

North San Francisco Bay Selenium Total Maximum Daily Load
Advisory Committee
DRAFT MEETING SUMMARY
Meeting No. 3
September 16, 2008

1. Welcome

Dave Ceppos, California State University Sacramento, Center for Collaborative Policy (CCP), opened the meeting for the North Bay Selenium (Se) Total Maximum Daily Load (TMDL), welcomed participants, reviewed the agenda and went over the handouts. Mr. Ceppos explained that for each agenda item he would be taking comments from the Advisory Committee (AC) members first, and then non-AC members.

Draft Numeric Targets

Barbara Baginska, San Francisco Bay Regional Water Quality Control Board (Water Board), Project Manager started things off with a PowerPoint presentation. The purpose of the presentation was to explain how a proposed numeric target has been derived and to hear feedback on the target value. To view the presentation, please go to:

http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/seleniumtmdl.shtml. The following slides were the focus of most of the comments and questions posed by the Advisory Committee during the presentation.

 Slide 13, "Target Development Approach"

- i. The comprehensive review of fish and avian Se toxicity studies, detailed in Technical Memorandum 3, was a starting point for the development of the numeric target. The factors that influenced the proposed target value also included the availability of the local data, site-specific conditions, toxicity mitigating factors, and a focus on the species that might be particularly at risk in the North San Francisco Bay (NSFB).

 Slide 15, "Diving Ducks Exposure in NSFB"

- i. The conditions in the Bay may have lesser than expected impact on diving ducks. In 2005-2006, twenty three female scoters from the Bay area were marked with satellite transmitters and their migration was tracked to their breeding areas (*Wainwright-De La Cruz, USGS, pers. comm.*). Eleven fresh eggs were collected from three nests of the marked birds. The concentrations of selenium in these eggs were well below those

thought to be of concern for these and other sensitive bird species.

✚ Slides 16 and 17, "Toxicity Thresholds in Fish" & "White Sturgeon"

- i. The Water Board has focused on fish because selenium concentrations in fish tissue best reflect the relationship between exposure and toxic effects. In addition, selenium toxicity in the NSFB is more pronounced in benthic-based food webs, as is the case for fish. Among all fish species in the NSFB the Water Board identified white sturgeon as potentially the most affected fish.
- ii. The studies listed on slide 16 represent toxicity experiments in freshwater. For the purpose of the presentation, the results are focused on the data for juvenile fish only and when more than one study was available the more stringent results were shown.

✚ Slide 21, "Numeric Target Derivation"

- i. The Water Board is using the "no effect" concentration (NEC) concept in developing the target. The approach used to establish a numeric target is similar to the process proposed for determining the objective for avian egg selenium for the Great Salt Lake, as well as used in development of water quality criteria by the EPA.

Additional Questions and Comments from the AC:

Question: *What about green sturgeon as a toxicity target? They could be more sensitive; have you considered that?*

- ✚ Ms. Baginska said that yes, the Water Board has considered the green sturgeon, but that they do not have enough data to draw conclusive results. She explained that the numeric target derivation focused on the most sensitive fish and toxicity endpoints. The use of the NEC approach and consideration of mitigating factors (Slide 13) provide the required margin of safety for the proposed target and makes it protective of other fish species. If data become available, the Water Board is open to rethinking the proposed value for the target and the target species.

Discussion followed:

- o AC: The target should reflect uncertainty.
- o Tom Mumley, Water Board Assistant Executive Officer responded that an uncertainty factor would be understandable, but also raised the question of the basis for such a factor: should it be a factor of 10 or a 100? He stated that Water Board's efforts are intended to be consistent with the Federal

process underway for Se and that the Federal process should address the uncertainty concerns.

