FINAL

RMP Emerging Contaminants Workgroup Meeting

April 19, 2023
San Francisco Estuary Institute

Meeting Summary

ECWG Science Advisors	Affiliation	Present
Bill Arnold	University of Minnesota	Yes
Miriam Diamond	University of Toronto	Yes
Lee Ferguson	Duke University	Yes
Derek Muir	Environment and Climate Change Canada	Yes
Heather Stapleton	Duke University	Yes
Dan Villeneuve	U.S. Environmental Protection Agency	Yes

Attendees

Adam Wong (SFEI)
Alicia Chakrabarti (EBMUD)
Alicia Gilbreath (SFEI)
Amy Kleckner (SFEI)
Andria Ventura (Clean Water Action)
Anna Mahony (U. of Minn.)
Anne Cooper Doherty (DTSC)
Autumn Ross (SFPUC)
Ben Priest (CIL)
Bernard Crimmins (Clarkson University)
Blake Brown (CCCSD)
Bonnie de Berry (EOA)
Bushra Khan (UC Davis MPSL)
David Robertson (City of San Jose)
Diana Lin (SFEI)
Don Yee (SFEI)
Elana Varner (DPR)
Eric Dunlavey (City of San Jose)
Erica Kalve (SWRCB)
Ezra Miller (SFEI)
Gaurav Mittal (SFBRWQCB)
Jay Davis (SFEI)
Jaylyn Babitch (City of San Jose)
Jennifer Doughtery (SFEI)
Jennifer Teerlink (DPR)
Julie Weiss (City of Palo Alto)
June-Soo Park (DTSC)
Kaitlyn Kalua (OPC)
Kayli Peterson (U of Charleston)
Karin North (PA)
Kelly Moran (SFEI)
Lester McKee (SFEI)
Louia Harding (WDFW)
Luisa Valiela (US EPA Region 9)
Mala Mattanayek (Integral Consulting)
Manoela de Orte (SWRCB)
Mary Lou Esparza (CCCSD)
Martin Trinh (SFEI)
Mary Cousins (BACWA)
Maureen Dunn (Chevron)
Maya McInerney (SFBRWQCB)
Meltem Musa (OEHHA)

Million Woudneh (SGS AXYS)
Miguel Mendez (SFEI)
OIMA staff (SWRCB)
Pedro Avellaneda (SFEI)
Rebecca Sutton (SFEI)
Reid Bogert (C/CAG)
Richard Grace (SGS AXYS)
Robert Budd (CDPR)
Ruth Sofield (Western Washington Univ.)
Shoba Iyer (SF Environment)
Simona Balan (DTSC)
Simret Yigzaw (City of San Jose)
Tan Zi (SFEI)
Terry Grim (independent)
Tom Mumley (SFBRWQCB)
Tom Bruton (DTSC)
Tom Hall (EOA Inc.)
Violet Renick (Orange County Sanitation)
Xueyuan (Helen) Yu (Central Valley RWQCB)
Xin Xu (EBMUD)

DAY ONE - April 19, 2023

1. Introductions and Goals for This Meeting

Amy Kleckner began by highlighting remote meeting tips, reviewing the Zoom platform functionalities, and giving a land acknowledgment to the Native peoples of the San Francisco Bay Area. She also presented the group with guidelines for inclusive conversations. Amy then introduced the workgroup advisors and continued with a brief roll call for the various groups present to introduce themselves.

Amy continued by reviewing the ECWG two-day agenda, including tomorrow's joint meeting with SPLWG, and giving an overview of the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP), including the program's goals, history, management questions, monitoring structure, and budget. Additionally, Amy communicated the goals of the meeting, highlighting discussion on the science during updates on current projects, prioritization of special study proposals, and future directions.

2. Discussion: CECs Science Update

Rebecca Sutton started the workgroup meeting with a brief update of current CECs efforts and an overview of the RMP workgroup structure. She reintroduced the CECs team, including the newest addition, Jennifer Dougherty, as an Environmental Scientist. Rebecca's outline of current CECs activities categorized efforts into four strategic elements: (1) Bay monitoring and risk evaluation, (2) pathways monitoring and modeling, (3) novel approaches, and (4) learning from others/sharing expertise. Related ongoing projects and activities were noted for each element, respectively.

Rebecca started by presenting the updated tiered risk-based framework, with an additional Very High Concern tier, and updated placements of contaminant classes. Tom Mumley asked about the asterisks on some classes, which Rebecca noted are there to indicate classes with ongoing studies that may change their classification under the new framework. Rebecca then highlighted current Bay monitoring projects, beginning with contaminants in the high concern tier including RMP Status and Trends (S&T) monitoring of organophosate esters (OPEs) and per- and polyfluoroalkyl substances (PFAS) in water, with further analysis of sediment, marine mammals and prey fish for PFAS. She continued with Moderate Concern CECs including studies of bisphenols in water and sediment through S&T as well as special studies of alkylphenol ethoxylates & other surfactants in water and sediment. Within the possible concern tier, there

are two ongoing special studies examining quaternary ammonium compounds (QACs) and tire chemicals (not yet formally classified), while a SEP-funded study is monitoring chlorinated paraffins in sediment. Rebecca also spotlighted pathways monitoring work such as multi-year data available for stormwater for various class (PFAS, OPEs, bisphenols, tire chemicals, and ethoxylated surfactants), with preliminary data to be presented later in the meeting. In addition, Rebecca noted the various wastewater monitoring projects including study of PFAS in collaboration with Bay Area Clean Water Agencies (BACWA) and QACs, both of which will also be discussed in presentations on Day 1. Further, she mentioned the pending data on ethoxylated surfactants as well as two recently completed reports on select organic sunscreens (with a pending manuscript) and bisphenols.

Rebecca continued with discussion of novel approaches ongoing across various projects, focused on non-targeted analysis (NTA) and ecotoxicology. There have been previous presentations on sediment NTA with a manuscript in preparation for a study of nonpolar compounds using GC-based methods. In addition, a manuscript and fact sheet are planned for an examination of polar compounds in sediment using LC-based methods. Rebecca also noted an ongoing NTA project of marine mammals using both GC and LC-based methods. Further, a special study mining past results is set to begin later this year. She highlighted a possible future ecotoxicology project using “new approach methodologies,” in particular an in-vitro cell assay that advisor Dan Villeneuve is tracking that has potential stormwater applications to better understand toxicity. She discussed a couple of recently published and forthcoming scientific publications, such as a QACs review paper organized by the Green Science Policy Institute and a review paper on tires as a complex pollutant. Miriam Diamond noted the need for a specific website with all SFEI publications, provided here: https://www.sfei.org/biblio. Rebecca noted upcoming conferences (SETAC in Dublin, Ireland; SETAC in Louisville, Kentucky; and ACS in SF) to be attended by the CECs group to share findings and learn about global efforts relevant to the RMP. Rebecca ended with a short overview of the current RMP structure, indicating the variety of workgroups and collaborative efforts with ECWG.

3. Discussion: CECs Strategy Revision

Rebecca Sutton continued the day with a discussion on the draft CEC strategy revision. She briefly reviewed the current draft, highlighting four significant components in the revision: tiered risk-based framework, monitoring and management recommendations, risk quotient calculations (including approaches to non-detects), and secondary factors. She then noted the timeline for the revision, with a full draft report and meeting with the ECWG Strategy Subgroup in the fall, draft report for the ECWG in December, and final draft in Spring 2024.

