Consensus-based Weight-of-Evidence Approach as a Tool for Developing a Risk-based Remedial Footprint: Case Study - Hunters Point Shipyard

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Navy's San Francisco Bay Sediment Work Group (SWG)

- Formed to develop and apply a consistent approach to investigating and identifying remedial action alternatives for Naval sediment sites in San Francisco Bay
- One approach developed by the SWG is a weight-of-evidence (WOE) approach

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WOE Approach

- Objective of WOE
  - To integrate results from various lines of evidence from the risk assessment to identify areas requiring further investigation in the FS
- Part of the risk characterization stage of the risk assessment
- Visual tool to present risk drivers and areas of concern

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Characteristics of WOE Approach

- Flexible for each site
- Semi-quantitative
- Select highest quality data and endpoints with strongest links to sediments
- Use other endpoints in an ancillary or supporting role
- Visual

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WOE Approach

- Approach developed through consensus-based process with regulatory technical team
- First applied successfully at NFD Point Molate
- Loosely based on concepts developed for the State of Massachusetts (Menzie et al 1996)
- Best if developed as part of the work plan, but flexible enough to be used to interpret historical data.

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WOE Case Study: Hunters Point Shipyard (HPS)

- Developed in a consensus process as part of the planning for the Validation Study (VS)
  - Objective is to more clearly define the extent of sediments that pose an unacceptable risk to the environment and that require evaluation in the FS
- Four Endpoints:
  - sediment chemistry
  - amphipod bulk sediment bioassay
  - sediment-water interface larval bioassay
  - bioaccumulation evaluation

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HPS WOE Approach

- Determine weight of endpoint
  - For HPS it was decided that all endpoints will be weighted evenly
- Determine finding of result (positive or negative) and magnitude of result
  - Indicates whether a single line of evidence supports inclusion or exclusion of the sample location in the footprint
- Integrate weight, finding and magnitude for a given endpoint result
- Integrate all endpoint results for a given station
- Map all station results

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WOE Finding and Magnitude Criteria: Amphipod Bioassay

Score	Attribute	Amphipod Bioassay
+2	High Positive	≤ 50% survival relative to control
+1	Low Positive	> 50% but ≤ 69.5% survival relative to control
-1	Low Negative	> 69.5% but ≤ 80% survival relative to control
-2	High Negative	> 80% survival relative to control

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WOE Finding and Magnitude Criteria:Sediment Chemistry

Score	Attribute	Sediment Chemistry
+2	High Positive	•ERM-Q >1.25 or •7 or more COPECs >ER-Ms or •Any one COPEC >10X its ER-M
+1	Low Positive	•ERM-Q >0.5 but ≤1.25 or •4-6 COPECs >ER-Ms or •Any one COPEC >5X its ER-M
-1	Low Negative	•ERM-Q ≤0.5 but >UTL of ambient ERM-Q (0.3) or •1-3 COPECs >ER-Ms excluding Ni
-2	High Negative	•ERM-Q ≤UTL of ambient ERM-Q (0.3) or •All individual COPECs <ER-Ms

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WOE Finding and Magnitude Criteria:Sediment-Water Interface Bioassay

Score	Attribute	SWI Larval Bioassay
+2	High Positive	≤ 50% normal development relative to control response
+1	Low Positive	> 50% but ≤ 60% normal development relative to control response
-1	Low Negative	> 60% but ≤ 80% normal development relative to control response
-2	High Negative	> 80% normal development relative to control response

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WOE Finding and Magnitude Criteria:Bioaccumulation

Score	Attribute	Bioaccumulation
+2	High Positive	•One or more priority COPECs or two or more non-priority COPECs exceed reference and •HQ_{low} >10 or HQ_{high} >1.
+1	Low Positive	•One or more priority COPECs or two or more non-priority COPECs exceed reference and •HQ_{low} ≤10 and HQ_{high} ≤1.
-1	Low Negative	No priority COPECs or no more than one non-priority COPEC exceeds reference and HQ_{low} ≤1
-2	High Negative	No COPEC concentrations in HPS tissues exceed reference

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Integrate Endpoint Results for a Given Station

- Integrate all endpoints at a given sampling station to determine the appropriate action
  - integrated score is the average score for all the endpoints
  - represent the finding and magnitude score for each endpoint and the integrated score on a bar chart
- The height of the bar for each endpoint reflects the level of certainty for validating a footprint
- A positive integrated score represents a positive finding of risk based on all endpoints; conversely, a negative integrated score is a negative finding of risk

