Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

EXECUTIVE SUMMARY

DRAFT FINAL | November 2022

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

EXECUTIVE SUMMARY

DRAFT FINAL | November 2022

This document is released for the purpose of information exchange review and planning only under the authority of Andrew Thomas Salveson, November 14, 2022, California C-56902.

Contents

Tables

Figures

Abbreviations

AACE International	Association for the Advancement of Cost Engineering
AF	acre-foot
AFY	acre-feet per year
ADWF	average dry weather flow
AOP	advanced oxidation process
AWPF	advanced water purification facility
AWTO	advanced water treatment operator
BAC	biologically active carbon
CAPP project	Carpinteria Advanced Purification Project
Carollo	Carollo Engineers, Inc.
CAS	conventional activated sludge
Cater WTP	William B. Cater Water Treatment Plant
CCI	construction cost index
City	City of Santa Barbara
CSD	Carpinteria Sanitary District
DAF	dissolved air flotation
CVWD	Carpinteria Valley Water District
DPR	direct potable reuse
ENR	*Engineering News-Record*
EQ	equalization
GIS	geographic information system
GSA	groundwater sustainability agency
IPR	indirect potable reuse
MBR	membrane bioreactor
MG	million gallons
mgd	million gallons per day
MSD	Montecito Sanitary District
MWD	Montecito Water District
NGO	non-governmental organization
NPDES	National Pollutant Discharge Elimination System
NPR	non-potable reuse
O&G	oil and grease
O&M	operations and maintenance
PWWF	peak wet weather flow

RO	reverse osmosis
ROC	reverse osmosis concentrate
RWA	raw water augmentation
Santa Barbara	City of Santa Barbara
SSD	Summerland Sanitary District
TM	technical memorandum
TWA	treated water augmentation
UF	ultrafiltration
UV	ultraviolet
WRP	water reclamation plant
WTP	water treatment plant
WWTP	wastewater treatment plant

EXECUTIVE SUMMARY

ES.1 Introduction

The purpose of this project is to provide the Montecito Sanitary District (MSD) and the Montecito Water District (MWD) with clear direction for implementation of water reuse. Implementation of water reuse will produce a new local drought-proof water supply for the community and reduce the discharge of treated wastewater to the ocean. Previously, MWD completed a Recycled Water Facilities Plan in 2019 that identified top potential uses of recycled water along with recommended next investigative steps. This new collaborative project, contracted in partnership with MWD and MSD, builds on the previous effort by, evaluating regional partnerships and developing next steps, as well as incorporating updated information, such as the State of California's draft direct potable reuse (DPR) regulations[1].

The project also contains a "mini" master plan for the MSD wastewater treatment plant (WWTP), evaluating flows, capacity, upgrade/replacement needs, and costs. Such analysis is a crucial part of this recycled water analysis, providing valuable information on the long-term viability of the MSD WWTP.

Four distinct approaches to identify the preferred method of pursuing wastewater reuse were evaluated. The analysis considered local and regional partnerships, non-potable and potable reuse alternatives, and various treatment methods and technologies. The project concepts included in the study are as follows:

- **Montecito Non-Potable Reuse (NPR)** – local project producing tertiary quality water for irrigation of large commercial and institutional landscapes in Montecito.
- **Carpinteria Indirect Potable Reuse (IPR)** – regional project partnering with neighboring special district(s) and the use of the Carpinteria Groundwater Basin.
- **Montecito DPR** – local project in Montecito utilizing treatment at MSD and either raw water augmentation (RWA) at the MWD water treatment facility or treated water augmentation (TWA), both forms of DPR.
- **Santa Barbara DPR** – regional project partnering with the City of Santa Barbara (Santa Barbara) involving RWA at the William B. Cater Water Treatment Plant (Cater WTP).

The location of relevant regional facilities with potential for inclusion are shown in the map below. Note that Summerland Sanitary District (SSD), while shown on the map, is not part of any particular project detailed herein, but could be incorporated into a regional option.

[1] The State of California's State Water Resources Control Board is mandated by law to develop DPR regulations by the end of 2023. Current draft versions, as of August 2021, are very detailed and allow for proper evaluation of DPR for this project.

ES.2 Regional Partners

Collaboration with regional partners was essential for this project, specifically from Santa Barbara, the Carpinteria Valley Water District (CVWD), and the Carpinteria Sanitary District (CSD). At specific points in the project, representatives from these agencies met with project team staff, reviewed concepts, and provided comments. Comments from these agencies were incorporated into this document, where possible. The participation of these agencies is appreciated.

We do note that findings in this study that include these agencies do not indicate "approval" from these agencies for a particular project. Any regional project that comes out of this effort will require continued dialogue and formal agreement.

Figure ES.1 Regional Wastewater and Water Treatment Map

ES.3 Summary of Technical Memoranda

This project consisted of nine technical memoranda (TMs) (all attached as appendices to this document) that were used to conduct analysis and develop the information needed to assess the four reuse project concepts described above as well as the "mini" master plan for MSD.

- **TM 1: MSD Flow and NPDES Permit Analysis -** This TM reviewed current and anticipated wastewater flows to establish relevant flows for facility sizing. It also evaluated the minimum flow required to keep the outfall operational based on the National Pollutant Discharge Elimination System (NPDES) permit for effluent discharge. Key findings include:
  - As documented in TM 1, the average dry weather flow (ADWF) is 0.62 million gallons per day (mgd), based on data from 2017 to 2019. Flows from 2022 have been slightly lower, about 0.4 mgd, with some users offline. The future ADWF is estimated to be 0.7 mgd. It is important to note that future flows may be impacted by conservation.
    - Includes potential septic to sewer conversions within Montecito.

- Equalization (EQ) would be needed depending upon the potential project application.
  - Small EQ[2] of tertiary effluent is needed for NPR in Montecito to meet diurnal NPR demands.
  - EQ of secondary effluent for the ADWF is needed for potable reuse project options in order to provide constant flow to the membranes.
  - EQ of raw wastewater would be needed for one Santa Barbara potable reuse option and for any option that includes a new membrane bioreactor (MBR) at MSD.
  - The maximum anticipated EQ volume for future peak wet weather flow (PWWF) that would be needed is estimated to be 2.7 million gallons (MG).
  - There is available space for EQ at MSD.
- An analysis of future ocean discharge was conducted in which anticipated future discharge qualities were compared with existing NPDES[3] and Ocean Plan requirements. Based on this analysis for the reuse alternatives considered, and anticipating that future dilution credits through the outfall will increase as flows decrease, there are no anticipated significant issues with future discharge through the outfall.

- **TM 2: CSD and Santa Barbara WRP Capacity -** TM 2 reviewed historical wastewater flows for both CSD and Santa Barbara to establish available capacity to accept raw wastewater from MSD. Key findings include:
  - The CSD water reclamation plant (WRP), could accommodate 0.7 mgd of additional flow for 99 percent of hours based on data from the past year.
    - Such a potential addition of flows to CSD would essentially utilize all existing capacity and would likely trigger a WRP expansion.
    - MSD would need to buy into the CSD facility, paying for the as-built capacity of the facility proportional to the flow delivered, which would be approximately 1/3 of the total flow.
    - EQ of MSD flow would be needed for any CSD collaborative project, the amount depends upon the type of project.
      - For a project sending raw wastewater to CSD, all MSD flow (including PWWF) would need to be equalized.
      - For a project sending secondary effluent to CSD, only the ADWF of 0.7 mgd would need to be equalized. Flows exceeding the EQ capacity, such as wet weather flows, would be treated similar to current operation and discharged through the MSD outfall.

---

[2] "Equalization" and "storage" can be used interchangeable in this Executive Summary. Both provide the same function.

[3] The NPDES permit was renewed in 2022 with no major changes from the previous permit.

    - Santa Barbara's El Estero WRP could accommodate a range of flow from MSD, ranging from an equalized ADWF to potentially all flow without EQ at MSD. Flows could be either raw wastewater or MSD secondary effluent.
        - If flows were not equalized at MSD, EQ would be needed at El Estero WRP.
        - EQ of MSD flows at MSD would reduce transport pipeline capacity requirements while minimizing impact to El Estero WRP capacity.
        - Flows from MSD, if added at the proper times, could help El Estero WRP have a larger minimum flow for treatment while also providing more water for Santa Barbara's NPR program.
- **TM 3: Condition Assessment -** This TM presented condition assessment results from an onsite assessment at the MSD WWTP. Structural, electrical, and process engineers, working with MSD engineering and operations staff, determined the current condition of assets at the WWTP to support this project.
    - Electrical assets were the only assets that scored in very poor condition, and most of these assets are planned for replacement in an upcoming Electrical CIP project.2022-2023.
    - As noted in TM 3, there are many assets that are doing well and need only minimal repair.
    - Repairs and replacements, ranging throughout the WWTP for nearly all process areas, were categorized into Urgent (0-2 years), Priority (3-5 years), Short Term (6-10 years), Mid-Term (11-20 years), and Long Term (20+ years).
- **TM 4: Evaluation of MSD WWTP Performance and Capacity -** This TM provides a description of the existing MSD WWTP, an evaluation of the WWTP process performance, and a capacity assessment of the WWTP.
    - For each unit process, performance was assessed relative to typical anticipated performance. This evaluation provided a benchmark for assessing unit process capacity.
    - The capacity evaluation showed that all processes meet the projected ADWF of 0.7 mgd. The permitted capacity of the plant is 1.5 mgd.
- **TM 5: Cost for Rehabilitation and 30-Year Operations -** This TM used results from the condition assessment (TM 3) and the performance and capacity evaluation (TM 4) to develop a prioritized capital improvement plan and operating costs for MSD over the next 30 years.
    - MSD will need to implement an estimated $7.75 million of capital improvements over the next 30 years to maintain current treatment and operations at the plant, of which approximately $3 million will occur within the next 10 years.
- Additional studies are recommended to further evaluate several process areas (aeration basins, clarifiers, select buildings, and the ocean outfall) that could result in the need for additional capital investments.
- **TM 6: Cost for MBR Construction and 30-Year Operations -** This TM evaluates the implementation of an MBR treatment system, which is a biological wastewater treatment process that can replace conventional activated sludge (CAS) and secondary clarification in a smaller footprint and produce consistent, high-quality effluent. The TM evaluates two alternatives to replacing MSD's existing secondary treatment facilities: constructing a new MBR facility on undeveloped land, commonly referred as

"greenfield" (Alternative 1), or constructing a new MBR facility via retrofitting the existing secondary process infrastructure (Alternative 2).

- Alternative 1: A greenfield MBR facility would require several new structures that could be built in the open area on the western end of the WWTP property.
  - This facility could be constructed without disruption to existing treatment and operations and would not need to be replaced within the 30-year planning period.
  - Components of the MBR are "right sized" due to the use of all new tankage.
  - Most of the concrete infrastructure that would be abandoned for a new Greenfield MBR can be re-purposed as part of several of the recycled water project concepts.
- Alternative 2: Existing treatment structures could be retrofit to fit the new bioreactor and membrane tanks, maximizing the use of existing concrete infrastructure.
  - Components of the MBR may not be optimally sized due to the use of existing tankage.
  - Based on the condition assessment results, concrete repair would likely be required.
  - These structures would likely need to be replaced within the 30-year planning period.
  - There is significant added constructability challenges and complexity because the plant would need to continue to operate while converting existing infrastructure to an MBR.
- Estimated construction and operations and maintenance (O&M) costs are similar for the two alternatives.
- See Section ES 4.1 below for key cost assumptions.

- **TM 7: O&G Treatment at MSD –** Oil and grease (O&G) can impact membrane treatment systems. Accordingly, a review of historical O&G data from the MSD WWTP was performed ,and it was determined that additional O&G treatment is needed for non-MBR-based potable reuse options to protect downstream membranes. Two alternatives for O&G removal were analyzed: primary and secondary dissolved air flotation (DAF).
  - The MSD historically meets the NPDES requirements for O&G, but is not designed for the robust O&G removal needed to protection the membranes that are part of many of the reuse treatment trains.
  - Cost estimates indicate that the secondary DAF alternative treating the ADWF of 0.7 mgd is significantly less expensive than a primary DAF treating 100 percent of MSD WWTP influent flow.
  - Bench and pilot testing is recommended prior to implementing a DAF for O&G removal.

- **TM 8: Recycled Water Treatment Options at MSD -** This TM looked at potential treatment trains for all four reuse project concepts. It provides treatment train design criteria, layouts, and estimated costs for each option.
  - A reuse facility at MSD (non-potable or potable) could be located in the open area at the westerly end of the plant.
  - There is room for a new MBR, a new advanced water purification facility (AWPF), and new EQ at MSD.
  - For a regional project with Santa Barbara, the AWPF would be located near the Santa Barbara El Estero WRP, at the existing corporation yard (per Santa Barbara's existing potable reuse plans).
  - For a regional project with CSD, the AWPF could be located at MSD or located at the CSD WRP. Expanding the AWPF at CSD to accommodate the additional flows from MSD may be challenging due to space constraints.
  - Water reuse of MSD flows is maximized for any potable water reuse project, but reduced by ~75 percent for NPR due to limited number of potential customers and seasonal recycled water demand.
  - Costs are directly impacted by scale.
    - A joint project with Santa Barbara has a larger economy of scale and thus reduced costs per gallon produced.
    - A joint project with Carpinteria has a smaller economy of scale for treatment and thus higher relative costs per gallon produced than the Santa Barbara option.
    - A Montecito only project for NPR is the smallest project due to limited demand for NPR water and achieves no economy of scale and thus higher unit cost.
    - A Montecito only project for potable reuse has an improved economy of scale compared to NPR due to larger water production, but smaller economy of scale than Carpinteria or Santa Barbara options.
  - Total costs for treatment systems range from $9 million for a NPR system to $112 million for a large project at Santa Barbara. The portion of the total treatment costs that would be borne by Montecito are provided in Table ES.1.
- **TM 9: Distributed Infrastructure Analysis -** This TM developed distributed infrastructure alternatives for all reuse project concepts. Infrastructure components include pipelines, pump stations, storage, and various pipeline crossings (highway, railroad, and creek)[4]. This TM also examined the potential NPR opportunities through engagement with potential customers.
  - Multiple pipeline alignments were developed for each project concept, with a recommended alternative identified for each.
  - Costs are directly impacted by proximity of the MSD WWTP to other project partner facilities.
    - A joint project with Santa Barbara has less pipeline infrastructure compared to other options.
    - A joint project with Carpinteria has longer pipeline infrastructure, increasing project costs.

[4] The cost for injection wells for the Carpinteria IPR options is included in the treatment costs in Table ES.1 and Table ES.2.

    - A Montecito only project for NPR would require fairly extensive infrastructure to transport a relatively small amount of recycled water to various customers, increasing project costs.
    - A Montecito only project for potable reuse has options for shorter pipeline infrastructure compared to a Carpinteria option.
  - The costs for distributed infrastructure are significant, ranging from $8 million to $37 million.
  - Customer assessments were conducted for the three "anchor" customers (i.e., Birnam Wood Golf Club, Santa Barbara Cemetery, and Valley Club Montecito) to better estimate recycled water use at each site.
  - Customer usage projections for the golf courses were difficult to estimate from potable water use records due to their use of on-site groundwater wells. Also, the golf courses have implemented over the last several years conservation measures, such as turf replacement to reduce irrigation demand.
  - The previous 2019 Recycled Water Feasibility Plan assumed groundwater use from all customers could be offset by recycled water use. From the customer surveys it is now understood that recycled water would augment groundwater use. This is primarily driven by cost.
  - Lower total irrigation demand combined with only offsetting potable water use created a lower recycled water demand than previously estimated and results in a higher unit cost for NPR.

ES.4 Mini Master Plan

One goal of this project was to provide a "mini" master plan of the MSD WWTP. The mini master plan served to document the performance and necessary upgrades to maintain the wastewater treatment facility into the future to support a recycled water project. TMs 1, 3, 4, 5, and 6 summarize all aspects of the master plan analysis, including flows, treatment capacity, a condition assessment, costs for upgrades, and an evaluation of full replacement with a new MBR.

Regarding the MSD WWTP performance, condition, and rehabilitation needs:

- In terms of capital spending, it is estimated that MSD will need to implement $7.7 million of capital improvements over the next 30 years to maintain current level of treatment and operations at the plant. Approximately $3 million will occur within the first 10 years.
- The plant has sufficient capacity for the projected future 0.7 mgd ADWF.

Regarding full replacement of the MSD WWTP with a new MBR:

- The replacement of the existing MSD WWTP with an MBR is costly, in the $30 million range for either a retrofit or greenfield construction. Recent permitting of a PWWF bypass at Morro Bay for their MBR could also be applied to a Montecito project, resulting in an estimated $8 million in cost reduction for this option due to reduced EQ needs.

- Maintaining the existing MSD WWTP level of treatment as is would allow for a NPR project, but would not be sufficient to support the implementation of potable reuse without modification.
- Although implementing an MBR is expensive, it provides several benefits for a potable reuse project. MBR effluent is generally consistent and high-quality, which leads to better performance of downstream advanced treatment processes. MBRs can also provide reliable treatment in a small footprint. As it takes the place of two existing treatment processes, CAS and secondary clarification; it also reduces the total number of processes to operate.

Regarding the alternative to an MBR:

- An MBR is not the only way to achieve the water quality needed for potable reuse; the alternative entails the addition of DAF and membrane filtration (ultrafiltration (UF)) following the existing MSD WWTP to attain the same water quality as an MBR. The cost of this option as compared to the MBR cost would include the full rehabilitation of the existing MSD WWTP, along with the addition of DAF and UF. These costs are less than half the costs for MBR, as follows:
  - Full Rehabilitation - $7.7 million.
  - DAF – $1.4 million.
  - UF - $4.6 million.
  - Total cost of $13.7 million.

The capital costs favor the status quo (keeping the existing facility and adding DAF and UF). The operational costs for MBR are similar to the costs of operating the existing plant plus the costs of operating the DAF and UF. In total, maintaining the existing treatment facilities and supplementing with DAF and UF is more cost effective than converting to MBR.

ES.5 Project Comparison/Cost Analysis

The different types of recycled water projects are summarized in the table below and then further in the pages that follow, including a comparative ranking of projects. Included within the table are important details on project components that impact cost, such as necessary pretreatment, pipelines, and use of existing assets (such as a water treatment plant [WTP]).

ES.5.1 Key Cost Assumptions

All capital cost estimates were prepared consistent with Association for the Advancement of Cost Engineering (AACE International) Class IV Estimates for feasibility and project screening. As such, the expected accuracy range could span -50 to +100 percent. The costs and assumptions used during this exercise were developed from the information available at the time the cost estimate was prepared since the upgrades have not yet been fully designed. There are numerous design related criteria, decisions, and assumptions that will need to be vetted and evaluated, including additional surveys, modeling, permit conditions, and unforeseen circumstances that could impact the cost of the project as the design progresses.

Note on construction costs: Construction costs have been rising at an unprecedented rate since May 2021. The increase in construction costs is largely attributed to workforce shortages, supply chain issues, and increases in energy (fuel) costs and inflation. *Engineering News-Record* (ENR) develops Construction Cost Index (CCI) for 20 cities across the U.S. and 2 in Canada. Using ENR data, national trends can be observed and analyzed. Between May 2021 and March 2022, ENR's

CCI has risen by nearly 6.7 percent. The industry is seeing an increase in projects that are bid at 20 percent over the engineer's estimate, outpacing the CCI increase. Accordingly, there are two key items to recognize when evaluating costs in this document:

1. They are conservative. Refinement of these costs require more detailed engineering analysis, preliminary design level at a minimum, to allow for reduction in safety factors.
2. They are based upon today's (September 2022) costs, as this analysis is not attempting to predict the rate of change (up or down) several years in advance.

Note on grant funding: Potential future grant funding has not been accounted for in cost estimates for this project. Receiving grant funding for a particular project would reduce the associated unit cost for Montecito.

In the sections below, this analysis highlights the approach to costing out the various treatment and delivery infrastructure necessary to implement water reuse for Montecito.

- **Reuse treatment:** Capital costs are based on vendor quotes and similar facilities with allowances for civil, mechanical, structural, and electrical improvements, as well as engineering cost. Construction costs presented include an estimating contingency, sales tax, general conditions, and contractor's overhead and profit. The percentages assumed for these factors are provided in TM 8. Total project costs include a fee for engineering, legal, and administration, as well as an owners reserve for change orders. The percentages assumed for these factors are also provided in TM 8.
- **Reuse O&M:** These O&M costs include power consumption, chemical consumption, maintenance, and staffing. The staffing costs were developed using the results of a Carollo Engineers, Inc. (Carollo) survey of IPR operations, with extrapolation to DPR requirements. For DPR, the staffing costs assume that three Grade 5 advanced water treatment operators (AWTOs) will be needed to provide full staff for 12 hours per day and skeletal staff for 12 hours per day, with an Grade 5 AWTO on call at all times. Staffing costs for both IPR and DPR also include regulatory and compliance staff, as well as new lab staff to supplement existing lab staff, which would encompass costs associated with regulatory compliance (e.g., preparing plans, water quality sampling).
- **Montecito Portions of Reuse Treatment and O&M:** For regional projects where purification is happening at a facility not located in Montecito, it is assumed that capital and O&M costs would be shared with the regional partner. In these cases, the Montecito portion of the treatment and O&M costs were estimated to be proportional to the share of purified water that Montecito would receive versus the total project production. For example, in the case of the Carpinteria IPR project with purification in Carpinteria, Montecito's portion would be 0.56 mgd out of 1.56 mgd, or approximately 36 percent. Montecito would therefore be responsible for 36 percent of the capital and O&M costs for the facility[5].
- **EQ:** The cost for EQ is included in the cost estimates provided. The existing MSD WWTP currently does not have any EQ. Potable reuse requires EQ of the ADWF to capture and reuse as much water as possible. The maximum EQ that would be needed to equalize the PWWF at MSD is 2.7 MG. For treatment trains with an MBR, 2.1 MG of EQ is needed ahead of the MBR, reducing membrane size but also allowing a peak flow of 1.5 mgd.

[5] Costs allocated to Montecito in a regional project may be higher than what was assumed here and would depend on the outcome of negotiations with partner agencies.

Several of the options do also require storage of the treated water to meet peak demands or minimize pipeline sizes; these costs are included in the distributed infrastructure cost.

- **Distributed Infrastructure:** Capital costs for distributed infrastructure include construction and contractor overhead, contingency for unknown conditions and professional services (or "soft costs"). The capital cost estimates are expressed in March 2022 dollars (the corresponding 20-Cities Average ENR CCI of 12,791). Construction costs were developed using cost indexes, quotes from suppliers, recent bids for similar projects, recent engineering estimates, and known industry planning-level unit costs. Quantities were estimated using geographic information system based maps of alignments. A percentage of the construction costs is dedicated for contingency to cover as-yet-unknown aspects of the project, in accordance with AACE International recommendations. Soft costs are also estimated as a percentage of the construction costs based on typical percentages of total project costs for similar projects. Project costs were annualized and combined with reoccurring O&M costs to come up with a total annual cost. The annual cost was used to estimate the unit cost based on the annual water delivery (i.e., acre-feet per year [AFY]) for each alternative. A summary of construction, soft cost and escalation assumptions for distributed infrastructure is provided in TM 9.
- **Total project capital costs:** The total project capital costs include both reuse treatment and distributed infrastructure costs.
- **Additional O&M costs:** For some project concepts there are additional O&M costs included in the estimates. In the case of Santa Barbara DPR where Montecito sends secondary effluent to the El Estero WRP, there is an assumed cost of wastewater retreatment of $3,000/acre-foot (AF) based on information provided by Santa Barbara. For all Santa Barbara DPR options, there is also treatment at the Cater WTP, with an assumed cost of $600/AF based on information provided by Santa Barbara.

ES.5.2 Water Supply Cost Perspective

It is prudent to consider the costs of other water supplies when comparing to the high cost of potable water reuse. Our understanding is that Montecito currently pays $3.500/AF for their desalination water. This represents the current price of desalinated water, not the future price of additional desalinated water supply. A thorough evaluation of the cost to expand desalination in Santa Barbara for additional supplies to Montecito would need to be conducted to have confidence in the unit cost.

Table ES.1 Montecito Water Reuse Project Costs Summary

Reuse Type	Wastewater Treatment	Additional Treatment for Reuse	Infrastructure Components	Total Project Size (AFY)	Annual Water Supply Benefit for Montecito (AFY)	Total Project Capital Cost ($ million)	Montecito Capital Cost	Montecito Capital Cost Components ($M)		Total Annual O&M Cost ($ million)	Montecito Annual O&M Cost ($ million)(2)	Montecito Cost of Water ($/AF)(1) Estimate (-30 to +50 percent)	Notes
								Treatment(1)	Distributed Infrastructure				
Non-Potable	CAS + DAF (at Montecito)	Cloth filter + UV (at Montecito)	EQ of secondary effluent, tertiary recycled water treatment, pipelines to non-potable customers.	128	128	$20.6	$20.6	$5.8	$14.8	$0.5	$0.5	$12,400 ($8,700 - $18,600)	Other NPR trains evaluated in TM 8 include ones with MBR instead of CAS and side-stream RO for salt reduction. Maintaining the existing CAS is more cost effective than replacing with a new MBR, which would have higher $/AF costs. Adding sidestream RO is not necessary to allow for NPR options, though some users may prefer the desalted water. Adding RO adds cost to the $/AF shown.
Carpinteria IPR	CAS + DAF (at Montecito)	RO – UV/AOP (at Montecito)	EQ of secondary effluent, addition of DAF for O&G removal, advanced treatment, pipeline to Carpinteria, groundwater injection well.	560	504	$50.4	$50.4	$18.3	$32.1	$2.5	$2.5	$10,400 ($6,700 - $15,600)	MBR instead of CAS is a possible change to this treatment system, but it would increase the cost of purified recycled water production. Montecito supply benefit is reduced by 10 percent "leave behind" in the Carpinteria groundwater basin.
	CAS + DAF (at Montecito)	UF – RO – UV/AOP (at Carpinteria)	EQ of secondary effluent, addition of DAF for O&G removal, pipeline to Carpinteria, advanced treatment, groundwater injection well.	1,792	504	$104.2	$54.3	$21.0	$33.3	$2.9	$1.2	$8,300 ($5,700 - $12,300)	MBR at MSD is not a good option for this potential project, as the MBR effluent would blend with CAS effluent a Carpinteria and thus require UF before processing with RO (redundant processing). Montecito supply benefit is reduced by 10 percent "leave behind" in the Carpinteria groundwater basin. The concept of sending raw MSD wastewater to Carpinteria was not evaluated due to anticipated challenges with CSD capacity and cost.

-This Page Intentionally Left Blank-

Reuse Type	Wastewater Treatment	Additional Treatment for Reuse	Infrastructure Components	Total Project Size (AFY)	Annual Water Supply Benefit for Montecito (AFY)	Total Project Capital Cost ($ million)	Montecito Capital Cost	Montecito Capital Cost Components ($ million)		Total Annual O&M Cost ($ million)	Montecito Annual O&M Cost ($ million)[2]	Montecito Cost of Water ($/AF)[1] Estimate (-30 to +50 percent	Notes
								Treatment[1]	Distributed Infrastructure				
DPR in Montecito	CAS + DAF (at Montecito)	Ozone/BAC – UF – RO – UV/AOP (at Montecito)	EQ of secondary effluent, addition of DAF for O&G removal, advanced treatment, pipeline to Bella Vista WTP.	560	560	$47.6	$47.6	$26.8	$20.8	$4.9	$4.9	$13,300 ($9,300 – 19,900)	Purified recycled water in this option would be delivered either ahead of the Bella Vista WTP or after the WTP, resulting in a blend of purified water to most customers. Options for TWA via addition of purified water into the nearest water main near the MSD was examined in TM 9 but not evaluated here.
DPR at Santa Barbara	CAS (at Montecito and again at Santa Barbara)	Ozone/BAC – UF – RO – UV/AOP (at Santa Barbara)	EQ of secondary effluent, pipeline connection to Santa Barbara sewer system, secondary treatment at El Estero WRP, advanced treatment, pipeline to the forebay of the Cater WTP.	4,145	560	$94.4	$23.0	$10.3	$12.7	$8.1	$2.9	$7,400 ($5,200 - $11,100)	This concept keeps the MSD WWTP operational but does result in retreatment of MSD effluent at El Estero WRP. Options exist for significantly larger EQ of raw wastewater at MSD, eliminating the "retreatment" aspect of this option but increasing costs due to EQ. Another option could involve transport of the secondary effluent direct to El Estero WRP without blending with other raw wastewaters, resulting in increased pipeline costs but no "retreatment" costs.
	CAS at Santa Barbara	Ozone/BAC – UF – RO – UV/AOP (at Santa Barbara)	Unequalized raw wastewater from MSD to Santa Barbara via a pipeline connection to El Estero WRP, secondary treatment at El Estero WRP, advanced treatment, pipeline to the forebay of the Cater WTP.	4,145	560	$105.6	$34.1	$10.3	$23.8	$6.5	$1.3	$5,700 ($4,000 - $8,600)	The cost assumes no EQ but this option could add EQ of MSD raw wastewater to reduce the size of the transport pipeline to El Estero WRP.

Notes:
Abbreviations: AOP - advanced oxidation process; BAC - biologically active carbon, RO - reverse osmosis.
(1) Cost of water was calculated based on total annual cost. The capital costs were annualized assuming a discount rate of 3.5 percent over a 30-year period. Annual capital and O&M costs were added together to obtain the total annual cost.

-This Page Intentionally Left Blank-

Table ES.2 Summary of Costs Specific to Montecito for Each Project in $/AF

Project Element	Montecito NPR	Carpinteria IPR - Groundwater Storage	Carpinteria IPR - Purification in Carpinteria	Montecito DPR	Santa Barbara DPR - Secondary Effluent	Santa Barbara DPR - Raw Wastewater
Reuse Treatment at MSD	$2,500	$2,000	$0	$2,600	$0	$0
Reuse Treatment at Carpinteria	$0	$0	$2,300(1)	$0	$0	$0
Reuse Treatment at Santa Barbara	$0	$0	$0	$0	$1,000(2)	$1,000(2)
Conveyance to NPR Customers	$6,300	$0	$0	$0	$0	$0
Conveyance to Carpinteria Injection Wells	$0	$3,500(3)	$0	$0	$0	$0
Conveyance to Carpinteria AWPF	$0	$0	$3,600	$0	$0	$0
Conveyance to Bella Vista	$0	$0	$0	$2,000	$0	$0
Conveyance Secondary Effluent to El Estero WRP	$0	$0	$0	$0	$1,100	$0
Conveyance Raw Wastewater to El Estero WRP	$0	$0	$0	$0	$0	$2,200
Conveyance El Estero to Cater WTP	$0	$0	$0	$0	$100(2)	$100(2)
O&M – Retreatment at El Estero WRP	$0	$0	$0	$0	$3,000	$0
O&M – Treatment at Cater WTP	$0	$0	$0	$0	$600	$600
O&M – Treatment at Bella Vista	$0	$0	$0	$1,000	$0	$0
O&M – Reuse Treatment at MSD	$3,600	$4,500	$500	$7,500	$0	$0
O&M – Reuse Treatment at Carpinteria	$0	$0	$1,400(2)	$0	$0	$0
O&M - Reuse Treatment in Santa Barbara	$0	$0	$0	$0	$1,400(2)	$1,400(2)
O&M - Distributed Infrastructure	$0	$500	$500	$100	$200	$300
Total ($/AF)	**$12,400**	**$10,400**	**$8,300**	**$12,300**	**$7,400**	**$5,700**

Notes:
(1) Reuse treatment for purification in Carpinteria also includes the cost for injection and monitoring wells.
(2) These items represent the Montecito portion of a shared regional cost. The costs for Montecito are proportional to the share of water received by Montecito relative to the total project size. Costs allocated to Montecito in a regional project may be higher than what was assumed here and would depend on the outcome of negotiations with partner agencies.
(3) Conveyance cost for groundwater storage option also includes the cost for injection and monitoring wells.

ES.6 Project Concept Summaries

The following sections include summaries of the five main project concepts. Each summary includes the treatment trains considered, an overview of the layouts of new infrastructure, maps of alignments for new pipelines, and a summary of project benefits and risks.

ES.6.1 Project Concept 1 - NPR in Montecito

This concept is for a local project producing water meeting Title 22 tertiary quality requirements for irrigation of large landscapes in Montecito. Some of the key information developed for this project concept is summarized here.

- Three treatment train options were evaluated, as shown in Figure ES.2. Option 1A includes sidestream RO to reduce salinity, while Options 1B and 1C are cheaper, non-RO based systems. The use of sidestream RO increases the treatment cost, but may result in more customers using non-potable water. Treatment train 1C was used as the basis for the cost estimates provided in the previous section.
- The arrangement of infrastructure at the existing MSD WWTP is shown in Figure ES.3. As shown, there is space for a new reuse facility to house reuse treatment equipment on the west portion of the site. This facility would house the UF, RO, and ultraviolet (UV) for Option 1A, and the cloth disc filter and UV in Option 1C. Option 1B would not need a separate reuse facility because it would use the MBR and chlorine contact basin as shown in the site layout.
- The alignment for a pipeline to serve non-potable water to several customers is shown in Figure ES.4. The alignment shown is the preferred alternative because it has a preferred US 101 crossing and allows more customers to be served without additional laterals. Alternative alignments are presented in TM 9.
- A summary of the benefits and challenges for a NPR project in Montecito is shown in Table ES.3.

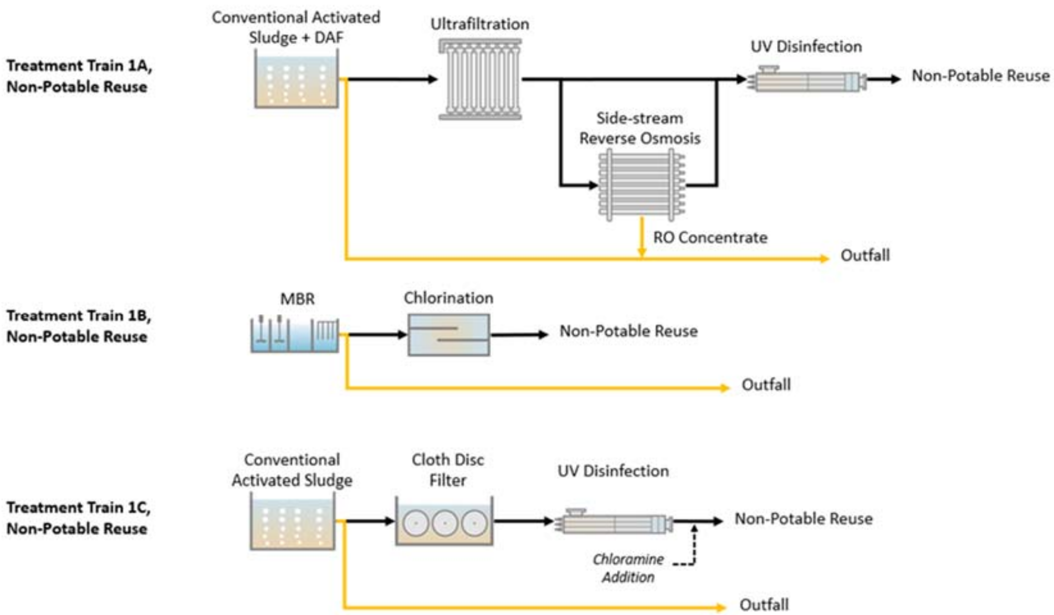


Figure ES.2 Treatment Trains Evaluated for NPR at Montecito

Note: MBR infrastructure assumes the retrofit alternative.

Figure ES.3 Layout of Potential Infrastructure Needed for NPR in Montecito

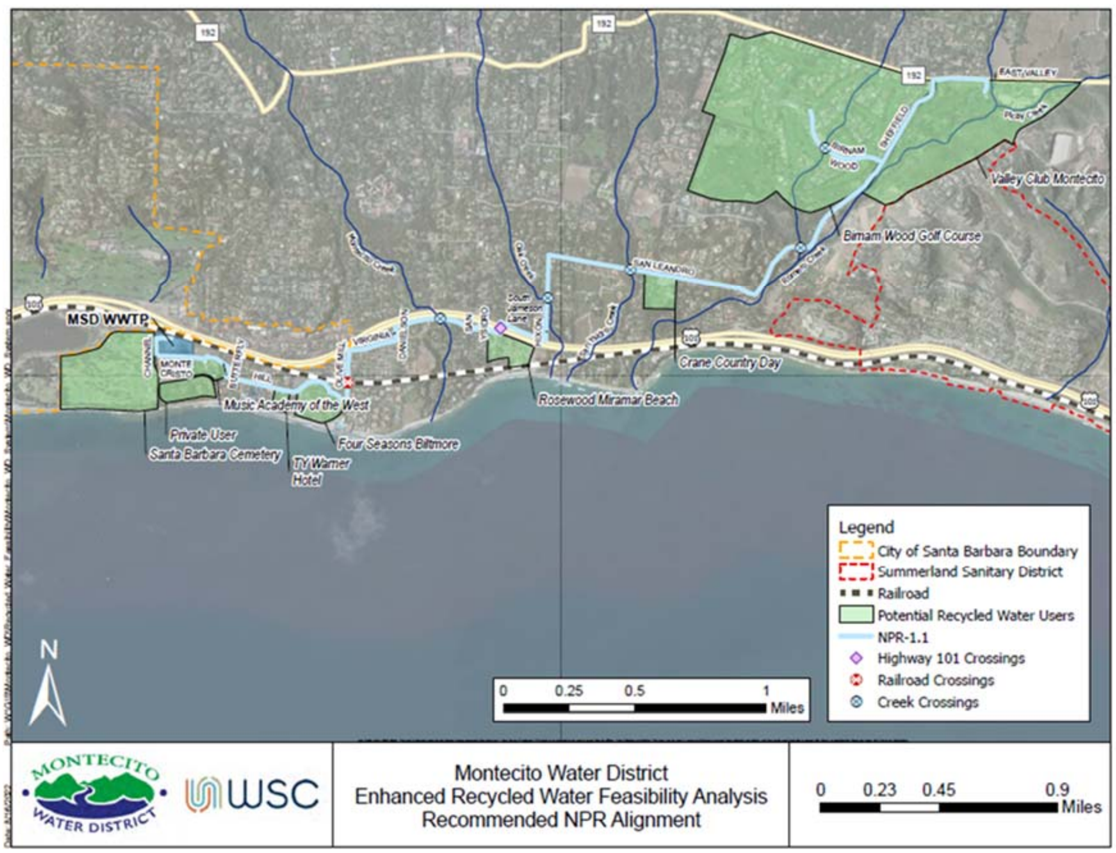


Figure ES.4 Recommended Alignment for Serving Non-Potable Customers From an NPR Project in Montecito

Table ES.3 Summary of Benefits and Challenges for an NPR Project in Montecito

Project Benefits	Challenges and Risks
• Agency controlled, drought-resistant water supply • Lower capital cost than potable reuse alternatives • Operationally less complex than potable reuse • Near term implementation • Some distributed infrastructure could be repurposed for a future Montecito DPR project	• Limited users • Minimal demand, thus minimal reuse • Need for larger irrigation customers to accept recycled water • Requires significant conveyance infrastructure • Some smaller users may want lower salt concentrations and thus may require sidestream RO • High unit cost

ES.6.2 Project Concept 2 - IPR in Carpinteria: Groundwater Storage in Carpinteria

This project concept is a regional project in which Montecito produces purified wastewater and sends it to Carpinteria for injection into the Carpinteria groundwater basin. This project entails a partnership with neighboring special district(s). Some key elements that were evaluated for this project are summarized below.

- Two potential treatment trains were evaluated, as shown in Figure ES.5. The main difference between the two trains is whether or not an MBR is used, or the existing CAS process with a new secondary DAF.
- The arrangement of infrastructure at the existing MSD WWTP is shown in Figure ES.6. Like in the NPR concept, there is space for a new reuse facility to house reuse treatment equipment on the west portion of the site. This facility would house the UF (if needed), RO, and UV/AOP.
- The proposed alignment for a pipeline to send purified water for injection in Carpinteria is shown in Figure ES.7. Note that the distributed infrastructure did not include a pipeline to return water from Carpinteria to Montecito, because it was assumed that the primary mechanism for Montecito to obtain the water supply benefit would be through a water exchange via the South Coast Conduit. However, further definition of this project may result in the addition of a return pipeline, which would increase the distributed infrastructure cost.
- A summary of the benefits and challenges for a groundwater storage IPR project in Carpinteria is shown in Table ES.4.

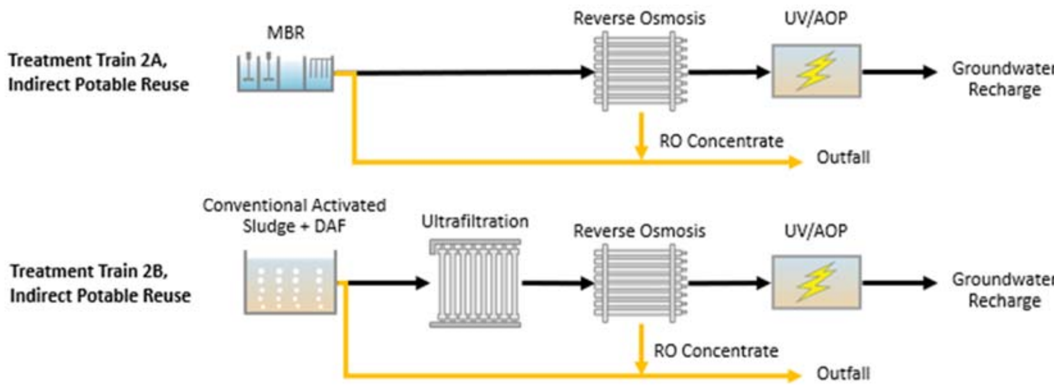
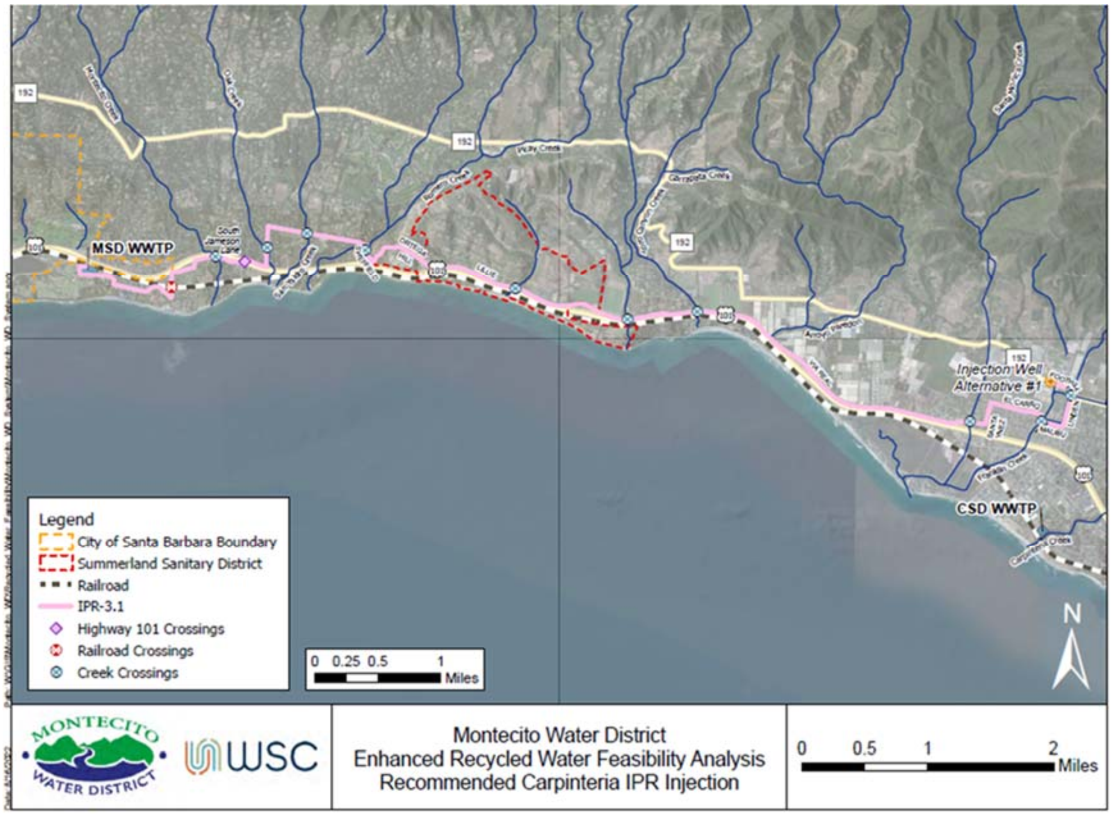


Figure ES.5 Treatment Trains Evaluated for IPR in Carpinteria Where Advanced Treatment Takes Place in Montecito and Purified Water is Sent to Carpinteria for Injection in Their Groundwater Basin

Note: MBR infrastructure assumes the retrofit alternative.

Figure ES.6 Layout of Potential Infrastructure Needed for IPR With Carpinteria When Advanced Treatment Takes Place in Montecito



Note: Injection well location shown is estimated; ultimate location would be determined during future project definition.

Figure ES.7 Recommended Alignment for Sending Purified Water to Injection Wells in Carpinteria

Table ES.4 Summary of Benefits and Challenges for IPR in Carpinteria Where Purified Water is Sent by Montecito for Injection in Carpinteria's Groundwater Basin

Project Benefits	Challenges and Risks
• Maximizes reuse of available MSD wastewater • Minimizes ocean discharge • Utilizes the potable distribution system for delivery • Provides drought-resistant supply of drinking water • Provides seasonal storage(1); potential for longer term shortage • Storage avoids potential loss due to an inability to use water in real time during low demand periods (as with DPR) • Potential low-cost water recovery option through water exchange	• Requires interagency coordination with CVWD and groundwater sustainability agency (GSA) • Requires significant transmission infrastructure • Requires further groundwater modeling to confirm storage capability in confined and unconfined zones • Involves more complex operations of an AWPF • Basin injection could be infeasible during future wet periods due to lack of storage capacity • Compensation for use of Carpinteria Basin assumed to be 10 percent leave behind; negotiations required

Notes:
(1) Potentially provides seasonal storage, but may be an annual "put and take" operation depending on future groundwater modeling results.

ES.6.3 Project Concept 3 - IPR in Carpinteria: Purification in Carpinteria

This project concept is a regional project in which Montecito sends secondary effluent to Carpinteria for treatment at a new advanced water purification facility and injection into the Carpinteria groundwater basin. This project builds on the existing Carpinteria IPR project, which is currently in design, to create a larger regional project.

- The treatment train evaluated is shown in Figure ES.8. The only change required in Montecito is the addition of secondary DAF for O&G removal to protect downstream membranes. No additional reuse treatment would be needed in Montecito. Alternatively, the use of an MBR could also replace the existing wastewater treatment; this alternative was not specifically evaluated.
- No site layout is provided here because the only additional infrastructure needed is the new secondary DAF.
- The proposed alignment for a pipeline to send purified water for injection in Carpinteria is shown in Figure ES.7.
- A summary of the benefits and challenges for a groundwater storage IPR project in Carpinteria is shown in Table ES.5.

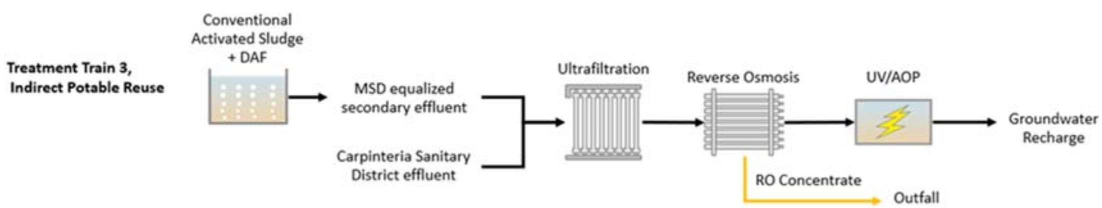


Figure ES.8 Treatment Train Evaluated for IPR in Carpinteria Where Montecito Sends Secondary Effluent to Carpinteria for Treatment at Their AWPF

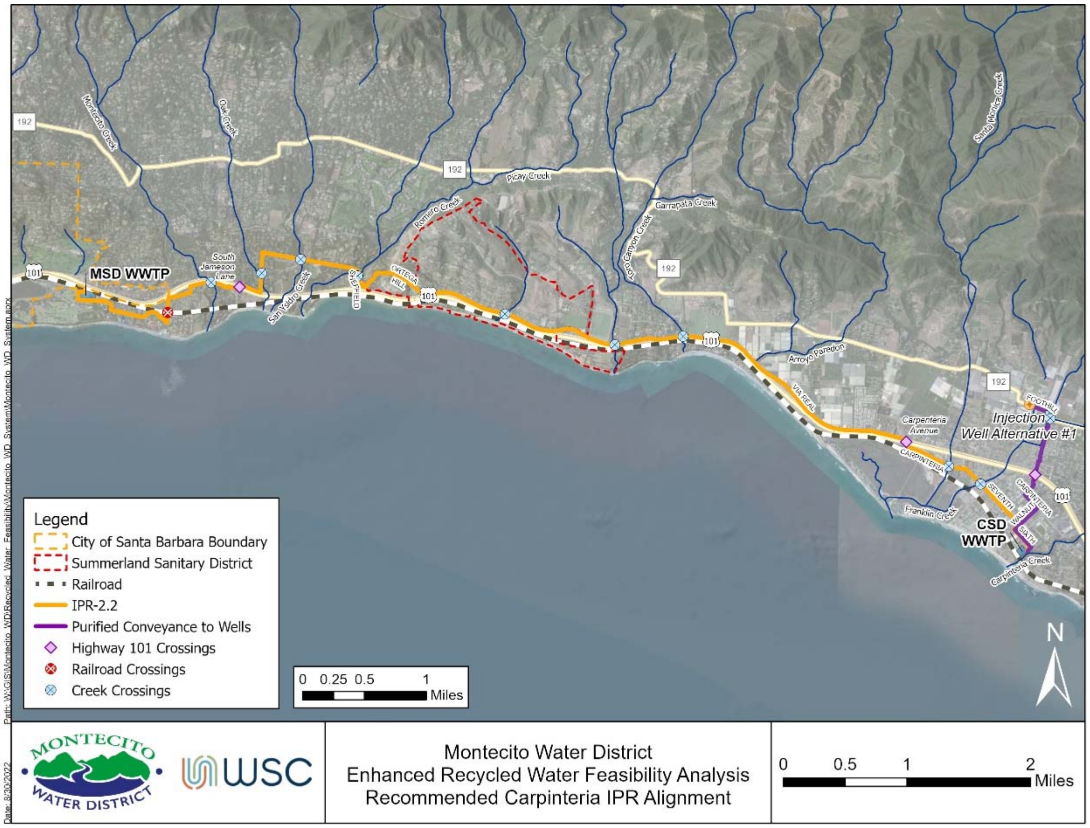


Figure ES.9 Recommended Alignment to Send Secondary Effluent to Carpinteria for Treatment at the CSD AWPF and Alignment for Sending Purified Water to Injection Wells in Carpinteria Groundwater Basin

Table ES.5 Summary of Benefits and Challenges for an IPR Project With Purification in Carpinteria

Project Benefits	Challenges and Risks
• Achieves some economy of scale • Does not impact CSD WRP capacity • Removes responsibility for AWPF operations from MSD • Maximizes reuse of available MSD wastewater • Minimizes ocean discharge • Utilizes the potable distribution system for delivery • Provides drought-resistant supply of drinking water • Storage avoids potential loss due to an inability to use water in real time during low demand periods (as with DPR) • Provides seasonal storage; potential for longer term shortage	• Likely resistance to the Carpinteria Advanced Purification Project (CAPP project) delay to allow for incorporation of Montecito • Requires interagency coordination with CVWD and GSA • Requires significant transmission infrastructure • Potential public concern with Montecito's wastewater going to Carpinteria (via ROC) • Potential public concern over Montecito's use of Carpinteria groundwater basin • Basin injection could be infeasible during future wet periods due to lack of storage capacity • Requires further groundwater modeling to confirm storage capability in confined and unconfined zones • Cost uncertainty; negotiations likely result in a cost benefit to Carpinteria for Montecito's participation, above proportional participation in capital and O&M costs

ES.6.4 Project Concept 4 - DPR in Montecito

This project concept is a local project in Montecito producing purified water and utilizing either RWA or TWA for use within the existing distribution system.in Montecito. Some of the key elements evaluated for this project concept are as follows:

- The treatment trains evaluated are shown in Figure ES.10. Extensive advanced treatment is required for DPR – ozone and biologically activated carbon have been added to the treatment trains per the state of California's draft DPR regulations. The use of the Bella Vista WTP is necessary in treatment train 4B in order to achieve the required pathogen log removal targets. For treatment train 4A, the targets can be met without the use of a WTP, and purified water from the AWPF could be placed directly into the distribution system.
- A site layout of potential infrastructure needed for DPR in Montecito is shown in Figure ES.11.
- Potential alignments for DPR in Montecito are shown in Figure ES.12. There is not a preferred alignment identified because the alignments shown represent different approaches to DPR. Alignment 4.3 would involve sending the water to Bella Vista reservoir for additional treatment at the WTP, while the other alignments would involve sending purified water directly to the distribution system for TWA.
- A summary of the benefits and challenges for a DPR project in Montecito is provided in Table E.S6.

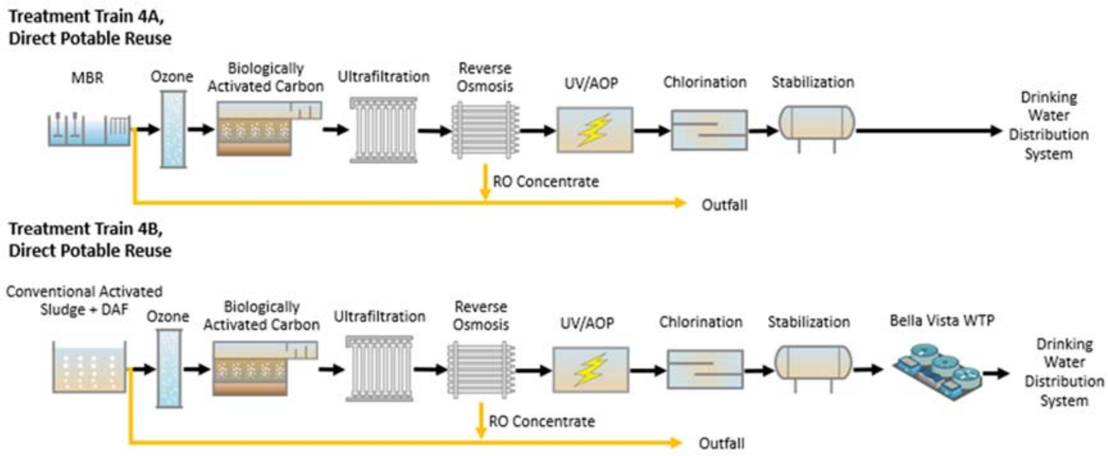


Figure ES.10 Treatment Trains Evaluated for Direct Potable Reuse in Montecito

Figure ES.11 Site Layout of Infrastructure Needed for DPR in Montecito

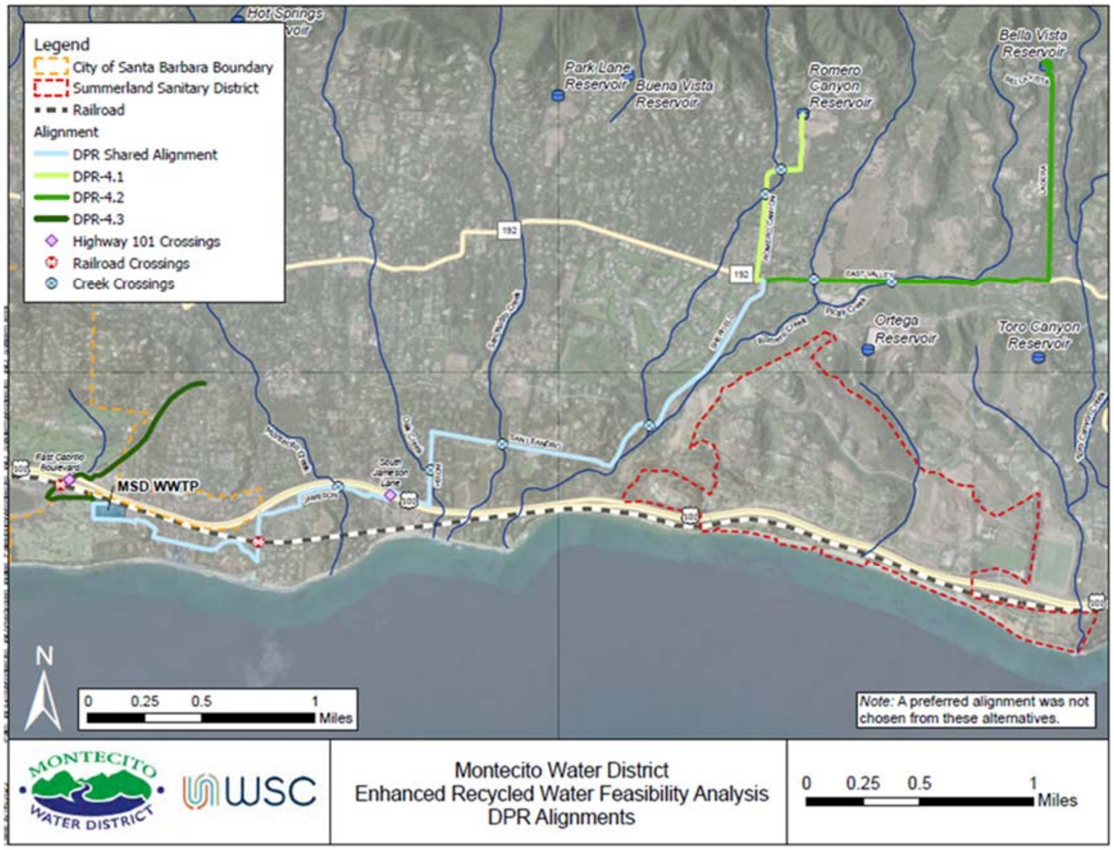


Figure ES.12 Potential Alignments for Purified Water Distribution in Montecito

Table ES.6 Summary of Benefits and Challenges for DPR in Montecito

Project Benefits	Challenges and Risks
• Provides agency controlled, drought-resistant supply of drinking water • Regional cooperation and collaboration with neighboring agencies are not required • Maximizes reuse of available MSD wastewater • Minimizes ocean discharge • Utilizes the potable distribution system for delivery	• Significantly more complex operation of AWPF • Requires real time use • Potential water loss during periods when desal and DPR combined flow exceed demand • Must meet extensive regulatory requirements, including technical and managerial capacity • Public engagement and acceptance • DPR regulations have not been finalized so there is uncertainty about final requirements

ES.6.5 Project Concept 5 - DPR in Santa Barbara

This project concept is a regional project in which Montecito sends either raw or secondary effluent to Santa Barbara for treatment at the El Estero WRP and subsequently a new AWPF. Purified water would then be used for RWA at the Cater WTP. Some of the key elements evaluated for this project concept are as follows:

- The treatment train evaluated is shown in Figure ES.13. The treatment train is the same as shown above for DPR in Montecito, although in this case the advanced water purification facility would be located in Santa Barbara, not in Montecito.
- A site layout for a new AWPF in Santa Barbara is shown in Figure ES.14. For this alternative, new infrastructure is not needed at Montecito's wastewater treatment plant.
- Potential alignments for DPR in Santa Barbara are shown in Figure ES.15. There is not a preferred alignment identified because the alignments shown represent different approaches to DPR. Alignments 5.1 and 5.2 would convey dry weather secondary effluent flows from Montecito to Santa Barbara, while Alignment 5.3 would convey PWWFs[6]. Alignment 5.1 would leverage the existing Santa Barbara collection system, with upsizing required for some segments. The other two alignments involve construction of new gravity sewers.
- A summary of the benefits and challenges for a DPR project in Santa Barbara is provided in Table ES.7.

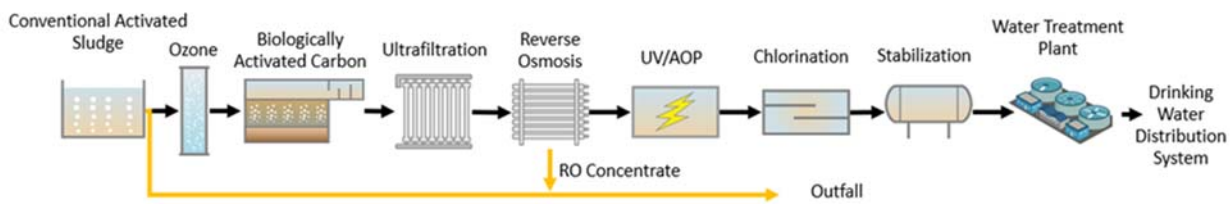


Figure ES.13 Treatment train Evaluation for DPR in Santa Barbara

[6] Alignment 5.2 was used for the cost estimate for a project sending secondary effluent to Santa Barbara for DPR; Alignment 5.3 was used for the project sending raw wastewater to Santa Barbara.

Figure ES.14 Potential Layout for New Advanced Water Purification Facility in Santa Barbara

Note: Figure also shows the location of a potential new advanced water purification facility.

Figure ES.15 Potential Alignments for Sending Raw Wastewater or Secondary Effluent to Santa Barbara's Wastewater Treatment Plant

Table ES.7 Summary of Benefits and Challenges for a DPR Project in Santa Barbara

Project Benefits	Challenges and Risks
• Provides drought-resistant supply of drinking water • Maximizes reuse of available MSD wastewater • Minimizes ocean discharge • Removes responsibility for AWPF operations from MSD • Larger project leverages economies of scale and may be more likely to receive grant funding • Utilizes existing potable water delivery systems • Potentially ends need for ocean discharge at MSD	• Requires interagency collaboration with Santa Barbara • Not anticipated to provide new water supply until at least 2035 • Public engagement and acceptance • Final DPR regulation not known • Uncertain costs and project timing 10 to 15 years in the future • Future changes in City Council and staff could impact Santa Barbara's long term plans for reuse. • Santa Barbara's control over multiple water supplies for Montecito. • Requires real time use • Potential water loss during periods when desalination and DPR combined flow exceed demand

ES.7 Project Evaluation and Scoring

ES.7.1 Project Evaluation Criteria

The following evaluation criteria were developed to capture the priorities and interests of MSD and MWD, and to aid in the selection of a preferred project concept.

- **Cost of Water –** All in cost-per-unit of water based on capital cost for reuse treatment systems, infrastructure needed to move water and/or wastewater, annual O&M costs, and retreatment (if required).
- **Annual Water Supply Benefit -** Total amount of water produced by a project and made available annually to MWD.
- **Implementation Timeline -** Timing of when recycled water would become available for use.
- **Political Support -** Likelihood of support from elected officials; considering political impacts and challenges associated with projects (e.g., local vs. regional).
- **Public and Non-Governmental Organization (NGO) Support -** Likelihood of support from public and NGOs; considering factors like sustainability, customer benefits, rate impacts, and challenges like ocean discharge.
- **Technical and Managerial Capacity -** Complexity of staffing (particularly O&M, and laboratory); this increases significantly going from NPR to IPR to DPR.
- **Grant Funding Potential -** Likelihood to receive grant funding, which may be higher for regional projects and for potable reuse projects as compared with non-potable projects.
- **Local Control -** Ownership of project within Montecito. Projects in Montecito minimize challenges and effort related to interagency cooperation and collaboration.
- **Permitting Complexity -** Anticipated complexity of permitting process, including the number of agencies involved, and RWQCB, DDW, CEQA, and Caltrans permitting.

ES.7.2 Pairwise Comparison for Criteria Ranking

A pairwise comparison is a process of comparing criteria in pairs to determine a relative preference for each criterion. The process is illustrated in Figure ES.16 in an example with four criteria: A, B, C, and D.

In the first step, the criteria are compared in pairs and in each pair a preferred criterion is identified. In the second step, the relative preference for each criterion is calculated based on the number of times each one was favored. Criterion A was favored 2 times out of 6; therefore its relative preference is 33 percent.

The relative preference for each criterion, also called the weighting factor, is used later in the project scoring process to develop a total project score that reflects MSD and MWD priorities.

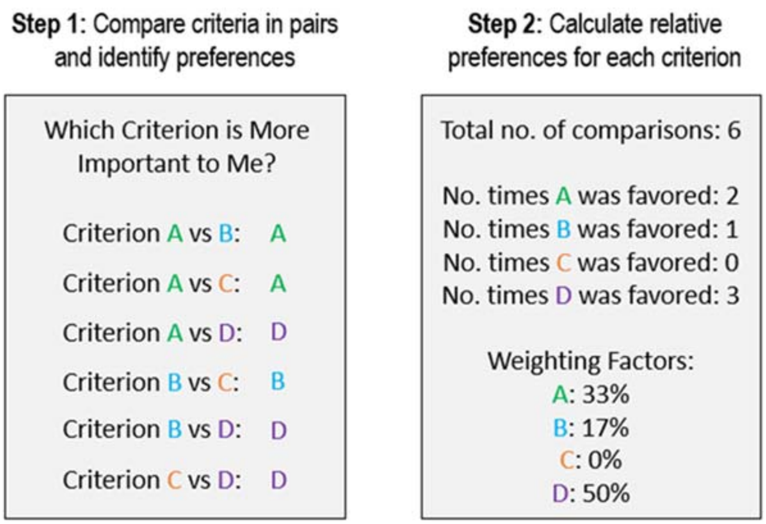


Figure ES.16 Example Illustrating the Process of Pairwise Comparison

ES.7.3 Evaluation Criteria Ranking Results

Staff from MSD and MWD were guided through the process of pairwise comparison for the 10 project evaluation criteria for water reuse projects. The results of the relative preferences for each criterion are summarized in Figure ES.17. Note that all criteria are important, even criteria with low or no relative ranking.

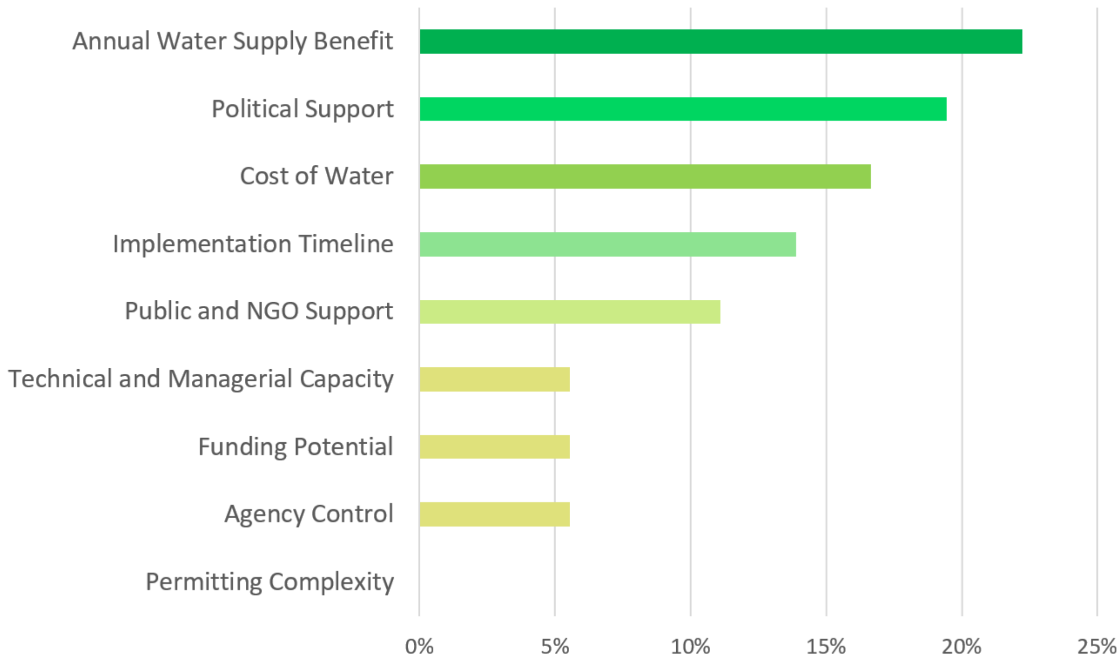


Figure ES.17 Weighting of Project Evaluation Criteria as a Result of Pairwise Comparison

ES.7.4 Project Scoring Results

Projects were scored in a collaborative process incorporating feedback from MWD and MSD representatives. Some of the key points underpinning the project scoring are as follows:

- For the quantitative categories of annual water supply benefit and cost of water, the project scores are normalized to the 'best' project – i.e., more water and lowest cost per unit. The best projects were scored as a 5.
- Political support: this criterion is intended to capture the likely future support of the MWD and MSD boards, as well as other elected officials. The highest score for DPR in Montecito reflects the support for agency control and maximizing the water supply benefit. The lower score for an NPR project reflects the general preference for potable reuse projects, while the lower score for IPR in Carpinteria via purification in Carpinteria reflects potential anticipated challenges related to the cost and schedule impacts of expanding the existing Carpinteria "CAPP" project. The delivery of purified water from Montecito to Carpinteria scores higher because it will not impact the CAPP project implementation.
- Implementation timeline: NPR in Montecito would be the least complex project to implement and therefore could likely be implemented within a few years. IPR projects could be implemented sooner than DPR projects and thus are scored higher. Santa Barbara has indicated that they will not pursue DPR before 2035, which is why that is the lowest scoring project in this category.

- Public and NGO support: several factors play into this category, including public confidence in water quality and safety of new supplies, trust in utility staff, and protection of the environment. There was an acknowledgement that DPR projects can be more challenging for the public to accept, therefore these projects were scored lower. In addition, a project in which Montecito's secondary effluent is sent to Carpinteria was also scored lower based on potential concerns about Montecito's waste going to Carpinteria for treatment and discharge into the ocean.
- Grant funding potential: factors that were assumed to increase the likelihood of receiving grant funding include larger project size, inclusion of regional partners, and implementing potable reuse (as opposed to NPR).
- Agency control: projects under the complete control of Montecito agencies were scored higher in this category. Project 2, IPR in Carpinteria via groundwater storage, also scored higher because Montecito would be in full control of the advanced water treatment portion of the project.
- Technical and managerial capacity: this category applies to the capacity needed in Montecito specifically (not for the project overall). The more advanced treatment Montecito is responsible for, the lower a project scored in this metric. If Montecito is operating an AWPF, there would be significant new needs regarding operational capacity (e.g., new AWTOs, additional lab staff), reporting, and other technical aspects.
- Permitting complexity: the score for this metric is highest for NPR, which is anticipated to be the easiest project to permit, and low for DPR, which is significantly more difficult to permit given the novelty of these types of projects.

As shown in Table ES.8, the project that received the highest score from the scoring process is IPR in Carpinteria via groundwater storage, followed by DPR in Santa Barbara. Both of these projects benefit from having regional partners while providing the highest water supply benefits for Montecito.

Table ES.8 Summary of Project Scoring

Criterion	Weight(1)	Project 1: NPR in Montecito	Project 2: IPR in Carpinteria (Groundwater Storage)	Project 3: IPR in Carpinteria (Purification in Carpinteria)	Project 4: DPR in Montecito	Project 5: DPR in Santa Barbara
Annual Water Supply Benefit	22%	2	5	5	5	5
Political Support	19%	3	3.5	2	5	3
Cost of Water	17%	1.5	2	2	1	4.5
Implementation Timeline	14%	5	3	3.5	1.5	1
Public and NGO Support	11%	4	4.5	3	3	3
Grant Funding Potential	6%	1	3	4	3	5
Agency Control	6%	5	4	2	5	1
Technical and Managerial Capacity	6%	5	3	4	1	4
Permitting Complexity	0%	5	3	3	2	1.5
WEIGHTED SCORE		**3.0**	**3.6**	**3.2**	**3.3**	**3.5**

Notes:
(1) Weighted scores were rounded for this table.

ES.8 Project "Loose Ends"

Throughout the documentation of this work, suggestions from internal stakeholders were captured and in some cases incorporated into the overall effort, such as the change to NPR treatment that does not include salt removal or the parallel examination of greenfield and retrofit MBR options. Other suggestions were not incorporated, either due to having a perceived fatal flaw or due to being outside the scope of work for this project. Such suggestions are chronicled below, allowing for them to be re-evaluated at a future date. These suggestions are categorized based upon the end use of the recycled water and the project partners for that end use.

- **NPR in Montecito:**
  - Salt removal:
    - As documented in TM 9 and illustrated previously, the expectation for NPR in Montecito is 128 AFY, of which about 100 AFY would go to larger customers that can blend with groundwater and thus reduce TDS levels in the tertiary recycled water.
    - For the remaining smaller potential users and the 28 AFY, more detailed discussions are needed to gain support, with a focus on salt tolerant landscaping.
    - Should salt removal be perceived as a necessity for some of the NPR customers, the addition of sidestream RO can be implemented, though at high cost, or decentralized at the point of use and customer's responsibility.
  - Santa Barbara Collaboration:
    - Santa Barbara recently completed an updated recycled water master plan, evaluating non-potable and potable water reuse (September 2022).
    - Within Santa Barbara's analysis is the potential for sending tertiary recycled water to the Montecito cemetery (30 AFY) and the Ty Warner Estate (5 AFY), at an approximate cost of $3,400/AF.
- **IPR in Carpinteria:**
  - Secondary Treated Water in Carpinteria:
    - Having Carpinteria treat a combined MSD and CSD flow for purification means increased reverse osmosis concentrate (ROC) into the CSD outfall.
    - While analysis across California indicates that ROC discharge can be managed to minimize (or avoid) NPDES impacts, detailed analysis would be required prior to proceeding with this option.
  - Raw Wastewater to Carpinteria:
    - As documented in TM 8, two concepts for potable reuse involving Carpinteria were evaluated and costed, one sending secondary effluent to Carpinteria for purification as part of the CAPP project, and then groundwater injection and a second sending of purified water to Carpinteria for groundwater injection.
    - The concept of transferring raw wastewater to Carpinteria for treatment at the CSD WRP was discussed. Incorporation of all MSD flows at CSD may be feasible, but will significantly impact available capacity at CSD while also coming at a high cost to "buy in" to the CSD facility at about 30 percent of total capacity.

    - Further discussions could be had on this concept, which would require a detailed CSD capacity review, potential analysis for expansion, and cost sharing agreements.
    - For this work, the concept of sending raw wastewater to CSD from MSD was not included in the final evaluations.
- Secondary Effluent to Carpinteria Via Alternative Transport:
    - Within TM 9, pipeline infrastructure alignment and costs to transport equalized secondary effluent from MSD to Carpinteria for purification and later groundwater injection.
    - Project stakeholders suggested that the project team consider ways to transport secondary effluent from MSD to Carpinteria via a pipeline in the ocean, under the assumption that costs would be reduced compared to land-based construction.
    - The project team discussed the challenges of a pipeline in the ocean to transport secondary effluent from Montecito to Carpinteria, and concluded that it was not feasible from a cost or regulatory perspective. Example challenges include:
        - High construction cost via barge that requires significant anchoring to resist tidal energy.
        - Sensitive ocean habitats that would prohibit pipelines in TBD areas.
        - Robust engineering to address fault lines.
        - Leakage into the pipeline which would add salt to the feed water to purification.
        - Permitting requirements with RWQCB, Coastal Commission, Coast Guard, State Lands Commission, NOAA, National Marine Fisheries, US Fish and Wildlife, Army Corps of Engineers, CEQA.
        - Navigation impacts.
        - Public concern.
- Groundwater Modeling in the Carpinteria Basin
    - Prior to implementing a regional partnership with Carpinteria, new groundwater modeling is needed.
        - Modeling would determine (a) where additional injection of purified water could occur, (b) how much water can be injected, and (c) how long can water be stored.
        - New modeling should consider the inland confined and unconfined groundwater basins as well as a seawater intrusion barrier located closer to the coast.
        - Modeling would inform the need, or lack thereof, for additional injection wells, extraction wells, and monitoring wells.
    - Negotiations, coupled with the groundwater modeling, would also be required to determine several items:
        - The necessity of "put and take" into the groundwater basin, where the volume of purified water injected into the basin would need to be extracted within a short timeframe to avoid raising the pressure in the basin. If a put and take operational mode is required, it would limit the benefit of storage provided by the groundwater basin. However, even a put and take

      - operation could provide benefit to Montecito by allowing for storage of water during low demand periods.
      - Water transfer agreements, such as the injected water would be kept and used in Carpinteria and the equivalent volume would be recovered by Montecito through transfers from the South Coast Conduit. Interagency agreements would be needed to define these terms.
  - Regional Partnership with SSD:
    - SSD could become a third partner in a collaboration between Montecito and Carpinteria, providing their raw wastewater or secondary effluent for treatment and purification.
    - In one example, SSD could send equalized raw wastewater to MSD for secondary treatment, adding new supply to subsequent purification and groundwater recharge in the region.
  - Distributed Infrastructure
    - A more favorable alignment may exist within Caltrans right-of-way. Attempts were made to reach out to Caltrans but further engagement will be required during preliminary design. The more favorable alignment would bypass the Ortega Hill Road area through a bike path parallel to Highway 101. The alternative alignment would reduce pipeline lengths, pump sizing and operating costs, and reduce risk of conflicts in the utility dense area of Ortega Hill Road.
- **Direct Potable Reuse in Montecito:**
  - TM 8 and TM 9 evaluated methods to implement DPR in Montecito.
  - The evaluated option highlighted in this document utilizes a pipeline to the head of the Bella Vista WTP, which provides important pathogen credits while also mixing the purified recycled water with other water to Montecito customers.
    - Implementation of this option should also consider the capacity of the Bella Vista WTP and any need for future expansion due to the added flow of purified water.
    - Testing would also be required to determine if there were any significant impact to WTP operation based upon the change in feed water quality.
  - Other options for DPR exist in Montecito without the use of Bella Vista, with specific benefits and challenges.
    - Benefits:
      - Reduced pipeline length to connect directly into the potable water distribution system.
      - No impact to Bella Vista capacity or operations.
    - Challenges:
      - Reduced pathogen credits, potentially requiring additional treatment prior to use.
      - Uneven distribution of purified recycled water within Montecito.

- **Direct Potable Reuse in Santa Barbara:**
  - TM 9 evaluated different options for moving MSD wastewater to Santa Barbara, including:
    - Equalized secondary effluent using new gravity sewers to connect into the Santa Barbara wastewater collection system.
    - Unequalized raw wastewater using new gravity sewers to connect directly to the El Estero WRP.
  - Other options not investigated for sending wastewater to Santa Barbara could include:
    - Installation of a force main to transfer either secondary effluent or raw wastewater.
    - Full EQ of raw wastewater at Montecito followed by connection to the existing Santa Barbara wastewater collection system.
    - Transfer of MSD secondary effluent directly to the effluent of the El Estero WRP.
  - Impacts of climate change, such as sea level rise and permitting concerns, were not included in Carollo's scope of work. The alternatives for DPR in Santa Barbara pose the most risk based on conveyance path and topographic issues in terms of sea level rise, and, therefore, future analyses during the design phase would need to incorporate potential California Coastal Commission and Regional Water Quality Control Board input.

ES.9 Preferred Project and Next Steps

For Montecito to move forward with a reuse project, the next step is to identify the preferred project. The analysis above showed the highest ranking for Project 2 - IPR in Carpinteria (Groundwater Storage), which at this time is the preferred project.

For each of the project options, some high-level next steps have been identified and are presented in Table ES.9.

Moving ahead with Project 2, then, dictates pursuit of grant funding, predesign and 30 percent design, and initiating the CEQA process. Moving through predesign and 30 percent design provides much more accurate cost estimates, which, coupled with grant funding, will refine the economic viability of Project 2. Once completed, Montecito can revisit all project options to determine whether the preferred project should continue moving forward. It is possible that further analysis and other future unknown considerations may lead to the desire to pivot to a different project option.

Table ES.9 Potential Next Steps for Each Reuse Project Alternative

	Next Steps
Project 1: NPR in Montecito	• Confirm recycled water customers and verify water quality expectations to determine whether RO is needed • Secure access to freeway undercrossing(s) • Initiate CEQA and predesign/30 percent design
Project 2: IPR in Carpinteria (Groundwater Storage)	• Develop a memorandum of understanding or other documentation that defines terms of partnership between participating agencies • Coordinate with CVWD on additional groundwater basin modeling to confirm capacity • Secure access to freeway undercrossing • Pilot test secondary DAF if MBR is not the selected wastewater treatment process • Initiate CEQA and predesign/30 percent design • Position for and submit for grant funding
Project 3: IPR in Carpinteria (Purification in Carpinteria)	• Develop a memorandum of understanding or other documentation that defines terms of partnership between participating agencies • Coordinate with CVWD on additional groundwater basin modeling to confirm capacity • Pilot test secondary DAF if MBR is not the selected wastewater treatment process • Initiate CEQA, predesign/30 percent design, and design to minimize schedule impact to the CAPP project • Position for and submit for grant funding
Project 4: DPR in Montecito	• Move forward with design and implementation of a demonstration facility • Begin developing public outreach plan • Monitor DPR regulations due by end of 2023
Project 5: DPR in Santa Barbara	• Develop a memorandum of understanding or other documentation that defines terms of partnership between participating agencies • Based on project timing and selected alternative, determine what investments are needed at MSD WWTP if plant will be decommissioned in the 15-year horizon

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 1
MSD FLOW AND NPDES PERMIT ANALYSIS

DRAFT FINAL | September 2022

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 1
MSD FLOW AND NPDES PERMIT ANALYSIS

DRAFT FINAL | September 2022

This document is released for the purpose of information exchange review and planning only under the authority of Farzaneh Shabani, September 1, 2022, California CH-6944.

Contents

Technical Memorandum 1 - MSD Flow and NPDES Permit Analysis

Appendices

Tables

Figures

Abbreviations

ADWF	average dry weather flow
Ammonia-N	Ammonia Nitrogen
Carollo	Carollo Engineers, Inc.
CBOD	carbonaceous biochemical oxygen demand
City	City of Santa Barbara
DDT	Dichlorodiphenyltrichloroethane
DPR	direct potable reuse
EQ	flow equalization
fps	feet per second
gpd	gallons per day
HCH	Hexachlorocyclohexane
I/I	infiltration/inflow
IPR	indirect potable reuse
lb/d	pounds per day
LVMWD	Las Virgenes Municipal Water District
µg/L	micrograms per liter
MBR	membrane bioreactor
MD	maximum day
MG	million gallons
mgd	million gallons per day
mg/L	milligrams per liter
MM	maximum month
MSD	Montecito Sanitary District
MWD	Montecito Water District
N	Nitrogen
N/A	not applicable
NPDES	National Pollutant Discharge Elimination System
NPR	non-potable reuse
Ocean Plan	California Ocean Plan
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyls
pCi/L	picoCuries per liter
PF	peaking factor
PWWF	peak wet weather flows
RO	reverse osmosis
ROC	reverse osmosis concentrate
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin

TM	technical memorandum
TSS	total suspended solids
TUa	toxic unit-acute
TUc	toxic unit-chronic
WQO	water quality objectives
WWTP	wastewater treatment plant

Technical Memorandum 1

MSD FLOW AND NPDES PERMIT ANALYSIS

1.1 Introduction

This project will provide guidance to Montecito Water District (MWD) and Montecito Sanitary District (MSD) for implementation of recycled water and the beneficial use of treated wastewater from the community of Montecito. The project seeks to identify the best method of maximizing wastewater reuse capabilities thus producing a new local drought proof water supply for the community and reducing the discharge of treated wastewater to the ocean. The analysis will consider local and regional partnerships, non-potable and potable reuse alternatives, and various treatment methods and technologies. The potential options included in the study are as follows:

1. **Montecito Non-Potable Reuse (NPR)** – local project producing tertiary quality water for irrigation of large landscapes in Montecito.
2. **Carpinteria Indirect Potable Reuse (IPR)** – regional project producing purified water involving a partnership with neighboring special district(s) and the use of the Carpinteria Groundwater Basin.
3. **Montecito Direct Potable Reuse (DPR)** – local project in Montecito producing purified water and utilizing raw water augmentation at the Montecito Water District water treatment facility.
4. **Santa Barbara DPR** – regional project producing purified water and involving a partnership with the City of Santa Barbara (City) and raw water augmentation at the City's regional water treatment facility.

Figure 1.1 shows the potential regional partners.

Figure 1.1 Potential Regional Partners

The focus of this technical memorandum (TM) is to establish the current and future anticipated flows as well as solids and nutrients loads from the Montecito service area to the MSD wastewater treatment plant (WWTP). The range of flows and mass loads have a critical role in determining the feasibility of regional partnerships, as well as modifications to the existing plant.

Additionally, with implementation of recycled water, the current discharges from MSD through the outfall will decrease considerably and under most scenarios will result in smaller, more concentrated discharge to the ocean. Therefore, it is important to compare future anticipated discharges with National Pollutant Discharge Elimination System (NPDES) and California Ocean Plan (Ocean Plan) requirements and identify pollutants in the discharge that have the potential to exceed effluent limitations based on the Ocean Plan water quality objectives (WQOs).

Lastly, all future discharges from the MSD will still go through the outfall. Therefore, it is important to understand the hydraulics of the outfall and the minimum discharge requirements to keep the existing duckbill valves operational.

All of the above items were investigated and results and conclusions are summarized in this TM.

1.2 Objectives

The main objectives of this TM are:

- Reviewing current and anticipated future wastewater flows to establish representative average dry weather flow (ADWF) and peak wet weather flows (PWWF) for alternative facility sizing needs.
- Reviewing the current and future solids and nutrients loads.
- Estimating concentrations and mass loads of constituents regulated by the Ocean Plan and NPDES permit for effluent discharge; and.
- Establishing the minimum flow required to keep the outfall operational.

1.3 Available data

The following data was reviewed to perform the analysis that is summarized in this TM:

- Influent flow, Carbonaceous Biochemical Oxygen Demand (CBOD), Total Suspended Solids (TSS) and Ammonia from January 2017 - October 2021 and Oil and Gas from February 2021 - May 2021.
- MSD WWTP annual Self-Monitoring Reports: 2016-2020.

1.4 Flow and Mass Loads

This section summarizes the current and future flow conditions and mass loads to MSD. Understanding the range of flow and mass loads is important to determine the feasibility of potential future process modifications at MSD or the potential to divert flows from MSD to other treatment plants in the region.

WWTPs are designed to achieve NPDES permit compliance not only under average conditions, but for the full range of flow and load conditions and for permit compliance during all months and all days of the year. Therefore, establishing the influent wastewater design criteria involves conducting a statistical analysis of facility's historical flow and pollutant loading data to estimate the incidence of higher flows and loads and define the basis of design conditions. Design conditions that are identified in this section are as follows:

- **Average:** The average daily value of a wastewater characteristic for the past five years.
- **Average Dry Weather:** The average value of a wastewater characteristic for the dry weather season, typically July through September. This condition is used to consider the ability to take tankage out of service for maintenance while there is little risk of wet flows.
- **Maximum Month (MM):** The average flow or loading value for a wastewater characteristic from the month with the highest monthly average. This value is also known as the "design value", because it corresponds to a worst-case loading for a monthly average limit in the NPDES permit. MM loading is also typically used to define maximum throughput needs for solids handling systems.
- **Maximum Day (MD):** The highest 24-hour average value of a wastewater characteristic. MD load conditions are typically used to define maximum aeration capacity in secondary treatment with advanced Nitrogen (N) removal. MD flow is typically considered when evaluating flow equalization (EQ) or the hydraulic capacity of liquid stream facilities.

1.4.1 Current Flows and Loads

The influent flow, CBOD, TSS, and ammonia loads were analyzed for 2017-2021 and results are summarized in Table 1.1 and presented on Figures 1.2 - 1.5.

Table 1.1 Flows and Loads for 2017 - 2021

Parameter		Average	Maximum Month	Maximum Day
Flow (mgd)		0.62(1)	1.05(2)	3.99(2), (3)
CBOD	(lb/d)	1,263	2,407	3,602(5)
	(mg/L)	245	434	616
TSS	(lb/d)	2,203	5,092	5,853(4), (5)
	(mg/L)	422	865	1,262
Ammonia	(lb/d)	218	300	358(5)
	(mg/L)	39.5	54.8	66.8

Notes:
Abbreviation: I/I - infiltration/inflow; lb/d - pounds per day; mgd - million gallons per day; mg/L - milligrams per liter.
(1) 0.62 mgd includes flow data between 12/2017 - 1/2019. The flow data within this time frame was influenced as a result of fire evacuations. The average flow excluding this time frame was 0.64 mgd.
(2) 1.05 mgd is maximum monthly flow for February 2017, which includes flow data for 2/17/2017 and 2/18/2017. The City received over 5-inchs of rain on 2/18/2017 and 1.3 inches on 2/17/2017. The 2/18/2017 was a 10 year, 24-hour event.
(3) Maximum Average Daily Flow including the 2/17/2017 and 2/18/2017 flows. The next Maximum Average Daily Flow excluding 2/17/2017 and 2/18/2017 was 1.53 mgd. Maximum Instantaneous Flow was 7.76 mgd including 2/17/2017-2/18/2017. The next Maximum Instantaneous Flow excluding 2/17/2017 and 2/18/2017 was 5.9 mgd.
(4) Higher TSS loading of 10,635 lb/d has been recorded on 12/26/2019, which is excluded as an outlier.
(5) CBOD, TSS and Ammonia were not measured on 2/17/2017 and 2/18/2017. Although I/I may dilute the influent, but higher loads were anticipated.

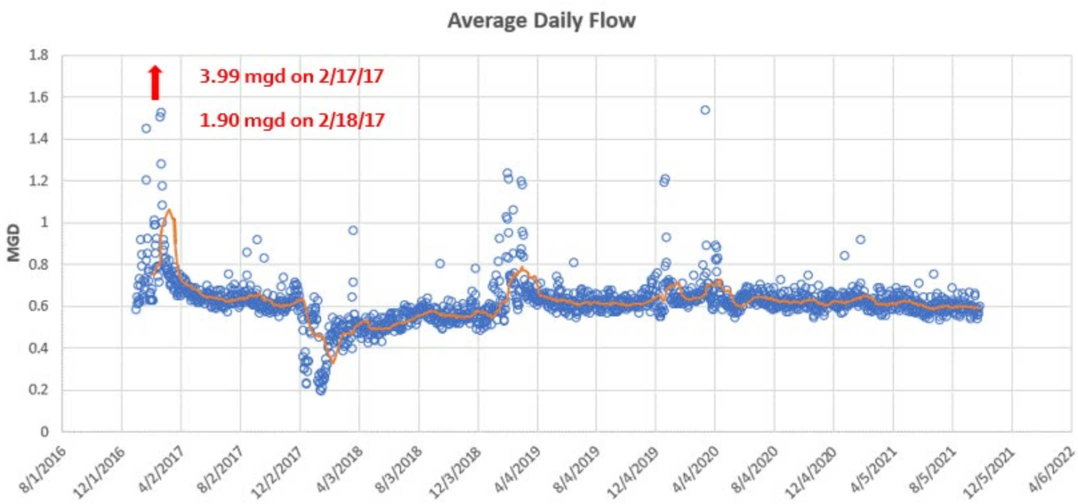


Figure 1.2 Current Influent Flow

The average daily flow for 2017-2021 was 0.62 mgd and the average daily flow for the months of July-September was 0.61 mgd over the same period. Therefore, the current ADWF is assumed to be 0.62 mgd.

The MM flow was 1.06 mgd and 99 percent of average daily flows were below this value between 2017 - 2021. Figure 1.3 presents the average daily flow exceedance frequency. There were 16 days with average daily flows above 1.06 mgd, with MD flow of 3.99 mgd and maximum instantaneous flow of 7.76 mgd. Therefore, the PWWF is assumed to be 7.76 mgd. The high peak storm event in 2017 creates important concerns related to equalization of flows for various potential projects, such as equalization ahead of MBR. As a result, the project team evaluated the storm event in more detail, including a comparative analysis in Santa Barbara. That analysis is captured in Appendix A of this TM.

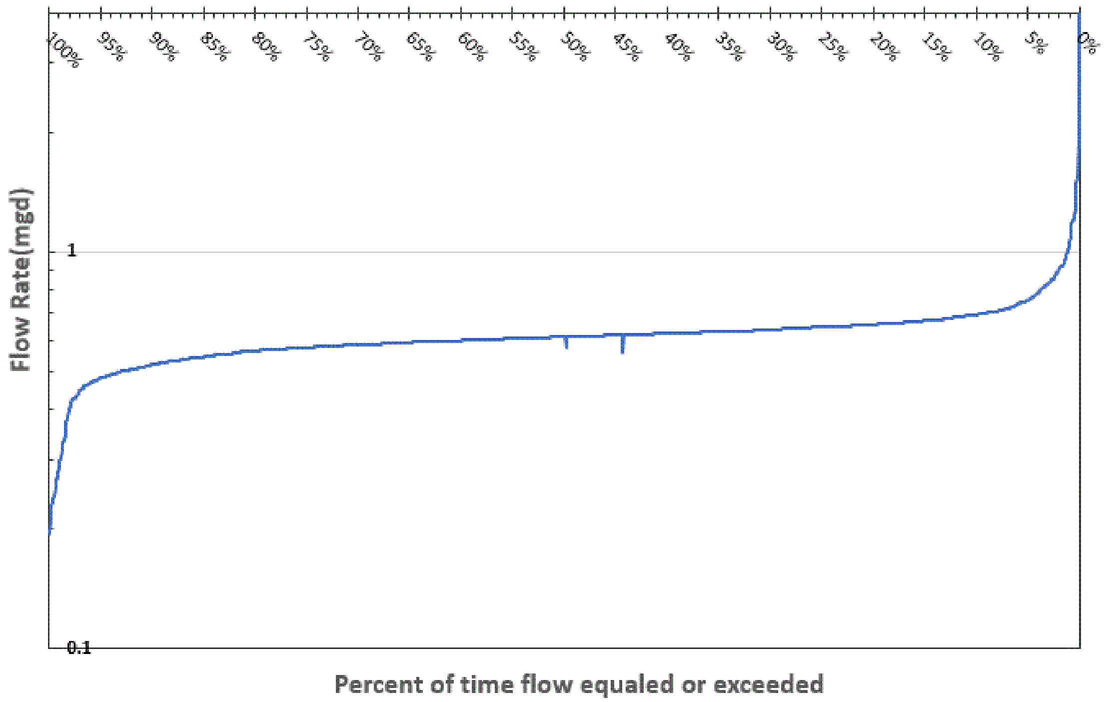


Figure 1.3 Average Daily Flow Exceedance Frequency for 2017 - 2021

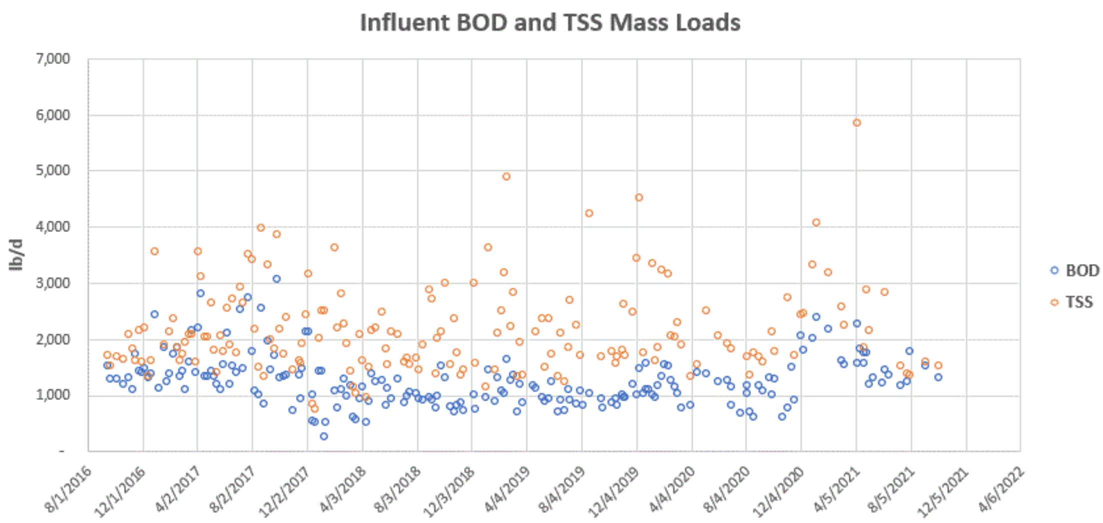


Figure 1.4 Historical Mass Loads: BOD and TSS

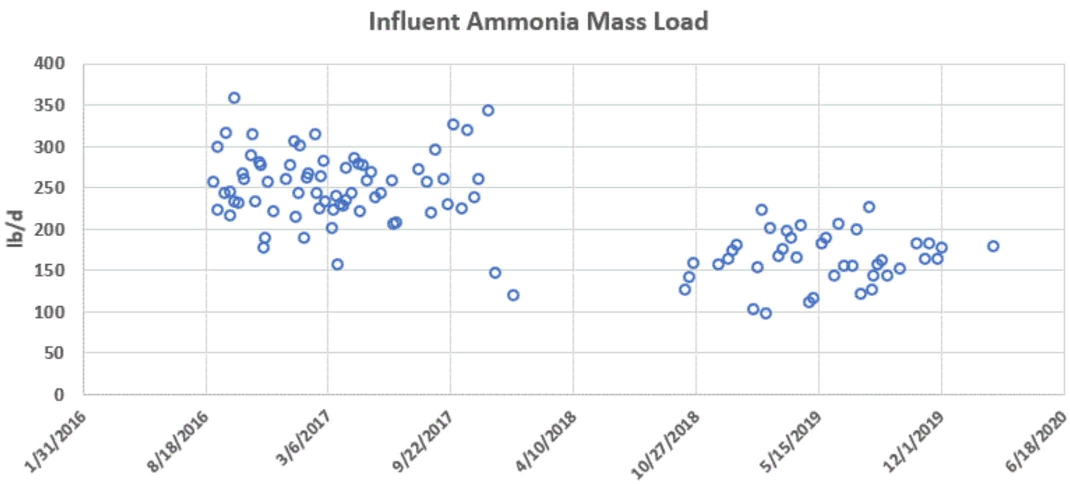


Figure 1.5 Historical Mass Loads: Ammonia

1.4.2 Sources and Quantity of Anticipated Additional Flow

The future septic to sewer conversion are described in this section, along with basis for estimating the quantity of the additional flow.

There are 588 properties within MSD's service area that are on septic systems, some of which already are connected to the sewer, others of which can be potentially connected as part of the Main Extension Project, and still others that cannot be readily connected to the sewer system. Table 1.2 summarizes these 588 properties as it pertains to sewer connections.

Table 1.2 Future Flows

Parameter	Number of Properties	Total Flow(1), gpd
Properties on Septic with Sewer Currently Available (but not used)	100	12,730
Properties on Septic - Sewer not Available, Possible Sewer Connection (Main Extension Project)	159	30.210
Total New Flows		**42,940**
Properties on Septic - Sewer not Available	329	62,510
Total Septic Flows		**105,540**

Notes:
Abbreviation: gpd - gallons per day.
(1) Average flow per property = 190 gpd based on estimate provided by MSD.

Future septic to sewer connections that can feasibly tie into MSD add up to 42,940 gpd, increasing the influent ADWF to 0.66 mgd. In other to account for other potential factors, such as population growth within the service area, for the purpose of this study the future ADWF is assumed to be 0.7 mgd. Other flows will also increase, but the impact of I/I can only be estimated for PWWF. A conservative assumption is for all flows to increase based upon a ratio of future average flows to current average flows (0.7 mgd/0.62 mgd), which is 1.13.

1.4.3 Flow Equalization

For projects under consideration that would send raw wastewater to one of the regional partners, equalization needs to performed for 100 percent of all flow for some options (e.g., for sending wastewater to Carpinteria). It is assumed that equalization would occur at the MSD site due to proximity, control, and available space. There may be opportunities for equalization at other sites, but such sites have not been evaluated for this project.

The need for EQ results from the diurnal variations in flows tributary to the MSD and the relatively narrow band of allowable additional flow to other regional WWTPs. EQ also provides benefit for greater capture of water for recycling at MSD. The required maximum EQ volume was assessed based on limiting flow through the plant to the future ADWF of 0.7 mgd and the 8 wet weather events in the past five years. Figure 1.6 shows an example diurnal flow pattern during a wet weather event and Table 1.3 summarizes the EQ volume calculation.

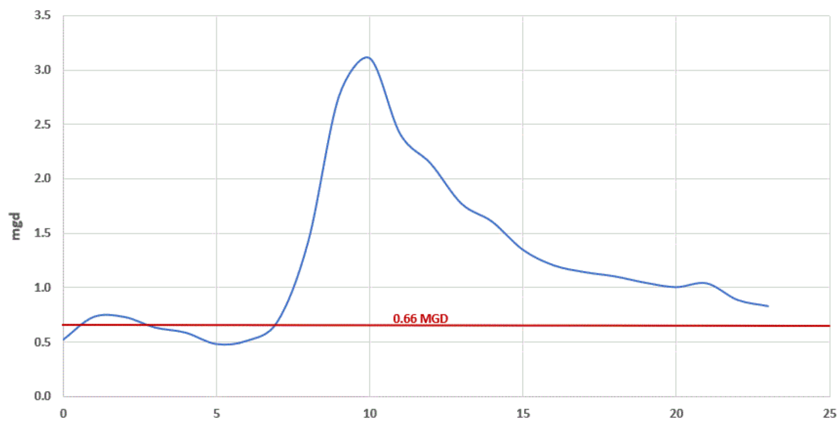


Figure 1.6 Diurnal Curve During a Wet Weather Event (2/2/2017) - Flows Multiplied by 1.13

Table 1.3 EQ Volume Estimates

Date	Average Daily Flow (mgd)	EQ Volume Required to Equalize Flow at 0.7 mgd (MG)(1)
2/17/2017	3.99	2.67
2/18/2017	1.90	2.27
2/19/2017	1.50	0.97
2/2/2019	1.23	0.63
3/6/2019	1.18	0.71
12/25/2019	1.20	0.52
3/16/2020	1.53	0.95
1/28/2021	0.91	0.31

Notes:
Abbreviation: MG - million gallons.
(1) Diurnal flows on these days were also multiplied by 1.13 factor to estimate future EQ volume needs.

For a future 0.7 mgd ADWF flow condition, the maximum total EQ volume needed to equalize the maximum PWWF is 2.7 MG. However, based on potential available flow capacity at other regional plants (as documented in TM 2 (*CSD and Santa Barbara WRP Capacity*), another scenario is to equalize the MSD flows at a higher flowrate, which in turn will result in smaller EQ volume. For instance, an EQ with 2.5 MG storage capacity requires the plant be able to treat 1 mgd during wet weather events. An EQ with 2.1 MG storage capacity will require the plant be able to treat 1.5 mgd during wet weather events. This determination is driven primarily by the historical diurnal flow analysis described above.

One of the options for EQ is to place a new storage tank, above or below grade, within MSD's existing footprint. There are several factors that need to be further investigated to identify the optimal siting and operation of the storage tank, which is outside the scope of this TM. For instance for an above grade tank, steel or concrete, plant's hydraulics needs to be reviewed to identify the potential water depth and pumping requirements. For this option, pumping would be required to divert flows to the storage tank. Whether the existing influent pumps can provide enough head or influent pumping upgrades are required remains to be verified. If the hydraulic grade line of the tank is high enough, it may be possible to flow from equalization to the aeration tanks by gravity. If the hydraulic grade line is not high enough, then a new equalization pump station would be needed.

Further structural and geotechnical review of the site condition is required to evaluate different approaches and identify the best approach.

Since the EQ will be for raw sewage, odor control and cleaning facilities should be provided.

1.5 Outfall: Description of the Outfall and Flow Requirements for Optimal Operation

For a future project in which MSD wastewater is reclaimed, the amount of flow discharged to the outfall will be reduced. For a potable reuse project in which all flow is purified (e.g., treated with reverse osmosis (RO)), the effluent to the outfall will make up only about 20 percent of the total influent flow. For a project that treats about 0.7 mgd, the effluent to the outfall would thus be about 0.14 mgd. Under this low flow scenario, it is useful to understand if the current ocean outfall system can be operated without concerns over discharge of the reverse osmosis concentrate (ROC) or requirements for an extensive maintenance regime to avoid pipeline scaling.

To answer this question, the project team reviewed the outfall As Built drawings, as well as recent inspection reports. Figure 1.7 shows the outfall profile. The outfall is an internal diameter of 18 inches cast iron pipe that extends approximately 1,500 feet into the ocean and ends with a 90-foot diffuser section, with 10 ports with duckbill check valves.

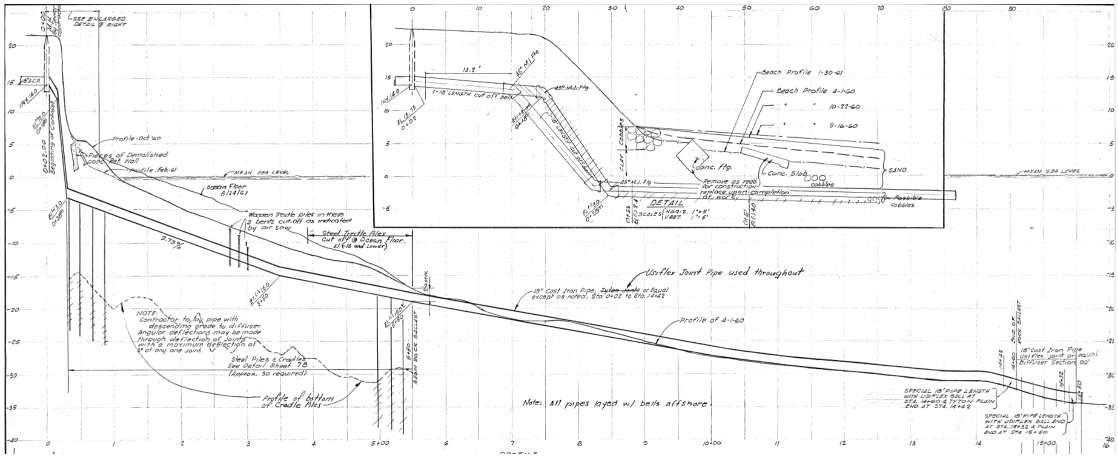


Figure 1.7 MSD As-Built Outfall Section View

The MSD effluent flows by gravity into the outfall and due to the plant hydraulics and the available static head, the outfall remains full at all times and the duckbill valves always remain open, and thus is not expected to be a challenge.

Regarding scaling of the outfall line, the main factor influencing the scaling potential is the discharge velocity in the outfall, which equates to time. The ROC has anti-scalant to minimize scaling within the RO, but even with anti-scalant present, minerals will precipitate with sufficient time. Studies done by Carollo Engineers, Inc. (Carollo) at the Las Virgenes Municipal Water District (LVMWD) on ROC from their demonstration facility, documented the following scale inhibition time frames:

- 48 hours: at a 75 percent RO Recovery with 0.5 mg/L of antiscalant.
- 24 hours: at a 80 percent RO Recovery with 1.5 mg/L of antiscalant.
- 8 hours: at a 85 percent RO Recovery with 2 mg/L of antiscalant.

The point of this information is that with the right amount of antiscalant and at the right RO percent recovery, scaling can be inhibited for a reasonable period of time.

Specific to this project, the outfall has a total volume of approximately 2,650 ft^3. With current ADWF of 0.62 mgd, the average discharge velocity is 0.54 feet per second (fps) and travel time in the outfall is 46 minutes. In the future, the velocity may drop to as low as 0.1 fps and the travel time in the outfall may increase to approximately 230 minutes (less than 4 hours). Accordingly, scaling of the outfall line is not anticipated to be a problem.

1.6 NPDES Permit and Ocean Plan Requirements

1.6.1 Summary of Current Permit and Discharge Requirements

MSD currently provides full secondary treatment to the entire flow and discharges secondary effluent to the Pacific Ocean through a 1,500-foot outfall. The current draft NPDES permit (No. CA0047899), to be adopted August 25 or August 26, 2022, shall be effective on November 1, 2022 and expire October 31, 2027. This draft permit provides a dilution credit of 89 to 1. With implementation of water recycling through NPR, IPR or DPR, future discharge through the existing outfall will become a smaller, more concentrated stream because, where the water recycling process involves RO, a concentrate flow is generated, which is approximately 15-20 percent of the treated volume.

In this section the Ocean Plan requirements are summarized and future anticipated concentration of constituents in MSD discharge are reviewed to identify any constituent that may impose a challenge for meeting the effluent limits.

Tables 1.4 - 1.6 summarize the Ocean Plan WQOs. Table 1.7 summarizes the constituent concentrations and mass loads that were detected in the plant's effluent grab samples between 2016-2020 as part of the NPDES monitoring program. Also, Table 1.7 presents the anticipated concentration of constituents in the ROC based on a conservative assumption that 100 percent of the constituents will be removed by the RO process and become concentrated in the ROC, and that only ROC would be discharged.

Table 1.4 Ocean Plan - Water Quality Objectives: Objectives for Protection of Marine Aquatic Life

Limiting Concentration (Ocean Plan Water Quality Objective)				
Constituent	Unit	6-Month Median	Daily Maximum	Instantaneous Maximum
Arsenic	µg/L	8	32	80
Cadmium	µg/L	1	4	10
Chromium (Hexavalent) (see below, a)	µg/L	2	8	20
Copper	µg/L	3	12	30
Lead	µg/L	2	8	20
Mercury	µg/L	0.04	0.16	0.4
Nickel	µg/L	5	20	50
Selenium	µg/L	15	60	150
Silver	µg/L	0.7	2.8	7
Zinc	µg/L	20	80	200
Cyanide	µg/L	1	4	10
Total Chlorine Residual	µg/L	2	8	60
Ammonia-N	µg/L	600	2,400	6,000
Acute Toxicity	TUa	N/A	0.3	N/A
Chronic Toxicity	TUc	N/A	1	N/A
Phenolic Compounds (non-chlorinated)	µg/L	30	120	300
Chlorinated Phenolics	µg/L	1	4	10
Endosulfan	µg/L	0.009	0.018	0.027
Endrin	µg/L	0.002	0.004	0.006
HCH	µg/L	0.004	0.008	0.012
Radioactivity	See 22 CCR 17 Section 30253			

Note:
Abbreviations: Ammonia N - Ammonia Nitrogen; HCH - Hexachlorocyclohexane; ug/L - micrograms per liter; N/A - not applicable; TUa - toxic unit-acute; TUc - toxic unit-chronic.

Table 1.5 Ocean Plan - Constituents for Protection of Human Health - Noncarcinogens

Constituent	Unit	30 day average
Acrolein	µg/L	220
Antimony	µg/L	1,200.00
bis(2-chloroethoxy) methane	µg/L	4.4
bis(2-chloroisopropyl) ether	µg/L	1,200.00
chlorobenzene	µg/L	570
chromium (III)	µg/L	190,000.00
di-n-butyl phthalate	µg/L	3,500.00
dichlorobenzenes	µg/L	5,100.00
diethyl phthalate	µg/L	33,000.00
dimethyl phthalate	µg/L	820,000.00
4,6-dinitro-2-methylphenol	µg/L	220
2,4-dinitrophenol	µg/L	4
ethylbenzene	µg/L	4,100.00
fluoranthene	µg/L	15
hexachlorocyclopentadiene	µg/L	58
nitrobenzene	µg/L	4.9
thallium	µg/L	2
toluene	µg/L	85,000.00
tributyltin	µg/L	0.0014
1,1,1-trichloroethane	µg/L	540,000.00

Table 1.6 Ocean Plan - Constituents for Protection of Human Health - Carcinogens

Constituent	Unit	30 day average
acrylonitrile	µg/L	0.1
aldrin	µg/L	0.000022
benzene	µg/L	5.9
benzidine	µg/L	0.000069
beryllium	µg/L	0.033
bis(2-chloroethyl) ether	µg/L	0.045
bis(2-ethylhexyl) phthalate	µg/L	3.5
carbon tetrachloride	µg/L	0.9
chlordane	µg/L	0.000023
chlorodibromomethane	µg/L	8.6
chloroform	µg/L	130
DDT	µg/L	0.00017
1,4-dichlorobenzene	µg/L	18
3,3'-dichlorobenzidine	µg/L	0.0081

Constituent	Unit	30 day average
1,2-dichloroethane	µg/L	28
1,1-dichloroethylene	µg/L	0.9
dichlorobromomethane	µg/L	6.2
dichloromethane	µg/L	450
1,3-dichloropropene	µg/L	8.9
dieldrin	µg/L	0.00004
2,4-dinitrotoluene	µg/L	2.6
1,2-diphenylhydrazine	µg/L	0.16
halomethanes	µg/L	130
heptachlor	µg/L	0.00005
heptachlor epoxide	µg/L	0.00002
hexachlorobenzene	µg/L	0.00021
hexachlorobutadiene	µg/L	14
hexachloroethane	µg/L	2.5
isophorone	µg/L	730
N-nitrosodimethylamine	µg/L	7.3
N-nitrosodi-N-propylamine	µg/L	0.38
N-nitrosodiphenylamine	µg/L	2.5
PAHs	µg/L	0.0088
PCBs	µg/L	0.000019
TCDD equivalents	µg/L	3.9E-09
1,1,2,2-Tetrachloroethane	µg/L	2.3
tetrachloroethylene	µg/L	2
toxaphene	µg/L	0.00021
trichloroethylene	µg/L	27
1,1,2-trichloroethane	µg/L	9.4
2,4,6-trichlorophenol	µg/L	0.29
vinyl chloride	µg/L	36

Notes:
Abbreviations: DDT - Dichlorodiphenyltrichloroethane; PAH - Polycyclic aromatic hydrocarbons; PCB - Polychlorinated biphenyls; TCDD - 2,3,7,8-Tetrachlorodibenzo-p-dioxin.

Table 1.7 5 Years of Effluent Data - Constituents that were Detected in the Plant's Effluent Between 2016-2020

Parameter	Measured Concentration 2016 (ug/L)	Calculated Mass Load Based on Average Daily Flow of 0.61 mgd on 6/6/2016 (lb/d)	Measured Concentration 2017 (ug/L)	Calculated Mass Load Based on Average Daily Flow of 0.65 mgd on 5/3/2017 (lb/d)	Measured Concentration 2018 (ug/L)	Calculated Mass Load Based on Average Daily Flow of 0.56 mgd on 9/5/2018 (lb/d)	Measured Concentration 2019 (ug/L)	Calculated Mass Load Based on Average Daily Flow of 0.59 mgd on 8/7/2019 (lb/d)	Measured Concentration 2020 (ug/L)	Calculated Mass Load Based on Average Daily Flow of 0.65 mgd on 7/15/2020 (lb/d)
Acute Toxicity	0.41(1)		0.5(1)		0(1)		0.51(1)		0(1)	
Antimony, Total Recoverable (ug/L)	0.786	0.0040	0.65	0.0035	0.78	0.0036	0.72	0.0035	0.32	0.0017
Arsenic, Total Recoverable (ug/L)	1.27	0.0065	0.6	0.0032	0.94	0.0044	0.949	0.0047	0.69	0.0037
Beryllium, Total Recoverable (ug/L)	0.150	0.0008	0	0	0	0	0	0	0	0.0000
Bis (2-Ethylhexyl) Phthalate (ug/L)	0.785	0.0040	1.96	0.0106	0	0	0	0	0	0.0000
Cadmium, Total Recoverable	0.315	0.0016	0.077	0.0004	0	0	0	0	0.11	0.0006
Chloroform	37.8	0.1920	40.2	0.2176	56.2	0.2620	57.9	0.2844	72	0.3897
Chromium (III)	0	0	0	0	0.32	0.0015	0.711	0.0035	0	0.0000
Chromium (Total)	1.82	0.0092	1.09	0.0059	0.59	0.0028	0.995	0.0049	0.34	0.0018
Chromium (VI)	0	0.000	6.77	0.0366	0.266	0.0012	0.284	0.0014	0	0.0000
Chronic Toxicity (Species 1)	10.00(2)		1(2)		10(2)		10(2)		10(2)	
Chronic Toxicity (Species 2)	10.00(2)		10(2)		10(2)		10(2)		10(2)	
Chronic Toxicity (Species 3)	10.00(2)		10(2)		10(2)		10(2)		10(2)	
Copper, Total Recoverable	30.8	0.1564	23.4	0.1266	17.8	0.0830	18.7	0.0919	23	0.1245
Di-n-butyl Phthalate	0.598	0.0030	0	0	0	0	0	0	0.23	0.0012
Dibromochloromethane	86.2	0.4378	21.7	0.1174	28.4	0.1324	30.9	0.1518	11	0.0595
Dichlorobromomethane	0	0	38.5	0.2084	56.2	0.2620	44	0.2161	36	0.1948
Halomethanes, Sum	32.8	0.1666	2.19	0.0119	2.79	0.0130	135.26	0.6644	0.44	0.0024
Lead, Total Recoverable	1.19	0.0060	0.329	0.0018	0.27	0.0013	0.26	0.0013	0.09	0.0005
Mercury, Total Recoverable	0.0358	0.0002	0.00465	0.0000	0	0	0.0122	0.0001	0.00	0.0000
Nickel, Total Recoverable	4.30	0.0218	5.8	0.0314	3.74	0.0174	4.1	0.0201	3.9	0.0211
Radioactivity	20.99	0.1066	38.07	0.2060	30.28	0.1412	43.36	0.2130	43.33	0.2345
Selenium, Total Recoverable	2.00	0.0102	2.51	0.0136	1.46	0.0068	1.34	0.0066	0.41	0.0022
Silver, Total Recoverable	0.0430	0.0002	0.132	0.0007	0.023	0.0001	0.055	0.0003	0.000	0.0000
Tetrachloroethene	0.177	0.0009	0	0	0	0	0	0	0	0.0000
Thallium, Total Recoverable	0.129	0.0007	0	0	0	0	0	0	0	0.0000
Toluene	0	0	0.363	0.0020	0.649	0.0030	0	0	0	0.0000
Zinc, Total Recoverable	82.3	0.4180	48.8	0.2641	72.6	0.3385	125	0.6140	55	0.2977

Notes:
(1) TUa.
(2) TUc.

