Summary of SQO SSC Meeting on July 1-2, 2008

July 1 Morning Session

Steve Weisberg (SCCWRP) welcomed and introduced the meeting participants and provided an overview of the meeting objectives.

Steve Bay (SCCWRP) presented an overview of the SQO program history and organization. The State Water Board contracted with SCCWRP in 2003 to develop the technical foundation and assessment tools to implement narrative sediment quality objectives in bays and estuaries. The program is organized around two types of effects from sediment contamination: direct effects on organisms in direct contact with the sediments, and indirect effects on human health or wildlife resulting from consumption of seafood contaminated by trophic transfer from sediments. Development of the assessment tools is divided into three phases. Phase I, which was focused on the development of assessment tools for direct effects in marine bays, was completed last year. Phase II, which includes the expansion of direct effects tools to estuaries and the development of an indirect effects assessment framework for human health, was started last year and is scheduled for completion in late 2010. Planning for Phase III is underway; this phase will likely include development of an indirect effects assessment framework for wildlife.

Steve Bay also described the scope and objectives of the indirect effects assessment for human health. This element of the SQO program has three goals:

1. Develop an assessment framework that will allow agencies to interpret the narrative SQO for human health: "Pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health."
2. Develop or calibrate the tools and indicators needed to use the framework.
3. Provide technical guidance on use of the tools and framework.

The indirect effects assessment framework is intended to be an entry level assessment that will integrate data from various sources and provide results that will be used by other regulatory programs, such as 303(d) listings, TMDLs, and NPDES monitoring. The Science Team has identified two key questions that the assessment framework should address: 1) Do pollutant concentrations in seafood pose unacceptable health risks to human consumers? and 2) Is sediment contamination substantially contributing to the health risk? The assessment framework products should have the following attributes:

- Numeric or categorical results that support a clear decision regarding SQO attainment.
- Multiple (as opposed to binary) results that support ranking and prioritizing of sites.
- Applicable at various spatial scales.

The primary objectives for the meeting were to obtain the SSC's recommendations regarding:

- Determining the assessment conceptual approach.
- Identification of needed tools and data gaps.
- Prioritization of technical activities.

Mike Connor (SFEI) described three conceptual approaches for the indirect effects assessment as a starting point for SSC discussion. Each of the approaches is based on the same basic conceptual model of contaminant transfer from sediment to humans that includes partitioning from sediment and trophic-level interactions. The conceptual approaches included:

- Multi-tiered risk assessment
- Relative risk ranking
- Stepwise decision tree

Each of the frameworks utilizes three lines of evidence: seafood tissue chemistry, sediment chemistry, and bioaccumulation data. Priority chemicals for assessment are PCBs, chlorinated pesticides, and methylmercury. The candidate frameworks differed in several respects, as summarized in the following table.

	A Multi-tiered risk assessment	B Relative risk ranking	C Stepwise decision tree
3 lines of evidence?	Yes	Yes	Yes
Specifies Screening Thresholds	Seafood	Seafood	Seafood and Sediments
Order of evaluation	Seafood first	Seafood first	Sediments first
Complexity	Highest	Middle	Lowest
Scale of Conceptual Model	Local Site	Local Site or Water Body	Local Site
Sediment evaluation	Model contribution to seafood	Compare individual stations to two thresholds	Compare all sediments to one threshold
Ranking Among Sites	Relative contribution to seafood	Four Categories	Binary
Uncertainty approach	Iterative	Multiple Thresholds	Screening vs. Site specific

Brock Bernstein (Advisory Committee Chair) provided a summary of the stakeholder Advisory Committee's concerns and suggestions regarding the assessment frameworks.

