Development of Sediment Quality Objectives for California Bays and Estuaries

Workplan for:

INCORPORATING MULTIPLE LINES OF EVIDENCE INTO SEDIMENT QUALITY OBJECTIVES

March 24, 2005

The State of California's sediment quality objectives (SQOs) must accomplish several objectives. First, they must be protective of multiple beneficial uses, including healthy habitat for aquatic life, human health risk from the consumption of seafood, and risk to fish and wildlife from the bioaccumulation of contaminants. Second, the SQOs must be feasible for use by a variety of agencies with variable types of information. Third, the SQOs must be applicable to various regulatory programs that have different objectives, such as the assessment of entire waterbodies or the regulation of dredging at a localized site. Finally, the SQOs need to be based on current scientific understanding regarding the effects of sediment contamination on organisms. Accomplishing these objectives requires an assessment framework that includes a mechanism to integrate multiple types of information and produce a result upon which management decisions can be based.

A critical decision in developing the SQO assessment framework is whether to base it on a single line of evidence (LOE) or multiple lines of evidence (MLOE). California's water quality objectives are presently based on a single LOE, which are chemical thresholds. A single LOE is appropriate in the water column because the binding effects of other water column constituents are well understood. Moreover, there is a single predominant means for chemical exposure in the water column, transport across the gills. As a result, scientists have has been able to integrate this information to describe site-specific bioavailability of chemical contaminants using tools such as the Biotic Ligand Model.

Sediment, however, is a more complex matrix that makes establishment of an objective based on chemical concentration alone problematic. Bulk measures of chemical concentration fail to differentiate between the fraction that is tightly bound to sediment and that which is found in interstitial waters and more available for transport across the gill. Further complicating interpretation of chemical data is that transport of chemicals in interstitial water across the gill is not the only mechanism for exposure, as many benthic organisms ingest the sediment and can uptake chemicals sorbed onto particles. Thus, even chemical measurement approaches that attempt to differentiate interstitial chemical concentrations, such as using equilibrium partitioning models or direct measurement of pore water chemistry, do not fully describe chemical bioavailability in the sediment.

For this reason, chemistry is often augmented in sediment assessments with measures such as toxicity tests, benthic infaunal condition or direct measures of chemical bioaccumulation to document bioavailability. These other LOEs, however, all have potential flaws that make them inappropriate for establishment of sediment quality objectives when used alone. Toxicity tests

improve in some ways on chemical measurements because they integrate the effects of multiple contaminants, even those chemicals that are not routinely measured. Toxicity tests are problematic, though, because the presence of natural factors such as ammonia, hydrogen sulfide or physical abrasion can lead to spurious results. Moreover, toxicity tests are typically conducted under laboratory conditions using species that may not occur naturally at the test site, making it difficult to interpret ecological significance of the results when used alone. This interpretational difficulty is compounded by the demonstrated difference in sensitivity among different types of toxicity tests and test species.

Benthic community condition is a good indicator because benthos are the resources at risk from sediment contamination and are one of the target biological resources the sediment quality objectives are intended to protect. However, their use alone is problematic because they are potentially affected by a large number of factors other than chemical contamination. Without chemistry or toxicity data for confirmation, it is difficult to distinguish whether degraded benthic communities resulted from chemical exposure or from physical disturbance such as an anchor or propwash.

Bioaccumulation is also a useful measure, but sediments classified based on only a tissue uptake/bioaccumulation LOE would not account for acute toxicants that tend not 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, chemicals that are readily biotransformed would not be appropriately addressed by this line of evidence alone.

For these reasons, California will use a MLOE approach in developing its sediment quality objectives. MLOE are frequently used in sediment assessments. Virtually all of the estuarine ambient monitoring programs in this country rely on some form of triad-based sampling to assess sediment quality. These include the two largest nationwide estuarine monitoring programs, EPA's Environmental Monitoring and Assessment Program and NOAA's National Status and Trends Program, as well numerous regional monitoring 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 the US, Canada, Australia, UK, France, The Netherlands, and Brazil, among others. 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. Even the national chemicals benchmarks issued by US EPA that rely on one line of evidence encourage users to apply them in concert with other sediment assessment tools in making management decisions.

