed Maximum Contaminant Levels (MCLs) of 4 ng/L for PFOA and PFOS in drinking water. Per DUDEK's input in January 2024, this design specifies full-scale DEXSORB treatment to meet PFAS discharge limit of PFOA and PFOS at 4 ng/L.

Table 1. PFAS Background Characterization

Compound	Maximum Concentration (ng/L)
PFBA	60
PFPeA	70
PFHxA	90
PFHpA	40
PFOA	130
PFBS	60
PFPeS	30
PFHxS	90
PFHpS	10
PFOS	170
6:2 FTS	90
Total PFAS	840

1. Overview

This proposal details the a preliminary full-scale system design with cost estimates for Cyclopure's DEXSORB packed bed filtration (PBF) system to remove PFAS from the Santa Ana Watershed Authority (SAWPA) brine discharge line. DEXSORB is a novel cyclodextrin adsorbent, designed for use in engineered applications to remove PFAS in diverse water sources. The media features rapid kinetics, high treatment capacity, and resistance to fouling by natural organic matter (NOM).

DEXSORB provides superior PFAS adsorption capacity over traditional adsorbents such as GAC and ion exchange resins. Notably, the high treatment capacity of DEXSORB for PFAS is consistent across different water qualities and diverse water matrices including drinking water, groundwater, surface water, and more complex matrices such as wastewater and landfill leachate.

DEXSORB Full-Scale System.

DEXSORB has demonstrated effective removal of PFAS in similar matrices with high TDS, such as metal-plating wastewater (~5,000 mg/L). With DEXSORB's high treatment capacity and selectivity for PFAS, DEXSORB PBF systems are characterized by smaller system footprint, lower media volume and significantly longer operation life when compared to GAC treatment systems.

The proposed DEXSORB system is designed in a lead-lag PBF configuration consisting of five parallel systems for PFAS treatment. Suspended solids treatment (i.e. sand filter, dissolved air flotation (DAF) unit) is required prior to the DEXSORB system.

Based on the PFAS levels in Table 1 and the PFAS treatment target, a system design summarized in Table 2. The design consists of ten vessels in total, configured in five parallel lead-lag systems. Each lead-lag system contains approximately 56.8 metric tons (mT) of dry granular DEXSORB to provide an empty bed contact time (EBCT) of 15 minutes. Backwash capabilities are incorporated into each vessel.

Table 2. DEXSORB System Design

Parameters		Unit
Overall System		
Vessels	10	#
Lead-Lag Systems	5	#
Empty Bed Contact Time	15	min
Flow Rate	10417	gpm
Total DEXSORB Loading	**283.9**	***mT***
Per Lead-Lag Vessel Combination		
Empty Bed Contact Time	**15**	min
Flow Rate	2083.3	gpm
DEXSORB Loading	56.8	mT
Per Vessel		
Hydraulic Loading Rate	**18.4**	gpm/ft^2
Vessel ID	**144**	inch
Vessel Height	**26**	feet
Vessel Cross-section Area	113.1	ft^2
Packed Bed Depth	**18.5**	ft
Packed Bed Volume	15626	gallon
DEXSORB Loading	**28.4**	mT
Empty Space Ratio	29.0	%
Estimated Pressure Drop	<15	psi
Media Replacement Frequency*	**4**	months

** Per EPA MCL Targets*

Media Replacement Frequency. In the SAWPA brine line, PFOA and PFOS are detected at peak concentrations of 130 ng/L and 170 ng/L respectively. US EPA has proposed MCLs of 4.0 ppt each for PFOA and PFOS in drinking water. DEXSORB PBF systems installed in Michigan to treat PFAS in similar matrices use Michigan Water Quality Value (WQV) discharge limits for surface water: 170 ppt for PFOA and 12 ppt for PFOS. Proposed media replacement criterion is to replace the lead vessel when PFAS is detected at 75% of the regulatory limit in the lag vessel effluent. To illustrate the impact of removal target goals, we show capacity estimations using EPA MCL and Michigan WQV values:

1. **EPA MCLs for drinking water.** Media replacement frequency for the lead vessel in each parallel lead-lag system (5 vessels in total) is estimated to be every **4 months** to remove PFAS below EPA drinking water MCLs. PFOS can be removed to < 4 ng/L for *67 weeks* and PFOA can be removed to < 4 ng/L for *17 weeks*. In this scenario, media replacement frequency is driven by PFOA breakthrough estimates.

2. **MI WQVs for surface water.** Media replacement frequency for the lead vessel in each parallel lead-lag system (5 vessels in total) is estimated to be every **30 months** to remove PFAS below MI WQVs for surface water. With PFOA concentration below the MI WQV limit, the treatment goal is to remove PFOS to below 12 ng/L. PFOS can be removed to < 12 ng/L for *119 weeks.*

This translates to a very large difference in annual media requirements. Over 3 years: EPA MCL target annual media requirements are estimated to average 473 metric tons per year; and MI WQV target annual media requirements are estimated to average 150 metric tons per year. That is roughly a 3X difference in media use based in removal targets.

2. Site Information

2.1 Brine Waste Treatment Operations

Currently, the facility processes a peak flow rate of 15 million gallons per day (i.e., 10417 gpm).

2.2 Site Preparation

The site should be equipped with the following items to accommodate the DEXSORB PBF system, consisting of ten 12-foot diameter vessels:

(1) **Supply Pressure Requirement**: each parallel lead-lag system requires backpressure of 35 psi from the existing system at 2083 gpm flow rate.

(2) **Space Requirement**: Adequate space for each DEXSORB PBF lead-lag system, 30 ft (Length) by 16 ft (Width) by 35 ft (Height) dimensions, including 2 ft of clearance on each side of the lead-lag system. The full system will require approximately 2,100 sqft of clearance. See APPENDIX for the system layout and footprint.

(3) **Installation**: A crane is required to position the ten-vessel system. 28.4 mT of DEXSORB media will be slurried into each vessel after the system is positioned and plumbed in.

3. DEXSORB System Design and Construction

Table 2 details the proposed DEXSORB PBF system design parameters, consisting of ten 12-foot vessels in parallel lead-lag configuration. Each lead-lag system will be loaded with 56.8 mT of DEXSORB granules to operate at a flow rate of 2083 gpm and accommodate an EBCT of 7.5 minutes per vessel. To handle bed heterogeneity and backpressure, a backwash function is incorporated into the system.

At the time of each media changeout, spent DEXSORB media in the five lead vessels will be replaced with fresh DEXSORB media. The lag vessels will then operate as the lead vessels, and the vessels with fresh media will operate as the lag vessels. Replacement media will be loaded as a slurry and exhausted media will be removed from the vessels using a vacuum truck and suction hose.

