

## **EVALUATING EMERGING CONTAMINANT PATHWAYS: WASTEWATER DISCHARGES**

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**ESTIMATED COST:** \$55,000

**OVERSIGHT GROUP:** Emerging Contaminants Work Group (ECWG)

### **PROPOSED DELIVERABLES AND TIMELINE**

<b>Deliverable</b>	<b>Due Date</b>
Task 1. Project Management (write and manage sub-contracts, track budgets)	Summer – Dec 2014
Task 2. Collection of wastewater effluent	Fall 2014
Task 3. Laboratory analysis	Fall 2014
Task 4. QA/QC and data management	Dec 2014
Task 5. Draft and final manuscript	Mar 2015

### **Background**

The State Water Resources Control Board's Chemicals of Emerging Concern (CECs) Science Advisory Panel has directed agencies to include sampling wastewater treatment plant (WWTP) effluent and stormwater when screening for emerging contaminants (Anderson et al. 2012). The follow-up state pilot study, now under development, similarly emphasizes examination of these contamination pathways as an important means of providing policymakers with the data they need to make sound, science-based decisions regarding CECs and environmental management (Advisory Panel Meeting 2013). To expand our knowledge of the role of WWTP effluent in contaminating the Bay environment, we propose monitoring high priority and newly identified CECs in this matrix.

This study will expand on already-approved WWTP effluent monitoring for alternative flame retardants and estrogenic contaminants (Denslow et al. 2012; Sutton and Sedlak 2013). Measurements made as part of this study may provide an indication of the relative importance of wastewater as a contamination pathway for specific CECs in San Francisco Bay, especially when compared to local stormwater discharges analyzed as part of ongoing studies (fipronil) or previously characterized in the literature (PFCs; Houtz and Sedlak 2012). In the case of fipronil, comparison of influent to effluent can provide information regarding the effects of treatment processes on contaminants of interest. By encouraging a collaborative monitoring effort among dischargers, it may be possible to avoid implementing new, costly permit requirements.

### **Applicable RMP Objectives and Management Questions**

This study will address the following RMP Objectives and Management Questions:

**MQ.1 Are chemical concentrations in the Estuary at levels of potential concern and are associated impacts likely?**

- A: Which chemicals have the potential to impact humans and aquatic life and should be monitored?

**MQ.2 What are the concentrations and masses of contaminants in the Estuary and its segments?**

- A: Do pollutant spatial patterns and long-term trends indicate particular regions of concern?

**MQ.3 What are the sources, pathways, loadings, and processes leading to contaminant-related impacts in the Estuary?**

- A: Which sources, pathways, and processes contribute most to impacts?

Detailed Outline of Study Objectives

**1. Describe the distribution and trends of pollutant concentrations in the WWTP effluent pathway leading to the Estuary.**

- This study will provide some of the first data to determine the distribution of concentrations of CECs in effluent discharged to the Estuary, and to place these concentrations in context with those observed in other locations.

**2. Project future contaminant status and trends using current understanding of ecosystem processes and human activities.**

- The relative significance of this exposure pathway in Bay contamination may suggest potential future trends, particularly in combination with time trends observed in biota.

**3. Measure pollution exposure and effects on selected parts of the Estuary ecosystem (including humans).**

- Policymakers need to know which pathways lead to Bay CEC pollution to evaluate whether management actions are needed.

**4. Compare monitoring information to relevant benchmarks, such as TMDL targets, tissue screening levels, water quality objectives, and sediment quality objectives.**

- The concentrations detected in this study will be compared to known threshold effect levels, where possible.

**Relationship of the Study to the ECWG Priority Question and Current RMP List of Emerging Contaminants**

The Emerging Contaminants Workgroup is focused on answering the following question: “What emerging contaminants have the greatest potential to adversely impact beneficial uses in the Bay?”

The State Water Resources Control Board’s CEC Science Advisory Panel has directed agencies to include sampling contamination pathways when screening for emerging contaminants (Anderson et al. 2012). For PFOS and fipronil, CECs of moderate concern to San Francisco Bay (Tier III), an evaluation of the effluent pathway of contamination is a logical next step in producing the science that policymakers need to make decisions that maintain Bay health. Comparison of effluent PFOS, PFC, and precursor concentrations from the South Bay with those

of other regions may establish whether this pathway could be a factor in the persistence of South Bay PFOS contamination despite a nationwide production phase-out. Limited data on concentrations of fipronil in influent and effluent suggest this is an appropriate data gap to fill via monitoring.

Finally, some new CECs under consideration for monitoring via special studies might be best examined in effluent first, to determine whether ambient Bay sampling is advisable. These include specific new PPCPs and plastic microbeads.

## Approach

PFOS and fipronil (and its degradates), both Tier III (moderate concern) CECs, are strongly recommended as analytical targets for WWTP effluent monitoring as an initial means of assessing the importance of wastewater as a pathway for Bay contamination. As described in the Rationale in Table 1, gaps in knowledge about the importance of the effluent pathway for each of these contaminants could be filled, providing information relevant to potential management actions.

