Monitoring Strategies for Constituents of Emerging Concern (CECs) in California's Aquatic Ecosystems

Recommendations of a Science Advisory Panel

Public Report Out
12/12/22

Panelists

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Panel Schedule

- Meeting series #1: October 12-15, 2020 (by webinar)
  - Hear perspectives from variety of interested parties
  - Review charge questions
  - Working sessions to develop approach to address questions

- Periodic videoconference working meetings and offline work

- Meeting series #2: February 7-10, 2022
  - Working meetings to address charge questions
  - Present current status

- Meeting series #3: May 2022
  - Working meetings to refine charge questions
  - Public status report meeting in late May

- Panel draft report: 12 Dec 2022

Background

- State of California formed an emerging chemicals scientific advisory panel for ambient waters about 10 years ago
  - Panel produced a 2012 report

- 2012 Panel provided a number of advances
  - Offered risk assessment framework to prioritize chemicals that should be monitored
  - Applied framework to identify specific chemicals that should be monitored, although sparse data on CEC occurrence hampered this effort
  - Presented approach beyond monitoring individual chemicals leveraging recent advances in cell-line assays and non-targeted chemical analysis

- Field has expanded greatly over last decade
  - Much more data on prevalence and fate for ambient CECs now
  - Cell-line assays and non-targeted analysis have advanced considerably

Charge questions

1. Which classes of CECs, including those with data gaps, have the potential to adversely impact marine, estuarine and freshwater wildlife, ecosystems, and beneficial uses in marine, estuarine and freshwater environments?
   a. Who are the leaders in the academic field for each of these classes of CECs?
   b. What are the applicable monitoring methods and reporting limits for these classes of CECs?

2. Update the risk prioritization framework developed in the 2012 report to address classes of chemicals, structurally-related chemicals (that may not be within the same class), and data-poor chemical classes (e.g., where there is either no monitoring trigger level or environmental concentration or predicted no-effect concentration)

3. What are the sources, pathways, and rate of inputs leading to the presence of classes of CECs in the marine, estuarine and freshwater ecosystems?

Charge questions

4. Considering the physical, chemical, and biological processes that affect the transport and fate of classes of CECs, what matrices (i.e., tissue, sediment, ambient water, and wastewater) should be screened in each of the three following ecosystems: marine, estuarine and freshwater?

5. What are the most important known and unknown biological effects for specific or classes of CECs and what approaches should be used to assess biological effects of classes of CECs to sentinel species in marine, estuarine and freshwater ecosystems?

6. How can state management agencies better address classes of CECs in the environment through implementation of the risk prioritization framework? Specifically, how can the State Water Board better address CECs?

Goal:

Provide recommendations for development of a monitoring program of CECs in fresh, estuarine, and oceanic water bodies of California

Where did we come from?

- Risk-based tiered CEC selection framework (Panel 2012, Panel 2022)
- Panel 2012 list of suggested CECs for monitoring primarily based on literature data
- Panel 2022: SWB CEC dataset with CA occurrence data since 2005
- SWB is building CEC program with dedicated staff
- SWB CEC dataset is retrospective using knowledge about known compounds using established analytical methods
- Need to expand view to include ‘new’ emerging CECs

Evaluation of the current SWB CEC dataset

- Available data confirm the Panel 2012 selection of relevant CECs

- Dataset requires refined quality assurance
  - starting with inputs
  - how data are sorted and extracted

  => Quality assurance workflow

- Opportunities
  - Addressing the occurrence of classes of compounds
  - Evaluating changes in concentration over time
  - Assessing geographical spread

Product #1: Guidance to structure, quality assurance and visualization of CECs covered by the existing State Water Board CEC dataset

Quality Assurance Workflow

- Matrix approach for individual CECs (dissolved and total concentrations in ambient fresh, wastewater, estuarine and marine water, tissues and sediments)
- Class-based approach
- Visualization to assess temporal and geographical variations
- Statewide guidance on water quality objectives for CEC monitoring

Evaluation of the current SWB CEC dataset

- A total of **423 CECs** were reported across all media

- Categorized into **eleven classes**:
  - Pesticides
  - Pharmaceuticals
  - Alkyl phenols/alkyl phenol ethoxylates (AP/APEs)
  - Phthalates
  - Polybrominated diphenyl ethers (PBDEs)
  - Brominated flame retardants (BFRs)
  - PFAS
  - Personal care products (PCPs)
  - Bisphenols
  - Organophosphate esters (OPEs)
  - Natural toxins (microcystins and marine toxins)

