IDENTIFYING AND ADDRESSING CONTAMINANT SOURCES IMPACTING AN URBAN ESTUARY

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THE REGIONAL MONITORING PROGRAM FOR WATER QUALITY IN SAN FRANCISCO BAY (RMP) is a novel partnership between regulatory agencies and the regulated community (Trowbridge et al. 2016). This independent, long-term monitoring program provides the scientific foundation to manage the water quality of this vital urban ecosystem. For nearly 25 years, high quality data and special studies from the RMP have guided dozens of important decisions about pollution prevention and Bay water quality management. The RMP regularly monitors water, sediment, bivalves, fish, and birds for a variety of legacy and emerging contaminants. To assist water quality managers in interpreting data and identifying the sources of contaminants, the RMP also funds special studies.

THREE EXAMPLES HIGHLIGHT RECENT RMP FINDINGS RELATING TO



EARLY DETECTION OF **CONTAMINANTS OF** CONCERN

INFORMING CONTAMINANT SOURCE **IDENTIFICATION**

DEMONSTRATING

LONG-TERM IMPACTS OF CONTROL ACTIONS

INDEPENDENT SCIENCE **NEEDED TO FILL KEY DATA GAPS**

- The lack of information on chemicals in consumer and industrial products
- The diversity of uses and sources for many chemicals of concern
- Early identification of chemicals of concern when data gaps for chemical production, environmental occurrence, and ecological impacts are common



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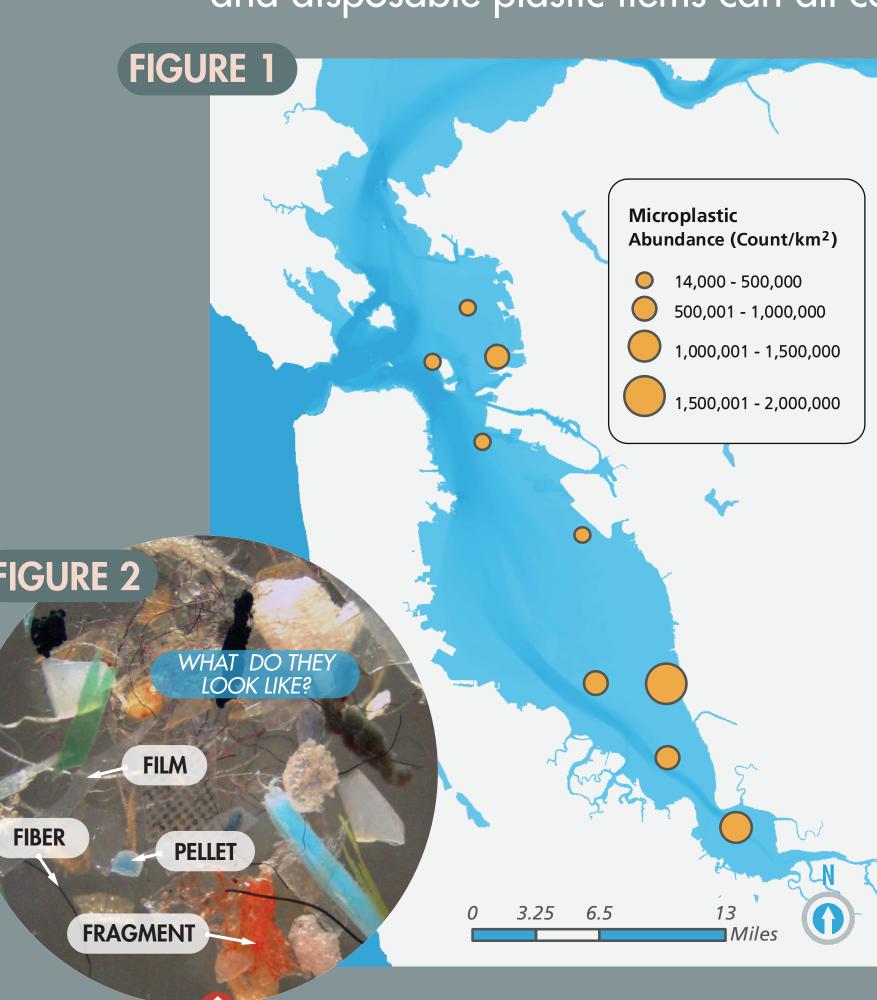
Identifying Poly- and Perfluoroalkyl Substances (PFAS) transformation products in a Wastewater Treatment Plant. SETAC Poster WP090. DJ. 2012. Brominated and chlorinated flame wildlife. Environment International 47:56-65.

