Sediment Assessment at the Mouths of Chollas Creek and Paleta Creek

Phase I Results

January 18, 2005

San Diego RWQCB

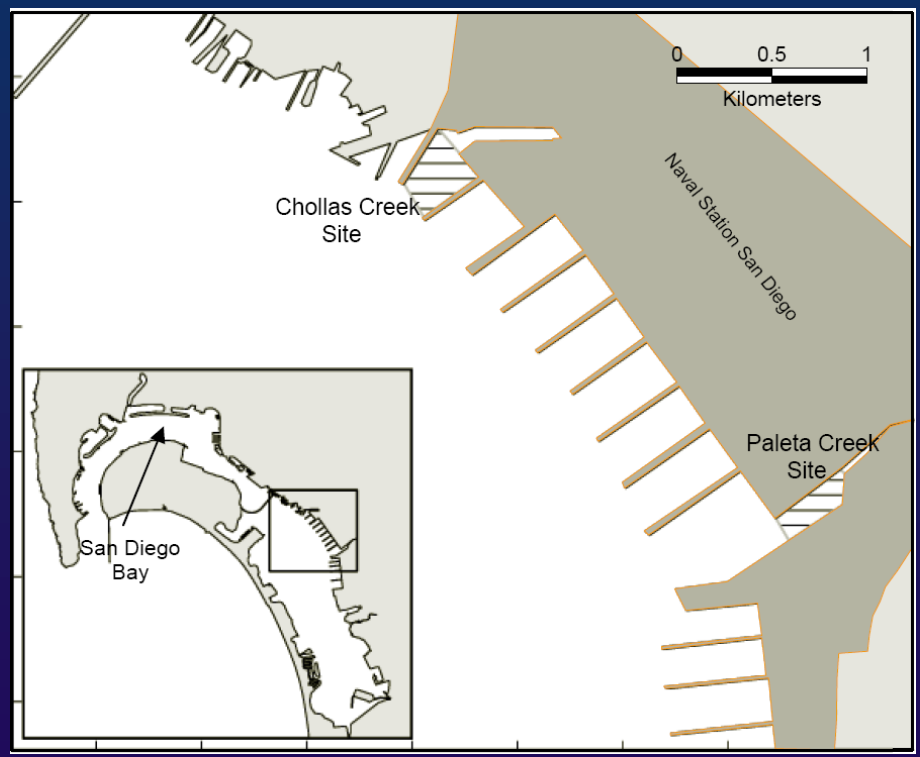
Outline

- Background
- Conceptual/Technical Approach
- Assessment Framework
- Aquatic Life Beneficial Use Assessment
- Aquatic-dependent Wildlife Beneficial Use Assessment
- Human Health Beneficial Use Assessment
- Conclusions and Recommendations

Background

Study Background

- Chollas and Paleta Creek Toxic Hot Spots
- Areas identified in Bay Protection and Toxic Cleanup Program (1996)
- Listed on 303d in 1998
- Toxic Hot Spot Workgroup developed assessment strategy
- Initiated Phase I spatial study in 2001



Mouth of Chollas Creek

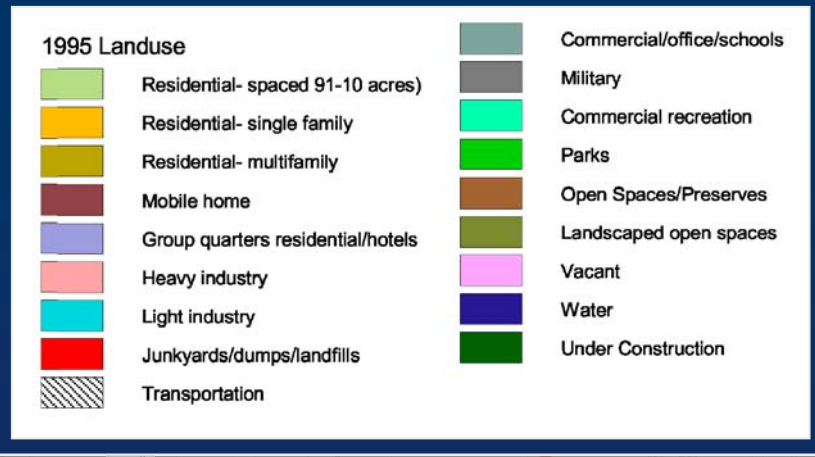
- Site ~1.8 acres located at northern extent of Naval Station San Diego (NSSD)
- Study site expanded to include inner area
- Bounded to north by NASSCO and NSSD Pier 1 to the south
- Subject to episodic flows from Chollas Creek

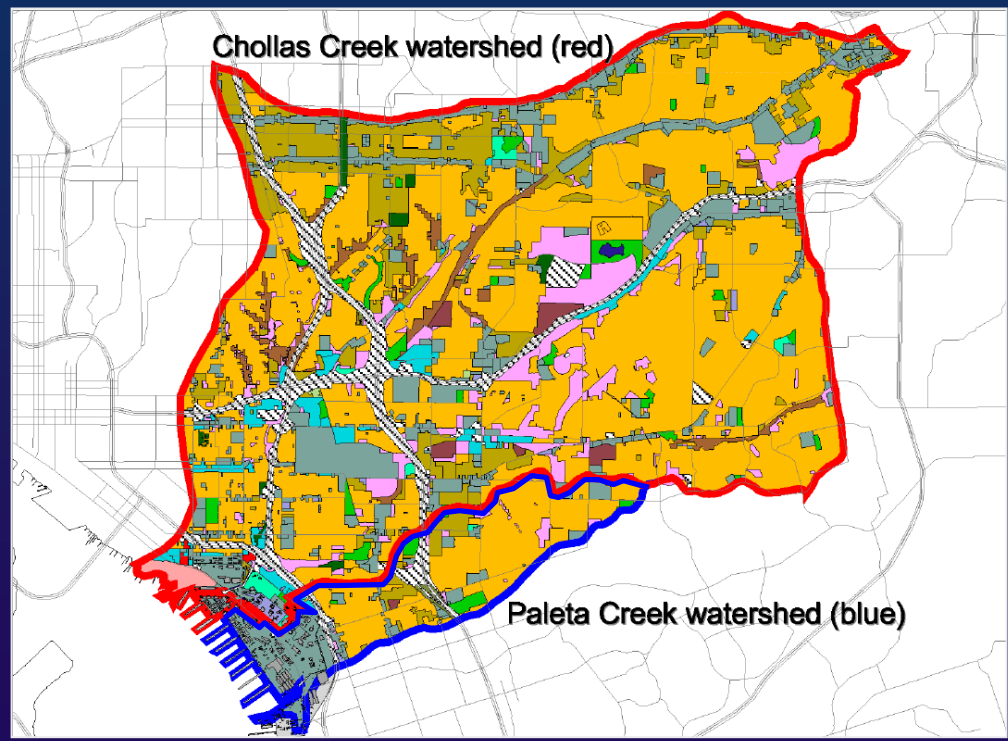
Mouth of Paleta Creek

- Site ~3.7 acres located near the mid-shoreline at Naval Station San Diego (NSSD)
- Study site expanded to include outer area
- Bounded to north by NSSD pier 8 and NSSD Pier 9 to the south
- Subject to episodic flows from Paleta Creek

Paleta Creek and Chollas Creek Watersheds

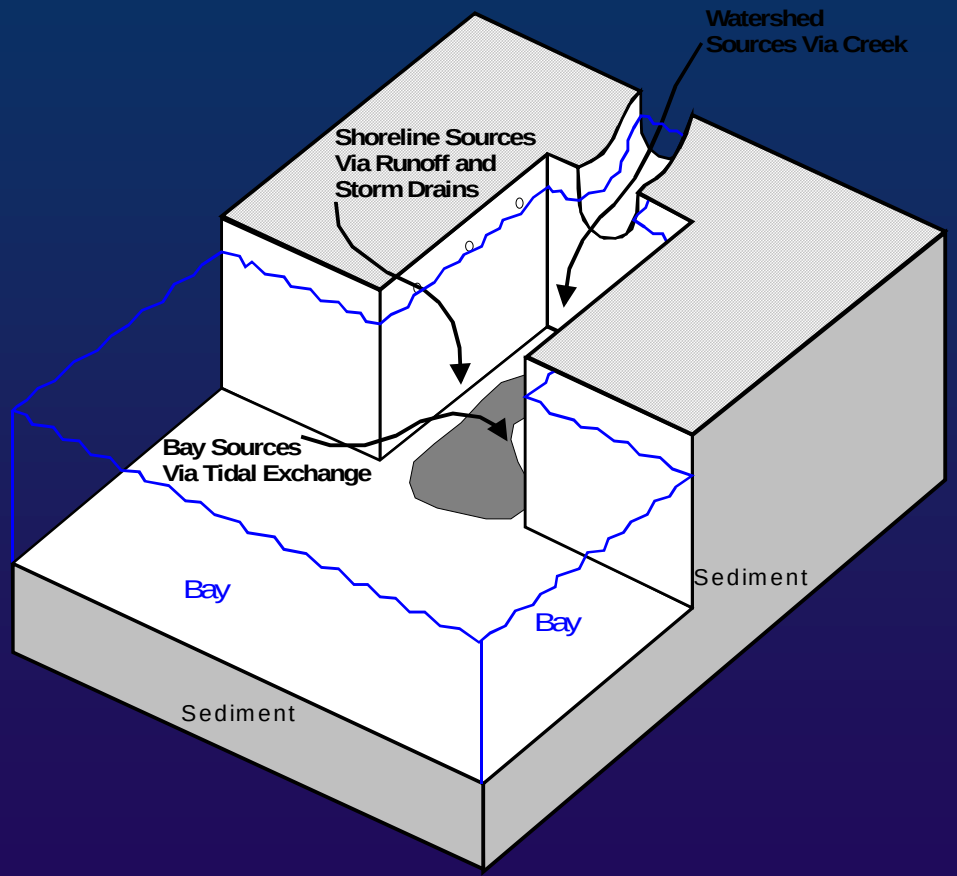
- Chollas ~16,000 acres
- Paleta ~1,600 acres
- Both watersheds are a mix of:
  - Residential
  - Industrial
  - Open Space
  - Roadways
  - Commercial





Potential Sources

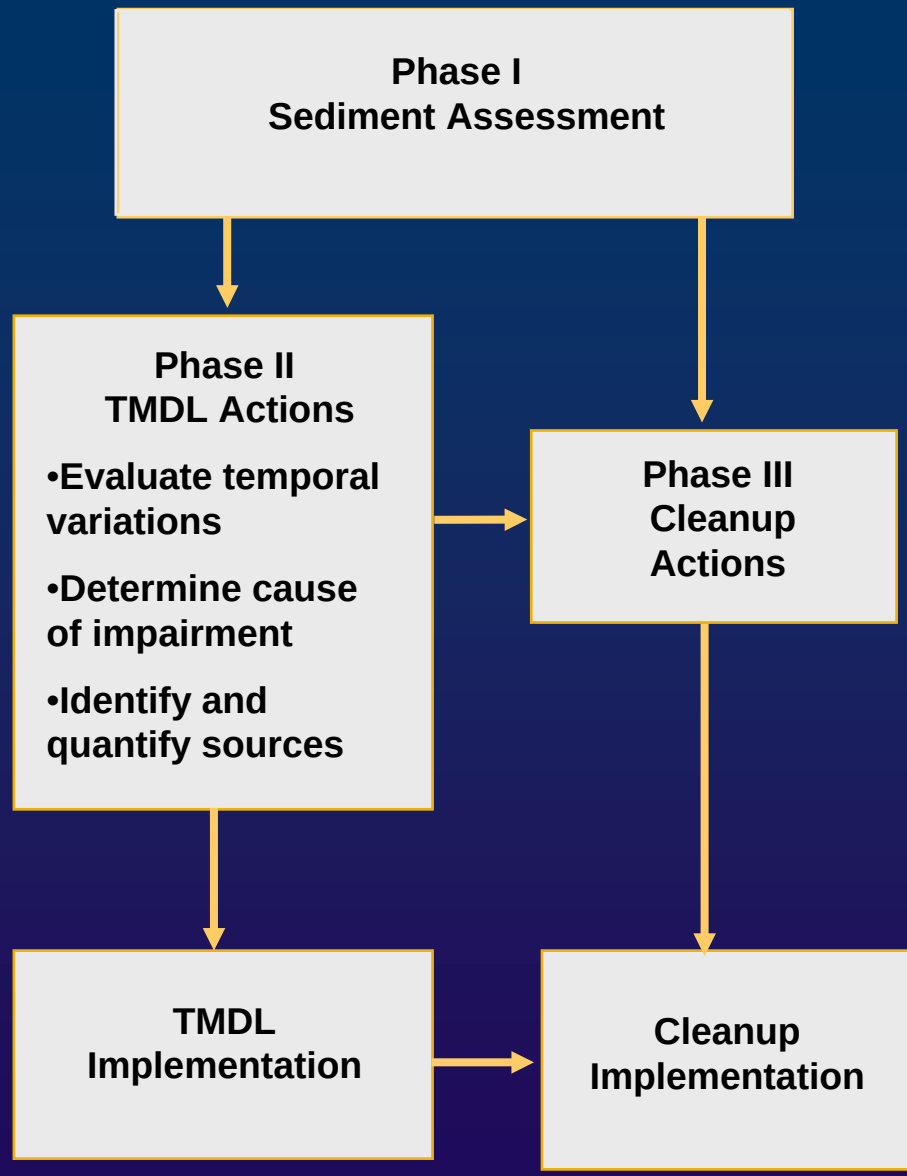
- Wet and dry weather flows from the Creeks
- Historical releases at NSSD and neighboring industries
- Shoreline runoff and storm drains
- Incidental and accidental releases from ships
- Transport and deposition from other areas of San Diego Bay



Study Approach

Program Framework

- Comprehensive program integrates requirements for:
  - THS clean up
  - TMDL source control
- Program phases allow implementation of source control while clean up requirements are determined



Phase I Study Objectives

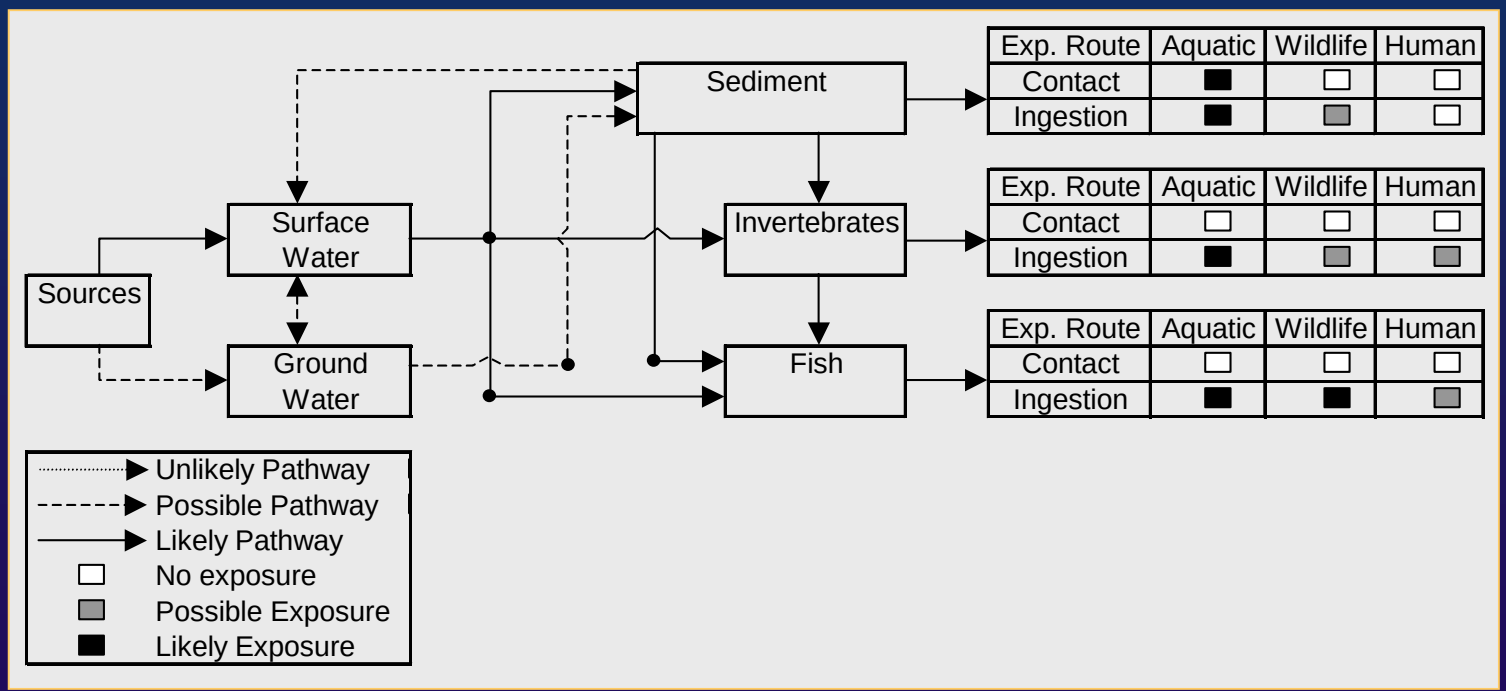
- Spatial distribution and magnitude of sediment contamination
- Assessment of beneficial use impairment
  - Aquatic life
  - Aquatic-dependent wildlife
  - Human Health

Beneficial Use Assessment

- Aquatic Life Beneficial Use – Weight of evidence (triad) approach (sediment contaminant chemistry, toxicity, and benthic community composition)
- Wildlife Beneficial Use – Ecological risk screening using contaminant bioaccumulation data for clams
- Human Health Beneficial Use – Human health risk screening using contaminant bioaccumulation data for clams

Conceptual Site Model

- Focuses on sediment exposure pathway for aquatic endpoints
- Incorporates exposure assessment for wildlife and human endpoints



Study Elements

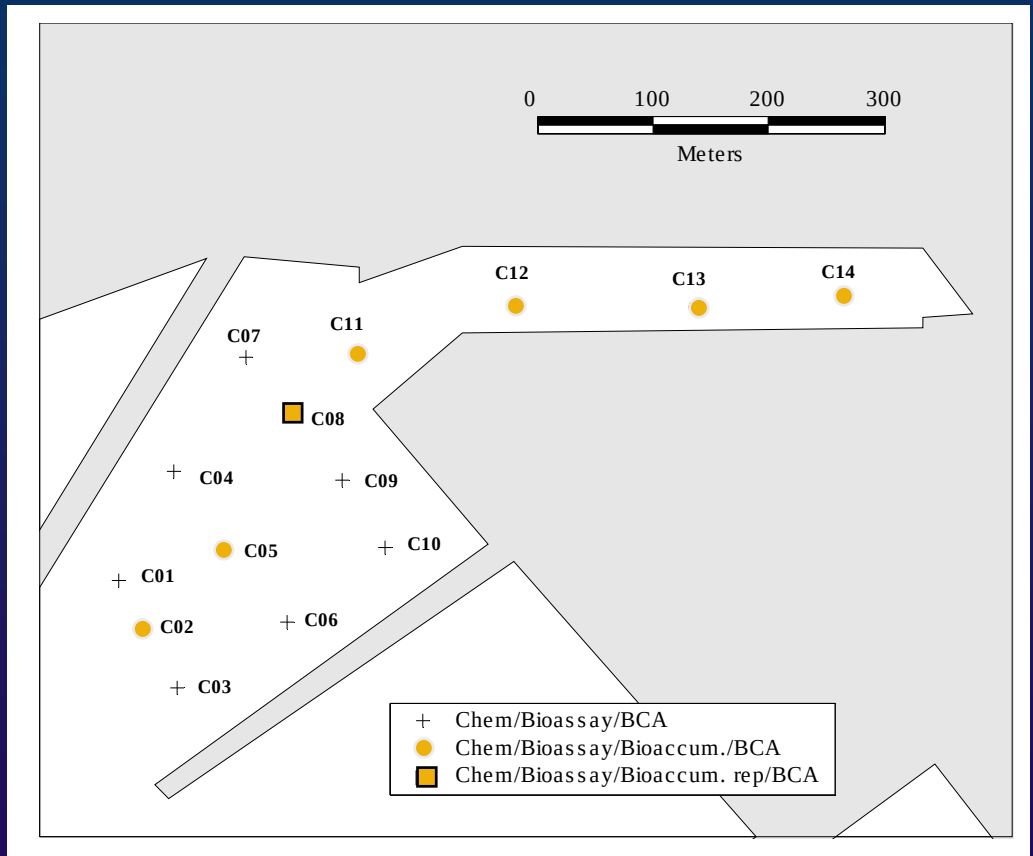
- Sediment physical and chemical analyses
  - Grain Size
  - TOC
  - Target Chemicals
- Toxicity testing
  - Amphipod Mortality
  - Sea Urchin Development
  - Sea Urchin Fertilization
- Benthic community analysis
- Bioaccumulation
  - Bivalve *Macoma nasuta*, 28-day test

Target Chemicals

- Contaminants of potential concern (CoPCs) selected based on BPTCP and historical review
- Metals (9)
- Polynuclear Aromatic Hydrocarbons (41)
- Polychlorinated biphenyls (41 congeners)
- Chlorinated Pesticides
  - Chlordane
  - DDT, DDD, DDE