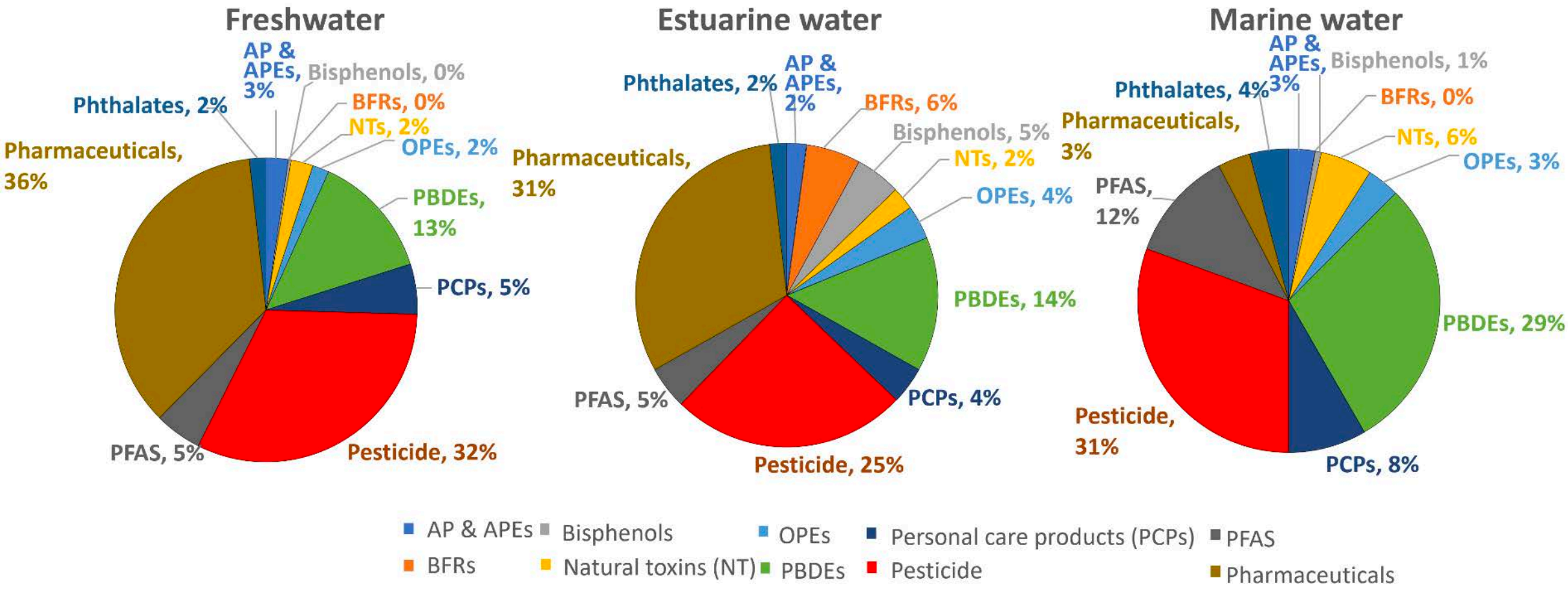
Evaluation of the current SWB CEC dataset

- Available as comprehensive, constantly updated dataset and as dashboard application to evaluate geographical spread in occurrence