July 1 Afternoon Session

The SSC discussed various aspects of the frameworks and identified several overarching questions that should be considered in developing an approach for the SQO program:

1. What scale for assessment: station, site, water body?
2. Should assessment start with fish or sediment data? Does it matter?
3. Should output be categorical or binary?
4. Lookup table vs. mechanistic approach for framework? Mechanistic approach best for TMDL activities and 303(d) applications. Lookup approach most practical for compliance/cleanup studies.
5. Should framework be flexible as to order of process and complexity?

6. What is sufficient sediment contribution to body burden to be of concern? How should site contributions be allocated?
7. Should pelagic fish be included in assessment? Benthic-pelagic coupling
8. Sediment-water fluxes of contaminants vs. straight food chain uptake.
9. How far should SQO assessment go?
    - Tee up issue
    - Problem formulation
    - Scale
    - Time course
    - ID contaminants of concern
    - Prioritization
    - Linkage to sediments
10. What technical guidance is needed for fish sampling: species, specific parts of fish? This includes developing the guidance for estimating of trophic transfer factors to model the final concentration in species consumed by humans.
11. What chemicals to focus on? DDTs, PCBs, legacy pest, MeHg. For the future, a procedure should be put in place to allow the introduction of 'new' contaminants into this process.
12. How should screening tables be developed keeping in mind the need for conservatism vs. having tables that are useful to actually screen out stations/sites? The tables should also address situations where due to global non-point sources (i.e., Hg) human consumption of fish already pose risks independent of local contaminant sources.

Bob Brodberg (OEHHA) described the current approach used to establish fish consumption advisories. CA advisories are based on 10^{-4} cancer risk and nutritional consumption rates. An alternate set of fish contaminant levels based on 10^{-6} risk are also described in the OEHHA guidance. In addition, levels for non-cancer endpoints will also need to be addressed, which may affect the temporal scales of the underlying exposure assumptions and subsequent human health risks.

The narrative SQO is "Pollutants shall not be present in sediments at levels that will bioaccumulated in aquatic life to levels that are harmful to human health. An alternate wording of one of the assessment questions was suggested: Could sediment contamination at a site be a significant contributor to contaminant concentrations of concern in seafood? The issue of significant and/or substantial was not fully resolved and is partially a policy issue. This could be further discussed at a future meeting.

SSC members indicated support for the use of multi-output tables for the initial evaluation of sediment and tissue contaminant data (more practical and flexible than single output tables). Two types of assessment output were suggested: 1) a "bucket analysis" to evaluate risk assuming 100% exposure of seafood to the sediment and 2) a spatially aggregated assessment to evaluate the site's contribution with consideration of fish home range and waterbody contamination. Development of a flow chart or related tool to guide fish species selection was recommended by some SSC members.

Several members of the Advisory Committee and audience provided comments and questions to the SSC:

- Lookup tables for sediment chemistry are prone to misuse as cleanup targets and other uses when the users forget or do not know the assumptions and nuances that were used to generate that tables; consider developing separate tables for each waterbody in order to help prevent misuse.
- Presence of risk from legacy pollutants is problematic for establishing TMDLs to improve water quality; need to avoid back calculating from historic sediment concentrations to generate unrealistic TMDL limits on current discharges.
- Desire to have human health framework be adaptable for evaluating wildlife risk and include easy methods to calculate BSAFs.
- Suggest that assessment framework be based on approaches currently used in California.
- Any clean up targets resulting from the program should be demonstrated to provide a measurable reduction in risk.
- Development of a SQO assessment framework will be of great value to regional water quality boards.
- Consider establishing first tier screening levels that are higher than ambient background or risk-based concentrations in order to prevent 100% fail rate at start of assessment. It is particularly important in situations where due to global non-point sources (i.e., Hg) or large legacy sources (i.e., DDT/DDE), human consumption of a large fraction of fish already pose risks independent of local contaminant sources.
- Most practical starting point for assessment is dependent upon application; makes most sense to start with fish tissue data for 303(d) analyses, but start with sediment data for site specific evaluations.