4. DEXSORB Waste Handling Advantages

In addition to the effectiveness and high capacity for PFAS removal, a unique advantage of DEXSORB treatment is that spent media can be regenerated in a process that isolates and concentrates PFAS waste for full destruction.

Spent DEXSORB media will be picked up by a Cyclopure contractor during media change-outs for regeneration at an offsite facility. During the regeneration process, PFAS is desorbed from spent DEXSORB and further concentrated for full destruction – *terminating the environmental life of the chemical*. A certificate of PFAS destruction will be provided for every batch of spent DEXSORB taken from the SAWPA facility.

5. Cost Estimate

The DEXSORB PBF system for PFAS treatment of brine wastewater at SAWPA is designed to encompass five lead-lag systems in parallel, containing a total of 283.9 mT of DEXSORB media. The system will have the following associated costs:

5.1 CAPEX.

Suspended Solids Treatment. Suspended solids treatment (e.g., sand filter, dissolved air flotation (DAF) unit) is needed prior to the packed bed filtration system.

Vessels. Ten filtration vessels capable of PBF operations. System design in **Table 2** uses vessels with 12-feet diameter and 26-feet height. Pipe and valve connections to be attached to vessel system on a manifold. System will connect to existing effluent hook-ups. SAWPA to make any preparations necessary to accommodate system connection.

5.2 OPEX.

DEXSORB Media. DEXSORB media is priced at **$85 per kg**, including spent media handling and PFAS waste disposal by destruction technologies. At the time of installation, 283.9 mT of DEXSORB media will be packed, with 28.4 mT of DEXSORB media in each vessel to provide a 15-minute EBCT at a flow rate of 2083 gpm per dual vessel. Media changeout frequency will determine annual costs for DEXSORB media. Annual costs may vary, and adjustments made, based on the actual changeout frequency.

O&M. DEXSORB has demonstrated effective removal of PFAS in complex matrices, with high PFAS adsorption capacity and resistance to biofilm formation or biofouling. With adequate suspended solids management prior to the system, DEXSORB PBF systems will demonstrate long-term operations with minimal O&M efforts. Backwash capability is incorporated in the system.

It is recommended to keep a weekly log of flow rate and pressure readings. Cyclopure offers to perform PFAS analysis of system water samples at no charge on a bi-weekly basis.

Appendix. DEXSORB System Process Flow Diagram and Layout.

The proposed DEXSORB PBF system design uses a total of ten 12-foot vessels, constituting five parallel lead-lag systems. The process flow diagram and system layout and estimated footprint are detailed in Figure A1 and Figure A2.

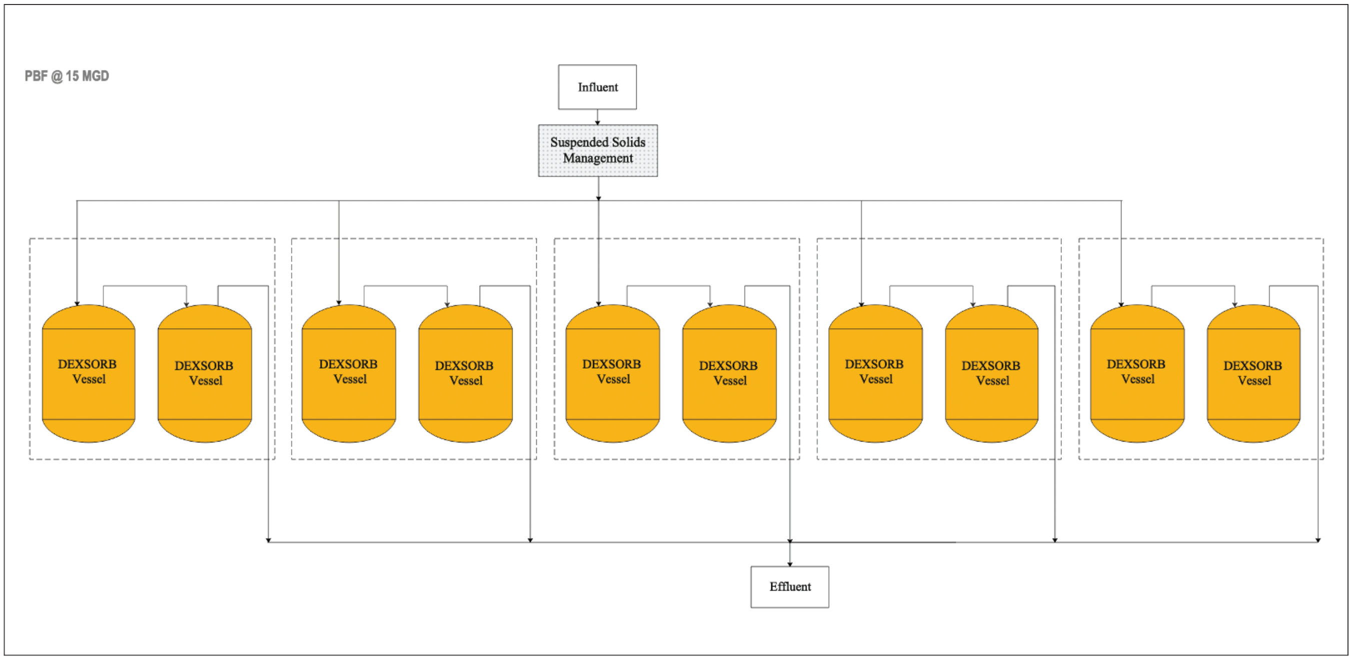

Figure A1. DEXSORB PBF System Process Flow Diagram.

