

**City of Morro Bay and  
Cayucos Sanitary District**

**OFFSHORE MONITORING  
AND REPORTING PROGRAM**

**2021 ANNUAL REPORT**



**Marine Research Specialists**

**4744 Telephone Rd Ste 3 PMB 315  
Ventura, California 93003**

**Report to the  
City of Morro Bay and  
Cayucos Sanitary District**

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Morro Bay, California 93442  
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**OFFSHORE MONITORING  
AND REPORTING PROGRAM**

**2021 ANNUAL REPORT**

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**Submitted by  
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**March 2022**

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30 March 2022

## **Reference: 2021 Annual Monitoring Report**

Dear Mr. Gunderlock:

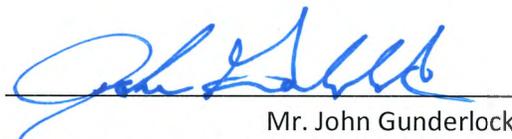
Enclosed is the referenced report. It documents the continued effectiveness of the treatment process, the absence of marine impacts, and compliance with the discharge limitations and reporting requirements specified in the NPDES discharge permits.

Please contact the undersigned if you have questions regarding this report.

Sincerely,

Douglas A Coats  
Project Manager

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A handwritten signature in blue ink, appearing to read "John Gunderlock", is written over a horizontal line.

Mr. John Gunderlock  
Wastewater/Collections System Supervisor  
City of Morro Bay/Cayucos CSD Wastewater Treatment Plant

Date: 3/30/22

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## LIST OF ACRONYMS AND DEFINITIONS

<b>AHA</b>	<b>Activity Hazard Analyses investigate potential facility hazards</b>
<b>Anthropogenic</b>	<b>Changes to the environment induced by human activities</b>
<b>APCD</b>	<b>San Luis Obispo County Air Pollution Control District</b>
<b>BMPs</b>	<b>Best Management Practices</b>
<b>BOD<sub>5</sub></b>	<b>Five-day biochemical oxygen demand</b>
<b>CCLEAN</b>	<b><a href="#">Central Coast Long-term Environmental Assessment Network</a></b>
<b>CCR</b>	<b>California Code of Regulations (CCR 2003)</b>
<b>CDFG</b>	<b>California Department of Fish and Game</b>
<b>CIWQS</b>	<b><a href="#">California Integrated Water Quality System Project</a></b>
<b>CDP</b>	<b>Coastal Development Permit</b>
<b>CMAR</b>	<b>Construction Manager at Risk: A project delivery method wherein the Construction Manager (CM) is required to deliver a project within a guaranteed maximum price</b>
<b>Coordinate Datum</b>	<b>All coordinates cited in this report are referenced to the WGS84 datum</b>
<b>COP</b>	<b>The California Ocean Plan (SWRCB 2005 2015) is regularly revised. The 2005 edition was in force when the prior NPDES discharge permit was issued to MBCSD and the 2015 edition was the basis for the current permit.</b>
<b>CSWP</b>	<b>Cayucos Sustainable Water Project</b>
<b>CV</b>	<b>A coefficient of variation is used to compare the relative amounts of variation in populations having different means. It is the standard deviation expressed as a percentage of the mean.</b>
<b>CWEA</b>	<b>California Water Environment Association</b>
<b>CWSRF</b>	<b>Clean Water State Revolving Fund (CWSRF) that includes a Water Recycling Funding Program administered by the SWRCB Division of Financial Assistance</b>
<b>dEIR</b>	<b>Draft Environmental Impact Report</b>
<b>DMR</b>	<b>Discharge Monitoring Report</b>
<b>DMR-QA</b>	<b>Discharge Monitoring Report Quality Assurance (DMR-QA) Study</b>
<b>DO</b>	<b>Dissolved Oxygen</b>
<b>EIR</b>	<b>Environmental Impact Report</b>
<b>ELAP</b>	<b>California Department of Health Services, Environmental Laboratory Accreditation Program</b>
<b>ESA</b>	<b>Endangered Species Act</b>
<b>FOG</b>	<b>Fats, Oils, and Greases</b>

## LIST OF ACRONYMS AND DEFINITIONS

(Continued)

<b>HAB</b>	<b>Harmful Algal Bloom</b>
<b>I&amp;I</b>	<b>Inflow and Infiltration</b>
<b>ITI</b>	<b>Infaunal Trophic Index</b>
<b>JPA</b>	<b>The Joint Powers Agreement between the City of Morro Bay and the Cayucos Sanitary District (MBCSD) outlines the contractual agreement between the two agencies for the operation of the WWTP</b>
<b>Leachate</b>	<b>A solution formed by leaching, especially a solution containing contaminants picked up through the leaching of soil</b>
<b>MBCSD</b>	<b>The City of Morro Bay and Cayucos Sanitary District</b>
<b>MDL</b>	<b>Method Detection Limit is the lowest concentration that can be reported under ideal conditions where the sample contains only the compound of interest with a concentration in an optimal calibration range and in a medium that does not interfere with the performance of the analytical instrument.</b>
<b>MGD</b>	<b>Million Gallons per Day</b>
<b>mg/Kg</b>	<b>Milligrams per Kilogram = <math>\mu\text{g/g}</math> dry weight = parts per million</b>
<b>mg/L</b>	<b>Milligrams per Liter = aqueous parts per million</b>
<b>ML</b>	<b>The Minimum Level is the method-specific minimum concentration of a substance that can be quantitatively measured in a sample given the current analytical performance used by most certified laboratories within California, as specified in the 2005 Ocean Plan.</b>
<b>MLLW</b>	<b>Mean Lower Low Water</b>
<b>MPN</b>	<b>Most Probable Number</b>
<b>MRS</b>	<b>Marine Research Specialists</b>
<b>MT</b>	<b>Metric Ton = 1,000 kg</b>
<b>NEP</b>	<b>National Estuary Program</b>
<b>ND</b>	<b>Not Detected indicates the substance was not found in the sample at concentrations above the MDL</b>
<b>NMFS</b>	<b>National Marine Fisheries Service</b>
<b>NOAA</b>	<b>National Oceanic and Atmospheric Administration</b>
<b>NOEC</b>	<b>No Observable Effect Concentration</b>
<b>NPDES</b>	<b>National Pollutant Discharge Elimination System</b>
<b>NRDC</b>	<b>Natural Resources Defense Council</b>
<b>NTU</b>	<b>Nephelometric Turbidity Units</b>
<b>O&amp;G</b>	<b>Oil and Grease</b>
<b>O&amp;M</b>	<b>Operations and Maintenance</b>

## LIST OF ACRONYMS AND DEFINITIONS

(Continued)

<b>OIT</b>	<b>Operator-in-Training</b>
<b>OSHA</b>	<b>Occupational Safety and Health Administration</b>
<b>PCB</b>	<b>Polychlorinated Biphenyl</b>
<b>POTW</b>	<b>Publicly Owned Treatment Works</b>
<b>ppm</b>	<b>Parts per million = mg/L in solution, or mg/Kg = µg/g dry weight</b>
<b>PQL</b>	<b>Practical Quantification Limit is the lowest concentration that can be measured with statistical reliability given the sample size and analytical method.</b>
<b>PSDFW</b>	<b>Peak seasonal dry-weather flow</b>
<b>PWWF</b>	<b>Peak wet-weather flow</b>
<b>QA/QC</b>	<b>Quality Assurance and Quality Control</b>
<b>RFP</b>	<b>Request for Proposal</b>
<b>RFQ</b>	<b>Request for Qualifications</b>
<b>RWQCB</b>	<b>State of California Regional Water Quality Control Board - Central Coast Region</b>
<b>SLO EHS</b>	<b><a href="#">San Luis Obispo County Environmental Health Services</a></b>
<b>SOP</b>	<b>Standard Operating Procedure</b>
<b>SSOs</b>	<b>Sanitary Sewer Overflows are sewage spills from wastewater collection systems</b>
<b>STLC</b>	<b>Soluble Threshold Limit Concentration applies to the measured concentration in the liquid extract from a biosolid sample, as determined by a Waste Extraction Test. The State of California classified biosolids with leachate concentrations exceeding the STLC as hazardous.</b>
<b>SWRCB</b>	<b>State Water Resources Control Board of the California Environmental Protection Agency</b>
<b>TKN</b>	<b>Total Kjeldahl Nitrogen</b>
<b>TRC</b>	<b>Total Residual Chlorine in effluent is determined from grab samples collected downstream of the chlorine contact chamber.</b>
<b>TSS</b>	<b>Total Suspended Solids</b>
<b>TSO</b>	<b>Time Schedule Order No. R3-2018-0019 dated 27 June 2018</b>
<b>TTLC</b>	<b>Total Threshold Limit Concentration applies to the total wet-weight concentration of a contaminant within a bulk biosolid sample consisting of the entire millable solid matrix rather than just the leachate. Biosolids are designated as hazardous wastes in the State of California if measured bulk concentrations exceed the TTLC.</b>
<b>TUc</b>	<b>Chronic Toxicity Units</b>
<b>TVS</b>	<b>Total Volatile Solids</b>
<b>USEPA</b>	<b>United States Environmental Protection Agency</b>

## LIST OF ACRONYMS AND DEFINITIONS

(Continued)

<b>USFWS</b>	<b>United States Fish and Wildlife Service</b>
<b>USGPO</b>	<b>United States Government Printing Office</b>
<b>WET</b>	<b>Waste Extraction Tests measure the soluble leachate or the extractable amount of a substance contained within a bulk sample of biosolids. A WET is indicated if the bulk wet-weight concentration of a contaminant in a biosolids sample exceeds ten times the STLC.</b>
<b>WRRF</b>	<b>Water Resource Recovery Facility</b>
<b>WRF</b>	<b><a href="#">City of Morro Bay Water Reclamation Facility</a></b>
<b>WWTP</b>	<b>City of Morro Bay-Cayucos Sanitary District Waste Water Treatment Plant</b>
<b>ZID</b>	<b>The Zone of Initial Dilution is a limited volume of water surrounding the outfall where wastewater rapidly mixes with receiving waters. Most receiving-water objectives of the Ocean Plan do not apply within the ZID.</b>

## **EXECUTIVE SUMMARY**

The City of Morro Bay and the Cayucos Sanitary District (MBCSD) jointly own the wastewater treatment plant operated by the City of Morro Bay. The treatment plant discharges effluent to the open ocean environment of northern Estero Bay under the authority of National Pollutant Discharge Elimination System (NPDES) permit No. CA0047881. During the first two months of 2018, the plant operated under a 301(h)-permit that modified NPDES limits on total suspended solids (TSS) and biochemical oxygen demand (BOD). This allowed the plant to discharge blended primary- and secondary-treated wastewater, although the vast majority of wastewater receives secondary treatment. All other NPDES limits, including restrictions on the discharge of toxic substances, applied to the MBCSD discharge without exception. Regardless, the partial-secondary level of treatment currently performed by the plant routinely achieves reductions in suspended solids and BOD that are close to, and often exceed, secondary treatment removal rates.

The current permit took effect in March 2018. It prescribed full-secondary treatment requirements on suspended solids and BOD, although their implementation was deferred to allow time for a new treatment plant to be built. Both permits require a monitoring and reporting program that evaluates short- and long-term effects of the effluent discharge on receiving waters, benthic sediments, and infaunal communities. This 2021 Annual Report partially satisfies those reporting requirements. Companion reports addressing receiving-water and benthic-sediment quality before 2019 fulfill additional reporting requirements.

This document presents a comprehensive analysis of the extensive monitoring data collected over the last 36 years. Virtually every aspect of the treatment process, receiving waters, and seafloor sediments was monitored. An exhaustive quantitative analysis of all measured parameters demonstrates that the effluent discharge consistently meets the permit requirements and has no discernible effect on the ocean environment. A comparison of influent and effluent properties affirms the treatment plant's proficiency at removing contaminants and reducing organic loads within the wastewater stream. All offshore water-quality measurements indicate that the effluent plume was largely restricted to a narrow 15-m zone of initial dilution (ZID) around the outfall. Measurements within the effluent plume collected shortly after discharge quantified the plume's rapid dispersion and demonstrated that the seafloor diffuser structure was operating better than predicted by modeling. Finally, the absence of adverse discharge-related impacts to the physics, chemistry, and biology of benthic sediments verified the effectiveness of the treatment process, the high dilution of effluent within receiving waters, and the low toxicity of the discharged effluent.

Effluent monitoring throughout 2021 documented another year of high operational performance by the treatment plant. Major effluent constituents, including TSS, BOD, and oil and grease (O&G), all had much lower concentrations and mass emissions than the permitted maximums, as has consistently been the case throughout the entire operational history of the plant. Although the treatment process efficiently removed major organic wastewater constituents, such as TSS, BOD, O&G, and coliform bacteria, the general lack of other chemical contaminants within effluent was largely due to their absence within the influent stream. Like most publicly owned treatment works, the MBCSD plant is not specifically designed to extract trace metals and synthetic organic compounds from wastewater.

Instead of removal by treatment, the effluent's low toxicity is primarily due to the absence of these contaminants within the influent, largely because of the lack of heavy industry within its service area. The few businesses that discharge to the sewer system produce wastewater that is similar to that of domestic sources, only on a larger scale. A digital database, maintained by collections system personnel, documents these sources. In addition, an ongoing public-outreach program and the convenience of an onsite

household hazardous waste recycling facility further reduced the potential introduction of pollutants into the waste stream.

Throughout the 36 years of contemporary operation, the treatment plant has consistently outperformed expectations for wastewater treatment based on regulatory standards. During that time, there has been no indication of deterioration in plant performance, and effluent quality has consistently exceeded the performance criteria anticipated in the original design. On rare occasions when brief exceptions to standards or criteria have occurred, they have been the direct result of unforeseen external events, or the temporary, unavoidable mechanical failure of a treatment-system component. In light of their diligent adherence to a program of preventative maintenance, the main challenge for plant personnel has been to respond quickly to unanticipated failures in system components or to unforeseeable external events.

Among the thousands of samples and measurements collected as part of the monitoring program during 2021, there was only one reportable exception to the waste-discharge limits specified in the NPDES permit. At the end of February, an intense winter storm deposited 5.4 inches of rainfall and the runoff generated an unprecedented 6.2 MG of inflow into the collection system. The resulting record-high daily flow of 3.654 MGD on January 28<sup>th</sup> temporarily increased flow speed through the chlorine contact chamber by a factor of five and reduced detention times by at least a factor of three. The reduced detention time within the disinfection process was insufficient for complete neutralization of coliform bacteria within the waste stream. Subsequently, an effluent grab sample collected around this time contained by far the highest total coliform density (7,000 MPN/100 ml) ever reported among the 6,179 effluent samples collected over the last two decades. It also resulted in the and the only ever exceedance of the 2,400-MPN/100 ml single-sample coliform limit in the Permit.

Several other aspects of this unprecedented event demonstrate that exceedance was unavoidable and not indicative of a plant-performance issue warranting corrective correction. First, it did not result from a malfunction, mechanical failure, or ongoing issue related to treatment components within the chlorination or disinfection processes. Equipment inspections and data reviews confirmed that disinfection and dechlorination components were operational. Second, it occurred in conjunction with sudden, unanticipated, and uncommon external factor related to atmospheric rivers within winter storm systems. Third, the coliform event occurred in isolation from other components of the treatment process. Other effluent properties were nominal at the time of the event, including effluent TSS and BOD concentrations, although emissions were slightly elevated due to increased throughput. Lastly, the event was highly transient. Effluent total coliform densities measured on the day before and after the event were nominal (5 and 2 MPN/100 ml).

Irrespective of this one unavoidable permit exceedance, the near-perfect level of compliance is laudable and represents the culmination of many years of hard work by dedicated and experienced MBCSD personnel. Their knowledge and experience has enabled them to quickly react and resolve unexpected perturbations in the plant process, and to enact appropriate proactive measures that has ensured the smooth operation of this facility over its long history.

## **1.0 INTRODUCTION**

The City of Morro Bay and the Cayucos Sanitary District (MBCSD) jointly own the wastewater treatment plant operated by the City of Morro Bay. The treatment plant's ocean discharge has been regulated by a series of National Pollutant Discharge Elimination System (NPDES) permits since March 1985.<sup>1</sup> The RWQCB<sup>2</sup> and USEPA<sup>3</sup> jointly issued the original Section-301(h) permit that relaxed the full-secondary-treatment standards for suspended solids and oxygen demand that are promulgated in conventional NPDES permits. Following an extensive evaluation process, the USEPA and the RWQCB reissued the 301(h)-modified permit three times (RWQCB-USEPA 1993ab 1998ab 2009). In March 2018, a conventional NPDES permit was issued that promulgated final effluent limits consistent with full-secondary-treatment standards (RWQCB 2018a). However, a Time Schedule Order (TSO) was also issued that set interim effluent limits to allow time for the MBCSD's partial-secondary discharge to achieve compliance with the current permit's new effluent limitations (RWQCB 2018b). The TSO also required the MBCSD to undertake a sequence of specific actions to ensure timely compliance with the final effluent limits.

### **1.1 REPORT SCOPE**

This report examines the MBCSD treatment-plant performance during 2021 in detail. Additionally, it compares the 2021 performance with that of the prior 35 years and assesses its compliance with the provisions with the permit and TSO that were in effect during 2021. Marine Research Specialists (MRS) began conducting the Offshore Monitoring and Reporting Program for the MBCSD in July 1993. Since then, treatment plant personnel, MRS, and various subcontracted laboratories, have collected and analyzed a multitude of samples and measurements as part of the extraordinarily intense monitoring program that is required as part of all 301(h)-modified permits.

This 2021 annual report summarizes results from the four major monitoring components that analyze the treatment plant, receiving waters, marine sediments, and benthic biota. However, the scope of this document departs from that of annual reports prior to 2019. Previous stand-alone and annual reports evaluated permit-compliance based on detailed analyses of offshore-monitoring surveys conducted prior to 2019 (MRS 2018ab, 2019ab). Quarterly receiving water-quality surveys and annual benthic surveys, required under the prior 301(h)-modified permits, were discontinued by the current NPDES permit,<sup>4</sup> so this annual report only summarizes findings from the 99 water-quality surveys conducted since 1993, and the 44 benthic surveys conducted since 1986.

A separate Annual Sewage Sludge Report (MBCSD 2021) is also incorporated in this report, largely by reference. That report, and its eight attachments of supporting documentation, contains detailed descriptions of the solids stabilization process, transportation offsite, pollutant concentrations, regulatory requirements, the pathogen reduction method, and the vector attraction reduction method. Some of that information is summarized in Chapter 6 of this report; namely, the results of chemical analyses conducted on composited biosolids subsamples, primarily because that data reflects on regulatory compliance, plant performance, and their potential for environmental impacts.

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<sup>1</sup> Permit Number CA0047881

<sup>2</sup> Regional Water Quality Control Board (RWQCB) - Central Coast Region

<sup>3</sup> United States Environmental Protection Agency (USEPA) – Region IX

<sup>4</sup> The current permit requires a benthic survey to be conducted once-in-the-life of the permit. That survey was conducted in 2018 (MRS 2019b).

## **1.2 REPORT ORGANIZATION**

In addition to this brief introductory chapter, the major chapters of this annual monitoring report are described below.

- **2.0 Overall Appraisal** Evaluation of the performance of the treatment plant and its compliance record throughout its thirty-six-year history, including the aforementioned summaries of receiving-water and seafloor-sediment conditions surrounding the offshore outfall;
- **3.0 Background** Description of current plant operations, treatment-plant history, regulatory setting of the ocean discharge, the treatment process and outfall system, and the MBCSD pollution prevention program;
- **4.0 Throughput** Examination of the volume of wastewater that passes through the treatment plant, including external factors that affect plant flow, reconciliation of flow measurements by two independent meters, and adjustments to flows reported during 2021;
- **5.0 Wastewater Properties** Characterization of the major properties of influent and effluent during 2021, the influence of the treatment process on those properties, and compliance with the relevant permit provisions;
- **6.0 Chemical Constituents** Summarization of quantifiable concentrations and mass emissions of chemical constituents within effluent, and comparison with numerical limits;
- **7.0 Biosolids** Description of the solids removal process, and the chemical compounds present within biosolids during 2021; and
- **8.0 References** Compilation of full bibliographic references for the documents cited in this report, including hyperlinks to reports available online.

In addition to these chapters, a set of appendices provides supporting documentation for the material in the body of this report. Appendix A lists the design specifications of the wastewater treatment plant. Appendix B contains a report of the annual outfall inspection that was conducted by diver. Adjustments made previously reported daily-plant-flow and monthly statistics are collated in Appendix C. A copy of the November 2021 calibration report for the influent flow meter is included as Appendix D.

## **2.0 OVERALL APPRAISAL**

The MBCSD monitoring program was designed to appraise the performance of the wastewater treatment plant, to monitor the quality of effluent discharged to the ocean, and to assess potential impacts within receiving waters and seafloor environment. This chapter evaluates compliance with NPDES discharge regulations and gauges the potential for discharge impacts through quantitative analyses of an extensive data set of observations collected over the 36-year history of the monitoring program. It reviews all aspects of the monitoring program, including receiving-water measurements, sediment chemical concentrations, and marine biological enumerations collected prior to 2019. It also compares the latest plant-performance data from 2021 with the historical record. In contrast, the following chapters emphasize data acquired during 2021 to evaluate current plant performance and to determine compliance with the present-day discharge limits.

Throughout the monitoring program, the treatment plant consistently removed nearly all organic materials and other solids from the wastewater stream. Analyses of key diagnostic constituents, including total suspended solids (TSS), biochemical oxygen demand (BOD), and oil and grease (O&G), documented the high operational performance of the plant. Similarly, periodic analyses of effluent for trace metals, pesticides, priority pollutants, and toxicity demonstrated the benign environmental character of the effluent. A proactive operation and maintenance (O&M) program eliminated avoidable exceptions to the limits specified in the NPDES discharge permits during 2021, as in prior years.

Despite processing a large fraction of sewage within the waste-stream during 2021, the plant discharged only 19% (37 MT<sup>1</sup>) of the allowed solids (199 MT), while still attaining an annual removal rate of 92.4%, which is 17.4% higher than the permitted 75% minimum (bottom row of Table 2.1 on the following page). The resulting effluent TSS concentration (28.1 mg/L) was less than half of the permitted maximum (70 mg/L). Additionally, because the treatment plant processed nearly all wastewater through the secondary-treatment process, it removed suspended solids at a rate exceeding the 85% standard for full secondary treatment in every month (Table 5.1 on Page 5-1). Effluent TSS concentrations during nine months of the year remained at or below the 30-mg/L criterion for full secondary treatment.

During 2021, the treatment plant also removed the vast majority (86.5%) of oxygen-demanding material from the influent stream (Table 2.1 on the following page). The resulting effluent BOD concentration (37.5 mg/L) was only one-third of the permitted maximum (120 mg/L), and the total mass emission for the year (49 MT) was 15% of the allowed BOD discharge (342 MT). Technology-based requirements for BOD are generally considered unimportant for open-ocean discharges because they are unlikely to result in oxygen depletion.<sup>2</sup> Nevertheless, the average BOD removal rate met or exceeded the 85% monthly standard for full secondary treatment during seven months and approached that standard in three of the other five months, when it exceeded 83% removal. (Table 5.1 on Page 5-1). The lowest monthly removal rate of 80.6% was more than double the minimum 30% rate required by the current discharge provisions.

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<sup>1</sup> Metric tons or 1,000 Kg (1.1 short tons)

<sup>2</sup> Page 6 in National Academy of Sciences (1993)

Table 2.1 Average Annual Wastewater Parameters

Year	Flow (MGD)	Suspended Solids				Biochemical Oxygen Demand			
		Influent (mg/L)	Effluent (mg/L)	Removal (percent)	Emission (MT)	Influent (mg/L)	Effluent (mg/L)	Removal (percent)	Emission (MT)
1986	1.42	332	32.8	90.1	64	235	77.0	67.2	151
1987	1.51	274	21.8	92.0	45	257	52.0	79.8	108
1988	1.51	397	29.8	92.5	62	242	43.9	81.9	92
1989	1.46	321	37.3	88.4	75	259	69.8	73.1	141
1990	1.38	345	36.0	89.6	69	261	75.7	71.0	144
1991	1.28	280	30.5	89.1	54	236	66.9	71.7	118
1992	1.41	310	43.0	86.1	84	224	59.3	73.5	116
1993	1.55	341	33.2	90.3	71	222	39.3	82.3	84
1994	1.38	310	31.5	89.8	60	249	32.8	86.8	63
1995	1.55	270	30.6	88.7	66	208	31.4	84.9	67
1996	1.55	344	33.1	90.4	71	241	35.7	85.2	77
1997	1.64	283	36.0	87.3	81	231	38.6	83.3	87
1998	1.95	236	38.8	83.6	105	216	39.1	81.9	105
1999	1.69	386	44.0	88.6	103	287	49.5	82.7	115
2000	1.77	337	37.4	88.9	92	271	50.3	81.4	123
2001	1.48	450	37.6	91.6	77	396	62.7	84.2	128
2002	1.14	374	49.2	86.8	77	386	67.5	82.5	106
2003	1.06	311	39.1	87.4	57	306	56.0	81.7	82
2004	1.09	354	28.9	91.8	44	336	53.3	84.1	81
2005	1.25	373	24.3	93.5	42	303	49.8	83.5	86
2006	1.19	335	20.5	93.9	34	291	45.3	84.4	75
2007	1.09	381	20.9	94.5	31	330	44.4	86.5	67
2008	1.10	337	20.0	94.1	30	331	38.3	88.4	58
2009	1.09	328	25.3	92.3	38	311	37.6	87.9	57
2010	1.19	383	26.6	93.0	44	350	49.4	85.9	81
2011	1.24	343	26.8	92.2	46	312	52.2	83.3	90
2012	1.10	379	27.1	92.8	41	322	49.9	84.5	76
2013	0.96	351	29.9	91.5	40	327	55.7	83.0	74
2014	0.94	377	29.2	92.2	38	352	51.4	85.4	66
2015	0.93	389	30.8	92.1	40	370	48.9	86.8	63
2016	0.84	358	37.1	89.6	43	384	63.7	83.4	74
2017	1.02	357	37.7	89.5	53	324	52.3	83.8	74
2018	0.90	306	31.7	89.6	40	279	40.6	85.5	51
2019	1.14	323	30.1	90.7	47	292	46.1	84.2	72
2020	1.06	347	32.3	90.7	48	300	41.1	86.3	61
2021	0.95	370	28.1	92.4	37	279	37.5	86.5	49
<b>Average</b>	<b>1.27</b>	<b>341</b>	<b>32.0</b>	<b>90.7</b>	<b>56</b>	<b>293</b>	<b>50.1</b>	<b>82.8</b>	<b>88</b>
<b>Limit</b>	<b>2.06</b>		<b>70.0</b>	<b>75.0</b>	<b>199</b>		<b>120.0</b>	<b>30.0</b>	<b>342</b>

(Continued on the next page)

Table 2.1 Average Annual Wastewater Parameters (continued)

Year	Oil and Grease				Turbidity (NTU)	pH	Chronic Toxicity (TUC)	Ammonia as NH <sub>3</sub> -N (mg/L)
	Influent (mg/L)	Effluent (mg/L)	Removal (percent)	Emission (MT)				
1986	64	13.8	78.4	27	26	7.7		18
1987	44	6.2	85.9	13	23	7.5		
1988	38	6.3	83.4	13	40	7.5		
1989	28	6.1	78.2	12	49	7.4		26
1990	34	8.5	75.0	16	55	7.4		26
1991	73	6.9	90.5	12	50	7.3		18
1992	33	5.3	83.9	10	56	7.3		9
1993	26	6.0	76.9	13	43	7.4	19.42 <sup>1</sup>	20
1994	60	≈4.1 <sup>2</sup>	≈93.2	≈8	36	7.5	4.37 <sup>3</sup>	27
1995	63	5.1	91.8	11	32	7.5	4.35	23
1996	52	7.9	84.9	17	34	7.7	4.83	23
1997	49	5.3	89.2	12	32	7.7	7.80	23
1998	51	5.4	89.4	15	34	7.6	7.80	19
1999	52	6.2	88.0	15	48	7.5	5.00	25
2000	74	5.5	92.6	13	39	7.5	5.60	24
2001	47	≈4.6	≈90.1	≈9	41	7.4	5.60	28
2002	39	≈4.4	≈88.9	≈7	41	7.5	4.98	31
2003	44	5.3	88.0	8	34	7.5	7.80	27
2004	47	≈3.7	≈92.1	≈6	26	7.5	5.60	29
2005	62	≈4.4	≈92.9	≈8	23	7.6	5.60	27
2006	44	≈4.1	≈90.6	≈7	26	7.6	4.36	28
2007	52	≈4.0	≈92.4	≈6	27	7.6	4.36	28
2008	84	≈4.4	≈94.8	≈7	30	7.5	5.56	27
2009	93	≈4.5	≈95.1	≈7	29	7.5	15.82 <sup>4</sup>	32
2010	76	≈4.7	≈93.8	≈8	31	7.6	10.88 <sup>4</sup>	34
2011	75	≈4.0	≈94.6	≈7	26	7.6	13.95	27
2012	91	5.0	94.5	8	26	7.6	13.95	33
2013	115	≈4.5	≈96.1	≈6	25	7.5	24.55	40
2014	81	≈4.0	≈95.1	≈5	28	7.5	17.90	50
2015	81	<1.7 <sup>5</sup>	>97.9	<2.2	29	7.5	17.90	45
2016	79	≈3.2	≈95.9	≈4	39	7.5	17.90	44

(Continued on the next page)

<sup>1</sup> Average of screening bioassay of three marine species that found Giant Kelp (*M. pyrifera*) to be the most sensitive

<sup>2</sup> Values preceded by an “approximation” symbol (≈) are estimated because they were based on measured concentrations that were too low to be reliably quantified because they were below the “PQL” or Practical Quantification Limit, which is the lowest concentration that can be measured with statistical reliability given the sample size and analytical method.

<sup>3</sup> Giant Kelp (*M. pyrifera*) bioassays were conducted until 2009.

<sup>4</sup> Screening bioassays of two marine species were conducted in 2009 and 2010 and found Red Abalone (*H. Rufescens*) to be the most sensitive organism.

<sup>5</sup> Values preceded by a “less-than” symbol (<) indicates that the substance was not detected in the sample at concentrations above the “MDL” or Method Detection Limit, which is listed after the “<” symbol. The MDL is the lowest concentration that can be reported under ideal conditions where the sample contains only the compound of interest with a concentration in an optimal calibration range and in a medium that does not interfere with the performance of the analytical instrument.

Year	Oil and Grease				Turbidity (NTU)	pH	Chronic Toxicity (TUc)	Ammonia as NH <sub>3</sub> -N (mg/L)
	Influent (mg/L)	Effluent (mg/L)	Removal (percent)	Emission (MT)				
2017	38	<1.8	>95.3	<2.5	35	7.4	17.90	41
2018	50	≈1.2	≈97.6	≈1.5	32	7.3	12.23 <sup>1</sup>	39 <sup>2</sup>
2019	— <sup>3,4</sup>	≈1.1	— <sup>4</sup>	≈1.7	32	7.5	14.77 <sup>1</sup>	29 <sup>2</sup>
2020	— <sup>4</sup>	≈1.2	— <sup>4</sup>	≈1.8	29	7.5	6.57 <sup>1</sup>	43 <sup>2</sup>
2021	— <sup>4</sup>	<0.74	— <sup>4</sup>	≈1.0	27	7.5	17.90	32 <sup>2</sup>
<b>Average</b>	<b>59</b>	<b>≈4.5</b>	<b>≈91.7</b>	<b>≈8</b>	<b>34</b>	<b>7.5</b>	<b>10.59</b>	<b>29</b>
<b>Limit</b>		<b>25.0</b>			<b>75</b>	<b>6-9</b>	<b>134.00</b>	<b>80.4</b>

The general absence of industrial contaminants in the waste-stream attests to the benign nature of the influent, which is almost entirely generated by nonindustrial commercial and residential sources. Prior to 2019, annual chemical analyses for 78 chemical contaminants within effluent samples typically quantified low-level concentrations of only a few common wastewater constituents and naturally occurring trace metals. Synthetic organic contaminants have been rarely detected within effluent samples collected during the long history of the monitoring program, and when they were, their concentrations were close to the detection limit. Because of this, the current permit only requires their analysis once, and that chemical scan was performed in 2018 (MRS 2018c 2019a).