-This Page Intentionally Left Blank-

Table 1.8 Concentration of Constituents in the Future ROC

Parameter	ROC - Conc. 85% Recovery 2016 (ug/L)	ROC - Conc. 85% Recovery 2017 (ug/L)	ROC - Conc. 85% Recovery 2018 (ug/L)	ROC - Conc. 85% Recovery 2019 (ug/L)	ROC - Conc. 85% Recovery 2020 (ug/L)	Maximum Concentration in the Ocean After Initial Dilution (ug/L)(1,2)	Ocean Plan Limit (ug/L)
Antimony, Total Recoverable	5.2	4.3	5.2	4.8	2.1	0.058	1,200 - 30 day average
Arsenic, Total Recoverable	8.5	4.0	6.3	6.3	4.6	3.061	8/32/80 6 month Median/Daily Max/ Instantaneous Max
Beryllium, Total Recoverable	1.00	0.00	0.00	0.00	0.00	0.011	0.033 - 30 day average
Bis (2-Ethylhexyl) Phthalate	5.2	13.1	0.0	0.0	0.0	0.146	3.5 - 30 day average
Cadmium, Total Recoverable	2.1	0.5	0.0	0.0	0.7	0.023	1/4/10 6 month Median/Daily Max/ Instantaneous Max
Chloroform	252.0	268.0	374.7	386.0	480.0	5.333	130 - 30 day average
Chromium (III)	0.0	0.0	2.1	4.7	0.0	0.052	190,000 - 30 day average
Chromium (Total)	12.1	7.3	3.9	6.6	2.3	0.134	-
Chromium (VI)	0.0	45.1	1.8	1.9	0.0	0.501	2/8/20 6 month Median/Daily Max/ Instantaneous Max
Copper, Total Recoverable(3)	205.3	156.0	118.7	124.7	153.3	**4.259**	**3/12/30** 6 month Median/Daily Max/ Instantaneous Max
Di-n-butyl Phthalate	4.0	0.0	0.0	0.0	1.5	0.044	3,500 - 30 day average
Dibromochloromethane	574.7	144.7	189.3	206.0	73.3	6.386	8.6 - 30 day average
Dichlorobromomethane	0.0	256.7	374.7	293.3	240.0	4.163	6.2 - 30 day average
Halomethanes, Sum	218.7	14.6	18.6	901.7	2.9	10.019	130 - 30 day average
Lead, Total Recoverable	7.9	2.2	1.8	1.7	0.6	0.088	2/8/20 6 month Median/Daily Max/ Instantaneous Max
Mercury, Total Recoverable	0.2	0.031	0.000	0.081	0.000	0.003	0.04/0.16/0.4 6 month Median/Daily Max/ Instantaneous Max
Nickel, Total Recoverable	28.7	38.7	24.9	27.3	26.0	0.430	5/20/50 6 month Median/Daily Max/ Instantaneous Max
Radioactivity(4)	139.9	253.8	201.9	289.1	288.9	3.212	
Selenium, Total Recoverable	13.3	16.7	9.7	8.9	2.7	0.186	15/60/150 6 month Median/Daily Max/ Instantaneous Max
Silver, Total Recoverable	0.3	0.9	0.2	0.4	0.0	0.168	0.7/2.8/7 6 month Median/Daily Max/ Instantaneous Max
Tetrachloroethene	1.2	0.0	0.0	0.0	0.0	0.013	2 - 30 day average
Thallium, Total Recoverable	0.9	0.0	0.0	0.0	0.0	0.010	2 - 30 day average
Toluene	0.0	2.4	4.3	0.0	0.0	0.048	85,000 - 30 day average
Zinc, Total Recoverable	548.7	325.3	484.0	833.3	366.7	17.170	20/80/200 6 month Median/Daily Max/ Instantaneous Max

Notes:
Abbreviation: pCi/L - picoCuries per liter.
(1) Calculated using maximum of ROC concentrations based on 2016 - 2020 data.
(2) Ocean concentration calculated using background seawater levels provided in Table 5 of the 2019 Ocean Plan. The resulting equation is (Ce + Dm Cs)/(Dm + 1), where Ce=calculated RO concentration, Dm=dilution, and Cs=seawater concentration. Background seawater concentrations in 2019 Ocean Plan Table 5 are as follows: Arsenic=3 µg/L; Copper=2 µg/L; Mercury=0.0005 µg/L; Silver=0.16 µg/L; Zinc=8 µg/L. The dilution ratio is 89 to 1.
(3) Anticipated copper concentration exceeded the 6 month median requirement of the Ocean Plan once.
(4) In pCi//L.

-This Page Intentionally Left Blank-

According to the data from the past 5 years, MSD has been continuously meeting the concentration and mass load requirements of the NPDES permit. Although the anticipated concentration of constituents in the ROC will be higher than the concentrations in the current discharge, the future mass load to the Pacific Ocean will be less than current loads calculated and summarized in Table 1.7 as described below.

The daily CBOD concentrations in the current discharge ranges from 1.7 - 32 mg/L and the average monthly concentrations ranges from 1.8 - 21 mg/L. As part of several different scenarios for recycled water treatment, there are water quality improvements which will drop the CBOD, such as the use of membrane bioreactors (MBR), the use of dissolved air flotation, and the use of advanced treatment for DPR (such as ozone and biofiltration). The type of particular improvement and the amount of CBOD reduction is speculative at this point, so those improvements are not considered in this analysis. However, future mass load of CBOD to the Pacific Ocean will be less than the current amount.

The daily TSS concentrations in the current discharge ranges from 1.7 - 29.9 mg/L and the average monthly concentrations ranges from 2.5 - 15.5 mg/L. The addition of tertiary treatment to the current treatment process will reduce the effluent TSS considerably and in the case of MBR or microfiltration/ultrafiltration will reduce it to almost non-detect. Therefore, if any of these improvements will be implemented, it is anticipated that the future TSS concentration and mass load will be close to zero.

Based on the analysis summarized in Table 1.8, the only constituent that has potential to exceed the Ocean Plan concentration limits is copper. This conclusion is based on limited available annual sample results compared with 6 months median concentration limit. The concentration of copper measured in 2016 would result in ROC concentration of 4.26 ug/L, which exceeds the 3 ug/L for 6 months median requirement according to the Ocean Plant. Similar to the CBOD discussion, some of the possible future improvements, such as MBR, will further reduce effluent copper concentrations. This is because these processes involve higher biosolid concentrations in the mixed liquor and higher copper removal as adsorbed to the biosolids.

Last, for copper, but applying to all constituents, other potable water reuse projects along the California coast have benefited from regulatory flexibility, in which dilution ratios are increased during periods of reduced effluent discharge, which will be the case for MSD. The concentrations in Table 1.8 are calculated based on the current dilution ratio of 89 to 1. However, the ROC flow will be 15-20 percent of the existing discharge to the ocean. Therefore, higher dilution credit is anticipated based on what has been granted to similar IPR projects in the central coast and can be estimated using a plume modeling tools. For instance, a dilution ratio of 127 to 1 can address the copper exceedance according to the available data. New outfall plume modeling and negotiation with the Regional Water Quality Control Board for new permit language would be required to obtain a 127 to 1 dilution[1].

Almost under all reuse scenarios, MSD will continue to discharge some amount of flow to the Pacific Ocean and therefore discharges should continue to meet the Ocean Plan requirements. Although the United States Environmental Protection Agency and the Regional Board are being

[1] The level of effort for modeling the outfall for increased dilution is significant and requires specialized expertise. Our experience is that this effort may cost about $80,000 and require 12 months to perform the work and gain regulatory approval.

more cautious of persistent constituents such as per-and polyfluoroalkyl substances and contaminants of emerging concern, there are no rigorous changes anticipated to the MSD's permit at this time.

1.7 Summary and Conclusions

The analysis within this TM evaluates:

1. The current and anticipated future flows to MSD, as well as mass loads. This information is important for analysis in other TMs to size treatment systems and transport systems. For example:
   a. The future ADWF is estimated to be 0.7 mgd. The current PWWF is 7.76 mgd and anticipated to increase to 8.76 mgd in the future.
   b. The current average effluent CBOD and TSS are 5.02 and 6.37 mg/L respectively. Both concentrations are anticipated to decrease with future plant improvements.
2. The EQ requirements for potential future reuse projects and regional partnerships. For example, the maximum EQ volume proposed to attenuate peak flows would need to be 2.67 MG based on 8 wet weather events in the past five years. This volume is sufficient to equalize the highest anticipated wet weather flows at 0.7 mgd. However, depending on the type of regional partnerships, the required EQ volume may differ.
3. The minimum flow requirements to keep the outfall operational and to minimize scaling was also investigated. Neither issue appear to be a challenge to future discharge.
4. The anticipated future discharge qualities based on available data was compared with Ocean Plan requirements to identify any constituent that has potential to exceed these requirements. The following conclusions can be made based upon this analysis are:
   a. Only one constituent, copper, is identified with potential to exceed the Ocean Plan requirements based on the limited data that was available. This issue can be addressed due to enhanced copper removal because of plant improvements.
   b. Also, the ROC flow is 15-20 percent of current total discharge. Therefore, higher dilution credit compared to the current 89 to 1 is expected. The higher dilution credit will address the copper exceedance issue. A plume modeling is required to estimate what the future dilution credit will be.

Appendix 1A

FEBRUARY 2017 STORM EVENTS AND EQ REQUIREMENTS

The influent flow to MSD was reviewed between 2017 – 2021. On 2/17/2017 and 2/18/2017 MSD recorded the two largest peaks of the influent flowrate in the past 5 years[2]. The City of Santa Barbara also received high flows, due to over 5-inches of rain on 2/18/2017 and 1.3 inches of rain on 2/17/2017 and the 2/18/2017. Based upon analysis of data, this was a 10 year, 24-hour event. Figure 1A.1 shows diurnal influent flows at El Estro and MSD between 2/17/2017 – 2/18/2017.

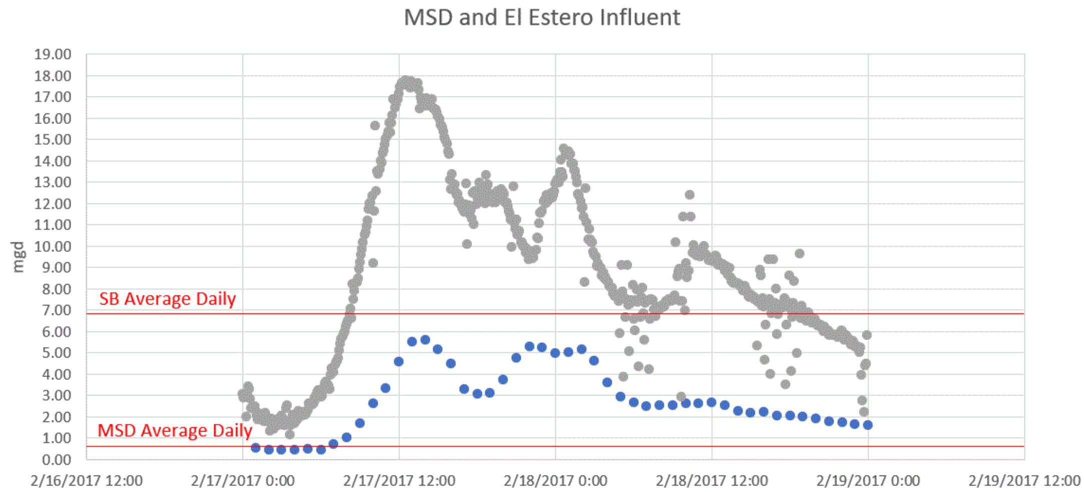


Figure 1A.1 Diurnal Influent Flows at El Estro and MSD between 2/17/2017 – 2/18/2017

During this storm event, influent flow at MSD of over 1.5 mgd sustained over 41 hours. The MSD influent flow measurements were the only source of flow data during this large storm event. The effluent flow gauge has a maximum value of 2.2462 mgd, so values above this are not recorded. Therefore, it was not possible to compare the influent flow to the effluent flow for verification purposes. The overall shape of the peak at MSD correlated with peak at El Estro; however, the peaking factor (PF) at MSD was 6.4 in comparison to the PF of 2.5 at El Estro. Thus, the storm flows happened at both sites, but the very large PF at MSD is questionable.

Equalization of flow to the MSD plant is most important as it pertains to MBR design, as an MBR can handle a PF of about 2, and thus needs some level of EQ. The MBR design for this project is for a peak flow of 1.53, as documented in the MBR TM.

The EQ volume requirement to equalize the flow at 1.53 mgd at MSD is summarized in Table 1A.1. To equalize a potential future peak similar to February 2017 and with the assumption that a sustained peak of over 41 hours can occur, total required EQ volume is 3.55 MG, which is costly and space consuming, and may not represent actual peak wet weather flow at MSD. For the purpose of this study and per discussions with MSD and MWD, it is assumed that the maximum EQ required will not exceed the volume dictated by the 2/12/2017 diurnal flow. Therefore, EQ volume of 2.1 MG will be used for planning purposes for the equalization of flow to a maximum throughput of 1.53 mgd.

[2] Influent flow data to MSD between 2014-2016 was downloaded from CIWQS and reviewed as well. The 2/17/2017 and 2/18/2017 influent flows were highest between 2014-2021.

Table 1A.1 EQ Volume Calculation Based on February 2017 Storm Events

Time	2/17/2018				2/18/2017			
	Flow (mgd)	Flow (mgd) X 1.13	Delta	V (MG)	Flow (mgd)	Flow (mgd) X 1.13	Delta	V (MG)
0	0.52	0.59	-0.04	0.00	5.02	5.68	0.17	0.17
1	0.42	0.47	-0.04	0.00	5.14	5.81	0.18	0.18
2	0.42	0.48	-0.04	0.00	4.63	5.23	0.15	0.15
3	0.44	0.49	-0.04	0.00	3.58	4.04	0.10	0.10
4	0.48	0.54	-0.04	0.00	2.94	3.32	0.07	0.07
5	0.45	0.51	-0.04	0.00	2.65	3.00	0.06	0.06
6	0.71	0.80	-0.03	0.00	2.50	2.82	0.05	0.05
7	1.02	1.15	-0.02	0.00	2.51	2.83	0.05	0.05
8	1.68	1.90	0.02	0.02	2.55	2.88	0.06	0.06
9	2.60	2.93	0.06	0.06	2.60	2.94	0.06	0.06
10	3.31	3.74	0.09	0.09	2.63	2.97	0.06	0.06
11	4.56	5.15	0.15	0.15	2.64	2.98	0.06	0.06
12	5.52	6.23	0.20	0.20	2.52	2.84	0.05	0.05
13	5.57	6.30	0.20	0.20	2.28	2.57	0.04	0.04
14	5.14	5.80	0.18	0.18	2.17	2.45	0.04	0.04
15	4.48	5.06	0.15	0.15	2.20	2.48	0.04	0.04
16	3.30	3.72	0.09	0.09	2.03	2.29	0.03	0.03
17	3.05	3.45	0.08	0.08	2.04	2.30	0.03	0.03
18	3.10	3.50	0.08	0.08	2.00	2.26	0.03	0.03
19	3.71	4.19	0.11	0.11	1.89	2.14	0.03	0.03
20	4.77	5.39	0.16	0.16	1.79	2.02	0.02	0.02
21	5.27	5.95	0.18	0.18	1.71	1.94	0.02	0.02
22	5.26	5.94	0.18	0.18	1.65	1.87	0.01	0.01
23	4.95	5.60	0.17	0.17	1.58	1.79	0.01	0.01
Total				**2.10**		**Total**		**1.45**

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 2
CSD AND SANTA BARBARA WRP CAPACITY

FINAL DRAFT | February 2022

carollo
WSC

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 2
CSD AND SANTA BARBARA WRP CAPACITY

FINAL DRAFT | February 2022

REGISTERED PROFESSIONAL ENGINEER
ANDREW THOMAS SALVESON
No. 56902
CIVIL
STATE OF CALIFORNIA

Contents

Tables

Figures

-This Page Intentionally Left Blank-

Abbreviations

ADWF	average dry weather flow
CSD	Carpinteria Sanitary District
Carollo	Carollo Engineers, Inc.
City	City of Santa Barbara
DPR	Direct Potable Reuse
El Estero	City of Santa Barbara El Estero Water Resource Center
IPR	Indirect Potable Reuse
mgd	million gallons per day
MSD	Montecito Sanitary District
MWD	Montecito Water District
NPDES	National Pollutant Discharge Elimination System
NPR	Non-Potable Reuse
PWWF	peak wet weather flow
TM	technical memorandum
WRP	water reclamation plants
WWTP	wastewater treatment plant

-This Page Intentionally Left Blank-

Technical Memorandum 2

CSD AND SANTA BARBARA WRP CAPACITY

2.1 Introduction

This project will provide guidance to Montecito Water District (MWD) and Montecito Sanitary District (MSD) for implementation of recycled water and the beneficial use of treated wastewater from the community of Montecito. The project seeks to identify the best method of maximizing wastewater reuse capabilities, thus producing a new local drought proof water supply for the community and reducing the discharge of treated wastewater to the ocean. The analysis considers local and regional partnerships, non-potable and potable reuse alternatives, and various treatment methods and technologies. The options included in the study are as follows:

1. **Montecito Non-Potable Reuse (NPR)** – local project producing tertiary quality water for irrigation of large landscapes in Montecito.
2. **Carpinteria Indirect Potable Reuse (IPR)** – regional project producing purified water involving a partnership with neighboring special district(s) and the use of the Carpinteria Groundwater Basin.
3. **Montecito Direct Potable Reuse (DPR)** – local project in Montecito producing purified water and utilizing raw water augmentation at the MWD water treatment facility.
4. **Santa Barbara DPR** – regional project producing purified water and involving a partnership with the City of Santa Barbara (City) and raw water augmentation at the City's regional water treatment facility.

Figure 2.1 shows the potential regional partners.

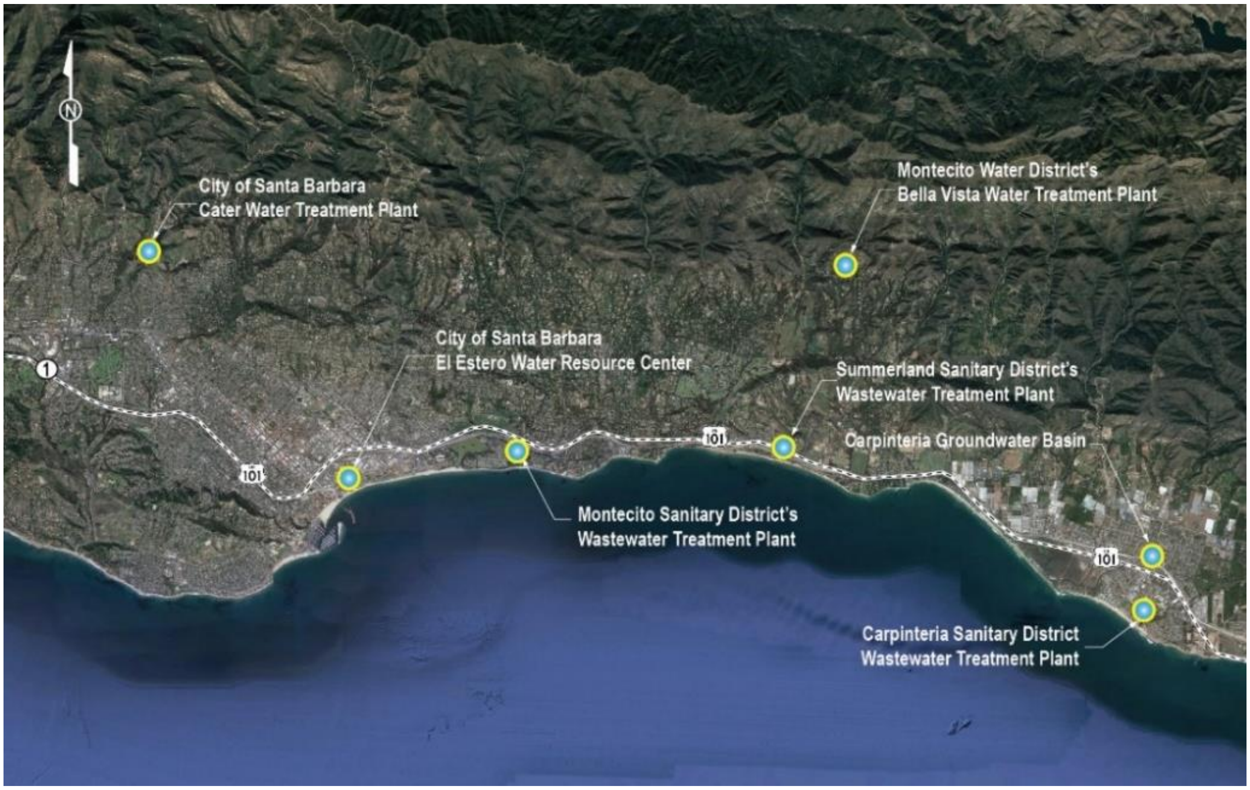


Figure 2.1 Potential Regional Partners

This technical memorandum (TM) provides important analysis of the wastewater treatment capacity of the Carpinteria Sanitary District (CSD) and City of Santa Barbara El Estero Water Resource Center (El Estero) to receive raw wastewater flow from the Montecito Sanitary District (MSD). With more flow from MSD, either of these potential regional partners could increase their water reuse production.

2.2 Objectives

The main objectives of this TM are:

- Review historical influent wastewater flows for the CSD to establish available capacity.
- Review historical influent wastewater and secondary effluent return flows for El Estero to establish available capacity.

2.3 Available Data

The following data was reviewed to perform the analysis that is summarized in this TM:

- CSD: hourly influent flows from December 2, 2020 to December 2, 2021.
- El Estero: monthly average day influent and monthly maximum day influent flows from January 2006 to June 2021.

- El Estero: average hourly influent, secondary effluent, and confluent flows for the month of October 2021[1].

2.4 Montecito Sanitary District Flow

A detailed flow analysis was completed for the MSD to establish average dry weather flow (ADWF), maximum day flow, peak wet weather flow (PWWF), and max instantaneous flow for both current and future conditions. The detailed flow analysis can be found in TM 1 MSD Flow and National Pollutant Discharge Elimination System (NPDES) Permit Analysis. For the analysis of the CSD and El Estero, it is assumed MSD would equalize all (or most) flow, noting that a future equalized ADWF for MSD is estimated at 0.70 million gallons per day (mgd). A few details on the equalization:

1) The equalization, which is presumed to be located at MSD, could be reduced in capacity if greater flows could be accepted at either CSD or El Estero[2].
2) Santa Barbara has expressed interest in providing equalization at or near El Estero, eliminating or minimizing the need for equalization at MSD.

The analysis below is intended to determine if capacity exists for the fully equalized flow (first) and for flows that are not fully equalized (second).

2.5 Carpinteria Sanitary District

CSD has a permitted capacity of 2.5 mgd. Flow through CSD is not significantly affected by any recycling within the facility or other outside flows. There is a small recycled flow that can be sent to the headworks of the facility when sludge is being pressed, but the recycled flow does not add substantially to the influent flow. Therefore, the measured influent flow can be used to analyze flow through CSD. With a permitted capacity of 2.5 mgd, and as shown further below, the CSD does have additional capacity. Figure 2.2 below shows the **hourly** influent flow to the CSD between December 2020 and December 2021. Figure 2.3 shows the **average daily** influent flow over the same period.

[1] The diurnal from October 2021 was used as an example. Note that the average of the diurnal in October 2021 was 6.54 mgd and average of monthly average day flows from Jan 2006 – Jun 2021 were 6.96 mgd, which are comparable.

[2] Equalization at MSD provides the benefit of reduced infrastructure sizes to transport flow from MWD to CSD or El Estero. There is limited space at CSD for equalization. There is potential for flow equalization at or near El Estero, which requires larger pipe sizes for flow transportation. Further discussion between project partners is required to identify the most suitable location for flow equalization.

Figure 2.2 Hourly Influent Flow to CSD – December 2020 to December 2021

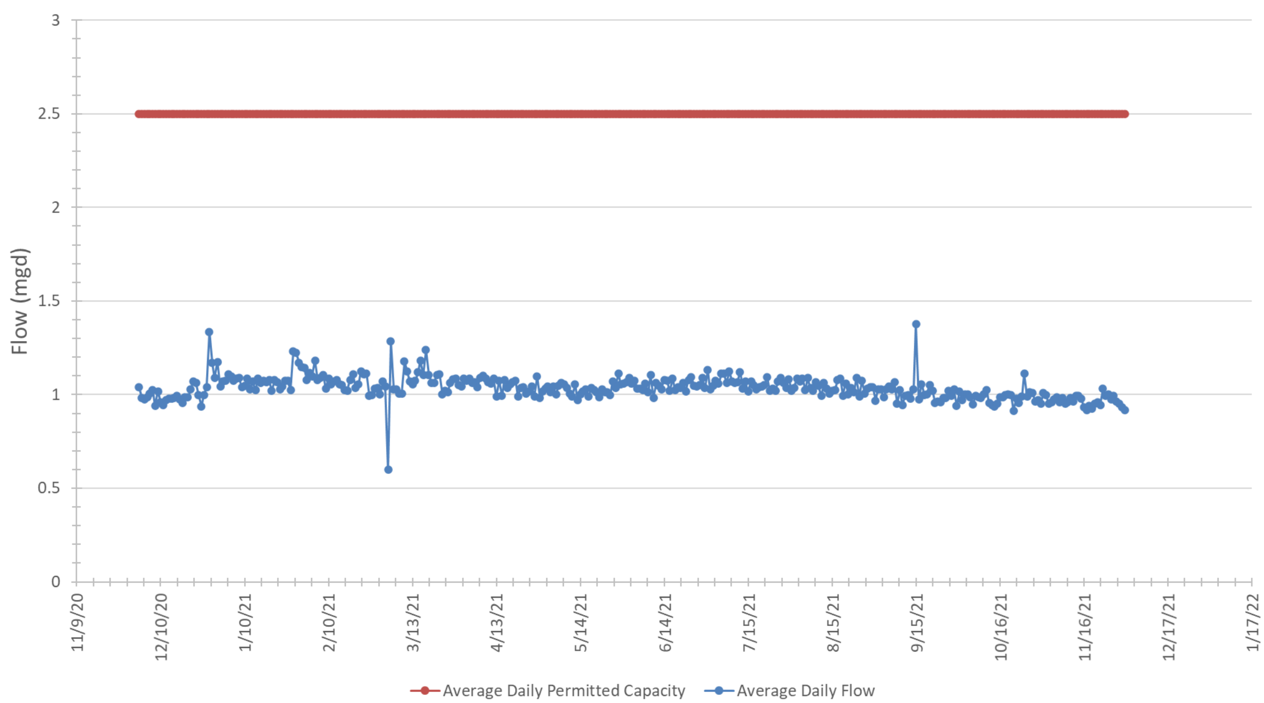


Figure 2.3 Average Daily Influent Flow to CSD – December 2020 to December 2021

The hourly influent flow data show that flows to CSD vary between 0.14 and 2.72 mgd. **The available capacity based upon these charts requires feedback from CSD.** Analysis, for example, shows that between December 2020 and December 2021:

- The average influent flow to CSD is 1.04 mgd.
- The 99th percentile influent flow is 1.78 mgd.

Table 2.1 shows the available capacity at the CSD at the average, maximum, minimum, and 99th percentile hourly flows. On average, the CSD could accommodate an additional 1.46 mgd per hour. The CSD could accommodate 0.72 mgd of additional flow for 99 percent of the hours over the last year. Should that capacity be deemed "available" by CSD, essentially complete equalization of MSD flows would be required prior to sending flow to CSD.

Table 2.1 Carpinteria WWTP Hourly Flow

	Hourly Flow (mgd)	Corresponding Available Capacity (mgd)
Average	1.04	1.46
Max	2.72	-0.22
Min	0.14	2.36
99th Percentile	1.78	0.72

2.6 City of Santa Barbara El Estero Water Resource Center

El Estero has a design flow rate of 11 mgd and a PWWF design flow rate of 19 mgd. El Estero has a wide range of hourly influent flow rates and does not have an equalization basin to equalize flow throughout the day. To better support process operation, El Estero recirculates secondary effluent through primary treatment throughout the day to maintain an equalized flow. Figure 2.4 below shows the average diurnal curve for El Estero in October 2021, which is a reasonable representation of diurnal flows at El Estero.

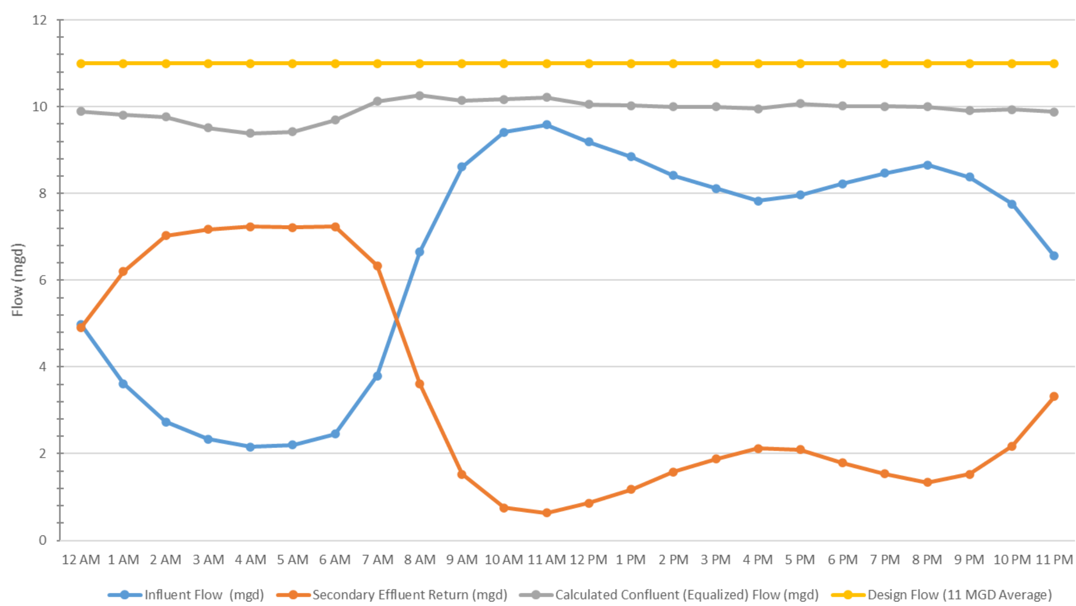


Figure 2.4 Average Influent Flow to El Estero – October 2021

As shown in Figure 2.4, the secondary effluent is recirculated throughout all hours of the day with flow rates varying between 0.63 and 7.24 mgd. The diurnal curve also shows the average confluent flow is 9.93 mgd, which is 1.07 mgd below the design flow of the facility. Figure 2.5

shows the average monthly and maximum daily influent flow to El Estero for every month between January 2006 and June 2021.

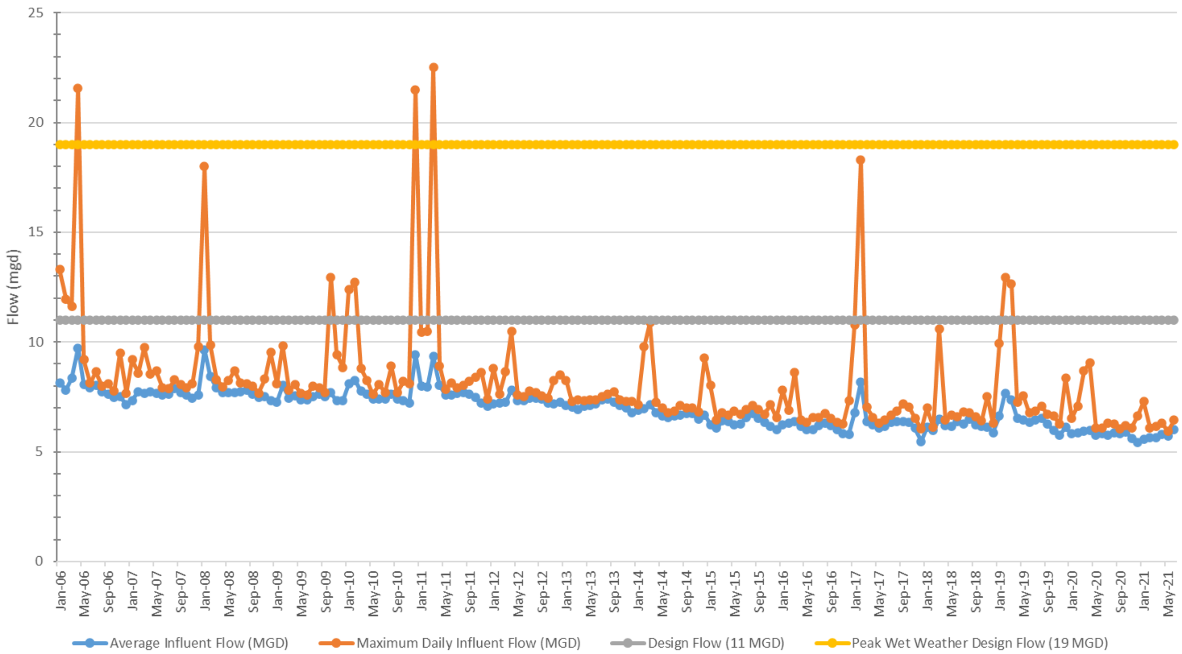


Figure 2.5 Average Monthly and Maximum Daily Influent Flow to El Estero - January 2006 to June 2021

In Figure 2.5, the blue line shows the average monthly influent flow to El Estero, which never exceeds the design flow of 11 mgd. The orange line represents the monthly maximum daily influent flow to El Estero, which exceeds the PWWF design flow of 19 mgd in 3 months over the last 15 years. Table 2.2 shows the average daily flow and available capacity compared to the design flow, and Table 2.3 below shows the monthly maximum daily flow and available capacity compared to the PWWF design flow.

Table 2.2 El Estero Average Monthly Flow – January 2006 to June 2021

	Average Monthly Flow (mgd)	Corresponding Available Capacity (mgd)
Average	6.96	4.04
Max	9.72	1.28
Min	5.42	5.58
99th Percentile	9.46	1.54

Table 2.3 El Estero Maximum Daily Flow – January 2006 to June 2021

	Maximum Daily Flow (mgd)	Available Capacity (mgd)[1]
Average	8.19	10.81
Max	22.49	-3.49
Min	5.92	13.08
99th Percentile	21.51	-2.51
98th Percentile	18.07	0.93

Notes:

1. Available capacity is calculated as follows: Peak Wet Weather Design Capacity (19 mgd) minus Maximum Daily Flow. For example, 19 - 8.19= 10.81

For El Estero, the addition of flow from MSD would allow for reduced recirculation of flow, the amount of which would be determined by El Estero staff. However, the reduction in recirculation could be significant, depending upon the time of day and rate of flow being sent from MSD to El Estero. For example, the diurnal curve of influent to El Estero shows flows less than 6 mgd between midnight and 8 a.m., with the lowest flows reaching 2 mgd. The captured and equalized MSD flow of 0.66 mgd could be pumped to El Estero over that 8-hour window, at a rate of 2 mgd. Such boosting of flow during the low flow periods would allow for the City of Santa Barbara to substantially increase the available water for reuse applications.

From the data above, the following conclusions can be made regarding available capacity at El Estero for MSD flows:

- The average monthly influent flow to El Estero is 6.96 mgd and the max average day flow is 9.72 mgd. During the maximum average day flow, El Estero would still have the capacity to accommodate an additional 1.28 mgd of influent flow. This capacity would be further increased if an equalization basin were located in or near El Estero, bringing additional capacity to ~3MGD of influent flow.
- The average of monthly peak day flow to El Estero is 8.19 mgd and the maximum monthly peak day flow is 22.49 mgd. Although there have been certain periods where wet weather flows exceed the design capacity, the data for the past 15 years show that El Estero is able to accommodate an additional 0.93 mgd of flow 98 percent of the time.
- The addition of flow from MSD would allow for a reduction of recirculation of flow at El Estero and increase water for water reuse applications.

With nothing else changed, El Estero could accommodate 0.93 mgd of additional flow for 98 percent of the time. Should that capacity be deemed "available" by the City of Santa Barbara, equalization and control of MSD wet weather flows would be applied either at MSD or at/near El Estero. Installation of additional equalization in the City would provide a greater safety factor to account for 100 percent of PWWF.

2.7 Summary

1. CSD could accommodate 0.72 mgd of additional flow for 99 percent of the hours over the last year. If MSD flows are to be sent to CSD, essentially 100 percent of MSD flows would need to be equalized.

2. El Estero could accommodate a range of flow from MSD, though the ability to equalize flows is needed so as to not impact El Estero capacity during extreme wet weather events. For 98 percent of the time, El Estero has 0.93 mgd of additional capacity. Equalization of MSD flows to this level at MSD would significantly reduce transport pipeline capacity challenges while not impacting El Estero capacity.

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 3
CONDITION ASSESSMENT

FINAL | April 2022

carollo
WSC

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 3
CONDITION ASSESSMENT

FINAL | April 2022

Digitally signed by Lisa Arroyo
Contact Info: Carollo Engineers, Inc.
Date: 2022.04.14 08:29:20-07'00'

REGISTERED PROFESSIONAL ENGINEER
LISA ARROYO
No. 57518
CIVIL
STATE OF CALIFORNIA

Contents

Technical Memorandum 3 - Condition Assessment

Appendices

Tables

Figures

Abbreviations

ACH	air changes per hour
ADA	Automatic Dialer Alarm
ASR	alkali-silica reaction
ATS	Automatic Transfer Switch
BFP	belt filter press
CMUs	concrete masonry units
DAFT	dissolved air flotation thickener
DO	dissolved oxygen
EUL	estimated useful life
gpd	gallon(s) per day
H_2S	hydrogen sulfide
I/I	Inflow and Infiltration
IPS	influent pump station
kVA	kilovolt-ampere
MCC	Motor Control Center
mgd	million gallons per day
MSD	Montecito Sanitation District
MWD	Montecito Water District
NPDES	National Pollutant Discharge Elimination System
Project	Enhanced Recycled Water Feasibility Analysis
RAS	return activated sludge
RUL	remaining useful life
SRT	solids retention time
TM	technical memorandum
TWAS	thickened waste activated sludge
VFDs	variable frequency drives
WAS	waste activated sludge
WSE	water surface elevation
WWTP	wastewater treatment plant

-This Page Intentionally Left Blank-

Technical Memorandum 3

CONDITION ASSESSMENT

3.1 Introduction and Purpose

This technical memorandum (TM) presents condition assessment results from an onsite assessment at the Montecito Sanitary District (MSD) Wastewater Treatment Plant (WWTP). The assessment was undertaken to support the larger Enhanced Recycled Water Feasibility Analysis (Project), a joint effort by MSD and Montecito Water District (MWD). The Project analyzes four potential approaches to maximize water reuse from the MSD WWTP, including local non-potable reuse, local potable water reuse, and regional potable water reuse projects (one in Carpinteria and one in Santa Barbara).

To effectively analyze several Project options which include treated effluent from the MSD WWTP, a condition assessment of the MSD WWTP was performed. This was a one-day physical condition assessment conducted by a team of electrical, structural and process mechanical engineers to determine the current condition of the structures, process mechanical equipment, electrical equipment, and ancillary assets. The goal of the condition assessment was to evaluate and document the current state of the WWTP.

This TM highlights the overall condition of the WWTP and identifies major assets determined to be moderately to severely deficient. TM 5 "Cost for Rehabilitation and 30 Year Operations" will use results from both this condition assessment (TM 3) and the performance and capacity evaluation (TM 4) to identify replacement, rehabilitation, and capacity needs over the next 30 years.

3.2 Overview of Facility

MSD is an independent special district in Santa Barbara County that collects, treats, and disposes of wastewater from the unincorporated community of Montecito. Its wastewater stream is predominantly residential with a few larger commercial facilities such as Westmont College and upscale hotels. There are no industrial users in their service area.

Built in 1961, the WWTP was constructed as a 750,000-gallon-per-day (gpd) secondary level treatment plant with discharge via its permitted ocean outfall. In 1983, the WWTP expanded its treatment capacity to 1.5 million gallons per day (mgd). MSD is designed to operate in an extended aeration mode with a solids retention time (SRT) of 20 to 30 days and to fully nitrify.

MSD has consistently made improvements to its facility and treatment processes since the 1983 expansion. The following summarizes the more significant improvements made to the facility:

- Updates to the Administration Building (1988).
- Treatment plant improvements, including a new digester blower building, digester modifications and rehabilitation, and electrical upgrades (1992).
- Sludge dewatering and disinfection upgrades which included a new belt filter press for dewatering biosolids that replaced the sludge beds. The disinfection chemical system

was relocated from the administration building to an outside location and upgraded (1997).

- Influent Pump Station (IPS) project that replaced the three influent pumps, installed a new Motor Control Center (MCC), and installed a new flow meter and vault (2004).
- Construction of a new maintenance building (2006).
- Replacement of the Aeration Header at the aeration basins (2007).
- Construction of a new laboratory building (2010).

Although the WWTP has been consistently improved since its 1961 construction, it lacks preliminary and primary treatment processes commonly found at wastewater treatment plants.

Preliminary treatment processes remove constituents that can disrupt downstream operations and maintenance activities. Bar screens or fine screens are typical preliminary processes used to remove large debris and rags. Grit removal removes coarse, inert suspended solids that can cause wear or clogging of equipment in downstream treatment processes. Debris and grit removed during the preliminary treatment process is typically cleaned of organic material and disposed in a landfill.

Primary treatment removes settleable suspended solids and organic matter, and it is typically accomplished with physical operations such as primary clarifiers. Primary sludge, the solids that settle as part of primary treatment, are usually pumped and processed as part of sludge processing. Effective primary treatment can reduce the size and operating cost of secondary treatment, which is typically one of the most energy intensive treatment processes in a wastewater treatment plant. A disadvantage to having primary treatment, however, is the additional effort and facilities needed to handle and stabilize the highly volatile and odorous primary sludge.

Most wastewater treatment plants with primary treatment choose to use anaerobic digestion for stabilization. While anaerobic digestion is an effective approach for stabilizing primary sludge and offers an opportunity to produce power, it requires many complex mechanical systems including sludge mixing, heating, and handling flammable digester gas. The benefits of anaerobic digestion rarely outweigh the additional complexity unless a facility processes more than a few million gallons per day of wastewater. For this reason, it is rare to see primary treatment and anaerobic digestion at facilities the size of MSD.

MSD's approach to forego primary treatment and operate with a long SRT in the secondary process is more common at small wastewater treatment plants and is recommended moving forward. As noted above, MSD was designed to operate in the extended aeration mode with an SRT of 20 to 30 days and to fully nitrify. Per MSD's Operations Manual, the aerobic digester detention time is approximately 22 days, which is barely adequate for good aerobic digestion or stabilization. A 30-day detention time is recommended for aerobic stabilization and therefore, the secondary treatment process is used to increase the stabilization and reduce solids. The higher SRT in the secondary treatment process means less and more stable solids to the digester as well as increased retention time in the digester. It also helps during periods of "shock" loads such as illegal pool cleanings, heavy BOD loads during holidays, septic conditions during wet weather, etc. It should be noted that MSD's current National Pollutant Discharge Elimination System (NPDES) permit does not require nutrient removal (nitrification).

Over the past few years, MSD staff have noted a significant decrease in flows and loads, partly due to the 2018 Montecito Debris Flow and subsequently the COVID-19 pandemic impacts. MSD currently discharges approximately 550,000 gpd, and biosolids reduction is estimated at approximately 20 percent over the past few years. Staff noted that a few of the larger hotels in their service area have not reopened from the COVID-19 shutdowns in spring 2020. There is also an effort to convert approximately 300 residential customers from septic to sewer in the future, which will result in a marginal increase in flow.

During the last major rain event (February 2017), staff estimates the rain dependent Inflow and Infiltration (I/I) peaked at approximately 7.5 mgd. This was not a typical rain event, as Montecito received approximately 5.77 inches of rainfall in one day, compared to a typical rain event where they may receive around an inch in a day. Although there were no rain-related collection system overflows, staff noted the plant can be a challenge to operate during rain events. The largest challenge rain poses to MSD operations is sludge washout due to high hydraulic loading or I/I. This can cause an upset to their biological process by having fewer organisms in the secondary process with no time to rebuild their biomass. If this were to happen, it would render MSD less capable of handling organic loading and less resistant to potential toxic loads. However, all past rain events have been managed and not led to permit violations.

MSD staff have set up a bypass pump that is capable of bypassing influent from the manhole just upstream of the IPS directly to the aeration basins, also bypassing the influent grinders. This can be used as a wet-weather strategy to reduce storm water flows into the IPS during rain events; however, the since the IPS pumps were replaced in 2004, the bypass pump has not been needed during wet-weather events. It is used as a redundant pump for the IPS.

It was also noted that MSD's NPDES Permit (No. CA0047899) renewal application contains a storm water management strategy for MSD which says that storm water is collected on-site at the treatment plant facility. It is diverted to the headworks/plant influent via a drain system through the facility. District practice has been to let the storm water drain into the system until staff feels the system is being overloaded with water and treatment processes will be affected in an adverse manner. Once this takes place, the drains are plugged, and the storm water is either gravity drained or pumped offsite to storm water drainage ditches that run to the North and East of the facility.

3.3 Condition Assessment

The following subsections provide a general overview of different levels of condition assessments and the condition assessment process used at MSD.

3.3.1 Condition Assessment Levels

A condition assessment is intended to document the physical deterioration of an asset and its probability of failure due to physical mortality. Physical mortality an asset's physical deterioration to a point where its condition prevents functional performance.

There are several types and levels of condition assessments that can be performed, all with a varying degree of tradeoff between level of effort and cost. The following provides a brief description of typical levels of condition assessments that can be performed:

- **Desktop Evaluation.** A desktop assessment is an age-based assessment that uses asset age, estimated useful life (EUL) and remaining useful life (RUL) to correlate age to probability of failure due to physical mortality. The EUL of an asset is the reasonable period it is expected to satisfactorily perform under normal and routine operations and maintenance practices. The EUL is typically the *starting point* for asset replacement planning.

- **Phase 1 Field Evaluation.** A Phase 1 Field Evaluation is a visual, non-invasive, and non-destructive condition assessment of the assets. A multi-disciplinary engineering team conducts a visual assessment of each asset identified for evaluation. Exterior corrosion, weathering, and deterioration, along with discipline-specific condition and performance issues, such as temperature, notice, vibration, leakage, wiring, foundational, and component concerns are considered when assessing an asset. Assets are scored based on set criteria to ensure consistency of scoring across all disciplines. If an asset is observed to be in a degraded condition or perform outside of an acceptable baseline condition, its EUL can be lowered. Conversely, an older asset that is performing optimally may have its EUL extended.
- **Phase 2 Field Evaluation.** A Phase 2 evaluation is an in-depth and invasive assessment of an asset, based on a specific area of interest, to better understand its condition or degradation. Typical evaluations may include concrete core sampling, petrographic testing, valve removal, electromagnetic pipeline testing, coating thickness measurements, etc.
- **Specialty Assessments.** These are in-depth comprehensive evaluations that provide additional information that may be needed to fully evaluate an asset, such as seismic or geotechnical evaluations, electrical load analysis, etc.

Condition assessment scoring will tend to be more conservative for desktop and Field 1 Evaluations, with the trade-off that they take less effort and cost to perform. As additional evaluations occur and asset deficiencies are studied, condition scores are less conservative. These follow-up evaluations, however, tend to be more effort and costly to perform. Therefore, there is also a tradeoff between the level of conservatism in scoring and type of condition assessment performed.

3.3.2 Condition Assessment Process at MSD

A Phase 1 Field Evaluation was utilized exclusively for this effort, which included only visual inspection; invasive equipment testing procedures used in Phase 2 assessments were not utilized per the scope of work. The intent of this condition assessment was to evaluate and document the current state of the major assets at the WWTP. Recommended follow-up studies and renewal strategies are identified in TM 5.

3.3.2.1 Protocol and Deployment

The condition assessment took place over the course of one day, November 17, 2021, and was conducted by a multi-discipline team of mechanical, structural, and electrical/instrumentation engineers. Exterior corrosion, weathering, and deterioration issues along with discipline-specific condition and performance issues, such as temperature, noise, vibration, leakage, wiring, foundational, and component issues were all considered under the purview of the assessment effort. Additionally, existing as-built drawings were reviewed.

Over the course of the assessment, staff was interviewed to compile a list of known deficiencies, identify operating limitations, and discuss maintenance and operations history of each process area. In addition to what was described by plant staff, the assessment team looked for potential problems such as structural deterioration, electrical and instrumentation issues, and mechanical degradation.

3.3.2.2 Scoring

Asset condition was ranked using a one-through-five scale at both a general level and across a series of discipline specific questions. A score of one represents the best condition assets, while a score of five represents the worst condition assets. The purpose of scoring is to provide a common rating scale so assets can be compared to one another. Table 3.1 provides the general description of the condition associated with each score.

Table 3.1 General Condition Score Descriptions

Condition Score	General Description(1)
1 (Best)	**Excellent** Installed with very little wear. Fully operable, well maintained, and consistent with current standards. Little wear shown and no further action required.
2	**Good** Sound and well maintained but may be showing slight signs of wear. Delivering full efficiency with little or no performance deterioration. Only minor renewal or rehabilitation may be needed.
3	**Moderate** Functionally sound and acceptable and showing normal signs of wear. May have minor failures or diminished efficiency and with some performance deterioration or increase in maintenance cost. Moderate renewal or rehabilitation needed.
4	**Poor** Functions but requires a high level of maintenance to remain operational. Shows abnormal wear and is likely to cause significant performance deterioration in the near term. Replacement or major rehabilitation needed.
5	**Very Poor** Effective life exceeded and/or excessive maintenance cost incurred. A high risk of breakdown or imminent failure with serious impact on performance. No additional life expectancy with immediate replacement required.

Notes:
(1) Discipline-specific scores are described in Appendix 3A - MSD Condition Scoring.

Discipline specific condition scores were used to provide further insight into the specific area(s) in which an asset is deficient and gives measure to the repair(s) needed to bring an asset to like-new condition. Table 3.2 provides the condition categories for each discipline.

Table 3.2 Summary of Condition Questions Categories by Discipline

Discipline	Condition Question Categories (1)
Mechanical	• General Condition • Corrosion/Exterior • Vibration • Temperature • Leakage • Components

Discipline	Condition Question Categories (1)
Structural	• General Condition • Surface Deterioration • Coating/Lining/Paint • Leakage • Foundation/Supports • Safety Components
Electrical	• General Condition • Equipment • Enclosure • Temperature/Noise • Wiring/Cable Condition • Components
Instrumentation and Controls	• General Condition • Equipment/Transmitter • Display/Enclosure/Mount • Wiring/Cable Condition • Components
HVAC	• General Condition • Corrosion/Exterior • Vibration • Temperature • Components

Notes:
(1) A more detailed description of discipline-specific scores can be found in Appendix 3A - MSD Condition Scoring.

3.3.2.3 Condition Assessment Locations

The assessment results are separated into MSD's major process areas:

- IPS.
- Secondary Treatment.
- Disinfection.
- Return activated sludge (RAS)/waste activated sludge (WAS) System.
- Thickening, Digestion and Dewatering.
- Control and Administration Building.

Although the some of the newer structures were not formally assessed, such as the laboratory and maintenance buildings, comments received from staff were noted.

Figure 3.1 below is an aerial photograph of MSD with the major process areas identified. Figure 3.2 is MSD's treatment process flow diagram.

Figure 3.1 Condition Assessment Areas

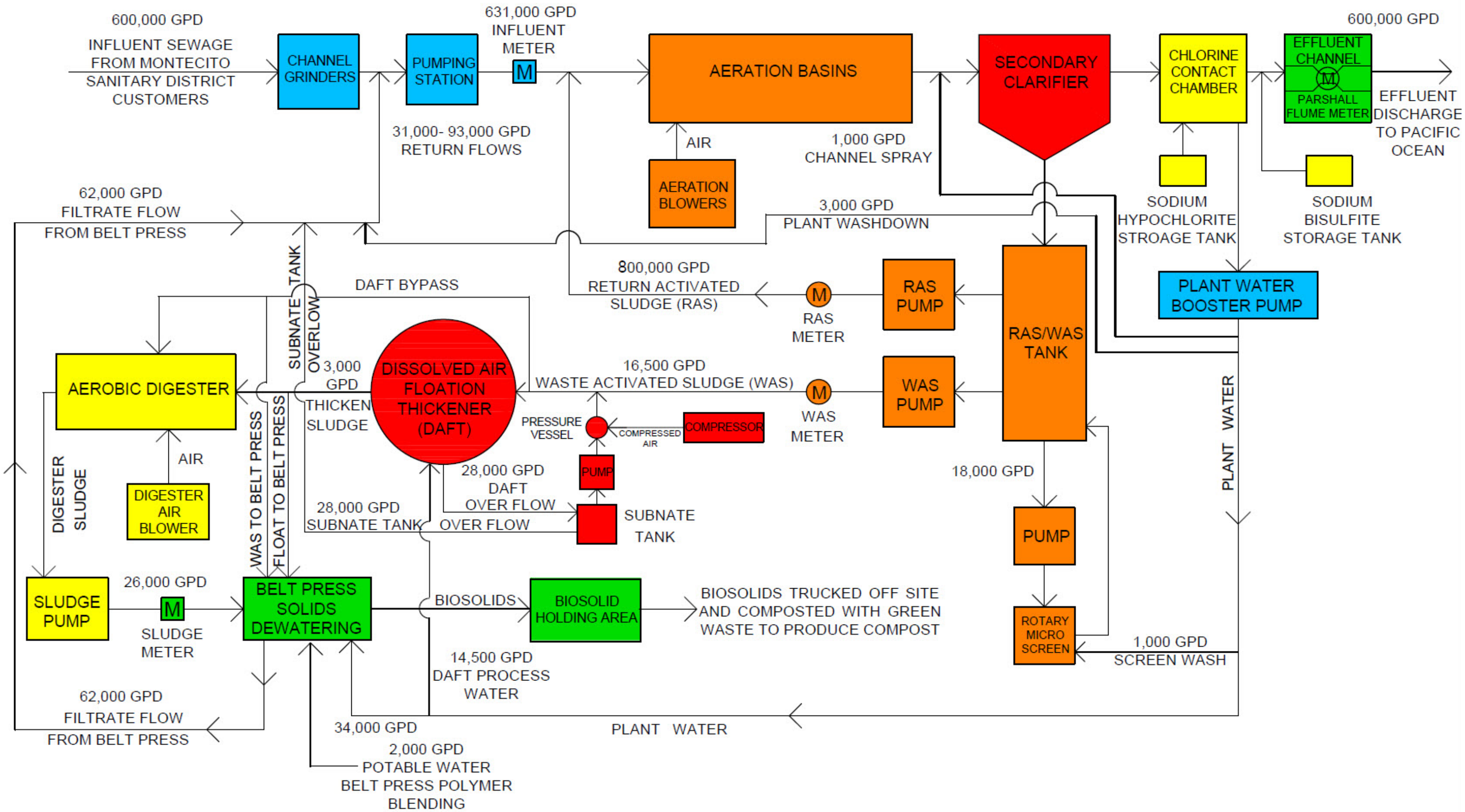


Figure 3.2 Process Flow Diagram

3.4 Observations and Findings

The following sections provide an overview of process area/locations, their relative geographical positions within the grounds of the MSD WWTP, and an overview of each process area. A summary of asset types present, along with notable observations, key photographs, and a summary condition scoring table, follows for each process area.

Each summary condition table identifies assets by asset name, provides the maximum condition score received, and lists the category or categories attributing to the maximum condition score for assets receiving a score of three or larger. The maximum value from both the general and discipline-specific questions represent the overall asset condition score and is what is presented in the findings below. The full list of assets assessed is in Appendix 3B.

3.4.1 Influent Pump Station

The IPS is a three-level process area located on the northern end of the Control and Administration Building. All MSD influent flows into a manhole just east of the IPS, and its approximate location is identified on Figure 3.1.

MSD influent enters the IPS via the influent wet well and flows through the channel grinders. Just downstream of the channel grinders, return flows from the various plant process areas are combined with plant influent for treatment. See Figure 3.2 for an overview of MSD's treatment process. The combined flow is lifted approximately 24.5 feet to street level where it continues via gravity through the influent meter.

The following notable observations were made about assets at the IPS area.

- Influent Wet Well, Gate, and Channels: The influent wet well, gate, and channels were evaluated to be in overall poor condition. The influent gate is very corroded, but staff noted it is still serviceable (Photo 3.2). Staff exercises the main influent gate regularly and they feel it is in good condition mechanically. The channels have concrete surface loss with exposed aggregate. There is concrete spalling from the side of the frame and severe corrosion of the grating supports including spalled concrete at the grating support locations (Photos 3.3 and 3.4). The stop plates used to take channels in and out of service for maintenance are operational but very corroded (Photo 3.5). There is a lot of corrosion in the channels, gates, and grating framing that supports the grating. Rehabilitation or replacement of concrete may be warranted for safety and should be carefully monitored (Photo 3.5). Staff switches channels each week to clean and de-grit the channel. Corrosion is severe at equipment conduits (grinders, Photo 3.6), and the floor coating is in poor condition.
- Influent Grinders 1 and 2: Influent Grinders 1 and 2 were evaluated to be in overall poor condition. Although the grinder units have some RUL, they are in a highly corrosive environment and require frequent maintenance and replacement approximately every 5 to 7 years. Grinder 1 was replaced this year; however, the motor was not replaced. Control panels are in a different room, which is not ideal for safety but does protect the electrical panels from corrosion.
- Influent Pumps 1 through 3: Influent Pumps 1 through 3 were evaluated to be in overall good condition. The pumps are 16 years old and are submersible pumps in a dry-well (basement level/IPS pump room). This type of pump was specifically selected so they are

protected in the event of flooding. They appear to be in good condition with minor corrosion of the exterior coating in some areas.

- IPS Pump Room (basement level): The basement level of the IPS pump room was evaluated to be in overall moderate condition. The coating on the floor is poor, and the coating has failed at the wall where the pipes penetrate. There is minor cracking and deterioration at the wall/floor joint interface.
- Influent Dry Well Sump Pump: The influent dry well sump pump was evaluated to be in overall good condition based largely on age. It was installed in 2014 and was difficult to observe during the condition assessment.
- Plant Water Pumps and Motors (intermediate level): The intermediate level plant water pumps and motors were evaluated to be in overall good condition. They are well-maintained but aged. There is corrosion on the floor and equipment baseplates, which appear to be older than some of the equipment anchored to it. In some cases, anchorage may be compromised. The pumps are not large pumps, so anchorage may not have been an issue to date. However, this could become an issue if there is a change, such as pump vibration or a seismic event.
- Froth Sprayer Pumps and Motors (intermediate level): The intermediate level froth sprayer pumps and motors were evaluated to be in overall moderate condition. There is corrosion on the floor and equipment baseplates, which appear to be older than some of the equipment anchored to it. In some cases, anchorage may be compromised. The pumps are not large pumps, so anchorage may not have been an issue to date. However, this could become an issue if there is a change, such as pump vibration or a seismic event.
- IPS (intermediate level): The intermediate level of the IPS room interior was evaluated to be in overall poor condition. It shows signs of corrosion and age. Anchorage for some pumps appear to be insufficient (Photo 3.10). Mechanical piping shows some corrosion and signs of wear. The gas monitor did not appear to be functional during the site visit, so a portable gas monitor was used. The gas monitor has since been replaced and is functioning properly. There is a drainage channel at the floor slab that is corroded with spalled concrete (Photo 3.9). The floor coating is delaminating, and the equipment hatch is damaged at the floor (hinge).
- IPS Control Panel: The IPS control panel was evaluated to be in overall good condition. Although the IPS control panel is more than 10 years old, it is in good condition with normal wear.
- IPS Variable Frequency Drives (VFDs): The IPS VFDs were evaluated to be in overall good condition with moderate rusting. They were replaced in the early 2006, but currently past their EUL. They are performing well, however, experiencing rust and corrosion inside and out. This could be due to moisture and potentially hydrogen sulfide (H_2S).
- IPS Ventilation: IPS ventilation was not formally evaluated using air changes per hour (ACH) calculations but is considered in poor condition. The space, especially in the wet well area, had strong H_2S odor, which is typical of headworks/influent wet well areas. Foul air is currently routed to the intake of the aeration blowers, which contributes to accelerated wear for the blowers, air distribution system and diffusers. More ACH would be desirable to reduce H_2S levels and corrosion in the wet well room. Staff noted that

the intake ducting is scheduled for replacement in 2022. This will be an in-kind replacement and the foul air will not be rerouted.

- Backup Generator: The backup generator was evaluated to be in overall good condition. The generator was installed in 2010 and is used as temporary or emergency power. The generator can provide power needed to operate the plant during power outages. The generator itself was found to be in good condition; however, it is aging and is the only form of redundancy for the WWTP during a power outage.
- Emergency Distribution Panel: The emergency distribution panel was evaluated to be overall good condition. The distribution panel is over 10 years old, but otherwise showing typical signs of use. Like the backup generator, this distribution panel is the only form of redundancy for the WWTP during a power outage.
- Influent Meter Vault: The influent meter vault was evaluated to be in overall moderate condition. Some corrosion was observed on the piping exterior (surface corrosion) with flaking metal. The sump pump condition was not observed but was installed in 2005.
- MCC No. 4: MCC No. 4 was evaluated to be in overall good condition. While over 10 years old, wear is typical for this asset.

Table 3.3 summarizes the condition scores for the assets at the IPS location.

Table 3.3 Condition Assessment Summary - IPS location

Condition Score	Asset Name	Reason
4 - Poor	Influent Wet Well, Gate, and Channels	• Surface Deterioration • Supports • Coating • Corrosion
4 - Poor	Influent Grinders 1 and 2	• Corrosion
2 - Good	Influent Pumps 1 through 3	
3 - Moderate	IPS Pump Room (Basement)	• General Condition • Coating
2 - Good	Influent Dry Well Sump Pump	
2 - Good	Plant Water Pumps/Motors 1 and 2	
3 - Moderate	Froth Sprayer Pumps/Motors 1 and 2	• General Condition • Corrosion
4 - Poor	IPS Intermediate Level	• General Condition • Corrosion • Coating
2 - Good	IPS Control Panel	
2 - Good	IPS VFDs	• Corrosion
4 - Poor	IPS Ventilation	• General Condition
2 - Good	Backup Generator	
2 - Good	Emergency Distribution Panel	
3 - Moderate	Influent Meter Vault, Meter and Sump Pump	• Corrosion
2 - Good	MCC No. 4	

Photo 3.1 Influent Wet Well Overview

Photo 3.2 Influent Gate

Photo 3.3 Influent Channel

Photo 3.4 Influent Stop Plate

Photo 3.5 Influent Grating

Photo 3.6 Influent Grinder

Photo 3.7 Wet Well Levels

Photo 3.8 Influent Pumps/IPS Pump Room (Basement Level)

Photo 3.9 IPS Pump Room (Intermediate Level)

Photo 3.10 IPS Pump Room (Equipment Baseplate)

Photo 3.11 IPS Control Panel

Photo 3.12 IPS VFDs

Photo 3.13 Backup Generator

Photo 3.14 Emergency Distribution Panel

Photo 3.15 Influent Meter Vault

Photo 3.16 MCC No. 4

3.4.2 Secondary Treatment

Flow continues via gravity from the influent meter to the aeration basins. MSD has two aeration basins, approximately 22.5 feet wide by 126 feet long by 16.25 feet deep. Air is supplied via blowers located in the blower room, just east of the IPS at the northerly end of the Control and Administration Building. All blowers are positive displacement. The blowers are designed for constant-speed duty, which means the only control is with turning units on and off manually. MSD typically runs Unit 1 during off-peak hours and Units 2 and 3 during peak hours to balance run times. Only one unit was operating at the time of the condition assessment. The sound level was not uncomfortable in the room. Each blower had a filter silencer; however, it is unknown if the silencers were working properly during the assessment.

Air intake comes from the influent wet well as a means of odor control. Foul air high in H_2S has caused a lot of corrosion of the inlet filter silencers and likely in the air distribution piping. An uninstalled standby blower is stored in the blower room. MSD is planning to replace the motors with units suitable for use with VFDs as part of the upcoming electrical project. They are also planning to incorporate dissolved oxygen (DO) control.

Each aeration basin has seven retrievable headers mounted on one side the aeration tank. Aeration Basins are on a three- to four-year service schedule where they are drained, and grit and debris is removed. Diffusers are checked every couple of months since swing-arm diffusers are in place.

Flow continues via gravity from the aeration basins through a concrete channel to the secondary clarifiers. Two of the secondary clarifiers were constructed in 1961, and two newer clarifiers were added as part of the 1982 plant expansion project. Flow is split between clarifiers with submerged gates. Flow split is largely accomplished with influent gates (operated fully open) and effluent weirs. Scum troughs are located at the end of each clarifier and are manually opened and closed to remove floatable material.

The following notable observations were made about assets at the secondary treatment area:

- Aeration Basin 1: Aeration Basin 1 was evaluated to be in overall moderate-to-poor condition. At the time of the condition assessment, the basin was in service so only the exterior was assessed. The west, east, and middle struts have heavy cracking on the north side and spalling is imminent (Photo 3.17). There is significant amount of cracking at the north side walkway with evidence of previous crack injection repairs and core sampling, presumably to investigate the cause of cracking (Photo 3.18). The extensive cracking observed at the top side of concrete members may be related to alkali-silica reaction (ASR), which is a long-term chemical reaction within the concrete that creates internal volumetric expansive stresses that can exceed the concrete tensile strength, resulting in cracking. Spalling was observed at the top of the east wall. Petrographic testing of the concrete can be performed to confirm this is the cause of the observed damage.
- Aeration Basin 2: Aeration Basin 2 was evaluated to be in overall moderate-to-poor condition. This basin was out of service and was entered for detailed condition assessment in addition to visual assessment. The top surface of the concrete was chipped with a chipping tool to determine the depth of deterioration (depth to sound concrete). The pH of the concrete was measured at the depth of sound concrete using a pH pencil. Typically, the pH of concrete is high (10 and higher). In addition to the

concrete cover on the reinforcement rebar, the high pH of the concrete protects the rebar from corrosion damage. A pH value of 7 and lower indicates high likelihood of corrosion damage to the reinforcement rebar, and a pH value of 8 and higher indicates low likelihood of corrosion damage to the rebar.

  - Exterior Assessment: The assessment found typical concrete cracking on the top concrete walking surfaces at the guardrail post embeds (Photo 3.19). The guardrail is a z-rail with coating that has local fractures throughout. The concrete beams that span over the top of the basin generally have numerous longitudinal concrete cracks with heavier cracking observed at the middle and east beams. The west cross beam has a patch of exposed rebar but no spalled concrete (Photo 3.21). It also has large cracks similar to the middle beam (Photo 3.20). There was pervasive cracking at the south top slab with evidence of prior repairs. The south top slab appears to have structural flexure cracks at the cantilever, but these cracks might also be due to ASR. The southeast corner top slab has exposed rebar with spalled concrete. Concrete cracking was observed at the outlet windows/channels, which could be a result of rebar corrosion. The west weir plate is severely corroded and in poor condition (Photo 3.23).
  - Interior Assessment: This basin was taken out of service for an interior assessment. The condition is good-to-moderate below the water line and in moderate-to-poor condition above the water surface elevation (WSE) with pervasive cracking at the top slab and bracing beams. The concrete is sound below the water line. This means the cement paste has not deteriorated. Some exposed aggregate was observed at the north side of bottom of the tank immediately adjacent to the aerators, but the concrete is sound. The north side has large (3-inch diameter) embedded steel that is exposed and has biological overgrowth. This steel is corroded at the surface, but no signs of associated cracking or spalling was observed. This steel is likely the cut anchor supports from a previously abandoned air header support system. Elsewhere, similar biological overgrowth and corrosion was observed in smaller sized pockets. There was longitudinal cracking of the bottom side of the west two bracing beams that was observed from below. Some exposed aggregate on the west wall was also observed; however, this appears to be due to poor consolidation when the concrete was originally placed. The pH of the concrete was tested at the east and west walls and was measured to be around 7. This indicates that there is a potential for the concrete to be damaged chemically, and there is a high likelihood of corrosion damage to the reinforcement rebar.

- Air Diffuser System: The air diffuser system was evaluated to be in overall poor condition due to performance issues. While the exterior of the air distribution piping and headers appeared to be in moderate condition, there were significant challenges in the performance, control, and operation of the aeration system. The diffusers were installed around 2017 and are Wyss sock-type diffusers. There are a lot of challenges with air distribution. Each aeration tank has seven retrievable headers mounted on one side of the aeration tank. This configuration results in a strong spiral roll recirculation pattern, and currently, all drop-leg valves (which are gate valves) are wide open. There are areas of excessive surface turbulence, which are indications of more air being discharged in some areas than in others. Headers 2 and 4 (out of seven) appear to have the worst air control and therefore experience the largest surface turbulence. This could be caused by torn or damaged diffusers or restrictions in the headers that limit air flow. In addition, the manual isolation valves are gate valves, which are not very good for throttling or controlling airflow. More positive air distribution control is desirable. While diffusers are routinely replaced and in good condition, grid configuration is not optimal, air distribution system lacks sufficient control to optimize the process, and the air header interior is likely severely corroded due to foul air service. MSD should consider replacing diffusers with more energy efficient types (such as a membrane disc) with a fixed header to save power and improve performance. Staff noted that after the assessment, they air scoured the aeration basin headers and air distribution has been balanced since.

- Secondary Clarifiers Structures: The secondary clarifiers structures were evaluated to be in overall moderate-to-poor condition. Two of the secondary clarifier structures were installed in 1961 and the other two were installed in 1982. They are approximately 40 and 60 years old, had coating failure throughout the walls, and pervasive cracking at the wall tops (possible ASR cracking). Petrographic testing of the concrete can be performed to confirm the root cause of the damage. Moderate-to-severe corrosion was observed at the launder support channel. Minor aggregate corrosion and spalled concrete was observed at the east and west ends of the Secondary Clarifier No. 2. The mixed liquor gates (clarifier inlet) appear to be original, and Gates 1 through 4 (Clarifier Nos. 1 and 2) are significantly more aged than Gates 5 through 8 (Clarifier Nos. 3 and 4). Corrosion damage was observed at the base plate of the light pole.
- Secondary Treatment Clarifier Mechanical Components: The secondary treatment clarifier mechanical components were evaluated to be in moderate condition. The mechanical components, chains and scrapers are approximately 10 years old while the drives are approximately 40 years old. The drives are well maintained and utilize non-metallic parts, which helps prolong their useful life. The mixed liquor feed gates were heavily corroded, and unsubmerged metallic components are in poor condition. The scum troughs are manually operated and are in poor condition. The scum troughs have been budgeted for replacement in 2022.
- Aeration Blowers and Motors 1 through 3: Aeration Blowers and Motors 1 through 3 were evaluated to be in moderate condition. Given the age and foul air service, the blowers are in remarkable condition and have been well maintained. They appear to have useful life remaining. Insulation on discharge piping is sufficient to protect staff, and noise levels are bearable. The inlet ducting is likely very corroded and contributing to accelerated wear of the blowers, air distribution system, and diffusers. It is also recommended that the blower inlet is moved from the influent wet well to an alternate location where the H_2S levels are not as high. This would trigger other improvements to handle the foul air in the influent wet well. It was also noted that Blower 3 leaks oil. All aeration blowers have been budgeted and scheduled to be replaced in 2022 as part of the Electrical Rehabilitation Project.

Photo 3.17 Aeration Basin 1 Strut Cracking

Photo 3.18 Aeration Basin 1 Walkway

Photo 3.19 Aeration Basin Cracking at Guard Post

Photo 3.20 Aeration Basin 2 Cross Beam Longitudinal Cracking

Photo 3.21 Aeration Basin 2 Exposed Rebar

Photo 3.22 Aeration Basin 2 Evidence of Repairs

Photo 3.23 Aeration Basin 2 Wier Plate

Photo 3.24 Aeration Basin 2 Channel Gate

Photo 3.25 Aeration Basin 2

Photo 3.26 Air Diffuser System

Photo 3.27 Secondary Clarifier

Photo 3.28 Secondary Clarifier

Photo 3.29 Secondary Clarifiers

Photo 3.30 Secondary Clarifiers

Photo 3.31 Aeration Basin Blowers

Photo 3.32 Aeration Basin Filter Silencer

Table 3.4 Condition Assessment Summary - Secondary Treatment

Condition Score	Asset Name	Reason
3.5 - Moderate-to-Poor	Aeration Basin 1: Overall	
4 - Poor	Aeration Basin 1: Struts and Walkways	• Damaged concrete: spalling is imminent; significant cracking
3 - Moderate	Aeration Basin 1: Walls	• Spalled concrete
3.5 - Moderate-to-Poor	Aeration Basin 2: Overall	
4 - Poor	Aeration Basin 2: Exterior	• Damaged concrete: spalled concrete, significant cracking • Possible overstress in structural components
3.5 - Moderate-to-Poor	Aeration Basin 2: Interior, above the WSE	• Possible overstress in structural components • Potential corrosion damage to the reinforcement rebar
3 - Moderate	Aeration Basin 2: Interior, below the WSE	
4 - Poor	Air Diffuser System	• Components • Performance
3.5 - Moderate-to-Poor	Secondary Clarifiers 1 through 4	• Damaged concrete • Corroded gates
3 - Moderate	Secondary Treatment Clarifier Mechanical Components	• Corrosion
3 - Moderate	Aeration Blowers and Motors 1 through 3	• Corrosion

3.4.3 Disinfection

Treated secondary effluent flows via gravity to the chlorine contact chambers where it is disinfected using sodium hypochlorite. MSD has two chlorine contact chambers, which are not symmetrical and there are flow imbalances between the two tanks.

Chlorinated effluent is dechlorinated using sodium bisulfite and discharged through a Parshall flume meter. It is then discharged to the Pacific Ocean via MSD's approximately 1,550-linear-foot ocean discharge pipeline. MSD's final effluent sampling location is just upstream of the Parshall flume.

To provide additional contact time and redundancy, and to minimize algae growth, staff has moved the original bisulfite feed location downstream from its original location. They also have added an emergency bisulfite feed in the event of a power outage.

The hypochlorite and bisulfite chemical storage areas have multiple points of failure (electrically), and this area could use an electrical overhaul. There are several junction boxes within the containment area with conduit runs embedded within the slab. The hypochlorite tank is oversized and, when full, can distribute solution by gravity to the chlorine contact tanks in an emergency.

The following notable observations were made about disinfection system assets:

- Chlorine Contact Basin Nos. 1 and 2: Chlorine Contact Basin Nos. 1 and 2 were evaluated to be in moderate condition. The coating at the basins has failed and some cracks at the top of the walls were observed. The cracks could be related to ASR. The tank coating has failed in a few locations, and staff have noticed a difference in coliforms upstream and downstream of the failure. The sampling and compliance point has also been moved upstream to allow for a more representative effluent sample point. The previous location allowed analyzer discharge flow to comingle with effluent and had the potential to skew the results. Grease and floatable material collect in the chlorine contact basins.
- Chlorine Contact Basin Mechanical Equipment: The chlorine contact basin mechanical equipment was evaluated to be in moderate condition. Some equipment shows signs of wear and corrosion, which is typical of facilities that use hypochlorite. The metallic parts and supports have significant corrosion; however, it appears to be superficial.
- Sodium Hypochlorite Storage Facility: The sodium hypochlorite storage facility was evaluated to be in poor condition. Although well maintained, there is a lot of corrosion. The diaphragm metering pumps work well and are easy to replace at the end of their useful life. The floor coating has failed. The coating is beginning to peel off the metal canopy. Moderate to minor steel surface corrosion was observed as observed as shown in (Photo 3.38). There is no longitudinal bracing, and the canopy has insufficient separation from the adjacent canopy. This condition can allow structural pounding to occur during an earthquake, which can damage the supporting columns and framing.
- Sodium Bisulfite Storage Facility: The sodium bisulfite storage facility was evaluated to be in moderate condition. The tank and piping have insulation and heat tracing to prevent freezing. There is some corrosion within the area. The containment area liner is corroded and largely non-functional. The coating is beginning to peel off the metal canopy. Moderate-to-minor steel surface corrosion was observed. There is no longitudinal bracing, and the canopy has insufficient separation from the adjacent canopy. This condition can allow structural pounding to occur during an earthquake, which can damage the supporting columns and framing.
- Analyzer Shed: The analyzer shed was not formally evaluated. MSD should continue maintaining and replacing as needed. Equipment in the shed is critical for disinfection compliance.
- Chemical Storage Canopy (west of Aeration Basin 2): The chemical storage canopy was evaluated to be in moderate condition. This single canopy metal building has a few local areas of severe corrosion. The coating is mostly intact, but severe corrosion was observed at the connections.

Photo 3.33 Chlorine Contact Basins

Photo 3.34 Chlorine Contact Basin Mechanical Equipment

Photo 3.35 Sodium Hypochlorite Storage Facility

Photo 3.36 Sodium Bisulfite Storage Facility

Photo 3.37 Chemical Storage Area Canopy

Photo 3.38 Sodium Hypochlorite Storage Facility Canopy

Table 3.5 Condition Assessment Summary - Disinfection

Condition Score	Asset Name	Reason
3 - Moderate	Chlorine Contact Basins 1 and 2	
3 - Moderate	Chlorine Contact Basin Mechanical Equipment	• Corrosion
4 - Poor	Sodium Hypochlorite Storage Facility	• Corrosion • Coating Failure
3 - Moderate	Sodium Bisulfite Storage Facility	• Corrosion • Coating Failure
3 - Moderate	Chemical Storage Canopy	• Corrosion

3.4.4 Return Activated Sludge/Waste Activated Sludge System

Telescoping valves are used to adjust RAS flow from individual clarifiers into the RAS channel, which flows to the RAS/WAS wet well. Staff measures sludge blanket levels daily and use them as a guide to adjust valves and RAS flow rate. While working, RAS control is not automated, and RAS flow pacing cannot be practiced.

RAS pumps are controlled off a level setpoint in the RAS/WAS well, while WAS flow is controlled from a flow setpoint. WAS is typically wasted 6 to 7 hours a day.

The following notable observations were made about the RAS/WAS system assets:

- RAS/WAS Wet Well and Sump Pump: The RAS/WAS wet well and sump pump were evaluated to be in overall moderate condition with very poor condition locally. The concrete is in good condition and the metal canopy/cover was rated as in moderate condition overall, and in poor condition locally. The steel tube supports for the cover beams are severely corroded and should be replaced. The anchors, metal skid, and concrete housekeeping pad for the east pump were rated at very poor condition.
- RAS Pumps and Motors: The RAS pumps and motors were evaluated to be in overall good condition. There are two RAS pumps and motors that have acceptable wear and corrosion given their age.
- WAS Pump and Motor: The WAS pump and motor were evaluated to be in overall moderate condition. The WAS pump shows more wear and corrosion on the equipment and baseplate and anchorage. The pump pad and skid are in very poor condition. The WAS pump motor, base and piping is scheduled to be replaced in 2022. There is an uninstalled spare for redundancy, and wasting can also be accomplished via the RAS pumps.
- Rotary Microscreen and Pump: The rotary microscreen and pump were evaluated to be in excellent condition. The rotary drum thickener and feed pump were replaced approximately one year ago. The unit was designed to remove grit and debris, but staff has noted that it does not remove a lot of material.
- RAS/WAS VFDs: The RAS/WAS VFDs were evaluated to be in overall good condition. VFDs were added to the RAS and WAS pumps six to seven years ago. The panels in the area look new and are in good shape. One of the RAS VFDs kept failing but was replaced three years ago.

- RAS Dry Well Sump Pump: The RAS dry well sump pump was not evaluated. The sump pump and control is budgeted and scheduled for replacement in 2022.
- MCC No. 2: MCC No. 2 was evaluated to be in overall good condition. While more than 10 years old, it is in good condition with typical wear for its age.
- MCC No. 2 Control Panel: MCC No. 2 Panel was evaluated to be in overall good condition. It is more than 10 years old. It is showing typical aging but is in overall good condition.
- Distribution Panels: The distribution Panels by MCC2 were evaluated to be in very poor condition. This pertains to distribution panels A1, B1, the 45 kilovolt-ampere (kVA) transformer and 5-kVA transformer and disconnect. This electrical equipment is more than 20 years old and is deteriorated and obsolete. The blower distribution panels have been budgeted and scheduled for replacement in 2022.

Photo 3.39 RAS/WAS Wet Well

Photo 3.40 RAS/WAS Pumps

Table 3.6 Condition Assessment Summary - RAS/WAS System

Condition Score	Asset Name	Reason
3 - Moderate	RAW/WAS Wet Well and Pump	• Corrosion
2 - Good	RAS Pumps and Motors	
3 - Moderate	WAS Pump and Motor	• Corrosion
1 - Excellent	Rotary Micro Screen and Pump	
2 - Good	RAS/WAS VFDs	
NA	RAS Dry Well Pump	
2 - Good	MCC No. 2	
2 - Good	MCC No. 2 Control Panel	• Obsolete
5 - Very Poor	Distribution Panels	• Overall Condition • Deterioration • Obsolete

3.4.5 Thickening, Digestion, and Dewatering

WAS is pumped to the new dissolved air flotation thickener (DAFT). The DAFT achieves 3 to 3.5 percent thickened solids. The same polymer is being used for both the DAFT and belt filter press (BFP). Thickened waste activated sludge (TWAS) is pumped to the aerobic digester.

MSD has one aerobic digester with two blowers housed in the digester blower building. Digesters are continuously aerated with a target DO above 0.3 milligrams per liter, or just enough to keep it aerobic and prevent odors. WAS can be pumped directly to the digester if the DAFT is out of service. There is adequate storage in the digester to hold approximately 2 to 3 weeks of TWAS if empty.

The sludge dewatering area was constructed in 1997 and overhauled in 2013. The BFP achieves 17 to 18 percent thickened solids, and it uses the same polymer as the DAFT. Jar testing was performed as part of polymer selection.

The BFP typically operates once per week, and cake is stored in roll-off bins under a canopy. Biosolids are hauled off to a facility that further processes it for reuse in the community as composting.

The following notable observations were made about the biosolids handling assets:

- DAFT: The DAFT was evaluated to be in excellent condition. Although it is new (2018), some pitting and rust was observed on the outside of the stainless-steel piping, particularly at joints and welds. Continue monitoring minor rust and corrosion on new stainless-steel piping.
- TWAS Pumps: The TWAS pumps are in moderate condition. Staff is experiencing performance and reliability issues with these pumps. They are expensive to maintain, for example, the wear plate and lobe are replaced every six months and cost approximately $5,000 per unit. It may be more economical to purchase a new progressive cavity pump. The wearing of the TWAS pumps is believed to be due to grit and debris.
- Aerobic Digester: The aerobic digester was evaluated to be in good condition. The coated concrete is in good condition with minor defects in the coating. Severe corrosion was observed at one pipe support on the east side.
- Digester Blowers 1 and 2: Digester Blowers 1 and 2 were evaluated to be in overall good condition. The DO probes in the digester do not work properly; however, DO is monitored daily by Operations using handheld probes. The digester uses the same diffusers as in the aeration basins and have manual valves for air distribution and control. The blowers are over 25 years old and are expected to need replacement or rehabilitation in the next 5 to 15 years. They are currently budgeted and scheduled for replacement in 2022.
- Polymer Mix Area: The polymer mix area was not formally assessed. New in 2018, it was assumed to be in similar condition as the DAFT.
- BFP: The BFP was evaluated to be in good overall condition. Although in good condition, new rollers are needed. The belts are replaced every six to seven years. The incline conveyor works well and is able to keep cake on the conveyor and the surrounding area clean. The facility is aging well given its limited use and robust maintenance.
- Digester Blower Building: The Digester Blower Building was evaluated to be in moderate condition. The door has minor-to-moderate corrosion at the hardware. The roofing is in

fair condition. The walls are concrete masonry units (CMUs) with a wood-framed roof comprised of pre-engineered trusses overlain with a plywood diaphragm. No wall anchorage was visible at the north and south walls. This indicates a possible incomplete load transfer in the lateral force resisting system and could be a potential seismic deficiency.

- MCC No. 3: MCC No. 3 was evaluated to be in very poor condition. It is more than 30 years old, and while still functioning, the equipment is obsolete.
- Annunciator Panel: The annunciator panel was evaluated to be in very poor condition. It is more than 20 years old, deteriorating, and in very poor condition. It is also obsolete.

Photo 3.41 DAFT

Photo 3.42 Aerobic Digester

Photo 3.43 Belt Filter Press

Photo 3.44 Blower Room Distribution Panels

Photo 3.45 MCC No. 3

Photo 3.46 Annunciator Panel

Table 3.7 Condition Assessment Summary - Thickening

Condition Score	Asset Name	Reason
1 - Excellent	DAFT	
3 - Moderate	TWAS Pumps	• Performance • Reliability
2 - Good	Aerobic Digester	
2 - Good	Digester Blowers 1 and 2	
1 - Excellent	Polymer Mix Area	
2 - Good	Belt Filter Press	
	Digester Blower Building	
5 - Very Poor	MCC No. 3	• Overall Condition • Deterioration • Obsolete
5 - Very Poor	Annunciator Panel	• Overall Condition • Deterioration • Obsolete

3.4.6 Control and Administration Building

This building is on the eastern side of MSD property and houses administrative staff, the board room, and kitchen on the south side. The operations equipment room is in the middle, and the aeration blower room and IPS are north of the operations equipment room. Inside the operations equipment room is the main switchboard and MCC No. 1.

The existing electrical system is NOT grounded. In the operations building, staff are near panels and switchgear, which may be a safety hazard. There is a near-term project that will replace the aeration basin blowers and motors and various electrical equipment in the operations building.

- Control and Administration Building: The Control and Administration Building was evaluated to be in moderate condition. It is suspected that most of the electrical equipment is not anchored. Most of the electrical panels will be replaced as part of the upcoming electrical project. It is suspected that the east side has no defined lateral load resisting system. The roof diaphragm consists of steel framing. There is separation occurring at the CMU wall intersection north of the electrical panels. The ceiling panels appear worn with some water stains and loose panels. Uncommon diaphragm construction was observed above the ceiling; this could possibly be gypcrete, which is an obsolete diaphragm system that has minimal strength for resisting seismic loads. The monorail braces are missing anchorage to the CMU wall. Dry rot was observed at the northeast corner low roof eave. There is no clear lateral load resisting system at the north end of the building. The west side has CMU that could brace the building if proper connections are present. The diaphragm connections are unknown at the transverse CMU walls. **Based on structural conditions observed, a seismic evaluation is recommended.**
- MCC No. 1: MCC No. 1 was evaluated to be in very poor condition. This is due to its overall age, condition, deterioration, and obsolescence. It is scheduled for replacement in the upcoming electrical project.
- Newer Automatic Transfer Switch (ATS): The newer ATS was evaluated to be in overall good condition. Although more than 10 years old, it is in good condition with wear that is typical for its age. It is scheduled to be replaced in conjunction with the upcoming electrical project.
- Old ATS: The old ATS was evaluated to be in very poor condition. This asset is past its useful life, in very poor condition, deteriorated, and obsolete. This ATS is on the upcoming electrical project for replacement.
- Old Control and Automatic Dialer Alarm (ADA) Alarm Panel: The old control and ADA alarm panel was evaluated to be in very poor condition. This asset is past its useful life, in very poor condition, deteriorated, and obsolete. While the ADA system is currently functioning properly and has not had any failures in the past, it is recommended to replace it due to its age. Staff noted that the ADA system is currently used in other locations throughout MSD. The control panel is on the upcoming electrical project for replacement.

- Service and Metering Cabinet: The service and metering cabinet was evaluated to be in very poor condition. This asset is past its useful life, in very poor condition, deteriorated, and obsolete. This metering cabinet is on the upcoming electrical project for replacement.
- Distribution Panels: The distribution panels were evaluated to be in very poor condition. These panels are located outside of the office building or inside the Control and Administration Building and consist of Panel LP-D, the 10-kVA transformer, Transformer E, Panel E, and Panels A and B. These assets are more than 20 years old, in very poor condition, deteriorated, and obsolete. Some of these panels will be replaced in conjunction with the upcoming electrical project.

Photo 3.47 MCC No. 1

Photo 3.48 Old ATS

Photo 3.49 Old Control and ADA Alarm Panel

Photo 3.50 Service and Metering Cabinet

Photo 3.51 Distribution Panels

Table 3.8 Condition Assessment Summary - Control and Administration Building

Condition Score	Asset Name	Reason
3 - Moderate	Control and Administration Building	
5 - Very Poor	MCC No. 1	• Age • Condition • Deterioration • Obsolete
2 - Good	Newer ATS	
5 - Very Poor	Old ATS	• Age • Condition • Obsolete
5 - Very Poor	Old Control and ADA Alarm Panel	• Age • Condition • Deterioration • Obsolete
5 - Very Poor	Service and Metering Cabinet	• Age • Condition • Deterioration • Obsolete
5 - Very Poor	Distribution Panels	• Age • Condition • Deterioration • Obsolete

3.4.7 Laboratory and Maintenance Buildings

The laboratory is a newer building, constructed in 2010. The building was not formally assessed as part of this scope of work due to its age.

The maintenance building was put in service in 2007. It was not formally assessed and is assumed to be in excellent condition due to its age. It is desirable to have one additional toilet in the men's locker area. Currently there is one toilet for women, and that is sufficient at this time. Staff would benefit from a "mud" room that could be separate from the clean area.

Trailers were brought in to provide staff separation during the COVID-19 pandemic.

3.4.8 Ancillary Structures/Miscellaneous Assets

The following are notable observations regarding ancillary structures/miscellaneous assets:

- Storage Canopy: The storage canopy was evaluated to be in poor condition. There is severe local corrosion on the steel members at the base of the columns. The coating has failing on the underside of the deck, and there is no longitudinal bracing on the north side. The southeast column is damaged by impact, and there is a hole in the ridge at the east end. This is possibly due to corrosion damage.
- Lighting: Lighting was evaluated to be in overall very poor condition. The lighting is more than 20 years old and is in very poor condition, deteriorated, and obsolete.

- Pipes and Manholes: Pipes and manholes were not formally evaluated. A record drawing review revealed that most of the WWTP pipes and manholes appear to be either constructed as part of the WWTP original construction (1961) or constructed during the 1982 upgrade. These structures would be 40 to 60 years old. It is recommended that staff perform manhole and pipeline inspections (where feasible) to get a baseline condition assessment of all in-plant pipelines and manholes.
- Ocean Outfall: A desktop evaluation was performed on the ocean outfall. It was constructed in and is approximately 60 years old. The outfall is approximately 1,550 linear feet and is constructed of 18-inch cast iron pipe with a 90-foot diffuser section at the end.

  In 2003, a report by Brown and Caldwell estimated that the EUL of the outfall pipe was 75 years. They also recommended to replace the diffusers and re-ballast the outfall every 15 years. That same year, a contractor replaced the outfall diffusers with Tideflex valves. Tideflex valves are anticipated to have an EUL of 30 years. Additionally, the contractor installed a concrete saddle at an unsupported span of pipe in the surf zone.

  A review of the 2021 dive survey performed by Aquatic Bioassay Consulting showed the Tideflex valves functioning properly. There was a considerable amount of biological growth on the valves and outfall pipe itself. The shallow section had sections of unsupported pipe.

  It is recommended that MSD perform a condition assessment of the interior of the outfall pipe. This does not appear to have been previously done, and with the outfall undermined twice in the past 20 years, plus its overall age (60 years), a better understanding potential damage that cannot be observed from a dive survey is recommended.

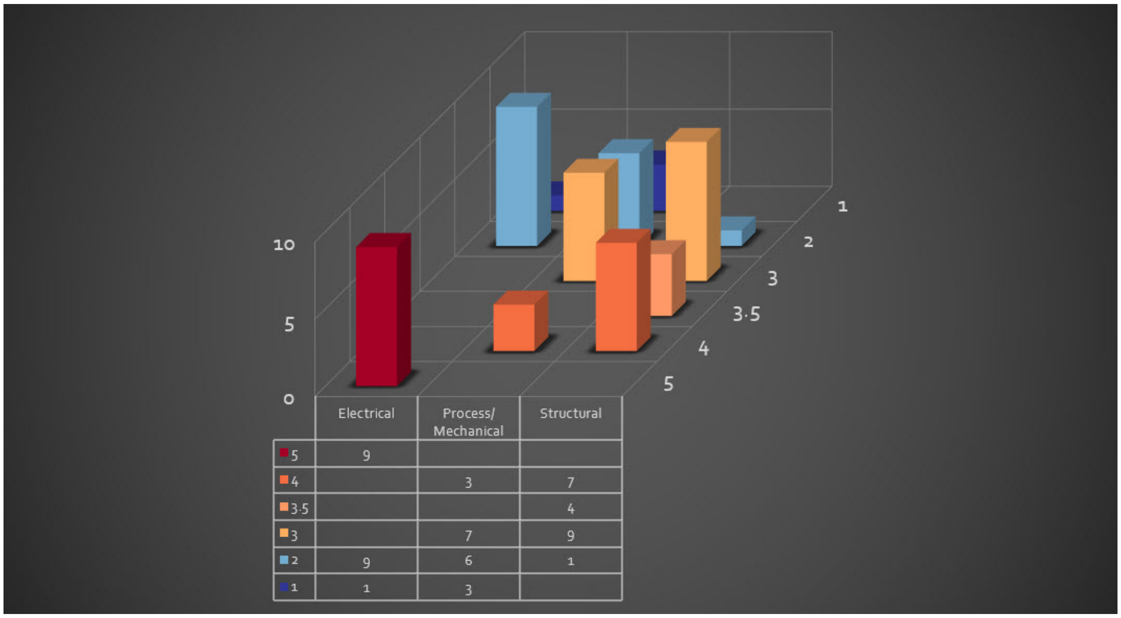
  It is recommended that MSD perform an assessment of the outfall so that condition can be correlated with age. This will allow MSD to better plan for the timing and extent of the outfall repairs or rehabilitation.

Table 3.9 Condition Assessment Summary - Ancillary Structures/Miscellaneous Assets

Condition Score	Asset Name	Reason
4 - Poor	Storage Canopy	• Corrosion • Condition • Coating
5 - Very Poor	Lighting	• Age • Condition • Obsolete
Not Evaluated	Pipes and Manholes	
4 - Poor	Ocean Outfall	• Age • Condition

3.5 Conclusion

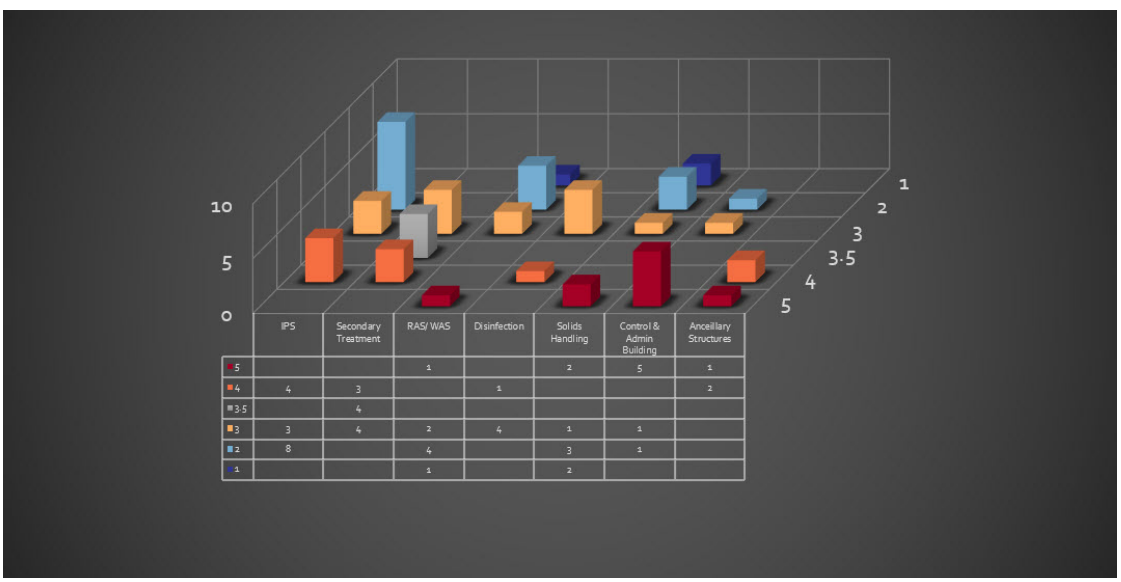
This TM presents the condition assessment results for the MSD WWTP. The results are summarized by discipline in Figure 3.3. Overall, electrical assets were the only assets that scored in very poor condition, and most of these assets are scheduled for replacement in 2022. Structural assets had the most assets scoring in the moderate to poor range.



	Electrical	Process/ Mechanical	Structural
5	9		
4		3	7
3.5			4
3		7	9
2	9	6	1
1	1	3	

Figure 3.3 Condition Assessment Scores by Discipline

Scores by process area show are illustrated in Figure 3.4 below. It shows that assets in the poor to very poor are throughout the WWTP and can affect nearly all process areas.



	IPS	Secondary Treatment	RAS/ WAS	Disinfection	Solids Handling	Control & Admin Building	Anceillary Structures
5			1		2	5	1
4	4	3		1			2
3.5		4					
3	3	4	2	4	1	1	
2	8		4		3	1	
1			1		2		

Figure 3.4 Condition Assessment Scores by Process Area

The results from this condition assessment will be used along with results from an upcoming performance and capacity evaluation to identify replacement, rehabilitation, and capacity needs over the next 30 years.

-This Page Intentionally Left Blank-

Appendix 3A

MSD CONDITION SCORING

Montecito Sanitary District
Condition Scoring (Vertical Assets)

Mechanical						
	Condition Score					
	0 NOT APPLICABLE	1 EXCELLENT	2 GOOD	3 MODERATE	4 POOR	5 VERY POOR
General Condition	N/A	New or excellent condition and no observed defects.	Well maintained with some wear. No rehabilitation or repair needed.	Functionally acceptable with minor wear. Minor repair or rehabilitation should be planned.	Significant wear or degradation. Requires a high level of maintenance to remain operational. Repair or major rehabilitation needed.	Expected life exceeded and high likelihood breakdown or failure. Immediate replacement or rehabilitation required.
Corrosion/ Exterior	N/A	No deterioration, wear or damage.	Minor and localized coating loss, rust or corrosion.	Moderate corrosion, coating loss or damage requiring maintenance.	Significant or wide-spread corrosion, damage or wear not affecting operation.	Severe corrosion, damage, or wear or impacts to operation.
Vibration	N/A	No observable.	Minor vibration, typical of equipment.	Moderate vibration, clearly visible.	Significant vibration, clearly visible and audible.	Excessive vibration, clearly visible with loud rattling.
Temperature	N/A	Equipment is reported to operate within temperature tolerances.	Equipment is reported to operate outside temperature tolerances, but nothing inhibiting functionality.	Equipment sometimes overheats and requires frequent maintenance.	Equipment often overheats and is not reliable.	Equipment rapidly overheats and is not capable of continuous running.
Leakage	N/A	No evidence of leakage.	Evidence of history of minor leaks.	Evidence of leakage or observed minor leaks.	Actively leaking more than is designed, in need of seal replacement.	Excessively leaking or seals deteriorated.
Components	N/A	No observed defects.	Minor wear, maintenance needed.	Significant wear or moderate corrosion, repair should be planned.	Significant damage or corrosion, repair or rehabilitation needed.	Severe degradation, deterioration or component failure.

Montecito Sanitary District
Condition Scoring (Vertical Assets)

Structural						
	Condition Score					
	0 NOT APPLICABLE	**1 EXCELLENT**	**2 GOOD**	**3 MODERATE**	**4 POOR**	**5 VERY POOR**
General Condition	N/A	New or excellent condition and no observed defects.	Well maintained with some wear. No rehabilitation or repair needed.	Functionally acceptable with minor wear. Minor repair or rehabilitation should be planned.	Significant wear or degradation. Requires a high level of maintenance to remain operational. Repair or major rehabilitation needed.	Expected life exceeded and high likelihood breakdown or failure. Immediate replacement or rehabilitation required.
Surface Deterioration	N/A	No observed defects.	Minor cracking, localized corrosion or surface wear. No repairs needed.	Moderate cracking or corrosion, minor surface spalling, repairs needed.	Major cracking, surface aggregate showing, exposed rebar, delaminated concrete, significant corrosion.	Major cracking or corrosion, corroded rebar, deterioration affecting structural integrity.
Coating/ Lining/ Paint	N/A	Recently applied.	Minor deterioration or wear.	Visible deterioration, cracking, bubbling, or peeling.	Widespread or large areas of failure, reapplication needed soon.	Significant areas or complete system failure, no longer protecting structure.
Leakage	N/A	No evidence of leakage.	Evidence of past leakage.	Observed leakage or moist surface.	Active leakage, repair needed.	Excessive leakage, emergency repair needed.
Foundation/ Supports	N/A	No observed defects.	Minor defects, evidence of minor movement from construction.	Observed defects, visible movement with no impact on structure.	Significant defects, measurable displacement impacting structure.	Severe defects, major movement affecting structural integrity.
Components	N/A	No observed defects.	Minor deterioration, maintenance needed.	Significant deterioration, repair should be planned.	Significant damage or deterioration, repair or rehabilitation needed.	Severe degradation, deterioration or component failure.

Montecito Sanitary District
Condition Scoring (Vertical Assets)

Electrical

	Condition Score					
	0 NOT APPLICABLE	**1 EXCELLENT**	**2 GOOD**	**3 MODERATE**	**4 POOR**	**5 VERY POOR**
General Condition	N/A	New or excellent condition and no observed defects.	Well maintained with some wear. Not rehabilitation or repair needed.	Functionally acceptable with minor wear. Minor repair or rehabilitation should be planned	Significant wear or degradation. Requires a high level of maintenance to remain operational. Repair or major rehabilitation needed.	Expected life exceeded and high likelihood breakdown or failure. Immediate replacement or rehabilitation required.
Equipment	N/A	Fully operable, no issues.	Minor defects or issues.	Intermittent or inconsistent issues.	Components malfunctioning or inoperable, equipment nearing expected life.	Not operable, equipment beyond expected life and in need of replacement.
Enclosure	N/A	No observed defects.	Minor wear or dirt buildup.	Moderate wear or corrosion, air vents dirty.	Significant corrosion, door hard to open or close, obstructed.	Enclosure not adequate, excessive corrosion or holes, indicators not working.
Temperature/ Noise	N/A	No observed heat or noise.	Heat or noise levels within expected operating ranges	Occasional overheating or abnormal noise, requires maintenance.	Often overheats or makes excessive noise, not reliable.	Rapidly overheats, makes alarming noises or is not capable of continuous operation.
Wiring/ Cable Condition	N/A	Excellent condition, no observed defects.	Good condition with minor defects.	Moderate condition, but requires significant maintenance.	Poor condition and requires rehabilitation.	Very poor condition and requires replacement.
Components	N/A	No observed defects.	Some corrosion or wear.	Parts missing.	Excessive corrosion or wear.	Not functional.

Montecito Sanitary District
Condition Scoring (Vertical Assets)

Instrumentation & Controls						
	Condition Score					
	0 NOT APPLICABLE	**1 EXCELLENT**	**2 GOOD**	**3 MODERATE**	**4 POOR**	**5 VERY POOR**
General Condition	N/A	New or excellent condition and no observed defects.	Well maintained with some wear. Not rehabilitation or repair needed.	Functionally acceptable with minor wear. Minor repair or rehabilitation should be planned.	Significant wear or degradation. Requires a high level of maintenance to remain operational. Repair or major rehabilitation needed.	Expected life exceeded and high likelihood breakdown or failure. Immediate replacement or rehabilitation required.
Equipment/ Transmitter	N/A	Fully operable, no issues.	Minor defects or issues.	Intermittent or inconsistent issues.	Components malfunctioning or inoperable, no longer compatible with other equipment.	Not operable, equipment beyond expected life and in need of replacement.
Display/ Enclosure/ Mount	N/A	No observed defects.	Minor wear or deterioration.	Moderate wear or corrosion, display hard to read.	Significant corrosion, display cannot be read, interface issues.	Not adequate, excessive corrosion or holes, indicators not working.
Wiring/ Cable Condition	N/A	Excellent condition, no observed defects.	Good condition with minor defects.	Moderate condition but requires significant maintenance.	Poor condition and requires rehabilitation.	Very poor condition and requires replacement.
Components	N/A	No observed defects.	Some corrosion or wear.	Parts missing.	Excessive corrosion or wear.	Not functional.

Appendix 3B

SUMMARY TABLE OF SCORES

Condition Score	Asset Name	Reason
4 - Poor	Influent Wet Well, Gate, and Channels	• Surface Deterioration • Supports • Coating • Corrosion
4 - Poor	Influent Grinders 1 and 2	• Corrosion
2 - Good	Influent Pumps 1 through 3	
3 - Moderate	IPS Pump Room (Basement)	• General Condition • Coating
2 - Good	Influent Dry Well Sump Pump	
2 - Good	Plant Water Pumps/Motors 1 and 2	
3 - Moderate	Froth Sprayer Pumps/Motors 1 and 2	• General Condition • Corrosion
4 - Poor	IPS Intermediate Level	• General Condition • Corrosion • Coating
2 - Good	IPS Control Panel	
2 - Good	IPS VFDs	• Corrosion
4 - Poor	IPS Ventilation	• General Condition
2 - Good	Backup Generator	
2 - Good	Emergency Distribution Panel	
3 - Moderate	Influent Meter Vault, Meter and Sump Pump	• Corrosion
2 - Good	MCC No. 4	

Condition Score	Asset Name	Reason
3.5 - Moderate-to-Poor	Aeration Basin 1: Overall	
4 - Poor	Aeration Basin 1: Struts and Walkways	• Damaged concrete: spalling is imminent; significant cracking
3 - Moderate	Aeration Basin 1: Walls	• Spalled concrete
3.5 - Moderate-to-Poor	Aeration Basin 2: Overall	
4 - Poor	Aeration Basin 2: Exterior	• Damaged concrete: spalled concrete, significant cracking • Possible overstress in structural components
3.5 - Moderate-to-Poor	Aeration Basin 2: Interior, above the WSE	• Possible overstress in structural components • Potential corrosion damage to the reinforcement rebar
3 - Moderate	Aeration Basin 2: Interior, below the WSE	
4 - Poor	Air Diffuser System	• Components • Performance
3.5 - Moderate-to-Poor	Secondary Clarifiers 1 through 4	• Damaged concrete • Corroded gates
3 - Moderate	Secondary Treatment Clarifier Mechanical Components	• Corrosion
3 - Moderate	Aeration Blowers and Motors 1 through 3	• Corrosion
3 - Moderate	Chlorine Contact Basins 1 and 2	
3 - Moderate	Chlorine Contact Basin Mechanical Equipment	• Corrosion
4 - Poor	Sodium Hypochlorite Storage Facility	• Corrosion • Coating Failure
3 - Moderate	Sodium Bisulfite Storage Facility	• Corrosion • Coating Failure
3 - Moderate	Chemical Storage Canopy	• Corrosion
3 - Moderate	RAW/WAS Wet Well and Pump	• Corrosion
2 - Good	RAS Pumps and Motors	
3 - Moderate	WAS Pump and Motor	• Corrosion
1 - Excellent	Rotary Micro Screen and Pump	
2 - Good	RAS/WAS VFDs	
NA	RAS Dry Well Pump	
2 - Good	MCC No. 2	
2 - Good	MCC No.2 Control Panel	• Obsolete

Condition Score	Asset Name	Reason
5 - Very Poor	Distribution Panels	• Overall Condition • Deterioration • Obsolete
1 - Excellent	DAFT	
3 - Moderate	TWAS Pumps	• Performance • Reliability
2 - Good	Aerobic Digester	
2 - Good	Digester Blowers 1 and 2	
1 - Excellent	Polymer Mix Area	
2 - Good	Belt Filter Press	
	Digester Blower Building	
5 - Very Poor	MCC No. 3	• Overall Condition • Deterioration • Obsolete
5 - Very Poor	Annunciator Panel	• Overall Condition • Deterioration • Obsolete
3 - Moderate	Control and Administration Building	
5 - Very Poor	MCC No. 1	• Age • Condition • Deterioration • Obsolete
2 - Good	Newer ATS	
5 - Very Poor	Old ATS	• Age • Condition • Obsolete
5 - Very Poor	Old Control and ADA Alarm Panel	• Age • Condition • Deterioration • Obsolete
5 - Very Poor	Service and Metering Cabinet	• Age • Condition • Deterioration • Obsolete

Condition Score	Asset Name	Reason
5 - Very Poor	Distribution Panels	• Age • Condition • Deterioration • Obsolete
4 - Poor	Storage Canopy	• Corrosion • Condition • Coating
5 - Very Poor	Lighting	• Age • Condition • Obsolete
Not Evaluated	Pipes and Manholes	
4 - Poor	Ocean Outfall	• Age • Condition

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 4
EVALUATION OF MSD PERFORMANCE AND CAPACITY

DRAFT | November 2022

carollo

WSC

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 4
EVALUATION OF MSD PERFORMANCE AND CAPACITY

DRAFT | November 2022

This document is released for the purpose of information exchange review and planning only under the authority of Farzaneh Shabani, June 14, 2022, CA PE No. 6944.

Contents

Appendices

Tables

Figures

Abbreviations

AAF	average annual flow
ADWF	average dry weather flow
aSRT	aerobic solids retention time
CBOD	carbonaceous biochemical oxygen demand
CCT	chlorine contact tanks
City	City of Santa Barbara
CT	contact time
DAF	dissolved air flotation
DPR	Direct Potable Reuse
gpd	gallons per day
gpm	gallons per minute
hr	hour
IPR	Indirect Potable Reuse
IPS	influent pumping station
lb	pound(s)
m	meter
MG	million gallons
mg/L	milligrams per liter
mgd	Million gallons per day
mL/L	Milliliter per liter
MLSS	mixed liquor suspended solids
MSD	Montecito Sanitary District
MWD	Montecito Water District
NPR	Non-Potable Reuse
OOS	out of service
PFD	process flow diagram
ppd	pounds per day
PWWF	peak wet weather flow
TM	technical memorandum
TS	total solids
TSS	Total Suspended Solids
TWAS	thickened waste activated sludge
RAS	return activated sludge
scfm	standard cubic feet per minute
sf	square feet
SRT	solids residence times

WAS	waste activated sludge
WEF	Water Environment Federation
WWTP	wastewater treatment plant

Technical Memorandum 4

EVALUATION OF PERFORMANCE AND CAPACITY

4.1 Introduction

This project will provide guidance to Montecito Water District (MWD) and Montecito Sanitary District (MSD) for implementation of recycled water and the beneficial use of treated wastewater from the community of Montecito. The project seeks to identify the best method of maximizing wastewater reuse capabilities thus producing a new local drought proof water supply for the community and reducing the discharge of treated wastewater to the ocean. The analysis will consider local and regional partnerships, non-potable and potable reuse alternatives, and various treatment methods and technologies. The potential options included in the study are as follows:

1. **Montecito Non-Potable Reuse (NPR)** – local project producing tertiary quality water for irrigation of large landscapes in Montecito.
2. **Carpinteria Indirect Potable Reuse (IPR)** – regional project producing purified water involving a partnership with neighboring special district(s) and the use of the Carpinteria Groundwater Basin.
3. **Montecito Direct Potable Reuse (DPR)** – local project in Montecito producing purified water and utilizing raw water augmentation at the Montecito Water District water treatment facility.
4. **Santa Barbara DPR** – regional project producing purified water and involving a partnership with the City of Santa Barbara (City) and raw water augmentation at the City's regional water treatment facility.

Figure 4.1 shows the potential regional partners.

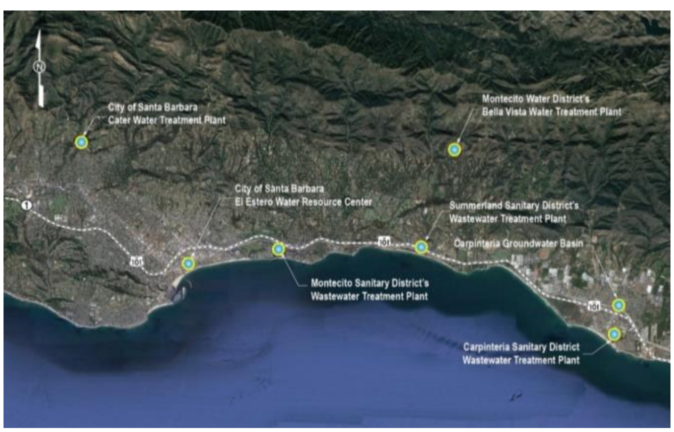


Figure 4.1 Potential Regional Partners

The focus of this technical memorandum (TM) is to provide a description of the existing MSD wastewater treatment plant (WWTP), an evaluation of the WWTP process performance, and a capacity assessment of the WWTP. As part of the performance assessment, recommended capacity rating criteria were developed for each unit process. The recommended capacity criteria were used along with steady-state process modeling and state-point analysis to develop average annual flow (AAF) and peak wet weather flow (PWWF) capacity for liquid stream unit processes. According to the TM 1, the average dry weather flow (ADWF) and PWWF at MSD will be 0.7 million gallons per day (mgd) and 7.76 mgd respectively. Since PWWF does not impact solids handling facilities, only AAF capacity was developed for them. Capacity limitations were identified when unit processes had less capacity than the anticipated flow and load projections.

4.2 Existing Facility Description

MSD serves the unincorporated area of Montecito in the Santa Barbara County. The influent to the plant is mostly residential sewer with some industrial sewer. The plant was originally built between 1961-1969 and it was upgraded in 1983 to achieve a permitted capacity of 1.5 mgd. MSD currently consists of the following main process areas:

1. Grinding and influent pumping station (IPS).
2. Biological treatment.
3. Chlorination and dechlorination.
4. Solid processing.

Figure 4.2 shows the process flow diagram (PFD). Numbers on the PFD are approximate flows during current average conditions. Appendix 4A.1 includes the design criteria for these processes.

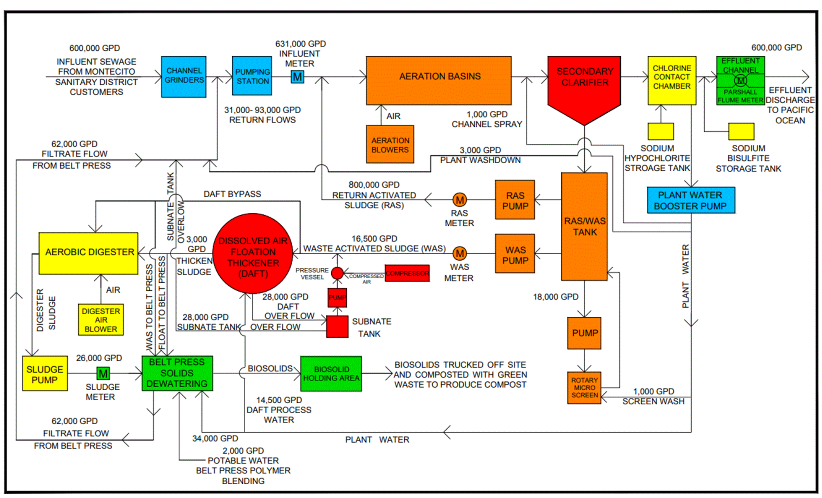


Figure 4.2 Process Flow Diagram

4.2.1 Grinding and IPS

There are two macerator grinders in the influent channel. The combined capacity of the two grinders are approximately 3.5 mgd. The influent flows through the grinders and into a wet well, where it is lifted by influent pumps to the aeration basins and flow by gravity thereafter through the WWTP. Three Flygt raw sewage influent pumps are located in the influent pump room.

4.2.2 Secondary Treatment Process

The secondary treatment process at MSD is an extended air activated sludge process to reduce carbonaceous biochemical oxygen demand (CBOD) to meet permit requirements as summarized in Table 4.1.

Table 4.1 MSD Effluent Limitations

Parameter	Units	Effluent Limitations(1)		
		Average Monthly	Average Weekly	Maximum Daily
Carbonaceous Biochemical Oxygen Demand (5-day @ 20° C) (CBOD)(2)	mg/L	25	40	85
	lbs/day	310	500	1,100
Total Suspended Solids (TSS)(2)	mg/L	30	45	90
	lbs/day	380	560	1,100
Oil and Grease	mg/L	25	40	75
	lbs/day	310	500	940
Settleable Solids	mL/L	1.0	1.5	3.0
pH	s.u.	6.0 to 9.0(3)		
Turbidity	NTU	75	100	225

Abbreviations:
mg/L = milligrams per liter.
mL/L = milliliter per liter.

Notes:
(1) NPDES Permit: Order No. R3-2022-0010, NPDES No. CA0047899
(2) The average monthly percent removal for CBOD and TSS shall not be less than 85 percent.
(3) When the Discharger continuously monitors effluent pH, levels shall be maintained within specified ranges 99 percent of the time. To determine 99 percent compliance, the following conditions shall be met:
- The total time during which pH is outside the range of 6.0 to 9.0 shall not exceed 7 hours and 26 minutes in any calendar month;
- No single excursion from the range of 6.0 to 9.0 shall exceed 30 minutes;
- No single excursion shall fall outside the range of 6.0 – 9.0; and
- When continuous monitoring is not being performed, standard compliance guidelines shall be followed (i.e., between 6.0 to 9.0 at all times, measured daily).

