Sediment Quality Objectives

Steven Bay

Commission Meeting March 7, 2014

Background

- **Sediment quality has been a research focus throughout SCCWRP's history**
  - **Key role in contaminant fate and effects**
  - **Long-term research on contaminant trends, toxicity, bioavailability, benthic ecology**
  - **Focus of most monitoring and regulatory programs**
- **Sediment monitoring and management programs are challenged by technical issues**
  - **Complex mixtures**
  - **Monitoring methods lag behind state of science**
  - **Unreliable methods to relate chemistry to biological impacts**

Opportunity for Incorporating Science

- **1989: The California Water Code required the State Water Board to develop sediment quality objectives (SQOs)**
  - **Little progress on SQO development for many years**
  - **Lawsuit and consent decree created mandate to develop SQOs for enclosed bays and estuaries**
- **Water Board enlisted SCCWRP to develop technical foundation for SQOs**
  - **Develop conceptual approach and tools for assessment**
  - **Utilize current research and updated methods**
  - **Technology transfer and implementation assistance**

CA Sediment Quality Objectives

- **Narrative statements of protection for key receptors from direct and indirect effects of contamination**
  - **Aquatic life (benthic community)**
  - **Humans**
  - **Fish and Wildlife**
- **Example: Direct impacts to aquatic life**
  - **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**
- **Specific tools and guidance needed to assess sediment quality and determine compliance with SQO**

Phased Project

- **Phase I: Benthic Community SQO**
  - Multiple line of evidence assessment framework based on sediment quality triad
  - Adopted by Water Board and approved by EPA
  - Training and implementation in progress
- **Phase II: Human Health SQO**
  - Assessment framework developed and under evaluation
  - Working with stakeholders to develop implementation guidance
- **Phase III: Fish and Wildlife SQO**
  - Not yet initiated

Assessment Conceptual Approach

- **Two principal modes of exposure and effects**
  - **Direct exposure through sediment contact and ingestion**
    - **Aquatic life**
  - **Indirect exposure through feeding on contaminated organisms**
    - **Human health and wildlife risk**
- **Each mode requires a separate assessment method**
- **Multiple indicators are needed to reliably predict sediment quality**
  - **Multiple Lines of Evidence (MLOE) approach**
  - **Widely applied approach, with multiple variations**
  - **Evolving discipline**