IF, Box C. 2016. Microplastic contamination in the diphenyl ether contamination of San Francisco Bay San Francisco Bay, California, USA. Marine Pollution following production phase-outs and bans. osterhaus SL, Stapleton HM, La Guardia MJ, Greig 🧼 Sutton R, Sedlak M. 2015. Contaminants of Emerging 📉 Trowbridge et al. 2016. The Regional Monitoring

Concern in San Francisco Bay: A Strategy for Future Program for Water Quality in San Francisco Bay retardants in San Francisco Bay sediments and Investigations. 2015 Update. San Francisco Estuary California, USA: Science in support of managing Institute, Richmond, CA. Contribution No. 761. water quality. Regional Studies in Marine Science

MICROPLASTIC, INCLUDING MICROBEADS

Microplastic is defined as tiny particles of plastic five millimeters or smaller, which enter the environment through human use. Personal care products with microbeads, synthetic clothing, plastic bags, polystyrene foam packaging, and disposable plastic items can all contribute to microplastic pollution.



derived from personal care products (e.g., the pellet in FIGURE 2) were recovered from all nine Bay sites.

Findings influenced state and ne U.S. Microbead-Free Waters Act bans manufacture of rinse-off personal care products containing microbeds in 2017, and the sale of these products in 2018.

INDEPENDENT SCIENCE NEEDS

- Source identification for diverse microplastic particles
- Improved information on ecological impacts

FUTURE WORK guided by the RMP's Microplastic Monitoring and Science Strategy (Sutton and Sedlak 2016) will explore:

- Sources of microplastic
- Pathways of discharge to the Bay
- Fate in the Bay

For another example of RMP early detection, see Poster WP088, Application of Non-targeted Analysis Approaches to Assess Input of Organic Micropollutants to San Francisco Bay, DeStefano et al.

CABSTRACT

HARBOR HIGH CONCENTRA-TIONS OF ANTHROPOGENIC CONTAMINANTS, RESULTING IN ELEVATED EXPOSURES AND IMPACTS TO WILDLIFE

Proactive, collaborative, and sus ained monitoring of estuarine nvironments can aid in early

strate the long-term impacts of

The Regional Monitoring Program for Water Quality in San co Bay, California, USA, the

25-year history, the RMP has major impacts to wildlife. The

of North America. Throughout its scientific information specifically This presentation will summarize gaps for chemical production, relevant to source identification tion among regulators, regulated contaminants such as flame retar- areas where research by indedischargers including wastewater dants, perfluorinated stain-repel- pendent scientists is needed. Exlants and surfactants, pesticides, independent scientists, which has and personal care product ingre-formation on chemicals in conrecovery of the Bay following management actions including chemical phase-outs and bans.

and potential control actions on prevention activities to highlight also allowed the RMP to track the the diversity of uses and sources for many chemicals of concern; and c) early identification of chemicals of concern when data

common challenges to pollution environmental occurrence, and RMP serves as a clearinghouse tor applied science that directly sions to reduce environmental

DETECTION

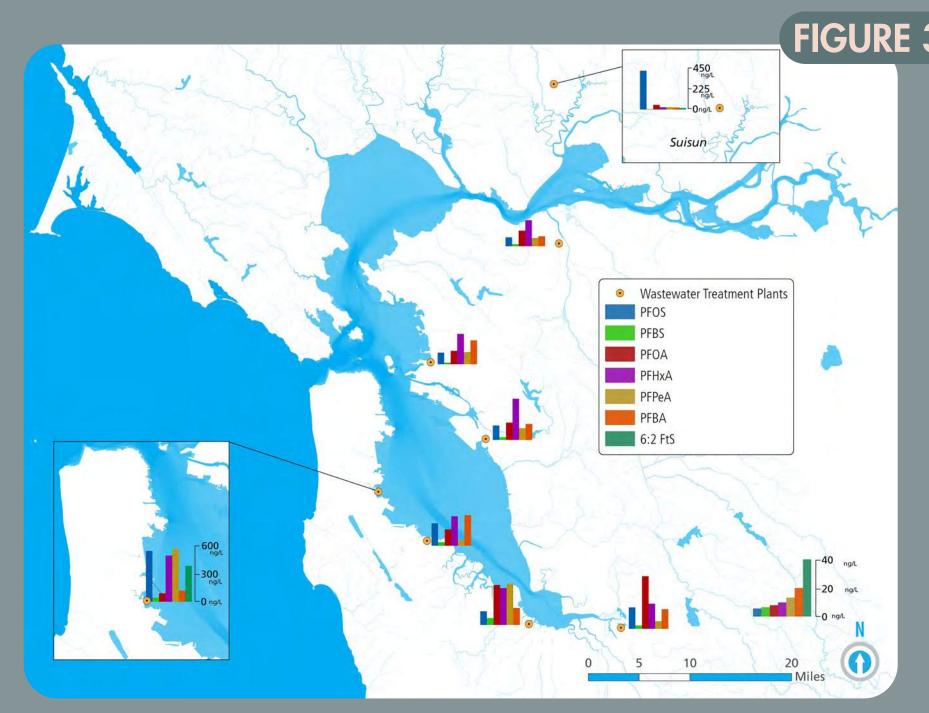
PERFLUOROOCTANE SULFONATE (PFOS)