During 2021, the reduced scope of effluent chemical analysis only required assessment of ten metallic/metalloid elements (Table 6.1 on Page 6-2). The effluent sample contained low but quantifiable concentrations for only four metals. All occur naturally and are regularly found within effluent, biosolid, and marine-sediment samples. Their 2021 effluent concentrations were well below permit limits, and their associated mass emissions were well within goals established to limit contaminant loading to the marine environment. As in prior years, the 2021 chemical assay of four bio-stimulatory nutrients found that the amount emitted by the MBCSD WWTP was insignificant compared to individual contributions from other individual ocean dischargers in the region, central-coast rivers, and upwelling (Table 5.3 on Page 5-16).

Chronic bioassays conducted on effluent samples that were collected during 2021 determined that the discharge had very low toxicity to marine organisms (Table 5.2 on Page 5-15), a result consistent with the prior 28-year record of toxicity testing (Table 2.1). Likewise, the benign character of biosolids generated by the MBCSD treatment plant during 2021, and in prior years, is reflected in chemicals assays for more than 150 chemical contaminants (Table 7.1 on Page 7-2). The few compounds, whose presence was detected, consisted largely of naturally occurring trace metals. Their concentrations were well below regulatory standards that would designate them as hazardous, or unsuitable for land application.

<sup>1</sup> Toxicity tests conducted on samples collected in July 2018, 2019, and 2020 included bioassays of three marine species to determine the most sensitive marine organism. The TUc values are averages of the results of the three-species tests conducted in each of those years. Larval abalone was found to be the most sensitive organism in all three years. This was also the case for the two-species screening bioassays conducted during 2009 and 2010. In 2021, only larval abalone were tested.

<sup>2</sup> The current permit changed the required ammonia sampling frequency from monthly to annually. Consequently, the 2018 average ammonia concentration was determined from three monthly ammonia concentrations while the averages in subsequent years were determined from the concentration in a single effluent grab sample.

<sup>3</sup> “—” indicates that the measurement was not required, or its limit was not specified.

<sup>4</sup> Measurement of oil & grease concentrations within influent samples is no longer required as part of the current discharge permit’s monitoring and reporting program. In the absence of influent oil & grease concentrations reported during 2019 and thereafter, the associated removal rate was also indeterminate.

The 36-year record of effluent and biosolids monitoring data is complemented by a 33-year record of offshore monitoring. During that time, 99 quarterly receiving-seawater surveys and 44 benthic surveys were completed. Comprehensive statistical analyses of the enormous amount of data generated by these surveys unequivocally demonstrates the absence of discernible impacts from the MBCSD wastewater discharge. Receiving-water surveys consistently found negligible but perceptible discharge-related excursions in seawater properties that were highly localized around the discharge point. None ever approached levels that would be considered an exception to water-quality objectives promulgated in the California Ocean Plan (COP) and the MBCSD NPDES permits. Similarly, detailed analyses of seafloor sediments, and the organisms within them, revealed a uniformly pristine environment with no evidence of spatial or temporal changes that could conceivably be ascribed to the discharge. Because of these findings, the current permit discontinued the requirement for offshore monitoring after 2018.

## **2.1 TREATMENT PROCESS**

Since 1986, the MBCSD Wastewater Treatment Plant (WWTP) has been operating under 301(h)-modified limits that relax the TSS and BOD requirements for full secondary treatment. However, because of the Plant's partial-secondary process, the discharge continually met the 301(h)-modified discharge requirements, and occasionally achieved treatment levels comparable to full-secondary treatment. Thus, measurements of wastewater characteristics acquired throughout the 36-year monitoring program demonstrate that the treatment process surpassed expectations based on the original plant design, and easily achieved compliance with the applicable NPDES discharge permit requirements and federal regulatory standards.

The superior overall performance of the treatment process during 2021 and throughout the prior 35 years was the direct result of vigilant control by plant personnel, a proactive program of preventative maintenance, and the successful completion of numerous major maintenance and repair projects. Plant personnel actively seek-out and correct potential mechanical problems with plant components before they occur, and responded quickly to the occasional unforeseen failure of those components.

### **2.1.1 Historical Record**

Many of the best measures of treatment performance have been achieved during the past decade of operation, and 2021 was no exception (Table 2.1). The historical record demonstrates the absence of an age-related decline in process efficiency, even after more than three and a half decades of uninterrupted plant operation. Despite processing influent with uniformly high TSS, BOD, and O&G concentrations throughout the plant history, the treatment process consistently removed over 80% of those constituents. Consistently low effluent concentrations and small emission volumes are the direct result of the treatment plant's efficiency at removing influent solids.

There is no evidence in the historical record of a decline in removal-rate efficiency, and the 2021 rates equaled or exceeded those of most prior years. For example, data in rows at the bottom of Table 2.1 show that the 92.7% TSS removal rate during 2021 was materially higher than the long-term average (90.7%) and the removal rates achieved in the prior five years. More revealing is the high 2021 BOD removal rate that contributed to lower-than-average effluent concentrations and emissions despite processing higher-than-average influent BOD concentrations. The 86.5% BOD removal rate during 2021 was well above the average removal rate (82.8%) and exceeded removal rates in all but five of the prior 35 years. Four of those five higher BOD removal rates were achieved in the last fourteen years of plant operation.

In contrast to removal rates, which primarily reflect plant performance, the concentration and mass-emission of discharged wastewater constituents quantify the effluent's ability to comply with permit limits and ostensibly, its potential for environmental consequences. That compliance capability is

demonstrated through comparison with permit limits listed in the last row of Table 2.1. That said, however, the uniformly low effluent concentrations and mass emissions reported in all 36 years of plant operations were the direct result of process efficiency, rather than low influent loads. The influent has always consisted largely of wastewater of domestic origin, and there has been little change in the service-area population, or in the character and volume of influent from commercial sources. Influent concentrations of TSS and BOD have been consistently high, with only minor fluctuations from year-to-year. For example, average influent concentrations of TSS and BOD during 2021 (370 and 279 mg/L) were comparable to their long-term averages (341 and 293 mg/L).

Despite processing concentrated wastewater from domestic sources, the average annual TSS, BOD, and O&G effluent concentrations unfailingly remained well below their respective allowable limits in each of the 36 years of operation. Accordingly, the resulting 36-year averages (32.0, 50.1, and  $\approx$ 4.5 mg/L) were less than half of their respective allowable limits (compare the values in bold in the two bottom rows of Table 2.1). The long-term average effluent O&G concentration was one-fifth of its allowable concentration. Even more indicative of the discharge's low historic potential for environmental consequences are the very low average annual emissions of TSS and BOD (56 and 88 MT), which are less than one-third of the permitted discharge (199 and 342 MT).

Throughout the three and a half decades of modern plant operation, other important effluent constituents were also consistently low. The highest annual average effluent turbidity and ammonia (56 NTU<sup>1</sup> in 1992, and 50 mg/L in 2014) were both well below their respective permit limits (75 NTU and 80.4 mg/L). Overall long-term averages (34 NTU and 29 mg/L) were less than half the allowable levels. The highest average toxicity (24.55 TUc<sup>2</sup> in 2013) was five-times lower than the allowed maximum (134 TUc). The uniformly lower reported chronic toxicities from 1994 through 2008 (<8 TUc) were an artifact of the reduced sensitivity of the test species (Giant Kelp) used in those bioassays.

### **2.1.2 Plant Throughput**

Historically, the most influential factor affecting flow rate was a metering inaccuracy that resulted in flow overtotalization. A study conducted during 2002 found that rates reported by the effluent flow meter were consistently overestimated by as much as 25%, although overtotalization is currently closer to 17% (see Section 4.4.2 on Page 4-7). After correcting for overtotalization in reported flows prior to 2002, the average flow over the 36-year record would be closer to 1.14 MGD rather than the reported 1.27 MGD (bottom of the first data column in Table 2.1). Because flows reported prior to 2002 were overestimated, the annual mass emissions were also overestimated. Consequently, the emissions averaged over the entire monitoring program's history, shown in bold in the second to last row of Table 2.1, are slightly inflated. Specifically, over the modern operational history of the WWTP, the reported average TSS emission of 56 MT was closer to 50 MT. Similarly, the average BOD emission reported at 88 MT was closer to 78 MT, and the estimated  $\approx$ 8 MT of discharged O&G was closer to 7 MT. Even after adjusting for past overtotalization in the historical averages, the 2021 emissions of TSS, BOD, and O&G (37, 49, and  $\approx$ 1.0 MT) were still well below those of the flow-corrected overall operational record (50, 79, and 7 MT).

During 2002, overtotalization was largely eliminated after a more accurate influent flow meter was commissioned, and flow began to be reported based on its measurements. In contrast to the existing impeller flow meter that was located within the plant's effluent-discharge stream, the new meter determined flow from influent wastewater elevations within a metering flume. However, on occasion, the new meter also overtotalizes flow, for example, when the influent flume becomes temporarily surcharged

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<sup>1</sup> Nephelometric Turbidity Units

<sup>2</sup> Chronic Toxicity Units

after water backs up into the influent channel behind the plant headworks.<sup>1</sup> Nevertheless, judicious use of corrected effluent flow totals in place of these obviously aberrant influent flow-meter reports effectively eliminated significant flow overtotalization after 2002. Highly accurate annual flow totals are now regularly achieved by reporting a downward-adjusted effluent-meter flow on those rare occasions that the influent flow data is compromised. The effluent-flow adjustment factor is updated at least annually as described in Section 4.4.2 on Page 4-8.

The 25% correction for effluent flow-meter inaccuracy prior to 2002 is unrelated to other long-term drops in flow rate that are evident in the historical record of annual average flow rates listed in Table 2.1. The uncorrected average flow from 1986 through 2001 (1.53 MGD) was 34% higher than the average flow reported from 2003 through 2012 (1.14 MGD). Thus, the 25% effluent flow-meter correction only accounts for part of the observed temporal difference. A detailed review of collection-system activities after 1999 (e.g., MRS<sup>2</sup> 2006) revealed that the additional 9% decline in flow was due to major efforts to reduce rainwater inflow and groundwater infiltration (I&I) into the collection system. These efforts included lining of the existing trunk line entering the plant along Atascadero Road during late 2000, which measurably reduced a known large infiltration source. Additionally, during 2001, a damaged major lateral serving the Morro Bay High School was replaced, and other major laterals were sealed and grouted. These efforts accounted for the additional decline in plant throughput after 2001, when average flow dropped below 1.26 MGD and remained there since. In all sixteen years prior to that time, annual reported flow was always above 1.27 MGD.

Irrespective of these past flow-measurement improvements and I&I reductions, a more-recent striking decrease in plant flow occurred over a six-year period prior to 2019. However, this decrease was largely due to a completely unrelated factor, water conservation. At  $\leq 1.02$  MGD, the reported flows were the lowest on record, with the 0.84 MGD flow in 2016 being the lowest. Some of these flow decreases can be attributed to reduced groundwater infiltration into the collection system due to a decline in the water-table elevation during the prolonged drought. However, much of the decrease was undoubtedly related to the successful water-conservation measures implemented by the citizens of Cayucos and Morro Bay. For example, the City of Morro Bay reduced water usage during 2015 by 13.5%, significantly surpassing the 12% mandatory water-restriction goal imposed by statewide limits that went into effect in April of that year.

Lastly, as discussed in Section 4.1 on Page 4-1, plant throughput permanently declined by approximately 28% after September 14<sup>th</sup> when the Cayucos Sanitary District (CSD) ceased discharging the MBCSD treatment plant. As discussed at the end of Section 3.2 on Page 3-8, the CSD brought their new Water Resource Recovery Facility online at that time. Had the CSD discharge continued through year-end, the 2021 plant flow would have been closer 1.04 MGD instead of the reported 0.95 MGD. The partial-year absence of wastewater input from the CSD collection system was probably also partially responsible for the higher plant-performance metrics reported during the last quarter of 2021 (Table 5.1 on Page 5-1). With monthly flows well below 1 MGD capacity of the plant's secondary process, the discharge met secondary treatment standards in all three months except for October when the 36-mg/L BOD concentration slightly exceeded the 30-mg/L standard.

### **2.1.3 Wastewater Constituents**

The treatment process was designed to remove organic particulates from the wastewater stream and disinfect effluent. As with most municipal treatment plants, the MBCSD WWTP was not designed to

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<sup>1</sup> A smaller amount of influent-meter overtotalization also occurs at very low flow (<1 MGD).

<sup>2</sup> Marine Research Specialists

eliminate chemical contaminants that may be present within wastewater entering the plant. Instead, a vigorous pollution-prevention program is in place, which seeks to limit the introduction of chemical contaminants at the source, before they enter the collection system. The multifaceted pollution-prevention program includes public education efforts, an onsite hazardous waste collection facility, source identification, and inspections of commercial and industrial users. Domestic users generate more than 80% of the sewage processed at the WWTP; non-industrial users or light industry, which generate wastewater similar to that of domestic sources but on a larger scale, contribute the remaining portion of the WWTP's influent. In the absence of heavy industry within the service area, there is a concomitant lack of industrial pollutants within the MBCSD wastewater.

Because of these pollution-prevention efforts, only a few common metals and ubiquitous chemical compounds have regularly appeared in low concentrations within the effluent and biosolids samples analyzed during last 29 years. Of the 78 chemical compounds in the semi-annual and annual effluent assays, only a few have been present in quantifiable amounts. Additionally, the measured concentrations of these compounds were all well below applicable NPDES discharge limits. In most cases, the concentrations were orders of magnitude lower than their respective limits. Accordingly, the associated mass emissions were also well below the goals identified in the discharge permits.

As described in prior annual reports, quantifiable compounds within the effluent typically include three commonly occurring trace metals (copper, lead, and zinc), selenium, and radionuclides. The three trace metals all occur naturally within the mineralogy of sediments along the central California coast, but they also enter the collection system through internal corrosion of household plumbing systems. The metalloid selenium also occurs naturally within the natural mineralogy of the region but is less likely to arise within plumbing systems. Lastly, some level of radioactivity in effluent samples is expected because of naturally occurring radionuclides, and because radioactivity can be detected at extraordinarily low levels.

Consistent with the general absence of chemical contaminants, the benign nature of treated wastewater has been repeatedly demonstrated with effluent bioassays conducted over the past quarter century (Table 2.1 on Page 2-3). The expanded chronic-toxicity screening tests conducted from 2018 through 2020 continued to confirm the MBCSD effluent's low toxicity to a diverse set of sensitive marine organisms.

As with effluent samples, comprehensive chemical analyses of biosolid samples only quantified very low concentrations of commonly occurring wastewater constituents. In addition to the bulk organic compounds, fifteen chemicals with quantifiable concentrations are typically found within biosolid samples (Table 7.1 on Page 7-2). Over the past 29 years, compounds found within the treatment-plant's sludge include ubiquitous metals, metalloids, and cyanide. All measured concentrations have been well below regulatory limits that would make the biosolids hazardous or unsuitable for composting and land application.

## **2.2 RECEIVING WATERS**

Prior to issuance of the current permit in 2018, the receiving-water environment was monitored on a quarterly basis to evaluate the oceanographic conditions near the outfall, particularly with respect to any adverse impacts from the offshore discharge of wastewater. Comparisons of water quality at the boundary of the zone of initial dilution (ZID)<sup>1</sup> with gradient areas beyond the dilution zone documented compliance with the receiving-water objectives of the California Ocean Plan (COP) as promulgated in the NPDES discharge permits. Extremely sensitive electronic probes provided a detailed picture of seawater quality during each of the four offshore surveys conducted during each year. Precision navigation, in combination

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<sup>1</sup> The Zone of Initial Dilution is a limited volume of water surrounding the outfall where wastewater rapidly mixes with receiving waters. Most receiving-water objectives of the COP do not apply within the ZID.

with high-resolution data on light transmittance, density, temperature, salinity, pH, and dissolved oxygen delineated the limited spatial extent of the dilute effluent plume within receiving waters.

During all 99 surveys conducted over 25 years, small anomalies in water properties associated with the submerged wastewater plume were detected. In all cases, the water-quality fluctuations were restricted to the ZID, were generated by the upward displacement of ambient seawater and not the presence of wastewater constituents, or were insignificant compared to the larger ambient variations resulting from natural oceanographic processes. Many of these plume measurements captured the signature of wastewater deep within the water column while it was undergoing rapid initial mixing during its ascent toward the sea surface. Dilution rates determined from these deep measurements were compared with expected critical initial dilution ratios based on modeling used to design the outfall. They demonstrated that the diffuser structure was dispersing the wastewater to a much greater degree than predicted by the modeling.

Because tests for compliance with the receiving-water limitations in the discharge permit only apply outside the ZID, the dilute wastewater measurements recorded shortly after discharge were not subject to COP objectives. Nevertheless, plume observations collected within the ZID were routinely below the permit limits applicable to observations collected outside this narrow 15-m mixing zone. None of the observed conditions suggested that unmixed wastewater was tangibly affecting receiving waters within or beyond the ZID. Because of this, the current permit eliminated the requirement for receiving-water surveys.

Figure 2.1 displays a horizontal map of plume dilution measured 1.5 m below the sea surface during the last survey conducted while the previous discharge permit was in effect (MRS 2018a). This snapshot of the highly localized plume footprint is typical of that observed during most offshore water-quality surveys. The lowest dilution (272-fold) is delineated in red and is offset 1.5 m south of the diffuser structure. Extremely sensitive instrumentation is incapable of discerning the effluent signature at dilutions exceeding 800-fold. Thus, detectable discharge-related changes to seawater are largely restricted to the 15-m ZID surrounding the outfall. The shoreline is located 827 m east of the discharge (Figure 3.4 on Page 3-14), so impingement of unmixed effluent onto the adjacent coastline implausible.

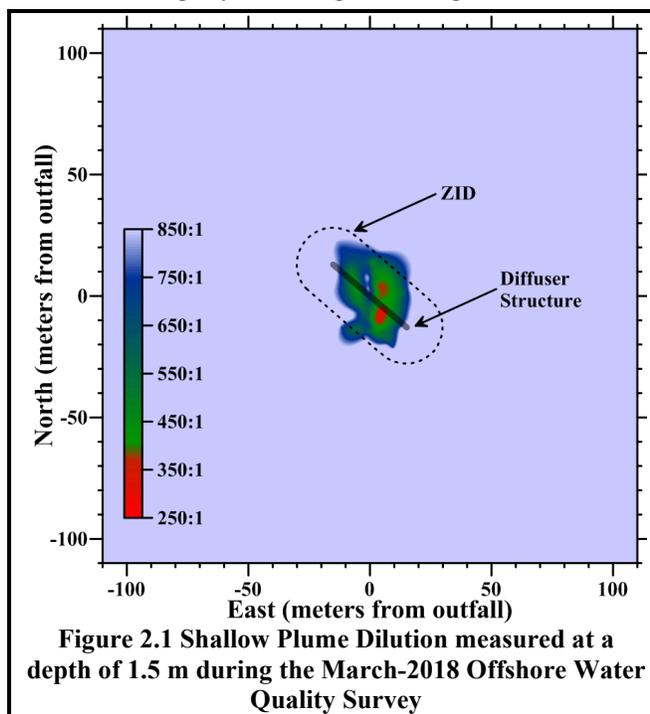


Figure 2.1 Shallow Plume Dilution measured at a depth of 1.5 m during the March-2018 Offshore Water Quality Survey

### 2.3 SEAFLOOR SEDIMENTS

The monitoring program has evaluated the physical, chemical, and biological conditions within benthic sediments surrounding the MBCSD outfall for more than three decades. Those evaluations provide strong empirical evidence that the quality of the sediments surrounding the outfall have not been perceptibly impacted by the discharge, and that a balanced indigenous population of marine organisms inhabits the benthos throughout the region, including locations along the ZID boundary. Because of these unequivocal

findings, the requirement for annual benthic surveys was eliminated in the current permit's monitoring program.

As one component of the benthic assessment, spatiotemporal analyses were applied to the entire physicochemical dataset, which spans 33 years since benthic monitoring began in 1986. Those analyses demonstrated that there has been no buildup of sediment contaminants surrounding the outfall. In addition, trace-metal and organic concentrations collected both near and far from the outfall were tested for consistent spatial trends related to ZID proximity, and none were found. As in prior years, sediment concentrations throughout the survey area remained below thresholds considered harmful to marine biota. In fact, most sediment trace-metal concentrations within Estero Bay were well below concentrations found in the vast majority of samples collected offshore Southern California. This attests to the pristine condition of the ocean environment within northern Estero Bay. Nickel and chromium are the only trace metals that have comparatively elevated concentrations within Estero Bay sediments. However, the concentrations of these particular metals are also naturally elevated in the chromite mineral ores found throughout the region. Thus, the Estero Bay sediment metal concentrations are comparable to those found in nearby benthic environments, such as Port San Luis (NOAA<sup>1</sup> 1991), and the Morro Bay Estuary (Tenera and MRS 1997).

To test for discharge-related biological effects, a large number of population indices and parameters were computed from an enumeration of the 270,000 specimens collected over the 33 years of benthic infaunal monitoring. None of these parameters exhibited statistically significant spatial distributions related to the effluent discharge or long-term spatiotemporal trends indicative of an increasingly degraded benthic habitat within or along the ZID boundary. Not only were spatial differences within individual surveys small compared to inherent sampling variability, but also the differences were generally much smaller than the long-term changes in community structure that arose from natural environmental fluctuations. Specifically, changes in the seafloor biology within the survey area correlate with widespread natural oscillations, the largest of which occur on seasonal and interannual time scales.

The most notable faunal variations within the survey area involve interannual population fluxes of the Pacific sand dollar (*Dendraster excentricus*). Specifically, striking increases in the abundance of juvenile sand dollars were documented in 1989, 1991, 1999, and 2009 in conjunction with major El Niño global climate fluctuations. During, and shortly after these episodic recruitment events, high numbers of juvenile sand dollars dominated infaunal population statistics, but because of their small size, their increased presence did not significantly alter the taxonomic composition of the infaunal community. Because these discrete population changes were related to widespread oceanographic fluctuations, they affected all the benthic monitoring stations, including the distant reference site, and therefore, were demonstrably unrelated to the MBCSD effluent discharge.

During the first three events, residual sand-dollar populations from the initial successful sand-dollar recruitment only persisted for a year or two following the event due to predation by ochre sea stars (*Pisaster ochraceus*). These sea stars are considered a keystone species, which are organisms that are disproportionately influential in maintaining local biodiversity. Specifically, their predation has been found to be the key to controlling the populations of other species, such as sand dollars, that would otherwise dominate the resident community. However, in recent years, sea-star populations along the Pacific coast of North America suffered widespread losses from an outbreak of the sea-star wasting syndrome. The resulting absence of sea stars within the MBCSD survey area allowed the initial 2009 sand-dollar population to grow unchecked (Figure 2.2 on the following page).

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<sup>1</sup> National Oceanic and Atmospheric Administration

As a result, during the 2018 benthic survey, and in the prior three annual surveys, numerous large sand dollars displaced nearly all the sediment normally collected within grab samples, and the resident infauna that are normally collected with it (MRS 2019b). Thus, the overwhelming presence of mature sand dollars within the MBCSD survey area not only dominated infaunal population statistics, as they had briefly after prior El Niño events, but the taxonomic makeup of the infaunal community had now changed dramatically. During the 29 years prior to the 2015 survey, the diverse infaunal community consisted almost exclusively of assemblages of delicate suspension feeding organisms and surface detritus feeders, whose presence is considered indicative of an extremely pristine undisturbed seafloor habitat. In contrast, after 2014, few infaunal specimens were found within the small amount of available sediment surrounding the many large sand dollars collected in each grab sample. This new low-diversity infaunal community consisted almost entirely of a marine snail, which is a sand-dollar parasite, and an opportunistic lugworm that thrives in disturbed seafloor habitats. This particular lugworm, *A. bioculata*, happens to have a well-known strong affinity for sand-dollar beds.

The enormous taxonomic change associated with the mature sand dollar bed resulted in an abrupt decline in every measure of infaunal community health after 2014, including infaunal density, diversity, species counts, and richness. However, a far more dramatic decline was observed in the infaunal trophic index (*ITI*). The *ITI* estimates the wellbeing of the infaunal community from the abundance of suspension-feeding infauna, which typically reside in clean sediments, relative to the abundance of pollution-tolerant detritus-feeding organisms, which opportunistically occupy organically contaminated seafloor habitats. Prior to improvements in wastewater treatment during the 1980s, striking *ITI* declines were observed within seafloor sediments immediately surrounding large ocean discharges from low-performance treatment works. However, the sharp *ITI* decline measured within the MBCSD survey area was unrelated to organic loading from effluent discharge. The concentrations of organic constituents measured within both effluent and benthic sediments over the last three years of benthic monitoring were comparable to those of the previous 29 years. Moreover, the *ITI* declines were clearly unrelated to the MBCSD discharge because they occurred uniformly throughout the survey area, with no evidence of a spatial gradient related to outfall proximity.

Instead of sediment-quality degradation resulting from organic material within MBCSD effluent, the dramatic *ITI* decline after 2014 was an artifact of the sharply increased presence of the *A. bioculata* lugworm within the sand-dollar community. Because this lugworm is a subsurface detritus feeder, it has



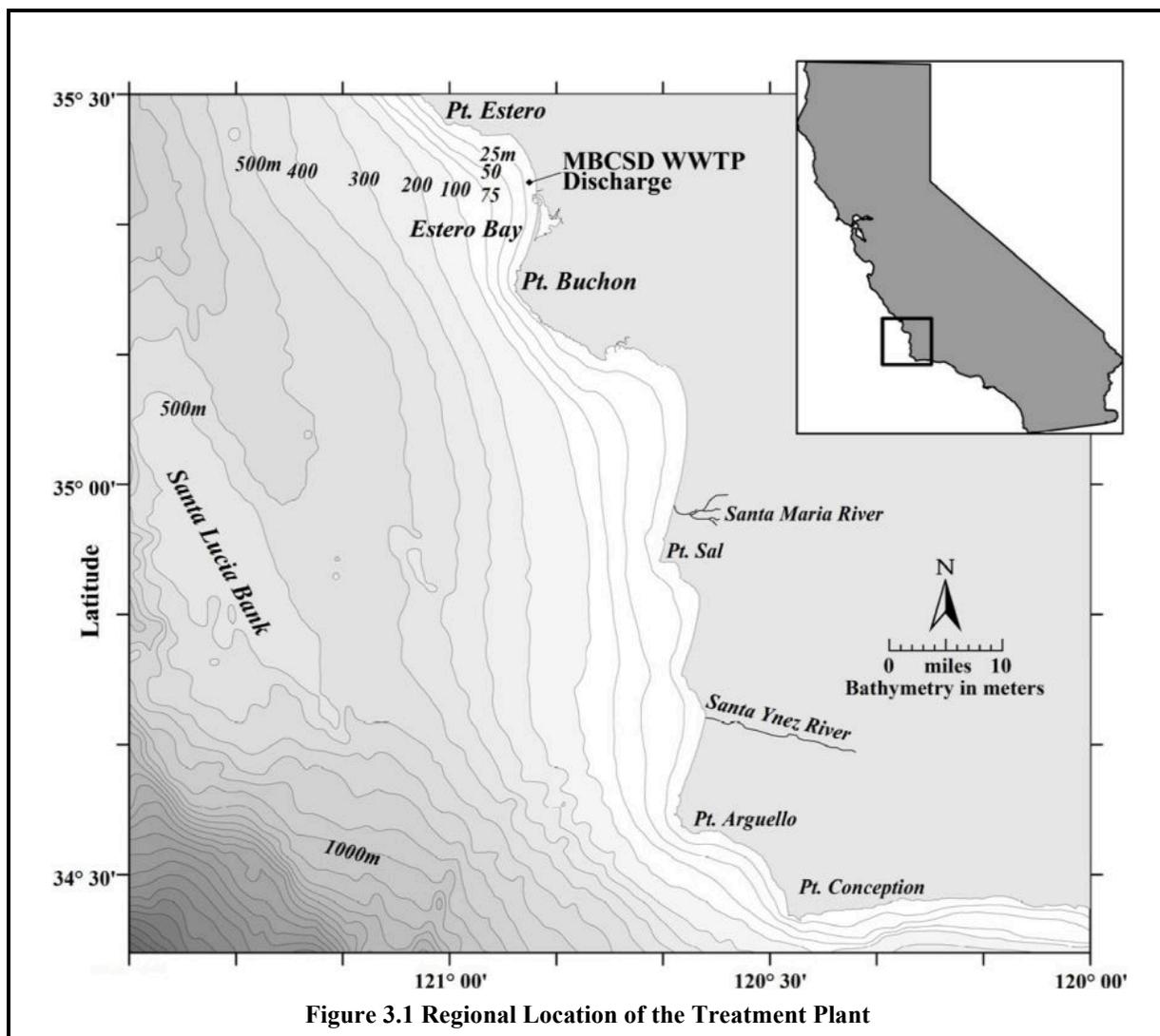
Figure 2.2 Photographic sequence of the growth of the 2009 Sand Dollar cohort in a) 2009, b) 2010, c) 2011, and d) 2012

an inordinately large negative influence on the *ITI* computation. However, regardless of its feeding style, this particular Opheliid lugworm is known to thrive within sand dollar beds irrespective of their organic content. Other field studies have consistently found significantly higher numbers of *A. bioculata* within sand dollar beds than in adjacent sediments with identical concentrations of organic material (Smith 1981).

Divers noted the continuing presence of numerous sand dollars surrounding the outfall during their December 2021 inspection (see Appendix B). Despite recent sand-dollar impacts on benthic infauna, macrofauna living on top of the sediment surface appear to be unaffected. This is evident from specimens occasionally encountered within grab samples, such as the juvenile East Pacific Red Octopus (*Octopus rubescens*) shown on the cover of this report. That specimen was found during 2018 benthic survey within a sediment grab-sample collected 15 m immediately south of the diffuser structure. This benthic predator appeared to be well fed and in good health. When macrofauna like it are encountered in the field, they are quickly identified, enumerated, photodocumented, and then immediately released.

### 3.0 BACKGROUND

The Morro Bay/Cayucos Wastewater Treatment Plant (WWTP) is publicly owned and operated by the City of Morro Bay and the Cayucos Sanitary District (MBCSD). The WWTP is located in the City of Morro Bay, within San Luis Obispo County, along the central coast of California (Figure 3.1). The plant serves the Morro Bay and Cayucos communities, which, according to the 2020 census, have a combined population of approximately 13,387 (10,757 in Morro Bay and 2,630 in Cayucos). The WWTP discharged, on average, 0.951<sup>1</sup> million gallons per day (MGD) during 2021. The plant was designed to accommodate an average dry-weather flow of 2.06 MGD, a peak seasonal dry-weather flow (PSDF) of 2.36 MGD, and a peak wet-weather flow (PWWF) of 6.64 MGD. The plant's throughput did not approach, much less surpass, any of these design limits during 2021.



<sup>1</sup> The daily flow data reported by the WWTP to regulatory agencies averaged 0.962 MGD but revisions that arose from this report's analyses in Section 4.4 reduced the average flow by 0.011 MGD.

**3.1 OPERATIONS**

Twelve certified personnel and six trainees operated the WWTP during 2021 (Table 3.1). John Gunderlock served as supervisor for both the WWTP and Collection System. Joe Mueller and Damaris Hanson provided additional WWTP oversight as the City’s Utilities Division Manager and Environmental Programs Manager. Mr. Mueller successfully passed the Grade V Advanced Water Treatment Operator exam during 2020, which placed him in the forefront of this new certification program. The certification program was developed to address the growing trend toward potable reuse, which is the treatment objective of the City’s new Water Reclamation Facility (WRF) currently nearing completion.

