

# Contaminants of Emerging Concern (CEC) Statewide Pilot Study

August 17, 2015

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# Talking Points

- Water Boards Mission and Authority
- What are CECs
- Status of CECs Monitoring in California
- Statewide Pilot Study

## Mission statement of the Water Boards

“The State Water Board’s mission is to preserve, enhance and restore the quality of California’s water resources, and ensure their proper allocation and efficient use for the benefit of present and future generations.”

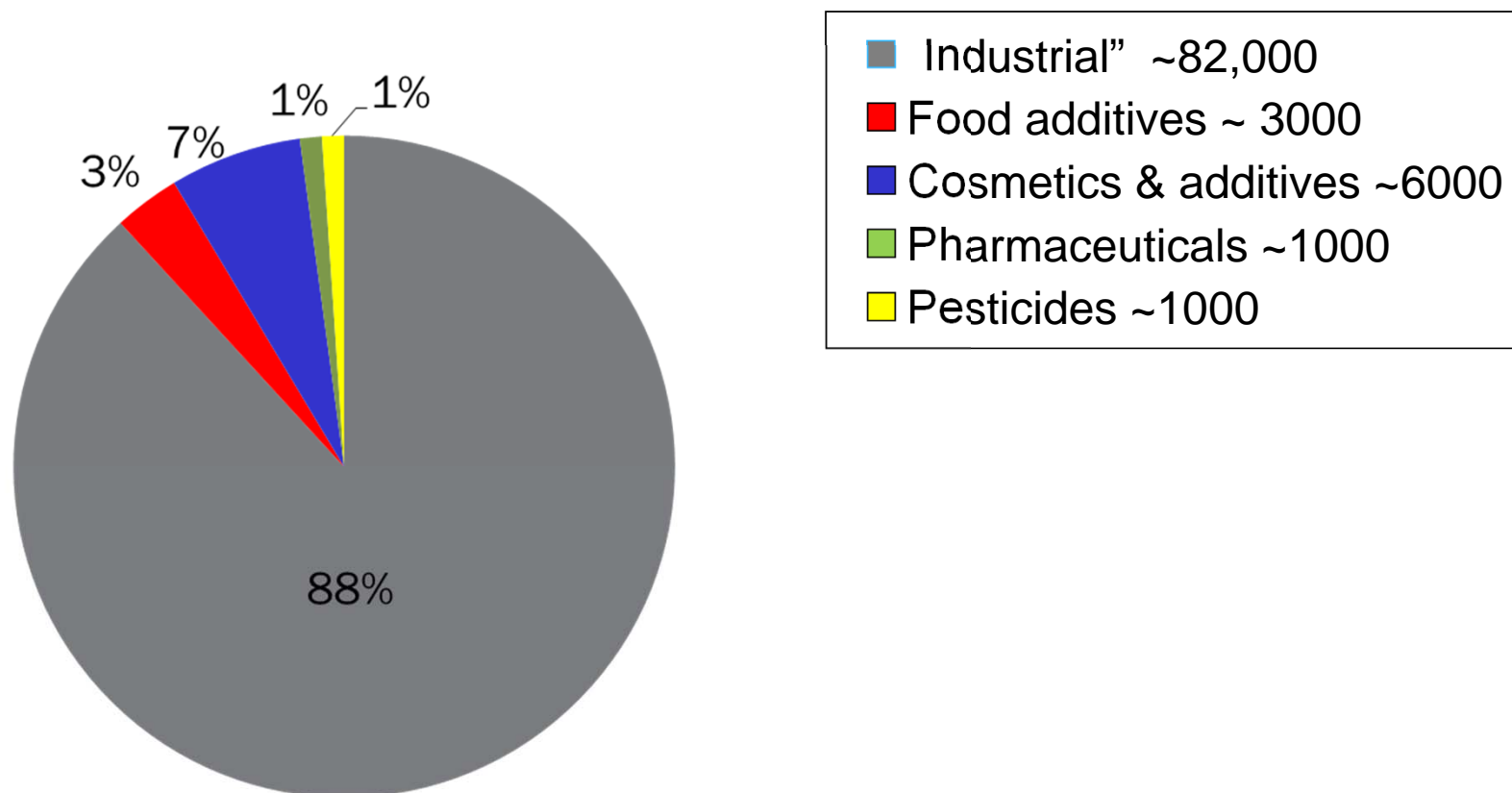
# Authority

- Under water quality laws, the State Water Board promulgates water quality standards to protect “beneficial uses” designated by Regional Water Boards, such as municipal water supply and aquatic life protection.
- Water quality standards for surface waters currently focus on specific chemicals: the USEPA-designated 129 “priority pollutants.”
- Emerging contaminants were unrecognized as potential threats to water quality when the “priority pollutant” list was established 30 years ago.

# Challenges

- More than 100,000 man-made chemicals
  - More than 1000 new chemicals per year
  - Only 129 EPA priority pollutants
- Approved methods unavailable (e.g. for any of the top 100 pharmaceuticals)
- Many CECs produce adverse effects not measured by typical toxicological testing

# Number of Commercial chemicals in the US



# Should we be concerned?

- Concerned, but not alarmed
- Occur in water bodies
