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

Technical Memorandum 1
MSD FLOW AND NPDES PERMIT ANALYSIS

DRAFT FINAL | September 2022

carollo

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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.

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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.

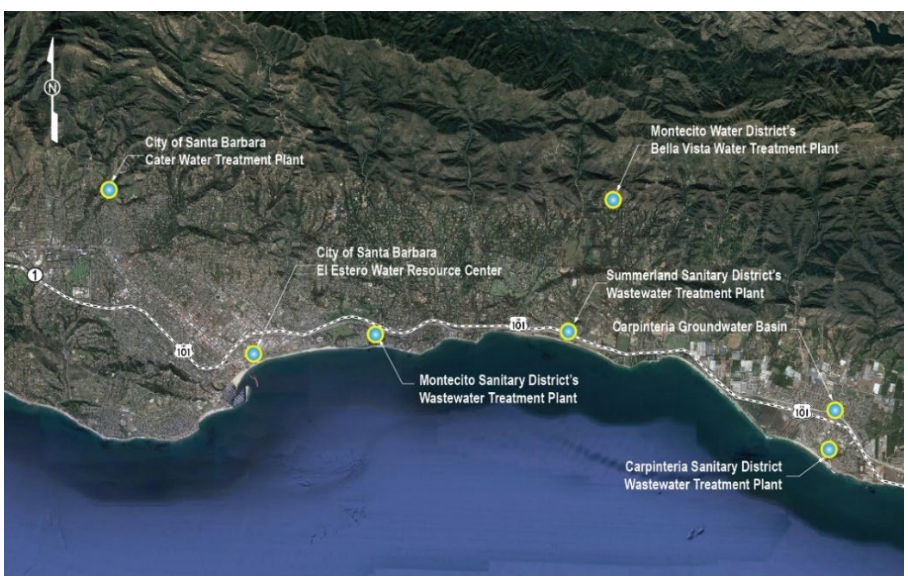

Figure 1.1 Potential Regional Partners

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.

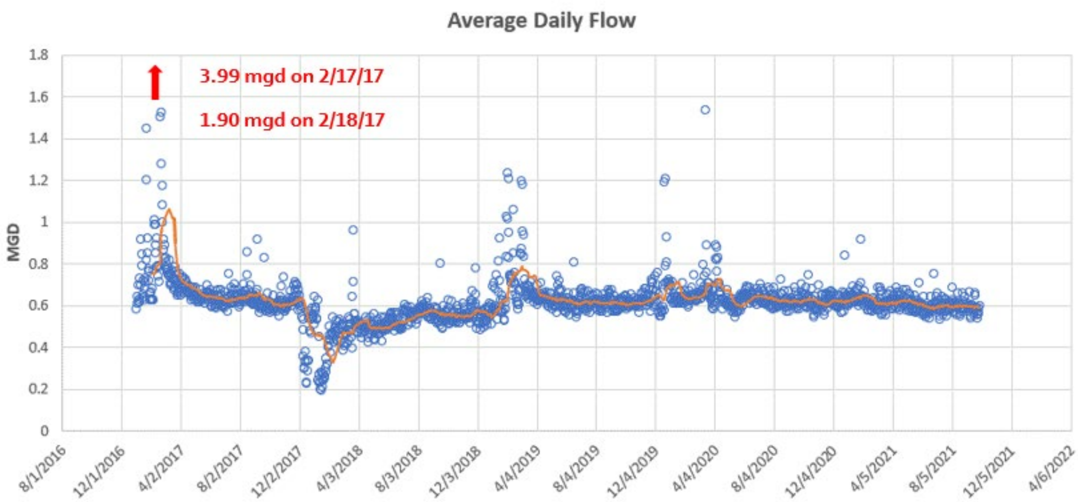

Figure 1.2 Current Influent Flow

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.

