



# The San Diego Regional Harbor Monitoring Program



National Water Quality Monitoring Conference  
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*Dana Point Harbor*

*Oceanside Harbor*



*Mission Bay*

*San Diego Bay*



# RHMP - Core Monitoring Questions

- 1. What are the contributions and spatial distributions of inputs of pollutants to harbors?*
- 2. Do the waters and sediments in the harbors sustain healthy biota?*
- 3. What are the long-term trends in each harbor?*

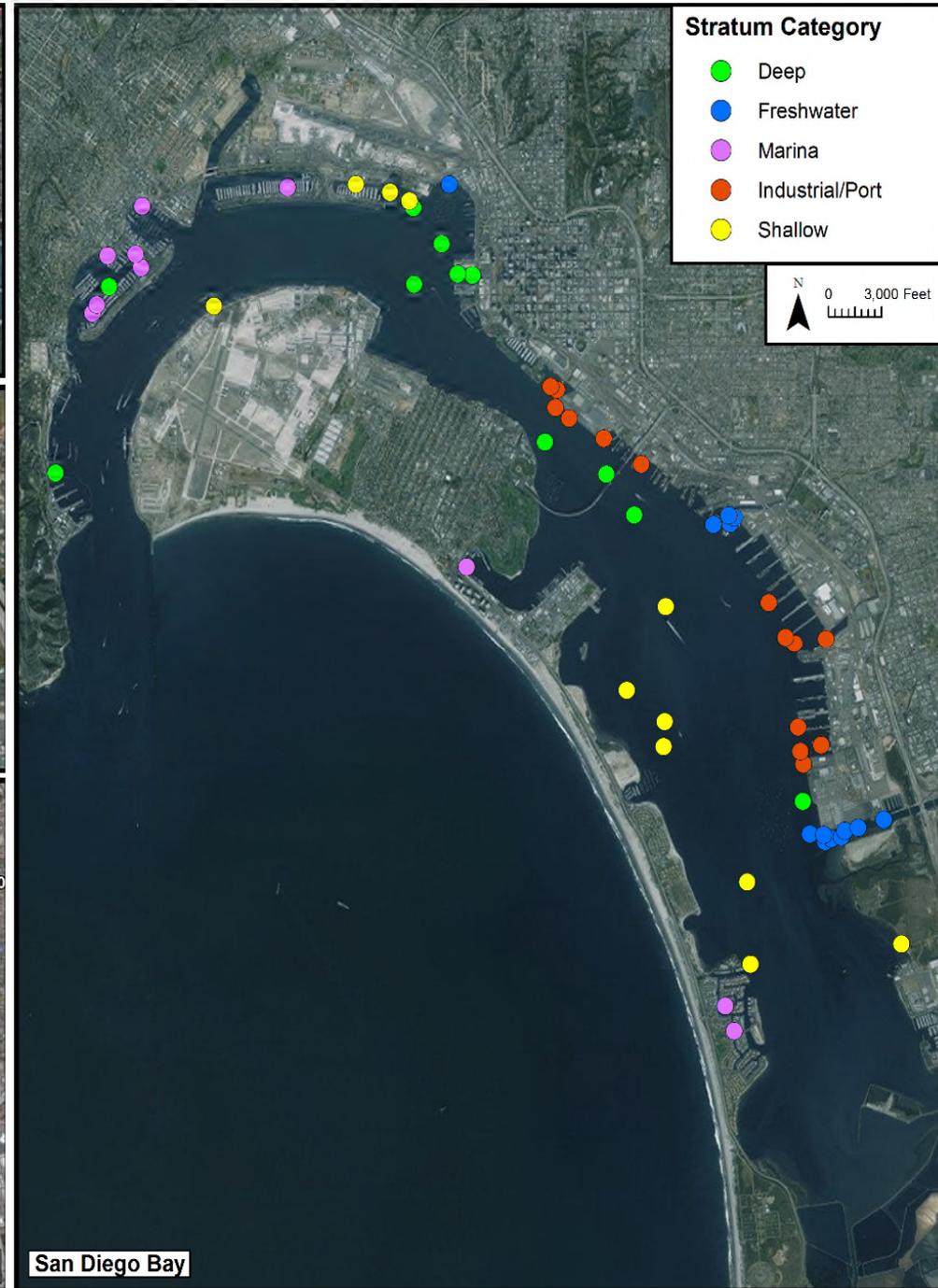
***2013 Special Study - Trophic transfer of bioaccumulative compounds (Hg, PCBs, DDTs, PBDEs)?***



# RHMP- Sampling Regional Overview

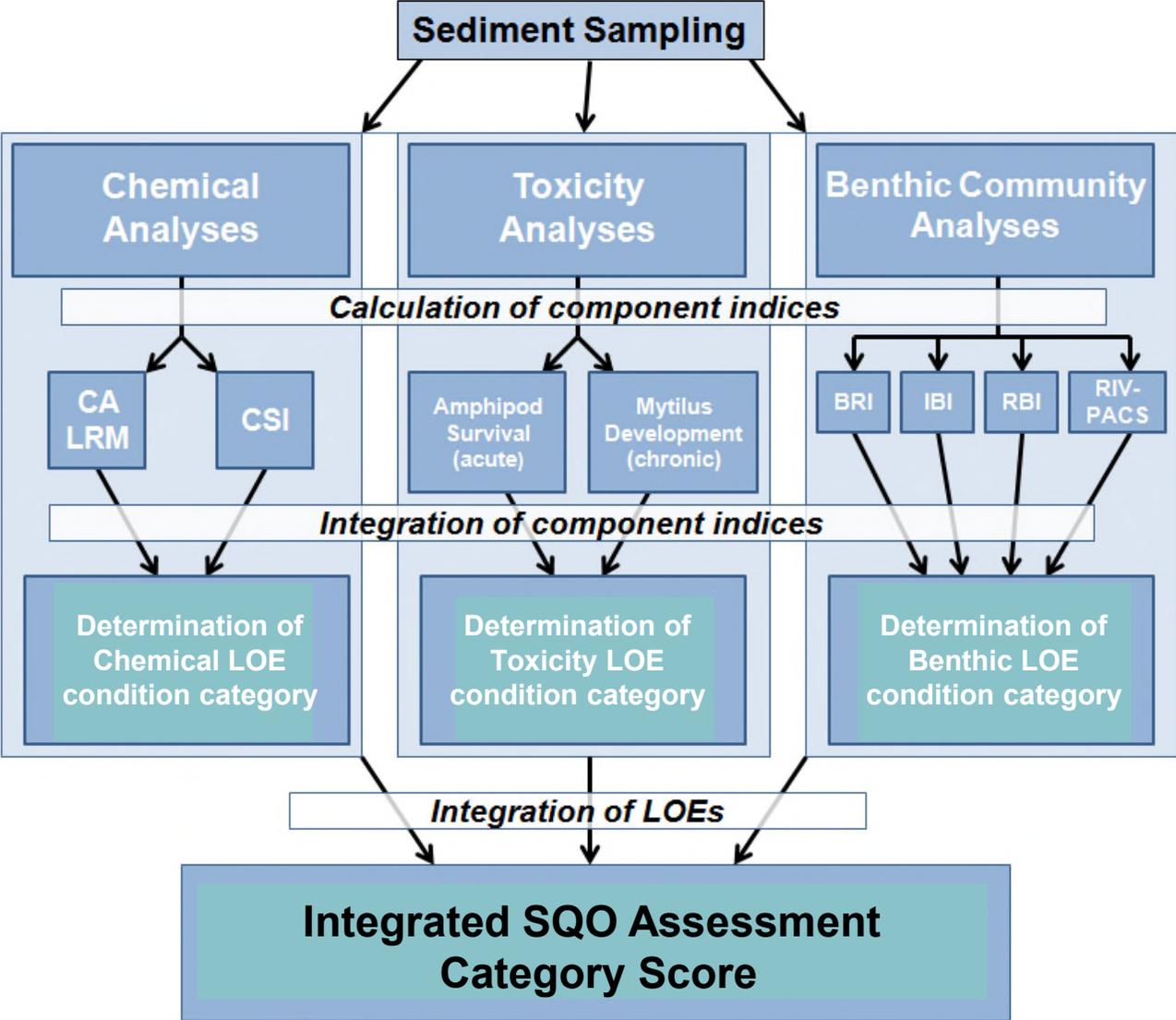


# RHMP Sampling Stations and Type



1. Marina
2. Port/ Industrial
3. Freshwater-influenced
4. Shallow
5. Deep

# Sediment Quality Objective (SQO) Approach



- Unimpacted
- Unlikely
- Possibly
- Likely
- Clearly

# Field Sampling and Data Collection

## Field Collection Routine

### ■ Water Collection

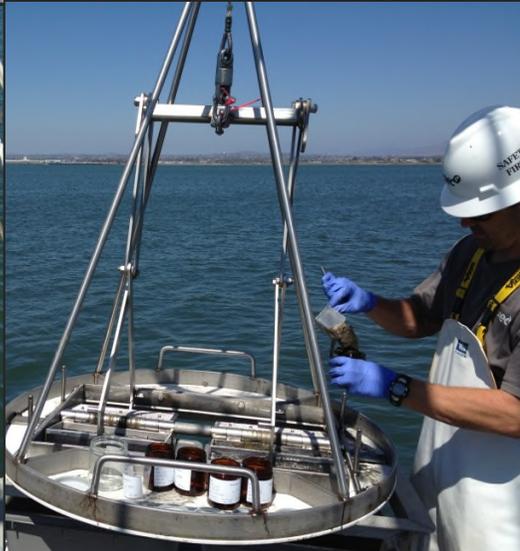
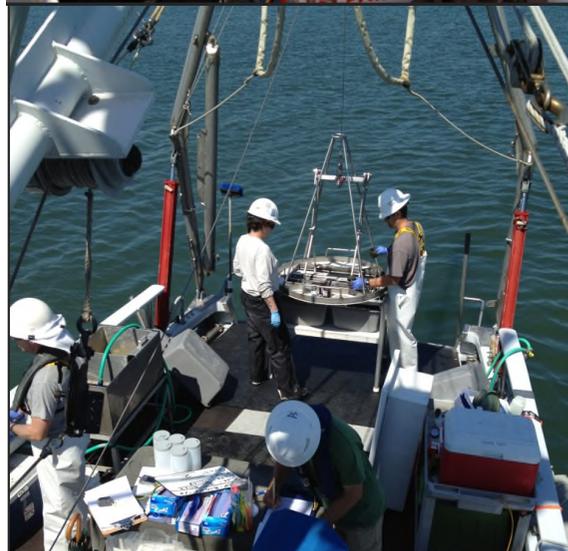
- Niskin Bottle for water chemistry
- CTD water profile (pH, DO, Temp, Salinity, Light transmittance)

### ■ Sediment Collection

- Tandem (Double) Van-Veen Clamshell
- 1<sup>st</sup> Sediment Grab
  - Chemistry (metals, pesticides, PBDEs, TOC, AVS/SEM, grain size)
  - Benthic Community
- 2<sup>nd</sup> Sediment Grab
  - Toxicity Sample

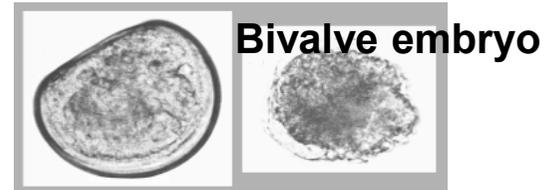


# Sample Collection

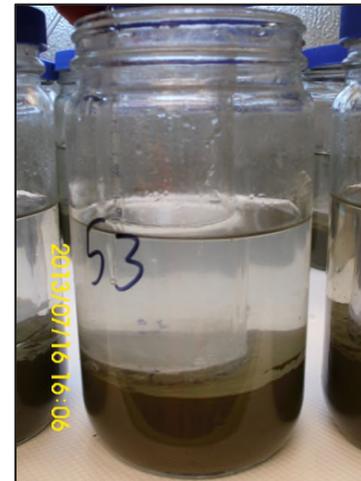


# Toxicity Testing

- 10-day Amphipod Survival
- 48-hour Bivalve Embryo Development
  - Sediment-Water Interface Test



*Eohaustorius*



# Benthic Community Characterization

- Van-Veen 0.1m<sup>2</sup> sediment grab
- Sieve / Wash table
  - 1.0 mm stainless steel mesh
  - Rinsed with site water
- Relaxant / Preservative



# Benthic Otter Trawls



# Special Study - Bioaccumulation

## ■ Trophic transfer of contaminants

– Sediment → Infauna → Fish → Birds



# Bight '13 Special Studies

- Bioaccumulation
- DNA bar-coding vouchers
- Plastic ingestion
- Debris (trawls & sediment grabs)
- CDFW Halibut Study
- Contaminants of Emerging Concern  
(alkylphenols, perfluorinated compounds)



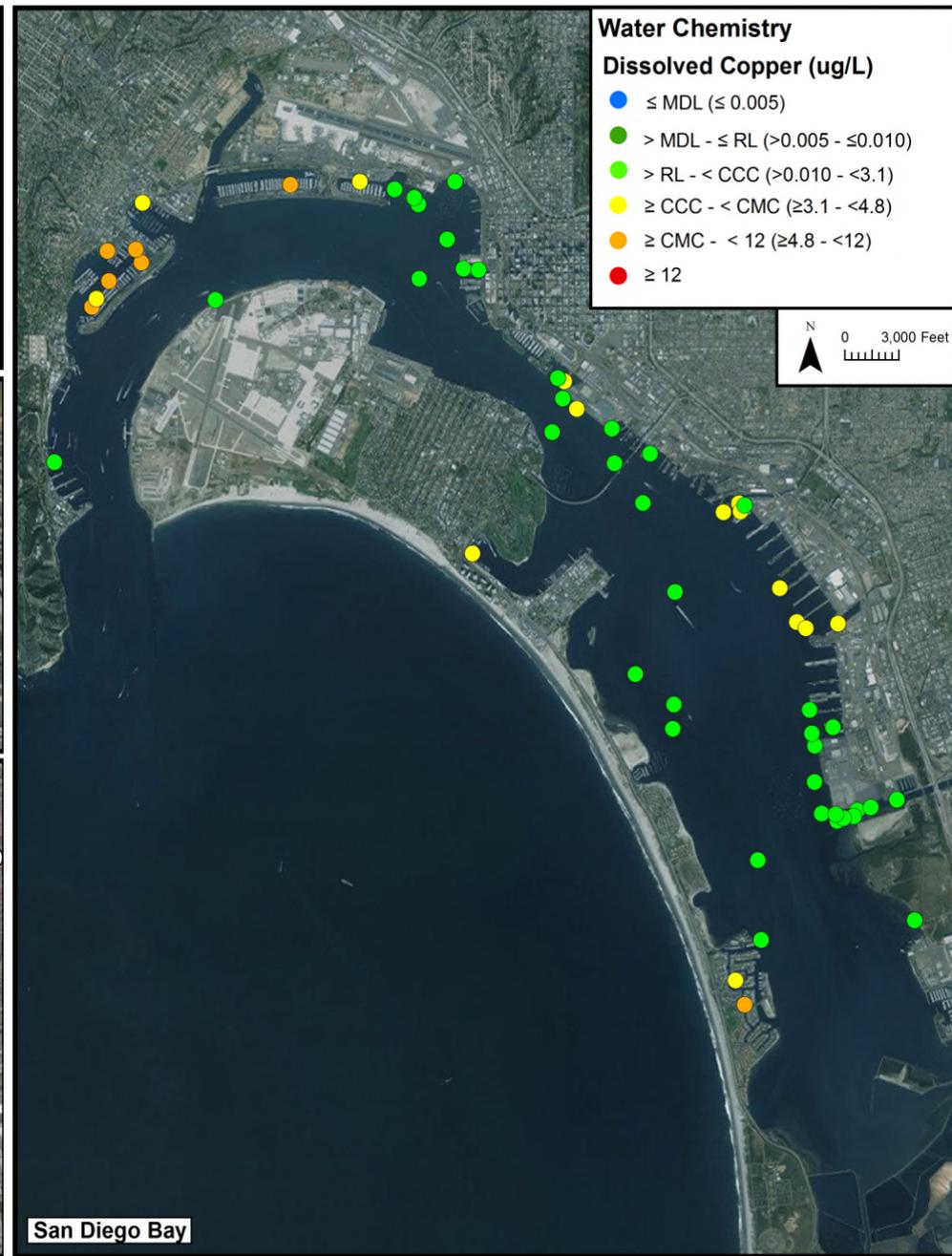
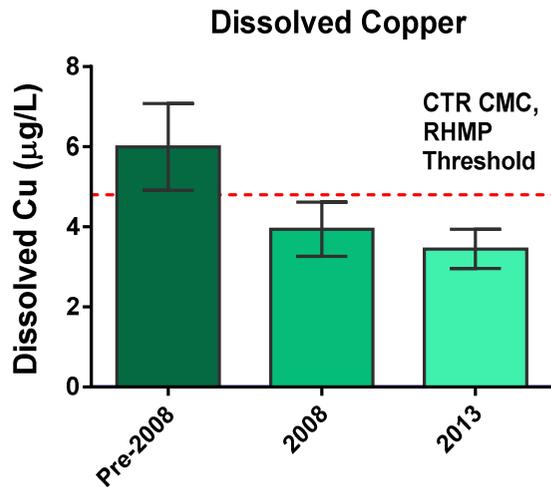
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***What are the Contributions and  
Spatial Distributions of  
Pollutants?***

