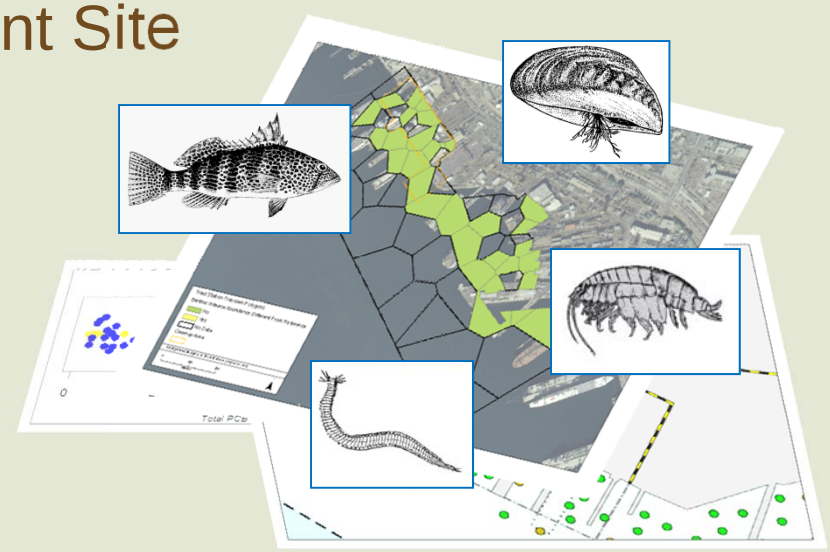
Site Conditions and Cleanup Protectiveness

San Diego Shipyard Sediment Site



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Introduction

- MSc Biological Oceanography
- Worked on approximately 20 sediment sites
- Regulatory support for sediment assessment
- Managed the 2001-2002 shipyard investigation
- Data analysis and interpretation

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Protectiveness of Planned Cleanup

- Multiple conservative assumptions in the TCAO and DTR
- Conservative assumptions overstate potential effects
- Conservative assumptions compound
- How conservative is the remedy?
- Compare to an accurate assessment
- 2003 sediment report is a more accurate assessment

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Lines of Evidence for Biological Effects

LOE
Benthic macroinvertebrate community stage (SPI)
Benthic macroinvertebrate community composition (4 metrics)
Sediment toxicity (3 tests)
Fish histopathology (253 fish)
PAH metabolites in fish
Fish growth and condition
Risk assessment for aquatic-dependent wildlife (6 receptors)

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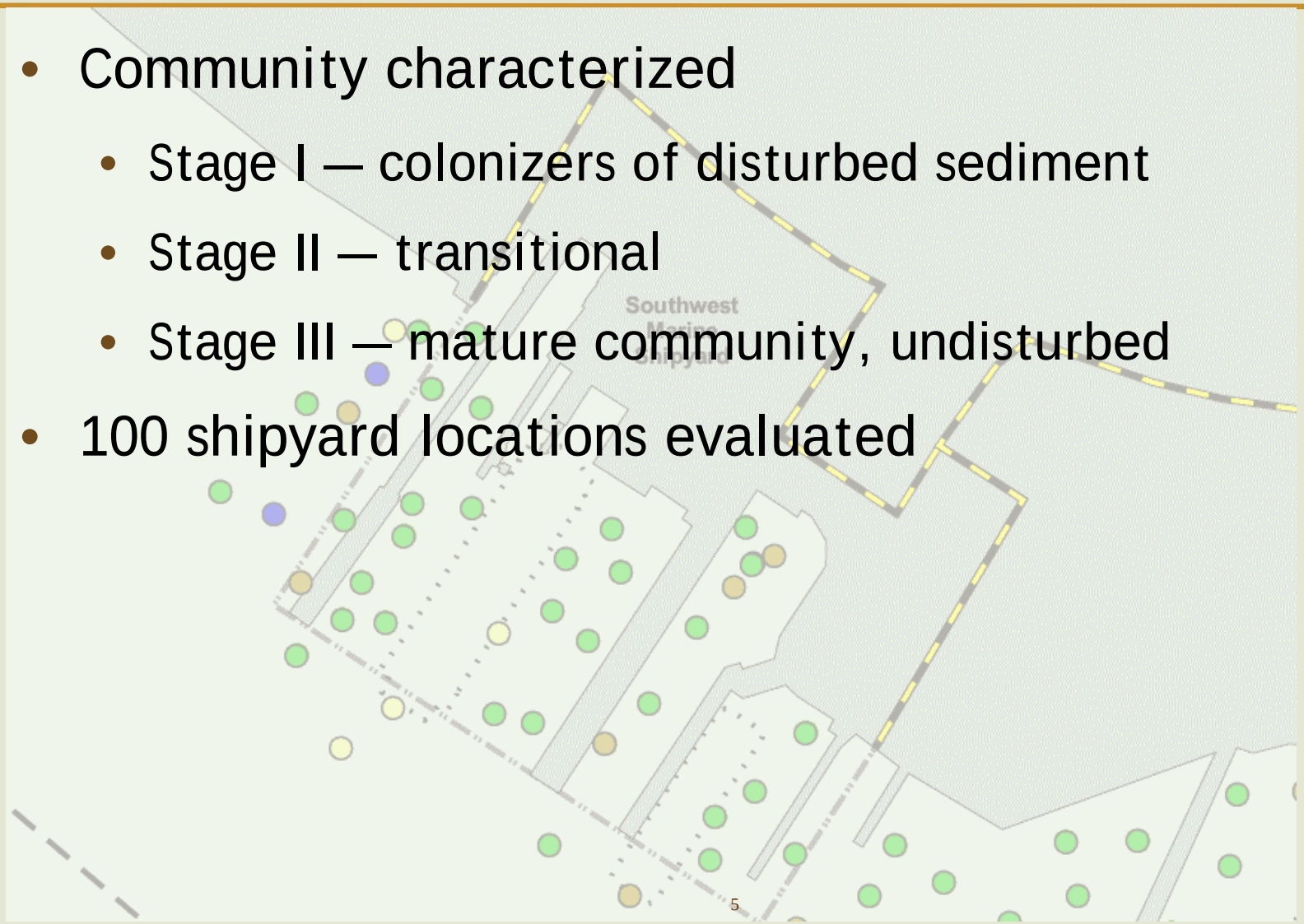
Macroinvertebrate Community Stage