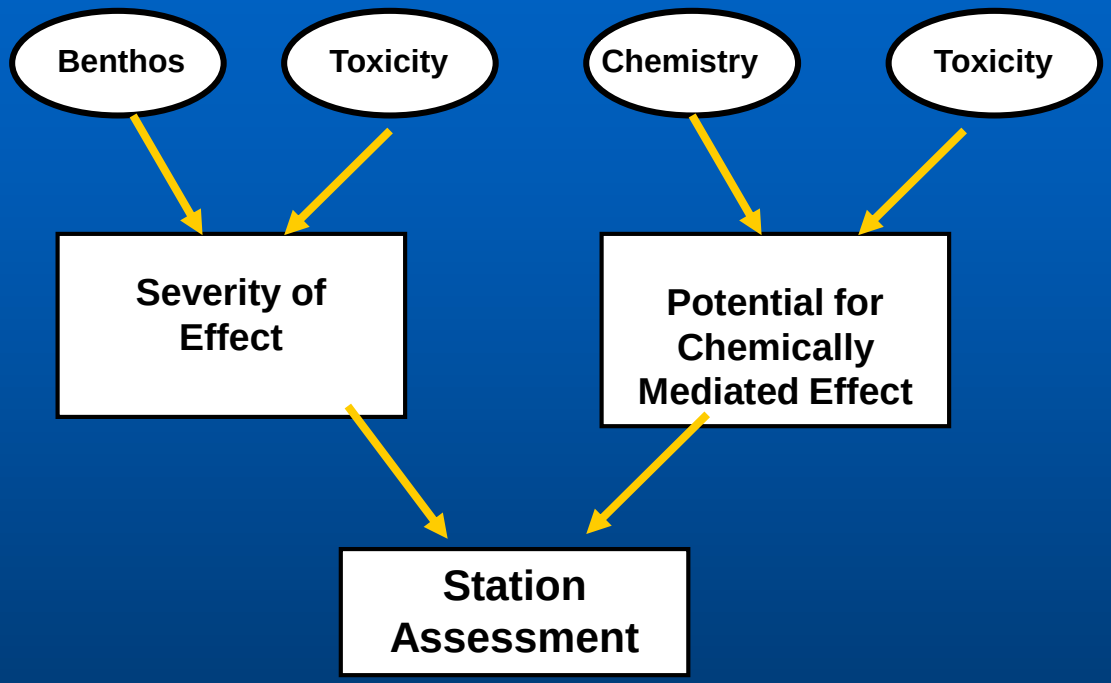
SCCWRP Activities

- **Developing methods/assessment consistency**
  - **Evaluated and selected indicators for lines of evidence**
  - **Incorporate local scientific knowledge**
- **Standardizing data interpretation**
  - **Established quantitative thresholds for each indicator**
  - **Developed a framework for integrating across lines of evidence**
- **Validation and communication**
  - **Independent evaluations**
  - **Advisory and review Committees**
  - **Training**

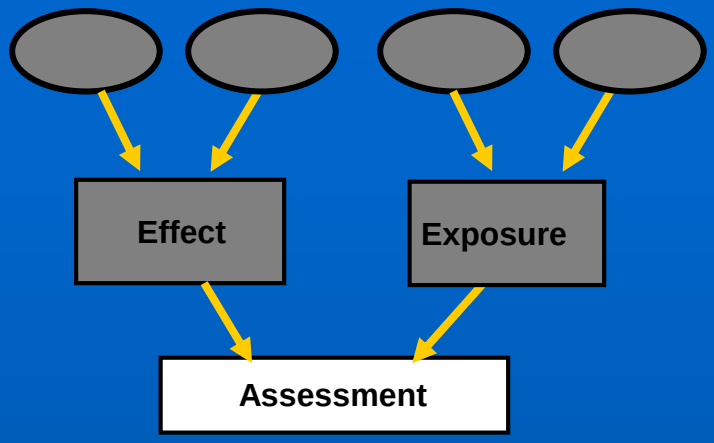
Developing Consensus

- **Technical Committees**
  - **Local and national scientists**
  - **Indicator selection, calibration, and validation**
- **Scientific Steering Committee**
  - **Independent national experts**
  - **Are methods based on sound science?**
- **Stakeholder Advisory Committee**
  - **Representatives of regulated entities (municipal, industry) and NGOs**
  - **Are methods reasonable, appropriate, and effective?**
- **Agency Coordination Committee**
  - **California regulatory agencies (regional water boards)**
  - **Will methods meet program needs?**

MLOE Integration Framework for Aquatic Life Impacts



- Three lines of evidence (LOE) required to assess contamination effects
- Multiple indicators needed to determine each line of evidence
- Benthic community effects given more weight
- Toxicity is a measure of both chemical exposure and effects