The aeration tanks are fully aerated, and the plant currently operates at long solids residence times (SRT) typically greater than 20 days. Although it is not required for the permit, the plant achieves full nitrification.

The secondary treatment process consists of two aeration basins, four rectangular clarifiers, return activated sludge (RAS) and waste activated sludge (WAS) pump stations and aeration system. The recycle streams from the solids processing (DAF subnatant and belt press filtrate) are returned to the head of the plant and combined with the influent. The combined influent is pumped to two aeration basins for biological treatment. The mixed liquor suspended solids (MLSS) from the aeration basins is settled in the final clarifiers. Most of the settled sludge (or RAS) is returned to the aeration basins while excess sludge (WAS) is sent to the solids processing facilities.

4.2.3 Disinfection and effluent discharge

There are two chlorine contact tanks (CCT). The effluent from the secondary clarifiers split between the two tanks and sodium hypochlorite is added in the mixing chambers at the inlet of each CCT. The CCT effluent is dechlorinated by adding Sodium Bisulfite, before being discharged to the ocean through the 1,500 ft outfall.

4.2.4 Solids Processing

The solids processing consists of dissolved air flotation (DAF), aerobic digestion, belt press for dewatering (and drying beds for backup to the mechanical process). The WAS is thickened in the DAF using compressed air, which floats the solids to the top of the DAF. The float, or solids collected at the surface of the DAF (thickened WAS (TWAS)) is pumped to the aerobic digester. The subnatant from the DAF is low in solids and is returned to the headworks where it is combined with the influent.

The aerobic digester stabilizes the sludge with long detention times and aeration, and it is compartmentalized, so half of it can be taken out of operation for maintenance. The digester is also equipped with capabilities to decant thicken by turning off aeration, allowing solids to settle, and returning the supernatant back to headworks.

Th digested sludge is normally dewatered by the belt press system. The belt press is operated every 1-2 weeks for 8 hours. During emergencies or if maintenance is being performed, the digested sludge can be dried on the drying beds.

4.3 Performance Evaluation

The historical load and performance of each unit process between 2017-2021 was compared to typical anticipated performance. When the original process design criteria were not available for comparison, the Water Environment Federation (WEF) Manual of Practice No. 8 (MOP-8) industry standards were used for comparison. The performance of each unit process provides a benchmark for assessing capacity. In some cases, historical performance confirms that original design criteria are appropriate for assessing unit process capacity. In others, above or below average performance warrants adjusting original design criteria for assessing capacity. For each unit process, recommended design criteria are identified for use in the capacity assessment.

Table 4.2 summarizes the results of the performance evaluation for the MSD.

Table 4.2 MSD Process Performance Data and Criteria for Capacity Analysis

Process Area	Design Parameter	Units	Design Capacity or Rating	Source	Average Performance from September 2016- October 2021	MOP-8 or Typical Values	Recommended Criteria for Capacity Assessment
IPS	PWWF	mgd	3 x 2.3 mgd	O&M manual	0.62 mgd ADWF 6.9 mgd PWWF	Sufficient firm capacity (i.e., 1 unit out of service (OOS)) to pump PWWF	Sufficient firm capacity (i.e., 1 unit OOS) to pump PWWF. The maximum capacity with 1 unit OOS is 4.6 mgd
Aeration Basins	Aerobic SRT	days	-	-	24[1]	Variable depending on treatment objectives and desired safety factor	Minimum of 15 days
	90th Percentile SVI	mL/g	-	-	62	150	Maximum SVI of 86
	MLSS	mg/L			3,070[2]	1,500 – 3,500	Maximum of 3,850
	Process Aeration	scfm	3 x 1,550 scfm blowers Normal operation 1+2	O&M manual	1,780	Variable	Firm capacity at peak day load

Commented [BR1]: List out rated max flow rates for each pump for a total of 2.3 mgd

Commented [AS2R1]: Farzaneh - please confirm if the capacity is 2.3 mgd total or per pump.

Process Area	Design Parameter	Units	Design Capacity or Rating	Source	Average Performance from September 2016- October 2021	MOP-8 or Typical Values	Recommended Criteria for Capacity Assessment
Secondary Clarifiers	Surface Overflow Rate at AAF	gpd/sf	-	-	161[3]	400 – 600	182
	Surface Overflow Rate at Peak Day Flow	gpd/sf	-	-	1,042[3,4]	600 – 1,200	Maximum of 398
	Average Annual Solids Loading Rate	ppd/sf	-	-	10.1[2]	20 – 30	14.6
	Peak Day Solids Loading Rate	ppd/sf	-	-	43.2[3,5]	30 – 40	Maximum of 31
RAS Pumps	Flow Rate	mgd	2 x 1,350 gpm	O&M manual	0.9	Sufficient firm capacity (i.e., 1 unit OOS) to pump 100 percent of MMF or minimum required by state point analysis	Sufficient firm capacity (i.e., 1 unit OOS) to pump 100 percent of MMF or minimum required by state point analysis

Process Area	Design Parameter	Units	Design Capacity or Rating	Source	Average Performance from September 2016- October 2021	MOP-8 or Typical Values	Recommended Criteria for Capacity Assessment
DAF	Solids Load average (maximum month)	lbs/sf/hr	-	-	0.17 (0.4)	0.4 – 1	0.4
	Percent Solids Capture	Percent	-	-	98[6]	90 – 95	Maximum of 95
	TWAS Concentration	Percent	-	-	3.6	3 – 4	Maximum of 3.6
Aerobic Digester	TS in digested sludge - average	mg/L	-	-	27,254		Maximum of 30,000
	TS reduction	Percent	-	-	23		Variable
	HRT - average	days			34.7	Variable	40-60 days if targeting time and temperature requirements for Class B biosolids. If not needed or met through other means, 14 days storage is recommended so that the dewatering belt press can be taken out of service for maintenance

Process Area	Design Parameter	Units	Design Capacity or Rating	Source	Average Performance from September 2016- October 2021	MOP-8 or Typical Values	Recommended Criteria for Capacity Assessment
Belt Press	Solids Loading Rate average (maximum month)	lbs/hr/m	-	-	380	500	Maximum of 500
	Cake	% TS	-	-	18.8		18.8
	Average Runtime	hours/ week	-	-	6		18[7]

Abbreviations:
gpd = gallons per day.
gpm = gallons per minute.
hr = hour
lbs = pounds.
m = meter.
OOS = out of service.
ppd = pounds per day.
scfm = standard cubic feet per minute.
sf = square feet.
TS = total solids.

Notes:
(1) Assumed to be same as effluent temperature.
(2) Excluding January 2018 – June 2019, when MLSS was much higher than typical values due to unusually high influent solids load.
(3) Assuming all clarifiers were in service.
(4) The 1,042 is based on the February 2017 storm events. The peak day flow SOR was 398 gpd/sf, if 2/17/2017 and 2/18/2017 events were excluded.
(5) The 43.2 ppd/sf is based on the February 2017 storm events. The peak day SLR was 27.3 ppd/sf, if 2/17/2017 and 2/18/2017 events were excluded.
(6) The necessary flow data around the DAF system for calculation of the percent removal is not available. Based on the estimated flows from the PFD, the average percentage removal is 98 percent.
(7) Based upon operational experience at MSD.

4.3.1 Influent Pump Station

The IPS capacity is assessed based on having sufficient firm capacity (i.e. capacity with one unit out of service) to pump observed PWWFs. The IPS has a firm capacity of 4.6 mgd. PWWFs (i.e., the observed maximum instantaneous daily influent flow) seen at the plant exceeded the IPS firm capacity 9 times during the past five years. During those periods, the plant would have been required to operate all of the influent pumps. The District also owns a portable engine driven pump that could be used if additional capacity is needed.

4.3.2 Aeration Tanks

4.3.2.1 Aerobic SRT

Total SRT is defined as the total mass of solids in the aeration tanks divided by the total mass of the solids leaving the system in the WAS and secondary effluent. It is a measure of the average sludge age. The aerobic solids retention time (aSRT), which is equal to total SRT at MSD, reflects the portion of the total MLSS that is under aerobic conditions.

The total SRT and aSRT required to meet effluent limits depends on the treatment objectives With CBOD and TSS limits, an SRT of 3 days would be sufficient for an activated sludge process. However, the aeration tanks are currently operating at an aSRT of approximately 24 days, on average, which is significantly higher. While operating at a long SRT is not required for meeting CBOD and TSS limits, there are other benefits including:

- Consistent removal of CBOD and TSS, and also ammonia. Although MSD does not have ammonia limits, removing ammonia likely has benefits in meeting any toxicity requirements in the permit.
- Reduced odor potential. Since the plant does not have primary treatment, operating with a longer SRT has the benefit of stabilizing organic material and reducing the odor potential in the aerobic digester and dewatering process.
- Improved settleability. Operating at SRTs greater than 20 days has likely resulted in the very good settleability the plant currently experiences. Most plants that operate at lower SRTs (i.e. 2-4 days) experience settleability issues and use selectors to mitigate it.
- Process monitoring and control is simplified. When operating at shorter SRTs, there is more variability in process parameters, and process monitoring and control upgrades will be critical to maintain target SRTs, MLSS, wasting, and DO within an acceptable range.

While operation at longer SRTs has benefits, it also reduces the secondary process capacity. An aSRT of 15-days under maximum month loading conditions was selected for the capacity assessment. This is lower than the average 24-day aSRT seen in the historical plant data, yet sufficient to achieve the permit limits and realize the other benefits noted above. Operating with a 15-day aSRT allows MSD to maximize the capacity of the existing secondary process without compromising performance. To be able to operate with a 15-day aSRT, it is recommended to implement automated aeration controls to ensure dissolved oxygen concentrations stay within the target range.

4.3.2.2 MLSS Concentration

The MLSS concentration impacts the SRT and treatment capacity of the aeration basins. Higher concentrations correspond to longer SRTs and improved nitrification performance. Higher MLSS concentrations also increase solids loading on the secondary clarifiers, so there are limits to how high the MLSS concentration can be. The historic MLSS concentration averaged 3,070 mg/L, which is within typical industry values. The capacity of the secondary process is optimized at an MLSS concentration of 3,850 mg/L. At concentrations above 3,850 mg/L, the plant is at risk of overloading the secondary clarifiers during wet weather events.

4.3.2.3 SVI

A key performance parameter in aeration basins is assessing whether well-settling sludge is being generated. The SVI represents the volume of solids in a mixed liquor sample after 30 minutes of settling. In general, the lower the SVI, the faster the solids settle. The SVI is important as it directly affects the capacity of the downstream clarifiers. Higher SVI can require that the aeration tanks maintain a lower MLSS concentration to avoid clarifier overload. A lower MLSS concentration results in a lower SRT and reduced overall secondary capacity. The "reasonable worst-case" SVI of a well-designed and operated extended air activated sludge system is around 150. The 90th percentile SVI, which is typically used as a "reasonable worst-case" at the MSD aeration basins was 86, indicating fast settling sludge at MSD. This 90th percentile value was used as the criteria for analysis based on historical performance. If for some reason settleability is not as good in the future, it will impact the calculated capacity.

4.3.3 Secondary Clarifiers

4.3.3.1 Overflow Rates

Overflow rates were assessed to ensure adequate solids capture. The average overflow of the secondary clarifiers, which were 161 and 1,042 gpd/ sf during AAF and peak day flow respectively, was within or lower than the typical industry range both for AAF and peak day flow conditions, indicating that the clarifiers are not over loaded. Recommended overflow criteria for the capacity analysis were based on the recommended MLSS concentration of 3,850 mg/L and the 90th percentile SVI of 86 mL/g. This results in a recommended capacity criteria of 182 and 398 gpd/sf for AAF and peak day flow day conditions, respectively.

4.3.3.2 Solids Loading

The solids loading rate at both AAF and peak day flow conditions, which were 10.1 and 27.3 ppd/sf, fell within the typical range of industry values, except for the 2 large storm events in February 2017. Recommended solids loading rate criteria for the capacity analysis was also based on the recommended MLSS concentration of 3,850 mg/L and the 90th percentile SVI of 86 mL/g. This results in a recommended capacity criteria of 14.6 and 31 ppd/square foot (sf) for average and max day conditions, respectively.

4.3.4 RAS Pump Station

The RAS pump station capacity is assessed based on having sufficient firm capacity to pump observed maximum monthly flows. The RAS pump station has a firm capacity of 1.9 mgd (with one unit OOS). This is ample capacity for a plant this size.

4.3.5 DAF

4.3.5.1 Solids Loading

Solids loading rate is the primary parameter used in DAF design and operation. Generally, solids loading is lower than typical industry values, and that the DAF is not operating under a stressed condition. The selected criterion for performance evaluation falls in the center of this typical range.

4.3.5.2 DAF Percent Solids Capture

Percent solids capture is calculated as the mass of TWAS divided by the mass of WAS. It is desirable for this to be as close to 100 percent as possible to minimize the amount of solids that are returned back to the headworks and processed again through the liquid stream process. These solids effectively reduce the secondary process capacity, and could negatively impact process performance if present in excess. There is no data available for the flows around the DAF system, but the average suspended solids concentration in the thickened sludge (DAF float) was 35,380 mg/L while the subnatant (recycle returned to the headworks) was 59 mg/L. The exact capture can't be calculated as the volume of plant water added to the process has not been confirmed. Based on current estimates, it is believed the process is performing very well with a capture of 98 percent.

4.3.5.3 TWAS Concentration

The percent solids of the TWAS from the DAF averaged 3.6, which is in the middle of the range of typical industry values for the DAF performance with respect to solids capture and TWAS concentration. Polymer is used to assist in achieving good performance.

4.3.6 Aerobic Digesters

4.3.6.1 Volatile Solids

The main purpose of an aerobic digester is to store and further stabilize the sludge prior to dewatering and disposal. Prior to being fed to the digester, the TWAS is already well stabilized from the long SRT of the activated sludge process, it is not very meaningful to use volatile or total solids reduction as a measure of digester performance. The average VS reduction was XX percent, which is within typical range for aerobic digestion of the sludge from extended air activated sludge process.

Commented [AS3]: MSD – Need information here please, if you have it.

Commented [CR4R3]: We have no data for volatile solids on the digester - only aeration basins.

Commented [FS5R3]: VS in WAS or TWAS? Double check and back calculation % VS reduction in the digester

The Digesters are currently operated at an average TS concentration of 27,254 mg/L, which is slightly less than 3 percent and approaching the high end of what can be sufficiently mixed in an aerobic digester. Typically, digesters have difficulty mixing above 3 percent. The long detention times in the digesters (35 day average) coupled with the long SRT from the activated sludge process) have minimized any odor potential. If the plant needs to meet Class B requirements for land application, detention time requirements must be met (40 days at 20 deg C or 60 days at 15 deg C) or pathogen reduction must be demonstrated through testing. If MSD does not dispose biosolids through land application, a minimum of two weeks of detention time is recommended. This provides sufficient time for additional stabilization, and allows the plant to take the belt press out of service for up to two weeks to perform maintenance when needed.

Since MSD disposes of the biosolids through XX, etc...

Commented [AS6]: MSD – Need information here please on the MSD biosolids disposal process.

Commented [MF7R6]: Engel & Gray, Inc.

Commented [FS8R6]: Does the plant need to meet class B?

Commented [AS9R6]: Please reach out to Carol.

4.3.7 Belt Press Dewatering

Loading rates are determined based on the make and model of the belt Press (US Filter 2000-14 series) The loading rate seems to be 380 lb/hr/m, while typical rates for this machine are 500 lb/hr/m. The belt press is running at typical solids loading rate for this machine.

The belt press is run once every 1-2 weeks for 8 hours. This translates to an average usage of 6 hours per week. Because the belt press is not run continuously, it is ultimately at the discretion of operations to set the maximum hours per week it can be run. Staff have indicated they are able to operate the belt press up to 18 hours per week.

4.3.8 Chlorine Contact Chambers

4.3.8.1 Theoretical Contact Time

Theoretical contact time (CT) ensures that the effluent water is adequately disinfected before being discharged to the ocean. The CCCs provides 30 minutes contact time at 1.5 mgd indicating the CCCs have long contact times except during extreme storm events. For effluent discharge, effective chlorination only needs ~10 minutes of contact time. For water reuse, the discussion is a bit more nuanced, noting the following:

- Regulations require a 90-minute modal contact time to obtain virus credits under Title 22 of the California Code of Regulations;
- Regulations allow for a much shorter contact time, such as 10 minutes based upon a t10[1] analysis, as long as the chlorination is free chlorine, which is anticipated for the WWTP due to complete nitrification;
- Regulations for Title 22 require filtration ahead of chlorine disinfection. Accordingly, an MBR option at the WWTP would include the opportunity to disinfect with free chlorine and have some flow be reused as needed for non-potable applications. Note for the MBR option, the peak MBR flow is 1.53 mgd, resulting in ~30 minutes of contact time.

4.4 Capacity Evaluation

Capacities were estimated for each unit process and are dependent on a range of parameters including flow, influent WW characteristics, treatment objectives, process configurations, operational setpoints, and desired redundancy. As part of the performance assessment, original design capacity, historical loading rates, and performance were reviewed and recommended capacity rating criteria were developed for each unit process. Capacities are based on the recommended rating criteria summarized in Table 4.2.

4.4.1 Assumptions

The AAF and peak day capacity was estimated for all liquid and solids stream facilities. The general approach for estimating peak day capacity is summarized below:

- Applied recommended criteria is summarized in Table 4.2.
- Assumed all units are in service.
- IPS capacity was based on firm capacity with one-unit OOS and booth Muffin Monster grinders in service.

[1] t10 is a tracer test in which the time for 10% of the seeded tracer to pass to the effluent of the contactor is demonstrated.

- Since pump station capacity is driven by peak day conditions, the equivalent AAF capacity was based on a peaking factor of 5.7.
- Aeration tanks and secondary clarifiers were assigned the same peak day capacity as both processes are integral to each other, and depend on several factors including the SRT, MLSS concentration, SVI, temperature, and flow distribution. The equivalent AAF was also based on a peaking factor of 5.7.
- The Chlorine Contact Basin capacity must have a minimum contact time of 10 minutes for all potential applications.
- Peak day flows are not meaningful in assessing solids handling capacity, therefore peak day ratings were not provided for those processes.
- For the secondary process and solids handling facilities, max month loading conditions during AAF flow conditions were simulated with a process model to determine the influent AAF when key limiting criteria (identified in Table 4.2) such as solids loading rate or HRT were met. The max month influent conditions used for COD, BOD, and TSS concentration were 940, 460, and 407 mg/L, respectively. See Appendix B for discussion on how those influent criteria were established.
- A Biowin model, Version 6.2 was used to simulate max month loading conditions. The model was calibrated to 2017-2021 data and Appendix B describes the calibration effort and results.

4.4.2 MSD Capacity Ratings

Table 4.3 present the estimated capacity for each unit process at the MSD based on the recommended criteria in Table 4.2 and the assumptions in Section 4.4.1.

Table 4.3 MSD Unit Process Capacity Ratings

Process	Maximum Day Capacity (mgd)	AAF Capacity (mgd)
IPS (mgd)	4.6	0.8[2]
Muffin Monster Grinders	3.5	0.6[2]
Secondary Processes (1)	4	0.7
Chlorine Disinfection (3)	4.5	0.8
DAF	-	0.8
Digesters(4)	-	2 Weeks
Dewatering (5)	-	0.7

Notes:
(1) Secondary processes include aeration tanks and secondary clarifiers.
(2) AAF Capacity is 1.6 and 2.1 mgd for IPS and 1.2 and 1.6 mgd for Muffin Monster grinders at PF 2.9 and 2.2 respectively
(3) Chlorination capacity based upon chlorine contact time minimum of 10 minutes. Disinfection to NPDES standards possible at lesser contact times but demonstration testing is recommended for very short contact times.
(4) Digester capacity is based on providing sufficient storage for maintaining the dewatering equipment (2 weeks). If time and temperature requirements must be met for land application, 40 to 60 days of storage will be required, which will reduce the rated AAF capacity.
(5) Based on operating XX hours per week. If operating hours are increased or decreased, rated capacity will change.

All processes meet the projected AAF of 0.7 mgd. All of the liquid stream facilities meet or exceed projected maximum daily flows per TM1 if the largest of two storm events in 2017 are excluded from the analysis. A discussion on the estimated capacity for the secondary treatment processes and solids handling is provided in the sections below.

Commented [FS10]: Estimate the average annual flowrates for the 2 weeks detention time in the digesters. Run for max month load

Commented [FS11]: Estimate the average influent based on 18hr operation of the BP (~1.8 mgd). Check with model

4.4.2.1 Secondary Treatment Processes (Aeration Tanks and Secondary Clarifiers)

The secondary process capacity noted in Table 4.3 is based on a 15-day SRT and a wet weather peaking factor of 5.7. To better understand the impact SRT and wet weather peaking factors have on the capacity, a range of scenarios were considered.

Currently, the plant is operated at an aSRT of 24.0 days. Simulations for capacity were performed at a 15-day and 20-day aSRT. These simulations indicated that there will be insufficient capacity for projected flows at a 20-day aSRT and a peaking factor of 5.7. Thus, capacity was determined using a 15-day aSRT, which is sufficient to achieve permit limits.

The secondary clarifier capacity is based on its ability to settle sludge which is dependent on the MLSS concentration and SVI or site-specific settling characteristics. State point analysis was performed for 90th percentile SVI based on plant data. State point analysis was used to estimate the PWWF capacity over a range of recommended MLSS and settleability conditions. The PWWF capacity was converted to an equivalent AAF capacity using PWWF/AAF peaking factors of 5.7, 2.9 and 2.2. The 5.7 and 2.9 peaking factors correspond to the 2 storm events during the February of 2017 and were taken into consideration in this analysis. Also, the analysis was performed at a peaking factor of 2.2, which is based on the assumption that future flows at MSD will be equalized at 1.53 mgd.[2] Therefore, it was important to understand Figure 4.3 shows the aeration basin and secondary AAF capacity over a range of SRT, settleability, and MLSS concentration, assuming all units are in service.

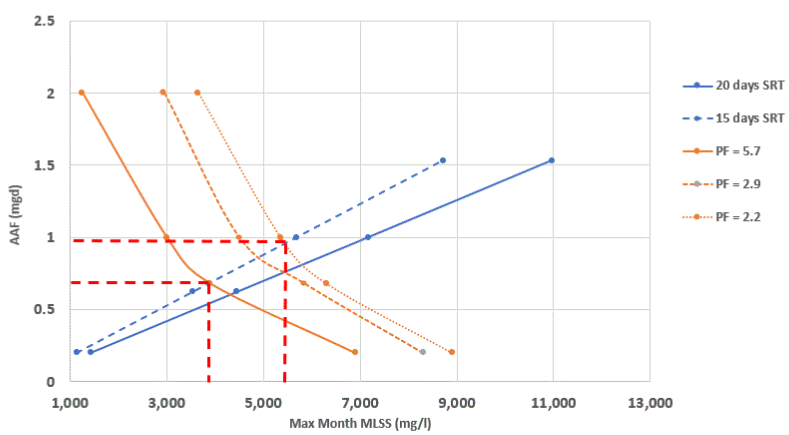


Figure 4.3 MSD Secondary Treatment Capacity

[2] 1.53 mgd is the peak day flow, if excluding the February 2017 storm events. Refer to TM 1 for further information.

The recommended capacity rating is 0.7 mgd AAF at 15 days aSRT and assuming PF of 5.7, which represents a target MLSS concentration of approximately 3,850 at a 15-day aSRT. If the settleability were degraded, then the capacity will be reduced. If the secondary process were maintained at the current aSRT of 24 days, the estimated capacity will be reduced and not meet the projected flow and loads.

-This Page Intentionally Left Blank-

Appendix 4A

MSD TECHNICAL DATA

-This Page Intentionally Left Blank-

Table 4A.1 MSD Technical Data

Plant Area	Sub Area	Parameter	Value
Headworks	IPS	Number of Units	2 Duty, 1 Standby
		Type	Flygt
		Total Capacity	6.9 mgd
		Firm Capacity	4.6 mgd
	Grinders	Number of Units	2
		Type	Muffin Monsters
		Total Capacity	7.0 mgd per O&M, 7.5 mgd per operational experience
	Flow Measurement	Number of Units	2
		Type	
		Total Capacity	
		Firm Capacity	
Secondary Treatment	Aeration Basins	Number of Tanks	2
		Shape	Rectangular
		Sidewater Depth	15 feet
		Total Volume	0.78 MG
	Aeration Blowers	Number of Units	3
	Final Sedimentation Tanks	Number of Tanks	4
		Shape	Rectangular
		Length, Each	80 feet
		Width, Each	12 feet
		Surface Area, Total	3,840 sf
		Number of WAS Pumps	1
		WAS Pump Capacity, Total	0.1 mgd
		WAS Pump Capacity, Firm	0.1 mgd
		Number of RAS Pumps	1 Duty, 1 Standby
		RAS Pump Capacity, Total	3.8 mgd
		RAS Pump Capacity, Firm	1.9 mgd

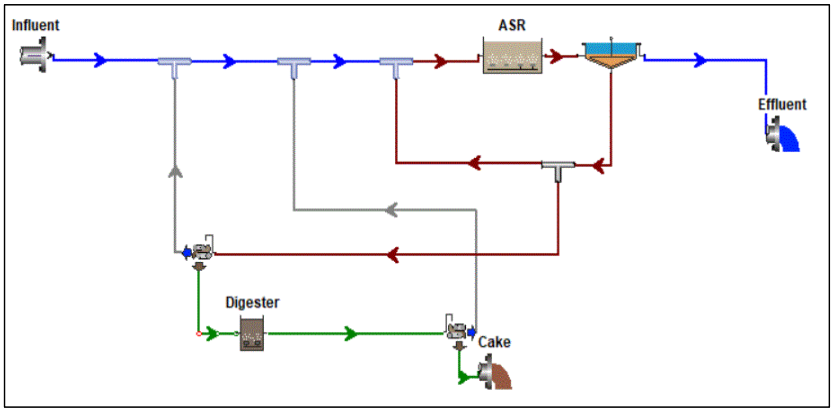
Plant Area	Sub Area	Parameter	Value
Solids Handling	DAF	Number of Units	1
		Shape	Circular
		Surface Area, Each	200 sf
		minimum Air/Solids Ratio	0.04 lbs of air/lbs of WAS
		Number of Pressurization Pumps	1 Duty
		Pressurization Pump Capacity, Firm	0.43 mgd
		Pressurization Pump Pressure	60 psi
	Aerobic Digestion	Number of Digester Tanks	1
		Surface Area	840 ft^2
		Sidewall Depth	18 feet
		Total Volume	0.1 MG
	Belt Press Solids Dewatering	Number of Units	1
		Maximum Weekly Runtime	8 hours per week

Appendix 4B

INFLUENT CHARACTERISTICS AND PROCESS MODEL CALIBRATION

-This Page Intentionally Left Blank-

A process model of MSD's WWTP was built using the latest version of Biowin (6.2). Biowin is a commercially available software package that is commonly used to simulate municipal treatment plant operation and performance. A graphical illustration of the flow sheet is provided below.



The model was set up to reflect the volume and dimensions of the aeration tanks, secondary clarifiers, and aerobic digester. The average influent flows and loads from 2017-2021 were used as model inputs, and the WAS flows, TWAS flows, and thickener and dewatering performance was also adjusted to match historical data. The table below summarizes the historical data and model results for two scenarios; one where the influent COD matched historical data, and one where the influent COD was adjusted to better match the sludge production throughout the plant.

Table 4B.1 Historical Data and Model Results

Item	MSD Data 2017-2021 Avg	Model Simulation Match Influent COD	Model Simulation Match Sludge Production
Influent			
Flow, mgd	0.62	0.62	0.62
COD, mg/L	954	954	512
$CBOD_5$, mg/L	233	468	250
TSS, mg/L	398	412	237
TSS, lb/d	2,060	2,100	1,280
NH_3, mg/L	40	40	40
Aeration Basins			
MLSS, mg/L	3,300	6,800	4,100
MLVSS, mg/L	2,900	5,500	3,000
Process Air, scfm	1,780	3,200	2,200

Item	MSD Data 2017-2021 Avg	Model Simulation Match Influent COD	Model Simulation Match Sludge Production
Secondary Effluent			
TSS, mg/L	6	6	6
NH_3, mg/L	0.2	0.2	0.2
WAS			
Flow, mgd	13,840	13,840	13,840
TSS, mg/L	6,160	11,300	6,800
TS, lb/d	720	1,300	790
Thickened WAS or Digester Feed			
Flow, gpd	3,000	3,000	3,000
TSS, mg/L	33,800	49,500	29,900
TS, lb/d	840	1,240	750
Digested Sludge			
Flow, gpd	3,000	3,000	3,000
TSS, mg/L	27,300	42,500	26,100
TS, lb/d	790	1,070	650
Belt Press Cake			
% TS	18.8	18.8	18.8
Cake-Dry, lb/d	720	1,000	620

When using the average influent COD, the model predicts 40 to 80 percent more sludge production and process air usage than the plant's operating data shows. When using a lower influent COD, the model predicts values that would be expected for a mostly domestic wastewater. In addition, the model predictions for sludge production and air usage match up with the operating data. This suggested the possibility that the influent samples were not representative of the actual influent characteristics, or that there is an issue with the COD analysis for the samples. Non-representative samples could be captured if the samples are not flow composites, if they are taken from an area in the wet well where solids have accumulated, or if there is any sort of contamination.

A few other observations suggest the COD data may not be accurate or representative:

- For typical municipal wastewater characteristics, the influent BOD_5 and TSS concentrations are within 5-10 percent of each other. During the data review period, the average influent CBOD5 was 233 mg/L, which is significantly lower than expected based on the average influent TSS of 398 mg/L.
- For typical municipal wastewater characteristics, the COD/BOD_5 ratios range from 1.8 to 2.2. For the MSD data, with the average influent COD of 954 mg/L and a CBOD5 of 233, this ratio is 4:.1. High COD/BOD_5 ratios are often indicative large industrial contributions in the service area, however, that was unlikely given what was known about the community in the service area.

- Effluent COD averaged 232 mg/L, which is significantly higher than expected for a WWTP that operates a long-SRT activated sludge process. More typical values are in the 50 to 100 mg/L range. A significant industrial discharger could explain this observation, however it was unlikely given the service area.

After discussing the data and observations with MSD staff, it was decided to run a four- weeks long QA/QC test on MSD's influent to verify the influent's water quality. The QA/QC special sampling was performed during the March 2022, and provided significant value to the analysis. The table below summarizes the detailed results of the QA/QC testing.

Table 4B.2 QA/QC Testing Results

Date	INFL-001 BOD (mg/L)	INFL-001 CBOD (mg/L)	INFL-001 COD (mg/L)	INFL-001 SOLUBLE COD (mg/L)	INFL-001 TSS (mg/L)	INFL-001 VSS (mg/L)	Time or Flow Composite
02/27/22	384	255	1094	358	444	411	Time
03/01/22	303	195	1438	912	378	351	Flow
03/03/22	357	250	1235	844	357	332	Flow
03/06/22	264	195	1093	550	305	298	Time
03/08/22	246	174	1276	950	271	256	Time
03/10/22	224	178	1046	406	310	297	Time
03/13/22	222	166	920	692	214	208	Time
03/15/22	201	130	774	368	277	260	Time
03/17/22	264	221	838	414	252	231	Time
03/20/22	218	178	1214	478	281	268	Time
03/22/22	355	226	774	496	292	283	Time
03/24/22	254	206	898	460	268	258	Time
Average	274	198	1,050	577	304	288	-

The following were the key takeaways from the QA/QC test:

- The influent BOD and TSS results were consistent with the overall solid balance and the model predictions.
- The influent COD was still quite high compared to the influent BOD and TSS. MSD lab noted that there have been issues with the COD test kits being used. Sometimes, multiple analysis of the same sample would result in different COD values. It was concluded that the COD analysis was the likely issue and that the District would further investigate the accuracy of the COD analysis.

In order to complete the capacity analysis for the existing process, as well as the future potential MBR system (see TM 6), the TSS and BOD from the QA/QC test was used as the basis for the analysis. Historical COD data was assumed to be erroneous and was not used.

The table below summarizes the historical influent data and the recommended parameters to use for the capacity assessment and MBR analysis. Since biological processes are sized on max month conditions, the recommended parameters selected reflect max month load conditions.

Table 4B.3 Historical Influent Data and Recommended Parameters for Capacity Assessment

Item	MSD Data 2017-2021 Average	March 2022 Testing	Recommended Average Annual Conditions	Recommended Max Month Conditions (1)
Influent COD, mg/L	954	1094	590	885
Influent $CBOD_5$, mg/L	233	198	289	434
Influent BOD_5, mg/L		274		
Influent TSS, mg/L	398	311	278	417

Notes:
(1) Calculated as the recommended average annual conditions times a 1.5 peaking factor. Peaking factor selected reflects historical mass load peaking factor for influent $CBOD_5$ and TSS.

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 5
COST FOR REHABILITATION AND 30-YEAR OPERATIONS

FINAL DRAFT | November 2022

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 5
COST FOR REHABILITATION AND 30-YEAR OPERATIONS

FINAL DRAFT | November 2022

This document is released for the purpose of information exchange review and planning only under the authority of
Lisa J. Arroyo,
May 5, 2022,
California Civil C-57518

Contents

Tables

Figures

-This Page Intentionally Left Blank-

Abbreviations

AACE International	Association for the Advancement of Cost Engineering
ADA	Automatic Dialer Alarm
ASR	alkali-silica reaction
ATS	automatic transfer switch
CCB	chlorine contact basin
CIP	capital improvement plan
CMMS	Computerized Maintenance Management System
DAFT	dissolved air floatation thickener
I&C	instrumentation and control
IPS	Influent Pump Station
K	thousand
LED	light-emitting diode
M	million
MCC	motor control center
MBR	membrane bioreactor
MSD	Montecito Sanitation District
MWD	Montecito Water District
O&M	Operational and Maintenance
Project	Enhanced Recycled Water Feasibility Analysis
RAS	return activated sludge
SCADA	supervisory control and data acquisition
TM	technical memorandum
TWAS	thickened waste activated sludge
VFD	variable frequency drive
WAS	waste activated sludge
WWTP	wastewater treatment plant

-This Page Intentionally Left Blank-

Technical Memorandum 5

COST FOR REHABILITATION AND 30-YEAR OPERATIONS

5.1 Introduction and Purpose

This technical memorandum (TM) uses results from the Condition Assessment (TM3) and Performance and Capacity Evaluation (TM4) to develop a prioritized capital improvement plan (CIP) and operating costs for Montecito Sanitary District (MSD) over the next 30 years.

5.2 Background

This work supports the larger Enhanced Recycled Water Feasibility Analysis (Project), a joint effort by MSD and Montecito Water District (MWD). The Project analyzes four potential approaches to maximize water reuse from the MSD Wastewater Treatment Plant (WWTP), including local non-potable reuse, local potable water reuse, and regional potable water reuse projects (one in Carpinteria and one in Santa Barbara).

To effectively analyze several Project options which include treated effluent from the MSD WWTP, Carollo performed a condition assessment (TM3) and a capacity and performance evaluation (TM4) to understand the state of the assets at MSD. Using the results from TM3 and TM4, combined with anticipated replacements based on end of useful life projections, an asset renewal prioritization plan was developed, and operational costs were estimated for the WWTP over a 30-year planning horizon.

5.3 Capital Improvement Planning

Using condition assessment scores and estimated useful life projections, a 30-year CIP was developed. Projects were assigned a capital planning group which defines the initial planning period for implementation. The five (5) capital planning groups are presented in Table 5.1 below.

Table 5-1 Capital Planning Groups

Planning Group	Timeframe (years)	Description
Urgent	0 to 2	Assets recommended for immediate action for replacement or rehabilitation or to address safety related deficiencies.
Priority	3 to 5	Assets recommended for CIP planning and replacement or rehabilitation within 3-5 years.
Short-Term	6 to 10	Assets recommended for CIP planning and implementation within the 6 to 10-year timeframe.
Mid-Term	11 to 20	Assets recommended for CIP planning and implementation within the 11 to 20-year timeframe.
Long-Term	20+	Assets recommended for CIP planning and implementation within the 20+ year timeframe.

5.3.1 Condition Based Prioritization

Assets were prioritized based on their condition assessment scores from the on-site condition assessment performed in November 2022 (TM3). Condition scores were used as a basis to determine the planning group timeline for asset renewal as shown in Table 5.2 below. Assets which have redundancy or are not critical for WWTP operations had their planning group timeline extended. Conversely, planning group timelines were shortened for assets that were deteriorating more quickly than expected or if they pose a risk to WWTP operations if they failed.

Table 5-2 Assignment of Capital Planning Groups by Condition

Planning Group	Condition Assessment Score
Urgent	5
Priority	4
Short-Term	3
Med-Term	2
Long-Term	1

Figure 5.1 shows the condition assessment results by planning group, distributed by the number of major assets assessed (not replacement cost). As illustrated, 26 percent or 15 assets are assigned to the urgent planning group with recommended renewal action to be performed within the next 0-2 years; 15 percent or 9 assets should be addressed in the following 3–5-year timeframe; with the remaining assets requiring rehabilitation or replacement beyond 5 years.

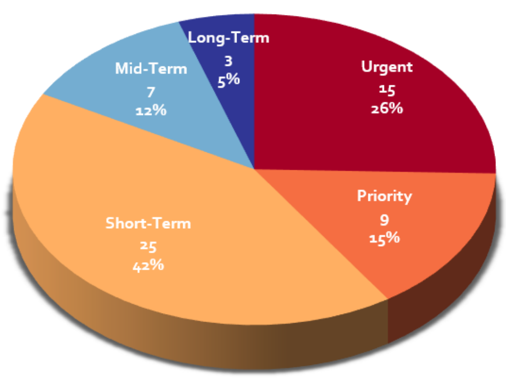


Figure 5.1 Capital Planning Groups by Condition Assessment

As noted in TM3, MSD electrical and instrumentation and control systems have the highest concentration of assets in very poor condition. These systems comprise most of the urgent capital planning group assets. MSD is already in the planning stages to replace many of the assets identified in the urgent planning category in 2022.

The on-site field condition assessment comprised of major assets and did not include ancillary assets such as valves, headers or manifolds, electrical feeders and conduits, pipelines, etc. It is recommended that MSD consider including replacement of ancillary assets in conjunction with major assets to ensure proper operation. Additionally, many of these ancillary assets are aging and past their useful life.

5.3.2 Renewal Strategy

The goal of the renewal strategy is to balance short term infrastructure and operational needs with long term capital investment based on the pending decision regarding the future of MSD's wastewater, whether it will be treated at a different facility or continue to be treated at MSD's WWTP. If a decision is made to have MSD wastewater treated at another facility, it is anticipated that MSD will remain operational for approximately 10 more years.

Using the CIP planning group timelines will allow MSD to budget the necessary capital dollars for each asset rehabilitation, repair, or replacement project. Projects falling within the urgent through short-term planning groups are recommended to be implemented regardless of the future wastewater treatment location to minimize risk to MSD's operations and maintain permit compliance. Longer-term projects would be implemented if MSD remains operational long-term, and CIP projects would be confirmed by MSD management through detailed asset investigations, coordination with future capacity expansion or reuse projects, and priority-based scheduling of projects.

5.3.3 Cost Estimating Methodology

Cost estimates were aggregated from information provided by discipline leads that participated in the field assessment, MSD staff, and the engineer's opinion of probable cost. Asset replacement costs are planning level or "Order-of-Magnitude" estimates (Class 5 estimates) per the Association for the Advancement of Cost Engineering (AACE International) and should not be considered pre-design cost estimates.

A Class 5 estimate is made without detailed engineering data and the expected accuracy range is within +100 percent to -50 percent. This means that bids can be expected to fall within a range of 100 percent over the estimate to 50 percent under the estimate. While they have a wide range of accuracy, they are typically used to quickly determine overall project feasibility or to screen several alternatives.

As noted above, detailed asset investigation should be performed and other ancillary assets such as piping, valves, feeders, etc. should be reviewed and considered when implementing each CIP project. MSD should also consider grouping similar or smaller projects together to take advantage of cost savings that typically occur due to economy of scale of larger projects.

Replacement and rehabilitation costs were developed in today's dollars (2022) and include direct costs (equipment, material, and labor) and allowances for indirect costs as shown in Table 5.3 and discussed in more detail below. For assets where no direct cost information was identified, previous studies and projects were used to estimate a reasonable direct replacement cost for equipment, material, and labor. Projected inflation over the next 30 years was not considered as part of the cost estimate.

Estimated costs were further categorized between assets MSD staff plan to replace or rehabilitate themselves (insource) and assets MSD would hire a consultant and/or contractor to perform the work (outsource). Insource work only considered direct costs associated with materials, as most of the equipment and labor would be provided by MSD staff. Work to be outsourced would include direct and indirect costs as explained in the following section.

Planning Level Cost Markups

Cost markups were applied to work to be outsourced to account for indirect costs. Indirect costs are components of the estimate that are subject to much more variability and subjectivity than direct costs. The markups represent a percentage of direct cost total (equipment, material, and labor) as shown in Table 5.3 below. Note again that these are Class 5 planning level estimates, which have an expected accuracy range of -50 to +100 percent. A brief description of the cost markup categories is outlined as follows:

- General Conditions: accounts for the general conditions and general requirements of the contract specifications and typically includes items such as contractor's field overhead costs, mobilization, demobilization, temporary facilities, testing and start-up.
- Estimating Contingency: this is the amount added to account for design elements that are not well defined yet. It also accounts for minor design changes but does not include changes in scope or unforeseeable major events such as strikes or earthquakes. As the design matures and the project is better defined, the contingency is typically reduced.
- Contractor Overhead and Profit: refers to the general contractor's overhead, an amount allocated to each project to cover the cost of his main office operations, administration of subcontracts, etc. and the contractor's profit.
- Engineering, Administrative and Legal: these costs are sometimes referred to as "soft costs" and cover the owner's expenses for engineering fees, construction management and inspection, legal fees, and owner's internal administrative expenses, bid advertisement, etc.

Table 5-3 Allowances by Category

Item	Estimated Cost	Estimated Cost of "A"
Direct Cost	**"A"**	**100 %**
Sales Tax	8 % of 1/2 "A"	4 %
Estimating Contingency (1)	3 %	31%
General Conditions (1)	12 %	16%
Contractor Overhead and Profit(1)	12%	18%
Bonds and Insurance(1)	2.5%	4%
Construction Cost Total	**"B"**	**174%**
Engineering, Legal and Administrative	20% of "B"	35%
Owner's Reserve for Change Orders	5% of "B"	9%
Project Cost Total	**"C"**	**217%**

Notes:

(1) The construction cost elements are applied sequentially, e.g., the sales tax is calculated and added on to the equipment cost, then the estimating contingency is 30 percent of the sum of the equipment cost and sales tax.

Commented [LA1]: I updated the table to align with TM8. I did not go through and recalculate costs because MSD provided many of the costs that they wanted to use (noted in the revised table) and the difference between my original mark-ups and this table is 17%.

5.4 CIP Project Recommendations

A preliminary list of asset replacements was developed for the next 30 years. It was developed based on the results from TM3, TM4, and anticipated replacements based on end of useful life projections over the 30-year planning period. It is based on in-kind or like replacement or rehabilitation. No alternatives analysis was performed.

5.4.1 Recommended Additional Evaluation

In November 2021, a Phase 1 Field Evaluation was conducted at MSD WWTP. This evaluation was a visual, non-invasive, and non-destructive condition assessment of the major assets. TM3 identified additional follow-up evaluations that would provide in-depth assessments to better identify condition or cause of degradation needed to fully evaluate certain assets. These follow-up evaluations are described in more detail below. Please note that costs for the additional evaluation are engineering effort costs and do not include the cost of potential repairs. Any repairs identified as a result of the evaluation would need to be added to the list of CIP projects.

- Petrographic Testing of Concrete. It is recommended that MSD perform petrographic testing of the concrete at the aeration basins and clarifiers due to the extensive cracking observed during the condition assessment. Petrographic testing analyzes concrete core samples under a microscope to find the cause of distress or deterioration of concrete. Petrographic testing is used to determine whether alkali-silica reaction (ASR) between the contaminants and the concrete matrix has occurred. The main effect of ASR is extensive cracking in the concrete. ASR is an initial chemical reaction and occurs when the aggregates used in the concrete contain high content of reactive silica materials. The high silica content reacts with alkali hydroxide in the cement, and this creates internal volumetric expansive stresses. These stresses can induce enough pressure to damage the concrete which is typically visible as excessive cracking. There is no cure for ASR; however, there are some remedial actions to prolong the life of the structures if ASR is observed. The long-term solution would be to replace the concrete structure if ASR is determined to be the cause of the cracking and deterioration.
- Seismic Evaluation. It is recommended that MSD perform seismic evaluations on several structures. During the condition assessment, potential seismic deficiencies were noted in the Digester Blower and Administration and Control Buildings. In addition, the Aeration Basin and Secondary Clarifier structures appeared to have overstressed beams that should be evaluated.

Table 5.4 summarizes the asset replacements by renewal timeline. It provides the major asset name, condition score, process area, recommended action, driver, recommended scope, project pathway, and estimated cost contingent on whether the project execution would be insourced, outsourced, or a combination of the two.

The "driver" category is intended to identify asset replacements that are safety related (Safety), those that could affect MSD meeting its National Pollutant Discharge Elimination System permit requirements (Permit), replacements that would benefit recycled water (Recycled Water), and assets that can be eliminated if MSD implements membrane bioreactor (MBR) treatment technology.

The "project pathway" category is intended to quantify the necessity of the recommended replacement based on pending selection of a Project Alternative as follows:

- Applies to All Alternatives. This indicates that regardless of the alternative selected, this asset should be replaced. This could be due to timing or the function it serves at the WWTP.

- Applies to MSD NPR or DPR. This indicates that if the alternative Project selected is either NPR or DPR at MSD, this asset will need to be replaced; however, if an offsite alternative Project is selected (Carpinteria IPR or Santa Barbara DPR), replacement of this asset is not necessary.
- May apply to Carp and SB. This indicates that asset replacement may be required if the alternative Project selected is either Carpinteria IPR or Santa Barbara DPR.
- Will not be replaced. This indicates that MSD is eliminating the need for that asset through construction of an upcoming project.

Assets identified by MSD for replacement in 2022 are shown at the top of the table with MSD's scope of work and estimated costs per their CIP funding form 2021-2023. Figure 5.2 follows Table 5.4 and illustrates the list of asset replacements by process area and planning group.

-This Page Intentionally Left Blank-

Table 5-4 30-Year CIP Strategy

Item No.	Asset Name	Condition Score	Process Area	Recommended Action	Driver	Recommended Scope	Project Pathway	Delivery Method	Estimated Cost
MSD Scheduled Replacement for 2022									
1	IPS Ventilation	Poor	IPS	Replace(2)	Permit Compliance	In-kind replacement of air ducting from aeration basin blower manifold to IPS. It is recommended that MSD consider rerouting foul air, especially if MSD will continue to operate long-term. Foul air from the wet well is currently routed to the intake of the aeration blowers, which contributes to accelerated wear for the blowers, air distribution system and diffusers. More air changes per hour would be desirable to reduce H_2S levels and corrosion in the wet well room. This work will be performed as part of the electrical project.	Applies to All Alternatives	Outsource	$58,000(3)
2	WAS Pump and Motor	Moderate	RAS/WAS System	Replace(2)	Permit Compliance	In-kind replacement of WAS pump and motor and base piping.	Applies to All Alternatives	Insource	$15,000(3)
3	RAS Dry Well Sump Pump	Very Poor	RAS/WAS System	Replace(2)	Permit Compliance	In-kind replacement of RAS dry well sump pump and control panel.	Applies to All Alternatives	Insource	$40,000(3)
4	Secondary Clarifier Skimmer Troughs	Poor	Secondary Treatment	Replace(2)	Permit Compliance	In-kind replacement of skimmer troughs.	Applies to All Alternatives	Combination Insource / Outsource	$140,000(3)
5	Digester Blowers	Good	Thickening, Digestion and Dewatering	Replace	Permit Compliance	In-kind replacement of digester blowers. Work completed in 2021-2022	Applies to All Alternatives	Completed	$0
6	SCADA Upgrade	Moderate	I&C	Replace(2)	Permit Compliance	Upgrade SCADA System. Incorporate new processes and alarms for MSD's treatment plant processes and lift stations into the existing backbone SCADA system. SCADA upgrades would eliminate the need to replace the annunciator panel.	Applies to All Alternatives	Outsourced	$125,000(3)
7	Aeration Basin Blowers and Motors	Moderate	Secondary Treatment	Replace(1)	Permit Compliance	Electrical Rehabilitation Project. MSD work includes replacing motors with units suitable for use with VFDs, replace blowers and incorporate dissolved oxygen control. Consider replacing valves associated with each asset as part of this project.	Applies to All Alternatives	Outsourced	Included below
8	Distribution Panels by MCC2	Very Poor	Electrical	Replace(1)	Permit Compliance & Safety	Electrical Rehabilitation Project.	Applies to All Alternatives	Outsourced	Included below
9	MCC No. 1	Very Poor	Electrical	Replace(1)	Permit Compliance & Safety	Electrical Rehabilitation Project.	Applies to All Alternatives	Outsourced	Included below
10	Old ATS	Very Poor	Electrical	Replace(1)	Permit Compliance & Safety	Electrical Rehabilitation Project.	Applies to All Alternatives	Outsourced	Included below
11	Old Control and ADA Alarm Panel	Very Poor	I&C	Replace(1)	Permit Compliance & Safety	Electrical Rehabilitation Project.	Applies to All Alternatives	Outsourced	Included below
12	Service and Metering Cabinet	Very Poor	Electrical	Replace(1)	Permit Compliance & Safety	Electrical Rehabilitation Project.	Applies to All Alternatives	Outsourced	Included below
13	Distribution Panels	Very Poor	Electrical	Replace(1)	Permit Compliance & Safety	Electrical Rehabilitation Project.	Applies to All Alternatives	Outsourced	Included below
14	IPS VFDs	Good	IPS	Replace(1)	Permit Compliance	VFDs are past their useful life and will be replaced as part of the rehabilitation project.	Applies to All Alternatives	Outsourced	Included below
15	Newer ATS	Good	Electrical	Replace(1)	Permit Compliance & Safety	Electrical Rehabilitation Project.	Applies to All Alternatives	Outsourced	Included below
						Electrical Rehabilitation Project Cost			$1,680,000(4)
								Subtotal	**$2,058,000**

Item No.	Asset Name	Condition Score	Process Area	Recommended Action	Driver	Recommended Scope	Project Pathway	Delivery Method	Estimated Cost
Urgent (Next 0-2 Years)									
16	Influent Wet Well, Gate and Channels	Poor	IPS	Repair/ Rehabilitation	Permit Compliance & Safety	Replace influent gate and stop plates. Perform concrete repair on channels, side of frame and grating supports. There is a lot of corrosion, and this area should be monitored carefully until repaired due to safety concerns. Install or rehabilitate floor coating to protect concrete.	Applies to All Alternatives	Outsource	$141,000
17	Influent Grinders	Poor	IPS	Replace	Permit Compliance	Replace motor on Grinder 1, as it was not replaced with Grinder 1 in 2021. Replace Grinder 2 as it is past its useful life and corroded. Replace every 5-7 years.	Applies to All Alternatives	Insource	$40,000
18	IPS Intermediate Level	Poor	IPS	Repair/ Rehabilitation	Permit Compliance	Pump baseplates and anchorage appear to be insufficient and should be monitored until they are replaced. Perform concrete repair, replace corroded piping and hatches, and replace/rehabilitate concrete coating to protect it from the corrosive environment.	Applies to All Alternatives	Combination Insource & Outsource	$65,000
								Subtotal	**$246,000**
Priority (Next 3-5 Years)									
19	Aeration Basins and Secondary Clarifiers	Moderate to Poor	Secondary Treatment	Additional Assessment		Perform petrographic testing of concrete to rule out cracking due to ASR.	Applies to MSD NPR or DPR. May apply to Carp and SB	Outsource	$10,000
20	Aeration Basins and Secondary Clarifiers	Moderate to Poor	Secondary Treatment	Additional Assessment		Perform seismic evaluation to identify deficiencies in structural components such as overstressed beams.	Applies to MSD NPR or DPR. May apply to Carp and SB	Outsource	$40,000
21	Digester Blower Building	Moderate	Thickening, Digestion and Dewatering	Additional Assessment		Perform seismic analysis building to verify the capacity of the wall-to-room diaphragm connection and any other seismic deficiencies.	Applies to All Alternatives	Outsource	$20,000
22	Control and Administration Building	Moderate	Administration	Additional Assessment		Perform seismic analysis of building.	Applies to All Alternatives	Outsource	$20,000
23	Ocean Outfall	Poor	Piping	Additional Assessment		Perform assessment to determine condition of the outfall. This will help to correlate condition to age and better plan for the timing and extent of repairs/rehabilitation.	Applies to All Alternatives	Outsource	$15,000
24	CCB Flash Mixers	Moderate	Disinfection	Replace	Permit Compliance	Replace flash mixers, supports and anchors. Continue to monitor corrosion.	Applies to All Alternatives	Insource	$105,000[3]
25	Storage Canopy	Poor	Structural	Replace		Replace canopy due to corrosion, coating failure, seismic concerns, and impact damage.	Applies to All Alternatives	Outsource	$120,000
26	Lighting	Very Poor	Electrical	Replace	Safety	Replace lighting with LED lighting.	Applies to All Alternatives	Insource	$25,000[3]
27	Secondary Clarifiers (Mechanical)	Moderate	Secondary Treatment	Replace	Permit Compliance	Replace drives, chains and scrapers. Drives are past their useful life, so monitory closely for deterioration. Chains and scrapers are expected to be at the end of their useful life in approximately 10 years.	Applies to All Alternatives	Outsource	$290,000
								Subtotal	**$645,000**

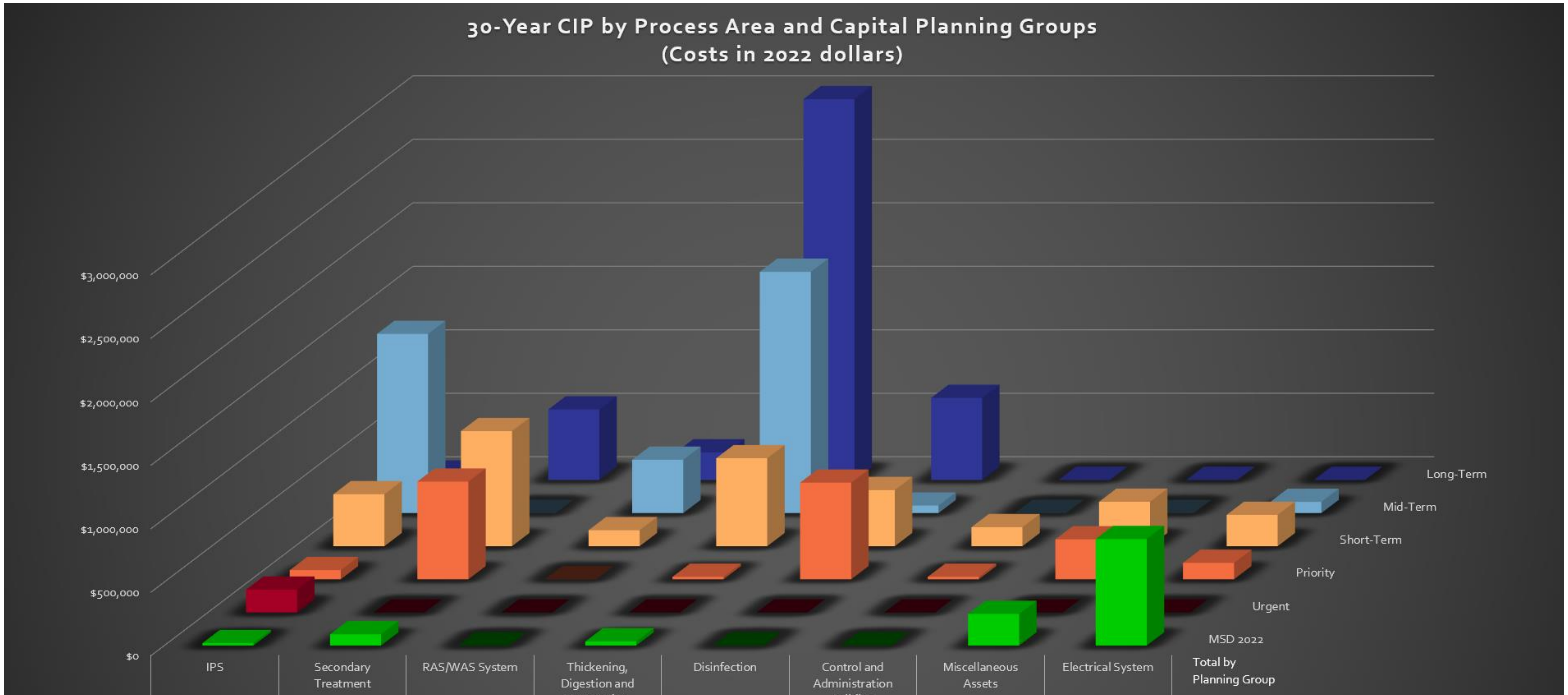
Item No.	Asset Name	Condition Score	Process Area	Recommended Action	Driver	Recommended Scope	Project Pathway	Delivery Method	Estimated Cost
Short-Term (Next 6-10 Years)									
28	Influent Grinders	Poor	IPS	Replace	Permit Compliance	Replace Grinders every 5-7 years as needed due to corrosion.	Applies to All Alternatives	Insource	$50,000
29	Belt Filter Press	Good	Thickening, Digestion and Dewatering	Replace		Replace belts every 6-7 years as needed due to typical wear.	Applies to All Alternatives	Insource	$5,000[3]
30	IPS Pump Room (Basement)	Moderate	IPS	Repair/ Rehabilitate	Permit Compliance	Repair concrete as needed in basement pump room. Install or rehabilitate coating to protect concrete from corrosive environment.	Applies to All Alternatives	Outsource	$40,000
31	Froth Sprayer Pumps & Motors	Moderate	IPS	Replace		It is anticipated that the froth sprayer pumps and motors will not be replaced. The plan water pumps would be able to be plumbed into the froth sprayers. Minor cost for modifications	Will not be replaced	Insource	$5,000[3]
32	Influent Meter Vault, Sump Pump and Flow Meter	Moderate	IPS	Replace	Permit Compliance	Monitor pump and flow meter condition and replace when condition deteriorates.	Applies to MSD NPR or DPR. May apply to Carp and SB	Insource	$30,000[3]
33	Aeration Basins (Structure)	Moderate to Poor	Secondary Treatment	Repair	Permit Compliance	Repair cracks with epoxy or polyurethane resin injection system. Repair damaged concrete (exposed aggregates and embedded items) with structural repair material. Repairs to entire structure (struts, walkways, walls, etc.). Perform recommended repairs per the Petrographic Testing and Seismic Evaluation. This estimate is a "place holder" cost and assumes that ASR is not detected in the concrete structures.	Applies to MSD NPR or DPR. May apply to Carp and SB	Outsource	$220,000
34	Secondary Clarifiers (Structures & Gates)	Moderate to Poor	Secondary Treatment	Repair/ Replace	MBR	Repair damaged concrete with structural repair material. Replace failed coating system. Replace corroded gates. Perform recommended repairs per the Petrographic Testing and Seismic Evaluation. This estimate is a "place holder" cost and assumes that ASR is not detected in the concrete structures.	Applies to MSD NPR or DPR. May apply to Carp and SB	Outsource	$400,000
35	CCB	Moderate	Disinfection	Rehabilitation	Permit Compliance	Repair cracks in concrete and replace liner.	Applies to MSD NPR or DPR. May apply to Carp and SB	Outsource	$90,000
36	Sodium Bisulfite Storage Facility	Moderate	Disinfection	Replace	Permit Compliance	Replace tank and mechanical components. Repair concrete and replace concrete coating. An alternative is to have chemical supplier install tank but chemicals must be purchased from supplier. Evaluate cost/benefit to owning tank vs supplier owned tank prior to replacing tank. Cost assumes chemical supplier will install new tank.	Applies to MSD NPR or DPR. May apply to Carp and SB	Outsource	$61,250[3]
37	Chemical Storage Canopy	Moderate	Disinfection	Replace	Permit Compliance	Recommend replacement of canopy with storage facility/tanks. Monitor condition until replaced.	Applies to All Alternatives	Outsource	$120,000
38	RAS/WAS Dry Well	Moderate	RAS/WAS System	Replace	Permit Compliance	Replace steel tube supports for the cover beams. Replace concrete pads, metal skid and anchors for the pumps.	Applies to MSD NPR or DPR	Outsource	$80,000
39	RAS/WAS VFDs	Good	RAS/WAS System	Replace	Permit Compliance	Replace at end of useful life.	Applies to MSD NPR or DPR	Outsource	$43,750[3]

Item No.	Asset Name	Condition Score	Process Area	Recommended Action	Driver	Recommended Scope	Project Pathway	Delivery Method	Estimated Cost
40	TWAS Pumps and Motors	Moderate	Thickening, Digestion and Dewatering	Replace		Frequent replacement of wear plates and internals are needed and believed to be due to grit and debris. Perform a cost/benefit analysis to determine if cost to continue to repair current rotary lobe pumps is the best alternative, verses replacing with new progressive cavity pump or grit removal. Continue maintaining pumps as needed. Cost estimate assumes replacement of wear plates, not pumps.	Applies to MSD NPR or DPR	Insource	$20,000[3]
41	MCC No. 3 (Digester Blower Room)	Very Poor	Thickening, Digestion and Dewatering	Replace	Permit Compliance	Replace MCC. Past its useful life and obsolete. Staff reported no issues. Monitor and replace sooner if needed.	Applies to MSD NPR or DPR	Outsource	$150,000
42	Control & Administration Building	Moderate	Administration	Repair	Safety	Repair building per seismic evaluation recommendations. This is a placeholder value. Reevaluate after seismic evaluation is performed and deficiencies are known.	Applies to All Alternatives	Outsource	$150,000
43	Digester Blower Motors	Good	Thickening, Digestion and Dewatering	Replace	Permit Compliance	Replace digester motors. These were not replaced when the blowers were replaced.	Applies to MSD NPR or DPR	Insource	$20,000
44	Digester Blower Building	Moderate	Thickening, Digestion and Dewatering	Repair	Safety	Repair building per seismic evaluation recommendations. This is a placeholder value. Reevaluate after seismic evaluation is performed and deficiencies are known.	Applies to MSD NPR or DPR	Outsource	$100,000
45	Air Diffuser System	Poor	Secondary Treatment	Replace	Recycled Water	Continue to maintain system until a decision is made on future of plant. If secondary process remains as-is for the long-term, consider the following changes: re-route exhaust of foul air from IPS wet well so that it no longer goes to aeration blowers and diffusers; replace air distribution header and drop legs and evaluate the ability to use fewer than 7 drop legs (i.e., 2 or 3 may be sufficient); replace diffusers with fixed type diffusers that provide full coverage along the floor (not along one side only). The current flexible tube diffusers are not as efficient as other fixed tube, disc, or panel designs.	Applies to MSD NPR or DPR	Outsource	$720,000
46	Sodium Hypochlorite Storage Facility	Poor	Disinfection	Repair/ Replace	Permit Compliance	Replace tank and all mechanical components. Repair concrete and replace concrete coating. An alternative is to have chemical supplier install tank but chemicals must be purchased from supplier. Evaluate cost/benefit to owning tank vs supplier owned tank prior to replacing tank. Cost assumes chemical supplier will install new tank.	Applies to MSD NPR or DPR	Outsource	$61,250[3]
						Subtotal			**$2,439,250**
						Mid-Term (Next 11-20 Years)			
47	Influent Grinders	Poor	IPS	Replace	Permit Compliance	Replace Grinders every 5-7 Years as needed due to corrosion.	Applies to MSD NPR or DPR	Insource	$50,000
48	IPS Pumps and Motors	Good	IPS	Replace	Permit Compliance	Replace pumps and motors. Consider replacement of pump suction and discharge valves with project.	Applies to MSD NPR or DPR. May apply to Carp and SB	Insource	$80,000[3]
49	Influent Dry Well Sump Pump	Good	IPS	Replace	Permit Compliance	Replace pump and motor.	Applies to All Alternatives	Insource	$2,000[3]
50	Plant Water Pumps and Motors	Good	IPS	Replace		Replace pumps and motors and install new equipment baseplates. Monitor pump anchorage and equipment baseplates until replaced, especially if there is a change such as a seismic event or pump vibration. Consider replacing valves (isolation, suction, gate, check and drain) with project.	Applies to MSD NPR or DPR	Insource	$30,000[3]
51	IPS Control Panel	Good	IPS	Replace	Permit Compliance	In-kind replacement due to end of useful life.	Applies to All Alternatives	Outsource	$110,000

52	Back-Up Generator	Good	IPS	Replace	Permit Compliance	Prior to replacement, evaluate sizing. Monitor closely when generator nears its end of useful life, as this is the only form of redundancy for the WWTP during a power outage.	Applies to MSD NPR or DPR. May apply to Carp and SB	Outsource	$100,000[3]
53	Emergency Distribution Panel	Good	IPS	Replace	Permit Compliance	Recommend replacement with back-up generator. While in good condition, this panel is the only form of redundancy for the WWTP during a power outage.	Applies to All Alternatives	Outsource	$30,000
54	MCC No. 4	Good	IPS	Replace	Permit Compliance	Replace at end of useful life. This MCC may be able to be eliminated once IPS the new IPS control panel is installed (MCC No. 1)	Will not be replaced		$0
55	CCB Sample Pumps	Good	Disinfection	Replace	Permit Compliance	Replace at end of useful life.	Applies to MSD NPR or DPR	Insource	$5,000[3]
56	RAS/WAS Wet Well Pump	Moderate	RAS/WAS System	Replace	Permit Compliance	Replace pump, motor, and replace skid, concrete pad and anchors.	Applies to MSD NPR or DPR	Insource	$40,000
57	RAS Pumps and Motors	Good	RAS/WAS System	Replace	Permit Compliance	Replace due to end of useful life.	Applies to MSD NPR or DPR	Insource	$100,000[3]
58	Aerobic Digester	Good	Thickening, Digestion and Dewatering	Replace		Replace at end of useful life.	Applies to MSD NPR or DPR	Outsource	$200,000[3]
59	Belt Filter Press	Good	Thickening, Digestion and Dewatering	Replace		Replace belt filter press due to end of useful life.	Applies to MSD NPR or DPR	Outsource	$400,000
60	Ocean Outfall	Poor	Piping	Repair	Permit Compliance	Repair unsupported span of pipe, replace tide-flex valves and perform internal repairs/rehabilitation per outfall condition assessment. This is a placeholder cost and must be reevaluated after the outfall condition assessment is complete.	Applies to MSD NPR or DPR	Outsource	$350,000
61	MCC No. 2	Good	Electrical	Replace	Permit Compliance	MCC2 is located outside and is well maintained. It is past its useful life but performing well. Monitor performance and replace sooner if needed.	Applies to MSD NPR or DPR	Outsource	$150,000
62	MCC2 Control Panel	Good	I&C	Replace	Permit Compliance	MCC2 control panel is past its useful life. Monitor and replace sooner if needed.	Applies to MSD NPR or DPR	Outsource	$100,000
56	RAS/WAS Wet Well Pump	Moderate	RAS/WAS System	Replace	Permit Compliance	Replace pump, motor, and replace skid, concrete pad and anchors.	Applies to MSD NPR or DPR	Insource	$40,000
57	RAS Pumps and Motors	Good	RAS/WAS System	Replace	Permit Compliance	Replace due to end of useful life.	Applies to MSD NPR or DPR	Insource	$100,000[3]

Long Term (20+ Years)									
63	Influent Grinders	Poor	IPS	Replace	Permit Compliance	Replace Grinders every 5-7 Years as needed due to corrosion.	Applies to MSD NPR or DPR	Insource	$50,000
65	Rotary Micro Screen	Excellent	Thickening, Digestion & Dewatering	Replace		The rotary drum thickener and feed pump were replaced in 2020. Replace at end of useful life.	Applies to MSD NPR or DPR	Insource	$60,000(3)
66	DAFT	Excellent	Thickening, Digestion & Dewatering	Rehabilitate		Continue to monitor for rust on stainless steel supporting piping. Cost estimate is based on overhaul components of DAFT (pumps and piping), not replacement.	Applies to MSD NPR or DPR	Insource	$100,000(3)
67	Polymer Mix Area	Excellent	Thickening, Digestion & Dewatering	Replace		Assumed to be in excellent condition due to its age (installed in 2018). Replace at end of useful life.	Applies to MSD NPR or DPR	Insource	$20,000(3)
68	WAS Pump and Motor	Moderate	RAS/WAS System	Replace	Permit	In-kind replacement of WAS pump and motor and base piping. The pump and motor were purchased in a previous budget year and will be installed by MSD staff. No anticipated cost in 2022.	Applies to MSD NPR or DPR	Insource	$10,000(3)
69	RAS Dry Well Sump Pump	Very Poor	RAS/WAS System	Replace	Permit Compliance	In-kind replacement of RAS dry well sump pump and control panel. The pump and control panel have been purchased and will be installed by a local contractor. No anticipated cost in 2022.	Applies to MSD NPR or DPR	Insource	$40,000(3)
70	Secondary Clarifier Skimmer Toughs	Poor	Secondary Treatment	Replace	Permit Compliance	In-kind replacement of skimmer troughs.	Applies to MSD NPR or DPR	Combination Insource/ Outsource	$140,000(3)
71	Digester Blowers	Good	Thickening, Digestion & Dewatering	Replace	Permit Compliance	In-kind replacement of digester blowers.	Applies to MSD NPR or DPR	Insource	$40,000(3)
72	Aeration Basin Blowers and Motors	Moderate	Secondary Treatment	Replace	Permit Compliance	Electrical Rehabilitation Project. MSD work includes replacing motors with units suitable for use with VFDs, replace blowers and incorporate dissolved oxygen control. Consider replacing valves associated with each asset as part of this project.	Applies to MSD NPR or DPR	Insource	$100,000(3)
	ATS Replacement	Good	Electrical	Replace	Permit Compliance	Replace due to end of useful life	Applies to MSD NPR or DPR	Outsource	$35,000(3)
								Subtotal	$595,000
						Total			**$7,730,250**

Notes:
Abbreviations: IPS - Influent Pump Station; RAS - return activated sludge; WAS - waste activated sludge; SCADA - supervisory control and data acquisition; I&C - instrumentation and control, MCC - motor control center; ATS - automatic transfer switch; ADA- Automatic Dialer Alarm; CCB - chlorine contact basin; LED - light-emitting diode; TWAS - thickened waste activated sludge; DAFT - dissolved air floatation thickener.
(1) Scheduled for replacement as part of 2022 Electrical Project.
(2) Scheduled for replacement in 2022 by MSD.
(3) Estimated cost provided by MSD.
(4) Estimated cost for electrical rehabilitation project in 2022.



	IPS	Secondary Treatment	RAS/WAS System	Thickening, Digestion and Dewatering	Disinfection	Control and Administration Building	Miscellaneous Assets	Electrical System	Total by Planning Group
MSD 2022	$20,000	$90,000	$0	$33,000	$0	$0	$250,000	$840,000	$1,233,000
Urgent	$180,000	$0	$0	$0	$0	$0	$0	$0	$180,000
Priority	$73,000	$770,000	$0	$20,000	$762,000	$20,000	$315,000	$130,000	$2,090,000
Short-Term	$409,000	$907,000	$126,000	$693,000	$442,000	$150,000	$350,000	$247,000	$3,324,000
Mid-Term	$1,411,000	$0	$420,000	$1,900,000	$59,000	$0	$0	$88,000	$3,878,000
Long-Term	$50,000	$555,000	$217,000	$2,999,000	$646,000	$0	$0	$0	$34,467,000
Total by Process Area	$2,143,000	$2,322,000	$763,000	$5,645,000	$1,909,000	$170,000	$915,000	$1,305,000	**$15,172,000**

Figure 5.2 30-Year CIP by Process Area and Capital Planning Groups

-This Page Intentionally Left Blank-

5.5 Operational Costs

MSD provided their Operational and Maintenance (O&M) expenditures for Wastewater Treatment for the previous three fiscal years. Table 5-5 summarizes operational expenses for Treatment by fiscal year.

Table 5-5. Summary of Treatment Operational Expenditures

Expense Category	Fiscal Year 2019-20	Fiscal Year 2020-21	Fiscal Year 2021-22
Salaries and Benefits	$1,254,226	$1,172,050	$1,043,215
Chemicals	$205,091	$165,496	$178,430
Electricity	$121,519	$129,714	$116,794
Covid-19 Expenses	$135,499	$135,499	$34,847
Other	$368,460	$354,826	$413,999
Total	$2,084,795	$1,957,585	$1,787,285

The following observations were made regarding the operational expenses:

- Salaries and Benefits: A decrease of over $200,000 was observed over the past three fiscal years. Most of the decrease was observed in regular salaries ($100,000) and Calpers contribution ($72,000). This was largely attributed to staff retirements and is expected return to Fiscal Year 2019-20 levels.
- Chemicals: Chemical expenditures decreased significantly and is attributed to Covid-19. These costs are expected to return to post Covid-19 levels.
- Electricity: Similar to chemicals, electricity expenditures were reduced during the Covid-19 pandemic. These costs are expected to return to post Covid-19 levels.
- Covid-19 Expenses: This was a new category used to additional expenses incurred by MSD during the pandemic such as portable bathrooms.
- Other Expenses: This category represents all of the other treatment expenditures as one lump sum. In general, it has remained relatively consistent with some outlier expenses that may be contributed to special projects and the Covid-19 pandemic.

5.6 The following categories were reviewed with the following recommendations: Other Considerations

The following items were discussed with MSD and should be considered as appropriate:

5.6.1 Electrical System

- **Load Analysis**. If there is a future expansion, it is recommended to perform a load analysis. It appears the service size has increased one time in the past, but if MSD wants to increase the nominal capacity of the plant, an electrical load analysis would be beneficial.

- **Arc-Flash Study**. The arc flash labels are old and not code compliant. It is recommended to do a new arc-flash study that could be part of the upcoming electrical project.
- **Ungrounded Electrical System**. There was a discussion to add variable frequency drives (VFDs) to the blower pumps, but it was not recommended due to ungrounded electrical system. It is recommended to do an electrical study and find solutions to add VFDs for the blowers; however, updating the system to a grounded system is recommended.

5.6.2 Electrical Project (2022)

During the November 2021 condition assessment, MSD staff reviewed the major elements of the upcoming electrical project. Prior to bidding the electrical project, it is recommended that MSD review and update the project plans and specifications to address potential safety hazards, bring the documents up to industry standards, provide additional details for constructability, contractor pricing, and ability to operate the WWTP during construction.

5.6.3 Computerized Maintenance Management System (CMMS)

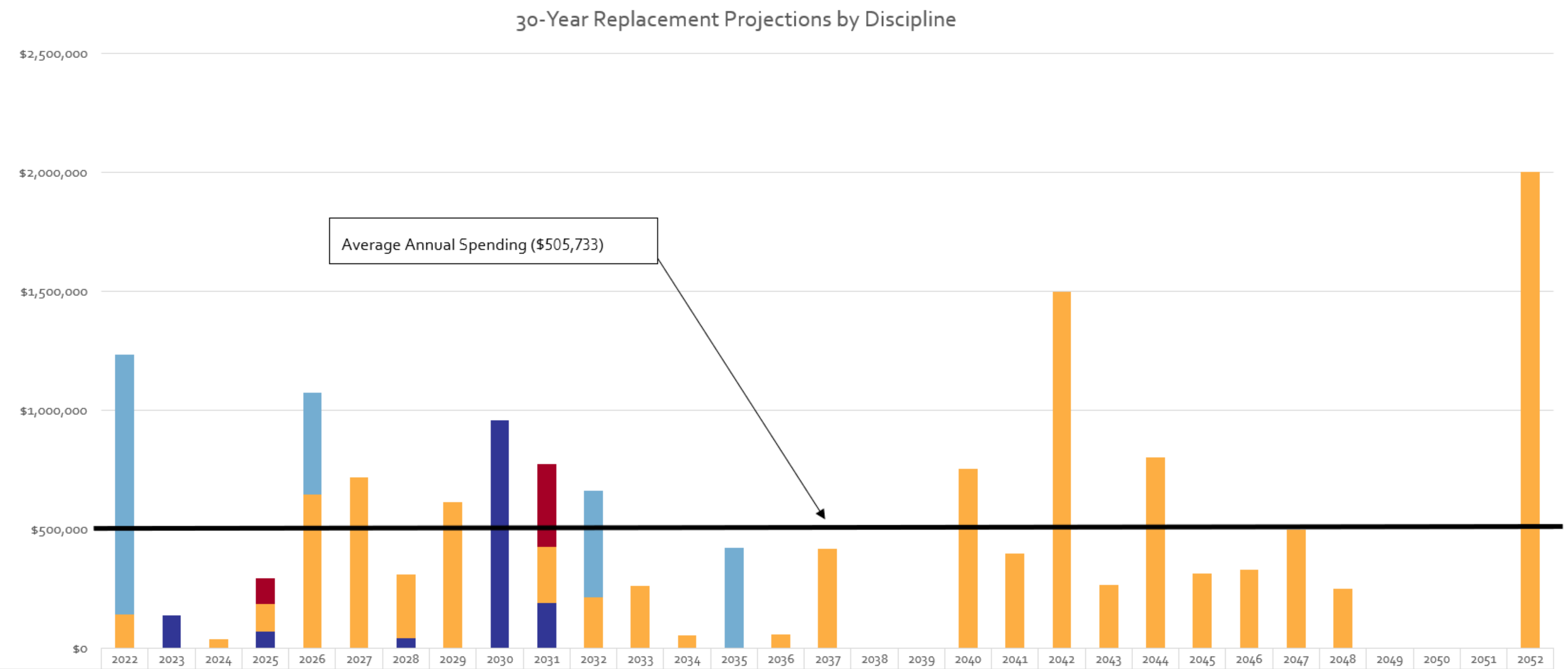
MSD has a "skeleton" CMMS for the WWTP asset inventory and maintenance history; however, it does not appear that it has been used regularly since 2016. There does not appear to be any type of CMMS for the collection system, but some data may be stored in the geographic information system.

It is recommended that MSD consider its approach for asset management. At a minimum, MSD should consider investing in a CMMS for its horizonal and vertical assets. Vertical assets are typically above ground assets and generally consist of assets found at water and wastewater facilities, whereas horizontal assets include the various pipelines, manholes, and cleanouts that make up MSD's collection system. A CMMS would allow staff to track maintenance history, and assist with planning and decision making for future capital improving program replacement or rehabilitation of assets.

5.7 Annual Capital Funding

As of the start of Fiscal Year 2022-23, MSD has a balance of approximately $7.4 million (M) in its CIP account to fund future collection, treatment, and facilities projects. Annually, the District adds approximately $1.2 M from rate revenue into the CIP account to fund its capital improvement projects. Currently, MSD anticipates allocating between $750,000 and $1M from that portion of the CIP funds for WWTP projects as "pay as you go" funding. Using this information, Figure 5.3 shows how each CIP project could be constructed based on MSD current funding levels.

MSD is planning a rate study in the next year to assess the adequacy of its rates and funding for operational and CIP goals. The expected capital funding requirements in Figure 5.3 will be useful during the rate study to identify any deficiencies in the District's 30-year capital improvement funding requirements and where rate adjustments or supplemental funding sources (bonds, loans, grants) will be needed to supplement the current "pay as you go" CIP funding strategy.



	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Studies/Other	$0	$0	$0	$105,00	$0	$0	$0	$0	$0	$350,00	$0	$0	$0	$0	$0
Electrical & Instrumentation	$1,090,	$0	$0	$0	$430,00	$0	$0	$0	$0	$0	$448,00	$0	$0	$424,00	$0
Mechanical	$143,00	$0	$39,000	$116,00	$646,00	$720,00	$266,00	$615,00	$0	$234,00	$214,00	$264,00	$57,000	$0	$59,000
Structural	$0	$141,00	$0	$73,000	$0	$0	$45,000	$0	$960,00	$192,00	$0	$0	$0	$0	$0

	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
Studies/Other	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Electrical & Instrumentation	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Mechanical	$420,00	$0	$0	$754,00	$400,00	$1,500,	$267,00	$803,00	$316,00	$330,00	$500,00	$251,00	$0	$0	$0	$2,000,
Structural	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Figure 5.3 30-Year Replacement Projections

-This Page Intentionally Left Blank-

5.8 Conclusion

This TM presents the 30-year CIP and Operational costs for MSD. It is estimated that MSD will need to implement approximately $7.7M of capital improvements over the next 30 years to maintain current treatment and operations at the plant, of which, approximately $3M will occur within the next 10 years. Several additional studies are recommended to further evaluate the aeration basins, clarifiers, select buildings and the ocean outfall. Pending the results, the capital cost could increase.

It is recommended that MSD determine the outcome of its wastewater, whether it will be treated at another regional facility or continue to be treated at MSD, prior to undergoing the additional assessments. If it is determined that MSD effluent will be treated at another facility, MSD will need to implement the necessary capital improvements to maintain treatment and operations for the next 10 years until such time the legal, permitting, and logistical challenges are overcome.

-This Page Intentionally Left Blank-

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 6
COST FOR MBR CONSTRUCTION AND 30-YEAR OPERATIONS

DRAFT | August 2022

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 6
COST FOR MBR CONSTRUCTION AND 30-YEAR OPERATIONS

DRAFT | August 2022

This document is released for the purpose of information exchange review and planning only under the authority of Andrew Thomas Salveson, August 29, 2022, California C-56902.

Contents

Appendices

Tables

Figures

-This Page Intentionally Left Blank-

Abbreviations

AWPF	advanced water purification facility
BOD	biochemical oxygen demand
BOD_5	5-day BOD test
Carollo	Carollo Engineers, Inc.
DDW	Division of Drinking Water
DPR	direct potable reuse
EQ	equalization
gal	gallons
gpd/sf	gallons per day per square foot
gpm	gallons per minute
LRV	log removal value
MBR	membrane bioreactor
MG	million gallons
mgd	million gallons per day
mg/L	milligrams per liter
MLSS	mixed liquor suspended solids
mm	millimeter
MSD	Montecito Sanitary District
MWD	Montecito Water District
NPDES	National Pollutant Discharge Elimination System
NPR	non-potable reuse
NPV	net present value
NTU	nephelometric turbidity unit
O&M	operations and maintenance
PDT	pressure decay testing
Q	flow
RAS	return activated sludge
SC	secondary clarifiers
scfm	standard cubic feet per minute
SRT	solids retention time
TM	technical memorandum
TSS	total suspended solids
WAS	waste activated sludge
WRF	Water Research Foundation
WWTP	wastewater treatment plant

-This Page Intentionally Left Blank-

Technical Memorandum 6

COST FOR MBR CONSTRUCTION AND 30-YEAR OPERATIONS

6.1 Introduction and Background

This project will provide guidance to Montecito Water District (MWD) and Montecito Sanitary District (MSD) for implementation of recycled water and the beneficial use of treated wastewater from the community of Montecito. The project seeks to identify the best method of maximizing wastewater reuse capabilities thus producing a new local drought proof water supply for the community and reducing the discharge of treated wastewater to the ocean. The analysis considers local and regional partnerships, non-potable and potable reuse alternatives, and various treatment methods and technologies.

This technical memorandum (TM) builds upon work performed in prior TMs. Prior work leveraged and referenced in this TM includes the wastewater flow and load projections from TM 1, MSD Flow and National Pollutant Discharge Elimination System (NPDES) Permit Analysis, the cost and effort to rehabilitate existing facilities in TM 3, Condition Assessment, and the calibrated plant process model that was built for the performance and capacity assessment for TM 4, Evaluation of Performance and Capacity. This TM evaluates two alternatives to replacing the secondary treatment facilities. Alternative 1 consists of constructing a new membrane bioreactor (MBR) facility, while Alternative 2 consists of retrofitting the MBR facilities within the existing secondary process infrastructure (i.e., aeration tanks and clarifiers).

The evaluation includes process schematics, design criteria, layouts, capital, operations and maintenance (O&M) and life cycle costs, and various non-economic considerations.

6.2 Summary of Findings

Alternatives were compared over a 30-year planning horizon. The key findings are summarized below:

- Alternative 1: New MBR:
  - New MBR facilities would require several new structures that could be built in the open area to the western end of the treatment plant property.
  - Processes could be constructed all at once without disruption to existing treatment.
  - New treatment processes will not require replacement within the 30-year planning horizon.
- Alternative 2: Retrofit Wastewater Treatment Plant (WWTP) With MBR:
  - Two of the four existing secondary clarifiers (SCs) could be retrofit to fit the new membrane tanks. The condition assessment performed at the plant (see TM 3) found the structural condition of the clarifiers to be moderate to poor. Concrete repair will be required.

- One of the two existing aeration tanks could be retrofit and reconfigured to house a two new bioreactor trains providing anoxic and aerobic treatment upstream of the membrane tanks. Concrete repair will be required.
- Rehabilitation will extend the life of the existing aeration tanks and SCs, but replacement will still be needed likely within the 30-year planning period. The condition assessment performed at the plant (see TM 3) found the structural condition of the clarifiers to be moderate to poor.

- Comparison of Alternatives:
  - Estimated construction costs are similar between the two facilities.
  - Uncertainties in structural condition of the existing facilities to be utilized in Alternative 2 may lead to full replacement of assets within the next 15 to 20 years, increasing the costs of Alternative 2.
  - Construction sequencing, phasing, and space requirements will be constrained for both alternatives, but more complicated for Alternative 2.
  - Alternative 1 allows for existing plant tankage to be utilized for future recycled water storage, pending structural condition.

6.3 Basis of Evaluation

The flow and load criteria for this MBR analysis comes from TM 1 (Tables 1.1 and 1.2). Several items of note:

- Flow values focus upon existing and future flow and load concentrations as well as with the addition of septic to sewer conversions identified in TM 1.
- The MBR would treat the entire process flow, not a side stream. Because of uncertainty related to climate change and storm intensities and the fact that MBR systems have distinct maximum production capacity, conservatism in sizing equalization (EQ) (pre-MBR) and MBR systems is included in this analysis.

The following modeling and process assumptions for the MBR are included:

- MBR system is based on a 10-day total solids retention time (SRT).
- Sizing is based on meeting existing permit for biochemical oxygen demand (BOD) and total suspended solids (TSS) removal only. Although the proposed system will remove nutrients, it does not need to meet a numeric nutrient target.

6.4 Alternatives Description and Overview

Two alternatives were developed to replace the secondary treatment facilities with the MBR process. Both alternatives utilize the same process and approach; the primary difference being whether the MBR facilities are constructed as new or retrofitted within the existing secondary process.

MBR systems are similar to the existing secondary process in that it utilizes aeration and microorganisms to remove soluble pollutants such as BOD and nutrients. However, instead of using gravity for solids separation in SCs, membranes are used. Because of this difference, the aeration tanks can be operated at much higher mixed liquor suspended solids (MLSS) concentrations and therefore achieve the same treatment in a reduced volume. Membranes can accommodate solids concentrations up to 10,000 to 15,000 milligrams per liter (mg/L), depending on the membrane type and manufacturer. In an activated sludge process with conventional clarifiers, MLSS concentrations are limited the ability to settle mixed liquor, which is difficult to do above 4,000 to 5,000 mg/L.

For the MBR, mixed liquor from the aeration tanks would flow to new membrane tanks, where micro- or ultra-filtration membranes are used to produce high quality effluent that meets Title 22 standards for effluent turbidity, which is 0.2 nephelometric turbidity unit (NTU) 95 percent of the time and 0.5 NTU not to exceed at any time. MBRs also provide pathogen disinfection, as noted further on in this document.

MBRs come in both hollow fiber and flat plate types. The advantages and disadvantages of each type are shown in Table 6.1.

Table 6.1 MBR Hollow Fiber vs. Flat Plate

Membrane Type	Advantages	Disadvantages
Hollow Fiber	• Lower blower air scour demand. • Smaller membrane footprint, more easily retrofit into shallow clarifiers. • More flexibility for retrofits with other manufacturers.	• More complex O&M. • Membranes susceptible to debris.
Flat Plate	• Membranes less susceptible to debris buildup and damage. • Higher allowable solids concentration, subsequently smaller bioreactors. • Less frequent cleanings required.	• Larger footprint and volume for membrane tank. • At higher MLSS, lower oxygen transfer efficiency and more process air utilization. • Retrofits with other manufacturers retrofits are less "streamlined".

For the purposes of this evaluation, a Kubota flat plate MBR system was used. Kubota is the leading installer of flat plate membranes globally and has undergone extensive virus and protozoa removal validation following the Water Research Foundation (WRF) 4997 protocols, which have been approved by the State of California. Other systems, such as Suez or DuPont, are anticipated to be equally effective once they have completed their own validation testing.

Other key common elements of both alternatives are as follows:

- The existing influent pumps will be utilized to pump to a new, partially buried flow EQ tank.
- Wet weather flow EQ would be utilized to limit the wet weather flow peaking factor to 2.0. Industry experience is that with higher peaking factors, MBRs are not as cost effective. An analysis of historic storms performed in TM 1 indicates 2.1 million gallons (MG) would be needed to limit the wet weather equalized flow to 1.5 million gallons per day (mgd) at buildout[1]. Due to site space constraints, the EQ tank will be constructed

[1] Note: In the summer of 2022, Morro Bay was permitted by the RWQCB to have a PWWF bypass for their 1.88 mgd peak flow MBR. Flows above 1.88 mgd receive primary treatment through cloth disc filters before discharge to an ocean outfall. A similar approach could be taken for a future MSD project, the equalization ahead of MBR would be replaced by a primary treatment bypass system, significantly reducing footprint and cost. A cost reduction of ~$8M is anticipated.

partially below grade at an equal depth to the existing influent pump station. A small pump station is required to pump equalized flow from the EQ basins to downstream treatment. Although the EQ tank would only need to be used during wet weather when the wastewater is dilute, it is assumed the tank would be covered and have odor control.

- New screening facilities will be needed to protect the membranes from rags and debris. The max opening size of the screens should not exceed 2-millimeter (mm) to sufficiently protect the downstream MBR process and meet typical membrane warranty requirements. It is assumed that rotating drum screens would be used and that they would be located between the EQ tank and MBR train. Locating the screening downstream of EQ and the EQ pump station will minimize the required size of the screening facilities. The EQ basin will need to be cleaned to remove debris from the influent wastewater after each use. However, due to the seasonal, wet weather use of the EQ basin it is anticipated this cleaning will be infrequent and minimal. The screening facility will be located at grade adjacent to the EQ basin and pumping facility.
- The new membrane system includes membrane tanks, membranes, permeate pumps, membrane air scour blowers, chemical cleaning facilities, and return activated sludge (RAS)/waste activated sludge (WAS) pumping.
- While the existing process aeration blowers can continue to be used for process aeration, RAS pumping will be at a significantly higher flow rate, and new membrane air scour blowers may require new electrical and power distribution facilities.
- Although MBRs provide a measure of disinfection, for this analysis it is assumed that the existing chlorination system would remain in place, although efficiency (and cost) will improve.
- If disinfection is enhanced in the future, the MBR effluent (or permeate) would be suitable for Title 22 reuse. To maximize the capture and reuse of effluent, and minimize the sizing of recycled water distribution facilities, it is assumed that MBR permeate would be equalized. The amount of EQ needed after the MBR depends upon the maximum production rate of recycled water and the diurnal flow through the WWTP. Based on the average dry-weather flow of 0.7 mgd, prior work (2019 Montecito Recycled Water Facilities Plan) has determined that 100,000 gallons of storage is needed to maximize the capability for non-potable reuse (NPR) and 230,000 gallons is needed for direct potable reuse (DPR). The volume needed for DPR is driven by the draft regulations, which require a minimum 10:1 dilution of flow in the event of a potential 1-hour chemical spike. See TM 8, Recycled Water Treatment Options at MSD and TM 9, Infrastructure Analysis for a more detailed review of post MBR EQ.

Detailed design criteria for this MBR analysis are available in Appendix 6A. Figure 6.1 illustrates the proposed flow schematic for both alternatives.

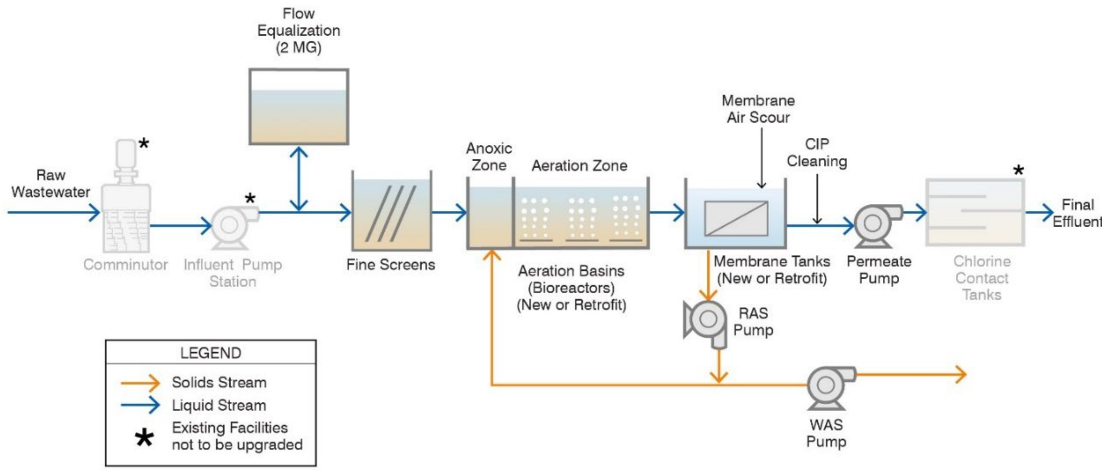


Figure 6.1 Proposed Treatment Schematic

6.4.1 Future NPR Considerations

MBR is an ideal treatment for NPR, providing an effluent with very low turbidity and very low bacterial counts. For NPR that does not require salt removal (see TM 8 and TM 9), disinfection with free chlorination using the existing chlorination system is proposed following MBR. Free chlorination is expected due to the reliable nitrification by an MBR system[2]. Ammonia could be added to the reclaimed water system to form chloramines if a long lasting residual is desired. In total , for NPR, no additional disinfection systems are needed to comply with regulations.

Should salt reduction be desired for NPR, MBR can be followed directly by reverse osmosis, then followed by a small ultraviolet disinfection system for final disinfection.

6.4.2 Future Potable Reuse Considerations

MBR treatment is a proven barrier to pathogens, including virus, protozoa, and bacteria and an integral component of potable reuse programs, should advanced treatment be implemented in the future.

With regard to pathogen removal by MBR, which is an important consideration for a potable reuse program, the following must be reinforced:

- Based upon WRF Project 4997, which was led by Carollo Engineers, Inc. (Carollo), the State of California Division of Drinking Water (DDW) will permit any MBR to receive 1 log removal value (LRV) for virus and 2.5 LRV for protozoa as long as turbidity values are 0.2 NTU (or lower) 95 percent of the time and do not exceed 0.5 NTU. These conservative credits are called "Tier 1".
- The same WRF Project 4997 details how to obtain higher LRV credits, referred to as "Tier 2". Industry progress on Tier 2 testing is summarized below:

[2] Disinfection credit under Title 22 of the California Code of Regulations would be based upon the Australian WaterVal process which allows for very short contact times for free chlorination.

- To date, only Kubota has finished their "Tier 2" work, documenting virus and protozoa LRVs in the 3 to 4 range. These "Tier 2" credits, once approved by DDW, would apply to any Kubota system used for potable reuse in California.
- Suez, DuPont, and Koch are each either working through Tier 2 efforts or Tier 2 efforts are in their near future.
- For Tier 2, turbidity remains a primary performance surrogate. Tier 2 also requires a secondary surrogate, which can be either total coliform monitoring in MBR permeate or pressure decay testing (PDT). Regarding PDT:
  - PDT is NOT required.
  - PDT testing of MBR is something that DuPont has pioneered, but has been included in the Metropolitan Water District and Hyperion MBR demonstration systems for Suez, DuPont, and Koch, all designed by Carollo.
  - Kubota cannot effectively perform PDT because of the flat sheet application, it is anticipated to be too destructive of a test. For Kubota, their Tier 2 monitoring would be turbidity and total coliform.

The Tier 2 validation will provide downstream benefits to the future advanced water purification facility (AWPF) processes. A full evaluation of MBR suppliers, such as DuPont-Memcor and Suez-Zenon, is recommended as part of the predesign effort, should this project move forward.

6.4.3 Alternative 1 – New MBR at WWTP

This alternative consists of constructing all new MBR facilities at the WWTP and includes three bioreactors and three membrane tanks to provide reliability and redundancy. The existing aeration tanks and SCs will not be used for the MBR facilities and can be used for recycled water storage if a recycled water program is implemented in the future. If desired, the existing aeration tanks and SCs could also be demolished if additional space is needed for other facilities, such as a future AWPF. TM 8 evaluates the space needed for a future AWPF.

A site layout of this alternative is provided on Figure 6.2.

6.4.4 Alternative 2 – Retrofit WWTP With MBR

This alternative consists of constructing new MBR facilities within the existing aeration tanks and SCs. One of the two aeration tanks would be modified with new diffusers, mixers, and partition walls so that the process includes two reactors. Two of the four SCs would be converted to membrane tanks. Unlike Alternative 1, this alternative includes two bioreactors and two membrane tanks because this configuration fit more logically into the existing infrastructure given the treatment capacity requirements. Plant staff will still have the ability to take one train out of service for maintenance activities if needed. Should additional redundancy be required, three bioreactors and membrane tanks could be considered, though this might require more significant retrofitting efforts and possible utilization of more aeration tanks and SCs. The remaining secondary infrastructure (one aeration tank and two SCs with this current configuration) can be used for recycled water storage if a recycled water program is implemented. To allow for the retrofit, the 2.1 MG of EQ would need to first be constructed, which then allows for operation of only two SCs during MBR system construction.

Alternative 2 does not include structure replacement. Condition assessment results, referenced in TM 3, indicate extensive cracking in both the existing aeration tanks and SCs. It is unknown at this time whether the cracking can be repaired and the tank rehabilitated to extend its useful life or if it is indicative of alkali-silica reaction, which would negate full structure replacement. It is recommended that a more detailed structural assessment be performed should retrofit be the preferred alternative.

A site layout of this alternative is provided on Figure 6.3.

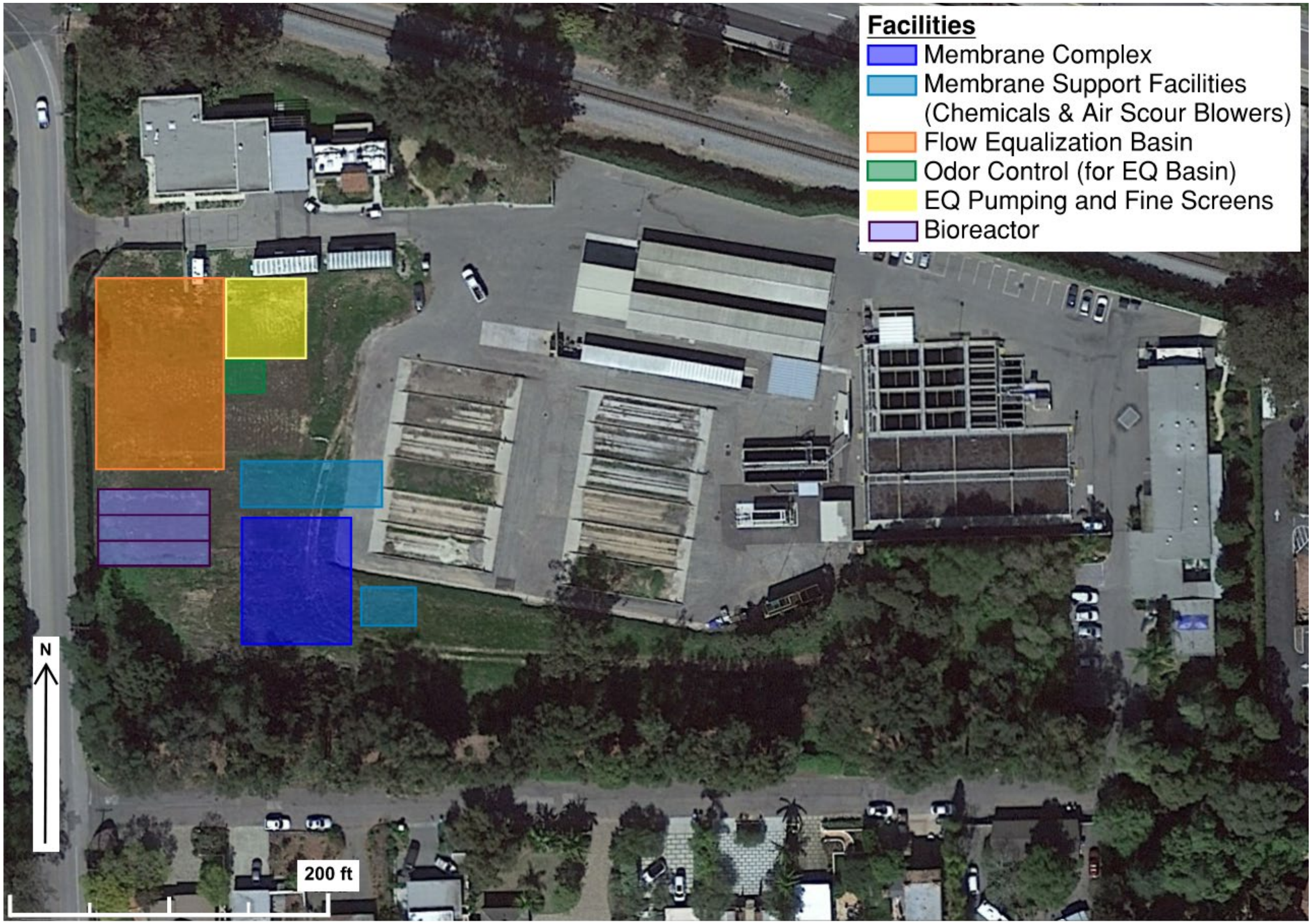


Figure 6.2 Alternative 1 New MBR Site Layout

Figure 6.3 Alternative 2 Retrofit WWTP Site Layout

6.5 Alternative Comparison

This section compares the costs and non-economic considerations, which assess the advantages and disadvantages for both alternatives.

6.5.1 Cost Comparison

The following section compares the capital costs, O&M costs, and life cycle costs for both alternatives. Detailed cost documentation is available in Appendix 6B.

6.5.1.1 Capital Cost Comparison

An AACE International Class 5 cost estimate was prepared for this each evaluated alternative. Per AACE International standards, a Class 5 cost estimate has an expected accuracy range of - 20 to - 50 percent and +30 to +100 percent for the low and high ranges, respectively.

The costs presented herein were developed using the Carollo Cost Estimation database, past similar projects, and vendor quotes.

Table 6.2 shows the anticipated capital costs for both alternatives. Note that these costs are developed for the purposes of alternative comparison and do not include mid-point escalation or bid market allowance. Current market conditions suggest large rates of cost escalation and high rates of variance in construction bidding. It is suggested that an escalation rate and bid market allowance be added to capital costing efforts as project development becomes more refined.

Costs presented include rehabilitation, but not full structure replacement, of the existing aeration tanks and SCs. Rehabilitation costs include repair to cracks and exposed aggregates, coating replacement, and repair to struts and walkways, as needed. Should results of subsequent structural studies indicate replacement of the aeration tanks and SCs is required in the near-term, the cost of Alternative 2 will increase substantially.

Table 6.2 Capital Cost Comparison (Presented in 2022 Dollars)(1,2)

Cost Item/Process Area	Description	Alternative 1 - New ($M)	Alternative 2 - Retrofit ($M)
Direct Costs			
Primary Treatment	Fine Screens	$1.30	$1.30
Flow EQ	EQ Basin and Pumping	$3.00	$3.00
	Odor Control System	$0.22	$0.22
Aeration Tanks	Structural Rehabilitation		$0.11
	New Aeration Basin (0.30 MG)	$0.71	
	Mechanical Equipment	$0.89	$0.89

Cost Item/Process Area	Description	Alternative 1 - New ($M)	Alternative 2 - Retrofit ($M)
MBR System	Secondary Clarifier Rehabilitation		$0.19
	Secondary Clarifier Retrofit		$0.04
	MBR System (Includes Membrane Complex and Equipment)	$2.56	$2.70
	Blower Building and Electrical Room	$0.74	$0.66
	Chemical Facility	$0.12	$0.12
Subtotal		**$9.60**	**$9.30**
Demolition			$0.50
Retrofit Contingency	5 percent of Subtotal		$0.47
Civil/Yard Piping	10 percent of Subtotal	$0.96	$0.93
Process Mechanical Allowance	10 percent of Subtotal	$0.96	$0.93
Electrical, Instrumentation & Controls	25 percent of Subtotal	$2.39	$2.31
Subtotal Direct Cost		**$13.91**	**$14.44**
Contingency	30 percent	$4.18	$4.33
Total Direct Costs	**Subtotal + Contingency**	**$18.09**	**$18.77**
Construction Costs			
General Conditions	12 percent of Total Direct Cost	$2.18	$2.26
Bond/Insurance	2.5 percent of Total Direct Cost	$0.46	$0.47
Contractor Overhead and Profit	12 percent of Total Direct Cost	$2.18	$2.26
Sales Tax	8 percent of Total Direct Cost	$0.73	$0.76
Total Construction Cost		**$23.64**	**$24.52**
Project Costs			
Engineering (Design and Construction Services)	20 percent of Total Construction Cost	$4.73	$4.91
Owner's Reserve for Change Orders	5 percent of Total Construction Cost	$1.19	$1.23
Total Project Cost		**$29.56**	**$30.66**

Notes:
(1) Expressed in 2021 dollars.
(2) Note that capital costs presented are for alternative comparison only. These costs do not include mid-point escalation or bid market allowance. Current market conditions suggest large rates of cost escalation and high rates of variance in construction bidding. It is suggested that an escalation rate and bid market allowance be added to capital costing efforts as project development becomes more refined.
(3) Permitting of a primary effluent bypass, similar to the Morro Bay MBR project, would minimize EQ needs and instead replace EQ with the primary bypass system, dropping the cost shown for EQ from $3M to $1.5M.

As noted earlier in this document, the recent approval of a primary effluent bypass for peak wet weather flow in Morro Bay presents a significant cost savings for the evaluated MBR project above. The 2022 construction costs for the Morro Bay primary bypass system was $1.46M. Applying that cost in lieu of the $3M cost for equalization results in a cost reduction of $4M for either MBR project, resulting in an estimated Total Project Cost for MBR in the range of $25M to $27M.

6.5.1.2 O&M Cost Comparison

Annual O&M costs were developed for each alternative. The following assumptions were made when developing these costs:

- $0.23 per kilowatt-hour for power costs.
- $2.75 per gallon for sodium hypochlorite (12.5 percent solution) based on the price MSD is currently paying.
- $7.00 per gallon for citric acid based on similar industry values.
- Additional labor and equipment maintenance were not included, as this is anticipated to be similar for both alternatives.

Table 6.3 shows the anticipated annual O&M costs for the MBR system and associated improvements. O&M costs are anticipated to be similar between the greenfield and retrofit alternatives.

Table 6.3 Annual O&M Costs (2022 Dollars)(1,2)

O&M Item	Annual Cost
Power	
EQ Pump Station	$33,000
EQ Odor Control	$18,000
Aeration Tanks	$124,000
MBR System	$150,000
Chemicals	
Sodium Hypochlorite (12.5 percent solution)	$5,000
Citric Acid (50 percent solution)	$2,000
Additional Annual Running Costs	
Diffuser Replacement	$3,000
MBR Membrane Replacement(3)	$40,000 to $55,000
Total	**~$400,000**

Notes:
(1) Expressed in 2021 dollars.
(2) Note that costs presented are for alternative comparison only. Current market conditions suggest large rates of cost escalation. Prices should be confirmed as project develops.
(3) Membrane replacement required approximately every ten years. New vs. retrofit membranes may range in replacement costs due to different configurations. Annualized membrane replacement for Alternative 1 (New) is anticipated to be approximately $40,000 while replacement for Alternative 2 (Retrofit) is anticipated to be approximately $53,000.

6.5.1.3 Life Cycle Cost Comparison

A comparison of construction, annual O&M, and net present value (NPV) costs are summarized in Table 6.4 for a 30-year life cycle. Equipment replacement and labor costs were not considered, as these are expected to be similar for both alternatives. The following assumptions were made when developing the life cycle costs:

- Two years of design.
- Three years of construction.
- Annual O&M for the remainder of the 30-year life cycle period.
- No replacement of structures will be required within the life cycle. Note that this is contingent on further structural assessment for existing concrete tanks.

Table 6.4 Cost Comparison(4)

Cost Item	Total Cost ($M)	
	Alt. 1 - New	Alt. 2 - Retrofit
Total Project Cost(1)	$29.56	$30.66
Escalated Capital Cost(2)	$31.94	$33.13
Annual O&M Cost(1)	$0.37	$0.39
Total O&M(1)	$9.30	$9.63
Escalated Total O&M(2)	$15.72	$16.28
NPV(3)	$41.33	$42.84

Notes:
(1) Expressed in 2021 dollars.
(2) Over a 30-year lifespan using a 3 percent escalation rate.
(3) Analysis based on a 30-year lifecycle using a 3 percent escalation rate and 2 percent discount rate.
(4) Note that capital costs presented are for alternative comparison only. These costs do not include mid-point escalation or bid market allowance. Current market conditions suggest large rates of cost escalation and high rates of variance in construction bidding. It is suggested that an escalation rate and bid market allowance be added to capital costing efforts as project development becomes more refined.

6.5.2 Phasing and Scheduling

Estimated phasing for each alternative must accommodate uninterrupted operation at the WWTP as well as meet required NPDES permit stipulations.

6.5.2.1 Alternative 1 (New) Phasing and Scheduling

The new facilities will be constructed on the vacant space on the west end of the WWTP property. Construction phasing is likely to be fairly straightforward, as preliminary sizing and layouts suggest that the facility can be constructed in open space. Based on sizing of the MBR, it is crucial that the flow EQ be operational prior to MBR startup.

After the new facilities are constructed, the existing aeration tanks and SCs can be taken out of service and utilized for future recycled water storage.

6.5.2.2 Alternative 2 (Retrofit) Phasing and Scheduling

Implementation of Alternative 2 will require construction sequencing that considers maintaining existing treatment process capacity.

Rehabilitation Requirements

Significant concrete and liner repairs are required to repurpose the existing aeration tanks and SCs. A BioWin model of the existing plant processes was used to assess the ability to convert one of the two aeration tanks into a bioreactor and two of the four SCs into membrane tanks. At existing flows, it was found that the plant will not have the required capacity to operate reliably at this reduced capacity during wet weather events. However, modeling results indicate that if the new flow EQ (2.1 MG) is completed prior to rehabilitation work, there will be sufficient capacity to maintain existing treatment while rehabilitation is taking place.

Anticipated Schedule

The following sequence is recommended for proceeding with a retrofitted MBR process:

1. Step 1 – Demolish existing sludge drying beds:
   a. Clear new space by demolishing the existing sludge drying beds for siting the new flow EQ basin. Existing sludge drying beds are used for emergency sludge management only. Typically, solids are dewatered through an existing belt filter press. It is recommended that, should additional solids dewatering be required, sludge is hauled offsite for processing by a third party.
2. Step 2 – Construct new flow EQ and MBR support facilities:
   a. Build new 1 MG of wastewater EQ, including mixing and odor control.
   b. Build new MBR fine screens.
   c. Construction additional MBR components (e.g., additional blowers, electrical, chemical systems) in the location of the existing drying beds.
   d. Build new membrane tanks in the location of the existing drying beds.
3. Step 3 – Rehab Structures:
   a. Remove one aeration tank from service and perform rehabilitation of the concrete and prepare one aeration tank to be converted into two biological reactors for new MBR.
   b. Remove two SCs from service and upgrade each to a membrane tank.
4. Step 4 – Transition of Processes, take old plant out of service.

6.5.3 Non-Economic Considerations

Non-economic factors for consideration include constructability, space constraints, and treatment reliability/flexibility to meet current and potential future regulations. Advantages and disadvantages of both alternatives is shown in Table 6.5.

Table 6.5 Alternative Non-Economic Comparison

Alternative	Advantages	Disadvantages
Constructability		
Alt. 1 – New	• Simplifies construction. Use existing treatment processes until MBR is completed, then switch over.	• More process tanks and equipment to fit into available space.
Alt. 2 – Retrofit	• Utilizes existing infrastructure as much as possible.	• Complicated construction phasing. Must keep plant running while rehab is taking place. • Higher risk of delays in schedule and unforeseen costs during rehab (e.g., detailed structural analysis not yet performed).

Alternative	Advantages	Disadvantages
Reliability		
Alt. 1 – New	• Upgrades structures all at once, will not require future rehabilitation or unforeseen costs.	• Slightly higher infrastructure cost
Alt. 2 – Retrofit		• The old tanks are already ~40 years old. Even with rehab they will likely need replacement within the 30-year planning period. Rehab is likely delaying an inevitable expenditure.
Flexibility		
Alt. 1 – New	• Frees up existing aeration tanks and SCs for future recycled water storage.	• Site requirements for new structures reduces available land.
Alt. 2 – Retrofit	• Keeps western edge of the property free for siting future AWPF.	• Additional storage may need to be constructed for recycled water.

6.6 Summary

Construction of the greenfield MBR (Alternative 1) allows for the plant to operate safely and efficiently during MBR construction. Construction of greenfield MBR allows for existing concrete infrastructure to be reused for recycled water storage and EQ.

Construction of a retrofit MBR (Alternative 2), if tightly managed and controlled, can be done without significantly impacting safety and efficiency. Construction of retrofit MBR results in repurposing of all concrete assets with the exception of two SCs as well as needing new construction of two concrete basins, similar to the greenfield option.

Costs for both greenfield and retrofit are similar.

-This Page Intentionally Left Blank-

Appendix 6A

DESIGN CRITERIA

Table 6A.1 Secondary Process Operation

Parameter	Unit	Alt. 1 – New	Alt 2. – Retrofit
Influent Flow			
Average Annual	mgd	0.70	
Maximum Month	mgd	1.2	
Peak Wet Weather Flow	mgd	8.76	
Influent Concentration			
Average Concentration at Average Flow			
BOD_5	mg/L	289	
TSS	mg/L	278	
Max Month Concentration at Average Flow			
BOD_5	mg/L	460	
TSS	mg/L	407	
EQ Basin			
Number	-	1	
Volume	MG	2.1	
Side Water Depth	feet	28	
Peak Equalized Flow	mgd	1.53	
Flow Control to Aeration Tanks	-	Gravity Flow through Modulating Gate or Valve	
EQ Pumping			
Number	-	2 + 1	
Capacity, each	gpm	0.77	
Firm Capacity	mgd	1.53	
Primary Effluent Screening			
Number (Duty + Standby)	-	2+1	
Type	-	Rotary Drum, 2-mm	
Capacity, each	mgd	1.53	
Bioreactors			
Number	-	3	2
Volume, each	gal	100,000	150,000
Anoxic Zone Volume, each	gal	16,700	25,000
Aerobic Zone Volume, each	gal	83,300	125,000
Total Volume	gal	300,000	
Max Month MLSS			
Aeration Tanks	mg/L	7,500 – 10,000	
Membrane Tanks	mg/L	10,000 – 12,000	
Process Air Usage			
Average	scfm	1,500	
Maximum Month	scfm	1,830	
Peak	scfm	3,000	

Parameter	Unit	Alt. 1 – New	Alt 2. – Retrofit
Membrane Flux (All Trains in Service)			
Average Annual	gpd/sf	8.0	6.0
Max Month	gpd/sf	13.6	10.2
Peak (24-hr sustained)	gpd/sf	17.6	13.2
Additional Secondary Process Operational Parameters			
Total SRT	Days	10	
RAS Flow, firm capacity	mgd	6	6
Typical RAS Flow	% of Q	300 to 500 percent	

Notes:
Abbreviations: BOD_5 - 5-day BOD test; gpm - gallons per minute; gal - gallons; gpd/sf - gallons per day per square foot; scfm - standard cubic feet per minute; Q - flow.

