DRAFT WATER QUALITY CONTROL PLAN FOR ENCLOSED BAYS AND ESTUARIES PLAN
PART 1 SEDIMENT QUALITY

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I. INTENT AND SUMMARY

A. Intent of Part 1 of the Water Quality Control Plan for Enclosed Bays and Estuaries (Part 1)

It is the goal of the State Water Resources Control Board (State Water Board) to comply with the legislative directive in Water Code §13393 to adopt sediment quality objectives (SQOs). Part 1 integrates chemical and biological measures to determine if the sediment dependent biota are protected or degraded as a result of exposure to toxic pollutants* in sediment and to protect human health. ~~This plan~~Part 1 is not intended to address low dissolved oxygen, pathogens or nutrients including ammonia. ~~This Draft Plan~~Part 1 represents the first p~~P~~hase of the State Water Board's SQO d~~D~~evelopment~~al~~ e~~E~~ffort and focuses primarily on the protection of benthic* communities in enclosed bays* and estuaries*. The State Water Board has committed in the second p~~P~~hase ~~II~~ to the refinement of benthic community protection indicators for estuarine waters and the development of an improved approach to address sediment quality related human health risk associated with consumption of fish tissue.

B. Summary of Part 1

Part 1 includes:

1. Narrative SQOs for the protection of aquatic life and human health;
2. Identification of the beneficial uses that these objectives are intended to protect;
3. A program of implementation that contains:
    a. Specific indicators, tools and implementation provisions to determine if the sediment quality at a station or multiple stations meets the narrative objectives;
    b. A description of appropriate monitoring programs; and
    c. A sequential series of actions that shall be initiated when a sediment quality objective is not met including stressor identification and evaluation of appropriate targets.
4. A glossary that defines all terms denoted by an asterisk

II. USE AND APPLICABILITY OF SQOS

A. Ambient Sediment Quality

The SQOs and supporting tools shall be utilized to assess ambient sediment quality.

B. Relationship to other narrative objectives

~~This Plan~~Part 1 supersedes all applicable narrative water quality objectives and related implementation provisions in water quality control plans (basin plans) to the extent that the objectives and provisions are applied to protect bay or estuarine benthic communities from toxic pollutants in sediments.

~~B~~C. Applicable Waters

~~This Plan~~Part 1 applies to enclosed bays[1] and estuaries[2] only. ~~This Plan~~Part 1 does not apply to ocean waters* including Monterey Bay and~~,~~ Santa Monica Bay, or inland surface waters*.

~~C~~D. Applicable Sediments

Part 1 applies to subtidal surficial sediments* that have been deposited or emplaced seaward of ~~below~~ the intertidal zone. ~~This Plan~~Part 1 does not apply to:

1. Sediments characterized by less than five percent of fines or substrates composed of gravels, cobbles, or consolidated rock.
2. Sediment as the physical pollutant that causes adverse biological response or community degradation related to burial, deposition, or sedimentation.

~~D~~E. Applicable Discharges

Part 1 is applicable in its entirety to point source* discharges. Nonpoint sources* of toxic pollutants are subject to Sections ~~Chapters~~ II, III, IV, V, and VI of Part 1.

III. BENEFICIAL USES

Beneficial uses protected by Part 1 and corresponding target receptors are identified in Table 1.

[1] ENCLOSED BAYS are indentations along the coast which enclose an area of oceanic water within distinct headlands or harbor works. Enclosed bays include all bays where the narrowest distance between headlands or outermost harbor works is less than 75 percent of the greatest dimension of the enclosed portion of the bay. This definition includes, but is not limited to: Humboldt Bay, Bodega Harbor, Tomales Bay, Drakes Estero, San Francisco Bay, Morro Bay, Los Angeles Harbor, Upper and Lower Newport Bay, Mission Bay, and San Diego Bay.

[2] ESTUARIES AND COASTAL LAGOONS are waters at the mouths of streams that serve as mixing zones for fresh and ocean waters during a major portion of the year. Mouths of streams that are temporarily separated from the ocean by sandbars shall be considered as estuaries. Estuarine waters will generally be considered to extend from a bay or the open ocean to the upstream limit of tidal action but may be considered to extend seaward if significant mixing of fresh and salt water occurs in the open coastal waters. The waters described by this definition include, but are not limited to, the Sacramento-San Joaquin Delta as defined by Section 12220 of CWC, Suisun Bay, Carquinez Strait downstream to Carquinez Bridge, and appropriate areas of the Smith, Klamath, Mad, Eel, Noyo, and Russian Rivers.

Table 1 Beneficial Uses and Target Receptors

BENEFICIAL USES	TARGET RECEPTORS
Estuarine Habitat	Benthic Community
Marine Habitat	Benthic Community
Commercial and Sport Fishing	Human Health
Aquaculture	Human Health
Shellfish Harvesting	Human Health

IV. SEDIMENT QUALITY OBJECTIVES

A. Aquatic Life – Benthic Community Protection

Pollutants in sediments shall not be present in quantities that, alone or in combination, are toxic to benthic communities in bays and estuaries of California. This narrative objective shall be implemented using the integration of multiple lines of evidence (MLOE) as described in Section V of Part 1.

B. 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. This narrative objective shall be implemented as described in Section VI of Part 1.

V. BENTHIC COMMUNITY PROTECTION

A. Multiple Lines of Evidence Approach

The methods and procedures described below shall be used to implement the Narrative Objective described in Section IV.A. These tools are intended to assess the condition of benthic communities relative to potential for exposure to toxic pollutants in sediments. Exposure to toxic pollutants at harmful levels will result in some combination of a degraded benthic community, presence of toxicity, and ~~or~~ elevated concentrations of pollutants in sediment. The assessment of sediment quality shall consist of the measurement and integration of three lines of evidence (LOE). The LOE are:

> **Sediment Toxicity**: Sediment toxicity is a measure of the response of invertebrates exposed to surficial sediments under controlled laboratory conditions. The sediment toxicity LOE is used to assess both pollutant related biological effects and exposure. Sediment toxicity tests are of short durations and may not duplicate exposure conditions in natural systems. This LOE provides a measure of exposure to all pollutants present, including non-traditional or unmeasured chemicals.
>
> **Benthic Community Condition**: Benthic community condition is a measure of the species composition, abundance and diversity of the sediment-dwelling invertebrates inhabiting surficial sediments*. The benthic community LOE is used to assess impacts to the primary receptors targeted for protection under Section IV.A. Benthic community composition is a measure of the biological effects of both natural and anthropogenic stressors.
>
> **Sediment Chemistry**: Sediment chemistry is the measurement of the concentration of chemicals of concern* in surficial sediments. The chemistry LOE is used to assess the potential risk to benthic organisms from toxic pollutants in surficial sediments. The sediment chemistry LOE is intended only to evaluate overall exposure risk from chemical pollutants. This LOE does not establish causality associated with specific chemicals.

B. Limitations

None of the individual LOE is sufficiently reliable when used alone to assess sediment quality impacts due to toxic pollutants. Within a given site, the LOEs applied to assess exposure as described in Section V.A. may underestimate or overestimate the risk to benthic communities and do not indicate causality of specific chemicals. The LOEs applied to assess biological effects can respond to stresses associated with natural or physical factors, such as sediment grain size, physical disturbance, or organic enrichment.

Each LOE produces specific information that, when integrated with the other LOEs, provides a more confident assessment of sediment quality relative to the narrative objective. When the exposure and effects tools are integrated, the approach can quantify protection through effects measures and also provide predictive capability through the exposure assessment.

C. Water Bodies

1. The tools described in the Sections V.D. through V.I. are applicable to Euhaline* Bays and Coastal Lagoons* south of Point Conception and Polyhaline* San Francisco Bay that includes the Central and South Bay Areas defined in general by waters south and west of the San Rafael Bridge and north of the Dumbarton Bridge.
2. For all other bays and estuaries where LOE measurement tools are unavailable, station assessment will follow the procedure described in Section V.J.

D. Field Procedures

1. All samples shall be collected using a grab sampler.
2. Benthic samples shall be screened through:
    a. A 0.5 millimeter (mm)-mesh screen in San Francisco Bay and the Sacramento-San Joaquin Delta;
    b. A 1.0 mm-mesh screen in all other locations.

3. Surface sediment from within the upper ~~Surface sediment consisting of the top~~ 5 ~~2~~ cm shall be collected for chemistry and toxicity analyses.

4. The entire contents of the grab sample, with a minimum penetration depth of 5 cm, shall be collected for benthic community analysis.

5~~4~~. Bulk sediment chemical analysis will include at a minimum the pollutants identified in Attachment A.