- Naomi Feger, Water Board, Planning & TMDL Section Leader, asked for more clarification as to what is different with green sturgeon compared to the white sturgeon such that it should be a target species?
 - William (Bill) Beckon, US Fish and Wildlife Service (USFWS), responded that there is likely variation in sensitivity between sturgeon species. We just don't know with green sturgeon, but it is likely they are more sensitive. But how much, we don't know.
- Tom Grieb, Tetra Tech requested more detail: What's the basis for thinking the green sturgeon could be more sensitive?
 - Mr. Beckon responded that the green sturgeon is rarer and its current limited population is likely related to environmental impacts. As such, it is a likely hypothesis that green sturgeon are more sensitive.

Question: *[In reference to slide 21 "Numeric Target Derivation" and the geometric mean of boundary concentrations] If there is no effect with $4\mu\text{g/g-dw}$ can you explain where that number came from?*

- ✚ In response, Ms. Baginska said that over the years there have been reviews of toxicity information. Threshold levels indicative of health effects and reproductive success of freshwater and anadromous fish were identified by Lemly and others. Agencies such as USGS, F&WS and BOR also use similar thresholds to interpret effectiveness of mitigation measures. Lemly and others indicated that a concentration of selenium exceeding 4 mg/kg-dw in fish may signify impairment. Ms. Baginska then reiterated (see slide 21) the need for the numeric target to be more protective than EC10 in sensitive environments and reviewed the approach used to compute the target.
- ✚ Rudy Rosen added to the discussion by saying that scaup and scoter are in decline and it is serious. He did not see an indication that this problem had been addressed in the presentation. Ducks Unlimited (DU) and others are having a hard time figuring out what is impacting scaup populations. The numbers of scaup in the winter are of great concern. Maybe the Water Board should begin touching base with DU folks who are working on this problem.
 - Ms. Baginska requested a contact to follow up with Mr. Rosen. She went on to note that so far no selenium related effects have been seen in the NSFB. She stated that the Water Board has spoken with John Takekawa of USGS who has been focusing his research on toxic effects of mercury and selenium on waterfowl such as scaup to obtain more information. Finally, Ms. Baginska also pointed out that while we are concerned about the declines in these species, the

interpretation of the decline of specific bird populations goes beyond the scope of this TMDL project.

- ✚ Mr. Rosen responded that there is an effect and that declining scaup numbers are being talked about nationally. He thought Ms. Baginska said there was a measured effect given the Se level. He said he was confused as there should be an effect. Mr. Rosen will provide names of experts that are familiar with this information.
 - Ms. Baginska responded that yes, the Water Board has historical documentation of physical effects in birds from elsewhere [Kesterson Reservoir], but those drastic effects have not been observed in the NSFB.

Questions: *The 303d listing includes human consumption of scaup and scoter (diving ducks). Therefore how did sturgeon get included in this analysis? In reference to the human health impacts, how many people are eating sturgeon? Please share more information on the reproductive concerns with sturgeon. Was it Se leading to reproductive impacts or reproductive impacts leading to Se concerns? Are we really focusing on reproduction issues for sturgeon or are we looking at draft criteria?*

- ✚ Ms. Baginska responded that the rationale for 303d listing of the North Bay segments also mentions beneficial uses of the impaired water body and includes habitat conditions. As part of this TMDL, the Water Board will consider selenium concentrations in tissue of diving ducks and fish, as well as water column concentrations in relation to human health and wildlife habitat.

Question: *Is there any surrogate, non-native species you can use?*

- ✚ Ms. Baginska responded that using surrogates [for monitoring] is possible but challenging. Different fish tissue may not accumulate Se at similar levels. Different species may have different life cycles and habitats that are not comparable to sturgeon. How easy or difficult it will be to measure is unclear and the Water Board is looking at this.

Comment: *Diane Fleck stated that regarding the recent data from the arctic breeding grounds of scoter, there is an inherent uncertainty with only eleven eggs in a data set. The US Environmental Protection Agency (EPA) is using a different process to assess Se impacts on migratory waterfowl*

- ✚ Ms. Baginska said that the Water Board was excited about the eleven eggs, despite the fact that they are few in number, because even six months ago they didn't have that information. Studies like the egg study are not conclusive but they add to the body of data and increase our understanding of the problem. The Water Board takes into consideration all available data in order to provide the best scientific basis for this project.

