POTW Participation in CECs Studies

White Paper

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Bay Area Clean Water Agencies

BACWA
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Updated November 2024

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Introduction

The Bay Area Clean Water Agencies (BACWA) is a joint powers agency whose members own and operate Publicly-Owned Treatment Works (POTWs) throughout the SF Bay Region. Through the San Francisco Estuary Institute's Regional Monitoring Program (RMP), BACWA members participate in studies on unregulated Contaminants of Emerging Concern (CECs) on a voluntary basis. However, a regional understanding of CECs in wastewater is skewed when studies only consider the handful of agencies who often volunteer to participate. This White Paper, originally prepared in 2020 and updated in November 2024, puts forth an approach to ensure that POTWS that are requested to participate in future regional studies of CECs are generally representative of wastewater effluent quality from all Bay Area POTWs.

A list of agencies participating in CECs studies, and the rationale for their selection for particular studies is being maintained as an appendix to this White Paper. This approach tracks participation over time and provides a historical record of which agencies have participated and how they were selected.

Background

The RMP forms the core of water quality, sediment quality, and tissue monitoring in the San Francisco Bay. Historically, each POTW was responsible for performing receiving water monitoring as part of its individual NPDES Permit. The RMP was created in 1993 through San Francisco Regional Water Quality Control Board (Regional Water Board) Resolution No. 92-043 that directed the Executive Officer to implement a Regional Monitoring Plan in collaboration with permitted dischargers pursuant to California Water Code, Sections 13267, 13383, 13268, and 13385. The goal was to replace individual receiving water monitoring requirements for dischargers with a comprehensive Regional Monitoring Program.

The Regional Monitoring Program's specific objectives[1] are to:

- Describe the distribution and trends of pollutant concentrations in the Estuary;
- Project future contaminant status and trends using best understanding of ecosystem processes and human activities;
- Describe sources, pathways, and loading of pollutants entering the Estuary;
- Measure pollution exposure and effects on selected parts of the Estuary ecosystem (including humans);
- Compare monitoring information to relevant benchmarks, such as total maximum daily load (TMDL) targets, tissue screening levels, water quality objectives, and sediment quality objectives; and
- Effectively communicate information from a range of sources to present a more complete picture of the sources, distribution, fate, and effects of pollutants and beneficial use attainment or impairment in the Estuary ecosystem.

[1] *Water Quality Control Plan (Basin Plan) for the San Francisco Bay Basin*, Chapter 6: Surveillance and Monitoring.

The RMP has been investigating CECs since 2001 and established a formal workgroup to address the issue in 2006. The RMP Emerging Contaminants Workgroup (ECWG) includes representatives from RMP stakeholder groups including POTWs, regional scientists, and an advisory panel of expert researchers that work together to address the Workgroup's guiding management questions[2]:

- Which CECs have the potential to adversely impact beneficial uses in San Francisco Bay?
- What are the sources, pathways and loadings leading to the presence of individual CECs or groups of CECs in the Bay?
- What are the physical, chemical, and biological processes that may affect the transport and fate of individual CECs or groups of CECs in the Bay?
- Have the concentrations of individual CECs or groups of CECs increased or decreased in the Bay?
- Are they predicted to increase or decrease in the future?
- What are the effects of management actions?

The overarching goal of the ECWG is to develop cost-effective strategies to identify and monitor CECs to support management actions to minimize impacts to the Bay. The ECWG guides an annual process of contaminant evaluation and long-term planning and optimization to respond to new RMP data and the rapidly evolving body of science on CECs.

Following this process for over a decade, the RMP has generated one of the world's most comprehensive datasets for CECs in an estuarine ecosystem. While RMP stakeholders are the primary audience and user of RMP data and communications, the Program informs broader decision-making through outreach to state and federal agencies.

The RMP first published a formal CEC Strategy in 2013 as part of a continuous effort to refine approaches for supporting the management of CECs in San Francisco Bay. Periodic revision of the Strategy is essential given the rapid evolution of the science surrounding emerging contaminants. The most recent update to the CECs strategy was completed in 2024[3].

For CECs known to occur in the Bay, the RMP prioritizes CECs using a tiered risk-based framework, as illustrated in Figure 1. This prioritization framework guides future monitoring proposals for each of these contaminants, the results of which, in turn, provide key data to update evaluations of potential risk. The criteria listed below are used for placement in each tier.

The 2024 update to the CEC Strategy added a "very high concern" tier to the table shown below in Figure 1, and also included changes to the monitoring strategies and water quality management actions for each tier. Up-to-date information, including the most recent CEC Strategy, can be found at the RMP's Emerging Contaminants webpage[4].

[2] Regional Monitoring Program Multi-Year Plan, 2024 Annual Update.
[3] Contaminants of Emerging Concern in San Francisco Bay: A Strategy for Future Investigations 2024 Revision | San Francisco Estuary Institute (sfei.org)
[4] https://www.sfei.org/programs/rmp#tab-6-2, "Contaminants of Emerging Concern" tab.

Figure 1. RMP's Risk-based tiered framework (2024 version)

