

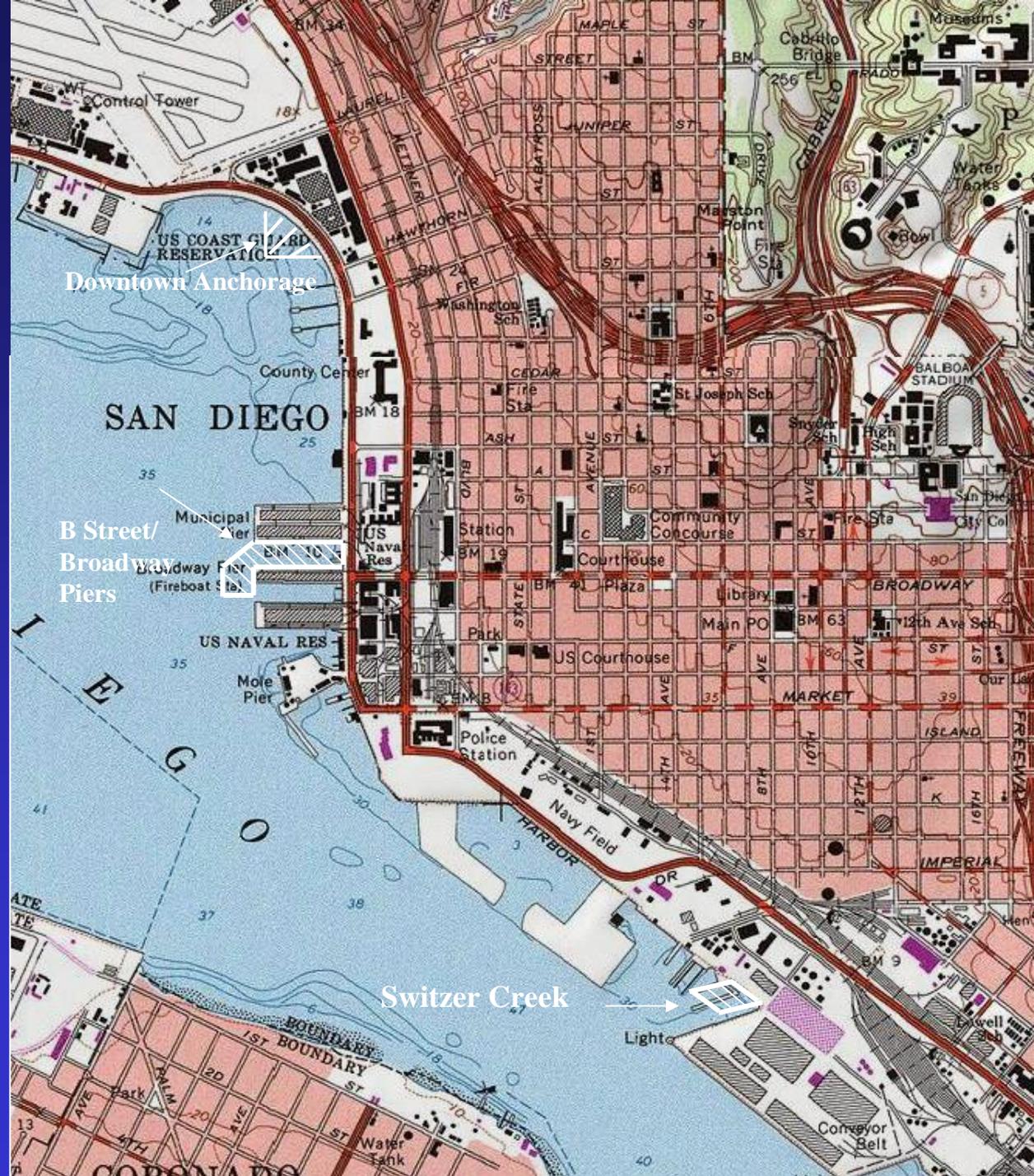
**Sediment Quality Assessment Study at  
the B Street/Downtown Piers, Downtown Anchorage, and Switzer Creek, San  
Diego**

**Phase I Results Preliminary Summary**

**May 13, 2004**

**Prepared by:  
Marine Pollution Studies Laboratory  
University of California  
Davis, CA**

*In cooperation with:*  
**San Diego Regional Water Quality Control Board  
City of San Diego  
Port of San Diego**



Downtown Anchorage

B Street/  
Broadway  
Piers

Switzer Creek

SAN DIEGO

ATE  
TE

CORONA DO

US COAST GUARD  
RESERVATION

County Center

US NAVAL RES

Municipal  
Pier

Handway Pier  
(Fireboat Sta.)

