

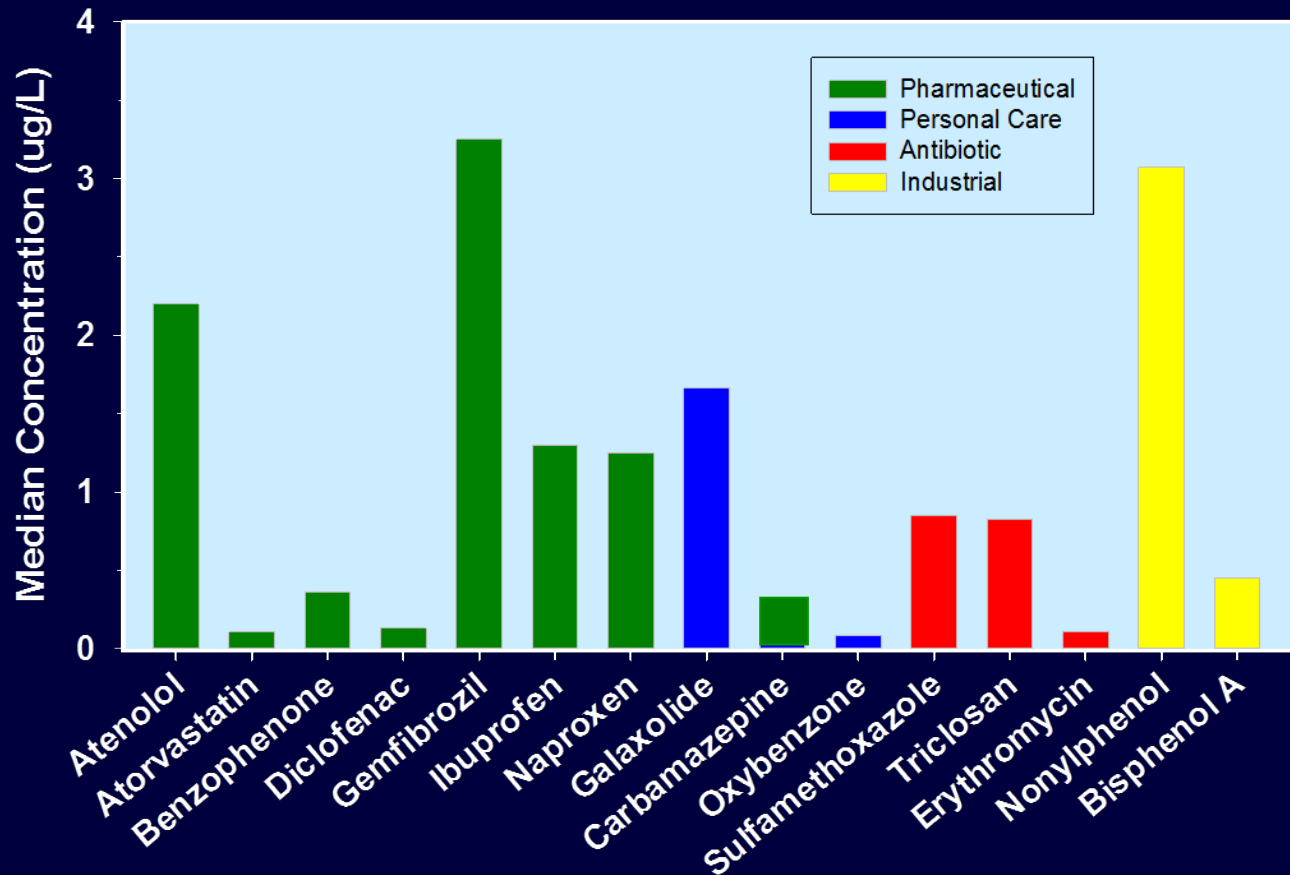
Science-based Recommendations for Monitoring Chemicals of Emerging Concern (CECs) in California's Receiving Waters