	Risk Evaluation	Recommended Monitoring Strategy	Water Quality Management Actions
Very High Concern	Bay occurrence data suggest a **very high probability** of an adverse impact on Bay wildlife or people	Studies to support TMDL or alternative management plan Include in Status and Trends monitoring	303(d) listing TMDL or alternative management plan Aggressive control/treatment actions for all controllable sources Track product use and market trends
High Concern	Bay occurrence data suggest a **high probability** of an adverse impact on Bay wildlife or people	Include in Status and Trends monitoring Prioritize special studies on sources, pathways, and loadings to inform potential management actions Consider special studies on fate and/or effects to confirm tier classification	Prioritize action plan/strategy Aggressive pollution prevention Cost-effective control/treatment actions Track product use and market trends
Moderate Concern	Bay occurrence data suggest a **moderate probability** of an adverse impact on Bay wildlife or people	Consider including in Status and Trends monitoring Consider special studies of sources, pathways, and loadings to inform potential management actions Consider special studies on fate and/or effects to confirm tier classification	Action plan/strategy Moderate pollution prevention Cost-effective control/treatment actions Track product use and market trends
Low Concern	Bay occurrence data suggest **minimal impact** on Bay wildlife or people	Periodic screening - Conduct periodic screening level monitoring in water, sediment, or biota; Periodic screening level monitoring in wastewater or stormwater to track trends Transitional - For CECs previously considered moderate concern, maintain Status and Trends monitoring for a limited number of cycles to confirm evaluation, as appropriate Deprioritized - Discontinue monitoring	Low-cost source identification and control Low-level pollution prevention Track product use and market trends
Possible Concern	Uncertainty in measured Bay concentrations or toxicity thresholds suggest **uncertainty** in the level of effect on Bay wildlife or people	Periodic screening - Conduct periodic screening level monitoring in water, sediment, or biota; Periodic screening level monitoring in wastewater or stormwater to track trends; track new information in scientific literature and other sources Deprioritized - Discontinue monitoring	Maintain ongoing effort to identify and prioritize emerging contaminants of potential concern for the Bay Track international and national efforts to identify high priority CECs and their sources Identify and/or develop quantitative chemical and/or biological screening methods

Benefits of CECs Program Management through RMP

Different approaches have been discussed for monitoring CECs in aquatic ecosystems through the State of California, including requirements in individual NPDES permits, and a State-wide

monitoring program. The San Francisco Bay Region is fortunate to have a mature and sustainable CECs program. The advantages of this program, over individual requirements include the following:

- CEC science and strategy planning happens under one umbrella and is directed by scientists and stakeholders. We avoid competing or duplicative studies.
- CECs monitoring is tailored to the specific questions that need to be answered in the SF Bay while maximizing use of limited funds.
- Data quality control for CECs follows protocols established by the RMP science team. Data upload is managed through RMP staff who routinely upload data to the California Environmental Data Exchange Network (CEDEN) database.

POTW Participation in RMP CECs Program

POTWs are an important pathway for some CECs to the SF Bay. Sampling of CECs in wastewater effluent has been a component of many of the studies conducted through the RMP. Past studies have looked at POTWs as sources of pharmaceuticals, pesticides, and more recently, microplastics. Over the previous decade, as the need for effluent studies was identified by the RMP staff and ECWG, a call was put out to POTWs seeking volunteers in these studies.

BACWA, a joint powers agency whose members own and operate POTWs throughout the SF Bay Region, has worked with the RMP to ensure that there has been participation in these studies by the POTW community. Involvement in these studies has been on a volunteer basis. Since 2020, BACWA has worked with RMP staff to ensure that the POTWs participating in these studies are representative of wastewater effluent quality from all POTWs, and studies do not focus on the subset of agencies who repeatedly volunteer to participate.

Identifying Representative Facilities for future studies

It is not cost-effective, nor particularly useful, to sample effluent at every POTW when a smaller number of representative POTWs can yield the information that is being sought in a particular study. One of the purposes of this White Paper is to provide information about BACWA's member agencies that can be used to identify "representative" participants for future studies. The following characteristics were identified as pertinent because of their potential impacts on CECs in wastewater effluent. The information about each of the Bay-discharging POTWs in the region is included in the Appendices as listed below[5]. The criteria used in various studies and the final selection of POTWs will vary based on the constituent(s) of interest and the scope of each study.

- Location by subembayment – Appendix 1[6]
- Population served – Appendix 2
- Average dry weather permitted flow – Appendix 2
- Discharge flow rate to Bay – Appendix 2

[5] Only major dischargers (> 1 MGD permitted dry weather flow) to San Francisco Bay are included. Minor dischargers (<1 MGD), ocean dischargers, and dischargers to the upper Napa River are not listed in the appendices.

[6] Subembayment boundaries may be reassigned in the future based on RMP modeling findings.

- Pretreatment Program Implementation – Appendix 2
- Recycled Water Program Implementation – Appendix 2
- Type of Treatment – Appendix 3
- Source water – surface vs. groundwater, potential agricultural impacts – Appendix 4

Flow and population served are important criteria; depending on the study, small agencies may be a low priority for sampling due to limited staffing and because they represent a small portion of wastewater contributions to the Bay.

Industrial inputs to POTWs will also be important for some CECs. POTWs with permitted average dry weather flow capacity over 5 million gallon per day (MGD) maintain pretreatment programs whereby they regulate industrial users that contribute significant flow or federally regulated pollutants to the collection system. However, many CECs may be discharged from commercial facilities that are not traditionally regulated, such as nursing homes, pet grooming facilities, hotels, and plant nurseries.

Keeping a comprehensive list of businesses that may be associated with CECs in each agency's jurisdiction is not feasible due to the changing identity and location of these businesses over time, and uncertainty regarding which CECs will be important in future studies. When an industrial use is associated with a CEC that is being studied, BACWA will work with the RMP to perform an online search for the businesses and industries of interest, then work to identify in which POTW's sewershed they operate. To help in this effort, BACWA, in conjunction with the Regional Water Board and SFEI, has developed a POTW sewershed map (see https://baywise.org/map/). Information on businesses present in each service area may also be available from agencies' billing records; BACWA can work with agencies to access these records, when needed.

Some agencies have expressed concern that participating in CEC studies would lead to adverse impacts to their agencies, in terms of negative attention from regulators or the public. The Regional Water Board has made it clear that the intent of monitoring representative POTWs is to ensure that the results will be considered characteristic of all POTWs of types similar to those monitored and not simply attributed to a particular POTW. Monitoring results will not be considered representative of just those POTWs that participated, and participating POTWs will not be subject to any specific action(s) or regulatory consequence as a result of monitoring results.

To provide the State Water Board with the data it needs to avoid regulatory action on CEC monitoring, results from these studies will be entered into California Environmental Data Exchange Network (CEDEN) database. However, agencies that participate in the studies may request that their data be anonymized and that they not be mentioned by name when the studies are described in articles submitted to scientific journals or in communications with the press.