Mole Pier

Police Station

Navy Field

HARBOR

Light

Conveyor Belt

MAPLE ST

STREET

JUNIPER ST

BM

Cabrillo Bridge

256 EL PRADO

Marston Point

Fire Sta

6TH

ST

Museums

Water Tanks

Bowl

BALBOA STADIUM

San Diego City Col

San Diego High Sch

San Diego City Col

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# **Toxic Hotspot Designation: Bay Protection Toxic Cleanup Program (Fairey et al. 1996, 1998)**

## **B Street/Downtown Piers:**

**Benthic community degradation**

**Elevated concentrations of polycyclic aromatic hydrocarbons (PAHs), copper, chlordane, and chemical mixtures**

## **Downtown Anchorage:**

**Toxicity**

**Metal and organochlorine pesticide contamination**

**Benthic community degradation.**

## **Switzer Creek:**

**Toxicity**

**Benthic community degradation**

**Elevated concentrations of copper, PAHs, chlordane and chemical mixtures**

# Study Collaborators

State Water Resources Control Board  $\xrightarrow{\text{\$}}$  Regional Water Board

**Sample Collection – Russell Fairey – Moss Landing Marine Labs**

**Benthic Community Analyses – Jim Oakden – Moss Landing Marine Labs**

**Toxicity Testing – Brian Anderson – UC Davis**

**Port of San Diego – additional \$**

**Bulk Phase Chemistry – Rich Gossett – CRG labs**

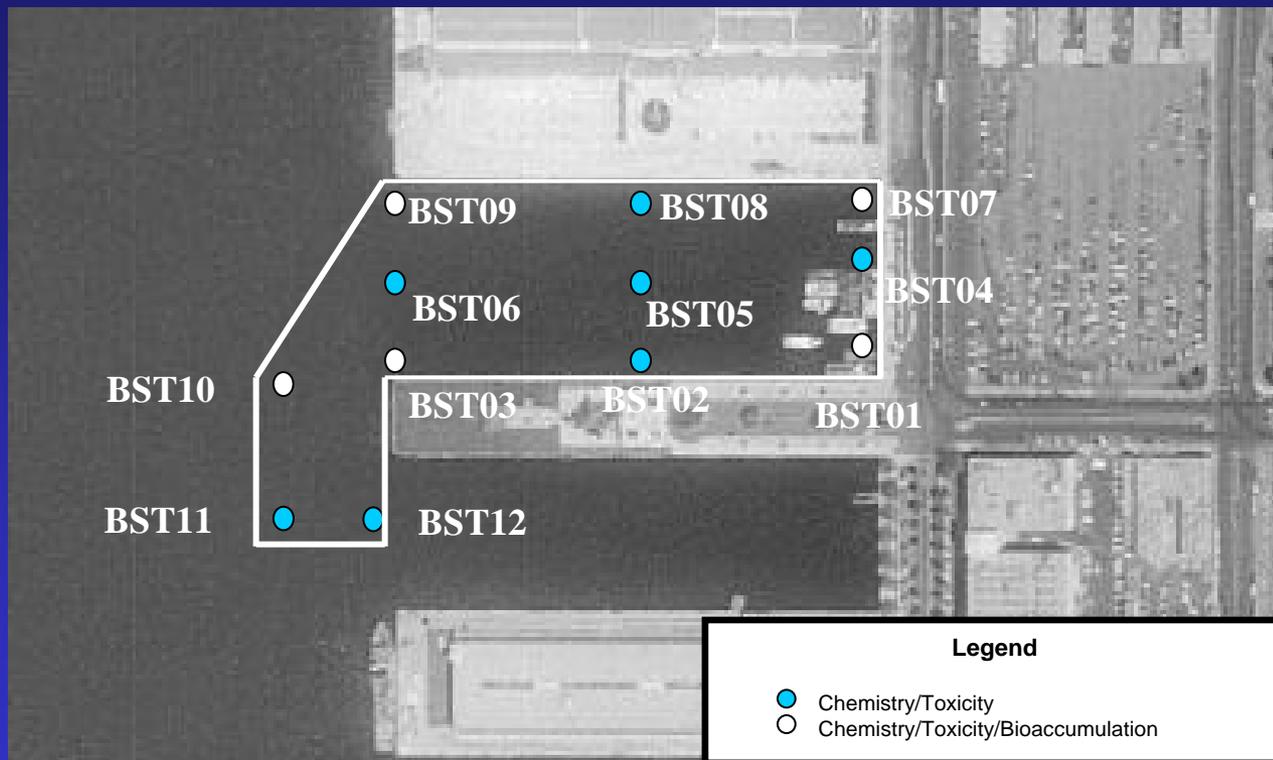
***Macoma nasuta* bioaccumulation exposures – Barry Snyder/Chris Stransky  
AMEC**