WWTP personnel attended online workshops, seminars, and continuing education classes throughout 2021. Training courses and seminars covered topics such as Environmental Safety Training, Confined Space Entry, Trench Shoring Safety, Lockout/Tagout Electrical Hazard Control, Bloodborne Pathogens/Bio-Hazard/Aerosol Transmissible Diseases, and OSHA<sup>2</sup> Construction Safety Training. Laboratory personnel training included refresher coursework in Basic Water Analysis, Laboratory Exam Review, and Distribution System Field Monitoring and Chlorine Testing for Small Systems. The City of Morro Bay Utilities Department enrolled staff in the American Water College online education system for additional training, study materials for exam preparation and opportunities to earn continued-educational-credits that can be used towards renewing professional certifications.

**Table 3.1 Morro Bay/Cayucos WWTP Personnel During 2021**

<b>Name</b>	<b>Grade and Certification No.</b>
Joe Mueller	V-8495
John Gunderlock	V-10500
Richard Fernandez	III-41341
Dane Lundy	III-36547
James Petersen	III-38360
Kyle Quaglino	III-43869
Michael Wentzel	III-28463
Paul Valley	III-44863
Steve Aschenbrener	II-7548
Robert Victor	II-43756
Alex Tapia	I-43754
Chad Rocha	I-43755
Chris Nichols	I-OIT <sup>1</sup>
Grant Chase	I-OIT
James Kelly	I-OIT
Amy Mills	I-OIT
Dylan Pruitt	I-OIT
Scott Ender	I-OIT

Prior to 2021, WWTP personnel provided laboratory workspace to the National Estuary Program (NEP). The NEP is dedicated to protecting and restoring the natural resources of Morro Bay and its watershed. NEP volunteers used the WWTP laboratory to analyze bacterial samples collected throughout the Morro Bay watershed. However, COVID-19 mandates and safety protocols restricted NEP access to the laboratory throughout 2021, and they are not currently using it. Throughout most of the year, COVID-19 constraints also eliminated opportunities for WWTP personnel to conduct plant tours for local students, staff from other plants, and other members of the public. However, as part of the Plant’s annual permit requirements, APCD<sup>3</sup> employees continued to conduct a regulatory-based tours and inspections.

Plant operations during 2021 continued to integrate and maintain an overall health and safety plan. The WWTP passed an annual inspection by SLO EHS<sup>4</sup> in conjunction with the WWTP Hazardous Waste Business Plan on file with that county agency. The WWTP’s chemical response plan was reviewed with SLO EHS representative during an inspection of the WWTP.

In addition to performing the periodic effluent analyses required by the NPDES Permit during 2021, the laboratories involved in the analyses of the MBCSD WWTP samples participated in laboratory performance evaluations intended to assess the accuracy of effluent measurements and ensure the overall

<sup>1</sup> Operator-in-training  
<sup>2</sup> Occupational Safety and Health Administration  
<sup>3</sup> San Luis Obispo County Air Pollution Control District  
<sup>4</sup> San Luis Obispo County Environmental Health Services

quality of the monitoring reports. In particular, the adequacy of each laboratory's analytical chemistry capabilities was demonstrated during 2021 when acceptable results were achieved in a Water Pollution Proficiency Testing Study, which is an annual requirement of laboratories certified by the State of California Environmental Lab Accreditation Program. It is administered by the State Water Resources Control Board and the USEPA. Successful completion of the federally mandated Discharge Monitoring Report Quality Assurance Study 41 satisfied this state and federal regulatory requirement.

The MBCSD WWTP laboratory analyzed residual chlorine concentrations within wastewater samples collected on a daily basis. Wastewater flow and temperature were also reported daily, while effluent turbidity was measured five days each week. Influent and effluent pH was measured at least twice weekly. Analyses of other influent and effluent properties were subcontracted to outside laboratories. Early in the year, Fruit Growers Laboratory performed TSS and BOD analyses on influent and effluent samples collected at least weekly. Abalone Coast Analytical determined effluent total coliform densities within effluent grab samples collected five days each week. After March, Oilfield Environmental and Compliance assumed responsibility for TSS and BOD analysis. After May, they also assumed responsibility for the coliform and weekly effluent settleable solids analyses. In July, Aquatic Testing Laboratories evaluated the toxicity of effluent to a marine organism with bioassays. BC Laboratories (now Pace Analytical) and Monterey Bay Analytical Services respectively determined trace-metal and nutrient concentrations as part of the annual effluent assay in July. BC Laboratories/Pace Analytical also performed weekly O&G analyses, and the annual chemical analysis of biosolid samples that is described in Chapter 7.0 of this report.

To assist WWTP personnel in the operation and maintenance (O&M) of major plant components, an O&M Manual (dated November 1987) was completed following the plant upgrade in 1986. The WWTP's O&M Manual has since been reviewed and updated on a regular basis. It is currently complete and valid for the operation and maintenance of the existing facility. The manual includes contingency plans for chemical spills, high flow/flood response, fire prevention, emergency evacuation, hazard communication, and heat illness. It also includes detailed lockout/tagout procedures, confined space procedures, emergency notifications, archived project records, activity hazard analysis, and standard operating procedures (SOPs).

The Manual was last reviewed and updated on 22 February 2022. SOP updates provided protocols to assist operators in taking Digester #3 offline, including isolating the Digester from the sludge & gas systems and draining it for non-use. Digester SOPs specified procedures for stopping digester gas production, and for monitoring boilers, circulation temperatures, gas pressures, digester levels, and control valves, as well as digester-health assessments based on volatile-acid, alkalinity, and pH measurements. Additionally, laboratory personnel prepared three SOPs covering composite sampler programming reset, preparing & replacing chlorine analyzer chemicals, and best practices for effluent coliform sampling. Staff updated the laboratory quality assurance manual on 1 February 2022. Lastly, one Activity Hazard Analysis (AHA) was completed in 2021 by plant personnel. The AHA investigated potential facility hazards for a non-routine project that involves draining, cleaning, inspection, and removal of chain-links in the chlorine contact chamber. No other process changes, non-routine projects, or equipment installations needed to be addressed during 2021. During the upcoming year, WWTP personnel will be developing AHAs and SOPs for process changes, equipment additions, and decommissioning of treatment components scheduled for removal at this facility during the transition to the new WRF.

As part of routine maintenance procedures, divers inspect the ocean outfall's exterior and the diffuser structure for signs of damage annually. The outfall was inspected on December 8<sup>th</sup>, and the written inspection report is included herein.<sup>1</sup> Divers observed mussels (*Mytilus californianus*), anemones (*Corynactis californica*), sand dollars (*D. excentricus*) and finfish (Osteichthyes), on and surrounding the outfall. The outfall and diffuser system were found to be in good condition, with no broken or plugged diffuser ports. The divers provided photodocumentation of the outfall's condition in the form of digital video recorded throughout their inspection.

Figure 3.2 is photograph of a diffuser port taken during the outfall inspection. It shows a variety of marine epifaunal organisms thriving on the outer surface of the diffuser port. California (*Megabalanus californicus*) and Buckshot (*Balanus glandula*) barnacles populate the outer surface of the port near the opening. Club-tipped sea anemones (*C. californica*), pinkish-red in color, colonize the mid-section of the port structure. White-plumed anemones (*Metridium giganteum*) occupy the back portion of the diffuser structure. The continued presence of these water-column-feeding organisms attests to the benign nature of the effluent discharge, and to the outfall's value as an artificial reef. Quantitative biological surveys conducted within the region found that club-tipped and white-plumed anemones are only occasionally observed on high-relief rock surfaces within Estero Bay, and then only in deeper water (>85 m) (Morro Group 1999). Ostensibly, their susceptibility to elevated suspended-sediment loads explains their rarity on nearshore, lower-relief rocky substrates.



**Figure 3.2 Photograph of a Diffuser Port Discharging Effluent during the 2021 Outfall Survey**

<sup>1</sup> Appendix B

### **3.2 PLANT HISTORY**

The original WWTP, built in 1954, had a nominal capacity of 0.7 MGD and a 1-MGD maximum throughput. The original plant included a headworks structure, primary and secondary clarifiers, a biofilter, a single-stage digester, chlorination facilities, biosolids drying beds, and a short ocean outfall.

In 1964, the plant upgraded to a nominal capacity of 1 MGD and a 1.3-MGD maximum throughput to meet the demands of the growing coastal community. This upgrade added a pump station, a splitter box, a primary clarifier, a secondary clarifier, a biofilter, chlorination facilities, biosolids beds, and another primary digester, which allowed conversion of the existing digester to process secondary sludge. The existing office building and laboratory were also constructed during this upgrade.

During the 1970s, the City of Morro Bay developed a plan for additional upgrades to the WWTP facilities intended to augment the plant's capacity further. In 1980, the City began designing these planned improvements, including the construction of a new outfall to protect the marine environment, and an upgrade of processing equipment to provide full secondary treatment.

Following a yearlong study of oceanographic conditions within Estero Bay, design of the new outfall was completed in April 1981. The new outfall and diffuser system extended the discharge from the surfzone to a point much farther offshore. This deeper discharge significantly increased the effluent mixing rate within the open-ocean environment. The new outfall was completed and placed in service in June 1982.

The design of the facility improvements, completed in September 1981, called for a final effluent suspended-solids concentration of 30 mg/L and an equivalent limit on BOD. However, monetary aid from state or federal agencies to finance the construction of a full-secondary-treatment facility was not available. Because discharge through the new outfall was not causing any apparent adverse environmental impacts, and the projected future throughput was low, the State determined that additional financial aid for upgrading the MBCSD WWTP to full secondary was not warranted. Instead, the City modified the design to provide secondary treatment to a majority (1 MGD) of the projected flow to ensure full compliance with the state water-quality standards set forth in the California Ocean Plan (COP) (SWRCB<sup>1</sup> 1990).

State officials concurred with this partial-secondary level of treatment, provided that the USEPA approve a 301(h)-modified NPDES discharge permit that adjusted secondary-treatment requirements on suspended-solid and BOD emissions. In a March 1983 letter, RWQCB personnel formally determined that the proposed discharge would comply with state water-quality standards pursuant to Subsection 301(h) of Title 40 of the Code of Federal Regulations.<sup>2</sup>

Upgrades to the treatment plant, completed between 1983 and 1985, increased the plant's capacity to a 2.06-MGD average dry-weather flow and a peak flow of 6.6 MGD. The plant now includes primary treatment of all influent by screening, grit removal, and primary sedimentation. Additionally, depending on the hydraulic conditions within the plant, up to 1 MGD of the flow can be diverted through a secondary-treatment process consisting of trickling filters, clarifiers, and a solids-contact chamber. The secondary-treatment process utilizes two trickling filters, an aerated solids-contact channel, and a secondary sedimentation tank. The original sedimentation tank, built in 1954, was converted to a

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<sup>1</sup> State Water Resources Control Board of the California Environmental Protection Agency

<sup>2</sup> Section 125.60(b)(2) [40 CFR 125.60(b)(2)] (USGPO 1982a) and 40 CFR 125.63(b) of the 301(h) regulations dated November 1982 (USGPO 1982b)

chlorination system where the primary- and secondary-treated effluents are mixed and disinfected prior to dechlorination and discharge through the ocean outfall.

In March 1985, an NPDES permit, based on the previously approved Section-301(h) modification, codified water-quality standards for the MBCSD WWTP. The permit required treated effluent to achieve a suspended-solids content of no more than 70 mg/L (75% removal) and a maximum BOD of 120 mg/L (30% removal). The permit also required an extensive monitoring program to assure maintenance of environmental quality. The permit was valid for five years and expired in March 1990. After an evaluation process, the permit was reissued in December 1992. During this evaluation period, improvements to the treatment facilities included the installation of a sludge-removal system within the Chlorine Contact Tank.

The MBCSD again applied for renewal of the permit in May 1997, supporting its application with an extensive technical review of more than 10 years of monitoring data (MRS 1997). An administrative extension until December 1998 allowed regulatory agencies additional time to review and issue the new permit (RWQCB 1998). In July 1998, RWQCB staff determined that the discharge described in the MBCSD application “*would comply with applicable state laws, including water quality standards, and would not result in additional treatment, pollution control, or other requirements on any other point or nonpoint source.*” This permit was finalized and issued by USEPA on 26 January 1999, with an effective date of 1 March 1999.

Based on discussions between RWQCB, USEPA, and MBCSD personnel and their consultants, the following revisions were also implemented in the 1999 permit:

- A 12.7% reduction in the allowed mass emission of suspended solids, BOD, and O&G;
- More extensive reporting requirements for biosolids;
- Elimination of shellfish monitoring;
- A revised benthic sampling program, increasing the number of stations close to the diffuser structure and eliminating seasonal sampling;
- A revised receiving-water sampling program, doubling the number of vertical profiles close to the diffuser structure and eliminating bottle casts; and
- Specification of mass emission goals for toxic chemicals.

Based on the historical absence of perceptible impacts from the discharge, and the projected continuation of consistently high effluent quality, the MBCSD again applied for a renewal of the Section-301(h)-modified discharge permit in July 2003 (MBCSD 2003). As with the previous permits, the application requested continued discharge under the 301(h) provision that allows minor modifications to the BOD and suspended-solids requirements. In February 2004, the RWQCB (2004) administratively extended the existing permit to allow time for further review. In September 2005, the USEPA Region IX (2005) issued a tentative decision concurring with issuance of a permit to the MBCSD in accordance with Section 301(h) of the Clean Water Act. In April 2006, the USEPA and RWQCB personnel issued a joint notice for a proposed action to reissue the 301(h) modified NPDES discharge permit to the MBCSD. However, in May 2006, the RWQCB and the USEPA conducted a joint public hearing addressing the reissuance of the MBCSD permit wherein the RWQCB voted to continue the hearing pursuant to the issuance of a biological evaluation by the USEPA (2007).

In 2008, the USEPA issued an Endangered Species Act (ESA) biological evaluation of continued discharge under a 301(h)-modified discharge permit wherein they determined:

*...that the continued wastewater discharge from the Morro Bay/Cayucos facility is not likely to adversely affect the brown pelican or southern sea otter, both of which occur in the vicinity of the subject discharge. EPA finds that any potential direct or indirect effects of the continued wastewater discharge would be insignificant to the brown pelican and southern sea otter.*

Pursuant to Section 7 of the ESA, the proposed action of the USEPA required consultation with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), which protect federally listed endangered species and designate critical habitat that may be affected by the proposed action. In December 2007, the USFWS concurred with the USEPA's "determination that the proposed project is not likely to adversely affect the brown pelican or southern sea otter."

Nevertheless, the USEPA incorporated three conservation measures in the new NPDES discharge permit to address concerns about potential contributions to otter morbidity by cat litter and domoic acid poisoning. First, the MBCSD would implement a public outreach program to minimize the input of cat-litter-box waste into the municipal sewer system. Second, the MBCSD would be required to monitor nutrient loading from the WWTP on a regular basis. Third, the facility would upgrade to a minimum of full secondary-treatment levels by 2014.

Based on the foregoing findings and the incorporation of conservation measures, the RWQCB unanimously adopted the prior discharge permit in December 2008. Subsequently, on 9 January 2009 the California Coastal Commission unanimously determined that the new discharge permit complied with the California Coastal Zone Management Act. On 14 January 2009, the USEPA issued the new NPDES permit, effective 1 March 2009. In addition to the conservation measures noted above, the following revisions were also implemented in the 2009 permit:

- Elimination of acute toxicity testing;
- Implementation of triggered shoreline coliform monitoring;
- Revision of benthic sampling pattern, eliminating cross-shore stations and shifting from grab to composite sediment-chemistry samples; and
- Revision of receiving-water sampling program, reducing the number of vertical profiles and implementing a tow-survey component.

Although this previous NPDES permit was not finalized until January 2009, the MBCSD had actually begun to implement several of the proposed conservation measures years before. For example, in April 2006, the MBCSD, working to address the concerns of the USEPA and RWQCB, adopted an eight-year time schedule to rehabilitate and upgrade the treatment plant to tertiary treatment, including onsite composting, as the preferred alternative for upgrading the WWTP by 2014. The MBCSD subsequently adopted a draft facilities master plan that outlined the facilities necessary for a tertiary treatment capacity of 1.5 MGD in September 2007. Meanwhile, in August 2007 the City of Morro Bay and the Cayucos Sanitary District individually adopted revenue programs that identified increases in sewer-rate fees necessary for each community to finance the proposed plant upgrade and to provide revenue for needed sewer-system capital improvement projects. In July 2008, the City of Morro Bay implemented new residential and commercial water-use rates that increased the existing fees by 50%.

During 2009, based on the findings of flood hazard analysis, the City and District voted to relocate the treatment plant site to an elevated area adjacent to the existing treatment plant. In October 2009, the MBCSD public noticed a Request for Proposal (RFP) for Engineering Design Services for the upgrade,

and the City of Morro Bay released a Revised Notice of Preparation for the project, reflecting changes to the project description involving construction of treatment-plant components adjacent to the current ones. Demolition of the existing plant was to occur after the relocated treatment-plant components were constructed and brought online. The engineering design contract was awarded at the February 2010 Joint Powers (JPA) meeting with a projected completion in 15 months.

The final Environmental Impact Report for the upgrade project was released in December 2010. The Morro Bay City Council certified the EIR<sup>1</sup> and approved the Conditional Use Permit and Coastal Development Permit (CDP) for the upgrade project in January 2011; however, the decision to issue the CDP was subsequently appealed to the California Coastal Commission. A *de novo* hearing was held in January 2013 after which the proposed upgrade project at its current location was terminated.

Subsequently, at the February 2013 JPA meeting, the MBCSD approved development of a Major Maintenance and Repair Plan. The Plan was instituted to ensure uninterrupted operation of the existing WWTP in compliance with regulatory requirements during the extended operational period required for the development and construction of a new treatment facility at a different site. In August 2013, the MBCSD submitted an application to the RWQCB for a new discharge permit to replace the current 301(h) modified permit due to expire on 28 February 2014. Based on direction from the MBCSD and RWQCB personnel, an application was submitted for a full secondary discharge permit.

During 2013 and 2014, the MBCSD explored various sites and treatment alternatives for a new facility to process wastewater currently treated by the existing WWTP. In early 2015, the City of Morro Bay identified a Water Reclamation Facility as the preferred design, and initially selected a location east of the City and north of Highway 41. On April 30, the Cayucos Sanitary District (CSD) suspended participation with the City in their WRF and began planning a separate Water Resource Recovery Facility (WRRF). The District began independently evaluating wastewater treatment alternatives, characterizing flow rates and mass loadings specific to the District's collection system, identifying beneficial uses for recycled water, evaluating potential facility locations, and developing a funding and financing strategy.

The WRRF was encompassed in the Cayucos Sustainable Water Project (CSWP), which also incorporated the necessary conveyance infrastructure. During 2016, the Cayucos Sanitary District selected a membrane bioreactor as the WRRF treatment process, identified a CMAR<sup>2</sup> as the construction delivery method for the CSWP, selected the CMAR contractor, began preparing a dEIR,<sup>3</sup> and purchased a property for the WRRF site along Toro Creek Road. During early 2017, the District published the dEIR and subsequently completed a final EIR, consisting of responses to comments on the dEIR. Groundbreaking for construction of the WRRF occurred in August 2018. Construction of the WRRF and associated infrastructure continued through the first half of 2021 and the facility was dedicated on June 25<sup>th</sup>.<sup>4</sup> Pumping of CSD wastewater to the MBCSD WWTP ceased on September 24<sup>th</sup>.

During this same period, the City of Morro Bay personnel and their consultants made significant progress on developing the new WRF to replace the existing WWTP. A Memorandum of Understanding was executed for the future purchase of a property near the South Bay Boulevard exit from Highway 1, after

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<sup>1</sup> Environmental Impact Report

<sup>2</sup> A Construction Manager at Risk (CMAR) is a project delivery method wherein the Construction Manager (CM) is required to deliver a project within a guaranteed maximum price.

<sup>3</sup> Draft Environmental Impact Report. The CSWP dEIR was completed in January 2017. The final EIR was certified in April 2017.

<sup>4</sup> <https://www.cayucossd.org/cayucos-sustainable-water-project-cswp>

site-selection studies were performed to identify a preferred location for the new WRF. A draft Facility Master Plan, Master Water Reclamation Plan, and Draft Rate Study were also completed. Based on recommendations in the Master Water Reclamation Plan, full advanced treatment, a recycled water pipeline, and injection wells to facilitate indirect potable reuse were anticipated as part of the preferred project. The City of Morro Bay received approval for a \$10.3M loan from the SWRCB CWSRF<sup>1</sup> for the design and planning of the recycled water project. During October and November 2017, an RFQ<sup>2</sup> was issued for the design and construction of WRF onsite improvements, and the design of WRF offsite improvements, including a lift station and pipelines.

On 7 December 2017, the RWQCB adopted a new permit for the MBCSD discharge with an effective date of 1 March 2018 (RWQCB 2018a). In contrast to prior permits, the current permit is not Section-301(h) modified. However, the accompanying Time Schedule Order (RWQCB 2018b) promulgated interim TSS and BOD effluent limits identical to those of the prior 301(h)-modified permit, to allow the MBCSD time to bring the CSWP and WRF online. The TSO<sup>3</sup> requires full compliance with the current permit's final effluent requirements by 23 February 2023.

The current MBCSD discharge permit also implemented the following revisions to the monitoring program:

- Decreased the sampling frequency to once-in-the-life of the permit for benthic sediment chemistry and biota, and all effluent chemical constituents except for metals and nutrients, which are to be analyzed on an annual basis;
- Instituted a three-species chronic-toxicity screening study to be conducted annually for three years, followed by annual tests on the most-sensitive species; and
- Eliminated offshore receiving-water monitoring and the cat-litter public-outreach program.

In compliance with TSO provisions, the City of Morro Bay personnel and their consultants completed a number of major WRF-project milestones during 2018, including certification of the Final EIR, adoption of new rates to support the project, and a notification to proceed with the design of onsite WRF improvements. The MBCSD also submitted a request to the RWQCB for acceptance of the upcoming Enhanced Source Control Program report, which is required under Title 22 Regulations for indirect potable reuse by the WRF, in lieu of the required submission of a Pollution Prevention Plan for BOD and TSS pursuant to the Clean Water Act (MBCSD 2019).

Significant progress on the WRF Project continued throughout 2019 and into 2020. Sixty-percent design deliverables for the WRF and conveyance facilities were submitted in July and September 2019. A final CDP for the WRF was issued by California Coastal Commission in November 2019. Project funding through low-interest loans from the USEPA and the SWRCB required USFWS consultation pursuant to Section 7 of the ESA for the proposed WRF location. Initial concerns over potential impacts to the California red-legged frog (*Rana draytonii*) led to a formal consultation with the USFWS. Their biological opinion was issued in February 2020, allowing future low-interest State and Federal loans to be secured.

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<sup>1</sup> Time Schedule Order

<sup>2</sup> Request for Qualifications

<sup>3</sup> The Clean Water State Revolving Fund (CWSRF) includes a Water Recycling Funding Program administered by the SWRCB Division of Financial Assistance.

By mid-2020, key design deliverables for both the WRF and associated conveyance facilities, which include pipelines and lift stations, were completed. A Notice to Proceed for WRF construction was issued while earthwork activities continued on the site. By year-end, major earthwork and yard piping for the WRF had been completed. A contract for the construction of conveyance facilities was awarded and a notice to proceed was issued in February 2021. By November, half of the construction of pipelines and lift stations had been completed. The WRF earthworks was largely finished, and yard piping had been installed. By year-end, infrastructure, piping, electrical, and controls had been installed for all the major components of the WRF, including the headworks, membrane bioreactor equipment, biological nutrient removal basins, reverse osmosis treatment, product water facilities, sludge processing, chemical storage, operations and maintenance buildings, and City yard facilities. Completion of the WRF and compliance with the final effluent limits in the NPDES permit is anticipated in advance of the TSO's February 2023 deadline.

### **3.3 REGULATORY SETTING**

The 1972 Federal Clean Water Act and its 1977 amendments established national water-quality goals and created a national permit system (NPDES) of minimum standards for the quality of discharged waters (USGPO 1997a). Pursuant to the new system, states established standards specific to water bodies and designated the types of pollutants to be regulated. Since 1973 the California State Water Resources Control Board and its nine Regional Water Quality Control Boards have been delegated the responsibility of administering permitted discharges into the coastal marine waters of California. The State Board prepares and adopts the COP, which incorporates the state water-quality standards that apply to all NPDES permits. The RWQCB established a Water Quality Control Plan for the basin containing San Luis Obispo County waters ("The Basin Plan" RWQCB 2017). The Plan's standards incorporate the applicable portions of the COP and promulgate water-quality objectives and toxic material limitations that are designed to protect the beneficial uses of receiving waters within individual basins. The MBCSD outfall site lies within the Estero Bay Coastal Segment where the Basin Plan identifies the following the existing beneficial uses specific to those marine waters.

- **Water Contact Recreation (REC-1)** uses include recreational activities involving body contact with water, where ingestion of water is reasonably possible. Specific uses include: swimming, wading, water skiing, skin and scuba diving, white water activities, and fishing.
- **Noncontact Water Recreation (REC-2)** uses include recreational activities involving proximity to water but not normally involving body contact with water, where ingestion of water is reasonably possible. Specific uses include: picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life studies, hunting, sightseeing, and aesthetic enjoyment.
- **Industrial Service Supply (IND)** uses include industrial activities that do not depend primarily on water quality, such as, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, and oil-well repressurization.
- **Navigation (NAV)** uses include shipping, travel, or other transportation by private, military, or commercial vessels. The RWQCB interprets NAV as being present within any natural body of water that that has sufficient capacity to float watercraft for the purposes of commerce, trade, transportation, and pleasure.

- **Marine Habitat (MAR)** uses support marine ecosystems and include preservation or enhancement of marine habitats, fish, shellfish, and vegetation (kelp), or wildlife (marine mammals and shorebirds).
- **Shellfish Harvesting (SHELL)** uses support habitats suitable for the collection of filter-feeding shellfish (clams, oysters, and mussels) for human consumption, commercial, or sport purposes. Specific uses include waters that have in the past, or may in the future, contain significant shellfisheries.
- **Ocean Commercial and Sport Fishing (COMM)** uses encompass the collection of fish, shellfish, or other organisms, including uses involving organisms intended for human consumption or bait purposes.
- **Preservation of Rare, Threatened, or Endangered Species (RARE)** uses support habitats necessary for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.
- **Wildlife Habitat (WILD)** uses support terrestrial ecosystems including the preservation and enhancement of terrestrial habitats, vegetation, wildlife (mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Section 301(b) of the Clean Water Act requires publicly owned treatment works to meet effluent limitations based on secondary treatment, which is defined in terms of limits on three effluent parameters (40 CFR 133; USGPO 1997a). These limitations are:

- Total suspended solids (TSS) concentrations not exceeding 30 mg/L as a 30-day average and removal rates not less than 85%;
- BOD concentrations not exceeding 30 mg/L as a 30-day average and removal rates not less than 85%; and
- Hydrogen-ion concentration (pH) between 6.0 and 9.0.

These limits were based on the treatment capabilities of the best technology available at the time, rather than an evaluation of the treatment necessary to reduce potential environmental impacts to an acceptable level within receiving waters. Recognizing that this level of treatment may not be necessary within ocean waters, Section 301(h) was added to the Act to allow an NPDES discharge permit to modify some or all of these full secondary-treatment requirements, if certain conditions are met. The MBCSD WWTP is a combined primary and secondary-treatment facility that operated under a Section 301(h)-modified NPDES permit (number CA0047881) from March 1985 to March 2018. The modifications only applied to the TSS and BOD requirements, so all other NPDES limitations remained in force without exception, including those for wastewater pH and toxic compounds. The modification was issued only after the MBCSD satisfied the following additional requirements:

- Demonstrate the existence of a water-quality standard specific to the pollutant for which the modification is requested (40 CFR 125.61; USGPO 1997a). The COP specifies limits on TSS and dissolved-oxygen (DO) depression, thereby establishing the relevant standards (SWRCB 2005). In January 2009, the California Coastal Commission determined that the last 301(h)-modified discharge permit issued to the MBCSD complied with the State Coastal Zone Program that incorporates COP standards.

- Demonstrate that the discharge does not adversely impact public water supplies or interfere with the protection and propagation of balanced, indigenous biological populations (40 CFR 125.62). Both the USFWS and the NMFS determined that the discharge would not adversely impact threatened or endangered species, or critical habitats, pursuant to the ESA.
- Conduct a monitoring and reporting program capable of evaluating the effects of the discharge (40 CFR 125.63). The comprehensive monitoring program described in this and prior annual reports satisfies this requirement.
- Demonstrate that the discharge will not result in any additional treatment requirements on any other point or nonpoint source (40 CFR 125.64). The highly localized footprint of the MBCSD discharge does not overlap that of other discharges.
- Determine whether the WWTP is subject to pretreatment requirements. Since there are no known sources of toxic pollutants or pesticides within the collection area, the WWTP is exempt from general pretreatment requirements in lieu of a pollution prevention program. In addition, because the discharge is considered small, it is exempt from the urban pretreatment requirement (40 CFR 125.65).
- Demonstrate whether the pollution-prevention program meets the requirement for a nonindustrial source control program (40 CFR 125.66). The MBCSD pollution prevention program implements public education and source reduction programs to limit the introduction of toxic pollutants or pesticides into the treatment plant.
- Demonstrate that there will be no new, substantially increased discharges of BOD and TSS beyond those specified in the permit (40 CFR 125.67). The historically high performance of the plant process, the limited projected growth in population and industry within the service area, and the analyses provided in this, and prior annual reports demonstrate this.
- Ensure that the WWTP exceeds the minimum requirements for primary treatment (40 CFR 125.60). The WWTP performs “*treatment by screening, sedimentation, and skimming adequate to remove at least 30 percent of the biochemical oxygen demanding material and of the suspended solids in the treatment works influent, and disinfection, where appropriate*” (40 CFR 125.58(r); USGPO 1997a).

The MBCSD WWTP is categorized as a Class III wastewater treatment facility by the Office of Operator Certification within the California State Water Resources Control Board. The Board reclassified the facility in 2001 from a Class IV facility based on the advanced treatment process and the plant’s low flow volume. A typical Class IV facility treats more than 20 MGD in the primary process, while the MBCSD plant processes a total flow of less than 2 MGD and performs partial-secondary treatment on a large portion of that flow.

During 2015, the California Department of Public Health developed a Management Plan for Commercial Shell Fishing within Morro Bay. The Plan provides reporting guidelines in the event of a sewage spill to the Bay or adjacent ocean. WWTP personnel provided comments on the Plan and signed a Statement of Agreement concerning its implementation.

### 3.4 TREATMENT PROCESS AND OUTFALL SYSTEM

The WWTP operating characteristics are listed in Appendix A. All wastewater is treated through a primary treatment process, which includes screening, grit removal, and primary sedimentation, as shown in Figure 3.3. Typically, a portion of the flow is diverted for additional secondary treatment using biofilters, a solids-contact chamber, and a secondary clarifier. The secondary process consists of parallel single-stage, high-rate, trickling filters whose combined outflow goes to a solids-contact channel and then to a secondary sedimentation tank. When flows exceed 1 MGD, secondary-treated effluent can be subsequently blended with primary-treated effluent, before the entire blend is chlorinated for disinfection and then dechlorinated. The disinfected and dechlorinated effluent is discharged into Estero Bay through a 4,400-ft (1,341-m) outfall terminating in a multi-port diffuser system. Waste biosolids are anaerobically digested, dried, composted and used as soil conditioner and fertilizer. A schematic of the biosolids process is shown in Figure 7.1 on Page 7-1.