CEC dataset (2005-2020) characteristics

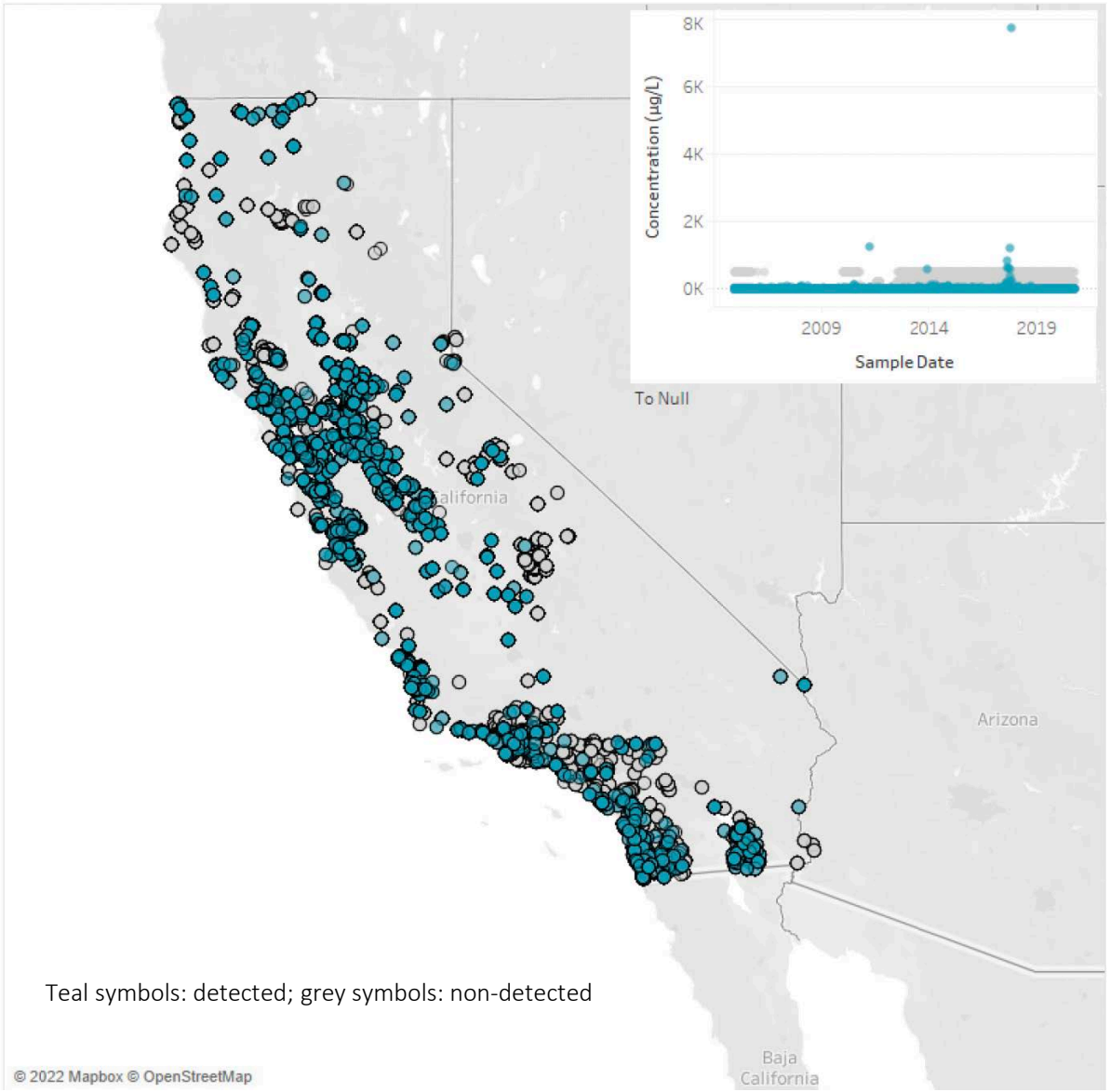
Media	Total measurements	Above detection limit
Surface waters (total)	427,111	54,328 (13%)
Surface waters (freshwater)	280,653	33,561 (12%)
Surface waters (estuarine)	8,880	1,550 (17%)
Marine water	21,385	6,399 (30%)
Sediment	130,652	27,812 (21%)
Biota	30,481	10,217 (34%)

Evaluation of the current SWB CEC dataset



Evaluation of the current SWB CEC dataset

Surface waters



Teal symbols: detected; grey symbols: non-detected

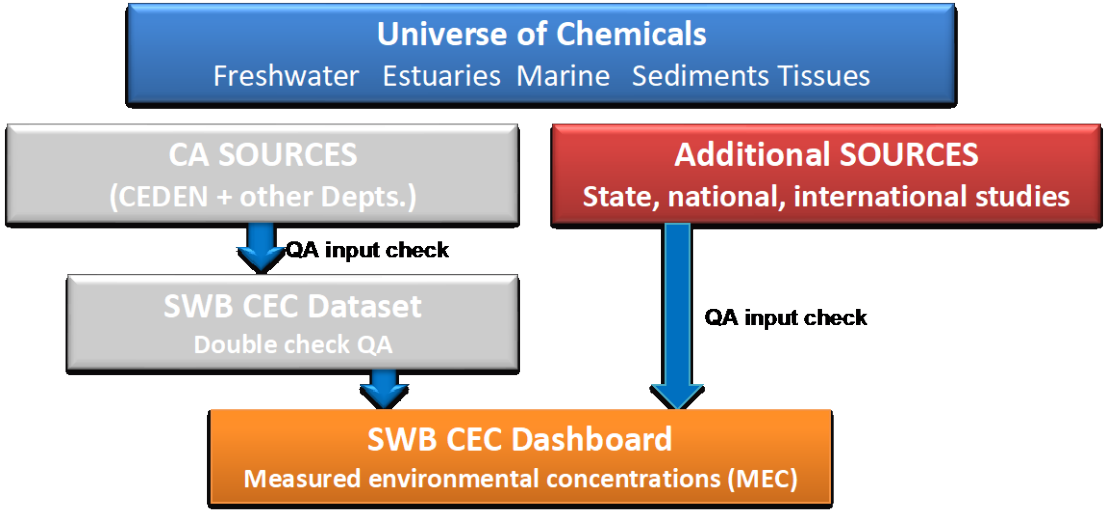
Product #1: Guidance to structure, quality assurance and visualization of CECs covered by the existing State Water Board CEC dataset