The challenge for the State of California is that while various MLOE approaches have been used to describe and classify sediment quality, they have typically been applied for site-specific or regional assessments. Moreover, MLOE applications are often based on use of best professional judgment (BPJ) for combining the individual lines of evidence (LOE). BPJ will be ineffective for use in sediment quality objectives because the expertise of the individuals applying them will vary considerably across the State and there is a need for statewide consistency in their

application. While there is no direct precedent for translation of MLOE into criteria, standards, or objectives, there are some applications that move in that direction from which lessons can be learned. The State of Washington sediment quality standards have provisions to use chemical, toxicological, and benthic composition data to classify sediments for multiple purposes, including disposal of dredged material. The Tampa Bay Estuary Program has adopted a triad of measures of sediment quality for management purposes there. The States of Minnesota and Illinois, in partnership with the ARCS Program of GLNPO, use the triad of measures to assess sediment quality for management in the Great Lakes. However, none of these programs serves as a model for wholesale use and adoption in California.

The goal of this workplan is to describe the activities that will be undertaken to develop a MLOE framework for California's SQOs. The primary goal of this work is to develop a framework that can be used to assess the sediment quality for a sample collected from a specific location (i.e., a station). A secondary goal of this workplan is to provide guidance regarding the use of this assessment information in regulatory programs for larger regions and waterbodies. The workplan is based on the following premises:

- **The MLOE approach is intended to evaluate whether beneficial uses are being protected at an individual sampling station.** The ultimate use of SQOs in California will be as a component of various regulatory programs (e.g., 303(d), NPDES, dredging) that use data from multiple stations to assess sediment quality in a waterbody or region. Each program has differing objectives and requirements that were established prior to the SQO project, however. It is not possible to provide a detailed method for using the SQO results to make a waterbody assessment; as such guidance would infringe upon the jurisdiction of other agencies and could not meet the varied requirements of multiple programs. The SQO MLOE approach will focus on assessing sediment quality at the station level using a standardized methodology, which will satisfy a requirement that the policy can be implemented in a consistent manner throughout the State. Other programs within the State Water Resources Control Board will subsequently integrate the outcome from multiple individual stations to conduct evaluations for a waterbody or region. Program-specific recommendations for the use of the station assessment results will be developed as part of the SQO project in order to maximize consistency among Regional Boards when integrating the data from multiple stations.

- **There are multiple beneficial uses to be protected and lack of protection for any use will lead to a station being classified as impacted.** The beneficial uses to be protected fall into three categories: 1) aquatic life (represented by benthic infaunal organisms), 2) human health, and 3) fish and wildlife.

- **Within a beneficial use category, multiple lines of evidence will be required to determine that a station is impaired.** A guiding principal of the MLOE framework is that no single LOE alone provides enough information to make an effective assessment. Demonstration of both exposure and effect will be necessary to conclude that there is sediment quality-induced impairment.

- **The MLOE approach must be straightforward and standardized.** Most personnel applying the MLOE will not have advanced degrees in biology/toxicology and the framework must be formulated in a way that is easily understood and consistently applied by people with differing technical backgrounds.

- **The MLOEs will be based on an ordinal scoring system.** There is considerable uncertainty in the enumeration and interpretation of sediment quality data. Use of an ordinal scoring system will assist in describing the certainty about whether an individual station is meeting objectives, which will provide additional information that can be used in the binary decisions that must be made about condition of water bodies as a whole. In addition, an ordinal system allows for assessment of trends, which will be another potentially important use of the objectives.

General Approach

The development of a sediment quality assessment framework involves the combination of both technical information and policy concepts. The technical information for this framework will be produced from the work described in other technical workplans for the SQO project (e.g., development of chemistry indicators, development of toxicity indicators, development of benthic community composition indicators, development of bioaccumulation-based indicators); description of these activities is not repeated in this document. This workplan describes the conceptual foundation for the MLOE approach and identifies the key issues and the steps that will be followed to develop the framework. The process of framework development will be iterative and will incorporate input from the SWRCB and various groups associated with the SQO project: Scientific Steering Committee, Sediment Quality Advisory Committee, and Agency Coordination Committee.

The specific tasks to develop the framework are described in the following sections. Tasks 1 to 4 describe the activities to develop a MLOE process for the assessment of a single station. Task 5 describes the development of guidance for how the outcomes from an MLOE application at an individual site can be used for larger scale assessments within selected regulatory programs.

