Date: April 25, 2007
To: CEP Executive Management Board
From: Bryan Bemis, CEP Staff
Subject: Draft Progress Report on Project 4.26

The purpose of this report is to update the EMB on the progress of CEP Project 4.26 (Multi-Box Contaminant Transport Model and Multi-Year Sediment Sampling Strategy). The Detailed Scope of Work for Project 4.26, which was approved by the Technical Committee (TC) in February 2005, described six technical tasks. The status of each task is summarized below.

Task 1. Prepare Documentation for USGS Sediment Transport Model and Augment Model Output (USGS)

Background:

- Under Task 1, the USGS will prepare a report that fully documents the sediment transport model that provides the basis for the PCB multi-box model.

Completed Deliverables:

- None

Remaining Deliverables:

- The draft report is expected September 15, 2007.
- The final published report is expected March 1, 2008.

Problems:

- Until March 2007, an administrative mechanism to contract with the USGS to conduct Task 1 had not been found.

Details:

- In March 2007, BACWA approved a Joint Funding Agreement (JFA) with the USGS to conduct this task. The contract was signed April 2007, with a start date of April 1, 2007.

Task 2. Model Verification, Initial Calibration, and Development of Performance Criteria (SFEI)

Background:

- The purpose of Task 2 (Create Graphic Output) was to provide graphical output for PCB Multi-box Model Version 1, so that the results could be communicated to a wide audience.
- In September 2005, the Contaminant Fate Work Group (CFWG) recommended that SFEI perform additional model calibration before conducting the sensitivity analysis (Task 3). Based on the CFWG recommendation, in November 2005 the TC approved amending the Detailed Scope of Work by substituting a new Task 2 (Model Verification, Initial Calibration, and Development of Performance Criteria) for the previous Task 2. There was no cost amendment for this change.

Completed Deliverables:

- Additional model calibration is complete.

Remaining Deliverables:

- None

Problems:

- None.

Details:

- Recommendations made in Tetra Tech, Inc. (2005) and by the CFWG were addressed by SFEI and documented in Oram et al (2006). This effort included improving model performance through model calibration exercises.
- The updated model code, along with the newly developed model documentation, was delivered to Tetra Tech in April 2006 to start the next round of testing. Tetra Tech and SFEI worked closely developing performance criteria to be used during testing. 10,000 model simulations were made in a Monte Carlo-type framework and analyzed by Tetra Tech. Results were summarized in Tetra Tech, Inc. (2006) and presented to the CFWG in October 2006.

References:

Oram, JJ, Leatherbarrow, JE, and Davis, JA. (2006). Multibox PCB Model Documentation v2.0b. An internal RMP/CEP technical report. San Francisco Estuary Institute, Oakland, CA.

Tetra Tech, Inc. (2005). Results of Independent Testing of SFEI's Multibox Model for PCB Fate and Transport. A draft technical report prepared for the Clean Estuary Partnership by Tetra Tech, Inc., Lafayette, CA.

Tetra Tech, Inc. (2006). Uncertainty Analysis of SFEI's Multibox Model for PCB Fate and Transport in San Francisco Bay. A draft technical report prepared for the Clean Estuary Partnership by Tetra Tech, Inc. Lafayette, CA.

Task 3. Conduct Initial Testing of SFEI PCB Model and Conduct Uncertainty Analyses (SFEI/Tetra Tech)

Background:

- In Subtask 3.1 (Review and Test Model), the model verification and calibration efforts by SFEI will be independently reviewed.
- In Subtask 3.2 (Conduct Sensitivity Analyses), sensitivity analyses will be conducted to identify the parameters and processes that that are most important in determining the model outcome. The sensitivity analysis results will be used to identify the uncertainties in our understanding of the system as well as the performance of the model.
- Based on the work from Subtasks 3.1 and 3.2, PCB Multi-box Model Version 2.0 will be produced.
- Documentation of Version 2.0 will include draft and final technical reports. The technical reports will be prepared to summarize the results of both the model testing and the sensitivity/uncertainty analyses conducted in Task 3.

Completed Deliverables:

- PCB Multi-box Model Version 2.0b was produced.
- The model was reviewed and tested by Tetra Tech.
- Sensitivity and uncertainty analyses are complete.

Remaining Deliverables:

- The draft technical report will be sent to the CFWG prior to their May 2007 meeting.
- The final technical report is expected August 2007.

Problems:

- Recoding the sediment and PCB modules to include the updates developed by the USGS to the sediment transport module was a significant task that took nearly two months.
- The CFWG determined that Tetra Tech's testing of the model was not a true uncertainty analysis. To address this issue, SFEI used model simulations made as part of Tetra Tech's testing to analyze uncertainty in a more classical Monte Carlo approach.