Station Assessment

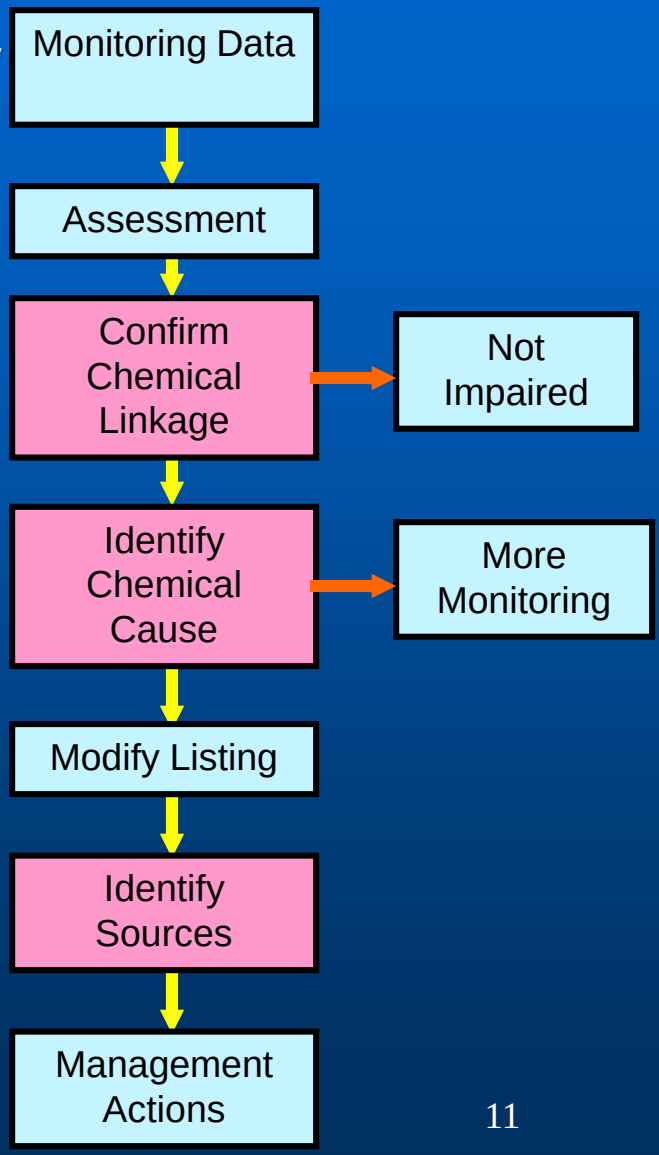
Severity of Effect (Benthos & Toxicity)

Potential that Effects are Chemically Mediated (Chemistry & Toxicity)

	Unaffected	Low Effect	Moderate Effect	High Effect
Minimal Potential	Unimpacted	Likely Unimpacted	Likely Unimpacted	Inconclusive
Low Potential	Unimpacted	Likely Unimpacted	Possibly Impacted	Possibly Impacted
Moderate Potential	Likely Unimpacted	Possibly Impacted	Likely Impacted	Likely Impacted
High Potential	Inconclusive	Likely Impacted	Clearly Impacted	Clearly Impacted

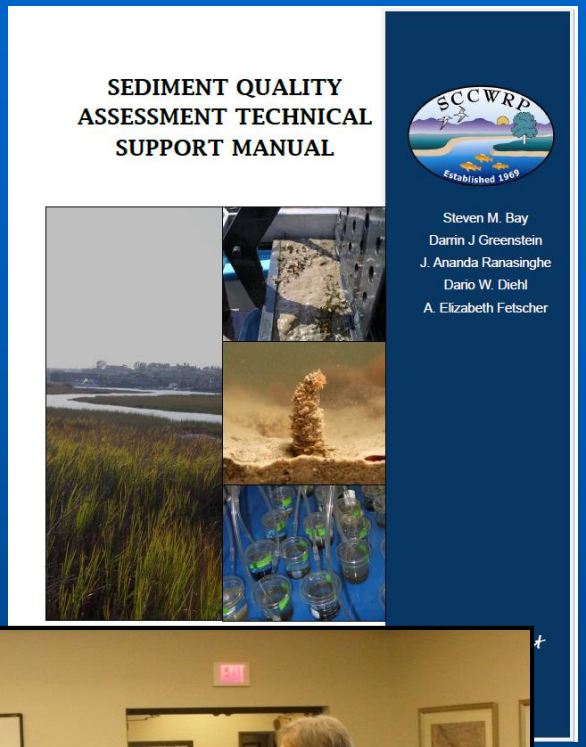
Program Application

- **Station assessment provides only part of information needed**
- **Stressor identification key to using assessment results**
  - **Confirmation that impacts due to contaminants**
  - **Determine contaminants responsible**
  - **Source identification**
- **Management action selection**
  - **Requires stressor identification**
  - **Use of SQGs for clean up targets not recommended**