Task 1: Define the lines of evidence that will be used for assessing each beneficial use category

California's sediment quality objectives will be based on protection of three categories of beneficial uses (habitat for sediment-dwelling aquatic life, consumption of seafood by humans, and consumption of prey by fish and wildlife). Each category of beneficial use (endpoint) will be assessed using a separate MLOE process (Figure 1). The first step is to identify which LOE will form the MLOE for each beneficial use endpoint. The LOE will be selected to provide a logical sequence from exposure to effect for each beneficial use category.

For the sediment-dwelling aquatic life endpoint, the three LOE will be sediment chemistry, sediment toxicity and benthic infauna community condition. Separate workplans to develop the indicators for these LOE have already been prepared. An indicator is a specific type of

measurement or analysis result that is used to describe each line of evidence. Other LOE, such as infaunal tissue contaminant concentrations will also be considered, but will be assessed in context of data availability.

The number of LOE for the seafood consumption and fish/wildlife endpoints are less clear at the present time and will be developed as described in the work plans for those elements. While three (or more) LOE may be desirable to demonstrate the linkage from exposure to effect, this chain may need to be shortened to accommodate the practicality of data collection (e.g. collection of direct human health effect data will likely be impractical). The outcome of modeling efforts for these beneficial uses will drive selection of specific LOE.

Task 2: Develop a scoring system within a LOE

Though MLOE will be used to make an assessment for each endpoint, the first step is to develop a scoring system for each LOE. The interpretation of each LOE will be based upon the results of one or more indicators. The specific indicators and thresholds used will be selected based on the results of work described by other technical workplans. Development of a LOE scoring system involves two subtasks.

Subtask 2.1: Develop scoring for an LOE when a single indicator is available

A scoring system will first be developed for the situation when results for only a single indicator are available for a LOE. An example of this situation is when one toxicity test is used to characterize the station. The goal of this system is to classify the LOE into one of several categories, each representing a different level of impact relative to the reference condition. Various types of scoring systems are possible. This task will investigate the pros and cons of several scoring systems and incorporate input from the SSC, Advisory Committee, and the Agency Coordinating Committee in developing the system to be used.

The simplest type of scoring system is a binary approach, where there are only two possible categories: unimpacted and impacted. The impacted category would be defined by a narrative description of a difference from the reference condition. The binary system is simple to use, but it may not provide sufficient resolution to describe important differences in magnitude of response or certainty in the data.

An alternative to the binary scoring system is an ordinal system consisting of multiple categories. A narrative statement would define each category in this system. The categories could be based on the severity of effect, the certainty of the result, or a combination of characteristics. An example of this type of system is shown in Table 1, where four categories are based on a combination of response magnitude and certainty.

The first category shown in Table 1 represents no distinguishable difference from the reference condition or control. The next category reflects a situation where a small effect is observed, but it is hard to distinguish the effect from measurement or interpretation error. While this category might not indicate a likely effect, it is important to distinguish it from the situation where there is clearly no effect, and is consistent with incorporation of a margin of safety into the sediment

quality objectives. The third category represents a response that is clearly different (in both a statistical and interpretational context) from reference condition, but where the effects are only moderate. The fourth category indicates a severe effect on the indicator.

Depending upon the method used to integrate the various LOE (Task 3) the scoring results will be summarized either as a narrative statement (i.e., moderate effect) or as a numeric value. Input from the SSC, the Stakeholder Advisory Committee and Agency Coordination Committees will be used to help determine of the number of categories and their definitions. The indicator response thresholds used to classify the sample will be based upon the results of analyses to develop each indicator (described in separate workplans).

Table 1. Example categorical scoring system to classify an indicator response.

Category	**Description**
Reference	Equivalent to reference or control condition
Marginal	Slight deviation from reference (possibly defined by measurement error)
Moderate	Clear difference from reference, intermediate response
High	Severe effect, generally present in a small percentage of samples

Task 2.2: Develop scoring for a LOE where multiple metrics are available

There will often be stations where data for more than one indicator within a single LOE is available, such as multiple toxicity tests using different test species. If data for multiple indicators are available, then the results will be combined to determine the LOE score. There are several possible approaches that can be used for integrating multiple indicators. This task will investigate the pros and cons of these methods and develop a system for generating a LOE score.