Mike Connor described some of the Science Team's initial concepts for an indirect effects approach and the key technical issues involved in developing an indirect effects assessment framework. These included:

- Development of general technical guidance for sampling, analysis, and data summarization.
- Using bioaccumulation data to help establish linkage between sediments and seafood.
- Integrating station-level sediment data to make a site assessment.
- Establishing linkage between fixed sediments and moving fish.
- Developing tools to evaluate methylmercury. May need to involve an evaluation of processes such as nutrient loading and hypoxia on the internal cycling of mercury and therefore the fraction total mercury present as methylmercury that can bioaccumulate in fish species consumed by humans?

July 2 SSC Recommendations

Several conceptual approaches for an indirect effects SQO assessment framework were discussed by SSC members. Key concepts recommended by the SSC include:

- Allow multiple paths to enter the framework, depending on application (e.g., regional monitoring, site investigation, emerging contaminants).
- First priority should be to address sediment contamination in framework since that is focus of SQO. Should acknowledge that fish impairment may be related to other sources that are outside of SQO focus
- Use food web models, along with BSAFs, to evaluate the contribution of sediments to fish tissue contaminant concentrations for evaluating SQO. Note, BSAF values are likely to have less uncertainty about source for organisms such as shellfish than for pelagic fish and require simpler modeling.
- Shellfish data should be included along with fish tissue data in the evaluation, provided there is a connection with human health.
- Evaluation of tissue chemistry can have greater uncertainty than sediment data and guidance for species selection, sampling, and tissue data integration are needed.
- Written descriptions of the primary types of regulatory applications by regional boards (e.g., TMDL, site assessment/cleanup) should be provided to SSC and Science Team as an aid in development of the framework.
- If seafood tissue concentrations don't pose significant risk, then the SQO is achieved, regardless of sediment contamination level.
- Case studies highlighting different types of applications should be developed to demonstrate feasibility and identify technical issues for framework development.
- Tables used for initial evaluations should contain multiple sets of numbers (thresholds) or weighting factors to provide greater utility for expressing relative risk and assessing concern (eg. 10, 50, 90^{th} percentile values).
- Several methods are feasible for constructing tables to determine the significance or proportional contribution of site sediment contamination to the overall exposure of the fish. These include consideration of contaminant distribution within site, various percentiles of risk, modifying factors, and average concentration with area curves (Freshman JS, Menzie CA. Two wildlife exposure models to assess impacts at the individual and population levels and the efficacy of remedial actions. Hum Ecol Risk Assess 1996; 2(3):481-496.

The SSC outlined a draft SQO assessment framework for development and refinement by the Science Team. A schematic of the framework is shown in the following figure and contains the following elements:

1. Flexible entry points: The assessment can be initiated with either sediment or seafood data, depending on program objectives and data availability.
2. Tiered analysis. Three levels of assessment are envisioned. The first tier consists of an evaluation of either tissue data or a preliminary analysis of sediment data that is intended to identify sites where there is likely risk to human health. Tier 2 uses simplified models to provide an initial evaluation of the SQO using both sediment and tissue data. Tier 3 consists of a refined analysis using additional

data and more sophisticated modeling approaches, as needed, to provide the desired level of confidence in the assessment.

3. Each tier of the assessment provides an opportunity to identify a site as meeting the SQO ("offramp"), based on increasingly realistic assumptions and more data.
4. The framework should also include a step (early in the process) to consider whether existing data is sufficient to determine management actions without a complicated and expensive refined analysis (i.e., Tier 3).
5. Results of the initial (Tier 2) or refined (Tier 3) analyses should consist of a range of values or categories that can be used to establish a clear decision point for determining SQO attainment, yet also support evaluation of management options and consideration of local conditions or concerns.
6. This conceptual approach is applicable in general to other contaminants (e.g., emerging contaminants), provided sufficient data and human health criteria are available. However it may not be possible to conduct the preliminary sediment analysis (See B on Figure) due to limited information regarding fate and bioavailability of the contaminant.

