CA Regional Water Quality Control Board
San Diego Region

PUBLIC WORKSHOP:

TENTATIVE CLEANUP AND ABATMEMENT ORDER (CAO) NO. R9-2005-0126

June 29, 2005

AQUATIC-DEPENDENT WILDLIFE BENEFICIAL USES IMPAIRMENT

(Tentative CAO Findings 22 – 25)

Finding 22

◆ **Aquatic-Dependent Wildlife Impairment**

"Aquatic-dependent wildlife beneficial uses designated for San Diego Bay are impaired due to the elevated levels of pollutants present in the marine sediment at the Shipyard Sediment Site."

Finding 23

◆ **Tier I**

 - **Screening level risk assessment**

 - **Based on tissue data derived from laboratory**
    bioaccumulation test

◆ **Tier II**

 - **Comprehensive risk assessment**

 - **Based on tissue data from site fish and shellfish**

Key Differences

- **Tier I**

  - SY Technical Report: Not reported

  - Regional Board: Conducted evaluation

- **Tier II**

  - Chemical concentrations in prey items

  - Receptor body weight

  - Food ingestion rate

  - Area use factor

  - Cumulative risk consideration

  - Results

Tier I
Screening Level Risk Assessment

(Tentative CAO Finding 24)

◆ **Tier I Results**

  - 6 of 9 site stations with Macoma nasuta tissue data as "likely" risks to wildlife receptors

  - Chemicals of concern: arsenic, copper, lead, zinc, BAP, and total PCBs.

  - Tier II risk assessment required.

Regional Board's Tier I Process

◆ **Key Elements from EPA Guidance**

- **Selection of Receptors of Concern**

- **Risk Characterization**

  Exposure assessment

  Effects assessment

- **Risk Management**

Selection of Receptors of Concern

◆ **Fish-Eating Marine Birds**

- **CA least tern, CA brown pelican, and western grebe**

◆ **Mollusc-Eating Birds**

- **Surf scoter**

◆ **Fish-Eating Marine Mammals**

- **CA sea lion**

◆ **Sea Grass-Eating Marine Reptiles**

- **East Pacific green turtle**

CA Brown Pelican

CA Least Tern

CA Sea Lion

Surf Scoter

Western Grebe

Risk Characterization

Tier I

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Step 1: Hazard Quotient Approach

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Step 2: Site/Baseline Comparison

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Wildlife Beneficial Uses Impaired?

Tier II Required?

Risk Characterization

Tier I

Step 1: Hazard Quotient Approach

Step 2: Site/Baseline Comparison

Wildlife Beneficial Uses Impaired?

Tier II Required?

Step 1 – Hazard Quotient Approach

$$HQ = IR_{chemical} / TRV$$

HQ   =   hazard quotient
                (unitless)

$IR_{chemical}$ =   total ingestion rate of the chemical
                (mg/kg body weight-day)

TRV   =   toxicity reference value
                (mg/kg body weight-day)

Step 1 – Hazard Quotient Approach

$$HQ = IR_{chemical} / TRV$$

HQ	=	hazard quotient (unitless)
$IR_{chemical}$	=	total ingestion rate of the chemical (mg/kg body weight-day)
TRV	=	toxicity reference value (mg/kg body weight-day)

$$IR_{chemical} = \Sigma_i(C_i \times M_i \times A_i \times F_i) / W$$

$IR_{chemical}$	=	total ingestion rate of chemical from all dietary components (mg/kg body weight-day)
C_i	=	concentration of the chemical in a given dietary component or inert medium (mg/kg)
M_i	=	rate of ingestion of dietary component or inert medium (kg/day)
A^i	=	relative gastrointestinal absorption efficiency for the chemical in a given dietary component or inert medium (fraction)
F_i	=	fraction of the daily intake of a given dietary component or inert medium derived from the site (unitless area-use factor)
W	=	body weight of receptor species (kg)

Exposure Factors Used by Regional Board

◆ **Prey Tissue Data for Ingestion Rate**

- 28-day laboratory bioaccumulation test (ASTM)