Details:

- A draft report (Leatherbarrow et al, 2005) was released February 2005 documenting version 1.0 of the multibox PCB model. The report was distributed to the CEP and the RMP Contaminant Fate Workgroup (CFWG) for review. A number of comments were received. These comments were not formally addressed, however, because at the same time Dave Schoellhamer (USGS) released an updated version of the sediment transport module. Given that the PCB module is dependent on the sediment module, energy was focused on recoding the sediment and PCB modules to include the updates developed by the USGS. The updated code was named version 2.0b.
- Version 2.0b of the multibox code was delivered to Tetra Tech in April 2005 for independent testing. Tetra Tech conducted tests to verify general plausibility of model results and to verify correct functionality of model code. Findings were summarized in a document released September 2005 (i.e., Tetra Tech, Inc. (2005)).
- A CFWG meeting was held in September 2005 to discuss the findings of Tetra Tech's independent testing. Workgroup members commented on the findings and a strategy for addressing the findings was developed. In short, it was decided that SFEI address issues deemed critical by the CFWG and produce a report explicitly documenting all equations and updates.
- A CFWG meeting was held October 30, 2006 to discuss the results of Tetra Tech, Inc. (2006). Workgroup members commented verbally during the meeting. Comments were captured in the meeting minutes and posted to the RMP website. A key workgroup comment was that the Tetra Tech testing was not a true uncertainty analysis in that it 'did not quantify the aggregate uncertainty of model predictions that result from uncertainties in model inputs'. It was agreed, though, that the 10,000 simulations made as part of the testing could be analyzed in a more classical Monte Carlo Analysis to answer this question.
- In January 2007, SFEI staff focused on quantifying the aggregate model uncertainty using a classical Monte Carlo approach, using the 10,000 simulations already made as part of Tetra Tech's testing. In addition, sensitivity analyses were performed on the key PCB and sediment transport related model parameters. Results of these analysis are being documented in draft and final technical reports.

References:

Leatherbarrow, JE, Oram, JJ, and Davis, JA. (2005). Draft Report: A Model of Long-Term PCB Fate and Transport in San Francisco Bay, CA. SFEI Contribution #388. San Francisco Estuary Institute, Oakland, CA.

Tetra Tech, Inc. (2005). Results of Independent Testing of SFEI's Multibox Model for PCB Fate and Transport. A draft technical report prepared for the Clean Estuary Partnership by Tetra Tech, Inc., Lafayette, CA.

Tetra Tech, Inc. (2006). Uncertainty Analysis of SFEI's Multibox Model for PCB Fate and Transport in San Francisco Bay. A draft technical report prepared for the Clean Estuary Partnership by Tetra Tech, Inc. Lafayette, CA.

Task 4. Conduct Sediment Sampling and Testing (AMS/SFEI)

Background:

- In Subtask 4.1 (Sediment Sampling Design), existing data will be used to design the initial field-sampling program.
- In the original Detailed Scope of Work, the CEP TC and the RMP TRC were to review and accept the final technical report from Task 3 prior to conducting the sampling described in Task 4.2 (Initial Sediment Sampling). However, in February 2006 the EMB approved moving ahead with sediment sampling without waiting for the TC to review the results of the sensitivity analysis.
- In Subtask 4.3 (Design of Expanded Sediment Sampling), the results of the initial field sampling and laboratory measurements will be analyzed. Particular attention will be placed on evaluating the use of these data to support the decision-making process by furthering the understanding of the basic processes that control pollutant fate and transport in the Bay. If it is determined that additional sampling will make substantial contributions to the modeling effort and overall water-quality management capabilities, additional sampling will be planned. If it is determined that additional sampling would not make a substantial contribution, the sampling program would be halted.
- In Subtask 4.4 (Expanded Sediment Sampling), the expanded sampling program, if selected, will be conducted.

Completed Deliverables:

- The Sampling and Analysis Plan was completed and approved by the TC.
- All field sampling has been completed, including collecting sediment cores from 11 Bay sites (with replicates) and six wetland sites.
- Additional shallow push cores collected from the Bay sites have been dated using short-lived radioisotopes (^{234}Th).
- All lab contracting for chemical analyses is in place.

Remaining Deliverables:

- Radiometric dating of the sediment cores is underway. Dating results are expected September 2007 for the Bay cores and December 2007 for the wetland cores.
- Chemical analyses of the sediment cores will begin after radiodating is completed. This will allow the appropriate depth intervals to be sent to the labs for analysis. Chemistry results are expected March 2008 for the Bay cores and June 2008 for wetland cores.
- Data QA and analysis will be implemented when chemistry results are delivered to SFEI, and are expected to be completed September 2008.
- A draft technical report on the sediment sampling results is expected October 2008.
- A final technical report on the sediment sampling results is expected December 2008.
- Design of expanded sediment sampling has not been implemented.
- Expanded sediment sampling has not been implemented.

Problems:

- During the Bay coring cruise in May 2006, sampling personnel experienced several issues that delayed the sampling schedule, including repeated failures of the vibracore generator, a fouled propeller on the boat, and illness of the boat captain. This required a second Bay cruise in July 2006 to complete sampling of the remaining Bay sites.
- Collecting the wetland cores took longer than anticipated. There were problems identifying appropriate sites in old high-elevation marsh, obtaining coring equipment (Livingston corer), determining access and permission issues regarding the sites, and determining the core length to

collect at each site, based on sedimentation rates. To assist with collecting the cores, AMS hired Dr. Elizabeth Watson (UC Berkeley), who has extensive experience coring wetland sites throughout the San Francisco Bay.