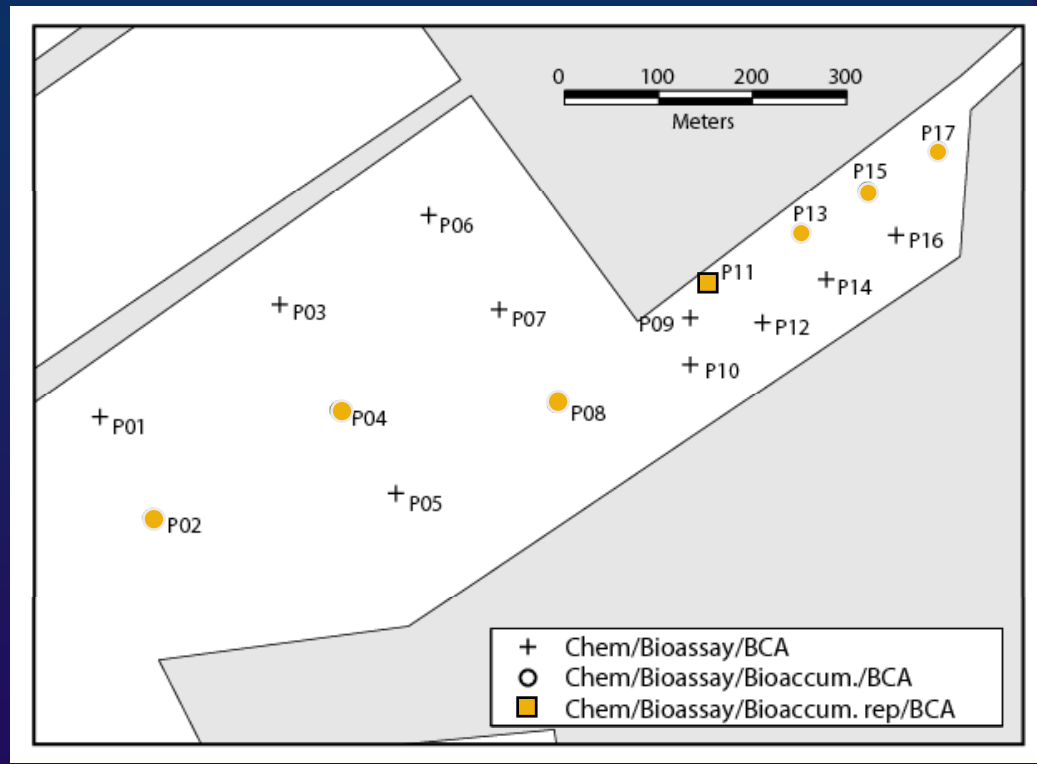
Sampling Design - Chollas

- Sampled 14 stations at ~50-100 m spacing
- Chemistry, toxicity and benthic community at all 14 stations
- Bioaccumulation at 7 stations
- Included inner site region



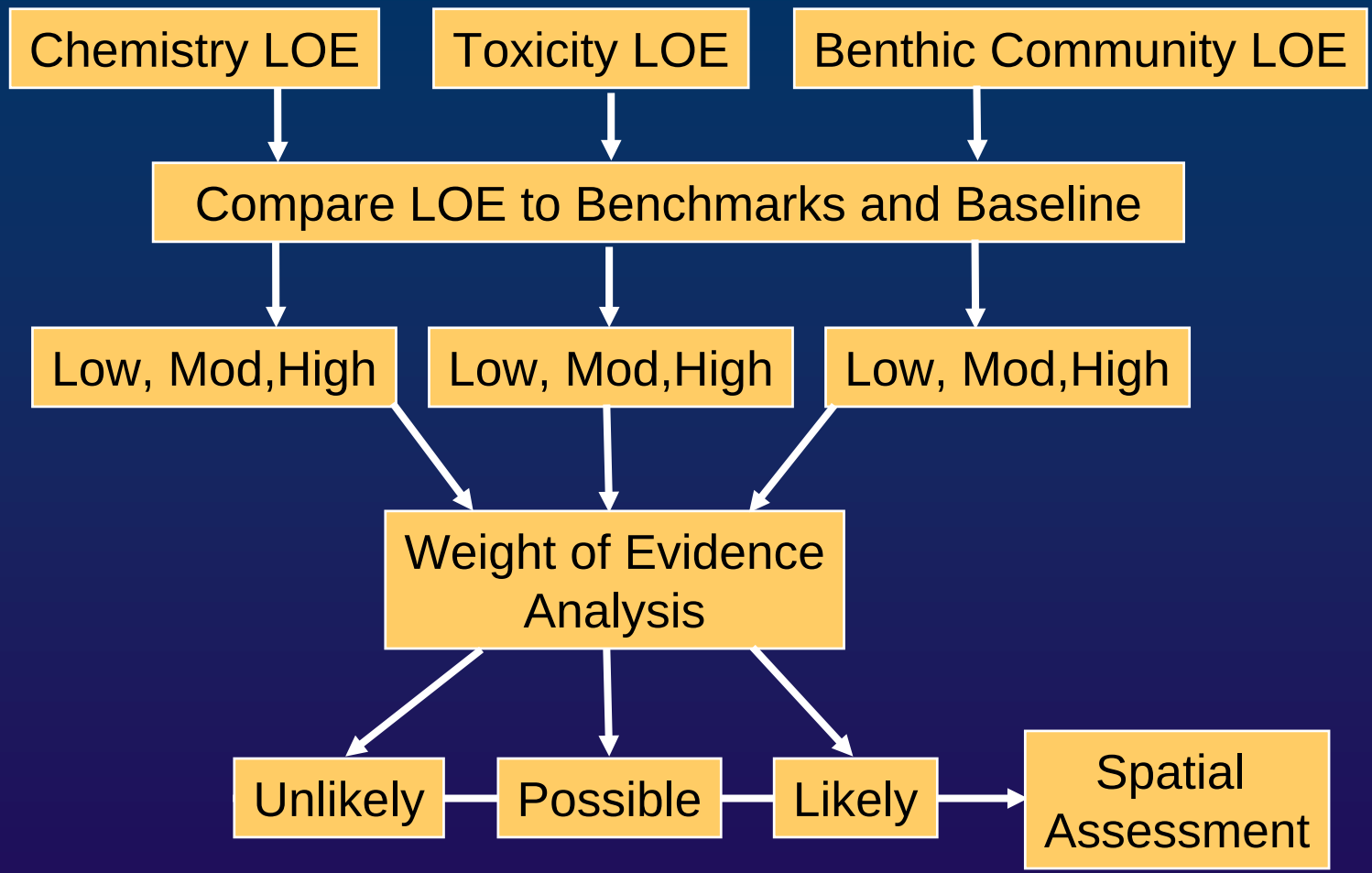
Sampling Design - Paleta

- Sampled 17 stations at ~50-200 m spacing
- Chemistry, toxicity and benthic community at all 17 stations
- Bioaccumulation at 7 stations
- Included outer site region

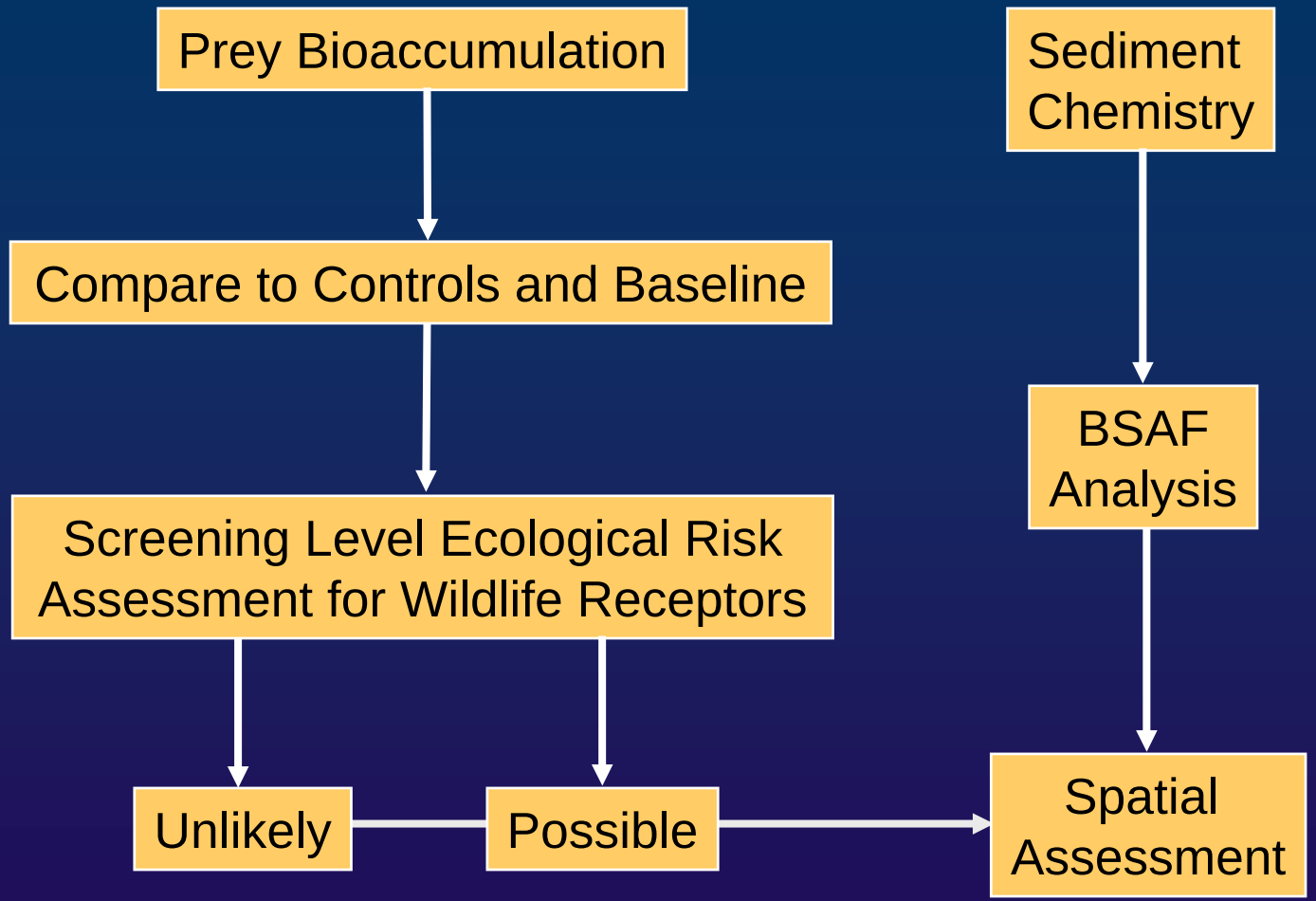


Assessment Framework

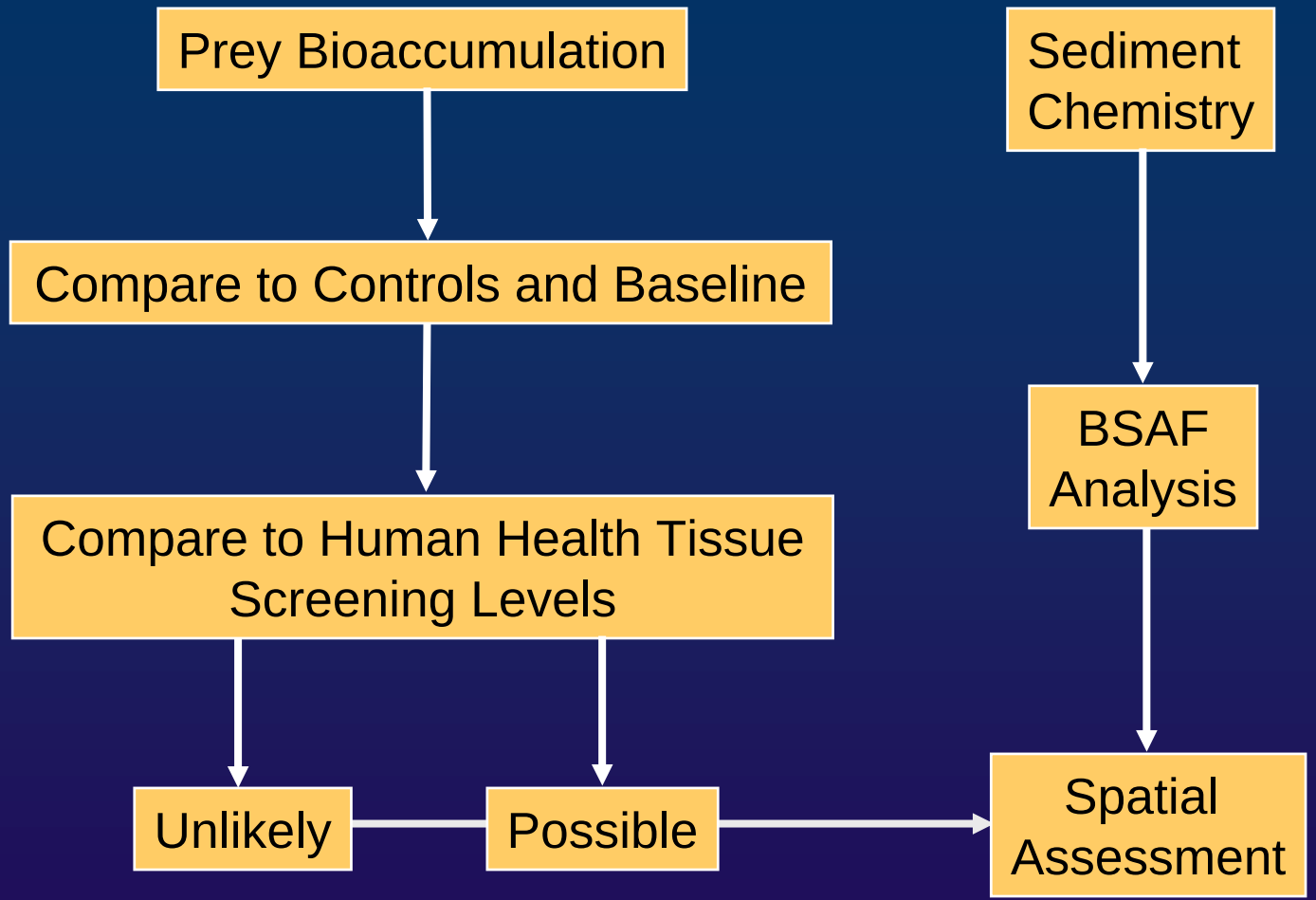
Assessment Framework-Aquatic Life Beneficial Use



Assessment Framework-Aquatic Dependent Wildlife Beneficial Use



Assessment Framework - Human Health Beneficial Use

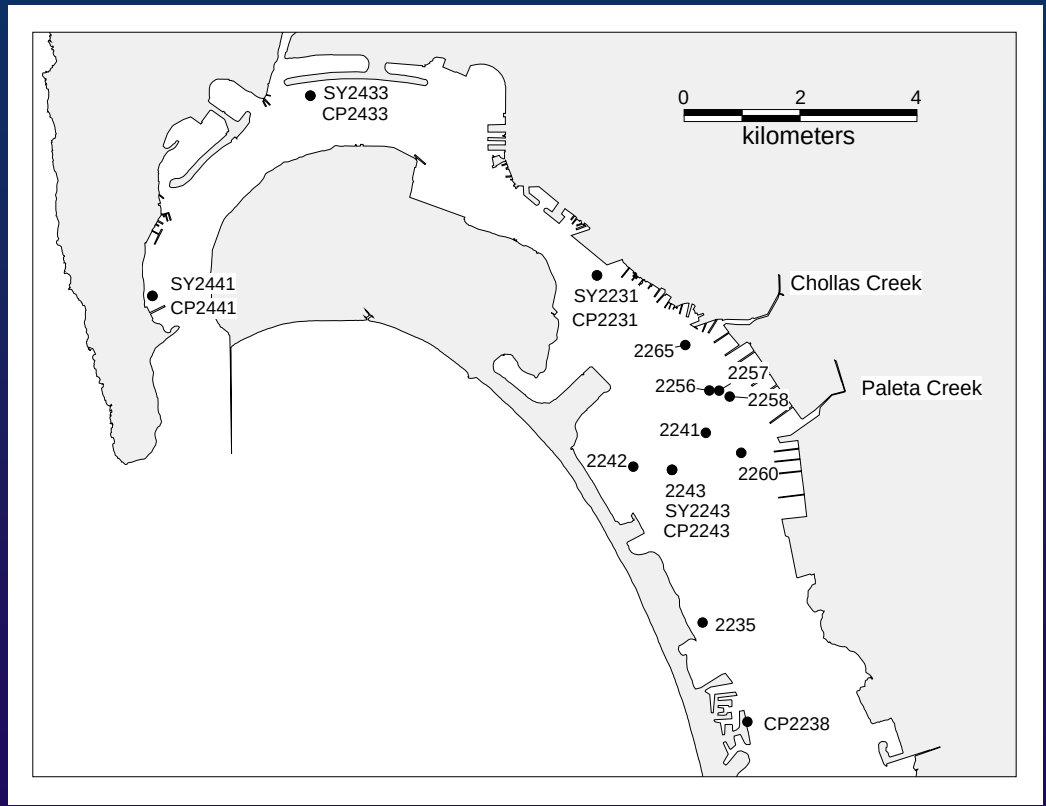


Definition of Baseline Condition

- Reference Station
  - A location remote from direct influence of contaminant sources
  - Historical data indicate low contaminant levels and toxicity
  - Similar habitat to the study site
  - Data will be representative of background chemical levels
- Baseline Condition
  - Existing ambient condition characterized by an unbiased pool of reference stations
  - Representative of natural variability in background chemicals
  - Used most recent reference station data collected during present study, from shipyard study, and from Bight98 study
  - Balanced number of stations collected recently and historically

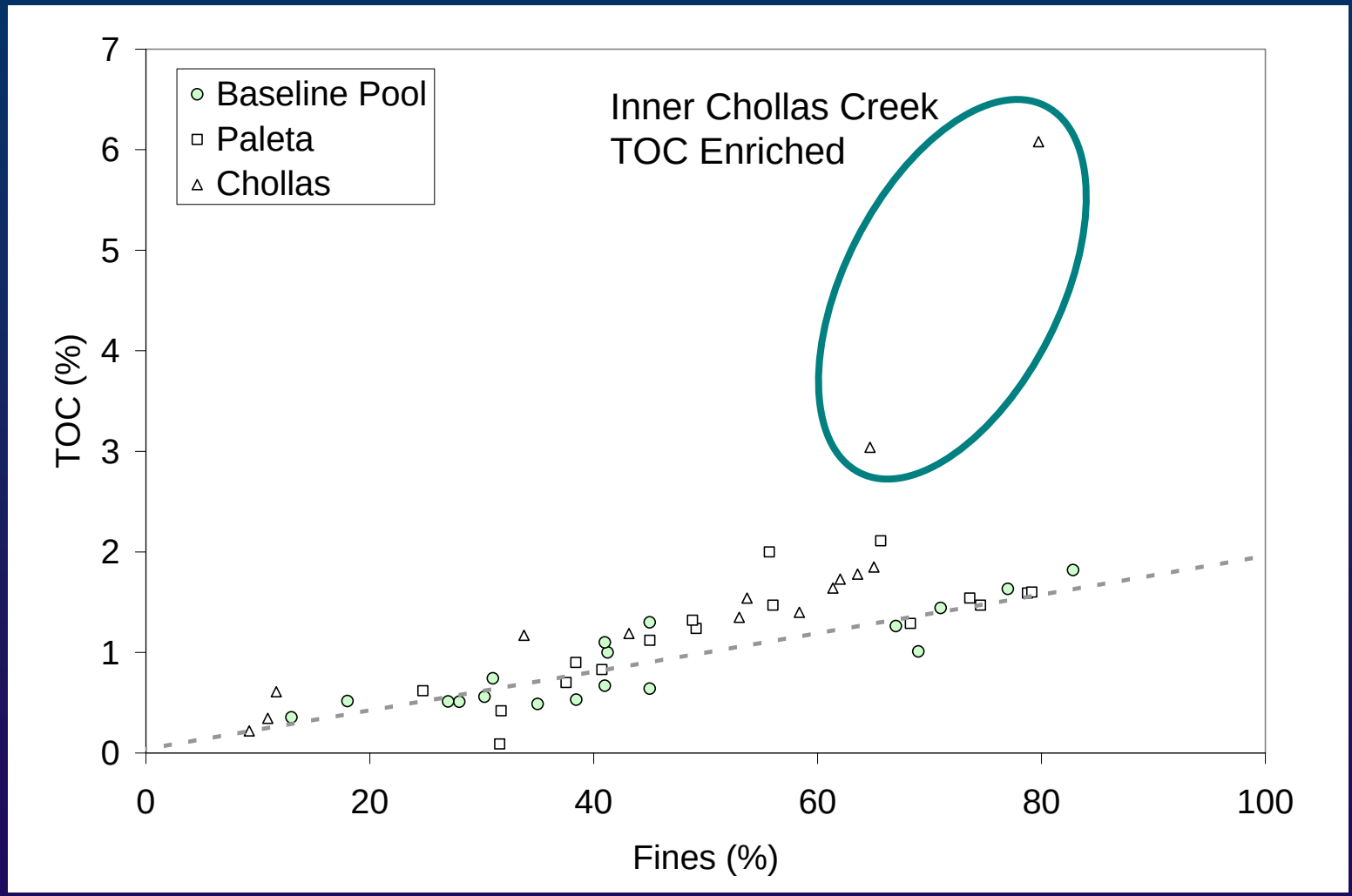
Baseline Pool Stations

- Location of reference stations included in the Baseline Pool. Stations were compiled from:
  - This study (CP)
  - NASSCO-Southwest study (SY)
  - Bight98 study (no prefix)



Baseline Sediment Characteristics

- Baseline pool provides representative range for most Chollas/Paleta stations



Baseline Chemistry Conditions

- Characterized by 95% Upper Prediction Limit (UPL) for metals and organics
- Metals

	Metals (mg/kg)								
	Ag	**As**	**Cd**	**Cr**	**Cu**	**Hg**	**Ni**	**Pb**	**Zn**
Mean	0.55	6.0	0.16	39.1	68	0.31	10.4	29.6	127
95% UPL*	1.08	7.5	0.33	56.5	121	0.57	14.8	53.2	192
ERM	3.7	70	9.6	370	270	0.71	51.6	218	410