- Tissue data from clam *Macoma nasuta*

- Sediment from 4 stations at NASSCO, 5 stations at SWM

- Maximum tissue concentration used

Exposure Factors Used by Regional Board

Receptor	Body Weight (kg)	Food Ingestion Rate (kg/day dry wt)	Sediment Ingestion Rate (kg/day dry wt)	Area Use Factor	Absorption Efficiency	Surrogate Dietary Composition
California brown pelican	2.845[a]	0.23[b]	0.005	1	1	100% *Macoma nasuta*
California least tern	0.036[c]	0.044[d]	0.0011	1	1	100% *Macoma nasuta*
Western grebe	0.808[e]	0.046[d]	0.0031	1	1	100% *Macoma nasuta*
Surf scoter	0.859[f]	0.048[d]	0.0028	1	1	100% *Macoma nasuta*
California sea lion	45.0[g]	0.99[h]	0.0308	1	1	100% *Macoma nasuta*
East Pacific green turtle	95[i]	0.31[j]	0.0186	1	1	100% *Macoma nasuta*

References

[a] Mean female weight minus 1 standard deviation from Dunning (1993).

[b] Based on Nagy (1999) equation for Pelecaniformes.

[c] Minimum adult body weight from Thompson et. al. (1997).

[d] Based on EPA (1993) equation for non-passerine birds.

[e] Minimum female body weight from Storer and Neuchterlein (1992).

[f] Minimum average female weight, as cited in Savard et al. (1998).

[g] Minimum female weight from Whitaker (1997).

[h] Based on Nagy (1999) equation for Carnivora.

[i] Median adult weight from Cornelius (1986).

[j] Based on data in Bjorndal (1980).

Step 1 – Hazard Quotient Approach

$$HQ = IR_{chemical} / TRV$$

HQ	=	hazard quotient (unitless)
$IR_{chemical}$	=	total ingestion rate of the chemical (mg/kg body weight-day)
TRV	=	toxicity reference value (mg/kg body weight-day)

TRVs Used by Regional Board

Chemical	Birds		Mammals	
	BTAG Low TRV (mg/kg-day)	BTAG High TRV (mg/kg-day)	BTAG Low TRV (mg/kg-day)	BTAG High TRV (mg/kg-day)
Arsenic	5.5	22.0	0.32	4.7
Benzo(a)pyrene	--	--	1.31	32.8
Butyltins	0.73	45.9	0.25	15
Cadmium	0.08	10.4	0.06	2.64
Copper	2.3	52.3	2.67	632
Lead	0.014	8.75	1.0	241
Mercury	0.039	0.18	0.027	0.27
	--	--	0.25	4.0
Nickel	1.38	56.3	0.133	31.6
PCBs	0.09	1.27	0.36	1.28
Selenium	0.23	0.93	0.05	1.21
Zinc	17.2	172	9.6	411

TRVs Used by Regional Board

	Birds		Mammals	
Chemical	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)
Benzo(a)pyrene	0.14	1.4	Not applicable	Not applicable
Chromium	0.86	4.3	3.3	69