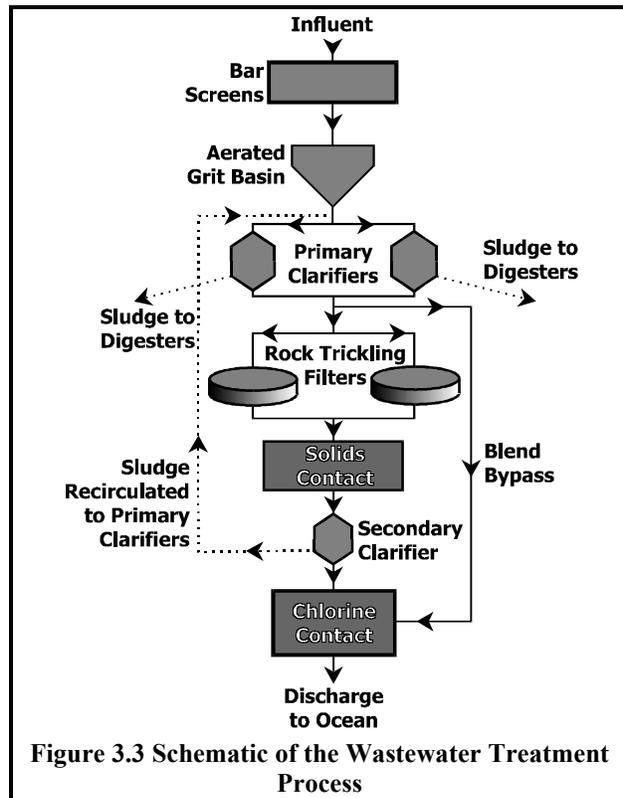


Figure 3.3 Schematic of the Wastewater Treatment Process

The location of the Morro Bay-Cayucos WWTP and outfall within Estero Bay is shown in Figure 3.4 on the following page. The treated wastewater is released into unstressed, open-ocean waters at 35°23'11"N latitude and 120°52'29"W longitude. The effluent flows through a 27-in (0.69-m) diameter outfall that extends approximately 4,400 ft (1,341 m) in a northwesterly direction. The outfall terminates in a multi-port diffuser approximately 2,700 ft (827 m) from shore. The 170-ft (51.8 m) long diffuser lies at a water depth of 50 ft (15.2 m), measured relative to the mean lower low water (MLLW) datum. Twenty-eight of the 34 available diffuser ports are currently open. The remaining six ports can be made operational if the sustained discharge exceeds 6.60 MGD.

Because of its location, the MBCSD discharge does not interfere with the maintenance of water quality and beneficial uses designated for Estero Bay (listed in Section 3.3 on Page 3-9). The discharge occurs in well-flushed, open coastal waters where re-entrainment or accumulation of effluent will not violate applicable water-quality standards, even if combined with pollutants from other sources. Intakes and outfalls from other publicly owned treatment works are distant from the MBCSD outfall. For example, water intake for the Morro Bay desalination plant is from saltwater wells and not from the open ocean where the MBCSD discharge occurs. Similarly, surface discharge of water from the desalination plant, when it does occur, is far south of the MBCSD discharge point and does not add chemical loads to the ocean environment.

### **3.5 POLLUTION PREVENTION PROGRAM**

The MBCSD's Pollution Prevention Program (PPP) seeks to minimize the introduction of incompatible contaminants, such as pollutants and pesticides, into the treatment process. The NPDES permit requires an annual status report detailing efforts to comply with PPP requirements for a PPP and this section serves as partial satisfaction of that requirement. Note, however, the City of Morro Bay and Carollo Engineers have prepared and submitted an Enhanced Source Control Program study (ESCP) in conjunction with the WRF. They have requested that it be considered in lieu of the PPP required by the TSO. Although it is currently in draft form, it includes a significantly updated Industrial Waste Survey, Sewer Use Ordinance, Enforcement Response Plan, and Outreach Program. The ESCP also addresses BOD and TSS, as well as several other constituents, intended to protect the purified water produced by the WRF.

In addition to efforts on the ESCP, the City's Sewer System Management Plan was updated during 2019. It established goals to manage, operate, and maintain all the components of the wastewater collection system to best prevent the occurrence of Sanitary Sewer Overflows (SSOs), and if they do occur, to mitigate potential impacts.<sup>1</sup> The City also began implementing its OneWater Plan<sup>2</sup> during 2019 (Morro Bay 2018a). That plan was finalized in October 2018 and integrated the Sewer System Management Plan, the Drinking-Water Master Plan, and the Stormwater Master Plan.

As in previous years, three aspects of pollution prevention were emphasized during 2021: 1) public outreach, 2) industrial-waste source control and identification, and 3) monitoring of influent and effluent for industrial contaminants.

#### **3.5.1 Industrial Waste Survey**

During 2021, as in previous years, elevated levels of industrial pollutants were not found within the MBCSD wastewater stream. Instead, more than three decades of comprehensive monitoring demonstrates that effluent discharged from the MBCSD treatment plant consists of benign constituents typical of



**Figure 3.4 Locations of the MBCSD Outfall and Monitoring Stations within Estero Bay**

<sup>1</sup> <https://www.morro-bay.ca.us/731/Sanitary-Sewer-Overflows-SSOs>

<sup>2</sup> <https://www.morrobayca.gov/DocumentCenter/View/12500/OneWater-Plan-Final>

wastewater generated from domestic sources. Based on analyses of water usage for 2013 through 2016,<sup>1</sup> domestic and government agency sources contributed 78% of the wastewater processed by the plant. Commercial and mixed-use businesses contributed 20%, with light-industrial usage accounting for less than 2%.

However, this usage-based approach overestimates the influence of nondomestic sources on the treatment process. For example, a substantial portion of the water-use attributed to the government agencies is utilized for the irrigation of landscaping, sports fields, and agricultural uses, and thus, would not be expected to flow into the collection system. These agencies include the City of Morro Bay, Morro Bay High School, the San Luis Coastal School District, Morro Elementary School, and the State Department of Parks (Morro Bay State Park). Additionally, the compounds added to the waste-stream by both large commercial and government users are not particularly toxic to humans or aquatic organisms, and do not generally interfere with the treatment process.

This general lack of chemical contaminants within the waste-stream arises because the local economy within the MBCSD service area relies largely on tourism and commercial fishing, with no heavy industry or manufacturing of environmental significance. Nevertheless, a digital database was developed in 1999 to catalogue business names, addresses, and contact information of potential industrial users within the service area. This database has been regularly updated to track the comparatively low volume of influent derived from light industrial sources within the service area. Examples include the slightly more than 50 restaurants and an approximately equal number of hotels that are found within the service area during any given year.

The list of businesses within the database and the nature of the wastewater they generate is updated regularly based on business license applications filed with the City of Morro Bay and input provided by the Cayucos Sanitary District. Businesses with no potential for industrial discharges, such as offices and retail stores, are classified separately from those with the potential for light-industrial discharge. Businesses that either do not generate wastewater at all, or discharge only domestic wastewater (e.g., theaters, beauty shops, and barbershops), are excluded from the industrial-discharge classification.

The City of Morro Bay's Source Control Program divides facility inspections into two classes: Class I light-industrial facilities and Class II food-service establishments, which constitute the majority of commercial businesses discharging to the collection system. During 2021, fourteen Class I and fifty-three Class II facilities were inspected. Class I inspections emphasized compliance with the discharge requirements set out in the City's Municipal Code, such as pre-treatment to maintain an acceptable pH range. Class II inspections emphasized the Best Management Practices (BMPs) for the disposal of fats, oils, and greases (FOG). During the Class II inspections, a FOG BMP handout was distributed along with "No Grease" stickers to be displayed above kitchen sinks to raise awareness and serve as a reminder of proper FOG disposal methods. FOG BMPs are also available online as part of the Wastewater Collections Division public outreach effort.<sup>2</sup> The inspections themselves focused on determining the presence of grease traps or interceptors, and if present, whether they were properly cleaned and maintained. For establishments with fryers, the method and frequency of oil disposal was documented.

Class I facilities consist of light industrial businesses such as commercial laundries, car washes, dry cleaners, print shops, and the oil-water separator maintained by the City of Morro Bay. Collections

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<sup>1</sup> Table 4.5 on Page 4-7 (Sequential Page 105) of the [OneWater Plan](#)

<sup>2</sup> <https://www.morro-bay.ca.us/730/FOG-Fats-Oils-and-Grease>

personnel perform scheduled visits, surprise onsite inspections, and formal tours of these facilities. Car-wash discharges are considered industrial in nature because of the volume of solids, oils, and grease that are washed from vehicles. As with restaurants, the sewer-use ordinance within the City of Morro Bay municipal code requires self-service car washes to install and maintain grease traps within their sewer line connections. The municipal code also prohibits smaller contributors, like gas stations and repair garages, from disposing known contaminants into the collection system.

As part of the City's pretreatment program, samples from a commercial laundry's discharge are occasionally collected and analyzed. Prior inspections found that the discharge pH had extended beyond the 5.5-to-9.0 range allowed in the municipal code. Throughout 2018, City personnel discussed strategies with the launderer's staff to improve pH stability within the launderer's discharge and to achieve uninterrupted compliance municipal discharge requirements. In mid-October 2018, laundry staff installed a large mixing equalization tank and new boiler. Subsequent pH monitoring by City personnel demonstrated uninterrupted compliance with municipal code's allowable range since the pretreatment buffering system was commissioned. This includes testing of six grab samples collected from the facility's discharge during 2021.

In addition to chemical input from light industry, the WWTP itself intentionally introduces three chemicals (ferrous chloride, sodium hypochlorite, and sodium bisulfite) into the treatment process. Ferrous chloride is used primarily to control hydrogen sulfide emissions during flaring of digester gas and heating of the digesters at the WWTP, as required by the APCD. Wastewater facilities commonly disinfect effluent prior to discharge with some form of chlorine; the WWTP uses sodium hypochlorite. However, because even low concentrations of residual chlorine can be hazardous to aquatic life, the MBCSD treatment plant adds sodium bisulfite to the waste-stream to remove excess total chlorine residual once disinfection is complete.

### **3.5.2 Public Outreach**

The MBCSD utilizes online and written literature to educate consumers and local businesses about the organization and operation of the treatment plant; sewer-system BMPs; and techniques for the proper disposal of a variety of household wastes. Prior to the implementation of COVID-19 restrictions in March 2019, the MBCSD also used direct communication through multiple workshops, presentations, talks, and plant tours.

The Cayucos Sanitary District maintains a website<sup>1</sup> with status updates and other information relating to the CSWP, along with Town Hall Meeting notices, responses to FAQs,<sup>2</sup> and links to other resources. The City's website<sup>3</sup> includes a series of pages devoted to an overview of the wastewater treatment plant and collection-system operations. The web pages contain pertinent information on current topics of interest. These include the status and history of the pending transition to an offsite WRF, the availability of an onsite Household Hazardous Waste Facility, and Collection System Do's & Don'ts. Do's & Don'ts specific to SSOs,<sup>4</sup> FOG,<sup>5</sup> and Car Washing<sup>6</sup> are available online. In addition, digital copies of the treatment plant's self-monitoring reports are also available online, including annual-monitoring and

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<sup>1</sup> <http://www.cayucossd.org/>

<sup>2</sup> Frequently Asked Questions

<sup>3</sup> <http://www.morro-bay.ca.us/342/Wastewater-Treatment-Plant-Operations>

<sup>4</sup> <https://www.morro-bay.ca.us/731/Sanitary-Sewer-Overflows-SSOs>

<sup>5</sup> <https://www.morro-bay.ca.us/730/FOG-Fats-Oils-and-Grease>

<sup>6</sup> <http://www.morrobayca.gov/documentcenter/view/7814>

biosolids reports from 2005 through 2019, and effluent chemistry reports through 2020.<sup>1</sup> Lastly, public awareness efforts regarding the City's progress on the on WRF are regularly provided in monthly City Manager's Reports,<sup>2</sup> monthly Public Works Advisory Board Minutes,<sup>3</sup> and in timely News Releases.<sup>4</sup>

The Collection System Do's & Don'ts section of the City's website also provides current BMPs for cat-litter disposal and the importance of avoiding its introduction into the collection system.<sup>5</sup> This outreach program was one of the conservation measures recommended in the USEPA's (2007) biological evaluation that was conducted in preparation for issuance of the prior NPDES discharge permit. During the permit-renewal process, USEPA personnel postulated that minimizing the input of cat-litter-box wastes into the municipal sewer system could limit the number of *Toxoplasma gondii* parasites introduced into the marine environment, thereby mitigating a known disease vector affecting southern sea otters. RWQCB personnel incorporated the USEPA's concerns into a special provision within the plant's final NPDES permit requiring the creation of a cat-litter public-outreach program.

However, immediately following the finalization of that prior permit, on 21 January 2009, Johnson et al. (2009) published the results of a detailed field study of southern sea otter exposure to *T. gondii*. That study unequivocally demonstrated that the incidental disposal of cat litter into the MBCSD collection system was not the cause of the observed impacts on otter morbidity from *T. gondii* infection. The authors of the 2009 study confirmed that the epicenter of *T. gondii* exposure in otters was not located within Estero Bay, as erroneously asserted by NRDC<sup>6</sup> (2006) and Miller et al. (2002). More importantly, Johnson et al. (2009) also hypothesized that, based in part on the new epicenter location, "a more important source of infection might be bobcats and mountain lions" instead of housecats. In fact, the world's largest reported outbreak of human toxoplasmosis was linked to a municipal drinking-water reservoir in British Columbia that had been contaminated by cougar feces (Bowie et al. 1997; Aramini et al. 1998). Based on these recent findings, the requirement for a cat-litter outreach program was eliminated when the current MBCSD discharge permit became effective on 1 March 2018 (RWQCB 2018a).

Other public-outreach endeavors by the MBCSD include its involvement in the collection of household hazardous wastes. Beginning in August 2000, the MBCSD collaborated with the Integrated Waste Management Authority to establish a permanent household hazardous-waste collection facility located at the WWTP. The collection facility offers free waste disposal to all residents of San Luis Obispo County every Saturday from 11:00 a.m. to 3:00 p.m., except holiday weekends. The facility remains one of the top waste-disposal sites in the county in terms of the volume of material collected. Between 20 and 50 individuals use the facility each weekend. During 2021, the disposal facility processed 152 MT of household hazardous waste, a large portion of which was recycled. Collected material is sorted, packaged, and labeled before transport to the appropriate offsite recycling and disposal facilities.

### **3.5.3 Source Identification**

Past and ongoing efforts to eliminate or reduce contaminants entering the WWTP's waste-stream have been successful, and as evidence of that success, elevated contaminant concentrations within effluent samples are rarely detected during the periodic chemical assays. Although nothing unusual was detected

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<sup>1</sup> <http://www.morrobayca.gov/355/Monitoring-Reports>

<sup>2</sup> <http://www.morrobayca.gov/Archive.aspx?AMID=81>

<sup>3</sup> <http://www.morrobayca.gov/Archive.aspx?AMID=44>

<sup>4</sup> <http://morrobaywrf.com/>

<sup>5</sup> <http://www.morrobayca.gov/documentcenter/view/1201>

<sup>6</sup> Natural Resources Defense Council

within the waste-stream during 2021, anomalous concentrations of individual chemicals have been sporadically reported in the past. On those occasions, MBCSD personnel successfully traced the contaminants to the source and worked with the source owner to eliminate the contamination.

In 2006, the State Water Resources Control Board adopted new statewide waste-discharge requirements for sanitary sewer systems, which transferred responsibility for managing the introduction of FOG, and other components from the WWTP to the Collections Department under the City of Morro Bay's Sewer System Management Plan<sup>1</sup> and the Cayucos Sanitary District.<sup>2</sup> Ongoing source identification and resolution efforts conducted by the City and District include a grease-trap inspection program for businesses subject to the requirements. Collections personnel regularly conduct scheduled inspections as well as spot checks as described in the *Industrial Waste Survey* subsection above. During inspections, personnel discuss BMPs with restaurant staff, provided educational materials such as a BMP handbook and make recommendations for grease trap maintenance as necessary.

Known light-industrial dischargers were also inspected for compliance with source control processes and procedures. One of the most important of the Class I facilities is the commercial laundry that operates within the City of Morro Bay. Although this facility only contributes approximately 1.6% to plant flow, commercial laundries use industrial-grade detergents, bleaches, surfactants, and brighteners that can potentially harm the bacteria within the WWTP's secondary-treatment system. In addition, solvents, oils, and other substances removed from soiled laundry have the potential to release contaminants into the waste-stream. To minimize this potential, the laundry installed a pretreatment system during 2002 that included pH buffering with acid to neutralize excessive increases in wastewater alkalinity that can potentially interfere with the plant's treatment process. As described in Section 3.5.1 on Page 3-14, further improvements to the buffering system were made in late 2018. Monitoring of the laundry's effluent throughout 2021 confirmed the efficacy of the improved pretreatment system.

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<sup>1</sup> City of Morro Bay Sewer System Management Plan, originally approved June, 2009, reapproved June, 2014. City of Morro Bay Public Services Department, Wastewater Collections Division

<sup>2</sup> [CSD Ordinances.pdf](#)

## 4.0 THROUGHPUT

Flow through the plant during 2021 remained well below both the plant’s design capacity and the limits established in the NPDES discharge permit. The waste discharge requirements (RWQCB 2018a) state that the “*peak seasonal dry weather flow shall not exceed a monthly average of 2.36 [MGD].*” Plant throughput never approached this flow limit during 2021 (Table 5.1 on Page 5-1 later in this report), not even during winter (October through March) when the limit does not apply because increased I&I<sup>1</sup> from precipitation events is expected. The highest average monthly flow, 1.115 MGD in July, was less than half of peak dry weather limit.

Over shorter periods, intense winter storms can markedly increase plant throughput and potentially impact plant performance. As described in Section 4.2 on Page 4-2, inflow into the collection system from surface runoff during these rainfall events contributes little to the overall annual plant flow because they tend to be infrequent and brief. However, sudden, very large and unexpected increases in plant flow can be challenging for the treatment process to accommodate. One such extreme inflow event occurred at the end of January when a three-day storm deposited 5.4 inches of rainfall within the collection areas (solid black spikes at the bottom of Figure 4.1). This event contributed 6.2 MG of inflow to plant throughput and resulted in a record-high daily flow of 3.654 MGD on January 28<sup>th</sup> that was the highest daily flow measured in two decades (dashed line in the Figure).

As discussed in the following subsections, obvious excursions in several in process-performance parameters were reported around that time because of the rainwater inundation. For example, the highest daily TSS and BOD mass emissions arose largely because of the sheer volume of the discharge, although concurrent excursions in TSS concentrations and turbidity measurements reflected increased turbulence within the solids process. More importantly, high flow speeds within the disinfection process significantly reduced detention time and resulted in a historically high total coliform density measurement that exceeded the instantaneous coliform limit (see Section 5.8 on Page 5-12).

### 4.1 CSD FLOW CESSATION

On September 14<sup>th</sup>, the CSD permanently discontinued discharge from its collection system into the MBCSD WWTP. This resulted in an abrupt 0.277 MGD decline in plant throughput (Figure 4.1). Based on flow measured in the days preceding cessation, the plant can be expected to process approximately three-quarters (72%) of its historical wastewater volume.<sup>2</sup>

Despite the flow reduction, the character of the wastewater is not expected to change. The design, maintenance, and age of the collection systems within the respective service areas are similar, as are the largely residential communities that contribute wastewater to the

Table 4.1 Source Contribution to Flow

Source	Time Span		
	With CSD (257 days)	Without CSD (108 days)	Year (365 days)
Base Load	0.606 MGD (83.4%)	0.207 MGD (92.0%)	0.812 MGD (85.4%)
Infiltration	0.082 MGD (11.3%)	0.012 MGD (5.3%)	0.094 MGD (9.9%)
Inflow	0.017 MGD (2.3%)	0.006 MGD (2.7%)	0.023 MGD (2.4%)
Tourism	0.022 MGD (3.0%)	0.000 MGD (0.0%)	0.022 MGD (2.3%)
Combined Sources	0.727 MGD (100.0%)	0.225 MGD (100.0%)	0.951 MGD (100.0%)
Fraction of year	70.4%	29.6%	100.0%
Annual flow fraction	76.4%	23.6%	100.0%

<sup>1</sup> Inflow (of rainwater) and Infiltration (of groundwater)

<sup>2</sup> The running monthly mean flow rate (solid line in Figure 4.1) was 0.978 MGD on September 13<sup>th</sup> and 0.704 MGD two days later, indicating a drop of 0.274 MGD, or 28%.

systems. This is likely to be the case even though the 2021 source analyses conducted before and after CSD input suggests otherwise (Table 4.1).

For example, the percentages in the first two data columns of the Table incorrectly suggest infiltration and tourism sources were proportionally higher when the CSD was conveying wastewater to the treatment plant. However, these apparent differences were an artifact of the seasonality of these flow source contributions. In Figure 4.1 and, as discussed in the following subsections, the 3% seasonal tourism contribution was deliberately limited to the summer timeframe and thus, was not captured by the post-CSD throughput (0%). Similarly, the flow-transition threshold between the “Infiltration” and “Base Load” flowrates was also a function of time. As described in the following subsection, the infiltration threshold was selected to capture fluctuations in groundwater level that were related to seasonal rainfall. Because of these timing artifacts, the source-contribution proportions shown in the third data column better characterize the overall wastewater composition during 2021 and thereafter.

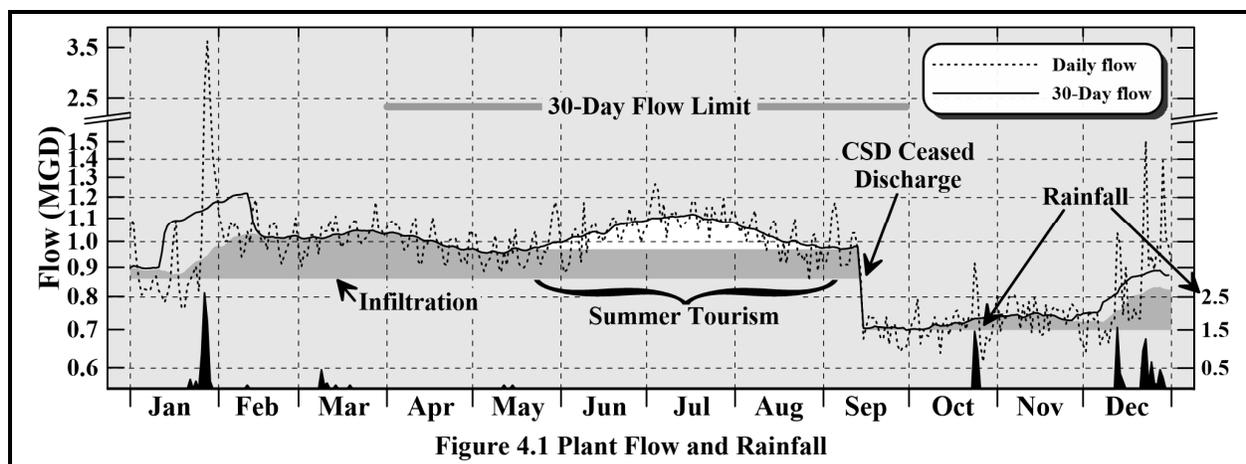


Figure 4.1 Plant Flow and Rainfall

## 4.2 INFLOW AND INFILTRATION

Rainfall is an external factor that perceptibly affects plant throughput in two ways: through direct inflow of rainwater into the collection system, and via increased infiltration of groundwater resulting from a longer-term increase in water-table elevation. Chapter 4 of the OneWater Plan<sup>1</sup> report (Morro Bay 2018a) characterized flow impacts from I&I within the City of Morro Bay’s collection system. This detailed I&I analysis was based on flow monitoring that was conducted throughout the City’s collection system during 2017 (Morro Bay 2018b).<sup>2</sup> These studies found that rainwater inflow into the collection system was closely related to the intensity of the rainfall event. Although brief, inflow determines peak wastewater flow rates that dictate downstream pipeline and lift-station design capacities. Infiltration, on the other hand, is not easily ascribed to individual rainfall events. Instead, infiltration occurs throughout the year, although it is typically higher in late winter and early spring when the cumulative effect of rainfall increases groundwater elevation. Infiltration impacts wastewater treatment by increasing the cost of pumping and treating the additional volume of water.

I&I contributions to plant throughput during 2021 can be estimated from the rainfall and wastewater flow data shown in Figure 4.1. The clusters of solid black spikes at the bottom of the Figure depict the duration

<sup>1</sup> Section 4.2 on Page 4-9 (Sequential Page 107) <https://www.morrobayca.gov/DocumentCenter/View/12500/OneWater-Plan-Final>

<sup>2</sup> *Ibid.* Appendix F on Sequential Page 425

and intensity of four major and three minor rainfall events during 2021. Together, these events deposited 15.9 inches of rainwater within the collection-system's service area. The four major events accounted for 14.7 inches of rainfall and include the 5.8-inch January storm series, and the pair of December events that deposited 6.4 inches of rain when the plant was receiving input from the City's collection system alone. The duration and intensity of these events produced brief but perceptible increases in daily plant throughput that are visually apparent as slightly delayed, sharp upward excursions in the dashed line. Short-term flow increases resulting from the remaining 1.2 inches of rainwater inflow during the less-intense rainfall events in March and May are not readily apparent.

In contrast, inflow during the intense rainfall event in January led to the three highest daily plant flow measured during the year. During 2021, this and the other three short-term inflow events contributed 8.5 MG of rainwater to the wastewater processed by the treatment plant.<sup>1</sup> However, because these events were episodic and brief, rainwater inflow only contributed 2.4% to the 347 MG of wastewater processed by the plant during 2021 (last column of Table 4.1 on Page 4-7).

Although rainfall events during 2021 were infrequent and brief, they influenced monthly plant flow, which is an important parameter in compliance evaluations (first data column in Table 5.1 on Page 5-1). For example, the large three-day spike in daily plant flow at the end of January (dashed line Figure 4.1), produced an obvious sloped-plateau feature in the 30-day<sup>2</sup> moving-average flow (solid line) during the time when the moving window encompassed the flow spike. Even on February 10<sup>th</sup>, when the monthly running mean flowrate reached a peak of 1.22 MGD, it was only half of the 2.36-MGD 30-day flow limit that applies during the dry season (shown by the thick shaded flat line at the top of the Figure). This demonstrates that the plant complied with the long-term flow limit throughout the year, and not just at the end of each month when compliance is officially evaluated (Table 5.1). It also demonstrates that the flow easily met this dry season limit, even during the rainy season, when the limit does not technically apply.<sup>3</sup>

Compliance evaluations aside, rainfall's influence on groundwater infiltration into the collection system is an important diagnostic factor in assessments of collection-system and plant performance. The fluctuating influence of infiltration is quantified in the darker shaded region of Figure 4.1. It removes much of the influence of large but brief rainwater inflow events tracked by the solid line by excluding them from the 30-day moving average. This provides an upper-bound estimate of the contribution of groundwater infiltration contribution to plant throughput, particularly from sustained periods of increased water-table elevation after rainy periods.

For example, excluding flow during the 3-day January rainfall event eliminated the sloped plateau seen in the solid line and revealed a steady long-term plant-flow increase in the shaded region that began around the time of the rainfall event and extended into mid-February. Infiltration remained at that level through the end of March, after which the slow decline into mid-May presumably reflected the slowly declining groundwater level in the absence of significant recharging by rainfall. The subsequent increase in long-term plant throughput, shown in white and described in the following subsection, was related to increased

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<sup>1</sup> The cumulative rainwater inflow during 2021 was determined from the difference in the area beneath the daily-flow trace in the Figure (dashed line) and the top of the shaded region, which is the 30-day running mean flow excluding 12 days when plant throughput briefly increased during, and shortly after, rain events.

<sup>2</sup> By necessity, the Figure uses a 31-day time window because a centered moving average is symmetric around the day in question (15-days on each side). In contrast, "monthly" compliance tests are retrospective and not constrained to an odd number of days. Their "monthly" average spans the 30 days prior to and including the last day of the month. To facilitate comparison with monthly permitted limits, the graphics in this report use the term "30-day" because the one-day difference in the averaging window is immaterial for compliance evaluations.

<sup>3</sup> If the leading edge of the averaging window for the peak of the sloping plateau in the figure happened to coincide with the last day of February, then the February average flow in Table 5.1 would have been the highest monthly flow (1.22 MGD) instead of the July maximum (1.115 MGD) currently identified as the maximum monthly flow for 2021.

seasonal-tourist populations within the service area. Sustained periods of infiltration-related increases in long-term flow are apparent after the October and mid-December rainfall events.

After excluding increased flow from seasonal tourism, the shaded portion of the flow time series indicates that at least 34.2 MG of groundwater flowed into the collection system from infiltration during and after rainy periods.<sup>1</sup> Although the lower-bound estimate of infiltration only represents 9.9% of total plant throughput, the long-term influence of rainstorms was fourfold more significant than inflow during brief but intense inflow events (last column of Table 4.1).

### 4.3 SEASONAL POPULATIONS

Throughput resulting from seasonal and holiday increases in tourist populations was also quantified for the City's collection system as part of the OneWater plan development. However, COVID-19 restrictions undoubtedly suppressed tourist-generated wastewater during 2021. Nonetheless, the influence of short and long-term tourism trends on plant flow were still apparent. Most obvious was the long-term influence of increased summer populations within the service areas that produced an upward bow in the 30-day moving average plant flow (solid line from late May through early September in Figure 4.1). The height and duration of this summer-season increase indicates that the treatment plant processed an additional 8.1 MG of wastewater during the summer of 2021 (last column of Table 4.1).<sup>2</sup> Although this additional wastewater volume was comparable to that of rainwater inflow during fall and winter, the seasonal-population contribution represents wastewater of sewage origin and is considered more challenging to process than rainwater. Nevertheless, at its 1.12 MGD peak in mid-July, the 30-day flow was less than half of the monthly allowance for peak dry-season flow shown by the thick shaded line that spans the 'dry' season (April through September) in Figure 4.1. Shorter-term increases in flow arising from tourism are also apparent around the Memorial, Independence and Labor Day holidays in late May, and at the beginning of July and September (dashed line in Figure 4.1).

### 4.4 FLOW REVISIONS

Daily plant throughput is typically determined by summing high-frequency readings from the influent flow meter. The influent data are used because they are based on a precision transducer that measures water levels within a specially designed flume. Generally, the influent-meter total are considered more reliable than the effluent meter's mechanical impeller, which is known to overtotalize the actual flow when flow rates are high. However, the overtotalization by the effluent meter is quantifiable and consistent, which allows influent and adjusted-effluent meter readings to be used interchangeably to quantify the daily wastewater volume processed by the plant.

Meter redundancy is valuable because the influent flow meter can report erroneously high values on rare occasions. Typically, these outliers are obvious in the flow record and result from easily identifiable causes. Such causes include surcharging of the influent trunk line during major rain events, or during

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<sup>1</sup> The actual contribution from groundwater inflow into the collection system is undoubtedly larger, but by assuming a baseline at the lowest 30-day flow measured during the past three years (0.86 MGD in 2019), at least 29.9 MG of plant flow can be unambiguously ascribed to the influence of water-table fluctuations resulting from rainfall between 1 January 2021 and 14 September. During the subsequent period without CSD input, a low-flow baseline of 0.70 MGD results in an additional 4.3 MG of flow that can be ascribed to infiltration.

<sup>2</sup> The white area beneath the 30-day flow (solid line) accounts for 8.1 MG of wastewater throughput. It spans the time from May 20<sup>th</sup> through September 7<sup>th</sup> when daily plant flows were close to 0.9868 MGD. The timespan encompasses the both the Memorial and Labor Day holidays.

periods when inflow at the headworks is intentionally reduced to facilitate equipment repair. On those occasions, water backs up into the influent meter's flume and artificially increases the measured water level. When that happens, the original, potentially inflated daily flow from the influent meter is still reported in the CIWQS<sup>1</sup> database for compliance-evaluation purposes. However, when plant personnel suspect, or have direct knowledge that the influent flow reading is inaccurate or compromised, they provide a description of the event in the monthly monitoring form and include an estimate of the actual flow along with the computational rationale for the estimate. Often, this corrected value is based on effluent flow readings adjusted downward to account for that meter's overtotalization. None of these types of corrections were noted in the CIWQS monthly compliance reports during 2021.

