Sediment Quality Obj.
Deadline: 11/28/06 5pm

Western States Petroleum Association
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Kevin Buchan
Environmental Representative

November 28, 2006

Ms. Song Her
Clerk to the Board, Executive Office
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100

Re: Comment Letter – Sediment Quality Objectives – CEQA Scoping Comments of Western States Petroleum Association

Dear Ms. Her:

This letter contains the comments of the Western State Petroleum Association ("WSPA") regarding the scope of compliance with the California Environmental Quality Act ("CEQA") for the proposed adoption of Sediment Quality Objectives ("SQOs") and a Sediment Quality Plan ("SQO Plan" or "Plan") for enclosed bays and estuaries by the State Water Resources Control Board ("State Board").

The Western States Petroleum Association is a trade association that represents the companies and other entities that conduct most of the petroleum-related operations in the western United States. These operations include production, transportation, refining and marketing of petroleum and petroleum-based products. We appreciate the opportunity to submit these CEQA scoping comments on the proposed SQO Plan.

As outlined in the *CEQA Scoping Meeting Informational Document - Development of Sediment Quality Objectives For Enclosed Bays and Estuaries* dated August 17, 2006 (hereinafter "Scoping Document"), the State Board intends to prepare a Substitute Environmental Document ("SED") in lieu of an Environmental Impact Report ("EIR"). The Scoping Document outlines a number of alternatives to aspects of the SQO Plan, but does not identify any environmental impacts that the State Board intends to consider in its SED. WSPA is concerned that implementation of SQOs by means of the SQO Plan will have reasonably foreseeable potential environmental impacts which must be fully analyzed in the SED. Moreover, we believe that additional alternatives, not considered in the Scoping Document, are available to avoid or reduce such impacts and therefore should be included and evaluated in the SED. These issues are addressed in our CEQA scoping comments, below, and in our technical comments, attached as Attachment A.

Comment 1 – Impacts Of Compliance Methods Must Be Analyzed

The CEQA guidelines require an SED to contain an analysis of reasonably foreseeable environmental impacts of methods of compliance with new standards or requirements, feasible mitigation measures, and alternative means of compliance which would avoid or eliminate the identified impacts. CEQA Guidelines (14 Cal. Code Regs.) § 15187. It is well settled that, where there is evidence that a program or regulation intended for environmental protection may have unintended adverse environmental consequences, those consequences must be analyzed, and feasible alternatives or mitigation incorporated in accordance with CEQA, before the program or regulation may be adopted. *See, e.g., County Sanitation District v. County of Kern*, 127 Cal. App. 4th 1544 (2005). One particularly relevant recent case is *City of Arcadia v. State Water Resources Control Board*, 135 Cal. App. 4th 1392 (2006), in which the court found that the Regional Water Quality Control Board ("Regional Board") failed to comply with CEQA in adopting a Total Maximum Daily Load ("TMDL") for trash in the Los Angeles River watershed, when the Board failed to evaluate reasonably foreseeable environmental impacts of the means of compliance likely to be utilized by the cities subject to wasteload allocations. For these reasons, the SED must evaluate the impacts of and alternatives to anticipated means of compliance with the SQO Plan.

Comment 2 – **Tiered CEQA Analysis**

While the Scoping Document is not entirely clear on this point, it appears that the SED will contain a program-level or Tier 1 CEQA analysis, deferring consideration of specific implementation actions to later project-level or Tier 2 CEQA analyses. While CEQA encourages tiered environmental review and would allow a Tier 1 SED to defer consideration of information that may not be feasibly reviewed at the programmatic level, the tiering approach does not excuse the lead agency from adequately analyzing reasonably foreseeable significant environmental effects of the project and does not justify deferring such analysis to a later tier. CEQA Guidelines § 15152(b). If a future implementation action "is reasonably foreseeable in general terms, the [tier 1 EIR or SED] must include a general discussion of the fact and its possible environmental effects, but need not include a detailed analysis of specific facts that cannot reasonably be foreseen at the time the [EIR or SED] is prepared." *Ebbetts Pass Forest Watch v. California Dept. of Forestry and Fire Protection*, 139 Cal. App. 4th 165 (2006). Again, for these reasons, the SED must evaluate the impacts of and alternatives to anticipated means of compliance with the SQO Plan.

Comment 3 – The SQO Plan Lacks Critical Specifics On Implementation Actions

We understand that the merits of the SQOs and SQO Plan are not yet being considered at the CEQA scoping stage. Even so, we must point out that the SQO Plan as drafted is fundamentally flawed in a manner that is highly relevant to CEQA review. Even as a program document, the Plan is excessively vague and lacking in critical specifics on potential implementation actions. Analysis of the environmental impacts of, and alternatives, to the Plan will require a sufficiently specific description of the proposed action and reasonably foreseeable means of compliance.

Aside from CEQA, the current draft Plan is so lacking in specificity that it fails to contain the elements required by Water Code § 13242. That section requires such implementation programs to contain "a description of the nature of actions which are necessary to achieve the objectives, including recommendations for appropriate action by any entity, public or private." The SQO Plan contains none of these things.

Moreover, when the State Board does come to consider the merits of the SQO Plan, we believe that a clearer understanding of its implementation mechanisms will be critically important, both

for the State Board's decision whether to adopt the Plan and to guide future decisions by the Regional Boards. A number of particularly important issues are addressed in WSPA's technical comments, Attachment A.

Comment 4 – Reasonable Range Of Alternatives

CEQA requires consideration of a reasonable range of alternatives to the project that could feasibly attain its basic objectives and would "substantially lessen the significant environmental effects." CEQA (Cal. Pub. Res. Code) § 21002; CEQA Guidelines § 15126.6. While the Scoping Document outlines a number of alternatives to specific aspects of the SQO Plan, these alternatives appear to have been crafted more as available options, without any attempt to develop alternatives that could lessen impacts. It is not reasonable to consider only alternatives that will have no effect on environmental impacts in the first place, or are by definition infeasible, and to then rely on the inadequacy of those "straw man" alternatives to justify adopting the SQO Plan as currently drafted.

Comment 5 – No Alternatives To "How SQOs Could Be Applied"

Most critically, Section 2.21 of the Scoping Document – "How could SQOs be applied?" – considers no alternatives. This is not surprising, since the SQO Plan is so vague in its discussion of future management actions that it is difficult to understand its meaning, much less identify and evaluate reasonably foreseeable means of compliance and associated impacts. It is impossible for the State Board to assess the environmental impacts of SQOs as required by CEQA prior to their adoption, without any description of how the SQOs will be applied to trigger management actions or affect regulatory decisions such as listing under Clean Water Act section 303(d), TMDL development and NPDES permitting. If the section is intended to describe which actions might be triggered by application of the SQOs, they must be described with sufficient specificity – including reasonably foreseeable means of compliance – to allow proper evaluation of impacts; and the State Board must consider alternatives that would avoid or lessen those impacts.

Comment 6 – The Current Regulatory Regime Is The CEQA "Baseline"

In CEQA analysis, environmental impacts of the proposed action and alternatives (including the No-Action Alternative) are compared to the baseline of existing conditions. CEQA Guidelines §§ 15125(a), 15126.2(a). The State Board is obligated by statute to adopt SQOs, so that a No-Action Alternative of not adopting SQOs themselves would be legally infeasible. However, the same is not true of discretionary implementation actions under the SQO Plan. When considering a new regulatory program such as the SQO Plan, the lead agency must compare impacts and alternatives to the baseline of the current regulatory regime. Sediment management issues to be addressed under the SQO Plan are currently regulated under the Clean Water Action section 404/401 program, the TMDL program under Clean Water Act section 303(d), and the toxic hotspots program under Water Code section 13394. In our view, continued reliance on these existing programs to implement SQOs constitutes the environmental baseline. Any change in activities that otherwise would have occurred under existing programs – for example, changes in patterns of maintenance dredging, or remedial actions triggered solely by SQO exceedances – must be considered as consequences of adopting the SQO Plan, and must therefore be evaluated for potentially significant environmental impacts.

Comment 7 – Changes To Current Dredging Regime

One clearly foreseeable context for SQO implementation is dredging. The SQO Plan could alter the current regime of dredging activities in two ways. First, Regional Boards could rely on

SQOs exceedances to trigger remedial actions or other dredging activities that might not otherwise have been undertaken. Second, routine maintenance dredging would become more difficult for marine terminals and other industrial facilities around the state, faced with additional regulatory burdens arising from the SQO Plan. The implications of these two issues are discussed in the following comments 8 to 13.

Comment 8 – Water Quality And Biological Resources Impacts Of Increased Remedial Dredging

With regard to the first point in Comment 7, the SED must consider the potential impacts that could arise from disturbance of sediments exceeding SQOs that would not otherwise have been disturbed. Sediment removal is typically performed by dredging. Dredged material must then be relocated, in some cases to approved ocean or bay disposal sites. However, in many instances, disposal of sediments exceeding SQOs would occur on land. Dewatering is often used to reduce the volume of sediment to be disposed, and the material must then be transported to a disposal site. These activities would be associated with potentially significant environmental impacts, including the following:

- Short-term water quality impacts from suspension of contaminants buried in sediment, temporarily increasing water column concentrations, due to releases of material during dredging and dewatering discharges (Zahakos, 2005; Lee and Jones, 2000; Kennish, 1998; Quantitative Environmental Analysis et al., 2001)

- Short-term water quality impacts from exceedance of water quality objectives for turbidity and suspended solids, due to dredging and dewatering discharges (Johnston, 1981; Koebel et al., 1999; Nichols et al., 1990)

- Longer-term water quality impacts, depending upon the duration and extent of the dredging operation, if contaminant concentrations at the sediment surface are increased as successive layers of sediment are removed and/or substantial material is lost during dredging (Su et al., 2002; Goossens and Zwolsman, 1996)

- Impacts on biological resources, from exposure of water column and benthic organisms to resuspended contaminants (Zahakos, 2005; Lee and Jones, 2000; Kennish, 1998)

- Impacts on benthic communities due to physical disturbance from dredging, including impacts to biota outside the dredged area which may receive additional sedimentation as resuspended material settles (Lee and Jones, 2000; Kennish, 1998)

- Air emissions from dredging and dewatering equipment operations (Starcrest Consulting Group, 2005)

- Air emissions from barge and truck trips for transport of dredged material to disposal sites (Starcrest Consulting Group, 2005; NRDC, 2004; Ports of Los Angeles and Long Beach, 2006)

- Solid and hazardous waste impacts on disposal site capacity which is already limited (CIWMB, 1992)

Comment 9 – Impacts To Disposal Site Capacity From Increased Remedial Dredging
It is reasonable to expect that implementation of the SQOs could result in substantial areas within active harbors being deemed in exceedance. To provide the basis for adequate evaluation of impacts, the State Board should develop an analysis of the enormous magnitude of additional disposal that could result. Available sediment data for representative locations could be used to estimate the number of acres of bottom where SQOs would be exceeded. Assuming that sediment exceeding SQOs is removed to a depth of two feet, the volume of sediment that would require disposal can be estimated. The estimated volume, in turn, can be compared to the volume of available land disposal or (for sediments characterized as hazardous) hazardous waste landfill capacity. Unless it performs such an analysis of the reasonably foreseeable consequences of SQO implementation, the State Board would have no basis to conclude that the potential impacts on disposal capacity sites will be less than significant.