Risk Characterization

Tier I

Step 1: Hazard Quotient Approach

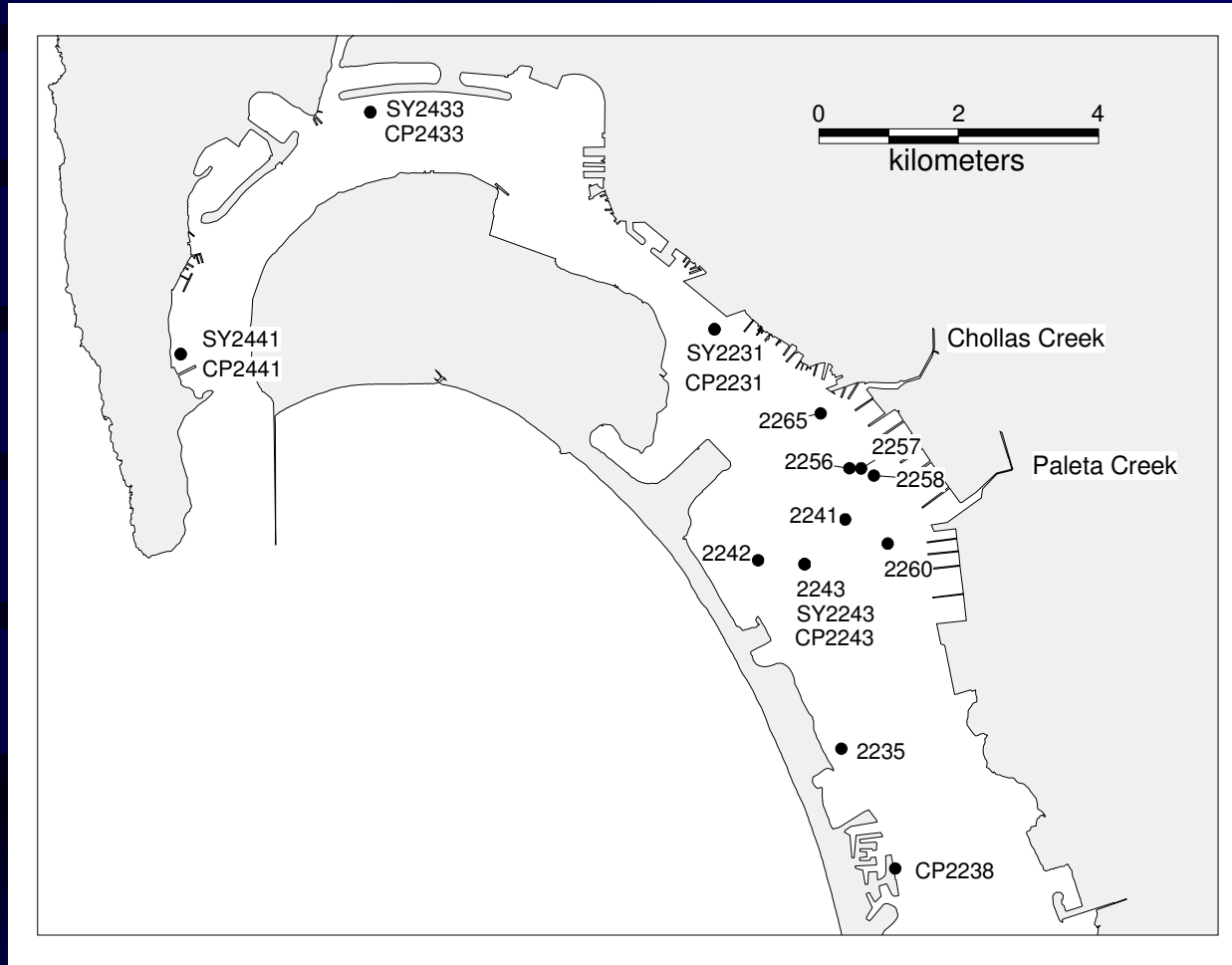**Step 2: Site/Baseline Comparison**

Wildlife Beneficial Uses Impaired?

Tier II Required?

Step 2 – Site/Baseline Comparison

◆ **Baseline Pool**

    - *Macoma nasuta* tissue concentrations

    - 95% upper prediction limit (UPL)

Baseline Pool Stations

Location of reference stations included in the Baseline Pool. The station identifiers indicate whether the station was sampled during the Chollas/Paleta TMDL study (CP prefix), the Shipyard study (SY), or the Bight'98 survey (no prefix).

95% Upper Prediction Limits

Macoma Tissue Chemicals	95% Upper Prediction Limits
Metals	
Arsenic	22.8 mg/kg
Cadmium	0.39 mg/kg
Chromium	3.9 mg/kg
Copper	19.2 mg/kg
Lead	3.3 mg/kg
Mercury	0.15 mg/kg
Nickel	4.4 mg/kg
Selenium	4.9 mg/kg
Silver	0.57 mg/kg
Zinc	85.7 mg/kg

95% Upper Prediction Limits

Macoma Tissue Chemicals	95% Upper Prediction Limits
Organometallic Compounds	
Tributyltin	**12 ug/kg**
Organics	
Benzo[a]pyrene	**132 ug/kg**
Total Polychlorinated Biphenyls (PCB), as congeners	**186 ug/kg**
Total Polychlorinated Terphenyls (PCT)	**All Baseline Pool stations undetected**

