PROJECT MEMORANDUM

SALINAS VALLEY BASIN GROUNDWATER SUSTAINABILITY AGENCY

Brackish Groundwater Restoration Project

Project No.:	202058
Date:	March 26, 2026
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Subject:	Brackish Groundwater Project Infrastructure Planning Background Information

1.1 Introduction to the Brackish Groundwater Restoration Project

The elements of the Brackish Groundwater Restoration Project (BRGP) include constructing a series of extraction wells to form a hydraulic barrier by continuously extracting brackish groundwater and capturing seawater where the Monterey Bay (Bay) interfaces with the freshwater aquifers along the coastline of the 180/400-foot and Monterey Subbasins. The extraction wells generate significant volumes of brackish water (a mixture of freshwater and seawater) that will be desalted at a centralized treatment facility and used as a new potable water supply through the BGRP. A conceptual process flow diagram of the BGRP is shown in Figure 1. This memo was developed to document the infrastructure planning effort in the development of multiple BGRP scenarios that were evaluated in BGRP Scenario Tech Memo.

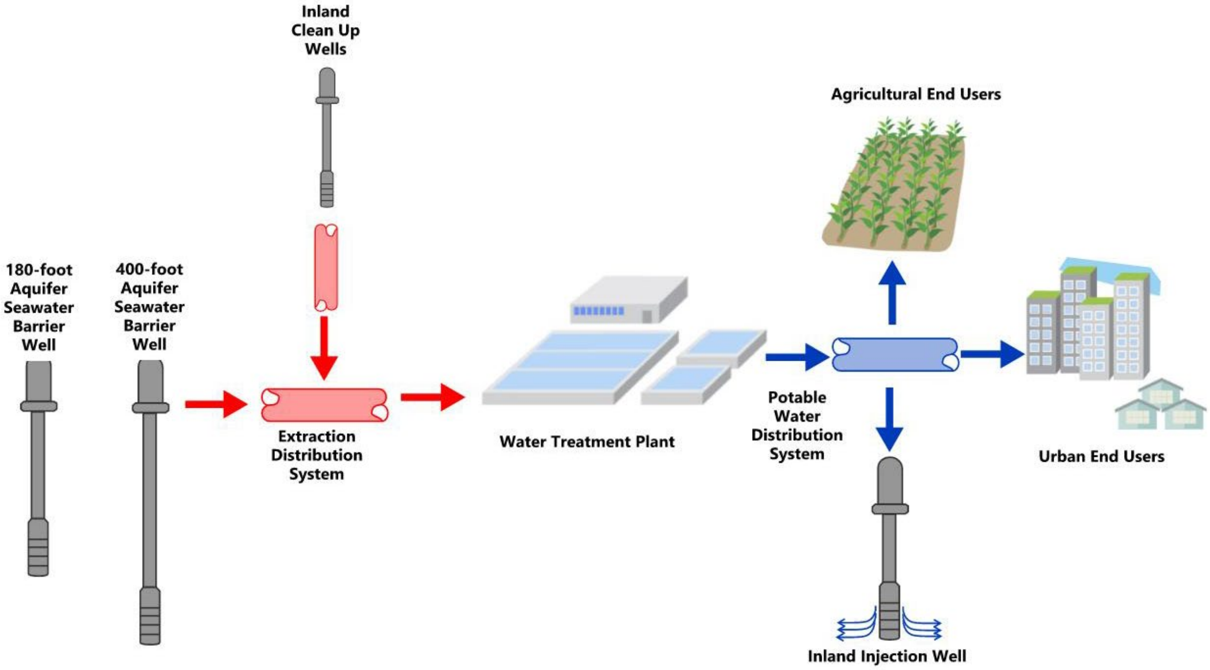


Figure 1 BGRP Conceptual Process Flow Diagram

While initial project scenarios focused on direct deliveries of the treated water, the seasonal nature of water demands in the study area did not allow for efficient and effective operation of either the extraction wells or the treatment, both of which require relatively consistent volumes to maintain efficacy. Injection wells were added to the scenarios to accommodate the winter season excess treated water flows (due to low irrigation and drinking water demands). An injection-only scenario with no direct deliveries was added to determine if it would be as effective at mitigating seawater intrusion and a way to potentially reduce delivery pipeline lengths and associated costs. The cumulative investigation has led to the development of seven project scenarios that vary in their volumes produced, type of delivery, and location. The seven scenarios represent a range of possible solutions to meet the subbasin's minimum thresholds (MTs). The seven BGRP scenarios considered are:

1. Extraction, Treatment, and Direct Deliveries Plus Injection – Small.
2. Extraction, Treatment, and Direct Deliveries Plus Injection – Medium.
3. Extraction, Treatment, and Direct Deliveries Plus Injection – Large.
4. Extraction, Treatment, and Injection Only.
5. Extraction, Treatment, and Eastside Injection.
6. Extraction North of the Salinas River, Treatment, and Direct Deliveries Plus Injection.
7. Extraction From the 180-Foot Aquifer, Treatment, and Injection in the 400-Foot Aquifer.

1.1.1 Regional Demands and Scenario Development

Prior to the development of regional infrastructure, the total supply and demand water use was identified for the BGRP scenarios. The total water use in the study area is approximately 148,470 acre-feet per year (AFY), see Table 1. This total volume used is comprised from urban and agricultural users. For both urban and agricultural users, consumption patterns vary throughout the year with below average use in the late fall and winter months and peak use in the spring and summer months. These usage patterns correspond with the increase in landscape irrigation due to rising seasonal temperatures and the food crop growing season. These seasonal variations are important to understand and document to determine monthly as well as annual end uses that can be served. This information informed the development of project alternatives sizing, if urban and/or agricultural direct deliveries were included, which is the volume of groundwater demand that could be offset with alternative water supplies.

Figure 2 shows the total urban demand based on the 5-year pumping average and Figure 3 shows the seasonality of the urban groundwater use over a year. This includes smaller water systems who could benefit from the alternative water source produced by this project, even though they may be outside of the area at risk of seawater intrusion under the no project alternative. This total demand, including the satellite urban users, is 25,057 AFY broken down by service provider. The seasonality of each end user demand was also included in this analysis.

Table 1 All End User Total Demand in the Study

End User	Demand (AFY)
CSIP	3,606
Ag Users within SWI Boundary	6.,034
Agricultural wells within 1000 feet of treated water pipelines.	2,390
Total Agricultural Demand	**12,030**
Alco Water Service	4,027
Cal Water Salinas	14,503
Cal Water Salinas Hills	1,806
Castroville Community Services District	738
Marina Coast Water District	3,217
Normco, Toro, Oak Hills, Ambler Park	765
Total Municipal- Demand	25,057
Total Agricultural and Municipal Demand	**37,087**
Ag Demand Not Directly Served	103,336
Municipal-Urban-Rural Demand Not Served	8,051
Total Demand in Project Study Area	**148,473**