Nevertheless, this report's throughput analysis is based daily flow values that often depart slightly from the flows reported in the CIWQS database. The principal advantage of this revised flow dataset is its precise determination of the relationship between influent and effluent flow meters, so data from one meter can be used when the other meter reports potentially anomalous data. Additionally, the revised data provides a marginally more accurate representation of actual plant throughput for use in rigorous assessments of plant performance. For example, the revised dataset enabled detailed determination of the flow-response during rainfall events and seasonal tourism that are described above. Additionally, it provides updated evaluations of various parameters considered diagnostic of plant performance, and that are limited by the discharge permit. In addition to an improved determination of available plant-flow capacity, use of corrected flow values in conjunction with chemical concentrations reliably establishes their mass loading to the marine environment. These chemical mass-emissions are compared to goals that were established from historical measurements to assess whether pollutant loading has significantly increased.

Appendix Table C.2 lists adjustments to 151 of the 365 reported daily flows that were applied in this report, along with the rationale for each individual revision. Most of the revisions were minor, and their combined 3.86 MG volume only amounts to a 0.011 MGD (1.1%) reduction in the 0.962 annual average flow determined from CIWQS submissions.<sup>2</sup> These flow revisions did not alter conclusions regarding compliance with the discharge permit during 2021.

Five of the 151 revisions consisted of minor mismatches between the flow database and CIWQS-reported flow that resulted from transcription errors. They accounted for only a 0.447 MG reduction in the flow reported during 2021. Twenty-eight revisions involved differences in the time of day that daily totals from each meter were reported. As a result of totalization-time offsets, the influent flow reported on a given day appeared unusually high (or low) compared to effluent flow. On the following day, the opposite is usually observed where the influent meter flow report appears unusually low (or high). Thus, flow discrepancies related to meter recording time tend to be offset by opposite discrepancies on the preceding or following days. Consequently, they had negligible influence on average monthly or annual flows reported by either meter. However, they produce large outliers in the comparison of pairs of daily meter readings that unduly influenced the determination of the overall relationship between the two meters.

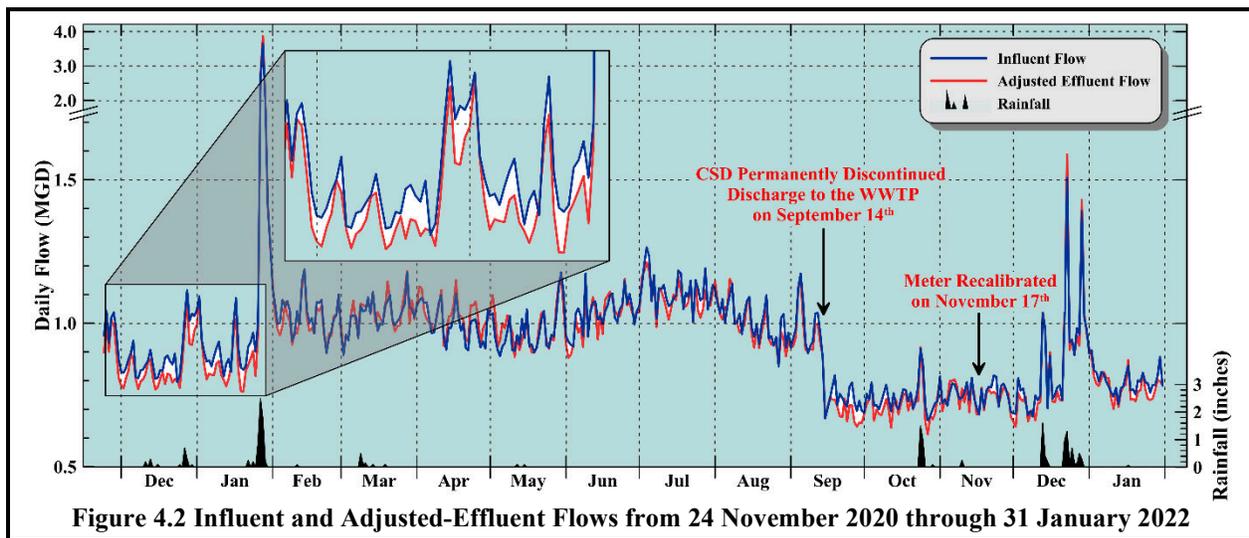
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<sup>1</sup> California Integrated Water Quality System Project

<sup>2</sup> All the plant data analyzed and reported-on within this report, including the annual average flow of 0.951 MGD, are based on the revised flow readings.

#### 4.4.1 Influent Meter Overtotalization at Low Flow

The 118 (81%) remaining flow revisions corrected slight influent-meter inaccuracies when flowrates dropped below 1.1 MGD. Because of the large number of these small revisions, their cumulative 3.1 MG reduction in annual flow contributed to most of the 3.86 MG total of all types of revisions combined. Low-flow influent meter inaccuracies result in overestimates of daily flow compared to the effluent meter (white shading between the offset blue and red lines in the inset of Figure 4.2). As described in the following section, the adjusted effluent flow normally closely tracks the flow reported by the influent meter. However, at low flow, the visible difference in the waveforms suggests that the influent meter overestimates daily flow by not fully capturing the very-low, or no-flow conditions that occur during the late evening and early morning hours.



Low-flow inaccuracies associated with the influent meter’s 27-inch Palmer-Bowlus flume are well documented in the flume’s User Manual, and associated NPDES inspection guidance. The User Manual (OpenChannelFlow n.d.)<sup>1</sup> states that the accuracy of the Palmer-Bowlus flume ranges between  $\pm 3\%$  and  $\pm 5\%$  under normal operating conditions; namely when the water level (head) in the flume is large in comparison to the length of the throat of the flume. For lower flows, when the head is small compared to throat length, the reported accuracy error range increases to between  $\pm 5$  and  $\pm 6\%$ . This low-flow decrease in accuracy reflects the increased influence of the boundary layer at low flows. In contrast, the impeller-based effluent flow meter does not have the same fluid-dynamics-related limitation at low flows because it continues to spin even within the smallest flow.

Because of the boundary-layer influence, flumes are normally sized according to expected flow range (Table 4.2 on the following page). NPDES guidance does not recommend a 27-inch flume size when flow rates consistently range below 0.945 MGD. When these low flow rates occur over a significant portion of the 24-hour daily flow-measurement period, a smaller flume is recommended. These low-flow measurement issues were exacerbated when CSD wastewater input was discontinued on September 14<sup>th</sup>. Regardless, retrofitting the existing influent flume or installing a smaller flume is unwarranted given that data from the effluent flow meter can be used in its place.

<sup>1</sup> Page 3 (Sequential Page 6) in [https://www.openchannelflow.com/assets/uploads/documents/Palmer-Bowlus\\_Flume\\_Users\\_Manual.pdf](https://www.openchannelflow.com/assets/uploads/documents/Palmer-Bowlus_Flume_Users_Manual.pdf)

Nevertheless, the influent meter should continue to be calibrated annually. Calibration can lend insight into flow thresholds where adjusted effluent-meter data may provide better accuracy. For example, the calibration conducted in November 2021 indicated that transducer drift was smallest at flows below 2 MGD (Table 4.3). The forgoing discussion suggests that boundary-layer influences become problematic at flows below 1 MGD. This suggests that influent-meter measurements collected during 2021 were most accurate at flow rates somewhere between 1 and 2 MGD. Additionally, because the calibration found no substantive sensor drift during 2021, the influent and effluent time series remained visually consistent before and after November 17<sup>th</sup> (Figure 4.2 on Page 4-6). This finding supports using data from the Figure’s entire 14-month time span to determine the relationship between the two flow meters that is described below.

#### 4.4.2 Effluent Meter Overtotalization at High Flow

The preceding discussions demonstrate the value of having contemporaneous flow measurements, despite the tendency for both meters to marginally overtotalize the flow within different flow regimes. The availability of precise and closely matching measurements also provides valuable redundancy in the event that either meter is taken offline for repairs or calibration, or when influent meter’s readings are compromised by surcharging within the metering flume.

This meter interchangeability is only possible because of the close correspondence between the meters when they are both functioning optimally, which was the case throughout the uninterrupted 434-day timespan shown in Figure 4.2. It justifies the use of an adjusted effluent-meter reading when the influent meter’s output is clearly compromised. This results in a continuous time series of flow data that is more reliable than data from either meter alone. Flow reported by the influent meter is shown by the blue time series in Figure 4.2. The red time series was determined from effluent-meter readings that were adjusted to account for its historical tendency for overtotalization.

To ensure that the adjustments to effluent flow readings continue to be as accurate and timely as possible, the coefficients in the adjustment equation are recomputed at least annually, when major modifications are made to the meters or flow system, or when recalibration of the influent flow meter results in a substantial correction in its readings. The revised effluent-meter adjustment equation was determined from a linear regression of flow data recorded by both meters after the last influent-meter calibration on 23 November 2020. As described above, the subsequent recalibration of the influent meter on 17

**Table 4.2 Flow-Rate Accuracy Limits for Palmer-Bowlus Flumes<sup>1</sup>**

Flume Size (Inches)	Minimum		Maximum	
	Head (Inches)	Flow (MGD)	Head (Inches)	Flow (MGD)
6	1.3	0.023	4.3	0.203
8	1.8	0.048	5.9	0.433
10	2.2	0.079	7.3	0.752
12	2.6	0.128	8.8	1.18
15	3.2	0.216	10.9	2.06
18	4.0	0.355	13.1	3.24
21	4.6	0.504	15.4	4.81
24	5.3	0.721	17.5	6.70
27	5.9	0.945	19.7	8.95
30	6.6	1.260	21.8	11.6

**Table 4.3 Flow Error Rates from the Influent Meter Calibration conducted on 17 November 2021<sup>2</sup>**

Benchmark		Meter		Error <sup>3</sup>	
Head (Inches)	Flow (MGD)	Head (Inches)	Flow (MGD)	Head (%)	Flow (%)
0.0	0.000	0.0	0.000	—	—
3.0	0.302	3.0	0.300	0.00%	0.29%
6.0	0.971	6.0	0.972	0.00%	0.06%
9.0	1.974	9.0	2.016	0.00%	2.11%
12.0	3.375	12.0	3.419	0.00%	1.28%

<sup>1</sup> Adapted from Table O-6 on Page 596 (Sequential Page 13) in Appendix O of USEPA (2017): <https://www.epa.gov/sites/production/files/2017-03/documents/npdesinspect-appendix-o.pdf>

<sup>2</sup> Adapted from the calibration certificate for the MBCSD influent meter that is reproduced in Appendix D of this report

<sup>3</sup> Note that the error rate for 6-inch-head measurement in the calibration table (Appendix D.2 of this report) was not updated from those of the prior calibration on 23 November 2020 (Appendix D of the 2020 Annual Report [MRS 2021a]). The correct error rate for the 21 November 2021 calibration is shown in this table and in Appendix D.1 of this report.

November 2021 did not result in substantive temporal changes in its readings, so the regression time series spans the entire 14-month period shown in Figure 4.2. The adjustment equation determined from these data (Equation 4.1) found that actual flow was 83.1% of the original uncorrected effluent meter readings. This revised adjustment factor differed little from that of the prior year when the actual flow was found to be 88.8% of the effluent meter’s data (MRS 2021a).

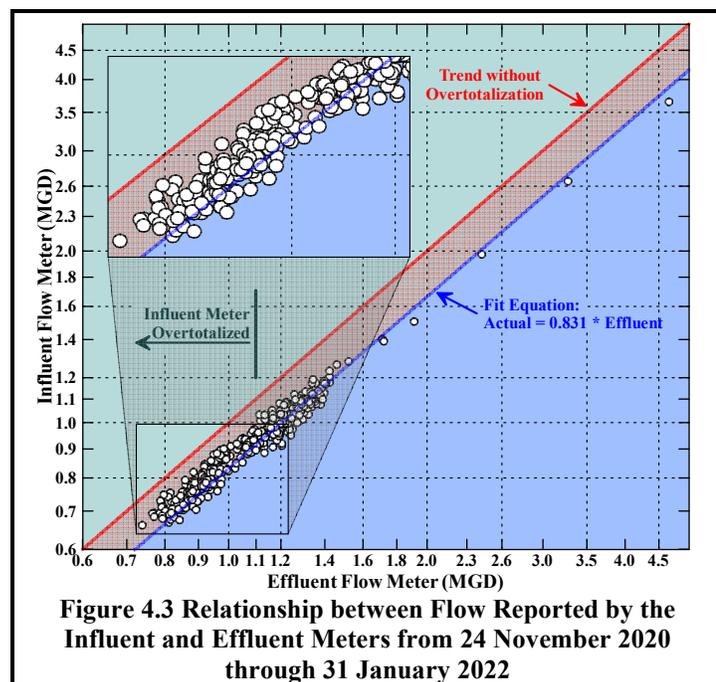
$$A = 0.831 \times E \quad \text{Equation 4.1}$$

where:  $A$  = the actual plant flow in MGD, and  
 $E$  = the flow measured by the effluent meter.

Equation 4.1 applies across a broad range of plant throughput. By excluding low-flow influent data, the recommended zero-intercept equation provides excellent agreement between the adjusted-effluent and target flow data. This suggests that the currently recommended adjustment equation can be used with confidence over the upcoming year, barring major physical changes to the meters. Equation 4.1 was determined from a linear regression of 241 pairs of daily flow observations that were measured by the influent and effluent meters after the prior influent-meter calibration on 23 November 2020, and when effluent flow exceeded 1.1 MGD, which is equivalent to an actual flow of 0.915 MGD.

Despite its emphasis on high flow rates, Figure 4.3 shows that the prediction equation, shown in blue, closely matches the relationship between the entire set of 434 pairs of data recorded since 23 November 2020. However, as shown by the inset, the equation underestimated most of the measured influent flows when they dropped below 0.915 MGD. These data were excluded from the regression because they reflect the influent meter’s tendency to overtotalize low flows that was described in the previous subsection.

In general, the Figure demonstrates that the effluent meter’s overtotalization remains significant and that an adjustment of its readings remains necessary for interchangeability. For comparison, the red line in Figure 4.3 displays the relationship between the influent and effluent meters that would be expected in the absence of overtotalization by the effluent meter, namely, the same readings from each meter. That relationship



**Figure 4.3 Relationship between Flow Reported by the Influent and Effluent Meters from 24 November 2020 through 31 January 2022**

departs significantly from the scatter among the cloud of white points surrounding the blue regression line in the Figure, which represent the actual post-calibration measurements made by each meter. At low flows around 1 MGD, the effluent meter overestimates actual flow by 0.2 MGD, at flows near 2 MGD, the required adjustment to the effluent-meter readings are twice that much.<sup>1</sup>

<sup>1</sup> Note the logarithmic axes in the Figure.

## 5.0 WASTEWATER PROPERTIES

Monthly characterizations of wastewater properties documented several different aspects of the treatment plant's performance during 2021 (Table 5.1). Removal rates quantified the plant's ability to reduce major organic constituents within the waste-stream. Effluent concentrations characterized the overall quality of effluent discharged through the ocean outfall, while mass emissions quantified the cumulative load of wastewater constituents introduced into the marine environment. Monthly averages listed in Table 5.1 depart slightly from the averages reported to CIWQS for the variety of reasons listed in Table C.1 of Appendix C. None of the differences were substantive, and none changed the outcome of compliance analyses.

Table 5.1 Monthly Averages of Influent and Effluent Parameters

Month	Flow (MGD)	Suspended Solids				Biochemical Oxygen Demand			
		Influent (mg/L)	Effluent (mg/L)	Removal (percent)	Emission <sup>1</sup> (kg/day)	Influent (mg/L)	Effluent (mg/L)	Removal (percent)	Emission <sup>1</sup> (kg/day)
January	1.087	420	44.2	89.5	182	262	53.0 <sup>2</sup>	79.7	218
February	1.033	410	28.6	93.0	112	258	42.0	83.7	164
March	1.027	446	42.6	90.4	166	263	51.2	80.5	199
April	1.002	421	36.9	91.2	140	279	40.0	85.7	152
May	0.973	333	24.4	92.7	90	220	35.5	83.9	131
June	1.030	416	24.3	94.2	95	379	44.0	88.4	171
July	1.115	408	25.2	93.8	107	280	45.0	83.9	190
August	1.009	353	21.8	93.8	83	360	27.3	92.4	104
September	0.828	386	25.8	93.3	81	306	32.8	89.3	103
October	0.716	350	27.2	92.2	74	295	36.0	87.8	98
November	0.748	278	18.3	93.4	52	203	23.5	88.4	67
December	0.849	222	16.8	92.4	54	224	29.0	87.1	93
<b>Average</b>	<b>0.951</b>	<b>370</b>	<b>28.1</b>	<b>92.4</b>	<b>101</b>	<b>279</b>	<b>37.5<sup>2</sup></b>	<b>86.5</b>	<b>135</b>
<b>Monthly Limit<sup>3</sup></b>	<b>≤2.36<sup>4</sup></b>		<b>≤70</b>	<b>≥75.0</b>	<b>≤546</b>		<b>≤120</b>	<b>≥30.0</b>	<b>≤936</b>
<b>Annual Total (MT)</b>					<b>37</b>				<b>49</b>
<b>Nominal Annual (MT/year)</b>					<b>≤199</b>				<b>≤342</b>

(Continued on the next page)

<sup>1</sup> For the reasons described in Appendix C.1, most emissions listed in this table depart perceptibly from those reported to CIWQS. Often, the difference arises because the average monthly emissions in this table were computed from the product of average monthly flow and concentration rather than the average of individual emissions computed from a concentration and flow reported on a given day.

<sup>2</sup> The median is listed instead of the average because the concentration determined within one of the four samples collected in January was censored, namely, below the 8.7 mg/L detection limit (see Appendix C.1).

<sup>3</sup> Interim limits are listed for TSS and BOD as specified in the TSO

<sup>4</sup> Peak Seasonal Dry-Weather Flow (PSDWF)

Table 5.1 (continued) Monthly Averages of Influent and Effluent Parameters

Month	pH		Turbidity (NTU)	Settleable Solids (ml/L)	Median <sup>1</sup> Total Coliform (MPN <sup>2</sup> /100ml)	Oil and Grease	
	Influent	Effluent				Effluent (mg/L)	Emission (kg/day)
January	7.9	7.4	39	<0.1	<2	≈1.2	≈4.9
February	7.9	7.5	27	<0.1	2	≈1.2	≈4.7
March	7.9	7.6	39	<0.1	2	≈1.6	≈6.2
April	8.1	7.5	32	<0.1	<2	≈1.4	≈5.3
May	7.9	7.7	25	<0.1	2	<0.74	<2.7
June	8.0	7.5	23	<0.1	<1.8	<0.74	<2.9
July	7.9	7.6	25	<0.1	2	<0.74	<3.1
August	7.9	7.6	19	<0.1	5	<0.74	<2.8
September	7.8	7.5	22	<0.1	2	<0.74	<2.3
October	7.7	7.5	32	<0.1	2	<0.74	<2.0
November	7.7	7.4	22	<0.1	2	<0.74	<2.1
December	7.8	7.5	20	<0.1	<1.8	<0.74	<2.4
<b>Average</b>	<b>7.9</b>	<b>7.5</b>	<b>27</b>	<b>&lt;0.1</b>	<b>2</b>	<b>&lt;0.74</b>	<b>&lt;2.7</b>
<b>Monthly Limit</b>		<b>6-9</b>	<b>≤75</b>	<b>≤1.0</b>	<b>≤23</b>	<b>≤25.0</b>	<b>≤195</b>

Treatment-plant personnel periodically collected wastewater samples throughout 2021. Results from the analyses of those samples were used to compute the monthly averages of the principal influent and effluent characteristics listed in Table 5.1. Laboratory analyses of influent and effluent samples quantified the principal physicochemical properties of the wastewater stream by determining concentrations of TSS, BOD, settleable solids, O&G, total residual chlorine (TRC), ammonia, and nutrients. Other analyses measured wastewater temperature, scattered light (turbidity), coliform density, basicity (pH), and toxicity.

The frequency and the duration of individual sampling and testing events varied among the parameters. For example, average reductions in suspended solids and BOD were determined from 24-hour composite samples of both influent and effluent that were collected and analyzed at least weekly. For the remaining properties, the permit requires analyses of effluent samples alone, although the treatment plant personnel continued influent pH determinations that coincided with effluent measurements twice each week during 2021. Effluent temperature, TRC, plant flow, and rainfall were recorded on a daily basis. Total coliform density and turbidity were measured within discrete effluent grab samples collected five days each week. Lastly, O&G and settleable solid concentrations were determined within effluent grab samples collected once per week.

Detailed analyses of these measurements confirm that, during 2021, the plant regularly exceeded wastewater treatment expectations established in regulatory standards and the original WWTP design criteria. Moreover, the plant has consistently discharged exceptionally high-quality effluent over its long history, and there has never been an indication of deteriorating plant performance. Rare exceptions to standards or criteria have been brief, and have often resulted from unavoidable repairs to, or mechanical failures of a treatment-system component. However, as a byproduct of a diligent preventative maintenance program, the plant has consistently operated at a high level of efficiency with little equipment down time.

<sup>1</sup> The current NPDES discharge permit requires reporting of the 30-Day Geometric Mean except when one or more values are censored, namely, below the quantification limit. In that case, the median is reported. Non-quantifiable coliform densities were present in every month of 2021.

<sup>2</sup> Most Probable Number

## 5.1 PARTICULATE LOAD

Suspended solids, turbidity, and settleable solids measure the particulate load within wastewater. One of the principal functions of the treatment process is to remove organic material from the waste-stream. As in the past, all measures of this particulate-removal capability unequivocally demonstrate that the treatment process was operating at peak performance throughout 2021. All complied with the interim limits specified in the TSO.

### 5.1.1 Suspended Solids

The treatment plant's continued high overall performance is particularly evident in its removal of nearly all (92.4%) of the solids from the influent stream during 2021 (Figure 5.1b; Table 5.1). In particular, the monthly solids removal rate significantly exceeded the 75% minimum required by the interim effluent limits in the TSO.<sup>1</sup> Moreover, the plant's removal rate even exceeded the 85% monthly removal rate established for full-secondary treatment. This minimum level of treatment is specified the TSO's final effluent limits that will apply in 2023, when the WRF is scheduled to be completed.

The WWTP achieved a TSS removal rate equivalent to full secondary treatment consistently throughout the year. All the 52 weekly pairs of influent and effluent samples exhibited reductions in TSS exceeding 87%. The secondary-treatment standard applies to monthly averages, and the treatment process easily achieved the benchmark in every month, and even exceed 90% removal in eleven months (Table 5.1). This high plant performance is expected because monthly plant flow remained close to 1 MGD, which allowed the majority to be processed through the secondary treatment process.

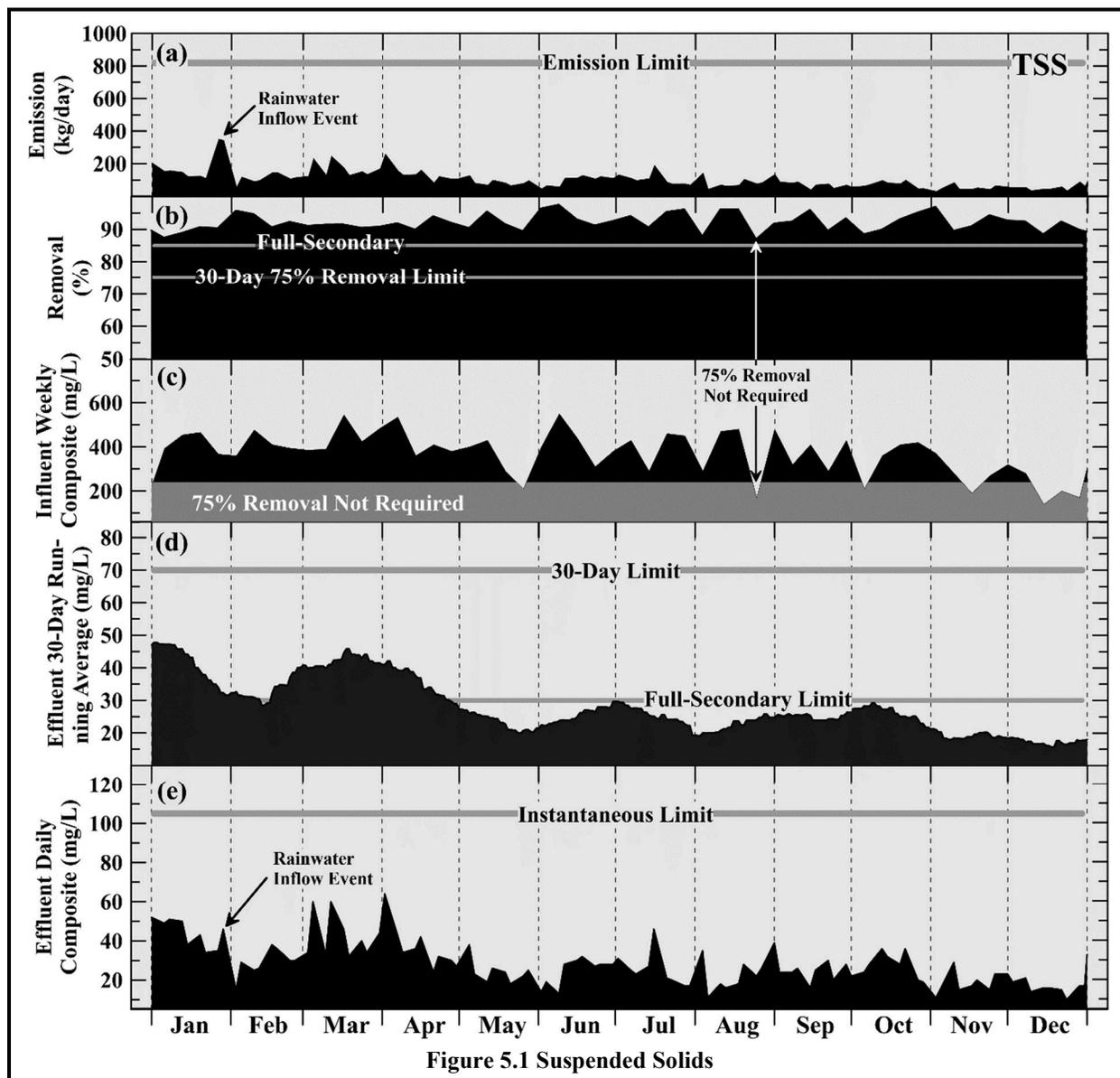
In fact, the few occasions when slightly lower removal rates were observed, the reductions were unrelated to overall plant performance (Figure 5.1b). This is apparent because the slight reductions did not coincide with reductions in effluent TSS concentrations (Figure 5.1e). Instead, they coincided with influent samples with unusually low solids loads, especially those with influent TSS concentrations below 240 mg/L (Figure 5.1c). For example, the lowest removal rate of 87.06% on August 25<sup>th</sup> coincided with an influent TSS concentration of only 170 mg/L (see the double arrow in the Figure). Clearly, the sub-240 mg/L influent concentrations are independent of plant performance and yet profoundly affect the effluent-influent ratio that determines removal rate.

Removal-rate limits specified in the COP, NPDES discharge permit, and TSO are technology-based requirements rather than ones that reflect the actual potential for environmental impacts within receiving waters. Regulators recognize that requiring a high removal rate is unnecessary when effluent TSS concentrations are low to begin with. Consequently, the applicability of the 75% monthly removal-rate limit specified in COP Table 2 is abrogated when the requirement would result in an effluent TSS concentration of less than 60 mg/L (COP Table 2 Notes in SWRCB 2015). Thus, application of the 75% removal-rate is questionable when influent TSS concentrations fall below 240 mg/L.<sup>2</sup> This occurred within seven of the 52 weekly influent samples, which are located within the gray-shaded region in Figure 5.1c. Despite these low influent TSS concentrations, the treatment process still consistently achieved removal rates above 87%, far exceeding the minimum 75% removal limit (Table 5.1 on Page 5-1).

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<sup>1</sup> This minimum removal rate is also promulgated in COP Table 2 (SWRCB 2015) which applies to dischargers for which Effluent Limitations Guidelines have not been established under the Federal Clean Water Act.

<sup>2</sup> 240 mg/L is four-times the 60-mg/L threshold on effluent concentration that determines the applicability of removal rate for compliance evaluations. This applicability threshold derives from the first note to Table 2 of the COP (SWRCB 2015), which states: "... the discharger shall remove 75% of suspended solids from the influent stream at any time the influent concentration exceeds four times [the effluent concentration limit]."



In contrast to plant-performance-related removal rates, the actual amount of solids discharged to the ocean directly determines the discharge’s potential for environmental effects. In that regard, daily mass emissions of suspended solids were uniformly low throughout 2021, and never reached even half of the TSO’s allowed amount (thick shaded gray line labeled “*Emission Limit*” in Figure 5.1a). Low overall effluent TSS concentrations, combined with low flow rates during 2021, resulted in an annual total solids emission that was well below the allowable solids emission (Table 5.1 on Page 5-1).<sup>1</sup> Over the entire year, the WWTP only discharged 37 MT of suspended solids into the ocean. That solids emission was merely 19% of the projected 199 MT that would have been discharged if effluent had contained the permitted

<sup>1</sup> As described in Table C.1 of Appendix C, the monthly TSS emissions listed in Table 5.1 depart from those reported to CIWQS in monthly reports. While CIWQS values follow compliance-reporting protocols, the values in Table 5.1 better reflect plant performance.

TSS concentration of 70 mg/L and annual throughput reached the average dry-weather design flow of 2.06 MGD.

The only notable excursion in TSS emission occurred because of higher effluent discharge at the end of January (Figure 5.1a). As described at the beginning of Section 4.0 on Page 4-1, rainwater inflow into the collection systems from a major winter storm produced record-high plant flow and resulted in noticeable excursions in several plant-performance parameters. TSS emission is one such parameter. Specifically, the two highest emissions reported during 2021, 351 kg/day on January 27<sup>th</sup> and 344 kg/day on January 29<sup>th</sup>, were 30% greater than the next highest emission reported during 2021. In contrast, the associated effluent concentrations used in the emission computation were not particularly elevated (Figure 5.1e). Thus, the noticeably higher TSS emissions were primarily a result of increased plant throughput rather than some issue related to the solids process.

Unlike time-averaged summary statistics described above, individual daily and weekly measurements are neither diagnostic of overall plant performance nor the potential for long-term marine environmental effects from the discharge. Despite fluctuating day-to-day effluent TSS concentrations (Figure 5.1e), both calendar month-end averages (Table 5.1) and the 30-day moving average (Figure 5.1d) remained well below the monthly limit of 70 mg/L. This is because only three of the 105<sup>1</sup> daily effluent samples had perceptibly higher concentrations. The rest never ranged above half of the 105-mg/L instantaneous maximum limit specified in the TSO. These three slightly elevated measurements<sup>2</sup> are readily apparent in Figure 5.1e as completely isolated excursions that are visually unrelated to the measurements on surrounding days. If a decline in plant performance had caused these excursions, then elevated TSS concentrations would be expected in other samples collected around the same time.

### **5.1.2 Turbidity**

Turbidity measures the optical clarity of an effluent sample and as such, is a somewhat independent measure of solids content. Turbidity levels within individual daily grab samples were uniformly low, and all comfortably complied with the effluent limits specified in the NPDES permit. Month-end (Table 5.1 on Page 5-2) and 30-day moving averages (Figure 5.2a on Page 5-6) never exceeded 57% of 75-NTU monthly limit. Over shorter periods, the 7-day moving averages remained less than 55% of the 100-NTU weekly limit (Figure 5.2b).

Similarly, 259 of the 261<sup>3</sup> daily turbidity measurements remained at or below 61 NTU, which is only 27% of the allowed 225-NTU instantaneous limit (Figure 5.2c).<sup>4</sup> The effluent samples collected on January 27<sup>th</sup> and October 25<sup>th</sup> had noticeably higher turbidities (89 and 73 NTU) that were caused by inflow of turbid rainwater during the two largest rainfall events of the year (Figure 4.1). Although effluent turbidity measurements directly quantify the discharge's potential to impact seawater clarity offshore, they are less diagnostic during rainstorms when sediment-laden runoff causes visible discoloration of coastal sea water.