Table 6A.2 Secondary Process Equipment

Parameter	Unit	Alt. 1 – New	Alt 2. – Retrofit
Aeration Tank Diffusers			
Type	-	9-inch membrane disc	
Number per Aeration Tank	-	500	750
Total	-	1,500	
Process Aeration Blowers			
Number	-	2 + 1	
Capacity, each	scfm	1,500	
Firm Capacity	scfm	3,000	
Mixers			
Number per Anoxic Zone	-	1	
Total	-	3	2
RAS Pumping			
Number (Duty + Standby)	-	2 + 1	1 + 1
Capacity, each	gpm	2,083	4,167
Firm Capacity	mgd	2.8	2.8
Membrane Air Scour Blowers			
Number (Duty + Standby)	-	2 + 1	1 + 1
Capacity, each	scfm	426	1,365
Permeate Pumps			
Number (Duty + Standby)	-	2 + 1	1 + 1
Capacity, each	gpm	550	1,150
Firm Capacity	mgd	1.58	1.66

Appendix 6B

DETAILED COST DOCUMENTATION

COST SUMMARY

Project:	**Enhanced Recycled Water Feasibility Analysis**	**Estimate Class:**	**5**
Client:	**City of Montecito**	**CSM:**	**A. Salveson**
Location:	**Montecito, CA**	**PM:**	**A. Salveson**
Zip Code:	**93108**	**Date:**	**May 9, 2022**
Carollo Job #	**12289A10**	**By:**	**M. Rasmus**

Area or Spec Section	DESCRIPTION		Alt. 1 New	Alt. 2 Retrofit
Liquid Process				
Primary Treatment				
	Fine Screens		$1,300,000	$1,300,000
Flow Equalization				
	Equalization Basin and Pumping		$3,000,000	$3,000,000
	Odor Control System		$220,000	$220,000
Aeration Basins				
	Aeration Basin Structural Rehabilitation			$110,000
	New Aeration Basin (0.30 MG)		$710,000	
	Aeration Basin Mechanical Equipment		$890,000	$890,000
MBR System				
	Secondary Clarifier Rehabilitation			$190,000
	Secondary Clarifier Retrofit			$40,000
	MBR System (Includes Membrane Complex and Equipment)		$2,560,000	$2,700,000
	Blower Building and Electrical Room		$740,000	$660,000
	Chemical Facility		$120,000	$120,000
	SUBTOTAL		$9,600,000	$9,300,000
	Demolition			$500,000
	Retrofit Contingency	5.0%		$470,000
	Civil/Yard Piping	10.0%	$960,000	$930,000
	Process Mechanical Allowance	10.0%	$960,000	$930,000
	Electrical, Instrumentation & Controls	25.0%	$2,390,000	$2,310,000
Other Construction				
	SUBTOTAL DIRECT COST		$13,910,000	$14,440,000
	Contingency	30.0%	$4,180,000	$4,330,000
	TOTAL DIRECT COST		$18,090,000	$18,770,000
	INDIRECT COST			
	General Conditions/Requirements	12.0%	$2,180,000	$2,260,000
	Bond and Insurance	2.5%	$460,000	$470,000
	Contractor Overhead, Profit & Risk	12.0%	$2,180,000	$2,260,000
	Sales Tax (Based on 50% of direct cost)	8.0%	$730,000	$760,000
	TOTAL INDIRECT COST		$5,550,000	$5,750,000
	TOTAL ESTIMATED CONSTRUCTION COST		$23,640,000	$24,520,000
	Engineering, Administrative, and Legal	20.0%	$4,730,000	$4,910,000
	Owner's Reserve for Change Orders	5.0%	$1,190,000	$1,230,000
	TOTAL ESTIMATED PROJECT COST		$29,560,000	$30,660,000

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

Note that capital costs presented are for alternative comparison only. These costs do not include mid-point escalation or bid market allowance. Current market conditions suggest large rates of cost escalation and high rates of variance in construction bidding. It is suggested that an escalation rate and bid market allowance be added to capital costing efforts as project development becomes more refined.

Engineers...Working Wonders With Water®

ANNUAL O&M COST SUMMARY

Project:	**Enhanced Recycled Water Feasibility Analysis**	**Estimate Class:**	**5**
Client:	**City of Montecito**	**CSM:**	**A. Salveson**
Location:	**Montecito, CA**	**PM:**	**A. Salveson**
Zip Code:	**93108**	**Date:**	**May 9, 2022**
Carollo Job #	**12289A10**	**By:**	**M. Rasmus**

O&M Item	Quantity	Quantity	Unit	Unit Cost	Annual Cost(1)	Annual Cost(1)
	Alt 1 - New	Alt 2 - Retrofit			Alt 1 - New	Alt 2 - Retrofit
Power						
EQ Pump Station	141,116	141,116	KW-hr/year	$0.23	$33,000	$33,000
EQ Odor Control	76,650	76,650	KW-hr/year	$0.23	$18,000	$18,000
Aeration Basins	537,661	537,661	KW-hr/year	$0.23	$124,000	$124,000
MBR System	648,447	648,447	KW-hr/year	$0.23	$150,000	$150,000
Chemicals						
Sodium hypochlorite (12.5% solution)	1,522	1,522	gallon	$1.00	$2,000	$2,000
Citric acid (50% solution)	152	152	gallon	$7.00	$2,000	$2,000
Annual Running Costs						
Aeration Basin Diffusers Replacement	300	300	diffuser	10	$3,000	$3,000
MBR Membrane Replacement	1	1	LS		$39,600	$52,800
					$372,000	$385,000

(1) Expressed in 2022 dollars

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 7
O&G TREATMENT AT MSD

FINAL | September 2022

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 7
O&G TREATMENT AT MSD

FINAL | September 2022

REGISTERED PROFESSIONAL ENGINEER
ANDREW THOMAS SALVESON
No. 56902
CIVIL
STATE OF CALIFORNIA

Contents

Appendices

Tables

Figures

Abbreviations

AACE International	Association for the Advancement of Cost Engineering International
ADWF	average dry weather flow
Carollo	Carollo Engineers, Inc.
City	City of Santa Barbara
DAF	Dissolved Air Flotation
DPR	Direct Potable Reuse
ft	foot, feet
gpm	gallons per minute
gpm/sf	gallons per minute per square foot, feet
IPR	Indirect Potable Reuse
MBR	membrane bioreactor
MDL	method detection limit
mgd	million gallons per day
mg/L	milligrams per liter
MSD	Montecito Sanitary District
MSD WWTP	Montecito Sanitary District Wastewater Treatment Plant
MWD	Montecito Water District
N/A	not available
NPDES	National Pollutant Discharge Elimination System
NPR	Non-Potable Reuse
O&G	oil and grease
O&M	operations and maintenance
PFD	process flow diagram
sf	square foot, feet
TDS	total dissolved solids
TM	technical memorandum
TSS	total suspended solids

-This Page Intentionally Left Blank-

Technical Memorandum 7

O&G TREATMENT AT MSD

7.1 Introduction

This project, conducted for and in collaboration with the Montecito Water District (MWD) and the Montecito Sanitary District (MSD), examines the potential implementation of recycled water projects and the beneficial use of treated wastewater from the community of Montecito. The project goal is to maximize wastewater reuse capabilities, thus producing a new local drought-proof water supply for the community and reducing the discharge of treated wastewater to the ocean. The analysis considers local and regional partnerships, non-potable and potable reuse alternatives, and various treatment methods and technologies. The options included in the study are as follows:

1. **Montecito Non-Potable Reuse (NPR)** - local project producing tertiary quality water for irrigation of large landscapes in Montecito.
2. **Carpinteria Indirect Potable Reuse (IPR)** - regional project producing purified water involving a partnership with neighboring special district(s) and the use of the Carpinteria Groundwater Basin.
3. **Montecito Direct Potable Reuse (DPR)** - local project in Montecito producing purified water and utilizing raw water augmentation at the MWD water treatment facility.
4. **Santa Barbara DPR** - regional project producing purified water and involving a partnership with the City of Santa Barbara (City) and raw water augmentation at the City's regional water treatment facility.

Figure 7.1 shows the potential regional partners.

Figure 7.1 Potential Regional Partners

This technical memorandum (TM) provides background on oil and grease (O&G) concentrations in the Montecito Sanitary District Wastewater Treatment Plant (MSD WWTP) effluent and the need for reducing the O&G concentrations to facilitate downstream membrane treatment processes. Dissolved Air Flotation (DAF) is a proven technology that effectively removes the O&G either ahead of or after biological treatment at the MSD WWTP. A Class 5 cost assessment was completed for DAF options using quotes from three different vendors for both primary full stream (spanning a range of flow) and secondary effluent flow (flow based upon future average dry weather flow (ADWF) of 0.7 million gallons per day (mgd)) treatment alternatives. Note: DAF would only apply for non-membrane bioreactor (MBR) treatment options, as MBR is capable of handling O&G in the raw wastewater.

7.2 Objectives

The main objectives of this TM are:

- Review historical O&G data for the MSD WWTP.
- Develop and evaluate a primary DAF treatment alternative for O&G removal where all MSD WWTP influent flow would be treated by DAF.
- Develop and evaluate a secondary DAF treatment alternative for O&G removal where a smaller ADWF from the MSD WWTP would be treated by DAF.

7.3 Available Data

The following data was reviewed to perform the analysis that is summarized in this TM:

- MSD WWTP: O&G data from February 23, 2021, to October 6, 2021.

7.4 Sources of O&G

O&G is a category of waste that includes emulsions or solids comprised of esters of glycerol, fatty acids, or triglycerides obtained from vegetable or animal sources. They are produced both from municipal, commercial and industrial sources. Although O&G are often discussed together, the component that remains a liquid at room temperature is referred to as "oil" and "grease" refers to fats, waxes, and soaps that solidify and plug pipelines and treatment processes. When left untreated, O&G can be harmful to wastewater systems and wastewater treatment processes.

7.5 Background of O&G at MSD

MSD is considering using the treated effluent from the MSD WWTP as a source for either NPR or potable reuse applications, and a key part of treatment for water reuse is membrane treatment for total dissolved solids (TDS) reduction. O&G pose a threat to membrane treatment since O&G can clog the membranes, which could reduce their capacity or lead to significant maintenance such as too frequent chemical cleanings or even replacement[1]. To maintain an efficient membrane performance and not create warranty challenges with membrane suppliers, there should be no detectable O&G going into the membranes treatment (until proven otherwise and guaranteed by membrane suppliers). The MSD WWTP goal for O&G effluent concentration should therefore be less than the method detection limit (MDL) of 1.4 milligrams per liter (mg/L).

[1] The membrane pilot system at the MSD WWTP is investigating the extent of impact.

It should be noted MSD has a source control program for fats, oils and grease generated at commercial food service facilities within the District. Each food service establishment is required to use grease control devices to separate and remove the oil and grease with a permitted effluent limit maximum of 100 mg/L. District staff also perform periodic random inspections to verify source control procedures are followed.

Limiting residential oil and grease is difficult and the District does not have a compliance program for residential homeowner. Instead, the Districts uses public outreach to educate homeowners on methods to minimize oil and grease within their wastewater stream.

Figure 7.2 shows the MSD WWTP influent and effluent O&G concentrations. Figure 7.3 shows only the MSD WWTP effluent O&G concentrations, providing greater clarity for the lower level values. Both figures show good O&G removal through the aeration basins; however, the data show periods with high O&G concentrations in the MSD WWTP effluent.

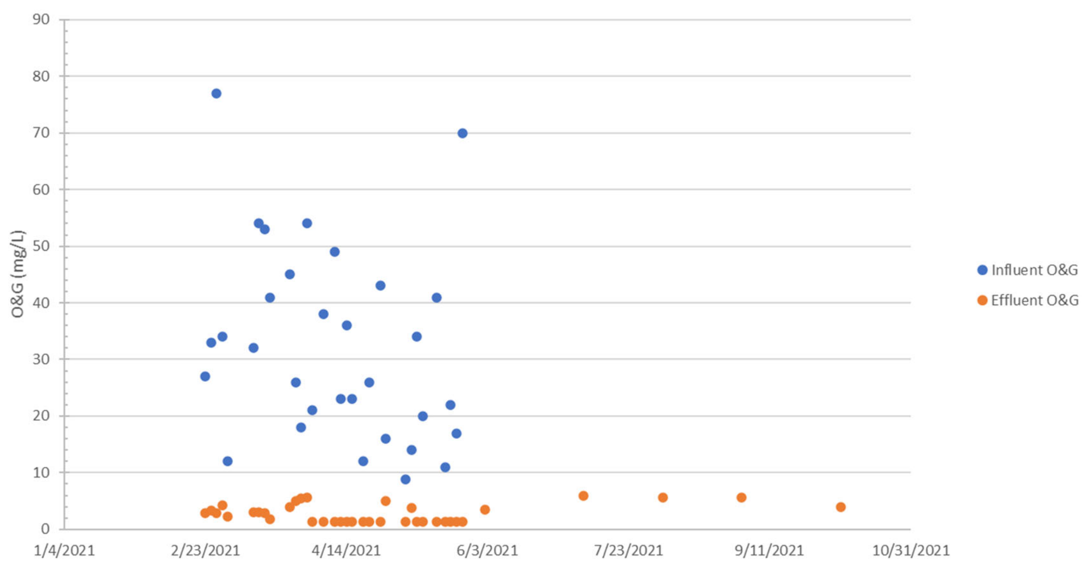


Figure 7.2 MSD WWTP O&G Data from 2/2021 to 10/2021 (*Note: MDL is 1.4 mg/L*)

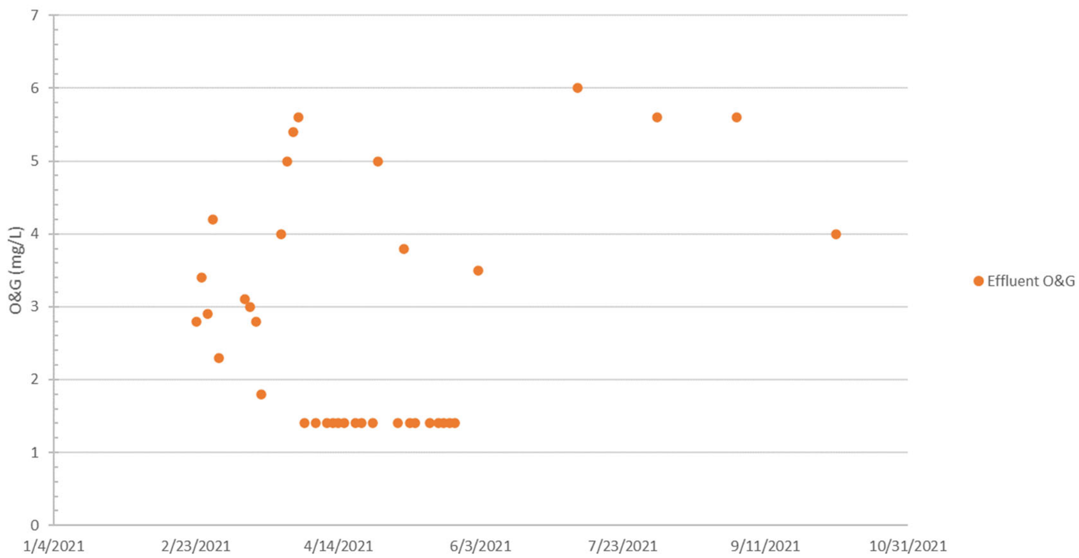


Figure 7.3 MSD WWTP Effluent O&G Data from 2/2021 to 10/2021 (*Note: MDL is 1.4 mg/L*)

Table 7.1 shows the statistics for the MSD WWTP influent and effluent O&G concentrations. The average effluent O&G concentration is 2.8 mg/L, which is above the detection limit of 1.4 mg/L target treatment goal. The 95th percentile and maximum effluent O&G concentration shows the effluent concentration can exceed 5 mg/L. A robust treatment step, such as DAF, could be used to further reduce O&G concentrations ahead of membrane treatment to protect the membranes.

Table 7.1 MSD O&G Data from February 2021 to October 2021

	Influent O&G Concentration (mg/L)	Effluent O&G Concentration (mg/L)
Maximum	77.0	6.0
Average	32.2	2.8
Minimum	8.8	1.4
95th Percentile	61.2	5.6

7.6 DAF Process Analysis

DAF is a physical/chemical treatment process used to remove total suspended solids (TSS) and O&G from wastewater streams. A recycled stream of clarified DAF effluent is injected with air under pressure and is mixed with the influent wastewater stream in a contact basin at atmospheric pressure. In the contact basin, millions of tiny air bubbles are released that attach to the contaminants. The lighter contaminants attached to the air bubbles rise to the surface of the contact basin, where they are skimmed off the top by a surface skimmer. The skimmer brings the contaminants into a hopper before they are conveyed to further solids handling with other solids produced at the facility. The process is assisted by coagulant or a flocculant to promote the colloidal particle formation in the wastewater stream and help the separation process. An efficient DAF system has a high degree of contaminant separation and takes up a smaller footprint compared to a conventional clarifier. A typical DAF system includes the following components:

- DAF unit:
  - Contact basin.
  - Air saturation tank.
  - Settling plates.
  - Sludge scraper.
  - Sludge hopper.
  - Recycle pump.
- Chemical reaction tank/ Flocculator.
- Chemical feed pumps.
- Polymer feed system.
- Sludge transfer pump.

Figure 7.4 shows a process flow diagram (PFD) of a DAF system. Figure 7.5, Figure 7.6, and Figure 7.7, show example photos of a DAF system installed for wastewater treatment.

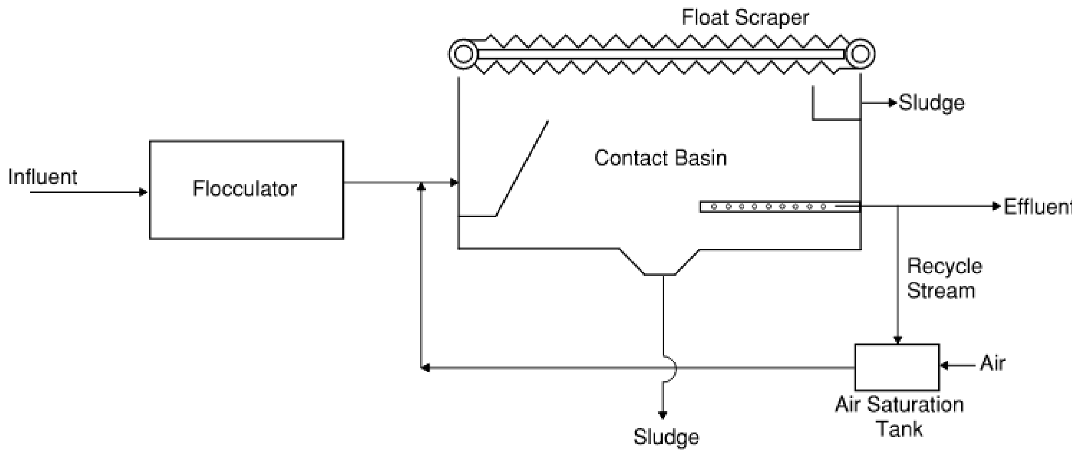


Figure 7.4 PFD for a DAF System

Figure 7.5 DAF Unit Contact Basin with External Platform and Chemical Feed System

Figure 7.6 DAF Unit Sludge Scrapper System

Figure 7.7 DAF Unit in Service

In this study, two DAF alternatives were evaluated to treat O&G in order to protect downstream membrane treatment processes:

- Alternative 1: Primary DAF that treats 100 percent of the MSD WWTP influent flow.
- Alternative 2: Secondary DAF that treats a smaller flow of MSD WWTP effluent for reuse.

Figure 7.8 and Figure 7.9 present simplified process schematics of the two DAF alternatives considered for the MSD WWTP.

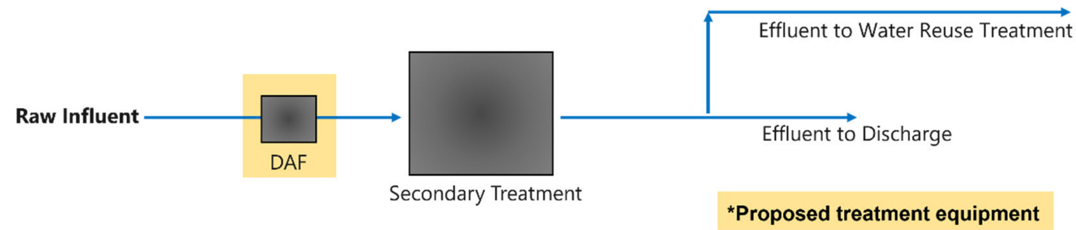


Figure 7.8 Alternative 1: Primary DAF Full Flow Simplified PFD

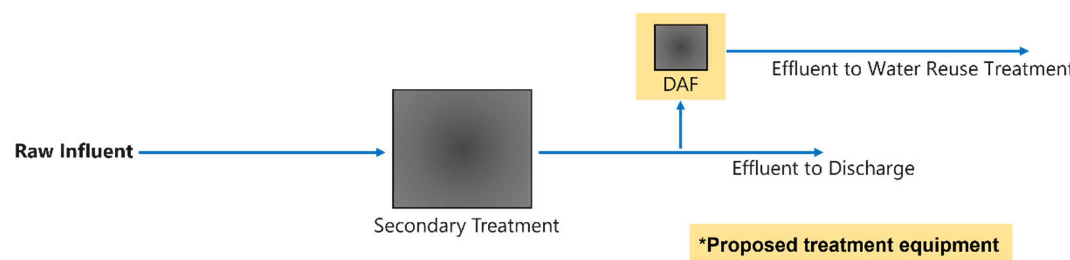


Figure 7.9 Alternative 2: Secondary DAF Simplified PFD

7.6.1 Conceptual Design Criteria

Table 7.2 summarizes the treatment criteria and forms the fundamental basis of the DAF system sizing for the alternatives evaluated. The Alternative 1 design flow is the MSD WWTP's future maximum instantaneous flow of 8.76 mgd. The future maximum instantaneous flow was calculated by applying a 1.065 factor to the current maximum instantaneous flow of 8.23 mgd as described in *Technical Memorandum 1 MSD Flow and NPDES Permit Analysis* (TM01; Carollo Engineers, Inc.(Carollo), 2021). The lower future ADWF of 0.70 mgd is the design flow for Alternative 2.

Table 7.2 DAF Treatment Criteria

Treatment Criteria	Units	Alternative 1: Primary DAF Full Flow	Alternative 2: Secondary DAF ADWF
Max Instantaneous Flow	mgd (gpm)	8.76	0.7
Max Hourly Flow	mgd (gpm)	6.29	0.7
Effluent O&G Goal	mg/L	<1.4	<1.4

Notes:
Abbreviation: gpm - gallons per minute.

Table 7.3 presents the conceptual design criteria of the DAF systems for two DAF vendors considered for this study. A third vendor was contacted but did not provide the design criteria and cost for their system by the time of this analysis. Additionally, a fourth vendor was considered but did not believe they could reach the 1.4 mg/L O&G treatment goal without pilot testing or further bench scale studies. It was also recommended by the vendor to consider a walnut shell filter as a polishing step or an activated glass media filter for flows with lower O&G concentrations. Pilot testing, or at a minimum bench-scale laboratory testing, is recommended before proceeding with a DAF design. The two vendors that provided a conceptual cost for this study are:

- Ecologix - Option 1a for Alternative 1 and option 1b for Alternative 2.
- World Water Works - Option 2a for Alternative 1 and option 2b for Alternative 2.

For Alternative 1, option 1a has two DAF units each treating half the influent flow, whereas 2a has one large DAF unit and one smaller DAF unit with flows split to equalize the liquid loading rate. For Alternative 2, both options 1b and 2b use a single unit to treat the partial effluent flow. The overall system length, width, and area in Table 7.3 are based on the size of the DAF units, chemical reactors, and walking space between the units.

Table 7.3 DAF System Design Criteria

Design Parameter	Unit	Alternative 1: Primary DAF - Full Flow				Alternative 2: Secondary DAF - Lower Flow		
		Option 1a	Option 2a		Option 3a	Option 1b	Option 2b	Option 3b
Vendor	--	**Ecologix**	**World Water Works**		**Suez**	**Ecologix**	**World Water Works**	**Suez**
Model Number	--	E-1035	RSP-13L	RSP-25SW	N/A(1)	E-515	RSP-11S	N/A(1)
Design Flow	mgd (gpm)	8.76 (6,083)	6.4 (4,444)	2.36 (1,639)		0.70 (486)	0.70 (486)	
Number of Trains	--	2	1	1		1	1	
Flow/train	gpm	3,042	4,444	1,639		486	486	
Projected Surface area	sf	5,058	2,311	847		1,085	291	
Loading rate	gpm/sf	0.60	1.92	1.93		0.45	1.67	
Overall System Length	ft	80	70			40	50	
Overall System Width	ft	55	50			35	40	
Overall System Area	sf	4,400	3,500			1,400	2,000	

Notes:
Abbreviations: ft - foot, feet; gpm/sf - gallons per minute per square foot, feet; N/A - not available; sf - square foot, feet.
(1) Not provided by the vendor at the time of this analysis.

7.6.2 Conceptual Cost Opinion

Appendix 7A includes a conceptual-level capital and annual operations and maintenance (O&M) cost opinion developed for the two treatment alternatives. There was no bench- or pilot-scale tests completed to support the development of this cost estimate. The capital cost opinions are expressed in March 2022 dollars (the corresponding 20-Cities Average Engineering News Record Construction Cost Index of 12,791). Cost opinions are consistent with the Association for the Advancement of Cost Engineering International's (AACE International) Class 5 estimates. This level of engineering cost estimating is generally made with limited information (e.g., PFDs, preliminary equipment lists, and preliminary O&M cost). Typical accuracy for Class 5 estimates is expected to be in the range of -50 to +100 percent.

7.6.2.1 Economic Analysis of Cost Opinions

An economic analysis was performed for the two treatment alternatives evaluated with two different vendor options. The values introduced in this section represent the sum of capital cost opinions and the present worth of annual O&M cost projections, assuming a discount rate of 4 percent and term of 20 years.

Table 7.4 summarizes the conceptual-level cost opinions for the two treatment alternatives and two vendors. Figure 7.10 compares capital costs, annual O&M costs, and total present worth. The cost analysis indicates:

- For Alternative 1, full flow wastewater influent DAF treatment, the capital costs of the two vendor options are comparable, whereas the annual O&M costs and total present worth of option 1a is higher compared to option 2a.
- For Alternative 2, smaller secondary effluent DAF treatment of ADWF, the capital costs of the two vendor options are comparable and the annual O&M costs and total present worth of option 1b is higher compared to option 2b.
- The higher O&M cost associated with option 1a and 1b is due to a more conservative approach resulting in higher chemical usage provided by the vendor, Ecologix. The chemical usage provided by the vendor could be further refined by water quality testing and jar testing to obtain site-specific chemical doses, which is out of the scope of the study.

Overall, Alternative 2, DAF treatment of secondary effluent ADWF is more cost effective than Alternative 1, full flow DAF treatment. Bench- or pilot-scale testing of both alternatives would help refine the costs for the two alternatives. If MSD proceeds with a DAF treatment option for O&G removal, bench-scale or pilot-scale testing is recommended.

The detailed cost opinions are provided in Appendix 7A, and the additional vendor information of the DAF units evaluated are provided in Appendix 7B.

Table 7.4 Montecito Sanitary District Wastewater O&G Treatment Cost Options

Cost Opinions	Alternative 1: Primary DAF - Full Flow		Alternative 2: Secondary DAF - Partial Flow	
	Option 1a	Option 2a	Option 1b	Option 2b
Construction cost	$6,030,000	$6,660,000	$1,250,000	$1,440,000
Annual O&M Cost	$710,000	$470,000	$370,000	$250,000
Present Worth				
Present worth of annual O&M(1)	$9,650,000	$6,390,000	$5,030,000	$3,400,000
Total present worth	$15,680,000	$13,050,000	$6,280,000	$4,840,000

Notes:
(1) Assuming a discount rate of 4 percent annually and a term of 20 years.

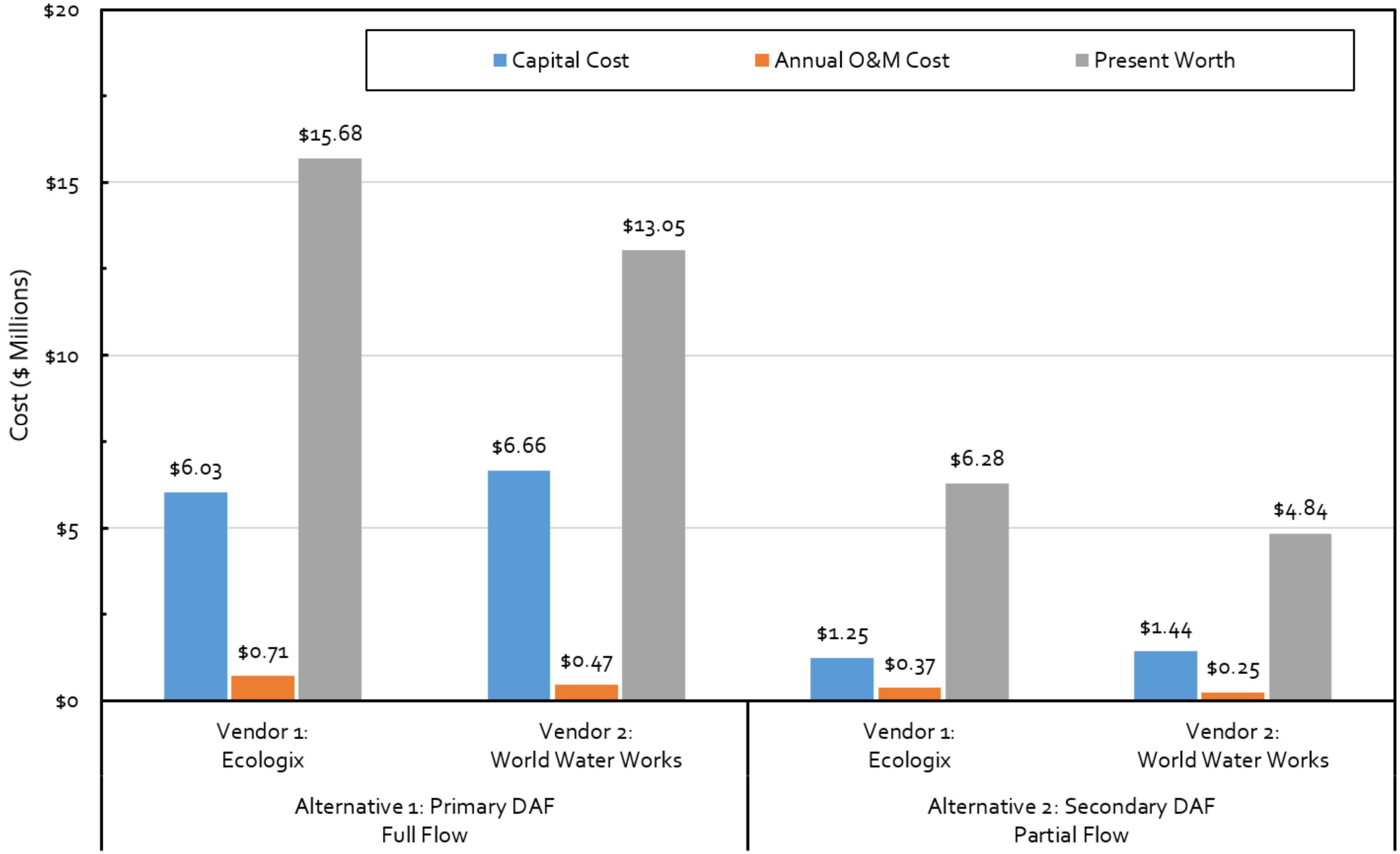


Figure 7.10 Montecito Sanitary District Wastewater O&G Treatment Cost Options

7.7 Summary

Historical water quality shows the MSD WWTP can have as high as 6 mg/L of O&G in the effluent stream. To meet the operational target of 1.4 mg/L O&G to protect downstream membrane treatment, the MSD WWTP needs additional, targeted, O&G treatment. DAF is a proven technology that can effectively reduce O&G. In this study, a cost analysis was completed for different DAF alternatives for O&G removal and the conclusions are summarized as follows:

- Two DAF treatment alternatives were evaluated:
  - Alternative 1: Primary DAF that treats 100 percent of the MSD WWTP influent flow.
  - Alternative 2: Secondary DAF that treats the future ADWF of 0.7 mgd of the MSD WWTP effluent for reuse subsequent water reuse.
- Two different equipment supplier options were evaluated for the two treatment alternatives.
- A Class 5 cost opinion was completed for each treatment alternative and vendor option.
  - The average capital cost for Alternative 1 is $6,345,000 and the average capital cost for Alternative 2 is $1,345,000.
- If MSD proceeds with a DAF design, bench- or pilot-scale testing for O&G reduction is recommended. Further, there are other technology options, such as a walnut shell filter, activated glass filtration media, or organoclay filter that could also be evaluated as part of the pilot-scale testing for Alternative 2 with lower O&G concentrations.

7.8 References

Carollo Engineers, Inc., 2021. Montecito Sanitary District & Montecito Water District Enhanced Recycled Water Feasibility Analysis, Technical Memorandum 1 MSD Flow and NPDES Permit Analysis. Project Number 12289A10, December 2021

-This Page Intentionally Left Blank-

Appendix 7A

CAPITAL AND ANNUAL OPERATIONS AND MAINTENANCE COST OPINIONS

-This Page Intentionally Left Blank-

Alternative 1 - Primary DAF
Full Flow
Conceptual Cost Opinion

3/31/2022
DRAFT

AACE International Class 5 Estimate (Expected Accuracy Range of -50% to +100%)	*Factor*	Vendor Option 1	Vendor Option 2
		Ecologix	World Water Works
CAPITAL COST[1]			
DIRECT COST			
Site Work[2]	10%	$172,000	$172,000
Yard Piping and Valves[2]	15%	$258,000	$258,000
Foundation		$213,000	$169,000
DAF System[3]		$1,577,000	$1,859,000
Installation[2]	20%	$344,000	$344,000
Electrical[4]	15%	$288,000	$330,000
I&C[4]	10%	$192,000	$220,000
SUBTOTAL DIRECT COST		**$3,040,000**	**$3,350,000**
Contingency[5]	30%	$912,000	$1,005,000
TOTAL DIRECT COST		**$3,950,000**	**$4,360,000**
INDIRECT COST			
General Conditions, Overhead, Profit & Risk[6]	22%	$869,000	$959,000
Bonds and Insurance[6]	3%	$119,000	$131,000
Tax (7.75% Montecito Rate)[6]	7.75%	$306,000	$338,000
TOTAL INDIRECT COST		**$1,290,000**	**$1,430,000**
TOTAL CONSTRUCTION COST		**$5,240,000**	**$5,790,000**
Engineering, Administration, and Legal[7]	15%	$786,000	$869,000
TOTAL CAPITAL COST		**$6,030,000**	**$6,660,000**
ANNUAL OPERATION & MAINTENANCE COST			
Chemical (Coagulant, Caustic Soda, and Polymer)[8]		$425,000	$271,000
Annual Power		$250,000	$167,000
Labor	$ 35.00	$10,000	$10,000
General[5]	0.5%	$20,000	$22,000
TOTAL ANNUAL O&M COST		**$710,000**	**$470,000**
ECONOMIC ANALYSIS			
Present Worth of Annual O&M[9]		$9,650,000	$6,390,000
TOTAL PRESENT WORTH		**$15,680,000**	**$13,050,000**
Annualized Capital Cost		$440,000	$490,000
TOTAL EQUIVALENT ANNUAL COST		**$1,150,000**	**$960,000**
COST $/1,000 Gallons Treated		$3.42	$2.85

[1]Cost opinions correspond to March dollars (ENR 20-Cities Average Construction Cost Index = 12,791).
[2]Discipline allowance is calculated from average equipment costs of the two DAF vendor systems.
[3]Includes DAF unit, reaction tanks/ flocculator, chemical feed pumps, polymer feed system, and sludge transfer pump.
[4]Applied to equipment costs and installation.
[5]Applied to direct costs.
[6]Applied to direct costs with contingency.
[7]Applied to total construction cost.
[8]Applied unit chemical cost to monthly maximum flow of 0.92 MGD.
[9]Assumes discount rate of 4% per year and term of 20 years.

Alternative 2 - Secondary DAF
Partial Flow
Conceptual Cost Opinion

3/31/2022
DRAFT

AACE International Class 5 Estimate (Expected Accuracy Range of -50% to +100%)	*Factor*	Vendor Option 1	Vendor Option 2
		Ecologix	World Water Works
CAPITAL COST[1]			
DIRECT COST			
Site Work[2]	10%	$34,000	$34,000
Yard Piping and Valves[2]	15%	$51,000	$51,000
Foundation		$68,000	$97,000
DAF System[3]		$314,000	$360,000
Installation[2]	20%	$67,000	$67,000
Electrical[4]	15%	$57,000	$64,000
I&C[4]	10%	$38,000	$43,000
SUBTOTAL DIRECT COST		**$630,000**	**$720,000**
Contingency[5]	30%	$189,000	$216,000
TOTAL DIRECT COST		**$820,000**	**$936,000**
INDIRECT COST			
General Conditions, Overhead, Profit & Risk[6]	22%	$180,000	$206,000
Bonds and Insurance[6]	3%	$25,000	$28,000
Tax (7.75% Montecito Rate)[6]	7.75%	$64,000	$73,000
TOTAL INDIRECT COST		**$270,000**	**$310,000**
TOTAL CONSTRUCTION COST		**$1,090,000**	**$1,250,000**
Engineering, Administration, and Legal[7]	15%	$164,000	$188,000
TOTAL CAPITAL COST		**$1,250,000**	**$1,440,000**
ANNUAL OPERATION & MAINTENANCE COST			
Chemical (Coagulant, Caustic Soda, and Polymer)[8]		$305,000	$195,000
Annual Power		$55,000	$43,000
Labor	$ 35.00	$10,000	$10,000
General[5]	0.5%	$4,000	$5,000
TOTAL ANNUAL O&M COST		**$370,000**	**$250,000**
ECONOMIC ANALYSIS			
Present Worth of Annual O&M[9]		$5,030,000	$3,400,000
TOTAL PRESENT WORTH		**$6,280,000**	**$4,840,000**
Annualized Capital Cost		$90,000	$110,000
TOTAL EQUIVALENT ANNUAL COST		**$460,000**	**$360,000**
COST $/1,000 Gallons Treated		$1.90	$1.49

[1]Cost opinions correspond to March dollars (ENR 20-Cities Average Construction Cost Index = 12,791).
[2]Discipline allowance is calculated from average equipment costs of the two DAF vendor systems.
[3]Includes DAF unit, reaction tanks/ flocculator, chemical feed pumps, polymer feed system, and sludge transfer pump.
[4]Applied to equipment costs and installation.
[5]Applied to direct costs.
[6]Applied to direct costs with contingency.
[7]Applied to total construction cost.
[8]Applied unit chemical cost to the design flow of 0.7 MGD.
[9]Assumes discount rate of 4% per year and term of 20 years.

Appendix 7B

VENDOR INFORMATION

-This Page Intentionally Left Blank-

Line	Item Description	Qty	Unit	Price (USD)	Ext. Price (USD)

Ecologix Environmental Systems LLC
Accounts Receivable
11800 Wills Road, Suite 100
Alpharetta, Georgia 30009
United States

ECOLOGIX ENVIRONMENTAL SYSTEMS
(678) 514-2100

Quote Date: 1-Jan-2022
Revised 30-March-2022

Quotation

Bill To:	Viking Edeback, PE	**Ship To:**	
	Carollo		
	Tel: 520-230-4712		
	Email: VEdeback@carollo.com		
Quote #:	44043	**Terms:**	50% deposit with PO, 25% Net 30, balance due prior to shipment.
Sales Rep:	Vincent Palermo	**F.O.B:**	Alpharetta, GA
Customer #:	15511	**Ship Via:**	Best Way

Line Item	Item Description		Qty	Unit	Price US)	Ext. Price (USD)
1	**Ecologix E-1035 DAF System** The Ecologix E-1035 can process flow rates up to 3,237 GPM (735.1 m³/hr) with combined TSS loadings of up to 1,500 mg/L. This system provides extra capacity for either potential future growth or improved processing, due to the increased surface area capacity. Counter-Current flow design for increased effluent quality, Lamella Tubes with 5,058ft² (469.9m²) of Surface Area, 304 Stainless Steel DAF Body, Top Scraper with Viton Flights, Sch40 316SS Piping and Valves, Sch 80 PVC or HDPE Sludge Piping, Internal Duplex Steel Whitewater Pump, 316SS Saturation Tank, and Mezzanine with Alternating Tread Stairs. DAF Dimensions: 43' 5" L x 11' 2" W x 10' 10" H	 *Image for illustration only*	2	EA	$ 596,250.00	$ 1,192,500.00
2	**CRT-7500 - 1900-3800gpm - Chemical Reaction Tank** The CRT-7500 is sized for 1900-3800gpm with 2-4 minute contact time. Made of 304SS, each unit has three compartments with three mixers. The first compartment is for the addition of Coagulant, pH adjustment and Oxidation, as necessary. The second compartment is for the rapid mixing of Polymer. The Third compartment is for slow mixing and expansion of the polymer.	 *Image for illustration only*	2	EA	$ 192,300.00	$ 384,600.00

Line	Item Description	Qty	Unit	Price (USD)	Ext. Price (USD)
3	**System PLC - Allen Bradley CompactLogix** PLC is compact, skid mounted, fully controlled, with 10.5" TFT high resolution HMI panel, remote monitoring and control capabilities. Panel includes the Allen Bradley CompactLogix PLC processor, able to be tied into a plant SCADA system. Panel is capable of connecting to other process skids by simply adding power and a single CAT5E ethernet cable. Easy remote access to PLC, HMI, IPC, and IP Camera. Industrial VPN router designed to for remote access, across the Internet, to machines and installations on site. Troubleshoot machines remotely without going on-site, drastically reducing support costs.  *Image for illustration only*	2	EA	Included	Included
4	**Pneumatic Control Panel** Air distribution control panel for air flow as well as the air pressure throughout the E-DAF system. It manages the air distribution to the whitewater pump along with the solenoid valves for the pneumatically actuated valves. This gives the operator peace-of-mind and if needed, the freedom to add additional pneumatically actuated valves by simply adding more solenoids to the existing solenoids bank. This panel is the master hub for all compressed air applications making it easy to maintain and control. As it is also connected to the main PLC, this panel alerts the operator for any compressed air loss or fluctuation in air supply.  *Image for illustration only*	2	EA	Included	Included
5	**Saturation Tank** 304SS saturation tank provides hydraulic retention time under pressure allowing separation and removal of large, undissolved air bubbles. Resulting average air bubble size is as low as 1-10 microns, much smaller than industry average.  *Image for illustration only*	2	EA	Included	Included
6	**Whitewater Pump** Off the shelf, non-proprietary, ANSI pump with internal duplex steel hardened for high salinity levels. Easier to maintain and readily available to replace, if needed. Results in lower capital cost and lower operating cost.  *Image for illustration only*	2	EA	Included	Included
7	**Rotary Lobe Sludge Transfer Pump** 4" skid mounted pump transfers sludge away from the DAF system.  *Image for illustration only*	2	EA	Included	Included
8	**Flow Sensor + pH Sensor + TSS sensor** Eight inch, flanged magnetic flow meter for automatic and accurate sensing of influent and effluent flow rates to treatment system. Meter is equipped with an internal PTFE liner for industrial applications.  *Image for illustration only*	2	EA	Included	Included
9	**Chemical Feed Pumps** Two (2) Grundfos (or equivalent) chemical feed pumps: one (1) coagulant feed pump and one (1) caustic feed pump. PVC Sch80 pipe and nylon tubing (or equivalent compatible materials). Pumps to be mounted on the floc tubes. Includes foot valves and injection quills.  *Image for illustration only*	2	EA	Included	Included
10	**Emulsion Polymer Activation System + Polymer Feed Pump** Pre-engineered polymer mixing system designed with intuitive controls. It is an in-line or makedown unit and is engineered to meet liquid polymer applications utilizing diaphragm or progressive cavity pump technologies. The unique mixing regime delivers a highly activated polymer solution to every application with optimum performance. Dimensions: 2' 10" (0.86m) L x 2' 0" (0.60m) W  *Image for illustration only*	2	EA	Included	Included
				Subtotal:	$ 1,577,100.00

Line	Item Description	Qty	Unit	Price (USD)	Ext. Price (USD)

Ecologix Environmental Systems LLC
Accounts Receivable
11800 Wills Road, Suite 100
Alpharetta, Georgia 30009
United States

(678) 514-2100

Quote Date: 1-Jan-2022

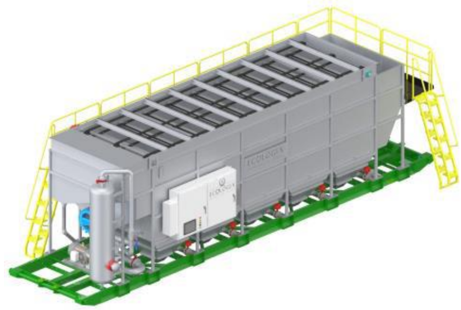
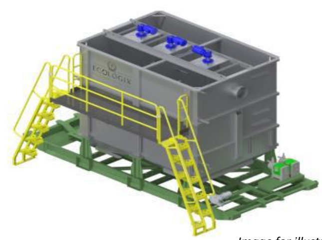
Quotation

Bill To: Viking Edeback, PE
Carollo
Tel: 520-230-4712
Email: VEdeback@carollo.com

Ship To:

Quote #: 44043
Sales Rep: Vincent Palermo
Customer #: 15511

Terms: 50% deposit with PO, 25% Net 30, balance due prior to shipment.
F.O.B: Alpharetta, GA
Ship Via: Best Way

Line Item	Item Description	Qty	Unit	Price US)	Ext. Price (USD)
1	**Ecologix E-1030 DAF** The Ecologix E-1030 can process **flow rates up to 2,774 GPM (630 m³/hr) with combined TSS loadings of up to 1,500 mg/L**. This system provides extra capacity for either potential future growth or improved processing, due to the increased surface area capacity. Counter-Current flow design for increased effluent quality, **Lamella Tubes with 4,335ft² (402m²) of Surface Area**, 304 Stainless Steel DAF Body, Top Scraper with Viton Flights, Sch40 316SS Piping and Valves, Sch 80 PVC or HDPE Sludge Piping, Internal Duplex Steel Whitewater Pump, 316SS Saturation Tank, and Mezzanine with Alternating Tread Stairs. **DAF Dimensions:** 37' 11"L x 11' 2"W x 10' 10"H  *Image for illustration only*	2	EA	$ 520,000.00	$ 1,040,000.00
2	**CRT-7500 - 1900-3800gpm - Chemical Reaction Tank** The CRT-7500 is sized for 1900-3800gpm with 2-4 minute contact time. Made of 316SS, each unit has three compartments with three mixers. The first compartment is for the addition of Coagulant, pH adjustment and Oxidation, as necessary. The second compartment is for the rapid mixing of Polymer. The Third compartment is for slow mixing and expansion of the polymer.  *Image for illustration only*	2	EA	$ 180,000.00	$ 360,000.00
3	**Ecologix E-515 DAF** The Ecologix E-515 can process flow rates up to **695 GPM (157m³/h)** with combined TSS and O&G loadings of up to **1,500 mg/L**. This system provides extra capacity for either potential future growth or improved processing, due to the increased surface area capacity. Counter-Current flow design for increased effluent quality, Lamella Tubes with **1,085ft² (100m²)** of Surface Area, **304 Stainless Steel DAF Body**, Scraper, Flight, Weirs, Sch40 PVC Piping and Valves, internal 316 Stainless Steel Pumps, Whitewater Pump, Saturation Tank, Top Scraper and Bottom Cone, and Galvanized Mezzanine. **DAF Dimensions:** 20'L x 9' W x 11' H  *Image for illustration only*	1	EA	$ 199,000.00	$ 199,000.00
4	**FLT-640 Floctube** Triple wrap for longer reaction time and compact footprint. DAF flocculation tubes are sized for 160-450gpm. Includes a painted CS support structure. Also includes PVC Piping and Fittings for flocculation, pH sensor, flow meter, sample ports and drain ports, chemical injection ports for coagulant, caustic soda and polymer.  *Image for illustration only*	1	EA	$ 19,000.00	$ 19,000.00

Line	Item Description	Qty	Unit	Price (USD)	Ext. Price (USD)
5	**<u>System PLC Controls - Allen Bradley Controls</u>** This panel is compact and skid mounted, fully PLC controlled, it has a 10.5" TFT high resolution HMI panel and remote monitoring and control capabilities. This panel includes the Allen Bradley CompactLogix PLC processor, capable of tying into a plant SCADA system. It is capable of connecting to other process skids by simiply adding power and a single CAT5E Ethernet cable. Easy Remote Access to PLC, HMI, IPC, IP Camera. Industrial VPN router designed to offer easy remote access, across the Internet, to machines and installations on site. Troubleshoot machines remotely without going on-site, drastically reducing support costs  *Image for illustration only*	3	EA	$ 39,000.00	$ 117,000.00
6	**<u>Pneumatic Control Panel</u>** A second Panel mounted on the E-DAF is an Air Distribution Control panel. It controls both the air flow as well as the air pressure throughout the E-DAF system. It manages the air distribution to the Whitewater Pump along with the Solenoid Valves for the pneumatically actuated valves. This gives the operator peace-of-mind and if needed, the freedom to add additional pneumatically actuated valves by simply adding more solenoids to the existing solenoids bank. This panel is the master hub for all Compressed Air application making it easy to maintain and control. As it is also connected to the main PLC, this panel alerts the operator for any compressed air loss or fluctuation in  *Image for illustration only*	3	EA	$ 7,500.00	$ 22,500.00
7	**<u>Chemical Feed Pumps</u>** Two (2) chemical feed pumps: one (1) Caustic Soda, one (1) Coagulant feed pump. HDPE Plastic Stand. Grundfos brand or Equivalent quality. PVC Sch80 Pipe and Nylon Tubing (or equivalent compatable materials). Includes foot valves and injection quills.  *Image for illustration only*	6	EA	$ 8,500.00	$ 51,000.00
8	**<u>Emsulsion Polymer Activation System + Polymer Feed Pump</u>** This pre-engineered polymer mixing system is designed with intuitive controls. It is an in-line or makedown unit, and is engineered to meet liquid polymer applications utilizing diaphragm or progressive cavity pump technologies. The unique mixing regime delivers a highly activated polymer solution to every application with optimum performance. **Skid Dimensions:** 2'-10" L x 2'-0" W  *Image for illustration only*	3	EA	$ 19,800.00	$ 59,400.00
9	**<u>Rotary Lobe Sludge Transfer Pump</u>** Sludge Transfer Skid: 4" skid mounted on a skid. Transfers sludge away from the DAF system.  *Image for illustration only*	3	EA	$ 8,500.00	$ 25,500.00
				Freight Estimate:	TBD
				Total:	**$ 1,893,400.00**

Payments: 50% deposit with PO, 25% Net 30, balance due prior to shipment.
Shipping: Ex-Factory, 12-16 weeks after receipt of PO and approval of submittals.
Warranty: One (1) Year on workmanship and equipment.
Start-Up and Training: $1,800/man-day plus Travel and Expenses.
Remote Monitoring and Control: Shall be automatically charged at the rate of $0.07/BBL
Terms: Your use and access of the Hardware, Products, Services specified herein are governed by Ecologix Environmental Systems terms of service found at https://www.EcologixSystems.com/terms-of-service. You agree to be bound by those terms of service unless otherwise agreed to herein or in another agreement.

E-1035 DAF System Specifications:

1. SHIPPING WT: 22,000 lbs (approx.)
2. OPERATING WT: 150,000 lbs (approx.)
3. DESIGN PARAMETERS:
- DAF Design Flow Rate: 3,237 gpm / 110,982 BPD
- Loading Rate: 0.64 gpm/ sq. ft. of projected area
- Maximum TSS @ Designed Flow Rate: 1440 mg/ l
- Projected Surface Area: 5,058 sq. ft.

4. MATERIAL OF CONSTRUCTION:
- All wetted metal materials to be SS 304 / SS 316
- All non-wetted metal materials to be SS 304
- All flanges to be ANSI 150# ANSI flanges ASTM A-182 - ANSI B16.5
- All metal piping to be Sch 10 - pipe SS 304 / SS 316
- All non-metal piping materials to be PVC Sch80 / HDPE
- All Structure Beams to be Rectangular Tubing 3" x 2" x 11 ga SS 304
- All anchor material to be 1/2" SS 304
- Flight Material of Construction: EPDM Rubber / Viton
- Tube Settlers Material of Construction: Polypropelyne

5. SAFETY AND HEALTH:
- All moving parts are inacessible, as required by OSHA
- All electric power elements are in accordance with OSHA regulations

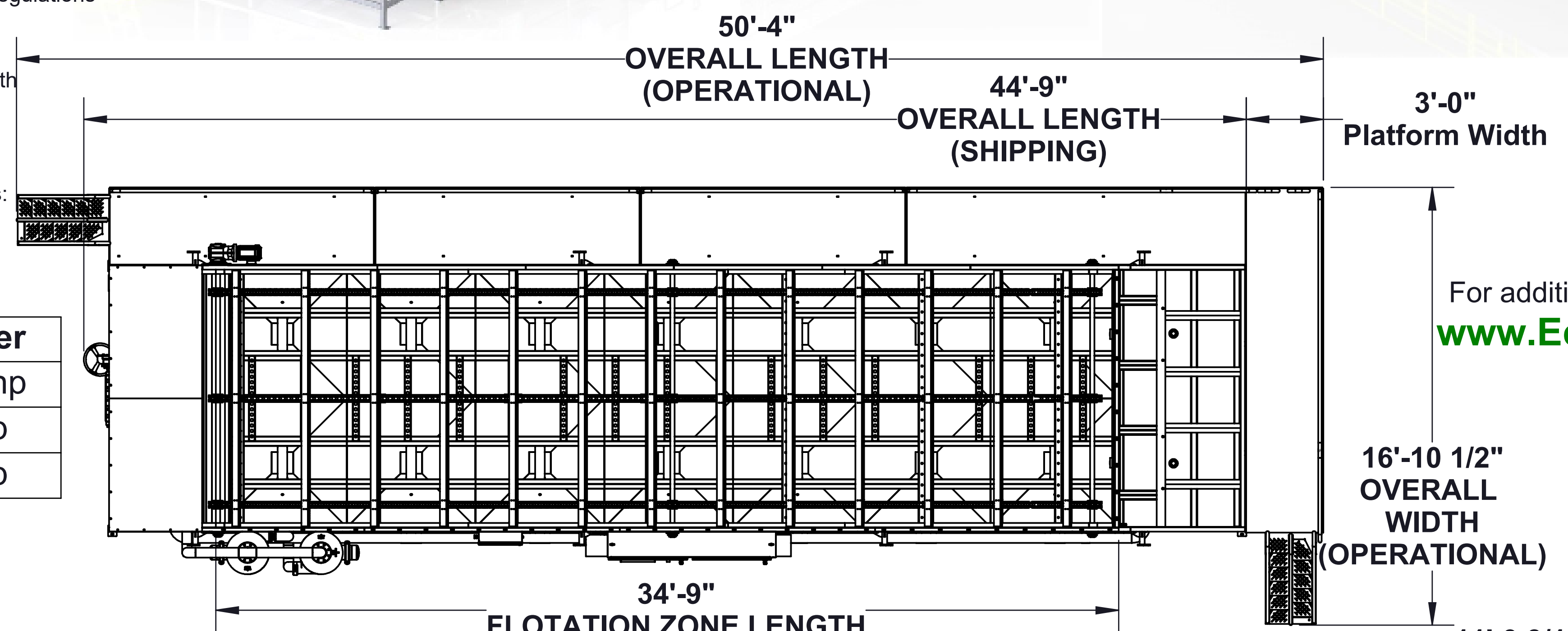
6. COATING:
- All stainless steel parts are sandblasted
- Mezzanine platform to be carbon steel painted grit black with safety yellow handrails and alternating tread stairs

7. WELDING:
- All welds to conform to AWS applicable specification(s).
- Welding equipment for sheet metal and structural elements: Wirefed MIG or TIG where applicable
- Welding equipment for piping and fittings: TIG or MIG

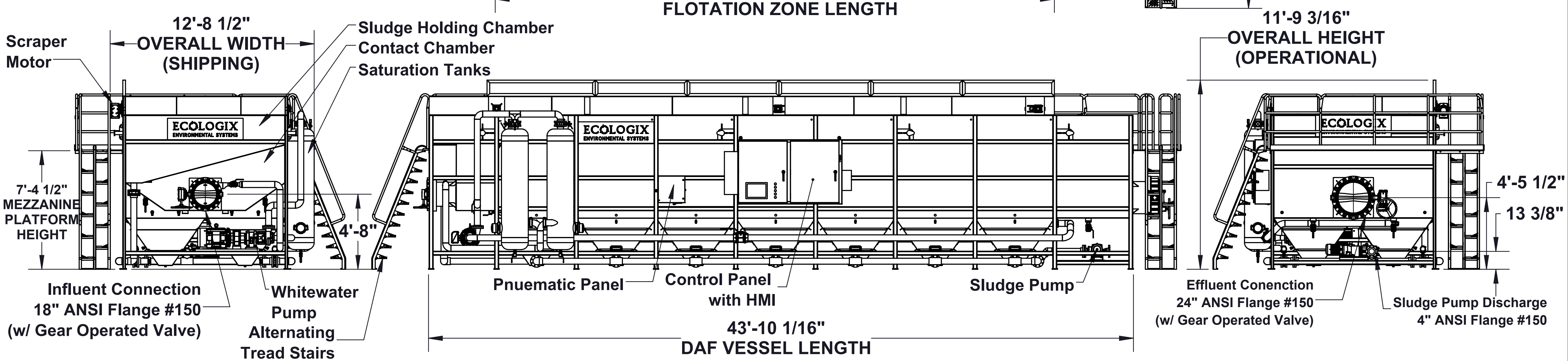
8. EQIPMENT INFORMATION: See Table.

Equipment	Brand	Power
Whitewater Pump	Pioneer	100 hp
Sludge Pump	Boerger	3 hp
Scraper Motor	SEW	1 hp

ECOLOGIX E-1035 DAF



For additional information, please visit
www.EcologixSystems.com



REVISION HISTORY

REV	DESCRIPTION	DATE	BY	APV
1	----	--------	---	---
2	----	--------	---	---
3	----	--------	---	---
4	----	--------	---	---
5	----	--------	---	---
6	----	--------	---	---
7	----	--------	---	---
8	----	--------	---	---
9	----	--------	---	---
10	----	--------	---	---

ECOLOGIX
ENVIRONMENTAL SYSTEMS
11800 Wills Road Suite 110, Alpharetta, GA 30009
Phone: 678-514-2100 Fax: 678-514-2106
www.ecologixsystems.com

	SIGN:	NAME	DATE
DRAWN		MNT	7/22/2021
CHECKED		NPT	7/22/2021
ENG APPR		NPT	7/22/2021
MGR APPR		NPT	7/22/2021

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
ANGLES ±0.5°
CUTTING DISTANCE ± 1/16"
WELDING DISTANCE ± 1/8"

DRAWING TITLE
ECOLOGIX E-1035
Submittal Drawing

SIZE: D
DRAWING: Configuration Name: ECOLOGIX-E1035
REV:
FILE NAME: AN00215.1035
MATERIAL: SEE SPECS
SCALE: N.T.S
WEIGHT: SEE SPECS
SHEET NO. 1 OF 1

LAST UPDATE:
CAD FILE LOCATION:

-This Page Intentionally Left Blank-

ECOLOGIX E-515 DAF System Specifications

1. SHIPPING WT = 7,800 lbs (approx)
2. OPERATING WT =29,000 lbs (approx)
3. DESIGN PARAMETERS:
- DAF Design Flow Rate: 695 GPM / 23,828 BPD
- Loading Rate: 0.64 gpm/ sq. ft. of projected area
- Maximum TSS @ Designed Flow Rate: 1440 mg/ l
- Projected Surface Area: 1085 sq. ft.

4. MATERIAL OF CONSTRUCTION:
- All wetted metal materials to be 304SS or 316SS
- All non-wetted metal materials to be 304SS or 316SS
- All flanges to be ANSI 150# ANSI flanges ASTM A-182 - ANSI B16.5
- All metal piping to be Sch 40 - pipe 304SS or 316SS
- All non-metal piping materials to be PVC Sch80
- All Structure Beams to be Rectangular Tubing 3" x 2" x 11 ga 304SS
- All anchor material to be 1/2" 304SS
- Flight Material of Construction: Viton or EPDM Scraping Rubber
- Tube Settlers Material of Construction: Polyprolyne

5. SAFETY AND HEALTH:
- All moving parts are inacessible, as required by OSHA
- All electric power elements are in accordance with OSHA regulations

6. COATING:
- All stainless steel parts are sandblasted
- Mezzanine Platform to be carbon steel painted Grit Black with Safety Yellow Handrails and Alternating Tread Stairs

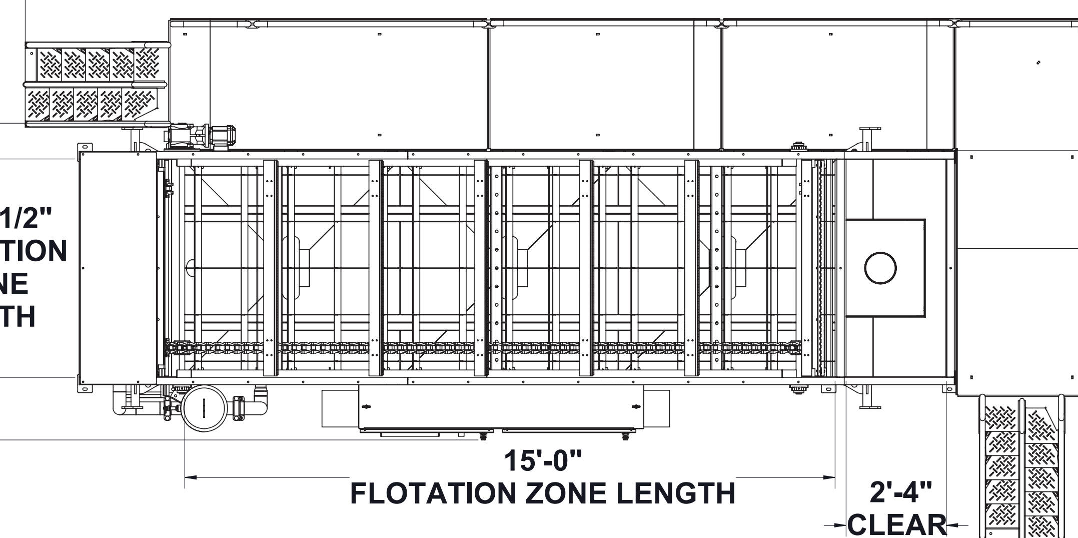
7. WELDING:
- All welds to conform to AWS applicable specification(s)
- Welding equipment/ supplies for sheet metal and structural elements: Wire
fed MIG machine or TIG where applicable
- Welding equipment/ supplies for piping and fittings: TIG or MIG

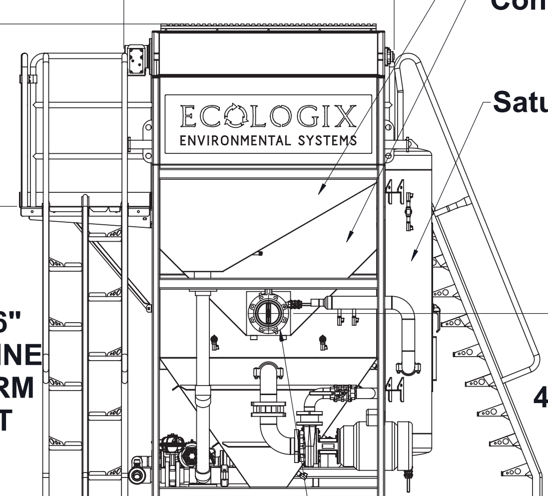
8. EQUIPMENT INFORMATION:

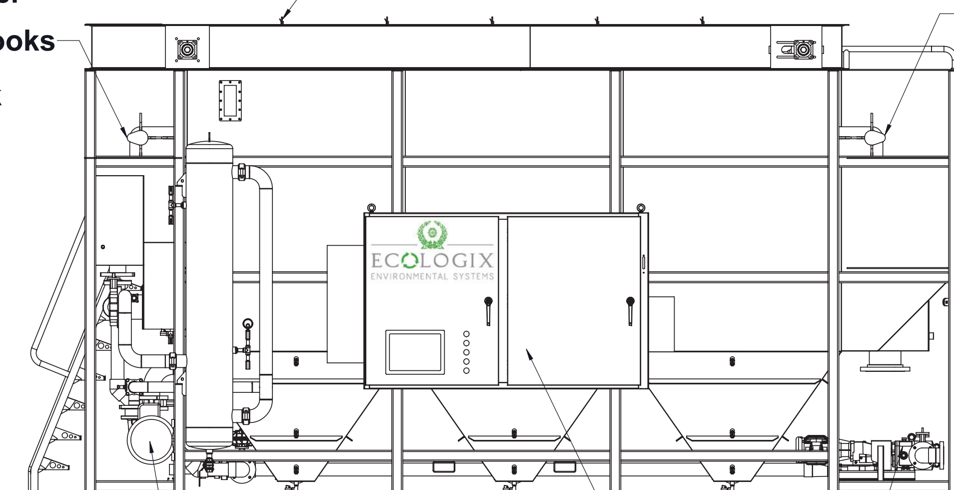
Equipment	Brand	Power
Whitewater Pump	Pioneer	30 hp
Sludge Pump	Boerger	2 hp
Scraper Motor	SEW	1/2 hp

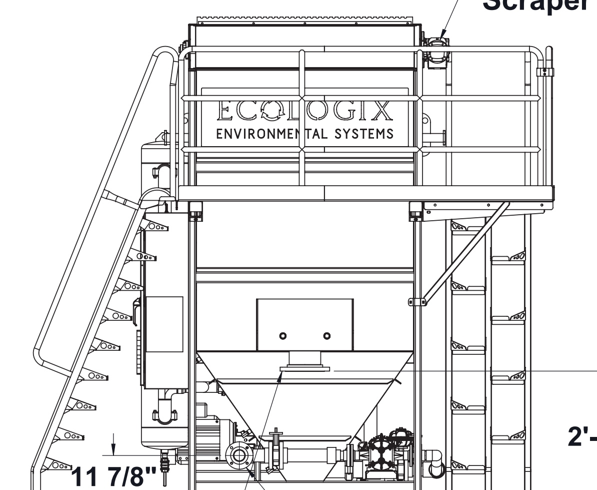
ECOLOGIX E-515 DAF

For additional information, please visit
www.ecologixsystems.com









REVISION HISTORY

REV	DESCRIPTION	DATE	BY	APV
1	—	——	–	–
2	—	——	–	–
3	—	——	–	–
4	—	——	–	–
5	—	——	–	–
6	—	——	–	–
7	—	——	–	–
8	—	——	–	–
9	—	——	–	–
10	—	——	–	–

ECOLOGIX ENVIRONMENTAL SYSTEMS
11800 Wills Road Suite 100, Alpharetta, GA 30009
Phone: 678-514-2100 Fax: 678-514-2106
www.ecologixsystems.com

	SIGN:	NAME	DATE
DRAWN		NPT	11/18/2020
CHECKED		NPT	11/18/2020
ENG APPR		NPT	11/18/2020
MGR APPR		EG	11/18/2020

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
ANGLES ±0.5°
CUTTING DISTANCE $\pm \frac{1}{16}$"
WELDING DISTANCE $\pm \frac{1}{8}$"

DRAWING TITLE: **ECOLOGIX E-515**
Submittal Drawing

SIZE: D | DRAWING: Configuration Name: ECOLOGIX : E-515 | REV

FILE NAME: AN00218
MATERIAL: SEE SPECS
SCALE: N.T.S. | WEIGHT: SEE SPECS | SHEET NO. 1 OF 1

LAST UPDATE:
CAD FILE LOCATION:

-This Page Intentionally Left Blank-

FLT-640 - 3 STAGE FLOC TUBES:

1. SHIPPING WT: 3030 lbs (approx.)
2. OPERATING WT: 5950 lbs (approx.)
3. DESIGN PARAMETERS:
- Design Flow Rate: 160 to 450 GPM
- Retention Time: 150 to 55 sec.
- Volume: 350 Gallons

4. MATERIAL OF CONSTRUCTION:
- All pipings materials to be Sch 80 PVC
- All non-wetted metal materials to ASTM A36 Carbon Steel
- All flanges to be ANSI 150# ANSI flanges ASTM A-182 - ANSI B16.5
- All the structure to be ASTM A36 Carbon Steel
- Gasket Materials to be: Buna or EPDM Rubber

5. SAFETY AND HEALTH:
- All electric power elements are in accordance with OSHA regulations

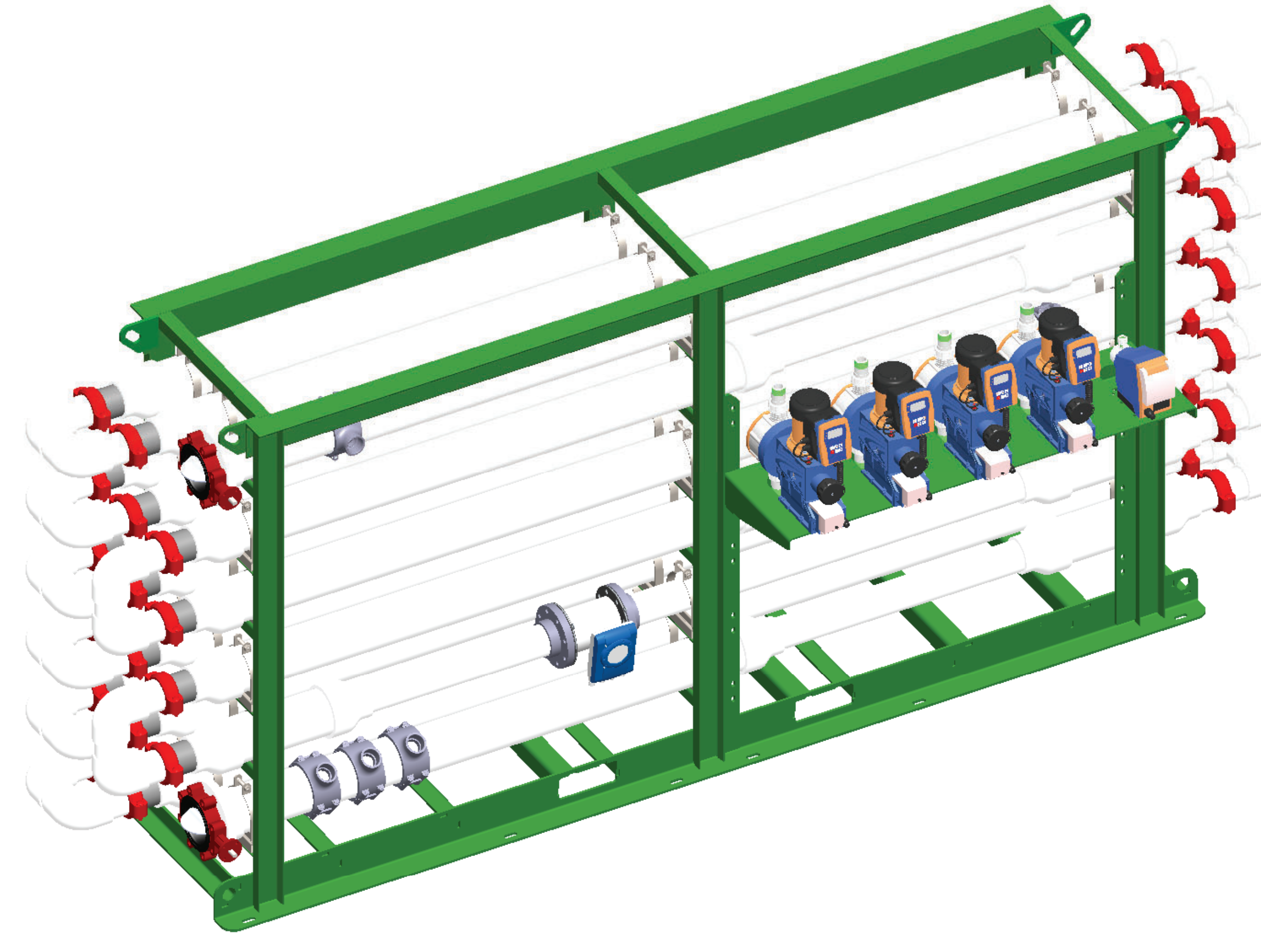
6. COATING:
-All A-36 ASTM Carbon Steel parts to be power coated with Performance Polymer Alloy Coating Plastcoat PPA 571 ES

7. WELDING:
- All welds to conform to AWS applicable specification(s)
- Welding equipment/ supplies for sheet metal and structural elements: Wirefed MIG machine

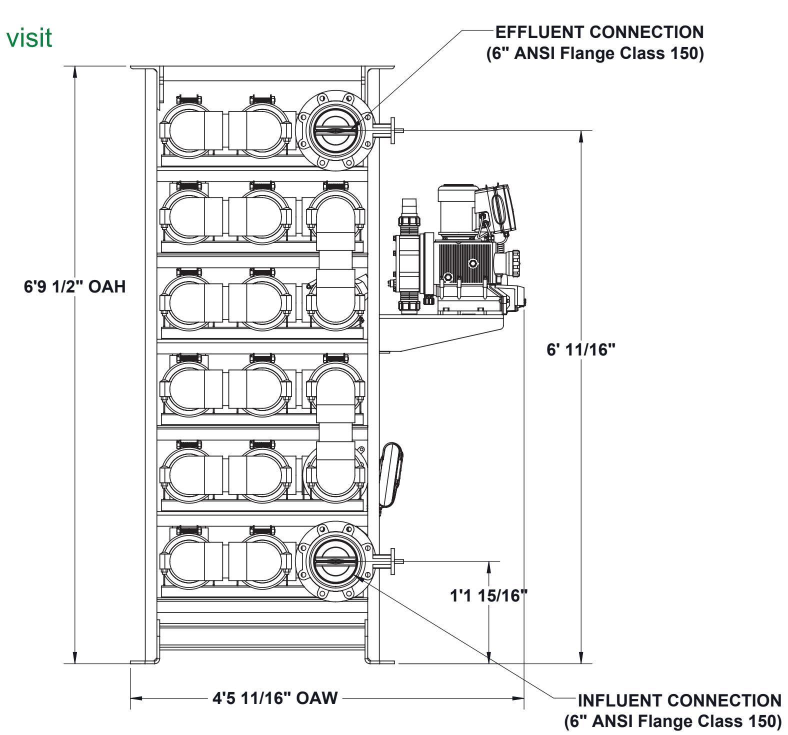
7. PUMPS:
- Pump shelf to fit up to (5) five Prominent Chemical Feed Pumps / Grundfos Chemical Feed Pumps
  Prominent / Grundfos Chemical Feed Pumps
- Pumps to be defined per project
- All tubing and/or hose connetions between the pump and the injections
  main process line to be supplied by Ecologix
- Injection Quills and foot valves to be supply in accordance with the application and number of pumps.

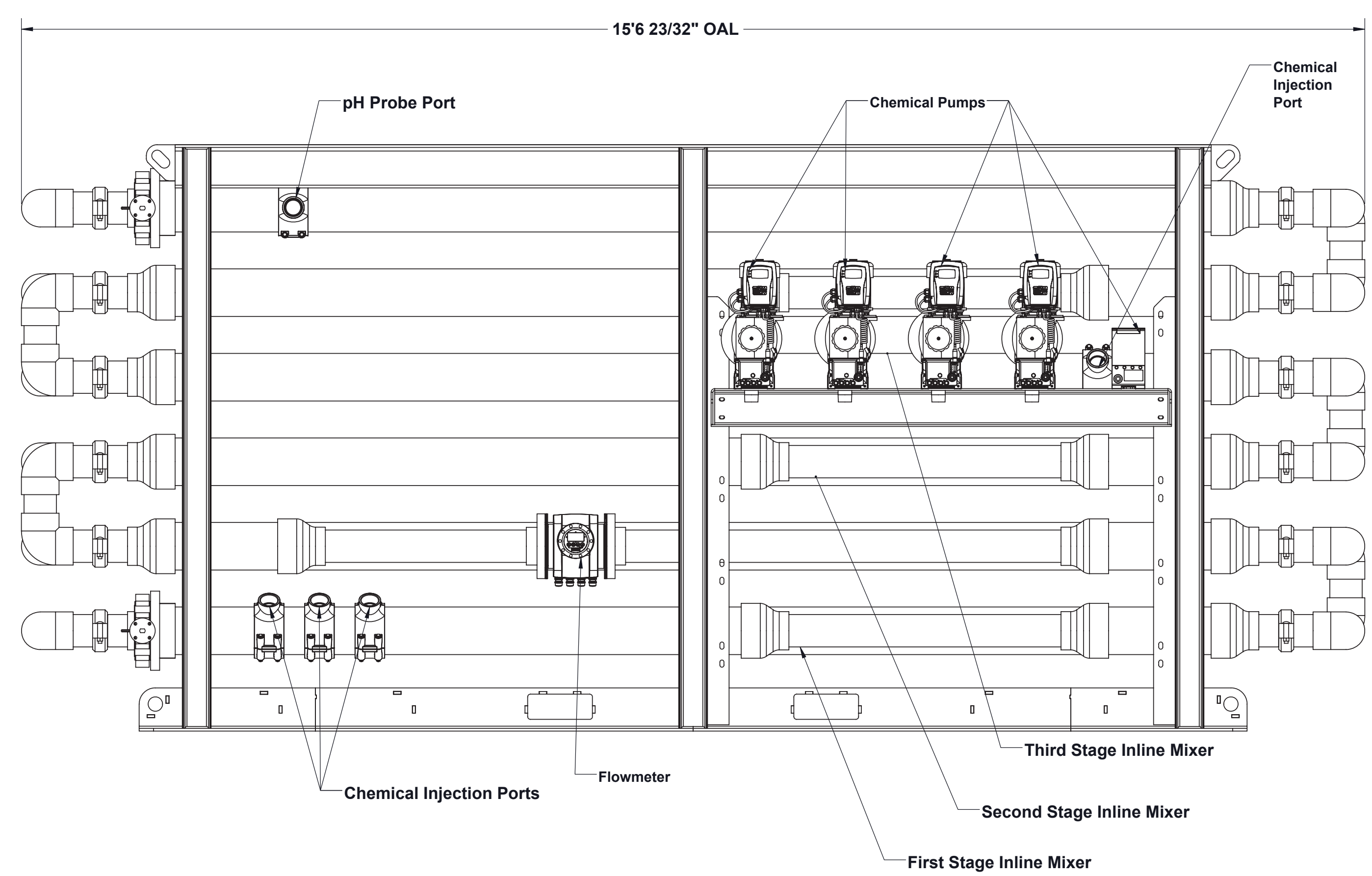
8. INSTRUMENTATION:
- Flowmeter and pH probe to be Kronhe / Endress Hauser

For additional information, please visit
www. EcologixSystems.com



ECOLOGIX FLOC TUBES FLT-640





REVISION HISTORY				
REV	DESCRIPTION	DATE	BY	APV
1	---- / ----	---------	---	---
2	---- / ----	---------	---	---
3	---- / ----	---------	---	---
4	---- / ----	---------	---	---
5	---- / ----	---------	---	---
6	---- / ----	---------	---	---
7	---- / ----	---------	---	---
8	---- / ----	---------	---	---
9	---- / ----	---------	---	---
10	---- / ----	---------	---	---

ECOLOGIX ENVIRONMENTAL SYSTEMS
11800 Wills Road Suite 100, Alpharetta, GA 30009
Phone: 678-514-2100 Fax: 678-514-2106
www.ecologixsystems.com

	SIGN:	NAME	DATE
DRAWN		IK	6/11/2020
CHECKED			6/11/2020
ENG APPR			
MGR APPR			

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
ANGLES ±0.5°
CUTTING DISTANCE $\pm\frac{1}{16}$"
WELDING DISTANCE $\pm\frac{1}{8}$"

DRAWING TITLE
6"X4" FLT Submittal Drawing

SIZE D | DRAWING: Configuration Name AM00221.06.2 | REV

FILE NAME: **AM00221.6-Submittal**

MATERIAL:

SCALE: 1:4 | WEIGHT: | SHEET NO. 1 OF 1

LAST UPDATE:
CAD FILE LOCATION:

-This Page Intentionally Left Blank-

DISSOLVED AIR FLOTATION – RSP-13L

The Ideal DAF™ Dissolved Air Flotation system removes suspended solids, fats, oils and greases, and other insoluble materials. The Ideal DAF™ achieves high rate removal efficiencies at a low operational cost by employing such proprietary techniques as: Progressive Water Extraction, Cross-Flow, Dissolved Air Generator (Ideal DAG™), Lamella Plate Pack Design, and proficient Hydraulic design.

Dissolved Air Flotation (DAF) is the process whereby micro-air-bubbles cause suspended materials to float to the surface of a vessel to achieve liquid/solids separation. The water to be treated enters the vessel through a proprietary influent system designed to reduce velocity and distribute water across the length of the system. In order to optimize treatment, the influent system is designed with multiple options for "whitewater" and flocculant injection points, where applicable. Whitewater is a highly saturated pressurized stream of air and DAF effluent that is generated through a proprietary, highly efficient, and robust DAG™ system. The wastewater then enters the vessel, and the microbubbles, which have attached to the particle surface, affect the particle density, causing the suspended solids to float to the surface where a chain and flight system skim them from the surface into a top cone. The clarified liquid is continuously removed at several points inside the vessel and passes over pipe weirs into an effluent box. From the effluent box, the wastewater gravity feeds out of the system.

FEATURES

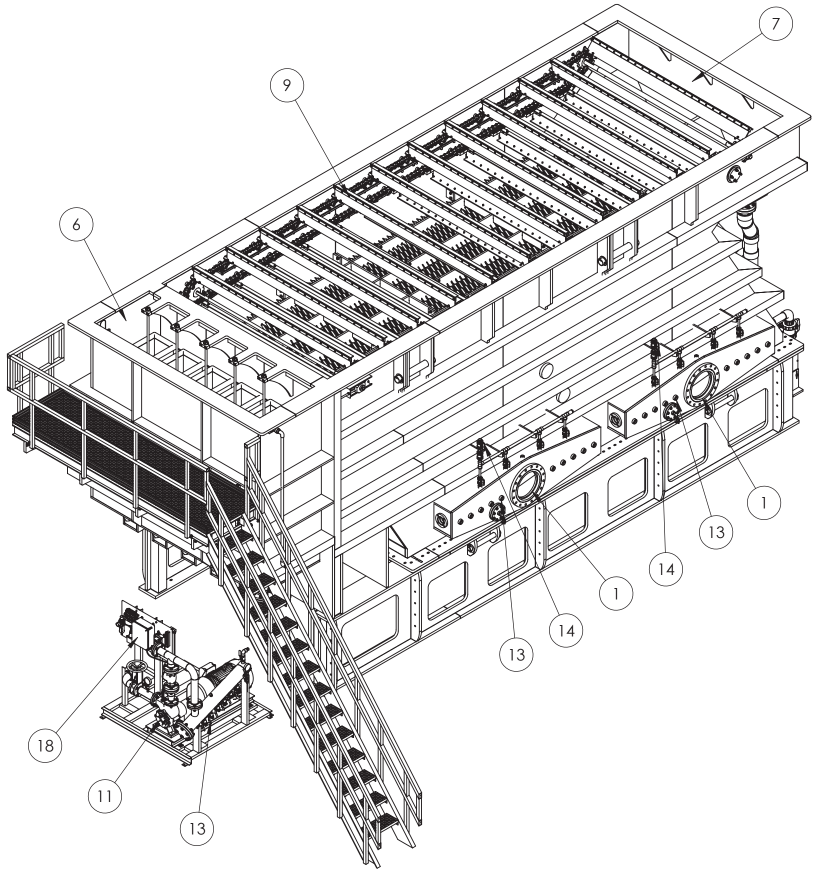
- Polypropylene Frame Construction
  - Provides superior qualities compared to stainless steel such as: lighter weight, higher chemical resistance (corrosion resistance), longer life span, less expensive (materials costs), and lower maintenance.
- Lamella Plates
  - Corrugated plates provide increased surface area to enhance separation performance.
- Progressive Water Extraction
  - The process of extracting the clean water from the system as the influent travels through the system, providing additional time for the concentrated slurry to separate.
- Dissolved Air
  - The DAG™ is used for generating 5-12 micron bubbles at very high saturation efficiencies.
- Cross Flow
  - The vessel design is such that the influent water is spread across the length of the vessel to reduce the velocity of the water to optimize separation efficiencies.
- Cone Bottom Sludge Removal
  - A safe, low-maintenance method for efficient removal of any settled particles.

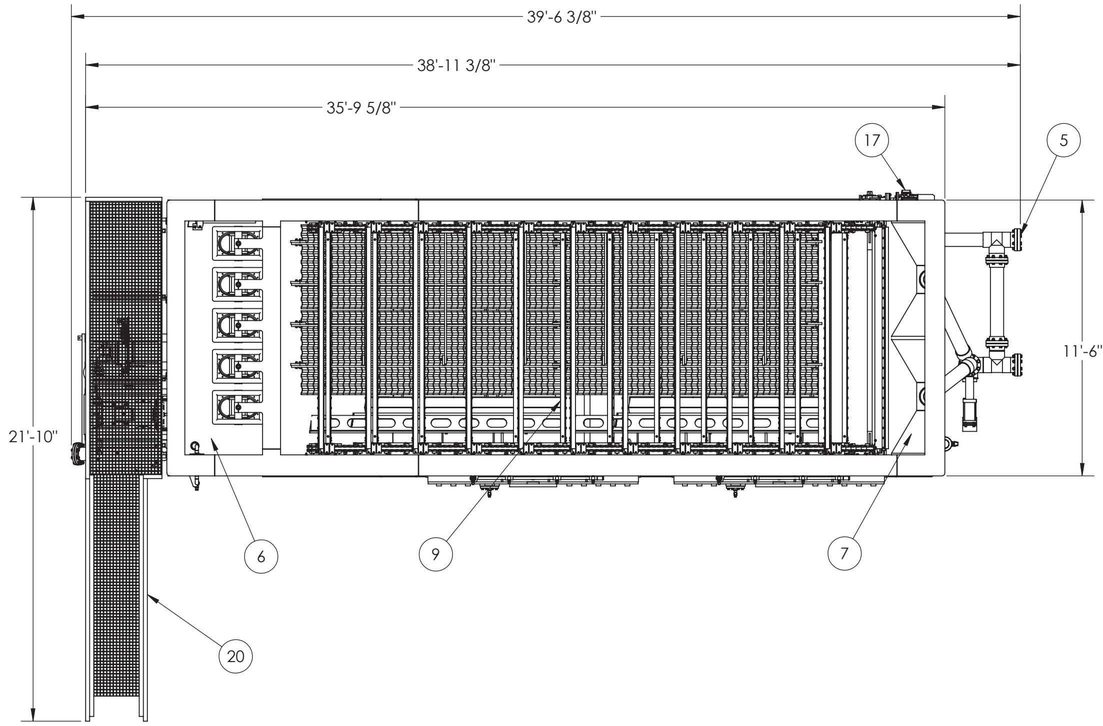
SPECIFICATIONS

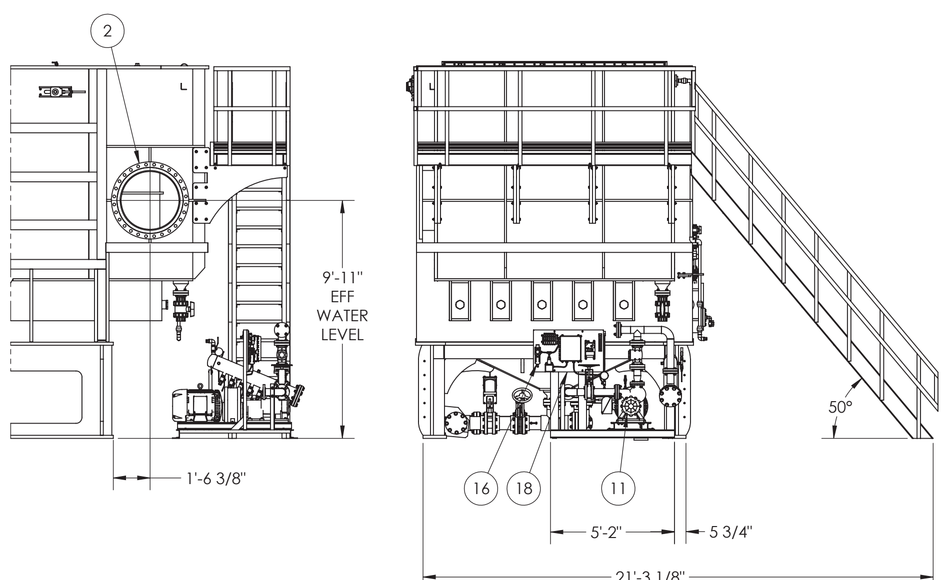
Overall System		
Model	**RSP-13L**	
Maximum Temp	**170 °F**	**77 °C**
pH Tolerance	**1 – 12 S.U.**	
Dimensions (approximate)		
Vessel (WxLxH)	**11’0” x 32’5” x 15’6”**	**3.36 m x 9.00 m x 3.05 m**
Overall (excluding platform)	**15’2” x 37’9” x 15’6”**	**4.98 m x 11.82 m x 3.05 m**
Platform Dimensions		
Standard (WxL)	**3’0” x 11’0”**	**0.92 m x 3.36 m**
Extended (Optional)	**2’0” x 33’6”**	**0.61 m x 7.96 m**
DAF Weight (approximate)		
Shipping	**43,000 lbs**	**19,505 kg**
Operational	**209,000 lbs**	**94,805 kg**
Pipe Diameters		
Inlet	**2 x 16” (150 lb ANSI Flange)**	
Outlet	**30” (150 lb ANSI Flange)**	
Sludge	**6” (150 lb ANSI Flange)**	
Standard Equipment		
Dissolved Air Generator DAG™	***See Proposal***	
Sludge Pump	***See Proposal***	
Solenoid Valves	**SMC**	
Rake Drive Motor	**Motovario Gear Reducer (5 HP, TEFC Inverter Duty)**	
Control Valves	**Orbinox 3” Pneumatic Knife Gate**	
Materials of Construction		
Vessel	**Polypropylene**	
Exo Skeleton	**304 Stainless Steel**	
Piping	**Polypropylene and Sch.80 PVC**	
Lamella Plates	**HDPE**	
Platform/Grating	**Fiberglass**	
Pneumatic Valves	**Cast Body / Stainless Steel Internals**	
Manual Valves	**SCH 80 PVC or Cast Body / Stainless Steel Internals**	
Chain/Flight/Wear Blocks	**Acetal / Fiberglass / UHMW**	
Gaskets	**EPDM**	
Optional Equipment		
Advanced Pipe Flocculator	**Sludge Tank**	
Advanced PLC Controls	**Splash Guards Stainless**	
Cover	**Steel Vessel**	
Effluent Tank	**Thickening Beach™**	
Extended Platform		

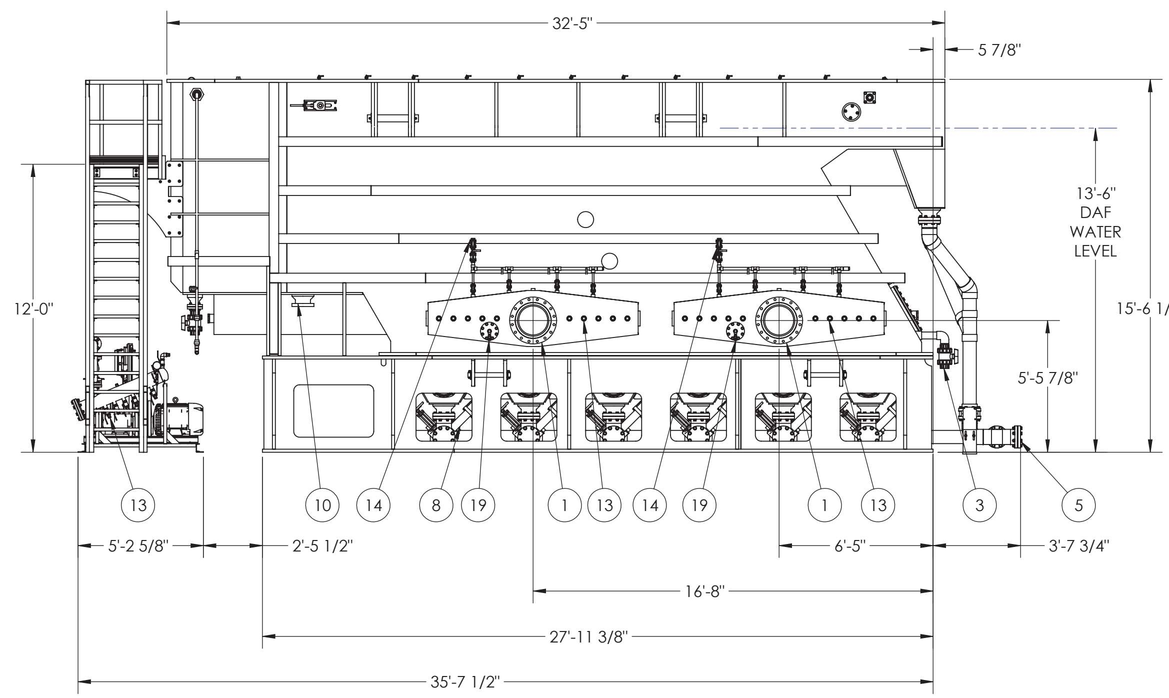
RSP-13L-R-B DAF

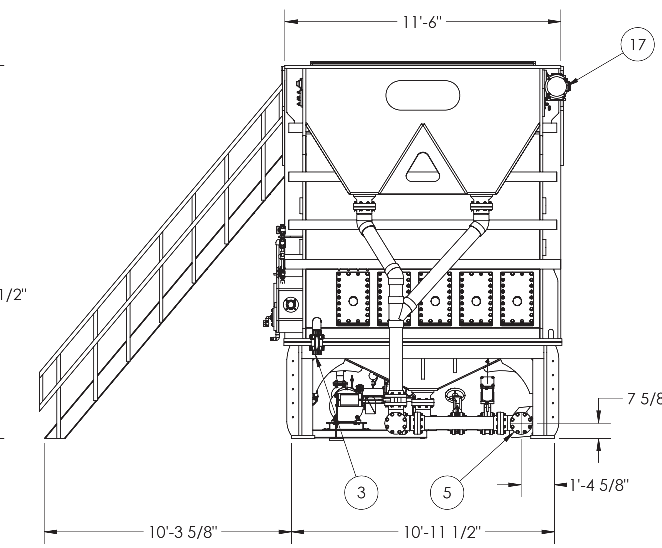
ITEM NO.	DESCRIPTION
1	INFLUENT, (2) 16" FLANGE 150 LB
2	EFFLUENT, 30" FLANGE 150 LB
3	INFLUENT DRAIN, 3" PVC BALL VALVE
4	EFFLUENT DRAIN, 3" PVC BALL VALVE
5	SLUDGE DISCHARGE, 6" FLANGE 150 LB
6	CLEAN WATER EFFLUENT WEIR BOX
7	SLUDGE HOPPER
8	CONE BOTTOM SOLIDS REMOVAL VALVES (AUTO), 6"
9	SKIMMER PADDLE
10	DAG RECIRCULATION, 3" FLANGE 150 LB
11	DAG PUMP SKID (M80)
12	-----
13	DISSOLVED AIR INJECTION VALVES
14	POLYMER INJECTION
15	-----
16	1/2" AIR CONNECTION 50 PSI (MIN)
17	SOLIDS SKIMMER AND GEAR DRIVE MOTOR (5 HP)
18	JUNCTION PANEL
19	SAMPLE/INJECTION PORTS, -" PVC BALL VALVE
20	WALKWAY, STD











GENERAL NOTES

1. ALL IS TO BE CONSTRUCTED GREY FROM HIGH IMPACT NATURAL STRESS RELIEVED, VIRGIN COPOLYMER POLYPROPYLENE. U.O.W.S
2. SERVICE: WASTE WATER @ 40° ~ 130°
3. ALL FLANGES TWO-HOLED TO THE CENTER LINE
4. STEEL REINFORCEMENTS TO BE: 304 STAINLESS STEEL
5. ALL DIMENSIONS SHOWN APPLY TO AMBIENT TEMPERTURE (NON-EXPAND)
6. A SPREADER BEAM IS REQUIRED TO BE DESIGNED TO ENSURE VERTICAL OR MINIMUM OUTWARD LIFT
7. SOME HIDDEN LINES AND COMPONENTS OMITTED FOR CLARITY
8. TANKS TO BE TRANPORTED EMPTY
9. ALL GASKET MATERAIL TO BE 3/16" THK. EPDM
10. ALL FASTENERS TO BE 304 SS
11. HYDRO. TEST TO BE ADMINSTRATED BEFORE SHIPMENT
12. ALL FLANGES FACES TO BE PROTECTED WITH WOOD BLANKS FOR SHIPPING

EMPTY WEIGHT: 43,000 LBS
OPERATIONAL WEIGHT: 209,000 LBS

NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	BY

World water works
1-800-607-PURE
4000 SW 113th * OKLAHOMA CITY, OK 73137

CLIENT: --
LOCATION: --
FILE NAME: WWW-GA-SALES DRAWING-RSP-13L-R
DESCRIPTION: GA-SALES DRAWING RSP-13L-R

SALES DRAWING
P.O.#:
DRAWN BY: ES
CHECKED BY: KB
DATE: 7/29/13
SCALE: 1:48
JOB #: --
DRAWING #
--
SHEET: 1 OF 1 SHEETS

-This Page Intentionally Left Blank-

DISSOLVED AIR FLOTATION – RSP-25SW

The Ideal DAF™ Dissolved Air Flotation system removes suspended solids, fats, oils and greases, and other insoluble materials. The Ideal DAF™ achieves high rate removal efficiencies at a low operational cost by employing such proprietary techniques as: Progressive Water Extraction, Cross-Flow, Dissolved Air Generator (Ideal DAG™), Lamella Plate Pack Design, and proficient Hydraulic design.

Dissolved Air Flotation (DAF) is the process whereby micro-air-bubbles cause suspended materials to float to the surface of a vessel to achieve liquid/solids separation. The water to be treated enters the vessel through a proprietary influent system designed to reduce velocity and distribute water across the length of the system. In order to optimize treatment, the influent system is designed with multiple options for "whitewater" and flocculant injection points, where applicable. Whitewater is a highly saturated pressurized stream of air and DAF effluent that is generated through a proprietary, highly efficient, and robust DAG™ system. The wastewater then enters the vessel, and the microbubbles, which have attached to the particle surface, affect the particle density, causing the suspended solids to float to the surface where a chain and flight system skim them from the surface into a top cone. The clarified liquid is continuously removed at several points inside the vessel and passes over pipe weirs into an effluent box. From the effluent box, the wastewater gravity feeds out of the system.

FEATURES

- Polypropylene Frame Construction
  - Provides superior qualities compared to stainless steel such as: lighter weight, higher chemical resistance (corrosion resistance), longer life span, less expensive (materials costs), and lower maintenance.
- Lamella Plates
  - Corrugated plates provide increased surface area to enhance separation performance.
- Progressive Water Extraction
  - The process of extracting the clean water from the system as the influent travels through the system, providing additional time for the concentrated slurry to separate.
- Dissolved Air
  - The DAG™ is used for generating 5-12 micron bubbles at very high saturation efficiencies.
- Cross Flow
  - The vessel design is such that the influent water is spread across the length of the vessel to reduce the velocity of the water to optimize separation efficiencies.
- Cone Bottom Sludge Removal
  - A safe, low-maintenance method for efficient removal of any settled particles.

SPECIFICATIONS

Overall System

Model	**RSP-25SW**	
Maximum Temp	**170 °F**	**77 °C**
pH Tolerance	**1 – 12 S.U.**	

Dimensions (approximate)

Vessel (WxLxH)	**11’0” x 29’6” x 10’0”**	**3.36 m x 9.00 m x 3.05 m**
Overall (excluding platform)	**16’4” x 38’9” x 10’0”**	**4.98 m x 11.82 m x 3.05 m**
Platform Dimensions		
Standard (WxL)	**3’0” x 11’0”**	**0.92 m x 3.36 m**
Extended (Optional)	**2’0” x 26’1”**	**0.61 m x 7.96 m**

DAF Weight (approximate)

Shipping	**20,750 lbs**	**9,415 kg**
Operational	**127,950 lbs**	**58,040 kg**

Pipe Diameters

Inlet	**14”**	**(150 lb ANSI Flange)**
Outlet	**18”**	**(150 lb ANSI Flange)**
Sludge	**3”**	**(150 lb ANSI Flange)**

Standard Equipment

Dissolved Air Generator DAG™	***See Proposal***
Sludge Pump	***See Proposal***
Solenoid Valves	**SMC**
Rake Drive Motor	**Nord Gear Reducer (5 HP, TEFC Inverter Duty)**
Control Valves	**Orbinox 3” Pneumatic Knife Gate**

Materials of Construction

Vessel	**Polypropylene**
Exo Skeleton	**304 Stainless Steel**
Piping	**Polypropylene and Sch.80 PVC**
Lamella Plates	**HDPE**
Platform/Grating	**Fiberglass**
Pneumatic Valves	**Cast Body / Stainless Steel Internals**
Manual Valves	**SCH 80 PVC or Cast Body / Stainless Steel Internals**
Chain/Flight/Wear Blocks	**Acetal / Fiberglass / UHMW**
Gaskets	**EPDM**

Optional Equipment

Advanced Pipe Flocculator	**Sludge Tank**
Advanced PLC Controls	**Splash Guards Stainless**
Cover	**Steel Vessel**
Effluent Tank	**Thickening Beach™**
Extended Platform	

GENERAL NOTES

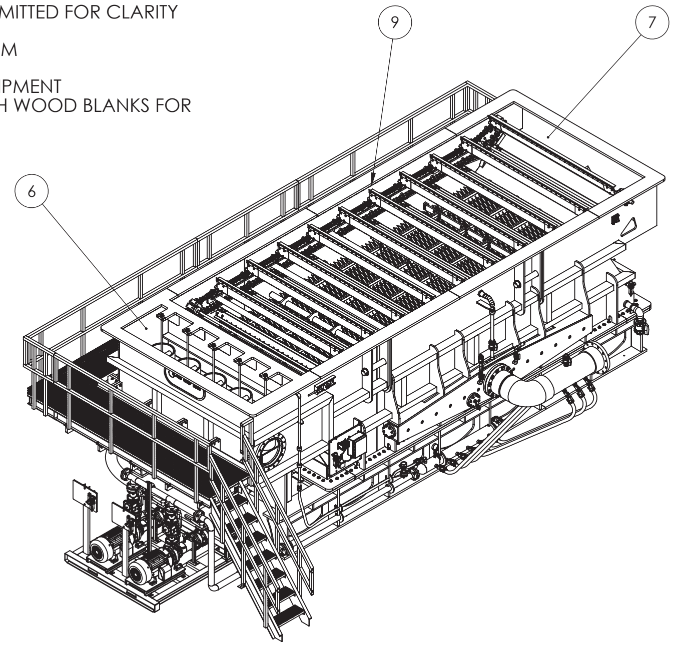
1. ALL IS TO BE CONSTRUCTED GREY FROM HIGH IMPACT NATURAL STRESS RELIEVED, VIRGIN COPOLYMER POLYPROPYLENE. U.O.W.S
2. SERVICE: WASTE WATER @ 40°F ~ 130°F
3. ALL FLANGES TWO-HOLED TO THE CENTER LINE
4. STEEL REINFORCEMENTS TO BE: 304 STAINLESS STEEL
5. ALL DIMENSIONS SHOWN APPLY TO AMBIENT TEMPERTURE (NON-EXPAND)
6. A SPREADER BEAM IS REQUIRED TO BE DESIGNED TO ENSURE VERTICAL OR MINIMUM OUTWARD LIFT
7. SOME HIDDEN LINES AND COMPONENTS OMITTED FOR CLARITY
8. TANKS TO BE TRANPORTED EMPTY
9. ALL GASKET MATERAIL TO BE 3/16" THK. EPDM
10. ALL FASTENERS TO BE 304 SS
11. HYDRO. TEST TO BE COMPLETED BEFORE SHIPMENT
12. ALL FLANGES FACES TO BE PROTECTED WITH WOOD BLANKS FOR SHIPPING

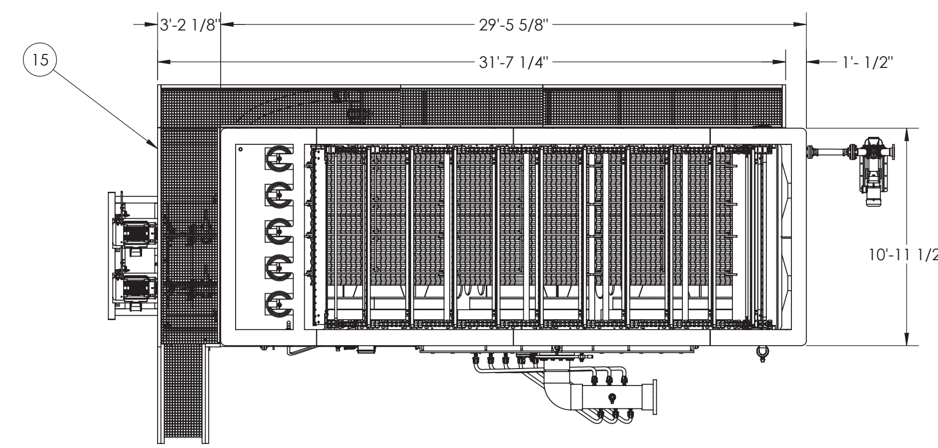
RSP-25SW SH-101 DAF

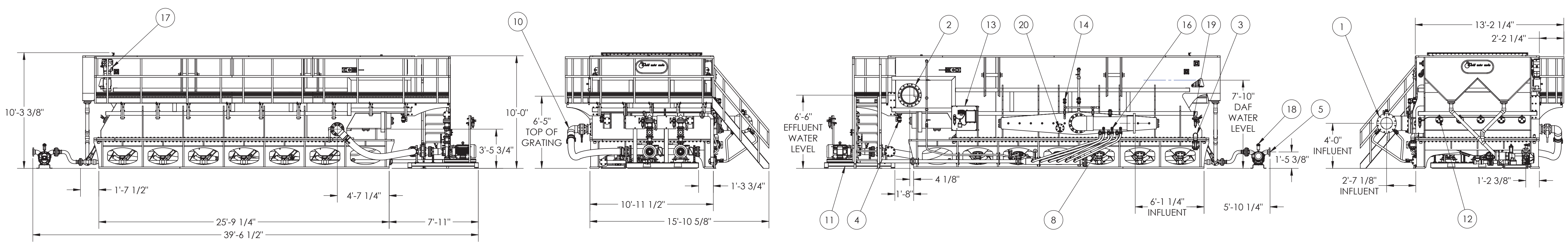
ITEM NO.	DESCRIPTION
1	INFLUENT, 14" FLANGE 150 LB
2	EFFLUENT, 18" FLANGE 150 LB
3	INFLUENT DRAIN, 3" PVC BALL VALVE
4	EFFLUENT DRAIN, 1-1/2" PVC BALL VALVE
5	SLUDGE DISCHARGE, 3" FLANGE 150 LB
6	CLEAN WATER EFFLUENT WEIR BOX
7	SLUDGE HOPPER
8	CONE BOTTOM SOLIDS REMOVAL VALVES (AUTO), 3"
9	SKIMMER PADDLE
10	DAG RECIRCULATION, 3" FLANGE 150 LB
11	DAG PUMP SKID 40HP
12	AIR BLOWDOWN
13	JUNCTION PANEL
14	POLYMER INJECTION
15	EXTENDED WALKWAY AND STAIRS
16	DISSOLVED AIR INJECTION VALVES
17	SOLIDS SKIMMER & GEAR DRIVE MOTOR (5 HP)
18	SLUDGE PUMP, 3"
19	1/2" AIR CONNECTION 50 PSI (MIN)
20	SAMPLE/INJECTION PORTS, 1/2" PVC BALL VALVE

REV	DATE	DESCRIPTION	BY
00	02/19/20	INITIAL REVIEW	LM

EMPTY WEIGHT: 22575 LBS
OPERATIONAL WEIGHT: 44250 LBS







World water works
1-800-607-PURE
4000 SW 113th * OKLAHOMA CITY, OK 73137

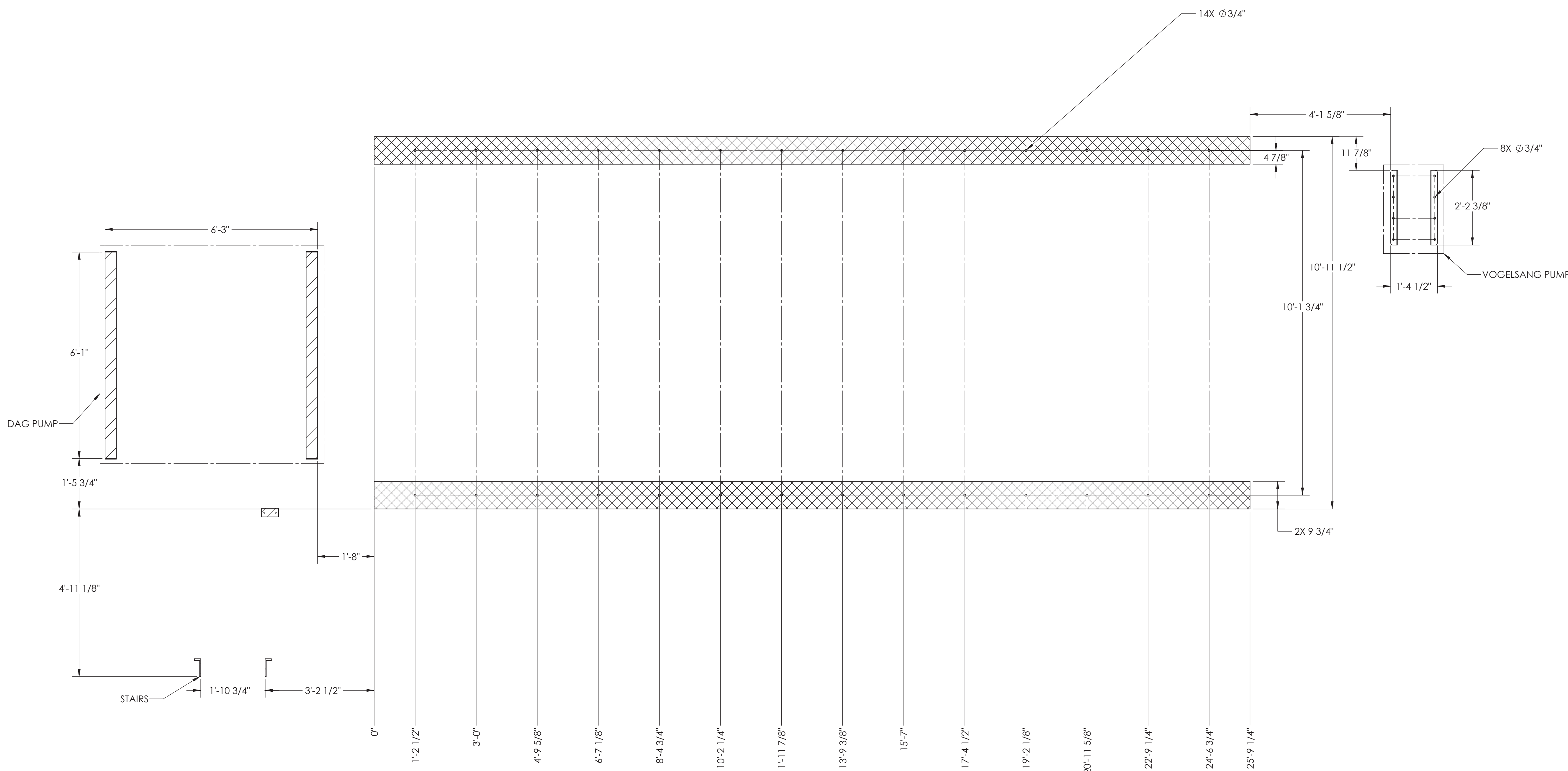
CLIENT: World Water Works - OK
LOCATION: Oklahoma City, OK
FILE NAME: 20057-0701
DESCRIPTION: GENERAL ARRANGEMENT

FOR APPROVAL
P.O.#:
DRAWN BY: LM
CHECKED BY: RG
DATE: 02/19/20
SCALE: 1:48
JOB #: 20-057
DRAWING # 0701
SHEET: 1 OF 2 SHEETS

-This Page Intentionally Left Blank-

FOOTPRINT DETAIL

SCALE 1 : 20



REV	DATE	DESCRIPTION	BY
00	02/19/20	INITIAL REVIEW	LM

World water works

CLIENT: World Water Works - OK
LOCATION: Oklahoma City, OK
FILE NAME: 20057-0701
DESCRIPTION: GENERAL ARRANGEMENT

P.O.#:
DRAWN BY: LM
CHECKED BY: RG
DATE: 02/19/20
SCALE: 1:48
JOB #: 20-057
DRAWING # 0701
SHEET: 2 OF 2 SHEETS

-This Page Intentionally Left Blank-

DISSOLVED AIR FLOTATION – RSP-11S

The Ideal DAF™ Dissolved Air Flotation system removes suspended solids, fats, oils and greases, and other insoluble materials. The Ideal DAF™ achieves high rate removal efficiencies at a low operational cost by employing such proprietary techniques as: Progressive Water Extraction, Cross-Flow, Dissolved Air Generator (Ideal DAG™), Lamella Plate Pack Design, and proficient Hydraulic design.

Dissolved Air Flotation (DAF) is the process whereby micro-air-bubbles cause suspended materials to float to the surface of a vessel to achieve liquid/solids separation. The water to be treated enters the vessel through a proprietary influent system designed to reduce velocity and distribute water across the length of the system. In order to optimize treatment, the influent system is designed with multiple options for "whitewater" and flocculant injection points, where applicable. Whitewater is a highly saturated pressurized stream of air and DAF effluent that is generated through a proprietary, highly efficient, and robust DAG™ system. The wastewater then enters the vessel, and the microbubbles, which have attached to the particle surface, affect the particle density, causing the suspended solids to float to the surface where a chain and flight system skim them from the surface into a top cone. The clarified liquid is continuously removed at several points inside the vessel and passes over pipe weirs into an effluent box. From the effluent box, the wastewater gravity feeds out of the system.

FEATURES

- Polypropylene Frame Construction
  - Provides superior qualities compared to stainless steel such as: lighter weight, higher chemical resistance (corrosion resistance), longer life span, less expensive (materials costs), and lower maintenance.
- Lamella Plates
  - Corrugated plates provide increased surface area to enhance separation performance.
- Progressive Water Extraction
  - The process of extracting the clean water from the system as the influent travels through the system, providing additional time for the concentrated slurry to separate.
- Dissolved Air
  - The DAG™ is used for generating 5-12 micron bubbles at very high saturation efficiencies.
- Cross Flow
  - The vessel design is such that the influent water is spread across the length of the vessel to reduce the velocity of the water to optimize separation efficiencies.
- Cone Bottom Sludge Removal
  - A safe, low-maintenance method for efficient removal of any settled particles.