Notes:
CSIP - Castroville Seawater Intrusion Project

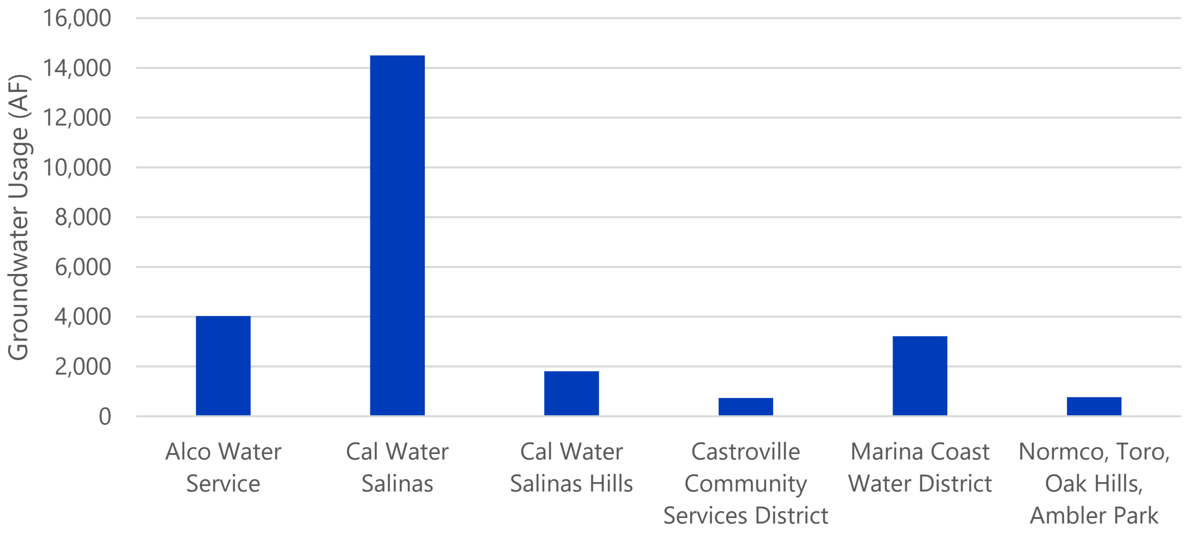


Figure 2 Total Urban Usage in Study Area

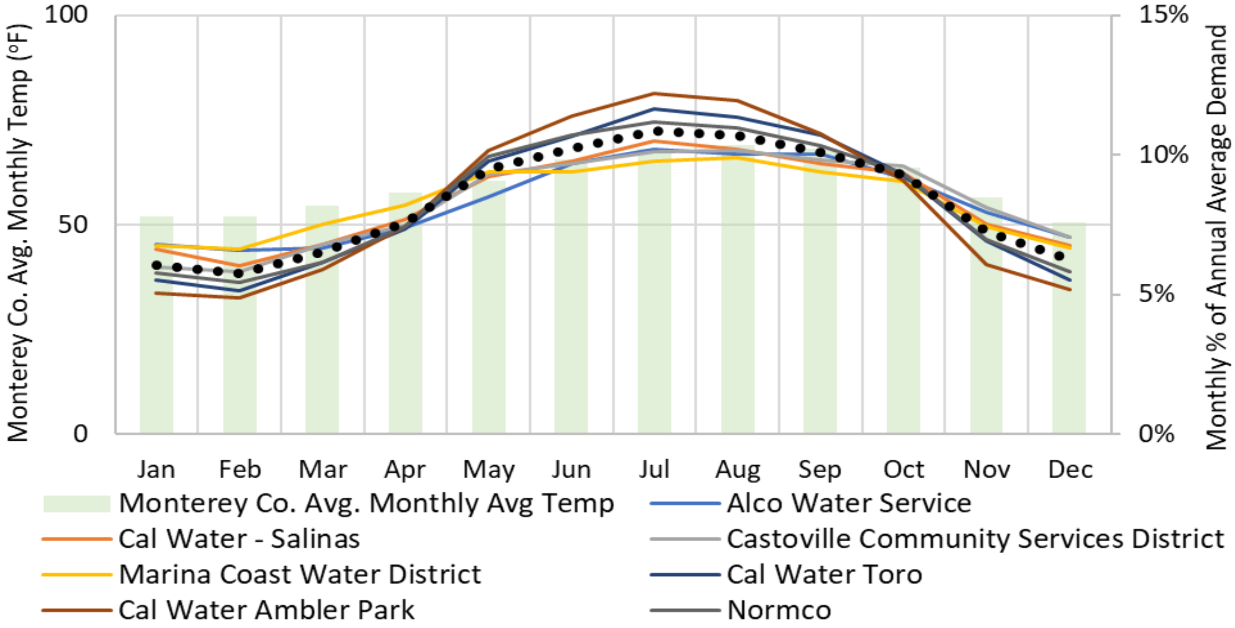


Figure 3 Urban End Users Seasonality of Demands

Figure 4 shows the agricultural groundwater usage data by the following groupings: 1) agricultural end users within the seawater intruded area that are intended to be offset, 2) potential agricultural users within the study area that fall within a servable distance that could be offset, 3) Castroville Seawater Intrusion Project (CSIP) supplemental well users, and 4) all remaining agricultural users within the entire study area. It was assumed that any agricultural users directly north or east of the City of Salinas would not be able to be served due to limitations of proposed infrastructure. Agricultural users south and west of the City of Salinas could be served through the proposed potable water distribution infrastructure that would be serving other end users. Figure 5 shows the agricultural seasonality is much higher than the municipal usage due to the growing seasons primarily occurring in the spring and summer with minimal groundwater needs in the winter.