In addition, some new CECs that may merit initial monitoring via a special study might be best examined in effluent to determine whether ambient Bay sampling is advisable. These include specific new PPCPs and plastic microbeads. A specific funding request for these analyses is not included here. Funding limitations necessitate careful consideration as to the utility of each additional target, and for this reason PBDEs are not recommended for effluent monitoring (see Rationale, Table 1).

Samples of WWTP effluent voluntarily provided by up to eight Bay Area dischargers will be characterized. A replicate sample will be collected as well, for a total of up to nine WWTP effluent samples. Effluents obtained via secondary and advanced treatments must be included in the study. An ideal group of WWTPs would include facilities in South, Central, and North Bay, with an emphasis on South Bay dischargers due to the lower levels of dilution and resulting higher concentrations of contaminants in that region. The persistence of high levels of PFOS in South Bay wildlife (Sedlak and Greig 2012) provides another rationale for contrasting South Bay effluents with those from other parts of the Bay. An emphasis on high volume dischargers is also recommended. Finally, inclusion of WWTPs that discharge into wetlands is recommended, as different physical, chemical, and biological processes may occur in wetlands relative to the greater Bay environment.

For PFCs and precursors, an effluent grab sample is considered preferable to a 24-hour composite sample because the equipment used to aggregate samples could expose sample water to potential sources of contamination. In addition, grab samples that pass through teflon pipes at the point of collection will not be suitable for these analyses. Samples will be collected during diurnal peak flow. PFCs/precursors analyses will be conducted by AXYS (~\$1,670/sample). Samples will be analyzed for total suspended solids as well.

In contrast, for fipronil and degradates, a composite effluent sample is preferable because any contamination will not interfere with analysis, and a composite sample will assure a

representative measurement should there be diurnal variation in discharge levels. Composite influent samples will also be collected, to further explore findings from a limited number of studies that suggest wastewater treatment does little to reduce concentrations of this pesticide in effluent (Heidler and Halden, 2009; Weston and Lydy, 2014). Fipronil analyses will be conducted by the California Department of Fish and Wildlife or a comparable laboratory (~\$400/sample). Samples will be analyzed for total suspended solids as well.

Dischargers are not specifically identified here, and they will have the option to keep their identities confidential in subsequent reporting of the data. Measurements for each discharger will be reported individually using unique identifiers should dischargers request their identities be withheld. Through cooperative relationships with wastewater dischargers, we can obtain and share data about concentrations of CECs in effluent without implementing expensive permit requirements.

## Reporting

Results of these proposed study elements will be reported as a RMP Technical Report and/or manuscript in 2015. A conference poster and web-based presentation of said poster (using Prezi software) may also be appropriate deliverables. Comparisons will be made to past screening efforts in the Bay and in the literature from other locations, as well as to relevant toxicological information on these emerging contaminants available at that time. Estimates of the relative contribution of wastewater and stormwater derived contamination will be provided, using stormwater data from ongoing studies or the literature (e.g., Houtz and Sedlak 2012).

## Proposed Budget

The budget is presented as separate tasks that can be performed as separate elements or combined.

Task	Estimated Cost
Analysis of 2014 WWTP effluent for PFCs and precursors (n=8+1 replicate), data management and reporting	\$36,000
Analysis of 2014 WWTP influent and effluent for Fipronil and degradates (n=8+1 replicate for each), data management, and reporting	\$19,000
<b>Total</b>	<b>\$55,000</b>

## References

Advisory Panel Meeting – State of California Pilot Study: Monitoring Constituents of Emerging Concern (CECs) in Aquatic Ecosystems. September 12-13, 2013: Costa Mesa, CA.

Anderson, P.D., N.D. Denslow, J.E. Drewes, A.W. Olivieri, D. Schlenk, G.I. Scott and S.A. Snyder. 2012. Monitoring Strategies for Chemicals of Emerging Concern (CECs) in California's Aquatic Ecosystems. Costa Mesa, CA.

Denslow N., Maruya K., Bay S. 2012. Linkage of *In Vitro* Assay Results with *In Vivo* End Points. Proposal for the RMP Emerging Contaminants Workgroup.

Heidler J., Halden R.U. 2009. Fate of organohalogens in us wastewater treatment plants and estimated chemical releases to soils nationwide from biosolids recycling. *Journal of Environmental Monitoring* 11:2207-2215.

Houtz E.F., Sedlak D.L. 2012. Oxidative conversion as a means of detecting precursors to perfluoroalkyl acids in urban runoff. *Environmental Science & Technology* 46:9342-9349.

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Sutton R., Sedlak M. 2013. Monitoring alternative flame retardants in SF Bay water, sediment, and biota: Pathway characterization – wastewater and stormwater. Proposal addendum requested by the RMP Steering Committee. September 2013.

Weston D.P., Lydy M.J. 2014. Toxicity of the insecticide fipronil and its degradates to benthic macroinvertebrates of urban streams. *Environmental Science & Technology* 48:1290-1297.