E. Laboratory Testing

All samples will be tested in accordance with U.S. Environmental Protection Agency (USEPA) or American Society for Testing and Materials (ASTM) methodologies where such methods exist. Where no EPA or ASTM methods exist~~s~~, the State Water Board or Regional Water Quality Control Boards (Regional Water Boards) (collectively Water Boards) shall approve the use of other methods. ~~-~~ Analytical tests shall be conducted by laboratories certified by the California Department of Health Services in accordance with Water Code Section 13176.

F. Sediment Toxicity

1. Short Term Survival Tests.
   A minimum of one short-term survival test shall be performed on sediment collected from each station. Acceptable test organisms and methods are summarized in Table 2.

Table 2 Acceptable Short Term Survival Sediment Toxicity Test Methods

TEST ORGANISM	EXPOSURE TYPE	DURATION	ENDPOINT*
Eohaustorius estuarius	Whole Sediment	10 days	Survival
Leptocheirus plumulosus	Whole Sediment	10 days	Survival
Rhepoxynius abronius	Whole Sediment	10 days	Survival

2. Sublethal Tests.
   A minimum of one sublethal test shall be performed on sediment collected from each station. Acceptable test organisms and methods are summarized in Table 3.

Table 3 Acceptable Sublethal Sediment Toxicity Test Methods

TEST ORGANISM	EXPOSURE TYPE	DURATION	ENDPOINT
Neanthes arenaceodentata	Whole Sediment	28 days	Growth
Mytilus galloprovincialis	Sediment-water Interface	48 hour	Embryo Development

3. Assessment of Sediment Toxicity.
   Each sediment toxicity test result shall be compared and categorized according to responses in Table 4. The response categories are:

   Nontoxic: Response not substantially different from that expected in sediments that are uncontaminated and have optimum characteristics for the test species (e.g., control sediments).

   Low toxicity: A response that is of relatively low magnitude; the response may not be greater than test variability.

   Moderate toxicity: High confidence that a statistically significant toxic effect is present.

   High toxicity: High confidence that a toxic effect is present and the magnitude of response includes the strongest effects observed for the test.

~~4.Use of Supplemental Toxicity Tests.~~
~~Additional sediment toxicity tests may be included in the assessment. The design of these tests must be consistent with the narrative objective and approved by the Regional Water Board. Response categories that are consistent with those described in Table 4 and specific to each supplemental test must be available for the test to be included in the assessment.~~

Table 4 Sediment Toxicity Categorization Values

TEST SPECIES/ENDPOINT	STATISTICAL SIGNIFICANCE	NONTOXIC (PERCENT)	LOW TOXICITY (PERCENT OF CONTROL)	MODERATE TOXICITY (PERCENT OF CONTROL)	HIGH TOXICITY (PERCENT OF CONTROL)
Eohaustorius Survival	Significant	90 to 100	82 to 89	59 to 81	< 59
Eohaustorius Survival	Not Significant	82 to 100	59 to 81		<59
Leptocheirus Survival	Significant	90 to 100	78 to 89	56 to 77	<56
Leptocheirus Survival	Not Significant	78 to 100	56 to 77		<56
Rhepoxynius Survival	Significant	90 to 100	83 to 89	70 to 82	< 70
Rhepoxynius Survival	Not Significant	83 to 100	70 to 82		< 70
Neanthes Growth	Significant	90 to 100*	68 to 90	46 to 67	<46
Neanthes Growth	Not Significant	68 to 100	46 to 67		<46
Mytilus Normal	Significant	80 to 100	77 to 79	42 to 76	< 42
Mytilus Normal	Not Significant	77 to 79	42 to 76		< 42

* Expressed as a percentage of the control.

~~5.~~4. Integration of Sediment Toxicity Categories.
The average of all test response categories shall determine the final toxicity LOE category. If the average falls midway between categories it shall be rounded up to the next higher response category.~~;~~

G. Benthic Community Condition

1. General Requirements.
   a. All benthic invertebrates in the screened sample shall be identified to the lowest possible taxon and counted.
   b. Taxonomic nomenclature shall follow current conventions established by local monitoring programs and professional organizations (e.g., master species list).

2. Benthic Indices.
   The benthic condition shall be assessed using the following methods:
   a. Benthic Response Index (BRI), which was originally developed for the southern California mainland shelf and extended into California's bays and estuaries. The BRI is the abundance-weighted average pollution* tolerance score of organisms occurring in a sample.
   b. Index of Biotic Integrity (IBI), which was developed for freshwater streams and adapted for California's bays and estuaries. The IBI identifies community measures that have values outside a reference range.
   c. Relative Benthic Index (RBI), which was developed for embayments in California's Bay Protection and Toxic Cleanup Program. The RBI is the weighted sum of: (a) several community parameters (total number of

species, number of crustacean species, number of crustacean individuals, and number of mollusc species), and abundances of (b) three positive, and (c) two negative indicator species.

d. River Invertebrate Prediction and Classification System (RIVPACS), which was originally developed for British freshwater streams and adapted for California's bays and estuaries. The approach compares the assemblage at a site with an expected species composition determined by a multivariate predictive model that is based on species relationships to habitat gradients.

3. Assessment of Benthic Community Condition.
Each benthic index result shall be categorized according to disturbance as described in Table 5. The disturbance categories are:

Reference: A community composition equivalent to a least affected or unaffected site.

Low disturbance: A community that shows some indication of stress, but could be within measurement error of unaffected condition.

Moderate disturbance: Confident that the community shows evidence of physical, chemical, natural, or anthropogenic stress.

High disturbance: The magnitude of stress is high.

Table 5 Benthic Index Categorization Values

INDEX	REFERENCE	LOW DISTURBANCE	MODERATE DISTURBANCE	HIGH DISTURBANCE
		Southern California Marine Bays		
BRI	< 39.96	39.96 to 49.14	49.15 to 73.26	> 73.26
IBI	0	1	2	3 or 4
RBI	> 0.27	0.17 to 0.27	0.09 to 0.16	< 0.09
RIVPACS	> 0.90 to < 1.10	0.75 to 0.90 or 1.10 to 1.25	0.33 to 0.74 or > 1.25	< 0.33
		Polyhaline Central San Francisco Bay		
BRI	< 22.28	22.28 to 33.37	33.38 to 82.08	> 82.08
IBI	0 or 1	2	3	4
RBI	> 0.43	0.30 to 0.43	0.20 to 0.29	< 0.20
RIVPACS	> 0.68 to < 1.32	0.33 to 0.68 or 1.32 to 1.67	0.16 to 0.32 or > 1.67	< 0.16

4. Integration of Benthic Community Categories.
The median of all benthic index response categories shall determine the benthic condition LOE category. If the median falls between categories it shall be rounded up to the next higher effect category.

H. Sediment Chemistry

1. All samples shall be tested for the analytes identified in Attachment A.
   This list represents the minimum analytes required to assess exposure. In water bodies where other toxic pollutants are believed to pose risk to benthic communities, those toxic pollutants shall~~ould~~ be included in the analysis. Inclusion of additional analytes cannot be used in the exposure assessment described below. However, the data can be used to conduct more effective stressor identification studies as described in Section VII. F.~~modify the final sediment quality assessment category and assist in stressor identification~~.

2. Sediment Chemistry Guidelines.
   The sediment chemistry exposure shall be assessed using the following two methods:
   a. Chemical Score Index (CSI), that uses a series of empirical thresholds to predict the benthic community disturbance category (score) associated with the concentration of various chemicals (Table 6). The CSI is the weighted sum of the individual scores (Equation 1).

   Equation 1. $CSI = \Sigma(w_i \times cat_i)/\Sigma w$

   Where: cat_i = predicted benthic disturbance category for chemical I;
   w_i = weight factor for chemical I;
   Σw = sum of all weights.

   b. California Logistic Regression Model (CA LRM), that uses logistic regression models to predict the probability of sediment toxicity associated with the concentration of various chemicals (Table 7 and Equation 2). The CA LRM exposure value is the maximum probability of toxicity from the individual models (P_{max})

   Equation 2. $p = e^{B0+B1\,(x)} / (1 + e^{B0+B1\,(x)})$
   Where: p = probability of observing a toxic effect;
   B0 = intercept parameter;
   B1 = slope parameter; and
   x = concentration the chemical.