***Macoma nasuta* tissue analyses – Rich Gossett – CRG labs**

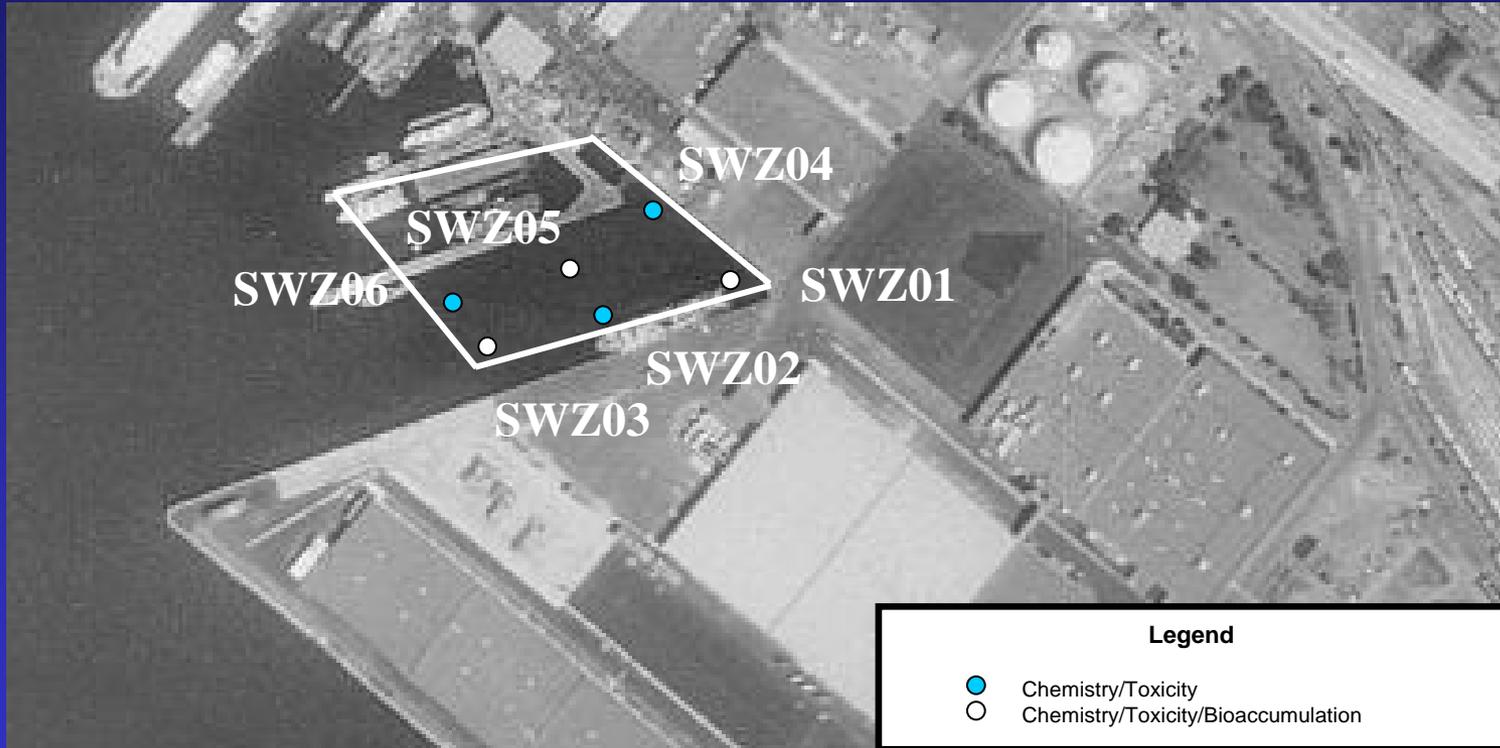
# Downtown Anchorage stations



## B Street/Broadway Piers stations



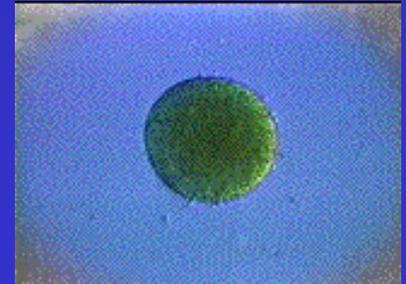
# Switzer Creek stations



# Toxicity Test Results

**Samples are considered toxic if they meet three criteria:**

- 1. Significantly different from control (t-test)**
- 2. Less than Minimum Significant Difference value (MSD)**
- 3. Less than reference site values based on 95% Lower Prediction Limit (LPL)**



## Downtown Anchorage toxicity test results

<b>Station#</b>	<b>Amphipod survival</b>	<b>SWI *</b>	<b>Fertiliz.**</b>
<b>DAC01</b>	<b>83%</b>	<b>89%</b>	<b>89%</b>
<b>DAC02</b>	<b>91%</b>	<b>96%</b>	<b>83%</b>
<b>DAC03</b>	<b>90%</b>	<b>90%</b>	<b>75%</b>
<b>DAC04</b>	<b>60%</b>	<b>77%</b>	<b>84%</b>
<b>DAC05</b>	<b>90%</b>	<b>89%</b>	<b>81%</b>
<b>DAC06</b>	<b>96%</b>	<b>100%</b>	<b>83%</b>
<b>DAC07</b>	<b>80%</b>	<b>86%</b>	<b>88%</b>