Rebecca continued with an overview of the important topics of discussion in this item, beginning with revisions to the ECWG management questions (MQs). Based on previous guidance, the fourth management question, focused on understanding changes in CECs concentrations in the Bay, would now include pathways and potential drivers of the trend. She noted that the Subgroup generally agreed with the revision, though indicated a potential need for clarification of the difference in Bay processes (MQ 3) and anthropogenic drivers. Rebecca stated the accompanying text will include further explanation to note these drivers as anthropogenic

actions. She opened the floor to discussion, with Miriam Diamond noting the potential overlap in MQs 2 and 3, with Rebecca Sutton noting the second is a focus on pathways while the third is in the Bay. Miriam recommended further clarification within the adjacent text and review of the responses to the MQs to limit redundancy, while also noting a potential nexus in MQs 4 and 5 that combines retrospective and future/predictive work, including an integrated monitoring/modeling approach. Lee Ferguson agreed with the current separation of MQs 2 and 3, and notes the combination of questions is dependent on their use across studies. Rebecca remarked that the studies aim to answer as many management questions as possible within the scope and that processes could be added to the second question for further clarity. Discussion continued on whether to group or split the questions, with several members spotlighting the purpose and use of the questions to guide potential changes. Miriam noted a more thorough response in each special study proposal to answering some of these questions would be helpful. Others discussed the differences in physical processes and anthropogenic drivers, highlighting the important integration of climate change related drivers. Rebecca wrapped up the discussion, noting the limited time and further communication via email.

Rebecca followed with other updates in this draft including the elevation of pathways science as its own element within the strategy, including an updated table laying out the potential priorities for pathways projects. The table highlights each chemical class under the tiered risk-based framework, its chemical properties, notable sources, and current knowledge of potential pathways to the Bay. Initial feedback from the Subgroup was positive with continued discussion remaining for the role of the RMP in evaluating sources. The Subgroup also noted care in specific terminology used to describe available knowledge or understanding of occurrence in pathways, and whether in-water applications (such as boats, docks, etc.,) should be included within the table. Lee Ferguson noted interest in the impacts of boats and related waters to the Bay while also recommending changes to specify the terminology describing the importance of individual pathways to the Bay. Tom Mumley recommended consideration of each pathway with notes of current RMP knowledge and data gaps, instead of the relevant significance, though this could be added as footnotes over time. He also suggested consideration of back-of-the-envelope calculations for the relative loads of these pathways to the Bay to better understand their influence. Several meeting attendees agreed with both suggestions. Kelly Moran asks if industrial wastewater should be specifically separated from municipal wastewater, which Tom noted would likely work better as two different categories.

Ezra Miller then presented an update to the RMP ecotoxicology and human health approach, highlighting a recent draft living document of all of the relevant thresholds used for contaminants with available data in the RMP. Ezra began with an introduction to ecotoxicology thresholds, noting the thresholds included within the spreadsheet are ecosystem-level thresholds calculated from toxicity data across species and endpoints (as opposed to single species thresholds such as LC50s). The draft thresholds spreadsheet indicates the variability in available thresholds for each chemical, with filtering of column O (to “Y”) showing recommended thresholds for use in the tiered risk-based framework. These thresholds are recommended based on expert judgement, prioritizing thresholds that were calculated using more experimental data and chronic/sublethal exposures, lower (i.e., more protective values, and California-specific values.

For a few prioritized compounds with no existing ecosystem-level thresholds, Ezra can calculate a new threshold, such as for 6PPD-quinone, using available ecotoxicology data. Ze suggested strategic use of a read-across approach to use an available contaminant threshold for structurally similar compounds, usually within the same class. Ze also noted there are some cases where no thresholds are available due to limited data. An additional secondary factor of consideration is the potential for cumulative impacts of contaminants, with an updated approach to understand additive impacts. Key human health thresholds for fish consumption are available in the spreadsheet, with preference given to California values; Ezra does not propose to calculate human health thresholds when these are unavailable. Initial feedback on the approach recommended further consideration of the scope of each contaminant class. Heather Stapleton asked about updating the spreadsheet considering the complexity of mixtures and current use of CAS numbers, with several participants echoing connection to mixtures and polymers. Ezra noted this is an ongoing challenge and the team would continue to tackle potential solutions.

Rebecca Sutton continued with discussion on updates to the tiered risk-based framework. The ecotoxicity thresholds, from the spreadsheet, are compared to the 90th percentile occurrence level to develop a risk quotient (RQ). This value serves as a starting point for classification within the risk-based approach, along with secondary factors such as persistence, temporal trends, and cumulative impacts. In development of the RQ, more recent data (since 2013) will be prioritized, with at least 10 samples needed. Further, this is a class-based approach, with chemical classes requiring an approach where the individual contaminant of highest concern driving the risk tier for the class, while other groupings may warrant separation of subclasses within different tiers. Rebecca then briefly reviewed the updated risk tiers, highlighting the addition of a Very High Concern tier and the various RQ thresholds across tiers. Several participants noted concerns with current communication of the range of RQs associated with each tier, with Tom Mumley recommending potential further clarification via symbols to help note the specific thresholds and secondary factors. Rebecca noted further text could be used to specifically describe the risk evaluation for each class. She also briefly noted a potential update to the illustration of the Possible Concern tier, suggesting a figure that better demonstrates the uncertainty and broader relative risk of this category. Tom remarked that this design could lead to misinterpretation of the Possible Concern tier, with clarification needed on what is presented. Rebecca noted the strategy will discuss a list of new/unmonitored contaminants to be on-ramped, and Possible Concern contaminants to be off-ramped, and can further emphasize this aspect in the figure through a caption.

Rebecca then reviewed the monitoring and management recommendation summary table, soliciting any feedback from meeting participants. Lee Ferguson asked about tracking product use and market trends within the Low Concern class, and the process to reconsider contaminants based on new information. Miriam Diamond agreed a process to update based on new information would be useful. Tom Mumley noted specific needs would warrant tracking specific classes, as it is not feasible to track everything.

Rebecca then gave a quick overview of an updated approach to analysis of non-detects (ND). Each class would be analyzed to select an appropriate ND substitution approach, which would

also be informed by information on use, environmental distribution, and analytical methods. The replacement of NDs with half the method detection limit (MDL) is the preferred option that has been shown to perform adequately compared to other ND treatment methods. This would be limited by the detection frequency (potentially above 50%) of contaminants. In addition, this includes a sensitivity analysis when the ND substitution may influence the conclusion, with comparison to other substitutions including 0 and MDL, as well as comparison to other available data. Several meeting participants noted careful consideration in this approach with clear understanding of its use and limitations (such as sample size and distribution of normality). Don Yee noted a range from 0 to MDL could also work to represent the potential concentration in a matrix. Rebecca agreed that this could be a useful tool, though for communication it would be most useful to have a single value. Tom Mumley notes the specific use of the data may warrant different approaches.

Rebecca continued by presenting an example CEC profile of organophosphate esters (OPEs). These profiles would serve as a concise communication of essential data and information within the CEC strategy revision, with standardized content and organization. This also would serve to demonstrate the rationale for threshold selection, risk evaluation, and future monitoring strategies. The profile structure includes an overview of the contaminant class (i.e., definition, properties, use), RMP monitoring to-date with risk evaluations, current and upcoming management actions, and future monitoring strategy. She continued by spotlighting these sections for OPEs, asking for feedback on the current format. Heather Stapleton noted the need for complete inclusion of the OPEs class in the text, with potential separation of chlorinated and non-chlorinated contaminants, in current toxicity thresholds. Several meeting participants noted further description of the consideration of the class-based approach in each class, including definition and relevant secondary factors, and brief summary of the narrative in the full report. Tom Mumley indicated the need to specify the recommended scope and scale of Status and Trends monitoring for relevant classes.