# Dissolved Copper in Surface Waters

2013 RHMP →

## Trends



**Water Chemistry**

**Dissolved Copper (ug/L)**

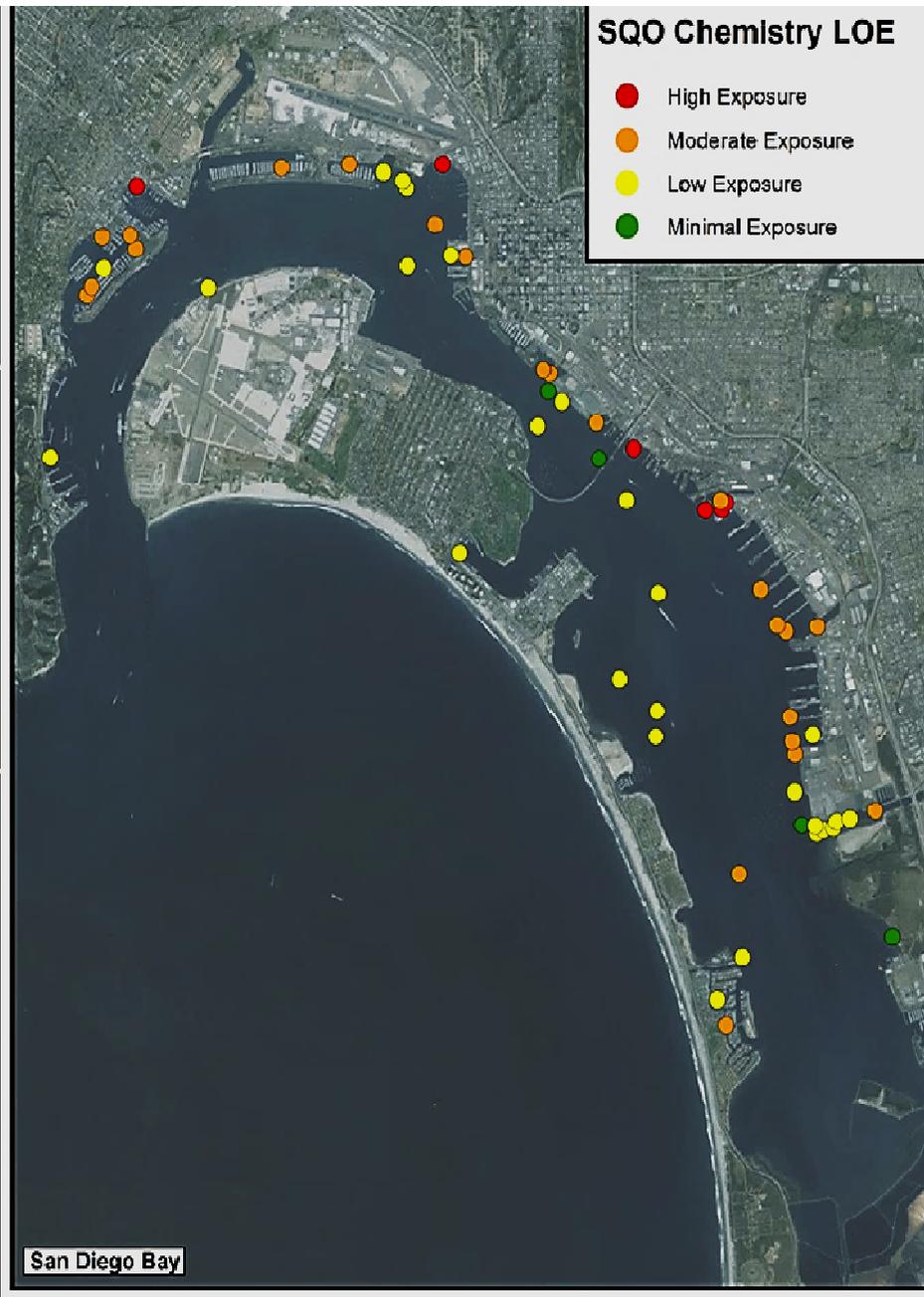
- ≤ MDL (≤ 0.005)
- > MDL - ≤ RL (>0.005 - ≤0.010)
- > RL - < CCC (>0.010 - <3.1)
- ≥ CCC - < CMC (≥3.1 - <4.8)
- ≥ CMC - < 12 (≥4.8 - <12)
- ≥ 12

# Sediment Chemistry LOE

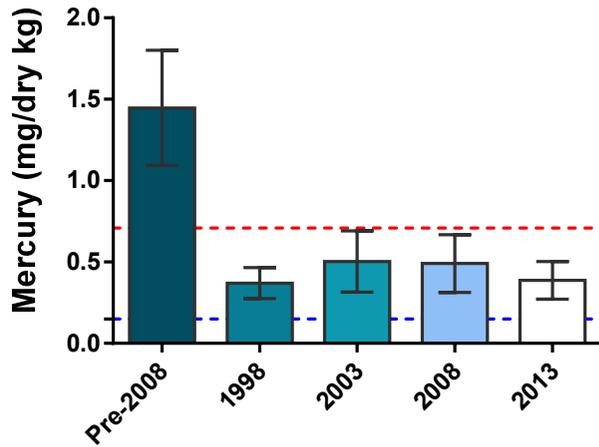
## Integrated Chemical Scores using the SQO Approach 2013

### SQO Chemistry LOE

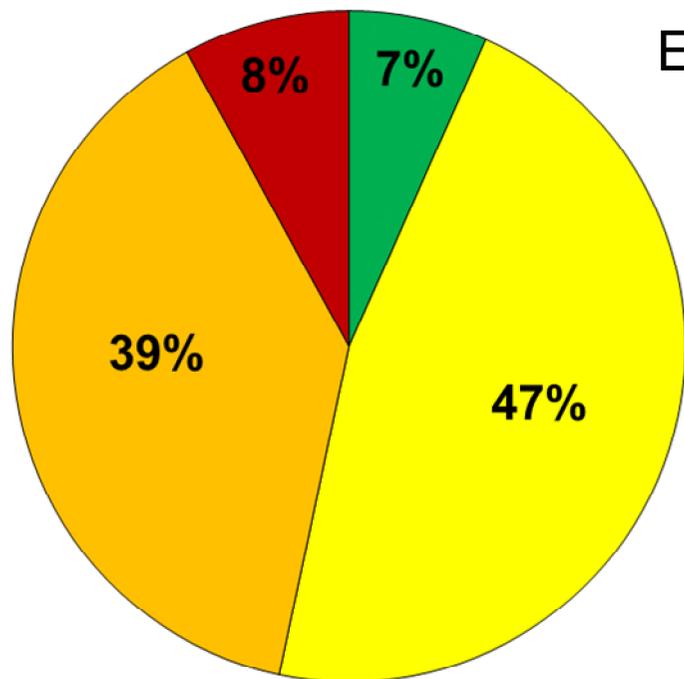
- High Exposure
- Moderate Exposure
- Low Exposure
- Minimal Exposure



Mercury



# Sediment Chemistry – SQO Integrated LOE Assessment - 2013



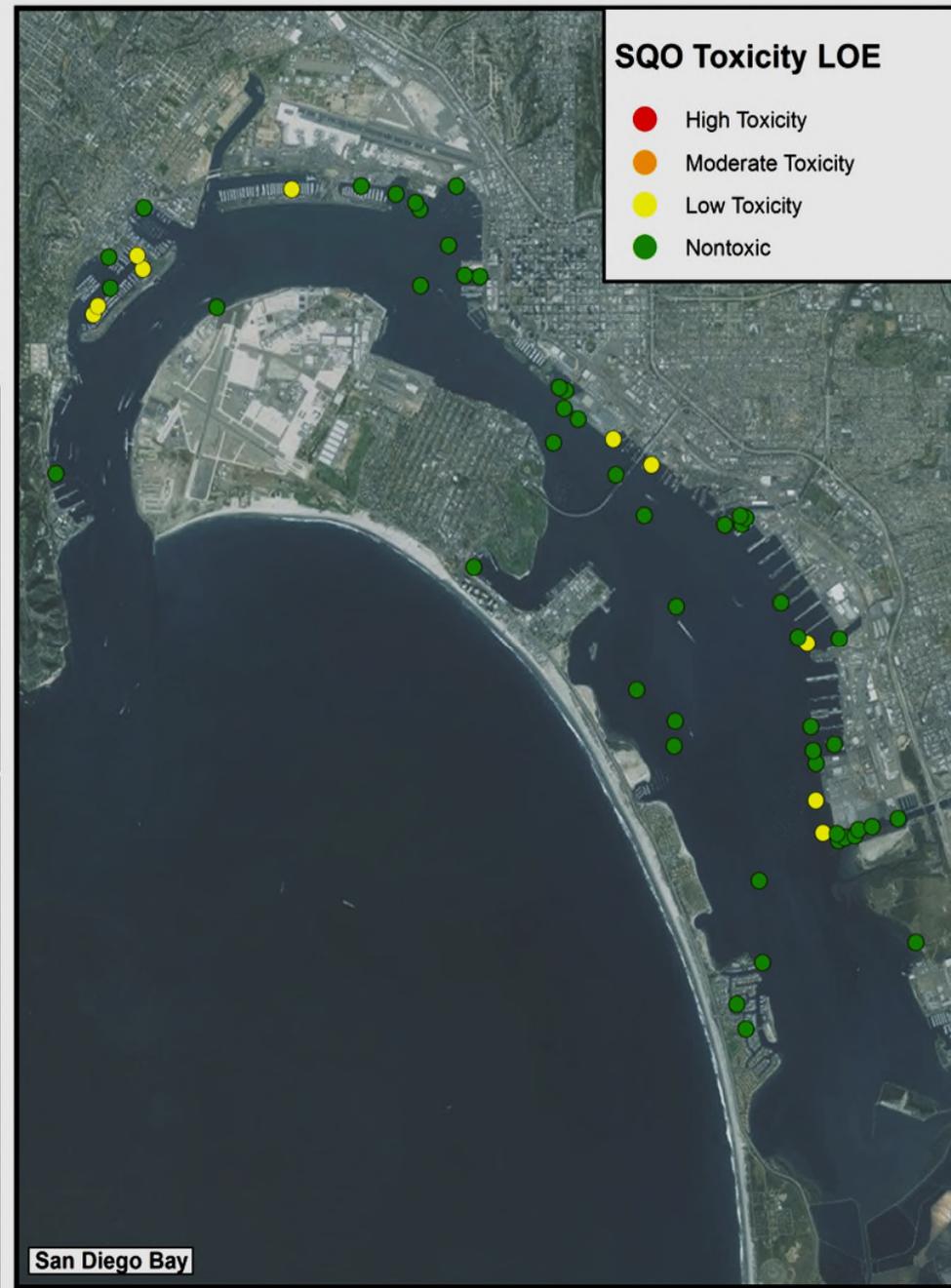
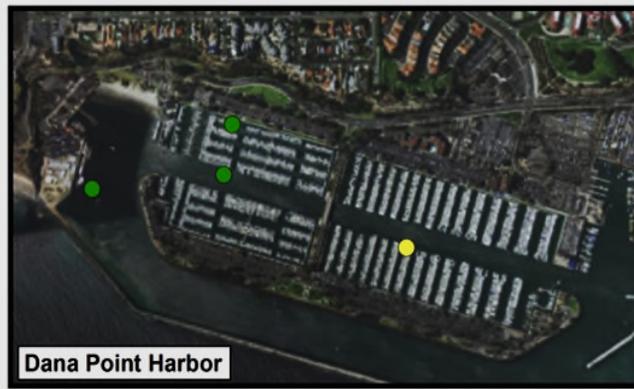
## Exposure Potential

