Indicators of Anthropogenic Contamination in the Estuary

Introduction
Anthropogenic contamination exists in the water, sediment, and biota of the Estuary. Various contaminants may exceed various regulatory levels or have the potential for human health or biological effects in the Estuary. This complexity is often difficult to convey to managers and the public in a concise and understandable way.

An Estuary Contamination Index (ECI) is being developed as a major component of the Indicators of Condition of San Francisco Estuary.

Water Contamination Index (WCI)
The WCI provides an assessment of conditions for aquatic life residing in the San Francisco Estuary (Thompson et al. 2006). The WCI integrates three lines of evidence:
- Water Contamination
  - Four categories of contamination were established by comparing the concentrations of fifteen commonly measured contaminants to regulatory guidelines (EPA, 2000)
  - The final category is determined by the average score of the fifteen contaminants
- Aquatic Toxicity
  - Four categories of aquatic toxicity were established based on results of tests comparing control and test samples
- Biological Effects
  - Four categories of biological effects were established using data on biological thresholds for 25 contaminants in 21 common species that inhabit the Estuary water column (e.g., EPA, 2005)

The Water Contamination Index (WCI) is determined by combining the three LOEs.

Sediment Quality Index (SQI)
Consistent with the SQO framework (see SQO section), each site is evaluated and characterized as one of the following:
- Unimpacted
- Likely Unimpacted
- Likely Impacted
- Clearly Impacted
- Possibly Impacted
- Inconclusive

A demonstration of the WCI procedure for three RMP sites is shown in Table 1. These sites suggest that there is an impact to aquatic life from exposure to water contaminants at these sites.

Wildlife and Human Health Assessment
This indicator evaluates the potential for contaminant effects to wildlife and humans from indirect exposure to water contamination via the estuary food web.

An assessment framework was developed, and a case study was conducted as part of the California Sediment Quality Objectives Program (Greenfield et al. 2007). The case study demonstrated application of the framework to legacy pesticides (DDTs, chlordane, and dieldrin) in San Francisco Bay. These pollutants were chosen because their fate and bioavailability are relatively well characterized in the Bay using literature and local data.

The Wildlife and Human Health assessment uses three exposure indicators:
- Chemical concentrations in prey organisms
- Chemical concentrations in sediment
- Bioavailability of contaminant, as demonstrated in field or laboratory test organisms

Figure 3 depicts the assessment procedure.

Conclusions
The WCI demonstration at three RMP sites suggests that there is little impact on aquatic life from exposure to water contamination.

The Sediment Quality Index (SQI) is a summary of the condition of Estuary sediments, expressed as a categorical narrative assessment.

The SQID methodology was applied to 40 samples from the San Francisco Estuary using data collected by EPA and NOAA in 2000, as part of a statewide assessment of sediment quality (Barnett et al. 2007). The final assessment values are shown on Figure 2.

Conclusions
- The WCI demonstrates that there is little impact on aquatic life from exposure to water contamination.
- Most sediments in the Estuary are impacted to some degree, mainly due to widespread sediment toxicity.
- Sediment contamination by DDTs and other legacy pesticides are unlikely to impact wildlife or human health.
- Indicators of anthropogenic contamination in the Estuary and sediments have not been formally developed for the ECI. However, the potential for impacts of PCBs and mercury in water are well documented, and are the current focus of regulatory TMDLs in the Estuary.

Summary
At this stage of development of the ECI, conclusions about the condition of the Estuary in terms of contamination are generalized based on the three components developed so far, and are considered preliminary.

- The WCI results at three sites suggest that there is little impact on aquatic life from exposure to water contamination.
- Most sediments in the Estuary are impacted to some degree, mainly due to widespread sediment toxicity.
- Sediment contamination by DDTs and other legacy pesticides are unlikely to impact wildlife or human health.
- Indicators of anthropogenic contamination in the Estuary and sediments have not been formally developed for the ECI. However, the potential for impacts of PCBs and mercury in water are well documented, and are the current focus of regulatory TMDLs in the Estuary.

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References