- The potential for adverse effects has been demonstrated
- Emerging contaminants in effluent
  - Some are removed by treatment, but many remain

# What do we know?

- Southern California
- San Francisco Bay  
Regional Monitoring  
Program (RMP)



# South Cal CEC Monitoring Summary

## Effluent Dominated Rivers

- Occurrence of CECs confirmed
- Some exceeded monitoring trigger quotients; many did not
- SoCal channelized systems act as rapid conduit to coast

## Embayment(s) and Oceans

- Occurrence of CECs confirmed
- Occurrence data from focused surveys and an understanding of CEC fate in specific systems is lacking
- Data on stormwater contributions is lacking

# Los Angeles River Watershed

- Document occurrence & fate of >60 CECs in Los Angeles and San Gabriel rivers
- Samples downstream had higher numbers of detected CECs
- Little attenuation down to the estuary was observed
- exceeded thresholds to trigger monitoring
- 52% of the CECs detected

Compound	Matrix
bifenthrin	water
permethrin	water
diclofenac	water
galaxolide	water

# Santa Clara River Watershed

- Document occurrence & fate of > 60 CECs
- Higher attenuation
- Some exceeded monitoring thresholds
- 70% detected

Compound	Matrix
bifenthrin	FW Sediment (embayment)
PBDE -47 & -99	FW Sediment (embayment)
PBDE -47 & -99	tissue
permethrin	FW Sediment (embayment)
fipronil	FW Sediment (freshwater)
fipronil	FW Sediment (embayment)

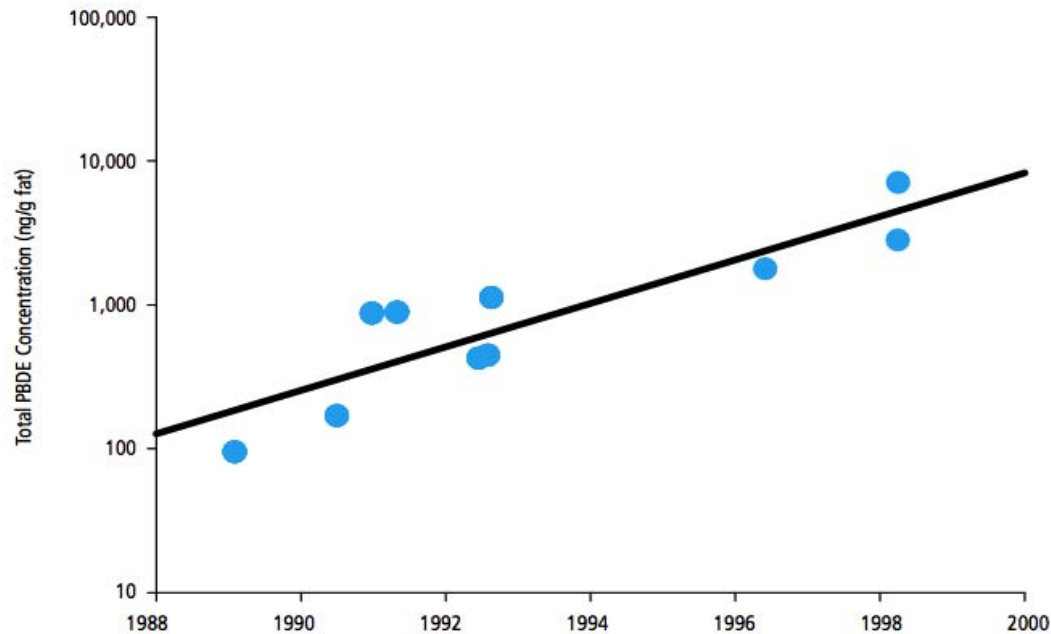
# San Francisco Bay Regional Monitoring Program (RMP)