Note: the term fish used in this evaluation should include shell fish, fin fish and other aquatic based organisms that would be consumed by humans. While the assessment is based on species consumed by humans, concentrations in prey species consumed by top predators, using estimates of trophic transfer factors to model the final concentration in consumed species, may lead to the assessment concentration.

The SSC provided additional information regarding the four evaluation components of the framework (boxes A-D on figure).

A. Comparison of seafood tissue data from the site or water body to criteria established by the State Water Board to determine if tissue concentrations pose an unacceptable risk to human health for both cancer and non-cancer effects.
B. Preliminary evaluation of sediment contaminant data. Tables, a decision support system, or other simple tools based upon mechanistic relationships should be used to determine if sediment contaminants concentrations at the site are likely to result in unacceptable risk to human health. This analysis would use standard and relevant assumptions to make a preliminary assessment of the linkage between sediment contaminants and fish tissue contamination. Default factors to consider in this preliminary analysis would likely include: trophic level, lipid content, organic carbon content, site use, BSAFs (especially for shellfish), ingestion rate, bioavailability %, and proportional extent of contamination relative to water body/home range. Minimum data standards should also be met. If no substantial risk is indicated, then the SQO is determined to be attained and the assessment is completed.
C. An initial assessment of risk to human health is conducted if either the seafood (A) or sediment (B) evaluations indicate the need for further analysis. First, an analysis of seafood tissue data should be conducted (A) to verify the presence of human health risk and establish the need for further analysis. Then, both sediment and tissue data from the site or water body are evaluated using software tools based on a mechanistic

model. Ideally, it is best to avoid a proliferation of models. The model should be as simple as practical and be the same for both tiers 2 and 3 with the model for tier 3 to provide opportunities for site specific input. Potential sources for these tools include Trophic Trace, Gobas food web models, and EPA spreadsheet models. The output from this analysis step should describe the contribution of sediment contamination at the site to human health risk. These results will be used to decide if a determination of SQO attainment can be made, or whether a more refined analysis is needed.

D. The refined analysis would include a more complex analysis using a mechanistic modeling approach. The modeling tool should have capability to evaluate potential management actions (not essential for SQO assessment, but beneficial for subsequent planning at the Regional Board level). This analysis would include consideration of factors such as:
    - actual home range of the population of fish that are collected at specific sites. Note that EPA's newest technical guidance for use of the BAF in human WQC has a method for calculating fish home ranges. This might serve as a default approach.
    - size of site
    - distribution of contaminant concentrations
    - likelihood of the human health risk

Next Steps

The SSC recommends that the Science Team develop the next level of framework details and determine whether the approach is feasible. The Science Team should use a case study approach to identify the priority technical issues where SSC input is needed.

A priority of the Science Team should be to develop the tools needed for the preliminary and initial assessments. Tools for the preliminary assessment should not be overly conservative, such that no sites are ever determined to meet the SQO. One way for this to happen would be for the "tool" (model) offer information that provides for characteristics such as the differences that might exist between areas that could reflect food web differences say in Southern California versus Northern California, include information on uncertainty, and other aspects such that the tool provides information that can create a clear screen.

Guidance for conducting the refined analyses should also be provided, but the specific modeling approach used will be determined on a site-specific basis.

The SSC proposed that the tool to be developed for assessing the sediments for human health risk would be a software product that would carry the user from the initial entry to the framework to the final evaluation of the sediment.

The SSC recognized that temporal issues could affect the evaluation of sediments such that if sediment concentrations were declining then some projection of time for the sediments to meet the SQO could be evaluated, likewise if concentrations were increasing for future sediment contaminants that time to projected exceedance could be projected that would trigger evaluation

to prevent continued contamination. This concept could be incorporated to each tier or the framework if data were available.

SSC Conceptual Indirect Effects Assessment Framework