She continued with a brief overview of the multi-year plan and future directions. She introduced the updated stormwater monitoring and modeling approach which will be further discussed during the joint meeting on the second day. She then discussed any ideas or recommendations for monitoring in future years for the various contaminant classes of interest, NTA, and toxicology. She highlighted the potential use of a new in vitro assay for stormwater monitoring (in development with Dan Villenueve). Lee Ferguson expresses interest in point-source industrial discharges with Anne Cooper Doherty also noting interest in in-water pathways.

4. Information: Update on PFAS Sewershed Source Investigations

Diana Lin presented the preliminary results of a SF Bay regional study of wastewater to investigate the fate and transport of PFAS, fluorine rich and persistent compounds with known negative effects. She notes this project is a collaboration with BACWA, the SF Regional Water Quality Board (RWB), and the State Water Board, which has provided an opportunity to efficiently monitor PFAS across the region. As the second phase of a two-phase study, POTW participants collected sewershed samples (before the waste streams enters the POTW influent) from diverse residential communities and various industries to understand potential sources to

wastewater. All samples in both phases of the study were examined using EPA method 1633 with 40 target analytes and most (except effluent in Phase 1) were also analyzed using the total oxidizable precursors (TOP) assay, which converts oxdizable PFAS precursors to detectable PFAS end-products to better understand the presence of PFAS in wastewater samples.

Diana continued by first summarizing the results from Phase 1 of the study as important context to understand the Phase 2 study design and preliminary results. Phase 1 of the project examined wastewater influent, effluent, and biosolids (digested sludge) from 12 representative municipal POTWs. Analysis at these municipal POTWs yielded comparable concentrations for the sum of PFAS, with median concentrations of 27 ng/L in influent, 58 ng/L in effluent, and 178 ng/g in biosolids. The precursors in influent can be converted to PFAS end-products during wastewater treatment, which explains the higher levels of target PFAS observed in effluent relative to influent. In addition, the biosolids showed a different signature of PFAS compared to influent and effluent, particularly an intermediate precursor 5:3 FTCA, which could indicate the breakdown of precursors throughout the digestion process. The TOP method PFAS concentrations were significantly higher across matrices studied, with median concentrations of 231 ng/L in influent and 594 ng/g in biosolids. Overall, there is a significant presence of unknown PFAS precursors in both influent and biosolids, demonstrating the importance of continued analyses using broad methods of analysis, and further understanding of potential sources upstream of the facilities themselves.

Diana then reviewed the recent Phase 2 results, where influent, effluent and biosolids samples were collected from 7 municipal POTWs, as well as influent from several residential and industrial flows within their respective sewersheds, to understand their contribution to PFAS levels in wastewater. Results presented today are preliminary, and results may change depending on a more careful review of the data. Only the target results presented today have undergone a QA review, and TOP have not been undergone QA review, although preliminary data will be presented. The QA officer's evaluation of the Target dataset was that the dataset was acceptable, with 5% of data flagged for quantification issues; there were many estimated values where the detected value lies between the method detection limit (MDL) and reporting limit (RL). Field and equipment rinse blanks were mostly below detection limits except for 6:2 FTS in a few field blanks. Compared to Phase 1, the median value of the sum of PFAS in influent was nearly double, which could be due to lower detection limits for PFOS, as it was more widely detected, along with contributions from the many analytes observed at levels close to MDLs. Influent TOP data showed a similar median level of precursors compared to Phase 1, indicating their continued significant presence in wastewater. Effluent target results were slightly lower than Phase 1, with TOP results showing levels higher than target results but well below those in influent TOP, which could indicate partitioning to biosolids. Similar to Phase 1, biosolids in Phase 2 showed a different signature relative to influent and effluent, with high levels of precursors present, including 5:3 FTCA.

In addition, Diana discussed the diverse residential neighborhoods sampled, highlighting the wide variety and range of measured concentrations across neighborhoods. Most sampled residential areas were below median influent concentrations, though a few showed elevated

levels. When examining TOP results, more residential samples exhibited levels above POTW influent. For industrial samples, industrial laundries were presented as they provided some of the most interesting results relative to other sampled industries. The levels measured in industrial laundries varied significantly, with several facilities indicating elevated PFAS concentrations especially with the TOP assay. She concluded with upcoming steps including completion of the QA/QC review, ongoing data analysis, upload of POTW target data to Geotracker, and a final report early next year.

Meeting participants discussed the various preliminary results, with Lee Ferguson noting the potential for underestimation in TOP due to incomplete conversion of precursors. Diana noted the use of matrix spikes within TOP samples and analysis by the lab to ensure complete oxidation. Lee also noted interest in understanding the PFAS signature in the laundry samples and expressed confidence in high values of a few laundry samples, based on his experience measuring high levels of PFAS in textile wastewater. Luisa Valiela and Maggie Monahan questioned if the sewershed samples were truly representative of all Bay Area sewersheds due to their variability. Diana clarified that the sewershed investigations were designed to be a screening study that may inform follow-up investigations and was not designed to be representative of the sampled industries. Heather Stapleton commented that inclusion of GC-MS methods would be useful to understand vaporization of PFAS. Erica Kalve asked about AOF analysis results, with Richard Grace noting that these analyses are more experimental and to exercise caution with interpretation. Simona Balan asked about sewershed data from semiconductor facilities, and Diana Lin noted that results were not more than an order of magnitude above median influent values. Tom noted the complicated factors in analysis of the data and indicated further interest in understanding the full context of fate and transport of PFAS in the Bay.

5. Information: Update on PFAS in Bay Fish

Miguel Mendez presented on a recent special study examining PFAS in archived fish samples across SF Bay. The RMP has monitored sportfish since 1994, and most recently in 2019, including hundreds of samples of various fish species and a variety of contaminants analyzed over several sampling rounds (every three years until 2009, then every five years). This RMP data is a prime example of actionable information for the public, especially as it has helped inform the Bay Consumption Advisories developed by the Office of Environmental Health Hazard Assessment (OEHHA). Jay Davis spotlighted rare release of a Bay advisory update this day based on mercury and polychlorinated biphenyls (PCBs) concentration of fish caught in the Bay. The RMP has monitored fish for PFAS since 2009, detecting a variety of PFAS across 83 samples from up to 8 fish species. A decade of monitoring data has found PFAS persisting at concentrations exceeding thresholds established by some US states for the development of consumption advisories, though, no human health thresholds have yet been established for PFAS in California fish.

Miguel discussed the current study aims to better understand the temporal and spatial trends of PFAS in Bay fish through the analysis of an additional 56 archived composite samples from four fish species collected across 10 Bay locations in three sampling rounds in 2009, 2014, and

2019. Fish species were selected based on a number of criteria, including species that are: popular for consumption, sensitive indicators of problems (accumulating relatively high concentrations of contaminants), widely distributed, representative of different exposure pathways (benthic versus pelagic), and included in past monitoring. An additional special study on PFAS in prey fish was done in 2012, in locations not typically sampled that are near marine mammal feeding sites; these data were included to compare to relevant species eaten recreationally in the Bay (shiner surfperch). The archived samples were analyzed for 40 PFAS using EPA method 1633, with the lowest detection limits and most analytes examined so far.