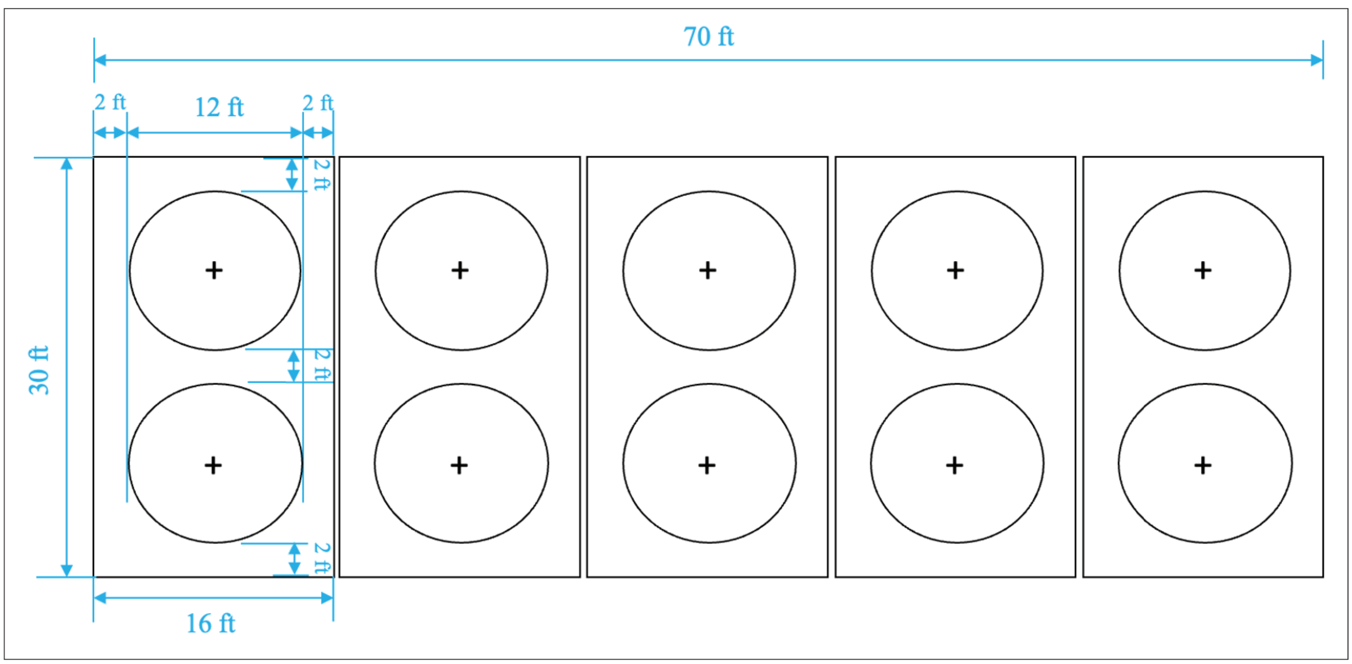

Figure A2. DEXSORB PBF System Layout and Estimated Footprint.

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Appendix C
Aclarity Octa Sizing and Performance Information

Aclarity Octa™

The Aclarity OCTA is a skidded system consisting of eight (8) reactors, eight (8) power supplies, pumps, HMI, and controls. Each reactor is plumbed in parallel and skids are deployed in parallel to handle higher flows and concentrations. Depending on the plant's hydraulic profile, wastewater influent to the Aclarity system can either be pumped into the system by external pumps or the systems internal pumps can pull the water into the system. An influent flow meter is used upstream of the Aclarity system to monitor incoming flow and to control the treatment level being applied. The Aclarity system is capable of operating with a variety of water qualities and chemical concentrations.

PFAS destruction occurs in the system reactors. Unlike other PFAS mitigation technologies, Aclarity chemically destroys PFAS, rather than concentrating for disposal.

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Aclarity will be available 24/7 for remote support with scheduled site visits for standard operations and to perform maintenance.

Training: Aclarity will provide a qualified trainer to conduct a safety training course for site staff.

Octa Specifications

The Aclarity Octa™ system destroys PFAS compounds using a proprietary electrochemical process to break down contaminants. We work with waste treatment facilities, municipalities, landfills and other organizations to solve large, cost prohibitive water problems. Each Aclarity Octa is outfitted with 8 reactors, and can treat up to 16 gallons per minute. The system is modular and additional skids are installed in parallel when flow rates or concentrations of PFAS increase. Other alternatives, such as removal and disposal, move the problem around, wasting more resources along the way. Aclarity's technology destroys PFAS on-site, eliminating PFAS from our environment and preventing the chemicals from migrating and contaminating downstream.

Aclarity's solution is robust enough to treat concentrated leachate without worries of performance decrease or fouling of electrodes. Our Octa incorporates reverse polarity for on-line cleaning as well as a Clean-In-Place (CIP) system for periodic cleaning of the reactors.

Octa Dimensions & Weight

• Installed Dimension: 6' wide x 20' long x 8.5' tall

• The skid is designed with forklift pockets for on site handling.

Facility Requirements

• Required minimum footprint, including service and operational access is 11ft x 26ft. Octas may be mounted with overlapping service corridors.

• Diluting air equivalent to 7.5 cfm or 60 air changes per hour per 7.5 ft3/0.213m3 are required.

Influent/Effluent Connections & Requirements

• 2" Male Camlock connections for feed and effluent
• 2" Male Camlock for main drain (piping)
• 1" Male Camlock for secondary drain (piping)
• 1" Male NPT for pan drain

Environmental Requirements

• Designed to be operated between 40°F to 122°F (4°C to 50°C)
• Dry storage between -20F and 122F (-29°C and 50°C)
• Wiring is all contained in corrosion resistant solid wire duct for protection from rodents and other environmental hazards.

Electrical Requirements

• Each Octa requires 400A 240VAC/3 Phase power.
• Connection is through a fused disconnect switch with provision for connecting up to 4 separate 5 wire, 3 phase feeder circuits.
• Each Octa is provided with a single equipment ground point to avoid ground loops.

Safety & Environmental Features

Fluid Containment

• Octa includes integrated secondary containment for 125% of the system fluid volume, with drain provisions for connection to recovery tanks or other containment control systems.

Seismic

• Octa includes foundation tie downs for seismic restraint.
• Rack structure meets California requirements for non-structural seismic bracing for floor mounted equipment.

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Ventilation

• The system produces hydrogen, oxygen, chlorine, and hydrogen sulfide gases which are vented through an activated carbon filter. System requires operation in a well-ventilated area.

Electrical

• All electrical cabinets are designed in compliance with the NFPA 70 National Electrical Code and NFPA 79 Electrical Standard for Industrial Machinery and have provision for lock out/tag out.

• E-stops provided at both ends of the skid. All wiring and bus bars are either enclosed or guarded.

• All electrical enclosures & junction boxes are NEMA 3R/IP54 enclosures.

Trailer Specs

Electrical

• Power requirements: 240v - 3 phase w/ 60 amp service via pin and sleeve receptacle

• Service powered locally or by generator

• Ethernet port or Wi-Fi access

Space Configuration & Housing

• Trailer dimensions: 8.5’ wide x 20’ long x 11’ tall

• Weight of trailer: 4,000lbs

• Work bench and storage areas inside trailer

Plumbing & Ventilation

• 1” influent and effluent male coupler

• 2” ventilation exhaust port

• Trailer includes sink with self contained water source and disposal

Safety

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• Trailer is equipped with gas monitor, eye wash station, first aid kit, AED, and fire extinguisher

Site Requirements

• Flat surface that can accommodate the load and size of trailer

• Minimum of three (3) 275 gallon totes required on site

• If trailer must be parked in an enclosed space a 2" FNPT will need to be routed out to a ventilated area

Note: Aclarity will provide secondary containment and generator as needed

References

Aclarity has several customers. Many of whom remain confidential. Aclarity has worked closely with Xylem. Let us know if you would like us to arrange a reference call with Kyle Schoenheit, a manager at Xylem, so you can learn more about what it is like to work with Aclarity.