Comment 10 – Air Quality Impacts Of Increased Remedial Dredging
Air emissions from dredging activity and truck trips to transport large volumes of material would be likely to exceed applicable CEQA significance thresholds. For example, the South Coast Air Quality Management District (SCAQMD) has adopted CEQA significance thresholds of (i) daily emissions of 100 pounds NOx, 75 pounds ROG, 150 pounds SOx or PM10, or 550 pounds of CO and (ii) calendar quarterly emissions of 2.5 tons of ROG or NOx, 6.75 tons of SOx or PM10, or 24.75 tons of CO (SCAQMD 1993).

Based on the estimated volumes of dredge material (see comment 9), the amount of air emissions, should SQO exceedances be addressed by remedial action over large areas, can be estimated. The typical suite of equipment involved in dredging operations includes the dredge vessels and dredges themselves, tugs used to transport barges of dredged material to shore, off-loading equipment, and trucks to transport dredged material to disposal sites. All are sources of emissions with potentially significant effects on air quality. The emissions associated with removing and transporting the estimated volume of additional dredged material, from representative origins to likely disposal destinations, can be calculated and compared to the applicable CEQA emission thresholds.

Even without performing such a quantitative analysis, given the low thresholds set by SCAQMD and other air districts, it is foreseeable that potentially significant air quality impact would result. Unless it performs such an analysis of the reasonably foreseeable consequences of SQO implementation, the State Board would have no basis to conclude that the potential impacts on air quality will be less than significant.

Comment 11 – Cumulative Impacts Of Increased Remedial Dredging
The State Board should also consider potentially significant cumulative impacts in the vicinity of areas likely to be affected by the SQO Plan. For example, according to the *San Pedro Bay Ports Clean Air Action Plan Technical Report* (Ports of Los Angeles and Long Beach, 2006), other projects are contributing and will contribute to serious environmental concerns related to truck traffic, air pollution and noise in the areas adjacent to the Ports of Los Angeles and Long Beach.

Comment 12 – Capping Impacts
In addition to sediment removal by dredging, sediment sequestering or capping is another reasonably foreseeable activity that could result from adoption of SQOs and identification of sediments that exceed SQOs. Accordingly, the State Board's CEQA evaluation for adoption of

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the SQO Plan must evaluate the reasonably foreseeable environmental impacts of capping as an implementation strategy.

Sediment sequestration or capping would entail covering contaminated bed sediments in a water body with clean fill material from another source. Capping is used to make the contaminants less biologically available by sequestering them from the human environment and from the biologically active sediment layer, which is generally the top six inches of sediment. Construction of sediment caps on contaminated sediments can result in impacts similar to those that occur for dredging, including increased ship and boat traffic (barges are generally used to transport clean sediment to the area to be capped), truck traffic (when capping material comes from land-based sources), and increased air pollution. In addition, capping requires a clean sediment source, which is generally taken from a marine borrow area or from a land-based source, and the capture and transport of the capping material can also cause environmental impacts.

- Capping areas of contaminated sediments would temporarily increase the turbidity of overlying waters, with impacts to organisms in the water column (Koebel et al., 1999)

- Similar to dredging operations, exhaust emissions from barges and sediment placement equipment would contribute to air quality impacts (EA Engineering, Science, and Technology, 2005)

- Taking capping material from marine borrow sources would disturbs a area of clean sediment elsewhere, resulting in impacts to the biota in the borrow location, resuspension of sediments, and associated turbidity that would likely be similar to impacts for dredging (see dredging references cited above)

- Using capping material from land-based sources would require the transport of clean material to the capping area by truck, with resulting air emissions that would likely be similar to impacts for dredging (see dredging references cited above)

Comment 13 – Economic And Indirect Environmental Effects

As noted above in Comment 7, another foreseeable consequence of SQO implementation is that routine maintenance dredging will become more difficult for ports, marine terminals and other industrial facilities around the state. Moreover, if contaminated sediments in port areas were capped, maintenance dredging would have to avoid the sediment caps and thus would become more difficult, potentially reducing the frequency and scope of maintenance projects.

While economic effects are not environmental impacts, CEQA requires consideration of environmental impacts that may arise as a reasonably foreseeable consequence of economic effects. CEQA Guidelines §§ 15064(e), 15131(a). In this case, the increased difficulty of maintenance dredging could have indirect impacts as a consequence of the reduced availability of port facilities, leading to re-routing of goods and petroleum products to land transport with resulting increased traffic impacts and emissions of air pollutants from truck cargo trips (NRDC, 2004; Ports of Los Angeles and Long Beach, 2006).

Comment 14 – Economic Analysis Under Water Code Section 13241

We also note that, under Water Code section 13241, economic considerations must be taken into account, separately from CEQA, in evaluating the proposed SQOs. As the State Board has

itself acknowledged: "Under Water Code section 13241, the State Board is legally required to consider economics, as well as other factors, prior to adopting SQOs. The analysis of economic considerations will likely be incorporated into or appended to the [SED]." State Board, Responses to Comments on the Draft Revised Workplan (2003), p. 19; see also p. 29: "The State Board will comply with all applicable federal and state legal requirements, including Water Code section 13241, prior to adopting any SQOs." This analysis has not yet been done. The SQO Plan and Scoping Document contain no discussion of economic considerations or indication of how the State Board intends to carry out its obligation to do so. This is an important issue on which the regulated community should have a full and fair opportunity to comment. Accordingly, the State Board should make its analysis available for review and comment no later than the public draft SED.

Comment 15 – Implementation In NPDES Permits And TMDLs

With respect to the prospect of SQO implementation in NPDES permits and/or TMDLs, the State Board should consider the following potential impacts:

- Solid and hazardous waste impacts from disposal of residuals from increased wastewater treatment (City of St. Helena, 2006)
- Construction impacts for new treatment facilities (Pierce County, 2000)[1]
- Energy consumption for treatment facility operations (SBW Consulting, Inc., 2002; M/J Industrial Solutions, 2003)
- Cumulative impacts of wastewater treatment expansion and/or remedial dredging at upstream sources of contaminants (Pierce County, 2000)

Comment 16 – Remedial Action Alternatives

In Section 2.4 of the Scoping Document, the recommended Alternative 1 – "Regional Water Boards retain the discretion to apply the SQOs and the supporting tools to cleanup activities, where appropriate" – is excessively vague and would likely lead to sediment removal or remediation actions that would not have occurred otherwise. Potentially significant impacts could result, including effects on water quality, biological resources, air quality, etc. as discussed above. Each of these impacts should be evaluated in the SED for the State Board staff's recommended alternative.

The SED should also consider other alternatives that would reduce or avoid such impacts:

> *Alternative 3:* An SQO evaluation, by itself, would not be used to trigger or initiate a sediment cleanup action. SQOs will be implemented in sediment cleanup actions under the existing toxic hotspots and TMDL programs, not through independent sediment cleanup actions.

These existing regulatory programs constitute part of the existing conditions or "CEQA baseline," against which the SED must evaluate impacts of adopting the new SQO Plan. By

[1] See Tables A-12 and A-13, pp. 29-32.

limiting the application of SQOs to the existing regulatory programs, adverse environmental impacts associated with SQO adoption will be reduced.

> *Alternative 4:* Remedial actions that are already underway and those for which plans have been approved will not be affected by the SQO process or subject to SQO evaluation.

The reason for this alternative is that planned remedial measures at a site will have already been formulated to include ecological risk evaluations. SQO evaluation for these projects would duplicate prior work and likely delay remediation plans that already taken a significant amount of time and effort to formulate.

Comment 17 – Alternatives Regarding Use Of Multiple Lines Of Evidence

WSPA generally agrees with the multiple lines of evidence (MLOE) approach proposed in the SQO Plan. However, the draft Plan, Section C.2, specifies that only two lines of evidence (chemistry and toxicity) shall be used for bays and estuaries where benthic tools are unavailable. Section J provides an evaluation matrix that uses chemistry and toxicity to make a determination for a station with missing benthic data. WSPA is especially concerned with the classifications of some of the boxes within Table 3.10 on p. 50, which allow final SQO assessments to be made using only two lines of evidence. Section 2.19 of the Scoping Document (pp. 30-32) discusses the application of SQOs to estuaries and recommends adoption of Alternative 3, which would allow use of sediment toxicity and chemistry alone (i.e., only two lines of evidence) to implement the narrative objective.