Miguel continued by noting the method of analysis for combining data from previous sampling rounds, with less sensitive detection limits, to the most recent dataset of archived samples in 2022. This includes both older and newer data together within one dataset with further comparison via non-detect substitution methods to accommodate for the variety of detection limits over the past decade. Currently, the RMP method for non-detect treatment is to replace these values with 0. An updated methodology provides a nuanced approach with any analytes detected above 60% in the newest sampling round meriting further examination of concentrations and MDLs to determine the most appropriate substitution of 0, 0.5MDL, or MDL. The presentation focused on the normal RMP method with inclusion of the new substitution method as a comparison. Overall, median and average concentrations remained similar even with substitution changes.

Up to 17 PFAS have been detected in archived Bay fish since 2009, with PFOS and PFOSA, a precursor, the two most frequently detected analytes. Long-chain perfluorocarboxylates (PFCAs) made up most of the remaining PFAS signature. For shiner surfperch, the sum concentrations of PFAS appear to be leveling off near 5 ng/g ww (median), with a comparison of PFAS across subembayments indicating levels consistently higher in the South and Lower South Bays. However, the highest sum concentration of PFAS in shiner surfperch was found in the Carquinez Strait. This is of particular interest to understand the impact on recreational fishers in the area, which will be further elucidated through an EPA funded study by All Positive Possible, a local environmental justice organization, with SFEI collaboration. The sum concentration of PFAS in striped bass are above 5 ng/g since 2009 with the highest in 2019 (median 14 ng/g) likely due to the collection of samples from only Lower South Bay, also shown to have higher concentrations. All samples showed PFOS levels close to or above a current New Jersey general population threshold of 3.9 ng/g ww for a single serving per week. White croaker concentrations were more variable across years (range: ND – 29 ng/g ww), with 2014 samples showing higher levels overall, which may be due to these being analyzed as whole body compared to typical skin-off fillet. This work will be highlighted in a presentation at SETAC Europe and upcoming draft report and manuscript. Miguel concluded by noting future directions including monitoring of prey fish this summer, sportfish in 2024, and monitoring of fish in Carquinez Strait with All Positives Possible.

Several meeting participants discussed the use of non-detect substitution methods and noting caution when applying them across several analytes. Heather Stapleton mentioned particular care in performing statistical analyses and noting the changes that may occur when data are

substituted. Robert Budd noted the difficulties of analyzing censored data, with Derek Muir highlighting potential benefits to better understanding the true concentrations of contaminants relative to their detection limits. Derek also noted the unique result of 5:3 FTCA in fish and further investigation into the presence of PFBA as it is likely a terminal product.

6. Information: Quaternary Ammonium Compounds (QACs) Update

Anna Mahony, a graduate student with Dr. Bill Arnold of the University of Minnesota, presented the preliminary findings of the QACs in wastewater and the environment study, with preliminary findings on wastewater influent, effluent, and biosolids from Bay Area treatment plants as well as Bay Area stormwater and surface water. QACs are a broad category of compounds separated into several subclasses: benzalkyldimethyl ammonium compounds (BACs), dialkyldimethyl ammonium compounds (DADMACs), ethylbenzylalkyl ammonium compounds (EtBACs), and alkyltrimethyl ammonium compounds (ATMACs). These compounds have been used since the 1930s in a wide range of industrial, agricultural, and consumer products, especially as antimicrobials. The emergence of the COVID-19 pandemic has increased the use of QACs, known to be toxic to aquatic species and contribute to the development of antibiotic resistance in bacteria. Anna briefly reviewed the extraction methods, noting that the compounds stick to filter materials, requiring additional extraction steps to accurately discern concentrations in samples.

Anna continued by briefly discussing a few stormwater and Bay water sites as well as the three different wastewater facilities analyzed (anonymized as Plants X, Y, and Z) to understand the most common QACs present and understand the temporal trends of QACs in wastewater throughout the pandemic. She discussed preliminary stormwater results, which showed sum of QACs in a range from about 800 ng/L to 1800 ng/L. BACs and DADMACs were dominant in these samples. Preliminary surface water results indicated variability across sites, with most around the 100 ng/L range and a few above 600 ng/L. She continued with discussion of preliminary wastewater results: in Plant X, QACs levels are variable throughout a three-year period in influent, though most effluent samples are below 2 ug/L. Limited biosolids samples (range: 150-325 ug/L) appear to show an increasing trend over time, with C8 and C10 DADMACs as the most prevalent. Plant Y showed more consistent concentrations of QACs over time, with influent around 35 ug/L and effluent concentrations below 0.7 ug/L. QACs concentrations appear to vary for each sampled lagoon bed, though the most recent biosolids show the highest sum of QACs (which includes the first year of the pandemic; range: 100-200 ug/L). Plant Z showed some variability across all matrices, with some increase in EtBACs in influent over time. Influent sum QACs concentrations ranged from 20-100 ug/L, effluent ranged from 0.5-2.5 ug/L, and biosolids from 200-1200 ug/L.

Anna then highlighted the difference in QACs fingerprint in influent, which exhibited similar QACs profile as those used in disinfectants, while effluent and biosolids are clearly different. This could indicate degradation happening in the treatment process. Across facilities, there is a 97% average removal of QACs from influent to effluent, though some could still be released into the environment. Several participants discussed the study and its findings. Tom Mumley noted a

correction of flow for one of the facilities. Anne Cooper Doherty noted DTSC is currently undertaking a systematic investigation to understand where QACs are being used.

7. Information: In-Bay Fate Modeling

In the interest of time, Jay Davis opted to forgo a presentation and instead send a short email to the workgroup detailing the progress on a multi-year workplan for modeling legacy contaminants (PCBs), CECs, and sediment in the Bay. A robust in-Bay fate model will be valuable in guiding S&T monitoring of CECs (e.g., placement of sampling stations and timing of sample collection) and in assessing the likely spatial distribution and temporal duration of potential water quality impacts.

8. Discussion: Integrated Watershed Bay Modeling Strategy and Pilot Study

Tan then introduced the general integrated modeling framework and strategy, highlighting any feedback on contaminant classes of high priority and specific management questions to tackle first. He began the discussion noting a key step, scenario building, where the specific needs of the model can first be identified, including model structure, data needs, scenario representations, and building of a model implementation plan. This then leads into a core modeling framework with various modules to tackle specific questions. These modules are customizable and can range from simple to complex. Management questions are then used as a guide to develop a specific question and a clear goal (output) for the model.

Tan then provided two examples of this modeling framework in action with the first highlighting a potential project to estimate a screening level stormwater load for CEC X. He reviewed the steps to consider in scenario building, such as land features, solubility, and rainfall. He noted a sample core modeling framework and the important modules to consider (i.e., urban runoff and watershed loads). He then highlighted a more complex example assessing the relative contribution of different pathways to the Bay. This would require additional scenario representations to consider stormwater and wastewater loads separately, and involving additional modules from the core modeling framework. The overall general modeling strategy is intended to be flexible and iterative to best fit the goals and needs of a specific project. Tan concluded by noting a complete modeling strategy will be done in early fall and asking for feedback on CECs and management questions of highest interest.