Keith Maruya

**SCCWRP Commission Meeting
September 7, 2012**

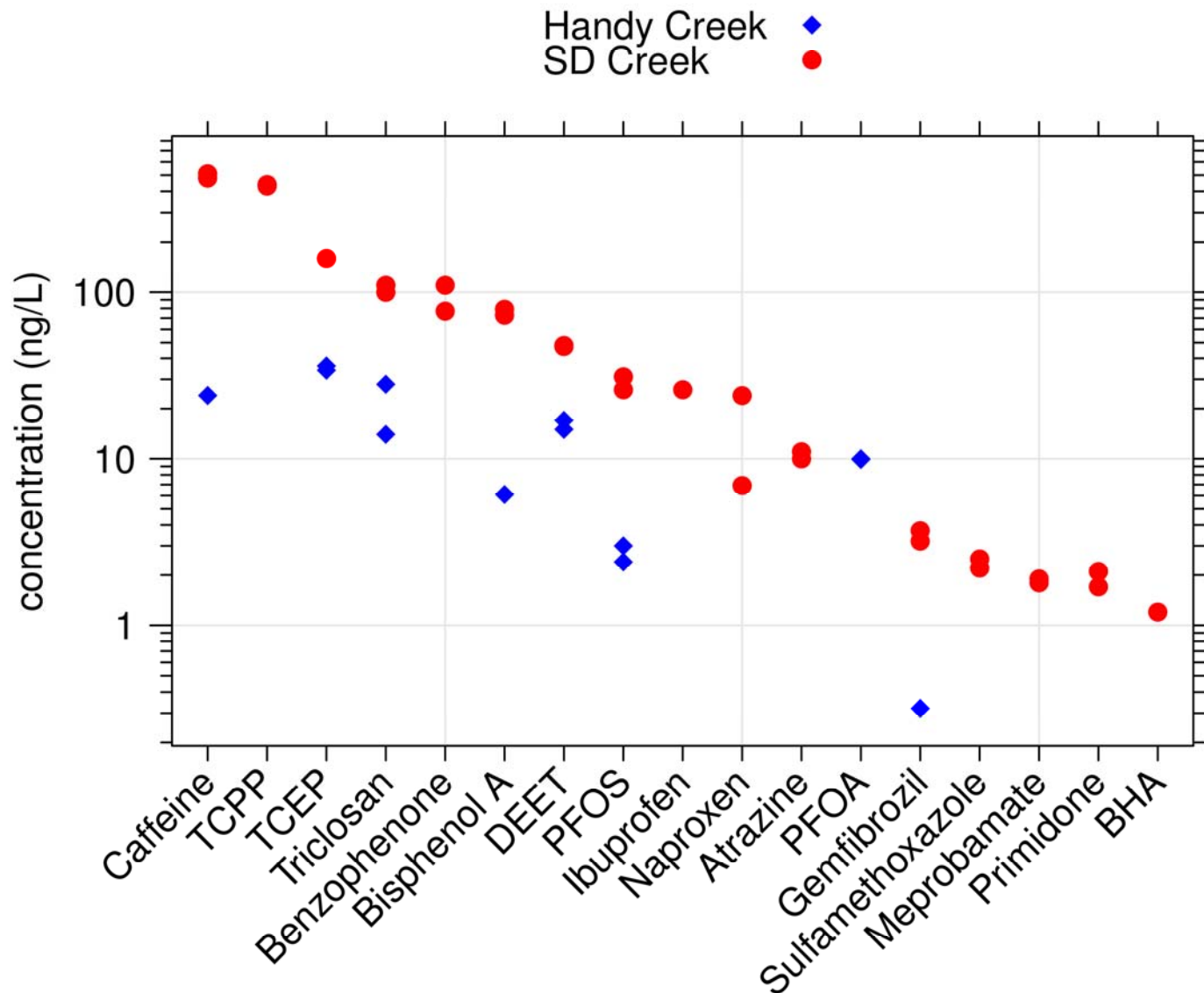


CECs are detected in effluent discharged from California WWTPs