Technology Transfer

- **Technical support manual**
  - **Method and study design reference**
- **Data analysis tools**
  - **Excel workbooks to promote consistent application and interpretation**
  - **SQO support page on SCCWRP web site**
- **Training**
  - **Hands on experience for end users**



Implementation Progress

- **SQO assessment methods are being incorporated into monitoring and regulatory programs throughout California**
  - **Regional monitoring and assessments**
  - **Stormwater discharge permits**
  - **TMDLs**
  - **Site cleanups**

Aquatic Life SQO Summary

- **Assessment framework is being used in a variety of programs**
  - **Current focus is on assisting implementation**
  - **Lack of reliable benthic indices limiting for some habitats**
- **SQO stressor identification methods rarely used**
  - **Few or incomplete TIE studies**
  - **Often use unreliable values as chemical thresholds (e.g., ERM/ERL)**
- **Methods for sediment management target development not consistent with SQO guidance**
  - **Little site-specific calibration**
  - **Thresholds usually not based on dose-response data**

Human Health SQO Overview

- **Draft tiered assessment framework developed in coordination with Scientific Steering Committee and Advisory Committee**
  - **Evaluates site sediment and tissue contamination data**
- **Decision Support Tool (DST) in development to facilitate data analyses**
- **Initial application of framework to CA bays and estuaries is in progress**
- **TMDL case study in progress to help develop implementation guidance**

Key Framework Elements

- **Assessment conducted at the site scale**
  - An area characterized by multiple sampling locations
  - Boundaries and study design reflect site conceptual model
- **Tiered framework used to guide assessment**
- **Two indicators inform assessment**
  - Consumption Risk
  - Sediment Linkage
  - Initial focus on PCBs and chlorinated pesticides
- **Multiple levels of result**
  - Categorical for regulators and managers
  - Numeric for scientists and alternative assessments
- **Uncertainty in key parameters included**
  - Monte Carlo simulation and results distribution

Tiered Assessment Framework

- **Multiple tiers**
  - **Data requirements and complexity relate to situation**
  - **Reduced effort/cost for sites of low concern**

Tier 1: Screening
Low Data Requirements
Conservative Assumptions

↓

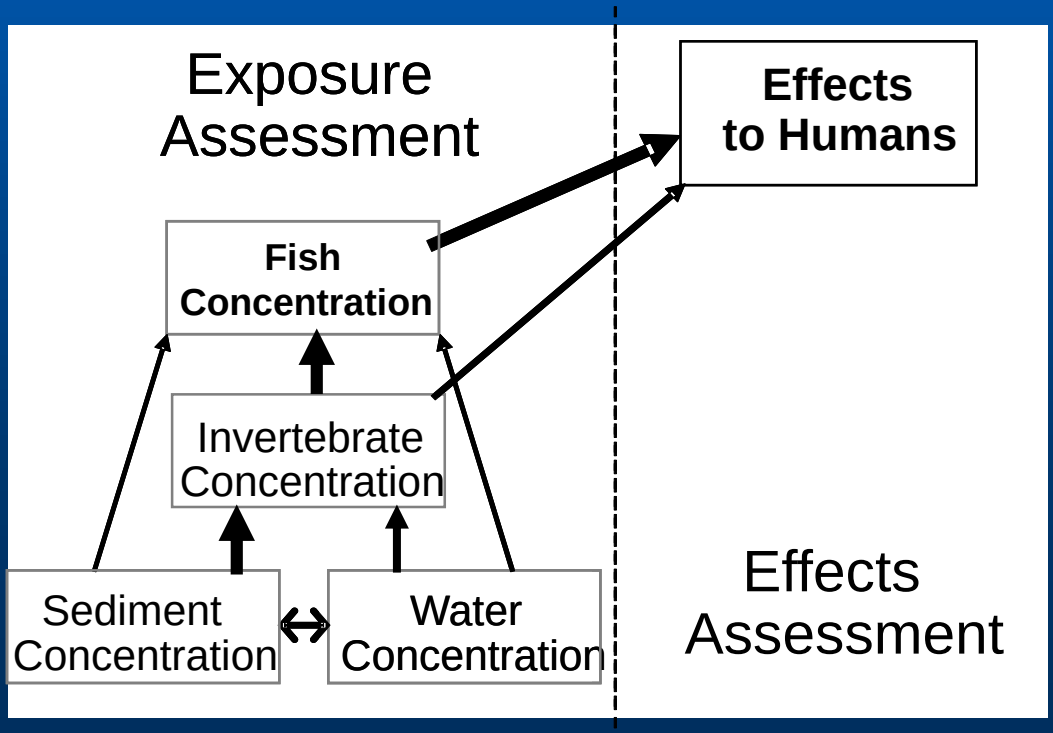
Tier 2: Site Assessment
More Data Required
Site Specific Conditions