The simplest approach for combining indicators would be to take the average response of all of the indicators. An alternative approach would be to score the LOE based on the indicator that scores the poorest, with the rationale that multiple tests measure different attributes. For example, different toxicity tests may be sensitive to different classes of contamination or may work through different routes of exposure. However, scoring a LOE based on the assumption that each indicator measures a different property must be balanced against the possibility of laboratory measurement error when only one of many tests produces an apparent effect.

A third approach would be to base the LOE score on the indicator in which there is greatest confidence. This would require a ranking of indicators, which could be problematic. In addition, if different indicators truly measure different properties, it may be inappropriate to rank one test as better than others.

A fourth approach would be to use a combination, scoring the LOE based on both severity of response for the most sensitive indicator and concordance of response among indicators. An example of this approach is shown in Table 2. In this example, the LOE could be scored as "Moderate" if either multiple indicators indicated a moderate effect or if one indicator indicated a severe effect in absence of agreement from other indicators. The highest score would only occur if one indicator indicated a severe effect and multiple indicators also indicated at least some effect.

Table 2. Possible LOE scoring system when multiple metrics are measured.

Category	Description
Reference	No effect observed in any test
Marginal	Measured effect in at least one test
Moderate	Effect measured in multiple tests or a severe effect in one test
High	Severe effect in one test and concordance of effect among multiple tests

Task 3: Develop a means for integrating scoring across multiple lines of evidence to develop a station assessment

Once the individual LOE have been scored, they must be combined in a manner that allows State personnel to determine whether beneficial uses are protected at that sampling site. Emphasis will be placed on the development of integration methods that require only limited technical expertise to apply. The target audience of local water quality managers that will be applying and interpreting the SQOs may not be proficient in the many disciplines required to evaluate raw sediment quality data. A well-defined process that can generate consistent results when applied by individuals having different technical backgrounds is needed.

There are two important underlying issues that will determine the direction taken in determining how to integrate the individual LOEs:

- What are the critical decision thresholds desired from the scoring system and should they be based on a categorical or continuous response?

- Should the individual LOEs be weighted equally or should one of more LOEs be given a higher priority in the scoring?

In part, these are scientific issues, but they also involve policy decisions about desired products from the scoring system and about the relative importance of protection vs. prediction in a scoring system. For that reason, this task will be conducted in close cooperation with the Stakeholder Advisory and Agency Coordination Committees.

Initial discussions with these advisory committees suggest that the desired scoring system should be categorical. A categorical approach is consistent with the State's planned emphasis on

narrative criteria, which is being employed because the associated assessment tools are likely to evolve with time. A continuous scale can provide additional information regarding certainty about whether an individual station is meeting objectives and can also be useful in conducting trend analysis. However, a continuous scale also implies a linearity that may not be possible to achieve in a simplified scoring manner.

Preliminary discussions with the advisory committees suggest that if a categorical approach is selected, there are likely to be at least five assessment categories, such as:

- Unimpacted
- Likely unimpacted
- Possibly impacted
- Likely impacted
- Clearly impacted

The number and nomenclature for these categories will be constructed in partnership with the Stakeholder Advisory and Agency Coordination Committees. One option these groups will be asked to consider is whether to include an assessment category of "inconclusive". The advantage of this category would be to acknowledge interpretational uncertainty in some indicators, particularly where the observed effects are marginal or there is considerable disagreement among the different LOE. The disadvantage of incorporating this category would be that data from such sites could effectively be discarded unless a mechanism is available to gather additional data.

Weighting among individual LOEs will most likely be equal, consistent with the MLOE rationale that there is a need to demonstrate a linkage between exposure and effect. Giving greater weight to a contaminant exposure LOE may create uncertainty as to whether the exposure is causing an effect in the target organisms. Similarly, giving greater weight to a biological effect LOE may add uncertainty as to whether sediment contaminant exposure is causing the observed effect. Still, there could be merit in placing greater emphasis on the biological condition, as that is the desired endpoint to be protected. These alternatives will be discussed with the advisory committees.

If equal weighting is employed, there will be a finite number of individual LOE combinations, with the exact number dependent on the number of categories created within each LOE in Task 2. A narrative interpretation and site assessment categorization, similar to that created for the eight categories used in the original applications of the triad (Table 3), will be created for each of these combinations through interaction with the advisory committees. Interaction with all advisory committees will be necessary because assignations at this level of integration, as mentioned above, are part science and part policy.