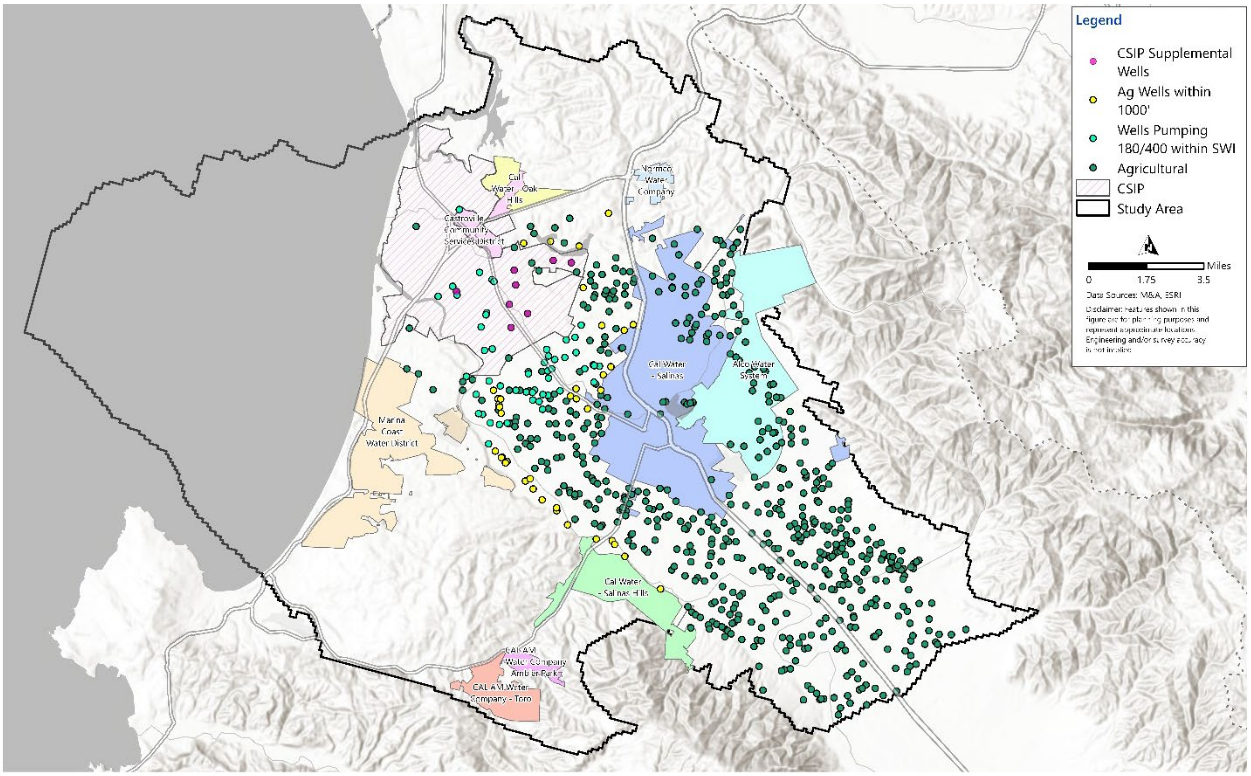


Figure 4 All Agricultural Users Within Study Area and Their Respective Volumes

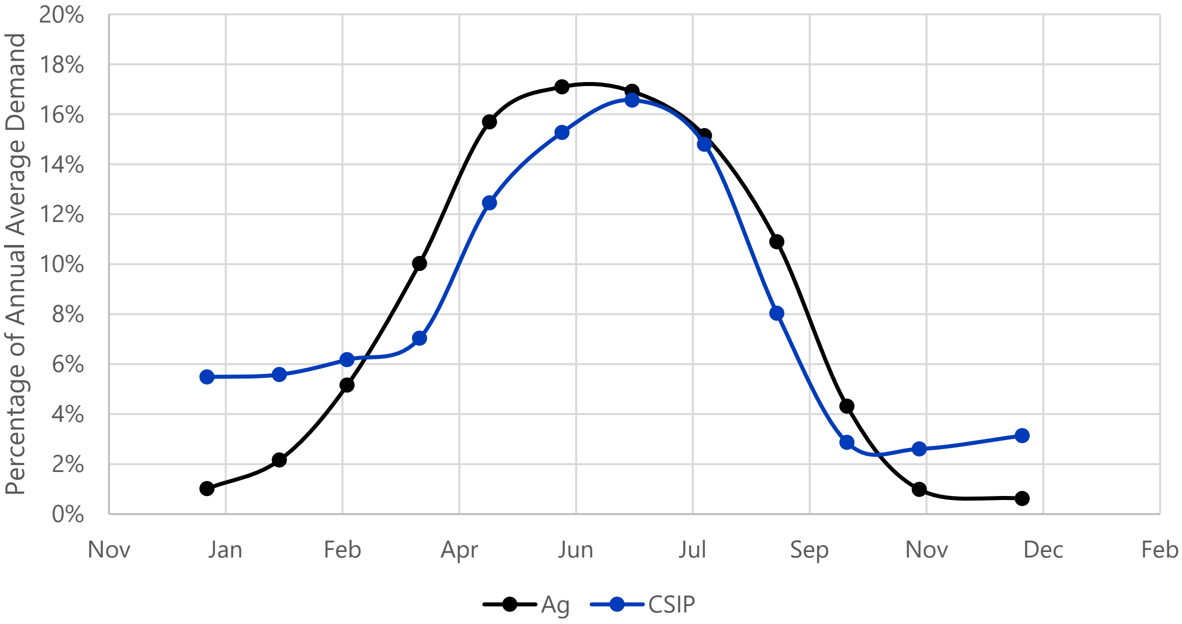


Figure 5 Agricultural Water Use Seasonality

The demands for each of the municipal and agricultural users were annually distributed with respect to these factors. For the BGRP project, a constant supply of brackish water will be extracted from the extraction barrier wells. This volume was determined by the Seawater Intrusion Model to identify an approximate extraction volume that would effectively halt and reverse seawater intrusion in the 180- and 400-foot aquifers. For the initial BGRP development, an extracted volume of approximately 50,000 gallons per minute (gpm) (≈80,000 AFY) was extracted from a theoretical seawater barrier to be sent to a brackish groundwater treatment facility. Assuming a 70 percent treatment recovery, the total available treated water for delivery is about 56,000 AFY.

To identify months where there is more user demand than groundwater extraction, the constant extraction and treatment volume was compared to the municipal demands shown in Table 1 with seasonality factors applied. This analysis highlighted monthly gaps between the amount of water produced from the groundwater extraction system and the available demand from both municipal and agricultural users. This excess water available during lower demand months could be used for inland injection or by additional unidentified users. Figure 6 shows the distribution in the demands listed in Table 1 with the annual seasonality factors applied and the approximate volume of treated water available for injection defined as “excess volume available”.

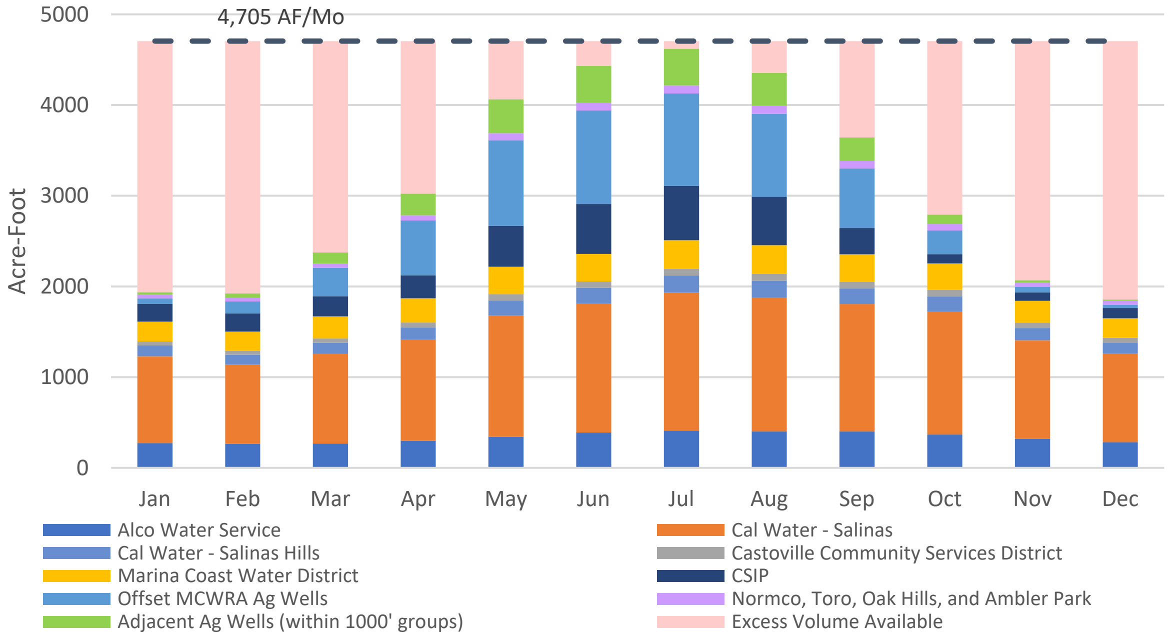


Figure 6 Monthly Demands New Water Produced

1.2 Infrastructure Development

Having the brackish groundwater extraction volumes and the treated water distribution volumes to end users and injection wells, the preliminary sizing and alignments of the brackish and treated water infrastructure could be determined. Referencing the conceptual process flow diagram in Figure 1, the following sections describe the infrastructure development of the extraction and potable water distribution infrastructure which includes the coastal extraction barrier wells, the extracted water pipelines, potable water pipelines, and raw water conveyance infrastructure.

1.2.1 Extraction Well Sites

The extraction well sites would be for the BGRP scenarios only. Each well would be connected to a pipeline leading to a transmission main sent to the treatment facility near Monterey One Water (M1W). The extraction wells have approximate capacities that range between 1,400 gpm and 2,500 gpm. Each well site includes two wells sourced individually into the 180- and 400-foot aquifers. A typical well site shown in Figure 7 was assumed for this study. Sites would utilize either existing agricultural roads for access or small gravel driveways from main roads, depending on the location. Each site would have a building to house electrical, instrumentation, and controls equipment to protect them from the coastal environmental elements such as wind, sand, and salt water. Well sites are assumed to be 100-square feet, would be completely enclosed with a fence for security, and would provide an access gate large enough for operations and maintenance including a well crane truck. The extraction wells mechanical infrastructure is assumed to be typical above ground and well equipping infrastructure. This would include a vertical turbine well pump and motor, with pressure gage, combination air vacuum valves, check valve, flow meter, sampling ports, and all the necessary mechanical couplings and fittings to install the well and fittings. Last, each well site would have a backup emergency generator to continue pumping even during power outages. Note all site components and appurtenances associated with the entire well site would be further detailed in a later design phase.