↓

Tier 3: Refined Assessment
More Complex Situations
Evaluate Management Options

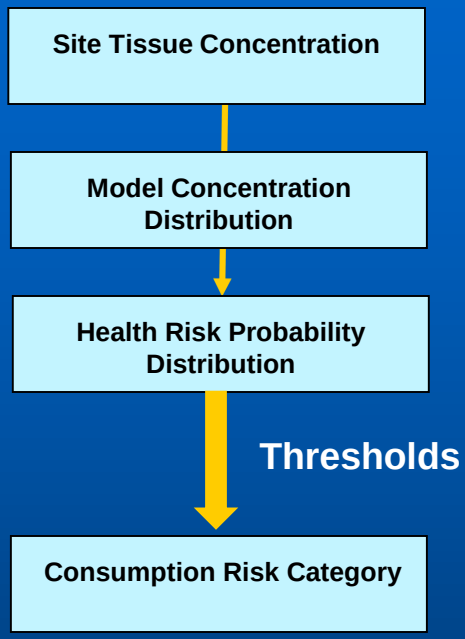
Assessment Questions

- **Assessment framework based on two key questions:**
  - **Do pollutant concentrations in seafood (fish and shellfish) pose unacceptable health risks to human consumers? (seafood consumption risk)**
  - **Does sediment contamination at the site have a substantial influence on seafood contamination? (sediment linkage)**



Consumption Risk Indicator

- **Risk calculation based on tissue contaminant concentration**
  - **Cancer risk and noncancer hazard quotient**
- **Tissue concentration based on integrated data for site**
  - **Stations**
  - **Species**
- **Monte Carlo simulation of key parameters to generate risk distribution**
  - **Proportion exceeding threshold determines risk category**