This white paper was originally prepared to guide selection of agencies for participation in effluent monitoring, but also may be useful for related efforts to monitor influent, biosolids, or air quality.

Case study – selecting a suite of representative POTWs to participate in CEC study

To illustrate the process of selecting representative POTW, a case study is presented below. In the summer of 2019, the RMP conducted a study of ethoxylated surfactants (ES). The goal for POTW selection was to recruit a selection of POTWs with the following characteristics:

- Geographical diversity to help interpret observed surface water concentrations
- Diversity of treatment technologies to understand impact of treatment processes on ES compounds
- Facilities with higher flow rates to capture a significant portion of the total wastewater loading of ES compounds to the Bay

In a literal sense, some of these criteria are mutually exclusive. For example, sampling at the EBDA outfall would allow capture of a greater portion of the loading to the Bay, but since the outfall discharge is made up of effluent from six different POTWs with different treatment trains, no information about individual treatment processes would be available from sampling at EBDA. Likewise, sampling at SFPUC's Southeast Plant would have allowed capture of more of the total load to the SF Bay, but SFPUC uses the same secondary treatment technology, high purity oxygen activated sludge, and discharges to the same subembayment as EBMUD, so smaller facilities with different treatment technologies that discharge to different subembayments were selected.

The final selection of treatment facilities is presented in Table 1.

A list of agencies participating in recent or ongoing CECs studies is in Appendix 5 of this White Paper. This allows BACWA members, the Regional Water Board, and RMP staff to track participation over time, and provide a historical record of which agencies have participated and how they were selected.

Table 1. POTW sampling design for ethoxylated surfactants.

	Facility	Annual Average Daily Effluent Flow (MGD)	Sub-embayment	Secondary	Tertiary Treatment	Nitrification	Denitrification	Disinfection
1	**San José-Santa Clara**	87	Lower South Bay	Activated Sludge/Biological Nutrient Removal	Y	Y	Y	Liquid Chorine
2	**Palo Alto**	18.4	Lower South Bay	Trickling Filter/Nitrifying Activated Sludge	Y	Y		UV
3	**Hayward**	10.0 (discharge through EBDA outfall)	South Bay	Trickling Filter/Solids Contact				Sodium Hypochlorite
4	**EBMUD**	52.5	Central Bay	High Purity Oxygen Activated Sludge				Sodium Hypochlorite
5	**CCCSD**	35.4	Suisun Bay	Activated Sludge with Anaerobic Selector				UV
6	**Fairfield Suisun**	13.4	Suisun Bay	Activated Sludge	Y	Y		UV
7	**Vallejo**	9.2	San Pablo Bay	Trickling Filter/Solids contact				Sodium Hypochlorite
8	**San Mateo**	10.4	South Bay	Activated Sludge				Sodium Hypochlorite

POTWs funding for RMP CECs Program

The RMP participants, including dredgers, stormwater agencies, and municipal and industrial dischargers that hold Regional Water Board permits for waste discharge into the Estuary, fund the RMP as a requirement of their permits. Each year, a portion of this funding was allocated to CECs studies, but by 2016, as overall RMP funding was decreasing due to diminishing contribution from the dredgers, an alternative source of funding was sought.

In 2015, BACWA worked with the SF Regional Water Board to review the costs and benefits of the routine monitoring required by agencies' individual NPDES permits, and concluded that significant resources were being spent on monitoring for pollutants that were rarely detected. BACWA and the Regional Water Board reached an agreement to reallocate resources from low-value effluent testing to the RMP. The strategy reflected the need to shift our effort from contaminants that were of concern historically, largely due to industries that are no longer located in the region, to emerging priorities. In April 2016, the Regional Water Board adopted order R2-2016-0008, which established opt-in Alternative Monitoring and Reporting Requirements for municipal NPDES permittee. This permit raised $1.3M over five years to support the RMP. In 2021, the Regional Water Board replaced the 2016 order with a new order (R2-2021-0028) amending individual NPDES permit with a similar suite of monitoring revisions. In calendar year 2023, this order raised $330,000 for the RMP.

Because of the limited funding available to the RMP for CECs studies, POTW effluent monitoring is not included in some RMP studies where it is a lower priority than monitoring other matrices. In the past, individual POTWs have volunteered to fund effluent monitoring for studies that are managed by RMP staff. A recent example of this approach is the 2017 *Screening of Pharmaceuticals in San Francisco Bay Wastewater* Study[7]. Because relying on agency volunteers to fund these special studies puts an unfair burden on those agencies who step up, when all agencies throughout the Region benefit, beginning in FY21 BACWA has provided budget to support POTW-specific CEC studies led by the RMP and/or SFEI. Descriptions of POTW-funded studies are included as Appendix 5.

CEC Management in SF Bay – Next Steps

As described in the Tiered Risk Framework, CECs in the "moderate" tier are subject to management plans and pollution prevention. While BACWA welcomes information about removal efficacy for CECs through different wastewater treatment trains, we view pollutant prevention as the most important strategy for reducing CEC loading to receiving waters.

BACWA's Bay Area Pollution Prevention Group (BAPPG) funds public outreach, and professional outreach and training for both traditional pollutants such as Fats, Oils, and Grease, mercury, and copper, as well emerging contaminants such as pharmaceuticals. In recent years, microplastics, pesticides, and PFAS have been identified as prioritized pollutants. BAPPG's public facing website, Baywise.org, contains public outreach materials that can be used by member and partner agencies.

[7] See full report:
https://www.sfei.org/sites/default/files/biblio_files/BACWA%20Pharmaceutical%20Report_103018.pdf

In addition to public outreach, BAPPG also supports regulatory advocacy for pollutants such as pesticides, including fipronil. POTWs do not have direct authority to regulate pesticides in their service area. However, over the past few years, BAPPG has partnered with the Regional Water Board to comment on EPA's pesticide re-registrations, to urge them to consider pathways to the sewer when doing risk assessments. The selection approach proposed in this White Paper can be used to support BAPPG's efforts such as in collaborative studies with the California Department of Pesticides Regulation. More information about BAPPG's Pollution Prevention activities can be found in their most recent Annual Report[8].