- Minimal
- Low
- Moderate
- High



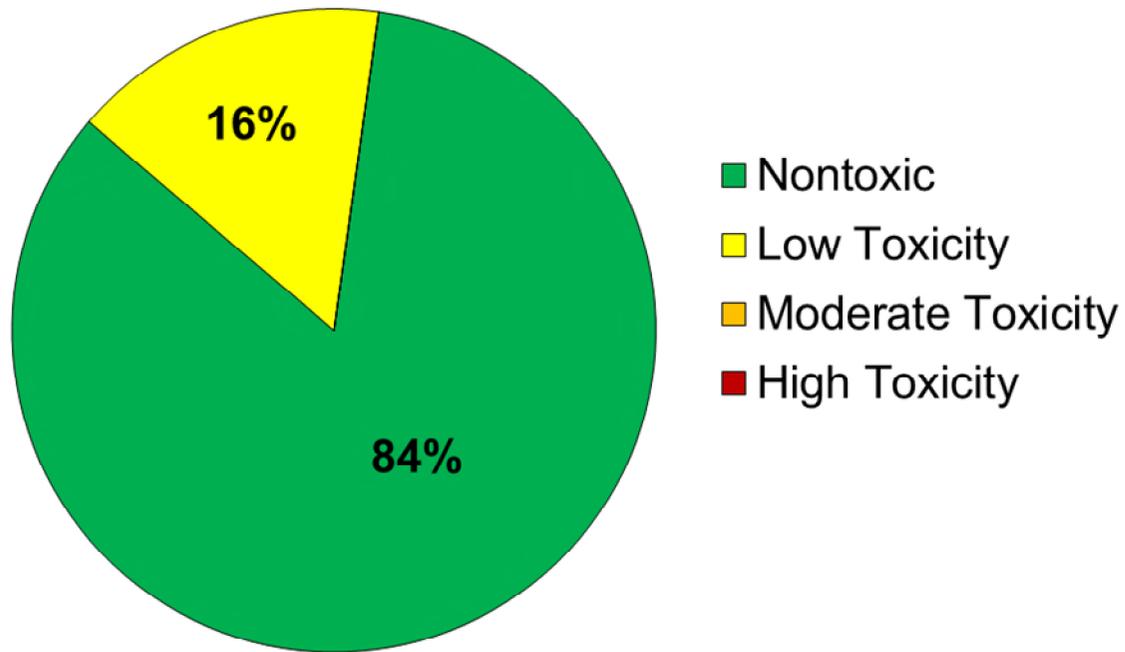
# Toxicity LOE

## Integrated Toxicity Scores using the SQO Approach 2013



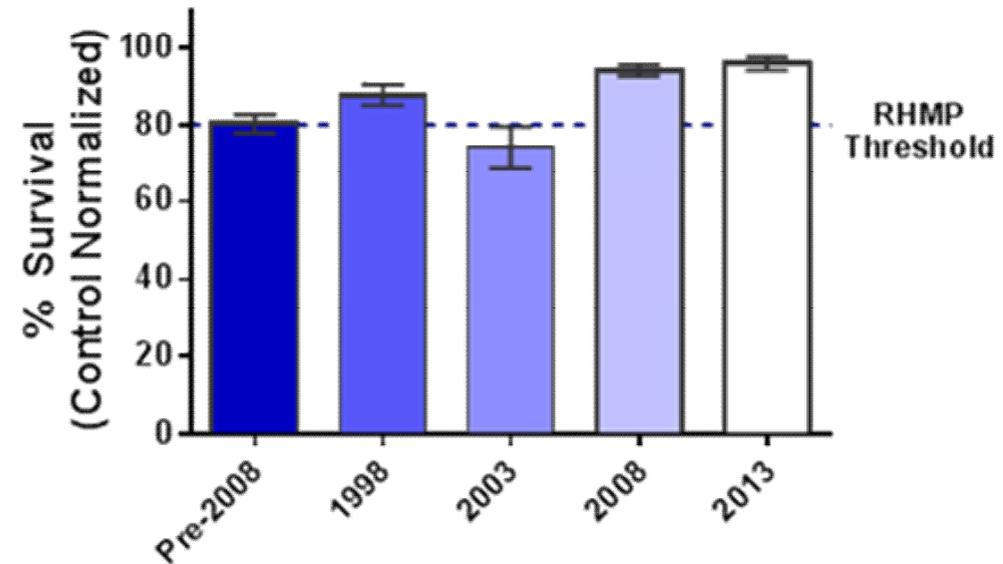
# Toxicity Summary

## 2013 – SQO LOE

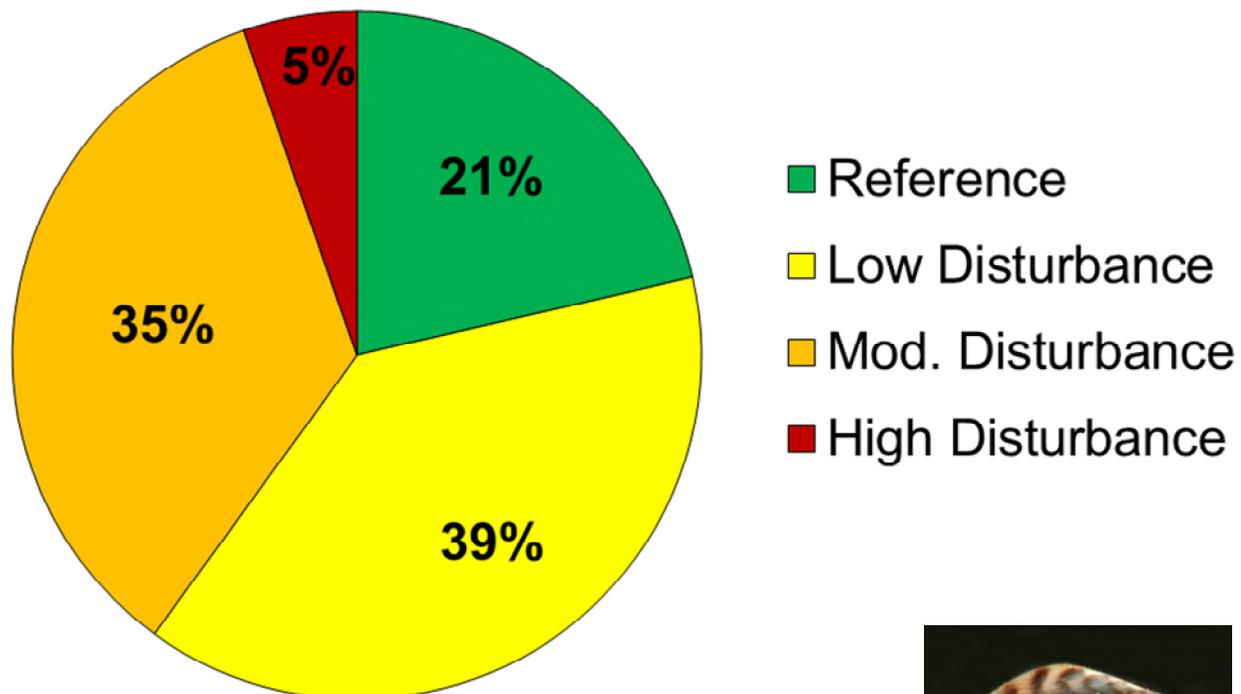


## Historical

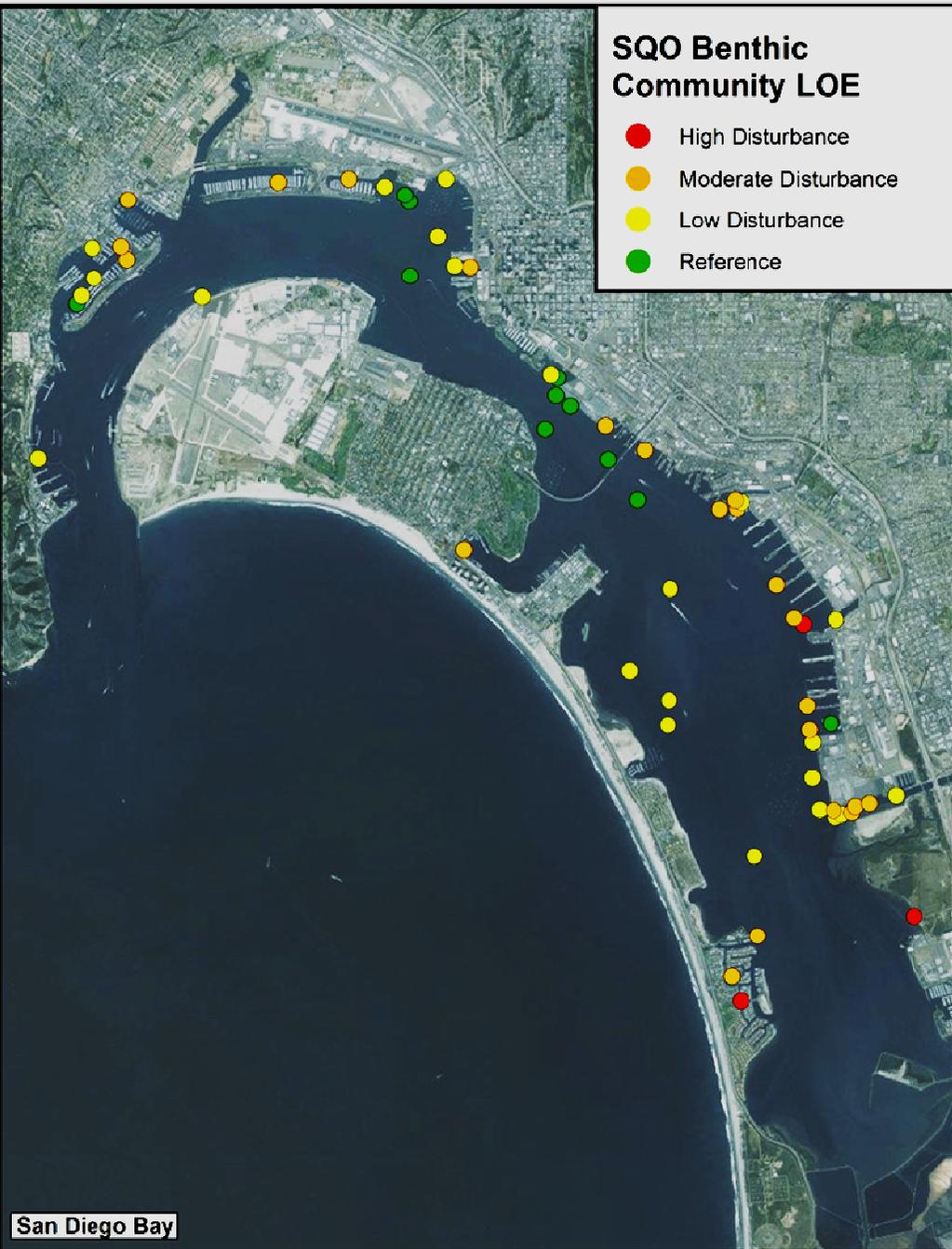
Amphipod Survival



# Benthic Infauna Summary



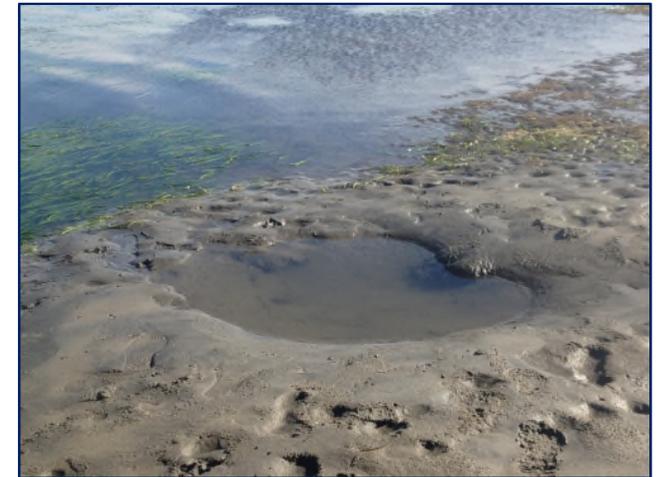
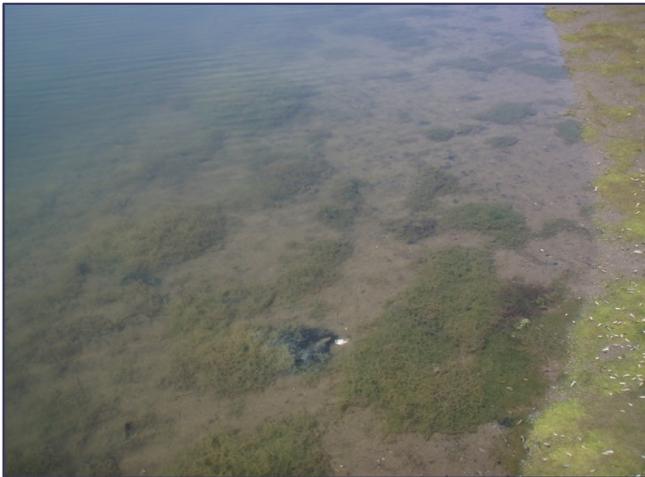
# Benthic Community LOE



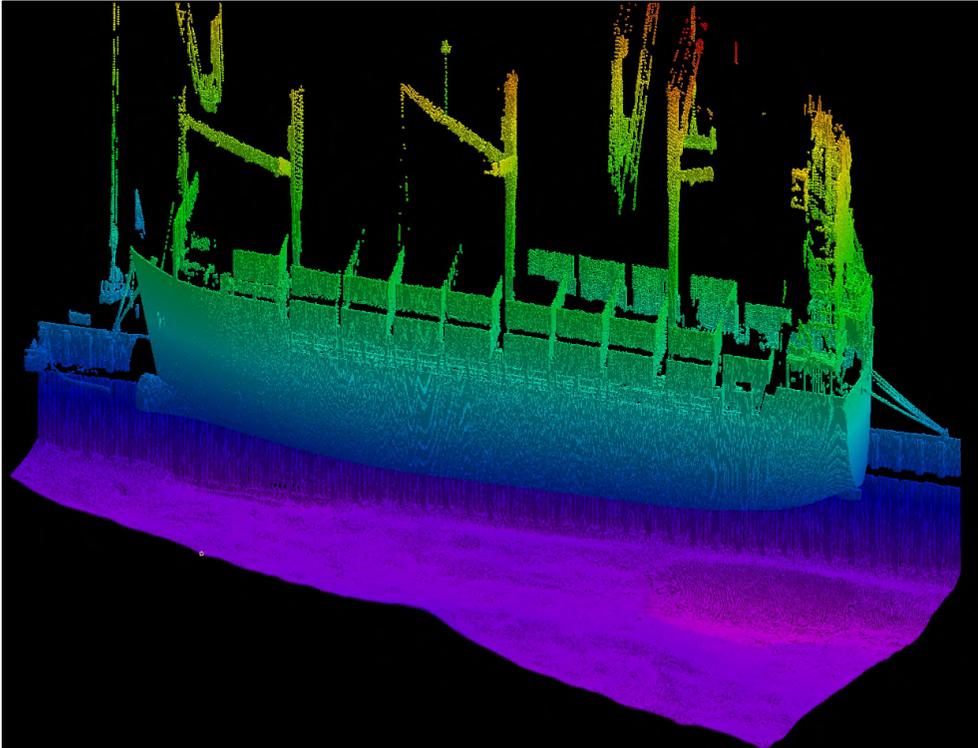
Integrated  
Scores  
using the  
SQO  
Approach  
2013

# Causal Assessment for Benthic Community Impacts

- Association with elevated chemistry, boating activities, industry, freshwater influence
- Spatial variability and physical disturbance
- Outside subtidal zone



# Site B13-8064 in Central San Diego Bay



Courtesy of Figuro



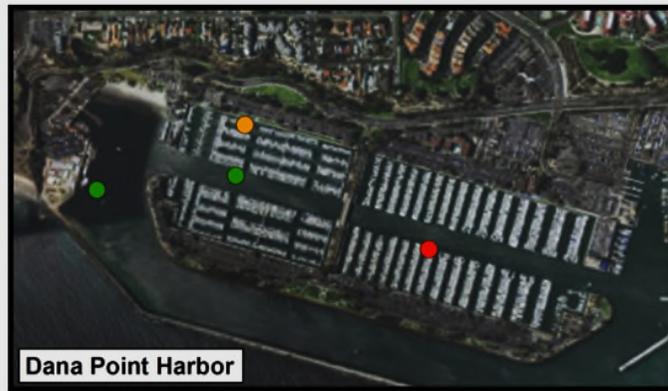
Courtesy of Google

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# ***Integrated MLOE Sediment Quality Assessment***

# Integrated SQO Results

MLOE Scores using the SQO Triad Approach (Chem, Tox, Benthic Community)