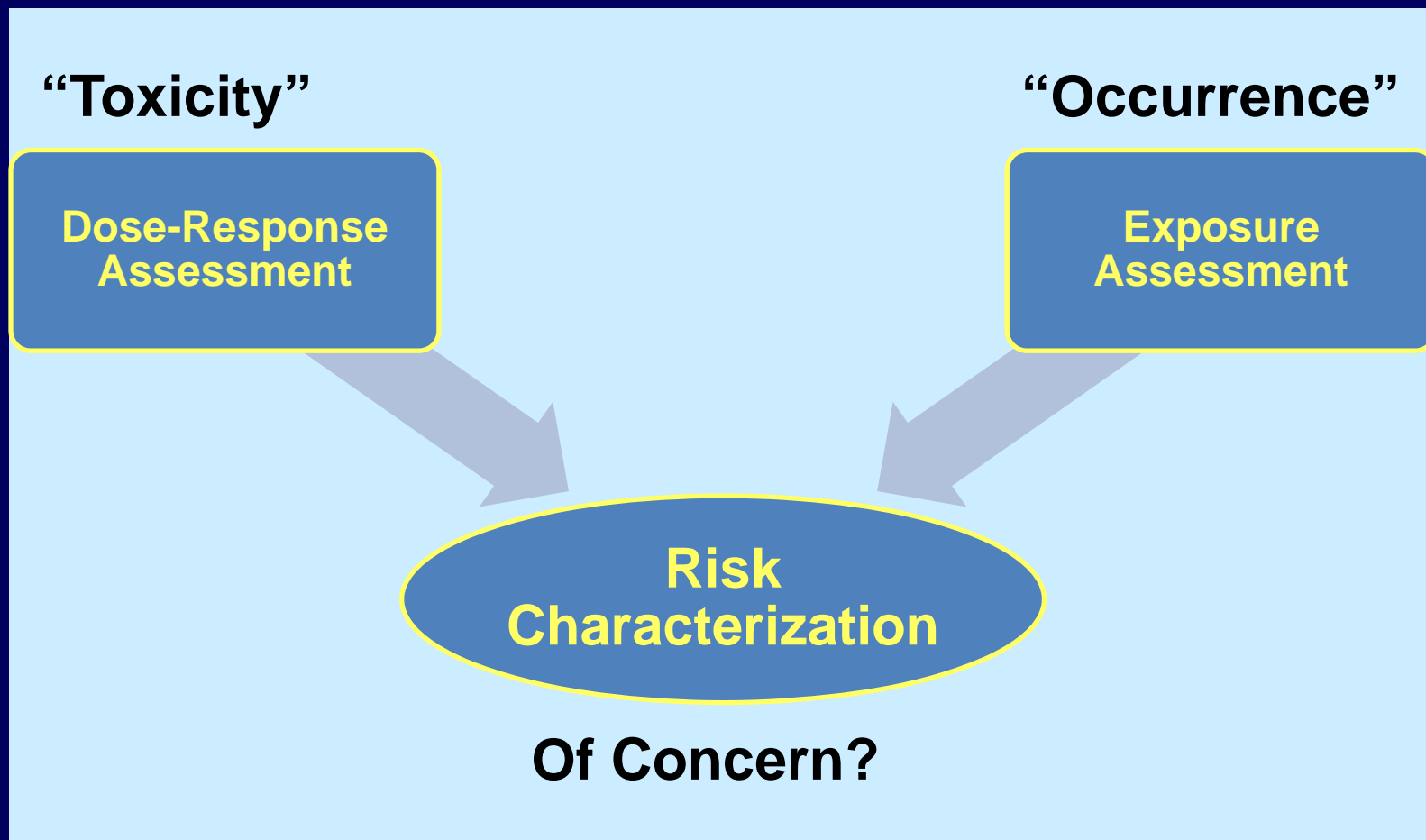


- low parts per billion (ug/L) range
- concentrations dependent on level of treatment