- Community characterized
  - Stage I — colonizers of disturbed sediment
  - Stage II — transitional
  - Stage III — mature community, undisturbed
- 100 shipyard locations evaluated



Macroinvertebrate Community Stage

- Mature communities at 39/43 locations at BAE
- Within the remedial footprint, mature communities at 8/10 locations

LOE	2001-2002 Investigation	DTR
Macroinvertebrate community stage	Mature communities throughout	Mature communities throughout

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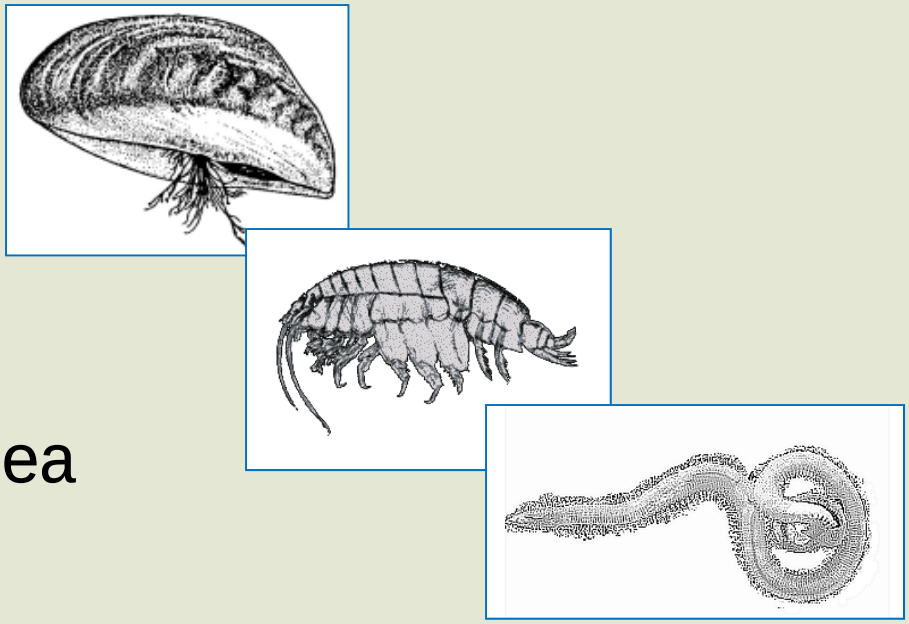
Macroinvertebrate Community Composition

- Count the number of organisms in the sediment
  - Clams
  - Crustacea
  - Worms
  - Others
- Compare to reference area



Macroinvertebrate Community Composition

- Benthic Response Index: equivalent to reference
- Total abundance: equivalent to reference
- Number of species: equivalent to reference
- Diversity: equivalent to reference at 14/15

LOE	2001-2002 Investigation	DTR
Macroinvertebrate community composition; difference from reference	None or minor	None or minor

