

**SOCIETY OF ENVIRONMENTAL TOXICOLOGY AND CHEMISTRY.
ANNUAL MEETING– November 2014**

<http://www.setac.org>

A tiered, integrated biological and chemical monitoring framework for contaminants of emerging concern (CECs) in aquatic ecosystems

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Abstract

To infuse the best available science into regulatory decisions to protect the integrity of aquatic ecosystems, the State of California Water Resources Control Board (SWB) tasked the Southern California Coastal Water Research Project Authority (SCCWRP) to convene and manage a panel of experts to provide guidance on monitoring of constituents of emerging concern (CECs). During a three-year process open to public participation, the Panel adopted and applied a risk-based screening paradigm using available information to identify CECs for initial monitoring in different receiving water scenarios, recommended development of better measurement and modeling tools to improve risk assessment, and outlined an adaptive strategy to respond to changing conditions and new science. To evaluate these recommendations, the SWB commissioned SCCWRP to develop pilot study designs and requirements for CECs in receiving waters statewide. Pilot monitoring questions revolved around informing risk assessment and, ultimately, management decisions to protect beneficial uses: (1) what is the occurrence of high priority CECs (i.e. industrial and consumer chemicals, pesticides, natural and synthetic hormones); (2) what are the appropriate endpoints and effects thresholds for protection of ecosystem and human health; and (3) do the pilot study data support continued monitoring of CECs identified by the Panel? In response, SCCWRP is generating design elements and requirements for targeted CEC monitoring and special studies that are fully responsive to the Panel's recommendations. Scenario- and matrix-specific lists of CECs, minimum reporting limits, frequency and spatial coverage of sampling are specified for targeted monitoring. Toxicity endpoints of ecological relevance, measurement sensitivity and precision, and linkage among screening level (cellular or molecular) responses and higher order effects are specified in the special study elements. A two-tier strategy is proposed that takes advantage of cost-effective screening level tools (i.e. bioanalytical assays, targeted chemical analysis) in directing the degree to which more involved assessment techniques (e.g. whole organism bioassays, non-targeted chemical analysis) are needed. Remaining challenges include developing tools that are appropriate and relevant for both freshwater and marine environments, and harmonizing pilot study designs and requirements with existing local, regional and national monitoring efforts.