Risk Level Description	CECs in San Francisco Bay
Tier IV: High Concern	Bay occurrence data suggest a high probability of a moderate or high level effect on Bay wildlife
Tier III: Moderate Concern	Bay occurrence data suggest a high probability of a low level effect on Bay wildlife
Tier II: Low Concern	Bay occurrence data or predicted environmental concentrations suggest a high probability of no effect on Bay wildlife
Tier I: Possible Concern	Potential for concerns or uncertainty in measured or predicted Bay concentrations or toxicity thresholds suggest uncertainty in the level of effect on Bay wildlife

# San Francisco Bay Regional Monitoring Program (RMP)

Risk Level Description	CECs in San Francisco Bay
Tier IV: High Concern	None
Tier III: Moderate Concern	PFOS (water replants) Fipronil Nonylphenol & nonylphenoethoxylates PBDEs (flame retardants)
Tier II: Low Concern	Pyrethroids Pharmaceuticals & personal care products HBCD
Tier I: Possible Concern	Alternative flame retardants Bisphenol A Plasticizers Pesticides Many, many others

# RMP Success story: PBDEs



Bay harbor  
seal PBDE  
levels doubled  
every 1.8 years

She et al. 2002

# PBDE Phase out & Ban

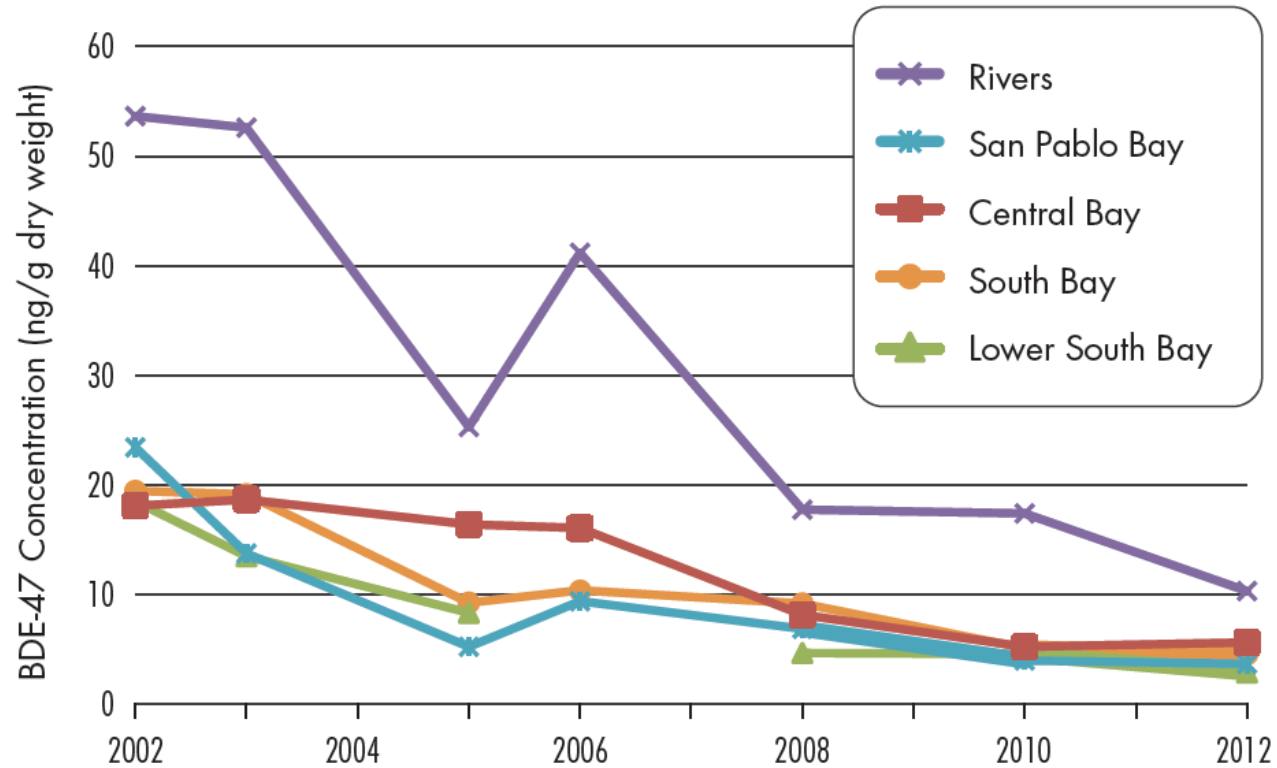


US phase out  
2004

California  
ban 2006

# PBDE Decline

PBDEs in Bay Bivalves





# Statewide CEC Pilot Study

## Objective

- generate consistent statewide data and narrow the data gap among regions
- inform of the status and trends of CECs in California waters (water managers, legislatures, public).
- comprehensive information of water quality indicators and covering a wide range of waterbody types