Meeting participants discussed the new directions of the modeling project, with Miriam Diamond indicating appreciation for the flexibility and comprehensiveness of the strategy. Derek Muir and Miriam Diamond initially suggested PBDEs as a contaminant of interest, but. Tom Mumley noted the limited data available for PBDEs. Miriam suggested taking a step back from constraints with inputs and considering other options such as whether the model could indicate data gaps and where to best target monitoring. Derek indicated PFOS, because it is ionizable, would be harder to model, and that hydrophobic compounds might be easier. Miriam Diamond also mentioned consideration of OPEs, as she has done some modeling of these compounds. She also suggested QACs, and noted the need for a model that considers biota too. Jay Davis noted

bioaccumulation will be a component of the in-Bay model. Kelly brought up PFAS again. Miriam indicated that the physical properties and transformation rates are variable across PFAS and they are generally not well behaved compared to other classes. Similar cautions came up for QACs.

10. Information: Setting the Stage for Day 2

Rebecca Sutton thanked the group for their focused, productive discussion, and then reviewed the schedule and goals for the following day. She spotlighted the joint ECWG and SPLWG during the first half of the second day, and the review and prioritization of special study proposals.

Joint Meeting of Emerging Contaminants Workgroup & Sources, Pathways, and Loadings Workgroup

April 20, 2023
San Francisco Estuary Institute

Meeting Summary

Science Advisors *(ECWG shaded in blue; SPLWG shaded in grey)*	**Affiliation**	**Present**
Bill Arnold	University of Minnesota	Yes
Miriam Diamond	University of Toronto	Yes
Lee Ferguson	Duke University	Yes
Derek Muir	Environment and Climate Change Canada	Yes
Heather Stapleton	Duke University	Yes
Dan Villeneuve	U.S. Environmental Protection Agency	Yes
Robert Budd	CA Department of Pesticide Regulation	Yes
Jon Butcher	Tetra Tech	Yes
Steven Corsi	US Geological Survey	Yes
Tom Jobes	Independent Consultant	Yes

Attendees

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David Peterson (SFEI)
Diana Lin (SFEI)
Don Yee (SFEI)
Ed Kolodziej (U of Washington)
Elana Varner (DPR)
Emily Corwin (FSSD/Solano Stormwater

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Erica Kalve (SWRCB)
Ezra Miller (SFEI)
Gaurav Mittal (SFBRWQCB)
Hope Taylor (Sacramento County Water Resources Dept)
Ian Wren (SF Baykeeper)
Jay Davis (SFEI)
Jaylyn Babitch (City of San Jose)
Jennifer Doughtery (SFEI)
Jennifer Teerlink (DPR)
June-Soo Park (DTSC)
Kayli Peterson (U of Charleston)
Kelly Moran (SFEI)
Lester McKee (SFEI)
Lisa Austin (Geosyntec)
Lisa Welsh (Geosyntec)
Maggie Monahan (SFBRWQCB)
Manoela de Orte (SWRCB)
Martin Trinh (SFEI)
Mary Cousins (BACWA)
Maya McInerney (SFBRWQCB)
Meltem Musa (OEHHA)
Million Woudneh (SGS AXYS)
Miguel Mendez (SFEI)
OIMA staff (SWRCB)
Paul Salop (Applied Marine Sciences)
Pedro Avellaneda (SFEI)
Rachel Scholes (Univ. British Columbia)
Rebecca Sutton (SFEI)
Reid Bogert (C/CAG)
Richard Grace (SGS AXYS)
Rob Carson (Marin Countywide Stormwater)
Robert Budd (CDPR)
Sarabeth George (SCWRB)
Setenay Frucht (SWRCB)
Sami Harper (SFBRWQCB)
Simona Balan (DTSC)
Simret Yigzaw (City of San Jose)
Steven Corsi (USGS)
Tan Zi (SFEI)
Terry Grim (independent)
Tom Mumley (SFBRWQCB)
Violet Renick (Orange County Sanitation)
Xueyuan (Helen) Yu (Central Valley RWQCB)?
Xin Xu (EBMUD)

10. Information: Summary of Day 1 and Goals for Day 2

Amy Kleckner began the day by reviewing meeting tips for live and remote attendees, highlighting important Zoom features, and allowing time for an abbreviated roll call of the day's attendees. Amy then briefly recapped the events of Day 1 of the ECWG meeting, which led into the agenda and goals for Day 2. The first half of Day 2 was a combined meeting of the SPLWG and ECWG, centering the collaboration across the groups, and the second half focused on the prioritization of special study proposals from ECWG.

11. Information: Stormwater CECs Screening Study Preliminary Findings

Rebecca Sutton reviewed preliminary findings from the multi-year screening study of a diverse set of CECs in SF Bay urban stormwater. This study has been a 4-year effort in sample and data collection to understand the occurrence of a broad range of CECs in urban stormwater and overall help fill data gaps for this important pathway of contaminants to the Bay. Rebecca noted that a total of 25 sites were selected based on general site selection criteria including a minimum drainage area of 1 km^2, leveraged legacy contaminant monitoring, and relative urban land use, with 21 sites being highly urban (>80% urban land use) and 4 less urban sites (<20% urban land usage). Sampling occurred when storms were forecast to have a minimum of 1.3 cm of rainfall within 6 hours, with some samples taken from the first event in the season. Five contaminant classes (PFAS, organophosphate esters (OPEs),bisphenols, ethoxylated surfactants, and tire & roadway contaminants) and over 240 individual compounds were analyzed via multiple academic and commercial analytical partners.

Rebecca continued by highlighting the preliminary results of PFAS, organophosphate esters, and 6PPDQ in urban stormwater. A high priority set of contaminants at both the state and federal level, PFAS are used in a plethora of consumer and industrial products and are known to be persistent, bioaccumulative, and highly toxic. PFAS were widely detected; PFOS and PFOA, two of the most well studied PFAS contaminants, along with another PFAS, PFHxA,showed the highest concentrations among those detected. She noted concentrations of PFAS in urban stormwater are comparable to those appearing in municipal wastewater, another important pathway to the Bay. She continued with discussion of OPEs, mobile and toxic chemicals used as flame retardants and plastic ingredients. Several OPEs were detected in stormwater with two OPEs (TBOEP and TCIPP) at the highest concentrations. Also observed in stormwater were two OPEs previously detected at levels exceeding toxicity thresholds in Bay water, TDCIPP and TPhP. There was some variation in the detection of OPEs across sites, with specific OPEs in the thousands of ng/L. Isopropylated and tert-butylated triphenylphosphate esters (ITPs & TBPPs), novel OPEs recently identified in commercial flame retardant mixtures, were also detected in many sites. Rebecca then talked about 6PPDQ, a contaminant derived from a common tire antiozonant ingredient (6PPD), now known to be acutely toxic to multiple fish species at low levels, and under potential regulation through the CA Department of Toxic Substances Safer Consumer Products Program (for vehicle tires containing 6PPD). Levels in the Bay may be of concern, especially with several surpassing a suggested interim PNEC of 10 ng/L for rainbow trout (an important species relevant to the Bay).

Rebecca briefly reviewed the problems with several of the “reference” sites, spotlighting the detection of many CECs in these sites. Though the current process examined watersheds with <20% urban area overall, in some cases sampling sites were located near specific urban land uses (e.g., highways) that are clearly impacting these sites. Future site selection will include more robust analysis to ensure the suitability of sites as less-urban or reference sites.

Overall, these results showed many CECs are present in stormwater, with variations within and between chemical classes. There is a continued need for data and conceptual models to inform future monitoring strategies, particularly as it pertains to supporting urban runoffmodeling. Rebecca ended by summarizing the ongoing efforts in analyzing the stormwater dataset including examination of the influence of storm size, watershed and landscape features, comparison to Bay wet season data, and assessment of variability. A manuscript and summary for managers are expected to be completed by Fall 2023.