INFORM SOURCE

IDENTIFICATION

PFOS is a persistent and bioaccumulative compound largely phased out in the U.S. and regulated under the Stockholm Convention as a Persistent Organic Pollutant. PFOS has been classified as an emerging contaminant of moderate concern for San Francisco Bay due to high levels in harbor seals and bird eggs (Sutton and Sedlak 2015).

To explore potential sources and loadings, treated wastewater efflu ent was characterized for PFOS and other poly- and perfluoroalky substances at eight wastewater treatment plants discharging to the Bay (Houtz et al. 2016). RMP collaboration with the Environmental Chemistry Laboratory (ECL) at California's Department of Toxic Substances Control provided a unique opportunity to characterize a broad array of related compounds.



Higher levels of PFOS at two facilities, one treating only industrial airport waste and the other treating wastewater from a community that includes a military base (FIGURE 3), suggested that the source is aqueous film forming foam (AFFF), a specialized fire-fighting product that was once formulated with PFOS. Remnants of this extremely persistent surfactant may remain sorbed to surfaces in drains, sewer lines, and fire-fighting equipment and slowly leach into wastewater. At the facility receiving airport industrial wastewater, required annual tests mobilize a significant volume of PFOS even though the AFFF being used is PFOS-free.

Followup testing at the airport treatment plant by the ECL suggests that electroplating may be an additional steady source of PFOS, possibly from the historical or current use of PFOS as a mist suppressant (Houtz et al., SETAC Poster WP090).

INDEPENDENT SCIENCE NEEDS

- Relative contributions of different sources to the Bay
- Improved information on PFOS replacements in AFFF, mist suppressant, and other products
- Improved information on ecological impacts of these PFOS replacements

For another example of RMP source identification, see MP167, Sources of Fipronil in Urban Aquatic Environments, Moran et al.

DEMONSTRATE IMPACTS OF CONTROLS

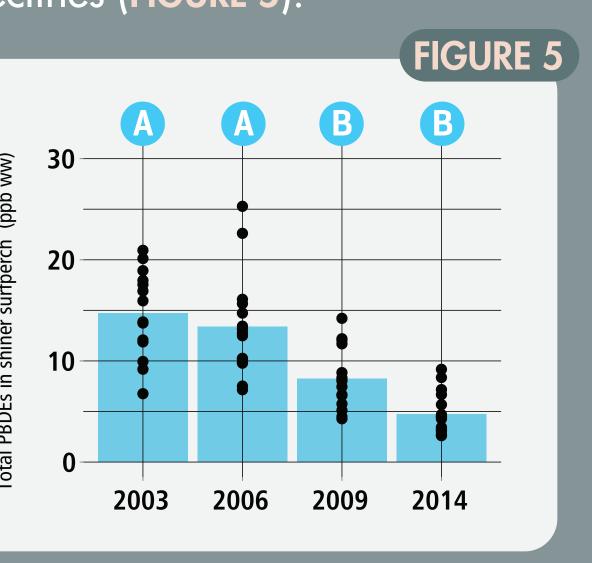
POLYBROMINATED DIPHENYL ETHERS (PBDES)