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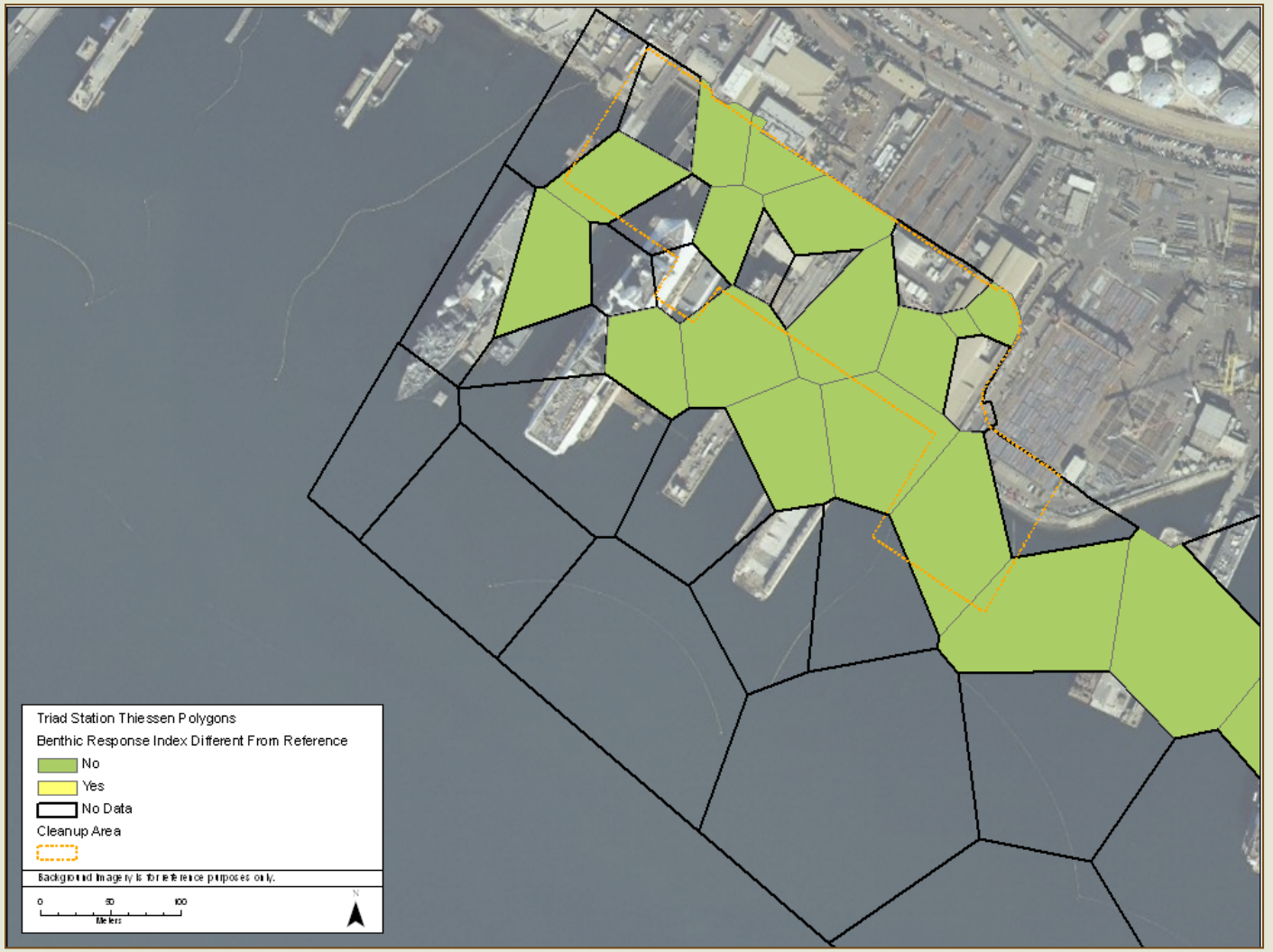
Benthic Response Index



Total Abundance

Number of Species

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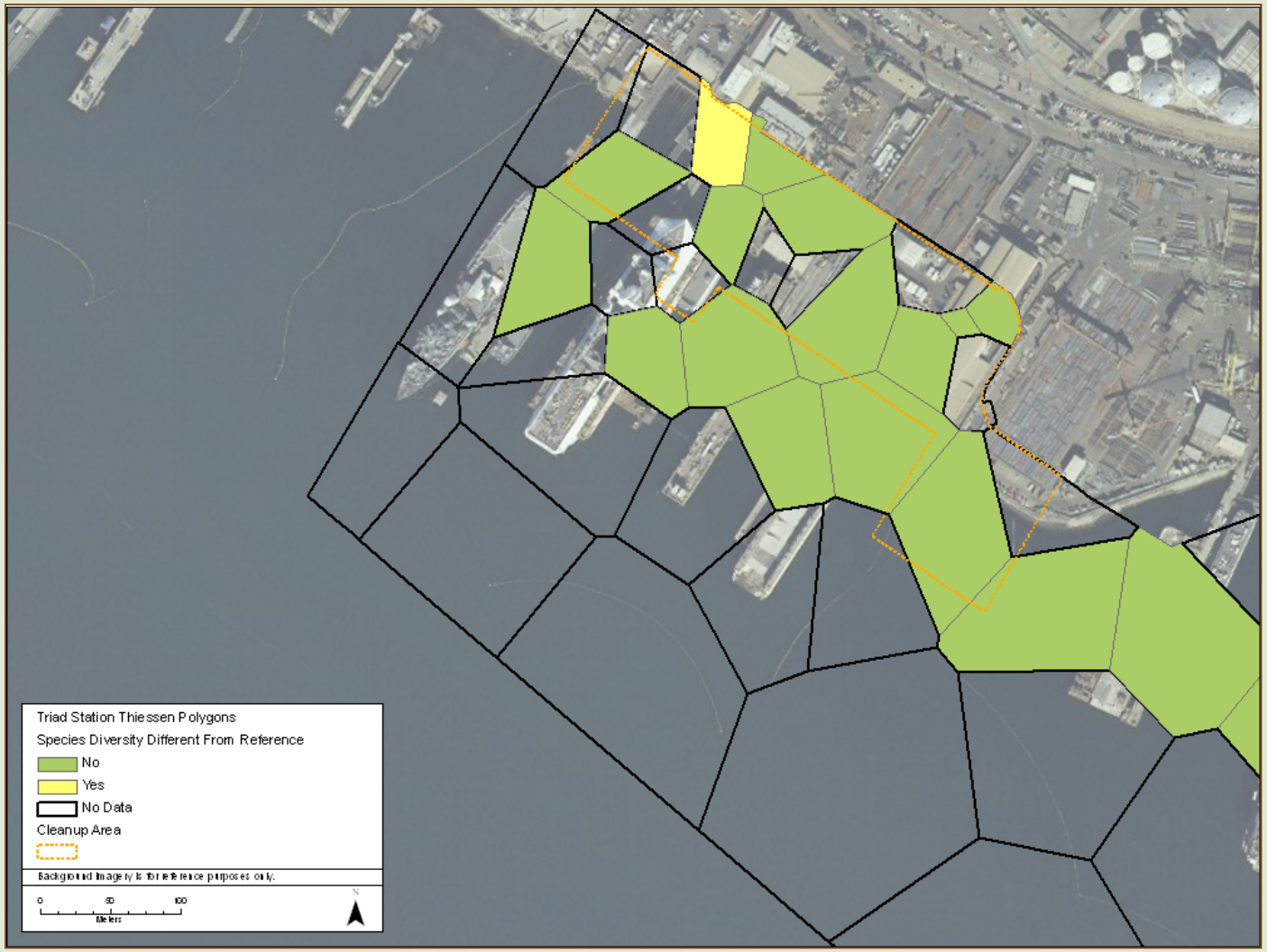
Diversity



