

## Statewide Monitoring Pilot Study for Contaminants of Emerging Concern

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There are thousands of chemicals in commerce today, and many have the potential to be released into the environment. But only a handful of them have numeric water quality standards. Most are not monitored in California's waters.

### Statewide Pilot Study

Contaminants of Emerging Concern (CECs) are unregulated chemicals that originate from a variety of point and non-point source waste discharges. The presence of CECs in water ways and their potential hazards to human health, and aquatic life, are receiving special attention from the State and Regional Water Boards. Public concerns, newly adopted policies, and regulations prompted the Water Boards to monitor for the occurrence of CECs, and to investigate their potential to cause toxicity, to both aquatic life, and humans. A pilot study is intended to provide baseline information for Water Board programs, and the public. Groundwater Replenishment Reuse Project (GRRP) regulations adopted in 2014, and the Recycled Water Policy adopted in 2013, require water quality monitoring for both regulated chemicals and CECs to provide evidence of the efficiency of removal by wastewater treatment processes.

In 2014, under contract from the Water Boards, the Southern California Coastal Water Research Project (SCCWRP) developed a [Statewide CEC Monitoring Guidance](#) and [Quality Assurance and Quality Control Guidance](#), as a blueprint for a statewide CEC pilot study.

The Statewide Pilot Study Guidance:

- Develops a list of target compounds to monitor;
- Evaluates the utility of new monitoring approaches for CECs;
- Applies monitoring to a variety of CEC discharge scenarios and geographical regions; and
- Incorporates chemical and bioanalytical screening to inform and reduce the scope of more costly whole animal toxicity and field monitoring efforts.

For targeted CEC monitoring, a phased monitoring approach was recommended. Phase I has already developed a list of target CECs for monitoring. Phase II is a pilot study to collect and analyze field samples for target CECs. Phase III will provide an update to the target CEC list, and monitoring frequency, based on monitoring results.

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**Flame retardants**  
**Pesticides**  
**Pharmaceuticals**  
**Cosmetics**  
**Fragrances**  
**Sunscreens**  
**Detergents**  
**Synthetic hormones**  
**Paints and coatings**

To develop the initial list of CECs, a chemical-specific risk-based assessment framework was used to identify those chemicals that have the greatest potential to adversely affect aquatic organisms. It involved compiling exposure and toxicity information to compute a Monitoring Trigger Quotient (MTQ) – the measured environmental concentration of the chemical, divided by the chemical's threshold toxicity levels, taken from the published literature. If the MTQ is greater than or equal to 1, the CEC was identified as a priority for initial pilot monitoring.

Along with identifying a list of CECs for initial monitoring, the program is investigating new tools that could improve CEC monitoring. This includes an evaluation of bioanalytical screening, and the use of non-targeted diagnostic tools, at the watershed scale. All of this information will be used to develop a routine CEC monitoring program.

### Monitoring Questions and Design

To test the veracity of the CEC monitoring strategy described above, the statewide CEC pilot study is designed to answer several management level questions, including:

- Are target CECs detectable in waterbodies across the State, and if so, at what concentrations?
- How fast and at what distance do CECs attenuate to below levels of concern once they enter the water body?
- Do the occurrence and effects associated with CECs persist over time?
- Do target CECs adversely affect the health of aquatic organisms?

Regulated sources of CECs include stormwater and wastewater treatment plant discharges. Based on the statewide distribution and magnitude of wastewater treatment plant (WWTP) discharges, three discharge scenarios were identified for study:

Scenario 1 – WWTP discharges to freshwater streams and rivers;

Scenario 2 – WWTP and stormwater discharges to bays and estuaries; and

Scenario 3 – WWTP discharges to the ocean.

The geographical regions selected for pilot study are Southern California, San Francisco Bay, and the Central Valley including the Delta.