DTSC's Safer Consumer Products initiative is another pathway to address the use of CECs of moderate or higher concern[9]. DTSC maintains this program to identify and develop a regulatory response for chemicals, formulations, or products that may pose a human health or ecological risk.

Finally, POTWs, either individually or through BAPPG, CASA, or other associations, support legislation to control products leading to CEC pollution. Support of pharmaceutical take-back programs is an example of effective advocacy in the past.

The RMP's CEC Program has been key to our understanding of emerging concerns in the San Francisco Bay. Moving into the future, the CEC program through the RMP will continue to inform BACWA's pollution prevention efforts, and BACWA is committed to its continued support.

[8] https://bacwa.org/document-category/bappg-annual-reports/
[9] https://dtsc.ca.gov/scp/safer-consumer-products-program-overview/

Appendix 1: POTW Location

Figure A1. Location of POTWs Discharging to SF Bay, by subembayment

Additional location information in a geolocated format is available at https://baywise.org/map/

Appendix 2: Population and Flows

Table A2: Population and flows for POTWs Discharging to SF Bay

POTW	Estimated Population[d]	Permitted Average Dry Weather Flow, MGD[d]	Average Flow to Bay, 2019-2022, MGD[e]	Pretreatment Program (Y/N)	Recycled Water Production for use off-site (Y/N)
American Canyon	20,000	2.5	1.4	Y[f]	Y
Benicia	28,000	4.5	1.9	N	N
Burlingame[a]	37,000	5.5	2.6	Y	N
CCCSD	484,800	53.8	34	Y	Y
CMSA	104,500	10	9.5	Y	N
Delta Diablo	213,000	19.5	8.1	Y	Y
DSRSD[b]	162,500	20.2	6.1	Y	Y
EBDA[b]	1,023,300	107.8	57	Y	N
EBMUD	710,000	120	51	Y	Y
FSSD	144,000	23.7	14	Y	Y
Hayward[b]	160,000	18.5	10	Y	Y
Las Gallinas	30,000	2.92	1.8	N	Y
Livermore[b]	92,000	8.5	4.4	Y	Y
Millbrae[a]	23,200	3.0	1.5	Y	N
Mt. View SD	21,000	3.2	1.3	N	N
Napa SD	83,300	15.4	3.7	Y	Y
Novato SD	60,000	7.0	3.0	Y	Y
Oro Loma SD[b]	192,000	20	12	Y	N
Palo Alto	236,000	39	19	Y	Y
Petaluma	65,000	6.7	2.6	Y	Y
Pinole	45,000	4.06	2.5	N	N
Richmond[c]	72,000	16	5.9	Y	N
Rodeo	10,500	1.14	0.61	N	N
San José-Santa Clara	1,500,000	167	81	Y	Y
San Leandro[b]	60,000	7.6	4.7	Y	Y
San Mateo	150,000	15.7	10	Y	N

POTW	Estimated Population[d]	Permitted Average Dry Weather Flow, MGD[d]	Average Flow to Bay, 2019-2022, MGD[e]	Pretreatment Program (Y/N)	Recycled Water Production for use off-site (Y/N)
Sewerage Agency of Southern Marin	29,000	3.6	2.3	N	Y
SFO[a]	n/a	2.4	0.95	N	Y
SFPUC Southeast	650,000	85.4	53	Y	N
Sausalito-Marin City SD	22,290	1.8	1.1	N	N
South San Francisco-San Bruno[a]	113,500	13	7.6	Y	N
Sunnyvale	150,000	29.5	11	Y	Y
Sonoma Valley County SD	28,000	3.0	0.90	N	Y
Silicon Valley Clean Water	220,000	29	16	Y	Y
Treasure Island	2,500	Current: 2.0 Planned: 1.3	0.31	N	Current: N Planned: Y
Union Sanitary District[b]	356,800	33.0	23	Y	N
Vallejo	120,000	15.5	8.9	Y	N
West County Wastewater District[c]	102,000	12.5	7.9	Y	N
West County Agency[c]	174,000	28.5	13.8	Y	N

[a] The Burlingame, Millbrae, South San Francisco - San Bruno, and San Francisco International Airport plants discharge to a common outfall to SF Bay operated by the North Bayside System Unit (NBSU), a joint powers authority.

[b]EBDA provides the outfall to SF Bay for the City of Hayward, Oro Loma Sanitary District, City of San Leandro, and Union Sanitary District, as well as the Livermore Amador Valley Water Management Agency, which includes Livermore and Dublin San Ramon Services District. Flows listed for EBDA are the sum of these six plants.

[c]West County Agency provides the outfall to SF Bay for the City of Richmond and West County Wastewater District. Flows listed for West County Agency are the sum of these two plants.

[d]Unless noted otherwise, service area population and ADWF are from each POTW's NPDES permit current as of September 2024. The population estimate for SFPUC Southeast is from the 2019 administrative draft NPDES permit for the plant.

[e]Flow for most agencies are from the Volumetric Annual Report of Wastewater and Recycled Water from the State Water Board, available online at https://data.ca.gov/dataset/volumetric-annual-report-of-wastewater-and-recycled-water. Flows for West County Wastewater District, Richmond, and West County Agency are from monthly averages reported to CIWQS in electric self-monitoring reports.

[f] The City of American Canyon's pretreatment program is not subject to USEPA approval.

Appendix 3: Treatment Technology

Treatment technology can impact the removal of CECs biodegradation and partitioning to solids. Disinfection technology will impact the formation of disinfection byproducts. Table A3 shows the treatment technologies used at each POTW. The last column indicates whether the plant has filtration, often denoted as "advanced secondary" in NPDES permits in the SF Bay Region.