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Sediment Toxicity

- Sensitive organisms tested in laboratory
  - Amphipods — mortality
  - Echinoderm (sea urchin) eggs — fertilization
  - Mussel larvae — development
- Statistical comparison of site and reference areas

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Sediment Toxicity

- Mussel test: apparent effects, but QC problems
- Amphipod test: no toxicity at BAE Systems
- Echinoderm test: no toxicity at BAE Systems

LOE	2001-2002 Investigation	DTR
Sediment toxicity	Minor toxicity	Moderate, driven by mussel test

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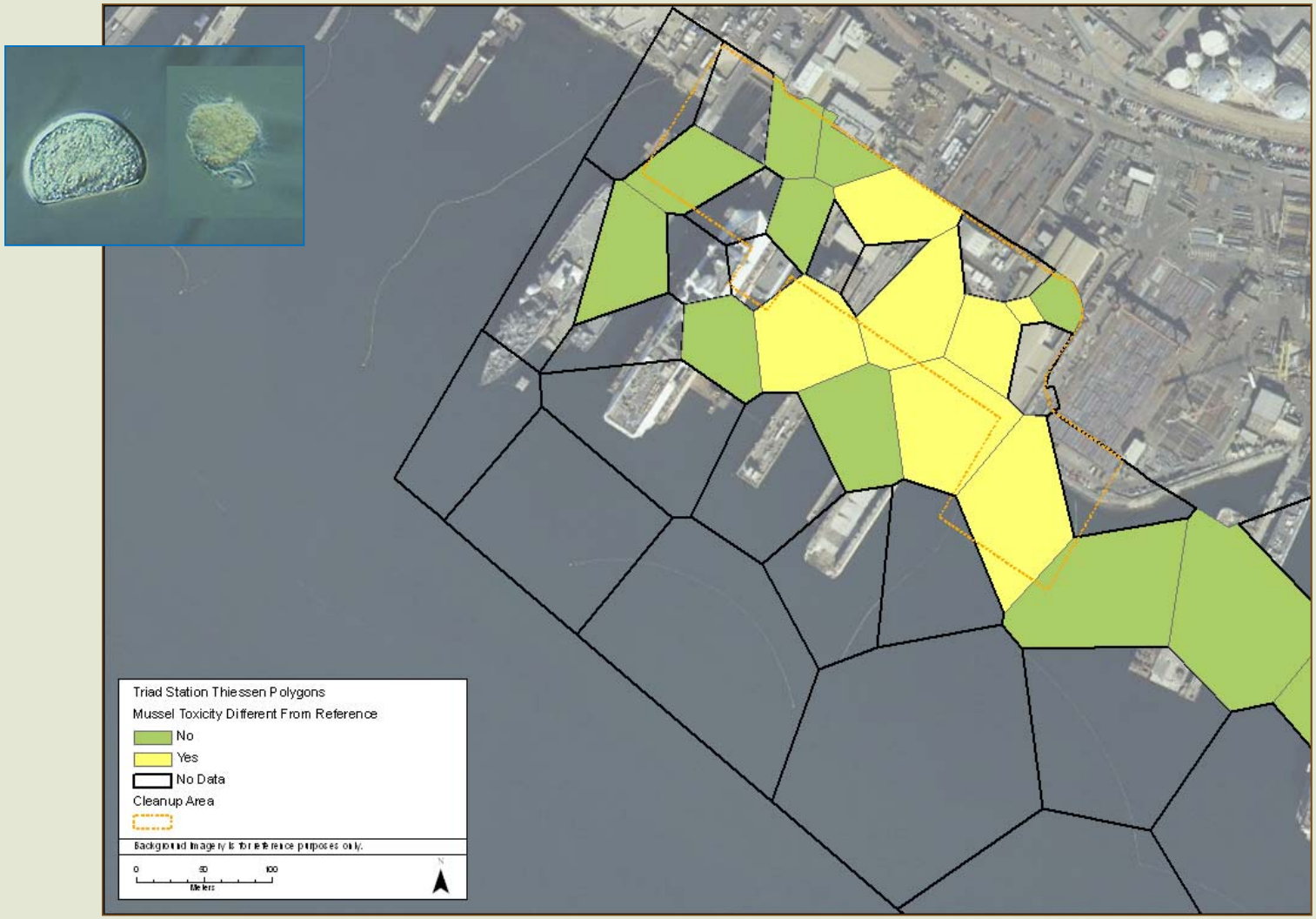
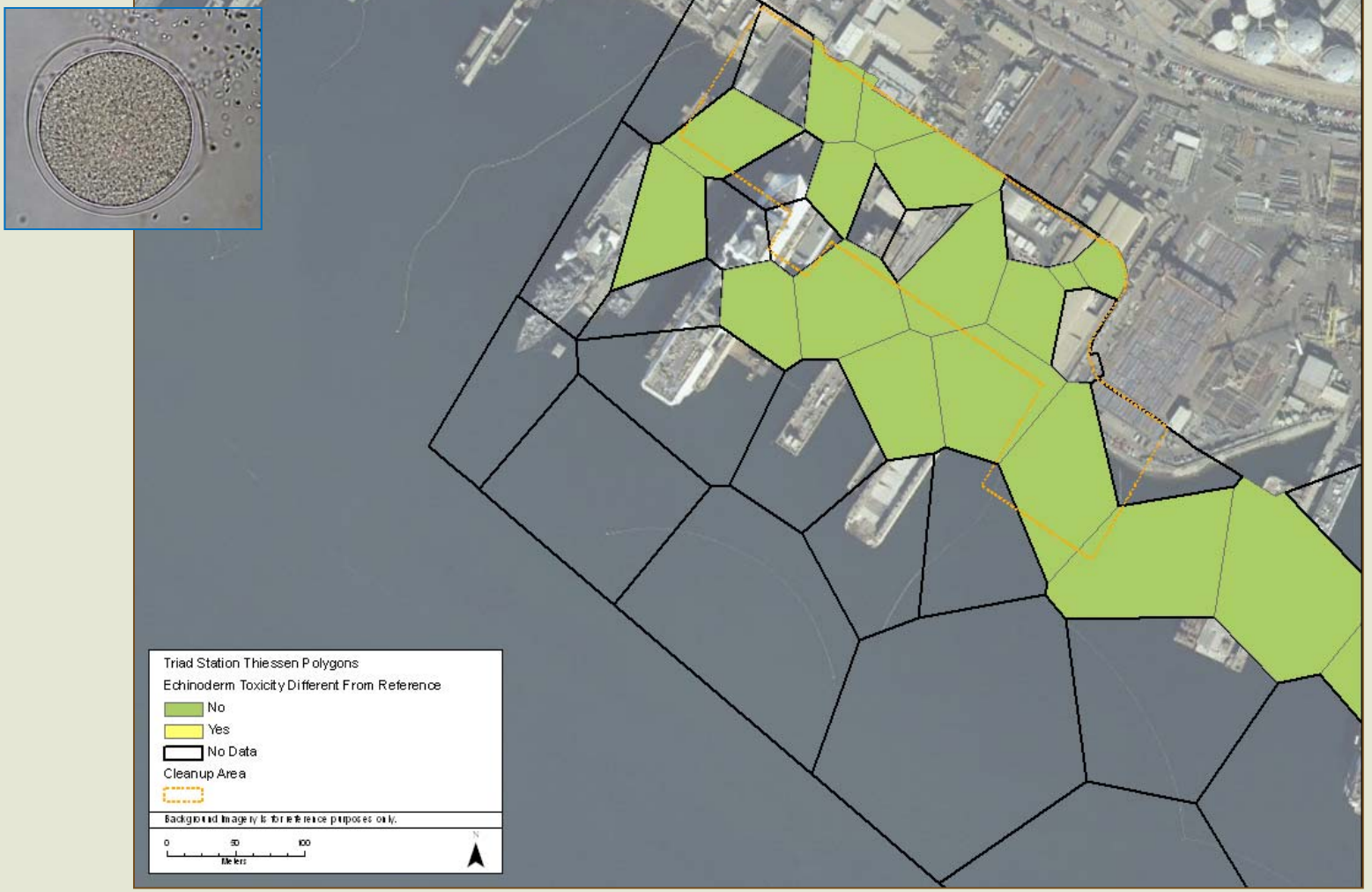
Mussel Development Test