Risk Management

	STEP 1: HQ > 1.0 (for one or more site stations)	STEP 2: Site Tissue > Baseline 95% UPL Tissue (for one or more site stations)	Wildlife Beneficial Uses Potentially Impaired			Risk Management	
			Unlikely	Possible	Likely	No Further Action	Tier II Required
1	No	No	X			X	
2	No	Yes	X			X	
3	Yes	No		X			X*
4	Yes	Yes			X		X

Tier II
Comprehensive Risk Assessment

(Tentative CAO Finding 25)

Key Differences

◆ **Tier II**

    - **Chemical concentrations in prey items**

    - **Receptor body weight**

    - **Food ingestion rate**

    - **Area use factor**

    - **Cumulative risk consideration**

    - **Results**

◆ **Tier II Results**

-**Ingestion of prey items poses risk to all receptors feeding exclusively at Shipyard Sediment Site (excludes green turtle).**

- **Primary contaminants of concern: lead, mercury, selenium, BAP, and chromium.**

*Key Difference

- **Shipyard technical report concluded no risk to aquatic-dependent wildlife**

Regional Board's Tier II Process

◆ **Key Elements from EPA Guidance**

- **Selection of Receptors of Concern**

- **Risk Characterization**

  Exposure assessment

  Effects assessment

- **Risk Management**

Selection of Receptors of Concern

- **Fish-Eating Marine Birds**

  - **CA least tern, CA brown pelican, and western grebe**

- **Mollusk-Eating Birds**

  - **Surf scoter**

- **Fish-Eating Marine Mammals**

  - **CA sea lion**

- **Sea Grass-Eating Marine Reptiles**

  - **East Pacific green turtle**

CA Brown Pelican

CA Least Tern

CA Sea Lion

Surf Scoter

Western Grebe

Photo by Jim Zingo

Photo by Marcus Martin

Photo by Fred Fallon

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Risk Characterization

Tier II

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Step 1: Site Cumulative Hazard Quotients (HQ)

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Step 2: Site/Reference Cumulative HQ Comparison

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Wildlife Beneficial Uses Impaired?

*Key Difference: SY technical report did not consider cumulative HQs

Risk Characterization

Tier II

↓

Step 1: Site Cumulative Hazard Quotients (HQ)

↓

Step 2: Site/Reference Cumulative HQ Comparison

↓

Wildlife Beneficial Uses Impaired?

Key Difference: SY technical report did not consider cumulative HQs

Step 1: Site Cumulative HQs

$$HQ = IR_{chemical} / TRV$$

HQ	=	hazard quotient (unitless)
$IR_{chemical}$	=	total ingestion rate of the chemical (mg/kg body weight-day)
TRV	=	toxicity reference value (mg/kg body weight-day)

Step 1 – Hazard Quotient Approach

$$HQ = IR_{chemical} / TRV$$

HQ	=	hazard quotient (unitless)
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$$IR_{chemical} = \Sigma_i (C_i \times M_i \times A_i \times F_i) / W$$

|		
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C_i	=	concentration of the chemical in a given dietary component or inert medium (mg/kg)
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F_i	=	fraction of the daily intake of a given dietary component or inert medium derived from the site (unitless area-use factor)
W	=	body weight of receptor species (kg)