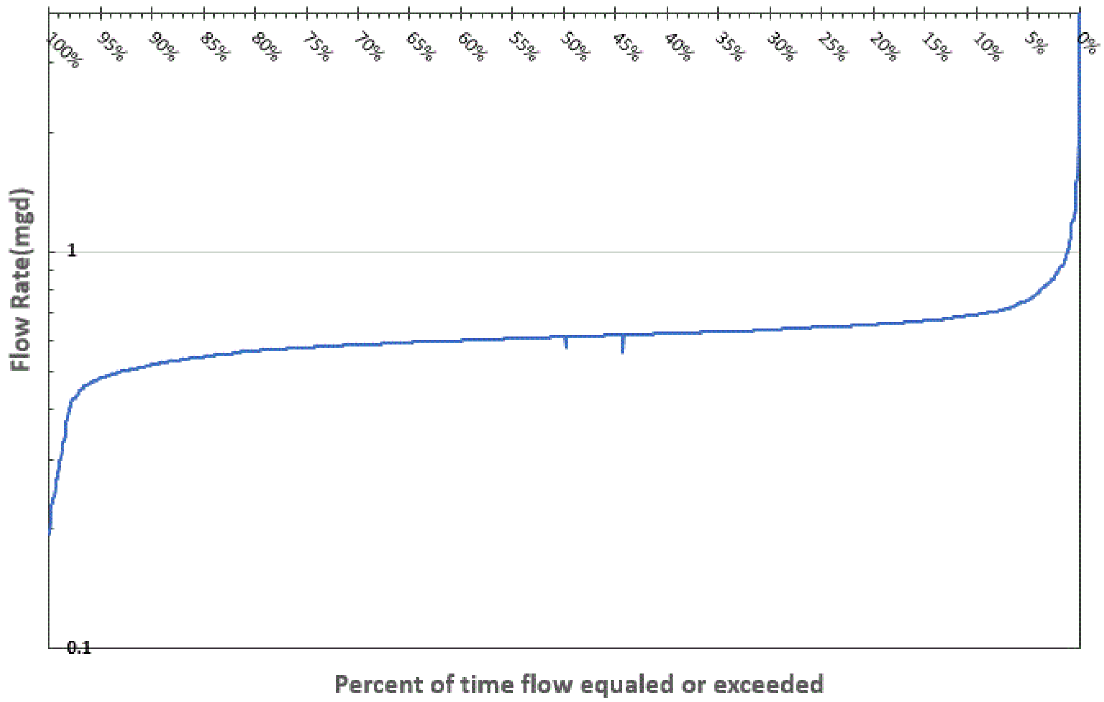

Figure 1.3 Average Daily Flow Exceedance Frequency for 2017 - 2021

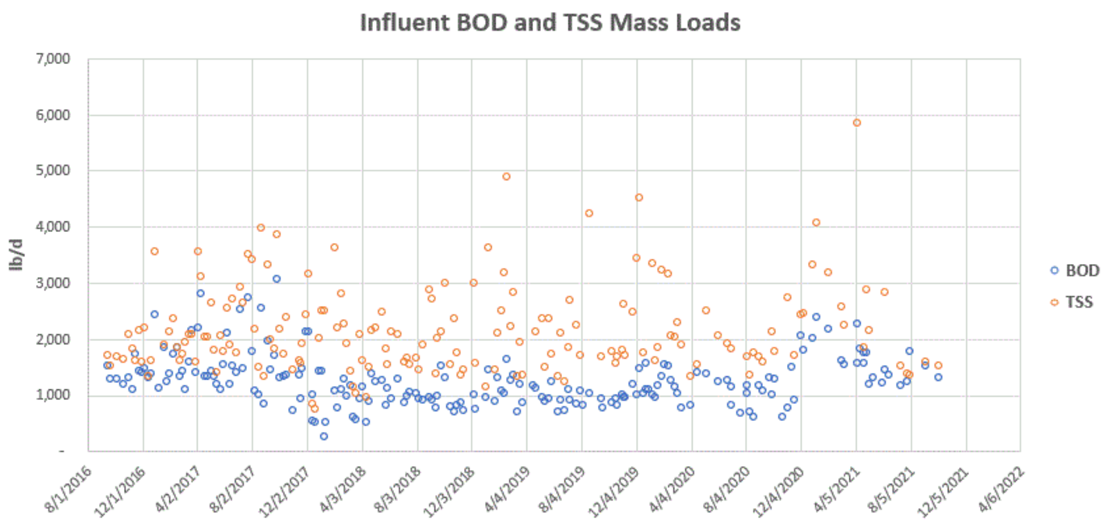

Figure 1.4 Historical Mass Loads: BOD and TSS

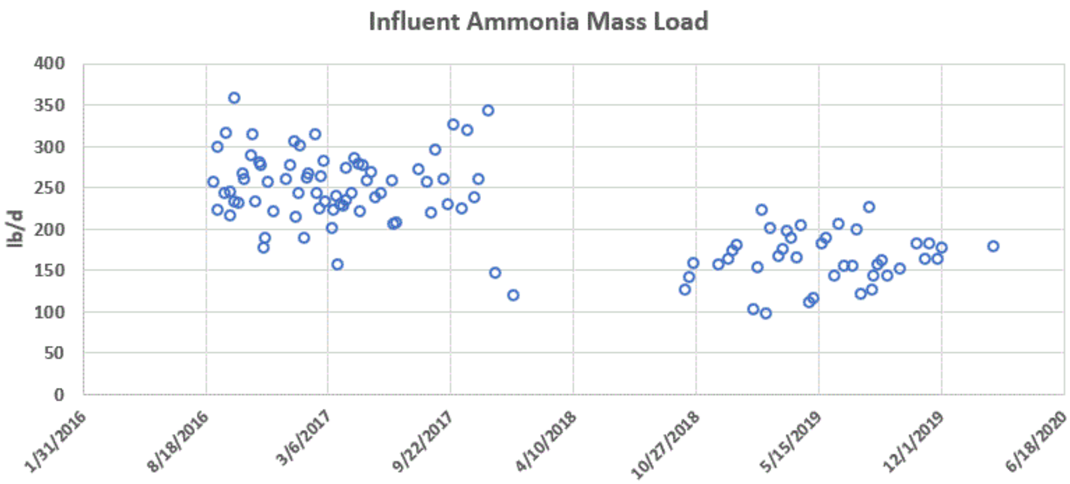

Figure 1.5 Historical Mass Loads: Ammonia

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.