Table 6 **Category Score Concentration Ranges and Weighting Factors for the CSI**

CHEMICAL	UNITS	WEIGHT	SCORE (DISTURBANCE CATEGORY) 1 REFERENCE	2 LOW	3 MODERATE	4 HIGH
~~Cadmium~~	~~mg/kg~~	~~38~~	~~≤ 0.09~~	~~> 0.09 to 0.22~~	~~> 0.22 to 1.66~~	~~> 1.66~~
Copper	mg/kg	100	≤52.8	> 52.8 to 96.5	> 96.5 to 406	> 406
Lead	mg/kg	88	≤ 26.4	> 26.4 to 60.8	> 60.8 to 154	> 154
Mercury	mg/kg	30	≤ 0.09	> 0.09 to 0.45	> 0.45 to 2.18	> 2.18
Zinc	mg/kg	98	≤ 112	> 112 to 200	> 200 to 629	> 629
PAHs, total high MW	µg/kg	16	≤ 312	> 312 to 1325	> 1325 to 9320	>9320
PAHs, total low MW	µg/kg	5	≤ 85.4	> 85.4 to 312	> 312 to 2471	> 2471
Chlordane, alpha-	µg/kg	55	≤ 0.50	> 0.50 to 1.23	> 1.23 to 11.1	>11.1
Chlordane, gamma-	µg/kg	58	≤ 0.54	> 0.54 to 1.45	> 1.45 to 14.5	> 14.5
DDDs, total	µg/kg	46	≤ 0.50	> 0.50 to 2.69	> 2.69 to 117	> 117
DDEs, total	µg/kg	31	≤ 0.50	> 0.50 to 4.15	> 4.15 to 154	> 154
DDTs, total	µg/kg	16	≤ 0.50	> 0.50 to 1.52	> 1.52 to 89.3	> 89.3
PCBs, total	µg/kg	55	≤11.9	> 11.9 to 24.7	> 24.7 to 288	> 288

Table 7 **CA LRM Regression Parameters**

CHEMICAL	UNITS	B0	B1
Cadmium	mg/kg	0.29	3.18
Copper	mg/kg	-5.59	2.59
Lead	mg/kg	-4.72	2.84
Mercury	mg/kg	-0.06	2.68
Zinc	mg/kg	-5.13	2.42
PAHs, total high MW	ug/kg	-8.19	2.00
PAHs, total low MW	ug/kg	-6.81	1.88
Chlordane, alpha	ug/kg	-3.41	4.46
Dieldrin	ug/kg	-1.83	2.59
Trans nonachlor	ug/kg	-4.26	5.31
PCBs, total	ug/kg	-4.41	1.48
p,p' DDT	ug/kg	-3.55	3.26

3. Assessment of Sediment Chemistry Exposure.
   Each sediment chemistry guideline result shall be categorized according to exposure as described in Table 8. The exposure categories are:

   Minimal exposure: Sediment-associated contamination* may be present, but exposure is unlikely to result in effects.

   Low exposure: Small increase in pollutant exposure that may be associated with increased effects, but magnitude or frequency of occurrence of biological impacts is low.

   Moderate exposure: Clear evidence of sediment pollutant exposure that is likely to result in biological effects; an intermediate category.

High exposure: Pollutant exposure highly likely to result in possibly severe biological effects; generally present in a small percentage of the samples.

Table 8 Sediment Chemistry Guideline Categorization Values

GUIDELINE	MINIMAL EXPOSURE	LOW EXPOSURE	MODERATE EXPOSURE	HIGH EXPOSURE
CSI	< 1.69	1.69 to 2.33	2.34 to 2.99	>2.99
CA LRM	< 0.33	0.33 to 0.49	0.50 to 0.66	> 0.66

3. Integration of Sediment Chemistry Categories.
   The average of all chemistry exposure categories shall determine the final sediment chemistry LOE category. If the average falls midway between categories it shall be rounded up to the next higher exposure category.

I. Integration and Interpretation of MLOE

Assessment as to whether the aquatic life sediment quality objective has been attained at a station is accomplished by the integration of MLOE. The categories assigned to the three LOE, sediment toxicity, benthic community condition and sediment chemistry are evaluated to determine the station level assessment. The assessment category represented by each of the possible MLOE combinations reflects the presence and severity of two characteristics of the sample: severity of biological effects, and potential for chemically-mediated effects.

1. Severity of Biological Effects.
   The severity of biological effects present at a site shall be determined by the integration of the toxicity LOE and benthic condition LOE categories using the decision matrix presented in Table 9.

Table 9 Severity of Biological Effects Matrix

		TOXICITY LOE CATEGORY			
		NONTOXIC	LOW TOXICITY	MODERATE TOXICITY	HIGH TOXICITY
BENTHIC CONDITION LOE CATEGORY	Reference	Unaffected	Unaffected	Unaffected	Low Effect
	Low Disturbance	Unaffected	Low Effect	Low Effect	Low Effect
	Moderate Disturbance	Moderate Effect	Moderate Effect	Moderate Effect	Moderate Effect
	High Disturbance	Moderate Effect	High Effect	High Effect	High Effect

2. Potential for Chemically-Mediated Effects.
   The potential for effects to be chemically-mediated shall be determined by the integration of the toxicity LOE and chemistry LOE categories using the decision matrix presented in Table 10.

Table 10 Potential for Chemically Mediated Effects Matrix

		TOXICITY LOE CATEGORY			
		NONTOXIC	**LOW TOXICITY**	**MODERATE TOXICITY**	**HIGH TOXICITY**
SEDIMENT CHEMISTRY LOE CATEGORY	Minimal Exposure	Minimal Potential	Minimal Potential	Low Potential	Moderate Potential
	Low Exposure	Minimal Potential	Low Potential	Moderate Potential	Moderate Potential
	Moderate Exposure	Low Potential	Moderate Potential	Moderate Potential	Moderate Potential
	High Exposure	Moderate Potential	Moderate Potential	High Potential	High Potential

3. Station Level Assessment.
   The station level assessment shall be determined using the decision matrix presented in Table 11. This assessment combines the intermediate classifications for severity of biological effect and potential for chemically-mediated effect to result in six categories of impact at the station level:

   Unimpacted: Confident that sediment contamination is not causing significant adverse impacts to aquatic life living in the sediment at the site.

   Likely Unimpacted: Sediment contamination at the site is not expected to cause adverse impacts to aquatic life, but some disagreement among the LOE reduces certainty in classifying the site as unimpacted.

   Possibly Impacted: Sediment contamination at the site may be causing adverse impacts to aquatic life, but these impacts are either small or uncertain because of disagreement among LOE.

   Likely Impacted: Evidence for a contaminant-related impact to aquatic life at the site is persuasive, even if there is some disagreement among LOE.

   Clearly Impacted: Sediment contamination at the site is causing clear and severe adverse impacts to aquatic life.

   Inconclusive: Disagreement among the LOE suggests that either the data are suspect or that additional information is needed before a classification can be made.

   The station assessment resulting from each possible combination of the three LOEs is shown in Attachment B. As an alternative to Tables 9, 10 and 11, each LOE category can be applied to Attachment B to determine the overall condition of the station. The results will be the same regardless of the tables used.

Table 11 Station Assessment Matrix

		SEVERITY OF EFFECT			
		UNAFFECTED	LOW EFFECT	MODERATE EFFECT	HIGH EFFECT
POTENTIAL FOR CHEMICALLY-MEDIATED EFFECTS	Minimal Potential	Unimpacted	Likely Unimpacted	Likely Unimpacted	Inconclusive
	Low Potential	Unimpacted	Likely Unimpacted	Possibly Impacted	Possibly Impacted
	Moderate Potential	Likely Unimpacted	Possibly Impacted or Inconclusive[1]	Likely Impacted	Likely Impacted
	High Potential	Inconclusive	Likely Impacted	Clearly Impacted	Clearly Impacted

[1] Inconclusive category when chemistry is classified as minimal exposure, benthic response is classified as reference, and toxicity response is classified as high.

4. Relationship to the Aquatic Life – Benthic Community Protection Narrative Objective.

   a. The categories designated as **Unimpacted** and **Likely Unimpacted** shall be considered as achieving the protective condition at the station. ~~except as described under b.~~ All other categories shall be considered as degraded except as provided in b. below.

   b. The ~~A Regional~~Water Board shall~~may~~ designate the category **Possibly Impacted** as meeting the protective condition if the studies identified in Section VII.F demonstrate that the combination of effects and exposure measures are not responding to toxic pollutants in sediments and that other factors are causing these responses within a specific reach segment or waterbody. In this situation, the ~~Regional and State~~Water Board will consider only the Categories **Likely Impacted** and **Clearly Impacted** as degraded when making a determination on receiving water limits and impaired water bodies described in Section VII.

J. Application of Aquatic Life – Benthic Community Protection to Other Bays and Estuaries

Station assessments for waterbodies identified in Section V.C.2. will be conducted using the same conceptual approach and similar tools to those described in Sections V.D-H. Each LOE will be evaluated by measuring a set of readily available indicators in accordance with Tables 12 and 13.