*Based on 50% fines

- Organics

	Organics (ng/g)			
	PPPAH	**TPCB**	**TCHLOR**	**TDDT**
Mean	497	40	0.6	2.6
95% UPL	1234	84	1.3	21
SQG	18000*	400	4.8	1000*

*Based on 1% TOC

Baseline Toxicity & Benthic Community Conditions

- Toxicity

	Amphipod Survival (%)	Urchin Development (% normal)	Urchin Fertilization (%)
Mean	88	100	85
95% LPL	72.9	64.7	41.9

- Benthic Community

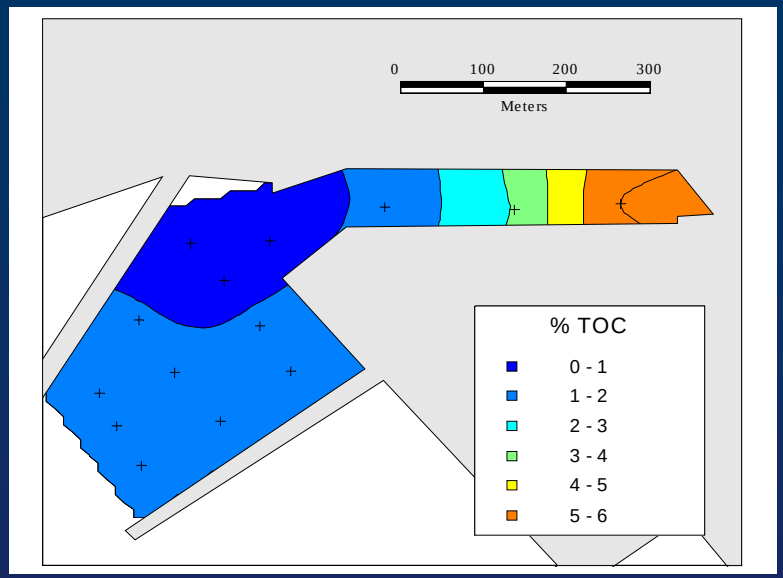
	Benthic Community Metric			
	Abundance	**# Taxa**	**Diversity**	**BRI**
Mean	794	48	2.4	35.3
95% PL	239	22	1.8	57.7

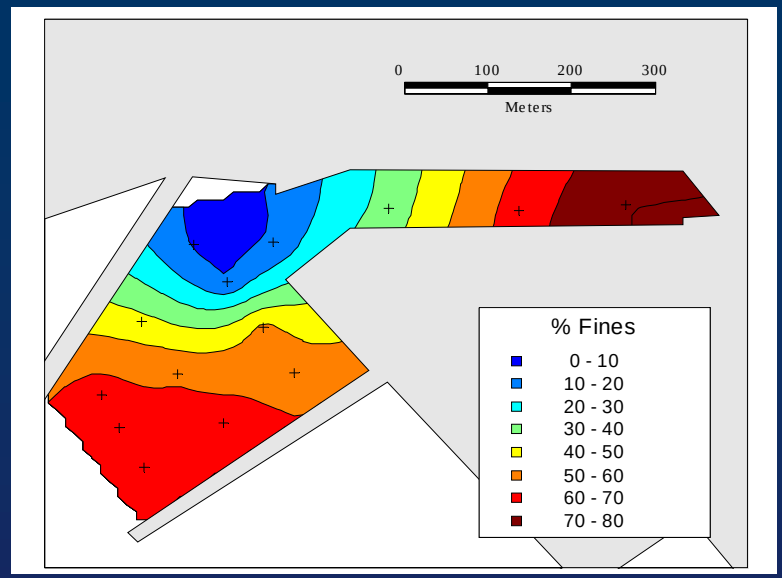
Aquatic Life Beneficial Use Assessment

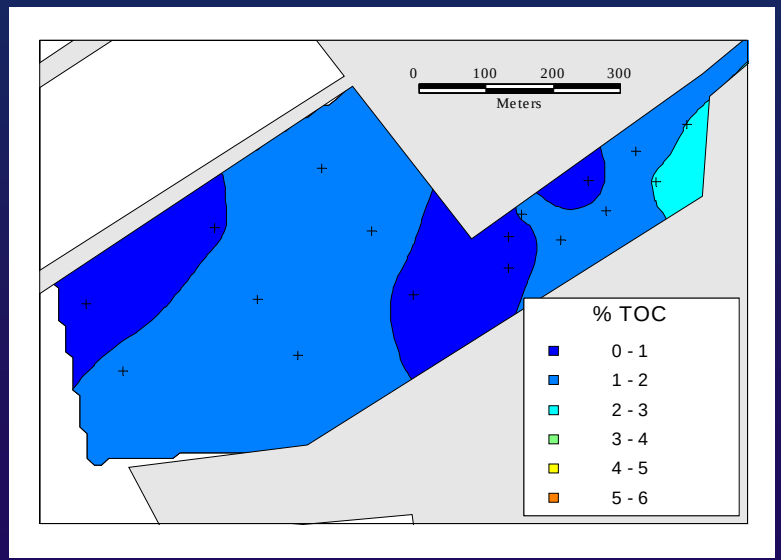
Aquatic Life Assessment Framework

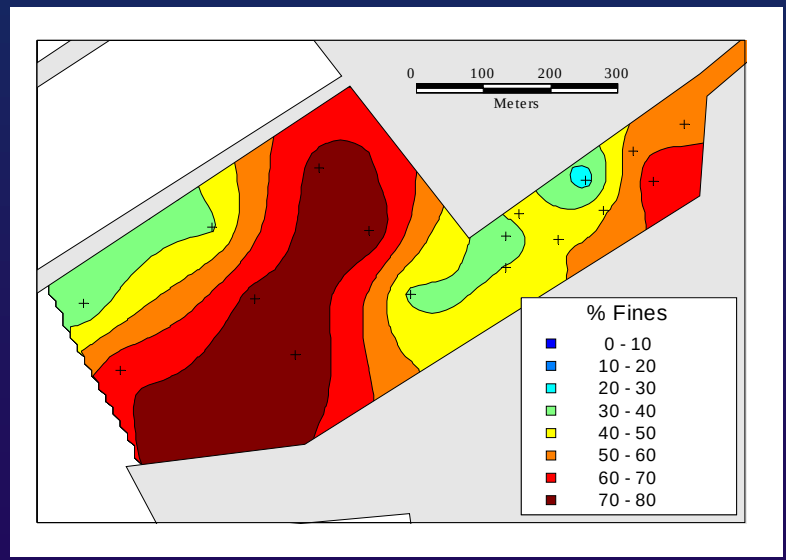
- Line of Evidence (LOE)
  - Measure chemical, toxicity, benthic community parameter
  - Check for normality and apply transform if necessary
  - Evaluate against commonly accepted benchmarks
  - Evaluate against baseline condition
  - Categorize potential for impact as low, moderate, or high using literature guidelines and best professional judgment
- Weight of Evidence (WOE) Triad
  - Evaluates beneficial use impairment from site derived CoPCs
  - Integrates chemistry, toxicity, and benthic community LOE
  - Applies weighting of likely, possible, or likely impairment based on literature guidelines