...and in urban stormwater



COMMERCIAL CHEMICALS IN THE US



Source: Muir and Howard 2006

SCCWWRP SELECTED TO FACILITATE CEC SCIENCE ADVISORY PANEL

- **Convened on behalf of SWB in 2009 for recycled water, then later for coastal & marine ecosystems**
- **Solicited stakeholder input on panel charge & selection**
- **Organized 6 meetings with public participation**
 - charge & perspectives (Winter 2010)
 - expanded to include freshwater systems (Fall 2011)
 - addressed public comments on draft report (Spring 2012)
- **Coordinated production, dissemination of report**
 - final recommendations submitted to SWB in May 2012

STAKEHOLDER ADVISORS

- **Jim Colston** (Tri-TAC; OCSD)
- **Chris Crompton** (CASQA; County of Orange)
- **Mark Gold** (Heal the Bay)
- **Amber Mace** (CA Ocean Science Trust)
- **Rick Moss*** (State Water Board)
- **Linda Sheehan** (CA Coastkeeper Alliance)

* succeeded by **Gary Dickenson, Melene Emanuel**

HOW DO WE MONITOR FOR CECs?

- What are the relative contributions from stormwater & WWTP effluent?
- What are the fate(s) of CECs in WWTPs, storm & receiving waters?
- *What are the appropriate CECs to be monitored, including analytical methods and MDLs?*
 - Scenarios, matrices, frequency
- What approaches should be used to assess biological effects?
- What levels of CECs should trigger additional action? What range of actions should be considered?

ASK THE EXPERTS

- **Dr. Paul Anderson**
 - Human Health Toxicologist
 - Arcadis US
- **Dr. Adam Olivieri**
 - Risk Assessor
 - EOA Incorporated
- **Dr. Nancy Denslow**
 - Biochemist
 - University of Florida
- **Dr. Daniel Schlenk (Chair)**
 - Environmental Toxicologist
 - UC Riverside
- **Dr. Jörg Drewes**
 - Civil Engineer
 - Colorado School of Mines
- **Dr. Shane Snyder**
 - Analytical Chemist
 - Univ. Arizona
- **Dr. Geoff Scott**
 - Coastal & Marine Sciences
 - NOAA

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 $MTQ \geq 1$, add to candidate list

EXPOSURE SCENARIOS

- **#1 -- Effluent dominated inland waterway**
 - low flow (dry weather) conditions
 - no dilution of WWTP effluent
- **#2 -- Coastal embayment**
 - WWTP effluent and stormwater discharge
 - 10 fold dilution of source input
- **#3 -- Offshore ocean discharge**
 - Large WWTP outfalls on mid-Shelf
 - 100 fold dilution of WWTP effluent

ADAPTIVE MONITORING STRATEGY

- Incorporate new information and revisit recommendations

High concern – control (all controllable) sources

Elevated concern – confirm levels; expand monitoring (ID sources); refine risk assessment; control (easy) sources

Moderate concern – continue monitoring to ensure concentrations are not increasing

Little/No concern – Discontinue monitoring

Monitoring Trigger Quotient

PURPOSES FOR MONITORING

- **Investigative or exploratory: e.g. lack of occurrence data**
 - changing chemical use/discharge patterns
 - evolving methodology
 - serves an “on-ramp” for problematic CECs
- **Validation of concept or model:**
 - are trigger levels (e.g. MTQs) consistently exceeded?
 - If yes, continue and/or take action; If no, remove or monitor less frequently
- **Regulatory or compliance: CECs with demonstrated risk**
 - proven methods with established QA/QC procedures

PANEL's LIST OF CECs

- **Aqueous Phase (River & Bay)**
 - Pesticides (bifenthrin, permethrin, chlorpyrifos)
 - Consumer (bisphenol A, diclofenac, galaxolide, ibuprofen)
 - Hormones (17b-estradiol, estrone)
 - Antibiotics (triclosan) -- River only
- **Sediments (Bay & Ocean)**
 - Plasticizers (bis-2-ethylhexyl, butylbenzyl phthalates)
 - Flame retardants (PBDE-47, -99)
 - Detergents (4-nonylphenol)
 - Pyrethroids (bifenthrin, permethrin) – Bays only
- **Biological tissue (All)**
 - PBDEs
 - Perfluorinated chemicals (PFOS)