Aclarity was awarded Frost & Sullivan's North American PFAS Treatment Industry Company of the Year for 2023.
https://www.aclaritywater.com/newsroom/frost-sullivan-award/

Summary

Aclarity looks forward to addressing PFAS contamination challenges for this project with our innovative destruction technology. We anticipate the opportunity to collaborate, contributing to a cleaner, safer environment. For any further inquiries, please don't hesitate to contact us. Together, let's shape a PFAS-free future.

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Appendix D
GAC Treatment System Sizing and Performance Information

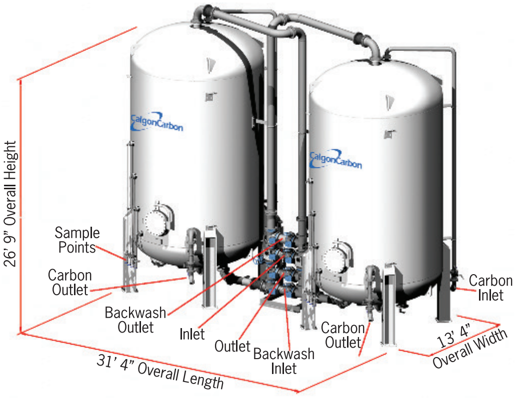
Data Sheet

Pure Water. Clean Air. Better World.

CalgonCarbon

MODEL 12-40

Modular Carbon Adsorption System



Description

The Calgon Carbon MODEL 12-40 is an adsorption system designed for the removal of dissolved organic contaminants, including disinfection byproducts (DBP) or natural organic matter (NOM) from liquids using granular activated carbon (GAC). The vessels are sized to hold 40,000 pounds of GAC, which provides the additional contact time required to remove either compounds at low concentrations or poorly adsorbing compounds. The standard design (MODEL 12-40 SYSTEM) consists of two vessels combined with a centralized pipe manifold to allow for series operation. Many of the DBP installations utilize multiple vessels operated in parallel. For these cases, an optional offering is the single vessel concept (MODEL 12-40 SINGLE). This flexibility of configurations allows the engineer to select the alternative that best meets the requirements of the site and treatment objectives.

The MODEL 12-40 SYSTEM is delivered as two adsorbers, a centrally located valve manifold and interconnecting piping requiring minimal space and field assembly. The process piping network for the MODEL 12-40 SYSTEM accommodates operation of the adsorbers in series (with either adsorber placed in first stage) or parallel. The valve manifold can be configured to isolate either adsorber from the flow, which permits carbon exchange or backwash operations to be performed on one adsorber without interrupting treatment. Each vessel is provided with GAC fill and discharge pipe including appropriate quick connect fittings for connection to water and compressed air sources. All valves and accessories are located at low elevations for ease of operation and maintenance.

The MODEL 12-40 SINGLE is delivered as a single adsorber with process pipe extending to grade. The single vessel is typically provided for systems consisting of multiple units operated in parallel. Process valves are not part of the standard package but can be supplied as an option. The vessel is provided with GAC fill and discharge pipe including appropriate quick connect fittings for connection to water and compressed air sources. All valves and accessories are located at low elevations for ease of operation and maintenance.

The MODEL 12 vessels – either systems or single vessels – are provided with features common in either configuration:

- The unique internal cone under-drain design provides for the efficient collection of treated water and the distribution of backwash water. The internal cone also insures efficient and complete discharge of spent carbon from the adsorber without the need to open the manway to manually wash out the residual spent carbon.
- In bed sample ports. The MODEL 12 vessel is provided with three (3) nozzles located along the straight side of the vessel. These nozzles can be fitted with in-bed sample assemblies which allow the operator to monitor the progress of the adsorbent as it flows through the bed. For the MODEL 12-40 SYSTEM in-bed sample assemblies are an option. For the MODEL 12-40 SINGLE in-bed sample assemblies are standard.
- The MODEL 12 vessel is provided with one (1) GAC fill line and two (2) GAC discharge lines. The multiple discharge lines are positioned to each extract 20,000 pounds of spent carbon. This feature minimizes the time required for GAC exchanges by eliminating the guesswork of loading the spent to the trailers. The one (1) side mounted discharge nozzle is provided with a stainless steel insert which has two functions. The stainless nozzle projects into the vessel and protects the lining during carbon exchange. Also, since GAC can vary in density depending on starting material and activity, the discharge nozzle inserts can be rotated 360 degrees to accommodate the differing densities. If the nozzle insert wears away, it is designed to be easily removed and replaced.
- The MODEL 12 vessel is sized to contain 40,000 lbs of GAC and to allow for backwash expansion of approximately 25% contained within the straight side of the vessel.

The pre-engineered MODEL 12-40 design assures that all adsorption system functions can be performed with the system as provided. Standard designs have the benefit of Calgon Carbon's extensive expertise and have been proven in numerous applications. The engineering package can be provided quickly and the system expedited through Calgon Carbon's production capabilities.

Safety Message

Wet activated carbon can deplete oxygen from air in enclosed spaces. If use in an enclosed space is required, procedures for work in an oxygen deficient environment should be followed.

DS-MODEL124015-EIN-E1

The MODEL 12-40 system is designed for use with Calgon Carbon's closed loop carbon exchange service. Using specially designed carbon transport trailers, the spent carbon can be removed from the adsorber via pressurized carbon-water slurry and fresh carbon refilled in the same manner. This closed loop transfer is accomplished without exposure of personnel to either spent or fresh carbon. Calgon Carbon can also manage the disposition of the spent carbon, which is typically returned to Calgon Carbon for reactivation – avoiding the need for the site to arrange for disposal.