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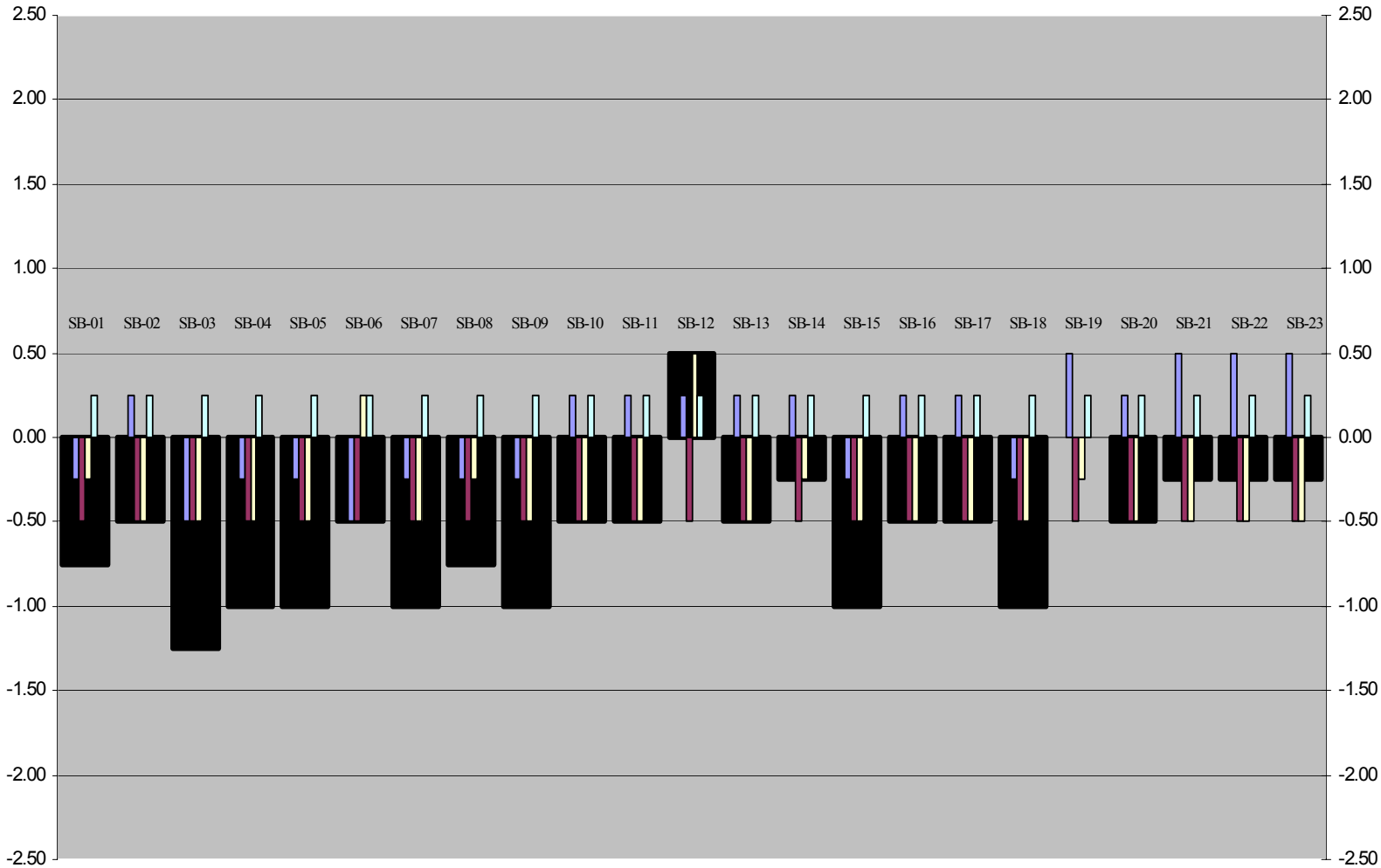
WOE Scores for South Basin (Area X)



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Consensus-based "bright-line criteria"

- Integrated WOE scores $\leq$ -1 mapped as white and identified as not requiring additional evaluation in the FS
- WOE scores > 0.5 mapped as black and identified as requiring evaluation in the FS
- WOE scores between -1 and 0.5 mapped as shades of gray and evaluated further with ancillary data to decide whether station should be included or excluded in the FS