WSPA strongly disagrees with the recommendation to adopt Alternative 3 and requests that the State Board carefully consider Alternative 1, requiring use of three lines of evidence in estuarine environments. The use of only two lines of evidence directly contradicts the recommendations of the Scientific Steering Committee and cannot be implemented with the tools currently specified in the draft SQO Plan. (See discussion in WSPA's technical comments, Attachment A to this letter, and the excerpts from the Scientific Steering Committee Consensus Opinion on MLOE Approach (March 2, 2005), attached to the technical comments.) Reliance on too few lines of evidence risks both under- and over-inclusive results, i.e., mistakenly failing to identify some affected sediments while mistakenly identifying others that are in fact unaffected. For example, relying on the chemistry line of evidence could lead to mis-classifying sediments which were not tested for those toxic contaminants actually causing serious impacts to benthic community organisms. Conversely, without chemistry and toxicity data, it is impossible to determine if alterations in the benthos may result from natural factors. Sediments not actually causing biological impacts could be misclassified due to the presence of toxic chemicals that are not bioavailable. Spurious results of toxicity tests could also be attributable to the presence of natural factors such as ammonia, hydrogen sulfide or physical abrasion or alternatively, the result of contaminants not tested.

An under-inclusive result could result in direct environmental consequences, by ignoring sediments that should be addressed; while an over-inclusive result could lead to inappropriate remedial actions with potentially significant adverse side-effects for water quality, air quality and disposal site capacity as discussed above. These reasonably foreseeable consequences must be considered in the SED. The SED must also consider alternatives requiring three lines of evidence for all provisions in the draft Plan that currently allow reliance on only two lines of evidence. As discussed in WSPA's technical comments, two options that should be considered when the SQO tool for benthic community evaluation is unavailable: using the best professional

judgment of a trained benthic ecologist or taxonomist; or using available indices developed outside the SQO program.

Comment 18 - Natural Attenuation/Recovery Alternative

In particular, the SED should evaluate an alternative providing that, whenever remedial action is considered based on exceedance of SQOs, management by means of natural attenuation (also referred to as natural recovery) must be evaluated. Natural attenuation is generally preferred when a remedial action (either dredging or capping) would cause more harm than leaving the sediment in place. Natural attenuation is generally appropriate in "accretional areas" where cleaner sediments are already accumulating and burying existing contamination; or for pollutants that are degrading in situ (e.g., via biodegradation).

As discussed at the outset of these comments, WSPA understands that the State Board intends the SED to serve as a programmatic CEQA document. That is, the SED will not purport to fully evaluate environmental impacts in a manner that would permit the Regional Boards to order implementing actions without any further CEQA review. Rather, the SED will constitute a "tier 1" CEQA document covering only adopting of the SQO Plan and analyzing impacts of implementation on a program level. This approach requires the Regional Boards to conduct subsequent "tier 2" CEQA analyses for the actions they ultimately select to implement SQOs. However, even under the tiered approach, as noted above, if a later implementation action "is reasonably foreseeable in general terms, the [Tier 1 CEQA document] must include a general discussion of the act and its possible environmental effects." *Ebbetts Pass Forest Watch*.

For this reason, the SQO Plan should direct the Regional Boards that they should evaluate a natural attenuation/recovery alternative before ordering remedial actions based on exceedance of SQOs. While it not necessary to conduct a full evaluation of the impacts of future actions in the Tier 1 CEQA document, if the Tier 1 document does defer certain areas of specific analysis to Tier 2, those issues must be addressed by the Regional Boards which undertake future Tier 2 actions. In other words, the Regional Boards cannot rely on the State Board for CEQA compliance that the State Board deferred to the Regional Boards. By adopting an alternative that requires the Regional Board to consider the benefits and impacts of natural attenuation, on a case-by-case basis, the State Board can rely on the Regional Boards to perform the evaluation of impacts and alternatives, which the State Board did not perform.

Thank you for considering WSPA's scoping comments. Please contact me at 916-498-7755 if you have any questions or wish to discuss our comments. We look forward to the opportunity to comment on the SED when it is issued and for further discussion of these issues with the State Board.

Sincerely yours,

s/Kevin Buchan
(sent via email)

Enclosure: Attachment A

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ATTACHMENT A:

TECHNICAL COMMENTS ON
CEQA SCOPING MEETING INFORMATIONAL DOCUMENT

This attachment contains technical comments of the Western States Petroleum Association ("WSPA") regarding the CEQA Scoping Meeting Informational Document entitled *Development of Sediment Quality Objectives for Enclosed Bays and Estuaries* (hereinafter "Scoping Document"), dated August 17, 2006, by the State Water Resources Control Board ("State Board").

These comments are organized around a series of technical issues. Where relevant, page numbers from the August 17, 2006, scoping document are included. We suggest that addressing the comments below would assist both with the required CEQA analyses of the environmental impacts associated with the proposed SQO and with the economic and implementation requirements of the Porter-Cologne Water Quality Control Act (Sections 13241 and 13242). In addition, many of the technical issues detailed below have been discussed in some detail by the members of the Advisory Committee for this matter.

Comment 1 – Multiple Lines Of Evidence

We concur strongly with the Scoping Document's recommendation to base sediment quality objectives (SQO) on the application of multiple lines of evidence (MLOE) (p. 17). As discussed by State Board staff in the Scoping Document, and as detailed by the State Board's Scientific Steering Committee (SSC) (Attachment B), sediment chemistry, bioavailability, and impacts are very complex. Use of a single line of evidence (LOE), or even two LOE alone, are contrary to the direction of the SSC and will lead to erroneous results and management actions that are either unnecessary or that do not have the intended effect. We suggest that the State Board add language to the policy specifying that all three LOE should be used, except, perhaps, in very limited circumstances where a small fraction of data for a single LOE is missing due to sample loss or other mishap.

Section C.2 (p. 42) specifies that only two lines of evidence (chemistry and toxicity) shall be used for bays and estuaries where benthic tools are unavailable. Section J (pp. 49-50) provides an evaluation matrix that uses chemistry and toxicity to make a determination for a station with missing benthic data. As discussed above, use of only 2 LOE directly contradicts the recommendations of the Scientific Steering Committee and is not implementable with the tools currently specified in the preliminary draft plan. Instead, the SWRCB should develop a procedure to use all 3 LOE, even when the SQO tool for benthic community evaluation is missing. Two options that should be considered include (1) using the best professional judgment (PBJ) of a trained benthic ecologist or taxonomist (and not BPJ of SWRCB or RWQCB staff), or (2) using available indices, even if developed outside the SQO program.

WSPA is especially concerned with the classifications of some of the boxes within Table 3.10 on p. 50, which allow final SQO assessments to be made using only two LOE. For example, the "low exposure" chemistry category is defined as "small increase in contaminant exposure that may be associated with increased effects, but magnitude or frequency of occurrence of biological impacts is low." The "low toxicity" category is defined as "a response that is of relatively low magnitude; the response may not be greater than test variability." However, use of Table 3.10 would indicate that sediments categorized as having low toxicity and low exposure would be "possibly impacted." Thus, the table biases results toward a finding of impact in the absence of direct measurements of impact (i.e., in the absence of the benthic LOE), and even when test results cannot be distinguished from normal test variability.

Comment 2 – Application of SQO To Estuaries

The Scoping Document discusses the application of SQO to the Delta and other estuaries in Alternative 2.19, at pp. 30-32. We disagree strongly with the recommendation to adopt Alternative 3 in the Scoping Document and encourage the State Board to carefully consider Alternative 1. Alternative 3 would allow using of sediment toxicity and chemistry alone (i.e., only two LOE) to implement the narrative objective, in direct contradiction to the direction taken by the Science Team and the recommendations of the SSC. Using only two LOE is not sound scientific practice. More importantly, the toxicity tools and thresholds to evaluate the toxicity LOE in estuarine environments do not exist. In fact, several of the test species proposed for use in enclosed bays and harbors (see p. 43) may not be appropriate for evaluating toxicity in estuarine environments, and thresholds have not been developed for this purpose. A separate estuarine biological community analysis would be required to determine appropriate test species for the estuarine environment. Similarly, thresholds and tools for evaluating chemical concentrations in estuarine environments do not currently exist. Thus, the recommended alternative 3 currently cannot be implemented.

The SSC also strongly discouraged the use of two LOE to implement narrative objectives for estuaries, equating that approach to "making up data." Several TMDLs that use only two LOE have been adopted in the State, and the approach has been highly problematic. For example, the Los Angeles Regional Board adopted TMDLs for sediment in the Ballona Creek estuary that would require sediments to achieve "Effects Range Low" ("ERL") concentrations for compounds such as DDT and nickel (among others), for which ERLs and other traditional sediment quality guidelines are notoriously unreliable (see also discussion in Comment 10 below). Such an approach fails to identify the true cause of the impairment, and has resulted in implementation plans and management actions that are costly and unnecessary, and that are highly unlikely to result in a change in the impairment status of the waterbody.

Alternative 1, in contrast to the recommended Alternative 3, would allow development of proper SQO for estuarine environments using all three lines of evidence, and through an open, public process.

Comment 3 – Need For Stressor Identification Before Implementation

WSPA requests that the State Board carefully consider adopting a policy that specifies that implementation measures or actions be undertaken only where the chemical(s), or class(es) of chemicals, responsible for an impairment have been identified. As detailed in Comment 2 above and in Comment 10 below, comparison of chemical concentrations for a limited number of constituents to the thresholds in the draft policy (pp. 45-47) or to sediment quality guidelines or other "chemistry-only" measures should not be used to trigger implementation actions. In particular, toxicity identification evaluations (TIEs) or similar stressor identification evaluations should be undertaken to establish the chemical(s) responsible for the observed effect, and to establish site-specific sediment concentrations targets for any subsequent sediment cleanup action. We also request that the State Board consider at which point in the SQO evaluation process stressor identification should be performed. Options that should be considered include:

- Whether stressor identification should be performed before placing a water body on the 303(d) list of impaired waters, so that any listing identifies the chemical(s), or class(es) of chemicals, responsible for the impairment

- Whether stressor identification should be done as part of the TMDL process (i.e., after SQO evaluation and listing)

- Whether stressor identification should be performed in a two-phase manner, with limited stressor identification as part of the SQO evaluation process and more detailed stressor identification required as part of the TMDL process.