Carbon Adsorbers	**System**	**Single**
Carbon Steel ASME code pressure vessels	✓	✓
Internal vinyl ester lining (nominal 35 to 45 mil) where GAC contacts steel for potable water and most liquid applications	✓	✓
Polypropylene slotted nozzles for water collection and backwash distribution	✓	✓
Standard Adsorption System Piping	✓	✓
Schedule 40 carbon steel process piping with cast iron fittings	✓	✓
Cast iron butterfly valves for process piping	✓	●
Full bore stainless steel ball valves for GAC fill and discharge	✓	✓
PPL lined steel pipe for GAC discharge	✓	✓
Pressure relief using graphite rupture discs	✓	✓
Pressure gages to measure pressure drop across system and each adsorber	✓	✓
System External Coating	✓	✓
High solids epoxy paint system	✓	✓
System skid, shipped seperately, upon which system components can be assembled	●	●
In-bed water sample collection probes	●	✓

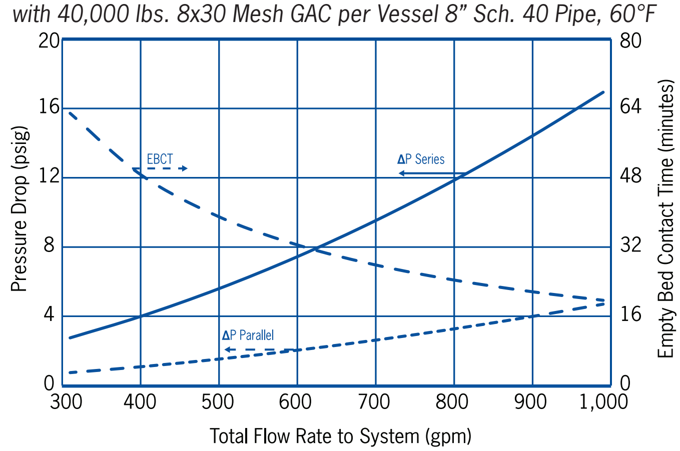
✓ Included as Standard ● Available as Option

Dimensions and Field Conditions	**MODEL 12-40**
Adsorber Vessel Diameter	12' (3,660 mm)
Process and Backwash Pipe	8"
Process Pipe Connection	125# ANSI flange
Utility Water Connection	3/4" hose connection
Utility Air Connection	3/4" hose connection
Carbon Hose Connection	4" Kamlock type
Backwash Connections	8" flange
Drain/Vent Connection	8" flange
Adsorber Maintenance Access	20" round flanged man-way, 14" x 18" man-way below cone
Adsorber Shipping Weight	25,400 lbs. empty (11,550 kg)
System Operating Weight	385,000 lbs. (175,000 kg)

Operating Conditions	**MODEL 12-40**
Carbon per Adsorber	40,000 lbs. (18,180 kg)
Pressure Rating	125 psig (862 kPa) @ 140°F
Pressure Relief	Graphite rupture disk (125 psig)
Temperature Rating	140°F maximum (60°C)
Backwash Rate	Typical 1,700 gpm (25% expansion)
Carbon Transfer	Air pressure slurry transfer
Utility Air	100 scfm at 30 psig (reduce to 15 psig for trailer)
Utility Water	100 gpm at 30 psig
Freeze Protection	None provided; enclosure or protection recommended

Pressure Drop Model 12-40 System

with 40,000 lbs. 8x30 Mesh GAC per Vessel 8" Sch. 40 Pipe, 60°F



Safety Message

Wet activated carbon can deplete oxygen from air in enclosed spaces. If use in an enclosed space is required, procedures for work in an oxygen deficient environment should be followed.