<b>DAC08</b>	<b>74%</b>	<b>90%</b>	<b>90%</b>
<b>DAC09</b>	<b>88%</b>	<b>79%</b>	<b>84%</b>
<b>Control</b>	<b>98%</b>	<b>85%</b>	<b>74%</b>
<b>95% LPL</b>	<b>85%</b>	<b>45%</b>	<b>57%</b>

\* bivalve embryo development, \*\* 100% PW

## B St/Downtown Piers toxicity test results

<u>Station#</u>	<u>Amphipod survival</u>	<u>SWI *</u>	<u>Fertiliz.**</u>
<b>BST01</b>	<b>93%</b>	<b>82%</b>	<b>84%</b>
<b>BST02</b>	<b>88%</b>	<b>70%</b>	<b>78%</b>
<b>BST03</b>	<b>89%</b>	<b>79%</b>	<b>85%</b>
<b>BST04</b>	<b>95%</b>	<b>79%</b>	<b>93%</b>
<b>BST05</b>	<b>86%</b>	<b>80%</b>	<b>82%</b>
<b>BST06</b>	<b>96%</b>	<b>90%</b>	<b>90%</b>
<b>BST07</b>	<b>87%</b>	<b>82%</b>	<b>92%</b>
<b>BST08</b>	<b>97%</b>	<b>82%</b>	<b>92%</b>
<b>BST09</b>	<b>90%</b>	<b>79%</b>	<b>88%</b>
<b>BST10</b>	<b>93%</b>	<b>82%</b>	<b>83%</b>
<b>BST11</b>	<b>97%</b>	<b>80%</b>	<b>91%</b>
<b>BST12</b>	<b>95%</b>	<b>76%</b>	<b>54%</b>
<b>Control</b>	<b>98%</b>	<b>85%</b>	<b>74%</b>
<b>95% LPL</b>	<b>85%</b>	<b>45%</b>	<b>57%</b>