Exposure Factors Used by Regional Board

◆ **Prey Tissue Data for HQ Calculation**

- **Spotted sand bass for brown pelican and sea lion**

- **Top smelt and anchovies for least tern and grebe**

- **Benthic mussels for surf scoter**

- **Eelgrass for green turtles**

- **Maximum tissue concentration used**
  (*key difference)
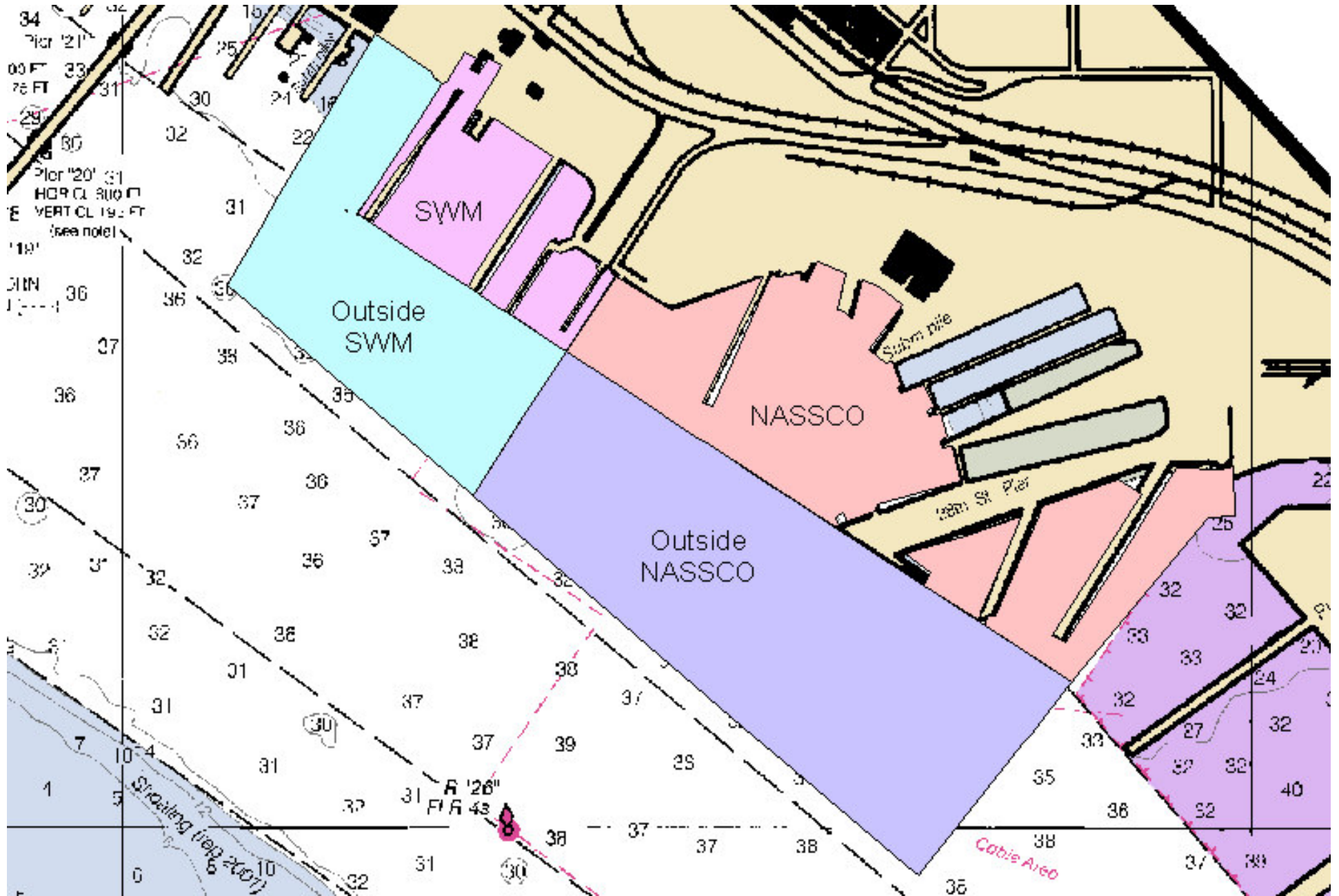
Sub-sections of study area.

Exposure Factors Used by Regional Board

Receptor	Body Weight (kg)	Food Ingestion Rate (kg/day dry wt)	Sediment Ingestion Rate (kg/day dry wt)	Area Use Factor	Absorption Efficiency	Surrogate Dietary Composition
California brown pelican	2.845[a]	0.23[b]	0.005	1	1	100% *medium-sized fish*
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East Pacific green turtle	95[i]	0.31[j]	0.0186	1	1	100% *eelgrass*

Exposure Factors in SY Technical Report

Receptor	Body Weight (kg)	Food Ingestion Rate (kg/day dry wt)	Sediment Ingestion Rate (kg/day dry wt)	Area Use Factor	Absorption Efficiency	Surrogate Dietary Composition
California brown pelican	3.174	0.25	0.005	0.01	1	100% *medium-sized fish*
California least tern	0.045	0.0053	0.0011	0.01	1	100% *small fish*
Western grebe	1.2	0.062	0.0031	0.01	1	100% *small fish*
Surf scoter	1.05	0.056	0.0028	0.01	1	100% *mollusks*
California sea lion	75	1.54	0.0308	0.01	1	100% *medium-sized fish*
East Pacific green turtle	95	0.35	0.0186	0.01	1	100% *eelgrass*