Once the combinations are assigned narrative interpretations within the context of assessment categories, several data analyses will be conducted to ground truth the system. Dry runs will be conducted using data from real places in California where there is general consensus among stakeholders regarding the presence of impacts. These data will also be used to compare alternative MLOE integration strategies. The rate of potential false negatives and false positives

produced for these sites will then be used to refine the scoring system to achieve correct classification at the large majority of sites. This type of verification will allow stakeholders to develop a consensus comfort that their local contaminated sites are being appropriately ranked both absolutely and in context of other known types of sites in the State.

Second, the repeatability of the assessments will be evaluated by applying the system to sites where replicate samples are available. Some differences among replicates are expected because of small-scale spatial variability and laboratory measurement error, but these differences should not lead to large or frequent differences in assignation of sites to an assessment category.

Finally, concordance among the individual LOEs will be assessed for sites in the SQO database. Some disagreement among LOEs is expected, but expert judgment will be used to determine the frequency that poor concordance results from limited bioavailability, nonchemical impacts or failure of the scoring system to correctly classify a site.

Table 3. Interpretation of MLOE results using a binary classification system.

Typical Triad Interpretation			
Chem	Tox	Benthos	Interpretation
+	**+**	**+**	Impact highly likely: Contaminant-induced degradation in field evident
+	**+**	**-**	Impact likely: Toxic contaminants probably stressing sediment-dwelling organisms
-	**+**	**+**	Impact likely: Unmeasured chemicals contributing to toxicity
+	**-**	**+**	Impact likely: Toxicity test not sensitive enough
+	**-**	**-**	Impact unlikely: Contaminants unavailable to organisms in the field
-	**+**	**-**	Impact unlikely: Unmeasured factors contributing to toxicity
-	**-**	**+**	Impact unlikely: Effects on benthos not due to sediment contamination
-	**-**	**-**	Impact highly unlikely: Contaminant-induced degradation not evident

Task 4: Develop a strategy to evaluate incomplete data

The algorithms developed in Task 3 will be based on having all LOE available. While the State can require the proper types of data be collected for future assessments, many historical datasets will have incomplete information necessary to evaluate all of the required LOE. This task will involve developing algorithms for application of the MLOE framework to these incomplete data sets.

The simpler missing data circumstance will be when at least two LOE, representing both exposure and effect, are available. In this case, the scoring system could be adjusted to compensate for fewer lines of evidence, but it could still be based on the same principle of demonstrating both exposure and effect that would be used for assessments with complete information. The principal difference would be that there would not be a third LOE for confirmation in the event that the two LOE disagree. It is likely that that an assessment category of "inconclusive" would need to be established or augmented to reflect the greater uncertainty associated with the situation where there is nonconcordance between the LOE.

The more difficult situation will be when only a single LOE is available. As outlined earlier in this document, use of a single LOE to establish lack of beneficial use protection is problematic. However, there is a difference between having a single LOE indicating concern that conflicts with the other LOE and having only a single line, where other LOE are unavailable for confirmation.

Input from the Stakeholder Advisory and Agency Coordinating Committees will be used to develop guidance on how to deal with sites having only a single LOE. Several options will be considered. One option is to classify stations having only a single LOE as insufficient for assessment and defer any decisions until more data are provided. A second option could include a burden-shifting mechanism to encourage the prompt collection of additional data so that a definitive assessment can be made about the site. This mechanism might include classifying a station with severe effects for a single LOE, where other LOEs are unavailable, as "presumed impaired". Under this classification, a specified time period would be allowed to collect additional data for the evaluation of multiple LOEs before this station would be used in an assessment. If additional LOE became available, then the station assessment would be made using the new data. If no additional data were collected during that appointed period of time, the station classification would be changed to "likely impaired". The use of an automatic reclassification mechanism would be intended to shift the burden for additional data collection to the potentially responsible parties in the circumstances where such data are critical to a confident assessment of a water body. A third option would be to consider associated information or the intended use of the data. If the data are consistent with related types of information (not formally part of the LOE) or the application is judged to be of relatively low risk, then a decision could be made to use the incomplete information in a limited manner.