\* bivalve embryo development, \*\* 100% PW

# Switzer Creek toxicity test results

<u>Station#</u>	<u>Amphipod survival</u>	<u>SWI *</u>	<u>Fertiliz.**</u>
<b>SWZ01</b>	<b>73%</b>	<b>74%</b>	<b>94%</b>
<b>SWZ02</b>	<b>76%</b>	<b>66%</b>	<b>95%</b>
<b>SWZ03</b>	<b>84%</b>	<b>86%</b>	<b>93%</b>
<b>SWZ04</b>	<b>69%</b>	<b>67%</b>	<b>91%</b>
<b>SWZ05</b>	<b>73%</b>	<b>82%</b>	<b>94%</b>
<b>SWZ06</b>	<b>70%</b>	<b>80%</b>	<b>82%</b>
<b>Control</b>	<b>98%</b>	<b>85%</b>	<b>74%</b>
<b>95% LPL</b>	<b>85%</b>	<b>45%</b>	<b>57%</b>

\* bivalve embryo development, \*\* 100% PW



## Location of Phase I Reference Stations

Field Survey

July, 2003



## Reference station toxicity test results

<b>Station#</b>	<b>Amphipod survival</b>	<b>SWI *</b>	<b>Fertiliz.**</b>
<b>2229</b>	<b>99%</b>	<b>89%</b>	<b>84%</b>
<b>2238</b>	<b>87%</b>	<b>86%</b>	<b>75%</b>
<b>2243</b>	<b>94%</b>	<b>78%</b>	<b>70%</b>
<b>2433</b>	<b>93%</b>	<b>65%</b>	<b>68%</b>
<b>2435</b>	<b>95%</b>	<b>55%</b>	<b>75%</b>
<b>2441</b>	<b>96%</b>	<b>68%</b>	<b>63%</b>
<b>Control</b>	<b>98%</b>	<b>85%</b>	<b>74%</b>

\* bivalve embryo development, \*\* 100% PW

# Chemistry Results

**Chemical mixtures were compared to a Sediment Quality Guideline Quotient value (SQGQ1)**

**SQGQ1 comparison to reference stations based on 95% UPL**

**Individual chemicals were compared to either ERM guidelines or consensus-based guideline values (CBGVs: PAHs & PCBs)**

# Sediment Quality Guideline Quotient Value

	Guideline#	Guideline type
<b>Chemical</b>		
<b>Metals (ug/g dry)</b>		
Cadmium	4.21	PEL
Copper	270	ERM
Lead	112.2	PEL
Silver	1.77	PEL
Zinc	410	ERM
<b>Organics (ng/g dry)</b>		
Tot Chlordane*	6	ERM
Dieldrin*	8	ERM
Tot. PAHs (ug/ g oc dry)	1800	Consensus Based
Tot. PCBs*	400	Consensus Based
<b>SQGQ1**</b>	<b>0.218</b>	<b>UPL Reference conditions</b>

\*\* after Fairey et al. 2001

**Station**

**SQGQ1**

**Guideline values exceeded**

<b>2229</b>	<b>0.147</b>	
<b>2238</b>	<b>0.188</b>	
<b>2243</b>	<b>0.135</b>	
<b>2433</b>	<b>0.131</b>	
<b>2435</b>	<b>0.089</b>	
<b>2441</b>	<b>0.166</b>	
<b>DAC01</b>	<b>0.409</b>	<b>* + Hg</b>
<b>DAC02</b>	<b>0.551</b>	<b>* + Hg and PCBs (Q = 1.178)</b>
<b>DAC03</b>	<b>0.618</b>	<b>* + Hg and PCBs (Q = 2.105)</b>
<b>DAC04</b>	<b>0.352</b>	<b>*</b>
<b>DAC05</b>	<b>0.342</b>	<b>*</b>
<b>DAC06</b>	<b>0.288</b>	<b>* + Hg</b>
<b>DAC07</b>	<b>0.283</b>	<b>* + Hg</b>
<b>DAC08</b>	<b>0.223</b>	<b>*</b>
<b>DAC09</b>	<b>0.237</b>	<b>*</b>