1. Station assessment shall ~~will also be based on widely-accepted practices in the literature, and~~ be consistent with the following key principles of the assessment approach described in Sections V.D. through V.I~~veloped for euhaline bays~~:

   a. Results for a single LOE shall not be used as the basis for an assessment.

b. Evidence of both elevated chemical exposure and biological effects must be present to indicate pollutant-associated impacts.

c. The categorization of each LOE shall be based on numeric values or a statistical comparison.

2.~~1~~Lines of Evidence and Measurement Tools.
Sediment chemistry, toxicity, and benthic community condition shall be measured at each station. Table 12 lists the required ~~recommended~~ tools for evaluation of each LOE. Each measurement shall be conducted using standardized methods (e.g., EPA or ASTM guidance) where available.

3.~~2~~.Categorization of LOEs.
Determination of the presence of an LOE effect (i.e., biologically significant chemical exposure, toxicity, or benthic community disturbance) shall be based on a comparison to a numeric response value or a statistical comparison to reference stations. The numeric values or statistical comparisons (e.g., confidence interval) used to classify a LOE as Effected shall~~should~~ be comparable to those specified in Sections V.F-H. to indicate High Chemical Exposure, High Toxicity, or High Disturbance. Reference stations shall~~should~~ be located in an area expected to be uninfluenced by the discharge or pollutants of concern in the assessment area and shall~~should~~ be representative of other habitat characteristics of the assessment area (e.g., salinity, grain size). Comparison to reference shall be accomplished by compiling data for appropriate regional reference sites and determining the reference envelope using statistical methods (e.g., tolerance interval).

Table 12 Tools for Use in Evaluation of LOEs

LOE	TOOLS	METRICS
Chemistry	Bulk sediment chemistry to include existing list (Attachment A) plus other chemicals of concern	CA LRM P_{max} Concentration on a dry weight basis
Sediment Toxicity	10-Day amphipod survival using a species tolerant of the sample salinity and grain size characteristics. e~~E~~.g., *Hyalella azteca* or *Eohaustorius estuarius*	Percent of control survival
Benthic Community Condition	Invertebrate species identification and abundance	Species richness* Presence of sensitive indicator taxa Dominance by tolerant indicator taxa Presence of diverse functional and feeding groups Total abundance

Table 13 Numeric Values and Comparison Methods for LOE Categorization

METRIC	THRESHOLD VALUE OR COMPARISON
CA LRM	Pmax > 0.66
Chemical Concentration	Greater than reference range or interval
Percent of Control Survival	*E. estuarius*: < 59 *H. azteca*: < 62 or SWAMP criterion
Species Richness	Less than reference range or interval
Abundance~~Presence~~ of Sensitive Indicator Taxa	Less than ~~Outside of~~ reference range or interval
Abundance of~~Dominance by~~ Tolerant Indicator Taxa	Greater than ~~Outside of~~ reference range or interval
Total Abundance	Outside of ~~Less than~~ reference range or interval

3. Station Level Assessment.
   The station level assessment shall be determined using the decision matrix presented in Table 14. This assessment combines the classifications for each LOE to result in two categories of impact at the station level:

   Unimpacted: No conclusive evidence of both high pollutant exposure and high biological effects present at the site. Evidence of chemical exposure and biological effects may be within natural variability or measurement error.

   Impacted: Confident that sediment contamination present at the site is causing adverse direct impacts to aquatic life.

Table 14 Station Assessment Matrix for Other Bays and Estuaries

CHEMISTRY LOE CATEGORY	TOXICITY LOE CATEGORY	BENTHIC CONDITION LOE CATEGORY	STATION ASSESSEMENT
No effect	No effect	No effect	Unimpacted
No effect	No effect	Effect	Unimpacted
No effect	Effect	No effect	Unimpacted
No effect	Effect	Effect	Impacted
Effect	No effect	No effect	Unimpacted
Effect	No effect	Effect	Impacted
Effect	Effect	No effect	Impacted
Effect	Effect	Effect	Impacted

4. Relationship to the Aquatic Life – Benthic Community Protection Narrative Objective. The category designated as **Unimpacted** shall be considered as achieving the protective condition at the station.

VI. HUMAN HEALTH

The narrative human health objective in Section IV. B. of this ~~Plan~~Part 1 shall be implemented on a case-by-case basis ~~Protection of human health~~, ~~will be assessed~~ based upon a human health risk assessment. In conducting a risk assessment, the Water Boards shall consider any applicable and relevant information, including ~~in accordance with the~~ California Environmental Protection Agency's (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA) policies for fish consumption and risk assessment, Cal/EPA's Department of Toxic Substances Control (DTSC) Risk Assessment~~,~~ and U.S. EPA Human Health Risk Assessment policies~~,~~.

VII. PROGRAM OF IMPLEMENTATION

Implementation of Part 1 shall be conducted in accordance with the following provisions and consistent with the process shown in Figures 1 and 2.

A. Dredge Materials

1. ~~This Plan~~Part 1 shall not apply to d~~D~~redge material suitability determinations. ~~Suitability determinations shall be based upon USACE and U.S. EPA methodologies developed for ocean, inland and upland disposal, and guidance developed by regional dredging teams and approved by the Regional Water Boards.~~

2. The ~~Regional~~ Water Boards shall not approve a dredging project that involves the dredging of sediment that exceeds the objectives in ~~this plan~~Part 1, unless the ~~Regional~~ Water Boards determine that:

    a. The polluted sediment is removed in a manner that prevents or minimizes water quality degradation.

    b. 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.

    c. The activity will not cause significant adverse impacts upon a federal sanctuary, recreational area, or other waters of significant national importance.

B. NPDES Receiving Water and Effluent Limits

1. If a ~~the Regional~~Water Board determines that sediment quality in the vicinity of permitted point sources (e.g. within discharge gradient) is potentially at risk, sediment quality objectives may be applied as receiving water limits in the permit.

2. The Permittee shall be in violation of such limits if it is demonstrated that the discharge is causing or contributing to the SQO exceedance as defined in Section VII.C.

3. Receiving water monitoring required by an NPDES permit may be satisfied by a Permitee's participation in a regional SQO monitoring program described in Section VII.E.

4. The sediment chemistry guidelines shall not be translated into or applied as effluent limits. Effluent limits established to protect or restore sediment quality shall be developed only after:

    a. A clear relationship has been established linking the discharge to the degradation,
    b. The pollutants causing or contributing to the degradation have been identified, and
    c. Appropriate loading studies have been completed to estimate the reductions in pollutant loading that will restore sediment quality.

    These actions are described further in Sections VII.F and VII.G. Nothing in this section shall limit a Water ~~Regional~~ Board's authority to develop and implement waste* load allocations* for Total Maximum Daily Loads. However, it is recommended that the Water ~~Regional~~ Boards develop TMDL allocations using the methodology described herein, wherever possible.

C. Exceedance of Receiving Water Limit

Exceedance of a receiving water limit is demonstrated when:
1~~,~~ U~~u~~sing a binomial distribution*, the total number of stations designated as not meeting the protective condition as defined in Sections V.I.4. or V.J.4. supports rejection of the null hypothesis* as presented in Table 15. The stations included in this analysis will be those located in the vicinity of the discharge and identified in the permit, and
2~~.~~ ~~An exceedance is not a violation until Ii~~ It is demonstrated that the discharge is causing or contributing to the SQO exceedance, following the completion of the stressor identification studies described in Section VII.F.
3. If studies by the Permittee demonstrate that other sources may also be contributing to the degradation of sediment quality, the Regional Water Board shall, as appropriate, require the other sources to initiate studies to assess the extent to which these sources are a contributing factor.

Table 15 Minimum Number of Measured Exceedances Needed to Exceed the Direct Effects SQO as a Receiving Water Limit

SAMPLE SIZE	LIST IF THE NUMBER OF EXCEEDANCES EQUALS OR IS GREATER THAN
2 – 24	2*
25 – 36	3
37 – 47	4
48 – 59	5
60 – 71	6
72 – 82	7
83 – 94	8
95 – 106	9
107 – 117	10
118 – 129	11

Note: *Null Hypothesis: Actual exceedance proportion $\leq$ 3 percent. Alternate Hypothesis: Actual exceedance proportion > 18 percent. The minimum effect size* is 15 percent.*
*Application of the binomial test requires a minimum sample size of 16. The number of exceedances required using the binomial test at a sample size of 16 is extended to smaller sample sizes.

Exceedance will require the Permittee to perform additional studies as described in Sections VII.F and VII.G.

D. Receiving Water Limits Monitoring Frequency

1. Phase I Stormwater Discharges and Major Discharges: Sediment Monitoring shall not be required ~~more often then annually or~~ less frequently than~~then~~ twice per permit cycle. For Stations that are consistently classified as unimpacted or likely unimpacted the frequency may be reduced to once per permit cycle. The Water ~~Regional~~ Board may limit receiving water monitoring to a subset of outfalls for Phase I Stormwater Permitees.