- Mr. Beckon added that considering the egg data is a good step. His recollection was that there had been work that had shown that there are elevated Se levels in eggs where San Francisco Bay birds breed. Somehow they got Se. Until there is more data from more birds, room for consideration of uncertainty is needed. What about their condition when they migrate?
- Mr. Rosen commented that waterfowl have a tendency to go to places that are bad for them, and this needs to be accounted for when assessing impacts to the species.
- Ms. Baginska closed the discussion by explaining that the Water Board has also tried to compare concentrations in the San Francisco Bay with those in the Central Valley, where the TMDL has led to some successes in decreasing levels of selenium.

Comments from the Public:

There were no comments from the public.

Additional Questions and Comments from the AC:

Question: Please provide more clarification on the results of the experimental studies.

- ✚ By using the information from toxicity studies conducted in freshwater, whereas the NSFB is brackish, we are potentially making this target more stringent.

Question: Your target is 6 µg/g for fish [Slide 22]. What fish would that apply to?

- ✚ The details of monitoring to demonstrate attainment of the target has not yet been determined. What species the monitoring should focus on is still something that needs to be discussed – white sturgeon are the likely candidate species.

Question: Have you considered water column values and the translation of the toxicity and bioavailability in the water column?

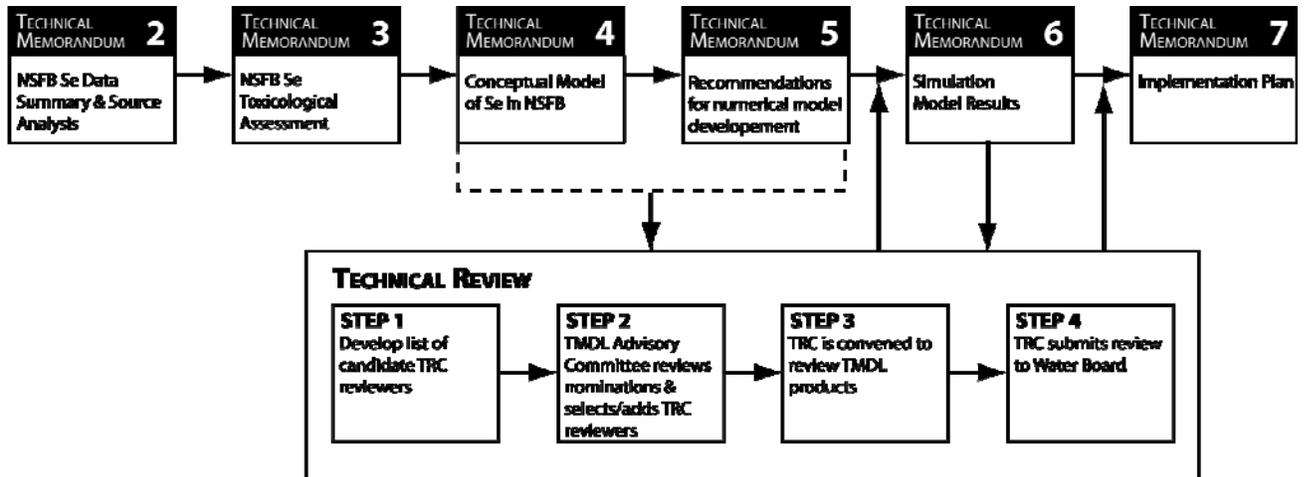
- ✚ It is anticipated that this issue will be considered during model simulations.

BREAK

3. Technical Review Committee (TRC) Meeting Outcomes

Tom Grieb, Tetra Tech (Tt), gave a PowerPoint presentation reviewing the May 30, 2008 meeting of the Technical Review Committee. The purpose of the TRC meeting was to evaluate Technical Memoranda (TM) 4 and 5. TM4 is the conceptual model report. TM5 makes a recommendation for the modeling approach. A key objective was to have the TRC members ensure that the

technical basis of the project, key decisions and assumptions were technically sound. Dr. Grieb reviewed the process with the following diagram:



Dr. Grieb explained how Tt has addressed the key reviewers' comments (shown in *italics* below).