Step 1 – Hazard Quotient Approach

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HQ	=	hazard quotient (unitless)
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TRVs Used by Regional Board

Chemical	Birds		Mammals	
	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)	NOAEL (mg/kg-day)	LOAEL (mg/kg-day)
Benzo(a)pyrene	0.14	1.4	Not applicable	Not applicable
Chromium	0.86	4.3	3.3	69

TRVs in SY Technical Report

◆ **NOAELs**

No-Observed-Adverse-Effects-Levels

*key difference

◆ **LOAELs**

Lowest-Observed-Adverse-Effects-Levels

*key differerence

Risk Characterization

Tier II

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Step 1: Site Cumulative Hazard Quotients (HQ)

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Step 2: Site/Reference Cumulative HQ Comparison

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Wildlife Beneficial Uses Impaired?

Key Difference: SY technical report did not consider cumulative HQs

Step 2 – Site/Reference Comparison

◆ **Reference Area**

- **Located in San Diego Bay across from Shipyard Sediment Site**

- **Vicinity of Reference Station 2240**

- **Same reference area used in fish histopathology, fish bile, and human health assessments**

- **Same exposure and effects assumptions**

◆ **Simple Comparison**
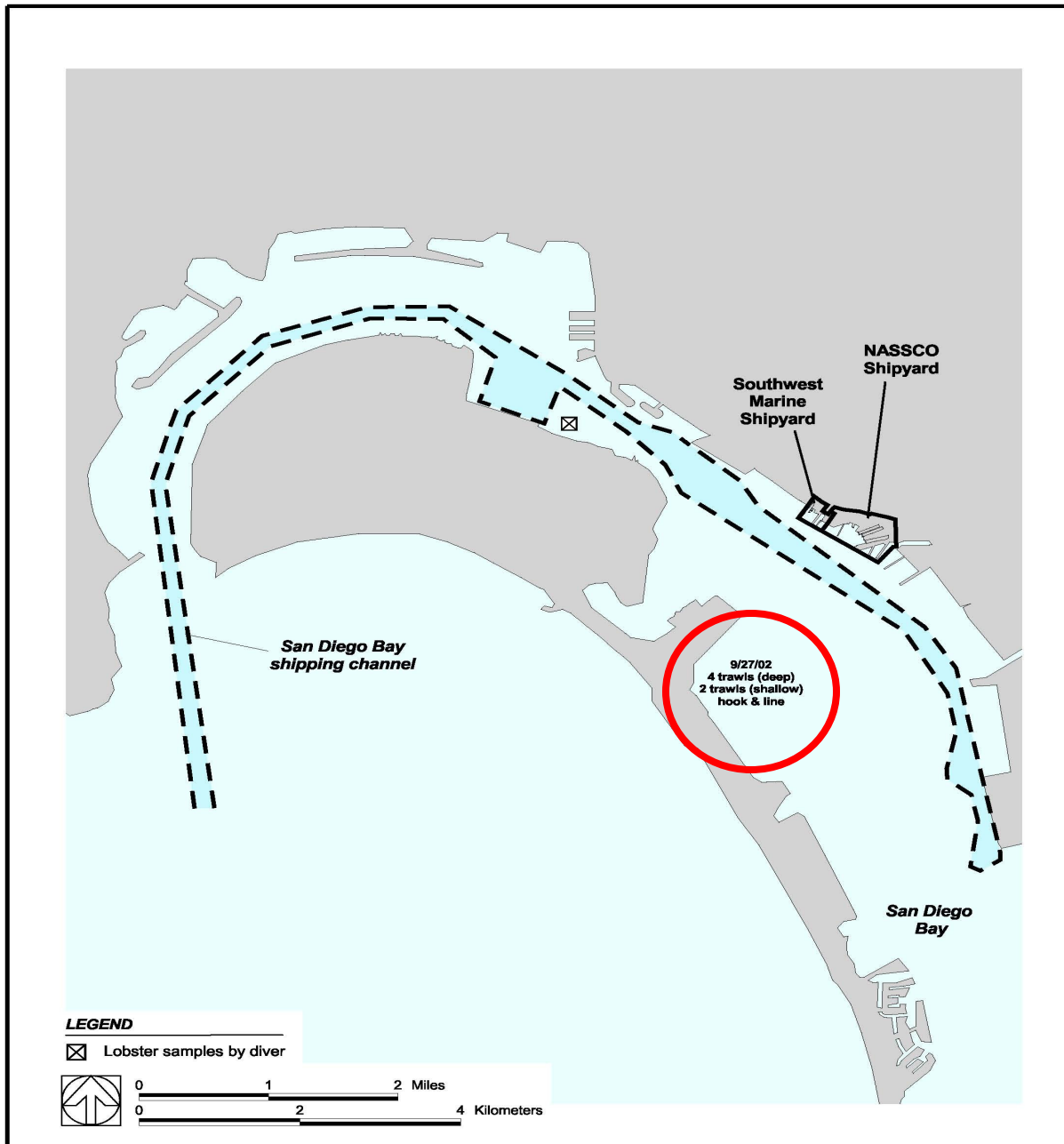
- **Site HQ cumulative risk > Reference HQ cumulative risk?**

