Toxic Hot Spot – TMDL Study
Chollas and Paleta Creeks

Preliminary Phase I Results

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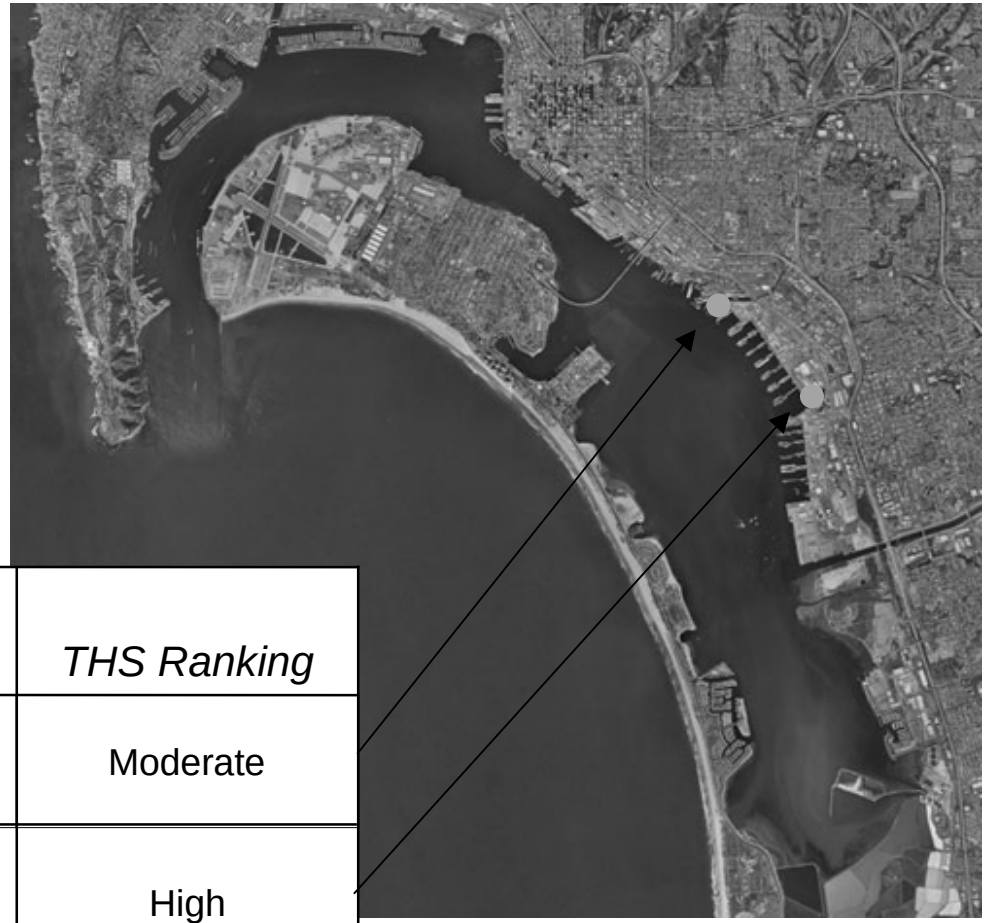
Outline

- Study Background – Alan's Talk
- Technical Approach
- Preliminary Results
  - Reference Stations
  - Sediment Chemistry
  - Sediment Bioassays
  - Benthic Community Analysis
  - Bioaccumulation
- Next Steps

Background

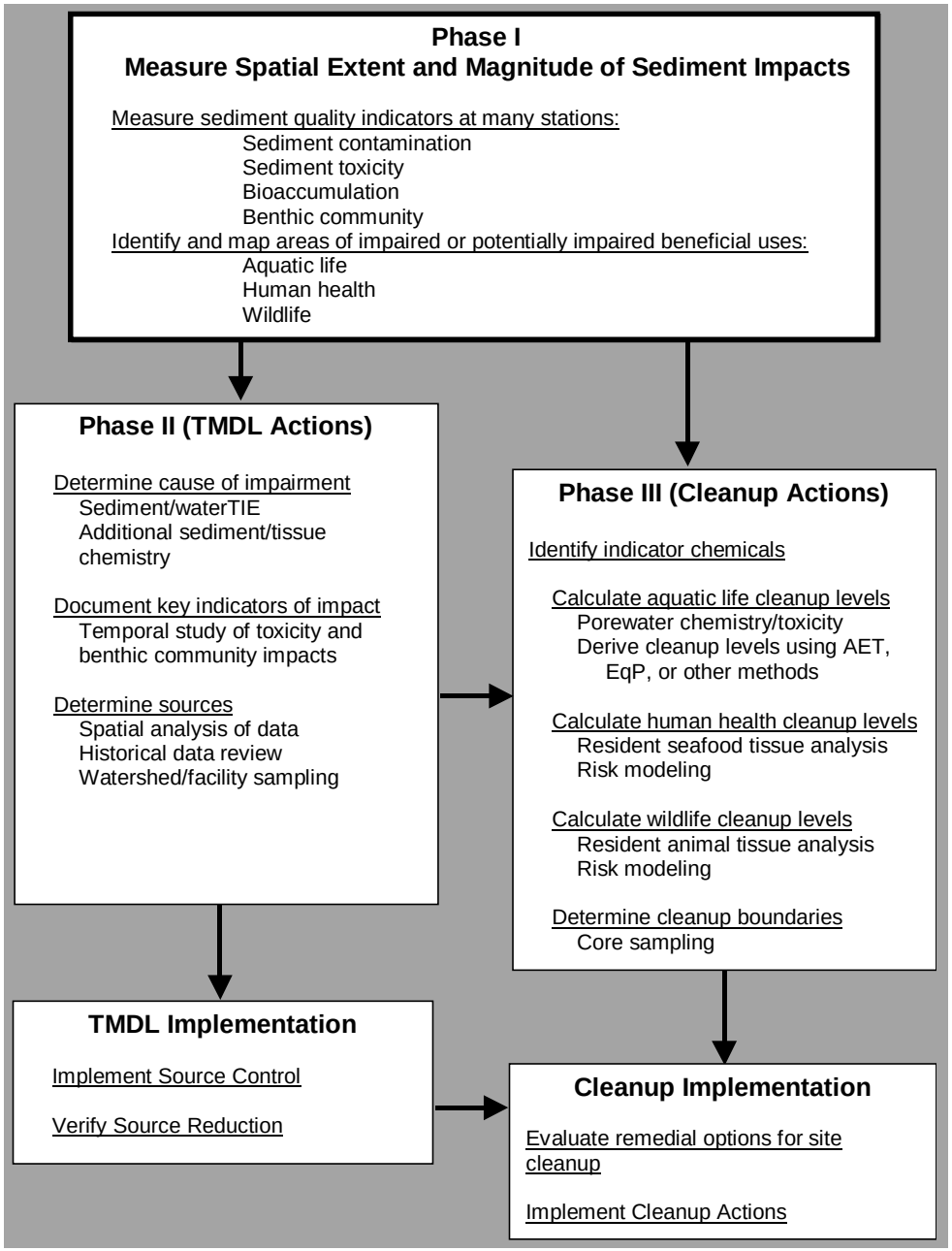
- Two sites are being assessed for TMDL and cleanup assessment simultaneously
- Interagency THS-TMDL workgroup approach to pool resources and develop consistent approaches



Site Identification	*THS Ranking*
Chollas Creek	Moderate
Seventh Street Channel/Paleta Creek	High

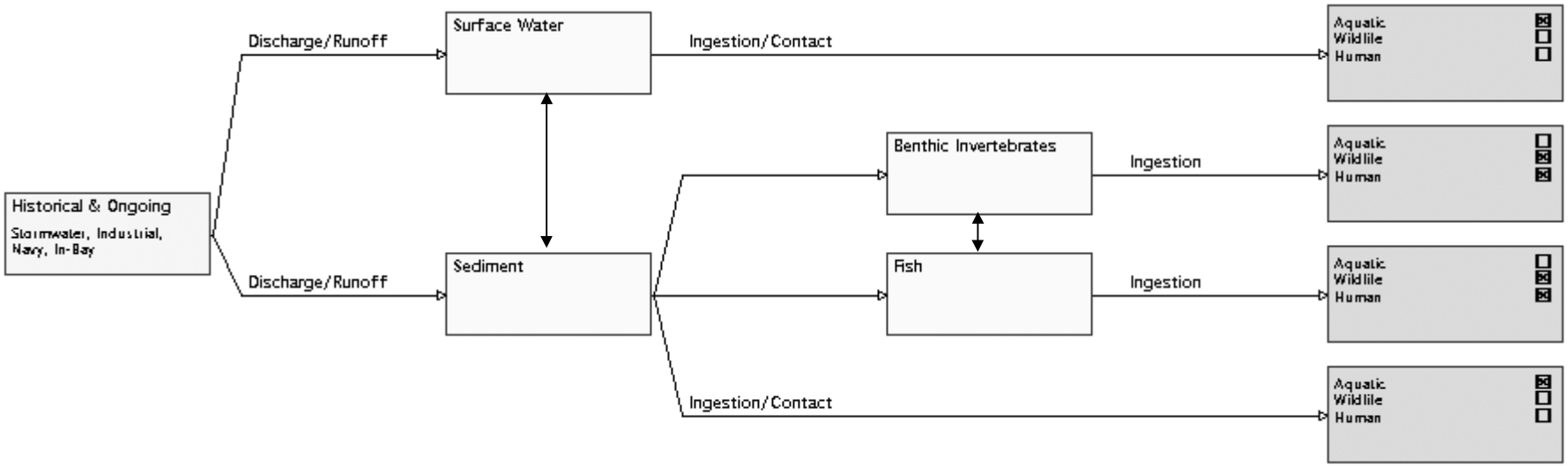
Technical Approach

- Comprehensive program integrates requirements for:
  - THS clean up
  - TMDL source control
- Program designed in phases to allow implementation of source control while clean up requirements are determined
- Currently completing Phase I assessment for spatial assessment and screening level impact assessment



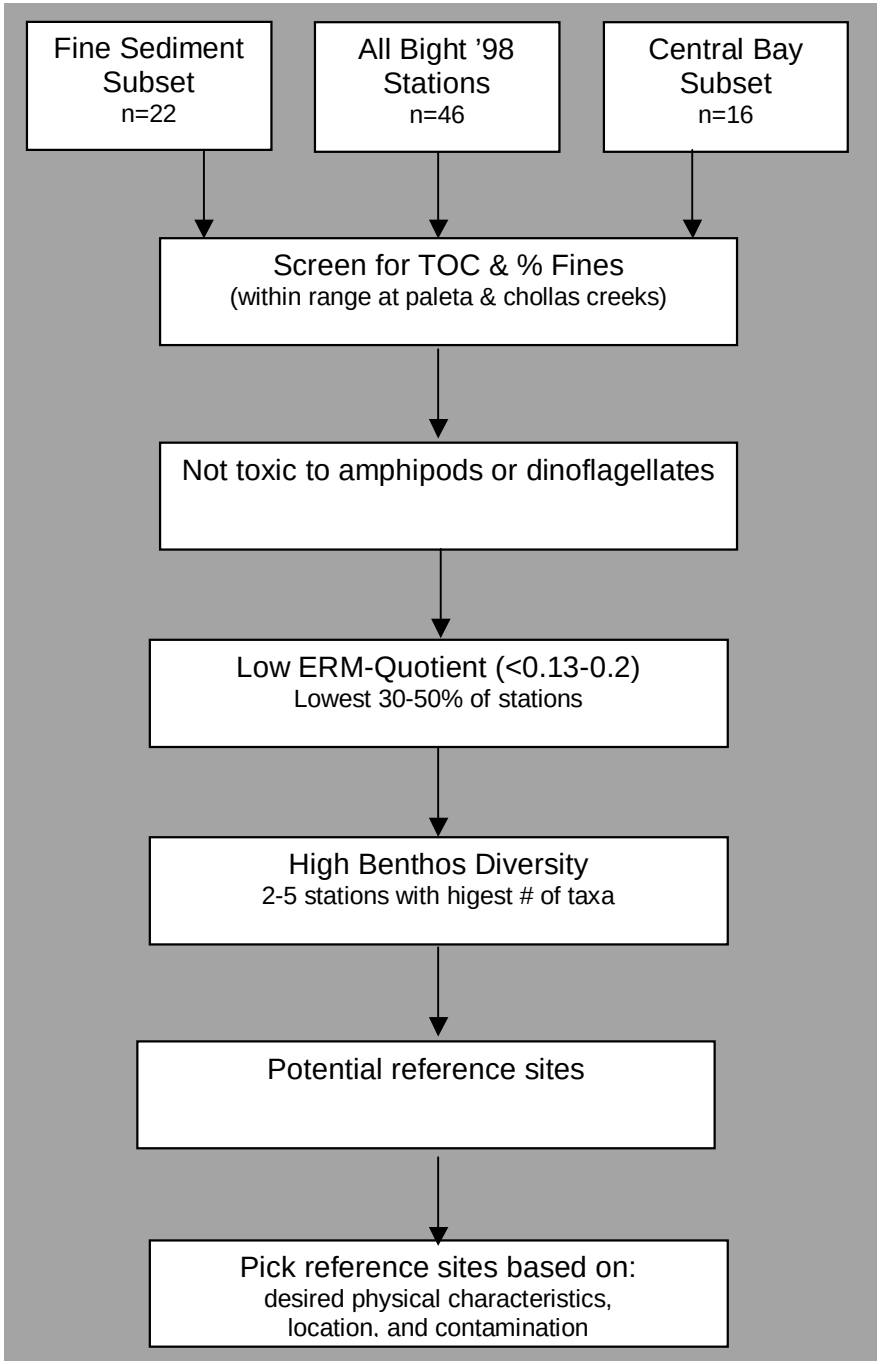
Site Conceptual Model

- Focuses on sediment exposure pathway
- Incorporates exposure assessment for aquatic, wildlife and humans

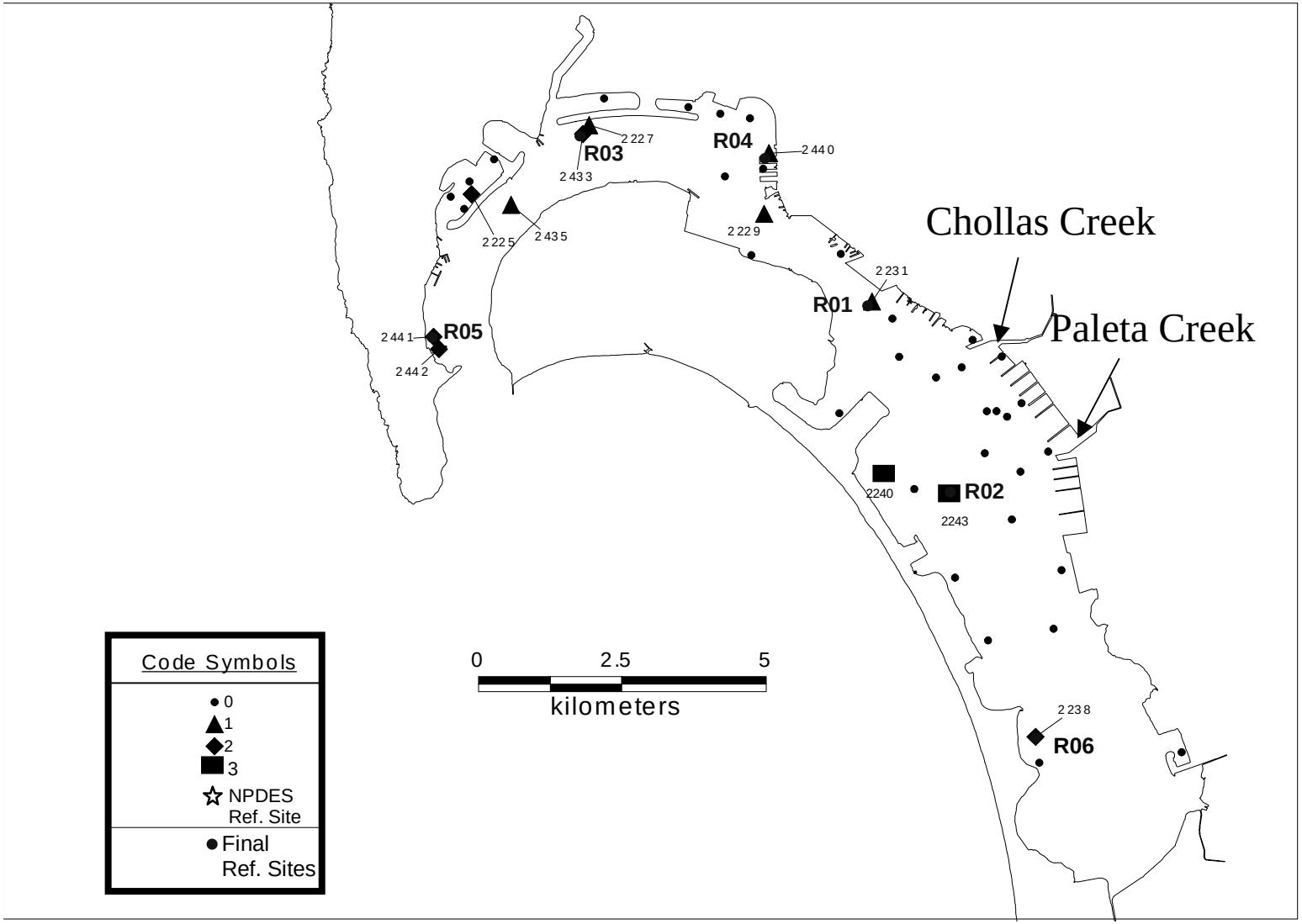


Reference Station Selection

- Reference areas selected from Bight ’98 stations
- Station selection based on:
  - Physical properties
  - Low toxicity
  - Low contamination
  - High diversity
  - Spatial location