Spatial Distribution - Grain Size & TOC

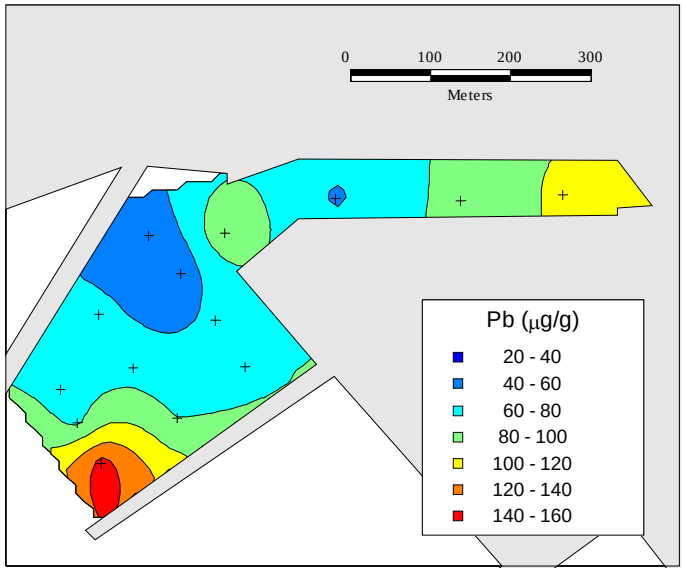


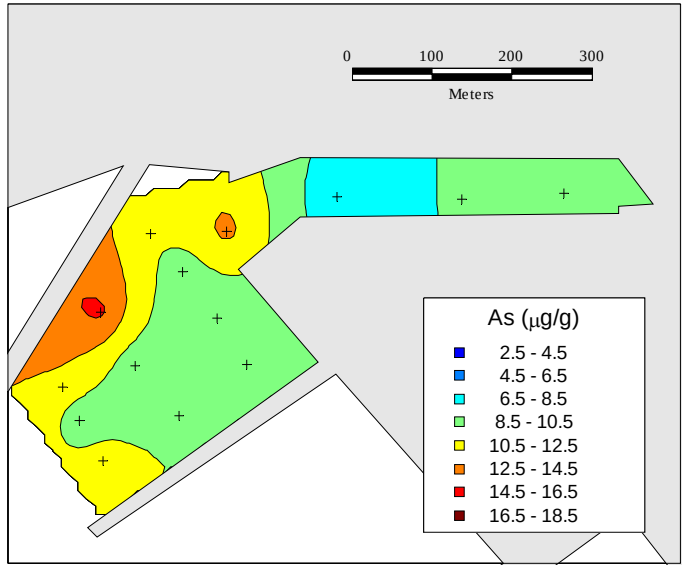


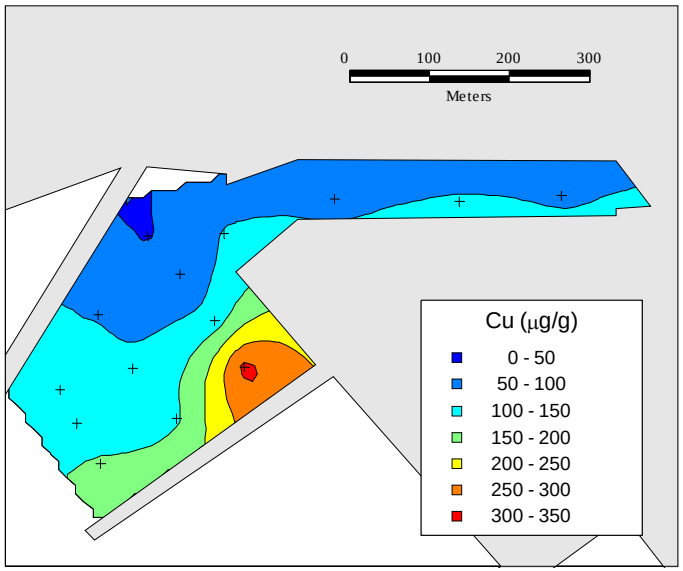


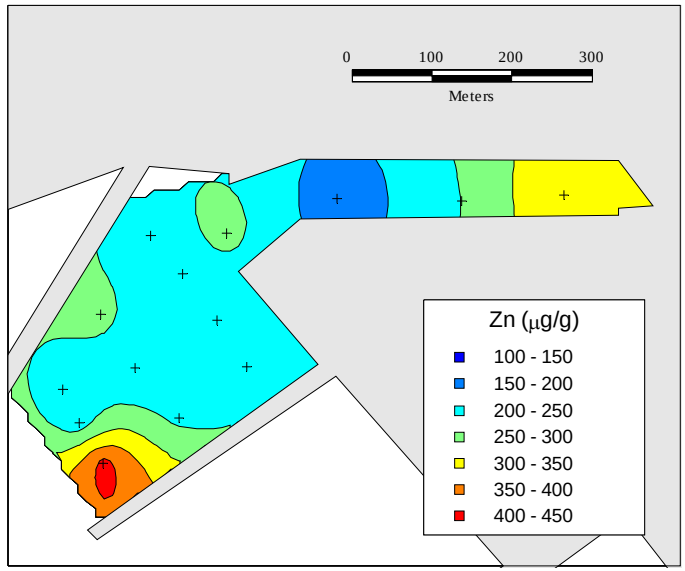


Spatial Distribution – Chollas Metals

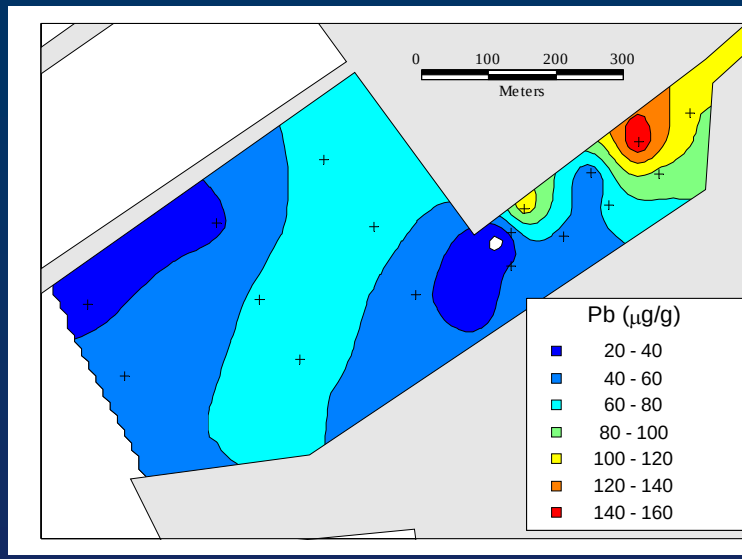


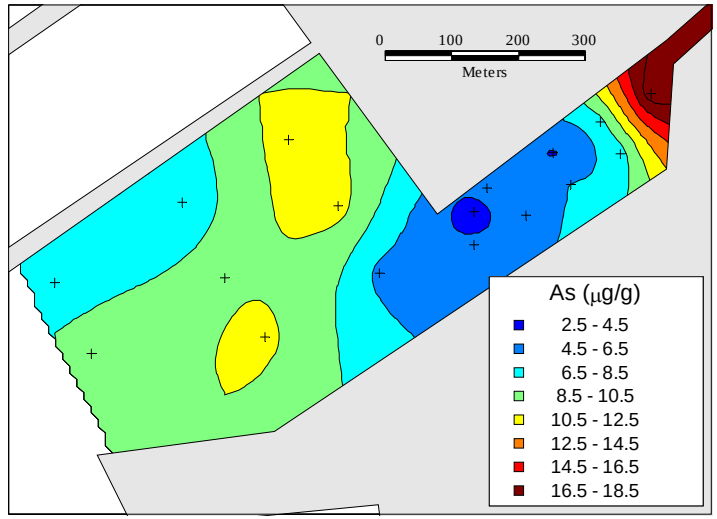


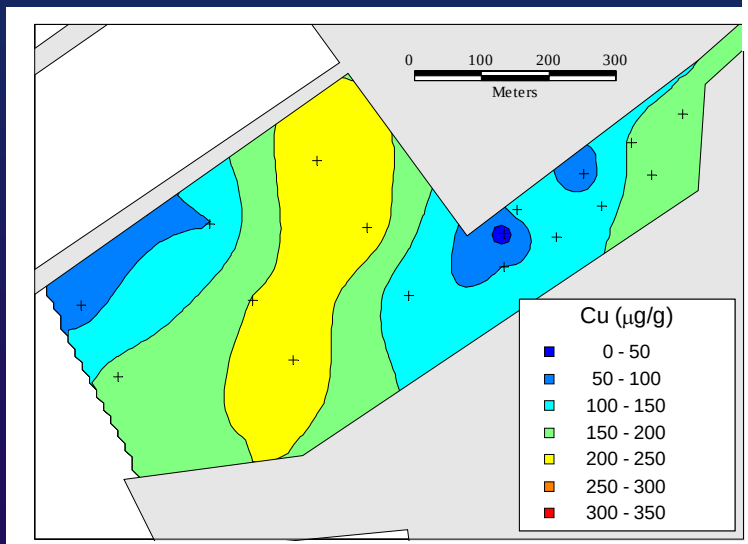


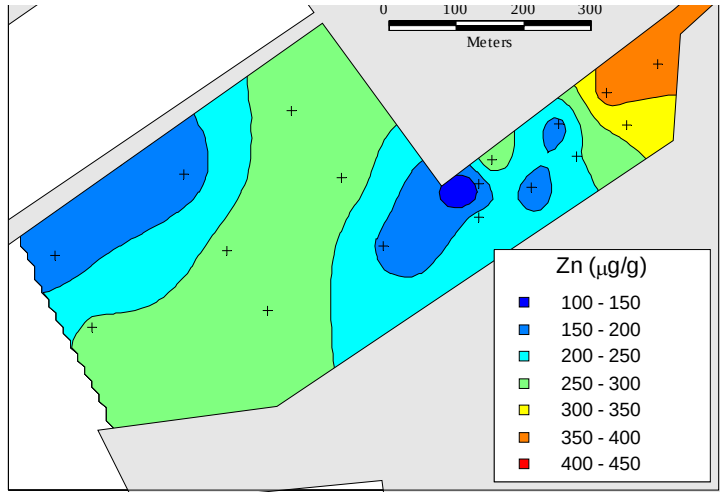


Spatial Distribution-Paleta Metals

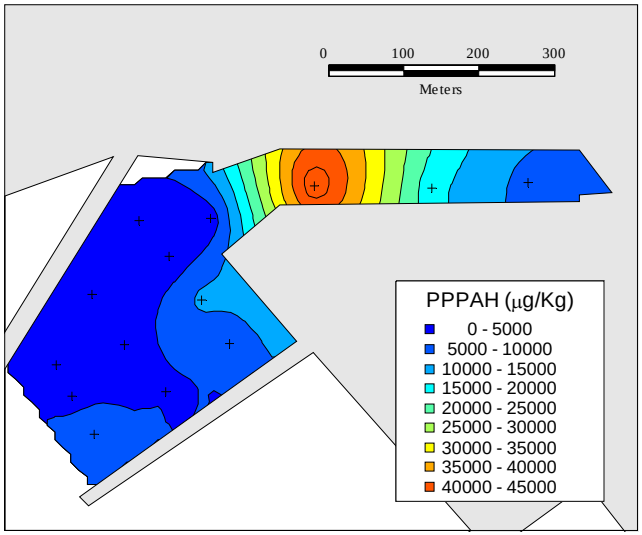


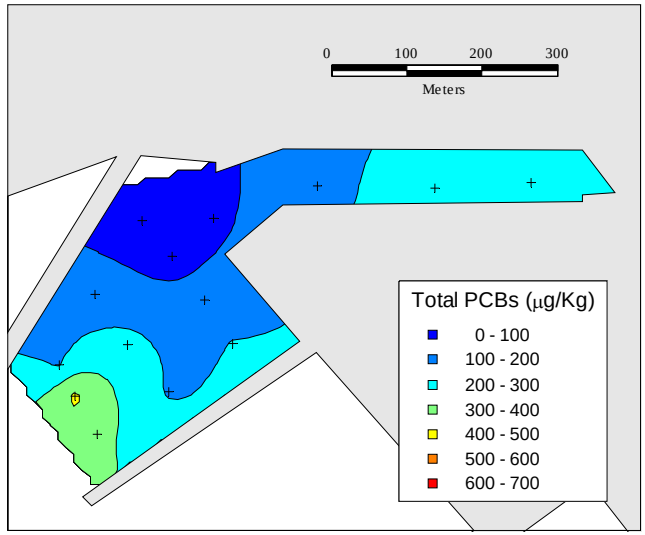


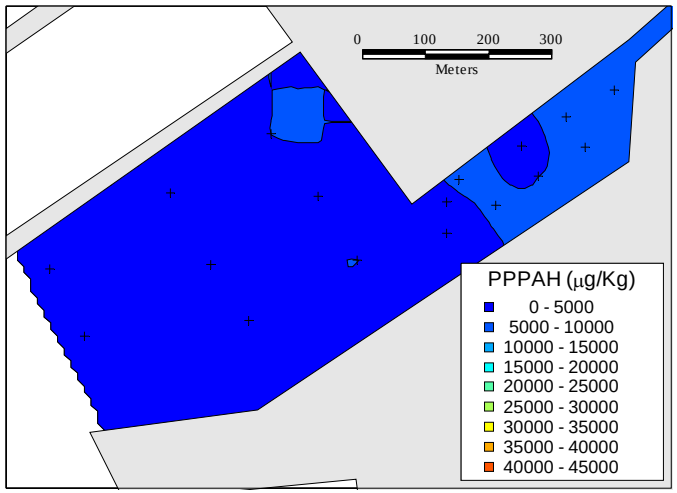


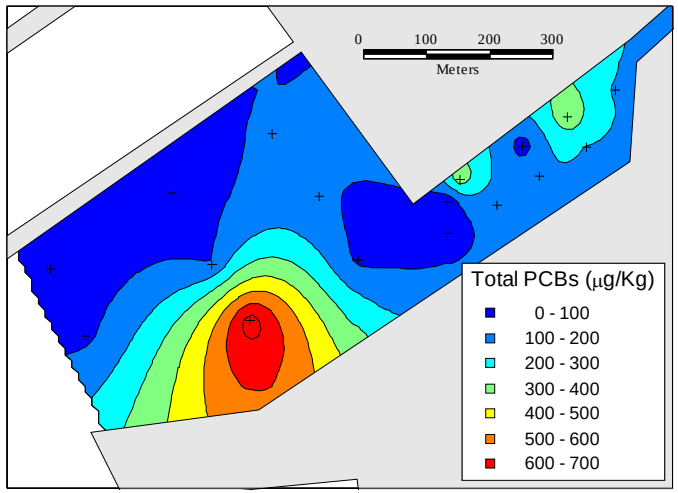


PAH and PCB Spatial Distribution

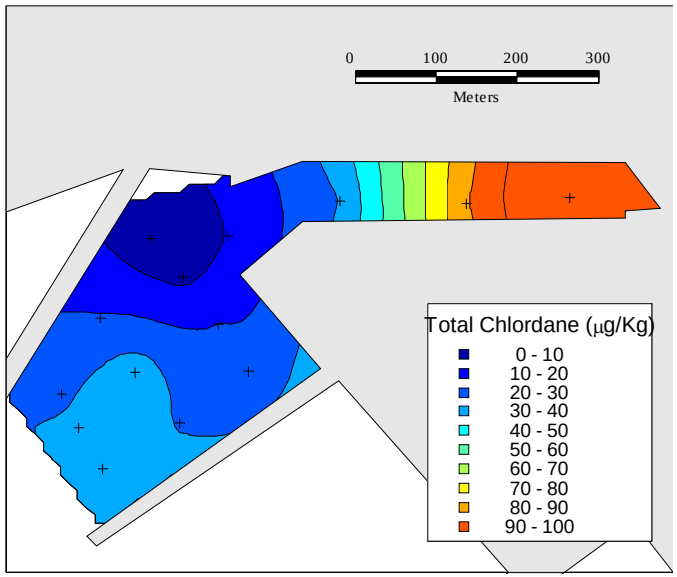


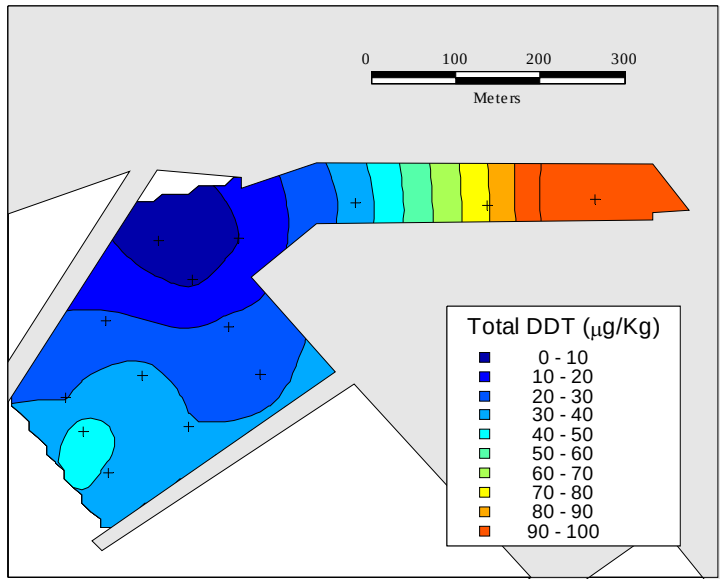


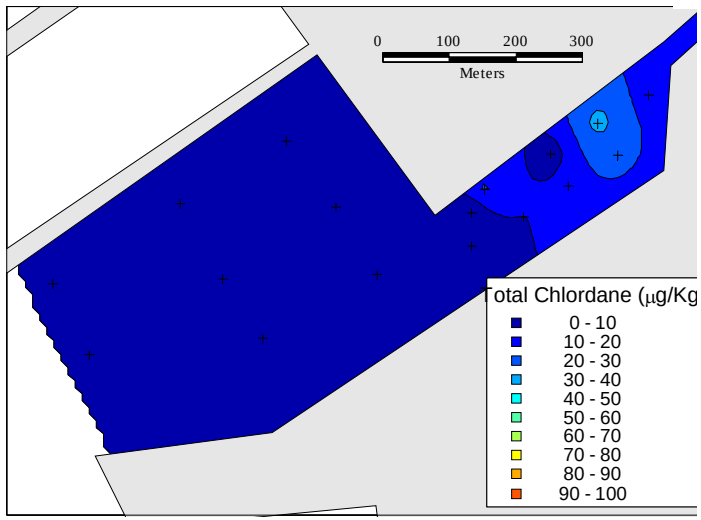


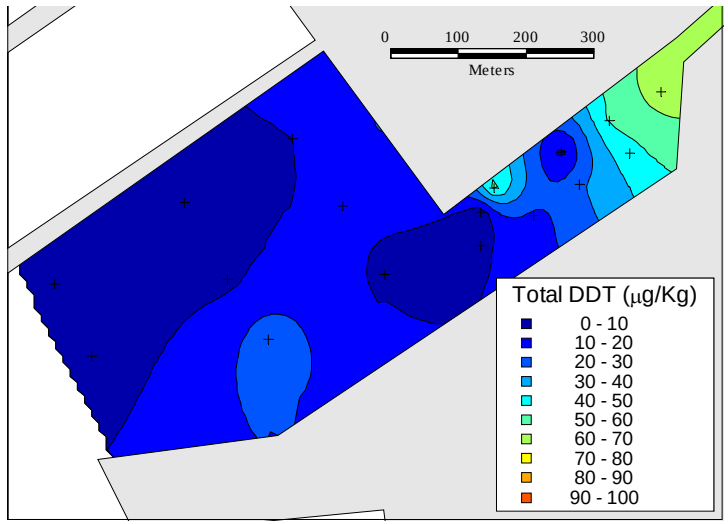


Chlordane and DDT Spatial Distribution









Chemistry Line of Evidence (LOE)

- Contamination impacts categorized based on two factors:
  - Number of individual chemicals exceeding the Baseline UPL and SQG
  - Chemical quotient (SQGQ1) exceeding the Baseline UPL and published thresholds

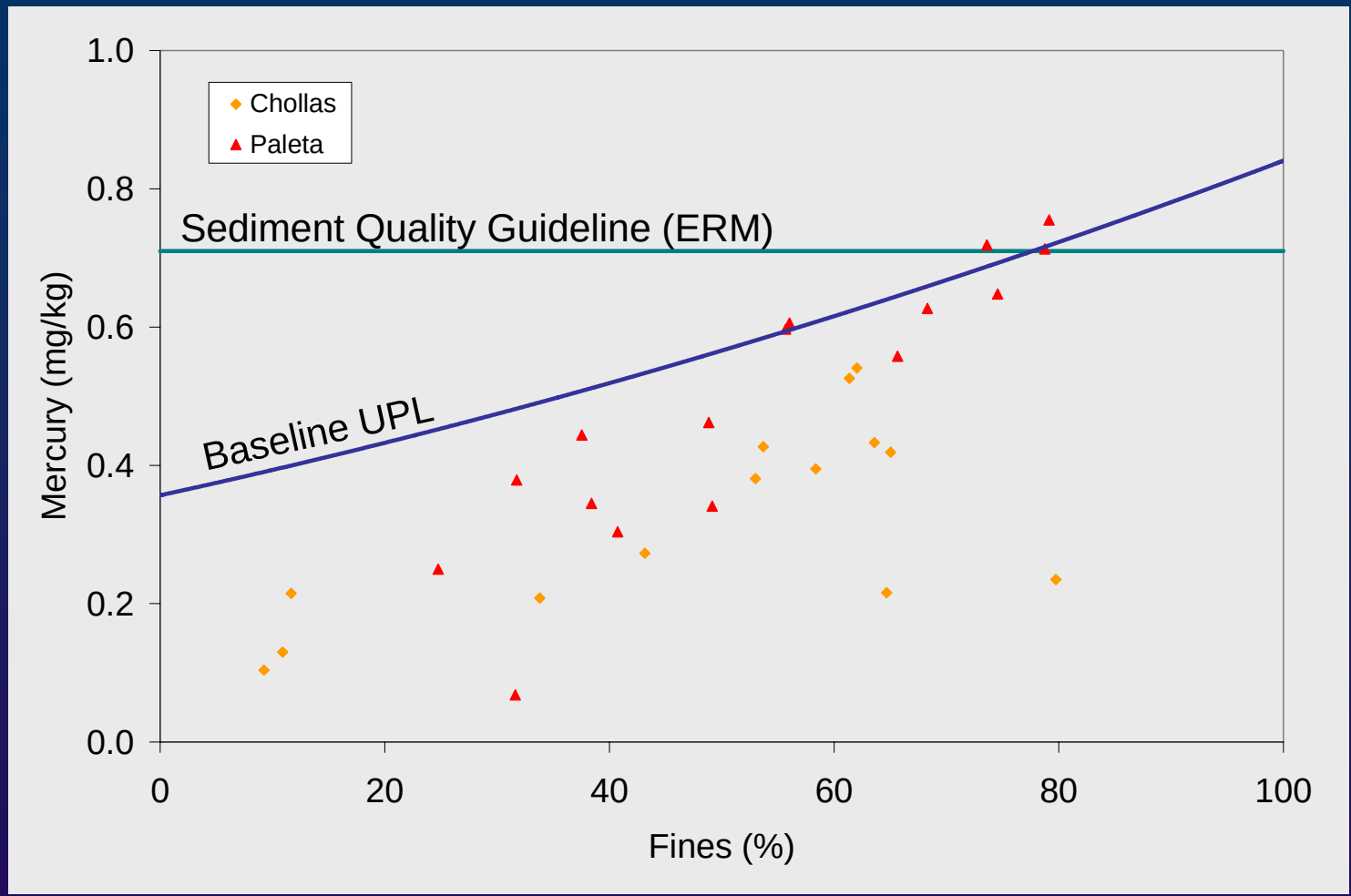
Sediment Quality Guidelines

- Metals
  - Effects Range Median (Long et al., 1995)
- PAHs
  - Consensus-based midrange effects concentration (MacDonald et al., 2000)
- PCBs
  - Consensus-based midrange effects concentration (Swartz, 1999)
- Pesticides
  - Chlordane – Probable Effects Level (MacDonald et al., 1996)
  - DDT – Organic carbon normalized DDT effects value (Swartz et al., 1998)
- Chemical Quotient
  - SQGQ1 quotient benchmark (Fairey et al., 2001)

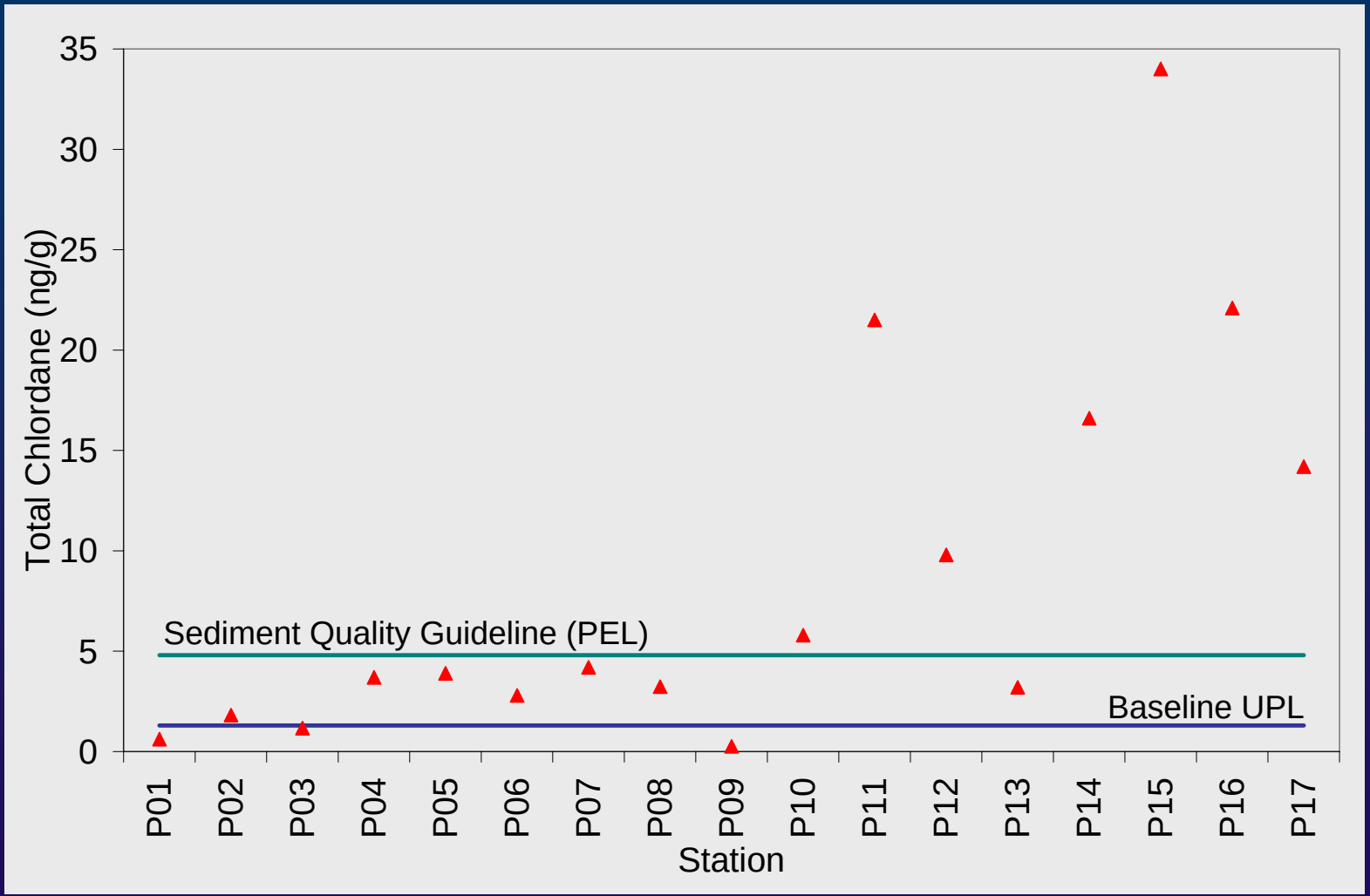
Chemistry LOE Ranking Rules

- High
  - SQGQ1 > 1 and Baseline UPL, or
  - More than 5 chemicals exceeding individual SQG and Baseline UPL
- Moderate
  - SQGQ1 > 0.25 and Baseline UPL, or
  - At least 1 chemical exceeding individual SQG and Baseline UPL
- Low
  - SQGQ1<0.25 and no chemical exceeding individual SQG and Baseline UPL

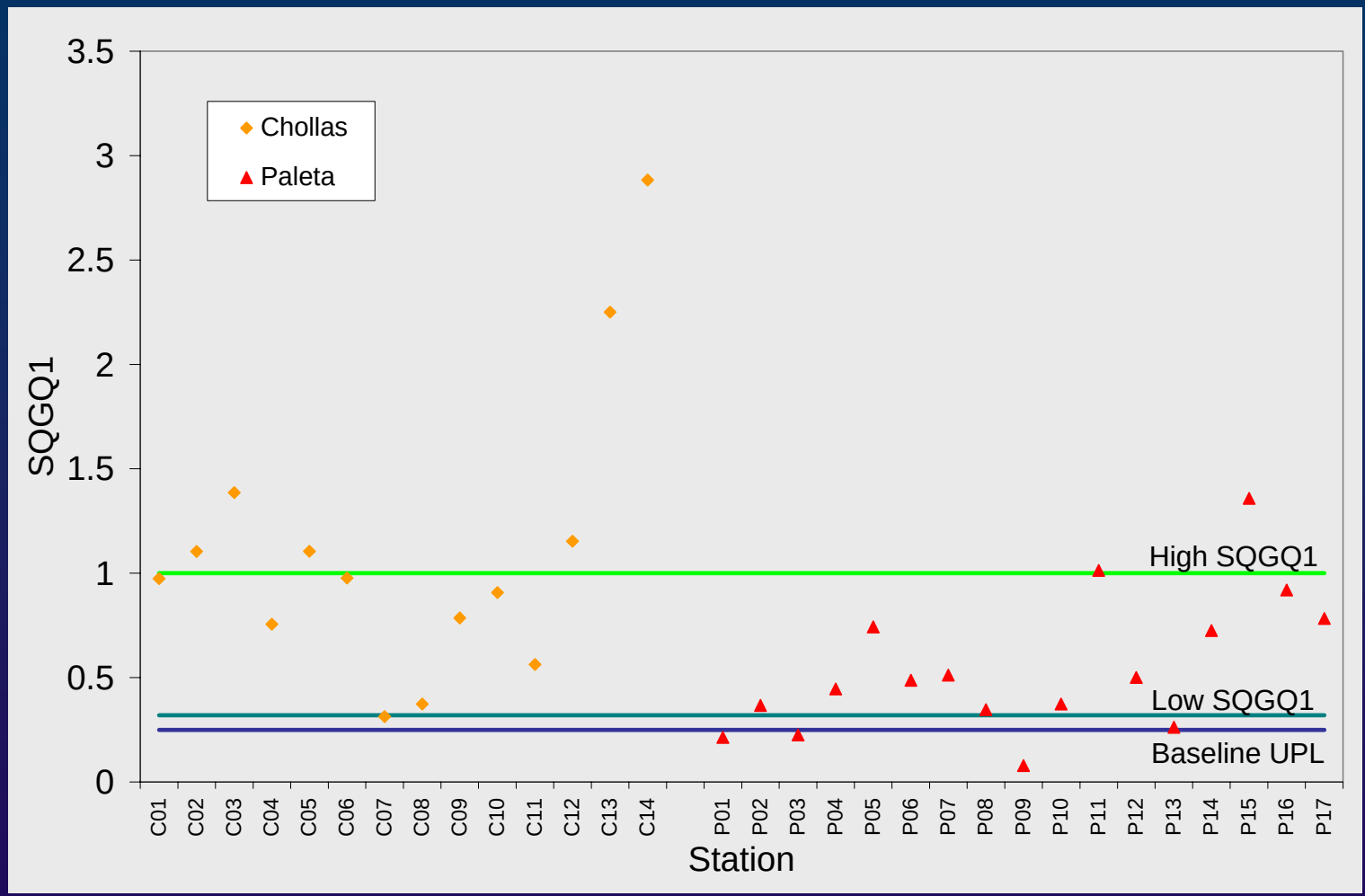
Chemistry LOE - Mercury



Chemistry LOE - Chlordane



Chemistry LOE – SQGQ1



Chemistry LOE Results - Chollas

Station	# Chemicals exceeding SQG and UPL	SQGQ1 Level	SQGQ1 > Reference	Chem Class
C01	1 (TChlor)	II	+	⊙
C02	1 (TChlor)	III	+	●
C03	2 (Tchlor, Zn)	III	+	●
C04	1 (TChlor)	II	+	⊙
C05	1 (TChlor)	III	+	●
C06	1 (TChlor)	II	+	⊙
C07	0	II	-	O
C08	1 (TChlor)	II	+	⊙
C09	1 (TChlor)	II	+	⊙
C10	2 (Tchlor, Cu)	II	+	⊙
C11	1 (TChlor)	II	+	⊙
C12	2 (TChlor, PAH)	III	+	●
C13	1 (TChlor)	III	+	●
C14	1 (TChlor)	III	+	●

●	High
⊙	Medium
O	Low

SQGQ1 Level
I <0.25; II 0.25 to 1.0; III>1.0

Chemistry LOE Results - Paleta

Station	# Chemicals exceeding SQG and UPL	SQGQ1 Level	SQGQ1 > Reference	Chem Class
P01	0	I	-	○
P02	0	II	+	⊙
P03	0	I	-	○
P04	0	II	+	⊙
P05	1 (PCB)	II	+	⊙
P06	1 (Hg)	II	+	⊙
P07	1 (Hg)	II	+	⊙
P08	0	II	+	⊙
P09	0	I	-	○
P10	1 (TChlor)	II	+	⊙
P11	2 (Tchlor, Hg)	III	+	●
P12	1 (TChlor)	II	+	⊙
P13	0	II	-	○
P14	1 (TChlor)	II	+	⊙
P15	1 (TChlor)	III	+	●
P16	1 (TChlor)	II	+	⊙
P17	1 (TChlor)	II	+	⊙

●	High
⊙	Medium
○	Low

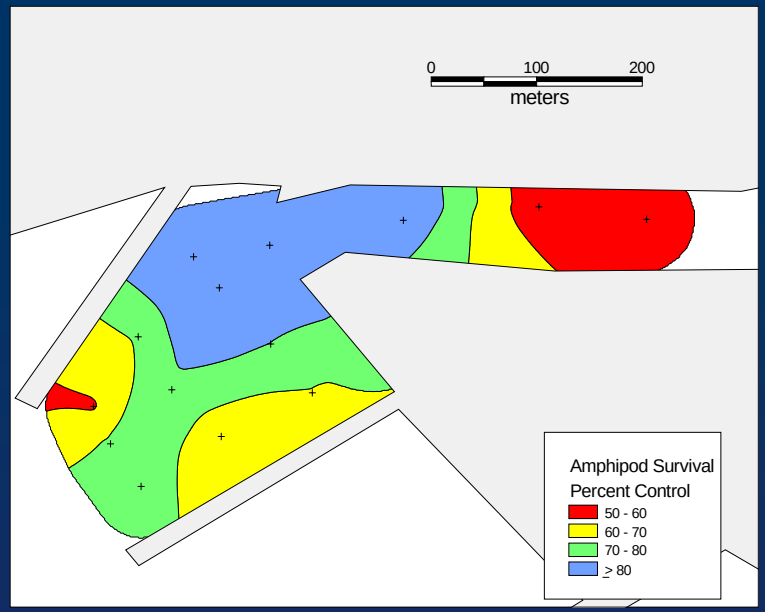
SQGQ1 Level
I <0.25; II 0.25 to 1.0; III>1.0