2. Phase II Stormwater and Minor Discharges: Sediment Monitoring shall not be required more often then twice per permit cycle or less then once per permit cycle. For s~~S~~tations that are consistently classified as unimpacted or likely unimpacted, the number of stations monitored may be reduced at the discretion of the Water ~~Regional~~ Board. The Water ~~Regional~~ Board may limit receiving water monitoring to a subset of outfalls for Phase II Stormwater Permitees.

3. Other Regulated Discharges and Waivers: The frequency of the monitoring for receiving water limits for other regulated discharges and waivers will be determined by the ~~State or Regional~~ Water Board.

E. Sediment Monitoring

1. Objective.
   Bedded sediments in bays contain an accumulation of pollutants from a wide variety of past and present sources discharged either directly into the bay or indirectly into waters draining into the bay. Embayments also represent highly disturbed or altered habitats as a result of dredging and physical disturbance caused by construction and maintenance of harbor works, boat and ship traffic, and development of adjacent lands. Due to the multitude of stressors and the complexity of the environment, a well-designed monitoring program is necessary to ensure that the data collected adequately characterizes the condition of sediment in these water bodies.

2. Permitted Discharges.
   Monitoring may be performed by individual Permitees to assess compliance with receiving water limits, or through participation in a regional or water body monitoring coalition as described under VII.E.3, or both as determined by the ~~Regional~~ Water Board.
3. Monitoring Coalitions.
   To achieve maximum efficiency and economy of resources, the State Water Board encourages the regulated community in coordination with the Regional Water Boards to establish water body-monitoring coalitions. Monitoring coalitions ~~would~~ enable the sharing of technical resources, trained personnel, and associated costs and create an integrated sediment-monitoring program within each major water body. Focusing resources on regional issues and developing a broader understanding of pollutants effects in these water bodies ~~will~~ enables the development of more rapid and efficient response strategies and ~~enable~~facilitates better management of sediment quality.

   a. If a ~~Each~~ regional monitoring coalition is established, the coalition shall be responsible for sediment quality assessment within the designated water body and for ensuring that appropriate studies are completed in a timely manner. ~~and act cooperatively to ensure that appropriate studies are completed in a timely manner~~.

   b. The ~~Regional~~ Water Board~~s~~ shall provide oversight to ensure that coalition participants are proactive and responsive to potential sediment quality related issues as they arise during monitoring and assessment.

   c. Each regional monitoring coalition shall prepare a workplan that describes the monitoring, a map of the stations, participants and a schedule that shall be submitted to the Water ~~Regional~~ Board for approval.

4. Methods.

Sediments collected from each station shall be tested or assessed using the methods and metrics described in Section V.~~5~~.

5. Design.
    a. The design of sediment monitoring programs, whether site-~~-~~specific or region wide, shall be based upon a conceptual model. A conceptual model is useful for identifying the physical and chemical factors that control the fate and transport of pollutants and receptors that could be exposed to pollutants in the sediment. The conceptual model serves as the basis for assessing the appropriateness of a study design. The detail and complexity of the conceptual model is dependent upon the scope and scale of the monitoring program. A conceptual model shall ~~ould~~ consider~~include~~:
        - Points of discharge into the segment of the waterbody or region of interest
        - Tidal flow and/or direction of predominant currents
        - Historic and or legacy conditions in the vicinity
        - Nearby land and marine uses or actions
        - Beneficial uses
        - Potential receptors of concern
        - Changes in grain size salinity water depth and organic matter
        - Other sources or discharges in the immediate vicinity.
    b. Sediment monitoring programs shall be designed to ensure that the aggregate stations are spatially representative of the sediment within the water body.
    c. The design shall take into consideration existing data and information of appropriate quality.
    d. Stratified r~~R~~andom design ~~network~~ shall be used where resources permit to assess ~~will provide the most useful information when assessing~~ conditions throughout a water body.
    e. Identification of appropriate strata shall consider characteristics of the water body including sediment transport, hydrodynamics, depth, salinity, land uses, inputs (both natural and anthropogenic) and other factors that could affect the physical, chemical, or biological condition of the sediment.
    f. Targeted designs shall be applied to those Permitees that are required to meet receiving water limits as described in Section VII. B.~~A~~.

6. Index Period.
   All stations shall be sampled between the months of June through September to be consistent with the benthic community condition index period.

7. Regional Monitoring Schedule and Frequency.
    a. Regional sediment quality monitoring will occur at a minimum of once every three years.
    b. Sediments identified as exceeding the narrative objective will be evaluated more frequently.

8. Evaluating Waters for placement on the Section 303(d) list

   a. Water segments shall be placed on the section 303(d) list for exceedance of the narrative sediment quality objective for aquatic life protection in Section IV.A. of Part 1 only if the number of stations designated as not achieving the protective condition as defined in Sections V.I. and V.J. supports rejection of the null hypothesis, as provided in Table 3.1 of the State Water Board's Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (2004) (Section 303(d)) Listing Policy).

   b. Water segments that are not covered under a. above and that exhibit sediment toxicity shall continue to be listed in accordance with Section 3.6 of the Section 303(d) Listing Policy.
      (1) If a water segment is listed under Section 3.6 and the Regional Water Board later determines that the applicable water quality standard that is impaired consists of the sediment quality objective in Section IV.A. of Part 1 and a bay or estuarine habitat beneficial use, the Regional Water Board shall reevaluate the listing in accordance with Section V.I and V.J
      (2) If the Regional Water Board reevaluates the listing, as provided in subsection (1) above, and the water segment does not meet the criteria in section a. above, the Regional Water Board shall delist the water segment.

~~Water Body Assessment of Impairment to the Aquatic Life – Benthic Community. The number of stations designated not achieving the protective condition as defined in Section V.I. 4, will be applied as the total number of exceedances when applying the Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List. Every effort shall be made to utilize spatially representative stations in this assessment.~~

F. Stressor Identification

If sediments fail to meet the narrative SQOs in accordance with Sections V and VI, the Water ~~Regional~~ Boards shall direct the regional monitoring coalitions or Permittees to conduct stressor identification~~a sequential approach is necessary to manage the sediment appropriately~~.

The Water ~~Regional~~ Boards shall assign the highest priority for stressor identification to those segments or reaches with the highest percentage of sites designated as Clearly Impacted and Likely Impacted.

Where segments or reaches contain Possibly Impacted but no Clearly or Likely Impacted sites, confirmation monitoring shall be conducted prior to initiating stressor identification.

The stressor identification ~~sequential~~ approach consists of development and implementation of a work plan to seek confirmation and characterization of pollutant-related impacts, pollutant identification and source identification. The workplan shall be submitted to the Water ~~Regional~~ Board for approval. Stressor identification consists of the following studies:

1. Confirmation and Characterization of Pollutant Related Impacts.

Exceedance of the direct effects SQO at a site indicates that pollutants in the sediment are the likely cause but does not identify the specific pollutant responsible. The MLOE assessment establishes a linkage to sediment pollutants; however, the lack of confounding factors (e.g., physical disturbance, non-pollutant constituents) must ~~should~~ be confirmed. There are two generic stressors that are not related to toxic pollutants that may cause the narrative to be exceeded:

Physical Alteration: Examples of physical stressors include reduced salinity, impacts from dredging, very fine or coarse grain size, and prop wash from passing ships. These types of stressors may produce a non-reference condition* in the benthic community that is similar to that caused by pollutants. If impacts to a site are purely due to physical disturbance, the LOE characteristics will likely show a degraded benthic community with little or no toxicity and low chemical concentrations.

Other ~~Nontoxic~~ Pollutant Related Stressors: These constituents, which- include elevated total organic carbon, ammonia, nutrients and pathogens, may have sources similar to chemical pollutants. Chemical and microbiological analysis will be necessary to determine if these constituents are present. The LOE characteristics for this type of stressor would likely be a degraded benthic community with possibly an indication of toxicity, and low chemical concentrations.

To further assess a site that is impacted by toxic pollutants, there are several lines of investigation that may be pursued, depending on site-specific conditions. These studies may be considered and evaluated in the work plan for the confirmation effort:

a. Evaluate the spatial extent of the Area of Concern. This information can be used to evaluate the potential risk associated with the sediment, distinguish areas of known physical disturbance or pollution and evaluate the proximity to anthropogenic source gradient from such inputs as outfalls, storm drains, and industrial and agricultural activities.

b. Body burden data may be examined from animals exposed to the site's sediment to indicate if pollutants are being accumulated and to what degree.

c. Chemical specific mechanistic benchmarks* may be -applied to interpret sediment chemistry concentrations.

d. Chemistry and biology data from the site should be examined to determine if there is a correlation between the two LOE.

e. Alternate biological effects data may be pursued, such as bioaccumulation* experiments and pore water toxicity or chemical analysis.

f. Other investigations that may commonly be performed as part of a Phase 1 Toxicity Identification Evaluation* (TIE).