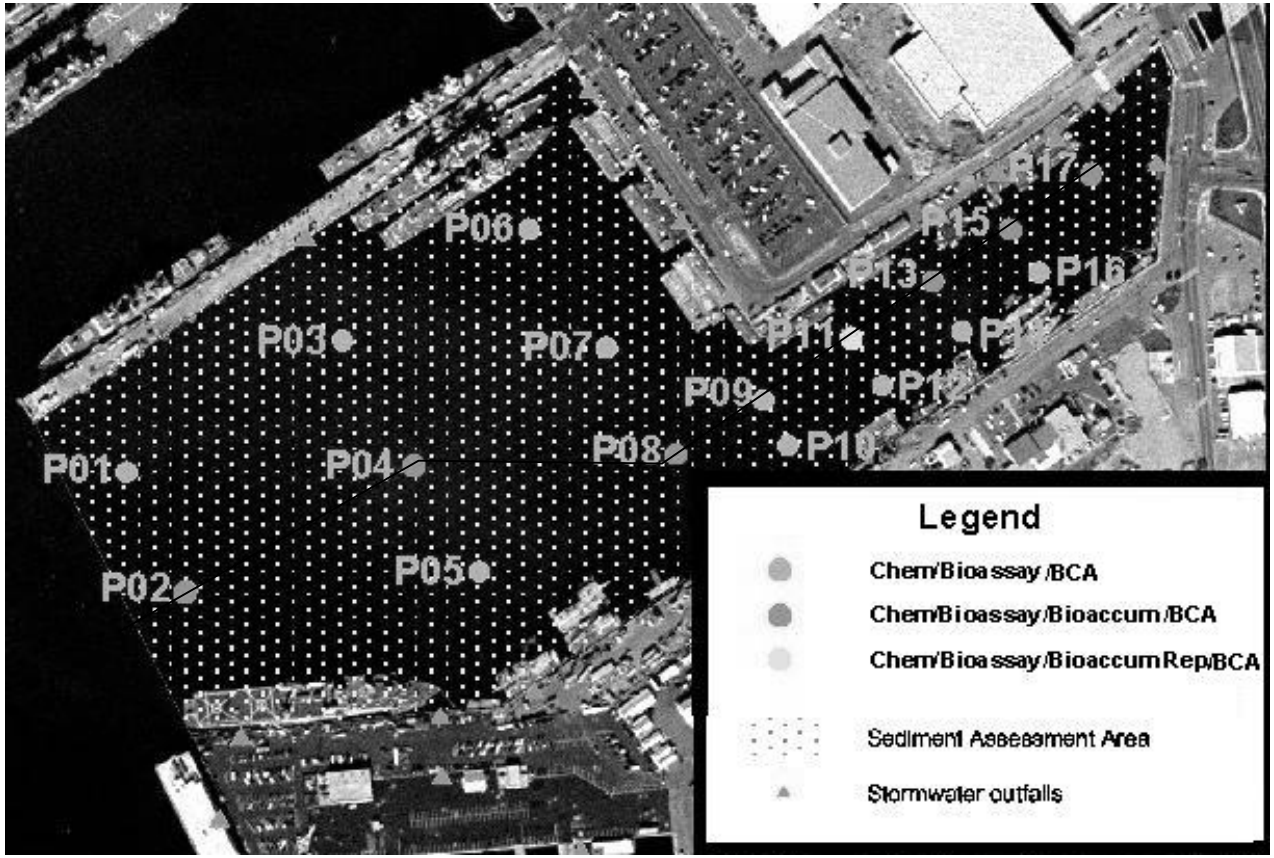


Reference Station Locations

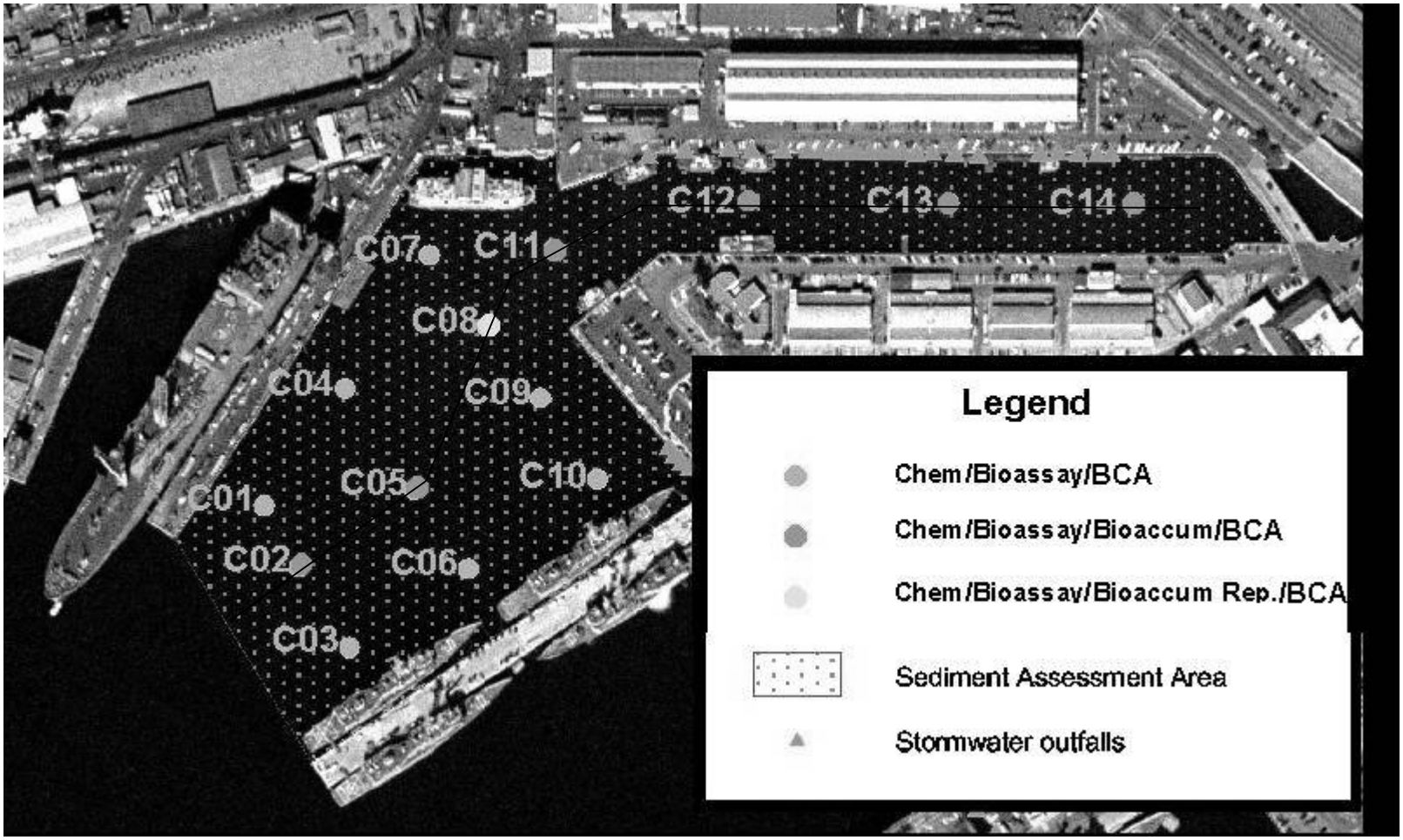


Sampling Design – Paleta Creek

- Station locations selected to
  - Determine spatial extent of impairment
  - Assist in locating source areas
- Number of stations selected to provide:
  - Adequate spatial assessment
  - Sufficient data for development of clean up levels

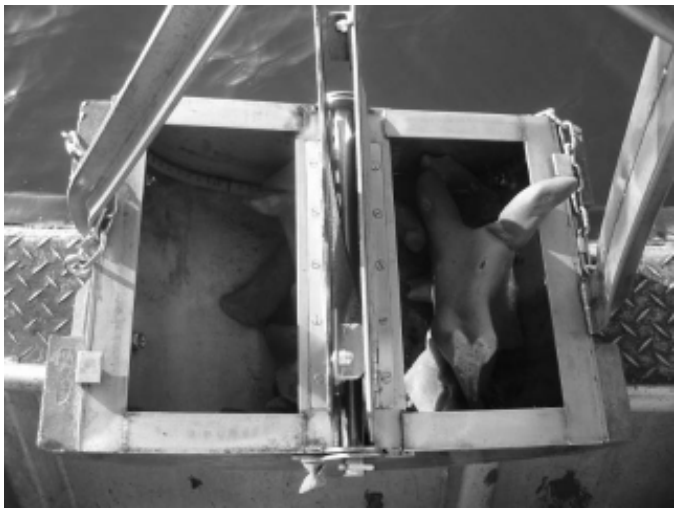


Sampling Design – Chollas Creek



Field Program - Sediment Grab Samples

- Surface samples (2 cm) collected by grab for chemistry, porewater toxicity, solid phase toxicity testing, and bioaccumulation

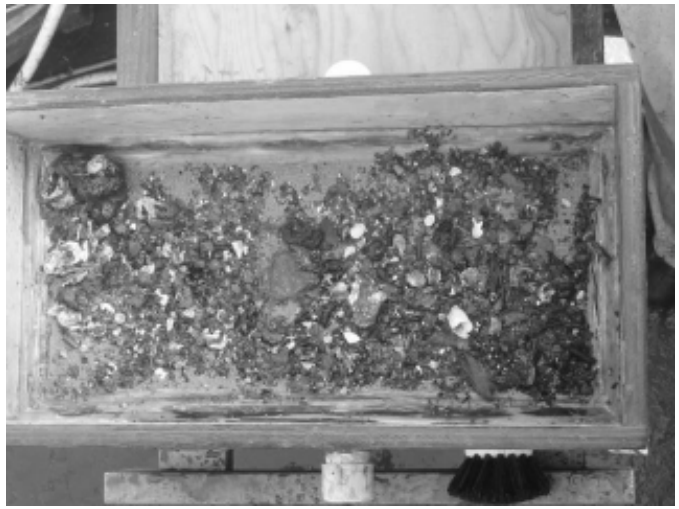


Field Program - Sediment/Water Interface Samples

- New sampling technology allows collection of undisturbed sediment/water interface samples
- Collected samples at 37 stations (Chollas Creek, Paleta Creek and reference) to support sediment-water interface toxicity testing

Field Program - Benthic Community Sampling

- Benthic community samples collected and sieved at all Chollas Creek, Paleta Creek and reference stations
- All samples sieved and preserved during cruise

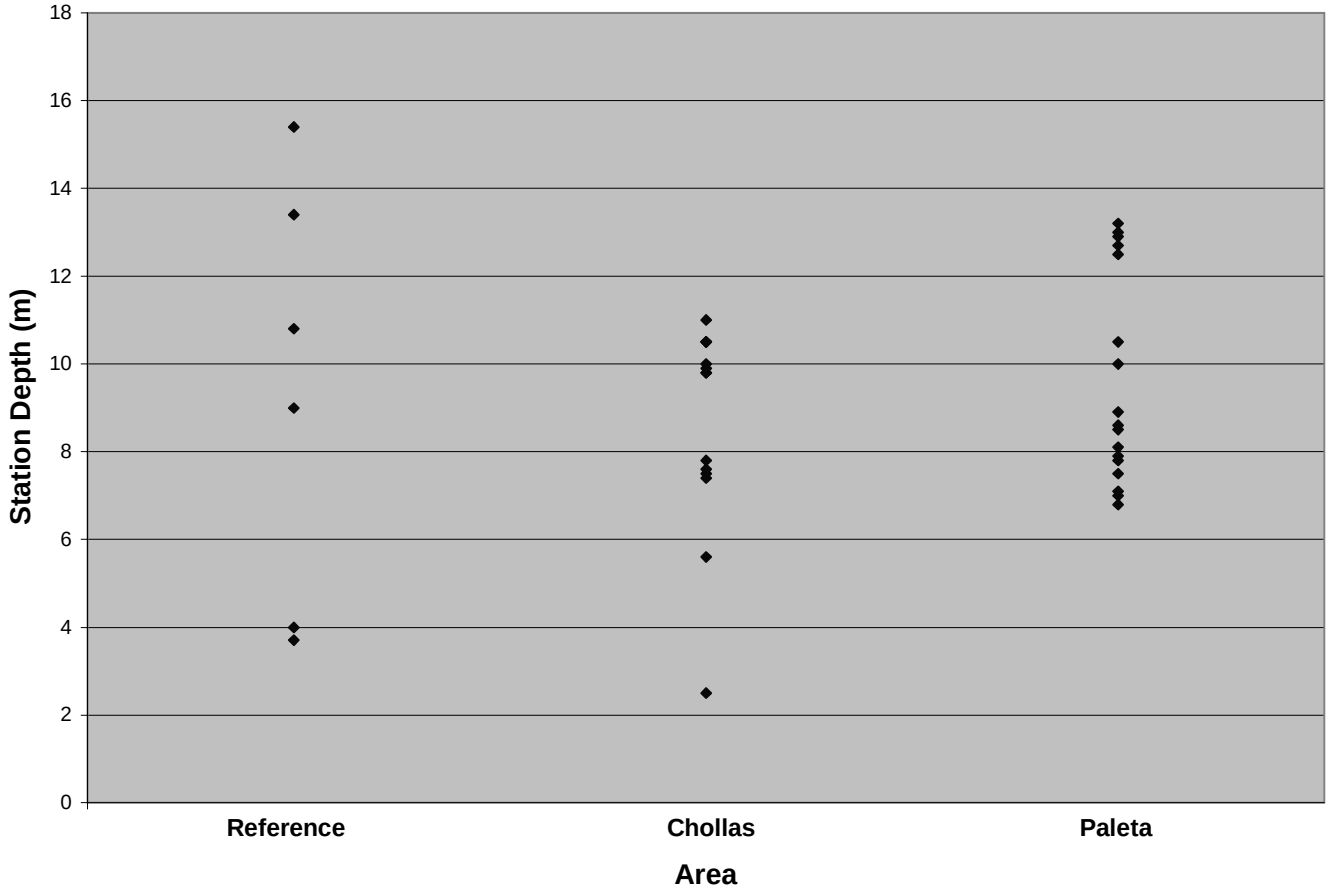


Results - Reference Site Properties

- Reference stations should be representative of the study sites absent the local contamination release
  - Evaluate water depth as a general indicator of ecological habitat type
  - Compare grain size and total organic carbon (TOC) content at reference and study sites

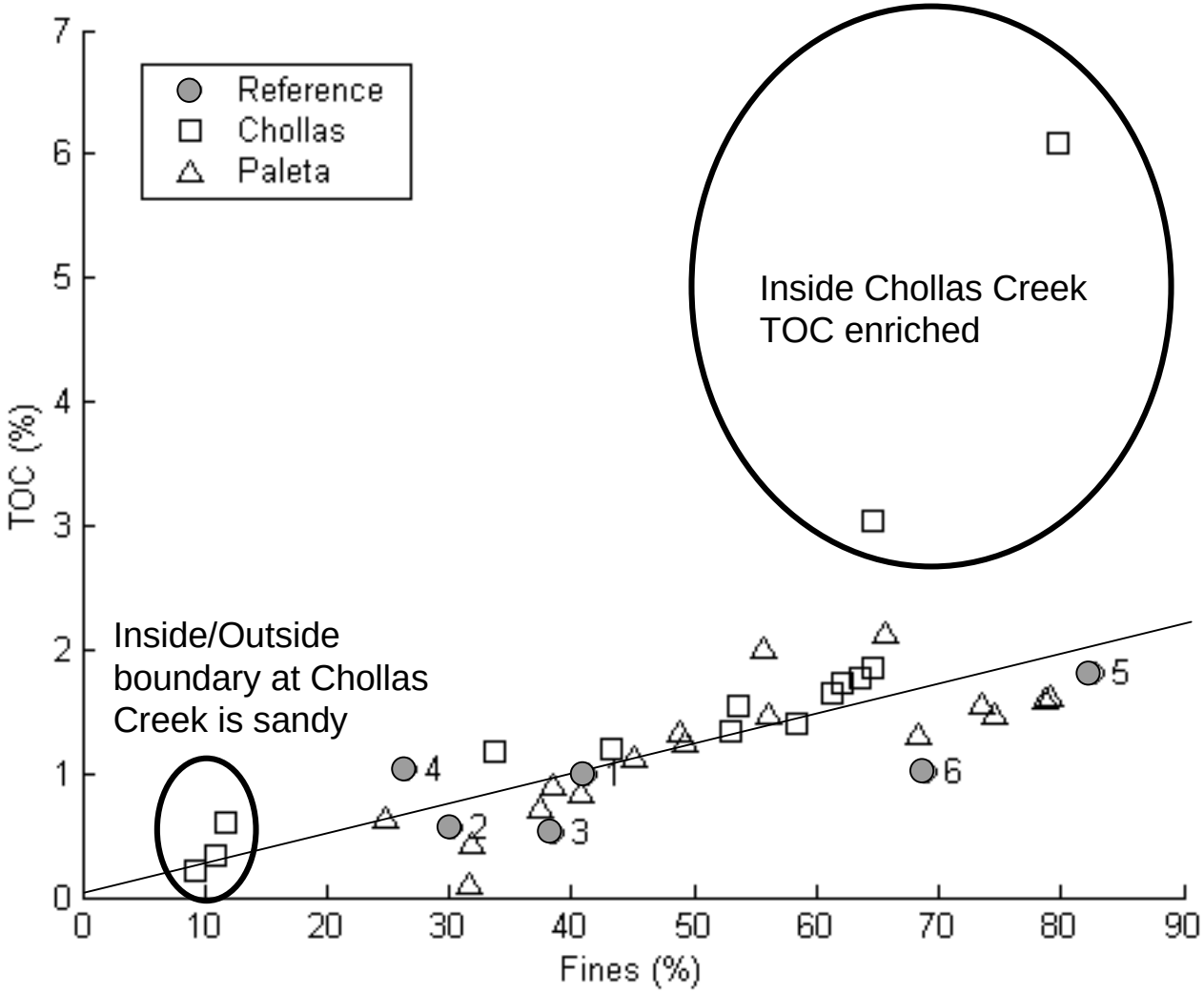
Water Depth Comparison

- Water depth is an important parameter for establishing comparable ecological environments
- The range of depths at the reference stations brackets the range of depths encountered at the sites