Appendix E

CIP Table Summary & Detailed Cost Estimates

Santa Ana Watershed Project Authority
Inland Empire Brine Line Master Plan

APPENDIX E: Capital Improvement Cost Summary

August 2024

						Near-Term										Long-Term														Build-Out
Project ID	Planning Scenario	Project Name	Description	Justification	Total Project Cost	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049 to 2065
Capacity Projects																														
CAP-1	Long-Term (2035-2059)	Reach IV-A Lower (Prado Inundations Area) Pipeline	Replace 18,000 LF of existing 36-inch pipe with 48-inch pipe in Reach IV-A Lower, west of	Pipeline is under capacity and located adjacent to the Prado Dam.	$ 55,114,000															$ 500,000	$ 18,204,667	$ 18,204,667	$ 18,204,667							
CAP-2	Near-Term (2024-2034)	Smart Manhole Cover Installation	Install smart manhole covers at five (5) locations to monitor water levels during maximum flow conditions.	Monitor the "choke points," including six (6) sections with d/D values anticipated to be between 0.75 and 1.0 identified in the capacity analysis.	$ 172,000						$ 86,000	$ 86,000																		
CAP-3	Build-Out Term (Beyond 2048)	Reach IV-D Parallel Line from MAS 4D-	Construct a parallel 36" line.	Relieve anticipated buildout capacity deficiencies in Reach 4D.	$ 4,825,000																									$ 4,825,000
CAP-4	Build-Out Term (Beyond 2048)	Reach IV Parallel Line from MAS 4-0130 to MAS 4-0030	Construct a parallel 30" line.	Relieve anticipated buildout capacity deficiencies in Reach 4.	$ 19,520,000																									$ 19,520,000
CAP-5	Near-Term (2024-2034)	Future Study on Green Hydrogen	Evaluate the feasibility of using green hydrogen technology using Brine Line water.	The use of green hydrogen technology in the future could significantly reduce overall Brine Line flows.	$ 198,000		$ 198,000																							
CAP-6	Near-Term (2024-2034)	Future Studies on Brine Minimization	Evaluate various brine minimization strategies for the Brine Line system.	Minimize brine flows in order to increase the available capacity of the Brine Line.	$ 263,000						$ 87,667	$ 87,667	$ 87,667																	
				Total Capacity Projects:	**$ 80,092,000**	**$ -**	**$ 198,000**	**$ -**	**$ -**	**$ -**	**$ 173,667**	**$ 173,667**	**$ 87,667**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 500,000**	**$ 18,204,667**	**$ 18,204,667**	**$ 18,204,667**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 24,345,000**
Facility Management Projects																														
FM-1	Near-Term (2024-2034)	Reach IV-E Siphon Mainline Valve	Installation of a new MAS within the Brine Line downstream of existing MAS 4E-0040 to facilitate newly constructed Agua Mansa Lateral.	To be used as a low flow bypass, thereby allowing dewatering of the existing siphon section.	$ 970,000			$ 485,000	$ 485,000																					
FM-2	Near-Term / Long-Term (2025-2045)	Off-Line Storage System	Install six (6) 2-MG and one (1) 0.5-MG off-line storage reservoirs (locations TBD); Project to be phased over 10 years.	To dewater the Brine Line system for necessary repairs/rehabilitation.	$ 109,278,000				$ 200,000			$ 10,907,800		$ 10,907,800		$ 10,907,800		$ 10,907,800		$ 10,907,800		$ 10,907,800		$ 10,907,800		$ 10,907,800		$ 10,907,800		$ 10,907,800
FM-3	Long-Term (2034-2034)	Reach IV Pipeline Inspection & Condition Assessment/Rehabilitation	A complete inspection and condition assessment of the Reach to identify existing structural or maintenance issues. Based on recommendations from the 2024 Condition Assessment.	Reach IV is the oldest portion of the Brine Line. The goal is a rehabilitation program intended to improve and extend the remaining useful life of the existing Reach.	$ 9,100,000										$ 850,000										$ 1,250,000	$ 3,500,000.00	$ 3,500,000.00			
FM-4A	Near-Term (2024-2034)	Reach IV-B Ductile Iron Pipe Mid-Term Condition Assessment	Heavy cleaning, CCTV and Sonar inspection of 8,600 LF of pipe. Perform Joint repairs and spot repairs. Based on recommendations from the 2024 Condition Assessment	A portion of Reach IV-B (8,500 LF) was constructed with 36" cement-mortar lined DIP in the late 1990s and is now over 20 years old. Corrosion (both internal and external) can significantly impact the structural integrity of DIP pipe.	$ 3,680,000					$ 3,680,000																				
FM-4B	Long-Term (2035-2059)	Reach IV-B Ductile Iron Pipe Rehabilitation Project	Rehabilitate approximately 8,600 feet of 36 inch DIP with CIPP Liner. Based on recommendations from the 2024 Condition. Reevaluate after mid-term condition assessment.	A portion of Reach IV-B (8,500 LF) was constructed with 36" cement-mortar lined DIP in the late 1990s and is now over 20 years old. Corrosion (both internal and external) can significantly impact the structural integrity of DIP pipe.	$ 8,790,000														$ 4,395,000	$ 4,395,000.00										
FM-5A	Near-Term (2024-2034)	Reach IV-D Corrosion Rehabilitation	Cleaning, CCTV and Concrete and liner repairs in the near term. Reinspecting entire 7 miles including siphons in the mid-term. Based on recommendations form the 2024 Condition Assessment.	Approximately 7 miles of Reach IV-D is unlined along the pipeline invert so that the existing material has been exposed to corrosion. SAWPA performed a condition assessment of Reach IV-D in 2018 and 2024.	$ 993,000		$ 94,000							$ 899,000.00																
FM-5B	Long-Term (2035-2059)	Reach IV-D Corrosion Rehabilitation, Phase 1 and 2.	Lining of 7-miles of 42-inch pipeline	Approximately 7 miles of Reach IV-D is unlined along the pipeline invert so that the existing material has been exposed to corrosion. SAWPA performed a condition assessment of Reach IV-D in 2018 and 2024 concluded that all 7 miles will likely require structural rehabilitation in 7-10 years.	$ 41,477,800										$ 13,670,150	$ 13,670,150										$ 7,068,750	$ 7,068,750			
FM-6	Near-Term (2024-2034)	Reach V MAS Condition Assessment	Perform condition assessment on Reach V to define and locate the adequate number of structures and develop an order of magnitude project cost.	Approximately 15 miles of Reach V is currently not accessible due to the lack of an adequate number of MAS. Access to Reach V is critical for performing routine inspections, cleaning of the pipeline, and mitigating operational issues. Additional study is necessary to identify a suitable number and placement of MAS within Reach V.	$ 6,575,000						$ 575,000.00			$ 2,000,000	$ 2,000,000	$ 2,000,000														
FM-7	Near-Term (2024-2034)	Reach IV-B Pipeline Inspection & Condition Assessment/Rehabilitation	Approximately 30,000 LF of Reach IV-B, constructed between 1981 and 1996, will be inspected and evaluated for rehabilitation.	Maintain high level of system performance.	$ 35,670,000			$ 850,000					$ 850,000					$ 850,000				$ 120,000.00	$ 16,000,000	$ 17,000,000						
FM-8	Near-Term (2024-2034)	Reach IV-B DIP Section Additional MAS Structures	Construct additional MAS on Reach IV-B. Based on recommendations from the 2024 Condition Assessment.	Maintain high level of system performance.	$ 325,000	$ 325,000																								
FM-9	Near-Term (2024-2034)	Reach IV-E Inspection / Repairs	Perform an investigation and assessment to understand the reliability and performance of Reach IVE and identify potential issues and actions needed to extend the remaining useful life of the system.	Reach IVE was constructed in 1995. A portion of the Reach IVE is in a long siphon and access is limited. This inspection and subsequent repairs will extend the remaining useful life of the system	$ 1,200,000			$ 450,000										$ 750,000												
FM-10	Near-Term (2024-2034)	Reach V - Temescal Canyon Rd (El Cerrito Segment) Widening	Relocate existing Air Release Valves and protect Brine Line during street widening project.	Riverside County Transportation Department plans to widen Temescal Canyon Road from El Cerrito to Tom Barnes Road.	$ 200,000		$ 100,000	$ 100,000																						