- develop tiered based management framework to manage CECs similar to Regional Monitoring Program (RMP) framework.

# Experts Panel for Pilot Study

Dr. Paul Anderson  
Human Health Toxicologist  
AMEC

- Dr. Adam Olivieri  
Risk Assessor  
EOA Incorporated

Dr. Nancy Denslow  
Biochemist  
University of Florida

- Dr. Daniel Schlenk  
Environmental Toxicologist  
UC Riverside

Dr. Jörg Drewes  
Civil Engineer  
Colorado School of Mines

- Dr. Shane Snyder  
Analytical Chemist  
Total Environmental Solutions,  
Inc

# Stakeholder Advisors

- Philip Friess (CASA, Tri-TAC)
- Geoff Brosseau (CA StormwaterQuality Association)
- Jay Davis (SF Bay Regional Monitoring Program)
- Sara Aminzadeh (CA CoastkeeperAlliance)
- Rich Breuer (SWRCB, SWAMP)
- Thomas Mumley (San Francisco Bay RWQCB)
- Deborah Smith (Los Angeles RWQCB)
- Adam Laputz/Kenneth Landau (Delta Regional Monitoring Program)
- Richard Gossett (Commercial Services)

# Three discharge scenarios

## Scenario I

- Effluent dominated: WWTP effluent and receiving water
- Stormwater: effluent and receiving water

## Scenario II

- Embayment: effluent and receiving water

## Scenario III

- Ocean: effluent and receiving water

# Narrowing down the compounds

## Two steps process

- Qualitative compound prioritization
  - Focus compounds
- Quantitative via risk-based analytical approach
  - Target compounds

# Compound Prioritization

- pharmaceuticals and personal care products
- endocrine disrupting chemicals
- persistent and bioaccumulative organic chemicals