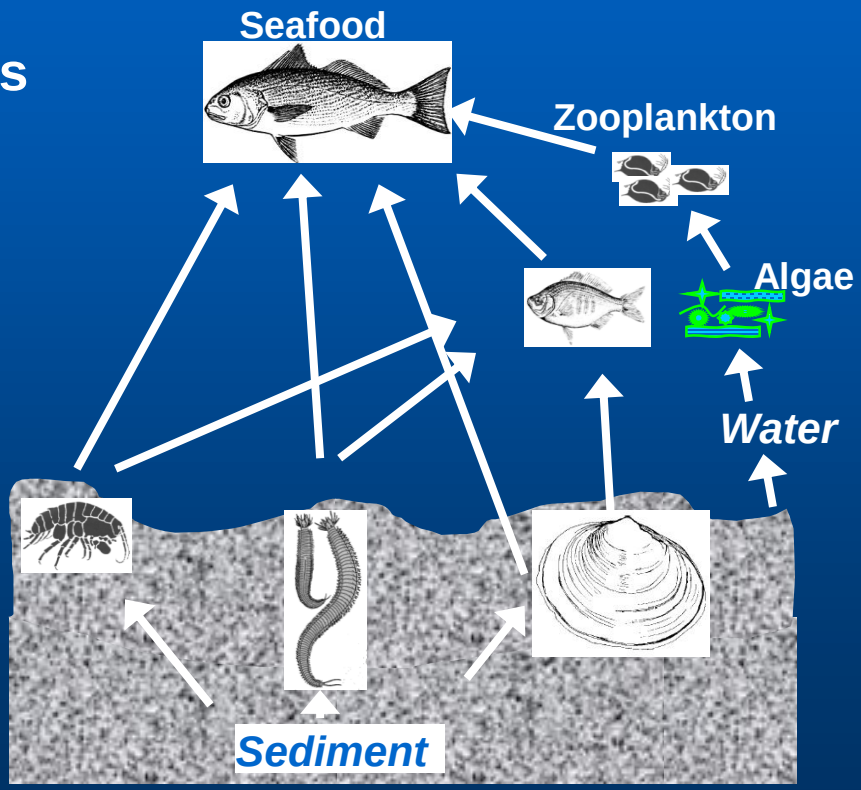


Sediment Linkage

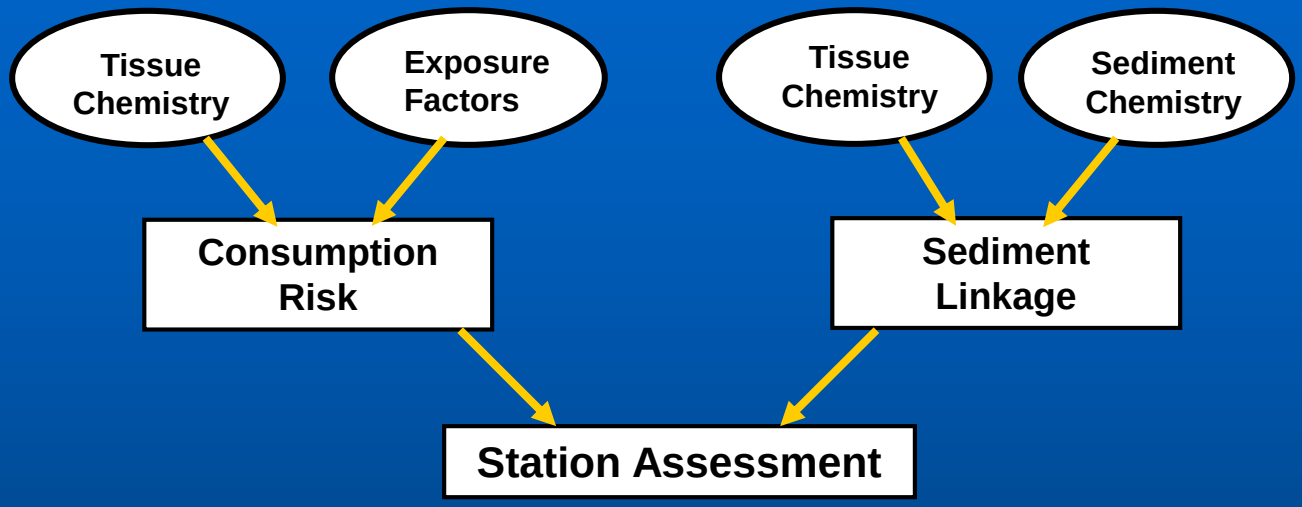
- **Determines influence of site sediment on seafood tissue contamination**
- **Food web bioaccumulation models used to estimate site-associated bioaccumulation in fish**
  - **Biota Accumulation Factor (BAF)**
- **Linkage Factor =**

  est. seafood conc
  measured conc at site

  - **Proportion exceeding threshold determines linkage category**



Assessment Framework for Human Health Impacts



- **Considers both consumption risk and sediment linkage**
  - **Both indicators must exceed thresholds to identify impacts**
- **Categorical outcome**
  - **Similar structure as for aquatic life SQO**
  - **Facilitates use in monitoring and regulatory programs**