1. You need to make distinction between uncertainty and variability – you are stating uncertainties without context of the larger body of knowledge

- Tt response: There's a section in the conceptual model that addresses this.

2. A balanced approach is needed in interpretation of the data

- Tt response: They felt only one interpretation of the data was given; this has been expanded and will be addressed further in the revision.

3. There is concern that biological explanations for observed conditions are not adequately explored, e.g., the difference in the phytoplankton community could result in differences in Se uptake by bivalves

4. Key questions and scenarios are not identified

- Tt response: This was particularly in regards to TM5. TM5 was intended to give a review of the available models and their pluses and minuses.

5. There should be further exploration of the extent and mechanism of uptake of each of the forms of Se, e.g., dissolved organic selenides

- Tt response: The TM now addresses dissolved organic selenides further.

6. Additional references and sources of information should be provided

- Tt response: Some additional references have been incorporated; these documents will be revised further to include additional information.

Dr. Grieb went on to explain that TRC member Dr. Sam Luoma of USGS could not make the TRC meeting and so Tt and Water Board spoke with him by phone from London on September 11, 2008. He summarized his comments on TM4 and 5, and indicated that, although there were still remaining issues, some dealing with the discussion of assumptions and uncertainties, some dealing with the tone of the documents. He thought that many of his comments could be addressed through some editorial changes. Since the time of the phone call, Dr. Luoma has provided written comments on the revised documents. Tetra Tech will make additional modifications to TM4 and to a lesser extent on TM5 to address Dr. Luoma's comments. Tt also talked to Dr. Luoma about participating in a one or two day session as Tt runs the model and addresses the various scenarios. He was supportive of the idea.

Questions and Comments from the AC:

Question: *Regarding the USGS data. Has any progress been made in getting our hands on that data [2001-2003 bivalve data]?*

- ✚ Tt: Tt has requested that data but it is difficult to get right now since the results have not been published. One approach may be for the USGS to send a memo with some of the data so that it could be used in the TMDL. Tt is working with USGS scientists on this.
- ✚ AC: I understand their concerns, but how can this project find a way to have the benefit of this data without (USGS) giving too much?
 - Tt: Personal communication has been the method used thus far – it is possible and we are working on that.

Ms. Baginska explained what would happen next with the technical review process.

- The reports have been revised
- Additional revisions will be made to address Dr. Luoma's concerns
- TM 4 and TM5 will be posted on the Se TMDL project website as soon as the draft reports are finalized.

Question: *Mr. Ceppos (facilitator) reiterated a question asked of him by an AC member regarding if and how technical memorandums will be finalized. Will they always be interim since they aren't required?*

- ✚ Ms. Baginska responded that until all work on the TMDL is complete it is possible that additional small changes could be made, but as the project comes to completion the documents will become de-facto, final.

Comments from the Public:

There were no comments from the public.

4. Conceptual Model

Sujoy Roy, Tetra Tech, gave a PowerPoint presentation entitled "Selenium in North San Francisco Bay: Conceptual Model and Recommendations for Numerical Model Development." To view the presentation please go to:

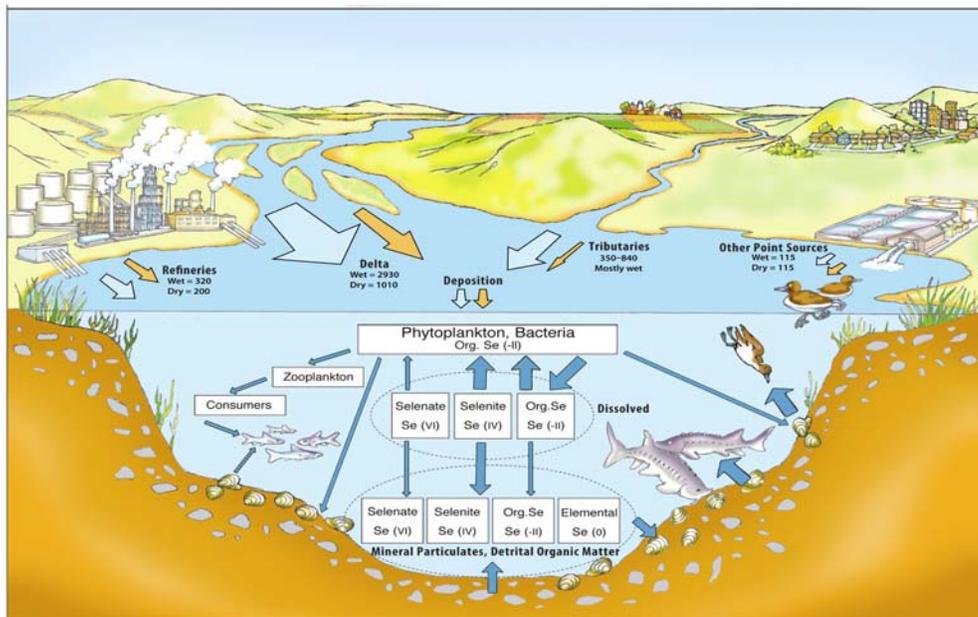
http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/seleniumtmdl.shtml. Objectives included:

- Explain important Se-related processes, and lay out broad areas of agreement in the scientific literature.
- Summarize spatial and temporal trends in Se data, with a focus on concentrations in bivalves, waterfowl and fish, so that they can be compared against toxicological and health-based guidelines.
- Highlight data gaps and uncertainties of relevance to the TMDL.
- Guide the development of a numerical model that is proposed to be used to link Se sources (quantified in TM2) to biota.

His presentation covered:

- A summary of processes in the
 - Water column; Sediments; Phytoplankton/bacteria; Fish and birds
- Recent data from North San Francisco Bay (NSFB)
- Recommendations for numerical model development

The presentation included this depiction of Selenium Cycling in the NSFB:



Questions and Comments from the AC:

Questions were taken throughout the presentation. (There are a couple of key slides that deserve additional attention and are noted below but do not initially have questions attached to them)

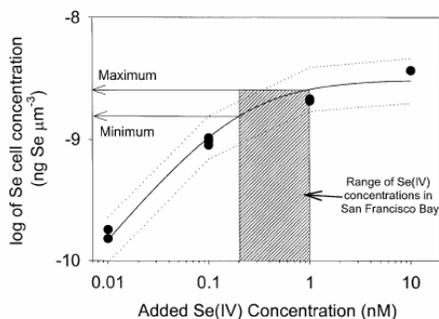
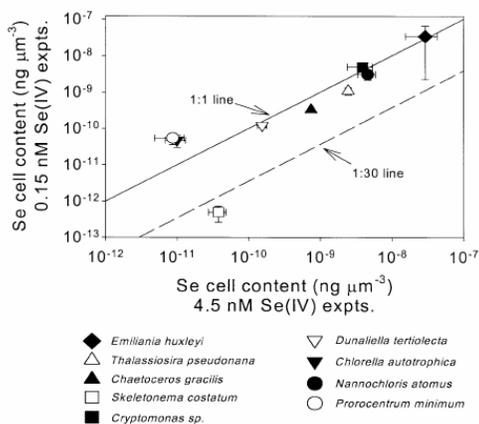
Question: *Michelle Pla asked about Se in the sediment; it could come from bed sediment. It could be both bed sediment and local tributaries. This was of interest at the last meeting and it could be significant. It could be as significant as the point sources.*

- ✚ Mr. Mumley responded have the Water Board has estimated the mass of Se in the total waterbody (particularly sediments) versus that in the water column. He asked for additional clarification from Tt as to the assumptions being made if one is predicting or estimating the load from sediment into the water column.
 - Mr. Roy explained that the figures come from sediment erosion estimates in existing SF Bay TMDLs (e.g., PCBs and mercury) and that they assess Se concentrations to a sediment depth of 15 centimeters thickness. The mass of Se in sediment is higher than what flows into the Bay in an average year, but by a relatively small factor. In contrast, the sediment reservoir of PCBs might be orders of magnitude larger than the average annual load. Mr. Roy went on to explain sediment suspension and erosion.