DIFFERENT LISTS FOR DIFFERENT NEEDS

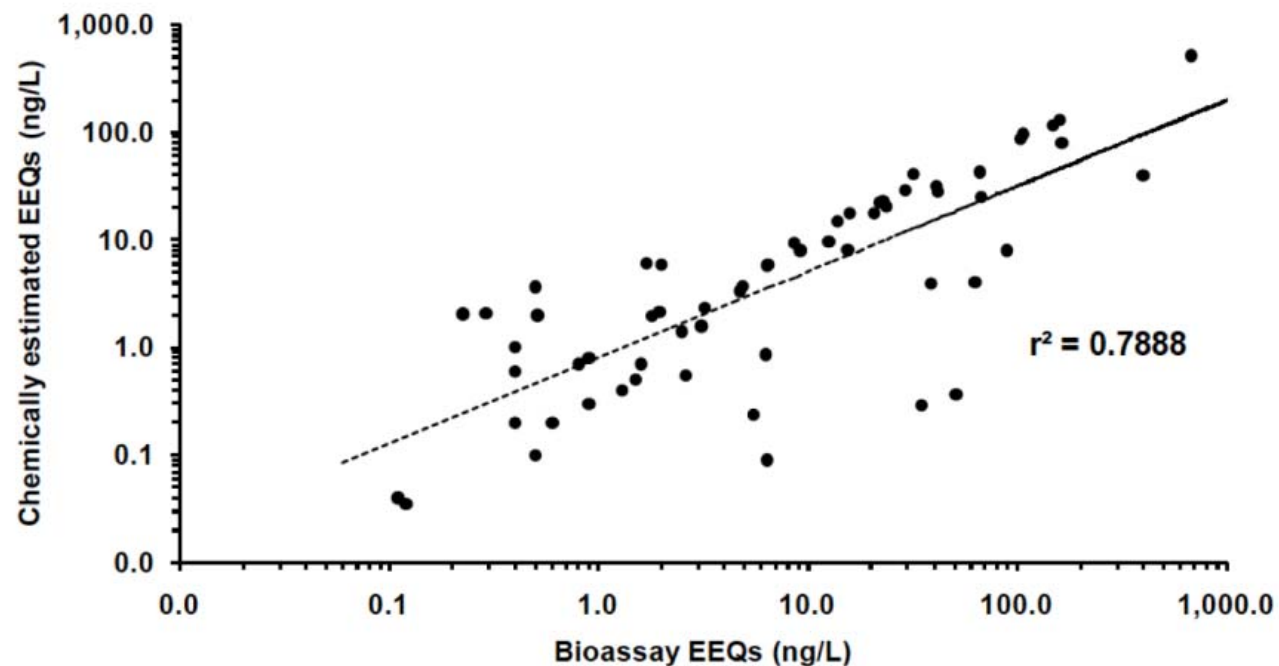
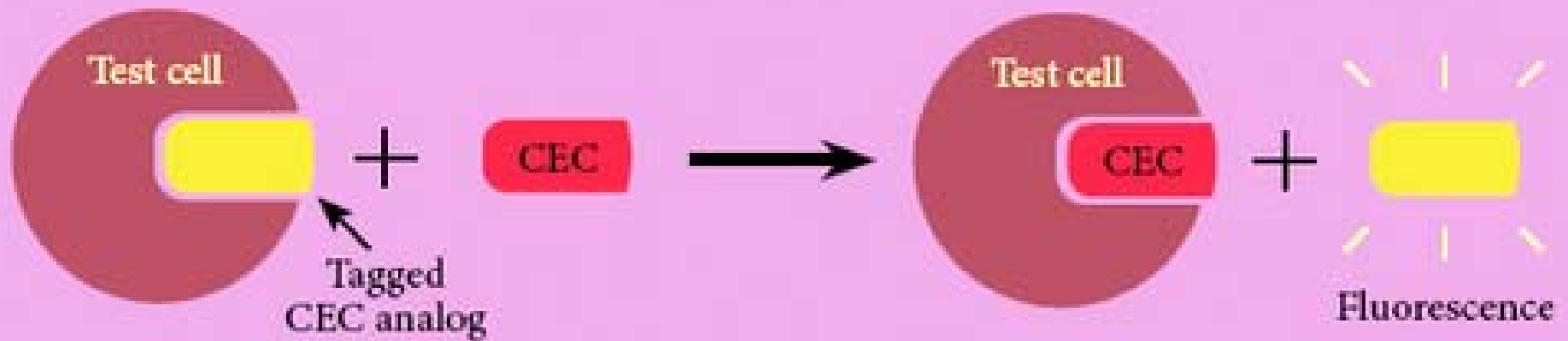
PPCPs	PANEL	LARB	SAWPA	SDRB
Acetaminophen		x	x	
Amoxicillin, Azithromycin		x		
Atorvastatin (lipitor)		x		
Caffeine		x	x	x
Carbadox				x
Carbamazepine		x	x	x
Chloro-, oxy-tetracycline				x
Ciprofloxacin		x		
DEET		x	x	
Diclofenac	x			
Dilantin		x		
Doxycycline				x
Erythromycin hydrate				x
17-alpha ethinyl estradiol		x	x	
17-beta estradiol	x	x	x	x
Estrone	x	x		
Gemfibrozil		x	x	x
Galaxolide (HHCB)	x			
Fluoxetine				x
Ibuprofen	x	x	x	x
Iopromide		x		
Lincomycin, Roxithromycin				x
Salicylic acid		x		
Sulfamethoxazole		x	x	
Sulfachloropyridazine				x
Sulfa-methazine, -methizole				x
Sulfa-merazine, -dimethoxine, -thiazole				x
TCEP	I	x	x	
Triclosan	x	x	x	x
Trimethoprim		x		x
Tylosin				x