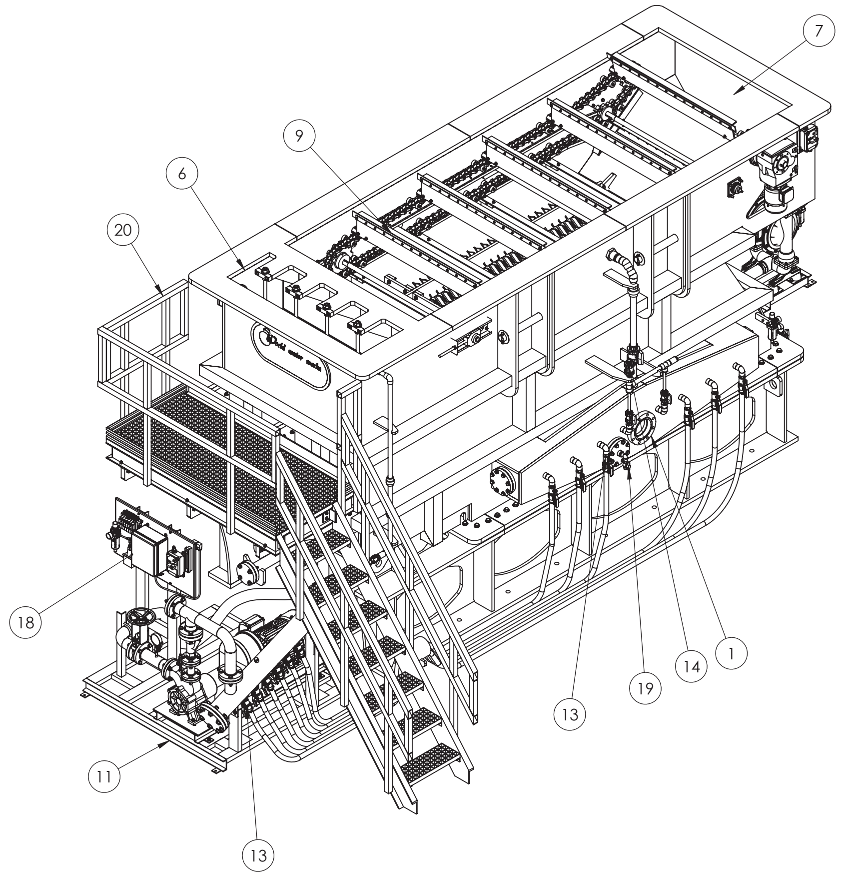
SPECIFICATIONS

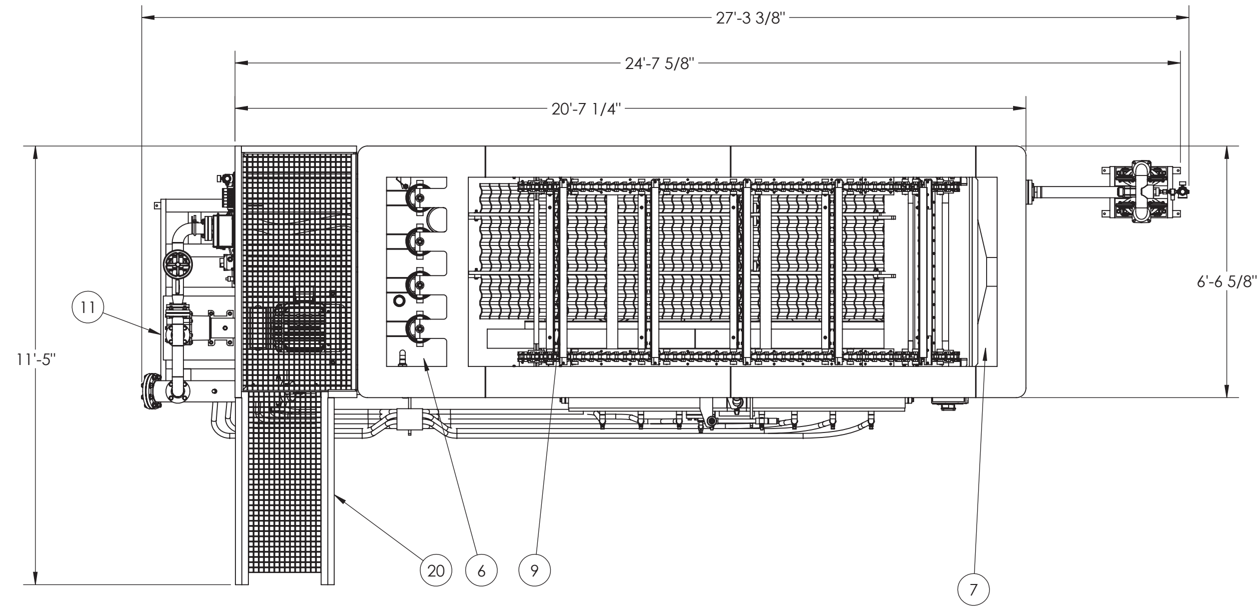
Overall System		
Model	**RSP-11S**	
Maximum Temp	**170 °F**	**77 °C**
pH Tolerance	**1 – 12 S.U.**	
Dimensions (approximate)		
Vessel (WxLxH)	**6’7” x 17’5” x 10’0”**	**2.01 m x 5.31 m x 3.05 m**
Overall (excluding platform)	**8’9” x 21’2” x 10’0”**	**2.67 m x 6.46 m x 3.05 m**
Platform Dimensions		
Standard (WxL)	**3’0” x 5’10”**	**0.92 m x 1.78 m**
Extended (Optional)	**2’0” x 20’5”**	**0.61 m x 6.23 m**
DAF Weight (approximate)		
Shipping	**10,250 lbs**	**4,650 kg**
Operational	**37,450 lbs**	**16,990 kg**
Pipe Diameters		
Inlet	**8” (150 lb ANSI Flange)**	
Outlet	**8” (150 lb ANSI Flange)**	
Sludge	**3” (150 lb ANSI Flange)**	
Standard Equipment		
Dissolved Air Generator DAG™	***See Proposal***	
Sludge Pump	***See Proposal***	
Solenoid Valves	**SMC**	
Rake Drive Motor	**Nord Gear Reducer (1.5 HP, TEFC Inverter Duty)**	
Control Valves	**Orbinox 3” Pneumatic Knife Gate**	
Materials of Construction		
Vessel	**Polypropylene**	
Exo Skeleton	**304 Stainless Steel**	
Piping	**Polypropylene and Sch.80 PVC**	
Lamella Plates	**HDPE**	
Platform/Grating	**Fiberglass**	
Pneumatic Valves	**Cast Body / Stainless Steel Internals**	
Manual Valves	**SCH 80 PVC or Cast Body / Stainless Steel Internals**	
Chain/Flight/Wear Blocks	**Acetal / Fiberglass / UHMW**	
Gaskets	**EPDM**	

Optional Equipment

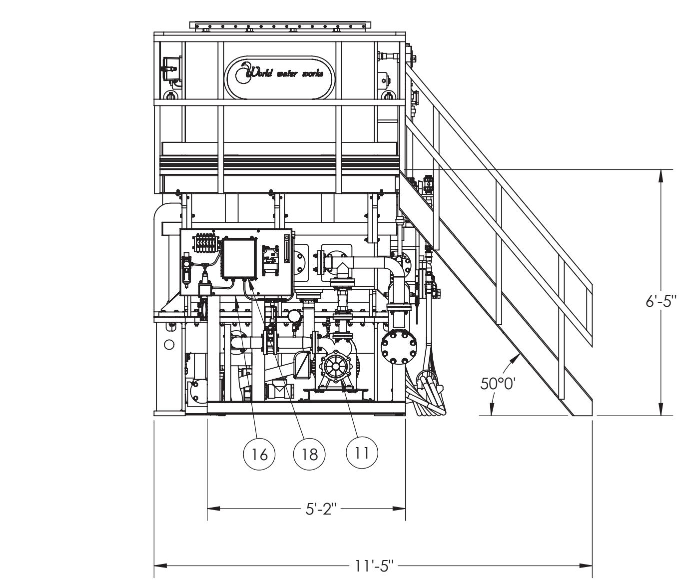
Advanced Pipe Flocculator	**Sludge Tank**
Advanced PLC Controls	**Splash Guards Stainless**
Cover	**Steel Vessel**
Effluent Tank	**Thickening Beach™**
Extended Platform	

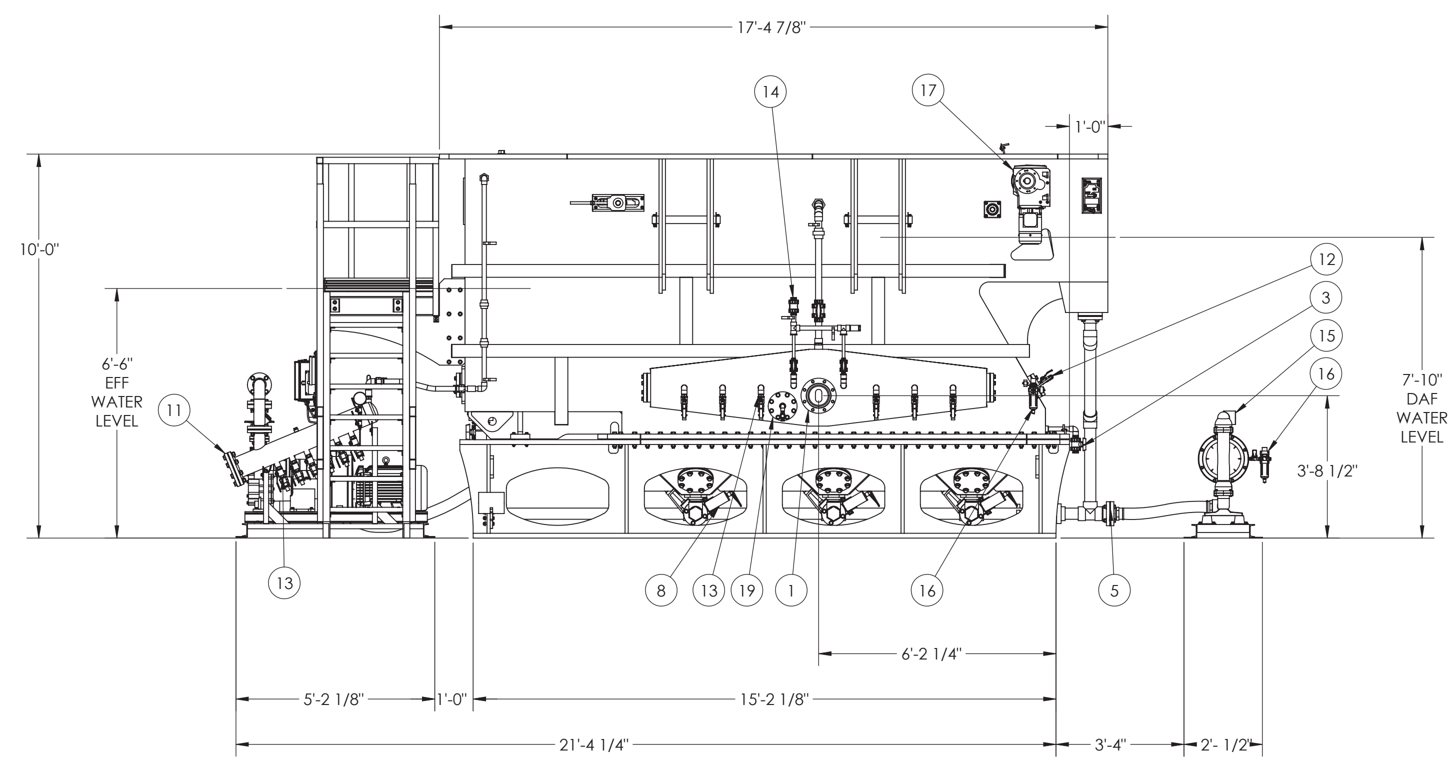
RSP-11S-R-B DAF

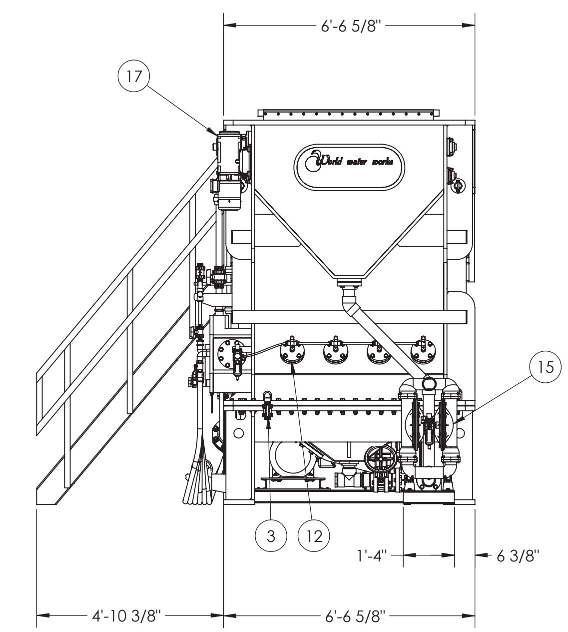


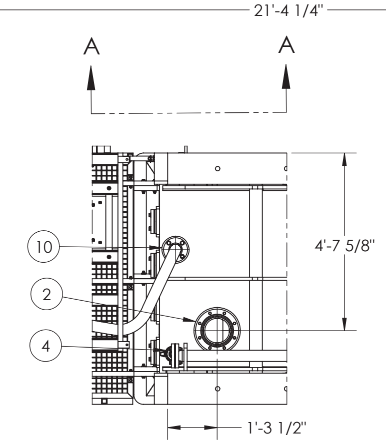


ITEM NO.	DESCRIPTION
1	INFLUENT, 6" FLANGE 150 LB
2	EFFLUENT, 8" FLANGE 150 LB
3	INFLUENT DRAIN, 1" PVC BALL VALVE
4	EFFLUENT DRAIN, 1 -1/2" PVC BALL VALVE
5	SLUDGE DISCHARGE,3 " FLANGE 150 LB
6	CLEAN WATER EFFLUENT WEIR BOX
7	SLUDGE HOPPER
8	CONE BOTTOM SOLIDS REMOVAL VALVES (AUTO), 3"
9	SKIMMER PADDLE
10	DAG RECIRCULATION, 3" FLANGE 150 LB
11	DAG PUMP SKID (PER SALES PROPOSAL)
12	AIR BLOWDOWN
13	DISSOLVED AIR INJECTION VALVES
14	POLYMER INJECTION
15	SLUDGE PUMP,3 " AOD
16	1/2" AIR CONNECTION 50 PSI (MIN)"
17	SOLIDS SKIMMER & GEAR DRIVE MOTOR (1/2 HP)
18	JUNCTION PANEL
19	SAMPLE PORTS, 1/2" PVC BALL VALVE
20	WALKWAY, STD









GENERAL NOTES

1. ALL IS TO BE CONSTRUCTED GREY FROM HIGH IMPACT NATURAL STRESS RELIEVED, VIRGIN COPOLYMER POLYPROPYLENE. U.O.W.S
2. SERVICE: WASTE WATER @ 40° ~ 130°
3. ALL FLANGES TWO-HOLED TO THE CENTER LINE
4. STEEL REINFORCEMENTS TO BE: 304 STAINLESS STEEL
5. ALL DIMENSIONS SHOWN APPLY TO AMBIENT TEMPERTURE (NON-EXPAND)
6. SOME HIDDEN LINES AND COMPONENTS OMITTED FOR CLARITY
7. TANKS TO BE TRANPORTED EMPTY
8. ALL GASKET MATERAIL TO BE 3/16" THK. EPDM
9. ALL FASTENERS TO BE 304 SS
10. HYDRO. TEST TO BE ADMINSTRATED BEFORE SHIPMENT
11. ALL FLANGES FACES TO BE PROTECTED WITH WOOD BLANKS FOR SHIPPING

EMPTY WEIGHT: 10,250 LBS
OPERATIONAL WEIGHT: 37,450 LBS

NOT FOR CONSTRUCTION

WWW CONFIDENTIAL

REV	DATE	DESCRIPTION	BY

World water works
1-800-607-PURE
4000 SW 113th * OKLAHOMA CITY, OK 73137

CLIENT: --
LOCATION: --
FILE NAME: WWW-GA-SALES DRAWING RSP-11S-R-B
DESCRIPTION: GA-SALES DRAWING RSP-11S-R-B

SALES DRAWING
P.O.#:
DRAWN BY: AH
CHECKED BY: ES
DATE: 12/01/14
SCALE: 1:30
JOB #: --
DRAWING # M1
SHEET: 1 OF 1 SHEETS

-This Page Intentionally Left Blank-

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 8
RECYCLED WATER TREATMENT OPTIONS AT MSD

DRAFT FINAL | November 2022

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 8
RECYCLED WATER TREATMENT OPTIONS AT MSD

DRAFT FINAL | November 2022

This document is released for the purpose of information exchange review and planning only under the authority of Lisa J. Arroyo, May 2022, California PE No. 57518.

Contents

Appendices

Tables

Figures

Abbreviations

AACE	Association for the Advancement of Cost Engineering International
AF	acre-feet
AFY	acre-feet per year
ADWF	average dry weather flow
AL	action level
AOP	advanced oxidation process
ATW	advanced treated water
AWPF	advanced water purification facility
AWT	advanced water treatment
AWTO	advanced water treatment operator
BAC	biologically-enhanced activated carbon
Carollo	Carollo Engineers
CCR Title 22	Title 22 of the California Code of Regulations
DAF	dissolved air flotation
DBP	disinfection byproduct
DDW	Division of Drinking Water
DPR	direct potable reuse
EC	electrical conductivity
ESCP	enhanced source control program
FAT	full advanced treatment
gph	gallons per hour
gpm	gallons per minute
GWR	groundwater rule
IPR	indirect potable reuse
LRV	log removal value
MBR	membrane bioreactor
MCL	maximum contaminant level
MF	membrane filtration
MG	million gallons
mgd	million gallons per day
mg/L	milligrams per liter
mg-min/L	milligrams per minute per liter
mJ/cm^2	millijoules per square centimeter
mL	milliliter
MSD	Montecito Sanitary District

MWD	Montecito Water District
NDMA	N-Nitrosodimethylamine
NL	notification level
NPR	non-potable reuse
NTU	nephelometric turbidity unit
NWRI	National Water Research Institute
O&M	operations and maintenance
PDT	pressure decay test
Pretreatment Program	industrial pretreatment and pollutant source control program
RO	reverse osmosis
SF	square feet
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
TM	technical memorandum
TOC	total organic carbon
UF	ultrafiltration
UV	ultraviolet
UVT	ultraviolet transmittance
WRF	Water Research Foundation
WRP	water reclamation plant
WTP	water treatment plant
WWTP	wastewater treatment plant

Technical Memorandum 8

RECYCLED WATER TREATMENT OPTIONS AT MSD

Technical Memorandum (TM) 8 develops recycled water treatment trains for non-potable reuse (NPR), indirect potable reuse (IPR), and direct potable reuse (DPR) projects. For projects that utilize dissolved air flotation (DAF) (either primary or secondary), all recycled water treatment trains will require low pressure membrane filtration (MF) (e.g., MF or ultrafiltration [UF]) followed by reverse osmosis (RO). For projects that utilize membrane bioreactors (MBRs), low pressure membranes after MBR are not necessary and MBR is simply followed by RO. Implementation of IPR requires additional treatment barriers compared to NPR, and implementation of DPR requires additional treatment barriers compared to IPR, all of which is detailed in the sections below.

For each treatment option, simple process schematics, design criteria, preliminary sizing, conceptual site plans, and cost estimates are completed.

8.1 Summary of Treatment Trains Analyzed

Seven treatment trains were developed to reflect the options for NPR, IPR, or DPR. These Advanced Water Treatment (AWT) treatment trains are summarized in Table 8.1. Additional information about each train is provided in the sections below.

Table 8.1 Summary of Alternative Reuse Treatment Trains

Reuse Type	Treatment Train	Wastewater Treatment	Advanced Treatment	Feed Flow	Finished Water Flow
Non Potable	1A	Conventional activated sludge + DAF(1)	UF - Partial RO - UV	0.38 mgd	0.3 mgd
	1B	MBR	Chlorine	0.3 mgd	0.3 mgd
	1C	Conventional activated sludge	Cloth filter – UV	0.3 mgd	0.3 mgd
Indirect Potable	2A	MBR	RO - UV/AOP	0.7 mgd	0.56 mgd
	2B	Conventional activated sludge + DAF(1)	UF - RO - UV/AOP	0.7 mgd	0.56 mgd
	3	Conventional activated sludge + DAF (@ Montecito)	UF – RO – UV/AOP (@ Carpinteria)	1.9 mgd	1.5 mgd

Reuse Type	Treatment Train	Wastewater Treatment	Advanced Treatment	Feed Flow	Finished Water Flow
Direct Potable at MSD	4A	MBR	Ozone/BAC - UF - RO - UV/AOP	0.7 mgd	0.56 mgd
	4B	Conventional activated sludge + DAF[1]	Ozone/BAC - UF - RO - UV/AOP	0.7 mgd	0.56 mgd
Direct Potable at Santa Barbara	5A	Conventional activated sludge + DAF[1]	Ozone/BAC - UF - RO - UV/AOP	7.7 mgd	6.2 mgd
	5B			4.6 mgd	3.7 mgd

Abbreviations: AOP - advanced oxidation process; BAC - biologically enhanced activated carbon; mgd - million gallons per day; MSD - Montecito Sanitary District; UV - ultraviolet.

Notes:

(1) DAF is necessary for oil and grease removal ahead of membrane treatment. DAF can be placed either before or after conventional activated sludge treatment.

8.2 Non-Potable Water Reuse

In discussions with the project team, the presumed total dissolved solids (TDS) target of the recycled water is ~1,000 milligrams per liter (mg/L), based on recycled water projects implemented in Santa Barbara and Goleta. Chloride data from Santa Barbara averages 340 mg/L, which has proven acceptable to some (but not all) vegetation. Recent sampling by MSD indicated TDS values in the ~1,400 mg/L range and chloride values in the ~400 mg/L range. Salt and chloride levels in this range will be problematic for some plants. To reduce TDS and chloride, this analysis assumes that RO would be employed on a side stream, as detailed below.

Multiple non-potable treatment trains are evaluated here. The treatment trains are:

- Treatment Train A – Using secondary clarifier effluent that has either primary DAF or secondary DAF, treatment will include a full stream UF followed by partial stream RO for TDS reduction and UV disinfection for the full flow. Train A will take a feed flow of 0.38 mgd. The goal is 50 percent RO permeate in the blended flow, so with 80 percent recovery the RO will require 0.19 mgd of feed flow. The RO permeate would blend with ~0.15 mgd of UF filtrate, resulting in ~0.3 mgd of blended recycled water. The full flow will be disinfected by UV, noting that the UV dose will be 80 millijoules per square centimeter (mJ/cm^2) following the National Water Research Institute (NWRI) UV Guidelines with a small 10 percent safety factor based upon a ultraviolet transmittance (UVT) of 65 percent (which allows for compliance with the RO not in operation). For this analysis, no stabilization of RO permeate is envisioned, as the split stream treatment will result in sufficient hardness, alkalinity and pH in the blended recycled water.
  - Costs and system size can readily be adjusted **down** by simply removing the partial stream RO, resulting in no reduction of TDS and chloride.
  - Costs and system size can readily be adjusted **up** by simply doubling the RO capacity, resulting in 100 percent RO as part of a potable reuse system.
- Treatment Train B – This train entails the use of an MBR followed by chlorine disinfection. The existing chlorine contact basin would be used to achieve the CT required for non-potable reuse. 0.3 mgd of chlorinated effluent would be used for non-potable reuse, with the remainder going out the existing outfall.

- Treatment Train C – Secondary clarifier effluent would be further treated using a cloth filter and UV disinfection. The addition of primary or secondary DAF would not be needed for this train. 0.3 mgd of secondary effluent would be treated for non-potable reuse.

8.2.1 Regulations for Non-Potable Reuse

In California, recycled water is regulated by the State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW). Title 22 of the California Code of Regulations (CCR Title 22) establishes the treatment requirements for recycled water as well as the approved uses based on the level of treatment[1]. Title 22 defines four classifications of recycled water determined by the level of treatment provided, total coliform bacteria, and turbidity levels. The highest level of treatment for non-potable recycled water must comply with the requirements for "Disinfected Tertiary Recycled Water," which entails a water that is oxidized, coagulated, filtered, and disinfected according to the requirements summarized in Table 8.2[2].

Table 8.2 Non-Potable Unrestricted Use Recycled Water Treatment and Quality Standards for California

Category	Compliance Approach	Requirements
Filtration Requirements	Media Filters	< 2 NTU (average) and <10 NTU (maximum)
	Membrane Filters	< 0.2 NTU (average) and <0.5 NTU (maximum)
Disinfection Requirements	Chlorine Disinfection	CxT > 450 milligrams per minute per liter (mg-min/L); 90 minutes modal contact time at peak dry weather flow
	UV Disinfection	UV dose 50 mJ/cm^2 after RO; 80 mJ/cm^2 after MF/UF; or 100 mJ/cm^2 after media filter
	Alternative Disinfection	Demonstrate 5-log (i.e., 99.999 percent) virus inactivation
Bacterial Indicators	Daily Effluent Sampling	Total coliform: < 2.2/100 milliliters (mL) (7-day median) < 23/100 mL (not more than one sample exceeds this value in 30 days) < 240/100 mL (maximum)

8.2.2 Treatment Train Details and Design Criteria

For this project, the criteria for "Disinfected Tertiary Recycled Water" applies and will be met with a combination of UF, UV light disinfection and a side-stream RO system for TDS and chloride reduction.

[1] SWRCB October 2018. Regulations Related to Recycled Water. Title 17 and Tile 22 Code of Regulations.

[2] The requirements for oxidized and coagulated wastewater are non-quantitative. Oxidized wastewater is "wastewater in which the organic matter has been stabilized, is nonputrescible, and contains dissolved oxygen". Coagulated wastewater is "oxidized wastewater in which colloidal and finely divided suspended matter have been destabilized and agglomerated upstream from a filter by the addition of suitable floc-forming chemical".

The treatment requirements for "Disinfected Tertiary Recycled Water" are met as described in Table 8.3.

Table 8.3 Treatment Processes for NPR and Their Role in Meeting Regulatory Requirements

Process	Description
UF	• MF process. • Reduces turbidity in filtrate to meet the regulatory limits. • Provides reduction in total coliform bacteria
Partial Stream RO	• Removes TDS and chlorides.
UV Disinfection	• Provides required virus inactivation. • Further reduces total coliform bacteria below regulatory limits.

The NPR treatment train is shown in Figure 8.1 for both MBR and non-MBR options. The design criteria for each process are summarized in Appendix 8A.

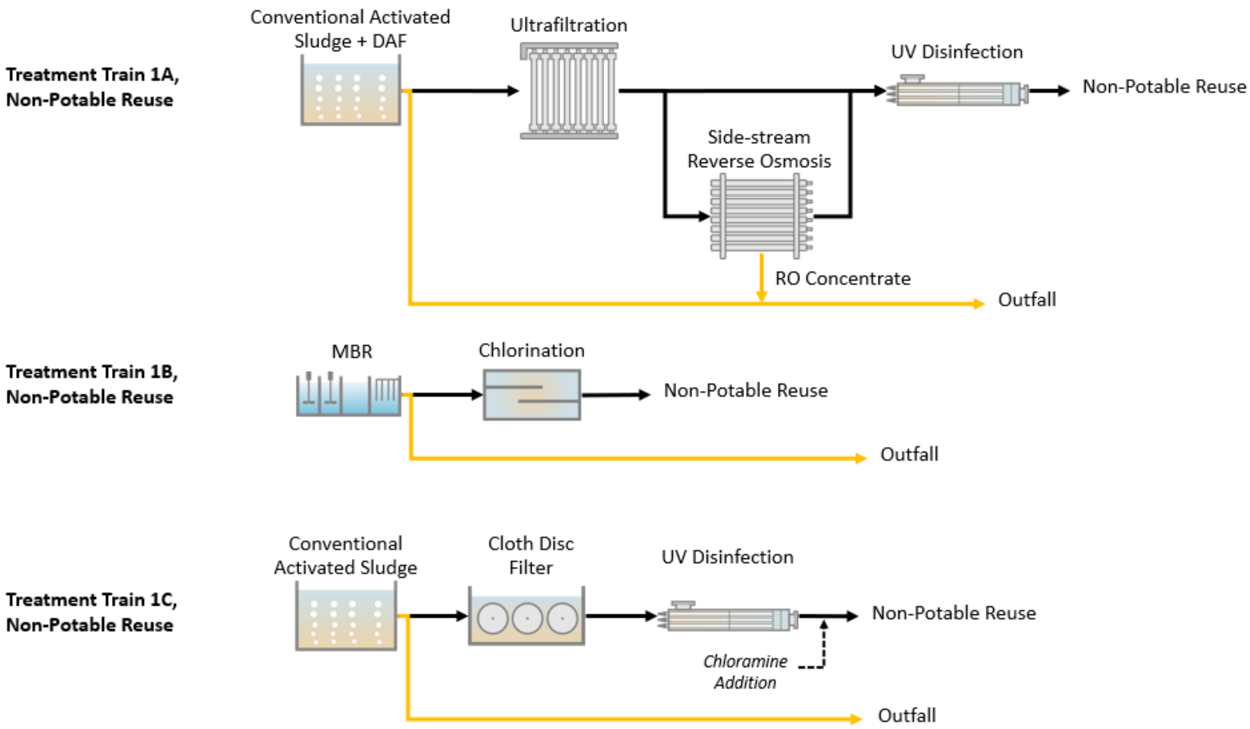


Figure 8.1 Non-Potable Water Reuse Treatment Trains (a) MBR and (b) no MBR

8.2.3 Treatment Train Layout and Footprint

A reuse facility is needed on the MSD site for Treatment Trains 1A and 1C, which have additional reuse-specific treatment. For Treatment Train 1B, either the greenfield or retrofit MBR would need to be implemented, and the existing chlorine contact basin would be used, so not additional reuse facility is needed.

An overall site plan with the location of the non-potable reuse facility is shown in Figure 8.2, with the layout for the non-potable reuse system shown in Figure 8.3 and Figure 8.4. The layout shown is for Treatment

Train 1A, which is the larger facility. A facility for train 1C would be significantly smaller. Should MSD want to create a second story on the reuse facility, it could be used for office and meeting space.

Figure 8.2 Overall Site Plan for NPR at MSD; the Facility is Sized for NPR with the Potential to Expand to IPR

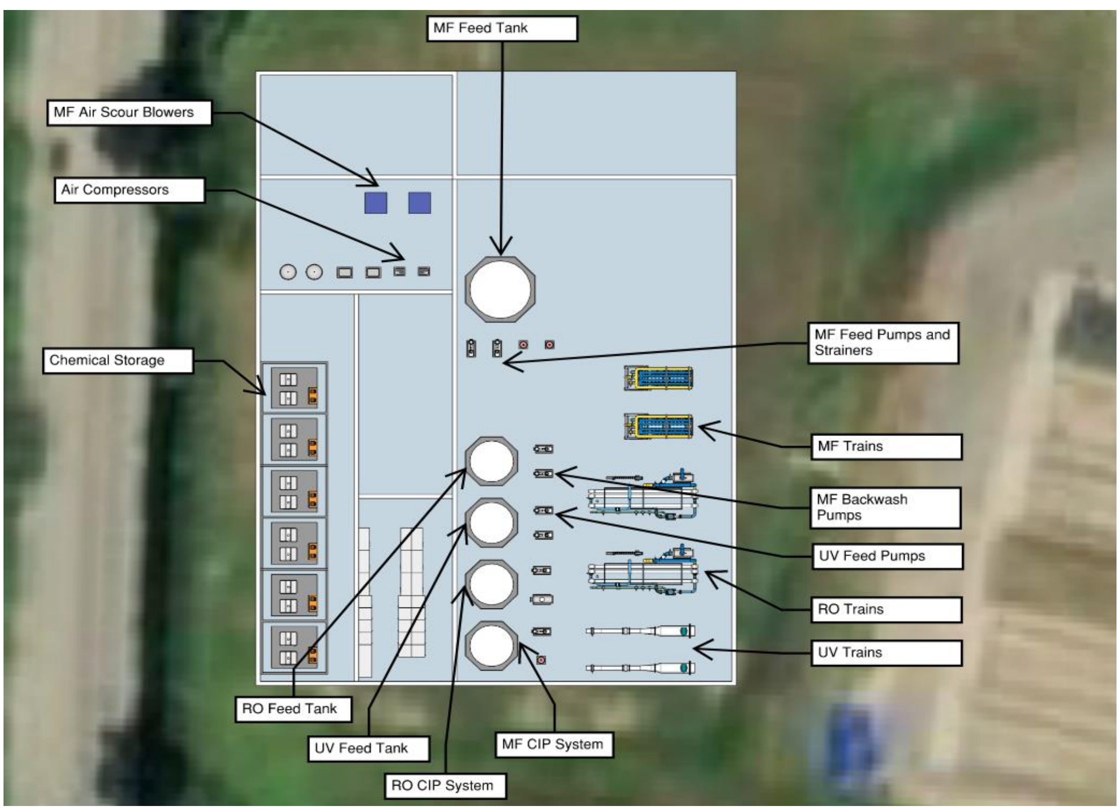


Figure 8.3 NPR System Layout at MSD

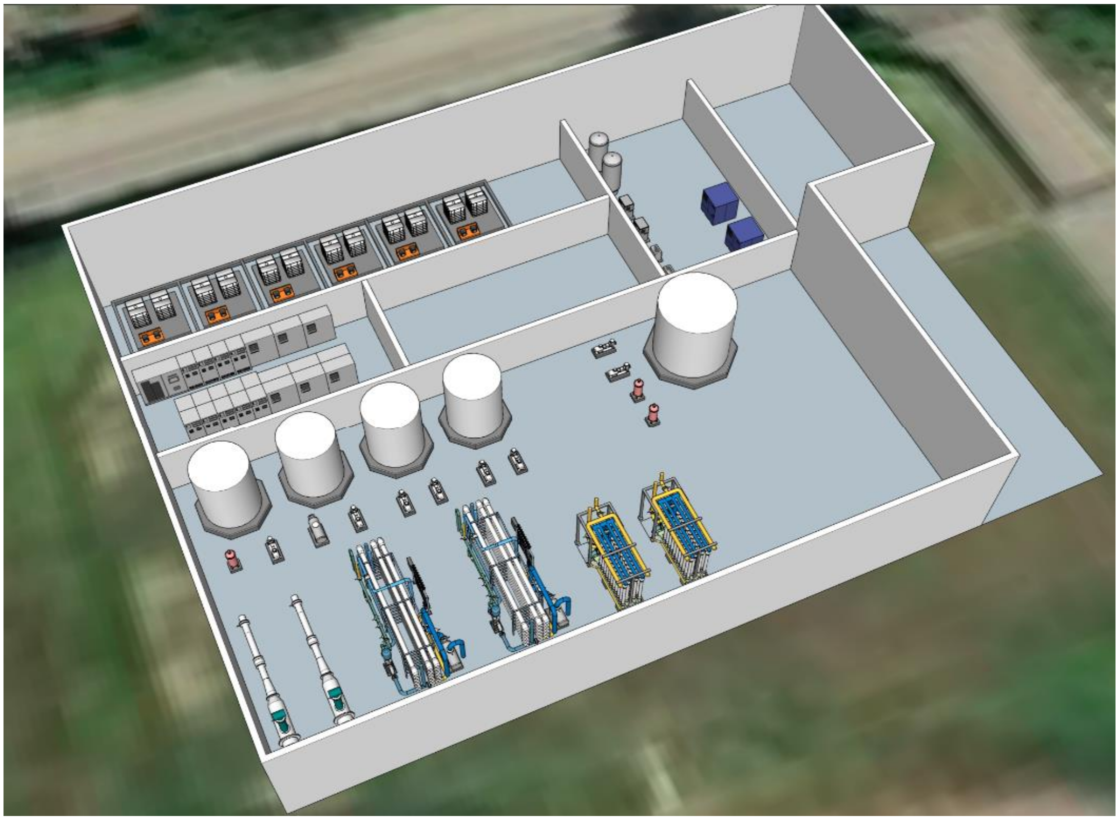


Figure 8.4 Isometric View of NPR Treatment Train Layout at MSD

The layout is for a non-MBR based wastewater effluent as described in Treatment Train 1A. The layout provided also includes space for an expansion to indirect potable reuse (i.e., the treatment train discussed in 8.3.2 below). The total area required for the advanced water purification facility (AWPF) building is 15,000 square feet (sf).

Flow to the recycled water treatment system will be equalized. For efficient MBR operation, that equalization would occur ahead of the MBR, as detailed in TM6. For options that do not include an MBR, equalization of secondary effluent would occur to allow for consistent capture and treatment of the average dry weather flow (ADWF). Post treatment, for NPR, another 100,000 gallons of storage is needed to allow for peak instantaneous demand for irrigation.

8.3 Indirect Potable Reuse

Two IPR treatment trains are evaluated here, as follows:

- Treatment Train 2A – Following MBR, treatment will include a full stream RO and UV AOP at the ADWF of 0.7 mgd, resulting in 0.56 mgd of new water.
- Treatment Train 2B – Using WRP effluent that has either primary DAF or secondary DAF, treatment will include a full stream UF, RO, and UV AOP at the ADWF of 0.7 mgd, resulting in 0.56 mgd of new water.
- Treatment Train 3 – A third IPR alternative is also considered, in which secondary effluent from MSD is sent to Carpinteria for treatment at their AWPF. This alternative does not have a layout defined

here because additional reuse treatment does not occur on the MSD site. This alternative would require upgrades to the wastewater treatment at MSD, via either the inclusion of DAF or replacement with MBR. It would also require equalization to provide a consistent flow of 0.7 mgd of secondary effluent.

Engineering analysis for Treatment Trains 2A and 2B includes stabilization of the purified water. Infrastructure (piping, pumping) for Trains 2 and 3 is detailed in a TM09.

8.3.1 Regulations for Indirect Potable Reuse

Regulations for IPR reuse via groundwater recharge are contained in CCR Title 22, Division 4, Chapter 3 (Water Recycling Criteria). Within Title 22, there are regulations for groundwater recharge via both surface spreading and subsurface application/direct injection. Some of the key requirements for IPR are as follows:

Source Control: IPR projects must use treated wastewater from a wastewater management agency that administers an industrial pretreatment and pollutant source control program (Pretreatment Program). The source control program must include several elements, including an assessment of the fate of site-specific chemicals through the wastewater and recycled water treatment systems, monitoring and investigation of chemical sources, and an outreach program to minimize discharge of chemicals into the source water. Because of the higher rigor (and cost) associated with a Pretreatment Program for potable water reuse, a more detailed approach is now implemented for potable water reuse projects, called the Enhanced Source Control Program (ESCP).

Pathogen Control: IPR treatment must provide 12-log reduction of enteric virus, 10-log reduction of *Giardia* cysts, and 10-log reduction of *Cryptosporidium* oocysts. In addition, there are requirements for how projects must verify that the treatment processes they are using can achieve the required levels of pathogen reduction. The pathogen reduction requirements are based on achieving a pathogen concentration in the treated water that meets an established risk threshold. This threshold is the same for drinking water, IPR, and DPR.

Treatment Train: For GWR via direct injection, which would be the case for an IPR project collaborating with Carpinteria, full advanced treatment (FAT) is required prior to injection. FAT requires all flow to go through both RO and an AOP that achieves 0.5-log reduction of 1,4-dioxane. While microfiltration or ultrafiltration are not required for FAT from a pure regulatory standpoint, the protozoa reduction of these membranes is important, as is their role in pretreatment ahead of RO. In addition to these requirements, all Cryptosporidium and Giardia reduction credit must be accomplished prior to injection. Virus credit is granted for retention time in the aquifer.

Chemical Control: All IPR projects must meet all current drinking water standards, including maximum contaminant levels (MCLs), disinfection byproducts (DBPs), and action levels (ALs). These constituents must be monitored quarterly. Constituents with secondary MCLs must be monitored annually. In addition, the regulations impose limits on total organic carbon (TOC) of wastewater origin, as a bulk mechanism to control chemical pollutants in the treated water. For groundwater rule (GWR) projects, no more than 0.5 mg/L of TOC from the recycled water may be present in the blended groundwater. Because these projects are required to provide FAT with RO that achieves an effluent TOC below 0.5 mg/L, diluent water is not required. The injected water is generally already in compliance with the maximum TOC requirement of 0.5 mg/L.

Environmental Buffer: Requirements for environmental buffers describe the minimum characteristics that these buffers must provide. Smaller environmental buffers (e.g., shorter groundwater travel time) provide less response time, treatment, and/or dilution, which results in an increase in advanced treatment requirements. A minimum aquifer retention time of 2 months is required. The retention time must be verified using a tracer study.

Additional Monitoring: Quarterly monitoring must be conducted for priority toxic pollutants, a list of site-specific unregulated chemicals to be determined in conjunction with the State Board, and constituents with notification levels (NLs). Monitoring must be conducted in recycled water and at downgradient groundwater monitoring wells.

8.3.2 Treatment Train Details and Design Criteria

In the treatment trains proposed here, the IPR regulations for GWR via direct injection are met using MF followed up full-stream RO and UV/AOP, i.e., full advanced treatment. Treatment Train 1 accomplishes membrane filtration via the use of MBR, while Treatment Train 2 has a standalone UF process upstream of the RO. These unit processes achieve the requirements for GWR as described in Table 8.4.

Table 8.4 Treatment Processes for IPR via Groundwater Recharge and Their Role in Meeting the Regulatory Requirements

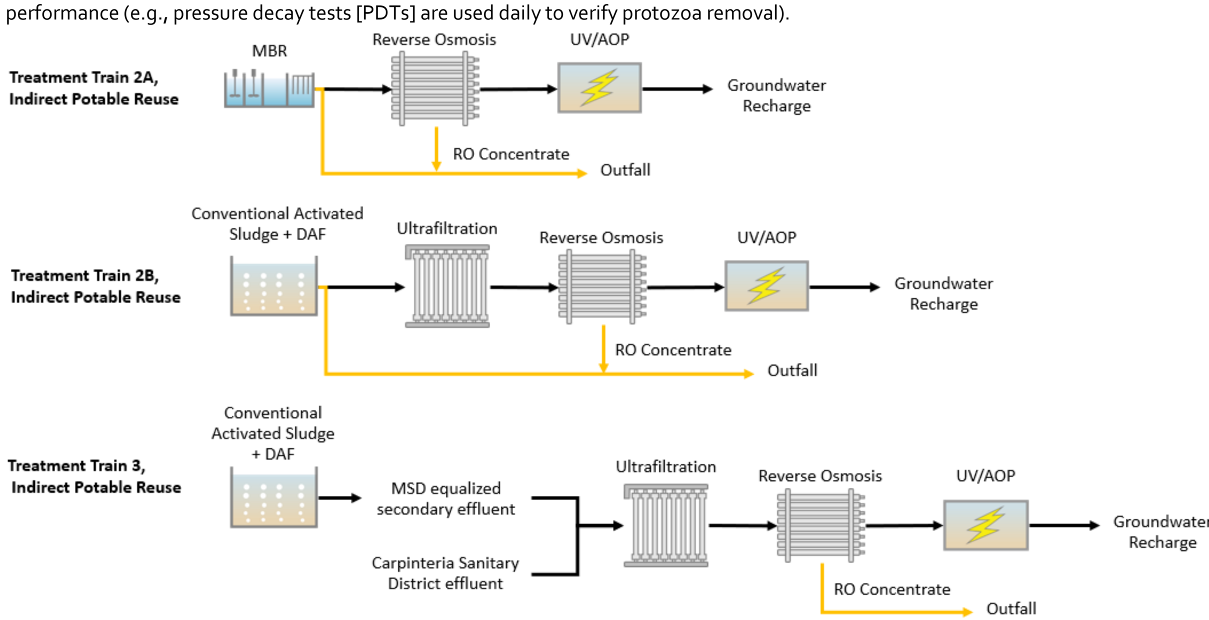
Process	Description
MBR or UF	• Reduces turbidity in filtrate to meet the following: – No more than 0.2 nephelometric turbidity units (NTU) more than 5 percent of the time within a 24-hour period. – No more than 0.5 NTU at any time. • Removes pathogens via size exclusion through membranes. • Provides necessary pretreatment upstream of RO and UV AOP similar to all existing California potable reuse plants.
RO	• Reduces total organic carbon to meet regulatory limit of 0.5 mg/L. • Reduces TDS. • Decreases level of all chemicals with high molecular weights, and uncharged chemicals with low molecular weights. • Removes pathogens via size exclusion. • Effectively removes many contaminants of emerging concern, including PFAS.
UV/AOP	• Combination disinfection and chemical oxidation process. • Provides pathogen disinfection. • Achieves oxidation requirement by providing no less than 0.5-log (69 percent) reduction of 1,4-dioxane. Providing this level of reduction also ensures that other unregulated chemicals are also reduced through this process. • Provides final chemical abatement, including for 1,4-dioxane and N-Nitrosodimethylamine (NDMA).

The pathogen log removals for each process are summarized and compared to the total required log removals in Table 8.5.

Table 8.5 Pathogen Log Removal Values (LRVs) per Process for the IPR Treatment Trains

Process	Pathogen Log Removals by Pathogen Category		
	Virus	*Giardia*	*Cryptosporidium*
Treatment Train 2A (MBR-Based)			
MBR(1)	1	2.5	2.5
RO(2)	2	2	2
UV AOP	6	6	6
Groundwater Basin	6(3)	0	0
Total	**15**	**10.5**	**10.5**
Required	**12**	**10**	**10**
Treatment Train 2B (WRP with DAF)			
WRP(4)	0+	0+	0+
UF(5)	0	4	4
RO(2)	2	2	2
UV AOP	6	6	6
Groundwater Basin	6(3)	0	0
Total	**14**	**12**	**12**
Required	**12**	**10**	**10**

Notes:
(1) MBR credits are based on Tier 1 approach from Water Research Foundation (WRF) 4997, *Membrane Bioreactor Validation Protocols for Water Reuse.*
(2) Can receive up to 1 log credit during permitting for electrical conductivity (EC) as a monitoring surrogate; 1.5 log credit for TOC, and 2 for strontium. An additional half log can typically be gained once the facility is operational.
(3) 1-log virus credit is granted for each month spent in the ground. If retention time shorter than 6 months is used the pathogen credits would be reduced accordingly.
(4) Pathogen removal through the wastewater treatment plant (WWTP) would need to be evaluated and confirmed through a 3 to 12 months study including evaluation of a broad range of pathogens and surrogates.
(5) UF systems can remove virus (2 to 4+ LRV) but currently are not credited due to the lack of a reliable surrogate to be used daily to verify performance (e.g., pressure decay tests [PDTs] are used daily to verify protozoa removal).



(6)

Figure 8.5 Indirect Potable Water Reuse Treatment Trains with (a) MBR and (b) no MBR

8.3.3 Treatment Train Layout and Footprint

The footprint of an IPR facility in Montecito is the same as that shown above for the NPR facility in Figure 8.2 and Figure 8.3, because that layout has been sized for potential expansion to IPR. For Treatment Train 3, additional footprint would be needed at Carpinteria's advanced water purification facility. Analysis of the additional footprint needed is not within the scope of this work and has not been conducted.

8.4 Direct Potable Reuse at MSD

Two DPR treatment trains are evaluated here; both serve to purify water ahead of addition to Montecito Water District's (MWD's) Bella Vista Water Treatment Plant (WTP), which is designated as raw water augmentation:

- Treatment Train 5 - Following MBR, treatment will include a full stream ozone, BAC, UF, RO and UV AOP at the ADWF. The second membrane filtration step is required to achieve the pathogen reduction targets. Additional monitoring systems and storage/dilution systems are included in this analysis. The DPR system will produce 0.56 mgd of new water.
- Treatment Train 6 - Using WRP effluent that has either primary DAF or secondary DAF, treatment will include a full stream ozone, BAC, UF, RO, and UV AOP at the ADWF. Additional monitoring systems and storage/dilution systems are included in this analysis. The DPR system will produce 0.56 mgd of new water.

Engineering analysis for both options includes stabilization of the purified water. Infrastructure (piping, pumping) for this option is detailed in TM9. Direct potable reuse with the City of Santa Barbara, which would require Santa Barbara to do the treatment and purification, is included in a subsequent section.

8.4.1 Regulations for Direct Potable Reuse

Regulations for DPR in California are not yet finalized but are well developed. Assembly Bill 574 was signed into law in October 2017 and requires that DDW develop raw water augmentation regulations by 2023. Since then, DDW has published a proposed framework and a second edition framework stating that they intend both raw and treated water augmentation to be regulated under one uniform regulation published in 2023 (SWRCB 2019). Most recently, DDW published Addendum version 8-17-2021 to A Framework for Direct Potable Reuse (SWRCB 2021), which provides the second draft of regulations as they might be housed within a new Article under the Surface Water Treatment chapter of Title 22 of the California Code of Regulations. The draft regulations contain extensive requirements for treatment, monitoring, source control, reporting, and more, as described further below.

There is currently one operating DPR system in the country, in Big Spring, Texas. There are no DPR systems in California, and any DPR project proposed will be on the leading edge and will need to work closely with DDW. It is important to note that a small DPR project will face additional challenges in terms of demonstrating sufficient technical, managerial, and financial capacity to successfully build and operate a DPR project without existing precedents.

Enhanced Source Control: An enhanced source control program must be implemented by the wastewater management agency to limit contaminants in wastewater used in DPR projects. The source control program has several required elements, including investigation and monitoring of State Board-specified chemicals and contaminants and an outreach program to industrial, commercial, and residential dischargers within the service area contributing to the DPR project. In addition, a sewershed surveillance program must be implemented to provide early warning of a potential occurrence that could adversely impact the DPR treatment. It must include online monitoring that may indicate a chemical peak resulting from an illicit discharge, coordination with the pretreatment program for notification of discharges above allowable limits, and monitoring of local surveillance programs to determine when community outbreaks of disease occur.

Feed Water Monitoring: Prior to operation, the feed water to a DPR project must be monitored monthly for a minimum of 24 months for regulated contaminants (i.e., those with an MCL), priority pollutants, NLs, a specific list of solvents, DBPs, and DBP precursors.

Pathogen Control: Treatment and monitoring systems must be designed and validated to attain 20, 14, and 15-log reduction credit for virus, Giardia, and Cryptosporidium, respectively. The treatment train must consist of at least four separate treatment processes for each pathogen type (a single process can receive credit for multiple pathogens), and each credited process must demonstrate at least 1-log reduction of the target pathogen. For each treatment process that is proposed to receive pathogen reduction credit, a validation study must be conducted and a report of the results must be submitted to the State Board. The regulations contain specific requirements for what must be provided in the validation study to verify the proposed pathogen credit and the proposed online surrogate monitoring for ongoing demonstration of process performance.

Treatment Train: In addition to RO and an advanced oxidation process, as required for IPR, the treatment train for DPR must include ozone/BAC ahead of RO[3]. It must also include UV disinfection with a dose of at least 300 mJ/cm^2. The system must be designed to meet certain response time requirements to ensure that diversion and/or shutoff can occur in the event of a failure to meet the pathogen and/or chemical control requirements.

Chemical Control: DPR systems must meet several requirements for chemical control.

- Finished water must meet all current drinking water standards, including MCLs, DBPs, and ALs. Monthly monitoring in the product water is required.
- The TOC shall not exceed 0.5 mg/L prior to distribution.
- Nitrate and nitrite must be continuously monitored in the RO permeate. Continuous monitoring of lead and/or perchlorate may also be required if the required weekly grab samples indicate that it is justified. The control system must be designed to automatically divert purified water if there is an exceedance of the TOC limit, the nitrate MCL, and potentially levels for perchlorate and lead.
- In order to address a potential chemical peak, the system must provide sufficient mixing at some point prior to distribution to attenuate a one-hour elevated concentration of a contaminant by a factor of ten. This dilution can occur at any point in the treatment and distribution process before the water is consumed. Examples include:
  - Blending within a WWTP, such as occurs with return activated sludge recycle streams.
  - Blending in an equalization basin, such as primary equalization or secondary effluent equalization.
  - Blending within a distribution system, such as blending within a water storage reservoir before distribution to customers.
- DBP formation must be evaluated by characterizing chemicals to evaluate precursors, byproduct production, and options to minimize DBP formation.

---

[3] The latest version of the draft regulations has included a provision that allows for a treatment train without ozone/BAC, provided that the purified water comprises 10 percent or less of total water supplied on a continuous basis. Partial ozone/BAC treatment is allowable if purified water will comprise up to 50 percent of the total water supplies. For example, if the purified water were going to make up 25 percent of the water supplied, then approximately 75 percent of the purified water would need to be treated through ozone/BAC.

Additional Monitoring: Extensive chemical monitoring is required on an ongoing basis in the feed water to the DPR project, the effluent from the advanced oxidation process, and the finished water prior to entering distribution[4]. In each location, monthly sampling is required for all MCLs, secondary MCLs, NLs, priority toxic pollutants, alert levels, DBPs and DBP precursors, and specified solvents. Weekly sampling is required for nitrate, nitrite, perchlorate, and lead. In addition, quarterly sampling is required for chemicals known to cause cancer or reproductive issues for at least three years.

Operations: The draft DPR regulations contain new requirements for advanced water treatment operators (AWTOs). The AWTO certification goes from grade 3 to grade 5. In order to obtain AWTO certification, a grade 3 water or wastewater treatment operator certification is needed[5]. There must be one chief and one shift operator that are AWTO grade 5 certified. An AWTO grade 5 must be present on site at all times[6]. All operators at the advanced treatment facility must be AWTO certified (can be at any grade).

8.4.2 Bella Vista Water Treatment Plant

The role of Bella Vista Water Treatment Plant is different for the two Montecito DPR alternatives. In Treatment Train A, purified recycled water would be blended with the finished water from the WTP, increasing the overall production from the location. In this option, additional virus credits would be needed by free chlorination as part of reclaimed water purification, which is shown below in Table 8.7.

For Treatment Train B, the treatment credits at the Bella Vista WTP are necessary to meet the draft DPR requirements; therefore in this alternative, the purified water would be blended upstream of the WTP. Recent work conducted for WRF Project 5049, *Benefits and Challenges in Pathogen Removal when Blending Advanced Treatment Water with Raw Water upstream of a Surface Water Treatment Plant in DPR*, has provided insights into the potential impacts of blending advanced treated water (ATW) upstream of the Bella Vista WTP. The project conducted bench and pilot testing on blends of ATW and conventional surface water to characterize potential impacts on WTP performance. Although the study found that the effects of blending are site specific, and treatment specific, there are some general takeaways that are relevant for a future DPR project at Bella Vista WTP.

In general, for RO-based DPR treatment trains, blending ATW with conventional surface water resulted in lower TOC, turbidity, and alkalinity in the WTP feedwater. The reduction in TOC generally also resulted in a reduced coagulant dose needed for charge neutralization. ATW contributions of up to 50 percent of the feed water did not add challenges to coagulation, flocculation, sedimentation, and filtration processes in terms of turbidity and TOC removal. In some cases, a benefit was observed in terms of the performance of these processes. In addition, blending with ATW reduced chlorine demand in the filtered water, but did not show a significant impact on DBP formation.

---

[4] DDW may allow for the finished water sampling location to be used to satisfy the requirement for the post-oxidation sampling point.
[5] Obtaining AWT Grade 3 certification requires passing an exam; higher levels of certification require increasing levels of experience operating advanced treatment processes. See https://www.awtoperator.org/awto-certification/ for additional information.
[6] The latest version of the draft regulations does allow for some degree of remote operations. A project must submit an operations plan that demonstrates an equivalent degree of operational oversight and reliability with either unmanned operation or operation under reduced operator oversight. The chief or shift operator must still be able to monitor operations and exert physical control over the treatment facility within a maximum of one hour.

Blends greater than 50 percent ATW were not tested in this WRF study. For a DPR project at Bella Vista WTP, the ATW flow would be 0.56 mgd, or about 388 gallons per minute (gpm). Based on available flow data, there are times during periods of lower demand where 0.56 mgd would represent more than 50 percent of the source water to Bella Vista WTP. Additional pilot testing is recommended to further characterize the impacts of blending at higher proportions of ATW on the water treatment processes.

8.4.3 Treatment Train Details and Design Criteria

The treatment trains proposed here have been selected to meet the draft DPR regulations. The unit processes and their associated role in meeting these requirements are described in Table 8.6. The treatment train process flow diagram is shown in Figure 8.6.

Table 8.6 Treatment Processes Used for DPR and Their Role in Meeting Regulatory Requirements

Process	Description
Ozone	• Provides pathogen disinfection. • Facilitates biological treatment by breaking down organic carbon for removal by the downstream biological filters. • Reduces concentrations of some chemicals and metals, such as iron and manganese, through chemical oxidation, thereby: – Decreasing toxicity of product water and potentially RO concentration. – Providing effective pretreatment of water upstream of membranes thereby reducing fouling potential and required level of chloramines.
BAC Filtration	• Biological filtration process. • Removes organic carbon, made more bioavailable by the upstream ozone process. • Decreases level of some chemicals, including NDMA. • Reduces turbidity. • Can provide some nitrification
UF	• Same as IPR; see Table 8.4.
RO	• Same as IPR; see Table 8.4.
UV/AOP	• Same as IPR; see Table 8.4.
Chlorination	• Provides pathogen disinfection.
Stabilization (calcite contactors)	• Provides corrosion control. • Required for water treated by RO.
Blending	• Meets draft DPR blending requirement to reduce a one-hour chemical spike by a factor of 10. • Provides response time if a monitoring alarm were to signal an issue in the upstream treatment.

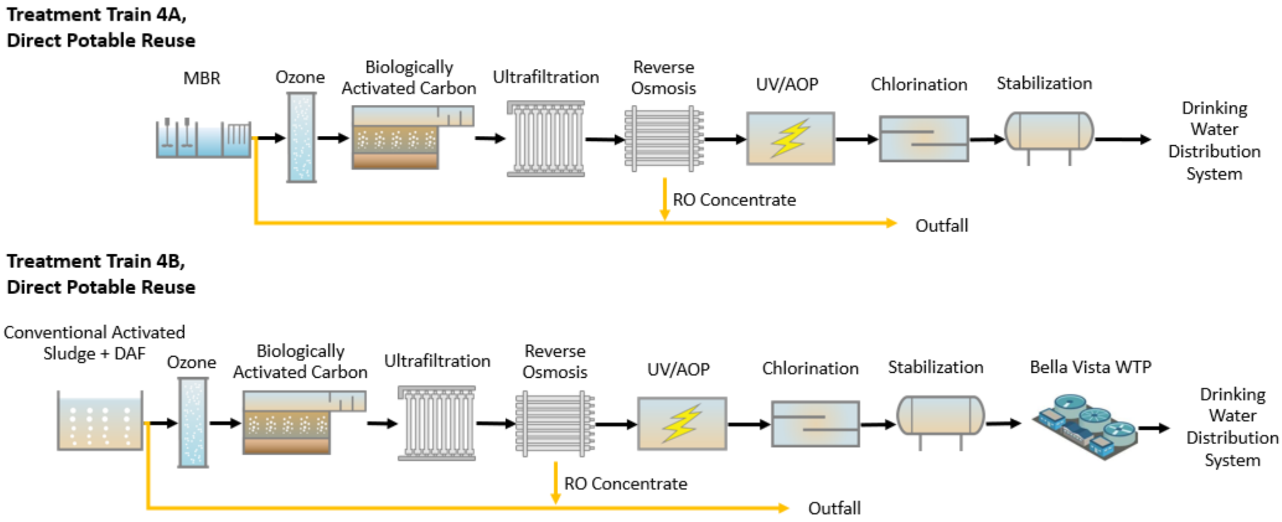


Figure 8.6 Direct Potable Water Reuse Treatment Trains with (a) MBR and (b) no MBR

Table 8.7 Pathogen LRVs per Process for DPR Treatment Trains at MSD

Process	Pathogen Log Removals by Pathogen Category		
	Virus	*Giardia*	*Cryptosporidium*
Treatment Train 4A (MBR-Based)			
MBR(1)	1	2.5	2.5
Ozone/BAC(2)	6	6	1
UF(3)	0	4	4
RO(4)	2	2	2
UV AOP	6	6	6
Chlorination(5)	6	0	0
Total	**21**	**20.5**	**15.5**
Required	**20**	**14**	**15**
Treatment Train 4B (WRP with DAF)			
WRP(6)	0+	0+	0+
Ozone/BAC(2)	6	6	1
UF(3)	0	4	4
RO(4)	2+	2	2
UV AOP	6	6	6
Chlorination(5)	2	0	0
Bella Vista WTP	4	3	2
Total	**20**	**21**	**15**
Required	**20**	**14**	**15**

Notes:
(1) MBR credits are based on Tier 1 approach from WRF 4997, *Membrane Bioreactor Validation Protocols for Water Reuse*.
(2) Based on United States Environmental Protection Agency protocols with a contact time of 6.24 mg-min/L, the project will result in the credits assigned to Pure Water San Diego, shown here.
(3) UF systems can remove virus (2 to 4+ LRV) but currently are not credited due to the lack of a reliable surrogate to be used daily to verify performance (e.g., PDTs are used daily to verify protozoa removal).
(4) Can receive up to 1 log credit during permitting for EC as a monitoring surrogate; 1.5 log credit for TOC, and 2 for strontium. An additional half log can typically be gained once the facility is operational.
(5) Chlorination credits based upon the Australian WaterVal analysis, which has been approved by the State of California for up to 6 log reduction of virus.
(6) Pathogen removal through the WWTP would need to be evaluated and confirmed through a 3 to 12 months study including evaluation of a broad range of pathogens and surrogates.

8.4.4 Treatment Train Layout and Footprint

The overall site plan for the AWPF is shown in Figure 8.7, which includes the location of the future AWPF as well as the use of an existing aeration basin to achieve the required 10:1 dilution of a one-hour chemical peak. The layout for the DPR treatment train at MSD is shown in Figure 8.8 and Figure 8.9. The total area required for the AWPF building is 15,000 sf.

Figure 8.7 Overall Site Plan for DPR at MSD. Site plan assumes the use of retrofit MBR for Treatment Train 4A.

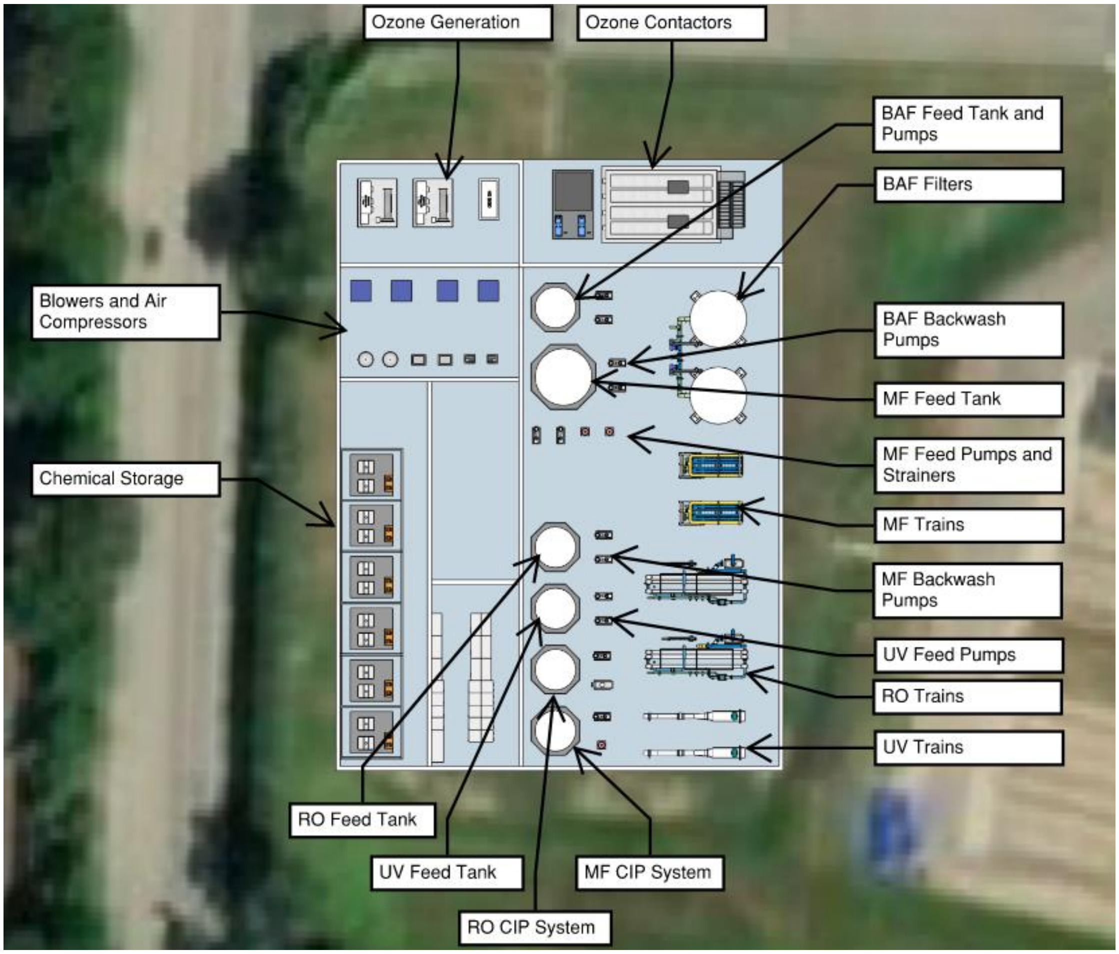


Figure 8.8 DPR Treatment Train Layout at MSD

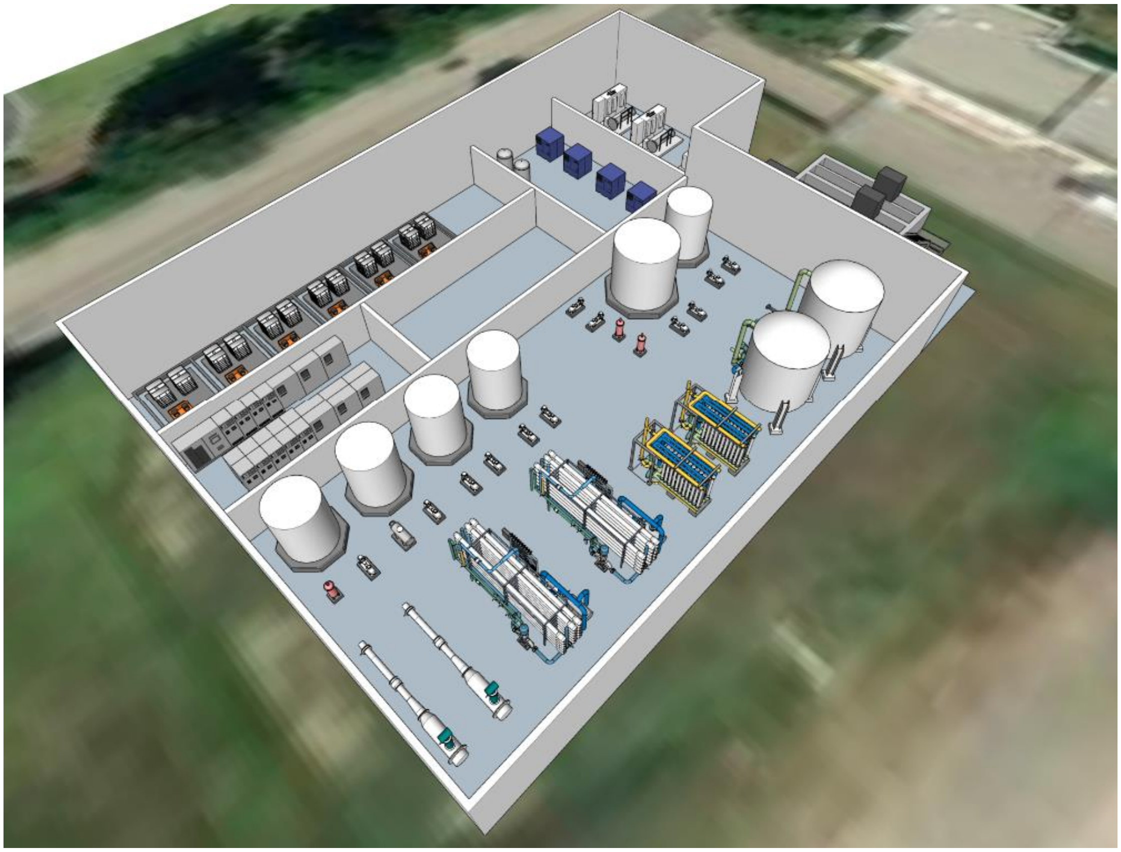


Figure 8.9 Isometric View of DPR Treatment Train at MSD

8.5 Direct Potable Reuse at Santa Barbara

One DPR treatment train is evaluated for Santa Barbara here, serving to purify water ahead of addition to Santa Barbara's Cater WTP, which is designated as raw water augmentation:

- Treatment Train 5 – Using WRP effluent that has either primary DAF or secondary DAF, treatment will include a full stream ozone, BAC, UF, RO, and UV AOP at the ADWF. Additional monitoring systems and storage/dilution systems are included in this analysis.

For Treatment Train 5, two different treatment capacities are to be used, as follows:

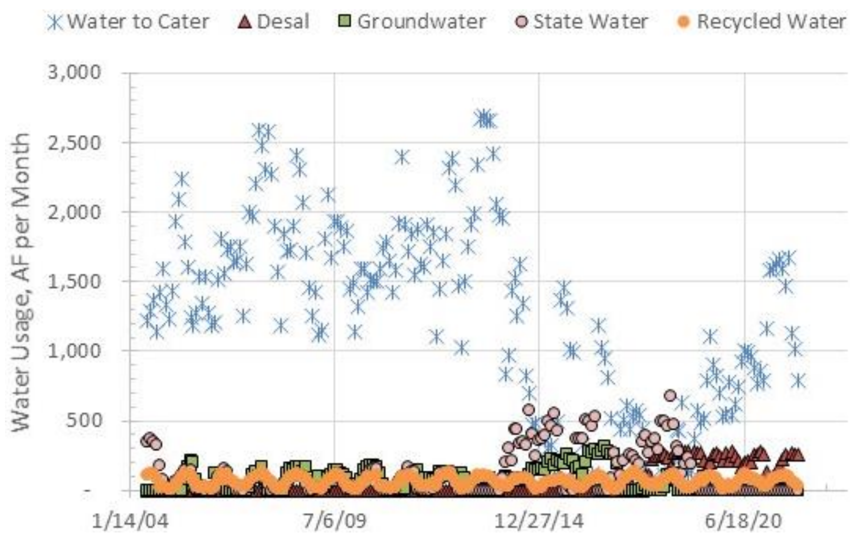
- Treatment Train 5A: Production Rate 6.2 mgd – This production rate is based on the maximum feed flow rate that could be accomplished through equalization of the combined MSD and El Estero ADWFs. From TM1, the anticipated maximum ADWF from MSD is 0.7 mgd. From TM2, the average monthly influent flow to El Estero is 6.96 mgd. For this analysis, a feed flow to advanced purification is assumed to be 7.7 mgd. This scenario represents the maximum purified water that could be produced using wastewater from MSD and El Estero; an alternate use of potable water would need to be identified during the wet season when purified water production would exceed potable water demands.
- Treatment Train 5B: Production Rate 3.7 mgd – The low-end production rate is based on the wet season potable water use (average monthly use, November through February) minus the amount of water produced by desal (which, looking to the future and according to the City of Santa Barbara,

would be 5,000 AFY). The result from the analysis below is 4,120 acre-feet per year (AFY) of purified water production, which is 3.7 mgd. Details are as follows:

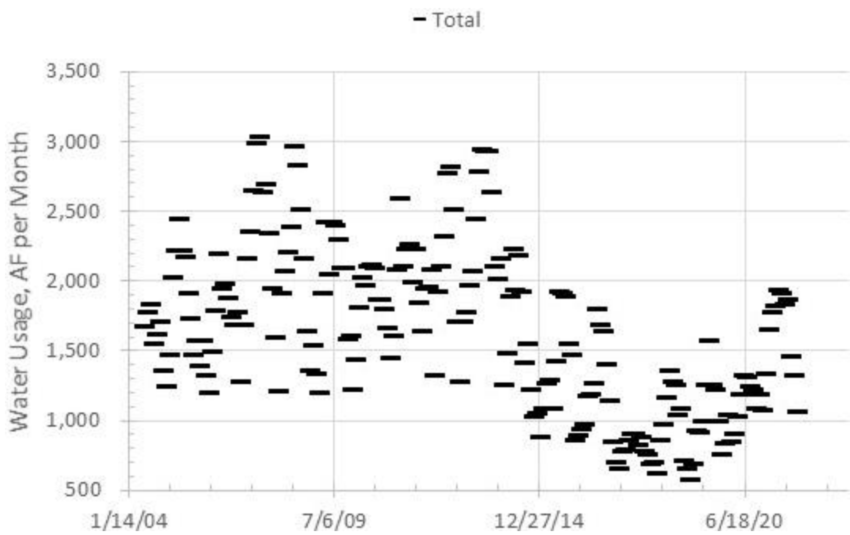
- Monthly water use data provided by the City of Santa Barbara, from 2004 to 2021 was examined.
- This data set includes water to Cater ("Cachuma", "Cachuma Overlap", "Gibralter", "Devil's Canyon", and "Mission Tunnel"), water from Groundwater, water from State Water, and Recycled Water (see the figure below).
- The data shows a significant reduction in water usage toward the end of 2014, with relatively consistent usage from 2014 to 2021.
- Examining the total usage since 2015, the graph below shows an average monthly usage fluctuating over the wet season between ~500 acre-feet (AF) to ~2,000 AF.
- In total, the wet season data suggests:
  - From 2004 to 2014: Average Monthly Usage: 1,579 AF.
  - From 2015 to 2021: Average Monthly Usage: 760 AF.
  - From 2004 to 2021: Average Monthly Usage: 1,257 AF.
- In conclusion, for this analysis, the annual low-end production for AWPF utilizes the data from 2015 to 2021, with an average wet season monthly usage of 760 AF minus desalination flows.
  - (760 X 12) – 5,000 = 4,120 AF/YR of DPR purified water production.

Engineering analysis includes stabilization of the purified water. Infrastructure (piping, pumping) for this option is detailed in a subsequent task.

(a)



(b)



(c)

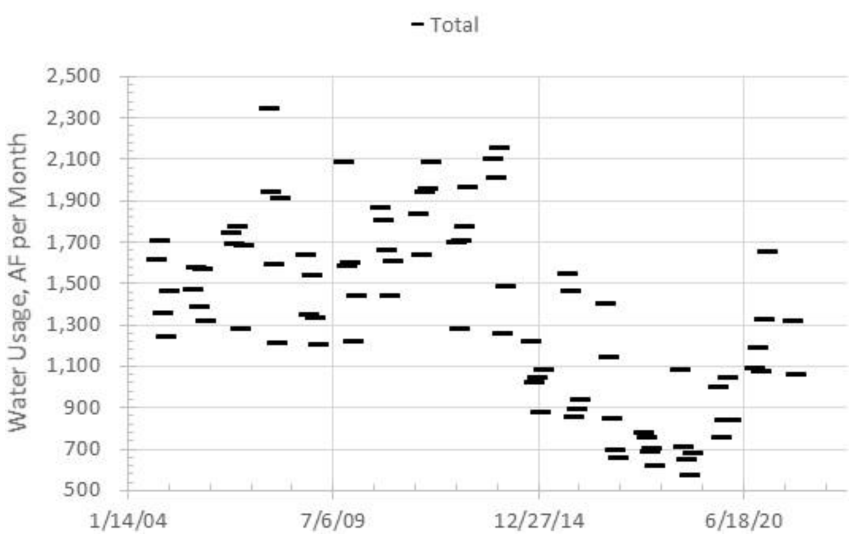


Figure 8.10 Monthly Water Supplies in Santa Barbara (a) All Data, (b) Totals for All Data, (c) Totals for November through March Only

8.5.1 Cater WTP

The general impacts of purified water on conventional water treatment processes were discussed previously in Section 8.4.2 . In the two scenarios identified for raw water augmentation to Cater WTP, the DPR source water could make up 100 percent of the supply to Cater WTP at certain times during the year. We would expect significant impacts to a conventional WTP with a 100 percent purified water feed; the ability of the plant to receive its existing credits could be impacted. Additional pilot work would be needed to characterize the treatability and impacts of this configuration on the conventional surface water treatment.

8.5.2 Treatment Train Details and Design Criteria

The treatment processes for this option are the same as those used for the Montecito DPR option discussed above in Table 8.6 and shown in Figure 8.6(b). The pathogen credits that would be sought for each treatment process compared to the requirements are summarized in Table 8.8.

Table 8.8 Pathogen LRVs per Process for DPR at Santa Barbara

Process	Pathogen Log Removals by Pathogen Category		
	Virus	*Giardia*	*Cryptosporidium*
Treatment Train 5 (WRP)			
WRP(6)	0+	0+	0+
Ozone/BAC(2)	6	6	1
UF(3)	0	4	4
RO(4)	2+	2+	2+
UV AOP	6	6	6
Chlorination(5)	2+	0	0
Cater WTP	4	3	2
Total	**20+**	**21+**	**15+**
Required	**20**	**14**	**15**

Notes:
(1) MBR credits are based on Tier 1 approach from WRF 4997, *Membrane Bioreactor Validation Protocols for Water Reuse*.
(2) Based on United States Environmental Protection Agency protocols with a contact time of 6.24 mg-min/L, the project will result in the credits assigned to Pure Water San Diego, shown here.
(3) Ultrafiltration systems can remove virus (2 to 4+ LRV) but currently are not credited due to the lack of a reliable surrogate to be used daily to verify performance (e.g., PDTs are used daily to verify protozoa removal).
(4) Can receive up to 1 log credit during permitting for EC as a monitoring surrogate; 1.5 log credit for TOC, and 2 for strontium. An additional half log can typically be gained once the facility is operational.
(5) Chlorination credits based upon the Australian WaterVal analysis, which has been approved by the State of California for up to 6 log reduction of virus. The low LRV shown here is representative of a relative contact time (Value 9 mg-min/L, based upon a t10 contact time of 6 minutes, and a minimum wastewater temperature of 15 degrees Celsius, and a pH of <8.5). Sampling for pH and temperature could allow for lower contact time values to meet the target credits. Higher residuals could also be applied to result in increased pathogen credits.
(6) Pathogen removal through the WWTP would need to be evaluated and confirmed through a 3 to 12 months study including evaluation of a broad range of pathogens and surrogates.

8.5.3 Treatment Train Layout and Footprint

The treatment train layout for DPR at Santa Barbara for treatment train 7a, i.e., a purified water production of 6.2 mgd, is shown in Figure 8.11 and Figure 8.12. The site used was the City of Santa Barbara's Corporation Yard, which was identified as a location for potable reuse in Santa Barbara's 2017 Potable Reuse Feasibility Study. It was assumed that the full site would be available for use for potable reuse. For the smaller DPR option with a production rate of 3.7 mgd, the layout would be smaller than what is shown here.

These layouts do not include storage tanks to achieve the 10:1 required dilution of a one-hour chemical peak; for this analysis, it is assumed that the dilution would be achieved in Lauro Canyon Reservoir upstream of Cater WTP. The reservoir has a capacity of 640 AF (208 million gallons [MG]), which would be sufficient to achieve 10:1 dilution of a one hour flow in the 6.2 mgd production scenario (260,000 gallons per hour [gph]).

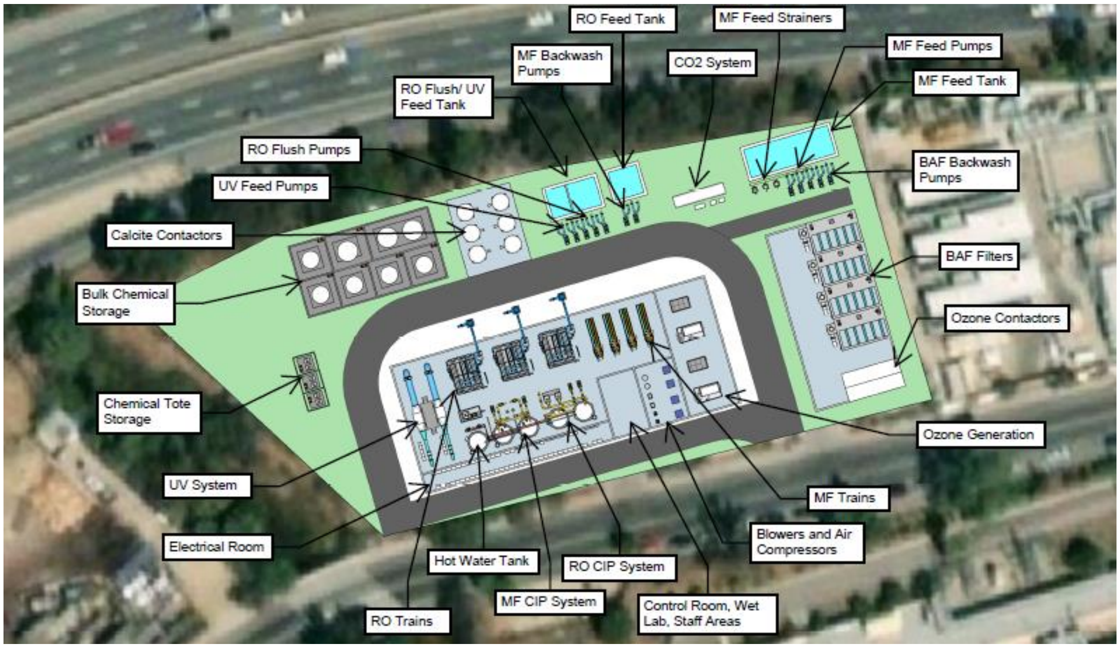


Figure 8.11 DPR Treatment Train Layout in Santa Barbara

Figure 8.12 Isometric View of DPR Treatment Train in Santa Barbara

8.6 Treatment Train Costs

8.6.1 Planning Level Cost Estimate

The Association for the Advancement of Cost Engineering International (AACE) has suggested levels of accuracy for five estimate classes. These five estimate classes are presented in the AACE International Recommended Practice No. 18R-97 (Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries). Table 8.9 presents a summary of these five estimate classes and their characteristics, including expected accuracy ranges (AACE, 2020).

Table 8.9 Classes of Cost Estimates

Estimate Class	Maturity Level of Project Definition Deliverables(1)	End Usage(2)	Methodology(3)	Expected Accuracy Range(4)
Class 5	0 percent to 2 percent	Concept Screening	Capacity factored, parametric models, judgement, or analogy	L: -20 percent to -50 percent H: +30 percent to +100 percent
Class 4	1 percent to 15 percent	Study or Feasibility	Equipment factored or parametric models	L: -15 percent to -30 percent H: +20 percent to +50 percent
Class 3	10 percent to 40 percent	Budget, Authorization, or Control	Semi-detailed unit costs with assembly level line items	L: -10 percent to -20 percent H: +10 percent to +30 percent
Class 2	30 percent to 75 percent	Control or Bid/Tender	Detailed unit cost with forced detailed take-off	L: -5 percent to -15 percent H: +5 percent to +20 percent
Class 1	65 percent to 100 percent	Check Estimate or Bid/Tender	Detailed unit cost with detailed take-off	L: -3 percent to -10 percent H: +3 percent to +15 percent

Notes:
(1) Expressed as percent of complete definition.
(2) Typical purpose of estimate.
(3) Typical estimating method.
(4) Typical variation in low and high ranges at an 80 percent confidence interval.

The quantity and quality of the information required to prepare an estimate depends on the end use for that estimate. Typically, as a project progresses from the conceptual phase to the study phase, preliminary design and final design, the quantity and quality of information increases, thereby providing data for development of a progressively more accurate cost estimate. A contingency is often used to compensate for lack of detailed engineering data, oversights, anticipated changes, and imperfection in the estimating methods used. As the quantity and quality of data becomes better, smaller contingency allowances are typically utilized. For this project, cost estimates are developed following the AACE International Recommended Practice No. 18R-97 estimate classes 5 and 4.

8.6.2 Capital and Operations and Maintenance Cost Basis

Capital costs are based on vendor quotes and similar facilities with allowances for civil, mechanical, structural, and electrical improvements, as well as engineering cost.

Construction costs presented typically include an estimating contingency, sales tax, general conditions, and contractor's overhead and profit. The percentages assumed for these factors are shown in Table 8.10.

Total project costs presented typically include a fee for engineering, legal, and administration, as well as an owners reserve for change orders. The percentages assumed for these factors are also shown in Table 8.10.

Table 8.10 Basis for Estimating Capital Costs

Item	Estimated Cost	Estimated Cost of "A"
Equipment / Infrastructure Cost Total	**"A"**	**100 percent**
Sales Tax	8 percent of 1/2 "A"	4 percent
Estimating Contingency(1)	30 percent	31 percent
General Conditions(1)	12 percent	16 percent
Contractor Overhead and Profit(1)	12 percent	18 percent
Bonds and Insurance(1)	2.5 percent	4 percent
Construction Cost Total	**"B"**	**174 percent**
Engineering, Legal, and Administrative	20 percent of "B"	35 percent
Owner's Reserve for Change Orders	5 percent of "B"	9 percent
Project Cost Total	**"C"**	**217 percent**

Notes:
(1) The construction cost elements are applied sequentially, e.g., the sales tax is calculated and added on to the equipment cost, then the estimating contingency is 30 percent of the sum of equipment cost and sales tax.

Operations and maintenance (O&M) costs were developed for the proposed AWPF facility. These O&M costs include power consumption, chemical consumption, maintenance, and staffing. The staffing costs were developed using the results of a Carollo Engineers (Carollo) survey of IPR operations, with extrapolation to DPR requirements. For DPR, the staffing costs assume that 3 AWTO Grade 5 operators will be needed to provide full staff for 12 hours/day and skeletal staff for 12 hours/day, with an AWTO Grade 5 operator on call at all times. Staffing costs for both IPR and DPR also include regulatory and compliance staff, as well as new lab staff to supplement existing lab staff, which would encompass costs associated with regulatory compliance (e.g., preparing plans, water quality sampling).

8.6.3 Cost Estimates

The costs for reuse treatment and annual reuse treatment O&M for each treatment train are summarized in Table 8.11. These costs are just for the reuse treatment component, and do not include upgrades to the wastewater treatment plant (i.e. MBR or addition of DAF, covered in TM6), conveyance (covered in TM9), wastewater re-treatment, or treatment at a water treatment plant. Montecito-specific costs are also included; these are only different for certain regional projects and are calculated based on Montecito's proportional share of the total purified water production.

Table 8.11 Summary of Treatment and O&M Costs for Each Treatment Train

	Use	Project Partners	Project Size (AFY)	Water Supply Benefit for Montecito (AFY)	Total Reuse Treatment Cost	Total Annual Reuse O&M Cost	Montecito Reuse Treatment Cost	Montecito Reuse O&M Cost
1A	NPR	Montecito Only	128	128	$9,100,000	$945,000	$9,100,000	$945,000
1B	NPR	Montecito Only	128	128	$0	$330,000	$0	$330,000
1C	NPR	Montecito Only	128	128	$5,770,000	$369,000	$5,770,000	$369,000
2A	IPR	Montecito and Carpinteria	560	560	$12,980,000	$1,971,000	$12,980,000	$1,971,000
2B	IPR	Montecito and Carpinteria	560	560	$16,890,000	$2,002,000	$16,890,000	$2,002,000
3	IPR	Montecito and Carpinteria	1,792	560	$69,500,000	$2,484,000	$19,544,000[1]	$699,000[1]
4A	DPR	Montecito Only	560	560	$25,360,000	$3,957,000	$25,360,000	$3,957,000
4B	DPR	Montecito Only	560	560	$25,360,000	$3,957,000	$25,360,000	$3,957,000
5A	DPR	Montecito and Santa Barbara	6,945	560	$112,810,000	$7,065,000	$9,096,000[1]	$570,000[1]
5B	DPR	Montecito and Santa Barbara	4,145	560	$76,310,000	$6,003,000	$10,311,000[1]	$811,000[1]

Notes:
(1) Montecito portion of cost calculated based on proportional share of total purified water production.

-This Page Intentionally Left Blank-

Appendix 8A

TREATMENT TRAIN DESIGN CRITERIA

Treatment train design criteria are summarized below for three of the potable reuse options. The criteria shown are applicable to the other treatment alternatives as follows:

Table 8A.1 Summary of Design Criteria Provided for Potable Reuse Alternatives

Reuse Type	Treatment Train	Wastewater Treatment	Advanced Treatment	Finished Water Flow	Design Criteria
NPR	1	MBR	Partial RO – UV	0.6 mgd	RO and UV criteria same as for TT2
	2	Conventional activated sludge + DAF[1]	UF - Partial RO - UV	0.6 mgd	Provided in Tables A.2 – A.6
IPR	3	MBR	RO – UV/AOP	0.56 mgd	RO and UV/AOP criteria same as for TT6
	4	Conventional activated sludge + DAF[1]	UF – RO – UV/AOP	0.56 mgd	UF, RO and UV/AOP criteria same as for TT6
DPR at MSD	5	MBR	Ozone/BAC – UF – RO – UV/AOP	0.56 mgd	Same as for TT6
	6	Conventional activated sludge + DAF[1]	Ozone/BAC – UF – RO – UV/AOP	0.56 mgd	Provided in Tables A.2 – A.6
DPR at Santa Barbara	7a	Conventional activated sludge + DAF[1]	Ozone/BAC – UF – RO – UV/AOP	6.2 mgd	Provided in Tables A.2 – A.6
	7b			3.7 mgd	Between TT6 and TT7a

Table 8A.2 Ozone Design Criteria

Process and Criteria	Unit	Alternatives		
		NPR – TT2	DPR at MSD – TT6	DPR at SB – TT7a
Feed Flow	mgd		8.7	0.7
Ozone Production				
Ozone applied dose	mg/L	N/A	21	21
Ozone MTE	percent	N/A	90 percent	90 percent
Ozone Transferred Dose	mg/L	N/A	19	19
Ozone Production	ppd	N/A	123	1,527
Power Consumption	kW	N/A	26	318
Ozone wt percent	percent	N/A	12 percent	12 percent
Ozone contact time	min	N/A	10	10
Ozone CT(1)	mg-min/L(1)	N/A	6.43	6.43
Oxygen Production	ppd	N/A	1,022	12,724

Notes:

(1) Ozone CT required to remove 1 log *Cryptosporidium* at 10 degrees C, according to the equation *Cryptosporidium* LRV = CT*0.0397*(1.09757)^Temperature (EPA 2010). The ability to achieve this CT is dependent on the dose-response curve and must be confirmed through jar testing.

Table 8A.3 BAC Design Criteria

Process and Criteria	Unit	Alternatives		
		NPR – TT2	DPR at MSD – TT6	DPR at SB – TT7a
No. of Filters	No.	N/A	2	4
Filter Area	sq ft	N/A	113	456
Filter Depth	ft	N/A	10	10
Flow per filter		N/A		
All Filters Operating	gpm	N/A	243	1,513
One Filter in Backwash	gpm	N/A	486	2,018
Hydraulic Loading		N/A		
All Filters Operating	gpm/ft	N/A	2.1	3.3
One Filter in Backwash	gpm/ft	N/A	4.3	4.4
EBCT		N/A		
All Filters Operating	min	N/A	34.8	22.5
One Filter in Backwash	min	N/A	17.4	16.9

Table 8A.4 UF Design Criteria

Process and Criteria	Unit	Alternatives		
		NPR – TT2	DPR at MSD – TT6	DPR at SB – TT7a
UF Process				
Type	-			
Flow rate	gpm	486	486	5,570
Number of trains in service	No.	1	1	3
Number of Redundant Trains	No.	1	1	1
Number of Total Trains	No.	2	2	4
Installed Modules per Train	No.	40	20	70
Spare Module Spaces per Train	No.	8	8	8
Temperature correction				
Peak Capacity Design Temperature	°C	15	15	15
Reference Temperature	°C	20	20	20
Temperature Correction Factor	-	1.14	1.14	1.14
Pilot Peak Flux Direct (@Reference Temp)	gfd	70	70	70
Design Peak Flux (@Design Temp)	gfd	61.3	61.3	61.3
Flow Criteria				
Average Feed Flowrate	gpm	486	486	5,570
Feed Water Loss	percent	2.0 percent	2.0 percent	2.0 percent
Gross Filtrate Production	gpm	476	476	5458

Process and Criteria	Unit	Alternatives		
		NPR – TT2	DPR at MSD – TT6	DPR at SB – TT7a
Filtrate Losses	percent	2.0 percent	2.0 percent	2.0 percent
Overall Recovery	percent	96.0 percent	96.0 percent	96.0 percent
System Net Filtrate	gpm	467	467	5347
Instantaneous Factor	-	1.15	1.15	1.15
Online Factor (1/Instantaneous)	percent	87 percent	87 percent	87 percent
Instantaneous Filtrate Production	gpm	548	548	6,277
Module Criteria				
Membrane Area per Module	sq ft	775	775	775
Membrane Area per Train	sq ft	31,000	15,500	54,250
Membrane Area Total	sq ft	62,000	31,000	217,000
Gross Flux Rate	gfd	22.1	44.3	48.3
Instantaneous Flux Rate	gfd	25.4	50.9	55.5
Backwash Criteria				
Type		Reverse Flow Followed By Air Scour and Drain	Reverse Flow Followed By Air Scour and Drain	Reverse Flow Followed By Air Scour and Drain
Backwash Interval per Train				
Minimum	min	20	20	20
Maximum	min	30	30	30
Filtration Flow	Ratio	1.1	1.1	1.1
Backwash Supply Flowrate	gpm	603	603	2,302
Backwash Duration	sec	30	30	30
Air Scour Flowrate	ACFM	280	140	490
Air Scour Duration	Sec	30-60	30-60	30-60
Forward Flush Flowrate	gpm	720	360	1,260
Forward Flush Duration	sec	20	20	20

Table 8A.5 RO Design Criteria

Process and Criteria	Unit	Alternative		
		NPR – TT2	DPR at MSD – TT6	DPR at SB – TT7a
Design Feed Flowrate	gpm	306	467	5,347
Recovery	percent	80 percent	80 percent	80 percent
Permeate Flowrate	gpm	244	373	4,278
Concentrate Flowrate	gpm	61	93	1,069
Feed Flowrate Per Train	gpm	306	467	2,673
Permeate Flowrate per Train	gpm	244	373	2,139
Concentrate Flow per Train	gpm	61	93	535

Process and Criteria	Unit	Alternative		
		NPR – TT2	DPR at MSD – TT6	DPR at SB – TT7a
Number of RO Trains				
In-Service	No.	1	1	2
Reliability	No.	1	1	1
Total	No.	2	2	3
Staging of RO Trains				
1st Stage				
Pressure Vessels per Train	No.	8	12	70
Elements per Pressure Vessels	No.	7	7	7
2nd Stage				
Second Stage	No.	4	6	35
Elements per Pressure Vessels	No.	7	7	7
Number of Elements				
Per Train	No.	84	126	735
Total (In - service)	No.	168	252	2,205
Membrane Area				
Per Element	sq ft	400	400	400
Per Train	sq ft	33,600	50,400	294,000
Total (In-service)	sq ft	33,600	50,400	588,000
Average Flux Rate	11.7	10.5	10.7	10.5

Table 8A.6 Primary UV or UV AOP Design Criteria

Process and Criteria	Unit	Alternative		
		NPR – TT2	DPR at MSD – TT6	DPR at SB – TT7a
Number of Vessels				
In-Service	No.	1	1	1
Reliability	No.	1	1	1
Total	No.	2	2	2
Feed Flowrate	mgd	0.58	0.54	6.16
Feed Flowrate per Reactor	mgd	0.58	0.54	6.16
Lamp aging and Fouling factor	percent	80 percent	80 percent	80 percent
Design inlet UVT	percent	96	96	96
Design outlet UVT	percent	98	98	98
Design NDMA LRV(1)	LRV	N/A	1	1
Design 1,4-dioxane LRV	LRV	N/A	0.5	0.5
Hypochlorite dose	mg/L	N/A	4.75	4.75

Notes:
(1) Assumed NDMA reduction requirement. Bench scale testing required to confirm NDMA in RO permeate.

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 9
INFRASTRUCTURE ANALYSIS

DRAFT FINAL | November 2022

WSC carollo

Montecito Sanitary District & Montecito Water District
Enhanced Recycled Water Feasibility Analysis

Technical Memorandum 9
INFRASTRUCTURE ANALYSIS

DRAFT | November 2022

This document is released for the purpose of information exchange review and planning only under the authority of Michael Goymerac, November 2022, California PE No. 84894.

Contents

Appendices

Tables

Figures

-This Page Intentionally Left Blank-

Abbreviations

AACE	Association for the Advancement of Cost Engineering
AFY	acre-feet per year
ADWF	average dry weather flow
amsl	above mean sea level
AWPF	advanced water purification facility
AWWA	American Water Works Association
Caltrans	California Department of Transportation
Carollo	Carollo Engineers
CCC	California Coastal Commission
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CSD	Carpinteria Sanitary District
DDW	Division of Drinking Water
ENR	Engineering News-Record
ERWFS	Enhanced Recycled Water Feasibility Study
ft	feet
GIS	geographic information system
HDPE	high-density polyethylene
hp	horsepower
I&I	inflow and infiltration
MCC	motor control center
MD	maximum day
MG	million gallons
mgd	million gallons per day
Miramar	Rosewood Miramar Beach Resort
MM	maximum month
MSD	Montecito Sanitary District
MWD	Montecito Water District
PVC	polyvinyl chloride
PWWF	peak wet weather flow
RO	reverse osmosis
rpm	rotations per minute
RWA	Raw Water Augmentation
RWFP	Recycled Water Facilities Plan
RWQCB	Regional Water Quality Control Board
Santa Barbara	City of Santa Barbara

SR	California State Route
TDWA	treated drinking water augmentation
TM	technical memorandum
UPRR	Union Pacific Railroad
US 101	U.S. Highway 101
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
WRP	water reclamation plant
WWTP	wastewater treatment plant
WTP	water treatment plant

-This Page Intentionally Left Blank-

Technical Memorandum 9

INFRASTRUCTURE ANALYSIS

9.1 Summary

The purpose of this technical memorandum (TM) – TM9 – is to develop distributed infrastructure alternatives for joint recycled water project concepts originating from Montecito. The analysis was undertaken to support the larger Enhanced Recycled Water Feasibility Analysis (ERWFS or Project), a joint effort by Montecito Sanitary District (MSD) and Montecito Water District (MWD). TMs 1 through 8 provide other aspects of the project including MSD and project partner flows, condition assessment, performance and capacity, treatment criteria, rehabilitation costs, and treatment components and upgrades to achieve the various levels of water reuse.

Table 9.1 and Table 9.2 summarize the components for each alternative and the costs and assessment for each alternative, respectively. The analyzed infrastructure alternatives will be combined with treatment components from the other TMs in a separate document.

Table 9.1 Alternatives – Infrastructure Components

Alt	MSD WWTP[1]	AWPF Location	Use of Existing Facilities	Product Water Storage (MG)	Pipelines (LF)
Montecito NPR					
NPR-1.1	O&G Removal & Tertiary Treatment or MBR	N/A	N/A	0.06	26,400
NPR-1.2				0.06	26,300
NPR-1.3				0.06	24,900
Carpinteria IPR					
IPR-2.1	O&G Removal or MBR	CSD WWTP	CAPP AWPF and pipeline; Carpinteria GW Basin	N/A[2]	52,000
IPR-2.2					51,600
IPR-2.3					56,300
IPR-3	O&G Removal or MBR; AWPF	MSD WWTP	Carpinteria GW Basin	N/A[2]	53,900
Montecito DPR					
DPR-4.1	O&G Removal or MBR; AWPF for RWA	MSD WWTP	Bella Vista WTP	N/A[2]	29,100
DPR-4.2	O&G Removal or MBR; AWPF for TDWA			N/A[2]	37,500
DPR-4.3				0.5[3]	6,400
Santa Barbara DPR					
DPR-5.1	Existing Secondary Treatment	Santa Barbara	Santa Barbara Collection System & El Estero WRP	0.47[3]	3,700
DPR-5.2			El Estero WRP		8,200
DPR-5.3	Abandoned (All MSD wastewater to Santa Barbara)				11,800

Notes:
(1) MSD WWTP treatment improvements and recycled water treatment are addressed in other TMs.
(2) Storage is not needed beyond wet well for product water pump station.
(3) Storage needs defined in section 9.6.2.2.

Table 9.2 Alternatives – Cost and Assessment Summary (Infrastructure Costs Only)

Alt	Total Project Cost ($M) (1)	Yield (AFY)	Unit Cost ($/AF) (2)	Comments
Montecito NPR				
NPR-1.1	$14.8	128	$5,900	NPR-1.1 preferred over NPR-1.2 and 1.3 due to • Highest yield and lowest unit cost; however, benefits are dependent on connecting all identified customers • Preferred US 101 crossing (like NPR-1.2) due to lower cost and more time for project decisions
NPR-1.2	$14.7	113	$6,700	
NPR-1.3	$15.5	102	$7,700	
Carpinteria IPR				
IPR-2.1	$33.4	560	$3,100	IPR-2.2 preferred over IPR-2.1 and -2.3 due to: • Lowest cost along with IPR-2.1 without private easement issues for IPR-2.1 All alternatives have: • Utility unknowns along Ortega Hill Rd/Lillie Ave/Via Real • Construction impacts to Summerland and Carpinteria communities • Major US 101 crossing with permitting risks • Carpinteria AWPF and infrastructure cost share • IPR-3 comments also apply to IPR-2 subalternatives
IPR-2.2	$33.3	560	$3,100	
IPR-2.3	$36.3	560	$3,200	
IPR-3	$32.1	560	$3,000	• IPR-3 has several potential new injection well sites but a preferred or most likely site has not been identified • Water exchange method must be confirmed
Montecito DPR				
DPR-4.1	$17.0	560	$1,700	• DPR-4.2 has the highest cost due to longest distance but feeds the Bella Vista WTP • DPR-4.3 has the lowest cost due to the shortest pipeline difference, but will result in uneven distribution of purified recycled water and requires additional hydraulic analysis to confirm feasibility.
DPR-4.2	$20.8	560	$2,000	
DPR-4.3	$10.3	560	$1,100	
Santa Barbara DPR				
DPR-5.1	$9.9	560	$900	• DPR-5.2 is preferred over DPR-5.1 due to the permitting and constructability risks with the DPR-5.1 alignment • DPR-5.3 is feasible and would send all MSD flows to Santa Barbara
DPR-5.2	$11.9	560	$1,200	
DPR-5.3	$23.0	560	$2,200	

Notes:
(1) Treatment costs are not included in this table. Total Project Cost includes construction cost, contingency, and soft costs (i.e., engineering, administration, and legal) for infrastructure only.
(2) Unit costs includes annualized Total Project Costs and annual operations and maintenance costs. No grant funding is included. Financing assumes 3% over 30 years.

9.2 Introduction

9.2.1 Purpose and Background

The purpose of this TM is to develop various distributed infrastructure components for a joint recycled water project between MSD and MWD. The analysis was undertaken to support the larger Enhanced Recycled Water Feasibility Analysis (ERWFS or Project), a joint effort by MSD and MWD.

The Project analyzes four potential approaches to maximize water reuse from the MSD wastewater treatment plant (WWTP), including non-potable reuse, potable water reuse, and regional potable water reuse projects (one in Carpinteria and one in Santa Barbara). Distributed infrastructure components involved in this analysis include pipelines, pump stations, and various pipeline crossings (highway, railroad, and creek). Also included in this analysis are conversations with non-potable reuse (NPR) customers to better understand how much non potable recycled water could reasonably be supplied and used. The four potential approaches include assorted modifications and upgrades to the WWTP to produce water at varying levels of treatment (included siting an Advanced Water Purification Facility (AWPF) within the MSD's WWTP site), analyzed and presented in detail in other TMs. Within this TM, treatment components are provided for context in sizing the conveyance infrastructure but are not the focus of this TM.

Figure 9.1 shows the potential regional partners.

Figure 9.1 Potential Regional Partners

This TM highlights alternative alignments for each of the four reuse approaches, including design criteria, recommended alignment descriptions cost estimate, schedule, permitting considerations, and a project summary. The TM builds upon the infrastructure analysis conducted as part of the MWD Recycled Water Facilities Plan (RWFP) (Woodard & Curran, 2019).

9.2.2 Project Flows

TM 1 reviewed current and anticipated future wastewater flows into the MSD WWTP to establish representative average dry weather flow (ADWF) and peak wet weather flows (PWWF) for alternative facility sizing needs. TM 1 also evaluated upstream flow equalization (EQ) storage volumes as some of the project alternatives under consideration would send raw wastewater to one of the regional partners. Upstream EQ associated with sizing of treatment components is not included in this TM. Conveyance infrastructure sizing can be optimized if peak flows can be temporarily stored at the MSD WWTP. EQ and storage downstream of the treatment (before conveyance), to support instantaneous peak recycled water use, is evaluated in this TM as part each alternative.

Table 9.3 presents flows for various design conditions. All projects using advanced treated water will treat up to the future MSD WWTP ADWF of 0.7 million gallons per day (mgd) and would produce up to 0.56 mgd of finished water from the AWPF (based upon 80% recovery of water through reverse osmosis (RO) treatment).

Table 9.3 Project Flows

Design Condition	Existing Flow (mgd)[1]	Buildout Flow (mgd)[1]
Average Dry Weather Flow (ADWF)	0.62	0.70
Advanced Water Purification Facility (AWPF) Finished Water		0.56
Instantaneous Peak Wet Weather Flow (PWWF)	7.76	8.76

Notes:
(1) Values from Final TM 1 MSD Flow and NPDES Permit Analysis

9.2.3 Summary of Alternatives

The analysis will consider projects both entirely within MSD/MWD service areas and regional partnerships, non-potable and potable reuse alternatives, and various treatment methods and technologies. The potential alternatives included in the study are as follows:

1. **Montecito Non-Potable Reuse (NPR)** – project producing water meeting Title 22 tertiary quality requirements for irrigation of large landscapes within Montecito.
2. **Carpinteria Indirect Potable Reuse (IPR)** – regional project producing purified water involving a partnership with neighboring special district(s) and the use of the Carpinteria Groundwater Basin.
3. **Montecito Direct Potable Reuse (DPR)** – project producing purified water and utilizing raw water augmentation (RWA) at the MWD water treatment facility or delivery of purified water directly into the potable water distribution system in Montecito, termed "Treated Water Augmentation". This project would be implemented entirely within MSD/MWD service areas.
4. **Santa Barbara DPR** – regional project producing purified water and involving a partnership with the City of Santa Barbara (City) and raw water augmentation at the City's regional water treatment facility.

9.3 Distributed Infrastructure Evaluation Criteria

Overall project criteria were developed that apply to each alternative (Montecito NPR, Carpinteria IPR, Montecito DPR, and Santa Barbara DPR). This section summarizes specific criteria for comparing alignments within each alternative as well as a basis for cost development.

9.3.1 Alignment Comparison Criteria

Conceptual pipeline alignments were developed as part of the 2019 RWFP (Woodward & Curran, 2019). One of the primary goals of this new study is to further refine the conveyance piping alignments into feasible alignments for each alternative project. As part of the alignment refinement and comparison, a number of criteria were developed to evaluate and select a preferred alignment under each alternative. This section discusses the alignment criteria only. An alignment alternatives comparison for each complete recycled water project alternative is provided in Sections 9.4through 9.7. The infrastructure alignment criteria include the following:

- Probable Infrastructure Cost
- Potential Recycled Water Demand
- Highway Crossings
- Railroad Crossings
- Use of Roadways
- Creek Crossings
- Community Impacts
- Easement Acquisition
- Topography
- Permitting

Each alternative alignment is evaluated using the criteria above. For the quantifiable criteria, values are provided. For non-quantifiable criteria the alignments were compared against each other.

Relevant information was collected from MWD and MSD and supplemented by field assessments for each alignment alternative to gather more detailed information. Based on the field assessment the alignment alternatives were refined to address construction feasibility concerns.

The criteria for alignment alternatives are detailed in the following sections.

9.3.1.1 Probable Infrastructure Cost

Generally shorter and more efficient alignments are less expensive but needs to be balanced with the other criteria such as community impacts, additional permitting, and additional highway, railroad or creek crossings. Alternatives are evaluated and compared with each other based on total cost and overall pipeline length. See Section 9.3.3for additional criteria and assumptions used to develop alternative costs.

9.3.1.2 Potential Recycled Water Demand

The overall project benefits (e.g., more water supply) and the cost efficiency of the projects (e.g., economy of scale) are improved if greater recycled water demand can be documented. Each alignment was evaluated based on overall demand by comparing unit costs (dollars per flow (i.e. ,$/acre-foot)). Demand is driven by the number of customers able to be served by the alignment without additional pipeline branches (i.e., additional cost). Generally the more potential recycled water demand, the more economically feasible an alignment (and an overall project) can be. This criterion only applies to the Montecito NPR alternative project, as the other IPR and DPR projects will be constant production projects and not have variations in demand for different alignments.

9.3.1.3 Highway Crossings

Due to the location of the MSD WWTP, all alternatives except Santa Barbara DPR will need to cross U.S. Highway 101 (US 101). Crossing locations of US 101 were developed based on an evaluation of existing MSD and MWD crossings as summarized in Section 9.3.2. A total of 14 crossing locations were evaluated and narrowed to three preferred locations. The three preferred crossings vary in location, cost, and timing with ongoing California Department of Transportation (Caltrans) US 101 widening project[1]. Alignment alternatives were compared based on the impacts to cost and schedule as a result of the requirements specific to each US 101 crossing location. Depending on timing with the US 101 widening project several crossings could be open cut. Other crossings outside of the widening project area would require pipelines to be installed via trenchless methods which impacts project cost. Also the crossing locations will need to be installed to meet the Caltrans US 101 widening project schedule and have varied schedule impacts on the recycled water project.

9.3.1.4 Railroad Crossings

Railroads typically grant right-of-way permits allowing utilities to locate pipelines within their properties. Railroads have strict standard requirements and well-documented permitting processes for submitting crossing requests. Specific requirements for pipelines within railroad corridors include:

- All pipelines crossing underneath tracks shall be encased in steel by bore and jack, and generally should cross at a right angle to the track, although variances to crossing angles can be obtained
- Pipelines under pressure shall utilize leak proof mechanical or welded joints.
- Casing pipe shall have an internal diameter of 4 inches or greater than the carrier pipe outside diameter. Cathodic protection or coating is not required, but a thicker pipe is required if no protection is used. Casings must extend 25 feet from center of track when terminated below ground. Casing must be 5.5 feet below base of rail.
- Shut off valves must be included within effective distances of each side or railway.

Alignment alternatives will be compared on the impacts from the location of the railroad crossing that can impact cost. In some cases given the proximity of the railroad to US 101, both can be traversed in a single trenchless crossing.

9.3.1.5 Creek Crossings

Provided the location of Montecito along the Santa Ynez Mountain range, creeks originating from the mountains to the north terminate at the Pacific Ocean to the south. Piping alignments will require multiple creek crossing locations typically at existing County of Santa Barbara (County) bridges. Creek crossings at existing bridges were observed during a field evaluation of alignments. It appears at this time most bridge crossings could be installed along the side of the

[1] https://www.hwy101carpinteria-santabarbara.com/

bridge unless otherwise noted in the following sections. For creek crossings not located at bridges or which require installation below the bridge permits through the California Department of Fish and Wildlife (CDFW), U.S. Army Corps of Engineers (USACE), and Regional Water Quality Control Board (RWQCB) may be required. Creek crossings will also include environmental considerations and mitigation measures through the eventual California Environmental Quality Act (CEQA) plans. To the extent practical, alignments will avoid creek crossings. Alignments with less crossings will be scored more favorably due to lower cost and less permitting complexity.

9.3.1.6 Community Impacts

The Montecito community is largely residential. Alignment alternatives were compared with community impacts in mind, such as disruption to localized traffic, access to homes, businesses, and other community resources such as schools, churches, and emergency service centers. The alignment alternatives that are routed in close proximity to homes have a higher potential for these impacts.

The MSD WWTP is also located just across US 101 from the Coast Village, a commercial zone including boutique shopping, restaurants, upscale hotels, and other businesses. Alignments through the Coast Village area would need to consider additional community impacts such as time of work, parking, traffic, noise, and general community disturbance. Although, alignments through commercial districts typically score more favorability as the typically wider streets allow for more room to install pipeline without road closures.

9.3.1.7 Use of Roadways

Alignment alternatives were routed along existing roadways to minimize construction in steep terrain, easement acquisitions, and impacts to property owners. Alignments were compared based on available width of right-of-way, presence of other utilities, levels of anticipated traffic, and potential restoration. Alignments within Montecito and Summerland would comply with County requirements for road restoration. Alignments within City of Santa Barbara and City of Carpinteria would meet road restoration requirements specific to those jurisdictions.

9.3.1.8 Easement Acquisition

Some pipeline alignments cross multiple private parcels. During the development of the alignments, routes were used that minimize, to the extent possible, the number of privately owned parcels crossed. In locations where crossing private property is unavoidable, the pipeline was kept as close as possible to property boundaries to facilitate easement acquisition.

Obtaining easements from private or commercial property owners is generally easier if the pipeline is routed as close as possible to property boundaries, which was considered in the development of alternatives. If required by a given alternative, MSD/MWD would need to negotiate with property owners to obtain the necessary easements.

9.3.1.9 Topography

Montecito is a coastal community located along the Pacific Ocean bound by the Santa Barbara Channel to the south and the Santa Ynez Mountains to the north. As discussed previously, the MSD WWTP is located in an area of south Montecito bound by US 101 and the railroad to the north, the Andrée Clark Bird Refuge to the west, and a narrow area at Fernald Point to the east where US 101 and the railroad are in close proximity to the ocean. The topographical bounds creates an area with pinch points that require traversing of highways, creeks, environmentally sensitive zones, and other non-ideal areas. The general topography of Montecito is fairly flat in the coastal areas with elevations increasing to the north along the mountains. During development of the alignments, routes were used to minimize steep slopes and to avoid localized high points or low points that could increase operational costs for pumping and maintenance where possible.

9.3.1.10 Permitting

Project permitting can impact the project due to delays and the expense of obtaining and complying with the permit requirements. Specific permits required by the alternatives may include:

- California Coastal Commission Coastal Development Permit
- County Department of Transportation Encroachment Permit for county roads
- Caltrans Encroachment Permit for State roads
- Union Pacific Railroad (UPRR) Encroachment Permit

The following permits shall be evaluated on a case-by-case basis for non-bridge creek crossings or where crossings at bridges may require pipelines to be installed within the normal high water level:

- CDFW Section 1602 permit
- USACE Section 404 permit for creek crossings within the Waters of the U.S. jurisdiction
- RWQCB Section 401 permit within the Waters of the State jurisdiction

While CEQA review and study will be required for any project, individual alternatives are evaluated on overall number of permits required relative perceived difficulty of obtaining permits, and resulting permit requirements and mitigation measures which may add project complexity and cost.

9.3.2 Highway Crossing Evaluation

For all alternatives, except for Santa Barbara DPR, conveyance pipeline alignments will need to cross US 101 and the UPRR. Identifying a location suitable for crossing in Montecito influences the selection of feasible alignment alternatives.

To evaluate all potential US 101 crossings, a detailed list was compiled of existing and future US 101 crossings currently owned or planned for future construction by either MSD or MWD. Many of these existing crossings are being impacted by Caltran's US 101 widening project and are being required to be relocated. A total of 14 crossing locations were identified. Based on input from MSD and MWD, the feasible locations were narrowed to 6 medium and high preference locations. The narrowed list of crossings were evaluated based on factors such as cost, location, size and capacity, availability, viability, and potential impacts by the impending Caltrans US 101 widening project. The remaining low preference crossings were not included in this analysis due to unfavorable alignments, poor timing with Caltrans US 101 widening project, or are in use by the respective district with no viable replacement option.

Figure 9.2 shows the crossing locations. Table 9.4 lists the feasible crossings (6 of 14) with noted inputs from the Districts, Caltrans US 101 project timing, and other critical information.

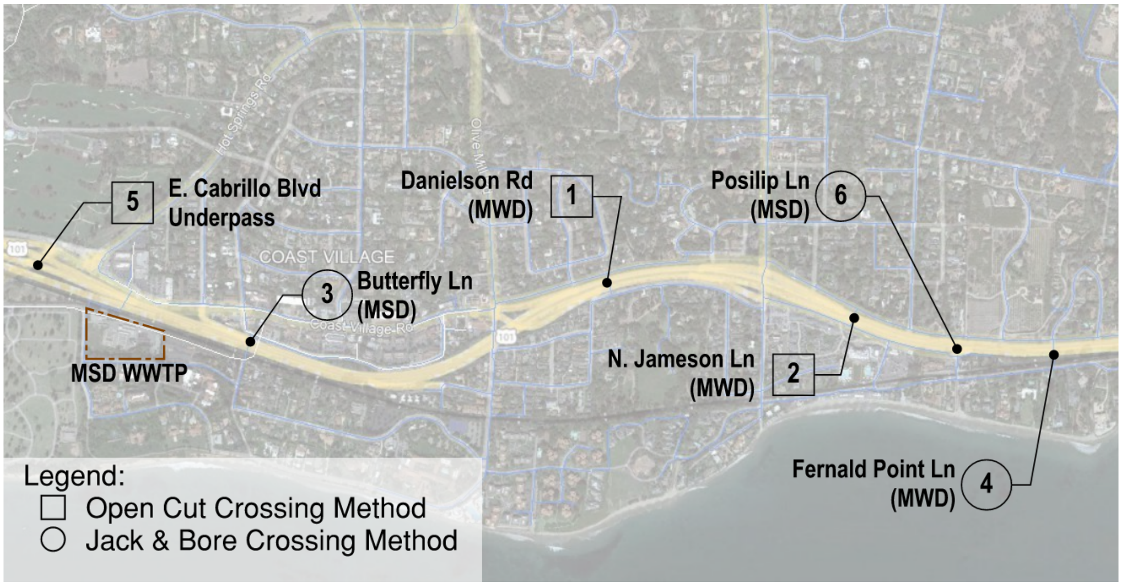


Figure 9.2 Feasible US 101 Crossing Locations

Table 9.4 US 101 Highway Crossing Locations and Rankings

Crossing No.	Prefer. / Ranking	Owner[1]	Crossing Location	Crossing Method	Existing Carrier / Casing Pipe Dia. (in)	Notes/Input
1	High	MWD	Danielson Rd	Open Cut	4 / 16	Either crossing would be installed during Caltrans widening work scheduled for 2024-2025. MWD modeling shows existing crossing could be repurposed for recycled water.
2	High	MWD	N. Jameson Rd (at Miramar)	Open Cut	6 / 16	
3	Medium	MWD	Butterfly Ln.	Jack and Bore	6 / TBD	Planned potable water pipeline crossing of US 101 and railroad in one bore. Recycled water pipeline could be added but would need appropriate separation from potable pipeline.
4	Medium	MWD	Fernald Point Ln.	Jack and Bore	8 / 36	MWD to construct potable water crossing in 2023. Adding recycled water pipeline is not recommended due to tight working constrains and easement requirements.
5	Medium	N/A[2]	E. Cabrillo Blvd. Underpass[2]	Open Cut	NA / NA	The entire underpass is scheduled to be rebuilt with a new roundabout and a pipeline could be installed during construction but Caltrans schedule is not firm. Crossing location adds distance to alignments going east
6	Medium	MSD	Posilipo Ln.	Jack and Bore	8 / 24-26	Crossing is being relocated due to widening of Oak Creek. Crossing relocation is already in design to meet Caltrans timeline so project timing is unfavorable.

Notes:
(1) Current owner of the pipeline crossing US 101 and the associated easement. The easement is being considered for the recycled water pipeline crossing.
(2) Cabrillo Blvd underpass is scheduled to be redesigned including a roundabout as part of the Caltrans US 101 widening project. As such no current crossing exists.

Based on input from MSD and MWD, two high preference crossings (Danielson Road and the Rosewood Miramar Beach Resort [Miramar]) and the first medium preference crossing (Butterfly Lane) were carried forward.

The two crossings with "high" preference would be installed via open cut compared with a higher cost trenchless crossing for Butterfly Lane. MWD is finalizing agreements with Caltrans for the Highway widening contractor to install new highway crossings via open cut means during highway construction instead of using jack and bore methods. Also, the construction is estimated to occur in 2024 or 2025, which gives time for both districts to decide on the preferred recycled water project.

9.3.3 Basis for Project Cost Assumptions

Costs for the NPR alternative include construction capital costs and a percentage-based allowance for engineering, administration, legal fees, and contingencies. Costs were generated for each alternative alignment based on pipeline unit costs as well as the number and location of each crossing (US 101, railroad, and creek).

TM9 capital cost estimates were prepared consistent with Association for the Advancement of Cost Engineering (AACE) International Class IV Estimates for feasibility and project screening. As such, the expected accuracy range could span -50% to +100%. The costs and assumptions used during this exercise were developed from the information available at the time the cost estimate was prepared since the upgrades have not yet been fully designed. There are numerous design related criteria, decisions, and assumptions that will need to be vetted and evaluated, including additional surveys, modeling, permit conditions, and unforeseen circumstances that could impact the cost of the project as the design progresses.