If there is compelling evidence that the SQO exceedances contributing to a receiving water limit exceedance are not due to toxic pollutants, then the assessment area shall be designated as having achieved the receiving water limit.

2. Pollutant Identification.

Methods to help determine cause may be statistical, biological, chemical or a combination. Pollutant identification studies should be structured to address site-specific conditions, and may be based upon the following:

a. Statistical methods: Correlations between individual chemicals and biological endpoints (toxicity and benthic community).

b. Gradient analysis. Comparisons are made between different samples taken at various distances from a chemical hotspot to examine patterns in chemical concentrations and biological responses. The concentrations of causative agents should decrease as biological effects decrease.

c. Additional Toxicity Identification Evaluation efforts: A toxicological method for determining the cause of impairments is the use of toxicity identification evaluations (TIE). Sediment samples are manipulated chemically or physically to remove classes of chemicals or render them biologically unavailable. Following the manipulations, biological tests are performed to determine if toxicity has been removed. TIEs should be conducted at a limited number of stations, preferably those with strong biological or toxicological effects.

d. Bioavailability*: Chemical pollutants may be present in the sediment but not biologically available to cause toxicity or degradation of the benthic community. There are several measures of bioavailability that can be made. Chemical and toxicological measurements can be made on pore water to determine the availability of sediment pollutants. Metal compounds may be naturally bound up in the sediment and rendered unavailable by the presence of sulfides. Measurement of acid volatile sulfides and simultaneously extracted metals analysis can be conducted to determine if sufficient sulfides are present to bind the observed metals. Similarly, organic compounds can be tightly bound to sediments. Measurements of sediment organic carbon and other binding phases can be conducted to determine the bioavailable fraction of organic compounds. Solid phase microextraction (SPME) or laboratory desorption experiments can also be used to identify which organics are bioavailable to ~~animals~~benthic organisms.

e. Verification: After specific chemicals are identified as likely causes of impairment, analysis should be performed to verify the results. Sediments can be spiked with the suspected chemicals to verify that they are indeed toxic at the concentrations observed in the field. Alternately, animals can be transplanted to suspected sites for *in situ* toxicity and bioaccumulation testing.

When stressor Identification yields inconclusive results for sites classified as Possibly Impacted, the Water ~~Regional~~ Board shall require the Permittee or regional monitoring coalition to perform ~~either~~ a one-time augmentation to that study or, alternatively, the Water Board may suspend further stressor identification studies pending the results of future routine SQO monitoring.

3. Sources Identification and Management Actions.
   a. Determine if the sources are ongoing or legacy sources.
   b. Determine the number and nature of ongoing sources.

c. If a single discharger is found to be responsible for discharging the stressor pollutant at a loading rate that is significant, the Regional Water Board shall require the discharger to take all necessary and appropriate steps to address exceedance of the SQO, including but not limited to reducing the pollutant loading into the sediment.

d. When multiple sources are present in the water body~~,~~ that discharge the stressor pollutant at a loading rate that is significant, the Regional Water Board shall require the sources to take all necessary and appropriate steps to address exceedance of the SQO. If appropriate, the Regional Water Board may adopt a TMDL to ensure attainment of the sediment standard.

G. Development of Site-Specific Management Guidelines

1. Cleanup and Abatement

Cleanup and abatement actions covered by Water Code section 13304 for sediments that exceed the objectives in Chapter IV shall comply with Resolution No. 92-49 (Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304), Cal. Code Regs., tit. 23, §§2907, 2911. Resolution No.92-49 provides in part that:

a. Cleanup and abatement actions shall conform to the provisions of Resolution No. 68-16 (Statement of Policy with Respect to Maintaining High Quality of Waters in California);

b.. Cleanup and abatement actions shall promote attainment of either background water quality or the best water quality that is reasonable if background levels of water quality cannot be restored, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible;

c. . Where a Regional Water Board finds that it is unreasonable to remediate to a level that achieves water quality objectives, the Regional Water Board may consider designation of a containment zone.

2. Development of Site-Specific Sediment Management Guidelines

~~Wwhere~~ The Regional Water Boards may ~~d~~development ~~ment of~~ site-specific sediment management guidelines where ~~is~~ appropriate, for example, ~~(i.e.~~ where toxic stressors have been identified and controllable sources of these stressors exist or remedial goals are desired. ~~), guideline development should be considered~~.

Development of site-specific sediment management guidelines is the process to estimate the level of the stressor pollutant that will meet the narrative sediment quality objective. The guideline can ~~could~~ serve as the basis for cleanup goals or revision of effluent limits described in B~~C~~. 4 above, depending upon the situation or sources. Guideline development should only be initiated after the stressor has been identified. The goal is to establish a relationship between the organism’s exposure and the biological effect. ~~Although this relationship is not always easy identify, o~~Once this relationship is established, a pollutant specific guideline ~~target~~ may be designated that corresponds with minimum biological effects. The following approaches can be applied to establish these relationships:

a. Correspondence with sediment chemistry. An effective guideline ~~target~~ can best be derived based upon the site-specific, or reach- specific relationship between the stressor pollutant exposure and biological response. Therefore the correspondence between the bulk sediment stressor concentration and biological effects should be examined.

b. Correspondence with bioavailable pollutant concentration. The concentration of the bioavailable fraction of the stressor pollutants is likely to show a less variable relationship to biological effects that bulk sediment chemistry. Interstitial water analysis, SPME, desorption experiments, selective extractions, or mechanistic models may indicate the bioavailable pollutant concentration. The correspondence between the bioavailable stressor concentration and biological effects should be examined.

c. Correspondence with tissue residue. The concentration of the stressor accumulated by a target organism may provide a measure of the stressor dose for some chemicals (e.g., those that are not rapidly metabolized). The tissue residue threshold concentration associated with unacceptable biological effects can be combined with a bioaccumulation factor or model to estimate the loading or sediment concentration guideline.

d. Literature review. If site-specific analyses are ambiguous or unable to determine a guideline, then the results of similar development efforts for other areas should be reviewed. Scientifically credible values from other studies can be combined with mechanistic or empirical models of bioavailability, toxic potency, and organism sensitivity to estimate guidelines ~~targets~~ for the area of interest.

VIII. GLOSSARY

BENTHIC: Living on or in bottom of the ocean, bays, and estuaries, or in the streambed.

BINOMIAL DISTRIBUTION: Mathematical distribution that describes the probabilities associated with the possible number of times particular outcomes will occur in series of observations (i.e., samples). Each observation may have only one of two possible results (e.g., standard exceeded or standard not exceeded).

BIOACCUMULATION: A process in which an organism's body burden of a pollutant exceeds that in its surrounding environment as a result of chemical uptake through all routes of chemical exposure; dietary and dermal absorption and transport across the respiratory surface.

BIOAVAILABILITY: The f~~F~~raction of a pollutant that an organism is exposed to that is available for uptake through biological membranes (gut, gills).

CHEMICALS OF CONCERN (COCS): Pollutants that occur in environmental media at levels that pose a risk to ecological receptors or human health.

CONTAMINATION: An impairment of the quality of the waters of the State by waste to a degree that creates a hazard to the public health through poisoning or through the spread of disease. "Contamination" includes any equivalent effect resulting from the disposal of waste whether or not waters of the State are affected (CWC section 13050(k)).

EFFECT SIZE: The m~~M~~aximum magnitude of exceedance frequency that is tolerated.

ENCLOSED BAYS: Indentations along the coast that enclose an area of oceanic water within distinct headlands or harbor works. Enclosed bays include all bays where the narrowest distance between headlands or outermost harbor works is less than 75 percent of the greatest dimension of the enclosed portion of the bay. This definition includes, but is not limited to: Humboldt Bay, Bodega Harbor, Tomales Bay, Drakes Estero, San Francisco Bay, Morro Bay, Los Angeles Harbor, Upper and Lower Newport Bay, Mission Bay, and San Diego Bay.

ENDPOINT: A measured response of a receptor to a stressor. An endpoint can be measured in a toxicity test or in a field survey.

ESTUARIES AND COASTAL LAGOONS: Waters at the mouths of streams that serve as mixing zones* for fresh and ocean waters during a major portion of the year. Mouths of streams that are temporarily separated from the ocean by sandbars shall be considered as estuaries. Estuarine waters will generally be considered to extend from a bay or the open ocean to the upstream limit of tidal action but may be considered to extend seaward if significant mixing of fresh and salt water occurs in the open coastal waters. The waters described by this definition include, but are not limited to, the Sacramento-San Joaquin Delta as defined by Section 12220 of the California Water Code, Suisun Bay, Carquinez Strait downstream to Carquinez Bridge, and appropriate areas of the Smith, Klamath, Mad, Eel, Noyo, and Russian Rivers.