- Radiometric dating of the cores is taking longer than anticipated. In the SAP, it was estimated that initial and follow-up dating of all 17 cores would take three months. However, because the samples are being dated in a small lab that can process samples in only small batches, the total dating time will be closer to 12 months. Samples cannot be sent out for chemical analyses until the radiometric dating results allow AMS and SFEI to identify core intervals of the appropriate ages. To streamline this as much as possible, samples will be dated and analyzed for chemistry in groups to keep the labs continuously fed with samples.
- Chemical analyses will take longer than anticipated. The SAP estimated that the labs could analyze all samples in four months. However, EBMUD estimates a turnaround time of six months for samples. And because samples from the Bay and wetland cores will need to be sent separately due to delays in radiodating, it is estimated that it will take until June 2008 to receive the last results from chemical analyses.

Details:

- In February 2005, the Scope of Work for Project 4.26 was approved.
- During its November 2005 meeting, the CEP Technical Committee approved a second draft of the SAP as an acceptable and technically sound product for completing the original Scope of Work as written, with the stipulation that it be made clear to the EMB that, due to the timing of this project, the SAP is designed to assist with implementation issues, not development of TMDLs over the short term. The TC did not decide if the sensitivity/uncertainty analysis should be completed prior to implementation of the SAP.
- During its February 2006 meeting, the EMB approved moving ahead with sediment coring without waiting for the Technical Committee to review the results of the sensitivity analysis.
- During May 2006, AMS conducted a four-day coring cruise to collect sediment cores from Bay stations identified in the SAP.
- During July 2006, AMS conducted a second four-day coring cruise to collect the remaining sediment cores from Bay stations.
- From mid November to mid December 2006, AMS cored the wetland sites.
- In February 2007, AMS processed and shipped two intervals from each of the 11 Bay vibracores to Doug Hammond (USC) for the initial round of radiodating.

Task 5. Apply Multi-Box Model to Other Pollutants

Background:

- Under Task 5, the PCB Multi-box Model Version 2.0 will be modified and used to evaluate the fate of other pollutants.
- This task will only be implemented with future CEP and RMP Committee approval.

Completed Deliverables:

- None

Remaining Deliverables:

Problems:

Details:

Task 6. Plan Next Generation of Sediment and Pollutant Transport Models

Background:

- Under Task 6, a final report will assess the efficacy of the multi-box model as a tool for calculating assimilative capacity for TMDLs and evaluating projected rates of recovery associated with specific load reductions. The report will also provide a guide for the expected benefits of more complex models to the overall goal of effective management of the water quality and beneficial uses of the Estuary. Potential costs will also be evaluated to determine if future generations of models (enhanced models) are cost effective.
- This task will only be implemented with future CEP and RMP Committee approval.

Completed Deliverables:

- None

Remaining Deliverables:

Problems:

Details:

Table 1: Key milestones and revised schedule for Project 4.26.

Milestone	Subcontractor	Start Date	Completion Date
Detailed Scope of Work			2/05
Task 1. Prepare Documentation for USGS Sediment Transport Model and Augment Model Output	USGS	4/1/07	**3/1/08**
Draft Report			**9/15/07**
Final Published Report			**3/1/08**
Task 2. Model Verification, Initial Calibration, and Development of Performance Criteria	SFEI	11/05	4/06
Subtask 2.1 Address Key Recommendations Set Forth by Initial Independent Model Testing			
Update Model Documentation		1/06	4/1/06
Review and Modify Input Data		1/06	4/1/06
Subtask 2.2 Improve Model Performance			
Report		1/06	4/1/06
Subtask 2.3 Define Set of "Performance Criteria" to Be Used in Task 3.2		3/06	4/31/06
Task 3. Conduct Review and Testing of PCB multi-box Model	SFEI/Tetra Tech	11/05	**8/07**
PCB multi-box 2.0 Draft Technical Report		1/07	**5/07**
PCB multi-box 2.0 Final Technical Report		5/07	**8/07**
Task 4. Conduct Sediment Sampling and Testing	AMS/SFEI	2/05	**TBA**
Subtask 4.1 Sediment Sampling Design		2/05	11/05
Draft Sediment Sampling Design		2/05	9/05
Final Sediment Sampling Design		9/05	11/05
Subtask 4.2 Initial Sediment Sampling		2/06	**12/08**
Sediment Study Year 1 Draft Technical Report		**9/08**	**10/08**
Sediment Study Year 1 Final Technical Report		**10/08**	**12/08**
Subtask 4.3 Design of Expanded Sediment Sampling		***TBD**	***TBD**
Draft Sediment Sampling Design			
Final Sediment Sampling Design			
Subtask 4.4 Expanded Sediment Sampling		***TBD**	***TBD**
Sediment Study Year 2 Draft Technical Report			
Sediment Study Year 2 Final Technical Report			
Task 5. Apply SFEI multi-box Model, Other Pollutants		***TBD**	***TBD**
Task 6. Plan Next Generation of Sediment and Pollutant Transport Models		***TBD**	***TBD**

* Tasks will only be implemented with future CEP and RMP Committee approval