In any case, the selected option should result in management actions that would address the compound(s) that are responsible for causing the impairment.

Comment 4 – Clarification and Detail Needed For Implementation Measures

It is unclear in the Scoping Document which implementation measures may be triggered by SQO evaluations. In fact, Section 2.21 on p. 32 of the Scoping Document provides no alternatives for how the SQOs could be applied, or the actions that may be triggered by SQO evaluations. We suggest that the State Board consider a number of options, and specify clearly how the SQO program will interact with other existing programs. Options that should be considered include:

- SQO should be implemented only via receiving water limits in NPDES permits (see also p. 52)

- SQO should be implemented via the existing hot spots program

- SQO should be implemented via the TMDL program

- SQO should be implemented via the TMDL program unless either (1) the impairment is clearly due to a "hot spot" that can be addressed via the toxic hot spots program, or (2) the impairment is clearly due to a current discharge from a single source that can be addressed via that facility/discharger's NPDES permit

Although the Scoping Document addresses applicability to Sediment Cleanup Actions (Issue 2.4 on p. 6), we request that the State Board provide additional clarification of key issues. For

example, it is unclear whether an SQO evaluation, by itself, would be used to trigger a sediment cleanup action, if SQOs will be implemented in sediment cleanup actions under the existing toxic hot spots program, or via TMDL programs. Similarly, it is unclear how remediation actions that are already underway (or those for which plans have been approved) will be affected by the SQO process or subject to SQO evaluations. We note that planned remedial measures at a site will already have been formulated to include ecological risk evaluations, and thus an SQO evaluation might duplicate prior work. Moreover, conducting an SQO evaluation could result in the delay of remediation plans.

Comment 5 – Implementation of SQO in NPDES Permits

The Scoping Document recommends that narrative SQOs would be applied in NPDES permits as receiving water limits (p. 34, p. 52), but does not specify how this would be done. We believe that several issues must be addressed by the State Board before receiving water limits can be calculated. For example,

- The State Board must specify how "reasonable potential analyses" are to be made to determine that a regulated discharge has reasonable potential to cause or contribute to an exceedance of SQOs.

- The State Board must specify how appropriate receiving water limits would be calculated for the narrative SQO.

We note that the procedures contained in the State Implementation Policy ("SIP") for the development of effluent limits do not provide a means of calculating effluent or receiving water limits that would protect sediments, or that even relate water column or discharge concentrations to sediment concentrations of a given pollutant. The relationship between a given discharge and sediment concentrations can be very complex, particularly in tidal environments and large bodies of water.

As detailed in Comment 4, we note that the insertion of receiving water limits into NPDES permits should not be regarded as the only management tool for dealing with an SQO exceedance. In fact, there are many instances (most notably, legacy pollutants) where regulation via NPDES permits would be an ineffective management tool, as current sources represent only a small fraction of the contaminant reservoir or load within a water body. In any case, the SWRCB should specify that effluent limits calculated from narrative SQOs should account for dilution within the receiving water body, the legacy "reservoir" of pollutants within the sediments, etc. We encourage the SWRCB to specify that a link be established between any permit limit and sediment concentrations of a given pollutant, and to specify that the permit limit would have a reasonable expectation of producing the desired result.

Comment 6 – Legacy Contaminants

As noted in Comment 5, legacy contaminants are likely to be a cause of SQO exceedances, and as such we request that the State Board consider how SQO exceedances that are due to legacy pollutants will be identified and addressed. For example, the State Board should address how remedial measures will be implemented if there is no on-going discharge of a compound, and if no "responsible party" can be identified. On p. 55 of the Scoping Document, we request that the State Board provide additional specificity on Source Identification and Management Actions, and suggest that the State Board may wish to include a new section "c" detailing how legacy compounds will be addressed.

Comment 7 – SQO and Dredging Activities

Regarding how the SQO will interact with the dredging program (p. 9, p. 38), we recommend that the existing federal dredging program continue to govern dredging activities, pursuant to the current, existing relationship between the Regional and State Boards, the US Army Corps of Engineers, and USEPA. We believe that the State Board should give closer consideration to Alternative 2 and to including the language discussed in the advisory committee, as follows:

> *Sediment quality objectives developed under this plan may be used in dredged material assessments as a screening tool in a Tier I or Tier II assessment within the existing Federal Framework for dredged material management suitability determinations. The Federal Framework has been designed, and includes appropriate procedures, to ensure that:*
>
> - *The polluted sediment is removed in a manner that prevents or minimizes water quality degradation;*
> - *The polluted sediment is not deposited in a location that may cause significant adverse effects to aquatic life, fish, shellfish, or wildlife or may harm the beneficial uses of the receiving waters, or does not create maximum benefit to the people of the State;*
> - *The activity will not cause significant adverse impacts upon a federal sanctuary, recreational area, or other waters of significant national importance; in accordance with requirements of section 13396 of the State Water code.*

Because of discrepancies between the "active layer" over which SQOs will be evaluated, and the potential for dredging activities to extend well below this layer, it is important to explicitly describe how the two programs will inter-relate. The current federal dredging program, also implemented under the authority of the Clean Water Act, has worked to protect important resources from negative impacts during dredging activities, and was specifically designed to evaluate and be applicable to a deeper sediment horizon than that for which the SQOs will apply.

Comment 8 – SQO and Navigation Beneficial Use

While we concur with the Scoping Document's recommendation of Alternative 2 for beneficial use selection ("Beneficial uses linked to specific receptors," p. 10, p. 39), we believe that the State Board should consider the insertion of additional language into the draft policy to clarify the effect of SQOs on the beneficial use of Navigation. We suggest that the State Board consider whether SQO evaluations should be considered prior to dredging for the purposes of maintaining navigable channels, and whether SQO evaluations will be used to change the scope of dredging projects conducted for the purposes of navigation. We note that the proposed regulation could interfere with maintenance dredging activities if it could be used to prevent routine, maintenance dredging where the sediment is in "good" or "acceptable" condition, with the idea that dredging could disturb sediments that have been determined, using the SQO evaluation framework, to be in compliance with SQO and thereby to represent a non-impaired condition. (Note that, by its very nature, dredging will cause a change in the benthic community condition, and so could temporarily result in a change from "passing" SQO evaluations to a condition in which the benthic community is absent or re-establishing.)

Comment 9 – Evaluation of Additional And Emerging Chemicals

While we concur with the State Board's use of MLOE to perform sediment quality assessments, one potential difficulty with the proposed MLOE approach is that it defines chemistry thresholds for only a small subset of all available constituents. It excludes three major classes of constituents: (1) existing contaminants for which analytical methods exist but for which thresholds have not been evaluated; (2) existing contaminants for which analytical techniques do not exist or have not been proven; and (3) emerging contaminants, including replacement pesticides and others, for which, by definition, no data are available.

A related issue can be found on p. 45 (Section H, point 1) of the Scoping Document, which refers to a standard list of analytes that should be tested for when evaluating the level of toxic pollutants in sediments. However, it also states that "In water bodies where other toxic pollutants [i.e., pollutants other than those on the standard list] are believed to pose risk to benthic communities, those toxic pollutants should be included in the analysis." Analyses for these additional analytes cannot be incorporated into the exposure assessment that is specified in the subsequent paragraphs. Although we agree that such additional data "can provide greater value in the overall sediment quality assessment," we request that the State Board clarify how these additional samples would be used in such an assessment.

To address issues related to evaluation of existing data for contaminants not currently addressed by the draft policy and related to the addition of new chemicals to the SQO policy, WSPA requests that the State Board consider various alternatives. For example, alternatives to be evaluated could include:

- SQO will not be modified in the future to include new pollutants
- SQO will be modified to include new pollutants using data gathered as part of the SQO process
- Information on new pollutants will be considered only in site-specific evaluations

We request that the State Board carefully consider making modifications to SQO using a similar scientific evaluation process to add new chemicals to the MLOE as that used to develop the current draft SQO. We believe that it is vitally important that new chemicals be added to the SQO in a scientifically defensible, open public process that will include peer review and the opportunity for public comment.

Comment 10 – Request for Information On Chemistry LOE

The Scoping Document details an approach for the chemistry LOE which attempts to correlate an effect (toxicity or benthic condition) to chemical concentrations, and to derive chemical concentration thresholds for use in SQO evaluations using these correlations (p. 19-25, p. 45). We believe that this approach can be challenged by the scatter present in any such plots. As noted above, previous attempts to find correlations for several compounds have not been successful. We suggest that SCCWRP and the SWRCB perform "goodness of fit" type evaluations to determine for which chemicals such relationships can reasonably be expected to be predictive. If not predictive, those chemicals should be deleted from Tables 3.5 and 3.6 (pp. 46-47). In the unusual and unexpected circumstance that these chemicals are not included in the SQO process but do in reality cause an effect in a particular situation, they would be picked up using TIE testing or other methods of identifying the chemical(s) responsible for effects, much in the way that any other chemical not included in Tables 3.5 and 3.6 would be. In any case, the SWRCB should present the raw data used to generate the thresholds (i.e., the scatter plots for, say, DDT concentration v. toxicity results for all samples used to develop the threshold values), goodness-of-fit evaluations, and a discussion of any additional relevant information.

Our initial review indicates that inclusion of thresholds for some compounds currently included in the draft policy may be unwarranted, and suggest that some compounds would be better left out of the chemistry component of the MLOE framework. For example, several of the threshold values proposed for total DDTs in Table 3.5 on p. 46 are below the detection limits of analytical methods used to generate existing data (e.g., 0.02 ppb ug/kg = T1). Available evidence indicates that for the DDT family of compounds, Sediment Quality Guidelines are generally unreliable as predictors of effects (SCCWRP, 1998; Bay, 2004; Attachment B). Even though it is possible to develop thresholds for this family of compounds (i.e., even though chemistry measurements are available for these compounds), there is no reason to suggest that DDT concentrations are in any way predictive of impacts. We suggest deleting these compounds from Tables 3.5 and 3.6, or, at a minimum, providing information describing how predictive these threshold values are (e.g., data similar to R^2 values).