Industrial & Commercial	PANEL	LARB	SAWPA	SDRB
Bifenthrin	x			
Bis(2-ethylhexyl) phthalate	x			
Bisphenol A	x	x	x	
Butylbenzyl phthalate	x			
Chlorpyrifos	x			
Diuron	I		x	
Fipronil + degradates	I			
Octylphenol		x		
p-Nonylphenol	x	x		x
Nonylphenol ethoxylates		x		x
Permethrin	x			
PBDE -47 and 99	x	x		
PFOS	x			
2,3,4-Trimethylphenol				x
X – targeted for monitoring				
I -- recommended by Panel				
for investigative monitoring				

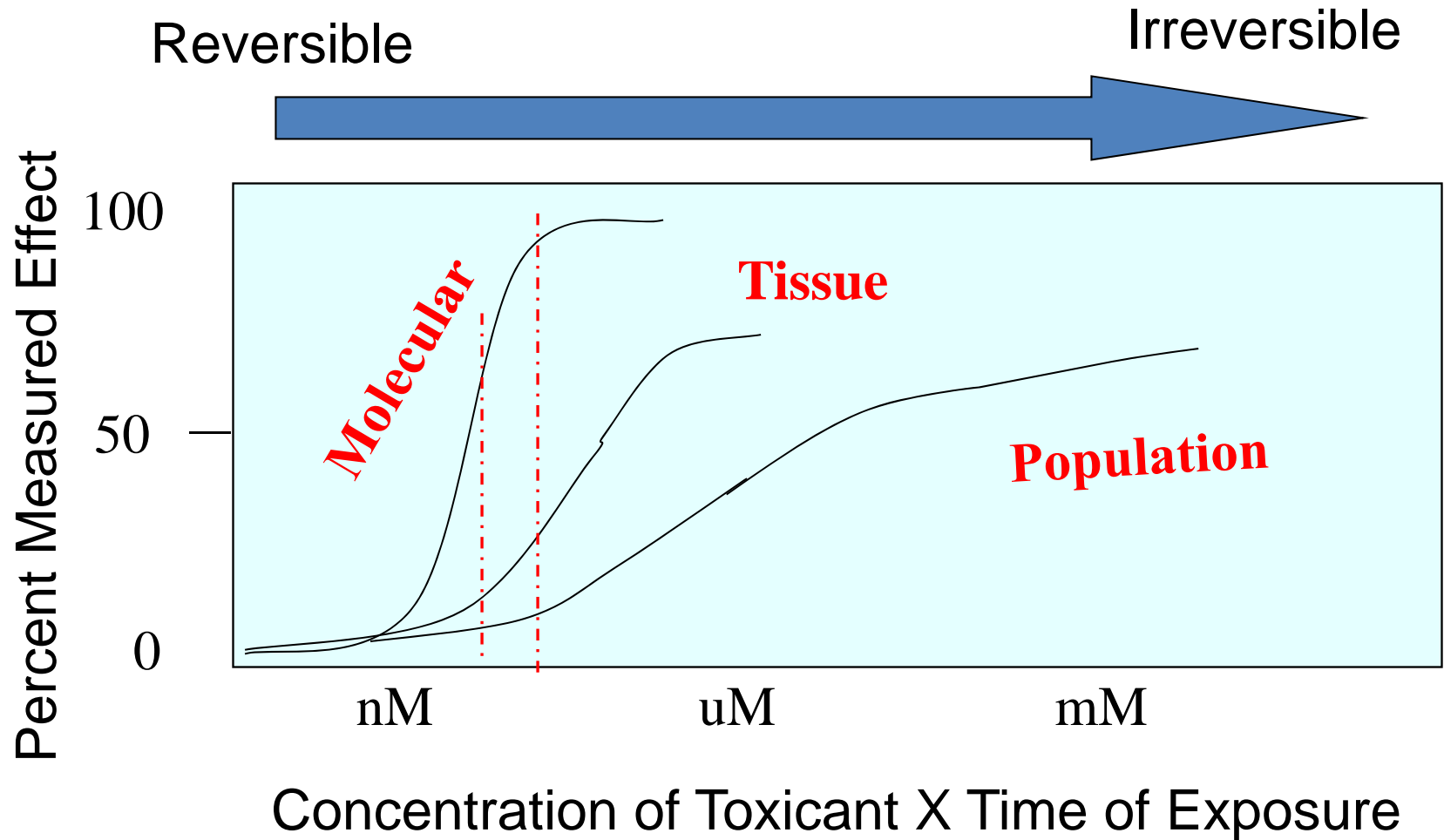
DEVELOPING BIOANALYTICAL TOOLS

- **Ultimate endpoint of interest**
 - Of lesser concern if the biology (e.g. the consumer) is unaffected
- **In vitro bioassays to screen for CECs by mode of action**
 - applicable to known & unknown chemicals
 - multiple endpoints are needed to address range of possible effects
 - must be cost-effective, easily transferable to practitioners
- **Linking molecular responses with higher order effects**
 - CECs may not impact populations until later generations
 - Invertebrate, fish life cycle tests in conjunction with screening bioassays