**\* 95% UPL = 0.218**

<b>Station</b>	<b>SQGQ1</b>	<b>Guideline values exceeded</b>
<b>SWZ01</b>	<b>0.364</b>	<b>*</b>
<b>SWZ02</b>	<b>0.288</b>	<b>*</b>
<b>SWZ03</b>	<b>0.468</b>	<b>* + PCBs (Q = 1.566)</b>
<b>SWZ04</b>	<b>0.416</b>	<b>*</b>
<b>SWZ05</b>	<b>0.367</b>	<b>* + Chlordane (Q = 2.35)</b>
<b>SWZ06</b>	<b>0.389</b>	<b>* + Chlordane (Q = 2.15)</b>
<b>BST01</b>	<b>0.374</b>	<b>* + Hg</b>
<b>BST02</b>	<b>0.303</b>	<b>* + Hg</b>
<b>BST03</b>	<b>0.221</b>	<b>*</b>
<b>BST04</b>	<b>0.400</b>	<b>* + Hg</b>
<b>BST05</b>	<b>0.226</b>	<b>* + Hg</b>
<b>BST06</b>	<b>0.206</b>	<b>+ Hg</b>
<b>BST07</b>	<b>0.462</b>	<b>* + Hg and PAHs (Q = 1.179)</b>
<b>BST08</b>	<b>0.293</b>	<b>* + Hg</b>
<b>BST09</b>	<b>0.290</b>	<b>* + PAHs (Q = 1.077)</b>
<b>BST10</b>	<b>0.175</b>	
<b>BST11</b>	<b>0.168</b>	
<b>BST12</b>	<b>0.234</b>	<b>* + Hg</b>

# Benthic Community Characterization

## 1. Relative Benthic Index (RBI): used in Bay Protection Toxic Cleanup Program

Responds to all stressors

Incorporates 6 metrics : Total No. species, Total No. mollusc species, No. crustacean species, No. crustacean individuals, No. positive indicator species (3), No. negative indicator species (2).

## 2. Benthic Response Index (BRI)

Calculated using pollution tolerance values and weighting based on abundance

## Downtown Anchorage Benthos

<b>Station</b>	<b>RBI</b>	<b>Assessment</b>	<b>&lt; 95% LPL (0.646)</b>	<b>BRI</b>	<b>Assessment</b>	<b>% Fines</b>	<b>% TOC</b>
<b>DAC01</b>	<b>0.53</b>	<b>T</b>	<b>X</b>	<b>25.8</b>	<b>R</b>	<b>84.3</b>	<b>2.31</b>
<b>DAC02</b>	<b>0.57</b>	<b>T</b>	<b>X</b>	<b>24.5</b>	<b>R</b>	<b>80.1</b>	<b>2.02</b>
<b>DAC03</b>	<b>0.37</b>	<b>T</b>	<b>X</b>	<b>26.6</b>	<b>R</b>	<b>73.7</b>	<b>1.79</b>
<b>DAC04</b>	<b>0.33</b>	<b>T</b>	<b>X</b>	<b>28.4</b>	<b>R</b>	<b>56.0</b>	<b>1.38</b>
<b>DAC05</b>	<b>0.60</b>	<b>U</b>	<b>X</b>	<b>24.6</b>	<b>R</b>	<b>57.4</b>	<b>1.20</b>
<b>DAC06</b>	<b>0.52</b>	<b>T</b>	<b>X</b>	<b>27.2</b>	<b>R</b>	<b>72.0</b>	<b>1.40</b>
<b>DAC07</b>	<b>0.45</b>	<b>T</b>	<b>X</b>	<b>28.9</b>	<b>R</b>	<b>69.0</b>	<b>1.29</b>
<b>DAC08</b>	<b>0.51</b>	<b>T</b>	<b>X</b>	<b>27.1</b>	<b>R</b>	<b>59.4</b>	<b>1.33</b>
<b>DAC09</b>	<b>0.87</b>	<b>U</b>		<b>26.2</b>	<b>R</b>	<b>68.3</b>	<b>1.24</b>