Comment 11 – Comments on SQO and State Listing Policy

The State Listing Policy as currently written appears to be inconsistent with the proposed SQO evaluation procedures. For example, Section 3.6 (Water/Sediment Toxicity) of the Listing Policy allows a water body to be listed if (1) "statistically significant… sediment toxicity" is observed, and (2) "if the observed toxicity is associated with a pollutant or pollutants …" The Listing Policy further specifies that the association of pollutants with toxic or other biological effects can be established using sediment quality guideline exceedances, equilibrium partitioning approaches, or TIE or similar evaluations. The SQO process, on the other hand, requires three lines of evidence, and utilizes chemistry thresholds developed within the SQO program using California datasets. As discussed elsewhere (see Comment 1 and Attachment B), the use of only two lines of evidence is without solid scientific foundation. Thus, we encourage the State Board either to amend the Listing Policy, especially Section 3.6, to be consistent with the SQO, or to clarify explicitly within the SQO policy that listings based on sediment pollutant impairments be made only after evaluation of all three LOE as described in the SQO Scoping Document. If this change is not made, the State will continue to list water body segments using only toxicity data and comparison of chemical concentrations to sediment quality guidelines. Failing to amend the Listing Policy, or to otherwise correct this inconsistency between programs, will result in listings that are directly counter to the SQO policy and will result in a greater number of inappropriate, unfounded listings than would otherwise occur. In addition and as discussed in Comment 3, we request that the State Board consider whether stressor identification should be required prior to listing or should be done in the context of a TMDL.

Comment 12 – Comments on Proposed SQO Monitoring Activities

As currently drafted, the SQO policy places the burden for SQO monitoring on current NPDES permittees. These permittees would be responsible for SQO monitoring (either individually or through coalitions funded by permittees), for follow-on studies to determine the pollutant(s) responsible for observed effects, and (apparently) for meeting new receiving water limits or conducting other sediment management actions. We encourage the SWRCB to develop additional means of funding and implementing the SQO program, particularly for water bodies and/or pollutants affected primarily by legacy pollutants (e.g., DDT, mercury) or for which non-point sources are likely the primary source (e.g., pesticides and herbicides applied to agricultural land uses; pollutants, such as dioxins and some metals, that arrive to land surfaces primarily via atmospheric deposition and are subsequently washed off into surface flows). We also request that the State Board consider alternatives to the current proposal that existing NPDES permittees will conduct all SQO monitoring, as follows:

- All monitoring will be conducted by monitoring coalitions funded by NPDES permittees
- All monitoring will be conducted by monitoring coalitions funded by NPDES permittees and the State and Regional Boards
- Monitoring will be conducted by existing NPDES permittees without monitoring coalitions
- Existing permittees will be required both to contribute to monitoring coalitions and to conduct additional sediment monitoring as required by their NPDES permit

In any case, we support the requirement of the Scoping Document that monitoring programs must be designed to ensure that monitoring data are spatially and temporally representative, and sample appropriate strata of the water body. We suggest that sediment grain size should

be added to the list of water body characteristics in Section VII.B.5.d (p. 53). We also suggest that the State Board provide additional detail regarding the use of monitoring conducted using "targeted designs" by permittees whose permits are required to meet receiving water limits.

Comment 13 – Data To Be Used In SQO Evaluations

The Scoping Document is unclear on whether existing data will be used to perform an initial SQO evaluation prior to the collection of data using the framework described in the draft plan (pp. 52-53). We request that the State Board provide clarification on this point, including an evaluation of the suitability and appropriateness of using existing data to perform SQO evaluations.

Comment 14 – Revision of TMDLs And Permits After SQO Adoption

As noted in Comment 11, TMDLs and NPDES permits have been adopted throughout the State that address sediment contamination and sediment impairments as described in the State's 303(d) List. Many of these TMDLs and NPDES permits were developed using methodology that is inconsistent with the proposed SQO, in particular the MLOE approach, and where stressor identification was not performed. We request that the State Board specify in the SQO Policy that Regional Boards shall be required to reopen and amend these TMDLs and permits to be consistent with the policy, upon request.

Comment 15 – Technical Comments On MLOE Approach

It appears that additional detail should be provided to allow proper evaluation of the LOE required for an SQO evaluation. Some of this information has been discussed in Advisory Committee meetings and in conversations with Steve Bay at SCCWRP, and we request that the State Board include several clarifications and add additional detail to the draft policy, as follows.

- We suggest clarifying Table 3.4 (p. 44) so that classifications are clearer, as follows:

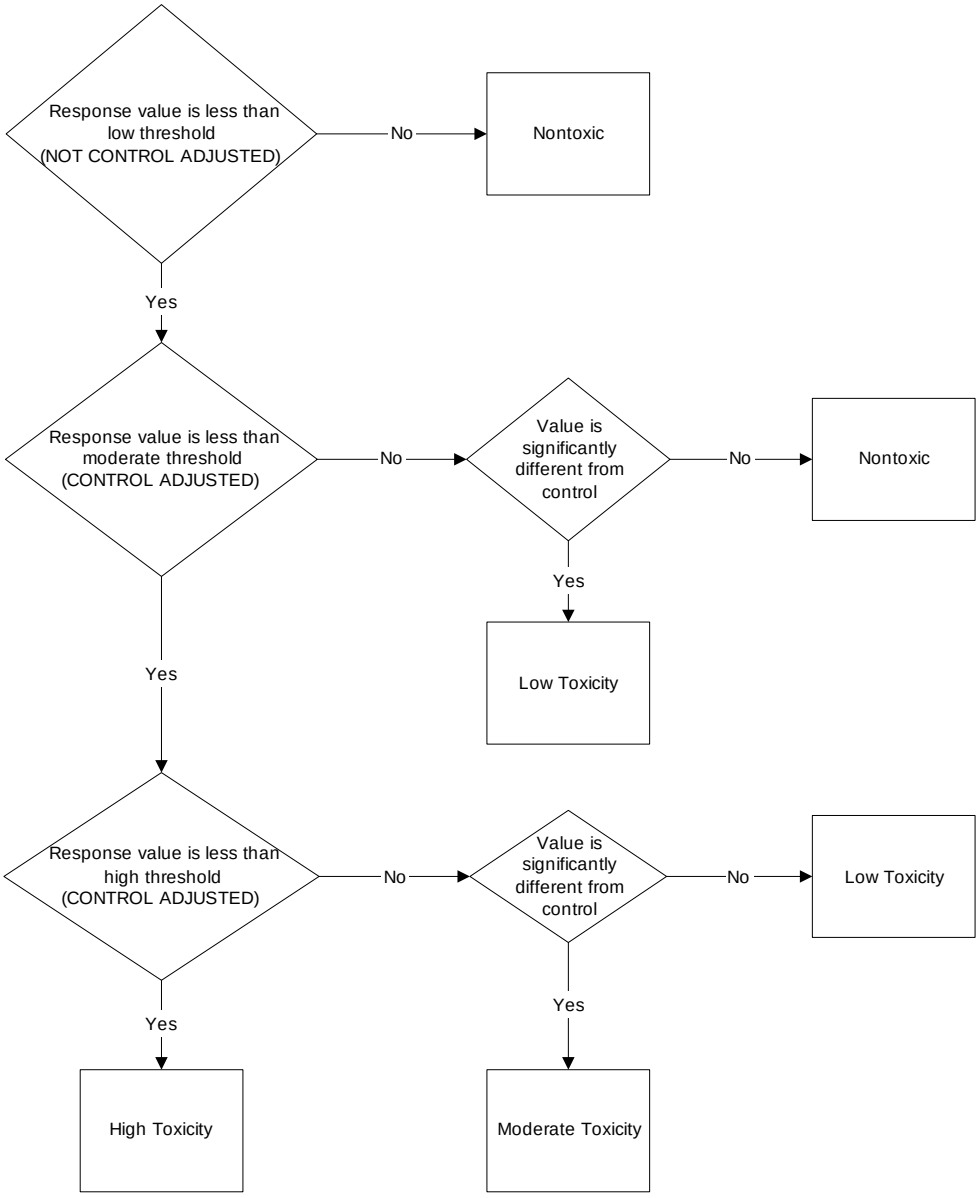
Test Organism/Methods	Nontoxic (Percent)	Low Effects (Percent relative to control)	Moderate Effects (Percent relative to control)	High Effects (Percent relative to control)
Eohaustorius Survival	100-90	≥82	81-63	<63
Leptocheirus Survival	100-90	≥78	77-60	<60
Rhepoxynius Survival	100-90	≥81	80-63	<63
Neanthes Growth	100-90	≥68	67-59	<59
Mytilus Normal	100-80	≥77	76-38	<38

- We request that the State Board clarify the averaging procedures to be used to combine multiple data points (see p. 44, Integration of Sediment Toxicity Data). Candidate language has been provided by Steve Bay of SCCWRP, as follows:

  "The average of the classifications is used to determine the final category for the toxicity line of evidence. Classification and averages are calculated for each sample (i.e., a single sampling event). First the classification for each test type is determined. Generally there is only one test result for each organism type (e.g., mean of lab replicates). For the typical anticipated application, this would represent one acute test category and one sublethal test category. If additional qualifying tests are conducted

(e.g., more that one amphipod species or both Mytilus and Neanthes tests), each test is classified separately. Then the average of all categories is calculated, giving equal weight to each test. The category average can be easily calculated by assigning number values to each category (i.e., nontoxic=1, low=2, moderate=3, high=4). In the case of averages in the middle (e.g., 1.5), the result is rounded up to produce the final toxicity category (e.g., 1.5 becomes 2 or low toxicity)."

- We request that the State Board provide additional detail on the use of controls and statistical procedures to be used to evaluate toxicity data. For example, at a minimum the following diagram provided by Steve Bay at SCCWRP should be included. Ideally, additional explanatory text should be included also, with an example toxicity evaluation.