Table A3. Treatment Technologies for POTWs Discharging to SF Bay

AS = Activated Sludge; DAF = Dissolved Air Flotation; TF = Trickling Filter; MBR = Biological Membrane Reactor; NDN = Nitrification + Denitrification

POTW	Secondary Treatment Type	Nitrogen Removal	Disinfection Type	Advanced Secondary / Filtration? (Y/N)
American Canyon	MBR	Nitrification	UV	Y
Benicia	AS and Rotating Biological Contactor	--	Sodium Hypochlorite	N
Burlingame	AS	--	Sodium Hypochlorite	N
CCCSD	AS	--	UV	N
CMSA	TF/AS	--	Sodium Hypochlorite	N
Delta Diablo	TF/AS (in parallel)	--	Sodium Hypochlorite	N
DSRSD	TF and/or AS	--	Sodium Hypochlorite	N
EBMUD	High Purity Oxygen AS	Dry Season NDN (Partial stream)	Sodium Hypochlorite	N
FSSD	AS	Nitrification (Full Stream) NDN (Partial stream)	UV	Y
Hayward	TF/AS	In Design: NDN	Sodium Hypochlorite	N
Las Gallinas	Biowheel Fixed Film / AS	NDN	Sodium Hypochlorite	N
Livermore	AS	--	Sodium Hypochlorite	N
Millbrae	AS	--	Sodium Hypochlorite	N
Mt. View SD	TF, Biotower	Nitrification	UV	Y
Napa SD	AS	NDN	Sodium Hypochlorite	N
Novato SD	AS	NDN	UV	N
Oro Loma SD	AS	NDN	Sodium Hypochlorite	N

POTW	Secondary Treatment Type	Nitrogen Removal	Disinfection Type	Advanced Secondary / Filtration? (Y/N)
Palo Alto	Fixed Film / AS / Dual Media Filtration	Nitrification	UV	Y
Petaluma	AS / Ponds / Wetland	NDN	Sodium Hypochlorite	N
Pinole	AS	Plant has NDN functionality but has not operated in NDN mode	Sodium Hypochlorite	N
Richmond	AS	--	Sodium Hypochlorite	N
Rodeo	AS	NDN	Sodium Hypochlorite	N
San José-Santa Clara	AS / Dual Media Filtration	NDN	Sodium Hypochlorite	Y
San Leandro	TF/AS	--	Sodium Hypochlorite	N
San Mateo	Current: AS In construction: MBR	In Construction: NDN	Sodium Hypochlorite	N
Sewerage Agency of Southern Marin	TF	Nitrification	Sodium Hypochlorite	N
SFO	AS (Sanitary plant) DAF / TF (Industrial plant)	In construction: NDN for Sanitary Plant	Sodium Hypochlorite	N
SFPUC	High Purity Oxygen AS	--	Sodium Hypochlorite	N
Sausalito-Marin City SD	Fixed Film Reactors / Sedimentation / Disk Filters	--	Sodium Hypochlorite	Y
SSF	AS	--	Sodium Hypochlorite	N
Sunnyvale	Oxidation Ponds/TF/DAF/Dual Media Filtration	NDN	Sodium Hypochlorite	Y
Sonoma	AS / cloth media filtration	NDN	Sodium Hypochlorite	Y
Silicon Valley Clean Water	TF/AS	--	Sodium Hypochlorite	Y
Treasure Island	Current: TF In Construction: MBR	NDN	Current: Sodium Hypochlorite In Construction: UV	Current: N In Construction: Y
Union Sanitary District	AS	In Construction: NDN	Sodium Hypochlorite	N
Vallejo	TF/AS	--	Sodium Hypochlorite	N
West County WD	AS	NDN	Sodium Hypochlorite	N

Appendix 4: Water sources

There are seven major water wholesalers and large retailers serving residents in the service area of Bay Area POTWs. These seven are highlighted below; see Table A4 for a complete list of water agencies and supplies in the Bay Area.

- Alameda County Water District (ACWD) – ACWD's primary sources for water supply are the State Water Project (SWP), SFPUC, and local groundwater.
- Contra Costa Water District (CCWD) - CCWD's primary source of water supply is the United States Bureau of Reclamation's Central Valley Project (CVP).
- East Bay Municipal Utility District (EBMUD) - EBMUD delivers water from the Mokelumne River watershed, supplemented with water from East Bay watershed reservoirs. Water from EBMUD is not expected to include groundwater, or be influenced by agricultural drainage.
- SFPUC Region Water System (RWS) – The SFPUC delivers water imported from the Hetch Hetchy reservoir, as well as reservoirs in the Alameda Watershed and Peninsula Watershed. Beginning in 2017, SFPUC began accessing local groundwater supplies. Water from the SFPUC is not expected to be influenced by agricultural drainage.
- Santa Clara Valley Water District (Valley Water) – Sources of supply for Valley Water include natural groundwater recharge, local surface water, imported surface water from the State Water Project (SWP) and CVP, and transfers. Imported water from the State Water Project and Central Valley Project is expected to have some impact from agricultural drainage at its source in the SF Delta.
- Sonoma County Water Agency (SCWA) – The Russian River provides most of the Water Agency's water supply with groundwater supply from the Santa Rosa Plain as a secondary source. Water from the Russian River is expected to have some impact from agricultural drainage.
- Zone 7 –The SWP is Zone 7's largest water supply, and is supplemented by local surface water and groundwater. Imported water from the SWP and CVP is expected to have some impact from agricultural drainage at its source in the SF Delta.

Information about the water supplies in the sewersheds of each POTW is presented in the Water Agencies' Urban Water Management Plans (UWMP), which are available on DWR's website[10]. The POTWs for each Water Agency are reported in Table 6.3 of each UWMP. For each POTW, Table A4 identifies the Water Agencies supplying their service area, the agencies' water sources, and whether there may be an agricultural influence on the source water supply, or if groundwater is a significant supply source. Most areas are served by smaller retailers who provide a combination of water purchased from wholesalers, and local surface or groundwater.