Task 5: Develop guidance for SQO applications

California's SQOs will be oriented towards assessments for individual stations or samples, but the results from these assessments will subsequently be used to identify impaired waterbodies, assess impacts from point source and nonpoint source discharges, regulate dredging/disposal activities, and plan sediment cleanup activities. These regulatory decisions are typically made on a collection of stations that encompass a waterbody or a potentially affected area and there needs to be a translation to this larger scale from the individual station assessments made through the SQOs. While different departments within the State Water Resources Control Board make these decisions, this task will provide guidance to those program managers about possible use of SQOs as a means of enhancing consistency in their application.

The program areas to be targeted in developing this guidance will be based on input received from the Advisory Committee and regulatory agencies within California. It is anticipated that the guidance will address 303d assessments, dredging and aquatic disposal, and NPDES impact determinations. Existing approaches for these State programs will not be redefined in this task. Rather, the goal will be to assess whether use of the SQOs is compatible with these existing programs and to provide guidance that will enhance consistency of their use within the programs. The guidance development process will solicit and incorporate input from State agencies responsible for implementing regulations in each program area as well as the Advisory Committee. The process of obtaining input from agencies and stakeholders regarding SQO applications is in progress and will continue throughout 2005.

Part of the guidance may describe the appropriate amount of data necessary to make different types of decisions using the sediment quality objectives. For instance, there may be desired economies of scale in which the amount of data necessary to conduct a preliminary site assessment is less than that needed to develop a 303d listing recommendation, which is less than that needed to make cleanup decisions. Similarly, it may be advisable to develop guidance for implementing the MLOE in a phased manner for some applications, in which the need for collecting or processing all LOE is determined sequentially based on collecting only a subset of LOE initially. For instance, the absence of toxicity in multiple toxicity tests could preclude the need for processing chemistry and benthic infaunal data where the principal question is a simpler one, such as preliminary screening of sites.

Application guidance will also need to include mechanisms for translating failure of sediment quality objectives to management actions. The MLOE approach relies on a rigorous set of information for classifying a site as impacted or waterbody as impaired, but it does not specify which chemical is responsible for that determination. This limits managers' ability to act on the response. There are several possible means for resolving this. Depending on success of the analyses to develop the chemistry LOE indicators, it may be possible to develop chemical specific thresholds that can be used as guidance for the underlying chemical cause when MLOE indicate impacts at a site. Spatial gradient analysis is another approach that will be described which can provide managers with information about sources that need to be addressed. Toxicity Identification Evaluations for sediment are also under development in California and the application guidance will describe the state of that science and how they might be used to move

from a determination of site impact to implementing management actions to resolve the most likely chemical cause.

Finally, development of program-specific application guidance will also incorporate the results from preliminary analyses of data using the proposed SQOs. For example, the draft SQOs may be applied to data from waterbodies expected to represent reference conditions. The results of these station assessments may be used to refine the methods used to classify individual stations, or they may be used to develop recommendations regarding the minimum amount of data or frequency of impacts needed to classify a waterbody as impaired.

MLOE GLOSSARY

Endpoint	A general beneficial use category that is composed of several related specific beneficial uses (e.g. aquatic life).
Line of Evidence	A category of information that describes contaminant exposure and/or biological effects (e.g. sediment chemistry, toxicity).
Indicator	Specific type of measurement or analysis result used to determine the characteristics for an individual line of evidence (e.g. sediment toxicity, bulk sediment chemistry, benthic macrofauna abundance).
Indicator Score	A classification of an indicator result using either a categorical or numeric system.
Line of Evidence Score	A summary classification (numeric or categorical) of a line of evidence that is based on the responses of one or more indicators.
Endpoint Score	A summary classification describing the level of beneficial use protection/impacts that is based on an integration of multiple lines of evidence pertaining to a single endpoint type.
Station Assessment	An overall description of beneficial use protection/impacts for a station based on the integration of information from multiple endpoints.
Waterbody Assessment	An evaluation based on SQO results for multiple stations as to whether program-specific criteria or requirements have been met (e.g., 303d listing or NPDES permit compliance).