As detailed in Comment 10, we request that the SWRCB provide detailed information (data plots, goodness-of-fit evaluations, etc.) so that the chemistry thresholds (Tables 3.5 and 3.6 on

pp. 46-47) and utility of the thresholds can be evaluated for various pollutants. As detailed above, we are concerned that some pollutants (e.g., the DDT compounds) should not be included in the evaluation, as chemical concentrations have been shown to be unrelated to impact(s) in sediments at concentrations typically found in sediments in California bays and harbors. Several additional technical concerns remain:

- It is unclear how the thresholds are to be used in the evaluation process. We suggest that the State Board provide more clarity and definition. For example, we suggest specifying category scores as a range of concentrations, as follows (per Steve Bay at SCCWRP):

CCS Category	Sediment Concentration
1	≤T1
2	>T1 and ≤T2
3	>T2 and ≤T3
4	>T4

- It is unclear how thresholds will be evaluated when thresholds are below analytical detection limits. For example, as noted in Comment 10, detection limits for DDT are likely to be above several of the thresholds in Table 3.5.
- It is unclear how calculations will be made when data for some pollutants are missing.
- We suggest that the State Board again specify how averaging of exposure categories should be conducted (e.g., convert to ordinal scores and average those, then convert back to categories?).

REFERENCES

SCCWRP (1998). Sediment chemistry on the mainland shelf of the Southern California Bight. 1997-1998 Annual Report. Available at *http://www.sccwrp.org/pubs/annrpt/97/ar08.htm*.

Bay, Steve (2004). Conclusions regarding the performance of SQGs in the Los Angeles Region. SCCWRP, March 30.

ATTACHMENT B:

Scientific Steering Committee Consensus Opinion on MLOE Approach, March 2, 2005.

The SSC's Perspective On The MLOE Approach:

It is the consensus opinion of the SSC that classification of sediment quality with an approach that follows multiple lines of evidence (MLOE) is superior to a single line of evidence (SLOE) approach. Therefore, we encourage the science team to pursue some form of a MLOE approach in establishment of state sediment quality objectives. Because there are various sources of uncertainty with any single approach, the step of combining the different lines of evidence tends to increase the certainty in correctly classifying the quality of sediments. This step also recognizes the need for data analyses that can link measures of exposure and response (effect).

Thus far, there is no precedent for establishing sediment quality criteria, standards, or objectives based on a MLOE approach. Various MLOE approaches have been used to describe and classify sediment quality, but none thus far establish criteria, standards, or objectives. US EPA developed national sediment benchmarks with one line of evidence, using an equilibrium partitioning approach. The guidelines derived for NOAA, Florida, Manitoba, and British Columbia were derived by statistical analyses of chemistry data and either toxicity or benthic measures. The mid-western sediment quality guidelines calculated by USGS and MESL were established with toxicity data associated with chemistry. Although the Washington standards were based on chemistry data related to both toxicity and benthic measures, the data from these lines of evidence are not added or combined into an overall index or score. In most cases, the measure of effect in the data used to derive such guidelines was acute mortality in a laboratory test with little or no information on the ecological relevance or predictive ability of the toxicity test.

This information would suggest that a SLOE approach would be in line with what has been done previously and therefore acceptable for California. However, given the Legislative mandate and the degree of uncertainty associated with each of the individual lines of evidence, the SSC recommends the pursuit of some form of a MLOE approach and views this approach as a significant step forward in the science of contaminated sediments management.

The scientific community has had considerable experience with characterizing and classifying sediments using data from multiple lines of evidence. The US EPA bioeffects manuals describe the virtues and uses of all lines of evidence that SCCWRP and the State Board have in their MLOE plan. The State of Washington uses a combination of chemistry, toxicity and benthic information to classify their sediments in Puget Sound, but not as a combined index or score. Although the current set of national benchmarks issued by US EPA relies on one line of evidence, users of these guidelines are encouraged to apply them with other sediment assessment tools in making management decisions (e.g., http://www.epa.gov/nheerl/publications/; see the third paragraph of Foreword in any of the ESBs). The triad concept first applied by Long and Chapman in Puget Sound and Chapman and Long in San Francisco Bay relies on a weight of evidence from three kinds of complimentary data. Virtually all of the estuarine ambient monitoring programs in this country rely on some form of the triad to classify sediment quality. Such programs include the two largest nationwide estuarine programs; EMAP operated by US EPA, and NSTP operated by NOAA and many regional programs, including those for the Great Lakes, Puget Sound, San Francisco Bay, Chesapeake Bay, Southern California Bight, Tampa Bay, and NY/NJ harbor. The triad concept has been used and published in, at least, the USA, Canada, Australia, UK, France, The Netherlands, and Brazil. Most regulatory programs, including those that control open water disposal of dredged material, require tests of sediment chemistry, toxicity,

and bioaccumulation. Comprehensive ecological risk assessments invariably use a weight of evidence from multiple kinds of assays and tests to estimate and manage risks at waste sites.

The use of any single line of evidence in isolation is problematic. For example, there are several reasons to avoid classifying sediment quality based on the chemical information alone. If only the sediment chemistry line of evidence were used to classify California sediments, mis-classifications of sediments could occur as a result of un-measured toxicants in the sediments, measured toxicants or mixtures for which no objectives were derived, or the presence of substances that would preclude or inhibit the bioavailability of toxicants. Although the predictive abilities of chemical objectives could be determined as an estimate of their reliability, the only way to be sure that the toxicants in the sediments are bioavailable and toxic or not is to subject them to actual testing. Tests of acute mortality and/or sublethal effects are not good surrogates of tests for uptake and bioaccumulation and vice versa. Empirical data are necessary for both lines of evidence.

Similarly, there are several reasons to avoid classification of sediment quality with only the toxicity line of evidence. The SSC is not aware of any monitoring or regulatory program in this country in which the quality of sediments is classified with only toxicity data. It is noteworthy, however, that Washington programs allow biological information to override chemical information; thus, recognizing that the biological line of evidence can have heavier weight than the chemical data. Without the chemistry data, the environmental factors associated with observations of toxicity would be unknown. Spurious results of toxicity tests could be attributable to the presence of natural factors such as ammonia, hydrogen sulfide or physical abrasion or alternatively, the result of un-measured contaminants. Regulatory agencies cannot control toxicity as they would the discharge of specific toxicants or toxicant groups. That is, the regulatory process is inevitably chemical-based, not toxicity-based, so it is necessary to establish a chemistry-toxicity relationship to implement regulatory controls. Toxicity tests performed in the laboratory can be effective measures of the relative bioavailability of toxicity of sediment-bound toxicants, but the ecological relevance of each test can differ considerably among tests. The only accurate way to determine if the toxicity observed in the laboratory is also apparent in the field is to analyze the composition of the resident benthic assemblage at the site to determine whether or not it is impaired.

The use of benthic community condition as the sole measure of sediment quality also is problematic. The composition, diversity and abundance of the benthos can be affected or controlled by a large, complex battery of anthropogenic and natural factors that can work together or in combinations to impair the communities. Without the chemistry and toxicity data, it is impossible to determine if the benthos appears to be adversely altered at a site as a result of natural factors or man-made factors that are subject to regulation. The benthic communities are the resources most at risk from sediment contamination and are the target biological resources for which the sediment quality objectives are intended to protect. Many of the laboratory tests of toxicity are performed with species that are not particularly important components or indicators of the health of the resident biota. The laboratory test species were selected for other virtues. Therefore, to determine if toxicity observed in the laboratory is indicative of actual losses of biological resources, it is necessary to analyze the local benthos to establish that line of evidence.

Sediments classified based on only the tissue uptake/bioaccumulation line of evidence would not account for acute toxicants that do not tend to bioaccumulate in tissues of biota. Most trace metals and polynuclear aromatic hydrocarbons (PAHs) do not bioaccumulate in tissues, so their presence and toxicity would not be accounted for in such an approach. In addition, like the PAHs, all other chemicals that are readily biotransformed would not be appropriately addressed.

Despite our support of the use of a MLOE approach to classify sediments, the SSC members share several concerns regarding the method that might be used to combine SLOE scores into an overall site score. The work plans thus far are purposefully vague on how the individual scores would be calculated and, more importantly, how they would be combined. The MLOE work plan proposes working with stakeholders and scientific advisors to develop an acceptable method. The SSC members believe that a combined scoring method must account for the varying kinds of data that might be generated among sites, account for incomplete data, and identify a numerical score with one line of evidence as different from the same score resulting from a different line of evidence. For example, a chemistry hit in one site should not be scored the same as a benthic hit in another site. However, such accounting of data for individual sites would be impossibly cumbersome in any state-wide or large regional assessment. Necessarily, the way the SLOE scores are combined may be a function of the purpose or intent of the sediment classification and the management questions being addressed. Finally, it will be challenging to communicate or address the uncertainties in the underlying data, especially if the sources of uncertainty differ among the SLOEs among sites or regions of the state.

One perspective on this issue is that the more lines of evidence used in a sediment assessment, the smaller the likelihood of incorrectly designating a site as unimpacted as compared to a single line of evidence situation. That is, with a full compliment of triad data, the sediment analyst can be most assured that a clean site is not contaminated, not toxic, and supports a healthy benthos. On the opposite end of the scale, the analyst can be most assured of classifying a degraded site correctly when the data indicate it is contaminated, the chemicals are bioavailable, the sediments are toxic, and the benthos are adversely impaired. Therefore, the use of a MLOE approach increases the likelihood of the accurate and correct classification of sediments.

Sediment Quality Objectives

Environmental Caucus Meeting With SSC, April 6, 2005

These notes summarize discussion during the meeting held between representatives of the Environmental Protection caucus of the Advisory Committee and members of the Scientific Steering Committee. This meeting was originally scheduled for February 25 and had been agreed to by all members of the Advisory Committee. Its purpose was to allow members of this constituency group to explore science-based questions related to the Multiple Lines of Evidence (MLOE) approach in more depth. As agreed with all members of the Advisory Committee, detailed notes of the meeting are being provided to the entire Committee. There were no materials (e.g., agenda, PowerPoint presentations, documents) prepared for the meeting. Attendees at the meeting are listed at the end of the meeting summary.