EUHALINE: Waters ranging in salinity from 25–32 practical salinity units (psu).

INLAND SURFACE WATERS: All surface waters of the State that do not include the ocean, enclosed bays, or estuaries.

LOAD ALLOCATION (LA): The portion of a receiving water's total maximum daily load that is allocated to one of its nonpoint sources of pollution or to natural background sources.

MECHANISTIC BENCHMARKS: Chemical guidelines developed based upon theoretical processes governing bioavailability and the relationship to biological effects.

MIXING ZONE: A l~~L~~imited zone within a receiving water that is allocated for mixing with a wastewater discharge where water quality criteria can be exceeded without causing adverse effects to the overall water body.

NONPOINT SOURCES: Sources that do not meet the definition of a point source as defined below.

NULL HYPOTHESIS: A s~~S~~tatement used in statistical testing that has been put forward either because it is believed to be true or because it is to be used as a basis for argument, but has not been proved.

OCEAN WATERS: Territorial marine waters of the State as defined by California law to the extent these waters are outside of enclosed bays, estuaries, and coastal lagoons. Discharges to ocean waters are regulated in accordance with the State Water Board's California Ocean Plan.

POINT SOURCE: Any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.

POLLUTANT: Defined in section 502(6) of the CWA as “dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water.”

POLLUTION: Defined in section 502(19) of the CWA as the “the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water.” *Pollution* is also defined in CWC section 13050(1) as an alternation of the quality of the waters of the State by waste to a degree that unreasonably affects either the waters for beneficial uses or the facilities that serve these beneficial uses.

POLYHALINE: Waters ranging in salinity from 18–25 psu.

REFERENCE CONDITION: The characteristics of water body segments least impaired by human activities. As such, reference conditions can be used to describe attainable biological or habitat conditions for water body segments with common watershed/catchment characteristics within defined geographical regions.

SPECIES RICHNESS: The number of species in a sample.

SURFICIAL SEDIMENTS: Those sediments representing recent depositional materials and containing the majority of the benthic invertebrate community.~~materials that extend from the surface of the bedded sediments to a depth of two centimeters. This term is operationally defined to provide consistency in sample collection and data comparability.~~

STATISTICAL SIGNIFICANCE: When it can be demonstrated that the probability of obtaining a difference by chance only is relatively low.

TOXICITY IDENTIFICATION EVALUATION (TIE): Techniques used to identify the unexplained cause(s) of toxic events. TIE involves selectively removing classes of chemicals through a series of sample manipulations, effectively reducing complex mixtures of chemicals in natural waters to simple components for analysis. Following each manipulation the toxicity of the sample is assessed to see whether the toxicant class removed was responsible for the toxicity.

WASTE: As used in this document, waste includes a discharger’s total discharge, of whatever origin, i.e., gross, not net, discharge.