Capital costs include construction and contractor overhead, contingency for unknown conditions and professional services (or "soft costs"). The capital cost estimates are expressed in March 2022 dollars (the corresponding 20-Cities Average Engineering News Record Construction Cost Index of 12,791). Construction costs were developed using cost indexes, quotes from suppliers, recent bids for similar projects, recent engineering estimates, and known industry planning-level unit costs. Quantities were estimated using geographic information system (GIS) based maps of alignments. A percentage of the construction costs is dedicated for contingency to cover as-yet-unknown aspects of the project, in accordance with AACE recommendations. Soft costs are also estimated as a percentage of the construction costs based on typical percentages of total project costs for similar projects. Project costs were annualized and combined with reoccurring operations and maintenance costs to come up with a total annual cost. The annual cost was used to estimate the unit cost based on the annual water delivery (i.e., acre-feet per year (AFY)) for each alternative. A summary of construction, soft cost and escalation assumptions is provided in Table 9.5.

Table 9.5 Summary of Cost Estimate Assumptions

Description	Value	Units	Applied To
Contingency for unknown conditions	30	%	Sum of Contractor Overhead and Construction Costs
Engineering, legal, and administration costs	25	%	Sum of Contractor Overhead and Construction Costs
Financing rate (annualized cost)	3	%	Total project cost (sum of construction, overhead, contingency, and soft costs)
Return period (annualized cost)	30	years	Total project cost (sum of construction, overhead, contingency, and soft costs)

9.3.4 Basis for Hydraulic Characterizations

A hydraulic analysis is performed for each alternative using the criteria presented in Table 9.6 to develop pipeline and pump station capacities for each alternative. Pipeline sizing was calculated balancing minimum velocity, friction loss, and future expected demands. The hydraulic analysis is used to estimate pump design point and a preliminary system curve. Pumps are assumed to be on variable frequency drives to accommodate anticipated demand-based flow variability.

Table 9.6 General Hydraulic Design Criteria

Criteria	Units	Value	Notes
Maximum Design Flow	gpm		Dependent on alternative
Target Operating Flow	gpm		Dependent on alternative
Minimum Operating Flow	gpm		Dependent on alternative
Maximum Velocity	ft/s	5	Set to minimize head losses in pipeline
RO Configuration	NA	2+1	2 duty trains and 1 redundant train at 0.35 mgd each
RO Turndown Capacity	%	10	10% turndown on each RO train
Pump Discharge Elevation	ft amsl	45	Elevation of MSD WWTP used for static head
Highest Delivery Elevation	ft amsl		Dependent on alternative
Friction Loss	unitless	135	Hazen-Williams C-factor for aged PVC pipe
Fitting Loss	%	5	Assumed percentage of minor friction losses
Delivery Pressure (NPR customers)	psi	60	Should be similar to existing pressure
Delivery Pressure (to storage)	psi	10	

9.3.5Pipeline Assumptions

Pressurized recycled water (tertiary or purified water) conveyance piping will be constructed of either C900 polyvinyl chloride (PVC) or ductile iron. In both cases fittings and valves constructed to American Water Works Association (AWWA) standards will be required. Pipeline restraint systems will be required to counteract thrust forces. Where feasible pipelines will be buried to standard depths in accordance with MSD/MWD and County standards. Sufficient appurtenances will be included to allow for future operation of the pipeline including isolation valves, testing stations, blow offs (regional low points), and air-vacuum valves (regional high points).

Sanitary sewer conveyance piping will be constructed to industry and project stakeholder standards using either PVC or high-density polyethylene (HDPE). Pipelines will be installed at depths accommodating the system hydraulics and in consideration of industry and project stakeholder standards. Manholes will be included at sufficient interval spacing and at appropriate locations (i.e., bends, junctions, etc.).

The pipeline alignments will be adjusted for required offsets from existing utilities. Where required offsets from sanitary sewer, storm, or potable water can't be met due to topographical, space, or other constraints, the State of California Division of Drinking Water (DDW) waterworks standards main separation waivers will be prepared for approval. Where offsets can't be met to other utilities, coordination with and approval from the each utility company will be required.

Pipelines will be installed via traditional open cut trench methods unless otherwise noted. Aerial crossings of creeks are assumed to be feasible through attaching the pipe to existing bridge crossings unless otherwise noted. Otherwise, trenchless crossings will be required. Trenchless construction methods (e.g., jack and bore) are assumed to be required at railroad and highway crossings, except for those locations where MWD has reached agreement to install using open cut methods during highway widening work. All railroad and highway crossings will require carrier pipes within casings.

9.3.6 Treated Water Pump Station Assumptions

All alternatives except for Santa Barbara DPR include a new treated water pump station to convey treated water (secondary, tertiary, purified) to various end points. The pump stations will be in a wet-well style configuration. Pump electrical equipment, motor control center (MCC), operator controls, and a hydropneumatics tank (if needed) will be placed nearby as shown on Figure 9.3.

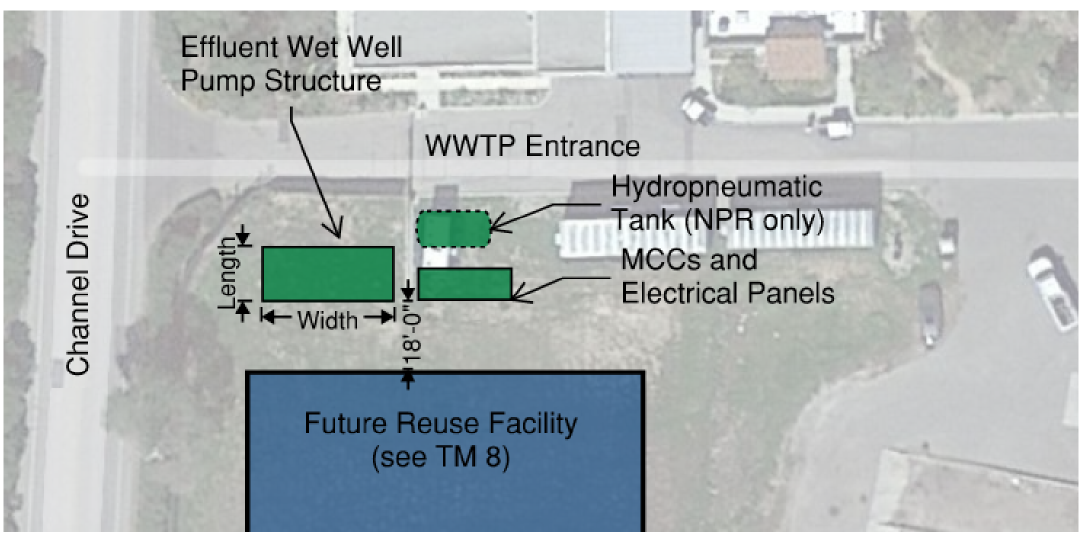


Figure 9.3 Example Pump Station Site Plan

Pumps will be configured with multiple duty pumps and one standby. Pumps will be vertical turbine pumps with motors and discharge heads located on top of the shared wet well structure as shown on Figure 9.4. Appropriate discharge side appurtenances and instruments will be provided for system control and maintenance.

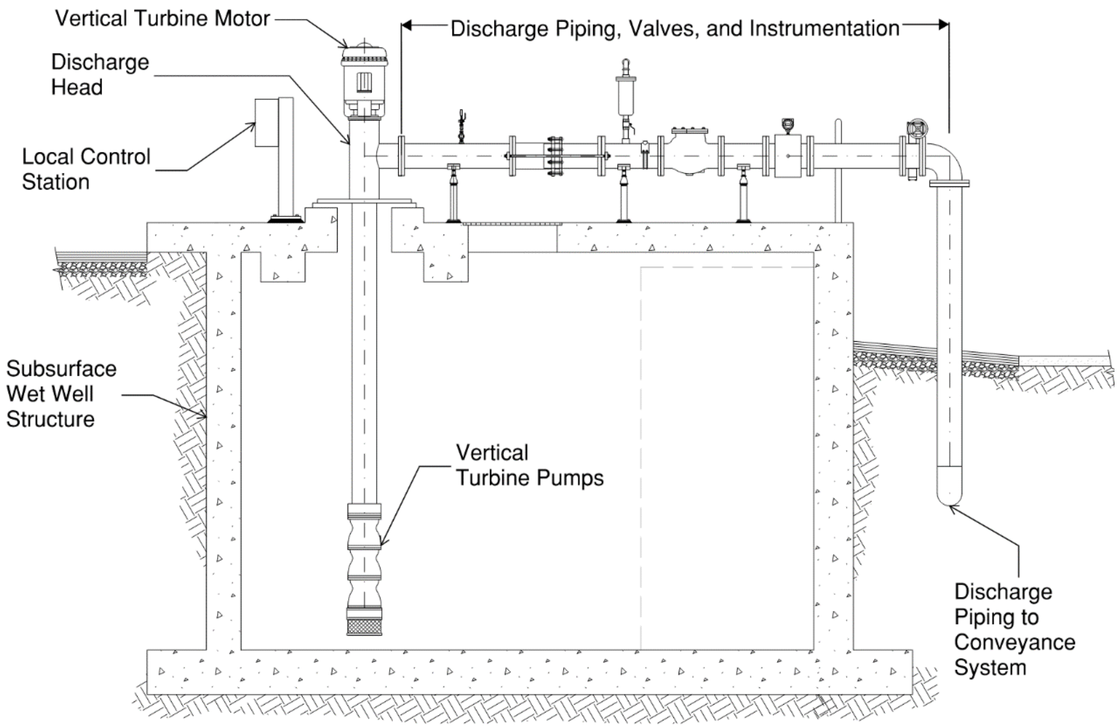


Figure 9.4 Typical Pump Station Preliminary Cross-Section

The wet well will be constructed of cast-in-place concrete with internal semi-divided intake structures dedicated to each pump. For the purposes of estimating costs, wet well bays were sized for larger pumps to allow for flexibility in the event of future system expansion and an additional empty bay was assumed to allow for addition of another duty pump in the future.

The wet well depth will need to be sufficient to provide the required suction head for the pumps, which is anticipated to be approximately 10 ft of working volume plus require structural freeboard. Pumps will discharge to a common header and transition to below ground conveyance piping. Instrumentation will be provided to allow for sufficient flexibility in controls including pressure, flow, and level equipment. Pumps will be provided with VFDs in all project alternatives and pump control will be dependent upon the alternative.

As required by the NPR alternatives, a hydropneumatic tank can be provided for low flow scenarios as well as to protect against surge.

9.4 Montecito NPR

9.4.1 Alternative Introduction

The Montecito NPR alternative represents a project entirely within MSD/MWD service areas with recycled water meeting Title 22 tertiary quality requirements water for unrestricted non-potable use focused on irrigation of large landscapes in Montecito. This alternative would require infrastructure for the delivery of recycled water to customers for landscape irrigation use. Infrastructure assumed under this analysis includes conveyance piping, effluent pump station, NPR storage, and customer connections and retrofits. Potential customers include nearby golf courses, cemetery, hotels, and other facilities.

9.4.2 Potential Customers

The 2019 RWFP identified eight non-potable customers that could provide demand for recycled water within Montecito (Woodward & Curran, 2019). The eight customers include three large "anchor" customers (Birnam Wood Golf Club, Santa Barbara Cemetery, and Valley Club Montecito) as well as other smaller customers that could be served from the pipeline alignments between the MSD WWTP and the "anchor" customers. The RWFP recommended, as a next step, conducting customer demand assessments to better estimate the potential recycled water use at each site since many were difficult to estimate from potable water use records due to the use of on-site groundwater wells.

For this study, the anchor customers were engaged through discussions and a list of questions to better understand potential recycled water service needs. In addition, the team reviewed potable use from 2018 to 2021 for each anchor customer based on MWD billing records. Both golf courses have implemented extensive conservation measures in the past five years, including removing turfgrass and converting turfgrass type to a more drought tolerant variety. In addition, Valley Club constructed groundwater wells that are used to offset the purchase of potable water from MWD for turfgrass irrigation.

Table 9.7 presents updated recycled water demand estimates for potential NPR customers. Demand estimates were developed by focusing on offsetting potable water demand; whereas the 2019 RWFP also included offsetting groundwater demands. Discussions with the golf courses indicated a preference to maximize the use of groundwater from recently installed wells before purchasing recycled water for irrigation. Demands for the five largest customers were updated using potable water demands from 2018 to 2021 and through discussions with each customer. Appendix 9A includes a review of the customer engagement and basis of demand estimates.

Table 9.7 NPR Customer Demands – Average Annual

Customer	2019 RWFP Annual NPR Demand Estimate (AFY)(1)	Private Well(s)	2018-2021 Annual Potable Use for Irrigation (AFY)	Estimated Annual NPR Demand (AFY)
Birnam Wood Golf Club	100	Yes	30 – 60(2)	40
Four Seasons Biltmore	15	Yes	N/A(3)	15(3)
Miramar Resort	11	No	N/A(3)	11(3)
Music Academy of West	2	No	N/A	2
Private Residence	9	Yes	N/A(3)	--(4)
Santa Barbara Cemetery	80	No	16 – 34(2)	30
Ty Warner Hotels	6	Yes	N/A	--(4)
Valley Club Montecito	150	Yes	0 – 35(2)	30
Total	**373**		**46 – 129**	**128**

Notes:
(1) Values from 2019 RWFP (Woodward & Curran, 2019)
(2) Potable water use is based on MWD meter records for dedicated irrigation meters.
(3) Irrigation use is not metered separately so non-potable demand estimate is based on discussions with each customer.
(4) Irrigation demand is assumed to be met with onsite groundwater well.

9.4.3 Design Criteria

Criteria and assumptions were developed to aid in the preliminary sizing of infrastructure. Due to the seasonal nature of irrigation demands, flow requirements range from peak periods during extended hot periods in the summer to no demands during extended wet periods during the winter. Also, recycled water irrigation periods are commonly restricted to nighttime in publicly accessible areas. As shown in Table 9.8, peak hour demands are projected to range from 260 gpm during the day to 430 gpm at night.

Approximately 2,000 gallons of recycled water storage is needed to provide sufficient supply during the nighttime peak demand. This storage will be provided by the wet well for the recycled water pump station, described in Section 9.4.5.

Table 9.8 NPR Customer Demands – Peak Periods

Customer	Estimated Annual NPR Demand (AFY)(1)	Max Day Demand (mgd)(2)	Delivery Period(3)	Peak Hour – Day (gpm)	Peak Hour – Night (gpm)
Birnam Wood Golf Club	40	0.11	Day – 12 hours	149	
Four Seasons Biltmore	15	0.04	Night – 6 hours		112
Miramar Resort	11(2)	0.03	Night – 6 hours		82
Music Academy of West	2	0.01	Night – 6 hours		15
Santa Barbara Cemetery	30	0.08	Night – 6 hours		260(4)
Valley Club Montecito	30	0.08	Day – 12 hours	112	
Total	**128**	**0.34**		**261**	**469**

Notes:

(1) Values from previous table

(2) Assumes 3.0 ratio for max day to average annual demand based on 2.5 ratio for peak month to average annual demand and 20% increase for extended hot periods.

(3) Irrigation with recycled water is generally restricted to nighttime for publicly accessible sites. Golf courses have on-site storage that allows for delivery outside of nighttime hours and, as publicly restricted locations, are able to irrigate during the day if needed.

(4) See assumptions in Non-Potable Customer Assessments Memorandum (Appendix A).

Based on the information above, hydraulic criteria used to develop pipeline and pump station capacities is presented in Table 9.9.

Table 9.9 Montecito NPR – Hydraulic Design Criteria

Criteria	Units	Value	Notes
Maximum Design Flow	gpm	459	Largest Peak Hour
Target Operating Flow	gpm	261	Set to Total Peak Hour – Day demand
Minimum Operating Flow	gpm	40	Based on half of the second smallest Peak Hour – Night demand from Miramar
Maximum Velocity	ft/s	5	Set to minimize head losses in pipeline
Pump Discharge Elevation	ft amsl	45	Elevation of MSD WWTP used for static head
Highest Delivery Elevation	ft amsl	270	Elevation of highest customer used for static head
Friction Loss	unitless	135	Hazen-Williams C-factor for aged PVC pipe
Fitting Loss	%	5	Assumed percentage of minor friction losses
Delivery Pressure (direct service)	psi	60	Three times the minimum pressure (20 psi) required by Cal. Code Regs. Tit. 22, § 64602
Delivery Pressure (to storage)	psi	10	

Notes:

Based on the hydraulic analysis, a minimum 8-inch nominal diameter is anticipated for the Montecito NPR alternative conveyance piping.

Results of the hydraulic analysis are included in Appendix 9B. The analysis showed that the range of operating flows (minimum, target, and maximum) could be met with a 3 + 1 pump configuration. As shown in Appendix 9B, the minimum operating flow could be met with a single pump by reducing speed with a VFD. Similarly, the target operating flow could be met with two pumps on reduced speed and the maximum operating flow could be met with three pumps at full speed. Additional details such as size of pumps for the recommended alternative are included in Section 9.4.5

The design flows listed in Table 9.9 do not consider extreme extended drought periods where demands could be much higher. The system was sized using reasonable flow assumptions. Oversizing the system for unknown drought conditions could result in larger than needed pumps, higher capital and operating costs, and piping with excess capacity. Oversized pumps could result in unused pumps and low velocities.

To address expected annual or diurnal periods of low demand a hydropneumatic tank would be coupled with the VFD pumps. The hydropneumatic tank will prevent pumps cycle on and off for short intervals during low- to no- flow periods.

9.4.4 Alignment Analysis and Recommendation

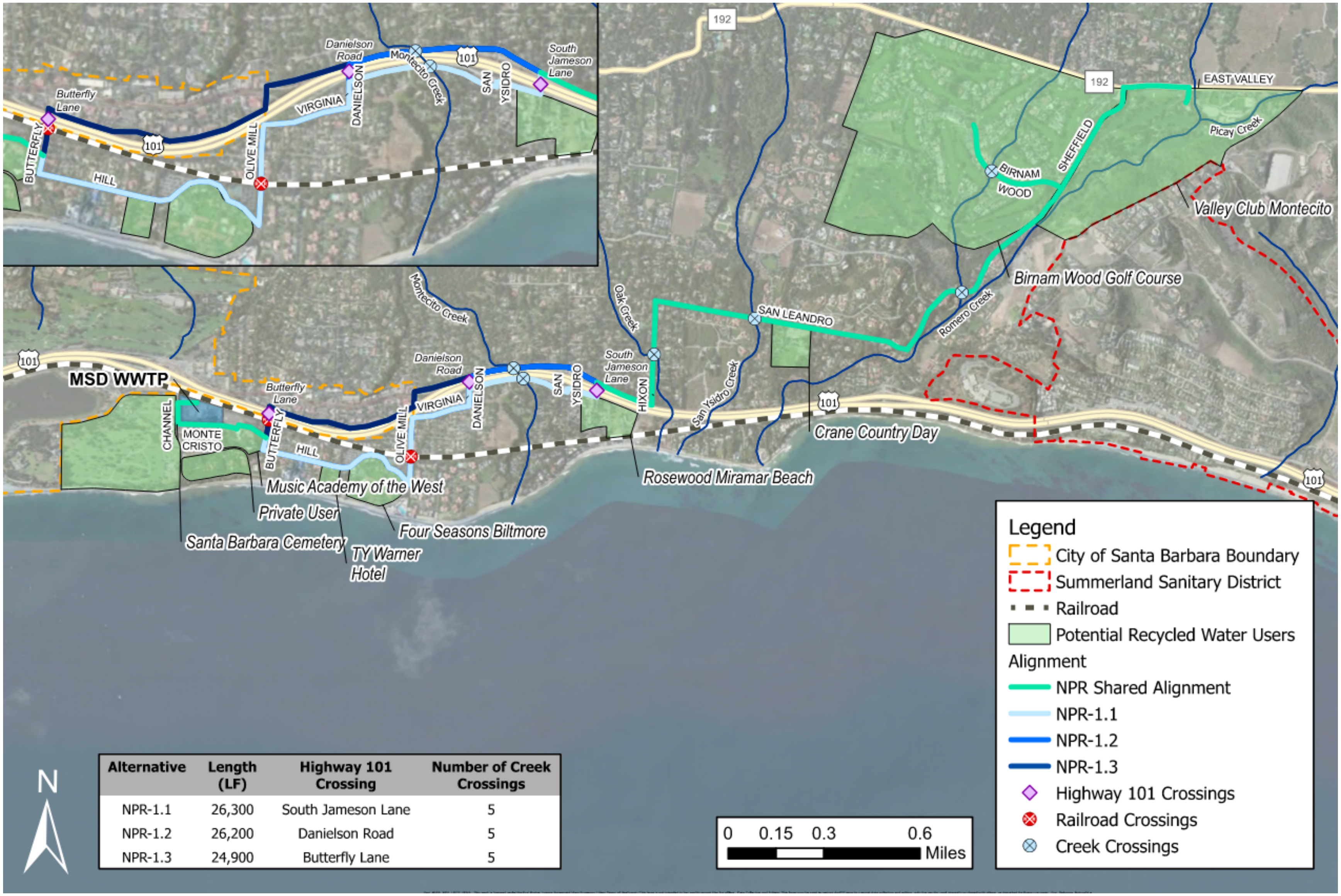
Three alignment options were considered based on review and selection of a narrowed list of preferred US 101 crossings (Section 9.3.1.3). This section describes the assessment and ranking that was completed for the alignments and provides a recommendation for the preferred alignments.

As shown on Figure 9.5, the NPR alternative alignments differ only at the US 101 crossing location with shared alignments at the beginning (nearest the MSD WWTP) and the furthest customers (past Miramar). The three alignment alternatives are:

- NPR-1.1 – Danielson Road US 101 crossing
- NPR-1.2 –Miramar US 101 crossing
- NPR-1.3 – Butterfly Lane US 101 crossing

The following describe considerations for each Montecito NPR alternative alignment. The following considerations apply to all Montecito NPR alternatives:

- Music Academy of the West: The alignment crosses the academy from the Monte Cristo Lane dead end to North Jameson Way. This will require negotiation and acquisition of an easement.
- Oak Creek: The alignments crosses the creek along Hixon Road.
- San Ysidro Creek: The alignments crosses the creek along San Leandro Lane via an aerial bridge crossing.
- Romero Creek: The alignment crosses the creek (labeled Buena Vista Creek on bridge) along Sheffield Drive via an aerial bridge crossing.
- Birnam Wood Golf Course Lateral: The lateral would extend from Sheffield Drive to the golf course's existing lake and discharged to the lake with an approved air gap.
- Valley Club Lateral: The lateral would continue along Sheffield Drive and east on East Valley Road (California State Route [SR] 192) to the Valley Club northern service entrance. The lateral would discharge into the golf course's existing water tank with an approved air gap.



Alternative	Length (LF)	Highway 101 Crossing	Number of Creek Crossings
NPR-1.1	26,300	South Jameson Lane	5
NPR-1.2	26,200	Danielson Road	5
NPR-1.3	24,900	Butterfly Lane	5

Figure 9.5 Montecito NPR Alignment Alternatives

The following considerations apply to the Montecito NPR alternative(s) listed. Figure 9.6 shows a representative clear alignment through Music Academy of the West.

Figure 9.6 Representative Clear Alignment Path through Music Academy of the West

NPR-1.1 & NPR 1.2

- Railroad: The alignment crosses the railroad along Olive Mill Road via trenchless installation method.
- Olive Mill Road / Virginia Road: This alignment was selected over Danielson Road due to utility congestion (water, sewer, a 16-inch gas main, and telecommunications lines) on Danielson Road that presents a constructability and cost risk due to minimum utility separation requirements and reduced construction rates to protect existing utilities in place.
- Residential Areas: The alignment is within residential areas Hill Road, Virginia Road, and Danielson Road. That will have temporary construction impacts to local residents and have tighter working areas.

Figure 9.7 shows a dense existing utility backdrop along Danielson Road.

Figure 9.7 Existing Utility Markings on Danielson Road

NPR-1.1

- Montecito Creek: The alignment crosses the creek at Miramar via an aerial bridge crossing.
- US 101 Crossing: The existing MWD crossing would be removed and reinstalled via open cut trench methods as part of the Caltrans US 101 widening project extending across the highway to North Jameson Lane.

NPR-1.2

- US 101 Crossing: The existing MWD crossing between Danielson Road and North Jameson Road would be removed and reinstalled via open cut trench methods as part of the Caltrans US 101 widening project extending across the highway.

NPR-1.3

- Railroad and US 101 Crossing: At the northern dead end of Butterfly Lane, the alignment will cross the railroad and US 101 via trenchless installation methods to Coast Village Circle.
- Coast Village Circle / Coast Village Road: The alignment through this business district would have construction impacts for local businesses.

9.4.4.2 Alignment Comparison

The three alternative alignments (NPR-1.1, NPR-1.2, and NPR-1.3) differ primarily in the location of the US 101 crossing, which impacts pipeline length, cost, schedule constraints, customers served, and community impacts.

NPR-1.1

- Pipeline Length: NPR-1.1 is the longer than NPR 1.3 and similar to NPR 1.2.
- Customers: NPR 1.1 serves the identified potential customers with a total demand of 128 AFY.
- US 101 crossing: Preferred crossing location (along with NPR 1.2) due primarily to the lower cost installation method (traditional open cut trench).
- Railroad: A trenchless crossing will be required at Olive Mill Road. The crossing is typical for railroad but further review of available right-of-way and construction staging is required for future design.
- Community Impacts: Similar to NPR 1.2, alignment is in residential areas along Hill Road, Virginia Road, and Danielson Road.
- Roadways: Similar to NPR 1.2, the residential areas are tight due to 25 to 30 foot road widths and existing utilities that include both potable water and sewer lines.

NPR-1.2

- Pipeline Length: NPR-1.2 is longer than NPR 1.3 and similar to NPR 1.1.
- Customers: Serves all but one customer (Miramar) unless a lateral is added
- US 101 Crossing: Preferred crossing location (along with NPR 1.2) due primarily to the lower cost installation method (traditional open cut trench) and additional time to make project decisions.
- Railroad: Similar to NPR 1.1.
- Community Impacts: Similar to NPR 1.1.
- Roadways: Similar to NPR 1.1.

NPR-1.3

- Pipeline Length: NPR-1.3 is the shortest of the three NPR alignment alternatives
- Customers: Serves all but two customers (Miramar and Biltmore) unless laterals are added that follow NPR 1.1 to Miramar
- US 101 Crossing: Requires trenchless crossing at Butterfly Lane that is more expensive than NPR 1.1 and 1.2 and must be installed much sooner, requiring an investment by MSD/MWD before any potential recycled water project is developed further. Also, the addition of a recycled water crossing may require planning with MSD and MWD to meet offset requirements within the available right of way.
- Railroad Crossing: The railroad and US 101 can be crossed in a single mobilization due to their proximity to one another; however, this requires a longer crossing with multiple permitting partners.
- Community Impacts: The route through Coast Village has less residential impacts but will have unique impacts to the Coast Village area businesses and parking along Coast Village Circle.
- Roadways: Due to less alignments in residential areas, there are less potential conflicts along small residential streets with existing utilities.

Evaluation Summary

Table 9.10 includes a summary of the analysis for each alternative. Based on the evaluation of each alternative against each of the developed criteria, NPR-1.1 is the recommended alternative alignment because NPR-1.1:

- Has a preferred US 101 crossing (due to less costly open trench method and more time for project decisions),
- Allows more customers to be served without additional laterals, which results in the lowest unit cost

However, the unit cost and customer criteria advantages are dependent on customers connecting to the system. If Miramar does not want recycled water and Biltmore does want recycled water, then NPR 1.2 would be preferred. If neither Miramar nor Biltmore wants recycled water, NPR 1.3 would be preferred, with the largest tradeoff being impacts to Coast Village versus higher residential area impacts for the other alignments.

Further considerations such as schedule, permitting, and community impacts as well as a full project description including all conveyance infrastructure components for the NPR alternative will be discussed in Section 9.4.5.

Table 9.10 Summary of NPR Alternatives

Criteria	Summary of NPR Alternatives		
	NPR-1.1 (US 101 crossing at Miramar)	NPR-1.2 (US 101 crossing at Danielson Rd)	NPR-1.3 (US 101 crossing at Butterfly Ln)
Capital Cost	$14.8 Mil	$14.7 Mil	$15.5 Mil
Unit Cost	$5,900/AF	$6,700/AF	$7,700/AF
Pipeline Length	26,400 LF	26,300 LF	24,900
Recycled Water Demand	128 AFY	113 AFY	102 AFY
Summary of Benefits	• More favorable US 101 crossing • Most RW customers served	• More favorable US 101 crossing	• Less topographical impacts (i.e, flatter vertical alignment)
Summary of Risks	• Alignment through residential area	• One customer not served • Alignment through residential area	• Two customers not served • Alignment through Coast Village • Less ideal US 101 crossing

9.4.5 Project Summary For Recommended Alternative

This section provides a full project summary including distributed infrastructure components for the recommended NPR alternative (NPR-1.1). Section 9.4.3 presented design criteria for the NPR alternative for sizing of conveyance infrastructure, including pipelines and pump stations. Section 9.4.4 presented an assessment of conveyance piping alignment alternatives from the MSD WWTP to the end recycled water customers. The distributed infrastructure for the NPR-1.1 alternat ive will include three primary components: NPR pump station located at the MSD WWTP, conveyance piping for delivery to customers, and customer connections and retrofits allowing for permitted use of the recycled water.

9.4.5.1 Project Description

As summarized in TM8, the MSD WWTP will be updated with tertiary treatment. Additional RO treatment may be included to reduce salinity in the recycled water concentrations acceptable to potential customers. If RO is not included, recycled water salinity can be mitigated by blending with other water supplies at the point of use or with on-site management. The treatment alternatives presented int TM8.

Upon discharge from the treatment system the recycled water will be supplied to customers via an NPR pump station located at the MSD WWTP. The NPR pump station will be in a wet-well style configuration. Pump electrical equipment, motor control center (MCC), operator controls, and a hydropneumatic tank will be placed nearby as shown on Figure 9.8.

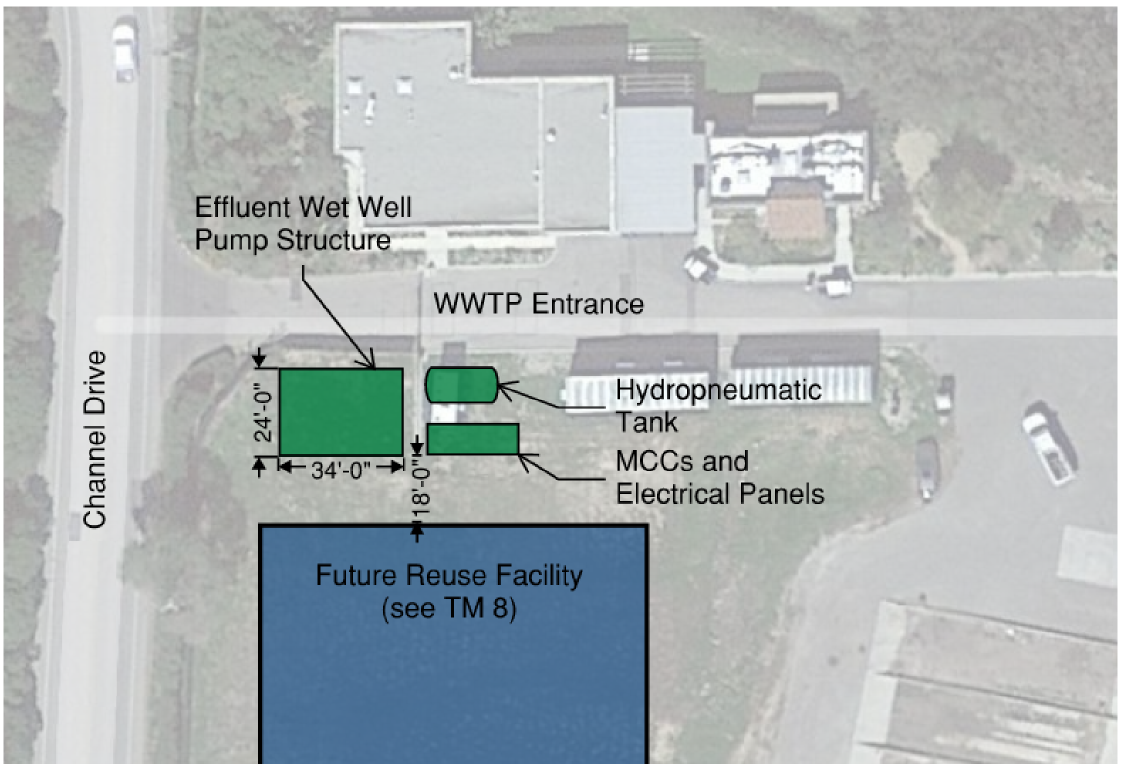


Figure 9.8 NPR Distributed Infrastructure Site Plan

A hydropneumatic tank will also be provided for low demand and flow scenarios as well as protect against surge. Pumps will be configured in a 3+1 with three duty pumps and one standby. The wet well structure will be designed to allow for efficient pump operations and control, with approximately 60,000 gallons of storage (which includes the 2,000 gallons of storage to allow for peak usage) with the dimensions shown on Figure 9.8. Based on the hydraulic analysis, 25 horsepower (hp) pumps with a maximum speed of 1,800 rotations per minute (rpm) are anticipated for the pump station.

Pump control is ultimately dependent on the final operation of the entire recycled water system and demands from the users. If the end usage is highly schedule dependent, pumps may be controlled on a prescribed flow rate at set usage schedule for customers. More than likely the usage is expected to be variable and pump controls will be pressure based (i.e., demand based). A pressure-based control will better integrate with the hydropneumatic tank with a set pressure window programmed to allow pumps to remain off for a minimum of 30 minutes during periods of low demand. Level instrumentation in the wet well will provide high- and low-level overrides.

Turnouts will be provided along the alignment for the various recycled water customers. Sizing of the turnouts will be dependent on anticipated demands specific to each user. Meters will be provided for monitoring specific user demands and for billing purposes. Customer connections and retrofits are specific to each user:

- For the two golf courses (Valley Club and Birnam Wood) piping will be terminated at each facility's specific irrigation storage (e.g., tank or pond). Air gaps will be provided for these types of connections to prevent cross contamination and backflow into the recycled water system.
- For newer resorts, such as Miramar, existing dual plumbed irrigation systems are already in place. The point of connection to the on-site purple pipe system will be identified and a pressurized connection with appropriate backflow devices will be made.
- For other customers, existing irrigation systems will need to be isolated at the irrigation meter (if available). Cross-connection surveys will be performed in accordance with DDW standards and policies.

9.4.5.2 Project Cost and Schedule

Table 9.11 presents a more detailed construction cost break down for the recommended NPR-1.1 alternative including piping and other infrastructure components. For detailed cost breakdowns including other alternatives, see Appendix 9C, Cost Estimates.

Table 9.11 Montecito NPR-1.1 Project Costs

Cost Item	Alternative NPR-1.1
Construction	$9,512,000
Contingency (30%)	*$2,854,000*
Engineering, Admin., and Legal (25%)	*$2,378,000*
Total Project Cost	**$14,744,000**
Annual O&M	$95,300

The Project schedule is dependent on several factors. Once MSD/MWD decide on the preferred recycled water alternative, the Project schedule is dependent on design progress, permitting approvals, regulatory approvals, bid and construction climate, timing of US 101 widening work by Caltrans, and other unforeseen factors. Given these factors, it is estimated that the engineering, funding, and permitting could be completed in 20 to 24 months, project bidding and contracting in 3 months, and distributed infrastructure construction in 18 to 24 months.

The schedule constraint for this project is construction of the US 101 Highway crossing, As discussed in Section 9.3.2, the recommended (and lower cost) crossing would be constructed at the same time as the section of highway is constructed, which is currently projected by Caltrans for

2024 to 2025. MWD currently has plans to reinstall the crossing regardless of a future project for integration into their potable water system. Caltrans construction delays could result in delays in starting project operations if the crossing is constructed after the rest of the project.

9.5 Carpinteria IPR

The Carpinteria IPR alternative represents a regional project in partnership with Carpinteria Sanitary District (CSD) and Carpinteria Valley Water District (CVWD). CSD and CVWD are currently developing the Carpinteria Advanced Purification Project (CAPP), an IPR project treating water from the CSD's WWTP and injecting into the Carpinteria Groundwater Basin. A regional IPR partnership would include expanding CAPP with additional source water from MSD's WWTP. Such a regional project has two primary alternatives[2]:

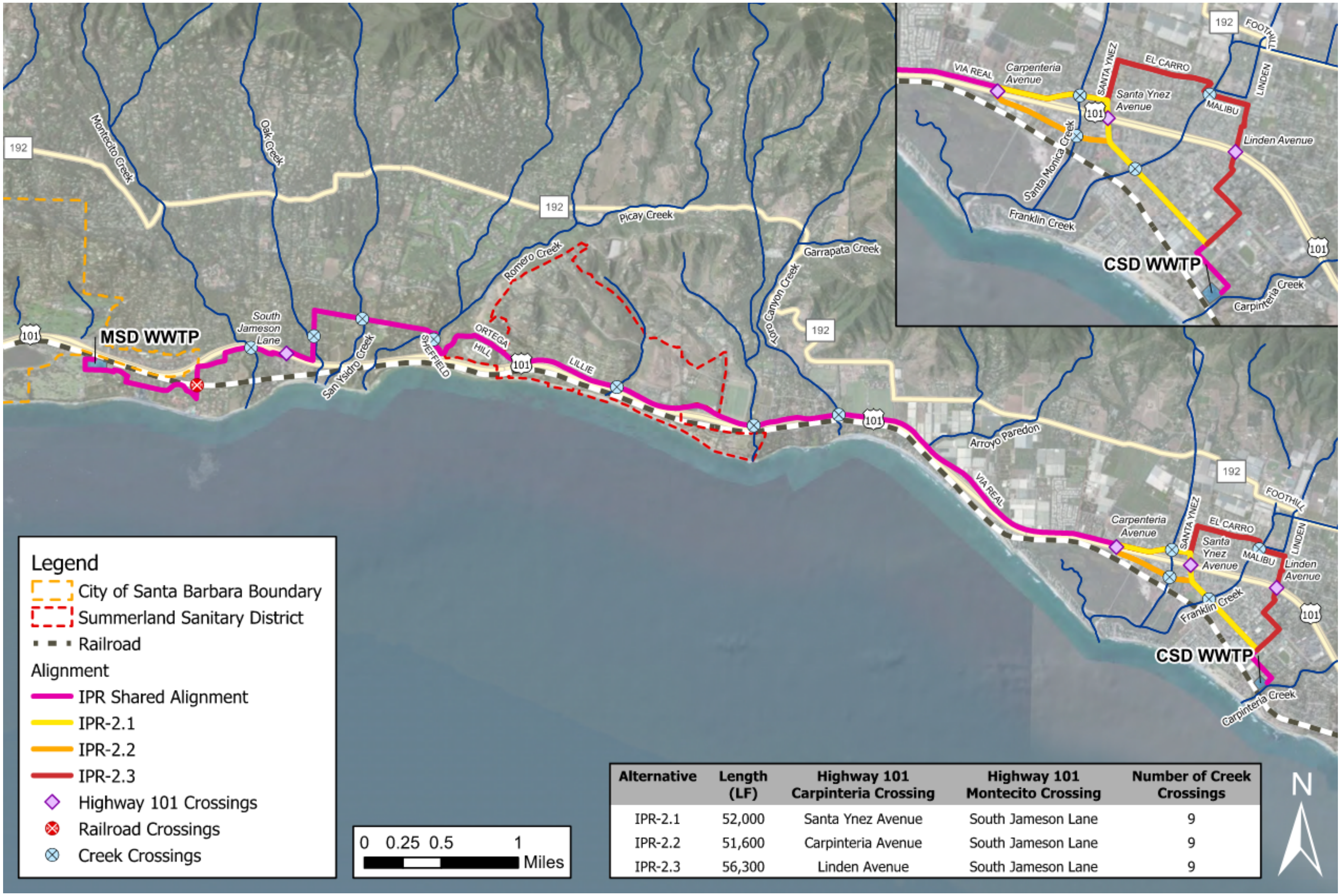
1. IPR 2 alternative (including subalternative alignments IPR-2.1, IPR-2.2, and IPR-2.3) would send 0.7 mgd secondary treated water to the CSD WWTP for advanced treatment as part of an expanded CAPP AWPF, conveyance, and injection. (Figure 9.9)
2. IPR 3 alternative would include advanced treatment at the MSD WWTP and sending 0.56 mgd of purified water to the injection well sites. (Figure 9.10)

The difference in the two primary Carpinteria IPR alternatives is the location of the AWPF required to meet drinking water standards for treatment before eventual injection into the Carpinteria Groundwater Basin. Infrastructure components for the two primary alternatives includes effluent pump station and conveyance piping, and connections to convey either secondary treated water (IPR-2.1, IPR-2.2, and IPR-2.3) or purified water (IPR-3.1).

Each alternative includes a new groundwater production well for CVWD to use the new IPR water. MWD is assumed to receive a similar amount of surface water delivered from Cater WTP in exchange for the purified water injected into the groundwater basin. MWD's exchange volume is assumed to be 90% of the volume of injected water based on leaving behind 10% of recharged water, which is typical for groundwater banking projects.

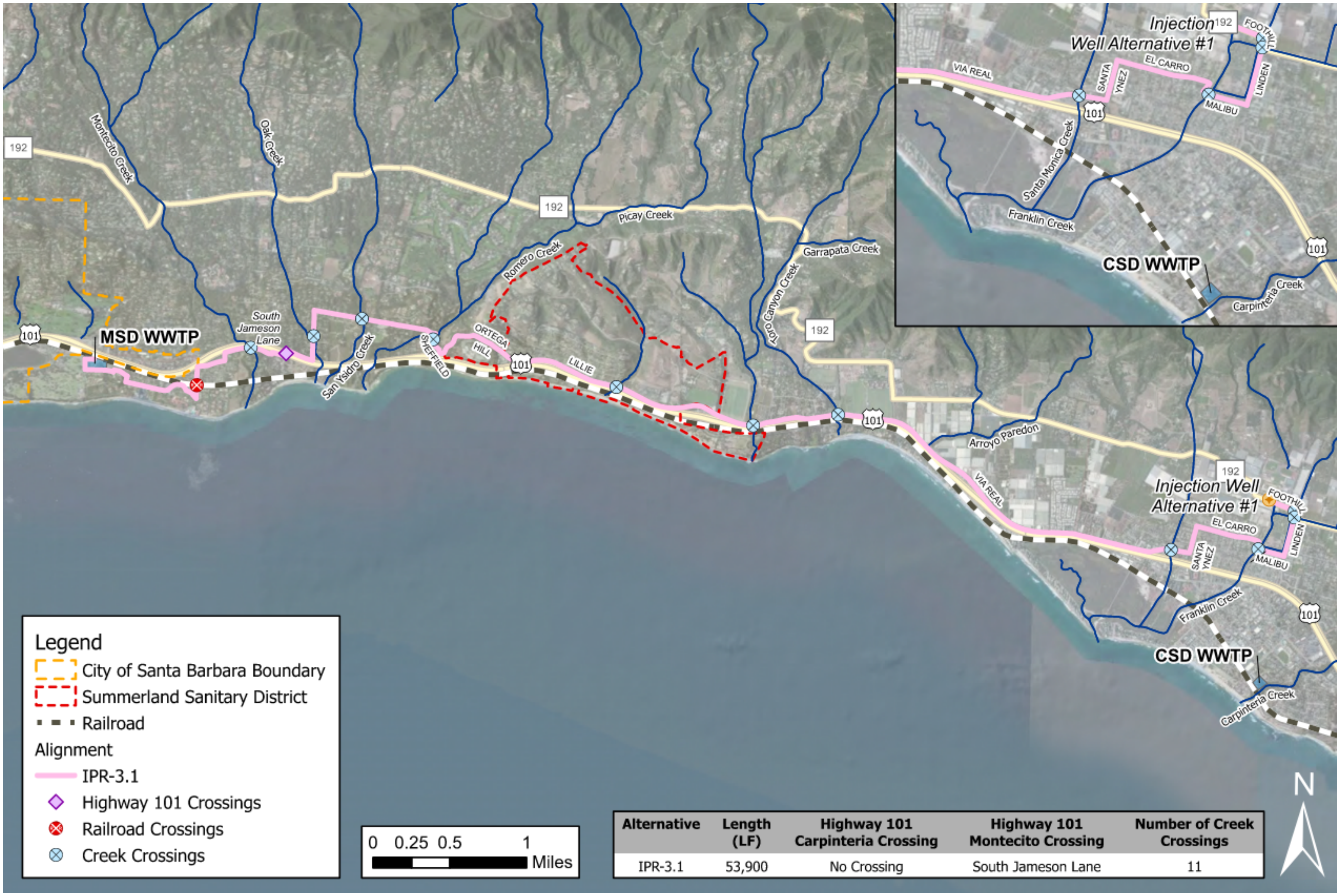
---

[2] A third alternative was considered - send raw MSD wastewater from the MSD WWTP to the CSD WWTP for secondary treatment and then incorporation into an expanded CAPP AWPF, conveyance, and injection. However, TM2: CSD and Santa Barbara WRP Capacity evaluated the feasibility of sending raw wastewater to CSD, and while capacity for fully equalized flow marginally exists, CSD would require plant expansion to maintain operational flexibility. As such, this third alternative was not further investigated.



Alternative	Length (LF)	Highway 101 Carpinteria Crossing	Highway 101 Montecito Crossing	Number of Creek Crossings
IPR-2.1	52,000	Santa Ynez Avenue	South Jameson Lane	9
IPR-2.2	51,600	Carpinteria Avenue	South Jameson Lane	9
IPR-2.3	56,300	Linden Avenue	South Jameson Lane	9

Figure 9.9 Carpinteria IPR 2 (CAPP Treatment) Alignment Alternatives



Alternative	Length (LF)	Highway 101 Carpinteria Crossing	Highway 101 Montecito Crossing	Number of Creek Crossings
IPR-3.1	53,900	No Crossing	South Jameson Lane	11

Figure 9.10 Carpinteria IPR 3 (MSD Treatment) Alignment Overview

9.5.1 Design Criteria

Criteria and assumptions were developed to aid in the preliminary sizing of infrastructure. The IPR water will be delivered on a near constant basis with no demand variability. The criteria for the IPR alternatives distributed infrastructure (piping and pump capacity) are provided in Table 9.12 and assume equalized treated water flow at MSD WWTP.

Table 9.12 Carpinteria IPR-2 – Hydraulic Design Criteria

Criteria	Units	Value	Notes
Maximum Design Flow	gpm	486	Equalized, average dry weather flow (0.70 mgd from Table 9.1)
Target Operating Flow	gpm	486	Same as Maximum Design Flow
Minimum Operating Flow	gpm	437	10% turndown of Target Operating Flow
Highest Delivery Elevation	ft amsl	255	Highest elevation in pipeline (205 ft) plus 50ft additional head
Delivery Pressure (to storage)	psi	10	

Table 9.13 Carpinteria IPR-3 - Hydraulic Design Criteria

Criteria	Units	Value	Notes
Maximum Design Flow	gpm	389	0.56 mgd from Table 9.1
Target Operating Flow	gpm	389	Same as Maximum Design Flow
Minimum Operating Flow	gpm	175	10% turndown of Target Operating Flow with 50% of RO equipment off
Highest Delivery Elevation	ft amsl	255	Highest elevation in pipeline (205 ft) plus 50ft additional head
Delivery Pressure (to injection well)	psi	10	

Based on the hydraulic analysis, a minimum 8-inch nominal diameter is anticipated for the Carpinteria IPR-2 and IPR-3 alignments.

For IPR-2 the pump station will be designed to accommodate a range of plant effluent flows. The pump station will have 3 duty pumps and 1 standby pump. Pumps are assumed to be on variable frequency drives to accommodate the lowest flow scenarios. For IPR-3, the pump station will be designed to accommodate the range of RO flows. The pump station will have 2 duty pumps and 1 standby pump. Pumps are assumed to be on variable frequency drives to accommodate the lowest flow scenarios.

Results of the hydraulic analysis for both alternatives are included in Appendix 9B. The analysis showed that the range of operating flows (minimum, target, and maximum) could be met with the pump configuration. As shown in Appendix 9B, the minimum and target operating flow conditions could be met with a single pump by reducing speed with a VFD. Similarly, the maximum operating flow could be met with two pumps on reduced speed. Additional details such as size of pumps for the recommended alternative are included in Section 9.5.4.

9.5.2 Carpinteria IPR-2 Alternative Comparison

This section describes the assessment and ranking that was completed for the alignments, providing a recommendation for selecting an alignment.

As discussed in Section 9.3.1.3, several alignment options were considered to cross US 101 and the list was narrowed to three preferred US 101 crossings. The South Jameson Road (at Miramar) crossing is assumed for the IPR-2 alternatives to be consistent with the recommended alternatives with NPR-1 alternative. From the MSD WWTP to Sheffield Drive, the IPR-2 alternative alignments follow the recommended Montecito NPR-1.1. Analysis for the IPR-2 alternative alignments will begin at the point of divergence from NPR-1.1 at Sheffield Drive and San Leandro Lane.

As shown on Figure 9.9, the Carpinteria IPR 2 alternative alignments differ at the second US 101 crossing location in Carpinteria and the associated pipeline alignments to and from the crossing points:

- IPR 2.1 – Second US 101 crossing in Carpinteria at Santa Ynez Avenue
- IRP 2.2 – Second US 101 crossing in Carpinteria at Carpinteria Avenue
- IPR 2.3 – Second US 101 crossing in Carpinteria at Linden Avenue

The following subsections describe the alternatives in Carpinteria IPR alternatives.

9.5.2.1 Alignment Considerations

Shared Alignment

- Music Academy of the West: Similar to NPR, the alignment would require an easement through the academy property.
- Max Elevation: The alignment gains over 100 ft of elevation in less than a quarter mile (average slope of 8%) before reaching the highest altitude at the top of Ortega Hill Road. This elevation was used as the maximum pumping elevation in the hydraulic analysis.
- Ortega Hill Road: Based on review of field markings, the portion from Sheffield Drive to Ortega Ridge Road includes sanitary sewer, a 16-inch high pressure gas main, potable water, and telecommunications. The presence of these utilities in a narrow and winding road may prove difficult in locating a feasible route for a new recycled water pipeline. Easements may need to be purchased through the commercial property at the top of Ortega Hill for portions of the alignment.
    - Alternatively, the alignment could follow the bike path that parallels Highway 101. This would require an easement from Caltrans and utility investigation. The alignment alternative should be evaluated if this recycled water alternative is selected.
- Lillie Avenue: Based on review of field markings, this segment appears to contain a high-pressure gas main as well as sanitary sewer and potable water mains. Lillie Avenue transitions to Via Real and the alignment route continues.
- Toro Canyon Creek: Creek is crossed via an aerial bridge crossing along Via Real.
- Unnamed Creek: Creek is crossed via an aerial bridge crossing along Via Real.

Figure 9.11 shows a typical bridge crossing along the north side of US 101. Figure 9.12 shows the top of Ortega Hill Road with dense utility backdrop as shown by presence of existing field markings.

Figure 9.11 Typical Bridge Crossing for Carpinteria Alignments

Figure 9.12 Ortega Hill Road Existing Utility Backdrop

IPR-2.1

- US 101 Crossing: Trenchless (jack and bore) from Santa Ynez Avenue to the hotel property located at 4558 Carpinteria Avenue. Easements will need to be secured to route the pipeline with the hotel parking lot to Carpinteria Avenue where the alignment will cross to 7th Street.
- Franklin Creek Crossing: Along 7th Street the alignment will cross Franklin Creek via an aerial bridge crossing.

IPR-2.2

- US 101 Crossing: Trenchless (jack and bore) from Via Real to the Carpinteria Avenue offramp from US 101 South. The lanes of Carpinteria Avenue form a tear drop shaped park near the offramp from US 101 South. The park includes a small grass area, several trees, and a welcoming sign for City of Carpinteria. This tear drop shaped area would provide sufficient space to cross US 101 via trenchless jack and bore to Via Real. The location of the crossing at Via Real is across from a community church. The church property is quite large with minimal development and may provide a suitable location for the start of the trenchless jack and bore or at minimum a construction laydown area.
- Santa Monica Creek Crossing: Along Carpinteria Avenue via an aerial bridge crossing located on Carpinteria Avenue.
- Franklin Creek Crossing: Along 7th Street via an aerial bridge crossing.

Figure 9.13 shows the existing US 101 turnoff onto Carpinteria Avenue. US 101 lanes are located on right of photo.

IPR-2.3

- El Carro Lane: There appears to be two waterlines with one located in each lane and a sanitary sewer in the middle. The presence of these utilities requires additional research into alignment positioning and may require DDW waivers if offsets can't be met.
- Franklin Creek Crossing: Along Malibu Drive via an aerial bridge crossing.
- US 101 Crossing: via trenchless jack and bore from Linden Avenue (north of highway) frontage road to an area just west of Linden Avenue (south of the highway) that used to be the former offramp before the US 101 widening project. Historical photos on Google Earth® and Street View® indicate the area was used for installation of a gas line crossing. Additional utility research will be required if this alignment is part of the selected project.

Figure 9.14 shows the potential north side of the crossing at Linden Avenue. US 101 lanes are located just behind sound wall. Existing utility background (gas lines and markers) are present in foreground of photo.

Figure 9.13 Carpinteria Avenue US 101 Crossing (south end)

Figure 9.14 Linden Avenue US 101 Crossing (north end)

9.5.2.2 Alignment Comparison

The Carpinteria IPR 2 alternative alignments differ at the second US 101 crossing location in Carpinteria and the associated pipeline alignments to and from the crossing points, which impacts pipeline length, cost, and community impacts.

All alternative alignments are over 9 miles, stretch through three distinct shoreline communities (Montecito, Summerland, and Carpinteria), and have the potential for significant community opposition as well as the need for extended easement negotiations. All alternative alignments have shared segments with potential for complicated impacts from existing utilities. Portions of the shared segments have existing large diameter and high-pressure gas mains as well as potable water, sanitary sewer, and telecommunications. Final design will require detailed utility research and significant potholing effort to confirm presence and location of existing utilities.

IPR-2.1

- Pipeline Length: IPR-2.1 is similar to IPR 2.2 and shorter than IPR2.3
- US 101 Crossing: The crossing location would require easement negotiation and purchase with the hotel property owner as well as financial compensation for disruption during construction. Easement acquisition adds variable cost and schedule impacts that are difficult to quantify. Costs presented for this alternative do not include easement acquisition through the hotel property.

IPR-2.2

- Pipeline Length: IPR-2.2 is similar to IPR 2.1 and shorter than IPR2.3
- US 101 Crossing: Entrance and exit pits located within existing right-of-way. Temporary easements could be secured with a church property located near the crossing location on Via Real. Negotiation and purchase with the church property owner may require financial reparation and post-construction repairs. Easement acquisition adds variable cost and schedule impacts that are difficult to quantify at this time. Costs presented for this alternative do not include easement acquisition (if needed) for access to the church property.

IPR-2.3

- Pipeline Length: IPR-2.3 is the longest of the three alternatives.
- US 101 Crossing: The crossing could be completed with jack and bore entrance and exit pits located within existing right-of-way. The north pit would be located within a Linden Avenue frontage road in front of houses. The south pit is located within an area that used to be the former southbound US 101 offramp for Linden Avenue but is no longer used. Temporary or permanent easements do not appear to be needed from private property owners.

Comparison Summary

Table 9.14 includes a summary of the analysis for each alternative. IPR-2.2 is the recommended alternative alignment because it has the most feasible crossing. The location of the IPR-2.1 US 101 crossing in Carpinteria has the most unknowns and will require negotiation of easements with a hotel property owner. The location of the IPR-2.3 US 101 crossing in Carpinteria also has unknowns related to the presence of other existing utilities that may be crossing the highway at the same location and impacts to adjacent residences.

Table 9.14 Summary of IPR Alternatives

Criteria	IPR-2.1 (2nd US 101 crossing at Santa Ynez Ave)	IPR-2.2 (2nd US 101 crossing at Carpinteria Ave)	IPR-2.3 (2nd US 101 crossing at Linden Ave)
Cost	$33.4 Mil	$33.3 Mil	$36.3 Mil
Unit Cost	$3,100/AF	$3,100/AF	$3,200/AF
Pipeline Length	52,000 lf	51,600 LF	56,300 lf
Demand	560 AFY	560 AFY	560 AFY
Summary of Benefits	• No apparent benefits	• More ideal US 101 crossing location	• Likely no additional easements needed
Summary of Risks	• US 101 crossing has significant unknowns due to trenchless crossing in hotel property • Utility unknowns on Ortega Hill Rd • Ownership and maintenance of MSD/MWD pipeline in multiple jurisdictions	• Utility unknowns on Ortega Hill Rd • Ownership and maintenance of MSD/MWD pipeline in multiple jurisdictions	• Requires additional utility research in area of US 101 crossing to determine feasibility • Utility unknowns on Ortega Hill Rd • Ownership and maintenance of MSD/MWD pipeline in multiple jurisdictions

9.5.3 Carpinteria IPR-3

9.5.3.1 Alignment

Alternative IPR-3 follows the same alignment as IPR-2.1 from the MSD WWTP to Via Real in Carpinteria. Potential alignment issues include:

- El Carro Lane: There appears to be two waterlines with one located in each driving lane and a sanitary sewer in the middle. The presence of these utilities requires additional research into alignment positioning and may require DDW waivers if offsets can't be met.
- Franklin Creek Crossing: Along Malibu Drive via an aerial bridge crossing.
- Residential Areas: The alignment is through predominantly residential areas.

From Malibu Drive, the alignment depends on which of the three potential injection well location selected[3]. The Canalino Elementary School Well pipeline turns south on Linden Avenue and east into the Canalino Elementary School. The other two well sites are north on Linden Avenue, which transitions to Foothill Road/SR 192. At the junction with SR 192 the alignment crosses two unnamed canals via culverts. The Family Baptist Church Well site is adjacent to Foothill Road/SR 192. The Carpinteria High School Well pipeline continues west along Foothill Road/SR 192 to the Carpinteria High School.

One well site is assumed to be required for the additional flow contributed from MSD since it is similar to the design flows for the two CAPP injection wells. (Groundwater modeling is needed to

[3] Note that the potential well sites were identified for cost estimating purposes and the owners of the potential well sites have not been contacted.

confirm the injection well assumptions for MWD/MSD). Easements will need to be secured for the well site – at the two school properties or church property.

9.5.4 Project Summary for Recommended Alternative

This section provides a full project summary including distributed infrastructure components for the recommended IPR alternative. Section 9.5.1presented design criteria for the IPR alternative for sizing of conveyance infrastructure including pipelines and pump stations. Section 9.5.2 presented an assessment of IPR-2 conveyance piping alignment alternatives from the MSD WWTP to the CSD WWTP.

The hydraulic analysis showed that the pump sizing is largely dependent on the highest point which happens along a portion of a shared segment along Ortega Hill Road. As such, all IPR alternatives require similar sized pumps making the pump station located at MSD WWTP the same size. The IPR-2 alternatives will require 3 duty pumps to meet the flow requirements where the IPR-3 alternative only needs 2 duty pumps.

The distributed infrastructure for the IPR-2 project will include the following primary components: effluent pump station located at the MSD WWTP, conveyance piping for delivery to CAPP AWPF at CSD WWTP, laterals off CAPP pipelines to a new injection well site, and a new injection well.

The distributed infrastructure for the IPR-3 project will include three primary components: effluent pump station located at the MSD WWTP, conveyance piping for delivery to a new injection well site, and a new injection well.

9.5.4.1 Project Description

For IPR-2, MSD WWTP secondary effluent would be pump secondary effluent to the CAPP AWPF at CSD WWTP while the AWPF would be at the MSD WWTP for IPR-3. In each alternative, the water conveyed via an effluent pump station located at the MSD WWTP. The effluent pump station will be in a wet-well style configuration. Pump electrical equipment, motor control center (MCC), operator controls, and a hydropneumatic tank will be placed nearby as shown on Figure 9.15.

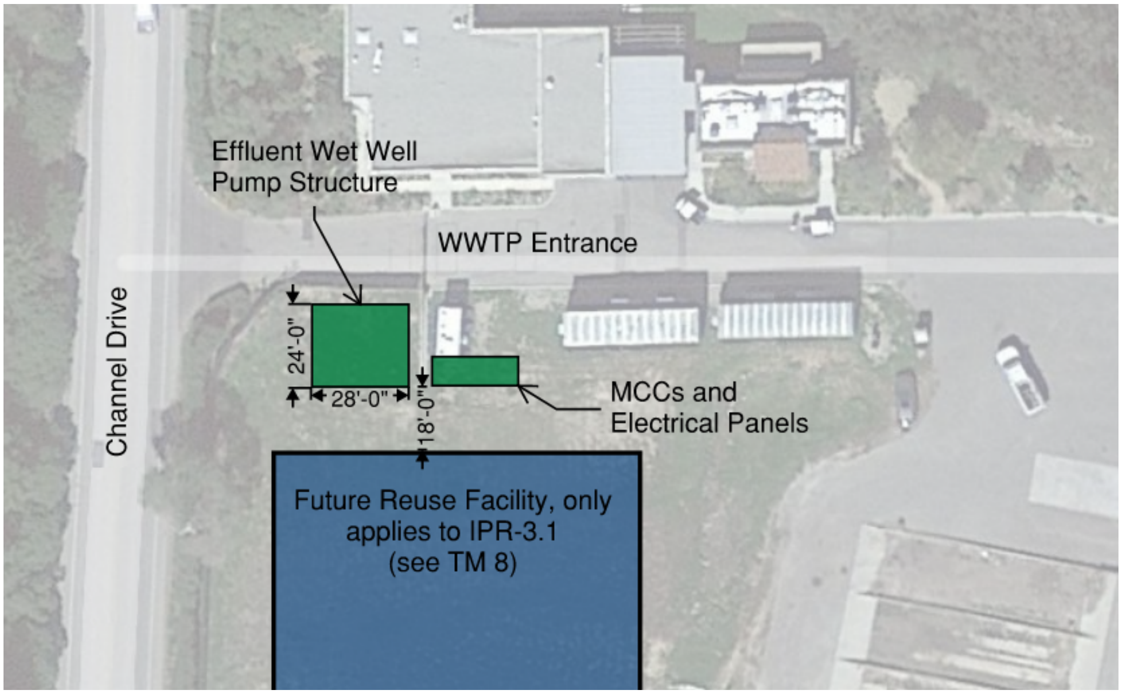


Figure 9.15 IPR Distributed Infrastructure Site Plan

Pumps will be configured in a 3+1 with three duty pumps and one standby. The structure will be designed to allow for approximately 50,000 gallons of storage with the dimensions shown on Figure 9.15.. Based on the hydraulic analysis, 20 horsepower (hp) pumps are anticipated for the pump station.

Pump control is ultimately dependent on the final alternative. It's likely the pumps will be controlled off wet well levels or a set flow point that is coordinated with the MSD WWTP treatment output. In all cases a remote pressure sensor may be required at the regional high point along Ortega Hill Road to ensure sufficient pressure in the pipeline and vacuum conditions don't occur. Level instrumentation in the wet well will provide high- and low-level overrides. Local control stations will be provided at each pump with a nearby motor control center.

As discussed previously end connections are dependent on the selected IPR project and final CAPP integration location:

- For IPR-2, flows are assumed to be discharge to the CAPP EQ basin that feeds the AWPF.
- For IPR-3, flow will be delivered under pressure to a new injection well.

9.5.4.2 Project Cost and Schedule

Table 9.15 presents a more detailed construction cost break down for the recommended IPR-2.2 alternative as well as the IPR-3.1 alternative including piping and other infrastructure components. For detailed cost breakdowns including other alternatives, see Appendix 9C.

Table 9.15 Carpinteria IPR Project Costs

Cost Item	Alternative IPR-2.2	Alternative IPR-3.1
Construction	$21,467,000	$20,697,000
Contingency (30%)	*$6,441,000*	*$6,210,000*
Engineering, Admin., and Legal (25%)	*$5,367,000*	*$5,175,000*
Total Project Cost	**$33,275,000**	**$32,082,000**
Annual O&M	$233,400	$226,900

Project schedule is dependent on several factors once the decision from MSD/MWD on the preferred recycled water alternative, including design progress, permitting, regulatory approvals, bid and construction climate, timing of Caltrans US 101 widening work, and other unforeseen factors. Given these factors, it is estimated that the engineering, funding, and permitting could be completed in 20 to 24 months, project bidding and contracting in 3 months, and distributed infrastructure construction in 32 to 34 months.

The Project is also dependent on the timing of CAPP, which is currently planned to start construction in early 2024 and start operations in late 2025. Although, timing for CAPP is subject to receipt of grant funding.

Another schedule constraint for this project is construction of the US 101 Highway crossing. As discussed in Section 9.3.2, the recommended (and lower cost) crossing would be constructed at the same time as the section of highway is constructed, which is currently projected by Caltrans for 2024 to 2025. MWD currently has plans to reinstall the crossing regardless of a future project for integration into their potable water system. Caltrans construction delays could result in delays in starting project operations if the crossing is constructed after the rest of the project.

9.6 Montecito DPR

The Montecito DPR alternative represents a project entirely within MSD/MWD service areas. This alternative would require infrastructure for the delivery of purified recycled water meeting drinking water quality standards to the influent of the MWD surface water treatment plant or potable distribution system. Infrastructure assumed under this analysis includes effluent pump station and conveyance piping, and potable connections.

9.6.1 Design Criteria

The DPR water will be delivered on a near constant basis. As such, the distributed infrastructure (piping and pump capacity) are largely tied to RO system output (overall capacity, train capacity, and turndown). A number of criteria and assumptions were developed to aid in the preliminary sizing of infrastructure. Hydraulic criteria used to develop pipeline and pump station capacities is presented in Table 9.16.

Table 9.16 Montecito DPR Hydraulic Design Criteria

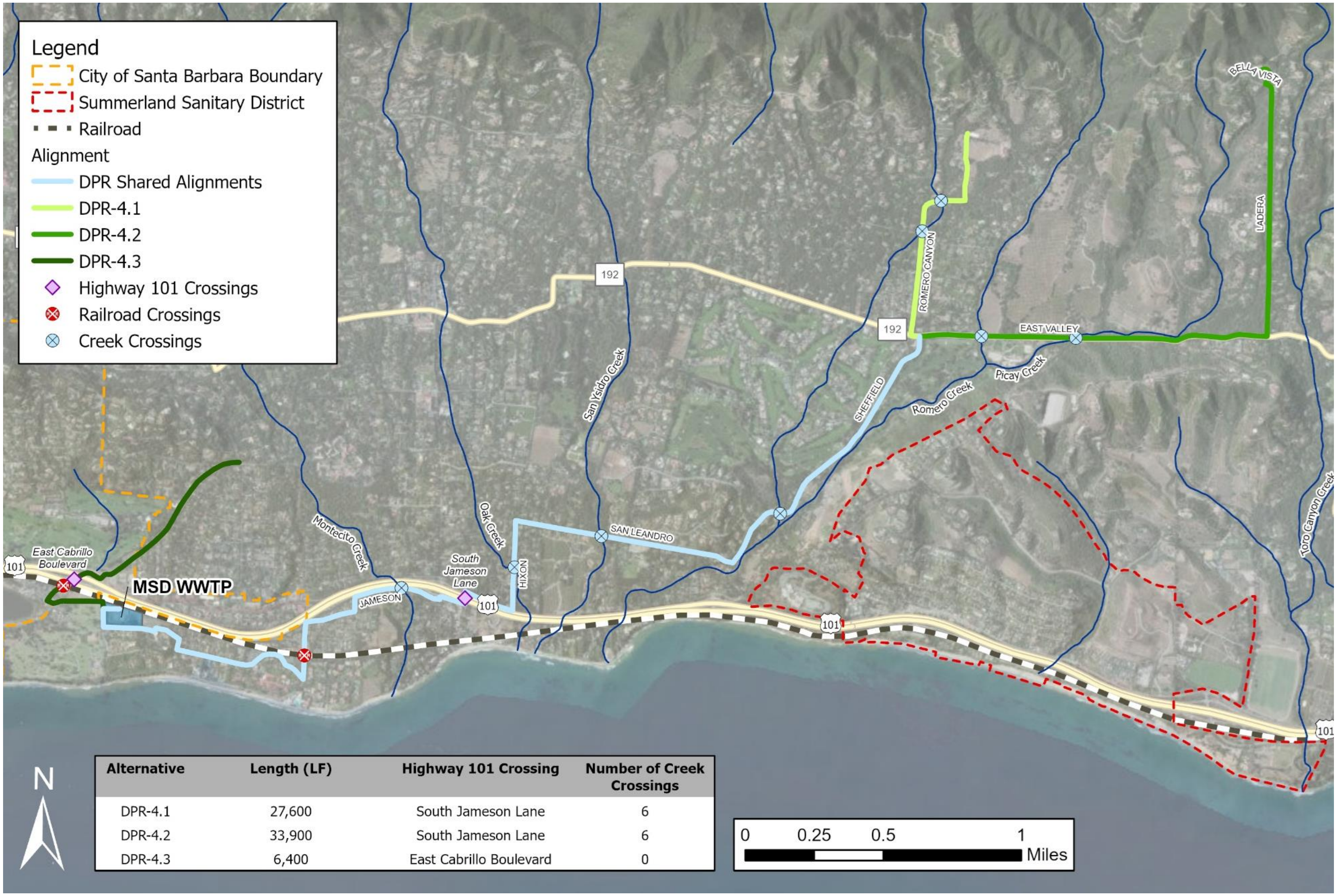
Criteria	Units	Value	Notes
RO Configuration	NA	2+1	2 duty trains and 1 redundant train at 0.35 mgd each
RO Turndown Capacity	%	10	10% turndown on each RO train
RO Efficiency	%	80	TM 8
Maximum Design Flow	gpm	389	80% of 0.7 mgd from Table 9.1
Target Operating Flow	gpm	194	80% of 0.35 mgd individual RO train capacity
Minimum Operating Flow	gpm	175	10% turndown of Target Operating Flow
Maximum Velocity	ft/s	5	Assumed maximum value
Pump Discharge Elevation	ft amsl	45	Elevation of MSD WWTP used for static head
Highest Delivery Elevation	ft amsl	1080	Elevation of the Bella Vista WTP
Friction Loss	unitless	135	Hazen-Williams C-factor for PVC pipe
Fitting Loss	%	5	Assumed percentage of friction losses
Delivery Pressure (to potable water system)	psi	135	As reported by MWD
Delivery Pressure (to WTP influent storage)	psi	10	

Notes:

A hydraulic analysis was performed using the criteria above for three alignment alternatives (Figure 9.16):

- DPR 4.1 – to Romero Canyon Reservoir
- DRP 4.2 – to Bella Vista WTP
- DPR 4.3 – to nearest large diameter (≥ 12-in) potable main

The terminating location at each alternative is meant to provide bounds on the project for various options (i.e., reservoir, WTP, and direct connection). Other reservoirs or direct system connection points could provide additional benefits and should be evaluated during future preliminary design.



Alternative	Length (LF)	Highway 101 Crossing	Number of Creek Crossings
DPR-4.1	27,600	South Jameson Lane	6
DPR-4.2	33,900	South Jameson Lane	6
DPR-4.3	6,400	East Cabrillo Boulevard	0

Figure 9.16 Montecito DPR Alignment Alternatives

The conveyance pipeline sizing was calculated balancing maximum velocity and friction loss. A minimum 10-inch nominal diameter is anticipated for the Montecito DPR-4.1 and DPR4.2 alignments. The Montecito DPR-4.3 alignment can accommodate an 8-inch nominal diameter pipeline due to the lower overall pipeline length and resulting less friction headloss. Using anticipated head losses, the hydraulic analysis was used to further determine the future pump design point and preliminary system curve. TM 8 includes analysis and preliminary sizing of the reverse osmosis (RO) system. Treatment trains with RO systems have limited turndown capacity, and the effluent pump station will be designed to accommodate the range of RO flows. Similar to the RO configuration (2 duty trains and 1 standby train) the effluent pump station will have 2 duty pumps and 1 standby pump. Pumps are assumed to be on variable frequency drives to accommodate the 10 percent (%) turndown of each RO train as well as anticipated demand-based flow variability.

9.6.2 Alignment Analysis and Recommendation

Several alignment options were considered based on review and selection of a narrowed list of preferred US 101 crossings. For the purposes of the Montecito DPR analysis, the preferred a portion of the NPR-1.1 alignment was used for the US 101 crossing at Miramar. As shown on Figure 9.16, the alternative alignments presented in the following section differ only at the MWD potable water system connection point. The following subsections describe the alternatives in Montecito DPR alignments and connection points.

Figure 9.17 shows the bridge crossing at Romero Creek along Sheffield Drive.

Figure 9.17 Romero Creek Crossing on Sheffield Drive

9.6.2.1 Alignment Considerations

DPR-4.1

Romero Canyon Road: Narrow semi-rural road with existing potable water line, sewer line, and gas main. Alignment follows Romero Canyon Road as it bends east before turning on a private driveway to access MWD's Romero Reservoir.

DPR-4.2

From Sheffield Drive the alignment will turn east on East Valley Road/SR 192. Along East Valley Road/SR 192 the alignment will cross two creeks, Romero Creek and Picay Creek, via aerial bridge crossings. From East Valley Road/SR 192 the alignment will turn north on Ladera Lane. The alignment will follow Ladera Lane north before briefly turning west on Bella Vista Drive. The alignment will then turn on a private driveway to access MWD's Bella Vista WTP.

Figure 9.18 shows a secondary Romero Creek crossing on East Valley Road/SR 192.

Figure 9.18 Romero Creek Crossing at East Valley Road/SR 192

DPR-4.3

The alignment for alternative DPR-4.3 differs from DPR-4.1 and DPR-4.2. The alignment exits the west side of the MSD WWTP and heads west along Channel Drive, then turning north onto East Cabrillo Boulevard. From East Cabrillo Boulevard the alignment will go under US 101 overpass, through Old Coast Highway and continuing north on Hot Springs Road. The alignment will follow a long east trending sweep in Hot Springs Road before connecting with the MWD system at the intersection of Hot Springs Road and Sycamore Canyon Road.

9.6.2.2 Hydraulics Requirements

DPR-4.1

MWD's Romero Reservoir is located at approximately 550 ft elevation and is lower in elevation than MWD's Bella Vista Water Treatment Plant (WTP) which is the connection point for alternative DPR-4.2. The lower elevation (smaller required static head) requires smaller pumps (less stages) and motors (40 hp) than those required for alternative DPR-4.2. Smaller pumps are generally less capital and require less operational costs (lower energy demand).

DPR-4.2

MWD's Bella Vista WTP is located at approximately 1,085 ft elevation. The higher elevation (larger static head) requires larger pumps (more stages) and motors (75 hp) than those required for alternative DPR-4.1.

DPR-4.3

The connection point in Hot Springs Road and Sycamore Canyon Road is significant in that it represents one of the nearest large diameter pipelines (12-inches) within MWD's distribution system. Accordingly, this option also does not uniformly distribute the purified water into the MWD system, compared to DPR-4.1 and DPR-4.2, which sends all water to Bella Vista. The proposed connection point is located at approximately 180 ft elevation, which is significantly lower than the connection points for alternatives DPR-4.1 and DPR-4.2. Although the elevation is lower the pumps will need to meet the distribution system hydraulic gradient in this area (i.e., minimum regional distribution pressure). The lower elevation (smaller required static head) requires smaller pumps (less stages) and motors (30 hp) than those required for higher static head alternatives. Both alternatives DPR-4.1 and DPR-4.2 make use of existing potable water storage, however, this alternative would include additional storage (0.5 MG) at the MSD WWTP to supply the potable system during diurnal periods when potable water demand may exceed the DPR production.

9.6.2.3 Alternative Alignment Evaluation

The three alternatives (DPR-4.1, DPR-4.2, and DPR-4.3) differ primarily in the MWD potable water system connection point. Table 9.17 provides a summary of the alternatives. DPR-4.2 is the most expense of the three alternatives but it provides the only RWA connection. DPR-4.1 and DPR-4.3 are less expensive due to shorter pipelines but entail TDWA. Further considerations such as schedule, permitting, and community impacts as well as a full project description including all conveyance infrastructure components for the DPR alternative are included in Section 9.6.3

Table 9.17 Summary of Montecito DPR Alternatives

Criteria	DPR-4.1 (TDWA to Romero Reservoir)	DPR-4.2 (RWA to Bella Vista WTP)	DPR-4.3 (TDWA to Distribution System)
Capital Cost	$17.0 Mil	$20.8 Mil	$10.3 Mil
Unit Cost	$1,700/AF	$2,000/AF	$1,100/AF
Pipeline Length	29,100 LF	37,500 LF	6,380 LF
Summary of Benefits	• Enables greater distribution of DPR supply across MWD versus DPR-4.3	• Connection point allows for RWA • Enables greater distribution of DPR supply across MWD versus DPR-4.3	• Significantly shorter and cheaper • Less impacts to sensitive residential areas
Summary of Risks	• Much longer than DPR-4.3 • Impacts to sensitive residential areas	• Highest cost • Impacts to sensitive residential areas	• Integration with existing potable water system capacity

9.6.3 Project Summary

This section will provide a full project summary including distributed infrastructure components for the Montecito DPR alternative. Section 9.6.1 presented design criteria for the Montecito DPR alternative for sizing of conveyance infrastructure including pipelines and pump stations. Section 9.3 presented alignment evaluation criteria and Section 9.6.2 assessment of conveyance piping alignment alternatives from the MSD WWTP to the end potable water connection point. The distributed infrastructure for the DPR alternative will include three primary components: effluent pump station located at the MSD WWTP, conveyance piping for delivery to potable water connection point, and end connections and retrofits allowing for permitted direct potable reuse of the water.

9.6.3.1 Project Description

The effluent pump station will be in a wet-well style configuration. Pumps will be configured in a 2+1 with two duty pumps and one standby. Given potable water demand far exceeds DPR production, no smaller pump was assumed for the alternatives DPR-4.1 and DPR-4.2 since existing potable water system storage can be used to even out diurnal demands. In these alternatives pump station will deliver all produced water from the treatment system. The DPR-4.3 alternative directly connects to the system and require an additional jockey pump and storage at MSD. Instrumentation will be provided to allow for sufficient flexibility in controls including pressure, flow, and level equipment.

Pump control is ultimately dependent in this alternative on the final operation of the entire DPR system. Given the limitations on treated effluent production, it is expected controls will be based on levels in the wet well structure or a set flow rate based on treatment capacity. Level instrumentation in the wet well will also provide high- and low-level overrides.

Each alternative discharges to a different location within MWD's potable water system as summarized below:

- The DPR-4.1 alternative would discharge into the existing Romero Canyon Reservoir which is one of nine reservoirs operated by MWD.
- The DPR-4.2 alternative would discharge on the raw water side of the Bella Vista WTP for eventual treatment.
- The DPR-4.3 alternative would connect directly with a 12-inch distribution main in the intersection of Hot Springs Road and Sycamore Canyon Road.

9.6.3.2 Project Cost and Schedule

Table 9.18 presents a summary of construction cost estimates for the three alternative alignments and other infrastructure components. For detailed cost breakdowns, see Appendix 9C, Cost Estimates.

Table 9.18 Montecito DPR Project Costs

Cost Item	Alternative DPR-4.1	Alternative DPR-4.2	Alternative DPR-4.3
Construction	$10,953,000	$13,405,000	$6,639,000
Contingency (30%)	*$3,286,000*	*$4,022,000*	*$1,992,000*
Engineering, Admin., and Legal (25%)	*$2,739,000*	*$3,352,000*	*$1,660,000*
Total Project Cost	**$16,978,000**	**$20,779,000**	**$10,291,000**
Annual O&M	$162,000	$166,000	$117,200

Project schedule is dependent on several factors most importantly the decision from MSD/MWD on the preferred recycled water alternative, design progress, numerous permitting hurdles, regulatory approvals, bid and construction climate, timing of Caltrans US 101 widening work, and other unforeseen factors. In addition, the State plans to issue final DPR regulations in December 2023. Given these factors, it is estimated that the engineering, funding, permitting, and DPR regulatory compliance could be completed in 24 to 36 months, project bidding and contracting in 3 months, and distributed infrastructure construction in 23 to 25 months.

Another schedule constraint for this project is construction of the US 101 Highway crossing. As discussed in Section 9.3.2, the recommended (and lower cost) crossing would be constructed at the same time as the section of highway is constructed, which is currently projected by Caltrans for 2024 to 2025. MWD currently has plans to reinstall the crossing regardless of a future project for integration into their potable water system. Caltrans construction delays could result in delays in starting project operations if the crossing is constructed after the rest of the project.

9.6.3.3 Project Considerations

The project also has the potential to affect sensitive segments of the community including residential areas with small streets limiting work access and with potential for noise and other environmental impacts.

9.7 DPR in Santa Barbara

The Santa Barbara DPR alternative represents a regional project in partnership with the City of Santa Barbara (Santa Barbara). Santa Barbara has developed conceptual plans for a potential future DPR project that includes: new AWPF supplied from and near the Santa Barbara's El Estero Water Reclamation Plant (WRP); use of the existing NPR distribution system combined with new pipelines to deliver purified water to the Lauro Reservoir; blending with surface water supplies from Lake Cachuma and State Water Project in the reservoir; and final treatment at the

Cater Water Treatment Plant (WTP). Treated water from Cater WTP is delivered to Santa Barbara's potable water system and is conveyed to MWD via the South Coast Conduit transmission pipeline.

This alternative would convey MSD's wastewater flows to the El Estero WRP to supplement Santa Barbara wastewater flows and potentially increase the size of Santa Barbara's planned DPR project. This alternative requires infrastructure to deliver MSD treated wastewater or raw wastewater to the El Estero WRP with new pipelines and the existing the Santa Barbara collection system. Potential infrastructure includes new gravity sewer alignments, upsizing of existing Santa Barbara collection system segments, and new pipelines to convey purified water to the Cater WTP. The treated water would be conveyed to MWD via the South Coast Conduit.

Three alternatives are evaluated:

- DPR-5.1: Convey MSD dry weather flow by upsizing segments of the existing Santa Barbara collection system.
- DPR-5.2: Convey MSD dry weather flow by constructing a new gravity sewer
- DPR-5.3: Convey MSD wet weather flow (instantaneous peak) by constructing a new gravity sewer

For DPR-5.1 and DPR-5.2, these two options are either transport of treated secondary effluent to Santa Barbara (and thus maintain the operation of the MSD WWTP) or are equalized raw wastewater and require construction of a large equalization tank to handle all flow in excess of the ADWF.

9.7.1 Design Criteria

Criteria and assumptions were developed to aid in the preliminary sizing of infrastructure. The alternatives include conveyance of only MSD dry weather flows or all MSD flows (including peak wet weather flows). Santa Barbara requested that dry weather flows be delivered to El Estero WRP overnight to help increase wastewater flows to El Estero when they receive their lowest flows. The criteria for the DPR alternatives distributed infrastructure (gravity piping) are provided in Table 9.19. A hydraulic analysis was performed using an existing Santa Barbara sanitary sewer model in InfoSewer® by Innovyze.

Table 9.19 Santa Barbara DPR - Hydraulic Design Criteria

Criteria	Units	Value	Notes
MSD Dry Weather Flow (DPR-5.1 and DPR-5.2)	mgd	2.1	Average Dry Weather flow delivered over 8-hour period, Table 9.1
MSD Instantaneous Peak (DPR-5.3)	mgd	8.76	Wet Weather Flow, Table 9.1
MSD WWTP Influent Pipe Elevation	ft amsl	21.0	MSD estimate of 20.5 ft – 21.5 ft based on May 2022 field investigation
Downstream MH Elevation	ft amsl	-4.8	Elevation per City of Santa Barbara collection system model, MH located near intersection of E. Cabrillo Blvd. and Calle Puerto Vallarta
Maximum Pipe Capacity (q/Q)	unitless	0.6	Used for sizing gravity sewer pipes

Santa Barbara's existing collection system includes parts of Montecito – primarily the Coast Village Road area. A Santa Barbara sewer routes through the MSD WWTP (as shown on Figure 9.19). The Santa Barbara sewer easement provides a convenient location to connect MSD's system for a joint DPR project. The flows associated with each alternative dictate the extent and size/capacity of the upgrades required to convey MSD flows to the El Estero WRP. Preliminary discussions with both MSD and Santa Barbara indicated the preference for a gravity flow system (versus pressurized force main) if feasible from MSD WWTP to El Estero WRP. Surveying was not performed in preparation of the ERWFS, however, MSD staff were able to take field invert measurements and determine the approximate elevation of the influent line from previous surveys. Elevations would need to be confirmed during future preliminary and final design phases to confirm the extent of new gravity pipeline installation needed if this project is selected. The infrastructure components of the Santa Barbara DPR alternatives are presented in the following section.

9.7.2 Alternative Comparison

The Santa Barbara DPR alternatives differ in the discharge volume or alignment. The alternatives discussed in the following sections describe varying gravity sewer alignments to convey wastewater from MSD to Santa Barbara's El Estero. Improvements required for all alternatives, such as conveying purified water from a new AWPF to Cater WTP is discussed in the project summary (Section 9.7.3). The following subsections describe the alternatives in Santa Barbara DPR alternatives.

.

Alternative	Length (LF)	Number of Creek Crossings
DPR-5.1	5,400	0
DPR-5.2	8,200	1
DPR-5.3	11,700	1

Figure 9.19 Santa Barbara DPR Alignment Alternatives

9.7.2.1 Santa Barbara Alternative DPR-5.1

Under alternative DPR-5.1, the MSD WWTP would produce secondary effluent and effluent would be stored for discharge at night (8 hours) to the El Estero WRP. While resulting in retreating the effluent at El Estero, this option preserves the MSD treatment facilities and leaves options open for future variations of water reuse.

For this option, the storage would be sized at 0.47 MG enough to accept 16 hours of flow (0.7 mgd) during non-discharge times. The MSD effluent would discharge to the Santa Barbara system at the manhole located in the intersection of Channel Drive and East Cabrillo Boulevard. This would require approximately 1,700 ft of new 8-inch gravity that would be installed parallel to the existing 8-inch sewer. According to the model results the full capacity of the existing 8-inch is just under 0.5 mgd, therefore a parallel line would be required to release the 2.1 mgd at night (Table 9.19).

Beyond the manhole, a new 18-inch gravity sewer main would be required replacing the existing alignment along Los Patos Way and the north side of the Andree Clark Bird Refuge (Figure 9.20). The 42-acre Andree Clark Bird Refuge is bound by US 101 and includes an artificially modified estuary that supports brackish wetlands and wildlife. The park provides passive recreation opportunities such as bird watching, hiking, and biking. There are a number of sensitive wildlife species, such as tidewater goby, southwest pond turtle, and several birds protected under the Migratory Bird Treaty Act. Once through the Andree Clark Bird Refuge, the new pipe would reconnect with an existing manhole located within the Santa Barbara Zoo.

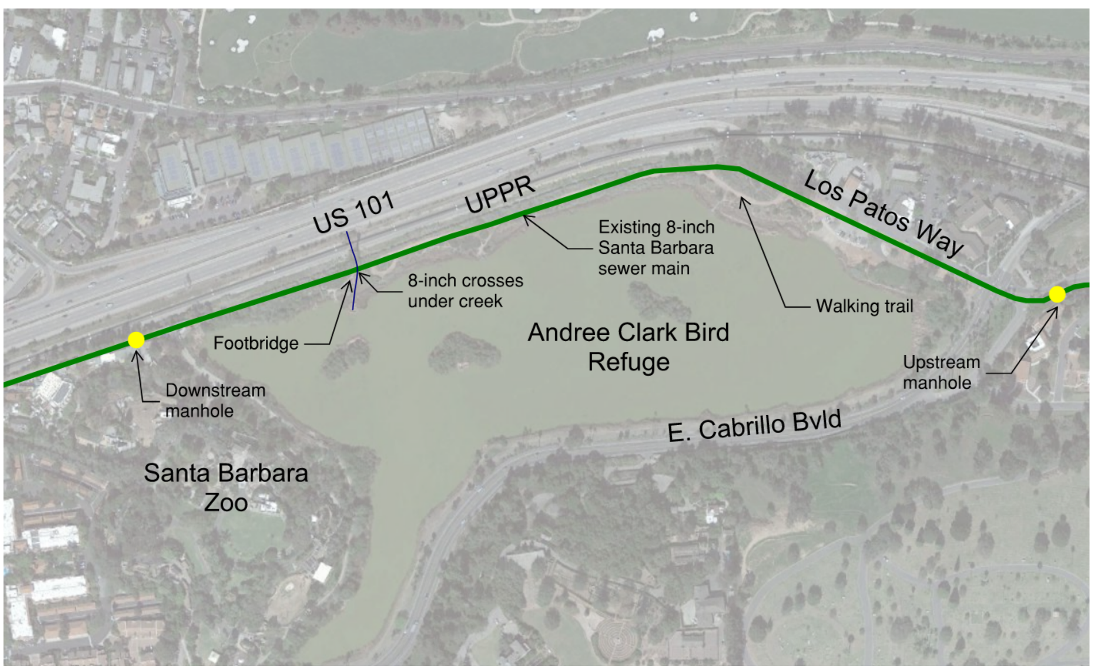


Figure 9.20 DPR-5.1 Alignment along Andree Clark Bird Refuge Area

The existing gravity main alignment is between UPRR (and US 101) to the north and the estuary to the south (Figure 9.20). The narrow corridor is ranges from approximately 80 to 160 ft bound by the natural variability of the north bank of the Andree Clark Bird Refuge estuary and the UPRR property. Replacing the main here will require overcoming numerous challenges including envi ronmental permitting, constructability, access and working constraints, and navigating a creek crossing on the upland inlet to the estuary. Figure 9.21 shows the path the existing sewer follows with an existing manhole pictured. The sewer would cross below the creek at a similar vertical alignment as the existing pipeline. The environmental permitting and resulting mitigation measures will add complexity, cost, and lengthen schedule. Construction windows may be limited to off-breeding seasons and there will be temporary impacts to recreational activities during this time. In addition, future coastal inundation and sea level rise should be considered for the pipeline alignment. MWD/MSD will need to work with Santa Barbara on how to best address this issue.

The alternative would include upsizing the existing 8-inch to an 18-inch gravity main, replacement of approximately 10 existing manholes, and tie-ins to the existing system.

Figure 9.21 Andree Clark Bird Refuge Existing Sewer and Path

9.7.2.2 Santa Barbara Alternative DPR-5.2

Alternative DPR-5.2 is similar to DPR-5.1 except that a new sewer is proposed in East Cabrillo Boulevard instead of upsizing the existing sewer. Similar to DPR-5.1, DPR-5.2 includes:

- Use of secondary effluent from MSD WWTP
- 0.47 MG storage of effluent for nighttime discharge (similar to DPR-5.1)
- 1,700 ft of new 8-inch gravity main to the manhole at Channel Drive and East Cabrillo Boulevard

Beyond the manhole, a 15-inch gravity sewer main along East Cabrillo Boulevard paralleling the coastline. The alignment along East Cabrillo Boulevard may require an inverted siphon as the hydraulic gradient may be impacted by the elevation of a culvert associated with the estuary. The gravity main will also cross Sycamore Creek. If hydraulics allow, the crossing may be suspended from the bridge or placed over the highwater mark. If the hydraulic gradient is unfavorable in this location a second inverted siphon may be required. The new gravity main would terminate at an existing manhole located at East Cabrillo Boulevard and Calle Puerto Vallarta.

Figure 9.22 shows the existing culvert at the estuary outlet and Figure 9.23 shows the existing bridge and pedestrian bridge over Sycamore Creek.

Figure 9.22 Culvert Crossing along Cabrillo Boulevard

Figure 9.23 Sycamore Creek Crossing along Cabrillo Boulevard

DPR-5.2 would be located within an existing roadway thereby reducing the environmental impact, constructability, and permitting risks. However, the DPR-5.2 carries unique risks. The alignment requires potentially two inverted siphons in close proximity due to culvert and creek crossings. DPR-5.2 is lower in elevation and closer to the ocean. The California Coastal Commission recently released new guidance for new infrastructure within the coastal zone particularly those in proximity to the coast. Sea level rise will increase risk to water infrastructure from hazards such as inflow and infiltration (I&I), saltwater intrusion, tidal inundation, rising groundwater, coastal erosion, and storm flooding (California Coastal Commission, 2021). Similar to DPR-5.1, future coastal inundation and sea level rise should be considered for the pipeline alignment. MWD/MSD will need to work with Santa Barbara on how to best address this issue.

9.7.2.3 Santa Barbara Alternative DPR-5.3

Under Alternative DPR-5.3, the MSD WWTP would not operate and all MSD flows would be conveyed to the El Estero WRP. DPR-5.3 uses the same alignment as DPR-5.2 but has a larger gravity main (24-inches) to accommodate instantaneous peak flows (up to 8.8 mgd) and continues to the El Estero WRP rather than stopping at Calle Puerto Vallarta. This would require crossing the UPRR with a new pipeline via trenchless methods by Chase Palm Park.

Similar to DPR-5.2, this alternative would require an inverted siphon at the estuary culvert as well as the potential for a second inverted siphon at the Sycamore Creek crossings. The alternative would also include 0.47 MG of storage at MSD WWTP to capture dry weather flows during the day for delivery at night, similar to delivery plans for DPR 5-1 and 5.2.

DPR-5.3 carries risks similar to DPR-5.2 due to the need for at least one and likely two inverted siphons in close proximity for culvert and creek crossings as well as sea level rise risks. DPR 5.3 also has a trenchless crossing will be required at the railroad.

9.7.2.4 Alternative Evaluation

The Santa Barbara DPR alternatives differ in the flow design criteria and alignment path. DPR-5.1 and DPR-5.2 have the same flow assumptions but the DPR-5.2 alignment follows a southerly route along East Cabrillo Boulevard. Conversely, DPR-5.2 and DPR-5.3 share similar alignments but vary in the end flow assumptions driving pipeline capacity and sizing. Ultimately the recommended Santa Barbara DPR alternative depends largely on permitting constraints and the plan for the MSD WWTP.

DPR-5.1's alignment through the Andree Clark Bird Refuge introduces permitting constraints, environmental impacts, access issues, and constructability risk that greatly lower the feasibility of this alternative. A new sewer in East Cabrillo Boulevard, which has its own permitting risks, would be the most feasible route from the MSD WWTP to the El Estero WRP. All three DPR alternatives are carried forward for the complete analysis of water reuse options.

Table 9.20 Summary of DPR Alternatives

Criteria	DPR-5.1 (2 mgd Nighttime flows)	DPR-5.2 (2 mgd Nighttime flows)	DPR-5.3 (8.76 mgd instantaneous peak)
Cost	$9.9 Mil	$11.9 Mil	$23.0 Mil
Unit Cost	$900/AF	$1,200/AF	$2,200/AF
Pipeline Length	3,665 LF	8,180 LF	11,780 LF
Summary of Benefits	• Shortest overall length	• Pipeline installed entirely in roads; No easement acquisitions • Lower residential impacts	• Same as DPR-5.2
Summary of Risks	Project setting causes: • Permitting risks • Environmental and community impacts mitigation and risks • Constructability issues due to difficult access • Ownership and maintenance of MSD/MWD pipeline in another jurisdiction	• Inverted siphons required for creek and culvert crossings • CA Coastal Commission permitting approvals • Future maintenance concerns with I&I and sea level rise • Ownership and maintenance of MSD/MWD pipeline in another jurisdiction	• Same as DPR-5.2 • Add'l required pipe to El Estero

9.7.3 Project Summary for Recommended Alternatives

The DPR alternatives include three primary components: 1) MSD WWTP modifications; 2) Gravity main from MSD WWTP to El Estero WRP; and 3) conveyance from new Santa Barbara AWPF to Cater WTP.

9.7.3.1 MSD WWTP Modifications

DPR-5.1 and DPR-5.2 propose to convey secondary effluent and DPR-5.3 propose to convey raw wastewater. As a result, MSD WWTP modifications differ greatly:

- DPR-5.1/DPR-5.2: MSD WWTP would continue operate without improvements. 0.47 MG of storage would be needed to store daytime dry weather flows for discharge to El Estero WRP at night.
- DPR-5.3: MSD WWTP would be abandoned and retrofitted to provide 0.47 MG of storage to store daytime dry weather flows for discharge to El Estero WRP at night. Wet weather flows would be conveyed without any equalization.

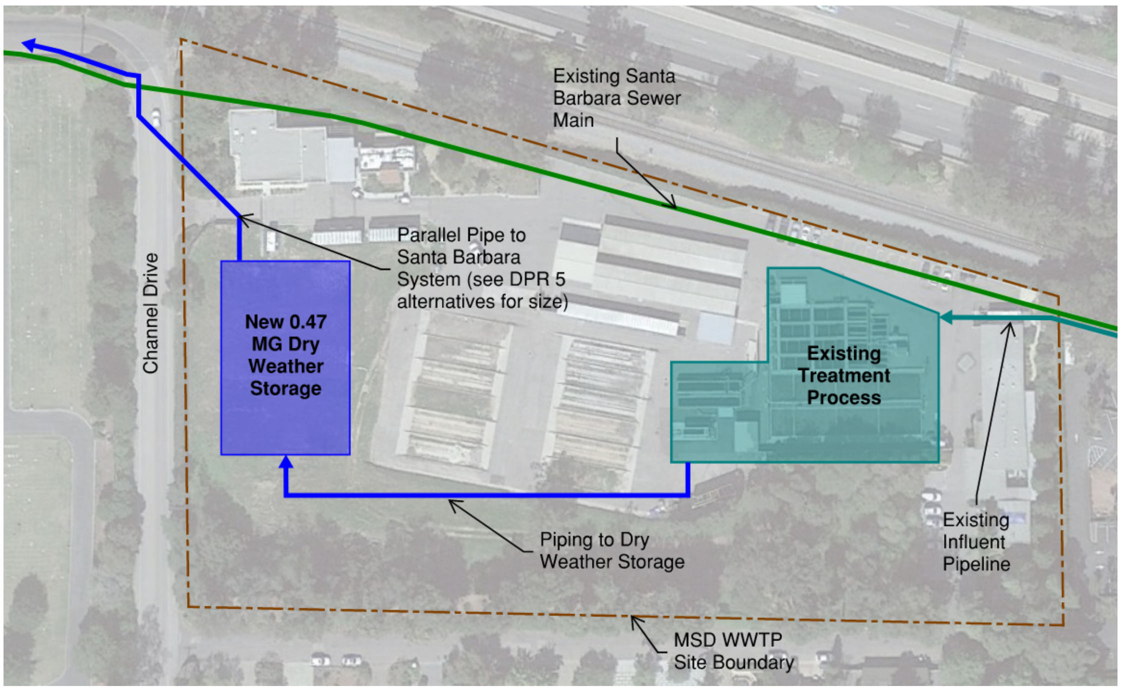


Figure 9.24 Santa Barbara DPR Infrastructure Site Plan

9.7.3.2 Purified Water Conveyance

Modifications will be required to Santa Barbara's existing recycled water conveyance infrastructure for the new DPR conveyance to the Cater Water Treatment Plant. The 2017 Potable Reuse Feasibility Study (Carollo Engineers, Inc., 2017) alternative 1B recommends repurposing an existing 12-inch NPR pipeline and adding a parallel 12-inch conveyance pipeline to accommodate the projected 5.7 mgd project flows. TM8 estimates project flows will be either 3.7 or 6.2 mgd. Required modifications to Santa Barbara's NPR system is summarized in Table 9.21.

Table 9.21 Santa Barbara DPR, Purified Water Conveyance Pipeline Sizing

Project Flows, TM 8 (mgd)	Velocity in Existing 12-inch (ft/sec)	Needs parallel pipe? (over 5 ft/sec)	Size of Parallel Pipe (in)
6.2	12.21	Yes	16
3.7	7.29	Yes	8

Modifications would include approximately 14,000 linear feet of piping at the diameters presented in Table 9.21. WSC estimates $3,864,000 (8-inch) to $5,096,000 (16-inch) of additional piping costs as presented in Table 9.22. The conveyance piping would be a shared cost between project partners and is not included in the totalized amount.

9.7.3.3 Project Cost and Schedule

Table 9.22 presents a more detailed construction cost break down for the DPR alternatives including piping and other infrastructure components. For detailed cost breakdowns including other alternatives, see Appendix 9C, Cost Estimates.

Table 9.22 Santa Barbara DPR Infrastructure Project Costs

Cost Item	Alternative DPR-5.1	Alternative DPR-5.2	Alternative DPR-5.3
Construction	$6,374,000	$7,661,000	$14,816,000
8-inch DPR Conveyance (not included in total)	*$3,864,000*	*$3,864,000*	*$3,864,000*
16-inch DPR Conveyance (not included in total)	*$5,096,000*	*$5,096,000*	*$5,096,000*
Contingency (30%)	*$1,913,000*	*$2,299,000*	*$4,445,000*
Engineering, Admin., and Legal (25%)	*$1,594,000*	*$1,916,000*	*$3,704,000*
Total Project Cost	**$9,881,000**	**$11,876,000**	**$22,965,000**
Annual O&M	$37,700	$93,700	$163,100

Project schedule is dependent on several factors but most importantly the decision from MSD/MWD on the preferred recycled water alternative and the City of Santa Barbara's plans to implement DPR. Overall project schedule is dependent on outside factors such as timing of regulations and Santa Barbara's project. The State plans to issue final DPR regulations in December 2023 and Santa Barbara currently doesn't foresee implementing DPR until at least 2035.

9.8 References

California Coastal Commission. (2021). *Draft Critical Infrastructure at Risk: Sea Level Rise Planning Guidance for California's Coastal Zone.*

Carollo Engineers, Inc. (2017). *Potable Reuse Feasibility Study.* City of Santa Barbara.

Woodward & Curran. (2019). *Recycled Water Facilities Plan.*

Appendix 9A

CUSTOMER DEMAND ASSESSMENT SUMMARY

Memorandum

Date: 8/22/2022

Prepared by: Rob Morrow, PE

Reviewed by: Michael Goymerac, PE

Project: Montecito Enhanced Recycled Water Feasibility Study

SUBJECT: NON-POTABLE CUSTOMER ASSESSMENTS

---

1 Introduction

The 2019 RWFP identified eight non-potable customers that could provide demand for recycled water within Montecito (Woodward & Curan, 2019). The eight customers include three large “anchor” customers (Birnam Wood Golf Club, Santa Barbara Cemetery, and Valley Club Montecito) as well as other smaller potential customers that could be served from the pipeline alignments between the MSD WWTP and the “anchor” customers. The RWFP recommended, as a next step, conducting customer assessments to better estimate the potential recycled water use at each site since many were difficult to estimate from potable water use records due to the use of on-site groundwater wells.

For this study, the larger customers were engaged through in person and remote discussions and a list of questions to understand potential recycled water service needs. In addition, potable use from 2018 to 2021 was reviewed for each customer based on MWD billing records. This memo summarizes the information collected from these conversations combined with data available from MWD.

The following sections summarize the latest basis for recycled water service to the five largest potential customers:

- Birnam Wood Golf Club
- Valley Club Montecito
- Santa Barbara Cemetery
- Four Seasons Resort The Biltmore Santa Barbara at Montecito
- Rosewood Miramar Beach Resort

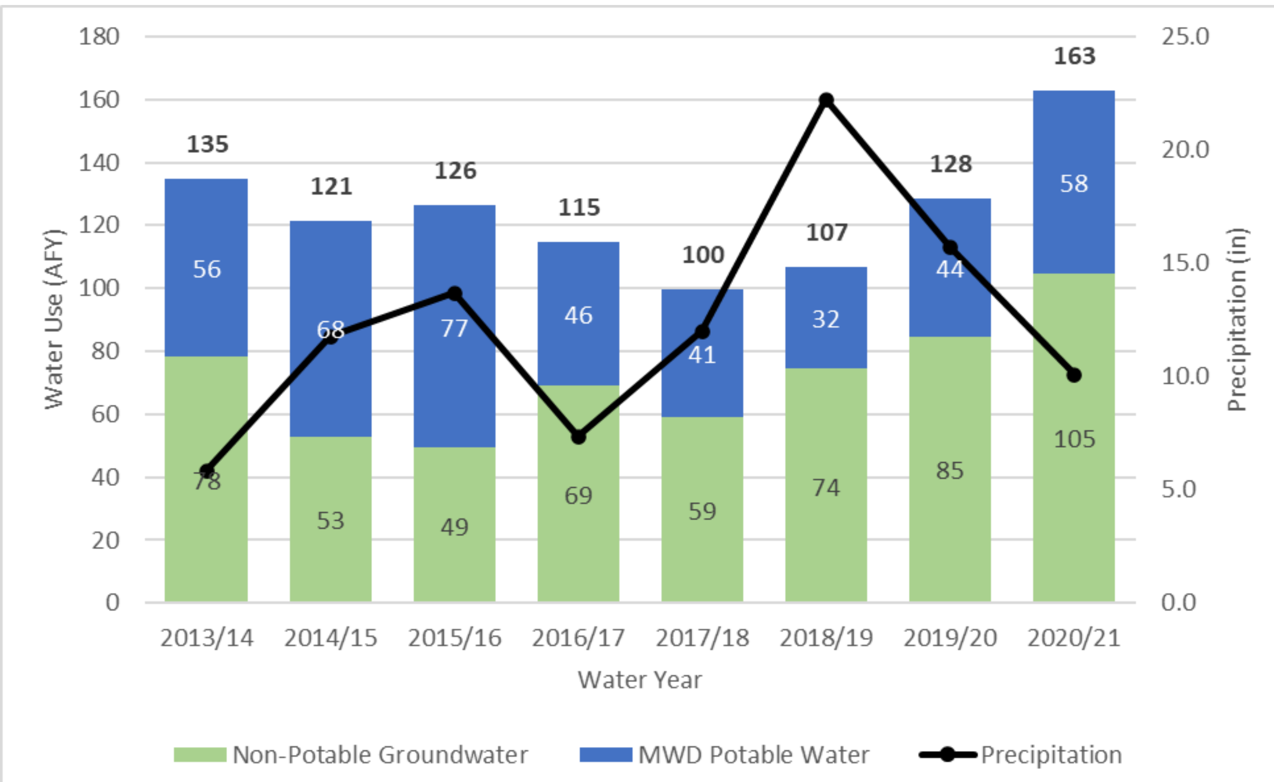
2 Birnam Wood Golf Couse

Birnam Wood Golf Club (Birnam Wood) uses untreated groundwater and potable water for irrigation. MWD operates non-potable wells at Birnam Wood and, in turn, Birnam Wood, pays for this water at the non-potable water rate. Birnam Wood generally uses groundwater first and takes delivery of potable water from MWD to meet the balance of irrigation water demand. Birnam Wood blends groundwater and potable water in a pond, which is roughly 400,000 gallons and is located off of Birnam Wood Drive. The irrigation system is supplied from the pond. Most irrigation occurs at night while some targeted watering occurs during the day. For the purpose of this study, it was assumed that recycled water would offset potable water use and be delivered to the pond.

MWD delivers non-potable groundwater to Birnam Wood from five wells – three are shallow and two are deeper: Las Fuentes well and Valley Club well. The shallow wells frequently go dry during drought conditions so the two deeper wells historically provide the bulk of groundwater to Birnam Wood.

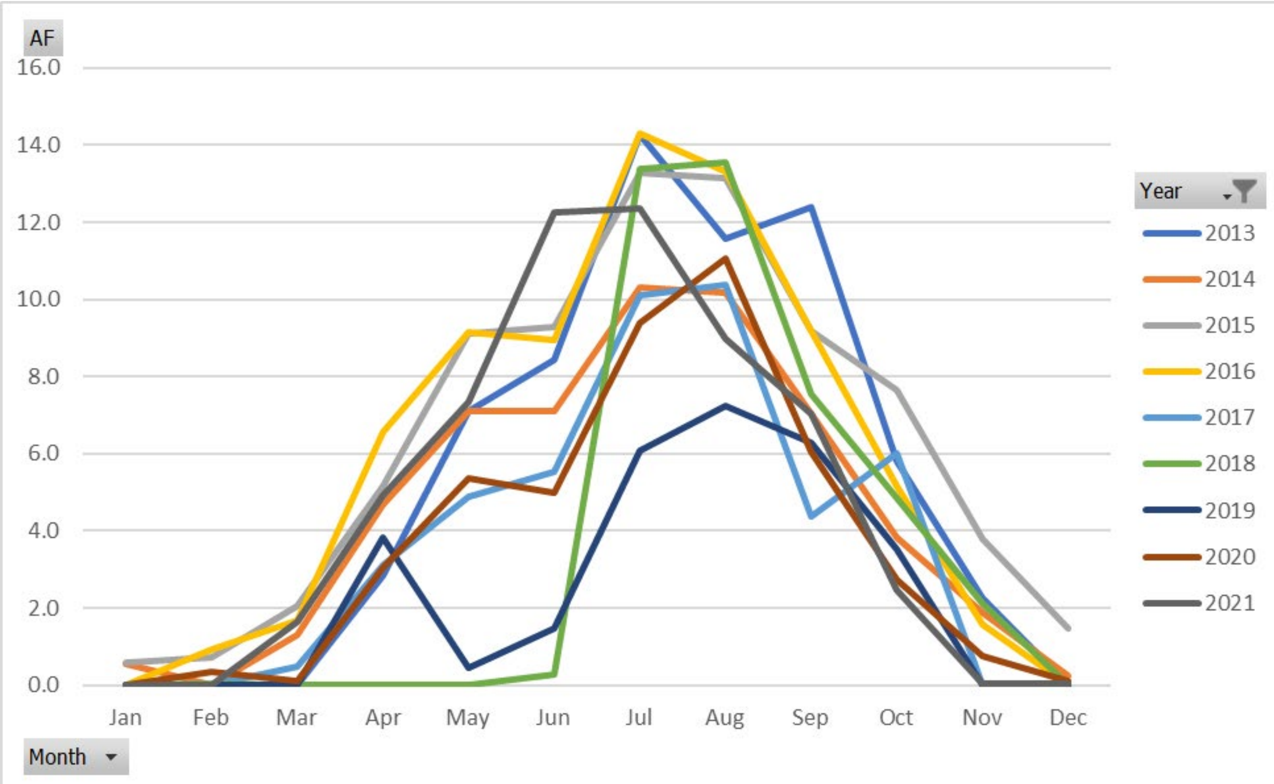
Potable water use has ranged from 32 to 58 AFY in the previous four water years. As shown in **Figure 1**, demand decreased during the previous drought as conservation measures were implemented but have rebounded in the past two years due to unprecedented dry conditions – only water year (WY) 2018/19 had precipitation (22.2 inches) greater than the 30-year average (20.0 inches) in the last 8 years. The conservation measures included removing some turf and installing Bermuda grass, which is more drought tolerant and more tolerant of a range of irrigation water quality. Bermuda grass was installed in fairways and rough areas in 2014. New grass for the greens was more recently installed. In addition, Birnam Wood is currently conducting an irrigation system audit to identify more measures to implement to reduce water use. Also, Birnam Wood is currently designing a new irrigation system.

Figure 1. **Birnam Wood Golf Course, Annual Water Use, Water Years 2013/14 – 2020/21**



As shown in **Figure 2**, monthly water use of potable water peaks in the summer months but the peak month demand varies depending on total water demand and available groundwater. In the last four years, the highest peak month demand was 13.6 AF (in 2018) while lowest peak month demand was 7.2 AF (in 2019). The monthly peaking factor (versus average demand) ranged from 2.6 to 3.9 with a median value of 3.0.

Figure 2. **Birnam Wood Golf Course, Monthly Potable Water Use, 2013 – 2021**



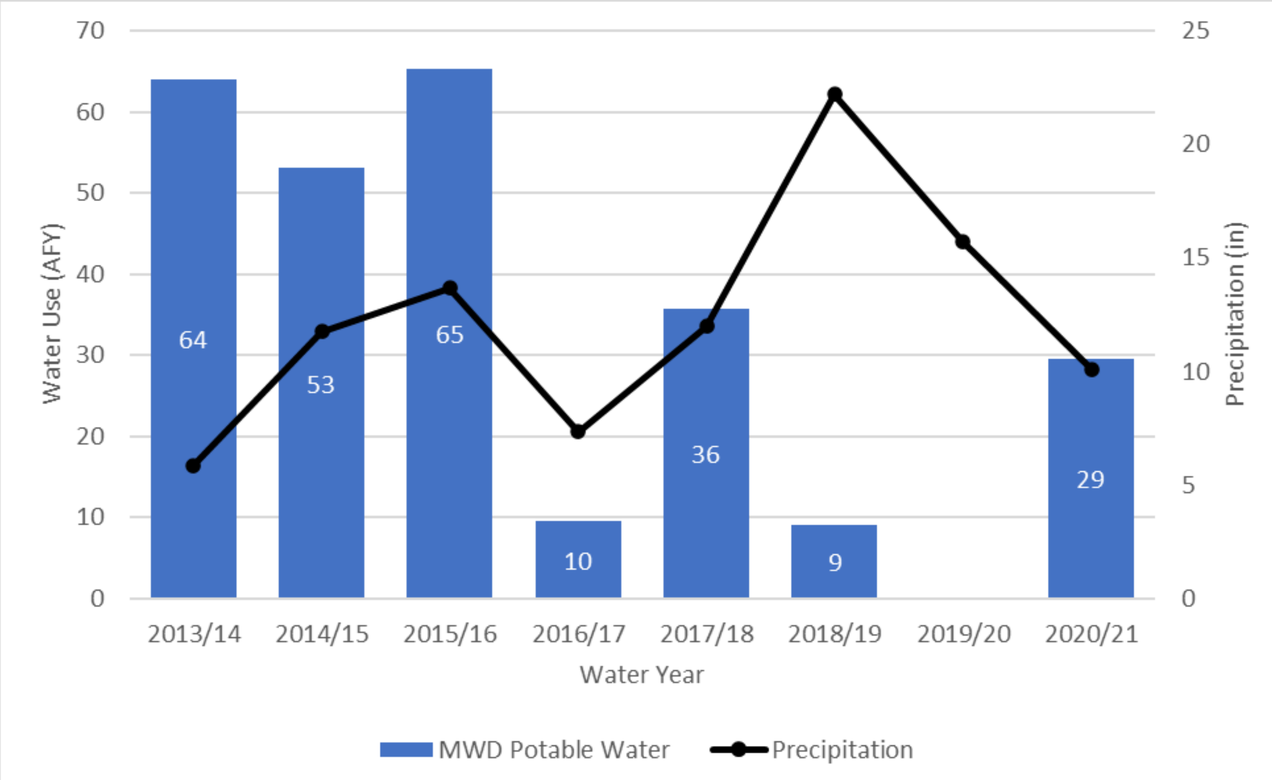
Recycled water would offset potable water but Birnam Wood has a wide range of potable water use because potable water supplements non-potable groundwater for irrigation. However, cost-effective recycled water systems must be designed to meet a more targeted range of demands so that sufficient recycled water use (e.g., sales, revenue) can justify system facilities sizes (and costs). Therefore, for Birnam Wood, the study assumes an annual average recycled water use of 43 AFY (average demand since 2018) and along with a peak month demand of 13 AF (equivalent to max month since 2018). Max day irrigation demands are typically 20% higher than peak month demand, which is equivalent to 0.20 million gallons per day (mgd).

3 Valley Club of Montecito

Valley Club of Montecito (Valley Club) previously only used MWD potable water for irrigation but the club constructed two wells in recent years for irrigation. Valley Club uses groundwater as the primary irrigation water supply and supplements with potable water when groundwater cannot meet demands. The two waters are blended in an open air reservoir located near East Valley Road and Sheffield Drive. The irrigation system is supplied from the reservoir. Recycled water would offset potable water use and be delivered to the reservoir.

Potable water use has ranged from 0 to 36 AFY in the previous four water years. (Note that, unlike Birnam Wood, groundwater use data by Valley Club is not publicly available). As shown in **Figure 3**, potable water use has decreased substantially following conservation measures implemented during the previous drought and construction of groundwater wells. The conservation measures included removing some turf and installing Bermuda grass, which is more drought tolerant and more tolerant of a range of irrigation water quality. Bermuda grass was installed in fairways and rough areas in the last 15 years. Potable water use by Valley Club has shown an inverse relation to precipitation in recent years since groundwater can meet irrigation demands in a typical year but potable water is needed following multiple dry years.