In order to provide other Advisory Committee members with the most complete picture possible of the discussion, the following notes identify the speaker and track the detailed content of the discussion to the greatest extent possible. Speakers identified as follows:

- BB: Brock Bernstein, Advisory Committee Facilitator
- EK: Ed Kimura, Sierra Club, Advisory Committee member
- EL: Ed Long, ERL Environmental, Scientific Steering Committee member
- GS: Gabriel Solmer, San Diego Baykeeper, Advisory Committee member
- SB: Steve Bay, SCCWRP, project science team
- SW: Steve Weisberg, SCCWRP, project science team
- TB: Todd Bridges, U.S. Army Corps of Engineers, Scientific Steering Committee member.

BB: this meeting grew out of a letter the environmental caucus of the Advisory Committee sent me late last year, outlining their concerns with the MLOE approach. Some of those concerns have been addressed to some extent in subsequent Advisory Committee meetings, but there are two remaining issues that are of primary concern. These are:

- Better understanding the basis of the SSC's conclusion that a single line of evidence approach to sediment quality objectives (SQO) is not scientifically appropriate and the SSC's support for a MLOE approach
- Determining whether the details (both technical and policy) of developing and implementing a MLOE approach can be resolved in a practical way.

[agreement from EK and GS that these are two key issues]

I suggested that it would be useful for the Caucus members to discuss these questions with one or members of the SSC and the remainder of the Advisory Committee agreed to such a meeting with the conditions that the meeting focus on technical issues, that notes and materials from the meeting be provided to the entire Committee, and that the regulated community members of the Committee have the option for a similar meeting if they so desire.

TB: there are just so many examples where the actual data show that using a single line of evidence would have led to an erroneous conclusion. There are lots of examples I'm familiar with from dredging. We have lots of experience with the uncertainty in interpreting data from single lines of evidence and the only way to deal with that is by using more than one line of

evidence. For example, the Contaminated Sediments Task Force led to striking results when DDT was involved, showing that it had little explanatory value. And metals in sediments in San Francisco Bay have little explanatory value in terms of explaining impacts.
SW: other examples. In one wetland study, lead and antimony were very high in the sediments but there was no biological problem detected. The high chemistry was due to lead shot but it was not bioavailable. Without data from toxicity tests, we would have drawn the wrong conclusion based on the chemistry alone. In other examples, the benthos has been all dead and test organisms die in toxicity tests, but the source of the mortality is not on the list of standard chemical analyses so would not have been identified without the biological effects information.
EK: there was an example of a waste treatment plant causing high toxicity but with no chemical signal and it was due to a surfactant that was not being measured.
GS: is the goal of the SQO effort to identify chemistry problems?
SB: yes, the focus of the legislation and of the project is specifically on contaminated sediments.
EL: SQO will become law. But sediment objectives are not the same as water quality criteria. Water quality criteria are based on laboratory tests and exposure, done chemical by chemical, for both acute and chronic exposures, and we have a lot of this kind of data from tests done over a number of years. We can't do that for sediment. We can spike sediments with specific chemicals, but there is no agreement on how to actually spike sediments. This is because sediments are so much more complex than water. The physical and biogeochemical characteristics of the sediment determine the responses of animals and there is such a large range of conditions and variables that it is incredibly complex. So, if we develop something in the lab and try to apply it to the field, there would be huge errors.
TB: EPA finally decided that there is too much uncertainty involved to be able to develop numeric criteria for sediments
EK: then why do they support a pore water approach? Aren't there problems with that as well?
TB: it does simplify things but also introduces lots of other artifacts. For example, organisms can digest sediment and so on.
EL: this has all followed a progression since the 1970s. We went to the chemists back then and asked them to tell us what was in the sediments, but it was very hard to interpret the toxicological relevance of the sediment chemistry results. So, we went to using toxicity tests as an assessment tool to help interpret the chemistry. But, then we had to ask what the toxicity data actually meant and began to look for changes in the resident benthos to provide context for the toxicity data. The status quo is the use the Triad approach but to keep the legs separate for interpretation. The new step here is to put the three legs together.

[discussed that the goal of the project's MLOE approach is to try to get a numeric score for a site]

EK: I have a question about defining a reference as the basis of comparison
GS: and we're also concerned about what the SQO will be used for. We want a law that will force a cleanup and to have that done to a certain level. Will the SQO help define what level should clean up to?
EK: the MLOE approach seems to be missing the goal
BB: members of the Advisory Committee have been grappling with the need for a target, for some way of knowing when we're done and have gotten where we want to be
EL: that's a common problem, identifying the level of a chemical that's unacceptable. We've done lab tests to show the relationship between chemicals in the sediment and toxicity and how these influence the response. And we've combined multiple chemicals into an index but each of them has its own distribution and history. We've done site-specific chemical guidelines to get at this problem.

TB: New York state has no statewide cleanup level for mercury. Cleanup values (targets) are inherently site-specific.
EL: nickel, chromium, and mercury in San Francisco Bay are coming out of the Delta and "reference" areas are toxic, even though the chemicals are coming from natural sources

[discussion of how SQOs could be used in conjunction with monitoring data to track cleanup success and see how close are getting to a desirable level of sediment quality]

TB: it's easier to set a goal when you have a single contaminant. But when there are mixtures that differ in their mode of action and toxicity, this gets very complex
BB: the big question for the Advisory Committee is where the "line" will be on the SQO scoring scale
SB: the state will probably set one score for the state which will define which level of SQO is protective
EL: that's a policy decision whether you have a basic binary decision point to separate good from bad sediment conditions or a gradient. But at some point you have to draw a bright line to say whether it's good or bad
SW: this is an ongoing discussion with the SSC. At the moment, we have identified several categories for a site:

- Unimpacted
- Likely unimpacted
- Possible impacted
- Likely impacted
- Clearly impacted

We would identify a series of thresholds for the three lines of evidence that would be merged to get the site score. Then would make an assessment about that site and the state needs to set the line(s) separating the degrees of impact and the Advisory Committee should be deeply involved in that process. This would be the process for a single site, but decisions are rarely made on the basis of a single site. Most often we're concerned about a waterbody with many sites. The scientists want nothing to do with the policy of how to make decisions about an area or a waterbody containing multiple sites.
EK: we have a concern with how to define an area, especially sediment management zones
SW: first, have to ask is there a problem? Second, then have to ask what the nature of the problem is and how much cleanup to do.
TB: I think that you would want an approach that would help you set priorities. It's relatively trivial to say that a site is good or bad. It's more important and useful to have information that would enable the state to allocate resources, since the fact is that there's not enough money or time to address every single problem of every size. Would want to know how big the problem is, whether it involves human health or merely a couple of missing amphipod species, what contaminants are involved, etc.
GS: not sold on drawing a single line. There could be different decision pathways for different points on the scale (i.e., the categories listed above) and each kind of result would lead to different sorts of actions.
BB: also have talked about the importance of considering the context, what the condition is at all sites and how the SQO would help to compare conditions across sites
EK: and it would be important to include the possibility that something could be more bioavailable in the future even though it's not a problem now

TB: when you start asking “what do I do now?” you’re going well beyond the SQO itself and into policy decisions
EL: and you need to collect much more evidence to help with that kind of decision, site-specific information and details
SW: the evaluation we appear to have here is that we are moving away from a single bright line and that a gradation (i.e., categories above) is more useful and the stakeholders have to have input about the categories themselves and the thresholds that separate them
TB: I understand the utility of a single line as a basis for action. But the state needs to provide more detail on how the SQOs will be used. It’s difficult to discuss this or provide context-free advice
BB: the Advisory Committee is writing drafts of application guidance, but what we need now is more detailed information on the biological, chemical, and toxicological relationships and their association with the different SQO categories and how the state intends to use these
EK: bioaccumulation is important
SW: yes, but the science is not there yet to develop quantitative-based objectives and the best we can do at this point is the detailed case studies of San Francisco and Newport Bays to move it along
EL: some SSC members have argued for adding a fourth leg for bioaccumulation to the direct effects approach, for example, mussel watch
TB: we have more ability to work with the benthos but fish advisories get much more attention. However, nobody knows how to link sediments and fish tissue and the SQO approach has to spell out how to address such issues if they’re going to be included in the objectives.
SW: we will have narrative objectives for human health and guidance on how to do site-specific assessments. We can’t be as prescriptive as we can be with the benthos.
EK: can you extrapolate from benthic tissue and ecology up the feedweb?
TB: we’ve been measuring chemical toxicity and bioaccumulation in the same tests. But this doesn’t tell you what the residues mean and therefore can’t use them to develop objectives or criteria. We’ve been working on bioaccumulation criteria for New York dredged material, but this is inherently site-specific because of the dependence on details of sediment characteristics. The overall approach could be transferred but the details would have to be site-specific. This is very contentious and has not been done the same way twice.
SW: in response to Ed’s earlier question about sublethal toxicity tests, I think it’s smart to separate the narrative objectives themselves from the tools used to develop the data to implement the objectives. For example, for each line of evidence, there will be thresholds to determine:

- Reference
- Marginal deviation from reference
- Moderate effects
- Severe effects

And, as new toxicity tests and other tools come along, their results can be fitted into this framework without having to redo the entire objectives.
TB: you want to have flexibility to adapt the approaches, because the objectives themselves will probably be around for a long time
EL: state of WA made their approach to SQOs rigid and they can’t be adapted readily
SW: this is a good question for Chris Beegan – how can the underlying indices and tests be changed as science improves?
GS: and that will influence how hard we decide to fight now to get something included