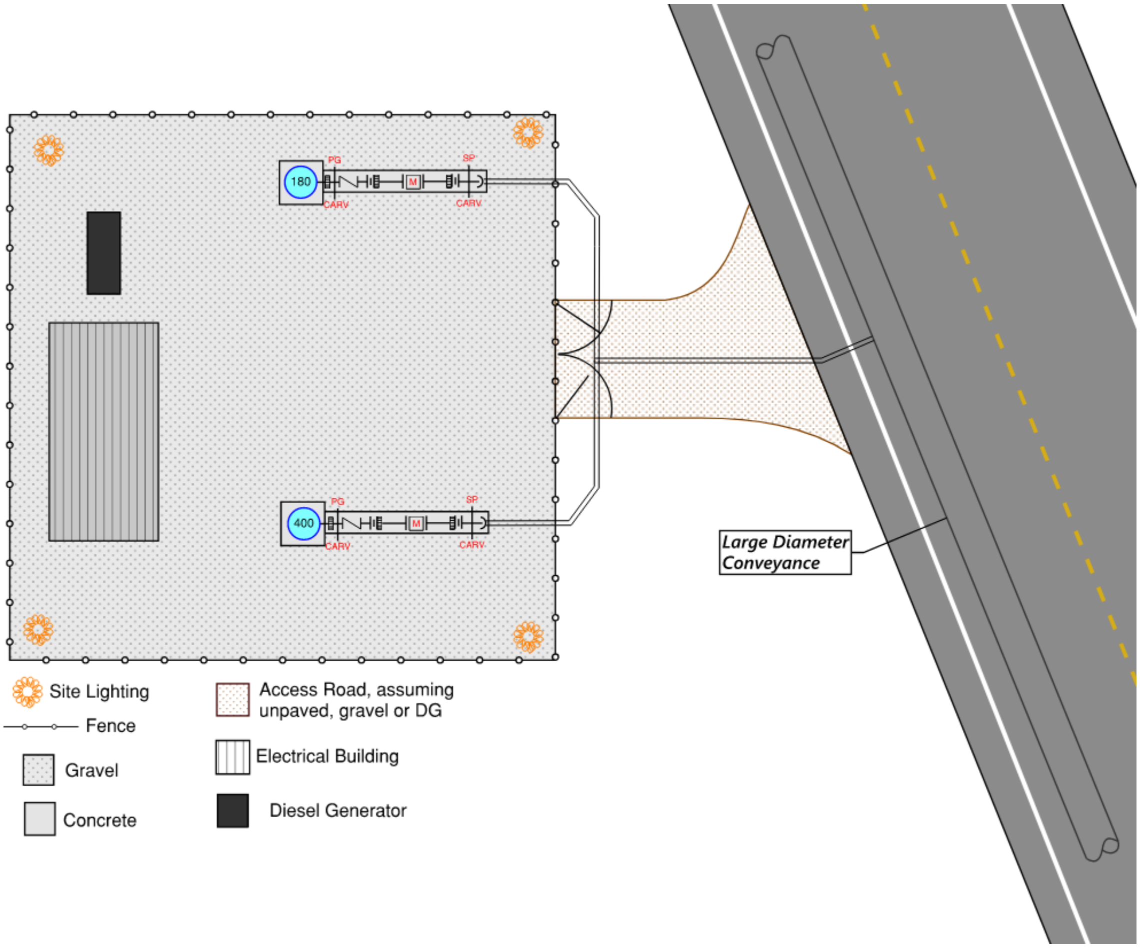


Figure 7 Typical Well Site

1.2.1.1 Extraction Well Conveyance Infrastructure

The extraction well conveyance infrastructure would be for the BGRP scenarios, only. Extraction wells would require a pipeline to convey extracted brackish water to the regional RO treatment facility, which is assumed to be located near the existing M1W Regional Treatment Facility so that reverse osmosis concentrate (ROC) can easily be discharged to the M1W outfall. The layout of the extraction pipeline follows existing developed corridors such as local roads, collector streets, or arterials and avoided parallel alignments within railway and highways as much as possible. Additionally, the extraction infrastructure follows the existing M1W regional collection system infrastructure alignments, where practical, to minimize impacts to undisturbed areas and to potentially share rights-of-way. For this study, the pipeline sizing was dependent on keeping the velocity of the extracted water between three and five feet per second to minimize friction head loss and aimed to keep the pipeline total head loss rate below 10 feet per 1,000 linear feet. The size range of the extraction conveyance infrastructure ranged from 18 to 60 inches in diameter. Figure 8 shows the assumed alignment of the extraction conveyance infrastructure with respect to the seawater intrusion extraction barrier wells and the M1W facility.

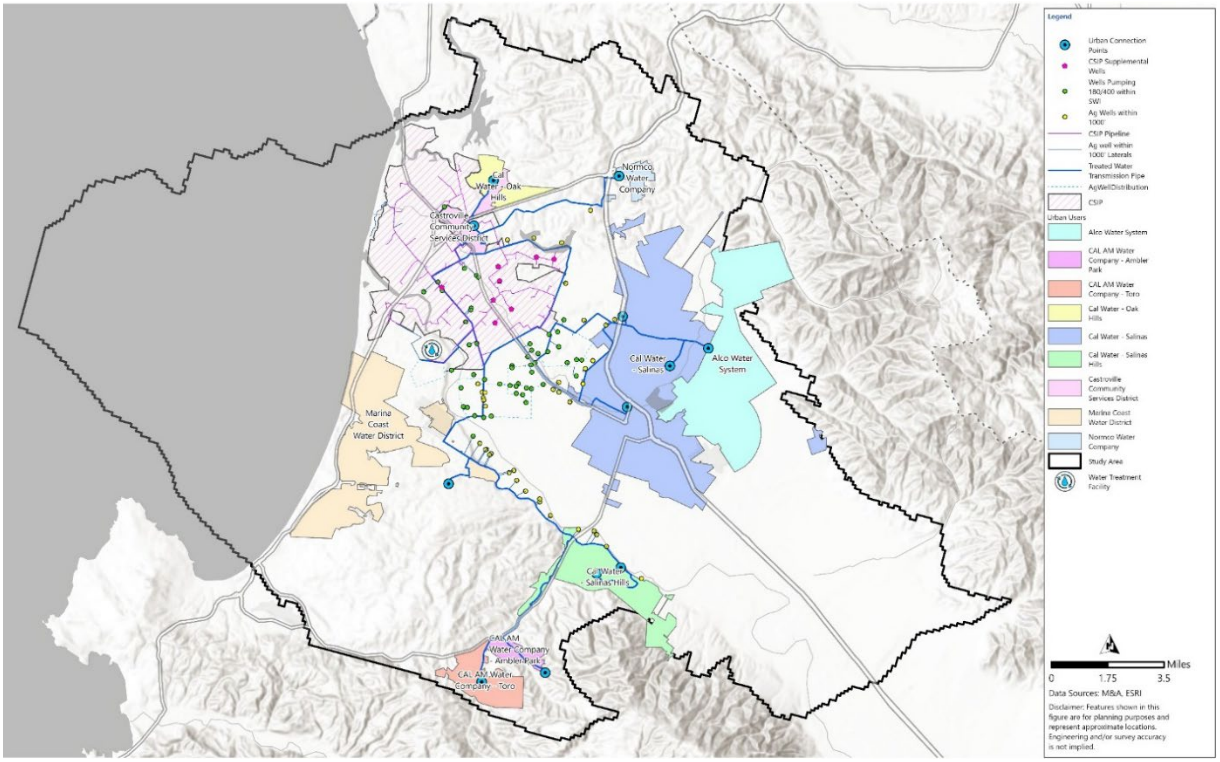
Figure 8 Extraction Well Conveyance Infrastructure

1.2.1.2 Potable Water Distribution Infrastructure

The potable water distribution infrastructure includes linear pipelines that distribute the treated water that would be produced at the treatment facility for the individual alternatives. This treated water would be distributed to either urban users, agricultural end users or injection wells for all alternatives. The same planning level design parameters were utilized in preliminary sizing the potable water distribution piping as the extraction conveyance infrastructure. The treated water flow volumes were based on the average flowrate from the maximum monthly volume (typically July or June, see Figure 3 and 5). Note that all pipe sizes are subject to change with confirmation in end users, seasonality of usage, and detailed design of the facilities in the future.