Comment *Stormwater should be considered in developing the numeric model even though it is not part of the 303d listing.*

- ✚ Mr. Roy explained that storm water was included in the local tributaries source computation. That information is specifically broken out in the data summary.

Mr. Roy noted a key finding in explaining the diagrams below; In lab tests, algal uptake response occurs in a non-linear fashion. This will be looked at in the modeling.



With some exceptions, over a wide range of concentrations, algal concentrations are relatively similar.
(Baines and Fisher, 2001)

Comment: How do NSFB water quality conditions compare to other parts of the Bay,

✚ Mr. Roy responded that Tt made an estimate of the source from the South Bay to the North Bay. Water column concentrations are higher at many locations in the South Bay.

✚ **Comment:** In regards to slide 21, "Bioconcentration/Bioaccumulation Factors," Consider using the rows from this table that show the higher concentrations in red.

Media	Concentration	Bioconcentration/ Bioaccumulation Factors
Water Column	0.10 $\mu\text{g}/\text{l}$ (low flow) 0.12 $\mu\text{g}/\text{l}$ (high flow)	
Seston	0.73 $\mu\text{g}/\text{g}$ (low flow) 0.49 $\mu\text{g}/\text{g}$ (high flow)	7,300 L/kg (low flow) 4,800 L/kg (high flow)
Plankton	3 $\mu\text{g}/\text{g}$	25,000 – 100,000 L/kg
Sediment	0.25 $\mu\text{g}/\text{g}$	2,200 L/kg
Bivalve <i>P. amurensis</i>	11 $\mu\text{g}/\text{g}$	100,000 L/kg 3 – 4 times plankton concentrations
White Sturgeon (liver)	24.1 $\mu\text{g}/\text{g}$	219,000 L/kg 2 - 3 times <i>P. amurensis</i> concentrations
Zooplankton	4.5 $\mu\text{g}/\text{g}$ (low flow) 1.9 $\mu\text{g}/\text{g}$ (high flow)	17,200 - 40,900 L/kg 0.6 – 1.5 times plankton concentrations
Splittail (liver)	11.4 $\mu\text{g}/\text{g}$	103,600 L/kg 2 - 6 times zooplankton concentrations

Comment/Question: What are the whole fish concentration numbers? Sturgeon appears to be the basis and that would be expected to be high.

- Mr. Roy explained that the list presented was illustrative, and not all tissue types were shown. Further, these numbers may change in time and space. One could say liver is twice as high and if sturgeon muscle tissue were compared, the bioconcentration factors would be two to three times lower.

Mr. Roy showed a diagram entitled, "Uncertainty in Predicting Bioaccumulation" and highlighted new information.

Uncertainty in Predicting Bioaccumulation

	Dissolved	Particulate	Prey Items	Predators
Selenium in Different Compartments	Selenate, Selenite, and Organic Selenide	Bacteria, Phytoplankton Mineral Particles Organic Detritus	Water Column Species (e.g., zooplankton) Benthic Species (e.g., bivalves)	Splittail, Striped bass White Sturgeon Diving Ducks (Greater and Lesser Scaup, Surf Scoter)
Key Factors for TMDL Analysis	<p>Speciation data needed for accurate understanding of uptake.</p> <p>Speciation data shows a decline in selenite concentrations after refinery cleanup in mid-1998.</p> <p>No speciation data available after 1999.</p>	<p>The bioavailability of different particulate forms varies, with algal selenium being more bioavailable than other forms.</p> <p>Particulate selenium data available for select years, most recently for 1999.</p> <p>In recent years algal concentrations in NSFB have increased.</p>	<p>Bivalve uptake of selenium is primarily through particulates.</p> <p>Different bivalve species have different uptake rates.</p> <p>Bivalve data are not available after 1999. Prior data show stable concentrations in the late 1990s.</p>	<p>Limited recent data on predator species.</p> <p>Most data show similar results over the late 1990s, although a small amount of diving duck muscle tissue data suggest a small decrease.</p>