Santa Ana Watershed Project Authority
Inland Empire Brine Line Master Plan

APPENDIX E: Capital Improvement Cost Summary

August 2024

Project ID	Planning Scenario	Project Name	Description	Justification	Total Project Cost	Near-Term										Long-Term														Build-Out
						2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049 to 2065
FM-11	Near-Term (2024-2034)	Reach V Air Vac Modifications	Relocations or modification to place the Air Vacuum Valves in vaults will protect them from damage and uncontrolled spills.	Modification to Air Vacuum Valves on Reach V is necessary due to location in unsecure areas and at risk due to vandalism, traffic accidents or development.	$ 450,000						$ 450,000.00																			
FM-12	Near-Term (2024-2034)	Reach IV-D Inspection / Repairs Project 1	Perform an assessment to identify potential issues and actions needed to extend the remaining useful life of the system. Project 1 includes approximately 38,000 feet of pipe.	Reach IVD was constructed in the early to mid 1990s. An investigation and assessment is necessary to understand the reliability and performance of Reach IVD.	$ 625,000						$ 625,000.00																			
FM-13	Near-Term (2024-2034)	Reach V Indian Truck Trail Protection	Protection of the Brine Line to prevent further erosion and impact to the Brine Line	A portion of the Reach V Brine Line on Indian Truck Trail in Temescal Valley is subject to erosion due to stormwater.	$ 575,000								$ 575,000																	
FM-14	Near-Term (2024-2034)	Reach IV-D Inspection / Repairs Project 2	Perform an assessment to identify potential issues and actions needed to extend the remaining useful life of the system. Project 2 includes approximately 38,000 feet of pipe.	Reach IVD was constructed in the early to mid 1990s. An investigation and assessment is necessary to understand the reliability and performance of Reach IVD.	$ 650,000								$ 650,000																	
FM-15	Near-Term (2024-2034)	Reach IV-D Inspection / Repairs Project 3	Perform an assessment to identify potential issues and actions needed to extend the remaining useful life of the system. Project 3 includes approximately 38,000 feet of pipe.	Reach IVD was constructed in the early to mid 1990s. An investigation and assessment is necessary to understand the reliability and performance of Reach IVD.	$ 700,000										$ 700,000															
FM-16	Near-Term (2024-2034)	Reach V Baker St Protection	Project approximately 2 miles of Reach V on the unpaved portion of Baker Street from erosion and human activity.	Structural projection of the Brine Line.	$ 1,040,000										$ 40,000	$ 1,000,000														
FM-17	Long-Term (2035-2059)	Prado Access Road Improvements.	This project would improve about 3 - 6 miles of the Brine Line access road giving access to critical Brine Line facilities immediately once the reservoir has drained.	Provide access to the Brine Line.	$ 2,700,000	$ 100,000		$ 100,000	$ 2,500,000.00																					
FM-18	Near-Term (2024-2034)	Capacity Management	Project involves planning for future discharges and understanding and controlling peak flows. Capacity management projects could include flow stabilization and peak discharge elimination and concentration of brine flows.	Capacity management is critical to achieve the goal of salt balance in the upper watershed. Flow to OCSD is limited to 30 MGD and instantaneous peaks above 30 MGD are not allowed.	$ 27,325,000						$ 325,000																			$ 27,000,000
FM-19	Near-Term (2024-2034)	Reach IV-D Mission Tunnel	Correct an existing joint lead on Reach IV-D in the Mission Tunnel.	Maintain high level of system performance.	$ 175,000		$ 175,000																							
FM-20	Near-Term (2024-2034)	Hydraulic "Choke Points" Analysis	Further evaluation to determine sizing of parallel lines to alleviate choke points in the Brine Line system.	Improve system capacity.	$ 200,000						$ 100,000.00					$ 100,000														
FM-21A	Near-Term (2024-2034)	Alcoa Dike Protection Relocation (Raise 2 MAS upon completion of project).	Raise two new MAS upon completion of project.	Relocation of portion of IV-B due to Alcoa Dike. Two new MAS were constructed and left below existing grade during construction of the Dike.	$ 75,000	$ 75,000.00																								
FM-21B	Near-Term (2024-2034)	Prado Reservoir (below 556") MAS Projection	Modify 1 - 3 MAS below 556' to be watertight.	As part of the Army Corps Mainstem project, all structures below 556 need to be watertight.	$ 200,000		$ 200,000																							
FM-22	Near-Term (2024-2034)	OC San Future CIP	Annual contribution of $600,000 for future OC San CIP. SAWPA is working with OCSD to further define their future CIP.	SAWPA through the cost sharing agreement for the Operation and maintenance of the SARI in Orange County, is obligated to pay a portion of the costs for this CIP.	$ 16,400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 400,000	$ 6,800,000.00
				Total O&M Projects:	**$ 269,373,800**	**$ 900,000**	**$ 969,000**	**$ 2,385,000**	**$ 3,585,000**	**$ 4,080,000**	**$ 2,475,000**	**$ 11,307,800**	**$ 2,475,000**	**$ 14,206,800**	**$ 17,660,150**	**$ 28,077,950**	**$ 400,000**	**$ 12,907,800**	**$ 4,795,000**	**$ 15,702,800**	**$ 400,000**	**$ 11,427,800**	**$ 16,400,000**	**$ 28,307,800**	**$ 1,650,000**	**$ 21,876,550**	**$ 10,968,750**	**$ 11,307,800**	**$ 400,000**	**$ 44,707,800**
System Monitoring Projects																														
MON-1	Near-Term (2024-2034)	SCADA System Phase 1	Construct Master Station, operation workstation; initial set-up, integration of programming and automation. Install SCADA system at twelve (12) existing discharger sites that currently produce highest flows	Collection of real-time flow and quality information increases SAWPA's ability to monitor, operate, and control the Brine Line system.	$ 1,055,000	$ 527,500	$ 527,500																							
MON-2	Near-Term (2024-2034)	SCADA System Phase 2	Install SCADA system at twelve (12) existing discharger sites that currently produce next highest flows, after those included in Project MON-1.	Collection of real-time flow and quality information increases SAWPA's ability to monitor, operate, and control the Brine Line system.	$ 691,000				$ 230,333	$ 230,333	$ 230,333																			
MON-3	Near-Term (2024-2034)	SCADA System Phase 3	Install SCADA system at remaining twelve (12) existing discharger sites that currently produce lowest flows, after those included in Project MON-1 and MON-2.	Collection of real-time flow and quality information increases SAWPA's ability to monitor, operate, and control the Brine Line system.	$ 691,000							$ 230,333	$ 230,333	$ 230,333.33																
MON-4	Near-Term (2024-2034)	SCADA System Phase 4	Install Brine Line for in-line flow monitoring stations #1 through #5 with monitoring program (locations TBD).	Collection of real-time flow information increases SAWPA's ability to monitor, operate, and control the Brine Line system.	$ 204,000	$ 40,800	$ 40,800	$ 40,800	$ 40,800	$ 40,800																				
				Total System Monitoring Projects:	**$ 2,641,000**	**$ 568,300**	**$ 568,300**	**$ 40,800**	**$ 271,133**	**$ 271,133**	**$ 230,333**	**$ 230,333**	**$ 230,333**	**$ 230,333**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
				TOTAL:	**$ 352,106,800**	**$ 1,468,300**	**$ 1,735,300**	**$ 2,425,800**	**$ 3,856,133**	**$ 4,351,133**	**$ 2,879,000**	**$ 11,711,800**	**$ 2,793,000**	**$ 14,437,133**	**$ 17,660,150**	**$ 28,077,950**	**$ 400,000**	**$ 12,907,800**	**$ 4,795,000**	**$ 16,202,800**	**$ 18,604,667**	**$ 29,632,467**	**$ 34,604,667**	**$ 28,307,800**	**$ 1,650,000**	**$ 21,876,550**	**$ 10,968,750**	**$ 11,307,800**	**$ 400,000**	**$ 69,052,800**
				CUMULATIVE TOTAL:		**$ 1,468,300**	**$ 3,203,600**	**$ 5,629,400**	**$ 9,485,533**	**$ 13,836,667**	**$ 16,715,667**	**$ 28,427,467**	**$ 31,220,467**	**$ 45,657,600**	**$ 63,317,750**	**$ 91,395,700**	**$ 91,795,700**	**$ 104,703,500**	**$ 109,498,500**	**$ 125,701,300**	**$ 144,305,967**	**$ 173,938,433**	**$ 208,543,100**	**$ 236,850,900**	**$ 238,500,900**	**$ 260,377,450**	**$ 271,346,200**	**$ 282,654,000**	**$ 283,054,000**	**$ 352,106,800**