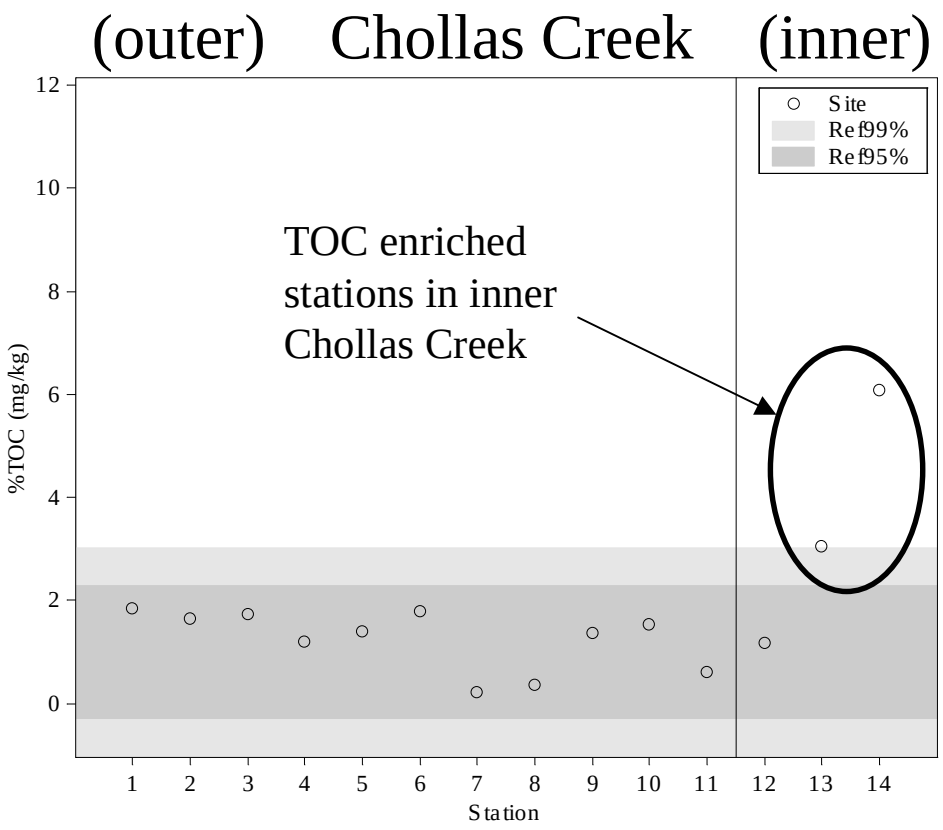
Results - TOC and Grain Size Comparison

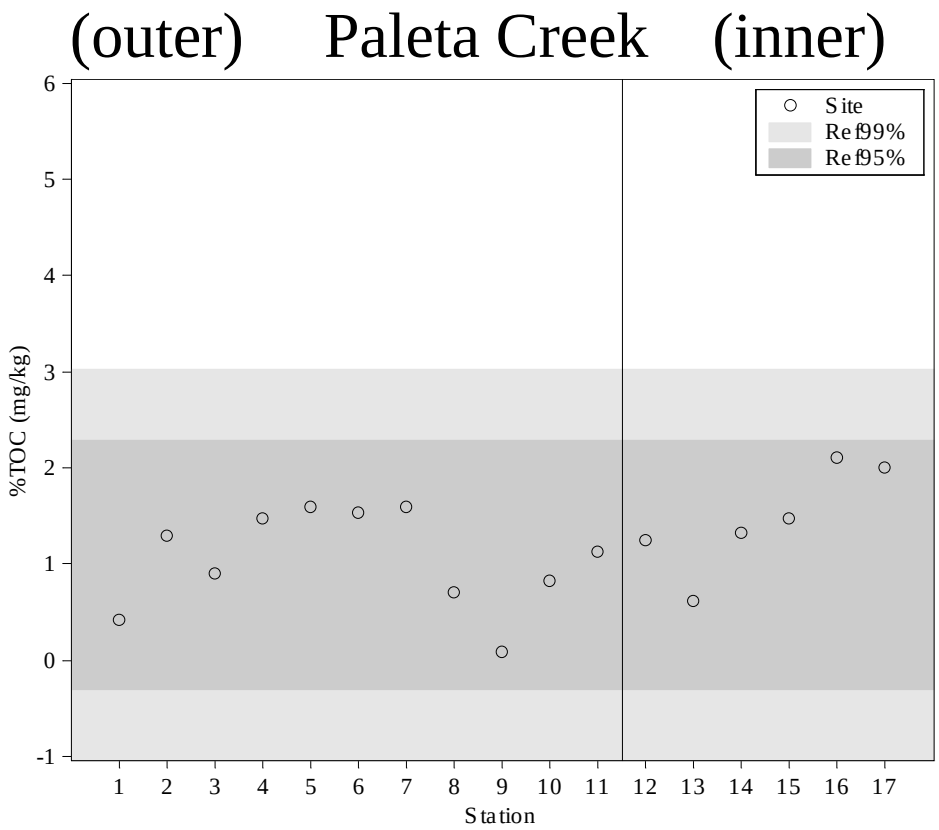
- TOC and grain size are important parameter for establishing comparable geochemical environments
- The range of TOC and grain size at the reference stations brackets the range encountered for most sites



Results - TOC

- TOC at 29 out of 31 site stations falls within statistical range of reference sites
- Inner area of Chollas Creek has high TOC compared to reference
- Important difference to keep in mind during data interpretation

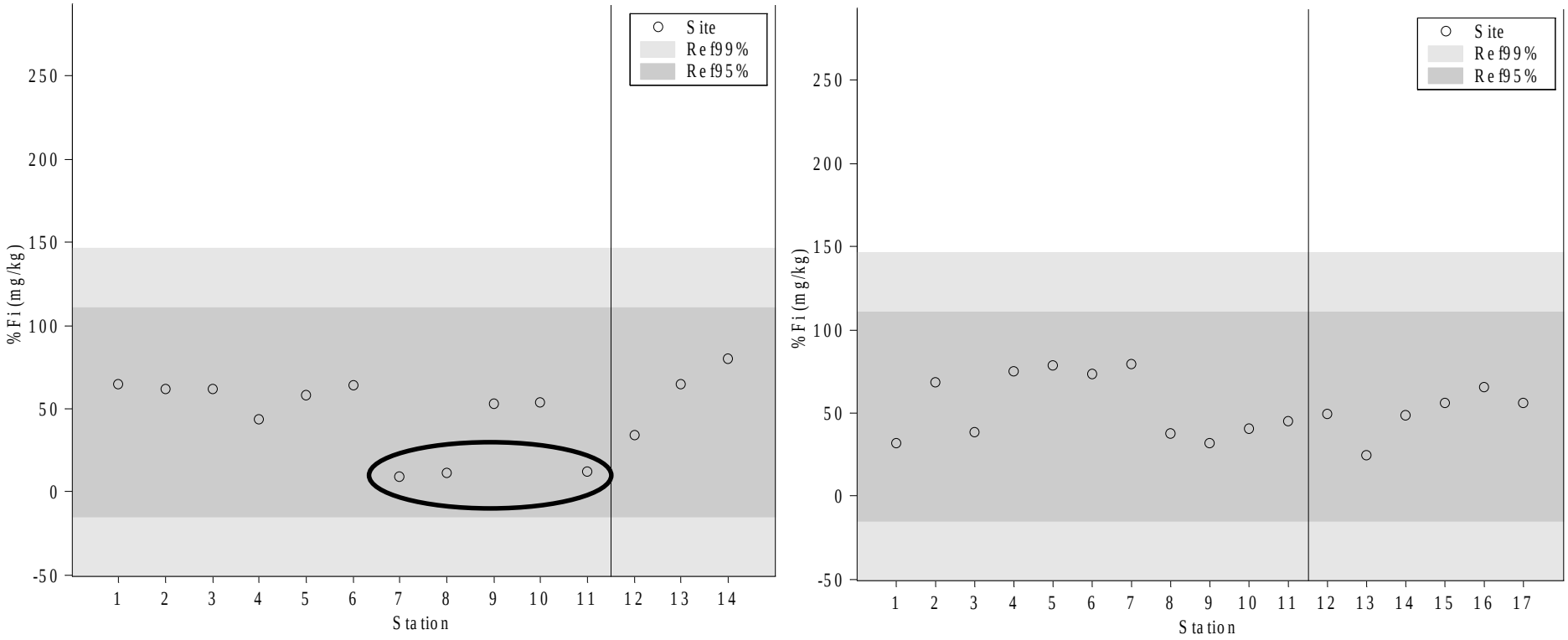




Results - Grain Size

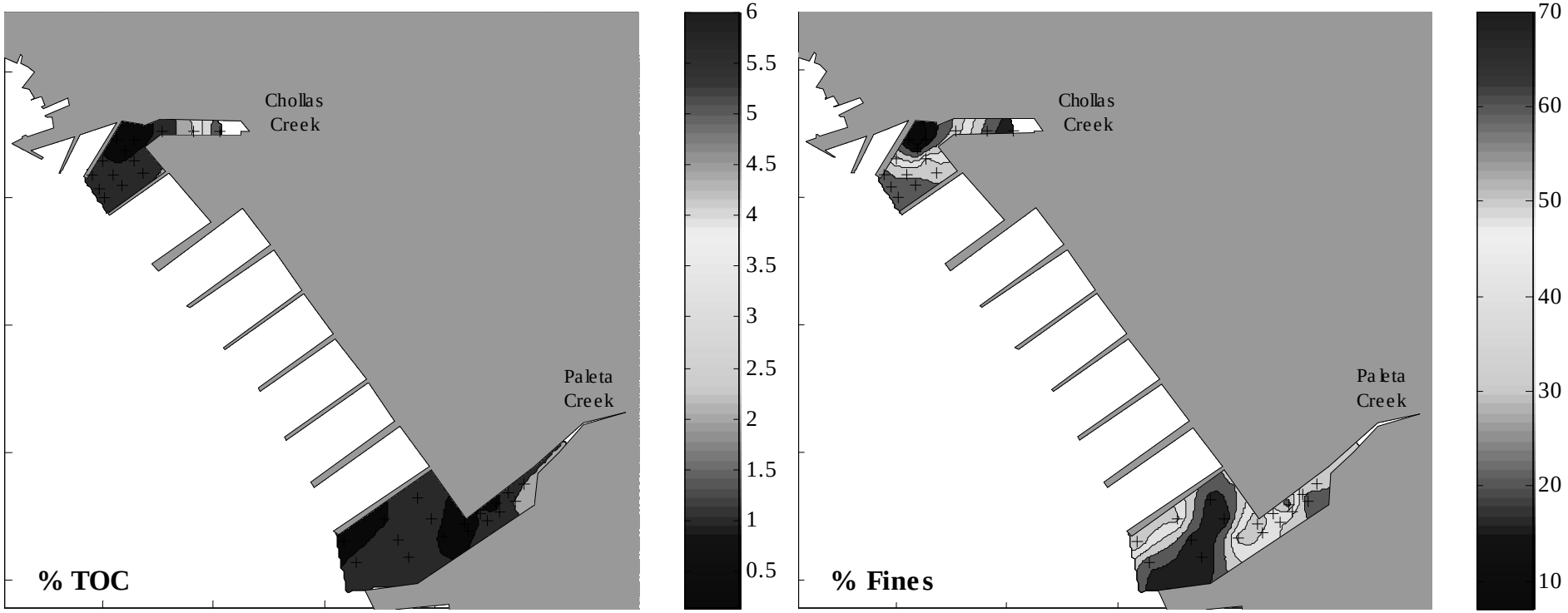
- Grain size at all site stations falls within statistical range of reference sites
- Sandy region at inner/outer boundary of Chollas Creek is still within range of reference

(outer) Chollas Creek (inner) (outer) Paleta Creek (inner)



TOC and Grain Size Spatial Distribution

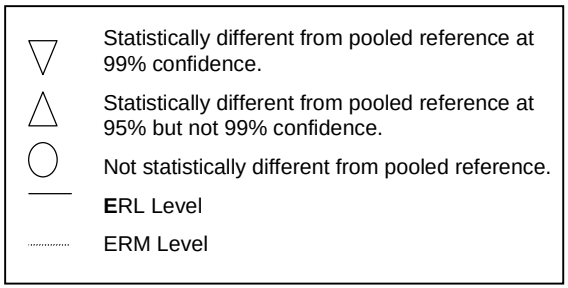
- Inner creek areas have high TOC and % fines
- Boundary between inner and outer creek areas are sandy with low TOC
- Outer creek areas have fine sediment with moderate TOC
- Spatial distribution of many contaminants show similar patterns



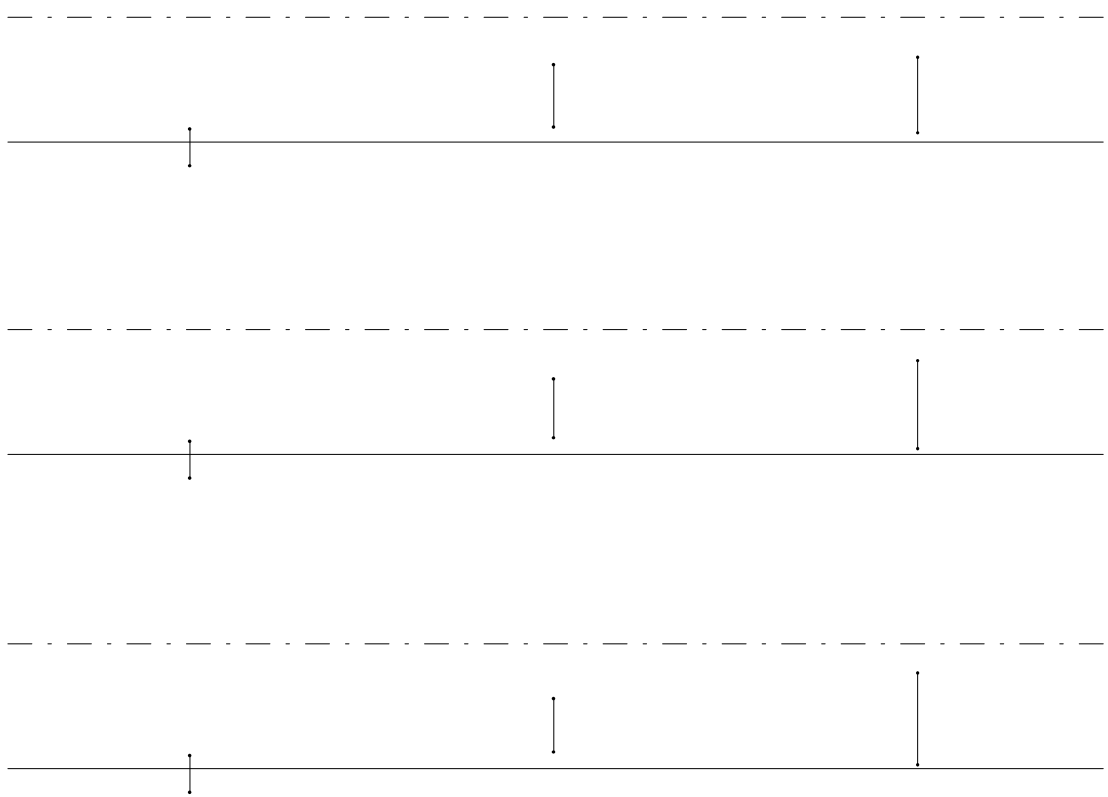
Sediment Chemistry Results

- Sediments analyzed for a range of chemicals including metals, PAHs, PCBs and Pesticides based on analysis of historical data
- Provides data for Phase I analysis of TMDLs, aquatic, wildlife, and human health beneficial use assessment
- Phase I analysis to date includes
  - Grouped creek data compared to:
    - reference at 95 and 99% confidence intervals
    - screening levels ERL/ERM
  - Individual station data compared to:
    - reference at 95 and 99% predictive intervals
    - screening levels ERL/ERM
  - Spatial mapping

Zinc - Grouped Station Results



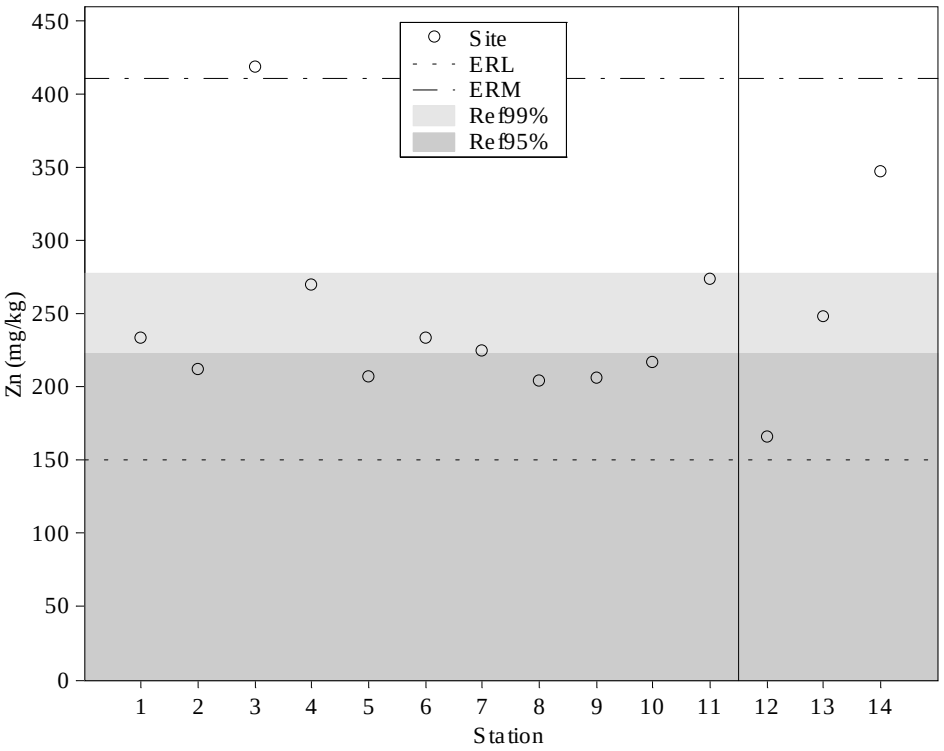
- Grouped zinc concentrations generally above reference and between ERL and ERM
- No clear differences between outer and inner areas