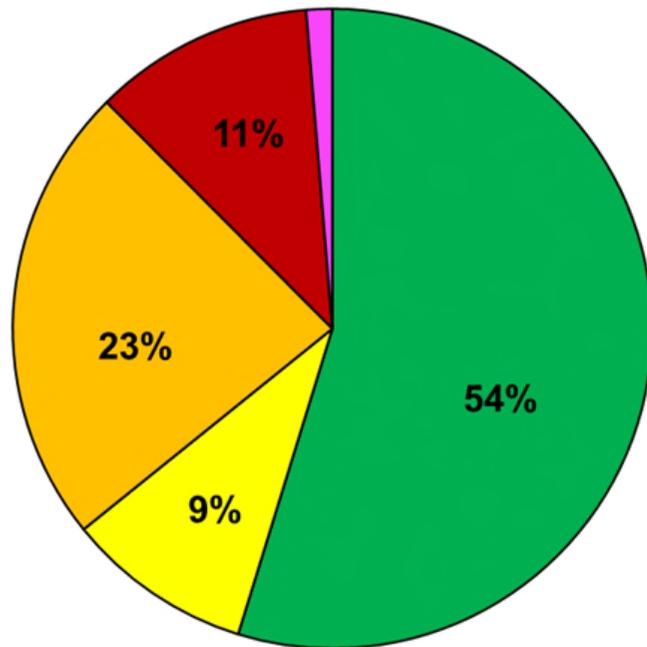


# Final Integrated SQO Assessment by Strata – RHMP 2013

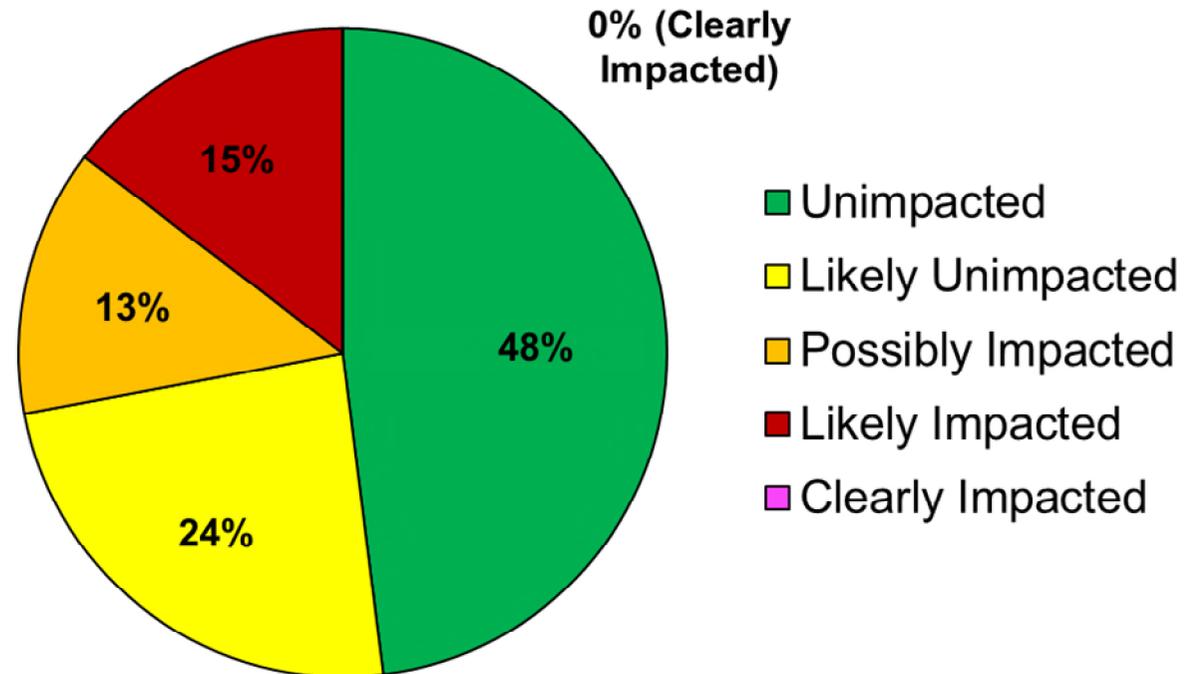
Stratum		Overall SQO Station Assessment (Percent)				
		Unimpacted	Likely Unimpacted	Possibly Impacted	Likely Impacted	Clearly Impacted
2013 Strata	Deep	81	13	6	0	0
	Freshwater- Influenced	33	47	7	13	0
	Marina	7	33	20	40	0
	Industrial / Port	43	7	29	21	0
	Shallow	73	20	7	0	0

# Final Integrated Sediment Quality Assessment

**2008**



**2013**



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***Do the waters and sediments in the harbors sustain healthy biota?***

# Benthic Trawl Species Count/ ID Summary



## ■ Fish

- Total of 2134 individuals
- 33 distinct taxa

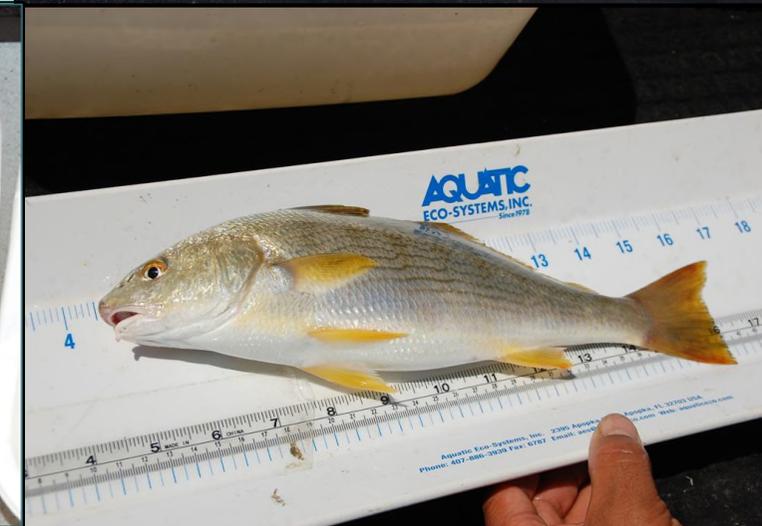
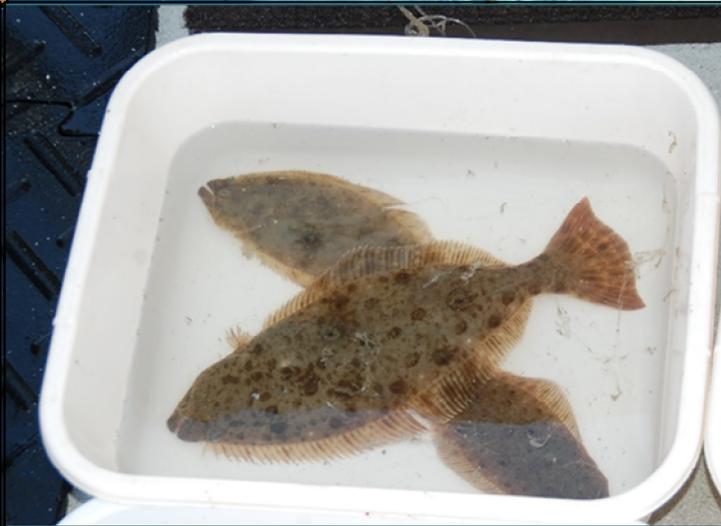
## ■ Invertebrates

- Total of 457 individuals
- 40 distinct taxa

Harbor	Fish		Invertebrates	
	# Individuals	# Taxa	# Individuals	# Taxa
Dana Point	20	10	7	4
Oceanside	48	10	15	6
Mission Bay	574 <sup>a</sup>	23	189	22
San Diego Bay North	330	17	29	8
San Diego Bay Central	1070	17	133	18
San Diego Bay South	92	8	90	7

<sup>a</sup> 409 juvenile slough anchovy

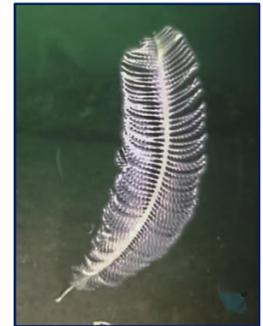
# Demersal Fish



# Demersal Invertebrates



amec  
foster  
wheeler



# Ecological Community Assessment – Benthic Fish Species Monitoring

- Diverse and healthy populations of fish and invertebrates have returned to the bay*



# *Do The Waters and Sediments in the Harbors Sustain Healthy Biota?*

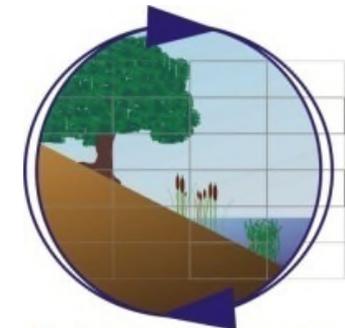
## **Lines of Evidence Summary:**

- **Integrated SQOs** – 72% of stations unimpacted or likely unimpacted
- **Chemistry** – Majority of stations low to moderate exposure; Marina and port/industrial have highest frequency of moderate/high exposures
- **Toxicity** – 100% are non-toxic or are have low toxicity
- **Benthic Infauna** – 60% of assemblages were determined to be reference or low disturbance; Marinas, port/industrial, and shallow regions have highest high frequency of moderate/high disturbance
- **Demersal Fish and Invertebrate Communities** – Appear to be healthy and consistent with findings with previous regional studies

# Acknowledgements



*Seaventures Inc.*



# QUESTIONS?



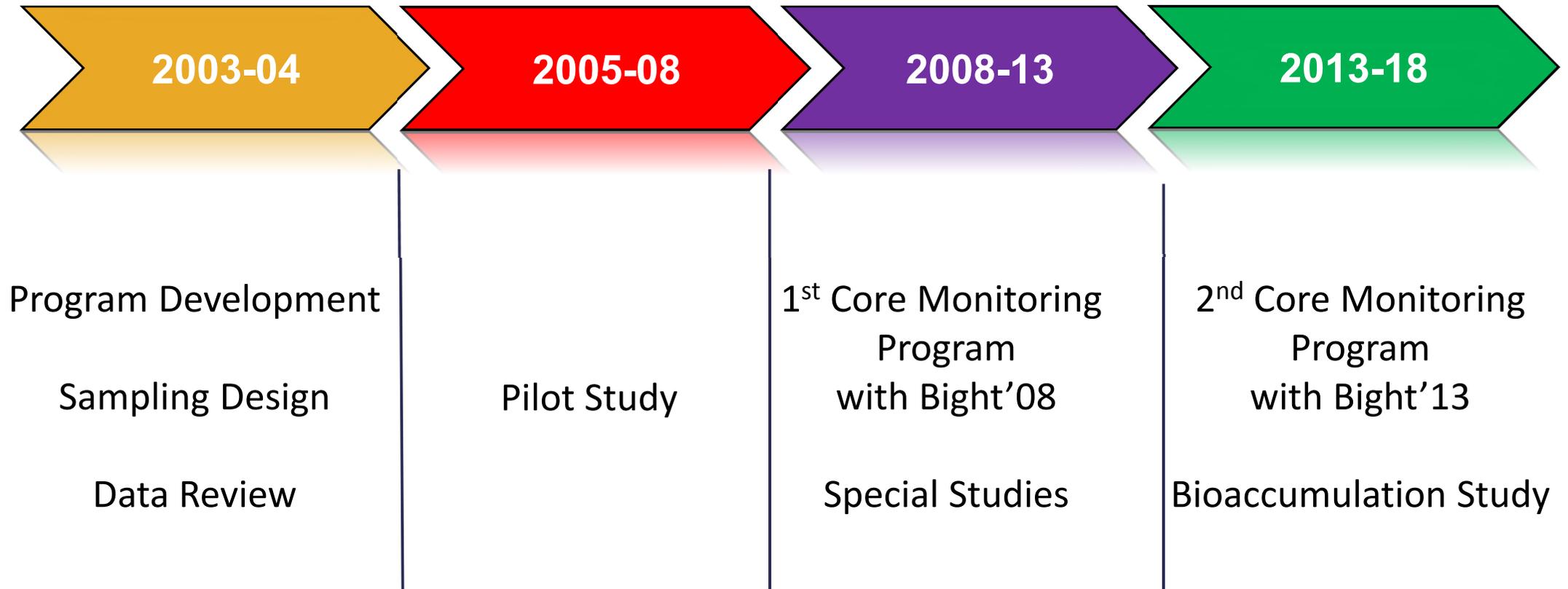
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**chris.stransky@amecfw.com**  
**858-300-4350**

**<https://www.portofsandiego.org/environment>**

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# ***Backup Slides***

# RHMP - Schedule



# Summary of Threshold Values and Historical Baselines

Measure	Threshold Value	Historical Baseline % >Threshold
<b>Primary Indicators</b>		
Dissolved Copper (water)	4.8 µg/L	42
Total Copper (water)	5.8 µg/L	49
Mean ER-M Quotient	0.2	54
BRI	40	45
Amphipod Mortality	20%	45
<b>Secondary Indicators</b>		
Dissolved Zinc (water)	90 µg/L	0
Total Zinc (water)	95 µg/L	1
Dissolved Nickel (water)	74 µg/L	0
Total Nickel (water)	75 µg/L	0
Sediment Arsenic	8.2 µg/g	48
Sediment Cadmium	1.2 µg/g	8
Sediment Chromium	81 µg/g	17
Sediment Copper	175 µg/g	32
Sediment Lead	46.7 µg/g	25
Sediment Mercury	0.15 µg/g	74
Sediment Nickel	20.9 µg/g	20
Sediment Zinc	150 µg/g	55
Sediment Total PAHs	4022 ng/g	21
Sediment Total Chlordanes	2 ng/g	14
Sediment Total DDTs	2 ng/g	46
Sediment Total PCBs	22.7 ng/g	53
Shannon-Wiener Diversity Index	2	24
Number of Taxa	24	18

# Sediment Chemistry Summary - 2013

- **Copper & Mercury** - exceeded ER-M values in ports and marinas
- **Arsenic, Lead, & Zinc** - exceeded ER-L values, a few ER-Ms
- **PAHs** - exceeded an ER-L in only one station (marina). Highest overall in ports
- **Total PCBs/DDTs** - variable, but generally highest in industrial and marinas
- **Total Chlordanes and Pyrethroid Pesticides** – elevated in freshwater-influenced areas and marinas, but overall low concentrations
- **PBDEs** – frequent low detections overall; elevated primarily in industrial/port areas

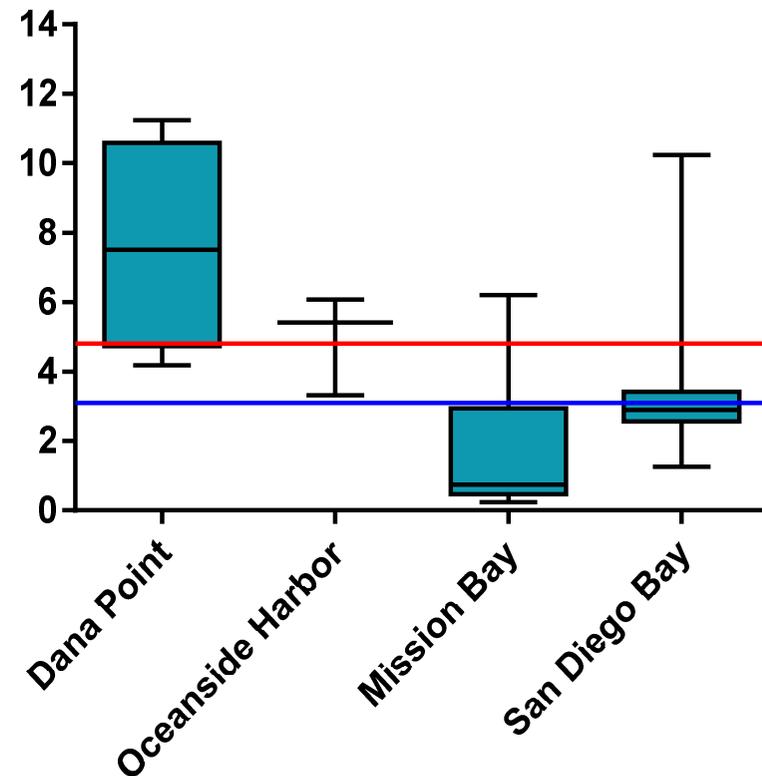
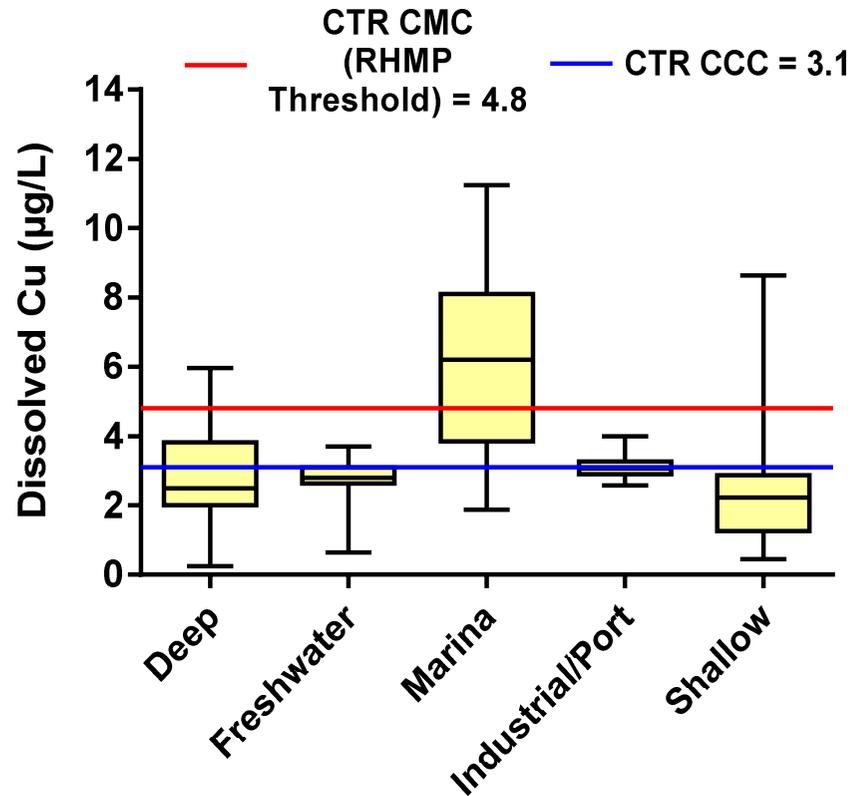
# Surface Waters - 2013