Fish	Non-Fish	Non-fish (cont.)
p-nonylphenol	AHTN	Ibuprofen
Octylphenol	p-nonylphenol	Miconazole
AHTN (tonalide)	octylphenol	Nonylphenol monoethoxylate (NP1EO)
Atrazine	Atenolol	Octocrylene
Bisphenol A (BPA)	Atorvastatin	PBDE-47, PBDE-99
Chlorpyrifos	Atrazine	Permethrin
Cis-androstenedione	Azithromycin#	PFDA
Diclofenac	Bifenthrin	PFOS
Droperinone	Bis (2-ethylhexyl) phthalate	Progesterone
17-beta estradiol (E2)	Butylbenzyl phthalate	Sulfamethoxizole
Estrone	Carbamazepine	Testosterone
Galaxolide	Chlorpyrifos	Triclosan
Ibuprofen	Ciprofloxacin	Trimethoprim
Levonorgestrel	Desulfinyl fipronil	Ziprasidone
Miconazole	di-n-butylphthalate	
Nonylphenol monoethoxylate (NP1EO)	Erythromycin	
PBDE-47	Fenofibrate	
PBDE-99	Fipronil	
Permethrin	Fluorouracil	
Propranolol	Fluoxetine	
Setraline	Galaxolide	
Triclosan	Gemfibrozil	

## RISK-BASED SCREENING FRAMEWORK

- **Step 1: measure or predict occurrence (MEC or PEC)**
  - Provided through investigative monitoring (e.g. regional, special studies)
  
- **Step 2: determine concentration that is protective of resource (aka “monitoring trigger level” or MTL)**
  - Published information on no/low observable effects concentrations
  
- **Step 3: calculate “Monitoring Trigger Quotient” (MTQ)**  
**= MEC (or PEC) /MTL**
  - If  $MTQ < 1$ , no concern
  - **If  $MTQ > 1$ , add to candidate list**



# Statewide Target Compounds

Scenario		WWTP Effluent		Scenario 1		Scenario 2 Embayment		Scenario 3 Ocean	All Scenarios
				Storm Water (MS4)	Effluent Dominated Inland Freshwater				
Matrix	Aqueous	Aqueous, Sediment	Aqueous	Aqueous	Sediment	Sediment	Tissue		
Bis(2-ethylhexyl) phthalate (BEHP)	O	NA	NA	NA	NA	M	NA		
Butylbenzyl phthalate (BBP)	O	NA	NA	NA	NA	M	NA		
p-Nonylphenol	O	NA	NA	NA	NA	M	NA		
Bifenthrin	E	F	M	M	M	M	NA	NA	
Permethrin	E	F	M	M	M	M	NA	NA	
Chlorpyrifos	E	F	M	M	M	NA	NA	NA	
Estrone	E	F	M	M	M	NA	NA	NA	
17-beta estradiol	E	F	M	M	M	NA	NA	NA	
Galaxolide (HHCB)	E	F	M	M	M	NA	NA	NA	
Bisphenol A	E	F	M	M	M	NA	NA	NA	
Ibuprofen		F	M	M	NA	NA	NA	NA	
Diclofenac		F	M	M	NA	NA	NA	NA	
Triclosan		F	M	M	NA	NA	NA	NA	
PBDE -47 and -99	E	F	O	M	NA	M	M	M	
PFOS	E	F	O	M	NA	M	M	M	

# Analytical Approaches

## ➤ Chemistry

- Determine the concentration of target compounds in all matrices water, sediment and tissue

## ➤ Bio-analytical:

- Determine the adverse effect of the target compounds on organisms step-by-step at cellular, whole species and population level