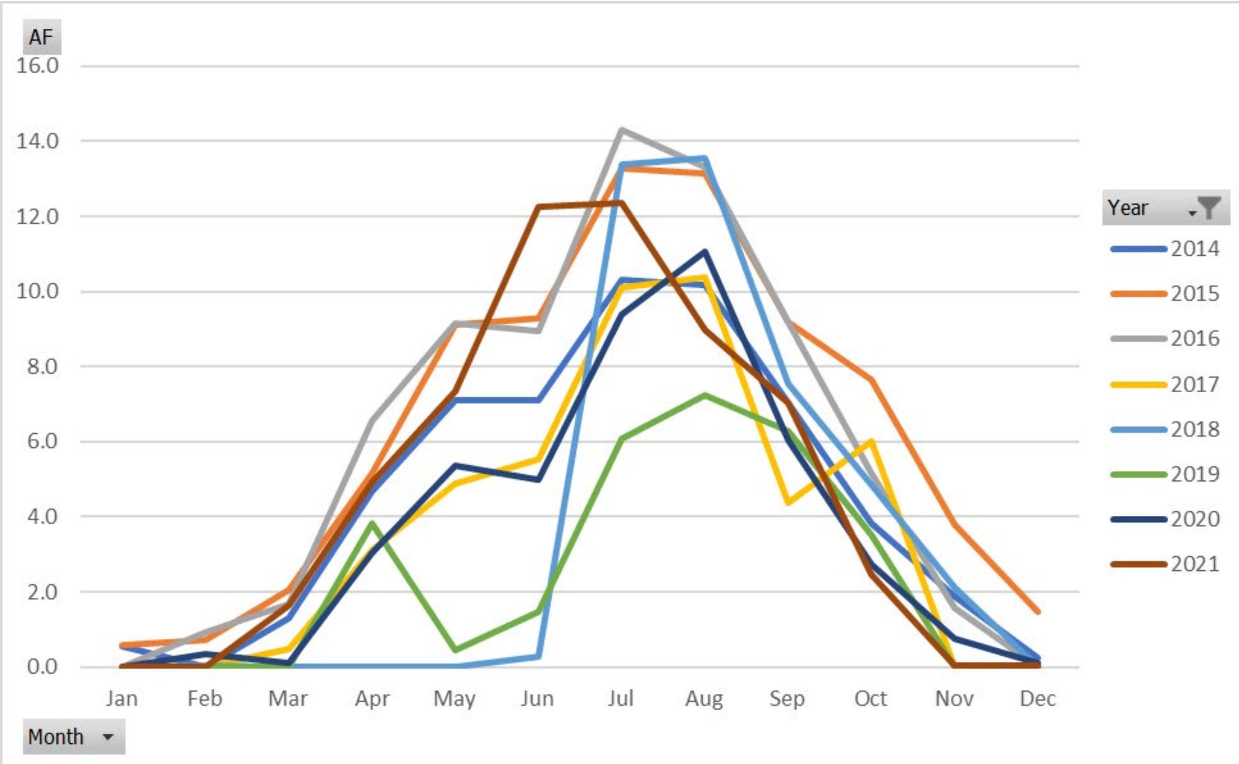
Figure 3. **Valley Club of Montecito, Annual Water Use, Water Years 2013/14 – 2020/21**



As shown in **Figure 4**, monthly water use of potable water peaks in the summer months but the peak month demand varies depending on total water demand and available groundwater. In the last four years, the highest peak month demand was 13.7 AF (in 2018) while lowest summer month demand was 0 AF (in 2019 and 2020). The monthly peaking factor (versus average demand) averaged 3.7 in years when potable water is used.

Recycled water would offset potable water use but Valley Club has a wide range of potable water use because potable water supplements groundwater for irrigation. Valley Club has used an average of 19 AFY of potable water use the last four water years, including 29 straight months without any potable water use. In years when Valley Club has needed potable water, use has averaged 37 AFY. However, cost-effective recycled water systems must be designed to meet a more targeted range of demands so that sufficient recycled water use (e.g., sales, revenue) can justify system facilities sizes (and costs). Extending a recycled water system to Valley Club requires a minimum amount of recycled water use to justify the infrastructure investment. Therefore, an annual average recycled water use of 30 AFY is assumed for Valley Club. A peak month demand of 13 AF (equivalent to max month since 2018) is assumed. Max day irrigation demands are typically 20% higher than peak month demand, which is equivalent to 0.20 million gallons per day (mgd).

Figure 4. **Valley Club of Montecito, Monthly Potable Water Use, 2013 – 2021**



4 Santa Barbara Cemetery

Santa Barbara Cemetery uses only MWD potable water for irrigation. As shown in **Figure 5**, Potable water use has ranged from 19 to 37 AFY in the previous four years with an average of 27 AFY. Based on discussions with the cemetery, annual irrigation water use is tied annual budget such that water use decreased when rates were increased during drought stages.

The cemetery receives potable water at two, 3-inch meters located along Channel Drive: 1) across from the MSD WWTP; and 2) near Fairway Road. Recycled water would be used to replace potable water used for irrigation and could be connected to the cemetery's irrigation system at these locations. However, the cemetery's potable system must be separated from the irrigation system. If a non-potable reuse project is selected, an important next step is a review of the on-site water system to evaluate system retrofit requirements.

As shown in **Figure 6**, in the last four years, the highest peak month demand was 5.7 AF (in 2018). Max day irrigation demands are typically 20% higher than peak month demand, which is equivalent to 0.09 mgd. Due to public access, recycled water use would be restricted to night time hours. Assuming 6 hours per day, this is equivalent to 260 gallons per minute (gpm) for 6 hours.

Figure 5. Santa Barbara Cemetery, Annual Water Use, Water Years 2013/14 – 2020/21

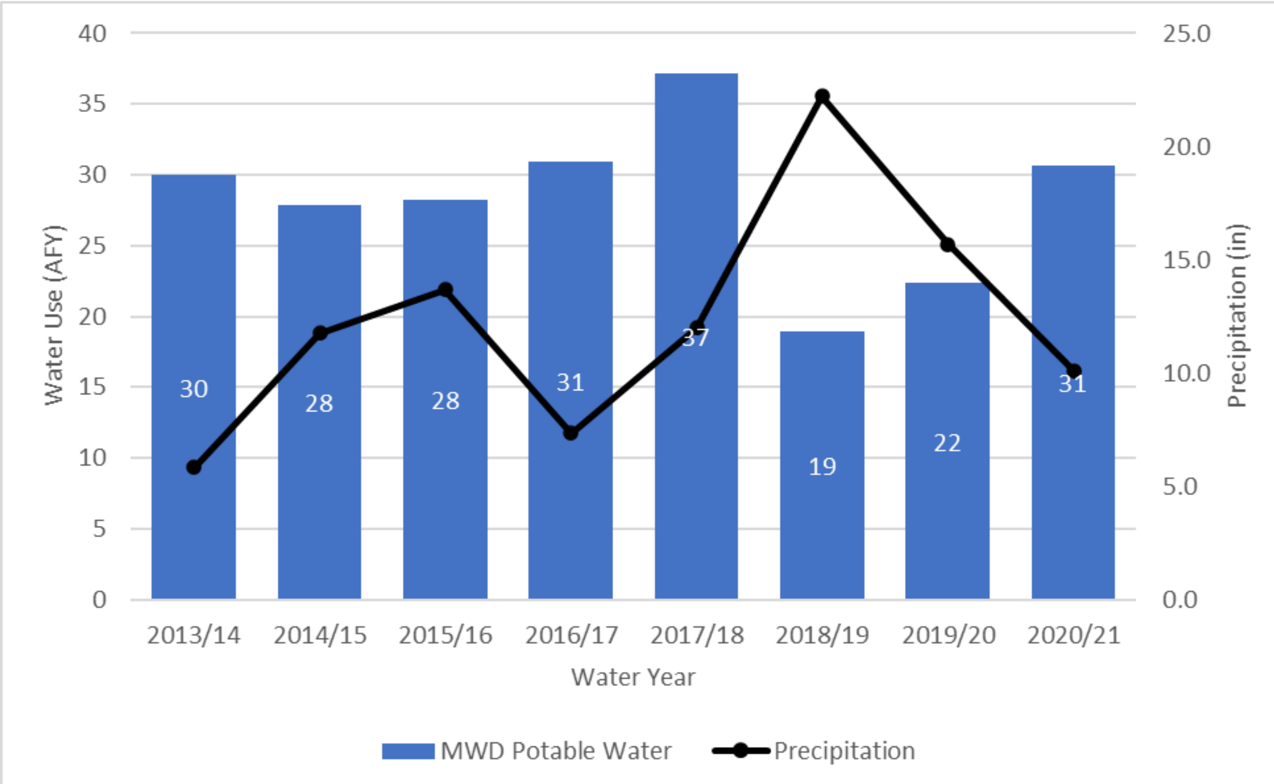
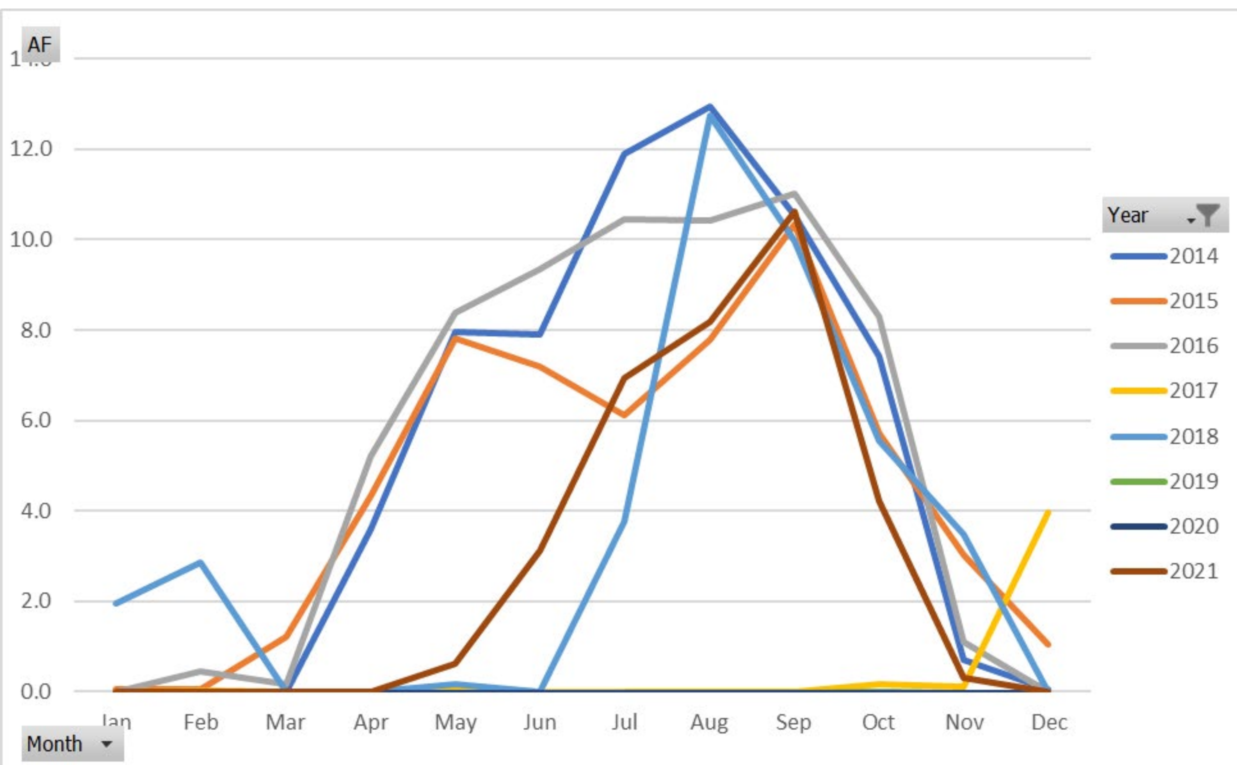


Figure 6. Santa Barbara Cemetery, Monthly Potable Water Use, 2014 – 2021



5 Four Seasons Resort The Biltmore Santa Barbara at Montecito

MWD contacted the Four Seasons Resort, the Biltmore Santa Barbara at Montecito (Biltmore) about their interest in using recycled water. The Biltmore expressed an interest in using recycled water to replace use of on-site groundwater wells with high chlorides (~500 mg/L). The majority of their irrigation system is sprinklers (versus drip).

The Biltmore does not have a separate irrigation meter and did not have an estimated irrigation demands so the previous estimate of 15 AFY is used for this estimate. If a non-potable reuse project is selected, a next step is to temporarily monitor flow in the irrigation system to more accurately estimate demand.

In addition, the Biltmore has two cooling towers that use potable water. Recycled water can be used in cooling towers; however, cooling towers tend to have high sensitivity to salinity and metals so a site-specific water quality assessment would be needed to determine feasibility of using recycled water on the cooling towers. This demand was not included in the analysis.

6 Rosewood Miramar Beach Resort

MWD contacted the Rosewood Miramar Beach Resort (Miramar) about their interest in using recycled water. The Miramar expressed an interest in using recycled water for their drip irrigation system, which includes all irrigation needs except for their "great lawn" due to potential impacts to the grass.

The Miramar does not have a separate irrigation meter and did not have an estimated demand for irrigation demands or drip irrigation demands so the previous estimate of 11 AFY is used for this estimate. If a non-potable reuse project is selected, a next step is to temporarily monitor flow in the drip irrigation system to more accurately estimate demand.

7 Water Quality

Water quality of existing irrigation water sources and projected recycled water quality are compared in **Table 1**. As shown in the table, projected recycled water from MSD has higher salinity than existing MWD potable water and MWD non-potable groundwater wells at Birnam Wood but is similar to the groundwater quality for the Biltmore and the Miramar irrigation wells. (Water quality data for Valley Club groundwater wells was not available). As a result, use of recycled water at the golf courses will likely result in the use of irrigation water with higher salinity than in current irrigation water. However, the golf courses will be blending recycled water with their groundwater supplies, which will lower manage salinity to acceptable levels.

Table 1. Supply Sources Salinity Comparison

Supply Source	Total Dissolved Solids(1) (mg/L)	Specific Conductance (umhos/cm)	Chloride (mg/L)
Projected MSD Recycled Water(2)	*1,360 – 1410*	*2,300 – 2,430*	*382 – 401*
MWD Potable Water(3)	584 – 710	872 – 1,167	6 - 148
Las Fuentes Well (Birnam Wood)(4)	750	1140	73
Valley Club Well (Birnam Wood)(4)	720	1160	149
Biltmore Groundwater Well(5)	1,330	2,210	502
Well 6A & 6B (Miramar)(6)	1,360 – 1,690	1,980 – 2,520	329 - 523

Notes:

1. MSD effluent TDS concentrations were analyzed using method EPA Method 200.1 while the other TDS concentrations were reported using Standard Method 2540, which tends to be 10% to 20% higher.
2. Range is from three samples collected in March 2022.
3. 2022 Consumer Confidence Report. Range provided from average concentration for each source (Jameson Lake, Cachuma Lake, Groundwater).
4. Sample collected on November 7, 2018.
5. Sample collected in on April 21, 2021. Well is only used for irrigation.
6. Sampled on January 28, 2022. Lower values are from Well 6A. Wells are only used for irrigation.

MWD/MSD recently contacted the City of Santa Barbara as well as the Goleta Water District (GWD) and Goleta Sanitary District (GSD) about their recycled water quality and customer's salinity concerns. Below is a summary of their feedback.

Goleta

GWD/GSD completed a study in the early 1990s that specific micro-climate of the users and the species of plants receiving the water. From this study they determined that the maximum allowable chlorides would be 300 mg/L. Current chloride concentrations are approximately 270 mg/L. They have not been made aware of any salinity issues or complaints from customers. Although, both golf courses (Sandpipe Golf Course and Glen Annie Golf Course) use recycled water for irrigation of fairways but use potable water for greens and tee boxes.

Santa Barbara

The City has been using recycled water since the early 1990s for irrigation of local schools, parks, and golf courses. Customers had initial concerns with salinity but no long-term impacts have been observed. The City completed a decade long study testing soil irrigated by recycled water in the 1990s and was unable to identify any long-term issue related to recycled water use. The study showed that salt concentration were driven by rainfall or lack of rainfall.

Recent recycled water quality averaged around 1,000 mg/L for TDS and 340 mg/L for chloride. La Cumbre Country Club had salinity concerns but after doing research concluded that they could manage the situation with the ability to blend with potable water.

8 Summary

Table 2 presents updated recycled water demand estimates for potential NPR customers. Demand estimates were developed by focusing on offsetting potable water demand; whereas the 2019 RWFP also included offsetting groundwater demands. As shown in **Table 3**, peak hour demands are projected to range from 260 gpm during the day to 430 gpm at night.

Table 2 NPR Customer Demands – Average Annual

Customer	2019 RWFP Annual NPR Demand Estimate (AFY)(1)	Private Well(s)	2018-2021 Annual Potable Use for Irrigation (AFY)	Estimated Annual NPR Demand (AFY)
Birnam Wood Golf Club	100	Yes	30 – 60(2)	40
Four Seasons Biltmore	15	Yes	N/A(3)	15(3)
Miramar Resort	11		N/A(3)	11(3)
Music Academy of West	2		N/A(3)	2
Private Residence	9	Yes	N/A(3)	--(4)
Santa Barbara Cemetery	80		16 – 34(2)	30
Ty Warner Hotels	6	Yes	N/A(3)	--(4)
Valley Club Montecito	150	Yes	0 – 35(2)	30
Total	**373**		**46 – 129**	**128**

Notes:

1. Values from 2019 RWFP (Woodward & Curan, 2019).
2. Potable water use is based on MWD meter records for meter predominantly used for irrigation.
3. Irrigation use is not metered separately so non-potable demand estimate is based on discussions with each customer.
4. Irrigation demand is assumed to be met with onsite groundwater well.

Table 3. NPR Customer Demands – Peak Periods

Customer	Estimated Annual NPR Demand (AFY)(1)	Max Day Demand (mgd)	Delivery Period(3)	Peak Hour – Day (gpm)	Peak Hour – Night (gpm)
Birnam Wood Golf Club	40	0.11(2)	Day – 12 hours	149	
Four Seasons Biltmore	15	0.04(2)	Night – 6 hours		112
Miramar Resort	11	0.03(3)	Night – 6 hours		82
Music Academy of West	2	0.01(3)	Night – 6 hours		15
Santa Barbara Cemetery	30	0.08(3)	Night – 6 hours		260
Valley Club Montecito	30	0.08(2)	Day – 12 hours	112	
Total	**128**	**0.34**		**261**	**469**

Notes:

1. Values from previous table.
2. Based on 2018 to 2021 monthly potable water use.
3. Assumes 3.0 ratio for max day to average annual demand based on 2.5 ratio for peak month to average annual demand and 20% increase for extended hot periods.
4. Irrigation with recycled water is generally restricted to nighttime for publicly accessible sites. Golf courses have on-site storage that allows for delivery outside of nighttime hours and, as publicly restricted locations, are able to irrigate during the day if needed.

9 References

Woodward & Curan. (2019). *Recycled Water Facilities Plan.*

Attachment A – Water Quality Reports

March 29, 2022

Montecito Sanitary District
Attn: Carole Rollins, Mg.
1042 Monte Cristo Lane
Santa Barbara, CA 93108

Description : Secondary Clarifier Eff (SCE)
Project : Feasibility Study

Lab ID : SP 2203948-001
Customer : 2001797

Sampled On : March 10, 2022
Sampled By : Carole Rollins, Mgr.
Received On : March 11, 2022
Matrix : Waste Water

General Irrigation Suitability Analysis

Test Description	Result				Graphical Results Presentation
Cations	mg/L	Meq/L	% Meq	Lbs/AF	Good / Possible Problem / Moderate Problem / Increasing Problem / Severe Problem
Calcium	90	4.5	20	240	**
Magnesium	46	3.8	17	130	**
Potassium	59	1.5	7	160	**
Sodium	286	12	56	780	
Anions					
Carbonate	<10	0	0	0	
Bicarbonate	140	2.3	11	380	**
Sulfate	235	4.9	24	640	**
Chloride	401	11	55	1100	
Nitrate	130	2.1	10	350	
Nitrate Nitrogen	29.4			80	
Fluoride	0.6	0.032	0	2	
Minor Elements					
Boron	0.70			1.9	
Copper	0.020			0.054	
Iron	0.030			0.082	
Manganese	<0.01			0	
Zinc	0.040			0.11	
TDS by Summation	1390			3800	
Other					
pH	7.6	units			
E. C.	2.43	dS/m			
SAR	6.10				
Crop Suitability					
No Amendments	Poor				
With Amendments	Poor				
Amendments					
Gypsum Requirement	0.9	Tons/AF			
Sulfuric Acid (98%)	7.70	oz/1000Gal			Or 19 oz/1000Gal of urea Sulfuric Acid(15/49)
Leaching Requirement	21	%			

Good — Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.
** Used in various calculations; mg/L = Milligrams Per Liter (ppm) meq/L = Milliequivalents Per Liter.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

March 29, 2022

Montecito Sanitary District

Description : Secondary Clarifier Eff (SCE)
Project : Feasibility Study

Lab ID : SP 2203948-001
Customer : 2001797

Sampled By : Carole Rollins, Mgr.
Matrix : Waste Water

Micro Irrigation System Plugging Hazard

Test Description	Result		Graphical Results Presentation		
			Slight	Moderate	Severe
Chemical					
Manganese	<0.01	mg/L			
Iron	0.03	mg/L			
TDS by Summation	1390	mg/L			
No Amendments					
pH	7.6	units			
Alkalinity (As CaCO3)	110	mg/L			
Total Hardness	414	mg/L			
With Amendments					
Alkalinity (As CaCO3)	22	mg/L			
Total Hardness	22	mg/L			
pH	5.4 - 6.7	units			

Good — Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.

Water Amendments Application Notes:
The Amendments recommended on the previous pages include:

Gypsum:
This should be applied at least once a year to the irrigated soil surface area. Gypsum can also be applied in smaller quantities in the irrigation water.Apply the smaller (bracketed) amount of gypsum when also applying the recommended amount of Sulfuric Acid and the larger amount when applying only Gypsum.

Sulfuric Acid:
These products should be applied as needed to prevent emitter plugging in micro irrigation systems and/or as a soil amendment to adjust soil pH to improve nutrient availability and to facilitate leaching of salts. Please exercise caution when using this material as excesses may be harmful to the system and/or the plants being irrigated. The reported Acid requirement is intended to remove approximately 80 % of the alkalinity. The final pH should range from 5.4 to 6.7. We recommend a field pH determination to confirm that the pH you designate is being achieved. This application is based upon the use of a 98% Sulfuric Acid product. The application of Urea Sulfuric Acid is based upon the use of a product that contains 15% Urea (1.89 lbs Nitrogen), 49% Sulfuric Acid and has a specific gravity of 1.52 at 68 °F.
Please contact us if you have any questions.

BRW:KEH

Reviewed and Approved By **Ben Waddell**
Digitally signed by Ben Waddell
Title: Director of Ag. Services
Date: 2022-03-29

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

March 29, 2022

Montecito Sanitary District
Attn: Carole Rollins, Mg.
1042 Monte Cristo Lane
Santa Barbara, CA 93108

Description : SCE
Project : Feasibility Study

Lab ID : **SP 2204127-001**
Customer : **2001797**

Sampled On : March 13, 2022
Sampled By : Carole Rollins, Mgr.
Received On : March 15, 2022
Matrix : Waste Water

General Irrigation Suitability Analysis

Test Description	Result				Graphical Results Presentation				
Cations	mg/L	Meq/L	% Meq	Lbs/AF	Good	Possible Problem	Moderate Problem	Increasing Problem	Severe Problem
Calcium	88	4.4	21	240	**				
Magnesium	42	3.5	17	110	**				
Potassium	53	1.4	7	140	**				
Sodium	265	12	56	720					
Anions									
Carbonate	<10	0	0	0					
Bicarbonate	130	2.1	10	350	**				
Sulfate	236	4.9	24	640	**				
Chloride	382	11	53	1000					
Nitrate	166	2.7	13	450					
Nitrate Nitrogen	37.6			100					
Fluoride	0.5	0.026	0	1					
Minor Elements									
Boron	0.60			1.6					
Copper	0.020			0.054					
Iron	<0.03			0					
Manganese	<0.01			0					
Zinc	0.040			0.11					
TDS by Summation	1360			3700					
Other									
pH	7.8	units							
E. C.	2.3	dS/m							
SAR	5.80								
Crop Suitability									
No Amendments	Poor								
With Amendments	Poor								
Amendments									
Gypsum Requirement	0.8	Tons/AF							
Sulfuric Acid (98%)	7.70	oz/1000Gal			Or 19 oz/1000Gal of urea Sulfuric Acid(15/49)				
Leaching Requirement	20	%							

Good — Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.
** Used in various calculations; mg/L = Milligrams Per Liter (ppm) meq/L = Milliequivalents Per Liter.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

March 29, 2022

Montecito Sanitary District

Description : SCE
Project : Feasibility Study

Lab ID : SP 2204127-001
Customer : 2001797

Sampled By : Carole Rollins, Mgr.
Matrix : Waste Water

Micro Irrigation System Plugging Hazard

Test Description	Result		Graphical Results Presentation		
			Slight	Moderate	Severe
Chemical					
Manganese	<0.01	mg/L			
Iron	<0.03	mg/L			
TDS by Summation	1360	mg/L			
No Amendments					
pH	7.8	units			
Alkalinity (As CaCO3)	110	mg/L			
Total Hardness	392	mg/L			
With Amendments					
Alkalinity (As CaCO3)	22	mg/L			
Total Hardness	22	mg/L			
pH	5.4 - 6.7	units			

Good — Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.

Water Amendments Application Notes:
The Amendments recommended on the previous pages include:

Gypsum:
This should be applied at least once a year to the irrigated soil surface area. Gypsum can also be applied in smaller quantities in the irrigation water.Apply the smaller (bracketed) amount of gypsum when also applying the recommended amount of Sulfuric Acid and the larger amount when applying only Gypsum.

Sulfuric Acid:
These products should be applied as needed to prevent emitter plugging in micro irrigation systems and/or as a soil amendment to adjust soil pH to improve nutrient availability and to facilitate leaching of salts. Please exercise caution when using this material as excesses may be harmful to the system and/or the plants being irrigated. The reported Acid requirement is intended to remove approximately 80 % of the alkalinity. The final pH should range from 5.4 to 6.7. We recommend a field pH determination to confirm that the pH you designate is being achieved. This application is based upon the use of a 98% Sulfuric Acid product. The application of Urea Sulfuric Acid is based upon the use of a product that contains 15% Urea (1.89 lbs Nitrogen), 49% Sulfuric Acid and has a specific gravity of 1.52 at 68 °F.
Please contact us if you have any questions.

BRW:KEH

Reviewed and Approved By **Ben Waddell**
Digitally signed by Ben Waddell
Title: Director of Ag. Services
Date: 2022-03-29

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

March 29, 2022

Montecito Sanitary District
Attn: Carole Rollins, Mg.
1042 Monte Cristo Lane
Santa Barbara, CA 93108

Description : SCE
Project : Feasibility Study

Lab ID : SP 2204127-002
Customer : 2001797

Sampled On : March 13, 2022
Sampled By : Carole Rollins, Mgr.
Received On : March 15, 2022
Matrix : Waste Water

General Irrigation Suitability Analysis

Test Description	Result				Graphical Results Presentation
Cations	mg/L	Meq/L	% Meq	Lbs/AF	Good / Possible Problem / Moderate Problem / Increasing Problem / Severe Problem
Calcium	94	4.7	21	260	**
Magnesium	45	3.7	17	120	**
Potassium	57	1.5	7	160	**
Sodium	286	12	56	780	
Anions					
Carbonate	<10	0	0	0	
Bicarbonate	140	2.3	11	380	**
Sulfate	235	4.9	23	640	**
Chloride	393	11	53	1100	
Nitrate	160	2.6	12	440	
Nitrate Nitrogen	36.1			98	
Fluoride	0.5	0.026	0	1	
Minor Elements					
Boron	0.60			1.6	
Copper	0.020			0.054	
Iron	<0.03			0	
Manganese	<0.01			0	
Zinc	0.040			0.11	
TDS by Summation	1410			3800	
Other					
pH	7.7	units			
E. C.	2.33	dS/m			
SAR	6.10				
Crop Suitability					
No Amendments	Poor				
With Amendments	Poor				
Amendments					
Gypsum Requirement	0.9	Tons/AF			
Sulfuric Acid (98%)	8.40	oz/1000Gal			Or 20 oz/1000Gal of urea Sulfuric Acid(15/49)
Leaching Requirement	20	%			

Good — Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.
** Used in various calculations; mg/L = Milligrams Per Liter (ppm) meq/L = Milliequivalents Per Liter.

ALP

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

March 29, 2022

Montecito Sanitary District

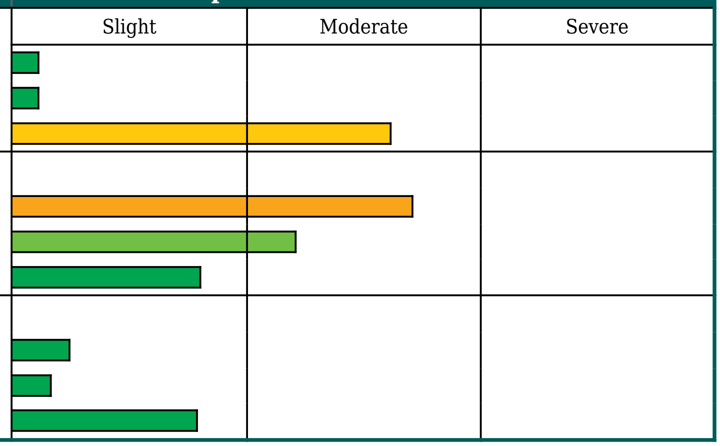
Description : SCE
Project : Feasibility Study

Lab ID : SP 2204127-002
Customer : 2001797

Sampled By : Carole Rollins, Mgr.
Matrix : Waste Water

Micro Irrigation System Plugging Hazard

Test Description	Result		Graphical Results Presentation
Chemical			
Manganese	<0.01	mg/L	
Iron	<0.03	mg/L	
TDS by Summation	1410	mg/L	
No Amendments			
pH	7.7	units	
Alkalinity (As CaCO3)	120	mg/L	
Total Hardness	420	mg/L	
With Amendments			
Alkalinity (As CaCO3)	24	mg/L	
Total Hardness	24	mg/L	
pH	5.4 - 6.7	units	



Good Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.

Water Amendments Application Notes:
The Amendments recommended on the previous pages include:

Gypsum:
This should be applied at least once a year to the irrigated soil surface area. Gypsum can also be applied in smaller quantities in the irrigation water.Apply the smaller (bracketed) amount of gypsum when also applying the recommended amount of Sulfuric Acid and the larger amount when applying only Gypsum.

Sulfuric Acid:
These products should be applied as needed to prevent emitter plugging in micro irrigation systems and/or as a soil amendment to adjust soil pH to improve nutrient availability and to facilitate leaching of salts. Please exercise caution when using this material as excesses may be harmful to the system and/or the plants being irrigated. The reported Acid requirement is intended to remove approximately 80 % of the alkalinity. The final pH should range from 5.4 to 6.7. We recommend a field pH determination to confirm that the pH you designate is being achieved. This application is based upon the use of a 98% Sulfuric Acid product. The application of Urea Sulfuric Acid is based upon the use of a product that contains 15% Urea (1.89 lbs Nitrogen), 49% Sulfuric Acid and has a specific gravity of 1.52 at 68 °F.
Please contact us if you have any questions.

BRW:KEH

Reviewed and Approved By **Ben Waddell**
Digitally signed by Ben Waddell
Title: Director of Ag. Services
Date: 2022-03-29

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

December 4, 2018

Montecito Water District
Attn: Chad Hurshman
583 San Ysidro Rd.
Santa Barbara, CA 93108

Lab ID : SP 1814799
Customer : 2-16013

Laboratory Report

Introduction: This report package contains total of 8 pages divided into 3 sections:

Case Narrative	(2 pages)	: An overview of the work performed at FGL.
Sample Results	(4 pages)	: Results for each sample submitted.
Quality Control	(2 pages)	: Supporting Quality Control (QC) results.

Case Narrative

This Case Narrative pertains to the following samples:

Sample Description	Date Sampled	Date Received	FGL Lab ID #	Matrix
Las Fuentes Well	11/07/2018	11/07/2018	SP 1814799-001	GW
Valley Club Well	11/07/2018	11/07/2018	SP 1814799-002	GW

Sampling and Receipt Information: All samples were received in acceptable condition and within temperature requirements, unless noted on the Condition Upon Receipt (CUR) form. All samples arrived on ice. All samples were prepared and analyzed within the method specified hold time. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

Quality Control: All samples were prepared and analyzed according to the following tables:

Inorganic - Metals QC

200.7	11/08/2018:216398 All analysis quality controls are within established criteria.
	11/09/2018:216560 All analysis quality controls are within established criteria.
	11/07/2018:213282 All preparation quality controls are within established criteria, except: The following note applies to Boron: 435 Sample matrix may be affecting this analyte. Data was accepted based on the LCS or CCV recovery.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

December 4, 2018 | Lab ID : SP 1814799
Montecito Water District | Customer : 2-16013

Inorganic - Wet Chemistry QC

2510B	11/08/2018:216406 All analysis quality controls are within established criteria.
	11/08/2018:213313 All preparation quality controls are within established criteria.
2540CE	11/12/2018:213446 All preparation quality controls are within established criteria.
300.0	11/08/2018:216550 All analysis quality controls are within established criteria.
	11/07/2018:213416 All preparation quality controls are within established criteria.
4500NH3G	11/12/2018:216606 All analysis quality controls are within established criteria.
	11/12/2018:213430 All preparation quality controls are within established criteria.

Certification:: I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:DMB

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S. Title: Laboratory Director Date: 2018-12-04

December 4, 2018

Montecito Water District
Attn: Chad Hurshman
583 San Ysidro Rd.
Santa Barbara, CA 93108

Description : Las Fuentes Well
Project : Birnam Samples

Lab ID : SP 1814799-001
Customer ID : 2-16013

Sampled On : November 7, 2018-09:00
Sampled By : Austin Prince
Received On : November 7, 2018-15:00
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
Metals, Total								
Boron	ND	0.1	mg/L		200.7	11/07/18:213282	200.7	11/09/18:216560
Sodium	66	1	mg/L		200.7	11/07/18:213282	200.7	11/08/18:216398
Wet Chemistry								
Chloride	73	1	mg/L		300.0	11/07/18:213416	300.0	11/08/18:216550
Specific Conductance	1140	1	umhos/cm		2510B	11/08/18:213313	2510B	11/08/18:216406
Nitrate Nitrogen	3.0	0.1	mg/L		300.0	11/07/18:213416	300.0	11/08/18:216550
Total Dissolved Solids (TFR)	750	20	mg/L		2540CE	11/12/18:213446	2540C	11/13/18:216650
Ionized Ammonia Nitrogen	ND	--	mg/L		4500NH3G	11/12/18:213430	4500NH3G	11/12/18:216606
Ammonia Nitrogen	ND	0.1	mg/L		4500NH3G	11/12/18:213430	4500NH3G	11/12/18:216606

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

December 4, 2018

Montecito Water District
Attn: Chad Hurshman
583 San Ysidro Rd.
Santa Barbara, CA 93108

Description : Las Fuentes Well
Project : Birnam Samples

Lab ID : SP 1814799-001
Customer ID : 2-16013

Sampled On : November 7, 2018-09:00
Sampled By : Austin Prince
Received On : November 7, 2018-15:00
Matrix : Ground Water

Sample Result - Support

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
Field Test								
pH (Field)	7.13		units			11/07/18 09:00	4500-H B	11/07/18 09:00
Temperature	19.1		°C			11/07/18 09:00	2550B	11/07/18 09:00

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

December 4, 2018

Montecito Water District
Attn: Chad Hurshman
583 San Ysidro Rd.
Santa Barbara, CA 93108

Description : Valley Club Well
Project : Birnam Samples

Lab ID : SP 1814799-002
Customer ID : 2-16013

Sampled On : November 7, 2018-08:45
Sampled By : Austin Prince
Received On : November 7, 2018-15:00
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
Metals, Total								
Boron	ND	0.1	mg/L		200.7	11/07/18:213282	200.7	11/09/18:216560
Sodium	76	1	mg/L		200.7	11/07/18:213282	200.7	11/08/18:216398
Wet Chemistry								
Chloride	149	5*	mg/L		300.0	11/07/18:213416	300.0	11/08/18:216550
Specific Conductance	1160	1	umhos/cm		2510B	11/08/18:213313	2510B	11/08/18:216406
Nitrate Nitrogen	7.4	0.1	mg/L		300.0	11/07/18:213416	300.0	11/08/18:216550
Total Dissolved Solids (TFR)	720	20	mg/L		2540CE	11/12/18:213446	2540C	11/13/18:216650
Ionized Ammonia Nitrogen	ND	--	mg/L		4500NH3G	11/12/18:213430	4500NH3G	11/12/18:216606
Ammonia Nitrogen	ND	0.1	mg/L		4500NH3G	11/12/18:213430	4500NH3G	11/12/18:216606

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

December 4, 2018

Montecito Water District
Attn: Chad Hurshman
583 San Ysidro Rd.
Santa Barbara, CA 93108

Description : Valley Club Well
Project : Birnam Samples

Lab ID : SP 1814799-002
Customer ID : 2-16013

Sampled On : November 7, 2018-08:45
Sampled By : Austin Prince
Received On : November 7, 2018-15:00
Matrix : Ground Water

Sample Result - Support

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
Field Test								
pH (Field)	6.97		units			11/07/18 08:45	4500-H B	11/07/18 08:45
Temperature	19.9		°C			11/07/18 08:45	2550B	11/07/18 08:45

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

December 4, 2018
Montecito Water District

Lab ID : SP 1814799
Customer : 2-16013

Quality Control - Inorganic

Constituent	Method	Date/ID	Type	Units	Conc.	QC Data	DQO	Note
Metals								
Boron	200.7		MS	mg/L	4.000	86.9 %	75-125	
		(STK1855989-001)	MSD	mg/L	4.000	71.6 %	75-125	435
			MSRPD	mg/L	4000	13.5%	≤20.0	
	200.7	11/09/18:216560AC	CCV	ppm	5.000	100 %	90-110	
			CCB	ppm		0.012	0.1	
			CCV	ppm	5.000	94.6 %	90-110	
			CCB	ppm		0.009	0.1	
Sodium	200.7		MS	mg/L	12.00	3.2 %	<¼	
		(STK1855989-001)	MSD	mg/L	12.00	33.1 %	<¼	
			MSRPD	mg/L	4000	3.4%	≤20.0	
	200.7	11/08/18:216398AC	CCV	ppm	25.00	100 %	90-110	
			CCB	ppm		0.13	1	
			CCV	ppm	25.00	105 %	90-110	
			CCB	ppm		0.15	1	
			CCV	ppm	25.00	100 %	90-110	
			CCB	ppm		0.17	1	
Wet Chem								
Conductivity	2510B	11/08/18:216406JMG	ICB	umhos/cm		0.15	1	
			CCV	umhos/cm	999.0	103 %	95-105	
			CCV	umhos/cm	999.0	103 %	95-105	
E. C.	2510B	11/08/18:213313jmg	Blank	umhos/cm		ND	<1	
		(SP 1814794-002)	Dup	umhos/cm		0.3%	5	
Total Dissolved Solids (TFR)	2540CE	11/12/18:213446CTL	Blank	mg/L		ND	<20	
			LCS	mg/L	993.1	94.1 %	90-110	
		(SP 1814799-001)	Dup	mg/L		0.9%	5	
		(SP 1814799-002)	Dup	mg/L		3.5%	5	
Chloride	300.0	11/07/18:213416MCA	Blank	mg/L		ND	<1	
			LCS	mg/L	25.00	104 %	90-110	
			MS	mg/L	500.0	100 %	85-121	
		(VI 1845757-004)	MSD	mg/L	500.0	99.6 %	85-121	
			MSRPD	mg/L	100.0	0.5%	≤19	
			MS	mg/L	500.0	99.6 %	85-121	
		(VI 1845765-001)	MSD	mg/L	500.0	99.1 %	85-121	
			MSRPD	mg/L	100.0	0.5%	≤19	
	300.0	11/08/18:216550MCA	CCB	ppm		0.04	1	
			CCV	ppm	25.00	105 %	90-110	
			CCB	ppm		-0.01	1	
			CCV	ppm	25.00	107 %	90-110	
Nitrate	300.0	11/07/18:213416MCA	Blank	mg/L		ND	<0.4	
			LCS	mg/L	20.00	104 %	90-110	
			MS	mg/L	400.0	99.7 %	85-119	
		(VI 1845757-004)	MSD	mg/L	400.0	99.4 %	85-119	
			MSRPD	mg/L	100.0	0.3%	≤19	
			MS	mg/L	400.0	99.3 %	85-119	
		(VI 1845765-001)	MSD	mg/L	400.0	98.9 %	85-119	
			MSRPD	mg/L	100.0	0.4%	≤19	
	300.0	11/08/18:216550MCA	CCB	ppm		-0.027	0.5	
			CCV	ppm	20.00	105 %	90-110	
			CCB	ppm		-0.028	0.5	
			CCV	ppm	20.00	107 %	90-110	
Ammonia Nitrogen	4500NH3G		MS	mg/L	2.000	106 %	70-130	
		(SP 1814831-001)	MSD	mg/L	2.000	105 %	70-130	
			MSRPD	mg/L	2.000	0.6%	≤20	
	4500NH3G	11/12/18:216606JDD	CCB	mg/L		0.027	0.1	
			CCV	mg/L	2.000	106 %	90-110	

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

December 4, 2018 | Lab ID : SP 1814799

Montecito Water District | Customer : 2-16013

Quality Control - Inorganic

Constituent	Method	Date/ID	Type	Units	Conc.	QC Data	DQO	Note
Wet Chem								
Ammonia Nitrogen	4500NH3G	11/12/18:216606JDD	CCB	mg/L		0.054	0.1	
			CCV	mg/L	2.000	108 %	90-110	

Definition

ICB	: Initial Calibration Blank - Analyzed to verify the instrument baseline is within criteria.
CCV	: Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria.
CCB	: Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria.
Blank	: Method Blank - Prepared to verify that the preparation process is not contributing contamination to the samples.
LCS	: Laboratory Control Standard/Sample - Prepared to verify that the preparation process is not affecting analyte recovery.
MS	: Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery.
MSD	: Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyted. The recoveries are an indication of how that sample matrix affects analyte recovery.
Dup	: Duplicate Sample - A random sample with each batch is prepared and analyzed in duplicate. The relative percent difference is an indication of precision for the preparation and analysis.
MSRPD	: MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis.
ND	: Non-detect - Result was below the DQO listed for the analyte.
<¼	: High Sample Background - Spike concentration was less than one forth of the sample concentration.
DQO	: Data Quality Objective - This is the criteria against which the quality control data is compared.

Explanation

435	: Sample matrix may be affecting this analyte. Data was accepted based on the LCS or CCV recovery.

Well Owner Report

Owner	FOUR SEASONS RESORT BILTMORE HOTEL	*Well Name*	Biltmore Hotel
Station ID	342508119383101	*GAMA ID*	SB-10
Station Name	004N026W19H003S	*Sample Date*	4/21/2021 @ 1030

Your well was one of several sampled for the Santa Barbara area basins study unit Trends Sampling of the Groundwater Ambient Monitoring and Assessment (GAMA) Priority Basin Project (PBP). Results from all sites will be published in a USGS Data Release report; your well will be identified by only the GAMA-ID in all publications and presentations.

This report lists the concentrations of chemical constituents detected in raw groundwater collected from your well. To put the results in some context, the concentrations of regulatory (r) and non-regulatory (nr) benchmarks set by the U.S. Environmental Protection Agency (USEPA) and the California State Water Resources Control Board Division of Drinking Water (SWRCB-DDW) for drinking water are also listed. This comparison is for context only; it does not indicate compliance or non-compliance with regulatory benchmarks. One category of benchmark listed here is the Health-Based Screening Level, a benchmark developed by the USGS National Water-Quality Assessment Program for contaminants that do not have other human health benchmarks (for more information see <http://water.usgs.gov/nawqa/HBSL> or <doi:10.5066/F71C1TWP>). Please contact your local Health Department if you have questions about potential health effects.

The chemical constituents are organized in the following groups: 1) field water-quality indicators, 2) major ions, 3) nutrients, 4) trace elements, 5) radioactivity (not a part of Trends sample schedule), 6) volatile organic compounds, 7) pesticides, 8) geochemical and age-dating tracers, 9) microbiological constituents (not a part of Trends sample schedule), and 10) constituents of special interest. Only detected constituents are reported here. Typical uses or sources are listed for all constituents; other sources not listed also may affect the concentrations of constituents in groundwater in your area.

See the List of Potentially Sampled Constituents for a complete list of potentially analyzed constituents evaluated by the GAMA PBP program. Not all constituents may have been evaluated for your well.

Thank you again for allowing the USGS to sample your well for the GAMA Project.

Connor J McVey
cmcvey@usgs.gov
(916) 278-3039

mg/L = milligrams per liter
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
ppm = parts per million
ppb = parts per billion
pCi/L = picocuries per liter
E = estimated value
M = presence verified, but quantity uncertain

AL-US = USEPA Action Level (r)
HAL-US = USEPA Lifetime Health Advisory (nr)
HBSL-C = USGS Cancer Health-Based Screening Level
HBSL-NC =USGS Noncancer Health-Based Screening Level
HHBP-C = USEPA Cancer Human Health Benchmark for Pesticide
HHBP-NC = USEPA Noncancer Human Health Benchmark for Pesticide

MCL-CA = SWRCB-DDW Maximum Contaminant Level (nr)
MCL-US = USEPA Maximum Contaminant Level (r)
NL-CA = SWRCB-DDW Notification Level (nr)
RL-CA = SWRCB-DDW Response Level (nr)
SMCL-CA = SWRCB-DDW Secondary Maximum Contaminant Level (nr)
SMCL-US = USEPA Secondary Maximum Contaminant Level (nr)

Well Owner Report

Concentrations of all chemical constituents detected in raw groundwater collected from your well were less than USEPA and SWRCB-DDW regulatory and non-regulatory benchmarks applied to drinking water, with the following exceptions:

Field Water Quality Indicators: pH, field, Specific Conductance, field
Major and Minor Ions: Chloride, Total dissolved solids (TDS)
Trace Elements: Manganese

mg/L = milligrams per liter
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
ppm = parts per million
ppb = parts per billion
pCi/L = picocuries per liter
E = estimated value
M = presence verified, but quantity uncertain

AL-US = USEPA Action Level (r)
HAL-US = USEPA Lifetime Health Advisory (nr)
HBSL-C = USGS Cancer Health-Based Screening Level
HBSL-NC =USGS Noncancer Health-Based Screening Level
HHBP-C = USEPA Cancer Human Health Benchmark for Pesticide
HHBP-NC = USEPA Noncancer Human Health Benchmark for Pesticide

MCL-CA = SWRCB-DDW Maximum Contaminant Level (nr)
MCL-US = USEPA Maximum Contaminant Level (r)
NL-CA = SWRCB-DDW Notification Level (nr)
RL-CA = SWRCB-DDW Response Level (nr)
SMCL-CA = SWRCB-DDW Secondary Maximum Contaminant Level (nr)
SMCL-US = USEPA Secondary Maximum Contaminant Level (nr)

Well Owner Report

Owner FOUR SEASONS RESORT BILTMORE HOT *Well Name* Biltmore Hotel
Station ID 342508119383101 *GAMA ID* SB-10
Station Name 004N026W19H003S *Sample Date* 4/21/2021 @ 1030
Detected constituents on the Trends *schedule* *Water level*

Constituent Name	Units	Value	Benchmark Value and Type		Typical Use or Source
1 Field Water Quality Indicators					
Bicarbonate (HCO3)	mg/L	254			Naturally occurring
Carbonate (CO3)	mg/L	0			Naturally occurring
Barometric pressure	mm of mercury	759			
Flow rate	gal/min	15			
Water Temperature	deg Celsius	19.5			
Specific Conductance, field	µS/cm	2210	1600	SMCL-CA	Naturally occurring
pH, field	standard units	6.2	<6.5, >8.5	SMCL-US	Naturally occurring
Dissolved Oxygen	mg/L	0.5			Naturally occurring
2 Major and Minor Ions					
Alkalinity (CaCO3), field	mg/L	208			Naturally occurring
Calcium	mg/L	143			Naturally occurring
Magnesium	mg/L	54.1			Naturally occurring
Potassium	mg/L	2.07			Naturally occurring
Sodium	mg/L	236			Naturally occurring
Bromide	mg/L	1.04			Naturally occurring

mg/L = milligrams per liter
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
ppm = parts per million
ppb = parts per billion
pCi/L = picocuries per liter
E = estimated value
M = presence verified, but quantity uncertain

AL-US = USEPA Action Level (r)
HAL-US = USEPA Lifetime Health Advisory (nr)
HBSL-C = USGS Cancer Health-Based Screening Level
HBSL-NC =USGS Noncancer Health-Based Screening Level
HHBP-C = USEPA Cancer Human Health Benchmark for Pesticide
HHBP-NC = USEPA Noncancer Human Health Benchmark for Pesticide

MCL-CA = SWRCB-DDW Maximum Contaminant Level (nr)
MCL-US = USEPA Maximum Contaminant Level (r)
NL-CA = SWRCB-DDW Notification Level (nr)
RL-CA = SWRCB-DDW Response Level (nr)
SMCL-CA = SWRCB-DDW Secondary Maximum Contaminant Level (nr)
SMCL-US = USEPA Secondary Maximum Contaminant Level (nr)

Well Owner Report

Owner **FOUR SEASONS RESORT BILTMORE HOT** ***Well Name*** **Biltmore Hotel**

Station ID **342508119383101** ***GAMA ID*** **SB-10**

Station Name **004N026W19H003S** ***Sample Date*** **4/21/2021 @ 1030**

Detected constituents on the **Trends** ***schedule*** ***Water level***

Constituent Name	Units	Value	Benchmark Value and Type		Typical Use or Source
Chloride	mg/L	**502**	500	SMCL-CA	Naturally occurring
Fluoride	mg/L	**0.54**	2	MCL-CA	Naturally occurring
Iodide	mg/L	**0.03**			Naturally occurring
Silica	mg/L	**39**			Naturally occurring
Sulfate	mg/L	**153**	500	SMCL-CA	Naturally occurring
Alkalinity (CaCO3), laboratory	mg/L	**216**			Naturally occurring
Total dissolved solids (TDS)	mg/L	**1330**	1000	SMCL-CA	Naturally occurring
Hardness	mg/L as CaCO3	**582**			Naturally occurring
3 Nutrients					
Nitrate, as nitrogen	mg/L	**7.26**	10	MCL-US	
Nitrite, as nitrogen	mg/L	**0.004**	1	MCL-US	Natural, fertilizer, sewage
Total nitrogen (ammonia, nitrite, nitrate, organic nitrogen)	mg/L	**7.46**			Natural, fertilizer, sewage
Orthophosphate, as phosphorus	mg/L	**0.142**			Natural, fertilizer, sewage
4 Trace Elements					
Chromium (VI)	µg/L	**0.1**	20	HBSL-NC	
Antimony	µg/L	**0.196**	6	MCL-US	Naturally occurring

mg/L = milligrams per liter
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
ppm = parts per million
ppb = parts per billion
pCi/L = picocuries per liter
E = estimated value
M = presence verified, but quantity uncertain

AL-US = USEPA Action Level (r)
HAL-US = USEPA Lifetime Health Advisory (nr)
HBSL-C = USGS Cancer Health-Based Screening Level
HBSL-NC =USGS Noncancer Health-Based Screening Level
HHBP-C = USEPA Cancer Human Health Benchmark for Pesticide
HHBP-NC = USEPA Noncancer Human Health Benchmark for Pesticide

MCL-CA = SWRCB-DDW Maximum Contaminant Level (nr)
MCL-US = USEPA Maximum Contaminant Level (r)
NL-CA = SWRCB-DDW Notification Level (nr)
RL-CA = SWRCB-DDW Response Level (nr)
SMCL-CA = SWRCB-DDW Secondary Maximum Contaminant Level (nr)
SMCL-US = USEPA Secondary Maximum Contaminant Level (nr)

Well Owner Report

Owner **FOUR SEASONS RESORT BILTMORE HOT** ***Well Name*** **Biltmore Hotel**

Station ID **342508119383101** ***GAMA ID*** **SB-10**

Station Name **004N026W19H003S** ***Sample Date*** **4/21/2021 @ 1030**

Detected constituents on the **Trends** ***schedule*** ***Water level***

Constituent Name	Units	Value	Benchmark Value and Type		Typical Use or Source
Arsenic	µg/L	**0.44**	10	MCL-US	Naturally occurring
Barium	µg/L	**184**	1000	MCL-CA	Naturally occurring
Boron	µg/L	**205**	6000	HAL-US	Naturally occurring
Cadmium	µg/L	**0.31**	5	MCL-US	Naturally occurring
Cobalt	µg/L	**1.27**			Naturally occurring
Lithium	µg/L	**39.7**			Naturally occurring
Manganese	µg/L	**273**	50	SMCL-CA	Naturally occurring
Molybdenum	µg/L	**0.351**	40	HAL-US	Naturally occurring
Nickel	µg/L	**6**	100	MCL-US	Naturally occurring
Strontium	µg/L	**961**	4000	HAL-US	Naturally occurring
Uranium	µg/L	**0.284**	30	MCL-US	Naturally occurring
Vanadium	µg/L	**0.93**	500	RL-CA	Naturally occurring
Zinc	µg/L	**43.2**	5000	SMCL-CA	Naturally occurring

5 Radioactivity **Not Sampled**

6 Volatile Organic Compounds **Not Sampled**

mg/L = milligrams per liter
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
ppm = parts per million
ppb = parts per billion
pCi/L = picocuries per liter
E = estimated value
M = presence verified, but quantity uncertain

AL-US = USEPA Action Level (r)
HAL-US = USEPA Lifetime Health Advisory (nr)
HBSL-C = USGS Cancer Health-Based Screening Level
HBSL-NC =USGS Noncancer Health-Based Screening Level
HHBP-C = USEPA Cancer Human Health Benchmark for Pesticide
HHBP-NC = USEPA Noncancer Human Health Benchmark for Pesticide

MCL-CA = SWRCB-DDW Maximum Contaminant Level (nr)
MCL-US = USEPA Maximum Contaminant Level (r)
NL-CA = SWRCB-DDW Notification Level (nr)
RL-CA = SWRCB-DDW Response Level (nr)
SMCL-CA = SWRCB-DDW Secondary Maximum Contaminant Level (nr)
SMCL-US = USEPA Secondary Maximum Contaminant Level (nr)

Well Owner Report

Owner	FOUR SEASONS RESORT BILTMORE HOT	*Well Name*	Biltmore Hotel
Station ID	342508119383101	*GAMA ID*	SB-10
Station Name	004N026W19H003S	*Sample Date*	4/21/2021 @ 1030
Detected constituents on the Trends *schedule*		*Water level*	

Constituent Name	Units	Value	Benchmark Value and Type		Typical Use or Source
7 Pesticides and Pesticide Degradates		**Samples Ruined**			
8 Geochemical and Age-Dating Tracers					
Tritium	pCi/L	**2.66**	20000	MCL-CA	For dating recent water
Hydrogen stable isotope ratio of water	per mil	**-35.2**			Info about recharge source area
Oxygen stable isotope ratio of water	per mil	**-5.53**			Info about recharge source area
9 Microbiological Constituents		**Not Sampled**			
10 Constituents of Special Interest					
Perchlorate	µg/L	**1**	6	MCL-CA	Natural, rocket fuel, fertilizer

mg/L = milligrams per liter
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
ppm = parts per million
ppb = parts per billion
pCi/L = picocuries per liter
E = estimated value
M = presence verified, but quantity uncertain

AL-US = USEPA Action Level (r)
HAL-US = USEPA Lifetime Health Advisory (nr)
HBSL-C = USGS Cancer Health-Based Screening Level
HBSL-NC =USGS Noncancer Health-Based Screening Level
HHBP-C = USEPA Cancer Human Health Benchmark for Pesticide
HHBP-NC = USEPA Noncancer Human Health Benchmark for Pesticide

MCL-CA = SWRCB-DDW Maximum Contaminant Level (nr)
MCL-US = USEPA Maximum Contaminant Level (r)
NL-CA = SWRCB-DDW Notification Level (nr)
RL-CA = SWRCB-DDW Response Level (nr)
SMCL-CA = SWRCB-DDW Secondary Maximum Contaminant Level (nr)
SMCL-US = USEPA Secondary Maximum Contaminant Level (nr)

Well Owner Report

Owner	**FOUR SEASONS RESORT BILTMORE HOTEL**	***Well Name***	**Biltmore Hotel**
Station ID	**342508119383101**	***GAMA ID***	**SB-10**
Station Name	**004N026W19H003S**	***Sample Date***	**2/8/2011 @ 1500**

Your well was one of several sampled for the Santa Barbara area basins study unit of the Groundwater Ambient Monitoring and Assessment (GAMA) Priority Basin Project (PBP). Results from all sites will be published in a USGS Data Series report; your well will be identified by only the GAMA-ID in all publications and presentations.

This report lists the concentrations of chemical constituents detected in raw groundwater collected from your well. To put the results in some context, the concentrations of regulatory (r) and non-regulatory (nr) benchmarks set by the U.S. Environmental Protection Agency (USEPA) and the California State Water Resources Control Board Division of Drinking Water (SWRCB-DDW) for drinking water are also listed. This comparison is for context only; it does not indicate compliance or non-compliance with regulatory benchmarks. One category of benchmark listed here is the Health-Based Screening Level, a benchmark developed by the USGS National Water-Quality Assessment Program for contaminants that do not have other human health (for more information see <http://water.usgs.gov/nawqa/HBSL> or <doi:10.5066/F71C1TWP>). Please contact your local Health Department if you have questions about potential health effects.

The chemical constituents are organized in the following groups: 1) field water-quality indicators, 2) major ions, 3) nutrients, 4) trace elements, 5) radioactivity, 6) volatile organic compounds, 7) pesticides, 8) geochemical and age-dating tracers, 9) microbiological constituents (not a part of sample schedule), and 10) constituents of special interest. Only detected constituents are reported here. Typical uses or sources are listed for all constituents; other sources not listed also may affect the concentrations of constituents in groundwater in your area.

See the List of Potentially Sampled Constituents for a complete list of potentially analyzed constituents evaluated by the GAMA PBP program. Not all constituents may have been evaluated for your well.

Thank you again for allowing the USGS to sample your well for the GAMA Project.

Connor J McVey
cmcvey@usgs.gov
(916) 278-3039

mg/L = milligrams per liter
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
ng/L = nanograms per liter
ppm = parts per million
ppb = parts per billion
pCi/L = picocuries per liter
E = estimated value

M = presence verified, but quantity uncertain
AL-US = USEPA Action Level (r)
HAL-US = USEPA Lifetime Health Advisory (nr)
HBSL-C = USGS Cancer Health-Based Screening Level
HBSL-NC =USGS Noncancer Health-Based Screening Level
HHBP-C = USEPA Cancer Human Health Benchmark for Pesticide

HHBP-NC = USEPA Noncancer Human Health Benchmark for Pesticide
MCL-CA = SWRCB-DDW Maximum Contaminant Level (r)
MCL-US = USEPA Maximum Contaminant Level (r)
NL-CA = SWRCB-DDW Notification Level (nr)
SMCL-CA = SWRCB-DDW Secondary Maximum Contaminant Level (nr)
SMCL-US = USEPA Secondary Maximum Contaminant Level (nr)

Well Owner Report

Concentrations of all chemical constituents detected in raw groundwater collected from your well were less than USEPA and SWRCB-DDW regulatory and non-regulatory benchmarks applied to drinking water, with the following exceptions:

Field Water Quality Indicators: pH, field, Specific Conductance, field
Major and Minor Ions: Total dissolved solids (TDS)
Trace Elements: Manganese

mg/L = milligrams per liter
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
ng/L = nanograms per liter
ppm = parts per million
ppb = parts per billion
pCi/L = picocuries per liter
E = estimated value

M = presence verified, but quantity uncertain
AL-US = USEPA Action Level (r)
HAL-US = USEPA Lifetime Health Advisory (nr)
HBSL-C = USGS Cancer Health-Based Screening Level
HBSL-NC =USGS Noncancer Health-Based Screening Level
HHBP-C = USEPA Cancer Human Health Benchmark for Pesticide

HHBP-NC = USEPA Noncancer Human Health Benchmark for Pesticide
MCL-CA = SWRCB-DDW Maximum Contaminant Level (r)
MCL-US = USEPA Maximum Contaminant Level (r)
NL-CA = SWRCB-DDW Notification Level (nr)
SMCL-CA = SWRCB-DDW Secondary Maximum Contaminant Level (nr)
SMCL-US = USEPA Secondary Maximum Contaminant Level (nr)

Well Owner Report

Owner **FOUR SEASONS RESORT BILTMORE HOTEL** ***Well Name*** **Biltmore Hotel**

Station ID **342508119383101** ***GAMA ID*** **SB-10**

Station Name **004N026W19H003S** ***Sample Date*** **2/8/2011 @ 1500**

Constituent Name	*Units*	*Value*	*Benchmark Value and Type*		*Typical Use or Source*
1 Field Water Quality Indicators					
Barometric pressure	mm of mercury	**761**			
Water Temperature	deg Celsius	**19**			
Specific Conductance, field	µS/cm	1660	1600	SMCL-CA	Naturally occurring
pH, field	standard units	6.3	<6.5, >8.5	SMCL-US	Naturally occurring
Dissolved Oxygen	mg/L	**0.3**			Naturally occurring
2 Major and Minor Ions					
Calcium	mg/L	**101**			Naturally occurring
Magnesium	mg/L	**39.1**			Naturally occurring
Potassium	mg/L	**1.78**			Naturally occurring
Sodium	mg/L	**174**			Naturally occurring
Bromide	mg/L	**0.998**			Naturally occurring
Chloride	mg/L	**314**	500	SMCL-CA	Naturally occurring
Fluoride	mg/L	**0.55**	2	MCL-CA	Naturally occurring
Iodide	mg/L	**0.03**			Naturally occurring
Silica	mg/L	**36**			Naturally occurring
Sulfate	mg/L	**134**	500	SMCL-CA	Naturally occurring

mg/L = milligrams per liter
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
ng/L = nanograms per liter
ppm = parts per million
ppb = parts per billion
pCi/L = picocuries per liter
E = estimated value

M = presence verified, but quantity uncertain
AL-US = USEPA Action Level (r)
HAL-US = USEPA Lifetime Health Advisory (nr)
HBSL-C = USGS Cancer Health-Based Screening Level
HBSL-NC =USGS Noncancer Health-Based Screening Level
HHBP-C = USEPA Cancer Human Health Benchmark for Pesticide

HHBP-NC = USEPA Noncancer Human Health Benchmark for Pesticide
MCL-CA = SWRCB-DDW Maximum Contaminant Level (r)
MCL-US = USEPA Maximum Contaminant Level (r)
NL-CA = SWRCB-DDW Notification Level (nr)
SMCL-CA = SWRCB-DDW Secondary Maximum Contaminant Level (nr)
SMCL-US = USEPA Secondary Maximum Contaminant Level (nr)

Well Owner Report

Owner	FOUR SEASONS RESORT BILTMORE HOTEL	*Well Name*	Biltmore Hotel
Station ID	342508119383101	*GAMA ID*	SB-10
Station Name	004N026W19H003S	*Sample Date*	2/8/2011 @ 1500

Constituent Name	*Units*	*Value*	*Benchmark Value and Type*		*Typical Use or Source*
Alkalinity (CaCO3), laboratory	mg/L	218			Naturally occurring
Total dissolved solids (TDS)	mg/L	1070	1000	SMCL-CA	Naturally occurring
Hardness	mg/L as CaCO3	415			Naturally occurring
3 Nutrients					
Nitrate, as nitrogen	mg/L	7.39	10	MCL-US	
Nitrite, as nitrogen	mg/L	0.004	1	MCL-US	Natural, fertilizer, sewage
Total nitrogen (ammonia, nitrite, nitrate, organic nitrogen)	mg/L	7.63			Natural, fertilizer, sewage
Orthophosphate, as phosphorus	mg/L	0.157			Natural, fertilizer, sewage
4 Trace Elements					
Aluminum	µg/L	2.3	1000	MCL-CA	Naturally occurring
Arsenic	µg/L	0.35	10	MCL-US	Naturally occurring
Barium	µg/L	192	1000	MCL-CA	Naturally occurring
Beryllium	µg/L	0.009	4	MCL-US	Naturally occurring
Boron	µg/L	150	6000	HAL-US	Naturally occurring
Cadmium	µg/L	0.13	5	MCL-US	Naturally occurring
Copper	µg/L	5.1	1300	AL-US	Natural, pipe corrosion
Lithium	µg/L	30.1			Naturally occurring

mg/L = milligrams per liter
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
ng/L = nanograms per liter
ppm = parts per million
ppb = parts per billion
pCi/L = picocuries per liter
E = estimated value

M = presence verified, but quantity uncertain
AL-US = USEPA Action Level (r)
HAL-US = USEPA Lifetime Health Advisory (nr)
HBSL-C = USGS Cancer Health-Based Screening Level
HBSL-NC =USGS Noncancer Health-Based Screening Level
HHBP-C = USEPA Cancer Human Health Benchmark for Pesticide

HHBP-NC = USEPA Noncancer Human Health Benchmark for Pesticide
MCL-CA = SWRCB-DDW Maximum Contaminant Level (r)
MCL-US = USEPA Maximum Contaminant Level (r)
NL-CA = SWRCB-DDW Notification Level (nr)
SMCL-CA = SWRCB-DDW Secondary Maximum Contaminant Level (nr)
SMCL-US = USEPA Secondary Maximum Contaminant Level (nr)

Well Owner Report

Owner	FOUR SEASONS RESORT BILTMORE HOTEL	*Well Name*	Biltmore Hotel
Station ID	342508119383101	*GAMA ID*	SB-10
Station Name	004N026W19H003S	*Sample Date*	2/8/2011 @ 1500

Constituent Name	*Units*	*Value*	*Benchmark Value and Type*		*Typical Use or Source*
Manganese	µg/L	190	50	SMCL-CA	Naturally occurring
Molybdenum	µg/L	0.356	40	HAL-US	Naturally occurring
Nickel	µg/L	4.4	100	MCL-US	Naturally occurring
Selenium	µg/L	0.2	50	MCL-US	Naturally occurring
Strontium	µg/L	688	4000	HAL-US	Naturally occurring
Uranium	µg/L	0.198	30	MCL-US	Naturally occurring
Vanadium	µg/L	1.2	500	RL-CA	Naturally occurring
Zinc	µg/L	11.4	5000	SMCL-CA	Naturally occurring

5 Radioactivity

Constituent Name	*Units*	*Value*	*Benchmark Value and Type*		*Typical Use or Source*
Gross-beta radioactivity, 30 day count	pCi/L	1.69			Naturally occurring
Gross-beta radioactivity, 72 hr count	pCi/L	2.04	50	MCL-US (trigger)	Naturally occurring
Radon-222	pCi/L	757			Naturally occurring

6 Volatile Organic Compounds

Constituent Name	*Units*	*Value*	*Benchmark Value and Type*		*Typical Use or Source*
Methyl tert-butyl ether (MTBE)	µg/L	1.87	13	MCL-CA	Gasoline oxygenate and degradate

7 Pesticides and Pesticide Degradates None Detected

8 Geochemical and Age-Dating Tracers

mg/L = milligrams per liter
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
ng/L = nanograms per liter
ppm = parts per million
ppb = parts per billion
pCi/L = picocuries per liter
E = estimated value

M = presence verified, but quantity uncertain
AL-US = USEPA Action Level (r)
HAL-US = USEPA Lifetime Health Advisory (nr)
HBSL-C = USGS Cancer Health-Based Screening Level
HBSL-NC =USGS Noncancer Health-Based Screening Level
HHBP-C = USEPA Cancer Human Health Benchmark for Pesticide

HHBP-NC = USEPA Noncancer Human Health Benchmark for Pesticide
MCL-CA = SWRCB-DDW Maximum Contaminant Level (r)
MCL-US = USEPA Maximum Contaminant Level (r)
NL-CA = SWRCB-DDW Notification Level (nr)
SMCL-CA = SWRCB-DDW Secondary Maximum Contaminant Level (nr)
SMCL-US = USEPA Secondary Maximum Contaminant Level (nr)

Well Owner Report

Owner **FOUR SEASONS RESORT BILTMORE HOTEL** ***Well Name*** **Biltmore Hotel**

Station ID **342508119383101** ***GAMA ID*** **SB-10**

Station Name **004N026W19H003S** ***Sample Date*** **2/8/2011 @ 1500**

Constituent Name	*Units*	*Value*	*Benchmark Value and Type*		*Typical Use or Source*
Carbon stable isotope ratio of dissolved inorganic carbon	per mil	**-16.59**			For dating ancient water
Carbon-14	percent modern	**87.28**			For dating ancient water
Tritium	pCi/L	**3.89**	20000	MCL-CA	For dating recent water
Hydrogen stable isotope ratio of water	per mil	**-34.9**			Info about recharge source area
Oxygen stable isotope ratio of water	per mil	**-5.55**			Info about recharge source area

9 Microbiological Constituents **Not Sampled**

10 Constituents of Special Interest

Perchlorate	µg/L	**1.03**	6	MCL-CA	Natural, rocket fuel, fertilizer

mg/L = milligrams per liter
µg/L = micrograms per liter
µS/cm = microsiemens per centimeter
ng/L = nanograms per liter
ppm = parts per million
ppb = parts per billion
pCi/L = picocuries per liter
E = estimated value

M = presence verified, but quantity uncertain
AL-US = USEPA Action Level (r)
HAL-US = USEPA Lifetime Health Advisory (nr)
HBSL-C = USGS Cancer Health-Based Screening Level
HBSL-NC =USGS Noncancer Health-Based Screening Level
HHBP-C = USEPA Cancer Human Health Benchmark for Pesticide

HHBP-NC = USEPA Noncancer Human Health Benchmark for Pesticide
MCL-CA = SWRCB-DDW Maximum Contaminant Level (r)
MCL-US = USEPA Maximum Contaminant Level (r)
NL-CA = SWRCB-DDW Notification Level (nr)
SMCL-CA = SWRCB-DDW Secondary Maximum Contaminant Level (nr)
SMCL-US = USEPA Secondary Maximum Contaminant Level (nr)

February 23, 2022

Montecito Water District-GSA		Lab ID	: SP 2201596
Attn: Nick		Customer	: 2-27330
583 San Ysidro Rd.			
Santa Barbara, CA 93108			

Laboratory Report

Introduction: This report package contains total of 8 pages divided into 3 sections:

Case Narrative	(2 pages)	: An overview of the work performed at FGL.
Sample Results	(2 pages)	: Results for each sample submitted.
Quality Control	(4 pages)	: Supporting Quality Control (QC) results.

Case Narrative

This Case Narrative pertains to the following samples:

Sample Description	Date Sampled	Date Received	FGL Lab ID #	Matrix
Well 6 A	01/28/2022	01/28/2022	SP 2201596-001	GW
Well 6 B	01/28/2022	01/28/2022	SP 2201596-002	GW

Sampling and Receipt Information: All samples were received, prepared and analyzed within the method specified holding except those as listed in the table below.

Lab ID	Analyte/Method	Required Holding Time	Actual Holding Time
SP 2201596-001	pH	15	5805 Minutes
SP 2201596-002	pH	15	5719.8 Minutes

All samples arrived on ice. All samples were checked for pH if acid or base preservation is required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Form.

Quality Control: All samples were prepared and analyzed according to the following tables:

Inorganic - Metals QC

200.7	01/31/2022:201574 All analysis quality controls are within established criteria
	01/31/2022:201168 All preparation quality controls are within established criteria (performed at FGL-SP ELAP# 1573)

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

February 23, 2022
Montecito Water District-GSA

Lab ID : SP 2201596
Customer : 2-27330

Inorganic - Wet Chemistry QC

2320B	02/07/2022:201871 All analysis quality controls are within established criteria
	02/06/2022:201388 All preparation quality controls are within established criteria (performed at FGL-SP ELAP# 1573)
2510B	02/01/2022:201571 All analysis quality controls are within established criteria
	02/01/2022:201186 All preparation quality controls are within established criteria (performed at FGL-SP ELAP# 1573)
2540CE	01/31/2022:201156 All preparation quality controls are within established criteria (performed at FGL-SP ELAP# 1573)
300.0	01/28/2022:201514 All analysis quality controls are within established criteria
	01/28/2022:201064 All preparation quality controls are within established criteria (performed at FGL-SP ELAP# 1573)
4500-H B	02/01/2022:201212 All preparation quality controls are within established criteria (performed at FGL-SP ELAP# 1573)
4500HB	02/01/2022:201587 All analysis quality controls are within established criteria
5540C	01/31/2022:201556 All analysis quality controls are within established criteria
	01/28/2022:201174 All preparation quality controls are within established criteria (performed at FGL-SP ELAP# 1573)

Certification:: I certify that this data package is in compliance with ELAP standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following electronic signature.

KD:MKH

Approved By **Kelly A. Dunnahoo, B.S.** Digitally signed by Kelly A. Dunnahoo, B.S. Title: Laboratory Director Date: 2022-02-23

February 23, 2022

Lab ID : SP 2201596-001
Customer ID : 2-27330

Montecito Water District-GSA
Attn: Nick
583 San Ysidro Rd.
Santa Barbara, CA 93108

Sampled On : January 28, 2022-10:30
Sampled By : Nick Kunstec
Received On : January 28, 2022-14:15
Matrix : Ground Water

Description : Well 6 A
Project : MGSA Seawater Intrusion

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	588	2.5	mg/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Calcium	145	1	mg/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Magnesium	55	1	mg/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Potassium	3	1	mg/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Sodium	254	1	mg/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Total Cations	22.9	---	meq/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Boron	0.2	0.1	mg/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Copper	ND	10	ug/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Iron	130	30	ug/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Manganese	310	10	ug/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Zinc	50	20	ug/L		200.7	01/31/22:201168	200.7	01/31/22:201574
SAR	4.6	0.1	--		200.7	01/31/22:201168	200.7	01/31/22:201574
Total Alkalinity (as CaCO3)	200	10	mg/L		2320B	02/06/22:201388	2320B	02/07/22:201871
Hydroxide as OH	ND	10	mg/L		2320B	02/06/22:201388	2320B	02/07/22:201871
Carbonate as CO3	ND	10	mg/L		2320B	02/06/22:201388	2320B	02/07/22:201871
Bicarbonate as HCO3	250	10	mg/L		2320B	02/06/22:201388	2320B	02/07/22:201871
Sulfate	157	0.5	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514
Chloride	523	12*	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514
Nitrate as NO3	32.4	0.4	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514
Nitrite as N	ND	0.2	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514
Nitrate + Nitrite as N	7.3	0.1	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514
Fluoride	0.5	0.1	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514
Total Anions	22.7	---	meq/L		2320B	02/06/22:201388	2320B	02/07/22:201871
pH	7.1	--	units		4500-H B	02/01/22:201212	4500HB	02/01/22:201587
Specific Conductance	2520	1	umhos/cm		2510B	02/01/22:201186	2510B	02/01/22:201571
Total Dissolved Solids	1690	20	mg/L		2540CE	01/31/22:201156	2540C	02/01/22:201588
MBAS Extraction	ND	0.1	mg/L		5540C	01/28/22:201174	5540C	01/31/22:201556
Aggressiveness Index	12.0	1	--		4500-H B	02/01/22:201212	4500HB	02/01/22:201587
Langelier Index (20°C)	0.03	1	--		4500-H B	02/01/22:201212	4500HB	02/01/22:201587
Nitrate Nitrogen	7.3	0.1	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514
Metals, Total								
Silica	36	1	mg/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Wet Chemistry								
Bromide	1.14	0.03	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

February 23, 2022

Montecito Water District-GSA
Attn: Nick
583 San Ysidro Rd.
Santa Barbara, CA 93108

Lab ID : SP 2201596-002
Customer ID : 2-27330

Sampled On : January 28, 2022-11:55
Sampled By : Nick Kunstec
Received On : January 28, 2022-14:15
Matrix : Ground Water

Description : Well 6 B
Project : MGSA Seawater Intrusion

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
General Mineral								
Total Hardness as CaCO3	628	2.5	mg/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Calcium	161	1	mg/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Magnesium	55	1	mg/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Potassium	2	1	mg/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Sodium	135	1	mg/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Total Cations	18.5	---	meq/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Boron	0.2	0.1	mg/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Copper	ND	10	ug/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Iron	510	30	ug/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Manganese	20	10	ug/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Zinc	40	20	ug/L		200.7	01/31/22:201168	200.7	01/31/22:201574
SAR	2.3	0.1	--		200.7	01/31/22:201168	200.7	01/31/22:201574
Total Alkalinity (as CaCO3)	210	10	mg/L		2320B	02/06/22:201388	2320B	02/07/22:201871
Hydroxide as OH	ND	10	mg/L		2320B	02/06/22:201388	2320B	02/07/22:201871
Carbonate as CO3	ND	10	mg/L		2320B	02/06/22:201388	2320B	02/07/22:201871
Bicarbonate as HCO3	260	10	mg/L		2320B	02/06/22:201388	2320B	02/07/22:201871
Sulfate	203	0.5	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514
Chloride	329	7*	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514
Nitrate as NO3	23.8	0.4	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514
Nitrite as N	ND	0.2	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514
Nitrate + Nitrite as N	5.4	0.1	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514
Fluoride	0.3	0.1	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514
Total Anions	18.2	---	meq/L		2320B	02/06/22:201388	2320B	02/07/22:201871
pH	7.2	--	units		4500-H B	02/01/22:201212	4500HB	02/01/22:201587
Specific Conductance	1980	1	umhos/cm		2510B	02/01/22:201186	2510B	02/01/22:201571
Total Dissolved Solids	1360	20	mg/L		2540CE	01/31/22:201156	2540C	02/01/22:201588
MBAS Extraction	ND	0.1	mg/L		5540C	01/28/22:201174	5540C	01/31/22:201556
Aggressiveness Index	12.1	1	--		4500-H B	02/01/22:201212	4500HB	02/01/22:201587
Langelier Index (20°C)	0.2	1	--		4500-H B	02/01/22:201212	4500HB	02/01/22:201587
Nitrate Nitrogen	5.4	0.1	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514
Metals, Total								
Silica	30	1	mg/L		200.7	01/31/22:201168	200.7	01/31/22:201574
Wet Chemistry								
Bromide	0.92	0.03	mg/L		300.0	01/28/22:201064	300.0	01/28/22:201514

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

February 23, 2022 Lab ID : SP 2201596
Montecito Water District-GSA Customer : 2-27330

Quality Control - Inorganic

Constituent	Method	Date/ID	Type	Units	Conc.	QC Data	DQO	Note
Metals								
Boron	200.7		MS	mg/L	4.000	94.4 %	75-125	
		(SP 2201596-001)	MSD	mg/L	4.000	91.3 %	75-125	
			MSRPD	mg/L	4000	3.3%	≤20.0	
	200.7	01/31/22:201574AC	CCV	ppm	5.000	97.8 %	90-110	
			CCB	ppm		0.005	0.1	
			CCV	ppm	5.000	97.8 %	90-110	
			CCB	ppm		0.01	0.1	
			CCV	ppm	5.000	99.0 %	90-110	
			CCB	ppm		0.002	0.1	
Calcium	200.7		MS	mg/L	12.00	58.3 %	<¼	
		(SP 2201596-001)	MSD	mg/L	12.00	89.1 %	75-125	
			MSRPD	mg/L	4000	2.4%	≤20.0	
	200.7	01/31/22:201574AC	CCV	ppm	25.00	99.0 %	90-110	
			CCB	ppm		-0.02	1	
			CCV	ppm	25.00	96.8 %	90-110	
			CCB	ppm		-0.01	1	
			CCV	ppm	25.00	96.3 %	90-110	
			CCB	ppm		-0.02	1	
Copper	200.7		MS	ug/L	800.0	104 %	75-125	
		(SP 2201596-001)	MSD	ug/L	800.0	102 %	75-125	
			MSRPD	ug/L	4000	2.8%	≤20.0	
	200.7	01/31/22:201574AC	CCV	ppm	1.000	104 %	90-110	
			CCB	ppm		-0.0002	0.01	
			CCV	ppm	1.000	105 %	90-110	
			CCB	ppm		0.0006	0.01	
			CCV	ppm	1.000	107 %	90-110	
			CCB	ppm		-0.0011	0.01	
Iron	200.7		MS	ug/L	4000	99.3 %	75-125	
		(SP 2201596-001)	MSD	ug/L	4000	100 %	75-125	
			MSRPD	ug/L	4000	0.9%	≤20.0	
	200.7	01/31/22:201574AC	CCV	ppm	5.000	98.0 %	90-110	
			CCB	ppm		-0.0065	0.03	
			CCV	ppm	5.000	97.1 %	90-110	
			CCB	ppm		-0.0087	0.03	
			CCV	ppm	5.000	95.4 %	90-110	
			CCB	ppm		0.0014	0.03	
Magnesium	200.7		MS	mg/L	12.00	88.2 %	75-125	
		(SP 2201596-001)	MSD	mg/L	12.00	93.1 %	75-125	
			MSRPD	mg/L	4000	0.9%	≤20.0	
	200.7	01/31/22:201574AC	CCV	ppm	25.00	102 %	90-110	
			CCB	ppm		0.02	1	
			CCV	ppm	25.00	100 %	90-110	
			CCB	ppm		0.03	1	
			CCV	ppm	25.00	98.9 %	90-110	
			CCB	ppm		0.001	1	
Manganese	200.7		MS	ug/L	800.0	103 %	75-125	
		(SP 2201596-001)	MSD	ug/L	800.0	103 %	75-125	
			MSRPD	ug/L	4000	0.2%	≤20.0	
	200.7	01/31/22:201574AC	CCV	ppm	1.000	105 %	90-110	
			CCB	ppm		0.0068	0.01	
			CCV	ppm	1.000	103 %	90-110	
			CCB	ppm		-0.0091	0.01	
			CCV	ppm	1.000	101 %	90-110	
			CCB	ppm		-0.0011	0.01	
Potassium	200.7		MS	mg/L	12.00	110 %	75-125	

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

February 23, 2022 | Lab ID : SP 2201596
Montecito Water District-GSA | Customer : 2-27330

Quality Control - Inorganic

Constituent	Method	Date/ID	Type	Units	Conc.	QC Data	DQO	Note
Metals								
Potassium	200.7	(SP 2201596-001)	MSD	mg/L	12.00	108 %	75-125	
			MSRPD	mg/L	4000	1.8%	≤20.0	
	200.7	01/31/22:201574AC	CCV	ppm	25.00	103 %	90-110	
			CCB	ppm		0.15	1	
			CCV	ppm	25.00	103 %	90-110	
			CCB	ppm		0.03	1	
			CCV	ppm	25.00	105 %	90-110	
			CCB	ppm		0.01	1	
Silicon	200.7		MS	mg/L	2.400	80.8 %	75-125	
		(SP 2201596-001)	MSD	mg/L	2.400	86.3 %	75-125	
			MSRPD	mg/L	4000	0.7%	≤20.0	
	200.7	01/31/22:201574AC	CCV	ppm	5.000	102 %	90-110	
			CCB	ppm		0.001	1	
			CCV	ppm	5.000	102 %	90-110	
			CCB	ppm		0.005	1	
			CCV	ppm	5.000	103 %	90-110	
			CCB	ppm		-0.03	1	
Sodium	200.7		MS	mg/L	12.00	27.4 %	<¼	
		(SP 2201596-001)	MSD	mg/L	12.00	77.9 %	75-125	
			MSRPD	mg/L	4000	2.3%	≤20.0	
	200.7	01/31/22:201574AC	CCV	ppm	25.00	98.4 %	90-110	
			CCB	ppm		0.09	1	
			CCV	ppm	25.00	98.2 %	90-110	
			CCB	ppm		0.06	1	
			CCV	ppm	25.00	98.2 %	90-110	
			CCB	ppm		0.05	1	
Zinc	200.7		MS	ug/L	800.0	94.6 %	75-125	
		(SP 2201596-001)	MSD	ug/L	800.0	90.2 %	75-125	
			MSRPD	ug/L	4000	4.4%	≤20.0	
	200.7	01/31/22:201574AC	CCV	ppm	1.000	98.0 %	90-110	
			CCB	ppm		-0.0024	0.02	
			CCV	ppm	1.000	98.7 %	90-110	
			CCB	ppm		0.0003	0.02	
			CCV	ppm	1.000	99.1 %	90-110	
			CCB	ppm		-0.0001	0.02	
Wet Chem								
Alkalinity (as CaCO3)	2320B	(SP 2201621-009)	Dup	mg/L		1.5	10	
	2320B	02/07/22:201871AMM	CCV	mg/L	235.8	103 %	90-110	
			CCV	mg/L	235.8	96.4 %	90-110	
Bicarbonate	2320B	(SP 2201621-009)	Dup	mg/L		1.7	10	
Carbonate	2320B	(SP 2201621-009)	Dup	mg/L		0.0	10	
Hydroxide	2320B	(SP 2201621-009)	Dup	mg/L		0.0	10	
Conductivity	2510B	02/01/22:201571sta	ICB	umhos/cm		0.0700	1	
			ICV	umhos/cm	999.0	97.9%	95-105	
			CCV	umhos/cm	999.0	97.8%	95-105	
E. C.	2510B	02/01/22:201186sta	Blank	umhos/cm		ND	<1	
		(CC 2280281-001)	Dup	umhos/cm		0.4%	5	
Total Dissolved Solids (TFR)	2540CE	01/31/22:201156CTL	Blank	mg/L		ND	<20	
			LCS	mg/L	991.0	101 %	90-110	
		(VI 2240607-001)	Dup	mg/L		2.8%	5	
		(VI 2240607-001)	Dup	mg/L		1.7%	5	
Bromide	300.0	01/28/22:201064NJB	Blank	mg/L		ND	<0.03	
			LCS	mg/L	5.000	95.6 %	90-110	
			MS	mg/L	10.00	86.8 %	86-118	

February 23, 2022
Montecito Water District-GSA

Lab ID : SP 2201596
Customer : 2-27330

Quality Control - Inorganic

Constituent	Method	Date/ID	Type	Units	Conc.	QC Data	DQO	Note
Wet Chem								
Bromide	300.0	(VI 2240385-001)	MSD	mg/L	10.00	90.8 %	86-118	
			MSRPD	mg/L	10.00	4.5%	≤11	
			MS	mg/L	10.00	97.3 %	86-118	
		(CH 2270539-001)	MSD	mg/L	10.00	99.0 %	86-118	
			MSRPD	mg/L	10.00	1.7%	≤11	
	300.0	01/28/22:201514njb	CCB	mg/l		0.00	0.03	
			CCV	mg/l	5.000	99.2%	90-110	
			CCB	mg/l		0.00	0.03	
			CCV	mg/l	5.000	98.7%	90-110	
Chloride	300.0	01/28/22:201064NJB	Blank	mg/L		ND	<1	
			LCS	mg/L	25.00	98.4 %	90-110	
			MS	mg/L	50.00	86.3 %	85-121	
		(VI 2240385-001)	MSD	mg/L	50.00	91.2 %	85-121	
			MSRPD	mg/L	10.00	5.0%	≤19	
			MS	mg/L	50.00	95.1 %	85-121	
		(CH 2270539-001)	MSD	mg/L	50.00	98.3 %	85-121	
			MSRPD	mg/L	10.00	2.6%	≤19	
	300.0	01/28/22:201514njb	CCB	mg/l		0.0780	1	
			CCV	mg/l	25.00	103%	90-110	
			CCB	mg/l		0.0680	1	
			CCV	mg/l	25.00	103%	90-110	
Fluoride	300.0	01/28/22:201064NJB	Blank	mg/L		ND	<0.1	
			LCS	mg/L	2.500	97.3 %	90-110	
			MS	mg/L	5.000	87.1 %	87-120	
		(VI 2240385-001)	MSD	mg/L	5.000	90.7 %	87-120	
			MSRPD	mg/L	10.00	4.0%	≤16	
			MS	mg/L	5.000	98.3 %	87-120	
		(CH 2270539-001)	MSD	mg/L	5.000	99.9 %	87-120	
			MSRPD	mg/L	10.00	1.6%	≤16	
	300.0	01/28/22:201514njb	CCB	mg/l		0.00	0.1	
			CCV	mg/l	2.500	102%	90-110	
			CCB	mg/l		0.00	0.1	
			CCV	mg/l	2.500	102%	90-110	
Nitrate	300.0	01/28/22:201064NJB	Blank	mg/L		ND	<0.4	
			LCS	mg/L	20.00	97.4 %	90-110	
			MS	mg/L	40.00	87.0 %	85-119	
		(VI 2240385-001)	MSD	mg/L	40.00	91.3 %	85-119	
			MSRPD	mg/L	10.00	4.8%	≤19	
			MS	mg/L	40.00	97.7 %	85-119	
		(CH 2270539-001)	MSD	mg/L	40.00	100 %	85-119	
			MSRPD	mg/L	10.00	2.2%	≤19	
	300.0	01/28/22:201514njb	CCB	mg/l		0.00	0.5	
			CCV	mg/l	20.00	101%	90-110	
			CCB	mg/l		0.00	0.5	
			CCV	mg/l	20.00	101%	90-110	
Nitrate + Nitrite as N	300.0	01/28/22:201064NJB	Blank	mg/L		ND	<0.1	
Nitrate Nitrogen	300.0	01/28/22:201064NJB	Blank	mg/L		ND	<0.1	
Nitrite	300.0	01/28/22:201064NJB	Blank	mg/L		ND	<0.5	
			LCS	mg/L	15.00	98.5 %	90-110	
			MS	mg/L	30.00	87.1 %	74-126	
		(VI 2240385-001)	MSD	mg/L	30.00	92.1 %	74-126	
			MSRPD	mg/L	10.00	5.6%	≤20	
			MS	mg/L	30.00	99.3 %	74-126	
		(CH 2270539-001)	MSD	mg/L	30.00	103 %	74-126	

February 23, 2022 | Lab ID : SP 2201596
Montecito Water District-GSA | Customer : 2-27330

Quality Control - Inorganic

Constituent	Method	Date/ID	Type	Units	Conc.	QC Data	DQO	Note
Wet Chem								
Nitrite	300.0	01/28/22:201064NJB	MSRPD	mg/L	10.00	3.4%	≤20	
	300.0	01/28/22:201514njb	CCB	mg/l		0.00	0.5	
			CCV	mg/l	15.00	104%	90-110	
			CCB	mg/l		0.00	0.5	
			CCV	mg/l	15.00	103%	90-110	
Nitrite Nitrogen	300.0	01/28/22:201064NJB	Blank	mg/L		ND	<0.2	
Sulfate	300.0	01/28/22:201064NJB	Blank	mg/L		ND	<0.5	
			LCS	mg/L	50.00	98.2 %	90-110	
			MS	mg/L	100.0	86.5 %	82-124	
		(VI 2240385-001)	MSD	mg/L	100.0	91.3 %	82-124	
			MSRPD	mg/L	10.00	5.3%	≤23	
			MS	mg/L	100.0	95.2 %	82-124	
		(CH 2270539-001)	MSD	mg/L	100.0	98.5 %	82-124	
			MSRPD	mg/L	10.00	3.0%	≤23	
	300.0	01/28/22:201514njb	CCB	mg/l		0.0890	0.5	
			CCV	mg/l	50.00	104%	90-110	
			CCB	mg/l		0.0910	0.5	
			CCV	mg/l	50.00	104%	90-110	
pH	4500-H B	(SP 2201645-002)	Dup	units		0.3%	4.80	
	4500HB	02/01/22:201587jba	CCV	units	8.000	101%	95-105	
			CCV	units	8.000	101%	95-105	
MBAS	5540C	01/31/22:201556jba	CCB	mg/l		-0.0611	0.25	
			CCV	mg/l	1.000	103%	90-110	
			CCB	mg/l		-0.0611	0.25	
			CCV	mg/l	1.000	104%	90-110	
MBAS Extraction	5540C	01/28/22:201174jba	Blank	mg/L		ND	<0.1	
			LCS	mg/L	0.5000	103%	86-114	
			BS	mg/L	0.5000	102%	86-114	
			BSD	mg/L	0.5000	104%	86-114	
			BSRPD	mg/L	0.5000	2.7%	≤5	

Definition

ICV	: Initial Calibration Verification - Analyzed to verify the instrument calibration is within criteria.
ICB	: Initial Calibration Blank - Analyzed to verify the instrument baseline is within criteria.
CCV	: Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria.
CCB	: Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria.
Blank	: Method Blank - Prepared to verify that the preparation process is not contributing contamination to the samples.
LCS	: Laboratory Control Standard/Sample - Prepared to verify that the preparation process is not affecting analyte recovery.
MS	: Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery.
MSD	: Matrix Spike Duplicate of MS/MSD pair - A random sample duplicate is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery.
BS	: Blank Spikes - A blank is spiked with a known amount of analyte. It is prepared to verify that the preparation process is not affecting analyte recovery.
BSD	: Blank Spike Duplicate of BS/BSD pair - A blank duplicate is spiked with a known amount of analyte. It is prepared to verify that the preparation process is not affecting analyte recovery.
Dup	: Duplicate Sample - A random sample with each batch is prepared and analyzed in duplicate. The relative percent difference is an indication of precision for the preparation and analysis.
MSRPD	: MS/MSD Relative Percent Difference (RPD) - The MS relative percent difference is an indication of precision for the preparation and analysis.
BSRPD	: BS/BSD Relative Percent Difference (RPD) - The BS relative percent difference is an indication of precision for the preparation and analysis.
ND	: Non-detect - Result was below the DQO listed for the analyte.
<¼	: High Sample Background - Spike concentration was less than one forth of the sample concentration.
DQO	: Data Quality Objective - This is the criteria against which the quality control data is compared.

February 16, 2022

Montecito Water District-GSA
Attn: Nick
583 San Ysidro Rd.
Santa Barbara, CA 93108

Subject: Subcontract Analysis for FGL Lab No. SP 2201596

Enclosed please find results for the following sample(s) which were received by FGL.

- Sub Inorganic-Iodide

Please note that this analysis was performed by Weck Laboratories, Inc. (ELAP Certified Laboratory)

Thank you for using FGL Environmental.

Sincerely,

Cindy Aguirre Digitally signed by Cindy Aguirre
Title: Customer Service Rep
Date: 2022-02-16

Enclosure

WECK LABORATORIES, INC.

Certificate of Analysis

FINAL REPORT

Work Orders:	2B01011	**Report Date:**	2/11/2022
		Received Date:	2/1/2022
Project:	SP 2201596	**Turnaround Time:**	7 workdays
		Phones:	(805) 392-2012
		Fax:	(805) 525-4172
Attn:	Cindy Aguirre	**P.O. #:**	
Client:	FGL Environmental 853 Corporation Street Santa Paula, CA 93060	**Billing Code:**	

Dear Cindy Aguirre,

Enclosed are the results of analyses for samples received 2/01/22 with the Chain-of-Custody document. The samples were received in good condition, at 2.6 °C and on ice. All analyses met the method criteria except as noted in the case narrative or in the report with data qualifiers.

Sample Results

Sample: Well 6 A — Sampled: 01/28/22 10:30 by Client

2B01011-01 (Water)

Method: EPA 332.0M — Instr: LCMS04

Batch ID: W2A1210 — Preparation: _NONE (LC) — Prepared: 02/08/22 10:02 — Analyst: kan

Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
Iodide	**13**	1.0	ug/l	1	02/08/22	

Sample: Well 6 B — Sampled: 01/28/22 11:55 by Client

2B01011-02 (Water)

Method: EPA 332.0M — Instr: LCMS04

Batch ID: W2A1210 — Preparation: _NONE (LC) — Prepared: 02/08/22 10:02 — Analyst: kan

Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
Iodide	**1.2**	1.0	ug/l	1	02/08/22	

14859 Clark Avenue,City of Industry CA, 91745 | Phone: (626) 336-2139 | Fax: (626) 336-2634
www.wecklabs.com

WECK LABORATORIES, INC.

Certificate of Analysis

FINAL REPORT

Quality Control Results

Iodide by LC-MS-MS

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Batch: W2A1210 - _NONE (LC)										
Blank (W2A1210-BLK1)				**Prepared & Analyzed: 02/08/22**						
Iodide	ND	1.0	ug/l							
LCS (W2A1210-BS1)				**Prepared & Analyzed: 02/08/22**						
Iodide	9.92	1.0	ug/l	10.0		99	80-120			
Matrix Spike (W2A1210-MS1)	**Source: 2B01011-01**			**Prepared & Analyzed: 02/08/22**						
Iodide	21.6	1.0	ug/l	10.0	*13.2*	85	80-120			
Matrix Spike Dup (W2A1210-MSD1)	**Source: 2B01011-01**			**Prepared & Analyzed: 02/08/22**						
Iodide	21.3	1.0	ug/l	10.0	*13.2*	81	80-120	2	20	

14859 Clark Avenue,City of Industry CA, 91745 | Phone: (626) 336-2139 | Fax: (626) 336-2634

www.wecklabs.com

Notes and Definitions

Item	Definition
%REC	Percent Recovery
Dil	Dilution
MRL	The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. The MRL is also known as Limit of Quantitation (LOQ)
ND	NOT DETECTED at or above the Method Reporting Limit (MRL). If Method Detection Limit (MDL) is reported, then ND means not detected at or above the MDL.
RPD	Relative Percent Difference
Source	Sample that was matrix spiked or duplicated.

Any remaining sample(s) will be disposed of one month from the final report date unless other arrangements are made in advance.

All results are expressed on wet weight basis unless otherwise specified.

All samples collected by Weck Laboratories have been sampled in accordance to laboratory SOP Number MIS002.

Reviewed by:

Rahul R. Nair
Project Manager

ELAP-CA #1132 • EPA-UCMR #CA00211 • Guam-EPA #17-008R • LACSD #10143 • NJ-DEP #CA015 • NV-DEP #NAC 445A • SCAQMD #93LA1006

This is a complete final report. The information in this report applies to the samples analyzed in accordance with the chain-of-custody document. Weck Laboratories certifies that the test results meet all requirements of TNI unless noted by qualifiers or written in the Case Narrative. This analytical report must be reproduced in its entirety.

14859 Clark Avenue,City of Industry CA, 91745 | Phone: (626) 336-2139 | Fax: (626) 336-2634
www.wecklabs.com

WECK LABORATORIES, INC.

Sample Receipt

WORK ORDER:	2B01011	**Printed:**	2/2/2022 5:32:13PM
Client:	FGL Environmental	**Project Manager:**	Rahul R. Nair
Project:	FGL Environmental	**Project Number:**	SP 2201596

Report To:
FGL Environmental
Cindy Aguirre
853 Corporation Street
Santa Paula, CA 93060
Phone: (805) 392-2012
Fax: (805) 525-4172

Invoice To:
FGL Environmental
Accounts Payable - Jackie Barnes
853 Corporation Street
Santa Paula, CA 93060
Phone :(805) 392-2038
Fax: (805) 525-4172

Date Due:	02/10/22 09:00 (7 day TAT)		
Received By:	Algabriel T. Holanda	**Date Received:**	02/01/22 09:40
Logged In By:	Algabriel T. Holanda	**Date Logged In:**	02/01/22 10:10

Samples Received at:	**2.6°C**				
All containers intact	**Yes**	Sample labels & COC agree	**Yes**	Sufficient holding time for all tests	**Yes**
		Samples preserved properly	**Yes**	Received on Ice	**Yes**
Chain of custody completed	**Yes**	Sample volume sufficient	**Yes**	Appropriate sample containers	**Yes**

Samples

Analysis	Expires	Analysis Comments
2B01011-01 Sample Name: Well 6 A [Water] Sampled 1/28/2022 10:30		
332.0M EPA_w Iodide	02/25/22 23:59	
2B01011-02 Sample Name: Well 6 B [Water] Sampled 1/28/2022 11:55		
332.0M EPA_w Iodide	02/25/22 23:59	

Note:
If any of the information included in this sample receipt acknowledgement is incorrect (sample information, analysis, etc), please contact the lab at (626) 336-2139. Thank you.

14859 Clark Avenue, City of Industry, California 91745-1396 (626) 336-2139 FAX (626) 336-2634
www.wecklabs.com

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

Subcontract to Weck Laboratories, Inc.

2B01011

CHAIN OF CUSTODY
AND ANALYSES REQUEST FORM

Chain of Custody Information

Lab Number:

Client: Fruit Growers Laboratory
Address: 853 Corporation St.
Santa Paula, CA 93060-3005

Phone: Fax:
Contact:
Project: **SP 2201596**
Purchase Order:

Sampler(s): Nick Kunstec

Compositor Setup Date: Time:

Samp Num	Location Description	Date Sampled	Time Sampled	Method of Sampling: Composite (C) Grab(G)	Type of Sample	Potable(P) Non-Potable(NP) Ag Waiver (AgW)	Bacti Type: Other(O) System(SYS) Source(SR) Waste(W)	Bacti Reason: Routine(ROUT) Repeat(RPT)	Replace(RPL) Other(O) Special(SPL)	Sub Inorganic-Iodide 8oz(P)								
1	Well 6 A	01/28/2022	10:30	G	GW					1								
2	Well 6 B	01/28/2022	11:55	G	GW					1								

Sample Information / Test Description(s)

Remarks
email loginsp@fglinc.com to confirm samples arrived.

Relinquished	Date	Time	Relinquished	Date	Time	Relinquished	Date	Time
[signature]	1/31/22	17:30	GLS	2/1/22	940			
Received By:	**Date**	**Time**	**Received By:**	**Date**	**Time**	**Received By:**	**Date**	**Time**
GLS			[signature]	2.6°C T-0254				

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

WECK LABORATORIES, INC.

Sample Receipt Checklist

Weck WKO: 2B01011
WKO Logged by: Algabriel Holanda
Samples Checked by: ATH

Date/Time Received: 02/01/22 @ 09:40
# of Samples: 2
Delivered by: GLS

	Task	Yes	No	N/A	Comments
COC	COC present at receipt?	☒	☐		
	COC properly completed?	☒	☐		
	COC matches sample labels?	☒	☐		
	Project Manager notified?	☐	☐	☒	
Receipt Information	Sample Temperature	2.6 °C			
	Samples received on ice?	☒	☐		
	Ice Type (Blue/Wet)	Wet			
	All samples intact?	☒	☐		
	Samples in proper containers?	☒	☐		
	Sufficient sample volume?	☒	☐		
	Samples intact?	☒	☐		
	Received within holding time?	☒	☐		
	Project Manager notified?	☐	☐	☒	
Sample Preservation Verification?	Sample labels checked for correct preservation?	☒	☐	☐	
	VOC Headspace: none, <6mm/<Pea size? 524.2, 524.3, 624.1, 8260, 1666 P/T, LUFT	☐	☐	☒	
	pH verified upon receipt? Metals <2; H2SO4 pres tests <2; 522<4; TOC <2; 608.3 5-9	☐	☐	☒	
	Free Chlorine Tested <0.1	☐	☐	☒	
	O&G pH <2 verified?	☐	☐	☐	pH paper Lot# pH Reading:
	pH adjusted for O&G	☐	☐	☐	Acid Lot# Amt added:
	Project Manager notified?	☐	☐	☒	

PM Comments

Sample Receipt Checklist Prepared by:
Signature: [signature]
Date: 02/01/22

FGL ENVIRONMENTAL AGRICULTURAL Analytical Chemists

www.fglinc.com

CHAIN OF CUSTODY
AND ANALYSIS REQUEST DOCUMENT

ORIGINAL

CLIENT DETAILS — SECTION I

Client: Montecito Water District - GSA

☐ New Customer Customer Number: 2027330

Address: 583 San Ysidro Rd
Santa Barbara, CA 93108

Phone: 805-881-1990 Fax:

E-Mail: ~~Nick~~ nkunstek@~~gm~~ montecitogsa.com

Project name: ~~Nick Kunstek~~ ~~Montecito~~ → MGSA Seawater Intrusion - N.M.

Contact person:

Billing Information (if different from above) → Nick Kunstek

Name:

Address:

Phone: Fax:

E-Mail:

Contact person:

Purchase order/contract/FGL quote number: SP20210308802

Pre Log Required: yes ____ Frequency: Monthly☐ Weekly☐ Quarterly☐ Other☐

SAMPLING — SECTION II

Sampler (s): Nick Kunstec (per bottle)

Comp Sampler Set up Date: ____ Time: ____

Time: ____ Mileage: ____

Shipping Charge: ____ Pickup Charge: ____

REPORT INFORMATION — SECTION III

Rush Analysis (surcharge will apply):

☐5 Day ☐4 Day ☐3 Day ☐2 Day ☐24 hour

Rush pre-approved by lab: ____

Electronic Data Transfer: ☐yes ☐no

If yes, To: State ____ Client ____ Other ____

Lab number: ~~2027330~~ 2201596

SAMPLE INFORMATION — SECTION IV

Sample Number	Location/Description	Date Sampled	Time Sampled	Type of Sampling: Composite (C) or Grab (G)	Number of Containers	Type of Containers: (G) Glass (P) Plastic (V) VOA (MT) Metal Tube	(P) Potable (NP) Non-Potable	(SW) Surface Water (MW) Monitoring Well (GW) Ground Water (TB) Travel Blank (AgW) Ag Water (WW) Wastewater (DW) Drinking Water	(S) Soil (SLG) Sludge (SLD) Solid (O) Oil	BacT: (Sys) System (SRC) Source (W) Waste	BacT: Routine (ROUT) Repeat (RPT) Other (OTH) Replace (RPL)	(LT) Leaf Tissue (PET) Petiole Tissue (PRD) Produce	Preservative: (1) NaOH + ZnAc, (2) NaOH, (3) HCL (4) H_2SO_4, (5) HNO_3, (6) $Na_2S_2O_3$, (7) Other	ANALYSES REQUESTED	Gen Min: 250ml (P) - HNO_3, Bor (P)	Wet Chem: Br (8oz)	Sub Inorganic - Iodide	Silica - 16oz
1	Well 6A	1/28/22	10:30	G	S	P	NP	GW							1	1	1	1
2	Well 6B	1/28/22	11:55	G	S	P	NP	GW							1	1	1	1

Please have results by 2/10/22

REMARKS — SECTION V

Results asked for by 2/10/22

CUSTODY — SECTION VI

Relinquished by and subject to the terms and conditions on the reverse of this document:

Relinquished by: [signature]	Date: 1/28/22	Time: 12:00	Relinquished by: CeRerDe	Date: 1/28/22	Time: 1304
Received by: CeRerDe	Date: 1/28/22	Time: 1415	Received by: CRA	Date: ↓	Time: ↓
Relinquished by:	Date:	Time:	Relinquished by:	Date:	Time:
Received by:	Date:	Time:	Received by:	Date:	Time:

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805) 392-2000
FAX: (805) 525-4172

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209) 942-0182
FAX: (209) 942-0423

Office & Laboratory
563 East Lindo Avenue
Chico, CA 95926
TEL: (530) 343-5818
FAX: (530) 343-3807

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805) 783-2940
FAX: (805) 783-2912

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559) 734-9473
FAX: (559) 734-8435

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

Subcontract to Weck Laboratories, Inc.

CHAIN OF CUSTODY
AND ANALYSES REQUEST FORM

Chain of Custody Information

Lab Number:

Client: Fruit Growers Laboratory
Address: 853 Corporation St.
Santa Paula, CA 93060-3005

Phone: Fax:
Contact:
Project: **SP 2201596**
Purchase Order:

Sampler(s): Nick Kunstec

Compositor Setup Date: Time:

Samp Num	Location Description	Date Sampled	Time Sampled	Method of Sampling: Composite (C) Grab(G)	Type of Sample	Potable(P) Non-Potable(NP) Ag Waiver (AgW)	Bacti Type: Other(O) System(SYS) Source(SR) Waste(W)	Bacti Reason: Routine(ROUT) Repeat(RPT) Replace(RPL) Other(O) Special(SPL)	Sub Inorganic-Iodide 8oz(P)								
1	Well 6 A	01/28/2022	10:30	G	GW				1								
2	Well 6 B	01/28/2022	11:55	G	GW				1								

Remarks
email loginsp@fglinc.com to confirm samples arrived.

Relinquished	Date	Time	Relinquished	Date	Time	Relinquished	Date	Time
Received By:	**Date**	**Time**	**Received By:**	**Date**	**Time**	**Received By:**	**Date**	**Time**

Condition Upon Receipt (Attach to COC) SP 2201596

Sample Receipt at SP:

1. Number of ice chests/packages received: **1**
2. Shipper tracking numbers ______
3. Were samples received in a chilled condition?
   Temps: **ROI** / **10c** / / / / / /
4. Surface water (SWTR) bact samples: A sample that has a temperature upon receipt of >10C, whether iced or not, should be flagged unless the time since sample collection has been less than two hours.
5. Do the number of bottles received agree with the COC? **[Yes]** **No** **N/A**
6. Verify sample date, time, sampler **[Yes]** **No** **N/A**
7. Were the samples received intact? (i.e. no broken bottles, leaks, etc.) **[Yes]** **No**
8. Were sample custody seals intact? **Yes** **No** **[N/A]**

Sample Verification, Labeling and Distribution:

1. Were all requested analyses understood and acceptable? **[Yes]** **No**
2. Did bottle labels correspond with the client's ID's? **[Yes]** **No**
3. Were all bottles requiring sample preservation properly preserved? **[Yes]** **No** **N/A** **FGL**
   [Exception: Oil & Grease, VOA and CrVI verified in lab]
4. VOAs checked for Headspace? **Yes** **No** **[N/A]**
5. Were all analyses within holding times at time of receipt? **[Yes]** **No**
6. Have rush or project due dates been checked and accepted? **Yes** **No** **[N/A]**

Include a copy of the COC for lab delivery. (Bacti. Inorganics and Radio)

Sample Receipt, Login and Verification completed by: Reviewed and Approved By **Celina Acosta** Digitally signed by Celina Acosta Title: Sample Receiving Date: 01/31/2022-12:13:35

Discrepency Documentation:

Any items above which are "No" or do not meet specifications (i.e. temps) must be resolved.

1. Person Contacted: ______ Phone Number: ______
   Initiated By: ______ Date: ______
   Problem:

   Resolution:

2. Person Contacted: ______ Phone Number: ______
   Initiated By: ______ Date: ______
   Problem:

   Resolution:

(2027330)
Montecito Water District-GSA
SP 2201596
CRA-01/31/2022-12:13:35

MONTECITO WATER DISTRICT 100 RELIABLE SINCE 1921

2021 ANNUAL DRINKING WATER CONSUMER CONFIDENCE REPORT

This report explains where your water comes from, provides information on water quality and how it is measured, and presents the District's 2021 test results which show that ***drinking water met, or was better than, state and federal water quality standards.***

Montecito Water District was founded in 1921 to address the challenge of providing sufficient water to a growing community in a semiarid region.

For the last century, the District has successfully achieved its mission:

to provide an adequate and reliable supply of high quality water to the residents of Montecito and Summerland, at the most reasonable cost.

In carrying out this mission, the District places particular emphasis on providing outstanding customer service, conducting its operations in an environmentally sensitive manner, and working cooperatively with other agencies.

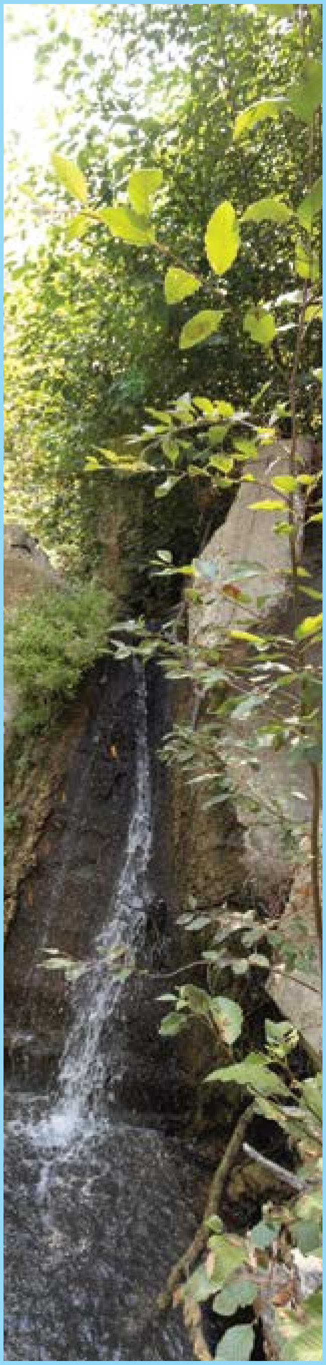
Foresight and action over the years has made this possible. The creation of Jameson Lake, participation in the Cachuma Project, and investment in the State Water Project are some of the District's most noteworthy accomplishments in its first 75 years.

Drought reached unprecedented levels in the past decade, and due to its reliance on rainfall dependent supplies the District found itself in a vulnerable position. Since 2015 we've made tremendous strides—maximizing current investments and securing more local, more reliable supplies.

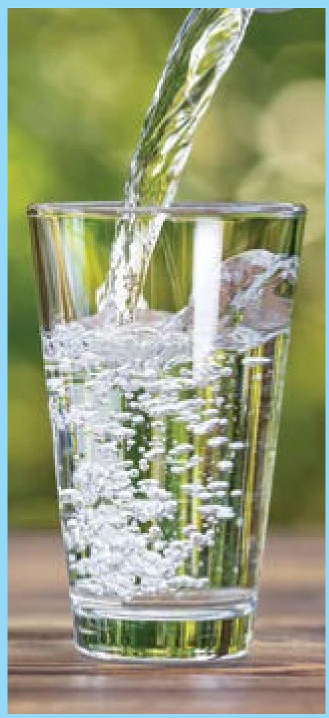
Through a century of experience we've learned: Change is certain in all arenas. We'll continue to focus on maintaining quality and improving resiliency. We'll also be asking all customers to do their part and practice efficient water use.

The District takes pride in continuing to deliver a reliable supply of high-quality water to the communities of Montecito and Summerland and plans to be well positioned to ensure a future of ongoing reliability and resilience—for the next 100 years!

Nick Turner,
General Manager



Reliable water service is essential for our health and safety, fire protection and to preserve the community's unique character.



Este informe contiene información muy importante sobre su agua potable. Tradúzcalo o hable con alguien que lo entienda bien. Para información en español llame al 805.969.2271.

MONTECITO WATER DISTRICT
583 San Ysidro Road, Santa Barbara, CA 93108
phone: 805.969.2271
email: info@montecitowater.com

Montecito Water District's Water Quality Summary 2021

Primary Standards (PDWS)	Units	Maximum Contaminant Level	Public Health Goal (MCLG)	Jameson Lake Average	Jameson Lake Range	Ground Water Average	Ground Water Range	Cachuma Lake Average	Cachuma Lake Range	Common Sources of Contamination in Drinking Water
Water Clarity										
Treated Turbidity	NTU	TT = 1 NTU TT = 95% of Samples ≤ 0.3	NA	0.05	0.03-0.20 100.0%	<0.1	<0.1 100%	NA	ND -0.07 100%	Soil runoff.
Radioactive Contaminants (2020)										
Gross Alpha Particle Activity	pCi/L	15	(0)	1.33	1.33	2.63	1.22 - 3.86	NA	NA	Erosion of natural deposits.
Inorganic Contaminants										
Aluminum	µg/L	1000	600	10	ND-10	ND	ND	26	ND - 83	Erosion of natural deposits; residue from some surface water treatment processes.
Arsenic	µg/L	10	0.004	ND	ND	0.33	ND-1	NA	NA	
Barium	mg/L	1	2	ND	ND	0.08	0.06-0.09	NA	NA	Discharges of oil drilling wastes: erosion of natural deposits.
Fluoride	mg/L	2	1	0.2	0.2	0.8	0.5 - 1.0	0.4	0.32 - 0.44	Erosion of natural deposits; discharge from fertilizer.
Mercury	µg/L	2	1.2	ND	ND	0.13	0.09-0.20	NA	NA	
Nickel	µg/L	100	12	ND	ND	1	ND-2.0	NA	NA	
Nitrate as N (Nitrogen)	mg/L	10	10	ND	ND	2.1	0.6-2.9	0.13	ND - 0.23	Runoff or leaching from fertilizer use; leaching from septic tanks and sewage; erosion from natural deposits
Selenium	µg/L	0.05	30	ND	ND	4	2.0-6.0	ND	NA	Discharge from petroleum, glass, and metal refineries; erosion of natural deposits; discharge from mines and chemical manufacturers; runoff from livestock lots (feed additive).

Primary Standards for Distribution System	Units	Maximum Contaminant Level	Public Health Goal (MCLG)	Distribution System Average	Distribution System Range	Common Sources of Contamination in Drinking Water
Disinfectant						
Free Chlorine Residual	mg/L	MRDL, 4.0	MRDLG, 4.0	0.76	0.20-2.01	Drinking water disinfectant added for treatment
Disinfection Byproducts						
Total Trihalomethanes	µg/L	80	NA	Highest LRAA, 51.3	14-64	Byproduct of drinking water disinfection
Haloacetic Acids	µg/L	60	NA	Highest LRAA, 44.3	9.0-66	Byproduct of drinking water disinfection
Bromate (Cachuma Lake)	µg/L	10	0.1	3.8	1.8 - 5.3	Byproduct of drinking water disinfection
Total Organic Carbon (DBP Precursor)	mg/L	TT	NA	3.0	1.5-3.7	Various natural and manmade sources. Total Organic Carbon (TOC) has no health effects. However, it provides a medium for the formation of disinfection byproducts.
Microbiological Contaminant Samples						
Total Coliform Bacteria	% Tests Positive	<5% of Monthly Samples of minimum 48 samples	0	0.00%	0	Naturally present in the environment.

Lead and Copper Rule (2020)	Units	RAL	PHG	Samples collected	Above RAL	90th Percentile	Schools Testing Again in 2022
Lead	µg/L	15	0.2	36	0	ND	Internal corrosion of household water plumbing systems; discharges from industrial manufacturers; erosion of natural deposits.
Copper	µg/L	1300	300	36	0	232	Internal corrosion of household plumbing systems; erosion of natural deposits; leaching from wood preservatives.

Lead and Copper Rule Every three years, a minimum of 30 residences are tested for lead and copper levels at the tap. The most recent set of 36 samples was collected in 2020. All of the samples were well below the regulatory action level (RAL). Copper was detected in 28 samples. The 90th percentile value was at 232 ug/L. Lead was not detected in any of the samples. The 90th percentile value was Non-Detect. If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. Montecito Water District is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline or at http://www.epa.gov/lead.