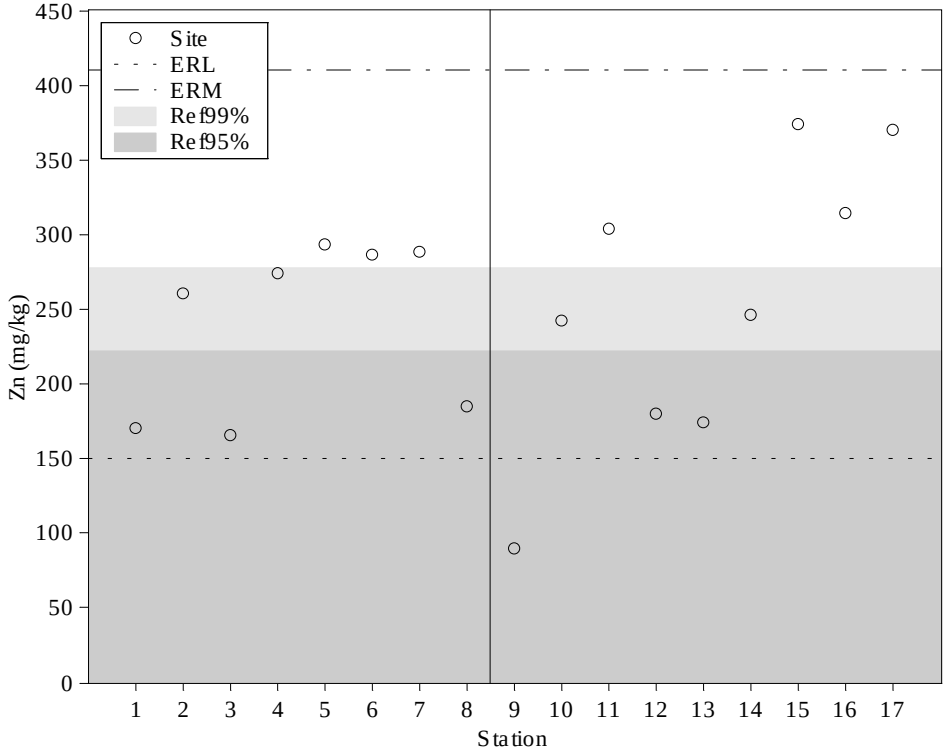
Zinc - Individual Station Results

- Individual Chollas Creek and Paleta Creek stations generally between ERL and ERM for zinc – some exceed ERM or reference at 99% PI

(outer) Chollas Creek (inner)

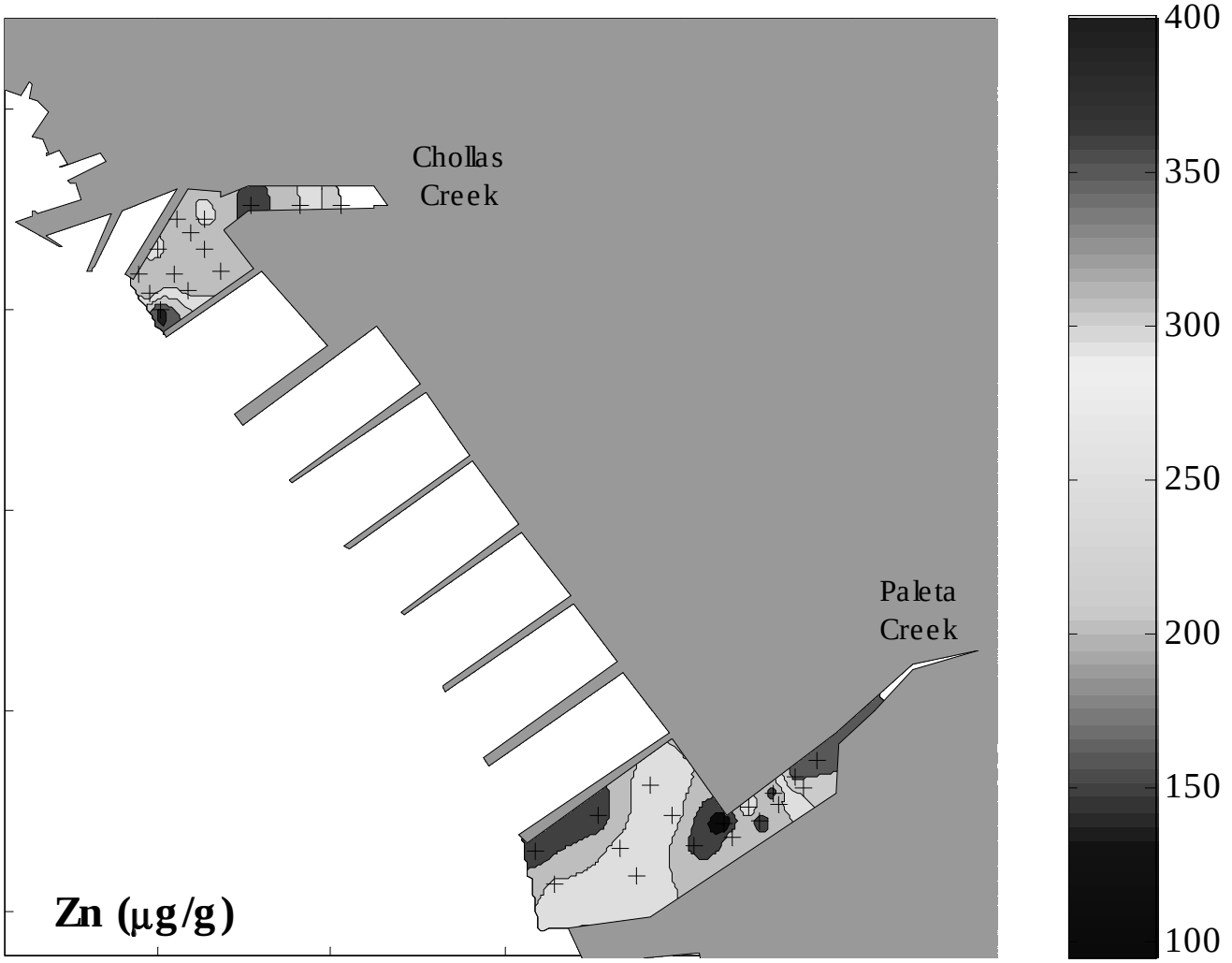


(outer) Paleta Creek (inner)



Zinc – Spatial Distribution

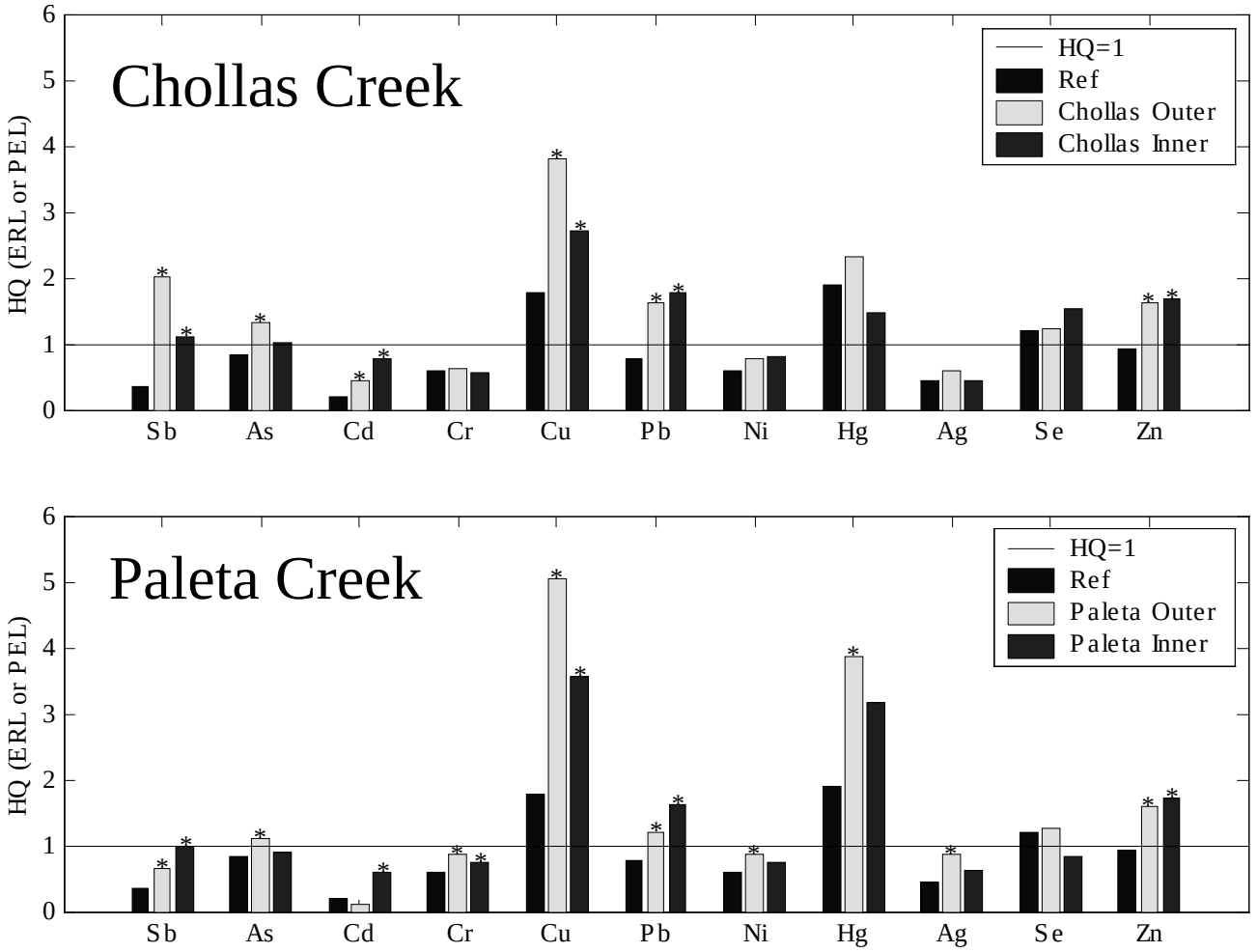
- Elevated levels in inner creek areas possibly reflect storm water sources
- Spatial distribution of zinc in outer creek shows relation to fines
- One elevated sample near end of pier 1



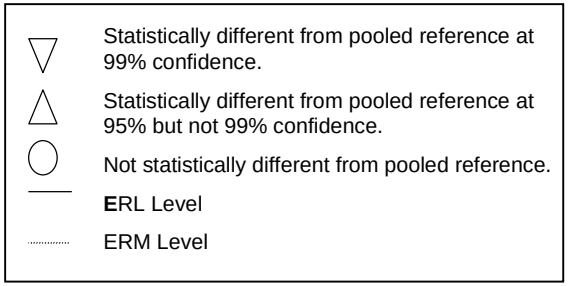
Sediment Metals Summary

- Chollas Creek – Sb, As, Cu, Pb and Zn exceed screening levels and reference
- Paleta Creek – As, Cu, Pb, Hg and Zn exceed screening levels and reference
- No clear trends between inner and outer creek areas for most metals

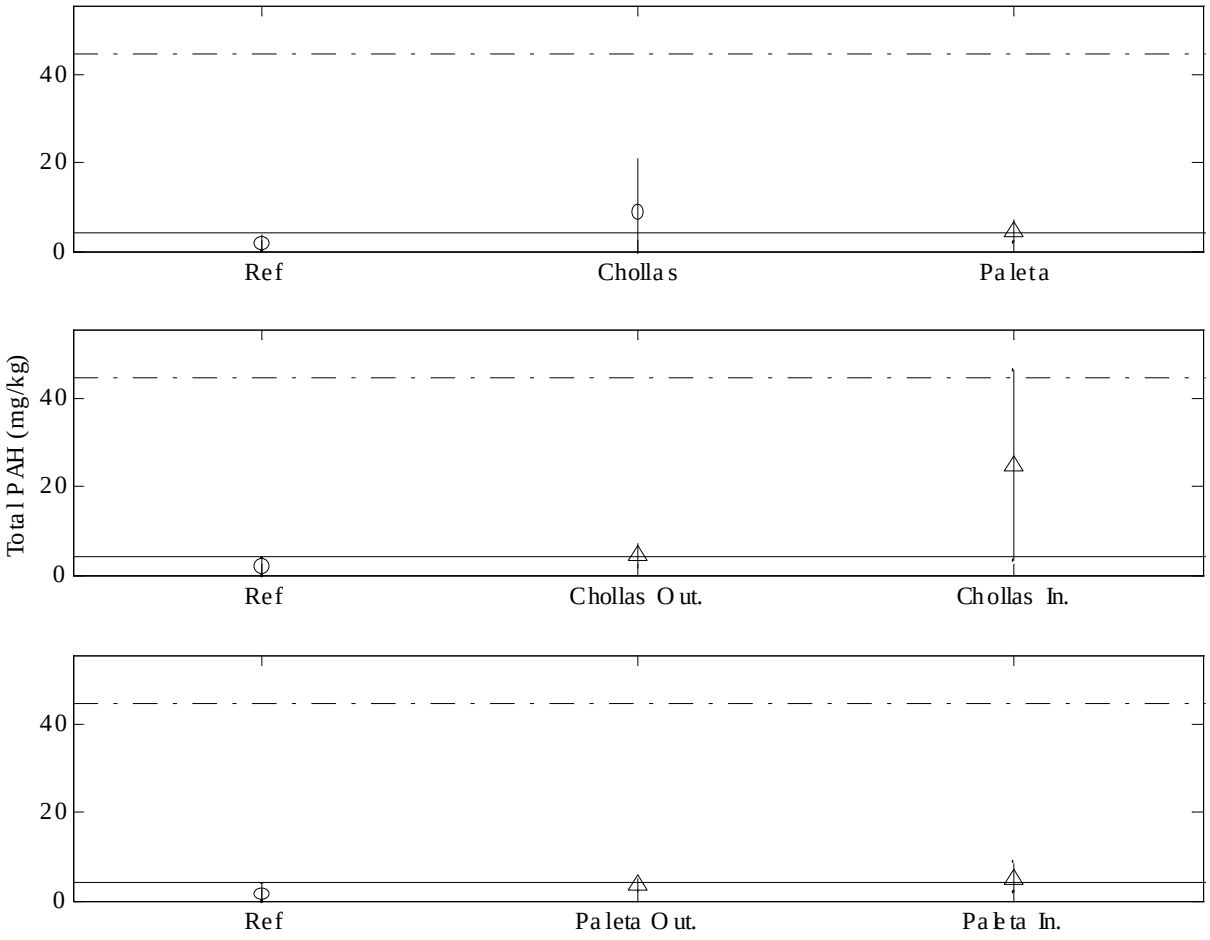
* = exceeds reference at 95% confidence



Total PAH - Grouped Station Results

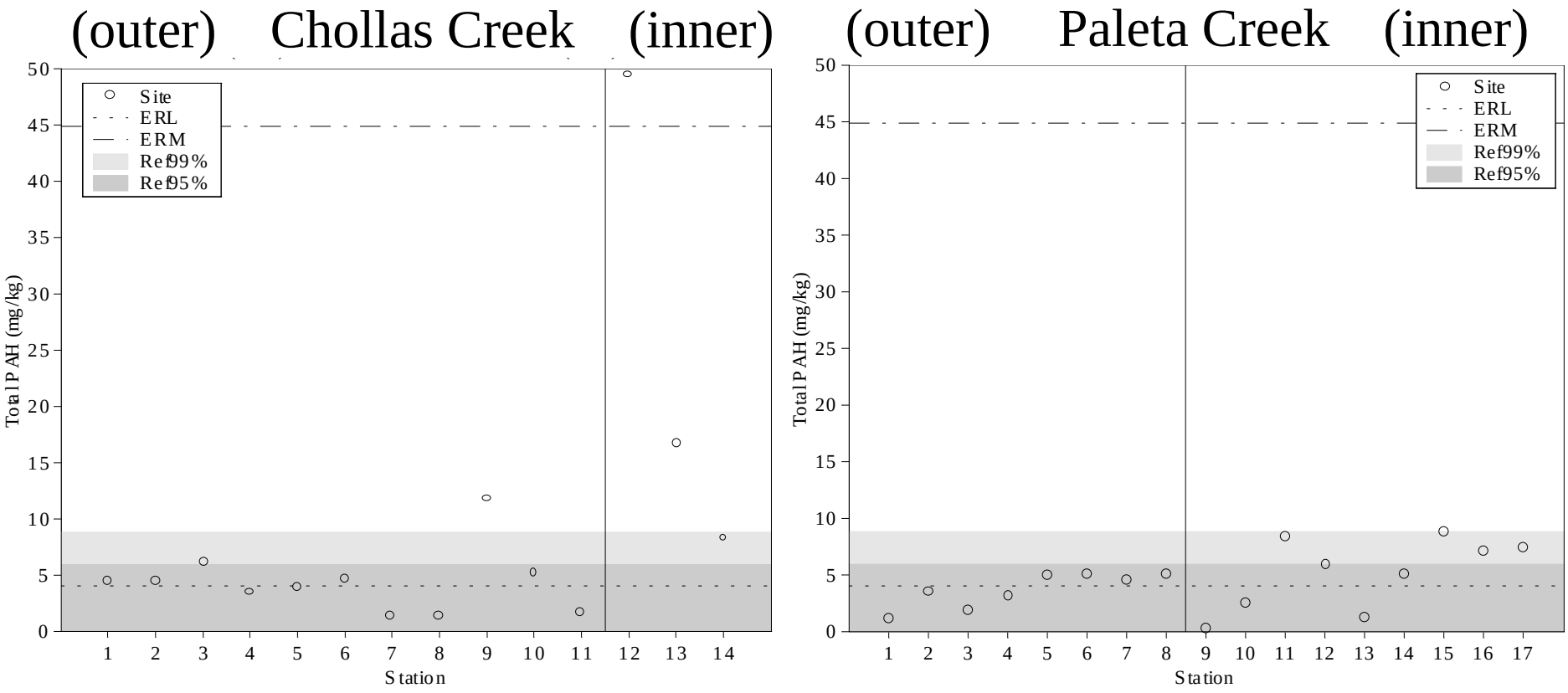


- Inner Chollas Creek area has Total PAH levels exceeding reference and ERL
- Paleta Creek levels generally near ERL but exceeding reference