- Depending on reported or non-reported detection limits MTQ_{detect} or MTQ_{sub} are computed

- Substitution clearly introduces uncertainty about the true range of concentrations in ambient waters

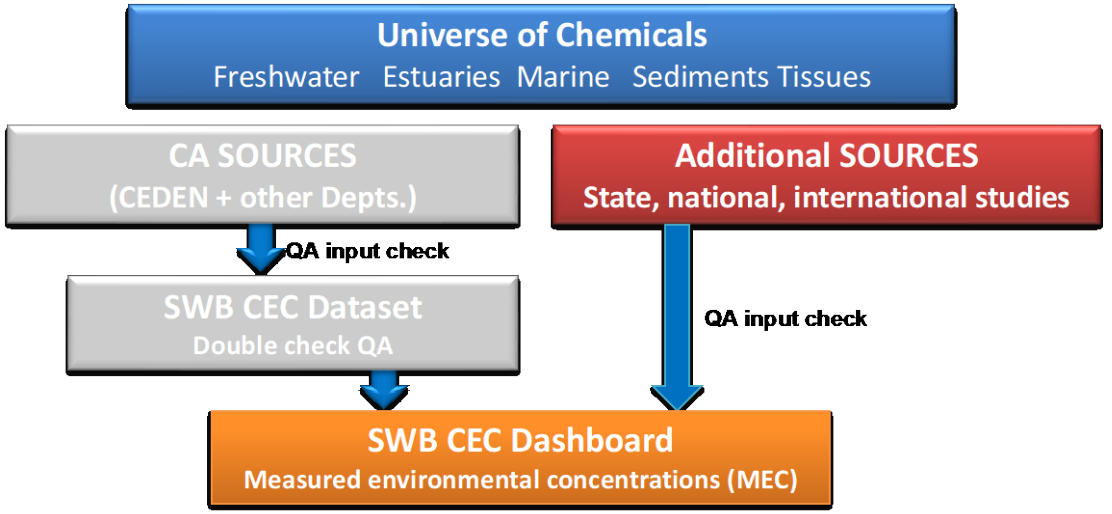
Product #2: Guidance to use other sources to inform a CEC monitoring program

- Consideration of additional occurrence data sources both within the state of California and outside (target analysis)
- Use of non-targeted analyses (NTA) to assess important known and unknown biological effects for specific or classes of CECs
- In total 133 compounds were included in the "new CECs" list. Twenty-one compounds were selected for prioritization including 6PPD-quinone (a compound highly toxic to coho salmon (Oncorhynchus kisutch) and salmonid species)



Product #2: Guidance to use other sources to inform a CEC monitoring program

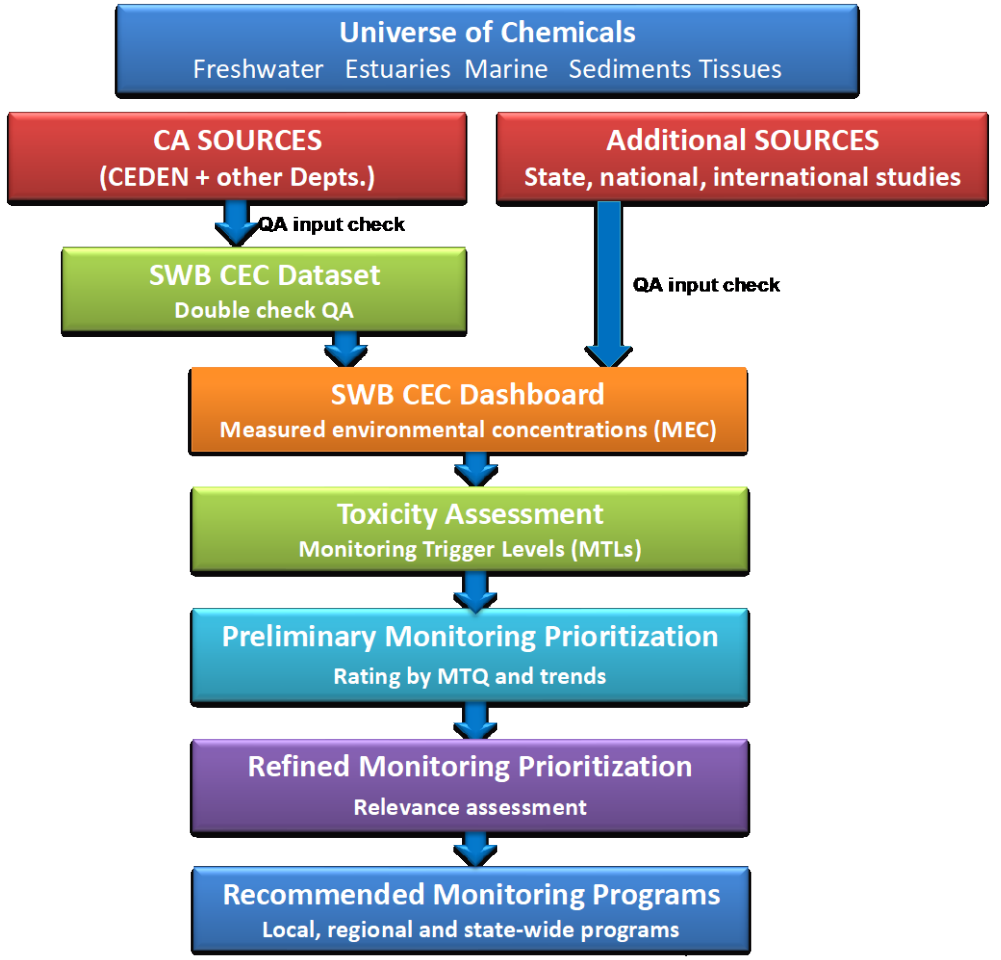
- Possible sources of additional information with strong evidence of relevance
  (f(x) = (occurrence, toxicity thresholds))
- Monitoring programs and databases conducted by other state and federal agencies (CA DPR, DWR, DTSC, etc.; USGS; NOAA)
- Literature reviews targeting studies reporting on occurrence of 'new' CECs in ambient waters (within CA, within the US, internationally)
- Effect-based analysis and NTA screening studies
- Regular USEPA CompTox screening of potentially relevant CECs