Amphipod Mortality Test

Echinoderm Toxicity Test



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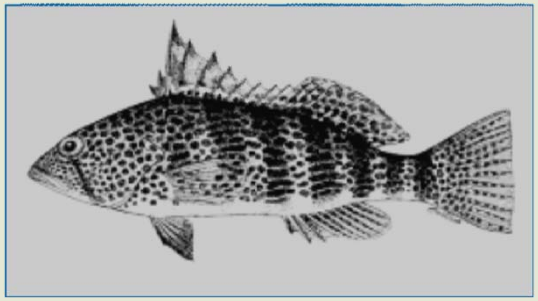
Fish Histopathology

- Spotted sand bass
  - Bottom-dweller, feeds on benthos
  - Localized



- 70 lesion types evaluated (Dr. Gary Marty, U.C. Davis)
- Statistical comparisons of fish from site and reference areas

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Fish Histopathology

- Some lesions found in all locations, including reference
- No cancerous lesions at BAE Systems
- Lesion severity was generally mild
- No consistent patterns at BAE Systems

LOE	2001-2002 Investigation	DTR
Fish histopathology	No adverse effects	No adverse effects

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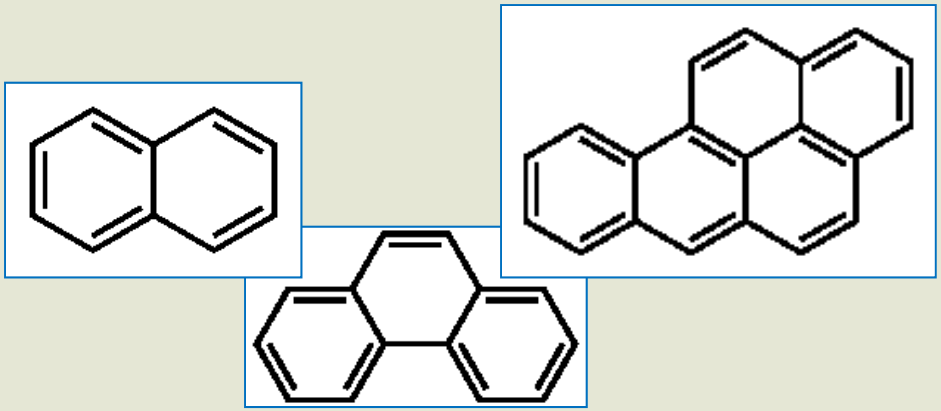
PAH Metabolites in Fish

- Metabolites in bile indicate exposure
- Three types of polycyclic aromatic hydrocarbon (PAH) breakdown compounds
- 40 composite samples from shipyards



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PAH Metabolites in Fish

- No difference between BAE Systems and reference

LOE	2001-2002 Investigation	DTR
PAH metabolites in fish	No effects	No effects

Fish Growth and Condition

- Age distribution
- Length and weight (“fatness”)
- Length at age

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Fish Growth and Condition

- No difference between reference and any location at the shipyards
- This LOE not evaluated or incorporated into the DTR

LOE	2001-2002 Investigation	DTR
Fish growth and condition	No effects	Not considered

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Ecological Risk Assessment

- Risks to aquatic-dependent wildlife: birds, marine mammals, turtles
- Receptors selected to represent all exposed species
  - Birds, mammals, turtles
  - Extensive home ranges
- Exposure via ingestion of prey from shipyards
- Calculated exposure compared to literature-based effect thresholds

Ecological Risk Assessment

- Exposure assessments differ
- "An animal's area-use factor [AUF] can be defined as the ratio of the area of contamination (or the site area under investigation) to the area used by the animal, e.g., its home range, breeding range, or feeding/foraging range." (U.S. EPA 1997)
- DTR assumes all prey is caught only within the site (AUF=1)

LOE	2001-2002 Investigation	DTR
Ecological risk assessment	No unacceptable risk	Risk from PCBs, copper, lead, mercury

Summary of LOE for Ecological Effects

LOE	2001-2002 Investigation Report	DTR
Benthic macroinvertebrate community maturity	Mostly mature communities	Mostly mature communities
Benthic macroinvertebrate community composition	Most locations equivalent to reference	Most locations equivalent to reference
Sediment toxicity (3 tests)	Minor effects	Moderate effects
Fish histopathology	No effects	No effects
PAH metabolites in fish	No effects	No effects
Fish growth and conditions	No effects	Not evaluated
Ecological risk assessment	Below thresholds	Above thresholds

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Human Health Risk Assessment

- Ingestion of fish and lobsters
- Screening-level and baseline assessments
- DTR used a conservative screening-level assumption for both

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Human Health Risk Assessment

- Shipyard report: potential risk from screening-level evaluation, not from baseline risk assessment
- DTR: potential risk from both screening-level and baseline risk assessments

LOE	2001-2002 Investigation	DTR
Human health risk assessment	No unacceptable risks	Risk from PCBs, copper, mercury, arsenic, and cadmium; also at reference areas

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Primary Areas of Conservatism

- DTR ignored quality issues with mussel test, used results indiscriminately
- Use of AUF=1 in ecological risk assessment
- Use of FI=1 in human health risk assessment
- Failure to incorporate all LOE in decision framework

How Conservative is the Remedy?

- Synthesizing effects of various types of conservatism is difficult
- Results of accurate and conservative assessment can be compared
  - Sediment volume
  - Cost
  - Change in beneficial uses