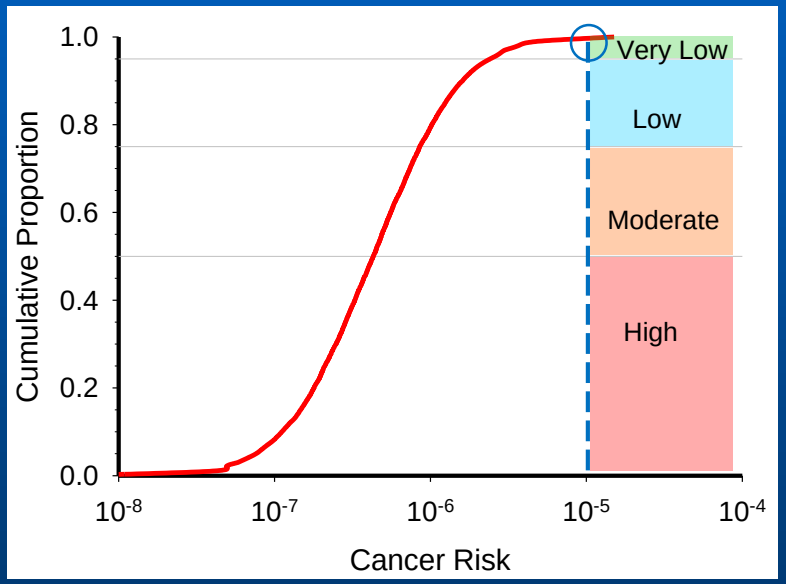
Site Assessment

- **Classification criteria reflects conceptual approach**
  - **Can't exceed SQO if health risk is low**
  - **Evidence of site sediment linkage needed to exceed SQO**
- **Provisional relationships shown**
  - **Subject to Water Board approval**

Consumption Risk	Sediment Linkage	Site Assessment
1. Very Low	1. Very Low	Unimpacted
1. Very Low	2. Low	Unimpacted
1. Very Low	3. Moderate	Unimpacted
1. Very Low	4. High	Unimpacted
2. Low	1. Very Low	Unimpacted
2. Low	2. Low	Unimpacted
2. Low	3. Moderate	Likely Unimpacted
2. Low	4. High	Likely Unimpacted
3. Moderate	1. Very Low	Likely Unimpacted
3. Moderate	2. Low	Possibly Impacted
3. Moderate	3. Moderate	Likely Impacted
3. Moderate	4. High	Clearly Impacted
4. High	1. Very Low	Likely Unimpacted
4. High	2. Low	Possibly Impacted
4. High	3. Moderate	Likely Impacted
4. High	4. High	Clearly Impacted

Decision Support Tool

- **Facilitate and standardize data analyses**
  - **Calculates bioaccumulation and health risk**
  - **Determines categorical outcomes**
- **Enable further analysis of results**
  - **Graphical analysis**
  - **Communicate uncertainty in results**
  - **Support scenario testing**