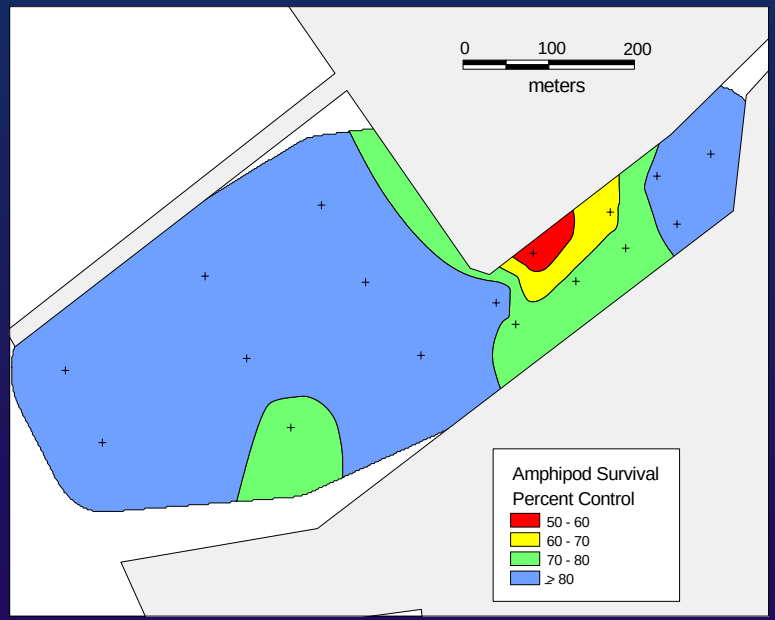
Sediment Toxicity

- Bulk sediment
  - Amphipod survival (*Eohaustorius estuarius*)
  - 2 cm sediment layer, 10 day exposure
- Pore water
  - Sea urchin fertilization
  - 40 minute exposure
- Sediment-water interface
  - Sea urchin embryo development
  - 3 day exposure

Amphipod Survival

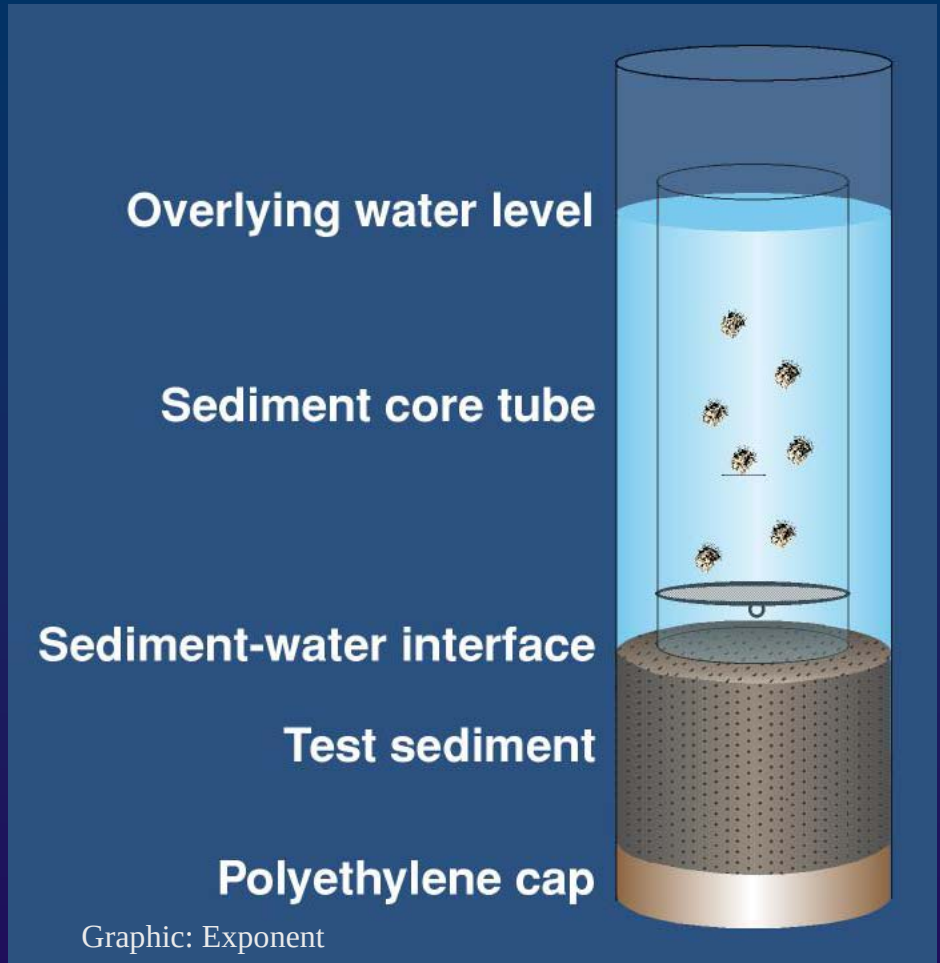
Bulk Sediment





Sediment-Water Interface Exposure

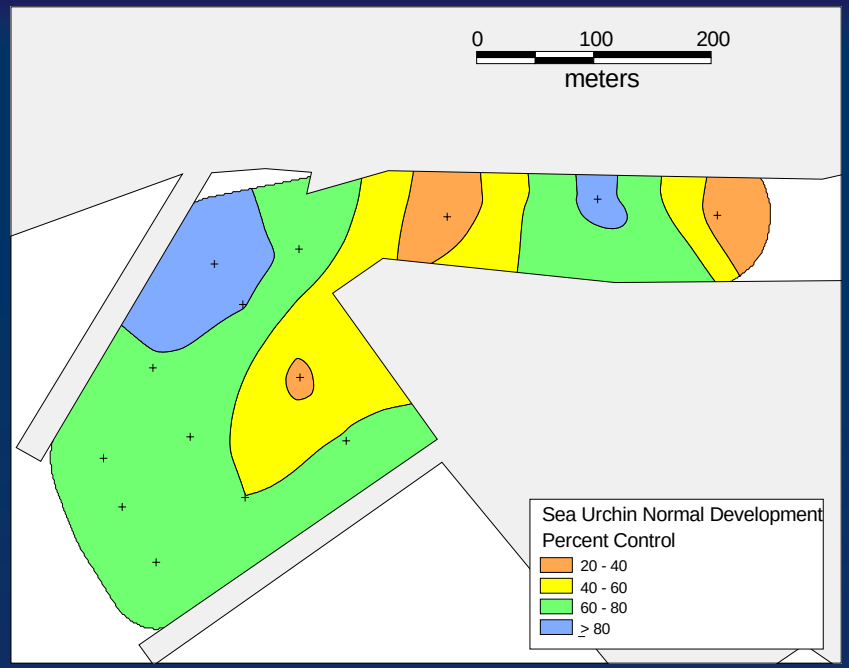
- Assess impacts from flux of constituents out of sediment
- Undisturbed sediment core

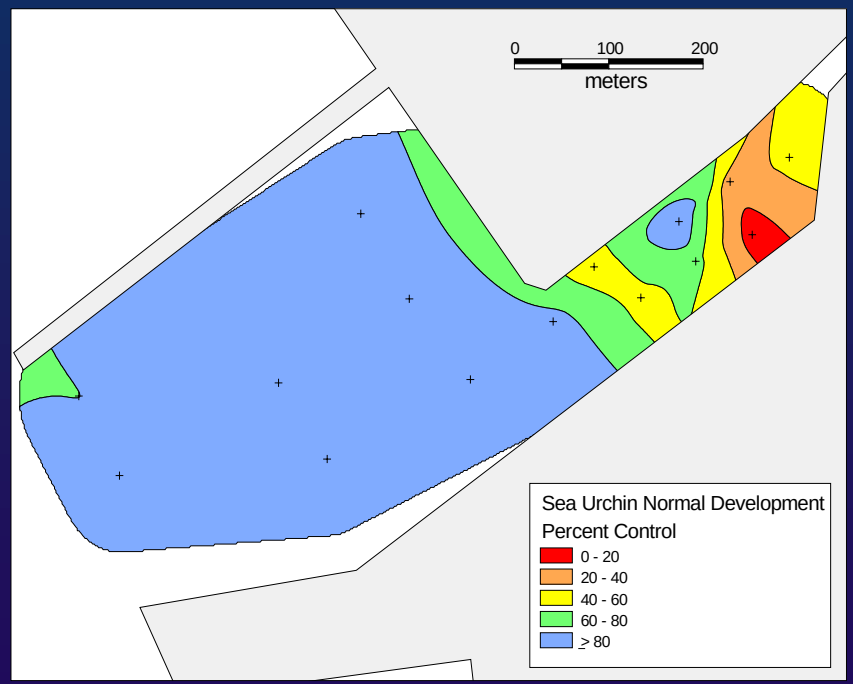


Graphic: Exponent

Sea Urchin Development

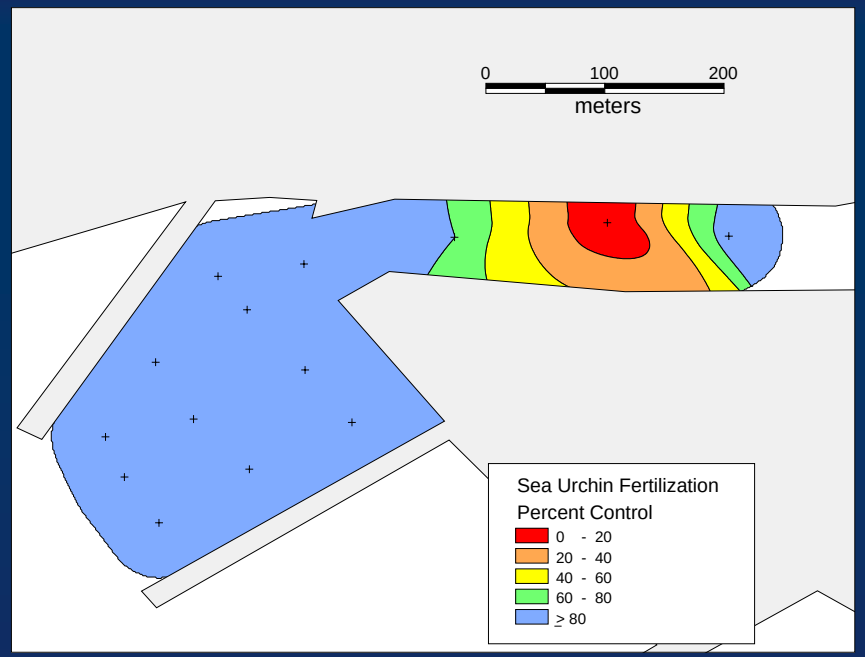
Sediment-Water Interface

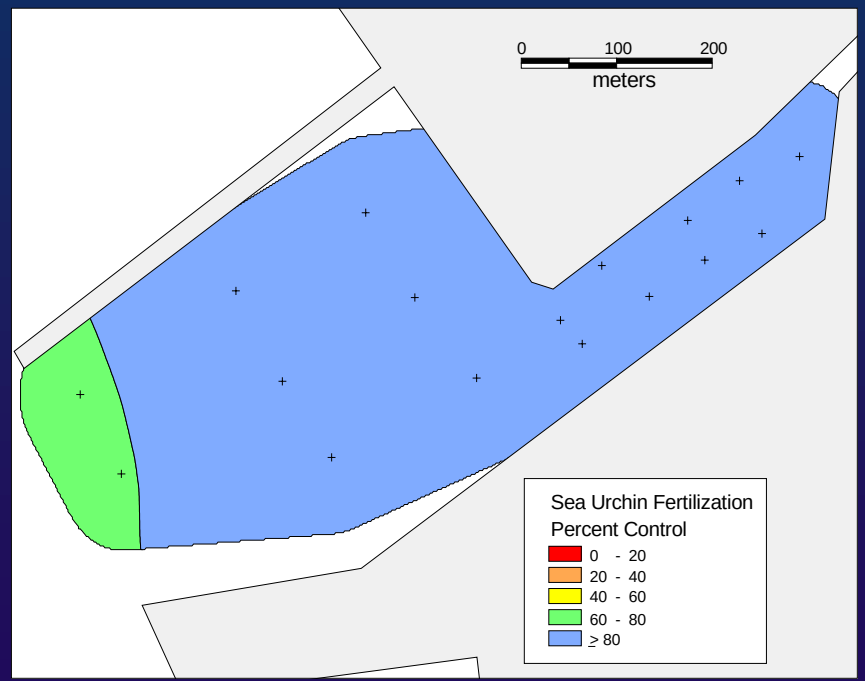




Sea Urchin Fertilization

Pore Water

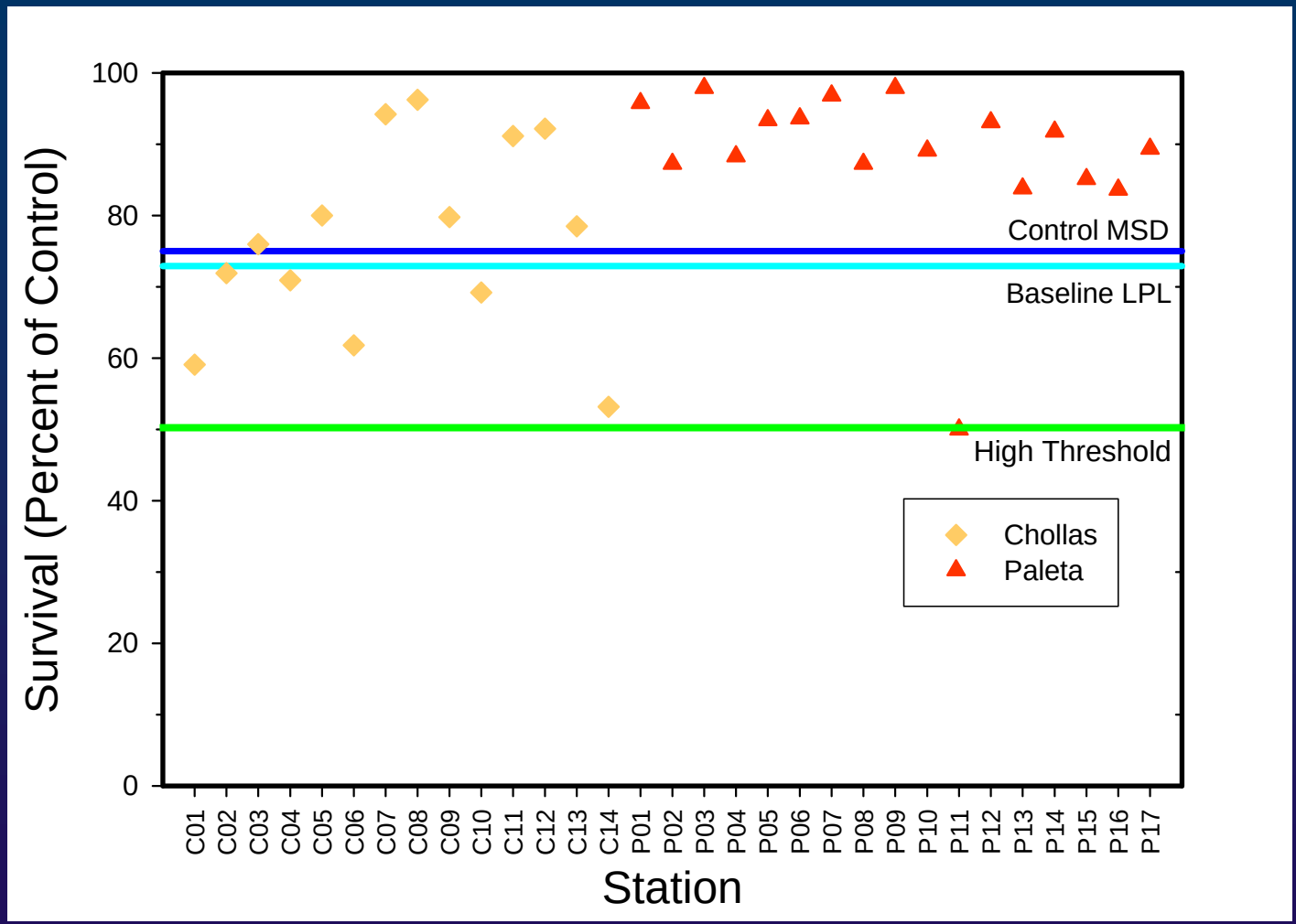




Toxicity LOE

- Low
  - All test responses not statistically different from controls, or
  - No responses exceed Baseline LPL
- Moderate
  - Any one test result is statistically different from its control and below Baseline LPL, and
  - Amphipod survival is greater than 50%
- High
  - Amphipod survival <50% and less than control and Baseline LPL
  - Two tests are statistically different from control and below Baseline LPL

Toxicity LOE-Amphipod Survival



Toxicity LOE Results

Station	Amphipod Survival		SWI Sea Urchin Development		PW Sea Urchin Fertilization		Tox Class
	<LPL	<50%	<LPL	<50%	<LPL	<50%	
C01	+	-	-	-	-	-	⊙
C02	+	-	-	-	-	-	⊙
C03	-	-	+	-	-	-	O
C04	+	-	-	-	-	-	⊙
C05	-	-	-	-	-	-	O
C06	+	-	+	-	-	-	⊙
C07	-	-	-	-	-	-	O
C08	-	-	-	-	-	-	O
C09	-	-	+	+	-	-	⊙
C10	+	-	+	-	-	-	⊙
C11	-	-	-	-	-	-	O
C12	-	-	+	+	-	-	⊙
C13	-	-	-	-	+	+	⊙
C14	+	-	+	+	-	-	●

O	Low
⊙	Medium
●	High

Toxicity LOE Results

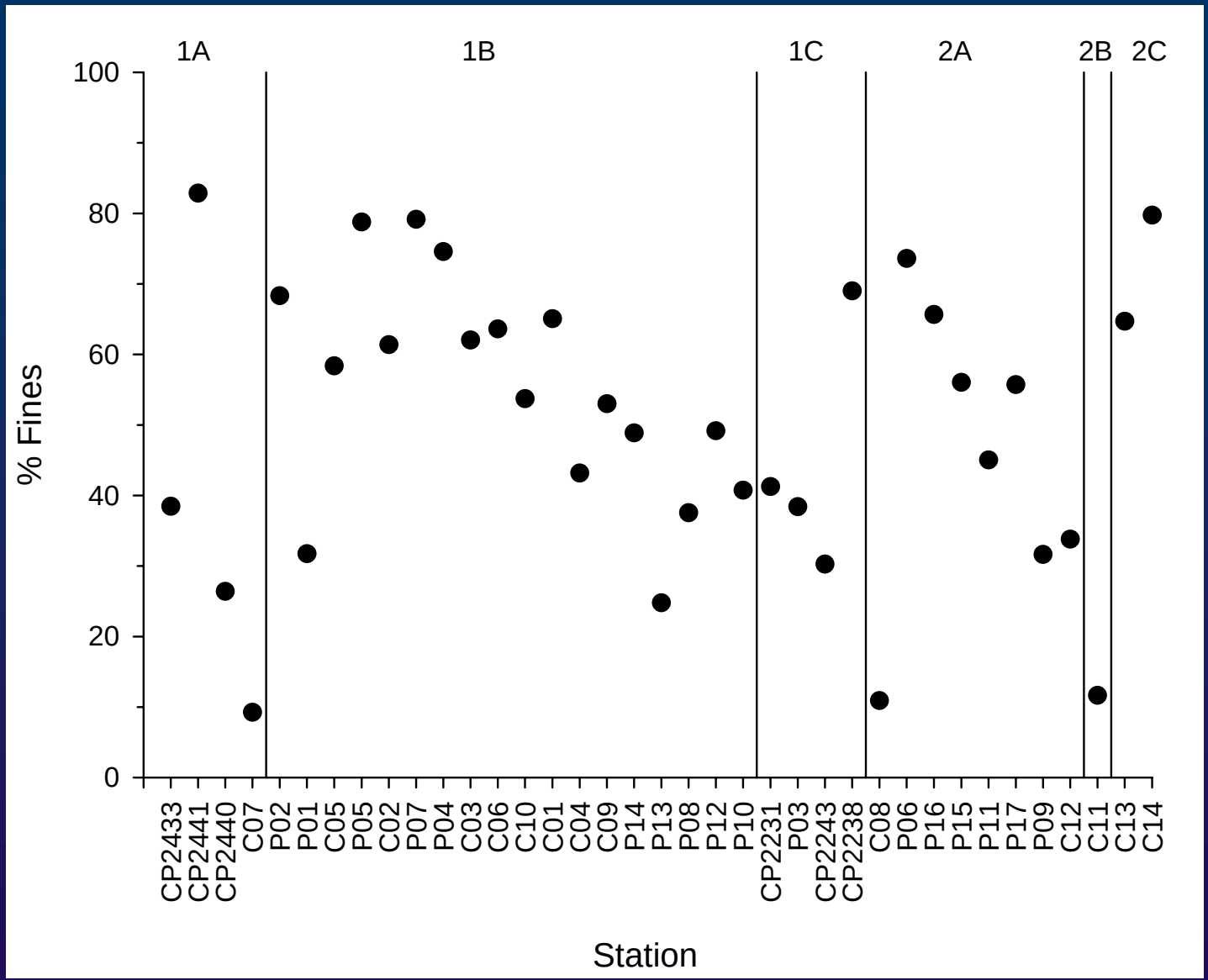
Station	Amphipod Survival		SWI Sea Urchin Development		PW Sea Urchin Fertilization		Tox Class
	<LPL	<50%	<LPL	<50%	<LPL	<50%	
P01	-	-	-	-	-	-	O
P02	-	-	-	-	-	-	O
P03	-	-	NA	NA	-	-	O
P04	-	-	-	-	-	-	O
P05	-	-	-	-	-	-	O
P06	-	-	-	-	-	-	O
P07	-	-	-	-	-	-	O
P08	-	-	-	-	-	-	O
P09	-	-	-	-	-	-	O
P10	-	-	NA	NA	-	-	O
P11	+	-	+	+	-	-	●
P12	-	-	+	-	-	-	O
P13	-	-	-	-	-	-	O
P14	-	-	-	-	-	-	O
P15	-	-	+	+	-	-	⊙
P16	-	-	+	+	-	-	⊙
P17	-	-	+	+	-	-	⊙