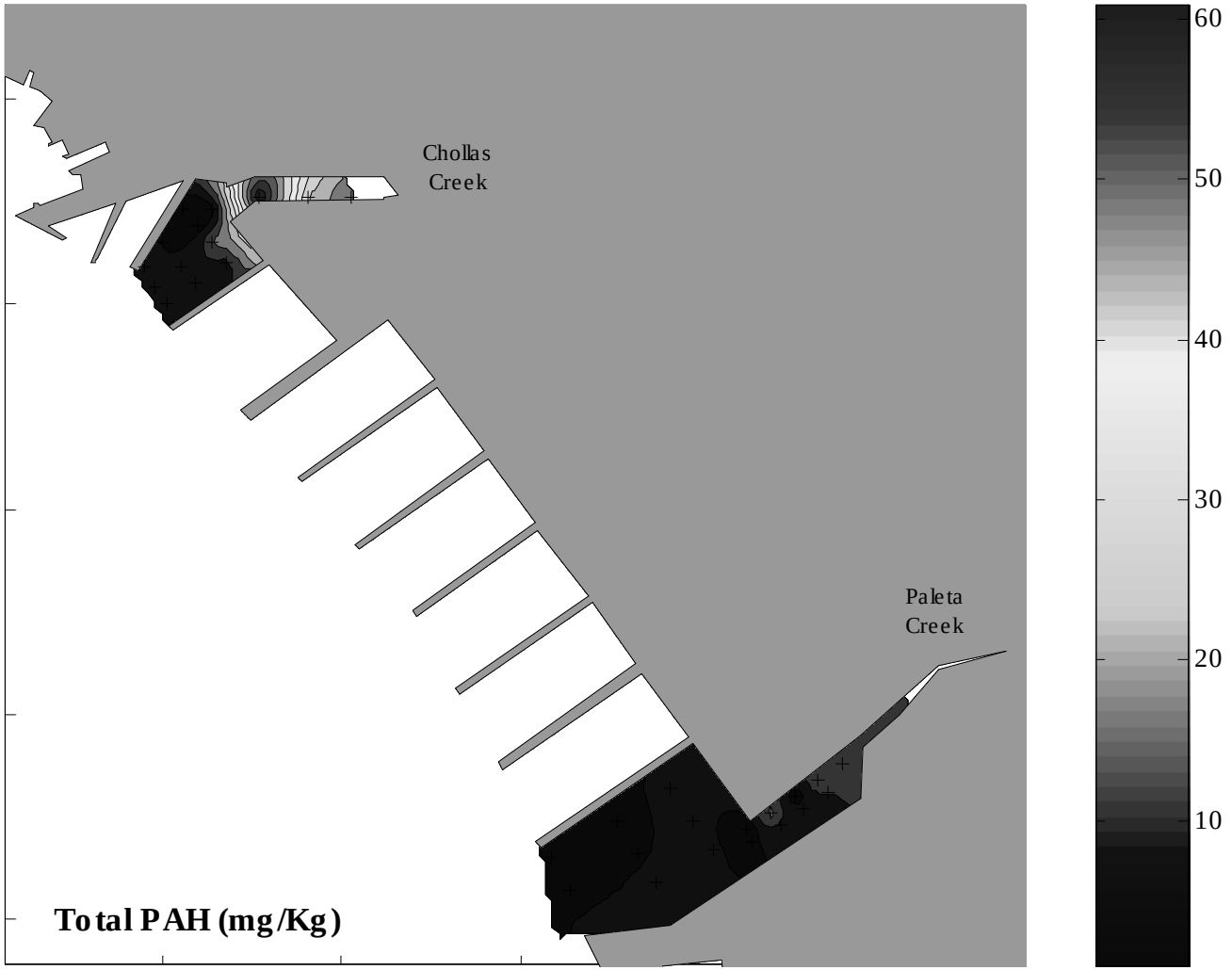
Total PAH - Individual Station Results

- Individual Chollas Creek and Paleta Creek stations generally between ERL and ERM for total PAH
- One station exceeds ERM and some exceed reference, especially inner Chollas Creek



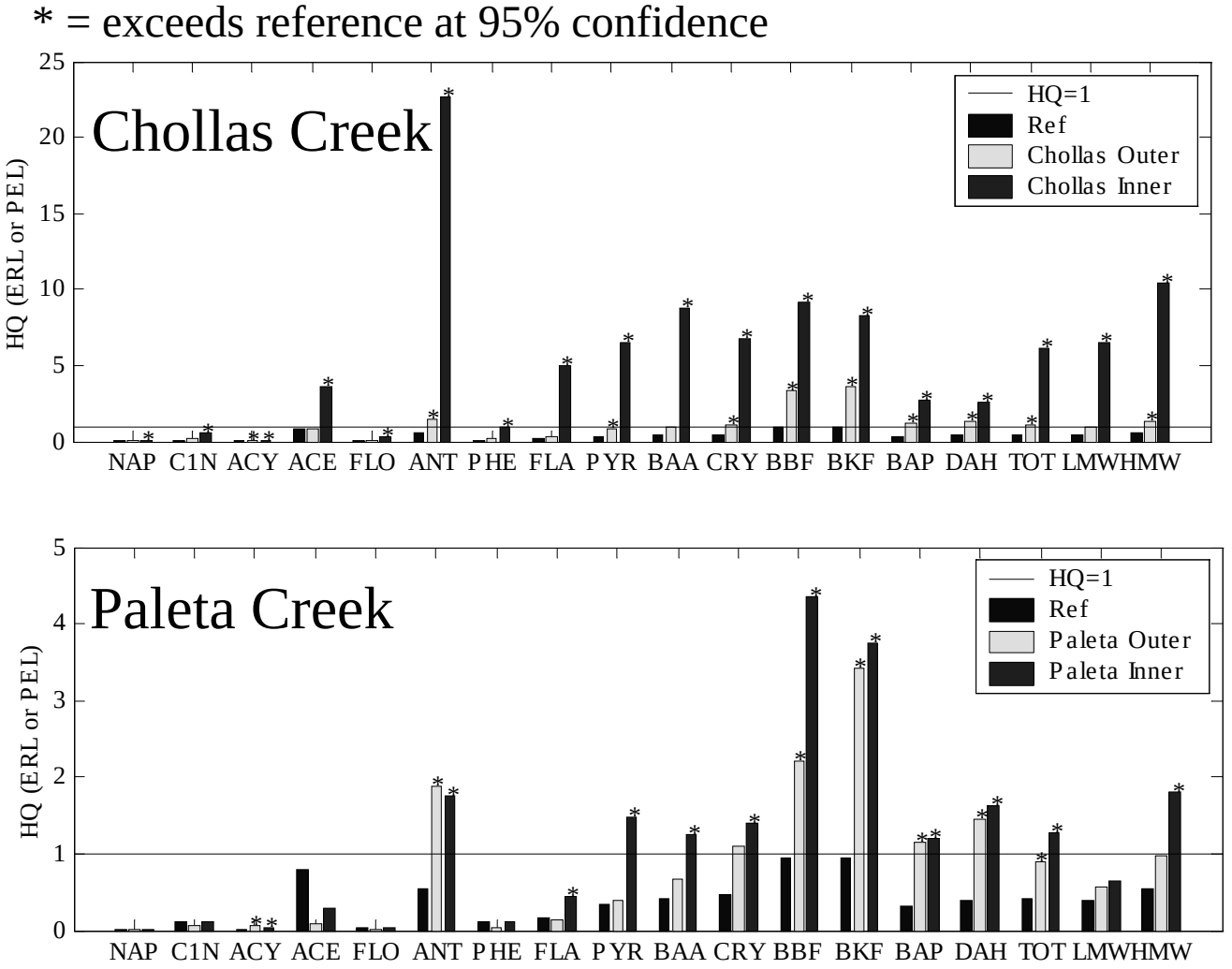
Total PAH – Spatial Distribution

- Highest levels in inner Chollas Creek – primarily driven by one sample
- Other areas of both creeks have fairly uniform distributions that correspond with distribution of TOC and fines

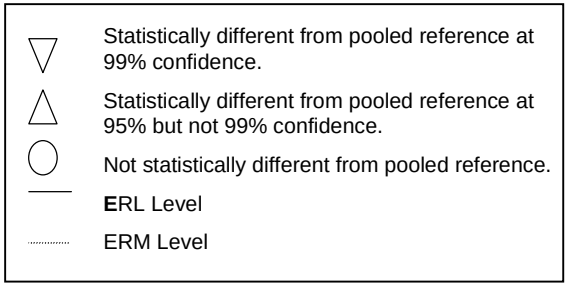


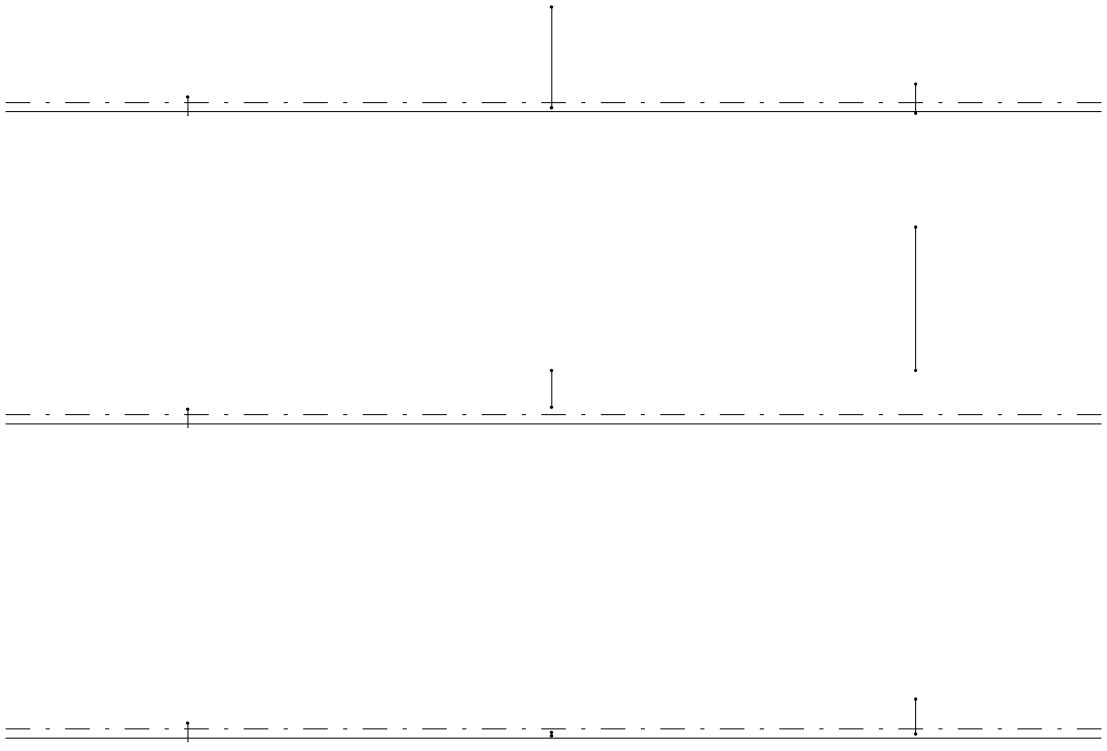
Sediment PAH Summary

- Chollas Creek – A range of PAHs exceed screening levels and reference, especially inner creek
- Paleta Creek – HQs are lower than Chollas, but some PAHs exceed screening levels and reference, inner creek generally higher



Total Chlordane - Grouped Station Results



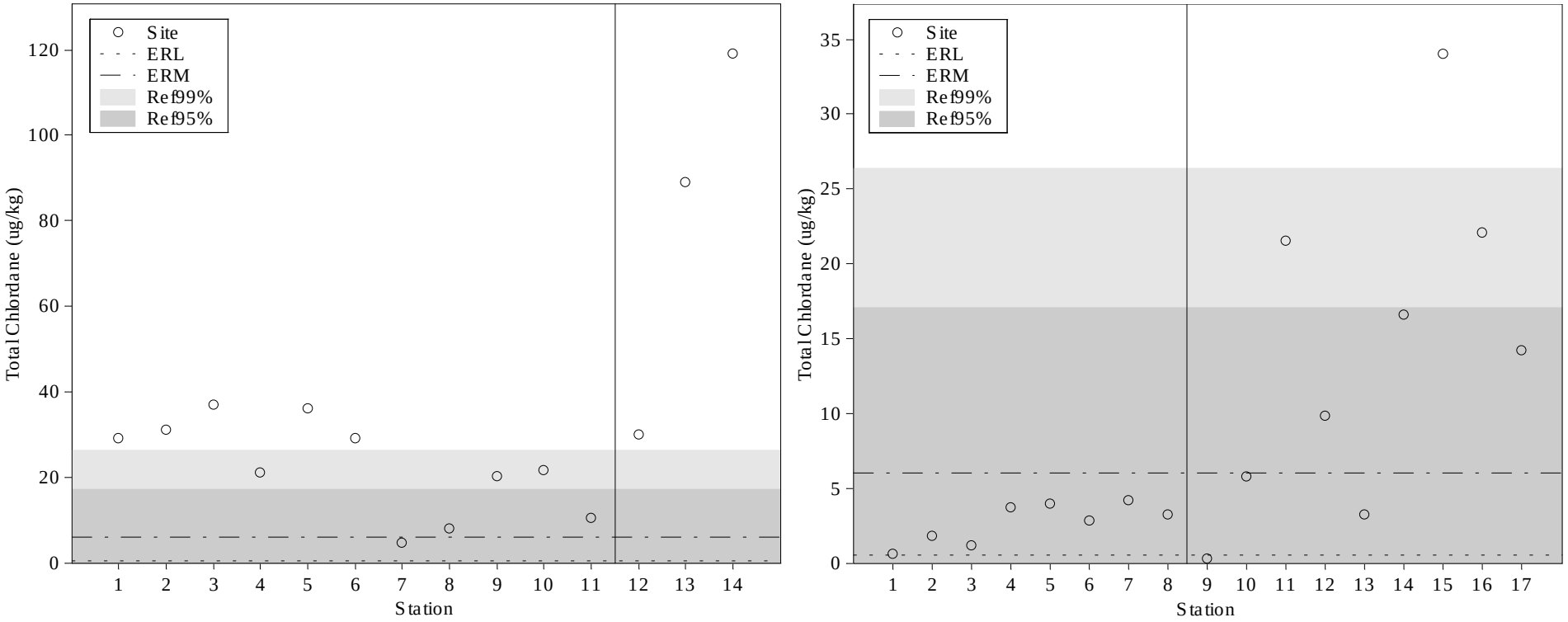


- Chollas Creek has Total Chlordane levels exceeding reference and ERM
- Inner Paleta Creek levels generally lower than Chollas but exceeding reference and ERM

Total Chlordane - Individual Station Results

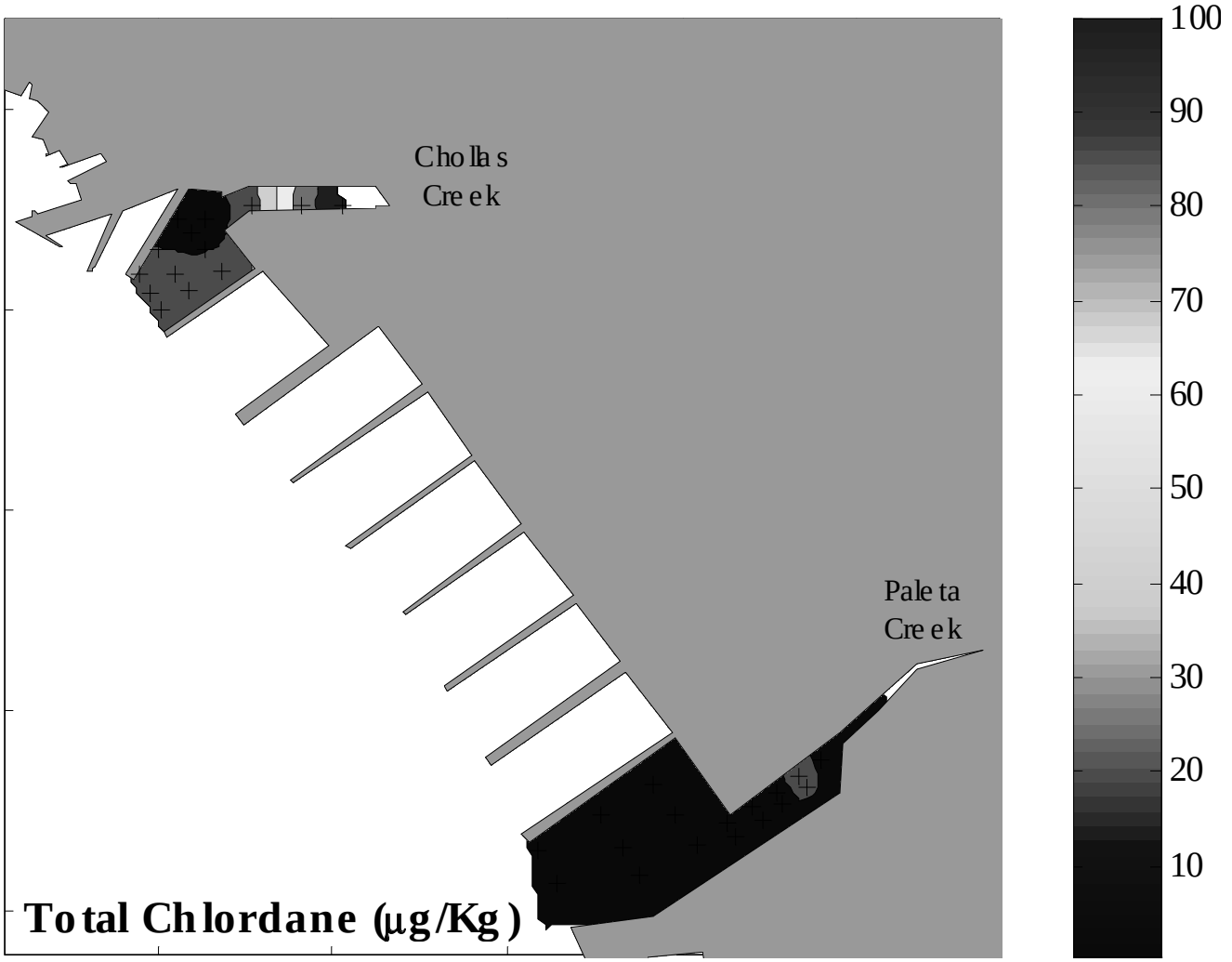
- Individual Chollas Creek stations generally exceed ERM and reference
- Stations in Inner Paleta Creek exceed ERM but are generally near reference levels