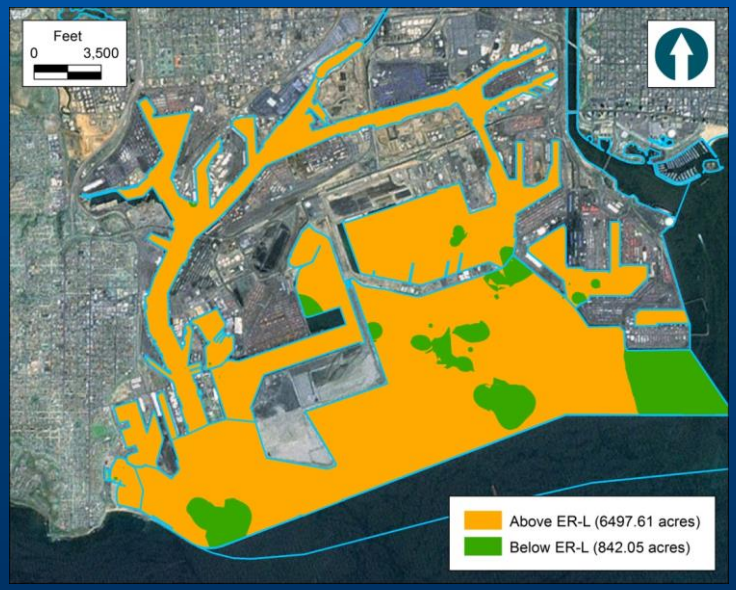
Current Activities

- **Framework application and evaluation**
  - **Statewide assessments**
  - **Ports of Los Angeles and Long Beach TMDL**
- **Decision support tool**
  - **Stakeholder trials**
- **Implementation guidance development**
  - **Stakeholder Advisory Committee**
  - **LA/LB Harbor TMDL**

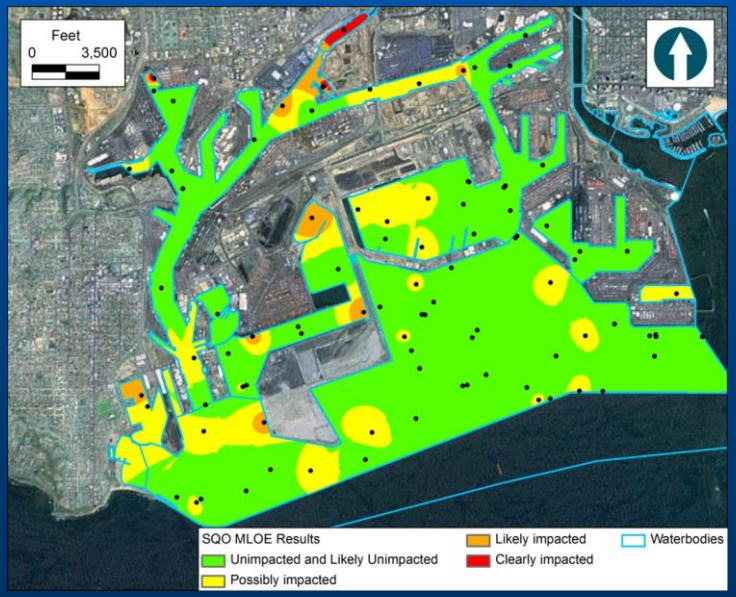
LA/LB Harbors TMDL

- **First incorporation of both aquatic life and human health SQOs into a TMDL**
  - **Multiple toxics of concern**
  - **Option to meet cleanup targets based on SQO outcome**

ERL Sediment Target



SQO Assessment



Anchor QEA

Implementation Test Drive

- **Harbor Technical Work Group established to coordinate and resolve SQO implementation issues with TMDL**
  - **Participation by Ports, SCCWRP, LARWQCB, Water Board**
  - **Test bed to develop more specific guidance in a complex system**
- **Endorsed by ports**
  - **Potential to develop more effective monitoring and remedies**
  - **Conducting research to support decisions**
    - **Will benefit SQO implementation in other areas**

Next Steps

- **Refinement and acceptance of assessment framework for human health SQO**
  - **Implementation challenges due to spatial issues and background contamination**
- **Improvements to stressor identification methods**
  - **Guidance and more effective methods needed for toxicity identification and threshold development**
  - **Methods for benthic community responses lacking**
- **Improvement of benthic community indices for low salinity habitats**
  - **San Francisco Bay and Delta**
  - **Greater complexity and less understanding of system**

Challenges

- **Alignment with listing policy and TMDLs**
  - **Listing and delisting criteria don't match sediment and SQO characteristics**
  - **Uncertain how to use non-chemical criteria in TMDLs**
- **Long-term program support**
  - **Maintenance of tools and guidance**
  - **User training and support**