TB: you can at least frame what approach could be used. But you have to be careful of overprescribing, because the framework will be set for many years. But on the other hand, you have to be specific enough to have a basis for action.
GS: this all has to happen in the real world with budget constraints. Wonder whether we want a phased approach that would allow a choice between cleanup or more study, depending on the situation
SW: the SSC has already said that we should consider a phased approach and that's an implementation question. We will do the whole MLOE approach first and then see how it could be scaled based on the size, severity, etc. of a particular situation
GS: and we will need science guidance about what data to use in that process
TB: there will be important issues such as defining the boundaries of a cleanup, etc.
GS: on a slightly different topic, we're concerned about whether the same objectives will apply to the whole state, and about how the site-specific aspect that is being mentioned will be dealt with
SB: the emphasis is that the objectives will be most valuable if they are as general as possible. We're asking whether and where they need to be regional. We have lots of data for San Francisco Bay and southern California, but relatively little data elsewhere. The first question is whether to combine San Francisco and southern California or not. The second question is whether there are subhabitats or mixtures of contaminants that need to be considered separately. There are big data limitations when we start subdividing the state and we want to avoid that as much as possible. For the benthos, there are habitat groupings we're starting to identify and we are striving for comparability. So, we may end up with one benthic index for the whole state or two or three regional indices with translations so that we end with comparable results for the whole state
GS: however, for water quality objectives, there is one number that's the same across the entire state
SW: toxicity tests are a good example of what we're talking about. We wouldn't want to use the same toxicity test for salt and fresh water, because using freshwater test organisms in salt water would provide a wrong answer, and vice versa. What we're working toward, using the toxicity test example, is a set of comparable tests that provide comparable answers about conditions in different environments
EL: chemistry objectives are based on associations with toxicity and toxicity objectives are based on associations with chemistry, but benthos is tricky because there are inherent differences between habitats, but indices will be scales or calibrated so that we get the same answer from different regions
SW: asking at what point benthic communities are different enough to need different indicators or different formulations of the index. But different indices will be calibrated against each other
EL: in Puget Sound, the number of species in benthic cores went down with increasing chemistry, but there were sites where the abundance went up. Indices of benthic response aren't necessarily linear

[discussion of the BRI benthic index has been scaled in terms of loss of community structure along a pollution impact gradient. The BRI is not sensitive to non-indigenous species, but reflects pollution tolerance and intolerance. In southern California, invasive species tend to increase habitat diversity and this leads to increased abundance and diversity of native species. The scientists agree that the index is not thrown off by the presence of non-indigenous species.]

TB: people have an interest in the state being consistent in terms of goals, definition of impact. Achieving this kind of consistency will require modifications to how the underlying tools work. If we don't allow for underlying flexibility then we won't achieve consistency at the higher level. For example, one benthic index might track with sediment chemistry better in one place and another

index track better in another place. Requiring the same index to be used in both places would result in an inconsistent measure of impact due to contamination. Just like the fresh and salt water toxicity tests described earlier.
EK: will we have an opportunity to provide feedback on the workplans?
SB: there's still an opportunity for that. There has been no feedback from the Advisory Committee since the bulk of the workplans were released last October. These are always a work in progress and we're receptive to feedback at any time.
EK: I had some similar questions as the SSC and some confusion about the review process
SW: we wanted the SSC to formally review the workplans as drafts
EK: I have no objection to the Triad but I had some concerns about the details and how they will work out
SD: we're open to comment and suggestions
EL: but the workplans have to be finalized at some point
SW: there's a difference between the workplans and the work. We will not produce new versions of the workplans again. There was just the single round of revision in response to the SSC comments on the drafts. The Advisory Committee did not see the first drafts, because we wanted to give the SSC first crack at commenting. We will adjust the work as we go, based on what we learn and on additional comments, but we are not going to produce a whole new series of workplans.
EK: so, the October workplans are not cast in concrete in terms of our input to the work and the reports?
SB/**SW**: absolutely not; there is always the opportunity for comment
BB: the Advisory Committee is concerned about the window for input into the products and about the overall schedule for developing the objectives and the documents
SW: the schedule still has to be confirmed by the State Board, but what we're working toward at this point is that by July we will have the methods for tying the legs of the MLOE together and that will be vetted with the Advisory Committee. We will have selected the specific indicators for the MLOE (e.g., which benthic index, which toxicity tests). However, we will not have selected thresholds that define levels of effect for each indicator. That is not required by the court and the August deliverable will be a set of narrative objectives. After July, we will work with the Advisory Committee to identify the thresholds and scoring. We will present scientific results to help with those decisions, but the thresholds will not be decided by the science team. After July, the Advisory Committee will also need to work on how the objectives would be used in different applications. In the October / November timeframe, we will go back to the SSC for a review of the whole package.
GS: what is the final SSC review, given that many of the decisions (e.g., about thresholds) will be policy decisions?
SW: a combination of science and policy, for example, have the uncertainties been identified and dealt with properly, from a scientific standpoint?
EL: will there be a written report for each workplan?
SB: we expect that there will be reports with analysis results, recommendations. These will be technical reports
BB: Chris Beegan and the State Board will be preparing the actual state document on the objectives
GS: why will the SSC see the policy and guidance for review?
SW: that's something you should ask Chris Beegan. But the policy does use science and the SSC should double-check to ensure that the science has been used properly
TB: I believe in an iterative approach because science and policy are inherently interrelated
GS: but you need a wall between the two because don't want the science tweaked to achieve a certain preconceived regulatory or policy goal

SW: this is a good question for Chris Beegan – whether the policy aspects should be reviewed by the Agency Coordination Committee, the State Board, etc.
GS: this is a really good question. You have to know what the decision options are.
TB: we still don't know exactly what the State Board plans to do with the SQO. You have to know what the objectives are going to be used for in order to select the proper tools. Different applications require different approaches
EK: my questions were about the tools, about whether the site was impacted or not and coming up with tools that are more definitive than what we have now
GS: my concern is how to define good cleanup levels
EL: have to realize that this has never been done. All sediment guidelines in the US and Canada and elsewhere are silent on how they should be used in this regard except for the open water disposal guidelines in the Netherlands. The Washington guidelines are totally silent on that (i.e., cleanup levels).
BB: it seems that the TMDL process is the mechanism for that
TB: it's hard to even define in a consistent way what you mean by cleanup. If at a Superfund site, then you have a set of tools for that, but in a TMDL in Newport Bay, for example, cleanup may mean cleaning up sources in the watershed, not contaminated sediment in the Bay itself
SB: the tools in the SQO will enable us to evaluate condition at a station and then the SQO result gets used in other management and regulatory programs
SW: but you do get one thing. Something concrete enough to force action. If the sediment fails and needs to be fixed, then the specific fix is more program and site specific
BB: the Advisory Committee is working now on developing that kind of application guidance
GS: I'm concerned that the tools will be applicable to and consistent with programs used in other instances, especially when we don't have all three legs. The 303d listing guidance says, for example, that a listing can be based on toxicity data alone, but the SQO approach says that we need more than one leg
EK: but if there was a cleanup effort implemented based on the toxicity data and the 303d listing, then it would of course use the full Triad of data
GS: what does the SSC think should be done with just one leg?
EL: I would use that information to perhaps flag that site but I would not move very far forward without additional information
EK: Basin Plans would have to be updated if we moved more toward a Triad approach
TB: we are trying to establish some level of confidence that we are right in our judgment about a site. The vast majority of sites are not ones where extreme levels of chemistry, toxicity, or benthic change make the conclusion obvious. The majority are ones where there is a large amount of uncertainty associated with making a decision based on one leg alone
SB: the good news is that we don't have that many really extreme sites; that's the dilemma of environmental progress
SW: if you have a site with one leg that's bad, then you could put that in the bin of presumed bad sites and if no more data are collected, then it gets judged bad. This is the burden-shifting approach the Advisory Committee has talked about
TB: the SSC said we didn't like that approach because it's not science based

[all participants agree that such a burden-shifting approach is a policy tool]

BB: it's clearly a mechanism to resolve uncertainty. At the October Advisory Committee meeting, one port representative said that in a situation like that they would want to go and gather more information to find out what was going on
EL: of the estuaries around the country, only a very few are clean or really bad; the majority are somewhere in the middle

SW / **EL**: if we only had chemistry, we could predict aquatic life condition in many cases but there are enough where we couldn't that there is substantial uncertainty. In terms of the burden shifting mechanism where only one leg was available, that could be framed as saying that the preponderance of evidence says there is some effect and more data are needed to resolve that
GS: I guess the analogy would be that if you saw someone standing over a dead body you could presume they had committed a murder but they are innocent until proven guilty and you wouldn't convict them without more evidence linking them directly to the crime
BB: it's also an issue of drawing conclusions at the population level vs. the individual. We can say that there is a quantifiable risk of getting lung cancer if you smoke and can predict how many people a year will get cancer, but we can't predict with certainty whether any specific individual will get cancer
GS: I would like science advice on what to do when all three legs are not available
SW: that's both a science and a policy question. Science can say that here is the level of uncertainty associated with that situation and then it's a science-informed policy decision what to do in that case
GS: if you could describe the uncertainty associated with decision making with one or two legs, that would be helpful
TB: it's hard to provide context-free advice. The more consequential the decision, the greater the impact of missing data. In cleanups, there is generally little doubt that the central area needs cleanup, but a huge amount of effort goes to where the boundaries should be drawn, as the degree of impact declines spatially, and all three legs are useful in those decisions
EL: if we only had toxicity data, without chemistry, we could not be sure that the toxicity response wasn't due to ammonia, for example. Or the benthos could be dead due to grainsize, not chemistry.
GS: in a vacuum, with one leg, would you say that more data were needed?
EL / **TB**: yes, absolutely
TB: and one leg could provide some sense of urgency, but you couldn't make a specific decision about taking action because you wouldn't know what's going on. You need to know what' going on, what the causes are, before deciding what action to take
EL: weight of evidence approaches are used in other environmental arenas, for example, fish tissue, liver function, and histopathological lesions in impacts on fish. For water issues, we often use aquatic chemistry, toxicity, and the plankton community