Nevertheless, offshore discharges have the potential to reduce ambient light transmission, and the offshore water-quality monitoring program that was required in prior permits included measurements of seawater clarity within the water column surrounding the outfall. Over the past 30 years, 99 receiving-water surveys have been conducted using a multi-sensor instrument package that included high-resolution

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<sup>1</sup> Effluent TSS concentrations were determined within effluent composite samples twice per week even though the current permit only requires an analysis frequency of once per week.

<sup>2</sup> 60 mg/L on March 2<sup>nd</sup>, and 60 mg/L on March 5<sup>th</sup> and 12<sup>th</sup>

<sup>3</sup> The current permit's requirement for turbidity determinations is five times per week.

<sup>4</sup> Note the logarithmic scale along the Y-Axis in Figure 5.2bc

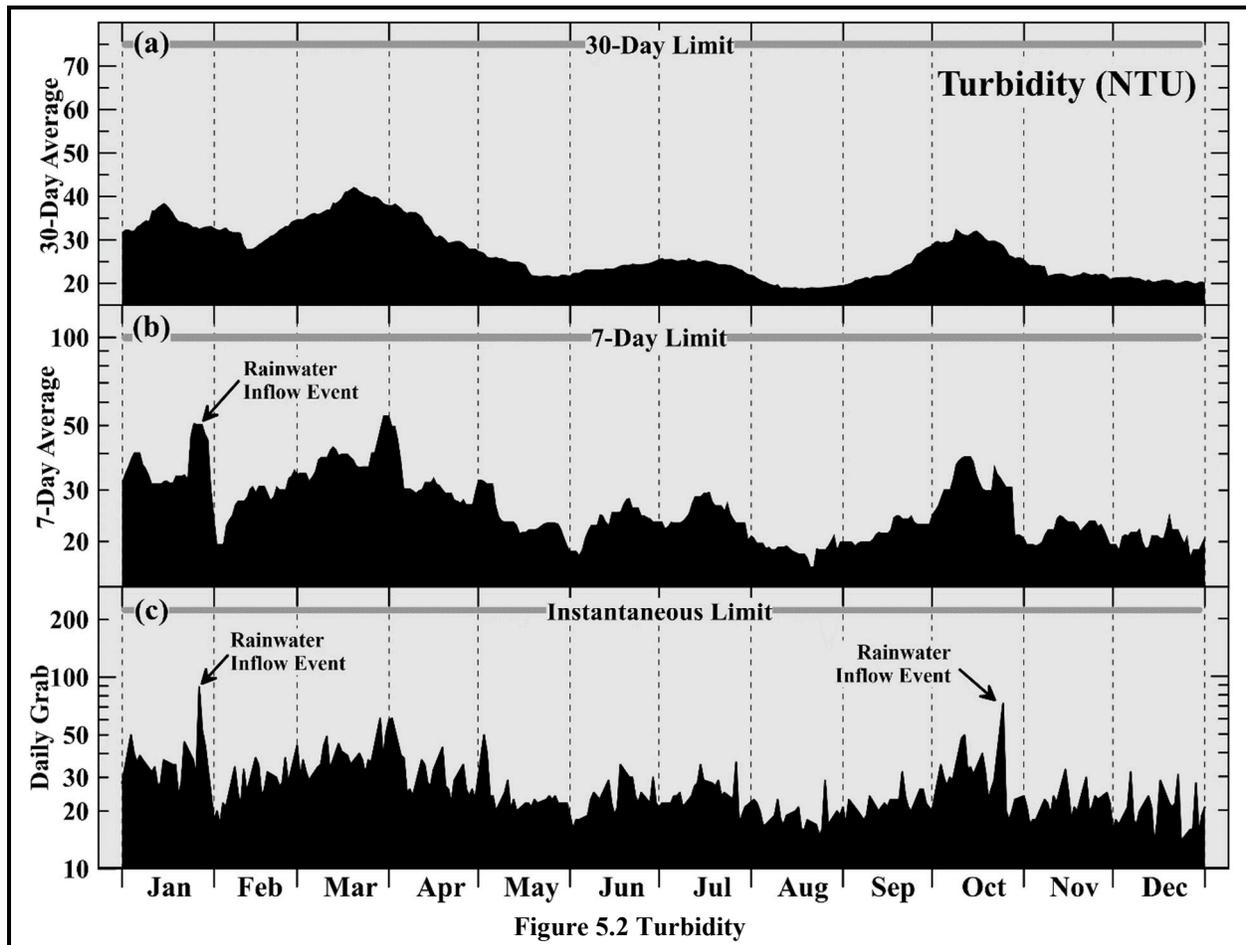


Figure 5.2 Turbidity

measurements of seawater transmissivity. Analyses of transmissivity measurements collected during these surveys repeatedly demonstrated that any turbidity associated with effluent discharge dissipates rapidly upon discharge. Perceptible changes in water clarity associated with effluent particulate loading were rarely found, and then, only when the transmissometer passed extremely close to a discharge port near the seafloor. Very little sunlight reaches that depth, demonstrating that the discharge has no impact on the penetration of ambient light. The highly localized and diffuse character of wastewater turbidity upon discharge is sometimes visually apparent as a wispy cloud emanating from the diffuser port, although it is difficult to discern in the photograph shown in Figure 3.2 on Page 3-4. Any distortion apparent in the photograph is probably more an artifact of differences in the plume’s refractive index at the seawater-wastewater interface rather than particulate loading.

### 5.1.3 Settleable Solids

Settleable solid concentrations, which are the only remaining particulate-related measure of effluent quality, echo the above findings that particulate loads of all types were low during 2021. Specifically, all monthly medians were below the 0.1-ml/L detection limit (Table 5.1 on Page 5-2), which is an order-

magnitude less than the permit limit of 1.0 ml/L.<sup>1</sup> In fact, only two of the 52 weekly effluent samples collected during 2021 contained a detectable amount of settleable solids. The higher of those two quantifiably concentrations was the 0.35-ml/L measured on March 10<sup>th</sup>, which was well below the weekly and instantaneous limits of 1.5 ml/L and 3.0 ml/L.

Thus, during 2021, as in prior years, all measures of effluent solids demonstrated that the treatment process exceeded performance expectations by regularly removing a greater amount of solids from the influent stream, and by discharging a small fraction of the maximum anticipated load to the marine environment. The consistently low monthly averages for effluent TSS, turbidity, and settleable solids attest to the overall effectiveness of the treatment plant's screening, grit removal, sedimentation, filtration, and clarifying processes.

## **5.2 BIOCHEMICAL OXYGEN DEMAND**

In combination with solids removal, a primary function of the treatment process is to reduce organic material within the wastewater stream. The effectiveness of the organic removal process is closely linked to solids removal because most organic constituents are associated with wastewater particulates. However, the measure of organic loading, namely BOD, differs from the direct physicochemical measurements of turbidity and solids concentrations. Instead, BOD indirectly measures organic loading within the wastewater stream by determining the amount of oxygen required for aerobic bacteria to decompose organic matter within a sample of wastewater. Organic material, which supports bacterial degradation and demands oxygen, can harm the environment if its decomposition severely depletes DO within receiving waters. Specifically, prolonged oxygen depletion can disrupt benthic and demersal communities, and cause mass mortalities of aquatic life (Diaz and Rosenberg, 1995).

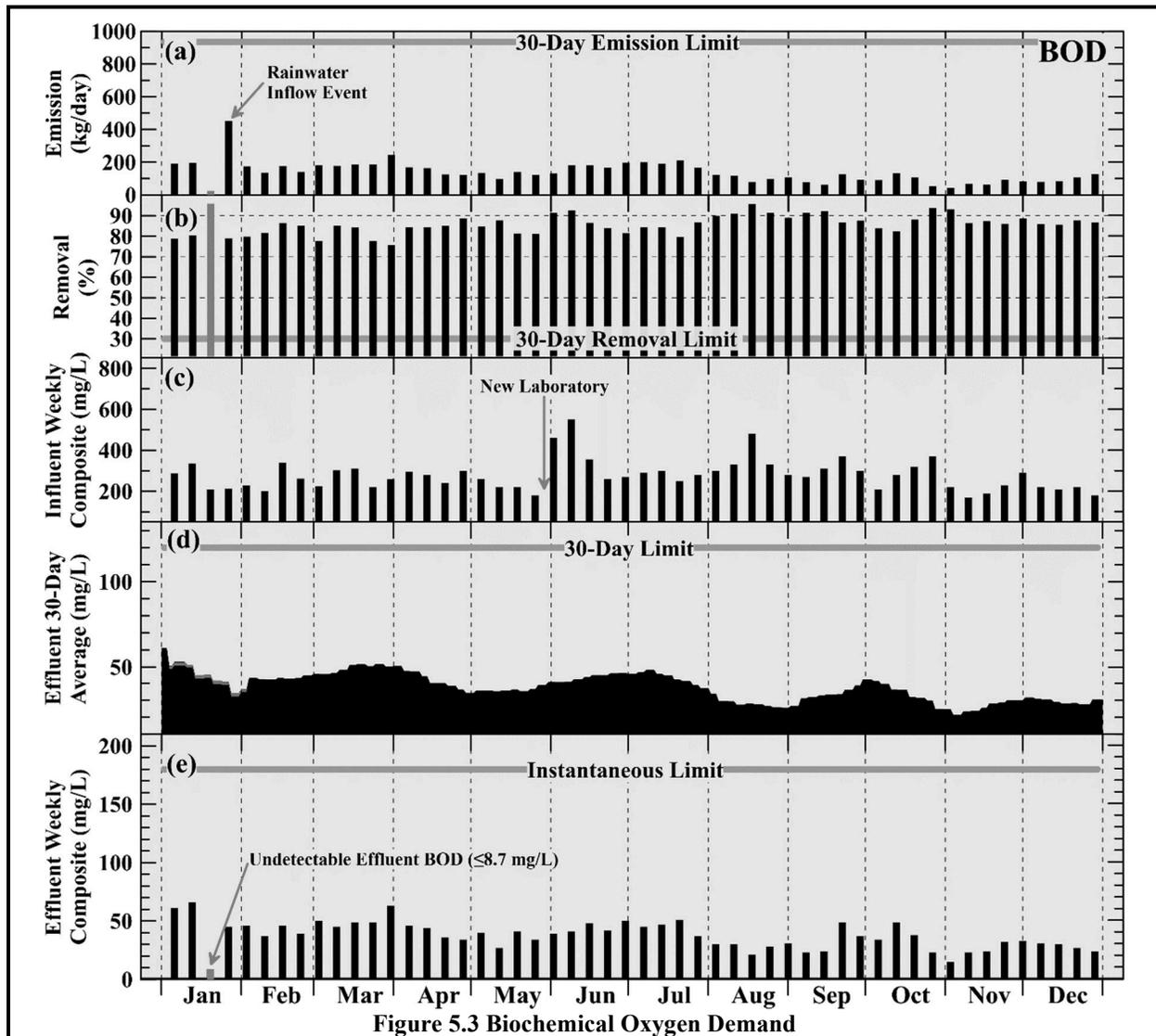
However, DO depletion is only of concern in semi-enclosed water bodies, such as bays and estuaries, which are environments that fundamentally differ from the highly oxygenated open-coastal marine environment of Estero Bay. In fact, because of the ocean's higher oxygen-replenishment capabilities, an evaluation by the National Academy of Sciences (1993) questioned the environmental benefits of imposing a technology-based BOD limit on open-ocean dischargers, namely, requiring secondary-treatment standards for BOD.

Nevertheless, the NPDES discharge permit and TSO set limits on the discharge of BOD, and independent of potential environmental influence, BOD constitutes an important measure of the overall performance of the treatment process. However, because BOD analysis is complex and time-consuming, it is only conducted on influent and effluent samples collected on a weekly basis (Figure 5.3 on Page 5-8).

The complex BOD determinations can be also challenging for laboratories. Aberrations in laboratory analyses may have led to the unexpected absence of a detectable amount of BOD in the effluent sample collected on January 21<sup>st</sup> (see the light shaded bar in Figure 5.3e). Of the 1,066 samples collected and analyzed for effluent BOD since 2000, this is the only non-detectable BOD result reported. The BOD concentration within the concurrent influent sample was comparable to samples collected around the same time and was not abnormally low (Figure 5.3e). Furthermore, after changing the contract laboratory for BOD analysis at the end of May, there was a distinct increase in influent BOD concentrations,

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<sup>1</sup> As described in Table C.1 of Appendix C, the March median monthly settleable solids emission listed in Table 5.1 (<0.1 ml/L) differs from the average detectable but not quantifiable concentration (≈0.1 ml/L) reported to CIWQS in the monthly report. This difference has no bearing on compliance determinations.



suggesting an improvement in laboratory technique and calling into question the January 21<sup>st</sup> effluent concentration reported by the prior laboratory (see the “new laboratory” arrow in Figure 5.3c). Nevertheless, without other tangible evidence that the January 21<sup>st</sup> non-detect was erroneous, it was included in the following plant-performance evaluation.

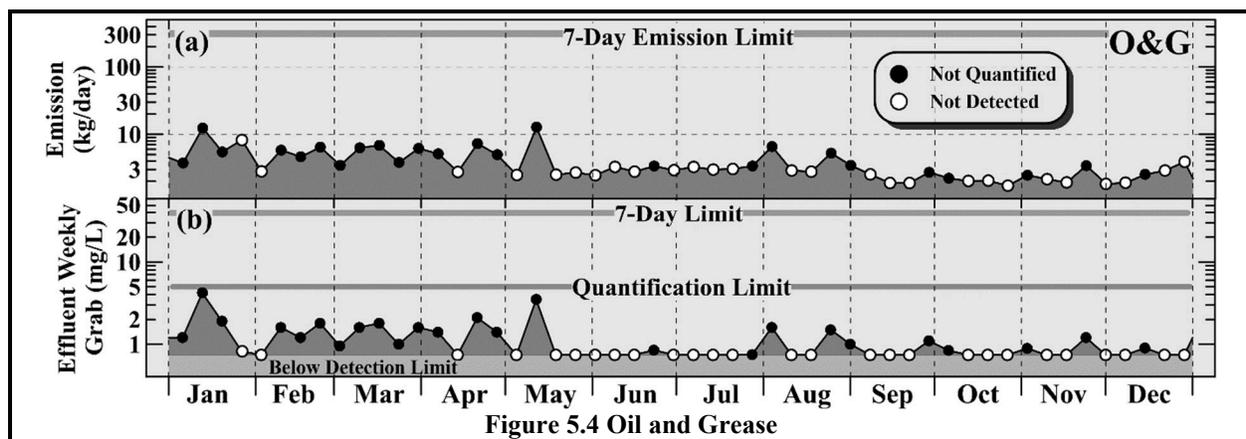
In conjunction with the high overall performance of the solids removal process during 2021, BOD removal was also exceptionally high. Annually, the WWTP reduced influent organics by more than 86%, as determined by the average of weekly composite-sample pairs analyzed for BOD (Table 5.1 on Page 5-1). Thus, the WWTP removed organic material at a rate nearly three times greater than the 30% removal rate required as part of the interim limits specified in the TSO (Figure 5.3b). The monthly removal rate even met or exceeded the 85% threshold established for secondary treatment in seven months of the year and was just shy of the secondary standard in three of the other five months, when it exceeded 83% removal.

BOD concentrations within individual effluent samples were consistently low throughout the year, and all were far below the TSO’s interim limit of 180 mg/L TSO (Figure 5.3e). Accordingly, the moving 30-day average remained well below the 120-mg/L interim limit that applies to averages over calendar months (Figure 5.3d). As with TSS, the low overall BOD concentrations combined with the low overall flow during 2021 led to the lowest annual BOD emission in the 36-year history of the MBCSD monitoring program (last column in Table 2.1 on Page 2-2). At 49 MT, it was only 14% of the projected 342 MT tons that would have been discharged if effluent had contained the permitted BOD concentration of 120 mg/L and throughput reached the average dry-weather design flow of 2.06 MGD allowed by the discharge permit (Table 5.1).

Individual weekly BOD emissions (Figure 5.3a) were consistently low, except for the 452 kg/day emission that was reported on January 27<sup>th</sup> (Figure 5.3a). It was nearly double the next highest emission recorded during 2021. However, as with TSS measurements around that time, the associated BOD concentration (Figure 5.3e) was not abnormally high, so the increased emission was not related to a lapse in plant performance. Instead, it was solely due to inflow of surface runoff during one of the largest rainfall events in recent memory.

### 5.3 OIL AND GREASE

During 2021, none of the 52 weekly effluent grab samples contained a quantifiable amount of O&G (Figure 5.4b). Thus, by default, all reported O&G results complied with all the limits specified in the NPDES discharge permit. The 5.0-mg/L quantification limit specified for the O&G analysis method was eight-times lower than the 40-mg/L weekly-average limit (compare the “Quantification Limit” and the “7-Day Limit” lines in the Figure) and fifteen-times lower than the 75-mg/L maximum-allowed daily concentration (not shown). The highest estimated concentration of ≈4.2 mg/L on January 13<sup>th</sup> was well below the quantification limit. The presence of O&G was not even detected in over half of the 52 samples that were collected and analyzed during 2021 (white datapoints along the top of the light gray shading at the bottom of the Figure). Most of the detectable concentrations were observed prior to May (black datapoints) and accordingly, monthly-average effluent concentrations were reported for the first four months of the year (Table 5.1 on Page 5-2).

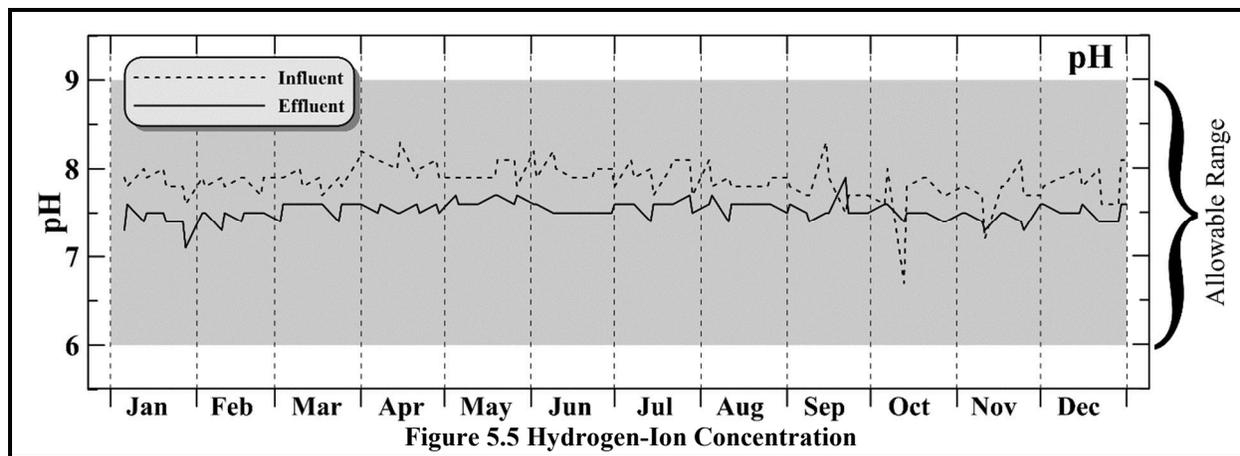


As described in monthly O&G summary reports (MRS 2021d), the COP requires a specific statistical methodology for reporting central tendency when some or all of the reported concentrations are censored, namely, below the MDL or PQL.<sup>1</sup> Because all of the individual 52 O&G measurements reported during 2021 were “censored,” the monthly O&G concentrations listed in Table 5.1 were computed using the COP-required statistical construct applied to median values rather than averages.

Reporting of O&G mass-emissions is subject to the same censored-data qualifiers that apply to the associated concentrations. However, regardless of plant flow for the month, no numerical value is to be reported for compliance evaluations of emissions when concentrations are censored. Nonetheless, as describe in Table C.1 in Appendix C, O&G mass loading estimates can lend insight into the potential for environmental effects. As expected from the uniformly unquantifiable individual measurements and low plant flow during 2021, all O&G emissions were more than an order-of-magnitude below the 312-kg/day weekly emission limit (note the logarithmic scale in Figure 5.4a). All the monthly emissions were similarly far below the monthly emission limit (last column of Table 5.1 on Page 5-2).

#### 5.4 pH

The MBCSD discharge permit requires hydrogen-ion concentrations (pH) within effluent samples remain between 6 and 9. Although Section 301(h) of the Clean Water Act allows an NPDES permit to be issued that exceeds these pH limits, none of the past or present MBCSD discharge permits, or the TSO, allowed this exception. Without heavy-industrial input into the collection system, the influent stream maintains a nominal pH that routinely meets the discharge requirement even without treatment. Thus, influent pH (dashed line in Figure 5.5) remained within the discharge limits (shaded area) throughout 2021 and as a result, effluent pH measurements remained within the allowable range performe (solid line).



Comparison of the two pH records shows that the treatment process neutralizes some of influent’s basicity (pH). The first two data columns of Table 5.1 on Page 5-2 quantifies the monthly variability and the average annual reduction in waste-stream pH. During 2021, average annual effluent pH (7.52) was slightly less basic than influent (7.87) and moderately less basic than the receiving seawater (8.0). The two pH records also demonstrate that the treatment process moderates short-term pH fluctuations that are occasionally present within influent samples. These can arise when the influent grab sample happens to capture an external event within the collection system or treatment process that briefly alters influent

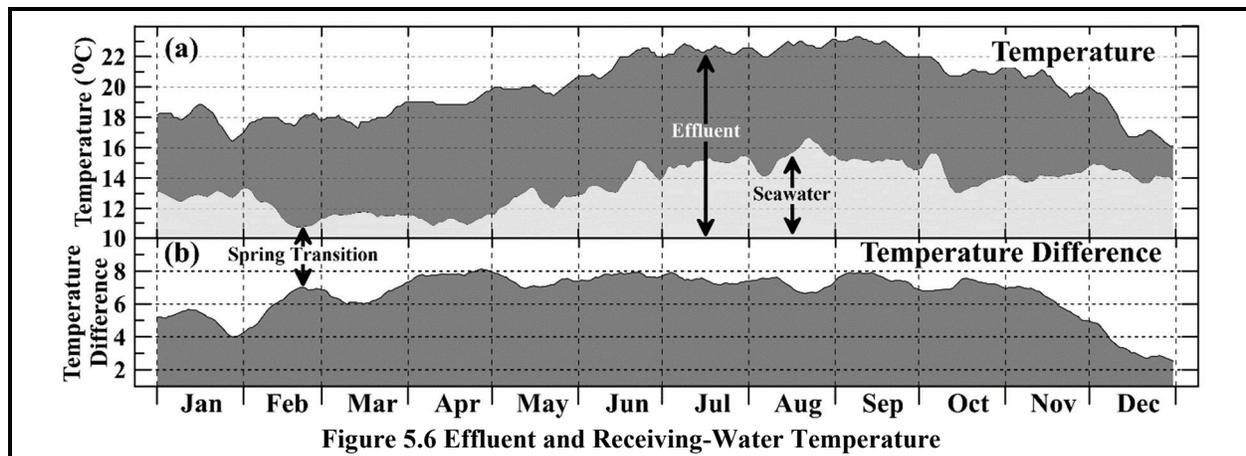
<sup>1</sup> The special statistical analysis is described in Section III.C.8.C. *Multiple Sample Data Reduction* on Page 18 (Sequential Page 25) of [https://www.waterboards.ca.gov/water\\_issues/programs/ocean/docs/cop2015.pdf](https://www.waterboards.ca.gov/water_issues/programs/ocean/docs/cop2015.pdf)

acidity. One obvious event is the low (6.7) influent pH on October 13<sup>th</sup>. It arose when pH was measured within an influent grab sample shortly after a small amount of acidic ferrous chloride was intentionally added to the waste stream to aid the treatment process.<sup>1</sup> The corresponding effluent pH of 7.4 was close to the annual average.

## 5.5 TEMPERATURE

Although the NPDES permit does not limit effluent temperature, it is an important physical property to document because the difference between effluent and receiving-water temperature dictates the amount of mixing that occurs shortly after the wastewater is discharged into the ocean. When compared with seawater temperature, warmer effluent creates a discharge plume with greater buoyancy which generates more turbulence during its rise within the water column (Section 3.2 on Plume Dispersion in MRS 2018b).

Like seasonal air-temperature oscillations, effluent temperature exhibited a distinct semiannual cycle that tracked the insolation cycle. Effluent temperatures (upper dark trace in Figure 5.6a) began gradually increasing in mid-winter (February), peaked in late summer (August), and then declined relatively quickly during fall (mid-September through December). However, seawater temperature did not track the seasonal-insolation trend seen in effluent temperature (lower lighter-shaded trace in Figure 5.6a). Instead, southeastward winds rapidly intensified at the end of February as part of an early-than-normal abrupt spring transition that signals the stabilization of high pressure over the eastern Pacific Ocean. These winds brought cool deep seawater to the sea surface. This upwelling process counteracted solar isolation's seasonal-warming influence on sea-surface temperatures and produced 11°C seawater temperatures that were actually lower than the 13°C early winter temperatures near the discharge location.



The competing influences of insolation (on wastewater) and upwelling (on seawater) produced a period of large thermal contrast between the discharged effluent and receiving water (dark shading in Figure 5.6b). The 5°C temperature difference typical of late fall and early winter began increasing through March and exceeded 7°C for the following seven months. The largest thermal contrast of 8°C occurred in late April as air and effluent temperatures steadily increased while seawater temperature continued to be suppressed by upwelling.

<sup>1</sup> See Section 3.5.2 on 3-16 for a discussion of chemicals used within the collection system and treatment plant.

This large thermal contrast would normally enhance buoyancy-induced dispersion of the effluent plume significantly. However, upwelling also leads vertical stratification of the water column, which can inhibit the plume's rise through the water column and partially offset some of the buoyancy-enhanced turbulence that results from the thermal contrast. As the intense upwelling winds of the spring transition gradually relaxed through mid-August, seawater temperature progressively increased. Except for a brief upwelling event in mid-October, seawater and effluent temperature reverted quickly back winter conditions by year-end. The foregoing indicates that buoyancy-induced vertical mixing of the discharge plume was greatest during the late summer of 2021 when thermal contrasts were still large but upwelling-induced water-column stratification had dissipated.

## **5.6 AMMONIA**

The long measurement history of low ammonia concentrations demonstrated no reasonable potential for ammonia to exceed water-quality objectives. As a result, the ammonia effluent limit was removed from the current permit's discharge limits, and its sampling frequency was reduced from monthly to annually. As part of the 2021 Annual Chemical and Bioassay Analysis (MRS 2021b), an effluent grab sample was collected July 20<sup>th</sup> that contained a 32-mg/L ammonia-as-nitrogen (NH<sub>3</sub>-N) concentration. This concentration was comparable to annual average ammonia concentrations measured over the past decade, which ranged from 27 mg/L to 50 mg/L (Table 2.1 on Page 2-3). The 2021 ammonia concentration was less than half of the 80.4-mg/L limit specified in the prior permit for the six-month median.

## **5.7 RESIDUAL CHLORINE**

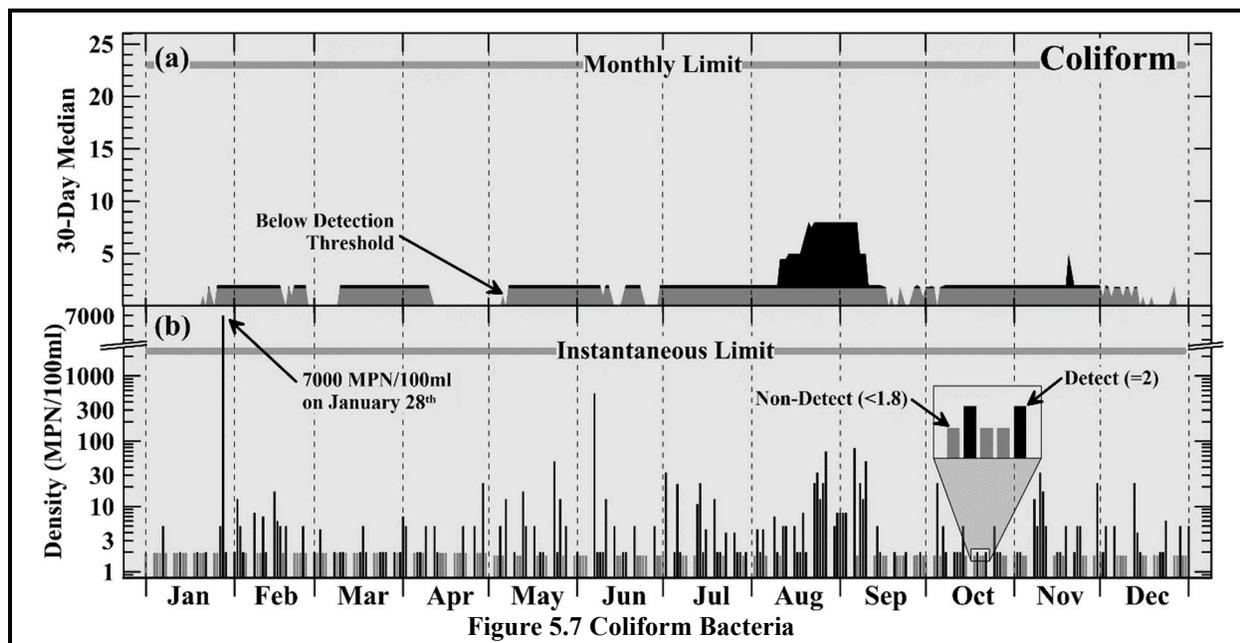
Total residual chlorine (TRC) quantifies the amount of chlorine remaining after disinfection with sodium hypochlorite and subsequent dechlorination, or buffering, with sodium bisulfite. TRC is measured in effluent grab samples collected when flow reaches its daily maximum. At that time, wastewater constituents, as well as hypochlorite and bisulfite dosage, are expected to be at their highest levels. Balancing chlorination and dechlorination to achieve adequate disinfection (coliform reduction) without dosing the marine environment with excess chlorine can be a complex process.

The complexity arises because chlorine demand is constantly changing due to continuous variations in flow and organic loading within the waste-stream. Hypochlorite and bisulfite dose is normally controlled by both total-chlorine-residual level and flow-paced pumps that automatically inject precisely measured amounts of these chemicals into the waste-stream. In practice, favoring a slightly higher bisulfite dose provides a safety factor to ensure elimination of residual chlorine within effluent discharged to the ocean. As a result, TRC is seldom detected within the daily effluent grab samples, despite the low 0.05-mg/L detection limit. During 2021, none of the 365 effluent grab samples had a detectable amount of TRC.

When measurable TRC concentrations are reported, they typically arise from equipment malfunction within the complex disinfection-dechlorination system. To limit these occurrences, plant personnel perform regular inspection, repair, and replacement of system components. Additionally, an auto-dialing alarm system is linked to the process to notify operators by phone of unusual excursions in TRC occur.

## **5.8 COLIFORM BACTERIA**

The efficacy of the disinfection process is tracked with measurements of coliform population densities within effluent grab samples collected on five consecutive days each week. During 2021, 261 samples were analyzed for the most probable number of total coliform organisms per 100 ml (MPN/100 ml). Figure 5.7b shows that when coliform is detected (solid black bars), their densities vary widely among



individual measurements.<sup>1</sup> WWTP personnel strive to maintain densities at or below the detection limit. During 2021, 43% (113) of the 261 samples did not contain a detectable amount of viable coliform bacteria (light-shaded bars in Figure 5.7b). Because of this, the median coliform density for the year was at the detection threshold (2 MPN/100 ml), and an order-of-magnitude below the 23-MPN/100 ml monthly permit limit (Table 5.1 on Page 5-2). For four months of the year, median monthly densities were below the detection threshold.<sup>2</sup>

Nevertheless, due the disinfection process’s complexity, measurable populations of coliform are occasionally observed within individual samples. Although their timing appears to be somewhat randomly distributed, longer-term patterns emerge in the 30-day moving median (Figure 5.7a). During 2021, most of the long-term clustering remained at the detection threshold in a manner consistent with the month-end medians of Table 5.1. However, the cluster of slightly higher coliform densities in late August into early September (Figure 5.7b) resulted in a sustained excursion above the detection threshold (solid black region in Figure 5.7a). It corresponds to the highest 5 MPN/100 ml month-end median reported for compliance purposes in Table 5.1.<sup>3</sup>

As described in prior subsections, end-of-January excursions in plant flow, TSS, Turbidity, and BOD removal were triggered by the same external event, namely, an intense winter storm that generated an abnormal amount of surface runoff and inflow into the collection systems. The same elevated-plant-flow event triggered an exceptionally high total coliform density in the effluent sample collected on January 28<sup>th</sup> (Figure 5.7b). At 7000 MPN/100 ml it was considerably higher than the highest coliform density

<sup>1</sup> Note that the density scale in Figure 5.7b is logarithmic and split above the instantaneous limit of 2400 MPN/100ml. The scale is linear in Figure 5.7a.