# Switzer Creek Benthos

<b>Station</b>	<b>RBI</b>	<b>Assessment</b>	<b>&lt; 95% LPL (0.646)</b>	<b>BRI</b>	<b>Assessment</b>	<b>% Fines</b>	<b>% TOC</b>
<b>SWZ01</b>	<b>0.11</b>	<b>D</b>	<b>X</b>	<b>28.8</b>	<b>R</b>	<b>96.1</b>	<b>2.06</b>
<b>SWZ02</b>	<b>0.09</b>	<b>D</b>	<b>X</b>	<b>27.9</b>	<b>R</b>	<b>99.8</b>	<b>2.16</b>
<b>SWZ03</b>	<b>0.86</b>	<b>U</b>		<b>27.5</b>	<b>R</b>	<b>92.6</b>	<b>1.40</b>
<b>SWZ04</b>	<b>0.35</b>	<b>T</b>	<b>X</b>	<b>25.0</b>	<b>R</b>	<b>74.7</b>	<b>2.42</b>
<b>SWZ05</b>	<b>0.31</b>	<b>T</b>	<b>X</b>	<b>29.1</b>	<b>R</b>	<b>46.7</b>	<b>1.45</b>
<b>SWZ06</b>	<b>0.46</b>	<b>T</b>	<b>X</b>	<b>24.5</b>	<b>R</b>	<b>57.0</b>	<b>1.90</b>

# Reference Station Benthos

<b>Station</b>	<b>RBI</b>	<b>Assessment</b>	<b>&lt; 95% LPL (0.646)</b>	<b>BRI</b>	<b>Assessment</b>	<b>% Fines</b>	<b>% TOC</b>
<b>2229</b>	<b>0.90</b>	<b>U</b>		<b>14.7</b>	<b>R</b>	<b>35.7</b>	<b>0.46</b>
<b>2238</b>	<b>0.76</b>	<b>U</b>		<b>25.4</b>	<b>R</b>	<b>66.5</b>	<b>0.92</b>
<b>2243</b>	<b>0.87</b>	<b>U</b>		<b>22.2</b>	<b>R</b>	<b>42.2</b>	<b>0.39</b>
<b>2433</b>	<b>0.84</b>	<b>U</b>		<b>13.3</b>	<b>R</b>	<b>49.1</b>	<b>0.56</b>
<b>2435</b>	<b>1.11</b>	<b>U</b>		<b>6.9</b>	<b>R</b>	<b>28.1</b>	<b>0.31</b>
<b>2441</b>	<b>0.95</b>	<b>U</b>		<b>14.8</b>	<b>R</b>	<b>62.9</b>	<b>2.00</b>

## *Macoma* 28-d Bioaccumulation Studies



**Tissue concentrations at Time 0 compared to tissue concentrations at 28-d to calculate net bioaccumulation**

**Tissue concentrations after 28-d compared to UPL based on clams exposed to reference sediments**

**Tissue concentrations were also compared to BTAG Toxicity Reference Values (TRVs) to assess risk to an avian predator, lesser scaup (*Aythya affinis*)**

**Quality assurance guidelines were met in these analyses, including those for PCB, PAH, and tetrachloro-m-xylene (TCMX) surrogate recoveries.**

## *Macoma* Tissue Bioaccumulation Summary

- **Metals bioaccumulated in all samples but no metal concentrations exceeded BTAG Toxicity Reference Values (high)**
- **PAHs bioaccumulated in some samples from B St/Broadway Piers (there are no BTAG TRV values for PAHs)**
- **No other organic compounds were detected in *Macoma* tissues**
- **Time 0 lipid (dry wt.) concentration was 1.28%**
- **The final (28-d) average percent lipid concentrations in clams exposed to site sediments were 0.47%, 2.37%, 1.60%, and 1.15%, in tissue samples from Switzer Creek, Downtown Anchorage, B Street/Broadway Piers, and the reference stations, respectively.**
- **Time 0 lipid (dry wt.) concentration in *Macoma* used in Chollas/Paletta study was 7.0%**