[10] https://wuedata.water.ca.gov/uwmp_plans.asp?cmd=2020

Table A4: Source Water Supplies

WW Agencies	Water Agency	Sources	Groundwater supply (Y/N)	Potential Agricultural Impacts (Y/N)
American Canyon	American Canyon City Of	SWP, City of Vallejo (see below)	N	Y
Benicia	City of Benicia	SWP, Sacramento River, Solano Project (Lake Berryessa), local surface water	N	Y
Burlingame	Hillsborough Town Of	SFPUC RWS	N	N
	Burlingame City Of	SFPUC RWS	N	N
CCCSD	Martinez City Of	CCWD	N	Y
	Contra Costa Water District	Central Valley Project, other Delta supplies	N	Y
	East Bay Municipal Utility District	Mokelumne Watershed, local surface water	N	N
CMSA	Marin Municipal Water District	Local surface water	N	N
Delta Diablo	Contra Costa Water District	Central Valley Project, other Delta supplies	N	Y
	Antioch City Of	Delta, and Contra Costa Canal (CCWD)	N	Y
	Pittsburg City Of	CCWD, and local groundwater	Y	Y
	Golden State Water Company - Bay Point	CCWD, and local groundwater	Y	Y
DSRSD	Zone 7	State Water Project, Local surface Water, Local Groundwater, Imported Surface Water from Byron-Bethany Irrigation District	Y	Y
	Pleasanton City Of	Zone 7, and local groundwater	Y	Y
	Dublin San Ramon Services District	Zone 7	Y	Y
	East Bay Municipal Utility District	Mokelumne Watershed, local surface water	N	N
EBMUD	East Bay Municipal Utility District	Mokelumne Watershed, local surface water	N	N
Fairfield-Suisun Sewer District (FSSD)	Suisun - Solano Water Authority	SWP, Solano Project (Lake Berryessa)	N	Y
Hayward	Hayward City Of	SFPUC RWS	N	N
LGVSD	Marin Municipal Water District	Local surface water	N	N

WW Agencies	Water Agency	Sources	Groundwater supply (Y/N)	Potential Agricultural Impacts (Y/N)
Livermore	Zone 7	State Water Project, Local surface Water, Local Groundwater, Imported Surface Water from Byron-Bethany Irrigation District	Y	Y
	California Water Service Company Livermore	Zone 7 (SWP), and local groundwater	Y	Y
	Livermore City Of	Zone 7	Y	Y
	Pleasanton City Of	Zone 7, and local groundwater	Y	Y
Millbrae	Millbrae City Of	SFPUC RWS	N	N
Mt. View Sanitary District	Contra Costa Water District	Central Valley Project, other Delta supplies	N	Y
	Martinez City Of	CCWD	N	Y
Napa Sanitation District	American Canyon City Of	State Water Project, City of Vallejo (see below)	N	Y
	Napa City Of	SWP, local surface water	N	Y
Novato Sanitary District	North Marin Water District	SCWA, local surface water	Y	Y
Oro Loma Sanitary District	East Bay Municipal Utility District	Mokelumne Watershed, local surface water	N	N
Palo Alto	California Water Service Company Los Altos/Suburban	Valley Water (State Water Project, Central Valley Project), Local Groundwater	Y	Y
	California Water Service Company Mid-Peninsula	SFPUC RWS	N	N
	East Palo Alto City Of	SFPUC RWS	N	N
	Mountain View City Of	SFPUC RWS, Valley Water, and local groundwater	Y	Y
Petaluma	City of Petaluma	SCWA, local groundwater	Y	Y
Pinole/Hercules	East Bay Municipal Utility District	Mokelumne Watershed, local surface water	N	N
Richmond	East Bay Municipal Utility District	Mokelumne Watershed, local surface water	N	N
Rodeo Sanitary District	East Bay Municipal Utility District	Mokelumne Watershed, local surface water	N	N

WW Agencies	Water Agency	Sources	Groundwater supply (Y/N)	Potential Agricultural Impacts (Y/N)
San José - Santa Clara	Milpitas City Of	SFPUC RWS, and Valley Water (CVP and SWP, not GW)	N	Y
	San Jose City Of	SFPUC RWS, Valley Water (surface), and local groundwater	Y	Y
	San Jose Water Company	Valley Water, and local groundwater	Y	Y
	Santa Clara City Of	SFPUC RWS, Valley Water (surface), and local groundwater	Y	Y
	Great Oaks Water Company Incorporated	Local groundwater	Y	N
San Leandro	East Bay Municipal Utility District	Mokelumne Watershed, local surface water	N	N
San Mateo	California Water Service Company Mid-Peninsula	SFPUC RWS	N	N
	Hillsborough Town Of	SFPUC RWS	N	N
Sanitary District No. 5 (Tiburon)	Marin Municipal Water District	Local surface water	N	N
	SCWA	Russian River	N	Y
Sewerage Agency of Southern Marin	Marin Municipal Water District	Local surface water	N	N
	SCWA	Russian River	N	Y
Sausalito-Marin City SD	Marin Municipal Water District	Local surface water	N	N
	SCWA	Russian River	N	Y
SFPUC	San Francisco Public Utilities Commission	SFPUC RWS (Hetch Hetchy, and local surface water, local groundwater)	Y	N
SFO	SFO	SFPUC RWS	N	N
Silicon Valley Clean Water	California Water Service Company Bear Gulch	SFPUC RWS, local surface	N	N
	East Palo Alto City Of	SFPUC RWS	N	N
	Menlo Park City Of	SFPUC RWS	N	N
	Mid-Peninsula Water District	SFPUC RWS	N	N