(outer) Chollas Creek (inner) (outer) Paleta Creek (inner)



Total Chlordane – Spatial Distribution

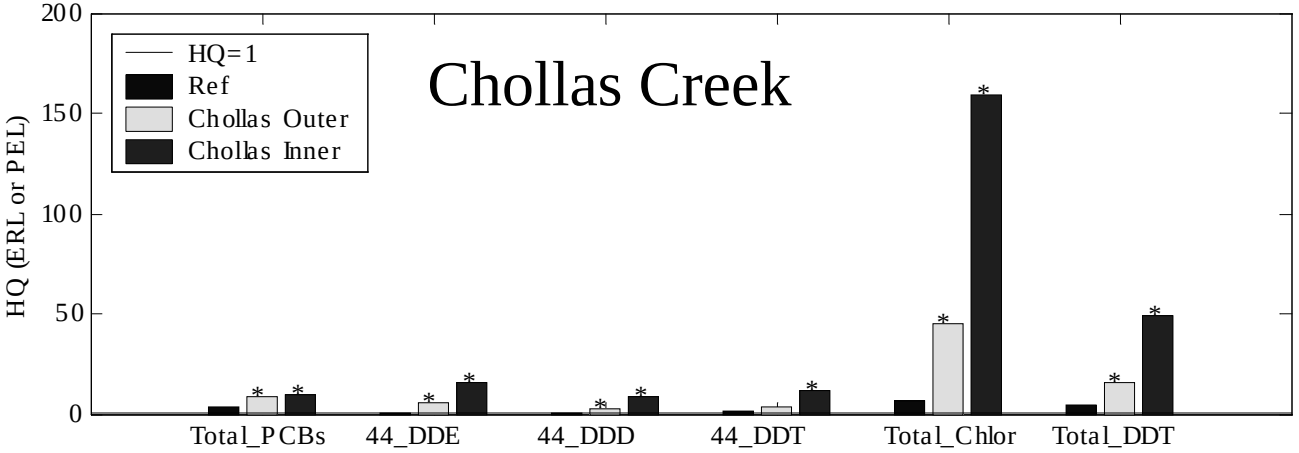
- Highest levels in inner Chollas Creek – strong up-creek gradient
- Other areas of both creeks have fairly uniform distributions that correspond with distribution of TOC and fines

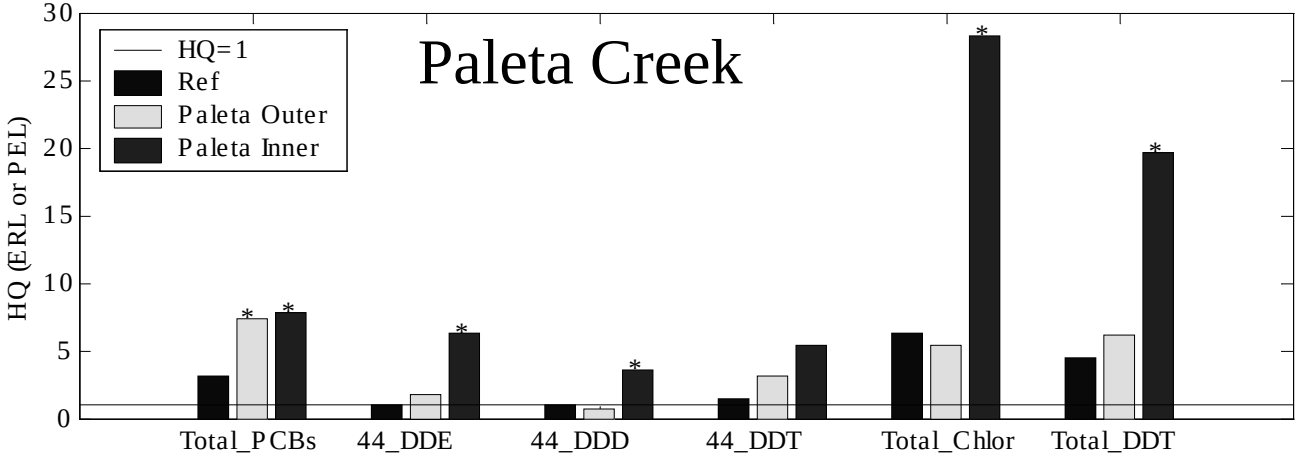


Sediment PCB & Pesticide Summary

- Chollas Creek – A range of PCBs and pesticide exceed screening levels and reference, especially inner creek
- Paleta Creek – HQs are generally lower than Chollas, but some levels exceed screening levels and reference, inner creek generally higher

* = exceeds reference at 95% confidence





Sediment Bioassay Results

- Sediment toxicity bioassays provide data for Phase I analysis of TMDLs and aquatic beneficial use assessment
  - Short-term response
  - Evaluates current sediment quality
  - Relatively few impacts of non-contaminant factors
- Bioassay Methods
  - Whole sediment - Amphipod survival (*Eohaustorius estuarius*)
  - Pore water - Sea urchin egg fertilization
  - Sediment-water interface - Sea urchin embryo development

Sediment Bioassay Data Analysis

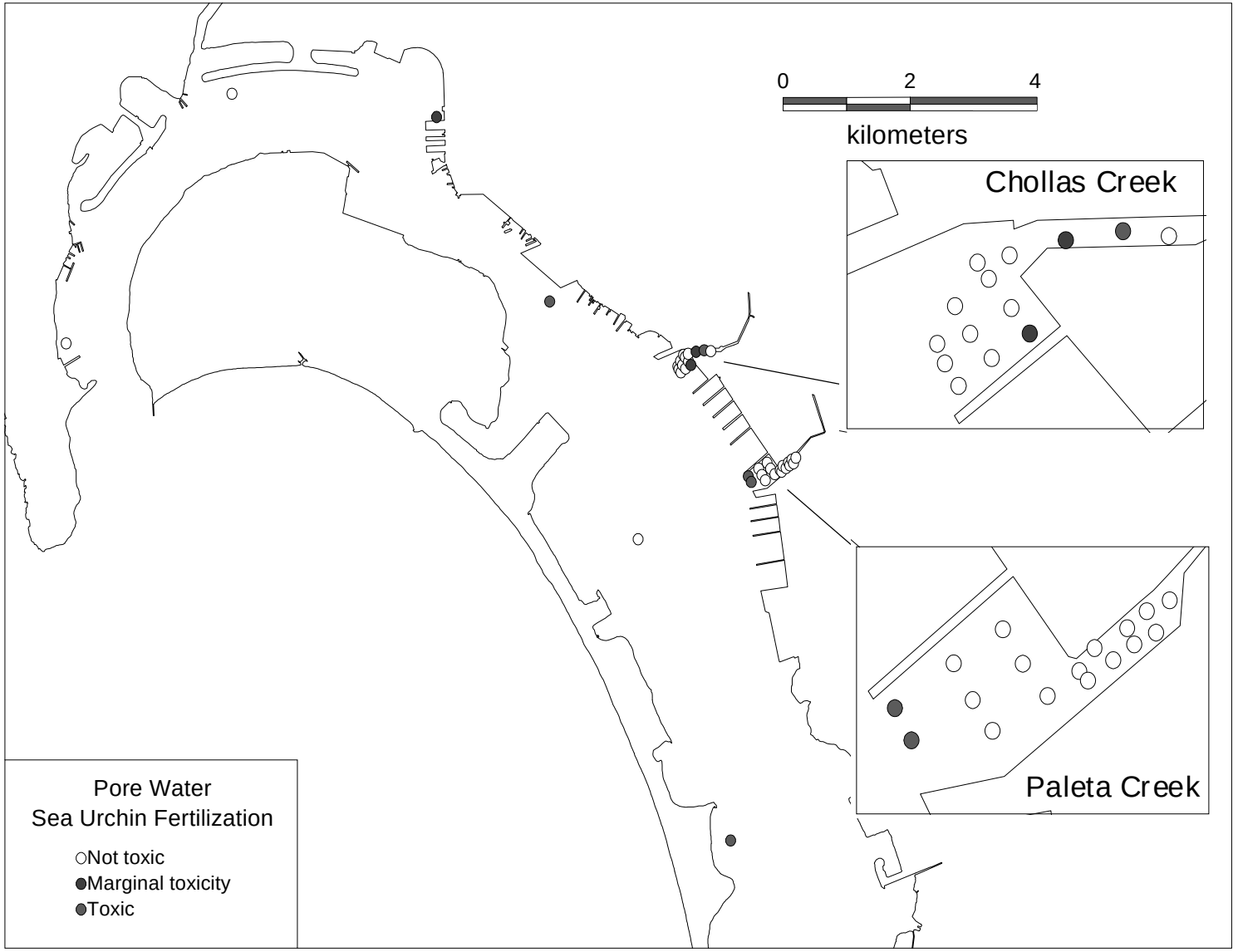
- Phase I analysis to date includes:
  - Normalize results to control
    - For comparisons between experiments
  - Comparison to control (t-test)
    - Identifies presence of toxicity
  - Station classification
    - Addresses test reproducibility and confounding factors
    - Toxic: significant t-test and <80% of control
    - Marginal: t-test only but > 80% of control
    - Ammonia interference

Amphipod Survival – Spatial Distribution

- Reference stations generally had good survival except R1
- Chollas Creek – About half the stations in both inner and outer areas showed toxicity compared to controls and 80% threshold
- Paleta Creek – Two stations in the inner creek showed toxicity

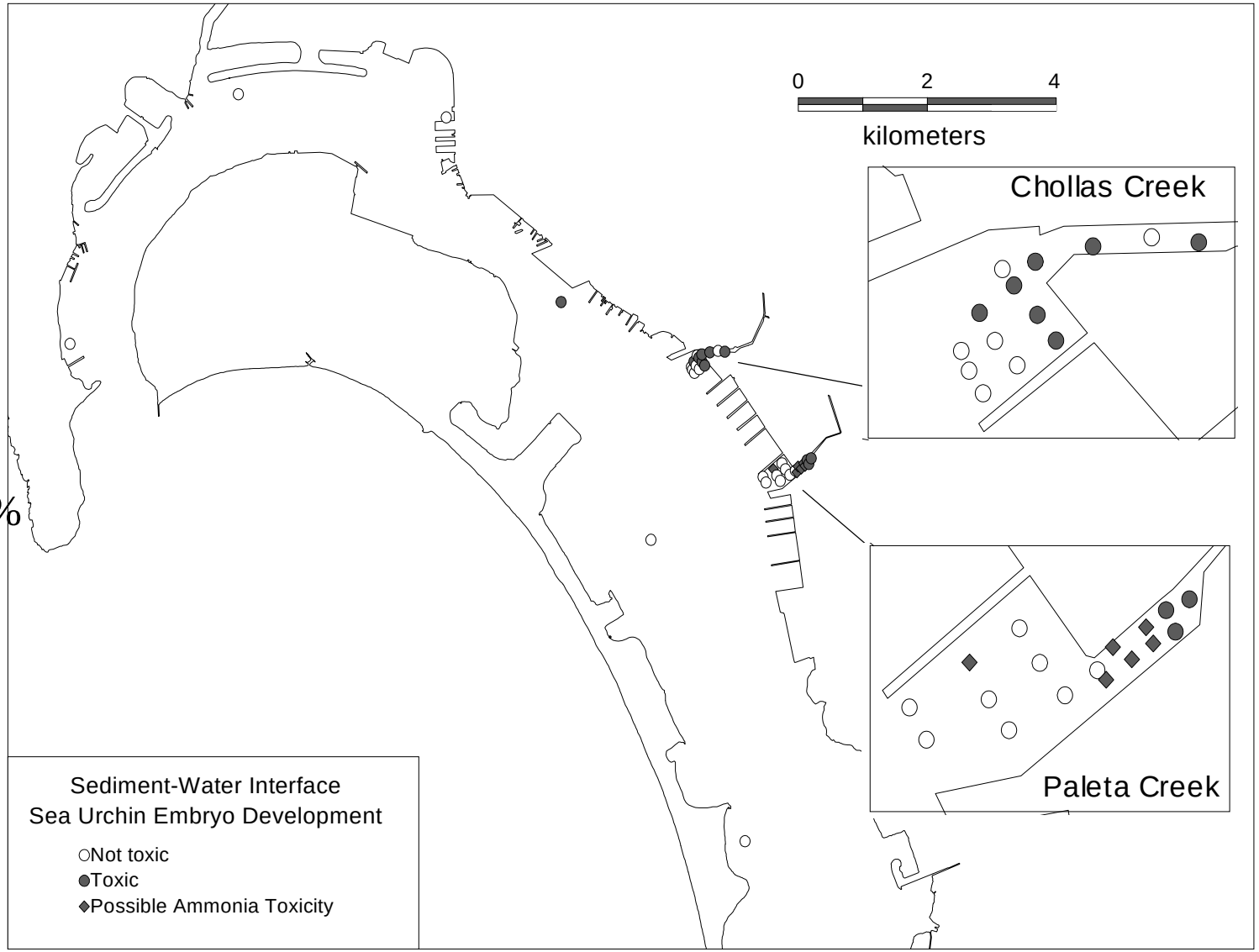
Sea Urchin Fertilization – Spatial Distribution

- Chollas Creek – One station in inner creek showed toxicity compared to controls and 80% threshold
- Paleta Creek – Two stations in the outer creek showed toxicity compared to controls and 80% threshold
- Some toxicity at reference stations



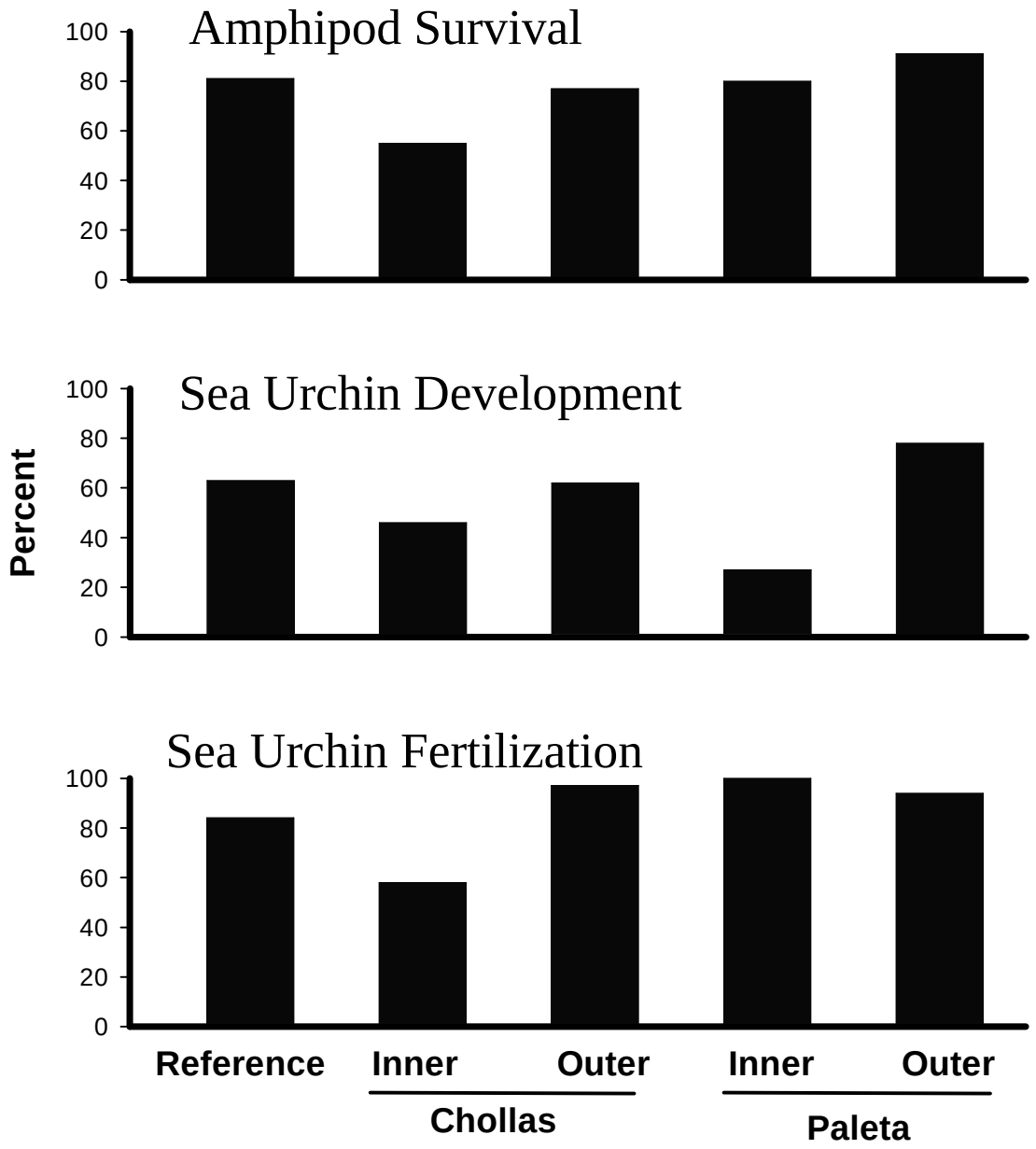
Sea urchin embryo development – Spatial Distribution