## Metals

- *Only dissolved Cu exceeded acute CTR (in marina stratum)*

## Organics

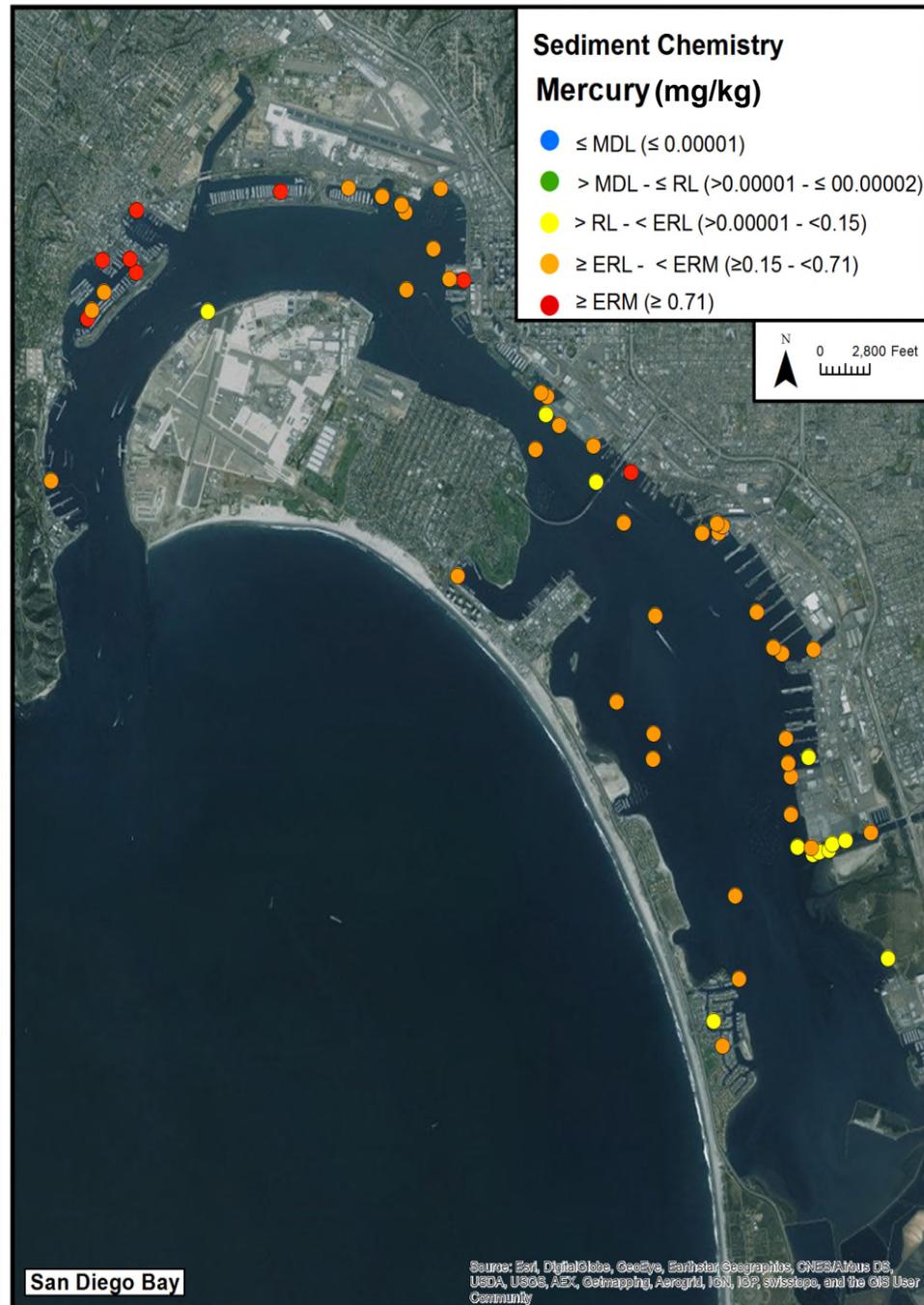
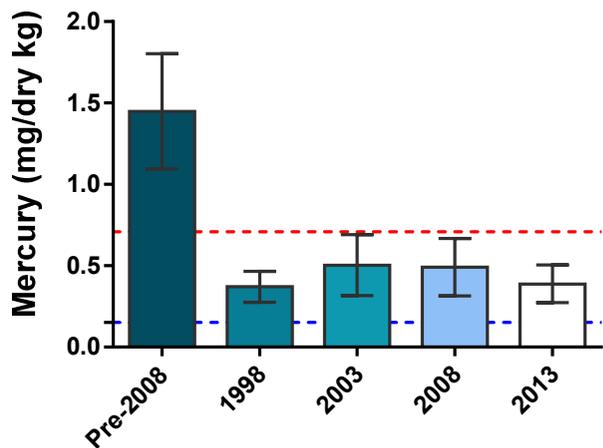
- *Few detected*
- *PAHs highest in marinas and industrial/port stratum*



# Mercury in Sediments

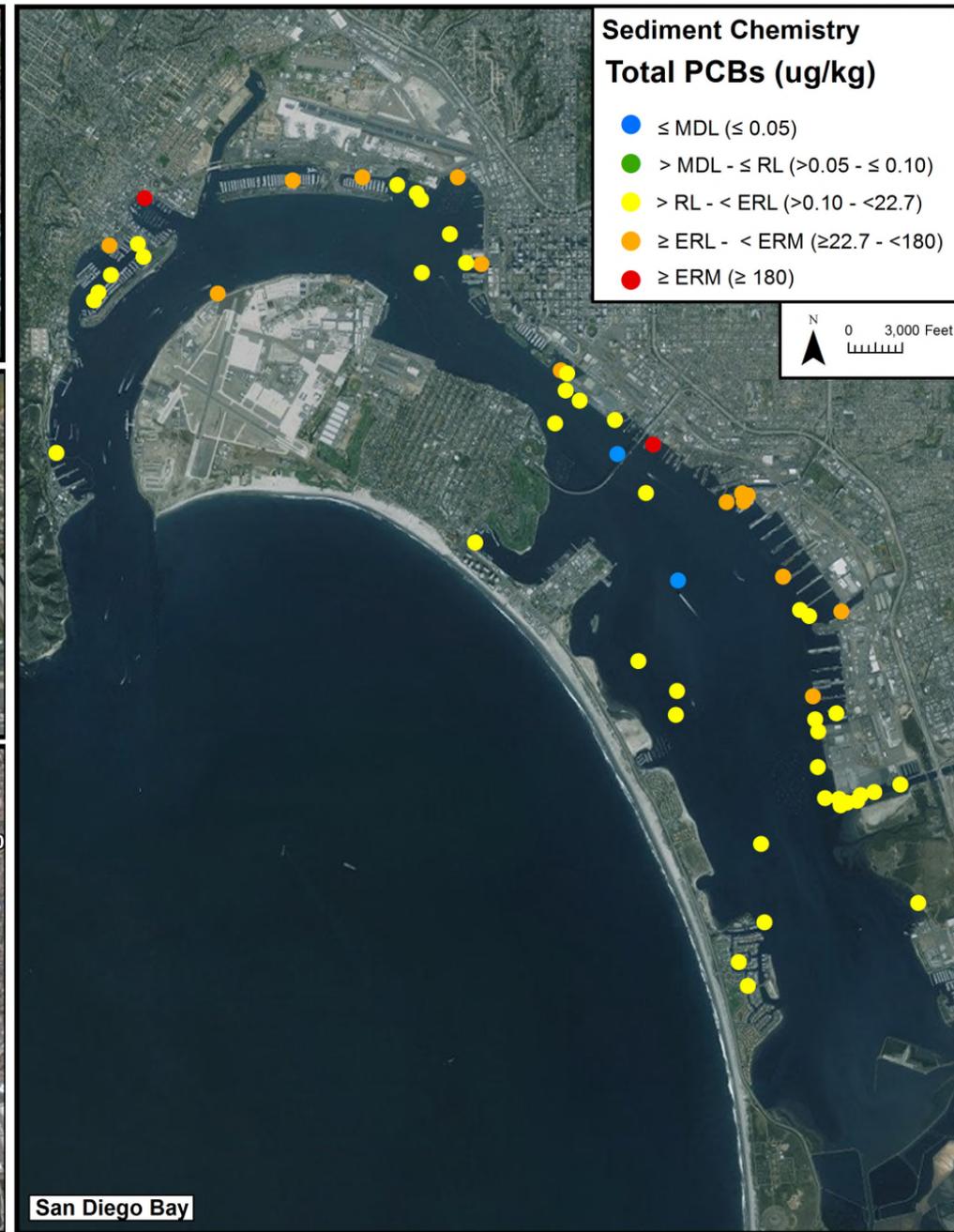
2013  
RHMP →

## Trends Mercury



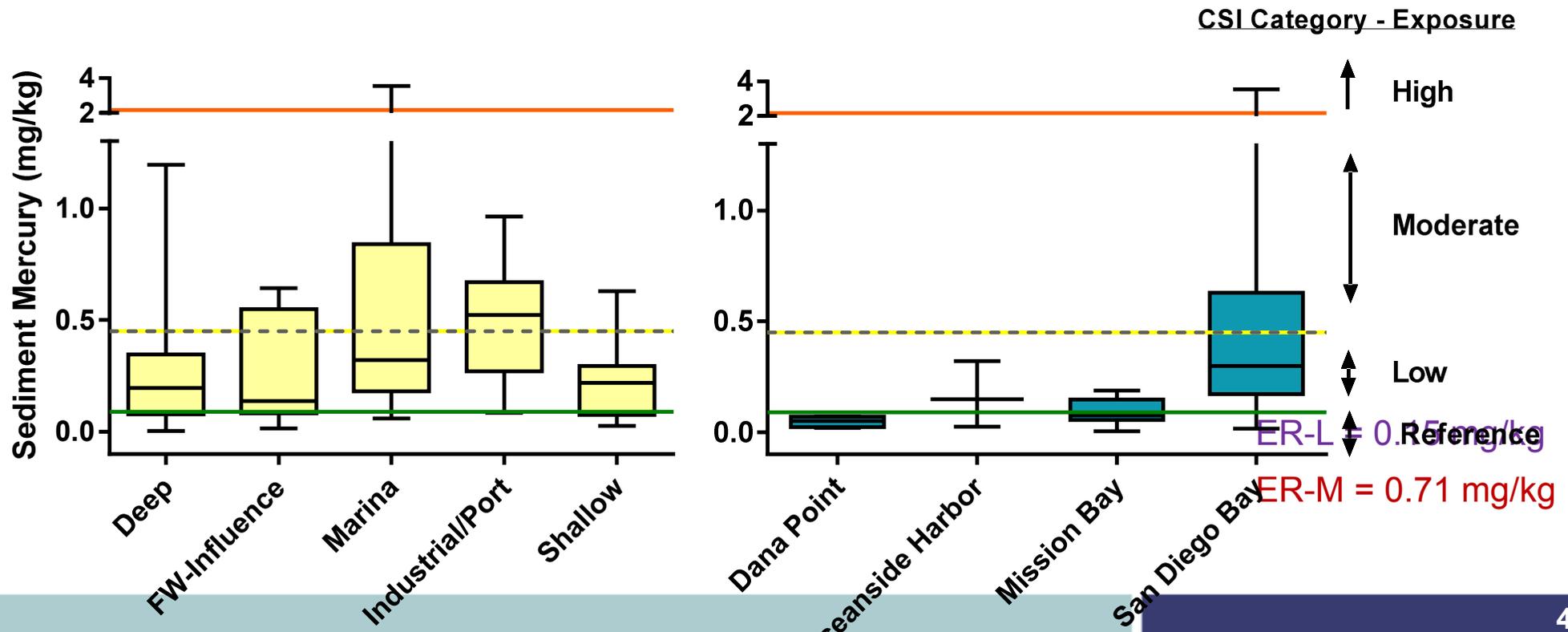
# Total PCBs in Sediments

## Spatial Distribution 2013

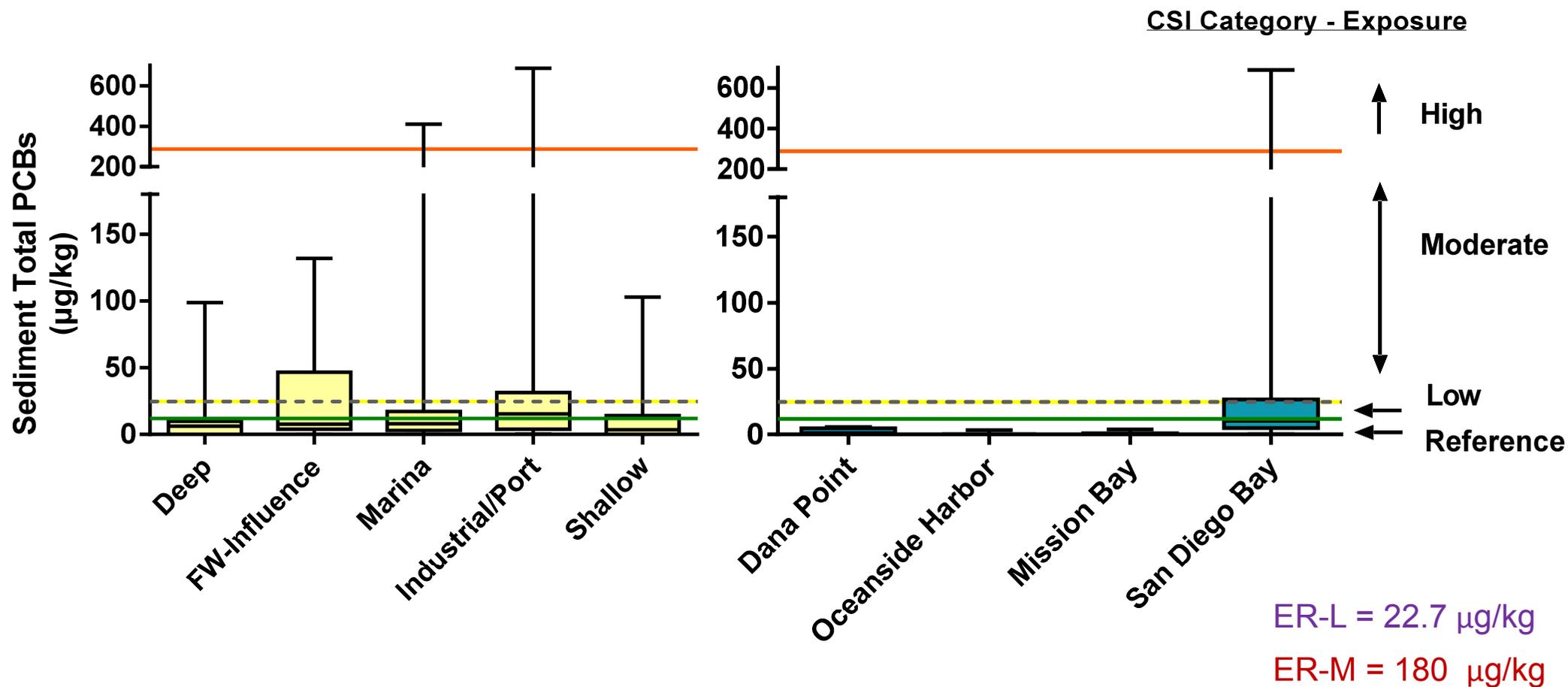


# Sediment Chemistry 2013 - Trace Metals

- **Copper & Mercury** - exceeded ER-M values in ports and marinas
- **Arsenic, Lead, & Zinc** - exceeded ER-L values