WW Agencies	Water Agency	Sources	Groundwater supply (Y/N)	Potential Agricultural Impacts (Y/N)
Sonoma	Sonoma County Water Agency (SCWA)	Russian River, local groundwater	Y	Y
South San Francisco and San Bruno	California Water Service Company South San Francisco	SFPUC RWS, and local groundwater	Y	N
Sunnyvale	California Water Service Company Los Altos/Suburban	Valley Water (State Water Project, Central Valley Project), Local Groundwater	Y	Y
	Sunnyvale City Of	SFPUC RWS, Valley Water (surface), and local groundwater	Y	Y
Treasure Island	Treasure Island Water System	SFPUC RWS	N	N
Union Sanitary District	Alameda County Water District	SWP, SFPUC RWS, local groundwater	Y	Y
Vallejo Flood & Wastewater District	Vallejo City Of	SWP, Solano Project (Lake Berryessa), local surface water	N	Y
West County Wastewater District	East Bay Municipal Utility District	Mokelumne Watershed, local surface water	N	N

Appendix 5: Recent Studies

Studies of CECs using wastewater effluent from Bay Area POTWs for the period 2019 through 2024 are described below.

1. **Ethoxylated Surfactants**

   Sampling dates: August through October 2019, July 2023

   Technical Leads: SFEI and Duke University

   Financial Sponsor: RMP

   Participating agencies (9): CCCSD, EBDA, EBMUD, Fairfield-Suisun Sewer District, City of Hayward, Palo Alto, San José-Santa Clara, City of San Mateo, and Vallejo Flood & Wastewater District

   Study Design: POTWs included in the study represent approximately 65% of total effluent flows to the Bay and were representative of various geographic locations, population sizes, and treatment types.

   References:

   - A. Lindborg et al., 2023. "Assessment of Long-Chain Polyethoxylate Surfactants in Wastewater Effluent, Stormwater Runoff, and Ambient Water of San Francisco Bay, CA." *ACS ES&T Water* 2023, 3, 4, 1233–1242. Available online at https://pubs.acs.org/doi/10.1021/acsestwater.3c00024
   - J. Dougherty et al. "Ethoxylated Surfactants in San Francisco Bay Water, Urban Stormwater Runoff, and Wastewater: Summary Report for Water Quality Managers." SFEI Contribution No.1202. San Francisco Estuary Institute, Richmond, CA. [final version in prep as of Nov. 2024]

2. **Bisphenols**

   Sampling dates: August and September 2020

   Technical Leads: SFEI, Southern Illinois University, and Jinan University

   Financial Sponsor: RMP

   Participating Agencies (6)**:** CCCSD, EBDA, EBMUD, Palo Alto, San José-Santa Clara, and SFPUC

   Study Design: These 6 POTWs were selected because they are the largest POTWs based on discharge to the Bay, and combined represent approximately 70% of total wastewater effluent flow. The study differentiates between two POTWs with advanced treatment (i.e., filtration) and four POTWs without advanced treatment.

   References: M. Mendez et al., 2022. "Bisphenols in San Francisco Bay: Wastewater. Stormwater, and Margin Sediment Monitoring." SFEI Contribution No.1093. San Francisco

Estuary Institute, Richmond, CA. Available online at https://www.sfei.org/sites/default/files/biblio_files/BisphenolsWWTP_Final_1022.pdf

3. **Sunscreen Chemicals** aka Organic UV Filters

   Sampling dates: August and October 2021

   Technical Leads: SFEI and Stanford University

   Financial Sponsor: RMP

   Participating agencies (6): CCCSD, EBDA, EBMUD, Palo Alto, SFPUC, and San José-Santa Clara

   Study Design: These 6 POTWs were selected because they are the largest POTWs based on discharge to the Bay, and combined represent approximately 70% of total wastewater effluent flow. The study differentiates between two POTWs with advanced treatment (i.e., filtration) and four POTWs without advanced treatment. In addition to 5 ultraviolet filters, the study also included 11 pesticides and pesticides degradation products and 5 pharmaceuticals (see Vuckovic et al., 2023).

   References:

   - M. Méndez et al., 2023. "Concentrations of Select Commonly Used Organic UV Filters in San Francisco Bay Wastewater Effluent." SFEI Contribution No. 1111. San Francisco Estuary Institute, Richmond, CA. Available online at https://www.sfei.org/documents/concentrations-select-commonly-used-organic-uv-filters-san-francisco-bay-wastewater
   - D. Vuckovic et al., 2023. "Pharmaceuticals, pesticides, and ultraviolet filters in wastewater discharges to San Francisco Bay as drivers of ecotoxicity." *Environmental Pollution* 336 (2023) 122432. Available online at https://doi.org/10.1016/j.envpol.2023.122432

4. **Quaternary Ammonium Compounds (QACs)**

   Sampling dates: March 2020 to November 2023

   Technical Leads: SFEI and University of Minnesota

   Financial Sponsor: RMP and National Science Foundation

   Participating Agencies (3): EBMUD, Palo Alto, and San José-Santa Clara

   Study Design: This study is tracking temporal trends in response to the COVID-19 pandemic.

   References:

   - A. Mahony et al., 2024. "Investigation of quaternary ammonium compounds (QACs) in wastewater effluent, influent, biosolids, and environmental matrices in San Francisco Bay." SFEI Contribution No. 1196. San Francisco Estuary Institute, Richmond, CA. Available online at https://www.sfei.org/documents/investigation-quaternary-ammonium-compounds-qacs-wastewater-effluent-influent-biosolids

- "Quaternary Ammonium Disinfectant Chemicals in Wastewater and the Bay," Presentation from M. Mendez at the 2020 RMP Annual Meeting. Available online at https://www.sfei.org/sites/default/files/events/S1%20Miguel%20Mendez.pdf
- "QACs in San Francisco Bay." Presentation from M. Mendez to the Bay Area Pollution Prevention Group, August 2023. Available online at https://bacwa.org/wp-content/uploads/2023/08/SFEI-Mendez-QACs-in-SFBay-2023-08-02.pdf

5. Per- and Polyfluoroalkyl Substances (PFAS), Phase 1 and Phase 2 Studies

Sampling Dates: Phase 1 samples were collected in Q4 2020. Phase 2 samples were collected in Summer 2022.