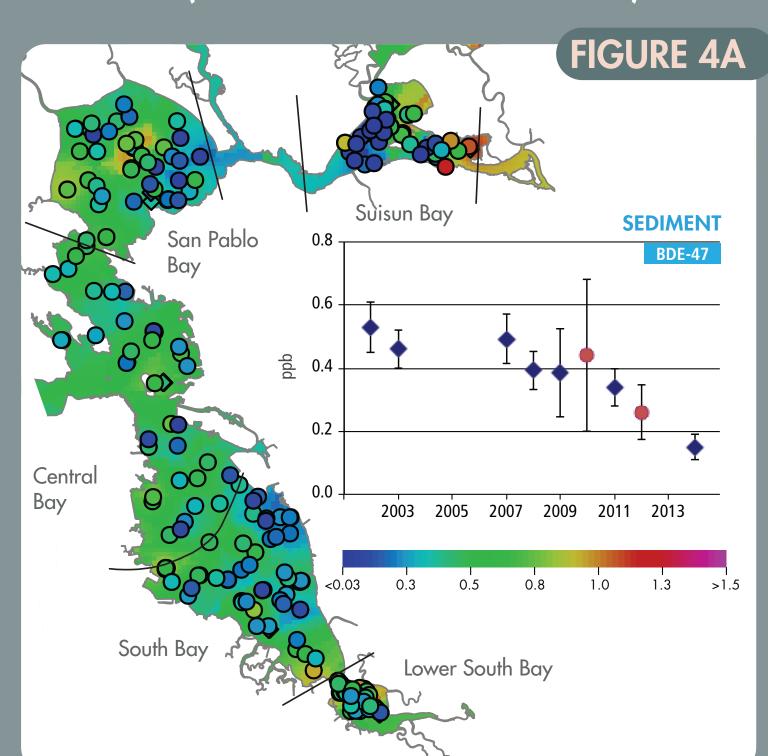
PBDEs are flame retardant additives once widely used in a variety of consumer goods, and now phased out of production and use in the U.S. The San Francisco ly was once considered a contamination hot spot (She et al. 2002); PBDEs continue o be listed as an emerging contaminant of moderate concern for San Francisco Bay due to levels detected in sediment, fish, and harbor seals (Sutton and Sedlak 2015).

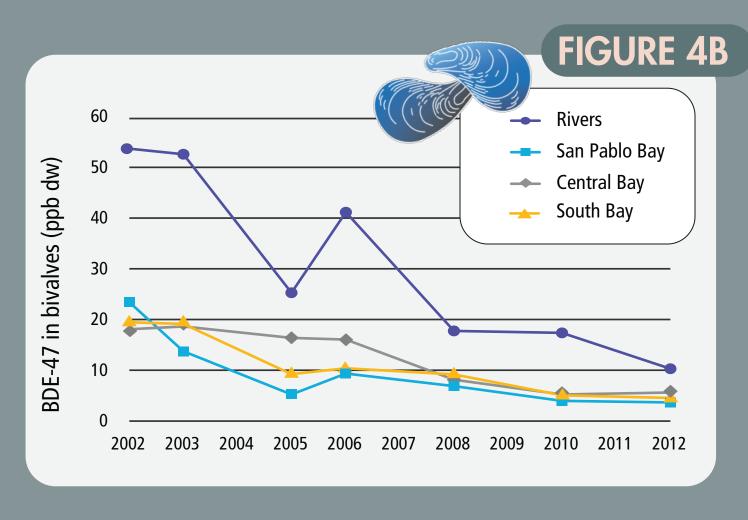
The RMP has monitored multiple Bay matrices for PBDEs since 2002 (Sutton et al. 2015) Two commercial mixtures of PBDEs (PentaBDE and OctaBDE) were phased out nationwide in 2004 following a California state ban. The third and final commercial mixture (DecaBDE) was phased out in 2013.

Over a decade of RMP monitoring shows clear declines in PBDEs associated with the videly used Pentabut commercial mixture following its phase-out. Significant declines were observed in sediment, deployed bivalves, sport fish, and bird eggs (FIGURES 4A and 4B).

Additional RMP work shows the presence of other flame retardants, including some used as PBDE replacements, in San Francisco Bay (e.g., Klosterhaus et al. 2012). The RMP continues regular monitoring of PBDEs and targeted monitoring of PBDE alternatives. The latest data on sport fish suggest continuing declines (FIGURE 5)









- Improved information on PBDE replacements in a variety of products
- Relative contributions of different sources of flame retardants to the Bay, particularly as some are also used as plasticizers
- Improved information on ecological impacts of PBDE replacements