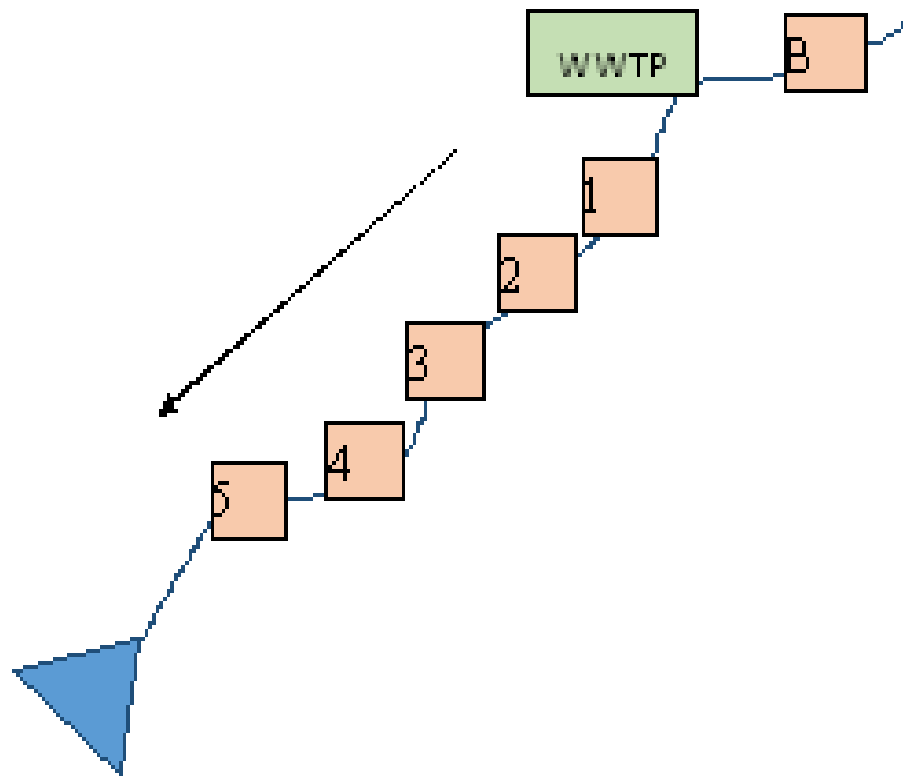
## ➤ Non-targeted

- Determine the occurrence of untargeted compounds.
- Literature search

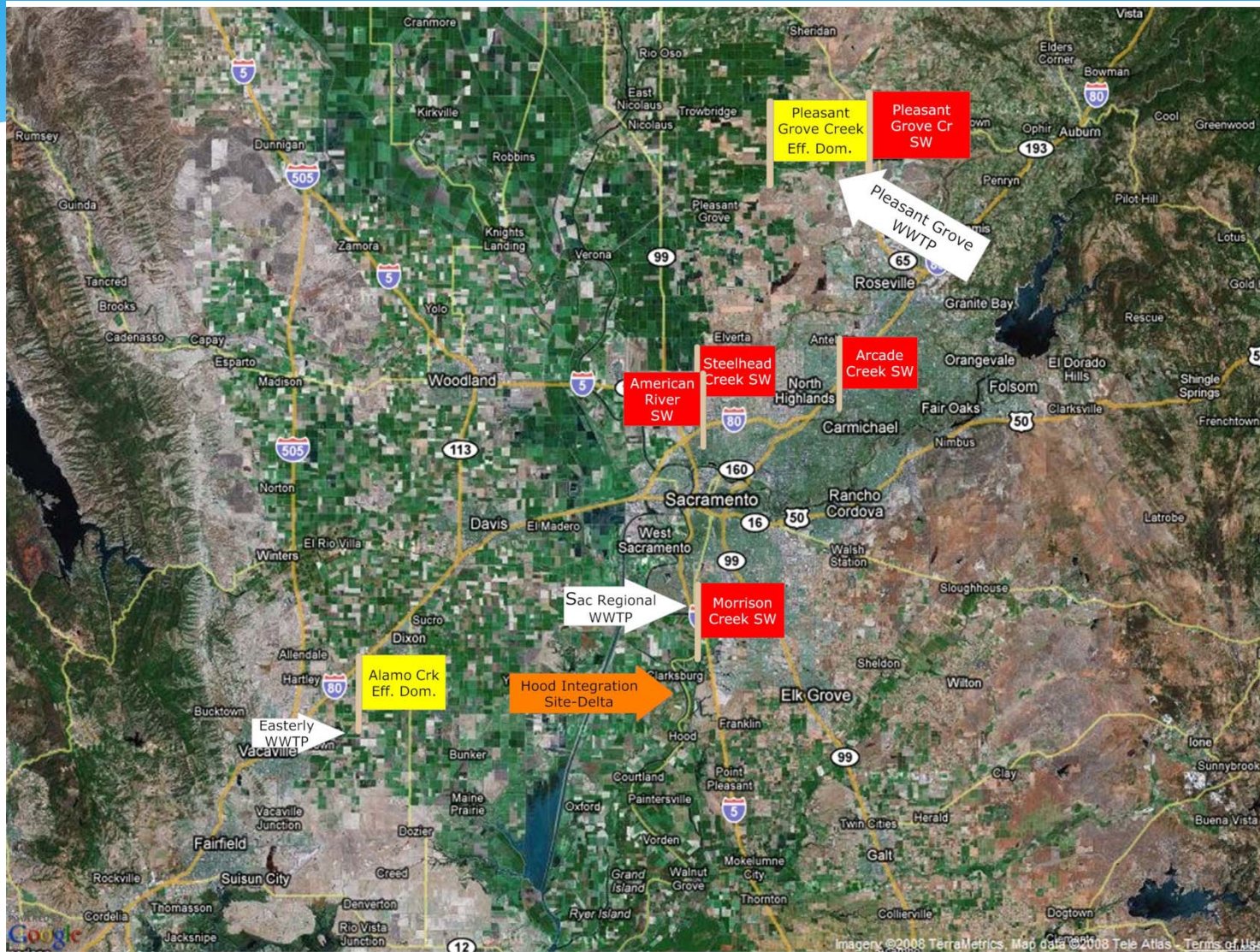
# Monitoring Questions

- Which CECs are detected in waterways?
- What are their concentrations and loadings in the dry vs. wet seasons?
- What is the relative contribution of CECs in WWTP effluent vs. stormwater?
- What is the spatial and temporal variability in loadings and concentrations?
- Which priority CECs are detectable at or below their respective monitoring trigger levels (MTLs) using the endocrine-related cell assays?
- What are the responses (additive or antagonist) of priority CECs mixtures using the selected cell assays?

# Monitoring Design



# Proposed CECs Monitoring Sites for Bay Delta



# Tiered interpretation of results

Categories	San Francisco Bay	Southern California	Central Valley/ Delta	Monitoring	Management
<b>Tier IV High Concern</b>				Studies to support cleanup plan	303(d) listing, Cleanup Plan (TMDL), Aggressive Control
<b>Tier III Moderate Concern</b>	CECs will be assigned in each category when results are available			Status and trends monitoring; and/or Studies of fate, effects, and sources and pathways	Action plan or strategy; Aggressive pollution prevention; Low-cost control
<b>Tier II Low Concern</b>				Reduced frequency screening. Periodic screening in pathways, track trends	Low-cost source ID and control; Low-level pollution prevention; Track use trends
<b>Tier I Possible Concern</b>				Screening in water, sediment, biota, wastewater, urban runoff	Prioritize contaminants of potential concern, track other efforts; Develop analytical methods