Product #3: An updated risk-based approach to assess and identify CECs for monitoring in California receiving waters

The Panel expanded the previously developed risk-based screening framework; it now includes four primary steps:

1. Toxicity assessment: developing monitoring trigger levels (MTLs) based on published effects concentrations.
2. Preliminary monitoring prioritization: rating short-lists of CECs based on measured environmental concentrations (MECs) and trends for CECs for which MTLs could be estimated.
3. Refined monitoring prioritization: CEC priority ranking based on sample size, verification of trend (geographical and temporal), and monitoring trigger quotient (MTQ).
4. Recommended Monitoring Program: specify the nature of local, regional and state-wide monitoring efforts.



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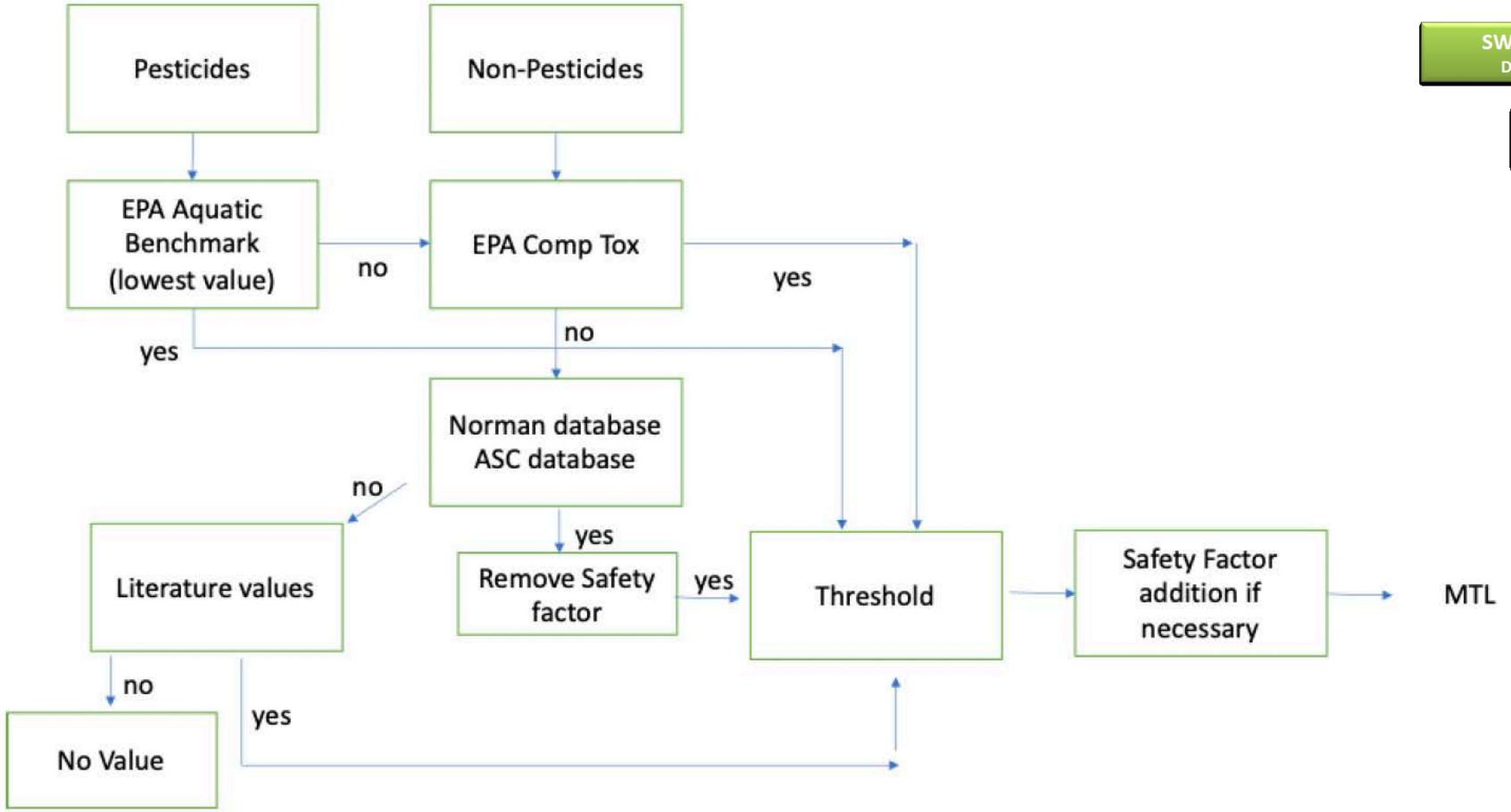
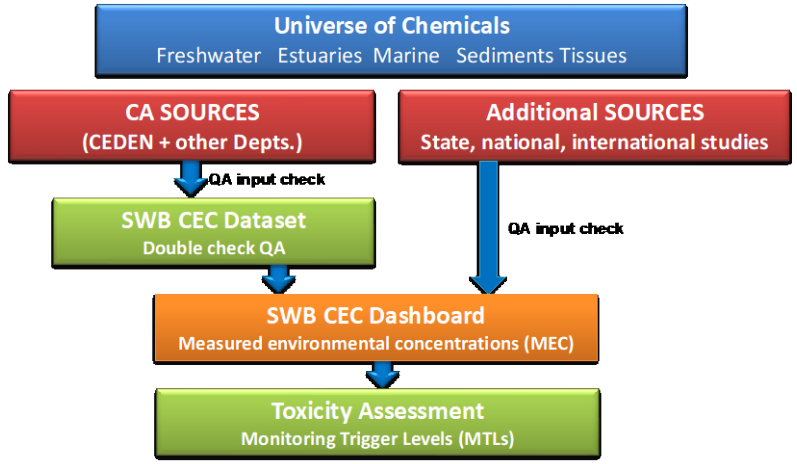
Effects assessment to derive monitoring trigger levels:





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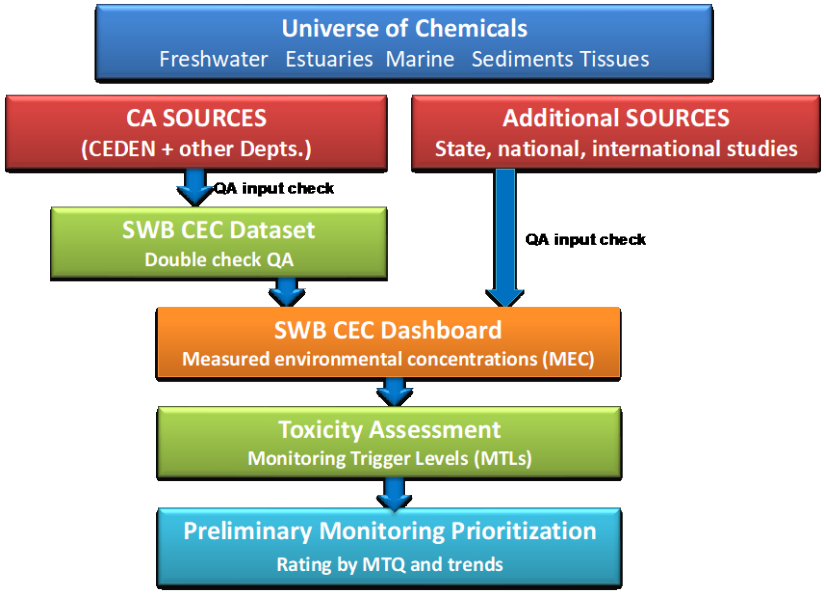
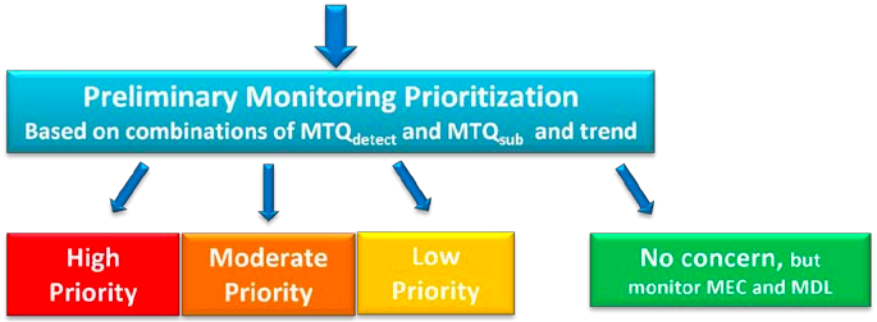
Preliminary monitoring prioritization:

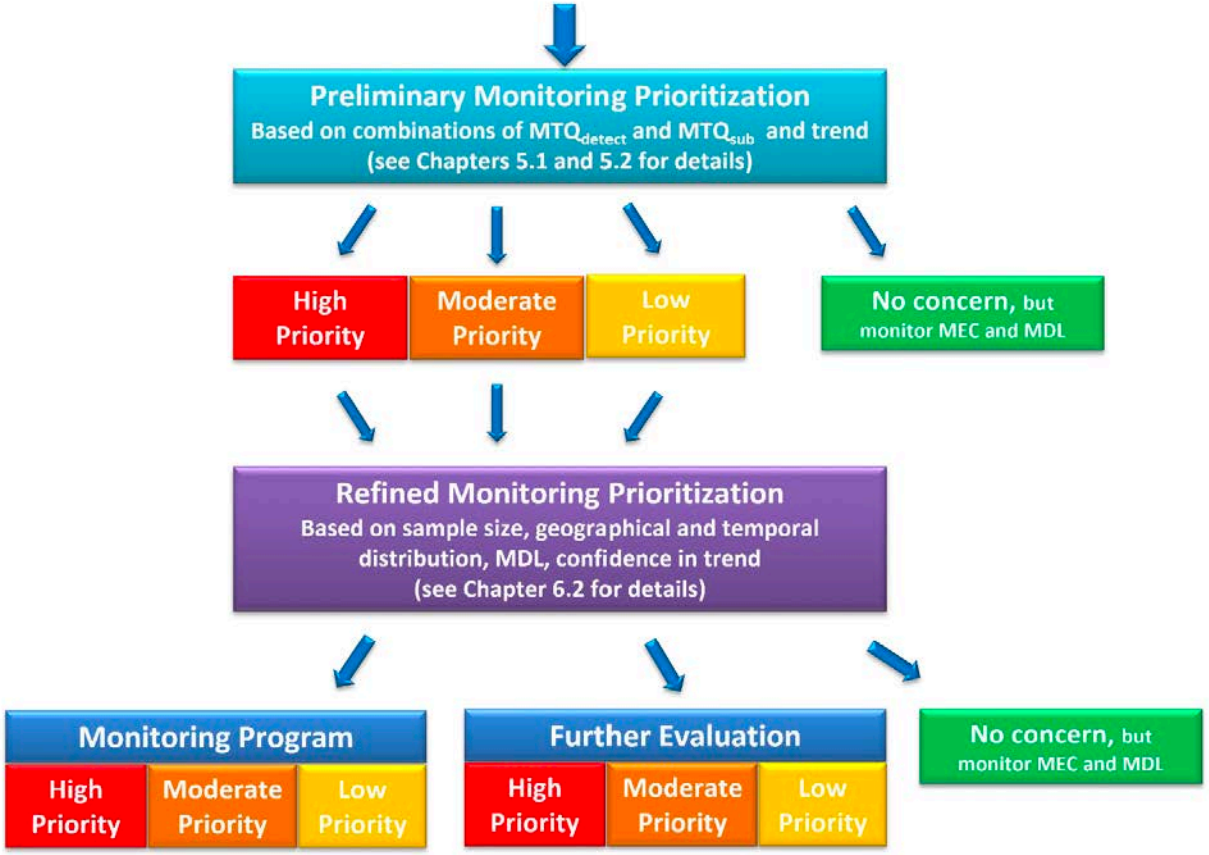
- available data and MTLs are used to calculate an MTQ and trend
- If data are available, MTQs and trend can be calculated for all environmental media (e.g., fresh, marine water, estuarine water, sediment, and tissue)
- Prioritization process categorizes CECs as either needing to be retained for possible inclusion in a monitoring program or eliminated from consideration in a current monitoring program
- CECs that are retained for possible inclusion in a monitoring program are categorized as having either 'High', 'Moderate' or 'Low' monitoring priority