- Reference stations generally had good survival except R1
- Chollas Creek – About half the stations in both inner and outer areas showed toxicity compared to controls and 80% threshold
- Paleta Creek – Most stations in the inner creek showed toxicity compared to controls and 80% threshold



Bioassays - Grouped Station Results

- Chollas Creek – General trends show more toxicity at inner Chollas Creek for all tests compared to reference
- Paleta Creek – Sea Urchin development test shows more toxicity at inner creek compared to reference
- However, no grouped areas had toxicity statistically different than reference



Benthic Community Results

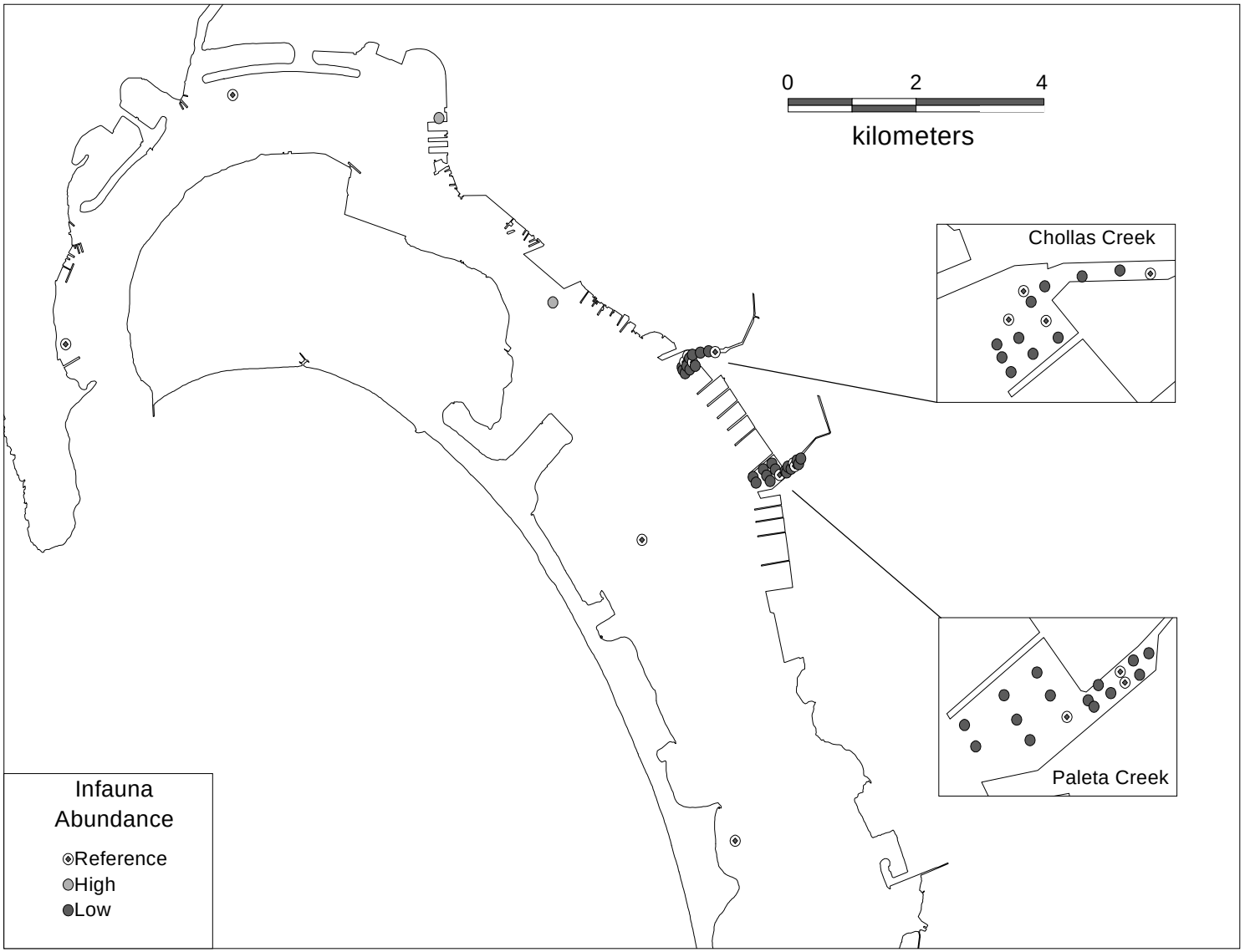
- Benthic Community analysis provide data for Phase I analysis of TMDLs and aquatic beneficial use assessment
  - Reflects chronic exposure
  - May reflect past events or conditions
  - Integrates contamination and other factors
- Benthic Community Methods
  - 0.1 m^2 V an Veen Grab (1.0 mm screen)
  - Identify to species
  - Record abundance

Benthic Community Data Analysis

- Community measures
  - Abundance, number of taxa
  - Shannon Wiener diversity, evenness
- Indicator species
  - Brittle stars (sensitive)
  - *Capitella capitata* (indicative)
  - *Streblospio benedicti* (tolerant)
- Station classification
  - Low: below 10^{th} percentile of reference
  - High: above 90^{th} percentile

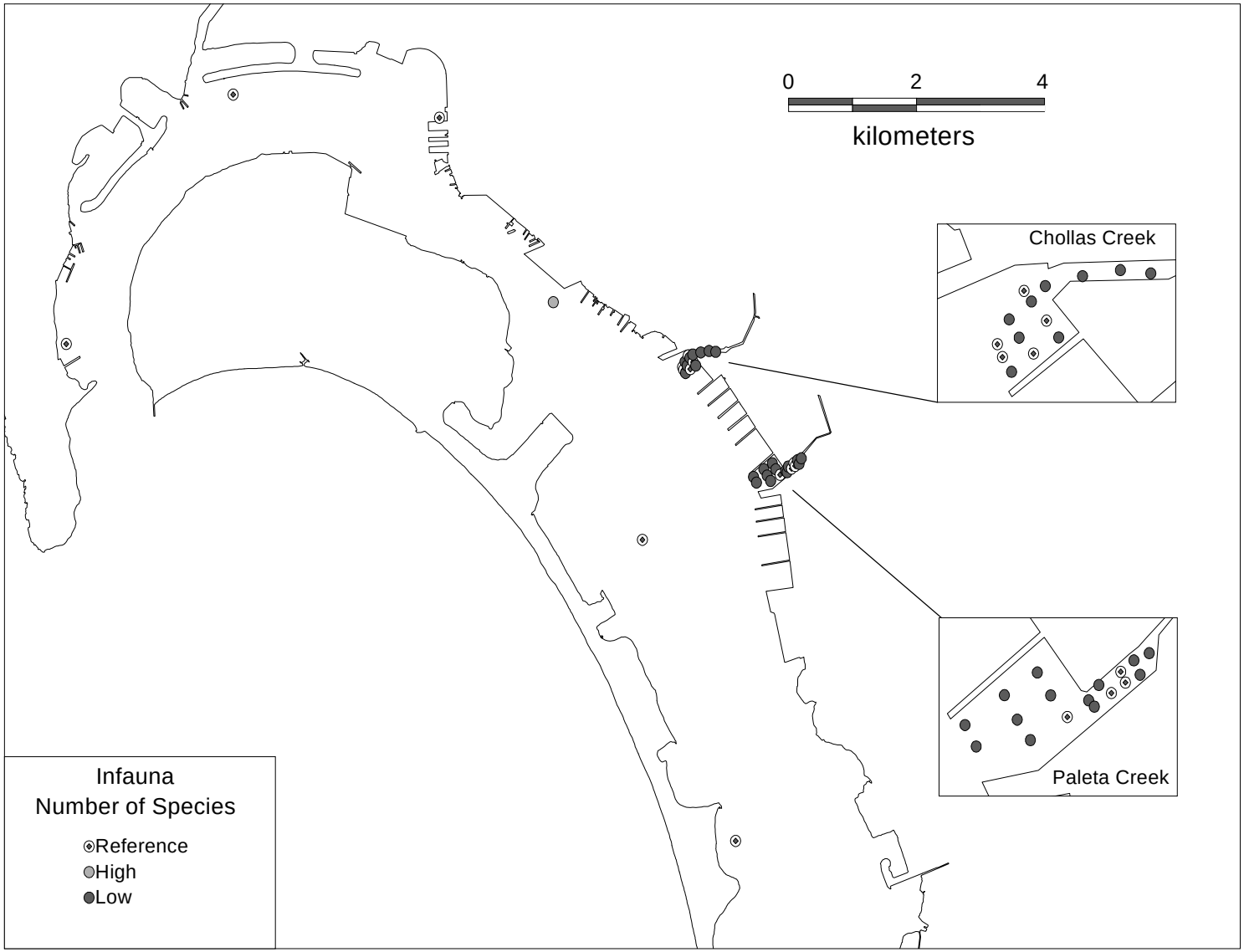
Infauna Abundance – Spatial Distribution

- Chollas Creek – Most stations in both inner and outer areas showed reduced abundance compared to reference
- Paleta Creek – Most stations showed reduced abundance compared to reference



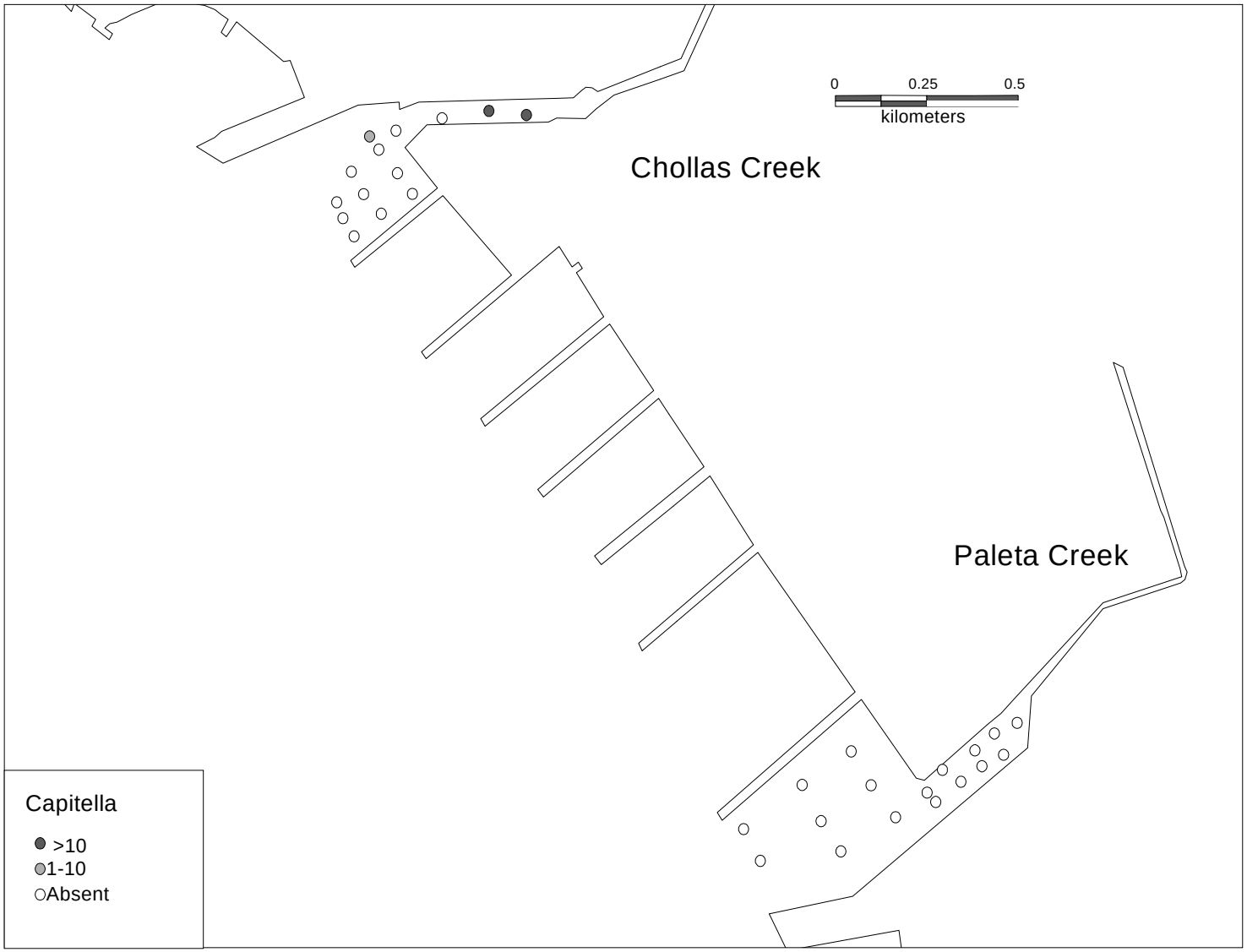
Number of Species – Spatial Distribution

- Chollas Creek – Most stations in both inner and outer areas showed reduced number of species compared to reference
- Paleta Creek – Most stations showed reduced number of species compared to reference



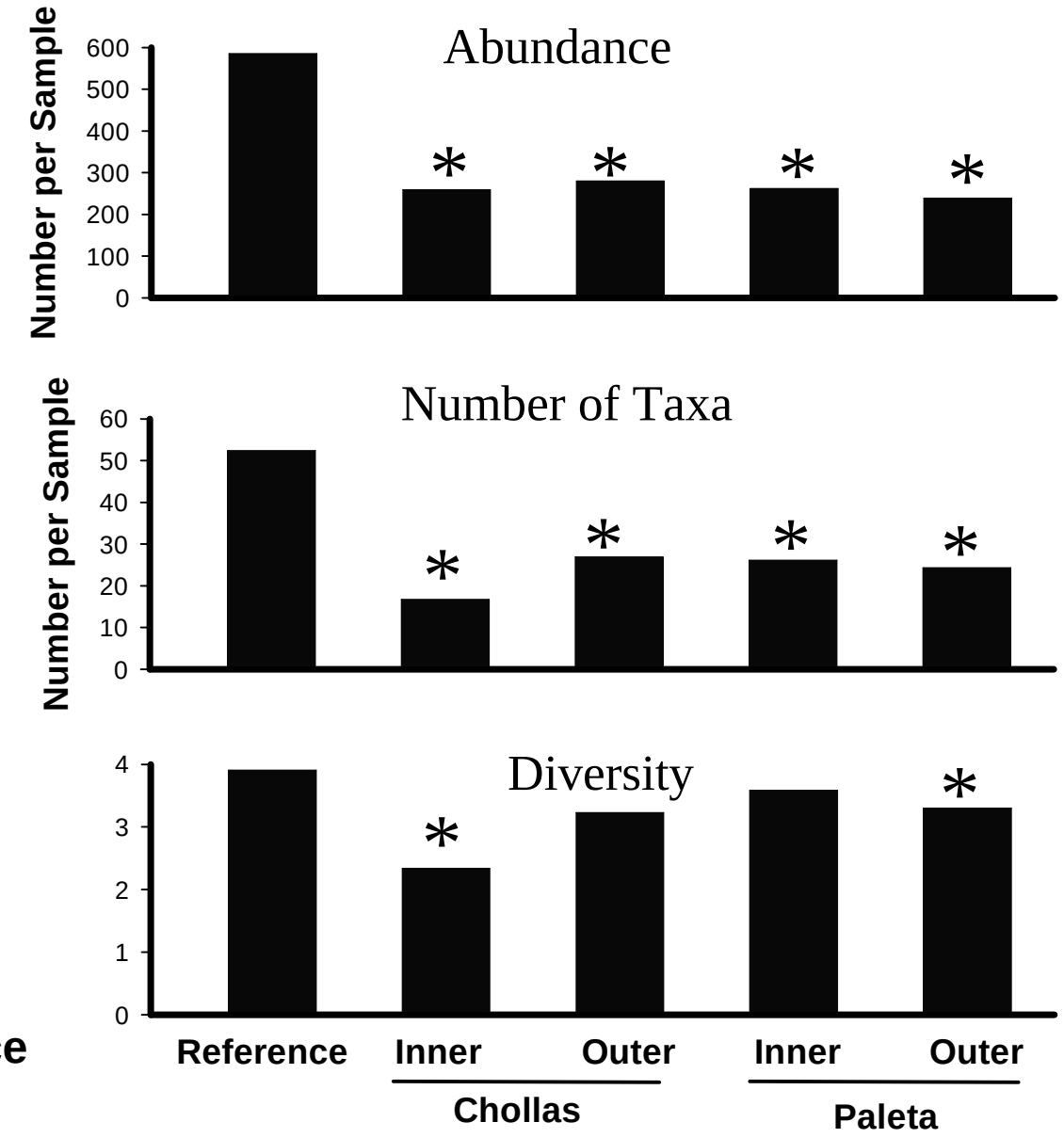
Capitella capitata – Spatial Distribution

- Chollas Creek – Stations in inner creek area had presence of Capitella
- Paleta Creek – No Capitella found in Paleta Creek sediments



Benthic Community Analysis - Grouped Station Results

- Chollas Creek – All areas, and particularly inner creek show altered benthos compared to reference
- Paleta Creek – Abundance and taxa are reduced compared to reference, no clear differences between inner and outer



* **Sig. Difference from reference**

Effects Summary

- Toxicity present at both study areas when compared to controls and 80% threshold
  - Inner Chollas sediments most toxic
  - Different responses obtained with each test
- Benthic community impacted at both areas
  - Fewer organisms and taxa
  - Fewer brittle stars
  - Inner Chollas is most severely affected

Bioaccumulation Results

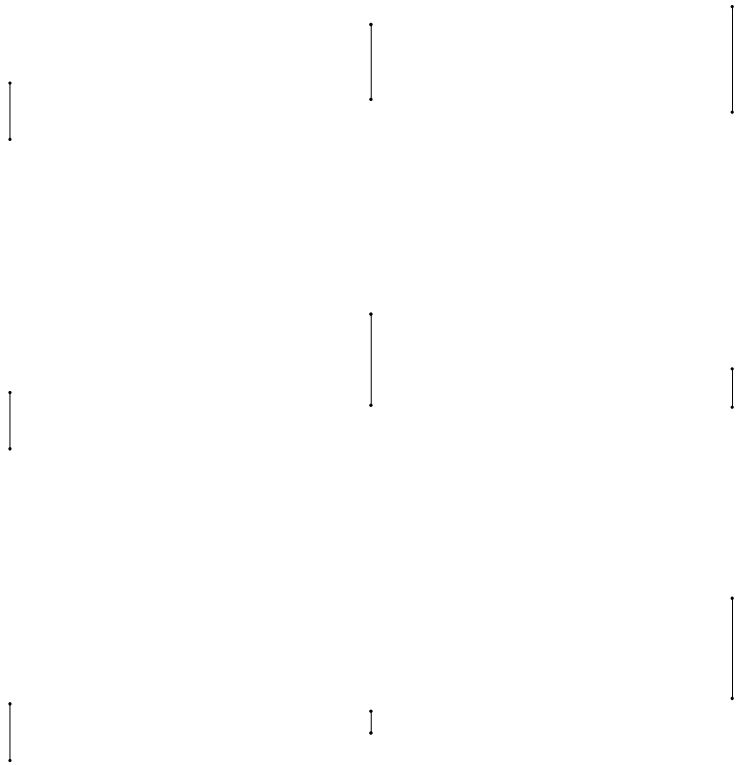
- Tissues analyzed for a range of chemicals including metals, PAHs, PCBs and Pesticides based on analysis of historical data
- Provides data for Phase I wildlife and human health beneficial use assessment
- Phase I analysis to date includes
  - Grouped creek data compared to reference
  - Individual station data compared to reference
  - Tissue vs. Sediment Correlations

Lead Bioaccumulation - Grouped Station Results

▽ Statistically different from pooled reference at 99% confidence.