Several meeting participants asked questions and discussed this study, with Miriam Diamond recommending the creation of a foundational stormwater model across all contaminant classes that can then be crafted to emphasize different inputs for each class. Many participants emphasized the need for improved spatial analysis and understanding of the connection of sources to sampled sites. Lee Ferguson highlighted the potential for consideration of the ratio of transformation products and the freshness of the stormwater samples. Miriam Diamond and Bill Arnold noted potential complicating factors to this analysis including antecedent dry days and the limited understanding of photodegradation. Tom Jobes mentioned the importance of understanding sources and their relative contribution to best target monitoring and modeling efforts. Jon Butcher added the potential for fugacity modeling including roadway factors among

other chemical and physical properties could be useful. Tom Mumley noted a need for understanding the loadings of these contaminants into the Bay for better comparison across pathways. Derek Muir recommended consideration of rainfall sampling to understand background contamination levels. Dan Villeneuve added that comparison of data from baseline events in the dry season to large loads of stormwater could be useful. Dan also inquired if the Bay RMP considered ecological impacts of pathways and watersheds, which Tom Mumley noted was outside of the scope of current Bay RMP design focused on Bay water.

12. Discussion: Stormwater CECs Groundwork - Management Level Review

Kelly Moran presented a management level review of the important groundwork needed to best develop and establish the stormwater CECs approach centered on integrated modeling and monitoring. She noted a subgroup of RMP stakeholders and science advisors, including a mix of experts in CECs and watershed monitoring and modeling, known as the Stormwater CECs Stakeholder Science Advisor Team (SST), are providing guidance on the development of the overall approach. Kelly continued by discussing the relevant management context and actions related to stormwater in the Bay. At present, there are no immediate regulatory drivers for stormwater (CECs) monitoring and management, though that could change in the near future. There is a general regulatory goal of protection of the Bay's beneficial uses. Kelly highlighted PFAS as a contaminant class that has garnered increasing regulatory and stakeholder interest in the past few years. Currently, there are several relevant actions for emerging contaminants across regional, state, and federal agencies including California State and Regional Water Board efforts on CECs, the DTSC Safer Consumer Products Program, the Municipal Regional Stormwater Permit (MRP), and voluntary early management interventions by local agencies. Notably, there is potential for PFAS in the Bay to be added to the §303(d) list of impaired waters in a future Clean Water Act §305(b) Integrated Report. . There are currently no CECs on the 303d listing, but any inclusion would merit reexamination and likely elevation under the RMP tiered risk-based framework. Richard noted that microplastics are on the "watchlist" for the Bay and pesticides are not included here since we are working with DPR on related monitoring projects.

Kelly then reviewed the current budget planning guidance for stormwater CECs modeling and monitoring provided by the SST, which recommended a planning budget of $400k/year for the next three years. This budget includes $300k from the RMP per year (which includes $100k from BAMSC for CECs monitoring) as well as $100k from an EPA Water Quality Improvement Fund Grant. As a note, costs related to remote samplers will be funded separately (e.g., as a separate special study).

Kelly summarized the near term priority management guidance developed in consultations with the SST, which includes three near-term priority topics: loads, changes, and sources of CECs. The SST recommended that the stormwater CECs monitoring design also address two additional considerations. First, it should support addressing the RMP's overarching Management Questions through linkage to the ECWG Management Questions and wet season

elements of the Bay Status and Trends monitoring design. Second, it should provide the ability to determine if previously unmonitored CECs are present in local watershed runoff.

With general agreement on the summarized management guidance from participants, Kelly went through the specific suggested near-term priority stormwater CECs management questions for any comments or recommendations. The management question regarding load estimates (*How does the local watershed runoff load to San Francisco Bay compare to loads from other pathways?)* was the first examined, with Miriam Diamond noting its importance and the need to examine temporal variability, particularly through calibration with S&T redesign (with monitoring in dry and wet seasons). Lee Ferguson commented on current sampling design, specifically if selected sites provide enough coverage to accurately estimate/understand contaminant loads to the Bay, and what criteria would tell us that we have enough information for estimates. Tom Mumley similarly remarked on the scope of analysis for load estimates, with Kelly noting these are important needs to identify and continue to think about further within the context of the finalized question.

The next management question presented focuses on change of concentrations/trends (*a. Are presence or concentration in local watershed runoff changing over time? b. Are presence, concentration, or load expected to change in the future?*) following a “trends light concept” where datasets would provide multi-year insights without a requirement for statistically significant trends. This question groups past, current, and future concentrations together, which after some discussion the group agreed was appropriate. Richard Looker commented on the connection between this question and discussion of a similar approach to trends analysis related to the S&T redesign, with potential for a special study to incorporate relevant Bay data, watershed, and source data into a more comprehensive approach.

The third management question reviewed centered on sources (*a. What are the likely sources? b. What land features correlate with presence, concentration, and load in runoff?*), with focus on true sources including products and contaminated sites with consideration of all pathways between source and stormwater runoff. Lee Ferguson inquired about the land features under consideration and inclusion of specific chemicals related to industries. Tan Zi noted many land features, such as land use, land cover, road density, and population, would be included, with Kelly Moran highlighting the availability of data that could provide further analysis and connection to sources as determined per contaminant class. All participants reached a unanimous consensus on moving forward with the current management questions.

13. Information: Stormwater Groundwork Project Update

Kelly Moran kicked off the update on the stormwater CECs groundwork project, beginning with an overview of the three groundwork project elements and their relationships to the five other stormwater CECs-related projects currently underway. The overall stormwater CECs approach aims to integrate modeling and monitoring together to help inform management actions. This is a holistic process meant to examine all aspects of both monitoring and modeling, with the current groundwork project providing critical pieces in the group of related projects that together form the basis for the RMP develop the best monitoring approach possible for

stormwater CECs. Kelly introduced the project updates, first an update by Tan Zi on the stormwater CECs loads modeling exploration project and groundwork project stormwater CECs data analysis task, an update from Alicia Gilbreath on the groundwork project stormwater sampling locations database development task, and an update from Don Yee on the groundwork project task to develop a remote stormwater sampler.

Tan Zi continued by updating the group on the progress related to stormwater CECs loads modeling exploration and obtaining insights on monitoring design through stormwater CECs data analysis. The outcomes of these efforts will feed into, the development of a stormwater CECs modeling plan, the next step that is planned for early fall.. An examination of the literature revealed few relevant studies and no existing stormwater CECs modeling template ready to adapt to the Bay Area. Tan continued by reviewing some models used by others for CECs load estimation, beginning with a statistical/regression model, LOADEST, used to evaluate single watershed downstream from a known CEC (PFAS) production facility. This particular model is hard to adapt to the Bay area due to the complexity of the region's watersheds. A second approach uses a simplified process/relation to correlate chemical load relations to land, storm, and other features and extrapolates these to the whole region to estimate loads. The third model is more advanced, with consideration of the different fate and transport processes occurring within the watershed. Previously, this advanced approach has been applied to single watershed with identified discharges and a large monitoring network of a variety of matrices within the watershed. The second approach appears most viable for the RMP's near-term stormwater CECs watershed modeling needs. There remain further knowledge and data gaps to help bridge with findings. The model exploration outcome and recommended approach are expected in a report this summer.