NASSCO
Shipyard

Southwest
Marine
Shipyard

San Diego Bay
shipping channel

9/27/02
4 trawls (deep)
2 trawls (shallow)
hook & line

San Diego
Bay

LEGEND

⊠ Lobster samples by diver

0   1   2 Miles
0   2   4 Kilometers

Figure 2-2. Biota sampling reference locations
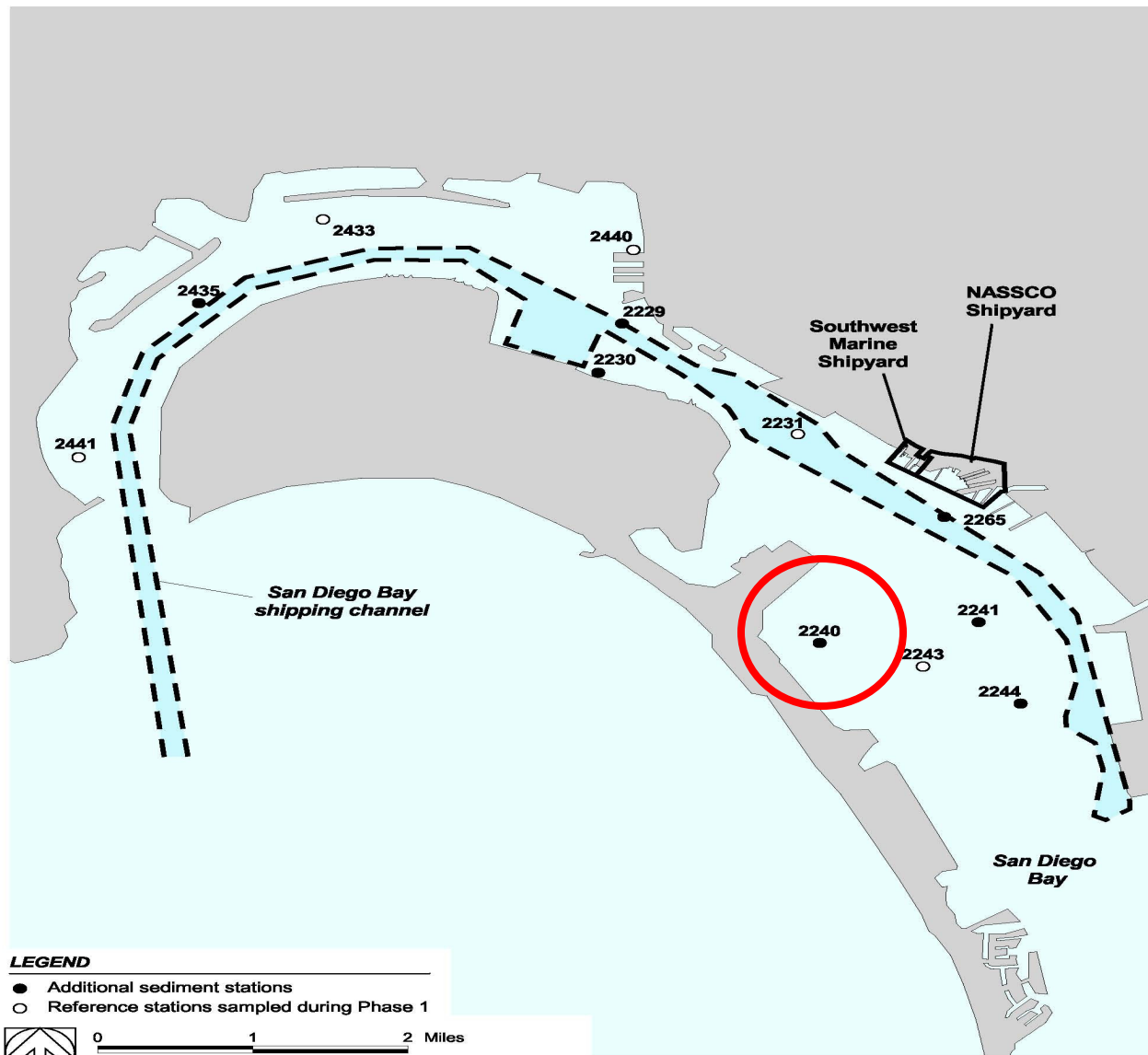
Exponent®