The treated water infrastructure was also utilized to convey water to the inland injection wells and the connect to the CSIP distribution system at its eastern boundary. Discussions with MCWRA identified a need for additional pressure and distribution points on the east side of the CSIP service area, which presented an opportunity to simultaneously serve potential inland injection barrier wells. The treated water pipelines were routed along local roads and collector streets as much as possible with the goal of avoiding major transportation corridors.

Service to additional agricultural end users not served by the existing CSIP system was also included in the potable water distribution system as optional end users. Agricultural end users were separated into two categories: Those that are within the 2070 simulated seawater intrusion boundary that would need to be offset from groundwater dependence and those that are within a serviceable distance to the treated water distribution system. The latter group was considered to only be serviceable within approximately 1,000 feet of the treated water distribution system and includes all agricultural wells between the Salinas River and Reservation Road, (southern region of the project). These two groups are shown in Figure 9.



Data Sources: M&A, ESRI

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Figure 9 Agricultural Wells Within 180/400 ft Subbasin 2070 Intrusion Zone to be Offset

1.3 Water Quality

Water quality was also considered in the early planning stages of the BGRP. Since the BGRP has a large treatment component, it was necessary to develop a thorough understanding of the existing water quality characteristics of the groundwater to identify any potential process limitations. Water quality data was gathered in a sampling effort from several wells throughout the study area. The water quality information gathered in the sampling efforts was used to define the projected extraction water quality to provide a better understanding of the appropriate treatment technologies and processes needed to produce potable water for the end users. The water quality data was also used to project waste characteristics through ROC, resulting from the treatment processes that would need to be disposed.

1.3.1 Existing Groundwater Water Quality

Two wells from the 180-foot aquifer and six wells from the 400-foot aquifer were sampled in the summer 2023 sampling event. Well locations are shown in Figure 9. The sample results were analyzed for conformance with California Ocean Plan (Ocean Plan) objectives, drinking water MCLs, secondary MCLs, and notification levels (NLs). Table 2 lists a summary of the sampling activities completed for this study.

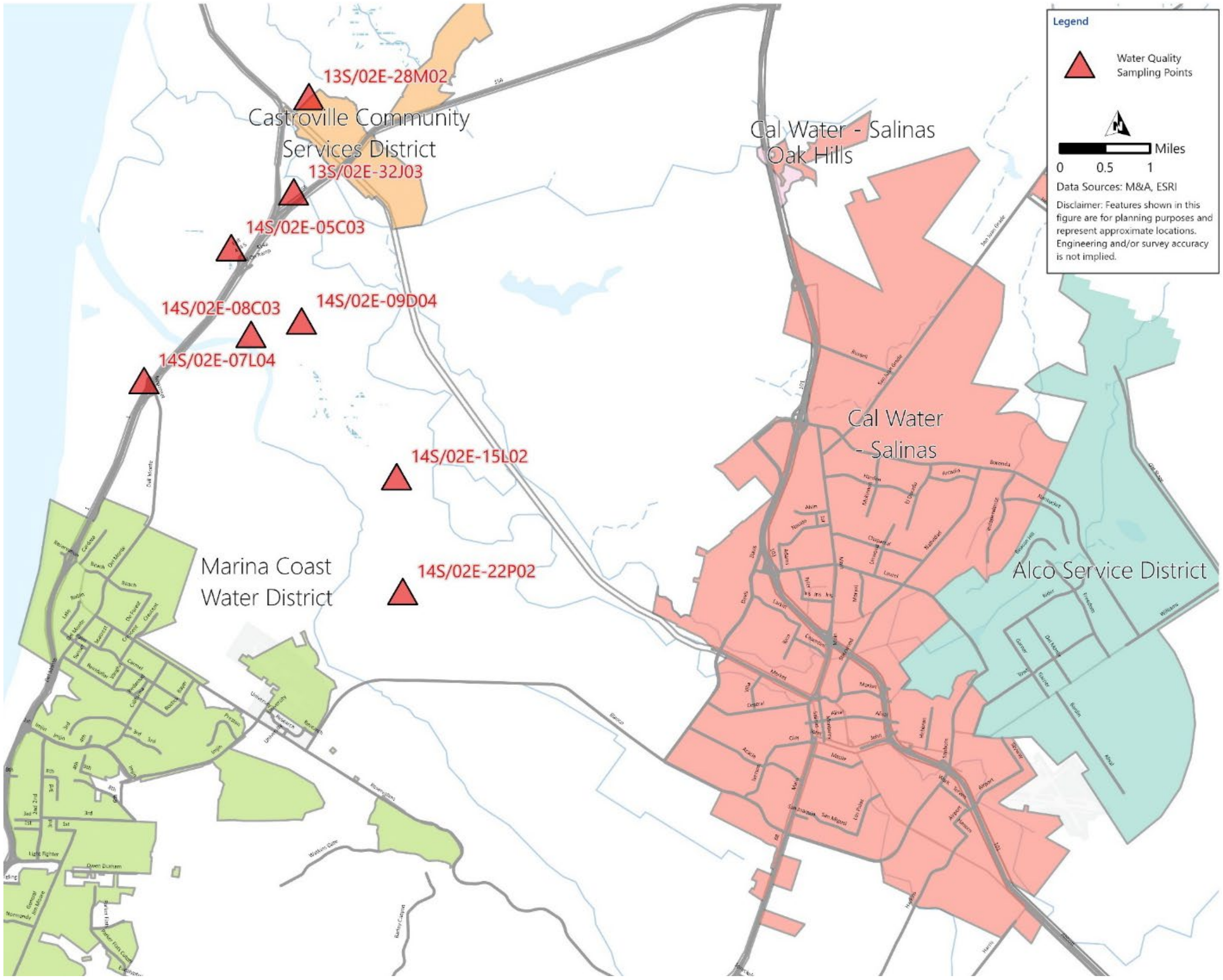


Figure 10 Wells included in Water Quality Sampling

Table 2 Water Quality Sampling Results

Constituent(s)	Sampling Result
Arsenic Thallium	Primary MCL Exceedance
Aluminum Beryllium Chloride Iron MBAS TDS Turbidity	Secondary MCL Exceedance
Bromodichloromethane Chloroform PFBS PFOS	NL Exceeded
4,4'-DDT Aldrin Beryllium Chlordane Dieldrin Endrin Heptachlor Heptachlor epoxide Hexachlorobenzene Nickel Silver Total chlorine Toxaphene Zinc	Violated Ocean Plan Limits

Notes:
DDT - Dichlorodiphenyltrichloroethane; MBAS - Methylene Blue Active Substance; PFBS - Perfluorobutane Sulfonic Acid; PFOS - Perfluorooctane Sulfonate; TDS – total dissolved solids

Ocean plan limits were evaluated to determine potential effects from the waste discharge stream from the treated brackish water. ROC generated from implementation of this project would be sent to the existing M1W outfall. Based on this preliminary water quality analysis, while contaminant levels would be higher in the ROC than the raw feed water, a sufficient amount of dilution would occur in the M1W outfall to allow compliance with the Ocean Plan. Dilution modeling efforts for this project are discussed further below.

