Item 7h Causes of Toxicity

RMP TRC December 19th 2006
Sediment TIE proposal (2007-2008)
Program funding source: 2007 RMP - Episodic Toxicity Monitoring Program/ Causes of Toxicity
Project Leads: Sarah Lowe (SFEI), Brian Anderson (UC- Davis)
Date: December 12th, 2006

This is an updated proposal to for the TRC to conduct sediment Toxicity Identification Evaluations (TIEs) near the mouths of selected tributaries entering the Estuary per TRC request at the October-2006 meeting. TIEs will be conducted with the estuarine amphipod *Eohaustorius estuarius*. The goal of this study is to use newly-developed sediment TIE methods to determine the causes of sediment toxicity at the margins of the Estuary.

Background
Sarah Lowe recently presented an overview of the historical findings of the RMP's - Episodic Toxicity Program, and the Status and Trends Program to the TRC on October 3rd, 2006. This overview emphasized results of water column and sediment toxicity studies. These studies show that sediments of the Estuary continue to demonstrate persistent toxicity, and that greater toxicity is observed in winter months relative to summer months. Results also show that water column toxicity is less common in tributaries of the Estuary than in the past, and this is thought to be due to decreased use of organophosphate pesticides, which has coincided with the increased use of more hydrophobic pyrethroid pesticides. One hypothesis is that instances of sediment toxicity in tributaries may be increasing with the increased use of pyrethroid pesticides.

The TRC has acknowledged there is a need to identify the causes of sediment toxicity in the Estuary, and this goal can be best achieved by conducting TIEs. Because greater sediment toxicity is observed in winter months, and contaminants are thought to enter the system via stormwater in tributaries, sediments collected during the rainy season from the mouths of tributaries should demonstrate the greatest toxicity. Because TIE results are easier to resolve using highly toxic sediments, TIEs should be conducted using samples collected during the winter near the mouths of toxic tributaries.

Sarah Lowe presented a preliminary proposal to conduct sediment TIEs, chemical analyses, and benthic community surveys at the mouth of selected tributaries entering the Estuary. The original presentation combined two study proposals: the sediment TIEs with a benthic invertebrate project recently funded by the Exposure and Effects Pilot Study (EEPS) under the direction of Bruce Thompson (SFEI). The study was designed to use sediment TIEs to identify the causes of toxicity, and to determine whether sites with persistent sediment toxicity due to specific chemicals, also demonstrated degraded benthic community structure. Studies were to be conducted at sites with a gradient of sediment contamination and toxicity, and the larger goal of the proposal was to combine sediment quality triad studies with TIEs in order to evaluate the sediment quality objectives being proposed by the State Water Resources Control Board.

The TRC discussion of the combined proposals diverged on several related topics. One conclusion was that due to the difficulties of identifying simple contamination and toxicity gradients in the system, the goal of combining sediment TIE studies with benthic community studies is premature, and that the proposal should be revised to emphasize determination of the causes of sediment toxicity as a first step. Once successful TIEs have been completed at specific

sites, the TRC suggested that sediment triad and TIE studies designed to evaluate the SWRCB's sediment quality objectives could be conducted as a later phase of the project.

The TRC requested that SFEI present the revised proposal (and background information) to the EEPS toxicity workgroup participants, other interested parties, and Lester McKee (SFEI's Watershed Program Manager) for comments and recommendations on our revised study design.

Based on the Toxicity Workgroup review and comments (see below), SFEI has updated the following proposal and is presenting it to the TRC December 19th 2006 meeting for review and approval.

Toxicity Workgroup comments:
The Toxicity Work Group[1] (WG) met on Monday November 27th to review and comment on the updated sediment TIE Study proposal (revised to focus on what is causing persistent sediment toxicity in Bay sediments per TRC request in October-2006).

The WG endorsed the overall proposal and agreed that it makes sense to focus on the standard 10-day amphipod test using *Eohaustorius estuarius* and the margins of the Estuary in the winter when sediments tend to be more toxic to amphipods than in the summer. The WG heard a summary of the proposed TIE methodology (by Brian Anderson of UC-Davis) and agreed that the TIE methods are well developed for this study. The TIE methods include all three phases of a TIE. They also said that the study design is consistent with what has been proposed in the past to address the persistent toxicity observed in the S&T program. Several people would like to participate in the development of the sampling site list. The WG wants us to develop site selection criteria and a prioritized short-list of possible sites based on previous Bay-margin and tributary studies around the Estuary (e.g. CEP – Analysis of Bay Area Urban Creeks (2005), BPTCP – Sediment quality & Biological Effects In San Francisco Bay (1998), Surface Water Ambient Monitoring Program –Region 2 (SWAMP), etc.). This will be incorporated into the Study development process and the WG (and TRC) can review and assist in narrowing the list to twelve sites.

[1] The toxicity WG participants include: Inge Werner, Don Weston, Bruce Thompson, Karen Taberski, Bryn Phillips, Scott Ogle, Sarah Lowe, Michael Kellogg, Patrick Conroy, John Hunt, Any Gunther, Jay Davis, Chris Sommers, and Brian Anderson (& special review by Lester McKee per TRC request). All participants were provided background information about the project, the current 2007-2008 proposal, and the TRC minutes from the October-2006 meeting. (Not all ToxWG members participated in this meeting.)

RMP proposal 2007-2008: Using Toxicity Identification Evaluation (TIE) methods on estuarine sediments to investigate causes of sediment toxicity to amphipods in the Estuary.