Schedule

Task	Activity	Completion Date
1. Define the LOE for each beneficial use category		June 2005
2. Develop LOE scoring system	2.1. Develop scoring for single metric	June 2005
	2.2 Develop scoring system for multiple metrics	June 2005
3. Develop a means for integrating scoring across multiple LOE		June 2005
4. Develop a strategy to evaluate incomplete data		June 2005
5. Develop guidance for SQO applications		August 2005

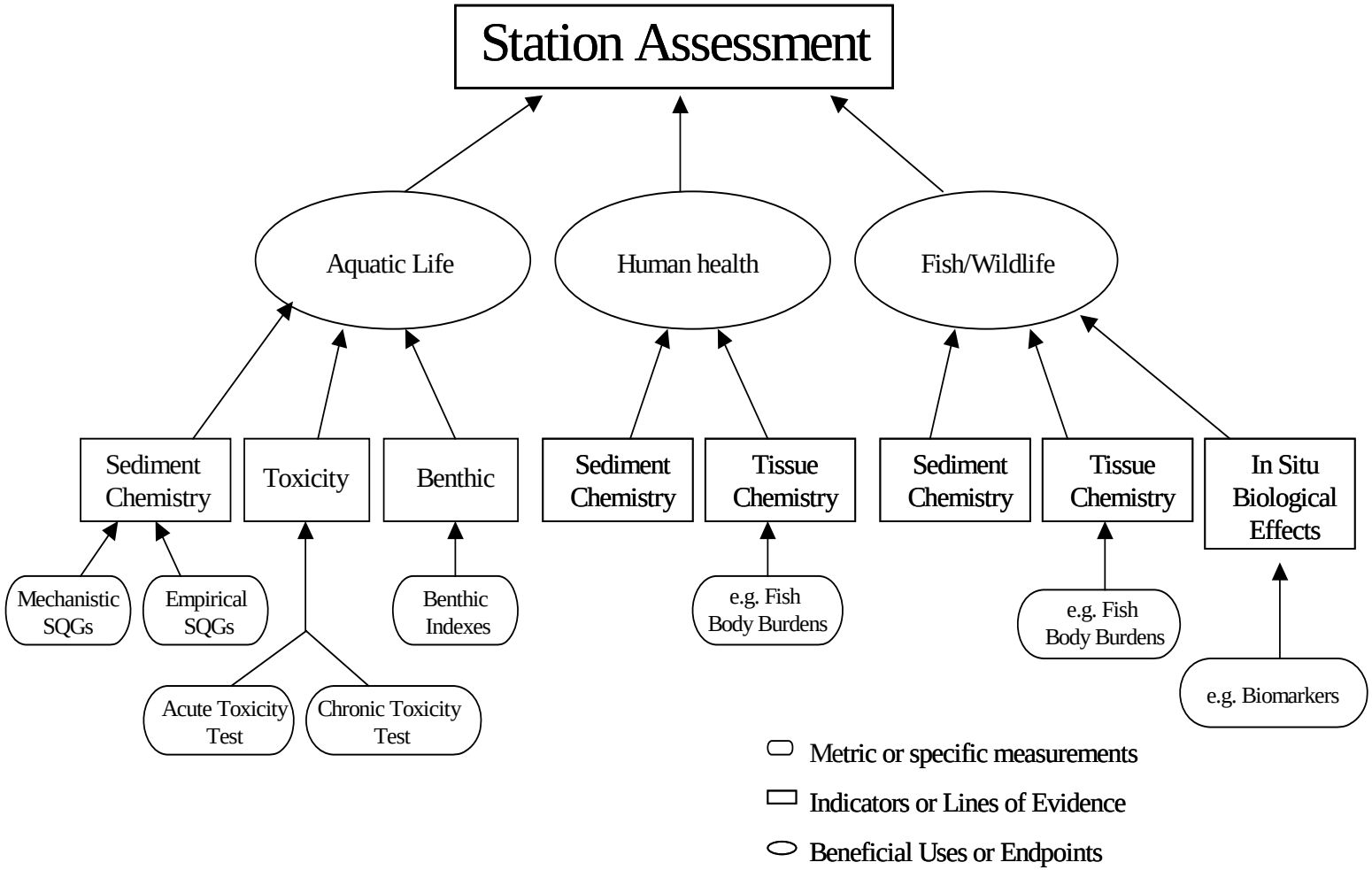

Figure 1. Components of MLOE framework for station assessments. Individual MLOE assessments will be conducted for each of three beneficial use categories. The overall station assessment is based upon the greatest degree of impairment among categories. Note that the LOE components shown for the Human Health and Fish/Wildlife categories are preliminary and subject to revision based on the results of work in progress.