1.3.1.1 Projected Water Quality From Model

The groundwater modeling provided predictive chloride concentrations from current day to 2070. For these initial modeling scenarios, the predictive chloride concentrations from 2030 and 2070 paired with the sampling data were utilized to predict other water quality parameters. The 2070 future water quality was used to assess the treatment type needed to utilize the extracted water for both agricultural and urban uses.

The following steps were taken to analyze the lab data and modeling data to arrive at reliable input into the treatment modeling software:

1. Each model scenario has a different volume of water extracted from the 180-foot and 400-foot aquifer. For each scenario, a blend of "current day" water quality was created using the sampling data and weighing the water quality by the volume pumped from each.
2. Using the current day blended water quality, typical seawater quality data, and predictive chloride concentrations from the groundwater model, a future water quality was calculated. The predictive chloride concentration was used as a benchmark to determine the percent blend of current day groundwater and seawater, mimicking the level of seawater intrusion predicted to occur in the relevant year (2030 or 2070). For example, a typical seawater chloride concentration is about 20,000 mg/L. If the current day chloride concentration is 500 mg/L and the 2030 modeled chloride concentration is 15,000 mg/L, then the modeled water is about 75 percent seawater based on a weighted average. Thus, the future water quality consists of 75 percent of seawater quality and 25 percent of current day groundwater water quality.

This future water quality was then input into treatment modeling software as the raw water quality to assess appropriate treatment design. In this case, assuming RO as the selected treatment technology, anticipated RO permeate and concentrate water qualities were able to be determined for comparison with regulatory objectives.

1.3.1.2 Surface Water Quality

Water quality data from the CSIP system were provided from three different locations. CSIP uses tertiary effluent from Salinas Valley Reclamation Project (SVRP) mixed with filtered Salinas River water from the Salinas River Diversion Project (SRDF) facility to provide agricultural irrigation water to farmers within the CSIP service area. The three different locations were the 80 acre-foot storage pond at M1W, SRDF (Salinas River) water, and SVRP System. Table 3 shows a summary of the CSIP quality data between 2019 and 2023.

Table 3 CSIP Water Quality Summary

Year	Pond			SRDF			SVRP Eff		
	Nitrate (mg/L)	Chloride (mg/L)	TDS (mg/L)	Nitrate (mg/L)	Chloride (mg/L)	TDS (mg/L)	Nitrate (mg/L)	Chloride (mg/L)	TDS (mg/L)
2019	16.5	148	634	26.6	60	460			
2020	22.1	179	761	23.6	56	476	16.8	293	964
2021	16.5	162	652	9.1	44	369	12.0	283	938
2022							12.7	327	928
2023	13.0	126	524	11.7	42	363	12.8	298	908

1.3.2 Treatment, Outfall Options, and Selection

The scenarios that were carried forward required some type of treatment facility to meet reclaim water requirements for either groundwater injection, agricultural irrigation, or drinking water. The following sections present the treatment evaluation for all the projects considered.

1.3.2.1 BGRP Treatment Selection and Evaluation

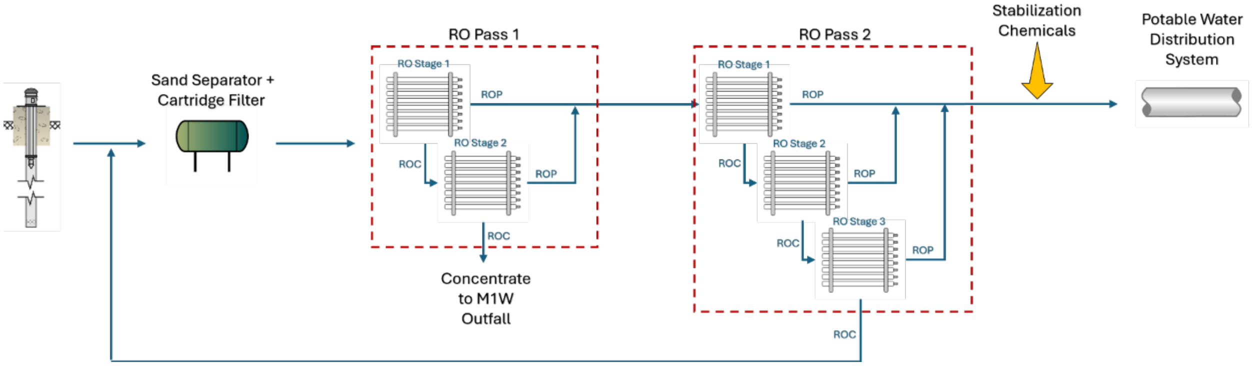
Brackish water treatment technology can be performed by multiple different methods. The technology selection for this study was RO due to its typical use in brackish and ocean water treatment applications. RO utilizes cartridge membranes under pressure with extremely small openings to filter out constituents. RO has two products as result of this process, permeate which is the potable product water that is filtered and ROC which is the non-filtered water with accumulated level of constituents. The ROC is sent to a disposal point, such as an ocean outfall pipeline. The RO treatment facility would receive the extracted water from the seawater intrusion extraction barrier wells. Feed water would be treated through a two-pass, multiple stage RO system to ensure compliance with permeate water quality targets.

The RO configuration was determined based on several parameters: desired recovery, influent flow rate, feed and concentrate pressures, membrane fluxes, and required permeate water quality.

The future groundwater quality determined using the methods previously described were input into an RO membrane design software as the feed water quality to obtain projections for the required RO configuration and permeate water quality. For each alternative, separate RO models were created based on 2030 and 2070 future water quality to verify that the permeate water quality would comply with all regulatory limits over the life of the project. Projection models were based on a first pass permeate flow of 1 mgd and a second pass permeate flow of 0.9 mgd for the entire RO system and scaled up to the correct flow rates upon completion.

The RO permeate water quality was assessed to ensure compliance with the drinking water MCLs, secondary MCLs, NLs, and the Central Coast Basin Plan. RO design was mainly governed by the Basin Plan boron limit of 0.2 mg/L for groundwater in the 400-foot aquifer, where injection of RO permeate water is potentially to occur. In order to reach this boron limit with a sufficient factor of safety, a second pass of RO would be required in which 100 percent of the first-pass RO permeate would go through a second pass of RO. All other water quality objectives would be met with the two-pass configuration. The combined permeates from the second pass stages would be properly stabilized before conveyance for end uses using lime, carbon dioxide, and sodium hypochlorite to maintain a chlorine residual.

The first pass of RO would use seawater RO membranes due to the high salinity of the future groundwater. Seawater membranes can typically achieve a maximum recovery of 60 percent. To maximize the water available for the various project end uses, a 2-stage configuration was employed for the first pass to achieve a 70 percent overall recovery through pass one. The second pass of RO would be a three-stage system to achieve 90 percent recovery, which is typical for brackish RO systems. Concentrate from the second pass of RO would be recycled to the influent of the first pass of RO, meaning that the effective recovery of the entire RO system would not change from 70 percent with the addition of the second pass. Thus, the concentrate sent to the ocean outfall would be only from the first pass of RO. The proposed treatment train for the RO system is shown in Figure 11.