Tan then presented a preliminary stormwater data analysis for OPEs and bisphenols. The goal of this effort is to inform development of design recommendations for CECs stormwater monitoring and to identify factors that may be useful in load modeling. There are variations of total chemical concentrations across the individual chemicals in the two noted classes, with OPEs concentration variation generally nearly an order of magnitude higher than bisphenols. There were clear spatial variations of total sum of bisphenols, with several sites showing levels well above the average/median concentration, and some sites showing differences based on the storm event. bisphenols A, F, and S (BPA, BPF, BPS) appear to be major contributors of bisphenols concentrations, while OPEs have a more diverse fingerprint across sites. In addition, consideration of partitioning behavior could be important for certain chemical classes, with sites showing variance in partitioning for bisphenols. Moving forward, watershed and storm characteristics will be examined to elucidate any relationships from the stormater CEC screening project data and to develop recommendations for the stormwater CECs monitoring and modeling approach.

Alicia Gilbreath reviewed the progress of the sampling locations database, which she is setting up with the help of David Peterson. They identified an initial candidate list of 225 locations in the Bay Area with flow gauges (in collaboration with the RWB). From these, 70 sites with flow gauges were identified for site reconnaissance to understand feasibility of monitoring based on

location within key areas of interest, estimated urban area >33%, and no tidal influences. So far, Alicia (and the stormwater team) have visited 19 sites with the rest to be completed this summer. Alicia notes the importance of this work as valuable for all RMP stormwater monitoring (not just CECs) and to support the first region in the world to establish an ongoing regional stormwater monitoring program.

Don Yee then presented on the development of a remote sampler, highlighting the current challenges facing stormwater monitoring including staffing difficulties, hazardous conditions, and imperfect prediction of rain events as well as several other issues. Commerical autosamplers (e.g., ISCO) are available, though they are bulky, expensive, require proprietary parts, and are limited in programming flexibility. Based on an initial autosampler model from USEPA, Don created an SFEI variant fit to meet our specific needs for stormwater monitoring. With the prototype complete, several mounting configurations were considered and tested, including fixed mountings and a semi-fixed pendant mounting using a PVC pipe and 50 lb weight plate to provide suitable collection and stability during a storm. Future work to examine the feasibility of using this sampler for CECs will focus on blank testing the remote sampler for four CECs classes, refining the tidal site adjustment to best determine set-up times, and adding remote programming to change capabilities. Several participants were excited about the progress with Richard Looker wondering about the cost. Don roughly estimated that it would be roughly $6k of total cost per sampler, including about $1500 in raw parts. Compared to an ISCO sampler, Don noted the cost was above $3k though it is actually upwards of $6k as a base cost and not any additional add-on features.

14. Summary of Proposed ECWG Special Studies for 2024

Rebecca Sutton gave an overview of all proposed special studies, highlighting the motivation and approach for each study, as well as associated budgets and deliverables. Meeting participants were allowed a few clarifying questions after the presentation of each proposal, though it was noted that more time would be available for discussion in the next agenda item. The focus of discussion was on seven high-priority proposals, one of which is already expected to be funded through RMP S&T, with a brief review of two special study proposals relevant to ECWG from other RMP workgroups: SPLWG and PCBWG.

The proposal for Stormwater CECs Monitoring and Modeling in 2024 is a placeholder for completing and implementing the novel integrated monitoring and modeling plan in the upcoming wet season (2023/24). This project continues the work of the Stormwater CECs Stakeholder-Science Advisor Team (SST) and will be developed together with the Stormwater CECs Approach. The proposal also requests early release of funds for this project to begin in this summer (2023).

Next, the PFAS Synthesis & Strategy proposal highlights an important updated review of the current state of the science of PFAS in the Bay, the development of a conceptual model framework for sources to the Bay, and an updated strategy for RMP monitoring of PFAS. This proposal would include a concise literature review to inform interpretation of current PFAS data and help further identify priority information gaps to best inform future monitoring. Several

members had questions about the scope of the project, specifically on the definition of PFAS to be used in the project, and whether sub-categories such as pharmaceuticals and pesticides will be included. Kelly Moran noted this project would use elementary concepts to first develop a conceptual model as a base of understanding PFAS in the Bay. Tom Mumley indicated that if this project could potentially be spread over two years due to on-going projects, that would be important to include.

PFAS and non-targeted analysis of marine mammal tissues, the second of a two-year study, was showcased next. This study aims to inform S&T study design by determining if it is appropriate to add routine monitoring of marine mammal tissues while monitoring PFAS, a contaminant of high priority. In addition, improved analytical methods, particularly for non-targeted analysis, are likely to provide new insights into the presence of CECs in marine mammal tissues. The first year of this study has been funded as a part of S&T efforts.

The next proposal discussed would expand on current S&T efforts to monitor PFAS with additional analysis using the total oxidizable precursors (TOP) assay in Bay water and sediment. The use of the TOP assay provides a means to indirectly quantify presence of a broader suite of PFAS precursors that break down to detectable compounds, providing a greater scope of PFAS present beyond a targeted method alone. The study could be spread across both wet and dry seasons, with three different funding levels available, and would require early release of funds to begin in summer 2023. A few meeting participants asked for clarification on the TOP sites, which will be correlated with S&T sites for targeted PFAS analysis. Others also asked about archiving samples, which Rebecca Sutton noted is also an option.

The next study was the third and final year in a multi-year monitoring effort to examine tire contaminants in Bay water during the wet season. A small number of samples have indicated the presence of the tire contaminant 6PPD-quinone and others in Bay water, with further results needed to classify these contaminants under the tiered risk-based framework. In addition, these findings can help evaluate the pilot wet season monitoring effort.

A proposal to examine OPEs, bisphenols, and other plastic additives in wastewater effluent was introduced to build our understanding of the fate and transport of these contaminants in the Bay. Limited previous findings of OPEs and bisphenols in wastewater, stormwater, and ambient Bay water merit further review to assess the importance of the effluent pathway while expanding analysis to additional classes of plastic additives potentially reaching the Bay. This study is presented in two tiers based on interest to examine only OPEs, which are expected to be of High Concern under the revised tiered risk-based framework, and the full suite of contaminant classes.

The final project presented was the first year of a two-year study on non-targeted analysis (NTA) of SF Bay fish. This study would leverage 2024 S&T sport fish monitoring to collect samples for NTA. This type of analysis will provide a means to identify unanticipated contaminants, including unknown PFAS and halogenated hydrophobic (bioaccumulative) compounds, that may merit follow-up targeted monitoring, and would provide the means to compare San Francisco Bay fish

contaminant profiles to those of fish in the Great Lakes, where this type of study has already occurred. Derek Muir noted that the analytical lab partner uses advanced analytical equipment, which may be able to detect additional contaminants like chlorinated paraffins. Heather Stapleton inquired if the sportfish study would be more human or ecologically focused, with Rebecca noting the study is on consumable fish tissues (e.g., fillets) and is meant to inform human and ecological health.

15. Discussion of Recommended Studies for 2023 - General Q&A, Prioritization

Amy Kleckner introduced the item by reviewing the process for prioritization and recommendation of special study proposals. She also noted the overall planning budget for the special studies to prioritize for the TRC and overall scope of the budget within the RMP. Meeting attendees asked any remaining questions while proposal PIs were still in attendance.

Stormwater CECs Monitoring and Modeling
Tom Mumley mentioned the stormwater proposal has many gaps remaining in what will be done and inquired what optimum use is needed now. Kelly Moran clarified the importance of building a strong foundation for the program in concert with what is occurring in the stormwater CECs approach. Bill Arnold inquired if there is flexibility in the analytes included in the study, which Kelly noted is possible, depending on funding levels.