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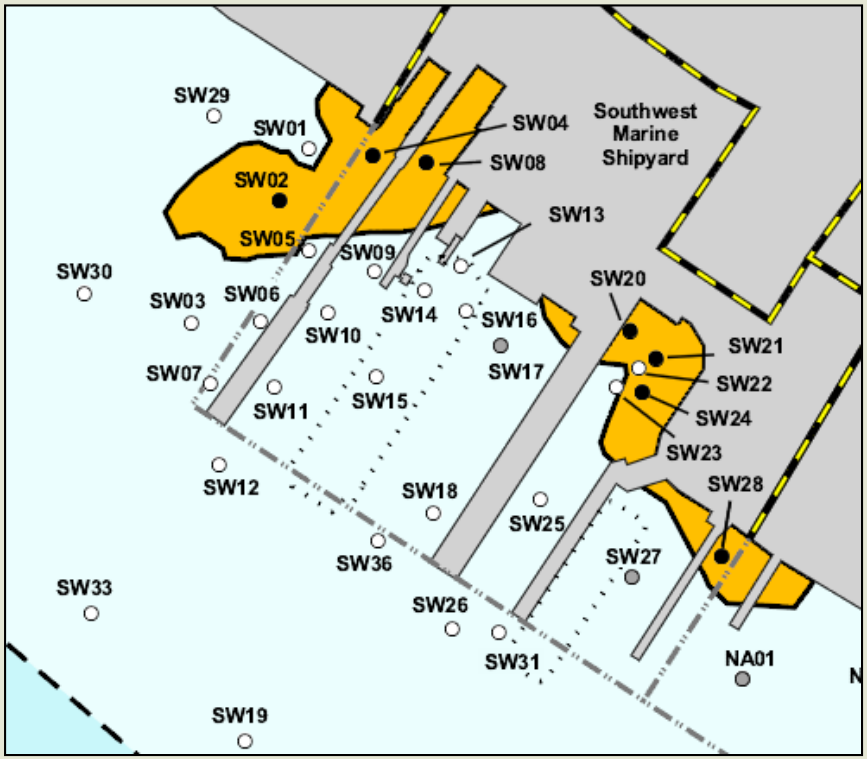
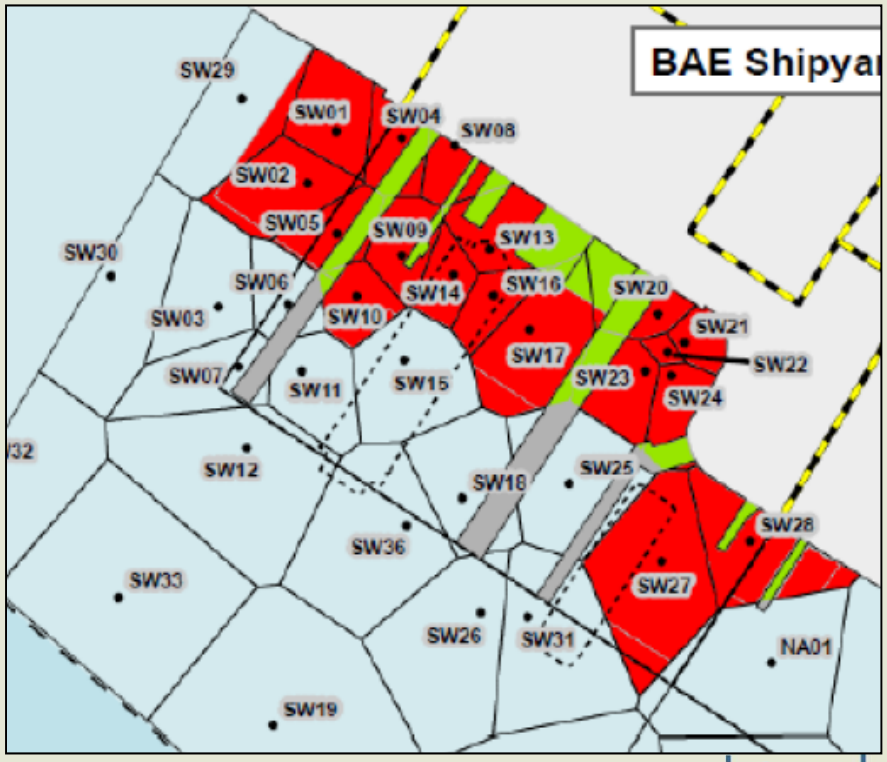
2003 Investigation Selected Remedy

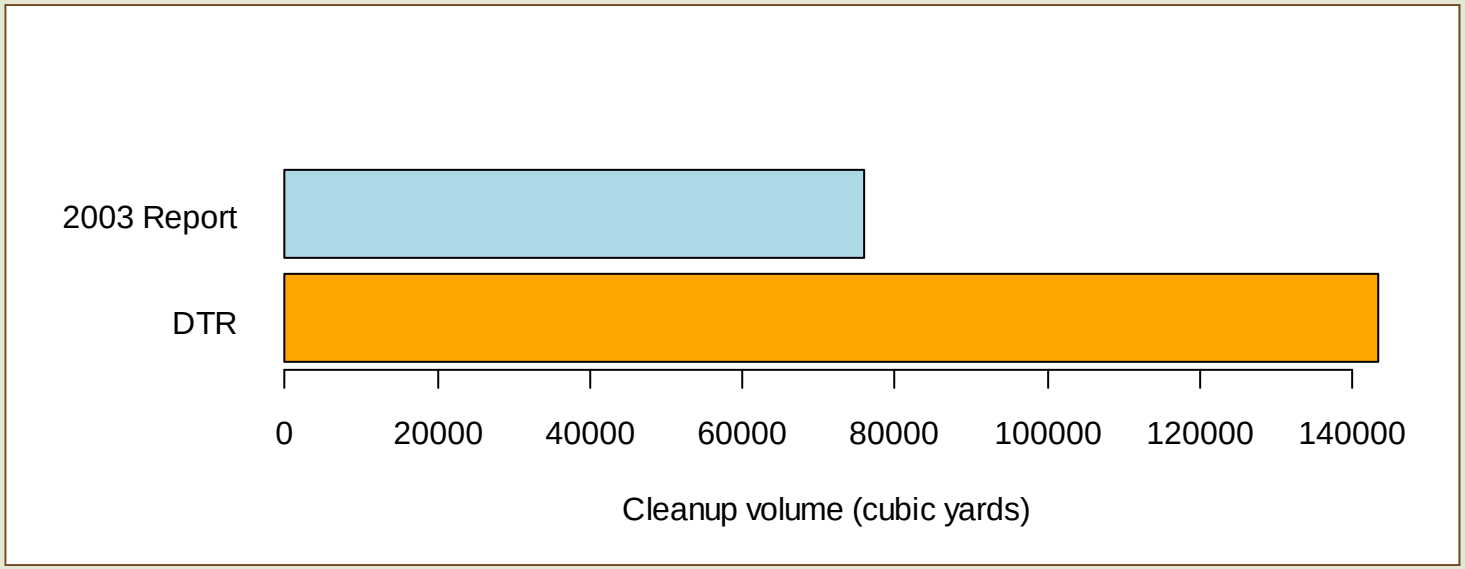
- Based on site-specific effect thresholds