Long-term Study Goals (includes components beyond the scope of the this proposal)
The long-term goals of this study are to locate sites within the Estuary that have sediments that are highly toxic to estuarine amphipods, use TIEs to determine the causes of sediment toxicity, and combine TIEs with sediment quality triad studies to evaluate SWRCB sediment quality objectives for the San Francisco Estuary. This current proposal only includes tasks 1 and 2 below.

1. Conduct screening to locate estuarine stations at the mouths of tributaries (near the margins of the Estuary), which have persistently toxic sediments: evaluate temporal variability of sediment toxicity during the winter at the most toxic stations.
2. Conduct phased sediment TIEs at the stations demonstrating the greatest magnitude of toxicity to identify the causes of sediment toxicity
3. Identify locations within the Estuary with distinct horizontal sediment contamination and toxicity gradients.
4. Conduct sediment quality triad studies, and TIEs, at gradient sites to evaluate the SWRCB sediment quality objectives for the Estuary.

2007-2008 Proposal (includes *only* tasks 1 & 2 outlined above)

January-March 2007: Locate Toxic Stations and Conduct TIEs

1. Develop the short-list of potential sites for sediment TIEs

SFEI will work with the interested Toxicity Workgroup and TRC participants to develop site selection criteria and create a prioritized short-list of at least 12 sites in the Estuary margins that could be evaluated for the phased sediment TIE study. The site selection criteria and development and prioritization of the short-list will draw on previous Bay-margin and tributary studies around the Estuary (see studies mentioned in "Toxicity Workgroup comments" above) and best professional judgment of the group.

2. Locate toxic stations and conduct TIEs

The study will proceed incrementally in the late winter of 2007 (February-April). The first step will be to screen the first four prioritized sites from the short-list. Bedded sediment will be collected and initially analyzed for toxicity to *E. estuarius* (standard 10-day survival test), and sediment quality characteristics only. Assuming that more than one site is significantly toxic (survival < 50 % of control), the two most appropriate sites (e.g., highest magnitude of toxicity, fewest confounding factors) will be re-sampled for the TIE study, sediment chemistry (RMP Status and Trends Program analyte list plus pyrethroids), and to assess duration of the observed toxicity. These sites may be re-sampled a third time to assess duration of toxicity (resulting in up to 8 possible toxicity samples).

The TIE study at the two most toxic stations identified in the initial screening (above) will be conducted on estuarine sediments using *E. estuarius*. Bulk sediment and porewater tests will be conducted side-by-side in a phased approach (Phase I characterization, II identification, and III confirmation) to determine the potential causes of the observed toxicity.

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If none of the four sites sampled in the initial screening are appropriate for TIEs (i.e., survival not < 50% of control), a second set of four sites listed on the prioritized short-list will be sampled. The two most appropriate sites from this second screening effort will be re-sampled for the TIE study and sediment chemistry analyses. No additional samples will be collected to assess duration.

If none of the eight sites sampled in 2007 are appropriate for the sediment TIEs, the TRC will be consulted to confirm the use of the 2008 funding.

Winter of 2008: Additional Site Screening and TIEs

If none of the eight sites screened in 2007 are appropriate for the sediment TIEs, four additional sites from the prioritized short-list will be sampled during late winter 2008. If up to two sites are appropriately toxic (as described above), up to two TIEs and sediment chemistry analyses will be conducted as described above.

Budget

	2007 Study $86,825		2008 Addition $9,746	
	Total Samples	Cost ($)	Total Samples	Cost ($)
Project and Data Management (SFEI)		**$ 12,000**	<--	<--
Logistics and Sampling	**8**	**$ 8,000**	4	**$ 4,000**
Sediment Analyses				
Trace Elements				
Al, Ag, As, Cd, Cu, Fe, Pb, Mn, Ni, Se, Zn	**2**	**$ 890**	<--	<--
Sediment Quality and Mercury		**$ 5,115**		**$ 1,936**
TOC, Grainsize	**10**		4	
Hg, MeHg	**2**		<--	
Organics		**$ 12,500**		<--
PAHs, PCBs, Pests, PBDEs, Pyrethroids, PBO	**2**		<--	
Sed TIE (chemistry)	**2**		<--	
Sediment Toxicity		**$ 48,320**		**$ 3,810**
Sed Tox (E. estuarius 10d)	**8**		4	
Sed TIE (amphipod toxicity)	**2**		<--	
Sed TIE sample collection	**2**		<--	

Total Estimated Cost 2007 - 2008	**$ 96,571**

<-- Indicates that budget from 2007 will be used in 2008.

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Episodic Toxicity Funding 2004 – 2008

At the October 2006, TRC meeting, it was requested that a summary of Episodic Toxicity Monitoring Program spending in recent years be provided.

Status and Trends - Episodic Toxicity Monitoring Program - Annual Allocation: $140K

Spending in Recent years:

•2004:	$75K	PRISM/EpTox tributary study - sediment chemistry and toxicity
•2005:	$8K	Aquatic Toxicity Screening in 5 tributaries (April – 2005)
•2006:	none	
•2007 - 2008:	$154,100	Sediment TIE Study proposal
	$49K	Site selection
	$61K	Sediment TIEs & sediment chemistry
		Three phase testing on bulk sediment & porewater
		Full suite of RMP sediment contaminants in 4 samples
	$44K	Contingency