Figure 2-3. Additional sediment sampling locations in San Diego Bay

Exponent®

Risk Management

	STEP 1: Cumulative HQ > 1.0 (for one or more site stations)	STEP 2: Site Cumulative Risk > Reference Cumulative Risk (for one or more site stations)	Aquatic-Dependent Wildlife Beneficial Uses Impaired	Risk Management	
				No Further Action	Remedial Action
1	No	No	No	X	
2	No	Yes	No	X	
3	Yes	No	No	X	
4	Yes	Yes	Yes		X

Risk Management Results

ASSESSMENT UNIT	
Inside NASSCO	Combination 4
Outside NASSCO	Combination 4
Inside Southwest Marine	Combination 4
Outside Southwest Marine	Combination 4

Inside NASSCO Leasehold

	Step 1 > 1	Step 2 **Cumulative Site Risk > Cumulative Reference Risk**
Brown Pelican	Yes	Yes
Least Tern	Yes	Yes
Sea Lion	Yes	Yes
Surf Scoter	Yes	Yes
Western Grebe	Yes	Yes

Risk Management Result: ???

Inside NASSCO Leasehold

	Step 1	Step 2
	> 1	**Cumulative Site Risk > Cumulative Reference Risk**
Brown Pelican	Yes	Yes
Least Tern	Yes	Yes
Sea Lion	Yes	Yes
Surf Scoter	Yes	Yes
Western Grebe	Yes	Yes

Risk Management Result: Combination 4

Outside NASSCO Leasehold

	Step 1 > 1	Step 2 Cumulative Site Risk > Cumulative Reference Risk
Brown Pelican	Yes	Yes
Least Tern	Yes	Yes
Sea Lion	Yes	Yes
Western Grebe	Yes	Yes

Risk Management Result: Combination 4

Inside Southwest Marine Leasehold

	Step 1	Step 2
	> 1	Cumulative Site Risk > Cumulative Reference Risk
Brown Pelican	Yes	Yes
Least Tern	Yes	Yes
Sea Lion	Yes	Yes
Surf Scoter	Yes	Yes
Western Grebe	Yes	Yes

Risk Management Result: Combination 4

Outside Southwest Marine Leasehold

	Step 1 **> 1**	**Step 2** **Cumulative Site Risk > Cumulative Reference Risk**
Brown Pelican	Yes	Yes
Least Tern	Yes	Yes
Sea Lion	Yes	Yes
Western Grebe	Yes	Yes

Risk Management Result: Combination 4

Risk Management

◆ **Primary Contaminant Drivers**

  - % contribution to cumulative risk

Chemical-Specific HQ Risk
Cumulative HQ Risk

  - Risk drivers: lead, mercury, selenium, BAP, and chromium