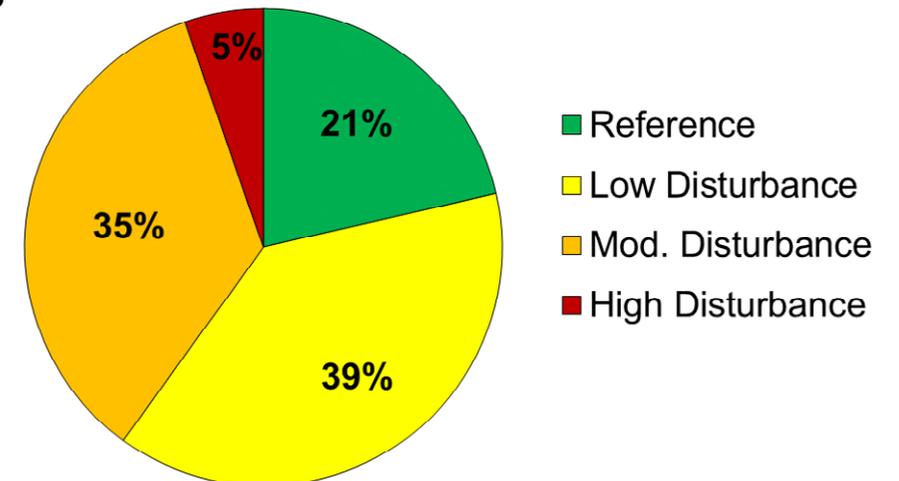
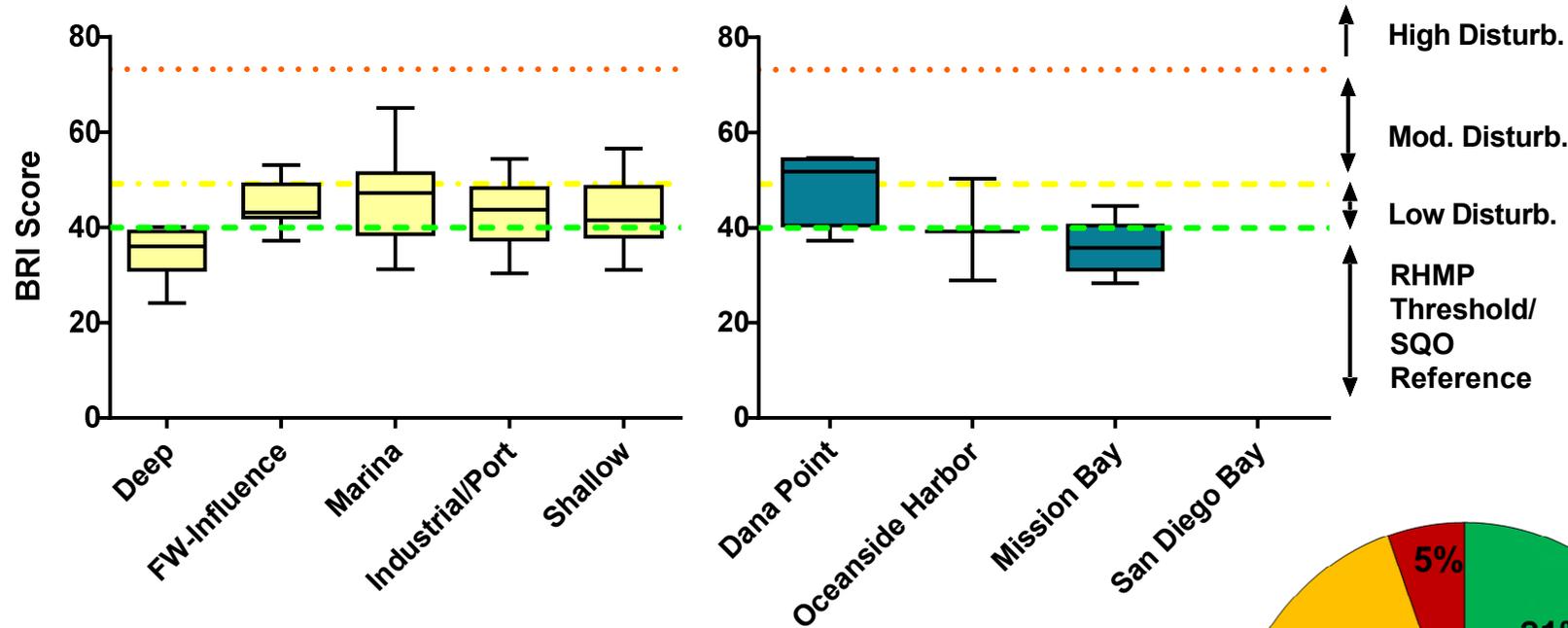


# Sediment Chemistry – PCBs





# Benthic Infauna Summary



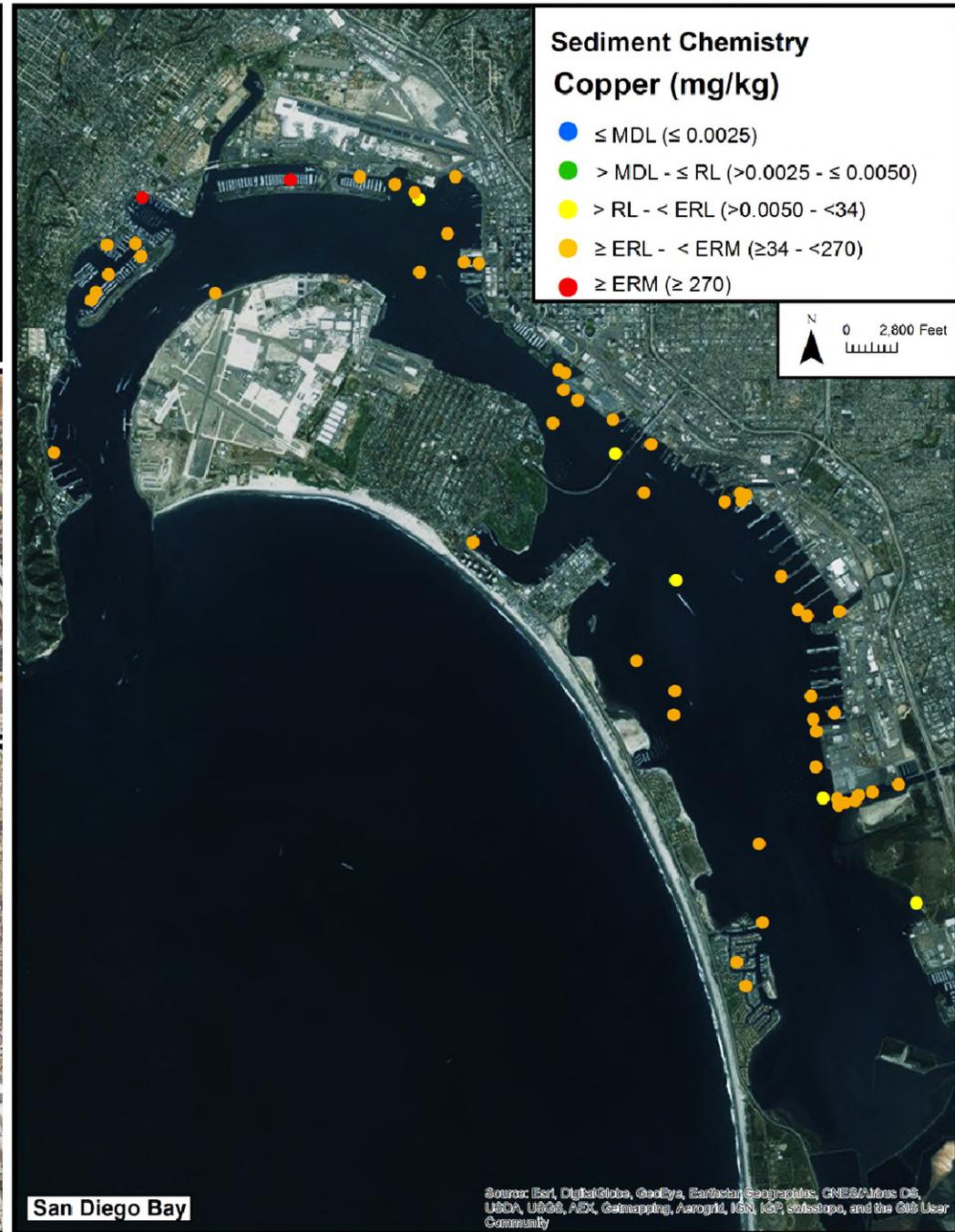
# RHMP- Background

- ❖ ***Purpose: Assess ambient conditions and evaluate trends of the quality of water, sediment, and biology life in the region's harbors***
- ❖ ***Monitoring effort coordinated among the Port of San Diego, City of San Diego, City of Oceanside, and County of Orange***
- ❖ ***Includes Dana Point Harbor, Oceanside Harbor, Mission Bay, and San Diego Bay***
- ❖ ***Developed as a result of a directive issued by the Regional Water Board in 2003***

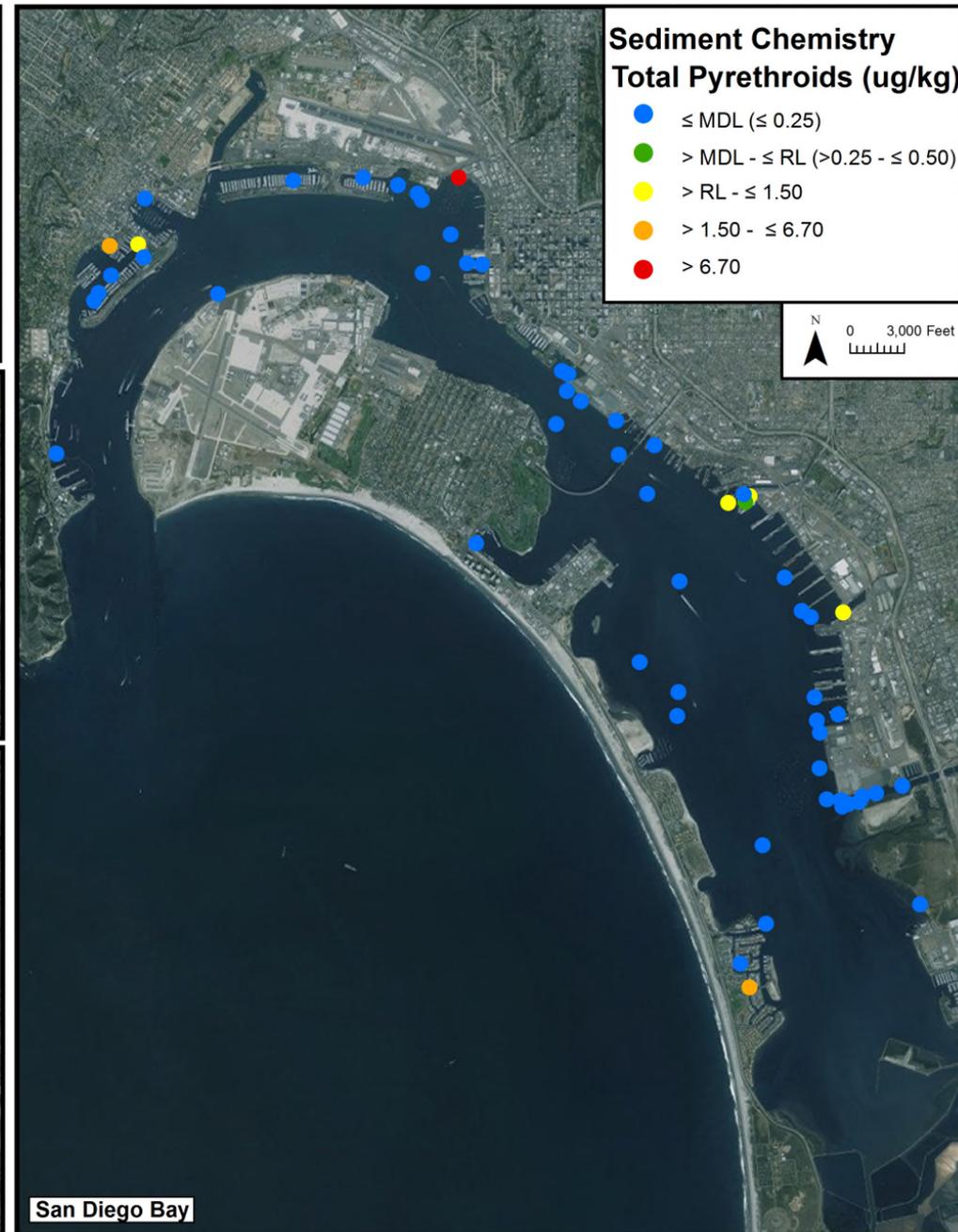
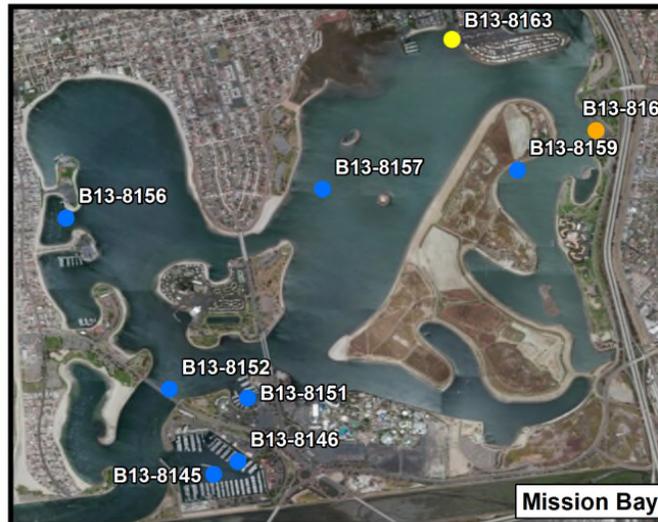
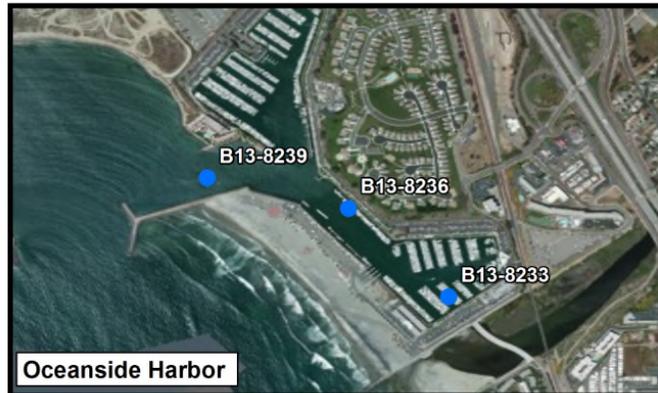
# Copper in Sediments