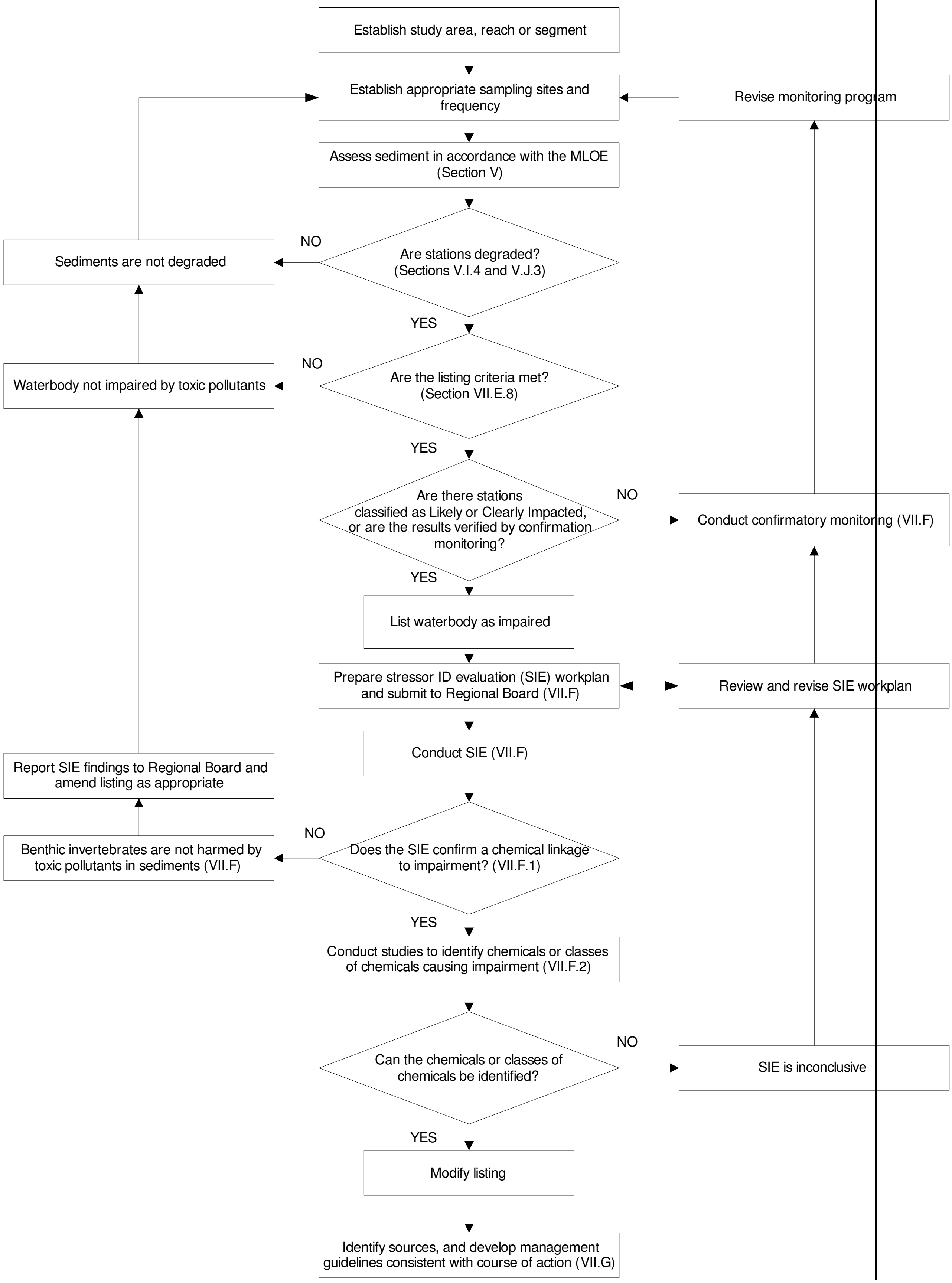

Figure 1. Waterbody Assessment Process

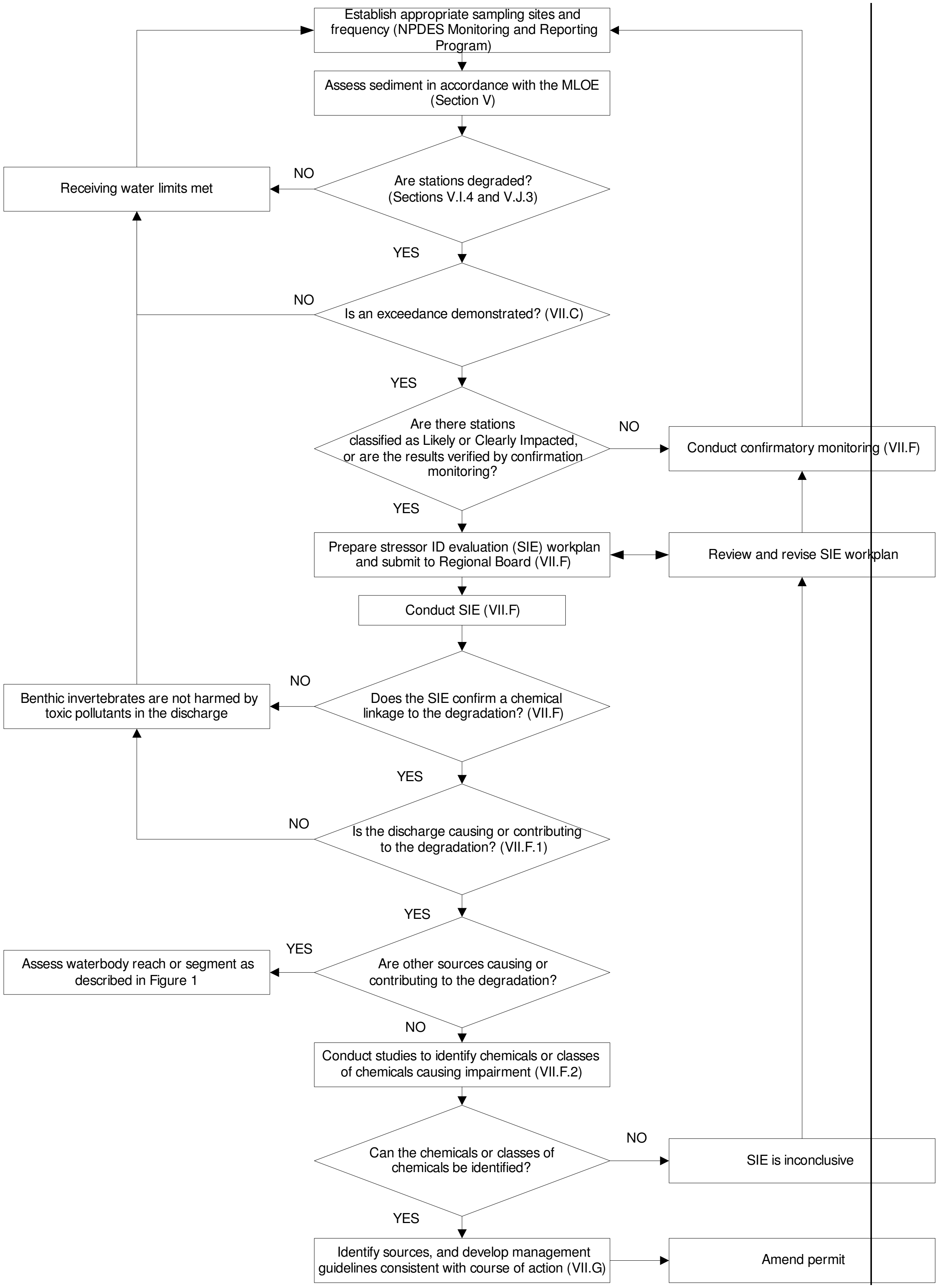

Figure 2. Point Source Assessment Process

Attachment A. List of chemical analytes needed to characterize sediment contamination exposure and effect.

CHEMICAL NAME	CHEMICAL GROUP	CHEMICAL NAME	CHEMICAL GROUP
Total Organic Carbon	General	Alpha Chlordane	Pesticide
Percent Fines	General	Gamma Chlordane	Pesticide
		Trans Nonachlor	Pesticide
Cadmium	Metal	Dieldrin	Pesticide
Copper	Metal	o,p'-DDE	Pesticide
Lead	Metal	o,p'-DDD	Pesticide
Mercury	Metal	o,p'-DDT	Pesticide
Zinc	Metal	p,p'-DDD	Pesticide
		p,p'-DDE	Pesticide
		p,p'-DDT	Pesticide
Acenaphthene	PAH	2,4'-Dichlorobiphenyl	PCB congener
Anthracene	PAH	2,2',5-Trichlorobiphenyl	PCB congener
Biphenyl	PAH	2,4,4'-Trichlorobiphenyl	PCB congener
Naphthalene	PAH	2,2',3,5'-Tetrachlorobiphenyl	PCB congener
2,6-dimethylnaphthalene	PAH	2,2',5,5'-Tetrachlorobiphenyl	PCB congener
Fuorene	PAH	2,3',4,4'-Tetrachlorobiphenyl	PCB congener
1-methylnaphthalene	PAH	2,2',4,5,5'-Pentachlorobiphenyl	PCB congener
2-methylnaphthalene	PAH	2,3,3',4,4'-Pentachlorobiphenyl	PCB congener
1-methylphenanthrene	PAH	2,3',4,4',5-Pentachlorobiphenyl	PCB congener
Phenanthrene	PAH	2,2',3,3',4,4'-Hexachlorobiphenyl	PCB congener
Benzo(a)anthracene	PAH	2,2',3,4,4',5'-Hexachlorobiphenyl	PCB congener
Benzo(a)pyrene	PAH	2,2',4,4',5,5'-Hexachlorobiphenyl	PCB congener
Benzo(e)pyrene	PAH	2,2',3,3',4,4',5-Heptachlorobiphenyl	PCB congener
Chrysene	PAH	2,2',3,4,4',5,5'-Heptachlorobiphenyl	PCB congener
Dibenz(a,h)anthracene	PAH	2,2',3,4',5,5',6-Heptachlorobiphenyl	PCB congener
Fluoranthene	PAH	2,2',3,3',4,4',5,6-Octachlorobiphenyl	PCB congener
Perylene	PAH	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	PCB congener
Pyrene	PAH	Decachlorobiphenyl	PCB congener

Attachment B. Station assessment category resulting from each possible MLOE combination

LOE CATEGORY COMBINATION	SEDIMENT CHEMISTRY EXPOSURE	BENTHIC COMMUNITY CONDITION	SEDIMENT TOXICITY	STATION ASSESSMENT
1	Minimal	Reference	Nontoxic	Unimpacted
2	Minimal	Reference	Low	Unimpacted
3	Minimal	Reference	Moderate	Unimpacted
4	Minimal	Reference	High	Inconclusive
5	Minimal	Low	Nontoxic	Unimpacted
6	Minimal	Low	Low	Likely unimpacted
7	Minimal	Low	Moderate	Likely unimpacted
8	Minimal	Low	High	Possibly impacted
9	Minimal	Moderate	Nontoxic	Likely unimpacted
10	Minimal	Moderate	Low	Likely unimpacted
11	Minimal	Moderate	Moderate	Possibly impacted
12	Minimal	Moderate	High	Likely impacted
13	Minimal	High	Nontoxic	Likely unimpacted
14	Minimal	High	Low	Inconclusive
15	Minimal	High	Moderate	Possibly impacted
16	Minimal	High	High	Likely impacted
17	Low	Reference	Nontoxic	Unimpacted
18	Low	Reference	Low	Unimpacted
19	Low	Reference	Moderate	Likely unimpacted
20	Low	Reference	High	Possibly impacted
21	Low	Low	Nontoxic	Unimpacted
22	Low	Low	Low	Likely unimpacted
23	Low	Low	Moderate	Possibly impacted
24	Low	Low	High	Possibly impacted
25	Low	Moderate	Nontoxic	Likely unimpacted
26	Low	Moderate	Low	Possibly impacted
27	Low	Moderate	Moderate	Likely impacted
28	Low	Moderate	High	Likely impacted
29	Low	High	Nontoxic	Likely unimpacted
30	Low	High	Low	Possibly impacted
31	Low	High	Moderate	Likely impacted
32	Low	High	High	Likely impacted
33	Moderate	Reference	Nontoxic	Unimpacted
34	Moderate	Reference	Low	Likely unimpacted
35	Moderate	Reference	Moderate	Likely unimpacted
36	Moderate	Reference	High	Possibly impacted
37	Moderate	Low	Nontoxic	Unimpacted
38	Moderate	Low	Low	Possibly impacted
39	Moderate	Low	Moderate	Possibly impacted
40	Moderate	Low	High	Possibly impacted
41	Moderate	Moderate	Nontoxic	Possibly impacted
42	Moderate	Moderate	Low	Likely impacted
43	Moderate	Moderate	Moderate	Likely impacted
44	Moderate	Moderate	High	Likely impacted
45	Moderate	High	Nontoxic	Possibly impacted

LOE CATEGORY COMBINATION	SEDIMENT CHEMISTRY EXPOSURE	BENTHIC COMMUNITY CONDITION	SEDIMENT TOXICITY	STATION ASSESSMENT
46	Moderate	High	Low	Likely impacted
47	Moderate	High	Moderate	Likely impacted
48	Moderate	High	High	Likely impacted
49	High	Reference	Nontoxic	Likely unimpacted
50	High	Reference	Low	Likely unimpacted
51	High	Reference	Moderate	Inconclusive
52	High	Reference	High	Likely impacted
53	High	Low	Nontoxic	Likely unimpacted
54	High	Low	Low	Possibly impacted
55	High	Low	Moderate	Likely impacted
56	High	Low	High	Likely impacted
57	High	Moderate	Nontoxic	Likely impacted
58	High	Moderate	Low	Likely impacted
59	High	Moderate	Moderate	Clearly impacted
60	High	Moderate	High	Clearly impacted
61	High	High	Nontoxic	Likely impacted
62	High	High	Low	Likely impacted
63	High	High	Moderate	Clearly impacted
64	High	High	High	Clearly impacted