O	Low
⊙	Medium
●	High

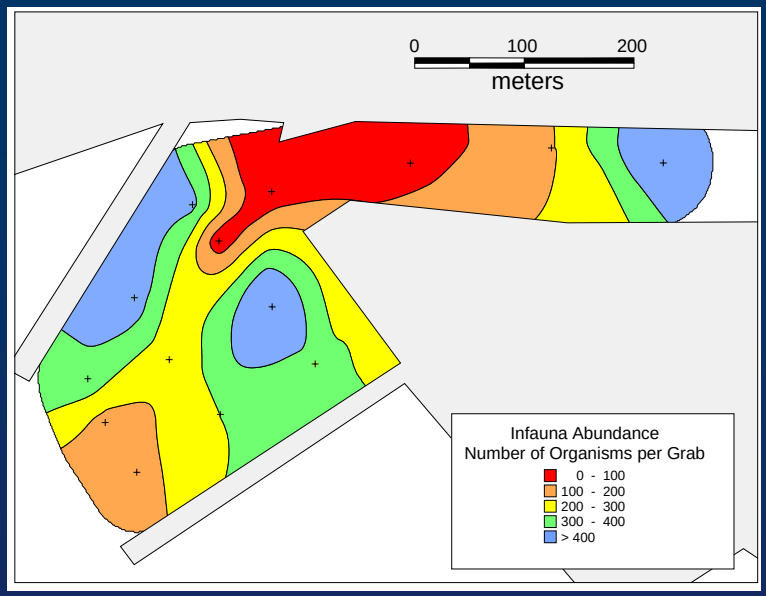
Benthic Community

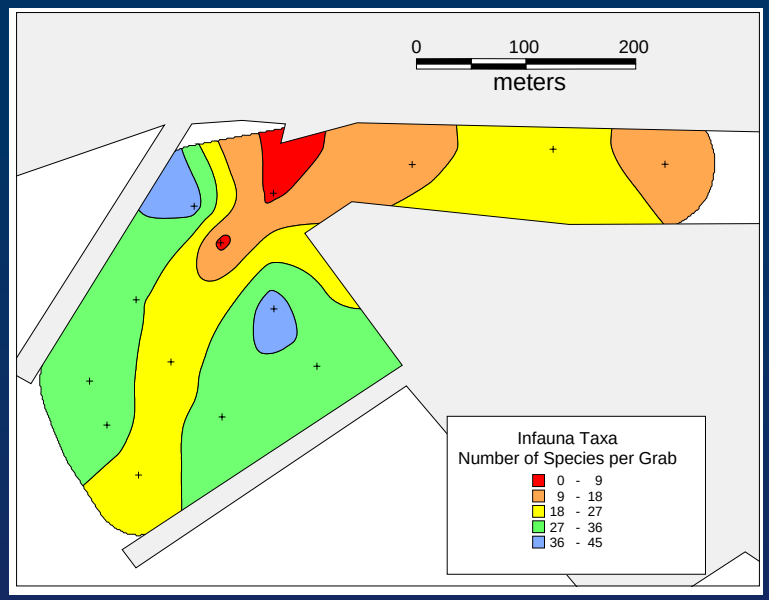
- Cluster Analysis
- Abundance
- #Taxa
- Diversity
- Benthic Response Index (embayment)

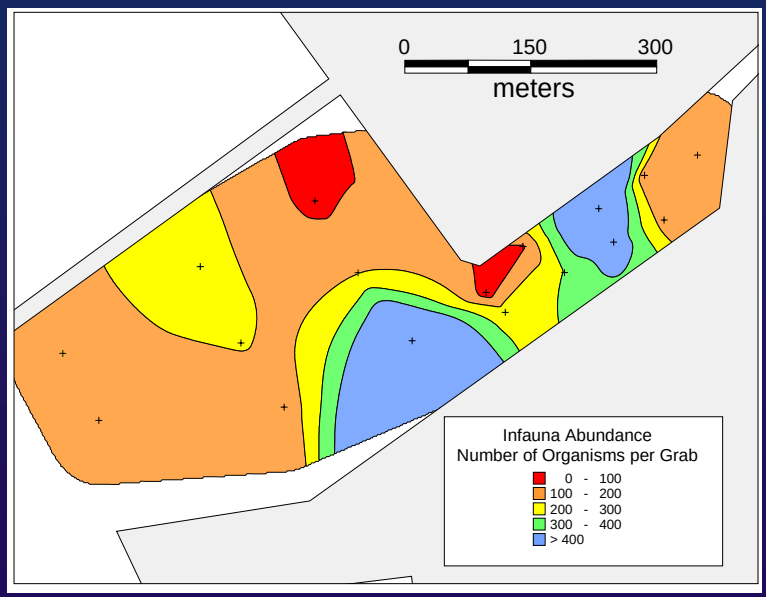
Cluster Analysis & Grain Size

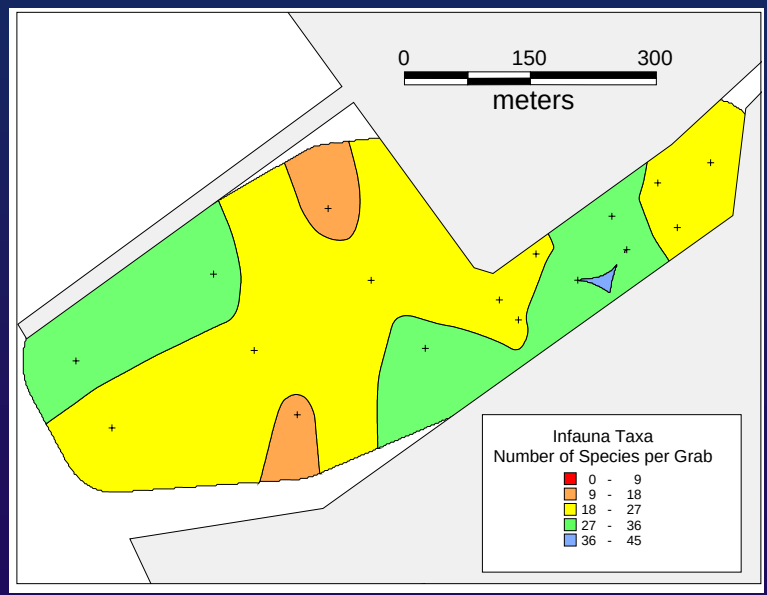


Abundance and # Taxa

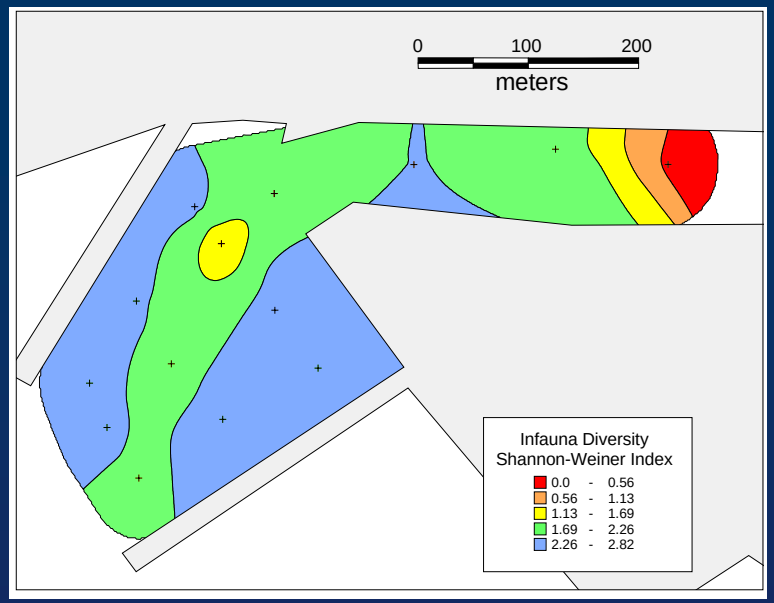


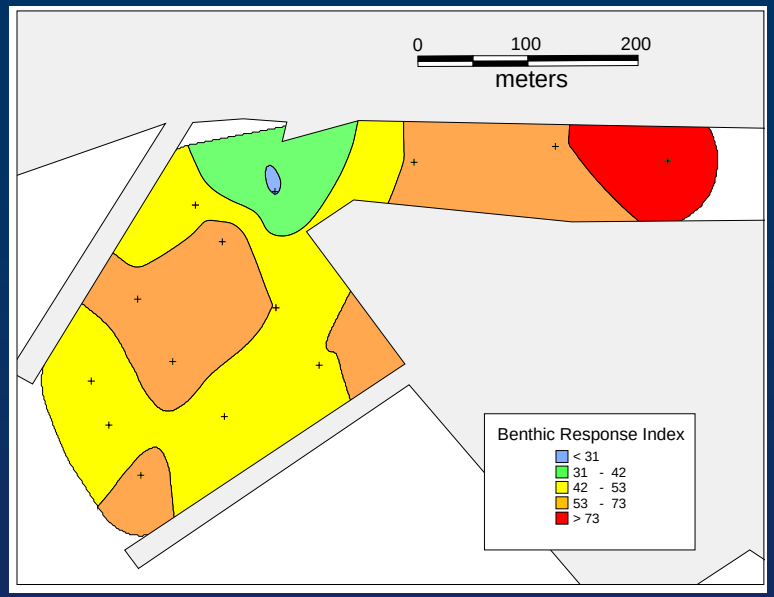


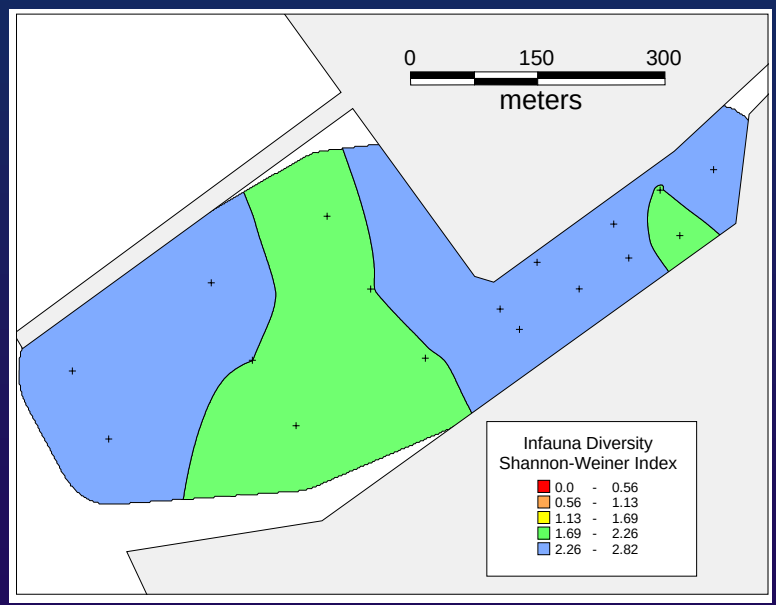


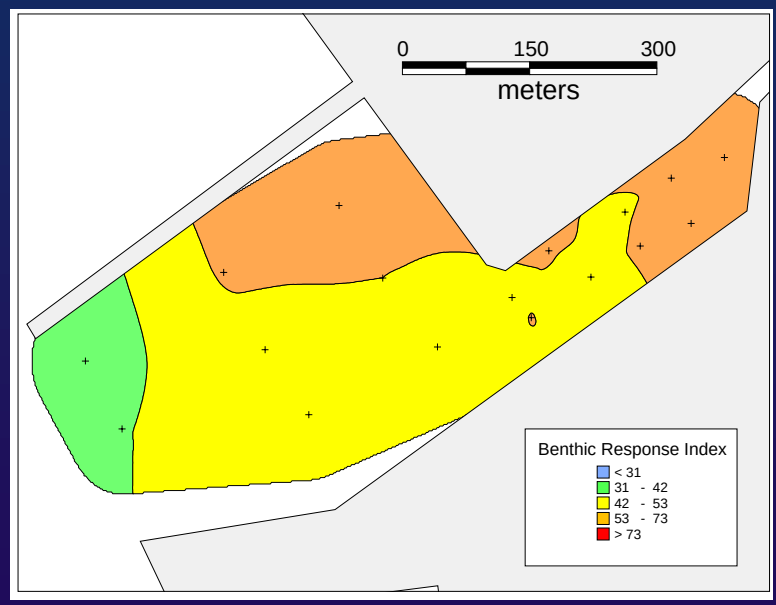


Diversity and Benthic Response Index





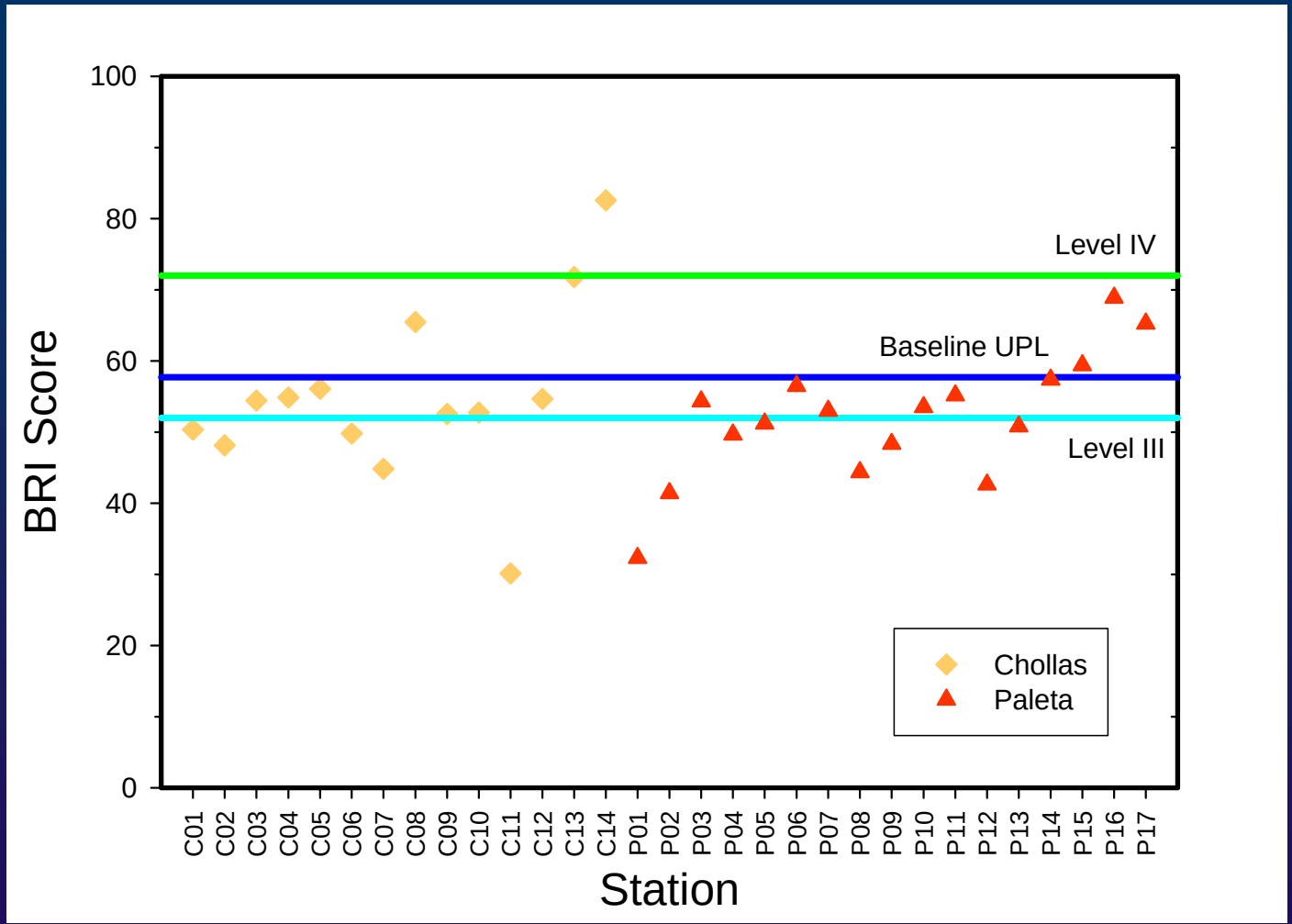




Benthic Community Composition LOE

- Low
  - No parameters exceed Baseline prediction level
- Moderate
  - Any one parameter exceeds Baseline prediction level
- High
  - BRI is at response level IV (>72), or
  - Or the BRI response is at level III (>52), exceeds the baseline UPL, and at least one of the other parameters exceeds the Baseline LPL

Benthos LOE-BRI



Benthic Community LOE Results

Station	Abundance <LPL	Taxa <LPL	Diversity <LPL	BRI>UPL	BRI Level	BCA Class
C01	-	-	-	-	II	○
C02	+	-	-	-	II	⊙
C03	+	+	-	-	III	⊙
C04	-	-	-	-	III	○
C05	+	+	-	-	III	⊙
C06	-	-	-	-	II	○
C07	-	-	-	-	II	○
C08	+	+	+	+	III	●
C09	-	-	-	-	III	○
C10	-	-	-	-	III	○
C11	+	+	-	-	Ref	⊙
C12	+	+	-	-	III	⊙
C13	+	-	-	+	III	●
C14	-	+	+	+	IV	●

○	Low
⊙	Medium
●	High

Benthic Community LOE Results

Station	Abundance <LPL	Taxa <LPL	Diversity <LPL	BRI>UPL	BRI Level	BCA Class
P01	+	-	-	-	I	⊙
P02	+	+	-	-	II	⊙
P03	-	-	-	-	III	O
P04	+	-	-	-	II	⊙
P05	+	+	+	-	II	⊙
P06	+	+	-	-	III	⊙
P07	+	+	-	-	III	⊙
P08	-	-	-	-	II	O
P09	+	+	-	-	II	⊙
P10	-	-	-	-	III	O
P11	+	-	-	-	III	⊙
P12	-	-	-	-	II	O
P13	-	-	-	-	II	O
P14	-	-	-	-	III	O
P15	+	+	-	+	III	●
P16	+	+	-	+	III	●
P17	+	+	-	+	III	●

O	Low
⊙	Medium
●	High

Weight of Evidence Assessment

Impairment from site CoPCs:

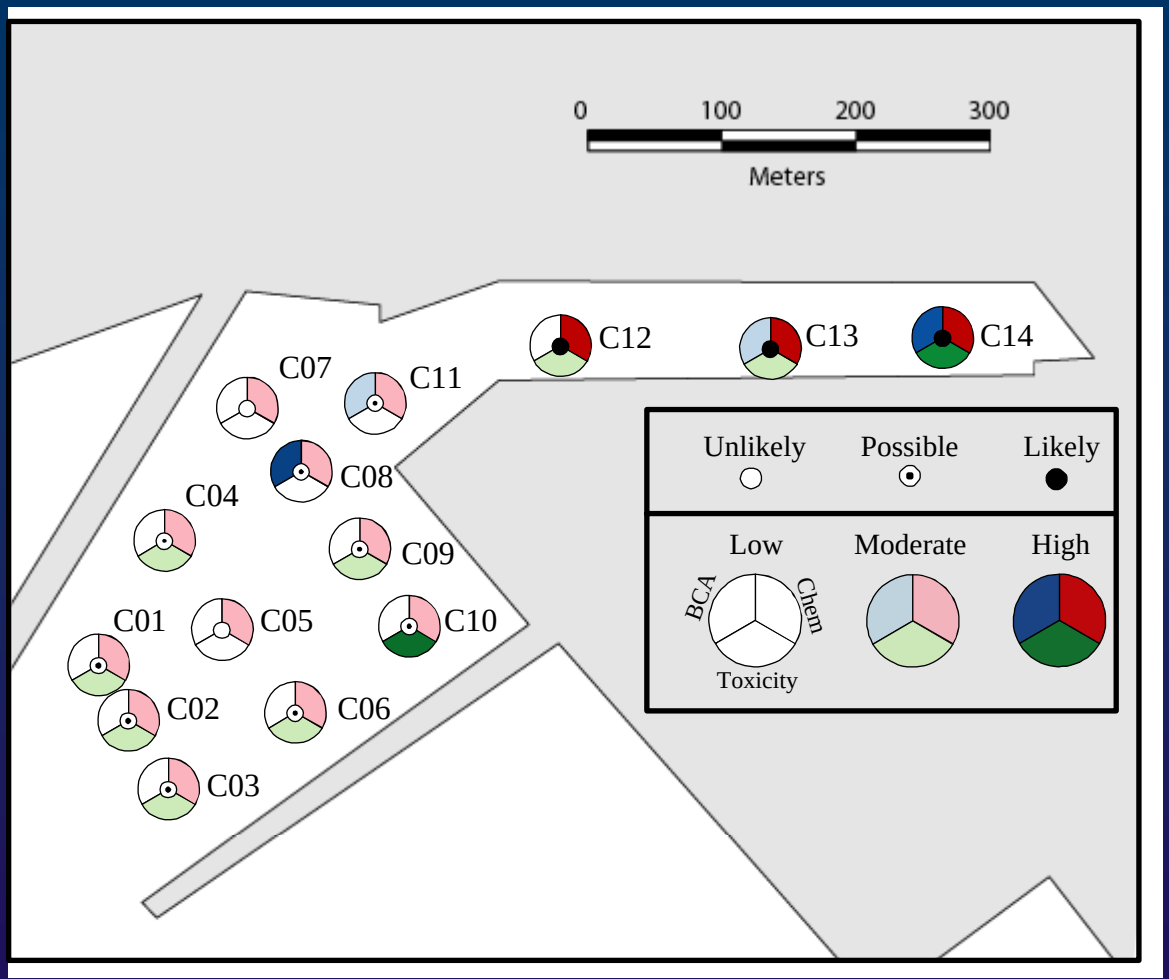
- Unlikely
  - Low site CoPC
  - Moderate CoPC and no biological impact
- Possible
  - Moderate site CoPC and one indicator of biological impact
  - High site CoPC and no biological impact
- Likely
  - High site CoPC and at least one indicator of biological impact
  - Moderate CoPC and two indicators of biological impact