△ Statistically different from pooled reference at 95% but not 99% confidence.

○ Not statistically different from pooled reference.

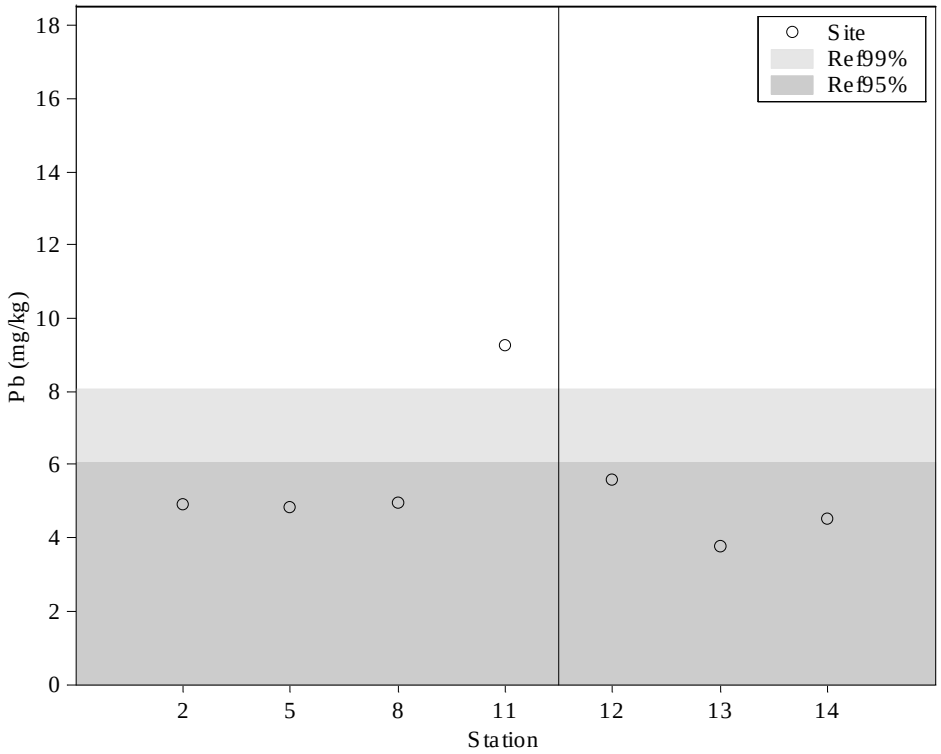


- Lead bioaccumulation in outer Chollas Creek exceeds reference
- Inner Paleta Creek levels exceed reference

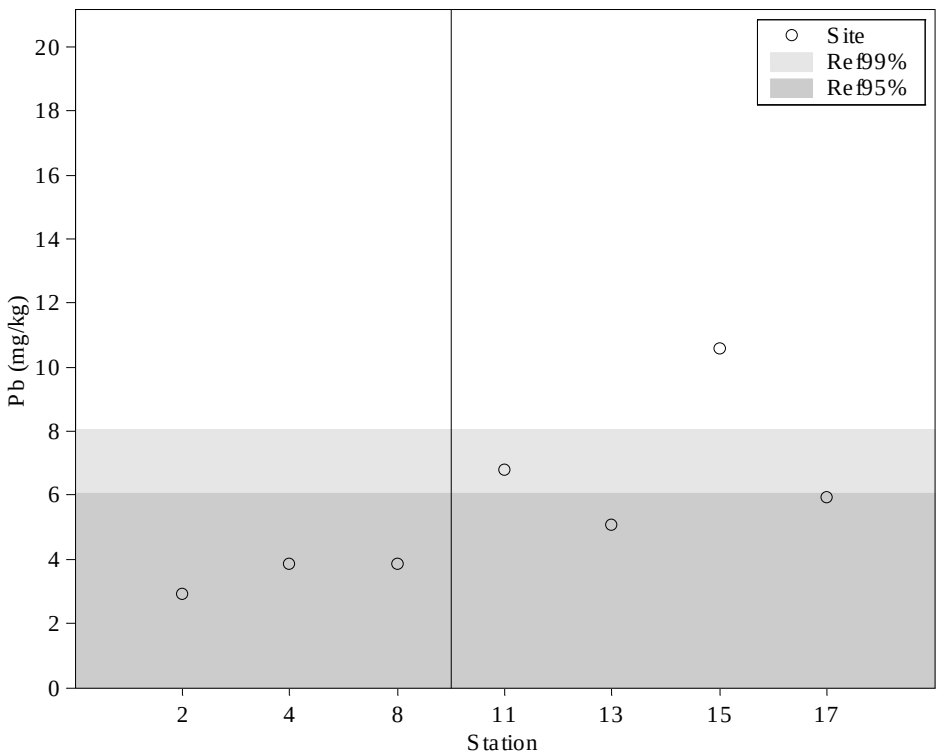
Lead Bioaccumulation - Individual Station Results

- Individual Chollas Creek stations are generally comparable to reference except one outer creek station
- Two stations in inner Paleta Creek exceed reference level at 95%

(outer) Chollas Creek (inner)



(outer) Paleta Creek (inner)



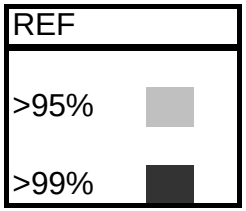
Lead Bioaccumulation – Sediment-Tissue Correlation

- Good correlation between bulk tissue and sediment concentrations
- Relationship is not improved by normalization to lipid and TOC content
- Provides means of extending analysis to other stations where sediment chemistry is available

○
□
△

Tissue Metals Summary

- In general, bioaccumulation of metals was comparable to reference
- Cd, Cr, Hg, Ni, Se, Ag and Zn usually below reference envelope
- As, Cu, Pb and Sb sometimes above reference, especially inner Paleta Creek



	Chollas						Paleta					
Analyte	**CH**		**CHo**		**CHi**		**PA**		**PAo**		**PAi**	
	REF95	REF99	REF95	REF99	REF95	REF99	REF95	REF99	REF95	REF99	REF95	REF99
Al												
Sb												
As												
Ba												
Be												
Cd												
Cr												
Cu												
Fe												
Pb												
Hg												
Ni												
Se												
Ag												
Zn												

Tissue PAH Summary

- A range of tissue PAHs exceed reference
- Highest accumulation is in inner creek areas
- Good correlations between sediment and tissue

	Chollas						Paleta					
Analyte	**CH**		**Cho**		**Chi**		**PA**		**PAo**		**PAi**	
	REF95	REF99	REF95	REF99	REF95	REF99	REF95	REF99	REF95	REF99	REF95	REF99
Naphthalene												
C1-Naphthalenes												
Acenaphthylene												
Acenaphthene												
Fluorene												
Anthracene												
Phenanthrene												
Fluoranthene												
Pyrene												
Benzo[a]anthracene												
Chrysene												
Benzo[a]pyrene												
Dibenzo[a,h]anthracene												
Low Molecular Weight PAH												
High Molecular Weight PAH												
Priority Polutant PAH												

REF	
>95%	
>99%	

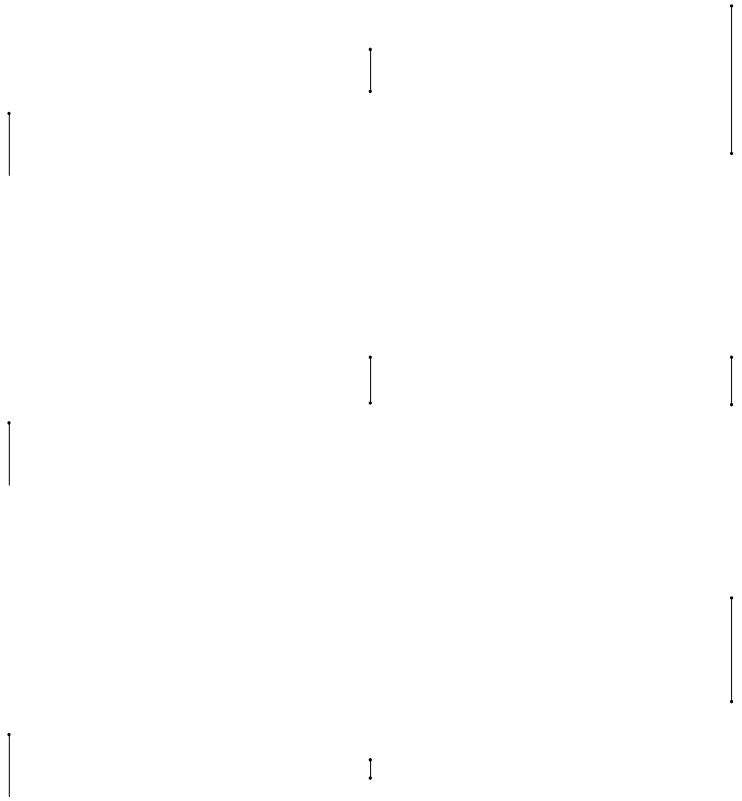
Chlordane Bioaccumulation - Grouped Station Results

▽ Statistically different from pooled reference at 99% confidence.

△ Statistically different from pooled reference at 95% but not 99% confidence.

○ Not statistically different from pooled reference.

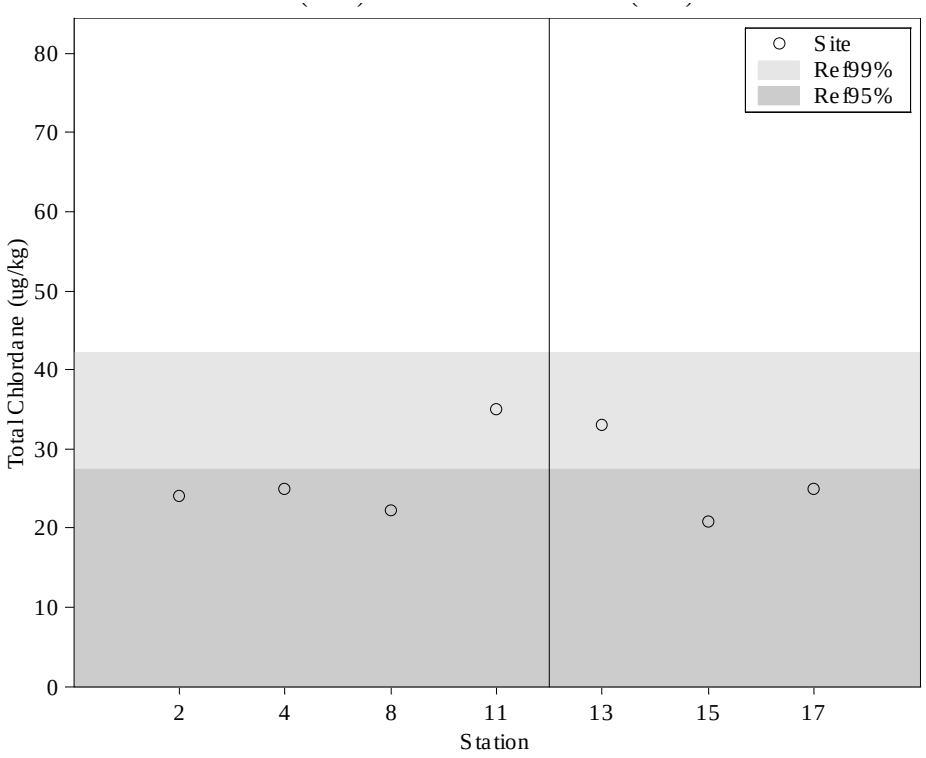
- Chlordane bioaccumulation in outer and inner Chollas Creek exceeds reference
- Inner Paleta Creek levels also exceed reference

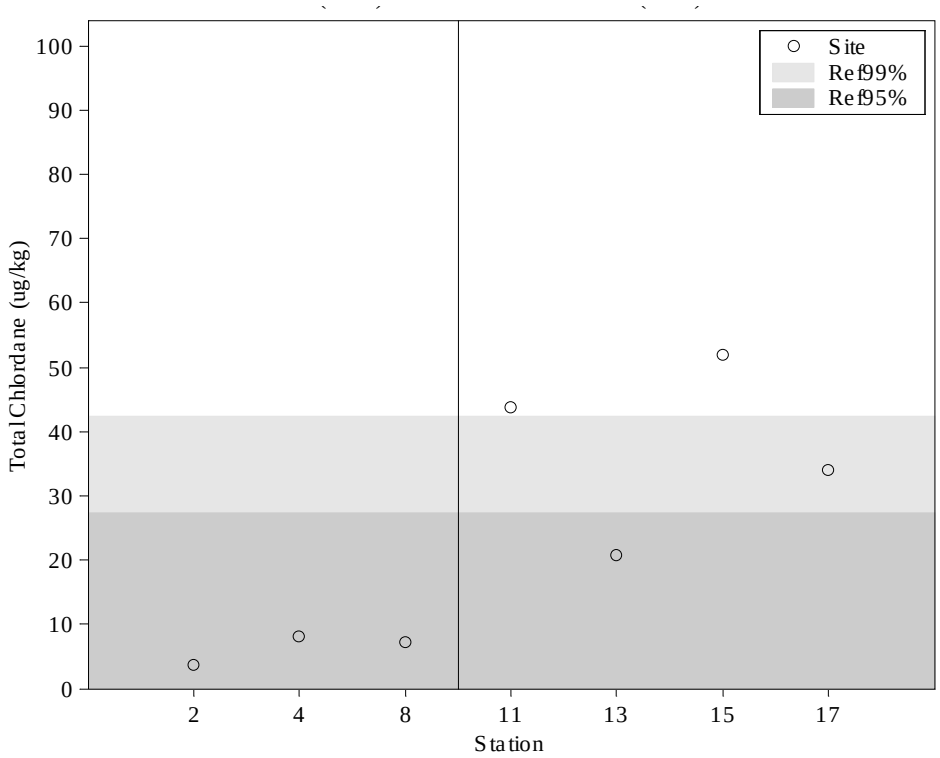


Chlordane Bioaccumulation - Individual Station Results

- Individual Chollas Creek stations are generally comparable to reference
- Three stations in inner Paleta Creek exceed reference level at 95%

(outer) Chollas Creek (inner) (outer) Paleta Creek (inner)



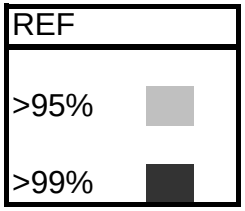


Chlordane Bioaccumulation – Sediment-Tissue Correlation

- Some correlation between bulk tissue and sediment concentrations
- Relationship is improved by normalization to lipid and TOC content
- Inner Chollas Creek stations have low accumulation relative to sediment levels

Tissue PCB & Pesticide Summary

- Tissue PCBs and DDTs don’t exceed reference envelope in Chollas Creek
- Chlordane is above reference in Chollas Creek
- PCBs, Chlordane and DDT are above reference for inner Paleta Creek area
- Most PCBs and pesticides have useful correlations between sediment and tissue



	Chollas						Paleta					
Analyte	**CH**		**Cho**		**Chi**		**PA**		**PAo**		**PAi**	
	REF95	REF99	REF95	REF99	REF95	REF99	REF95	REF99	REF95	REF99	REF95	REF99
Total PCBs												
Total Chlordane												
Total DDT												

Next Steps

- Impact assessment by indicator
  - Reference site comparisons
  - Confounding factors
- Impairment determination
  - Combine indicator results
  - Weight of evidence approach
- Spatial evaluation
  - Mapping
  - Identify sources
- Screening Level Wildlife and Human Health Risk Assessment

Phase I Schedule

Chollas/Reference Field Survey	July 2001
Paleta Field Survey	August 2001
Laboratory Analysis	Aug-Jan 2002
Phase I Data Analysis & Draft Report	July 2002