Question: Do you have predictions for other years with a given hydrology?

- Mr. Roy: You need hydrology to drive a given scenario with different loads.

Comment: The purpose of the modeling is to work back from an ambient water concentration and to see how that affects the sources of loads.

Question: Is there enough data already comparing ambient water to sturgeon to test that model? If we had a reduction of Se in the water and we have corresponding data in the fish tissue, do we need to do the modeling? What about regression using existing data? Is that more or less certain than doing the modeling?

- Mr. Roy: The strength of the modeling is in relating the source loads to water column concentrations under different hydrologic and loading conditions. A key output of the modeling is the speciation of selenium into different dissolved and particulate forms. The model can also include the uptake by bivalves. The uptake into fish is modeled through regression-type approaches. Simple regressions between the water column and fish may be too simplistic for this system. He said they do think there is a benefit to using modeling.

Question: *Is there a short cut to the modeling process?*

- ✚ Mr. Roy: The data can be evaluated for simple relationships, although a single number for relating total selenium to fish tissue or bird tissue concentrations may not work.
- ✚ Mr. Roy and Dr. Grieb added that they have been thinking about how selenite and selenate components of the external loads are represented as they set up future scenarios.

5. Next Steps

Ms. Baginska showed a project schedule slide. Model development will take longer than the Water Board expected. They want to go through a number of scenarios and get feedback from the TRC members.

Ms. Baginska asked the group if they would like another meeting in February 2009 to discuss how the document is going to be revised. She said she would query the AC members by email about the need for one more meeting and a preferred date.

The TRC will meet again in January 2009. AC members are invited to participate as they were at the initial meeting. Ms. Baginska noted that if the meeting is held by phone, all AC members would still be welcome to participate.

Next Steps, Adjourn

Mr. Ceppos asked if there were any final questions from AC members. There were none.

Mr. Ceppos then asked for final questions from the members of the public. There were none.

Mr. Ceppos thanked everyone for their time and contributions and closed the meeting.

Attendees:

Advisory Committee

Bay Area Clean Water Agencies	Michele Pla
Bureau of Reclamation, South-Central CA Area Office	Michael C.S. Eacock (Chris)
Ducks Unlimited	Rudy Rosen
EPA	Diane Fleck
EPA	Eugenia McNaughton
EPA	Nancy Yoshikawa
Fairfield Suisun Sewer District (for Bay Area Stormwater Mgmt Agencies Assoc)	Kevin Cullen
SWRCB	Tom Kimball
USFWS	Bill Beckon
Valero Refinery	Al Middleton
Western States Petroleum Association	Kevin Buchan

Members of the Public

Chevron-Richmond Refinery	Steven Yang
Valero	Marcus Cole
Grassland Growers	Tom Mongan
Shell	Steven Overman
CalTrans	Jagjiwan Greword
Central Contra Costa Sanitary District	Bhipinder Dhaliwal
Central Contra Costa Sanitary District	Tim Potter
CH2M Hill	Earl Byron
Tesoro Refinery	Peter Carroll
Larry Walker Associates	Denise Connors
EOA, Inc.	Tom Hall

Water Board Staff

Tom Mumley
Naomi Feger
Barbara Baginska

Project Consultants

Tom Grieb	Tetra Tech
Sujoy Roy	Tetra Tech
Dave Ceppos	Center for Collaborative Policy
Sarah Rubin	Center for Collaborative Policy