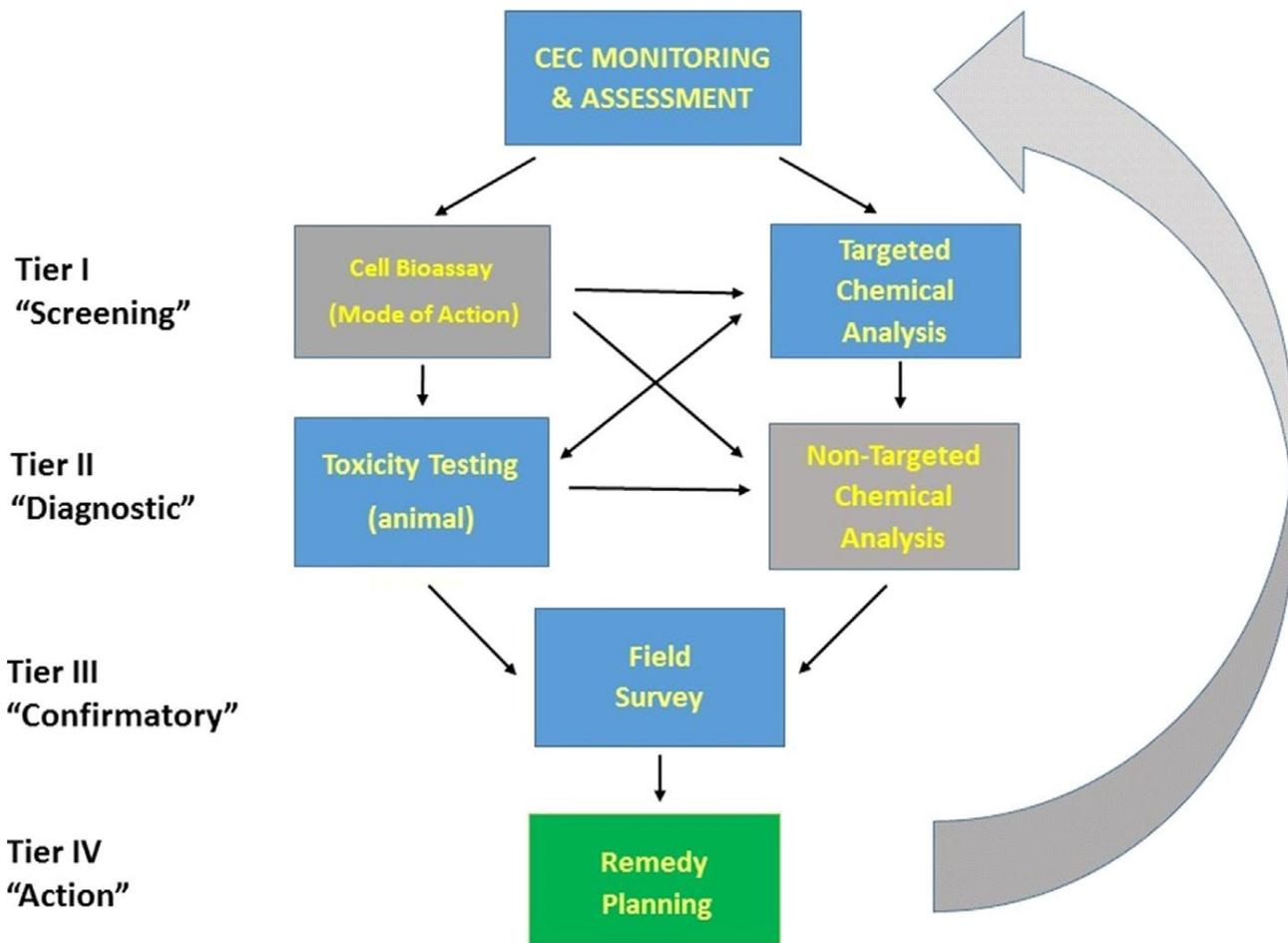
A tiered, integrated biological and chemical monitoring approach will be implemented (See Figure 1). The approach is to first screen for CECs using both bioanalytical (cell bioassays), and targeted chemical methods (Tier I). Cell bioassays will complement targeted chemical analysis, by screening for chemicals according to their common "mode of action" (MOA), (e.g. all estrogenic compounds that are present in a sample). In Tier II, whole animal toxicity testing (e.g. altered fish reproduction) provides a safeguard that adverse effects of CECs are minimal, and in conjunction with non-targeted chemical analysis, serves to identify those chemicals responsible for positive screening, and toxicity testing results, and where targeted chemical analysis is inconclusive. Confirmatory monitoring (Tier III) is carried out in actual receiving water to ensure that water quality is not affecting beneficial uses. Tier IV will evaluate the effectiveness of monitoring and, as needed, identify and implement management actions to mitigate the effects of CECs.

### Initial Target CECs

Bis(2-ethylhexyl) phthalate (BEHP)  
 Bisphenol A\*  
 Butylbenzyl phthalate (BBP)  
 Diclofenac\*  
 17-beta-Estradiol\*  
 Estrone\*  
 Galaxolide (HHCB)\*  
 Ibuprofen  
 p-Nonylphenol  
 PBDE-47  
 PBDE-99  
 PFOS  
 Triclosan

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**Figure 1.** Schematic presentation of CEC statewide and regional monitoring strategy (Maruya et.al. 2015).

Traditional chemistry based monitoring does not adequately address the broader universe of potential waterborne contaminants that are CECs. The availability of advanced analytical methods, such as non-targeted chemical analysis, that provide relevant information about compounds that are responsible for adverse impacts on aquatic organisms, is increasing. In addition to analyzing for unexpected compounds, cell bioassays can effectively screen for mixtures of chemicals, by accounting for additive, synergistic, and antagonistic effects, based on a common mode of action. Utilized within a structure framework that focuses in on water quality issues, with each successive tier (see Figure 1), bioanalytical screening (cell), assays and non-targeted chemical analysis, show promise in prioritizing waterbodies and watersheds, as well as compounds, for current and future CEC monitoring.