# Downtown Anchorage Summary Table

Station	Chemical Contamination		Toxicity	Benthic Community Degradation		Bioaccumulation	
	Sed. guideline exceed	SQGQ > reference		RBI	BRI	1+ analyte > reference	Risk avian receptor
DAC01	Hg	x				x	
DAC02	Hg, PCBs	x				x	
DAC03	Hg, PCBs	x				x	
DAC04		x	Eohaustorius			x	
DAC05		x				x	
DAC06	Hg	x				x	
DAC07	Hg, PAHs	x				x	
DAC08		x				x	
DAC09		x				x	



# Switzer Creek Summary Table

Station	Chemical Contamination		Toxicity	Benthic Community Degradation		Bioaccumulation	
	Sed. guideline exceed	SQGG > reference		RBI	BRI	1+ analyte > reference	Risk avian receptor
SWZ01	Chlordanes	x		x		x	
SWZ02		x		x		x	
SWZ03	PCBs	x				x	
SWZ04	Hg	x	<i>Eohaustorius</i>			x	
SWZ05	Chlordanes	x				x	
SWZ06	Chlordanes, Sb	x	<i>Eohaustorius</i>			x	

# Weight of Evidence Evaluation for Aquatic Life

## Chemistry: 3 categories

### Category      Sediment Chemistry LOE Characteristic

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Low	○	SQGQ1 < 0.1 or Reference UPL; and 0 chems. > Max (TEL/ERL and Ref. UPL)
Moderate	◉	SQGQ1 ≤ 1.0 and > Ref. UPL; or ≤ 5 chems are > MAX (PEL/ERM and Ref. UPL)
High	●	SQGQ1 > 1.0 and > Ref. UPL; or > 5 chems are > MAX (PEL/ERM and Ref. UPL)

# Weight of Evidence Evaluation for Aquatic Life

## Chemistry: 3 categories

### Category Toxicity LOE Characteristic

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Low	○	All tests > control; OR all tests > reference UPL
Moderate	◉	Amphipod > 50% and < reference UPL and control; OR SWI < reference UPL and control; OR urch. fert.< ref. UPL and control
High	●	Amphipod < 50%, < control, and < reference UPL and; OR Urch. Fert. and SWI < 50%, < control, and < reference UPL; OR Amph and urch fert. < ref. UPL and control; OR Amph and SWI ref. UPL and control

# Weight of Evidence Evaluation for Aquatic Life

## Benthic Community: 3 categories

### Category      Benthic Community LOE Characteristic

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Low      ○       $RBI \geq 0.60$  and reference LPL

Moderate      ⊙       $RBI = 0.31 - 0.59$  and reference LPL

High      ●       $RBI \leq 0.30$  and reference LPL

# Aquatic Life Weight of Evidence

- Likely
- Possible
- Unlikely

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

# Switzer Creek Aquatic Life Impairment WOE Table

Station	Chemical Contamination	Toxicity	Benthic Community Degradation	Impairment from CoPC?
SWZ01	⊙	⊙	●	Likely
SWZ02	⊙	⊙	●	Likely
SWZ03	⊙	⊙	○	Possible
SWZ04	⊙	⊙	⊙	Likely
SWZ05	⊙	⊙	⊙	Likely
SWZ06	⊙	⊙	⊙	Likely

○ = low

⊙ = moderate

● = high

## **Phase II Studies**

### **Temporal variability at a subset of stations:**

**Switzer - SWZ 01, SWZ 02, SWZ 04**

**Downtown Anch. - DAC 02, DAC 03, DAC 04**

**B Street/Broadway - BST 01, BST 04, BST 07**

**5 Reference Stations – 2238, 2243, 2433, 2441, 2229**

**Triad Studies: Toxicity tests, Chemistry, Benthos (spring only)  
Bioaccumulation**

### **Toxicity Identification Evaluations**

**Amphipod 10-d solid-phase toxicity tests**

**Sea Urchin fertilization in porewater**