Secondary Standards	Units	Maximum Contaminant Level	Jameson Lake Average	Jameson Lake Range	Ground Water Average	Ground Water Range	Cachuma Lake Average	Cachuma Lake Range	Common Sources of Contamination in Drinking Water
Aesthetic Standards									
Color	Units	15	12	12	ND	ND	ND	NA	Naturally-occurring organic minerals.
Chloride	mg/L	500	6	6	148	89-198	29	28 - 31	Runoff or leaching from natural deposits; seawater influence.
Iron	µg/L	300	ND	ND	6.2	ND-250	12	ND - 17	Leaching from natural deposits; industrial wastes.
Manganese	µg/L	50	ND	ND	5.8	ND-100	1.3	ND - 2.2	Leaching from natural deposits.
Threshold Odor at 60 degrees celcius	Units	3	ND	ND	ND	ND	3	2 - 4	Naturally-occurring organic minerals.
Specific Conductance	µS/cm	1600	872	863-881	1167	910-1390	923	890 - 1005	Substances that form ions in water; seawater influence.
Sulfate	mg/L	500	218	218	149	128-195	262	249 - 290	Runoff or leaching from natural deposits; industrial wastes.
Total Dissolved Solids	mg/L	1000	584	578-590	710	560-890	710	598 - 776	Runoff or leaching from natural deposits.
Zinc	mg/L	5	ND	ND	0.017	ND - 0.030	ND	NA	Runoff or leaching from natural deposits; industrial wastes.

Secondary Standards	Units	Maximum Contaminant Level	Jameson Lake Average	Jameson Lake Range	Ground Water Average	Ground Water Range	Cachuma Lake Average	Cachuma Lake Range
Additional Constituents Analyzed								
pH	pH units	NS	8.3	7.1-9.1	7.6	7.6-7.7	7.64	7.31 - 7.79
Total Hardness	mg/L	NS	372	344-400	311	225-461	391	368 - 432
Total Alkalinity	mg/L	NS	188	168-220	207	200-220	193	180 - 229
Boron	mg/L	1000 (RAL)	ND	ND	0.6	ND-0.6	0.38	0.37 - 0.39
Calcium	mg/L	NS	99	99	78	57-117	85	80 - 96.1
Magnesium	mg/L	NS	26	26	28	20-41	42	38 - 45
Sodium	mg/L	NS	28	28	97	72-137	53	48 - 58
Potassium	mg/L	NS	3	3	0.7	ND-1.0	4.0	3.8 - 4.5
Unregulated Contaminant Monitoring Rule 4 (2019-20)								
HAA5	µg/L	NS	32.87	23.98 - 44	NA	NA	13	ND - 32
HAA6Br	µg/L	NS	8.03	4.24 - 14.09	NA	NA	14	ND - 24
HAA9	µg/L	NS	39.95	32.57 - 48.94	NA	NA	24	ND - 51
Bromochloroacetic Acid	µg/L	NS	3.29	1.89 - 5.45	NA	NA	3.9	ND - 8.2
Bromodichloroacetic Acid	µg/L	NS	2.95	2.15 - 4.05	NA	NA	3.5	ND - 5.8
Chlorodibromoacetic Acid	µg/L	NS	0.85	0 - 1.9	NA	NA	2.2	ND - 3.3
Dibromoacetic Acid	µg/L	NS	0.71	0 - 1.9	NA	NA	2.3	ND - 4.2
Dichloroacetic Acid	µg/L	NS	12.34	7.75 - 20	NA	NA	6.0	ND - 16
Monobromoacetic Acid	µg/L	NS	0.24	0 - 0.8	NA	NA	2.3	ND - 4.9
Monochloroacetic Acid	µg/L	NS	1.17	ND - 1.6	NA	NA	2.3	ND - 4.9
Trichloroacetic Acid	µg/L	NS	18.41	10.75 - 26	NA	NA	4.2	ND - 12

This Consumer Confidence Report (CCR) reflects changes in drinking water regulatory requirements during 2021. These revisions add the requirements of the federal Revised Total Coliform Rule, effective since April 1, 2016, to the existing state Total Coliform Rule. The revised rule maintains the purpose to protect public health by ensuring the integrity of the drinking water distribution system and monitoring for the presence of microbials (i.e., total coliform and E. coli bacteria). The U.S. EPA anticipates greater public health protection as the rule requires water systems that are vulnerable to microbial contamination to identify and fix problems. Water systems that exceed a specified frequency of total coliform occurrences are required to conduct an assessment to determine if any sanitary defects exist. If found, these must be corrected by the water system. The state Revised Total Coliform Rule became effective July 1, 2021.

Nitrate as N (Nitrogen): Nitrate in drinking water at levels above 10 mg/L is a health risk for infants of less than six months of age. Such nitrate levels in drinking water can interfere with the capacity of the infant's blood to carry oxygen, resulting in a serious illness; symptoms include shortness of breath and blueness of the skin. Nitrate levels above 10 mg/L may also affect the ability of the blood to carry oxygen in other individuals, such as pregnant women and those with certain specific enzyme deficiencies. If you are caring for an infant, or you are pregnant, you should ask advice from your health care provider. MWD's highest nitrate level in 2021 was 2.9 mg/L

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Contaminants that may be present in source water include: Microbial contaminants, such as viruses and bacteria, that may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.

Inorganic contaminants, such as salts and metals, that can be naturally-occurring or result from urban storm water runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.

Pesticides and herbicides, that may come from a variety of sources such as agriculture, urban storm water runoff, and residential uses.

Organic chemical contaminants, including synthetic and volatile organic chemicals, that are by-products of industrial processes and petroleum production, and can also come from gas stations, urban storm water runoff, agricultural application, and septic systems.

Radioactive contaminants, that can be naturally-occurring or be the result of oil and gas production and mining activities.

People with Sensitive Immune Systems

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. USEPA/Centers for Disease Control (CDC) guidelines on appropriate means to lessen the risk of infection by Cryptosporidium and other microbial contaminants are available from the Safe Drinking Water Hotline (1-800-426-4791).

Drinking Water Info

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the U.S. Environmental Protection Agency's (USEPA's) Safe Drinking Water Hotline (1-800-426-4791).

In order to ensure that tap water is safe to drink, the U.S Environmental Protection Agency (USEPA) and the California Department of Public Health (CDPH) prescribe regulations that limit the amount of certain contaminants in water provided by public water systems. CDPH regulations also establish limits for contaminants in bottled water that provide the same protection for public health.

Source Water Assessment: A comprehensive source water assessment of the District's drinking water sources was adopted in June 2021. A copy of this report is available for public inspection at the District Office.

Last year, as in years past, your tap water met all EPA and State drinking water health standards. Montecito Water District vigilantly safeguards its water supplies and once again we are proud to report that our system has never violated a maximum contaminant level or any other water quality standard. This brochure is a snapshot of last year's water quality. Included are details about where your water comes from, what it contains, and how it compares to State standards. We are committed to providing you information because informed customers are our best allies.

WATER QUALITY TERMINOLOGY

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. Primary MCLs are set as close to the PHGs (or MCLGs) as is economically and technologically feasible. Secondary MCLs are set to protect the odor, taste, and appearance of drinking water.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. Environmental Protection Agency.

Public Health Goal (PHG): The level of a contaminant in drinking water below which there is no known or expected risk to health. PHGs are set by the California Environmental Protection Agency.

Primary Drinking Water Standard (PDWS): MCLs and MRDLs for contaminants that affect health along with their monitoring and reporting requirements, and water treatment requirements.

Maximum Residual Disinfectant Level Goal (MRDLG): The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.

Regulatory Action Level: The concentration of a contaminant which, if exceeded, triggers treatment or other requirements that a water system must follow.

Treatment Technique (TT): A required process intended to reduce the level of a contaminant in drinking water.

mg/L: Milligrams per liter, or parts per million. 1 mg/L is equal to about one drop in 17 gallons of water.

ug/L: Micrograms per liter, or parts per billion. 1 ug/L is equal to about one drop in 17,000 gallons of water.

<: Less than.

≤: Less than or equal to.

NA: Not applicable.

NS: No Standard.

ND: Non-detected.

pCi/L: Pico curies per liter, a measure of radiation.

umhos/cm: Micromhos per centimeter (an indicator of dissolved minerals in water).

NTU: Nephelometric turbidity unit.

LRAA: Locational Running Annual Average

For Water Softeners: MWD's surface water has a hardness range of 20 to 23 grains per gallon, while groundwater has a hardness range of 13 to 27 grains per gallon. One grain per gallon equals 17.1 mg/L.

Footnotes: The State allows us to monitor for some contaminants less than once per year because the concentrations of these contaminants do not change frequently. Some of our data, though representative, are more than one year old.

Surface water sources include the District's Jameson Lake and Lake Cachuma. The District's Amapola Well, Paden Well No. 2, Ennisbrook Well No. 5, Ennisbrook Well No. 2 and T Mosby Well No. 2 were used as groundwater supply sources.

An average number of 52 coliform samples were collected each month at 12 District sampling stations in compliance with the Federal Revised Total Coliform Rule. All sample results were negative.

Turbidity is a measure of the cloudiness of the water. Montecito Water District monitors for it continuously because turbidity is a good indicator of water quality. High turbidity can hinder the effectiveness of disinfectants. 100% of the District's samples met the Turbidity Performance standard. The highest single surface water turbidity measurement during the year was 0.20 NTU.

WATER SOURCES 2021

Most water supplies are rainfall dependent, and become limited in times of drought. As the District looks to the future, it aims to increase its access to local, reliable supplies.

Doulton Tunnel, a horizontal well, source of groundwater and conveyance from Jameson Lake.

Cachuma Project (Lake Cachuma), a federally owned surface water facility.

Jameson Lake, a District owned surface water facility.

Groundwater wells, source from the Montecito Groundwater Basin.

Conservation - Water efficiency.

State Water Project & Supplemental Water Purchase.

FACILITIES

The District's water source portfolio and array of facilities is highly diversified. The combination of its own assets and involvement with many partners provides regional water supply management opportunities and added resilency.

Conservation — water supply that is attained through efficiency of use — is unique in that it is people dependent. As climate change increases the uncertainty of hydrologic conditions, the District will continue to look to its customers for their partnership in using water wisely.

- **2 Surface Water Treatment Plants**
- **9 Storage Reservoirs**
- **114 (approximate) Miles of Pipeline**
- **943 Fire Hydrants**
- **7 Pumping Stations**
- **12 Groundwater Wells**
- **1 Surface Water Reservoir, Dam and Groundwater Conveyance Tunnel**

We encourage public participation.

For meeting times, agendas, and additional resources: **www.montecitowater.com**

Este informe contiene información muy importante sobre su agua potable. Tradúzcalo o hable con alguien que lo entienda bien. Para información en español llame al 805.969.2271.

For more information please contact **Chad Hurshman**, Water Treatment and Production Superintendent, at 805.969.7924

MONTECITO WATER DISTRICT

RELIABLE SINCE 1921

www.montecitowater.com

BOARD OF DIRECTORS:

Tobe Plough, *President*
Ken Coates, *Vice-President*
Floyd Wicks, *Director*
Cori Hayman, *Director*
Brian Goebel, *Director*
Nick Turner, P.E.
General Manager & Board Secretary

Appendix 9B

HYDRAULIC ANALYSIS

NPR-1.1 and NPR-1.2 Hydraulics Analysis and Calculations

Spreadsheet Legend

	Input cell
	Calculated cell, referenced from this sheet
	Referenced cell from other tab
	Spreadsheet info or standard cell

Basic Equations Used

Piping Losses (Hazen Williams Formula): $H_p = (10.44)(L[ft])\dfrac{Q[gpm]^{1.85}}{(C)^{1.85}(d[inches])^{4.8655}}$

Velocity: $V = \dfrac{Q[gpm]}{448.8 x \pi x D[ft]^2 / 4}$

Minor Losses: $H_f = \dfrac{KV^2}{2g} = K2'(Q)^2$

Total Dynamic Head: $TDH = StaticHead[H_S] + H_P + H_F$

Inputs

Elevations	Value	Units	Notes
Max WSEL Suction	45	feet	Elev. Per Google Earth at MSD WWTP
Min WSEL Suction	35	feet	Assumed 10' below Max
Pump Impeller Elevation	32	feet	Used in NPSHa Calculations Below
Discharge Static Elevation 1	270	feet	Elev. Per Google Earth at VC connection (corner of Valley Club Dr and E V
Discharge Static Elevation 2		feet	
Discharge Static Elevation 3		feet	

Flow Rates	Value	Units	Notes
Max Flow	700	gpm	This sets the plot range for the System Curve
Min Flow	0	gpm	This sets the plot range for the System Curve
Design Flow	230	gpm	This is input for straight pipe and fitting loss calcs below, see Tab9-1 Flow

<-- selecting two parallel duty pumps

Straight Piping Losses

$K_1' = 10.44\left(\frac{L}{C^{1.85}d^{4.8655}}\right)*\left(\frac{Q_i}{Q_T}\right)^{1.85}$ $h_{L1} = 10.44\left(\frac{L*Q_i^{1.85}}{C^{1.85}*d^{4.8655}}\right)$ L in feet, Q in gpm, d in inches

Seg no.	Pipe Name	Material	Diameter	Length	% of Design Flow	C	Flow	K1'	Velocity	Headloss (H_{L1})	Suction
1	Suction Piping	Steel	8 in	10.0 ft	33%	120	76 gpm	7.71759E-08	0.48 ft/sec	0.00 ft	Yes
2	Conveyance Piping	PVC	8 in	26400.0 ft	100%	135	230 gpm	0.001274097	1.47 ft/sec	29.81 ft	
							Sum of K1'	0.001274175	Sum of H_{L1}	29.81 ft	

Delivery pressure at Miramar:
13,400 LF between VC and Miramar
15.13213 ft of loss between VC and miramar
0.756606 ft of fitting loses
15.88873 ft of total losses
16 change in elevation between WWTP and Miramar
10 add psi to VC to boost pressure at Mirarmar
83.66298 psi at miramar

Fitting Losses

$K_2' = \frac{K}{2g*A^2}*\left(\frac{Q_i}{Q_T}\right)^2$ $h_{L2} = n\frac{KV^2}{2g}$ V in ft/s, g in ft/s^2, A in ft^2

Seg No.	Fitting Type	Fitting Code	Number	Diameter	K tot	Flow	K2'	Velocity	Headloss (H_{L2})	Suction
* K tot is the total K for this fitting, it is multipled by the number of fittings in the row.						Sum of K2'	0	Sum of H_{L2}	1.49 ft	

5% ***Using 5% of friction loss

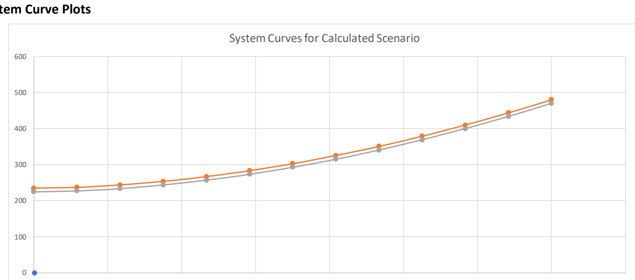
Max Static + H_{L1} + H_{L2} at Design Flow 266.30 ft <-- need 4.3290043 add'l ft at VC to maintain 60psi min pressure at Miramar

Calculations Table

$h_L = \sum K_1' * Q^{1.85} + \sum K_2' * \left(\frac{Q}{448.8}\right)^2$

Q (gpm)	Q mgd	Piping HL H_{L1}	Fitting HL H_{L2}	Hs max	Hs min	stem Curve M	System Curve Min
0	0.00	0.00	0.00	235	225	235.00	225.00
58	0.08	2.36	0.12	235	225	237.47	227.47
117	0.17	8.49	0.42	235	225	243.92	233.92
175	0.25	17.98	0.90	235	225	253.88	243.88
233	0.34	30.62	1.53	235	225	267.15	257.15
292	0.42	46.27	2.31	235	225	283.58	273.58
350	0.50	64.83	3.24	235	225	303.07	293.07
408	0.59	86.22	4.31	235	225	325.53	315.53
467	0.67	110.38	5.52	235	225	350.90	340.90
525	0.76	137.25	6.86	235	225	379.12	369.12
583	0.84	166.79	8.34	235	225	410.13	400.13
642	0.92	198.95	9.95	235	225	443.90	433.90
700	1.01	233.70	11.69	235	225	480.39	470.39

System Curve Plots



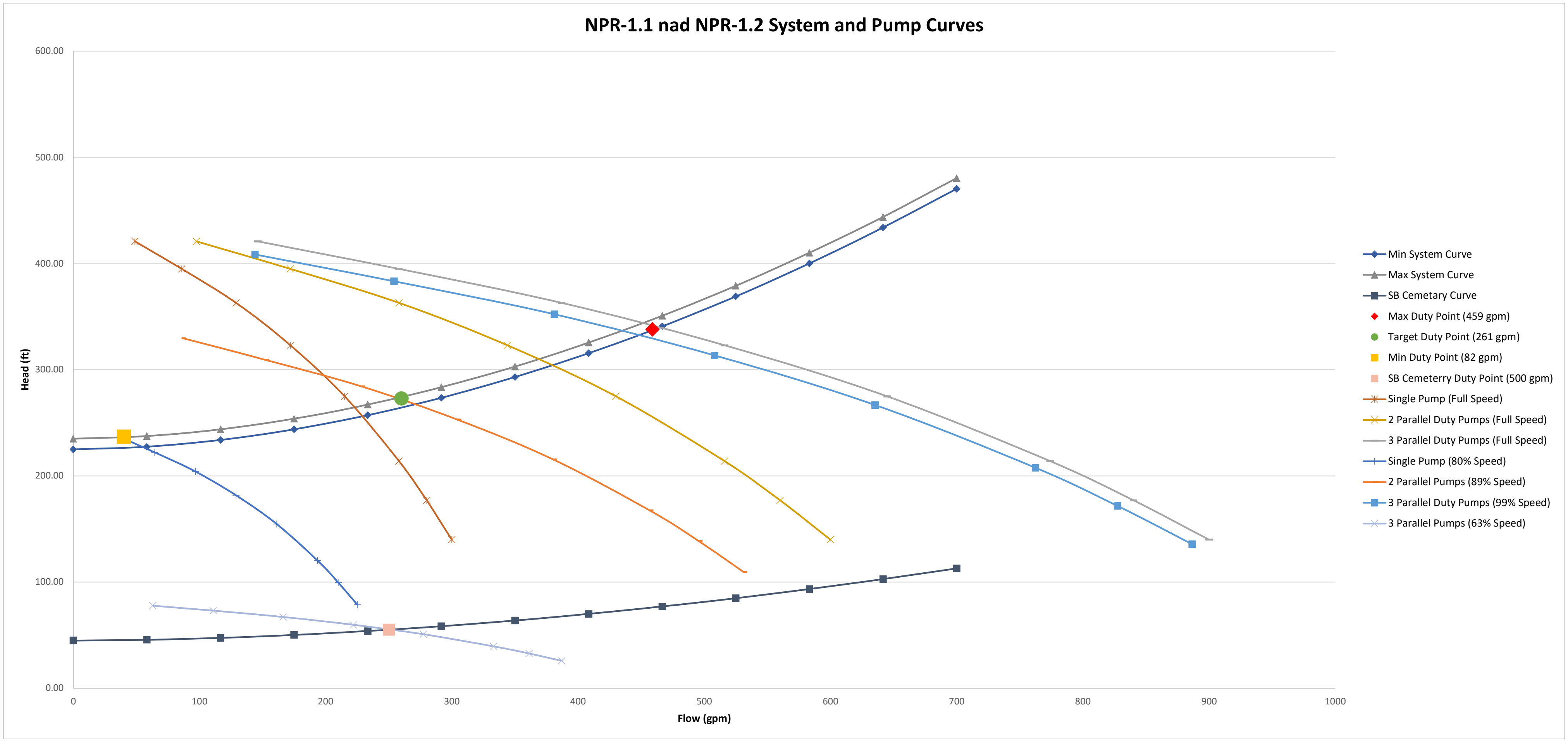
NPSHa Calculation

$NPSH_a = h_{bar} + h_{static} - h_{L,s} - h_{vap}$

Description	Notes	Value	Units
Site Elevation	Round up to nearest 500-feet	500	Feet
Pump Inlet Diameter	From selected pump cutsheet	8	inches
Suction Headloss Totals (H_{L1} + H_{L2})	Referenced in from Calculations above	29.81	feet
Suction Lift	Negative if Suction WSEL is above the pump impeller	3	feet
Maximum Water Temperature	Take a conversative estimate	80	degF

NPSHa = 5.28 **AT THE DESIGN POINT**

Maximum NPSHr 0.28 **AT THE DESIGN POINT**



NPR-1.1 nad NPR-1.2 System and Pump Curves
Head (ft)
Flow (gpm)
600.00
500.00
400.00
300.00
200.00
100.00
0.00
0
100
200
300
400
500
600
700
800
900
1000
Min System Curve
Max System Curve
SB Cemetary Curve
Max Duty Point (459 gpm)
Target Duty Point (261 gpm)
Min Duty Point (82 gpm)
SB Cemeterry Duty Point (500 gpm)
Single Pump (Full Speed)
2 Parallel Duty Pumps (Full Speed)
3 Parallel Duty Pumps (Full Speed)
Single Pump (80% Speed)
2 Parallel Pumps (89% Speed)
3 Parallel Duty Pumps (99% Speed)
3 Parallel Pumps (63% Speed)

NPR-1.3 Hydraulics Analysis and Calculations

Spreadsheet Legend

	Input cell
	Calculated cell, referenced from this sheet
	Referenced cell from other tab
	Spreadsheet info or standard cell

Basic Equations Used

Piping Losses (Hazen Williams Formula): $$H_p = (10.44)(L[ft])\frac{Q[gpm]^{1.85}}{(C)^{1.85}(d[inches])^{4.8655}}$$

Velocity: $$V = \frac{Q[gpm]}{448.8 x \pi x D[ft]^2 / 4}$$

Minor Losses: $$H_f = \frac{KV^2}{2g} = K2'(Q)^2$$

Total Dynamic Head: $$TDH = StaticHead[H_S] + H_P + H_F$$

Inputs

Elevations	Value	Units	Notes
Max WSEL Suction	45	feet	Elev. Per Google Earth at MSD WWTP
Min WSEL Suction	35	feet	Assumed 10' below Max
Pump Impeller Elevation	32	feet	Used in NPSHa Calculations Below
Discharge Static Elevation 1	270	feet	Elev. Per Google Earth at VC connection (corner of Valley Club Dr and E V
Discharge Static Elevation 2		feet	
Discharge Static Elevation 3		feet	

Flow Rates	Value	Units	Notes
Max Flow	500	gpm	This sets the plot range for the System Curve
Min Flow	0	gpm	This sets the plot range for the System Curve
Design Flow	230	gpm	This is input for straight pipe and fitting loss calcs below, see Tab9-1 Flow

<-- selecting two parallel duty pumps

Straight Piping Losses

$$K_1' = 10.44\left(\frac{L}{C^{1.85}d^{4.8655}}\right) * \left(\frac{Q_i}{Q_T}\right)^{1.85} \qquad h_{L1} = 10.44\left(\frac{L * Q_i^{1.85}}{C^{1.85} * d^{4.8655}}\right)$$

L in feet, Q in gpm, d in inches

Seg no.	Pipe Name	Material	Diameter	Length	% of Design Flow	C	Flow	K1'	Velocity	Headloss (H_{L1})	Suction
1	Suction Piping	Steel	8 in	10.0 ft	33%	120	76 gpm	7.71759E-08	0.48 ft/sec	0.00 ft	Yes
2	Conveyance Piping	PVC	8 in	24900.0 ft	100%	135	230 gpm	0.001201705	1.47 ft/sec	28.12 ft	
							Sum of K1'	0.001201783	Sum of H_{L1}	28.12 ft	

Fitting Losses

$$K_2' = \frac{K}{2g * A^2} * \left(\frac{Q_i}{Q_T}\right)^2 \qquad h_{L2} = n\frac{KV^2}{2g}$$

V in ft/s, g in ft/s^2, A in ft^2

Seg No.	Fitting Type	Fitting Code	Number	Diameter	K tot	Flow	K2'	Velocity	Headloss (H_{L2})	Suction
* K tot is the total K for this fitting, it is multipled by the number of fittings in the row.						Sum of K2'	0	Sum of H_{L2}	1.41 ft	

5% ***Using 5% of friction loss

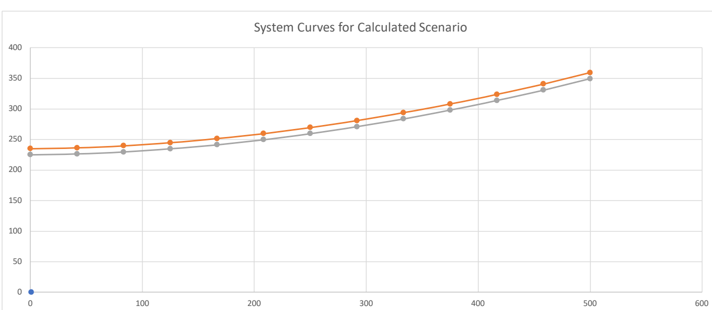
Max Static + H_{L1} + H_{L2} at Design Flow 264.52 ft

Calculations Table

$$h_L = \sum K_1' * Q^{1.85} + \sum K_2' * \left(\frac{Q}{448.8}\right)^2$$

Q (gpm)	Q mgd	Piping HL H_{L1}	Fitting HL H_{L2}	Hs max	Hs min	stem Curve M	System Curve Min
0	0.00	0.00	0.00	235	225	235.00	225.00
42	0.06	1.19	0.06	235	225	236.25	226.25
83	0.12	4.30	0.21	235	225	239.51	229.51
125	0.18	9.10	0.46	235	225	244.56	234.56
167	0.24	15.50	0.77	235	225	251.27	241.27
208	0.30	23.42	1.17	235	225	259.59	249.59
250	0.36	32.81	1.64	235	225	269.45	259.45
292	0.42	43.64	2.18	235	225	280.82	270.82
333	0.48	55.87	2.79	235	225	293.66	283.66
375	0.54	69.47	3.47	235	225	307.94	297.94
417	0.60	84.42	4.22	235	225	323.64	313.64
458	0.66	100.70	5.03	235	225	340.73	330.73
500	0.72	118.28	5.91	235	225	359.20	349.20

System Curve Plots



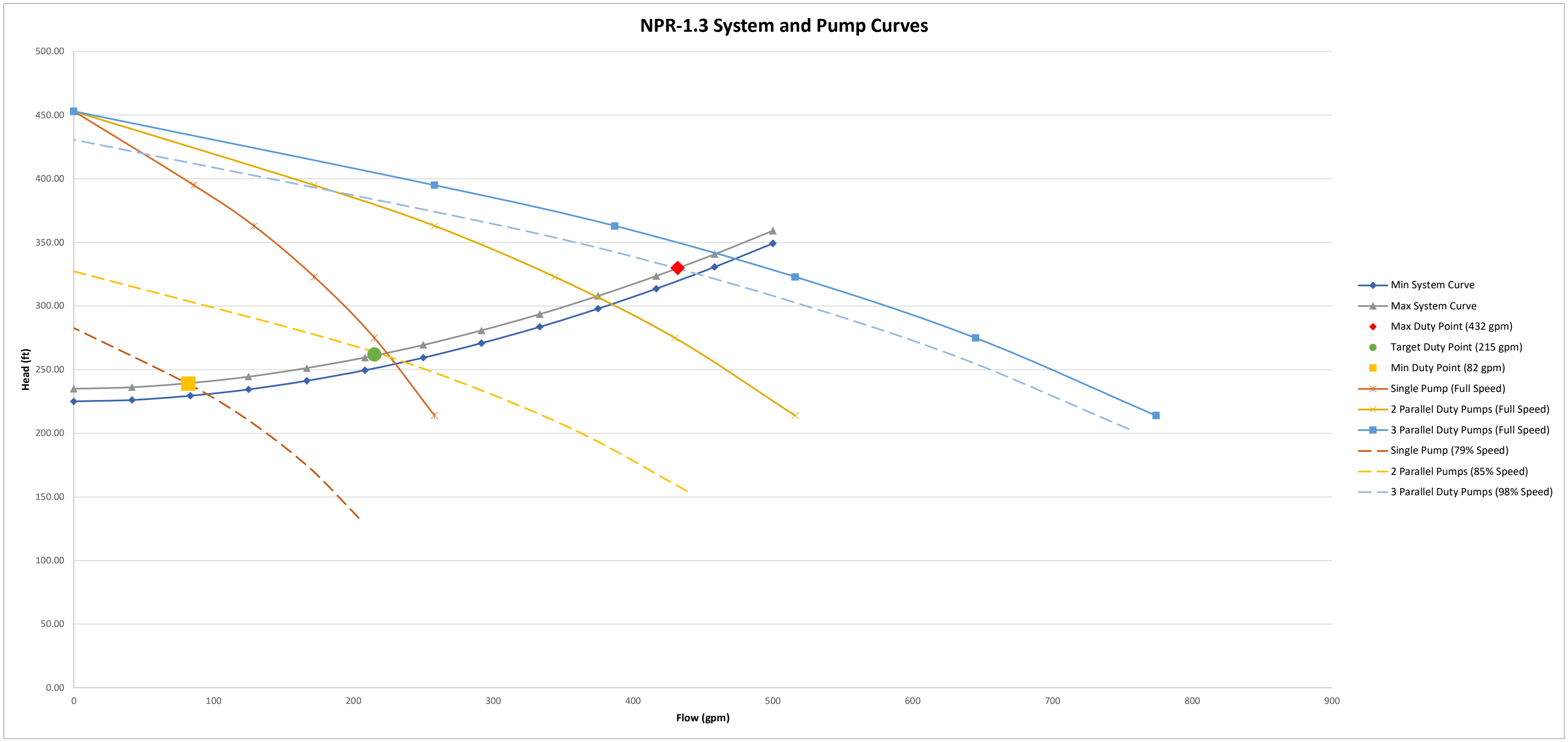
NPSHa Calculation

$$NPSH_a = h_{bar} + h_{static} - h_{L,s} - h_{vap}$$

Description	Notes	Value	Units
Site Elevation	Round up to nearest 500-feet	500	Feet
Pump Inlet Diameter	From selected pump cutsheet	8	inches
Suction Headloss Totals (H_{L1} + H_{L2})	Referenced in from Calculations above	28.12	feet
Suction Lift	Negative if Suction WSEL is above the pump impeller	3	feet
Maximum Water Temperature	Take a conversative estimate	80	degF

NPSHa = 6.97 **AT THE DESIGN POINT**

Maximum NPSHr 1.97 **AT THE DESIGN POINT**


NPR-1.3 System and Pump Curves
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Head (ft)
0
100
200
300
400
500
600
700
800
900
Flow (gpm)
Min System Curve
Max System Curve
Max Duty Point (432 gpm)
Target Duty Point (215 gpm)
Min Duty Point (82 gpm)
Single Pump (Full Speed)
2 Parallel Duty Pumps (Full Speed)
3 Parallel Duty Pumps (Full Speed)
Single Pump (79% Speed)
2 Parallel Pumps (85% Speed)
3 Parallel Duty Pumps (98% Speed)

IPR 2 Hydraulics Analysis and Calculations

Spreadsheet Legend

(blue)	Input cell
(orange)	Calculated cell, referenced from this sheet
(green)	Referenced cell from other tab
(yellow)	Spreadsheet info or standard cell

Basic Equations Used

Piping Losses (Hazen Williams Formula): $H_p = (10.44)(L[ft])\dfrac{Q[gpm]^{1.85}}{(C)^{1.85}(d[inches])^{4.8655}}$

Velocity: $V = \dfrac{Q[gpm]}{448.8 x \pi x D[ft]^2 / 4}$

Minor Losses: $H_f = \dfrac{KV^2}{2g} = K2'(Q)^2$

Total Dynamic Head: $TDH = StaticHead[H_S] + H_P + H_F$

Inputs

Elevations	Value	Units	Notes	
Max WSEL Suction	45	feet	Elev. Per Google Earth at MSD WWTP	
Min WSEL Suction	35	feet	Assumed 10' below Max	
Pump Impeller Elevation	32	feet	Used in NPSHa Calculations Below	
Discharge Static Elevation 1	255	feet		<-- using highest point along pipeline +50ft
Discharge Static Elevation 2		feet		
Discharge Static Elevation 3		feet		

Flow Rates	Value	Units	Notes	
Max Flow	800	gpm	This sets the plot range for the System Curve	
Min Flow	0	gpm	This sets the plot range for the System Curve	
Design Flow	486	gpm	This is input for straight pipe and fitting loss calcs below, see Tab9-1 Flows	<-- selecting two parallel duty pumps

Straight Piping Losses

$K_1' = 10.44\left(\dfrac{L}{C^{1.85}d^{4.8655}}\right) * \left(\dfrac{Q_i}{Q_T}\right)^{1.85}$ $h_{L1} = 10.44\left(\dfrac{L * Q_i^{1.85}}{C^{1.85} * d^{4.8655}}\right)$ L in feet, Q in gpm, d in inches

Seg no.	Pipe Name	Material	Diameter	Length	% of Design Flow	C	Flow	K1'	Velocity	Headloss (H_{L1})	Suction	
1	Suction Piping	Steel	4 in	10.0 ft	50%	120	243 gpm	4.85274E-06	6.20 ft/sec	0.13 ft	Yes	
2	Conveyance Piping	PVC	8 in	18796.8 ft	100%	135	486 gpm	0.000907157	3.10 ft/sec	84.71 ft		<---only length to highest point
							Sum of K1'	0.00091201	Sum of H_{L1}	84.84 ft		

Additional pipe loss after highpoint
149.64 ft
Additional fitting loss after highpoint
7.48 ft
157 ft
Residual pressure at discharge point (elev. 15 ft)
35.9 psi

Fitting Losses

$K_2' = \dfrac{K}{2g * A^2} * \left(\dfrac{Q_i}{Q_T}\right)^2$ $h_{L2} = n\dfrac{KV^2}{2g}$ V in ft/s, g in ft/s^2, A in ft^2

Seg No.	Fitting Type	Fitting Code	Number	Diameter	K tot	Flow	K2'	Velocity	Headloss (H_{L2})	Suction		
* K tot is the total K for this fitting, it is multipled by the number of fittings in the row.						Sum of K2'	0	Sum of H_{L2}	4.24 ft		5%	***Using 5% of friction loss

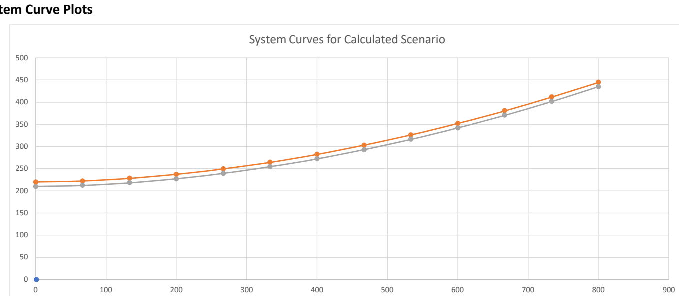
Max Static + H_{L1} + H_{L2} at Design Flow 309.08 ft

Calculations Table

$h_L = \sum K_1' * Q^{1.85} + \sum K_2' * \left(\frac{Q}{448.8}\right)^2$

Q (gpm)	Q mgd	Piping HL H_{L1}	Fitting HL H_{L2}	Hs max	Hs min	stem Curve M	System Curve Min
0	0.00	0.00	0.00	220	210	220.00	210.00
67	0.10	2.16	0.11	220	210	222.27	212.27
133	0.19	7.78	0.39	220	210	228.17	218.17
200	0.29	16.48	0.82	220	210	237.30	227.30
267	0.38	28.06	1.40	220	210	249.46	239.46
333	0.48	42.40	2.12	220	210	264.52	254.52
400	0.58	59.40	2.97	220	210	282.37	272.37
467	0.67	79.01	3.95	220	210	302.96	292.96
533	0.77	101.15	5.06	220	210	326.20	316.20
600	0.86	125.77	6.29	220	210	352.06	342.06
667	0.96	152.84	7.64	220	210	380.48	370.48
733	1.06	182.31	9.12	220	210	411.42	401.42
800	1.15	214.15	10.71	220	210	444.86	434.86

System Curve Plots

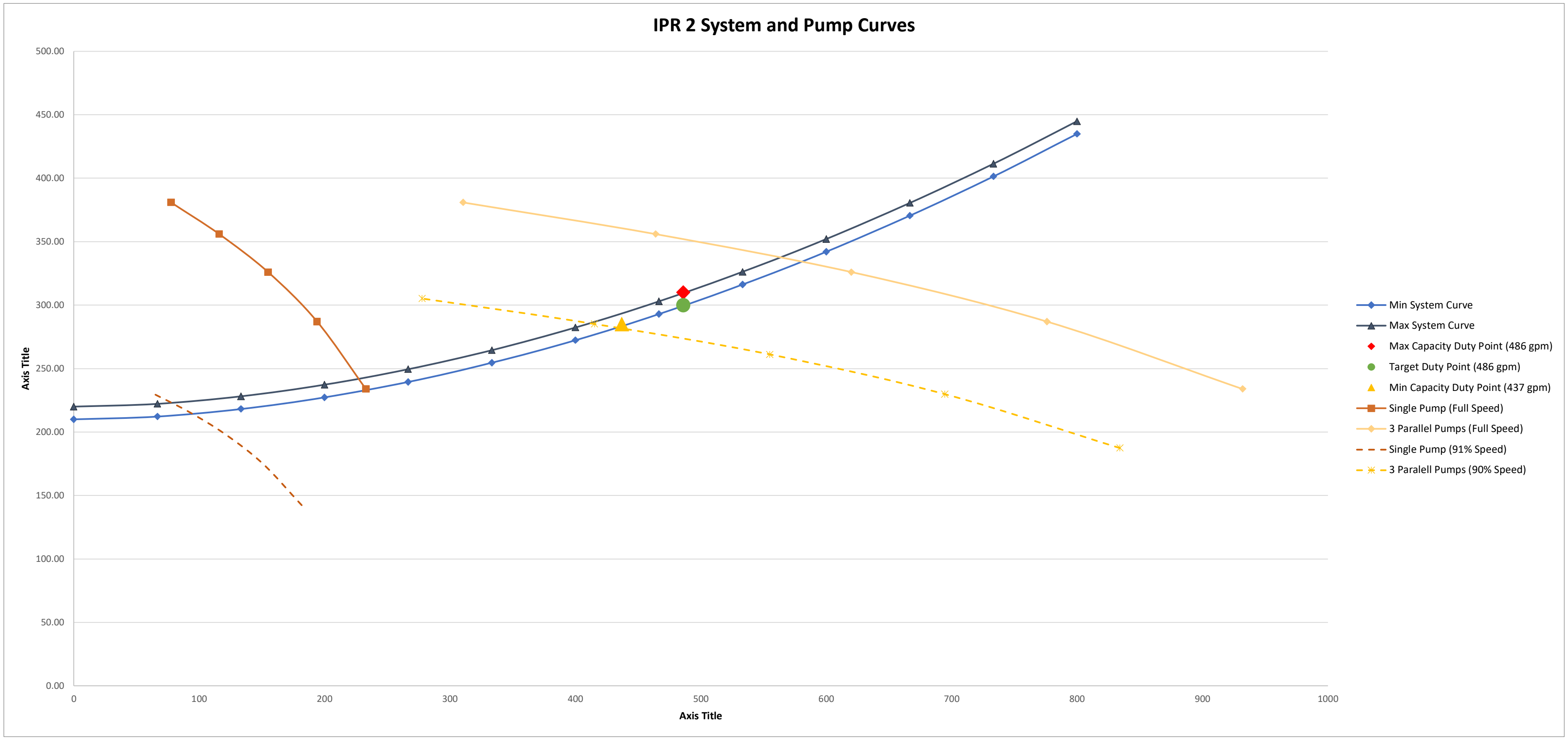


NPSHa Calculation

$NPSH_a = h_{bar} + h_{static} - h_{L,s} - h_{vap}$

Description	Notes	Value	Units
Site Elevation	Round up to nearest 500-feet	500	Feet
Pump Inlet Diameter	From selected pump cutsheet	8	inches
Suction Headloss Totals (H_{L1} + H_{L2})	Referenced in from Calculations above	84.84	feet
Suction Lift	Negative if Suction WSEL is above the pump impeller	3	feet
Maximum Water Temperature	Take a conversative estimate	80	degF

NPSHa = -49.75 **AT THE DESIGN POINT**
Maximum NPSHr -54.75 **AT THE DESIGN POINT**


IPR 2 System and Pump Curves
Axis Title
Axis Title
Min System Curve
Max System Curve
Max Capacity Duty Point (486 gpm)
Target Duty Point (486 gpm)
Min Capacity Duty Point (437 gpm)
Single Pump (Full Speed)
3 Parallel Pumps (Full Speed)
Single Pump (91% Speed)
3 Paralell Pumps (90% Speed)

IPR 3 Hydraulics Analysis and Calculations

Spreadsheet Legend

(blue)	Input cell
(orange)	Calculated cell, referenced from this sheet
(green)	Referenced cell from other tab
(yellow)	Spreadsheet info or standard cell

Basic Equations Used

Piping Losses (Hazen Williams Formula):	$H_p = (10.44)(L[ft])\dfrac{Q[gpm]^{1.85}}{(C)^{1.85}(d[inches])^{4.8655}}$
Velocity:	$V = \dfrac{Q[gpm]}{448.8 x \pi x D[ft]^2 / 4}$
Minor Losses:	$H_f = \dfrac{KV^2}{2g} = K2'(Q)^2$
Total Dynamic Head:	$TDH = StaticHead[H_S] + H_P + H_F$

Inputs

Elevations	Value	Units	Notes
Max WSEL Suction	45	feet	Elev. Per Google Earth at MSD WWTP
Min WSEL Suction	35	feet	Assumed 10' below Max
Pump Impeller Elevation	32	feet	Used in NPSHa Calculations Below
Discharge Static Elevation 1	255	feet	
Discharge Static Elevation 2		feet	
Discharge Static Elevation 3		feet	

<-- using highest point along pipeline +50ft

Flow Rates	Value	Units	Notes
Max Flow	800	gpm	This sets the plot range for the System Curve
Min Flow	0	gpm	This sets the plot range for the System Curve
Design Flow	194	gpm	This is input for straight pipe and fitting loss calcs below, see Tab9-1 Flows

<-- selecting two parallel duty pumps

Straight Piping Losses

$K_1' = 10.44\left(\dfrac{L}{C^{1.85}d^{4.8655}}\right) * \left(\dfrac{Q_i}{Q_T}\right)^{1.85}$ $h_{L1} = 10.44\left(\dfrac{L * Q_i^{1.85}}{C^{1.85} * d^{4.8655}}\right)$ L in feet, Q in gpm, d in inches

Seg no.	Pipe Name	Material	Diameter	Length	% of Design Flow	C	Flow	K1'	Velocity	Headloss (H_{L1})	Suction
1	Suction Piping	Steel	4 in	10.0 ft	50%	120	97 gpm	4.85274E-06	2.48 ft/sec	0.02 ft	Yes
2	Conveyance Piping	PVC	8 in	18796.8 ft	100%	135	194 gpm	0.000907157	1.24 ft/sec	15.49 ft	
							Sum of K1'	**0.00091201**	**Sum of H_{L1}**	**15.52 ft**	

<---only length to highest point

Additional pipe loss after highpoint
30.91 ft
Additional fitting loss after highpoint
1.55 ft
32 ft
Residual pressure at discharge point (elev 35 ft)
81.2 psi

Fitting Losses

$K_2' = \dfrac{K}{2g * A^2} * \left(\dfrac{Q_i}{Q_T}\right)^2$ $h_{L2} = n\dfrac{KV^2}{2g}$ V in ft/s, g in ft/s^2, A in ft^2

Seg No.	Fitting Type	Fitting Code	Number	Diameter	K tot	Flow	K2'	Velocity	Headloss (H_{L2})	Suction
						Sum of K2'	**0**	**Sum of H_{L2}**	**0.78 ft**	

* K tot is the total K for this fitting, it is multipled by the number of fittings in the row.

5% ***Using 5% of friction loss

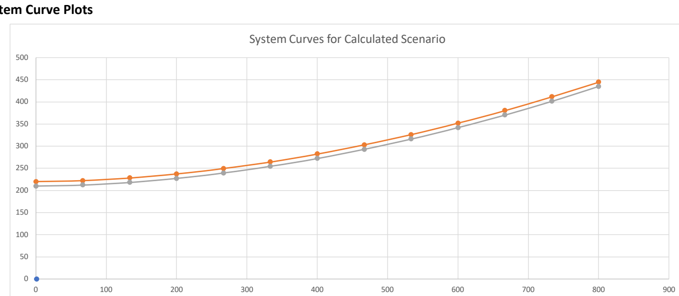
Max Static + H_{L1} + H_{L2} at Design Flow **236.29 ft**

Calculations Table

$h_L = \sum K_1' {*} Q^{1.85} + \sum K_2' * \left(\frac{Q}{448.8}\right)^2$

Q (gpm)	Q mgd	Piping HL H_{L1}	Fitting HL H_{L2}	Hs max	Hs min	stem Curve M	System Curve Min
0	0.00	0.00	0.00	220	210	220.00	210.00
67	0.10	2.16	0.11	220	210	222.27	212.27
133	0.19	7.78	0.39	220	210	228.17	218.17
200	0.29	16.48	0.82	220	210	237.30	227.30
267	0.38	28.06	1.40	220	210	249.46	239.46
333	0.48	42.40	2.12	220	210	264.52	254.52
400	0.58	59.40	2.97	220	210	282.37	272.37
467	0.67	79.01	3.95	220	210	302.96	292.96
533	0.77	101.15	5.06	220	210	326.20	316.20
600	0.86	125.77	6.29	220	210	352.06	342.06
667	0.96	152.84	7.64	220	210	380.48	370.48
733	1.06	182.31	9.12	220	210	411.42	401.42
800	1.15	214.15	10.71	220	210	444.86	434.86

System Curve Plots

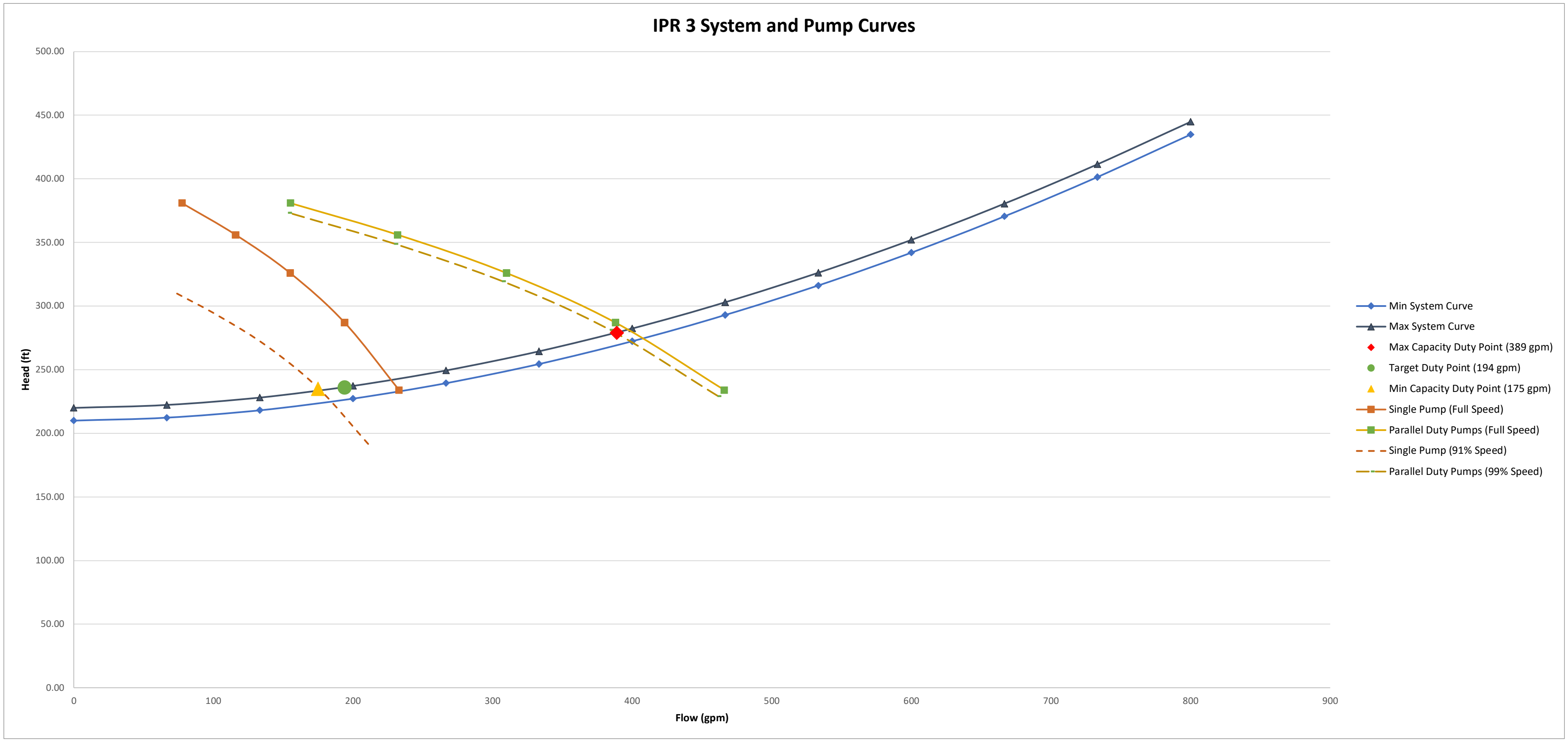


NPSHa Calculation

$NPSH_a = h_{bar} + h_{static} - h_{L,s} - h_{vap}$

Description	Notes	Value	Units
Site Elevation	Round up to nearest 500-feet	500	Feet
Pump Inlet Diameter	From selected pump cutsheet	8	inches
Suction Headloss Totals (H_{L1} + H_{L2})	Referenced in from Calculations above	15.52	feet
Suction Lift	Negative if Suction WSEL is above the pump impeller	3	feet
Maximum Water Temperature	Take a conversative estimate	80	degF

NPSHa = 19.58 **AT THE DESIGN POINT**
Maximum NPSHr 14.50 **AT THE DESIGN POINT**



IPR 3 System and Pump Curves
Head (ft)
Flow (gpm)
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
400.00
450.00
500.00
0
100
200
300
400
500
600
700
800
900
Min System Curve
Max System Curve
Max Capacity Duty Point (389 gpm)
Target Duty Point (194 gpm)
Min Capacity Duty Point (175 gpm)
Single Pump (Full Speed)
Parallel Duty Pumps (Full Speed)
Single Pump (91% Speed)
Parallel Duty Pumps (99% Speed)

DPR-4.1 Hydraulics Analysis and Calculations

Spreadsheet Legend

(blue-grey)	Input cell
(orange)	Calculated cell, referenced from this sheet
(green)	Referenced cell from other tab
(yellow)	Spreadsheet info or standard cell

Basic Equations Used

Piping Losses (Hazen Williams Formula): $$H_p = (10.44)(L[ft])\frac{Q[gpm]^{1.85}}{(C)^{1.85}(d[inches])^{4.8655}}$$

Velocity: $$V = \frac{Q[gpm]}{448.8 x \pi x D[ft]^2 / 4}$$

Minor Losses: $$H_f = \frac{KV^2}{2g} = K2'(Q)^2$$

Total Dynamic Head: $$TDH = StaticHead[H_S] + H_P + H_F$$

Inputs

Elevations	Value	Units	Notes
Max WSEL Suction	45	feet	Elev. Per Google Earth at MSD WWTP
Min WSEL Suction	35	feet	Assumed 10' below Max
Pump Impeller Elevation	32	feet	Used in NPSHa Calculations Below
Discharge Static Elevation 1	550	feet	Elev. Per Google Earth at VC connection (corner of Valley Club Dr and E V
Discharge Static Elevation 2		feet	
Discharge Static Elevation 3		feet	

Flow Rates	Value	Units	Notes
Max Flow	800	gpm	This sets the plot range for the System Curve
Min Flow	0	gpm	This sets the plot range for the System Curve
Design Flow	389	gpm	This is input for straight pipe and fitting loss calcs below, see Tab9-1 Flow

<-- selecting two parallel duty pumps

Straight Piping Losses

$$K_1' = 10.44\left(\frac{L}{C^{1.85}d^{4.8655}}\right) * \left(\frac{Q_i}{Q_T}\right)^{1.85}$$ $$h_{L1} = 10.44\left(\frac{L * Q_i^{1.85}}{C^{1.85} * d^{4.8655}}\right)$$

L in feet, Q in gpm, d in inches

Seg no.	Pipe Name	Material	Diameter	Length	% of Design Flow	C	Flow	K1'	Velocity	Headloss (H_{L1})	Suction
1	Suction Piping	Steel	4 in	10.0 ft	50%	120	195 gpm	4.85274E-06	4.97 ft/sec	0.08 ft	Yes
2	Conveyance Piping	PVC	10 in	29100.0 ft	100%	135	389 gpm	0.000474216	1.59 ft/sec	29.33 ft	
							Sum of K1'	**0.000479069**	**Sum of H_{L1}**	**29.42 ft**	

Fitting Losses

$$K_2' = \frac{K}{2g * A^2} * \left(\frac{Q_i}{Q_T}\right)^2$$ $$h_{L2} = n\frac{KV^2}{2g}$$

V in ft/s, g in ft/s^2, A in ft^2

Seg No.	Fitting Type	Fitting Code	Number	Diameter	K tot	Flow	K2'	Velocity	Headloss (H_{L2})	Suction
* K tot is the total K for this fitting, it is multipled by the number of fittings in the row.						**Sum of K2'**	**0**	**Sum of H_{L2}**	**1.47 ft**	

5% ***Using 5% of friction loss

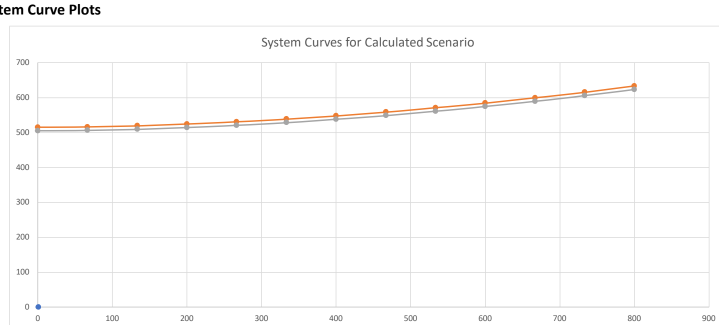
Max Static + H_{L1} + H_{L2} at Design Flow **545.89 ft**

Calculations Table

$$h_L = \sum K_1' * Q^{1.85} + \sum K_2' * \left(\frac{Q}{448.8}\right)^2$$

Q (gpm)	Q mgd	Piping HL H_{L1}	Fitting HL H_{L2}	Hs max	Hs min	stem Curve M	System Curve Min
0	0.00	0.00	0.00	515	505	515.00	505.00
67	0.10	1.13	0.06	515	505	516.19	506.19
133	0.19	4.09	0.20	515	505	519.29	509.29
200	0.29	8.66	0.43	515	505	524.09	514.09
267	0.38	14.74	0.74	515	505	530.47	520.47
333	0.48	22.27	1.11	515	505	538.38	528.38
400	0.58	31.20	1.56	515	505	547.76	537.76
467	0.67	41.50	2.08	515	505	558.58	548.58
533	0.77	53.13	2.66	515	505	570.79	560.79
600	0.86	66.07	3.30	515	505	584.37	574.37
667	0.96	80.28	4.01	515	505	599.30	589.30
733	1.06	95.76	4.79	515	505	615.55	605.55
800	1.15	112.49	5.62	515	505	633.11	623.11

System Curve Plots



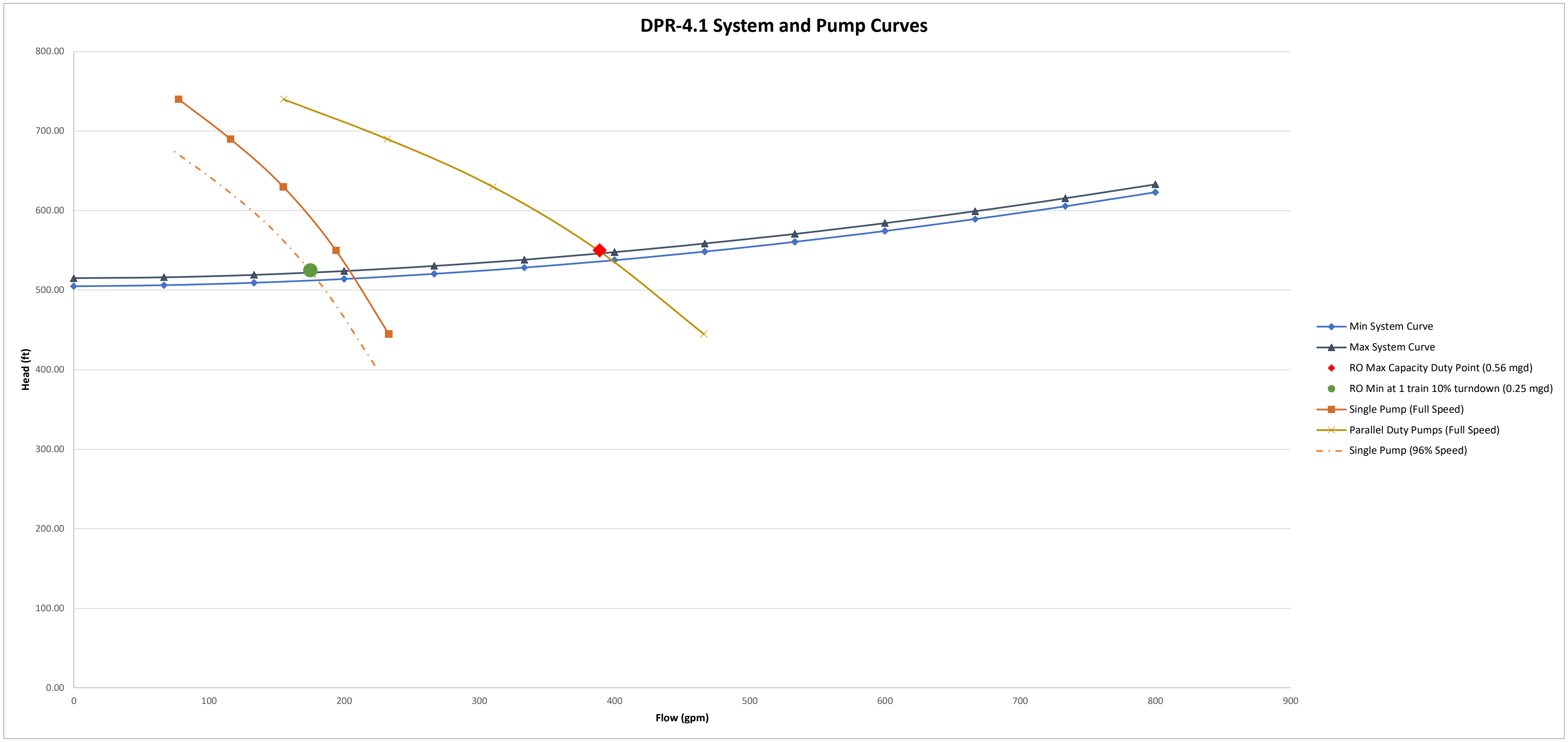
NPSHa Calculation

$$NPSH_a = h_{bar} + h_{static} - h_{L,s} - h_{vap}$$

Description	Notes	Value	Units
Site Elevation	Round up to nearest 500-feet	500	Feet
Pump Inlet Diameter	From selected pump cutsheet	8	inches
Suction Headloss Totals (H_{L1} + H_{L2})	Referenced in from Calculations above	29.42	feet
Suction Lift	Negative if Suction WSEL is above the pump impeller	3	feet
Maximum Water Temperature	Take a conversative estimate	80	degF

NPSHa = 5.67 **AT THE DESIGN POINT**

Maximum NPSHr 0.67 **AT THE DESIGN POINT**



DPR-4.1 System and Pump Curves
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Head (ft)
0
100
200
300
400
500
600
700
800
900
Flow (gpm)
Min System Curve
Max System Curve
RO Max Capacity Duty Point (0.56 mgd)
RO Min at 1 train 10% turndown (0.25 mgd)
Single Pump (Full Speed)
Parallel Duty Pumps (Full Speed)
Single Pump (96% Speed)

DPR-4.2 Hydraulics Analysis and Calculations

Spreadsheet Legend

	Input cell
	Calculated cell, referenced from this sheet
	Referenced cell from other tab
	Spreadsheet info or standard cell

Basic Equations Used

Piping Losses (Hazen Williams Formula): $$H_p = (10.44)(L[ft])\frac{Q[gpm]^{1.85}}{(C)^{1.85}(d[inches])^{4.8655}}$$

Velocity: $$V = \frac{Q[gpm]}{448.8 x \pi x D[ft]^2 / 4}$$

Minor Losses: $$H_f = \frac{KV^2}{2g} = K2'(Q)^2$$

Total Dynamic Head: $$TDH = StaticHead[H_S] + H_P + H_F$$

Inputs

Elevations	Value	Units	Notes
Max WSEL Suction	45	feet	Elev. Per Google Earth at MSD WWTP
Min WSEL Suction	35	feet	Assumed 10' below Max
Pump Impeller Elevation	32	feet	Used in NPSHa Calculations Below
Discharge Static Elevation 1	1085	feet	Elev. Per Google Earth at VC connection (corner of Valley Club Dr and E V
Discharge Static Elevation 2		feet	
Discharge Static Elevation 3		feet	

Flow Rates	Value	Units	Notes	
Max Flow	800	gpm	This sets the plot range for the System Curve	
Min Flow	0	gpm	This sets the plot range for the System Curve	
Design Flow	389	gpm	This is input for straight pipe and fitting loss calcs below, see Tab9-1 Flow	<-- selecting two parallel duty pumps

Straight Piping Losses

$$K_1' = 10.44\left(\frac{L}{C^{1.85}d^{4.8655}}\right)*\left(\frac{Q_i}{Q_T}\right)^{1.85}$$ $$h_{L1} = 10.44\left(\frac{L*Q_i^{1.85}}{C^{1.85}*d^{4.8655}}\right)$$ L in feet, Q in gpm, d in inches

Seg no.	Pipe Name	Material	Diameter	Length	% of Design Flow	C	Flow	K1'	Velocity	Headloss (H_{L1})	Suction
1	Suction Piping	Steel	4 in	10.0 ft	50%	120	195 gpm	4.85274E-06	4.97 ft/sec	0.08 ft	Yes
2	Conveyance Piping	PVC	10 in	37500.0 ft	100%	135	389 gpm	0.000611103	1.59 ft/sec	37.80 ft	
							Sum of K1'	**0.000615956**	**Sum of H_{L1}**	**37.89 ft**	

Fitting Losses

$$K_2' = \frac{K}{2g*A^2}*\left(\frac{Q_i}{Q_T}\right)^2$$ $$h_{L2} = n\frac{KV^2}{2g}$$ V in ft/s, g in ft/s², A in ft²

Seg No.	Fitting Type	Fitting Code	Number	Diameter	K tot	Flow	K2'	Velocity	Headloss (H_{L2})	Suction		
* K tot is the total K for this fitting, it is multipled by the number of fittings in the row.						**Sum of K2'**	**0**	**Sum of H_{L2}**	**1.89 ft**		5%	***Using 5% of friction loss

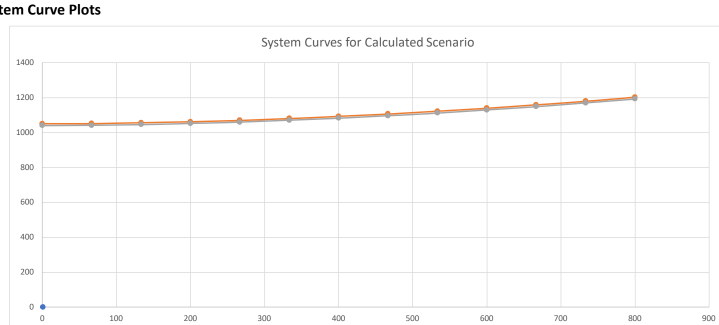
Max Static + H_{L1} + H_{L2} at Design Flow **1089.78 ft**

Calculations Table

$$h_L = \sum K_1' * Q^{1.85} + \sum K_2' * \left(\frac{Q}{448.8}\right)^2$$

Q (gpm)	Q mgd	Piping HL H_{L1}	Fitting HL H_{L2}	Hs max	Hs min	stem Curve M	System Curve Min
0	0.00	0.00	0.00	1050	1040	1050.00	1040.00
67	0.10	1.46	0.07	1050	1040	1051.53	1041.53
133	0.19	5.26	0.26	1050	1040	1055.52	1045.52
200	0.29	11.13	0.56	1050	1040	1061.69	1051.69
267	0.38	18.95	0.95	1050	1040	1069.90	1059.90
333	0.48	28.63	1.43	1050	1040	1080.07	1070.07
400	0.58	40.12	2.01	1050	1040	1092.13	1082.13
467	0.67	53.36	2.67	1050	1040	1106.03	1096.03
533	0.77	68.31	3.42	1050	1040	1121.73	1111.73
600	0.86	84.94	4.25	1050	1040	1139.19	1129.19
667	0.96	103.22	5.16	1050	1040	1158.39	1148.39
733	1.06	123.13	6.16	1050	1040	1179.28	1169.28
800	1.15	144.63	7.23	1050	1040	1201.86	1191.86

System Curve Plots



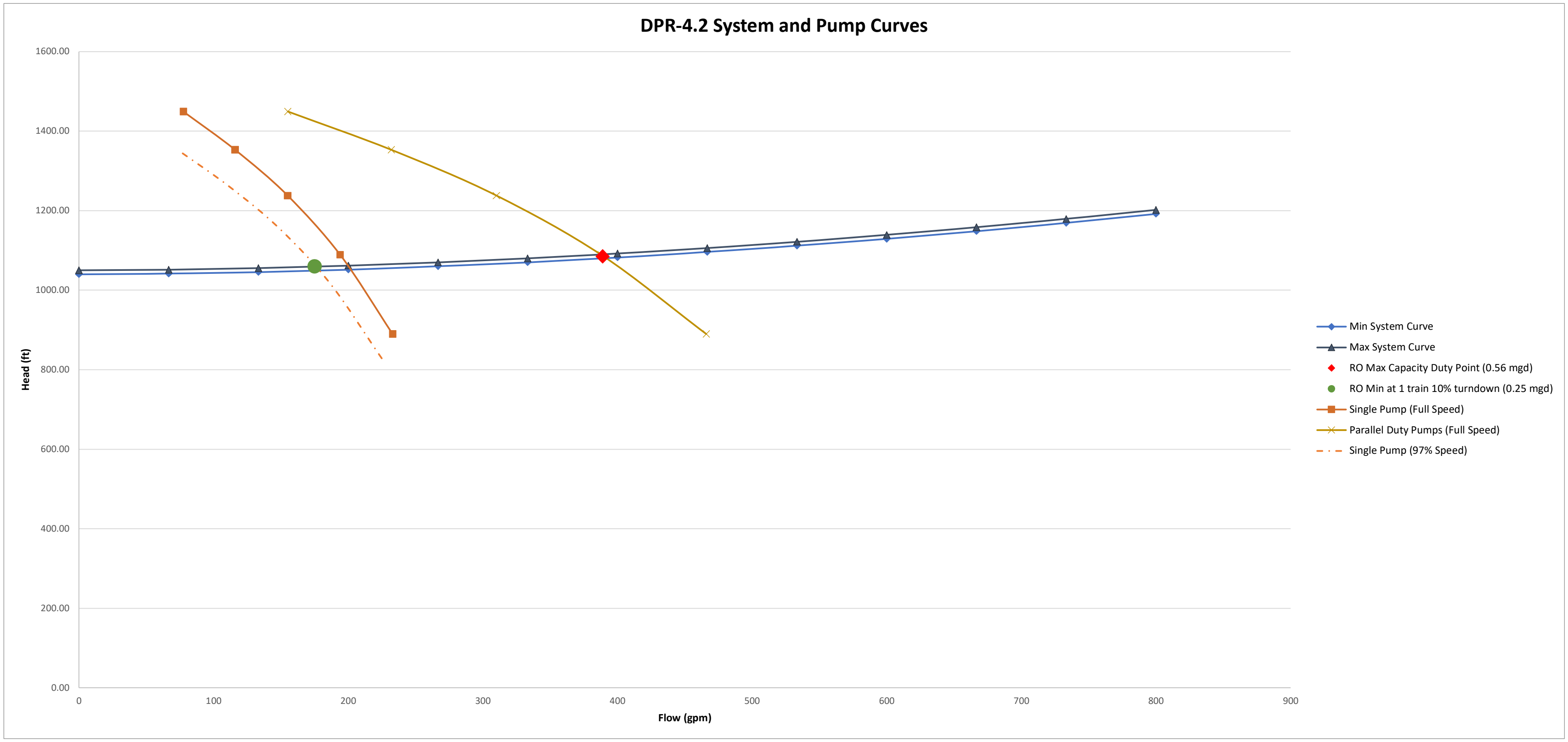
NPSHa Calculation

$$NPSH_a = h_{bar} + h_{static} - h_{L,s} - h_{vap}$$

Description	Notes	Value	Units
Site Elevation	Round up to nearest 500-feet	500	Feet
Pump Inlet Diameter	From selected pump cutsheet	8	inches
Suction Headloss Totals (H_{L1} + H_{L2})	Referenced in from Calculations above	37.89	feet
Suction Lift	Negative if Suction WSEL is above the pump impeller	3	feet
Maximum Water Temperature	Take a conversative estimate	80	degF

NPSHa = -2.79 **AT THE DESIGN POINT**

Maximum NPSHr -7.79 **AT THE DESIGN POINT**


DPR-4.2 System and Pump Curves
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
Head (ft)
0
100
200
300
400
500
600
700
800
900
Flow (gpm)
Min System Curve
Max System Curve
RO Max Capacity Duty Point (0.56 mgd)
RO Min at 1 train 10% turndown (0.25 mgd)
Single Pump (Full Speed)
Parallel Duty Pumps (Full Speed)
Single Pump (97% Speed)

DPR-4.3 Hydraulics Analysis and Calculations

Spreadsheet Legend

(blue)	Input cell
(orange)	Calculated cell, referenced from this sheet
(green)	Referenced cell from other tab
(yellow)	Spreadsheet info or standard cell

Basic Equations Used

Piping Losses (Hazen Williams Formula): $H_p = (10.44)(L[ft])\dfrac{Q[gpm]^{1.85}}{(C)^{1.85}(d[inches])^{4.8655}}$

Velocity: $V = \dfrac{Q[gpm]}{448.8 x \pi x D[ft]^2 / 4}$

Minor Losses: $H_f = \dfrac{KV^2}{2g} = K2'(Q)^2$

Total Dynamic Head: $TDH = StaticHead[H_S] + H_P + H_F$

Inputs

Elevations	Value	Units	Notes
Max WSEL Suction	45	feet	Elev. Per Google Earth at MSD WWTP
Min WSEL Suction	35	feet	Assumed 10' below Max
Pump Impeller Elevation	32	feet	Used in NPSHa Calculations Below
Discharge Static Elevation 1	410.6	feet	100psi + Elev. Per Google Earth at VC connection (corner of Valley Club D
Discharge Static Elevation 2		feet	
Discharge Static Elevation 3		feet	

Flow Rates	Value	Units	Notes
Max Flow	800	gpm	This sets the plot range for the System Curve
Min Flow	0	gpm	This sets the plot range for the System Curve
Design Flow	389	gpm	This is input for straight pipe and fitting loss calcs below, see Tab9-1 Flow <-- selecting two parallel duty pumps

Straight Piping Losses

$K_1' = 10.44\left(\dfrac{L}{C^{1.85}d^{4.8655}}\right) * \left(\dfrac{Q_i}{Q_T}\right)^{1.85}$ $h_{L1} = 10.44\left(\dfrac{L * Q_i^{1.85}}{C^{1.85} * d^{4.8655}}\right)$ L in feet, Q in gpm, d in inches

Seg no.	Pipe Name	Material	Diameter	Length	% of Design Flow	C	Flow	K1'	Velocity	Headloss (H_{L1})	Suction
1	Suction Piping	Steel	4 in	10.0 ft	50%	120	195 gpm	4.85274E-06	4.97 ft/sec	0.08 ft	Yes
2	Conveyance Piping	PVC	8 in	6380.0 ft	100%	135	389 gpm	0.000307907	2.48 ft/sec	19.05 ft	
							Sum of K1'	0.00031276	Sum of H_{L1}	19.13 ft	

Fitting Losses

$K_2' = \dfrac{K}{2g * A^2} * \left(\dfrac{Q_i}{Q_T}\right)^2$ $h_{L2} = n\dfrac{KV^2}{2g}$ V in ft/s, g in ft/s^2, A in ft^2

Seg No.	Fitting Type	Fitting Code	Number	Diameter	K tot	Flow	K2'	Velocity	Headloss (H_{L2})	Suction		
* K tot is the total K for this fitting, it is multipled by the number of fittings in the row.						Sum of K2'	0	Sum of H_{L2}	0.96 ft		5%	***Using 5% of friction loss

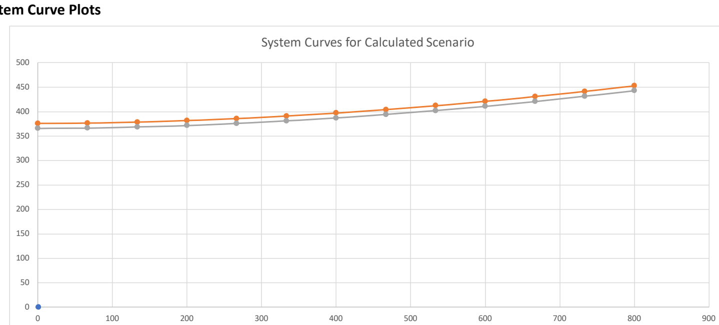
Max Static + H_{L1} + H_{L2} at Design Flow: 395.69 ft

Calculations Table

$h_L = \sum K_1' * Q^{1.85} + \sum K_2' * \left(\frac{Q}{448.8}\right)^2$

Q (gpm)	Q mgd	Piping HL H_{L1}	Fitting HL H_{L2}	Hs max	Hs min	stem Curve M	System Curve Min
0	0.00	0.00	0.00	376	366	375.60	365.60
67	0.10	0.74	0.04	376	366	376.38	366.38
133	0.19	2.67	0.13	376	366	378.40	368.40
200	0.29	5.65	0.28	376	366	381.53	371.53
267	0.38	9.62	0.48	376	366	385.70	375.70
333	0.48	14.54	0.73	376	366	390.87	380.87
400	0.58	20.37	1.02	376	366	396.99	386.99
467	0.67	27.09	1.35	376	366	404.05	394.05
533	0.77	34.69	1.73	376	366	412.02	402.02
600	0.86	43.13	2.16	376	366	420.89	410.89
667	0.96	52.41	2.62	376	366	430.63	420.63
733	1.06	62.52	3.13	376	366	441.25	431.25
800	1.15	73.44	3.67	376	366	452.71	442.71

System Curve Plots



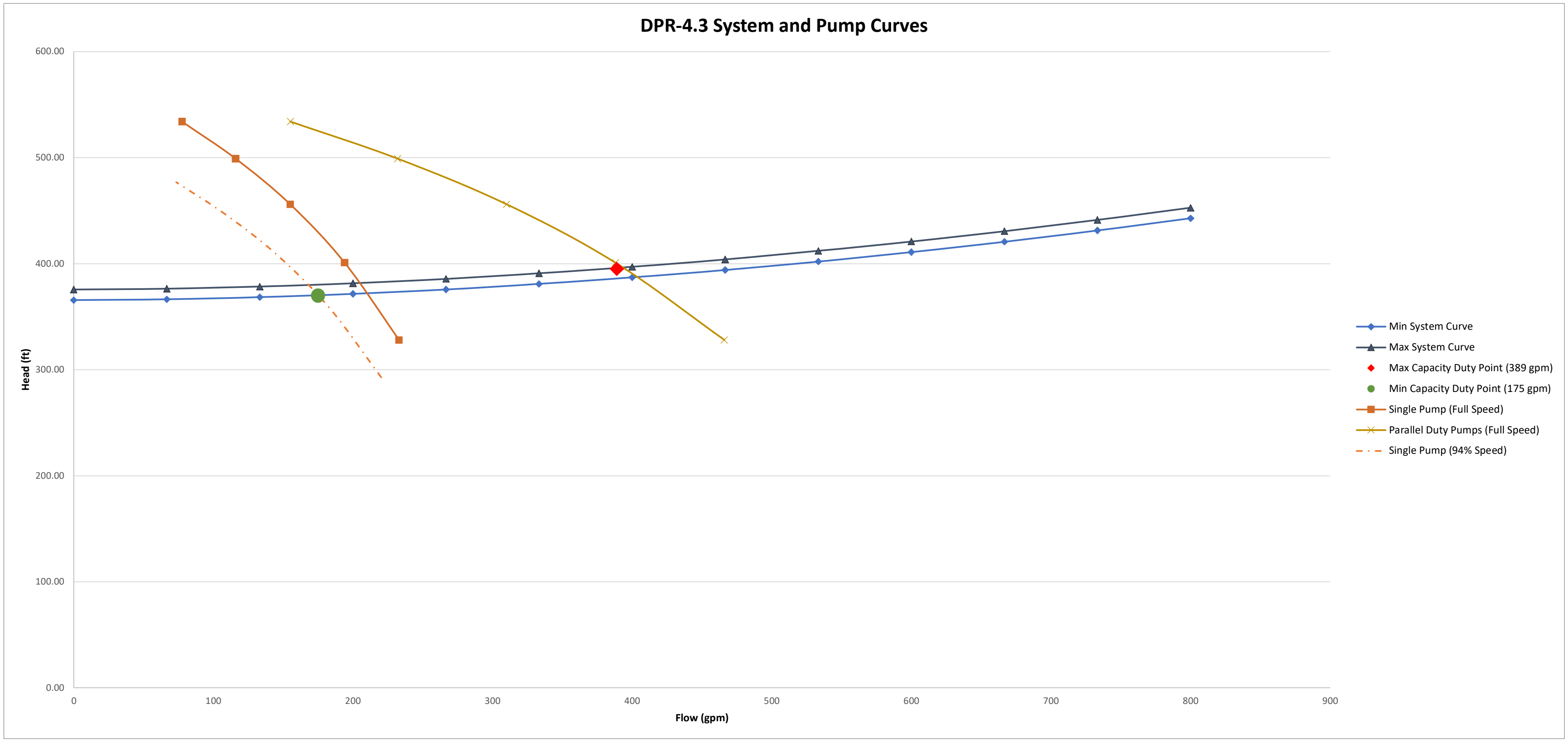
NPSHa Calculation

$NPSH_a = h_{bar} + h_{static} - h_{L,s} - h_{vap}$

Description	Notes	Value	Units
Site Elevation	Round up to nearest 500-feet	500	Feet
Pump Inlet Diameter	From selected pump cutsheet	8	inches
Suction Headloss Totals (H_{L1} + H_{L2})	Referenced in from Calculations above	19.13	feet
Suction Lift	Negative if Suction WSEL is above the pump impeller	3	feet
Maximum Water Temperature	Take a conversative estimate	80	degF

NPSHa = 15.96 **AT THE DESIGN POINT**

Maximum NPSHr 10.96 **AT THE DESIGN POINT**



DPR-4.3 System and Pump Curves
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Head (ft)
0
100
200
300
400
500
600
700
800
900
Flow (gpm)
Min System Curve
Max System Curve
Max Capacity Duty Point (389 gpm)
Min Capacity Duty Point (175 gpm)
Single Pump (Full Speed)
Parallel Duty Pumps (Full Speed)
Single Pump (94% Speed)

Appendix 9C

COST ESTIMATES

Preliminary Design Opinion of Probable Cost Computation

Project:	Montecito Enhanced Recycled Water Feasibility Study				
Alternative:	NPR-1.1			***By:***	***MG***
Task:	Task 3.5 / AACE Class IV Cost Estimate			***Reviewed by:***	***RM, SD***
				Date:	***11/22/2022***

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
CONTRACTOR OVERHEAD COSTS				
Mobilization/Demobilization	1	LS	7.00%	$621,400
Bonds and Insurance	1	LS	2.00%	$168,500
General Conditions	1	LS	3.00%	$255,400
Shop Drawings and O&M Manuals	1	LS	2.50%	$211,700
Contractor Overhead Subtotal				**$1,257,000**
CONSTRUCTION COSTS				
General Construction				
Sheeting and shoring protection	26,400	LF	$5	$132,000
Private property, driveway, sidewalk, landscape repair allowance	264	100 LF	$125	$33,000
Traffic control for piping project	26,400	LF	$25	$660,000
Piping and Appurtenances				
Piping, 8", PVC	26,400	LF	$176	$4,646,400
Hydrant, mechanical joints	3	EA	$6,010	$18,030
Blow off valve, 3"	8	EA	$2,970	$23,760
Air release and vacuum valve, 2" inlet	8	EA	$1,200	$9,600
Pump Station				
Vertical Turbine Pump, 25HP, 13 stage	4	EA	$82,800	$331,200
Discharge head, piping, valves, and mechanical	4	EA	$90,000	$360,000
Site work	1	LS	$117,400	$117,400
Effluent wet well structure	1	LS	$300,500	$300,500
Electrical and Controls	1	LS	$354,000	$354,000
Hydropnuematic Tank (10k gallons)	1	LS	$216,000	$216,000
Crossings				
Highway 101 crossing - South Jameson Lane	1	EA	$221,000	$221,000
8" trenchless railroad crossing	1	LS	$101,600	$101,600
Creek crossings	5	EA	$132,000	$660,000
Creek protections, environmental and permitting	5	EA	$10,000	$50,000
Environmental and Other				
Environmental protection, permit compliance, and BMPs	1	LS	$20,000	$20,000
Construction Costs Subtotal				**$8,255,000**
Constractor Overhead Costs Subtotal				$1,257,000
Construction Subtotal				**$9,512,000**
Contingency for unknown conditions	30%	PERCENT		$2,854,000
Engineering, Administration, and Legal Costs	25%	PERCENT		$2,378,000
Total Project Cost				**$14,744,000**
Project Flow	128	AFY		
Annualized Project Cost				$658,000
Annualized O&M Cost (see below)				$95,300
Total Annual Cost				**$753,300**
Unit Cost		$/AF		**$5,900**
ANNUAL OPERATIONS & MAINTENANCE COSTS				
Pump Station Energy Costs	$0.18	$/kW-HR	122,481	$22,047
Pump Station Annual Maintenance	5%	PERCENT	$1,463,100	$73,155
Pipeline Annual Maintenance	1%	PERCENT	$4,697,790	$46,978
Total Annual O&M Cost				**$95,300**

Preliminary Design Opinion of Probable Cost Computation

Project:	Montecito Enhanced Recycled Water Feasibility Study				
Alternative:	NPR-1.2			***By:***	***MG***
Task:	Task 3.5 / AACE Class IV Cost Estimate			***Reviewed by:***	***RM, SD***
				Date:	***11/22/2022***

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
CONTRACTOR OVERHEAD COSTS				
Mobilization/Demobilization	1	LS	7.00%	$617,600
Bonds and Insurance	1	LS	2.00%	$167,500
General Conditions	1	LS	3.00%	$253,800
Shop Drawings and O&M Manuals	1	LS	2.50%	$210,400
Contractor Overhead Subtotal				**$1,250,000**
CONSTRUCTION COSTS				
General Construction				
Sheeting and shoring protection	26,200	LF	$5	$131,000
Private property, driveway, sidewalk, landscape repair allowance	262	100 LF	$125	$32,750
Traffic control for piping project	26,200	LF	$25	$655,000
Piping and Appurtenances				
Piping, 8", PVC	26,200	LF	$176	$4,611,200
Hydrant, mechanical joints	3	EA	$6,010	$18,030
Blow off valve, 3"	6	EA	$2,970	$17,820
Air release and vacuum valve, 2" inlet	6	EA	$1,200	$7,200
Pump Station				
Vertical Turbine Pump, 25HP, 13 stage	4	EA	$82,800	$331,200
Discharge head, piping, valves, and mechanical	4	EA	$90,000	$360,000
Site work	1	LS	$117,400	$117,400
Effluent wet well structure	1	LS	$300,500	$300,500
Electrical and Controls	1	LS	$354,000	$354,000
Hydropnuematic Tank (10k gallons)	1	LS	$216,000	$216,000
Crossings				
Highway 101 crossing - Danielson Road	1	EA	$221,000	$221,000
8" trenchless railroad crossing	1	EA	$101,600	$101,600
Creek crossings	5	EA	$132,000	$660,000
Creek protections, environmental and permitting	5	EA	$10,000	$50,000
Environmental and Other				
Environmental protection, permit compliance, and BMPs	1	LS	$20,000	$20,000
Construction Costs Subtotal				**$8,205,000**
Constractor Overhead Costs Subtotal				$1,250,000
Construction Subtotal				**$9,455,000**
Contingency for unknown conditions	30%	PERCENT		$2,837,000
Engineering, Administration, and Legal Costs	25%	PERCENT		$2,364,000
Total Project Cost				**$14,656,000**
Project Flow	113	AFY		
Annualized Project Cost				$654,000
Annualized O&M Cost (see below)				$95,300
Total Annual Cost				**$749,300**
Unit Cost		$/AF		**$6,700**
ANNUAL OPERATIONS & MAINTENANCE COSTS				
Pump Station Energy Costs	$0.18	$/kW-HR	122,481	$22,047
Pump Station Annual Maintenance	5%	PERCENT	$1,463,100	$73,155
Pipeline Annual Maintenance	1%	PERCENT	$4,654,250	$46,543
Total Annual O&M Cost				**$95,300**

Preliminary Design Opinion of Probable Cost Computation

Project:	Montecito Enhanced Recycled Water Feasibility Study				
Alternative:	NPR-1.3			***By:***	***MG***
Task:	Task 3.5 / AACE Class IV Cost Estimate			***Reviewed by:***	***RM, SD***
				Date:	***11/22/2022***

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
CONTRACTOR OVERHEAD COSTS				
Mobilization/Demobilization	1	LS	7.00%	$649,600
Bonds and Insurance	1	LS	2.00%	$176,200
General Conditions	1	LS	3.00%	$267,000
Shop Drawings and O&M Manuals	1	LS	2.50%	$221,300
Contractor Overhead Subtotal				**$1,315,000**
CONSTRUCTION COSTS				
General Construction				
Sheeting and shoring protection	24,900	LF	$5	$124,500
Private property, driveway, sidewalk, landscape repair allowance	249	100 LF	$125	$31,125
Traffic control for piping project	24,900	LF	$25	$622,500
Piping and Appurtenances				
Piping, 8", PVC	24,900	LF	$176	$4,382,400
Hydrant, mechanical joints	3	EA	$6,010	$18,030
Blow off valve, 3"	6	EA	$2,970	$17,820
Air release and vacuum valve, 2" inlet	6	EA	$1,200	$7,200
Pump Station				
Vertical Turbine Pump, 25HP, 13 stage	4	EA	$82,800	$331,200
Discharge head, piping, valves, and mechanical	4	EA	$90,000	$360,000
Site work	1	LS	$117,400	$117,400
Effluent wet well structure	1	LS	$300,500	$300,500
Electrical and Controls	1	LS	$354,000	$354,000
Hydropnuematic Tank (10k gallons)	1	LS	$216,000	$216,000
Crossings				
Highway 101 & UPRR crossing - Butterfly Lane	1	EA	$1,017,000	$1,017,000
Creek crossings	5	EA	$132,000	$660,000
Creek protections, environmental and permitting	5	EA	$10,000	$50,000
Environmental and Other				
Environmental protection, permit compliance, and BMPs	1	LS	$20,000	$20,000
Construction Costs Subtotal				**$8,630,000**
Constractor Overhead Costs Subtotal				$1,315,000
Construction Subtotal				**$9,945,000**
Contingency for unknown conditions	30%	PERCENT		$2,984,000
Engineering, Administration, and Legal Costs	25%	PERCENT		$2,487,000
Total Project Cost				**$15,416,000**
Project Flow	102	AFY		
Annualized Project Cost				$688,000
Annualized O&M Cost (see below)				$95,300
Total Annual Cost				**$783,300**
Unit Cost		$/AF		**$7,700**
ANNUAL OPERATIONS & MAINTENANCE COSTS				
Pump Station Energy Costs	$0.18	$/kW-HR	122,481	$22,047
Pump Station Annual Maintenance	5%	PERCENT	$1,463,100	$73,155
Pipeline Annual Maintenance	1%	PERCENT	$4,425,450	$44,255
Total Annual O&M Cost				**$95,300**

Preliminary Design Opinion of Probable Cost Computation

Project:	Montecito Enhanced Recycled Water Feasibility Study		
Alternative:	IPR 2.1	***By:***	***MG***
Task:	Task 3.5 / AACE Class IV Cost Estimate	***Reviewed by:***	***RM, SD***
		Date:	***11/22/2022***

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
CONTRACTOR OVERHEAD COSTS				
Mobilization/Demobilization	1	LS	7.00%	$1,407,400
Bonds and Insurance	1	LS	2.00%	$381,600
General Conditions	1	LS	3.00%	$578,300
Shop Drawings and O&M Manuals	1	LS	2.50%	$479,500
Contractor Overhead Subtotal				**$2,847,000**
CONSTRUCTION COSTS				
General Construction				
Sheeting and shoring protection	52,000	LF	$5	$260,000
Private property, driveway, sidewalk, landscape repair allowance	520	100 LF	$125	$65,000
Traffic control for piping project	52,000	LF	$25	$1,300,000
Piping and Appurtenances				
Piping, 8", PVC	52,000	LF	$176	$9,152,000
Hydrant, mechanical joints	6	EA	$6,010	$36,060
Blow off valve, 3"	12	EA	$2,970	$35,640
Air release and vacuum valve, 2" inlet	12	EA	$1,200	$14,400
Piping, 6", PVC	1,800	LF	$132	$237,600
Injection Well Site and Equipping				
Injection Well Drilling	1	EA	$700,000	$700,000
Monitoring Well Drilling	2	EA	$575,000	$1,150,000
Well Site Equipping	1	LS	$1,700,000	$1,700,000
Pump Station				
Vertical turbine pump, 20HP, 5 stage	4	EA	$69,400	$277,600
Discharge head, piping, valves, and mechanical	4	LS	$90,000	$360,000
Site work	1	LS	$117,400	$117,400
Effluent wet well structure	1	LS	$300,500	$300,500
Electrical and Controls	1	LS	$354,000	$354,000
Crossings				
Highway 101 crossing - South Jameson Lane	1	EA	$221,000	$221,000
Highway 101 crossing - Santa Ynez Avenue	1	EA	$1,017,000	$1,017,000
8" trenchless railroad crossing	1	EA	$101,600	$101,600
Creek crossings	9	EA	$132,000	$1,188,000
Creek protections, environmental and permitting	9	EA	$10,000	$90,000
Environmental and Other				
Environmental protection, permit compliance, and BMPs	1	LS	$20,000	$20,000
Construction Costs Subtotal				**$18,698,000**
Constractor Overhead Costs Subtotal				$2,847,000
Construction Subtotal				**$21,545,000**
Contingency for unknown conditions	30%	PERCENT		$6,464,000
Engineering, Administration, and Legal Costs	25%	PERCENT		$5,387,000
Total Project Cost				**$33,396,000**
Project Flow	560	AFY		
Annualized Project Cost				$1,491,000
Annualized O&M Cost (see below)				$233,900
Total Annual Cost				**$1,724,900**
Unit Cost		$/AF		**$3,100**
ANNUAL OPERATIONS & MAINTENANCE COSTS				
Pump Station Energy Costs	$0.18	$/kW-HR	97,985	$17,637
Pump Station Annual Maintenance	5%	PERCENT	$1,409,500	$70,475
Well Site Annual Maintenance	3%	PERCENT	$1,700,000	$51,000
Pipeline Annual Maintenance	1%	PERCENT	$9,475,700	$94,757
Total Annual O&M Cost				**$233,900**

Preliminary Design Opinion of Probable Cost Computation

Project:	Montecito Enhanced Recycled Water Feasibility Study			
Alternative:	IPR 2.2		***By:***	***MG***
Task:	Task 3.5 / AACE Class IV Cost Estimate		***Reviewed by:***	***RM, SD***
			Date:	***11/22/2022***

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
CONTRACTOR OVERHEAD COSTS				
Mobilization/Demobilization	1	LS	7.00%	$1,402,300
Bonds and Insurance	1	LS	2.00%	$380,300
General Conditions	1	LS	3.00%	$576,200
Shop Drawings and O&M Manuals	1	LS	2.50%	$477,700
Contractor Overhead Subtotal				**$2,837,000**
CONSTRUCTION COSTS				
General Construction				
Sheeting and shoring protection	51,600	LF	$5	$258,000
Private property, driveway, sidewalk, landscape repair allowance	516	100 LF	$125	$64,500
Traffic control for piping project	51,600	LF	$25	$1,290,000
Piping and Appurtenances				
Piping, 8", PVC	51,600	LF	$176	$9,081,600
Hydrant, mechanical joints	6	EA	$6,010	$36,060
Blow off valve, 3"	12	EA	$2,970	$35,640
Air release and vacuum valve, 3" inlet	12	EA	$2,400	$28,800
Piping, 6", PVC	1,800	LF	$132	$237,600
Injection Well Site and Equipping				
Injection Well Drilling	1	EA	$700,000	$700,000
Monitoring Well Drilling	2	EA	$575,000	$1,150,000
Well Site Equipping	1	LS	$1,700,000	$1,700,000
Pump Station				
Vertical turbine pump, 20HP, 5 stage	4	EA	$69,400	$277,600
Discharge head, piping, valves, and mechanical	4	EA	$90,000	$360,000
Site work	1	LS	$117,400	$117,400
Effluent wet well structure	1	LS	$300,500	$300,500
Electrical and Controls	1	LS	$354,000	$354,000
Crossings				
Highway 101 crossing - South Jameson Lane	1	EA	$221,000	$221,000
Highway 101 crossing - Carpinteria Avenue	1	EA	$1,017,000	$1,017,000
8" trenchless railroad crossing	1	EA	$101,600	$101,600
Creek crossings	9	EA	$132,000	$1,188,000
Creek protections, environmental and permitting	9	EA	$10,000	$90,000
Environmental and Other				
Environmental protection, permit compliance, and BMPs	1	LS	$20,000	$20,000
Construction Costs Subtotal				**$18,630,000**
Constractor Overhead Costs Subtotal				$2,837,000
Construction Subtotal				**$21,467,000**
Contingency for unknown conditions	30%	PERCENT		$6,441,000
Engineering, Administration, and Legal Costs	25%	PERCENT		$5,367,000
Total Project Cost				**$33,275,000**
Project Flow	560	AFY		
Annualized Project Cost				$1,486,000
Annualized O&M Cost (see below)				$233,400
Total Annual Cost				**$1,719,400**
Unit Cost		$/AF		**$3,100**
ANNUAL OPERATIONS & MAINTENANCE COSTS				
Pump Station Energy Costs	$0.18	$/kW-HR	97,985	$17,637
Pump Station Annual Maintenance	5%	PERCENT	$1,409,500	$70,475
Well Site Annual Maintenance	3%	PERCENT	$1,700,000	$51,000
Pipeline Annual Maintenance	1%	PERCENT	$9,419,700	$94,197
Total Annual O&M Cost				**$233,400**

Preliminary Design Opinion of Probable Cost Computation

Project:	Montecito Enhanced Recycled Water Feasibility Study			
Alternative:	IPR 2.3		***By:***	***MG***
Task:	Task 3.5 / AACE Class IV Cost Estimate		***Reviewed by:***	***RM, SD***
			Date:	***11/22/2022***

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
CONTRACTOR OVERHEAD COSTS				
Mobilization/Demobilization	1	LS	7.00%	$1,529,100
Bonds and Insurance	1	LS	2.00%	$414,600
General Conditions	1	LS	3.00%	$628,300
Shop Drawings and O&M Manuals	1	LS	2.50%	$520,900
Contractor Overhead Subtotal				**$3,093,000**
CONSTRUCTION COSTS				
General Construction				
Sheeting and shoring protection	56,300	LF	$5	$281,500
Private property, driveway, sidewalk, landscape repair allowance	563	100 LF	$125	$70,375
Traffic control for piping project	56,300	LF	$25	$1,407,500
Piping and Appurtenances				
Piping, 8", PVC	56,300	LF	$176	$9,908,800
Hydrant, mechanical joints	6	EA	$6,010	$36,060
Blow off valve, 3"	12	EA	$2,970	$35,640
Air release and vacuum valve, 2" inlet	12	EA	$1,200	$14,400
Piping, 6", PVC	1,800	LF	$132	$237,600
Injection Well Site and Equipping				
Injection Well Drilling	1	EA	$700,000	$700,000
Monitoring Well Drilling	2	EA	$575,000	$1,150,000
Well Site Equipping	1	LS	$1,700,000	$1,700,000
Pump Station				
Vertical turbine pump, 20HP, 5 stage	4	EA	$69,400	$277,600
Discharge head, piping, valves, and mechanical	4	EA	$90,000	$360,000
Site work	1	LS	$117,400	$117,400
Effluent wet well structure	1	LS	$300,500	$300,500
Electrical and Controls	1	LS	$354,000	$354,000
Crossings				
Highway 101 crossing - South Jameson Lane	1	EA	$221,000	$221,000
Highway 101 crossing - Linden Avenue	1	EA	$1,743,000	$1,743,000
8" trenchless railroad crossing	1	EA	$101,600	$101,600
Creek crossings	9	EA	$132,000	$1,188,000
Creek protections, environmental and permitting	9	EA	$10,000	$90,000
Environmental and Other				
Environmental protection, permit compliance, and BMPs	1	LS	$20,000	$20,000
Construction Costs Subtotal				**$20,315,000**
Constractor Overhead Costs Subtotal				$3,093,000
Construction Subtotal				**$23,408,000**
Contingency for unknown conditions	30%	PERCENT		$7,023,000
Engineering, Administration, and Legal Costs	25%	PERCENT		$5,852,000
Total Project Cost				**$36,283,000**
Project Flow	560	AFY		
Annualized Project Cost				$1,620,000
Annualized O&M Cost (see below)				$142,400
Total Annual Cost				**$1,762,400**
Unit Cost		$/AF		**$3,200**
ANNUAL OPERATIONS & MAINTENANCE COSTS				
Pump Station Energy Costs	$0.18	$/kW-HR	97,985	$17,637
Pump Station Annual Maintenance	5%	PERCENT	$1,409,500	$70,475
Well Site Annual Maintenance	3%	PERCENT	$1,700,000	$51,000
Pipeline Annual Maintenance	1%	PERCENT	$323,700	$3,237
Total Annual O&M Cost				**$142,400**

Preliminary Design Opinion of Probable Cost Computation

Project: Montecito Enhanced Recycled Water Feasibility Study				
Alternative: IPR 3.1			***By:***	***MG***
Task: Task 3.5 / AACE Class IV Cost Estimate			***Reviewed by:***	***RM, SD***
			Date:	***11/22/2022***

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
CONTRACTOR OVERHEAD COSTS				
Mobilization/Demobilization	1	LS	7.00%	$1,352,000
Bonds and Insurance	1	LS	2.00%	$366,600
General Conditions	1	LS	3.00%	$555,600
Shop Drawings and O&M Manuals	1	LS	2.50%	$460,600
Contractor Overhead Subtotal				**$2,735,000**
CONSTRUCTION COSTS				
General Construction				
Sheeting and shoring protection	53,900	LF	$5	$269,500
Private property, driveway, sidewalk, landscape repair allowance	539	100 LF	$125	$67,375
Traffic control for piping project	53,900	LF	$25	$1,347,500
Piping and Appurtenances				
Piping, 8", PVC	53,900	LF	$176	$9,486,400
Hydrant, mechanical joints	6	EA	$6,010	$36,060
Blow off valve, 3"	12	EA	$2,970	$35,640
Air release and vacuum valve, 2" inlet	12	EA	$1,200	$14,400
Injection Well Site and Equipping				
Injection Well Drilling	1	EA	$700,000	$700,000
Monitoring Well Drilling	2	EA	$575,000	$1,150,000
Well Site Equipping	1	LS	$1,700,000	$1,700,000
Pump Station				
Vertical turbine pump, 20HP, 5 stage	3	EA	$69,400	$208,200
Discharge head, piping, valves, and mechanical	3	EA	$90,000	$270,000
Site work	1	LS	$117,400	$117,400
Effluent wet well structure	1	LS	$300,500	$300,500
Electrical and Controls	1	LS	$354,000	$354,000
Crossings				
Highway 101 crossing - South Jameson Lane	1	EA	$221,000	$221,000
8" trenchless railroad crossing	1	EA	$101,600	$101,600
Creek crossings	11	EA	$132,000	$1,452,000
Creek protections, environmental and permitting	11	EA	$10,000	$110,000
Environmental and Other				
Environmental protection, permit compliance, and BMPs	1	LS	$20,000	$20,000
Construction Costs Subtotal				**$17,962,000**
Constractor Overhead Costs Subtotal				$2,735,000
Construction Subtotal				**$20,697,000**
Contingency for unknown conditions	30%	PERCENT		$6,210,000
Engineering, Administration, and Legal Costs	25%	PERCENT		$5,175,000
Total Project Cost				**$32,082,000**
Project Flow	560	AFY		
Annualized Project Cost				$1,432,000
Annualized O&M Cost (see below)				$226,900
Total Annual Cost				**$1,658,900**
Unit Cost		$/AF		**$3,000**
ANNUAL OPERATIONS & MAINTENANCE COSTS				
Pump Station Energy Costs	$0.18	$/kW-HR	97,985	$17,637
Pump Station Annual Maintenance	5%	PERCENT	$1,250,100	$62,505
Well Site Annual Maintenance	3%	PERCENT	$1,700,000	$51,000
Pipeline Annual Maintenance	1%	PERCENT	$9,572,500	$95,725
Total Annual O&M Cost				**$226,900**

Preliminary Design Opinion of Probable Cost Computation

Project:	Montecito Enhanced Recycled Water Feasibility Study			
Alternative:	DPR 4.1		***By:***	***MG***
Task:	Task 3.5 / AACE Class IV Cost Estimate		***Reviewed by:***	***RM, SD***
			Date:	***11/22/2022***

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
CONTRACTOR OVERHEAD COSTS				
Mobilization/Demobilization	1	LS	7.00%	$715,500
Bonds and Insurance	1	LS	2.00%	$194,000
General Conditions	1	LS	3.00%	$294,000
Shop Drawings and O&M Manuals	1	LS	2.50%	$243,800
Contractor Overhead Subtotal				**$1,448,000**
CONSTRUCTION COSTS				
General Construction				
Sheeting and shoring protection	29,100	LF	$5	$145,500
Private property, driveway, sidewalk, landscape repair allowance	276	100 LF	$125	$34,500
Traffic control for piping project	27,600	LF	$25	$690,000
Piping and Appurtenances				
Piping, 10", PVC	27,600	LF	$220	$6,072,000
Hydrant, mechanical joints	3	EA	$6,010	$18,030
Blow off valve, 3"	10	EA	$2,970	$29,700
Air release and vacuum valve, 2" inlet	10	EA	$1,200	$12,000
Pump Station				
Vertical Turbine Pump, 40HP, 10 stage	3	EA	$88,700	$266,100
Discharge head, piping, valves, and mechanical	3	EA	$90,000	$270,000
Site work	1	LS	$117,400	$117,400
Effluent wet well structure	1	LS	$300,500	$300,500
Electrical and Controls	1	LS	$354,000	$354,000
Crossings				
Highway 101 crossing - South Jameson Lane	1	EA	$221,000	$221,000
8" trenchless railroad crossing	1	EA	$101,600	$101,600
Creek crossings	6	EA	$132,000	$792,000
Creek protections, environmental and permitting	6	EA	$10,000	$60,000
Environmental and Other				
Environmental protection, permit compliance, and BMPs	1	LS	$20,000	$20,000
Construction Costs Subtotal				**$9,505,000**
Constractor Overhead Costs Subtotal				$1,448,000
Construction Subtotal				**$10,953,000**
Contingency for unknown conditions	30%	PERCENT		$3,286,000
Engineering, Administration, and Legal Costs	25%	PERCENT		$2,739,000
Total Project Cost				**$16,978,000**
Project Flow	560	AFY		
Annualized Project Cost				$758,000
Annualized O&M Cost (see below)				$162,000
Total Annual Cost				**$920,000**
Unit Cost		$/AF		**$1,700**
ANNUAL OPERATIONS & MAINTENANCE COSTS				
Pump Station Energy Costs	$0.18	$/kW-HR	195,970	$35,275
Pump Station Annual Maintenance	5%	PERCENT	$1,308,000	$65,400
Pipeline Annual Maintenance	1%	PERCENT	$6,131,730	$61,317
Total Annual O&M Cost				**$162,000**

Preliminary Design Opinion of Probable Cost Computation

Project:	Montecito Enhanced Recycled Water Feasibility Study		
Alternative:	DPR 4.2	***By:***	***MG***
Task:	Task 3.5 / AACE Class IV Cost Estimate	***Reviewed by:***	***RM, SD***
		Date:	***11/22/2022***

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
CONTRACTOR OVERHEAD COSTS				
Mobilization/Demobilization	1	LS	7.00%	$875,700
Bonds and Insurance	1	LS	2.00%	$237,500
General Conditions	1	LS	3.00%	$359,800
Shop Drawings and O&M Manuals	1	LS	2.50%	$298,300
Contractor Overhead Subtotal				**$1,772,000**
CONSTRUCTION COSTS				
General Construction				
Sheeting and shoring protection	37,500	LF	$5	$187,500
Private property, driveway, sidewalk, landscape repair allowance	375	100 LF	$125	$46,875
Traffic control for piping project	37,500	LF	$25	$937,500
Piping and Appurtenances				
Piping, 10", PVC	37,500	LF	$220	$8,250,000
Hydrant, mechanical joints	4	EA	$6,010	$24,040
Blow off valve, 3"	10	EA	$2,970	$29,700
Air release and vacuum valve, 2" inlet	10	EA	$1,200	$12,000
Pump Station				
Vertical Turbine Pump, 40HP, 10 stage	1	EA	$88,700	$88,700
Discharge head, piping, valves, and mechanical	1	EA	$90,000	$90,000
Site work	1	LS	$117,400	$117,400
Effluent wet well structure	1	LS	$300,500	$300,500
Electrical and Controls	1	LS	$354,000	$354,000
Crossings				
Highway 101 crossing - South Jameson Lane	1	EA	$221,000	$221,000
8" trenchless railroad crossing	1	EA	$101,600	$101,600
Creek crossings	6	EA	$132,000	$792,000
Creek protections, environmental and permitting	6	EA	$10,000	$60,000
Environmental and Other				
Environmental protection, permit compliance, and BMPs	1	LS	$20,000	$20,000
Construction Costs Subtotal				**$11,633,000**
Constractor Overhead Costs Subtotal				$1,772,000
Construction Subtotal				**$13,405,000**
Contingency for unknown conditions	30%	PERCENT		$4,022,000
Engineering, Administration, and Legal Costs	25%	PERCENT		$3,352,000
Total Project Cost				**$20,779,000**
Project Flow	560	AFY		
Annualized Project Cost				$928,000
Annualized O&M Cost (see below)				$166,000
Total Annual Cost				**$1,094,000**
Unit Cost		$/AF		**$2,000**
ANNUAL OPERATIONS & MAINTENANCE COSTS				
Pump Station Energy Costs	$0.18	$/kW-HR	195,970	$35,275
Pump Station Annual Maintenance	5%	PERCENT	$950,600	$47,530
Pipeline Annual Maintenance	1%	PERCENT	$8,315,740	$83,157
Total Annual O&M Cost				**$166,000**

Preliminary Design Opinion of Probable Cost Computation

Project:	Montecito Enhanced Recycled Water Feasibility Study				
Alternative:	DPR 4.3			***By:***	***MG***
Task:	Task 3.5 / AACE Class IV Cost Estimate			***Reviewed by:***	***RM, SD***
				Date:	***11/22/2022***

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
CONTRACTOR OVERHEAD COSTS				
Mobilization/Demobilization	1	LS	7.00%	$433,700
Bonds and Insurance	1	LS	2.00%	$117,600
General Conditions	1	LS	3.00%	$178,200
Shop Drawings and O&M Manuals	1	LS	2.50%	$147,800
Contractor Overhead Subtotal				**$878,000**
CONSTRUCTION COSTS				
General Construction				
Sheeting and shoring protection	6,400	LF	$5	$32,000
Private property, driveway, sidewalk, landscape repair allowance	64	100 LF	$125	$8,000
Traffic control for piping project	6,400	LF	$25	$160,000
Piping and Appurtenances				
Piping, 10", PVC	6,400	LF	$220	$1,408,000
Hydrant, mechanical joints	1	EA	$6,010	$6,010
Blow off valve, 3"	5	EA	$2,970	$14,850
Air release and vacuum valve, 2" inlet	5	EA	$1,200	$6,000
Pump Station				
Vertical Turbine Pump, 15HP, 3 stage	3	EA	$67,700	$203,100
Jockey Pump, 5HP	1	EA	$15,000	$15,000
Discharge head, piping, valves, and mechanical	4	EA	$90,000	$360,000
Site work	1	LS	$117,400	$117,400
Effluent wet well structure	1	LS	$300,500	$300,500
Electrical and Controls	1	LS	$354,000	$354,000
Storage				
Welded steel storage for potable water	500,000	GAL	$1.50	$750,000
Crossings				
Highway 101 crossing - East Cabrillo Boulevard	1	EA	$1,453,000	$1,453,000
8" trenchless railroad crossing	1	EA	$101,600	$101,600
Environmental and Other				
Environmental protection, permit compliance, and BMPs	1	LS	$20,000	$20,000
Major traffic control	90	DAYS	$5,000	$450,000
Pedestrian control, bridge access, signs, etc.	1	LS	$1,500	$1,500
Construction Costs Subtotal				**$5,761,000**
Constractor Overhead Costs Subtotal				$878,000
Construction Subtotal				**$6,639,000**
Contingency for unknown conditions	30%	PERCENT		$1,992,000
Engineering, Administration, and Legal Costs	25%	PERCENT		$1,660,000
Total Project Cost				**$10,291,000**
Project Flow	560	AFY		
Annualized Project Cost				$459,000
Annualized O&M Cost (see below)				$117,200
Total Annual Cost				**$576,200**
Unit Cost		$/AF		**$1,100**
ANNUAL OPERATIONS & MAINTENANCE COSTS				
Pump Station Energy Costs	$0.18	$/kW-HR	195,970	$35,275
Pump Station Annual Maintenance	5%	PERCENT	$1,350,000	$67,500
Pipeline Annual Maintenance	1%	PERCENT	$1,434,860	$14,349
Total Annual O&M Cost				**$117,200**

Preliminary Design Opinion of Probable Cost Computation

Project:	Montecito Enhanced Recycled Water Feasibility Study			
Alternative:	DPR 5.1		***By:***	***MG***
Task:	Task 3.5 / AACE Class IV Cost Estimate		***Reviewed by:***	***RM, SD***
			Date:	***11/22/2022***

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
CONTRACTOR OVERHEAD COSTS				
Mobilization/Demobilization	1	LS	7.00%	$416,400
Bonds and Insurance	1	LS	2.00%	$112,900
General Conditions	1	LS	3.00%	$171,100
Shop Drawings and O&M Manuals	1	LS	2.50%	$141,900
Contractor Overhead Subtotal				**$843,000**
CONSTRUCTION COSTS				
General Construction				
Sheeting and shoring protection	5,400	LF	$5	$27,000
Private property, driveway, sidewalk, landscape repair allowance	54	100 LF	$125	$6,750
Traffic control for piping project	5,400	LF	$25	$135,000
Piping and Appurtenances				
Sewer, 18", SDR	5,400	LF	$630	$3,402,000
Install 15-ft deep manhole	6	EA	$20,000	$120,000
18" trenchless waterway crossing	*100*	*LF*	*$2,400*	*$240,000*
Pipe to manhole connection and repair	6	EA	$1,000	$6,000
Storage				
Post-treated storage	470,000	GAL	$1.75	$822,500
Environmental and Other				
Bird sanctuary environmental protection, permit compliance, and BMPs	1	LS	$50,000	$50,000
Constructability factor	15%	PERCENT	$4,809,250	$721,388
Construction Costs Subtotal				**$5,531,000**
Constractor Overhead Costs Subtotal				$843,000
Construction Subtotal				**$6,374,000**
Contingency for unknown conditions	30%	PERCENT		$1,913,000
Engineering, Administration, and Legal Costs	25%	PERCENT		$1,594,000
Total Project Cost				**$9,881,000**
Project Flow	560	AFY		
Annualized Project Cost				$441,000
Annualized O&M Cost (see below)				$37,700
Total Annual Cost				**$478,700**
Unit Cost		$/AF		**$900**
ANNUAL OPERATIONS & MAINTENANCE COSTS				
Pipeline Annual Maintenance	1%	PERCENT	$3,768,000	$37,680
Total Annual O&M Cost				**$37,700**

Preliminary Design Opinion of Probable Cost Computation

Project:	Montecito Enhanced Recycled Water Feasibility Study			
Alternative:	DPR 5.2		***By:***	***MG***
Task:	Task 3.5 / AACE Class IV Cost Estimate		***Reviewed by:***	***RM, SD***
			Date:	***11/22/2022***

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
CONTRACTOR OVERHEAD COSTS				
Mobilization/Demobilization	1	LS	7.00%	$500,400
Bonds and Insurance	1	LS	2.00%	$135,700
General Conditions	1	LS	3.00%	$205,700
Shop Drawings and O&M Manuals	1	LS	2.50%	$170,500
Contractor Overhead Subtotal				**$1,013,000**
CONSTRUCTION COSTS				
General Construction				
Sheeting and shoring protection	8,200	LF	$5	$41,000
Private property, driveway, sidewalk, landscape repair allowance	82	100 LF	$125	$10,250
Traffic control for piping project	8,200	LF	$25	$205,000
Piping and Appurtenances				
Sewer, 15", SDR	8,200	LF	$525	$4,305,000
Install 15-ft deep manhole	12	EA	$20,000	$240,000
Pipe to manhole connection and repair	12	EA	$1,000	$12,000
Infrastructure				
15" inverted siphon	*1*	*EA*	*$500,000*	*$500,000*
15" trenchless waterway crossing	*90*	*LF*	*$2,200*	*$198,000*
15" trenchless waterway crossing	*120*	*LF*	*$2,200*	*$264,000*
Storage				
Post-treated storage	470,000	GAL	$1.75	$822,500
Environmental and Other				
Environmental protection, permit compliance, and BMPs	1	LS	$50,000	$50,000
Construction Costs Subtotal				**$6,648,000**
Constractor Overhead Costs Subtotal				$1,013,000
Construction Subtotal				**$7,661,000**
Contingency for unknown conditions	30%	PERCENT		$2,299,000
Engineering, Administration, and Legal Costs	25%	PERCENT		$1,916,000
Total Project Cost				**$11,876,000**
Project Flow	560	AFY		
Annualized Project Cost				$530,000
Annualized O&M Cost (see below)				$93,700
Total Annual Cost				**$623,700**
Unit Cost		$/AF		**$1,200**
ANNUAL OPERATIONS & MAINTENANCE COSTS				
Inverted Siphon Annual Maintenance	5%	PERCENT	$962,000	$48,100
Pipeline Annual Maintenance	1%	PERCENT	$4,557,000	$45,570
Total Annual O&M Cost				**$93,700**

Preliminary Design Opinion of Probable Cost Computation

Project:	Montecito Enhanced Recycled Water Feasibility Study				
Alternative:	DPR 5.3			***By:***	***MG***
Task:	Task 3.5 / AACE Class IV Cost Estimate			***Reviewed by:***	***RM, SD***
				Date:	***11/22/2022***

DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST
CONTRACTOR OVERHEAD COSTS				
Mobilization/Demobilization	1	LS	7.00%	$967,900
Bonds and Insurance	1	LS	2.00%	$262,500
General Conditions	1	LS	3.00%	$397,700
Shop Drawings and O&M Manuals	1	LS	2.50%	$329,700
Contractor Overhead Subtotal				**$1,958,000**
CONSTRUCTION COSTS				
General Construction				
Sheeting and shoring protection	6,380	LF	$5	$31,900
Private property, driveway, sidewalk, landscape repair allowance	118	100 LF	$125	$14,728
Traffic control for piping project	11,782	LF	$25	$294,550
Piping and Appurtenances				
Sewer, 24", SDR	11,782	LF	$840	$9,896,880
Install 15-ft deep manhole	16	EA	$20,000	$320,000
Pipe to manhole connection and repair	16	EA	$1,000	$16,000
Infrastructure				
24" inverted siphon	*1*	*EA*	*$500,000*	*$500,000*
24" trenchless waterway crossing	*90*	*LF*	*$3,400*	*$306,000*
24" trenchless waterway crossing	*120*	*LF*	*$3,400*	*$408,000*
Storage				
Post-treated storage	470,000	GAL	$1.50	$705,000
Crossings				
24" trenchless railroad crossing	1	EA	$314,200	$314,200
Environmental and Other				
Environmental protection, permit compliance, and BMPs	1	LS	$50,000	$50,000
Construction Costs Subtotal				**$12,858,000**
Constractor Overhead Costs Subtotal				$1,958,000
Construction Subtotal				**$14,816,000**
Contingency for unknown conditions	30%	PERCENT		$4,445,000
Engineering, Administration, and Legal Costs	25%	PERCENT		$3,704,000
Total Project Cost				**$22,965,000**
Project Flow	560	AFY		
Annualized Project Cost				$1,025,000
Annualized O&M Cost (see below)				$163,100
Total Annual Cost				**$1,188,100**
Unit Cost		$/AF		**$2,200**
ANNUAL OPERATIONS & MAINTENANCE COSTS				
Inverted Siphon Annual Maintenance	5%	PERCENT	$1,214,000	$60,700
Pipeline Annual Maintenance	1%	PERCENT	$10,232,880	$102,329
Total Annual O&M Cost				**$163,100**