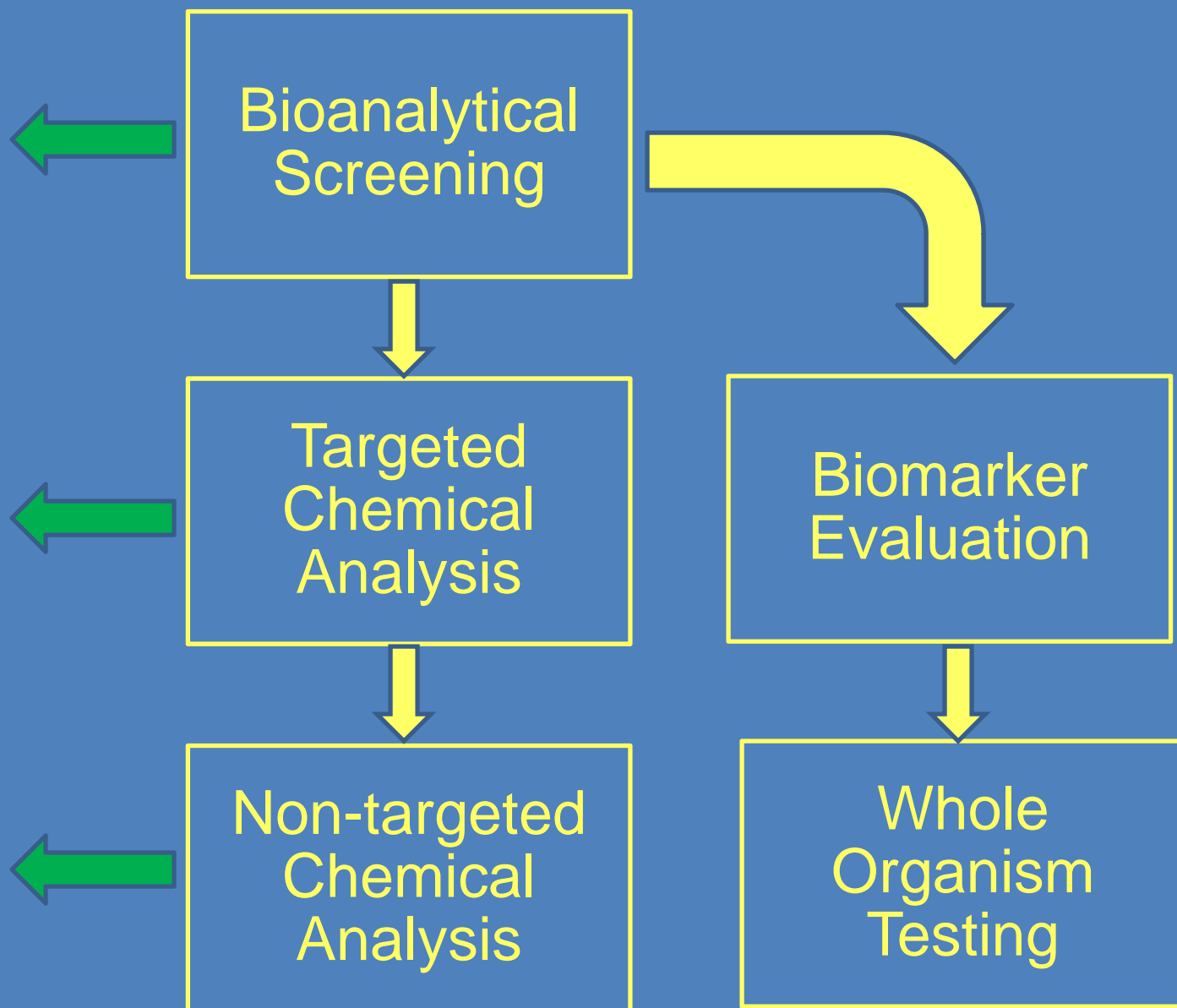
HIGH THROUGHPUT IN VITRO BIOASSAYS



Linking molecular responses with higher order effects



A NEW CHEMICAL MONITORING APPROACH



TAKING FULL ADVANTAGE OF BIGHT 13

- **Our next opportunity to work collaboratively on a regional scale**
 - validate Panel's and Regional Board's initial lists
 - fill data gaps on occurrence of other CECs of interest
 - put stakeholder talent and facilities to good use
- **Leverage collection of sediment & tissue samples**
 - Challenge member agencies to analyze “easy” CECs
 - Identify partners & prioritize funding for difficult to measure CECs
- **Advance the application of bioanalytical tools**
 - will they work for ambient samples? In different matrices?
- **Kickoff meeting will be held on Sep 24 @ SCCWRP**

SCHEDULE

- **Regulatory staff contemplating monitoring requirements**
- **SWB Informational Briefing – October 2012**
- **Development of relevant bioanalytical tools**
 - in vitro (“rapid screening”) methods for recycled water (2011-14)
 - linking in vitro responses to whole organism effects (2012-)
- **Filling data gaps on priority CECs**
 - Special studies (e.g. LARB River CECs)
 - Regional Monitoring (Bight 13; SMC, SFEI RMP)
- **Revisit recommendations after 3-5 years**