Aquatic Life Impairment Table			
Chemistry	Toxicity	Benthic Community	Site-specific Impairment from CoPCs
●	●	●	Likely impairment from CoPCs
●	●	⊙	
●	⊙	●	
⊙	●	●	
●	●	O	
●	O	●	
●	⊙	⊙	
⊙	●	⊙	
⊙	⊙	●	
⊙	⊙	⊙	
●	⊙	O	
●	O	⊙	
⊙	●	O	Possible Impairment from CoPCs
⊙	O	●	
⊙	⊙	O	
⊙	O	⊙	
●	O	O	
O	●	●	Unlikely impairment from CoPCs
O	●	⊙	
O	⊙	●	
O	⊙	⊙	
O	O	●	
O	●	O	
O	O	⊙	
O	⊙	O	
⊙	O	O	
O	O	O	

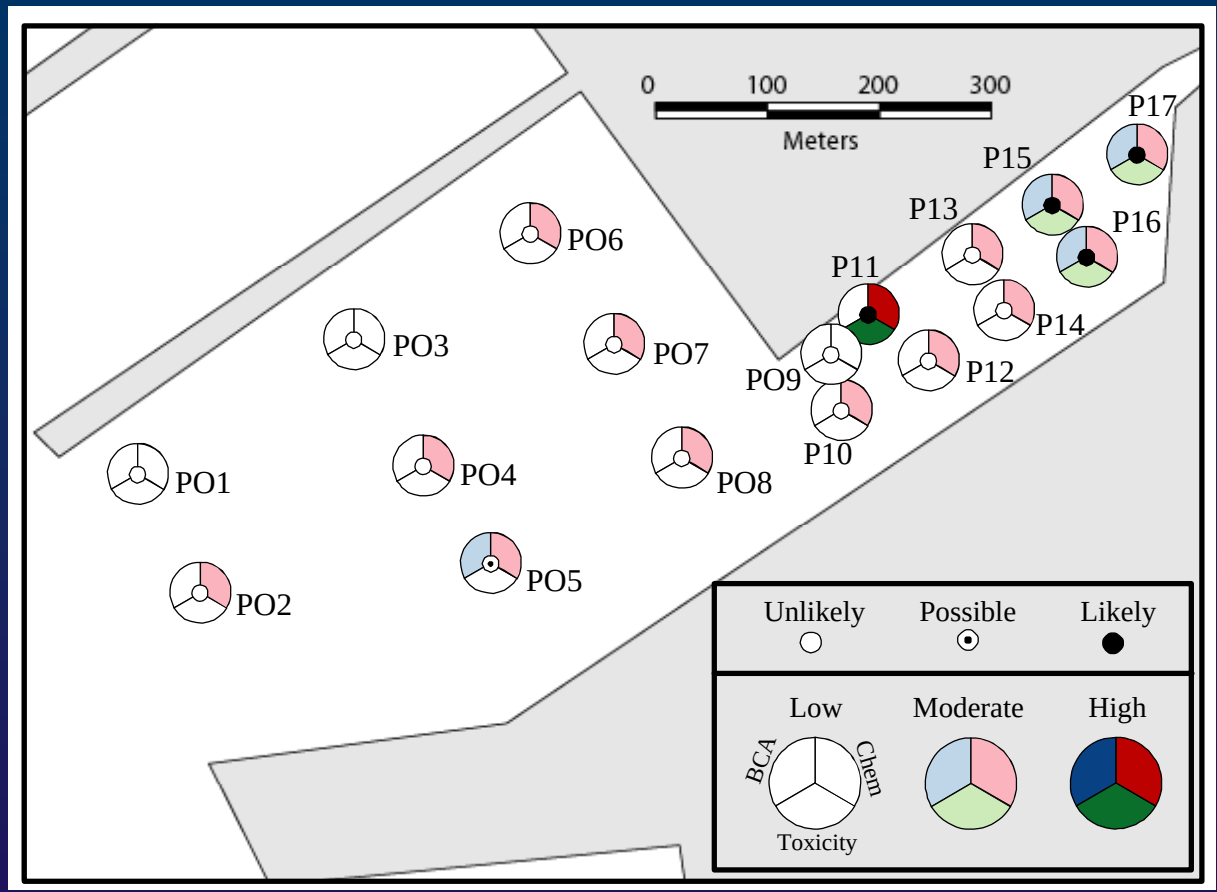
Aquatic Life Weight of Evidence Results

Aquatic Life Impairment WOE					
Station	**Chem Class**	**Tox Class**	**BCA Class**	**OVERALL WOE**	**Impairment from CoPC?**
C01	⊙	⊙	O	⊙	Possible
C02	●	⊙	⊙	●	Likely
C03	●	O	⊙	●	Likely
C04	⊙	⊙	O	⊙	Possible
C05	●	O	⊙	●	Likely
C06	⊙	⊙	O	⊙	Possible
C07	O	O	O	O	UnLikely
C08	⊙	O	●	⊙	Possible
C09	⊙	⊙	O	⊙	Possible
C10	⊙	⊙	O	⊙	Possible
C11	⊙	O	⊙	⊙	Possible
C12	●	⊙	⊙	●	Likely
C13	●	⊙	●	●	Likely
C14	●	●	●	●	Likely
P01	O	O	⊙	O	UnLikely
P02	⊙	O	⊙	⊙	Possible
P03	O	O	O	O	UnLikely
P04	⊙	O	⊙	⊙	Possible
P05	⊙	O	⊙	⊙	Possible
P06	⊙	O	⊙	⊙	Possible
P07	⊙	O	⊙	⊙	Possible
P08	⊙	O	O	O	UnLikely
P09	O	O	⊙	O	UnLikely
P10	⊙	O	O	O	UnLikely
P11	●	●	⊙	●	Likely
P12	⊙	O	O	O	UnLikely
P13	O	O	O	O	UnLikely
P14	⊙	O	O	O	UnLikely
P15	●	⊙	●	●	Likely
P16	⊙	⊙	●	●	Likely
P17	⊙	⊙	●	●	Likely

Aquatic Life WOE Results- Chollas



Aquatic Life WOE Results- Paleta



Aquatic-Dependent Wildlife Beneficial Use Assessment

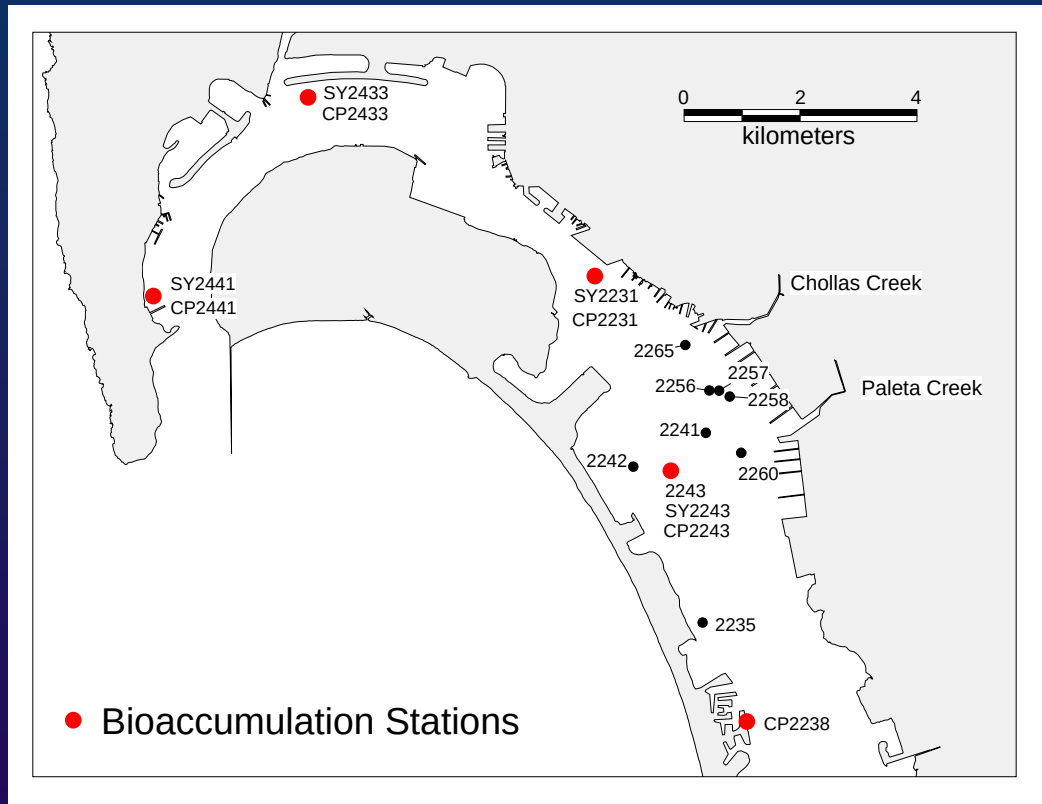
Aquatic-Dependent Wildlife Beneficial Use Assessment Framework

- **Assess impairment to representative ecological recptors in the bay based on the following procedure**

1. Compare site clam tissue concentrations to controls
   - Determine if there is a detectable difference for the site
2. Compare to Baseline Condition
   - Determine if there is a difference between the maximum site concentration and the ambient condition in the bay
3. Calculate Screening-Level Hazard Quotients
   - Using conservative exposure assumptions, determine if there is potential risk to representative wildlife receptors including:
     - Brown Pelican
     - Least Tern
     - Western Grebe
     - Surf Scoter
     - Sea Lion
4. Calculate BSAF for chemicals that exceed
5. Evaluate spatial extent

Baseline Pool Bioaccumulation Stations

- Subset of reference stations from the overall Baseline Pool. Stations were compiled from:
  - This study (CP)
  - NASSCO-Southwest study (SY)
  - Total of 9 indiviudal measurements from 5 areas



Baseline Bioaccumulation Conditions

- Characterized by 95% Upper Prediction Limit (UPL) for metals and organics
- Metals

	Tissue Concentration (mg/kg_{dry})								
	Ag	**As**	**Cd**	**Cr**	**Cu**	**Hg**	**Ni**	**Pb**	**Zn**
Mean	0.34	20.2	0.25	2.6	13.0	0.09	3.0	2.3	77.0
Upper 95% PL	0.57	22.8	0.39	3.9	19.2	0.15	4.4	3.3	85.7

- Organics

	Tissue Concentration ($\mu g/kg_{dry}$)							
	Naph	**BAP**	**TPCB**	**α-Chlor**	**γ-Chlor**	**DDE**	**DDD**	**DDT**
Mean	7.2	65	98	0.55	0.47	7.3	2.1	0.34
Upper 95% PL	10.4	132	186	1.75	1.30	9.3	4.7	0.54

Wildlife Risk Assessment

- Wildlife hazard quotient (HQ) is estimated dose divided by the Toxicity Reference Value (TRV)

$$HQ = \frac{C_{tiss} \times NFR \times FR \times AE \times AUF}{TRV}$$

Where C_{tiss}: prey concentration

NFR: normalized feeding rate

FR: contaminated fraction

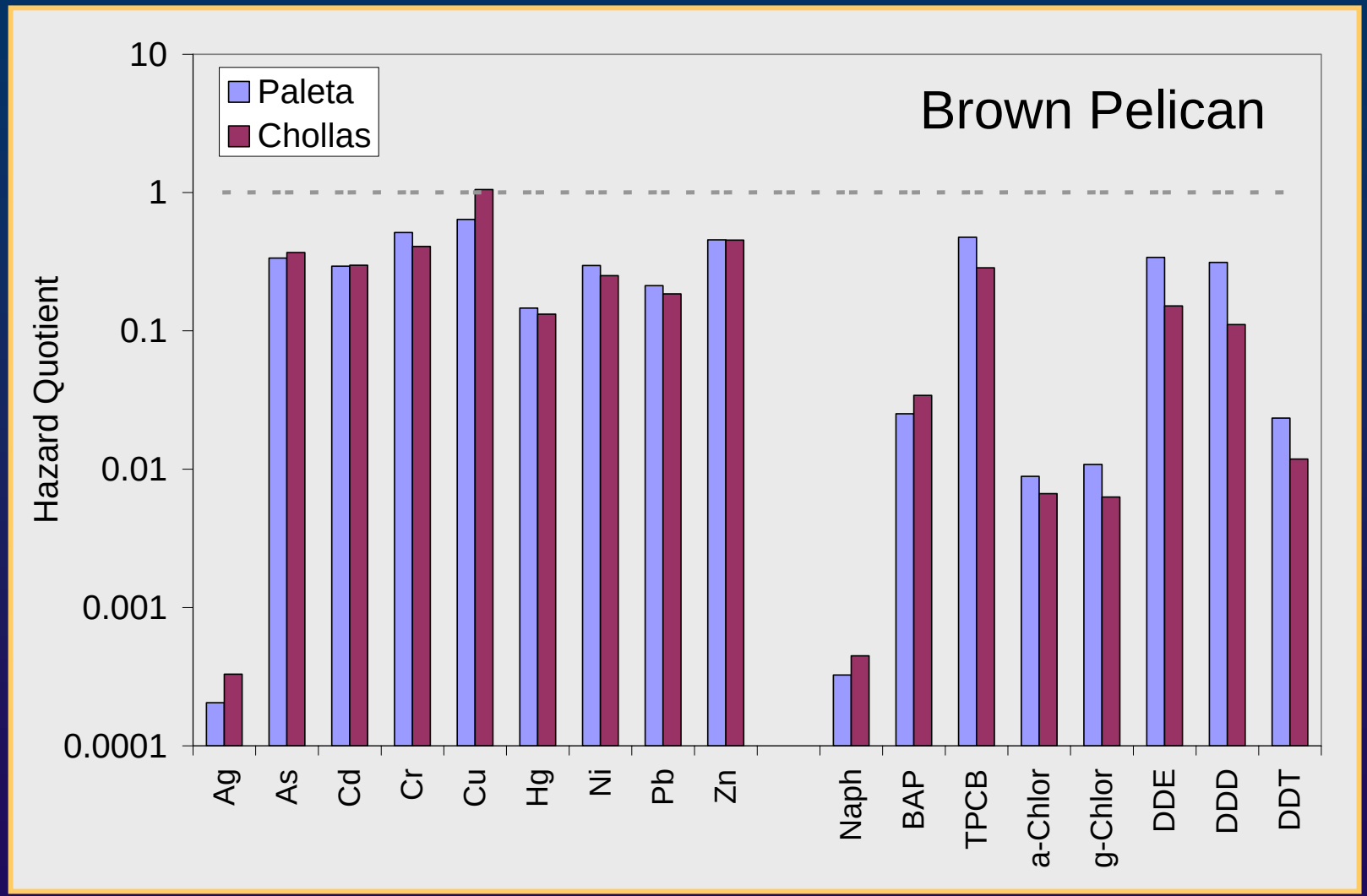
AE: assimilation efficiency

AUF: area use factor

Wildlife Risk Assessment - Assumptions

- Site-maximum clam tissue concentration used as surrogate prey for all wildlife endpoints (C_{tiss})
- 100% of diet contaminated at maximum concentration (FR=1)
- 100% assimilation efficiency (AE=1)
- 100% area use factor (AUF=1)
- Use low range TRV from Region 9 BTAG or other published sources

Wildlife Risk Assessment - Results



Wildlife Risk Assessment - Results

- Screening-level hazard quotients for all endpoints and all chemicals were <1 at Paleta
- Screening-level hazard quotients for all endpoints and all chemicals were <1 at Chollas with the exceptions of
  - Copper for the Least Tern (HQ = 1.6)
  - Copper for the Brown Pelican (HQ = 1.1)

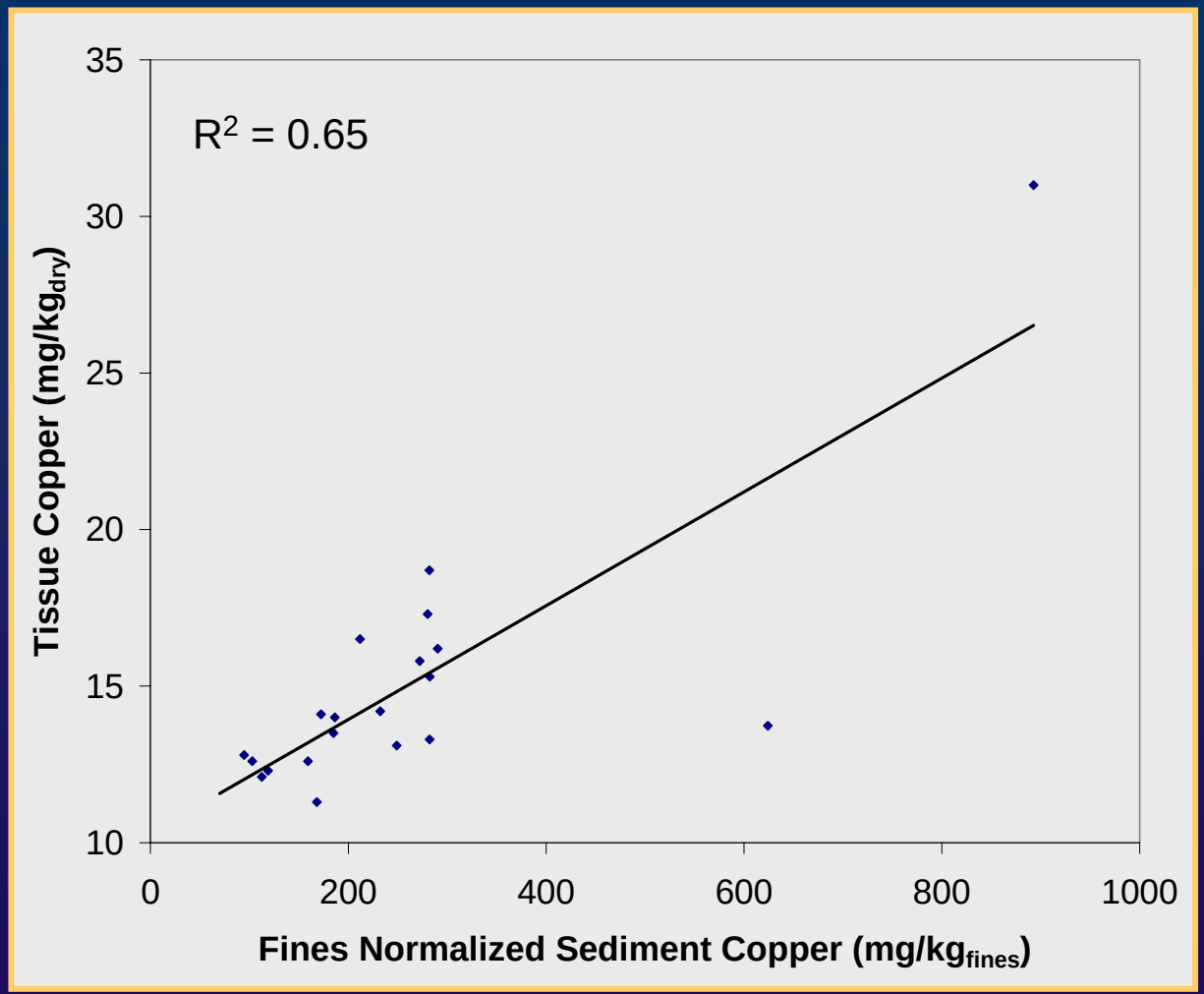
Wildlife Beneficial Use Assessment - Paleta

	>Control	>Baseline	Brown Pelican HQ>1	Least Tern HQ>1	Western Grebe HQ>1	Surf Scoter HQ>1	Sea Lion HQ>1
Ag	-	-	-	-	-	-	-
As	-	-	-	-	-	-	-
Cd	-	-	-	-	-	-	-
Cr	-	+	-	-	-	-	-
Cu	+	-	-	-	-	-	-
Hg	+	-	-	-	-	-	-
Ni	-	+	-	-	-	-	-
Pb	+	+	-	-	-	-	-
Zn	-	+	-	-	-	-	-
Naph	-	+	-	-	-	-	-
BAP	+	+	-	-	-	-	-
TPCB	+	+	-	-	-	-	-
α-Chlor	+	+	-	-	-	-	-
γ-Chlor	+	+	-	-	-	-	-
DDE	+	+	-	-	-	-	-
DDD	+	+	-	-	-	-	-
DDT	-	+	-	-	-	-	-