ROC = Reverse osmosis concentrate; ROP = Reverse osmosis permeate

Figure 11 RO Process Train

Outfall Evaluation

A mixing zone evaluation was completed for the existing M1W ocean outfall and diffuser to determine if it had adequate capacity to properly dispose of the small, medium, or large project ROC. The project treatment technology would produce a brine (or ROC) that is the by-product of the potable water production through reverse osmosis. Disposing brine from the brackish groundwater desalting processes through the existing M1W outfall is the most cost-effective means. The existing M1W regional wastewater treatment plant currently uses an ocean outfall with a diffuser section approximately 9,892 feet from shore. This diffuser includes a 1,360-foot diffuser at the end of the outfall pipeline with 129 open ports and 39 closed ports. M1W produces disinfected tertiary treated recycled water for agricultural irrigation and advanced purification water for groundwater injection (indirect potable reuse) through the Pure Water Monterey Groundwater Replenishment Project which involves treating secondary effluent through an Advanced Water Purification Facility (AWPF) and then injecting this highly purified recycled water into the Seaside Groundwater Basin. The AWPF produces a ROC that is discharged with excess M1W secondary effluent through the outfall diffuser into Bay. The brine produced by the BGRP is expected to be denser than the ambient ocean water. Due to the lower dilution and ammonia concentration of the denser commingled discharge, Ocean Plan water quality compliance would require M1W's ocean outfall to be configured differently.

Currently, Cal American Water Company and M1W are evaluating the proposed MPWSP Desalination (Desal) Facility brine discharge to determine the necessary project and outfall modifications to ensure that the brine produced by their ocean desal facility is adequately mixed and diluted to achieve Ocean Plan objectives. As with the Project brine, the MPWSP Desal Facility brine will be denser than the ambient ocean, so the discharge from the M1W diffuser may be more dense or less dense than the ambient ocean depending on the ratio of MPWSP brine commingled with M1W discharge (and any future Brackish Groundwater Restoration Project brine).

The MPWSP Desal Facility and the Brackish Groundwater Restoration Project are not expected to begin operating at the same time, therefore in the circumstance that MPWSP Desal Facility and M1W are the sole users of the outfall, an evaluation was performed to determine if a different configuration of diffuser modifications is required if only M1W and the Brackish Groundwater Restoration Project were the sole users of the outfall. The outfall evaluation concluded that same diffuser modifications for the latter scenario (with only M1W and the BGR Project) is also acceptable to meet Ocean Plan limits if all three agencies (M1W, MPWSP, and BGR) were simultaneously using the ocean outfall. M1W has informed the

SVBGSA, that MCWD has indicated that they would like to also use the ocean outfall in the future, however the details of this use are currently unknown, therefore was not analyzed as part of this study.

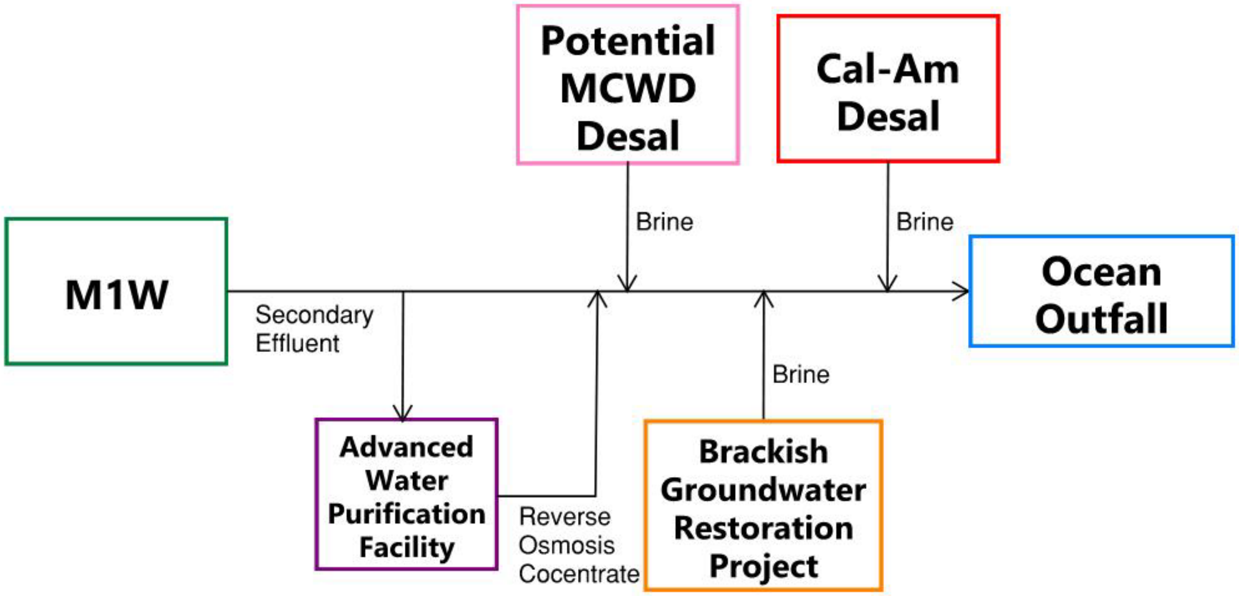


Figure 12 Potential Discharges to M1W Outfall

Reconfiguration of the M1W diffuser is necessary to ensure discharge of commingled brine complies with Ocean Plan water quality objectives. The current configuration of the diffuser set along the ocean floor has 129 horizontal ports, resulting in dense discharge receiving little dilution in the time it falls to the ocean bottom. The existing M1W diffuser has 129 open ports with attached Tideflex Series 35 Hydraulic Code (HC) 61 “duck bill” check valves discharging horizontally. There are 42 ports currently plugged. The benefit of the Tideflex valves is during periods of zero flow, they close which prevents intrusion of ocean water and organisms into the diffuser. Additionally, as the discharged flowrate increases the valves open progressively wider which produces a higher discharge velocity than would occur with a solid fixed port.

To increase dilution of brine discharges the number of open ports will be increased to 158 and the horizontal HC35 Tideflex valves will be replaced with HC24 Tideflex valves that angle 60 degrees upward. The inclined ports direct the dense brine up into the water column providing dilution as the momentum from the discharge is dissipated, and the plume receives additional dilution as it falls back to the ocean floor and collapses. The outfall diffuser modifications required for this project would include adding 60-degree elbow diffuser ports with rubber duckbill check valves to the ports to achieve the appropriate discharge velocities necessary to reach the dilution ratio set in the Ocean Plan. Additional major findings of the outfall evaluation included:

- The same outfall diffuser modifications for the small, medium and large alternatives would comply with water quality objectives with or without the Cal-Am Desal Facility brine and with or without any flow in the outfall from the M1W Secondary discharges or AWPF RO concentrate.
- Once modifications are made to the diffuser for the BGR project, if all three facilities (M1W, BGRP and MPWSP) are using the M1W ocean outfall the Ocean Plan requirements can be met. The Ocean Plan limits can also be met with any of the projects operating independently (not in combination).

The dilution modeling determined the dilution over the spectrum of potential commingled flows to find the critical D_m(s) for permitting. The D_m evaluation is performed for critical scenarios of the commingled flowrates, including: 12 levels of secondary effluent flowrates, the AWPF ROC off (0.0 mgd) or at maximum flowrate (1.78 mgd), and no MPWSP brine (0.0 mgd) and maximum flowrate of MPWSP brine (8.66 mgd). These scenarios were run through the dilution modeling commingled with SVBGSA brine from the small, medium (which is similar size to the Injection Only scenario), and large Project alternatives. Each combination of commingled flow is modeled for each of the three ocean conditions. These model runs span the possible commingling combinations and are all assessed in a water quality analysis to ensure compliance with water quality objectives.

Figures 13 and 14 show the range of flows and the estimated critical D_m(s) that would be achieved. As the figure shows, the solid lines indicate the required dilution to meet Ocean Plan requirements, and the dots represent the modeled dilution. All scenarios, with the proposed outfall diffuser modification, can meet the water quality objectives in the Ocean Plan.