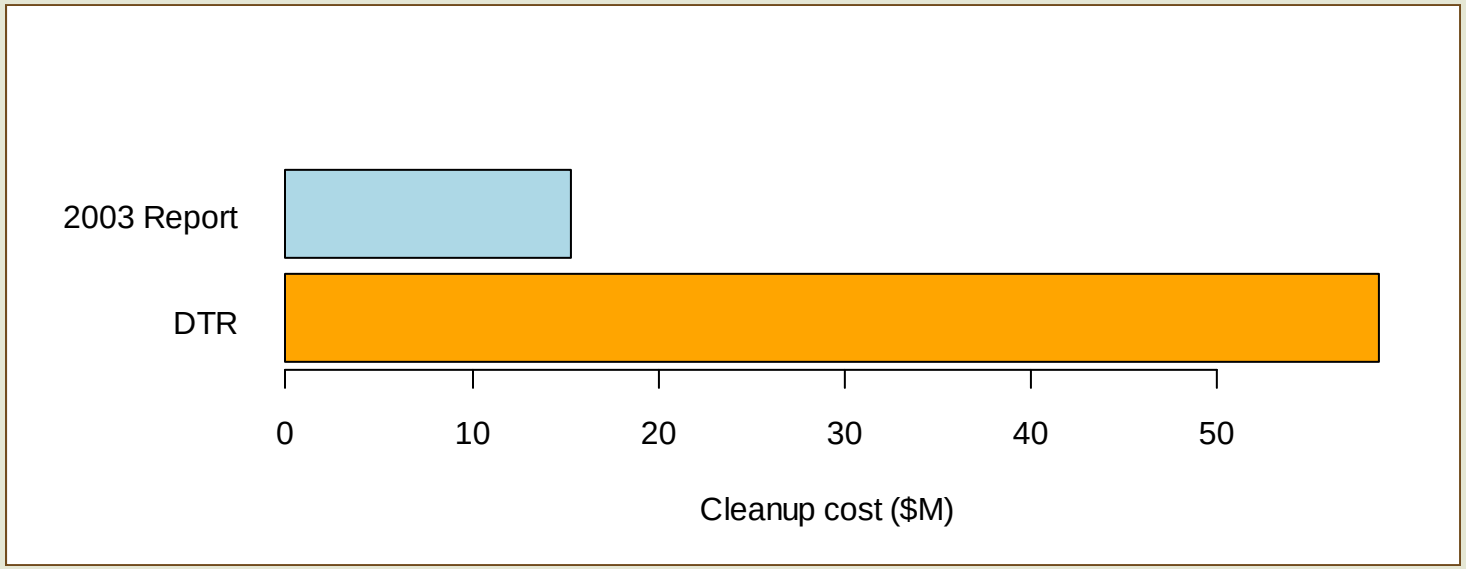
Cleanup Volumes

- 2003 sediment report: 75,850 yd^3
- DTR: 143,400 yd^3
- Conservativeness: a factor of 1.9



Cleanup Costs

- 2003 sediment report: $15,300,000
- DTR: $58,700,000
- Conservativeness: a factor of 3.8



Conclusion

- DTR uses conservative assumptions about ecological and human health effects, leading to:
  - Overstated adverse effects
  - Unnecessary cleanup
  - The proposed cleanup is 2 to 4 times larger than necessary
- *The proposed cleanup is more than sufficiently protective*

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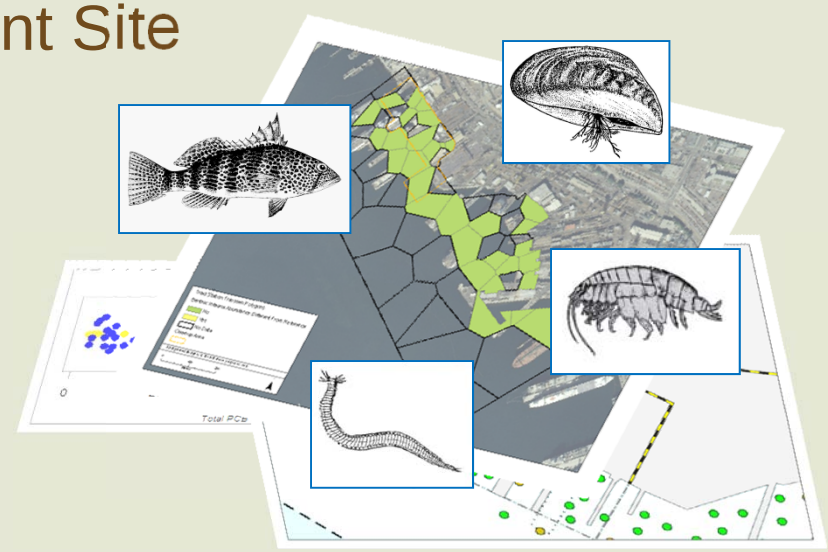
Site Conditions and Cleanup Protectiveness

San Diego Shipyard Sediment Site



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