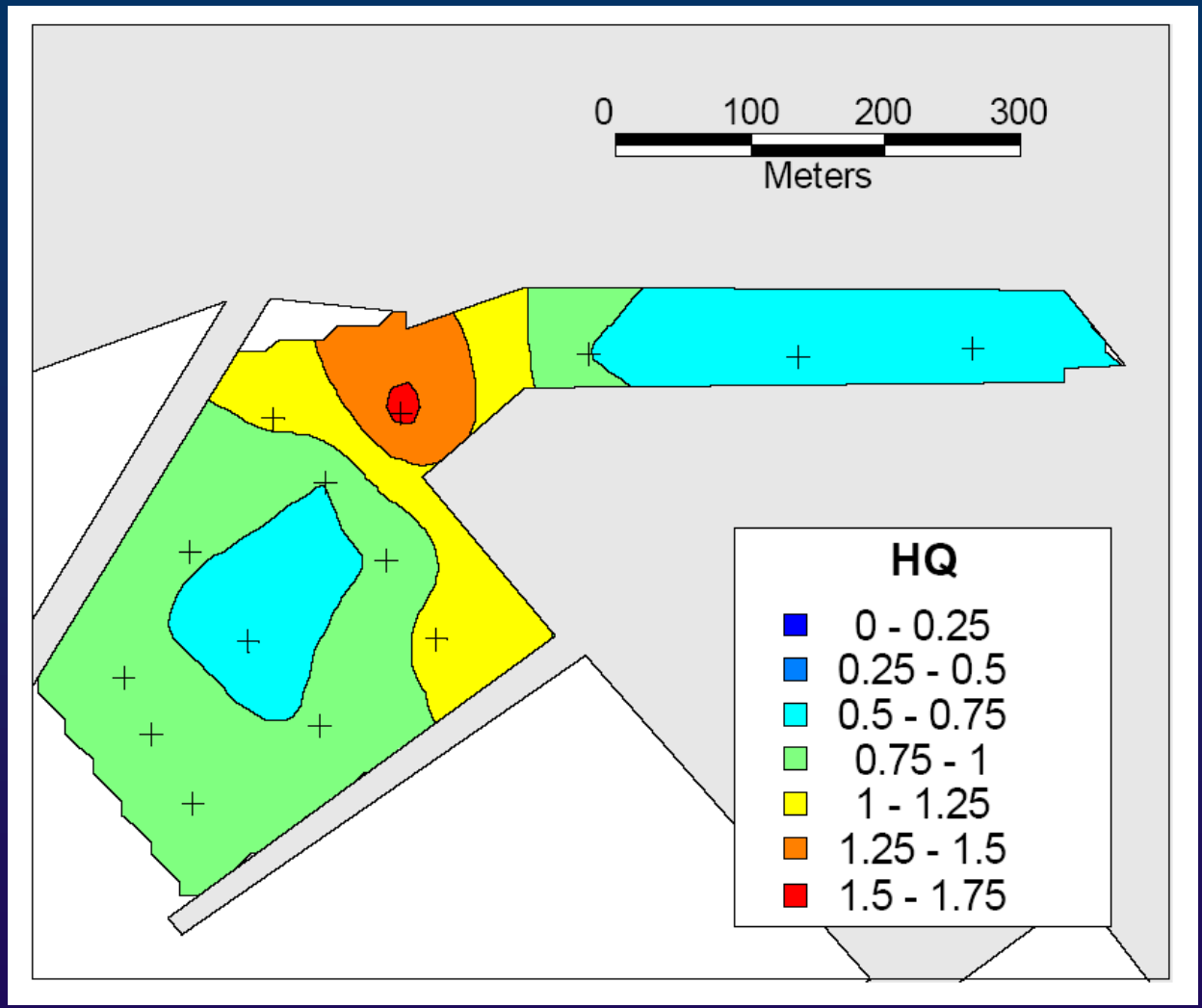
Wildlife Beneficial Use Assessment - Chollas

	>Control	>Baseline	Brown Pelican HQ>1	Least Tern HQ>1	Western Grebe HQ>1	Surf Scoter HQ>1	Sea Lion HQ>1
Ag	-	+	-	-	-	-	-
As	-	+	-	-	-	-	-
Cd	-	-	-	-	-	-	-
Cr	-	+	-	-	-	-	-
Cu	+	+	+	+	-	-	-
Hg	-	-	-	-	-	-	-
Ni	-	-	-	-	-	-	-
Pb	+	+	-	-	-	-	-
Zn	-	+	-	-	-	-	-
Naph	-	+	-	-	-	-	-
BAP	+	+	-	-	-	-	-
TPCB	+	+	-	-	-	-	-
α-Chlor	+	+	-	-	-	-	-
γ-Chlor	+	+	-	-	-	-	-
DDE	+	+	-	-	-	-	-
DDD	+	+	-	-	-	-	-
DDT	-	+	-	-	-	-	-

Biota-Sediment Accumulation Factor for Copper



Spatial Assessment for Least Tern Copper HQ at Chollas



Human Health Beneficial Use Assessment

Human Health Beneficial Use Assessment Framework

- **Assess potential impairment to human health beneficial use based on fish consumption using the following procedure**

1. Compare site clam tissue concentrations to controls
   - Determine if there is a detectable difference for the site
2. Compare to Baseline Condition
   - Determine if there is a difference between the maximum site concentration and the ambient condition in the bay
3. Compare to human health based Tissue Screening Levels
   - Using conservative exposure assumptions, determine if there is potential risk to representative anglers
4. Calculate BSAF for chemicals that exceed
5. Evaluate spatial extent

Human Health Risk Assessment

- Human health Tissue Screening Levels (TSLs) take minimum of:

$$TSL = \left\{ \begin{array}{l} TSL_c = \dfrac{TRL \times BW}{CSF \times CR \times FI \times ABS} \\ \\ TSL_t = \dfrac{RfD \times BW}{CR \times FI \times ABS} \end{array} \right\}$$

Where

TRL: target risk level (cancer)

RfD: reference dose (toxicity)

CSF: cancer slope factor

ABS: absorbed fraction

BW: body weight

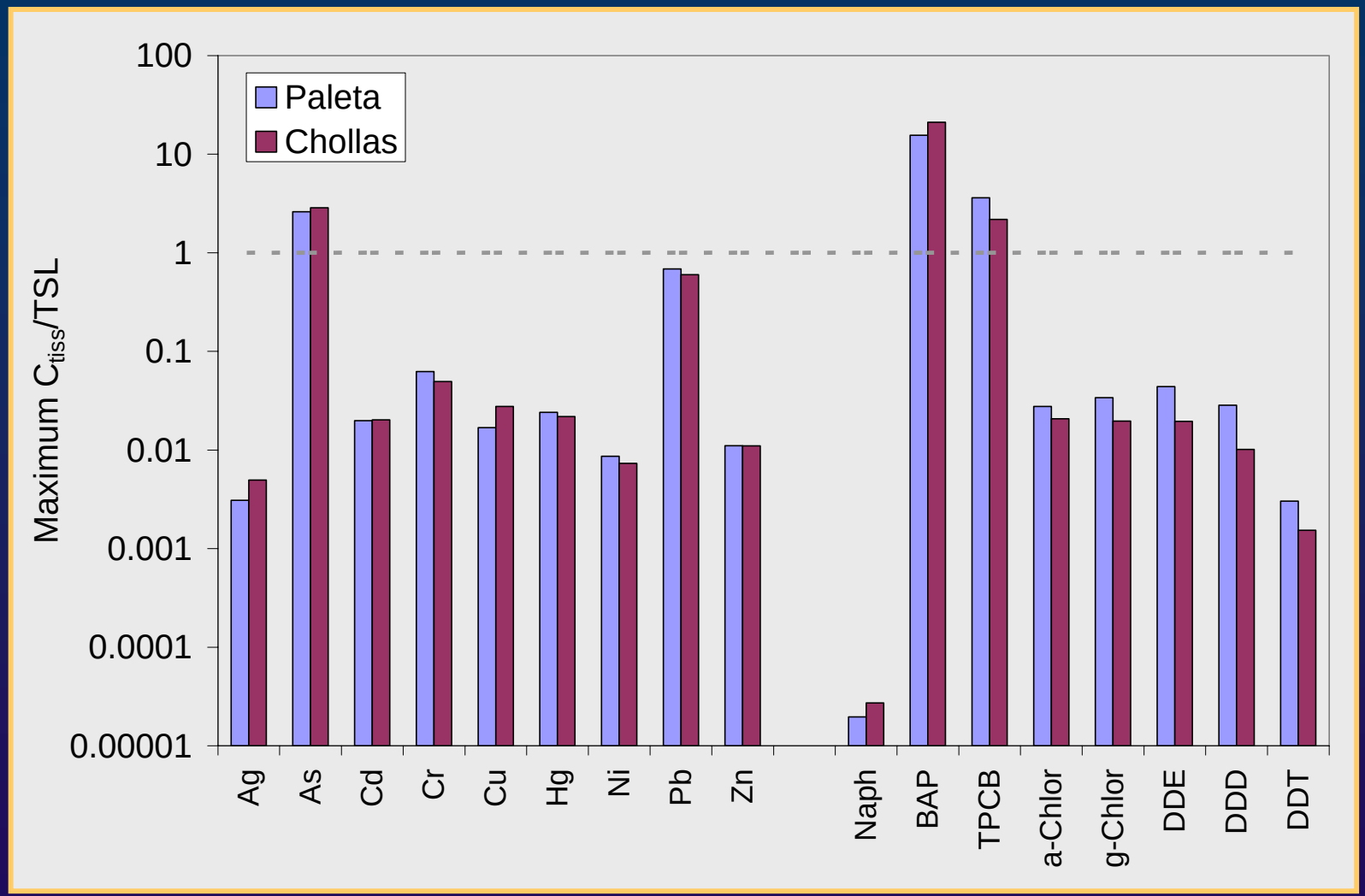
CR: consumption rate

FI: fraction ingested

Human Health Risk Assessment - Assumptions

- Site-maximum clam tissue concentration used as surrogate for all seafood from site
- Target risk level for cancer 10^{-5}
- RfD and CSF generally from EPA IRIS database
- 100% fraction ingested (FI=1)
- 100% absorbed (ABS=1)
- Body weight 70 kg (BW)
- Consumption rate of 21 g/day (High-end angler; OEHHA, 2001)

Human Health Risk Assessment - Results



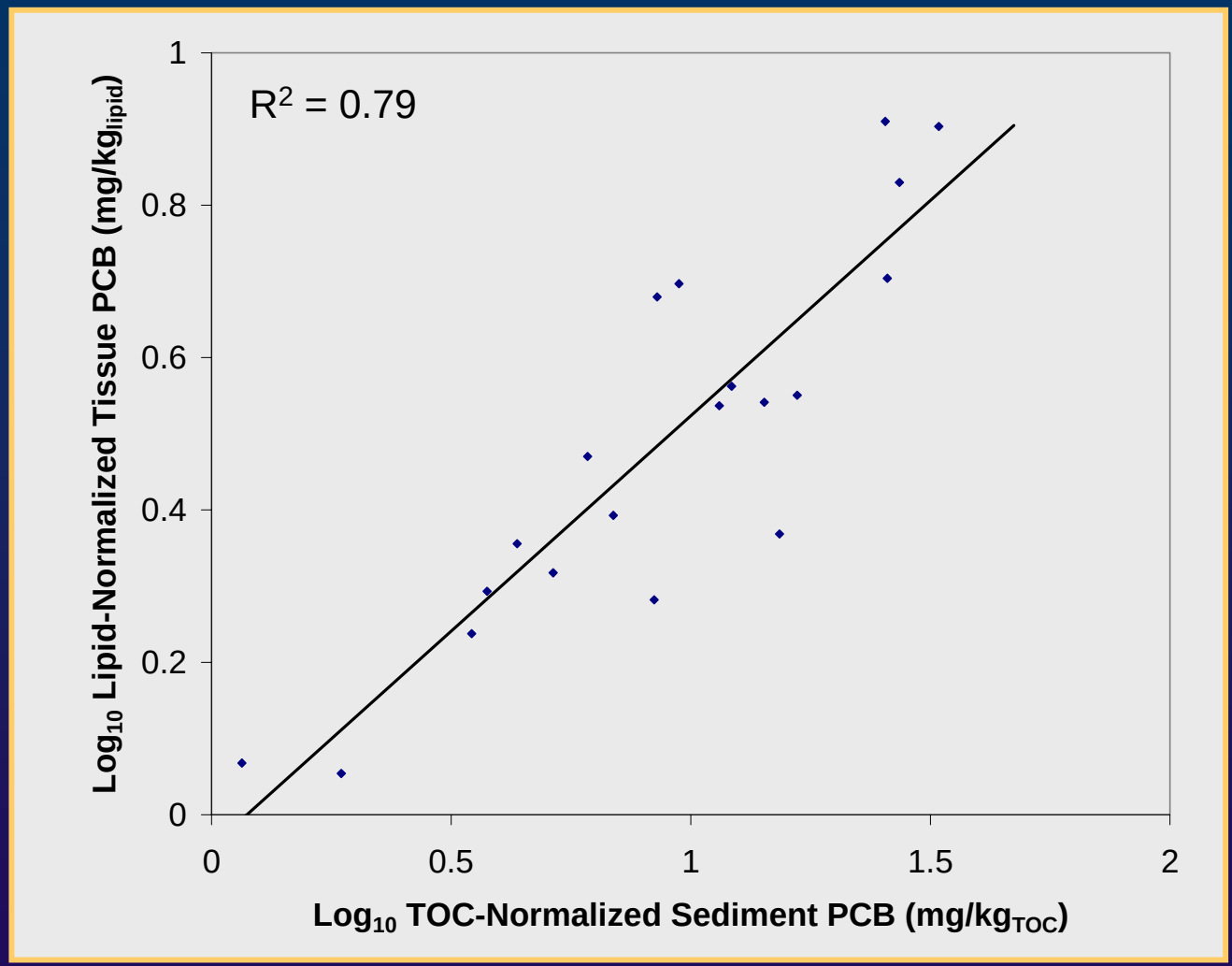
Human Health Risk Assessment - Results

- Site-maximum tissue concentrations at Paleta were <TSL for all chemicals except
  - Arsenic (×2.6)
  - BAP (×16)
  - Total PCB (×3.6)
- Site-maximum tissue concentrations at Chollas were <TSL for all chemicals except
  - Arsenic (×2.9)
  - BAP (×21)
  - Total PCB (×2.2)

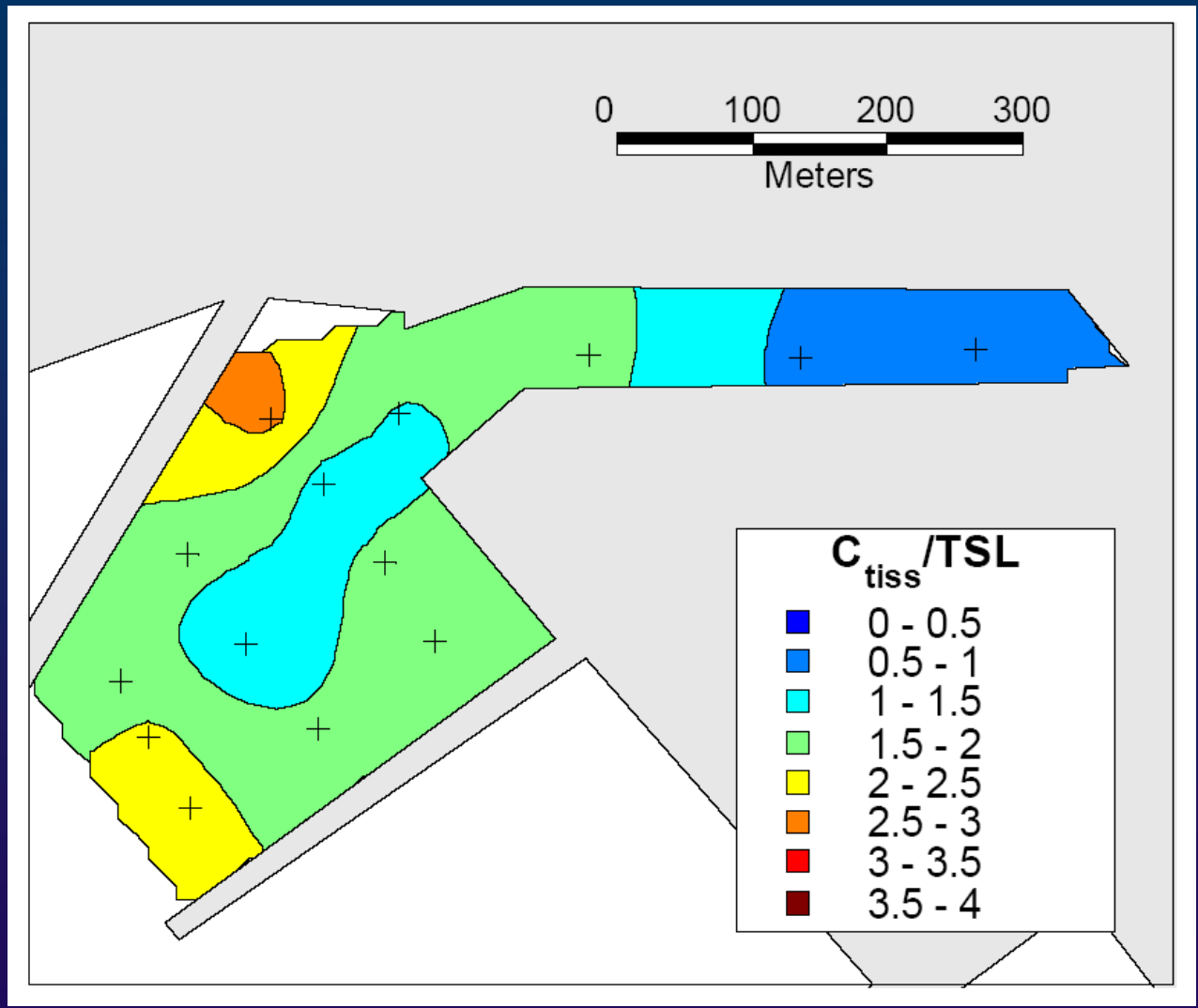
Human Health Beneficial Use Assessment

	Paleta				Chollas			
	>Control	>Baseline	>TSL_{min}	Station Analysis	>Control	>Baseline	>TSL_{min}	Station Analysis
Ag	-	-	-	no	-	+	-	no
As	-	-	+	no	-	+	+	no
Cd	-	-	-	no	-	-	-	no
Cr	-	+	-	no	-	+	-	no
Cu	+	-	-	no	+	+	-	no
Hg	+	-	-	no	-	-	-	no
Ni	-	+	-	no	-	-	-	no
Pb	+	+	-	no	+	+	-	no
Zn	-	+	-	no	-	+	-	no
Naph	-	+	-	no	-	+	-	no
BAP	+	+	+	yes	+	+	+	yes
TPCB	+	+	+	yes	+	+	+	yes
α-Chlor	+	+	-	no	+	+	-	no
γ-Chlor	+	+	-	no	+	+	-	no
DDE	+	+	-	no	+	+	-	no
DDD	+	+	-	no	+	+	-	no
DDT	-	+	-	no	-	+	-	no

Biota-Sediment Accumulation Factor for Total PCB



Spatial Assessment for Human Health Beneficial Use at Chollas



Conclusions and Recommendations

Aquatic Life Impairment - Chollas

- Outer Area
  - Most (7) stations classified as possibly impaired, three as likely impaired, and one unlikely impaired
  - Stations categorized as possibly impaired have co-occurrence of moderate CoPC and toxicity impacts
  - Stations categorized as likely impaired have co-occurrence of high CoPC and moderate benthic community impacts
  - Benthic community impacts at C8 and C11 related to physical disturbance
- Inner Area
  - All three stations classified as likely impaired
  - Gradient of impairment consistent with creek or nearby shoreline contaminant source
  - High fines content indicates area is depositional
  - Enriched TOC suggests loading related to urban runoff
- CoPC drivers: PAH, PCB, chlordane and DDT

Aquatic-Dependent Wildlife Impairment - Chollas

- A limited area of the Chollas site was classified as possibly impaired for effects of copper to the Least Tern and Brown Pelican
  - Three stations (C07, C10 and C11) were categorized as possibly impaired
  - Higher bioaccumulation at C07 and C11 related to low fines and TOC
  - Higher bioaccumulation at C10 related to high sediment copper concentrations

Human Health Impairment - Chollas

- The entire Chollas site was classified as possibly impaired for human health cancer risk related to the consumption of BAP in fish and shellfish
- The majority of the Chollas site was classified as possibly impaired for human health cancer risk related to the consumption of PCBs in fish and shellfish
  - Estimated risk level for BAP and TPCB exceeded their respective TSLs by a factor of 11and 1.7
  - Highest magnitude of BAP impairment in the mid-inner Creek area (C12-C13) and near the base of Pier 1 (C09-C10) corresponds to elevated sediment concentrations
  - Highest magnitude of TPCB impairment near the base of the NASSCO pier (C07) related to low binding and at end of Pier 1 (C02-C03) corresponds to elevated sediment concentrations

Aquatic Life Impairment - Paleta

- Outer Area
  - Five stations were classified as possibly impaired and three as unlikely impaired
  - All stations categorized as possibly impaired have co-occurrence of moderate CoPC and benthic community impacts
- Inner Area
  - Four stations (P11, P15, P16, and P17) were classified as likely impaired and four were classified as unlikely impaired
  - The three innermost sites group together spatially and have common sediment characteristics. P11 is spatially separated, has similar sediment chemistry, but differs in biological impacts suggesting additional sources of impairment
- CoPCs drivers: lead, PAH, PCB, chlordane and DDT

Aquatic-Dependent Wildlife Impairment - Paleta

- Potential for impairment to aquatic dependent wildlife at the Paleta site was categorized as unlikely for all receptors with respect to all CoPCs

Human Health Impairment - Paleta

- The entire Paleta site was classified as possibly impaired for human health cancer risk related to the consumption of BAP and PCBs in fish and shellfish
  - Estimated risk level for BAP and TPCB exceeded their respective TSLs by a factor of 16 and 3.6
  - Highest magnitude of BAP and TPCB impairment along the northern extent of the inner Creek area (P11, P13, P15 and P17) corresponds to elevated levels in the sediment
  - TPCB impairment at station (P05) near the Mole Pier corresponds to elevated levels in the sediment

Recommendations

- Identify causes of impairment
  - Complete Phase II TIE
  - Evaluate existing data
  - Use results to guide TMDL source quantification
- Evaluate sources of contaminants of concern
  - Utilize existing data
  - Fate and transport studies
  - Aerial deposition
- Conduct cleanup studies
  - Refine risk assessments using resident animals and site specific exposure patterns
  - Develop cleanup thresholds
  - Determine potential cleanup boundaries