<sup>2</sup> The detection limit dropped from 2 MPN/100ml to 1.8 MPN/100 ml in May when the contract laboratory for coliform analysis changed.

<sup>3</sup> Retrospective monthly compliance evaluations are required to be submitted after the end of each month and thus, cannot include results from samples that are yet to be collected (in the subsequent month). Because the 30-day moving median is centered on each day of interest, it is a more informative measure of the performance of disinfection process because it can be correlated with process changes or external events. Compliance with the 30-day bacterial requirement is evaluated at the end of each month using a 30-day look-back period. This effectively shifts the clusters shown in Figure 5.7a to the right by 15 days.

measured within 6,179 effluent samples collected over the last two decades.<sup>1</sup> It was also the first time the 2,400-MPN/100 ml maximum instantaneous limit on total coliform density was exceeded.

Despite the magnitude of this isolated coliform excursion, it is not indicative of a plant-performance issue warranting corrective correction. It was not the result of a malfunction, mechanical failure, or ongoing issue related to treatment components within the dechlorination or disinfection processes.<sup>2</sup> Effluent total coliform densities on the day before and after the event were nominal (5 and 2 MPN/100 ml). Instead, the transient increase in coliform density at the time of sampling was probably due to an unavoidable reduction in disinfection detention time within the chloring contact chamber. Typical plant throughput is 1 MGD, which provides at least 1.5 hours of disinfection time. However, the 5.3-MGD instantaneous flow at the time the grab sample was collected on January 28<sup>th</sup> would have reduced detention time to as little 30 minutes. Apparently, this reduced contact time did not adequately neutralize coliform bacteria before the waste stream was subsequently dechlorinated. A contact-time reduction of this magnitude would only be expected to occur when plant throughput is extremely high, such as on January 28<sup>th</sup> when the daily flow was the highest measured in two decades.

## **5.9 TOXICITY**

Chronic-toxicity bioassays measure the effluent's potential to impact a variety of marine organisms by exposing those organisms to a range of effluent dilutions in the laboratory. These toxicity studies have been conducted for 28 years (Table 2.1 on Page 2-3). All have found consistently low effluent toxicity, with levels far less than those allowed by the discharge permit. The same was true of the latest bioassay conducted in July 2021.

As part of the bioassays conducted in the three years prior to 2021, toxicity tests were performed on three separate species to determine which was most sensitive to MBCSD effluent exposure (see the footnotes in the "Chronic Toxicity" column of Table 2.1 on Page 2-3). Similar sets of species-sensitivity screening studies were completed in 1993 and 2010, after which the subsequent bioassays assessed effluent toxicity using only the most sensitive species. The species-screening studies conducted in 1993 indicated that giant kelp (*Macrocystis pyrifera*) was more sensitive to MBCSD effluent than other species typically used in bioassays at that time, namely, the larvae of the inland silverside (*Menidia beryllina*) and the bay mussel (*Mytilus edulis*) (MRS 1994). Over the following 16 years, MBCSD bioassays repeatedly demonstrated that giant kelp zoospores were only minimally affected by exposure to the treatment plant effluent.

The prior discharge permit (RWQCB-USEPA 2009) required a new set of screening studies, which were conducted on effluent samples collected in July 2009 and January 2010 (MRS 2010 2011). Those screening assays assessed the effluent's effect on the development of larval red abalone (*Haliotis rufescens*) in addition to that of giant kelp. They demonstrated that larval abalone were slightly more sensitive to MBCSD effluent than kelp zoospores. During eight subsequent years of monitoring, bioassays were conducted using larval abalone, at least through January 2018, when the previous discharge permit was still in effect.

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<sup>1</sup> A density of 1,700 MPN/100 ml was reported in an effluent grab sample collected on 24 December 2019. The next highest (1,600 MPN/100 ml) was in 2007.

<sup>2</sup> The January 2021 Monthly Monitoring Report to CIWQS (MBCSD 2021) documents the absence of equipment failure in the chlorination or disinfection equipment based on plant personnel's review of plant data and daily logs, as well as direct inspection of equipment shortly after the flow event.

The current permit required another set of three-species chronic-toxicity screening studies that were conducted over three consecutive annual monitoring events, beginning in 2018. Those screening studies assessed: 1) the development of larval red abalone (*Haliotis rufescens*); 2) the germination of kelp (*Macrocystis pyrifera*) spores and the growth of kelp germ tubes; and 3) the survival and growth of larval topsmelt (*Atherinops affinis*). As with the prior set of screen studies that were completed in 2010, the three most-recent screening studies confirmed that larval Red Abalone were more sensitive than two other marine species (MRS 2018c 2019c 2020b).

The subsequent bioassay conducted in July 2021 tested larval red abalone specimens alone (MRS 2021b). It revealed that the sensitivity of red abalone to effluent exposure in 2021 was similar to that of prior tests (Table 5.2). At 17.9 TUc, the measured toxicity level was well below the 134 TUc deemed to be of concern for marine organisms. Specifically, no adverse effects were observed when abalone specimens were exposed to MBCSD effluent-seawater mixtures that were at least seven times more concentrated than that allowed by the discharge permit. This was the case even though the larval abalone test organisms were found to be sensitive to contaminants in general, as demonstrated by their response to exposure to a reference toxicant.

**Table 5.2 Comparison of Measured Chronic Toxicity Levels and Permit Limits**

Sample Date	Bioassay Test	End Point (%)	Concentration (TUc)	Limit (TUc)
20 July	Red Abalone ( <i>Haliotis rufescens</i> ) Larval Development	5.6	17.9	134

## 5.10 NUTRIENTS

During the review process for the prior MBCSD discharge permit, concerns were raised regarding the relative contribution of nutrients discharged to the ocean by coastal treatment plants and their potential role in the promotion of harmful algal blooms (HABs). Because increased human activity and pollution are now thought to be contributing factors to the observed increase in the frequency and intensity of HABs, the USEPA proposed a conservation measure for “Regular monitoring of nutrient loading from the [MBCSD] facility’s ocean outfall” in their biological evaluation (USEPA 2007).

Historically, open-ocean dischargers, such as the MBCSD treatment plant, have not been required to monitor for bio-stimulatory nutrients because energetic, well-flushed marine environments rapidly dilute and disperse discharged nutrients, preventing their accumulation to deleterious levels. For this reason, there are no numerical objectives for nutrient compounds (except ammonia) promulgated in the COP. However, in response to the USEPA conservation measure regarding nutrient loading and its potential for HAB stimulation, MRS (2008) designed and instituted a nutrient-monitoring requirement for the MBCSD effluent monitoring program that included the semiannual analyses of nitrate [ $\text{NO}_3^-$ ], urea [ $\text{CO}(\text{NH}_2)_2$ ], ortho-phosphate [ $(\text{PO}_4)^{3-}$ ], and dissolved silica [ $\text{SiO}_2$ ]. These particular compounds were selected because they represent limiting macronutrients for phytoplankton growth within the euphotic zone of the ocean and have been associated with the stimulation of phytoplankton growth (Kudela and Cochlan 2000).

Ammonia [ $\text{NH}_3$ ] is another nitrogen compound typically associated with phytoplankton growth. However, ammonia concentrations are already regularly measured as part of the MBCSD permit’s waste-discharge requirements. RWQCB staff retained the nutrient-monitoring requirement in the current permit because nutrient discharge continues to be a concern along the central California coastal region, where

agriculture is a major activity, and where other wastewater treatment plants are required to monitor for nutrients.

HABs occur when periodic explosions of growth in naturally occurring algae result in extensive monoculture blooms of particular species that are harmful to humans and other life. In addition to harm caused through the production of toxins by these species, large phytoplankton blooms can negatively affect the marine ecosystem simply from their accumulated biomass. Historically, processes such as coastal upwelling and river runoff have been implicated as the primary factors that create physical and chemical conditions (e.g., high nutrient concentrations) conducive to the development of phytoplankton blooms (Trainer et al. 2002, Kudela et al. 2004). In particular, the upwelling process, which is prevalent within western U.S. coastal waters, has been chiefly implicated in the generation of HABs along the central California coastline (Trainer et al. 2000, Kudela et al. 2005).

However, over the last decade, the extent and duration of phytoplankton blooms have been increasing within the upwelling zones along central and southern California coastlines (Nezlin et al. 2012). Additionally, upwelling alone cannot account for the recent observed distributions, suggesting that anthropogenic nutrient input could be a contributing factor in the stimulation of phytoplankton biomass that promote HABs. Within highly localized nearshore areas adjacent to large wastewater dischargers offshore southern California, nutrient loads within the discharges are comparable to the nutrient flux associated with upwelling (Howard et al. 2014).

In fulfillment of the current permit’s requirement, an assay of nutrients within MBCSD effluent was conducted on grab samples collected in July 2021. The results were consistent with those of prior years, and demonstrate that nutrient concentrations within the MBCSD effluent, and their mass loading to the marine environment from discharge, are small compared to: 1) other central- and southern-California coastal dischargers, 2) the contribution from regional streams and rivers, and 3) the nitrogen flux from localized upwelling (Table 5.3).

**Table 5.3 Nutrient Concentrations and Loading from Central-Coast Ocean Discharges**

Source	Concentration (mg/L)				Mass Emission (kg)			
	Nitrate	Urea	Phosphate	Silica	Nitrate	Urea	Phosphate	Silica
MBCSD	<0.01	0.155	2.6	13.4	<13.	200.	3,400.	17,600.
Santa Cruz	9.52	0.087	7.7	30.2	139,000.	1,360.	117,000.	489,000.
Watsonville	10.52	0.110	13.6	35.6	105,000.	1,250.	154,000.	364,000.
Monterey	4.82	0.084	3.4	41.0	85,600.	1,100.	30,300.	488,000.
Streams and Rivers <sup>1</sup>	3.58	0.021	0.14	25.6	1,660,000.	33,500.	340,000.	25,200,000.
Localized Upwelling <sup>2</sup>	9.53	—	2.0	—	1,818,000.	—	377,000.	—

Although the urea concentration (0.155 mg/L) within the MBCSD effluent sample was slightly higher than the three large central-coast WWTP’s to the north ( $\leq 0.110$  mg/L), the concentrations of nitrate, phosphate, and silica within MBCSD effluent were all substantially less than those of the other dischargers. The MBCSD nitrate levels, in particular, were two orders of magnitude lower than those of the other WWTP’s within the central-coast region. Nitrate and silica concentrations within MBCSD effluent were also less than the average concentrations found within central-coast rivers and streams;

<sup>1</sup> Average concentrations and total emissions from fourteen streams and rivers discharging to the northern central coast from July 2005 and June 2006 (CClean 2007)

<sup>2</sup> McLaughlin et al. 2017 found that the nitrate volume discharged by the Orange County Sanitation District was comparable to the nitrogen flux from localized upwelling.

although, urea and phosphate concentrations were higher, as was the case for the other central-coast WWTP's.

Irrespective of effluent nutrient concentrations, potential marine bio-stimulatory effects from nutrient discharge are dictated by the total nutrient emission contributed by the various sources (right side of Table 5.3). After accounting for the relatively small volume of wastewater discharged by the MBCSD, its total nutrient loading<sup>1</sup> to the marine environment during 2021 was 28-times smaller than any of the three large WWTP's, all of which discharge into the waters of the Monterey Bay National Marine Sanctuary. Similarly, total nutrient loading from the MBCSD discharge was three orders-of-magnitude smaller than the contribution from runoff within the central-coast region. Lastly, and most relevant for evaluating the potential impacts on HAB stimulation, the nitrogen flux from the MBCSD outfall was five orders of magnitude smaller than the flux from the Orange County discharge, which was found to be comparable to that of localized upwelling (last row in Table 5.3).

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<sup>1</sup> Sum of the emissions from the four nutrient compounds listed on the right side of the Table

## 6.0 CHEMICAL CONSTITUENTS

In addition to the effluent properties and bioassay results described above, 78 chemical contaminants are regulated by the COP, and have their effluent concentrations limited in the discharge permit (SWRCB 2015; RWQCB 2018a). Prior to 2019, effluent and benthic sediment samples were regularly analyzed for the presence of these toxic chemical compounds, which include trace metals, chlorinated and nonchlorinated phenolic compounds, volatile organic compounds, organochlorine pesticides, PCBs, cyanide, base-neutral compounds, and radionuclides. The COP regulates the discharge of these compounds for the protection of marine life and human health from exposure to both carcinogenic and noncarcinogenic substances.

The historical record of 3,855 effluent chemical assays spanning 29 years of MBCSD effluent monitoring have detected only a few ubiquitous compounds with concentrations below regulatory limits. As part of the preparation for the current discharge permit, a statistical analysis of a five-year subset of these data found only TRC had a reasonable potential for an excursion above a COP water quality objective. The reasonable potential was inconclusive for many chemical contaminants because the five-year span did not include enough data points (degrees of freedom) and because many reported concentrations were censored, namely below their respective detection limit or minimum reporting level (ML).<sup>1</sup> As is customary, the permit established a once-in-the-life-of-the-permit monitoring frequency for all effluent chemical compounds regulated by the COP other than metals and metalloids. That monitoring requirement was satisfied by the comprehensive chemical assays of effluent samples collected in July 2018 (MRS 2018c). Other chemical compounds that require annual or more frequent monitoring include ammonia and nutrients, and results from the 2021 analyses of those compounds are summarized in the previous chapter.

Ten metallic and metalloid elements also have an annual sampling requirement. Their concentrations within the effluent sample collected in July 2021 are summarized below. The annual effluent self-monitoring report (MRS 2021b) provides a detailed discussion of effluent chemistry and toxicity analyses conducted on the July 2021 sample. This includes compliance with permit limits, minimum reporting levels, laboratory data sheets, pertinent QA/QC data, and chains of custody.

The presence of seven of the ten annually monitored metallic and metalloid elements were detected within the July 2021 effluent sample (Table 6.1 on the following page). Only four were present in a quantifiable amount, and their concentrations are shown in bold typeface in the Table. Three additional elements, arsenic, selenium, and possibly mercury were present within the sample, but at concentrations too low to be reliably quantified. Specifically, the reported concentrations of these compounds were higher than the MDL but lower than the ML. Reporting of these detected-but-not-quantified concentrations is required under the current NPDES discharge permit; although they are not compared to effluent limits for compliance determinations, except when the effluent limit itself is less than the MDL or ML, which was not the case for any of those elements. Additionally, it is unlikely that the effluent sample contained a detectable amount of mercury because the reported result was confounded by a low-level laboratory source of mercury contamination that was nearly as high as the estimated concentration itself (see Footnote 4 on the next page).

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<sup>1</sup> The Minimum Level (ML) for individual chemical compounds are as specified in the COP and represent the method-specific minimum concentration of a substance that can be reliably measured in a sample given the current analytical performance level achieved by most certified laboratories within California.

Table 6.1 Chemical Elements Detected within Effluent Samples

Element	Concentration (µg/L)		Mass Emission (kg/vr)	
	Limit	Measured	Goal	Measured
Arsenic	670.	≈1.5 <sup>1</sup>	17.	≈1.97
Chromium VI	270.	<b>0.94</b>	93. <sup>2</sup>	<b>1.24</b>
Copper	<i>140.</i> <sup>3</sup>	<b>12.</b>	690.	<b>15.8</b>
Lead	<i>270.</i> <sup>3</sup>	<b>0.80</b>	465.	<b>1.05</b>
Mercury	5.29	≈0.054 <sup>4</sup>	1.4	≈0.07
Selenium	<i>2,010.</i> <sup>3</sup>	≈1.5	65.	≈2.0
Zinc	<i>1,620.</i> <sup>3</sup>	<b>38.</b>	244.	<b>50.</b>

The quantifiable concentrations of hexavalent chromium, copper, lead, and zinc found within the July-2021 effluent sample were considerably below the limits specified in the NPDES discharge permit. This is not surprising because the reasonable-potential analysis found that copper, lead, and zinc did not exhibit a potential for exceeding their respective permit limits.<sup>3</sup> Consequently, the current discharge permit does not list effluent limitations for them. The reasonable potential analysis for hexavalent chromium was indeterminant because historical concentrations were often below the quantification limit. Because the analysis was inconclusive, its effluent limit was retained in the current permit.

Regardless of reasonable potential analysis, the 0.94-µg/L hexavalent chromium concentration within the July 2021 effluent sample was far below its 270-µg/L limit. It would have to be 287-times more concentrated to be deemed deleterious to marine organisms. Nevertheless, its sudden measurable presence in the July effluent samples collected in the past three years is noteworthy because it departs from the undetectable and non-quantifiable concentrations found in the 39 prior effluent samples that were collected over the past two decades.

However, the quantifiable chromium VI concentrations found in effluent samples collected in the last three years did not arise because of a change in effluent quality. Instead, it was purely an artifact of a change in the chemical analysis method that was necessitated when the current discharge permit became effective in 2018. Footnotes in the COP and in prior MBCSD permits allowed compliance with hexavalent chromium objective to be evaluated using total chromium, rather than the concentration associated with the +6-oxidation state alone. That footnote appears to have been inadvertently omitted in the current MBCSD discharge permit. As a result, the more costly and sensitive EPA Method 218.6 was required to determine hexavalent chromium concentrations in the 2021 chemical assay. Its 0.2-µg/L quantification limit is 50-times lower than the 10-µg/L limit associated with the total chromium methodology. Thus, the 0.27-µg/L chromium concentration found in the July 2021 sample would not have been detected, much less quantified, using the historical EPA Method 200.7 for total chromium.

<sup>1</sup> The “approximation” symbol (≈) indicates that the detected concentration, designated with an “as estimated” qualifier, was too low to be reliably quantified, namely, it was below the prescribed Minimum concentration Level (ML). Accurately quantified “as measured” concentrations are indicated by bold typeface.

<sup>2</sup> A chromium mass-emission goal was established for total-recoverable chromium and not for the hexavalent oxidation state.

<sup>3</sup> Effluent limitations for copper, lead, selenium, and zinc were removed in the current discharge permit based on reasonable potential analyses of historical effluent data. The limits listed for those metals in the table were from prior permits and are shown in italics.

<sup>4</sup> Method blank analyses found a detectable mercury concentration (≈0.040 µg/L) indicating potential laboratory contamination. Mercury concentration in the effluent sample would be ≈0.014 µg/L after bias adjustment, which is less than half of the 0.022 µg/L detection limit.

The remaining three metals are regularly found within effluent and biosolids samples at quantifiable but low concentrations. Copper concentrations within the July 2021 sample would need to be twelve-fold higher to be of concern for the protection of marine aquatic life. Zinc concentrations would need to be 42-times higher, and lead more than 300-times higher, to be of environmental concern. These three metals are routinely found within effluent and biosolids samples because they enter the wastewater collection system through erosion of natural metallic-rich mineral deposits along the central California coast. They also enter the system through corrosion of household plumbing systems. These elements have been detected at quantifiable levels within more than half of the effluent samples collected during the last 29 years; therefore, they do not represent a new or increased source of contaminants entering the collection system.

Additionally, the mass emission of these four metals into the marine environment did not significantly increase during 2021 (last two columns of the Table). This is both because their concentrations were low, and because the 0.95-MGD average plant throughput was low. All were well below the emission goals based on historical plant performance.

## 7.0 BIOSOLIDS

The monitoring and reporting requirements of the current NPDES permit (RWQCB 2018a) stipulate characterization of biosolids in accordance with 40 CFR 503 (USGPO 1997b). To that end, a complete description of sludge production and disposal activities covering 2021 was submitted by the MBCSD to the USEPA, RWQCB, and SLO EHS (MBCSD 2022). That letter-report and its eight attachments are incorporated in this annual monitoring report by reference. The November 2021 disposition of the 167.25 dry MT tons of biosolids generated by the WWTP in 2020 and 2021 is briefly summarized in this Chapter. This Chapter also discusses the major chemical compounds that were found within the biosolids produced by the plant, because they lend insight into the performance of the WWTP, and because they determine the suitability of biosolids for composting and land application (MRS 2021c).

### 7.1 SOLIDS TREATMENT PROCESS

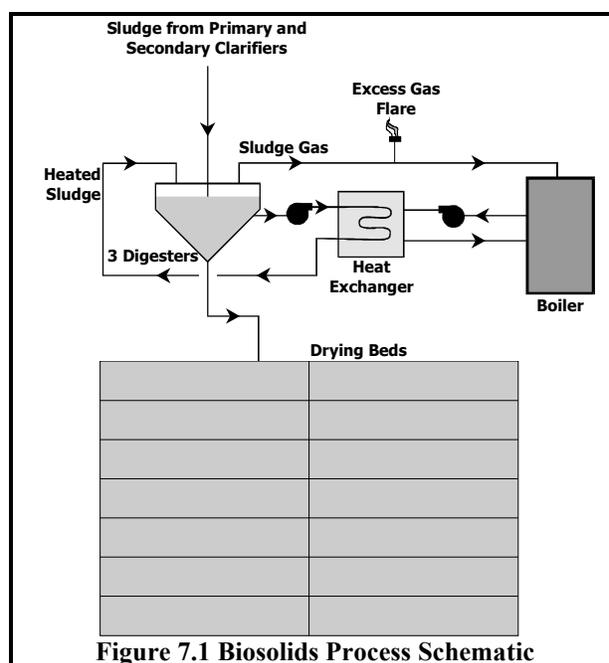
Solids removed by the clarifiers (Figure 3.3 on Page 3-13) are processed as shown in the schematic of Figure 7.1. Sludge is stabilized within two mixed-primary digesters in series with a secondary digester. Sludge is heated to temperatures between 95°F and 98°F (35°C to 37°C) in the primary digesters. Heated sludge is transferred to an unmixed and unheated secondary digester. Solids settle in the secondary digester and the supernate is returned to the wastewater treatment process. The sludge is transferred to solar drying beds. The primary digester's capacities are 170,544 gallons and 191,500 gallons, and the secondary digester's capacity is 166,056 gallons, giving a total capacity of 528,100 gallons.

Stabilized sludge drawn from the secondary digester was transferred to one of 12 sludge-drying beds. Each of these 5,200 ft<sup>2</sup> (483 m<sup>2</sup>) beds has an under-drain and decanting system that recirculates drainage through the treatment process. Once dried, the biosolids were removed from the beds and stored in a concrete containment area that also drained rainfall runoff through the treatment system. Biosolids were stored in this area until they were removed from the WWTP. Biosolids storage times are generally less than one year.

On December 14<sup>th</sup>, 15<sup>th</sup>, 16<sup>th</sup>, 17<sup>th</sup>, and 20<sup>th</sup>, all 167.25 dry MT of biosolids in storage at the WWTP were hauled to the Liberty Composting Facility, which operates under Solid Waste Information System Permit No. 15-AA-0287. The biosolids transferred to the Liberty Composting Facility were used for soil amendment after composting was completed at the facility. Prior to shipping, the MBCSD provided a Title 22 Certification for Non-hazardous Materials and a Class-B biosolid certification statement, based in part on the chemical analyses described below.

### 7.2 CHEMICAL COMPOUNDS

In compliance with the Monitoring and Reporting Program, chemical analyses were conducted on a composite of biosolid samples collected from the drying beds on 8 September 2021. Those beds



contained all the biosolids that were ready for shipment from the WWTP at the time. The full laboratory results, including chains of custody, instrument calibration reports, and analyses of method blanks and spikes, were reported by MRS (2021d). They are compared with regulatory limits in Table 7.1.

The data in the table show that biosolid contaminant concentrations were significantly less than regulatory thresholds that would designate them as hazardous, or that would limit their use for land application or composting. The analyses tested for the presence of more than 150 potential contaminants and measured seven other properties and nutrients within the biosolid sample. Nevertheless, only a few compounds were detected, primarily naturally occurring trace metals.

All trace-metal concentrations were below the total threshold limit concentrations (TTLC) that would designate the biosolids as hazardous. Dry-weight concentrations for all detected metals in the biosolid sample were well below the federally mandated thresholds, including the monthly limit for materials suitable for agricultural land application (as represented in the three right-most columns of Table 7.1). The other compounds listed in Table 7.1 further characterize the biosolids, as mandated in the waste discharge requirements. Additionally, a modified WET test (STLC) for hexavalent chromium and total dissolved solids was conducted in response to a request from the composter.

**Table 7.1. Comparison between Measured Biosolid Concentrations and State and Federal Limits**

Constituent	Units	Wet Weight				Dry Weight		
		Measured		Limit		Measured	Limit	
		Bulk	WET <sup>1</sup>	STLC <sup>2</sup>	TTLC <sup>3</sup>	Bulk	Monthly <sup>4</sup>	Ceiling <sup>5</sup>
Solids	%	85.0	— <sup>6</sup>	—	—	—	—	—
Cyanide	ppm	2.4	—	—	—	2.8	—	—
Antimony	ppm	ND	—	15.	500.	ND	—	—
Arsenic	ppm	6.7	—	5.	500.	7.8	41.	75.
Barium	ppm	110.	—	100.	10,000.	130.	—	—
Beryllium	ppm	≈0.29 <sup>7</sup>	—	0.75	75.	≈0.34	—	—
Boron	ppm	≈19.	—	—	—	≈22.	—	—
Cadmium	ppm	2.6	—	1.	100.	3.0	39.	85.
Chromium (Total)	ppm	43.	—	560.	2,500.	50.	1,200.	3,000.
Chromium (Hexavalent)	ppm	≈0.36	≈0.12	5.	500.	≈0.43	—	—
Cobalt	ppm	≈2.7	—	80.	8,000.	≈3.2	—	—
Copper	ppm	430.	0.20	25.	2,500.	500.	1,500.	4,300.
Lead	ppm	33.	—	5.	1,000.	39.	300.	840.
Mercury	ppm	0.48	—	0.2	20.	0.57	17.	57.
Molybdenum	ppm	17.	—	350.	3,500.	19.	18.	75.
Nickel	ppm	27.	—	20.	2,000.	31.	420.	420.
Selenium	ppm	ND	—	1.	100.	ND	36.	100.
Silver	ppm	≈1.8	—	5.	500.	≈2.1	—	—
Thallium	ppm	ND	—	7.	700.	ND	—	—
Vanadium	ppm	18.	—	24.	2,400.	21.	—	—
Zinc	ppm	1,400.	—	250.	5,000.	1,600.	2,800.	7,500.
Hydrogen-Ion	pH	6.52	—	—	—	—	—	—
Phosphate	ppm	65,000.	—	—	—	76,000.	—	—
Ammonia	ppm	6,000.	—	—	—	7,100.	—	—
TKN	ppm	32,000.	—	—	—	38,000.	—	—
Organic Nitrogen	ppm	26,000.	—	—	—	30,900.	—	—
Nitrate as NO <sub>3</sub>	ppm	110.	—	—	—	130.	—	—
Oil & Grease	ppm	13,000.	—	—	—	15,000.	—	—
Total Dissolved Solids	ppm	—	8,000.	—	—	—	—	—

<sup>1</sup> Waste Extraction Tests (WETs) measure the soluble leachate or the extractable amount of a substance contained within a bulk sample of biosolids. A WET is indicated if the bulk wet-weight concentration of a contaminant exceeds 10 times the STLC.

- <sup>2</sup> Soluble Threshold Limit Concentrations (STLC) apply to the measured concentration in the liquid extract from a biosolid sample, as determined by a WET. Biosolids with leachate concentrations exceeding the STLC are classified as hazardous in the State of California, as described in the California Code of Regulations (CCR 2003).
- <sup>3</sup> Total Threshold Limit Concentrations (TTL) apply to the total wet-weight concentration of a contaminant within a bulk biosolid sample consisting of the entire millable solid matrix, rather than just the leachate. Biosolids are designated as hazardous wastes in the State of California if measured bulk concentrations exceed the TTL, as described in the CCR (2003).
- <sup>4</sup> Federally mandated dry-weight limits imposed on biosolids suitable for application on agricultural land apply to monthly average concentrations as defined in Table 3 of the Code of Federal Regulations (USGPO 1997b). [40 CFR §503.13(b)(1)].
- <sup>5</sup> Federally mandated dry-weight ceiling concentrations above which biosolids are considered hazardous waste as defined in Table 1 USGPO (1997b).
- <sup>6</sup> “—” indicates that the measurement was not required or its limit was not specified.
- <sup>7</sup> Concentrations preceded by an “*approximation*” symbol ( $\approx$ ) were too low to be reliably quantified and represent estimated concentrations because they were reported below the minimum level (ML) but above the method detection limit (MDL).