Product #3: An updated risk-based approach to assess and identify CECs for monitoring in California receiving waters

Refined monitoring prioritization:



Range of possible monitoring programs:

- State-wide monitoring programs for widely distributed CECs whose MTQ is either stable or expected to increase either because concentrations are anticipated to increase or the MTL is expected to decrease

- Local or regional monitoring programs for CECs known or expected to occur in specific geographical areas

- Special studies for CECs with information gaps identified by the monitoring prioritization process Other types of monitoring programs, such as those for bioanalytical or NTA approaches, and those for receiving water

Product #4: Establishing a sound foundation for a state-wide and regional CEC monitoring program in California

- Complement the continuing risk-based monitoring approach with temporal and spatial evaluations
- Improve the quality of data reported to the State Water Board
- Regularly update the monitoring trigger levels (MTLs) as new CEC monitoring and toxicology information become available
- Develop a pilot biomonitoring program focused on early identification of effects in ambient waters
- Work with a future Ambient Ecosystems CEC Advisory Panel or an equivalent process for expert review
- Update existing policy and monitoring requirements to update the State's approach to CEC monitoring and management
- Guiding the state-wide CEC monitoring program for receiving waters by SWB staff

Product #4: Establishing a sound foundation for a state-wide and regional CEC monitoring program in California

- Tremendous challenge of using the existing disparate systems to collect and compile occurrence data in statewide database
- The Panel believes a more focused statewide monitoring program dedicated to evaluating CECs that relies on more than occurrence data will be a more efficient use of resources and provide the State an abundance of information about CECs in, and their possible effects on, California's aquatic ecosystems
- Binning approach for statewide or regional approach
  - state-wide vs. local occurrence
  - necessary monitoring frequency
  - linked to risk assessment taking local conditions and frequency of occurrence into consideration

Key Recommendations

SWB Dataset – Quality assurance

1. Existing occurrence data need **further refinement and quality assurance**; focus should be on elevated MDLs and MDLs > MTLs and effect of MDL uncertainty on CEC prioritization
2. For CECs with MTL less than an achievable MDL, SWB CEC staff should review the derivation of the MTL to determine if the inherently high level of conservatism in the MTLs is necessary to protect aquatic life and ecosystems in California waters. Similarly, the Panel recommends that for CECs with MTL > MDL, SWB CEC staff consider whether MDLs required by the monitoring program need to be as low as achievable or simply low enough to achieve the MTL
3. **Data collected in the future need to be of consistently high quality to be accepted into the dataset.** Data entry steps need to consider minimal information such as detection limits, sampling location etc.
4. Establish and implement a procedure to transfer and review the quality of CEC data from other sources such as CEDEN et al.

Key Recommendations

Other sources for CEC occurrence

5. Establish a procedure to review literature (published as well as grey literature) to inform SWB staff regarding potential newly emerging CECs making sure to take into consideration persistence, mobility, and bioaccumulation potential

6. Establish a process that encourages the use and acceptance of data from non-commercial (research) analytical methods and documented QA/QC procedures

Key Recommendations (cont.)

Developing CEC monitoring programs:

7. SWB CEC staff should apply the updated prioritization framework to all CECs in the High, Moderate and Low preliminary monitoring priority categories to develop a refined CEC prioritization list for monitoring
8. The Panel recommends the State explore alternative monitoring approaches to identify CECs that may pose a risk to aquatic life and aquatic ecosystems including bioanalytical methods, use of PECs for CECs without California-specific MEC data; NTA; and effects-based biomonitoring in a few key locations/ecosystems

Transitioning from monitoring programs to other actionable programs:

9. **Define a process to address how and when to handover certain CECs/CEC classes to other SWB programs.** At some point sufficient monitoring has occurred and the "status" of a CEC or CEC class changes from a monitoring program to another actionable program

Key Recommendations (cont.)

Automation of data handling and visualization of data:

10. The Panel recommends SWB CEC continue to refine the visualization dashboard and the incorporation of the CEC prioritization framework in the dashboard enabling the State to automate many of the steps necessary identify and prioritize CECs for monitoring, as well as identify the areas in California where monitoring for CECs would be most beneficial

Role of future expert panels:

11. Before implementing new monitoring programs, the Panel recommends that all aspects of such updated programs, and their bases, be reviewed by a subsequent Panel or similar process
12. Future Expert Panels or similar processes should not be expected to develop such programs and approaches

Acknowledgment

- California Water Resources Control Board
- Ocean Protection Council
- Interagency Advisory Committee
- Aquatic Science Center