# Schedule

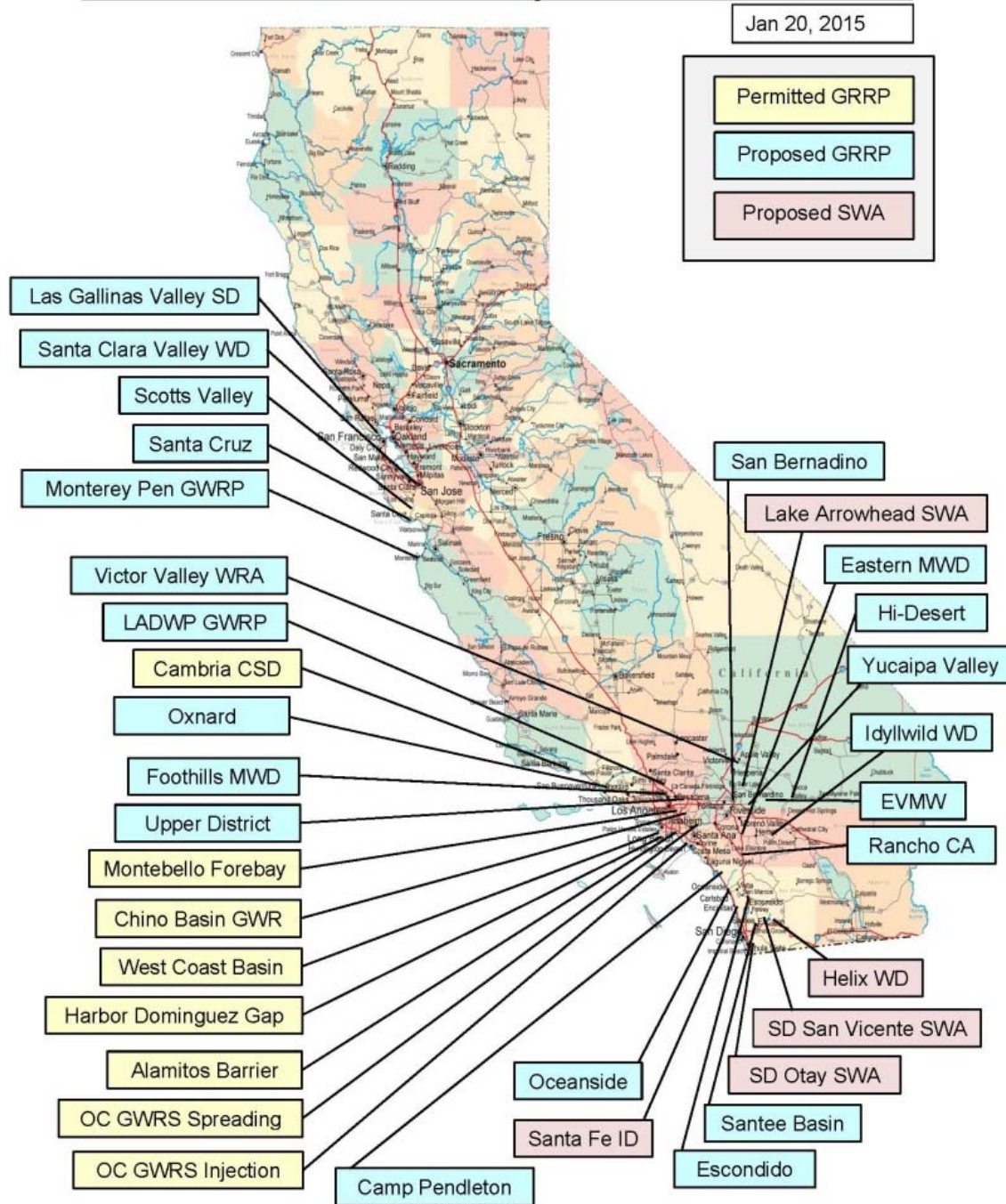
- \* Finalize the monitoring plan----- September 2015
- \* Management approval and identify funding ----- October & November 2015
- \* Develop contract ----- November & December 2015
- \* Implement ----- January 2016

# CA Recycled Water Policy

- Adopted in 2009 to increase recycled water use.
- Science Advisory Panel convened to provide recommendations for monitoring CECs in recycled water.
- Policy amended in 2013 to include Science Advisory Panel recommendations.
- [4/25/15 Recycled Water Policy Amendment](#) includes CEC monitoring requirements for recycled water producers including groundwater recharge/replenishment projects.



# Indirect Potable Reuse Projects Across California



CEC monitoring required for recycled water producers and use of recycled water for groundwater recharge reuse.

# CEC Monitoring Requirements

- Phased monitoring: initial assessment followed by baseline monitoring.
- Must monitor for:
  - (1) human health-based CECs (e.g. triclosan)
  - (2) performance indicator CECs (e.g. sucralose)
  - (3) Surrogates
    - Surface:  $\text{NH}_3$ , TOC,  $\text{NO}_2^-$ , UV Absorption
    - subsurface: electrical conductivity and TOC

# Thank you!! Questions?

All information are available at

[http://www.waterboards.ca.gov/water\\_issues/programs/swamp/cec\\_aquatic/](http://www.waterboards.ca.gov/water_issues/programs/swamp/cec_aquatic/)

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