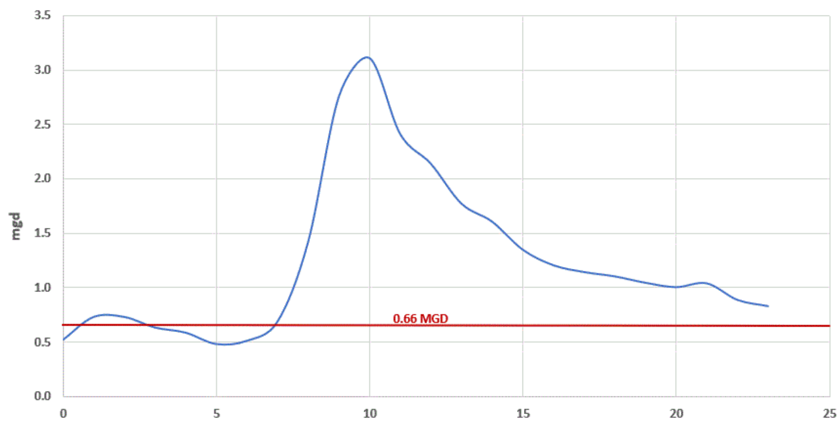

Figure 1.6 Diurnal Curve During a Wet Weather Event (2/2/2017) - Flows Multiplied by 1.13

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.

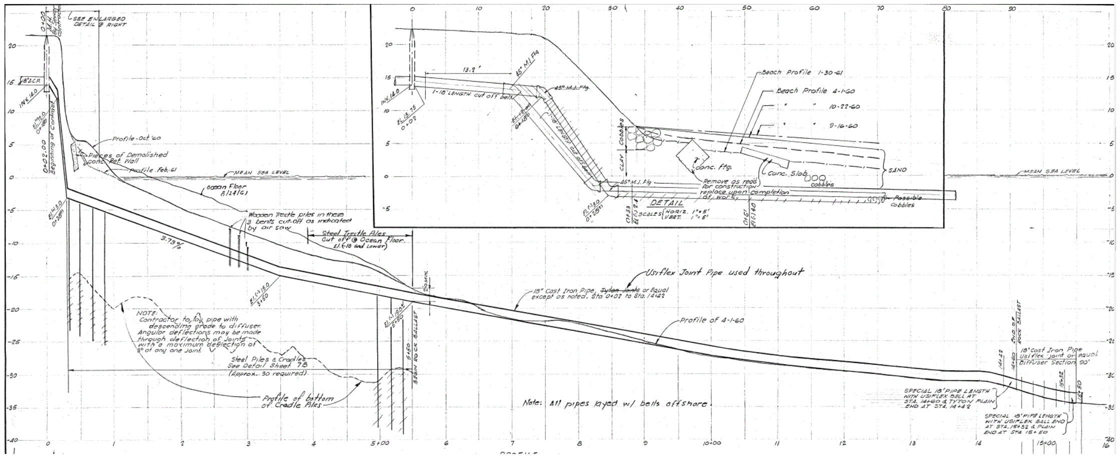

Figure 1.7 MSD As-Built Outfall Section View

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 Concentratio n 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.

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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.

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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.

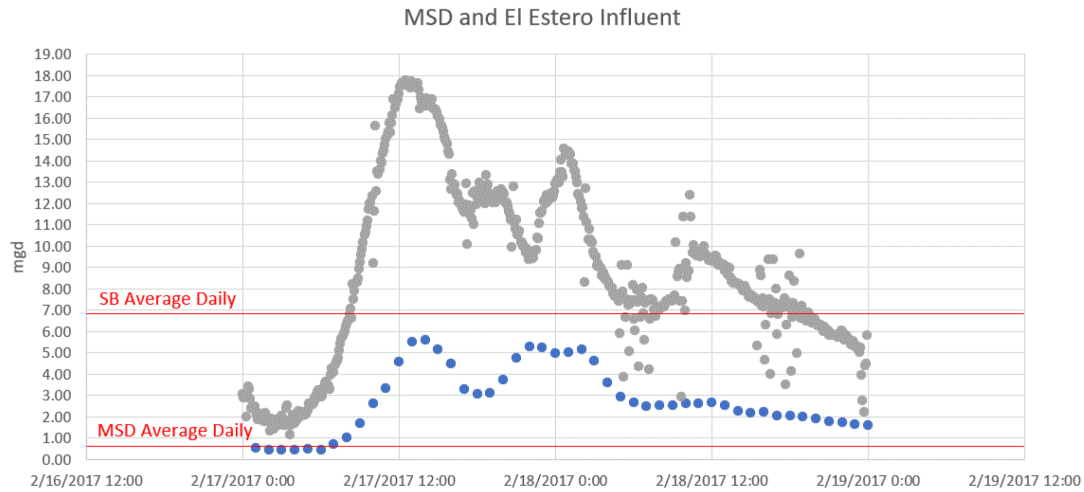

Figure 1A.1 Diurnal Influent Flows at El Estro and MSD between 2/17/2017 – 2/18/2017

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**