PFAS Synthesis & Strategy
Several attendees continued discussion of the best time to begin this project, with several noting the current value of the synthesis and development of a plan to continue updating the document. Rebecca Sutton noted this is an ideal time to start as a wide variety of our work is now centered around PFAS and it is critical to best inform our continued projects. She continued by noting this would help provide information on important data gaps and considers the document to be “living,” transforming as more data is available. Kelly Moran also noted the possibility to do a WQIF proposal for PFAS in the Bay to add more funds to this effort.

PFAS and Non-Targeted Analysis of Marine Mammal Tissues
Several attendees asked about year 1 results. Rebecca Sutton explained that no tissue analysis has happened yet, as harbor seal pup season is in the spring and we are waiting for more samples to be collected before sending them to the labs.

PFAS in Bay Water & Sediment using the TOP Assay
Several meeting attendees asked about the extraction method and its relation to sediment. Diana Lin described the solid phase extraction method, which Lee Fergson noted could be undercounting PFAS. He also mentioned consideration of the direct-TOP method to directly oxidize the sediment and get a full understanding of PFAS present. Tom Mumley inquired about the current importance beyond intellectual interest, which Derek Muir noted is important to consider as PFAS precursors have been observed in sediment and could be degrading to relevant contaminants. Lee Ferguson also noted it could be important to consider the high loadings from wastewater and if they are degrading or partitioning to sediments. Miriam

Diamond noted consideration of doing wet and dry season monitoring for wastewater sampling to understand if there is a difference in seasonality.

Tire Contaminants in Bay Water (Year 3/3)
Some participants asked whether the dry season should be monitored as well as the wet season (only wet season was proposed). Kelly Moran explained that tire-related chemicals were non-detected or very low concentrations in the dry season of year 1, which is why only wet season monitoring is being conducted this year and has been proposed for year 3. Whether a third year of the project is necessary was also brought up; while we have two years of data, the S&T wet season pilot is for three years and a third year's data would be helpful toward informing our understanding of these chemicals and to support inclusion of tire contaminants in Bay modeling.

OPEs, Bisphenols, and Other Plastic Additives in Wastewater
Several experts, led by Derek Muir, indicated a high interest in the option to gather data on the broader list of plastic ingredients, rather than focusing exclusively on OPEs.

Non-targeted Analysis of San Francisco Bay Fish (Year 1/2)
Stakeholders indicated an initial interest in reducing the requested budget, pondering whether this might impact the overall study design, and whether a portion of the budget for the first year could be covered via S&T. Tom Mumley indicated that S&T should fund collection of extra fish tissue to archive.

16. Closed Session - Decision: Recommendations for 2023 Special Studies Funding

Study Name	Budget	Modified Budget	Priority	Comments
Stormwater Contaminants of Emerging Concern (CECs) Monitoring and Modeling 2024	$300,000 (RMP) $100,000 (WQIF)		1	Leveraging additional funding and in year 3
PFAS Synthesis & Strategy	$107,000		4	When is the right time to do this? We may want to wait for more data Eventual consensus that sooner is better Maybe a lit review is necessary first, others say not as critical Could produce technical manucript Clarify scope of PFAS to include
PFAS and Nontargeted Analysis of Marine Mammal Tissues Year 2	$126,500			

PFAS in Bay Water & Sediment using the TOP Assay	$27,200 (Wet Season; Water only) $67,200 (Dry & Wet Seasons; Water only) $97,700 (Dry & Wet Seasons; Water & Sed)	$67,200 (Dry & Wet Seasons; Water only)	5	Qualms about methods for sediment TOP, Advocates for Middle Option- Will be interesting from a PFAS standpoint Interested in potential presence of precursors Think about Eurofins for analysis - Becky says Eurofins much more expensive
Tire and Roadway Contaminants in Wet Season Bay Water Year 3	$50,000		2	
OPEs, Bisphenols, and Other Plastic Additives in Wastewater	$48,400 (OPEs only) $95,400 (OPEs, Bisphenols, and Other Plastic Additives)	$95,400 (OPEs, Bisphenols, and Other Plastic Additives	3	
Non-targeted Analysis of San Francisco Bay Fish Year 1	$48,000 ($110,000 for both years)	$23,000 ($85,000 for both years)	6	Some advisors advocate to deprioritize, but others believe this study is complementary, program could stop after one year Cover sample collection ($25K) under the S&T fish monitoring budget (so it doesn't need to be included here) Could do lite version even if not preferred Could fund analysis of archived samples in subsequent years

17. Report out on Recommendations

After the closed door session, proposal authors were invited back to the meeting to hear the final prioritization decisions. Eric Dunlavey summarized the discussed suggestions and recommendations. The proposals for OPEs and plastic additives was of high interest due to its broad scope of analytes and prioritized. The PFAS Synthesis and Strategy was the next highest priority due to its need, though questions remained about the most appropriate time, clarification of overall scope, and potential development of a manuscript. The proposal on TOP PFAS in Bay water and sediment was next with exclusion of the sediment due to questions of the current analytical method and potential for analysis by another lab. The proposal on NTA in fish was last, with advisors noting a need to collect archived fish and fund analysis in future years.

Adjourn

About the RMP

RMP ORIGIN AND PURPOSE

In 1992 the San Francisco Bay Regional Water Board passed Resolution No. 92-043 directing the Executive Officer to send a letter to regulated dischargers requiring them to implement a regional multi-media pollutant monitoring program for water quality (RMP) in San Francisco Bay. The Water Board's regulatory authority to require such a program comes from California Water Code Sections 13267, 13383, 13268 and 13385. The Water Board offered to suspend some effluent and local receiving water monitoring requirements for individual discharges to provide cost savings to implement baseline portions of the RMP, although they recognized that additional resources would be necessary. The Resolution also included a provision that the requirement for a RMP be included in discharger permits. The RMP began in 1993, and over ensuing years has been a successful and effective partnership of regulatory agencies and the regulated community.

The goal of the RMP is to collect data and communicate information about water quality in San Francisco Bay in support of management decisions.

This goal is achieved through a cooperative effort of a wide range of regulators, dischargers, scientists, and environmental advocates. This collaboration has fostered the development of a multifaceted, sophisticated, and efficient program that has demonstrated the capacity for considerable adaptation in response to changing management priorities and advances in scientific understanding.

RMP PLANNING

This collaboration and adaptation is achieved through the participation of stakeholders and scientists in frequent committee and workgroup meetings (see Organizational Chart, next page).

The annual planning cycle begins with a workshop in October in which the Steering Committee articulates general priorities among the information needs on water quality topics of concern. In the second quarter of the following year the workgroups and strategy teams forward recommendations for study plans to the Technical Review Committee (TRC). At their June meeting, the TRC combines all of this input into a study plan for the following year that is submitted to the Steering Committee. The Steering Committee then considers this recommendation and makes the final decision on the annual workplan.

In order to fulfill the overarching goal of the RMP, the Program has to be forward-thinking and anticipate what decisions are on the horizon, so that when their time comes, the scientific knowledge needed to inform the decisions is at hand. Consequently, each of the workgroups and teams develops five-year plans for studies to address the highest priority management questions for their subject area. Collectively, the efforts of all these groups represent a substantial body of deliberation and planning.

PURPOSE OF THIS DOCUMENT

The purpose of this document is to summarize the key discussion points and outcomes of a workgroup meeting.

Governance Structure for the
Regional Monitoring Program for Water Quality in San Francisco Bay

Figure 1. Collaboration and adaptation in the RMP is achieved through the engagement of stakeholders and scientists in frequent committee and workgroup meetings.