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Appendix A WWTP Specifications

Parameter	Quantity
<b>Waste Loading</b>	
Flow (MGD)	
Average dry-weather flow	2.06
PSDWF	2.36
Peak dry-weather flow	6.64
PWWF	6.60
Strength	
BOD <sub>5</sub> (mg/L)	280
Suspended solids (mg/L)	280
Grit (ft <sup>3</sup> /mg)	10
Waste quantities at PSDWF	
BOD <sub>5</sub> (mt/day)	2.5
Suspended Solids (mt/day)	2.5
Grit (ft <sup>3</sup> /day)	23.6
<b>Preliminary Treatment</b>	
Mechanically Cleaned Bar Screen	
Number	1
Capacity (MGD)	8.2
Channel Monster	
Number	1
Capacity (MGD)	7.0
Influent Pumps (variable speed)	
Number	3
Capacity each (MGD)	3.3
Total head (m)	9.6
Aerated Grit-Removal Tanks	
Number	1
Length (m)	9.1
Width (m)	4.9
Depth (m)	2.4
Detention time at PWWF (min)	6.3
Grit Pumps	
Number	2
Capacity (gpm)	250
<b>Primary Treatment</b>	
Sedimentation Tanks	
Number	2
Diameter (m)	
Tank 1	15.2
Tank 2	12.2
Average side water depth (m)	
Tank 1	2.74

Parameter	Quantity
Tank 2	2.74
Surface loading rate PSDWF (10 <sup>3</sup> L/m <sup>2</sup> /day)	29.74
Detention time at PWWF (hr.)	2.2
<b>Total Treatment</b>	
Overall treatment efficiencies (%)	
BOD <sub>5</sub>	57
Suspended solids	75
Expected effluent quality (mg/L)	
BOD <sub>5</sub>	120
Suspended solids	70
<b>Solids stabilization</b>	
Anaerobic digester loading (mt/day)	
Primary solids	1.6
Secondary solids	0.4
Assumed sludge volatile content (%)	
Primary solids	70
Secondary solids	82
Sludge volume (m <sup>3</sup> /day)	50.7
Digester 1 (existing, fixed cover)	
Diameter (m)	12.2
Side water depth (m)	4.9
Volume (m <sup>3</sup> )	629
Digester 2 (existing, fixed cover)	
Diameter (m)	12.2
Side water depth (m)	5.8
Volume (m <sup>3</sup> )	725
Digester 3 (new, floating cover)	
Diameter (m)	10.7
Side water depth (m)	6.9
Volume (m <sup>3</sup> )	646
Hydraulic detention time based on net volume of digesters 2 and 3 (days)	23
Assumed volatile solids reduction (%)	55
Expected sludge gas production (m <sup>3</sup> /day)	804
Sludge Drying Beds	
Number	12
Length each (m)	49.4
Width each (m)	9.8
Solids Loadings (kg ft <sup>-1</sup> yr <sup>-1</sup> )	78.3

Parameter	Quantity
Assumed removal efficiency (%)	
BOD <sub>5</sub>	35
Suspended solids	65
Primary effluent quality (mg/L)	
BOD <sub>5</sub>	182
Suspended solids	98
<b>Secondary treatment</b>	
Biofilters (existing, in partial secondary treatment mode of operation)	
Flow distribution at PSDWF (MGD)	
Biofilter 1	0.39
Biofilter 2	0.58
Diameter (m)	
Biofilter 1	18.3
Biofilter 2	21.3
Net media surface area (m <sup>2</sup> )	
Biofilter 1	262
Biofilter 2	350
Average media height (m)	
Biofilter 1	1.4
Biofilter 2	1.5
Media Volume (m <sup>3</sup> )	
Biofilter 1	360
Biofilter 2	532
Specific organic loading rate (lbs BOD <sub>5</sub> /day/1000 ft <sup>3</sup> )	47
Circulated flow (MGD)	
Biofilter 1	1.37
Biofilter 2	2.04
Hydraulic loading rate (gpm/ft <sup>2</sup> media surface)	
Biofilter 1	0.34
Biofilter 2	0.38
Circulation Pumps	
Biofilter 1	
Capacity (gpm)	950
Total head (m)	3.4
Biofilter 2	
Capacity (gpm)	1420
Total head (m)	4.3
Stand-by (2-speed)	
Capacity (gpm)	960
Total head (m)	1660
Total head (m)	3.4
Total head (m)	4.4

Parameter	Quantity
Interstage pumping	
Biofilter Effluent Pumps (variable speed)	
Number	2
Capacity each (gpm)	2300
Total head (m)	8.2
Secondary sedimentation Tanks	
Number	1
Diameter (m)	16.8
Tank surface area (m <sup>2</sup> )	221
Tank volume (m <sup>3</sup> )	3125
Average water depth (m)	4.6
Overflow rate at PSDWF (10 <sup>3</sup> L/m <sup>2</sup> /day)	16.6
Expected secondary treatment effluent quality (mg/L)	
BOD <sub>5</sub>	30
Suspended Solids	30
<b>Chlorination</b>	
Chlorine Contact Tank (existing)	
Number of passes	2
Length (m)	
Pass 1	16.8
Pass 2	22.9
Width each pass (m)	4.6
Average depth (m)	2.3
Total volume (m <sup>3</sup> )	413
Detention time at PDWF (min)	24
Chlorinators	
Pre-chlorinator	
Number	1
Initial capacity (kg/day)	227.3
Ultimate capacity (kg/day)	909.1
RAS chlorinator	
Number	1
Capacity (kg/day)	227.3
Ultimate capacity (kg/day)	90.9
Sodium Hypochlorite Post Chlorinator	
Chemical feed pumps	3
Combined Capacity (kg/day)	5450
<b>Dechlorination</b>	
Sodium Bisulfite System	
Chemical feed pumps	3
Combined Capacity (kg/day)	1226

Morro Bay/Cayucos Wastewater Treatment Plant  
Outfall/Diffuser Annual Report

Name of Discharger: MBCSD  
NPDES Permit Number: R3-2017-0050

Name of Diver/Inspector: Ezekiel Porter, Andres Fajardo / Porter Diving Inc  
Firm & Address: \_\_\_\_\_

Telephone Number: (805) 591-9624

Outfall Length: 5160 Feet      Depth of Water: 55 Feet

Design of Diffuser (physical dimensions, shape, include sketch): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Number of Ports: 34      Number Ports Open: 28      Diffuser Level? 1' to 4'

End of Diffuser Open? \_\_\_\_\_ Closed? X

Outfall Marked by Bouys? Yes: X No: \_\_\_\_\_ Type: Spar

Diffusers Operating as Designed? Yes: X No: \_\_\_\_\_

Breaks in Outfall Line Noted? Yes: \_\_\_\_\_ No: X if yes, describe

Describe Problems Noted: None  
\_\_\_\_\_  
\_\_\_\_\_

Corrected Action Needed: None  
\_\_\_\_\_  
\_\_\_\_\_

Physical Description of Environment Around Outfall (i.e. fish noted, debris, sediment, etc.):

Fish, Sand dollars, enenomes  
\_\_\_\_\_  
\_\_\_\_\_

Direction of Plume in Relationship to Shoreline: None Seen  
\_\_\_\_\_  
\_\_\_\_\_

Pictures Taken? Yes: X No: \_\_\_\_\_ (Include copies if taken)

[Signature]  
Signature of Diver/Inspection

12-8-2021  
Date

[Signature]  
Signature of Diver/Inspection

12-8-21  
Date

Table C.1 Adjustments to Reported Monthly Plant Parameters

Period	Property	Parameter	Units	Reported	Adjusted	Change	Reason
January	Flow	Rate	MGD	1.121	1.087	-0.034	Low-flow inaccuracy <sup>1</sup>
September	Flow	Rate	MGD	0.851	0.828	-0.023	Low-flow inaccuracy
October	Flow	Rate	MGD	0.739	0.716	-0.023	Low-flow inaccuracy
November	Flow	Rate	MGD	0.756	0.748	-0.008	Low-flow inaccuracy
December	Flow	Rate	MGD	0.876	0.849	-0.027	Low-flow inaccuracy
March	O&G	Concentration	mg/L	≈1.0	≈1.6	≈0.6	Probable transcription error
January	O&G	Emission	kg/day	0.0	≈4.9	≈4.9	Provided for report analysis <sup>2,3</sup>
February	O&G	Emission	kg/day	0.0	≈4.7	≈4.7	Provided for report analysis
March	O&G	Emission	kg/day	0.0	≈6.2	≈6.2	Provided for report analysis
April	O&G	Emission	kg/day	0.0	≈5.3	≈5.3	Provided for report analysis
May	O&G	Emission	kg/day	0.0	<2.7	<2.7	Provided for report analysis
June	O&G	Emission	kg/day	0.0	<2.9	<2.9	Provided for report analysis
July	O&G	Emission	kg/day	0.0	<3.1	<3.1	Provided for report analysis
August	O&G	Emission	kg/day	0.0	<2.8	<2.8	Provided for report analysis
September	O&G	Emission	kg/day	0.0	<2.3	<2.3	Provided for report analysis
October	O&G	Emission	kg/day	0.0	<2.0	<2.0	Provided for report analysis
November	O&G	Emission	kg/day	0.0	<2.1	<2.1	Provided for report analysis
December	O&G	Emission	kg/day	0.0	<2.4	<2.4	Provided for report analysis
March	Settleable Solids	Concentration	(ml/L)	≈0.1	<0.1	ND	Lowest middle value <sup>4</sup>
April	Coliform	Density	MPN /100ml	2	<2	ND	Lowest middle value
June	Coliform	Density	MPN /100ml	2	<1.8	ND	Lowest middle value
December	Coliform	Density	MPN /100ml	1.8	<1.8	ND	Lowest middle value

<sup>1</sup> See Table C.2. As described in Section 4.4.1, most of the reduction in flow, 3.1 MG of the 3.9 MG change, arose because the reported influent flow was replaced with adjusted effluent flow-meter data when flows were low (<1.1 MGD). As shown by the white shading in the inset of Figure 4.2, consistently low flows occurred in January, before the first significant rainfall. Similarly low flows were again observed beginning in September when the CSD permanently ceased discharge to the WWTP. Plant throughput has been markedly reduced since that time.

<sup>2</sup> Estimated O&G emissions were added for this report's analysis of plant-performance and environmental-loading analyses. They have no bearing on the compliance assessment because all O&G concentrations were censored, and their emissions were correctly reported to CIWQS as zero.

<sup>3</sup> The 2015 COP specifies reporting of medians rather than averages when data are censored, namely below the quantification limit. All the O&G measurements during 2021 were censored. In that case, the following COP guidance applies: *When one or more sample results are reported as ND or DNQ, the central tendency concentration of the pollutant shall be the median (middle) value of the multiple samples. If, in an even number of samples, one or both of the middle values is ND or DNQ, the median will be the lower of the two middle values.*

<sup>4</sup> Three of the four settleable-solid concentrations during March 2021 were censored. In accordance with Footnote 3 above, the lower of the two middle values should be reported rather than the average of the two.

**Table C.1 Adjustments to Reported Monthly Plant Parameters**

Period	Property	Parameter	Units	Reported	Adjusted	Change	Reason
January	TSS	Emission	kg/day	196.7	182.0	-14.7	Product of averages <sup>1,2</sup>
February	TSS	Emission	kg/day	110.0	112.0	2.0	Product of averages
April	TSS	Emission	kg/day	142.7	140.0	-2.7	Product of averages
May	TSS	Emission	kg/day	87.7	90.0	2.3	Product of averages
June	TSS	Emission	kg/day	96.1	95.0	-1.1	Product of averages
July	TSS	Emission	kg/day	105.6	107.0	1.4	Product of averages
August	TSS	Emission	kg/day	81.8	83.0	1.2	Product of averages
September	TSS	Emission	kg/day	80.5	81.0	0.5	Product of averages
October	TSS	Emission	kg/day	74.1	74.0	-0.1	Product of averages
November	TSS	Emission	kg/day	52.7	52.0	-0.7	Product of averages
December	TSS	Emission	kg/day	54.7	54.0	-0.7	Product of averages
January	BOD	Concentration	mg/L	40.8	53.0	12.2	Median instead of average <sup>3</sup>
January	BOD	Removal	%	84.4	79.7	-4.7	Effluent concentration change
January	BOD	Emission	kg/day	210.0	218.1	8.1	Product of averages
February	BOD	Emission	kg/day	156.3	164.2	7.9	Product of averages
March	BOD	Emission	kg/day	195.0	199.1	4.1	Product of averages
April	BOD	Emission	kg/day	140.9	151.8	10.9	Product of averages
May	BOD	Emission	kg/day	123.8	130.8	7.0	Product of averages
June	BOD	Emission	kg/day	173.1	171.5	-1.6	Product of averages
July	BOD	Emission	kg/day	191.6	190.0	-1.6	Product of averages
August	BOD	Emission	kg/day	104.4	104.1	-0.3	Product of averages
September	BOD	Emission	kg/day	100.3	102.8	2.5	Product of averages
October	BOD	Emission	kg/day	99.8	97.5	-2.3	Product of averages
November	BOD	Emission	kg/day	69.4	66.6	-2.8	Product of averages
December	BOD	Emission	kg/day	95.8	93.2	-2.6	Product of averages

<sup>1</sup> The COP Standard Provisions (Attachment D §VII.G.20 Page D-20) specify reporting of monthly arithmetic averages of individual emission determinations made on days when samples are analyzed for TSS and BOD concentrations. That is how monthly emissions have been determined and reported for compliance evaluations. However, in this report's analysis of plant performance, monthly emissions were determined from the product of monthly average flow and monthly average concentration. This provides a more representative estimate of mass loading to the environment because monthly average flows incorporate variations in flow on days when effluent samples were not analyzed for TSS and BOD. A smaller portion of the emission difference was due to the use of reduced throughput that corrected for overtotalization of the influent meter at low flows (See Footnote 1 on the prior page).

<sup>2</sup> The larger reduction in January TSS emissions arose because the influent meter consistently overestimated reported flows during the low-flow periods throughout January, as shown by the white shaded regions in the inset of Figure 4.2. As a result, TSS emissions reported for January were also overestimated.

<sup>3</sup> An unusually low (non-detectable) BOD concentration was reported in the effluent sample collected on January 20<sup>th</sup>. In the absence of a detection-qualifier column within the internal database, the non-detect was indicated with a negative sign preceding the 8.7-mg/L detection limit. The negative sign was inadvertently propagated into the CIWQS compliance database and included in the computation of the reported 40.8-mg/L January arithmetic mean. Regardless, as described in Footnote 3 on the preceding page, the monthly central tendency should be reported as the median (53 mg/L) instead of the arithmetic average when the data contains censored (e.g., non-detectable) data. This correction significantly increased both the concentration and emission of January BOD. It also reduced the removal rate.

**Table C.2 Adjustments to Reported Daily Flow (MGD)**

Date	Reported	Adjusted	Change	Reason
Jan 04	0.8982	0.8559	-0.04227	Low-flow inaccuracy <sup>1</sup>
Jan 05	0.8672	0.8052	-0.06196	Low-flow inaccuracy
Jan 06	0.8710	0.8244	-0.04665	Low-flow inaccuracy
Jan 07	0.8507	0.8210	-0.02967	Low-flow inaccuracy
Jan 08	0.8844	0.8194	-0.06503	Low-flow inaccuracy
Jan 09	0.9135	0.8601	-0.05342	Low-flow inaccuracy
Jan 10	0.9360	0.8684	-0.06761	Low-flow inaccuracy
Jan 11	0.8683	0.8185	-0.04977	Low-flow inaccuracy
Jan 12	0.8150	0.8027	-0.01225	Low-flow inaccuracy
Jan 13	0.8581	0.7811	-0.07696	Low-flow inaccuracy
Jan 14	0.8764	0.8077	-0.06867	Low-flow inaccuracy
Jan 15	0.8317	0.8493	0.01758	Low-flow inaccuracy
Jan 18	0.9099	0.8368	-0.07308	Low-flow inaccuracy
Jan 19	0.8457	0.7637	-0.08201	Low-flow inaccuracy
Jan 20	0.8383	0.7629	-0.07544	Low-flow inaccuracy
Jan 21	0.8503	0.8360	-0.01431	Low-flow inaccuracy
Jan 22	0.9193	0.8551	-0.06420	Low-flow inaccuracy
Jan 23	0.9336	0.8784	-0.05523	Low-flow inaccuracy
Jan 24	0.9681	0.9041	-0.06397	Low-flow inaccuracy
Jan 25	0.9005	0.8169	-0.08363	Low-flow inaccuracy
Feb 23	0.8965	0.9116	0.01511	Low-flow inaccuracy
Mar 02	0.8900	0.9025	0.01247	Low-flow inaccuracy
Apr 09	1.1077	1.0217	-0.08597	Recording-time offset <sup>2</sup>
Apr 10	0.9868	1.0728	0.08597	Recording-time offset
Apr 12	0.9501	0.9216	-0.02852	Low-flow inaccuracy
Apr 14	0.9015	0.9836	0.08214	Recording-time offset
Apr 15	1.0744	0.9844	-0.08997	Recording-time offset
Apr 16	1.1456	1.0219	-0.12367	Recording-time offset
Apr 17	0.9726	1.1041	0.13150	Recording-time offset
Apr 27	0.9163	0.9216	0.00528	Low-flow inaccuracy
May 04	0.9076	0.9183	0.01066	Low-flow inaccuracy
May 11	0.9036	0.8825	-0.02108	Low-flow inaccuracy
May 13	0.9252	0.9066	-0.01858	Low-flow inaccuracy
May 18	0.9262	0.8991	-0.02706	Low-flow inaccuracy
May 19	0.8987	0.8990	0.00028	Recording-time offset
May 20	0.9148	0.9151	0.00029	Recording-time offset
May 25	0.9154	0.9116	-0.00379	Low-flow inaccuracy
Jun 02	0.9357	0.8809	-0.05484	Low-flow inaccuracy
Jun 03	0.9249	0.8908	-0.03407	Low-flow inaccuracy

<sup>1</sup> The influent meter's 27-inch Palmer-Bowlus flume is not recommended for reporting flow rates when flows range below 1 MGD. When low flow occurs over a significant portion of the 24-hour daily flow period, for example during the late evening or early morning hours, the accuracy and precision of the 24-hour reported flow can be impacted. These impacts are evident as a departure from data reported by the impeller-based effluent flow meter that is not apparent at higher flows. When material discrepancies in influent and effluent daily flows are observed, the adjusted effluent flow data is used in this report.

<sup>2</sup> Occasionally, influent and effluent meter readings appear to be recorded at materially different times of the day. The resulting flow discrepancies tend to be offset by opposite discrepancies on the preceding or following days, but adjustments for these offsets are necessary to create consistent daily-flow pairs for accurate determination of the effluent meter overtotalization.

**Table C.2 Adjustments to Reported Daily Flow (MGD)**

Date	Reported	Adjusted	Change	Reason
Jun 08	0.9551	0.9177	-0.03740	Low-flow inaccuracy
Aug 17	0.9516	0.9149	-0.03667	Transcription discrepancy <sup>1</sup>
Aug 19	0.9283	0.9141	-0.01420	Low-flow inaccuracy
Aug 27	0.8494	0.8526	0.00321	Low-flow inaccuracy
Aug 30	0.9151	0.8858	-0.02925	Low-flow inaccuracy
Sep 01	0.9159	0.9149	-0.00097	Low-flow inaccuracy
Sep 02	0.9493	0.9216	-0.02772	Low-flow inaccuracy
Sep 07	0.9307	0.9075	-0.02325	Low-flow inaccuracy
Sep 08	0.8962	0.9033	0.00710	Low-flow inaccuracy
Sep 09	0.9210	0.9108	-0.01022	Low-flow inaccuracy
Sep 10	0.9376	0.9083	-0.02932	Low-flow inaccuracy
Sep 14	0.7733	0.8883	0.11504	Recording-time offset
Sep 15	0.8409	0.6739	-0.16696	Recording-time offset
Sep 16	0.6867	0.7088	0.02214	Recording-time offset
Sep 17	0.6399	0.7429	0.10301	Transcription discrepancy
Sep 18	0.7809	0.7338	-0.04713	Low-flow inaccuracy
Sep 19	0.8193	0.7346	-0.08470	Low-flow inaccuracy
Sep 20	0.7163	0.7105	-0.00580	Low-flow inaccuracy
Sep 21	0.7541	0.6773	-0.07684	Low-flow inaccuracy
Sep 22	0.7408	0.6731	-0.06769	Low-flow inaccuracy
Sep 23	0.7219	0.7379	0.01603	Low-flow inaccuracy
Sep 24	0.7106	0.6590	-0.05162	Low-flow inaccuracy
Sep 25	0.7791	0.7147	-0.06444	Low-flow inaccuracy
Sep 26	0.7936	0.7138	-0.07977	Low-flow inaccuracy
Sep 27	0.7248	0.6557	-0.06914	Low-flow inaccuracy
Sep 28	0.6943	0.6407	-0.05360	Low-flow inaccuracy
Sep 29	0.7300	0.6548	-0.07517	Low-flow inaccuracy
Sep 30	0.6950	0.6532	-0.04183	Low-flow inaccuracy
Oct 01	0.6886	0.6847	-0.00386	Low-flow inaccuracy
Oct 02	0.7551	0.7180	-0.03712	Low-flow inaccuracy
Oct 03	0.7923	0.7338	-0.05853	Recording-time offset
Oct 04	0.7370	0.7928	0.05577	Recording-time offset
Oct 05	0.7128	0.6606	-0.05216	Low-flow inaccuracy
Oct 06	0.7148	0.6993	-0.01553	Recording-time offset
Oct 07	0.7004	0.6852	-0.01522	Recording-time offset
Oct 08	0.7254	0.6806	-0.04481	Low-flow inaccuracy
Oct 09	0.7564	0.7064	-0.05005	Low-flow inaccuracy
Oct 10	0.7861	0.7363	-0.04983	Low-flow inaccuracy
Oct 11	0.7331	0.7022	-0.03091	Low-flow inaccuracy
Oct 12	0.6936	0.6365	-0.05705	Low-flow inaccuracy
Oct 13	0.7564	0.7196	-0.03675	Low-flow inaccuracy
Oct 14	0.7134	0.7329	0.01954	Low-flow inaccuracy
Oct 15	0.7011	0.6836	-0.01750	Recording-time offset
Oct 16	0.7375	0.7191	-0.01841	Recording-time offset
Oct 17	0.7705	0.7513	-0.01923	Recording-time offset
Oct 18	0.7674	0.7570	-0.01036	Low-flow inaccuracy
Oct 19	0.7282	0.6964	-0.03182	Low-flow inaccuracy
Oct 20	0.7591	0.7329	-0.02616	Low-flow inaccuracy

<sup>1</sup> Mismatch between the CIWQS reported flow and the influent database that is likely due to a transcription or typographical error

**Table C.2 Adjustments to Reported Daily Flow (MGD)**

Date	Reported	Adjusted	Change	Reason
Oct 21	0.7031	0.6997	-0.00340	Low-flow inaccuracy
Oct 22	0.7265	0.7388	0.01226	Low-flow inaccuracy
Oct 23	0.7784	0.7288	-0.04961	Low-flow inaccuracy
Oct 24	0.9123	0.9166	0.00429	Low-flow inaccuracy
Oct 25	0.8629	0.8235	-0.03938	Low-flow inaccuracy
Oct 26	0.7115	0.6573	-0.05418	Low-flow inaccuracy
Oct 27	0.6614	0.6141	-0.04729	Low-flow inaccuracy
Oct 28	0.6767	0.6781	0.00140	Low-flow inaccuracy
Oct 29	0.7004	0.6656	-0.03477	Low-flow inaccuracy
Oct 30	0.7225	0.6872	-0.03526	Low-flow inaccuracy
Oct 31	0.7293	0.7479	0.01860	Low-flow inaccuracy
Nov 01	0.8145	0.8094	-0.00511	Low-flow inaccuracy
Nov 02	0.7229	0.6939	-0.02902	Low-flow inaccuracy
Nov 03	0.7354	0.7338	-0.00163	Low-flow inaccuracy
Nov 04	0.7133	0.7338	0.02047	Low-flow inaccuracy
Nov 05	0.7590	0.7986	0.03959	Low-flow inaccuracy
Nov 06	0.7901	0.8003	0.01015	Low-flow inaccuracy
Nov 07	0.7868	0.8044	0.01756	Recording-time offset
Nov 08	0.7625	0.7795	0.01702	Recording-time offset
Nov 09	0.7361	0.7014	-0.03474	Low-flow inaccuracy
Nov 10	0.7411	0.7728	0.03173	Low-flow inaccuracy
Nov 11	0.7589	0.7246	-0.03427	Low-flow inaccuracy
Nov 12	0.7952	0.7836	-0.01157	Low-flow inaccuracy
Nov 13	0.7323	0.6906	-0.04174	Low-flow inaccuracy
Nov 14	0.8101	0.7986	-0.01151	Low-flow inaccuracy
Nov 15	0.7388	0.7521	0.01326	Low-flow inaccuracy
Nov 16	0.7063	0.6823	-0.02405	Low-flow inaccuracy
Nov 17	0.7523	0.6864	-0.06589	Recording-time offset
Nov 18	0.7017	0.7753	0.07362	Recording-time offset
Nov 19	0.7058	0.6972	-0.00859	Low-flow inaccuracy
Nov 20	0.7653	0.7570	-0.00826	Low-flow inaccuracy
Nov 21	0.7794	0.7687	-0.01073	Low-flow inaccuracy
Nov 22	0.7767	0.7570	-0.01966	Low-flow inaccuracy
Nov 23	0.7818	0.7604	-0.02144	Recording-time offset
Nov 24	0.8506	0.7554	-0.09522	Recording-time offset
Nov 25	0.7091	0.7147	0.00556	Low-flow inaccuracy
Nov 26	0.7821	0.7504	-0.03171	Low-flow inaccuracy
Nov 27	0.7896	0.7770	-0.01261	Low-flow inaccuracy
Nov 28	0.7701	0.7662	-0.00392	Low-flow inaccuracy
Nov 29	0.7379	0.7545	0.01665	Low-flow inaccuracy
Nov 30	0.6911	0.6748	-0.01633	Low-flow inaccuracy
Dec 01	0.6869	0.6582	-0.02875	Low-flow inaccuracy
Dec 02	0.6842	0.6402	-0.04403	Recording-time offset
Dec 03	0.8088	0.7567	-0.05205	Recording-time offset
Dec 04	0.7662	0.7371	-0.02910	Low-flow inaccuracy
Dec 05	1.1930	0.7288	-0.46421	Transcription discrepancy
Dec 06	0.7279	0.7446	0.01668	Low-flow inaccuracy
Dec 07	0.6794	0.6590	-0.02042	Low-flow inaccuracy
Dec 08	0.6952	0.6798	-0.01544	Low-flow inaccuracy
Dec 09	0.6755	0.6997	0.02420	Low-flow inaccuracy
Dec 10	0.7484	0.6623	-0.08609	Transcription discrepancy

**Table C.2 Adjustments to Reported Daily Flow (MGD)**

<b>Date</b>	<b>Reported</b>	<b>Adjusted</b>	<b>Change</b>	<b>Reason</b>
Dec 11	0.7318	0.7213	-0.01049	Low-flow inaccuracy
Dec 12	0.7484	0.7246	-0.02377	Low-flow inaccuracy
Dec 15	0.7044	0.7413	0.03685	Transcription discrepancy
Dec 16	0.8867	0.8991	0.01244	Low-flow inaccuracy
Dec 17	0.7366	0.7280	-0.00864	Low-flow inaccuracy
Dec 18	0.7519	0.7255	-0.02644	Low-flow inaccuracy
Dec 19	0.7769	0.7629	-0.01404	Low-flow inaccuracy
Dec 20	0.7841	0.7338	-0.05033	Low-flow inaccuracy
Dec 21	0.7325	0.7313	-0.00122	Low-flow inaccuracy
Dec 24	0.9333	0.9066	-0.02668	Low-flow inaccuracy
Dec 25	0.9947	0.9427	-0.05199	Recording-time offset
Dec 26	0.8376	0.8908	0.05323	Recording-time offset
Dec 28	0.9616	0.9216	-0.04002	Low-flow inaccuracy

# Morro Bay WWTP - 27" Influent Palmer Bowlus

MH Location: **Morro Bay  
Wastewater Treatment Plant  
160 Atascadero Road  
Morro Bay, CA 93442**

Pipe Size: **30"**

P.M.D. **27 Palmer—Bowlus Flume**

Meter: **Siemens HydroRanger LUT**

G.P.S. **35.3797, -120.8604**

Time Period: **11/17/21, 8:15 a.m.**



**Transducer in Manhole**



**Site/Vault Condition**

- 30" influent line transitions into a 27" Palmer Bowlus flume with a drop on the effluent into a 30" line. This system does very well at preventing a downstream surcharge.
- Influent flow is laminar with very little turbulence.
- There was approximately 2 inches of silt and rocks on the influent side of the flume. Before the calibration this was jetted, the jetting did not remove all of the sand and rock.
- It was noted that there had been a back-up inside of the flume manhole due to high water marks and debris on the ladder and fiberglass grate.

**Flow Meter**



Siemens LUT 430 flow meter with an XRS-5 ultrasonic transducer.

- Transmitter is mounted inside of a NEMA 4X cabinet.
- Conduit into cabinet has been sealed with silicone to help prevent H2S intrusion.
- A Hobo 4 channel data logger is connected to this meter to log all flow data.



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## FLOW MONITORING SYSTEM CALIBRATION CERTIFICATE

Company Name: Morro Bay Wastewater Treatment Facility I.W. Permit #: \_\_\_\_\_Discharge/Calibration Address: 160 Atascadero Drive, Morro Bay, CA 93442Mailing Address: - same -Service Date: 11/17/21 Time: 8:15am Expires: 11/17/22 Calibration Type: Hydraulic Instrument: XOpen Channel: X Closed Pressurized Pipe: \_\_\_\_\_ Influent Pipe Size: 30" Effluent Pipe Size: 30"

### Primary Measuring Device

Manufacturer: American Sigma Weir: Type & Size: \_\_\_\_\_Flume: Parshall 27" Palmer-Bowlus Trapezoidal Cut Throat OtherFlume Depth – Top of Flume to Top of M.H.: 11'-6" Max. Head: 21" Flow at Max Head: 7083.333gpmInstrument Information: Secondary Device GPS Coordinates: 35.3797, -120.8604Manufacturer: Siemens HydroRanger 200 HMI Serial Number: PBD/F0190143 Tag #: \_\_\_\_\_Meter Type: Bubbler X Ultrasonic Area VelocityTransducer Height: 40.125" Blanking Distance: 11.8" Recorder 100% Span 7083.333 GPMTotalizer on Arrival 20746456 Totalizer on Departure 20747252 Totalizer Multiplier x100Sampling Signal Contact Closure Frequency: 1 Closure per n/a Gallons Discharged \_\_\_\_\_Flow Rate and Level On Arrival: 823gpm @ 6.6" Flow Rate and Level On Departure: 761gpm @ 6.3"

CALIBRATING SYSTEM		EXISTING METER			ERROR	
Head in Inches	GPM	Instrument Head in Inches	Flow Rate GPM Indicator Recorder	Total Discharge Gallons	Recorder (Level)	Totalizer (Flow)
0.0	0.0	0.0	0.0			
3.0"	209.4	3.0"	210		0.0%	0.28%
6.0"	674.6	6.0"	675		0.0%	0.05%
9.0"	1371	9.0"	1400		0.0%	2.11%
12.0"	2344	12.0"	2374		0.0%	1.27%

### Method of Calibration:

Manhole was entered to measure distance from transducer to flume and get a manual level measurement. We measured 6.5" of level to meter reading 6.5" prior to calibration. We removed transducer and installed on our calibration rack. We then step through multiple levels to simulate flow. Results listed above.

### Corrective Measures:

There was no corrective measures at this time.

Signature: Dave Thomas

Digitally signed by Dave Thomas  
DN: cn=Dave Thomas, o=Gold Coast Environmental, ou=email-dave@goldcoastenv.com, c=US  
Date: 2021.11.17 16:19:57 -0800



# Gold Coast Environmental



SPECIALIZING IN PROCESS INSTRUMENTATION AND CALIBRATION

## FLOW MONITORING SYSTEM CALIBRATION CERTIFICATE

Company Name: Morro Bay Wastewater Treatment Facility I.W. Permit #: \_\_\_\_\_Discharge/Calibration Address: 160 Atascadero Drive, Morro Bay, CA 93442Mailing Address: - same -Service Date: 11/17/21 Time: 8:15am Expires: 11/17/22 Calibration Type: Hydraulic Instrument: XOpen Channel: X Closed Pressurized Pipe: \_\_\_\_\_ Influent Pipe Size: 30" Effluent Pipe Size: 30"

### Primary Measuring Device

Manufacturer: American Sigma Weir: Type & Size: \_\_\_\_\_Flume: Parshall 27" Palmer-Bowlus Trapezoidal Cut Throat OtherFlume Depth – Top of Flume to Top of M.H.: 11'-6" Max. Head: 21" Flow at Max Head: 7083.333gpmInstrument Information: Secondary Device GPS Coordinates: 35.3797, -120.8604Manufacturer: Siemens HydroRanger 200 HMI Serial Number: PBD/F0190143 Tag #: \_\_\_\_\_Meter Type: Bubbler X Ultrasonic Area VelocityTransducer Height: 40.125" Blanking Distance: 11.8" Recorder 100% Span 7083.333 GPMTotalizer on Arrival 20746456 Totalizer on Departure 20747252 Totalizer Multiplier x100Sampling Signal Contact Closure Frequency: 1 Closure per n/a Gallons Discharged \_\_\_\_\_Flow Rate and Level On Arrival: 823gpm @ 6.6" Flow Rate and Level On Departure: 761gpm @ 6.3"

CALIBRATING SYSTEM		EXISTING METER			ERROR	
Head in Inches	GPM	Instrument Head in Inches	Flow Rate GPM Indicator Recorder	Total Discharge Gallons	Recorder (Level)	Totalizer (Flow)
0.0	0.0	0.0	0.0			
3.0"	209.4	3.0"	210		0.0%	0.28%
6.0"	674.6	6.0"	775		0.0%	0.05%
9.0"	1371	9.0"	1400		0.0%	2.11%
12.0"	2344	12.0"	2374		0.0%	1.27%

### Method of Calibration:

Manhole was entered to measure distance from transducer to flume and get a manual level measurement. We measured 6.5" of level to meter reading 6.5" prior to calibration. We removed transducer and installed on our calibration rack. We then step through multiple levels to simulate flow. Results listed above.

### Corrective Measures:

There was no corrective measures at this time.

Signature: Dave Thomas

Digitally signed by Dave Thomas  
DN: cn=Dave Thomas, o=Gold Coast Environmental, ou=email-dave@goldcoastenv.com, c=US  
Date: 2021.11.17 16:19:57 -0800