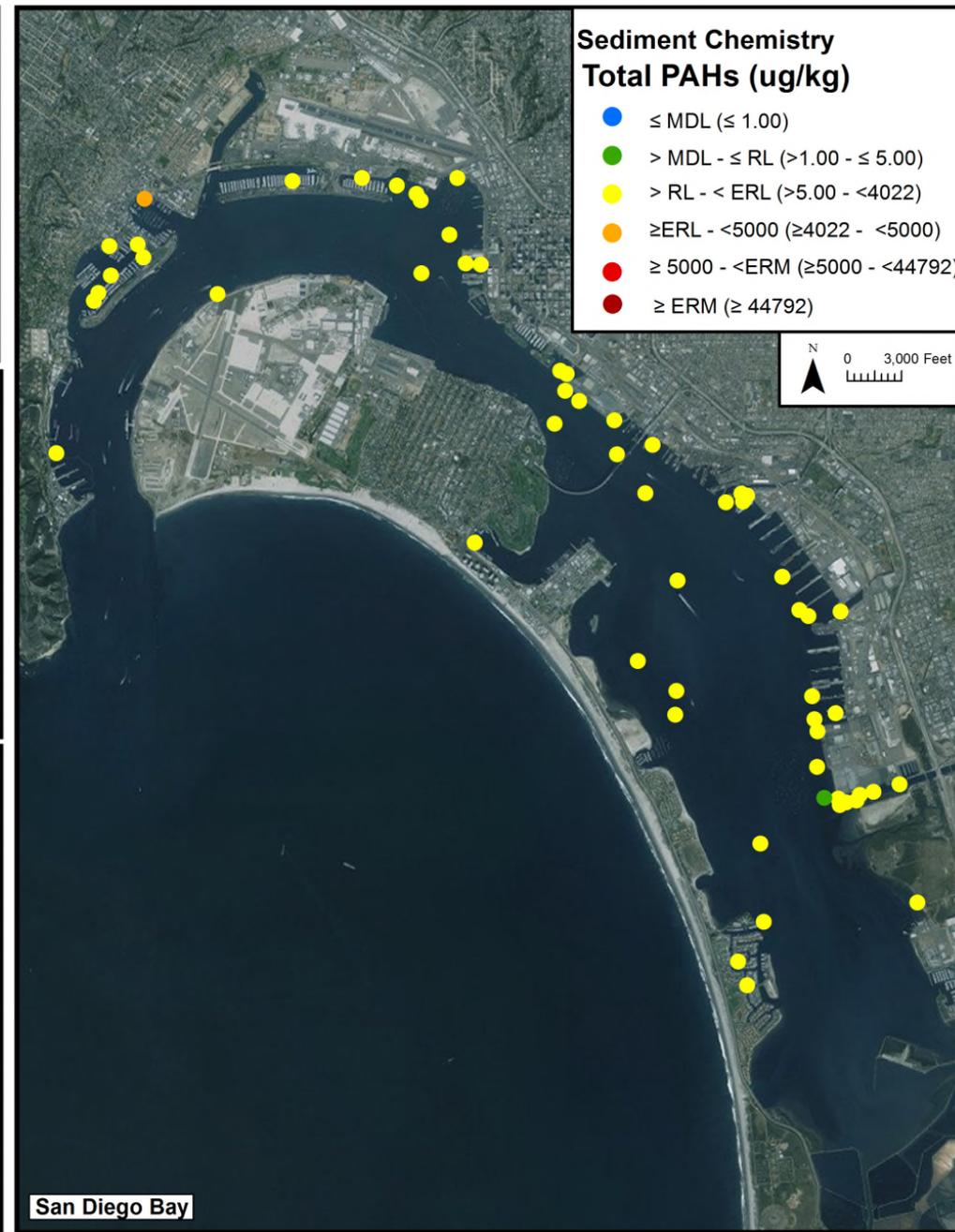
## Spatial Distribution 2013



# Spatial Distribution of Sediment Total Pyrethroid Pesticides

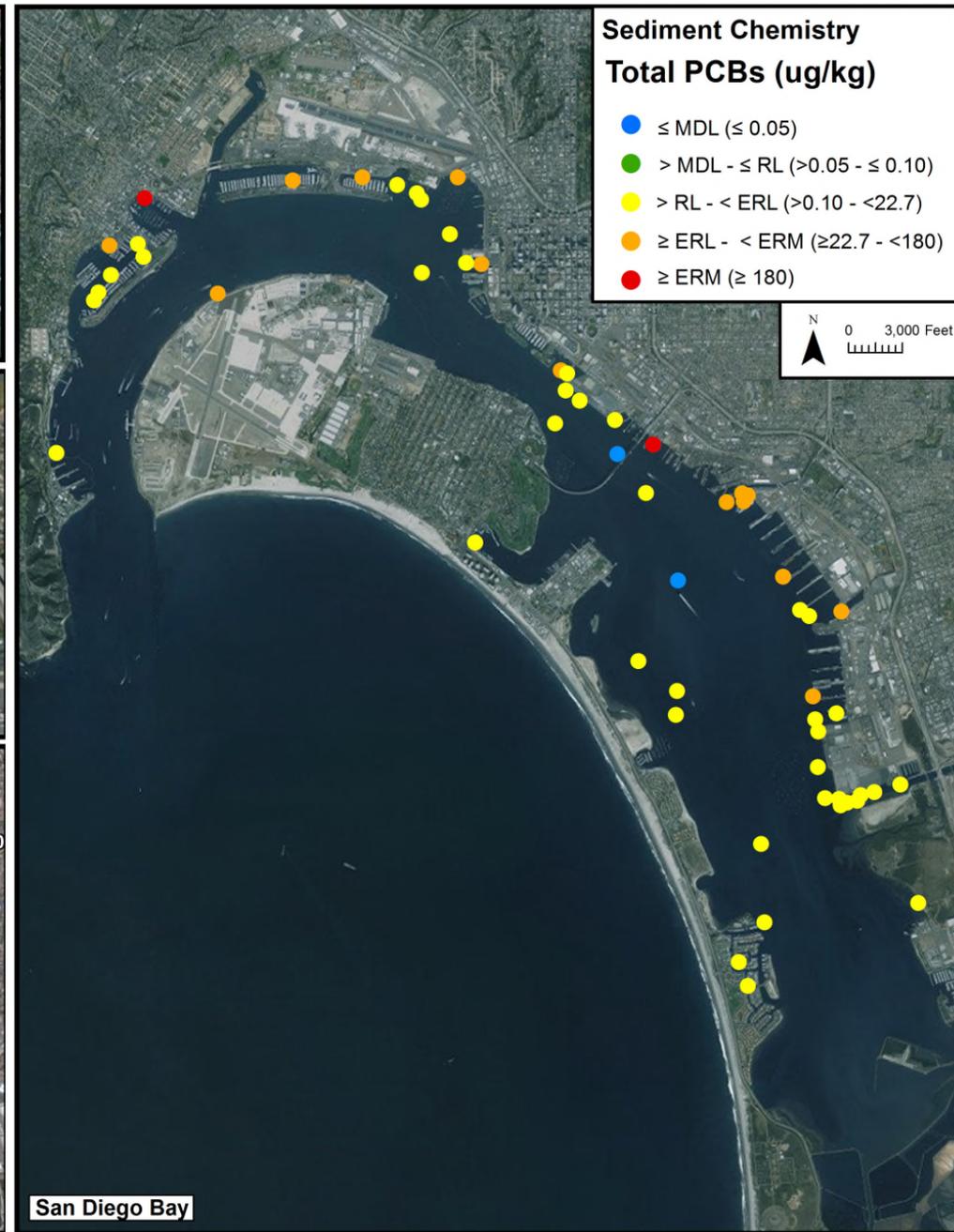


# Spatial Distribution of Sediment Total PAHs

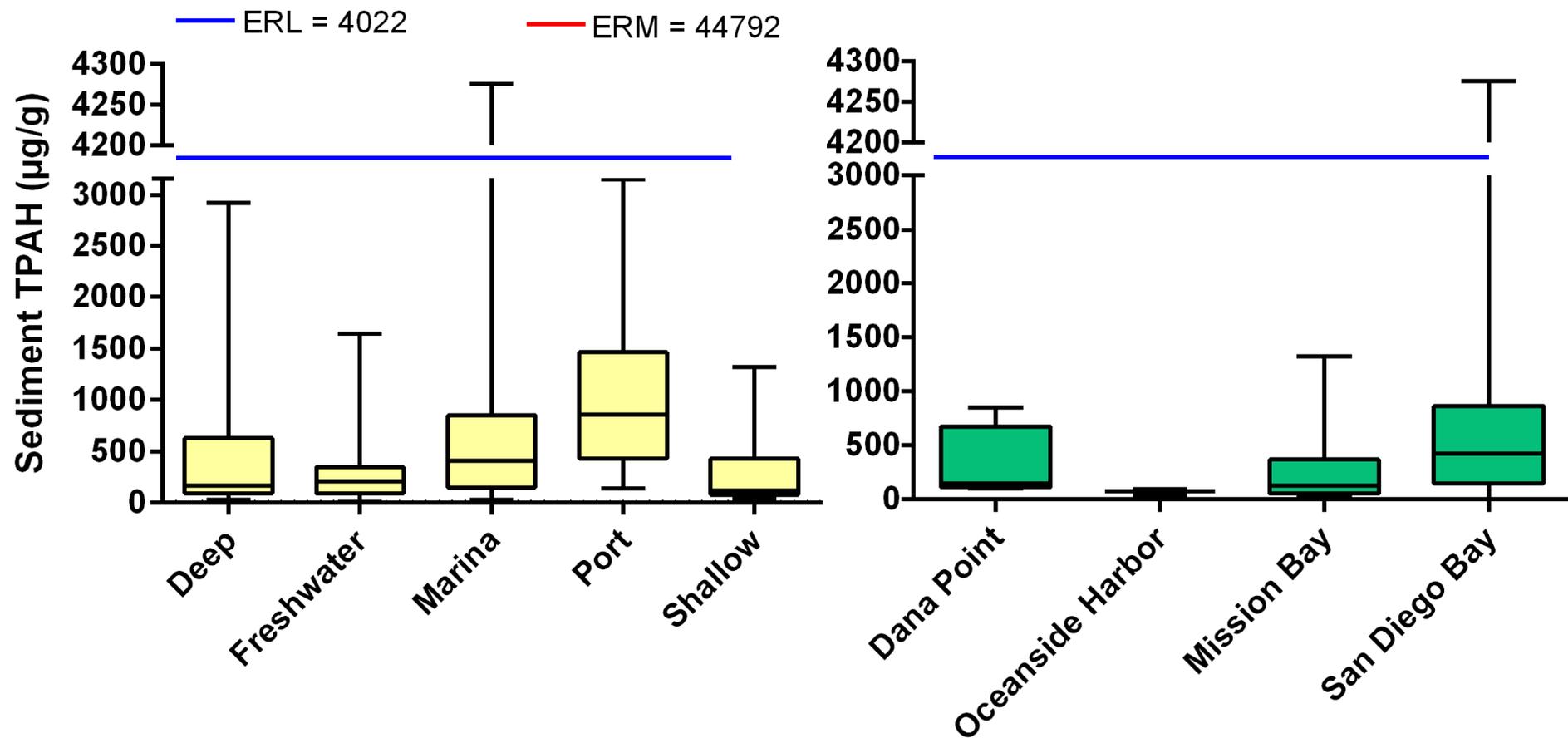


# Total PCBs in Sediments

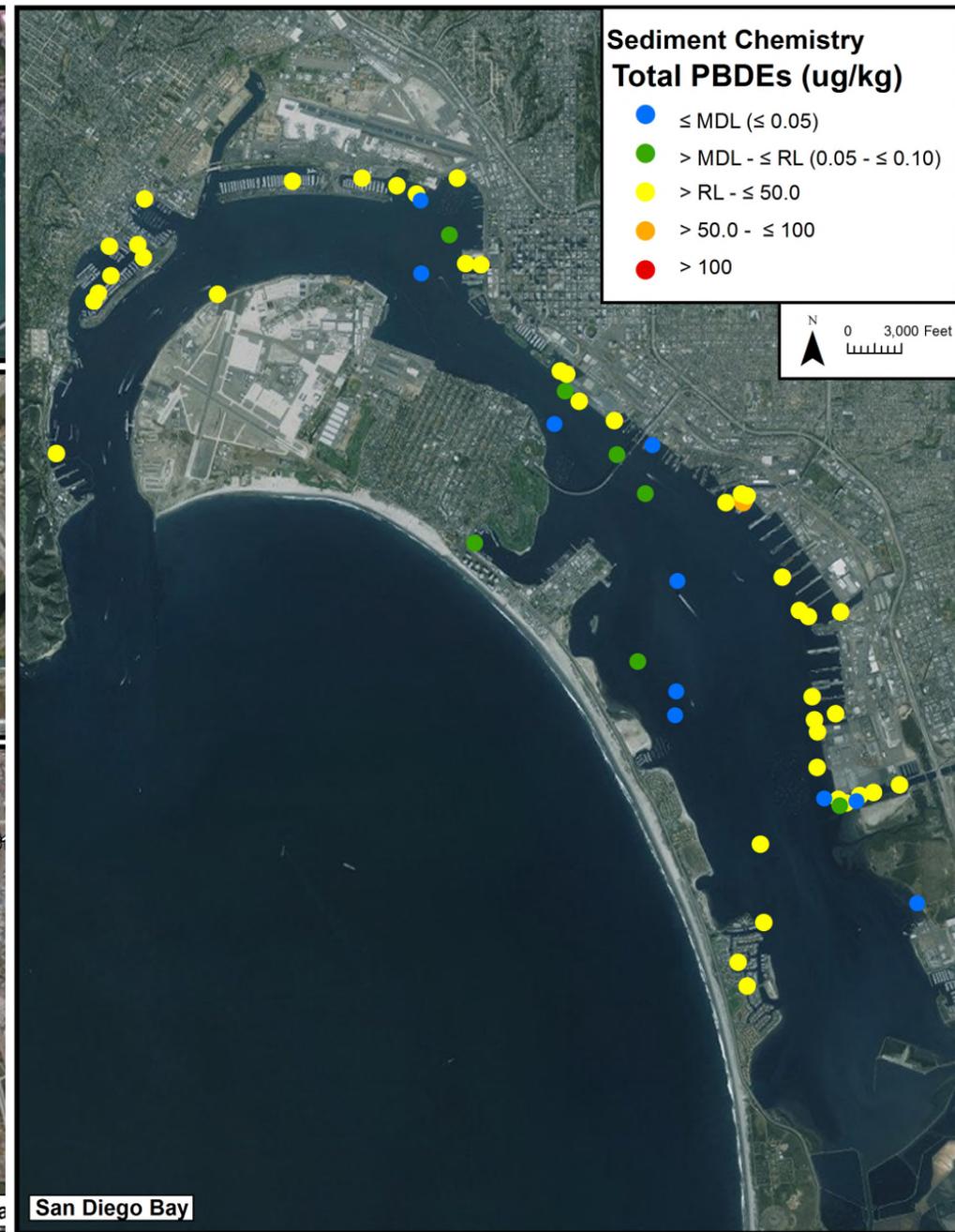
## Spatial Distribution 2013



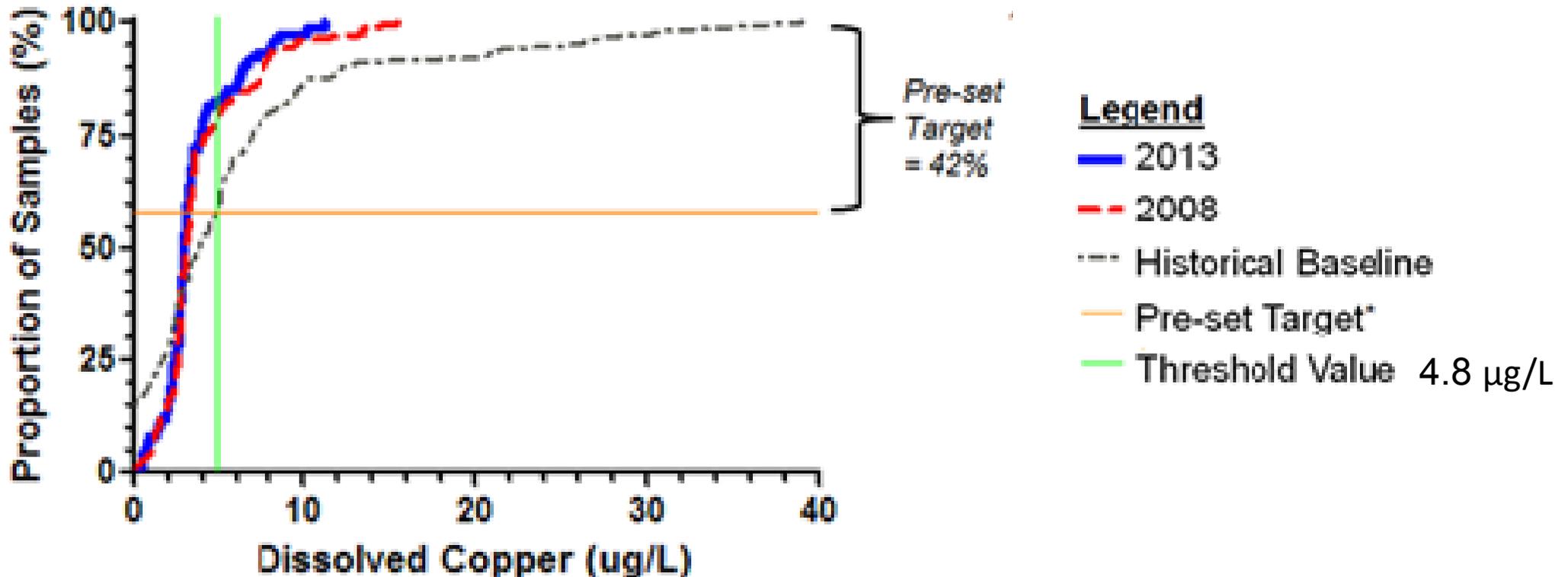
# Sediment Chemistry – PAHs



# Spatial Distribution of Sediment Total PBDEs

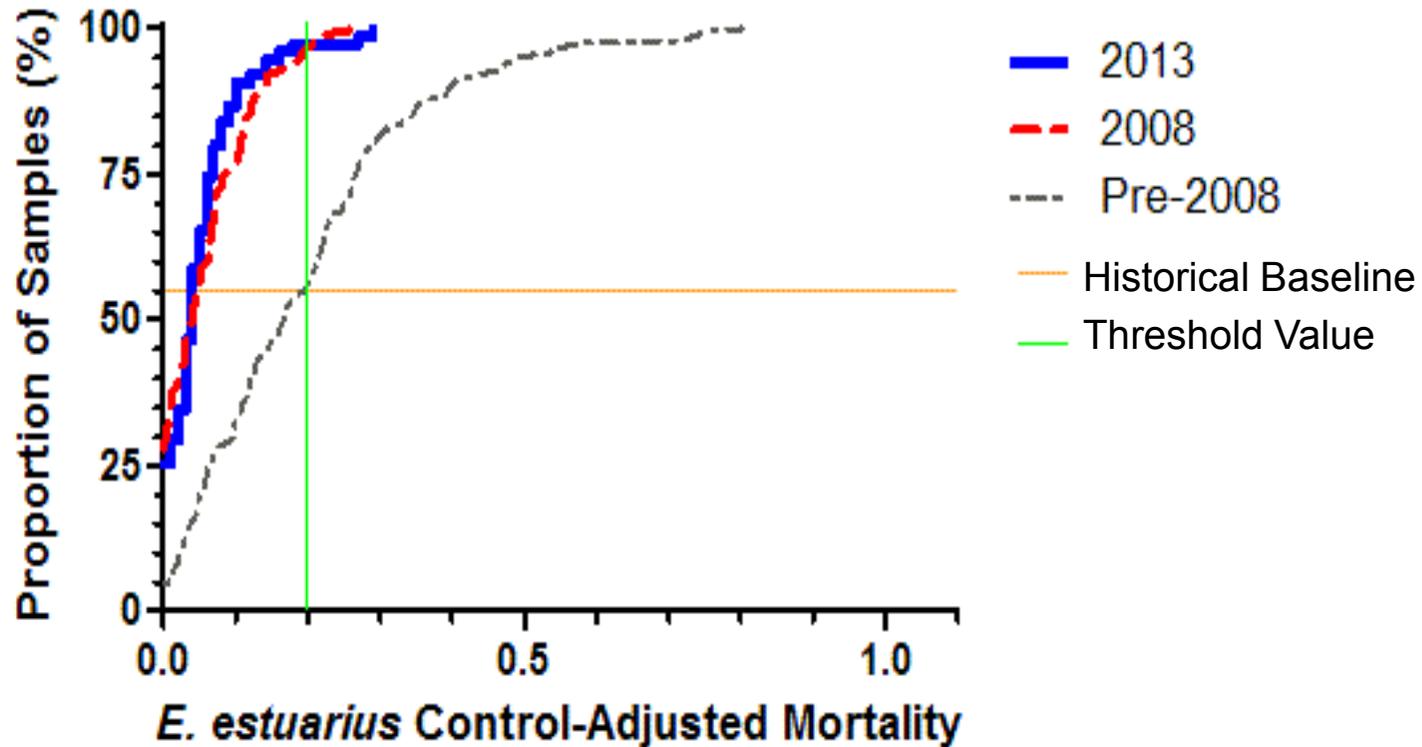


# Historic Analysis for Dissolved Copper



Note – The pre-set target is determined as the percentage of historical baseline stations which exceeded the threshold values