CAP-1: HOBAS WEST PIPELINE REPLACEMENT AND RELOCATION

Item No.	Item Description	Unit	Estimated Quantity	Unit Price	Item Total
1	48-inch Pipeline Replacement	LF	18,000	$1,680	$ 30,240,000
				Subtotal	**$ 30,240,000**
				General Requirements (10%)	$ 3,024,000
				Contingency (25%)	$ 7,560,000
				Construction Total	**$ 40,824,000**
					Soft Costs:
				Engineering (10%)	$ 4,083,000
				Construction Mgmt, Environmental & ESDC (20%)	$ 8,165,000
				Administration (5%)	$ 2,042,000
				Project Total	**$ 55,114,000**

CAP-2: Smart Manhole Cover Installation

Item No.	Item Description	Unit	Estimated Quantity	Unit Price	Item Total
1	Install 5 Smart Manhole Covers	EA	5	$6,000	$ 30,000
1	SCADA System Integration	EA	5	$20,000	$ 100,000
				Subtotal	**$ 130,000**
				Contingency (25%)	$ 33,000
				Construction Total	**$ 163,000**
					Soft Costs:
				Administration (5%)	$ 9,000
				Project Total	**$ 172,000**

CAP-3: Reach 4D Parallel Line from MAS 4D-150 to MAS 4D 0110

Item No.	Item Description	Unit	Estimated Quantity	Unit Price	Item Total
1	Parallel 36-inch Line	LF	2,100	$1,260	$ 2,646,000
				Subtotal	**$ 2,646,000**
				General Requirements (10%)	$ 265,000
				Contingency (25%)	$ 662,000
				Construction Total	**$ 3,573,000**
					Soft Costs:
				Engineering (10%)	$ 358,000
				Construction Mgmt, Environmental & ESDC (20%)	$ 715,000
				Administration (5%)	$ 179,000
				Project Total	**$ 4,825,000**

CAP-4: Reach 4 Parallel Line from MAS 4-0130 to MAS 4-0030

Item No.	Item Description	Unit	Estimated Quantity	Unit Price	Item Total
1	Parallel 30-inch Line	LF	10,200	$1,050	$ 10,710,000
				Subtotal	**$ 10,710,000**
				General Requirements (10%)	$ 1,071,000
				Contingency (25%)	$ 2,678,000
				Construction Total	**$ 14,459,000**
					Soft Costs:
				Engineering (10%)	$ 1,446,000
				Construction Mgmt, Environmental & ESDC (20%)	$ 2,892,000
				Administration (5%)	$ 723,000
				Project Total	**$ 19,520,000**

CAP-5: Future Study on Green Hydrogen

Item No.	Item Description	Unit	Estimated Quantity	Unit Price	Item Total
1	Green Hydrogen Study	EA	1	$150,000	$ 150,000
				Subtotal	**$ 150,000**
				Contingency (25%)	$ 38,000
				Construction Total	**$ 188,000**
					Soft Costs:
				Administration (5%)	$ 10,000
				Project Total	**$ 198,000**

CAP-6: Future Studies on Brine Minimization

Item No.	Item Description	Unit	Estimated Quantity	Unit Price	Item Total
1	Brine Minimization Study	EA	1	$100,000	$ 100,000
1	Pilot Study	EA	1	$100,000	$ 100,000
				Subtotal	**$ 200,000**
				Contingency (25%)	$ 50,000
				Construction Total	**$ 250,000**
					Soft Costs:
				Administration (5%)	$ 13,000
				Project Total	**$ 263,000**

FM-1: Reach IV-E Siphon Mainline Valve

Item No.	Item Description	Unit	Estimated Quantity	Unit Price	Item Total
1	New MAS downstream of MAS 4E-0040	EA	2	$250,000	$ 500,000
				Subtotal	**$ 500,000**
				General Requirements (10%)	$ 50,000
				Contingency (25%)	$ 125,000
				Construction Total	**$ 675,000**
					Soft Costs:
				Engineering (17%)	$ 119,000
				Construction Mgmt, Environmental & ESDC (20%)	$ 135,000
				Administration (5%)	$ 40,000
				Project Total	**$ 970,000**

FM-2: OFFLINE STORAGE SYSTEM

Item No.	Item Description	Unit	Estimated Quantity	Unit Price	Item Total
1	Feasibility Study	EA	1	$100,000	$ 100,000
2	(6) 2-MG Underground Storage Tanks	Gal	12,000,000	$4	$ 48,000,000
3	(1) 0.5-MG Underground Storage Tank	Gal	500,000	$4	$ 2,000,000
4	Land Acquisition	Ac	13	$750,000	$ 9,750,000
				Subtotal	**$ 59,850,000**
				General Requirements (10%)	$ 5,985,000
				Contingency (25%)	$ 14,963,000
				Construction Total	**$ 80,798,000**
					Soft Costs:
				Engineering (10%)	$ 8,080,000
				Construction Mgmt, Environmental & ESDC (20%)	$ 16,160,000
				Administration (5%)	$ 4,040,000
				Project Total	**$ 109,078,000**

MON-1: SCADA System Set up and High Discharger Install

Item No.	Item Description	Unit	Estimated Quantity	Unit Price	Item Total
1	Construct Master Station, operation workstation, initial set up, integration of programming and automation	LS	1	$200,000	$ 200,000
2	Install SCADA system at twelve (12) existing discharger sitest that currently produce the highest flows	LS	1	$350,000	$ 350,000
				Subtotal	**$ 550,000**
				General Requirements (10%)	$ 55,000
				Contingency (25%)	$ 138,000
				Construction Total	**$ 743,000**
					Soft Costs:
				Engineering (17%)	$ 125,000
				Construction Mgmt, Environmental & ESDC (20%)	$ 149,000
				Administration (5%)	$ 38,000
				Project Total	**$ 1,055,000**

MON-2 and MON-3: SCADA System Install

Item No.	Item Description	Unit	Estimated Quantity	Unit Price	Item Total
1	Install SCADA system at twelve (12) existing discharger sitest that currently produce the highest flows	LS	1	$350,000	$ 350,000
				Subtotal	**$ 350,000**
				General Requirements (10%)	$ 35,000
				Contingency (25%)	$ 88,000
				Construction Total	**$ 473,000**
					Soft Costs:
				Engineering (21%)	$ 99,000
				Construction Mgmt, Environmental & ESDC (20%)	$ 95,000
				Administration (5%)	$ 24,000
				Project Total	**$ 691,000**

MON-4: Inline Flow Metering Stations #1 through #5

Item No.	Item Description	Unit	Estimated Quantity	Unit Price	Item Total
1	Install Inline Flow Metering Station	EA	5	$8,500	$ 42,500
3	SCADA System	LS	1	$100,000	$ 100,000
				Subtotal	$ 143,000
				General Requirements (10%)	$ 15,000
				Contingency (25%)	$ 36,000
				Construction Total	**$ 194,000**
					Soft Costs:
				Administration (5%)	$ 10,000
				Project Total	**$ 204,000**