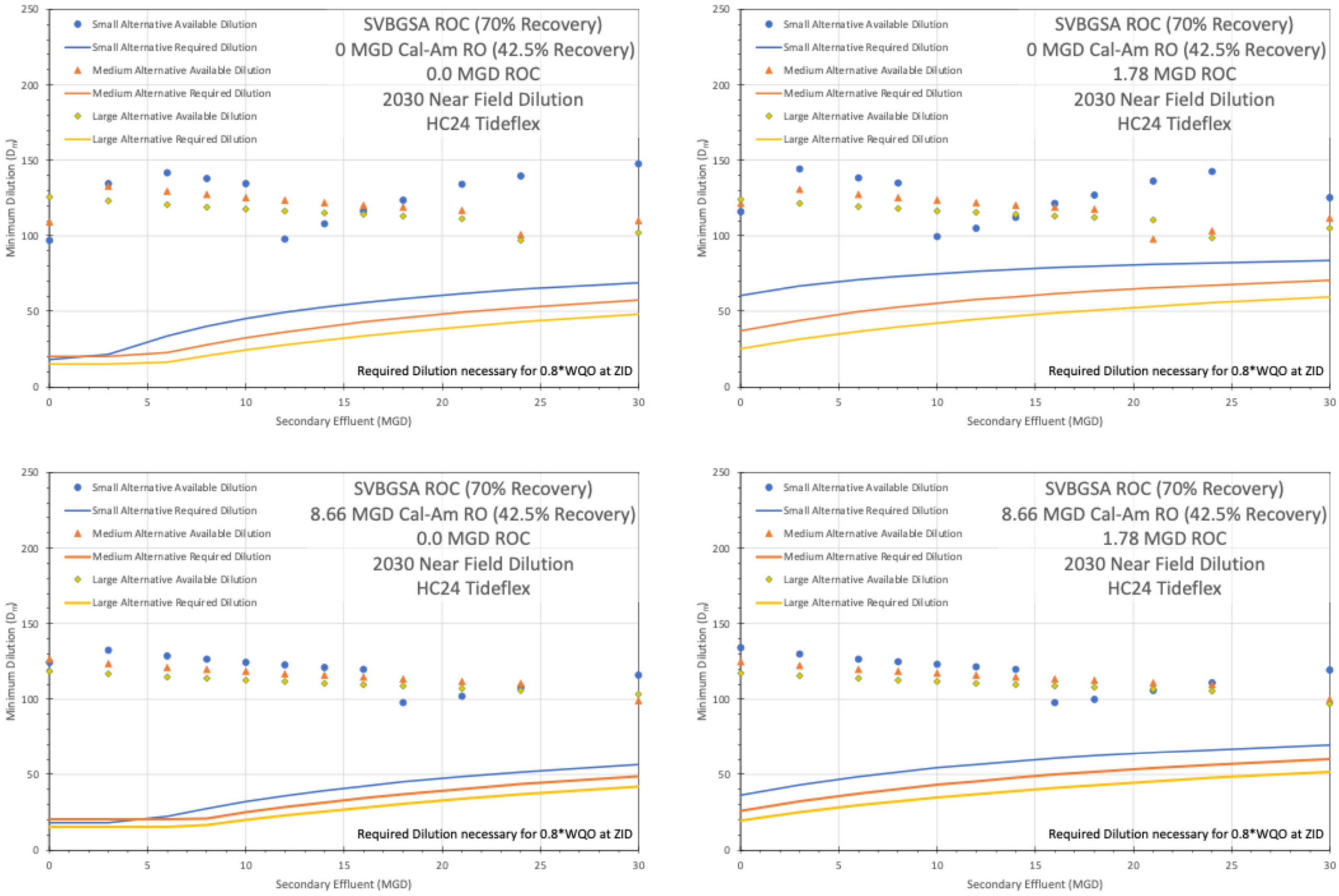


Figure 13 Critical D_m summary for 2030 groundwater conditions plotted by secondary effluent flowrate

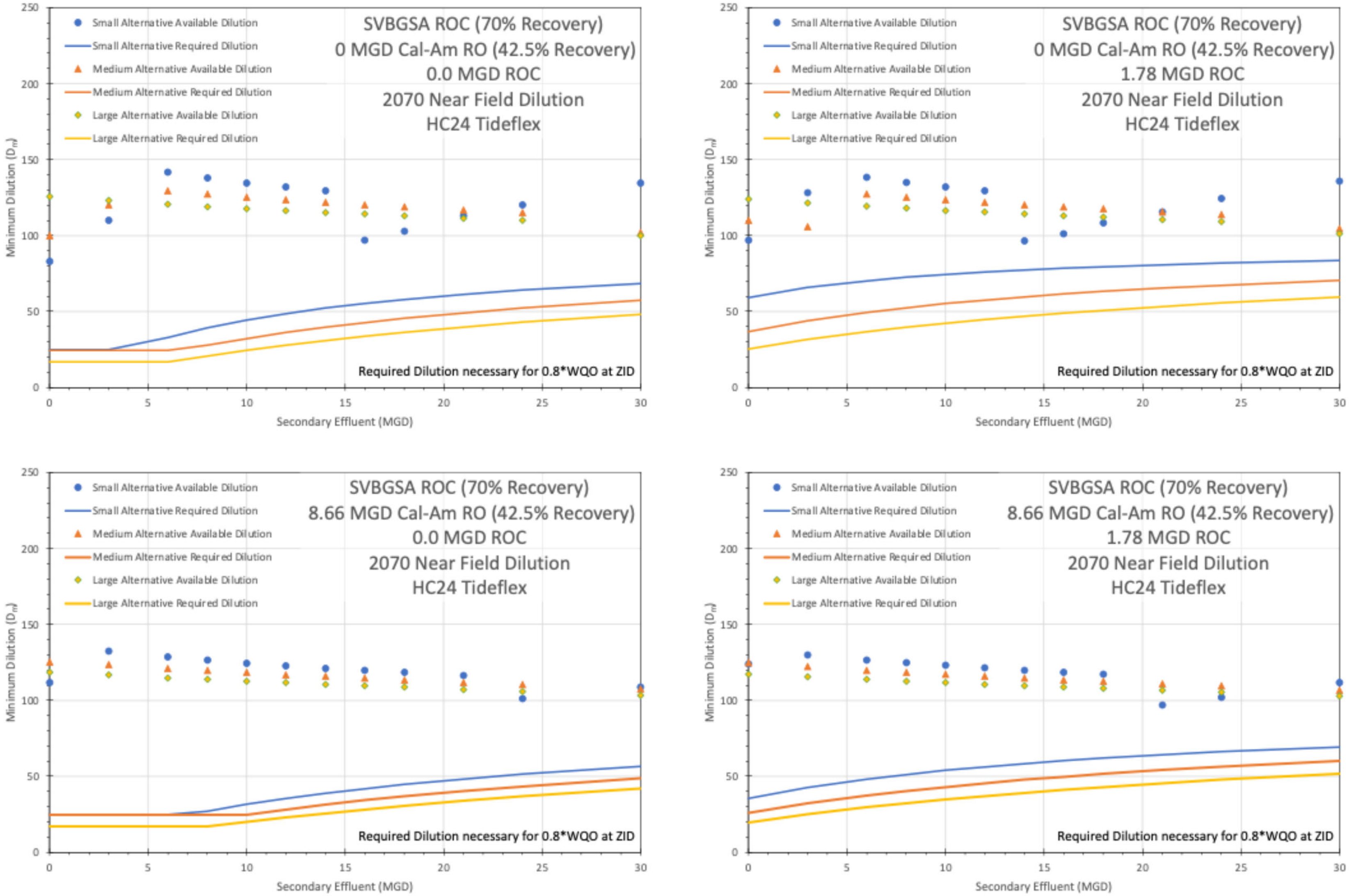


Figure 14 Critical D_m summary for 2070 groundwater conditions plotted by secondary effluent flowrate