# Cumulative Distribution Curves for Amphipod Mortality (*E. estuarius*)



# Integrated SQO Assessment - Dana Point and Oceanside Harbor



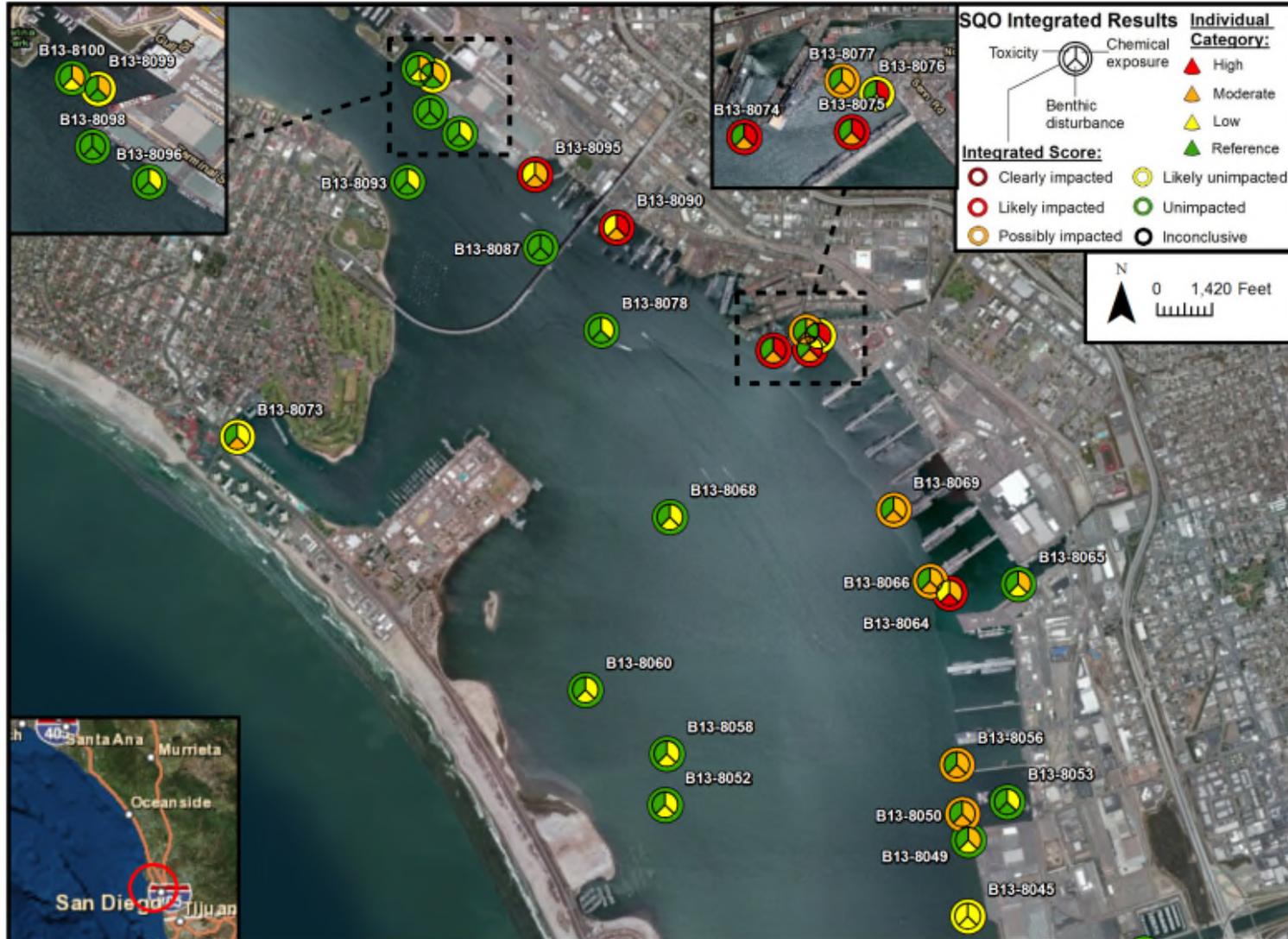
# Integrated SQO Assessment - Mission Bay



# Integrated SQO Assessment - North San Diego Bay



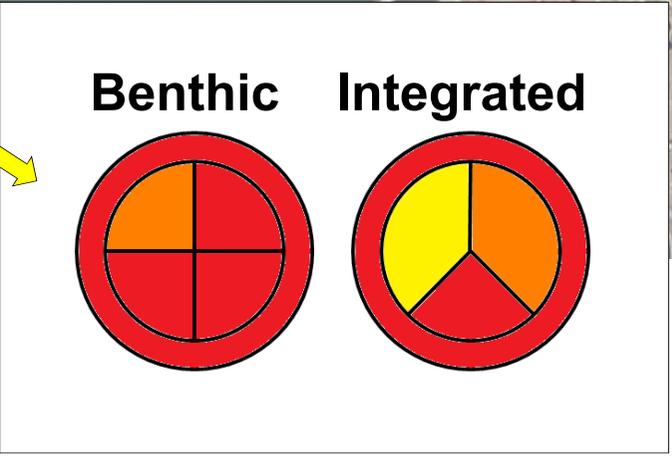
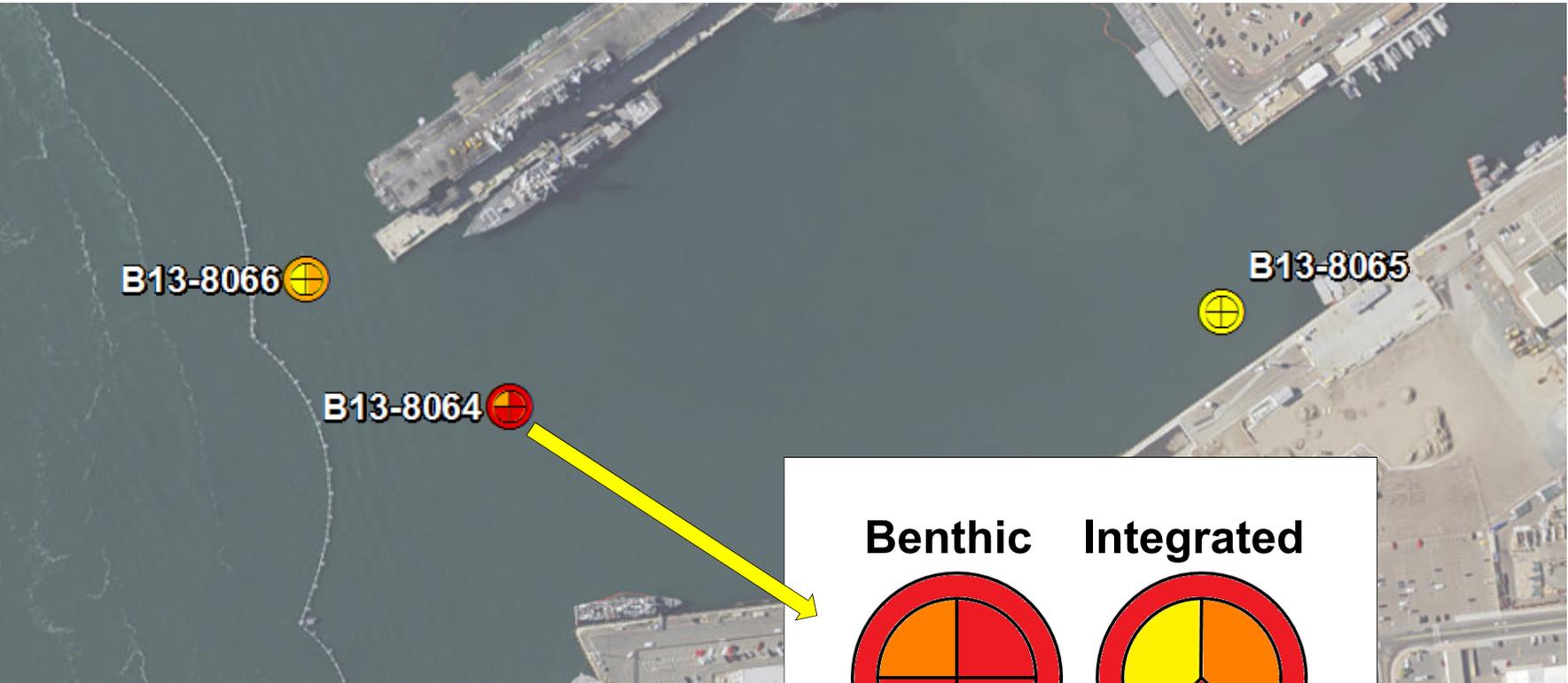
# Integrated SQO Assessment - Central San Diego Bay



# Integrated SQO Assessment - South San Diego Bay



# Site B13-8064 in Central San Diego Bay



# Site B13-8018 in South San Diego Bay