Technical Lead: SFEI

Financial Sponsor: BACWA

Participating Agencies in Phase 1 (14): CCCSD, DSRSD, EBDA, EBMUD, Fairfield-Suisun Sewer District, Novato Sanitary District, Palo Alto, San Francisco International Airport, SFPUC, San José-Santa Clara, City of San Mateo, Union Sanitary District, Vallejo Flood & Wastewater District, and Valley Water. **Participating Agencies in Phase 2** (6): CCCSD, DSRSD, EBMUD, SFPUC, San José-Santa Clara, and City of San Mateo.

Study Design: For Phase 1, POTW selection was based on discharge volume (sampling at the largest facilities was prioritized to capture dominant flows to the Bay; a few small and medium-sized facilities were also included); industrial sources as a percentage of flows (representing a range from minimal to more significant); and participation in previous RMP PFAS studies in 2014 (all facilities that participated in 2014 were included to evaluate changes over time). The study included a range of different treatment technologies (including secondary and advanced secondary treatment) and diverse geographic locations representing all subembayments. For Phase 2, POTW selection was based primarily on the ability to sample in residential, industrial, and commercial sewersheds, as well as biosolids digestion and disposal practices.

References:

- M. Mendez et al. "Study of Per- and Polyfluoroalkyl Substances in Bay Area POTWs: Phase 1 Memo." SFEI, November 2021. Available online at https://bacwa.org/wp-content/uploads/2023/03/Memo_BACWA-PFAS-Phase-1.pdf
- D. Lin and M. Mendez. "Study of Per- and Polyfluoroalkyl Substances in Bay Area POTWs: Phase 2 Sampling and Analysis Plan." SFEI, March 2022. Available online at https://bacwa.org/wp-content/uploads/2022/03/Final-PFAS-Phase-2-SAP-2022-03-28.pdf
- BACWA PFAS Study Summary, February 2024. Available online at https://bacwa.org/wp-content/uploads/2024/02/BACWA-PFAS-Study-Summary-2024-02-07.pdf
- Lin, D.; Méndez, M.; Paterson, K. 2024. "Study of Per- and Polyfluoroalkyl Substances in Bay Area POTWs: Final Report." SFEI Contribution No. 1145. San Francisco Estuary Institute: Richmond, CA. Available online at https://www.sfei.org/documents/study-and-polyfluoroalkyl-substances-bay-area-potws-final-report

- Lin, Diana et al., 2024. "Residential Wastewater as a Major Source of Per- and Polyfluoroalkyl Substances to Municipal Wastewater." *Environmental Science and Technology Water*. October 12, 2024. https://doi.org/10.1021/acsestwater.4c00507

6. Microplastics

Sampling Dates: 2022-2023

Technical Lead: Southern California Coastal Water Research Project (SCCWRP)

Financial Sponsor: Ocean Protection Council

Participating Agencies (4): CCCSD, EBMUD, EBDA, and San José-Santa Clara

Study Design: Treatment train diversity (1 POTW with primary treatment, 3-4 secondary POTWs, 4 tertiary POTWs); Geographic diversity (includes POTWs from northern and southern California); and inclusion of 4 POTWs that participated in the pilot phase of this study (including CCCSD, which prepared a sampling video for training POTWs).

References: Wong et al., 2024. "Characterizing the Removal of Microplastics by California Wastewater Treatment Plants: Implications for Management Strategies." Final Report to the California Ocean Protection Council. Data and metadata available at https://microplastics.sccwrp.org/. Report: https://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/1378_MicroplasticsWastewaterPlants.pdf

7. Pesticides

Sampling Dates: 2022-2024 (ongoing)

Technical Lead: California Department of Pesticide Regulation, Environmental Monitoring Branch, Surface Water Protection Program

Financial Sponsor: California Department of Pesticide Regulation

Participating Agencies: About 30 facilities are participating. Study participants and results are anonymous.

Study Design: "Participating WWTPs will span a wide range of comparative parameters, including geographic region, size (measured in gallons treated per day), treatment capability (secondary or tertiary), final treatment (disinfectant), surrounding land use patterns (e.g., urban, rural), and point of discharge (freshwater or marine)."

References:

- J. Wheeler, November 2022. "Study 322: Monitoring Pesticides in Wastewater Influent and Effluent FY22–23." California Department of Pesticide Regulation, Environmental Monitoring Branch, Surface Water Protection Program. Available online at: https://www.cdpr.ca.gov/docs/emon/pubs/protocol/study322_protocol_2022.pdf

- J. Wheeler, October 2023. “Study 322: Monitoring Pesticides in Wastewater Influent and Effluent (2024).” California Department of Pesticide Regulation, Environmental Monitoring Branch, Surface Water Protection Program. Available online at: https://www.cdpr.ca.gov/docs/emon/pubs/protocol/study_322_protocol_2024.pdf

8. **Organophosphate Esters, Bisphenols, and Other Plastic Additives**

   Sampling dates: September and October 2024

   Technical Leads: SFEI

   Financial Sponsor: RMP

   Participating Agencies: CCCSD, EBDA, EBMUD, Palo Alto, SFPUC, and San José-Santa Clara.

   Study Design: These 6 POTWs were selected because they are the largest POTWs based on discharge to the Bay, and combined represent approximately 70% of total wastewater effluent flow. The study differentiates between two POTWs with advanced treatment (i.e., filtration) and four POTWs without advanced treatment.

   References: This study was proposed at the April 2023 RMP Emerging Contaminants Workgroup Meeting (https://www.sfei.org/sites/default/files/events/Item%2000_20230419-20%20ECWG%20Agenda_FINAL_0.pdf) and subsequently included in the 2024 RMP Workplan and Budget available at https://www.sfei.org/sites/default/files/biblio_files/2024%20RMP%20Detailed%20Workplan%20and%20Budget_final_0.pdf