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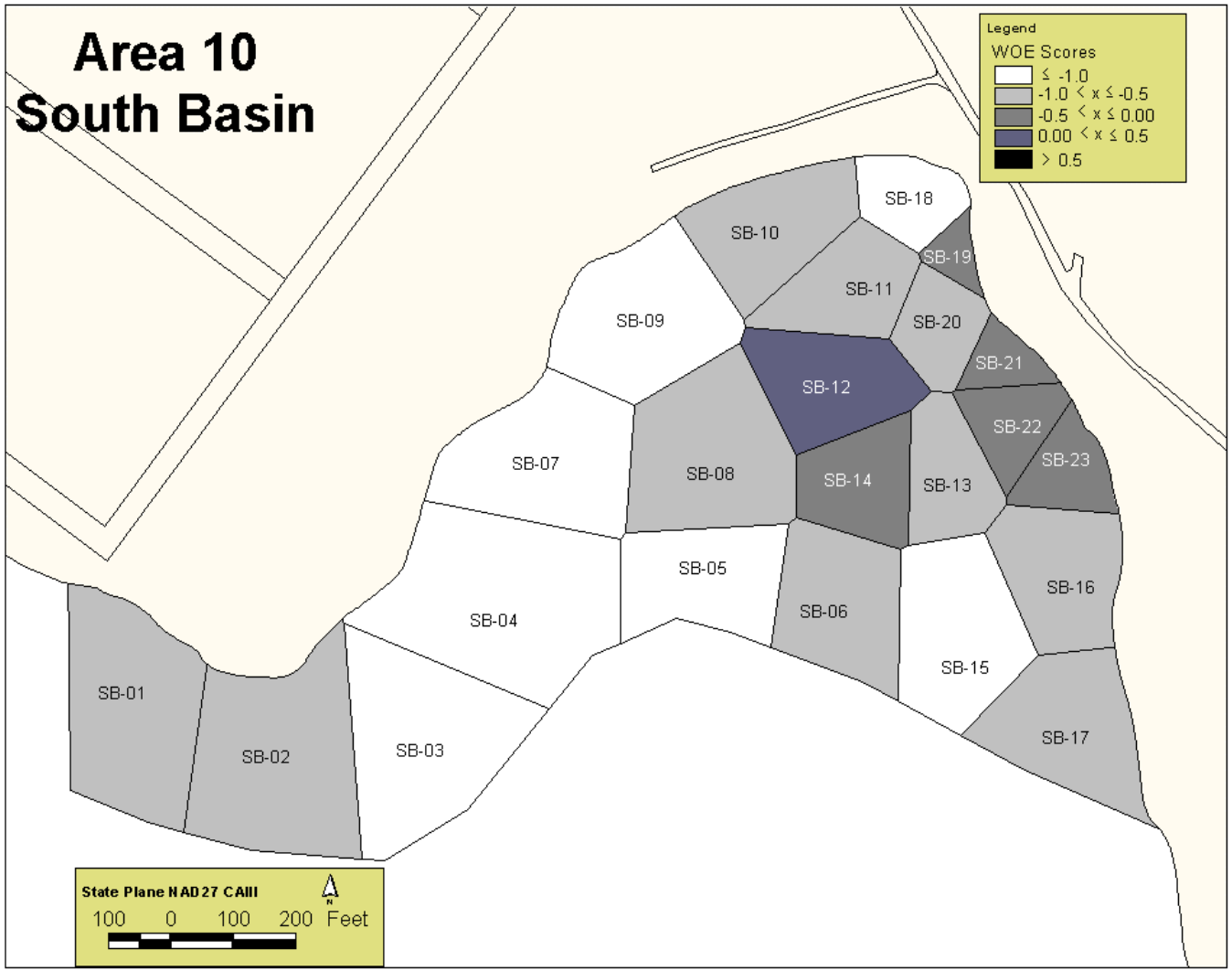

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Development of Remedial Footprint for South Basin

- All areas mapped either white or gray
- WOE and ancillary data (field-collected data) evaluated to identify risk drivers
- Bioaccumulation of PCBs identified as the main risk driver in South Basin
- Safe sediment values then developed for PCBs and receptors at site to finalize footprint for FS

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Pros and Cons to Consensus-based Approach

Pros

- Upfront agreement on data interpretation
- Efficient evaluation and interpretation of data
- Frequent communication on project objectives and goals as criteria are developed

Cons

- Time-intensive
- Requires participation of all parties
- Possible wasted effort, if product of the approach does not match "perceived" threat

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